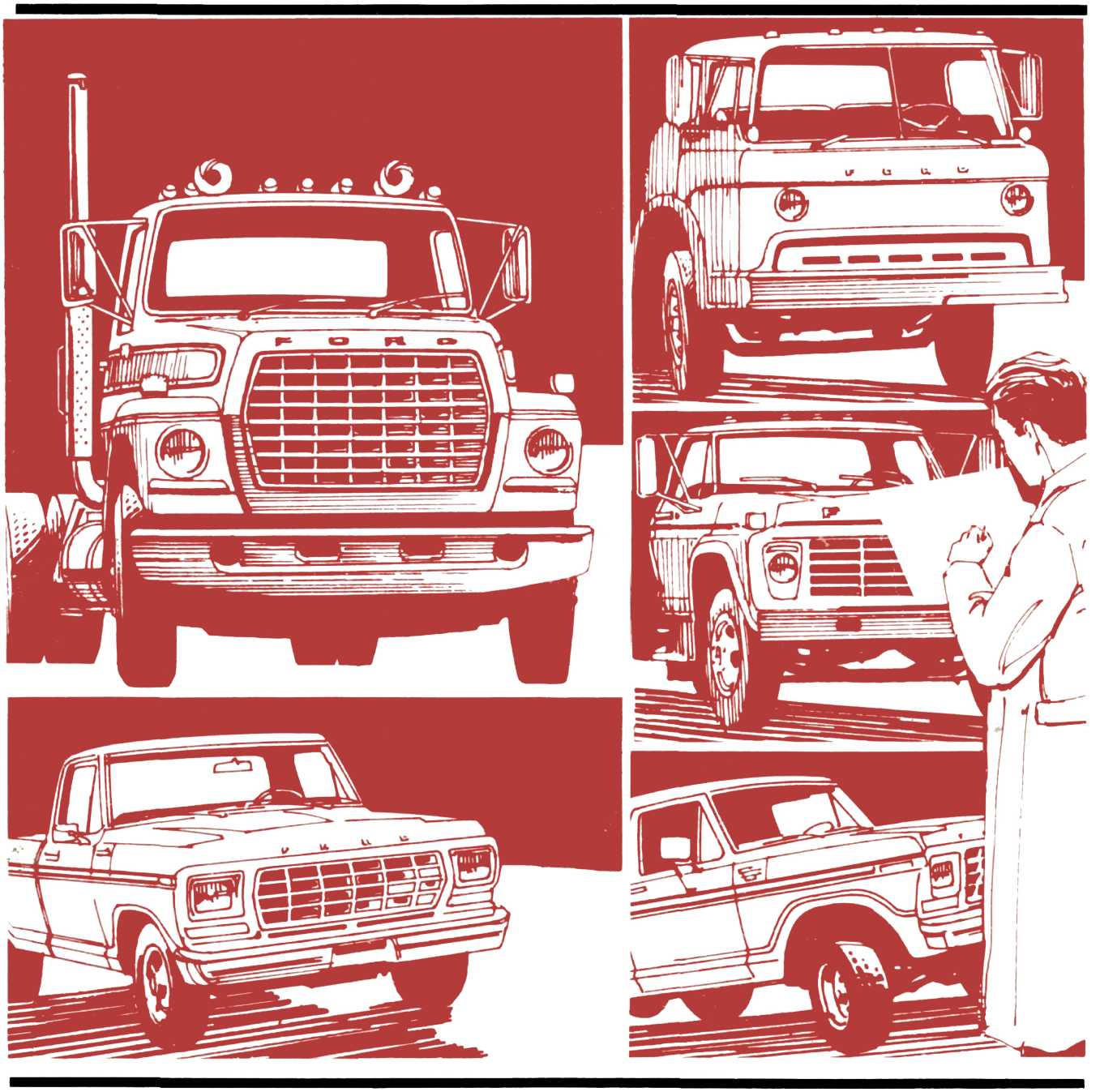
Ford

1979 TRUCK SHOP MANUAL



BODY, CHASSIS, & ELECTRICAL

QUICK REFERENCE INDEX. To use, move either the hand or selection tool directly over the section you desire to reference. Simply click once with the mouse button and the manual will automatically jump to that section.



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foreword...

This 1979 Truck Shop Manual has been prepared to provide information covering normal Body, Chassis and Electrical service repairs and maintenance for the 1979 Bronco, Econoline (E-100 through E-350) and F-100 through F-350 Ford Trucks manufactured in the United States and Canada. Engine, Pre-Delivery, Maintenance and Lubrication service repairs are covered in the 1979 Truck Engine Manual and 1979 Truck Pre-Delivery, Maintenance and Lubrication Manual.

Information in each manual is divided into Groups covering a general system. The basic part number for components covered in the Group is also included in parenthesis after the Group number.

Example: Cooling System (General System Covered in Group) Group 27 (Group Number) (8000) (Basic Part Number for Cooling System Components)

Some components covered within a Group do not have the same basic part number. In these cases, more than one basic part number will appear on the Group index.

Example: Gasoline Engines (General System Covered in Group) Group 21 (6000 (Basic Part Number for Gasoline Engine Components) & 9000) (Intake and Exhaust Manifold Basic Part Number Only)

For easy reference, information in each Group has been divided into smaller sections or Parts. There is one Part for each component in the system, as well as a General Service Part in some Groups to cover procedures common to several Parts within the Group. In general, each Part contains the Description, Operation, Diagnosis and Testing, Removal and Installation and Disassembly and Assembly procedures for the component covered in the Part. Diagnosis Charts are also included in some Parts to help you systematically locate and correct problems encountered. In most cases, specifications are included at the end of each Part.

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To aid in locating specific items in this manual, the index at the front of the manual provides an alphabetical listing, with page number, for all Parts in the manual. The tab locator on the right side of this index will help you find the first page of each Group.

On the first page of each Group there is an index listing the Part title and Part number for each component covered within the Group. The first page of each Part contains an index to locate service operations covered in that Part. This Group-Part breakdown is also indicated in the page number located at the top of each page.

Example: 11-02-21 = (Group) 11 — (Part) 02 — (Page) 21

Metric conversion tables have been included at the back of each manual to aid in converting specifications to the metric equivalent.

The descriptions and specifications in this manual were in effect at the time this manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design without notice and without incurring obligation.

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

Ford Parts and Service Division
Training and Publications Department

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IDENTIFICATION CODES

GROUP 10

Identification Codes

PART 10-00

APPLIES TO BRONCO, ECONOLINE (E-100—E-350) F-100—F-350

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GENERAL INFORMATION

VEHICLE CERTIFICATION LABEL

The Vehicle Certification Label (V.C. Label) is attached to the rear face of the driver's door or door pillar (Fig. 1). The upper half of the label contains the name of the manufacturer, the month and year of manufacture and the certification statement. The V.C. Label also contains the Vehicle Identification Number.

The remaining information codes on the V.C. Label are the same as the Truck Rating Plate Codes (Fig. 2). Vehicle codes shown on the Truck Rating Plate are explained in the following paragraphs.

RATING PLATE

Fig. 2 illustrates a typical Truck Rating Plate. On cowl and windshield vehicles, the Rating Plate is mounted on the right side of the cowl top panel under the hood. On stripped Parcel Delivery vehicles, the rating plate is placed in an envelope and included in the boxed items "parts". On all other vehicles, the Rating Plate is mounted on the rear face of the left front door.

VEHICLE IDENTIFICATION NUMBER (VEHICLE SERIAL AND WARRANTY)

The identification number is the first line of numbers and letters appearing on the Rating Plate (Fig. 2). The first letter and two numbers indicate the truck series code. The letter following the truck series code designates the engine identification code. The letter following the engine identification code indicates the assembly plant at which the vehicle was built. The remaining numbers indicate the consecutive unit number (Serial and Warranty number). The charts that follow list the various vehicle identification number codes.

VEHICLE DATA

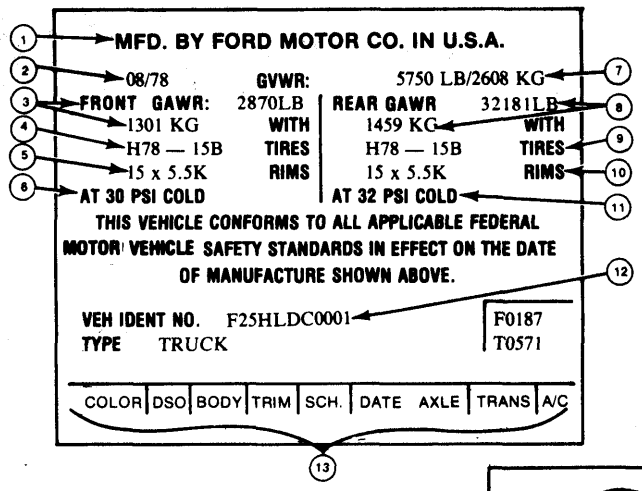
The Vehicle Data appears on the Rating Plate on the two lines following the identification number. The first three digits under W.B. designate the wheelbase in inches. The one or two letters under COLOR identify the exterior paint color (two letters designate a two-tone). The letter and three digits under TYPE/G.V.W. designate the truck model within a series and the gross

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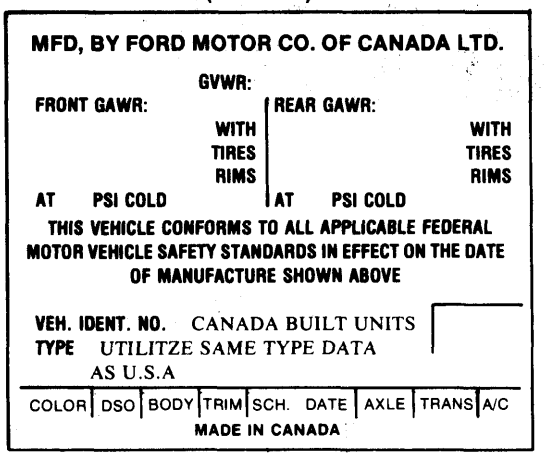
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COMPLETE VEHICLES

(UNITED STATES)



(CANADA)



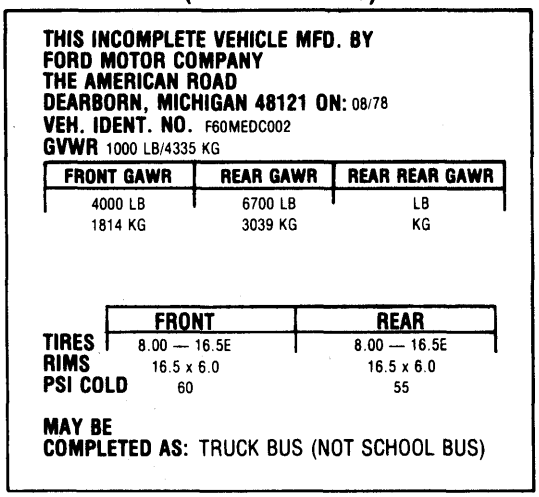


LABEL APPLIED TO ALL CANADIAN BUILT UNITS.

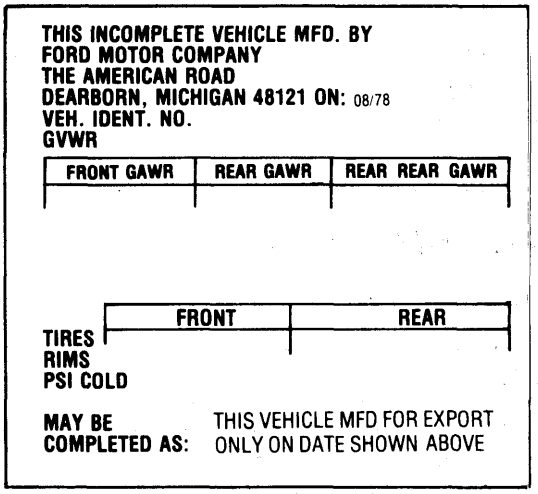
INCOMPLETE VEHICLES

THE INCOMPLETE VEHICLE LABEL IS ATTACHED TO A BOOKLET (INCOMPLETE VEHICLE MANUAL) AND SECURED TO A SUITABLE INTERIOR LOCATION FOR INFORMATION USE AT DESTINATION.

(UNITED STATES)



(EXPORT)



NOTE — The same information is on all Safety Certification Labels although the location of the information on the label may be different.

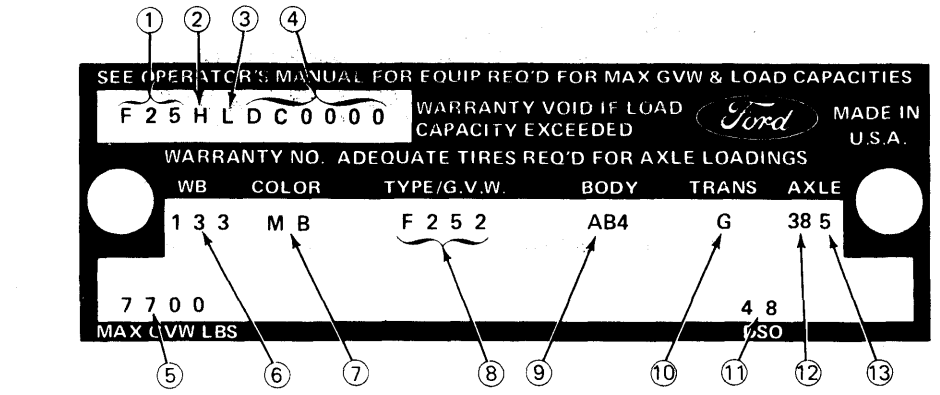
1. Name of Manufacturer
2. Date of Manufacture
3. Front Gross Axle Weight Ratings in Pounds (LB) and Kilograms (KG)
4. Front Tire Size
5. Rim Size
6. Front Tire Cold PSI
7. Gross Vehicle Weight Rating in Pounds (LB) and Kilograms (KG)
8. Rear Gross Axle Weight Rating In Pounds (LB) and Kilograms (KG)
9. Rear Tire Size
10. Rim Size
11. Rear Tire Cold PSI
12. Vehicle Identification Number (See Fig. 2 for details)
13. Vehicle Data (See Fig. 2 for details)

CY1813-2B

FIG. 1 Typical Truck Vehicle Certification Labels

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1. TRUCK SERIES CODE
2. ENGINE CODE
3. ASSEMBLY PLANT CODE
4. SEQUENTIAL SERIAL AND WARRANTY NUMBER
5. RECOMMENDED MAXIMUM GROSS VEHICLE WEIGHT RATING IN POUNDS
6. WHEEL BASE IN INCHES
7. EXTERIOR PAINT CODES
8. MODEL CODE AND GVW
9. INTERIOR TRIM, SEAT AND BODY/CAB TYPE
10. TRANSMISSION CODE
11. DISTRICT/SPECIAL ORDER CODES
12. REAR AXLE CODES
13. FRONT AXLE CODES (IF SO EQUIPPED)

W1017-2M

FIG. 2 Typical Truck Rating Plate

vehicle weight rating. The letter and numerals under BODY designate the interior trim, seat and body type. The transmission installed in the vehicle is identified under TRANS by either a numeric or alphabetical code (if two symbols appear, the first identifies the auxiliary transmission, if so equipped, and the second symbol identifies the main transmission). A letter and a number or two numbers under AXLE identify the rear axle ratio (when required, a letter is also stamped behind the rear axle code to identify the front axle capacity). The maximum gross vehicle weight in pounds is stamped above MAX. G.V.W.

A two-digit number is stamped under D.S.O. to identify the district which ordered the vehicle. If the vehicle is built to special order (Domestic Special Order, Foreign Special Order, Limited Production Option, or other special order), the complete order number will also appear under D.S.O. The charts that follow Fig. 2 list the various vehicle data codes.

BUILD DATE STAMP LOCATIONS

The vehicle build date stamp is located as follows: On Bronco and Light Trucks (F-100 through F-350) the vehicle build date is stamped on the front surface of the radiator support on the passengers side of the vehicle. On Econoline vehicles (E-100 through E-350), the build date is stamped on top of the radiator support. Following is a sample of the four digit number that indicates the month and day of build.

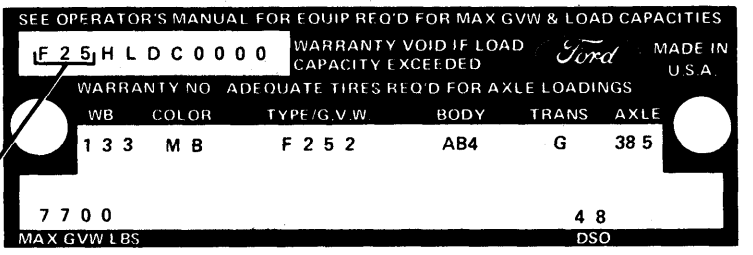
ACTUAL DATE OF BUILD	DATE STAMP ON VEHICLE
January 24	0124
October 21	1021

Yellow ink is used for the date stamp. When the marking surface is painted the body color, the date stamp will be marked in red ink. Units from the Ontario Truck Plant (Code C) will be marked with silver ink.

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TRUCK SERIES CODES



BRONCO

Code	Description
U15	U-150 (Wagon) 4x4

E-100 THRU E-350

Conventional Code	Super Code	Description
E-100 Series		
E01	—	E100 Club Wagon
E04	—	E100 Cargo Van
E05	—	E100 Window Van
E06	—	E100 Display Van
E-150 Series		
E11	S11	E150 Club Wagon
E14	S14	E150 Cargo Van
E15	S15	E150 Window Van
E16	S16	E150 Display Van

E-100 THRU E-350 (Continued)

Conventional Code	Super Code	Description
E-250 Series		
E21	S21	E250 Club Wagon
E24	S24	E250 Cargo Van
E25	S25	E250 Window Van
E26	S26	E250 Display Van
E-350 Series		
E31	S31	E350 Club Wagon
E34	S34	E350 Cargo Van
E35	S35	E350 Window Van
E36	S36	E350 Display Van
RV "Cutaway" and Chassis		
E37	—	E350 Cutaway
Commercial Cutaway and Chassis		
E37	—	E350 Cutaway
Parcel Delivery		
E38	—	E350 Cutaway

F-SERIES CONVENTIONAL — GAS

Chassis Cab Code	Pick-Up Code	Basic Series
F17	F10	F100
F16	F14	F150 4x4
F19	F15	F150
F27	F25	F250
F28	F26	F250 4x4
F37	F35	F350
F38	F36	F350 4x4

F-SERIES SUPER CAB — GAS

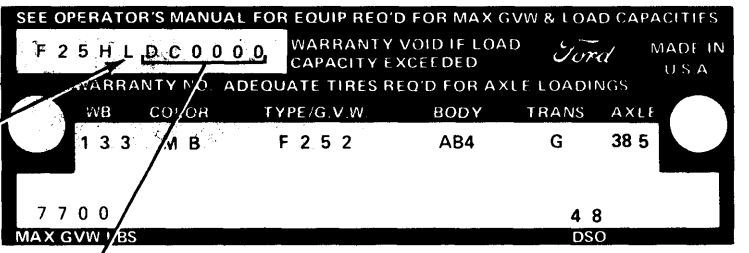
Chassis Cab Code	Pick-up Code	Basic Series
X17	X10	F100
X16	X14	F150 4x4
X19	X15	F150
X27	X25	F250
X28	X26	F250 4x4
X37	X35	F350
X38	X36	F350 4x4

CY1832-2A

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ASSEMBLY PLANT AND SEQUENTIAL SERIAL AND WARRANTY NUMBER CODES



ASSEMBLY PLANT CODES

Code	Assembly Plant
B	Oakville
C	Ontario Truck
E	Mahwah
H	Lorain
K	Kansas City
L	Michigan Truck
N	Norfolk
P	Twin Cities
R	San Jose
S	Allen Park
U	Louisville
V	Kentucky Truck

SEQUENTIAL SERIAL AND WARRANTY NUMBER CODES (1979 MODEL YEAR)

Bronco, LT Truck (F-100 thru F-350)

Code	Month and Year
DC0, 000 — DD9, 999	August, 1978*
DE0, 000 — DF9, 999	September, 1978
DG0, 000 — DH9, 999	October, 1978
DJ0, 000 — DK9, 999	November, 1978
EA0, 000 — EB9, 999	December, 1978
EC0, 000 — ED9, 999	January, 1979
EE0, 000 — EF9, 999	February, 1979
EG0, 000 — EH9, 999	March, 1979
EJ0, 000 — EK9, 999	April, 1979
FA0, 000 — FB9, 999	May, 1979
FC0, 000 — FD9, 999	June, 1979
FE0, 000 — FF9, 999	July, 1979
FG0, 000 — FK9, 999	August, 1979

E-100 thru E-350 (Econoline and Club Wagon)

Code	Month and Year
DC0, 000 — DD9, 999	August, 1978*
DE0, 000 — DF9, 999	September, 1978
DG0, 000 — DH9, 999	October, 1978
DJ0, 000 — DK9, 999	November, 1978
EA0, 000 — EB9, 999	December, 1978
EC0, 000 — ED9, 999	January, 1979
EE0, 000 — EF9, 999	February, 1979
EG0, 000 — EH9, 999	March, 1979
EJ0, 000 — EK9, 999	April, 1979
FA0, 000 — FB9, 999	May, 1979
FC0, 000 — FD9, 999	June, 1979
FE0, 000 — FF9, 999	July, 1979
FG0, 000 — FK9, 999	August, 1979

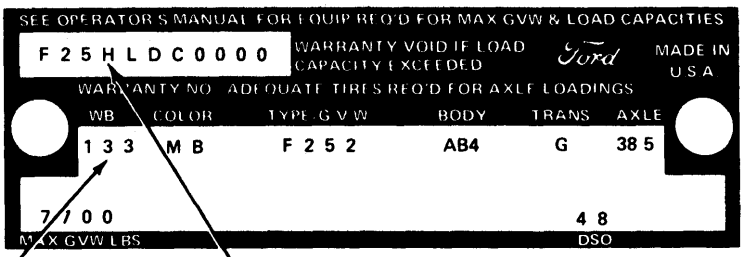
*Job #1 — 1979 Model Year

CY1833-2A

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WHEELBASE AND ENGINE CODES



WHEELBASE (Inches)

Bronco
104

F-100 thru F-350	
117	150
133	155
137	161
139	167
140	

E-100 thru E-350 (Econoline and Club Wagon)
124
138
158

ENGINE CODES

GAS ENGINE CODES — BRONCO

Code	Engine CID	Litre	Cyl.
H	351-2V	5.8L	8
S	400-2V	6.6L	8

GAS ENGINE CODES — LT. TRUCK (F-100 thru F-350)

Code	Engine CID	Litre	Cyl.
B	300-1V	4.9L	6
G	302-2V	5.0L	8
Z	(DSO)		
H	351-2V	5.8L	8
S	400-2V	6.6L	8
J	460-4V	7.5L	8
K	300-1V H.D.	4.9L	6

GAS ENGINE CODES — EXPORT LOW COMP.

Code	Engine CID	Litre	Cyl.
3	370-2V	6.1L	8
4	370-4V	6.1L	8
8	351-2V	5.8L	8

GAS ENGINE CODES — E-100 THRU E-350 (Econoline and Club Wagon)

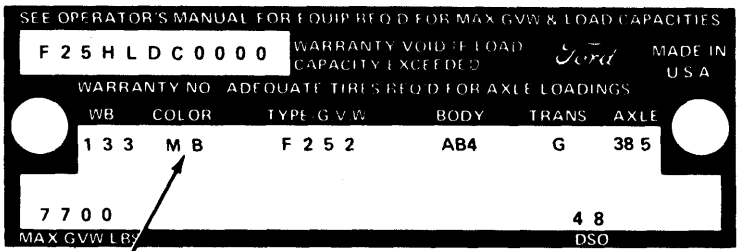
Code	Engine CID	Litre	Cyl.
B	300-1V L.D.	4.9L	6
K	300-1V H.D.	4.9L	6
G	302-2V	5.0L	8
H	351-2V	5.8L	8
A	460-4V	7.5L	8

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EXTERIOR PAINT COLOR CODES



BRONCO, LIGHT TRUCK (F-100 THRU F-350), ECONOLINE (E-100 THRU E-350)

Color Code ①	Color	Suffix #	Spec. #	Rel. #
1C (A)	Black	C1A	JASAXXA	1724-A
1G (J)	Silver Metallic	90P	SPLCXXA	5299-A
1G (O)	Silver Metallic	90P	SPLCXXA	5299-A
2A (F)	Coral	77D	JDKAXXA	1730-A
2A (P)	Coral	77D	JDKAXXA	1730-A
2E (T)	Candy Apple Red	80D	JDMAXXA	2008-A
2J (E)	Maroon	65D	JDQAXXA	3059-A
2Q (I)	Maroon Metallic	D5D	ADRCXXA	5433-A
2V (J)	Rangoon Red (KTP)	79D	JDNAXXA	1515-A
3B (3)	Midnight Blue Metallic	T4B	RBRCXXA	5660-A
3F (K)	Light Blue	E4B	MBLAXXA	5608-A
3G (S)	Bright Dark Blue Metallic	H9B	SBQCXXA	5094-A
46 (B)	Dark Jade Metallic	16K	AKQCXXA	5328-A
5M (V)	Medium Chestnut Metallic	09C	UCMCXXA	5144-A
5Q (F)	Dark Brown Metallic	75T	YTQCXXA	5477-A
5Q (H)	Dark Brown Metallic	75T	YTQCXXA	5477-A
6D (U)	Pastel Sand	17L	MLFAXXA	5620-A
6G (Y)	Med. Golden Sand Metallic	31Y	GYMCXXA	5624-A
6S (G)	Chrome Yellow	07V	JVMAXXA	1526-A
64 (6)	Bright Yellow	09V	GVTAXXA	5574-A
7A (R)	Light Jade	12R	CRJAXXA	5445-A
7D (L)	Holly Green (KTP)	89R	JRQAXXA	1237-A
7U (W)	Bright Emerald	08M	EMNAXXA	5500-A
72 (L)	Midnight Jade	45R	GRSAXXA	5530-A
76 (N)	Light Medium Pine	05M	MMLAXXA	5610-A
9A (M)	White	26W	JWFAXXA	1619-A
9E (C)	Special White (KTP)	32W	JWGAXXA	1525-A
99 (9)	Prime	—	XW Prime	—
	Glamour Colors ②			
3Z (8)	Medium Blue Metallic	J7B	MBMDXXA	5618-A
5W (D)	Medium Vaquero Metallic	14Z	MZMDXXA	5599-A
6F (7)	Desert Gold Metallic	20L	MLNDXXA	5619-A
	RPO Unique Colors ③ **Non-Polish "D"**			
3Z (8)	Medium Blue Metallic	J7B	MBNDXXA	5618-A
6F (7)	Desert Gold Metallic	20L	MLNDXXA	5619-A
8J (Z)	Golden Tan Metallic	90U	EUMDXXA	5484-A

① Bronco, Econoline (E-100 through E-350) and Light Trucks (F-100 through F-350), use the two-digit paint identification code system (corporate code), but will only show the single code for the rating plate exterior paint color codes as shown in ( ) parenthesis in the code column.

② Bronco and Light Truck (F-100 through F-350) only.

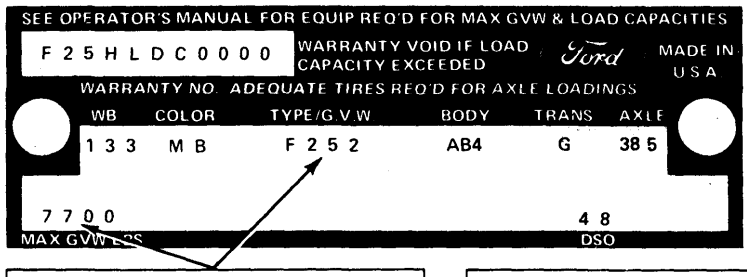
③ Econoline (E-100 through E-350) only.

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TYPE/GVW AND MAX. G.V.W. CODES



BRONCO

Code	G.V.W.
U150	6100
U151	6400
U152	6550

F-100 (4x2)

Pickup Code	Chassis Cab Code	G.V.W.
F101	F171	4800
F106	F176	5300
F107	F177	5500
F10N	F17N	5200

F-100 (4x2) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X108	X178	5600
X109	X179	5800
X10N	X17N	5200

F-150 (4x2)

Pickup Code	Chassis Cab Code	G.V.W.
F150	F190	6050
F151	F191	6150

F150 (4x2) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X150	X190	6050
X152	X192	6200
X153	X193	6400

F-150 (4x4)

Pickup Code	Chassis Cab Code	G.V.W.
F140	F160	6050
F141	F161	6300
F142	F162	6500

F-150 (4x4) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X143	X163	6400

F-250 (4x2)

Pickup Code	Chassis Cab Code	G.V.W.
F250	F270	6200
F251	F271	6900
F252	F272	7700
F253	F273	7900

F-250 (4x2) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X251	X271	6800
X254	X274	6300
X255	X275	6550
X256	X276	7800
X257	X277	7050
X258	X278	7600
X259	X279	8100
X25N	X27N	7500

F-250 (4x4)

Pickup Code	Chassis Cab Code	G.V.W.
F263	F283	6700
F264	F284	7400
F265	F285	8100
F266	F286	8400

F-250 (4x4) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X260	X280	7100
X261	X281	7800
X262	X282	8400

F-350 (4x2)

Pickup Code	Chassis Cab Code	G.V.W.
—	F370	8600
—	F37P	8800
—	F371	8900
—	F372	9000
—	F376	8900
—	F377	9500
—	F378	10,000
F351	F371	8800
F35P	F37P	9100
F356	—	8900
F358	—	9900

F-350 (4x2) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X359	X379	9200

F-350 (4x4)

Pickup Code	Chassis Cab Code	G.V.W.
F360	F380	8500

F-350 (4x4) SUPER CAB

Pickup Code	Chassis Cab Code	G.V.W.
X351	X371	8600

E-100 CLUB, CUSTOM, AND CHATEAU WAGONS

Conv. Code	G.V.W.
E010	5400
E011	5700
E012	5900
E013	5800
E014	6000

E-150 CLUB, CUSTOM, AND CHATEAU WAGONS

Conv. Code	Super Code	Conv. G.V.W.	Super G.V.W.
E110	S110	6000	6025
E111	S111	6200	6200
E112	S112	6100	6400
E113	S113	6300	6600
E114	S114	6500	6200
E115	S115	6100	6400
E116	S116	6300	6600
E117	—	6500	6600
E119	—	6300	—
E119	—	6500	—
E118	—	6600	—

E-250 CLUB, CUSTOM, AND CHATEAU WAGONS

Conv. Code	Super Code	Conv. G.V.W.	Super G.V.W.
E210	S210	6800	6900
E211	S211	7100	7200
E212	S212	7800	7400
E213	S213	6900	7700
E214	S214	7100	8000
E215	S215	7300	6900
E216	S216	7500	7300
E217	S217	7700	7400
E218	S218	8200	7700
E219	S219	7600	8000
E21J	S21J	7900	8300
E21K	S21K	8100	7600
E21L	S21L	8500	7800
E21M	S21M	8700	8000
—	S21N	—	8300
—	S21P	—	8500
—	S21Q	—	7700
—	S21R	—	7900
—	S21S	—	8100
—	S21T	—	8200
—	S21U	—	8300
—	S21V	—	8400

E-350 CLUB, CUSTOM, AND CHATEAU WAGONS

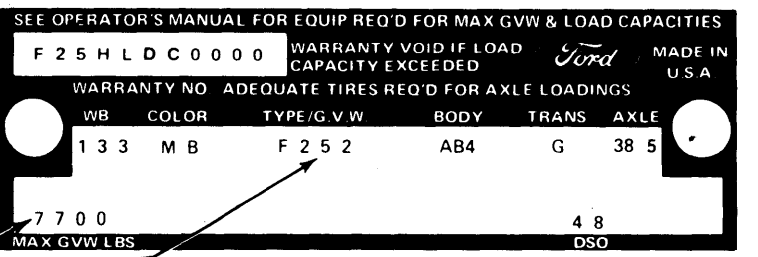
Code (Super)	G.V.W.
S310	8600
S311	8800
S312	8600
S313	8800
S314	9000
S315	8700
S316	8900
S317	9200
S318	8700
S319	8900
S31J	9200
S31K	9400

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TYPE/GVW AND MAX. GVW CODES — CONTINUED



E-100 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS

Conv. Cargo Code	Conv. Window Code	Conv. Display Code	G.V.W.
E040	E050	E060	5050
E041	E051	E061	5650

E-150 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS

Conv. Cargo Code	Super Cargo Code	Conv. Window Code	Super Window Code	Conv. Display Code	Super Display Code	G.V.W. (Conv.)	G.V.W. (Super)
E140	S140	E150	S150	E160	S160	6050	6050
E141	—	E151	—	E161	—	6100	—
E142	—	E152	—	E162	—	6300	—

E-250 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS

Conv. Cargo Code	Super Cargo Code	Conv. Window Code	Super Window Code	Conv. Display Code	Super Display Code	G.V.W. (Conv.)	G.V.W. (Super)
E240	S240	E250	S250	E260	S260	6750	6500
E241	S241	E251	S251	E261	S261	7500	7100
E242	S242	E252	S2S2	E262	S262	8250	7900

E-350 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS

Conv. Cargo Code	Super Cargo Code	Conv. Window Code	Super Window Code	Conv. Display Code	Super Display Code	G.V.W. (Conv.)	G.V.W. (Super)
E340	S340	E350	S350	E360	S360	8550	9000
E341	S341	E351	S351	E361	S361	9500	9400
E342	—	E352	—	E362	—	9800	—

E-350 CUTAWAY VAN

Code	G.V.W.
E370	8700 Single Rear
E371	9650 Single Rear
E372	8750 Dual Rear
E374	10,100 Dual Rear
E375	11,000 Dual Rear
E376	10,250 Dual Rear

E-350 CUTAWAY PARCEL DELIVERY VAN

Code	G.V.W.
E380	8750 Dual Rear
E381	9700 Dual Rear
E382	10,000 Dual Rear
E383	10,500 Dual Rear

E-350 COMMERCIAL CUTAWAY

Code	G.V.W.
E37X	8750 Dual Rear
E37Y	9700 Dual Rear
E37Z	9750 Dual Rear

E-350 COMMERCIAL STRIP (DSO)

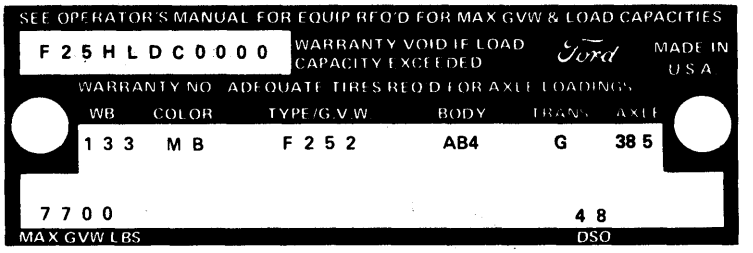
Code	G.V.W.
E37P	8650 Dual Rear
E37Q	9600 Dual Rear
E37R	8200 Dual Rear
E37S	9000 Dual Rear
E37T	9300 Dual Rear
E37U	9550 Dual Rear
E37V	9800 Dual Rear

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BODY CODES — BRONCO, LIGHT TRUCK (F-100 THRU F-350)



BODY

TRIM CODE (MATERIAL AND SEAT TYPE)

BRONCO CUSTOM

Code	Trim Type
A	Vinyl Bucket
B	Vinyl Bench
G	B/Cloth and Vinyl Captain Chair

BRONCO RANGER

Code	Trim Type
B	Vinyl Bench
C	Vinyl Bucket
D	B/Cloth and Vinyl Bucket
F	B/Cloth and Vinyl Bench
G	B/Cloth and Vinyl Captain Chair

LIGHT TRUCK CUSTOM BENCH

Code	Trim Type
A	Vinyl
D	Knit and Vinyl
G	Leather Grain Vinyl
P	Vinyl (Youth Package)
T	Poly Knit and Vinyl

RANGER BENCH

Code	Bench Trim Type
B	Vinyl
D	Knit and Vinyl
G	Leather Grain Vinyl HD (Black)
P	Vinyl (Youth Package)
Q	B/Cloth and Vinyl
T	Poly Knit and Vinyl
S	B/Cloth and Vinyl (Explorer)
R	Vinyl (Explorer)

RANGER XLT BENCH

Code	Trim Type
B	Vinyl
C	B/Cloth and Vinyl
D	Knit and Vinyl
G	Leather Grain Vinyl HD (Black)
T	Poly Knit and Vinyl

RANGER LARIAT BENCH

Code	Trim Type
B	Vinyl
D	Knit Vinyl
K	B/Cloth and Vinyl
T	Poly Knit and Vinyl

TRIM COLOR CODES

With HD Vinyl Opt. (Black Seat Only)	Code	Color
	A	Black
Note: "G" Trim Equals	B	Blue
Vehicle Order	D	Red
Column 21	F	Cordovan
Punch (3)	R	Jade
	T	Sand

BODY TYPE CODE

F-100 THRU 350

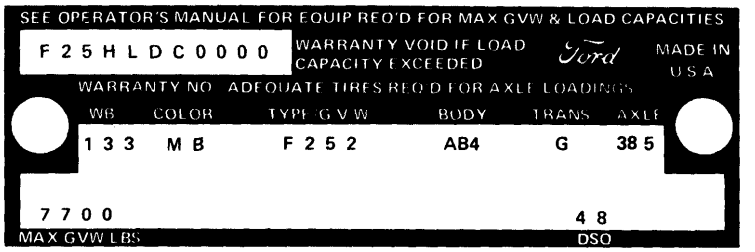
6-Man Crew Cab Code	Super Cab Code	Regular Code	Specifications
—	—	3	Flareside Pick-Up
D	M	4	Styleside Pick-Up
—	—	5	Platform Stake
G	P	8	Chassis Cab
—	—	9	Platform
—	—	2	Bronco Black Fiber Roof
—	—	1	Bronco White Fiber Roof
—	—	6	Bronco Sand Fiber Roof

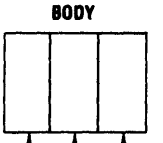
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BODY CODES — ECONOLINE (E-100 THRU E-350)





TRIM CODE (MATERIAL AND SEAT TYPE)

E-100 THRU E-350		
Code	**Trim**	**Type**
A	Vinyl	Bucket
B	Vinyl	Captain Chair
C	Vilon Knit & Vinyl	Captain Chair
D	B/Cloth & Vinyl	Captain Chair
E	Vinyl	Bucket
F	B/Cloth & Vinyl	Bucket
G	Vinyl	Flipfold

TRIM COLOR CODES

Code			Color
Custom	**Chateau**	**Base**	
A	J	1	Black
B	K	2	Blue
C	L	3	Jade
D	M	4	Sand
E	N	5	Saddle

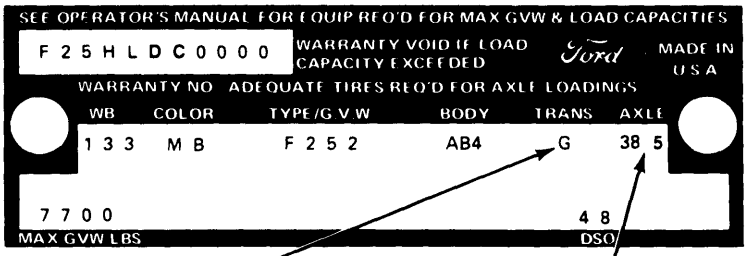
BLANK (Not Used On Econoline)

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TRANSMISSION AND AXLE CODES (REAR)



TRANSMISSION CODES

Code	Description
Bronco and F-100 thru F-350	
G	Automatic
C	Ford Manual 3-Speed
F	Warner 4-Speed Manual
A	New Process 4-Speed Manual
B	Clark Manual 4-Speed Overdrive
X	Automatic C-6 (Fleet Only)
Econoline — Club Wagon	
C	3-Speed Manual
G	Cruisomatic
B	Clark Manual 4-Soeed Overdrive

AXLE CODES (REAR)

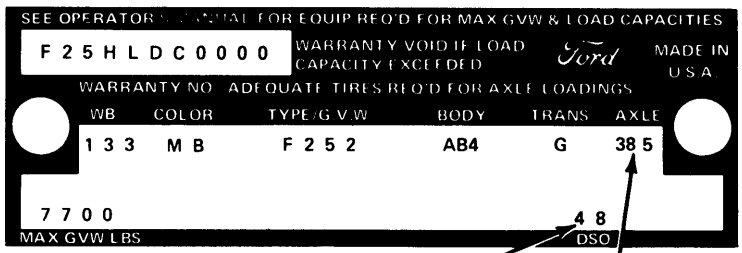
Code	Description	#Capacity	Ratio
Bronco and F-100 thru F-350			
06	Ford	2900	2.75
14	Ford	3750	3.00
15	Ford	3750	3.25
16	Ford	3750	3.50
13	Ford	3750	2.75
12	Ford	3750	4.11
H3	Limited Slip	3750	2.75
H2	Limited Slip	3750	3 50
H9	Limited Slip	3750	4 11
H4	Limited Slip	3750	3 25
23	Dana 61	5300	3.31
22	Dana 61	5300	3.07
24	Dana 60	5300	4.10
37	Dana 60	5300	3.54
38	Dana 60	5300	3.73
B4	Dana 60 Limited Slip	5300	4.10
C7	Dana 60 Limited Slip	5300	3.54
C8	Dana 60 Limited Slip	5300	3.73
27	Dana 70	7400	4.10
28	Dana 70	7400	4.56
36	Dana 70	7400	3.73
D7	Dana 70 Limited Slip	7400	4.10
E-100 thru E-350 (Non-Locking)			
05	Ford	2750	2.75
13	Ford	3750	2.75
14	Ford	3750	3.00
15	Ford	3750	3.25
22	Dana	5300	3.07
23	Dana	5300	3.31
37	Dana	5300	3.54
38	Dana	5300	3.73
36	Dana	7400	3.73
27	Dana	7400	4.10
E-100 thru E-350 (Locking)			
H3	Ford	3750	2.75
H4	Ford	3750	3.25
H7	Ford	3750	3.00
C7	Dana	5300	3.54
C8	Dana	5300	3.73
D7	Dana	7400	4.10

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FRONT AXLE AND D.S.O. CODES



DISTRICT SALES OFFICE (DSO) CODE

DSO — FSO — PTO (DOMESTIC, FOREIGN AND SPECIAL ORDER)

The D.S.O. space will show a two-digit code number of the district which ordered the unit (see chart below). This code will appear on all units — domestic or export. If unit is built on a D.S.O., E.S.O., P.T.O. (special orders), the complete order number is under the D.S.O. space **after** the district code.

FRONT AXLE CODES (Not Applicable On E-100 Thru E-350)

Bronco and F-100 Thru F-350

Adjustable Steering Column	Power Steering	Power Steering and Adjustable Steering Col.	Code	Front Axle
E	N	V	5	3850# Front Axle
I	R	Z	9	4500# Front Axle
B	K	S	2	Roll Bar
C	L	T	3	Roll Bar and 3850# Front Axle
D	M	U	4	Roll Bar and 4500# Front Axle

DISTRICT CODES

11 Boston	41 Chicago	71 Los Angeles
12 Buffalo	42 Cleveland	72 San Jose
13 New York	43 Milwaukee	73 Salt Lake City
14 Pittsburgh	45 Lansing	74 Seattle
15 Newark	46 Indianapolis	75 Phoenix
16 Philadelphia	47 Cincinnati	76 Denver
17 Washington	48 Detroit	
		83 Government
		84 Home Office Reserve
21 Atlanta	52 Dallas	85 American Red Cross
22 Charlotte	53 Kansas City	86 Recreation Vehicles
23 Memphis	54 Omaha	87 Body Company
24 Jacksonville	55 St. Louis	89 Transportation Services
25 Richmond	56 Davenport	
26 New Orleans	57 Houston	90's Export
28 Louisville	58 Twin Cities	00 Special

Ford of Canada

Mercury Regions	Ford Regions
A1 Central	B1 Central
A2 Eastern	B2 Eastern
A3 Atlantic	B3 Atlantic
A4 Midwestern	B4 Midwestern
A6 Western	B6 Western
A7 Pacific	B7 Pacific
A8 Great Lakes	B8 Great Lakes
12 Export	12 Export

Note: EXPORT ALPHABETICAL 1

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WHEELS AND TIRES

GROUP 11 (1000 & 2000)

General Wheel and Tire Service 11-01
Wheels and Tires — Drop-Center Rim 11-02
Wheel Hubs and Bearings — Front (Except Front Drive) 11-10
Wheel Hubs and Bearings — Front Wheel Drive 11-12
Wheel Hubs and Bearings — Rear (Semi Floating Axle) 11-11
Wheel Hubs and Bearings — Rear (Full Floating Axle) 11-14

General Wheel and Tire Service

PART 11-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
SAFETY	01-1	CLEANING AND INSPECTION	
DIAGNOSIS AND TESTING		Aluminum Wheels & Rims	01-8
Diagnosis Guides	01-3	Front Wheel Bearings	01-8
ADJUSTMENTS		Rim & Wheel Maintenance	01-10
Front Wheel Bearing Maintenance	01-7	Safety Precautions	01-8
Wheel and Tire Checking Procedure	01-7	Tires	01-8
Wheel and Tire Vibration Diagnosis Procedures	01-7	Wheels	01-7
		SPECIFICATIONS	01-10

SAFETY

When replacing tires, use the same size, load range and construction type (bias, bias belted or radial) as originally installed on your vehicle. When replacing wheels, use original equipment manufacturers wheels or equivalent available from your Ford dealer with equivalent capacity, width, offset and mounting configuration as those originally installed on your vehicle. Use of improper replacement wheels and tires may adversely affect ride, handling, load carrying capacity, bearing life, tire clearance to body and chassis components, vehicle ground clearance, vehicle width and brake cooling.

SAFETY PRECAUTIONS WHEN SERVICING TRUCK TIRES

CAUTION AND SAFETY FIRST are important bywords when handling tires, **particularly truck tires.** Careful attention to the suggestions that follow may prevent crippling injuries, or even death. **Make it a rule to respect the terrific force contained in an inflated tire.** You may be glad some day that you did.

Prepare for any tire repair operation in a safe and efficient way. In changing tires on drop center wheels, remove the wheel and tire from the truck, **as changing tires with the wheel on the truck is hazardous, more difficult, and takes more time.** In servicing of all tires use caution not to drop them (or the wheels or assemblies) on the feet, hands or body, or heavily on the floor (Fig. 1). Practice good methods of lifting; use your legs as well as your arms and your body. This will help to prevent painful, internal injury. When carrying tires or wheels don't step in oil or grease. **Keep the floor clean and dry.**

Deflating a tire properly is very important to your safety. First, reduce the pressure as much as you possibly can by pushing the valve core plunger. **Only then should you remove the valve core.** Keep your eyes away from the valve: Fig. 2 shows the safe way to do it.

Demounting tires from wheels or rims requires special care. Tires on drop center rims are best handled on a wheel holder, or tire-changing machine such as Rotunda Model 350010 or equivalent (Fig. 3).

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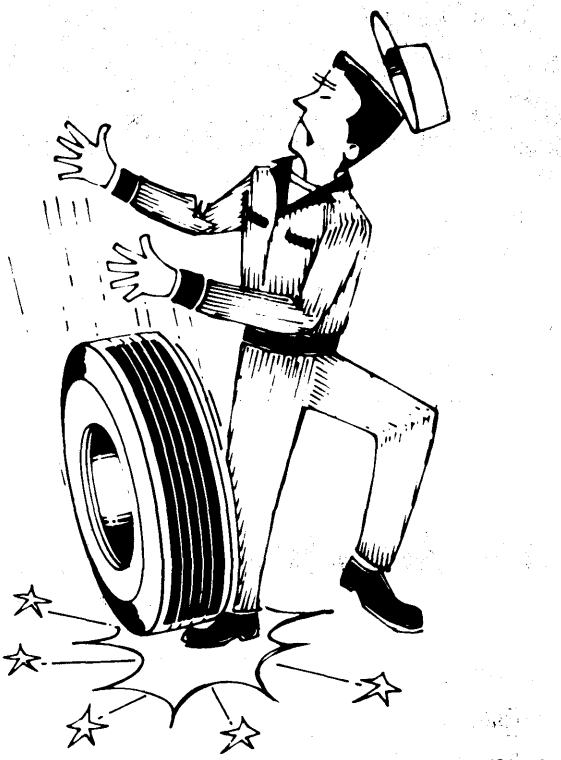


FIG. 1 Handling Wheels and Tires

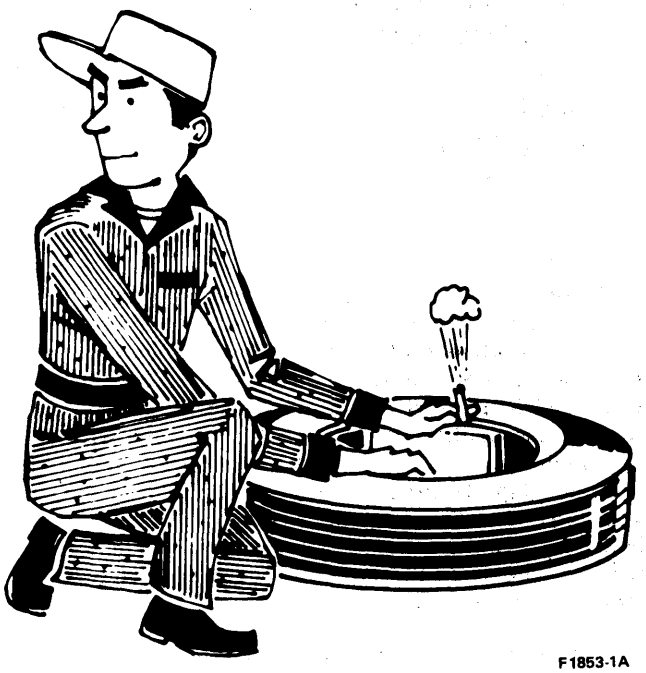


FIG. 2 Safe Air Removal

This can help prevent cuts on hands and wrists and will make it unnecessary to use a mallet for seating the tire.

Use only standard tire mounting tools and equipment. The use of makeshift tools, screwdrivers or pliers to force tires on or off rims or wheels is dangerous.



FIG. 3 Changing Tire on Drop Center Rim

Always lubricate tire beads to assure sealing of tire beads on rim with rubber lubricant ESA-M1B6-A, or equivalent.

The Rotunda tire changer includes a bead seater/inflator using an automatically adjustable inflation ring, which aids in properly seating the bead for inflation. To properly operate the Rotunda tire changer, follow the instructions provided.

A careful inspection should be made of the tire and all necessary repairs should be performed. A tire spreader is very helpful but use care when working around it. Keep the spreader arms closed when the machine is idle (Fig. 4).

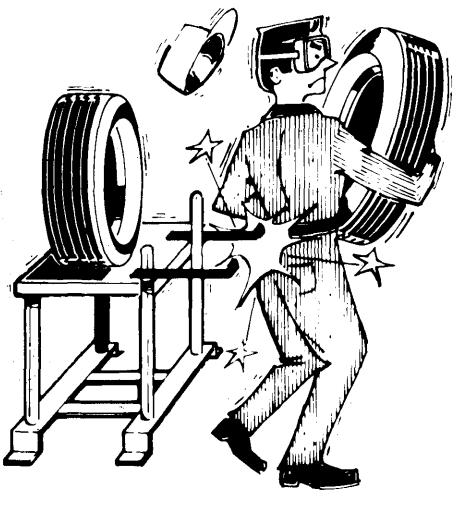


FIG. 4 Tire Spreader

Inspect the rim parts carefully for rust, damage or distortion.

Tires and rims often require a buffing operation before being mounted once the regular repairs have been made.

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Always wear Safety Goggles, or a face shield when performing any buffing operation.

Avoid hammering rims with steel hammers. Small bits of steel may be broken off the hammer or rim, flying into the eyes (wear safety goggles) face or body. Use rubber-covered, steel-headed hammers wherever possible. Rubber mallets only should be used on passenger car type tires; although with modern tire changing equipment no pounding is necessary.

Stand away from the valve stem as far as possible while inflating tires. Avoid a position where the face or body is immediately over the work being done on any tire in which there is pressure.

Attach a portable safety device, made especially for the purpose, to the assembly. This portable device should be used with all types of wheels and rims.

Use only accurate, tested gauges to insure proper air pressure. Check all gauges regularly with a master gauge.

Play it SAFE. Set a good example for others who work with you. Follow the above suggestions completely. **If you are ever tempted to take a short cut because you are in a hurry, that is the time that you could get hurt.**

Finally, always remember, a jack is provided for wheel and tire maintenance only. **Never run the engine when the vehicle is supported by a jack.**

DIAGNOSIS AND TESTING

DIAGNOSIS GUIDES

The following guides can be used as an aid in wheel and tire service diagnosis.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• Tires show excess wear on edge of tread.	• Under inflated tires.	• Adjust air pressure in tires.
	• Vehicle overloaded.	• Correct as required.
	• High-speed cornering.	• Correct as required.
	• Incorrect toe setting.	• Set toe to specification.
• Tires show excess wear in center of tread.	• Tires over inflated.	• Adjust air pressure in tires.
• Other excessive tire wear problems.	• Improper tire pressure.	• Adjust air pressure in tires.
	• Incorrect tire/wheel usage.	• Install correct tire and wheel combination.
	• Loose or leaking shock absorbers.	• Tighten or replace as necessary.
	• Front end out-of-alignment	• Align front end.
	• Front wheel bearings out of adjustment.	• Adjust front wheel bearings.
	• Loose, worn or damaged suspension components, bushings and ball joints.	• Inspect, repair or replace as required.
	• Wheels and tires out of balance.	• Balance wheels and tires.
	• Excessive lateral and/or radial runout of wheel or tire.	• Check, repair or replace as required. Use dial indicator to accurately determine runout.
• Excessive vehicle vibration, rough steering, or severe tire wear.	• Loose or improper attaching parts	• Tighten or replace.
	• Overloading or unbalanced loads.	• Check rim and tire specs against work load requirements. Recommend correct tire and rim. Check on loading procedure.
• Vehicle vibrations.	• Loose or worn driveline or suspension parts.	• Identify location of vibration carefully as it may be transmitted through frame making a rear end vibration appear to come from the front. Repair or replace loose and worn parts.
	• Improper front end alignment	• Align front end.
	• Excessive lateral runout (wheel or tire). Use a dial indicator to accurately verify runout reading.	• Replace wheel or tire.
	• Bent or distorted disc from over loading, road impact hazards or improper handling.	• Replace wheel. Attempts to straighten wheel can result in fractures in the steel and weakening of the disc or the weld between disc and rim; Check loading and operating conditions and shop practices.
	• Loose mountings — damaged studs, cap nuts, enlarged stud holes, worn or broken hub face or foreign material on mounting surfaces.	• Tighten and/or replace worn or damaged parts. Clean mounting surfaces.
	• Out-of-balance wheel and/or tire or hub and drum assembly.	• Determine the out-of-balance component and balance or replace.
	• Out-of-round wheel or tire (excessive radial runout).	• Replace the wheel or tire and check for overhauling and unbalanced loads, rugged operating conditions, proper wheel and tire specifications.
• Wheel mounting is difficult.	• Improper application or mismatched parts, including studs and nuts.	• Follow manufactures specifications.
	• Corroded or worn parts	• Clean or replace.
• Wheel-rust or corrosion	• Poor maintenance.	• Keep clean and protect with paint.

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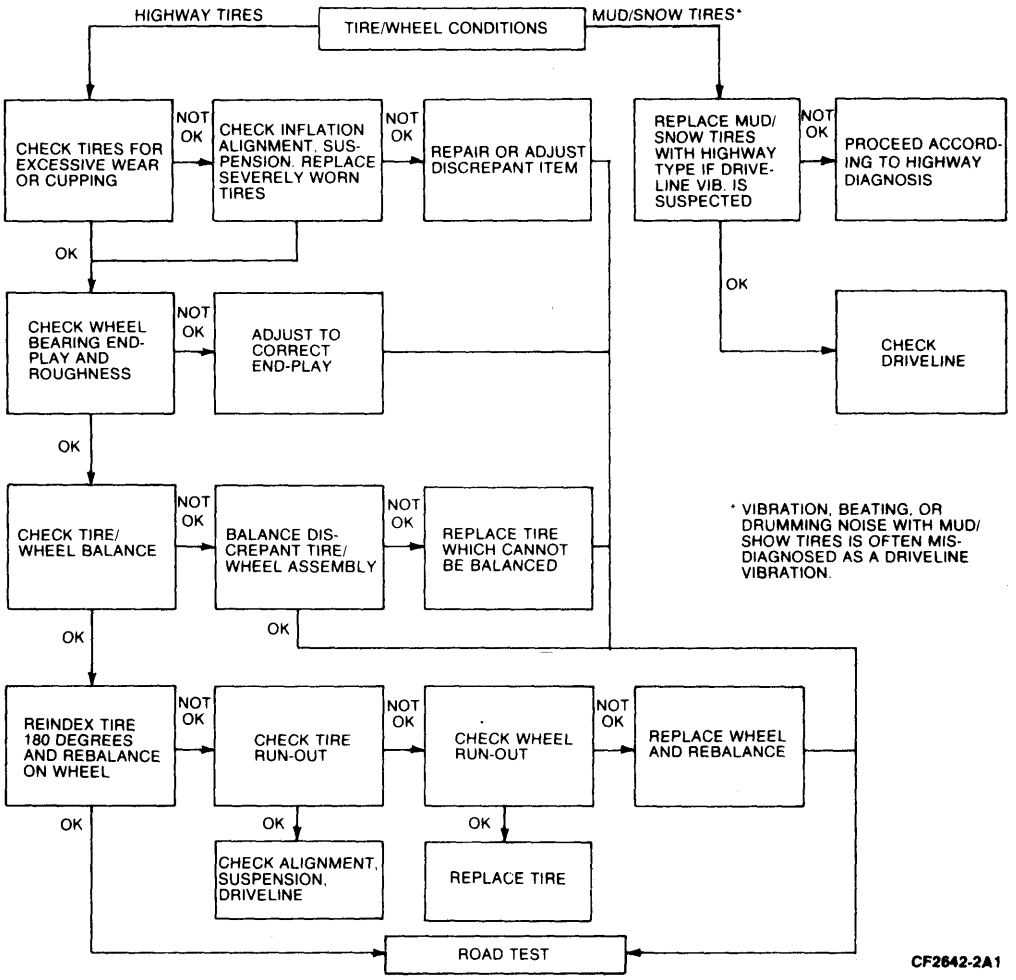
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CONDITION	POSSIBLE CAUSE	CORRECTION
• Cracked or broken wheel discs. Cracks develop in the wheel disc from hand hole to hand hole, from hand hole to rim, or from hand hole to stud. Stud holes become worn, elongated or deformed. Metal builds up around stud hole edges, cracks develop from stud hole to stud hole. Related driver complaints: unusual operating noise or vibration and on the road failures.	• Metal fatigue resulting in abusive handling.	• Replace wheel. Check position of wheel on vehicle for working load specifications.
	• Truck operated with loose wheel mounting.	• Replace wheel and check for: — Installation of correct studs and nuts, and recommend exact specifications. — Cracked or broken studs, and replace. — Worn hub face. Machine if not excessive, or replace if severe. — Broken or cracked hub barrel, replace. — Worn stud grooves, replace or install recommended serrated bolts. — Clean mounting surfaces and re-torque cap nuts periodically. — Rust streaks fanning out from stud holes are a sure indication that the cap nuts are or have been loose.
• Cracks develop in rim base back flange or the gutter area.	• Overloading or abusive use.	• Replace rim or wheel. Check loading and operating conditions. Avoid over inflation of tires. Check specs for rim load capacity, working loads, tire size, ply rating and tire construction.
	• Improper use of tools.	• Check mounting, demounting, and maintenance procedures.
• Dual tires rubbing (kissing).	• Insufficient wheel spacing.	• Check tire and wheel sizes. Make certain proper size tire and wheels are used.
• Damaged stud threads.	• Sliding wheel across studs during assembly.	• Replace studs. Follow proper wheel installation procedure.
• Loose drum.	• Stud too long.	• Replace stud with proper length stud.
• Loose inner wheel.	• Excessive stud standout from mounting face of hub permitting wheel nut to bottom out.	• Replace stud with proper length stud.
• Broken studs.	• Loose cap nuts.	• Replace studs. Follow proper torque procedure.
	• Overloading.	• Replace studs. Compare actual load against wheel load ratings.
• Stripping threads	• Excessive torque.	• Replace studs. Follow proper torque procedure.
• Rust streaks from stud holes.	• Loose cap nuts.	• Check complete assembly. Replace damaged parts. Follow proper torque procedure.
• Damaged inner or outer cap nuts. outer cap nuts.	• Loose wheel assembly.	• Replace cap nuts. Check for proper stud nuts standout. Follow proper torque procedure.
• Frozen inner or outer cap nuts.	• Corrosion or galling.	• If corrosion is slight, wire brush away corrosion. • If corrosion is excessive, replace studs and nuts. • If condition persists, lubricate first three threads of each stud with a graphite-based lubricant. CAUTION: Do not permit lubricant to get on ball seats of stud holes or on ball face of cap nuts.

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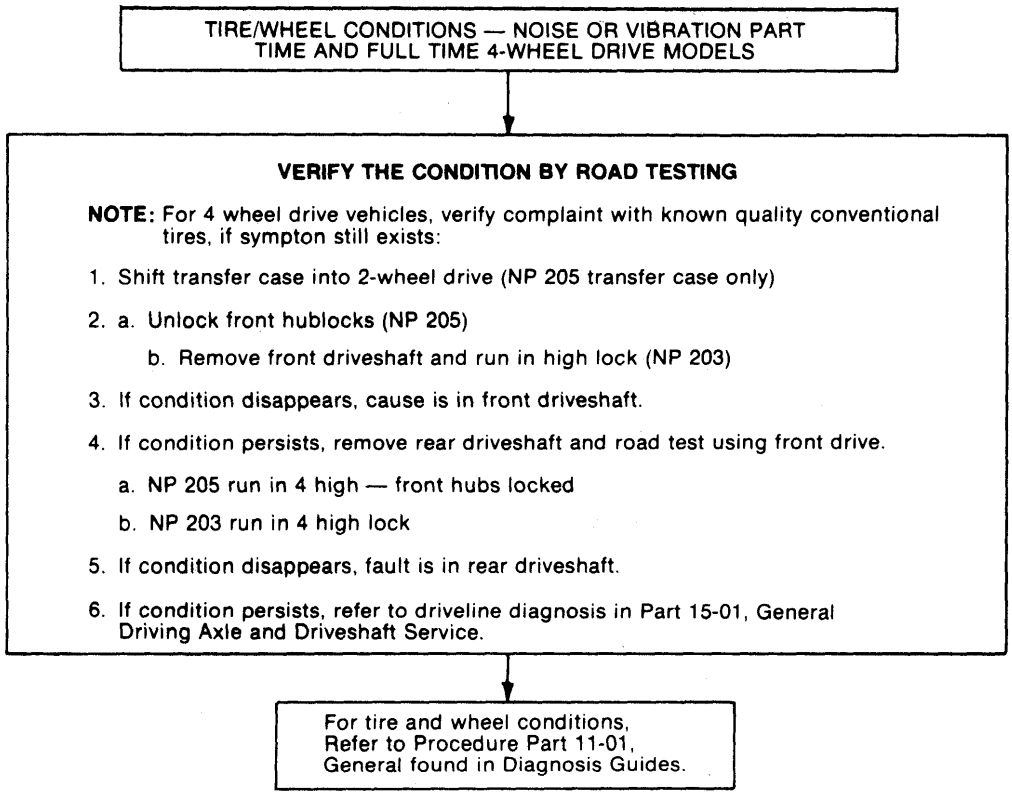
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ADJUSTMENTS

WHEEL AND TIRE CHECKING PROCEDURE

Inspect tires for wear from incorrect mounting misalignment, loose wheel bearings, bent wheels, or cupping or scalping from inbalance. Tires which show irregularities and definite roughness must be replaced.

Make certain that the brakes are not dragging and wheel bearings are properly adjusted before attempting to spin the wheels. On vehicles equipped with disc brakes, push the brake shoes into the caliper to free the rotor.

WHEEL AND TIRE VIBRATION DIAGNOSIS PROCEDURES

Refer to Part 18-01, Noise, Vibration and Harshness—Diagnosis.

NOTE: Mud and snow type tire vibration can often be mistaken for driveline problems, especially when mud and snow type tires are used on all wheels on four wheel drive vehicles.

FRONT WHEEL BEARING MAINTENANCE

Wheel bearings are adjustable. Satisfactory operation and long life of bearings depend on proper adjustment and correct lubrication. **If bearings are adjusted too tightly, they will overheat and wear rapidly. An adjustment that is excessively loose can cause pounding and contribute to uneven tire wear, steering difficulties and inefficient brakes. The bearing adjustment should be checked at regular inspection intervals.**

CLEANING AND INSPECTION

WHEELS

Wheel stud nuts should be inspected and tightened twice within the first 500 miles of operation. After the first 1000 miles of operation, they should again be inspected and tightened. Loose wheel stud nuts may cause shimmy stud damage and/or stud failure, possible wheel damage, and vibration. Elongated stud holes in the wheels may also result from the loose stud nuts.

Keep the wheels and hubs clean. Stones or lumps of mud wedged between the wheel and drum will unbalance a wheel and tire.

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Check for damage that would affect the runout of the wheels. Wobble or shimmy caused by a damaged wheel will eventually damage the wheel bearings and cause uneven tire wear. Inspect the wheel rims for dents that could permit air to leak from the tires.

TIRES

The tires should be checked frequently to be sure that the air pressures agree with those specified for the tires and vehicle model shown on the safety certification label on the vehicle. Inspect the tire tread, and remove all stones, nails, glass or other objects that may be wedged in the tread. Check for holes or cuts that may permit air leakage from the tire, and make the necessary repairs.

Inspect the tire side walls for cuts, bruises, and other damage. If internal damage is suspected, demount the tire from the wheel for further inspection, repair or replacement. Fig. 5 describes common tire conditions.

Check the tire valve for air leaks, and replace the valve if necessary. Replace any missing valve caps.

It is important that all wheels be balanced.

FRONT WHEEL BEARINGS

Wheel bearings are adjustable, to correct for bearing and shoulder wear of the spindle. Satisfactory operation and long life of bearings depend on proper adjustment and correct lubrication. **If bearings are adjusted too tightly, they will overheat and wear rapidly. An adjustment that is excessively loose can cause pounding and contribute to uneven tire wear, steering difficulties and inefficient brakes. The bearing adjustment should be checked at regular inspection intervals.**

Front hub assemblies and bearings should be cleaned, inspected and lubricated whenever the hub assemblies are removed or at the mileage/time periods indicated in the maintenance schedule.

New hub assembly grease seals should be installed when the hub is removed. A damaged or worn seal may permit bearing lubricant to reach the brake linings, resulting in ineffective brake operation and necessitating premature replacement of linings.

Bearing adjustment is described in Part 11-10 for front wheels. Part 11-12 covers front drive bearing adjustment. Parts 11-11 and 11-14 cover rear wheel bearing adjustments.

ALUMINUM WHEELS AND RIMS

CLEANING

Whenever tire is removed, thoroughly examine the complete wheel. Remove all grease and road dirt and use a wire brush or steel wool to remove the rubber from the bead seat.

STRAIGHTENING WHEELS

Do not heat wheels in an attempt to soften them for straightening to repair damage from striking curbs, etc. The special alloy used in these wheels is heat-treated, and uncontrolled heating from welding affects the properties of the material. Do not weld the wheels for any reason.

VALVES

Wheels for tubeless tires come from the factory with air valve installed. If it becomes necessary to replace an air valve it should be installed using 14 ft-lbs of torque on the hex nut.

MAINTENANCE AND PROTECTION IN CORROSIVE ENVIRONMENTS

Due to aluminum's natural resistance to corrosion, aluminum forged disc wheels do not need to be painted for most operating conditions. Washing them (do not use highly alkaline cleaning agents) when washing the rest of the vehicle will be enough to keep wheels looking good for many years. Certain environments, as created by some operations, can lead to corrosion. Some of these are: livestock hauling, salt, chloride compounds used for snow removal and highly alkaline materials. When these conditions are encountered, the following practice is recommended:

1. Clean frequently with steam or high-pressure water from a hose. Use of a mild detergent will speed up the cleaning process.
2. When tires are removed, the entire wheel should be cleaned and inspected. For maximum protection, there are various types of coatings which give good results. The following procedures are suggested:

Surface Preparation

1. Remove all the soil and oil from the wheel surface with either high-pressure steam or solvent. Suitable solvents would be mineral spirits and regular paint thinner, obtained in paint stores.
2. Remove any adherent soil or oxidation products by using a wire brush.
3. Clean the surface again with solvent, using mineral spirits to remove loose products.
4. Apply a clear protective or pigmented product as follows:

Clear Protective Coating

Spray apply about 1 1/2 to 2 mils wet film thickness, air curing clear epoxy polyamide meeting Military Specification MIL-C-22750 (WEP) or equivalent. To properly spray this particular coating, mix components A and B of the two-part organic coating and thin where necessary with 10 percent toluol. Spray apply with a spray gun at a pressure of 30-40 pounds (suction feed).

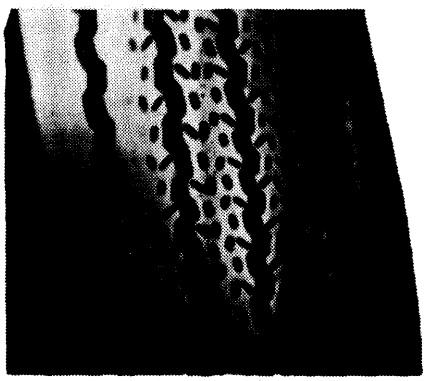
Pigmented Protective Coating

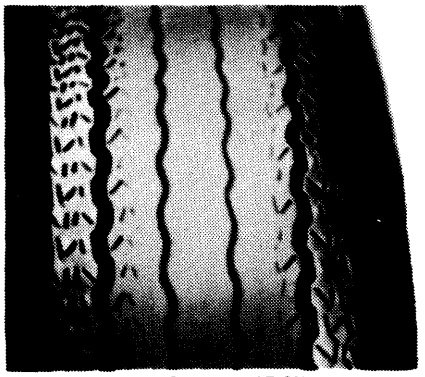
Primer-Spray apply the inhibited primer, meeting Military Specification MIL-C-23377 (SEP) or equivalent. Spray this primer at a 1 to 2 mil wet film thickness. Allow to air dry from 2 to 4 hours before top-coating.

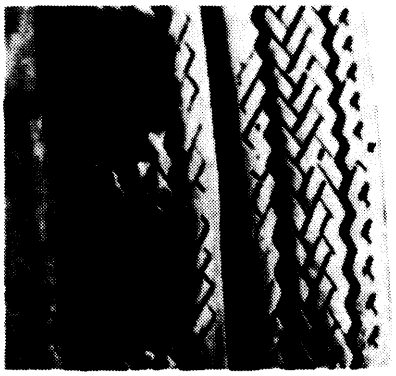
Top Coat-Spray a 1 1/2 to 2 mils wet film of a leafing aluminum pigmented epoxy. Allow enough time to air dry before handling; overnight will usually be sufficient.

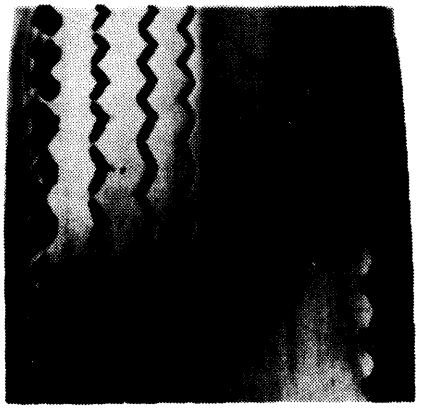
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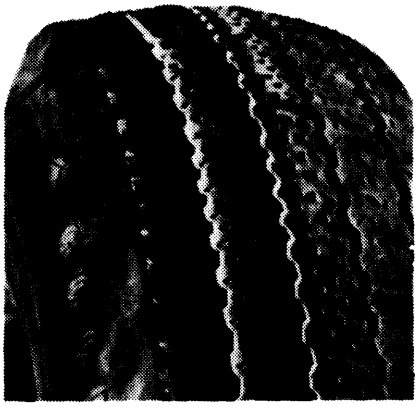
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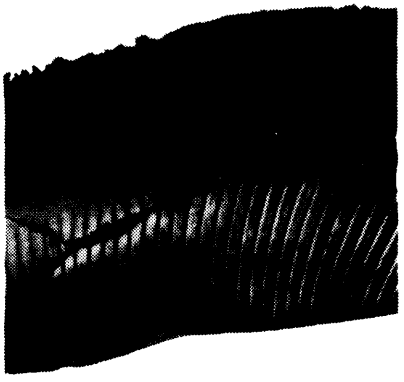

UNDERINFLATION

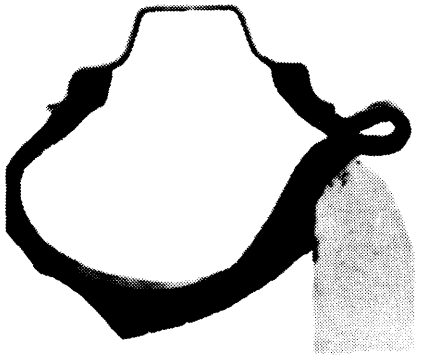

OVERINFLATION

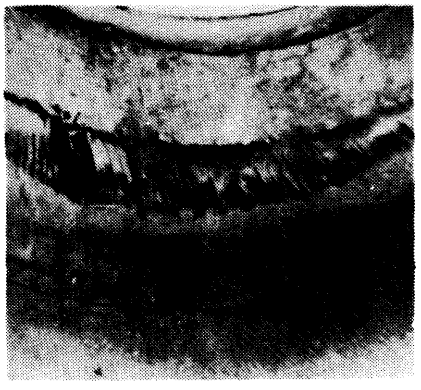

CUPPING-UNDERINFLATION AND/OR WORN OR LOOSE SUSPENSION OR STEERING COMPONENTS

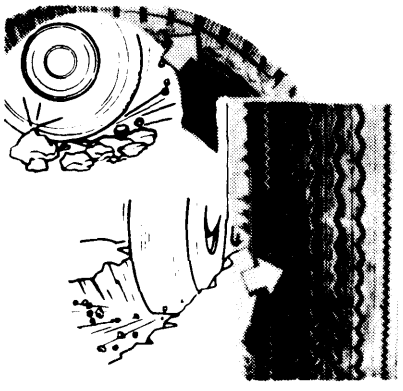

INCORRECT TOE-IN OR EXTREME CAMBER

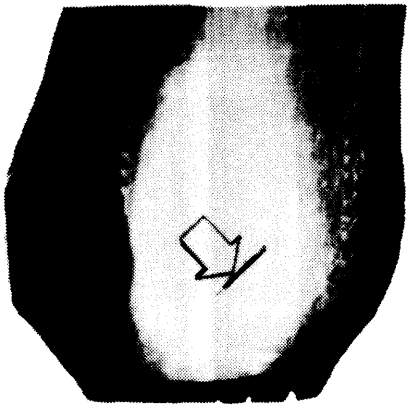

FEATHERING DUE TO INCORRECT TOE SETTING OR SEVERE CORNERING

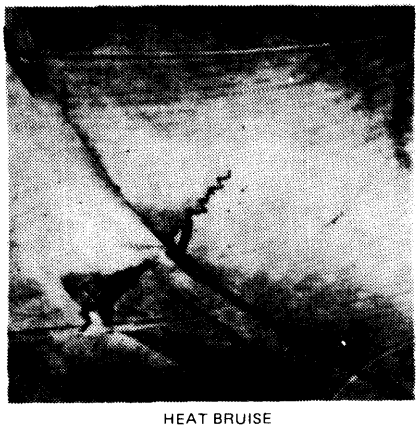

STONE BRUISE


STONE BRUISE


UNDERINFLATION


ROCK CUT


BRUISE


HEAT BRUISE


DOUBLE BRUISE-SHARP OBJECT AND RESULTING FATIGUE F1467-2E

FIG. 5 Tire Wear Conditions

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RIM AND WHEEL MAINTENANCE

DURING TIRE INSPECTIONS

1. Check all metal surfaces thoroughly while making tire inspections, including areas between duals and on inboard side of wheel. Watch for:
   - excessive rust or corrosion build-up
   - cracks in metal
   - bent flanges, resulting from road obstructions
   - loose, missing or damaged nuts
   - bent or stripped studs
2. Pull damaged rims or wheels.

   CAUTION: Excessively corroded or cracked rims can be dangerous. Deflate tires prior to the removal from the wheels.
3. Mark damaged or hazardous areas with chalk so that part will be removed from service.
4. Replace parts as required.
5. Inflate tires only to recommended air pressures.

DURING TIRE CHANGES

1. Check all metal surfaces. Watch particularly for the following items:
   - Cracks in the rim base and in the flange areas. These are caused by deep rim tool marks, overloading and overinflating tires or using larger than recommended tire sizes.
   - Cracks in the wheel disc, between the stud holes or hand holes. These are caused by loose wheel nuts, improper installation procedures or the use of incorrect sizes or types of attaching parts.
2. Replace the parts as necessary.

CAUTION: Insure that replacements are made with the proper sizes and types of wheels.

3. Thoroughly remove rust, dirt and other foreign materials from all surfaces. Hand or electric wire brushes, sand blasting or chemical baths may be used. Bead seat areas of rim should be free of rust and rubber deposits. This is especially important for drop-center tubeless rims, because the 15 degree bead seat is the air-sealing element.
4. Paint rim by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry prior to painting. Insure that bare metal areas on the outside or tire side of rim are covered. This is especially important on drop-center tubeless rims, because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.
5. Lubricate the tire side of the rim base just prior to mounting tire. Avoid the use of any lubricant which contains water or solvent that is injurious to rubber. A combination lubricant and rust-preventive compound is preferable. This protective measure is of particular importance with drop-center tubeless rims as the air in the tire is contained by the tire-side rim surface.
6. Inflate tire only to recommended air pressure.

SAFETY PRECAUTIONS

Air tank should incorporate moisture trap when used with drop-center tubeless rims in order to reduce the moisture in contact with the metal rim surfaces.

SPECIFICATIONS

SPECIAL TOOLS

Number	Description
350010	Tire Change Wheel Balancer

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E-100 — E-350 TIRE SIZES AND INFLATION PRESSURES

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
E-100 Cargo Van	124.0	5050	15 x 5.5K*	F78-15B ① ③*	TL	32	32	220.6	220.6
			15 x 5.5K	G78-15B ③	TL	32	30	220.6	206.8
			15 x 5.5K	H78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JJ	GR60-15B ② ③	TL	32	30	220.6	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
		5650	15 x 5.5K	H78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
E-100 Cargo Van	138.0	5050	15 x 5.5K	F78-15B ① ③*	TL	32	32	220.6	220.6
			15 x 5.5K	G78-15B ③	TL	32	30	220.6	206.8
			15 x 5.5K	H78-15B	TL	30	30	206.8	206.8
			15 x 6.0JJ	GR60-15B ② ③	TL	32	30	220.6	206.8
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
		5650	15 x 5.5K*	H78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
E-100 Club Wagon 5 Passenger	124.0	5400	15 x 5.5K*	G78-15B ⑤ ⑥*	TL	32	32	220.6	220.6
			15 x 5.5K	H78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 6.0JJ	GR60-15B ② ⑤	TL	32	32	220.6	220.6
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
		5700	15 x 5.5K*	H78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
		5900	15 x 5.5K*	H78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
E-100 Club Wagon 8 Passenger	124.0	5800	15 x 5.5K*	H78-15B*	TL	32	32	220.6	220.6
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8
		6000	15 x 5.5K*	H78-15B*	TL	32	32	220.6	220.6
			15 x 5.5K	L78-15B ④	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT) ④	TL	30	30	206.8	206.8

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E-100 — E-350 TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure PSI		Kilopascal	
						Front	Rear	Front	Rear
E-150 Club Wagon 5 Passenger	124.0	6050	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6200	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
E-150 Club Wagon 8 Passenger	124.0	6100	15 x 5.5K*	L78-15B ④*	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6300	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6500	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
E-150 Cargo Van	124.0	6100	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
		6300	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	L78-15C (AT) ④	TL	30	36	206.8	248.2
	138.0	6050	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6300	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	L78-15C (AT) ④	TL	30	36	206.8	248.2
E-150 Super Van	138.0	6050	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	L78-15C (AT) ④	TL	30	36	206.8	248.2
E-150 Club Wagon 5 Passenger	138.0	6100	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6300	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6500	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6

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E-100 — E-350 TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure PSI		Kilopascal	
						Front	Rear	Front	Rear
E-150 Club Wagon 8 Passenger	138.0	6300	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6500	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6600	15 x 5.5K*	L78-15B* ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
E-150 Super Wagon 5 Passenger	138.0	6025	15 x 5.5K*	L78-15B* ⑧ ④	TL	30	32	206.8	220.6
		6200	15 x 6.0JK	L78-15C (AT) ④	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
		6400	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	L78-15C (AT) ④	TL	30	36	206.8	248.2
E-150 Super Wagon 8 Passenger	138.0	6200 6400 6600	15 x 6.0JK* 15 x 6.0JK 15 x 6.0JK	L78-15C* LR78-15C L78-15C (AT) ④	TL TL TL	30 30 30	36 36 36	206.8 206.8 206.8	248.2 248.2 248.2
E-250 Cargo Van	138.0	6750	16.5 x 6.0*	8.00-16.5D* ⑨	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00-16.5E ⑧	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00R-16.5E	TL	55	65	379.2	448.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	55	310.2	379.2
		7500	16.5 x 6.75*	8.75-16.5D* ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
		8250	16.5 x 6.75*	8.75-16.5E* ⑧	TL	45	75	310.2	517.1
			16.5 x 6.75	8.75R-16.5E	TL	50	60	344.7	413.7
E-250 Club Wagon 5 Passenger	138.0	6000	16.5 x 6.0*	8.00-16.5D* ⑨	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00-16.5E ⑧	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00-16.5E	TL	55	65	379.2	448.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	55	310.2	379.2
		7100	16.5 x 6.0*	8.00-16.5D* ⑨	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00-16.5E ⑧	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00R-16.5E	TL	55	65	379.2	448.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75-16.5E	TL	45	55	310.2	379.2
		7800	16.5 x 6.75*	8.75-16.5D* ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1

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E-100 — E-350 TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure PSI		Kilopascal	
						Front	Rear	Front	Rear
E-250 Club Wagon 8 Passenger	138.0	7100	16.5 x 6.0*	8.00-16.5D* ⑨	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00-16.5E ⑧	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00R-16.5E	TL	55	65	379.2	448.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	55	310.2	379.2
		7300	16.5 x 6.0*	8.00-16.5D* ⑨	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00-16.5E	TL	50	60	344.7	413.7
			16.5 x 6.0	8.00R-16.5E	TL	55	65	379.2	448.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	55	310.2	379.2
		7500	16.5 x 6.75*	8.75-16.5D* ⑨	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
		7700	16.5 x 6.75*	8.75-16.5B* ⑨	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75-16.5E* ⑧	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75R-16.5E	TL	50	65	344.7	448.1
		8200	16.5 x 6.75*	8.75-16.5D* ⑨	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75R-16.5E	TL	50	65	344.7	448.1
E-250 Club Wagon 12 Passenger	138.0	7600	16.5 x 6.75*	8.75-16.5D* ⑨	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
		7900	16.5 x 6.75*	8.75-16.5D* ⑨	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75R-16.5E	TL	50	65	344.7	448.1
		8100	16.5 x 6.75*	8.75-16.5D* ⑨	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75R-16.5E	TL	50	65	344.7	448.1
		8500	16.5 x 6.75*	8.75-16.5E* ⑨	TL	45	75	310.2	517.1
			16.5 x 6.75	8.75R-16.5E	TL	50	80	344.7	551.6
		8900	16.5 x 6.75*	8.75-16.5E* ⑨	TL	50	75	344.7	517.1
			16.5 x 6.75	8.75R-16.5E	TL	55	80	379.2	551.6
E-250 Super Wagon 5 Passenger	138.0	6900	16.5 x 6.0*	8.00-16.5E* ⑧	TL	45	70	310.2	482.6
			16.5 x 6.0	8.00R-16.5E	TL	50	75	344.7	517.1
			16.5 x 6.75	8.75-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	8.75-16.5E ⑧	TL	35	55	241.3	379.2
			16.5 x 6.75	8.75R-16.5E	TL	40	60	275.8	413.7
		7200	16.5 x 6.0*	8.00-16.5E* ⑧	TL	45	70	310.2	482.6
			16.5 x 6.0	8.00R-16.5E	TL	50	75	344.7	517.1
			16.5 x 6.75	8.75-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	8.75-16.5E	TL	35	55	241.3	379.2
			16.5 x 6.75	8.75R-16.5E	TL	40	60	275.8	413.7
		7400	16.5 x 6.0*	8.00-16.5E* ⑧	TL	45	75	310.2	517.1
			16.5 x 6.0	8.00R-16.5E	TL	50	80	344.7	551.6
			16.5 x 6.75	8.75-16.5D ⑧	TL	35	60	241.3	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	35	60	241.3	413.7
			16.5 x 6.75	8.75R-16.5E	TL	40	65	275.8	448.1
		7700	16.5 x 6.75*	8.75-16.5E* ⑧	TL	35	70	241.3	482.6
			16.5 x 6.75	8.75R-16.5E	TL	40	75	275.8	517.1
		8000	16.5 x 6.75*	8.75-16.5E* ⑧	TL	35	70	241.3	482.6
			16.5 x 6.75	8.75R-16.5E	TL	40	75	275.8	517.1

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E-100 — E-350 TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure PSI		Kilopascal	
						Front	Rear	Front	Rear
E-250 Super Wagon 8 Passenger	138.0	6900	16.5 x 6.0*	8.00-16.5E ⑧	TL	50	70	344.7	482.6
			16.5 x 6.0	8.00R-16.5E	TL	55	75	379.2	517.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	55	275.8	379.2
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	55	275.8	379.2
			16.5 x 6.75	8.75R-16.5E	TL	45	60	310.2	413.7
		7200	16.5 x 6.0*	8.00-16.5E* ⑧ ⑩	TL	50	75	344.7	517.1
			16.5 x 6.0	8.00R-16.5E	TL	55	80	379.2	551.6
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
		7400	16.5 x 6.0*	8.00-16.5E* ⑧ ⑩	TL	50	75	344.7	517.1
			16.5 x 6.0	8.00R-16.5E	TL	55	80	379.2	551.6
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
		7700	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8000	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8300	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
E-250 Super Wagon 12 Passenger	138.0	7600	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	70	275.8	482.6
			16.5 x 6.75	8.75R-16.5E	TL	45	75	310.2	517.1
		7800	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	70	275.8	482.6
			16.5 x 6.75	8.75R-16.5E	TL	45	75	310.2	517.1
		8000	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8300	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8500	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
E-250 Super Wagon 15 Passenger	138.0	7700	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		7900	16.5 x 6.75*	8.75-16.5E ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8100	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8200	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8300	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
		8400	16.5 x 6.75*	8.75-16.5E* ⑧ ⑩	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
E-350 Cargo Van	138.0	8550	16.5 x 6.75*	9.50-16.5D* ⑨	TL	35	60	241.3	413.7
			16.5 x 6.75	9.50-16.5E	TL	35	60	241.3	413.7
		9500	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1
		9800	16.5 x 6.75*	9.50-16.5E*	TL	40	75	275.8	517.1

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E-100 — E-350 TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure PSI		Kilopascal	
						Front	Rear	Front	Rear
E-250 Super Van	138.0	6500	16.5 x 6.0*	8.00-16.5D* ⑧	TL	45	60	310.2	413.7
			16.5 x 6.0	8.00-16.5E ⑧	TL	45	60	310.2	413.7
			16.5 x 6.0	8.00R-16.5E	TL	50	65	344.7	448.1
			16.5 x 6.75	8.75-16.5D ⑧	TL	35	50	241.3	344.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	35	50	241.3	344.7
			16.5 x 6.75	8.75R-16.5E	TL	40	55	275.8	379.2
		7100	16.5 x 6.0*	8.00-16.5E* ⑧	TL	50	75	344.7	517.1
			16.5 x 6.0	8.00R-16.5E	TL	55	80	379.2	551.6
			16.5 x 6.75	8.75-16.5D ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75-16.5E ⑧	TL	40	60	275.8	413.7
			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
		7900	16.5 x 6.75*	8.75-16.5E* ⑧	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75-16.5E	TL	45	80	310.2	551.6
E-350 Super Van	138.0	9000	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1
		9400	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1
E-350 Super Wagon 5 Passenger	138.0	8600	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	70	241.3	482.6
		8800	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	70	241.3	482.6
E-350 Super Wagon 8 Passenger	138.0	8600	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		8800	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		9000	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
E-350 Super Wagon 12 Passenger	138.0	8700	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		8900	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		9200	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
E-350 Super Wagon 15 Passenger	138.0	8700	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		8900	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		9200	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
		9400	16.5 x 6.75*	9.50-16.5E* ⑩	TL	35	75	241.3	517.1
E-350 RV C/A S/R	138.0	8700	16.5 x 6.75*	9.50-16.5D*	TL	35	60	241.3	413.7
			16.5 x 6.75	9.50-16.5E	TL	35	60	241.3	413.7
		9700	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1
E-350 RV C/A D/R	138.0	8800	16.5 x 6.00*	8.00-16.5D* ⑧	TL	55	40	379.2	275.8
			16.5 x 6.00	8.00-16.5E ⑧	TL	55	40	379.2	275.8
			16.5 x 6.00	8.00R-16.5E	TL	60	45	413.7	310.2
E-350 RV C/A D/R	138.0	10250	16.5 x 6.0*	8.75-16.5D* ⑨	TL	50	50	344.7	344.7
			16.5 x 6.0	8.75-16.5E ⑨	TL	50	50	344.7	344.7
			16.5 x 6.0	8.00R-16.5E	TL	70	70	482.6	482.6
	150.0	10250	16.5 x 6.0*	8.75-16.5D* ⑨	TL	50	45	344.7	310.2
			16.5 x 6.0	8.75-16.5E ⑨	TL	50	45	344.7	310.2
			16.5 x 6.0	8.00R-16.5E	TL	65	60	448.1	413.7
		11000	16.5 x 6.0*	8.75-16.5D* ⑨	TL	45	50	310.2	344.7
			16.5 x 6.0	8.75-16.5E ⑨	TL	45	50	310.2	344.7
			16.5 x 6.0	8.00R-16.5E	TL	65	70	448.1	482.6
E-350 PDV D/R	138.0	8750	16.5 x 6.0*	8.00 x 16.5D* ⑧	TL	45	60	310.2	413.7
			16.5 x 6.0	8.00 x 16.5E	TL	45	60	310.2	413.7
		9700	16.5 x 6.0*	8.00 x 16.5E* ⑧	TL	45	65	310.2	448.1
	158.0	10000	16.5 x 6.0*	8.00 x 16.5D* ⑧	TL	50	60	344.7	413.7
E-350 Comm C/A D/R	138.0	9200	16.5 x 6.0*	8.00 x 16.5D* ⑪	TL	45	55	310.2	379.2
		9700	16.5 x 6.0*	8.00 x 16.5D* ⑪	TL	40	60	275.8	413.7
		9750	16.5 x 6.0*	8.00 x 16.5D* ⑪	TL	50	55	344.7	379.2
E-350 PDV S/R	138.0	8700	16.5 x 6.75*	9.50 x 16.5E*	TL	35	75	241.3	517.1

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E-100 — E-350

* Minimum wheel/tire sizes recommended for indicated Gross Vehicle Weight Rating (front and rear). All other combinations listed are optional except as noted.

① 5.8L (351 CID) V-8 or Passenger seat requires G78-15B as minimum tire.
② Available with 15 x 6.0JJ aluminum wheel only.
③ Not available with 4.25 axle.
④ L78-15B (M/S) and L78-15C (AT) not available with 4-speed Tremec over-drive and 2.75 axle.
⑤ 5.8L (351 CID) V-8, A/C, captains chair, not available with G78-15B or GR60-15C tires, use H78-15B or larger tires.
⑥ Not available with 3.25 axle.
⑦ L78-15C tires required with A/C, auxiliary fuel tank, captains chairs, dual batteries, insulation package and RPO trim package.
⑧ Reg. const. nylon, alt highway tread polyester available.
⑨ Polyester standard, Nylon alt.
⑩ Computer selected Gross Vehicle Weight on Super Wagon.
⑪ Nylon only.

Load Ranges
B — 4 Ply Rating
C — 6 Ply Rating
D — 8 Ply Rating
E — 10 Ply Rating

NOTE: Do not mix radial tires with bias-ply or belted tires.

TL — Tubeless Tires
T — Tube Type Tire
(AT) — All Terrain
(TT) — Tube Type Tires
C/A — Cut-Away
PDV — Parcel Delivery Van
S/R — Single Rear Wheels
D/R — Dual Rear Wheels

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-100 4 x 2 SWB	116.8	4800	15 x 5.5K*	F78-15B* ③	TL	32	32	220.6	220.6
			15 x 5.5K	G78-15B ③	TL	30	30	206.8	206.8
			15 x 5.5K	7.00-15D (TT)	TL	35	35	241.3	241.3
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 5.5K	H78-15B	TL	30	30	206.8	206.8
			15 x 6.0JJ	GR60-15B ③ ④	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
		5300	15 x 5.5K*	H78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	7.00-15D (TT)	TL	35	40	241.3	275.8
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
F-100 4 x 2 LWB	133.0	4800	15 x 5.5K*	F78-15B* ③	TL	32	30	220.6	206.8
			15 x 5.5K	G78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	7.00-15D (TT)	T	35	35	241.3	241.3
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	H78-15B	TL	30	30	206.8	206.8
			15 x 6.0JJ	GR60-15B ③ ④	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
		5200	15 x 5.5K*	G78-15B* ② ③	TL	32	32	220.6	220.6
			15 x 5.5K	7.00-15D (TT)	T	40	40	275.8	275.8
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	H78-15B	TL	30	30	206.8	206.8
			15 x 6.0JJ	GR60-15B ③ ④	TL	32	32	220.6	220.6
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
F-100 4 x 2 LWB	133.0	5200	15 x 5.5K*	H78-15B* ①	TL	30	30	206.8	206.8
			15 x 5.5K	L78-15B ①	TL	30	30	206.8	206.8
			15 x 5.5K	7.00-15D (TT) ①	T	40	40	275.8	275.8
			15 x 6.0JK	L78-15C ①	TL	30	30	206.8	206.8
			15 x 6.0JK	LR78-15C ①	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C (AT) ①	TL	30	30	206.8	206.8
		5500	15 x 5.5K*	H78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	7.00-15D (TT)	T	40	40	275.8	275.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
F-150 4 x 2 LWB	133.0	6050	15 x 5.5K*	L78-15B*	TL	30	32	206.8	220.6
			15 x 5.5K	7.00-15D	T	40	50	275.8	344.7
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT)	TL	30	32	206.8	220.6

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-150	133.0	6150	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
4 x 2			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
LWB			15 x 6.0JK	7.00-15D	T	40	55	275.8	379.2
			15 x 6.0JK	L78-15C (AT)	TL	30	36	206.8	248.2
F-150	133.0	6300	15 x 5.5K*	L78-15B*	TL	32	32	220.6	220.6
4 x 4			15 x 5.5K	7.00-15D (TT)	T	50	50	344.7	344.7
LWB			15 x 8.0JJ	10-15C (AT)	TL	35	35	241.3	241.3
			15 x 6.0JK	L78-15C	TL	32	32	220.6	220.6
			15 x 6.0JK	LR78-15C	TL	32	32	220.6	220.6
			15 x 6.0JK	L78-15C (AT)	TL	32	32	220.6	220.6
		6500	15 x 6.0JK	L78-15C*	TL	32	36	220.6	248.2
			15 x 6.0JK	7.00-15D (TT)	T	50	55	344.7	379.2
			15 x 8.0JJ	10-15C (AT)	TL	35	35	241.3	241.3
			15 x 6.0JK	LR78-15C	TL	32	36	220.6	248.2
			15 x 6.0JK	L78-15C (AT)	TL	32	36	220.6	248.2
F-150	116.8	6050	15 x 5.5K*	L78-15B*	TL	30	32	206.8	220.6
4 x 4			15 x 5.5K	7.00-15D (TT)	T	45	50	310.2	344.7
SWB			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 8.0JJ	10-15C (AT)	TL	35	35	241.3	241.3
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT)	TL	30	32	206.8	220.6
F-100	138.8	5200	15 x 5.5K*	H78-15B*	TL	32	30	220.6	206.8
4 x 2			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
SWB			15 x 5.5K	7.00-15D (TT)	T	40	35	275.8	241.3
Super			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
Cab			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
		5600	15 x 5.5K*	H78-15B*	TL	32	32	220.6	220.6
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	7.00-15D (TT)	T	40	40	275.8	275.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
F-100	155.0	5200	15 x 5.5K*	H78-15B*	TL	32	30	220.6	206.8
4 x 2			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
LWB			15 x 5.5K	7.00-15D (TT)	T	40	35	275.8	241.3
Super			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
Cab			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
		5800	15 x 5.5K*	H78-15B*	TL	32	32	220.6	220.6
			15 x 5.5K	L78-15B	TL	30	30	206.8	206.8
			15 x 5.5K	7.00-15D (TT)	T	40	40	275.8	275.8
			15 x 6.0JK	LR78-15C	TL	28	28	193.0	193.0
			15 x 6.0JK	L78-15C	TL	30	30	206.8	206.8
			15 x 6.0JK	L78-15C (AT)	TL	30	30	206.8	206.8
F-150	138.0	6050	15 x 5.5K*	L78-15B*	TL	30	32	206.8	220.6
4 x 2			15 x 5.5K	7.00-15D (TT)	T	45	50	310.2	344.7
Super			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
Cab			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT)	TL	30	32	206.8	220.6
		6200	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	7.00-15D (TT)	T	45	55	310.2	379.2
			15 x 6.0JK	L78-15C (AT)	TL	30	36	206.8	248.2

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-150	155.0	6200	15 x 5.5K*	L78-15B*	TL	30	32	206.8	220.6
4 x 2			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
LWB			15 x 5.5K	7.00-15D (TT)	T	45	50	310.2	344.7
Super			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
Cab			15 x 6.0JK	L78-15C (AT)	TL	30	32	206.8	220.6
		6400	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	7.00-15D (TT)	T	45	55	310.2	379.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	L78-15C (AT)	TL	30	36	206.8	248.2
F-150	155.0	6400	15 x 5.5K*	L78-15B*	TL	32	30	220.6	206.8
4 x 4			15 x 5.5K	7.00-15D (TT)	T	50	40	344.7	275.8
Super			15 x 6.0JK	L78-15C	TL	32	30	220.6	206.8
Cab			15 x 8.0JJ	10-15C (AT)	TL	35	35	241.3	241.3
			15 x 6.0JK	LR78-15C	TL	32	30	220.6	206.8
			15 x 6.0JK	L78-15C (AT)	TL	32	30	220.6	206.8
F-250	133.0	6200	16.5 x 6.0*	8.00-16.5D*	TL	45	60	310.2	413.7
4 x 2			16.5 x 6.0	8.00-16.5E	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75-16.5E	TL	35	45	241.3	310.2
			16.5 x 6.75	8.75R-16.5E	TL	40	50	275.8	344.7
			16.5 x 6.75	9.50-16.5D	TL	35	35	241.3	241.3
			16.5 x 6.75	9.50-16.5E	TL	35	35	241.3	241.3
			16 x 6K	7.50-16C	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	35	45	241.3	310.2
			16 x 6K	7.50-16E	TL-T	35	45	241.3	310.2
		6900	16.5 x 6.0*	8.00-16.5E*	TL	45	75	310.2	517.1
			16.5 x 6.75	8.75-16.5E	TL	35	60	241.3	413.7
			16.5 x 6.75	8.75R-16.5E	TL	40	65	275.8	448.1
			16.5 x 6.75	9.50-16.5D	TL	35	45	241.3	310.2
			16.5 x 6.75	9.50-16.5E	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	35	55	241.3	379.2
F-250	133.0	7700	16.5 x 6.75*	8.75-16.5E*	TL	35	75	241.3	517.1
4 x 2			16.5 x 6.75	8.75R-16.5E	TL	40	80	275.8	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	35	70	241.3	482.6
		7900	16.5 x 6.75*	8.75-16.5E*	TL	35	75	241.3	517.1
			16.5 x 6.75	8.75R-16.5E	TL	40	80	275.8	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	35	70	241.3	482.6
F-250	133.0	6700	16.5 x 6.0*	8.00-16.5D*	TL	55	60	379.2	413.7
4 x 4			16.5 x 6.0	8.00-16.5E	TL	55	60	379.2	413.7
			16.5 x 6.75	8.75-16.5E	TL	45	45	310.2	310.2
			16.5 x 6.75	8.75R-16.5E	TL	50	50	344.7	344.7
			16.5 x 6.75	9.50-16.5D	TL	35	35	241.3	241.3
			16.5 x 6.75	9.50-16.5E	TL	35	35	241.3	241.3
			16 x 6K	7.50-16C	TL	40	45	275.8	310.2
			16 x 6K	7.50-16D	TL-T	40	45	275.8	310.2
			16 x 6K	7.50-16E	TL-T	40	45	275.8	310.2

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-250 4 x 4	133.0	6700	16.5 x 6.0*	8.00-16.5D* Ⓢ	TL	55	60	379.2	413.7
			16.5 x 6.0	8.00-16.5E Ⓢ	TL	55	60	379.2	413.7
			16.5 x 6.75	8.75-16.5E Ⓢ	TL	45	45	310.2	310.2
			16.5 x 6.75	8.75R-16.5E Ⓢ	TL	50	50	344.7	344.7
			16.5 x 6.75	9.50-16.5D Ⓢ	TL	35	35	241.3	241.3
			16.5 x 6.75	9.50-16.5E Ⓢ	TL	35	35	241.3	241.3
			16 x 6K	7.50-16D Ⓢ	TL	40	45	275.8	310.2
			16 x 6K	7.50-16D Ⓢ	TL	40	45	275.8	310.2
		7400	16.5 x 6.0*	8.00-16.5E*	TL	55	75	379.2	517.1
			16.5 x 6.75	8.75-16.5E	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75R-16.5E	TL	50	65	344.7	448.1
			16.5 x 6.75	9.50-16.5D	TL	35	45	241.3	310.2
			16.5 x 6.75	9.50-16.5E	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	40	55	275.8	379.2
			16 x 6K	7.50-16E	TL-T	40	55	275.8	379.2
F-250 4 x 4	133.0	7300	16.5 x 6.0*	8.00-16.5E Ⓢ	TL	75	75	517.1	517.1
			16.5 x 6.75	8.75-16.5E Ⓢ	TL	60	60	413.7	413.7
			16.5 x 6.75	8.75R-16.5E Ⓢ	TL	65	65	448.1	448.1
			16.5 x 6.75	9.50-16.5D Ⓢ	TL	45	45	310.2	310.2
			16.5 x 6.75	9.50-16.5E Ⓢ	TL	45	45	310.2	310.2
			16 x 6K	7.50-16E Ⓢ	TL-T	55	55	379.2	379.2
			16 x 6K	7.50-16D Ⓢ	TL-T	55	55	379.2	379.2
		8100	16.5 x 6.75*	8.75-16.5E*	TL	45	75	310.2	517.1
			16.5 x 6.75	8.75R-16.5E	TL	50	80	344.7	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL	40	70	275.8	482.6
		8100	16.5 x 6.75*	8.75-16.5E* Ⓢ	TL	60	75	413.7	517.1
			16.5 x 6.75	8.75R-16.5E Ⓢ	TL	65	80	448.1	551.6
			16.5 x 6.75	9.50-16.5D Ⓢ	TL	45	55	310.2	379.2
			16.5 x 6.75	9.50-16.5E Ⓢ	TL	45	55	310.2	379.2
			16 x 6K	7.50-16E Ⓢ	TL-T	55	70	379.2	482.6
F-250 4 x 4	133.0	8400	16.5 x 6.75*	8.75-16.5E*	TL	45	75	310.2	517.1
			16.5 x 6.75	8.75R-16.5E	TL	50	80	344.7	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	40	70	275.8	482.6
		8400	16.5 x 6.75*	8.75-16.5E* Ⓢ	TL	60	75	413.7	517.1
			16.5 x 6.75	8.75R-16.5E Ⓢ	TL	65	80	448.1	551.6
			16.5 x 6.75	9.50-16.5D Ⓢ	TL	45	55	310.2	379.2
			16.5 x 6.75	9.50-16.5E Ⓢ	TL	45	55	310.2	379.2
			16 x 6K	7.50-16E Ⓢ	TL-T	55	70	379.2	482.6
F-250 4 x 2 SWB Super Cab	138.8	6300	16.5 x 6.0*	8.00-16.5D*	TL	45	60	310.2	413.7
			16.5 x 6.0	8.00-16.5E	TL	45	60	310.2	413.7
			16.5 x 6.75	8.75-16.5E	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	55	310.2	379.2
			16.5 x 6.75	9.50-16.5D	TL	35	35	241.3	241.3
			16.5 x 6.75	9.50-16.5E	TL	35	35	241.3	241.3
			16 x 6K	7.50-16C	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	35	45	241.3	310.2
			16 x 6K	7.50-16E	TL-T	35	45	241.3	310.2

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-250	138.8	6800	16.5 x 6.0*	8.00-16.5E*	TL	45	75	310.2	517.1
4 x 2			16.5 x 6.75	8.75-16.5E	TL	40	60	275.8	413.7
SWB			16.5 x 6.75	8.75R-16.5E	TL	45	65	310.2	448.1
Super			16.5 x 6.75	9.50-16.5D	TL	35	45	241.3	310.2
Cab			16.5 x 6.75	9.50-16.5E	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	35	55	241.3	379.2
		7600	16.5 x 6.75*	8.75-16.5E*	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	35	70	241.3	482.6
		7800	16.5 x 6.75*	8.75-16.5E*	TL	40	75	275.8	517.1
			16.5 x 6.75	8.75R-16.5E	TL	45	80	310.2	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	35	70	241.3	482.6
F-250	155.0	7100	16.5 x 6.0*	8.00-16.5D*	TL	55	60	379.2	413.7
4 x 4			16.5 x 6.0	8.00-16.5E	TL	55	60	379.2	413.7
LWB			16.5 x 6.75	8.75-16.5E	TL	45	45	310.2	310.2
Super			16.5 x 6.75	8.75R-16.5E	TL	50	50	344.7	344.7
Cab			16.5 x 6.75	9.50-16.5D	TL	35	35	241.3	241.3
			16.5 x 6.75	9.50-16.5E	TL	35	35	241.3	241.3
			16 x 6K	7.50-16C	TL	40	45	275.8	310.2
			16 x 6K	7.50-16D	TL-T	40	45	275.8	310.2
			16 x 6K	7.50-16E	TL-T	40	45	275.8	310.2
		7100	16.5 x 6.0*	8.00-16.5D* Ⓢ	TL	60	60	413.7	413.7
			16.5 x 6.0	8.00-16.5E Ⓢ	TL	60	60	413.7	413.7
			16.5 x 6.75	8.75-16.5E Ⓢ	TL	50	45	344.7	310.2
			16.5 x 6.75	8.75R-16.5E Ⓢ	TL	55	50	379.2	344.7
			16.5 x 6.75	9.50-16.5D Ⓢ	TL	40	35	275.8	241.3
			16.5 x 6.75	9.50-16.5E Ⓢ	TL	40	35	275.8	241.3
			16 x 6K	7.50-16D Ⓢ	TL-T	45	45	310.2	310.2
			16 x 6K	7.50-16E Ⓢ	TL-T	45	45	310.2	310.2
F-250	155.0	7800	16.5 x 6.0*	8.00-16.5E*	TL	55	75	379.2	517.1
4 x 4			16.5 x 6.75	8.75-16.5E	TL	45	80	310.2	551.6
LWB			16.5 x 6.75	8.75R-16.5E	TL	50	65	344.7	448.1
Super			16.5 x 6.75	9.50-16.5D	TL	35	45	241.3	310.2
Cab			16.5 x 6.75	9.50-16.5E	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	40	55	275.8	379.2
			16 x 6K	7.50-16E	TL-T	40	55	275.8	379.2
		7800	16.5 x 6.0*	8.00-16.5E* Ⓢ	TL	75	75	517.1	517.1
			16.5 x 6.75	8.75-16.5E Ⓢ	TL	60	60	413.7	413.7
			16.5 x 6.75	8.75R-16.5E Ⓢ	TL	65	65	448.1	448.1
			16.5 x 6.75	9.50-16.5D Ⓢ	TL	45	45	310.2	310.2
			16.5 x 6.75	9.50-16.5E Ⓢ	TL	45	45	310.2	310.2
			16 x 6K	7.50-16D Ⓢ	TL-T	55	55	379.2	379.2
			16 x 6K	7.50-16E Ⓢ	TL-T	55	55	379.2	379.2

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-250 4 x 4 LWB Super Cab	155.0	8400	16.5 x 6.75*	8.75-16.5E*	TL	45	75	310.2	517.1
			16.5 x 6.75	8.75R-16.5E	TL	50	80	344.7	551.6
			16.5 x 6.75	9.50-16.5D	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	40	60	275.8	413.7
		8400	16.5 x 6.75* ⑤	8.75-16.5E* ⑤	TL	60	75	413.7	517.1
			16.5 x 6.75	8.75R-16.5E ⑤	TL	65	80	448.1	551.6
			16.5 x 6.75	9.50-16.5D ⑤	TL	45	55	310.2	379.2
			16.5 x 6.75	9.50-16.5E ⑤	TL	45	55	310.2	379.2
			16 x 6K	7.50-16E ⑤	TL-T	55	70	379.2	482.6
F-250 4 x 2 LWB Super Cab	155.0	6550	16.5 x 6.0*	8.00-16.5D*	TL	55	60	379.2	413.7
			16.5 x 6.0	8.00-16.5E	TL	55	60	379.2	413.7
			16.5 x 6.75	8.75-16.5E	TL	40	50	275.8	344.7
			16.5 x 6.75	8.75R-16.5E	TL	45	55	310.2	379.2
			16.5 x 6.75	9.50-16.5D	TL	35	35	241.3	241.3
			16.5 x 6.75	9.50-16.5E	TL	35	35	241.3	241.3
			16 x 6K	7.50-16C	TL	40	45	275.8	310.2
			16 x 6K	7.50-16D	TL-T	40	45	275.8	310.2
			16 x 6K	7.50-16E	TL-T	40	45	275.8	310.2
F-250 4 x 2 LWB Super Cab	155.0	7050	16.5 x 6.0*	8.00-16.5E*	TL	55	70	379.2	482.6
			16.5 x 6.75	8.75-16.5E	TL	45	55	310.2	379.2
			16.5 x 6.75	8.75R-16.5E	TL	50	60	344.7	413.7
			16.5 x 6.75	9.50-16.5D	TL	35	45	241.3	310.2
			16.5 x 6.75	9.50-16.5E	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	40	55	275.8	379.2
			16 x 6K	7.50-16E	TL-T	40	55	275.8	379.2
		7500	16.5 x 6.75*	8.75-16.5E*	TL	45	65	310.2	448.1
			16.5 x 6.75	8.75R-16.5E	TL	50	70	344.7	482.6
			16.5 x 6.75	9.50-16.5D	TL	35	50	241.3	344.7
			16.5 x 6.75	9.50-16.5E	TL	35	50	241.3	344.7
			16 x 6K	7.50-16E	TL-T	40	65	275.8	448.1
		8100	16.5 x 6.75*	9.50-16.5D*	TL	35	55	241.3	379.2
			16.5 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16 x 6K	7.50-16E	TL-T	40	70	275.8	482.6
F-350 S/R Super Camper	140.0	8900	16.5 x 6.75*	9.50-16.5E*	TL	35	70	241.3	482.6
			16.5 x 6.75	(F) 9.50-16.5E	TL	35		241.3	
			16.5 x 9.75	(R) 12.0-16.5E	TL		45		310.2
F-350 4 x 4 S/R	133.0	8500	16.5 x 6.75*	9.50-16.5D*	TL	35	55	241.3	379.2
			16.6 x 6.75	9.50-16.5E	TL	35	55	241.3	379.2
			16.6 x 6K	7.50-16E	TL-T	45	70	310.2	482.6
F-350 4 x 4 Super Cab S/R	155.0	8600	16.5 x 6.75*	9.50-16.5D*	TL	40	55	275.8	379.2
			16.5 x 6.75	9.50-16.5E	TL	40	55	275.8	379.2
			16 x 6K	7.50-16E	TL-T	50	70	344.7	482.6
F-350 S/R	136.8	8600	16.5 x 6.75*	9.50-16.5E*	TL	35	70	241.3	482.6
	136.8	8900	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1
	160.8	8900	16.5 x 6.75*	9.50-16.5E*	TL	35	70	241.3	482.6
	160.8	9200	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-350 D/R	136.8	8800	16.5 x 6.0*	8.00-16.5D*	TL	45	50	310.2	344.7
			16.5 x 6.0	8.00-16.5E	TL	45	50	310.2	344.7
			16.5 x 6.0	8.75-16.5E	TL	35	40	241.3	275.8
			16.5 x 6.0	(F) 8.00-16.5D	TL	45		310.2	
			16.5 x 6.0	(R) 8.00-16.5E	TL		50		344.7
			16 x 6K	7.50-16C	TL	35	35	241.3	241.3
			16 x 6K	7.50-16D	TL-T	35	35	241.3	241.3
			16 x 6K	7.50-16E	TL-T	35	35	241.3	241.3
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16D	TL		35		241.3
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16E	TL		35		241.3
F-350 D/R	136.8	9500	16.5 x 6.0*	8.00-16.5D*	TL	45	60	310.2	413.7
			16.5 x 6.0	8.00-16.5E	TL	45	60	310.2	413.7
			16.5 x 6.0	8.75-16.5E	TL	35	45	241.3	310.2
			16.5 x 6.0	(F) 8.00-16.5D	TL	45		310.2	
			16.5 x 6.0	(R) 8.00-16.5E	TL		60		413.7
			16 x 6K	7.50-16C	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	35	45	241.3	310.2
			16 x 6K	7.50-16E	TL-T	35	45	241.3	310.2
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x6K	(R) 7.50-16D	TL		45		310.2
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16E	TL		45		310.2
F-350 D/R	136.8	9500	16.5 x 6.0*	8.00-16.5E*	TL	45	65	310.2	448.1
			16.5 x 6.0	8.75-16.5E	TL	40	50	275.8	344.7
			16 x 6K	7.50-16C	TL	35	50	241.3	344.7
			16 x 6K	7.50-16D	TL-T	35	50	241.3	344.7
			16 x 6K	7.50-16E	TL-T	35	50	241.3	344.7
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16D	TL		50		344.7
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16E			50		344.7
	160.8	9000	16.5 x 6.0*	8.00-16.5D*	TL	50	50	344.7	344.7
			16.5 x 6.0	8.75-16.5E	TL	40	35	275.8	241.3
			16.5 x 6.0	8.00-16.5E	TL	50	50	344.7	344.7
			16.5 x 6.0	(F) 8.00-16.5D	TL	50		344.7	
			16.5 x 6.0	(R) 8.00-16.5E	TL		50		344.7
			16 x 6K	7.50-16C	TL	35	35	241.3	241.3
			16 x 6K	7.50-16D	TL-T	35	35	241.3	241.3
			16 x 6K	7.50-16E	TL-T	35	35	241.3	241.3
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16D	TL		35		241.3
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16E	TL		35		241.3
F-350 D/R	160.8	9500	16.5 x 6.0*	8.00-16.5D*	TL	50	55	344.7	379.2
			16.5 x 6.0	8.75-16.5E	TL	40	45	275.8	310.2
			16.5 x 6.0	8.00-16.5E	TL	50	55	344.7	379.2
			16.5 x 6.0	(F) 8.00-16.5D	TL	50		344.7	
			16.5 x 6.0	(R) 8.00-16.5E	TL		55		379.2
			16 x 6K	7.50-16C	TL	35	45	241.3	310.2
			16 x 6K	7.50-16D	TL-T	35	45	241.3	310.2
			16 x 6K	7.50-16E	TL-T	35	45	241.3	310.2
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16D	TL		45		310.2
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16E	TL		45		310.2

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F-100 — F-350, BRONCO, TIRE SIZES AND INFLATION PRESSURES (Cont'd.)

Vehicle	Wheelbase	Gross Vehicle Weight Rating	Wheel Size	Tire Size	Type	A Recommended Inflation Pressure			
						PSI		Kilopascal	
						Front	Rear	Front	Rear
F-350 D/R	160.8	10000	16.5 x 6.0*	8.00-16.5D*	TL	55	60	379.2	413.7
			16.5 x 6.0	8.75-16.5E	TL	40	50	275.8	344.7
			16.5 x 6.0	8.00-16.5E	TL	55	60	379.2	413.7
			16.5 x 6.0	(F) 8.00-16.5D	TL	55		379.2	
			16.5 x 6.0	(R) 8.00-16.5E	TL		60		413.7
			16 x 6K	7.50-16C	TL	35	50	241.3	344.7
			16 x 6K	7.50-16D	TL-T	35	50	241.3	344.7
			16 x 6K	7.50-16E	TL-T	35	50	241.3	344.7
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16D	TL		50		344.7
			16 x 6K	(F) 7.50-16C	TL	35		241.3	
			16 x 6K	(R) 7.50-16E	TL		50		344.7
F-350 S/R LWB Super Cab	155	9200	16.5 x 6.75*	9.50-16.5E*	TL	35	75	241.3	517.1
Bronco	104.0	6100	15 x 5.5K*	L78-15B* ⑥	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15 x 5.5K	7.00-15D (TT)	T	40	50	275.8	344.7
			15 x 8.0JJ	10-15C (AT) ⑥	TL	35	35	241.3	241.3
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT)	TL	30	32	206.8	220.6
		6400	15.5 x 5K*	L78-15B* ⑤	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C	TL	30	32	206.8	220.6
			15.5 x 5K	7.00-15D (TT)	T	40	50	275.8	344.7
			15 x 8.0JJ	10-15C (AT) ⑥	TL	35	35	241.3	241.3
			15 x 6.0JK	LR78-15C	TL	30	32	206.8	220.6
			15 x 6.0JK	L78-15C (AT)	TL	30	32	206.8	220.6
		6550	15 x 6.0JK*	L78-15C*	TL	30	36	206.8	248.2
			15 x 6.0JK	LR78-15C	TL	30	36	206.8	248.2
			15 x 6.0JK	7.00-15D (TT)	T	40	55	275.8	379.2
			15 x 6.0JK	L78-15C (AT)	TL	30	36	206.8	248.2

F-100 — F-350, Bronco

* Minimum Wheel/Tire Sizes recommended for indicated Gross Vehicle Weight Rating (front and rear). All other combinations listed are optional except as noted.

① With 5.8L (351 CID) V-8/6.6L (400 CID) V-8 engine or dual batteries.

② Not available with 5.8L (351 CID) V-8/6.6L (400 CID) V-8 engine or dual batteries.

③ Not available with 3.25 axle

④ Available with 15 x 6.0JJ aluminum wheel only.

⑤ With 4500# front axle or snow plow option.

⑥ L78-15B or 10-15C (AT) not available with hydraulic suspension, heavy-duty trailer towing, 5 and 6 passenger vehicles with dual batteries.

Load Ranges

B — 4 Ply Rating
C — 6 Ply Rating
D — 8 Ply Rating
E — 10 Ply Rating

NOTE: Do not mix radial tires with bias ply or belted tires.

TL — Tubeless Tire
T — Tube Type Tire
(AT) — All Terrain
(TT) — Tube Type Tires
S/R — Single Rear Wheels
D/R — Dual Rear Wheels
SWB — Short Wheelbase
LWB — Long Wheelbase

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Wheels and Tires — Drop-Center Rim

PART 11-02

APPLIES TO BRONCO, E-100-E-350, AND F-100-F-350

SUBJECT	PAGE
DESCRIPTION	
Front Wheel Assembly	02-1
Front Wheel Assembly — Four Wheel Drive	02-1
Rear Wheel Assembly	02-1
REMOVAL AND INSTALLATION	
Tire Replacement Precautions	02-2
Wheel Replacement E-100 to E-350, F-100 to F-350 and Bronco	02-2
SPECIFICATIONS	02-2

DESCRIPTION

FRONT WHEEL ASSEMBLY

Each front wheel and tire assembly is bolted to its respective front hub and rotor assembly. Two opposed tapered roller bearings are installed in each front hub and rotor assembly (Fig. 1). A grease retainer is installed at the inner end of the hub to prevent lubricant from leaking. The entire assembly is retained on its spindle by the lock nut, adjusting nut and cotter pin.

FRONT WHEEL ASSEMBLY—FOUR-WHEEL DRIVE

The front axles used on 4-wheel drive models are described in Parts 15-30, 15-32 and 15-33 of this manual. The locking hub assemblies are described in Part 11-12.

REAR WHEEL ASSEMBLY

Information on rear wheels may be found in Parts 11-11 and 11-14.

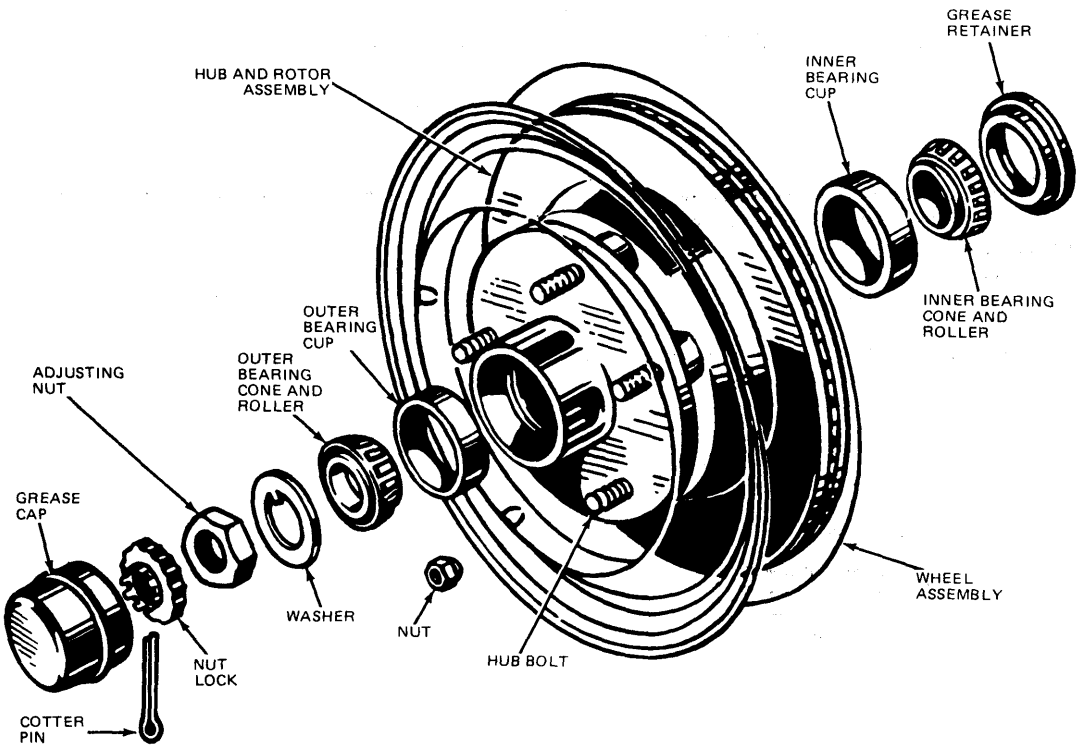


FIG. 1 Front Hub, Bearings and Grease Retainer—Disc Brakes—F100-F350, 4x2, E100-E350

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REMOVAL AND INSTALLATION

WHEEL REPLACEMENT

E-100 TO E-350, F-100 TO F-350, AND BRONCO

Removal

1. Pry off the hub cap or wheel cover (if the vehicle is so equipped), and loosen but do not remove the wheel stud nuts.
2. Raise the vehicle until the wheel and tire clear the floor.
3. Remove the wheel stud nuts and the wheel and tire from the hub and drum assembly, or the hub and rotor assembly.

Installation

1. Clean all dirt from the hub and rotor assembly. The replacement wheel and tire must be clean.
2. Position the wheel and tire on the hub and rotor assembly, and install the wheel stud nuts. Tighten the stud nuts enough to hold the wheel firmly in place. **Always tighten alternate nuts to draw the wheel evenly against the hub and drum (or hub and rotor).**

   E-350 and F-350 with dual wheels have mounting bolt holes which are alternately flared inward and outward. These surfaces must be mated when the wheels are mounted. Fig. 2 illustrates the dual wheel radial alignment locating pin used on E-350 and F-350.
3. Lower the vehicle to the floor, and tighten the wheel stud nuts to the specified torque. **On a new vehicle, and each time a wheel and tire is installed, the wheel nuts should be tightened to specification and rechecked at 500 miles.**

TIRE REPLACEMENT PRECAUTIONS

The tire must be completely deflated before removal, and the bead must not be damaged by a tire iron.

After installation, a tube tire should be inflated to recommended pressure, deflated, and then inflated again to insure that the tube is not folded inside the tire. Be sure the tube flap is properly positioned before inflating the tire. **It is important that each front and rear tire and wheel be balanced.**

When installing tires thoroughly lubricate the tire beads with lubricant ESA-M1B6A, or equivalent. Inflate the tire until both bead seats against the rim of the wheel, then deflate to the specified "Tire Inflation Pressures" shown on the safety certification label attached to the L.H. door pillar. To seat the tire beads, the initial inflation for truck-type tubeless tires, 50 psi maximum; for truck-type tube tires 75 psi maximum. Follow the instructions supplied with the Rotunda (model 350010 or an equivalent) tire changer. Refer to Part 11-01 for diagnosis and testing procedures, safety procedures and illustrations.

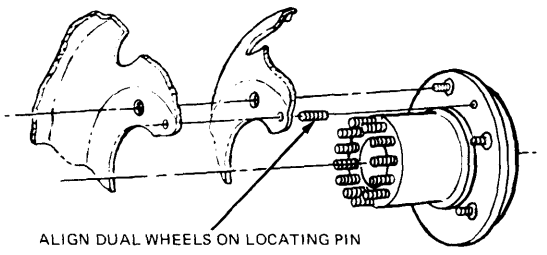


FIG. 2 Dual Rear Wheel Radial Alignment to Hub (E-350, F-350)

SPECIFICATIONS

WHEEL TORQUE LIMITS — F-100 THRU F-350, E-100-E-350, BRONCO

Model	Nut Size	(ft-lb)	N•m
E-100-E-250, F-100, F-150 (4 x 4), Bronco, F-150, F-250 (4 x 4)	1/2-20	90	122
F-350, E-350	9/16-18	135	183
w/Single Rear Wheels	①	145	196
E-350, F-350, (w/Dual Rear Wheels) ①	9/16-18 ②	220	298
(and 7400 lb. Axle) ②			

① E-350, F-250 and F-350 Single Rear Wheel Lug Nuts are black in color. (.066 inch length).

② E-350, F-350, Dual Rear Wheel Lug Nuts are zinc plate or black, in color. (.94 inch length). The lug nuts should not be mixed. The Dual Wheel Lug Nuts are left handed threads for left rear wheels only.

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SPECIAL TOOLS

Number	Description
350010	Tire Change Wheel Balancer

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Wheels, Hubs and Bearings — Front (Except Front Drive)

PART 11-10

APPLIES TO ALL LIGHT TRUCKS

SUBJECT	PAGE
DESCRIPTION	
Front Wheel Assembly	10-1
ADJUSTMENTS	
Front Wheel Bearing	10-1
F-100 — F-350 (4x2), E-100 — E-350 and Bronco	10-1
REMOVAL AND INSTALLATION	
Disc Brakes	
F-100 — F-350, E-100 — E-350	10-2
Front Wheel Grease Seal and Bearings	10-2
SPECIFICATIONS	10-3

DESCRIPTION

FRONT WHEEL ASSEMBLY

Each front wheel and tire assembly is bolted to its respective front hub and brake drum or hub and rotor assembly. Two opposed tapered roller bearings are installed in each hub, (Fig. 1). A grease retainer is installed at the inner end of the hub to prevent lubricant from leaking into the drum or onto the rotor. The entire assembly is retained to its spindle by the lock nut or adjusting nut washer and cotter pin.

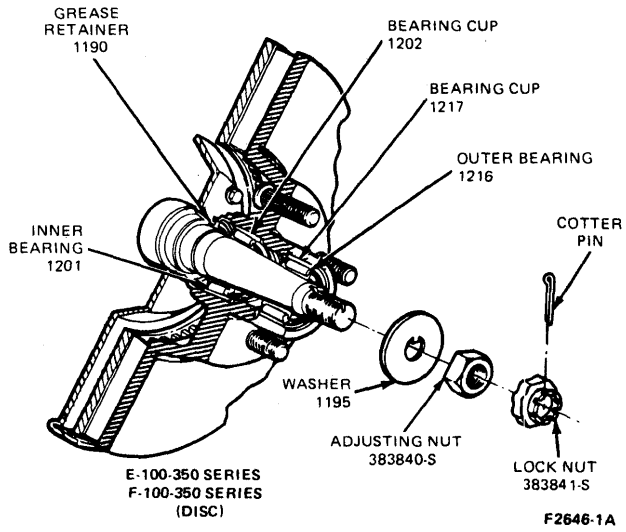


FIG. 1 Front Hubs and Rotor Assembly Bearings and Grease Retainers

ADJUSTMENTS

FRONT WHEEL BEARING ADJUSTMENT

To check the wheel bearing adjustment, raise the front of the vehicle. Then, grasp the tire at the sides, and alternately push inward and pull outward on the tire. If any looseness is felt, adjust the front wheel bearings.

F100-F350 (4x2), E100-E350 AND BRONCO

1. Remove the hub cap or wheel cover, wheel and tire assembly, disc brake caliper and pads, (refer to Part 12-24), dustcap, locknut, adjusting nut, washer and cotter pin.
2. Tighten wheel adjusting nut to 22-25 ft-lbs while rotating the disc brake rotor in the opposite direction.
3. Back off the wheel adjusting nut 1/8 turn and install locknut and cotter pin without additional movement of wheel nut (Fig. 1).
4. Re-install dustcap, caliper, pads and wheel and tire assembly.

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REMOVAL AND INSTALLATION

FRONT WHEEL GREASE SEAL AND BEARING REPLACEMENT AND REPACKING

Wheel bearing lubricant is a lithium-base grease, C1AZ-19590-B or equivalent.

Sodium-base grease is not compatible with lithium-base grease and should not be intermixed. Therefore, do not lubricate front and/or rear wheel bearings without first ascertaining the type of original wheel bearing lubricant. Usage of incompatible bearing lubricants could result in premature lubricant breakdown.

If bearing adjustment will not eliminate looseness or rough and noisy operation, the hub and bearings should be cleaned, inspected, and repacked with specified wheel grease. If the bearing cups or the cone and roller assemblies are worn or damaged, they should be replaced.

DISC BRAKES

F-100—F-350, E-100—E-350

1. Raise the vehicle until the tire clears the floor and remove the wheel and tire assembly from the hub and rotor.
2. Remove the brake caliper, (refer to Part 12-24), and wire it to the underbody to prevent damage to the brake hose. It is not necessary to disconnect the hose from the caliper. Do not let the caliper hang with its weight on the brake hose or the hose may become stretched, twisted or ruptured.
3. Remove the grease cap, cotter pin, locknut, nut and washer.
4. Remove the outer bearing cone and roller.
5. Pull the hub and rotor off the spindle and remove and discard the grease retainer, if necessary.
6. Remove the inner bearing cone and roller from the hub. Remove all traces of old lubricant from bearings, hub and axle spindle.
7. Inspect the cups for scratches, pits or cracks. If the cups are worn or damaged, remove them with a drift. Clean the inner and outer bearing cones and rollers with solvent and dry thoroughly. **Do not spin the bearings dry with compressed air.**
8. Inspect the cones and rollers for cracks, nicks, brinelling, or seized rollers. Inspect the grease retainer and replace it if it is cracked, nicked, or dented.
9. Cover the spindle with a clean cloth and brush all loose dust and dirt from the brake assembly using Rotunda brake vacuum (model 340009) or equivalent. **Remove the cloth from the spindle carefully to prevent dirt from falling on the spindle.**
10. If inner or outer bearing cups were removed, install replacement inner and outer bearing cups in the hub with tool T56P-1217-A, (Fig. 2). Be sure to seat the cups properly in the hub. The cups will be properly seated when they are fully bottomed.
11. Pack the inside of the hub with C1AZ-19590-B lubricant or equivalent. Fill the hub until the grease is flush with the inside diameters of both bearing cups. Pack the bearing cones and rollers with wheel bearing grease. Use a bearing packer for this operation, Rotunda models 120072, 120211, 120250 or equivalent. If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.
12. Place the inner bearing cone and roller in the inner cup and install the new grease retainer with driving tool T37T-1190-B, (Fig. 3). Be sure that the retainer is fully bottomed.
13. Install the hub and rotor on the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.**
14. Install the outer bearing cone and roller and the flat washer on the spindle, then install the adjusting nut, and adjust the wheel bearing as outlined under Adjustments. Install the grease cap.
15. Install the caliper, (refer to Part 12-24).
16. Install the wheel and tire assembly on the hub.
17. Lower the vehicle and tighten the lug nuts to specification. Re-install the wheel cover or hub cap.

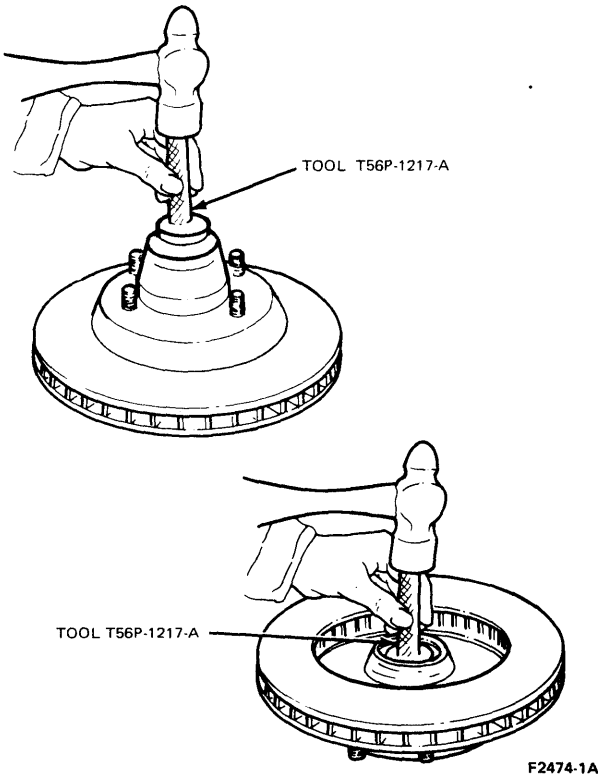


FIG. 2 Installing Bearing Cups

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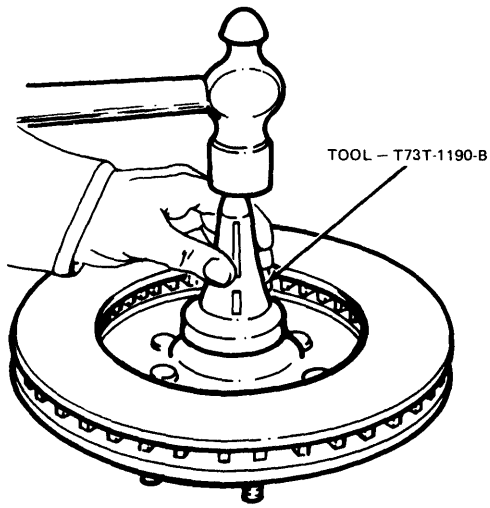


FIG. 3 Installing Grease Retainer

SPECIFICATIONS

WHEEL TORQUE LIMITS — F-100-F-350, E-100-E-350, BRONCO

Model	Nut Size	(ft-lb)	N•m
E-100, E-150, F-100-F-250		90	122
F-100 (4 x 4), Bronco (Std. Wheel) F-250-250 (4 x 4), Bronco	1/2-20	90	122
E-250 (Std. Wheel) (w/Single Rear Wheels)	1/2-20	90	122
F-350, E-350 w/Single Rear Wheels	9/16-18	145	196
F-350 (w/Dual Wheels and 7400 lb. Axle)	9/16-18	220	298
E-350 (w/Dual Rear Wheels)	9/16-18	220	298

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SPECIAL TOOLS

Number	Description
340009	Brake Vacuum
120072	Wheel Bearing Packer
120211	Wheel Bearing Packer
120250	Wheel Bearing Packer
T59T-1197-B	Front Wheel Bearing Adjustment Spanner Wrench
Tool-1175-AB	Grease Seal Remover Head
T50T-100-A	Impact Slide Hammer
T56P-1217-A	Front Hub Bearing Cup Replacer
T73T-1190-B	Shielded Grease Seal Installer

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Wheel Hubs and Bearings — Rear (Semi-Floating Axle)

PART 11-11

APPLIES TO BRONCO, E-100, E-150, F-100, F-150 AND F-150 (4x4)

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION	11-1
Rear Wheel Assembly	11-1		

DESCRIPTION

REAR WHEEL ASSEMBLY

The rear wheel brake drum assembly is retained on the studs on the rear axle shaft flange by three retainers. The wheel (and tire) is mounted on the same rear axle shaft flange studs, and is held against the hub and drum by the wheel nuts. The rear wheel bearing is pressed onto the axle shaft just inside the shaft flange. The assembly is retained to the rear axle housing by the bearing retainer plate, which is bolted to the housing flange.

REMOVAL AND INSTALLATION

Refer to Part 15-10 Removable Carrier Axle—Ford for removal and installation procedures.

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Wheel Hubs and Bearings — Front Wheel Drive

PART 11-12

APPLIES TO BRONCO, F-150, F-250, F-150-F-350 (4x4) Only

SUBJECT	PAGE
DESCRIPTION	12-1
ADJUSTMENTS	
Front Wheel Bearing	
Bronco and F-150 — F-350 4x4	12-1
REMOVAL AND INSTALLATION	
Free-Running Hub (Internal Type)	
Bronco and F-100 — F-250 F-350 4x4	12-2
DISASSEMBLY AND ASSEMBLY	
Front Wheel Grease Seal and Bearing Replacement and Repacking	12-5
Bronco and F-150, F-250 4x4	12-5

DESCRIPTION

Front drive assemblies are available for Bronco, and F-150—250 (4x4).

ADJUSTMENTS

FRONT WHEEL BEARING ADJUSTMENT

If equipped with free-running hubs, refer to Removal and Installation— Free-Running Hub, in this Part.

BRONCO AND F-150—F-350 4X4

1. Raise the vehicle and install safety stands.
2. Remove the front hub grease cap and the driving hub snap ring (Fig. 1).
3. Remove the splined driving hub and the pressure spring. This may require a slight prying assist (Figs. 2 and 3).
4. Remove the outer wheel bearing lock nut and lock ring.
5. Using Tool T59T-1197-B and a torque wrench, tighten the bearing inner adjusting nut to 50 ft-lb

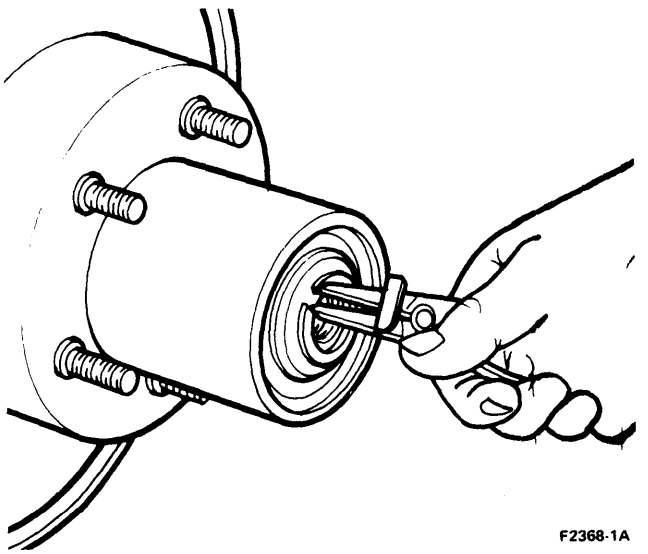


FIG. 1 Removing Snap Ring

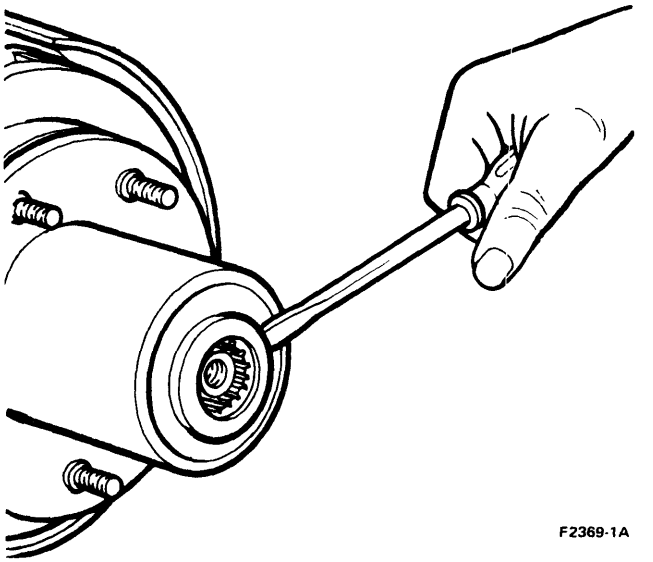


FIG. 2 Removing Splined Driving Hub

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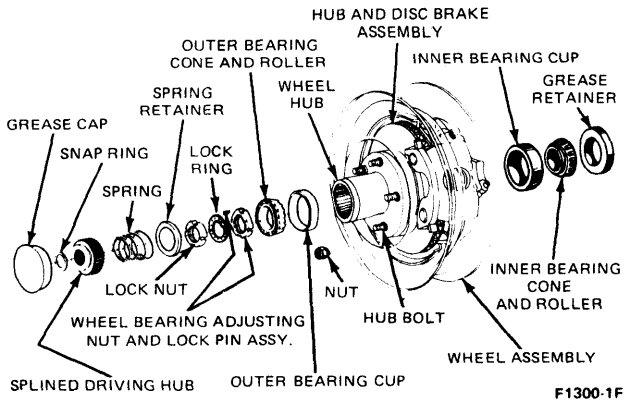


FIG. 3 Front Hub Installation—Four-Wheel Drive

while rotating the wheel back and forth to seat the bearing.

6. Back off the adjusting nut approximately 90 degrees.
7. Assemble the lock ring by turning the inner nut to the nearest hole for dowel pin installation. **Note: The dowel pin must seat in a lock ring hole for proper bearing adjustment and wheel retention.**
8. Install the outer lock nut and tighten to 50-80 ft-lb. Final end play of the wheel on the spindle should be 0.001 to 0.010 inch or 0.001 to 0.008 for F-250 (4x4) with Dana 44-9F Axle.
9. Apply non-hardening sealer to the seating edge of the grease cap, then install the pressure spring and driving hub, driving hub snap ring and grease cap.
10. Remove safety stands. Lower vehicle.

REMOVAL AND INSTALLATION

FREE-RUNNING HUB (INTERNAL-TYPE)

BRONCO AND F-100—F-250 F-350 4X4

Removal

1. Remove the lock-out hub screws hub bolts and washers (Fig. 4).
2. Remove the hub ring and the knob. Wipe the parts clean.
3. Remove the internal snap ring from the groove in the hub.
4. Remove the cam body ring and clutch retainer (as an assembly) from the hub. Disassemble the parts.
5. Remove the axle shaft snap ring. For easier snap ring removal, push inward on the axle shaft sleeve ring and, at the same time, pull out on the axle with a bolt.

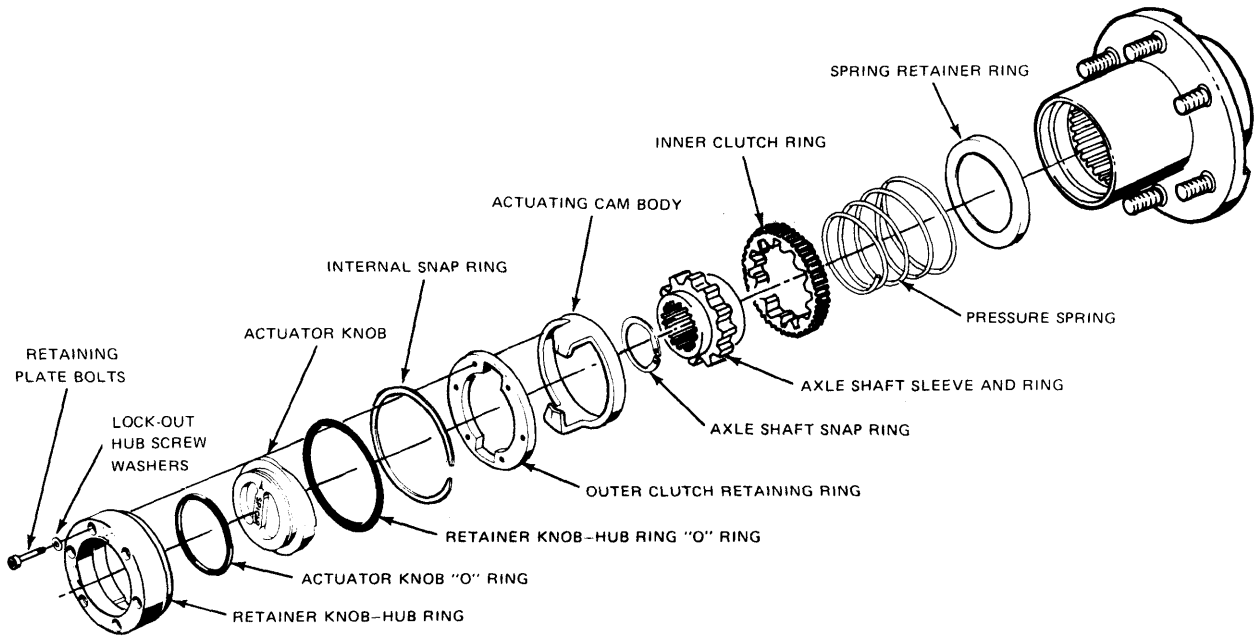


FIG. 4 Free-Running Hub—Internal-Type—Bronco and F-250 4x4 with Heavy Duty Axle

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6. Remove the axle shaft sleeve ring and inner clutch ring. A slight rocking of the hub may make them slide out easier.
7. Remove the pressure spring.
8. Remove the spring retainer ring.

Installation

1. Grease the hub inner spline with Moly grease or equivalent (Fig. 5).
2. Install the spring retainer ring, positioned as shown (Fig. 6) with recessed undercut area going in first. Be sure ring seats against the bearing.
3. Install the coil spring with large end entering first (Fig. 7).
4. Grease with Moly grease or equivalent and install the axle shaft sleeve and ring and the inner clutch ring. Be sure that the teeth are meshed together in a locked position for easy assembly. It may be necessary to rock the hub back and forth for spline alignment. Keep the two gears in locked position (Fig. 8).

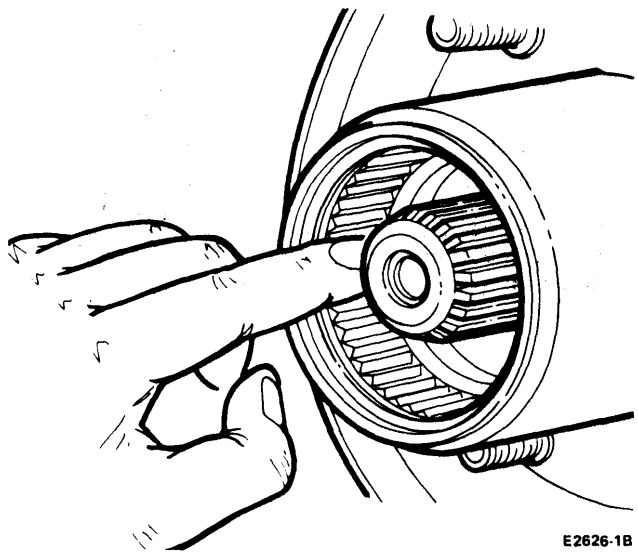


FIG. 5 Grease Application

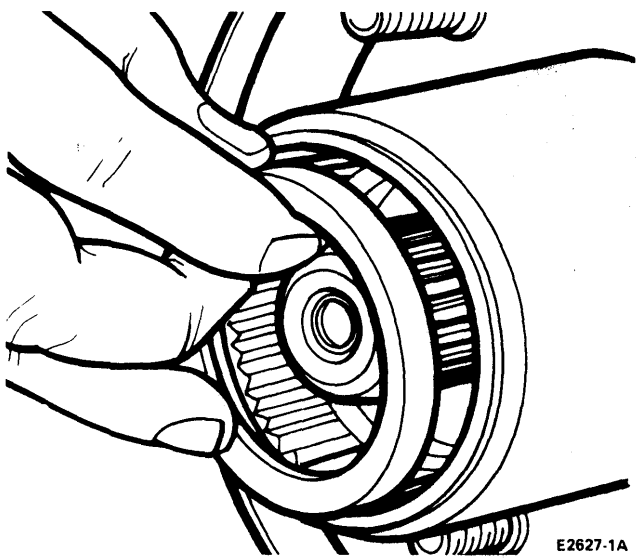


FIG. 6 Spring Retainer Ring Installation

5. Install the axle shaft snap ring. Push inward on gear and, if necessary, pull out axle shaft with bolt to allow groove clearance on shaft for the snap ring. Be sure snap ring is fully seated in the snap ring groove on the shaft (Fig. 9).
6. Install the actuating cam body ring into the outer clutch retaining ring. Assemble into hub (Fig. 10).
7. Install the internal snap ring. Be sure snap ring is fully seated in the snap ring groove of the hub (Fig. 11).
8. Apply a small amount of Moly grease or equivalent on the ears of the cam (Fig. 12).
9. Apply a small amount of Parker O-ring lube or an equivalent lube in groove of actuating knob before assembling outer O-ring (Fig. 13).
10. Assemble knob in hub ring and assemble to axle with knob in locked position. Assemble screws and washers alternately and evenly, making sure the retainer ring is not cocked in the hub.

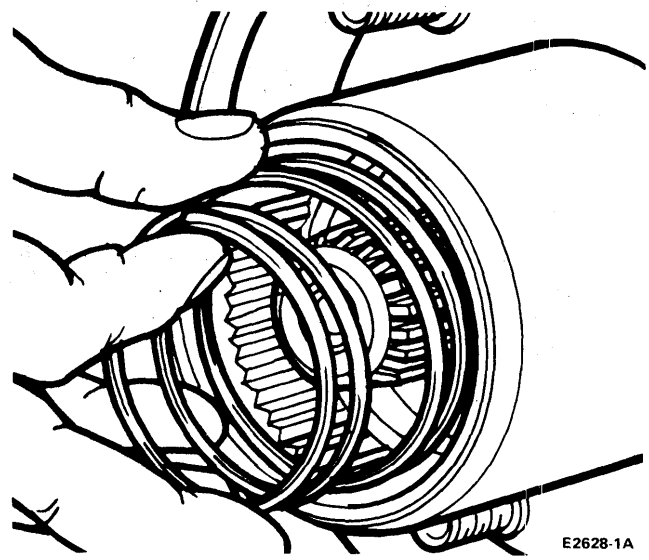


FIG. 7 Coil Spring Installation

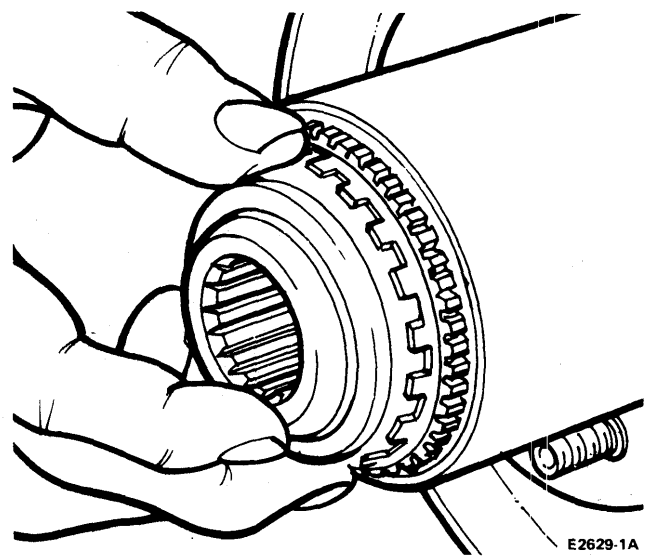


FIG. 8 Axle Shaft Sleeve and Ring and Inner Clutch Ring Installation

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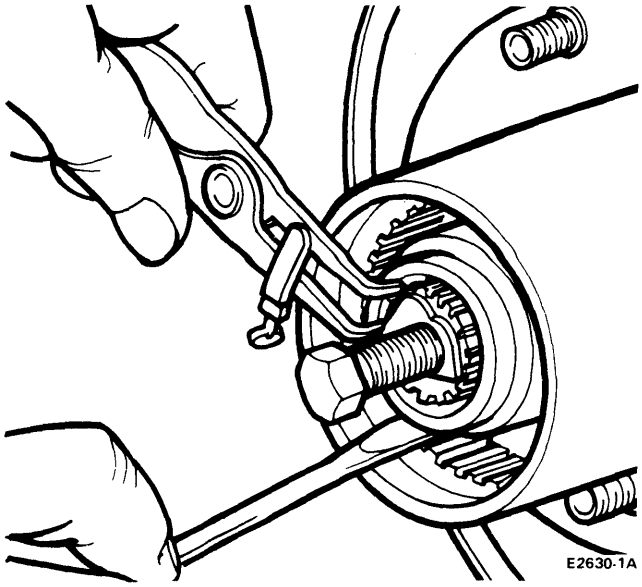


FIG. 9 Installing Axle Shaft Snap Ring

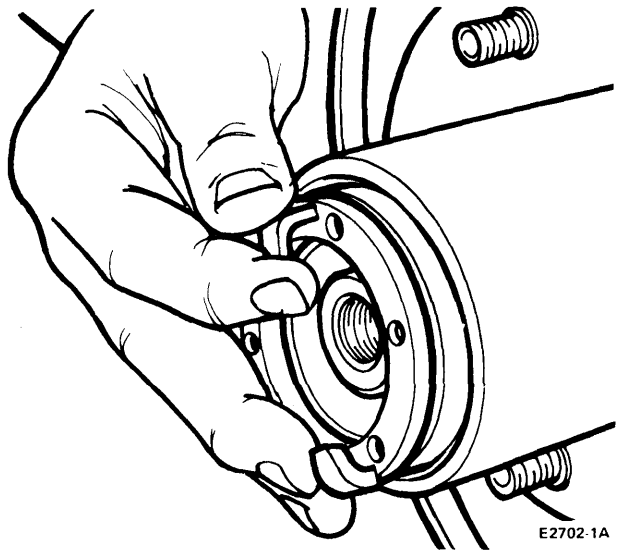


FIG. 10 Installing Cam Body Ring into the Clutch Retaining Ring

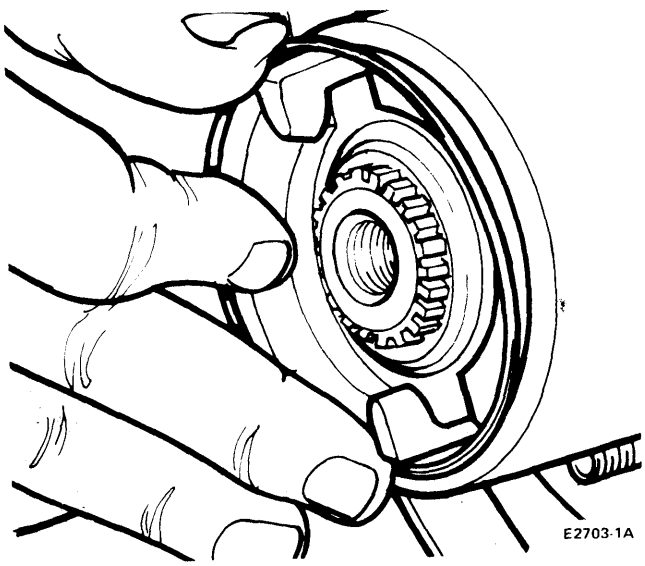


FIG. 11 Installing Internal Snap Ring

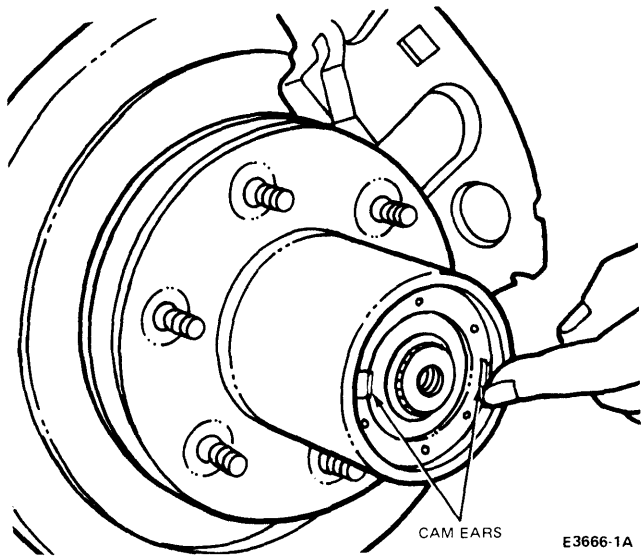


FIG. 12 Apply a Small Amount of Grease on the Ears of the Cam

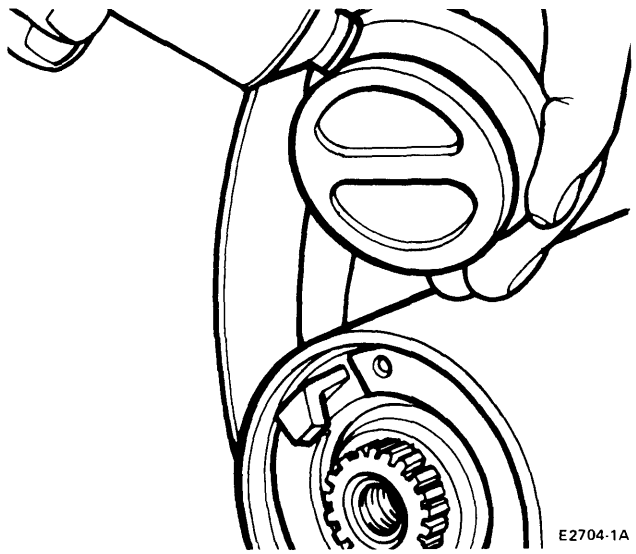


FIG. 13 Lubrication Areas

11. Tighten the six lock-out hub bolts to 30 to 35 in-lb. Be sure the washers are under each retaining screw. Each free-running hub will fit either wheel.

Do not drive vehicle until you are sure that both free-running hubs are engaged or disengaged. When vehicle is driven in water deep enough to cover the hubs, it is recommended that the internal parts be disassembled and inspected for possible water or dirt. After inspection, re-lubricate all parts before assembly to prevent rusting or corrosion.

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DISASSEMBLY AND ASSEMBLY

FRONT WHEEL GREASE SEAL AND BEARING REPLACEMENT AND REPACKING

The recommended wheel bearing lubricant is the lithium-base grease, Ford Specification, ESA-MIC75-B or equivalent.

Sodium-base grease is not compatible with lithium-base grease and should not be intermixed. Therefore, before lubricating front and/or rear wheel bearing, **note which type was used as the original wheel bearing lubricant.** Usage of incompatible bearing lubricant could result in premature lubricant breakdown.

If bearing adjustment does not eliminate looseness or rough and noisy operation, clean, inspect and repack the hub and bearings with specified wheel grease. If bearing cups or the cone and roller assemblies are worn or damaged, they should be replaced.

BRONCO AND F-150, F-250 4X4

1. Raise the vehicle and install safety stands.
2. If Equipped with free-running hubs refer to Free-Running Hub Removal and Installation, this Part.
3. Remove the front hub grease cap and driving hub snap ring (Fig. 1).
4. Remove the splined driving hub and the pressure spring. This may require a slight prying assist (Fig. 2).
5. Remove the wheel bearing lock nut, lock ring, and adjusting nut (Fig. 14), using Tool T59T-1197-B.
6. Remove the hub and disc assembly. The outer wheel bearing and spring retainer will slide out as the hub is removed (Fig. 15).
7. Remove the spindle retaining nuts, then carefully remove the spindle from the knuckle studs and axle shaft.
8. Clean all old grease from the needle bearings and wipe clean the spindle face that mates with the spindle bore seal.
9. Remove the spindle bore seal, V-seal, and thrust washer from the outer axle shaft (Fig. 17). Clean any old grease or dirt from these parts and replace those that show signs of excessive wear.
10. Using Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent, thoroughly lubricate the needle bearing and pack the spindle face that mates with the spindle bore seal.
11. Assemble the V-seal in the spindle bore next to the needle bearing. Assemble the spindle bore seal on the axle shaft (Fig. 16 and 17).
12. Assemble the spindle with the axle shaft on the knuckle studs. Adjust the retaining nuts to 50-60 ft-lbs.
13. Carefully drive the inner bearing cone and grease seal out of the hub (Fig. 18) using Tool T69L-1102-A.
14. Inspect the bearing cups for pits or cracks. If necessary, remove them with a drift (Fig. 18). **If new cups are installed, install new bearings.**
15. Lubricate the bearings with Multi-Purpose Lubricant Ford Specification, ESA-MIC75-B or equivalent. Clean all old grease from the hub. Pack the cones and rollers. If a bearing packer is not available, work as much lubricant as possible between the rollers and the cages.
16. Position the inner bearing cone and roller in the inner cup and install the grease retainer.
17. Carefully position the hub and disc assembly on the spindle.
18. Install the outer bearing cone and roller, and the adjusting nut.
19. Using Tool T59T-1197-B and a torque wrench, tighten the bearing adjusting nut to 50 ft-lb, while rotating the wheel back and forth to seat the bearings.
20. Back off the adjusting nut approximately 90 degrees.
21. Assemble the lock ring by turning the nut to the nearest hole and inserting the dowel pin. Note: The dowel pin must seat in a lock ring hole for proper bearing adjustment and wheel retention.

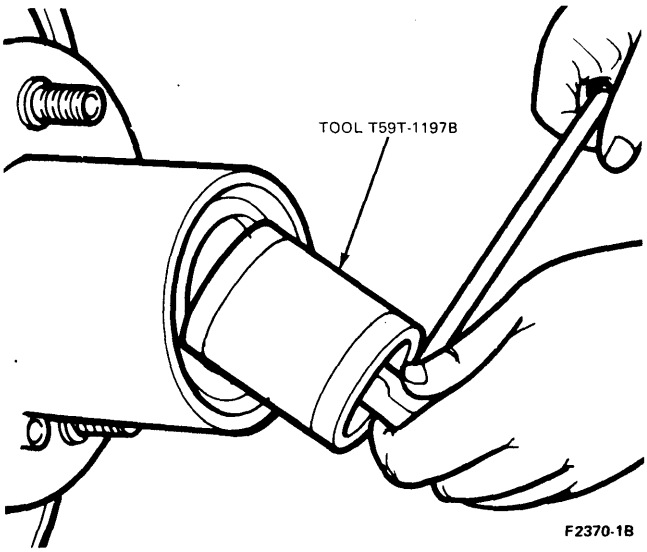


FIG. 14 Lock Nut, Lock Ring and Adjusting Nut Removal

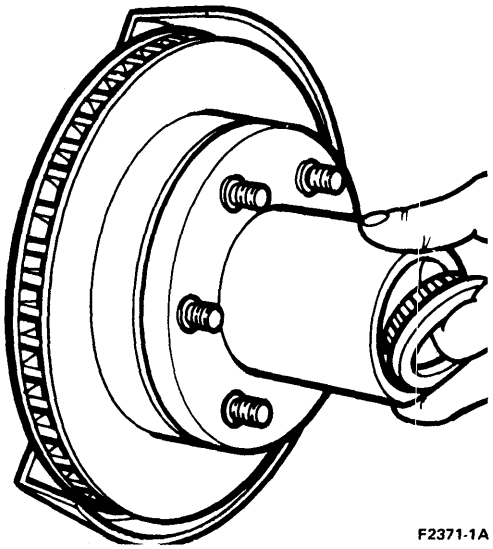


FIG. 15 Hub, Disc, and Outer Bearing Removal

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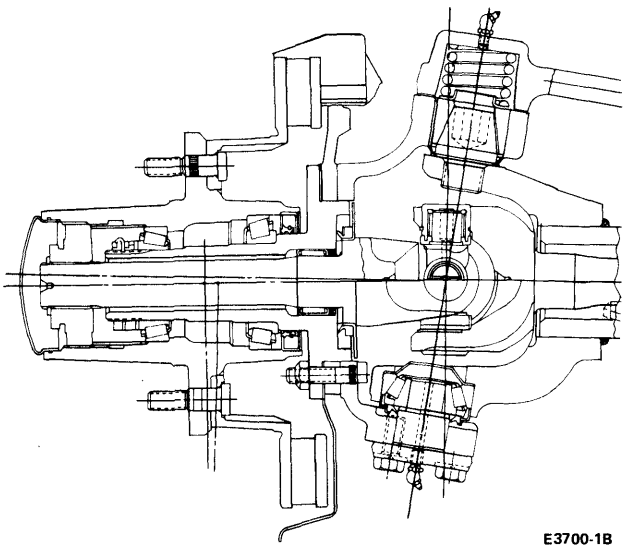


FIG. 16 Ball Joint and Socket Assembly—Dana Model 60-7F

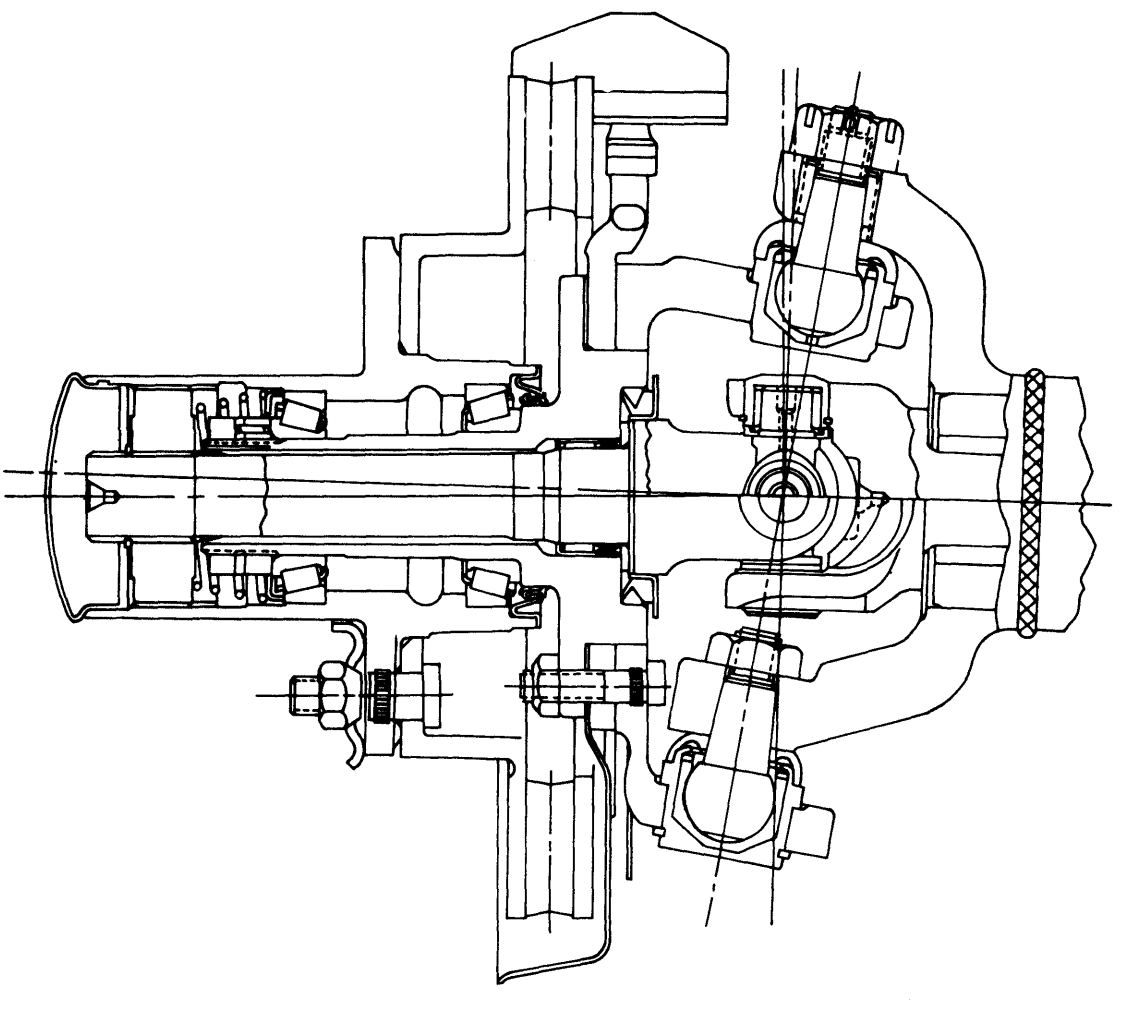


FIG. 17 Ball Joint and Socket Assembly—Dana Model 44-7 F

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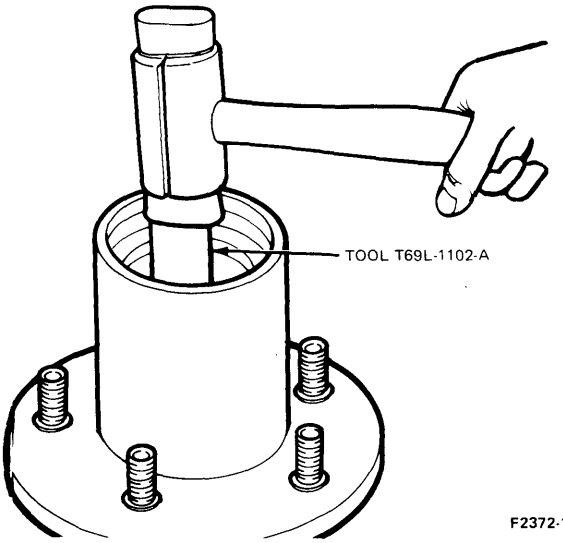


FIG. 18 Inner Bearing Cone and Grease Seal Removal

22. Install the outer lock nut and tighten to 50-80 ft-lb. Final end play of the wheel on the spindle should be 0.001 to 0.010 inch. For F-250 (4x4) with Dana 44-9F, .001 to .008 inch.
23. Install the pressure spring and driving hub snap ring.

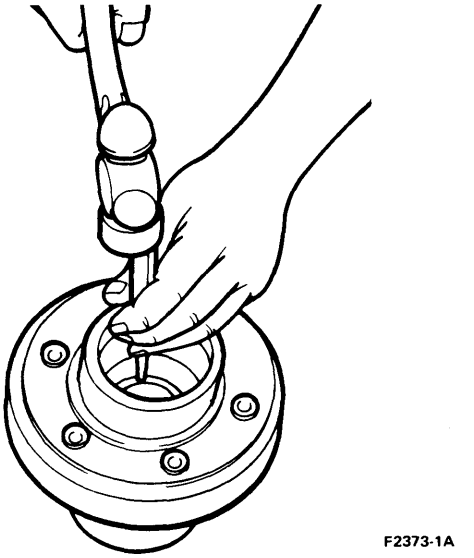


FIG. 19 Bearing Cup Removal

24. Apply non-hardening sealer to the seating edge of the grease cap, and install the grease cap.
25. Adjust the brake if it was backed off.
26. Remove the safety stands and lower the vehicle.

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Wheel Hubs and Bearings — Rear (Full Floating Axle)

PART 11-14

APPLIES TO E-250, E-350, F-250 AND F-350

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	14-1	SPECIFICATIONS	14-4
DISASSEMBLY AND ASSEMBLY			
Bearings, Cups, and Seals			
F-250 (4x2 and 4x4), F-350, E-250 and E-350 Series	14-3		

DESCRIPTION

On all full-floating rear axle wheel hubs with tapered roller bearings (F-250—F-350 and E-250—E-350), a seal is installed behind the inner bearing to keep the wheel bearing lubricant from the brake lining and brake drum (Fig. 1). Fig. 2 shows special details of Econoline E-250 and E-350 vehicle hubs.

The wheel bearings are packed with Multi-Purpose Lubricant Ford Specification C1AZ-19590-B or equivalent to provide initial lubrication until axle lubricant flows into the wheel hubs and bearings during vehicle operation. On these axles the wheel hub is vented through the axle housing vent.

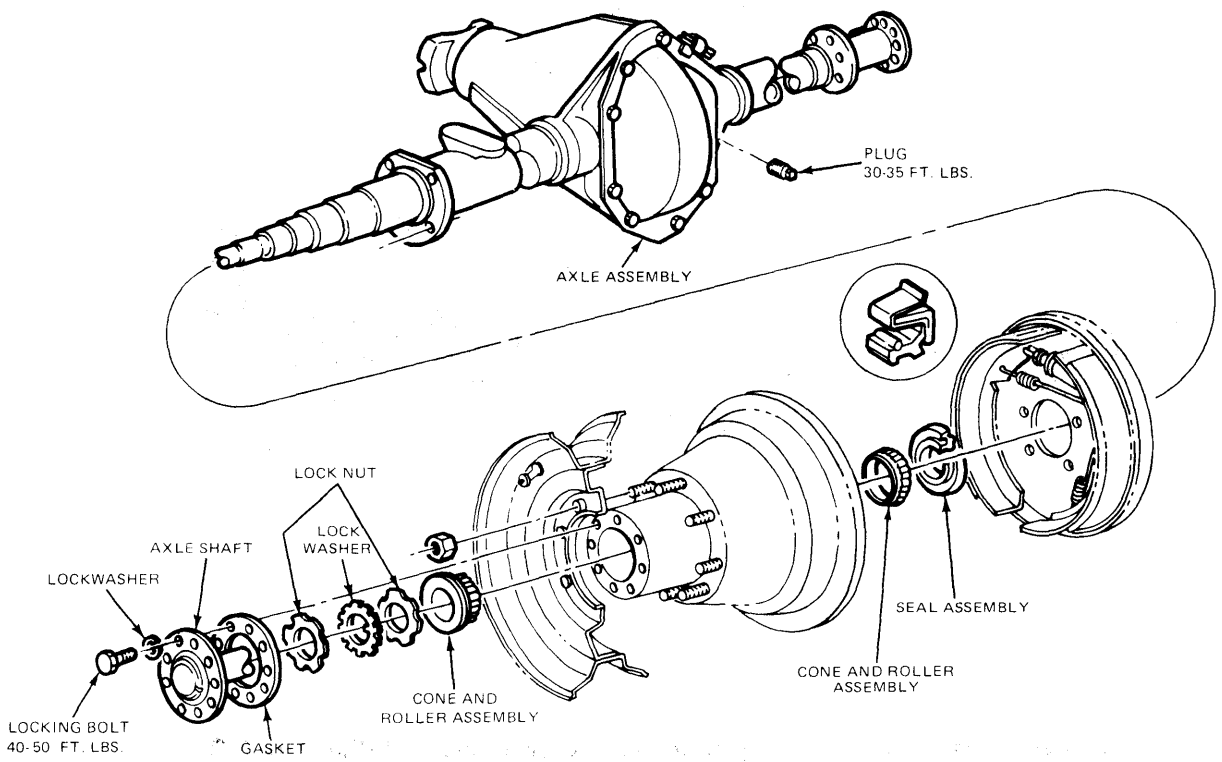
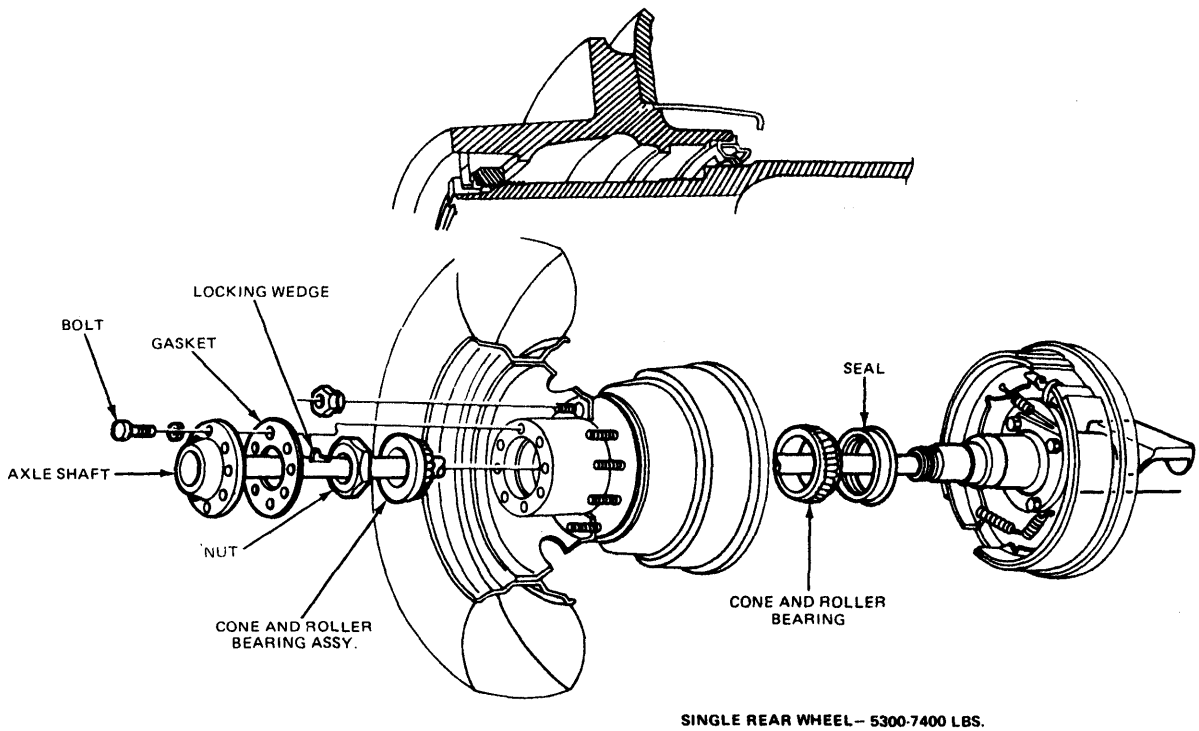


FIG. 1 Rear Wheel Hub—Dana Full-Floating Axle Single Rear Wheels—Models 60, 61 and 70—F-250—F-350

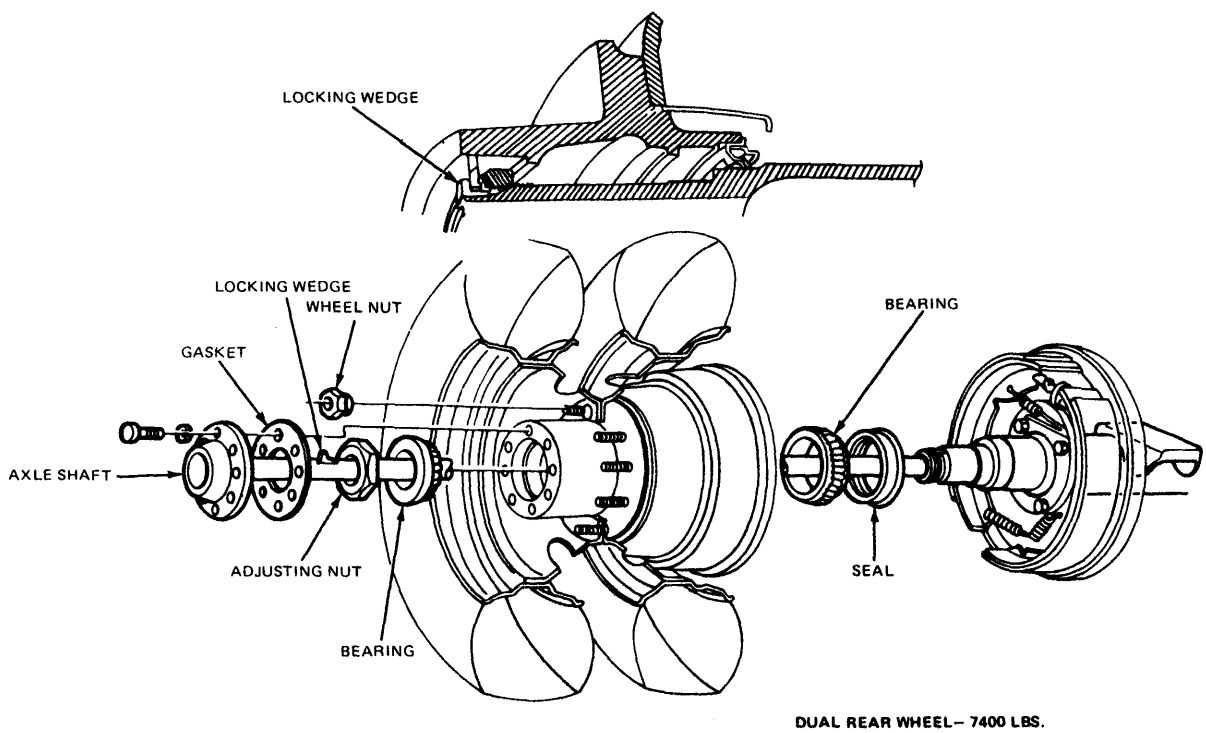
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SINGLE REAR WHEEL— 5300-7400 LBS.

SINGLE REAR WHEEL HUB E-250 – E-350



DUAL REAR WHEEL— 7400 LBS.

F1874-2C

FIG. 2 Rear Wheel Hub—Dana Full Floating Axle Dual Rear Wheels—E-250 and E-350

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DISASSEMBLY AND ASSEMBLY
BEARINGS, CUPS AND SEALS

F-250, (4 X 2 AND 4 X 4), F-350, E-250 AND E-350 SERIES

1. Set the parking brake and loosen the axle shaft attaching bolts (Fig. 1).
2. Raise the rear wheels off the floor and place safety stands under the rear axle housing so that the axle is parallel with the floor. Back off the rear brake adjustment, if necessary.
3. Remove the axle shaft attaching bolts and lock washers and discard them.
4. Remove the axle shaft and discard the gasket.

   On E250 and E350 vehicles a different procedure must be used. Do not remove or even turn the wheel bearing adjustment nut until the locking wedge is removed. Pry out with a screwdriver.
5. On F-250 and F-350 Vehicles, remove the wheel lock nut, lock washer and wheel bearing adjustment nut, using Tool T70T-4252-D or T70T-4252-E. **Under no condition should the lock nut be removed with a chisel. Discard the lock washer.**
6. Using a heavy duty dolly such as the Rotunda model 140030 or equivalent as shown in Fig. 3, raise the wheel to the point that all weight is removed from the wheel bearings.

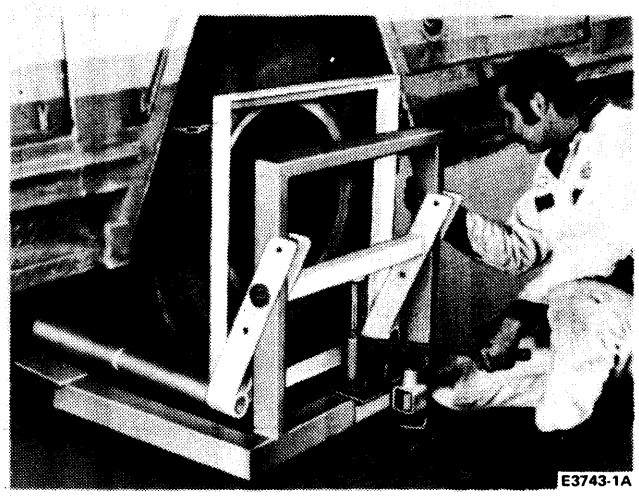


FIG. 3 Heavy Duty Wheel Dolly

7. Remove the outer bearing cone, pull the wheel assembly straight out and away from the axle.
8. Thoroughly clean the spindle of the axle housing.
9. With a brass drift, drive the inner bearing cone and inner seal out of the wheel hub. Use extra care to prevent damage to the bearing cage.
10. Clean all old grease and axle lubricant out of the wheel hub.
11. Inspect the bearing races and rollers for pitting, galling or erratic wear patterns. Inspect the rollers for end wear. Replace the bearings if worn or damaged (Fig. 4).

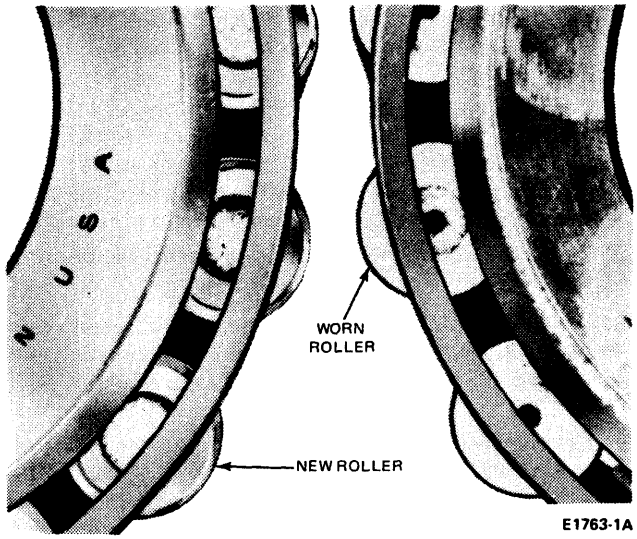


FIG. 4 Roller Bearing End Wear

12. If the bearing cups are to be replaced, drive them out with a brass drift. Install the new cups with Tool T75T-1170-A (Fig. 5).

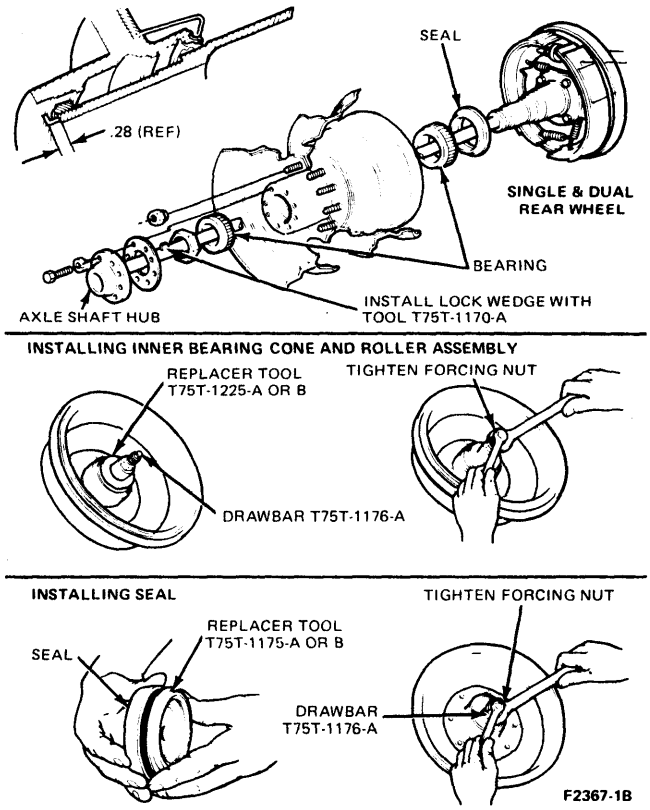


FIG. 5 Installation of Rear Wheel Bearings and Seal

13. Check for proper seating of the new bearing cups by trying to insert a 0.0015-inch feeler gauge between the cups and the wheel hub. The gauge should not enter beneath the cup. Check several places to make sure that the cups are squarely seated.
14. Pack each bearing cone and roller assembly with a bearing packing tool, using C1AZ-19590-B (ESA-M1C75-B) long-life lubricant or equivalent.

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15. Place the inner bearing cone and roller assembly in the wheel hub with tool T75T-1225-A or B (Fig. 5). Install a new hub inner seal with tool T75T-1175-A or B.
16. Position the wheel assembly at the axle housing. Wrap the threads of the spindle with electricians tape. **Carefully slide the wheel assembly straight (to avoid seal damage) onto the axle housing spindle.** Remove the electricians tape.
17. Install the outer wheel bearing and start the bearing adjuster nut. Remove the wheel jack.
18. While rotating the wheel, tighten the adjusting nut, 50 to 80 ft-lb. Back off (loosen) the adjusting nut 3/8 of a turn using Tool T70T-4252-D or T70T-4252-E.
19. Coat a new lock washer with axle lube and install it, smooth side out. Install the lock nut (Tool T70T-4252-D or T70T-4252-E). Tighten the lock nut, 90 to 110 ft-lb. With the lock nut at proper torque, the wheel assembly must rotate freely and with an end play of 0.001-0.010 inch. **Be sure of this specification. Check it closely with suitable dial indicator set up. Do not preload the bearings.**
20. With a satisfactory end play and freely turning wheel, bend two lock washer tabs inward over flats of the adjusting nut, and two tabs outward over flats of the lock nut.

    For E-250 and E-350 while rotating the wheel, tighten the adjusting nut to 120-140 ft-lbs using tool OTC-1928. Back off the nut enough to get a 0.001 to 0.010 inch end play. This should require 1/8 to 1/4 turn. Position the locking wedge in the key way slot (Fig. 6). **It must not be bottomed against the shoulder of the adjusting nut when fully installed. Do not hammer on the locking wedge.** Use tool T75T-1170-A, giving the tool a light tap with a hammer.

    The locking wedge and the adjusting nut can be used over again, provided the locking wedge cuts a new groove in the nylon retainer material within the 1/8 to 1/4 turn specified. The wedge must not be pressed into a previously cut groove.

    NOTE: If it is not possible to back the nut off within the limits of 1/8-1/4, turn to obtain proper assembly (.001-.010 end play and the wedge into solid uncut nylon). Discard the nut and wedge and replace with the new ones. Discard the nut and/or wedge if there is any evidence of mutilation, damage and/or scoring.
21. Prior to reinstallation of the axle shaft, clean and remove any metallic debris in the hub bolt holes. Also inspect for cracked material around the holes, depth of the threaded hole (minimum 1.0") and oversized threaded holes, and replace hub if any of these conditions are present. Install the axle shaft and new axle flange gasket, lock washers and new axle shaft retaining bolts. Tighten the lock bolts, 40 to 50 ft-lb.
22. Adjust the brakes.
23. Remove the safety stands and lower the vehicle.

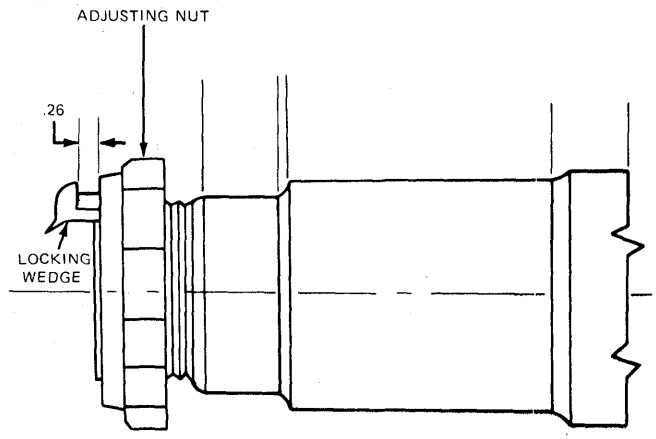


FIG. 6 Positioning Locking Wedge—E-250 and E-350

SPECIFICATIONS

SPECIAL TOOLS

Number	Description
T75L-1170-A	Lock Wedge Replacer Tool
T75T-1175-A or B	Axle Seal Replacer
T75T-1176-A	Threaded Drawbar
T75T-1225-A or B	Inner Bearing Replacer Tool
T70T-4252-D or E	Rear Axle Lock Nut Wrench
140030	Heavy Duty Wheel Dolly

CE3367-1B

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BRAKES

GROUP 12 (2000)

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General Hydraulic Brake Service	12-01
Parking Brake — Cable Actuated, Rear Wheels	12-70
Vacuum Brake Booster — Single Diaphragm, Dash-Mounted (Bendix)	12-50
Vacuum Brake Booster — Tandem Diaphragm, Dash-Mounted (Bendix)	12-52

General Hydraulic Brake Service

PART 12-01

APPLIES TO ALL LIGHT TRUCK MODELS

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DESCRIPTION AND OPERATION

Hydraulic brakes are standard equipment on all vehicles.

Hydraulic drum rear brakes on all Bronco, F-100—F-350 and E-100—E-350 trucks use automatic rear brake shoe adjusters.

DUAL MASTER CYLINDER BRAKE SYSTEM

Refer to Figs. 1, 2 and 4.

The dual master cylinder contains a double hydraulic cylinder with two fluid reservoirs, primary and secondary hydraulic pistons (Fig. 3).

The dual master cylinder performs in the following manner;

REAR WHEEL BRAKES—the rear wheel brakes are connected to the secondary outlet port and are actuated by the secondary piston assembly.

FRONT WHEEL BRAKES—the front wheel brakes are connected to the primary outlet port (nearest the dash panel) and are actuated by the primary piston assembly.

Both primary and secondary pistons function together.

On some vehicles, the hydraulic brake system may be assisted by a vacuum booster installed as either standard or optional equipment. Information about the vacuum booster is given in Parts 12-50 and 12-52.

DRUM BRAKES

F-100 thru F-350 Series and E-100-350, F-150-F-250 F-350 (4x4), and Bronco are equipped with front disc brakes. The rear brakes are drum type with internal expanding shoes. The rear drum brakes are of the single anchor type, mounted to the same anchor, and actuated by one wheel cylinder. The wheel cylinder has two pistons. One piston exerts force against the upper end of the primary shoe; the other piston exerts force against the upper end of the secondary shoe (Figs. 6 and 7).

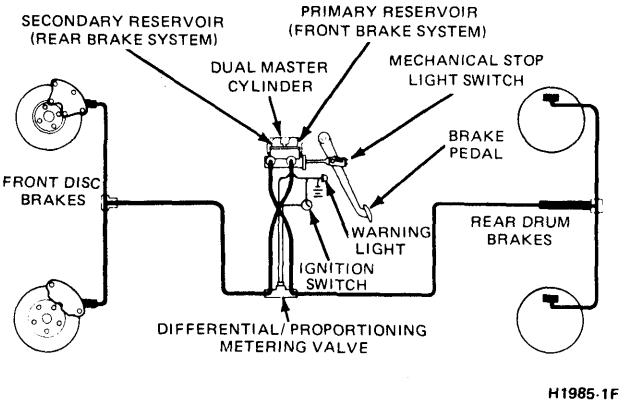


FIG. 1 Hydraulic Brake System—Manual Brakes F-100, (4x2), E-100

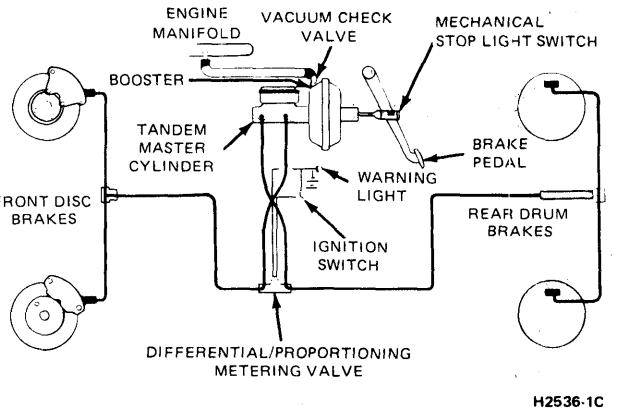


FIG. 2 Hydraulic Brake System with Dash-Mounted Booster—E-100—E-350, F-100—F-350 and Bronco

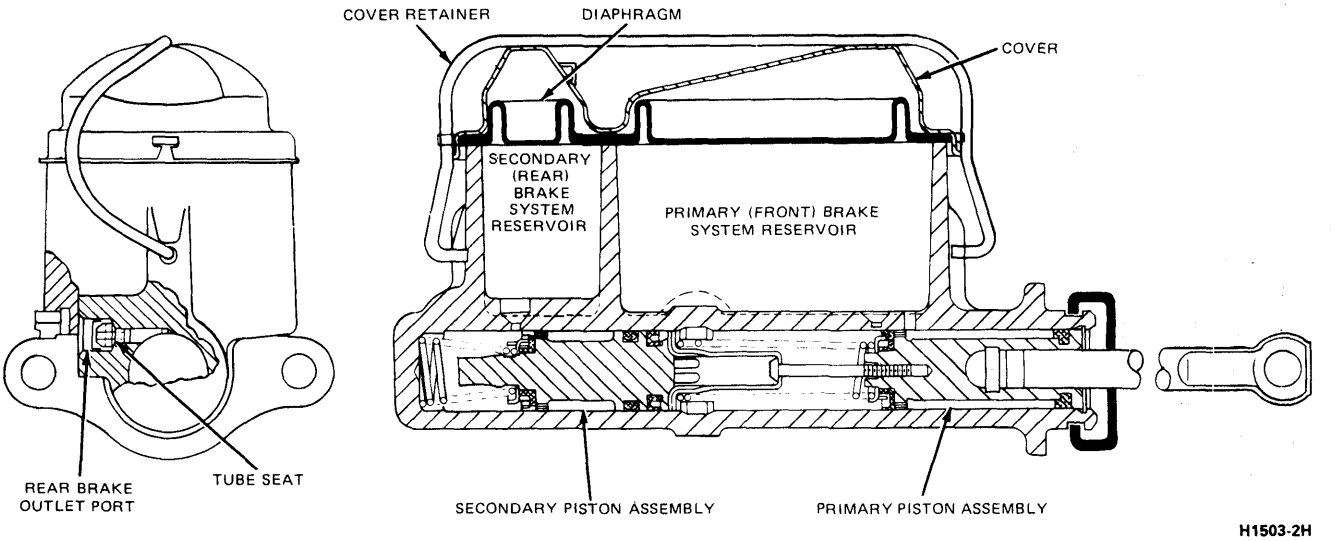


FIG. 3 Dual Master Cylinder—Manual Brakes F-100, E-100

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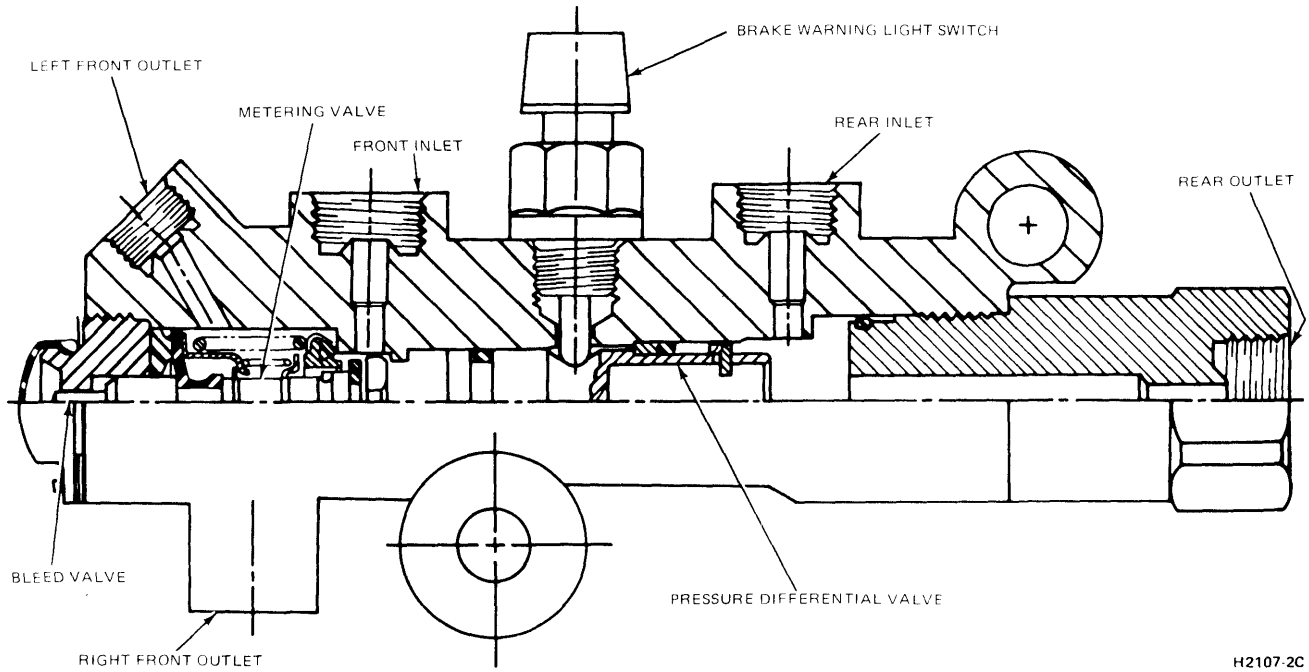


FIG. 4 Pressure Differential Metering Valve (Floating Calipers) Disc Brake F-250 (over G.V.W.) F-350 (4x2), E-250, E-350

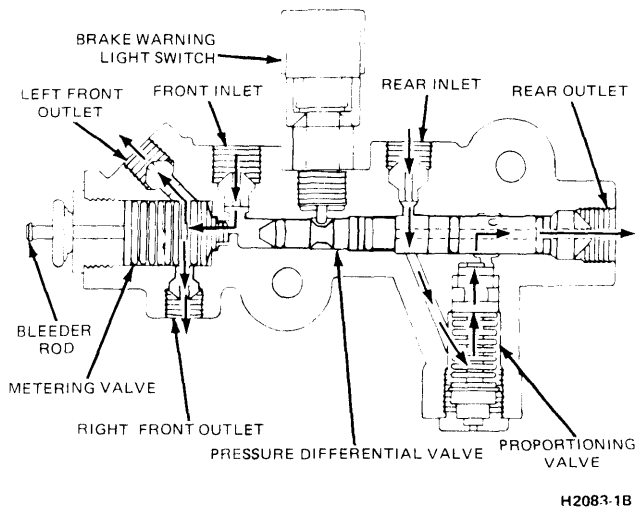


FIG. 5 Pressure Differential, Metering and Proportioning Valve—F-100-150, F-250, (up to 6800 G.V.W.) (4 x 2) F-150—F-250 (4 x 4), Bronco, E-100, E-150 Disc Brakes—Sliding Caliper

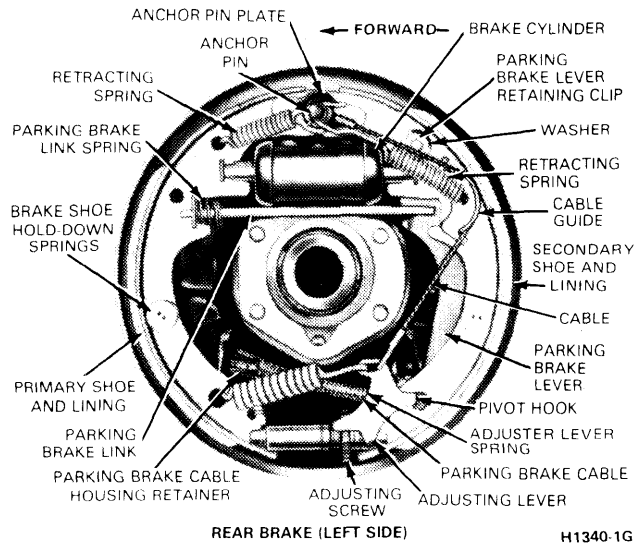


FIG. 6 Self Adjusting Brake Assemblies Standard—E-100, E-150, F-100, F-150, F-150 (4x4) and Bronco

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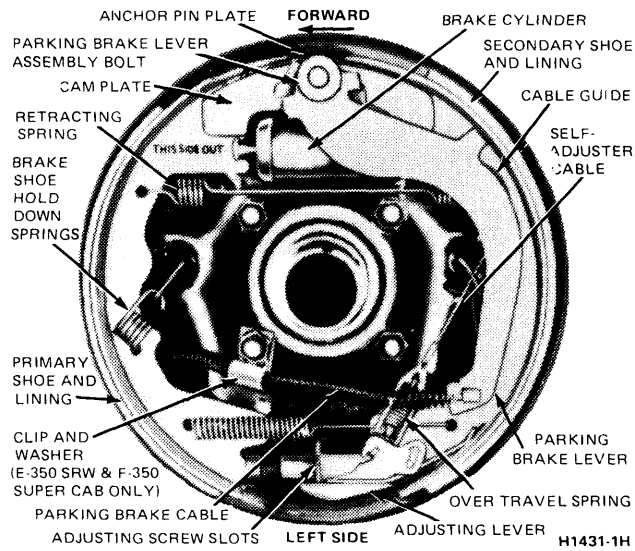


FIG. 7 Self Adjusting Brake Assemblies—F-250, (4 x 2) and F-250 (4 x 4), F-350—F-350 (4 x 4) and E-250-E-350

DIAGNOSIS AND TESTING

Occasional brake squeal can be caused by environmental conditions such as cold, hot, wet, snow, salt, mud etc. This occasional squeal is not a functional problem and does not indicate any loss in brake effectiveness.

BRAKE SYSTEM PRELIMINARY CHECKS

Always make the following preliminary checks before testing the brake system:

1. Check the fluid level in the brake master cylinder reservoir(s). If the fluid level is not within 1/4 inch of the top of the reservoir(s), add Ford Brake Fluid-Extra Heavy Duty Ford Specification ESA-M6C25-A or equivalent. **Do not mix low temperature brake fluids with the specified brake fluid.**
2. Push the brake pedal down as far as it will go. If the pedal travels more than halfway to the floor, adjust the brakes. If the vehicle is equipped with automatic brake adjusters, adjust brakes by backing up vehicle and applying brakes several times sharply.
3. If the brakes will apply and the vehicle can be safely stopped, road test the vehicle and apply the brakes at a speed of about 20 mph to see if the vehicle stops evenly. If it does not, manually adjust the brakes.

DUAL BRAKE WARNING LIGHT SYSTEM TESTS

1. Turn the ignition switch to the ACC or ON position. If the light on the brake warning lamp remains on, there may be a shorted or broken switch, grounded switch wires, or an un-centered pressure differential, metering, and proportioning valve. Center the valve as outlined in this Part under Adjustments. If the warning light still remains on, check for a grounded switch connector or wire and repair or replace the wire assembly. If the wire is in good condition, replace the brake warning lamp switch.
2. Turn the ignition switch to the start position. If the brake warning lamp does not light, check the light and wiring and replace or repair wiring, if necessary.

   When both brake systems are functioning normally, the equal pressure in the pressure differential, metering, and proportioning valve will keep the valve centered during brake pedal application. The brake warning lamp will light only when the ignition key is in the START position.
3. If the brake warning lamp does not light when pressure is not equal in both brake systems, the warning lamp may be burned out, the warning lamp switch may be inoperative or the switch-to-lamp wiring may have an open circuit. Check the bulb and replace it, if required. Check the switch-to-lamp wires for an open circuit and repair or replace them, if required. If the warning lamp still does not light, replace the switch.

POWER BRAKE FUNCTION TEST

1. With the engine stopped, eliminate all vacuum from the system by pumping the brake pedal several times. Then push the pedal down as far as it will go, and note the effort required to hold it in this position. If the pedal gradually moves downward under pressure, the hydraulic system is leaking and should be subjected to a hydraulic leak test.
2. With the brake pedal pushed all the way down, start the engine. If the vacuum system is operating properly, the pedal will move downward. If pedal position does not change, the vacuum system is not operating properly and should be subjected to a vacuum system test.

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DASH - MOUNTED VACUUM BOOSTER TEST

Use this procedure to test all diaphragm boosters equipped with a pipe thread outlet on the atmosphere portion of the diaphragm chamber.

1. With the brakes applied, visually inspect all hydraulic lines, connections, and hoses for evidence of leaks. Replace leaking part as necessary.
2. If the leak has not been found, remove the brake drums and inspect all wheel cylinders for evidence of fluid leaking past the wheel cylinder boot. Replace or re-build wheel cylinders as necessary.
3. Remove the pipe plug from the rear half of the booster chamber, and install a vacuum gauge, Rotunda tool 78-0015 or equivalent. Start the engine and run it at idle speed. The gauge should register 18 to 21 inches of vacuum.
4. With the engine running, push down on the brake pedal until the vacuum gauge reads zero. Hold the pedal down for one minute. If the pedal continues to move down, brake fluid is leaking. If the pedal moves up, brake fluid is leaking past the hydraulic piston check valve.
5. With the engine running, push down on the brake pedal until the vacuum gauge reads zero. Hold the pedal down, and shut the engine off. Hold pedal down for one minute. Any upward movement of the pedal indicates a vacuum leak in the vacuum check valve, vacuum line connections, or booster.

HYDRAULIC LEAK TEST

1. With the brakes applied, visually inspect all hydraulic lines, connections, and hoses for evidence of leaks. Replace leaking parts as necessary.
2. If the leak has not been found, remove the brake drums and inspect all wheel cylinders for evidence of leaks. Replace or re-build wheel cylinders as necessary.
3. If the leak has not been found, disconnect the hydraulic tubes from the master cylinder and plug the output ports using the appropriate size flared tube type plugs. Push the brake pedal down as hard as possible. If the pedal slowly moves downward, the master cylinder is leaking internally and should be re-built or replaced.
4. If the leak has still not been found, and the vehicle has a frame mounted booster(s), connect the tube back up to the master cylinder. Disconnect the output tube from the booster and plug the port with the plug just removed from the master cylinder. Pressure bleed the booster. Push down on the brake pedal again. If the pedal continues to move slowly downward the booster slave cylinder is leaking internally and should be replaced or re-built.
5. If the vehicle has two frame mounted boosters, each booster should be tested separately as in Step 4, while the other half of the system is plugged off at the master cylinder.

VACUUM SYSTEM TEST

1. If the vehicle is equipped with a vacuum gauge, start the engine and let it idle for at least one minute. Pump the brake pedal several times then allow the engine to idle for another minute. **If the gauge reads at least 18 inches of vacuum, omit Step 2.**

   Shut the engine off. If the vacuum does not drop more than one inch in one minute, omit Steps 3 through 8.

2. If the vehicle does not have a vacuum gauge, disconnect the engine vacuum line from the booster (vehicle with dash mounted booster) or from the dash mounted check valve (vehicle with frame mounted booster) and connect a vacuum gauge, Rotunda tool 78-0015 or equivalent to the vacuum line with a T-fitting. With the engine thoroughly warmed up, the gauge should read 18-21 inches at idle with the transmission in neutral. If the idle vacuum is not at least 18 inches, the engine requires a tune up.
3. With the engine properly tuned, connect the vacuum line back up.
4. Inspect the plastic check valve, rubber grommet, and all vacuum plumbing for cracks, holes, bad connections, or missing clamps that might cause leaks. Perform Step 2 of the Power Brake Function Test to determine if the problem has been corrected.
5. If the problem persists, and the vehicle has a frame mounted booster(s), disconnect the vacuum line and connect a vacuum gauge with a T-fitting to the lower part of the dash mounted plastic check valve. Start the engine and let it idle until the gauge reads 17 1/2-21 inches. Shut the engine off. If the vacuum drops more than one inch in one minute, replace the check valve (if the vehicle has a vacuum gauge in the instrument panel, it should be disconnected and the 1/4-inch gauge port on the valve should be sealed for this Step).
6. If the problem persists, reconnect the test gauge to the same point, leaving the rest of the vacuum system connected this time. Check the vacuum leak down rate as in Step 4. If the system does not pass the test, disconnect each component in turn (booster, reservoir, instrument panel gauge) and check the vacuum leak down rate holding a thumb over the open end of the line. Only one item should be disconnected at a time. When the system passes the leak down test, the item that is disconnected should be repaired or replaced.
7. If the vehicle is equipped with a dash mounted booster and a vacuum reservoir the test described above can be used by connecting the test gauge to the port of the plastic check valve closest to the booster.
8. If the vehicle is equipped with a dash mounted booster, but no reservoir, the plastic check valve should be replaced.
9. With the test gauge connected as in Step 5 or 6, with 17 1/2-21 inches of vacuum and the engine shut off, depress the brake pedal one time and release it after holding it down for a few seconds. If the vacuum drops to zero, a booster diaphram (control or power) is ruptured and the booster should be re-built or replaced.

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DIAGNOSIS GUIDES

The following guides can be used as an aid in diagnosing hydraulic brake systems.

CONDITION	POSSIBLE CAUSE	CORRECTION
• Brakes not working, excessive pedal travel, brake pedal feels spongy when fully applied.	• Low fluid level.	• Add fluid, bleed system, check for leaks.
	• Brakes out of adjustment.	• Adjust brakes.
	• Front wheel bearing out of adjustment.	• Adjust front wheel bearings.
	• Master cylinder or booster dash unit mounting loose.	• Torque nuts and bolts to specification.
	• Disc brake caliper attachment loose.	• Replace or tighten as required.
	• Worn or damaged self-adjusters.	• Remove drum and check lining for proper adjustment. Replace self-adjusters.
	• Glazed, worn, scored or damaged brake linings.	• Replace brake shoes and linings in sets.
	• Drums out of round or rotors with excessive runout.	• Refinish, or replace if wear exceeds limits.
	• Brake tubing improperly positioned.	• Check brake tubing for misposition near heat source. Hot fluid can boil and result in spongy pedal response.
• Excessive pedal travel or pedal goes to floor consistently.	• Low fluid level.	• Add fluid, bleed system, check for leaks.
	• Hydraulic system.	• Perform master cylinder diagnosis test. Refer to master cylinder diagnosis chart. Repair as required.
	• Drum brakes out of adjustment, worn, bad wear pattern, or cracked drums.	• Repair or replace as required.
	• Loose or improper attachment of pedal, pedal support booster and master cylinder.	• Repair or replace as required.
	• Misaligned anchor plate.	• Refer misaligned disc brake anchor plate diagnosis. Repair as required.
• Excessive pedal effort to fully apply brakes.	• Overloaded vehicle.	• Lighten load and advise owner of correct load limits of vehicle.
	• Insufficient vacuum to brake booster.	• Replace damaged or leaking vacuum hoses.
	• Restricted air filter on power brake booster.	• Clean or replace filter.
	• Booster and brake pedal linkage binding caused by worn bushings or corrosion.	• Replace worn bushings or clean and lubricate linkage.
	• Worn or damaged brake booster.	• Replace booster.
	• Brake lining worn, glazed, contaminated or improper type.	• Replace brake lining in axle sets.
	• Brake shoe and lining improperly installed.	• Reposition brake shoes properly and eliminate any binding.
	• Seized pistons in wheel cylinders or calipers.	• Repair or replace as required.
	• Restricted brake lines or hoses.	• Repair or replace as required.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• Brakes drag, slow or incomplete release.	• Parking brake control binding.	• Repair, lubricate, or replace parts as required.
• Parking brake cable out of adjustment or	• Repair, lubricate or replace parts as required. binding.	Adjust parking brake.
	• Brake pedal binding.	• Repair, lubricate, or replace parts as required.
• Front wheel bearing out of adjustment.	• Check bearings for adjustment, wear, damage	or bind. Lubricate and replace bearings if required. Adjust bearings.
	• Worn or damaged master cylinder.	• Check master cylinder for open compensator ports. Repair or replace.
	• Brakes out of adjustment.	• Adjust brakes.
	• Restriction in hydraulic system.	• Repair or replace as required.
	• Seized wheel cylinders or caliper pistons.	• Repair or replace as required.
	• Stoplight switch out of adjustment.	• Adjust switch.
• Noise at wheels when brakes are applied — snap or clicks.	• Cracked welds at brake shoe web.	• Replace brake shoe and lining assemblies in axle sets.
	• Brake shoes binding at backing plate ledges.	• Clean and lubricate ledges.
	• Machining marks on brake drums.	• Refinish, or replace brake drums.
	• Backing plate ledges worn.	• Replace backing plate and lubricate ledges.
	• On disc brakes — rust on front edge of inboard shoes.	• Inspect, lubricate, replace if necessary.
	• On disc brakes — loose or missing anti-rattle clips.	• Replace.
	• Other brake system components. — Loose outer shoe crimping. — Improper positioning, wear or damage of caliper support spring or retaining key.	• Inspect, repair or replace.
• Noise at wheels when brakes are applied — scrape or grind.	• Worn brake linings, loose rivets or foreign material between lining and drum or rotor.	• Replace brake shoes and lining in sets. Refinish brake drums or rotors if excessively scored.
	• Brake shoe interference with back of drum, or shield-to-rotor clearance also binding at backing plate guide ledges.	• Inspect. Replace as necessary. Lubricate.
	• Other brake system components. — Warped or bent brake backing plate causing interference with brake drum. — Cracked drums or rotors.	• Inspect and repair as necessary.
	• Tires rubbing against chassis or body.	• Inspect. Repair as necessary.
• Noise at wheels when brakes are applied — squeaks, squeals or chatter.	• Worn or scored brake drums and lining or rotors and pads.	• Inspect, repair or replace as required.
	• On disc brakes — missing or damaged brake pad insulators.	• Replace disc brake pads.
	• Burrs or rust on caliper that would obstruct seating of shoe to caliper.	• Clean or deburr caliper.
	• Dirty, greased or glazed linings.	• Clean or replace.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• Noise at wheels when brakes are applied — squeaks, squeals or chatter. (Continued)	• Improper lining parts. • Other brake system components. — Loose lining rivets. — Weak, damaged or incorrect shoe retracting springs. — Loose or damaged shoe retaining pins, springs and clips. — Grooved backing plate ledges.	• Inspect for correct usage. If necessary replace with correct type in axle sets. • Inspect, repair or replace as required.
• Noise at wheels, brakes not applied — squeak or squeal.	• Wheel covers improperly attached. • Loose wheel attaching lug nuts. • Worn, dry or improperly adjusted wheel bearings. • Glazed linings — adjustment too tight. • Other brake system components. — Stretched brake shoe retracting springs. — Backing plate guide ledges grooved. — Bent or warped backing plate causing interference with drum. — Improper positioning of disc brake in caliper. — Excessive run-out of disc brake rotor.	• Seat covers with a rubber mallet. Repair flanges or replace cover. • Tighten to proper torque. Replace wheel if stud holes are damaged. • Replace worn or damaged wheel bearings. Lubricate and adjust. • Remove glaze from linings. Adjust brakes properly. • Inspect, repair or replace as required.
• Noise at wheels, brakes not applied — growling, click or rattle.	• Stones or foreign material trapped inside wheel covers. • Loose wheel lug nuts. • Disc brake caliper assembly. — Loose or missing anti-rattle clips, or caliper support spring, or poor crimping on outer shoe. • Drum brakes loose or extra parts. • Worn, damaged or dry wheel bearings.	• Remove stones, etc. • Tighten to correct torque. Replace wheel if stud holes are elongated. • Inspect, repair or replace as required. • Inspect, remove or repair. • Inspect, lubricate or replace. Adjust bearings properly.
• Groan, roughness or chatter at wheel (brakes applied).	• Loose wheel lug nuts. • Worn, damaged, dry or improperly adjusted wheel bearings. • Loose or worn front suspension components. • Brake drum cracked or out of round. • Disc brake caliper backing plate and anchor plate loose, or missing parts — also loose or bent dust shield. • Excessive wear or lateral run-out of rotor. • Worn tires.	• Tighten to correct torque. Replace wheel if stud holes are elongated. • Inspect, lubricate or replace. • Inspect, repair or replace as required. • Replace drum if required. • Repair or replace as required. • Replace rotor. • Replace tires.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• Brakes pull to one side.	• Unequal air pressure in tires. • Grease or fluid on linings. Glazed linings. • Loose or missing disc brake caliper attaching bolts. • Improper size or type of lining on one wheel. • Improper size wheel cylinder on one wheel. • Stuck or seized pistons in wheel cylinders or calipers. • Restricted brake lines or hoses. • Other brake components. — Improper adjustment of drum brakes. — Improper positioning of disc brake shoe and lining in the caliper. — Improperly adjusted, damaged or worn wheel bearings. — Distorted drum brake shoes. — Worn brake linings. — Missing, broken or stretched retracting or retaining springs and clips. • Should brake system check OK and complaint still exists, see suspension, steering and tire section of this manual.	• Inflate tires to correct pressure. • Clean, sand and/or replace linings. • Replace missing bolts. Tighten to proper torque. • Replace with correct brake linings in sets. • Replace with correct wheel cylinder. • Repair or replace as required. • Repair or replace as required. • Inspect, adjust, repair or replace as required.
• Brakes grab or lock up when applied.	• Tires worn or incorrect pressure. • Grease or fluid on linings — damaged linings. • Improper size or type of linings. • Over-reaction of brake booster. • Rear brakes continually lock up at low pedal effort. • Other brake system components. — Loose or missing bolts for caliper attachment. — Worn, damaged or dry wheel bearings. • Parking brake cable binding or out of adjustment. • Parking brake cable control assembly binding.	• Inflate tires to correct pressure. Replace tires with worn tread. • Inspect, repair, or replace lining in sets. • Replace with correct brake linings in sets. • Check brake booster for over-reaction by comparing with a known quality vehicle. Replace brake booster if required. • Replace combination differential proportioning valve. • Inspect, repair, or replace as required. • Adjust cables. Repair, lubricate, or replace if required. • Repair, lubricate or replace if required.
• Brake warning light on.	• Low fluid level. • Shorted light circuit. • Worn or damaged brake warning switch. • Worn or damaged master cylinder. • Leak in brake system. • Worn or damaged pressure differential valve.	• Add fluid, bleed system and check for leaks. • Correct short in warning circuit. • Replace switch. • Perform master cylinder diagnosis test. Repair or replace as required. • Repair leak. • Replace valve.
• Parking brake will not hold.	• Parking brake cable out of adjustment. • Rear brakes out of adjustment. • Parking brake linkage, release lever, clevis and ratchet binding, worn or damaged.	• Adjust parking brake cable(s). • Adjust rear brakes. • Repair or replace linkage as required.

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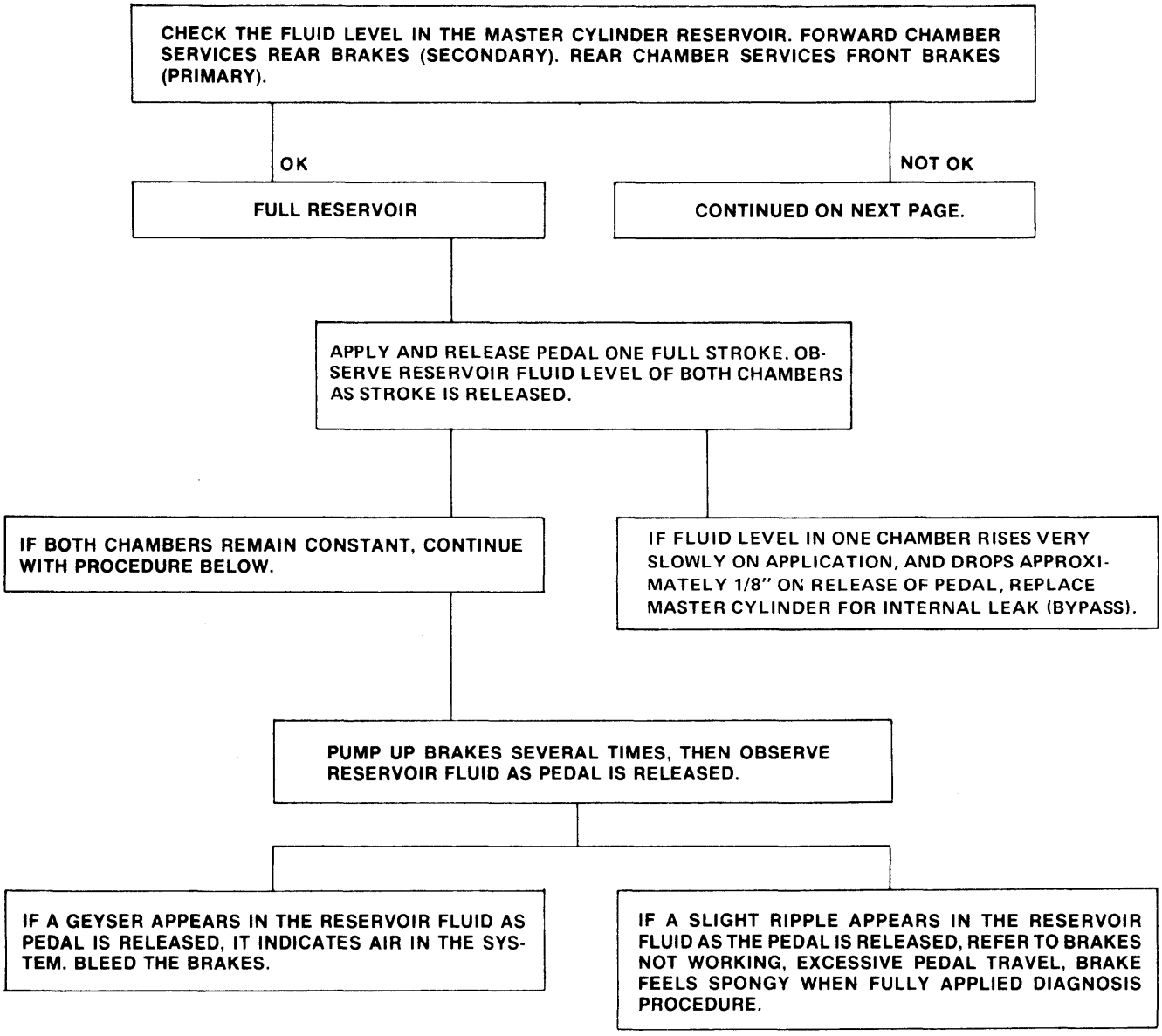
CONDITION	POSSIBLE CAUSE	CORRECTION
• Parking brake will not release or fully return.	• Manual release brake control components binding binding or damaged.	• Repair or replace manual parking brake control.
• Parking brake will not release or fully return. (Continued)	• Parking brake linkage and cables binding. • Worn or damaged rear brake components.	• Repair or replace as required. • Check rear brake shoe retracting springs and parking brake levers. Repair as required.
• Rough engine idle or stall — power brake only.	• Vacuum leak. • Worn or damaged vacuum booster.	• Check vacuum hoses and connections for leaks. Repair or replace as required. • Check vacuum booster for internal leaks. Replace if required.
• Intermittent loss of pedal.	• Hydraulic system. • Drum brakes out of adjustment, worn, bad wear pattern or cracked drums. • Loose or improper attachment of pedal, pedal support, booster and master cylinder. • Misaligned anchor plate.	• Perform master cylinder diagnosis. Repair as required. • Repair or replace as required. • Repair or replace as required. • Refer misaligned Disc Brake Anchor Plate diagnosis. Repair as required.
• Misaligned disc brake anchor plate.	• Worn or damaged anchor plate.	• Measure distance between outer disc brake shoe (not lining) and rotor at both upper and lower corners. The shoe must be seated flat against the caliper legs when checks are made. Replace the disc brake anchor plate on the affected side and shoe and lining assemblies on both front brakes.

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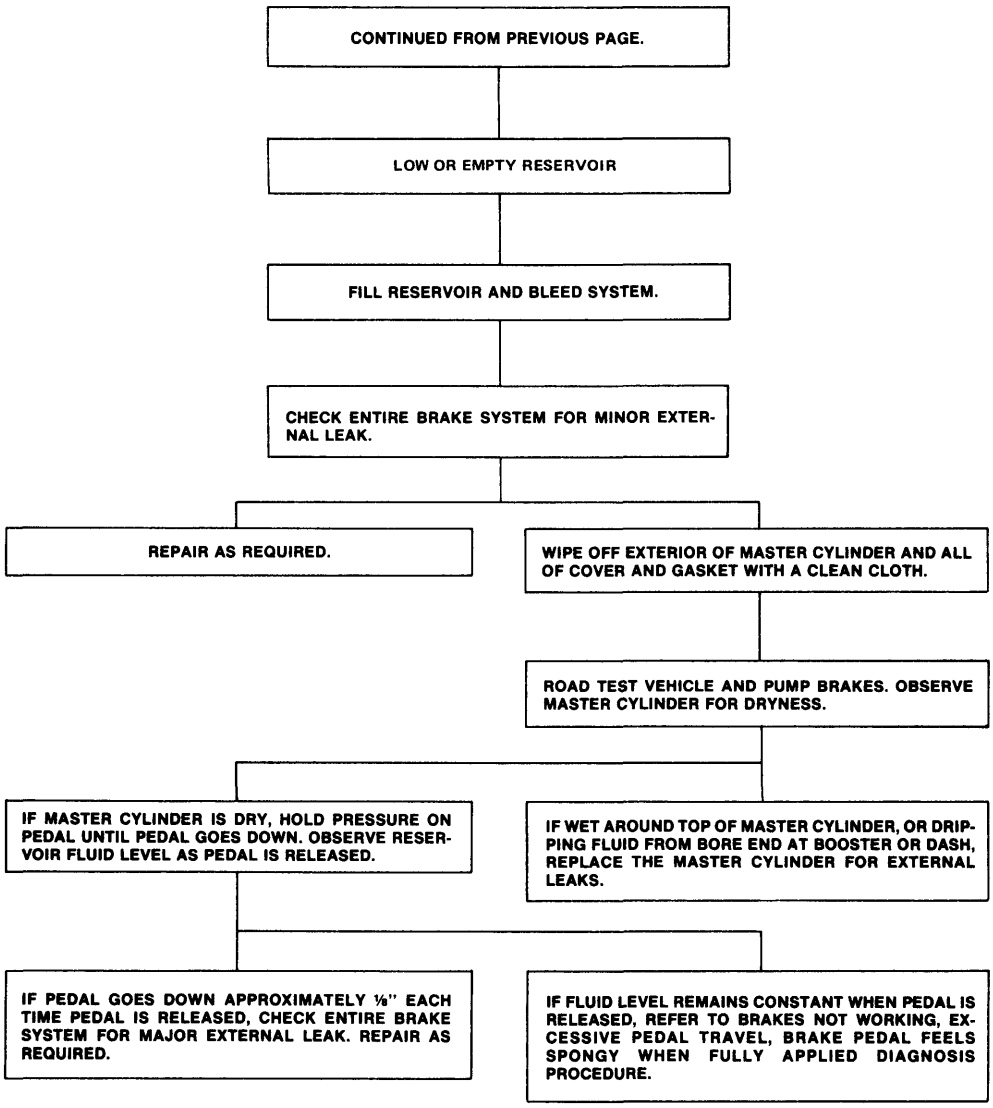
MASTER CYLINDER DIAGNOSIS



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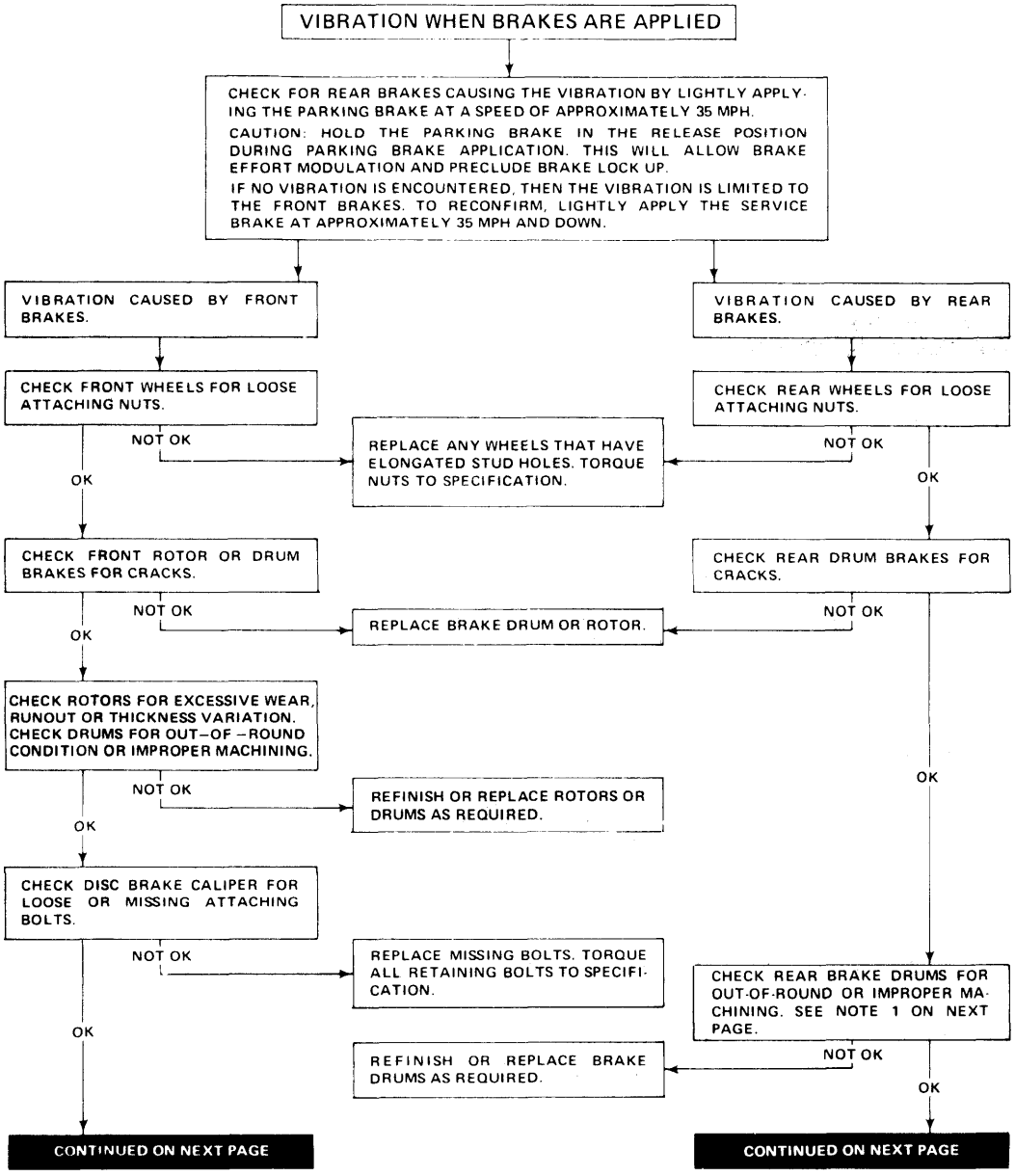
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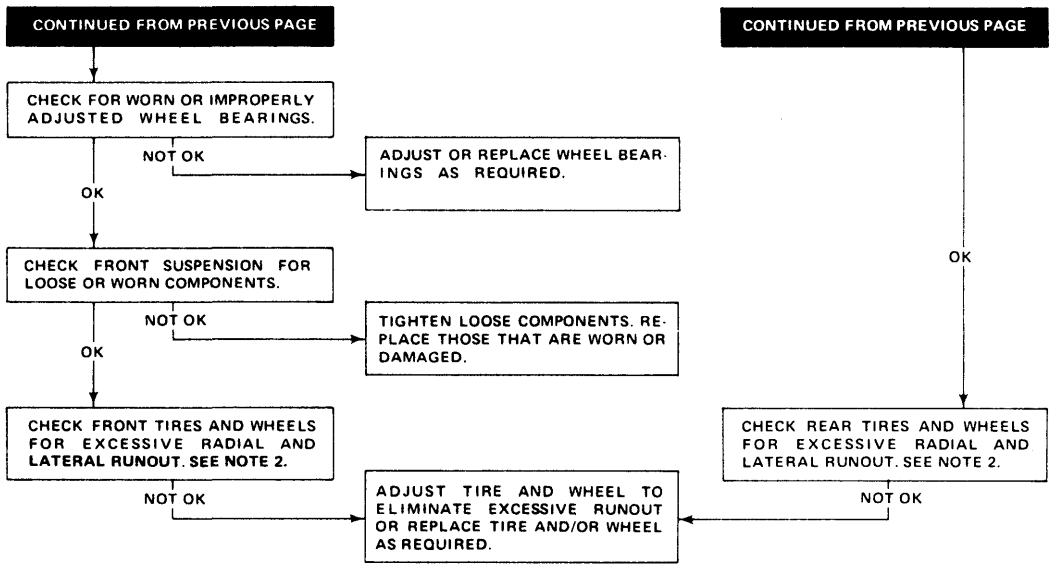
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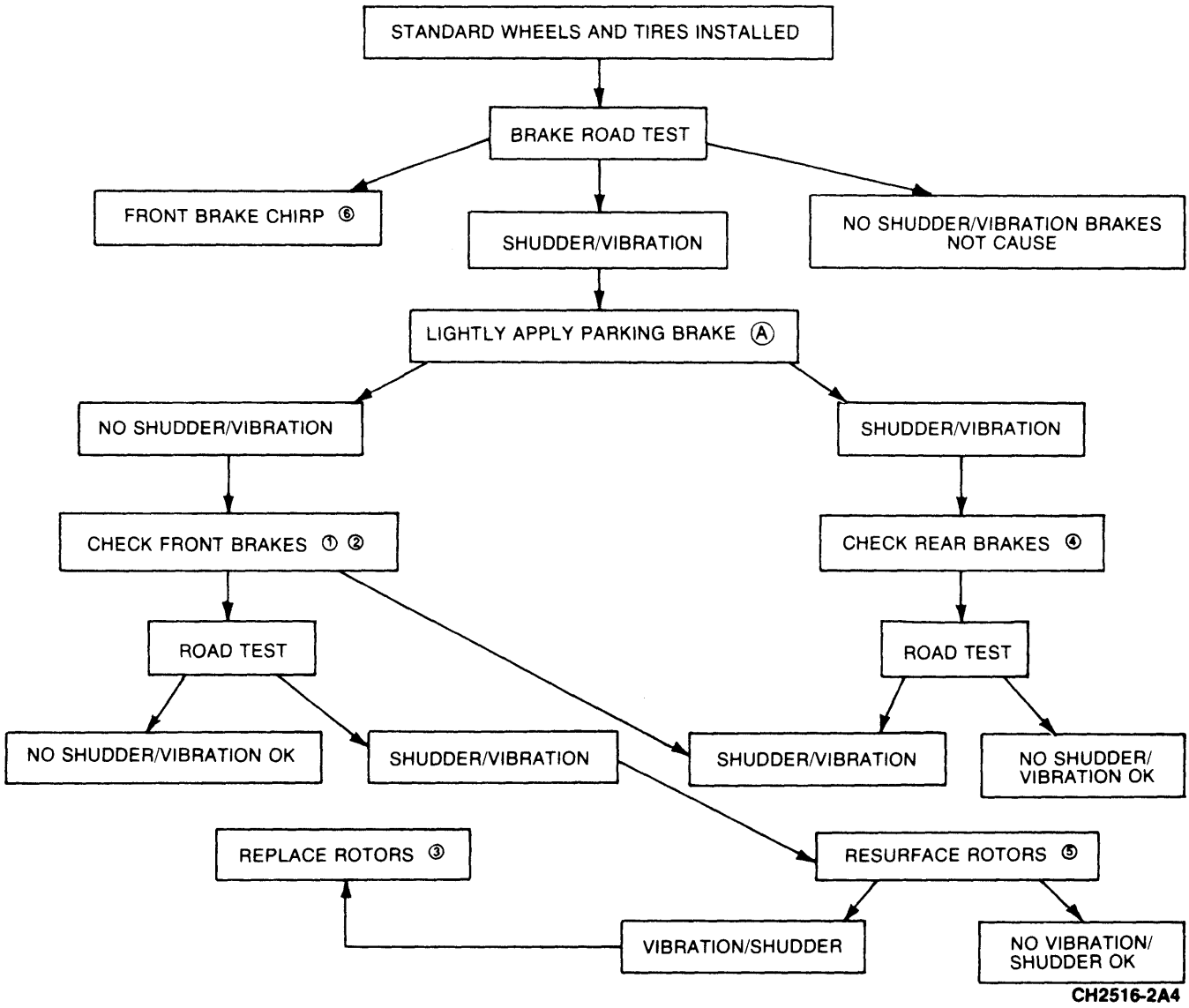
NOTE 1 – DRUM RUNOUT SPECIFICATION MEASURED 3/4 INCH IN FROM THE LIP EDGE.
11-INCH BRAKES – .007" TIR MAXIMUM
12-INCH BRAKES – .007" TIR MAXIMUM
NOTE 2 – TIRE AND WHEEL RUNOUT SERVICE SPECIFICATIONS.
RADIAL RUNOUT (INCHES) – TIRE: .070; WHEEL: .045
LATERAL RUNOUT – TIRE: .070; WHEEL: .045

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FRONT DISC BRAKE VIBRATION SHUDDER DIAGNOSIS CHART
E250/350 F250/350 DANA AXLE



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ADJUSTMENTS

BRAKE PEDAL ADJUSTMENT

On dual-brake master cylinder or dash mounted vacuum booster equipped vehicles, the brake systems are designed to permit a full stroke of the master cylinder when the brake pedal is fully depressed. A brake pedal clearance adjustment is not required.

To release the brakes, fluid must flow back to the master cylinder through a return port when pedal pressure is released. To be sure the piston moves back far enough to expose the return port, free-travel is built into the pedal linkage on standard and frame-mounted booster systems. This prevents the piston from becoming trapped in a partially released position. Pedal free travel is not always perceptible in dash-mounted booster systems, because the operating clearance for the piston is adjusted at the booster push-rod, rather than the pedal linkage. (Refer to Parts 12-50 and 12-52 for instructions on a dash-mounted booster push rod adjustment).

FRONT DISC BRAKES

F-100-350 (4X2), F-150-F-250 (4X4), BRONCO AND E-100-E-350

The front disc brake assembly is designed so that it is self-adjusting. Refer to Part 12-24.

BRAKE STOP LAMP SWITCH ADJUSTMENT

F-100—F-350, BRONCO

Stop lamp switch installation should be checked on vehicles with dragging or locking brakes. An improperly positioned switch may restrict the brake pedal from

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returning to its non-applied position and prevent the brake fluid from returning to the master cylinder reservoir and cause dragging or locked brakes.

Check switch installation for proper seating by pulling the brake pedal with no more than 25 lbs force, which will seat the switch properly and may relieve these conditions.

Be sure to insert the switch into the retainer on the brake pedal by pushing the switch rearward until it bottoms in the brake switch bracket, when installing a new switch. Then manually pull the brake pedal rearward against stop to set switch in proper position.

HYDRAULIC SYSTEM BLEEDING

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy pedal action. This requires the bleeding of the hydraulic system after it has been properly connected to be sure all air is expelled from the brake cylinders and lines. The hydraulic system can be bled manually or with pressure bleeding equipment such as Rotunda brake bleeder (model 10-0011) or equivalent.

Bleed one brake cylinder at a time. Start bleeding on the right rear brake, then the left rear. After completing, proceed to bleed the right front brake, then the left front. Keep the master cylinder reservoir filled with the specified Heavy Duty Brake Fluid, Ford Specification ESA-M6C25-A or equivalent, during the bleeding operation. **Never use brake fluid which has been drained from the hydraulic system.**

If the hydraulic system is equipped with a frame mounted vacuum booster, bleed the hydraulic section of the booster before bleeding the rest of the system. Bleed the system with the engine off and with no vacuum in the system. If the brake pedal is still spongy after the first bleeding, repeat the bleeding procedure.

To bleed the hydraulic section of brake line between the master cylinder and vacuum booster, follow Steps 1 through 4 of the Manual Bleeding Procedure below, attaching the drain tube to the bleeder screw at the end plate of the booster (or the bleeder screw nearest the power chamber). Repeat this procedure at the other bleeder screw, (if equipped).

On F-100-F-150, F-250 (up to 6800 G.V.W.) including all (4x4) vehicles and Bronco, E-100 and E-150 vehicles equipped with sliding caliper disc brakes, the bleeder rod of the metering valve (Fig. 5) must be pulled outward as shown in Fig. 8. On F-250 over 6800 G.V.W., F-350, E-250 and E-350 (Fig. 4) the bleeder rod must be pushed inward. This is to allow the brake fluid to reach the caliper assemblies. This operation is particularly important if pressure bleeding equipment is being used. The pressure differential valves are self-centering after a brake hydraulic system malfunction has been corrected and the hydraulic system has been bled.

MANUAL BLEEDING—DUAL-BRAKE SYSTEM HYDRAULIC MASTER CYLINDER

On trucks with frame mounted boosters, engine must be off and all vacuum depleted from the system prior to bleeding.

Bleed the primary and secondary hydraulic brake systems separately. Bleed the longest line first on each system. **DO NOT allow the reservoir to run dry during the bleeding operation. Keep the master cylinder reservoirs filled with the specified brake fluid. Never re-use the fluid that has been drained from the hydraulic system.**

1. Remove the brake warning light switch from the pressure differential, metering, and proportioning valve.
2. Loosen the fittings at the bottom of the master cylinder approximately one turn. **Do not use the secondary piston stop screw located on the bottom of the master cylinder to bleed the brake system. Loosening or removing this screw could damage the secondary piston or stop screw.**

   On a master cylinder without bleed screws, loosen the master cylinder-to-hydraulic line nut.
3. Wrap a shop cloth around the tubing below the fitting to absorb escaping brake fluid.
4. Push the brake pedal down slowly by hand to the floor of the cab. This will force air trapped in the master cylinder to escape at the fitting.
5. Hold the pedal down and tighten the fitting. Release the brake pedal. Do not release the brake pedal until the fitting is tightened or air will re-enter the master cylinder.
6. Repeat this procedure until air ceases to escape at the fitting and the brake pedal is firm.
7. Place a 3/8-inch box wrench on the bleeder fitting on the brake wheel cylinder. Attach a rubber drain tube to the bleeder fitting making sure the end of the tube fits snugly around the bleeder fitting.
8. Submerge the free end of the tube in a container partially filled with clean brake fluid. Loosen the bleeder fitting approximately three quarters of a turn.
9. Slowly push the brake pedal all the way down. Close the bleeder fitting, and return the pedal to the fully-released position. Repeat this operation until air bubbles no longer appear at the submerged end of the bleeder tube.
10. When the fluid is completely free of air bubbles, close the bleeder fitting and remove the bleeder tube.
11. Repeat this procedure at the brake wheel cylinder on the opposite side. Refill the master cylinder reservoir after each wheel cylinder is bled.

    When the bleeding operation is complete, fill the master cylinder to within 1/4 inch from the top of the reservoirs.
12. Centralize the pressure differential valve as described in this Part.
13. On trucks, install the brake warning light switch on the pressure differential metering and proportioning valve.

PRESSURE BLEEDING—DUAL BRAKE SYSTEM HYDRAULIC MASTER CYLINDER

Bleed the longest lines first. Be sure the bleeder tank contains enough specified brake fluid (Extra Heavy

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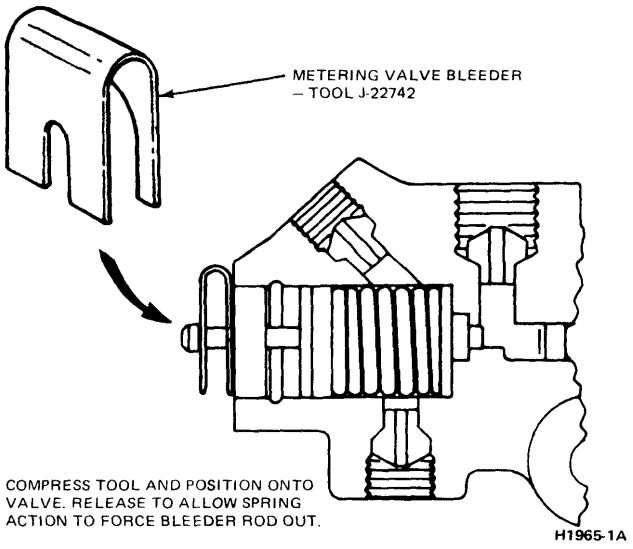


FIG. 8 Pressure Bleeding Tool—Sliding Caliper—Disc Brakes

Duty Ford Specification ESA-M6C25-A or equivalent) to complete the bleeding operation. Charge the tank with approximately 10 to 30 lbs. of air pressure. **Never exceed 50 lbs. of pressure. Never re-use brake fluid that has been drained from the hydraulic system.**

1. Remove the brake warning light switch from the pressure differential, metering, and proportioning valve.
2. Clean all dirt from the master cylinder reservoir cover.
3. Remove the master cylinder reservoir cover and rubber gasket, and fill the master cylinder reservoir with the specified brake fluid. Install the pressure bleeder adapter tool to the master cylinder, and attach the bleeder tank hose to the fitting on the adaptor.

   Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adaptor.
4. Place a 3/8-inch box wrench on the bleeder fitting on the right rear brake wheel cylinder. Attach a bleeder tube snugly around the bleeder fitting.
5. Open the valve on the bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.
6. Submerge the free end of the tube in a partially filled container with clean brake fluid and loosen the bleeder fitting.
7. When air bubbles no longer appear in the fluid at the submerged end of the bleeder tube, close the bleeder fitting and remove the tube.
8. When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose from the adaptor fitting.
9. **Remove the Pressure Bleeder Adapter Tool. Fill the master cylinder reservoirs to within 1/4 inch from the top. Install the master cylinder cover and gasket.**
10. Centralize the pressure differential, metering, and proportioning valve.
11. Install the brake warning lamp switch on the pressure differential, metering, and proportioning valve.

CENTRALIZING THE PRESSURE DIFFERENTIAL VALVE

After repairing and bleeding the primary (front brake) or secondary (rear brake) system, the dual-brake warning light will usually remain lit because the pressure differential metering and proportioning valve is in an off center position.

Centralize the pressure differential metering and proportioning valve as follows:

1. Turn the ignition switch to the ACC or ON position.
2. Make sure that the master cylinder reservoirs are filled to within 1/4 inch of the top with the specified brake fluid.
3. Push the brake pedal down, and the piston will center itself causing the brake warning light to go off.
4. Turn the ignition switch to the OFF position.
5. Before test-driving the vehicle, check brake operation and be sure the pedal is firm.

HYDRAULIC LINE REPAIR

Steel tubing is used in the hydraulic lines between the master cylinder and the front brake tube connector (Fig. 9), and between the rear brake tube connector (Fig. 10) and the rear brake cylinders. Flexible hoses connect the brake tube to the front brake cylinders and to the rear brake tube connector.

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After replacement, bleed the brake system at the wheel cylinders and at the booster, if equipped.

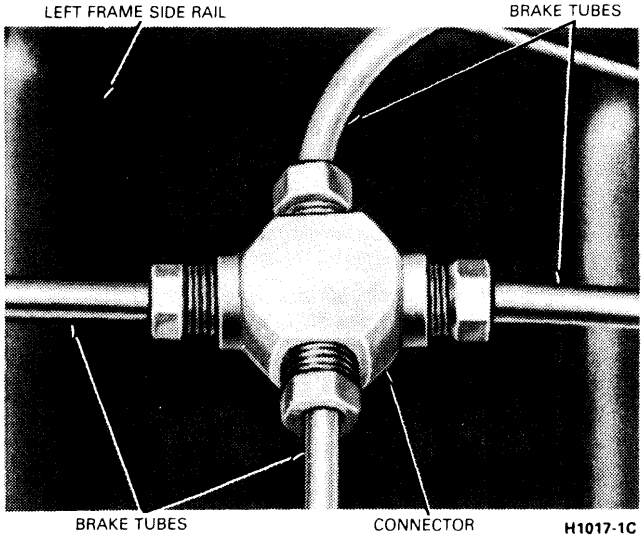


FIG. 9 Front Brake Tube Connector—Typical

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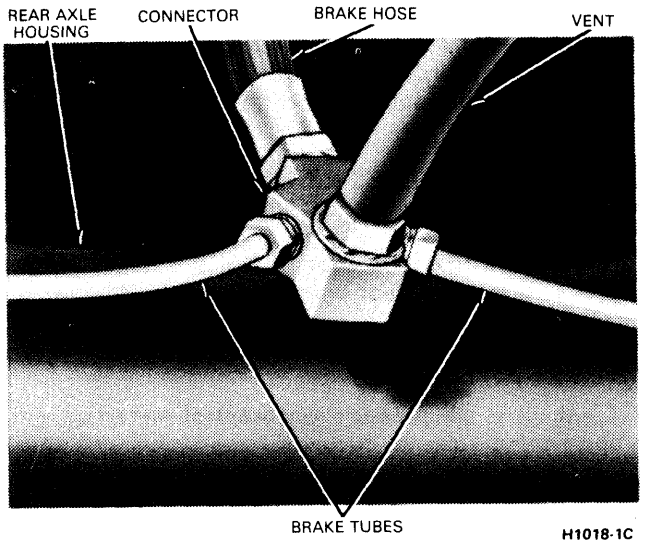


FIG. 10 Rear Brake Tube Connector

BRAKE TUBE

If a section of the brake tube is damaged, replace the entire section with tubing of the same type, size, shape, and length. **Copper tubing should not be used in the hydraulic system. Use only SAE J526 or J527 steel tubing, or equivalent. On 500 and up Series heavy vehicles, use only double wall, brazed steel tubing.** Be careful not to kink or crack the tubing when bending it to fit the frame or rear-axle forms.

Double flare brake tubing as described below should provide good leak-proof connections. Always clean the inside of a new brake tube with clean isopropyl alcohol.

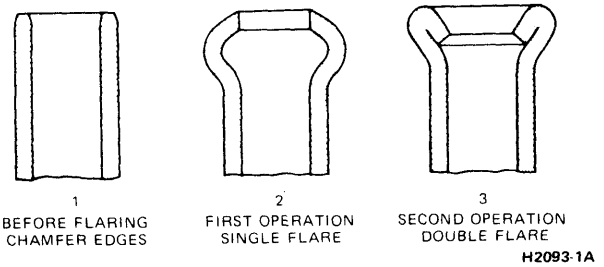


FIG. 11 Line Flaring Sequence

FLARING A LINE (SPLIT-DIE TYPE)

Refer to Figs. 11 and 12.

1. Cut off and straighten the required length of line (A tubing cutter tool will simplify making a clean and square cut).
2. Square off the ends of the line with a file, and chamfer the end of the line to be flared.
3. Select the split die for the line to be used and insert the die into the tapered hole in the body.
4. Push the tube through the die until the line is even with the face of the die. Lock the line in this position by tightening the wing nut securely.
5. The punches are marked Op. 1 and Op. 2. Slide the first operation punch into the hole in the center of the body and tighten the screw securely to form the single flare.
6. Release the screw and replace the first operation punch with the second punch and tighten the screw to form the double flare.
7. Release the screw, wing nut, punch, and dies.
8. Remove the line and inspect the flare for cracks or poor flare form. If the flare is not correct, cut it off and repeat the process.

   The finished flare must be square with the line, free of cracks and have a smooth mating surface to ensure a leakproof connection.

FLARING A LINE (FLARING-BAR TYPE)

Refer to Figs. 11 and 13.

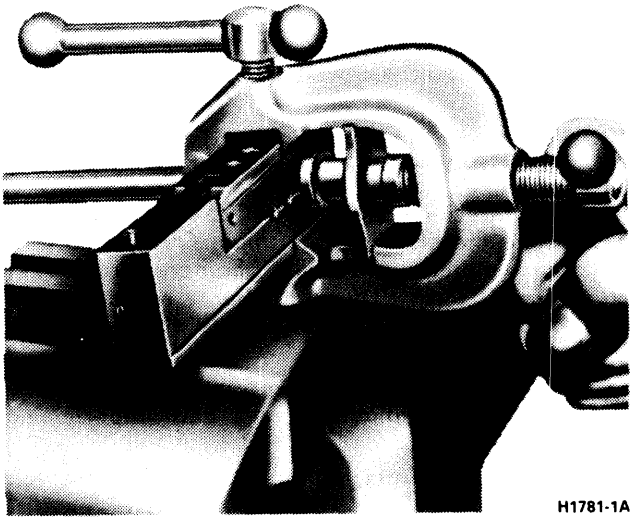


FIG. 12 Line Flaring (Split Die Type)

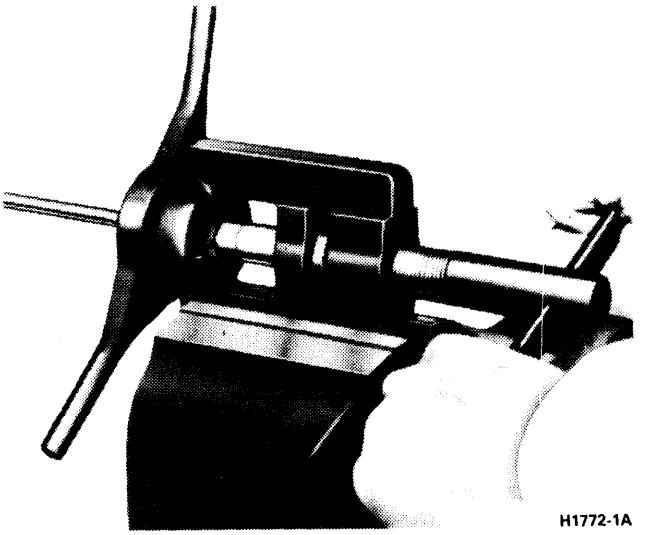


FIG. 13 Line Flaring (Flaring Bar Type)

1. Cut off and straighten the required length of line. (A tubing cutter tool will simplify making a clean and square cut).
2. Square off the ends of the line with a file, and chamfer the end of the line to be flared.
3. Insert the line through its appropriate ribbed hole in the bar assembly until the end of the line sticks

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out about as far as the thickness of the adapter above the bar, or even with the bar, depending on the tool used.

4. Fit the adapter onto the line and slide the bar into the yoke. Lock the bar in position with the line beneath the yoke screw.
5. Form the single flare by tightening the yoke screw securely.
6. Release the screw and remove the adaptor.
7. Form the double flare by tighening the yoke screw again, with second adaptor fitted, depending on the tool used.
8. Release the screw bar, and flared line. Inspect the flare for cracks or poor flare form, and repeat the process if the flare is not correct.
9. Repeat Steps 3 through 6 at the opposite wheel cylinder.

BRAKE HOSE

Replace a flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle parts.

OVERHAUL

Removal of dust and dirt from brake assemblies should be done by using the Rotunda brake vacuum (model 34-0009) or Rotunda brake parts washer (model 650016) or an equivalent. Brake assembly dust and dirt should **not** be removed by either blowing off with an air gun or vacuuming with a standard industrial vacuum cleaner because a health hazard from breathing in asbestos dust may develop. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment.

BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough, or out-of-round drum should be ground or turned on a drum lathe. (Refer to the lathe manufacturers instructions.) Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact. Brake drum maximum braking surface diameter is shown on each brake drum (Fig. 14). Brake drums which exceed the maximum braking surface diameter shown on the brake drum, either through wear or refinishing, must be replaced. The maximum braking surface diameter specification, which is shown on each brake drum (Fig. 14), allows for a 0.060 inch machining cut over the original nominal drum diameter plus 0.030 inch additional wear before reaching the drum-discard diameter.

FRONT DISC BRAKES

1. Remove the shoe and linings as described in Part 12-24.
2. Measure the thickness of the brake lining. If the lining thickness at any point on the assembly is less than 1/32 inch above the backing plate or rivets, or if the lining shows evidence of brake fluid or oil contamination that is causing a brake pull, replace all four shoe and lining assemblies.
3. To check rotor runout, first eliminate the wheel bearing end play by tightening the adjusting nut. Then check to be sure the rotor can still be rotated.
4. Clamp a dial indicator to the spindle so the stylus contacts the rotor approximately one inch from the outer edge. Rotate the rotor and take an indicator reading. If the reading exceeds 0.010-inch total lateral runout within a six inch radius on the indicator, replace or re-surface the disc brake rotor. **The following requirements must be met when re-surfacing disc brake rotors.**

   Use a disc brake lathe to re-finish the disc brake rotors. (Follow the manufacturers instructions.)

   No more than 0.020 inch of material may be machined equally off each surface (A and B, Fig. 15). If rotor thickness falls below the minimum shown on each rotor, it must be replaced.

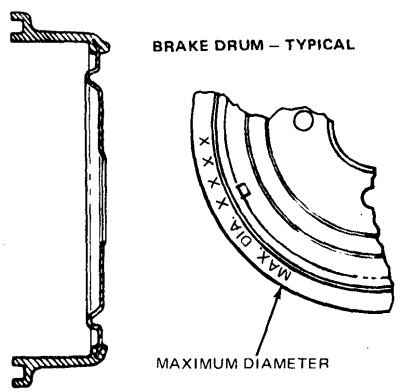


FIG. 14 Rear Brake Drum Maximum Inside Braking Surface Diameter Marking Location—E-100—E-350, Bronco, and F-100—F-350

The finished braking surfaces of the rotor must be flat and parallel within 0.001-inch; lateral runout must not exceed 0.003-inch total indicator reading, and the surface finish of the braking surfaces must be 16 to 80 micro inches.

When the runout check is finished, adjust the bearings as described in Part 11-10,to prevent bearing failure.

5. Check the rotor for scoring. Remove minor scores with a fine emery cloth. If the rotor is excessively scored, re-finish or replace the rotor if necessary.

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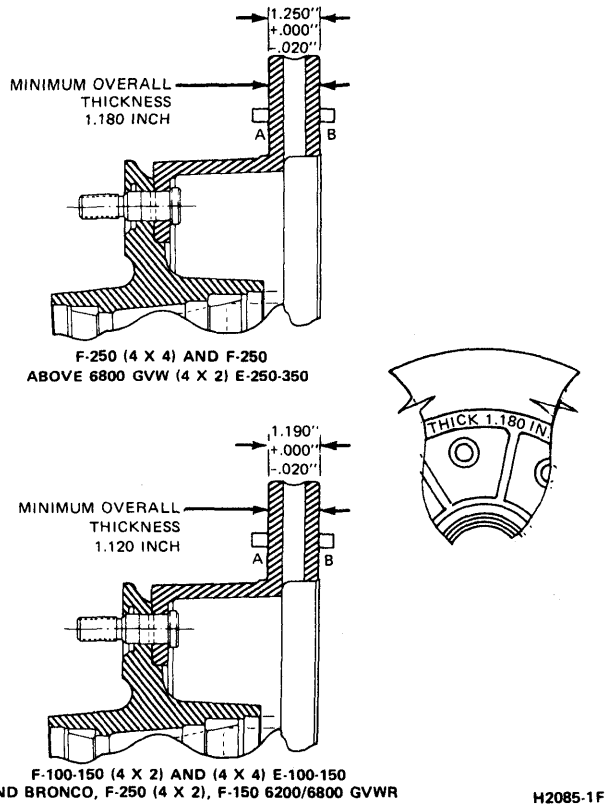


FIG. 15 Disc Brake Rotor Service Limits

6. Check the caliper. If it is cracked or shows any signs of leakage, replace it. If the caliper is leaking around the dust boot, remove and repair it.
7. Check brake hoses for signs of cracking, leaks or abrasion. Replace them, if necessary.

BRAKE CYLINDER

1. Clean all brake cylinder parts in clean isopropyl alcohol or use the Rotunda brake parts washer (model 650016) or equivalent. Inspect all parts for wear or damage. Check the cylinder bore for rust, scores, or other damage. Be sure the bleeder screw passage is clean and open. Replace all parts that are worn or damaged.
2. If dirt is found in any part of the hydraulic system, flush the entire system with clean isopropyl alcohol.

MASTER CYLINDER

1. Clean all master cylinder parts in clean isopropyl alcohol, or use the Rotunda brake parts washer (model 650016) or equivalent and inspect the parts for wear or damage. Replace them if required. **When a master cylinder repair kit is used, follow the instructions in the kit and install all of the parts provided.**
2. Make sure that all ports and vents in the master cylinder are open and free of foreign matter.
3. On a single brake system master cylinder, check the spring valve (riveted to the front end of the piston). If it is loose or has moved so the piston ports are open, replace the piston.
4. Inspect the cylinder walls for scores or rust. Remove scores and rust or obtain a smooth wall surface by honing the cylinder walls, but not more than 0.003 inch of material. Remove any burrs or loose metal from the honing operation, and clean the cylinder with clean isopropyl alcohol or use the Rotunda brake parts washer (model 650016) or equivalent.

BRAKE DRUMS AND LININGS

1. Remove all wheels and drums from the vehicle, and inspect the drums and brake shoe linings for wear or damage that would affect brake operation. **Do not let brake fluid, oil or grease touch the drum or linings.**
2. Re-line any brake shoe that is worn to within 1/32-inch of any rivet head, or when the lining is soaked with brake fluid, oil, or grease. **If a worn lining is not replaced, the brake drum may become severely damaged. Always replace the primary and secondary brake shoe lining assemblies on both front or both rear brake assemblies at the same time.**
3. Before relining a brake shoe, inspect the shoe for distortion, cracks, elongated rivet holes, or looseness between the rim and web. If any of these conditions are visible, replace the shoe. **Do not attempt to repair a damaged brake shoe.**
4. If the drum and linings are in good condition, install the wheel and drum. **The condition of the drums and linings of the opposite wheel will usually be about the same as the wheel that was removed.**
5. Fill the master cylinder reservoir with the specified brake fluid to within 1/4 inch of the top of the filler neck.
6. Be sure that the parking brake is fully released before making any brake adjustment.
7. On brake assemblies with an adjustable anchor pin, check the front brake anchor pin nut with a wrench. If the nut is loose, tighten it to 80 to 100 ft-lb.

SPECIFICATIONS

SPECIAL TOOLS

Number	Description
190001	Run-Out Gauge
350017	Run-Out Gauge
100011	Brake Bleeder
340009	Brake Vacuum
650016	Brake Parts Washer
780015	Vacuum Gauge

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Drum Brakes — Single Cylinder, Dual Piston

PART 12-02

APPLIES TO BRONCO, E-100 — E-350, F-100 — F-350 (4x2), F-150 — F-250 (4x4)

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DIAGNOSIS AND TESTING

Refer to Part 12-01, General Hydraulic Brake Service, for drum brake diagnosis and testing procedures.

ADJUSTMENTS

BRAKE SHOE ADJUSTMENT

SELF ADJUSTING BRAKES—F-100, F-350 (REAR ONLY), E-100-350 (REAR ONLY), BRONCO AND F-150-F250, (4 x 4)—MANUAL ADJUSTMENT

On Bronco F-100—F-350 (rear only) E-100-350, (rear only) and F-150—F-250 (4x4) rear only, the brake shoes are automatically adjusted when the vehicle is driven in reverse and the brakes applied several times sharply. Manual brake adjustment is required only after the brake shoes have been relined or replaced. Perform the manual adjustment with the drums removed, using the tool and the procedure described below. Refer to Figs. 1 thru 6 for typical brake system installations.

When adjusting the rear brake shoes, check the parking brake cables for proper adjustment. Make sure the equalizer operates freely.

1. Clean away all rust and dirt on the points where the shoes touch the backing plate.
2. Apply a small amount of Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent to the points where the shoes touch the backing plate. Be careful not to get the lubricant on the linings.
3. Use Rotunda Tool 11-001 or equivalent for F-100—F-250, E-100—E-350 and Bronco, 11-002 for

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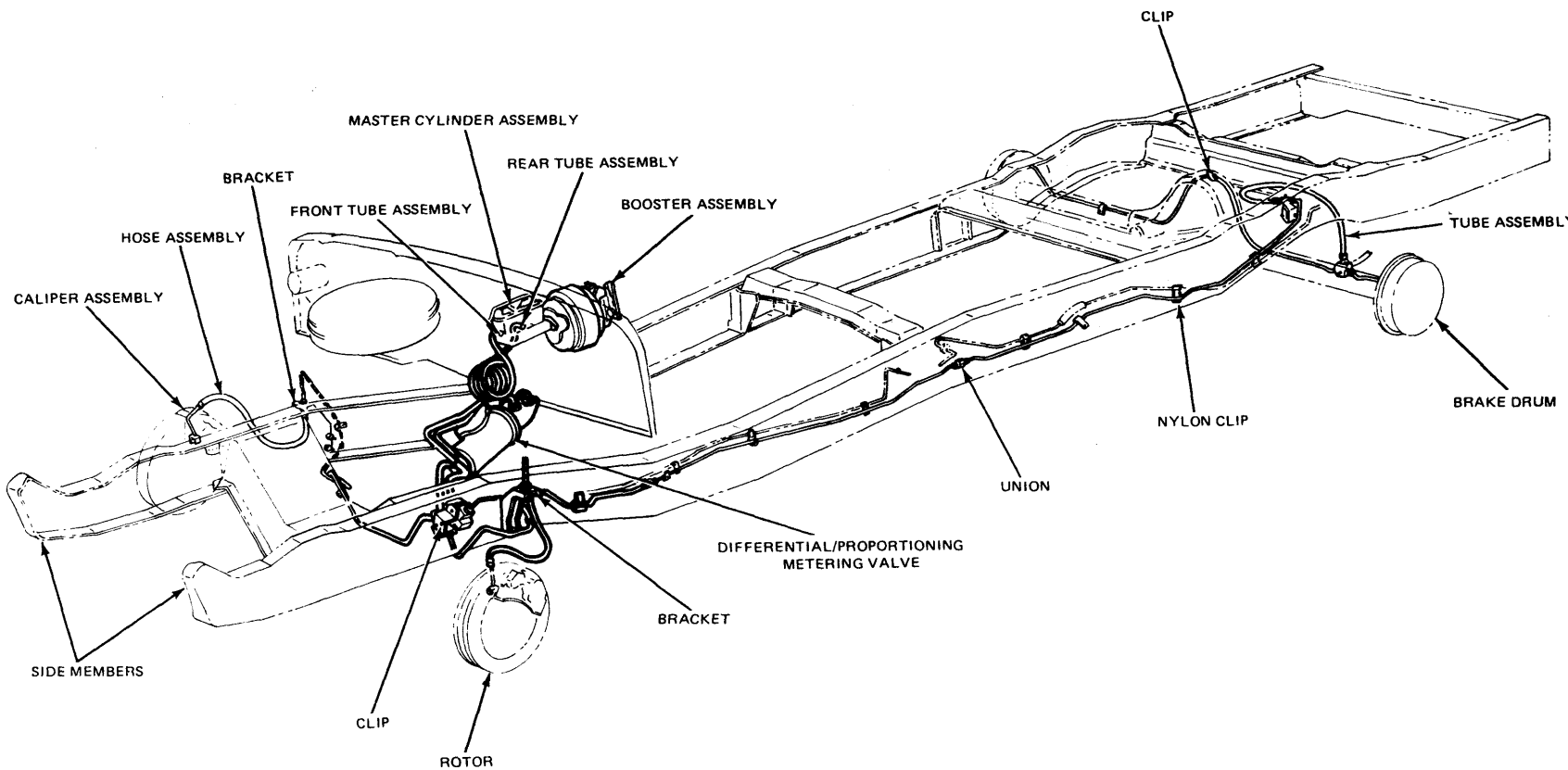


FIG. 1 F-100—F-350 (4 x 2)—Brake System

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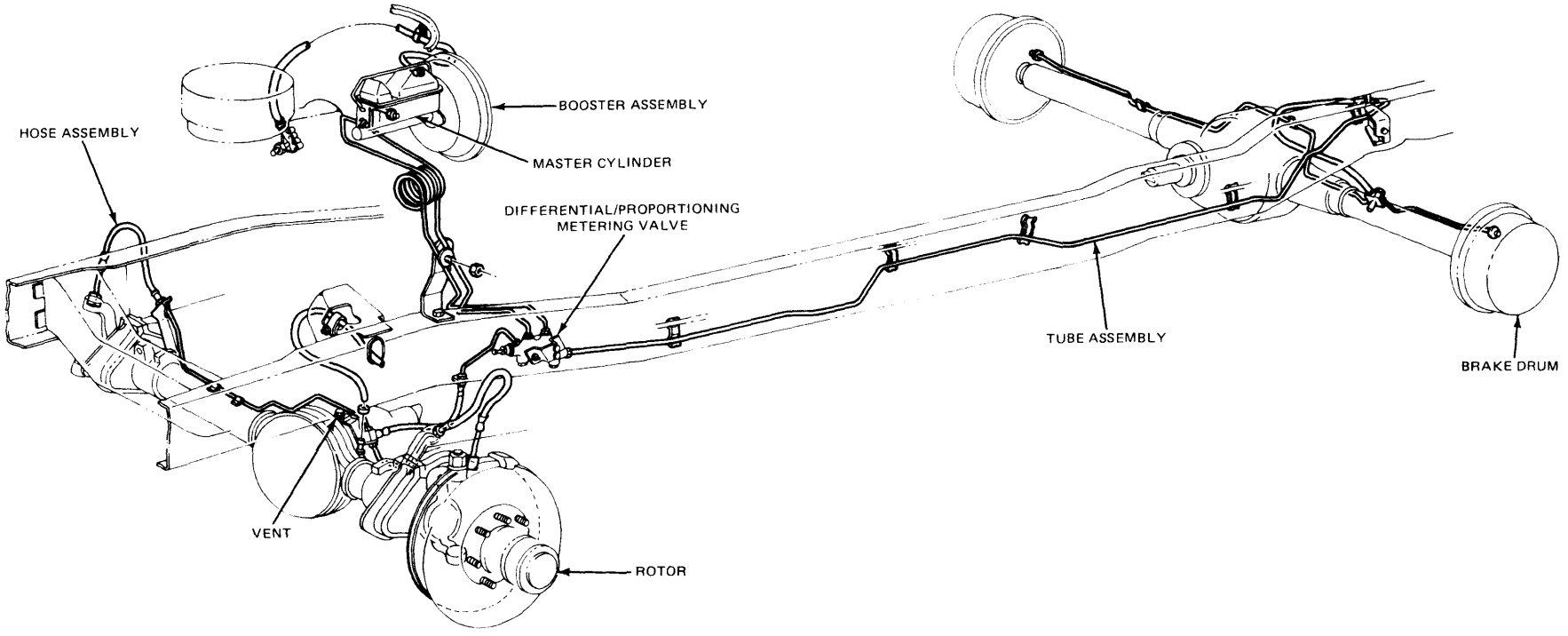


FIG. 2 Bronco—Brake System

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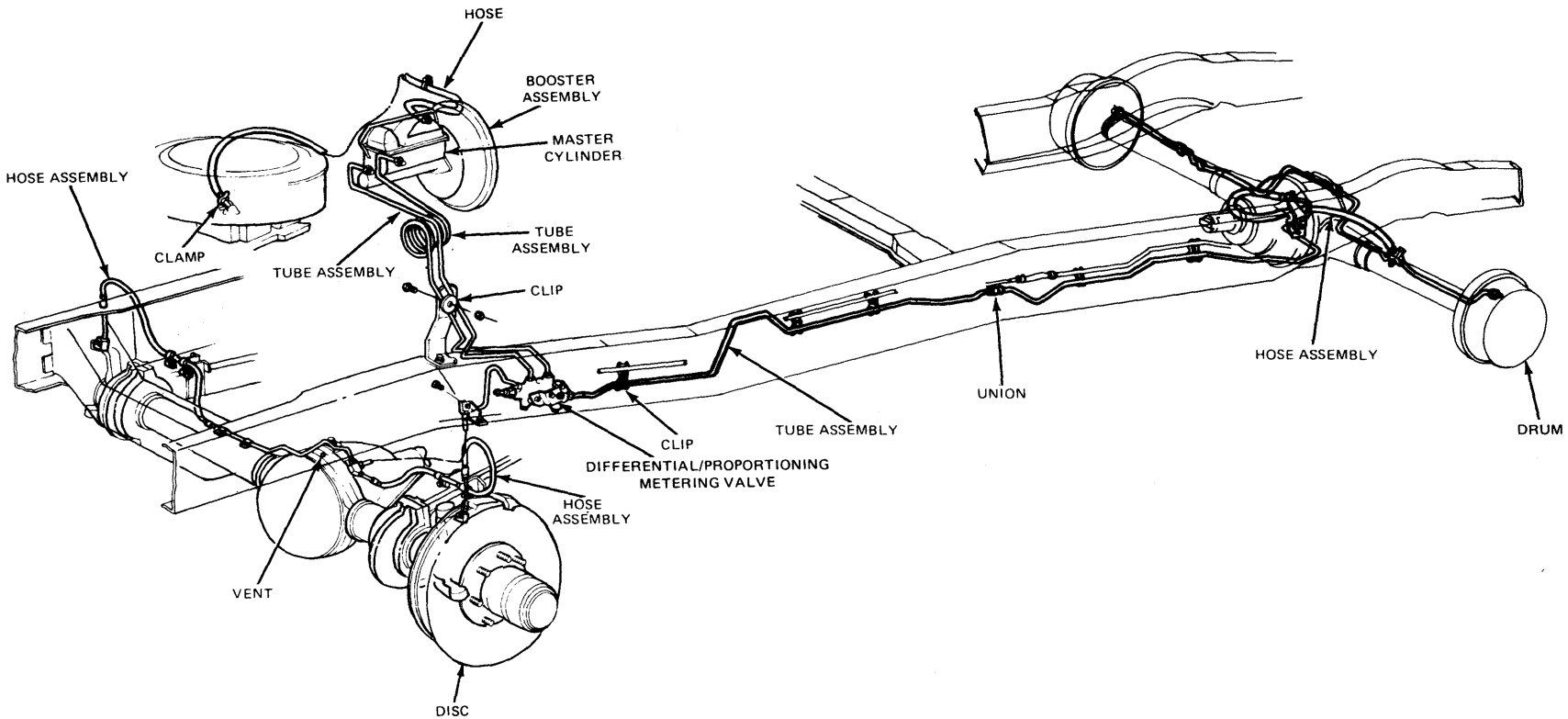


FIG. 3 F-150, (4 x 4)—Brake System

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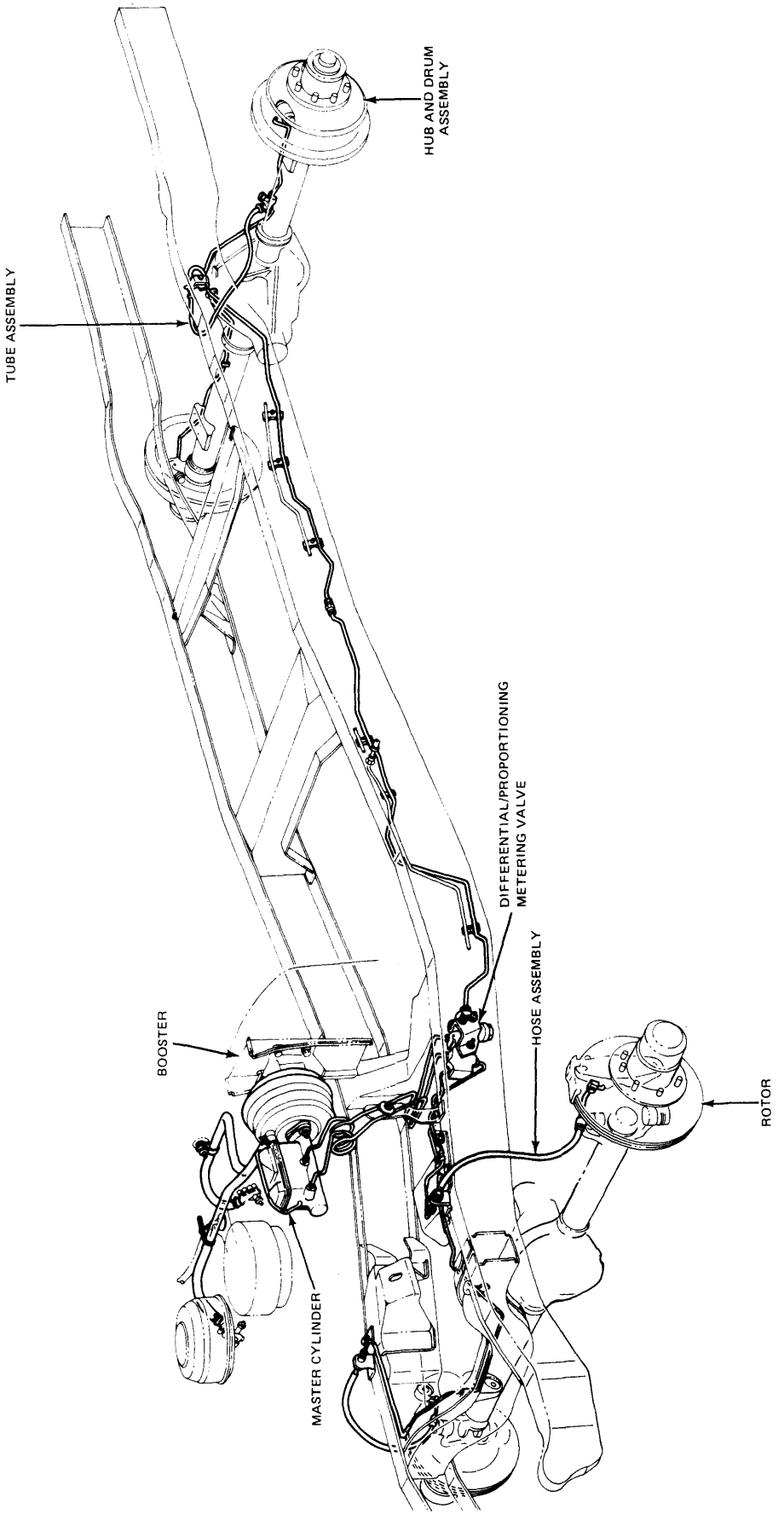
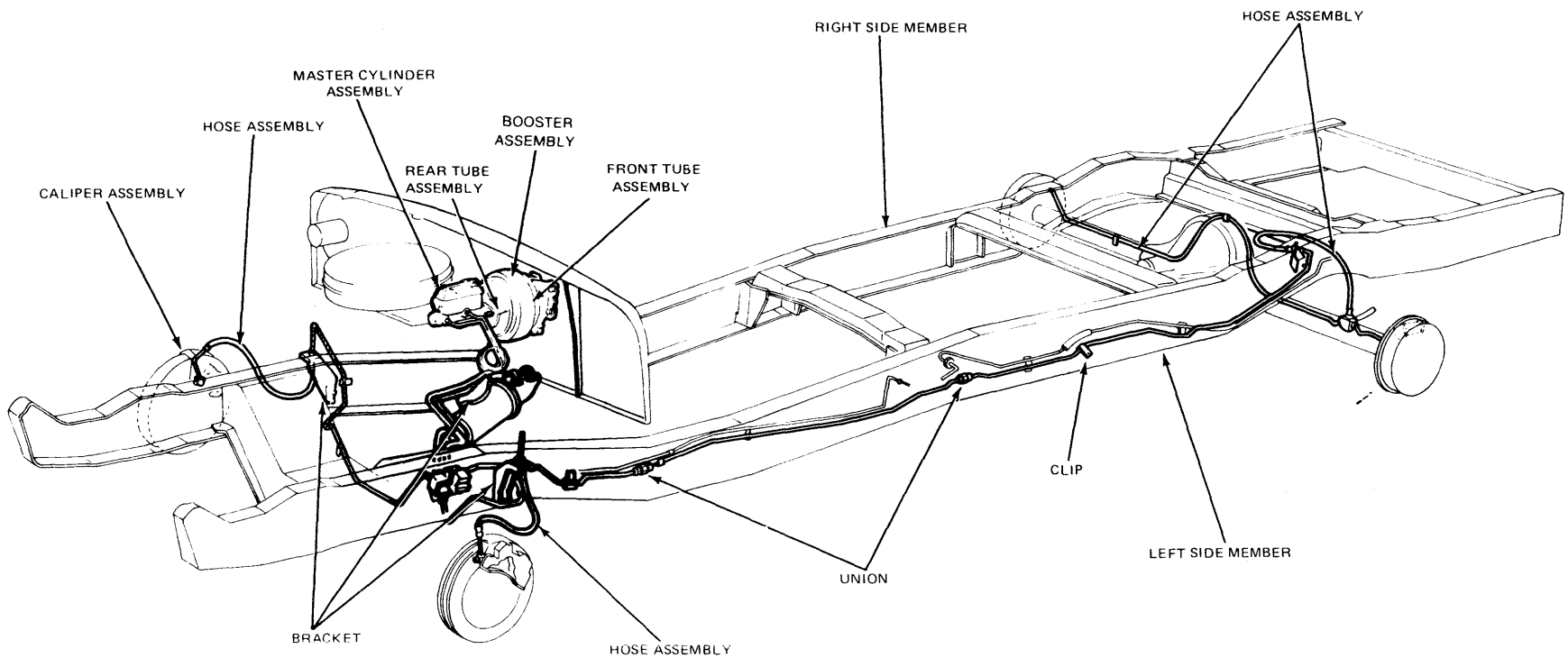


FIG. 4 F-250, (4 x 4)—Brake System

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E-100-F-100 – 4x2 DISC BRAKE SYSTEM

H2391-2E

FIG. 5 E-100 and F-100 With Manual Brakes—Brake System

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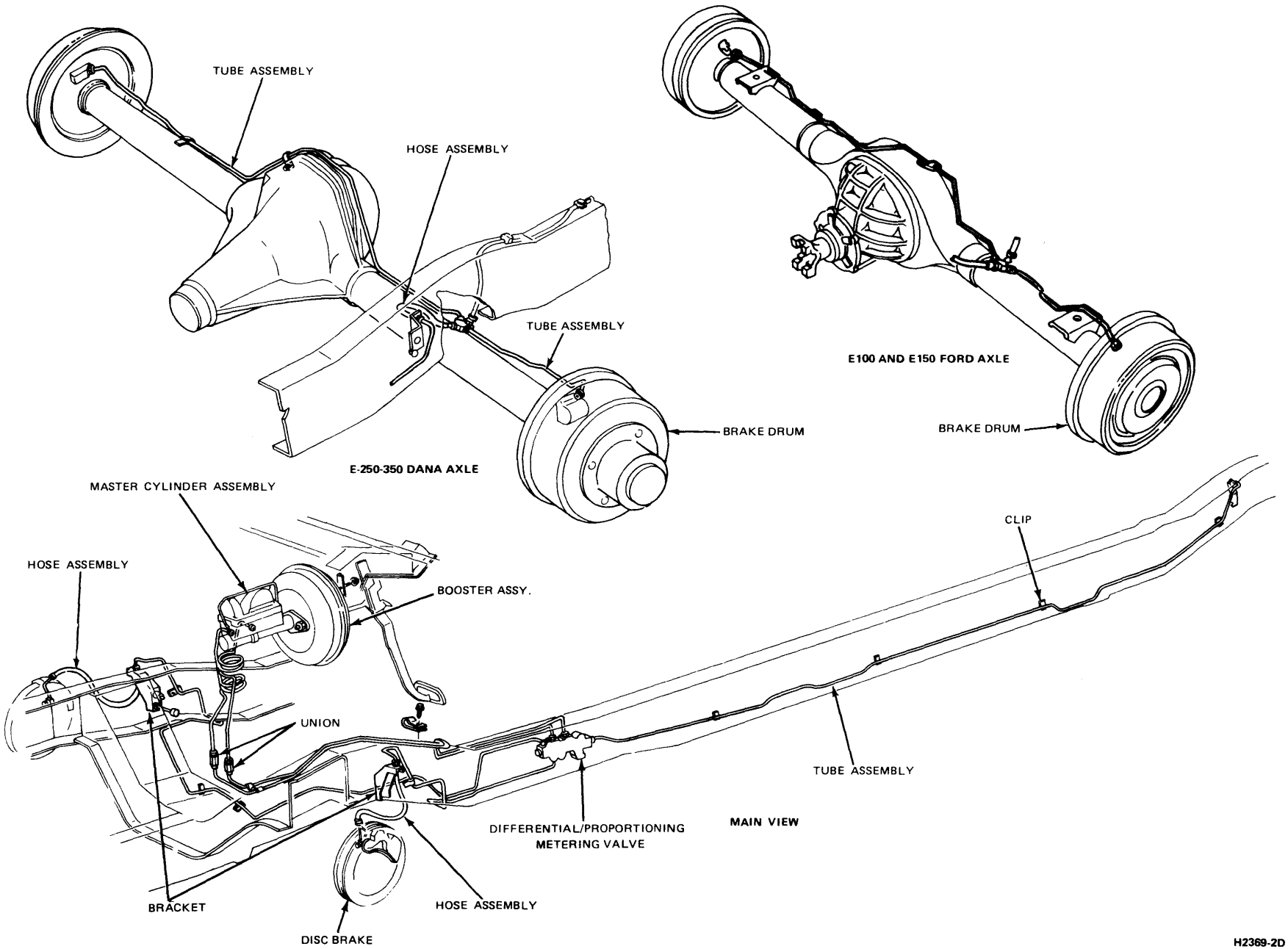


FIG. 6 E-100—E-350—Brake System

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trucks larger than F-250—F-350, E-250—E-350 (Fig. 7), and adjust to the inside diameter of the drum braking surface.

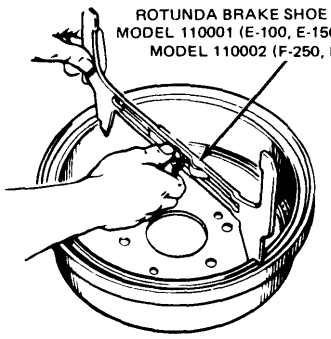


FIG. 7 Measuring Drum

4. Reverse the tool as shown in Fig. 8 and adjust the brake shoes until they touch the gauge. The gauge contact points on the shoes (Fig. 8) must be parallel to the vehicle with the center line through the center of the axle. Hold the automatic adjusting lever out of engagement while rotating the adjusting screw, to prevent burring the screw slots. Make sure the adjusting screw rotates freely. If necessary, lubricate the adjusting screw threads with a thin, uniform coating of Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent.

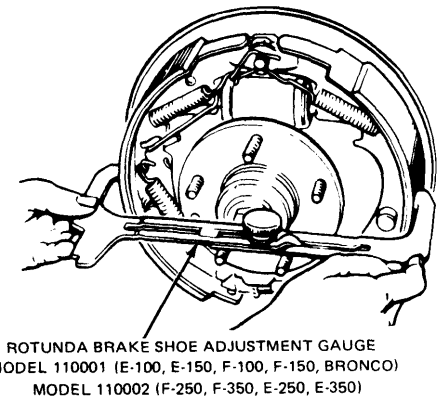


FIG. 8 Measuring Shoes

5. Install the drums. Install the retaining nuts and tighten securely.
6. Install the wheels on the drums and tighten the mounting nuts to specification.
7. Complete the adjustment by applying the brakes several times while driving the vehicle in reverse.
8. After adjusting the brake shoes, check brake operation by making several stops while driving forward.

REMOVAL AND INSTALLATION

REAR BRAKE DRUM

F-100, F-150, F-150 (4x4), E-100—150 AND BRONCO

WARNING: Under no circumstances should compressed air blow off be used to clean brakes, brake drums, clutches and associated components.

Removal

1. Raise the vehicle so the wheel is clear of the floor and install safety stands under the axle.
2. Remove the hub cap and wheel and tire assembly. Remove the three retaining nuts and remove the brake drum.

   If the brake drum will not come off, insert a narrow screwdriver through the brake adjusting hole in the backing plate, and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the adjusting screw, loosen the adjusting screw with the brake adjusting tool. **Loosen the adjusting screw only if the drum cannot be removed. Do not burr, chip, or damage the notches in the adjusting screw or the self adjusting mechanism will not function properly.**

   If the adjusting screw was loosened, check to be sure the adjusting lever is still properly seated in the shoe web.

Installation

1. Remove the protective coating from a new drum with carburetor degreaser.
2. Adjust the brakes as described in this Part.
3. Install the drum.
4. Install the brake drum retaining nuts and tighten securely. Install the wheel on the axle shaft flange studs against the drum, and tighten the retaining nuts to specification.

F-250—F-350, E-250—E-350

WARNING: Under no circumstances should compressed air blow off be used to clean brakes, brake drums, clutches, and associated components.

Removal

1. Raise the vehicle and install safety stands under the rear axle.
2. Remove the wheel and tire as an assembly. Loosen the rear brake shoe adjustment screw.
3. Remove the rear axle retaining bolts and lockwashers, axle shaft, and gasket.
4. Remove the wheel bearing locknut, lockwasher, and adjusting nut.
5. Remove the hub and drum from the axle.

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6. Remove the brake drum-to-hub retaining screws, bolts, or bolts and nuts. Remove the brake drum from the hub.
7. Check the drum for damage or wear, repair or replace as necessary. If a new drum will be installed, remove the wheel studs and the brake drum from the hub.

Installation

1. If a new drum is installed, remove the protective coating with carburetor degreaser.

   Install new grease retainer seals whenever a wheel and hub is removed, as described in Part 15-10.
2. Place the brake drum on the hub and install the attaching screws, or wheel studs.
3. Check the brake surface drum run-out. If the runout exceeds .007 inch, the hub and drum assembly should be turned.
4. Place the hub and drum as an assembly on the axle and start the adjusting nut.
5. Adjust the wheel bearing nut and install the wheel bearing lock washer and locknut as described in Part 11-11.
6. Install a **new** gasket and install bolts and lockwashers.
7. Install the wheel and tire as an assembly. Tighten wheel nuts to specification.
8. Adjust the brake shoes. Remove the safety stands and lower the vehicle.

BRAKE SHOE AND ADJUSTING SCREW

F-100—F-150 E-100—E-150 AND BRONCO

Removal

1. Remove the wheel and drum and install a clamp over the ends of the brake cylinder as shown in Fig. 9.
2. Contract the shoes as follows:
   a. Disengage the adjusting lever from the adjusting screw by pulling backward on the adjusting lever cable (Fig. 10).
   b. Move the outboard side of the adjusting screw upward and back off the pivot nut as far as it will go.
3. Pull the adjusting lever, cable and automatic adjuster spring down and toward the rear to unhook the pivot hook from the large hole in the secondary shoe web. **Do not pry the pivot hook out of the hole.**
4. Remove the automatic adjuster spring and adjusting lever.
5. Remove the secondary shoe- to-anchor spring using Tool 2035-W (Fig. 9). Using the same tool, remove the primary shoe-to-anchor spring and unhook the cable anchor. Remove the anchor pin plate (if equipped).
6. Remove the cable guide from the secondary shoe (Fig. 10).
7. Remove the shoe hold-down springs, shoes, adjusting screw, pivot nut, and socket. **Note the color and position of each hold-down spring.**

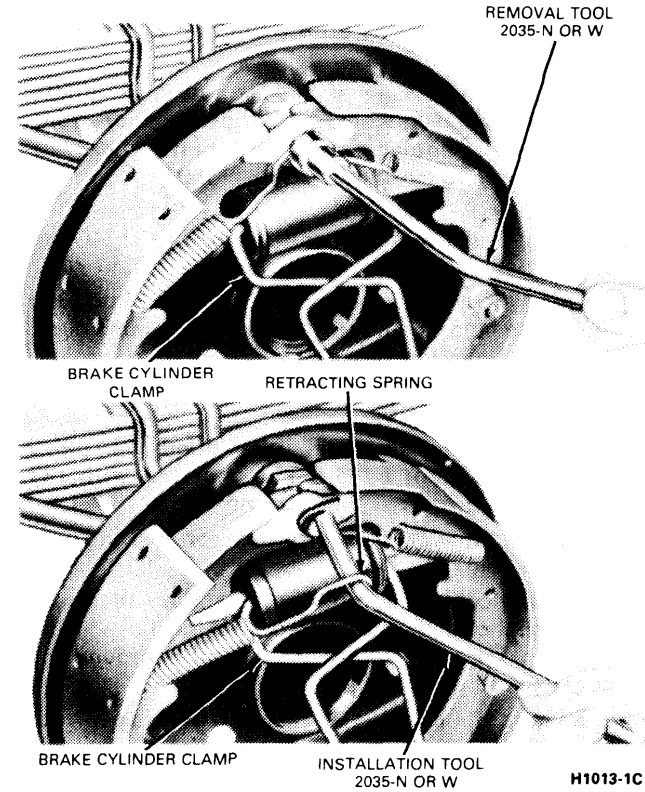


FIG. 9 Spring Replacement—Typical

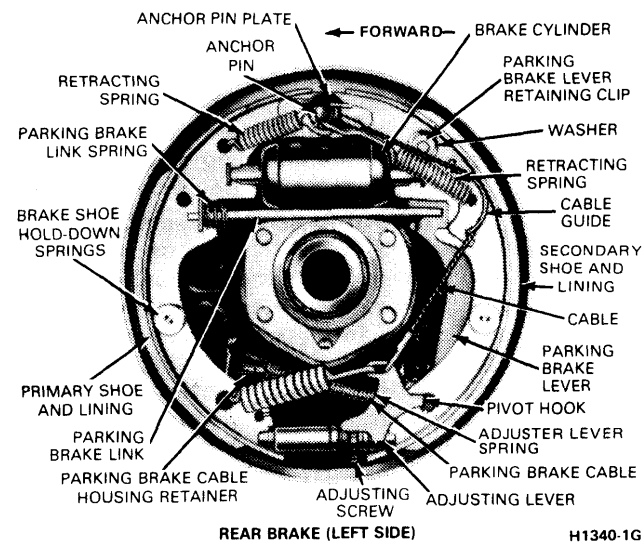


FIG. 10 Self Adjusting Brake Assemblies Standard—F100—F-150 and E-100—E-150 Rear and Bronco

They must be re-assembled in the same position.

8. Remove the parking brake link and spring. Disconnect the parking brake cable from the parking brake lever.
9. Remove the brake secondary shoe and disassemble the parking brake lever from the shoe by removing the retaining clip and spring washer (Fig. 10).

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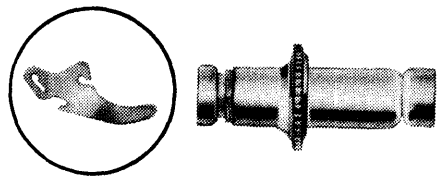
Installation

1. Clean the ledge pads on the backing plate. Sand lightly to bare metal.
2. Apply a light coating of high temperature grease Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent at the points where the brake shoes touch the backing plate.
3. Before installing the rear brake shoes, assemble the parking brake lever on the secondary shoe and secure with the spring washer and retaining clip.
4. Position the brake shoes on the backing plate, and install the hold-down spring pins, springs, and cups. Install the parking brake link, spring, and washer. Connect the parking brake cable to the parking brake lever (Fig. 10).
5. Install the anchor pin plate, (if equipped), and place the cable anchor over the anchor pin with the crimped side toward the backing plate.
6. Install the primary shoe-to-anchor spring using Tool 2035-W (Fig. 9).
7. Install the cable guide on the secondary shoe web with the flanged holes fitted into the hole in the secondary shoe web. Thread the cable around the cable guide groove (Fig. 10).

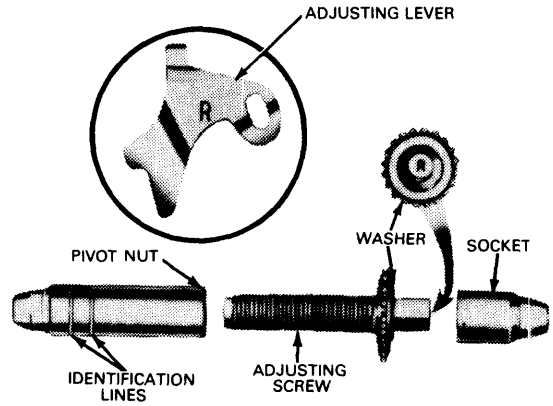
   Be sure the cable is positioned in this groove, and not between the guide and the shoe web.
8. Install the secondary shoe-to-anchor (long) spring (Fig. 10).

   Be sure the cable end is not cocked or binding on the anchor pin when installed. All parts should be flat on the anchor pin. Remove the brake cylinder clamp.
9. Apply Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent, to the threads and the socket end of the adjusting screw. Turn the adjusting screw into the adjusting pivot nut to the end of the threads and then loosen it one-half turn.

   Install the adjusting screw assembly in the same location from which it was removed. Interchanging the brake shoe adjusting screw assemblies from one side of the vehicle to the other will cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism is operated. To prevent incorrect installation, the socket end of each adjusting screw is stamped with R or L (Fig. 11) to indicate their installation on the right or left side of the vehicle. The adjusting pivot nuts can be distinguished by the number of lines machined around the body of the nut. Two lines indicate a right hand nut; one line indicates a left hand nut.
10. Place the adjusting socket on the screw and install the assembly between the shoe ends with the adjusting screw nearest the secondary shoe.
11. Hook the cable hook into the hole in the adjusting lever from the outboard plate side. The adjusting levers are also stamped with an R or L to indicate their installation on the right or left hand brake assembly (Fig. 11).
12. Place the hooked end of the adjuster spring in the large hole in the primary shoe web, and connect the loop end of the spring to the adjuster lever hole.



E-250-350 REAR; F-250 4x2 AND 4x4, F-350



F-100-150, E-100-150, F-150 (4x4), BRONCO REAR

H1621-1G

FIG. 11 Adjusting Screw and Lever Bronco, E and F Series-100-350 Rear

13. Pull the adjuster lever, cable and automatic adjuster spring down toward the rear to engage the pivot hook in the large hole in the secondary shoe web (Fig. 10).
14. After installation, check the action of the adjuster by pulling the section of the cable between the cable guide and the adjusting lever toward the secondary shoe web far enough to lift the lever past a tooth on the adjusting screw wheel. The lever should snap into position behind the next tooth, and releasing the cable should cause the adjuster spring to return the lever to its original position. This return action of the lever will turn the adjusting screw one tooth.

    If pulling the cable does not produce the action described, or if lever action is sluggish instead of positive and sharp, check the position of the lever on the adjusting screw toothed wheel. With the brake in a vertical position (anchor at the top), the lever should contact the adjusting wheel one tooth above the center line of the adjusting screw. If the contact point is below this center line, the lever will not lock on the teeth in the adjusting screw wheel, and the screw will not be turned as the lever is actuated by the cable.

    To find the cause of this condition:

    a. Check the cable end fittings. The cable should completely fill or extend slightly beyond the crimped section of the fittings. If this does not happen, the cable assembly may be damaged, and should be replaced.

    b. Check the cable guide for damage. The cable groove should be parallel to the shoe web, and the

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body of the guide should lie flat against the web. Replace the guide if it shows damage.

c. Check the pivot hook on the lever. The hook surfaces should be square with the body on the lever for proper pivoting. Repair the hook or replace the lever if the hook shows damage.

d. Be sure the adjusting screw socket is properly seated in the notch in the shoe web.

WEB LEDGE DESIGN-REAR—E-250-E-350, F-250 (4x2) AND (4x4), F-350

Removal

1. Raise the vehicle so the wheels clear the floor and install safety stands under the axle.
2. Remove the wheel and drum. If the drum does not clear the brake shoes, retract the brake shoes as shown in Fig. 3.

   Remove the parking brake lever assembly retaining nut from behind the backing plate and remove the parking brake lever assembly (Fig. 12).

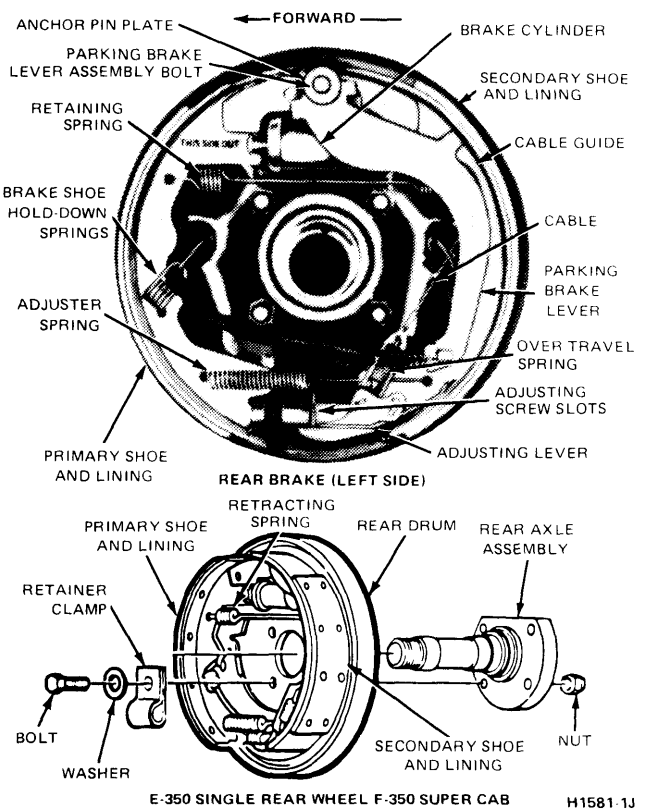


FIG. 12 Self Adjusting Brake Assemblies-Heavy Duty—E-250—E-350, F-250—F-350

3. Remove the adjusting cable assembly from the anchor pin, cable guide, and adjusting lever.
4. Remove the brake shoe retracting springs.
5. Remove the brake shoe hold-down spring from each shoe.
6. Remove the brake shoes and adjusting screw assembly.
7. Disassemble the adjusting screw assembly.

Installation

1. Clean the ledge pads on the backing plate. Sand lightly to bare metal.
2. Apply Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent. to the retracting and hold-down spring contacts on the brake shoes and backing plate.
3. Apply Multi-Purpose Lubricant, Ford Specification ESA-M1C75-B or equivalent, to the threads and socket end of the adjusting screw.
4. Install the upper retracting spring on the primary and secondary shoes as shown in Fig. 12, and position the shoe assembly on the backing plate with the wheel cylinder push rods in the shoe slots.
5. Install the brake shoe hold-down springs (Fig. 13).
6. Install the brake shoe adjustment screw assembly with the slot in the head of the adjusting screw toward the primary shoe, lower retracting spring, adjusting lever spring, adjusting lever assembly, and connect the adjusting cable to the adjusting lever. Position the cable in the cable guide and install the cable anchor fitting on the anchor pin.

   Install the adjusting screw assemblies in the same locations from which they were removed. Interchanging the brake shoe adjusting screw assemblies from one side of the vehicle to the other will cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism is operated. To prevent incorrect installation, the socket end of each adjusting screw is stamped with an R or L (Fig. 11) to indicate their installation on the right or left side of the vehicle. The adjusting pivot nuts can be distinguished by the number of lines machined around the body of the nut. Two lines indicate a right hand nut; one line indicates a left hand nut.
7. Install the parking brake assembly in the anchor pin and secure with the retaining nut behind the backing plate.
8. Adjust the brakes before installing the drums, using Rotunda Brake Shoe Gauge (model 11001 or 110002) or equivalent, as described in this Part.

BRAKE WHEEL CYLINDER

Removal

1. Remove the wheel, drum, and brake shoes. Remove the cylinder-to-shoe connecting links.
2. Disconnect the brake line from the brake cylinder.
3. Remove the brake cylinder retaining bolts and lockwashers, and then remove the cylinder from the backing plate.

Installation

1. Place the brake cylinder on the backing plate and install the retaining bolts and lockwashers.
2. Install a new gasket on the brake line fitting (if equipped) and connect the brake line to the brake cylinder.
3. Install the brake shoes and the connecting links between the shoes and cylinder. Install the drum and the wheel.

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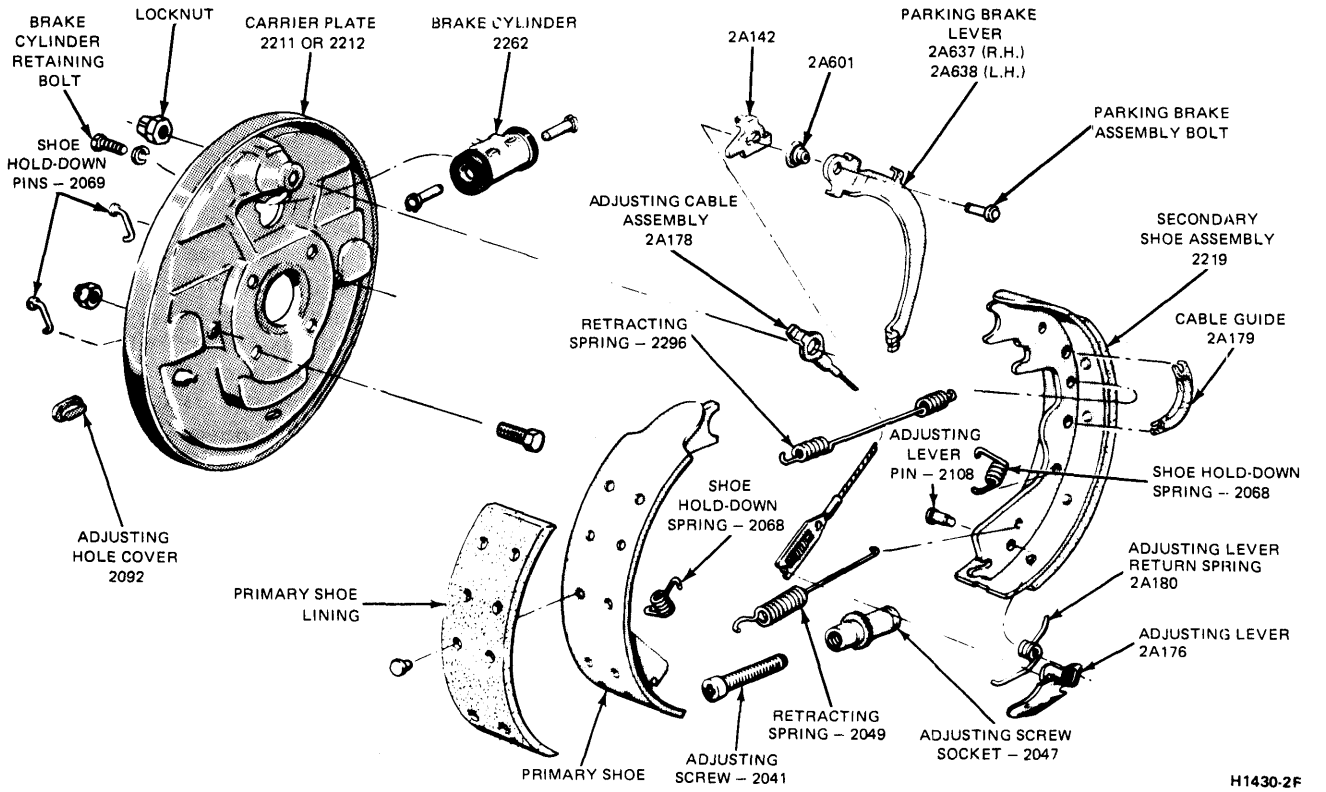


FIG. 13 F-250, F-350 and E-250, E-350 Rear Web Ledge Single Anchor Brake—Disassembled

4. Adjust the brakes and bleed the system. Check pedal operation before moving the vehicle.

REAR BRAKE BACKING PLATE

F-100-F-350 E-100-350 AND BRONCO

Removal

1. Remove the wheel, hub and drum assembly. Disconnect the brake line from the brake cylinder and submerge the end of the brake line in a can containing a small amount of brake fluid to prevent air from entering the system. Remove the brake shoes and brake cylinder. On the rear wheels, disconnect the parking brake lever from the cable.
2. If the rear backing plate is being removed on F-100, F-150, E-100—E-150 and Bronco, rotate the axle shaft so the hole in the axle shaft flange aligns with the backing plate retaining nuts. Remove the nuts. Pull the axle shaft assembly out of the housing using Tool 4235-C, and a slide hammer Tool T50T-100-C (Fig. 14). Lift off the backing plate.

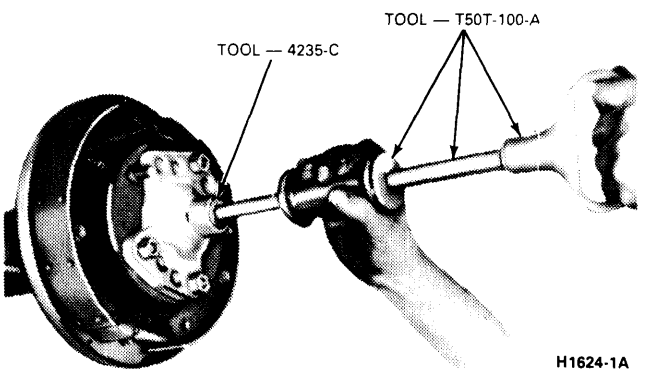


FIG. 14 Axle Shaft Removal

Installation

1. Position the rear backing plate on the retaining bolts in the axle housing flange. Insert the axle shaft assembly into the housing so the splines engage the differential side gear, with the bearing retainer sliding onto the retaining bolts and against the backing plate. Install the retaining nuts through the access hole in the axle shaft flange.
2. Install the brake cylinder and brake shoes. On rear brakes, connect the parking brake cable to the lever.
3. Connect the brake line to the brake cylinder and install the wheel and brake drum. Adjust the brake shoes and bleed air from the system.

BRAKE MASTER CYLINDER

POWER BRAKE—DASH-MOUNTED BOOSTER—F-100-350, (4x2 and 4x4), BRONCO AND E-100—E-350 SERIES

Removal

1. With the engine turned off, push the brake pedal down to expel vacuum from the brake booster system.
2. Disconnect the hydraulic lines from the brake master cylinder.

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3. Remove the brake booster-to-master cylinder retaining nuts and lock washers. Remove the master cylinder from the brake booster.

Installation

1. Before installing the master cylinder, check the distance from the outer end of the booster assembly push rod to the front face of the brake booster assembly. Turn the push rod adjusting screw in or out as required to obtain the specified length (Figs. 15 and 16).

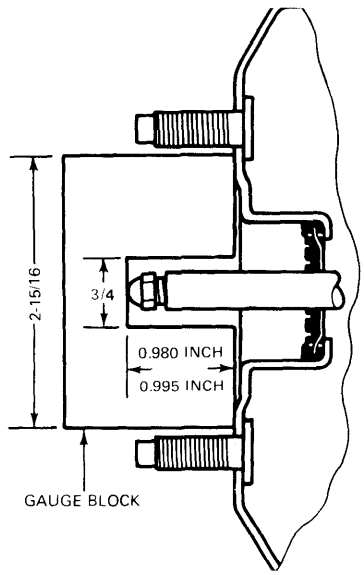


FIG. 15 Bendix Booster Push Rod Gauge Dimensions and Adjustment—E-350 Only

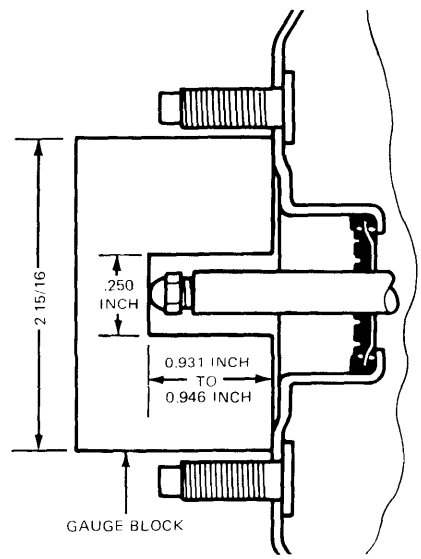


FIG. 16 Bendix Booster Push Rod Gauge Dimensions and Adjustment—All Models Except E-350

2. Position the master cylinder assembly over the booster push rod and onto the two studs on the booster assembly. Install the attaching nuts and lockwashers and tighten to specification.
3. Loosely connect the hydraulic brake system lines to the master cylinder.
4. Bleed the hydraulic brake system as described in this Part. Centralize the differential valve as described in this Part. Then, fill the dual master cylinder reservoirs with ESA-M1C75-B or an equivalent brake fluid to within 1/4 inch of the top. Install the gasket and reservoir cover.

NON-POWER BRAKE—F-100 (4x2), F-100

Removal

Refer to Figs. 17 and 18.

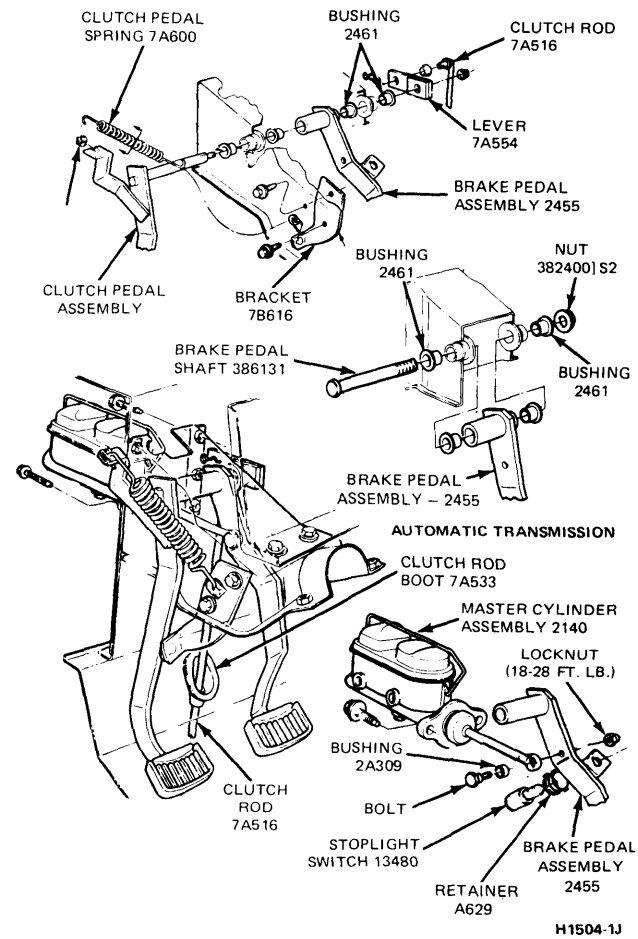


FIG. 17 Dual Master Cylinder and Brake Pedal Installation—F-100-350 and Bronco

1. Working from inside the cab below the instrument panel, disconnect the wires from the stop lamp switch.
2. Remove the retaining nut, shoulder bolt, spacers, and bushing securing the master cylinder push rod to the brake pedal assembly. Remove the stop lamp switch from the pedal.
3. Disconnect the brake hydraulic system lines from the master cylinder.
4. Remove the master cylinder-to-dash panel retaining screws, and remove the master cylinder.
5. Remove the boot from the master cylinder push rod.

Installation

1. Place the master cylinder assembly on the dash panel in the engine compartment and install the

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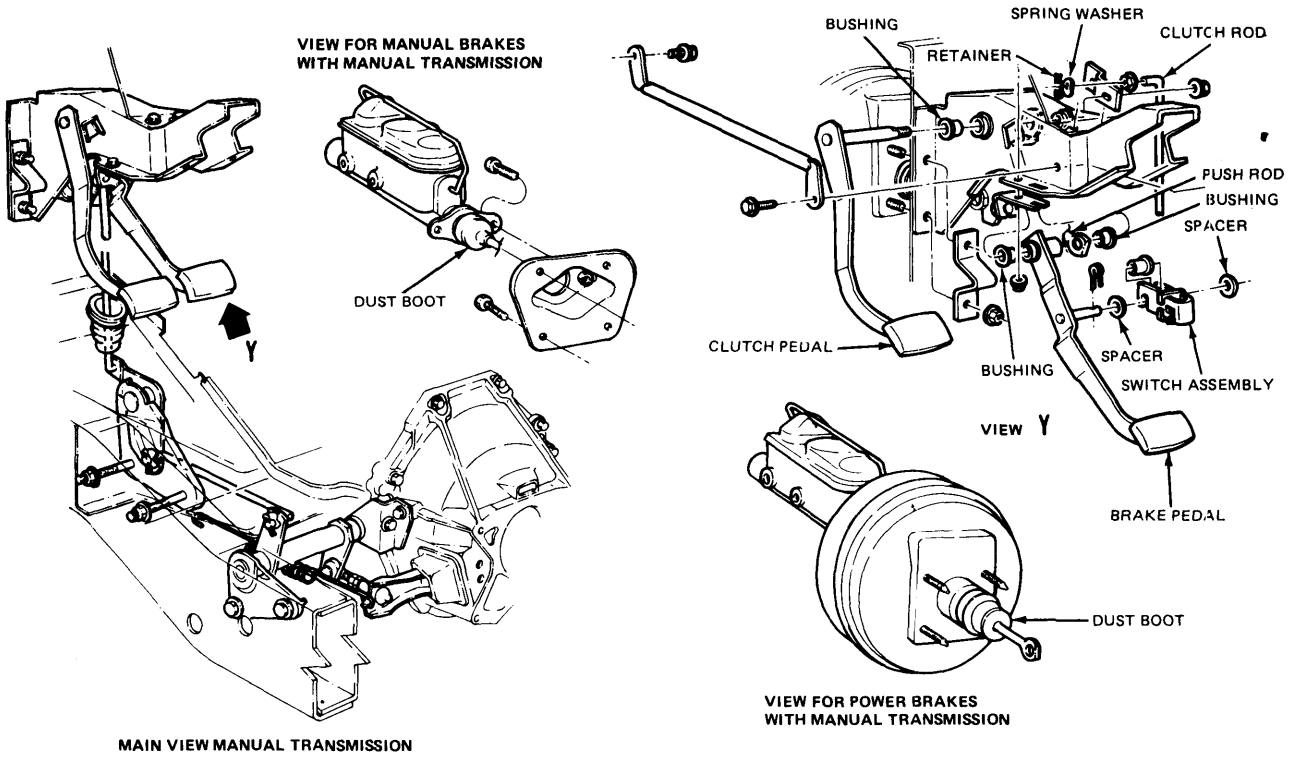


FIG. 18 Brake Pedal Installation—E-100—E-350

retaining bolts and washers. Tighten the bolts to specification.

2. Loosely connect the hydraulic brake system lines to the master cylinder.
3. Working from inside the cab below the instrument panel, position the boot over the push rod and secure the boot to the master cylinder.
4. Lubricate the push rod bushing with lubricant (ESA-M1C75-B or equivalent). Install the bushing in the push rod.
5. Secure the push rod to the brake pedal assembly using the shoulder bolt. Make sure the bushings and spacers are installed properly. Install self-locking nut.
6. Connect the wires to the stop lamp switch.
7. Bleed the hydraulic brake system as described in this Part. Centralize the differential valve as described in this Part. Fill the dual master cylinder reservoirs with the specified brake fluid to within 1/4 inch of the top. Install the gasket and reservoir cover.

PRESSURE DIFFERENTIAL, METERING AND PROPORTIONING VALVE ASSEMBLY

Removal

1. Raise the vehicle on a hoist. Disconnect the brake warning light wire from the valve assembly switch. **To avoid damaging the brake warning switch wire connector, expand the plastic lugs so the shell-wire connector may be removed from the switch body.**
2. Disconnect the brake hydraulic lines from the differential valve assembly.
3. Remove the screw retaining the pressure differential, metering, and proportioning valve assembly to the frame side rail or support bracket and remove the valve assembly.

Installation

1. Mount the pressure differential valve assembly on the frame side rail or support bracket and tighten the attaching screw.
2. Connect the brake hydraulic system lines to the differential valve assembly and tighten the tube nuts securely.
3. Connect the shell-wire connector to the brake warning lamp switch. **Make sure plastic lugs on the connector hold the connector securely to the switch.**
4. Bleed the brakes and centralize the pressure differential valve as outlined in this Part.

BRAKE PEDAL ASSEMBLY

E-100—E-350

Refer to Fig. 18.

Removal and Installation

1. Remove bolt and nut for stoplight switch and retaining clip. Disconnect master cylinder push rod from bracket.
2. Remove the cotter pin and nut holding the pedal shaft to the bracket.
3. Remove the pedal from the bracket by removing the nut.
4. Remove the bushings from the pedal shaft.

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5. Lubricate the bushings with lubricant ESA-M1C75-B or equivalent. Install the bushings on the pedal shaft.
6. Install the pedal assemblies through the brackets. Install the washer, nut and cotter pin.
7. Position the brake master cylinder push rod on the pedal assembly. Install the bolt or nut and/or stoplight switch and retaining clips.

F-100-350-Series and Bronco

Removal

Refer to Fig. 17.

1. Working inside the cab, below the instrument panel, disconnect the wires from the stop lamp switch.
2. Disconnect the clutch pedal retracting spring and remove the insulators. Remove the retaining nut, shoulder bolt, and bushing securing the push rod to the brake pedal assembly.
3. On vehicles with automatic transmissions, remove the nut, bushings and bolt securing the brake pedal to the support. Remove the brake pedal assembly.
4. On vehicles with standard transmissions, remove the cotter pin, nut, washer, bushings, and lever securing the brake pedal assembly to the support. Remove the brake pedal assembly.
5. Remove the stop lamp switch from the bracket on the brake pedal.
6. Remove the pedal pad, if required.

Installation

1. Install the pedal pad on the brake pedal assembly, if required.
2. Install the stop light switch retainer and stop light switch in the retainer on the brake pedal.
3. On vehicles with standard transmissions, lubricate the bushings with lubricant ESA-M1C75-B or equivalent.

   Insert the bushings in the brake pedal assembly, and install the brake pedal on the shaft. Install the bushings, lever, washer, nut and cotter pin on the shafts.

   Install the bushing in the lever. Connect the rod to the lever and install the cotter pin.
4. On vehicles with automatic transmissions, lubricate the bushings with lubricant ESA-M1C75-B or equivalent.

   Insert the bushings in the brake pedal assembly. Position the bushing on the bolt. Insert the bolt through the support and the pedal assembly.

   Insert the outer bushing on the bolt and install the nut.
5. Lubricate the push rod bushing with lubricant ESA-M1C75-B or equivalent. Position the bushing on the push rod.
6. Install the shoulder bolt. Secure the push rod to the brake pedal assembly with the self-locking nut.
7. Connect the wire to the stop light switch.
8. Install the clutch pedal retracting spring insulators and the spring.

DISASSEMBLY AND ASSEMBLY

BRAKE WHEEL CYLINDER

Disassembly

1. With the wheel cylinder removed, remove the rubber boots from the ends of the brake cylinder. Remove the pistons, cups, and piston return spring and piston expander assembly from the cylinder (Fig. 19).
2. Remove the bleeder screw from the cylinder.

Assembly

1. Coat all brake cylinder parts with clean extra heavy duty brake fluid ESA-M6C25-B or equivalent.
2. Install the bleeder screw (Fig. 19) in the brake cylinder.
3. Place the piston return spring and piston expander assembly, cups, and pistons in the cylinder bore,

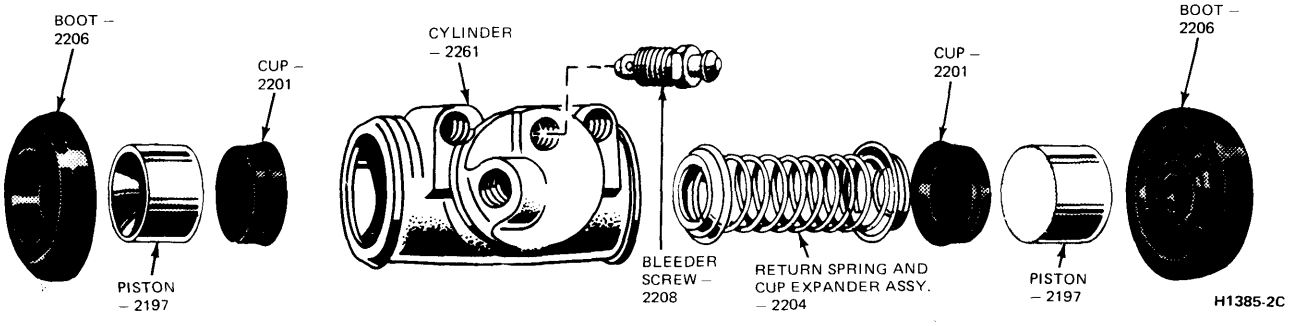


FIG. 19 Double Servo Brake Cylinder

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and install a boot and link over each end of the cylinder. Clamp the brake cylinder pistons against the ends of the cylinder. **When using a brake cylinder repair kit follow the instructions in the kit and use all of the parts provided.**

MASTER CYLINDER

DUAL BRAKE SYSTEM—F-100-350, E-100-350 AND BRONCO

Remove the master cylinder from the vehicle. Refer to Fig. 20.

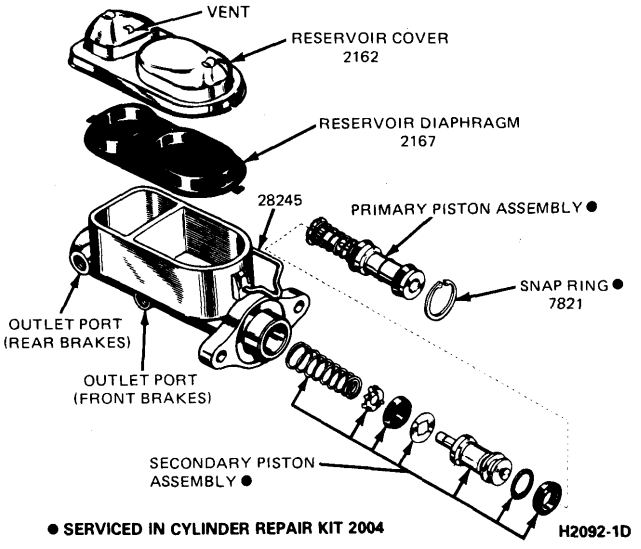


FIG. 20 Dual Master Cylinder Disassembled—F-100—F-350 E-100—E-350, Bronco

When it is necessary to repair the master cylinder during the warranty period, replace the cylinder as a unit instead of overhauling the cylinder with a service repair kit.

Disassembly

1. Clean the outside of the master cylinder and remove the reservoir cover and reservoir diaphragm. Drain any fluid left in the cylinder. Be careful with brake fluid as it damages painted surfaces.
2. Remove the push rod boot, (if equipped), from the groove at the rear of the master cylinder, and slide the boot away from the rear of the master cylinder.
3. Remove the snap ring (Fig. 21) holding the pistons in the cylinder body.
4. Remove the push rod, (if equipped), and primary piston assembly from the master cylinder. Discard the piston assembly, including the boot, (if equipped).
5. Using an air hose in the rear brake outlet port of the cylinder body, carefully blow the secondary piston out of the cylinder body.

   CAUTION: Use low air pressure to remove the piston. High pressure could result in damage or personal injury.
6. Remove the return spring, spring retainer, cup protector, and cups from the secondary piston. Discard the cup protector and cups.

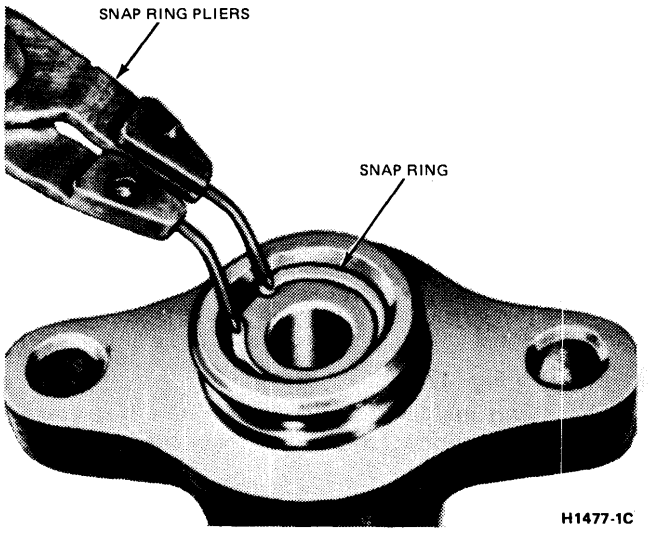


FIG. 21 Removing Snap Ring—Typical

Inspection and Repair

1. Clean all parts in **clean** isopropyl alcohol or Rotunda brake Parts washer (model 650016) or equivalent, and inspect the parts for chipping, excessive wear or damage. Replace them, if necessary. **When using a master cylinder repair kit, use all the parts provided.**
2. Check all recesses, openings and internal passages to be sure they are open and free of foreign matter. Use the air hose to blow out dirt and cleaning solvent. Place all parts on a clean pan or paper.
3. Inspect the hydraulic master cylinder bore for etching, pitting or rust. Replace the master cylinder if any of these conditions exist.

Assembly

1. Remove the master cylinder from the vise. Check the outlet ports for brass burrs, and remove, if present.
2. Dip all the parts **except the cylinder body** in **clean** ESA-M6C25-B extra heavy duty brake fluid or equivalent and lubricate the bore walls with brake fluid.
3. Assemble the two secondary cup and O-ring back-to-back, in the grooves near the end of the secondary piston. Assemble the cup protector, primary cup, spring retainer, and secondary piston return spring on the other end of the secondary piston.
4. Install the secondary piston assembly in the master cylinder.

   Wet the seals with the brake fluid and use caution when inserting the piston assemblies into the bore to prevent damage to the seals.
5. On vehicles with standard brakes, position the boot, snap ring and push rod retainer on the push rod. **Make sure the push rod retainer is seated securely on the ball end of the rod.** Seat the push rod in the primary piston assembly.
6. Install the primary piston assembly in the master cylinder. Push the primary piston inward and tighten the secondary piston stop bolt to hold the secondary piston in the bore.

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7. On vehicles with power brakes, position the stop plate and snap ring on the primary piston. Depress the primary piston and install the snap ring in the cylinder body.
8. On vehicles with standard brakes, push in the push rod and pistons and install the snap ring in the cylinder body.
9. Bleed the master cylinder.

BLEEDING THE MASTER CYLINDER

Before installing the master cylinder on the vehicle, bleed the unit as follows:

1. Support the master cylinder body in a soft-jawed vise, and fill both fluid reservoirs with ESA-M6C25-A extra heavy duty brake fluid or equivalent.
2. Loosely install plugs in the front and rear brake outlet ports. Depress the primary piston several times until air bubbles no longer appear in the brake fluid.
3. Tighten the plugs and try to depress the piston. Depressing the piston should be harder after all air is expelled.
4. Remove the plugs. Install the cover and diaphragm assembly, making sure the cover retainer is tightened securely.

SPECIFICATIONS

WHEEL TORQUE LIMITS

Model	Nut Size	(ft-lbs)	N•m
E-100 — E-250	1/2-20	90	122
F-150 (4x4), Bronco (Std. Wheel) F-250, F-250 (4x4) F-100, F-150 (4x2)	1/2-20	90	122
F-350, F-350	9/16-18	145	196
F-350 (with Dual Rear Wheels and 7400 lb. axle)	9/16-18	220	298

CE2705-1A

SPECIAL TOOLS

Number	Description
110001	Safe-Set Gauge F-150, E-100 — E-150, Bronco
110002	Safe-Set Gauge F-250 — F-350, E-250, E-350
2035 N or W	Brake Spring Installation/Removal Tool
4235-C	Axle Shaft Adapter for Removal of Axle Shaft on F-100, F-350, E-100 — E-350 and Bronco Rear to be Used with Slide Hammer — T50T-100-C
T50T-100-C	Slide Hammer
J-22742	Metering Valve Bleeder
65001-G	Brake Parts Washer

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Disc Brakes — Light and Heavy Duty — Sliding Caliper

PART 12-24

APPLIES TO F-100 — F-350 (4x2), BRONCO, F-150 — F-250 (4x4), E-100 — E-350

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DESCRIPTION AND OPERATION

HD RAIL SLIDER CALIPER DISC BRAKES

F-250 above 6800 G.V.W, F-350 (4x2), (Fig. 1), E-250-350, (Fig. 3), and F-250—F-350 (4x4), Fig. 4), model trucks are equipped with dual piston, rail slider caliper disc-brakes in the front, and conventional drum brakes in the rear. The system has a dual master cylinder and vacuum booster.

The dual master cylinder contains a double hydraulic cylinder with two fluid reservoirs and primary and secondary hydraulic pistons. The master cylinder secondary system outlet port is connected to the secondary (rear) hydraulic circuit. The primary system brake outlet port is connected to the primary (front) hydraulic circuit. Both systems function together (Fig. 8).

Brake lines extend from the brake master cylinder primary and secondary system outlet ports to the pressure differential metering valve assembly. Fig. 6 shows the major parts of the valve.

The disc brake is of the rail slider caliper design, with two pistons on the same side of the rotor. The unit consists of a caliper which slides on the support assembly and is retained by a key and spring. A key retaining screw maintains the key and spring position.

Each caliper contains two brake shoes and lining assemblies, one on each side of the rotor. The shoes are not identical and they slide on the caliper bridge. One anti-rattle clip is used on both shoes.

The cylinder housing contains the two pistons. The pistons and cylinder bores are protected by boot seals fitted to a groove in the piston and a groove in the cylinder housing. The cylinder assembly is attached to the caliper with cap screws and washers.

The support assembly and shield are bolted directly to the spindle on F-250, (above 6800 G.V.W.), F-350 (4x2), Fig. 1 and E-250—E-350, Fig. 3. The F-250 (4x4), (Fig. 4). The anchor plate positions the caliper assembly over the rotor forward of the spindle on F-250/350 (4x2), (Fig. 1), and rearward for E-250/350, (Fig. 3) and F-250 (4x4) models, (Fig. 4).

LD SLIDING CALIPER DISC BRAKES

The disc brake assembly used on F-100, F-150 and F-250 (4x2), (6200/6800 G.V.W.), (Figs. 7 and 8), E-100-150, (Fig. 2) and Bronco, F-150 (4x4) vehicles, (Fig. 5) is a sliding caliper, single piston type and attaches to its supporting member similarly to the rail slider design.

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On F-100-150-250, (6200/6800 G.V.W.), (4x2), (Figs. 7 and 8) and E-100-150, (Fig. 2) models, the supporting member and steering arm are cast as one piece and combined with a wheel spindle stem to form an integral spindle assembly.

On Bronco and F-150, (4x4) models, (Fig. 5), a separate unique support is used which is packaged between the spindle and dust shield of the front drive axle assembly.

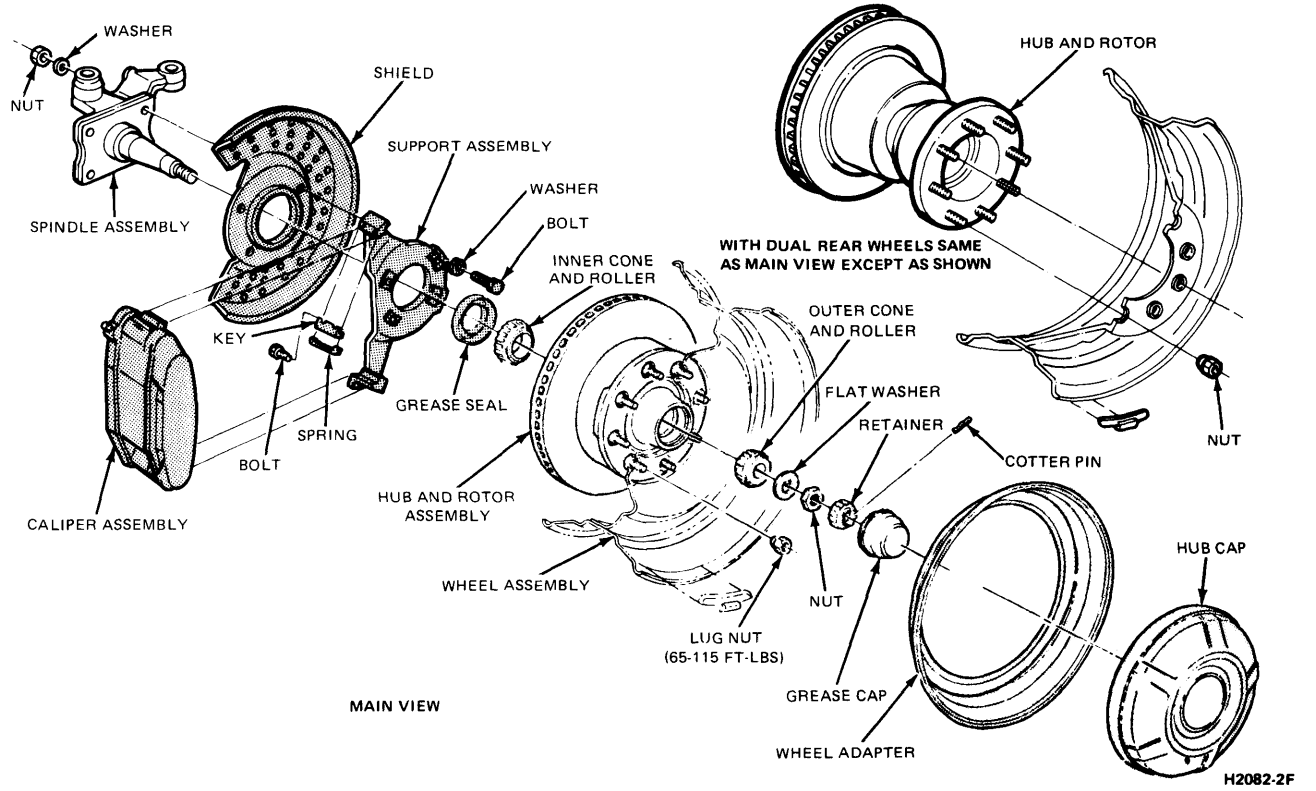


FIG. 1 Disc Brake—F-250 (Above 6800 GVW)—F-350, (4x2)

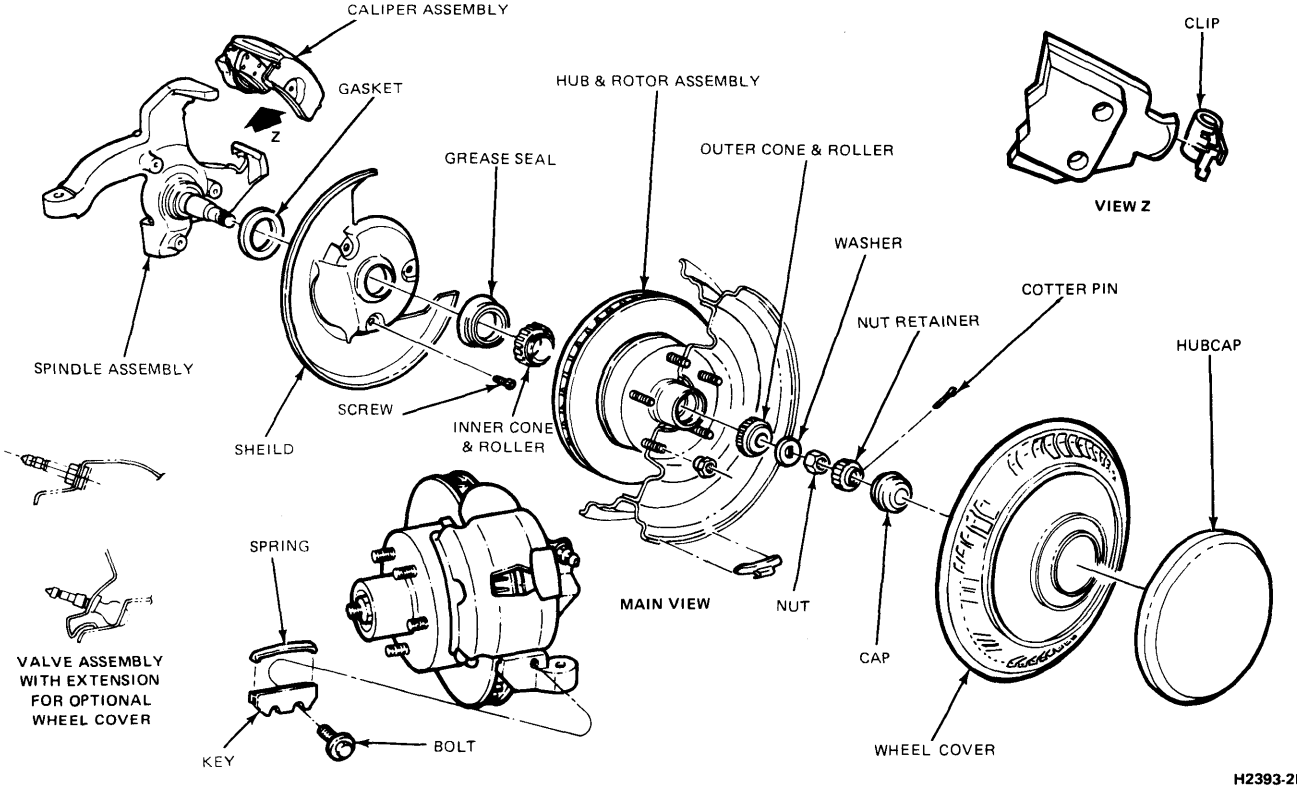


FIG. 2 Disc Brake System—E-100—E-150

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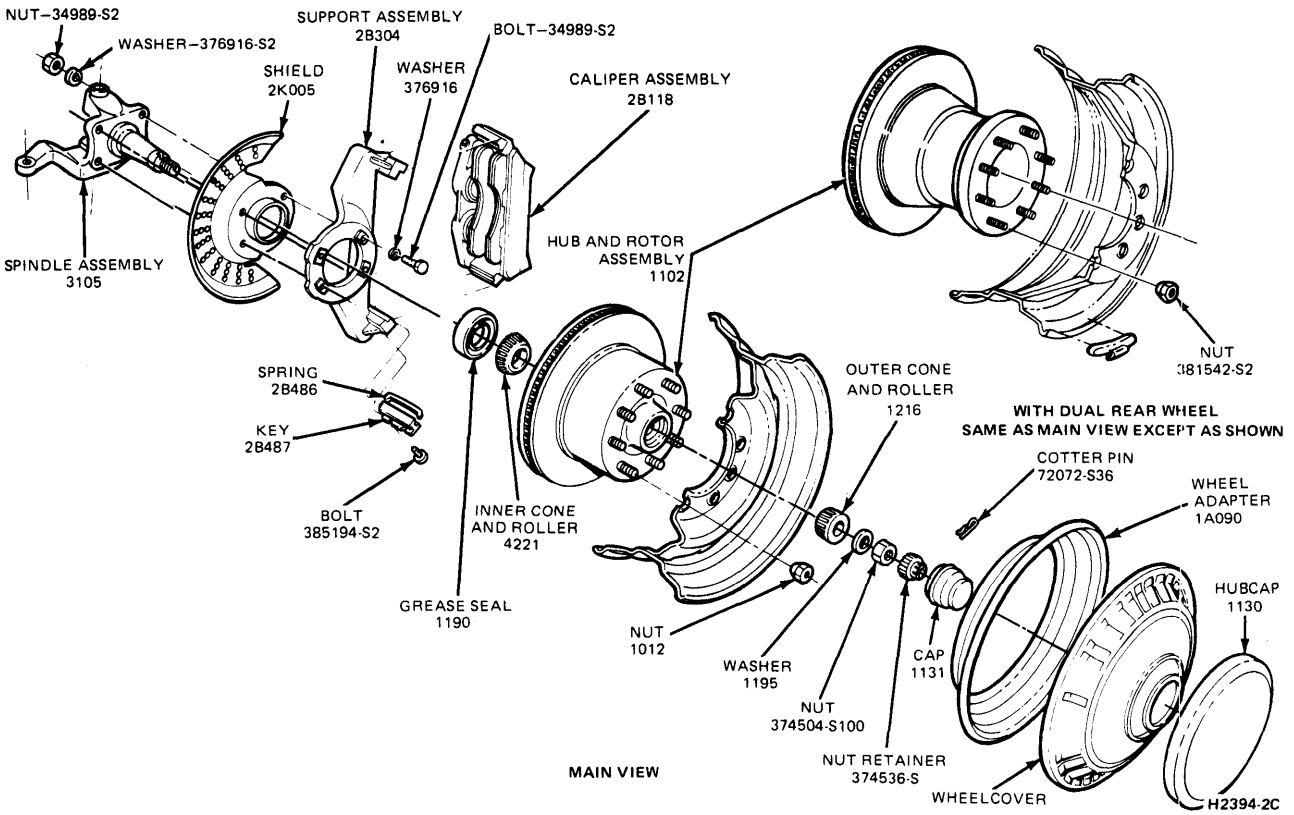


FIG. 3 Disc Brake System—E-250-350

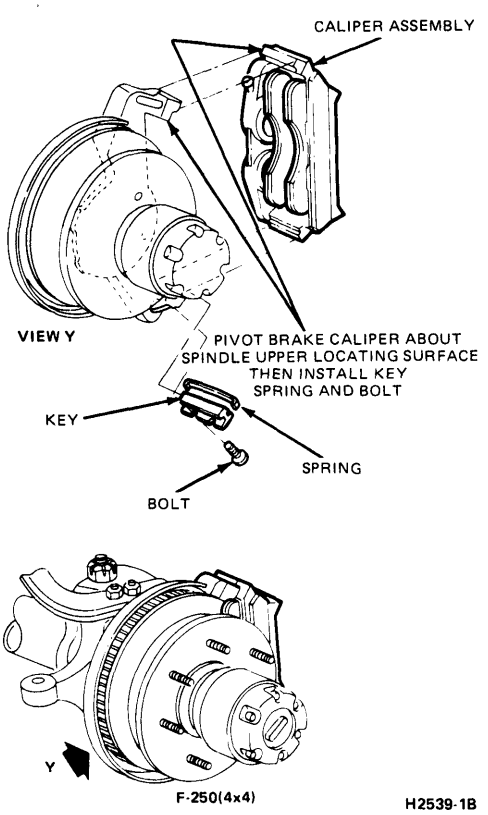


FIG. 4 Disc Brake System—F-250, (4x4)

The ends of the inner shoe and lining assembly are confined within the spindle assembly. An anti-rattle clip is positioned between the shoe and spindle assembly at the bottom of the caliper. The shoe flange bearing rests against the shoe locating and torque surfaces on the caliper housing.

The linings are riveted to the shoes. The inner and outer shoes are not interchangeable.

The caliper housing is a single piece finished casting positioned on the spindle (anchor plate on 4x4) assembly against machined surfaces at the top end. A caliper support key and spring are used to retain the caliper and spindle assembly as shown in Fig. 7. A key retaining screw keeps the key from sliding out of the spindle assembly.

A single hydraulic piston is located in the cylinder bore in the caliper housing, with the hydraulic fluid inlet at the top of the bore. A square section seal fitted into an annular groove in the caliper cylinder bore, and a rubber boot seal the piston and caliper bore from road splash and contamination. A bleeder screw located above the cylinder bore is used to bleed air from the system.

For F-100-150-250, (6200/6800 G.V.W.), (4x2), (Figs. 7 and 8) F-150-F-250 (4x4) and Bronco (Figs. 4 and 5), and E-100-350, (Figs. 2 and 3) a ventilated rotor is integrally cast with the wheel hub. A single piece splash shield, bolted to the spindle, protects the bearings and inboard surface of the rotor from road splash. The wheel protects the outboard surface of the rotor and brake assembly.

When the brake pedal is depressed, brake fluid from the master cylinder passes through the meter valve (Fig. 9) into the caliper cylinder. This moves the piston outward and forces the inner shoe and lining assembly against the inboard surface of the rotor.

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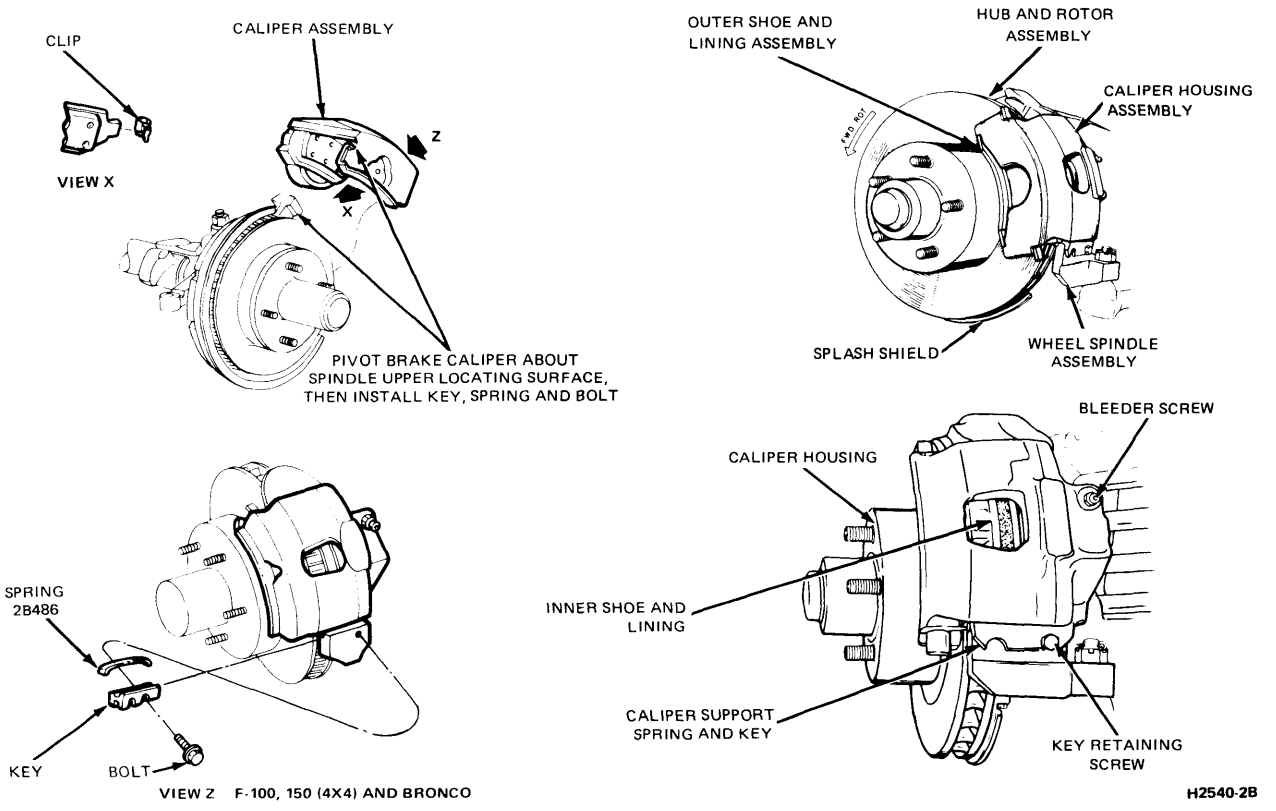


FIG. 5 Disc Brake System—F-150, (4x4) and Bronco

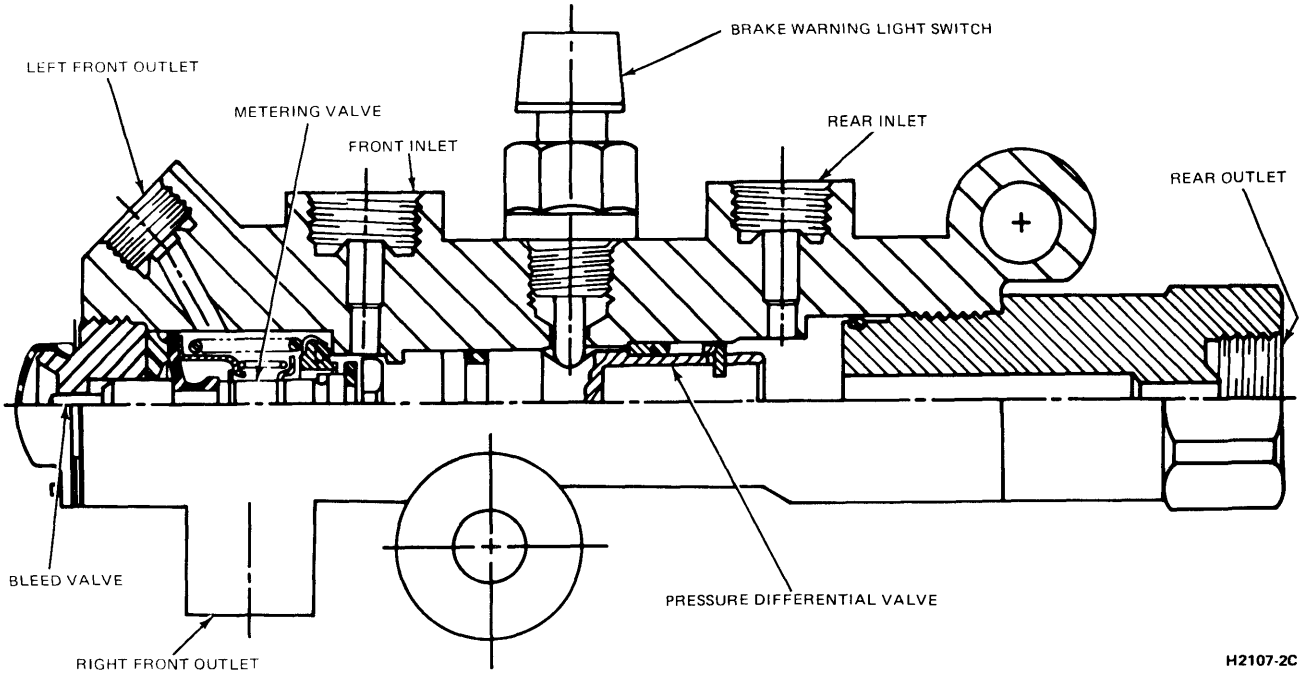


FIG. 6 Pressure Differential Metering Valve—F-250, (Above 6800 GVW), F-350, E-250, E-350

The inner lining pressing against the rotor moves the caliper housing slightly inboard. The outer legs of the caliper housing force the outer shoe and lining assembly against the outboard surface of the rotor.

The two shoe and lining assemblies clamp the rotor in a vise-type movement to provide the braking action.

Braking torque is transferred from the linings to the shoes. Torque from the inner shoe is transferred directly to the spindle (Anchor plate on 4x4) assembly, while the torque from the outer shoe is transferred through the caliper to the spindle (Anchor plate on 4x4) assembly.

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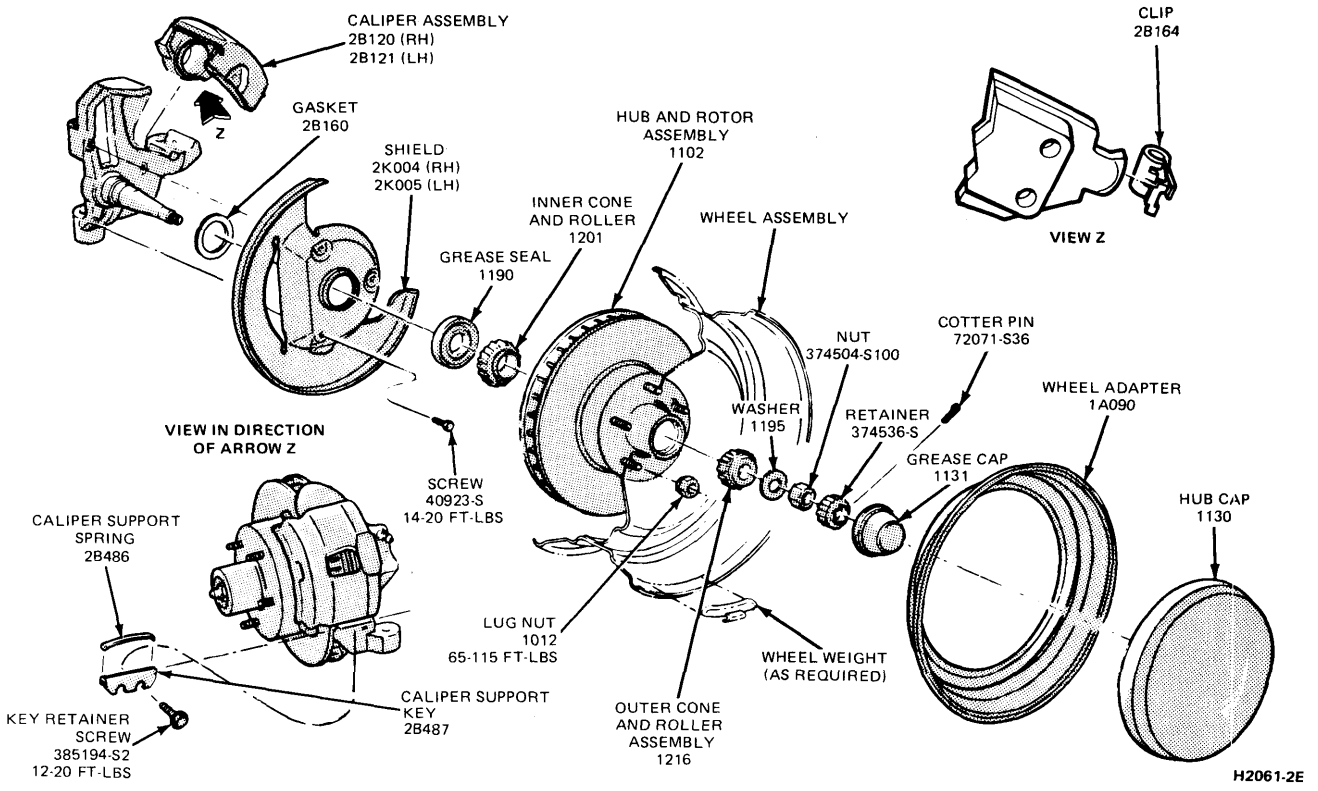


FIG. 7 Sliding Caliper Disc Brake Installation—F-100-F-250, (6200/6800 GVW), (4x2)

When the brake pedal is released, the piston seal retracts the piston into the cylinder, and the caliper housing slides slightly outboard, releasing the brakes.

PRESSURE DIFFERENTIAL METERING, AND PROPORTIONING VALVE

The pressure differential, metering, and proportioning valve (Figs. 6 and 9) senses unbalanced pressure between the front and rear brakes. A pressure loss in either the front or rear brake system upon brake pedal application will move the valve off center, causing the warning light to come on. After repairs are made, and the brake system properly bled, the valve will center itself and the warning light will shut off.

PRESSURE DIFFERENTIAL VALVE

The brake warning light switch is mounted on top of the valve body casting above the pressure differential valve tapered shoulder groove. When the valve is in the centralized position, the spring loaded switch plunger fits into the tapered shoulder groove. The switch contacts are open interrupting electrical continuity to the brake warning light on the instrument panel.

METERING VALVE

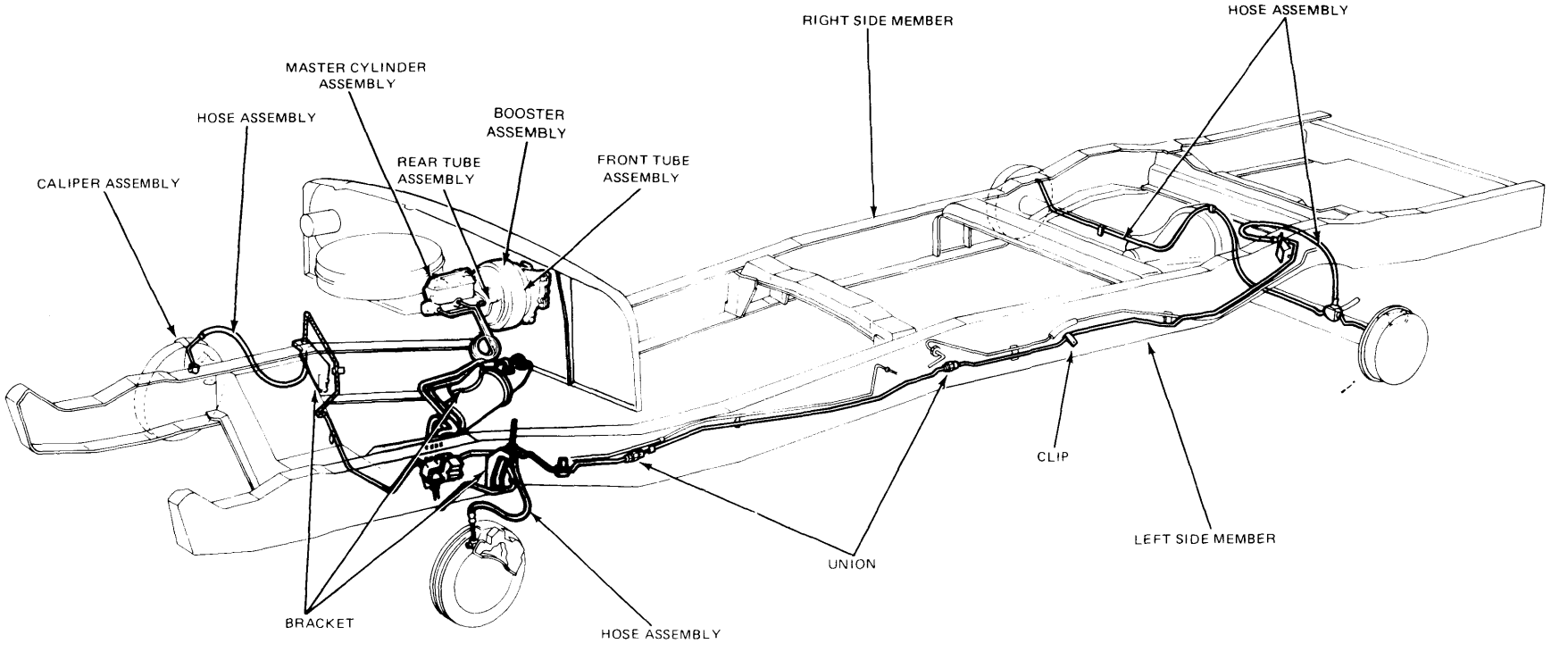
The metering valve is located in the front end of the control valve housing between the front brake system inlet port and the right and left front brake outlet ports. The valve functions to regulate the hydraulic fluid pressure to the front disc brakes. Its location provides easy accessability of the valve bleeder rod during bleeding of the front brake system.

PROPORTIONING VALVE

The proportioning valve is located at the bottom of the housing between the rear brake system inlet and outlet port, on F-100—F-250, (6200/6800 G.V.W.), E-100—E-150, F-150—F-250, F-350 (4x4) and Bronco, (Fig. 9). The valve functions to regulate rear brake system hydraulic pressure. A plug and tube seat is pressed into the rear end of the central bore. A hole through the center of the plug and tube seal directs the hydraulic fluid from the valve to the rear brake system outlet port.

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E-100-F-100 – 4x2 DISC BRAKE SYSTEM

H2391-2E

FIG. 8 Disc Brake System—F-100—F-250, (6200/6800 GVW), (4x2)

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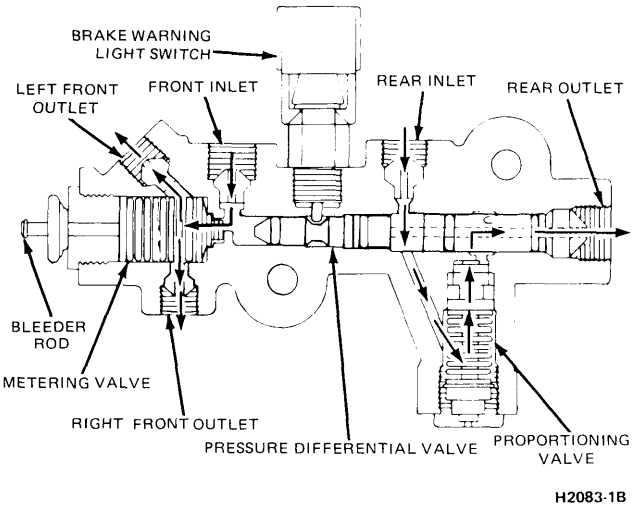


FIG. 9 Pressure Differential, Metering and Proportioning Valve Sliding Caliper—F-100—F-250, (6200/6800 GVW), E-100—E-350, F-150-250, (4x4) and Bronco

DIAGNOSIS AND TESTING

Refer to Part 12-01, General Hydraulic Brake Service, for disc brake diagnosis and testing procedures.

ADJUSTMENTS

DISC BRAKE SHOE ADJUSTMENT

The front disc brake assembly is designed so that it is inherently self-adjusting and requires no manual adjustment.

Automatic adjustment for lining wear is achieved by the piston sliding outward in the cylinder bore. The piston assumes a new position in the cylinder and maintains the correct adjustment.

HYDRAULIC SYSTEM BLEEDING

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy pedal action. This requires the bleeding of the hydraulic system after it has been properly connected to be sure all air is expelled from the brake cylinders and lines. The hydraulic system can be bled manually or with pressure bleeding equipment such as the Rotunda brake bleeder (model 110011) or equivalent.

When bleeding the brake system, bleed one brake cylinder at a time, beginning at the cylinder with the longest hydraulic line first. This will be the right rear brake, then bleed the left rear brake. Next bleed the right front brake, finally the left front brake. Keep the master cylinder reservoir filled with the specified brake fluid during the bleeding operation. Never use brake fluid which has been drained from the hydraulic system.

On F-100—F-250, (6200/6800 G.V.W.), E-100—E-150, F-150—F-250, F-350 (4x4) and Bronco vehicles equipped with disc brakes, the bleeder rod of the metering valve must be pulled outward as shown in Fig. 10, and pushed inward for F-250, (over 6800 G.V.W.), F-350, E-250 and E-350, (Fig. 6). This is to allow the brake fluid to reach the caliper assemblies. This operation is particularly important if pressure bleeding equipment is being used.

The pressure differential valves are self-centering after a brake hydraulic system malfunction has been corrected and the hydraulic system has been bled.

MANUAL BLEEDING

Bleed the front and rear hydraulic brake systems separately. Bleed the longest line first on each system. **DO NOT allow the reservoir to run dry during the bleeding operation. Keep the master cylinder reservoirs filled with the specified brake fluid. Never reuse the fluid that has been drained from the hydraulic system.**

1. Loosen the fittings at the bottom of the master cylinder approximately one turn. **Do not use the secondary piston stop screw located on the bottom of the master cylinder to bleed the brake system. Loosening or removing this**

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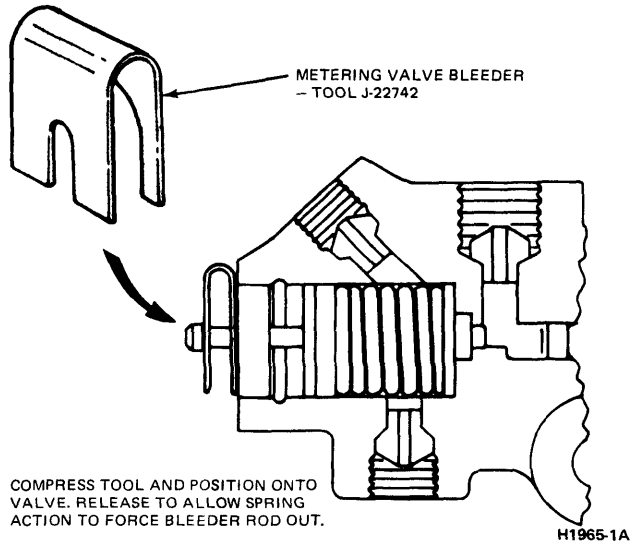


FIG. 10 Pressure Bleeding Tool—Sliding Caliper Disc Brakes—F-100/F-250, (6200/6800 GVW), E-100—E-150, F-150-250-350, (4x4) and Bronco

screw could damage the secondary piston or stop screw.

On a master cylinder without bleed screws, loosen the master cylinder-to-hydraulic line nut.

2. Wrap a shop cloth around the tubing below the fitting to absorb escaping brake fluid.
3. Push the brake pedal down slowly by hand to the floor of the cab. This will force air trapped in the master cylinder to escape at the fitting.
4. Hold the pedal down and tighten the fitting. Release the brake pedal. Do not release the brake pedal until the fitting is tightened or air will re-enter the master cylinder.
5. Repeat this procedure until air ceases to escape at the fitting and the brake pedal is firm.
6. Place a 3/8-inch box wrench on the bleeder fitting on the brake wheel cylinder. Attach a rubber drain tube to the bleeder fitting making sure the end of the tube fits snugly around the bleeder fitting.
7. Submerge the free end of the tube in a container partially filled with clean brake fluid. Loosen the bleeder fitting approximately three-quarters of a turn.
8. Slowly push the brake pedal all the way down. Close the bleeder fitting, and return the pedal to the fully-released position. Repeat this operation until air bubbles no longer appear at the submerged end of the bleeder tube.
9. When the fluid is completely free of air bubbles, close the bleeder fitting and remove the bleeder tube.
10. Repeat this procedure at the brake wheel cylinder on the opposite side. Refill the master cylinder reservoir after each wheel cylinder is bled. When the bleeding operation is complete, fill the master cylinder to within 1/4 inch from the top of the reservoirs.

PRESSURE BLEEDING

Be sure the bleeder tank contains enough of the specified brake fluid to complete the bleeding operation. Charge the tank with approximately 10-30 lbs of air pressure. **Never exceed 50 lbs of pressure. Never use brake fluid that has been drained from the hydraulic system. Bleed the longest lines first.**

1. Clean all dirt from the master cylinder reservoir cover.
2. Remove the master cylinder reservoir cover and rubber gasket, and fill the master cylinder reservoir with the specified brake fluid. Install the pressure bleeder adapter tool on the master cylinder, and attach the bleeder tank hose to the fitting on the adapter.

   Master cylinder pressure bleeder adapter tools are available from the manufacturers of pressure bleeding equipment. Follow the manufacturer's instructions when installing the adapter.
3. Place a 3/8 inch box wrench on the bleeder fitting on the right rear brake wheel cylinder. Attach a bleeder tube snugly to the bleeder fitting.
4. Open the valve on the bleeder tank and admit pressurized brake fluid to the master cylinder reservoir.
5. Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder fitting.
6. When air bubbles no longer appear in the fluid at the submerged end of the bleeder tube, close the bleeder fitting and remove the tube.
7. Repeat Steps 3 through 6 at the opposite wheel cylinder. On front brakes, bleed the right front caliper first.
8. When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose from the adapter fitting.
9. Remove the pressure bleeder adapter tool. Fill the master cylinder reservoirs with the specified brake fluid to within 1/4 inch from the top of the filler neck. Install the master cylinder cover and gasket.

HYDRAULIC LINE REPAIR

Steel tubing is used in the hydraulic lines between the master cylinder and the front brake tube connector, and between the rear brake tube connector and the rear brake cylinders. Flexible hoses connect the brake tube to the front brake cylinders and to the rear brake tube connector.

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After replacement, bleed the brake system at the wheel cylinders and at the booster (if equipped).

BRAKE TUBE

If a section of the brake tube is damaged, replace it with tubing of the same type, size, shape, and length. **Do not use copper tubing in the hydraulic system. Be careful not to kink or crack the tubing when bending it to fit the frame or rear axle.**

Double flare the brake tubing (Part 12-01, General Hydraulic Brake Service) to provide good leak-proof

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connections. Always clean the inside of a new brake tube with clean isopropyl alcohol.

BRAKE HOSE

Replace a flexible brake hose if it shows signs of softening, cracking, or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle parts. Whenever a brake hose is disconnected from a wheel cylinder or brake caliper, install a **new copper washer connecting the hose.**

REMOVAL AND INSTALLATION

HD RAIL SLIDER BRAKE SHOES AND LINING

F-250—F-350, (ABOVE 6800 GVW), F-350, E-250—E-350, F-250 (4X4)

Replace shoe and lining assemblies as follows when the lining is worn to a minimum thickness of 1/32 inch above the backing plate. Always replace both shoes and lining assemblies on an axle. Never service one wheel only.

Removal

1. To avoid fluid overflow when the caliper pistons are pressed into the caliper cylinder bores, siphon or dip part of the brake fluid out of the larger master cylinder reservoir, (connected to the front disc brakes). Discard the removed fluid.
2. Raise the vehicle and remove the front wheel and tire assembly.
3. Remove the key retaining screw, (Fig. 11).

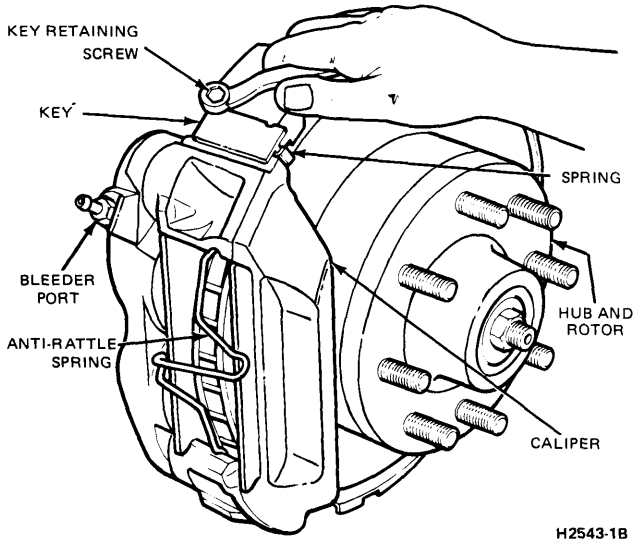


FIG. 11 Removing Key Retaining Screw

4. Using a brass rod and light hammer drive out the key and spring, (Fig. 12). It is not necessary to disconnect the hydraulic line to the caliper.
5. Remove the caliper from its support assembly by rotating the key and spring end out and away from the rotor. Slide the opposite end of the caliper clear of the slide in the support and off the rotor. Lay the caliper on the tie rod or axle. **Do not let the caliper hang with its weight on the brake hose or the hose may become stretched or twisted.**
6. Remove the caliper brake shoe anti-rattle spring and the inner and outer shoe and lining assemblies.
7. Clean and inspect the caliper assembly. Thoroughly clean the areas of the caliper and support that contact during the sliding action of the caliper.
8. Place a C-clamp on the caliper housing midway between the piston bores, (Fig. 13), and using the old inner shoe and lining over the pistons, tighten the clamp to bottom of the caliper pistons in the cylinder bores. Remove the clamp and inner shoe lining assembly.

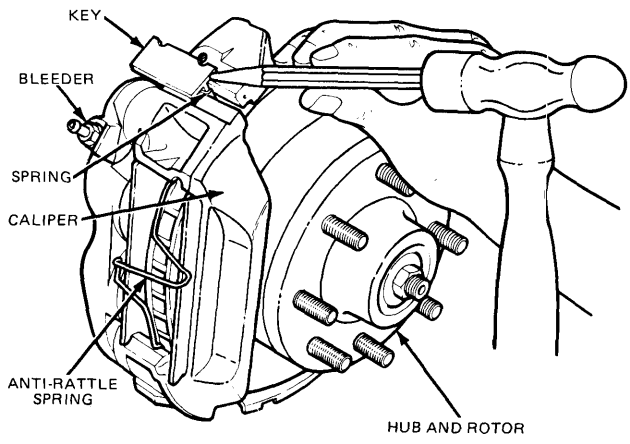


FIG. 12 Removing Spring and Key

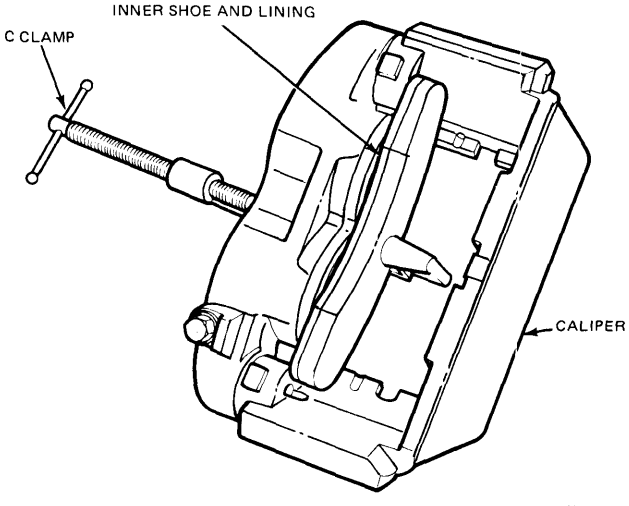


FIG. 13 Bottoming Caliper Pistons

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Installation

1. Check to be sure that the caliper pistons are fully bottomed in the cylinder bore.
2. Install new inner and outer shoe. Install anti-rattle spring. **Always replace both shoe and lining assemblies on an axle. Never service one wheel only.**
3. Position the caliper rail into the slide on the support and rotate the caliper onto the rotor.
4. Position the key and spring, (Fig. 14), and hand start the subassembly between the caliper and support. Note that the spring is between the key and caliper and that the spring tangs overlap the ends of the key, (Fig. 12). Use a brake adjusting tool or screwdriver to hold up the caliper, if required, against the support assembly.

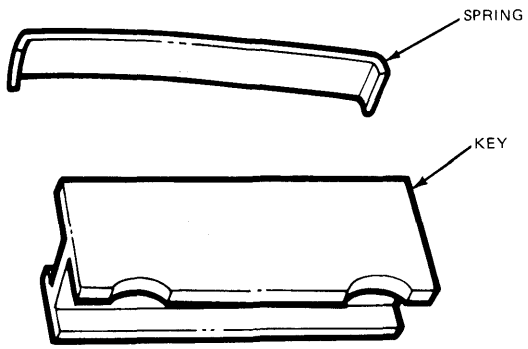


FIG. 14 Caliper Spring and Key

5. Using a hammer, drive the key and spring into position aligning the correct notch with the existing hole in the support.
6. Secure the key to the support with the key retaining screw, (Fig. 11). Tighten the screw to 12-20 ft-lbs.
7. After new shoe and lining assemblies and the wheel assemblies have been installed on both front wheels, lower the vehicle. Check the master cylinder reservoirs and fill if necessary with heavy duty brake fluid, (ESA-M6C25-A or equivalent).
8. Depress the brake pedal firmly several times to seat the linings on the rotor. Do not move the vehicle until the pedal is firm.
9. Bleed the brakes.

LD SLIDING CALIPER BRAKE SHOES AND LINING

F-100—F-250 (UP TO 6800 G.V.W.), E-100-150, BRONCO, F-150 (4X4)

Always replace both shoe and lining assemblies on an axle. Never service one wheel only.

Removal

1. To avoid fluid overflow when the caliper piston is pressed into the caliper cylinder bores, siphon or dip part of the brake fluid out of the larger master cylinder reservoir (connected to the front disc brakes). Discard the removed fluid.
2. Raise the vehicle and remove a front wheel and tire assembly.
3. Place an 8-inch C-clamp on the caliper (Fig. 15), and tighten the clamp to bottom the caliper piston in the cylinder bore. Remove the clamp.
4. Remove the key retaining screw (Fig. 16).

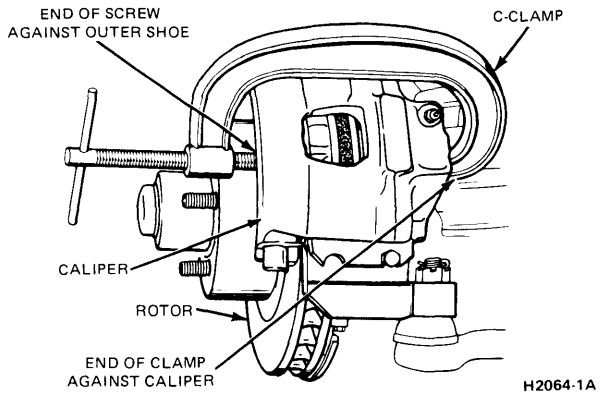


FIG. 15 Bottoming Caliper Piston

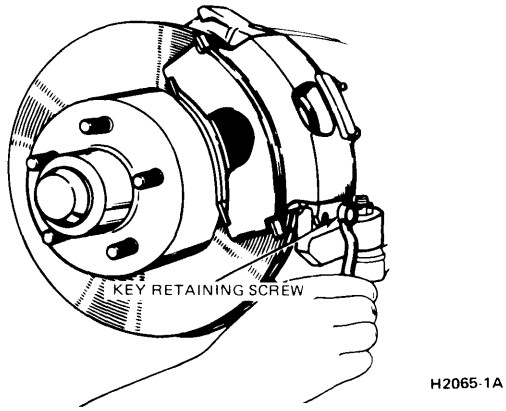


FIG. 16 Removing Key Retaining Screw

5. Using a brass rod and light hammer, drive out the caliper support key and caliper support spring (Fig. 17). It is not necessary to disconnect the hydraulic line to the caliper.

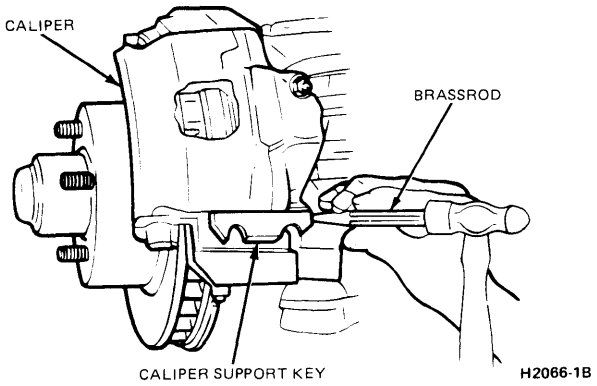


FIG. 17 Removing Caliper Support Spring and Key

6. Remove the caliper from it's support assembly, by pushing it downward against the spindle assembly, and rotating the upper end upward and out of the

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spindle assembly. Lay the caliper on a tie rod or axle. **Do not let the caliper hang with its weight on the brake hose or the hose may become stretched or twisted.**

7. Remove the outer shoe and lining from the caliper (Fig. 18). It may be necessary to tap the shoe to loosen the shoe flange from the caliper.

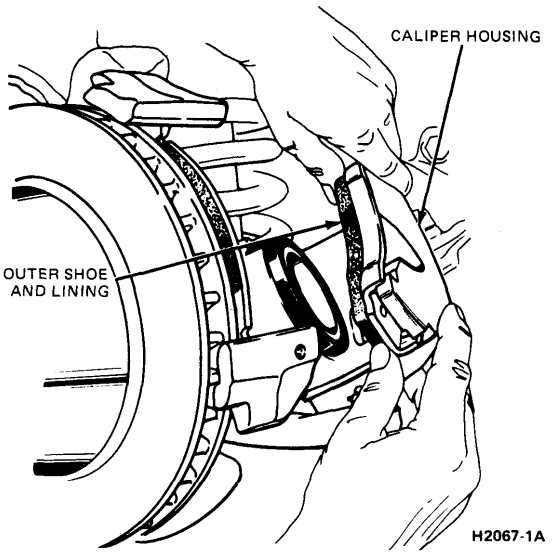


FIG. 18 Removing Outer Shoe and Lining

8. Remove the inner shoe and lining (Fig. 19). Remove the shoe anti-rattle clip from the lower end of the shoe.

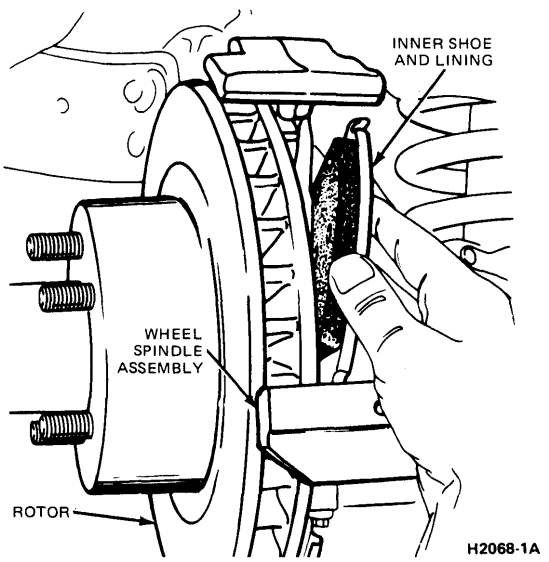


FIG. 19 Removing Inner Shoe and Lining

9. Clean and inspect the caliper assembly. **Thoroughly clean the areas of the caliper and spindle assembly that contact during the sliding action of the caliper.** Apply a light coating of D7AZ-19590-A lubricant or equivalent to both surfaces. Be careful not to get lube on rotors or linings. Wipe any excess lube off after assembly.

Installation

1. Place a new anti-rattle clip on the lower end of the inner shoe, (Fig. 20). Be sure the tabs on the clip are positioned properly, the clip is fully seated.

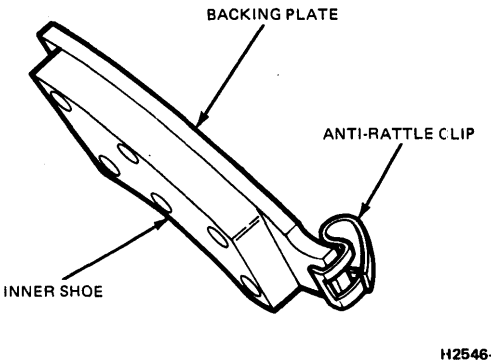


FIG. 20 Installing Anti-Rattle Clip-On Inner Shoe

2. Position the inner shoe and anti-rattle clip in the shoe abutment with the anti-rattle clip tab against the shoe abutment and the loop-type spring away from the rotor, (Fig. 21). Compress the anti-rattle clip and slide the upper end of the shoe in position.

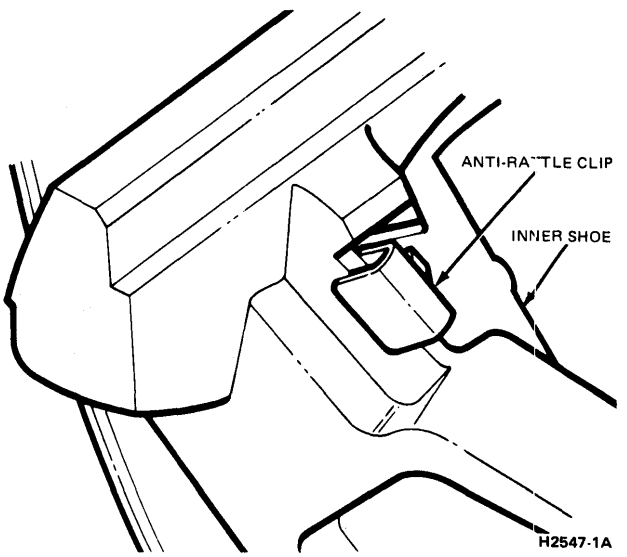


FIG. 21 Installing Inner Shoe and Anti-Rattle Clip

3. Check to be sure the caliper piston is fully bottomed in the cylinder bore. If necessary, use a large C-clamp to bottom the piston.

   The service replacement outer shoe and lining differ slightly from the shoe and lining originally installed. The replacement shoe has tabs on the flange at the lower edge of the shoe, and the distance between the upper tabs and lower flange is reduced to provide a slip-on interference fit.

4. Position the outer shoe and lining on the caliper, and use fingers to press the shoe tabs into place. If the shoe cannot be pressed into place by hand, use a C-clamp as shown in Fig. 22. Be careful not to damage the lining with the clamp.

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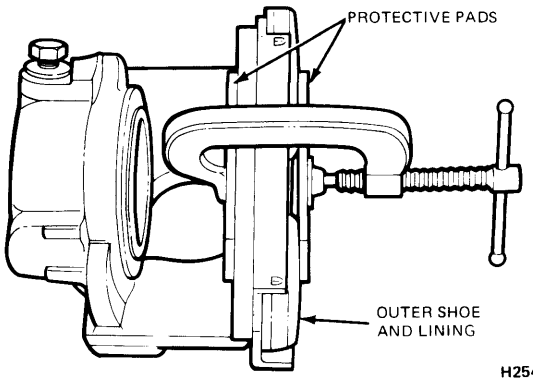


FIG. 22 Installing Outer Shoe and Lining

5. Position the caliper on the spindle assembly by pivoting caliper around the support upper mounting surface. Be careful not to tear or cut the boot as it slips over the inner shoe.
6. Using a brake adjusting tool or screwdriver (Fig. 23) to hold the upper machined surface of the caliper against the surface of the support assembly, install a new caliper support spring and new caliper support key (Figs. 24 and 25). Drive the key and spring assembly into position using a soft plastic mallet (Fig. 25), and install the key retaining screw. Tighten the screw to 12-20 ft-lb.

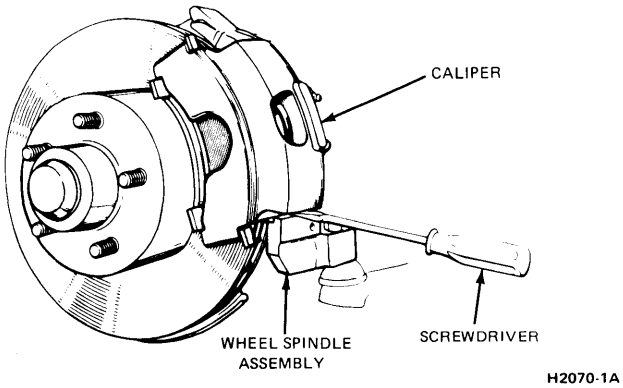


FIG. 23 Installing Caliper

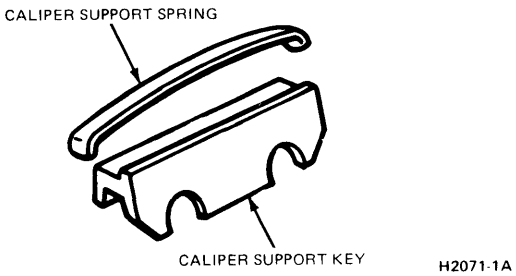


FIG. 24 Caliper Support Spring and Key

7. After new shoes and linings and the wheel assemblies have been installed on both front wheels, lower the vehicle. Check the master cylinder reservoirs, and fill, if necessary with heavy duty, (ESA-M6C25-A or equivalent), brake fluid.
8. Depress the brake pedal firmly several times to seat the linings on the rotor. **Do not move the vehicle until the pedal is firm.**
9. Bleed the brakes.

HD RAIL SLIDER DISC BRAKE CALIPER

F-250 (ABOVE 6800) F-350, E-250—E-350

Removal

1. Raise the front of the vehicle and remove the front wheel and tire assembly.
2. Disconnect the brake hose from the caliper. Plug the inlet port on the caliper and outlet on the hose.
3. Remove the key retaining screw, (Fig. 11).
4. Using a brass rod and light hammer, drive out the key and spring, (Fig. 12).
5. Remove the caliper from its support assembly by rotating the key and spring end out and away from the rotor. Slide the opposite end of the caliper clear of the slide in the support end off the rotor.
6. Thoroughly clean the areas of the caliper and support that contact during the sliding action of the caliper. Add a light coating of D7AZ-19590-A lubricant or equivalent to both sliding surfaces. Be careful not to get lube on rotors or linings. Wipe off any excess lube after assembly.
7. Clean any brake fluid, grease or grit off the rotor braking surfaces.

Installation

1. Position the caliper rail into the slide on the support and rotate the caliper onto the rotor.
2. Position the key and spring, (Fig. 14), and hand start the subassembly between the caliper and support. Note that the spring is between the key and caliper and that the spring tangs overlap the ends of the key, (Fig. 12). Use a brake adjusting tool or screwdriver to hold up the caliper, if required, against the support assembly.
3. Using a soft hammer, drive the key and spring into position aligning the correct notch with the existing hole in the support.
4. Secure the key to the support with the key retaining screw, (Fig. 11). Tighten the screw to 20 ft-lbs.
5. Connect the hydraulic hose to the caliper inlet port using new copper washers.
6. After the wheel assemblies have been installed, lower the vehicle. Check the master cylinder reservoirs, and fill, if necessary, with heavy duty, (ESA-M6C25-A or equivalent), brake fluid.
7. Depress the brake pedal firmly several times to seat the linings on the rotor. **Do not move the vehicle until the pedal is firm.**
8. Bleed the brake system.

LD SLIDING DISC BRAKE CALIPER

F-100—F-250, (6200/6800 G.V.W.), E-100—E-150, BRONCO AND F-150 (4X4)

Removal

1. Raise the vehicle, install safety stands, and remove the wheel and tire assembly.

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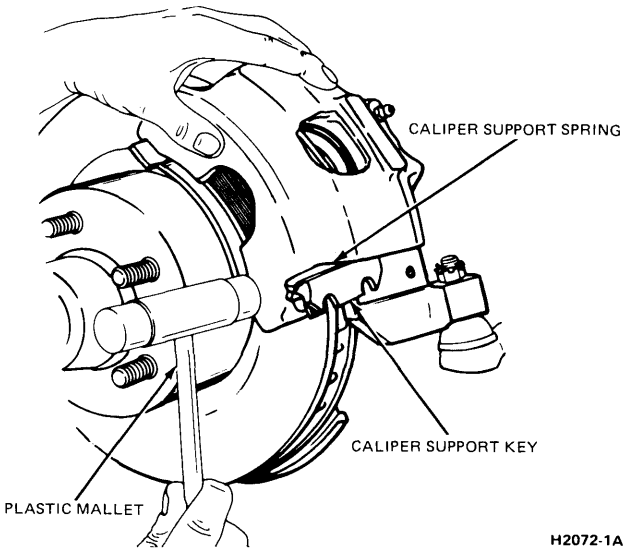


FIG. 25 Installing Caliper Support Spring and Key

2. Disconnect the brake hose from the caliper inlet port. Cap the hose and plug the inlet port to prevent fluid leakage.
3. Remove the caliper and the shoe and lining assemblies as described in this Part. **Do not get grease or brake fluid on the lining.**
4. Inspect the caliper housing for leakage, and overhaul the caliper if leakage is evident. A small amount of brake fluid wetness inside of the boot is normal.
5. Use a wire brush to remove any rust or corrosion from the machined surfaces of the support assembly and caliper. Thoroughly clean the areas of the caliper and spindle assembly that contact during the sliding action of the caliper.

Installation

1. Install the shoe and lining assemblies and the caliper as described in this Part.
2. Connect the hydraulic hose to the caliper inlet port. Install new copper washers.
3. Bleed the brake system.
4. Install the wheel and tire assembly and lower the vehicle.

DISC BRAKE HUB AND ROTOR

Removal

1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly.
3. Remove the caliper assembly from the rotor and hold it out of the way with wire. Refer to Caliper Removal instructions in this Part.
4. Remove the dust cap, cotter pin, nut, washer, and outer bearing, and remove the rotor from the spindle. (4x4 vehicles refer to Part 11-12, Wheels, Hubs and Bearings—Front Wheel Drive for procedures).
5. Remove inner bearing cone and seal. Discard the seal.

Installation

1. If a new hub and rotor will be installed, remove the protective coating or any dirt or grease deposits with degreaser.
2. Pack the inner and outer bearing cone with ESA-M1C75-B grease, or equivalent.
3. Install the inner bearing cone and seal as described in Part 11-10, Wheels, Hubs, and Bearings—Front (Except Front Drive). (4x4 vehicles refer to Part 11-12, Wheels, Hubs and Bearings—Front Wheel Drive, for procedures).
4. Install the hub and rotor on the spindle.
5. Install the outer bearing cone, washer, and nut. Adjust bearing end play and install the cotter pin and dust cap as described in Part 11-10, Wheels, Hubs and Bearings—Front (Except Front Drive). (4x4 vehicles refer to Part 11-12, Wheels, Hubs, and Bearings—Front Wheel Drive, for procedures).
6. Install the caliper as described in this Part.
7. Install the wheel and tire assembly.
8. Lower the vehicle.

MASTER CYLINDER

Removal

Refer to Fig. 26.

1. With the engine stopped, depress the brake pedal to expel all vacuum from the brake booster system.
2. Disconnect the hydraulic lines from the brake master cylinder.
3. Remove the brake booster-to-master cylinder retaining nuts and lock washers. Remove the master cylinder from the brake booster.

Installation

1. Before installing the master cylinder, check the distance from the outer end of the booster assembly push rod to the front face of the brake booster assembly. Turn the push rod adjusting screw in or out as required to obtain the specified length (Part 12-50, Vacuum Brake Booster—Single Diaphragm—Dash Mounted (Bendix) or Part 12-52, Vacuum Brake Booster—Tandem Diaphragm—Dash Mounted (Bendix) (Fig. 6)).

   Failure to maintain the specified length can prevent the master cylinder piston from completely releasing hydraulic pressure, causing the brakes to drag.
2. Check screw adjustment by fabricating a gauge as shown in Fig. 6, Part 12-50, Vacuum Brake Booster—Single Diaphragm—Dash Mounted (Bendix) or Part 12-52 Vacuum Brake Booster—Tandem Diaphragm—Dash Mounted (Bendix). Place the gauge against the master cylinder mounting surface of the booster body and adjust the push rod screw until the end of the screw just touches the inner edge of the slot in the gauge.
3. Position the master cylinder assembly over the booster push rod and onto the studs on the booster assembly. Install the attaching nuts and lock washers and tighten them to specification.
4. Loosely connect the hydraulic brake system lines to the master cylinder.

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5. Bleed the hydraulic brake system. Fill the dual master cylinder reservoirs with the specified brake fluid to within 1/4 inch of the top of the filler neck. Install the gasket and filler cap.

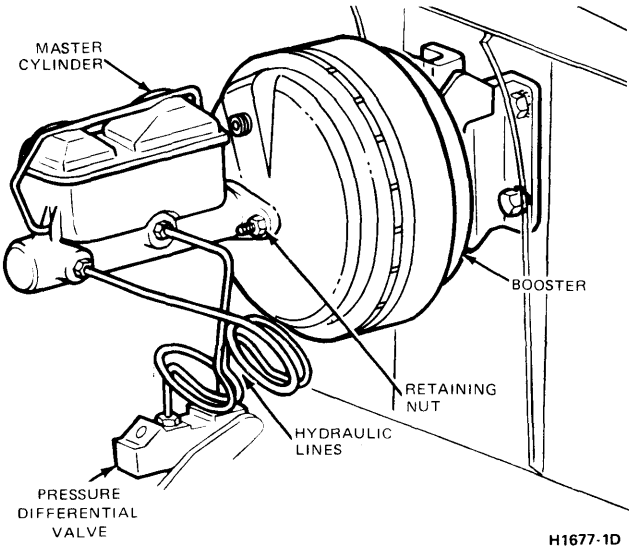


FIG. 26 Master Cylinder Installation on Booster—Typical

PRESSURE DIFFERENTIAL, METERING AND PROPORTIONING VALVE

Removal

1. Raise the vehicle on a hoist. Disconnect the brake warning light wire from the pressure differential valve assembly switch. **To prevent damage to the brake warning switch wire connector, expand the plastic lugs to allow removal of the shell-wire connector from the switch body.**
2. Disconnect the five hydraulic lines from the inlet and outlet ports of the valve assembly.
3. Remove the screws holding the pressure differential valve assembly to the mounting bracket or frame rail and remove the valve assembly.
4. If the differential valve is to be replaced, remove the brake warning lamp switch and install the switch in the new differential valve. **The pressure differential valve assembly and the brake warning lamp switch are separate units and must be serviced individually.**

Installation

1. Mount the pressure differential valve assembly on the mounting bracket and tighten the attaching screw.
2. Connect the five hydraulic lines to the valve assembly and tighten the tube nuts securely.
3. Connect the shell-wire connector to the brake warning lamp switch. **Make sure the plastic lugs on the connector hold the connector securely to the switch.**
4. Bleed the brakes.

BRAKE PEDAL

Removal and Installation

Refer to Part 12-02, Drum Brakes—Single Cylinder, Dual Piston for service procedures.

DISASSEMBLY AND ASSEMBLY

DISC BRAKE CALIPER—HD RAIL SLIDING CALIPER

Refer to Fig. 27.

If the caliper assembly is leaking, replace the piston assemblies. If the cylinder bores are scored, corroded or excessively worn, replace the cylinder housing. **Do not hone the cylinder bores. Piston assemblies are not available for oversize bores.**

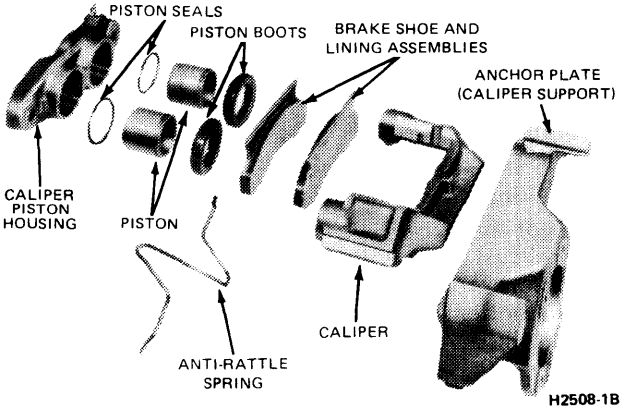


FIG. 27 Front Disc Brake Caliper Disassembled—HD Rail Slider

Disassembly

1. Disconnect the flexible brake hose and plug the end to prevent brake fluid leakage. Remove the caliper, retaining screw support key and spring and remove the caliper assembly.
2. Remove the brake shoe and lining assemblies and anti-rattle spring.
3. Drain the fluid from the cylinders.
4. Secure the caliper assembly in a vise.
5. Place a block of wood between the caliper bridge and the cylinders, and apply low pressure air to the brake hose inlet. The pistons will be forced out to the wood block.
6. Remove the wood block, and remove the pistons.
7. Remove the bolts and washers that attach the caliper to the cylinder housing and separate the caliper from the housing.
8. Remove and discard the piston seals.

Assembly

Never re-use piston seals and dust boots. Install a new set each time the caliper is assembled.

1. Lubricate new piston seals with clean brake fluid and install them in the seal grooves in the cylinder bores.

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2. Apply a film of clean brake fluid to the cylinder bores.
3. Lubricate the retaining lips of the dust boots with clean brake fluid and install them in the boot retaining grooves in the cylinder bores.
4. Apply a film of clean brake fluid to the pistons.
5. Insert the pistons into the dust boots and start them into the cylinders by hand until they are beyond the piston seals. **Be careful not to damage or dislodge the piston seal.**
6. Place a wood block over one piston and press the piston into the cylinder being careful not to cock the piston in the cylinder. Install the second piston in the same manner. Make certain that boots are correctly seated.
7. Place the piston housing on the caliper and install the piston housing-to-caliper mounting bolts and washers. Tighten the bolts to 155-185 ft-lb.
8. Install the shoe and lining assemblies and anti-rattle clip in the caliper assembly. Place the caliper assembly on the support and install the caliper support spring, key and the key retaining screw. Tighten screw to 12-20 ft-lbs.
9. Install the flexible brake hose and tighten to specification.
10. Bleed the brake system. **Do not move the vehicle until a firm brake pedal is obtained.**

DISC BRAKE CALIPER—SLIDING CALIPER—LD

Disassembly

1. Clean the exterior of the caliper in denatured alcohol.
2. Remove the plug from the caliper inlet port, and drain the fluid from the caliper housing.
3. Position the caliper as shown in Fig. 28 and place a block of wood between the piston and the outer legs of the caliper.

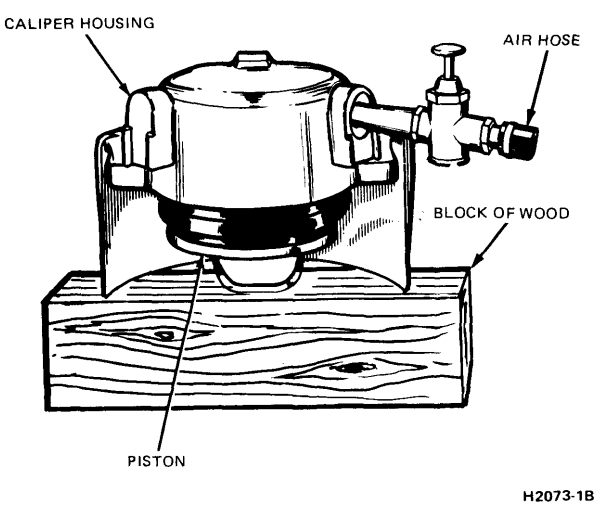


FIG. 28 Removing Caliper Piston

4. **Slowly and carefully** apply air pressure to the caliper inlet port until the piston comes out of the caliper. **Use low air pressure to remove the piston. If high pressure is applied, the piston may pop out with considerable force and cause personal injury. Also, be careful to avoid a spray of brake fluid.**
5. If the piston is jammed or cocked and will not come out readily, release the air pressure and tap sharply on the end of the piston with a soft (brass) hammer to straighten the piston. **Do not use a sharp tool to pry the piston out of the bore.** Then, re-apply air pressure and remove the piston, following the precautions in Step 4.
6. Remove the boot from the piston and the seal from the caliper cylinder bore (Fig. 29).

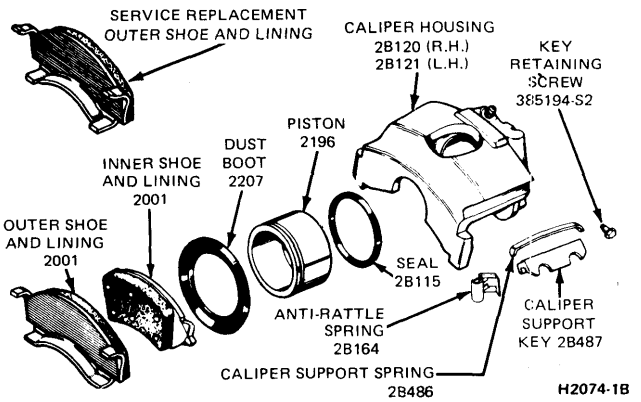


FIG. 29 Disc Brake Caliper—Disassembled—LD Sliding Caliper

CLEANING AND INSPECTION

Use a wire brush to remove any rust or corrosion from the machined surfaces of the caliper housing **(do not use a wire brush in the cylinder bore).**

Clean the caliper housing and the piston with clean denatured alcohol. Clean and dry the grooves and passages with clean compressed air. Be sure the cylinder bore is free of foreign matter.

Check the cylinder bore, seal groove, and boot groove in the bore and the piston for damage or excessive wear. Replace the piston if it is pitted, scored or worn. Use a wire brush to clean corrosion from the boot groove and the machined surfaces of the spindle assembly.

Replace the anti-rattle clip, caliper support spring and caliper support key, piston seal and dust boot with new components.

Assembly

1. Lubricate the piston seal with clean brake fluid, and position the seal in the groove in the cylinder bore.
2. Coat the outside of the piston and both beads of the dust boot with **clean** brake fluid. Insert the piston through the dust boot until the boot is around the bottom (closed end) of the piston (as shown in Fig. 30).
3. Hold the piston and dust boot directly above the caliper cylinder bore, and use fingers to work the bead of the dust boot into the groove near the top of the cylinder bore.

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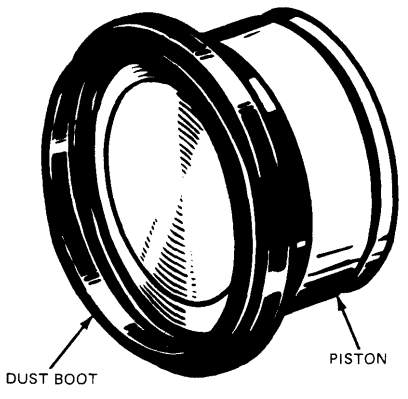


FIG. 30 Piston and Dust Boot Assembly

4. After the bead is seated in the groove, press straight down on the piston until it bottoms in the bore. **Be careful not to cock the piston in the bore.** Use a C-clamp with a block of wood inserted between the clamp and piston to bottom the piston, if necessary.

DISC BRAKE ROTOR

Each time the brakes are serviced, the disc brake rotor should be checked for scoring, runout, parallelism and thickness.

Rotor scoring and runout may be checked on most brakes with the caliper either on or off. To check parallelism and thickness, the caliper must be removed.

Rotor specifications are listed in the Specifications at the end of this Part.

ROTOR RUNOUT

Rotor runout is the side-to-side movement or wobble of the rotor as it rotates. Excessive runout may cause vibration, pedal pumping or brake chatter. Use the following procedure to check rotor runout.

1. Tighten the spindle nut to eliminate all end play from the bearings. Be sure the hub and rotor can be turned.
2. Attach a dial indicator to some part of the vehicle suspension so the stylus of the indicator touches the surface of the rotor approximately one inch from outer edge of the rotor (Fig. 31).

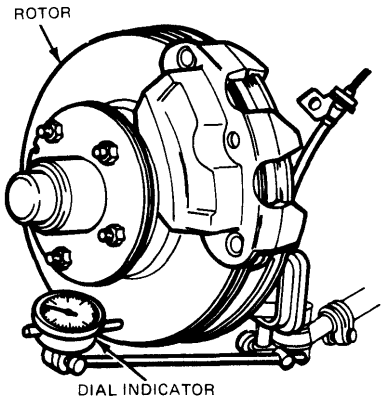


FIG. 31 Checking Rotor Runout

Note—Installing the wheel bolts helps to obtain more accurate readings.

3. Set the dial indicator to zero, slowly turn the rotor one complete turn and note the high and low readings on the dial. The total between the high and low reading must not exceed the specified runout limit.
4. Refinish or replace the rotor as required.

CAUTION—Be sure to adjust the spindle nut to specifications after the runout check.

PARALLELISM

Parallelism is the variations in the thickness of the rotor. If the two rubbing surfaces of the rotor are not parallel, the rotor may cause excessive pedal travel, a pulsating pedal, or noise.

Two methods can be used to check if the two faces of a rotor are parallel. A micrometer can be used to measure the rotor thickness at 12 points approximately 30 degrees apart and one inch from the outer edge of the rotor.

The other method is to mount the rotor on a precision lathe designed for machining disc brake rotors. Attach two dial indicators, one one each side of the rotor, so that the stylus of each indicator contacts the rubbing surface approximately one inch from the outer edge of the rotor.

Zero both indicators and rotate the rotor while watching both dials. If the total readings of both indicators exceed the specified limit for parallelism, the rotor must be refinished or replaced.

ROTOR THICKNESS

Measure the thickness of the rotor to determine if it is within the specifications listed at the end of this Part. Disc brake rotors have a minimum thickness dimension (minimum wear thickness or discard thickness). This is not the refinishing dimension.

CAUTION—Never refinish a rotor to the minimum wear or discard thickness.

Refinishing

Use a disc brake lathe to refinish the disc brake rotors.

A maximum of 0.020 inch of material may be machined equally off each surface (A and B, Fig. 32). Replace the rotor if thickness falls below the minimum thickness shown on the rotor.

The finished braking surfaces of the rotor must be flat and parallel within 0.0007 inch for Integral Hub and Rotor, .005 for F-150—F-250 (4x4) and B-150, or .001 inch for E-350, F-350 Separate Hub and Rotor Lateral run out must not exceed .003 inch for Integral Hub and Disc at 10.6 inch diameter or 0.010 inch for Separate Hub and Disc total indicator reading on the inboard surface at a 6 inch radius. The surface finish of the braking surfaces must be 15 to 80 micro-inches.

DUAL-BRAKE SYSTEM MASTER CYLINDER

Refer to Fig. 33.

Remove the master cylinder from the vehicle for overhaul.

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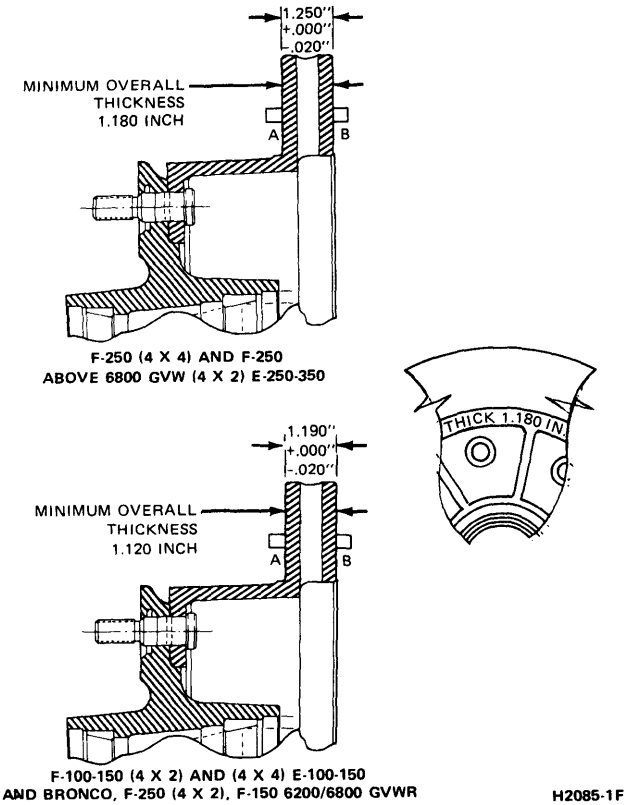


FIG. 32 Disc Brake Rotor Service Limits

During the vehicle warranty period, replace a damaged master cylinder assembly. Do not disassemble or repair it. After the warranty period, overhaul the cylinder using a service repair kit.

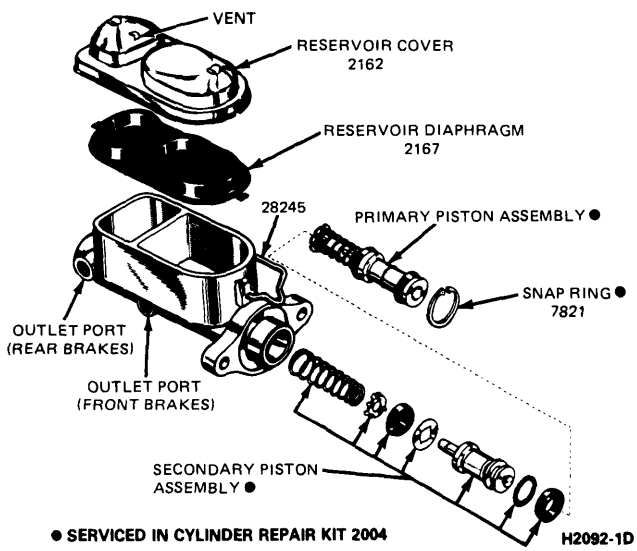


FIG. 33 Dual Brake System Master Cylinder

Disassembly

1. Clean the outside of the master cylinder and remove the reservoir cover and diaphragm. Drain any fluid that remains in the cylinder.
2. Unscrew the piston stop from the bottom of the cylinder body. Remove the O-ring seal from the piston stop. Discard the seal.
3. On F-100-150-F250 (4x2) 6200/6800 G.V.W. and E-100-150, unscrew the piston stop screw from the bottom of the secondary reservoir. There is no O-ring seal on this piston stop screw.
4. Remove the snap ring (Fig. 34) holding the primary and secondary piston assemblies in the cylinder body.

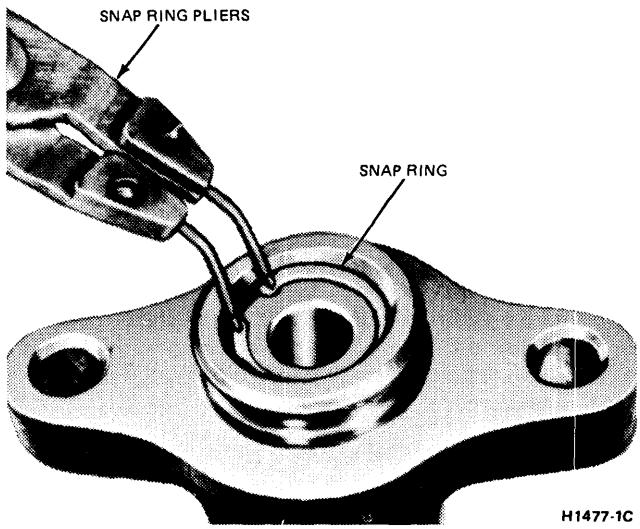


FIG. 34 Removing Snap Ring—Typical

5. Remove the primary piston assembly from the master cylinder. Discard the primary piston assembly.
6. Apply an air hose to the rear brake outlet port of the cylinder body and blow the secondary piston out of the cylinder body. **Use low air pressure to remove piston. If high pressure is applied, the piston may pop out with considerable force and cause personal injury.**
7. Remove the return spring and cup protector from the secondary piston. Discard the piston.

INSPECTION AND REPAIR

1. Clean all parts in **clean** isopropyl alcohol or the Rotunda brake parts washer (model 650016) or equivalent, and inspect for chipping, excessive wear or damage. Replace parts as required. **When using a master cylinder repair kit, follow the instructions in the kit, and install all the parts supplied.**
2. Check all recesses, openings and internal passages to be sure they are open and free from foreign matter. Use the air hose to blow out dirt and cleaning solvent. Place all parts on a clean pan or paper.
3. Inspect the hydraulic master cylinder bore for etching, pitting, or rust. If any of these conditions are present, replace the master cylinder.

Assembly

1. Dip all the parts **except the cylinder body in clean** C6AE-19542-A extra heavy duty brake fluid or equivalent and lubricate the bare walls with the clean brake fluid.
2. Assemble the secondary cup and O-ring in the

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grooves near the end of the secondary piston. Assemble the cup protector, primary cup, spring retainer, and secondary piston return spring on the other end of the secondary piston.

3. Install the secondary piston assembly in the master cylinder.

   Note: The seals should be wetted with brake fluid and caution used when inserting the piston assemblies into the bore to prevent mount damage to the seals.

4. Install a **new** O-ring on the piston stop, and start the stop into the cylinder body.
5. On F-100, F-250 (4x2) and 6200/6800 G.V.W., install the piston stop screw in the bottom of the secondary reservoir. There is no O-ring seal on the screw.
6. Install the primary piston assembly in the master cylinder. Push the primary piston inward and tighten the secondary piston stop to retain the secondary piston in the bore.
7. Place the stop plate and snap ring on the primary piston. Depress the primary piston and install the snap ring in the cylinder body.
8. Bleed the master cylinder before installing it on the vehicle.

BLEEDING THE MASTER CYLINDER

1. Support the master cylinder body in a vise, and fill both fluid reservoirs with ESA-M6C25A extra heavy duty brake fluid or equivalent.
2. Loosely install plugs in the front and rear brake outlet bores. Depress the primary piston several times until air bubbles no longer appear in the brake fluid.
3. Tighten the plugs and attempt to depress the piston. **Piston travel should be restricted after all air is expelled.**
4. Remove the plugs and install the cover and diaphragm assembly. Be sure the cover retainer is tightened securely.

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SPECIFICATIONS

TORQUE LIMITS — H.D. RAIL SLIDER

Description	(ft-lbs)	N•m
Key Retaining Screw	12-20	17-27
Piston Housing-to-Caliper Mounting Bolts	155-185	211-250
Spindle/Anchor Plate/Dust Shield/to Steering Knuckle — Bronco F-250 4x4	50-60	68-81
Anchor Plate to Spindle	74-102	101-138
Brake Hose to Caliper Attaching Bolt	17-25	24-33

DISC BRAKE SHOE AND LINING DIMENSIONS (INCHES) — H.D. RAIL SLIDER CALIPER

Lining Length	7.42	
Lining Area (Per Brake)	12.97 Sq. In.	
Lining Thickness	.436 Min.	
Lining Maximum Wear Limit (from front surface of shoe above backing plate)	1/32 Inch	
Lining Material	Inner	7161-A
	Outer	7157

TORQUE LIMITS — HYDRAULIC TUBE NUTS (FT.-LBS.)

Thread Size	(ft-lbs) (1)	N•m
3/8-24	8-15	11-20
7/16-24	12-17	17-23
1/2-20	12-17	17-23
9/16-18	15-25	21-33

(1) All hydraulic line connections (nuts) must be tightened to the specified valve and free of fluid leakage.

ROTOR REPAIR DIMENSIONS (INCHES)

Minimum Rotor Thickness (Discard Rotor)	Bronco, F150 (4x4)	1.12
	F250 (4x4)	1.18
	L.D. Integral Hub & Rotor	1.12
	H.D. Integral Hub & Rotor	1-18
	2-Piece Hub & Rotor	1-18
Rotor Thickness Maximum Variation	Integral Hub & Rotor	0.0007
	Separate Hub & Rotor	0.0010
Lateral Runout (maximum) (1)(2)	Integral Hub & Rotor	0.003
	Separate Hub & Rotor	0.010
Rotor Surface Finish		15-80 R.M.S.

(1) Total Indicator Reading on both surfaces at I.D. 6-inch Dia.

SLIDING CALIPER DISC BRAKE DIMENSIONS (INCHES)

Lining Material		Bendix FMB 7133
	F100/F150 (4x2) (4x4), E100/E150, U100	F250 (4x2) Regular Cab 6200 and 6900 GVW
Lining Size (Inch)		
Outer	6.98 x 1.80	6.96 x 1.80
Inner	4.30 x 1.80	4.28 x 1.80
New Lining Thickness (Inch) Min. to Rivet		
Outer	0.250	0.250
Inner	0.346	0.346
New Shoe and Lining Thickness (Inch) Nominal		
Outer	0.535	0.535
Inner	0.695	0.695
Wear Limit — Minimum Thickness (Above Rivet Heads)	0.030	
Caliper Piston Diameter — Nominal	2.875	

Disc Diameter — Nominal	11.720
New Disc Thickness — Nominal	1.185
Disc Thickness — Minimum After Re-Surfacing	1.120
Disc Runout — Maximum — Integral Hub and Disc	0.003
— Separate Hub and Disc	0.005
Disc Thickness Variation — Maximum	
— Integral Hub and Disc	0.0007
— Separate Hub and Disc	0.001
Rotor Surface Finish	15-80 RMS

TORQUE SPECIFICATIONS

Support Key Retaining Screw	12-20 Ft.-Lbs. (17-27 N•m)

CH2487-2D

SPECIAL TOOLS

Number	Description
110011	Brake Bleeder
650016	Brake Parts Washer

CH2701-1A

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Vacuum Brake Booster — Single Diaphragm — Dash-Mounted (Bendix)

PART 12-50

APPLIES TO F-100, F-150, F-250, (6200/6800 GVWR), E-100, E-150, F-150 — F-250 (4x4) AND BRONCO

SUBJECT	PAGE
DESCRIPTION	50-1
ADJUSTMENTS	
Push Rod Adjustment	50-2
REMOVAL AND INSTALLATION	
Booster	
F-100, F-150, F-250 (6200/6800 GVWR), E-100, E-150, F-150, F-250 (4x4), Bronco	50-2
DIAGNOSIS AND TESTING	50-3

DESCRIPTION

Service information (vacuum boosters only) is given here. Adjustments and repairs for the hydraulic brake systems are given in Parts 12-01, General Hydraulic Brake Service and 12-02, Drum Brakes—Single Cylinder, Dual Piston.

The single diaphragm vacuum booster is a self-contained vacuum hydraulic power braking unit. It is a vacuum-suspended unit that uses engine manifold vacuum and atmospheric pressure for its power. The booster consists of three basic elements combined into a single unit as shown in Figs. 1 and 2.

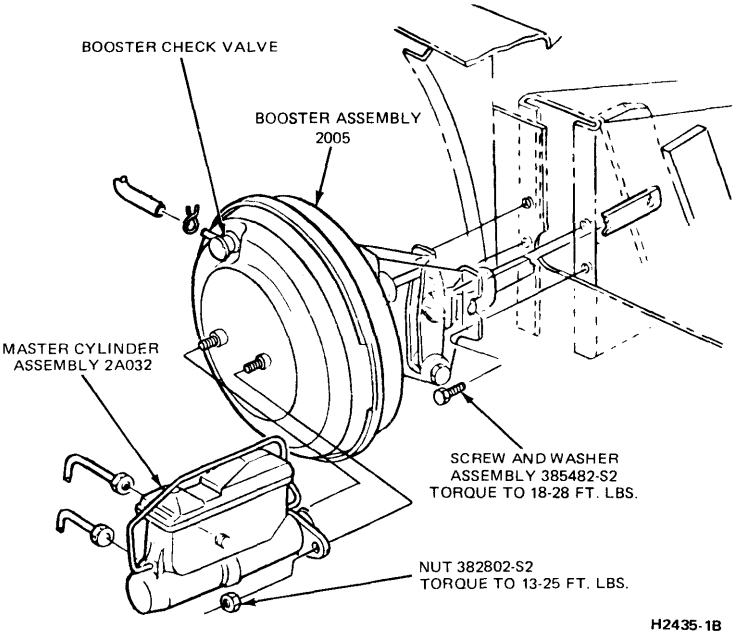


FIG. 1 F-100—F-250 (6200/6800 GVWR) Bronco Booster and Dual Master Cylinder

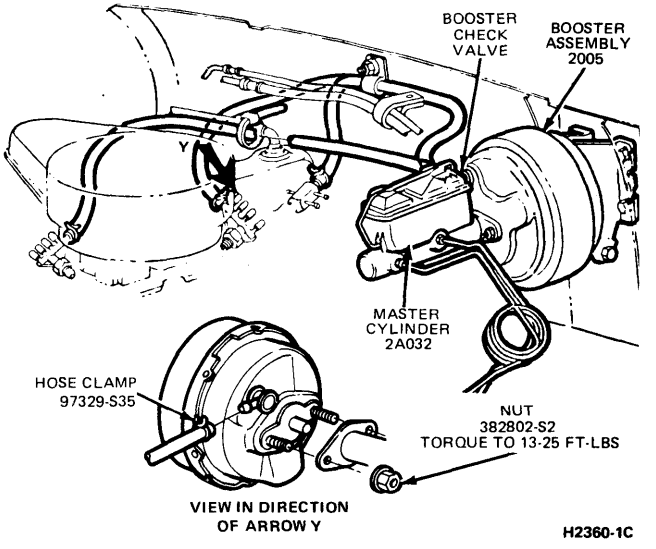


FIG. 2 E-100—E-250 Brake Booster Installation

The three basic elements are:

1. A vacuum power chamber consisting of a front and a rear shell, diaphragm, diaphragm plate, hydraulic push rod, and vacuum diaphragm return spring.
2. A mechanically actuated booster check valve, integral with the vacuum power diaphragm, which controls the degree of power brake application and release in accordance with foot pressure applied to the valve operating rod through the brake pedal linkage.
3. A hydraulic dual master cylinder which supplies hydraulic pressure to the brake system.

The Bendix single diaphragm, dash-mounted booster is not repairable and booster must be replaced as a unit. The booster check valve is the only component which can be serviced on the booster assembly.

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ADJUSTMENTS

PUSH ROD ADJUSTMENT

The push rod has an adjustment screw to maintain the correct relationship between the booster control valve plunger and the master cylinder piston. If the plunger is too long it will prevent the master cylinder piston from completely releasing hydraulic pressure, causing the brakes to drag. If the plunger is too short it will cause excessive pedal travel and an undesirable clunk in the booster area. Remove the master cylinder for access to the booster push rod.

To check the adjustment of the screw, fabricate a gauge and place it against the master cylinder mounting surface of the booster body as shown in Fig. 3. Adjust the push rod screw by turning it until the end of the screw just touches the inner edge of the slot in the gauge.

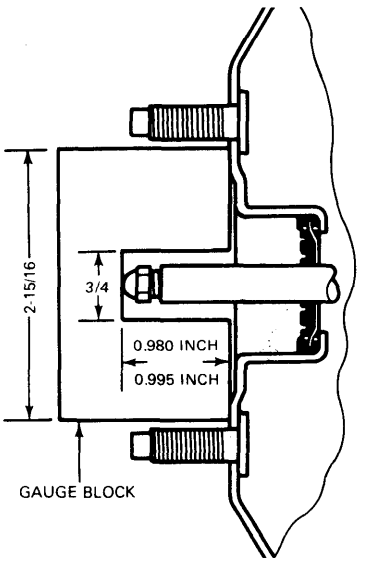


FIG. 3 Booster Push Rod Gauge Dimensions and Adjustment

REMOVAL AND INSTALLATION

BOOSTER

F-100, 150, F-250, 6200/6800 GVWR, E-100, E-150-F-150-F-250 (4X4) BRONCO

Note: Make sure that the booster rubber reaction disc is properly installed as shown in Fig. 4 if the master cylinder push rod is removed or accidentally pulled out. A dislodged disc may cause excessive pedal travel and extreme operation sensitivity. The disc is black compared to the silver colored valve plunger that will be exposed after the push rod and front seal is removed. The booster unit is serviced as an assembly and must be replaced if the reaction disc cannot be properly installed and aligned, or if it cannot be located within the unit itself.

Removal

1. Disconnect the stop lamp switch wiring to prevent running the battery down.
2. Support the master cylinder from the underside with a prop.
3. Remove the master cylinder-to-booster retaining nuts.
4. Loosen the clamp that secures the manifold vacuum hose to the booster check valve, and remove the hose. Remove the booster check valve.
5. Pull the master cylinder off the booster and leave it supported by the prop, far enough away to allow removal of the booster assembly.
6. From inside the cab on vehicles equipped with push rod mounted stop lamp switch, remove the retaining pin and slide the stop lamp switch, push rod, spacers and bushing off the brake pedal arm. On vehicles equipped with brake pedal mounted stop lamp switch remove the attaching bolt, nut and plastic bushing, and disconnect the booster push rod from the brake pedal.
7. From the engine compartment remove the bolts that attach the booster to the dash panel.

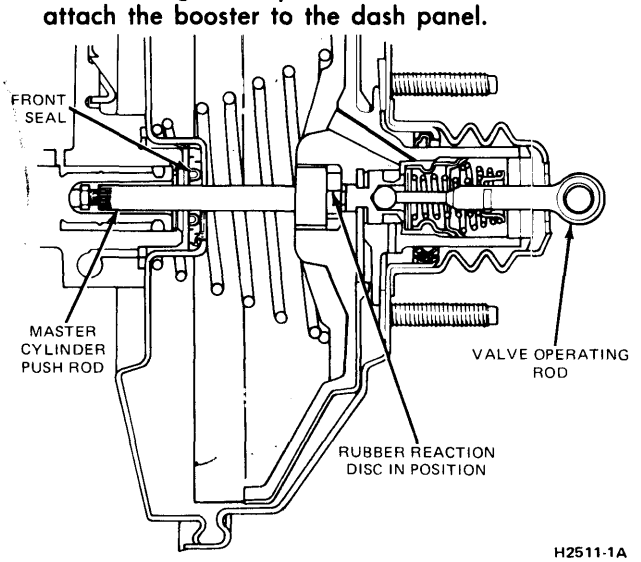


FIG. 4 Checking Reaction Disc Installation—Single Diaphragm 11 Inch Vacuum Booster

Installation

1. Mount the booster assembly on the engine side of the dash panel by sliding the bracket mounting bolts and valve operating rod in through the holes

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in the dash panel. Note: Make certain that the booster push rod is positioned on the correct side of the master cylinder to install onto the push pin prior to tightening the booster assembly to the dash.

2. From inside the cab on E-100—E-350 and Bronco, install the booster mounting bracket-to-dash panel retaining nuts.
3. Position the master cylinder on the booster assembly, install the retaining nuts, and remove the prop from underneath the master cylinder.
4. Install the booster check valve. Connect the manifold vacuum hose to the booster check valve and secure with the clamp.
5. From inside the cab on vehicles equipped with push rod mounted stop lamp switch, install the bushing and position the switch on the end of the push rod. Then install the switch and rod on the pedal arm, along with spacers on each side, and secure with the retaining pin. On vehicles equipped with pedal mounted stop lamp switch, connect the booster valve operating rod to the brake pedal with the attaching bolt, nut and plastic bushing.
6. Connect the stop lamp switch wiring.
7. Start the engine and check brake operation.

DIAGNOSIS AND TESTING

Refer to Part 12-01, General Hydraulic Brake Service.

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Vacuum Brake Booster — Tandem Diaphragm-Dash-Mounted (Bendix)

PART 12-52

APPLIES TO F-350, E-350

SUBJECT	PAGE
DESCRIPTION	52-1
DIAGNOSIS AND TESTING	52-3
ADJUSTMENTS	
Push Rod	52-3
REMOVAL AND INSTALLATION	
Vacuum Booster	52-3

DESCRIPTION

Service information for only the vacuum booster is given here. Adjustments and repairs for the hydraulic brake-system are given in Parts 12-01, General Hydraulic Brake Service, and 12-24, Disc Brakes—Light and Heavy Duty—Sliding Caliper.

The tandem diaphragm vacuum booster, is a self-contained vacuum hydraulic power braking unit. It is a vacuum suspended unit that uses engine manifold vacuum and atmospheric pressure for its power. The booster consists of three basic elements combined into a single unit, as shown in Figs. 1 and 2.

The three basic elements are:

1. A vacuum power chamber consisting of a front and a rear shell, center plate, front and a rear diaphragm, hydraulic push rod, and vacuum diaphragm return spring.
2. A mechanically actuated control valve, integral with the vacuum power diaphragms, which controls the degree of power brake application and release in accordance with the foot pressure applied to the valve operating rod throughout the brake pedal linkage.
3. A hydraulic dual master cylinder which supplies hydraulic pressure to the brake system. **The Bendix tandem diaphragm, dash-mounted booster is not repairable and must be replaced as a unit.**

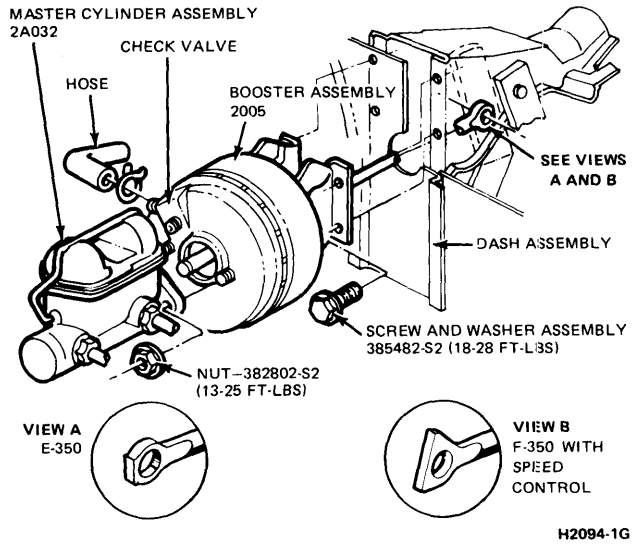


FIG. 1 F-350, E-350 Tandem Vacuum Booster and Dual Master Cylinder

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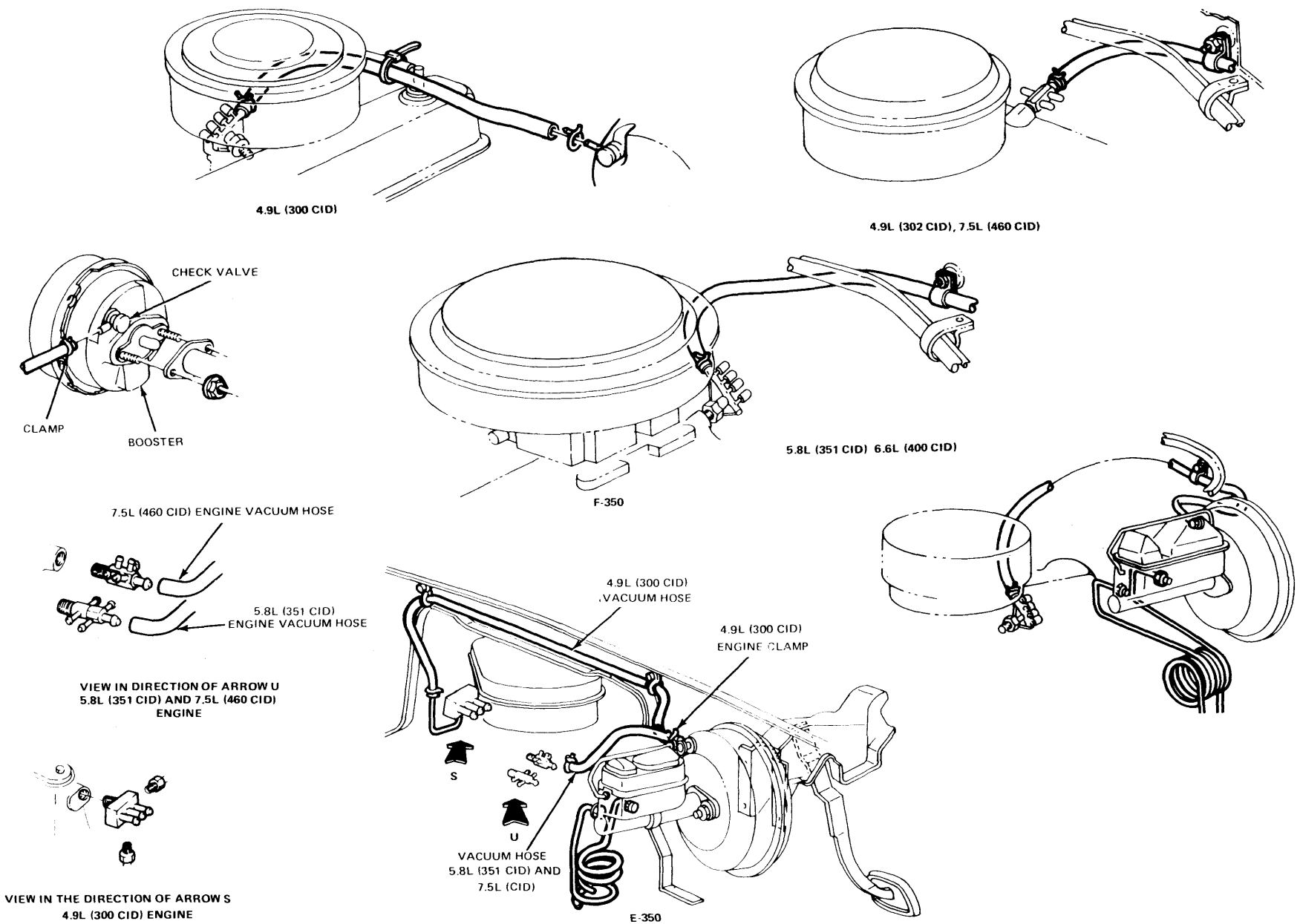


FIG. 2 Vacuum Line and Hose Installations—E-350, F-350,

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DIAGNOSIS AND TESTING

Refer to Part 12-01, General Hydraulic Brake Service.

ADJUSTMENTS

PUSH ROD

The push rod has an adjustment screw to maintain the correct relationship between the booster control valve plunger and the master cylinder piston. If the plunger is too long it will prevent the master cylinder piston from completely releasing hydraulic pressure, causing the brakes to drag. If the plunger is too short it will cause excessive pedal travel and an undesirable clunk in the booster area. Remove the master cylinder for access to the booster push rod.

To check the adjustment of the screw, fabricate a gauge and place it against the master cylinder mounting surface of the booster body as shown in (Figs. 3 and 4). Adjust the push rod screw by turning it until the end of the screw just touches the inner edge of the slot in the gauge.

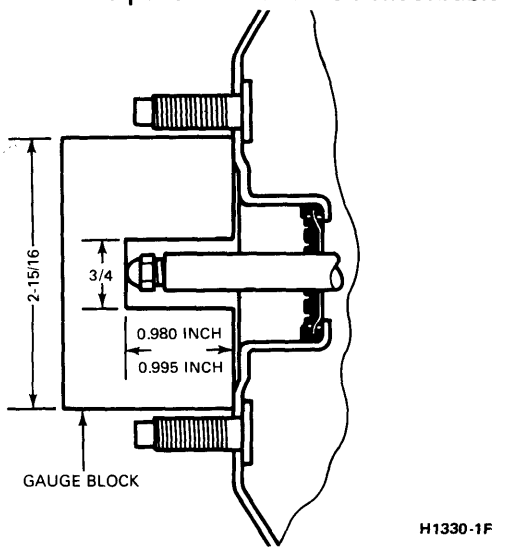


FIG. 3 Bendix Booster Push Rod Gauge Dimensions and Adjustments—E-350

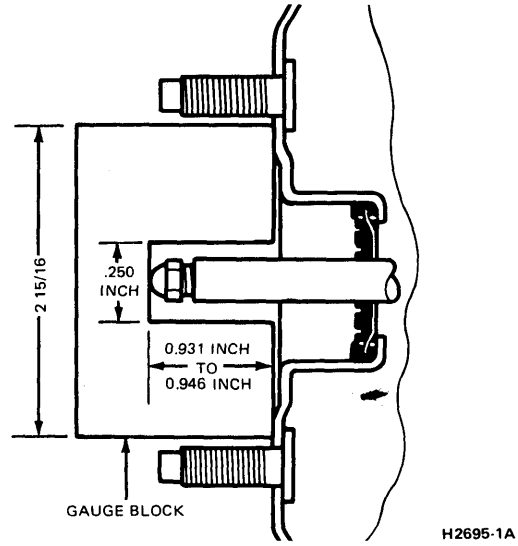


FIG. 4 Bendix Booster Push Rod Gauge Dimensions and Adjustments—F-350

REMOVAL AND INSTALLATION

VACUUM BOOSTER

Removal

1. Disconnect the stop lamp switch wiring to prevent running the battery down.
2. Support the master cylinder from the underside with a prop.
3. Remove the master cylinder-to-booster retaining nuts.
4. Loosen the clamp that secures the manifold vacuum hose to the booster, and remove the hose.
5. Pull the master cylinder off the booster and leave it supported by the prop, far enough away to allow removal of the booster assembly.
6. From inside the cab on vehicles equipped with push rod mounted stop lamp switch, remove the retaining pin and slide the stop lamp switch, push rod, spacers and bushing off the brake pedal arm.

   On vehicles equipped with brake pedal mounted stop lamp switch remove the attaching bolt, nut and plastic bushing and disconnect the booster push rod from the brake pedal. Remove the bolts that hold the booster mounting bracket to the engine compartment.
7. Remove the booster assembly from the engine compartment.

Installation

1. Mount the booster and bracket assembly on the engine side of the dash panel by sliding the valve operating rod in through the holes in the dash panel and securing it with bolts from engine compartment.
2. Position the master cylinder on the booster assembly, install the retaining nuts, and remove the prop from underneath the master cylinder.
3. Connect the manifold vacuum hose to the booster and secure with the clamp.
4. From inside the cab on vehicles equipped with push rod mounted stop lamp switch, install the bushing and position the switch on the end of the push rod. Then install the switch and rod on the pedal arm, along with spacers on each side, and secure with the retaining pin.

   On vehicles equipped with brake pedal mounted stop lamp switch connect the booster valve operating rod to the brake pedal with the attaching bolt, nut and plastic bushing.
5. Connect the stop lamp switch wiring.
6. Start the engine and check brake operation.

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Parking Brake—Cable Actuated, Rear Wheels

PART 12-70

APPLIES TO BRONCO, E-100 — 350, F-100 — 350

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Cable Actuated Rear Wheel Parking Brake	70-1
DIAGNOSIS AND TESTING	70-6
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Cable Actuated Rear Wheel Parking Brake F-100 — F-350, Bronco, E-100 — E-350	70-6
Final Adjustment All Light Trucks	70-6
Pre-Tension Procedure All Light Trucks	70-6
REMOVAL AND INSTALLATION	
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Parking Brake Equalizer to Control Assembly Cable, F-100 — F-350, E-100 — E-350 Bronco	70-7
Parking Brake Equalizer to Rear Wheel Cable F-100 — F-350, E-100 — E-350 Bronco	70-7
SPECIFICATIONS	70-8

DESCRIPTION

CABLE ACTUATED REAR WHEEL PARKING BRAKE

On F-100—F-350, E-100—E-350 and Bronco each rear wheel brake assembly contains a cable actuated parking brake assembly (Figs. 1 and 2).

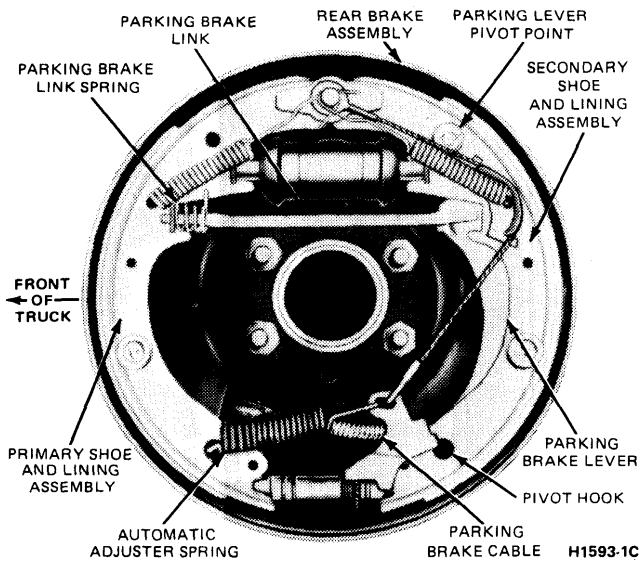


FIG. 1 Parking Brake Assembly-Cable Operated—E-100—E-150, F-100—F-150, Bronco

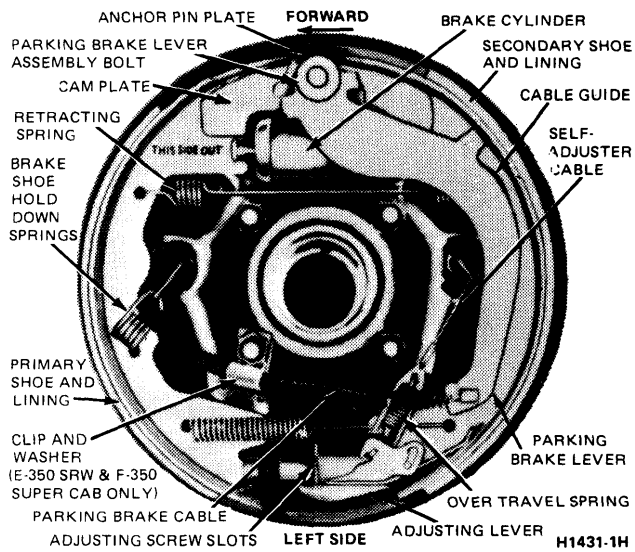


FIG. 2 Parking Brake Assembly-Cable Operated—E-250—E-350, F-250—F-350 H.D. Rear Brakes

On F-100—F-350, E-100—E-350 and Bronco, the manually operated parking brake lever cable is routed to the equalizer lever (Figs. 3 thru 7 and 8), which connects to the parking brake lever assembly in each rear wheel, through the equalizer assembly and brake cables.

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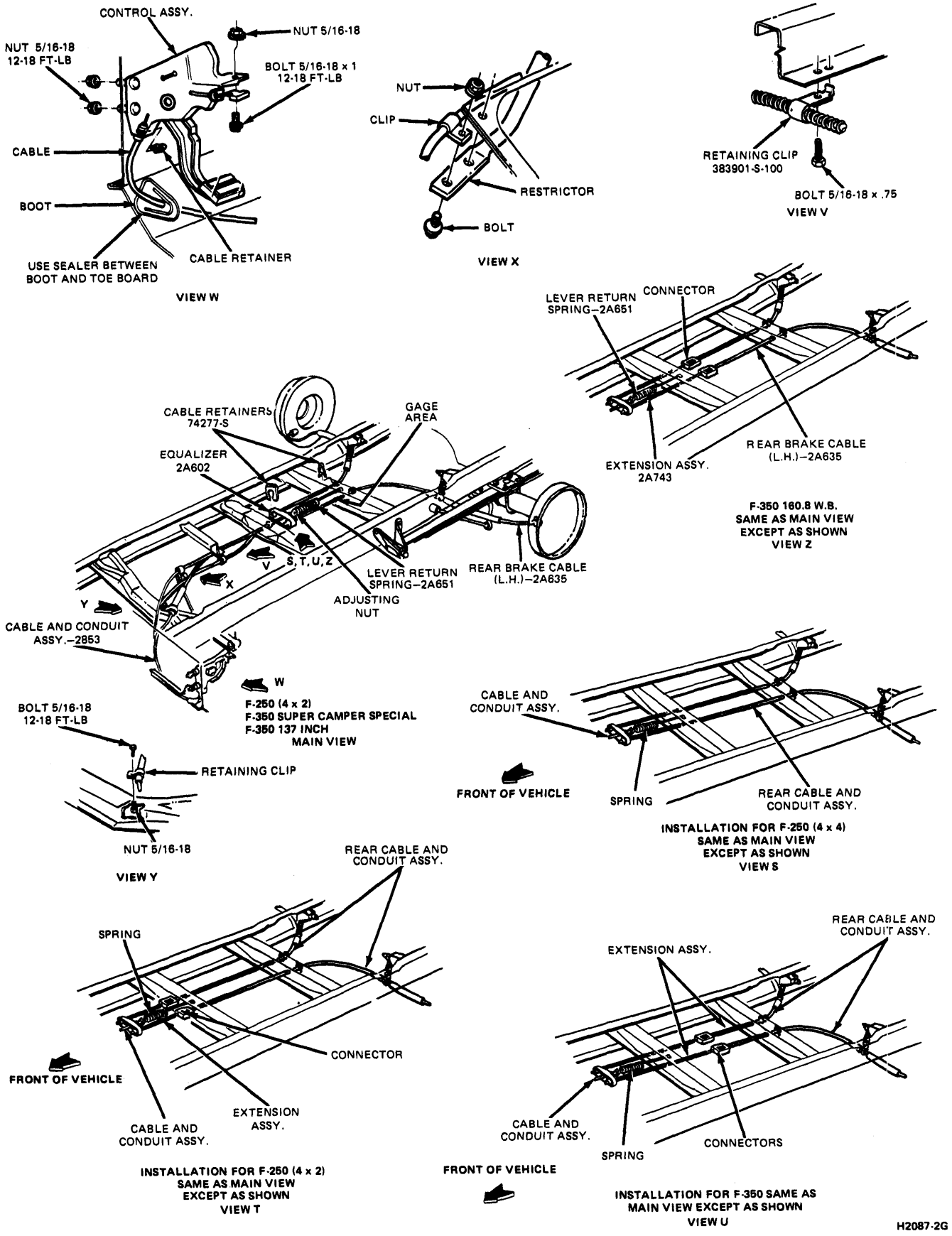


FIG. 3 Parking Brake System—F-250, F-350

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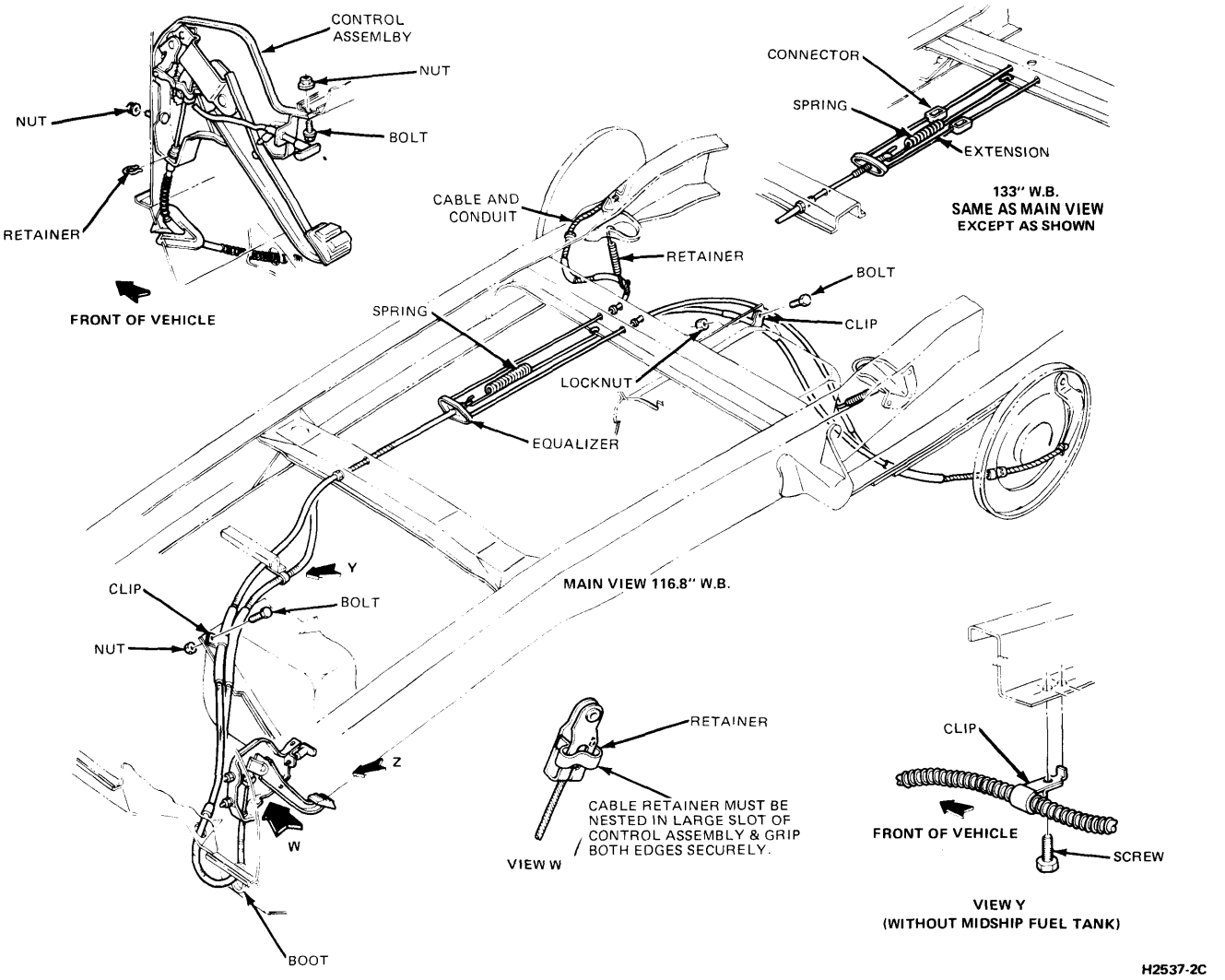


FIG. 4 Parking Brake System—F-100—F-150, F-150 (4x4)

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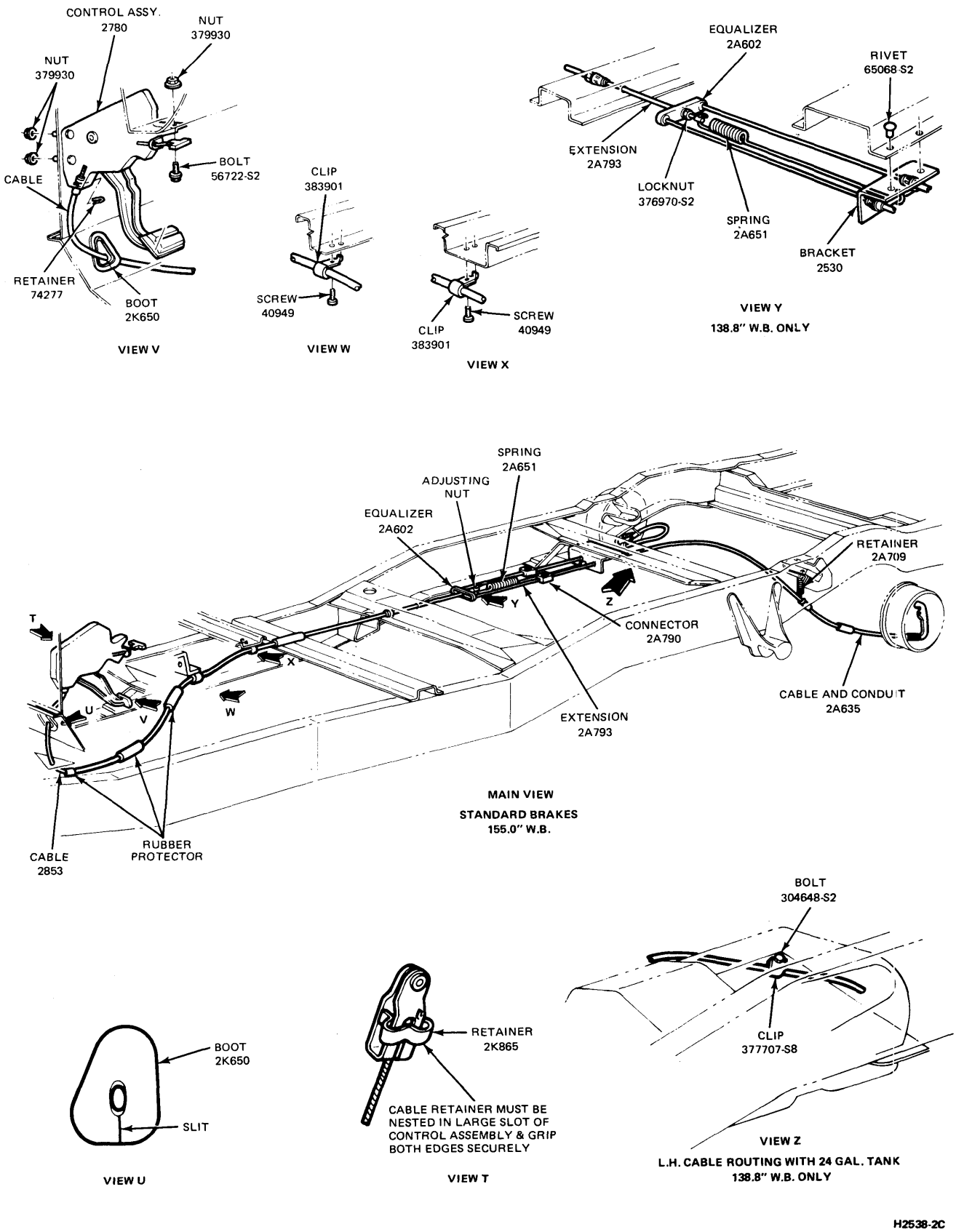


FIG. 5 Parking Brake System—F-100—F-350 Super Cab

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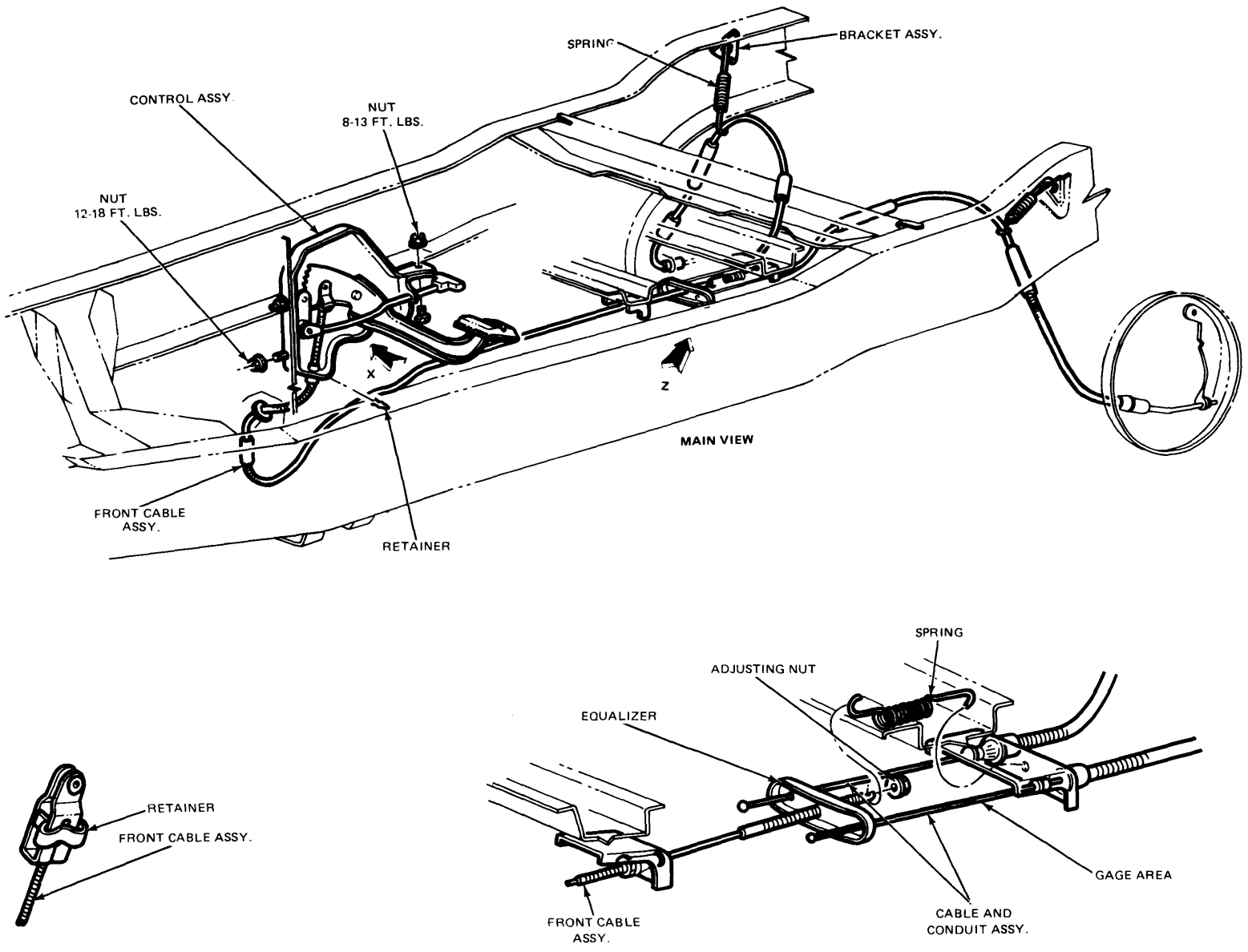


FIG. 6 Parking Brake System—Bronco

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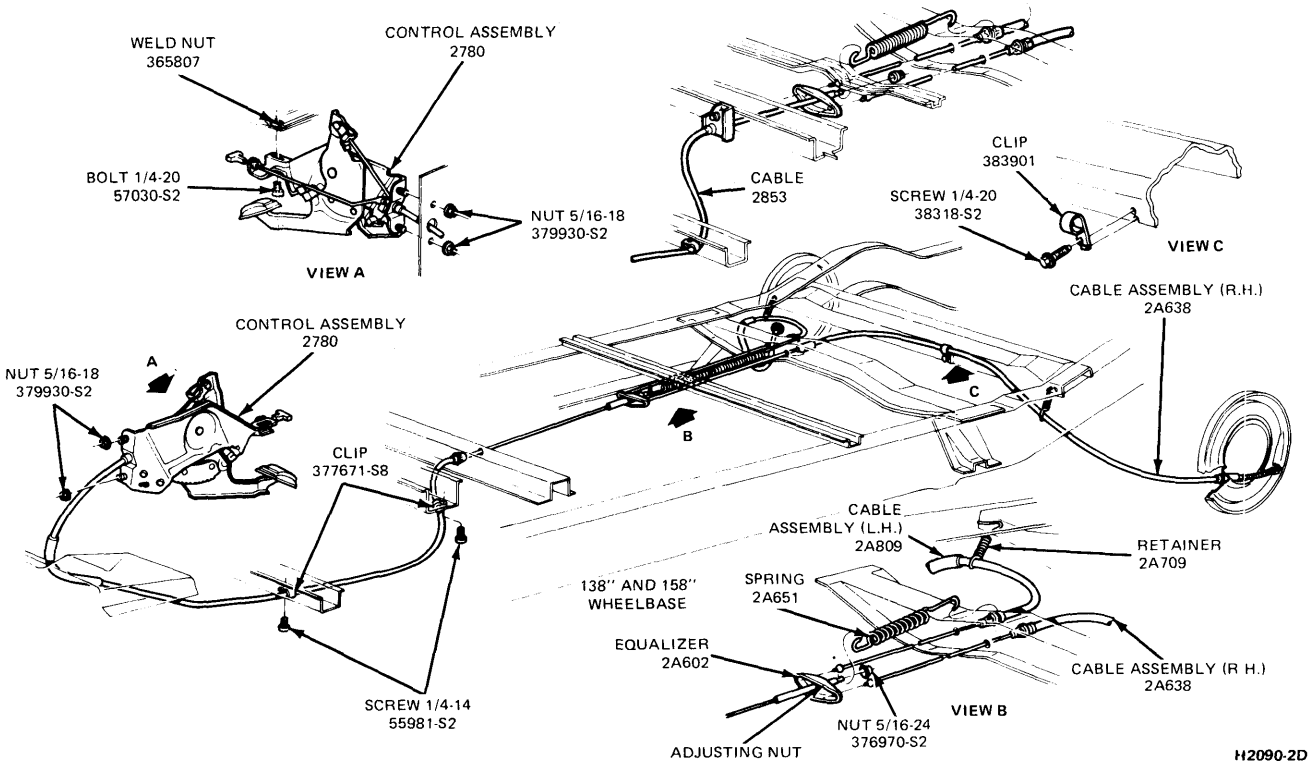


FIG. 7 Parking Brake System—E-100—E-150

DIAGNOSIS AND TESTING

Refer to Part 12-01, General Hydraulic Brake Service.

ADJUSTMENTS

CABLE ACTUATED REAR WHEEL PARKING BRAKE

F-100-F-350, BRONCO, E-100-E-350

Adjust the service brakes before adjusting the parking brake cables.

PRE-TENSION PROCEDURE ALL LIGHT TRUCKS

1. Depress the parking brake pedal until the parking brake control is in the second tooth (two notches or clicks).
2. Attach a Rotunda cable tension gauge (model 210018) or equivalent, to the LH rear cable and adjust the cable tension, registered on the gauge to 250 pounds, by tightening the equalizer nut. Hold for 5 minutes and release pedal.
3. Back off the equalizer nut until zero pounds of tension is registered on the gage.

FINAL ADJUSTMENT ALL LIGHT TRUCKS

1. Make sure brake drums are cold for correct adjustment.
2. Position the parking brake pedal as outlined under pre-tension procedure.
3. Adjust the final tension to the specified tension as registered on the Rotunda cable tension gauge (model 210018) or equivalent by tightening the equalizer nut.
4. Remove the gauge and release the parking brake.
5. If rear wheel brake drag is noted after adjustment on F-250, F-350, E-250 and E-350, the rear drums must be removed after the service and parking brakes have been adjusted. Check the clearance between the parking brake lever and the cam plate (Fig. 8). The clearance should be 0.015 inch with the brakes fully released. If the clearance is not within specifications, readjust the parking brake cable.
6. Place the parking brake pedal in the fully released position, then check the slack in the parking brake two rear cables.

   The cables should be tight enough to provide full application of the rear brake shoes, when the parking brake lever or foot pedal is placed in the fully applied position, yet loose enough to ensure complete release of the brake shoes when the lever is in the released position.

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REMOVAL AND INSTALLATION

PARKING BRAKE CONTROL

F-100-350, E-100—E-350 AND BRONCO

Removal

1. Loosen the adjusting nut at the equalizer (Figs. 3, 4, 5, 6 and 7).
2. Working under the left front fender, remove the nuts attaching the parking brake control assembly to the dash panel.
3. Working under the instrument panel, remove the bolt and nut attaching the control assembly to the lower flange of the instrument panel.
4. Remove the forward ball end of the parking brake cable from the control assembly clevis. Remove the hair pin retainer holding the cable assembly to the control, and remove the control.

Installation

1. Connect the forward ball end of the parking brake cable to the clevis of the control assembly, and install the cable assembly to the control assembly.
2. Position the control assembly on the lower flange of the instrument panel and install the attaching bolt and nut.
3. Working under the left front fender, install and tighten the nuts that attach the parking brake control assembly to the dash panel.
4. Adjust the parking brake equalizer lever to its original position. Check cable tension and adjust if necessary, as described in this Part.

PARKING BRAKE EQUALIZER TO CONTROL ASSEMBLY CABLE

F-100—F-350, E-100—E-350, BRONCO

Refer to Fig. 3, 4, 5, 6 and 7.

Removal

1. Raise the vehicle on a hoist. Remove the equalizer nut.
2. Remove the parking brake cable from the crossmember and all retaining clips.
3. Lower the vehicle. Remove the forward ball end of the parking brake cable from the control assembly clevis.
4. Remove the cable and hair pin retainer from the control assembly.
5. Using a fish wire or cord attached to the control lever end of the cable, remove the cable from the vehicle.

Installation

1. Transfer the fish wire or cord to the new cable. Position the cable in the vehicle, routing the cable through the dash panel. Remove the fish wire and secure the cable to the control with the hair pin retainer.
2. Connect the forward ball end of the brake cable to the clevis of the control assembly and raise the vehicle on a hoist.
3. Route the cable through the crossmember(s) and secure in place with the retaining clip(s).
4. Connect the rod end to the rear cables and equalizer using adjusting nut. Adjust the parking brake cable at the equalizer as described in this Part.
5. Rotate both rear wheels to be sure that the parking brakes are not dragging.

PARKING BRAKE EQUALIZER TO REAR WHEEL CABLE

F-100—F-350, E-100—E-350, BRONCO

Removal

1. Raise the vehicle and remove the hub cap, wheel, and brake drum. Loosen the locknut on the equalizer rod and disconnect the cable from the equalizer.
2. Compress the prongs that retain the cable housing to the frame bracket, and pull the cable and housing out of the bracket.
3. Working on the wheel side (Fig. 1), compress the prongs on the cable retainer so they can pass through the hole in the brake backing plate. Draw the cable retainer out of the hole.
4. With the spring tension off the parking brake lever, lift the cable out of the slot in the lever, and remove the cable through the brake backing plate hole.

Installation

1. Pull the cable through the brake backing plate until the end of the cable is inserted over the slot in the parking brake lever. Pull the excess slack from the cable and insert the cable housing into the brake backing plate plate access hole until the retainer prongs expand.
2. Insert the front end of the cable housing through the frame crossmember bracket until the prong expands. Insert the ball end of the cable into the equalizer and slightly tighten the locknut on the equalizer.

   On **vehicles with web ledge brakes,** check the clearance between the parking brake operating lever and cam plate. The clearance should be 0.015 inch when the brakes are fully released, (Fig. 8).
3. Install the rear brake drum, wheel, and hub cap, and adjust the rear brake shoes.
4. Tighten the locknut on the equalizer rod until the slack is taken out of the cables. Adjust the cable as outlined in this Part.
5. Rotate both rear wheels to be sure that the parking brakes are not dragging.

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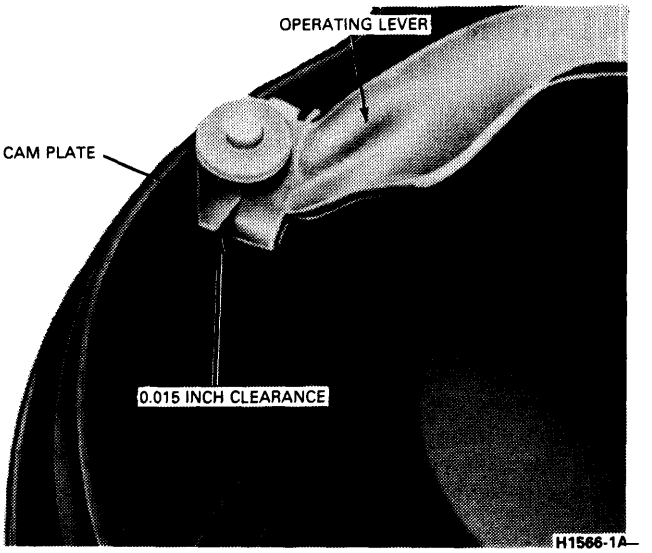


FIG. 8 Parking Brake Operating Lever and Cam Plate Clearance—Web Ledge Brakes

SPECIFICATIONS

PARKING BRAKE CABLE TENSION ADJUSTMENT

Model	Cable Tension ①	N•m
F-100-F-350	80 lbs	108
Bronco	80 lbs	108
E-100-E-350 ②	60 lbs	81

① With parking brake control in the second tooth
② E-250, E-350 with Dana rear axle, 65 lbs (88 N•m)

CH2506-1D

SPECIAL TOOLS

Number	Description
210018	Cable Tension Gauge

CH2702-1A

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STEERING

GROUP 13 (3000)

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General Steering Service

PART 13-01

APPLIES TO ALL MODELS

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DESCRIPTION

STEERING GEAR MODEL IDENTIFICATION

Steering gears are identified by a service identification tag fastened to the assembly, or by the steering gear model stamped in the housing or mounting bracket. Tags and stamped model numbers are located and contain information as shown in Fig. 1.

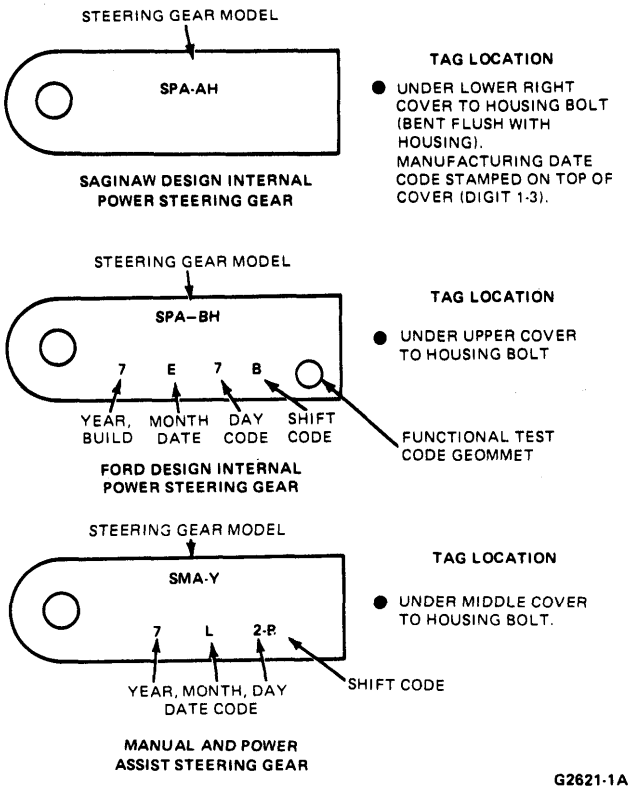


FIG. 1 Steering Gear Identification

DIAGNOSIS AND TESTING

POWER STEERING—PRELIMINARY CHECKS

Make the following preliminary checks before servicing the power steering system. If hoses are to be disconnected, label them prior to removal so they can be easily identified for re-assembly.

PUMP BELT CHECK

ALL PUMPS OTHER THAN FORD C-II

1. Replace a fan belt if it is broken, glazed, or shows signs of wear, such as cracking or rot.
2. Adjust the belt. Loosen the screws on the pump attaching bracket, and apply leverage to the web on the hub side of the pump. Do not pry against the reservoir when adjusting. Any pressure deforms the reservoir thus causing leaks.
3. Check belt tension with a belt tension gauge, Rotunda belt tension gauge (models 210019 and 210020) or equivalent. Adjust belt to specifications. A belt is considered "used" if it has been in operation beyond ten minutes.

FORD C-II PUMPS

Use same procedure as above, except do not pry on any part of the power steering pump. Due to the aluminum pump casting and plastic reservoir, prying on any part of the pump may result in damage. The power steering brackets provide a means for adjustment, such as an adjusting screw or a 1/2" square hole for attaching a socket handle wrench.

AIR BLEEDING

If bubbles are visible in the power steering fluid, bleed air from the system as follows:

1. Fill the reservoir to specification as described in this Part.
2. Run the engine until the fluid reaches normal operating temperature (165° to 175°F).
3. Turn the steering wheel all the way to the left and right several times. **Do not hold the wheel in the far left or far right position to prevent damage to pump.**

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4. Re-check fluid level and add fluid, if necessary.

FLUID LEVEL CHECK—FORD C-II PUMP

1. Run the engine until the fluid reaches normal operating temperatures (165 to 175°F or 73°-79°C).
2. Turn the steering wheel all the way to the left and right several times. Turn off the engine.
3. Check the fluid level in the power steering reservoir. If the level is low, add ATF C1AZ-19582-A, C, D (ESW-M2C33-F) or equivalent. Do not overfill the reservoir.

FLUID LEVEL CHECK—SAGINAW PUMP

NOTE: Fluid level should be checked when performing required maintenance checks.

1. Run the engine until the fluid is at normal operating temperature (approximately 165-175°F or 73°-79°C). Turn the steering wheel all the way from left to right several times. Shut off the engine. Remove the reservoir filler cap and check the fluid level on the dipstick. Level should be between the HOT mark and the end of the dipstick.
2. If the fluid level is low, add power steering fluid ESW-M2C33-F or equivalent to the proper level on the dipstick.
3. When checking the fluid level after the steering system has been serviced, air must be bled from the system.
4. With the engine off, add power steering fluid to the COLD mark on the dipstick.
5. Start the engine, run it at fast idle and re-check the fluid level. Add fluid if necessary to the COLD mark.
6. Bleed the system by turning the wheels from side to side without hitting the stops. Maintain the fluid level just above the internal pump casting. Air must be eliminated from the fluid before normal steering action can be obtained.
7. Return the wheels to the center position and continue to run the engine for two or three minutes. Shut the engine off.
8. Re-check the fluid level as described in Steps 1 and 2. The fluid should be at the HOT mark on the dipstick after the system has stabilized at its normal operating temperature.
9. Road test the vehicle to be certain the steering functions normally and is free from noise.

EXTERNAL LEAK CHECK

1. With the vehicle's engine off, wipe the complete power system dry (gear, pump, hoses, and connections).
2. Check oil level in pump's reservoir and adjust as directed in this part. If the power steering fluid does not already include dye, mix one teaspoonful of oil-soluble aniline dye with two pints of power steering fluid and fill the reservoir to specification.
3. Start engine and turn steering wheel from stop to stop several times. **Do not hold the wheel against the stops for more than 5 seconds.**
4. Determine the exact source of leakage by carefully observing the leakage areas shown in Figs. 2, 3, 4 and 5.
5. To stop the leakage shown in View A, Fig. 2, replace both sector shaft oil seals.

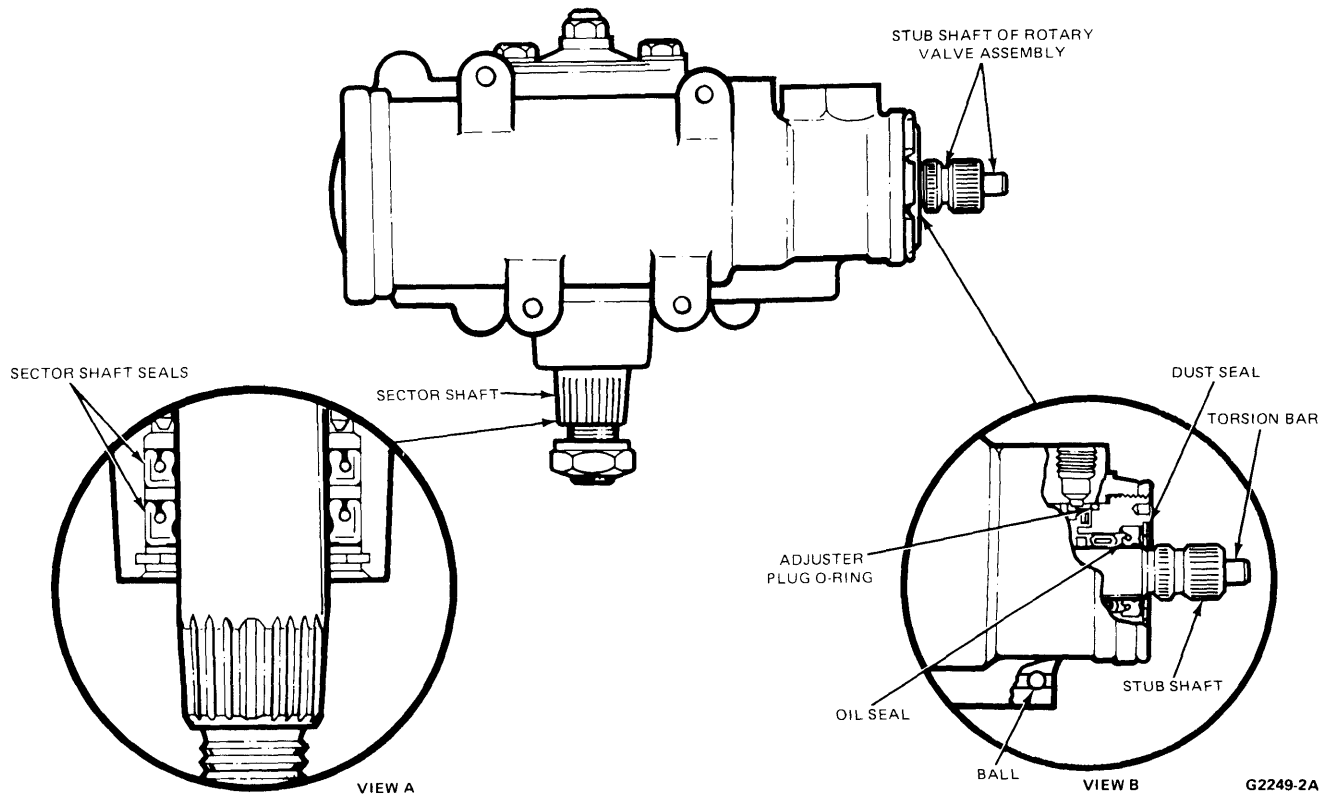


FIG. 2 Sector Shaft and Stub Shaft Leakage Areas—Saginaw Power Steering Gear

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6. Replace the adjuster plug O-ring to stop leakage at the adjuster plug (View B, Fig. 2).
7. If seepage is observed between the stub shaft and valve body (View B, Fig. 2), replace the stub shaft oil seal and dust seal.
8. Do not attempt to stop seepage between the torsion bar and the stub shaft (View B, Fig. 2). In this case the entire rotary valve assembly must be replaced.
9. To stop the leakage shown in View A, Fig. 3, replace the end cover O-ring.
10. If leakage is observed at the preload adjuster screw (View B. Fig. 3), tighten the locknut to 35 ft-lb torque.
11. For leakage between the side cover and gear housing (View B, Fig. 3), tighten the side cover bolts to 45 ft-lb torque. Replace side cover seal if leakage persists. If side cover seal replacement is required, discard the old bolts and use new ones supplied with the kit. Anytime the side cover is removed, new bolts supplied in the kits should be used.
12. Leakage at the hydraulic lines is shown in View C, Fig. 3. If leakage persists upon tightening the fitting nut to specified torque (35 ft-lb), replace the brass connector and reface the hose tube flare. If leakage is due to damaged threads (cross-threaded), replace the brass connector. Repair the fitting nut or replace the hose as required. If housing threads are badly stripped, replace the housing.

SAGINAW PUMP

1. For leakage between the hose fitting nut and hose tube (View A, Fig. 4), tighten the nut to 25-34 ft-lb torque. If leakage persists, replace the discharge fitting and reface the hose tube flare or replace the hose as required.
2. To stop leakage between the discharge fitting and the pump body (View A, Fig. 4), tighten the fitting to 35 ft-lb torque. If leakage persists, replace both O-ring seals.
3. For leakage shown in View B, Fig. 4, replace the reservoir O-ring.
4. To stop leakage at the pump drive shaft (View C, Fig. 4), replace the drive shaft seal.
5. If leakage is observed at the bottom of the filler neck or at the inlet line, (Fig. 5), replace the reservoir. If there is leakage at the filler cap, check the oil level and correct as required. If leakage persists, with correct oil level and the cap tight, replace the cap.

FORD C-II PUMP

1. Check fitting for proper torque (10-15 ft-lbs). Note that the pressure hose is free to swivel at the fitting when torqued properly (hose brackets may restrain swivel). If leakage persists, replace O-ring on the hose end tube.
2. To stop leakage between the discharge fitting and the pump body, tighten the fitting to 25-34 ft-lbs. If leakage persists, replace both O-ring seals.
3. For leakage shown in View B, Fig. 4, replace the reservoir O-ring.
4. To stop leakage at the pump drive shaft (View C, Fig. 4), replace the drive shaft seal.
5. If leakage occurs in other places on the reservoir, check reservoir for damages or cracks. If leakage

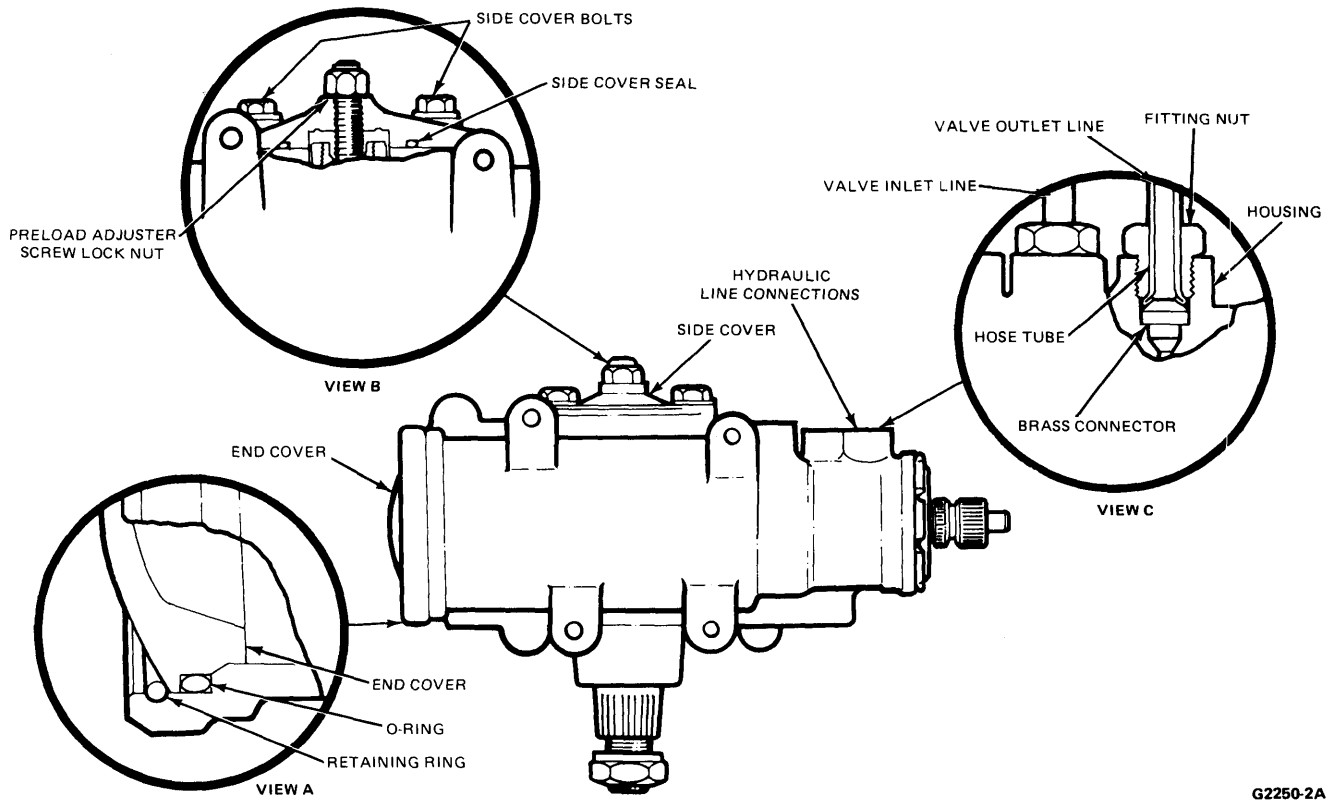


FIG. 3 Housing Cover and Line Connection Leakage Areas—Saginaw Power Steering Gear

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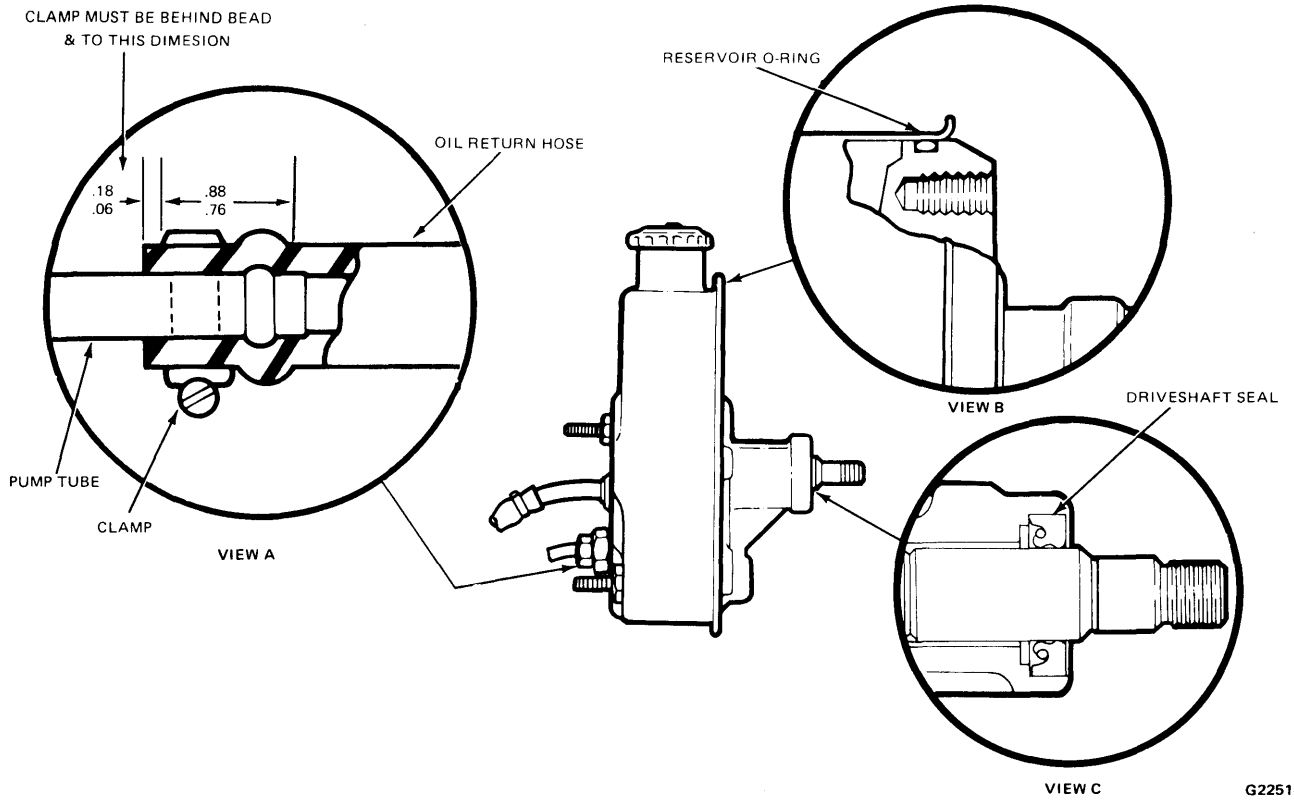


FIG. 4 Reservoir and Pump Leakage Areas—Discharge Line, O-Ring and Drive Shaft

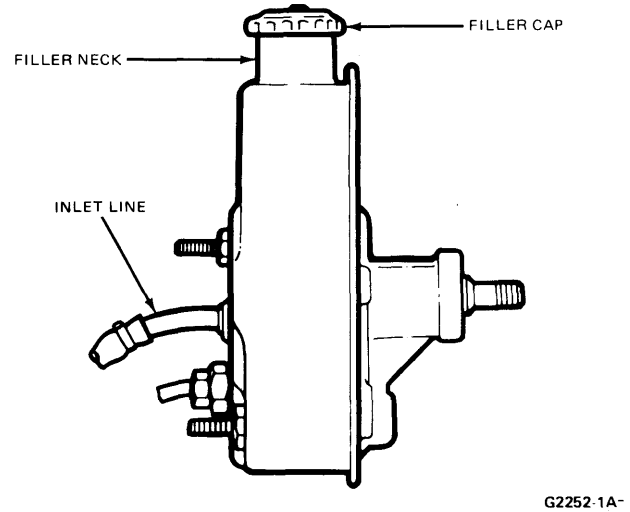


FIG. 5 Reservoir and Pump Leakage Areas—Inlet Line, Filler Neck, and Cap

occurs at filler cap, check cap O-ring and worn or damaged cap.

FITTING AND TUBE SEAT LEAK INSPECTION

Since most fluid leaks occur at the fittings and connections in a power steering hydraulic system, these parts should be checked before any other part is replaced.

1. Clean the outside of the steering gear and/or the control valve, the power cylinder, the bottom surfaces of the pump, and all lines and fittings. Be sure all dirt, oil, and grease is removed from areas where leaks may exist.
2. Tighten all fittings, using a special 5-flat tube wrench. **Do not tighten the fittings with a standard open end wrench.** If a properly tightened fitting leaks, replace the tube seat.

PUMP RESERVOIR LEAKS

Leaks in the pump reservoir may be caused by improper installation, a worn or damaged cover or reservoir gasket, or a worn or damaged stud gasket on the stud at the center of the cover or at the rear of the reservoir.

On **Eaton** pumps leakage may occur at the O-rings in the orifices at the top of the pump body, the shaft seal at the front of the pump, the pump housing O-ring and the flow director O-ring between the two halves of the pump, and the relief valve plug O-ring.

On **Ford C-II** pumps, leakage may be caused by improper installation of the reservoir, a damaged reservoir O-ring seal, a damaged fitting O-ring a damaged pump shaft seal, or a damaged pressure fitting or overfill of pump.

Replace parts, if necessary.

FORD AND SAGINAW POWER STEERING TESTS

The pump flow and pressure tests will confirm or rule out the pump as the cause of steering system problems. Follow the steps below.

Prior to performing the pump flow and pressure test, the following checks, for conditions which could cause

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loss of power assist, must be performed and corrective action taken if necessary.

1. Check pump reservoir for proper fluid level.
2. Check tires for correct air pressure.
3. Check pump belt for proper tension.
4. Check pump for correct model and vehicle application.
5. Check for correct size pulleys on pump and engine.
6. Check entire system for damage, replacing parts as necessary.

If the above items are to specifications, or have been corrected, and the loss of assist still exists, test the power steering pump flow and pressure to determine whether the trouble is in the pump, power steering gear, control valve using the following test equipment.

TEST EQUIPMENT

1. Engine tachometer
2. Thermometer—0° to 300°F or -17° to 140°C.
3. One (1) Rotunda Power Steering Analyzer (model 140207) or equivalent.
4. One set of adapter fittings.

PURGING POWER STEERING SYSTEM OF AIR

Air trapped in the power steering system, which causes a whine-type noise between 20-45 mph (17-39 km) on light acceleration, can be removed by using a power steering pump air evacuator assembly (DEVAC Tool) or the VACUUM FILL PROCESS.

DEVAC SYSTEM

Fabricate a DEVAC purging tool as shown in Fig. 6 for Ford pump, or Fig. 7 for Saginaw pump.

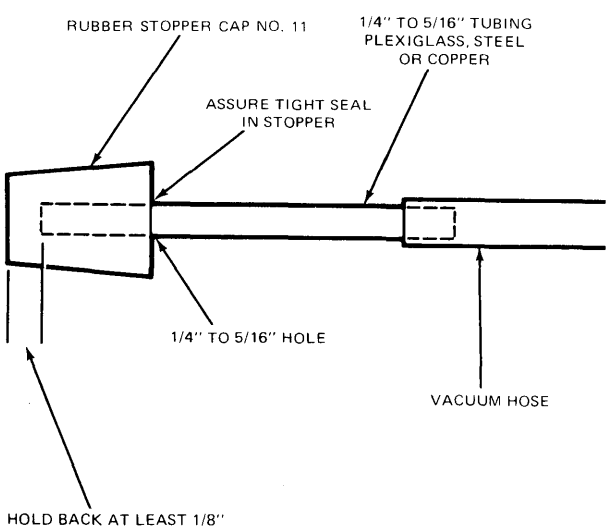


FIG. 6 Power Steering System Purging Tool—For Ford C-II Pump

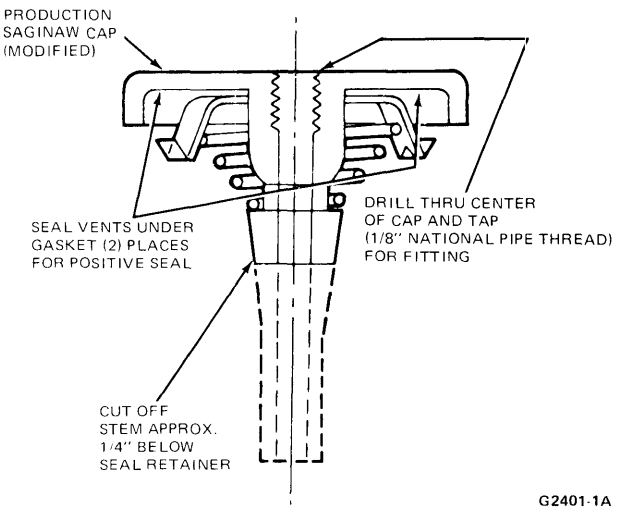


FIG. 7 Modified Pump Reservoir Cap

The procedure for removing entrapped air is as follows:

1. Check the pump reservoir oil level to make certain the fluid level is correct (add fluid if low, siphon out fluid if level is above full mark).
2. Insert the rubber stopper end of the air evacuator assembly tightly into the filler tube.
3. Connect a suitable length of hose from the other end of the air evacuator to a distributor machine or air-conditioner vacuum pump. Do Not Use Engine Vacuum.
4. Let the engine idle for approximately 15 minutes. Turn steering wheel one full cycle every five minutes. (Do not hit the stops.) This assists in removing air trapped in the system.
5. Disconnect and remove the evacuator and reinstall the filler tube dipstick.

START-UP PROCEDURE (AFTER POWER STEERING PUMP OR GEAR OVERHAUL)

Upon initial engine start-up after a power steering pump or gear overhaul (particularly the pump), there is very frequently much noise and aeration. This is due to air trapped in the overhauled unit which mixes with the surging fluid and causes aeration. The problem can be minimized if the following procedure is used.

1. Disconnect the coil wire.
2. Fill the reservoir.
3. Crank the engine with the starter and continue adding fluid until the level remains constant. Be careful to avoid prolonged cranking as the battery may be drained and the starter damaged.
4. Rotate the steering wheel approximately 30 degrees each side of center while continuing to crank the engine.
5. Re-check the fluid level and fill as required.
6. Reconnect the coil wire.
7. Start the engine and allow it to run for several minutes.
8. Rotate the steering wheel from stop to stop.
9. Shut off the engine and re-check the fluid level—add as required.

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DIAGNOSIS GUIDES

The following diagnosis guides can be used as an aid in diagnosing steering systems.

CONDITION	POSSIBLE CAUSE	CORRECTION
• Power steering pump leaks.	• Fluid, cap and dipstick.	• Check for indications of false leakage — overfilled reservoir, improperly installed, damaged or lost cap or dipstick.
	• Loose or damaged hose connections.	• Repair or replace as required.
	• Leakage between reservoir and housing.	• Repair or replace as required.
	• Leakage at pump shaft seal area.	• Replace shaft seal or pump.
• Noise in steering column.	• Steering column cover interference.	• Adjust or reposition as required.
(Squeak or creak)	• Steering column out of alignment.	• Align or adjust as required.
	• Lack of lubrication where horn brush contacts rub plate of steering wheel.	• Lube or adjust as required.
	• Loose steering column mounting bolts.	• Tighten to specification.
(Clunk)	• Flex coupling bottoming.	• Align or adjust as required.
	• Improper steering gear mesh load.	• Readjust to specification.
• Steering wheel off-center.	• Improperly installed steering wheel.	• Readjust steering wheel relative to column.
Excessive Steering Effort	**Manual and Power Steering**	
	• Improper oversized tires.	• Install correct tire and wheel combination.
	• Tires not uniform.	• Install correct tire and wheel combination.
	• Tire pressure.	• Adjust air pressure in tires.
	• Misaligned flexible coupling (if so equipped) to gear interference.	• Align or adjust as required.
	• Steering wheel to column interference.	• Align or adjust as required.
	• Steering column alignment.	• Align or adjust as required.
	• Steering linkage or front axle spindle pins for a binding condition or lack of lubrication.	• Lube, inspect, adjust or replace as required.
	• Bind in front axle spindle thrust bearings.	• Lube, inspect, adjust or replace as required.
	• Steering gear adjustment.	• Adjust to specification.
	Power Steering Only	
	• Power steering pump belt for looseness, glazing, or broken condition.	• Inspect, adjust or replace as required.
	• Power steering pump fluid level and possible leak in system.	• Add fluid, tighten connections and correct as necessary.
	• Power steering pump pressure and flow.	• Conduct pump flow and relief pressure tests and adjust or repair as necessary.
	• Air in power steering system.	• Add fluid, tighten connections and bleed system.
	• Contaminated fluid, incorrect fluid.	• Replace with correctly specified fluid.
	• Steering gear valve binding or out of adjustment (Integral Power Steering).	• Inspect, adjust.
	• Excessive internal integral gear leakage.	• Inspect, repair or replace as required.
	• Obstruction within steering gear or lines (including bent or kinked steel tubing).	• Inspect, remove obstruction(s) and repair or replace as required.
	• Worn or damaged parts in power cylinder.	• Inspect and replace as necessary.
Wanders Side to Side — Loose Steering	**Manual and Power Steering**	
	• Vehicle overloaded or unevenly loaded.	• Correct as required.

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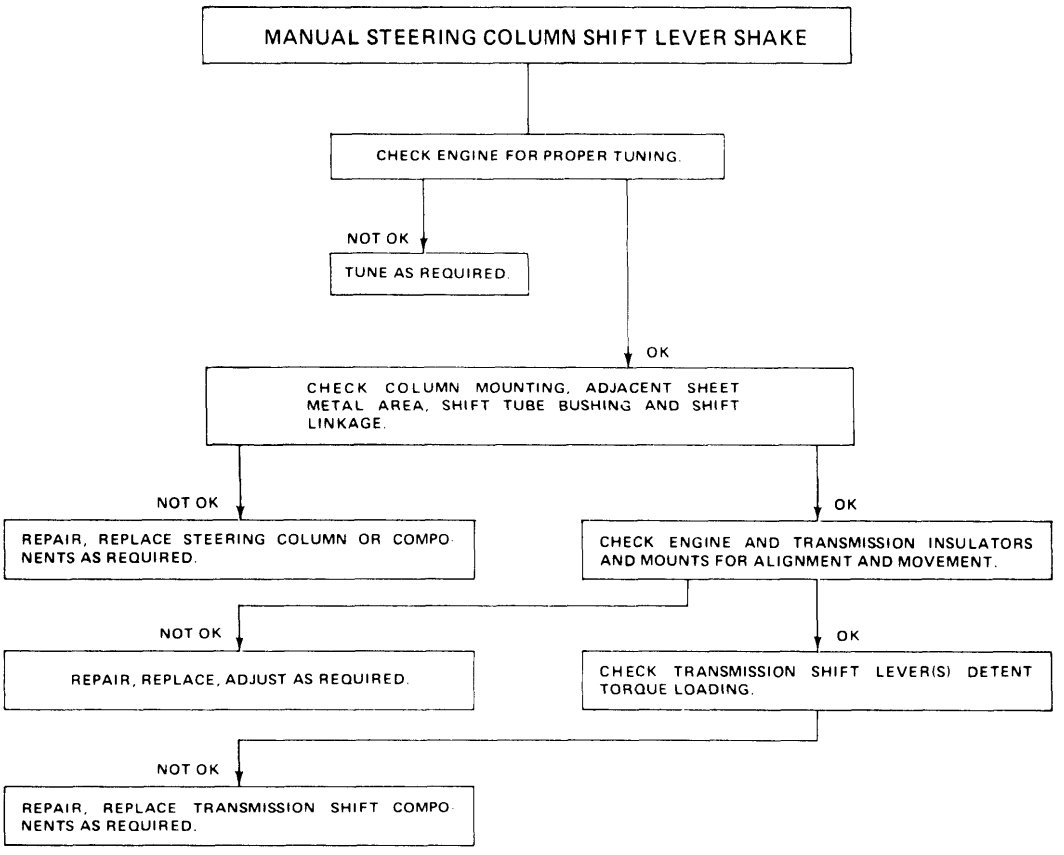
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CONDITION	POSSIBLE CAUSE	CORRECTION
Wanders Side to Side — Loose Steering (Continued)	• Improper (mismatched) tires and wheels.	• Install correct tire and wheel combination.
	• Tire pressure.	• Adjust air pressure in tires.
	• Loose steering gear mounting.	• Adjust to specification.
	• Front and rear suspension components for looseness, wear or damage.	• Tighten or replace as necessary.
	• Steering linkage connections for looseness, wear or damage.	• Tighten or replace as necessary.
	• Loose wheel lug nuts.	• Tighten to specifications.
	• King pin binding.	• Lubricate suspension.
	• Front wheel bearing adjustment.	• Adjust to specification.
	• Steering gear conditioning and adjustments.	• Adjust to specification.
	• Flexible coupling fractured.	• Replace as required.
	• Incorrect toe setting.	• Set to specifications.
Pulls To One Side	**Manual and Power Steering**	
	• Tire sizes of each wheel to be sure they are the same size and type.	• Install correct tire and wheel combination.
	• Tire pressure.	• Adjust air pressure in tire.
	• Vehicle unevenly loaded.	• Correct as required.
	• Improper brake operation or adjustment.	• Inspect, adjust and correct as required.
	• Front wheel bearing adjustment or faulty rear wheel bearing.	• Adjust or replace as required.
	• Broken or sagging springs on front and/or rear suspension.	• Inspect and replace as required.
	• Loose steering gear mountings.	• Tighten to specification.
	• Loose, worn or damaged steering linkage.	• Tighten and replace as required.
	• Bent spindle or spindle arm.	• Inspect and replace as required.
	• Bent rear axle housing and/or loose, worn or damaged spring, shock absorber and suspension arm attaching points.	• Inspect, tighten and replace as required.
	• Frame or underbody out of alignment.	• Correct as required.
	• Front wheel alignment.	• Set to specification.
	• Belted tires (misaligned belts).	• Replace as required.
	Power Steering Only	
	• Steering gear valve binding or out of adjustment (Integral Power Steering).	• Clean and replace as necessary.
Returnability Poor	**Manual and Power Steering**	
	• Tire pressure.	• Adjust air pressure in tires.
	• Steering column alignment.	• Align or adjust as required.
	• Steering linkage for a binding condition or lack of lubrication.	• Lube, adjust or replace as required.
	• Steering gear adjustment.	• Adjust to specification.
	• Tight front axle spindles.	• Lube, correct as required.
	• Bind in front axle spindle bolt thrust bearings.	• Lube, correct as required.
	Power Steering	
	• Glazed, loose or broken power steering pump bel	• Inspect, adjust or replace as required.
	• Kinked return hose or tube.	• Inspect and repair or replace as required.
	• Obstruction within steering gear or lines.	• Inspect, remove obstructions and repair or replace as required.
	• Scored piston bore in housing (integral Power Steering).	• Inspect, correct as required.
	• Excessively worn power steering pump parts.	• Replace as required.

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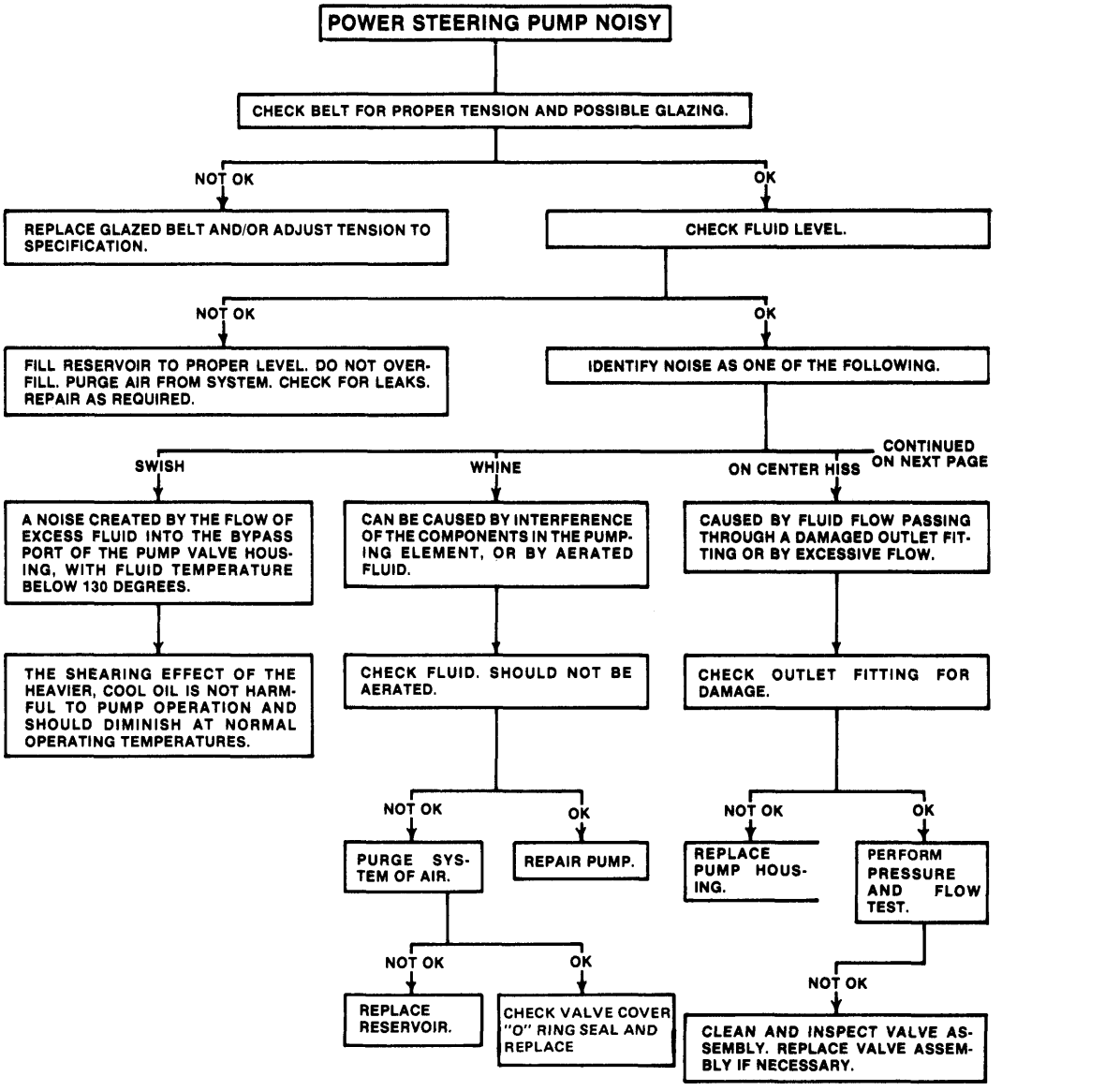
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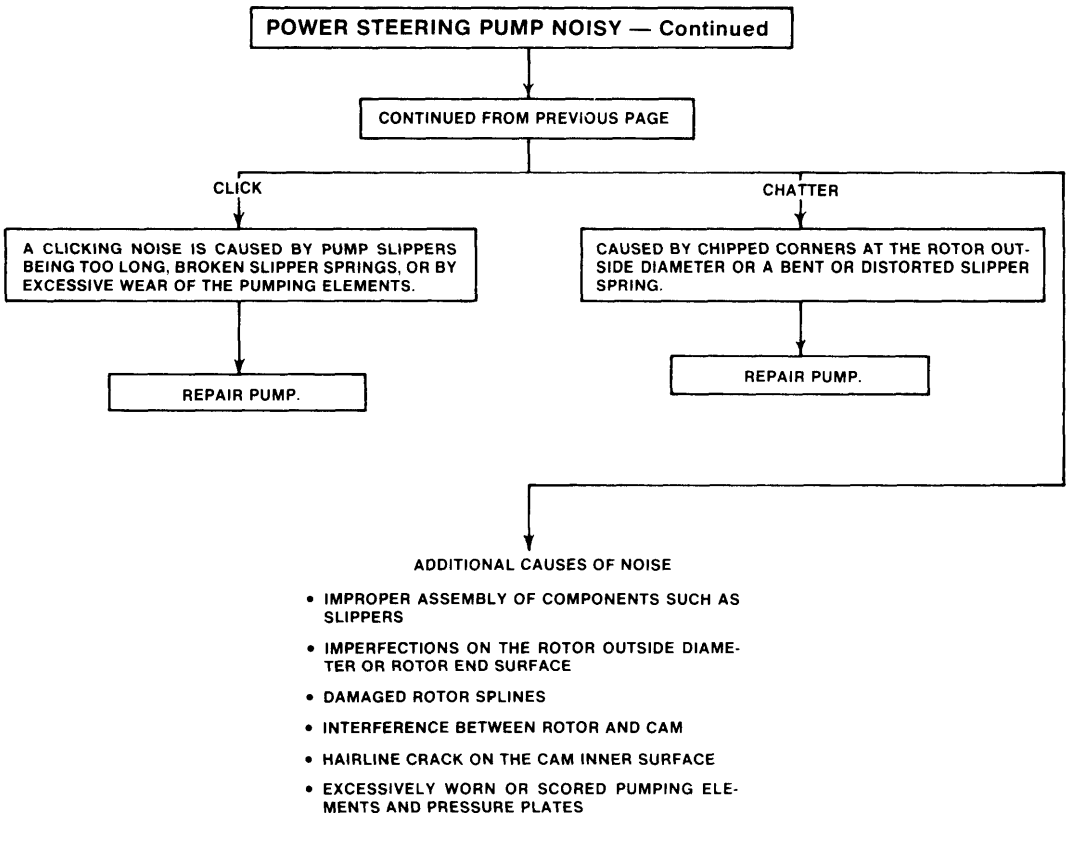
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ADJUSTMENTS

STEERING GEAR LUBRICANT CHECKING PROCEDURE

F-100—F-350 (4 X 2) SERIES MANUAL STEERING

1. Center the steering wheel.
2. Remove the bolt that attaches the upper cover to the housing and remove the cover.
3. Slowly turn the steering wheel to the left stop. Lubricant should rise in the cover bolt hole. Slowly turn the steering wheel to the right stop. Lubricant should rise in the filler plug hole. If lubricant does not rise in the holes as described above, add lubricant and repeat the test.
4. When lubricant rises in both holes, install the upper cover-to-housing attaching bolt.

F-150—F-250 (4 X 4), BRONCO

1. Remove the filler plug from the sector shaft cover.
2. Check to see if lubricant is visible in the filler plug-tower. If the lubricant is visible, re-install the filler plug. If the lubricant is not visible, add fluid as described in Step 3.
3. Add steering gear lubricant until the lubricant level is approximately 1 inch from the top of the hole in the filler plug tower; then, install the filler plug.

E-100—E-350

1. The steering gear is factory-filled with steering gear lubrication. Seasonal change of this lubricant should not be performed and the housing shield should not be drained, no lubricant is required for the life of the steering gear.

   Every 30,000 miles, the gear should be inspected for seal leakage (actual solid grease, not just oil film). If the seal is replaced or the gear is overhauled, the gear housing should be refilled. Refer to Part 13-33 for recommended lubricant and fill procedures.

CLEARVISION ADJUSTMENT

TWIN I-BEAM VEHICLES-E-100—E-350, F-100—F-350

Steering wheel misalignment (improper clear vision) on Twin-I-Beam vehicles can be corrected only by removing and recentering the steering wheel. Because the Twin-I-Beam steering linkage has only one tie rod adjustment, improper clear vision cannot be corrected by adjustment of the steering linkage or suspension components. If improper clear vision is attempted to be corrected by adjustment of the tie-rod sleeve, grossly miss-set toe may result.

Refer to Parts 13-06, Steering Column—Shift Rod Within Tube and 13-34, Manual Steering Gear—Worm and Roller for the clear vision adjustment.

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CLEANING AND INSPECTION

MANUAL STEERING GEAR

BRONCO F-150 (4 X 4) ONLY

1. Thoroughly clean all parts with solvent. **Do not use solvent on seals.** Wipe the parts dry with a lint-free cloth.
2. Check for scores, chips, or cracks in the worm. Check the steering shaft for straightness. Check the condition of the splines and threads at the end of the shaft. Inspect the worm bearing seats for wear or irregular surfaces. Replace the shaft and worm if wear or damage is present.
3. Inspect the sector shaft. Check the roller for scores, chips, or cracks. Check the condition of the sector shaft at the bushing locations. Replace the sector shaft assembly if any of these parts are worn or damaged.
4. Inspect the worm roller or ball bearings, and the sector shaft bushings or roller bearings for wear or damage. Inspect the worm bearing cup for pits, scores, or other damage. Replace the parts that are worn or damaged.
5. Inspect the steering gear housing, sector shaft cover, and housing end plate for cracks or other damage, and replace the parts, if necessary.

SAGINAW POWER STEERING GEAR

CLEANING

Disassembly and assembly of the steering gear and the sub-assemblies must be made on a clean workbench. As in repairing any hydraulically operated unit, cleanliness is of utmost importance. The bench, tools, and parts must be kept clean at all times. Thoroughly clean the exterior of the unit with a suitable solvent and, when necessary, drain as much of the hydraulic fluid as possible. Handle all parts very carefully to avoid nicks, burrs, scratches and dirt, which could make the parts unfit for use.

Do not clean, wash or soak seals in the cleaning solvent.

INSPECTION

1. Check the sector shaft contact surface in the cover for wear. If worn, replace the cover.
2. Inspect the input shaft bearing for cracked races, and the balls for looseness, wear, pitting, end play or other damage. Check the fit of the bearing on the input shaft. Replace the bearing, if required.
3. Inspect the valve housing for wear, scoring or burrs.
4. Inspect the tube seats in the pressure and return ports in the valve body for nicks, etc. If necessary, remove and replace.
5. Check the sector shaft contact surface in the housing for wear. If worn, replace the housing.
6. Check all fluid passages for obstruction or leakage.
7. Inspect the steering gear housing for cracks, stripped threads, and mating surfaces for burrs. Inspect the piston bore of the housing for scoring or wear. If necessary, replace the housing.
8. Check the input shaft bearing after installation to be sure that it rotates freely.
9. If the valve spool is not free in the valve housing, check for burrs, at the outward edges of the working lands in the housing and remove with a hard stone. Check the valve spool for burrs and if burrs are found, stone the valve in a **radial direction only.** Check for freedom of the valve again.
10. Check the piston rack teeth and sector shaft teeth for nicks and burrs.

FLUSHING

Should it be necessary to replace an inoperative power steering pump when fluid contamination could have occurred, flushing the steering gear is required when installing the repaired pump.

1. Remove the power steering pump and remove the pulley as outlined in Part 13-52, Power Steering Pump—Saginaw.
2. Install the pulley on the repaired pump. Install the pump and connect only the pressure hose to the pump.
3. Place the fluid return from the gear in a suitable container and plug the reservoir return pipe.
4. Fill the reservoir with ESW-M2C33-F (ATF) or equivalent on Ford C-II pumps and on Saginaw Pumps.
5. Disconnect the coil wire to prevent the engine from starting and raise the front wheels off the ground.
6. While approximately two quarts of steering gear fluid are being poured into the reservoir, turn the engine over using the ignition key. At the same time, cycle the steering wheel from stop to stop. Be careful to avoid excessive cranking as the battery will be drained and the starter damaged.
7. As soon as all of the lubricant has been poured in, turn off the ignition key, and attach the coil wire.
8. Remove the plug from the reservoir return pipe, and attach the return hose to the reservoir.
9. Check the reservoir fluid level if low, add fluid to the proper level. Do not overfill.
10. Lower the vehicle.
11. Start the engine and cycle the steering from stop to stop to expel any trapped air from the system.

FORD C-II AND SAGINAW POWER STEERING PUMP

FLUSHING

When contamination is noted while overhauling the gear, it will be necessary to flush the power steering pump.

1. Leave all hoses connected, except the pressure line at the gear.
2. Place the pressure line in a suitable container.
3. Fill the reservoir with fluid ESW-M2C33-F (ATF) or equivalent on Ford C-II and Saginaw Pumps.
4. Disconnect the coil wire to prevent the engine from starting.

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5. While approximately two quarts of the steering gear fluid are being poured into the reservoir, engage the starter.
6. As soon as all the fluid has been poured in, turn off the ignition.
7. Attach the pressure hose at the gear.
8. Check the reservoir fluid level.
9. Crank the engine with the starter and continue adding fluid until the level remains constant. Lower the vehicle and attach the coil wire.
10. Start the engine and cycle the steering wheel from stop to stop to expel any air from the system.

CLEANING

Wash all parts except seals in a chlorinated solvent and dry with compressed air.

INSPECTION (FORD C-II PUMP)

To determine when to replace power steering pump components follow these guidelines. Some components must be replaced regardless of condition.

1. Re-use the outlet fitting if the corners are not rounded and the threads intact.
2. Replace all seals except the rotor shaft seal. Re-use the rotor shaft seal if it does not leak.
3. Re-use the reservoir assembly if the reservoir seal areas are not damaged. Check for a broken or missing baffle.
4. Re-use the housing or housing assembly if the O-ring and snap ring surfaces are not damaged.
5. Re-use the rotor and cam assembly if wear is limited to removal of the phosphate coating on the cam contour. Do not disassemble the unit. Push the rotor part way through the cam insert, being careful not to dislodge the slippers and springs. Check the cam—inside diameter for scoring or burring. Check the rotor faces and outside diameter for scoring and chipping. Do not repair or refinish the upper and lower pressure plates, cam or rotor assembly. If wear or burring is evident, replace them with new components.
6. Install a new rotor and cam assembly if the slippers are worn. Replace the springs if they are bent or broken.
7. Re-use the rotor shaft if the thrust faces, bushing diameter and shaft seal diameter are not excessively worn or scored.
8. Re-use the housing and bushing assembly if all the threaded holes are not damaged beyond repair, and the bushing diameter is not scored or worn, .0005 inch over the .6897 inch maximum. Repair the threaded holes by drilling out the damaged threads and installing helicoil inserts. If the bushing is scored or excessively worn, install a new housing and bushing assembly.
9. Re-use the valve body if valve bore is free of nicks and scoring. Valve must fall freely in valve bore. Replace valve housing and or valve if valve sticks in bore.

INSPECTION (SAGINAW PUMP)

The following describes the components of the power steering pump which must be replaced regardless of condition and how to determine when other components should be replaced.

All seals must be replaced with new components except the rotor shaft seal which should be reused unless it was leaking.

The flow control valve assembly may be reused unless it is damaged (score marks, wear, burrs, etc).

The housing assembly may be reused if there is no damage (scratches, burrs, etc.) at machined surfaces, especially mating surfaces on O-ring seats.

If the shaft bushing in the pump housing is scored or excessively worn the pump housing assembly must be replaced.

The pressure plate may be reused unless the V-shaped notches at the edges of the discharge ports are damaged or other visual damage (cracks, etc.) is evident. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.

The cam ring may be re-used if it is not damaged (score marks, cracks, etc.).

The cam ring is treated with Lubrite which leaves a dull grey-black finish on the wear surface. A wavy grain appearance inside the cam ring is normal.

The vanes should be removed from the rotor and examined for wear; the vanes and rotor may be reused if not damaged.

The rotor shaft may be reused if there is no damage (score marks, excessive wear, etc.) at splines, keyway, bearing and seal surfaces.

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SPECIFICATIONS

STEERING TORQUE LIMITS — F-100 THRU 350, E-100 THRU E-350, BRONCO

Description	Model	Torque (ft-lbs)	Torque N•m
Steering Gear to Frame —	S/C F-150-250 (4x4), R/C F-250 (4x4)	95-125	129-169
Power and Manual	E-100-E350	54-66	74-89
	F-100 — F-350 (4x2)	50-65	68-88
	R/C F-150 (4x4) Bronco	60-85	82-115
Pitman Arm to Steering Gear	All	170-230	231-311
Drag Link Studs	E-100 thru E-350	50-75	68-101
Spindle Connecting Rod Studs	F-100 thru F-350, and		
	E-300	60-70	81-94
	E-100-E-350	50-75	68-101
Spindle Connecting Rod Clamps	F-100, F-250	35-45	48-61
	F-350	40-60	55-81
	E-100-E-350	29-41	40-55
Steering Shock Absorber to Brackets	Bronco, F-150 (4x4) R/C	15-25	21-33
Steering Shock Absorber to Frame	Bronco, F-150 (4x4) R/C	10-15	14-20
Steering Shock Absorber Bracket Drag Link	Bronco, F-150 (4x4) R/C	10-15	14-20
Steering Shaft or Coupling Shaft to Steering Gear	F-150 15/C (4x4) & F-250 (4x4)	40-60	55-81
Coupling Shaft to Upper Steering Shaft	F-250 (4x4)	40-60	55-81
Steering Wheel to Steering Column	All	30-40	41-54
Steering Column Supporting Bracket to Dash Panel	Bronco, F-Series	8-20	11-27
Steering Column Seal Cover Plate to Dash	Bronco, F-Series	5-20	7-27
Shroud	All	10-15 in. lbs.	1.2-1.6
Steering Column Opening Cover Plate to Floor	E-100-E-350	8-20	11-27
Steering Column to Floor Opening Cover Plate Clamp	E-100-E350	10-20	14-27
Flange & Insulator Assembly to Steering Column	E-100-E-350	11-21	15-28
	F-100-F-350 (4x2)	11-21	15-28
Flange & Insulator Assembly to Steering Gear	F-150 (4x2) BRONCO F-150-350 (4x2)	28-35	38-47
Flange & Insulator Assembly to Coupling Shaft	F-150 (4x4), R/C	11-21	15-28
	Bronco		
Steering Column Lower Bearing Retainer Clamp	E-100-E-350	10-14	14-18
Steering Column to Clutch and Brake Pedal Bracket	Bronco, F-Series	8-20	11-27
	E-100-E-350	8-20	11-27
Power Steering Adjusting Bracket to Engine (6 cyl.)	F-100, 250, 350	46-65	62-88
Power Steering Support Bracket to Engine (8 cyl.)	F-100, 250	30-45	41-61
Power Steering Pump Assembly to Bracket	Bronco, F-Series	30-45	41-61
Power Steering Support Bracket to Engine or A/C Bracket	E-100-E-350 (8 cyl.)	30-45	41-61
Power Steering Adjusting Bracket to Support Bracket	E-100-E-350 (8 cyl.)	30-45	41-61
Power Steering Pump to Adjusting Bracket	E-100-E-350 (All)	30-45	41-61
Power Steering Brace to Engine	E-100-E-350 (6 cyl.)	40-60	55-81
Power Steering Adjusting Bracket to Brace	E-100-E-350 (6 cyl.)	30-45	41-61
Power Steering Cooler to Frame Bracket	E-100-E-350 (All)	11-16	15-21
Power Steering Pressure Hose (Pump)	E-100-E-350 (All)	25-34	34-46
(Gear)		16-25	22-33
Steering Shock Absorber Bracket to Tie Rod	F-250 (4x4), S/C 4x4	10-15	14-20
Steering Shock Absorber to Right Hand Shock Bracket	F-250 (4x4), S/C 4x4	40-50	55-67
Power Steering Adjusting Bracket to Support Bracket 5.8L (351 CID) V-8, 6.6L (400 CID) V-8 and 7.5L (460 CID) V-8	F-Series, Bronco	30-40	41-55
Drag Link to Pitman Arm	F-250 (4x4), S/C 4x4	50-75	68-101
Tie Rod to Axle	F-250 (4x4), S/C 4x4	50-75	68-101

CG1766-2G

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DRIVE BELT TENSION

Belt Width	Minimum Tension (for use at maintenance interval only) (Hot Engine)		Installation Tension			
			Used Belt (1)		New Belt	
	(ft-lbs)	N•m	(ft-lbs)	N•m	(ft-lbs)	N•m
1/4"	30	40	60	81	80	108
3/8" and 15/32"	50	67	110	149	140	189
1/2"	50	67	110	149	140	189

(1) Any belt operated for ten minutes or more is considered a used belt.

CY1523-2B

SPECIAL TOOLS

Number	Description
210019	Belt Tension Gauge
210020	Belt Tension Gauge
140207	Power Steering Analyzer

CG2615-1A

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Steering Column — Shift Rod Within Tube

PART 13-06

APPLIES TO F-100 — F-350, E-100 — E-350 AND BRONCO ONLY

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DESCRIPTION

The F-100-350, Bronco and E-100—E-350, vehicles are equipped with columns which are designed with the shift tube within the column tube (Figs. 4, 5 and 6).

DIAGNOSIS AND TESTING

Refer to Part 13-01, General Steering Service.

ADJUSTMENTS

STEERING COLUMN ALIGNMENT

F-100—F-350, AND BRONCO

Before checking the steering gear adjustments, eliminate any steering column tube and steering shaft stress or misalignment as follows:

1. Check the flexible coupling for clearance between the slots and the coupling safety pins. The pins must be centered in the slots (Fig. 1). **If the flexible coupling has been driven in a non-flat condition for more than 12,000 miles, it is recommended that it be replaced during this adjustment.**
2. Loosen the four steering column lower support bracket bolts.
3. Remove the four screws attaching the trim cover to the instrument panel and remove the trim cover. Loosen the two screws attaching the steering column to the instrument panel, and allow the steering column to drop 1/8 inch from the instrument panel.
4. Grip the steering wheel and briskly shake the steering column to allow relaxation of stress or misalignment.
5. With the front wheels in the straight-ahead position, check the flexible coupling clearance (Fig. 1).
6. Move the column up or down until the flexible coupling is in the flat plane, then tighten the two screws that attach the steering column to the instrument panel and tighten to 10-15 ft-lb.

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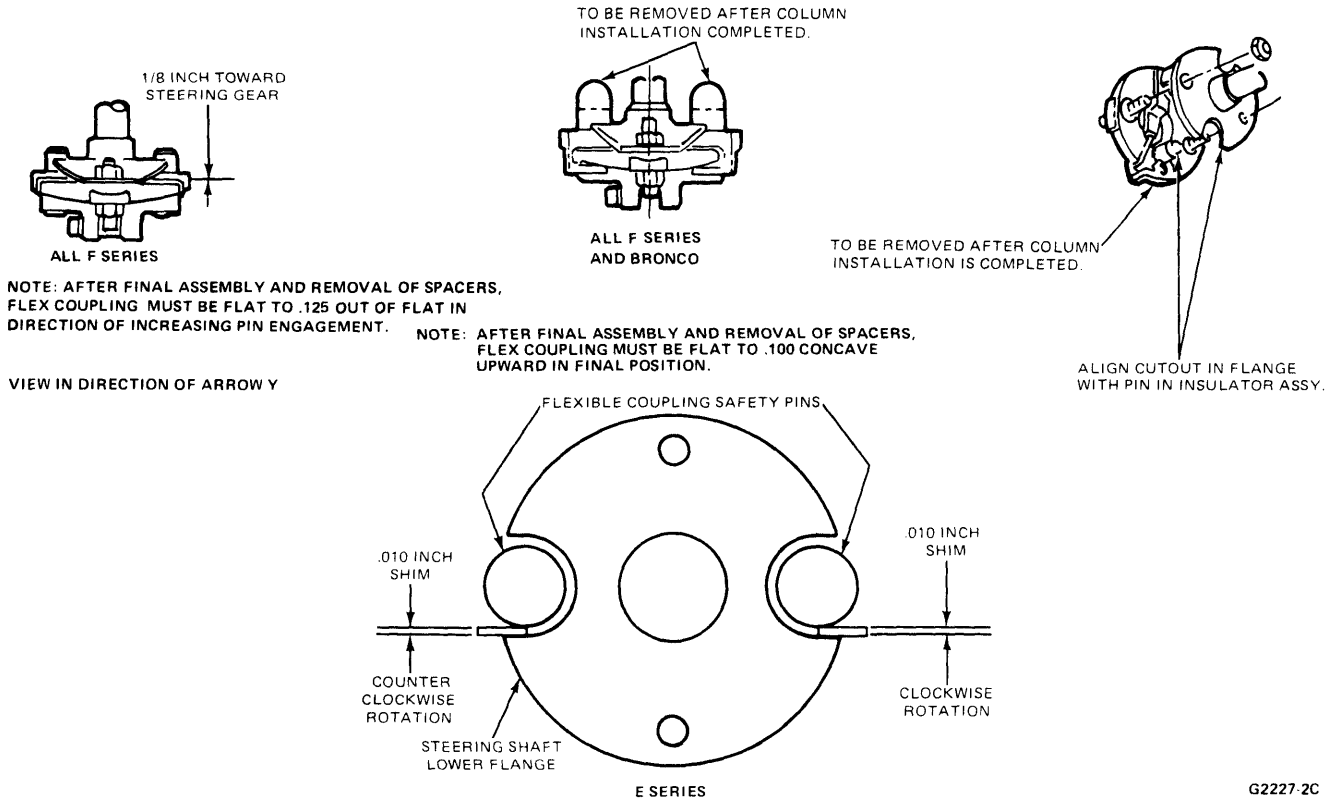


FIG. 1 Steering Column Alignment E-100—E-350, F-100—F350 and Bronco

7. Replace the trim cover to the instrument panel and tighten the four screws to secure the trim cover to the instrument panel.
8. Locate the steering column lower seal on the steering column and against the dash panel. Install the four bolts and tighten to 8-18 ft-lb.
9. Road test the vehicle to check for correction of the problem.
10. Re-check the flexible coupling for minimum slot and coupling safety pin clearance and flatness.

E-100—E-350

Any stress or misalignment in the steering column tube and steering shaft should be eliminated before checking the steering gear adjustments.

1. Remove the steering column trim cover.
2. Loosen the steering column-to-brake and clutch support bracket bolts (Fig. 6).
3. Loosen the steering column opening cover plate-to-dash panel bolts. Check the flexible coupling retaining nuts to be sure that they are tight.
4. With the front wheels in the straightahead position, pull the steering column upward until the flexible coupling is in a position between flat and concaved upward (toward steering wheel) 1/10-inch (Fig. 1).
5. Tighten the steering column-to-support bracket bolts.
6. Tighten the steering column opening cover plate-to-dash panel bolts.
7. Tighten the cover plate clamp bolt.
8. Insert a .010-inch shim between the flexible coupling right safety pin and steering column lower flange cut-out (Fig. 1) and turn the steering wheel one revolution clockwise.
9. Check to see if the shim is tight (cannot be removed). If the shim is tight, loosen the cover plate clamp and the plate attaching bolts (Fig. 6) and re-align the column until the shim remains loose enough to be removed when rotating the steering wheel.
10. Insert the .010-inch shim between the flexible coupling left safety pin and lower flange cut-out, turn the steering wheel one revolution counter-clockwise, and check as in Step 9.
11. Install the trim cover.

REMOVAL AND INSTALLATION

STEERING WHEEL

E-100—E-350, F-100—F-350 AND BRONCO

Alignment for Clear Vision

1. Set wheels in straight ahead position by driving vehicle a short distance and mark the steering wheel and steering column relationship with a chalk mark.
2. Note the steering wheel position with toe adjusted on F-Series and Bronco vehicles. If off center (spokes in horizontal position) more than plus or minus 22 1/2 degrees in a vertical plane, remove the steering

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wheel, (Fig. 2). With toe adjusted on E-Series, if off center (spokes in horizontal position) more than plus or minus 10 degrees in a vertical plane, remove the steering wheel (Fig. 2).

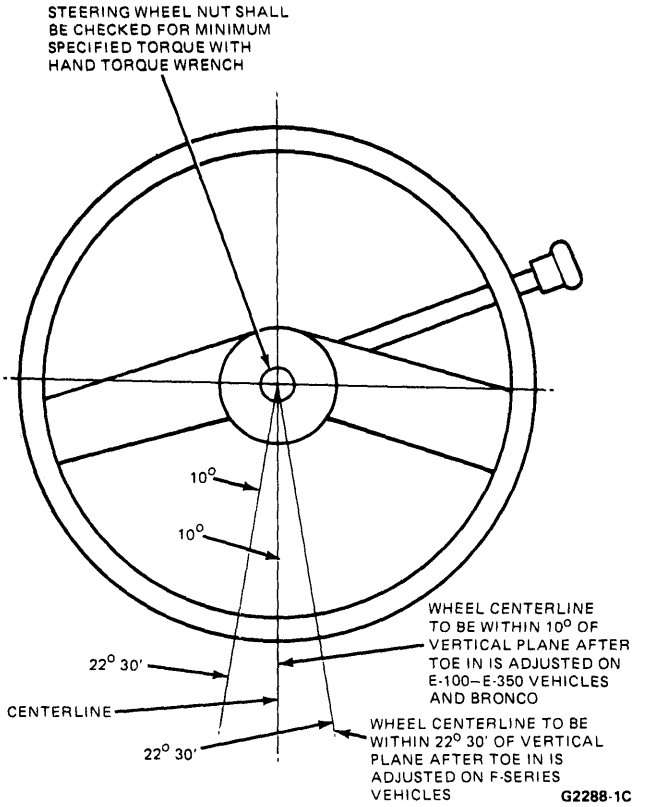


FIG. 2 Acceptable Steering Wheel Installation—Measured From Normal Spoke Angle

Removal

1. Park the vehicle with the chalk marks aligned.
2. Disconnect the battery ground cable.
3. Remove one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel on vehicles equipped with sport steering wheel option, pry the button cover off with a screwdriver.
4. Disconnect the horn switch wires by pulling the spade terminal from the blade connectors, (Fig. 3). On vehicles equipped with speed control, squeeze or pinch the "J" clip ground wire terminal firmly and pull it out of the hole in the steering wheel. Do not pull the ground terminal out of the threaded hole without squeezing the terminal clip to relieve the spring retention of the terminal in the threaded hole.
5. Remove the horn switch assembly.
6. Remove steering wheel retaining nut.
7. Use the proper steering wheel removal tool T67L-3600-A and remove steering wheel from shaft. Do not hammer on the steering wheel or center shaft.

Alignment Adjustment

The steering wheel has serrations equally spaced and can be installed in any position. Therefore, with front wheels in the straight ahead position install the steering wheel on the steering column so the alignment marks on the wheel hub are in line with the marks on the turn signal flange (specification 22 1/2 degrees plus or minus from horizontal for F-Series, 10 degrees plus or minus from horizontal for E-100—E-350).

1. Position steering wheel into place with retaining nut.
2. Tighten retaining nut to 40-50 ft-lbs.
3. Connect the spade terminal of the horn switch wire to the blade connector, and press the "J" clip ground terminal fully into the threaded hole, (Fig. 3).
4. Center the horn switch (pad) on the steering wheel, and install the two attaching screws. If equipped with sport steering wheel option, pop into place by hand or rubber mallet.

STEERING COLUMN

F-100 THRU F-350

Removal

1. Set the front wheels in the straight-ahead-position and mark the steering shaft flange and flexible coupling with a chalk or grease pencil to retain alignment during installation.
2. Remove the steering wheel as outlined in the foregoing procedure.
3. Remove the trim cover from the instrument panel pad.
4. Disconnect the turn signal wire connector and the back-up switch wires.
5. Remove the seal (four attaching screws) from the inner side of the dash panel (Fig. 4).
6. Disconnect the shift rods at the column shift levers.
7. Remove the two nuts that retain the steering shaft flange to the flexible coupling (Fig. 4).
8. Remove the two screws that attach the steering column upper bracket to the clutch and brake pedal support.
9. Remove the steering column through the dash panel opening toward the inside of the cab.

Installation

1. Install the steering column in the vehicle from inside the cab toward the engine compartment.
2. Loosely attach the steering column to the clutch and brake pedal support (two screws).
3. Locate the steering shaft flange on the flexible coupling following the chalk line made during removal. Make sure that the coupling pins are centrally located in the steering shaft slots, and then install the two retaining nuts and tighten to specifications.
4. Move the column up or down until the flexible coupling is in the flat plane. With the column thus located, tighten the two column upper bracket-to-clutch and brake pedal support screws to specifications.
5. Connect the column shift levers to the shift rods.
6. Connect the turn signal switch wire connector and the back-up switch wires.

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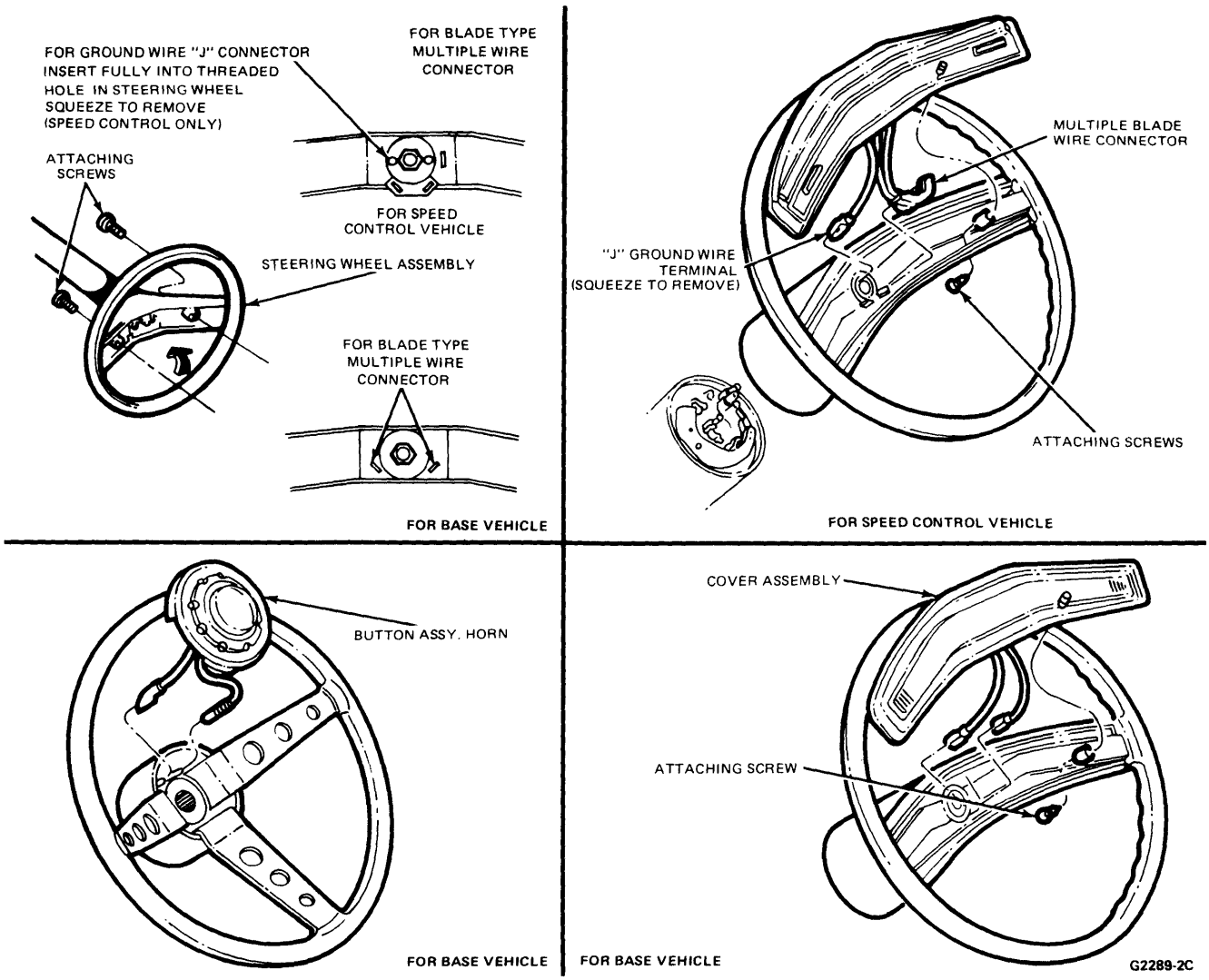


FIG. 3 Steering Wheel/Horn Switch Assembly Installation

7. Install the trim cover to the instrument panel (four screws).
8. Install the steering wheel on the steering shaft as outlined in this section.
9. Locate the steering column lower support bracket against the dash panel. Install the three bolts and tighten to 8-18 ft-lb.
10. Road test the vehicle including the direction signals and horn.
11. Re-check to make sure the flexible coupling is flat with the coupling pins centrally located in the steering shaft slots.

F-150 AND F-250 (4X4), AND BRONCO

Removal

1. Disconnect turn signal switch wire connector and back-up light or neutral start switch wires.
2. Remove the steering wheel as outlined in the procedure under steering wheel removal.
3. Remove the coupling shaft U-joint bolt.
4. Disconnect the shift rods at the column shift levers (Fig. 5).
5. Remove the bolts that hold the column seal assembly to the dash panel (Fig. 5).
6. Remove the four screws holding the trim cover. Remove the trim cover.
7. Remove the bolts that attach the column to the brake and clutch pedal support.
8. Remove the column assembly through the dash panel opening toward the inside of the cab.

Installation

1. Install the steering column in the vehicle from inside the cab toward the engine compartment.
2. Loosely attach the steering column to the clutch and brake pedal support (two screws).
3. Locate the steering shaft in the coupling shaft U-joint and secure with bolt tightened to 40-60 ft-lbs.
4. Move the column up or down until the flexible coupling is in the flat plane. With the column thus located, tighten the two column upper bracket-to-clutch and brake pedal support screws to 8-20 ft-lbs.
5. Connect the column shift levers to the shift rods.
6. Connect the turn signal switch wire connector and the back-up switch wires.
7. Install the trim cover to the instrument panel (four screws).

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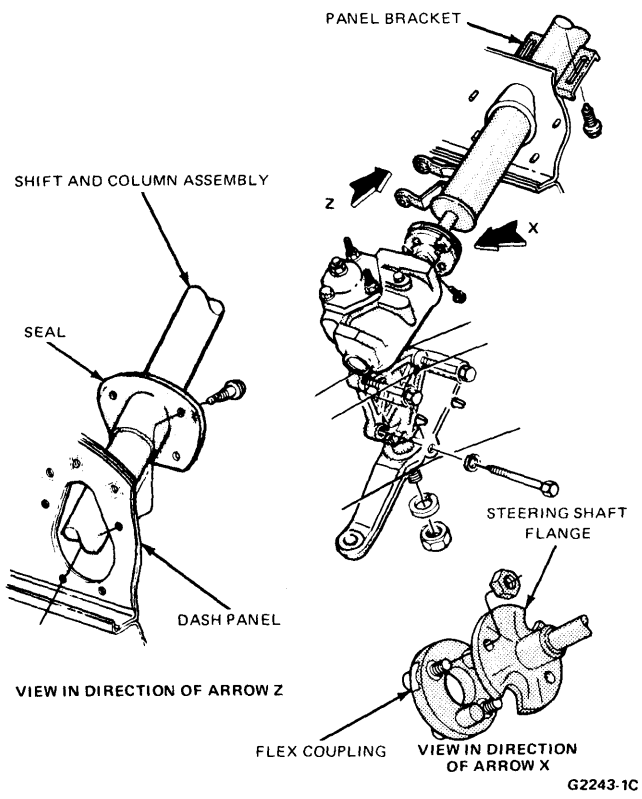


FIG. 4 Steering Column Installation F-100 thru F-350 (4x2)

8. Install the steering wheel on the steering shaft as outlined in this section.
9. Locate the steering column lower support bracket against the dash panel. Install the four bolts and tighten to 8-18 ft-lbs.
10. Road test the vehicle including the direction signals and horn.
11. Re-check to make sure the flexible coupling is flat with the coupling pins centrally located in the steering shaft slots.

E-100—E-350

Removal

1. Set the front wheels in the straight ahead position and mark the steering shaft flange and flexible coupling with chalk or grease pencil to retain alignment during installation.
2. Remove the steering wheel as outlined in this section.
3. Remove the steering column trim cover from the instrument panel (two screws).
4. Disconnect the ignition switch wire connector and the back-up switch wires.
5. Disconnect the shift rods at the column shift levers.
6. Remove the two nuts that attach the steering shaft flange to the flexible coupling.
7. Remove the three bolts that secure the steering column opening cover plate to the inside of the dash panel (Fig. 6).
8. Remove the column upper bracket-to-brake support bracket bolts.
9. Remove the column assembly through the dash panel opening toward the inside of the cab.

Installation

1. Install the steering column in the vehicle from inside the cab toward the engine compartment.
2. Loosely attach the steering column to the brake support bracket (upper bracket and two bolts Fig. 6).
3. Locate the steering shaft flange on the flexible coupling following the chalk line made during removal. Make sure that the coupling pins are centrally located in the steering shaft slots, and then install the two retaining nuts and tighten to specifications.
4. Pull the steering column upward until the flexible coupling is in a position between flat and concaved upward (toward steering wheel) 1/10 inch (Fig. 1). With the column thus located, tighten the column upper bracket-to-brake support bracket bolts to 8-20 ft-lbs (Fig. 6).
5. Connect the column shift levers to the shift rods. On vehicles with manual transmission, insert the alignment pin through the cross-over alignment spacer before adjusting the shift rod. See Part 16-11 for shift rod adjustment.
6. Slide the cover plate and seal assembly and the lower clamp down the column against the dash panel. Attach the cover plate to the dash panel so that the seal is not distorted. Tighten the three attaching bolts to 10-20 ft-lbs.
7. Connect the ignition switch wire connector and the back-up switch wires. For back-up light adjustment, see Part 32-31. For neutral start switch adjustment, see Part 17-02.
8. Install the steering column trim cover to the instrument panel (two screws).
9. Install the steering wheel as outlined in this section.
10. Road test the vehicle including the turn signals and horn. For horn check, see Part 35-80. For turn signal check. see Part 32-41. For speed control check, see Part 37-01.
11. Re-check the flexible coupling for proper location of pins in the steering shaft flange cut-outs. Use the .010-inch shims while turning the steering wheel as outlined under Steering Column Alignment in the Adjustment section of this Part.

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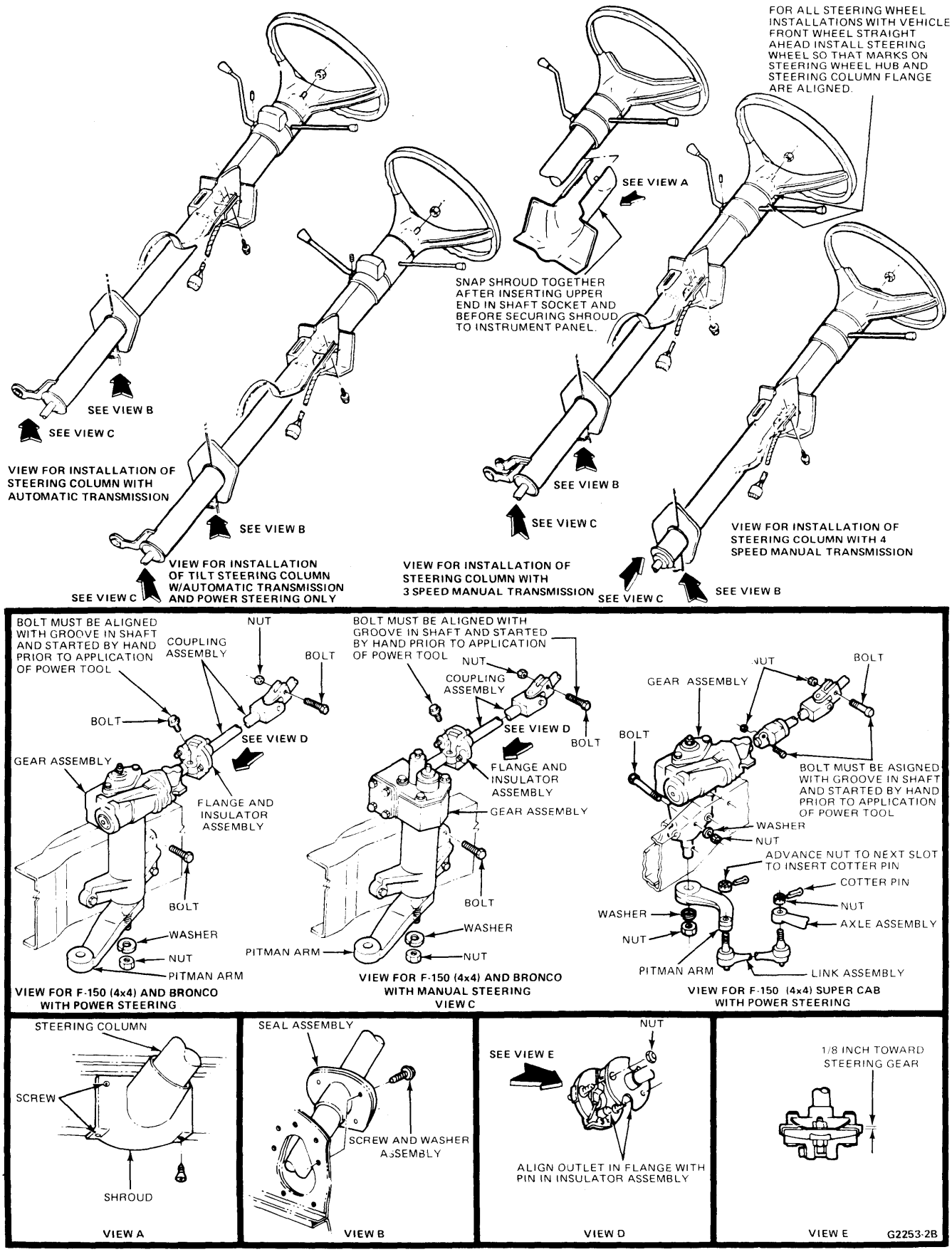


FIG. 5 Steering Column Installation—F-150 and F-250 (4x4), and Bronco

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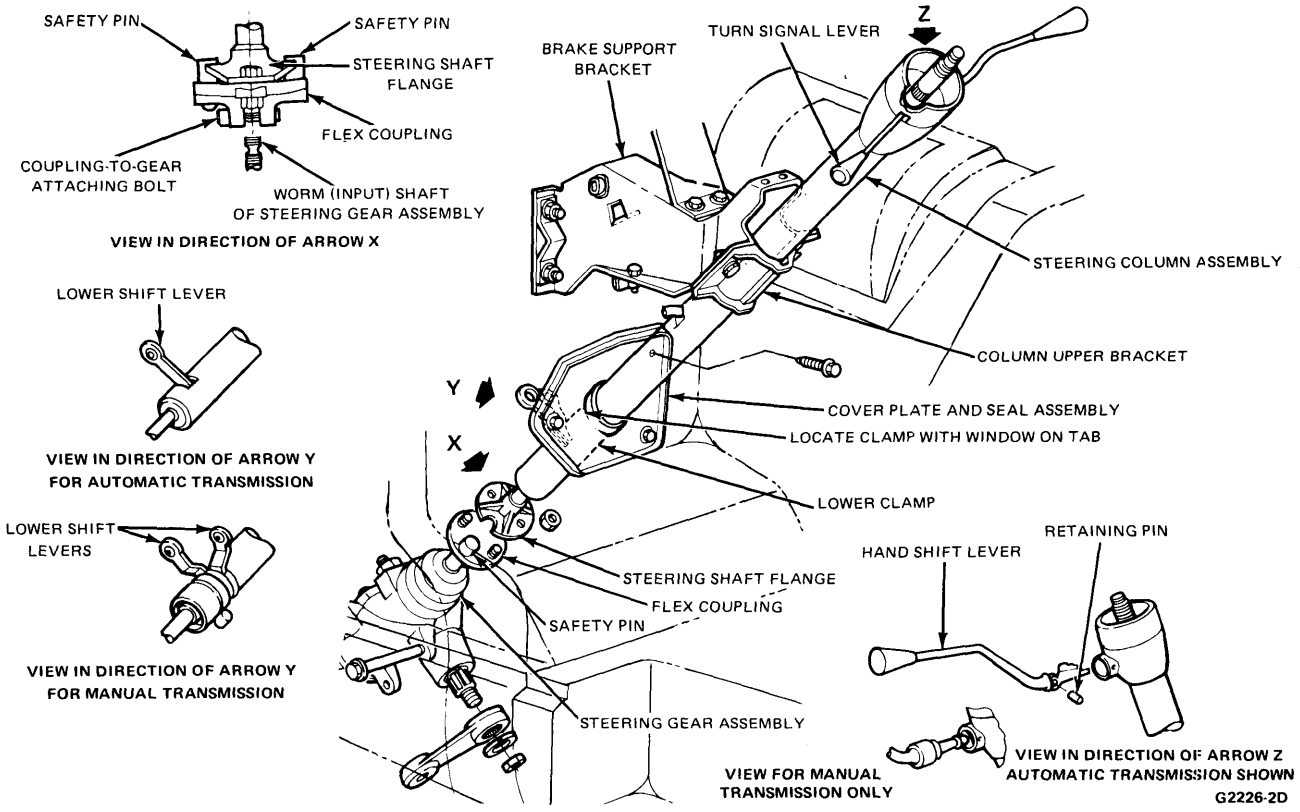


FIG. 6 Steering Column Installation—E-100—E-350

DISASSEMBLY AND ASSEMBLY

STEERING COLUMN NON-TILT WITH AUTOMATIC TRANSMISSION

Disassembly Refer to Fig. 7

1. Remove steering wheel and column as outlined in this part.
2. Using a punch and a hammer, remove the hand shift lever retaining pin. Remove the hand shift lever. Unscrew the turn signal lever from the column.
3. Remove the three screws attaching the turn signal unit to the upper flange. Remove the screw attaching the transmission indicator light and remove the light. Remove the turn signal assembly and wiring harness.
4. Remove the snap ring from the steering shaft.
5. Slide the steering column assembly off the steering shaft.
6. Remove the two nuts in the upper flange to separate the upper flange from the lower flange. Remove bolts. Note the position of the upper flange in relation to the lower flange.
7. With a punch and light hammer, gently tap the bearing out of the upper flange.
8. Remove the lower flange and shift tube from the steering column assembly. Remove spring and wave washer from shift tube.
9. Remove shift fork from steering column assembly.

Assembly

1. Install the shift fork in the steering column assembly.
2. Position spring and wave washer on shift tube. Install shift tube in steering column assembly. Make sure the tab on the shift tube is aligned with the notch on the shift fork.
3. Place a socket on the outside diameter of the bearing. Gently tap the bearing into the upper flange.
4. Install upper flange on lower flange so connecting bolt holes are in proper position. Install nut and bolt assemblies and tighten.
5. Slide column assembly over steering shaft.
6. Install snap ring in groove on the steering column shaft.
7. Slide wiring harness through hole in upper flange.
8. Position turn signal assembly and transmission indicator light. Install and tighten screws.
9. Install hand shift lever in position and drive in retaining pin. Screw in turn signal lever.
10. Install steering wheel and column as outlined in this Part.

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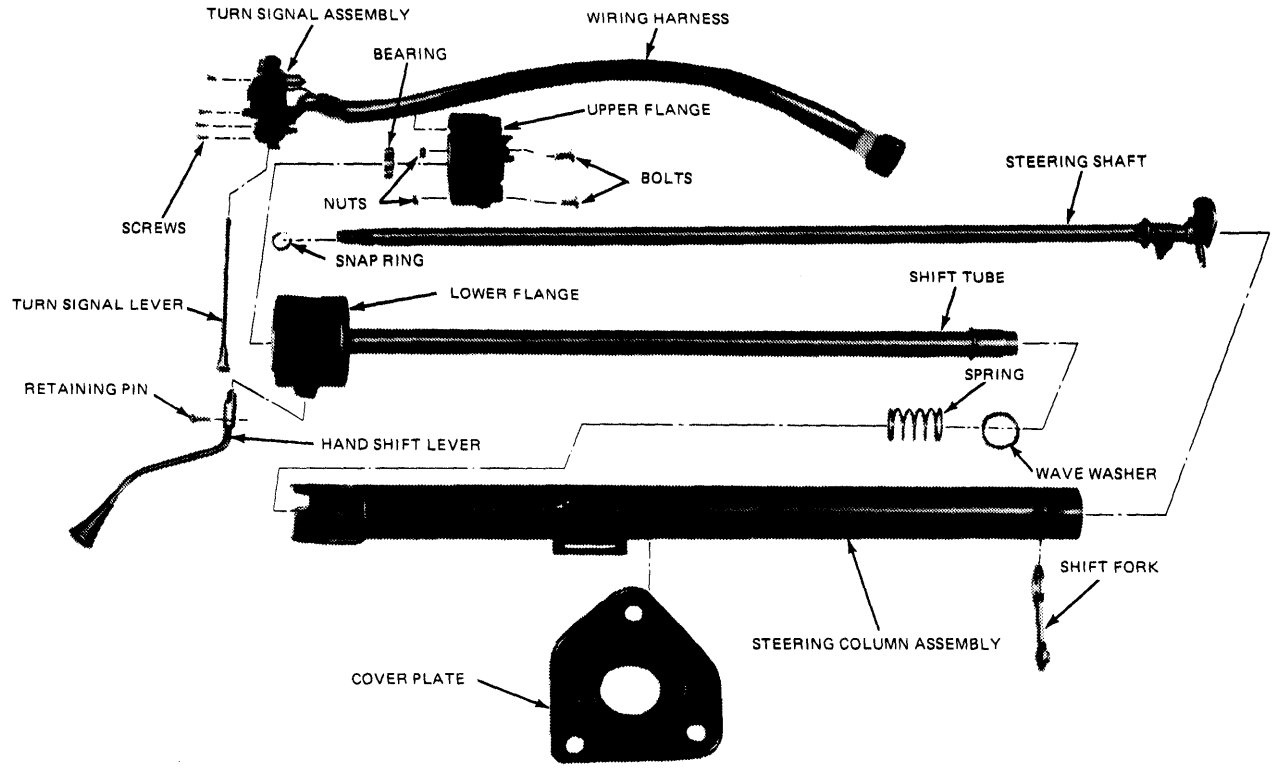


FIG. 7 Steering Column Non-Tilt with Automatic Transmission

STEERING COLUMN MANUAL TRANSMISSION

Disassembly Refer to Fig. 8

1. Remove steering wheel and column as outlined in this part.
2. Unscrew turn signal lever from upper flange.
3. Remove the three screws attaching turn signal assembly to upper flange. Remove turn signal assembly and wiring harness.
4. Remove snap ring from steering shaft in upper flange.
5. Remove upper flange from lower flange. Carefully note the position of the upper flange in relation to the lower flange.
6. With a punch and light hammer, gently tap out the bearing from the upper flange.
7. Slide the steering shaft out of the steering column assembly.
8. Remove the lower flange and shift tube from the steering column assembly.
9. Remove the shift fork assembly. Carefully note the position of the forks and spacers in the assembly.

Assembly

1. Install the shift fork and spacer assembly together. Install in the steering column assembly. The tang on the middle spacer should protrude through the hole in the steering column assembly.
2. Install the shift tube and lower flange in the steering column assembly. Position the tab on the shift tube in the notch on the fork assembly.
3. Slide the column assembly over the steering shaft.
4. Position a socket the same size diameter on the bearing. Gently tap the bearing into the upper flange.
5. Install the upper flange onto the lower flange in the correct position.
6. Install snap ring in the groove on the steering shaft.
7. Install the wiring harness through the hole in the upper flange.
8. Place turn signal assembly into position. Install and tighten screws.
9. Screw turn signal lever into position in the upper flange.
10. Install the column and steering wheel.

STEERING COLUMN TILT COLUMN WITH AUTOMATIC TRANSMISSION

Disassembly Refer to Fig. 9

1. Remove steering wheel and column as outlined in this part.
2. With a punch and hammer remove hand shift lever retaining pin. Remove the hand shift lever. Remove the shift lever spring. Unscrew the turn signal lever/tilt actuator lever from the upper flange.
3. Remove the bolt and two screws attaching turn signal assembly to upper flange.
4. Remove tilt actuator mechanism.
5. Remove four screw attaching upper flange to tilt upper flange. Remove the upper flange.
6. Remove snap ring from steering shaft.

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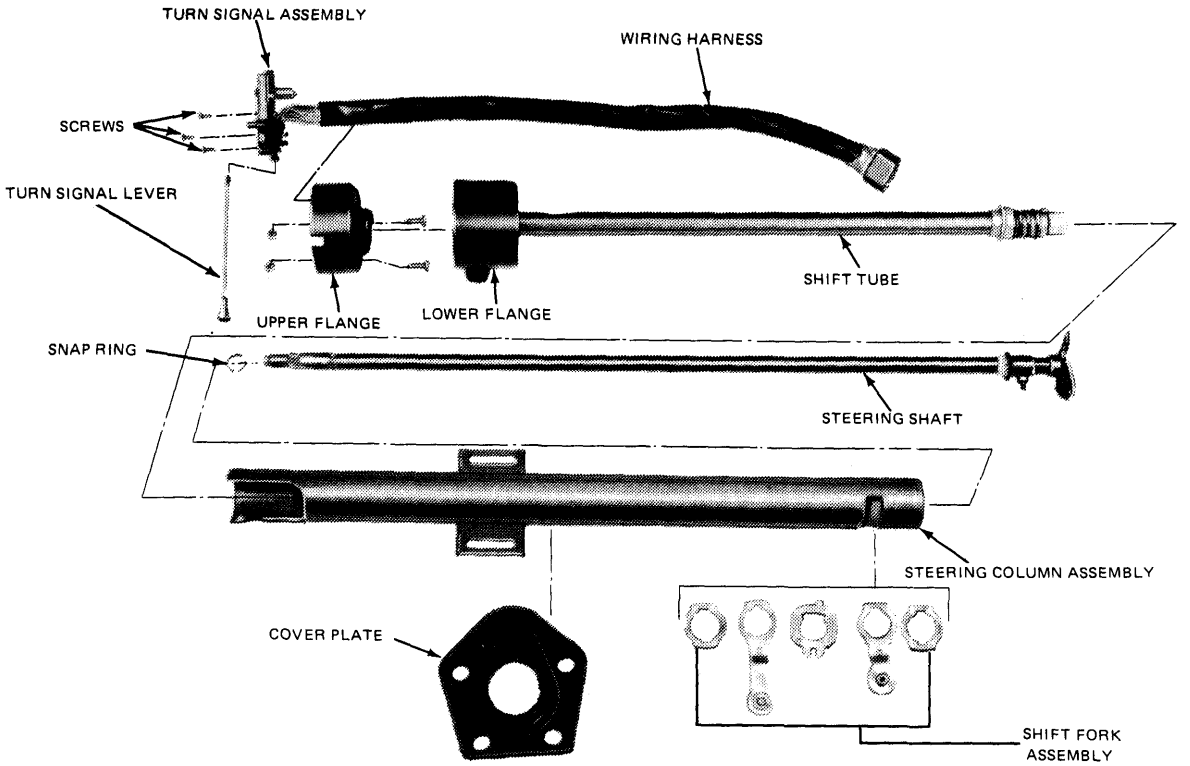


FIG. 8 Steering Column Manual Transmission

7. Invert assembly and remove the three Allen-head screws and spacers connecting lower flange to steering column assembly.
8. With a 7/16" 12-point socket, remove the flange connecting the steering column to the steering gear. After the bolt is removed, it may be necessary to pry open the flange with a screwdriver.
9. Remove the tilt column mechanism, steering shaft and wiring harness from the steering column. Remove the transmission indicator light.
10. Remove the shift tube and lower flange from the steering column assembly.
11. Remove the spring from the shift tube.
12. Remove shift fork. Remove cap at end of steering column assembly.

Assembly

1. Install shift fork in the steering column assembly.
2. Install spring on shift tube. Install shift tube in steering column assembly. Make sure that the tab on the shift column is inserted into the notch on the shift fork. Hold pressure on the lower flange to keep spring from unseating.
3. Install the Allen-head bolts and spacers that connect the steering column assembly to the lower flange and shift tube assembly.
4. Install the tilt mechanism, steering shaft and wiring harness in the steering column assembly. Install transmission indicator light.
5. Install cap on bottom of steering column assembly. Install flange connecting steering column to steering gear. Tighten to 28-35 ft-lbs.
6. Install snap ring in groove on the steering shaft.
7. Position upper flange in position. Install and tighten screws.
8. Install tilt actuating mechanism.
9. Place turn signal assembly in position and install and tighten bolt and two screws.
10. Install the shift lever spring. Install hand shift lever and retaining pin. Screw turn signal/tilt actuating lever in upper flange.

TILT MECHANISM

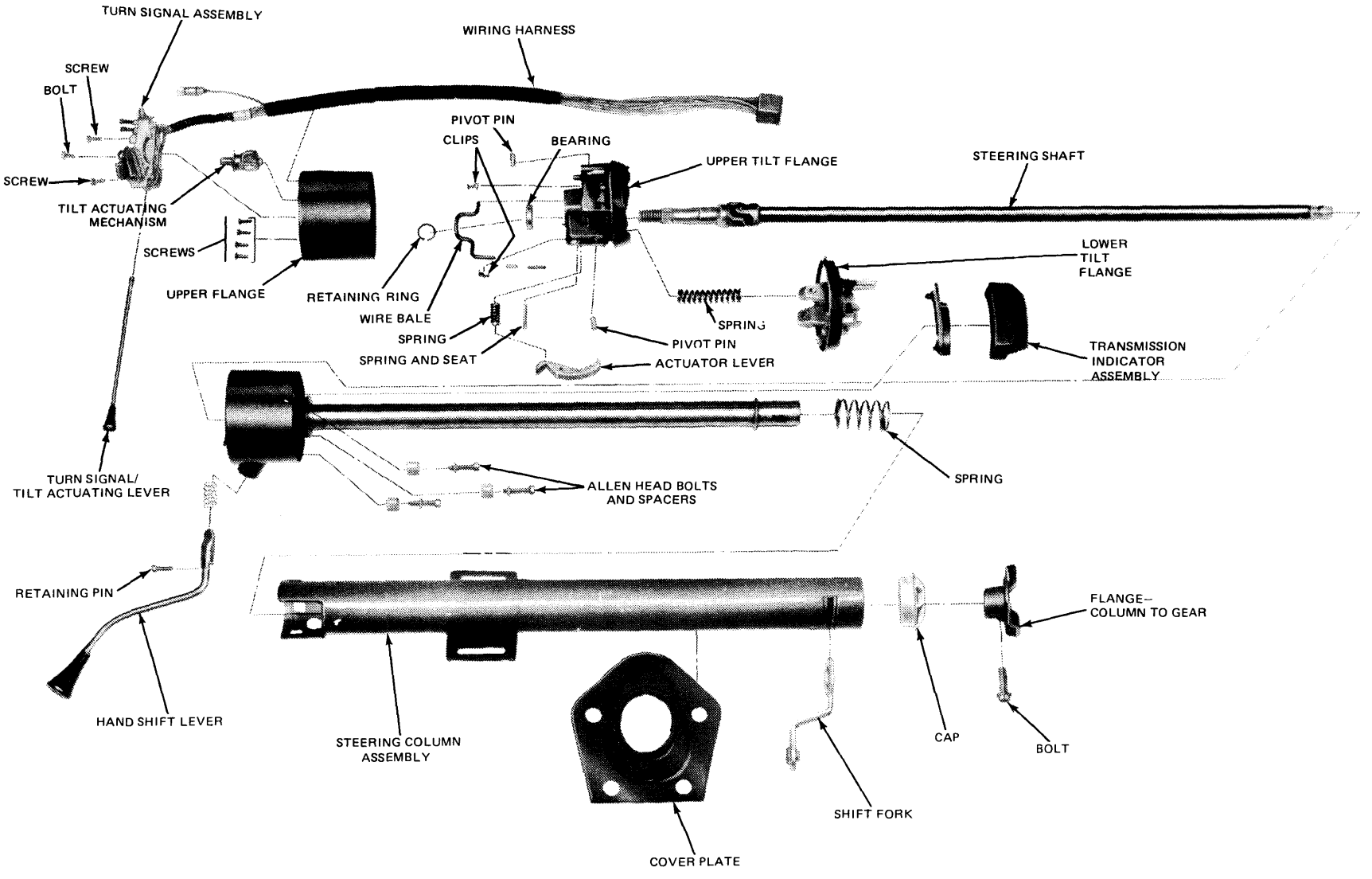
Disassembly Refer to Fig. 9

1. Remove tilt mechanism, steering shaft and wiring harness as outlined in this part.
2. Remove the two spring clips holding the wire bale which acts as a release lever for the locking lever. Remove the wire bale (Fig. 10).
3. With a punch and hammer, drive out the pin holding the locking lever. Remove the locking lever and spring. (A C-clamp may be necessary to remove the tension on the pin to make removal easier).
4. Remove the steering column snap ring.
5. The upper and lower tilt flange can now be separated by removing the two pivot pins located in the side of the upper flange assembly with either Tool T70P-3D739-A or Tools T70P-3D739-A and T67P-3D739-C (Fig. 11). Do not re-use pivot pins if the press fit is loose in the flanges.
6. Separate the upper tilt flange from the lower tilt flange. Be careful when removing flange as the spring may shoot out with damaging force. Remove spring.

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G2536-2B

FIG. 9 Tilt Column

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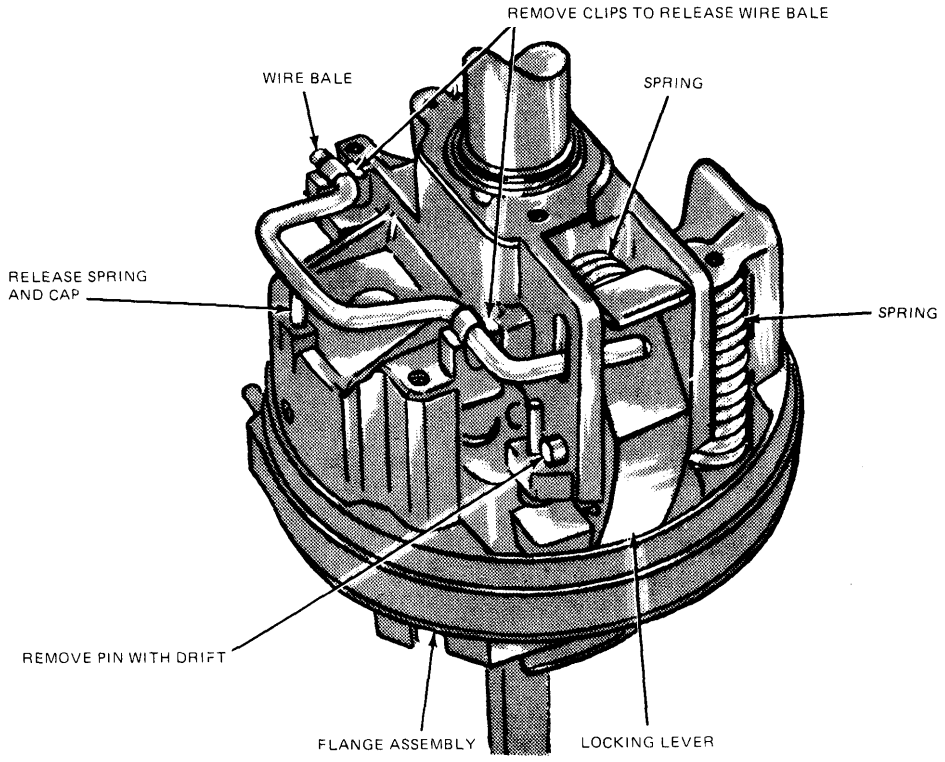


FIG. 10 Wire Bale and Tilt Locking Lever

7. Remove the flanges, steering shaft and wiring harness.
8. Remove the upper and lower bearings in the upper tilt flange as outlined in this Part.

Assembly

1. Assemble the upper and lower bearings in the upper tilt flange as outlined in this part.
2. Install the upper and lower flanges, steering shaft and wiring harness.
3. Assemble the upper and lower castings by installing the two pivot pins using a C-clamp as shown in Fig. 12. Do not re-use pivot pins if press fit is loose in the flanges. Insure that the spring is properly seated between the upper and lower tilt flanges.
4. Install the steering column upper snap ring.
5. Install the locking lever and spring. Insert the dowel pin that holds the 1 locking lever. A C-clamp may be used to relieve the tension on the pin during assembly (Fig. 11).
6. Install the small spring and cap assembly in the upper tilt flange.
7. Position the wire bale on the upper flange casting and install the two spring clips that hold the wire bale in place.

UPPER AND LOWER BEARINGS TILT COLUMN UPPER FLANGE

Disassembly

1. Remove the tilt mechanism as outlined in this Part.
2. Place the flange casting on a bench with the smaller bearing facing down.
3. With a small pick, lightly tap on the outer race of the small bearing at each slot. Never drive or apply pressure of any kind to the inner race of the bearing.
4. Invert the flange casting and place it on a bench with the large bearing facing down.
5. With a small pick, lightly tap on the outer race of the large bearing at each slot. Never drive or apply

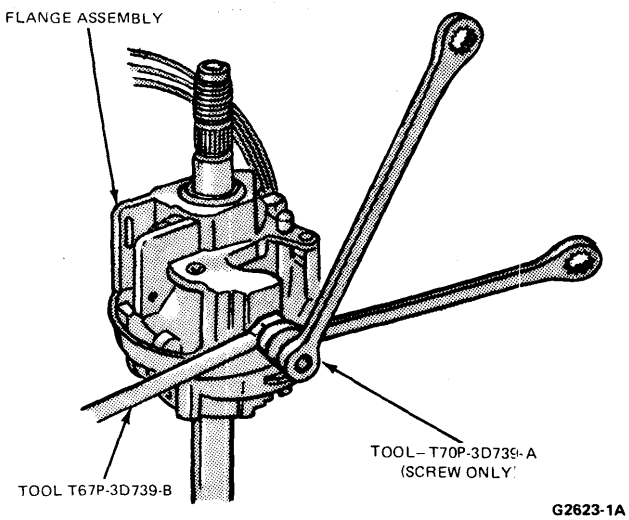


FIG. 11 Removing Pivot Pin

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pressure of any kind to the inner race of the bearing.

Assembly

1. Position the flange casting on a bench with the large bearing seat facing upward.
2. Select a socket wrench that is the same diameter as the outer race of the large upper bearing.
3. Position the large upper bearing over its bearing seat with the open side facing inward.
4. Place the socket wrench on the outer race of the bearing and lightly tap on the socket wrench until the bearing is in place. Be careful not to contact the bearing inner race as damage will result.
5. Invert the flange casting on a bench with the small bearing seat facing upward.
6. Select a socket wrench that is the same diameter as the outer race of the small bearing.
7. Position the small bearing over its bearing seat with the open side facing inward.
8. Place the socket wrench on the outer race of the bearing and lightly tap on the socket wrench until the bearing is in place.
9. Install the tilt column mechanism as outlined in this part.

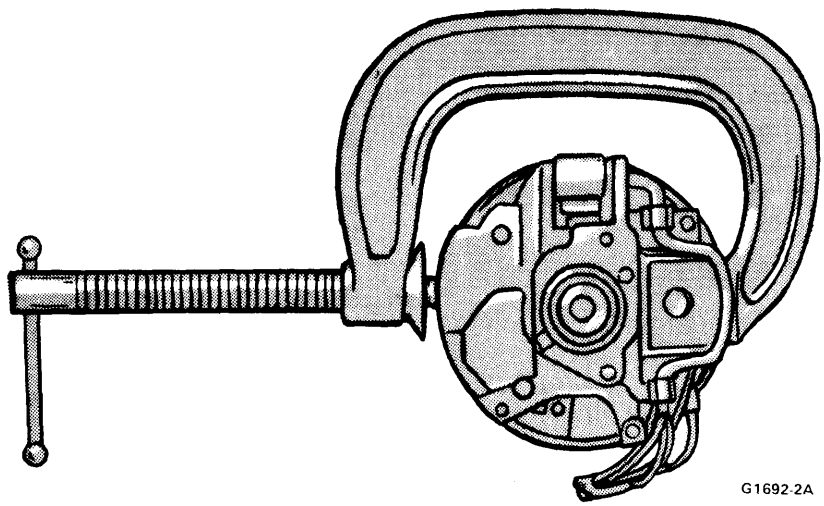


FIG. 12 Installing Pivot Pins

SPECIFICATIONS

Refer to the specifications chart in Part 13-01, General Steering Service.

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Steering Linkage — Manual 13-24

APPLIES TO ALL MODELS

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Pitman Arm	24-6
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REMOVAL AND INSTALLATION

DRAG LINK

F-250—F-350 4x4

Replace the drag link if the ball stud is excessively loose or if the drag link is bent. **Do not attempt to straighten a drag link.**

1. Remove the cotter pins and nuts from the ball studs.
2. Remove the ball studs from the arms.
3. Position new drag link ball studs in the arms and install the nuts. Tighten the nuts to specifications and install the cotter pins.

TIE ROD AND LINK ASSEMBLY

E-100—E-350, F-100—F-350, BRONCO, F-150, F-250 (4x4)

Replace the drag link if a ball stud is excessively loose or if the drag link is bent. **Do not attempt to straighten a drag link.**

Replace the connecting rod if the ball stud is excessively loose, if the connecting rod is bent or if the threads are stripped. Do not attempt to straighten connecting rod.

After installing a connecting rod or adjusting toe-in on E-100—E-350 models, check Fig. 6 to insure that the adjustment sleeve clamps are correctly positioned on the E-100 and E-150 and to insure that the clamp stop is correctly installed on the E-250 and E-350. Always check to insure that the adjustment sleeve and clamp stops are correctly installed on the Bronco.

1. Remove the cotter pins and nuts from the drag link, ball studs and from the right connecting rod ball stud (Figs. 1, 2, 4, 5 and 6).
2. Remove the right connecting rod ball stud from the drag link.
3. Remove the drag link ball studs from the spindle and the pitman arm.
4. Position the new drag link, ball studs in the spindle, and pitman arm and install nuts.
5. Position the right connecting rod ball stud in the drag link and install nut.
6. Tighten the nuts to 50-75 ft-lbs and install the cotter pins.
7. Remove the cotter pin and nut from the connecting rod (Figs. 4, 5 and 6).
8. Remove the ball stud from the mating part.
9. Loosen the clamp bolt and turn the rod out of the adjustment sleeve.
10. Lubricate the threads of the new connecting rod, and turn it into the adjustment sleeve to about the same distance the old rods were installed (for E-250 and E-350 see Fig. 6 and for Bronco see Fig. 3, for correct installation of the clamp stop). This will provide an approximate toe-in setting. Position the connecting rod ball studs in the spindle arms.
11. Install the nuts on to the connecting rod ball studs, tighten the nut to 50-75 ft-lbs and install the cotter pin.
12. Check the toe-in and adjust, if necessary. After checking or adjusting toe-in, center the adjustment sleeve clamps between the locating nibbs, position the clamps (F-Series see Fig. 6, E-100—E-350 see Fig. 6) and tighten the nuts to 29-41 ft-lbs.

Toe-in check and adjustment procedure. See Part 14-01.

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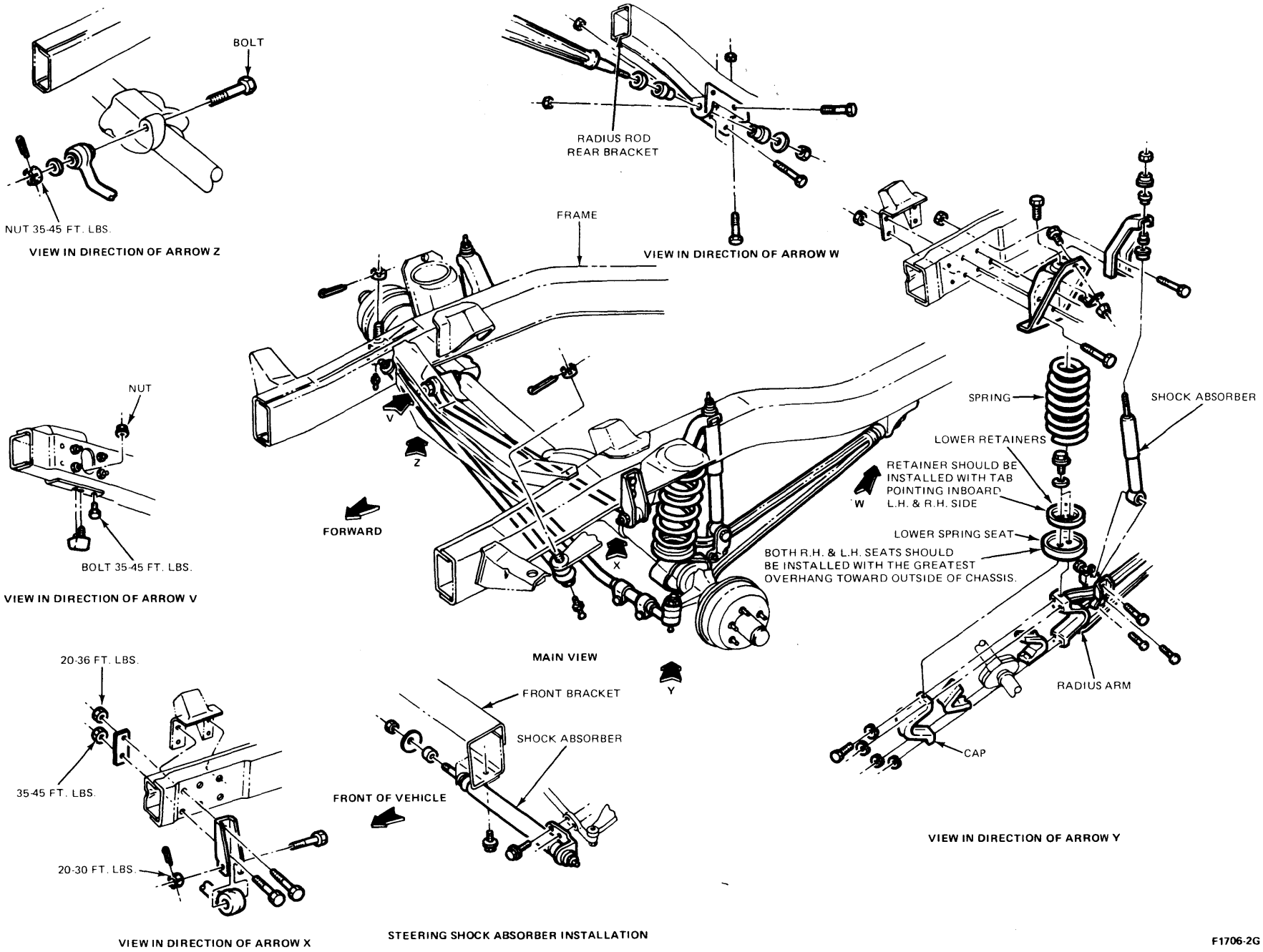


FIG. 1 Steering Linkage Disassembled F-150 (4x4) and Bronco

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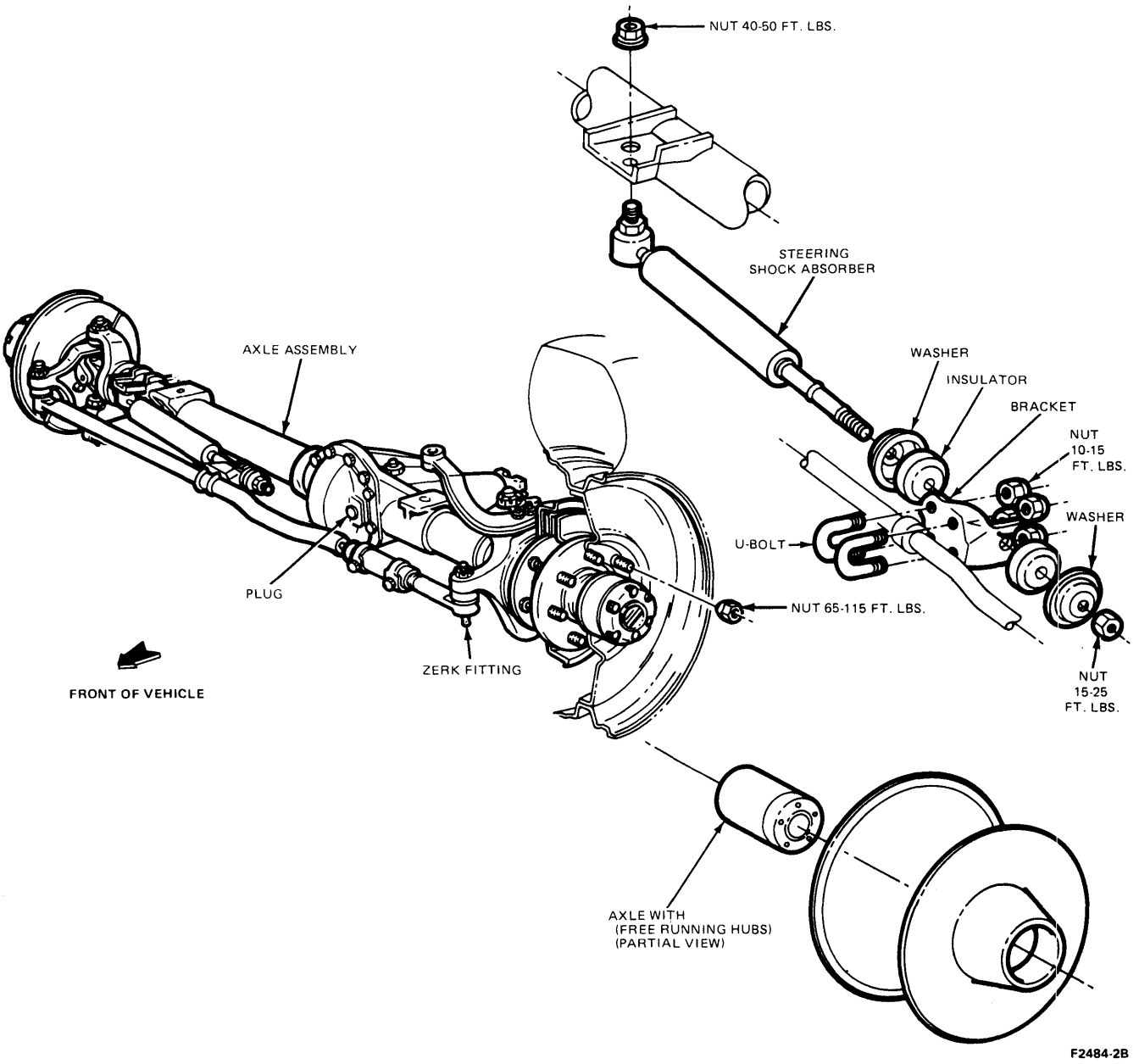


FIG. 2 Steering Linkage—F-250 F-350 (4x4)

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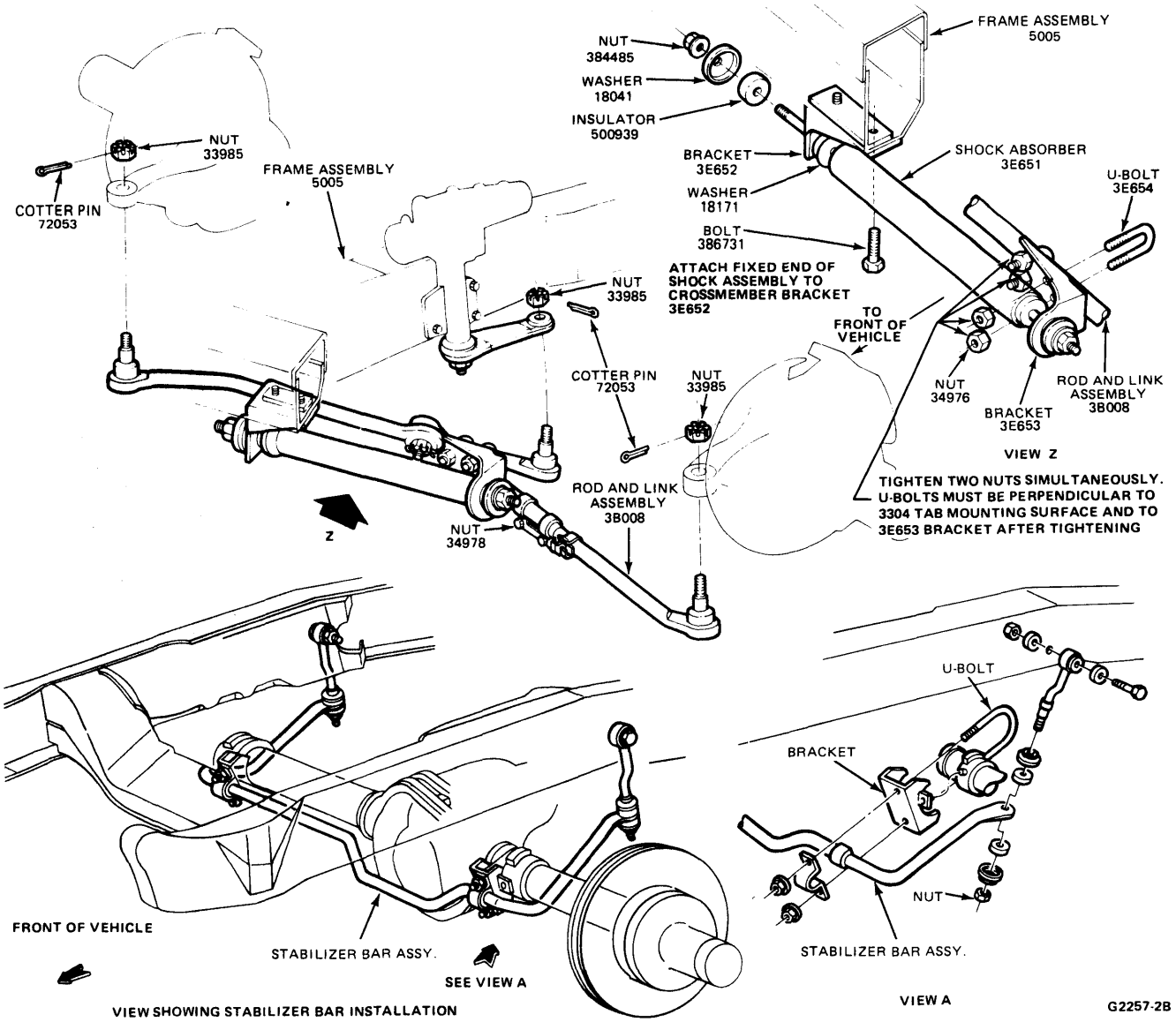


FIG. 3 Steering Linkage—F-150 (4x4) and Bronco

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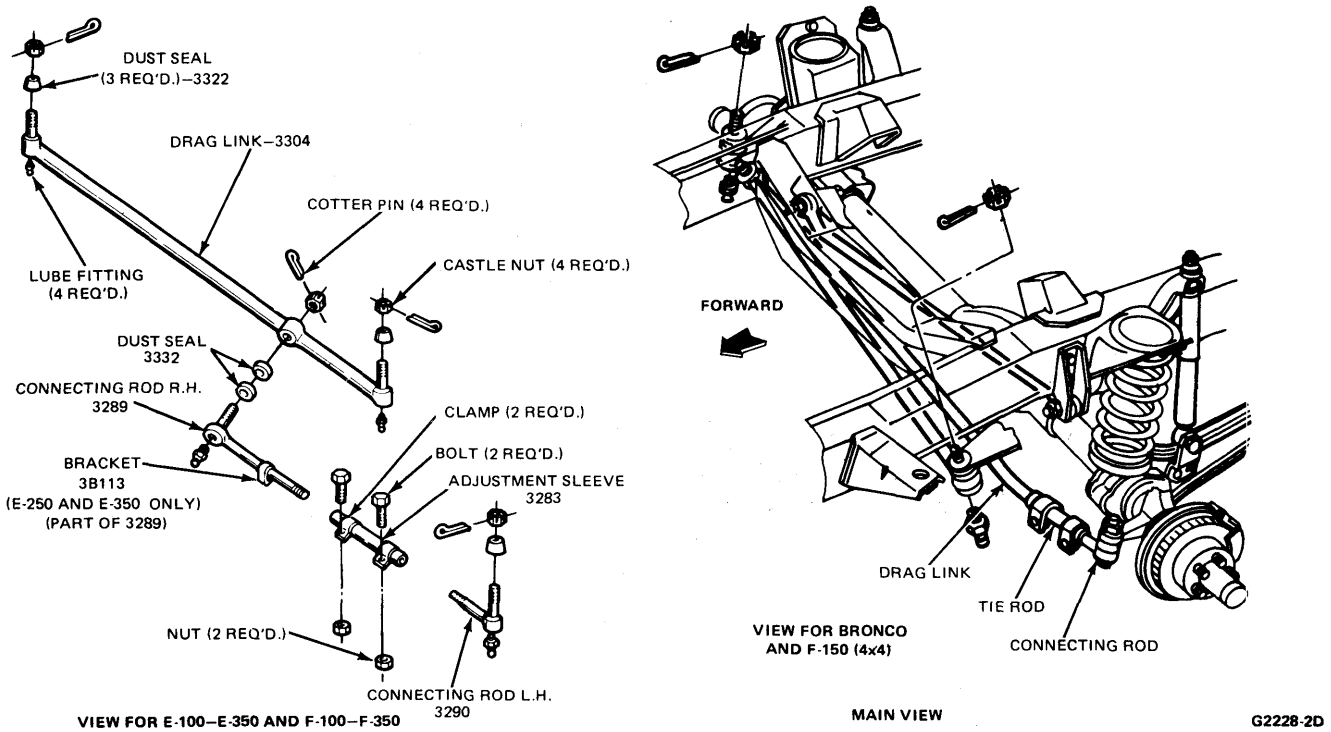


FIG. 4 Steering Linkage—E-100—E-350, F-100—F-350, F-150 (4x4) and Bronco

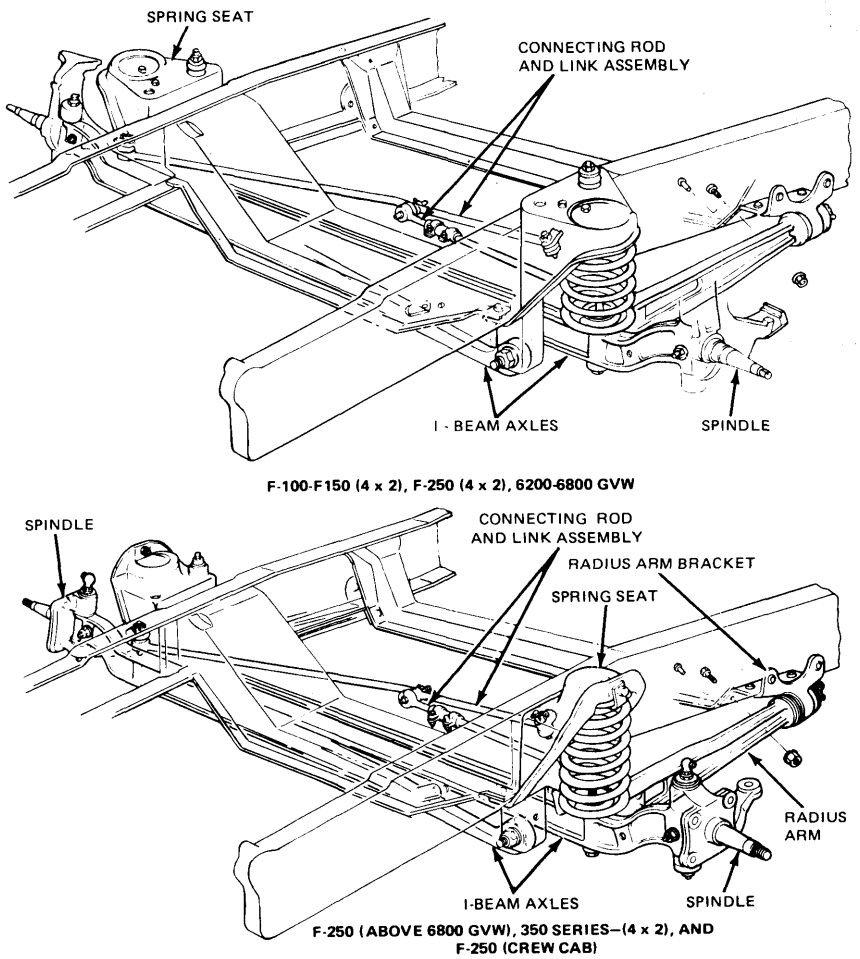


FIG. 5 Steering Linkage—F-100 Through F-350 with Twin I-Beam

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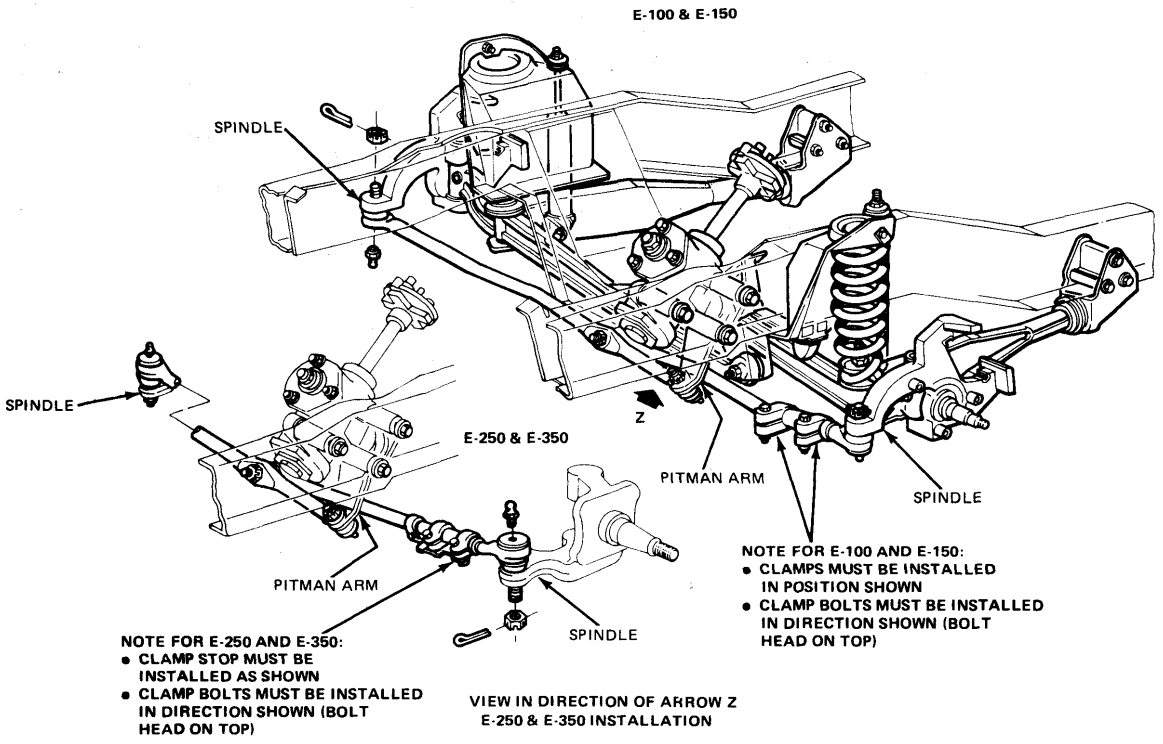


FIG. 6 Steering Linkage—E-100 Through E-350

PITMAN ARM

Replace the pitman arm if the pitman arm is bent. Do not attempt to straighten the pitman arm.

1. Remove the cotter pin and nut from the draglink ball stud at the pitman arm.
2. Remove the drag link ball stud from the pitman arm.
3. Remove the pitman arm attaching nut and washer.
4. Remove the pitman arm from the steering gear sector shaft using Tool T64P-3590-F. Remove the tool from the pitman arm.
5. Install the new pitman arm assembly on the sector shaft with wheels in straight ahead position. Install the pitman arm attaching washer and nut. Tighten the nut to 170-230 ft-lbs.
6. Install the draglink ball stud on the pitman arm, tighten the nut to 50-75 ft-lbs and install the cotter pin.

SPECIFICATIONS

Refer to Part 13-01 for Specifications.

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Manual Steering Gear — Recirculating Ball

PART 13-33

APPLIES TO F-100 — F-350, E-100 — E-350, BRONCO

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DESCRIPTION

The manual steering gear (Figs. 1 and 2) is of the recirculating- ball-nut type with the steering shaft, worm shaft and ball nut all in line, making a compact and easily serviced gear.

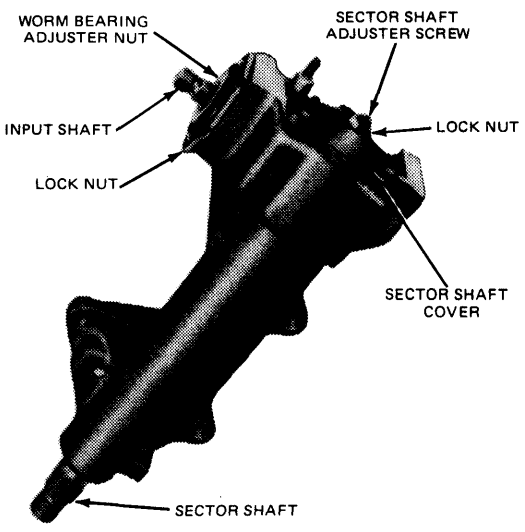


FIG. 1 Manual Steering Gear—Recirculating Ball—F-100 thru F-350 (4 x 2)

The steering shaft and worm shaft are separated with a coupling which permits removal of the gear assembly or steering shaft (and column) independent of each other.

The mechanical element of this steering gear is a low-friction, high-efficiency recirculating ball system in which steel balls act as a rolling thread between the steering worm and nut. The nut is one piece and is geared to the sector shaft. Lash between the sector shaft and rack of the ball nut is controlled by an adjusting screw through the sector cover which is retained in the end of the sector shaft (Fig. 3).

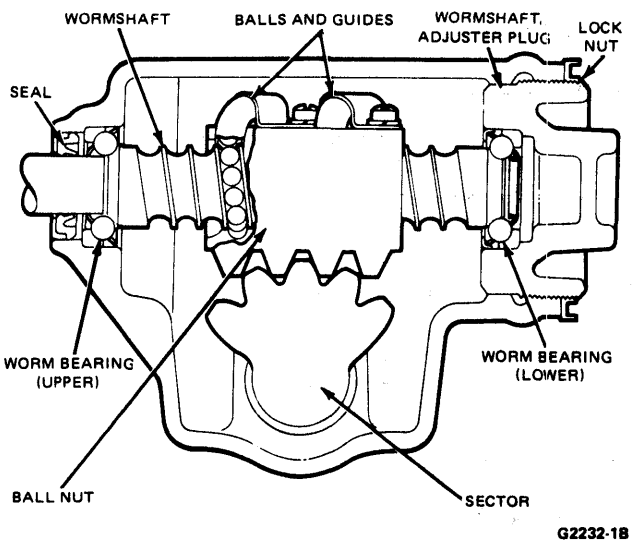


FIG. 2 Manual Steering Gear—Recirculating Ball E-100-E-350

The ball nut, mounted on the worm shaft, is driven through steel balls which circulate in helical grooves in both the worm and nut. Ball return guides, attached to the nut, serve to recirculate the two sets of balls (Fig. 2).

The teeth on the sector, which are an integral part of the sector shaft, and the ball nut are so designed that a tighter fit exists between the two when the front wheels are straight ahead. Proper engagement between the sector and the ball nut is obtained by an adjusting screw which moves the sector shaft endwise, permitting

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desired engagement of the tapered teeth of the ball nut and sector gear (Fig. 3). The worm bearing adjuster can be turned to provide proper preloading of the upper and lower worm thrust bearings (Fig. 2).

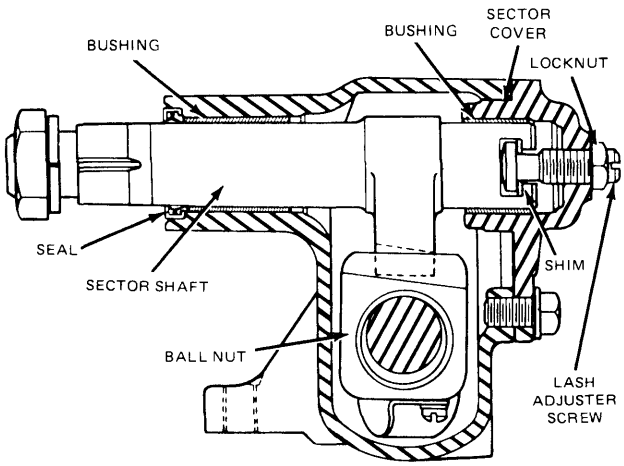


FIG. 3 Sector Shaft-To-Wormshaft Mesh E-100-E-350

ADJUSTMENTS

STEERING WORM AND SECTOR GEAR REMOVED FROM VEHICLE

E-100—E-350

Before adjusting the steering worm and sector:

1. Be sure the steering column is properly aligned, and not causing excessive turning effort.
2. Remove the steering gear from the vehicle.

   Make adjustments in the following order to avoid damage or gear malfunction.
3. Tighten the worm bearing adjuster plug until all end play has been removed and then loosen one-quarter turn (Fig. 2).
4. Using an 11/16 inch 12-point socket and an in-lb torque wrench, carefully turn the wormshaft all the way to the right and then turn back about one-half turn.
5. Tighten the adjuster plug until the proper worm thrust bearing preload is obtained (see Specifications 3-8 in-lbs.). Tighten the adjuster plug locknut to Specifications.
6. Turn the wormshaft from one stop all the way to the other, counting the number of turns. Turn the shaft back approximately three turns to center the ball nut. Loosen the sector shaft lash adjusting nut.
7. Turn the lash (sector shaft) adjuster screw clockwise to remove all lash between the ball nut and sector teeth. Tighten the locknut (Fig. 3).
8. Again using the 11/16 inch 12-point socket and an in-lb torque wrench, observe the highest reading while the gear is turned through center position. The reading should not exceed 16 in-lbs.
9. If necessary, readjust the sector shaft adjuster screw to obtain proper torque. Tighten the locknut to 25 ft-lbs. and again check torque reading through center of travel.

F-100-350 (4X2), BRONCO

Before adjusting the steering worm and sector:

1. Be sure the steering column is properly aligned, and not causing excessive turning effort.
2. Remove the steering gear from the vehicle.

   Make adjustments in the following order to avoid damage or gear malfunction.
3. Loosen the sector shaft adjusting screw locknut (Fig. 1) and turn the adjusting screw counterclockwise approximately three turns.
4. Measure worm bearing preload by attaching an in-lb torque wrench to the input shaft (Fig. 10). Measure the torque required to rotate the input shaft approximately two and one-half turns to either side of center. If the torque or preload is not within 3-8 in-lbs, adjust the steering gear as explained in the next step.
5. Loosen the input (worm) shaft bearing adjuster lock nut (Fig. 1), and tighten or loosen the bearing adjuster to bring preload within the specified limits. Tighten the lock nut and recheck preload (Fig. 10).
6. Turn the input shaft slowly to either stop. **Turn gently against the stop to avoid possible damage to the ball return guides.** Then rotate the shaft approximately three turns to center the ball nut.
7. Turn the sector shaft adjusting screw clockwise until the specified torque is obtained to rotate the worm

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past its center (Fig. 11). With the steering gear in the center position, hold the sector shaft to prevent rotation and check the lash between the ball nut, balls and worm shaft by applying a 15 in-lb torque on the steering gear input shaft, in both right and left turn directions. Total travel of the wrench should not exceed 1-1/4 inches when applying a 15 in-lb torque on the steering shaft.

8. Tighten the sector shaft adjusting screw lock nut, and recheck the backlash adjustment.

PRELOAD AND MESHLOAD IN VEHICLE CHECK—ALL VEHICLES

Correctly adjusted worm bearing preload will help eliminate excessive steering shaft and worm end play. **Always check worm bearing preload before checking and adjusting the ball nut and sector mesh. Adjust worm bearing preload as follows:**

1. Remove the Pitman arm from the steering gear sector shaft. (Do not hammer on end of sector shaft.)
2. Remove the horn pad assembly from the steering wheel.
3. Turn the steering wheel all the way to one side.
4. Place an in-lb torque wrench on the steering wheel nut (Fig. 4) and measure the lowest torque required to turn the wheel at a constant speed. This method can be used to measure worm bearing preload or sector shaft meshload. Refer to preceeding sections for adjustment procedures.
5. Replace horn pad and Pitman arm.

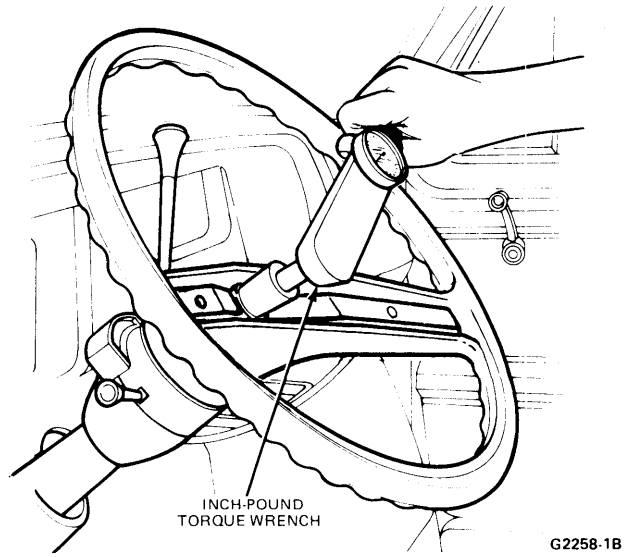


FIG. 4 Checking Manual Steering Gear Preload—Typical

REMOVAL AND INSTALLATION

STEERING GEAR

F-100 Thru F-350 (4 x 2)

Removal

1. Remove the bolt that attaches the flex coupling to the steering gear (Fig. 5). Remove the brake line bracket.
2. Raise the front of the vehicle and install safety stands.
3. Disconnect the Pitman arm from the sector shaft. Use special tool T64P-3590-F or equivalent. (Do not hammer on end of sector shaft.)
4. Remove the steering gear housing to frame attaching bolts, and remove the steering gear.

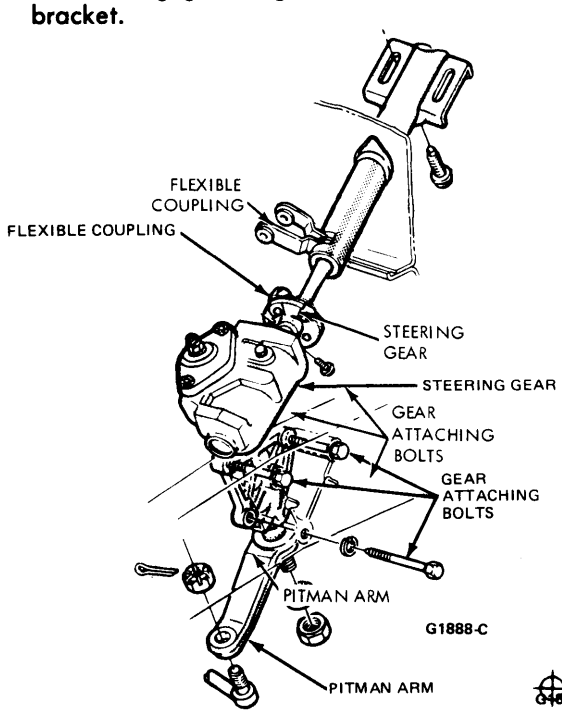


FIG. 5 Steering Gear Installation—F-100, 250 and 350 (4x2)

Installation

1. With the steering wheel spokes aligned and front wheels in a "straight ahead" position, and the sector shaft in the center position, install the steering gear. Tighten all attaching bolts to 50-65 ft-lbs. Re-install the brake line bracket to the steering gear cover stud.
2. With the wheels straight ahead, install the Pitman arm to the sector shaft. Tighten nut to 170-230 ft-lbs.
3. Install flex coupling on steering gear worm shaft. Connect flex coupling with steering shaft. Install and hand tighten connecting bolt in flex coupling so the bolt is aligned with the groove in the shaft. Tighten to 28-35 ft-lbs.
4. Remove the steering gear housing lower cover bolt and the lube filler hole plug. After turning the steering wheel to the left to move the ball nut away from the bolt hole, fill the steering gear with the correct lubricant. Fill the gear until lubricant comes out of the housing cover lower bolt hole. Install the cover bolt and tighten to 17-25 ft-lbs. Install the lube Filler Plug and tighten to 3-9 ft-lbs.

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E-100—E-350

Removal

1. Raise the vehicle on a hoist.
2. Disconnect the flex coupling from the steering shaft flange by removing the two attaching nuts (Fig. 6).

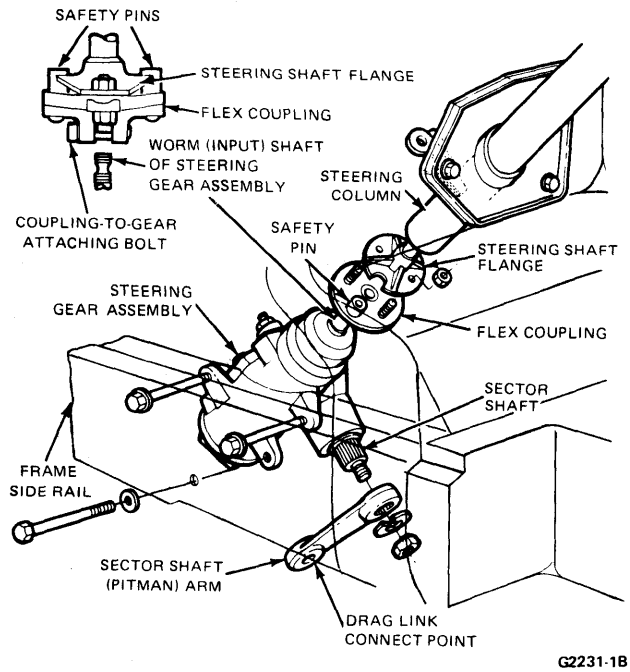


FIG. 6 Steering Gear Installation—E-100—E-350

3. Disconnect the drag link from the sector shaft (Pitman) arm, using Tool 3290-C.
4. Remove the Pitman arm-to-sector shaft attaching nut and washer. Remove the Pitman arm from the gear sector shaft using Tool T64P-3590-F. (Do not hammer on end of sector shaft.)
5. While supporting the steering gear, remove the bolts and washers that attach the steering gear assembly to the frame side rail. Lower the steering gear assembly from the vehicle.
6. Remove the coupling to gear attaching bolt from the lower half of the flex coupling and remove the coupling from the steering gear assembly.

Installation

1. Install the flex coupling on the worm (input) shaft of the gear assembly (Fig. 6). **Install a new coupling-to- gear attaching bolt** and tighten to 11-21 ft-lbs.
2. Center the input shaft (the center position is approximately three turns from either stop).
3. Position the steering gear assembly so that the stud bolts on the flex coupling enter the bolt holes in the steering shaft flange, and the holes in the mounting bosses of the gear match the bolt holes in the frame side rail (Fig. 6).
4. While supporting the gear in proper position, install the gear-to- frame side rail attaching bolts and washers and tighten to 54-66 ft-lbs.

If new gear-to-frame bolts and washers are required, use only those listed in the Truck Parts Catalog. Must be Grade-9.

5. Connect the drag link to the Pitman arm, install the drag link ball stud nut, and tighten to specified torque. Then install the cotter pin.
6. Assemble the Pitman arm on the sector shaft pointing downward. Install the attaching nut and washer, and tighten to 170-230 ft-lbs.
7. Secure the flex coupling to the steering shaft flange with the two attaching nuts and tighten to 28-35 ft-lbs. (See Part 13-06 for flex coupling and steering column alignment.)

F-150 (4X4), BRONCO

Removal

1. Remove the bolt that connects the flex housing with the coupling assembly shaft. Note how the bolt is aligned with the groove in the shaft.
2. Raise the vehicle so as to be able to work under the vehicle front.
3. Remove the drag link from the Pitman arm using Tool 3290-C.
4. Remove the Pitman arm from the steering gear sector shaft by first removing Pitman arm nut and washer. Remove Pitman arm with Tool T64P-3590-F.
5. Support the steering gear and remove three bolts attaching gear to frame. Lower gear from vehicle.

Installation

1. Position the steering wheel spokes, steering gear sector shaft, and the front wheels in the center or "straight ahead" position. Place the steering gear in position. Install and tighten attaching bolts to 60-90 ft-lbs.
2. With the wheels in the "straight ahead" or center position, install Pitman arm on steering gear sector shaft. Tighten washer and nut to 170-230 ft-lbs.
3. Place the flex housing on the steering gear sector shaft. Connect the flex housing with the coupling assembly shaft. Install connecting bolt in flex housing. Hand start bolt so it is aligned with the groove in the shaft. Tighten to 28-35 ft-lbs.

F-250-F-350 (4X4)

Removal

1. Remove the two bolts holding the steering shaft to steering gear and column shaft.
2. Remove the four bolts holding the fan shroud to the radiator and position the shroud to the right hand side.
3. Raise the vehicle on a hoist.
4. Remove the nut and washer on the Pitman arm and remove the Pitman arm.
5. Disengage the steering shaft coupling from the steering gear shaft.
6. Remove the three bolts and nuts holding the steering gear to the frame side rail and remove the steering gear.

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Installation

1. Position the steering gear to the frame side rail and install and tighten the three bolts and nuts.
2. Install the Pitman arm on the sector shaft. Tighten nut and washer to 170-230 ft-lbs.
3. Lower the vehicle.
4. Engage steering shaft coupling with steering gear shaft.

NOTE: Align steering column shaft with steering gear shaft and front wheels for proper steering wheel spoke position.

5. Install and tighten the two bolts holding the steering shaft to the steering column and steering gear shaft.
6. Reposition fan shroud to radiator and install and tighten four bolts.
7. Check steering gear lubricant level and refill if necessary.

DISASSEMBLY AND ASSEMBLY

STEERING GEAR

F-100 Thru F-350 (4x2)

Disassembly

Refer to Figs. 7 and 8.

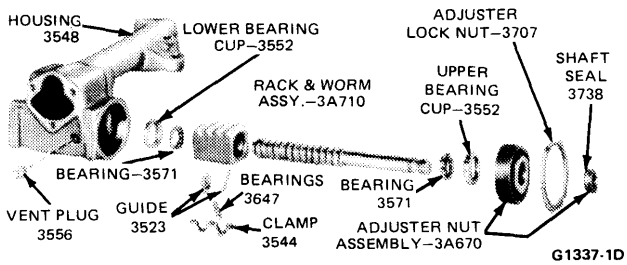


FIG. 7 Worm Shaft and Related Parts—Recirculating Ball Gear—F-100 through F-350 (4 x 2)

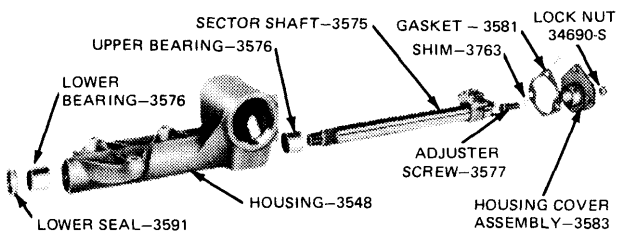


FIG. 8 Sector Shaft and Housing—Recirculating Gear—F-100 through F-350

1. Rotate the steering input shaft to the center position. Remove the sector shaft adjuster screw lock nut and loosen the adjuster screw one turn (Fig. 8).
2. Remove the sector shaft cover attaching screws and stud.
3. Remove the cover and sector shaft. **Keep the shim with the adjuster screw.**
4. Remove the worm shaft bearing adjuster lock nut (Fig. 7).
5. Loosen the worm bearing adjuster nut and remove the adjuster assembly and the worm shaft upper bearing.
6. Carefully pull the rack and worm shaft assembly from the housing and remove the worm shaft lower bearing (Fig. 7). **Keep the rack (ball nut) from running down to either end of the worm to avoid damaging the ball return guides. Disassemble the ball nut only if there is indication of binding or tightness.**
7. Remove the ball nut guide clamp screws and clamp. Remove the guides from the ball nut carefully, so as not to loose the balls that are retained in the guide tubes. **Keep the guide side of the ball nut up until ready to remove the balls.**
8. Turn the ball nut over, and remove all of the balls from the ball nut by rotating the worm shaft from side to side. When all the balls are removed, slide the ball nut off the shaft. Count the number of balls.
9. Remove the upper bearing cup from the adjuster nut (Fig. 7) and the lower bearing cup from the housing. It may be necessary to tap the housing or adjuster on a block of wood to jar the bearing cups loose.
10. Remove the sector shaft seal and lower bearing from the housing using Tool T62F-3576-A (Fig. 8). Using the same tool, remove the upper bearing. **Remove the sector shaft bearings only if preliminary inspection shows damage.**
11. Clean and inspect the housing and all parts. If the sector shaft bearings are not removed, do not permit cleaning solvents to contact the lubricant holding the needle bearings in place.

Assembly

1. If the sector shaft bearings were removed, install the sector shaft lower bearing in the housing using Tools T62F-3576-A and T64K-3576-B (Fig. 9). Install a new seal in the same manner.
2. Apply enough C3AZ-19578-A or equivalent lubricant to fill the pocket in the housing between the sector shaft bearings.
3. Install the worm shaft upper bearing cup in the adjuster nut and the lower bearing cup in the housing (Fig. 7). Both bearing cups must be firmly seated. If the seal in the bearing adjuster was removed, install a new seal. Swab the inside diameter of the ball nut and the outside diameter of the worm and gear with lubricant C3AZ-19578-A or equivalent prior to assembly. Slip the ball nut over the worm with the ball guide holes up and the shallow end of the ball nut teeth to the left from the Steering Wheel Position. Align the grooves in

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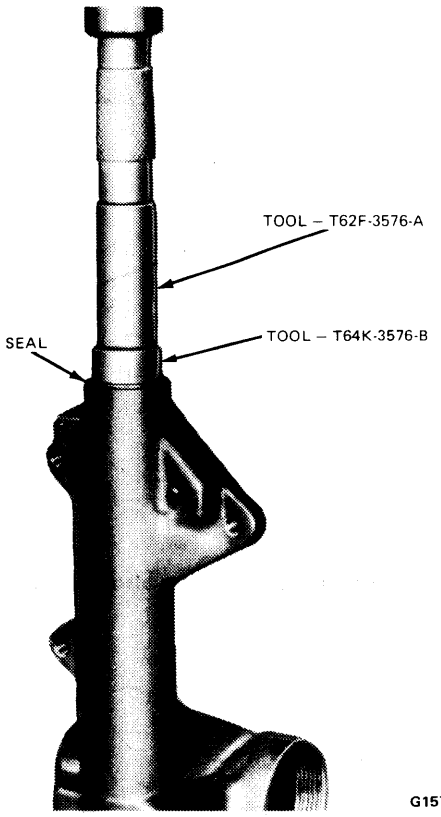


FIG. 9 Installing Sector Shaft Lower Bearing and Seal—Recirculating Ball Gear—F-100 through F-350 (4 x 2)

the worm and ball nut by sighting through the ball guide holes.

4. Insert the ball guides (Fig. 7) into the holes in the ball nut, tapping them lightly with the wood handle of a screwdriver, if necessary, to seat them.
5. Insert half of the balls (23 to 25) into the hole at the top of each ball guide (Fig. 18). It may be necessary to rotate the shaft back and forth to distribute the balls in the circuit. Fill one circuit at a time.
6. After the balls are installed, install the ball guide clamp and tighten the screws to specification. Check the worm shaft to make sure it rotates freely.
7. Coat the worm bearings, sector shaft bearings and gear teeth with gear lubricant (Figs. 7 and 8).
8. Clamp the housing in a vise, with the worm shaft axis horizontal (180 degrees opposite that shown in Fig. 9).
9. Install the sector shaft upper bearing using Tool T62F-3576-A. (Fig. 9).
10. Position the worm shaft and ball nut assemblies in the housing (Fig. 7).
11. Assemble the worm shaft upper bearing on the top of the worm and install the worm shaft bearing cup adjuster nut assembly (Fig. 7). Install the adjuster lock nut with the flat side against the bearing adjuster. Leave the nut loose.
12. Adjust worm bearing preload to specification (Fig. 10) using an in-lb torque wrench. New steering gear assemblies are factory-adjusted to specification.

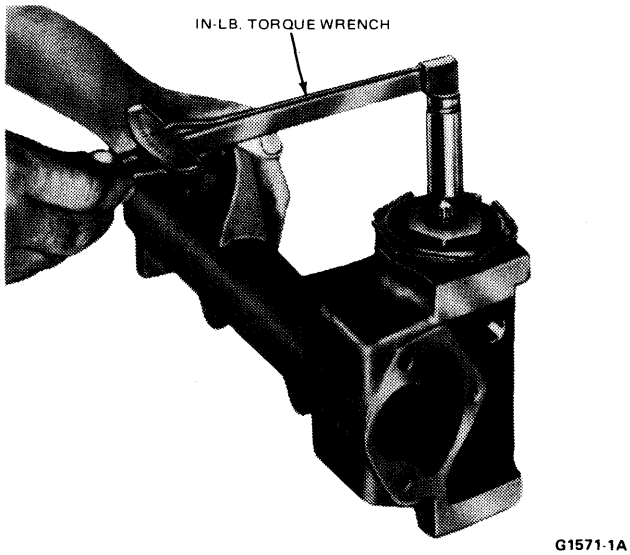


FIG. 10 Checking Worm Bearing Preload—Recirculating Ball Gear—F-100 thru F-350 (4 x 2)

13. Install the sector adjusting screw and adjuster shim (Fig. 8), and check to be sure end clearance between the screw head and the end of the sector shaft does not exceed .002 inch. If clearance is greater than 0.002 inch, replace the shim with one which will reduce the end play to within the 0.002 inch specification.
14. Start the sector shaft pilot into the housing cover. Insert a screwdriver through the hole in the cover, turn the adjusting screw counterclockwise to pull the pilot into the cover (Fig. 8).
15. Install a **new** gasket on the housing cover surface.
16. Tilt the housing so the ball nut tips toward the cover opening, and rotate the steering shaft until the ball nut teeth are in position to mesh with the sector gear.
17. Lubricate the sector shaft journal and install the sector shaft and cover.
18. Turn the housing cover out of the way and fill the gear to specification as described in Part 13-01, General Steering Service. Push the housing cover and sector shaft assemblies into place, **and install, but do not tighten** the housing cover bolts. **Check to be sure that the cover is firmly seated against the housing and that there is some lash between ball nut and sector gear teeth. If not, rotate the sector adjusting screw counterclockwise until lash is evident and the cover is seated. When lash is evident, hold the cover away from the ball nut and tighten the cover bolts to specification.**
19. Loosely install the sector shaft adjusting screw lock nut and adjust sector shaft mesh (backlash) to specification as shown in Fig. 11.
20. Rotate worm shaft from gear center position to each stop. Minimum turns should equal half of the total listed in specifications at the end of this part.

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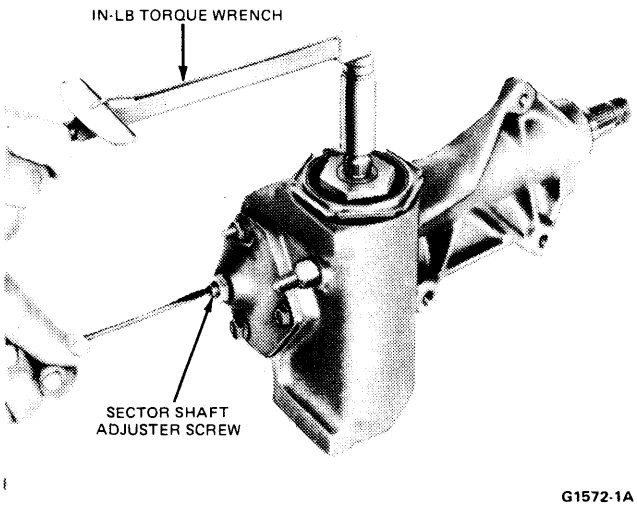


FIG. 11 Adjusting Sector Mesh Load—Recirculating Ball Gear—F-100 through F-350 (4X2)

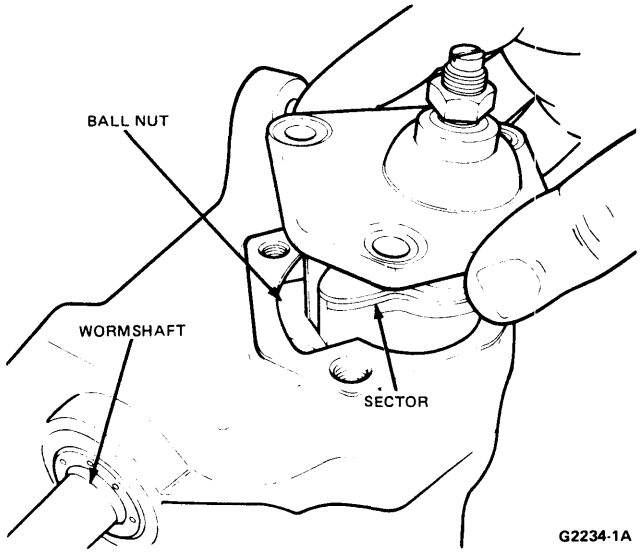


FIG. 12 Removing Sector Shaft Assembly—Typical

STEERING GEAR—E-100 THRU E-350

DISASSEMBLY OF PARTS FROM GEAR HOUSING

As with any ball bearing unit, the steering gear parts must be kept free of dirt. Clean paper or rags should be spread on the workbench before starting disassembly of the steering gear.

1. Place the steering gear in a vise, clamping onto one of the mounting tabs. The wormshaft should be in a horizontal position.
2. Rotate the wormshaft from stop to stop, counting the total number of turns. Then turn back exactly half-way, placing the gear on center.
3. Remove the three self locking bolts attaching the sector cover to the housing.
4. Tap lightly on the end of the sector shaft with a plastic hammer and lift the sector cover and sector shaft assembly from the gear housing (Fig. 12).

   If the sector shaft does not clear the opening in the housing easily, turn the wormshaft by hand until the sector will pass through the opening in the housing.
5. Remove the locknut from the adjuster plug.
6. Remove the adjuster plug assembly.
7. Draw the wormshaft and ball nut assembly from housing (Fig. 13).

   Use care that the ball nut does not run down to either end of the worm. Damage may be done to the ends of the ball guides if the ball nut is allowed to rotate until stopped at the end of the worm.
8. Remove the worm shaft upper bearing from inside the gear housing.
9. Use a suitable size screwdriver to pry the worm shaft lower bearing retainer from the adjuster plug housing and remove the bearing (Fig. 14).
10. Remove the locknut from the lash adjuster screw in the sector cover. Remove the lash adjuster screw from the sector cover by turning the screw

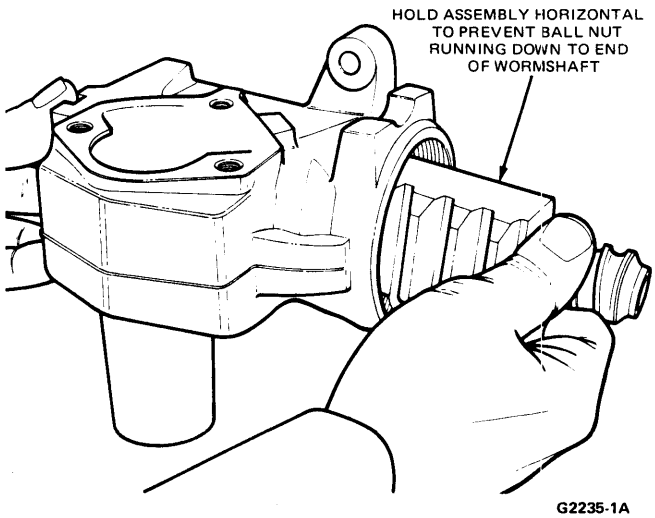


FIG. 13 Removing the Worm Shaft and Ball Nut

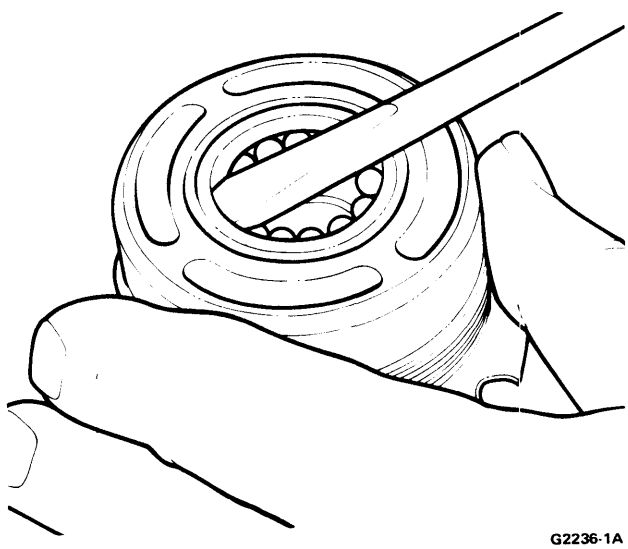


FIG. 14 Removing Bearing Retainer from Adjuster Plug

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clockwise. Slide the adjuster screw and shim out of the slot in the end of the sector shaft.

11. Pry out and discard both the sector shaft and wormshaft seals.

INSPECTION

With the steering gear completely disassembled, wash all parts in cleaning solvent. Dry them thoroughly with air. With a magnifying glass inspect the bearings and bearing cups for signs of indentation. Also check for any signs of chipping or breakdown of the surface. Any parts that show signs of damage should be replaced.

Inspect the fit of the sector shaft in the bushings in the sector cover and housing. If these bushings are worn, a new sector cover and bushing assembly or housing bushing should be installed.

Check steering gear wormshaft assembly for being bent or damaged in any way. **Never attempt to salvage steering parts by welding or straightening.**

SHAFT SEAL REPLACEMENT

The double lipped sector shaft and wormshaft seals should be replaced each time a defective seal is indicated or the steering gear is disassembled.

1. Pry out the old seal using a suitable size screwdriver.

   Before installing a new seal, check the condition of the sector shaft bushing(s) and the wormshaft bearing race installed in the gear housing.

2. A suitable size socket or Tool T75T-3527-A pressing on the outer diameter of the seal, may be used to install a new seal. Make sure that socket is large enough to avoid injuring the external lip of the seal.

SECTOR SHAFT BUSHING REPLACEMENT

1. Support the steering gear housing in an arbor press and press the sector shaft bushing from the housing using Tool T75T-3527A, inserted from the lower end of the housing (Fig. 15).

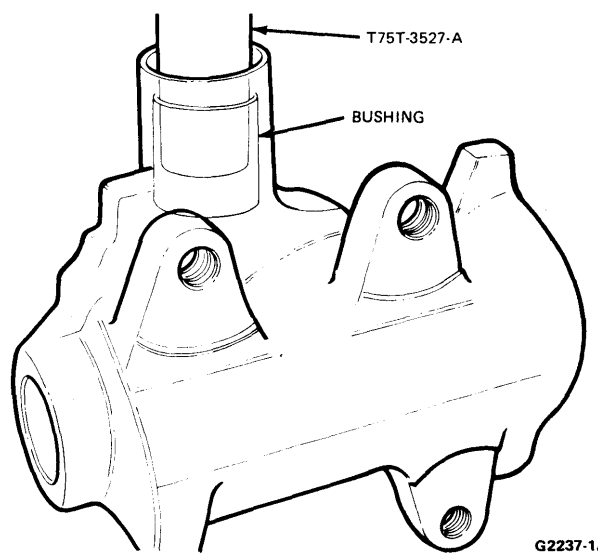


FIG. 15 Removing Sector Shaft Bushing

2. Press the new bushing(s) into position using Tool T75T-3527-A. Position the bushings as shown in Fig. 15.

   Service bushings are diamond bored to size and require no further reaming.

SECTOR COVER BUSHING REPLACEMENT

The entire sector cover assembly, including bushing, is serviced as a unit.

WORMSHAFT BEARING CUP REPLACEMENT

Adjuster Plug Cup

1. Remove the wormshaft lower bearing cup using Tool T58L-101-A and Slide Hammer T50T-100-A as shown in Fig. 16.

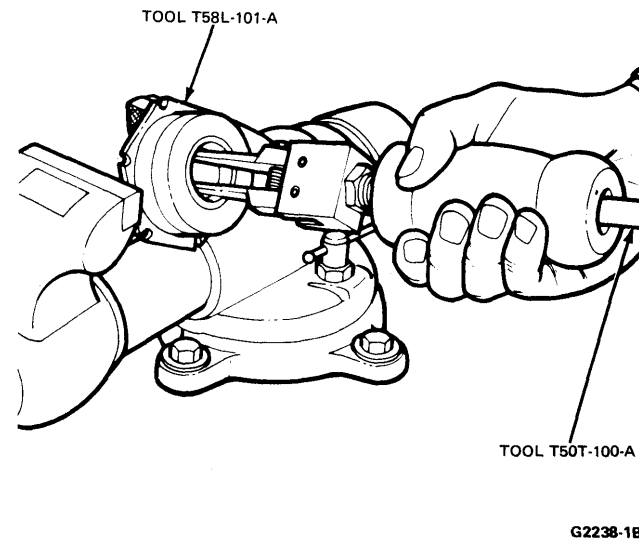


FIG. 16 Removing Wormshaft Lower Bearing Cup from Adjuster Plug

2. Press the new bearing cup into position using Tool T75T3576A.

Housing Cup

1. Using a drift or punch, drive the bearing cup out of the housing.
2. Press the new bearing cup into position using Tool T75T3576-A (Fig. 17).

BALL NUT SERVICING

As a rule, disassembly of the ball nut will not be necessary if it is perfectly free with no indication of binding or tightness when rotated on the worm. However, if there is any indication of binding or tightness, the unit should be disassembled, cleaned and inspected as follows:

Disassembly

1. Remove screws and clamp retaining the ball guides in the ball nut. Draw the guides out of the ball nut (Fig. 19).
2. Turn the ball nut upside down and rotate the wormshaft back and forth until all the balls have dropped out of the ball nut into a clean pan. With the balls removed, the ball nut can be pulled endwise off the worm.

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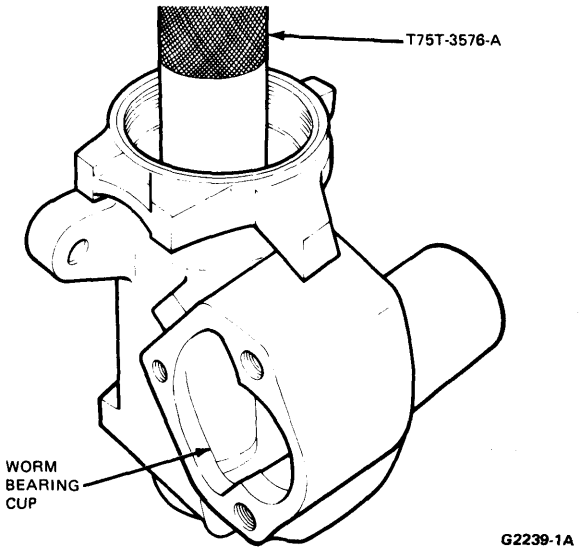


FIG. 17 Installing Wormshaft Upper Bearing Cup in Housing

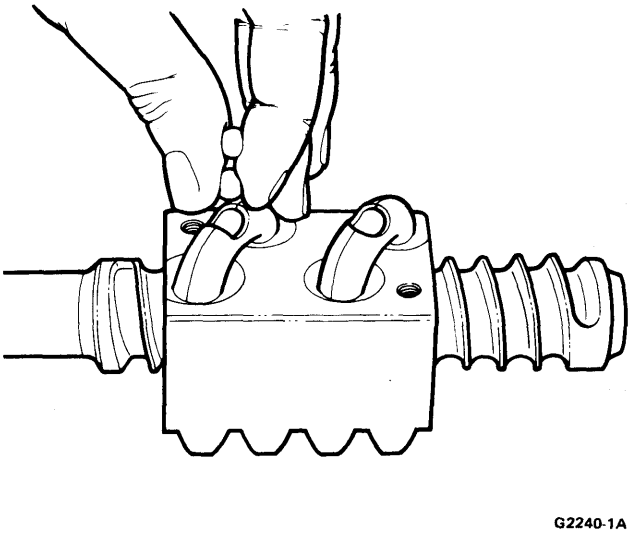


FIG. 18 Filling Ball Circuits

3. Wash all parts in cleaning solvent and dry them thoroughly with air. Using a magnifying glass, inspect the worm and nut grooves and the surface of all balls for signs of indentation. Check all ball guides for damage at ends where they deflect or pick up the balls from the helical path. Any parts that show signs of damage should be replaced.

Assembly

1. Slip the ball nut over the worm with the ball guide holes up and the shallow end of the ball nut teeth to the left from the steering wheel position. Align the grooves in the worm and ball nut by sighting through the ball guide holes.
2. Count 25 balls into a suitable container. This is the proper number of balls for one circuit. Press 20 of these balls into one of the guide holes using the end of a suitable pin punch. NOTE: Do not rotate worm shaft while installing balls. All balls must be enclosed within the two circuits.
3. Lay one half of the ball guide, groove up, on the bench and place the remaining five balls from the container on it.
4. Close this half of the guide with the other half. Hold the two halves together and plug each open end with grease so that the balls will not drop out while installing the guides in the ball nut.
5. Push the guide into the guide holes of the ball nut. This completes one circuit of balls. If the guide does not push all the way down easily, tap it into place lightly with the handle of a screwdriver.
6. Fill the remaining ball circuit in the same manner as described for the first circuit. Assemble the ball guide clamp to the ball nut and tighten the screws to 18-42 in-lbs.

Check the assembly by rotating the ball nut on the worm to see that it moves freely. Do not rotate the ball nut to the end of the worm threads as this may damage the ball guides. If there is any "stickiness" in the motion of the ball nut, some slight damage to the ends of the ball guides or to other gear components may have been overlooked.

ASSEMBLY OF GEAR HOUSING

After a major service overhaul, where all of the original factory installed lubricant has been washed out of the steering gear assembly, apply steering gear lubricant meeting Ford specification ESW-MIC87-A, Part Number C3AZ-19578-A or equivalent to the wormshaft bearings, sector shaft bushings and sector cover bushing.

1. Place the steering gear housing in a vise with the wormshaft bore horizontal and the sector cover opening up.
2. Make sure that the sector shaft and wormshaft seals, the sector shaft bushings, and the wormshaft bearing cups are installed in the gear housing. Make sure also, that the ball nut is installed on the wormshaft.
3. Slip the wormshaft upper bearing assembly over the wormshaft and insert the wormshaft and ball nut assembly into the housing, feeding the end of the shaft through the upper ball bearing cup and seal.
4. Place the wormshaft lower bearing assembly in the adjuster plug bearing cup and press the stamped retainer into place with a suitable socket.
5. Install the adjuster plug and lock nut into the lower end of the housing (being careful to guide the end of the wormshaft into the bearing) until nearly all end play has been removed from the wormshaft.
6. Position the lash adjuster (with shim) in the slotted end of the sector shaft. Check the end clearance, which should not be greater than .002" (Fig. 20). If clearance is greater than .002", a steering gear lash adjuster shim unit is available. It contains four shims - .063", .065", .067" and .069" thick.
7. Lubricate the steering gear with 11 oz. of lubricant C3AZ-19578-A or equivelent. Rotate the wormshaft until the ball nut is at the end of its travel and then pack as much new lubricant into the housing as possible without losing it out the sector shaft opening. Rotate the wormshaft until the ball

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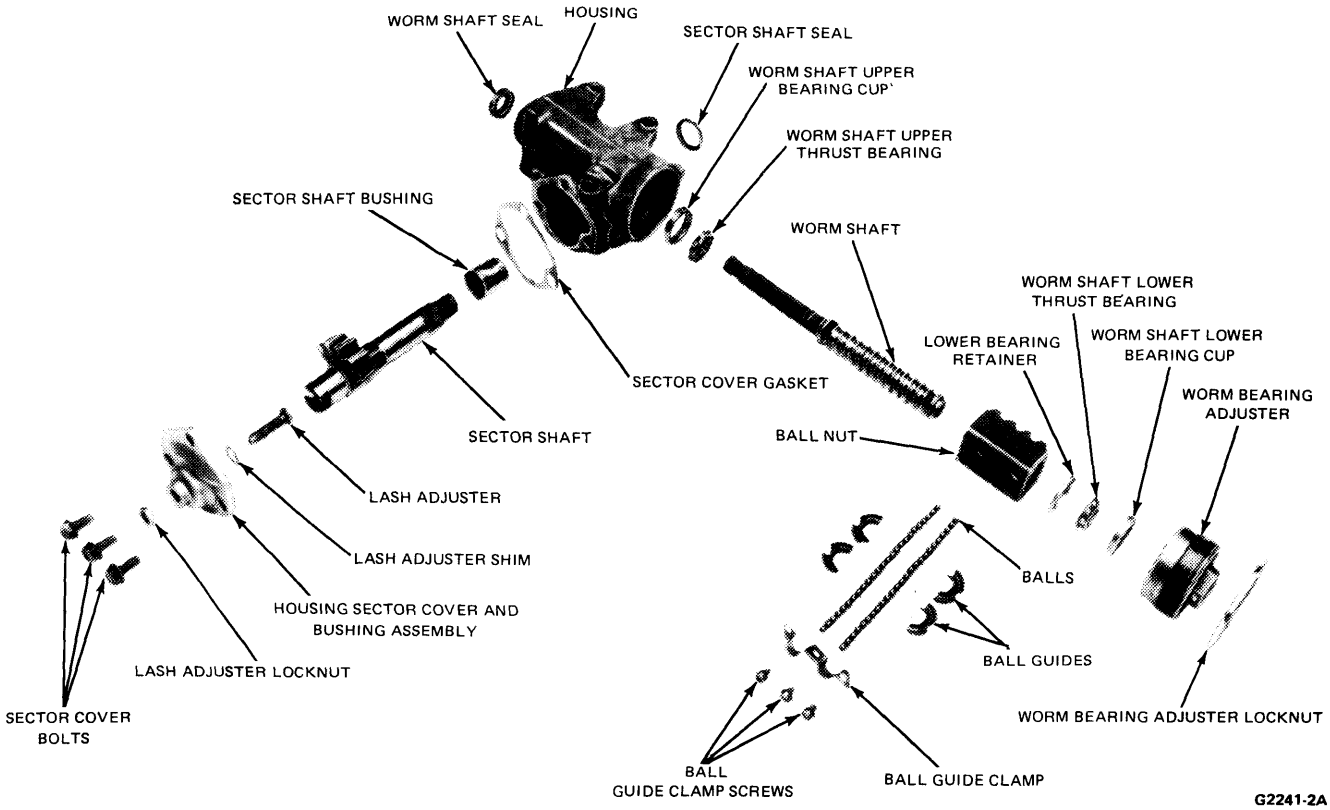


FIG. 19 E-100—E-350 Steering Gear—Exploded View

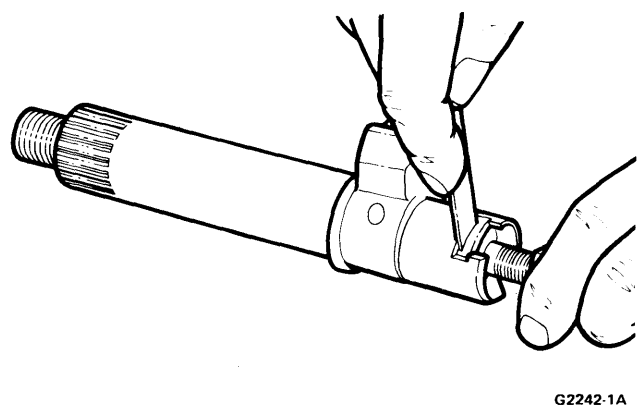


FIG. 20 Checking Lash Adjuster End Clearance

nut is at the other end of its travel and pack as much lubricant into the opposite end as possible.

8. Rotate the wormshaft until the ball nut is in the center of travel. This is to make sure that the sector shaft and ball nut will engage properly, with the center tooth of the sector entering the center tooth space in the ball nut.
9. Insert the sector shaft assembly (with lash adjuster screw and shim but without sector cover) into the housing so that the center tooth of the sector enters the center tooth space in the ball nut.
10. Pack the remaining portion of lubricant into the housing and place a quantity in the sector cover bushing hole.
11. Place the sector cover gasket on the housing.
12. Install the sector cover onto the sector shaft by reaching through the sector cover with a screwdriver and turning the lash adjuster screw counterclockwise until the screw bottoms; back the screw off one-half turn.
13. Install and tighten the sector cover bolts to specifications while holding the cover away from the ball nut.
14. Loosely install a new locknut onto the adjuster screw and adjust sector shaft mesh (backlash) to specifications (Fig. 11).
15. Rotate wormshaft from the gear center to each stop. Minimum turns should be half of total turns listed in the specifications at the end of this part.

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SPECIFICATIONS

RECIRCULATING BALL TYPE STEERING GEAR

Description	Vehicle	
	E-100 thru E-350	F-100 thru F-350 (4x2)
Model	SMA-W	SMA-H, SMA-K, SMA-Z
Gear Type	Manual	Manual
Gear Ratio	24:1	24:1
Turns of Steering Gear (Lock to Lock) ①	6	6
Lube Capacity	11 oz. + 1 oz.	11 oz. + 1 oz.
Lube Type	ESW-M1C87A ④	ESW-M1C87A ④
Worm Bearing Preload ②	3-8 in-lbs.	3-8 in-lbs.
Total Center Mesh Load in Excess of Worm Bearing Preload ③	10-16 in-lbs.	10-16 in-lbs.
Total Steering Gear Meshload on Center	16 in-lbs. Max.	16 in-lbs. Max.
Adjustments: Adjusting Screw to Bottom of Sector Shaft T-Slot Clearance	.000-.002"	.000-.002"

① Gear only — not attached to Pitman arm.

② Torque required to rotate input shaft at approx. 1½ turns either side of center (gear out of vehicle or Pitman arm disconnected).

③ Required to rotate input shaft and worm assembly past the center high point.

④ Or use an equivalent lubricant

TORQUE SPECIFICATIONS

Application	E-100 thru E-350		F-100 thru F-350 (4x2)	
	(ft-lbs)	N•m	(ft-lbs)	N•m
Sector Shaft Cover Bolt	30	40	17-25	24-33
Ball Return Guide Clamp Screw	18-42 in-lbs	2.5-4.5	18-42 in-lbs	2.5-4.5
Preload Adjuster Locknut	85	115	60-80	82-108
Meshload Adjusting Screw Locknut	25	33	32-40	43-54
Lubricant Fill Plug and Vent ①	3-9	4.5-12	3-9	4.5-12
Sector Shaft to Pitman Arm ②	170-230	231-311	170-230	231-311

① Minimum of one thread must remain exposed when installed.

② Two to five full threads of sector shaft must remain exposed after nut is torqued to specification.

SPECIAL SERVICE TOOLS

Number	Description	Application
T64P-3590-F	Steering (Pitman) Arm Remover	All
T62F-3576-A	Sector Shaft Bearing Remover and Replacer	F-100-350 (4x2)
T64K-3576-B	Sector Shaft Needle Bearings and Seal Remover and Replacer Adapter	F-100-350 (4x2)
T75T-3527-A	Sector Shaft Bushing Remover and Replacer	E-100 thru E-350
T75T-3576-A	Worm Shaft Bearing Cup Installer	E-100 thru E-350
T58L-101-A	Worm Shaft Bearing Cup Removal	E-100 thru E-350
T50T-100-A	Slide Hammer	E-100 thru E-350

CG2266-2D

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Manual Steering Gear — Worm and Roller

PART 13-34

APPLIES TO F-150 (4x4), BRONCO — WITH MANUAL STEERING

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	34-1	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING	34-1	Steering Gear	34-2
ADJUSTMENTS		Steering Wheel	34-3
Worm Bearing Preload	34-1	DISASSEMBLY AND ASSEMBLY	34-4
Worm and Roller Mesh Preload	34-2	SPECIFICATIONS	34-5

DESCRIPTION

These vehicles are equipped with a worm and roller type gear attached to the frame side rail in front of the front axle and steering linkage.

The worm, which is part of the input shaft, rotates on ball bearings. Preload is obtained by shim gaskets between the end plate and the housing (Fig. 1). The sector shaft and roller rotate as a unit in bushings in the lower part of the housing. Worm and roller adjustment is controlled by an adjusting screw threaded into the housing cover at the top end of the sector shaft. Turning the screw adjusts mesh of the worm and roller by pushing the sector shaft roller against the worm.

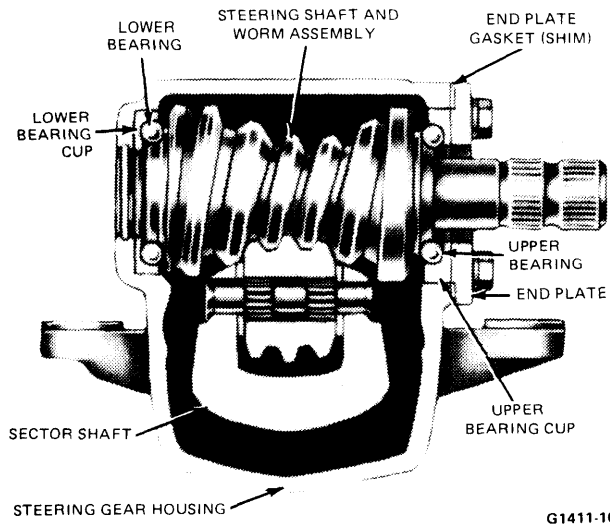


FIG. 1 Steering Gear—F-150, (4 x 4) and Bronco

DIAGNOSIS AND TESTING

Refer to Part 13-01, General Steering Service.

ADJUSTMENTS

WORM BEARING PRELOAD

1. Using Tool T64P-3590-F, disconnect the Pitman arm from the sector shaft.
2. Disconnect the battery ground cable. Remove the horn pad from the steering wheel.
3. Turn the steering wheel all the way to one side.
4. Place an in-lb torque wrench on the steering wheel attaching nut, and measure the torque required to keep the wheel moving at a constant rate for approximately one-quarter to one-half turn. This measurement is the worm bearing preload. If preload is not within specification, remove or add enough shims between the worm shaft bearing retainer cover and steering gear housing (Fig. 1) to bring preload within specification found at the end of this part. Install the cover and tighten the attaching bolts to 18-22 ft-lbs. Re-check preload to be sure it has not changed after tightening the bolts. **If erratic readings are experienced, disconnect the steering shaft joint at the**

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steering gear and check the torque required to rotate the steering shaft. If the torque is measurable, add it to the worm bearing preload specification.

5. After adjusting preload, turn the gear all the way to the other side and re-check preload.
6. Check the steering gear fluid level and add fluid, if necessary (Part 13-01).

WORM AND ROLLER MESH PRELOAD

Always check worm bearing preload and adjust, if necessary, before checking the worm and roller mesh preload. Adjust worm and roller mesh preload as follows:

1. Remove the steering gear from the vehicle.
2. Place an in-lb torque wrench on the steering gear input shaft and measure the torque required to turn the steering wheel through the straight ahead (high point) position. The highest torque reading is the worm and roller mesh preload. If preload is not within specification found at the end of this part adjust as described in Steps 3, 4, and 5.
3. To adjust mesh, loosen the adjusting screw lock nut on the side of the steering gear housing and turn the screw clockwise, to tighten mesh, or counterclockwise to loosen mesh.
4. When mesh is within specification, hold the adjusting screw in place with a screwdriver and tighten the lock nut.
5. Re-check mesh adjustment and repeat Steps 3 and 4, if necessary.
6. Install the steering gear and fill it to specification as described in Part 13-01, General Steering Service under Adjustments.

REMOVAL AND INSTALLATION

Removal

1. Raise the vehicle on a hoist and remove the Pitman arm attaching nut and lockwasher.
2. Remove the Pitman arm from the sector shaft using Tool T64P-3590-F.
3. Remove bolts, nuts and flat washers that attach the steering gear to the frame side rail, (Fig. 2), and lower the vehicle.
4. Remove the flex coupling bolt and nut from the coupling clamp (Fig. 2). Loosen the clamp from the coupling at the end of the steering column and separate the coupling from the steering gear input shaft by pushing the steering shaft toward the steering column. Discard the clamp, bolt, and nut.
5. Remove and discard the flex coupling clamp from the steering gear input shaft, and remove the steering gear from the frame side rail.

Installation

1. Place the steering gear on the frame side rail and install the attaching bolts, nuts, and flat washers.

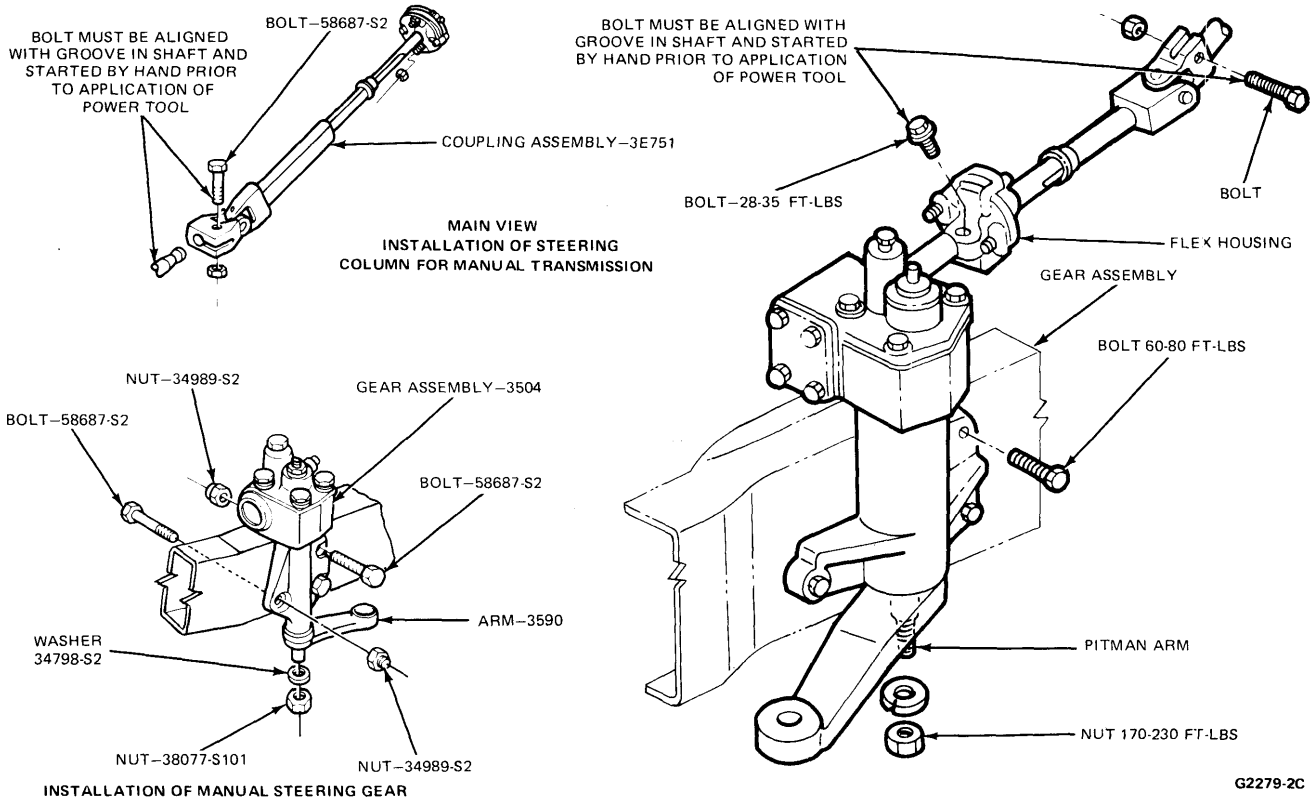


FIG. 2 Steering Gear Installation—Bronco, F-150 (4 x 4)

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2. Place the flex coupling and a new clamp on the steering gear input shaft and install the clamp bolt and nut (Fig. 2). Tighten the bolt and nut to specification. (Refer to specifications Part 13-01, General Steering Service.)
3. Install a new steering shaft clamp at the end of the steering column and tighten the bolt and nut to specification. (Refer to specifications Part 13-01, General Steering Service.)
4. Raise the vehicle and tighten the steering gear attaching bolts and nuts to specification (refer to specifications Part 13-01, General Steering Service).
5. Place the Pitman arm on the sector shaft and install the washer and attaching nut. Tighten the nut to 170-230 ft-lbs, lower the vehicle, and fill the gear with lubricant (SAE-90EP Engine Oil, Ford Spec.M-568-C) or equivalent.

ALIGNMENT FOR CLEAR VISION

1. Set wheels in straight ahead position by driving vehicle a short distance and mark the steering wheel and steering column relationship with a chalk mark.
2. Note the steering wheel position. If off center (spokes in horizontal position) more than plus or minus 22 1/2 degrees remove the steering wheel, (Fig. 3).

STEERING WHEEL

Removal

1. Park the vehicle with the chalk marks aligned.
2. Disconnect the battery ground cable.
3. Remove two screws from the underside of steering wheel and lift the horn switch assembly (steering wheel pad) from the steering wheel.
4. Disconnect the horn switch wires by pulling the spade terminal from the blade connector, (Fig. 4). Squeeze or pinch the "J" clip ground wire terminal firmly and pull it out of the hole in the steering wheel. Do not pull the ground terminal out of the threaded hole without squeezing the terminal clip to relieve the spring retention of the terminal in the threaded hole.
5. Remove the horn switch assembly.
6. Remove steering wheel retaining nut.
7. Use proper puller and remove steering wheel from shaft.

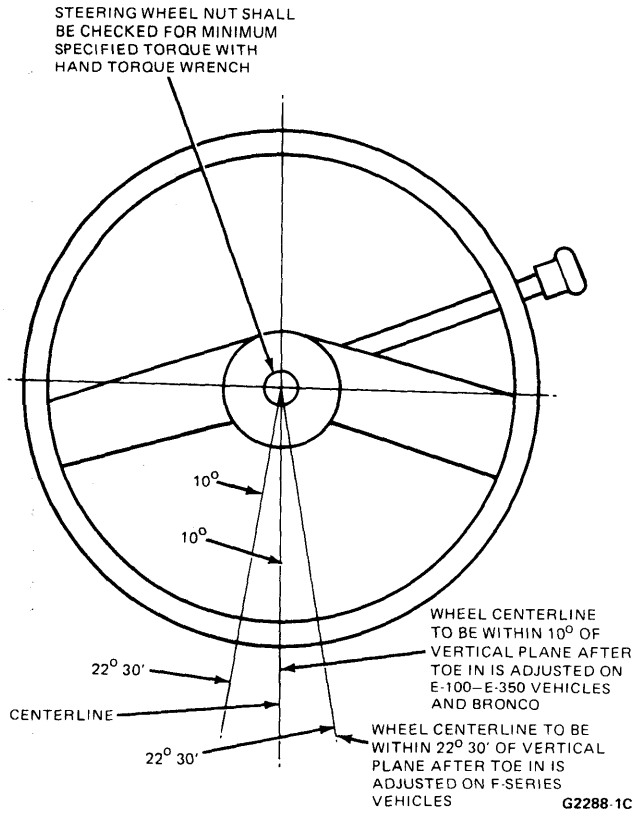


FIG. 3 Acceptable Steering Wheel Installation Measured From Normal Spoke Angle

ALIGNMENT ADJUSTMENT

The steering wheel has serrations equally spaced and can be installed in any position. Therefore, with front wheels in the straight ahead position install the steering wheel with the spoke in the horizontal position (Specification 22 1/2 degrees plus or minus from horizontal).

STEERING WHEEL

Installation

1. Position steering wheel into place with retaining nut.
2. Tighten retaining nut to 30-40 ft-lbs.
3. Connect the spade terminal of the horn switch wire to the blade connector, and press the "J" clip ground terminal fully into the threaded hole (Fig. 4).
4. Center the horn switch (pad) on the steering wheel, and install the two attaching screws.

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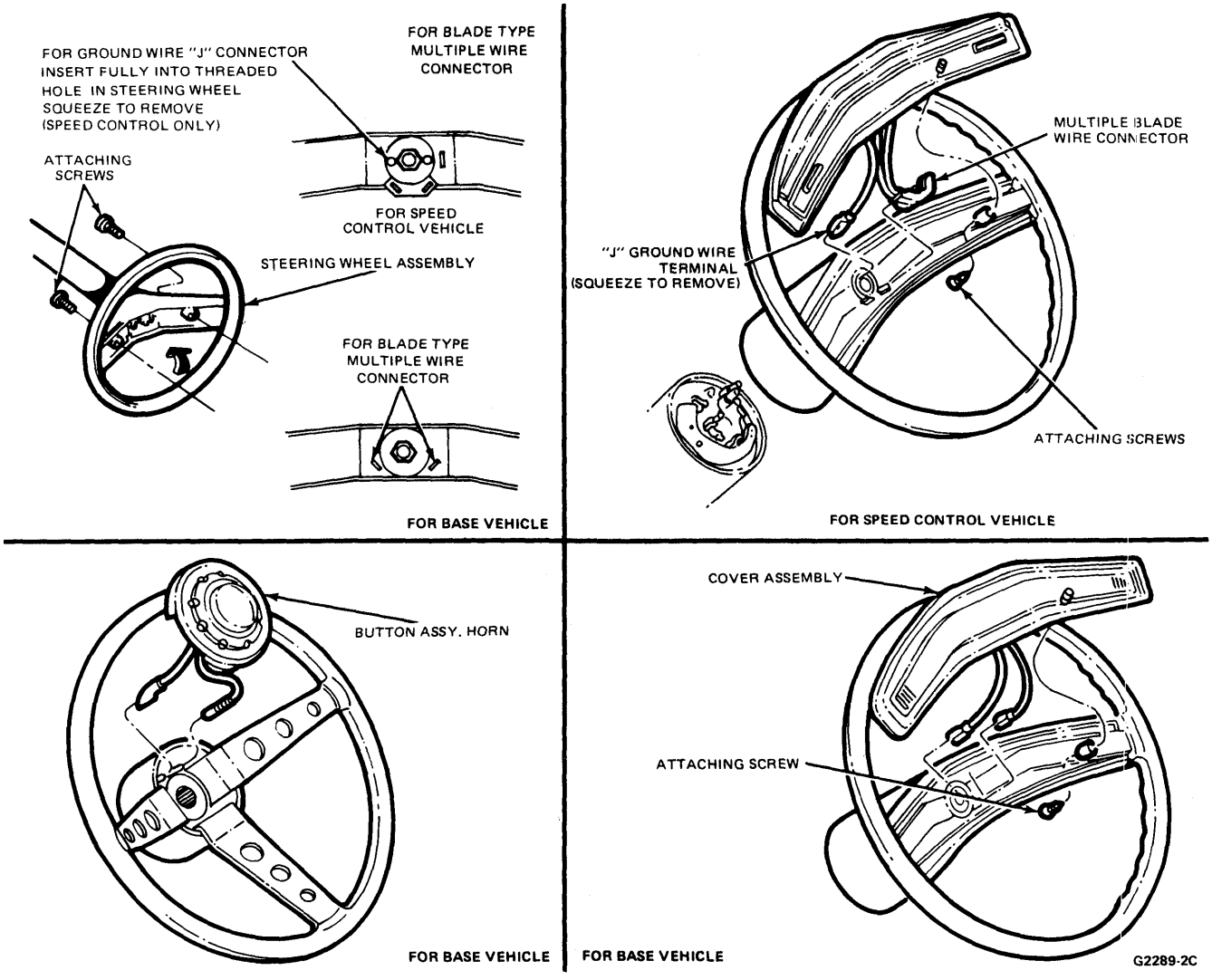


FIG. 4 Steering Wheel/Horn Switch Assembly Installation

DISASSEMBLY AND ASSEMBLY

Fig. 5 shows the special tools required to service the steering gears covered in this section. Identify gears by the output shaft diameter.

Operation	Gemmer 254
Output Shaft Diameter (inches)	1-1/4
Remove sector shaft seal	T58L-101-A T59L-100-B
Install sector shaft seal	Proper size socket
Remove sector shaft Outer bushing or bearing	T58L-3576-A
Install sector shaft Outer bushing or bearing	T58L-3548-A
Remove sector shaft Inner bearing or bushing	
Install sector shaft	
Remove worm shaft upper seal	T58L-101-A T59L-100-B
Install worm shaft upper seal	T54L-6015-A

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FIG. 5 Steering Gear Overhaul Tool Application Chart

MANUAL STEERING GEAR

F-150 (4 X 4), BRONCO

Disassembly

1. Mount the steering gear housing in a vise and center the gear.
2. Remove the shaft cover bolts (Fig. 6) and place a drain pan under the sector shaft. Remove rust and dirt from the sector shaft.
3. Remove the sector shaft assembly and shaft cover. It may be necessary to lightly tap the end of the output shaft with a soft mallet to loosen the cover.
4. Remove the shaft cover gasket and separate the shaft cover from the roller bearing assembly by removing the adjusting screw lock nut and turning the adjusting screw clockwise.
5. Remove the end plate bolts, end plate, and shims.
6. Remove the lower bearing cup and ball bearing assembly by pulling on the end of the input shaft. If the bearing cup cocks, do not force it. Tap the

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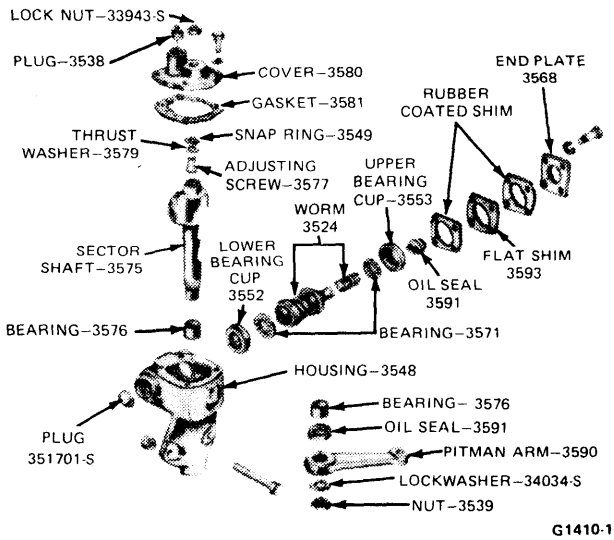


FIG. 6 Steering Gear Disassembled—F-150 (4 x 4), Bronco

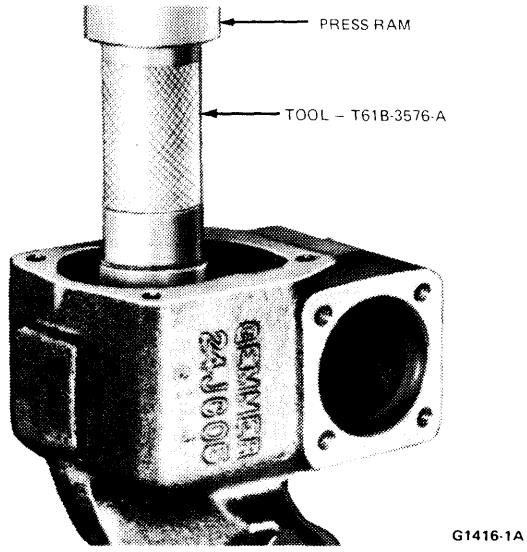


FIG. 7 Installing Sector Shaft Bushings

bearing cup lightly back into place and repeat the procedure.

7. Remove the upper bearing cup and ball bearing assembly.
8. Remove and discard the oil seals.

Assembly

If clearance between the sector shaft and bushing exceeds .005 inch, replace both bearings using Tool T61B-3576-A (Fig. 7), as follows:

1. Place the upper ball bearing assembly over the worm and input shaft assembly and into the upper bearing cup.
2. Insert the worm and shaft into the housing.
3. Place the lower ball bearing assembly on the worm and assemble the lower bearing cup.
4. Install the shims and worm cover on the housing and insert, but do not tighten, the cover bolts. Rotate the input shaft with one hand while tightening the worm cover bolts with the other. This will prevent damage to the worm bearing surfaces if the initial amount of shims is inadequate. When a light preload is obtained, tighten the bolts to 18 to 22 ft-lb and measure the preload.
5. Insert the adjusting screw into the shaft cover from inside and draw the roller bearing assembly into position until the shaft bottoms in the shaft cover. Turn adjusting screw in the opposite direction one full turn.
6. Install the gasket and shaft cover on the housing. Insert the cover bolts and tighten to 18-22 ft-lbs.
7. Install the adjusting screw lock nut and tighten to 16 to 20 ft-lb. Measure preload.
8. Install new shaft seals, fill the gear to specification, as outlined in Part 13-01, General Steering Service under Adjustments, and install the filler plug.

SPECIFICATIONS

Gear Model	Output Shaft Dia. (In.)	Meshload (In. x Lb.)	Worm Preload (In. x Lb.)
254 ①	1-1/4	12-21	5-10
254 ②	1-1/8	12-21	5-10

① Bronco Only ② F-150 (4x4)

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SPECIAL SERVICE TOOLS

Tool No.	Description
T58L-101-A	Puller Attachment
T61B-3576-A	Sector Shaft Bushing Remover
T58L-3548-A	Sector Shaft Bearing Replacer
T54L-6015-A	Worm Shaft Upper Seal Installer
T59L-100-B	Adapter

GEMMER — TORQUE LIMITS

Gear Model	Worm Cover Bolts or Nuts		Sector Shaft Cover Bolts		Sector Adjust Screw Locknut	
	(ft-lbs)	N•m	(ft-lbs)	N•m	(ft-lbs)	N•m
254	18-22	25-29	18-22	25-29	20-35	28-47

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Integral Power Steering Gear — Ford

PART 13-41

APPLIES TO F-100 — F-350 (4x2), F-150 — F-250 (4x4) AND BRONCO

SUBJECT	PAGE
DESCRIPTION AND OPERATION	41-1
DIAGNOSIS AND TESTING	41-1
ADJUSTMENTS	
In Vehicle	41-1
Mesh Load	41-1
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Piston and Ball Nut	41-8
Steering Gear	41-3
Steering Gear Housing	41-4
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DESCRIPTION AND OPERATION

This integral power steering gear (Fig. 1) is a torsion-bar type of hydraulic assisted system. The gear furnishes power to reduce turning effort at the steering wheel. It also reduces road shock and vibrations.

The torsion bar power steering unit includes a worm and one-piece rack piston, meshed to the gear teeth on the steering sector shaft. A hydraulic valve, input shaft and torsion bar assembly are mounted on the end of the worm shaft and activated by the twisting action of the torsion bar.

Because the rack-piston, worm and sector shaft are in one housing and the valve is in an attached housing (Fig. 1) fluid passes through internal passages between the valve and cylinder. The pressure and return hoses between the pump and gear assembly are the only external lines required.

The power cylinder is an integral part of the gear housing. The piston is double acting, in that fluid pressure may be applied to either side of the piston.

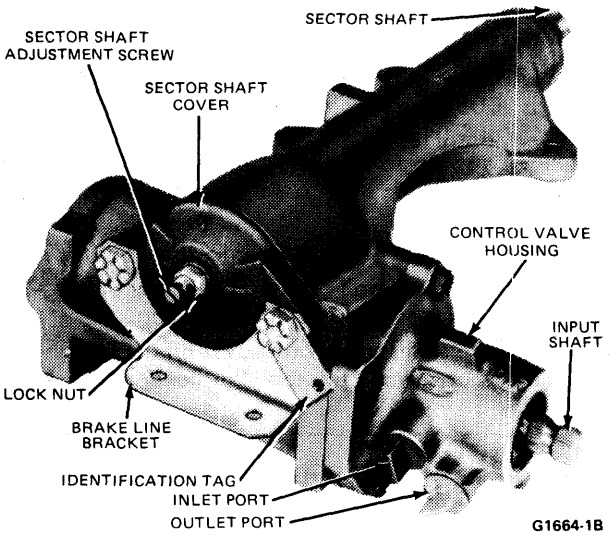


FIG. 1 Ford Integral Power Steering Gear F-100—F-350 and Bronco

DIAGNOSIS AND TESTING

Refer to Part 13-01, General Steering Service.

ADJUSTMENTS

MESH LOAD

During the vehicle breaking-in period, some factory adjustments may change. These changes in adjustment will not necessarily affect operation of the steering gear assembly, and need not be adjusted unless there is excessive lash or other malfunctioning.

ADJUSTMENT IN VEHICLE

Adjust total over center position load, to eliminate excessive lash between the sector and rack teeth as follows. This is the only adjustment required.

1. Disconnect the Pitman arm from the sector shaft using Tool 64P-3590-F.

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2. Disconnect the fluid return line at the reservoir and cap the reservoir return line pipe.
3. Place the end of the return line in a clean container and turn the steering wheel from left to right several times to discharge the fluid from the gear.
4. Turn the steering wheel to 45 degrees from the left stop.
5. Attach an in-lb torque wrench to the steering wheel nut and determine the torque required to rotate the shaft slowly approximately one-eighth turn from the 45 degree position.
6. Turn the steering gear back to center and determine the torque required to rotate the shaft back and forth across the center position. Loosen the adjuster nut, and turn the adjuster screw (Fig. 2) until the reading is 14 to 18 in-lb greater than the torque at 45 degrees from the stop.

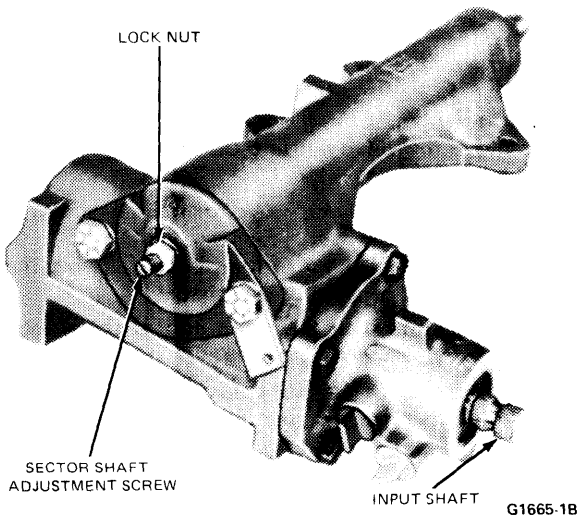


FIG. 2 Adjusting Mesh Load

Hold the screw in place, and tighten the lock nut.

7. Re-check torque readings and replace the Pitman arm and steering wheel hub cover.
8. Connect the fluid return line to the reservoir and fill the reservoir to specification (Part 13-01, General Steering Service). Adjust belt tension, if necessary.

Do not pry against the reservoir to obtain proper belt load. Pressure may deform the reservoir and cause it to leak.

ROTARY VALVE CENTERING CHECK

1. Install a 0-2000 psi pressure gauge (Tool T56L-33610-D) in the pressure line between the power steering pump outlet port and the integral steering gear inlet port. Be sure that the valve on the gauge is fully open.
2. Check the fluid level in the reservoir and add fluid if necessary.
3. Start the engine and turn the steering wheel from stop-to-stop to bring the steering lubricant to normal operating temperature. Turn off the engine and re-check the fluid level. Add fluid, if necessary.
4. With the engine running at approximately 1000 rpm and the steering wheel centered, attach an in-lb torque wrench to the steering wheel nut. Apply sufficient torque in each direction to get a gauge reading of 250 psi.
5. The torque wrench readings should be the same in both directions at 250 psi. If the difference between the readings exceeds 4 in-lb, remove the steering gear and replace the shaft and control assembly.
6. When performing the valve spool centering check outside the vehicle, use the procedures described above, except take the torque and pressure readings at the right and left stops instead of either side of center.

NOTE: A hissing noise is a normal characteristic of rotary valve steering gears and in no way effects steering. Do not replace the shaft and control assembly unless the hiss is EXTREMELY objectionable. A replacement valve will also exhibit slight noise, and is not always a cure for the complaint. Any metal-to-metal contacts, such as column grounding, coupling grounding, or sheet metal to steering components will transmit valve hiss noise into the passenger compartment.

The only service that can be performed on the new part is the replacement of the four valve sleeve O-rings on the valve sleeve.

REMOVAL AND INSTALLATION

STEERING GEAR

F-100—F-350 AND BRONCO

Removal

Service the steering gear as follows:

1. Disconnect the pressure and return lines from the steering gear. Plug the lines and the ports in the gear to prevent entry of dirt. Disconnect brake lines from the steering gear bracket.
2. Remove the bolts that secure the flex coupling to the steering gear and to the column steering shaft assembly.
3. Raise the vehicle and remove the Pitman arm attaching nut, and washer.
4. Remove the Pitman arm from the sector shaft using Tool T64P-3590-F. Remove the tool from the Pitman arm. **Do not damage the seals.**
5. On vehicles with standard transmission remove the clutch release lever retracting spring to provide clearance for removing the steering gear.
6. Support the steering gear, and remove the steering gear attaching bolts.
7. Work the steering gear free of the flex coupling. Remove the steering gear from the vehicle.

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Installation

1. Slide the flex coupling into place on the steering shaft assembly. Turn the steering wheel so the spokes are in the horizontal position.
2. Center the steering gear input shaft.
3. Slide the steering gear input shaft into the flex coupling and into place on the frame side rail. Install the attaching bolts and tighten to specification. Refer to the specifications at the end of Part 13-01, General Steering Service.
4. Be sure the wheels are in the straight ahead position, then install the Pitman arm on the sector shaft. Install the Pitman arm attaching washer and nut. Tighten nut to 170-230 ft-lbs.
5. Connect and tighten the pressure and the return lines to the steering gear. Re-install the brake lines on the steering gear bracket.
6. Disconnect the coil wire. Fill the reservoir to specification (Part 13-01, General Steering Service). Turn on the ignition and turn the steering wheel from left to right to distribute the fluid.
7. Re-check fluid level and add fluid, if necessary. Connect the coil wire, start the engine and turn the steering wheel from side to side. Inspect for fluid leaks.

DISASSEMBLY AND ASSEMBLY

Take the following precautions when servicing the steering gear:

1. Use a clean workbench and tools.
2. Thoroughly clean the exterior of the gear with solvent and drain off excess hydraulic fluid, if necessary.
3. Handle all parts carefully to avoid nicks, burrs, scratches and dirt.
4. Do not use solvent on seals.

STEERING GEAR

Disassembly

1. Hold the steering gear upside down over a drain pan and cycle the input shaft several times to drain the fluid from the gear.
2. Secure the gear in a soft-jawed vise.
3. Remove the locknut from the adjusting screw (Fig. 1).
4. Turn the input shaft to either stop then, turn it back approximately one and three-quarter turns to center the gear.
5. Remove the sector shaft cover attaching studs, brake line bracket and identification tag.
6. Tap the lower end of the sector shaft with a soft-hammer to loosen it, and lift the cover and shaft from the housing **as an assembly.** Discard the O-ring.
7. Turn the sector shaft cover counterclockwise and remove it from the adjuster screw.
8. Remove the valve housing attaching bolts. Hold the piston to keep it from spinning off the shaft, and lift the valve housing off the steering gear housing. Remove the valve housing and control valve gasket. Discard the gasket.
9. Stand the valve body and piston on end with the piston end down. Rotate the input shaft counterclockwise out of the piston allowing the ball bearings to drop into the piston.
10. Place a cloth over the open end of the piston and turn it upside down to remove the balls.
11. Remove the screws that attach the ball guide clamp (Fig. 3) to the ball nut and remove the clamp and the guides.
12. Install the valve body assembly in the bench mounted holding fixture, Tool T57L-500-A, and loosen the Allen head race nut screw from the valve housing. Remove the worm bearing race nut as shown in Fig. 4.
13. Carefully slide the input shaft, worm and valve assembly out of the valve housing. **Do not cock the spool or it may jam in the housing.**

Assembly

1. Mount the valve housing in the bench mounted holding fixture, Tool T57L-500-A, with the flanged end up.

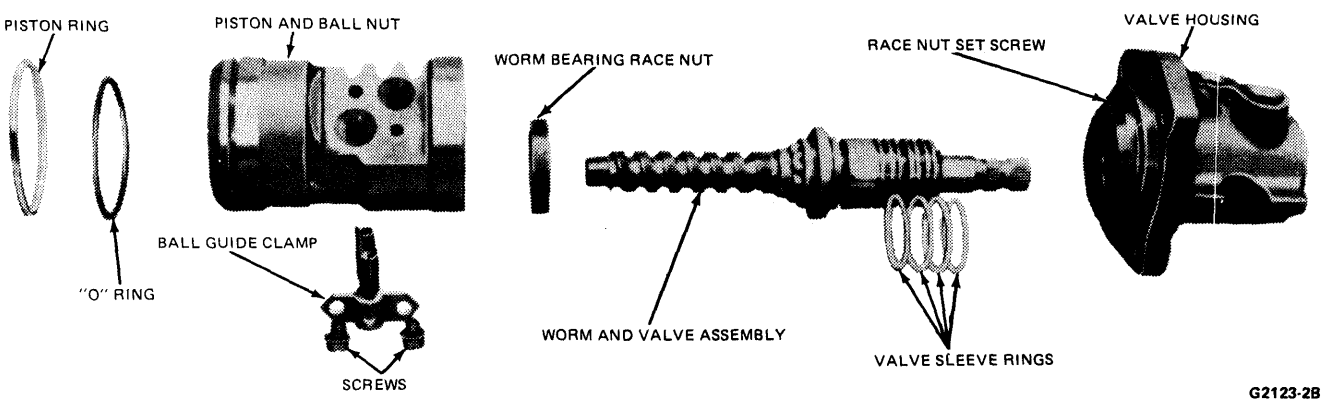


FIG. 3 Ball Nut and Housing Disassembled—Rotary Valve Type

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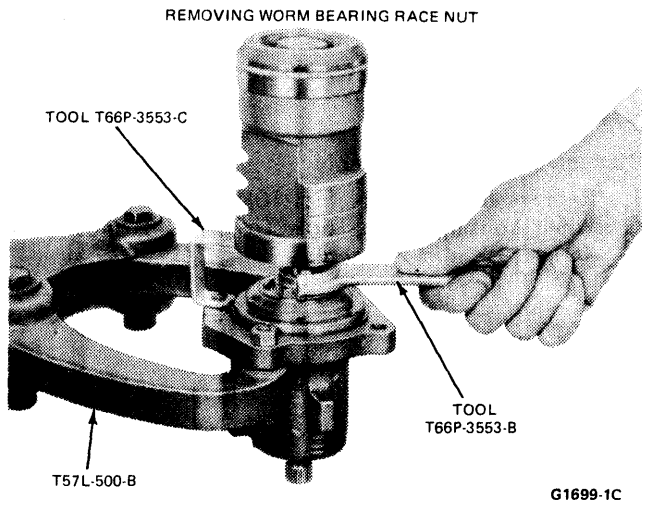


FIG. 4 Removing Worm Bearing Race Nut

2. Apply a light coat of gear lubricant to the Teflon rings on the valve sleeve.
3. Carefully install the worm and valve in the housing.
4. Install the race nut in the housing and tighten to specification.
5. Install the Allen head race nut set screw through the valve housing and tighten to specification.
6. Place the piston on the bench with the ball guide holes facing up. Insert the worm shaft into the piston so that the first groove is in line with the hole nearest the center of the piston (Fig. 5).

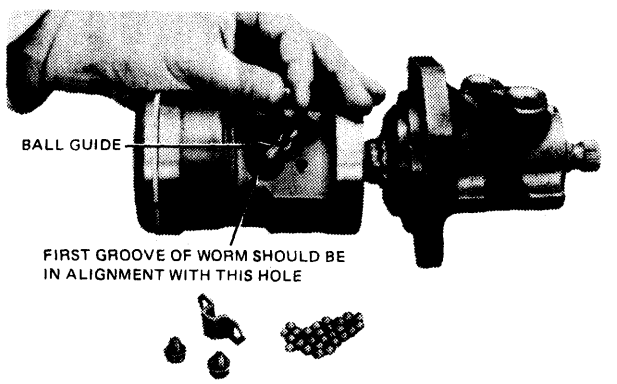


FIG. 5 Assembling Piston on Worm Shaft

7. Place the ball guide in the piston and insert 27 to 29 balls, (depending on the piston design) in the ball guide (Fig. 3) while turning the worm in a clockwise direction as viewed from the input end of the shaft. If all of the balls have not been fed into the guide upon reaching the right stop, rotate the input shaft back and forth and install the remaining balls. After the balls are installed, do not rotate the input shaft or piston more than three and one-half turns from the right stop or the balls will fall out of the circuit.
8. Secure the guides in the ball nut with the clamp (Fig. 5).
9. Apply Vaseline or equivalent to the Teflon seal on the piston.
10. Place a new control valve gasket on the valve housing.
11. Slide the piston and valve into the gear housing being careful not to damage the Teflon seal.
12. Align the lube passage in the valve housing with the passage in the gear housing, and install, **but do not tighten,** the attaching bolts.
13. Rotate the ball nut so that the teeth are in the same plane as the sector teeth. Tighten the valve housing attaching bolts to specification.
14. Position the sector shaft cover O-ring in the steering gear housing. Turn the input shaft to center the piston.
15. Apply Vaseline or equivalent to the sector shaft journal, and position the sector shaft and cover assembly in the gear housing. Install the brake line bracket, identification tag, and sector shaft cover attaching bolts. Tighten the bolts to specification.
16. Attach an in-lb torque wrench to the input shaft. Adjust mesh load to specification. Refer to specifications at the end of this part.

STEERING GEAR HOUSING

Disassembly and Assembly

1. Remove the snap ring and spacer washer (Fig. 6) from the lower end of the steering gear housing.

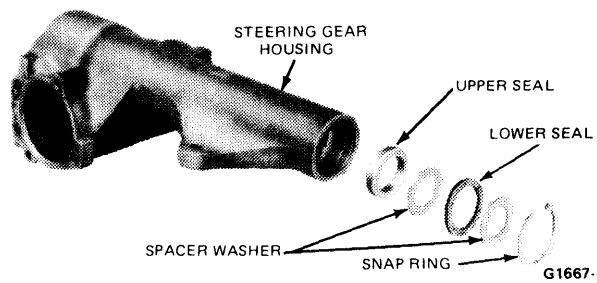


FIG. 6 Steering Gear Housing Disassembled

2. Remove the lower seal from the housing as shown in Fig. 7. Lift the spacer washer from the housing.

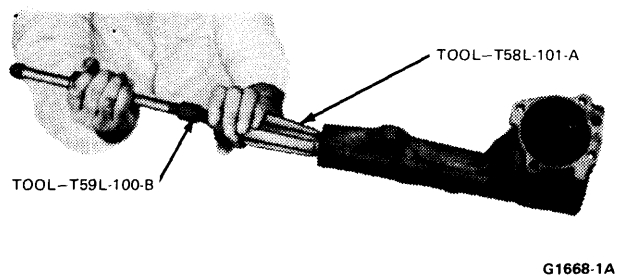


FIG. 7 Removing Upper and Lower Seals

3. Remove the upper seal as described in Step 2. Some housings will have only one seal and one spacer. Discard old seals.
4. Dip both sector shaft seals in gear lubricant.
5. Apply lubricant to the sector shaft seal bore of the housing and position the sector shaft upper seal in the housing with the lip facing inward. Press the seal into place using Tool T65P-3576-B (Fig. 8). Place on 0.090 inch spacer washer on top of the seal and apply more lubricant to the housing bore.

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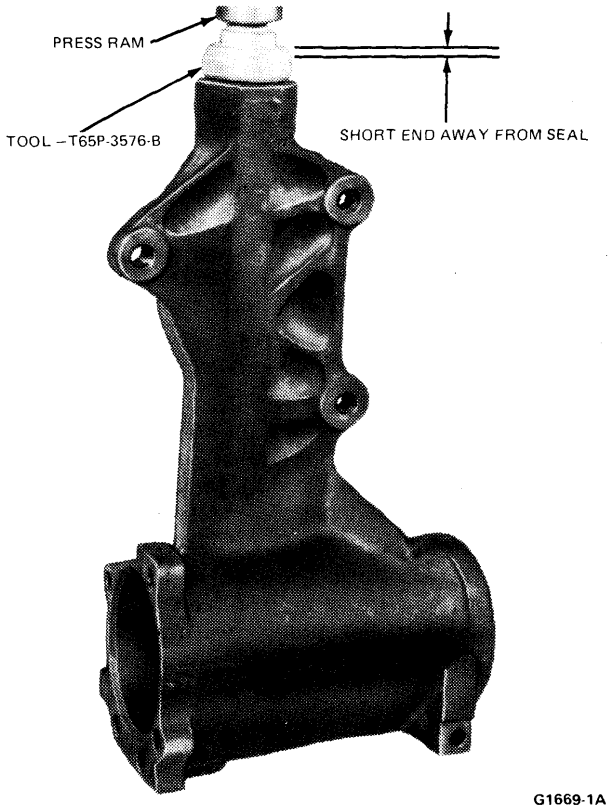


FIG. 8 Installing Sector Shaft Inner Seal

6. Place the lower seal in the housing with the lip facing inward and press it into place as shown in Fig. 9. Place an 0.090 inch spacer washer on top of the seal.

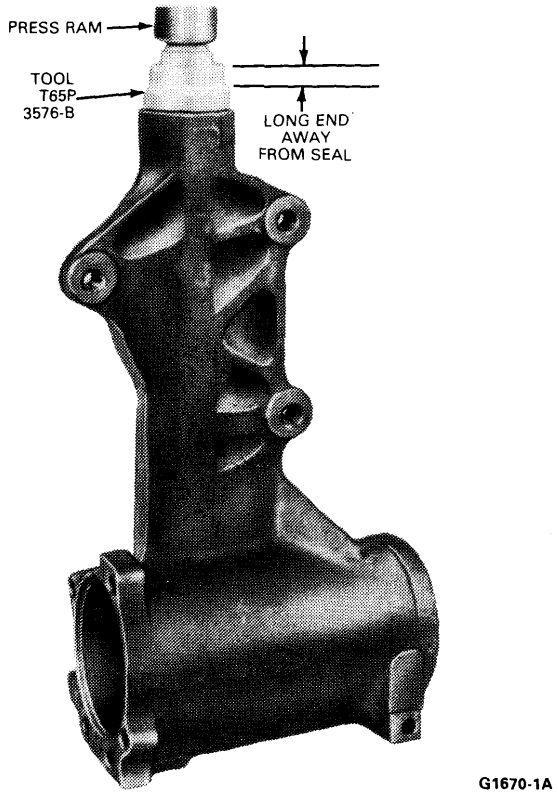


FIG. 9 Installing Sector Shaft Outer Seal

7. Position the snap ring in the housing and press into place to properly locate the seals. Be sure the snap ring engages in the groove.

VALVE HOUSING

Disassembly and Assembly

1. Remove the dust seal (Fig. 10) from the rear of the valve housing using Tools T59L-100-B and T58L-101-A. Discard the seal.

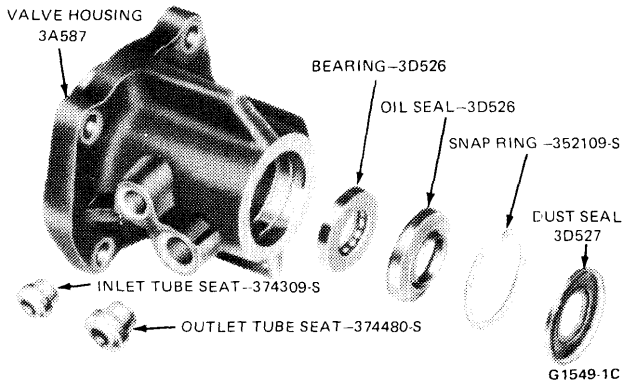


FIG. 10 Valve Housing Disassembled

2. Remove the snap ring from the valve housing.
3. Turn the bench mounted holding fixture to invert valve housing.
4. Insert Tools T65P-3524-A2 and T65P-3524-A3 in the valve body assembly opposite the oil seal end and gently tap the bearing and seal out of the housing as shown in Fig. 11. Discard the seal. **Do not damage the housing when inserting and removing the tools.**

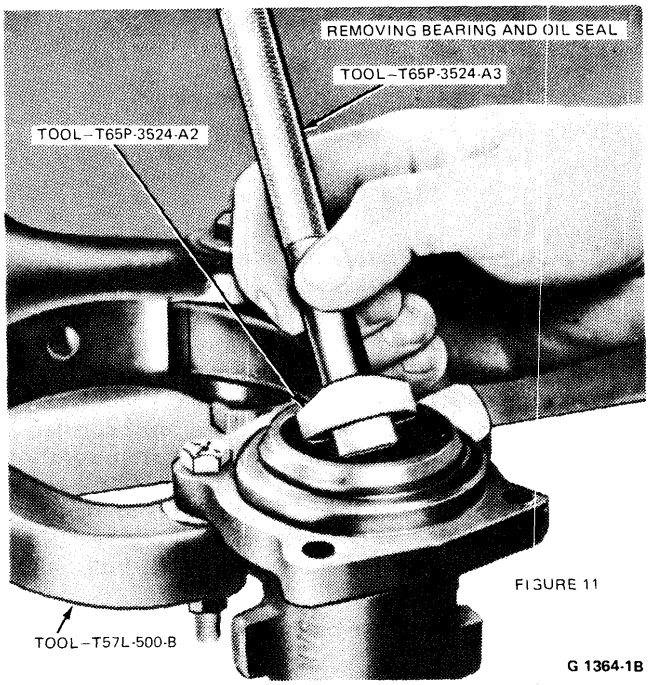


FIG. 11 Removing Bearing and Oil Seal

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5. Remove the fluid inlet and outlet tube seats with Tube Seat Remover T74P-3504-L if they are damaged.
6. Coat the fluid inlet and outlet tube seats with Vaseline or equivalent and install them in the housing with a Tube Seat Installer T74P-3504-M.
7. Coat the bearing and seal surface of the housing with a film of Vaseline or equivalent.
8. Position the bearing in the valve housing. Seat the bearing in the valve housing using Tool T65P-3524-A1 (Fig. 12). Be sure the bearing rotates freely.

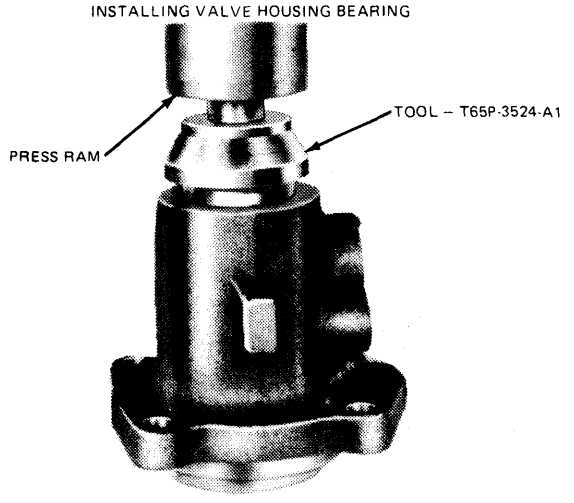


FIGURE 12 G1363-1A

FIG. 12 Installing Valve Housing Bearing

9. Dip a new oil seal in gear lubricant and place it in the housing with the metal side facing outward. Drive the seal into the housing until the outer edge does not quite clear the snap ring groove (Fig. 13).

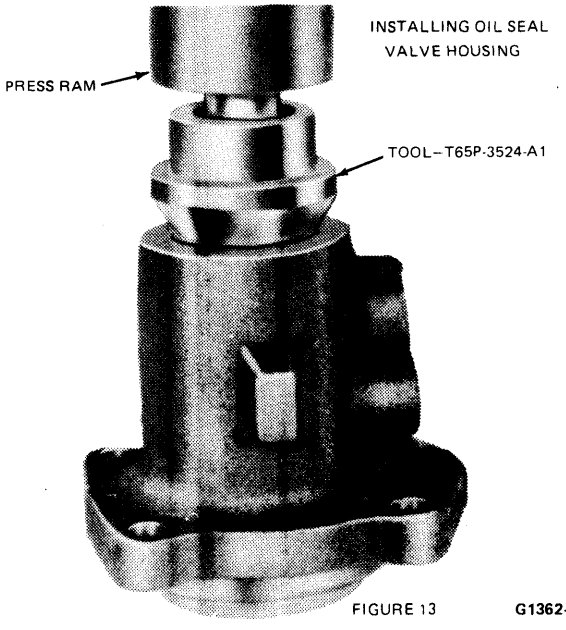


FIGURE 13 G1362-1A

FIG. 13 Installing Oil Seal in Valve Housing

10. Place the snap ring in the housing and drive on the ring using Tool T65P-3524-A1 until the snap ring seats in its groove.
11. Place the dust seal in the housing with the dished side (rubber side) facing out. Drive the dust seal into place using Tool T65P-3524-A1. When properly installed, the seal will be located behind the undercut in the input shaft.

WORM AND VALVE SLEEVE

Disassembly and Assembly

1. Remove valve sleeve rings from sleeve by inserting the blade of a small pocket knife under them and cutting them off (Fig. 14).

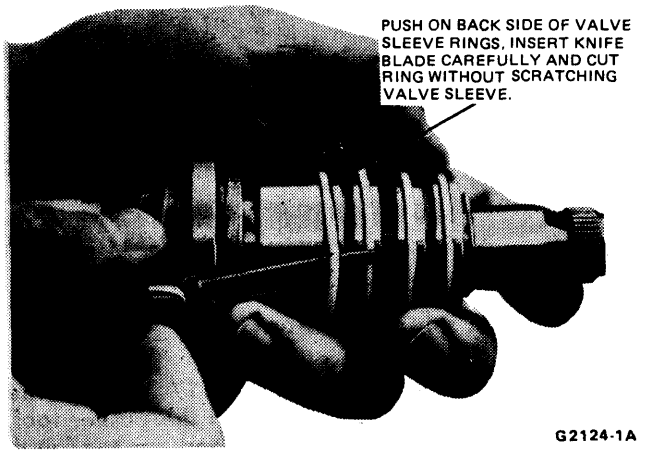


FIG. 14 Removing Valve Sleeve Rings

2. Mount the worm end of the worm and valve sleeve assembly into a soft-jawed vise (Fig. 15).

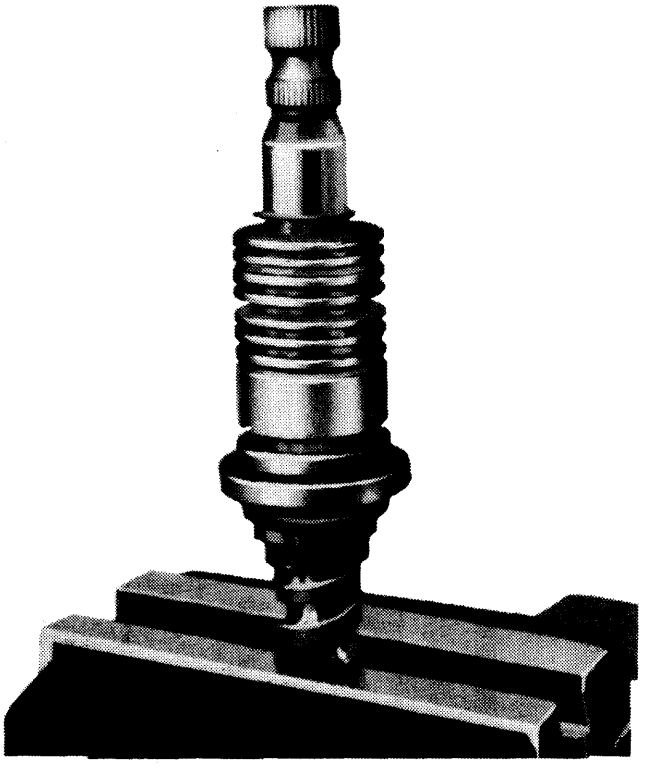


FIG. 15 Worm and Sleeve with Ring Removed

3. Install mandrel Tool T75L-3517-A1 over the sleeve; slide one valve sleeve ring over the tool (Fig. 16).

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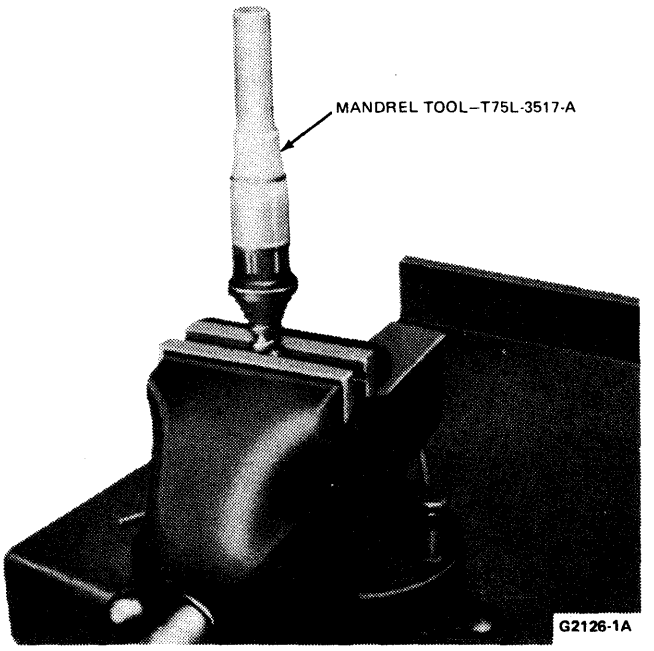


FIG. 16 Mandrel Installed on Sleeve

4. Slide the pusher Tool T75L-3517-A2 over the mandrel; rapidly push down on the pusher tool, forcing the ring down the ramp and into the fourth groove of the valve sleeve. Repeat this step three more times, and each time add one of the spacers, Tool T75L-3517-A3, under the mandrel tool. By adding the spacer each time, the mandrel tool will line up with the next groove of the valve sleeve (Figs. 17 and 18).

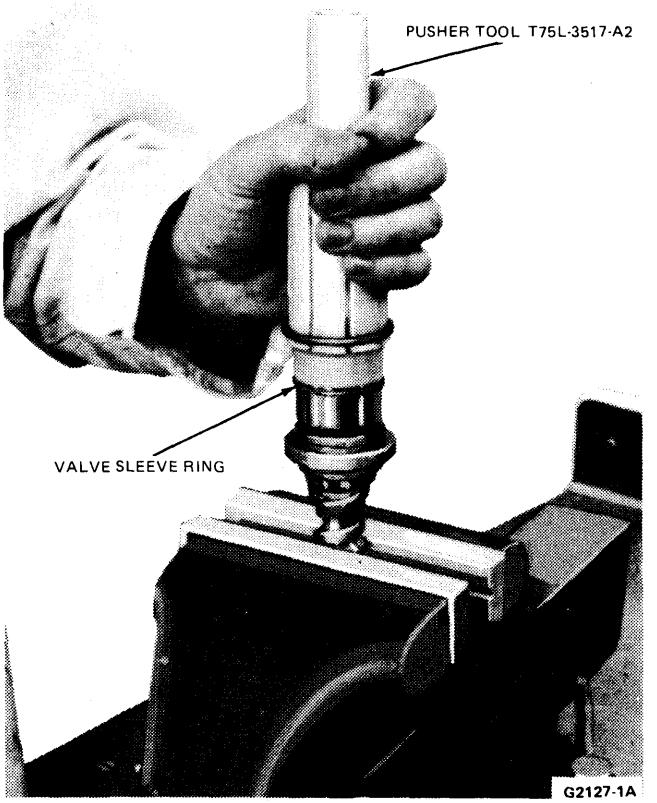


FIG. 17 Installing Ring on Valve

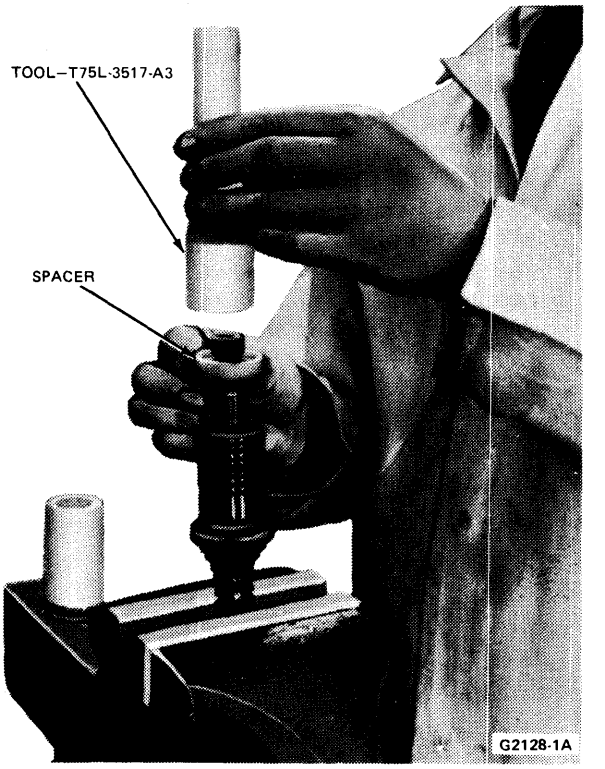


FIG. 18 Adding Spacer to Install Next Ring

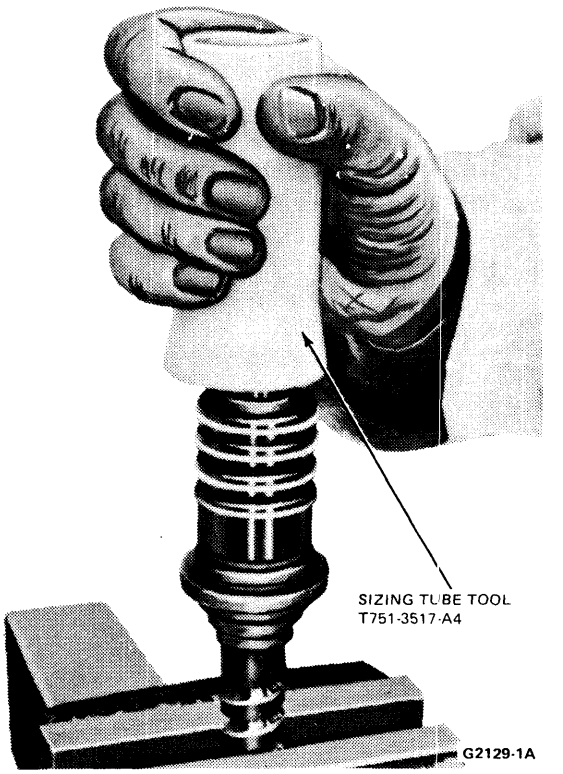


FIG. 19 Sizing Rings—Step 1

5. After installing the four valve sleeve rings, apply a light coat of gear lubricant to the sleeve and rings.
6. Slowly install the sizing tube Tool T75L-3517-A4, over the sleeve valve end of the worm shaft onto the valve sleeve rings. Make sure that the rings are

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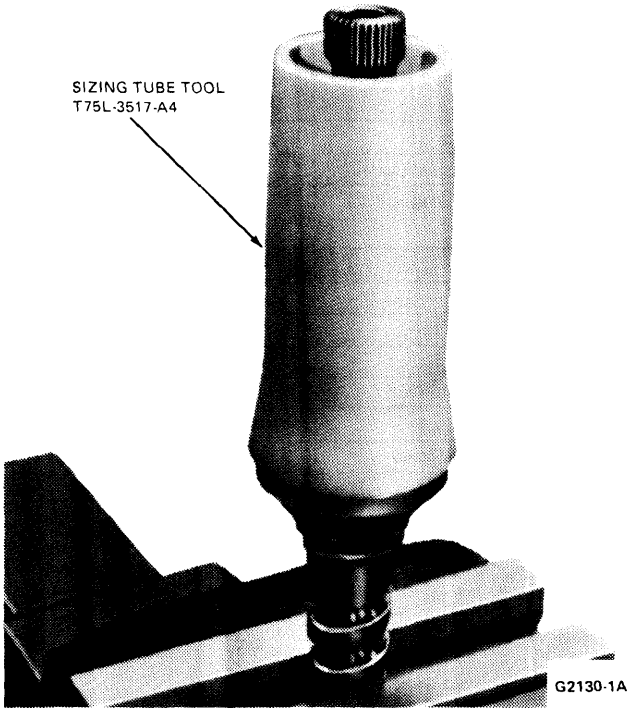


FIG. 20 Sizing Rings—Step 2

not being bent over as the tube is slid over them (Figs. 19 and 20).

7. Remove the sizing tube and check the condition of the rings. Make sure that the rings turn freely in the grooves.

8. Fig. 21 shows the complete set of tools needed to perform the above operations. The tool Kit Number for the complete set is T75L-3517-A.

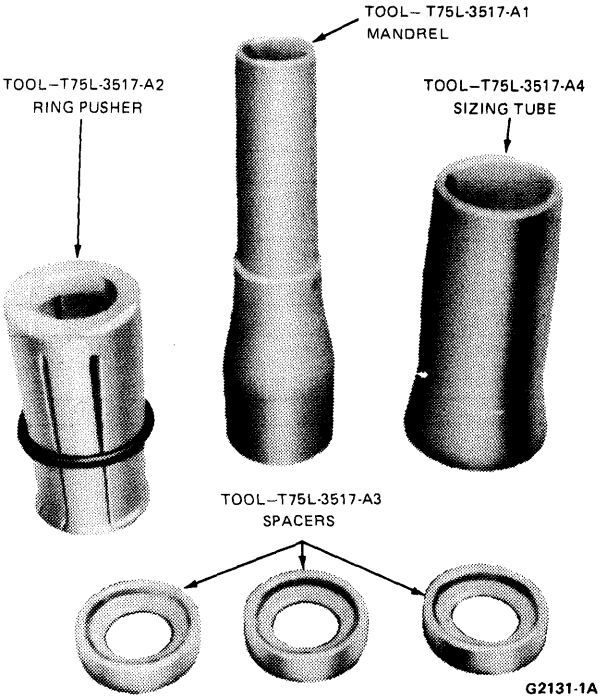


FIG. 21 Rotary Valve Tool Kit No. T75L-3517-A

PISTON AND BALL NUT

Disassembly and Assembly

1. Remove the Teflon piston ring and O-ring (Fig. 3) from the piston and ball nut. Discard both rings.
2. Dip a **new** O-ring in gear lubricant and install it on the piston and ball nut.
3. Install a **new** Teflon piston ring on the piston and ball nut being careful not to stretch it any more than necessary.

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SPECIFICATIONS

FORD INTEGRAL POWER STEERING GEAR SPECIFICATIONS

Description	
Type	Recirc. Ball Torsion Bar
Ratio	17:1
Turns of Steering Wheel (Lock to Lock — Linkage Disconnected)	4
Fluid Capacity (Included in Pump Reservoir Fill)	1.6 Pints (Approx.)
Fluid Specification	ESW-M2C33-F ②
Worm Bearing Preload	4-9 in-lbs ①
Total Meshload Over Mechanical Center	25 in-lbs (Max.)
Total Meshload Over Worm Bearing Preload	14-18 in-lbs
Worm to Piston Preload	1-3 in-lbs ①

① Not adjustable in field. Specification given for inspection purposes only.
② Or use an equivalent lubricant

FORD INTEGRAL POWER STEERING GEAR TORQUE LIMITS

Description	Torque Limits	
	(ft-lbs)	N•m
Sector Shaft Cover Bolts	55-70	75-94
Mesh Load Adjusting Screw Lock Nut	35-45	48-61
Valve Housing to Gear Housing Bolt	35-50	48-67
Rack Retaining Nut	55-90 ①	75-122
Piston End Cap	70-110	95-149
Pressure Hose to Gear	16-25	22-33
Return Hose to Gear	25-34	34-46
Hose Clamps	1-2	1.4-2.7
Pitman Arm to Sector Shaft Nut	200-250	272-338
	(in-lbs)	N•m
Ball Return Guide Clamp Screw	42-70	4.8-7.9
Set Screw Race Nut	15-25	1.7-2.8

① Specified Torque — Because the length of the tool required to torque the nut will affect the observed torque reading on the torque wrench, the torque reading should be computed using the length of the torque wrench and the nominal specified torque as follows:

$$\text{Torque Reading} = \frac{\text{Length of Torque Wrench} \times 72 \text{ ft-lbs}}{\text{Length of Torque Wrench} + 5.5 \text{ Inches (Using Tool T65P-3553-B)}}$$

Example: With 13 inch torque wrench

$$\frac{13 \text{ In.} \times 72 \text{ ft-lbs}}{13 \text{ In.} + 5.5 \text{ In.}} = \frac{13 \text{ In.} \times 72 \text{ ft-lbs}}{18.5 \text{ In.}} = 0.703 \times 72 \text{ ft-lbs} = 50 \text{ ft-lbs}$$

SPECIAL SERVICE TOOLS

Tool No.	Description
T56L-33610-D	Pressure Testing Gauge Assembly
T64P-3590-F	Steering Pitman Arm Remover
T57L-500-A	Bench Mounted Holding Fixture
T66P-3553-C	Spacer
T66P-3553-B	Spanner Wrench
T74P-3504-L	Tube Seat Remover

Tool No.	Description
T59L-100B	Slide Hammer—Short
T58L-101A	Puller Attachment
T65P-3524A1, A2, A3	Bearing Remover and Installer
T65P-3576-B	Sector Shaft Seal Installer
T74P-3504-M	Tube Seat Installer
T75L-3517-A	Rotary Valve Tool Kit

CG1843-2H

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Integral Power Steering Gear — Saginaw

PART 13-42

APPLIES TO E100 THROUGH E-350

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Mesh Load — In Vehicle	42-4
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Steering Gear Housing	42-9
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DESCRIPTION

The Rotary Valve power steering gear (Figs. 1 and 2) displaces fluid to provide hydraulic fluid pressure assists when turning. The gear assembly is always filled with fluid, making periodic lubrication unnecessary. In addition, the fluid acts as a cushion to absorb road shocks that may be transmitted to the driver. All fluid passages are internal except the pressure and return hoses between the gear and pump.

The rotary valve provides a smooth transmission through the driving range of steering wheel effort. A torsion bar transmits the road feel to the driver.

A one-piece rack piston nut is geared to the sector shaft. An adjusting screw on the end of the shaft gear maintains preload between the sector shaft and rack piston nut (Fig. 1).

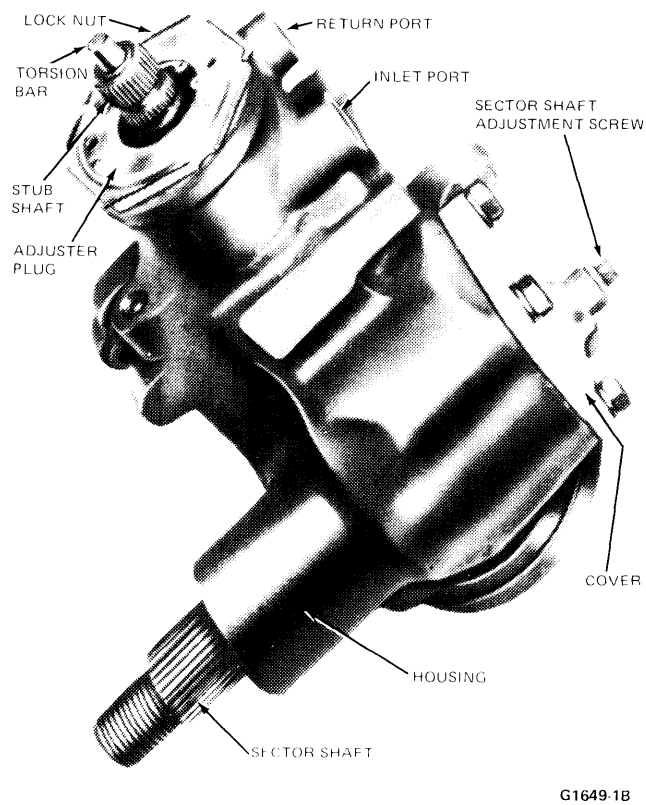


FIG. 1 Steering Gear—Exterior View

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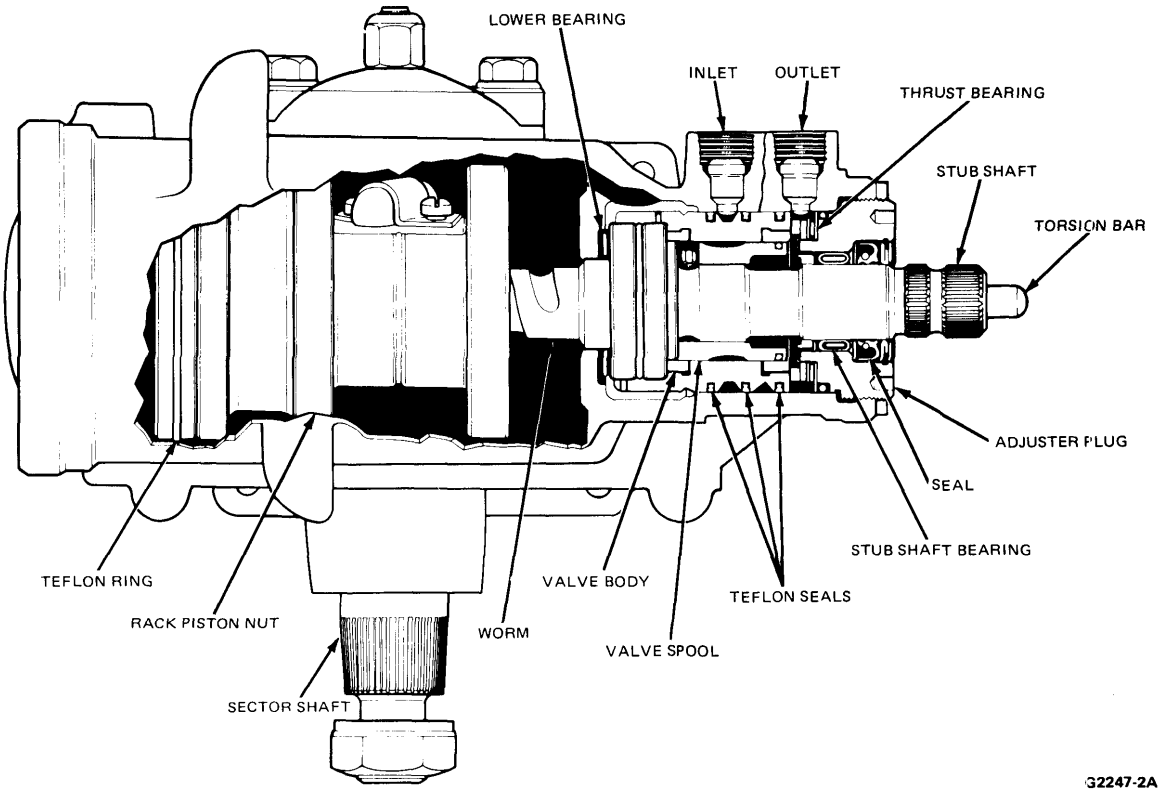


FIG. 2 Power Steering Gear—Sectional View

DIAGNOSIS AND TESTING

Refer to Part 13-01, General Steering Service.

ADJUSTMENTS

Only the over-center mesh load may be adjusted with the steering gear in the vehicle. Other adjustments require removal of the gear.

THRUST BEARING ADJUSTMENT—GEAR REMOVED

Saginaw power steering gears feature conical races on the input shaft lower thrust bearing. The races are essentially axial spring washers which prevent loss of thrust bearing preload (Fig. 3).

1. Drain the power steering fluid from the gear by rotating the stub shaft full travel in both directions several times.
2. Loosen and remove the adjuster plug lock nut (Figs. 4 and 5).
3. Turn the adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed, approximately 20 ft-lbs (Fig. 6).

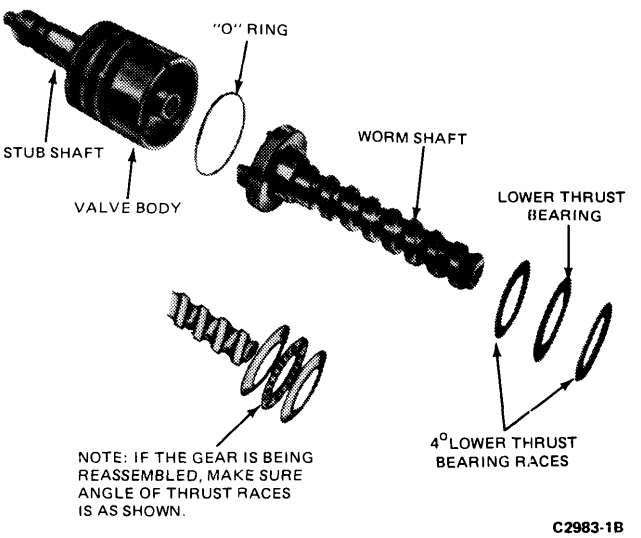
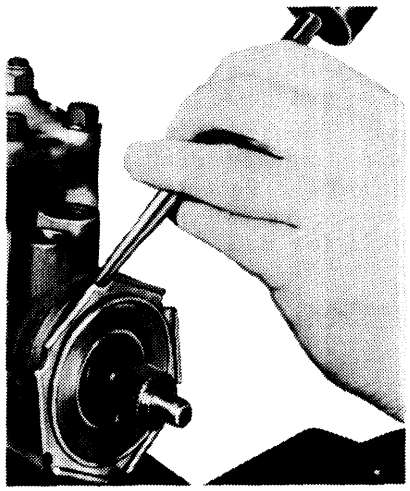


FIG. 3 Conical Thrust Races

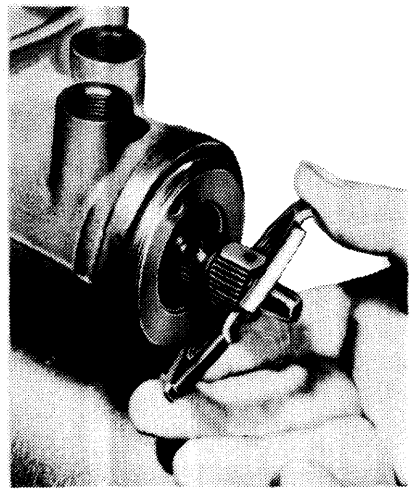
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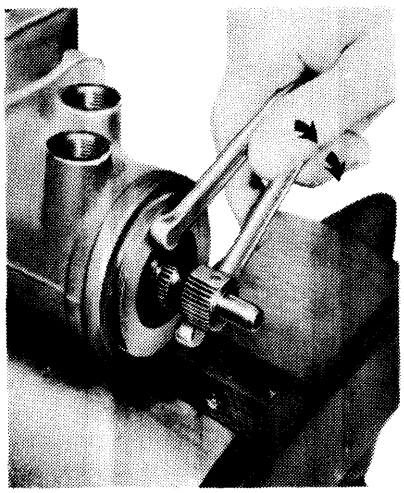
C2984-1A

FIG. 4 Loosening Adjuster Plug Lock Nut



C2985-1A

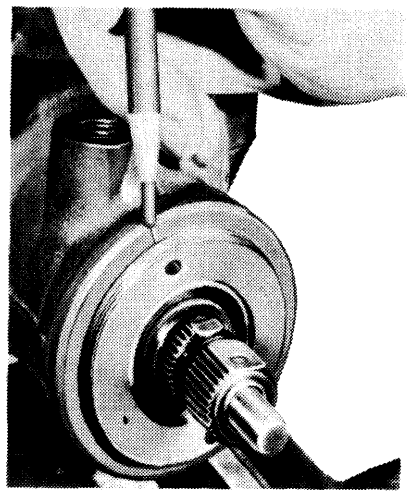
FIG. 5 Removing Adjuster Plug Lock Nut



C2986-1A

FIG. 6 Bottoming Adjuster Plug

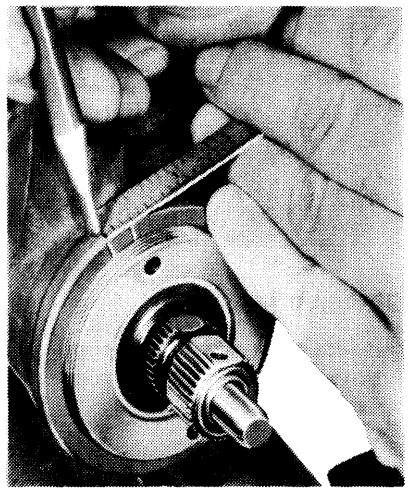
4. Mark the housing even with one of the holes in the adjuster plug (Fig. 7).



C2987-1A

FIG. 7 Marking Housing with Adjuster Plug Bottomed

5. Measure back (counterclockwise direction) 3/16 to 1/4 inch and remark the housing (Fig. 8).



C2989-1A

FIG. 8 Marking Housing 3/16-Inch Counterclockwise from Bottomed Position

6. Rotate the adjuster (counterclockwise) until the hole in the adjuster is in line with the second mark (Fig. 9).
7. Tighten the lock nut securely. Hold (or have held) the adjuster plug to maintain alignment of the hole with the mark (Fig. 10).
8. Using a 3/4 inch twelve point deepwell socket and an in-lb torque wrench, turn the stub shaft to the right stop and then back 1/4 turn. Measure the torque. Reading should be taken with the beam of the torque wrench near vertical while turning counterclockwise at an even rate (Fig. 11). If the

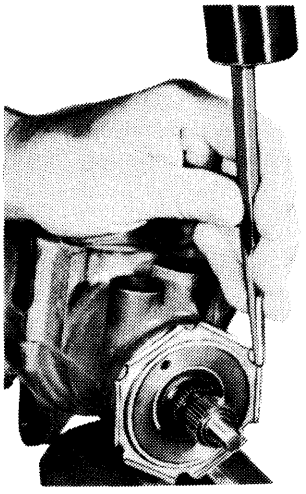
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C2990-1A

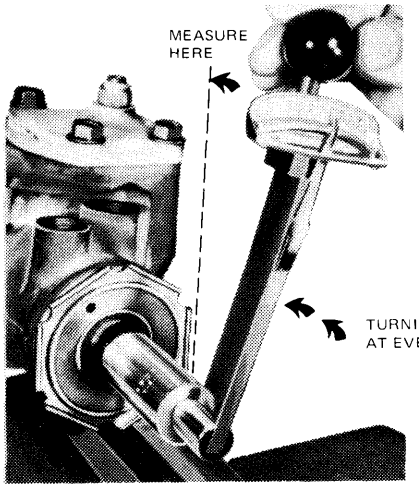
FIG. 9 Rotating Adjuster to Second Mark



C2991-1A

FIG. 10 Tightening Lock Nut

reading is less than 4, or more than 10 in-lbs, use the alternate adjustment procedure shown below.

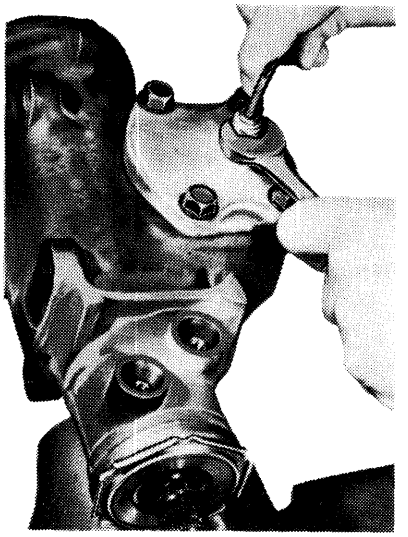


C2992-1A

FIG. 11 Checking Rotational Torque

ALTERNATE THRUST BEARING ADJUSTMENT PROCEDURE

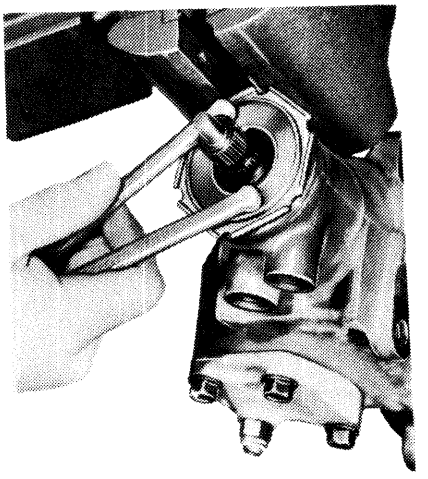
1. Drain the gear by rotating the stub shaft from stop to stop several times.
2. Loosen the Pitman shaft preload adjuster screw lock nut and turn the preload adjuster screw 1-1/2 turns counterclockwise. Retighten the locknut (Fig. 12) (If when turning the preload screw counterclockwise it bottoms, turn back clockwise 1/2 turn.)



C2993-1A

FIG. 12 Loosening Pitman Shaft Preload Adjusting Screw

3. Loosen (but do not remove) the adjuster plug lock nut (Fig. 4).
4. Loosen the adjuster plug one turn counterclockwise (Fig. 13).



C2994-1A

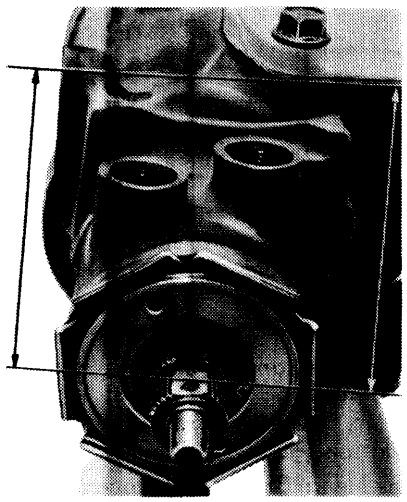
FIG. 13. Loosening Adjuster Nut One Turn

5. Turn the stub shaft to the right stop and then back 1/4 turn. Measure the drag torque, using an in-lb torque wrench (Fig. 11). Bottom the adjuster plug firmly (approximately 20 ft-lbs) by turning it clockwise (Fig. 14) then back it off until the total-

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torque reading is 3-4 in-lbs in excess of the drag torque (i.e., drag torque reading 3 in-lbs, total torque reading with adjuster plug tightened 6-7 in-lbs).



C2995-1A

FIG. 14 Aligning Stub Shaft Flat

6. Tighten the adjuster plug lock nut securely (Fig. 10).

NOTE: Preload torque tends to drop off when the lock nut is tightened. Therefore, the torque reading must be rechecked with the lock nut tight, and the torque must still be 3-4 in-lbs in excess of the seal drag.

NOTE: It is not possible to properly adjust the thrust bearing preload unless the adjuster plug is firmly bottomed out and the torque set while the adjuster plug is being loosened. Never attempt to adjust the thrust preload while tightening or advancing the adjuster plug into the gear assembly.

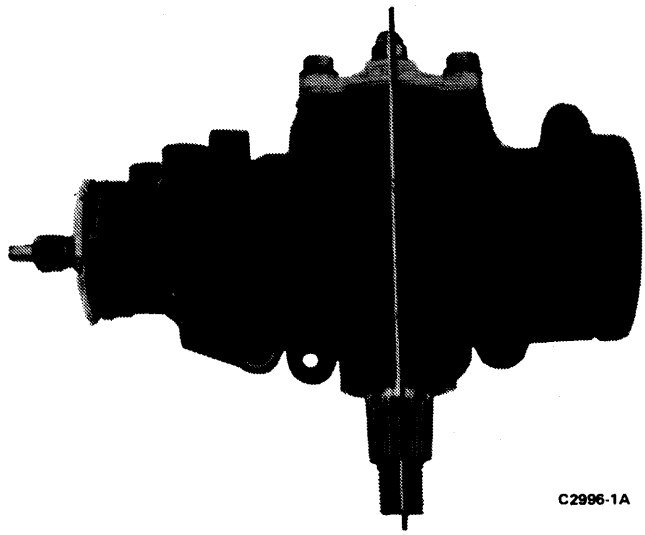
MESH LOAD—GEAR REMOVED

1. Turn the stub shaft from stop to stop, counting the total number of turns. Divide this number by 2. Starting at either stop, turn the stub shaft 1/2 turn the total number of turns. This is the "center" of the gear. (The flat on the stub shaft is normally up and parallel with the side cover when the gear is "on center" (Fig. 14) and the block tooth on the Pitman shaft is in line with the over-center preload adjuster (Fig. 15).

2. Rotate the torque wrench approximately 45 degrees each side of the center, and "read" near or on center (highest reading) (Fig. 11). Loosen the lock nut and turn the preload adjusting screw clockwise until the correct "O" center torque, in excess of the reading just taken, is obtained (Fig. 16).

NOTE: Limits for "new" and "used" gears differ as follows:

a. 'New" gear over-center torque to be 4-9 in-lbs additional torque, but total over-center torque must not exceed 20 in-lbs.

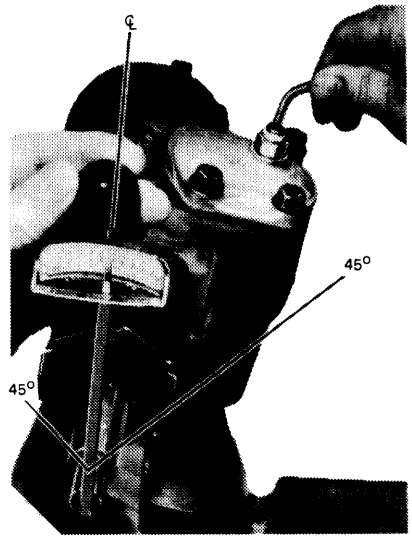


C2996-1A

FIG. 15 Aligning Pitman Shaft Block Tooth

b. 'Used" gear (400 or more miles). Over-center torque to be 4-6 in-lbs additional torque, but total over-center must not exceed 16 in-lbs.

Tighten the lock nut to 35 ft-lbs while holding the preload adjuster screw, Recheck the over-center adjustment.



C2997-1A

FIG. 16 Checking Over-Center Rotational Torque

MESH LOAD—IN VEHICLE

Adjust the total over-center position load (mesh load) to eliminate excessive lash between the sector shaft and rack teeth as follows:

1. Disconnect the Pitman arm from the sector shaft. Remove the steering wheel hub.
2. Disconnect the fluid return line at the reservoir, and cap the reservoir return line pipe.
3. Place the end of the return line in a clean container and turn the steering wheel from left to right to discharge the fluid from the gear.
4. Turn the gear one-half turn off center in either direction. Using a 24 in-lb torque wrench on the

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steering wheel nut, determine the torque required to rotate the shaft slowly through a 20 degree arc.

5. Turn the gear back to center and repeat Step 4. Loosen the adjuster lock nut and turn the screw inward using 7/32-inch Allen wrench, until the reading is 6 in-lb greater than the reading taken in Step 4. Retighten the lock nut while holding the screw in place.
6. Recheck the readings and replace the Pitman arm and steering wheel hub.
7. Connect the fluid return line to the reservoir and fill the reservoir with C1AZ-19582-A, C, or -D or equivalent to specification.

REMOVAL AND INSTALLATION

Removal

When servicing the steering gear label hoses before disconnecting them.

1. Position a drain pan under the steering gear. Disconnect the pressure and return lines from the steering gear and plug the lines and ports in the gear to prevent entry of dirt.
2. Raise the vehicle on a hoist and remove the drag link from the pitman arm.
3. Remove the nuts that secure the flex coupling to the steering column shaft assembly (Fig. 17).
4. Support the steering gear and remove the steering gear attaching bolts.
5. Remove the bolt from the flex coupling and remove the coupling from the gear.
6. Remove the pitman arm at this time from the sector shaft using tool T64P-3590-F if the gear is to be disassembled.

Installation

1. Before installing the gear in the vehicle, attach flex coupling to steering gear. Install bolt and tighten to specification.
2. Center the steering gear input shaft.
3. Install the pitman arm on the sector shaft with pitman arm facing forward. Install the pitman arm attaching washer and nut. Tighten nut to specification.
4. Slide the steering gear into place on the frame side rail. Install the attaching bolts and tighten to 54-66 ft-lbs. **NOTE: If new steering gear attaching bolts and washers are required, use only the bolt and washer specified. Use grade 9 bolts.**
5. Move steering column shaft flange into place on the flex coupling and install attaching nuts. Tighten nuts to specification.
6. Connect and tighten the pressure and return lines to the steering gear. Tighten fittings to specifications.

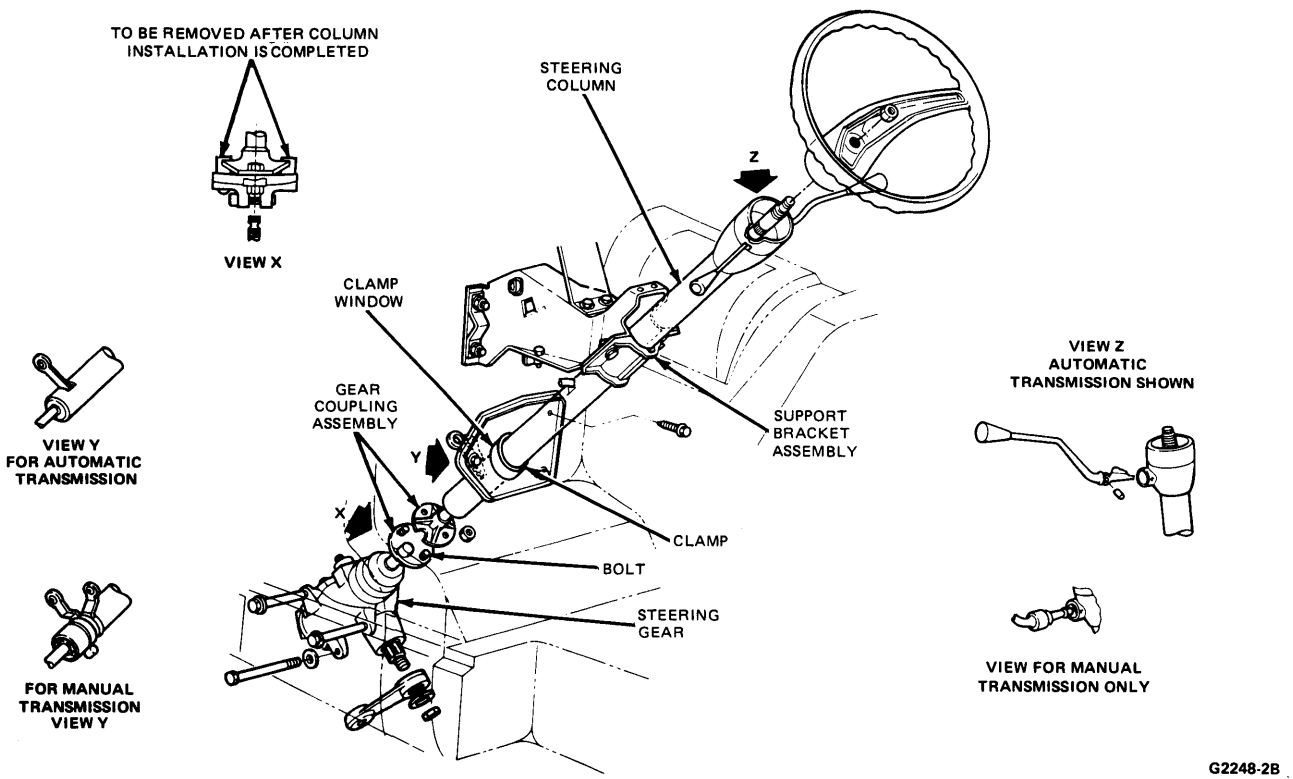


FIG. 17 Power Steering Gear Installation—E-100—E-350

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7. Disconnect the ignition coil wire. Fill the power steering pump reservoir to specification. Crank the engine and turn the steering wheel from left to right to distribute the fluid and bleed out trapped air.
8. Recheck fluid level and add fluid if necessary. Connect the coil wire, start the engine and turn the steering wheel from side-to-side. Inspect for fluid leaks.

DISASSEMBLY AND ASSEMBLY

Take the following precautions when servicing the steering gear:

1. Use a clean workbench and tools.
2. Thoroughly clean the exterior of the gear with solvent and drain off excess hydraulic fluid, if necessary.
3. **Do not use solvent on seals.**

STEERING GEAR

Disassembly

1. Mount the steering gear in a vise (Fig. 18).
2. Rotate the housing end plug retaining ring until one end of the ring is opposite the hole in the housing.
3. Working through the hole in the housing (Fig. 18) unseat the retaining ring and work it out of the groove with a screwdriver.
4. Rotate the input shaft counterclockwise, using a 3/4 inch, 12-point socket wrench to force the end plug out of the housing. **Do not rotate the shaft any more than necessary to remove the plug. Further rotation will allow the balls to fall from their circuit and allow the rack-piston to become disengaged from the sector shaft.**

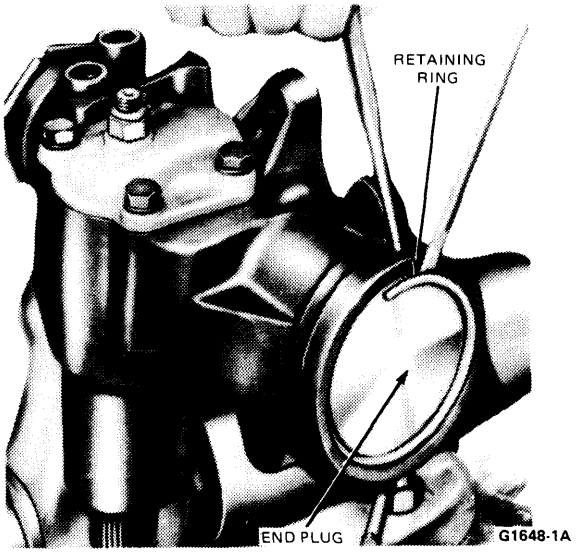


FIG. 18 Removing End Plug Retaining Ring

Remove the O-ring from the housing and discard it.

5. Rotate the input shaft clockwise one-half turn to draw the piston inward.

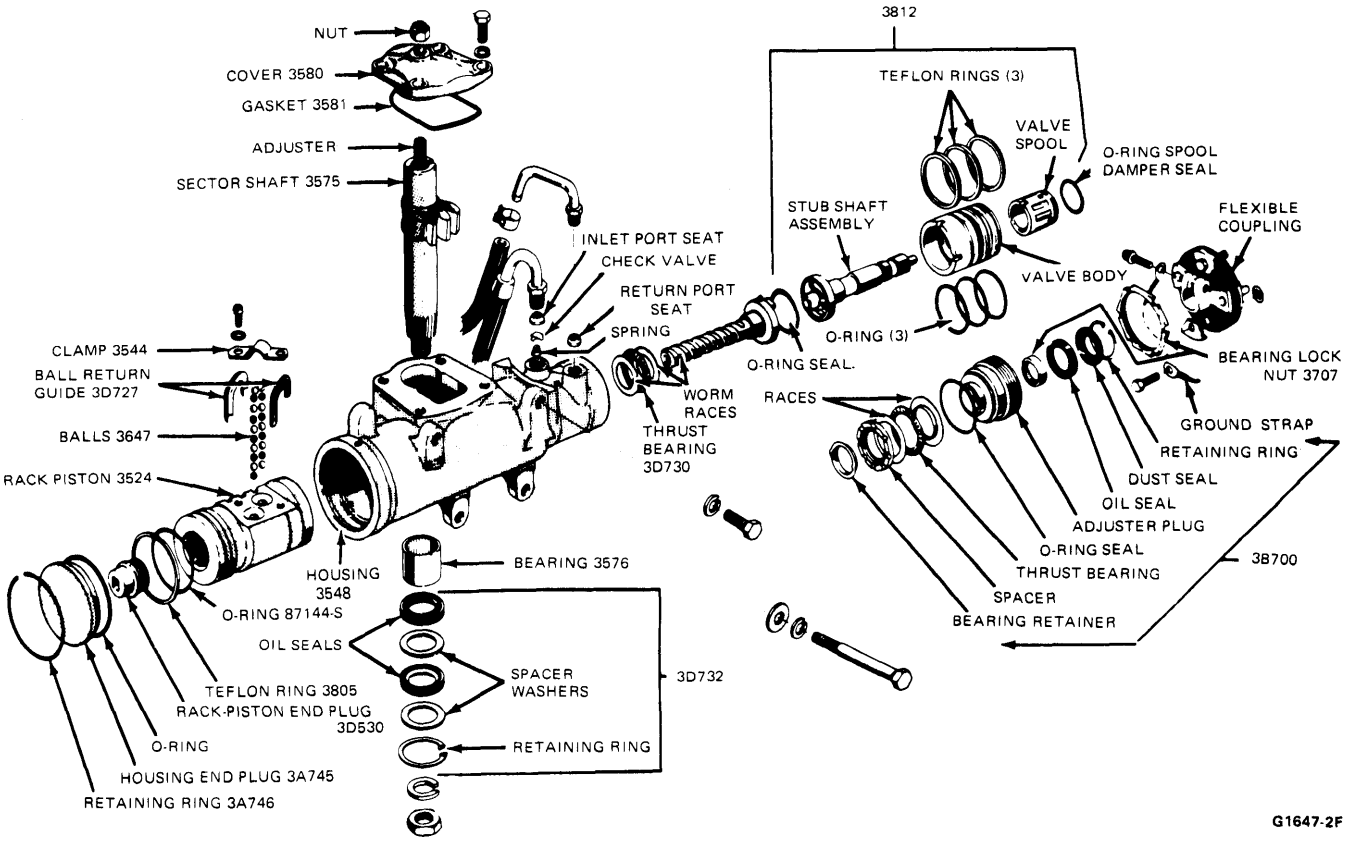


FIG. 19 Steering Gear Disassembled

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6. Turn the rack-piston end plug (Fig. 19) counterclockwise out of the piston using a 1/2-inch drive extension.
7. Remove the lock nut from the sector shaft adjustment screw. Discard the nut.
8. Remove the cover attaching screws. Rotate the sector shaft adjustment screw with an Allen wrench until the cover is free of the housing. Remove the cover and the O-ring. Discard the O-ring.
9. Turn the input shaft to center sector shaft teeth in the housing.
10. Top the end of the sector shaft with a soft-faced hammer to free it from the housing.
11. Remove the adjuster plug lock nut.
12. Remove the adjuster plug using spanner wrench T65P-3A537-A (Fig. 20).

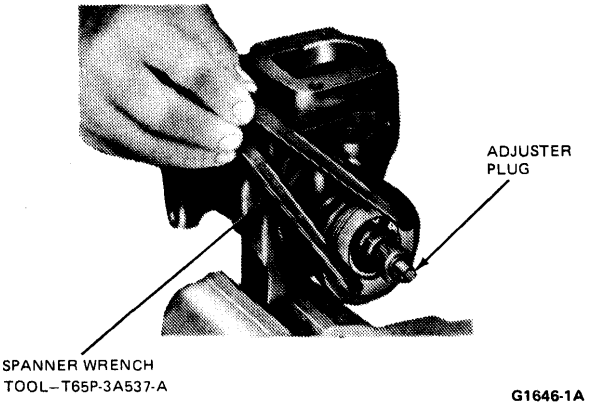


FIG. 20 Removing Adjuster Plug

13. Insert Tool T65P-3D517-A (Fig. 21) into the end of the rack-piston until it contacts the worm shaft. Rotate the stub shaft counterclockwise until the worm is free of the rack-piston. Withdraw the rack-piston from the housing holding the tool all the way in the piston to avoid dropping the balls. **Do not disassemble the rack-piston at this time.**

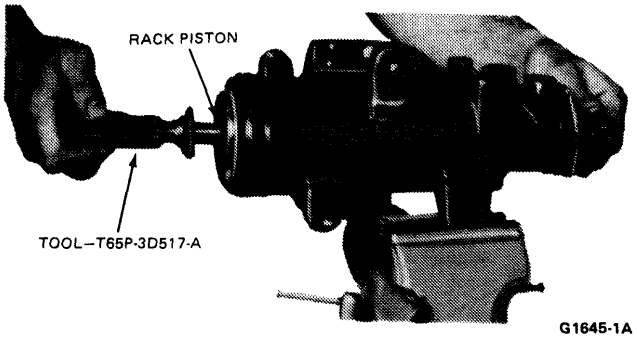


FIG. 21 Removing Rack Piston

14. Pull the stub shaft and valve assembly from the housing.
15. Lift the worm, lower thrust bearing and races out of the housing.

Assembly

1. Secure the steering gear housing in a vise.
2. Lubricate the worm shaft, lower thrust bearing, and races with steering gear fluid and install the thrust bearing and races on the worm.

   Align the valve body drive pin on the worm, with the narrow pin slot in the valve body. Install the O-ring seal between the valve body and the worm head. Lubricate the Teflon ring and lower cap O-ring with petrolatum.
3. Place the valve assembly and worm shaft in the housing as a unit (Fig. 22). **Do not push against the stub shaft as this could cause the stub shaft and cap to pull out of the valve body, allowing the spool seal to slip into valve body fluid grooves.** Install the valve assembly by pushing on the outer diameter of the valve body with the finger tips. Be sure that the Teflon rings do not bind inside the housing. The valve assembly is correctly seated when the fluid return hole in the gear housing is fully visible.
4. Place the Tool T65P-3A537-B over the end of the stub shaft (Fig. 23).
5. Lubricate a new adjuster plug "O" ring with Power Steering Fluid and install in groove on adjuster plug. Place Seal Protector T65P-3A537-B over stub shaft, then install the adjuster plug assembly in the housing until it seats against the valve body (Fig. 23). Remove Seal Protector.
6. Adjust the thrust bearing pre-load according to the procedure given under Adjustments in this part.
7. Install Tool T65P-3805-A in the steering gear housing. Position the rack-piston as shown in Fig. 15. Be sure Tool T65P-3D517-A contacts the worm shaft. Push the rack-piston inward until it contacts the worm shaft, while keeping pressure applied to Tool T65P-3D517-A. Turn the stub shaft clockwise until the middle rack groove in the rack-piston is aligned with the center of the sector shaft roller bearing. Remove the tool from the housing.
8. Install a new O-ring. Lubricate it with power steering fluid and place it in the sector shaft cover.
9. Thread the sector shaft cover onto the adjusting screw until it bottoms, then back it off one and one-half turns.
10. Install the sector shaft so the center gear tooth meshes with the center groove in the rack-piston. Be sure the cover gasket is in place before pushing the cover down on the housing.
11. Install the cover screws and lockwashers and tighten to 30 to 35 ft-lbs.
12. Install a new adjuster lock nut halfway on the adjuster screw.
13. Install the end plug in the rack-piston. Tighten the plug to 50 to 100 ft-lb.
14. Lubricate a **new** housing end plug O-ring and install it in the housing.
15. Place the end-plug in the gear housing and seat it against the O-ring seal. It may be necessary to tap the end plug lightly with a soft-faced mallet to seat it properly.

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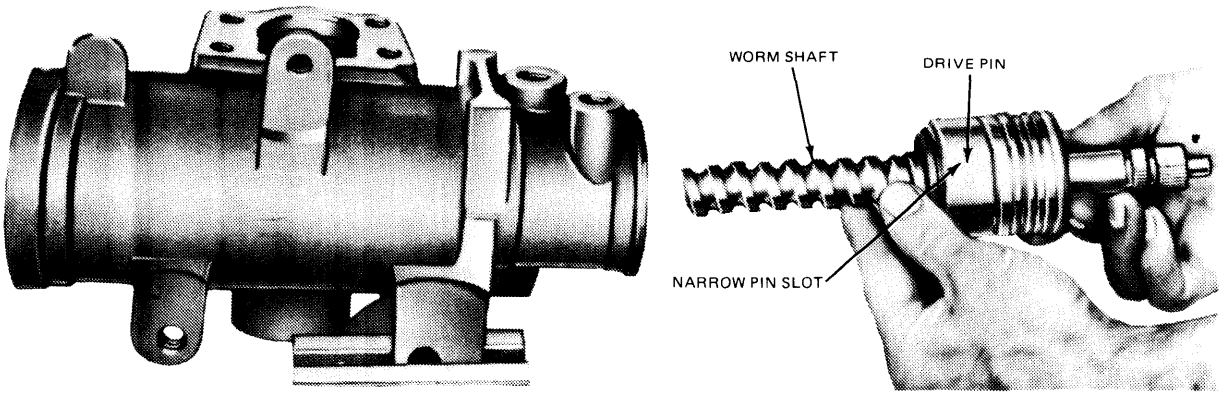


FIG. 22 Installing Valve and Worm Shaft in Housing

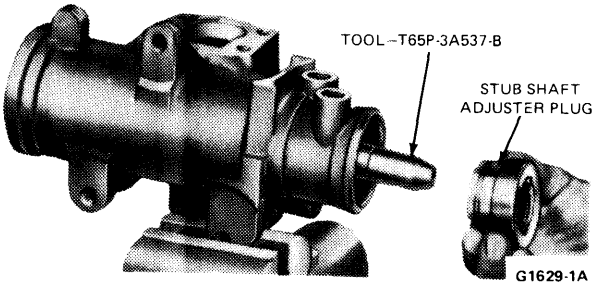


FIG. 23 Installing Adjuster Plug

16. Snap the retainer ring in place with the fingers. Tap lightly on the ring to be sure it is securely bottomed in the housing.
17. Adjust the over-center mesh load of the sector according to the procedure given under Adjustments in this Part.
18. After obtaining proper mesh load, tighten the sector shaft adjusting screw lock nut to 27 to 37 ft-lbs.

STEERING GEAR HOUSING

Disassembly and Assembly

1. Remove the snap ring (Fig. 24) that secures the sector shaft seals in the lower end of the housing. Remove the lower spacer washer.
2. Remove the lower seal (double lip), spacer washer, and upper seal (single lip) using Tools T58L-101-A and T59L-100-B (Fig. 25).
3. Check the housing bearing for wear and damage and remove if necessary. Working from the lower end of the housing (Fig. 26) press the bearing out of the housing. Discard the bearing.
4. Working from the upper end of the housing, press in a new bearing until the upper end is 0.030 inch below the housing bore. When installing the bearing, be sure to press only on the identification (stamped) end.
5. Lubricate new sector shaft seals in ESW-M2C128-C hydraulic fluid or equivalent. Install the single lip seal first, then a back-up washer. Using Tool T65P-

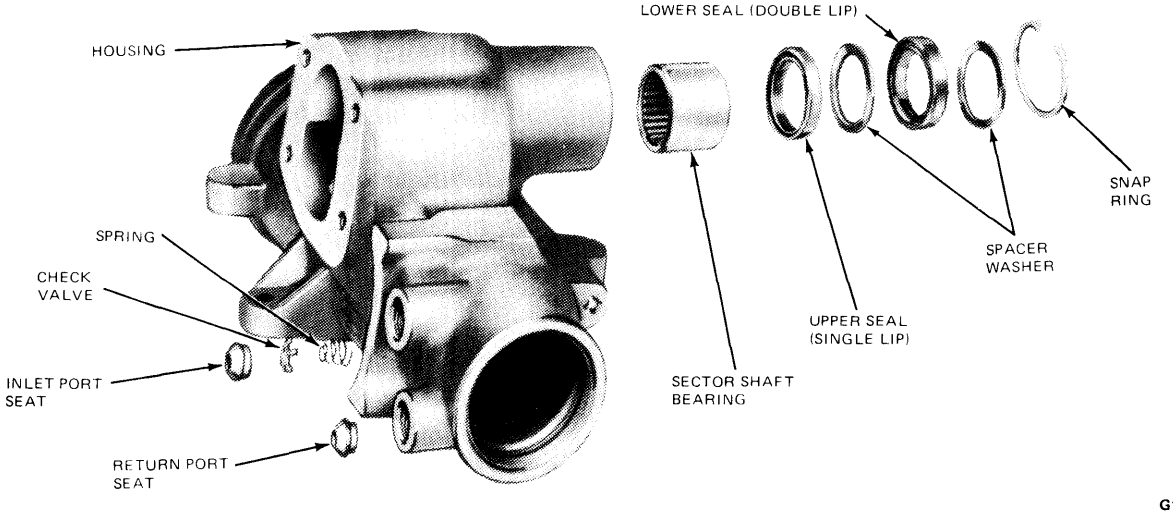


FIG. 24 Steering Gear Housing Disassembled

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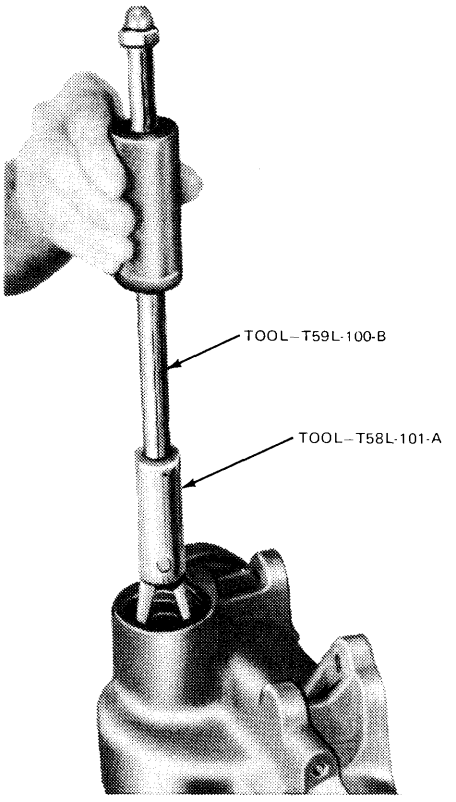


FIG. 25 Removing Sector Shaft Seals

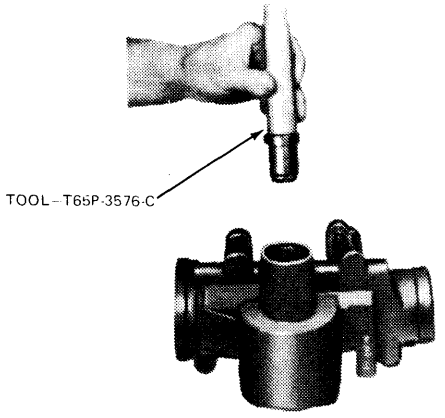


FIG. 26 Removing Sector Shaft Bearings

3D642-A (Fig. 27), drive the seal and washer in only far enough to provide clearance for the other seal and back-up washer and the retaining ring. **Do not let the seal bottom on the end of the counterbore.** Install the double lip seal and back-up washer. Using Tool T65P-3D642-A drive the seal and washer in only far enough to provide clearance for the retaining ring. Install the sector shaft seal retaining ring with snap ring pliers, making certain that the ring seats properly.

6. To remove a damaged port seat, use a 5/16-18 inch U.S. thread (coarse) tap and turn it two turns into the seat. Coat the end of the tap with petrolatum to prevent chips from entering the passage while tapping the seat.

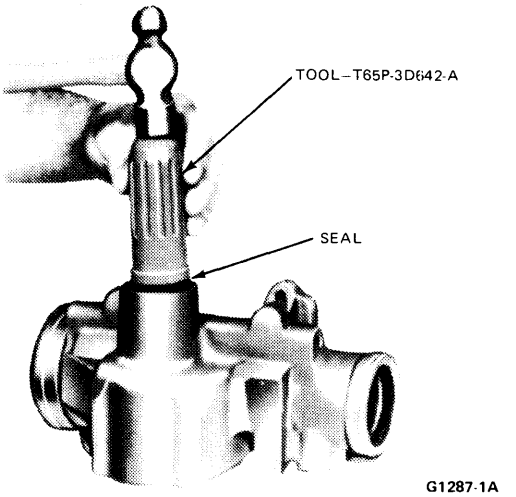


FIG. 27 Installing Sector Shaft Seal

7. Thread a bolt and nut with a flat washer into the tapped hole (Fig. 28).

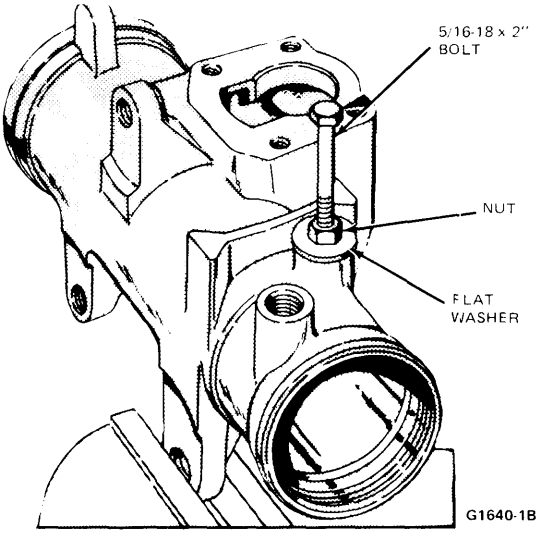


FIG. 28 Removing Port Seat

8. Hold the bolt in place and tighten the nut to extract the seat. Discard the seat.
9. Remove the check valve and spring from the inlet port.
10. Position the spring, check valve and a new seat in the inlet port.
11. Using Tool T65P-3548-A, drive the seat into place (Fig. 29).
12. Remove and install the outlet port seat in the same manner.
13. Do not remove the stop ring from the piston bore. Damage to the ring will necessitate replacing the housing assembly.

ADJUSTER PLUG

Disassembly and Assembly

1. Lift the adjuster plug off the stub shaft (Fig. 19).

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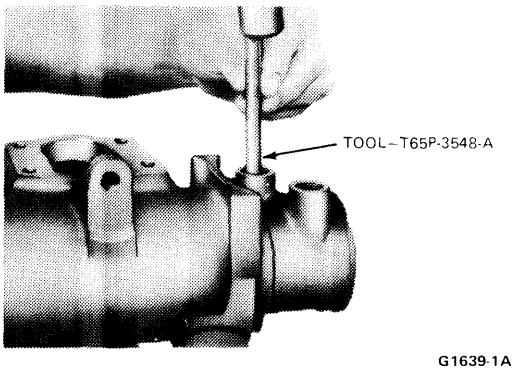


FIG. 29 Installing Inlet Port Seat

2. Pry the thrust bearing retainer off the adjuster plug as shown in Fig. 30. **Be careful not to score the needle bearing bore.** Discard the retainer.

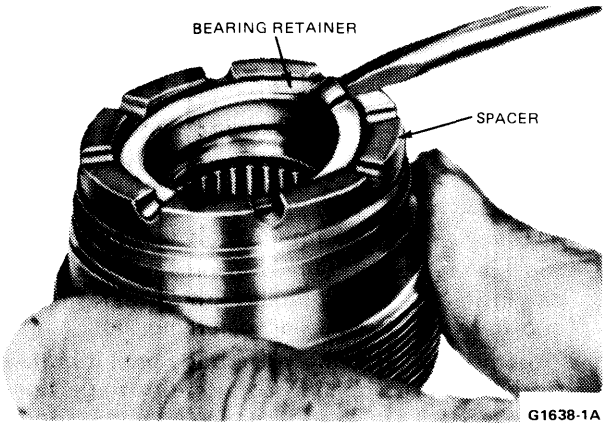


FIG. 30 Removing Thrust Bearing Retainer

3. Lift the spacer, thrust bearing, races and O-ring, off the plug (Fig. 31). Discard the O-ring.

4. If the roller bearing must be replaced, remove the dust seal retaining ring. Working from the spacer end of the adjuster plug, remove the roller bearing, oil seal and dust seal as shown in Fig. 32.

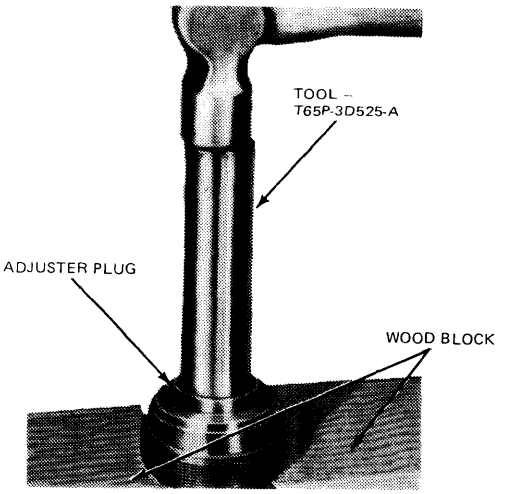


FIG. 32 Removing or Installing Roller Bearing from Adjuster plug

Do not remove the roller bearing if it is not damaged. Pry the dust seal and oil seal off the adjuster plug with a screwdriver.

5. Place a **new** roller bearing on Tool T65P-3D525-A, with the bearing manufacturer's identification facing toward the tool.
6. Insert the bearing and tool in the bore. Drive the bearing into the plug until it is flush with the bottom surface of the stub shaft seal bore.
7. Lubricate a **new** oil seal with ESW-M2C128-C, or equivalent. Install the seal with Tool T65P-3D526-A pressing it into the plug far enough to provide clearance for the dust seal and the snap ring (Fig. 33).

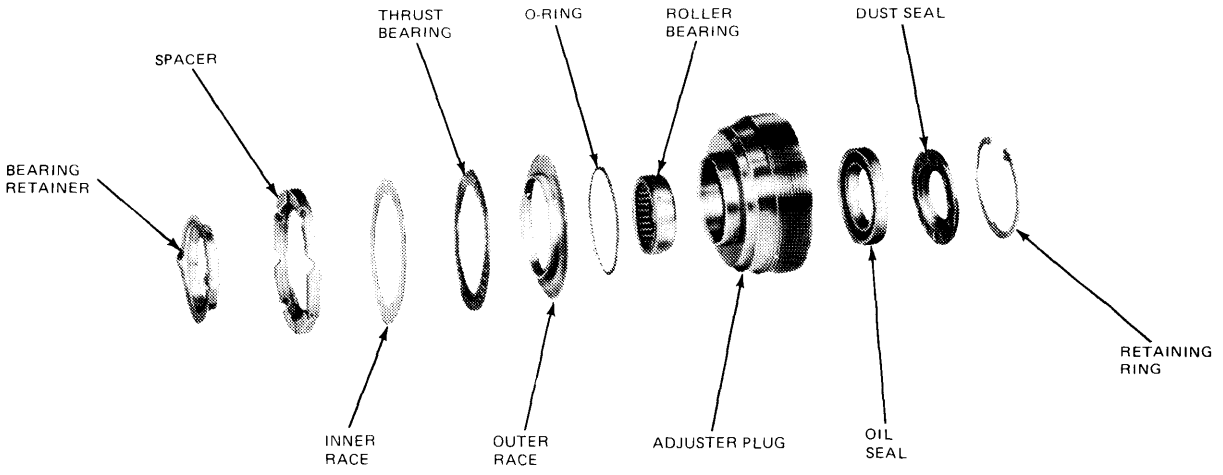


FIG. 31 Adjuster Plug Disassembled

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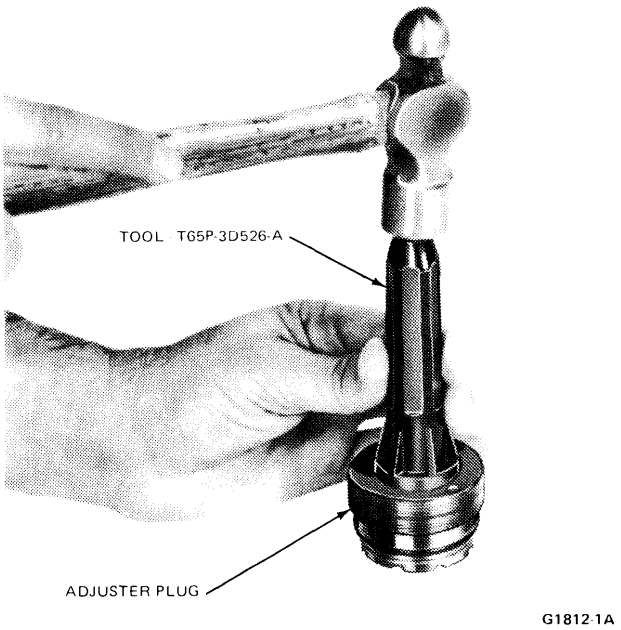


FIG. 33 Installing Oil Seal in Adjuster Plug

8. Lubricate a **new** dust seal with power steering fluid D2AZ-19580-A or equivalent and install it with its smooth rubber surface facing outward.
9. Secure the dust seal with the ring, making sure that the ring is properly seated.
10. Lubricate a **new** O-ring seal with Vaseline or an equivalent lubricant and install it on the adjuster plug.
11. Assemble the thrust bearing, outer race, thrust bearing, inner race, and the thrust bearing spacer on the adjuster plug (Fig. 31).
12. Install a new bearing retainer on the adjuster by carefully tapping on the flat surface of the retainer (Fig. 34).

STUB SHAFT AND ROTARY VALVE ASSEMBLY

Disassembly

Do not disassemble the valve (Fig. 35) unless the components have become contaminated or the dampener O-ring must be replaced.

1. Invert the valve and tap on the work bench (torsion bar end) until the torsion bar cap separates from the valve body (Fig. 36). Discard the cap-to-body O-ring.
2. Grasp the stub shaft and push it down through the valve body until the drive pin hole is visible (Fig. 35).
3. Tilt the stub shaft so the drive pin disengages from the spool. Remove the stub shaft from the valve body and spool assembly.
4. Slide the spool out the top of the valve body. **Do not attempt to remove the spool through the bottom as it may jam or become damaged.**

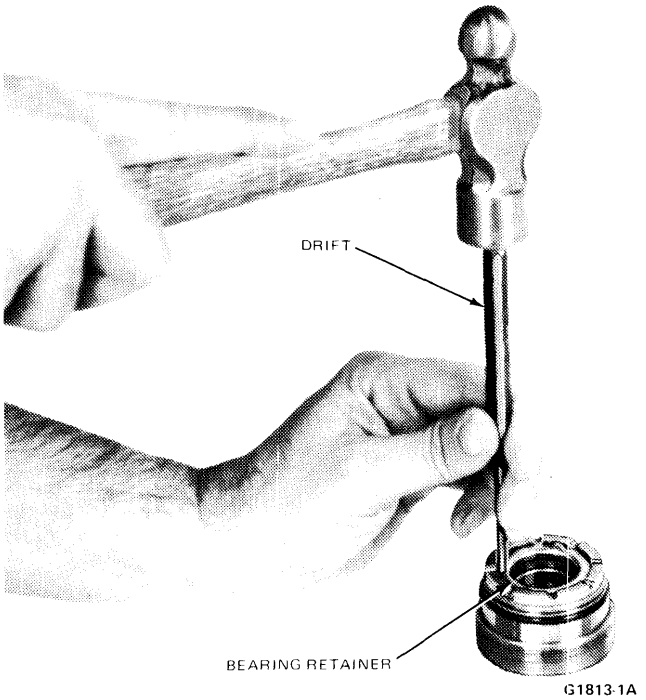


FIG. 34 Installing Thrust Bearing Retainer

Assembly

Only the O-ring and Teflon seals can be replaced.

1. Dip the dampener O-ring in power steering fluid and install the O-ring on the spool. Insert the spool into the valve body using a turning motion.
2. Push the spool into the valve body until it bottoms. Depress the dampener O-ring with fingertips to prevent it from being cut. When the spool is correctly installed, the spool drive pin hole will be directly opposite the deep valve body notch. This will correctly position the cap notch to the body pin.
3. Insert the stub shaft into the spool with the stub shaft drive pin aligned with the mating spool hole.
4. Insert the drive pin into the spool hole and pull the assembly into the valve body keeping the cap slot and body pin aligned. When the cap seats correctly in the valve body, the top surface of the cap will be at least 3/32 inch below the deep body notch.
5. Replace the cap to body O-ring.

RACK PISTON

Disassembly and Assembly

1. Cut the Teflon ring and O-ring from the piston.
2. Place the assembly on a clean lint-free cloth and remove the screws that attach the ball return guide clamp to the rack-piston. Remove the clamp (Fig. 37).
3. Remove the ball return guides from the rack-piston.
4. Remove Tool T65P-3D517-A from the piston and remove the remaining balls.
5. Thoroughly clean all parts.
6. Lubricate a new O-ring and Teflon ring and install the O-ring on the piston being careful not to twist

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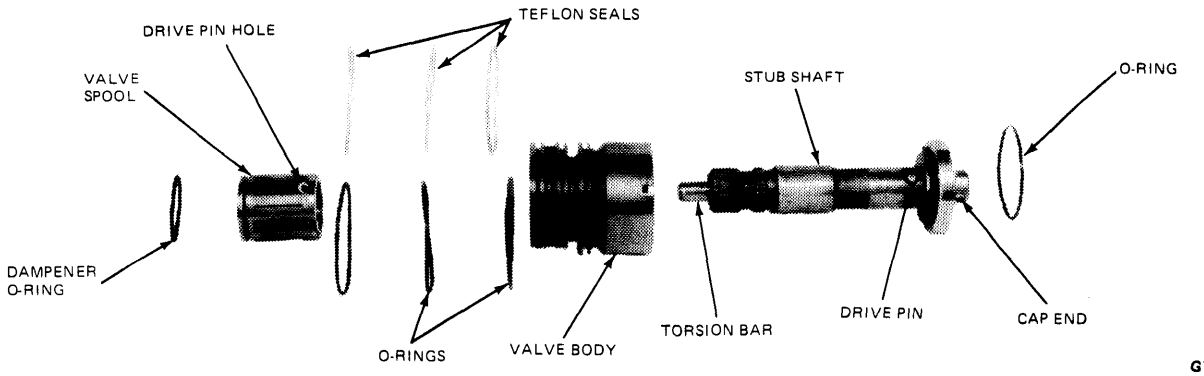


FIG. 35 Rotary Valve Disassembled

it. Slide the Teflon ring into place being careful not to stretch it any more than necessary.

7. Slide the worm (Fig. 38) all the way into the rack-piston. Insert 16 balls, alternating dark balls with polished balls, into the guide hole nearest the Teflon ring, While slowly rotating the worm counterclockwise to feed the balls through circuit.

Apply petrolatum liberally to one of the ball return guides and install the remaining balls in the guide. Install the remaining 5 balls alternating black with silver balls through the holes in the rack piston. Install the ball return guide with screws and lock washers. Tighten to 3-6 ft-lbs.

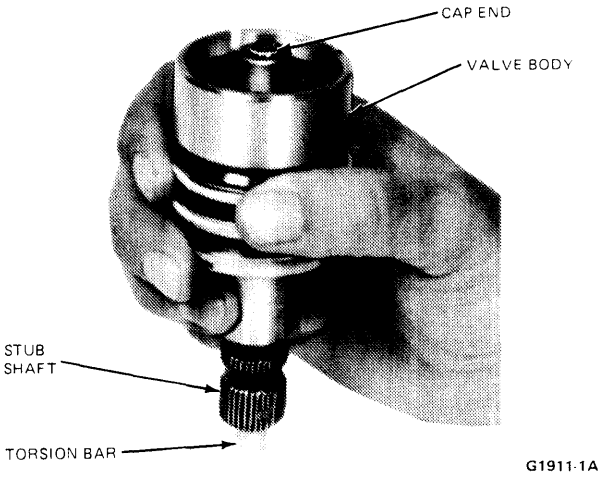


FIG. 36 Removing Spool from Rotary Valve

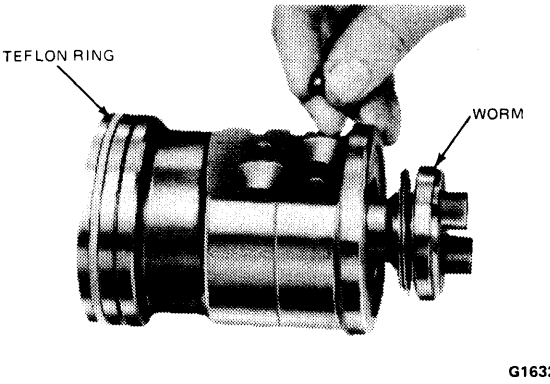


FIG. 38 Assembling Rack Piston

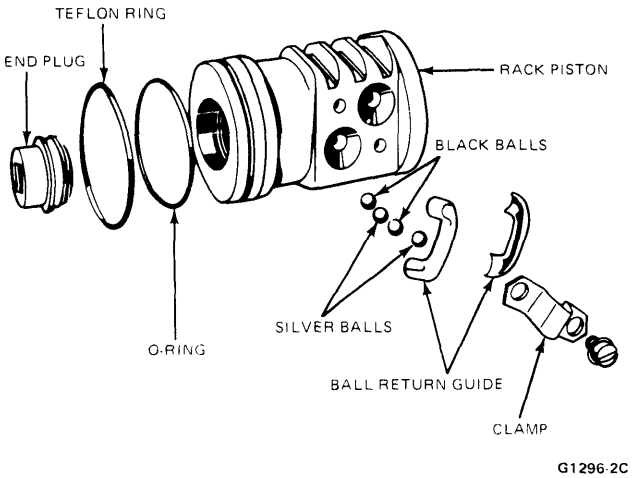


FIG. 37 Rack Piston Disassembled

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8. The worm groove is ground with a high point in the center. When the rack-piston passes over this high point there should be a preload of 1 to 4 in-lb. To adjust preload, clamp the rack-piston in a soft-jawed vise with the worm shaft pointing up. To avoid distortion, do not make the vise too tight.
9. Place the valve assembly on the worm, engaging the worm drive pins. Rotate the worm until it extends 1-1/4 inches from the rack-piston to the thrust bearing face.
10. Place an in-lb torque wrench with a 3/4 inch deep wall 12-point socket on the stub shaft, and rotate the wrench through a 60 degree arc in both directions several times. Take a torque reading. The highest average reading obtained while the worm is rotating should be between 1 and 4 in-lb.
11. Insert Tool T65P-3D517-A into the plug end of the rack and piston until it contacts the worm shaft (Fig. 39). Apply pressure on the tool while rotating the worm shaft out of the piston and rack. Leave the tool in place until the piston is installed in the housing.

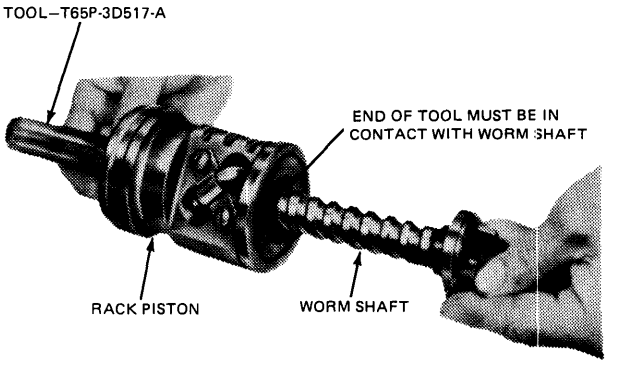


FIG. 39 Installing Tool in Rack Piston

SPECIFICATIONS

SAGINAW INTEGRAL POWER STEERING GEAR TORQUE LIMITS

Description	Torque Limits (ft-lbs)	Torque Limits N•m
Sector Shaft Cover Bolts	40-50	55-67
Mesh Load Adjusting Screw Lock Nut	27-37	37-50
Ball Return Guide Clamp Screw	3-8	4.5-10.0
Preload Adjusting Lock Nut	50-110	68-149
Piston End Cap	50-100	68-135
Pitman to Sector Shaft Nut	200-250	272-338
	(In-lbs)	N•m
Hose Clamps to Cooler	10-18	1.2-2

SAGINAW INTEGRAL POWER STEERING GEAR SPECIFICATIONS

	E-100—E-350
Type	Recirculating Ball
Ratio	17.5:1
Turns of Steering Wheel (Lock to Lock — Linkage Disconnected)	4
Fluid Specification	ESW M2C128-D ①
Fluid Capacity (Included in Pump Reservoir Fill)	1.6 Pt. (Approx.)
Total Mesh Load Over Mechanical Center	20 in-lbs Max.
Worm Bearing Preload	9 in-lbs Max.
Total Mesh Load Over Worm Bearing Preload	4-11 in-lbs.

① Or use an equivalent lubricant

SAGINAW INTEGRAL POWER STEERING GEAR SPECIAL SERVICE TOOLS

Tool No.	Description	Tool No.	Description
T59L-100-B	Impact Slide Hammer	T65P-3D525-A	Adjuster Plug Bearing Remover and Installer
T58L-101-A	Puller Attachment	T65P-3D526-A	Adjuster Plug Seal Installer
T65P-3548-A	Oil Line Connector Seat Installer	T65P-3A537-A	Bearing Preload Spanner Wrench
T65P-3576-C	Sector Needle Bearing Remover and Installer Adapter	T65P-3A537-B	Adjuster Plug Seal Protector
		T65P-3D642-A	Sector Shaft Seal Installer
T65P-3805-A	Piston Rack Ring Compressor	T64P-3590	Pitman Arm Remover
T65P-3D516-A or T65P-3D517-A	Rack Piston Arbor		

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Power Steering Pump — Saginaw

PART 13-52

APPLIES TO E-100 THROUGH E-350

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Power Steering Pulley	52-2
REMOVAL AND INSTALLATION (Cont'd)	
Rotor Shaft Seal	52-2
DISASSEMBLY AND ASSEMBLY	52-5
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DESCRIPTION

The power steering pump (Fig. 1) is a constant displacement vane type providing hydraulic pressure for the steering system. The housing and internal parts of the pump are inside the reservoir so the pump parts operate submerged in oil. The reservoir is sealed against the pump housing, leaving the housing face and the shaft hub exposed. The reservoir has a filler neck with a cap.

The drive shaft is fitted with a pulley and is belt driven from the crankshaft. The rotor is loosely splined to the drive shaft and secured with a retaining ring. Ten vanes are mounted in radial slots in the rotor.

An identification label showing the pump model number is located on the outboard side of the pump reservoir.

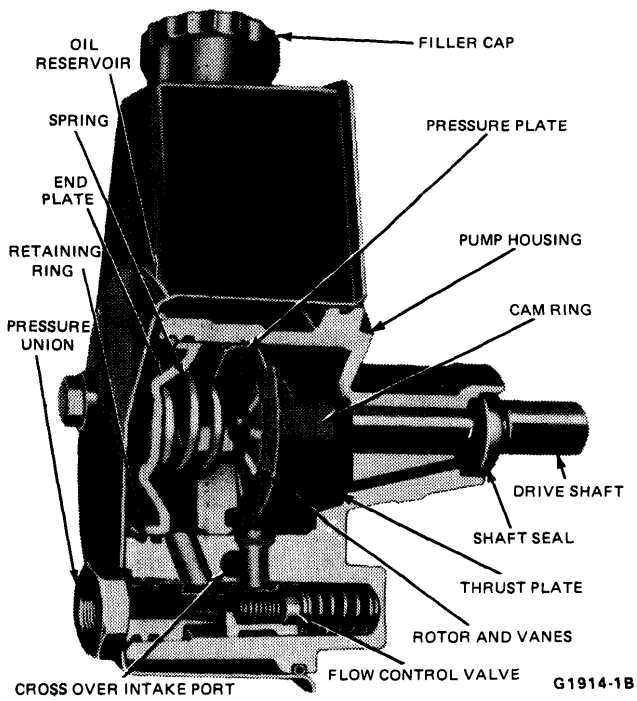


FIG. 1 Power Steering Pump—Sectional View

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DIAGNOSIS AND TESTING

Refer to Part 13-01, General Steering Service.

REMOVAL AND INSTALLATION

POWER STEERING PUMP

Removal

1. Disconnect the pressure and return lines from the pump and plug them to prevent loss of fluid or entrance of dirt into the system (Figs. 2 and 3).
2. Loosen the belt tension adjusting bolt all the way.
3. Remove the bolts attaching the pump mounting bracket to the air conditioning bracket (if equipped).
4. Remove the pump, mounting bracket, and pulley assembly.

Installation

1. Install the pump, bracket and pulley assembly and loosely attach the bolts that secure the pump mounting bracket to the air conditioning bracket (if equipped).
2. Install the drive belts on the pulley.
3. Loosely install the belt tension adjusting nut.
4. Tighten the adjusting bolt until the correct tension is acquired, on the 4.9L (300 CID) I-6 Engine (Fig. 3), on the 7.5L (460 CID) V-8 and the 5.8L (351 CID) V-8 engine. Pry between the pump adjustment bracket and the engine block until correct tension is achieved. While still holding this tension, tighten the adjusting bolt.
5. Tighten all attaching bolts to specification. Refer to specifications, Part 13-01, General Steering Service.
6. Connect the pressure and return lines to the pump.
7. Fill the reservoir as described in Part 13-01 with the specified power steering fluid. Bleed the air from the system by turning the steering wheel from left to right several times. Inspect for leaks.

POWER STEERING PUMP PULLEY

Removal

1. With the pump removed from the vehicle, drain as much fluid as possible through the filler tube.
2. Clamp the mounting bracket in a vise with the pump attached. Do not clamp too tightly or bearing damage will result.
3. Install the pulley remover, Tool T75L-3733-A, on pulley hub.
4. Rotate the tool nut counterclockwise to remove the pulley. If the snap ring is damaged, disassemble the pump, as outlined in this Part, and replace the ring. **Do not hammer the tool. This could damage the pulley and the snap ring at the inner end of the shaft.**

Installation

1. Install the pulley on the shaft using the Pulley Installer, Tool T65P-3A733-C.

ROTOR SHAFT SEAL

Remove the pump as outlined in this Part to replace the rotor shaft seal.

Removal

1. Drain as much fluid as possible through the filler tube.
2. Remove the pulley from the pump following the procedures described in this Part.
3. Insert a sharp tool between the rotor shaft seal and the pump housing. Pry out the seal. **Do not pry against the shaft or housing bore.**

Installation

1. Remove the pump and bracket from the vise and lay it flat on the workbench.
2. Place a new rotor shaft seal on the shaft with the metal backing facing the pulley end of the shaft.
3. Install the seal (Fig. 4) using shaft seal installer Tool T72P-3B592-A. Tap the tool lightly with a small hammer until the seal is properly seated in the shaft hub.
4. Install the pulley.

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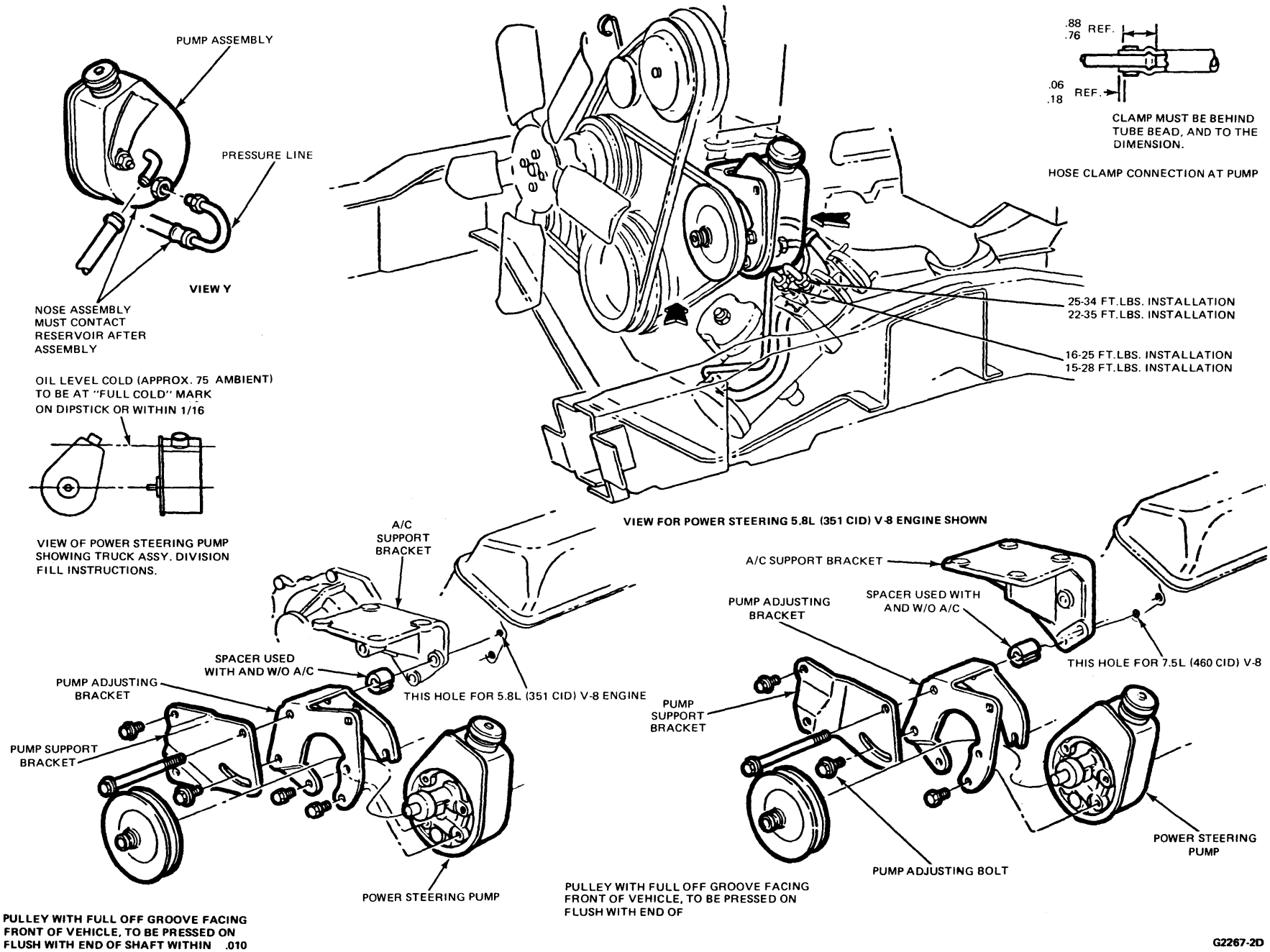


FIG. 2 Power Steering Pump Installation—8 Cylinder Engine

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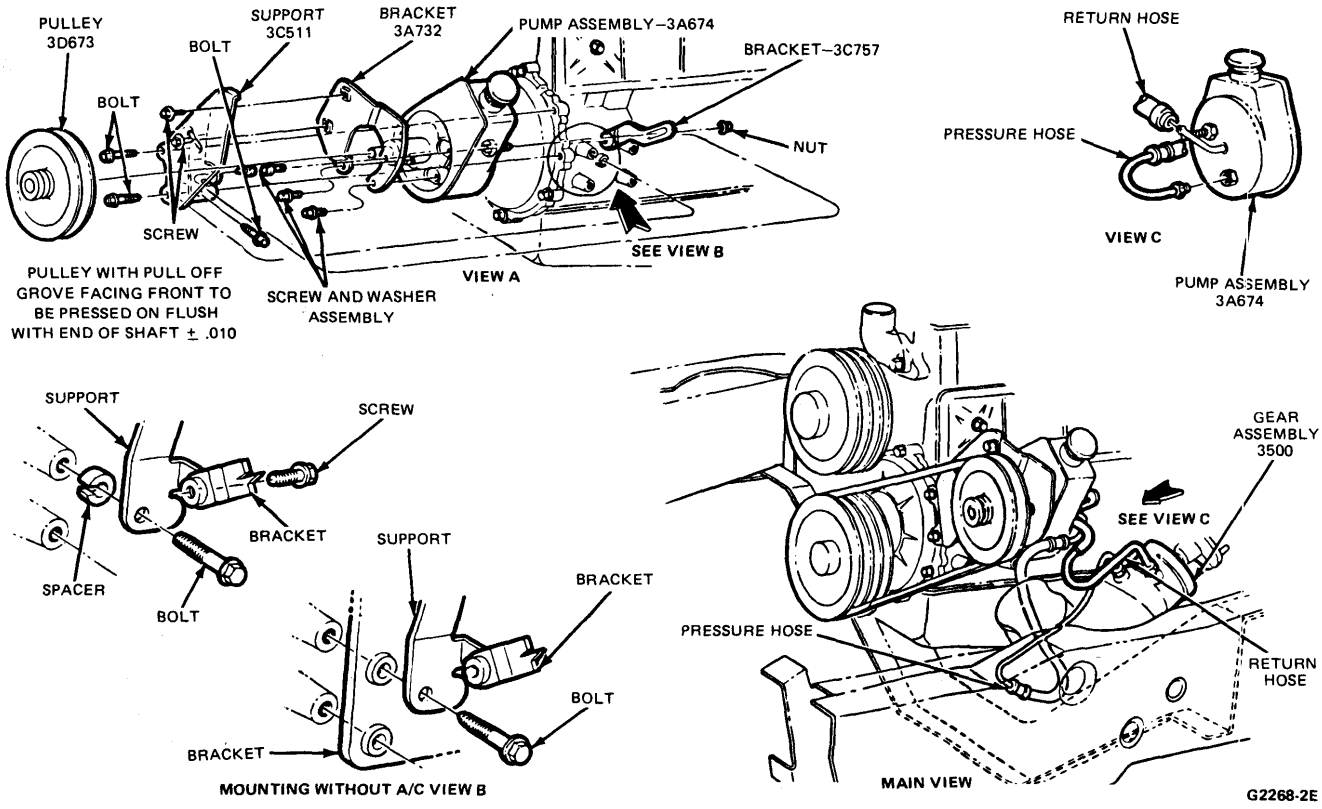


FIG. 3 Power Steering Pump Installation—4.9L (300 CID) I-6 Engine

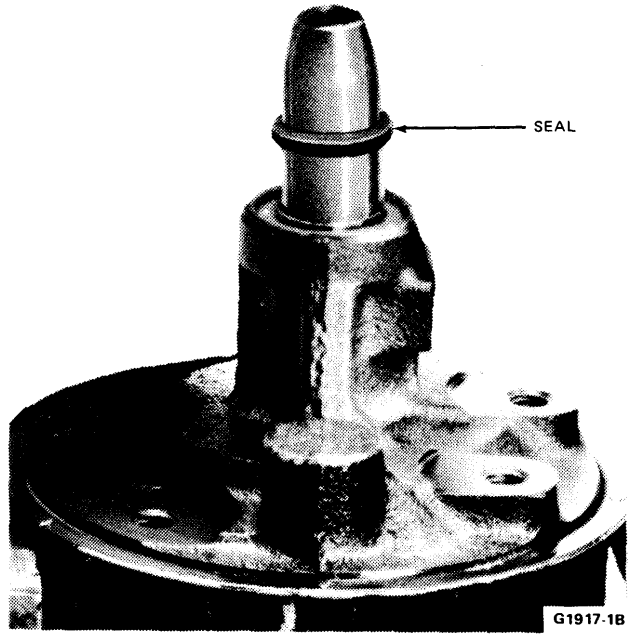


FIG. 4 Installing the Rotor Shaft Seal

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DISASSEMBLY AND ASSEMBLY

Take the following precautions when servicing the power steering pump:

1. **Use a clean work bench and tools.**
2. Clean the exterior of the unit with solvent. Drain as much fluid as possible.
3. If only the rotor shaft seal is being replaced, follow the procedures under Rotor Shaft Seal Removal and Installation in this Part.
4. **Do not use solvent on seals.**

Disassembly Refer to Fig. 5

1. Remove the bracket and pulley from the pump.
2. Clamp the front hub of the pump in a vise so the extending portion of the shaft points down. **Do not clamp the pump too tightly or bearing damage may result.**
3. Remove the pressure union, O-ring assembly, and both mounting bolts from the back of the reservoir. Discard all seals and O-rings.
4. Rock the reservoir slightly back and forth to unseat the O-ring seal. Remove the O-ring and discard. Remove the reservoir.
5. Remove the mounting bolt and pressure union seals from the counterbored spaces in the pump housing. Discard the seals.
6. Rotate the end plate retaining ring so that one end of the ring is over the hole in the housing. Insert a small punch in the 1/8 inch diameter hole in the housing side opposite the flow control valve hole. Compress the retaining ring with the punch and remove the ring by twisting a screwdriver under the ring (Fig. 6).
7. Remove the end plate. The end plate is spring loaded and will generally sit above the housing level for easy removal. If the plate sticks, rock it back and forth lightly to free it.
8. Remove the pressure plate spring.
9. Remove the pump from the vise and turn it over allowing the flow control valve and its spring to fall out. Do not disassemble the flow control valve. Service it as a unit.
10. With the end plate O-ring removed, tap very lightly on the end of the shaft until the pressure plate falls free.
11. Remove the cam ring, vanes and rotor (Fig. 7).
12. Remove the cam ring and vanes from the rotor.
13. Remove the retaining ring by clamping the shaft in a soft-jawed vise and prying the ring off the shaft with a pair of long nose pliers or a screwdriver. Do not damage the shaft with the vise jaws. Discard the retaining ring.
14. Remove the rotor and thrust plate from the shaft.
15. Remove both dowel pins from the housing.
16. Remove the pressure plate and end plate O-ring seals from the housing bore and discard them.
17. Remove the shaft seal only if it is worn or damaged. Removal will destroy the seal.

Assembly

1. Clean all metal parts with solvent.
2. If the shaft seal was removed, install a new seal following the instructions under Rotor Shaft Seal Removal and Installation in this Part.
3. Lubricate a new pressure plate O-ring seal with power steering fluid and install it in the third groove from the rear of the housing.

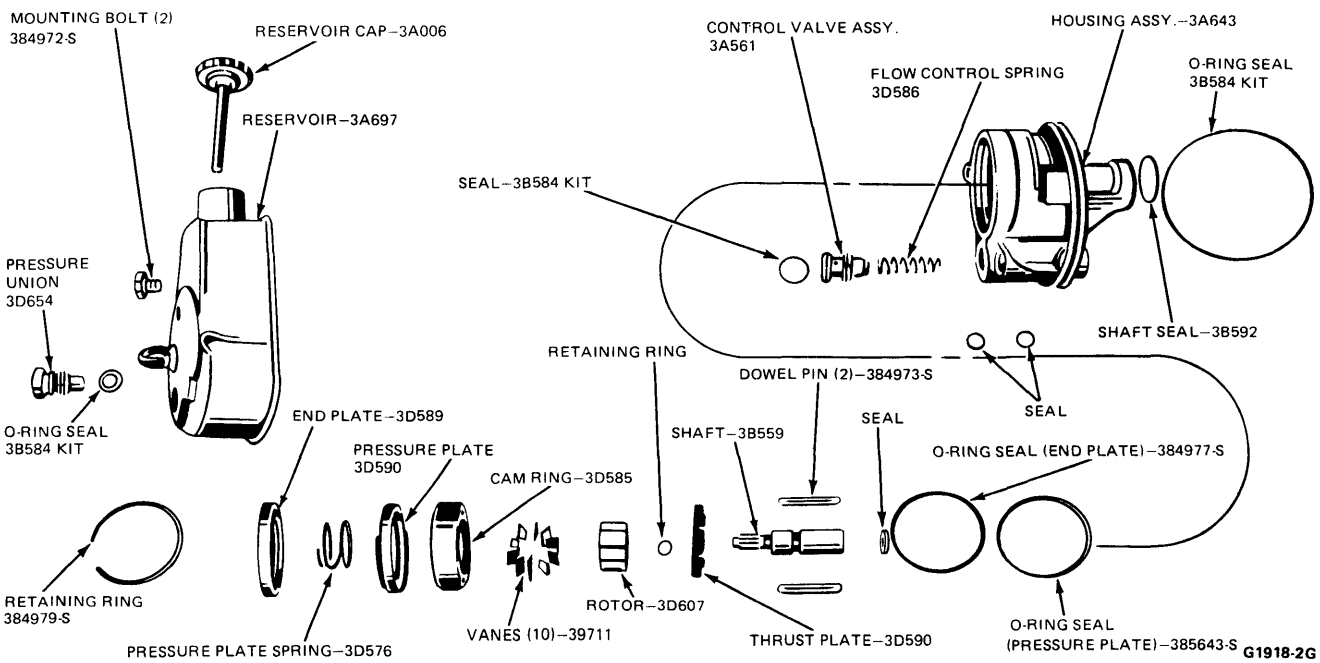


FIG. 5 Power Steering Pump Disassembled

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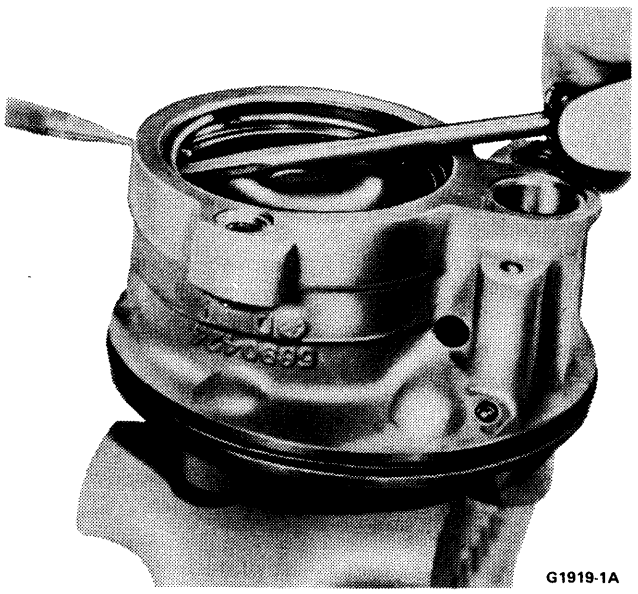


FIG. 6 Removing the End Plate Retaining Ring

4. Clamp the end hub of the housing in a vise so the extending portion of the shaft points down. Do not clamp the bearing too tightly or damage may occur.
5. Insert both dowel pins.
6. Install the thrust plate on the drive shaft with the ported face toward the splined end of the shaft.
7. Install the rotor on the shaft with the counterbored end toward the thrust plate.

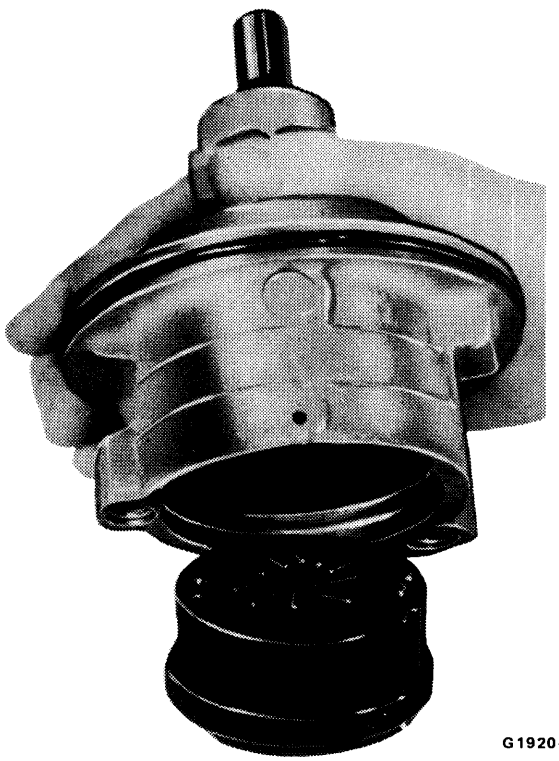


FIG. 7 Remove The Cam Ring, Vanes And Rotor

8. Clamp the shaft in a soft-jawed vise. Install a new retaining ring on the splined end of the shaft by prying the ring open and sliding it down over the shaft until it seats in the ring groove. **Do not damage the shaft.**
9. Insert the shaft in the housing. Lubricate shaft with power steering fluid, and make certain the thrust plate slides properly on the dowel pins.
10. Install the cam ring on the dowel pins with the rotation arrow toward the rear of the housing (Fig. 8).

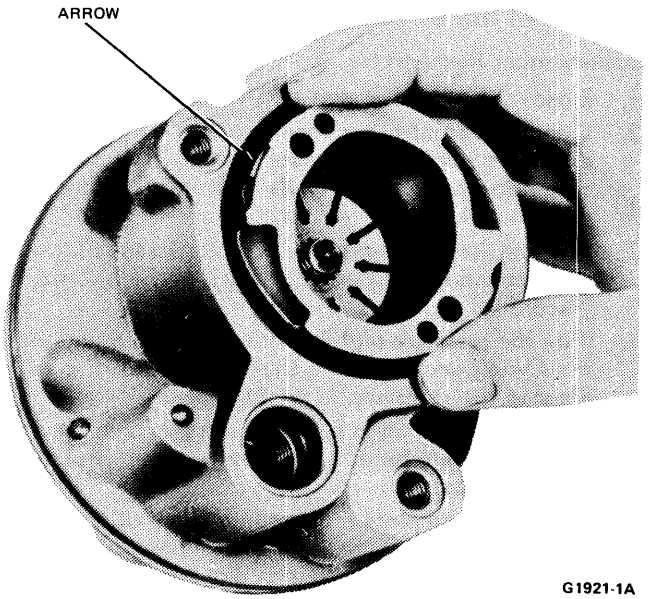


FIG. 8 Installing the Cam Ring

11. Install the vanes in the rotor slots with the rounded edge of the vanes outward. Be sure the vanes slide freely (Fig. 9).

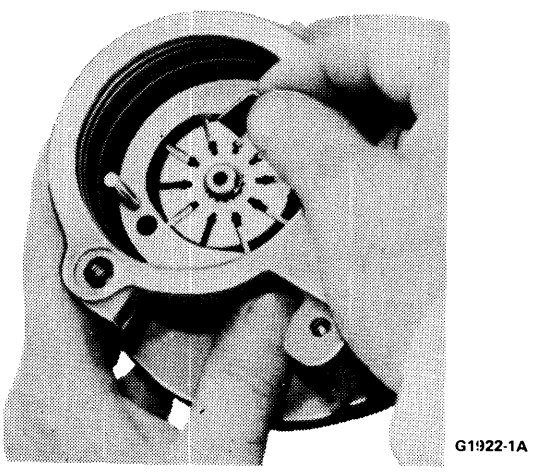


FIG. 9 Installing the Vanes in the Rotor

12. Lubricate the pressure plate with power steering fluid to prevent damage to the pressure plate O-ring seal.
13. Install the pressure plate on the dowel pins with the circular spring depression toward the rear of the

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housing (Fig. 10). The narrow slots in the plate should engage the dowel pins. To seat pressure plate press it about 1/16 inch over the O-ring.

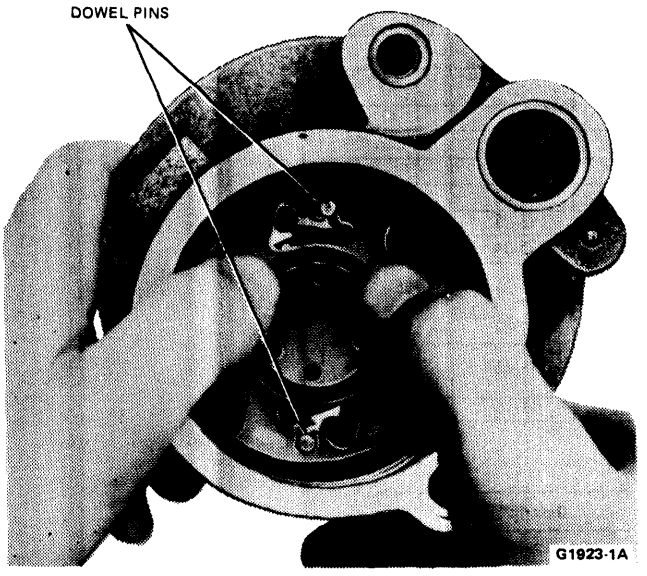


FIG. 10 Installing the Pressure Plate

14. Lubricate a new end plate O-ring with power steering fluid and install it in the second groove from the rear of the housing.
15. Install the pressure plate spring in the groove in the pressure plate.
16. Lubricate the end plate with power steering fluid to prevent damage to the O-ring, and press it into the housing with an arbor press (Fig. 11). Depress the end plate only far enough to allow installation of the retaining ring in its groove.
17. Install the end plate retaining ring. Release the arbor press.
18. Place the control valve spring in its hole and insert the control valve with the screened end towards the front of the housing.
19. Install new mounting bolt and pressure union seals in the countersunk holes. Lubricate a new reservoir O-ring seal with power steering fluid and install it on the housing.
20. Lubricate the inside edge of the reservoir with power steering fluid and install it on the housing. Align the holes in the reservoir and housing. Replacement reservoirs do not have an identification number. If a new reservoir is installed, imprint the model number of the worn or damaged on the new part for future identification.
21. Insert the mounting bolt and tighten to 35 ft-lbs.
22. Lubricate a new O-ring with power steering fluid, and install it on the pressure union in the groove next to the head hex. Insert the pressure union in the flow control valve hole in the back of the reservoir and tighten to specification.

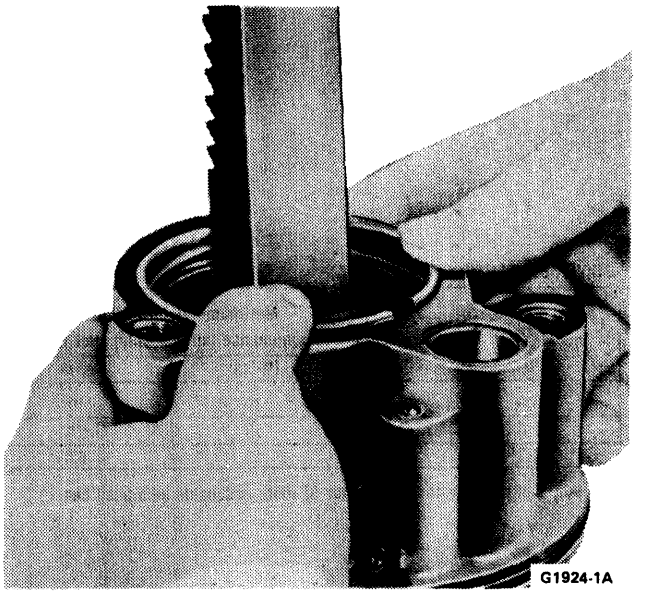


FIG. 11 Installing the End Plate Retaining Ring

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SPECIFICATIONS

SAGINAW POWER STEERING PUMP TORQUE LIMITS

Description	Torque Limits	
	(ft-lbs)	N•m
Reservoir Mounting Bolt	35	47
Flow Control Fitting Assembly	35	47
Pressure Union	35	47
Bracket Bolts	30-45	41-61
Pressure Line to Pump Nut	25-34	34-46
Pressure Line to Gear Nut	16-25	22-33
Return Line to Gear Nut	25-34	34-46
Support Bracket to Engine — 4.9L (300 CID) I-6	40-60	55-81
Pump Support to Engine	22-32	30-43
Mounting Bracket to Engine — 5.8L (351 CID) M-V-8, 7.5L (460 CID) V-8	45-65	62-88
Clamp Bolts	11-16	15-21

SPECIAL SERVICE TOOLS

Number	Description
T75L-3733-A	Pulley Remover
T72P-38592-A	Seal Installer
T65P-3A733-C	Seal Installer

CG2270-1C

DRIVE BELT TENSION

Belt Width	Minimum Tension (for use at maintenance interval only) (Hot Engine)		Installation Tension			
			Used Belt (1)		New Belt	
	(ft-lbs)	N•m	(ft-lbs)	N•m	(ft-lbs)	N•m
1/4"	30	40	60	81	80	108
3/8" and 15/32"	50	67	110	149	140	189
1/2"	50	67	110	149	140	189

(1) Any belt operated for ten minutes or more is considered a used belt.

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Power Steering Pump — C-II

PART 13-53

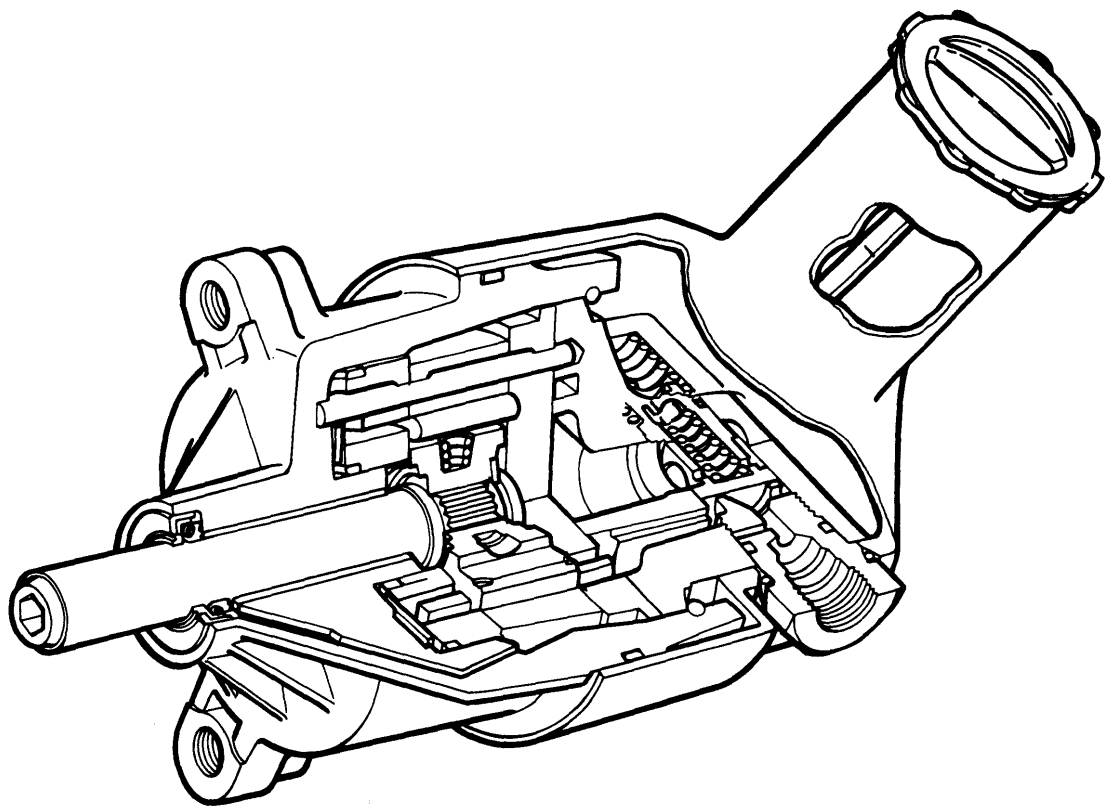
APPLIES TO BRONCO — F-100 THROUGH F-350

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Rotunda Flow/Pressure Power Steering Pump Analyzer or Equivalent	53-2
ADJUSTMENTS	
Pump Belt Tension (Pivot Type)	53-3
REMOVAL AND INSTALLATION	
Power Steering Pump	
Power Steering Pump Belt (Slider Type)	53-3
Power Steering Pump Drive Belt	53-3
Power Steering Pump Pulley	53-3
Power Steering Pump Reservoir	53-4
Rotor Shaft Seal	53-4
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DESCRIPTION

The C-II corporate power steering pump applies to all F-100-F-350 light trucks and Bronco (Fig. 1).

The C-II corporate power steering pump is a belt driven slipper type pump with a fiberglass nylon reservoir. The reservoir is attached to the rear side of the pump housing front plate and the pump body is encased within the housing and reservoir. The hoses are attached with a quick connect fitting, located below the filler neck at the outboard side of the reservoir. The pressure hose has a fitting which allows the line to



G2658-2B

FIG. 1 Ford Model C-II Power Steering Pump—Sectional View

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swivel. This is normal and does not indicate an untorqued fitting.

A pressure sensitive identification tag will be attached to the reservoir. The top line of this tag indicates the basic model number (HBA) and the suffix. Always use these tags when requesting service parts as there may be slight differences in internal components.

DIAGNOSIS AND TESTING

For problem diagnosis refer to Part 13-01, General Steering Service.

ROTUNDA FLOW/PRESSURE POWER STEERING PUMP ANALYZER OR EQUIVALENT

The test procedure using the Rotunda Power Steering Analyzer (model 140208 or equivalent) provides a method for checking the complete power steering system. The Rotunda Flow/Pressure Power Steering Analyzer or equivalent can be used on integral or nonintegral power steering systems to determine the cause of hard steering and/or lack of assist problems.

The analyzer provides readouts for the following:

- System Backpressure
- Pump Flow

The interpretation of the above readouts will determine which of the following conditions or components are the cause of the problem:

- Restriction in Hoses or Fittings
- Inefficient Pump Cam Pack
- Sticking Relief Valve
- Binding in Suspension

The following procedure should be followed when using the Rotunda Power Steering Analyzer or equivalent:

1. To connect the analyzer into the steering system, remove the pressure line from the pump and thread it into the appropriate adapter of the analyzer.
2. Thread the other adapter of the analyzer into the pump.
3. Connect the analyzer to the adapters and tighten all connections to a maximum of 15 ft-lbs.

   NOTE: The adapter on the analyzer may be switched so that the connection is made at alternate locations between the pump and gear.
4. Add power steering fluid to the pump if required. Start the engine and run it for approximately two minutes with the idle set at manufacturer's specifications.
5. Record the following at idle with the gate valve fully open.

   A. Flow (gallons/min. at 170 ± 5° F)

   B. Pressure (psi at 170 ± 5° F)

   (a) If flow (A) is below two gallons/min., the pump may require repair; however, at this point continue the diagnosis. Check chart for flow and relief pressure against the model pump being tested.

   (b) If pressure (B) is above 150 psi, check hoses for restrictions.

   NOTE: On non-integral power steering, jiggle the steering wheel to insure that the spool valve is centered prior to test.
6. Partially close the gate valve to build up 730 psi. Observe and record flow.

   C (gallons/min. at 170 ± 5° F)

   (a) If flow (C) drops to a level lower than the value on Chart 1 disassemble the pump and replace the camp pack. If the pressure plates are cracked or worn replace them. Continue with the diagnosis.
7. Completely close and partially open the gate valve three times. (Do not allow the valve to remain closed for more than five seconds.) Observe and record pressure (D), (psi).

   (a) Check the chart (Fig. 2) for the pressure specification listed for the applicable pump model. If the pressure recorded (D) is **lower** than the minimum specification listed, replace the flow control valve in the pump.

   (b) If the pressure recorded (D) is **above** the specification listed, the minimum flow control valve in the pump should be removed and either cleaned or replaced with a new valve.

Pump Model	Min. Flow GPM @ 170° ± 5°F	Min. Relief Pressure	Max. Relief Pressure
HBC-W	1.9	1050 PSI	1200 PSI
HBC-V	1.8	1050 PSI	1200 PSI
HBC-U	1.9	1200 PSI	1350 PSI
HBC-T	1.9	1300 PSI	1450 PSI

CG2634-1A

FIG. 2 Flow and Pressure Chart

8. With the valve on the analyzer fully open, increase the engine speed from idle to approximately 1500 rpm. Observe and record flow.

   (E) (gallons/min.).

   (a) If flow (E) varies more than one gallon/min. from flow (A) the flow control valve in the pump should be removed and either cleaned or replaced.

   If the system is severely contaminated, both hoses and pumps must be completely disassembled and cleaned before reassembly; and the steering gear should be flushed after reassembly.

NOTE: If problem still exists, check steering gear, ball joints, linkage (See Steering Diagnosis).

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ADJUSTMENTS

PUMP BELT TENSION ADJUSTMENT (PIVOT TYPE)

Pump drive belt tension cannot be accurately checked using the thumb pressure or belt deflection methods. The adjustment must be made with a belt tension gauge.

1. Check the belt tension with a Rotunda Belt Tension Gauge (model 210019 and 210020) or equivalent. For a new belt, or a belt that has been run less than 15 minutes, tension should be 120 to 150 ft-lbs. For a belt that has run longer than 15 minutes, tension should be 90 to 120 ft-lbs.
2. To adjust the belt on 6 cylinder engines, loosen the adjusting and pivot bolts on the front face of the pump cover plate.

On all vehicles with pivot type steering pumps, insert tool T70P-3D643-A over the boss on the pump housing. Using a 1/2" drive ratchet that fits into the 8 point hole in the tool, pry upward to correct belt tension. Tighten all bolts.

Do not pry against the reservoir to obtain proper belt load. Pressure on the fiberglass reservoir may cause cracks.

3. Recheck belt tension. When tension has been correctly adjusted, tighten the bolts and nuts to specifications (refer to Specifications, Part 13-01, General Steering Service).

REMOVAL AND INSTALLATION

POWER STEERING PUMP

Removal

1. Refer to the appropriate illustration (Figs. 3, 4 and 5). To remove the power steering fluid from the pump reservoir, disconnect the fluid return hose at the reservoir and drain the fluid into a container.
2. Remove the pressure hose from the pump.
3. Remove the bolts from the front of the pump that attach the pump to the mounting bracket. Disconnect the bolt from the pulley and remove the pump.

Installation

1. Place the pump on the mounting bracket and install the bolts at the front of the pump. Tighten to specifications.
2. Place the belt on the pulley and adjust belt tension as described in this part.
3. Install the pressure hose to the pump fitting.
4. Connect the return hose to the pump, and tighten the clamp.
5. Fill the reservoir with specified power steering fluid, turn the steering wheel from stop to stop to remove air from the system.
6. Check for leaks and recheck the fluid level. Add fluid if necessary.

POWER STEERING PUMP DRIVE BELT REPLACEMENT

1. On vehicles with air conditioning, loosen the idler pulley attaching bolts and remove the compressor drive belt.
2. Loosen adjusting and pivot bolts attaching the power steering pump to the pump bracket, and remove the pump drive belt.
3. Position the power steering pump drive belt on the pulleys.
4. Adjust the drive belt tension to specifications as outlined in this part.
5. On vehicles with air conditioning, install the compressor drive belt, and adjust to specifications (refer to Specifications in Part 13-01, General Steering Service).

POWER STEERING PUMP BELT INSTALLATION AND/OR ADJUSTMENT (SLIDER TYPE)

1. Loosen the nuts on the vertical studs so the adjustable bracket is free to slide inboard on the stationary bracket.
2. Loosen the belt adjustment nut on the horizontal stud enough to move the pump assembly and adjustable bracket inboard. Remove the belt.
3. If installing a new belt, place it on the proper pulleys.
4. Tighten the belt adjustment nut on the stud until snug.
5. Install a belt tension gauge and tighten the belt adjustment nut until the proper tension is attained (120 to 150 ft-lbs for a new belt, 90-120 ft-lbs for a used belt).
6. Tighten the nuts on the vertical studs to 30-40 ft-lbs.
7. Remove the tension gauge.

POWER STEERING PUMP PULLEY

Removal

1. Drain as much fluid as possible from the pump through the filler pipe.
2. Install pulley remover tool T69L-10300-A, on the pulley hub, placing the tool and pump in a vise.
3. Hold the pump and rotate the tool nut counter-clockwise to remove the pulley. Do not apply 'in and out' pressure on the pump shaft. Pressure will damage the internal thrust areas.

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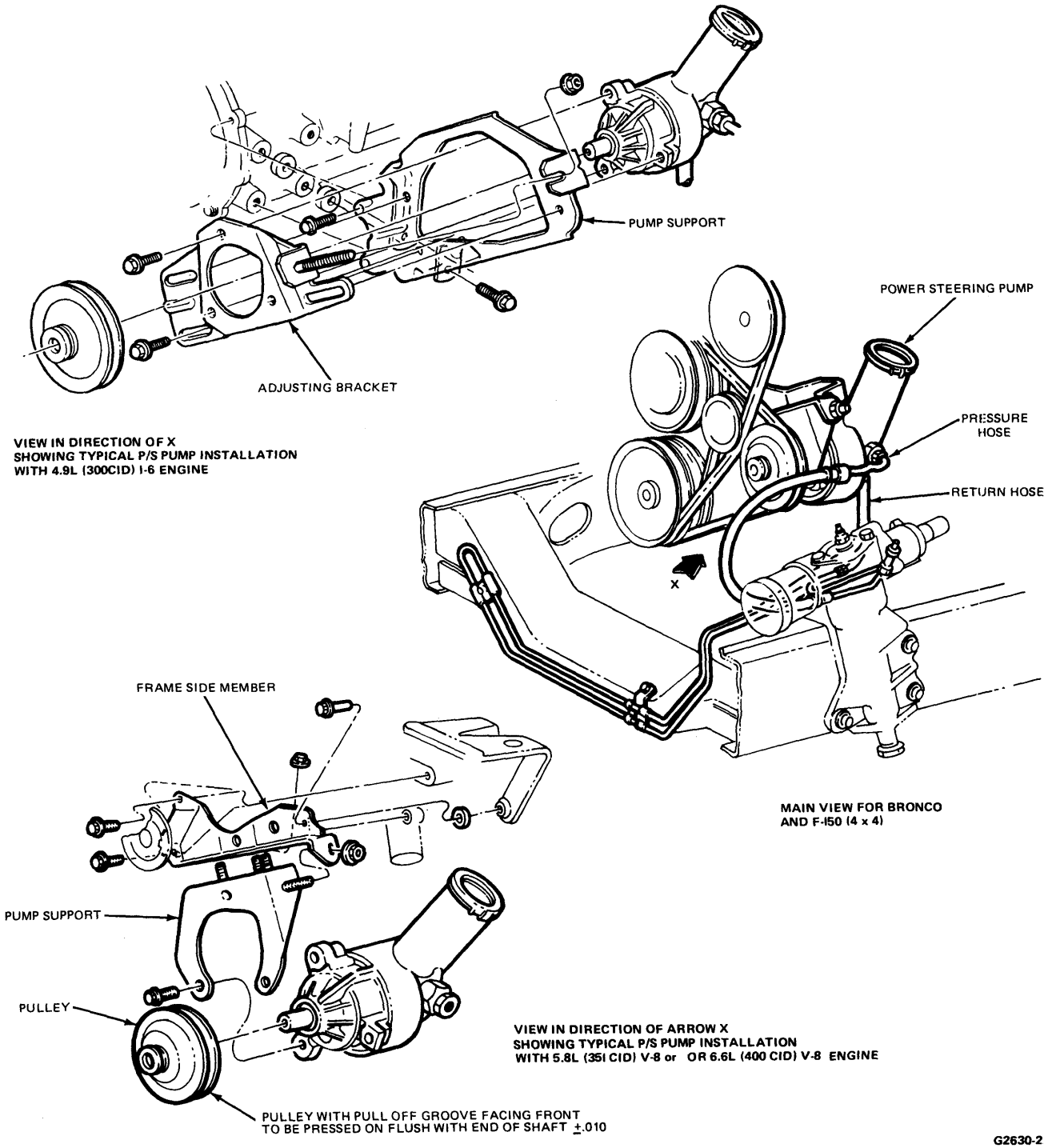


FIG. 3 Power Steering Pump Installation F-150 (4x4) and Bronco

Installation

1. Place the pulley on the pump shaft and install tool T65P-3A733-C.
2. Hold the pump and rotate the tool nut clockwise to install the pulley on the shaft. The pulley face will be flush with the end of the pump shaft. Don't apply 'in and out' pressure on the shaft. Pressure will damage the internal pump areas.
3. Remove the tool.

ROTOR SHAFT SEAL

Replacement of the rotor shaft seal requires pump disassembly. Refer to the Disassembly and Assembly section in this part for seal replacement procedure.

POWER STEERING PUMP RESERVOIR

Take the following precautions when servicing the power steering pump reservoir.

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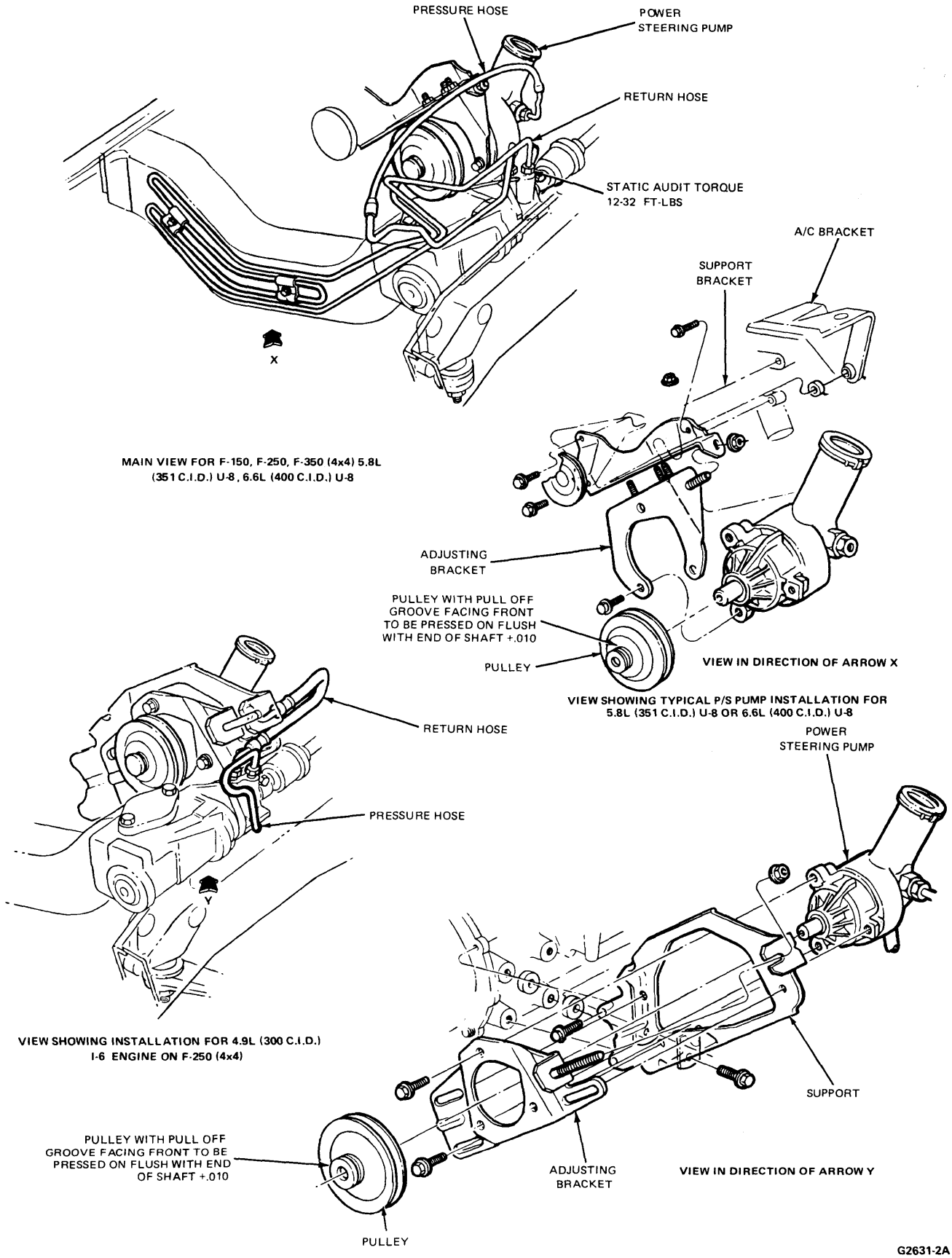


FIG. 4 Power Steering Pump Installation F-150, F-250, F-350 (4x4)

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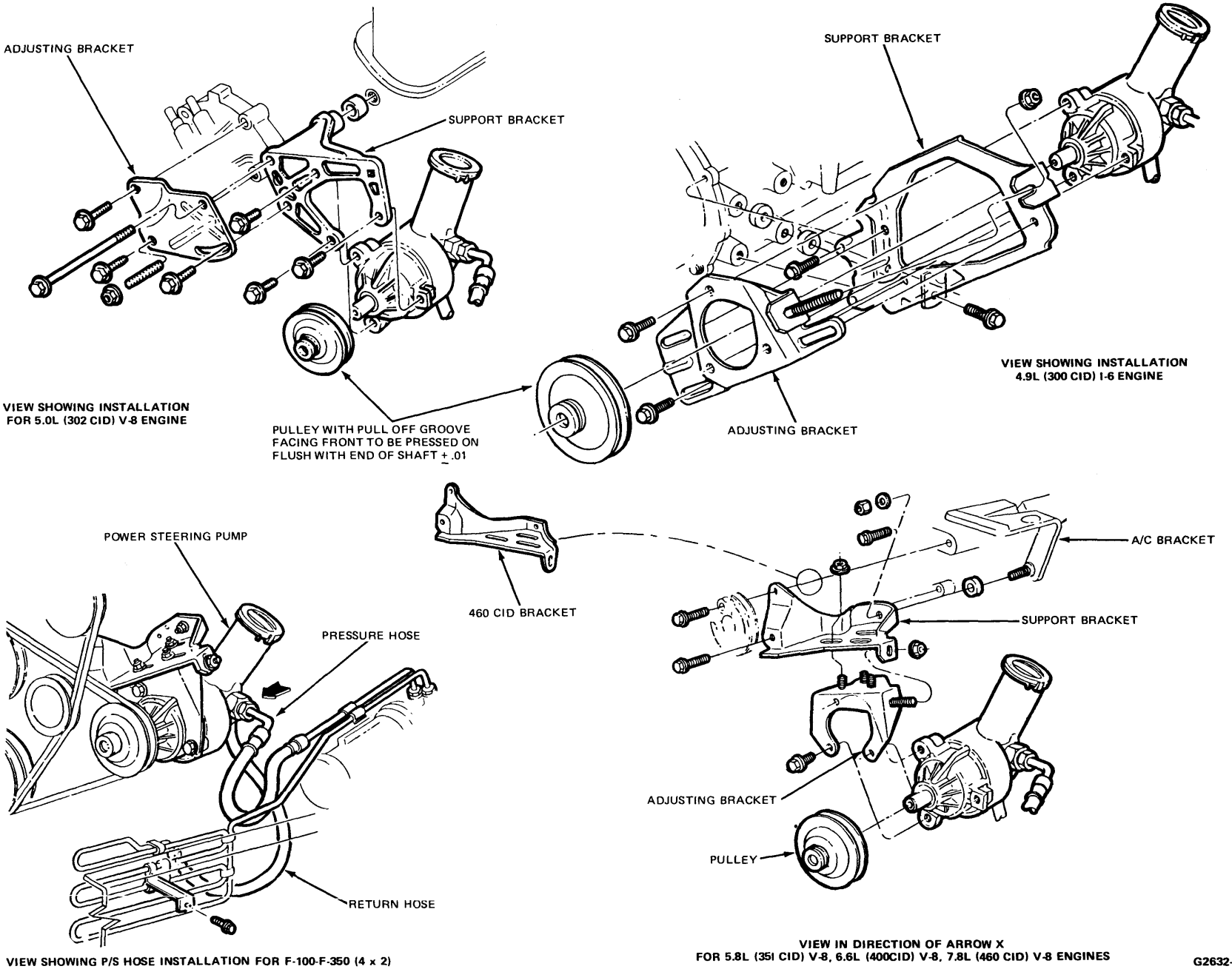


FIG. 5 Power Steering Pump Installation F-100—F-350 (4x2)

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1. Use a clean work bench and tools.
2. Plug the inlet and outlet openings of the pump with plugs or masking tape.
3. Thoroughly clean the exterior of the pump with solvent.

Removal

1. Place the pump assembly in a bench vise with soft jaws (Fig. 6), and remove the outlet fitting, flow control valve and spring. Discard all seals.

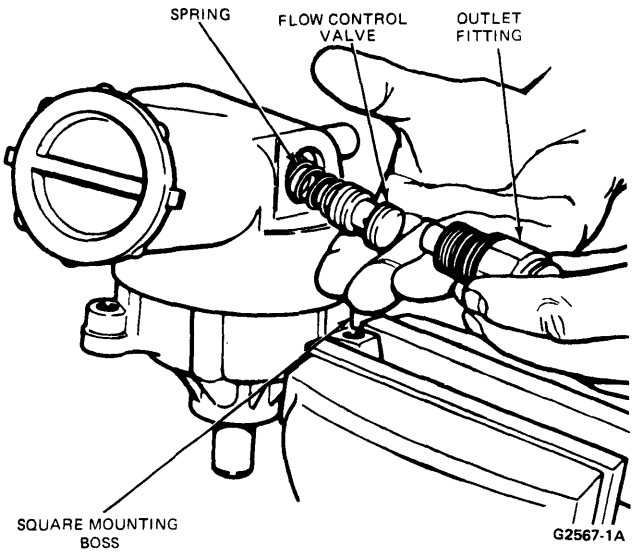


FIG. 6 Removing Outlet Fitting, Flow Control Valve and Spring

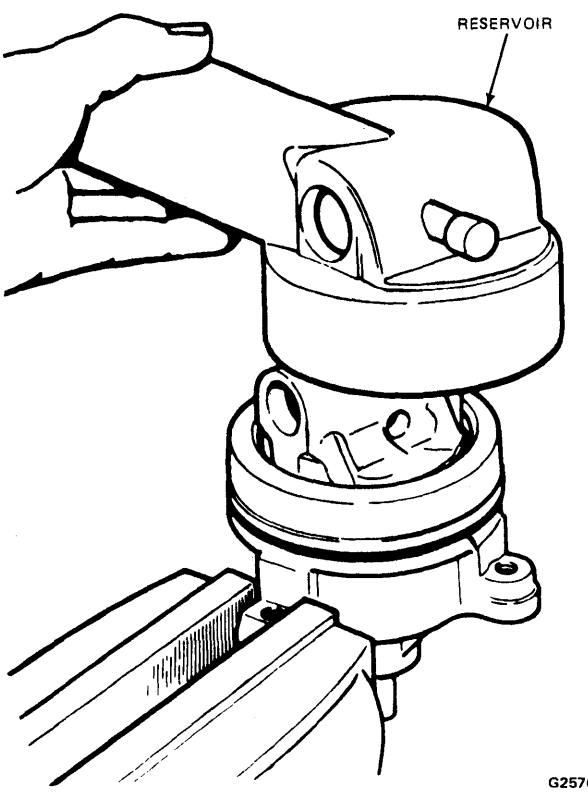


FIG. 7 Removing Reservoir

2. Remove the fiberglass reservoir (Fig. 7).
3. Discard 'O' ring seal on pump housing plate (Fig. 8).

Note: Do not hammer on the reservoir.

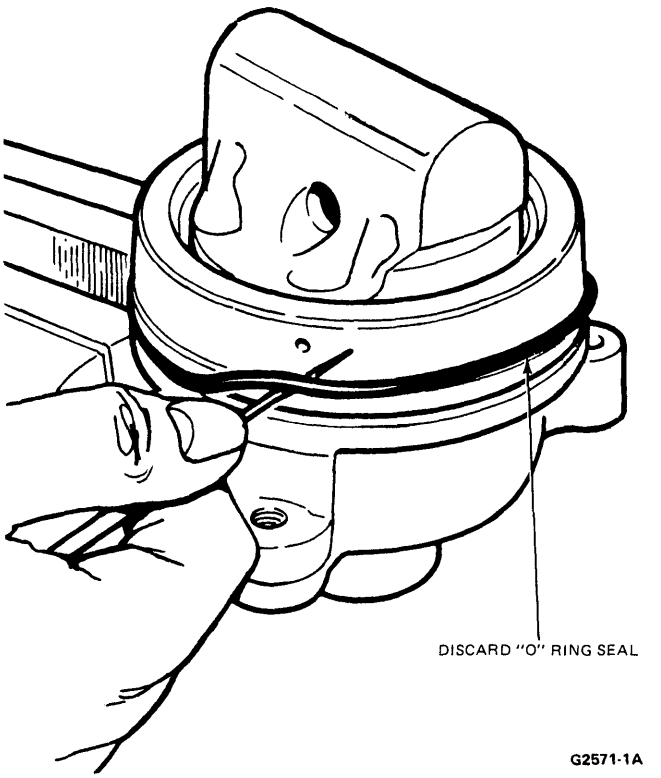


FIG. 8 Discarding "O" Ring Seal

Installation

1. Install a new 'O' ring seal on the pump housing plate.
2. Apply petroleum jelly to the reservoir 'O' ring seal and the inside edge of the reservoir. Do not twist the 'O' ring seal (Fig. 9).
3. Place the reservoir over the pump and align the outlet fitting hole in the reservoir with the hole in the valve cover.
4. Be sure the reservoir is evenly seated on the pump housing plate.
5. Place a new 'O' ring seal on the outlet fitting. Install the spring, flow control valve and outlet fitting into the reservoir and valve cover. Tighten the fitting to proper torque 25-34 ft-lbs.

NOTE: If the valve is cocked, it may become stuck in the valve cover. Do not force the valve forward; forcing the valve may shear off metal and carry the metal chips into the valve bore.

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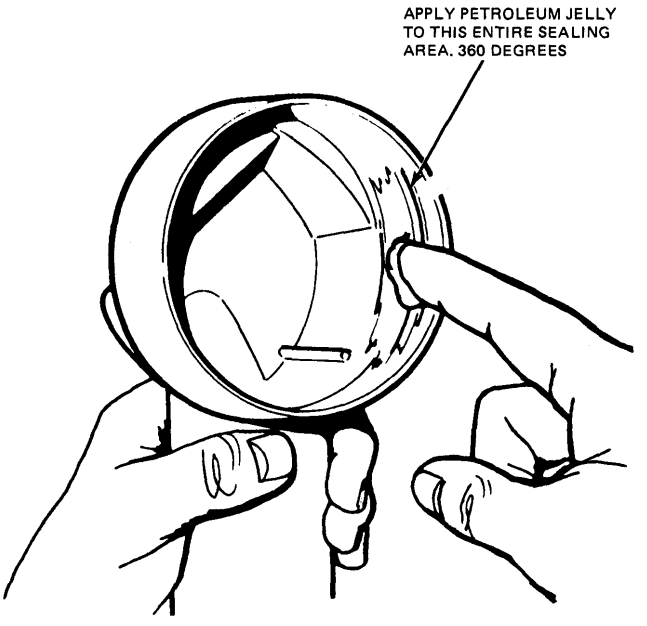


FIG. 9 Lubricating "O" Ring Seal

DISASSEMBLY AND ASSEMBLY

Refer to Figure 10.

The following precautions must be observed when servicing the power steering pump:

1. Use a clean work bench and tools.
2. Thoroughly clean the exterior of the pump with solvent. Drain as much fluid as possible.
3. If only the reservoir is to be removed, clean as detailed under Reservoir Removal.
4. If only the rotor shaft seal is to be removed, clean as detailed under Reservoir Removal.
5. Do not use cleaning solvent on the seals.

Disassembly

1. Remove the pump pulley as outlined under Pump Pulley Removal.
2. Remove the outlet fitting, flow control valve, and spring from the pump. Remove the pump reservoir.
3. Place "C" clamp (Tool No. T74P-3044-A-1) in a bench vise.
4. Place the lower support plate (Tool No. T78P-3733-A1) over the pump rotor shaft (Fig. 11).
5. Install the upper compressor plate (Tool No. T78P-3733-A2) into the upper portion of the "C" clamp.
6. Holding the upper compressor tool, place the pump assembly into the "C" clamp with the rotor shaft facing down (Fig. 12).

   Note: Position the contour of the upper compressor tool to fit the contour of the pump valve cover.
7. Tighten the "C" clamp until a slight bottoming of the valve cover is felt.
8. In the side of the pump housing plate is a small hole. Insert a small drift or suitable tool through this hole and push inward on the valve cover retaining ring. While applying pressure on the retaining ring, place a screwdriver under the edge of the retaining ring and remove the ring (Fig. 13).
9. Loosen the "C" clamp. Remove the upper compressor plate, and remove the pump assembly.
10. Remove the pump valve cover. Discard the "O" ring seal.
11. Push on the rotor shaft, and remove the rotor shaft, upper plate, rotor and slippers, cam insert and (2) dowel pins (Fig. 14).
12. The lower plate and the Belleville spring will remain in the pump housing plate. To remove, place the pump housing plate on a flat surface. Raise slightly and slam the housing plate down flatly until the lower plate and the Belleville spring fall out. Discard the "O" ring seals (Fig. 15).
13. Remove the rotor shaft seal and seal retainer simultaneously by prying out with a screwdriver (Fig. 16).

    Note: This method is used only when the pump is disassembled.

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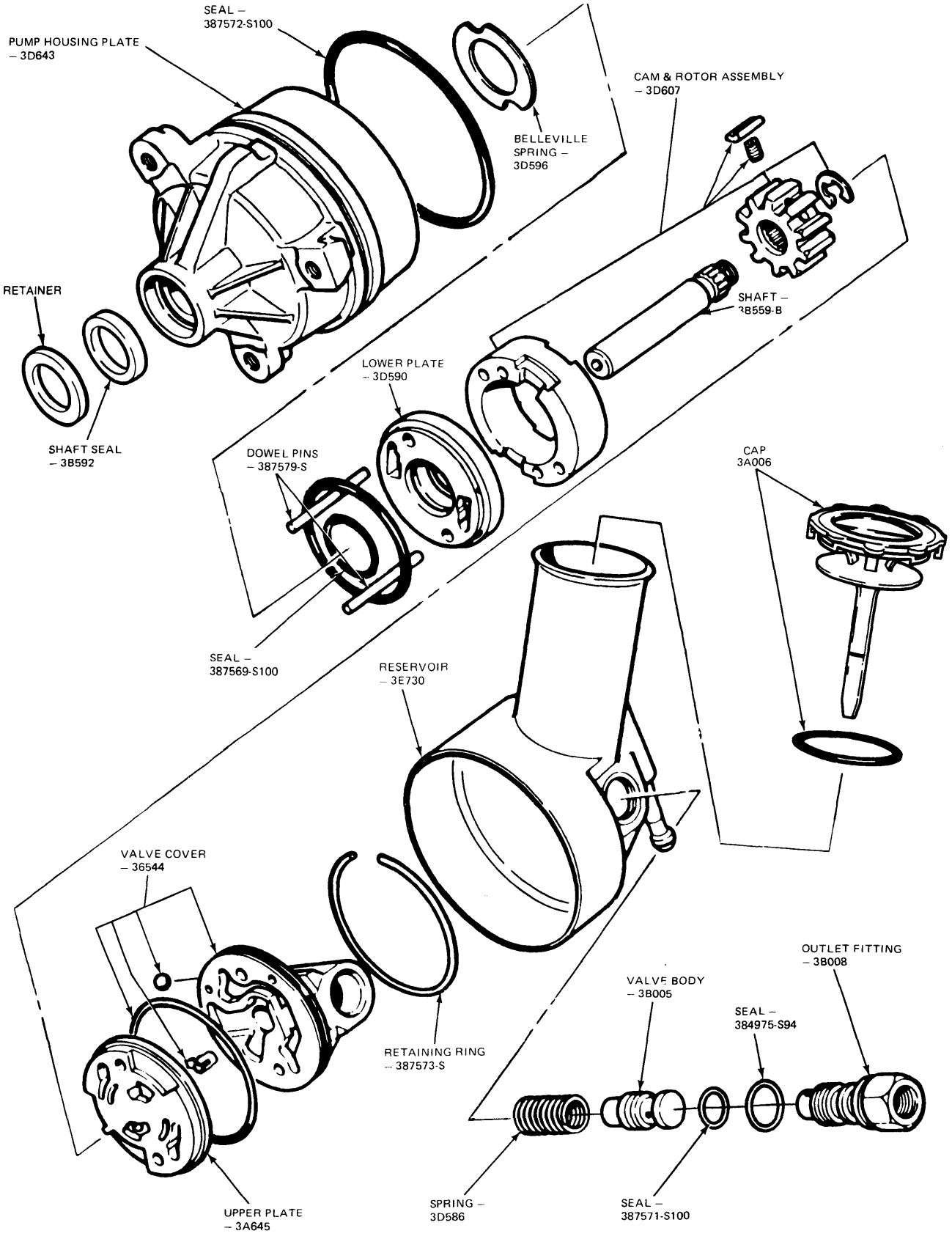


FIG. 10 C-II Power Steering Pump—Exploded View

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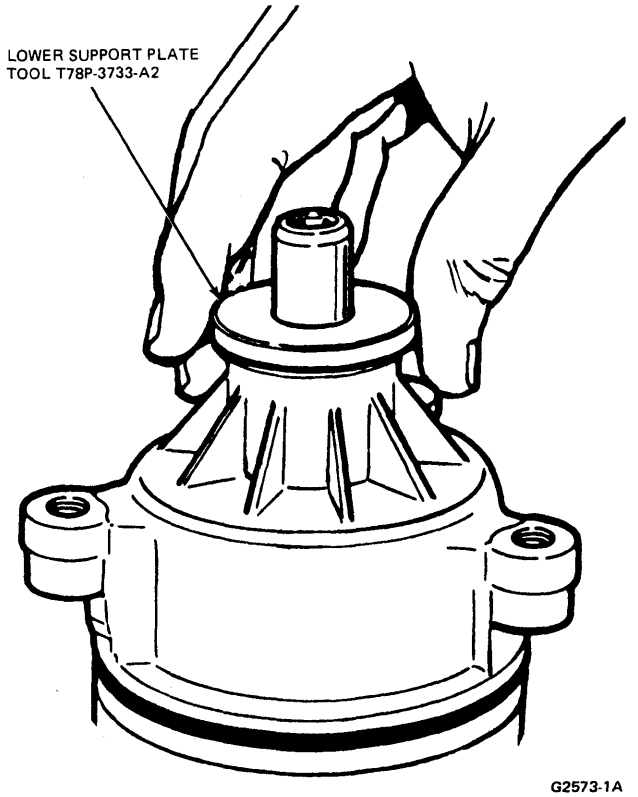


FIG. 11 Installing Lower Support Plate Tool

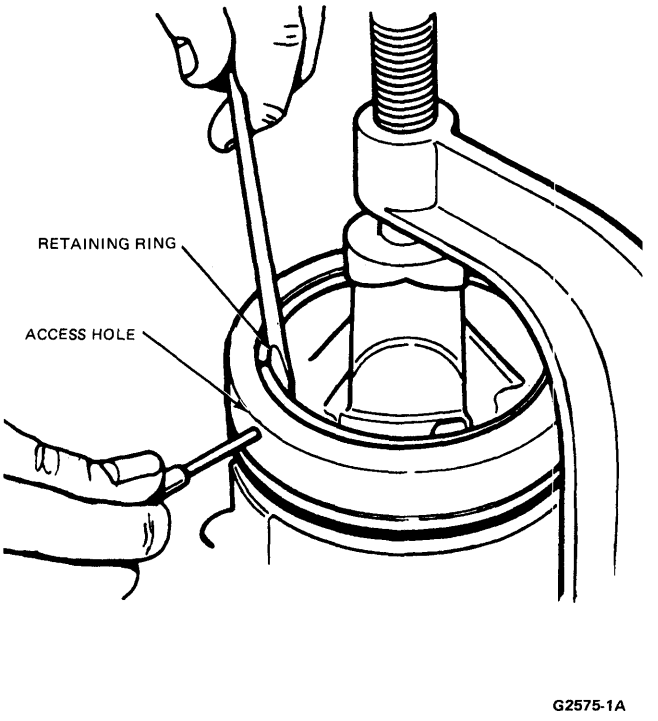


FIG. 13 Removing Retaining Ring

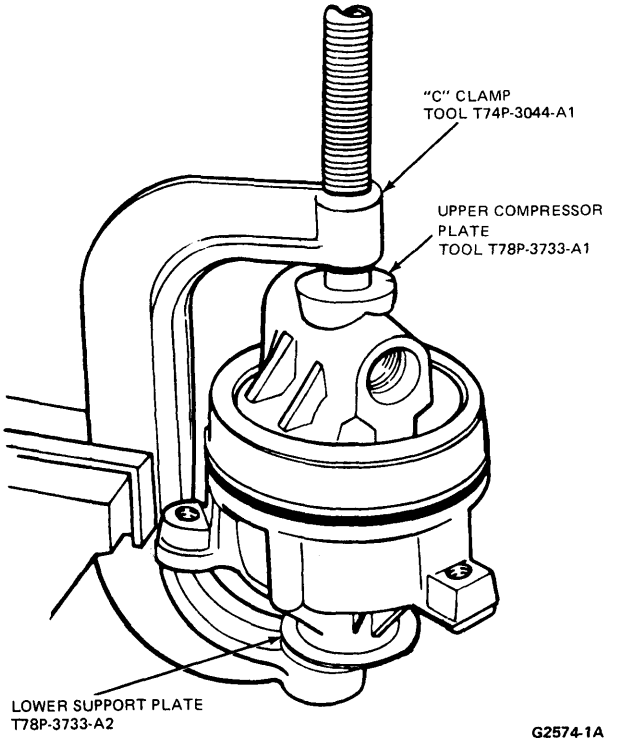


FIG. 12 Installing Compressor Plate Tool

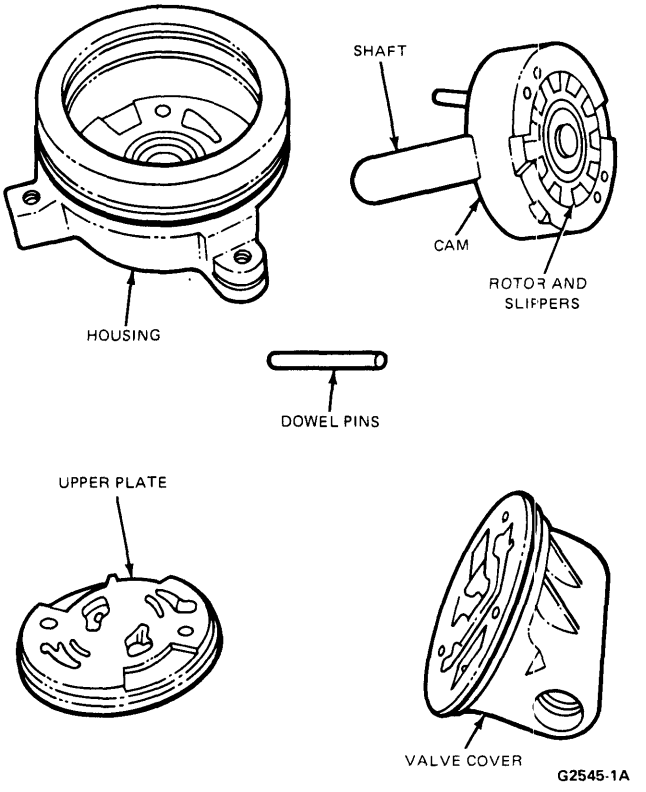


FIG. 14 Pump Housing Components

Assembly

If the rotors, slippers, spring and cam insert were disassembled for cleaning and/or inspection, assemble as follows:

1. Place the rotor on the rotor shaft splines, with the notches on the rotor teeth facing the right.
2. Install the retaining ring in the groove at the end of the rotor shaft.

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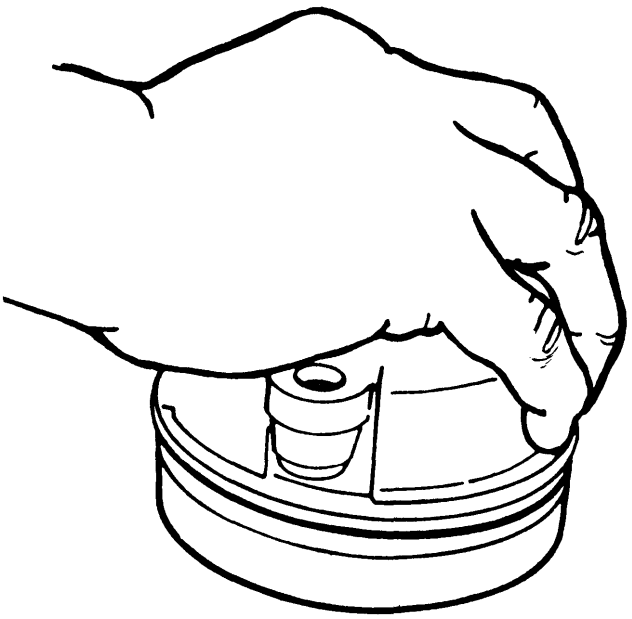


FIG. 15 Slamming the Housing Plate on a Surface to Remove Lower Plate and Belleville Spring

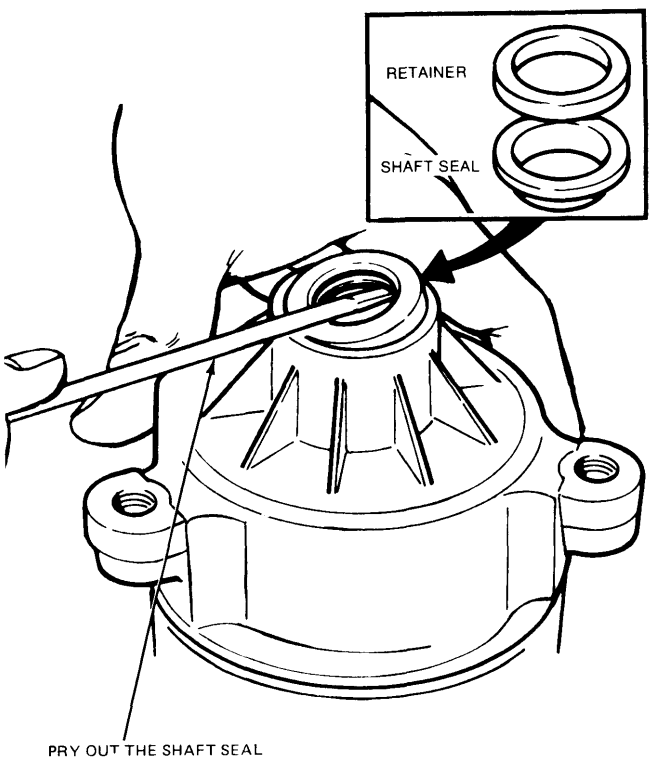


FIG. 16 Removing Rotor Shaft Seal

3. Place the insert cam over the rotor. Be sure the recessed flat on the insert cam is toward the reservoir.
4. With the rotor extended upward approximately half way out of the cam, insert a spring into a rotor spring pocket. Work in the rotor cavity directly beneath the recessed flat on the cam.
5. Use one of the slippers to compress the spring and install the slipper with the groove facing upward.
6. Hold the cam stationary, and turn the rotor either right or left one space at a time, and install another spring and slipper until all (10) rotor cavities have been filled. Be careful when turning the rotor, that the springs and slippers already installed do not fall out.
7. Install a new rotor shaft seal using seal driver tool No. T78P-3733-A3. Using a plastic mallet, drive the seal into the bore until a bottoming is felt (Fig. 17). Install the seal retainer in the same manner.

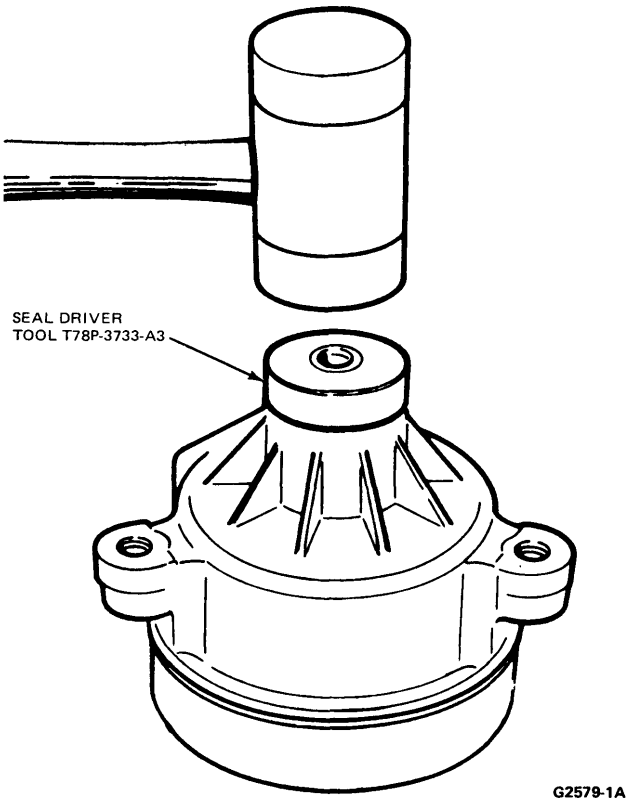


FIG. 17 Installing Rotor Shaft Seal

8. Place the pump housing plate on a flat surface, with the pulley side facing down.
9. Insert the (2) dowel pins and the Belleville spring into the housing plate (Fig. 18).

   Note: The Belleville spring must be inserted with the dished surface upward.
10. Lubricate the inner and outer "O" ring seals with the specified power steering fluid and install these seals on the lower pressure plate (Fig. 19).
11. Insert the lower pressure plate with the "O" ring seals toward the front of the pump into the pump housing plate (Fig. 20) and over the dowel pins. Place the entire assembly on the "C" clamp. Place

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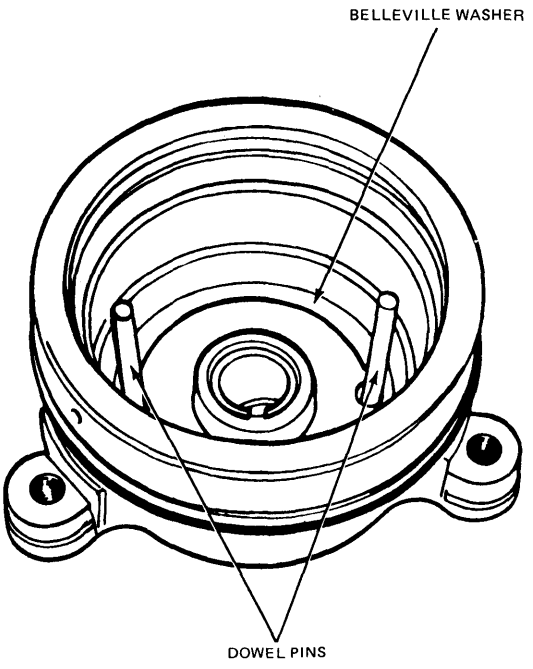


FIG. 18 Installing Belleville Washer and Dowel Pin

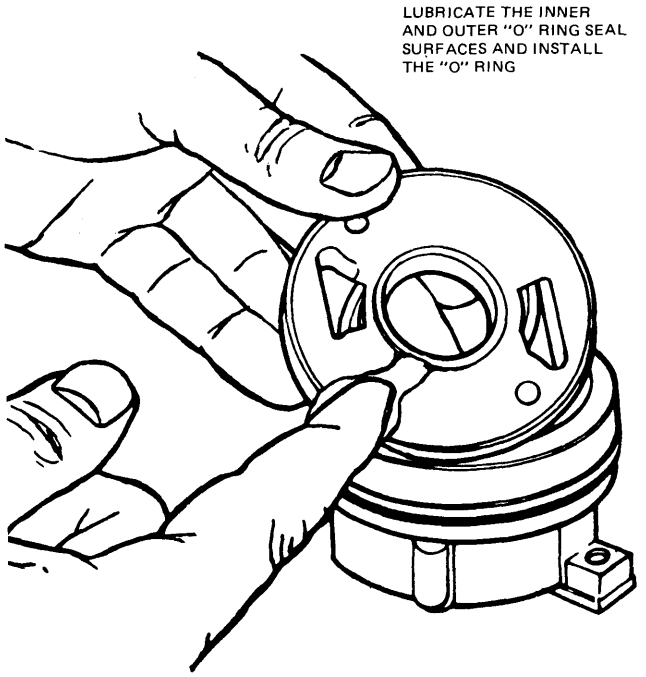


FIG. 19 Lubrication and Installation of "O" Rings

driver tool No. T78P-3733-A3 into the rotor shaft hole (Fig. 21) and press on the lower plate lightly. until it is felt to bottom into the pump plate housing. This operation will seat the outer "O" ring seal (Fig. 22).

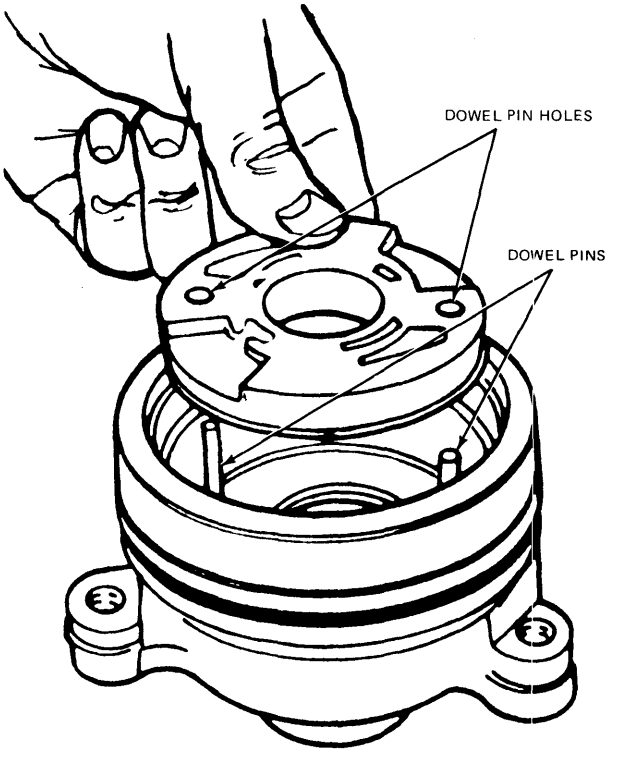


FIG. 20 Installing the Lower Plate with the Seals Facing Toward the Pump Housing

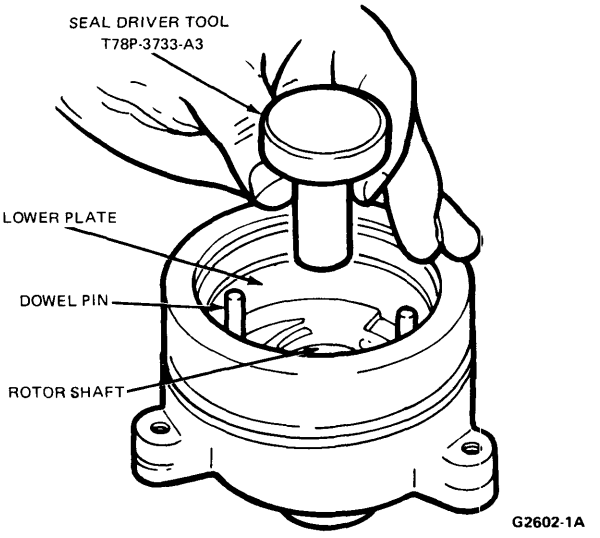


FIG. 21 Place Driver Tool Rotor Shaft Hole

12. Install the cam, rotor and slippers, and rotor shaft assembly into the pump housing plate over the dowel pins (Fig. 23).

    Note: When installing this assembly into the pump housing plate, the stepped holes must be used for the dowel pins, and the recessed notch in the cam

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insert must face toward the reservoir and be approximately 180° opposite the square pump mounting boss.

13. Place the upper pressure plate over the dowel pins (Fig. 24). When installing the upper plate into the pump housing, observe the notch on the outside diameter of the plate. One side has a square recess cast into the plate. This square recess must be facing toward the reservoir and positioned approximately 180° opposite the pump square mounting boss.

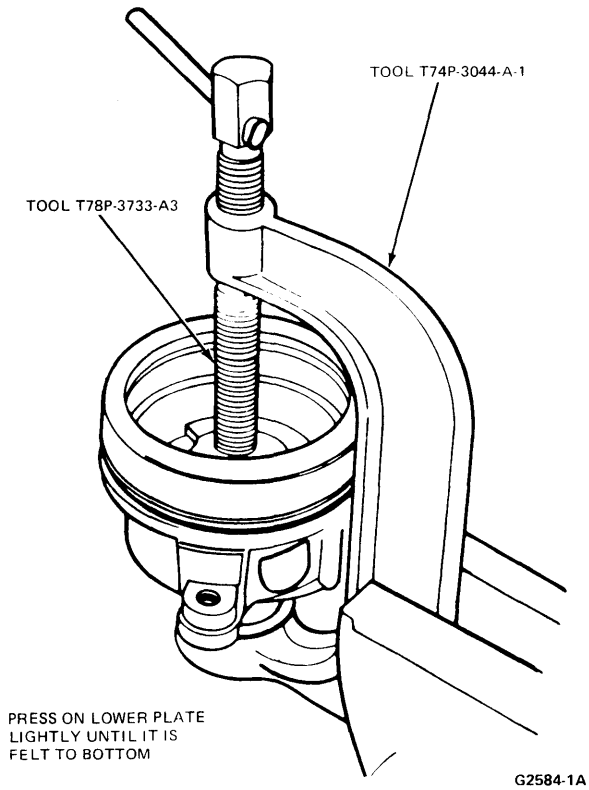


FIG. 22 Seating Outer "O" Ring Seal

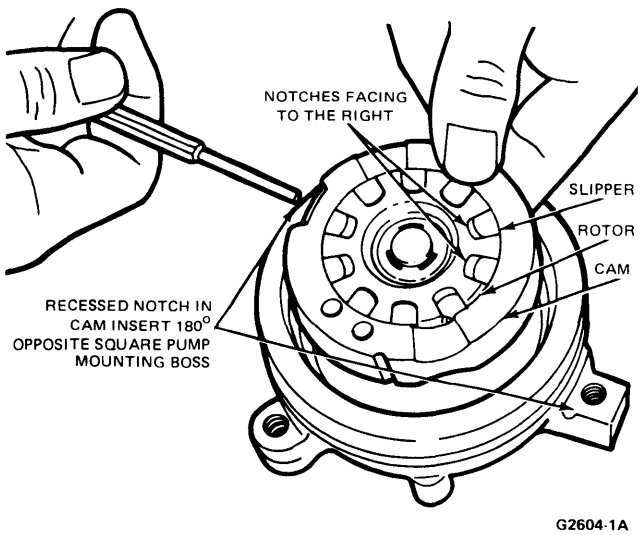


FIG. 23 Installing Cam, Rotor and Slippers

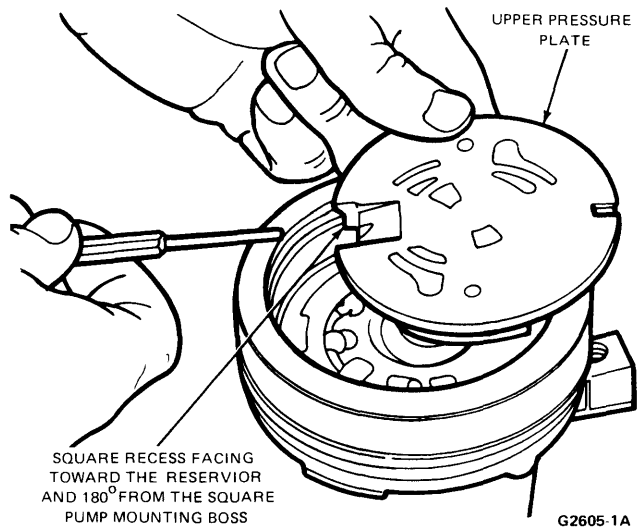


FIG. 24 Installing Upper Pressure Plate

14. Place a new "O" ring seal on the valve cover. Lubricate this seal with the specified power steering fluid (Fig. 25).

    NOTE: Be sure the plastic baffle is securely in place in the valve cover. If the baffle is loose, apply a coating of petroleum jelly on the baffle and install it into location on the valve cover.

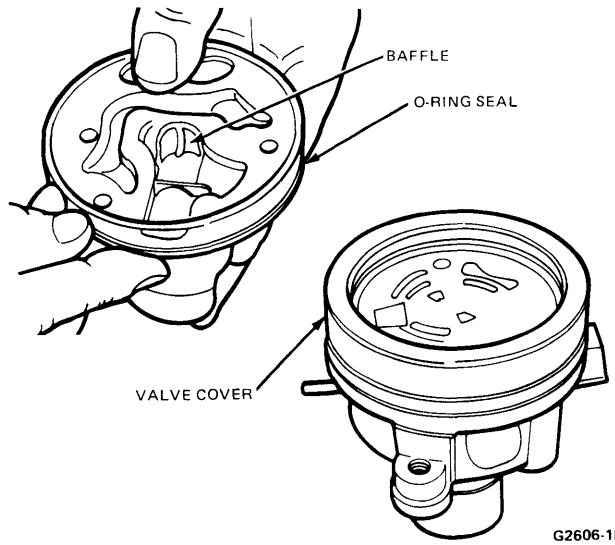


FIG. 25 Installing Valve Cover "O" Ring Seal

15. Insert this valve cover over the dowel pins. Be sure the outlet fitting hole in the valve cover is directly in line with the square mounting boss of the pump housing plate (Fig. 26).
16. Place the entire assembly in the "C" clamp tool and compress the valve cover into the pump housing plate, until the retaining ring groove is exposed in the pump housing plate.
17. Install the valve cover retaining ring with the ends near the access hole in the pump housing plate (Fig. 27).
18. Remove the pump assembly from the "C" clamp tool.

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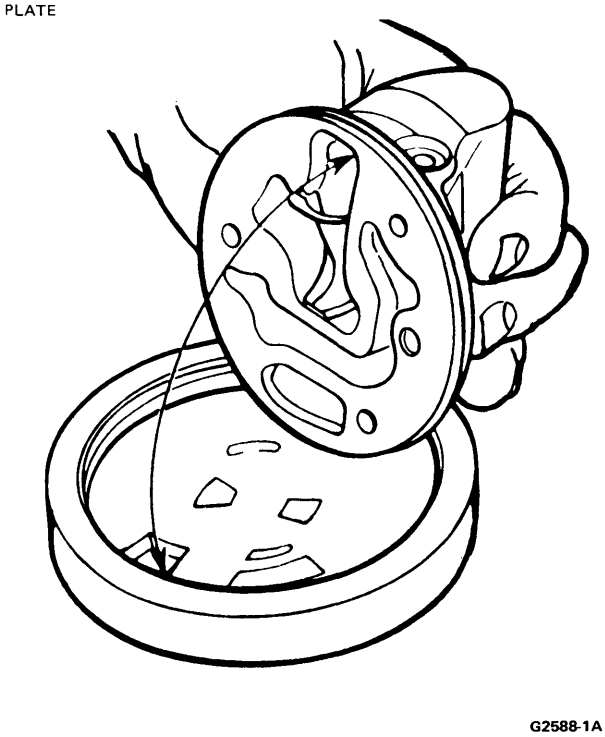


FIG. 26 Installing Valve Cover

19. Place a new "O" ring seal on the pump housing plate. Lubricate this "O" ring seal with the specified power steering fluid.
20. Install the power steering reservoir.
21. Install the flow control spring, and flow control valve into the valve cover.
22. Place new "O" ring seals on the outlet fitting. Lubricate these seals with the specified power steering fluid.
23. Install the outlet fitting into the valve cover and tighten to 25-34 ft-lbs (Fig. 28).

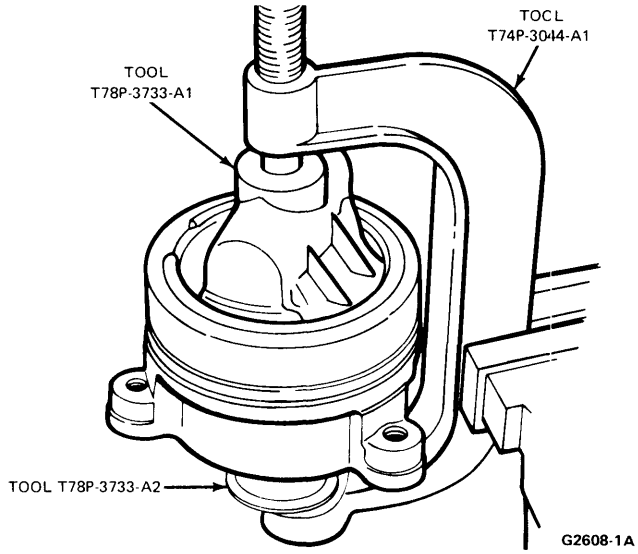


FIG. 27 Installing Valve Cover Retaining Ring

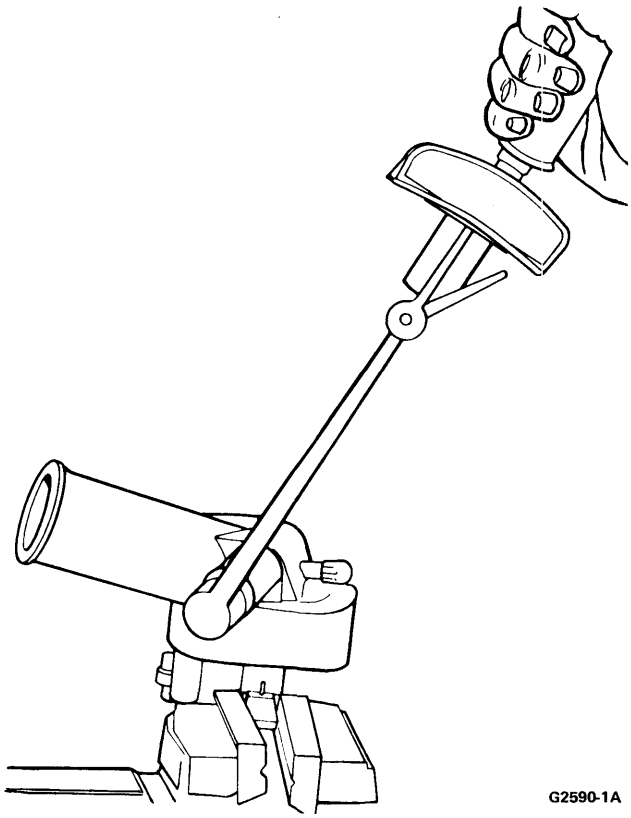


FIG. 28 Installing Outlet Fitting

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SPECIFICATIONS

SPECIAL TOOLS

Tool Number	Description
T78P-3733-A2	Upper Compressor Plate
T78P-3733-A1	Lower Support Plate
T78P-3733-A3	Seal Driver
T57L-500-B	Holding Fixture
T63L-8620-A	Belt Tension Gauge
T65P-3A733-A	Pulley Installation Tool
T68P-3B592-A	Seal Installation Tool
T68P-3B592-B	Shaft Seal Protector
T69L-10300-A	Pulley Removal Tool
T69P-3A674-A	Adapter Plate
T70P-3D643-A	Belt Tension Tool
T74P-3044-A1	"C" Clamp
210019	Belt Tension Gauge
210020	Belt Tension Gauge
140208	Power Steering Analyzer

CG-2560-1B

C-II POWER STEERING PUMP TORQUE SPECIFICATIONS

Description	Torque Limits	
	(ft-lbs)	N•m
Pivot Bolt	30-45	41-61
Front Bolts to Support Bracket	30-45	41-61
Support Bracket to Engine	30-45	41-61
Support Bracket to Water Pump Housing	30-45	41-61
Pump to Bracket	30-45	41-61
Pressure Hose Tube Nut to Pump Pressure Fitting	12-15	17-20
Return Hose to Pump (Hose Clamp)	12-24	17.32
Pump Outlet Fitting to Pump Valve Cover	25-34	34-46

CG2633-1A

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SUSPENSION

GROUP 14 (3000 & 5000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Front Suspension — Twin I-Beam	14-21	General Suspension Service	14-01
Front Suspension — 4-Wheel Drive	14-22	Rear Suspension — Leaf Springs	14-31

General Suspension Service

PART 14-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING		ADJUSTMENTS (Cont'd)	
Checking Caster and Camber Angles	01-2	Manual, Integral, Semi-Integral Power Steering Gear	01-11
Diagnosis Guides	01-8	Shock Absorber Checks	01-11
Front End Alignment Checks	01-1	Spindle Arm Stop Adjustments	01-11
ADJUSTMENTS		Steering Stop — Twin I-Beam Vehicles	01-11
Caster and Camber F-100-F-350, E-100-E-350, F-150-F-250 F-350 (4x4) and Bronco	01-10	Toe Alignment	01-10
Front End General Inspection E-100-E-350, F-100-F-350 and Bronco	01-11		

DIAGNOSIS AND TESTING

FRONT END ALIGNMENT CHECKS

E-100-E-350, F-100-F-350 VEHICLES WITH TWIN-I-BEAM FRONT SUSPENSION

Front wheel alignment specifications and the method of checking caster, camber and toe alignment for Twin-I-Beam vehicles are determined with the vehicle at its normal operating height and attitude provided the front ride height is within the range shown on the caster/camber charts and tires inflated to specified pressure (cold). If the ride height does not fall within this range, the height must be corrected by installing the proper springs or the use of shims, Part 385795. The machined-in caster/camber alignment feature of the Twin-I-Beam suspension requires that the front ride height is within the established limits.

Prior to checking caster and camber, be sure to attain correct front ride heights within 1/8 inch of each other by redistributing the load on loaded vehicles or slightly loading empty vehicles on one side or the other and tires inflated to specified pressure (cold). If the ride height cannot be brought within the 1/8 inch maximum variance by load shifting, verify correct spring installation.

NOTE: The 1/8 inch maximum variance of front ride heights is for checking purposes only. The vehicle does not normally have to operate within this specification.

Do not attempt to check or adjust front end alignment without first making the following preliminary inspections and/or adjustments of front suspension components:

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1. Inflate all tires to the specified pressure (cold).
2. Check the front axle pivot bushings and radius arm-to-frame bushings for excessive wear or deterioration. Replace if necessary.
3. Check the front wheel bearings and adjust if necessary.
4. Check both front tires. They should be the same size, ply rating, and load range.
5. If the alignment equipment being used attaches to the front wheels, the fixtures must be adjusted to compensate for wheel runout.
6. Tighten the spindle pin lock pin to 40-55 ft-lbs.
7. Check the spindle pins and/or spindle bushings for evidence of excessive wear. Grasp each tire at the top and bottom and rock the wheel, while watching the movement of the disc brake support or spindle assembly. If the disc brake support or front spindle assembly moves more than 1/32 inch, relative to the axle, replace the spindle pins and bushings.
8. Check and correct, if necessary, to assure that front ride height is within the range specified in the caster/camber charts.

   Incorrect toe setting is the most likely cause of excessive or uneven tire wear. Tire wear due to improper toe may be noticable on one or both front tires and is normally exhibited by outside wear on a toed-in vehicle and inside wear on a toed-out vehicle. Improper toe may also show as a feathering across the tread of the tire.

   Excessive or uneven tire wear may also be caused by incorrect tire pressure, wheel/tire imbalance, worn or loose steering or suspension components and loose wheel bearings. Typical tire wear patterns are shown in Figs. 1 and 2 to use as a guide only.

   Analysis of tire wear complaints should include inspection for the above described conditions, and in any event, toe should be checked and set within the specified limits in Fig. 3. Toe set to the 'nominal' value is recommended since it is judged to provide maximum tire life. Refer to adjustments in this part for toe adjusting procedures. Do not attempt to adjust by bending suspension or steering linkage components.

CHECKING CASTER AND CAMBER ANGLES

The Twin-I-Beam front suspension design, used on all F-Series, E-Series and Bronco vehicles has caster and camber angles built-in and are nonadjustable.

Caster is the number of degrees of backward (positive) or forward (negative) tilt of the spindle (king) pin. Camber is the number of degrees the top of the wheel tilts outward (positive) or inward (negative) from a vertical plane.

Before checking caster or camber, perform the toe alignment check. Using alignment equipment known to be accurate and following the equipment manufacturer's instructions, measure and record the caster angle and the camber angle of both front wheels. Refer to the front wheel alignment chart (Fig. 3) for specifications.

If the caster and camber measurements exceed the maximum variances inspect for damaged front suspension components. Replace as required.

If the recorded caster angles and/or camber angles do not fall within the specification shown on the chart (Fig. 2) then the following checking procedure must be followed.

On E-100-350 vehicles, level the vehicle and place height blocks of 3 1/2 inches between the top of the I-Beam axle and the flange on the lower part of the jounce bracket (Fig. 4). Do this on each axle before proceeding further.

Measure ride height at the inside area of the jounce bracket (towards the wheel) between the top of the front I-Beam axle and the spring seat lower surface on the frame (Fig. 4). Do this on both the right and left side of the vehicle at the same time.

Each measurement should be 1/8 inch of the other and also within the specifications listed in Fig. 4.

On F-100-350 vehicles, level the vehicle, and place height blocks of 5 inches between the top of the front I-Beam axle and the spring seat lower surface on the frame next to the jounce bracket (Fig. 4). Do this on each I-Beam axle before proceeding further.

Measure ride height at the inside of the spring seat lower surface (towards the wheel) between the top of the front I-Beam axle and the spring seat lower surface (Fig. 4). Do this on each side of the vehicle.

Each measurement should be within 1/8 inch of the other.

After determining the ride height between the axle and spring seat lower surface (Fig. 3), measure the caster and camber with approved front end alignment equipment. Be sure and follow the manufacturer's instructions.

Correlate the recorded actual vehicle ride height and the recorded actual caster and camber angles with the caster and camber angles shown on the charts in Fig. 3 to determine which wheel is truly out-of-specification if an excessive side-to-side variation has been verified.

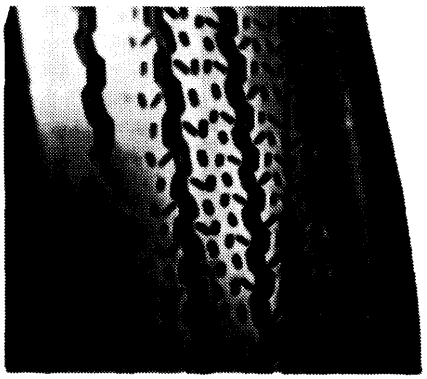
Caster is built into the Twin-I-Beam axles. Alignment equipment indicates a true reading only when the frame is horizontal, front to rear. Measure left and right hand angles as shown in Fig. 5. If the frame is not level (due to tire, spring or load differences), the caster angle reading must be modified to compensate for the above frame angles. If the front is higher than the rear, subtract the amount of angle from the reading. If the front is lower than the rear, add the angle.

On F-100/350 and E-100/E-350 vehicles measure the frame angle with a spirit level protractor.

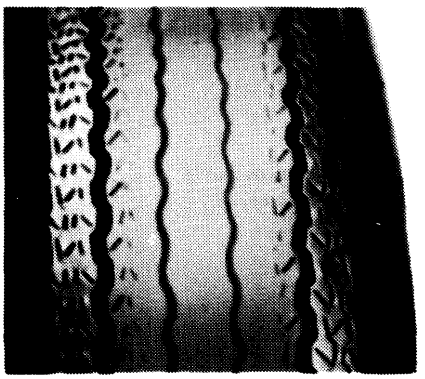
Take the "frame angle" measurement on the lower frame flange at the flat area immediately adjacent to the rear spring front hanger as shown in Fig. 5. **NOTE: Twin-I-Beam axles are not to be bent or twisted to correct caster or camber readings.**

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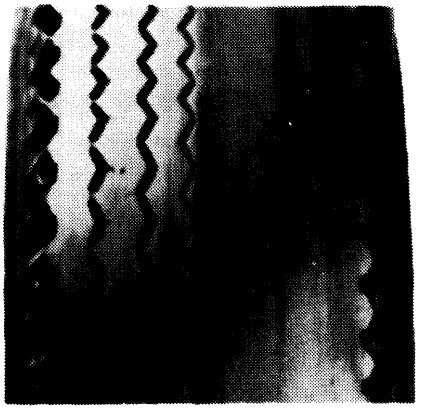
UNDERINFLATION



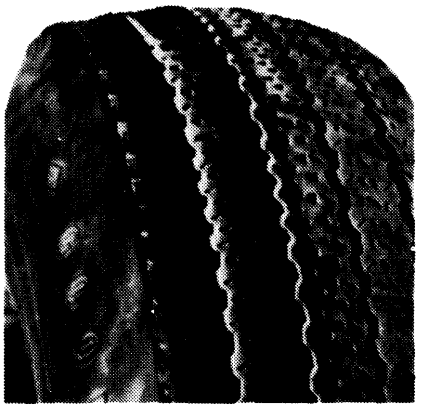
OVERINFLATION



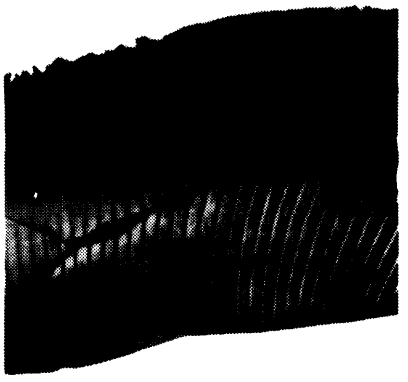
CUPPING-UNDERINFLATION AND/OR WORN OR LOOSE SUSPENSION OR STEERING COMPONENTS



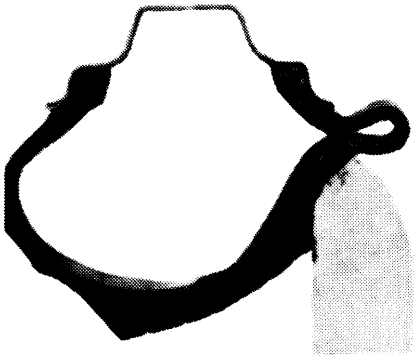
INCORRECT TOE-IN OR EXTREME CAMBER



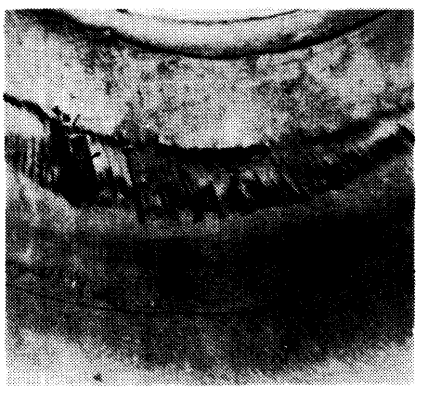
FEATHERING DUE TO INCORRECT TOE SETTING OR SEVERE CORNERING



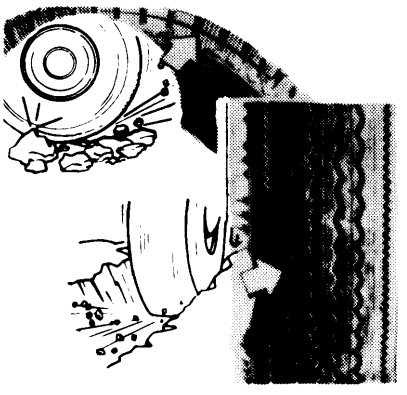
STONE BRUISE



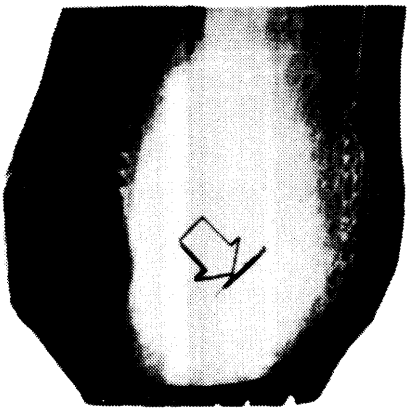
STONE BRUISE



UNDERINFLATION



ROCK CUT



BRUISE



HEAT BRUISE



DOUBLE BRUISE-SHARP OBJECT AND RESULTING FATIGUE F1467-2E

FIG. 1 Tire Wear Conditions

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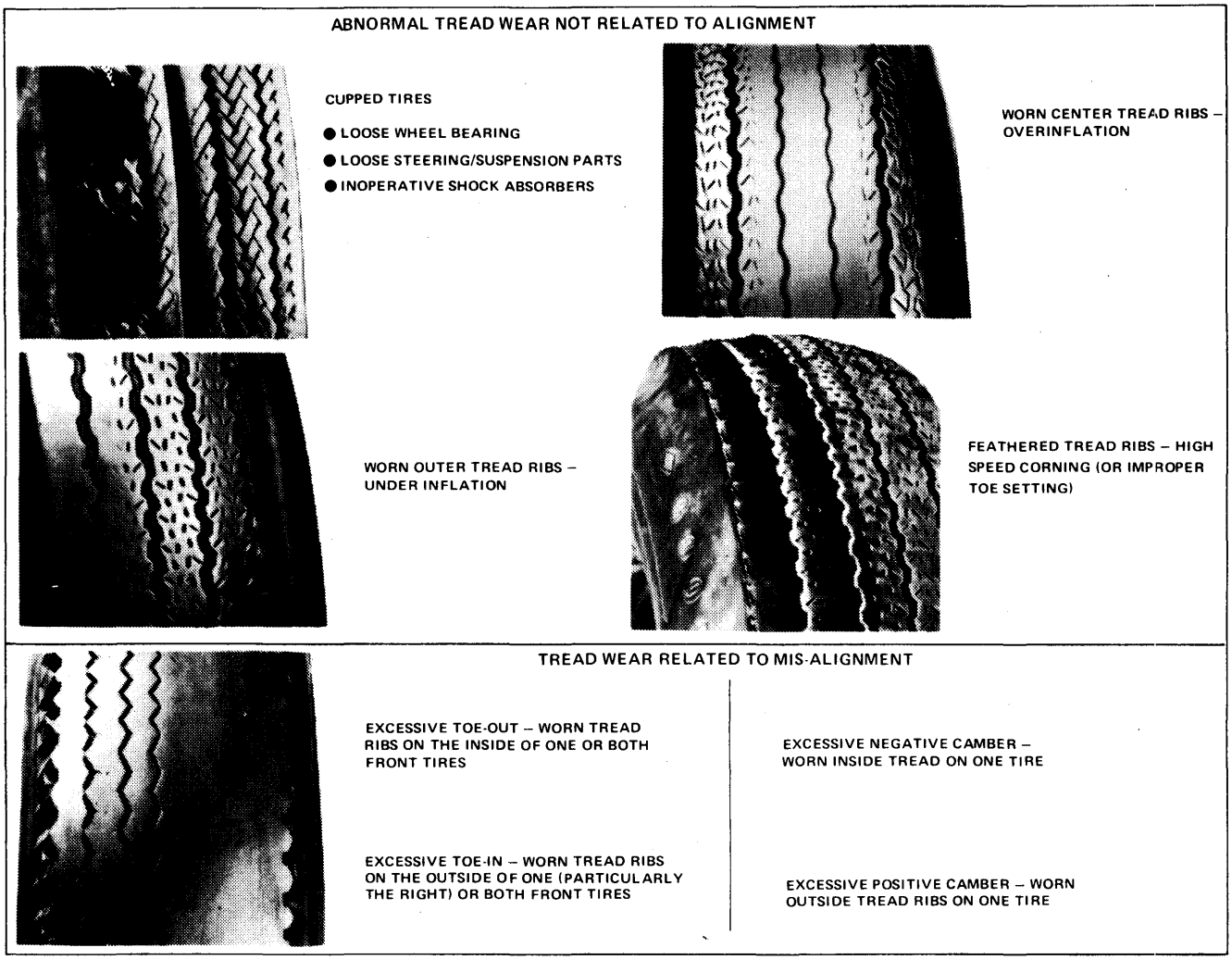


FIG. 2 Twin I-Beam Axle Alignment Diagnosis Chart

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F-100 TO F-350 (4x2)

Model / Axle Part # / Ride Height		E-100/150 ①③ D7UA-BB				E-250/350 ①③ D5UA-AB				F-100 All, F-150 All, F-250 (6200-6800) ①② D8TA-CA			
		Camber		Caster		Camber		Caster		Camber		Caster	
At Least	Not More Than	Min. ①	Max.	Min. ①	Max.	Min. ①	Max.	Min. ①	Max.	Min. ①	Max.	Min. ①	Max.
2.75	3.00	—	—	—	—	—	—	—	—	−2	−¼	8⅜	9⅝
3.00	3.25	—	—	—	—	—	—	—	—	−1½	+⅛	7¾	9
3.25	3.50	−1¾	−¼	6¼	8	−1¾	−¼	9	10½	−1⅛	+½	7	8⅜
3.50	3.75	−1½	+¼	5¾	7¼	−1½	+¼	8½	9¾	−¾	+1	6¼	7⅝
3.75	4.00	−1	+¾	5	6¾	−1	+¾	7⅞	9	−⅜	+1¼	5⅞	7⅛
4.00	4.25	−½	+1¼	4½	5¾	−½	+1¼	7⅛	8½	0	+1⅝	5⅛	6½
4.25	4.50	0	+1¾	4	5¼	0	+1¾	6½	7¾	+⅜	+2	4½	5⅞
4.50	4.75	+½	+2¼	3¼	4½	+½	+2¼	5¾	7	+¾	+2⅜	3¾	5¼
4.75	5.00	+1	+2¾	2½	4	+1	+2¾	5¼	6½	1¼	+2¾	3¼	4⅝
5.00	5.25	+1½	+3¼	2	3¼	+1½	+3¼	4⅝	6	1⅞	+3⅛	2½	4
5.25	5.50	+2	+3¾	1½	2¾	+2	+3¾	4	5½	—	—	—	—

Model / Axle Part # / Ride Height		F-250 R/C (7700-7900), F-250 S/C (6300-7800) ①② D8TA-BA				F-350 All ③, F-250 S/C (3100), F-250 S/C RPO Suspension ①② D8TA-DA			
		Camber		Caster		Camber		Caster	
At Least	Not More Than	Min. ①	Max.	Min. ①	Max.	Min. ①	Max.	Min. ①	Max.
2.75	3.00	−1⅞	−¼	7¾	9	−2⅛	−⅝	9⅝	11
3.00	3.25	−1½	+⅛	7	8⅜	−1¾	−¼	8⅞	10⅜
3.25	3.50	−1⅛	+½	6⅜	7¾	−1⅜	+⅛	8⅜	9¾
3.50	3.75	−¾	+⅞	5⅞	7⅛	−1⅛	+½	7¾	9
3.75	4.00	−⅜	+1¼	5⅛	6½	−¾	+¾	7	8⅜
4.00	4.25	0	+1⅝	4½	5⅞	−¼	+1¼	6⅜	7¾
4.25	4.50	⅜	+2	3⅞	5¼	0	+1⅝	5¾	7⅛
4.50	4.75	⅞	2½	3¼	4⅝	+⅜	+2	5⅛	6½
4.75	5.00	1¼	2¾	2⅝	4	+¾	+2⅜	4½	5⅞
5.00	5.25	1⅝	3⅛	2	3⅜	+1¼	+2¾	3⅞	5¼
5.25	5.50	—	—	—	—	—	—	—	—

① All vehicles with normal operating altitudes.
② Toe setting is 3/32 inch in.
③ Toe setting is 1/32 inch in.

FRONT WHEEL ALIGNMENT — F-150, F-250, F-350 (4x4), Bronco

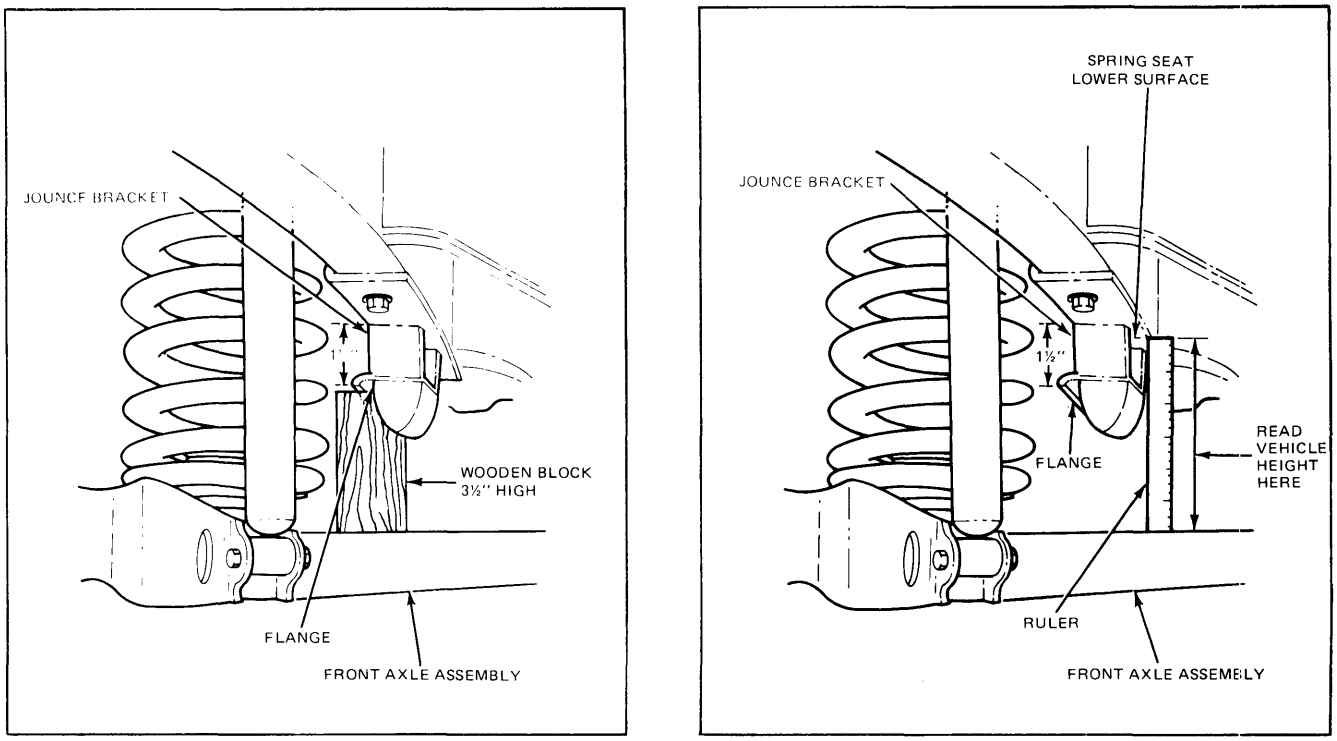
Vehicle Type	Front Axle Capacity	Alignment Factors	Minimum	Maximum	Maximum Variation Between Wheels	Optimum Resetting Specifications Desired Alignment
F-250 (4x4) ① F-150 (4x4) S/C F-350 (4x4)	3800-4500 lbs.	Caster ①②	+2½°	+5½°	1½°	+4°
		Camber ②	0	+3°	⅝°	+1½°
		Toe				3/32 inch in
		King Pin Angle ②				8½°
F-150 (4x4) ①② Reg. I/C Bronco ①②	3550 lbs	Caster ①②	+6½°	+9½°	⅝°	3½° + 8°
		Camber ②	+1°	+3°	½°	1½°
		Toe				3/32 inch in
		King Pin Angle ②				8½°

① Manual or Power Steering
The caster specifications shown are with the frame level from front to rear. Measure front to rear frame angle when checking alignment and compensate as follows. If the front of the frame is lower than the rear, the actual caster angle is obtained by adding the frame angle to the caster angle shown on the checking equipment. If the front of the frame is higher than the rear, subtract the frame angle from the caster angle shown on the checking equipment.
The radius of both front tires must be equal within ⅛ inch. Radius to be checked from center line of spindle to the ground.
② Not adjustable.

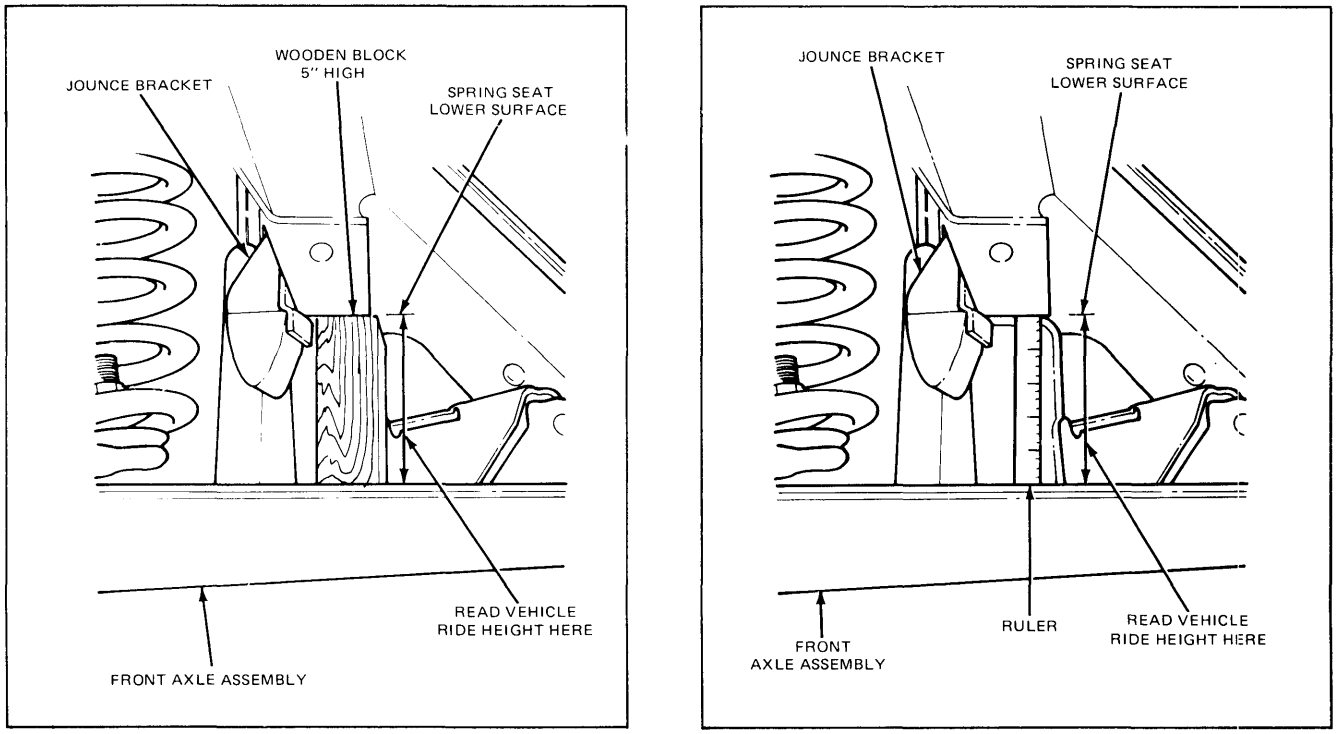
FIG. 3 Caster and Camber Angle—F-100—F-350, E-100—E-350 and Bronco CF2468-2C

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E-100—E-350 VEHICLES



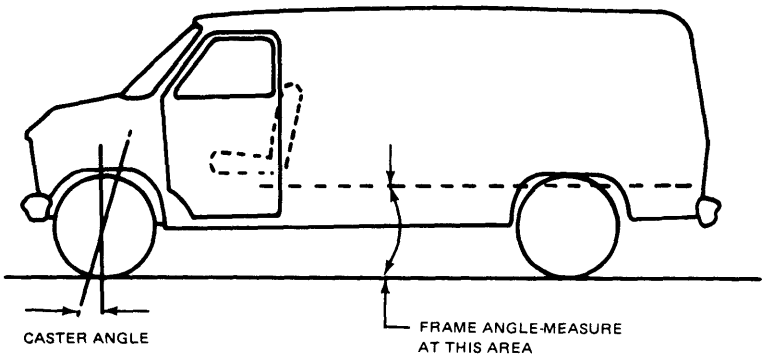
F-100—F-350 VEHICLES

F2454-2C

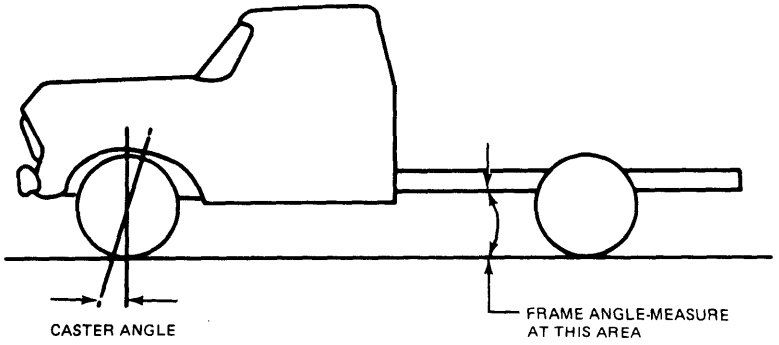
FIG. 4 Ride Height Measurement Procedure

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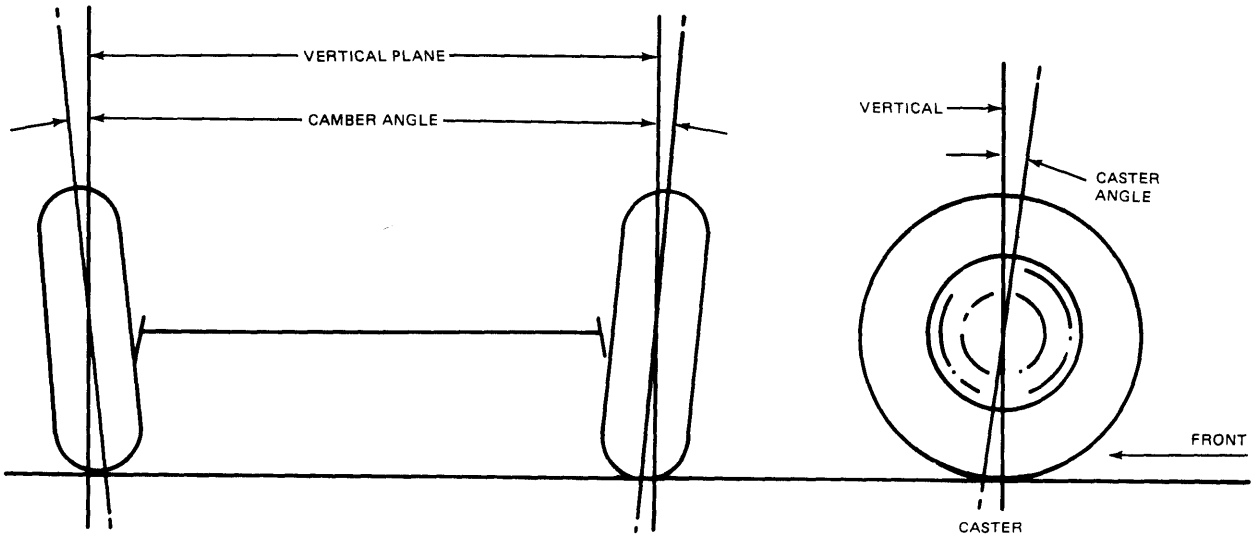
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MODEL E100-E350 VEHICLES



MODEL F100-F350 TRUCKS



F2469-2B

FIG. 5 Front End Alignment Data, E-100—E-350, F-100—F-350 (4x2) Vehicles

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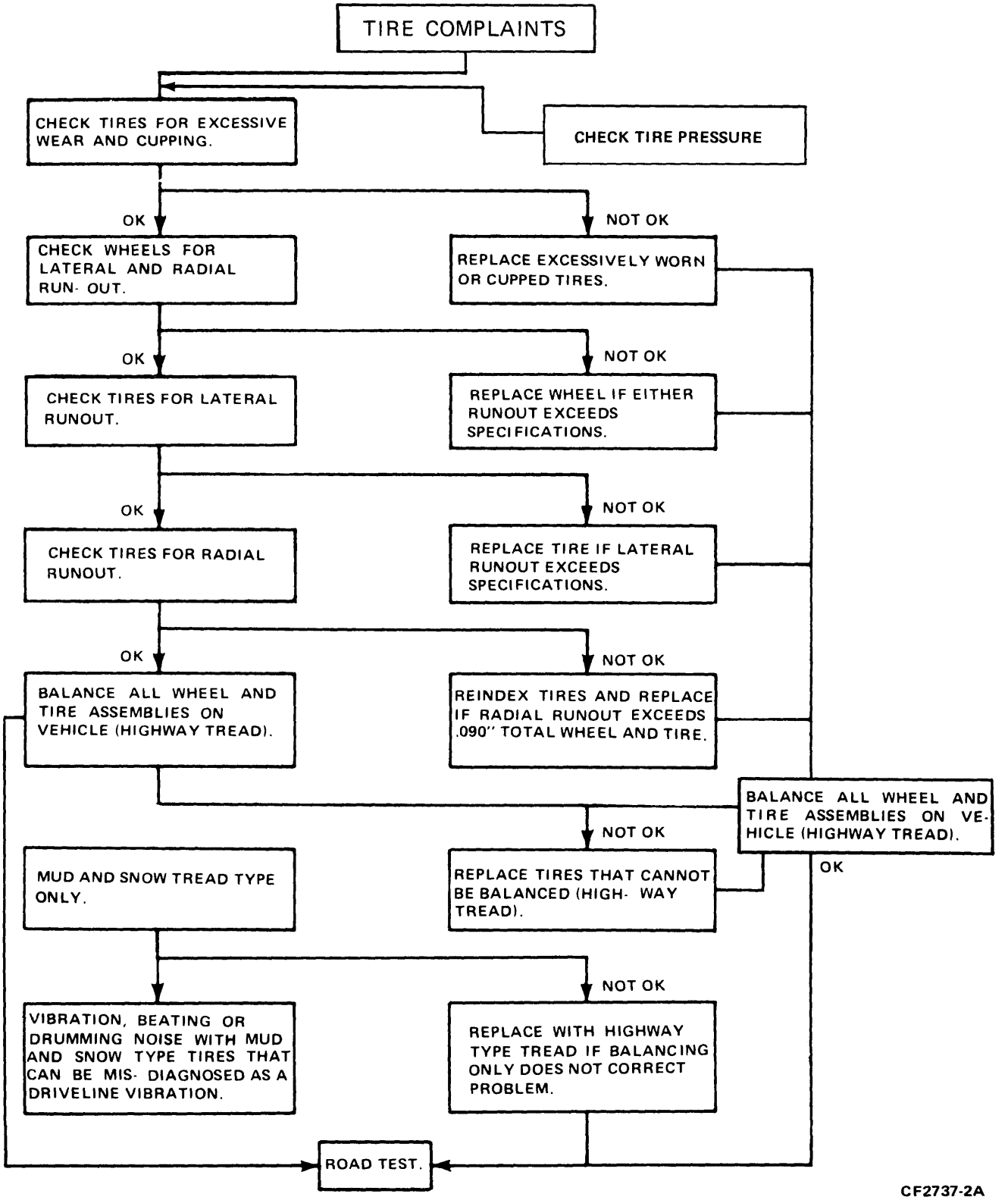
DIAGNOSIS GUIDES

CONDITION	POSSIBLE CAUSE	CORRECTION
• Vehicle leans to one side	• Incorrect tire pressure. • Improper tire/wheel usage. • Vehicle overloaded or unevenly loaded. • Loose, worn or damaged front or rear suspension components. • Improper spring usage or improperly installed and seated. • Incorrect rear axle riding heights. — Rear axle to frame dimension out of spec. (over 3/8" difference side to side). — Twin I-beam to frame dimension out of specs. (over 1/4" difference side to side).	• Assure uniform tire pressure for all four tires. • Install correct tire/wheel combination. • Correct as required. • Visually inspect suspension systems. Repair or replace as required. • Correct as required. • Adjust or replace as required. — Loosen spring shackles and hanger bolts. Jounce vehicle. Tighten U-bolts to specs. Recheck height. — Interchange rear springs side to side. Tighten U-bolts, remeasure ride height. — Replace both rear springs if difference in dimension is 3/8" or greater. Tighten shackle or hanger bolts. — If less than 3/4": install shims between lower spring seat and radius arm on low side (P/N 385795-2 max) — If over 3/4": replace low side spring. Recheck wheelhouse openings, and tailgate height
• Front bottoming or riding low	• Incorrect tire pressure. • Improper tire/wheel usage. • Vehicle overloaded or unevenly loaded. • Broken or incorrectly installed front springs. • Loose or broken shock absorbers. • Loose or broken shackles. • Distorted or split jounce bumper. • Improper ride height. • Weak springs.	• Correct as required. • Install correct tire/wheel combination. • Correct as required. • Repair or replace as necessary. • Tighten or replace as necessary. • Tighten or replace as necessary. • Correct as required. • Measure vertical distance between axle and spring tower flange/frame rail. If height is below 3.25" install shims (P/N 385792-2 shims max) under lower spring seat. • Replace springs.
• Dog tracking of rear wheels	• Loose or damaged front or rear suspension components. • Loose rear spring U-bolts. • Rear springs improperly installed on axle. • Rear spring center bolt bent. • Improperly installed front leaf springs (4x4).	• Inspect, repair or replace as required. • Tighten to specification. • Repair as required. • Replace center bolt. • Repair as necessary.
• Shimmy or wheel tramp	• Tire pressure. • Excessive tire sidewall deflection. • Irregular tire wear or tire sizes not uniform. • Loose wheel lug nuts. • Front wheel bearing adjustment. • Out-of-round wheels. • Out-of-round tires. • Wheel and tire lateral runout not to specifications. • Wheel and tire balance. • Front wheel alignment (toe-in and caster). • Deteriorated R/A bushing. • Loose or damaged shock absorbers. • Loose, worn or damaged steering linkage and idler arm connections. • Broken or sagging springs. • Loose steering gear mounting. • Incorrect steering gear adjustment.	• Adjust air pressure in tires. • Inspect, adjust air pressure and replace as necessary. • Check front wheel alignment, adjust and replace with same size tires. • Tighten to specifications. • Adjust to specifications. • Replace as required. • Replace as required. • Follow tire and wheel runout check — Group 11. • Balance wheels and tires. • Set toe to specifications. Set caster to specifications on vehicles with front leaf springs. • Replace. • Tighten and replace as necessary. • Tighten or replace as necessary. • Replace as required. • Tighten to specifications. • Adjust to specifications.
• Sway or roll	• Unequal load distribution (side-to-side). • Excessive load or body height. • Tire pressure. • Loose wheel lug nuts. • Worn or loose stabilizer assembly. • Loose or defective shock absorbers. • Broken or sagging spring. • Steering gear adjustment. • Loose steering gear mounting. • Excessive front or rear overhang. • Broken tie bolts on rear spring.	• Correct as necessary. • Correct as necessary. • Adjust air pressure in tires. • Tighten to specifications. • Tighten or replace as required. • Tighten or replace as required. • Replace as required. • Adjust to specifications. • Tighten to specifications. • Correct as necessary. • Replace as required.

CF2459-2B

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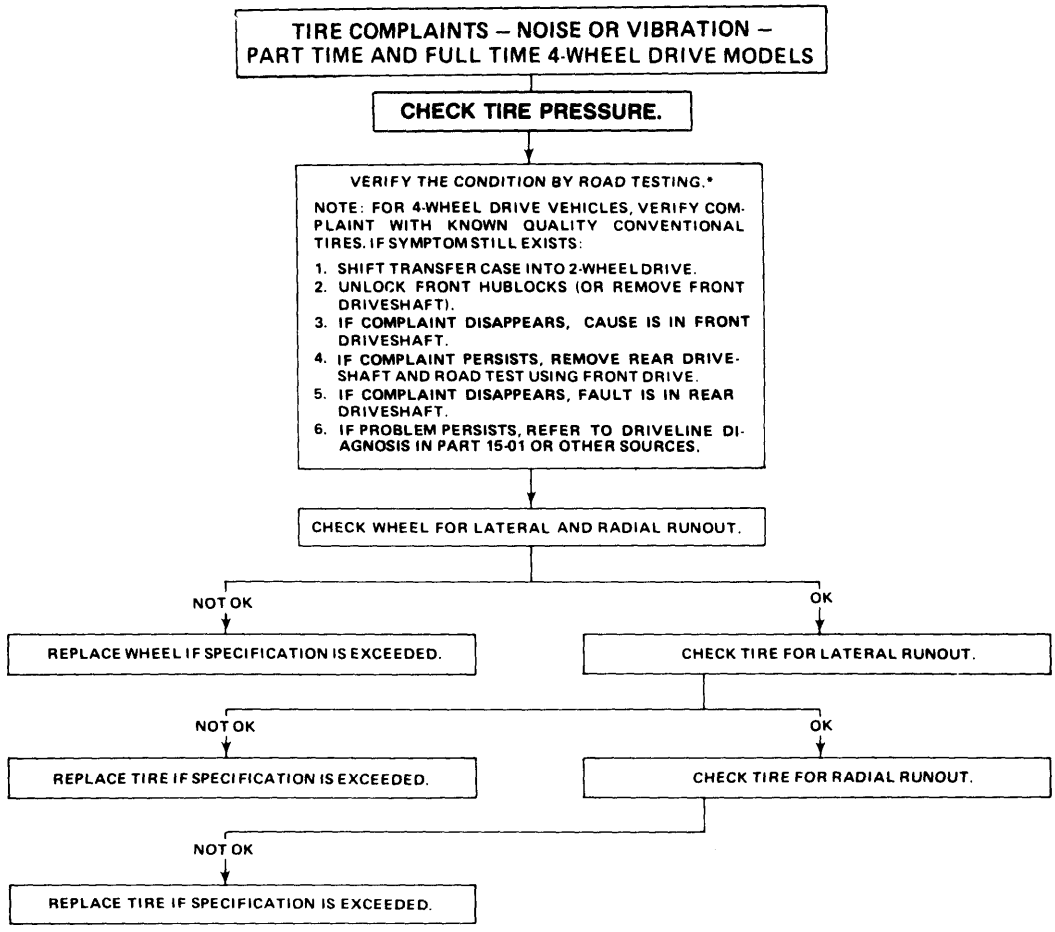
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CF2737-2A

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* FULL TIME DRIVE EXCEPTIONS:
1. REMOVE FRONT DRIVE SHAFT.
2. SHIFT TRANSFER CASE INTO HI LOCK AND ROAD TEST.
3. IF COMPLAINT PERSISTS, REMOVE REAR DRIVE SHAFT, SHIFT TRANSFER CASE TO HI LOCK AND ROAD TEST USING FRONT DRIVE AXLE.

ALL OTHER INFORMATION APPLIES TO FULL AND PART TIME 4-WHEEL DRIVE.

CF2738-2A

ADJUSTMENTS

FRONT WHEEL ALIGNMENT ADJUSTMENTS

After front wheel alignment has been checked, make the necessary adjustments.

CASTER AND CAMBER F-100-F-350, E-100-E-350, F-150-F-250-F-350 (4x4) AND BRONCO

The caster and camber angles are designed into the front axle and cannot be adjusted. The checking procedure, use of specified blocks and determination of frame angle, also apply to front drive axle vehicles. Refer to specifications section for front wheel alignment chart which contains caster, camber and toe settings. Do not bend either mechanically or by heat to correct caster or camber readings.

CHECKING AND ADJUSTING TOE ALIGNMENT

Refer to toe specifications (Fig. 4) for F-100—F-350 (4x2) and E-100—E-350 and to front wheel alignment chart in specifications section for F-150—F-250—F-350 (4x4) Bronco and adjust toe as follows, if toe alignment is not within specifications:

1. Loosen the clamp bolts at each end of the spindle connecting rod tube.
2. Rotate the sleeve until the correct toe alignment is obtained.
3. With the clamps 3/16 inch from the end of the sleeve on (4x4) models and centered between the adjustment sleeve lockring nibbs on F-100/F-350 (4x2) and E-100/E-150 models, position the bolts vertical and forward of the sleeve with the clamp nuts facing downward, (see Part 13-24) for E-100/E-150, F-100/F-350 (4x2), and (4x4) models, and tighten the clamp nuts to specifications.
4. Recheck the toe alignment to make sure no changes occurred as the clamp nuts were tightened. Steering wheel misalignment (improper clear vision) on Twin-I-Beam vehicles can be corrected only by removing and recentering the steering wheel. Because the Twin-I-Beam steering linkage has only one tie rod

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adjustment, improper clear vision cannot be corrected by adjustment of the steering linkage or suspension components. If improper clear vision is attempted to be corrected by adjustment of the tie-rod sleeve, grossly miss-set toe may result.

STEERING STOP—TWIN-I-BEAM VEHICLES

All F100-350 (4x2) and Econoline-E100-150 models have built in steering stops which cannot be altered. Econoline E-250-350 models have non-adjustable steering stop pins which are pressed into the axle. These stop pins are matched to tire size and may necessitate replacement with different length stop pin if the tire size is changed.

SPINDLE ARM STOP ADJUSTMENTS

Fig. 6 shows the position of the front wheels when checking the stop adjustment angles shown in the specification charts at the end of this Part.

MANUAL, INTEGRAL OR SEMI-INTEGRAL POWER STEERING GEAR

1. Raise the front of the vehicle until the wheels clear the floor.
2. Set spindle stop bolts to obtain specified angle. (Bronco, F-150—F-250 4x4 cannot be adjusted.)

FRONT END GENERAL INSPECTION

E-100-E-350, F-100-F-350 AND BRONCO

The following front end general inspection should be performed before checking caster and camber and adjusting toe or if steering or handling difficulties and/or excessive tire wear are encountered.

1. Inflate all tires to the specified pressure (cold). Check both front tires, they should be the same size, ply rating and load range.
2. Raise the front of the vehicle off the floor. Grasp each front tire at the front and rear, and push the wheel inward and outward. **If any free play is noticed between the hub and rotor and front spindle, adjust the wheel bearings.** Replace the bearings if they are worn or damaged. Adjust and/or replace worn or damaged bearings as outlined in Group 11.
3. Grasp each tire at the top and bottom, and shake the wheel while watching the movement of the disc brake support or front spindle assembly. **If the front spindle assembly moves more than 1/32 inch at the upper or lower spindle assembly relative to the axle, or the spindle pin is loose in the I-Beam, rebush the spindles as outlined in this Group.** Refer to Group 15 for front axle removal and installation procedures on four wheel drive vehicles.
4. Check all steering linkage for wear or maladjustment. Adjust and/or replace worn parts as outlined in Group 13.
5. Check the steering gear mounting bolts, and tighten them wherever required. Check the front spring clips (U-bolts) and the spring tie bolt, and tighten them if necessary on F-250—F-350 (4x4) vehicles.
6. Inspect the radius arm to be sure it is not bent or damaged. Inspect the bushings at the radius arm-to-frame and radius arm-to-axle attachments for wear or looseness. Repair or replace parts as necessary.
7. Check for suspension that is not lubricated properly. Refer to the Maintenance and Lubrication Volume 5 of the Truck Shop Manuals for proper lubricant and lubricating procedures.
8. Check the condition of suspension components. For example, rubber pads on F-150 (4x4) and Bronco in poor condition will cause harsh or poor ride problems.
9. Check for suspension components installed with a preload on pivot points and bushings. As an example, a leaf spring with a rear shackle bound up. To neutralize a condition such as this, loosen the attaching nuts and position the components in a neutral condition; then, tighten the nuts to specifications.
10. Check for heavy-duty suspension components installed on the lighter vehicles. Competition or heavy duty suspension components have hard ride characteristics. If these components are installed through error on a vehicle the components should be replaced with standard suspension parts.
11. Check wheel and tire runout and check and balance each front wheel as required. Refer to procedures in Diagnosis and Testing, Group 11, Wheels and Tires.

SHOCK ABSORBER CHECKS

The hydraulic shock absorbers on vehicles are of the direct-acting type. This type shock absorber is nonadjustable and non refillable and cannot be repaired.

Before replacing a shock absorber, check the action of the shock absorbers as follows:

ON VEHICLE TESTS

1. Check the shock absorber to be sure it is securely and properly installed. Check the shock absorber insulators for damage and wear. Replace any worn or damaged insulators and tighten attachments to the specified torque (on a shock absorber which incorporates integral insulators, replace the shock absorbers). Tighten shock absorber attachments to Specifications in Specifications Section of each suspension group.
2. Inspect the shock absorber for evidence of fluid leakage. A light film of fluid is permissible. Be sure any fluid observed is not from sources other than the shock absorber.

   Replace the shock absorber if leakage is severe.
3. Disconnect the lower end of the shock absorber. Extend and compress the shock absorber as fast as possible, using as much travel as possible. Action should become smooth and uniform throughout each stroke. Higher resistance on extension than on compression is a normal condition. Faint swish noises are also normal.

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Tire Size	Tire Type	Wheel Size	Wheel Type & Number of Studs	F-100/F-150 (4x2) F-100/F-150 Super Cab Angle	F-250 (4x2) Std. Brks. F-250 S/C Lt. Duty Angle	F-250 (4x2) RPO F-250 S/C Hvy. Duty Angle	Brks.F-350 (4x2) F-350 Super Cab Angle
G78 x 15	Tubeless	5.5K	Disc — 5	39°			
H78 x 15	Tubeless	5.5K @	Disc — 5	39°			
7.00 x 15	Tube	5.5K @	Disc — 5	39°			
8.00 x 16.5	Tubeless	6.00	Disc — 8		32°	31.3°	31.3°
8.75 x 16.5	Tubeless	6.75	Disc — 8		32°	31.3°	31.3°
9.50 x 16.5	Tubeless	6.75	Disc — 8		32°	31.3°	31.3°
L78 x 15	Tubeless	5.5K @	Disc — 5	39°			
7.50 x 16	Tube	5.5F	Disc — 8		32°	31.3°	31.3°
6.50 x 16	Tube	5.00	Disc — 5	39°			
8.75R x 16.5	Tubeless	6.75	Disc — 8		32°	31.3°	31.3°
HR78 x 15	Tubeless	5.5K @		39°			
9.50R x 16.5	Tubeless	6.75	Disc — 8		32°	31.3°	31.3°
7.50R x 16	Tube	5.5F	Disc — 8		32°	31.3°	31.3°

@ 6.0K Wheel Required on F-150 (4x2), F-150 Super Cab.

				Bronco		F-150 (4x4)		Non Adjustable Stops	
Tire Size	Tire Type	Wheel Size	Wheel Type & Number of Studs	Power Angle	Manual Angle	Power Angle	Manual Angle	1977½ F-250 (4x4)* 1978 S/C F-150/250 (4x4) w/Dana 44 Axle Angle	F-250 (4x4) w/Dana 60 Axle
E78 x 15-B	Tubeless	5.5K	Disc — 5						
H78 x 15	Tubeless	5.5K	Disc — 5	35.6°	33.9°	35.6°	33.9°		
G78 x 15	Tubeless	5.5K	Disc — 5						
L78 x 15	Tubeless	5.5K #	Disc — 5	35.6°	33.9°	35.6°	33.9°		
8.75R x 16.5	Tubeless	6.75	Disc — 8					35.0°	33.0°
7.00 x 15	Tube	5.5K #	Disc — 5	35.6°	33.9°	35.6°	33.9°		
8.00 x 16.5	Tubeless	6.00	Disc — 8					35.0°	
8.75 x 16.5	Tubeless	6.75	Disc — 8					35.0°	33.0°
9.50 x 16.5	Tubeless	6.75	Disc — 8					35.0°	33.0°
9.50R x 16.5	Tubeless	6.75	Disc — 8					35.0°	33.0
7.50 x 16	Tube	5.5.0 F	Disc — 8					35.0°	33.0°
6.50 x 16	Tube	5.00	Disc — 5						
7.50R x 16	Tube	5.5F	Disc — 8					35.0°	33.0°

1/ Use cap C7TA-38279-A with L78 x 15 tires only to restrict turn angle to 33°

2/ Use cap C7TA-38279-A with L78 x 15 and 7.00 x 15 tires, mud and snow only, to restrict turn angle to 33.5° L.T./34° R.T.

6.0K wheel required on F-150 (4 x 4)

* Manual steering not available.

CF2364-2D

FIG. 6 Spindle Arm Stop Adjustment—All Except Twin-I-Beam Vehicles

3. If the action is smooth, but the shock absorber is suspected of being weak, follow Step 4:
4. Repeat Step 3 on the mating shock absorber installed on the opposite side of the vehicle, and compare results of both tests. If the action is similar, it is unlikely that either shock absorber is worn or damaged. Reconnect both shock absorbers.
5. If there is a difference between the two, replace the shock absorber having the lower resistance. **Ensure that the part number of the replacement is the same as that of the original shock absorber.** The replacement shock absorber resistance will appear to be higher than either original, due to initial friction of the rod seal.

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Front Suspension — Twin I-Beam

PART 14-21

APPLIES TO F-100 — F-350 (4x2) AND E-100 — E-350 ONLY

SUBJECT	PAGE
DESCRIPTION	
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Front Shock Absorber	21-1
Front Stabilizer Bar	21-1
Front Suspension	
E-100 — E-350, F-100 — F-350	21-1
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Shock Absorber Lower Bracket On Radius Arm	21-7
Spindle Bushing — Bronze	21-8
Stabilizer Bar	21-7
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DESCRIPTION

FRONT SUSPENSION

E-100—E-350, F-100—F-350

The F-100—F-350 (4x2) and E-100-350 vehicles use coil springs with the two I-beam type front axles. The springs are mounted between the frame spring pocket and the axle, (Figs. 1 and 2).

FRONT AXLE

The F-100—F-350 (4x2) and E-100-350 vehicles use two I-beam type front axles (one for each front wheel). One end of each axle is attached to the spindle and a radius arm, and the other end is attached to a frame pivot bracket on the opposite side of the vehicle.

Each spindle is held in place on the axle by a spindle pin, which pivots in bronze bushings pressed in the upper and lower ends of the spindle. A thrust bearing is installed between the lower end of the axle and the spindle to support the load on the axle (Fig. 6). All vehicles have a steering arm which is an integral part of the spindle (Figs. 3, 4 and 5).

FRONT SHOCK ABSORBER

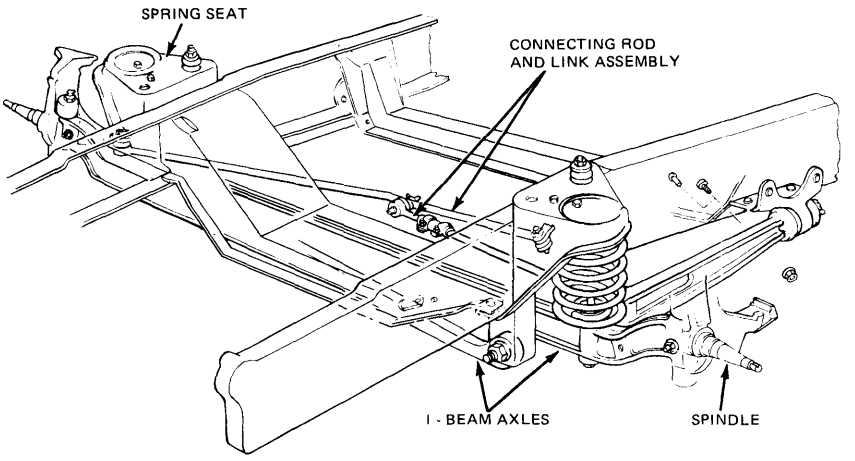
The hydraulic shock absorbers are of the direct, double-acting type. They provide a continuous dampening effect both on compression and rebound. These shock absorbers are of telescopic design with rubber grommets at the mounting points for quiet operation. The shock absorbers are sealed, non-adjustable units and must be replaced as complete assemblies.

FRONT STABILIZER BAR

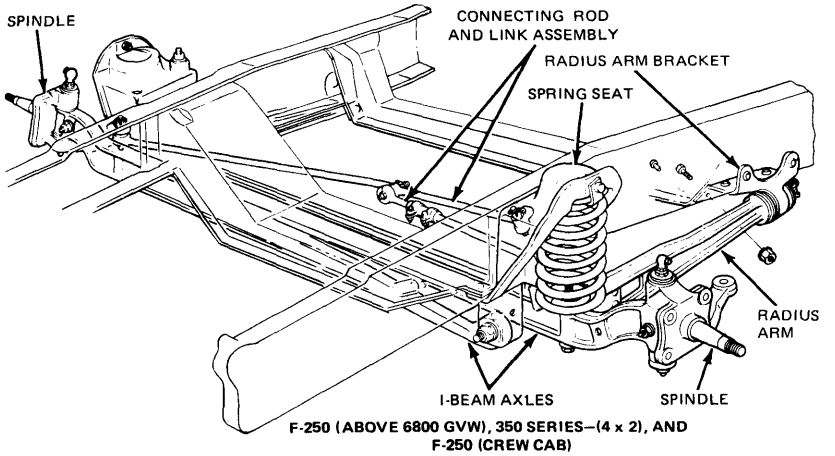
The Front Stabilizer bar (F-100—F-350 and E-100—E-350) is located forward of the front axle and is attached to the I-Beam through a special link assembly that is dampened by an insulator sandwich where it is attached to the I-Beam Link Assembly. Stabilization is acquired through torque loads transmitted to the frame side rails through the stabilizer bar assembly. Refer to Figs. 10 and 11.

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F-100-F150 (4 x 2), F-250 (4 x 2), 6200-6800 GVW



F-250 (ABOVE 6800 GVW), 350 SERIES—(4 x 2), AND
F-250 (CREW CAB)

F1752-2D

FIG. 1 Front Suspension—F-100 Thru F-350

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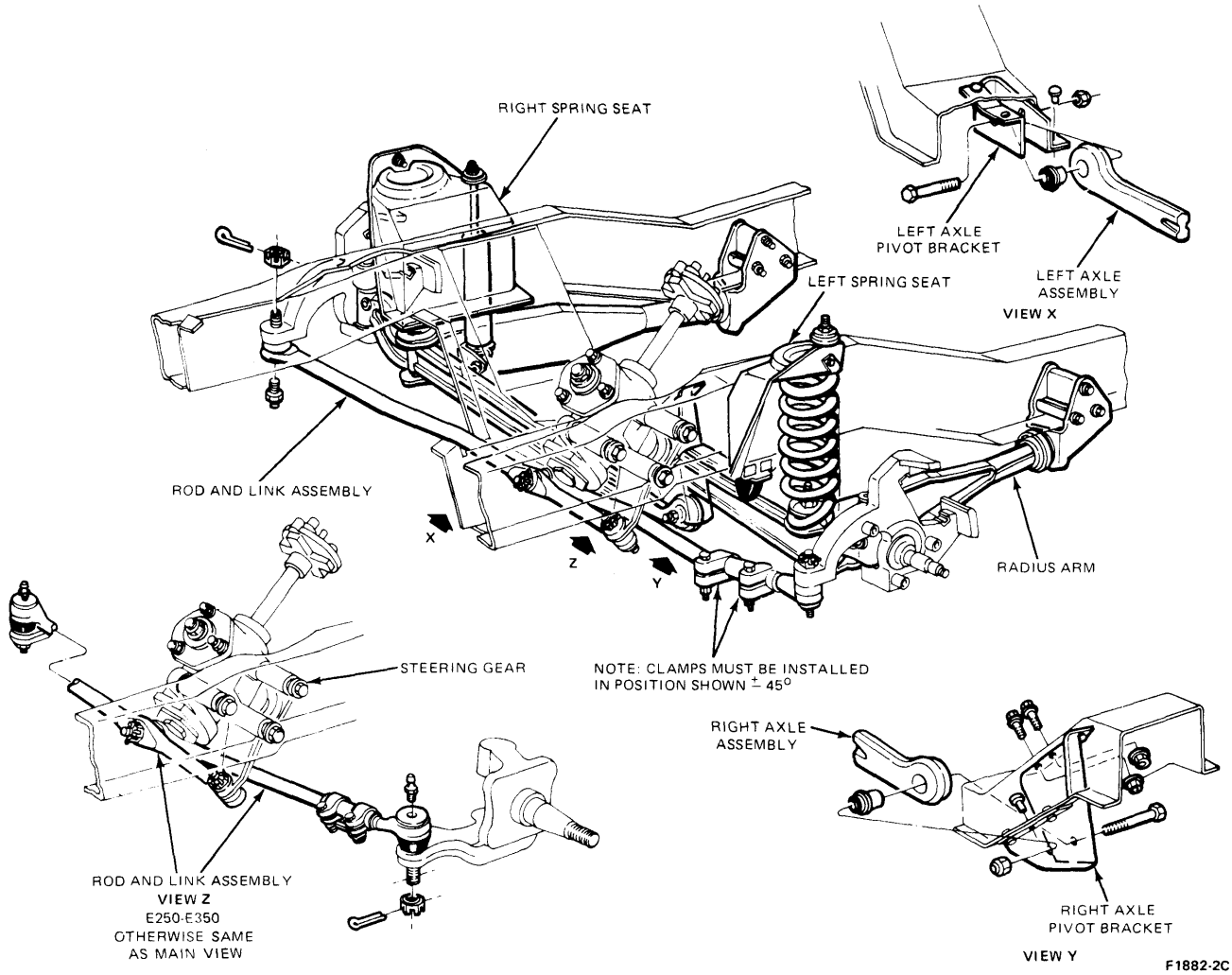


FIG. 2 Front Suspension—E-100—E-350

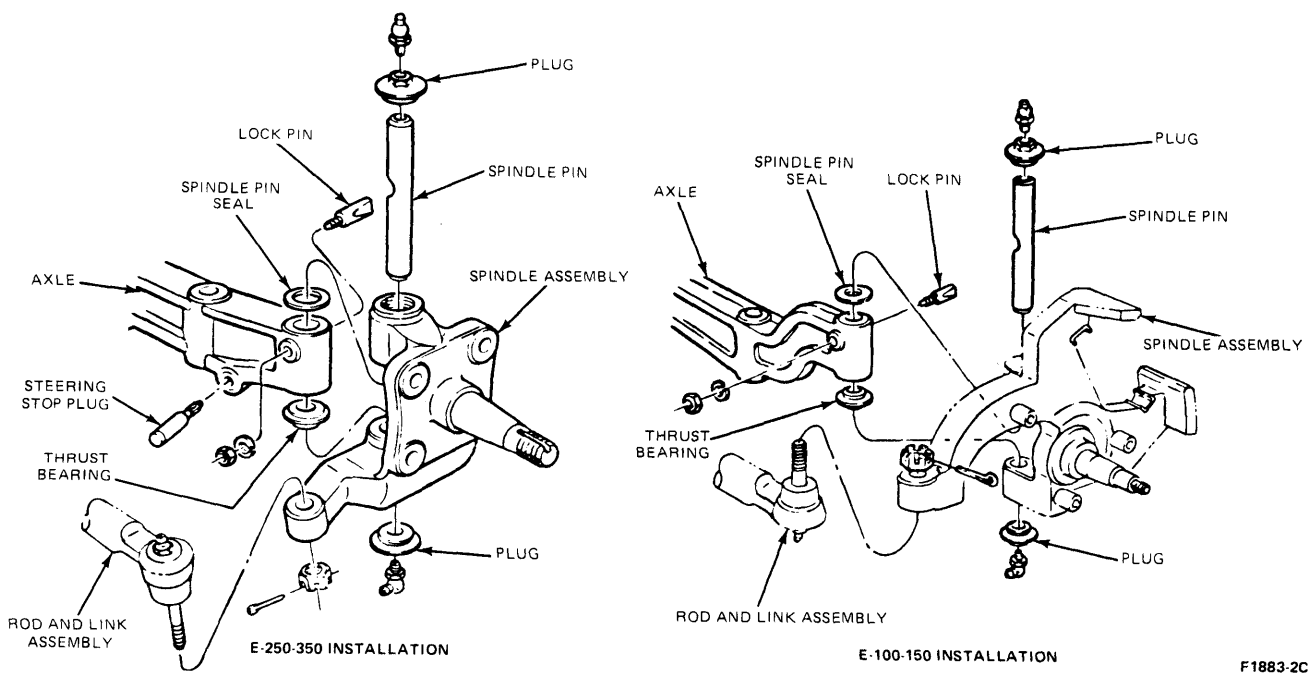


FIG. 3 Spindle Installation—E-100 Through E-350

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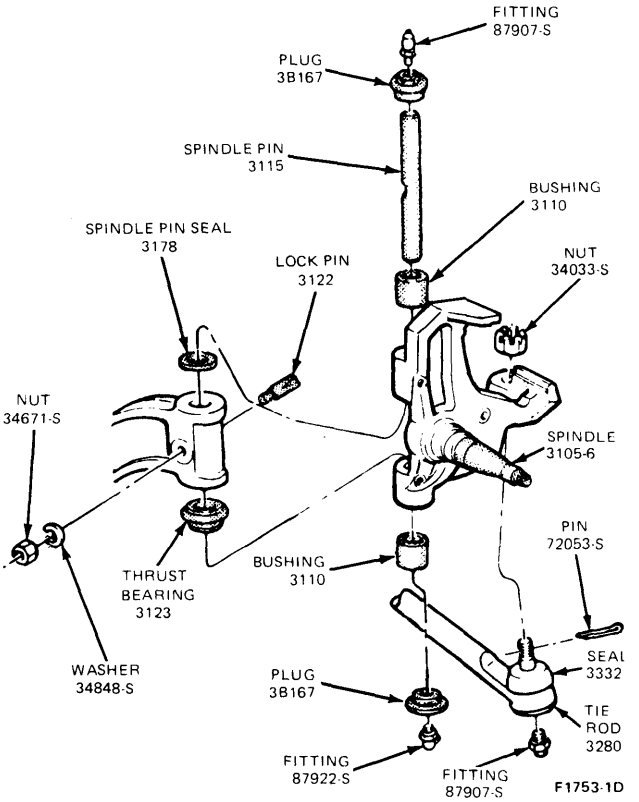


FIG. 4 Spindle Installation—F-100-150-250 (6800 GVW or less)

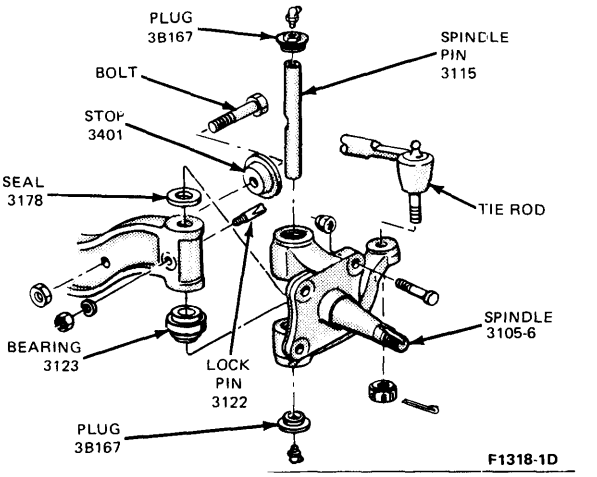


FIG. 5 Spindle Installation—F-250 (over 6800 GVW), F-350

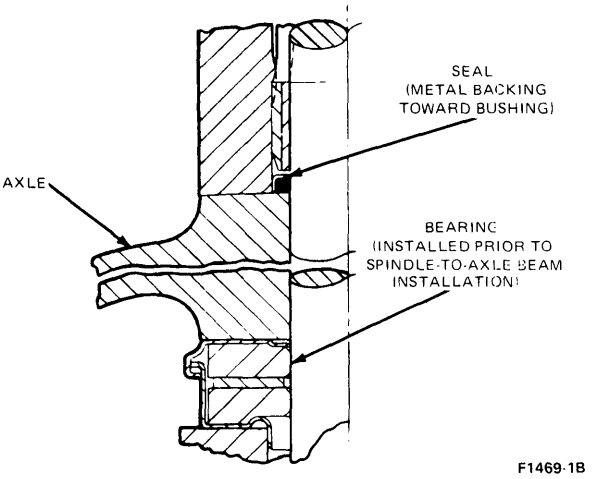


FIG. 6 Bearing Seal Installation

REMOVAL AND INSTALLATION

FRONT SPRING

Removal Refer to Figs. 7 and 8

1. Raise the front of the vehicle and place safety stands under the frame and a jack under the axle. Refer to Group 50 for hoisting instructions.
2. Disconnect the shock absorber from the lower bracket.
3. Remove two spring upper retainer attaching bolts from the top of the spring upper seat and remove the retainer.
4. Remove the nut attaching the spring lower retainer to the lower seat and axle and remove the retainer.
5. Slowly lower the axle and remove the spring.

Installation

1. Place the spring in position and slowly raise the front axle.
2. Position the spring lower retainer over the stud and lower seat, and install the attaching nut.
3. Position the upper retainer over the spring coil and against the spring upper seat, and install the two attaching bolts.
4. Tighten the upper retainer attaching bolts and lower retainer attaching nut to 30-70 ft-lbs.
5. Connect the shock absorber to the lower bracket and install the rebound bracket.
6. Remove the jack and safety stands.

FRONT WHEEL SPINDLE

Removal Refer to Figs. 3, 4 and 5

1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly.
3. Remove the caliper assembly from the rotor and hold it out of the way with wire. Refer to Caliper Removal instructions in Part 12-24.

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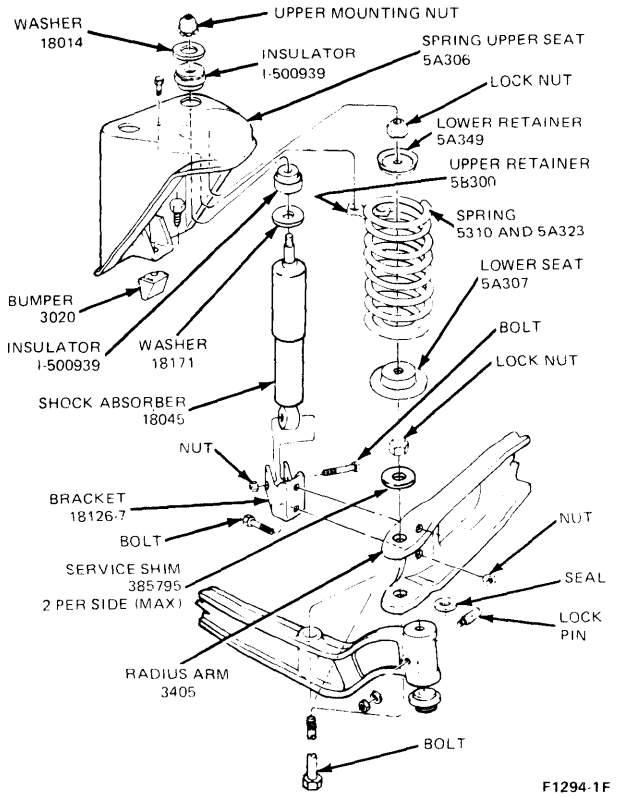


FIG. 7 Front Spring and Related Parts—F-100—250 (F-350 Similiar)

4. Remove the dust cap, cotter pin, nut, nut retainer, washer, and outer bearing, and remove the rotor from the spindle.
5. Remove inner bearing cone and seal. Discard the seal.
6. Remove brake dust shield and if equipped, the caliper anchor plate. Refer to Part 12-24.
7. Disconnect the steering linkage from the integral spindle and spindle arm (Figs. 3, 4 and 5) with Tool 3290C.
8. Remove the nut and lockwasher from the locking bolt, and remove the locking bolt.
9. Remove the upper and lower spindle pin plugs; then, drive the spindle pin out from the top of the axle and remove the spindle and bearing (Figs. 3, 4 and 5). Knock out the spindle pin seal.

Installation

1. Make sure the spindle pin hole in the axle is free of nicks, burrs, corrosion or foreign material. Clean up the bore as necessary and lightly coat the surface with grease.
2. Install a new spindle seal with the metal backing facing up towards the bushing as shown in Fig. 6. Gently press into position, being careful not to distort the casing.
3. Install a new thrust bearing with the lip flange facing down towards the lower bushing as shown in Fig. 6. Press until the bearing is firmly seated against the surface of the spindle.
4. Lightly coat the bushing surfaces with grease and place the spindle in position on the axle.
5. Install the spindle pin with the "T" stamped on one end towards the top, and the notch in the pin aligned with the lock pin hole in the axle. Drive the

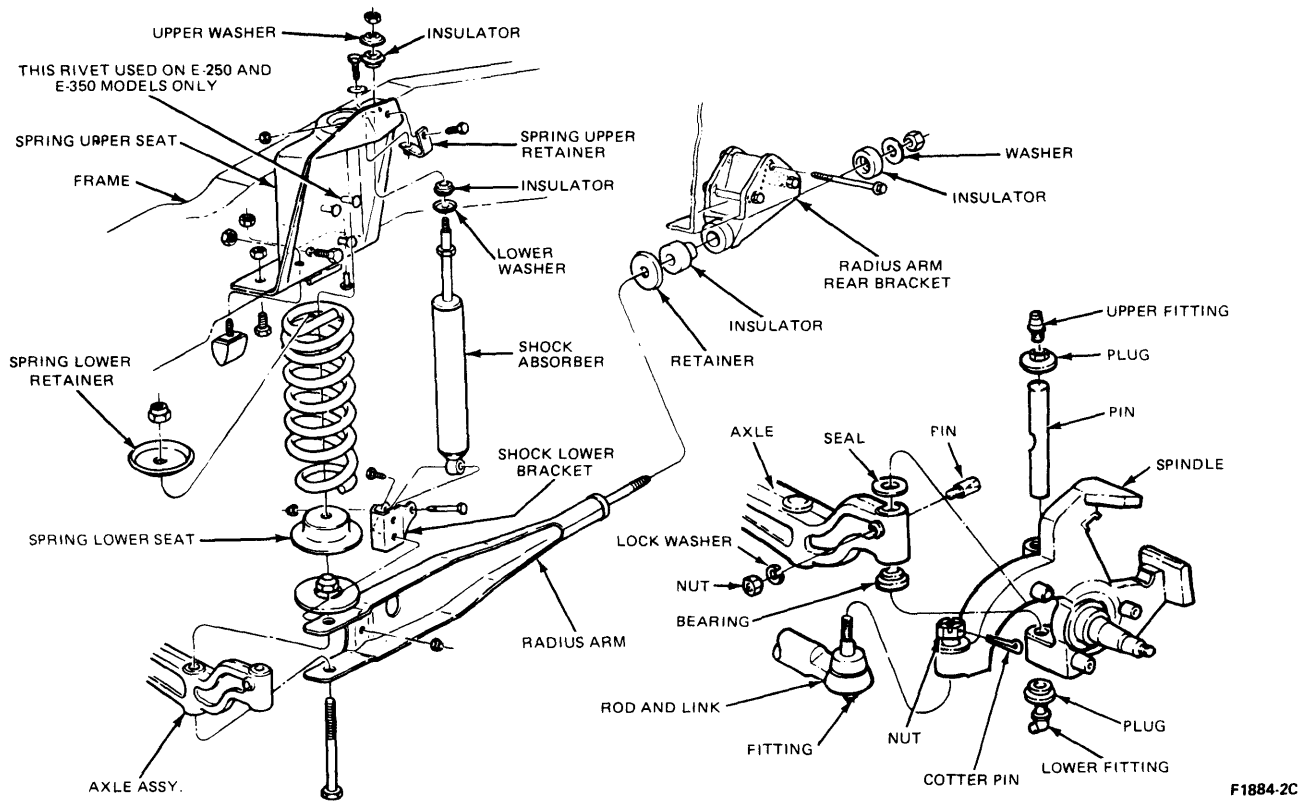


FIG. 8 Front Spring And Related Parts E-100—E-150

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pin through the bushings and axle from the top until the spindle pin notch and axle lock pin hole are in line.

6. Install the lock pin with the threads pointing forward and the wedge groove facing the spindle pin notch. Firmly drive the lock pin into position and mount the lockwasher and nut. Tighten the nut to 38-62 ft-lbs.
7. Install the spindle pin plugs into the threads at the top and bottom of the spindle. Tighten the plugs to 35-50 ft-lbs. Orient the 45 degree zerk fittings to insure access when the brake and wheel components are installed.
8. Lubricate the spindle pin and bushings through both fittings until grease is visible seeping past the upper seal at the top and from the thrust bearing slip joint at the bottom. If grease does not appear, recheck the installation procedure to correct the problem. Lack of adequate lubrication will result in rapid failure of the spindle components.
9. Install the dust shield and (if so equipped) the caliper anchor plate. Refer to Part 12-24.
10. Pack the inner and outer bearing cone with bearing grease. Use a bearing packer. If a bearing packer is unavailable pack the bearing cone by hand working the grease through the cage behind the rollers.
11. Install the inner bearing cone and seal as described in Part 11-10. Install the hub and rotor on the spindle.
12. Install the outer bearing cone, washer, and nut. Adjust bearing end play and install the cotter pin and dust cap as described in Part 11-10.
13. Install the caliper as described in Part 12-24.
14. Connect the steering linkage to the spindle. Tighten the nut to 50-75 ft-lbs and advance the nut as required for installation of the cotter pin.
15. Install the wheel and tire assembly.
16. Lower the vehicle.
17. Check, and if necessary adjust the toe setting. Refer to Part 14-01, General Suspension Service under Adjustments.

FRONT SHOCK ABSORBER

E-100—E-350

Removal

1. Insert a wrench from the rear side of the spring upper seat to hold the shock absorber upper retaining nut. Loosen the stud by turning the hex provided on the exposed (lower) part of the stud (Fig. 8).
2. Disconnect the lower end of the shock absorber from the lower bracket (bolt and nut).
3. Remove the shock absorber, washers and rubber insulators.

Installation

1. When installing a new shock absorber, use new rubber insulators. Install the lower washer and insulator on the stud end, and position the shock absorber in the spring upper seat. Install the upper insulator, washer and self-locking nut. While holding the nut as described in Step 1, tighten to specified torque by turning the hex provided on the stud.
2. Connect the lower end of the shock absorber to the lower bracket by installing the bolt and nut. Tighten to 40-60 ft-lbs.

F-100-350

Removal

1. Remove the upper mounting nut (Fig. 7). Disconnect the lower end of the shock absorber from the lower bracket (bolt and nut).
2. Remove the shock absorber, washers and rubber insulators.

Installation

1. When installing a new shock absorber, use new rubber insulators. Install the lower washer and insulator on the stud end, and position the shock absorber in the spring upper seat. Install the upper insulator, washer and self-locking nut and hand tighten.
2. Connect the lower end of the shock absorber to the lower bracket by installing the bolt and nut. Tighten to 40-60 ft-lbs, then tighten the upper mounting nut to 15-25 ft-lbs.

RADIUS ARM

Removal

1. Raise the front of the vehicle, place safety stands under the frame. Place a jack under the axle.
2. Disconnect the lower end of the shock absorber from the shock lower bracket (bolt and nut).
3. Remove tie rod.
4. Remove the front spring as outlined in this part.
5. Remove the spring lower seat from the radius arm, and then remove the bolt and nut that attaches the radius arm to the axle and front bracket (Figs. 7, 8, 9, 10 and 11).
6. Remove the nut, rear washer and insulator from the rear side of the radius arm rear bracket; Disconnect the tie rod.
7. Remove the radius arm from the vehicle, and remove the inner insulator and retainer from the radius arm stud.

Installation

1. Position the front end of the radius arm to the axle and front bracket, install the attaching bolt from underneath through the bracket, radius arm and axle, and then install the nut finger tight (Figs. 7, 8, 9, 10 and 11). Install tie rod.
2. Install the retainer and inner insulator on the radius arm stud and insert the stud through the radius arm rear bracket (Figs. 7, 8, 9, 10 and 11).
3. Install the rear washer, insulator and nut on the arm stud at the rear side of the arm rear bracket. Tighten the nut to 80-120 ft-lbs.
4. Tighten the nut on the radius arm-to-axle and front bracket bolt to 240-320 ft-lbs.

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5. Install the spring lower seat on the radius arm so that the hole in the seat indexes over the arm-to-axle bolt.
6. Install the front spring as outlined in the foregoing procedures.
7. Connect the lower end of the shock absorber to the lower bracket on the radius arm with the attaching bolt and nut, tighten the nut to 40-60 ft-lbs.

SHOCK ABSORBER LOWER BRACKET ON RADIUS ARM

The shock absorber lower bracket is attached to the radius arm by two bolts and nuts (Figs. 7 and 8). If this bracket is being replaced, be sure to use the serrated-shank, special bolts as specified in the Ford Truck parts catalog. **No substitutions are allowed.**

RADIUS ARM REAR BRACKET—E-100—E-350 ONLY

With the radius arm removed, remove the three rear bracket-to-frame bolts and nuts and remove the bracket, position the replacement bracket to the frame and install the three attaching bolts and nuts (Figs. 7 and 8). **Do not completely tighten one at a time. Partially tighten all three and repeat in sequence until specified torque (see specificatons at the end of the section) is obtained for all.**

STABILIZER BAR

Refer to Figs. 10 and 11.

Removal

1. Disconnect the left and right ends of the front stabilizer bar from the link assembly attached to the I-beam bracket (Fig. 10).
2. Disconnect frame side rail retainer bolts and remove the stabilizer bar.
3. Disconnect the stabilizer link assembly by loosening the right and left locknuts from their respective I-Beam brackets.

Installation

1. Connect the right and left stabilizer links to their respective I-Beam brackets by sliding the bolt through the I-Beam bracket hole toward the inside of the side rail. Tighten the washer and locknut to 40-60 ft-lbs. **The link must be installed with the bend facing forward.**
2. Connect the stabilizer bar to the frame side rails by placing the two retainers on the bottom of the side rails and tightening the four through bolts to 15-25 ft-lbs torque (Figs. 10 and 11).
3. Connect the stabilizer bar left and right ends to the left and right link assemblies respectively making sure that the washers and two insulators are

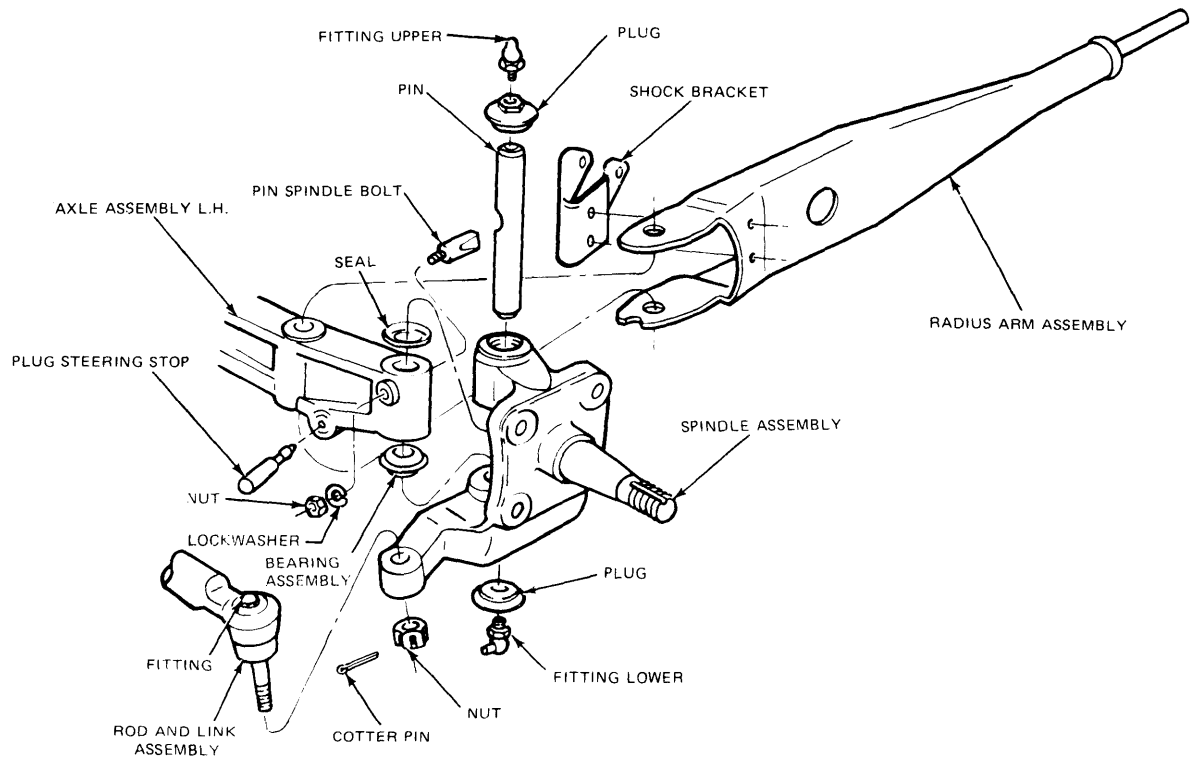


FIG. 9 Radius Arm Assembly—E-250 and 350

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properly positioned as in Figs. 10 and 11. Tighten the retaining nuts to 15-25 ft-lbs.

FRONT I-BEAM AXLE

1. Remove the front wheel spindle, the front spring, and the stabilizer bar (if so equipped) as outlined in the foregoing procedures.
2. Remove the spring lower seat from the radius arm, and then remove the bolt and nut that attaches the front bracket and radius arm to the (I-Beam) front axle (Figs. 7, 8, 9, 10 and 11).
3. Remove the axle-to-frame pivot bracket bolt and nut (Fig. 1, and View X or Y, Fig. 2).
4. To install, position the axle to the frame pivot bracket and install the bolt and nut finger tight.
5. Position the opposite end of the axle to the radius arm and front bracket, install the attaching bolt from underneath through the bracket, the radius arm, and the axle. Install the nut and tighten to 120-150 ft-lbs.
6. Install the spring lower seat on the radius arm so that the hole in the seat indexes over the arm-to-axle bolt (Figs. 7 and 8).
7. Install the front spring as outlined in this Part.
8. Tighten the axle-to-frame pivot bracket bolt to specified torque (Figs. 1 and 2).
9. Install the front wheel spindle and, if so equipped, the stabilizer bar as outlined in this part.

SPINDLE BUSHING—BRONZE

1. On a spindle with bronze bushings, drive the bushing out of the spindle (Fig. 12) with a tool that is slightly smaller than the spindle bore. If a tool is not available, carefully drive a small center punch between the bushing and the spindle, at the split side of the bushing. Collapse the bushing, and remove it from the spindle bore.
2. Clean the spindle bores thoroughly.
3. Position a new bushing in the spindle bore, with the open end of the grease groove of the bushing

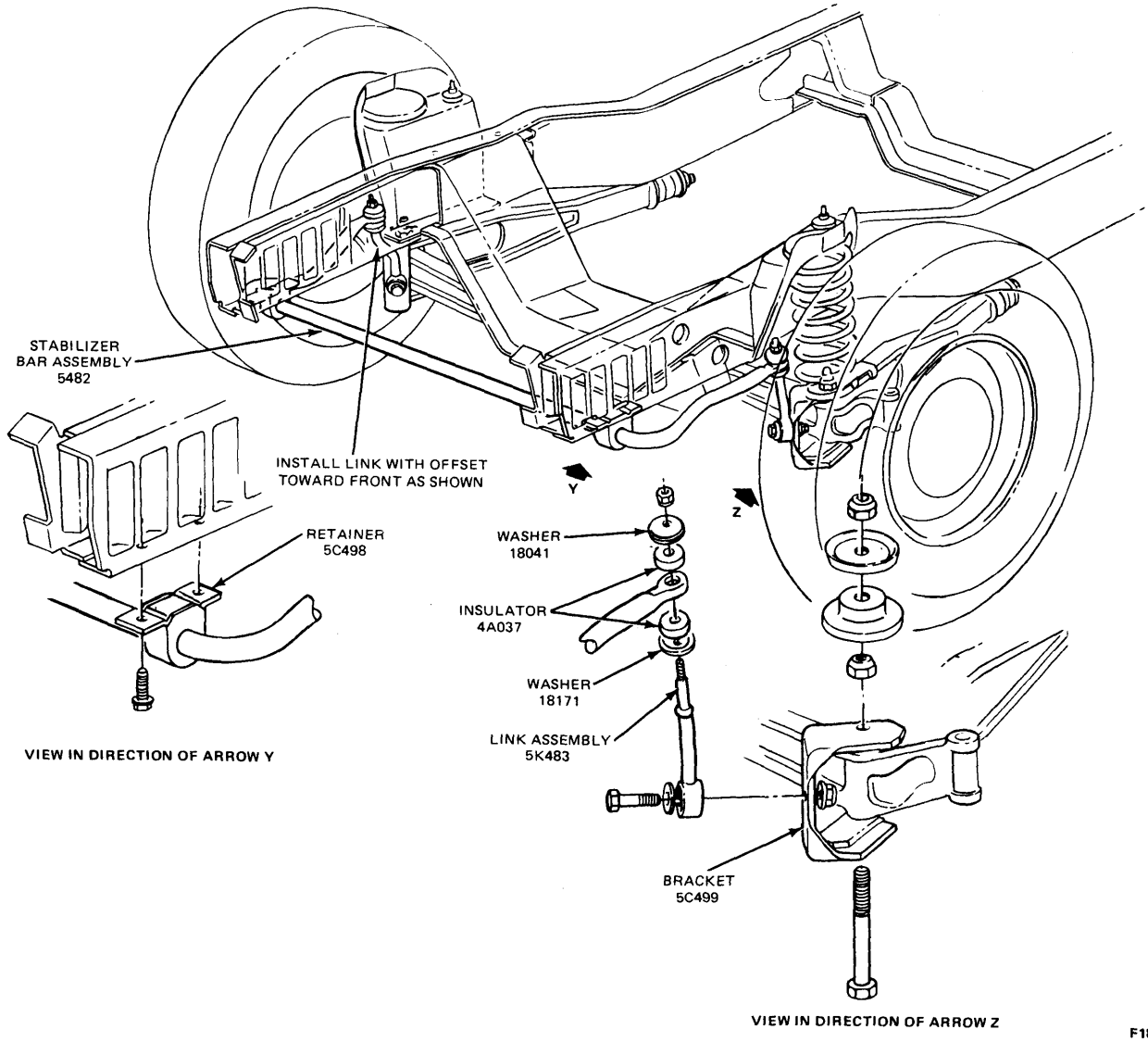


FIG. 10 Stabilizer Bar Installation—E-100-350

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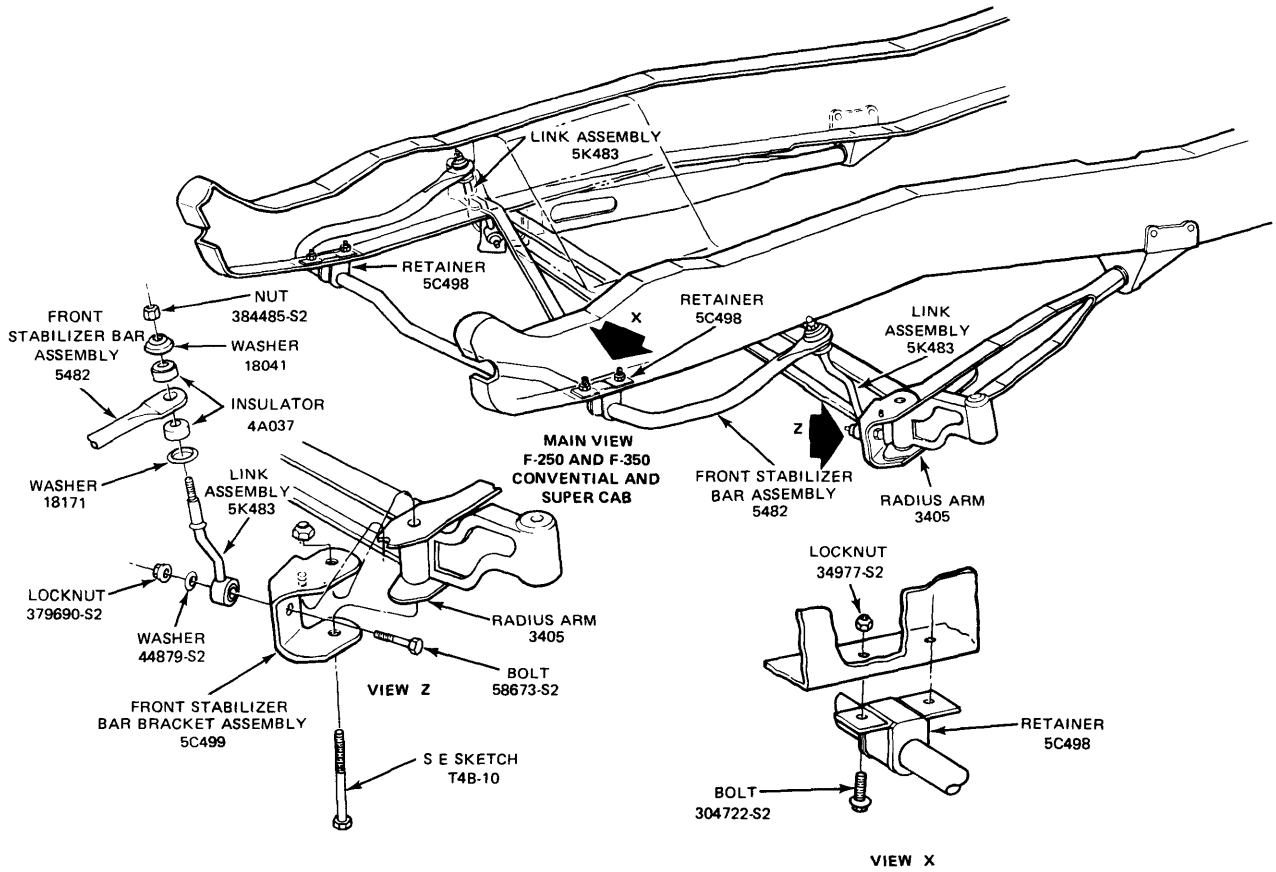


FIG. 11 Stabilizer Bar Installation—F-100—F-350

toward the axle. Drive the bronze bushing into the spindle (Fig. 13) with a driver that pilots in the bushing.

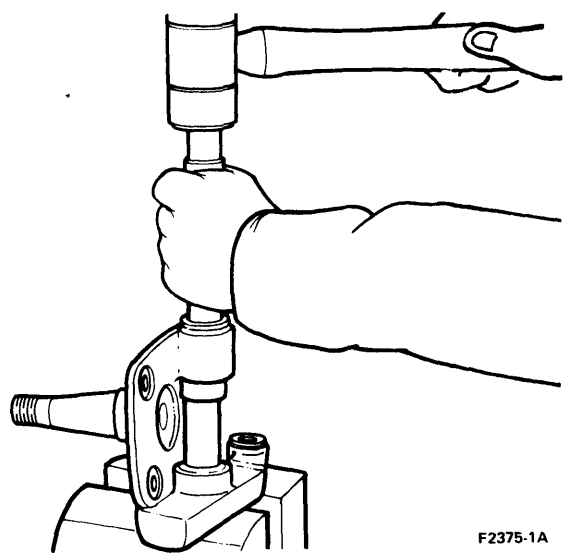


FIG. 12 Removing Bronze Bushing

4. Install the remaining bushing in the same manner.
5. Ream bronze bushings to 0.001-0.003 inch larger than the diameter of a new spindle pin (Fig. 14).

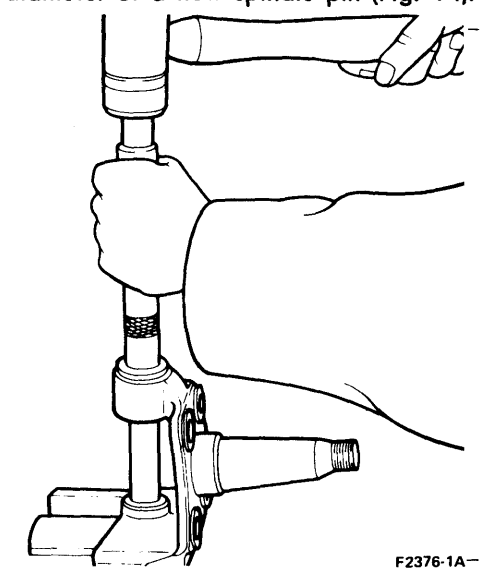


FIG. 13 Installing Bronze Bushing

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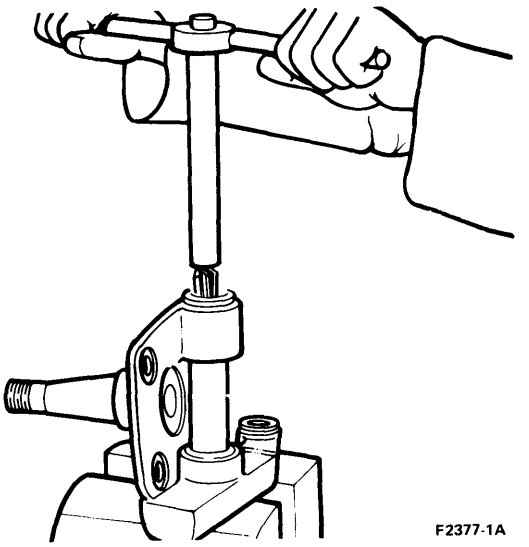


FIG. 14 Reaming Bronze Bushing

6. Clean all the metal shavings from bronze bushings after reaming, and coat the bushing and pin with ESA-MIC75-B lubricant or equivalent prior to assembly.

SPECIFICATIONS

FRONT SUSPENSION TORQUE LIMITS — F-100 THRU F-350 (4 x 2), E-100 THRU E-350 ①

Description	Torque Range (ft-lbs) F-100 thru F-350 E-100 thru E-350	N•m F-100 thru F-350 E-100 thru E-350
Spring Upper Retainer to Spring Upper Seat	18-25	25-33
Shock Absorber Stud to Spring Upper Seat	15-25	20-33
Shock Absorber to Lower Bracket	40-60	55-81
Shock Lower Bracket to Radius Arm	70-90	95-122
Spring Lower Retainer to Spring Lower Seat	30-70	41-94
Radius Arm to Front Axle and Bracket	240-320	326-433
Radius Arm to Frame (Rear) Bracket	80-120	109-162
Radius Arm Rear Bracket to Frame ③	75-90	102-122
Front Axle (I-Beam) to Pivot Bracket	120-150	163-203
Stabilizer Bar Link to Bracket	40-60	55-81
Stabilizer Bar Link to Stabilizer Bar	15-25	20-33
Stabilizer Bar Retainer to Frame	15-25	20-33
Wheel Spindle Pin Locking Bolt Nut	38-62	52-84
Wheel Spindle Steering Arm to Rod and Link Assembly	50-75	68-102
Wheel Spindle Plug	35-50	48-67
Front Wheel Adjusting Nut and Retainer	②	②

① When tightening by hand, tighten to the upper limit of the Torque Specifications.

② Tighten to 17-25 ft-lbs while rotating wheel. Install the nut retainer so that a slot in the retainer aligns with the cotter pin hole in the spindle. Back off both nut and retainer by two slots and install the cotter pin.
SPECIAL SERVICE TOOL: Tool 3290-C Tie Rod Ball End Remover

③ F-250 Conventional Cab (7800-8000 G.V.W.) and F-250 Super Cab (except 8100 G.V.W.). Torque is 47-70 ft x lbs (64-94 N•m).
The following models have a riveted radius arm rear bracket:
a. F-350 Conventional Cab (all G.V.W.)
b. F-350 Camper and 140 inch wheel base Style side.
c. F-250 Super Cab (8100 G.V.W.)
d. F-350 Super Cab (9350 G.V.W.)

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Front Suspension — 4-Wheel Drive

PART 14-22

APPLIES TO F-150 (4x4), F-250, F-350 (4x4), BRONCO

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Front Shock Absorber	22-1
Front Suspension	
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F-250 (4x4) and F-350 (4x4)	22-1
Steering Damper Shock Absorber	
Bronco — F-150 — F-350 (4x4)	22-1
REMOVAL AND INSTALLATION	
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Front Spring	
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F-250 (4x4) and F-350 (4x4)	22-8
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DESCRIPTION

FRONT SUSPENSION

F-150 (4X4), BRONCO

The front suspension consists essentially of a driving axle attached to the frame with two coil springs, two radius arms and a track bar, (Figs. 1 through 7).

The radius arms clamp around the axle tube on each side and attach to frame brackets behind the front axle. A coil spring is attached to each radius arm directly above the axle and extends to the frame spring seat. The shock absorbers are attached to the frame and to brackets on the radius arm.

F-250 (4X4) and F-350 (4X4)

The front suspension, (Figs. 2 through 5), consists essentially of a driving axle attached to the frame with two semi-elliptic leaf-type springs. Each spring is clamped to the axle with two U-bolts. The front of the spring rests in a front hanger bracket. The rear of the spring is attached to a shackle bracket.

The shock absorbers are the direct, double-acting type. They are attached to a frame bracket at the top and to an axle bracket at the lower end.

FRONT SHOCK ABSORBER

The hydraulic shock absorbers are of the direct, double-acting type. They provide a continuous dampening effect both on compression and rebound. These shock absorbers are of telescopic design with rubber grommets at the mounting points for quiet operation. The shock absorbers are sealed, non-adjustable units and must be replaced as complete assemblies.

STEERING DAMPER SHOCK ABSORBER

BRONCO, F-150—F-350 (4X4)

The steering damper shock absorber reduces any vibration or shock which may be transmitted through the steering linkage. The shock absorber is of the hydraulic piston type and has one end mounted to the frame on Bronco and F-150 (4x4), (Fig. 1), and the other end affixed to the tie rod and link assembly. The F-250 and F-350 (4x4) has one end mounted to the front driving axle housing while the opposite end is affixed to the rod and link assembly, (Fig. 5).

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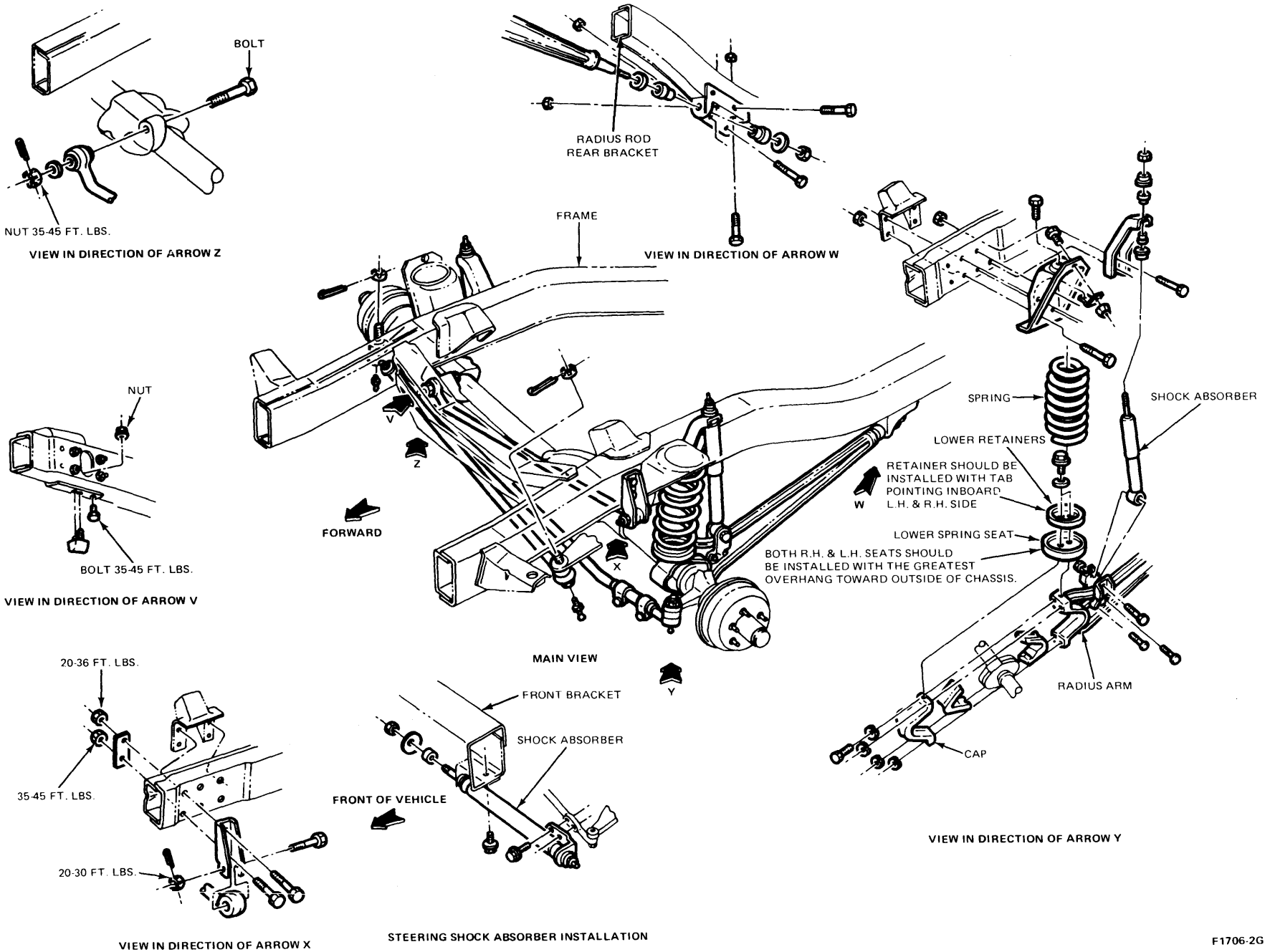


FIG. 1 Front Suspension Disassembled—F-150 (4X4) and Bronco

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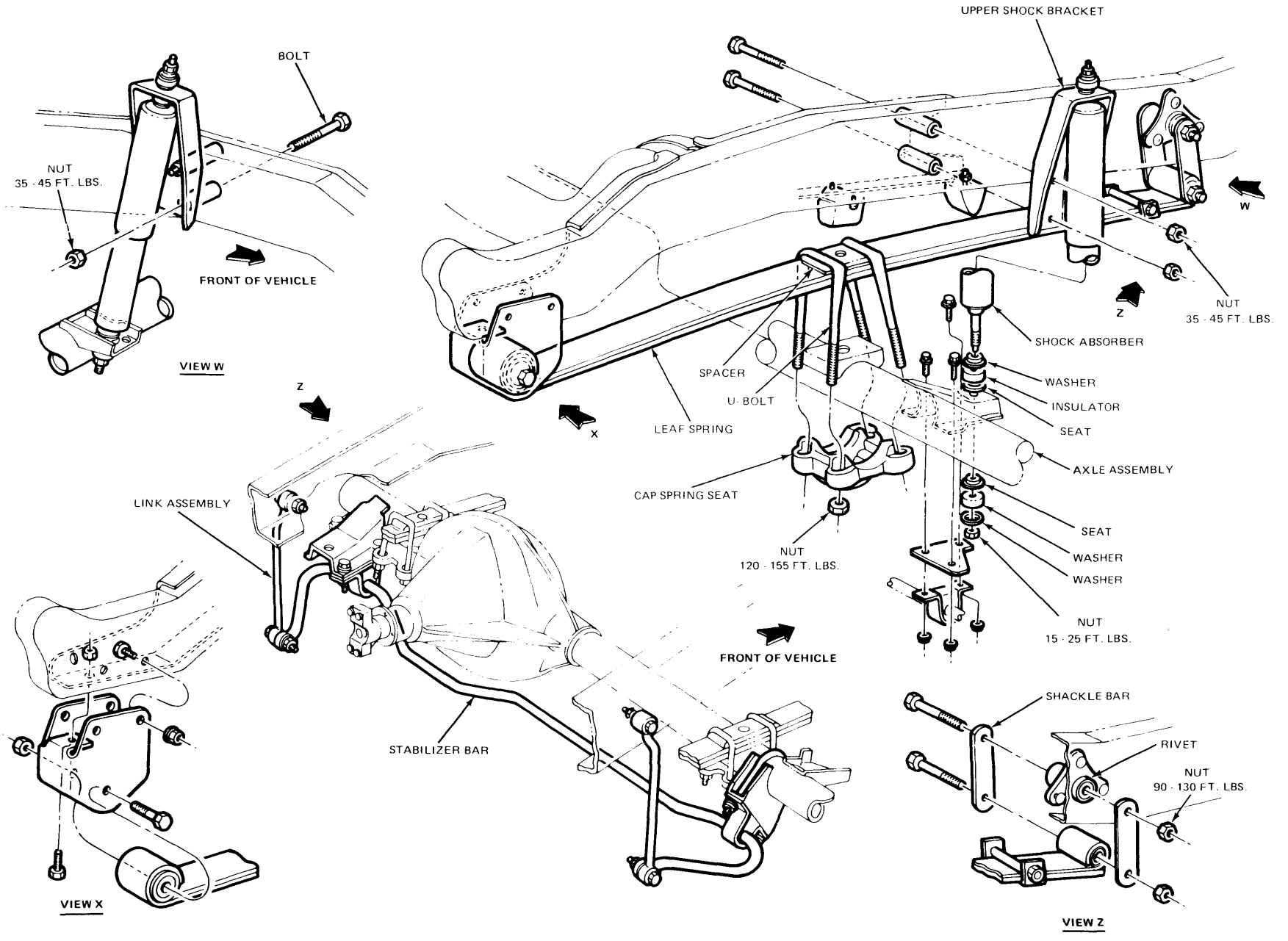


FIG. 2 Front Suspension—F-250, F-350 (4X4)

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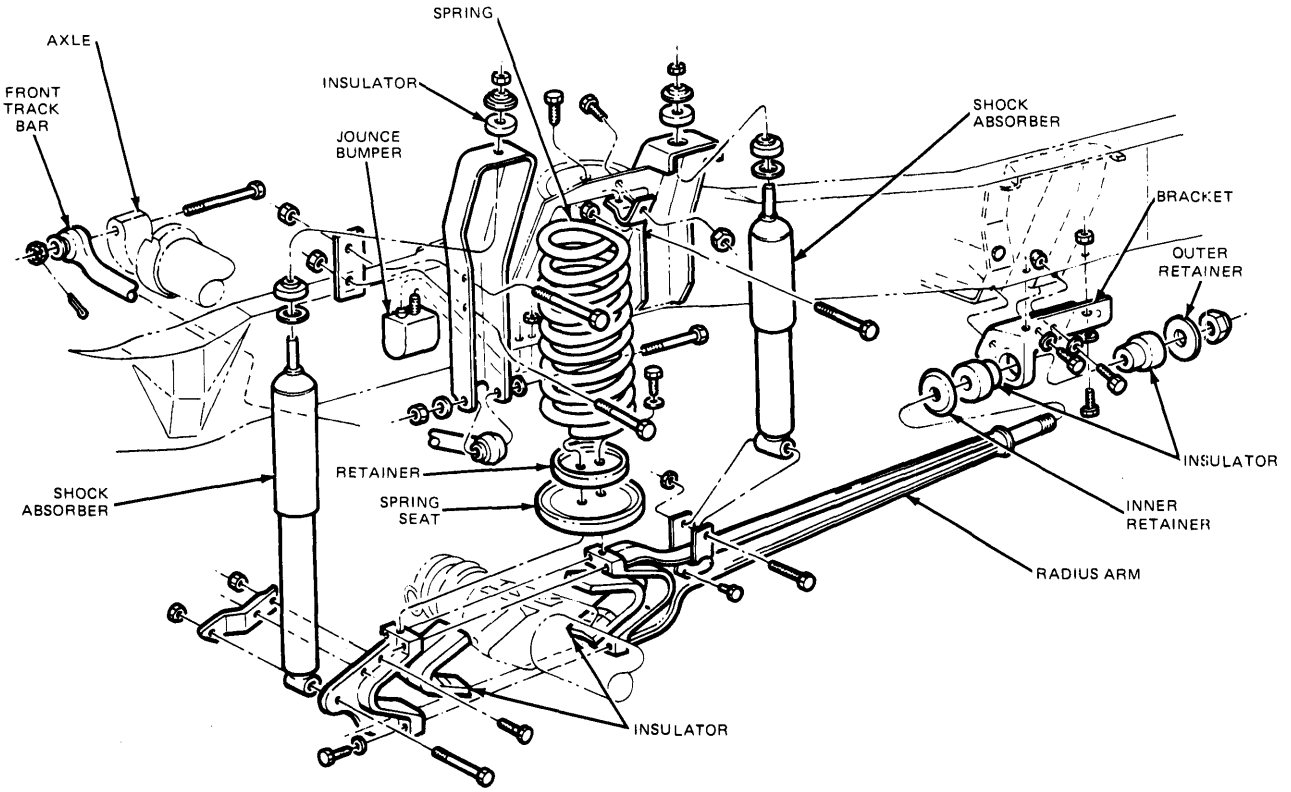


FIG. 3 Bronco Equipped with Dual Quad Shock Absorbers

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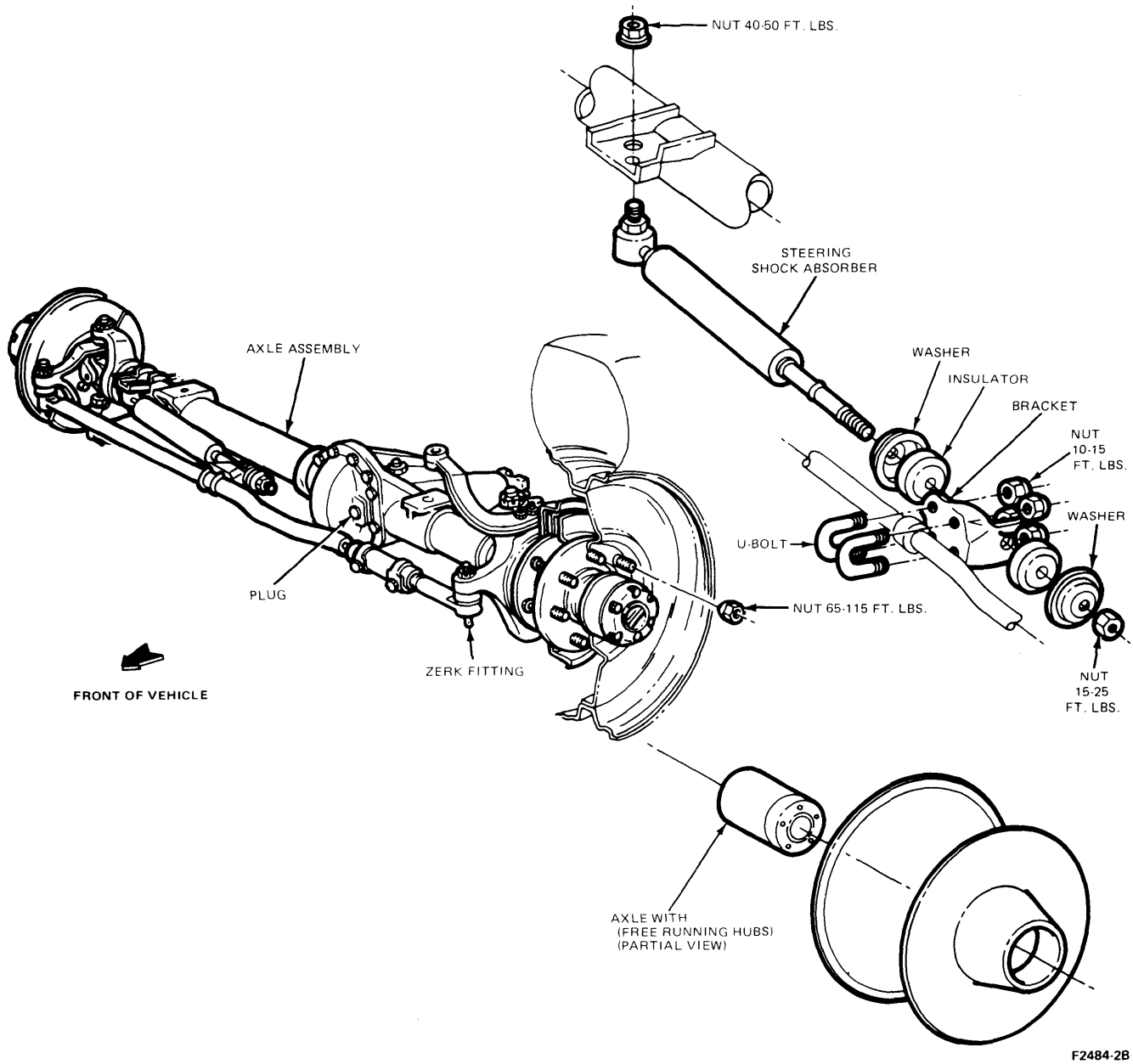


FIG. 4 Front Axle Assembly—F-250 (4X4)—Without Free Running Hubs

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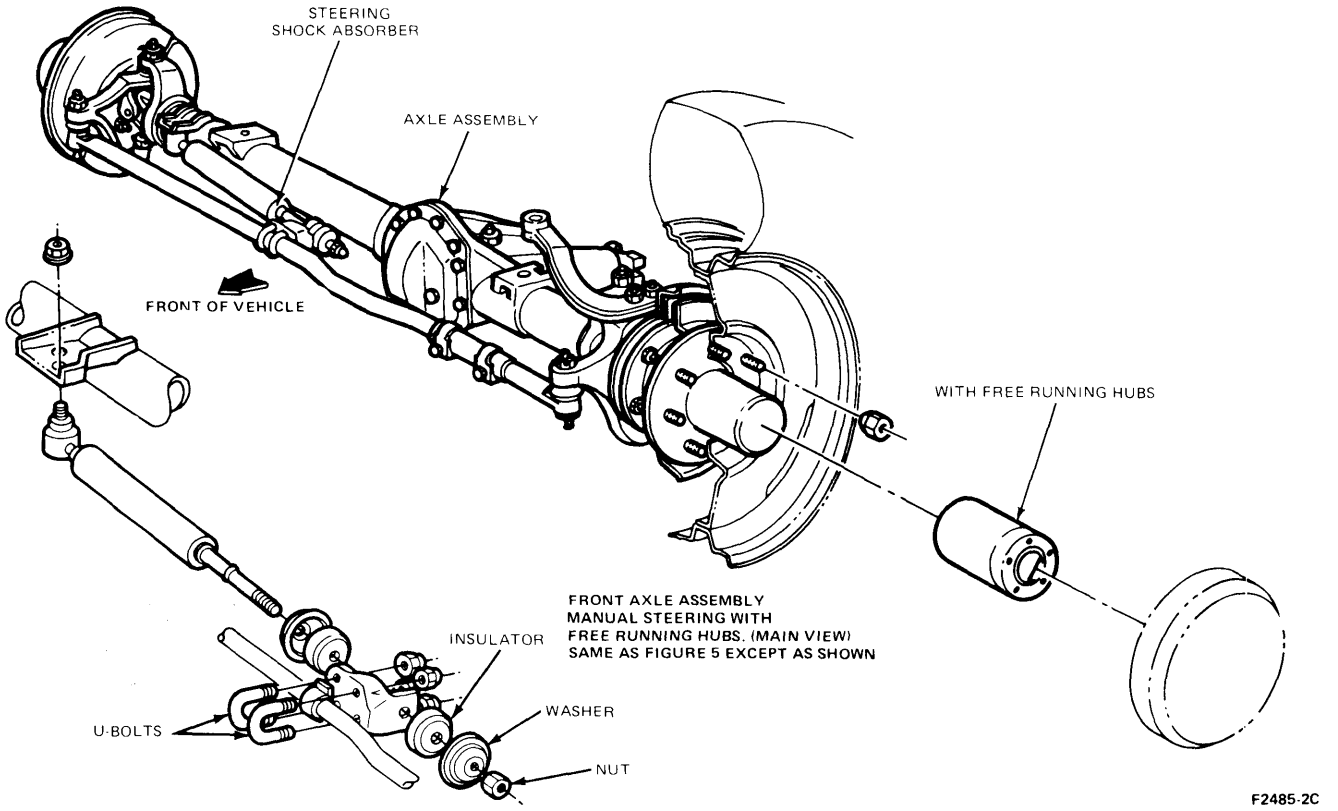


FIG. 5 Front Axle Assembly—F-250 (4X4)—With Free Running Hubs

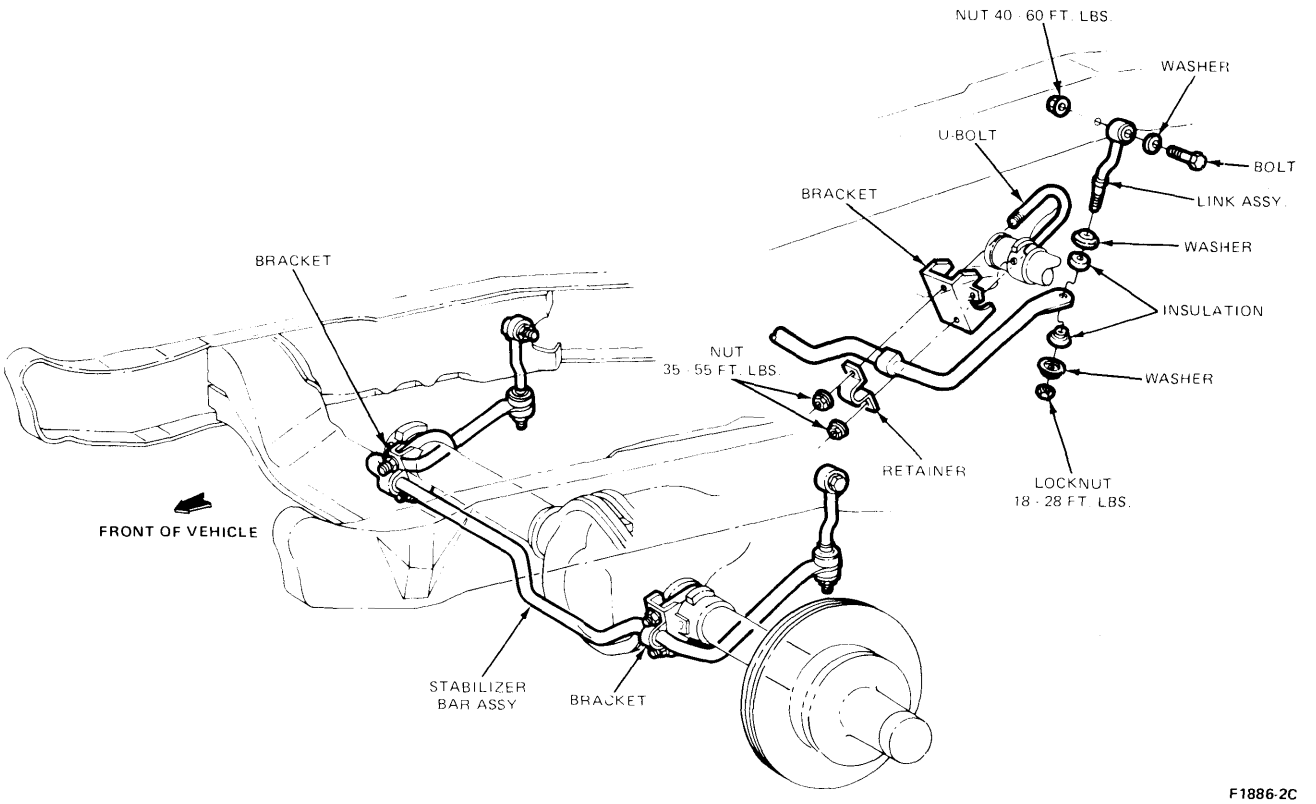


FIG. 6 Stabilizer Bar Assembly—F-150 (4X4), and Bronco

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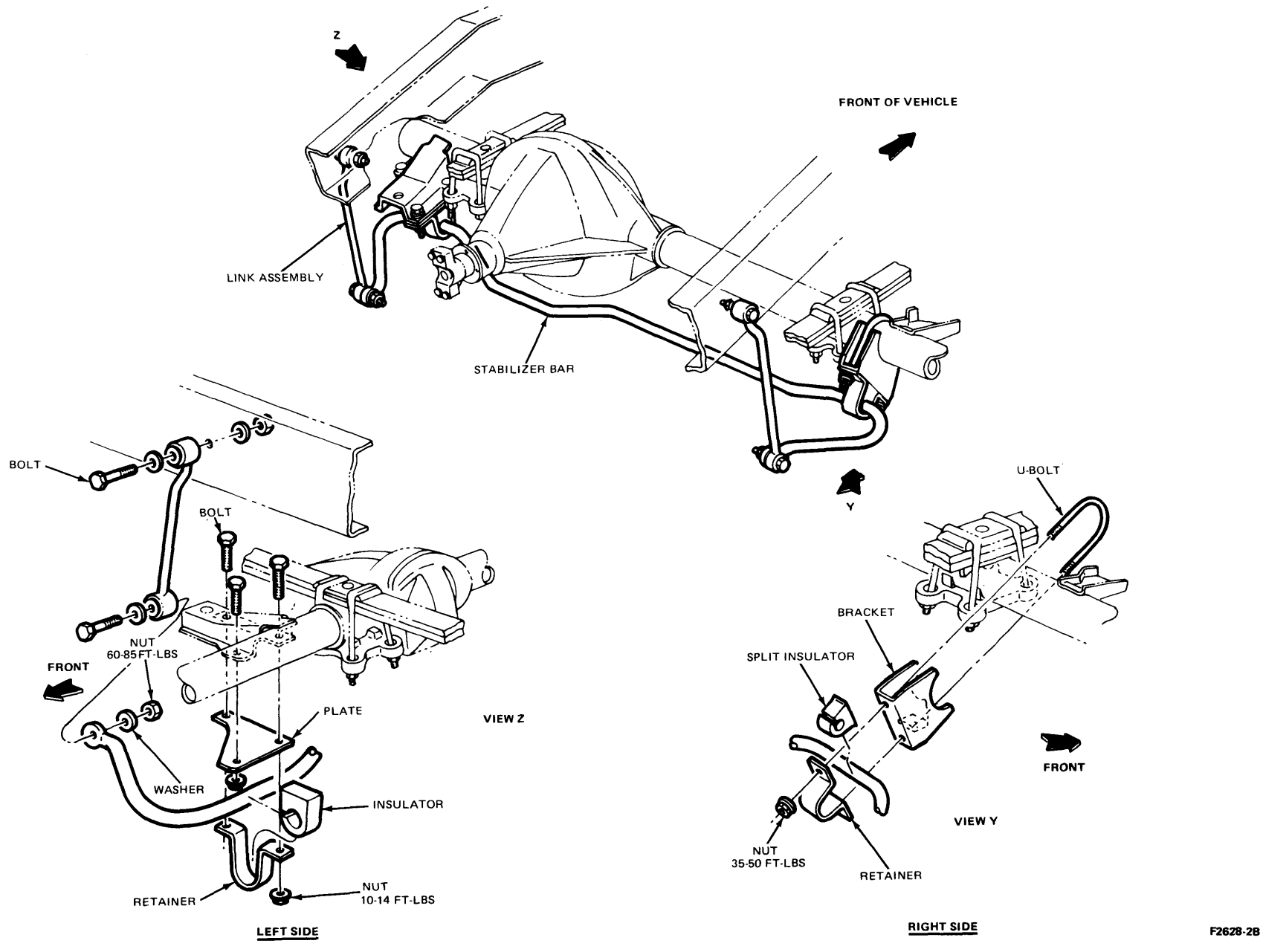


FIG. 7 Stabilizer Bar Assembly—F-150—F-250 (4X4) Super Cab

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REMOVAL AND INSTALLATION

STEERING DAMPER SHOCK ABSORBER

F-150 (4x4), F-250, F-350 (4x4), BRONCO

Refer to Figs. 1, 4 and 5.

1. Remove the attaching nut, washers and insulators which affix each end of the shock absorber to the rod and link assembly and frame of front driving axle mounting bracket.
2. Remove the shock absorber.
3. When installing a new shock absorber, use new insulators.
4. Install the inner washers and insulators on each end of the shock absorber and position the shock absorber rod ends in the rod and link assembly attachment holes and frame or front driving axle mounting bracket.
5. Install the outer insulators, washers and attachment nuts and tighten nuts to specifications.

FRONT SPRING

F-150 (4X4), BRONCO

1. Raise the vehicle and remove the shock absorber-to-lower bracket attaching bolt and nut (Fig. 1). Refer to Group 50 for Hoisting instructions.
2. Remove two spring lower retainer attaching bolts from inside of the spring coil.
3. Remove two spring upper retainer attaching bolts and nuts and remove the upper retainer.
4. Position safety stands under the frame side rails and lower the axle enough to relieve tension from the spring. Remove the spring, lower retainer, and lower the spring from the vehicle.
5. Position the spring, spring lower seat, and lower retainer to the frame spring pocket and the radius arm. Position the spring seat and the lower retainer.
6. Position the upper retainer over the spring coil and loosely install the two attaching bolts and nuts.
7. Install the two lower retainer attaching bolts and tighten to 80-120 ft-lbs as listed at the end of this Part.
8. Tighten the upper retainer attaching bolts to specifications as listed at the end of this Part.
9. Position the shock absorber to the lower bracket and install the attaching bolt and nut. Tighten the bolt and nut to 40-60 ft-lbs as listed at the end of this Part. Remove safety stands and lower the vehicle.

F-250, F-350 (4x4)

1. Raise the vehicle frame until the weight is off the front spring with the wheels still touching the floor.
2. Disconnect the lower end of the shock absorber from the axle. Remove the spring clips (U-bolts) and U-bolt cap and/or spacer (Fig. 2).
3. Remove the nut from the shackle bolt retaining the spring at the front. Drive out the shackle bolt.
4. Remove the nuts and shackle bar at the rear shackle bracket. Drive out the two shackle bolts and remove the spring.
5. Position the new spring on the spring seat cap. Install the shackle bolts, (Fig. 2), through the shackle bracket and spring. Install the shackle bar and nuts on the shackle bolts. Tighten to specifications.
6. Position the front of the spring to allow the front shackle bolt to be installed. Install the nut and tighten to specifications.
7. Position the U-bolt spacer and place the spring clips (U-bolts) in position through holes in the spring seat cap. Install but do not tighten the U-bolt nuts.
8. Connect the lower end of the shock absorber to the axle.
9. Lower the vehicle and tighten the U-bolt nuts to specifications.

FRONT WHEEL SPINDLE

Refer to Group 15 for spindle replacement on 4-wheel drive front axles.

FRONT SHOCK ABSORBER

F-150—F-350 (4x4) and BRONCO EQUIPPED WITH DUAL FRONT SHOCK ABSORBERS

To replace the front shock absorber, remove the self-locking nut, steel washer, and rubber bushings at the upper and lower ends of the shock absorber.

Remove the shock absorber.

When installing a new shock absorber, use new rubber bushings. Position the shock absorber on the mounting brackets with the large diameter at the top.

Install the rubber bushing, steel washer, and self-locking nut.

FRONT AXLE

Refer to Group 15 for front axle removal and installation procedures on 4-wheel drive vehicles.

RADIUS ARM

F-150 (4X4), BRONCO

Refer to Fig. 1.

1. Raise the vehicle and position safety stands under the frame side rails.
2. Remove the shock absorber-to-lower bracket attaching bolt and nut and pull the shock absorber free of the radius arm.
3. Remove two spring lower retainer attaching bolts from inside of the spring coil.
4. Remove the nut attaching the radius arm to the frame bracket and remove the radius arm rear insulator.
5. Remove four bolts attaching the radius arm cap to the radius arm and remove the cap and insulator. **The cap and radius arm are a matched set with identical numbers on each part and should not be mixed.**
6. Move the axle forward and remove the radius arm and insulator from the axle. Then, pull the radius arm from the frame bracket.

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The radius arm and cap must be identified by a T on each piece in addition to a number (1 through 100). If no T identification is found on an arm and cap, it must not be used on F-150 (4x4) vehicles.

7. Position the washer and insulator on the rear of the radius arm and insert the radius arm and insulator into the frame bracket.
8. Position the rear insulator and washer on the radius arm and loosely install the attaching nut.
9. Position the insulator on the axle and position the radius arm to the insulator and axle.
10. Position the front insulator to the axle and install the radius arm cap with the numbers on the radius arm and cap together. Tighten the attaching bolts diagonally in pairs to 90-110 ft-lbs as listed at the end of this Part.
11. Position the spring lower seat and retainer to the spring and axle. Install the two attaching bolts. Tighten the bolts to 80-120 ft-lbs as listed at the end of this Part.
12. Tighten the radius rod rear attaching nut to 80-120 ft-lbs as listed at the end of this Part.
13. Position the shock absorber to the lower bracket and install the attaching bolt and nut. Tighten the nut to specifications as listed at the end of this Part. Remove safety stands and lower the vehicle.

STABILIZER BAR

F-150-F-250-F-350 (4x4) SUPER CAB

Refer to Fig. 7.

1. Remove bolts, washers, and nuts connecting the link assemblies to the stabilizer bar. Remove bolts, washers and nuts connecting link assemblies to frame. Remove link assemblies.
2. On left side of vehicle, remove nuts connecting retainer to plate. Remove plate, bolts, and retainer. On right side of vehicle, remove nuts connecting U-bolts to bracket. Remove retainer, U-bolts, and bracket.
3. Remove stabilizer bar and insulators. Remove insulators from stabilizer bar.
4. Install insulators on stabilizer bar so the insulators cover the white stripes painted on the stabilizer bar.
5. On right side of vehicle, install bracket on axle so locator tab is indexed to the lower surface of the spring cap seat. This provides correct angularity of the bracket and stabilizer bar. Install U-bolts. Install insulator on stabilizer bar on bracket. Place retainer on bracket. Hand tighten nuts on U-bolts.
6. On left side of vehicle, install bolts through frame bracket and plate. Install insulator on stabilizer bar on plate and place retainer on plate. Install nuts and tighten 10-14 ft-lbs. Tighten bolts on right side to 35-50 ft-lbs.
7. Install link assemblies on frame. Install link assemblies to stabilizer bar. Tighten all nuts and bolts to 60-85 ft-lbs.

F-150 (4X4) and BRONCO

Refer to Fig. 6.

1. Remove locknut, washers, and insulator to remove link assemblies from stabilizer bar. Remove nuts, bolts, and washers connecting link assemblies to frame.
2. Remove nuts on U-bolts to remove stabilizer bar from retainers. Remove stabilizer bar. Remove U-bolts, brackets and retainers.
3. Place bracket assemblies on axle aligning holes in brackets with alignment pins on axles.
4. Install U-bolts through bracket assembly. Position stabilizer bar on brackets. Install retainer and tighten nuts to 35-55 ft-lbs.
5. Install link assemblies on frame. Connect link assemblies to stabilizer bar. Tighten link to stabilizer bar nuts to 18-25 ft-lbs. Tighten link to frame nuts to 40-60 ft-lbs.

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SPECIFICATIONS

FRONT SUSPENSION TORQUE LIMITS — F-150-F-250 (4x4), BRONCO

Description	Model	(ft-lbs)	N•m
Front Spring to Axle U-Bolt	F-250 (4x4)	120-155	163-210
Front Spring Assembly to Front Hanger Bracket	F-250 (4x4)	150-204	204-276
Front Spring Shackle to Shackle Bracket and Spring Front Jounce Bumper to Frame	F-250 (4x4)	90-130	123-176
Radius Arm to Bracket	F-250 (4x4) Bronco, F-150 (4x4)	15-25 80-120	21-33 109-162
Spring Retainer to Upper Spring Seat	Bronco, F-150 (4x4)	Bolt 20-30 Locknut 18-24	28-40 25-32
Track Bar Pivot to Frame	Bronco, F-150 (4x4)	119-161	162-218
Track Bar Pivot to Axle	Bronco, F-150 (4x4)	155-205	211-278
Lower Spring Seat to Radius Arm	Bronco, F-150 (4x4)	45-55	62-74
Axle Cap to Radius Arm Assembly	Bronco, F-150 (4x4)	90-110	123-149
Front Shock Bracket to Frame	F-250 (4x4)	35-45	48-61
Front Shock to Shock Bracket — Lower	Bronco, F-150 (4x4)	40-60	55-81
Front Shock Absorber Stud — Upper	Bronco, F-150 (4x4) F-250 (4x4)	15-25	21-23
Front Shock to Lower Mounting Bracket	F-250 (4x4)	15-25	21-33
Track Bar to Frame	F-150 (4x4)	9/12-12 Nut = 50-70 7/16-14 Nut = 20-30	68-94 28-40
Front Shock to Bracket — Upper	Bronco, F-150 (4x4)	15-25	21-33
Retainer to Radius Arm Bracket	Bronco, F-150 (4x4)	80-120	109-162
U-Bolt Nuts — Retainer to Axle Bracket	Bronco, F-150 (4x4)	35-45	48-61

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Rear Suspension — Leaf Springs

PART 14-31

APPLIES TO ALL MODELS

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Rear Suspension	
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F-150 (4x4), Bronco	31-4
F-250 (4x4)	31-4
DIAGNOSIS AND TESTING	31-7
ADJUSTMENTS	31-7
REMOVAL AND INSTALLATION	
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E-100 — E-350 and Bronco only	31-7
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Bronco	31-9
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F-100 and F-250 (4x2)	31-7
F-150 — F-250 F-350 (4x4)	31-8
F-350	31-9
SPECIFICATIONS	31-10

DESCRIPTION

REAR SUSPENSION

F-100—F-350 (4 x 2), E-100—E-350

Semi-elliptic, leaf-type springs are used for the rear axle suspension. The forward end of each spring is attached to a bracket on the frame side member. The rear end of each spring is shackled to a bracket on the frame side member. (Figs. 1, 2, 3 and 4).

Optional auxiliary rear springs are mounted on top of the main spring with free ends. These provide increased load carrying capacity and stability (Fig. 1).

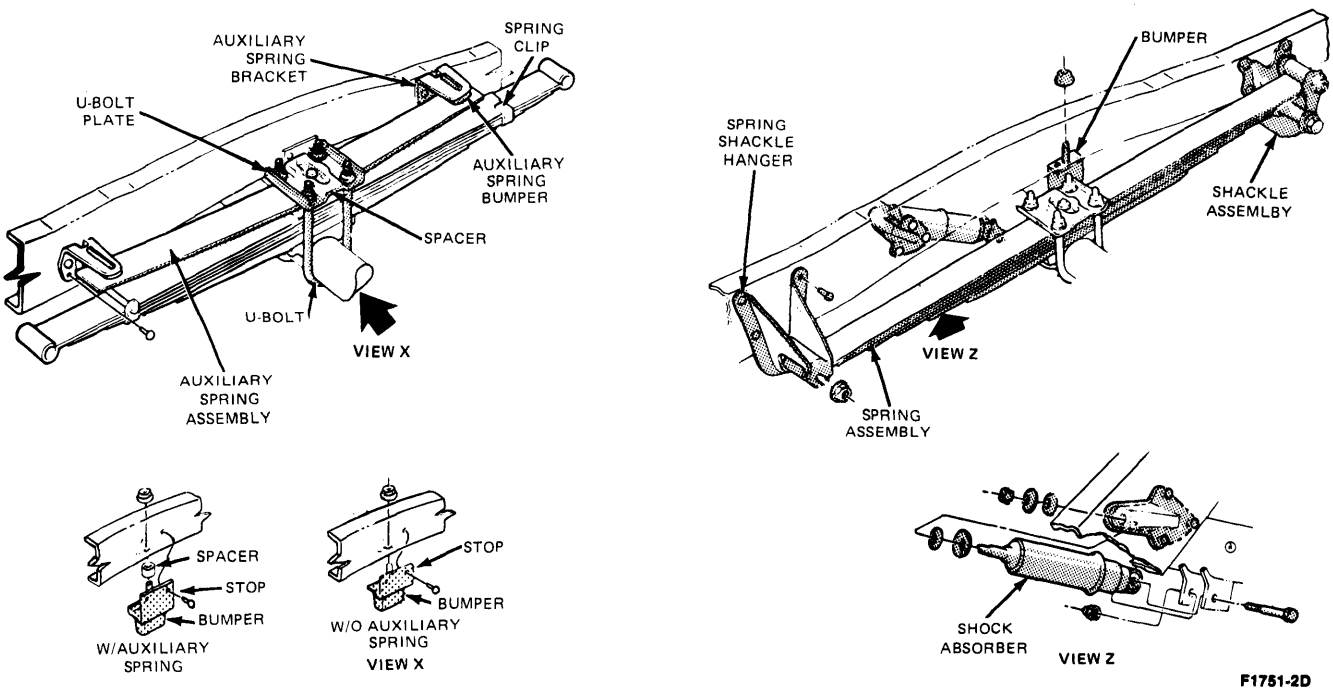


FIG. 1 Rear Spring Installation—F-100-F-250

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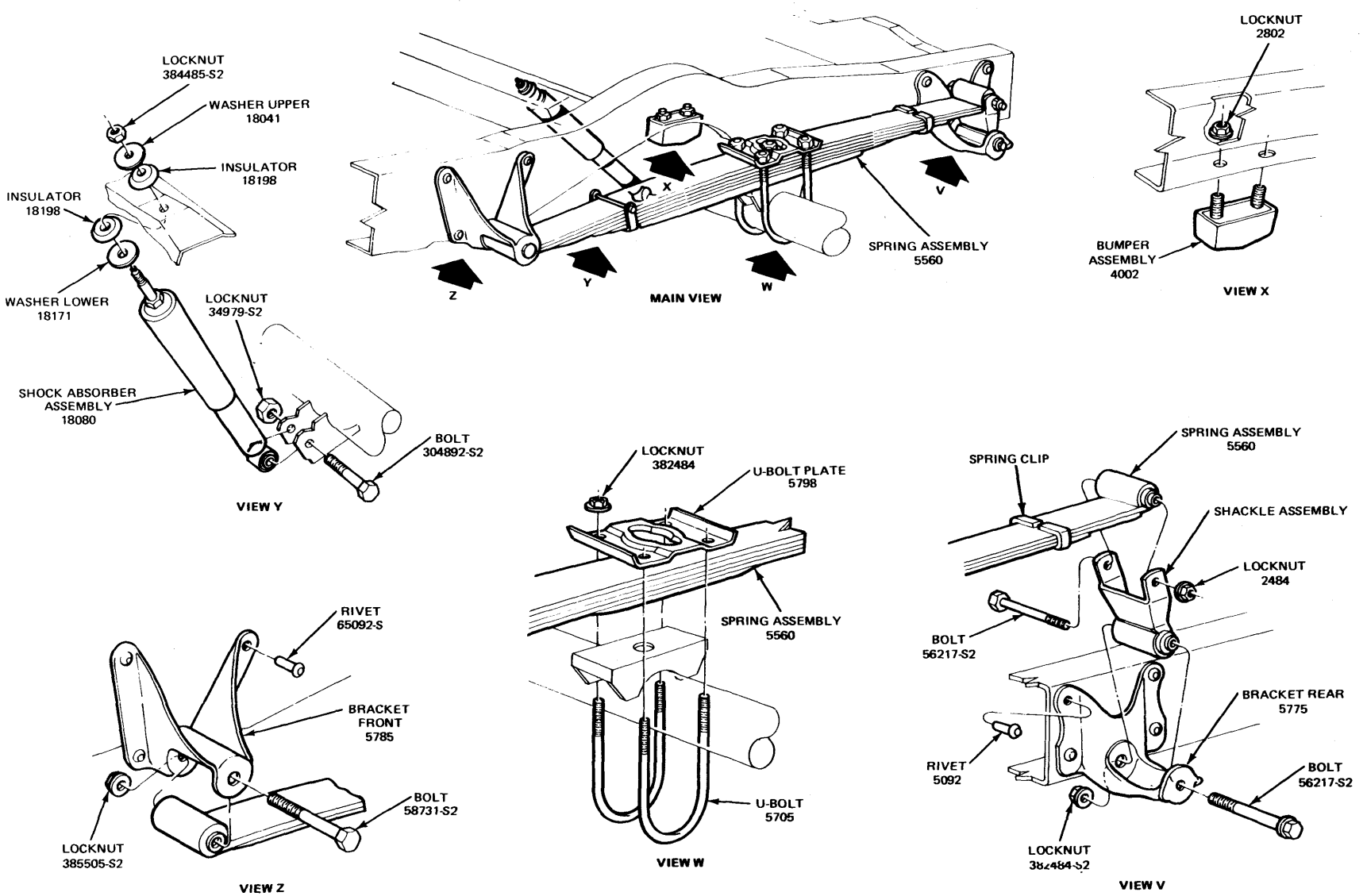


FIG. 2 Rear Spring Installation—E-100-E-150

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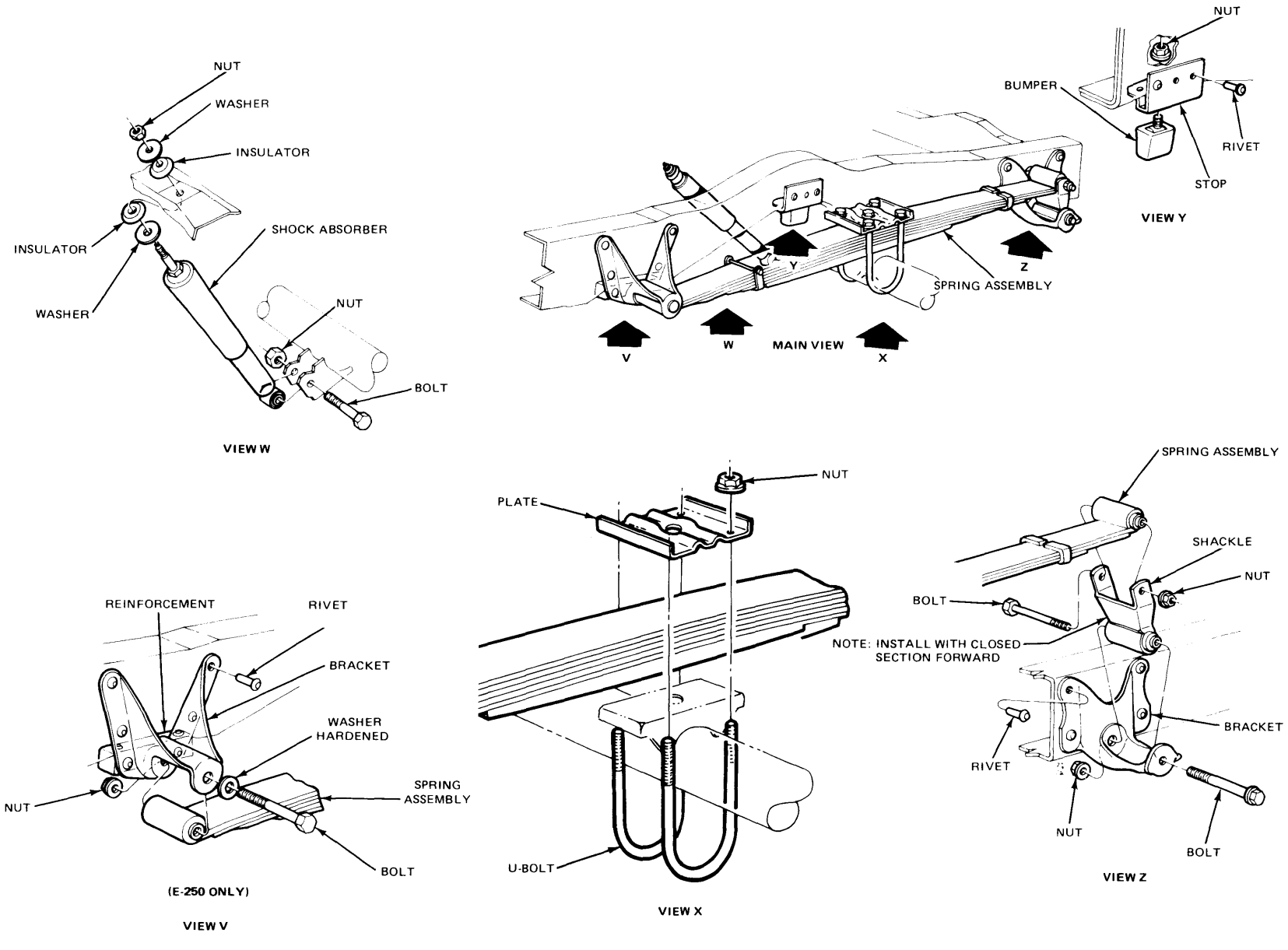


FIG. 3 Rear Spring Installation—E-250-E-350

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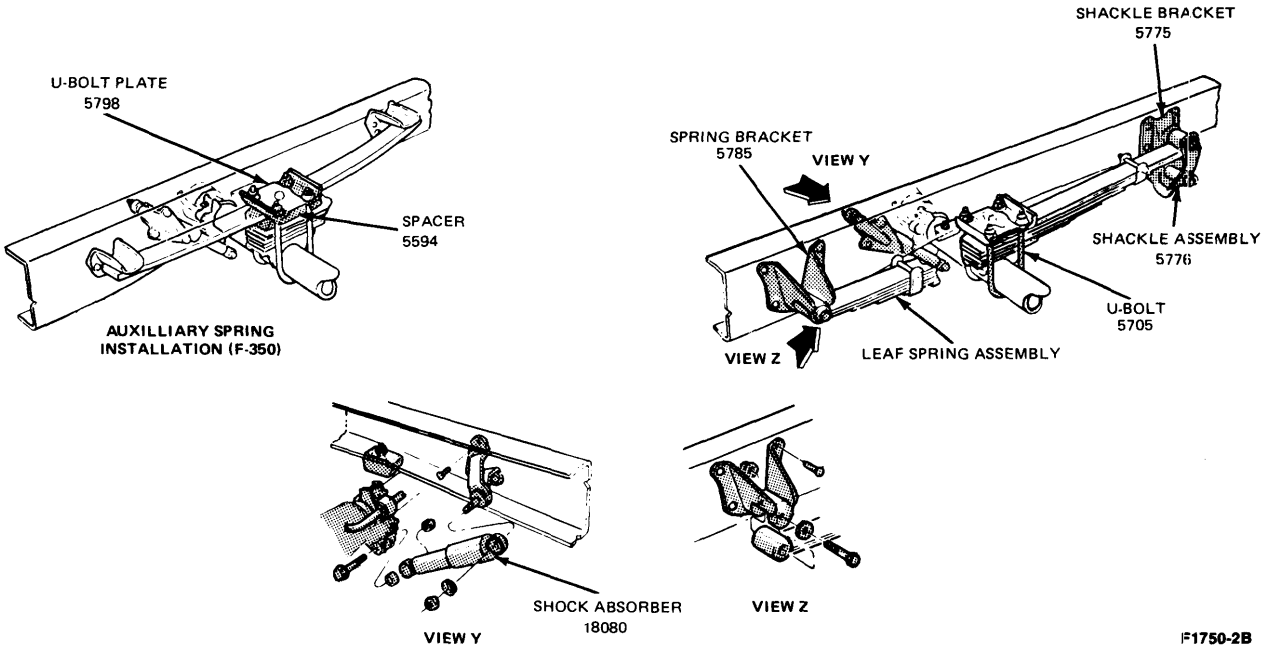


FIG. 4 Rear Spring Installation—F-350 (140 in. W.B.)

F-150 (4 x 4), BRONCO

Semi-elliptic, leaf-type springs are used for the rear axle suspension (Figs. 5 and 6). The front end of each spring is attached to a bracket on the frame side member. The rear end of each spring is attached to a bracket on the frame side member with a shackle. Each spring is attached to the axle with two U-bolts. A spacer is located between the spring and the axle to obtain a level ride position.

F-250 (4 x 4)

Semi-elliptic, leaf-type springs are used for the rear axle suspension (Fig. 6). The front end of each spring is attached to a spring bracket on the frame side member. The rear end of each spring is attached to a bracket on the frame side member with a shackle. Each spring is attached to the axle with two U-bolts. A spacer is located between the spring and the axle to obtain a level ride position.

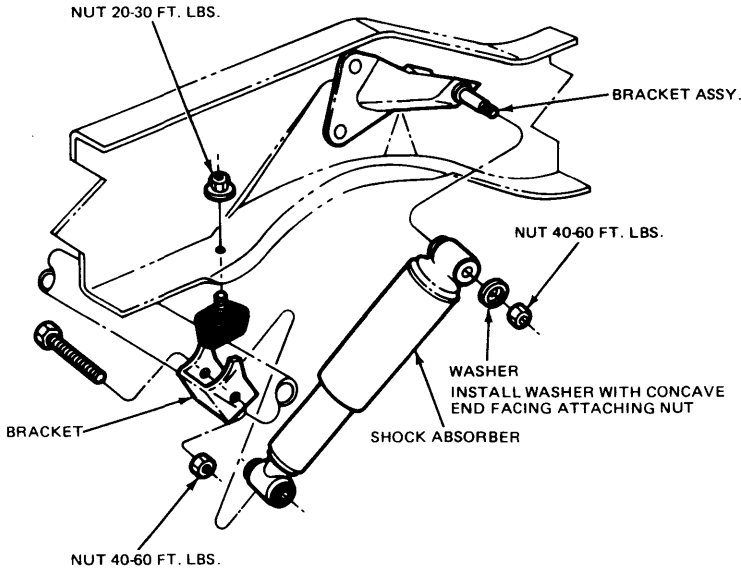
REAR SHOCK ABSORBER

The hydraulic shock absorbers are of the direct, double-acting type. They provide a continuous dampening effect both on compression and rebound. These shock absorbers are of telescopic design with rubber grommets at the mounting points for quiet operation. The shock absorbers are sealed, non-adjustable units and must be replaced as complete assemblies.

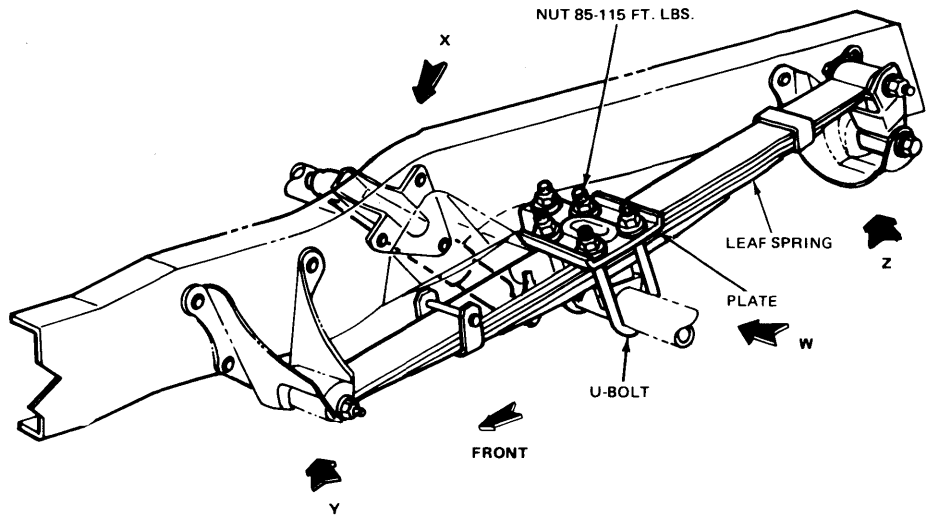
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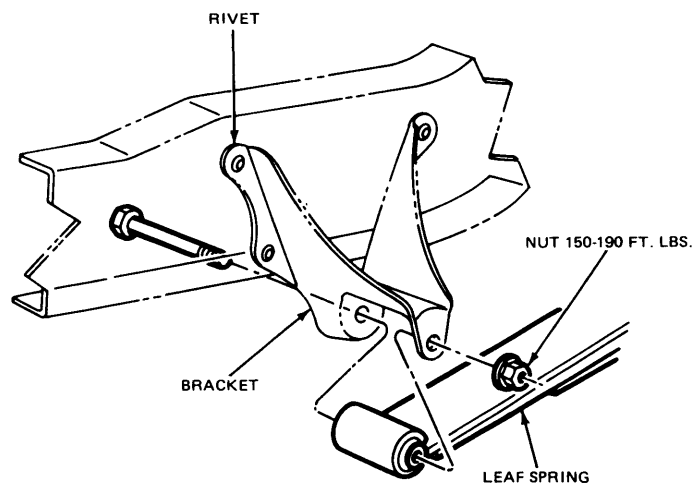
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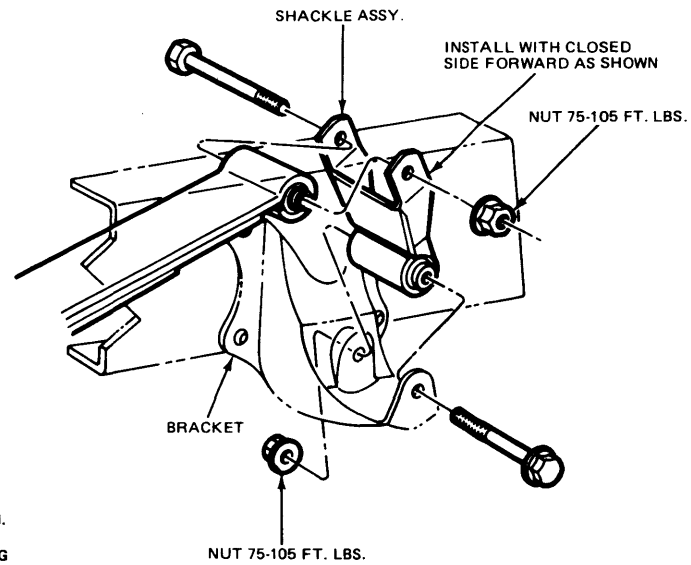
VIEW IN DIRECTION OF ARROW X





VIEW IN DIRECTION OF ARROW Y

REAR SPRINGS SHOULD BE INSTALLED IN MATCHED PAIRS.
ALIGN SPRING LEAVES PRIOR TO TORQUING U-BOLTS .25 INCH MAXIMUM.
END PLAY ALLOWABLE AT LEAF ENDS.
U-BOLTS TO CONTACT EDGES OF SPRING ASSEMBLY OR AXLE SEAT DURING U-BOLT NUT TORQUE OPERATION.



VIEW IN DIRECTION OF ARROW Z

F1349-2E

FIG. 5 Rear Spring—Bronco

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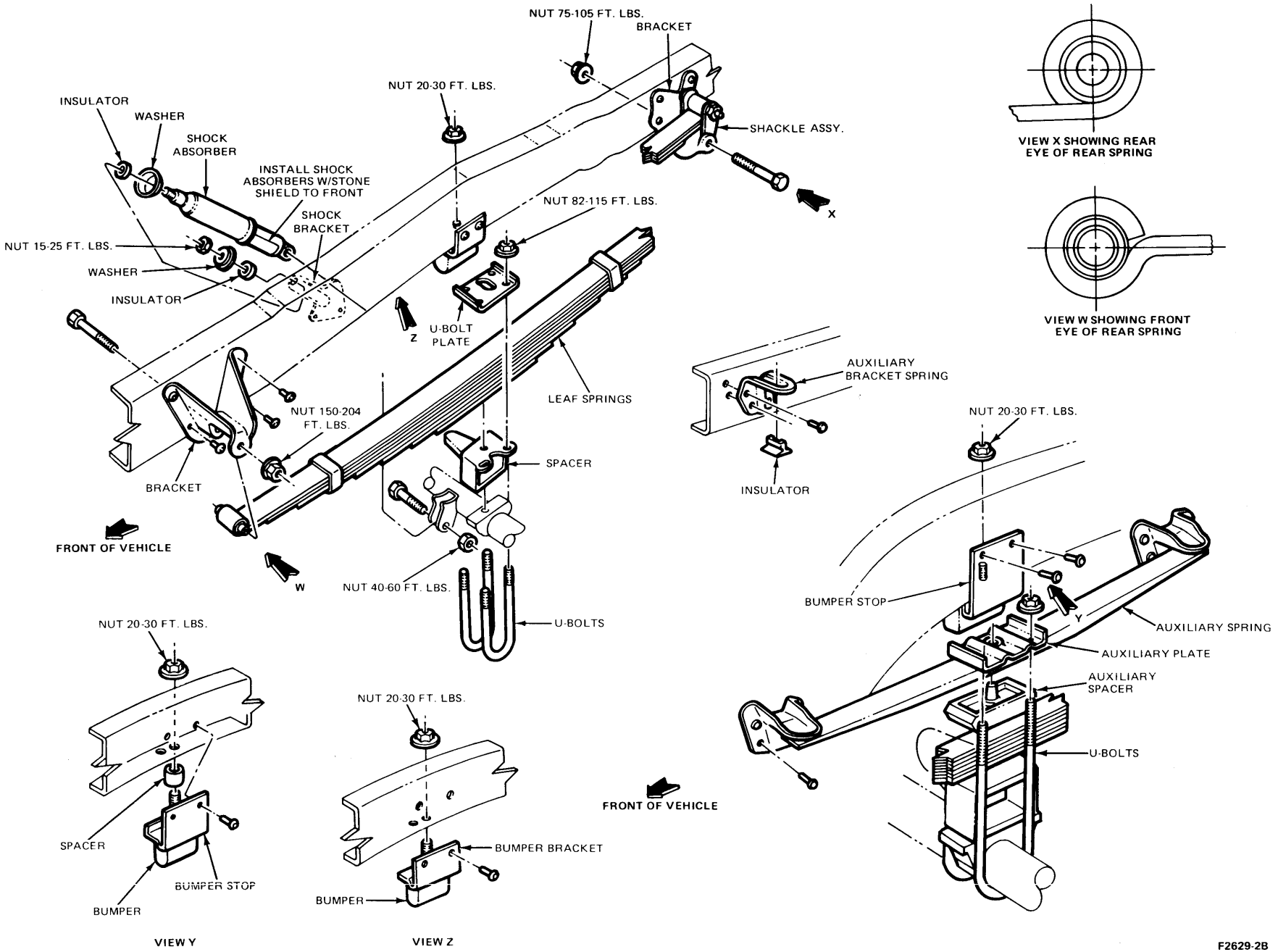


FIG. 6 Rear Suspension—F-150 and F-250 (4 x 4)

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DIAGNOSIS AND TESTING

REAR LEAF SPRING SQUEAK

The most likely causes of rear spring squeaks are loose attachments at the front or rear spring eyes, or individual leaf springs rubbing against each other or against the spring clips.

1. Tighten the rear spring front and rear eye, and rear shackle to specifications found in this section.
2. Raise the vehicle so the rear axle hangs freely. This will allow the leaf springs to spread. It may be necessary to remove the spring clips to assist in the spreading of the leaf springs. Apply lubricant in the spreading of the leaf springs. Apply lubricant C7AZ-19590-A or equivalent in a 3 inch area at the tip of each leaf spring. Make sure this area is clean and dry before applying lubricant.

ADJUSTMENTS

VEHICLE LEAN

F-100—F-350 AND BRONCO

A side-to-side lean at the rear of the vehicle can be adjusted by approximately 3/8 inch by installing a shim between the rear spring and axle on the low side of the vehicle. A "low at the rear" vehicle can be raised approximately 3/8 inch by installation of one shim on each side. Use the following procedure to install the shim (D7TA-5742-AA or equivalent):

1. Raise the vehicle frame until the weight is off the rear springs but with the tires still touching the floor.
2. Loosen the spring U-bolts to allow the axle to separate from the spring approximately 1/2 inch.
3. Position the shim (D7TA-5742-AA) between the spring and axle with the long edge of the shim parallel to the side of the spring and the spring tie bolt head through the hole in the shim. On 4 x 4 vehicles, position the shim between the rear spring and axle spacer. Tape may be used to hold the shim in position.
4. Assure that the spring leaves are properly aligned and the spring U-bolts contact the edges of the spring assembly or axle seat.
5. Tighten the spring U-bolt sufficiently to assure that the spring tie bolt head that extends through the shim enters the hole in the axle seat.

REMOVAL AND INSTALLATION

REAR SHOCK ABSORBER

E-100—E-350 AND BRONCO ONLY

1. Raise the vehicle on a hoist.
2. Remove the shock absorber lower attaching nut and bolt, and swing the lower end free of the mounting bracket on the axle housing (Fig. 7).

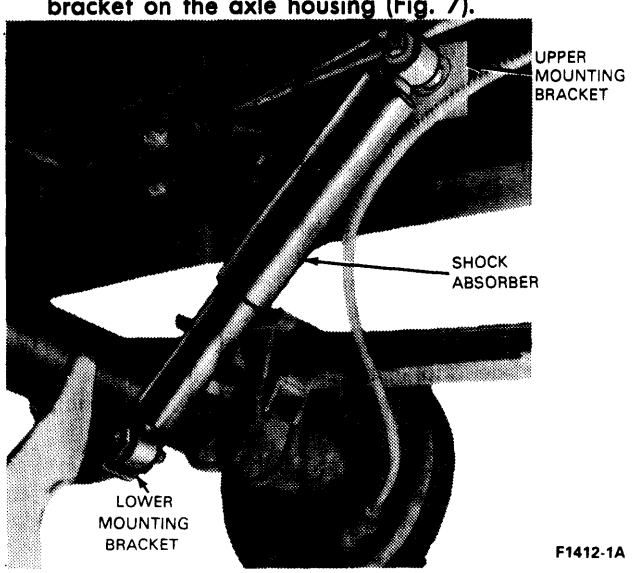


FIG. 7 Rear Shock Absorber Installed

3. Remove the attaching nut from the upper mounting stud, and remove the shock absorber.
4. Position the replacement shock absorber with rubber bushings and steel washers to the upper mounting bolt.
5. Swing the lower end of the shock absorber into the mounting bracket on the axle housing. Install the attaching washers, mounting bolt, and self-locking nut. Tighten the nut to 40-60 ft-lbs.
6. Install the self-locking nut on the upper mounting bolt. Tighten the nut to 15-25 ft-lbs.

F-100—F-350

To replace the rear shock absorber, remove the self-locking nut, steel washer, and rubber bushings at the upper and lower ends of the shock absorber. Remove the shock absorber.

When installing a new shock absorber, use new rubber bushings. Position the shock absorber on the mounting brackets with the large diameter at the top.

Install the rubber bushing, steel washer, and self-locking nut. Tighten the nut until it rests against the shoulder of the stud.

REAR SPRING

F-100 and F-250 (4 x 2)

1. Raise the vehicle frame, until the weight is off the rear spring, with the tires still touching the floor.

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2. Remove the nuts from the spring U-bolts (Fig. 1) and drive the U-bolts from the U-bolt plate. If so equipped, remove the auxiliary spring and spacer.
3. Remove the spring-to-bracket nut and bolt at the front of the spring.
4. Remove the shackle upper and lower nuts and bolts at the rear of the spring. Remove the spring and shackle assembly from the rear shackle bracket.
5. Position the spring in the shackle, and install the upper shackle-to-spring bolt and nut with the bolt head facing outboard.
6. Position the front end of the spring in the bracket and install the bolt and nut.
7. Position the shackle in the rear bracket and install the bolt and nut.
8. Position the spring on top of the axle with the spring tie bolt centered in the hole provided in the seat. If so equipped, install the auxiliary spring and spacer.
9. Install the spring U-bolts, U-bolt plate and nuts.
10. Lower the vehicle to the floor. Tighten the spring U-bolt nuts to specifications as listed at the end of this Part. Tighten the front spring bolt and nut and the rear shackle bolts and nuts to specifications as listed at the end of this Part.

F-150, F-250, F-350 (4 x 4)

1. Raise the rear end of the vehicle and support the chassis with safety stands. Support the rear axle with a floor jack or hoist. Disconnect the shock absorbers from the axle.
2. Remove the nuts from the axle to spring U-bolts, and drive the U-bolts out of the U-bolt plate using a soft hammer. The leaf springs are now separated from the axle. Remove axle spacer from axle assembly.
3. Remove the U-bolt plate, and (if installed) the auxiliary spring and spacer from the main spring.
4. Remove the nuts attaching the leaf springs to the frame at the front bracket and at the rear shackle assembly.
5. Place a drift or punch on the bolts attaching the leaf springs to the front bracket and the rear shackle assembly. Drive the bolts out of the attaching assemblies. Remove the spring and shackle from the vehicle.
6. Drive the bolt out that holds the shackle assembly to the leaf spring.
7. To assemble, position the shackle to the rear spring eye. Make sure the shackle is positioned with the closed section forward.
8. Install the bolt through the shackle and the spring eye. Install nut but do not tighten.
9. Install the bolt (bolt head facing inboard) in the shackle and spring assembly. Install nut but do not tighten.
10. Install axle spacer on axle spring seat and align spacer with seat. "Front" is cast on spacer which is to be positioned toward the front of vehicle. Spacer pin to be in pilot hole of axle seat.
11. Raise the axle to the spring assemblies and position springs on the axle spacer with the spring center bolt in the pilot hole in the spacer and see that the spacer dowel is still in the pilot hole in the axle seat.
12. If vehicle is equipped with auxiliary springs, place the auxiliary spring spacer on the leaf spring so that the spring bolt head is located in the spacer pilot hole. "Front" is cast on auxiliary spacer which is to be positioned toward the front of the vehicle. Install auxiliary springs on the auxiliary spacer so that the auxiliary spacer pin fits in the auxiliary spring pilot hole.
13. Install the U-bolts under the axle through the axle spacer (outboard side only) and through the U-bolt plates. Install nuts but do not tighten.
14. Connect the shock absorber to the axle and tighten the nut to specification (40-60 ft-lb). Raise the axle as required.
15. Raise the vehicle until the vehicle is free of the stands and tighten the U-bolt nuts to 150-204 ft-lb by increasing the torque in increments of 25-50 ft-lb until 150-204 ft-lb is obtained. During the tightening procedure align axle spacer, auxiliary spacer and auxiliary (if installed), and all spring supporting leaves with the main leaf. Jounce vehicle several times and retighten all suspension attachments to specification.

E-100, E-150

1. Raise the rear end of the vehicle and support the chassis with safety stands. Support the rear axle with a floor jack or hoist.
2. Disconnect the lower end of the shock absorber from the bracket on the axle housing (Fig. 2).
3. Remove the two U-bolts and plate.
4. Lower the axle and remove the upper and lower rear shackle bolts.
5. Pull the rear shackle assembly from the bracket and spring.
6. Remove the nut and mounting bolt that secures the front end of the spring. Remove the spring assembly from the front shackle bracket.
7. Assemble the front eye of the spring (Fig. 2) to the front bracket with the front mounting bolt and nut. Do not tighten the nut.
8. Mount the rear end of the spring with the upper bolt of the rear shackle assembly passing through the eye of the spring. Insert the lower bolt through the rear spring, shackle bracket.
9. Assemble the spring center bolt in the pilot hole in the axle and install the plate. Install the U-bolts through the plate. Do not tighten the attaching nuts at this time.
10. Raise the axle with a floor jack or hoist until the vehicle is free of the stands. Connect the lower end of the shock absorber to the bracket on the axle housing (Fig. 2).
11. Tighten the spring front mounting bolt and nut, the rear shackle nuts and the U-bolt nuts. Tighten all bolts and nuts to specifications as listed at the end of this Part.
12. Remove the safety stands and lower the vehicle.

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E-250-E-350

1. Raise the rear end of the vehicle and support the chassis with safety stands. Support the rear axle with a floor jack or hoist.
2. Disconnect the lower end of the shock absorber from the bracket on the axle housing (Fig. 3).
3. Remove the two spring U-bolts and the U-bolt plate.
4. Lower the axle and remove the spring front bolt from the hanger.
5. Remove the two attaching bolts from the rear of the spring. Remove the spring and the shackle.
6. Assemble the upper end of the shackle to the spring with the attaching bolt as shown in Fig. 3.
7. Connect the front of the spring to the front bracket with the attaching bolt.
8. Assemble the spring and shackle to the rear bracket with the attaching bolt.
9. Place the U-bolt plate over the nut of the center bolt.
10. Raise the axle with a jack. Install the center bolt head through the pilot hole in the pad on the axle housing.
11. Install the spring U-bolts and attaching nuts. Tighten the nuts snugly.
12. Connect the lower end of the shock absorber to the lower bracket.
13. Tighten the spring front mounting bolt and nut, the rear shackle nuts and spring U-bolt nuts. Tighten to specifications as listed at the end of this Part.
14. Remove the safety stands and lower the vehicle.

BRONCO

Removal

1. Raise the vehicle by the axles and install safety stands under the frame and support the rear axle with a floor jack or hoist.
2. Disconnect the shock absorber from the axle.
3. Remove the U-bolt attaching nuts and remove two U-bolts, the U-bolt plate (Fig. 5), and axle spacer.
4. Lower the axle to relieve spring tension and remove the nut from the spring front attaching bolt.
5. Remove the spring front attaching bolt from the spring and hanger with a drift.
6. Remove the nut from the shackle-to-hanger attaching bolt. Drive the bolt from the shackle and hanger with a drift, and remove the spring from the vehicle.
7. Remove the nut from the spring rear attaching bolt (Fig. 5). Drive the bolt out of the spring and shackle with a drift.

Installation

8. Position the shackle (Fig. 5) (closed section facing towards front of vehicle) to the spring rear eye and install the bolt and nut.
9. Position the spring front eye and bushing to the spring front hanger, and install the attaching nut and bolt. Do not tighten nuts.
10. Position the spring rear eye and bushing to the shackle, and install the attaching bolt and nut. Do not tighten nuts. Align axle spacer with axle seat. Small end of spacer faces front of vehicle.
11. Raise the axle to the spring and position the spring on the axle spacer with the spring center bolt in the hole provided in the spacer and see that the spacer dowel is positioned in the pilot hole of the axle seat.
12. Position the U-bolt plate on top of the spring at the centerbolt, and place the spring U-bolts under the axle and through the holes in the U-bolt plate. Align the U-bolt plate, spring leaves, and axle spacer. Install the nuts on the U-bolts. Align the U-bolts (square with axle tube) and tighten the U-bolt nuts to 85-115 ft-lbs in increments of 20-30 ft-lbs until 85-115 ft-lbs is attained. Tighten the spring front and rear attaching nuts and bolts to specifications as listed at the end of this part.
13. Connect the shock absorber to the axle. Tighten the nut to 40-60 ft-lbs.
14. Remove the safety stands and lower the vehicle.
15. Jounce vehicle several times and retighten all suspension attachments to specification. Rear springs are now installed.

F-350

1. Raise the vehicle frame until the weight is off the rear springs with the tires still touching the floor.
2. Remove the nuts from the spring U-bolts.
3. Drive the U-bolts out of the U-bolt plate and remove the U-bolts (Fig. 4).
4. Remove the spacer from the top of the spring.
5. If equipped with auxiliary springs, remove the auxiliary spring and spacer (Fig. 4).
6. Remove the shackle-to-bracket bolt and nut from the rear of the spring.
7. Remove the spring-to-hanger bolt and nut from the front of the spring and remove the spring.
8. Remove the shackle-to-spring bolt and nut and remove the shackle from the spring.
9. Position the shackle to the spring and install the attaching bolt and nut. **The bolt must be installed so the nut is away from the frame (Fig. 4).**
10. Position the spring to the spring front hanger and install the attaching bolt and nut (Fig. 4).
11. Position the shackle to the bracket and install the attaching bolt and nut.
12. Align the spring tie bolt with the pilot hole in the axle spring seat and, if so equipped, install the auxiliary spring and spacer (Fig. 4).
13. Position the spacer on top of the spring and install the U-bolts over the spacer, spring and axle.
14. Position the U-bolt plate on the axle and U-bolts. Install the U-bolt attaching nuts.
15. Lower the vehicle. Tighten the front spring bracket bolt and nut and the rear shackle bolts, nuts and U-bolt nuts to specifications as listed at the end of this Part.

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SPECIFICATIONS

REAR SUSPENSION TORQUE LIMITS — F-SERIES, E-SERIES, BRONCO

Description	Model	(ft-lbs)	N•m
Rear Shock Upper Mounting	F-100-F-250, F-150 (4x4), F-250 (4x4), E-100-350, F-350 SC, F-350, Bronco	15-25	21-33
Rear Shock Lower Mounting	F-Series, E-Series, Bronco	40-60	55-81
Rear Spring to Axle U-Bolt	F-150-F-250 (4x4), E-100-E-150	(9/16-12 Nut) 85-115	116-155
	F-350	110-160	150-216
	E-250-E-350	150-200	204-271
	Bronco	45-60	62-81
Rear Spring to Front Hanger	F-100, F-150 (4x2)	(9/16-12 Nut) 75-105	102-142
	F-150 (4x4), F-250, F-350	150-200	204-271
	E-100-E-350	(5/8-11 Nut) 110-160	150-216
Rear Spring to Rear Hanger	F-100-F-350 SC, Bronco E-100-E-350, F-150-F-250 (4x4)	75-105	102-142

CF2729-2A

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DRIVING AXLES AND DRIVE SHAFTS

GROUP 15 (4000)

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Drive Shaft — Single Snap Ring Type U-Joint	15-60
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Single-Speed Single-Reduction Axle — Eaton	15-15
Single-Speed Single-Reduction Axle — Rockwell	15-16
Tandem Axle — Eaton	15-50
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General Driving Axle and Driveshaft Service

PART 15-01

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General Driving Axle and Driveshaft Service — (Cont'd)

PART 15-01

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DIAGNOSIS AND TESTING

AXLE TESTING

Certain rear axle and drive line trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the rear axle before adjusting, repairing, or replacing any of its parts. See Group 18, Noise Vibration and Harshness.

On F-100 through F-350 vehicles, certain trouble symptoms may be caused by limited-slip differentials. Check the vehicle rating plate and axle ratio tag to determine the type of differential.

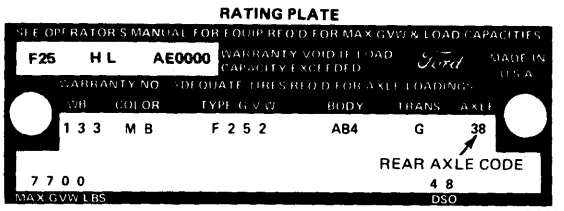
NOISE ACCEPTABILITY

A gear driven unit especially an automotive drive axle, will produce a certain amount of noise. Some noise is acceptable and may be audible at certain speeds or under various driving conditions. For example, as on a newly paved blacktop road. The slight noise is in no way detrimental to operation of the rear axle and must be considered normal.

Location of the axle identification code on the rating plate is shown in Figs. 1 and 2. Refer to Part 10-00 for a complete listing of the codes.

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E3790-1A

FIG. 1 Truck Rating Plate—Rear Axle Code Location

GEAR TOOTH CONTACT PATTERN CHECK (FORD AXLES)

Paint all gear teeth and roll a pattern. Diagnose the pattern and then make the appropriate adjustments.

When rolling a tooth pattern, use the special compound (tube) packed with each service ring gear and pinion set.

If making a final gear tooth contact pattern check, recognize that **there are three different types of gear sets: hunting, non-hunting, and partial non-hunting. Each type is determined by the number of teeth in the gears.** The non-hunting and partial non-hunting types can be identified by the paint timing marks on the drive pinion and ring gear teeth.

ACCEPTABLE TOOTH PATTERNS (FORD AXLES)

Fig. 3 shows acceptable tooth patterns for all Ford axles.

In general, they should have the following characteristics:

1. The drive pattern should be fairly well centered on the tooth.
2. The coast pattern should be fairly well centered on the tooth.
3. Some clearance between the pattern and the top of the tooth is desirable.
4. There should be no hard lines where the pressure is high.

The individual gear set need not conform exactly to the ideal pattern in order to be acceptable. **Any combination of drive and coast patterns shown in Fig. 3 is acceptable.**

HUNTING GEAR SET

In this type, any one drive pinion gear tooth comes into contact with all ring gear teeth. Several revolutions of the ring gear are required to make all possible gear combinations.

NON-HUNTING GEAR SET

In this type, any one drive pinion gear tooth comes into contact with only a few ring gear teeth. Only one revolution of the ring gear is required to make all possible tooth contact combinations.

PARTIAL NON-HUNTING GEAR SET

In this type, any one drive pinion tooth comes into contact with only part of the ring gear teeth. More than one revolution of the ring gear is required to make all possible gear tooth combinations.

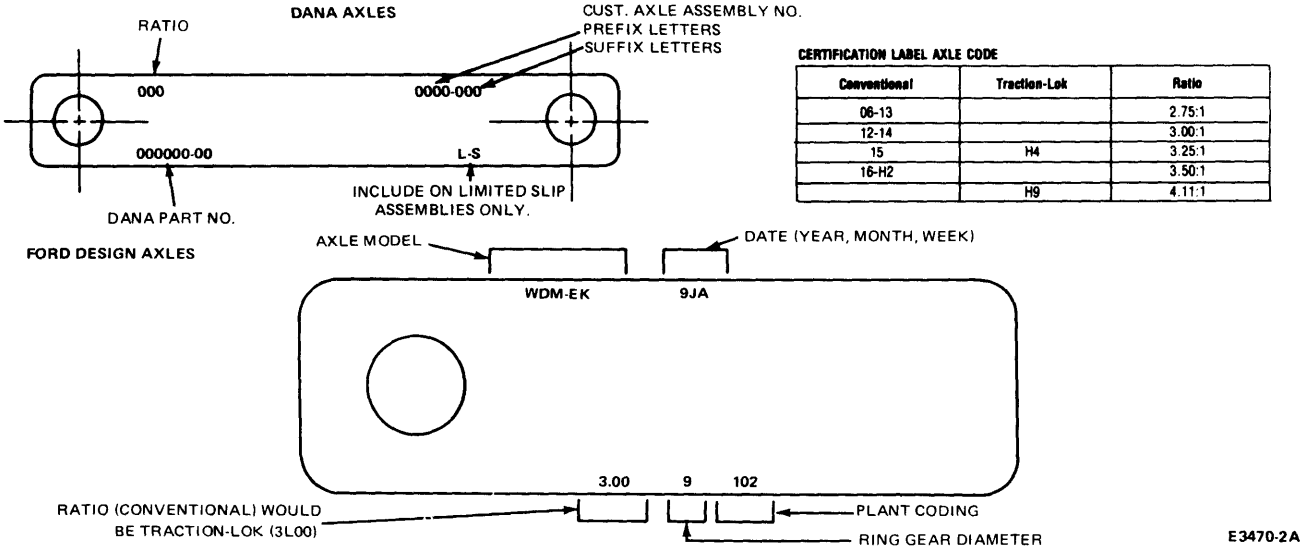
SHIM CHANGES

Since each gear set rolls a characteristic pattern, the patterns shown in Fig. 4 are considered acceptable and should be used as a guide. The drive pattern is rolled on the convex side of the tooth, and the coast pattern is rolled on the concave side.

The movement of tooth contact patterns with changes in shimming can be summarized as follows:

1. Thicker shim with the backlash set to specifications moves the pinion further from the ring gear.
2. Thinner shim with the backlash set to specifications moves the drive pinion closer to the ring gear.

If the patterns are not correct, make the changes as indicated. The drive pinion need not be disassembled to change a shim. All that is required is to remove the drive pinion, bearing, and retainer assembly and install a different shim. When re-installing the drive pinion and retainer assembly of a non-hunting or partial non-hunting gear set, be sure that the marked tooth on the



CERTIFICATION LABEL AXLE CODE

Conventional	Traction-Lok	Ratio
06-13		2.75:1
12-14		3.00:1
15	H4	3.25:1
16-H2		3.50:1
	H9	4.11:1

E3470-2A

FIG. 2 Axle Identification Tags

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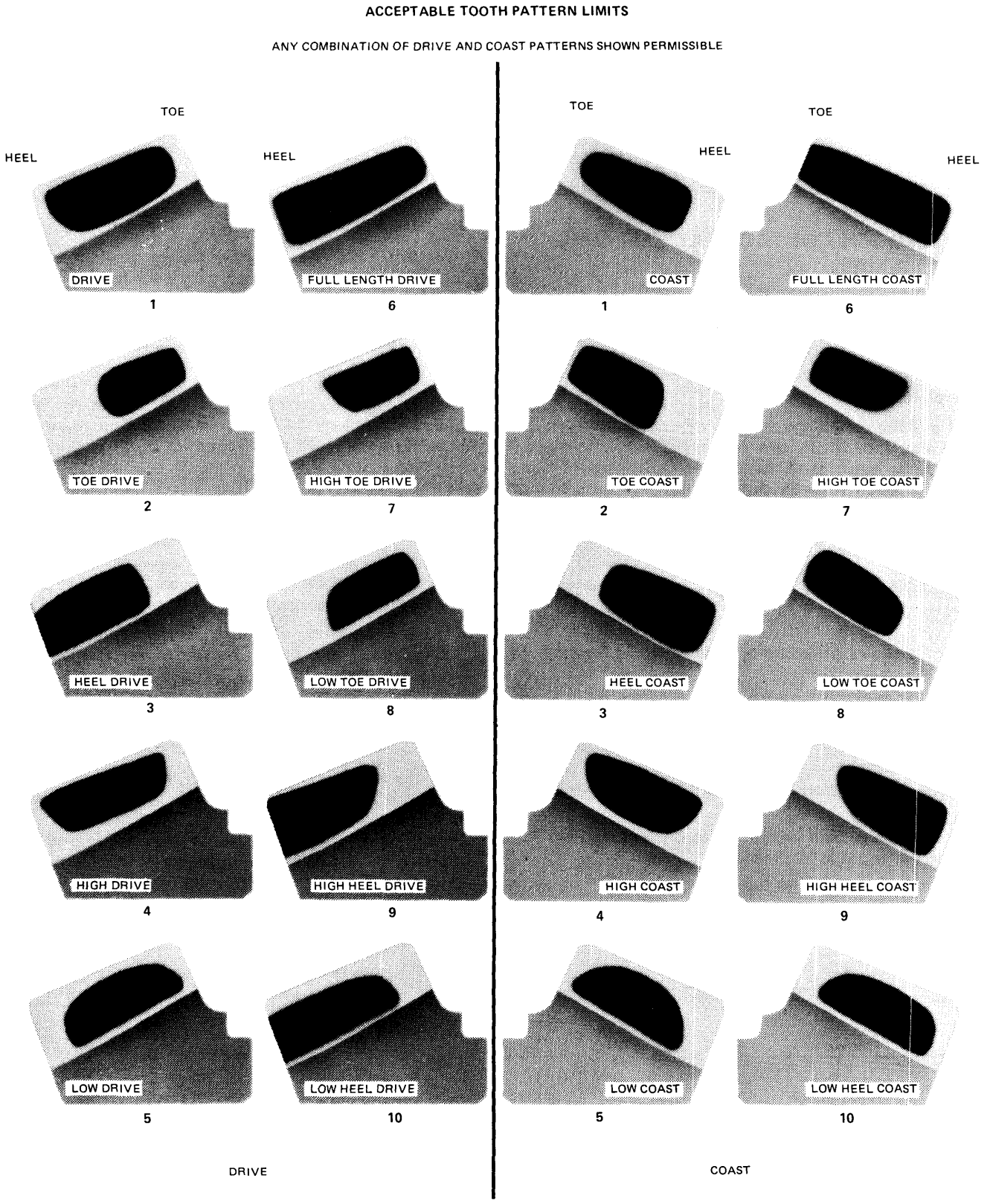


FIG. 3 Typical Gear Tooth Contact Pattern

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drive pinion indexes between the marked teeth on the ring gear. Refer to Pinion and Ring Gear Tooth Contact Adjustment.

TRACTION-LOK DIFFERENTIAL OPERATION CHECK FORD DESIGN

A traction-Lok differential can be checked for proper operation without removing the carrier from the axle housing.

Jack up one rear wheel and remove the wheel cover. Install the tool on the axle shaft flange studs as shown in Fig. 4.

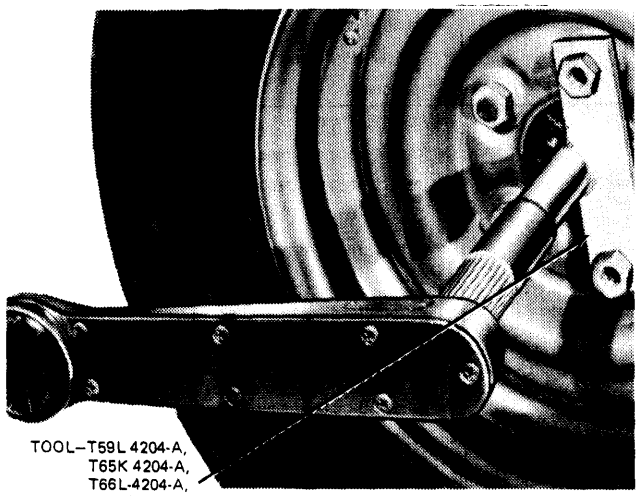


FIG. 4 Traction-Lok Differential Check

Using a torque wrench of at least 200 ft-lb. capacity, rotate the axle shaft. **Be sure that the transmission is in neutral, one rear wheel is on the floor, and the other rear wheel is raised off the floor.** The breakaway torque required to start rotation should be at least 40 ft-lb. The initial breakaway torque may be higher than the continuous turning torque, but this is normal. The axle shaft should turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential for improper assembly. **A vehicle equipped with a Traction-Lok differential will always have both wheels driving. If, while the vehicle is being serviced, only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack.**

LOCKING DIFFERENTIAL DOES NOT OPERATE IN MUD OR SNOW OR ON ICE

DANA LIMITED SLIP DIFFERENTIAL

Refer to Part 15-42, Limited Slip Differential—Dana.

To demonstrate proper performance of the Dana limited slip differential:

1. Place one wheel on good dry pavement, and the other on a 4 x 4 sheet of plywood, masonite, etc. completely covered with grease.

   CAUTION: Anchor plate to floor or fixed object. Constant spinning of the wheel can cut through the grease causing the plate to kick out from under vehicle.
2. Gradually open throttle to obtain maximum traction prior to "break-away". The ability to move the vehicle will demonstrate proper performance of a limited slip axle.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the limited slip feature of the Dana axle. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.

This limited slip differential does **not** have any internal residual (bias) torque. It cannot be tested by jacking up one rear wheel and trying to measure the torque required to continuously turn the wheel. The wheel will turn freely on a properly operating limited slip differential in the above models.

In vehicle operation, it should be noted that:

1. If, with unequal traction, both wheels slip, the limited-slip axle has done all it can possibly do.
2. In extreme cases of differences in traction, the wheel with the least traction may spin after the limited slip has transferred as much torque as possible to the non-slipping wheel.

TOTAL AXLE BACKLASH CHECK

FORD AXLES

Raise vehicle on hoist. Use a rigid bar or pipe of suitable length and clamp one end to the axle companion flange and the other end to the frame or body member in order to prevent all movement of the companion flange.

Lower the vehicle so that one rear wheel is resting on a wheel chock to prevent it from turning. The other rear wheel will then be used to measure total axle backlash.

Rotate the free wheel slowly until a feel of driving the axle is encountered. Position a crayon or chalk firmly on the side of the tire 12 inches from the center of the wheel. Rotate the wheel slowly in the opposite direction until the feel of driving the axle is encountered again.

Measure the length of the crayon or chalk mark in the tire. If the length of the mark is 1.0 inch or less, the axle backlash is within allowable limits.

DANA AXLES

Apply parking brake to keep both rear wheels from turning. Mount a dial indicator on the carrier housing with the indicator point positioned to contact the pinion yoke 1-1/2 inch from the center line of the pinion shaft.

With the transmission in neutral and engine not running, check the total rotational movement of the pinion yoke. If the total reading on the dial indicator is .075 inch or less, the axle backlash is within allowable limits.

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DIAGNOSIS GUIDES

The following guides can be used when diagnosing rear axle and driveline systems.

The following charts can be used when diagnosing rear axle and driveline systems.

CONDITION	POSSIBLE CAUSE	CORRECTION
• Excessive rear axle noise.	• N.V.H. problem. (Noise, vibration and harshness.)	• Perform the N.V.H. tests to determine whether the noise is a N.V.H. caused by an axle problem. Refer to group 18.
	• Worn or damaged wheel bearing.	• Perform wheel bearing noise test. Refer to group 18. Replace bearings if required.
	• Worn or damaged differential carrier assembly.	• Remove carrier (cover on DANA axles). Inspect carrier before disassembly. Repair and replace parts as required.
• Loud "clunk" in the driveline when shifting from reverse to forward.	• High idle speed.	• Adjust idle speed.
	• Loose engine mounts.	• Inspect, repair as required.
	• Loose or worn driveshaft components, companion flange attaching nut below specs.	• Inspect, repair or replace as required.
	• Inoperative shock absorbers and/or loose rear springs or suspension arms.	• Inspect, repair or replace as required.
	• Excessive back lash in axle, or transmission.	• Perform total backlash check of axle this group. Repair or replace as necessary.
	• Insufficient lubrication.	• Add lubricant as required.
• Drive line "clunk" as vehicle starts to move following a brake stop (2-piece driveshaft).	• Loose rear spring U-bolts.	• Tighten U-bolts to specification.
	• Worn or galled output shaft splines.	• Remove the driveshaft from the vehicle. Clean the male splines and inspect for worn or galled splines. Replace if necessary.
	• Worn or galled slip yoke splines.	• Clean and inspect the female splines of the slip yoke for worn or galled condition. Replace if necessary.
	• Damaged slip yoke seal.	• Replace seal.
	• Insufficient lubrication.	• Using a long handle (stencil type) brush, apply long life lube evenly on all the spline of the slip yoke. Reinstall driveshaft and using a hand grease gun lubricate the slip yoke thru the zerk fitting with long life lube. NOTE: Install the slip yoke making sure that the coupling shaft and driveshaft are in phase.
• On turns, DANA limited slip axle has a high pitched chattering noise.	• Improper lubricant.	• If axle chatters, siphon or drain lubricant from axle and refill with specified rear axle lubricant.
• DANA limited slip axle does not work in snow, mud or ice.	• Worn or damaged axle unit.	• Starting with one wheel on a slippery surface, slightly apply the parking brake. Gradually open throttle. If the vehicle moves the axle is operating satisfactorily.
• Differential lockout will not engage — air operated.	• Worn or damaged solenoid valve.	• Repair solenoid valve.
	• Open circuit in wiring.	• Repair circuit to ignition switch.
	• Damaged or blocked line between solenoid valve to lockout valve.	• Repair line.
	• Worn or damaged lockout valve.	• Repair or replace lockout valve.

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GENERAL DIAGNOSTIC PROCEDURE — FORD AXLES

CONDITION	POSSIBLE CAUSE
• Noise is the same on drive or coast.	• Road noise. • Tire noise. • Front wheel bearing noise.
• Noise changes with type of road.	• Road noise. • Tire noise.
• Noise tone lowers as truck speed is lowered.	• Tire noise.
• Similar noise is produced with truck standing and driving.	• Engine noise. • Transmission noise.
• Vibration.	• Refer to Noise, Vibration and Harshness, Part 18-01.
• Noise most pronounced on turns.	• Differential side gears and pinion.
• Drive noise, coast noise, or float noise.	• Wheel bearings. • Ring and pinion gear.
• Clunk on acceleration or deceleration.	• Worn differential cross shaft in case.

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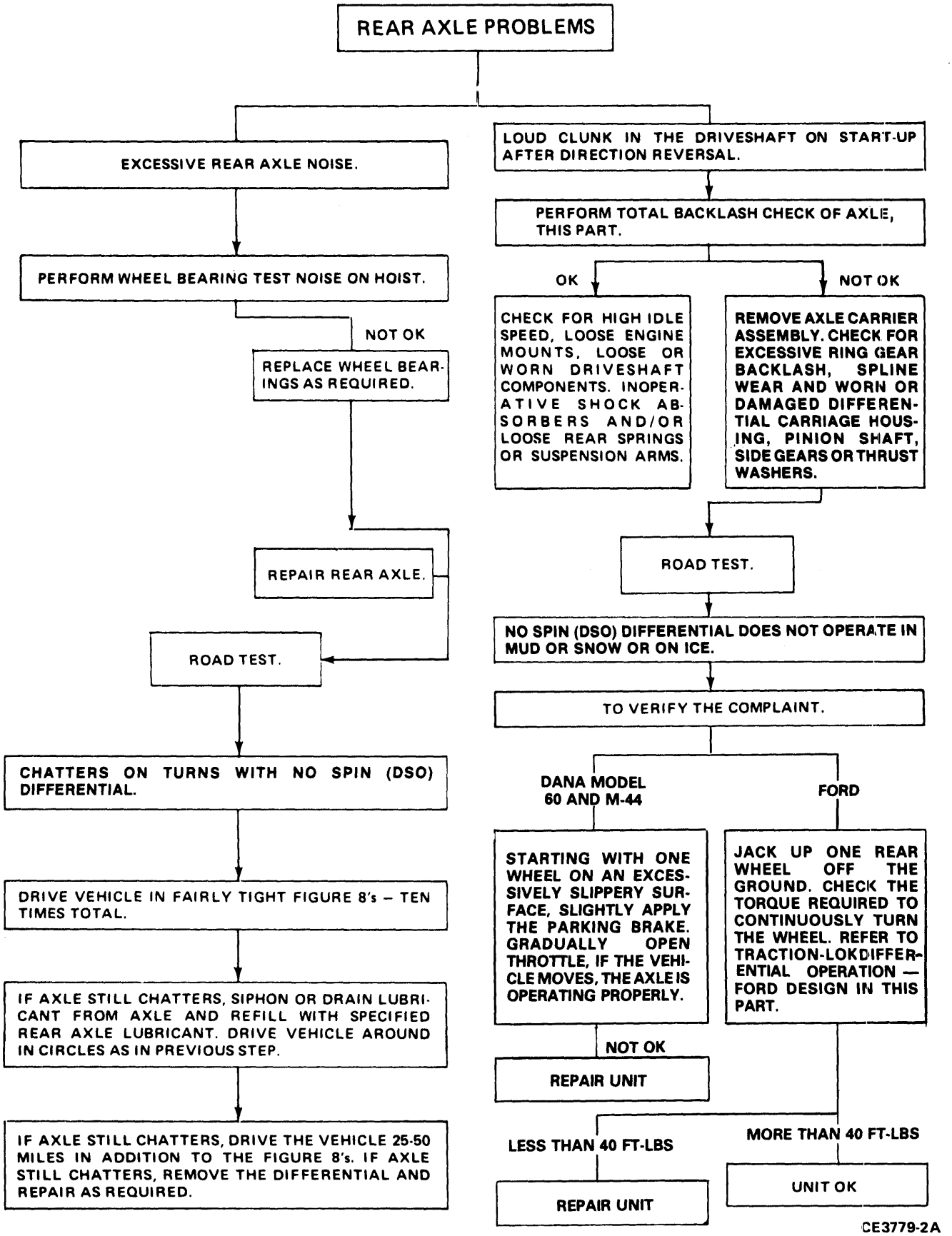
REAR AXLE DIAGNOSIS GUIDE — FORD AXLES

CONDITION	POSSIBLE CAUSE	CORRECTION
• Excessive rear axle noise	• Differential carrier.	• Road test vehicle to assure problem is rear axle noise rather than other system noise. Refer to General Diagnostic Procedure. Repair and replace parts as required.
• Loud "clunk" in the driveshaft when shifting from reverse to forward	• Driveshaft. • Rear axle shafts or carrier.	• Raise vehicle, rotate driveshaft by hand to isolate problem as driveshaft or rear axle problem. Repair or replace as required. • Remove and inspect. Repair as necessary.
• Limited-slip or Traction-Lok axle does not work in snow, mud or on ice	• Differential.	• Perform Traction-Lok Differential Operation Check in this Part. Repair as required.
• On turns, the rear axle has a high pitched chattering noise (Limited-slip or Traction-Lok axles only)	• Lubricant. • Differential.	• Road test vehicle — drive truck in tight circles, 5 clockwise and 5 counterclockwise. If chatter is still evident, flush and replace lubricant. • Remove differential, repair as required.

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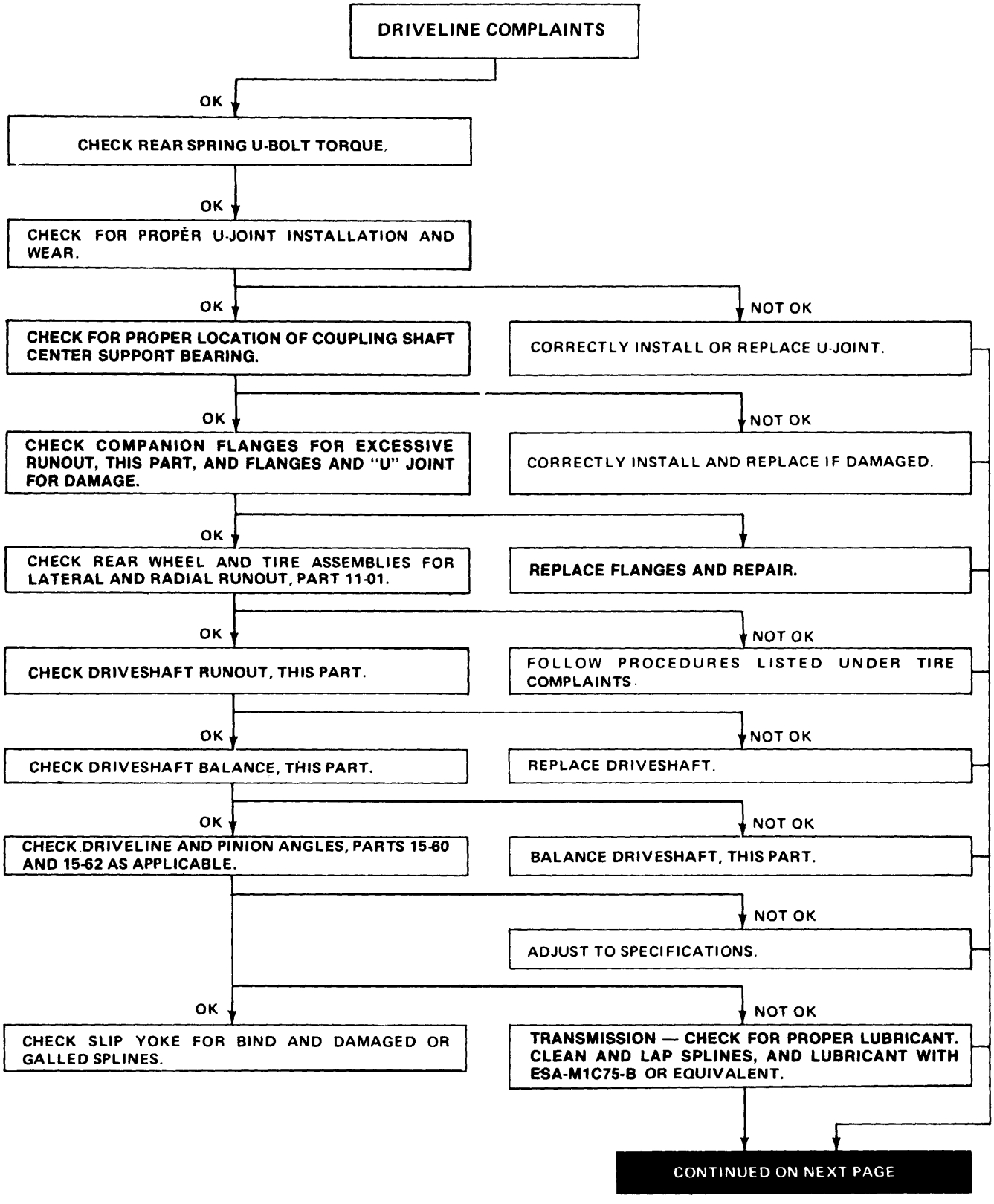
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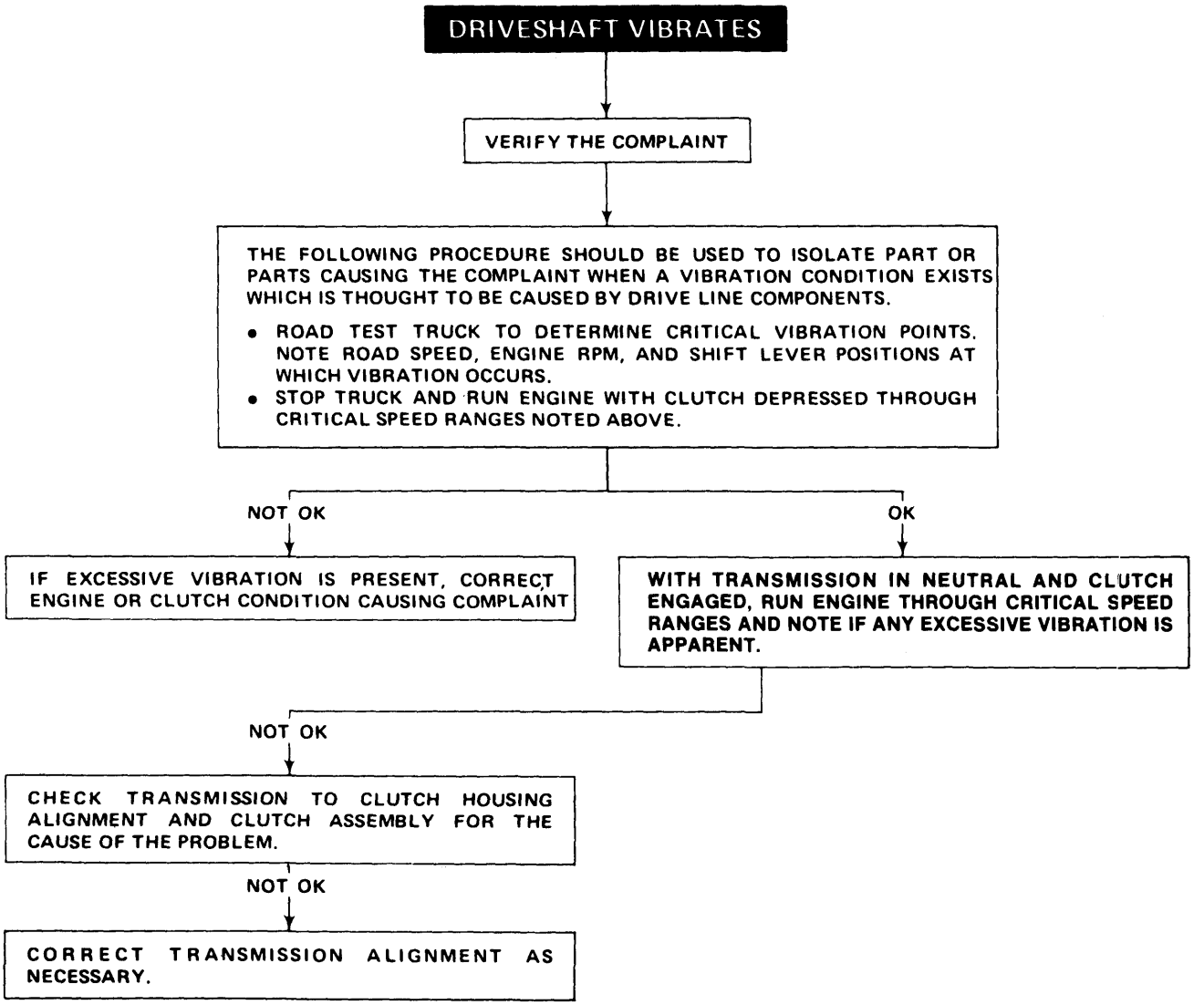
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ADJUSTMENTS

AXLE ADJUSTMENTS

Certain rear axle and drive line trouble symptoms are also common to the engine, transmission, wheel bearing, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the rear axle before adjusting, repairing or replacing any of the parts. See Group 18.

PINION AND RING GEAR TOOTH CONTACT ADJUSTMENTS (ALL EXCEPT DANA)

Two adjustments affect drive pinion and ring gear tooth contact. They are drive pinion depth and backlash (Fig. 5).

The pinion depth adjusting shims are installed between the drive pinion bearing retainer or cage and the carrier housing; therefore, adding shims moves the drive pinion out away from the ring gear, and removing shims moves the drive pinion in toward the ring gear.

The differential bearing adjusters locate the differential and ring gear assembly in the carrier housing. Tightening the adjuster on the ring gear side of the carrier moves the differential and ring gear into the pinion to decrease backlash. Tightening the adjuster on the drive pinion side of the carrier moves the ring gear away from the drive pinion to increase backlash. To move the ring gear from, or toward, the pinion, loosen one adjuster and tighten the other the same amount.

SHIM SELECTION

Individual differences in matching the carrier housing and the gear set requires a shim between the drive pinion bearing retainer sleeve and the carrier housing

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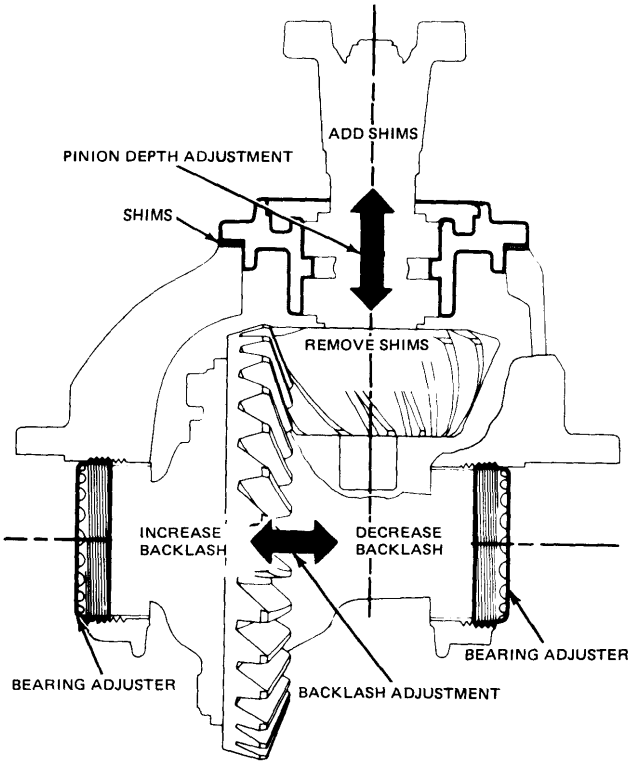


FIG. 5 Pinion and Ring Gear Tooth Contact Adjustment—Except Dana

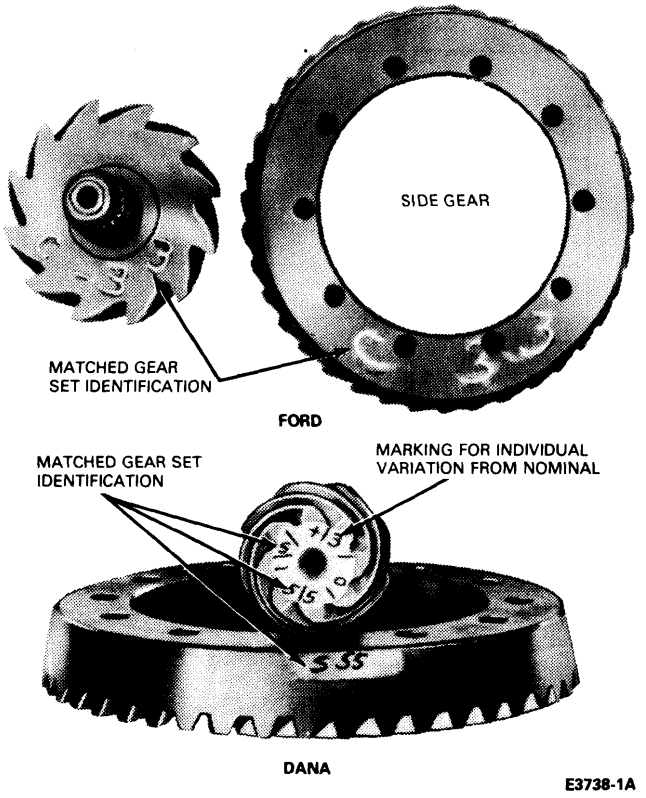


FIG. 6 Typical Pinion and Ring Gear Set Marking

to locate the drive pinion for correct tooth contact with the ring gear. In order to adjust the shim pack to the correct thickness for a given gear seat, each drive pinion gear is marked with an adjustment number (individual variation from nominal dimension) such as shown in Fig. 6.

Shim thickness for Ford gears is determined by the gear pattern check. Add or remove shims from the original or nominal shim pack, as required, until a proper gear pattern is established. Adding shims will move the drive pinion away from the ring gear and removing shims will move the drive pinion toward the ring gear.

If the original ring gear and drive pinion are used in reassembly, use the original shim pack removed during disassembly.

When replacing a ring gear and drive pinion, it should be noted that the original factory-installed shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the original gear set dimensions. Therefore, to select the correct shim thickness for the new gear set to be installed, follow these steps:

1. Measure the thickness of the **original shim** with a micrometer.
2. Note the shim adjustment number on both the old drive pinion and the new drive pinion.
3. Refer to Fig. 7 to determine the correct amount of shim thickness change. The amount shown in Fig. 7 under the old pinion shim adjustment number and in line with the new pinion number is the amount of **change that should be made to the original shim thickness. If the old pinion is marked 14, for example, and the new pinion is marked -5, the table indicates that 0.019 inch of shim stock should be removed from the original shim pack.**

RING GEAR REPLACEMENT

Special bolts should be used to attach the new ring gear to the differential case.

Place the new ring gear on the differential case and insert the bolts through the ring gear and into the case.

Install the bolts with their heads in the counterbores on the gear tooth side of the ring gear. The torque limits for these special bolts and nuts apply to threads lubricated with engine oil. If the bolts and nuts are tightened while dry, add 10 to the limits. If the threads are lubricated with axle lubricant, subtract 10 from the torque limits.

REAR AXLE LUBRICATION

The ability of any axle to deliver quiet, trouble-free operation over a period of years is largely dependent upon the use of good quality gear lubricants. To insure long life for gears and bearings, use only specified gear lubricants.

DRAINING

ALL AXLES

Dana axles do not have a drain plug. The cover should be loosened from the housing to allow drainage. For other axles, use the following procedure:

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New Pinion Marking	OLD PINION MARKING																													
	-15	-14	-13	-12*	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11	+12	+13	+14	+15
+15	+.030	+.029	+.028	+.027	+.026	+.025	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0
+14	+.029	+.028	+.027	+.026	+.025	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001
+13	+.028	+.027	+.026	+.025	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002
+12	+.027	+.026	+.025	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003
+11	+.026	+.025	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004
+10	+.025	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005
+9	+.024	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006
+8	+.023	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007
+7	+.022	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008
+6	+.021	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009
+5	+.020	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010
+4	+.019	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011
+3	+.018	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012
+2	+.017	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013
+1	+.016	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014
0	+.015	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015
-1	+.014	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016
-2	+.013	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017
-3	+.012	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018
-4	+.011	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019
-5	+.010	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020
-6	+.009	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021
-7	+.008	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022
-8	+.007	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023
-9	+.006	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024
-10	+.005	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024	-.025
-11	+.004	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024	-.025	-.026
-12	+.003	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024	-.025	-.026	-.027
-13	+.002	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024	-.025	-.026	-.027	-.028
-14	+.001	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024	-.025	-.026	-.027	-.028	-.029
	0	-.001	-.002	-.003	-.004	-.005	-.006	-.007	-.008	-.009	-.010	-.011	-.012	-.013	-.014	-.015	-.016	-.017	-.018	-.019	-.020	-.021	-.022	-.023	-.024	-.025	-.026	-.027	-.028	-.029	-.030

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FIG. 7 Drive Pinion Adjusting Shim Thickness Change—Inches (All except Dana)

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If possible, drain the lubricant when it is warm and it will run freely, allowing full drainage in minimum time. This is especially desirable in cold weather.

To drain, unscrew the plug at the bottom of the housing and allow sufficient time for all the old oil to run out. On tandem drive axles, also unscrew the plug at the bottom of the power divider for drainage of lubricant in the power divider.

FILLING

SINGLE-REDUCTION AXLES—FORD AXLE

If the filler hole is in the housing cover, or in the carrier casting, fill to the bottom of the hole.

To check these axles for proper lubricant level, the filler plug should be backed out slowly. If seepage occurs around the threads of the plug, immediately turn the plug back in to avoid any drainage. This condition indicates that the specified amount of lubricant is in the axle.

ALL OTHER VEHICLES

Fill the axle through the rear filler hole until oil flows from the bottom of the hole. After filling the axle with the specified amount of lubricant, install the oil filler hole plug.

REAR WHEEL BEARING AND SEAL REMOVAL AND INSTALLATION

Two types of rear wheel bearing assemblies are used in Ford truck axles. In the Ford semi-floating type axles of light series trucks, a single outer bearing is used, and is held in place by a retainer. This bearing is attached to the axle shaft and part of the vehicle load is carried on the axle shaft. Refer to Part 11-11 for removal and installation details. In the full-floating type axle used in the Dana axles, double tapered roller bearings are mounted on the axle housing and the vehicle load is carried on the housing and not on the shaft. The shaft therefore can be removed without disturbing the bearing.

Wheel bearings of the light series truck semi-floating axles are lubricated at assembly with a special lubricant, and require no further maintenance. A seal installed behind the bearing prevents axle lubricant leakage to the bearing. **Replace this seal whenever the hub and drum are removed from the axle. See Part 11-11.**

Certain of the light series vehicles with semi-floating axles are equipped with tapered roller bearings. The oil seal in this case is outboard of the bearings. Full service procedures for these bearings and seals are provided in Part 15-10.

On all the Dana full-floating axle wheel hubs with tapered roller bearings, a seal is installed behind the inner bearing to keep the wheel bearing lubricant from the brake lining and brake drum. See Part 11-14.

REAR AXLE COMPANION FLANGE RUNOUT CHECK (FORD—DANA AXLES)

1. Raise the vehicle on a hoist that supports the rear axles (twin-post hoist).
2. Remove the drive shaft assembly (Part 15-60).
3. Check the companion flange for damage to the universal joint bearing locating lugs. If the lugs are shaved (worn) or damaged, replace the flange (Fig. 8).

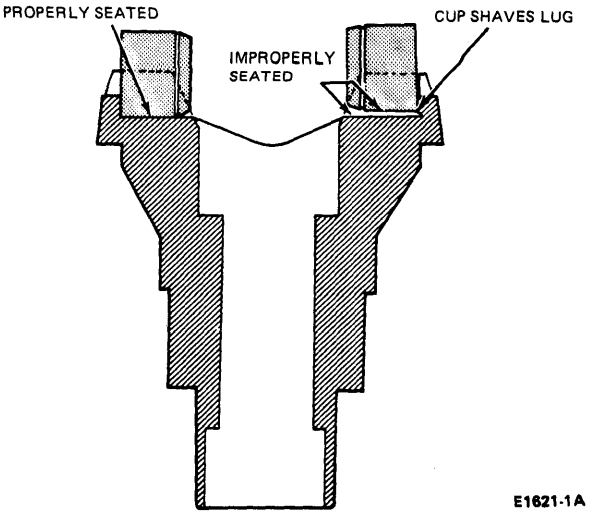


FIG. 8 Checking Companion Flange

4. The companion flange runout is checked with a dial indicator with 1.000-inch minimum travel, and a cup-shaped dial indicator adapter Tool 6565-AB (Fig. 9). To fabricate the checking tool, modify a universal joint assembly by removing two bearing cups that are opposite each other, and cutting or grinding off one of the universal joint bearing flanges (Fig. 9).

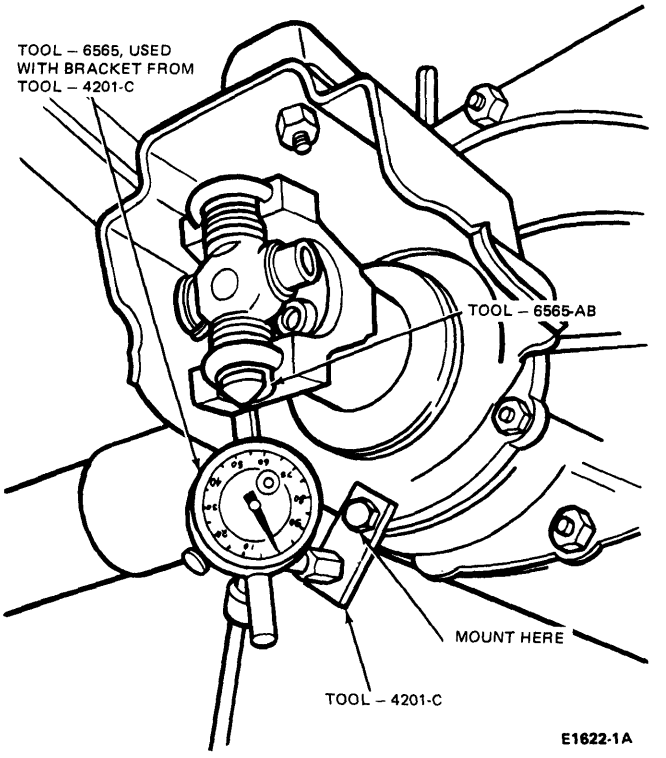


FIG. 9 Flange Bearing Cup Runout

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5. Install the cup-shaped adapter on the dial indicator stem. Install the dial indicator on the pinion retainer or pinion nose bumper bracket. Position the indicator to allow an indication at the ends of the universal joint bearing cups and the remaining exposed journal of the cross-shaft.
6. Turn the companion flange so that the dial indicator cup-type adapter rests on the machined surface of the bearing cup (Fig. 9). Rotate the companion flange side-to-side slightly to obtain a reading indicating that the bearing cup surface is perpendicular to the adapter. **This will be the point at which the dial indicator cup is closest to the center of companion flange rotation. It is also the point at which the dial indicator hand will reverse direction as the companion flange is turning.**
7. Carefully retract the dial indicator stem and rotate the companion flange 180 degrees to position the machined surface of the opposite universal bearing under the dial indicator adapter tool. Again, slightly rotate the flange side-to-side to position the bearing perpendicular to the dial indicator adapter. Again, this is the point at which the indicator hand will reverse direction as the flange is rotated. Record the flange bearing cup runout reading obtained from the indicator (Fig. 10).

Indicator Reading	Flange Bearing Cup Runout—Inch	Driveshaft Universal Cross-Shaft Runout—Inch
1	0.004	0.005
2	0.002	0.004
3	0.003	0.003
Average	0.003	0.004

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FIG. 10 Flange Bearing Cup and Cross-Shaft (V2) Runout Averaging Chart—Typical Reading

Rotate the companion flange 90 degrees and position the dial indicator adapter on the machined end of the exposed journal (Fig. 11). **Be sure the end surface of the journal is perpendicular to the adapter.** This requires that the cross-shaft be moved fore and aft on the flange bearing cups. **Note the point at which the indicator hand reverses direction.**

Rotate the flange assembly side-to-side until the cross-shaft is perpendicular to the pinion shaft axis, and the indicator hand reverses direction. Zero the dial indicator and check the zero point again by slightly moving the cross-shaft fore and aft; then, rotate the companion flange from side-to-side.

8. With the indicator at zero, carefully retract the dial stem and rotate the flange 180 degrees. Rotate the cross-shaft 180 degrees on the flange bearing cups to position the exposed journal under the dial indicator adapter. Rock the cross-shaft fore and aft and the companion flange side-to-side to establish the point at which the indicator hand reverses direction. This will determine the drive shaft universal cross-shaft runout. Record this reading (Fig. 11).

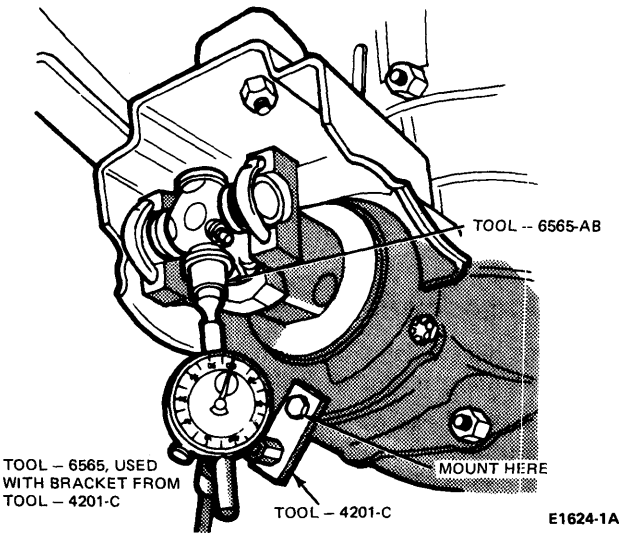


FIG. 11 Cross-Shaft Runout Check

9. **Repeat Steps 5 through 8 at least three times and average the indicator readings obtained (Fig. 10).**
10. To determine the total (combined) companion flange runout, use the combined runout guide (Fig. 12). With an indicated 0.003-inch flange bearing cup runout and an indicated 0.004-inch universal cross-shaft runout (Fig. 11), the combined companion flange runout will be 0.005-inch (Fig. 12).
11. If the reading obtained in Step 10 exceeds specifications, re-position the companion flange 180 degrees on the pinion shaft and repeat Steps 1 through 11.
12. If the repeat readings still exceed specifications, re-position the flange an additional 90 degrees on the pinion shaft and check the runout (Steps 4 through 10).
13. If the runout is still excessive, replace the companion flange and check the runout. If necessary, rotate the new flange on the pinion shaft until an acceptable runout is obtained.

    If excessive runout is still evident after replacement of the companion flange, replace the ring gear and pinion and repeat the above checks until the runout is within specifications.
14. Install the drive shaft assembly (Part 15-60). **Make sure the universal joint bearing cups are properly positioned between the companion flange lugs.**
15. Lower the vehicle. Road test the vehicle. If drive shaft vibrations are evident during the road test, remove the drive shaft from the companion flange and rotate it 180 degrees. Road test the vehicle again.

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Flange Bearing Cup Runout	Driveshaft Universal Cross-Shaft Runout — Inch												
	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.012
0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.012
0.001	0.001	0.0013	0.0022	0.0032	0.0042	0.0051	0.0061	0.0071	0.0081	0.0091	0.0010	0.011	0.012
0.002	0.002	0.0022	0.0027	0.0037	0.0045	0.0053	0.0062	0.0072	0.0082	0.0092	0.0101	0.0111	0.0121
0.003	0.003	0.0032	0.0036	0.0042	0.005	0.0058	0.0067	0.0077	0.0085	0.0094	0.0104	0.0113	0.0123
0.004	0.004	0.0042	0.0045	0.005	0.0057	0.0064	0.0072	0.0081	0.009	0.0097	0.0107	0.0116	0.0126
0.005	0.005	0.0051	0.0053	0.0058	0.0063	0.0071	0.0078	0.0087	0.0094	0.0102	0.0111	0.012	0.013
0.006	0.006	0.0061	0.0062	0.0068	0.0072	0.0078	0.0085	0.0092	0.010	0.0108	0.0116	0.124	0.0134
0.007	0.007	0.0071	0.0073	0.0075	0.0081	0.0087	0.0093	0.0099	0.0103	0.0114	0.0122	0.013	0.0138
0.008	0.008	0.0081	0.0082	0.0087	0.009	0.0094	0.010	0.0104	0.011	0.012	0.0128	0.0135	0.0144
0.009	0.009	0.0091	0.0092	0.0094	0.0097	0.102	0.108	0.0114	0.012	0.0127	0.0134	0.0141	0.015
0.010	0.010	0.010	0.0101	0.0104	0.0107	0.0111	0.0116	0.0122	0.0128	0.0134	0.0141	0.0148	0.0156
0.011	0.011	0.011	0.0111	0.0113	0.0116	0.012	0.0124	0.013	0.0135	0.0141	0.0148	0.0154	0.0162
0.012	0.012	0.012	0.0121	0.0123	0.0126	0.013	0.0134	0.0138	0.0144	0.015	0.0156	0.0162	0.0169

The total (combined) companion flange runout is located in the square where the columns containing the flange bearing cup runout and universal cross shaft runout readings intersect.

CE3683-2A

FIG. 12 Companion Flange Combined Runout Chart

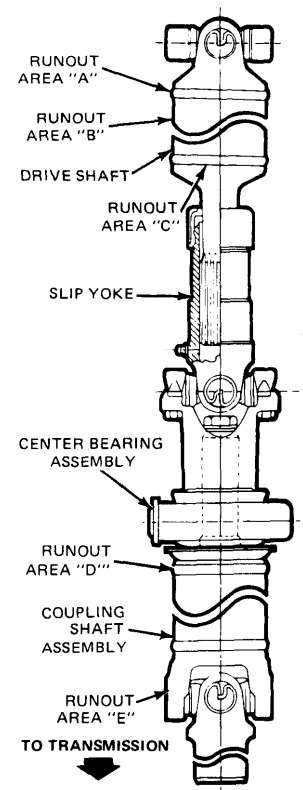
DRIVESHAFT ADJUSTMENTS

DRIVESHAFT AND COMPANION FLANGE RUNOUT CHECK

1. Check coupling shaft for proper phasing, this part (Fig. 22) as applicable. Check all U-joint to companion flange installations for improperly seated U-joint bearing caps.
2. Check the runouts at the front, and rear of the coupling shaft and the front, center and rear of the drive shaft. The runout at the rear of the driveshaft should be made on the tube as close to the universal joint as possible, Fig. 13.

   NOTE: Turn the rear wheel/drum to rotate the coupling shaft and drive shaft when checking runouts.
3. Mark the points of the greatest runouts on the coupling shaft and driveshaft. If the runout is .035 inch or more on the couplig shaft or at the front or center of the driveshaft, replace the shaft.
4. If the runout at the rear of the driveshaft is less than .035 inch (and the front and center runouts are also less than .035 inch) proceed to driveshaft balance.
5. If the runout at the rear is more than .035 inch (and the front and center runouts are less than .035 inch) mark the point of greatest runout on the shaft.

   NOTE: The runout at the rear of the driveshaft can be caused by either the driveshaft or the companion flange.
6. To determine the cause of the runout at the rear of the driveshaft, mark the U-joint and companion flange, remove and rotate the driveshaft 180 degrees to the companion flange and check and mark the greatest runout at the rear of the driveshaft. If the runout is less than .035 inch, evaluate on the hoist. Road test if the vibration is not present. Proceed to driveshaft balance if vibration is present. If runout is more than .035 inch proceed to Step 7.
7. Compare the first and second marks at the rear of the driveshaft to determine the cause of the runout.



E3669-1B

FIG. 13 Driveshaft Runout

If the marks are within approximately 1 inch, replace the driveshaft. If the marks are approximately on opposite sides of the shaft, replace the companion flange Fig. 14.

8. After replacing either the driveshaft or companion flange, re-check runouts. If the excessive runout is still evident after replacement of the companion flange, it will be necessary to replace the ring gear and pinion and repeat the above checks until runout is within specifications.
9. Evaulate on hoist. If the vibration is still present, proceed to driveline balance procedure.

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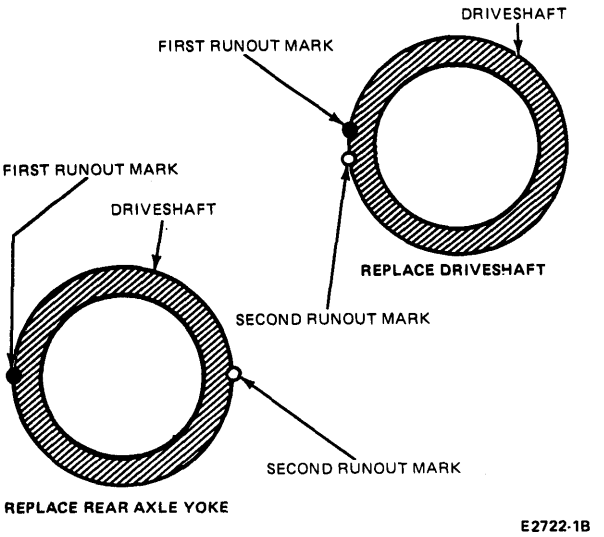


FIG. 14 First and Second Runout Mark Comparisons

DRIVE SHAFT BALANCING

Vibration or shudder which is noticeable either on fast acceleration, when coasting, or when using the engine for braking, may be caused by the rear axle housing being loose on the rear springs, improper tire balance, improper driveline installation, or driveline balance.

If detailed parts of the driveshaft are replaced and shaft vibration is encountered after installation, disconnect the shaft at the slip yoke. Rotate the slip yoke 180 degrees; then, reconnect the shaft to the slip yoke. If the vibration persists, disconnect the shaft at the rear axle companion flange. Rotate the companion flange 180 degrees and reconnect the shaft to the flange.

If rotating the driveshaft 180 degrees does not eliminate vibration, the driveshaft may be balanced, using the following procedure:

1. Raise the vehicle on a twin-post hoist so that both the front and rear axles are safely supported with all wheels free to rotate.
2. With the transmission in gear (include transfer unit on 4 x 4 type vehicles) increase the vehicle speed to the maximum vibration level. Note and record the speedometer speed of this vibration period as a baseline speed.

   Two people are required to perform this operation; one in the vehicle, and one under the vehicle making adjustments.
3. Check the attachment of all U-joint bearing caps of the driveshaft or coupling shaft to the transmission yoke, front or rear axle pinion yokes and all transfer unit drive yokes for improper installation or damaged U-joint bearing cap locating lugs. All yokes with worn, shaved, or damaged locating lugs must be replaced.
4. Check the driveshaft and coupling shaft for correct phasing. If necessary, rephase the driveshaft and coupling shaft as shown in Group 15-62 or this Part, as applicable.
5. With the transmission (and transfer unit) in gear, run the vehicle with the driveshaft and coupling shaft rotating at a speedometer speed of 40-50 mph, carefully bring a crayon, piece of chalk, or colored pencil up until it just barely contacts the rear end, center and front end of the driveshaft (Fig. 15). The chalk marks will indicate the heavy side of the driveshaft. Use caution when checking the driveshaft near the balance weights to prevent injury to the hands.

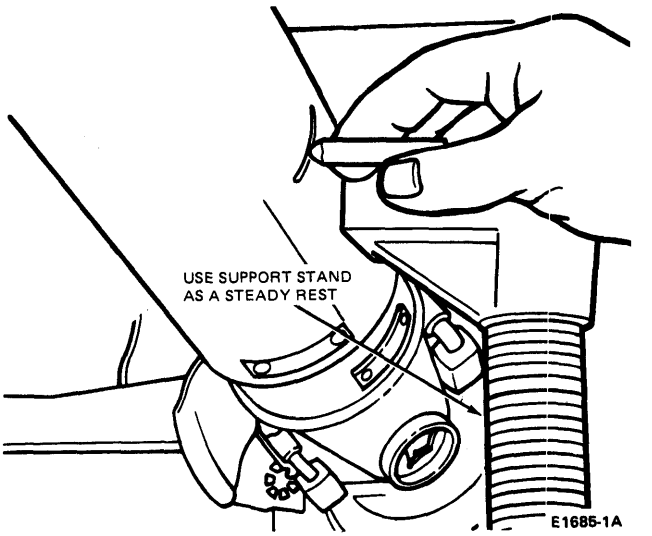


FIG. 15 Marking Driveshaft

6. Install two screw-type hose clamps on the driveshaft so that their heads are located 180 degrees from the chalk mark, starting at the pinion yoke end of the driveshaft. Tighten the clamps (Fig. 16).

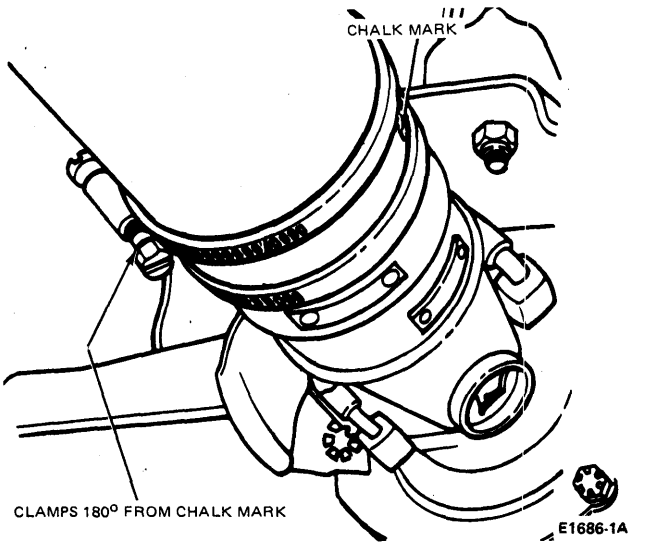


FIG. 16 Installing Clamps

7. Run the vehicle up to the baseline speed. If vibration is still evidenced, rotate the clamps approximately 45 degrees away from each other and test for correction of vibration (Fig. 17).

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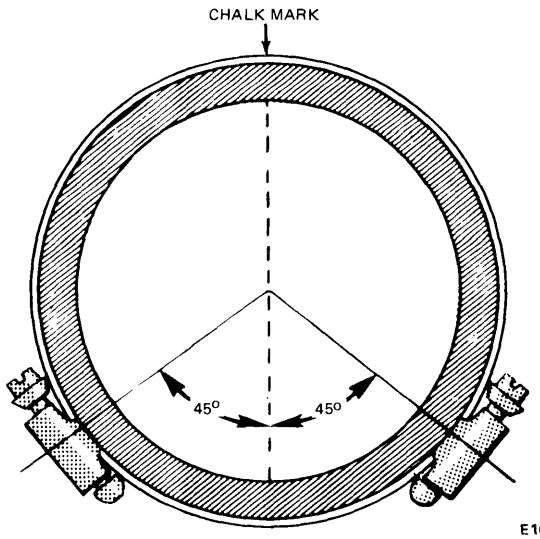


FIG. 17 Rotating Clamps

8. If necessary, continue to rotate the clamps apart in smaller increments until the vibration is eleminated or begins to be reduced.
9. If the vibration is not completely eliminated, repeat the foregoing procedure and balance the front end of the driveshaft, checking for elimination or reduction in the vibration level (Dana axles only).
10. To completely eliminate the driveline vibration, it may be necessary to balance the coupling shaft, following the same procedure as for the driveshaft. To prevent overheating, do not run the vehicle on the hoist for an extended period.
11. Remove the vehicle from the hoist and road test.

ALTERNATE IN VEHICLE DRIVESHAFT BALANCING PROCEDURE

ROTUNDA DYNAMIC WHEEL BALANCER (MODEL 061400) OR EQUIVALENT EQUIPMENT

1. Road Test—Evaluate and record road speed at which vibration occurs.
2. Raise vehicle on a frame contact hoist, and re-evaluate by starting the engine, engaging the transmission and accelerating to the indicated speeds at which the vibration was most severe during the road test. Allowing the rear axle to suspend makes the driveline more sensitive to vibration.
3. Disconnect the driveshaft from the companion flange. Rotate the driveshaft 180 degrees from its original position and re-install. Repeat evaluation per Step 2 above.

   NOTE: In some cases, rotating the driveshaft 180 degrees may decrease the vibration to an acceptable level. However, if the vibration level is increased, install the driveshaft in its original position and proceed to Step 4.
4. A vehicle is more sensitive to excessive unbalance and/or runout at the rearward end of the driveshaft; therefore, located the heavy side of the driveshaft by the use of the strobe light and transducer, as follows:

Remove rear wheels and tires, reinstall all the wheel lug nuts in reverse. Flat side of the nuts toward the drum or disc to avoid lug nut unbalance and to prevent the drum or disc from dislodging. Scribe an axial chalk line (at any radial location) approximately 4 inches long at the rear of the driveshaft (Fig. 18). Locate the transducer on the bottom side of the carrier (Figs. 19 and 20), and secure it in place. Run the engine and driveline at the worst vibration speed noted and visually note the position of the chalk line by use of the strobe light. This provides a starting point for the initial location of the Whittek clamps.

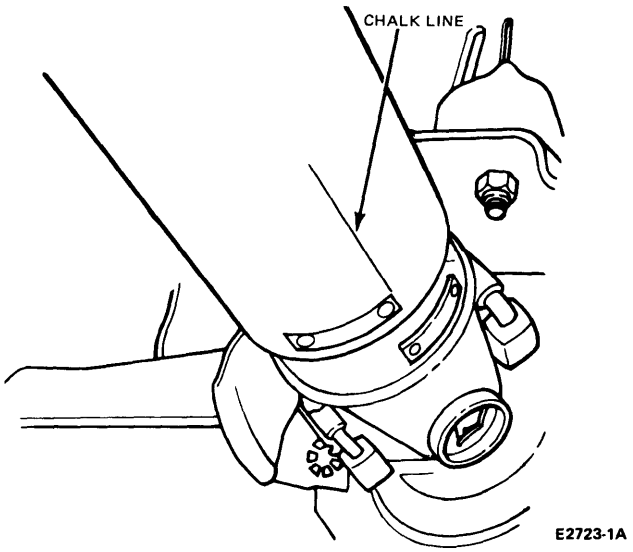


FIG. 18 Scribe or Axial Chalk Line Approximately 4 Inches Long

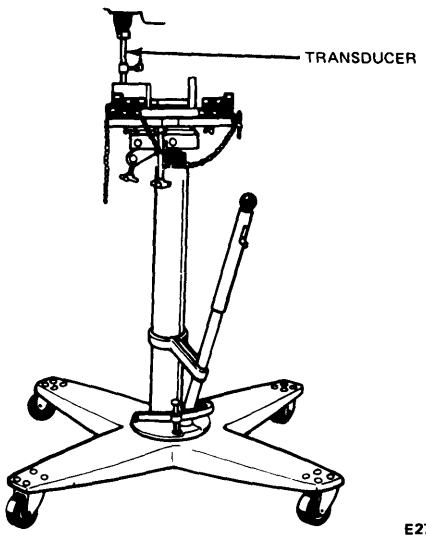


FIG. 19 Support of/and Position of Transducer

5. Stop the engine and rotate the driveshaft so that the chalk line is in the same location as it was noted under the strobe light.
6. Install two Whittek type (stainless steel) hose clamps on the driveshaft. Position the clamp heads 180 degrees from the transducer and tighten the clamps (Fig. 21).

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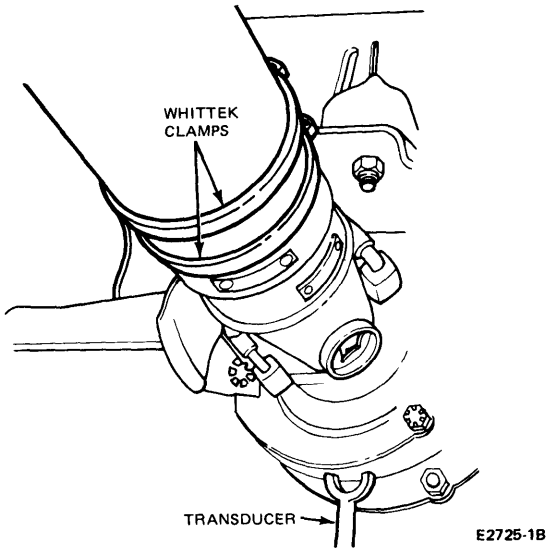


FIG. 20 Installation of Whittek Clamps and Position of Transducer

7. Run the engine and driveline through the speed range. If no vibration is felt, remove the lug nuts, install the wheels and tires and re-install the lug nuts in the correct position and proceed to Step 9. However, if any vibration still exists, the combined weight of the two hose clamp heads may be in excess. To reduce this excess weight, rotate the clamp heads away from each other approximately 15 degrees (one each way from the original position). Run the engine and driveline and note if the vibration has been reduced.

CAUTION: Do not turn the engine with the transmission engaged on the hoist for extended periods due to the danger of overheating the engine and/or transmission.

8. Continue to rotate the clamp heads apart in smaller angular increments until the vehicle feel of balance (vibration) is best. At this point, install the wheels and tires per Step 7 above and road test the vehicle to determine the actual degree of improvement. If satisfactory improvement has been obtained, proceed with Step 9. If no improvement has been obtained, the clamps must be removed and diagnosis should be re-directed to other areas, such as wheels, tires, driveline angle, and companion flange runout.
9. When the vehicle has been corrected to a satisfactory level, as determined by a road test evaluation, tighten the clamps securely. Clean thoroughly with lacquer thinner, and spray the clamps with a commercially available black paint for a finished appearance.

U-JOINT PHASING

When U-joint yokes are assembled to their shafts in the same plane, they are in phase (Fig. 21). When they are assembled to the shafts in different planes, they are out of phase.

To obtain vibration-free operation, check and correct as necessary, (Fig. 21).

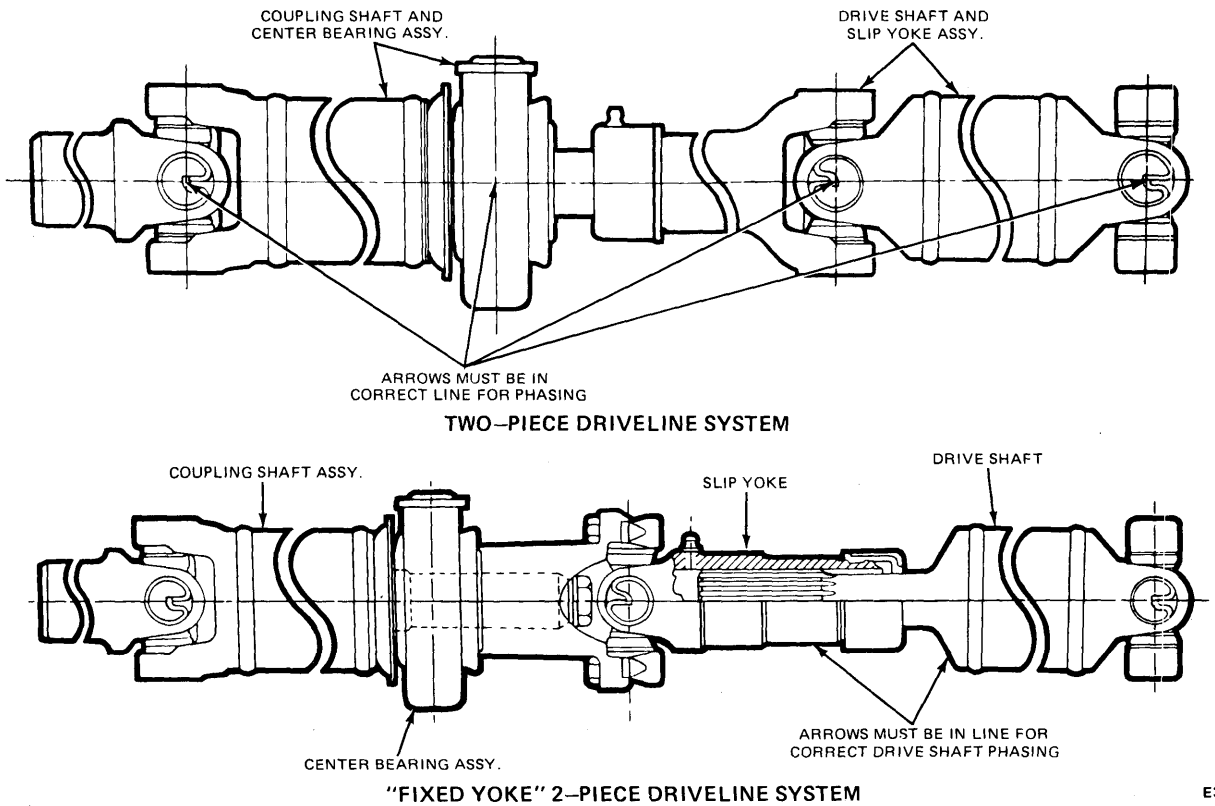


FIG. 21 U-Joint Phasing

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CLEANING AND INSPECTION

INSPECTION BEFORE DISASSEMBLY OF CARRIER (EXCEPT DANA)

An inspection of the adjustments and parts of the carrier as it is being disassembled can assist in locating the cause of trouble and in determining what corrections are needed.

Mount the carrier in a holding fixture. Wipe the lubricant from the internal working parts and visually inspect them for damage. Rotate the gears to see if there is any roughness which could indicate worn or damaged bearings or chipped gears. Look carefully at the surface of the gear teeth for any scoring, flaking, or signs or abnormal wear.

If no obvious misadjustment or damage is noted, inspect the gear tooth contact. Coat the gear teeth with the special compound furnished with each service ring gear and drive pinion. Too fluid a mixture will run and smear. Too dry a mixture cannot be squeezed out from between the teeth. As shown in Fig. 22, rotate the ring gear back and forth (using a box wrench on the ring gear attaching bolts for a lever), until a clean tooth contact pattern is obtained.

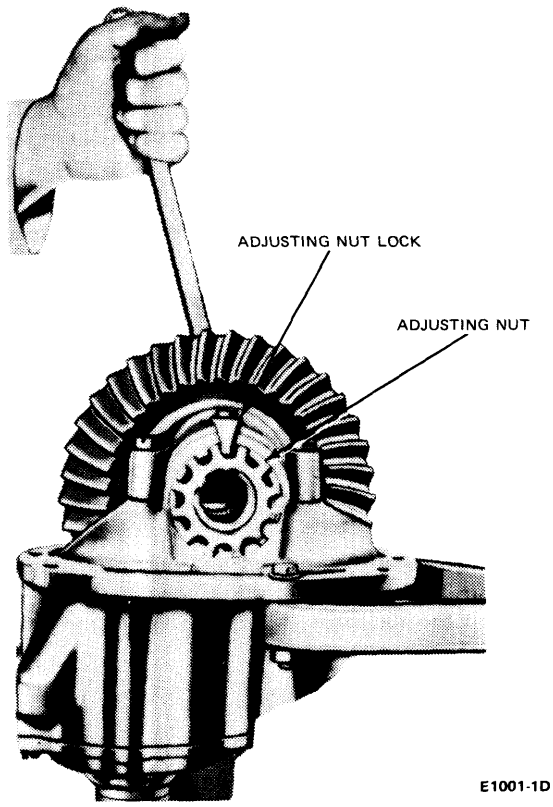


FIG. 22 Gear Tooth Contact Pattern Check—Ford

Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. A noise condition caused by incorrect adjustment can often be corrected by readjusting the gears. Gear tooth runout can be detected by an erratic pattern on the teeth. If ring gear runout is suspected, mount a dial indicator to measure the runout of the back face of the ring gear (Fig. 23).

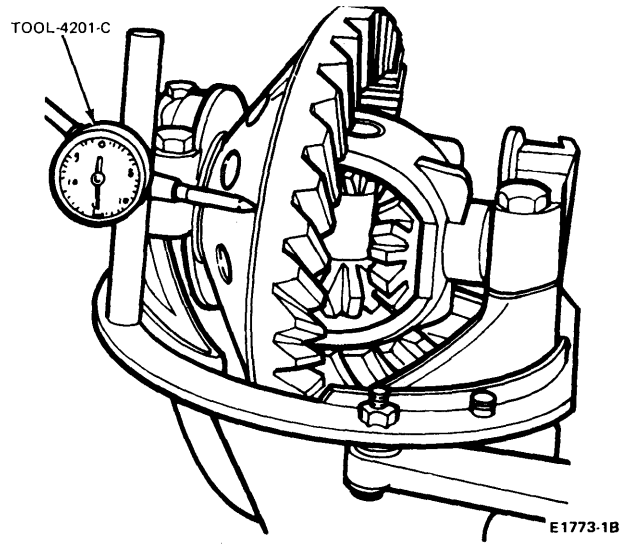


FIG. 23 Ring Gear Runout Check—Typical

INSPECTION AFTER DISASSEMBLY OF CARRIER ALL UNITS

Thoroughly clean all parts. **Synthetic seals must not be soaked or washed in cleaning solvents. Use only clean solvent to wash the bearings. Oil the bearings immediately after cleaning to prevent rusting.**

A visual inspection of parts will detect any major wear or damage. Clean the inside of the carrier and carrier housing, before rebuilding and assembling the parts. Inspect individual parts as follows:

GEARS

Examine the drive pinion and ring gear teeth for scoring or signs of excessive wear. The pattern taken during disassembly should be helpful in judging if gears can be reused. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring and flaking are the result of excessive shock loading or the use of an incorrect lubricant. Scored gears cannot be reused.

Examine the teeth and thrust surfaces of the differential gears. Wear on the hub of the differential side gears can cause a chucking noise known as chuckle, when the vehicle is operated at low speeds. Wear of splines, thrust surfaces or thrust washers can contribute to excessive drive line backlash.

BEARING CUPS

Check the bearing cups for rings, scores, galling, or erratic wear patterns. The pinion cups must be solidly seated. Check by attempting to insert a 0.0015 inch feeler gauge between the cups and the bottom of their bores.

CONE AND ROLLER ASSEMBLIES

When operated in the cups, the cone and roller assemblies must turn without any roughness. Examine the roller ends for wear. Step-wear on the roller ends indicates the bearings did not have enough preload, or the rollers were slightly cocked.

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DIFFERENTIAL BEARING ADJUSTERS

Test the fit of the bearing adjusters in their threads with the bearing caps installed. Be sure the bearing caps are on the side they were machined to fit. The adjusters on a Rockwell axle should turn easily when the caps are tightened to specifications.

The faces of the adjusters that contact the bearing cups must be smooth and square. Polish these with a fine abrasive on a flat surface. Replace the adjusters or examine the threads in the carrier if their fit is not proper.

COMPANION FLANGE

Be sure the flat machined surfaces and the bearing cup sockets of the flange have not been damaged in removing the drive shaft or in removing the flange from the axle. The end of the flange that contacts the oil slinger or pinion front bearing or flange, must be smooth. Polish this face if necessary. Roughness aggravates backlash noises, and causes wear on the slinger with a resultant loss in drive pinion bearing preload. The seal surface should be perfectly smooth or leakage will result.

PINION RETAINER

Inspect visually for damage. Be sure the pinion bearing cups are seated. Be sure there are no chips or burrs on the mounting flange. Clean all lubricant passages. If the pinion bearing cups were removed, examine the bores in the retainer carefully. Any nicks or burrs in these bores must be removed to permit proper seating of the cups.

CARRIER HOUSING

Inspect visually for damage. Make sure the differential bearing bores are smooth and the threads are not damaged. Remove any nicks or burrs from the mounting surfaces of the housing.

Axle lubricant leakage in Dana axle housings, due to porosity, sand holes, or small cracks, can be repaired with metallic plastic (part C6AZ-19554-A) or equivalent.

Only repairs to the cast axle housing and the "puddle-welded" area of the housing are approved. They should be made as follows:

1. Clean the surface to be repaired by grinding or rotary filing to a clean bright metal finish. Clean the repair area thoroughly. Metallic plastic will not stick to a dirty or oily surface. Chamfer or undercut the hole or porosity to a greater depth than the rest of the cleaned surface. Solid metal must surround the hole.

   Openings larger than 1/4 inch should not be repaired with metallic plastic. They can be drilled, tapped and plugged using common tools.
2. Mix the metallic plastic base and hardener as directed on the container. Stir thoroughly until uniform.
3. Apply the repair mixture with a suitable clean tool, (putty knife, wood spoon, etc.) forcing the epoxy into the hole or porosity.
4. Allow the repair mixture to harden. This can be accomplished by either of two methods: heat cure with a 250 watt lamp placed 10 inches from the repaired surface, or air dry for 10 to 12 hours at temperatures above 50 degrees F.
5. Sand or grind the repaired area to blend with the general contour of the surrounding surface.
6. Paint the surface to match the rest of the axle housing.

Further information on the above procedure is available in Part 21-01 in Volume II of the Truck Shop Manual.

DIFFERENTIAL CASE

Make sure the hubs where the bearings mount are smooth. Check the fit of the differential gears in the counterbores. Examine carefully the thrust surfaces, which are sometimes damaged when the bearings are removed. If the differential bearing assemblies do not seat firmly on the hubs, failure is certain. Be sure the mating surfaces of the two parts of the case and the face of the ring gear attaching flange are smooth and free from nicks or burrs.

RING GEAR RUNOUT

If the ring gear runout check during disassembly exceeded specifications, the condition could have been caused by a warped gear, a distorted or damaged case, or by excessively worn differential bearings.

To determine the cause of the excessive runout, assemble the differential case **without the ring gear,** and make the following checks:

Press the differential side bearings on the case hubs, and install the case in the differential carrier. Install the bearing caps and tighten the cap bolts to specifications. Mount a dial indicator, and then check the runout of the case flange and ring gear pilot. If the runout does not now exceed specifications, install a new ring gear to the case. If the runout at either point is excessive, the gear is probably true and the condition is due to either the case or differential side bearings.

Install new differential side bearings on the case hubs and install the case in the carrier. Check the case runout. If the runout is still excessive, repair or replace the case.

VENT SYSTEM

On F-150—F-250—F-350 (4x4), Bronco, E-100—E-150 vehicles, check the front and rear axle vent system. Make sure the vent hose is routed properly (Figs. 24 thru 26). Be sure the hose is not bent, plugged or kinked.

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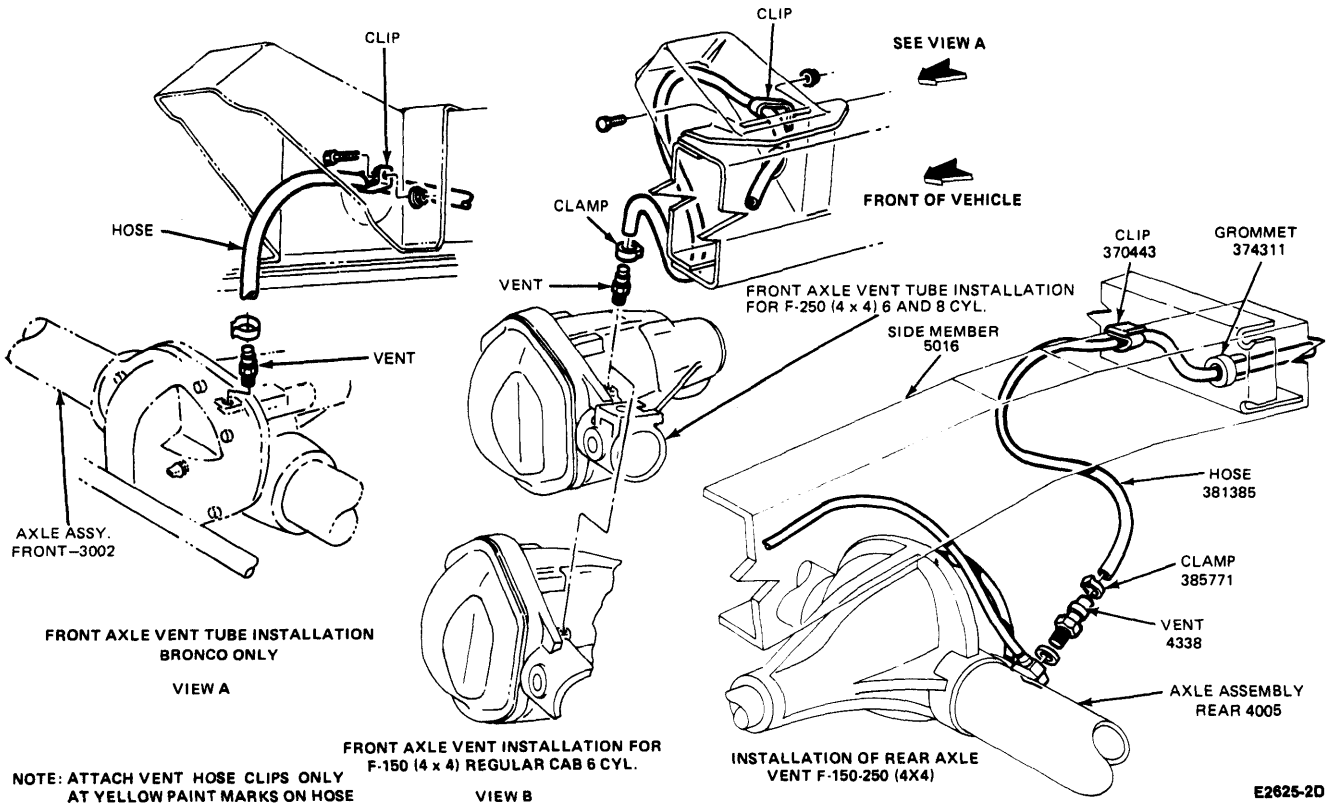
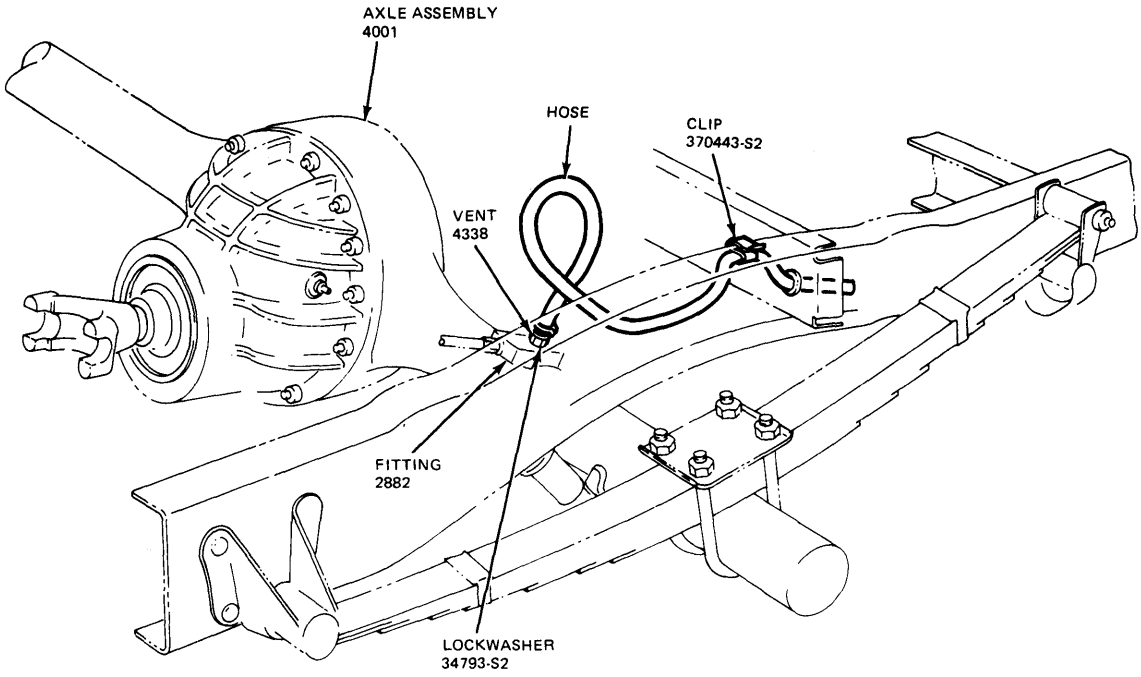


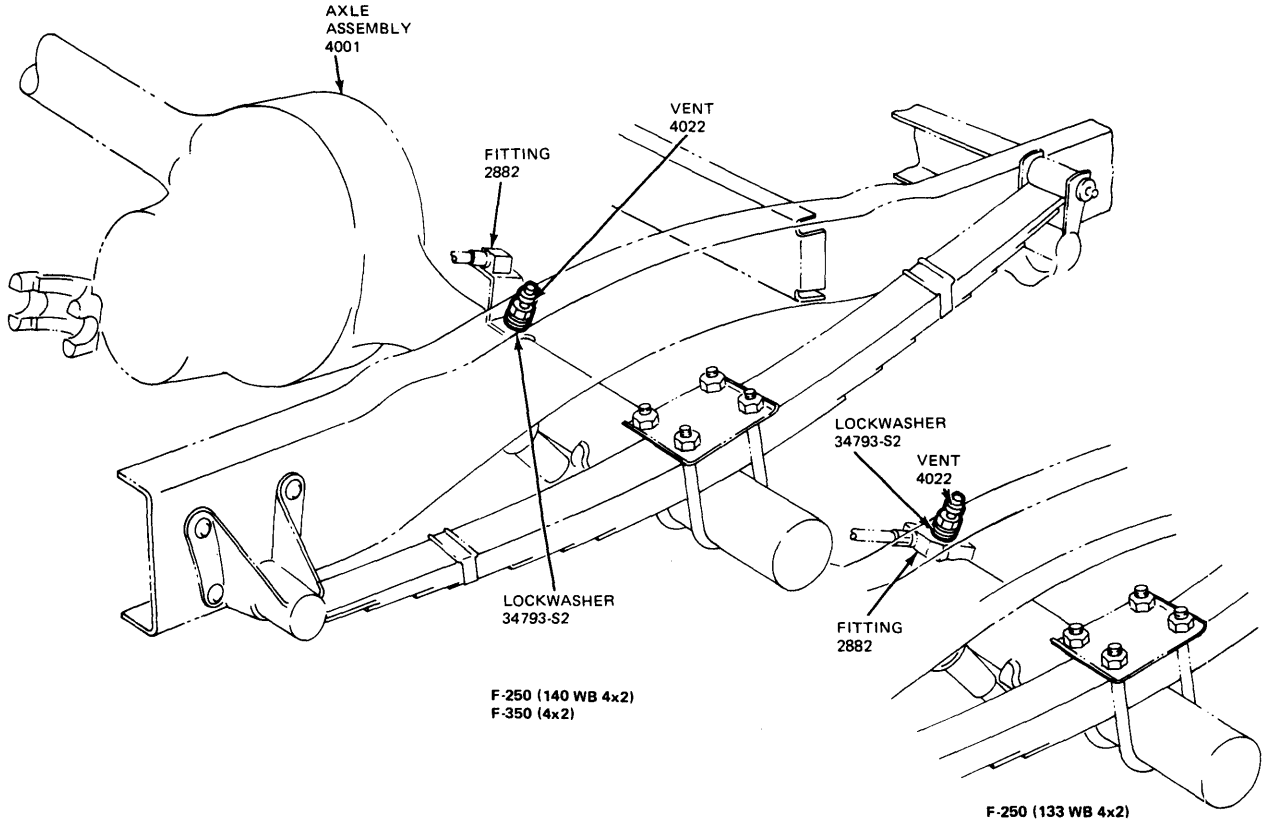
FIG. 24 Front and Rear Axle Vent System—F-150—F-250—F-350 (4 x 4), Bronco

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F100(4x2), F150(4x2)



F-250 (140 WB 4x2)
F-350 (4x2)

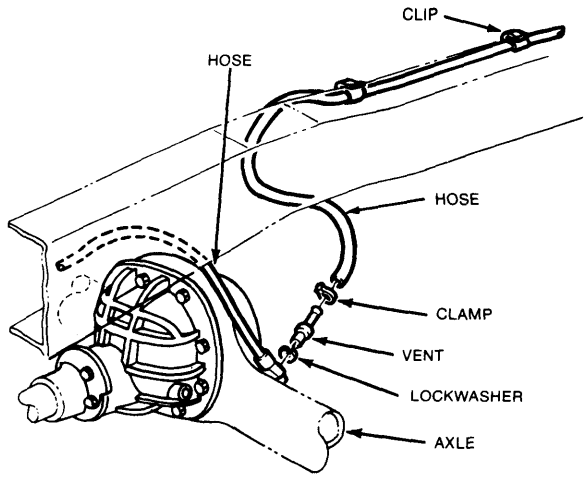
F-250 (133 WB 4x2)

E2750-2C

FIG. 25 Axle Vent System—F-100, (4 x 2)—F-350, (4 x 2)

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INSTALLATION OF REAR AXLE VENT E-100 & E-150 124 & 138 W.B.

E3501-1B

FIG. 26 Axle Vent System—E-100—E-350

SPECIFICATIONS

REAR AND FRONT DRIVING AXLE LUBRICANT CAPACITIES

Single-Speed Axle			
Make and Model	Approximate Capacity ①		
	U.S. Measure (Pts.)	Imperial Measure (Pts.)	Litres
Ford, All	6.5	5.4	3
Dana 44-9F Front ①	3.5	3	1.6
Dana 44-9F Front ②	4.0	3-1/4	1.8
Dana 44-6 CF HD Front ③	4.0	3-1/4	1.8
Dana 60-7F Front	6.0	5.0	2.8
Dana 60-4x2 ④	7.0	5.8	3.3
Dana 60-4x4 ④	6.0	5	2.8
Dana 61-1 ⑤	6.0	5	2.8
Dana 61-2 4x2 ⑤	6.0	5.0	2.8
Dana 70 ④	7.0	5.8	3.3
Dana 70 ⑤	7.0	5.8	3.3

① Bronco, F-150 (4 x 4) with full time transfer case.
② F-150 (4 x 4) and F-150 (4 x 4) with part time transfer case
③ F-250 (4 x 4)
④ F-Series
⑤ E-Series.

TANDEMN AXLES REAR AND FRONT DRIVING AXLE LUBRICANT CAPACITIES

Make and Model		Approximate Capacity		
		U.S. Measure (Pts.)	Imperial Measure (Pts.)	Litres
Eaton 34 DSC, 34DSE 34 DPC, 34 DTE ③	Forward Rearward Power Divider	32 29.5 2	26.5 24 1-5/8	15.1 13.9 .9
Eaton 38 DSC 38 DTC 38 DSE 38 DPC (4)	Forward Rearward Power Divider	32 29.5 2	26.5 24 1-5/8	15.1 13.9 .9
Eaton 42 DPB 50 DP ④	Forward Rearward Power Divider	29 30.5 2	24 25-1/4 1-5/8	13.7 14.4 .9
Rockwell SLHD ③	Forward Rearward Power Divider	32.5 32 2	27 26.5 1-5/8	15.3 15.1
Rockwell SQHD ④	Forward Rearward Power Divider	32.5 32 2	27 26.5 1-5/8	15.3 15.1 .9
Rockwell SRDD	Forward Rearward Power Divider	22 22 2	18-3/8 18-3/8 1-5/8	10.4 10.4 .9
Rockwell SYDD	Forward Rearward Power Divider	— — 2	— — 1-5/8	— — .9
Rockwell SFDD	Forward Reaward Power Divider	28 28 2	23-1/3 23-1/2 1-5/8	13.2 13.2 .9

CE2169-1K

SPECIAL TOOLS

Number	Description
061400	Strobe Wheel Balancer

CE3782-1A

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Integral Carrier Axle — Dana

PART 15-05

APPLIES TO E-250 — E-350, F-100, F-350, F-250 (4x4)

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Differential Bearing Preload and Ring Gear Backlash Adjustment	05-8
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SPECIFICATIONS	05-10

DESCRIPTION

Six models of Dana rear axles are used in regular production or are available as options on the light trucks.

The regular Model 60 2-pinion full-floating rear axle is used on the F-250 (4 x 2) and F-250—F-350 (4 x 4) trucks, with standard and limited-slip types available.

Dana Model 61-1 and 70 are used on E-250 and E-350 with S/R and D/R.

Model 61-2 is used on the F-250 and the E-250. Model 61 uses Model 60 service procedures. Model 61 is basically the same as Model 60 except that the axle housing is of heavier design.

The Model 70 4-pinion full-floating rear axle is used on the F-350 and E-350. It is of two piece case design and is used for limited-slip applications.

Another Model 70 axle of 2-pinion design has a one-piece case and is used for conventional applications. For this axle, follow Model 60 service procedures. All these axles are of the integral carrier-housing, hypoid gear type, in which the center line of the drive pinion is mounted below the centerline of the ring gear (Fig. 1).

The pinion gear and shaft is supported by two opposed tapered roller bearings which are assembled in the forward side of the carrier housing. Pinion locating shims, installed between the rear bearing cup and the cup seat, control the drive pinion depth adjustment. The pinion bearing preload is controlled by shims located between the pinion front bearing and the shoulder on the drive pinion shaft.

The differential case assembly is supported by two opposed tapered roller (side) bearings and cups, which are retained in the housing by removable caps. Shims, installed between each differential side bearing and the shoulder on the case, perform three functions: they take up the differential case side clearance; they adjust the backlash between ring gear and pinion; and they establish differential side bearing preload.

A cover on the rear of the carrier housing provides access for inspection, removal and installation of the differential assembly and drive pinion. A metal tag, stamped with the gear ratio, part numbers and limited slip (if applicable), is secured to the housing by two of the cover bolts (Fig. 2, Part 15-01).

Models 60, 61 and 70 (Fig. 1) have full-floating axle shafts, meaning that loads are borne by the axle housing and the shafts can be removed without disturbing the wheel bearings, which are tapered roller bearings.

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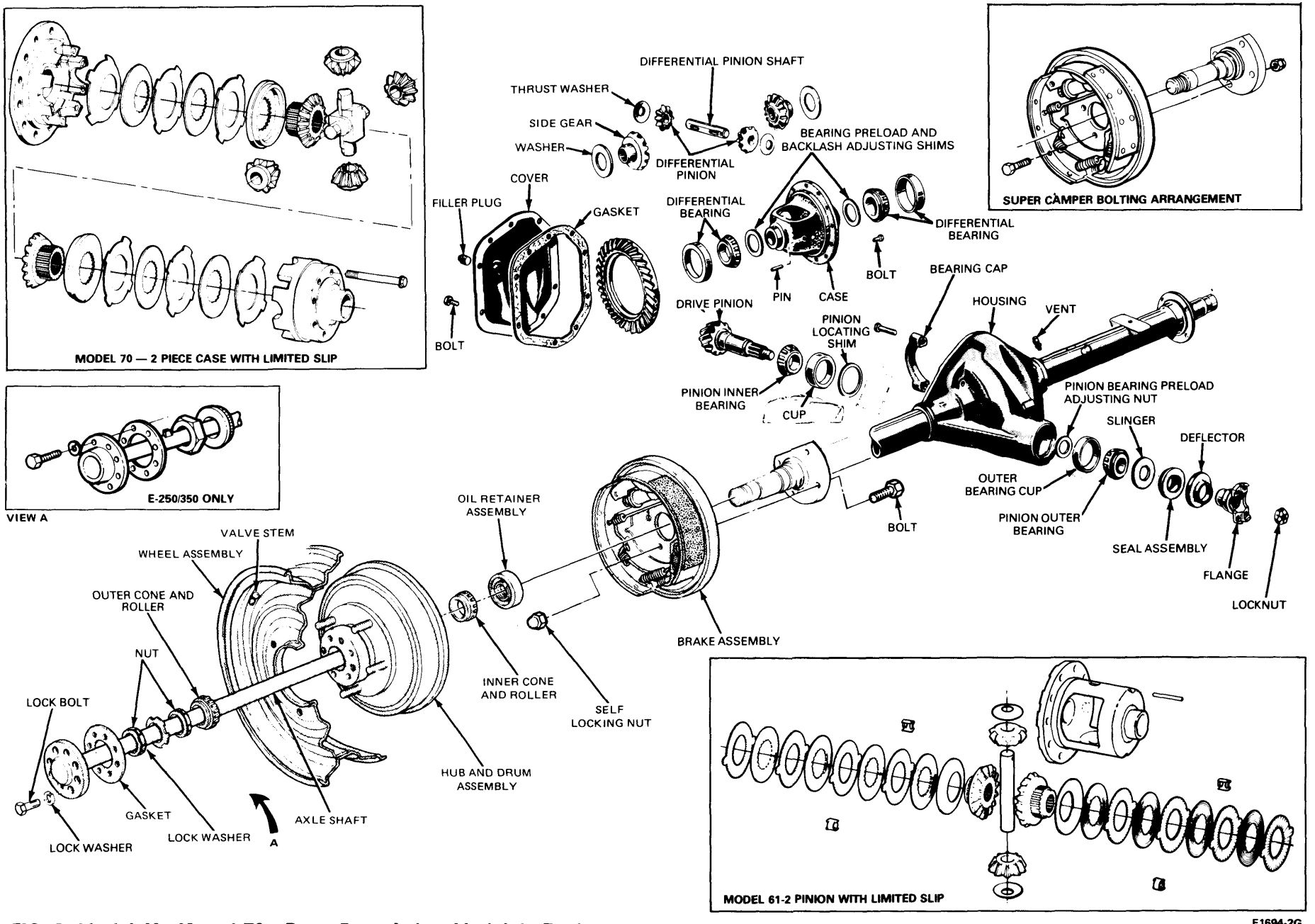


FIG. 1 Model 60, 61 and 70—Dana Rear Axle—Model 44 Typical

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DIAGNOSIS AND TESTING

Refer to Part 15-01, General Driving Axle and Driveshaft Service.

ADJUSTMENTS

For adjustments refer to the specific adjustments in this Part under Disassembly and Assembly and Part 15-01, General Driving Axle and Driveshaft Service.

REMOVAL AND INSTALLATION

REAR AXLE

Removal

NOTE: Axle shafts, wheel hubs, wheel hub bearings, and the wheel hub grease seals can be replaced without removing the differential assembly from the axle housing or the rear axle assembly from the vehicle.

The axle shafts, wheel hubs, bearings and grease seals may be replaced, lubricated, or adjusted as outlined in Part 11-11, 11-14 and 15-10.

1. Loosen the wheel stud nuts and the axle shaft retaining bolts.
2. Disconnect the rear shock absorbers from the rear axle, and unclamp the rear stabilizer bar. Then raise the rear end of the vehicle frame until the weight is off the rear springs. Place safety stands under the frame in this position.
3. Disconnect the flexible hydraulic brake line at the frame.
4. Disconnect the parking brake cable (if so equipped) at the equalizer, and remove the cables from the cable support brackets.
5. Disconnect the drive shaft from the rear U-joint flange.
6. Remove the nuts from the rear spring clips (U-bolts), and remove the spring seat caps.
7. Roll the axle from under the vehicle, and drain the lubricant. Remove the wheels. Mount the axle in a work stand. To remove axle shafts, hubs and drums refer to Part 11-14.

Installation

1. Apply a coating of ESA-M1C75-B or an equivalent lubricant to the lip surface; then, replace the hub inner grease seal (Fig. 3). Refer to Part 11-14 for hub and bearing installation (use new axle shaft gaskets); then, install the axle shafts through the housing ends so that they will spline to the differential side gears. Prior to re-installation of the axle shaft, clean and remove any metallic debris in the hub bolt holes. Also inspect for cracked material around the holes, depth of the threaded hole, (minimum 1.0 inch), and oversized threaded holes, and replace hub if any of these three conditions are present. Install **new** shaft retaining bolts and lockwashers.
2. After installing the rear wheels, roll the axle assembly under the vehicle.
3. Install the rear spring clips (U-bolts) and spring seat caps. Tighten the nuts to 110-160 ft-lb.
4. Connect the rear shock absorbers, and clamp the stabilizer bar in position.
5. Connect the drive shaft to the rear universal joint flange.
6. Connect and adjust the parking brake cables (if so equipped).
7. Connect the hydraulic brake hose and bleed the brakes. Also connect the axle vent hose to the axle fitting.
8. Fill the axle with the proper grade and amount of lubricant.
9. Lower the vehicle to the floor.

DISASSEMBLY AND ASSEMBLY

PINION, DRIVE GEAR AND DIFFERENTIAL REPAIR

Except for the overhaul procedures on the differential case itself, the overhaul procedures given here apply to both the conventional, locking and limited-slip differential axles. Overhaul procedures for the limited-slip differential case assembly are given in Part 15-42.

Disassembly

1. Remove the rear axle from the vehicle as outlined in Removal and Installation.
2. Clean around the differential housing cover, and remove it. Discard the cover gasket, if used. Remove the differential bearing caps.
3. Install the housing spreader Tool 4000-D, or Tool 4000-C (Fig. 2), making sure the tool hold-down clamp screws are tight if Tool 4000-C is used.

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Spread the housing until the differential assembly can be forced out with a small pry bar. **Do not spread the housing more than 0.020 inch to remove the differential assembly. Loosen the spreader thread immediately after lifting out the differential assembly to prevent springing the housing.**

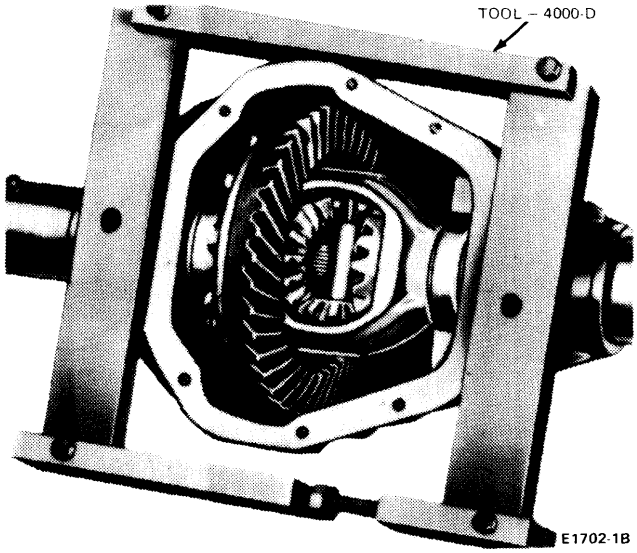


FIG. 2 Spreading Axle Housing

4. If the differential bearings are to be removed use T53T-4221-C.

   A shim pack will be found behind each differential bearing cone. These shim packs control differential bearing preload and drive pinion and ring gear backlash. When the differential bearing cones are removed, these shim packs are usually damaged by the puller jaws and should be replaced with new shims. Measure each shim pack, shim by shim, and write down the total thickness and location of each pack.

   If the axle is equipped with a limited-slip differential, see Part 15-42 for service procedures.
5. Remove the ring gear from the differential case. With a punch, drive out the differential pinion shaft locking pin. Remove the differential pinion shaft, differential pinions and thrust washers. Remove the side gears and thrust washers. Rotate the side gears to permit the differential pinion gears to turn to the opening of the case.
6. If the drive pinion rear bearing cone is to be replaced, use the type of tool shown in Fig. 4.
7. Attach a slide hammer puller tool with adapter Tool 4625 AA to the pinion outer bearing cone and remove the bearing cone, slinger, and oil seal from the housing.
8. Clean and inspect the axle parts as outlined in Part 15-01, General Driving Axle and Driveshaft Service.

ASSEMBLY OF CONVENTIONAL DIFFERENTIAL

1. Lubricate; then install the side gears and thrust washers, differential pinions and thrust washers, and the differential pinion shaft in the differential case. To do this easily, assemble the side gears and thrust washers, hold them in place and then position the pinion gears to hold the side gears in place. Install the differential shaft locking pin. Peen metal of the case over the pin to lock it in place.
2. Install the ring gear on the differential case, and tighten the attaching bolts to specification.

DIFFERENTIAL BEARING BACKLASH AND PRELOAD ADJUSTMENT

1. Press the differential bearings onto the case without shims (Fig. 5). The bearings must bottom on the case shoulder.
2. Place the cups on the differential bearings and install the assembly in the housing. Install the bearing caps and tighten the cap bolts just enough to keep the bearing caps in place. Make sure that the letters stamped on the caps are the same as those stamped on the carrier.
3. Mount a dial indicator on the axle housing, with the indicator button against the ring gear (Fig. 6).
4. Pry the differential assembly away from the dial indicator, using a screwdriver between the bearing cup and the case, and set the indicator at zero. Pry the differential assembly toward the indicator (Fig. 7) and note the indicator reading. This reading indicates the amount of shims needed behind the differential side bearings to take up the total clearance between the differential bearing cups and the case. Record this reading.
5. Remove the bearing caps and lift the differential assembly from the housing. **Do not install shims under the differential bearings at this time. The total-clearance reading obtained in the above step must be integrated with a second reading to be obtained after the pinion has been installed and pinion depth has been adjusted. The two readings are used to calculate the shim thickness necessary to obtain proper differential bearing preload and ring gear backlash, as well as end play adjustment.**

DRIVE PINION INSTALLATION AND DEPTH ADJUSTMENT

If the drive pinion bearing cups were removed, install them as shown in Fig. 8 using Tools T56T-4616-A, Drive Pinion Bearing Cup Replacement Adapters and T53T-1239-A.

Two separate adjustments affect pinion and ring gear tooth contact. They are pinion depth (location) and backlash. On Dana axles, the drive pinion locating shim pack is installed between the drive pinion rear bearing cup, and the carrier housing (Fig. 9). Therefore, adding shims moves the drive pinion toward the ring gear, and removing shims moves the drive pinion away from the ring gear.

ESTIMATED SHIM PACK

If the original gear set is being installed, install the drive pinion with the original shim pack and check the drive pinion location with a depth gauge (Fig. 11).

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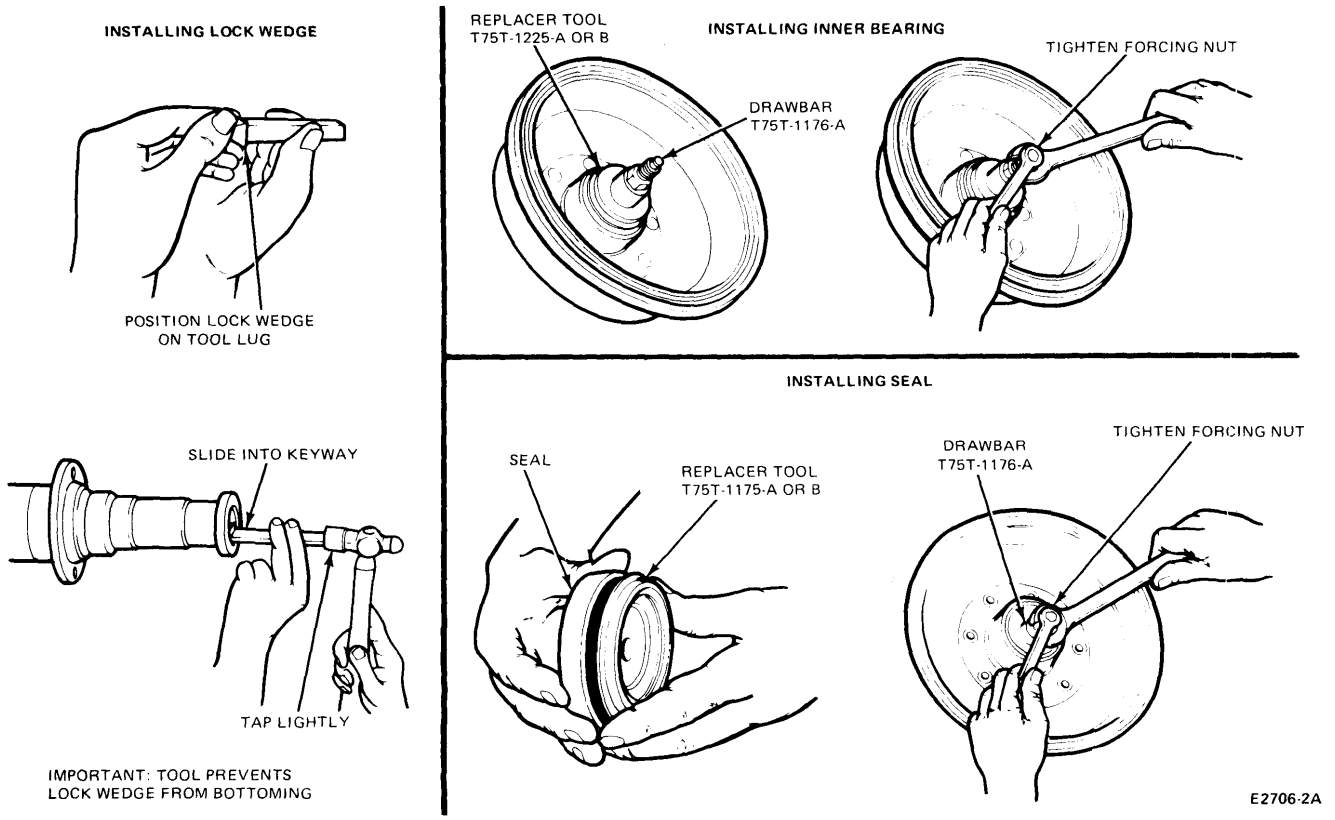


FIG. 3 Installation—Inner Bearing and Seal—E-250—E-350

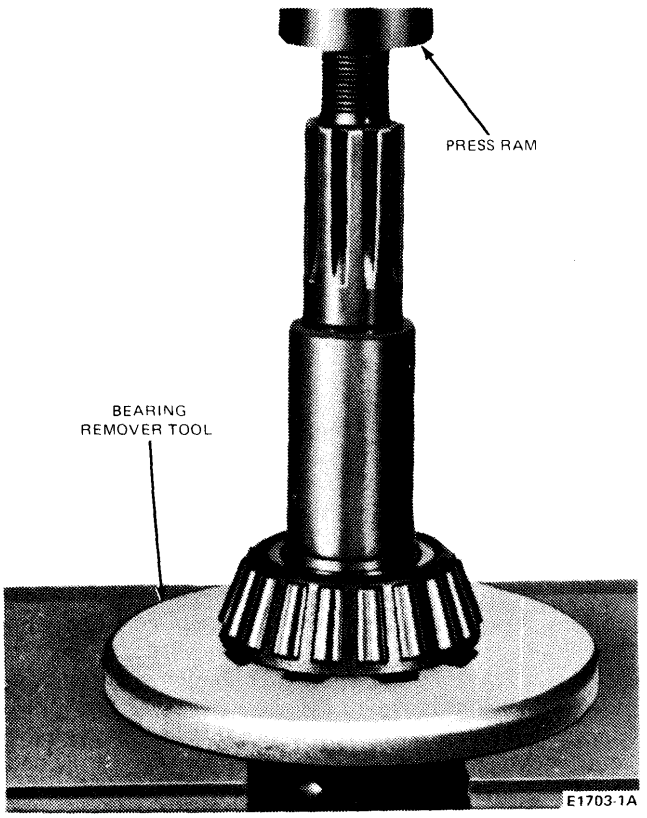


FIG. 4 Removing Pinion Bearing Cone

If the ring gear and drive pinion are being replaced, note that the original factory-installed (pinion locating) shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the original gear set dimension. Therefore, to estimate the correct shim thickness for the new gear set to be installed, follow these steps:

1. Measure the thickness of the original pinion locating shim with a micrometer.
2. Note the shim adjustment number on both the old pinion and the new pinion. Each drive pinion gear is marked with an adjustment number such as the marking in Fig. 6, Part 15-01.

Refer to Specifications for the correct amount of shim thickness change. **The amount that is shown under the new pinion shim adjustment number and in line**

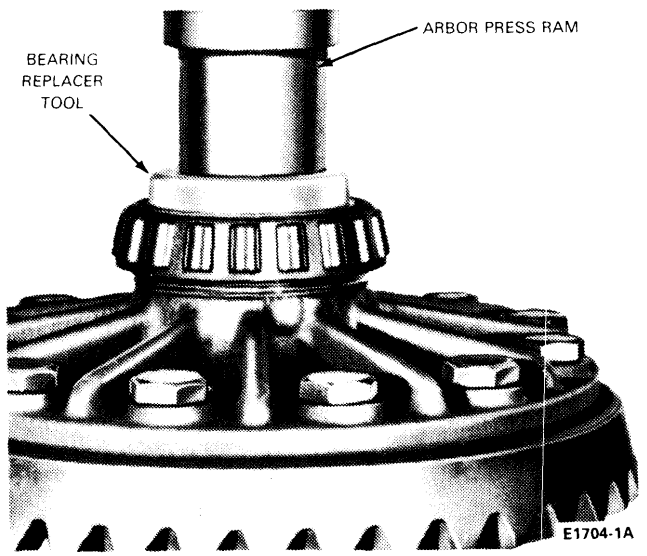


FIG. 5 Installing Differential Bearing

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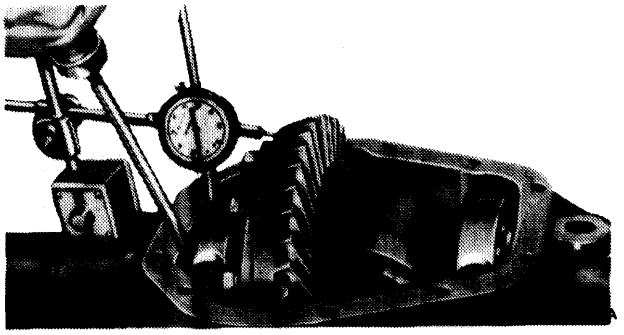


FIG. 6 Checking Differential End Play—First Step

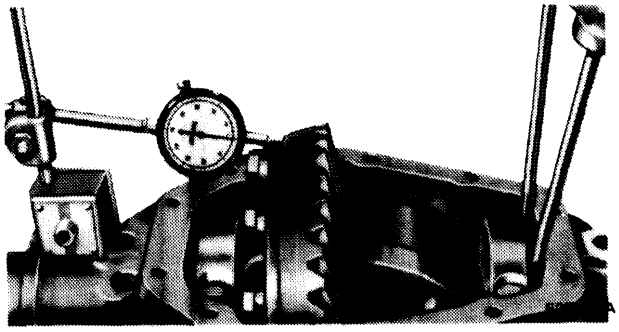


FIG. 7 Checking Differential End Play—Final Step

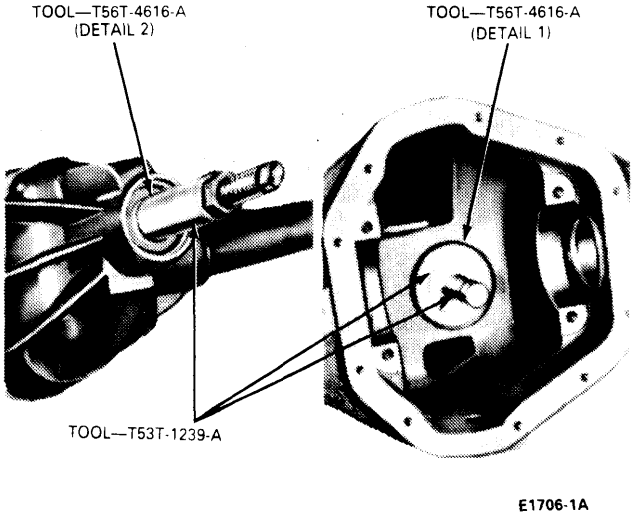


FIG. 8 Installing Pinion Bearing Cup—Models 60 and 70

with the old pinion number is the amount of change that should be made to the original shim pack.

If the old pinion is marked +4, for example, and the new pinion is marked -2, the table indicates that 0.006 inch of shim stock should be added to the original shim pack.

If the original shim pack was lost or if a new axle housing is being installed, substitute a nominal 0.030 inch shim for the original, and repeat the foregoing steps for a trial build-up.

If any further shim change is necessary, it will be indicated in the depth gauge check.

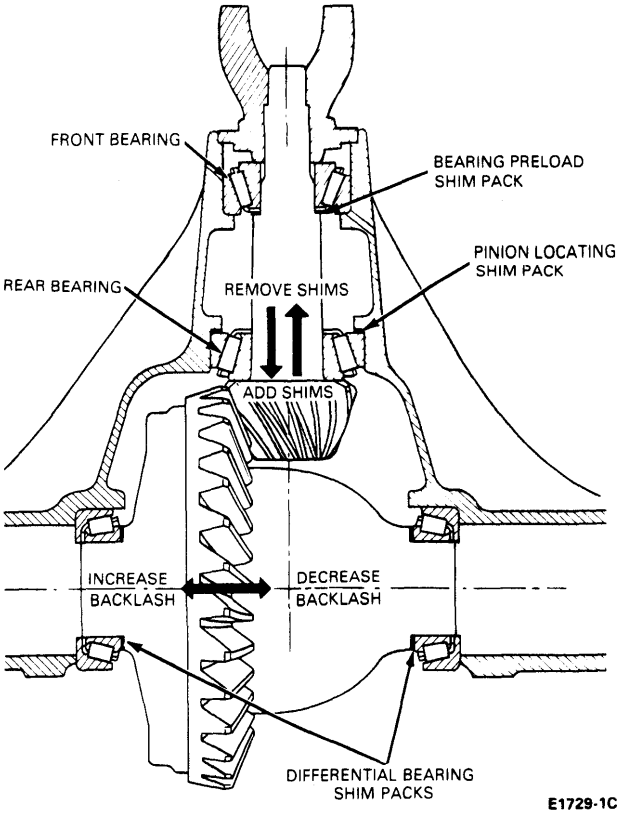


FIG. 9 Pinion and Ring Gear Tooth Contact Adjustments

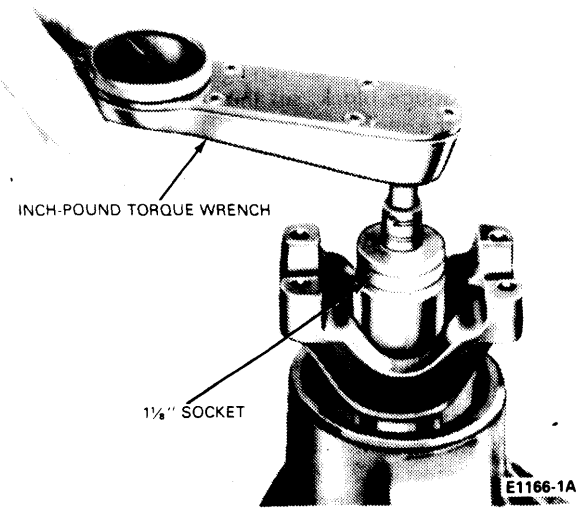


FIG. 10 Checking Pinion Bearing Preload

A new ring gear and drive pinion should always be installed in an axle as a matched set (never separately). **Be sure that the same matching number appears on both the drive pinion and the ring gear.** Note the number S55 in Fig. 6, Part 15-01, General Driving Axle and Driveshaft Service.

Install the drive pinion with the estimated shim pack, and check the pinion location with a depth gauge as outlined in the following procedure.

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DEPTH GAUGE CHECK

1. Install the drive pinion locating shim pack and drive pinion bearing cups. Refer to Specifications for proper tool application.
2. Press the rear bearing onto the drive pinion shaft.
3. Install the drive pinion into the carrier. Assemble the outer pinion bearing cone, (slinger if used) and end yoke onto the pinion spline. Do not assemble the preload shims or pinion oil seal at this time. Use a yoke installer to assemble the end yoke onto the spline of the pinion.
4. Install the drive pinion shaft flat washer and nut, and tighten the nut until the drive pinion bearing preload is between 20-40 in-lb. As the nut is tightened, rotate the pinion shaft in both directions to seat the bearing rollers. If required, add or subtract shims to obtain 20-40 in-lb. Tighten the nut to specifications.
5. Check the pinion bearing preload (Fig. 10). Disregard the torque required to start the pinion rotating. The specified torque of 10 to 30 in-lb refers to the torque required to keep the pinion rotating after it has been started.

   After the drive pinion is installed in the housing and the bearing preload is within limits, check the depth setting (actual assembly dimension) with the gauge shown in Fig. 11 Tool T56T-4020-A.

   Place the gauge shaft and discs in the differential bearing pockets and securely tighten the bearing caps.
6. Attach the dial indicator to its holder and place it on the higher step of the gauge block. Place the gauge block squarely on the drive pinion gear and squarely against the gauge shaft.
7. With the indicator button resting on the proper step of the gauge block, set the dial face to read zero. Swing the indicator (Fig. 11) to the highest point on the gauge shaft and note the reading at the highest point. **The highest point on the gauge shaft is the point of highest indicator reading while the indicator hand is moving clockwise. When the hand reverses and starts moving counterclockwise, the highest point has been passed.**

   The indicator reading at the highest point on the gauge shaft shows the actual assembly dimension with reference to the nominal assembly dimension. The nominal assembly dimension is 3.125 inches for Models 60 and 61, and 3.500 inches for Model 70 axles. The nominal dimension is the distance from the ground surface on the pinion gear rear face to the centerline of the ring gear. The highest point on the installed gauge shaft is exactly 1/2 inch higher than the ring gear centerline. The installed gauge block step heights are exactly 1/2 inch greater than the nominal assembly dimensions for each axle.

   When the gauge block is resting on a zero-marked pinion installed exactly at the nominal assembly dimension, the top of the gauge block and the highest point on the gauge shaft are exactly the same distance from the pinion gear rear face. In this case, the indicator, having been set at zero on the gauge block, will read zero when moved to the highest point on the gauge shaft. A plus or minus reading on the indicator at the highest point on the gauge shaft indicates, that the actual assembly dimension is not the same as the nominal assembly dimension. The plus and minus indicator readings are translated directly into plus and minus variations from the nominal assembly dimension.

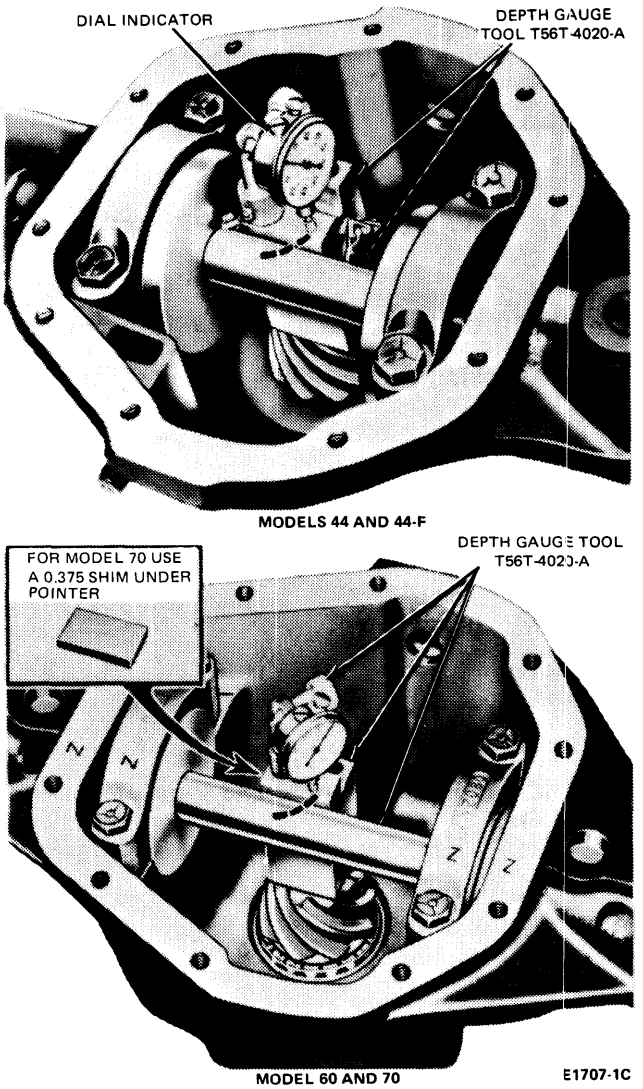


FIG. 11 Pinion Depth Gauge

The indicator reading at the highest point on the gauge shaft must correspond with the drive pinion gear marking, if the actual assembly dimension is correct. For example, a pinion marked -3 is installed at the proper depth when the indicator reads -3 at the highest point on the gauge shaft. Likewise, a pinion marked +3 is installed at the proper depth when the indicator reads +3 at the highest point on the gauge shaft.

A plus reading (clockwise from zero) at the highest point on the gauge shaft with a zero-marked pinion, means that the actual assembly dimension is too great in the amount of the plus reading. To correct, add shims in thousandths of an inch that correspond to the plus reading. For example, an indicator reading of +10 with a zero-

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marked pinion means that 0.010 inch in shims must be added to the rear bearing cup pack. The addition of shims will move the pinion gear closer to the ring gear and decrease the actual assembly dimension (Fig. 9).

Likewise, a minus reading (counterclockwise from zero) at the highest point on the gauge shaft with a zero-marked pinion means that the actual assembly dimension is deficient in the amount of the minus reading. To correct, remove shims in thousandths on an inch equal to the minus reading This will increase the actual assembly dimension.

Whenever the pinion rear bearing cup shim pack is changed, install the drive pinion and re-check the pinion depth.

8. After the pinion depth has been adjusted and checked, remove the universal joint flange and front bearing. Add or subtract from the original front pinion bearing preload shim pack the same amount in thousandths of an inch that was added or subtracted from the shim pack behind the rear drive bearing cup (Fig. 9). Install the bearing preload shim pack, the outer bearing, the universal joint flange, washer and nut. Tighten the flange nut to 250-270 ft-lb on models 60, 61 and 70 rear axles.
9. Check the pinion bearing preload (Fig. 10). The preload should be 20 to 40 in-lb. Add shims to decrease the preload and remove shims to increase preload.

   If the original bearing preload shim pack has been lost, or there is reason to believe that it is not correct, install a 0.065 inch shim pack for a trial build-up. Check the pinion bearing preload and adjust as necessary to obtain 20 to 40 in-lb preload.
10. When the pinion bearing preload is correct, remove the universal joint flange. Install the oil slinger on the outer side of the front pinion bearing and install the grease seal.

DIFFERENTIAL BEARING PRELOAD AND RING GEAR BACKLASH ADJUSTMENT

1. Refer to the reading taken in Step 4 under Differential Bearing Backlash Preload Adjustment. This reading (taken before the drive pinion was installed) represents the total clearance between the differential side bearing cups and the case.
2. Again install the differential assembly in the housing (this time with the pinion installed), and tighten the bearing caps lightly. Install the dial indicator with the button against the back face of the ring gear (Figs. 7 and 8). Move the differential and ring gear assembly tight against the pinion gear, and then set the dial indicator to zero. Move the differential and ring gear assembly toward the indicator, and note the reading.
3. This reading indicates the amount of shims necessary to take up the clearance between the bearing cup and the case at the ring gear side of the differential assembly. Subtract this reading from the previously recorded total reading to obtain the amount of shims necessary to take up the clearance between the differential bearing cup and the case at the pinion side of the differential. Increase this differential pinion-side shim pack by an additional 0.015 inch in order to provide correct bearing preload and backlash. Example, (Fig. 12): Total clearance previously recorded... 0.070 inch. Less reading in foregoing Step 2 (amount of shims necessary to take up clearance at ring gear side)... 0.038 inch. Shims necessary to take up clearance at pinion side... 0.032 inch. Plus 0.015 inch shims for preload and backlash... 0.015 inch. Total amount of shims at pinion side... 0.047 inch.

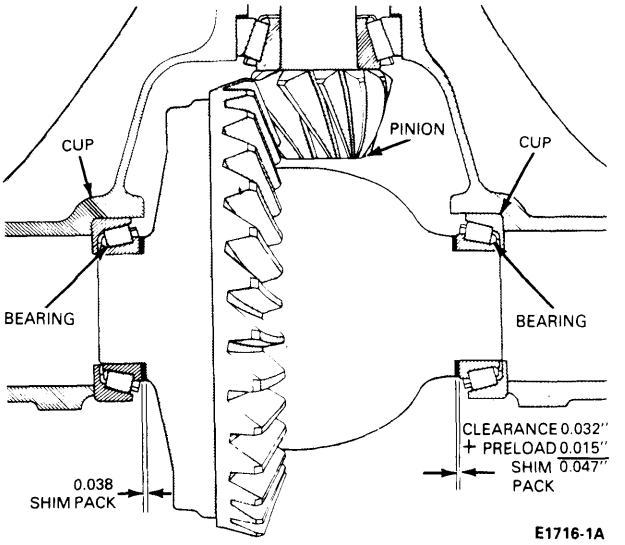


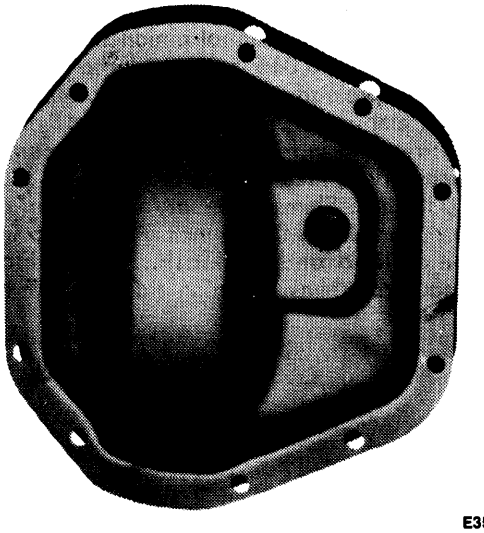
FIG. 12 Differential Bearing Preload and Ring Gear Backlash Adjustment

4. Remove the bearing caps, and lift the differential assembly from the housing. Remove the differential side bearings, and install the proper amount of shims on each side of the differential case. Press the side bearings onto the case until they are firmly seated against the shims.
5. Install the housing spreader, spread the housing not more than 0.020 inch, and install the differential assembly. Install the bearing caps, and remove the spreader. Install and tighten the cap bolts to specification.
6. Install a dial indicator to check the backlash at four equally spaced points around the ring gear. The backlash must be held to 0.004-0.009 inch and cannot vary more than 0.002 inch between the positions checked. If the backlash does not fall within these specifications, change the shim packs behind both differential side bearings, as required.
7. On all axles with "A" ribbed cover design (Fig. 15), position a new gasket on the rear face of the axle housing, and install the rear cover and ratio identification tag. Tighten the capscrews to 30-40 ft-lb.

   For Dana axles with flat flange cover design (Fig. 13) proceed with Steps (8 thru 11) for gasket installation.
8. Remove all previous gasket material (RTV or paper), dirt or any other foreign material from the housing cover flange and from the machined surface of the

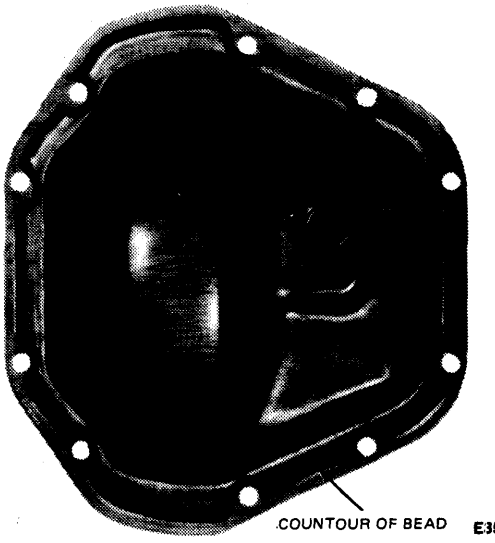
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E3502-1B

FIG. 13 Flat Flange Design



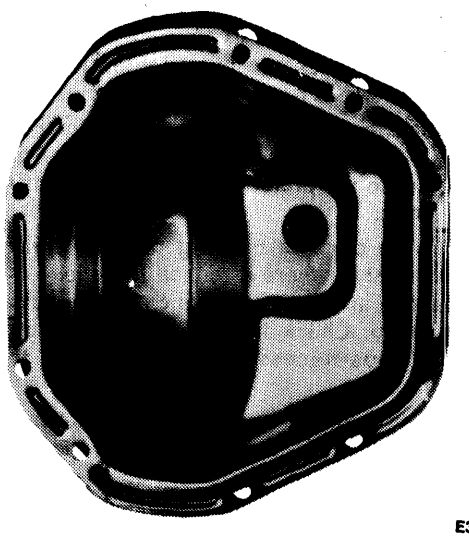
E3503-1B

FIG. 14 Bead Application

axle housing. Wipe housing cover flange and axle housing machine surface.

NOTE: Both surfaces must be oil and dirt free.

9. Before attaching the housing cover to the axle housing, verify that the housing cover (original or service replacement) has no reinforcing ribs (flat-flange) as shown in Fig. 13. Then, the RTV gasket application applicable to this cover design (see Fig. 13) should be done as follows:
   a. Apply RTV gasket material to the cover plate mounting surface as shown in Fig. 14.
   b. Ensure that the sealer bead is laid on the inside of the cover plate screw holes. The bead is not to pass through the holes or outside of the holes. The bead is to be 1/8 inch to 1/4 inch high and 1/8 inch to 1/4 inch wide. Allow one hour cure time prior to vehicle operation.
10. If the axle housing cover (original or service replacement) has reinforcing ribs as shown in Fig. 15, proceed as follows:
    a. Position the cover gasket to the axle housing face using grease to hold gasket in place if using ribbed flange cover, (Fig. 15).
    b. Attach the cover to the axle housing using new cover attaching screws. Tighten screws to 30-40 ft-lbs.
11. Fill axle housing with specified amount of ESW-M2C105-A or equivalent and add 4 oz. of EST-M2C118 or equivalent friction modifier to limited slip rear axles to complete the required re-fill. Install fill plug in cover. Tighten the filler plug to 20-30 ft-lbs.
12. Place new gaskets on the axle shafts and install the axle shafts. Install **new** retaining bolts and lockwashers. Tighten the bolts to 40-50 ft-lbs.
13. Install the rear axle on the vehicle as outlined in Adjustments under Rear Axle Installation.



E3504-1B

FIG. 15 Ribbed Flange Design

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SPECIFICATIONS

DRIVE PINION ADJUSTING SHIM THICKNESS CHANGES—DANA									
Old Pinion Marking	New Pinion Marking								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

DANA AXLE ADJUSTMENTS						
Description	Axle Model			Description	Axle Model	
	60, 61	70			60, 61	70
	Inch				Inch	
Backlash Between Ring Gear and Pinion	0.005	0.005		Pinion Bearing Preload	20-40 in-lbs	20-40 in-lbs
Backlash Maximum Variation Between Teeth	0.003	0.003				

DANA AXLE TORQUE LIMITS

Description	Axle Model			
	60, 61		70, 70B	
	(ft-lbs)	N•m	(ft-lbs)	N•m
Pinion Shaft Nut	250-270	339-366	250-270	339-366
Differential Bearing Cap Bolts	80-90	109-147	80-90	109-147
Ring Gear Attaching Bolts	110-125	150-169	110-115	150-169
Differential Case Bolts			55-75	75-107

Description	Axle Model			
	60, 61		70, 70B	
	(ft-lbs)	N•m	(ft-lbs)	N•m
Oil Filler Plug	20-30	28-40	20-30	28-40
U-Joint Bolts	15-20	21-27	15-20	21-27
Cover to Housing Bolts	30-40	41-54	30-40	41-54

CE2174-2J

SPECIAL TOOLS

Number	Description
Tool 4000-D or C	Differential Housing Spreader
T53T-4221-C	Differential Bearing Remover
Tool 4625-AA	Drive Pinion Cup Bearing Remover
T56T-4616-A	Drive Pinion Bearing Cup Replacement Adapter
T56T-4020-A	Pinion Depth Gauge
T53T-4020-A	Pinion Bearing Cup Installer

CE3677-1B

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Removable Carrier Axle-Ford

PART 15-10

APPLIES TO BRONCO, E-100 — E-150, F-100 — F-150

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DESCRIPTION AND OPERATION

DESCRIPTION

The rear axle is of the banjo-housing, hypoid gear removable carrier type, using a 9 inch ring gear, in which the centerline of the pinion is mounted below the centerline of the ring gear (Fig. 1).

The pinion gear and the pinion bearings are assembled in a pinion retainer, which is bolted in the carrier. In this axle, the pinion is straddle mounted: that is, the pinion is supported by bearings both in front of and to the rear of the pinion gear. Two opposed tapered roller bearings support the pinion shaft in front of the pinion gear with a solid spacer. A straight roller (pilot) bearing supports the pinion shaft at the rear of the pinion gear. Pinion and ring gear tooth contact is adjusted by shims between the pinion retainer and the carrier housing.

The differential assembly is mounted on two opposed tapered roller bearings, which are retained in the carrier by removable caps. The entire carrier assembly is bolted in the axle housing. The bearing assemblies (rear wheel bearings) are pressed onto the outer ends of the axle shafts and set in the outer ends of the axle housing. These bearings support the semi-floating axle shafts at the outer ends. The inner ends of the shafts spline to the differential side gears. Bearing retainer plates hold the shafts in the housing. The left and right axle shafts are interchangeable (Fig. 2).

A metal tag stamped with the model designation and gear ratio is secured to the axle under one of the carrier-to-housing bolts (Fig. 3). The first five spaces on the top line are reserved for the model designation letters such as WDM-AC, WDM-AG, WDM-AH, WDM-AJ or WDM-AK. These letters indicate a specific combination of the following factors: conventional or limited-slip axle: diameter of ring gear; size of differential bearings; size of wheel bearings; and the gear ratio. It is important, therefore to use the model designation for obtaining the correct replacement parts.

OPERATION

The rear axle drive pinion receives its power from the engine through the transmission and drive shaft. The pinion gear rotates the differential case through engagement with the ring gear, which is bolted to the case outer flange. Inside the case, two differential pinion gears are mounted on the differential pinion shaft which is pinned to the case. These pinion gears are engaged with the side gears, to which the axle shafts are splined. Therefore, as the differential case turns, it rotates the axle shafts and rear wheels. When

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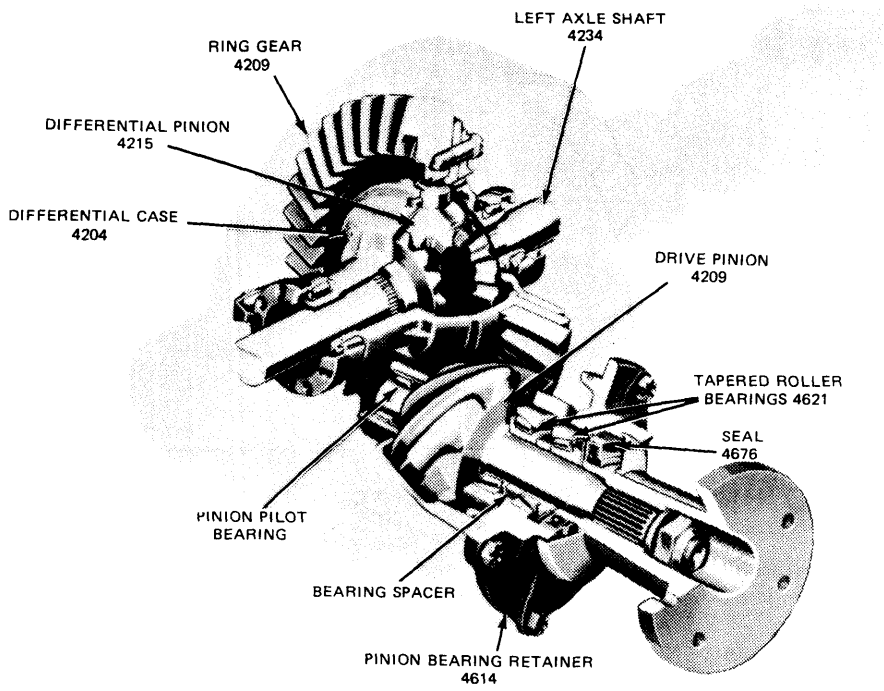


FIG. 1 Rear Axle—Ford

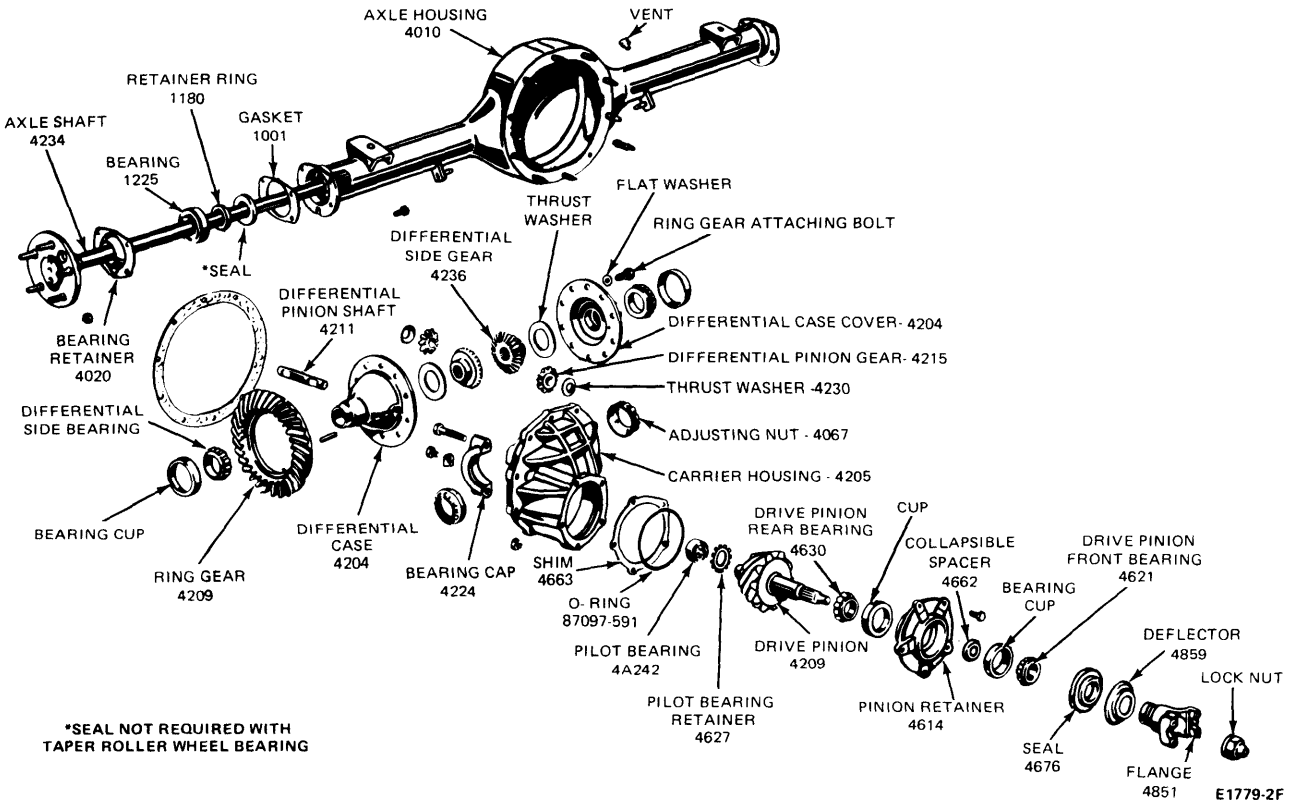


FIG. 2 Rear Axle Disassembled—Ford

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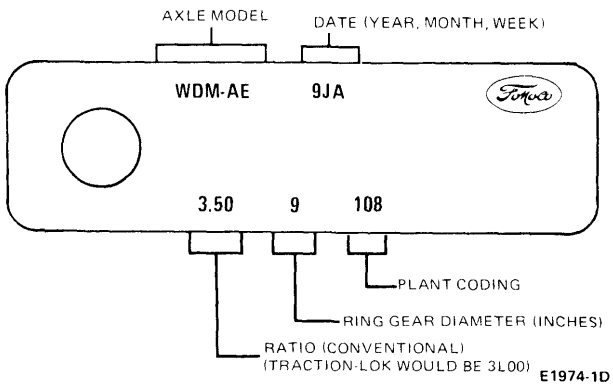


FIG. 3 Rear Axle Identification Tag

it is necessary for one wheel and axle shaft to rotate faster than the other, the faster turning side gear causes the pinions to roll on the slower turning side gear to allow differential action between the two axle shafts.

IN-VEHICLE ADJUSTMENTS AND REPAIRS

A traction-lok differential is available as optional equipment for all vehicles, (Part 15-40) Traction-Lok Limited Slip Differential—Ford. An axle with a traction-lok is identified by the metal tag which will have the ratio stamped with an "L" in place of the decimal point, (Fig. 3).

AXLE SHAFT

The rear axle shafts, wheel bearings and oil seals can be replaced without removing the carrier assembly from the axle housing.

F-100/150, E-100/150, and Bronco axle shafts are the same length and therefore interchangeable between the right and left sides of the individual vehicles.

There are two types of wheel axle bearings. A sealed grease packed ball bearing used in conjunction with an inboard oil seal pressed into the axle housing is employed on F-100 2900 lbs, E-100 2750 lbs. A tapered roller bearing with integral outer seal is used on F-100/150 3750 lbs and E-100/150 3750 lbs and Bronco axles (Fig. 4).

The wheel seals are made of synthetic rubber and must not be soaked or washed in solvents.

AXLE SHAFT WITH BALL BEARING

Removal

1. Remove the wheel cover or hub cap wheel and tire from the brake drum.
2. Remove the three retainers that secure the brake drum and remove the drum from the flange.
3. Working through the hole provided in the axle shaft flange, remove the nuts that secure the wheel bearing retainer plate.
4. Pull the axle shaft assembly out of the axle housing (Fig. 5). Remove the brake backing plate and wire it to the frame rail.
5. Whenever an axle shaft is removed, the oil seal should be replaced. Remove the seal with Tool 1175-AB and a slide hammer (Fig. 6).
6. Inspect the machined surfaces of the axle shaft and the axle housing for rought spots or other

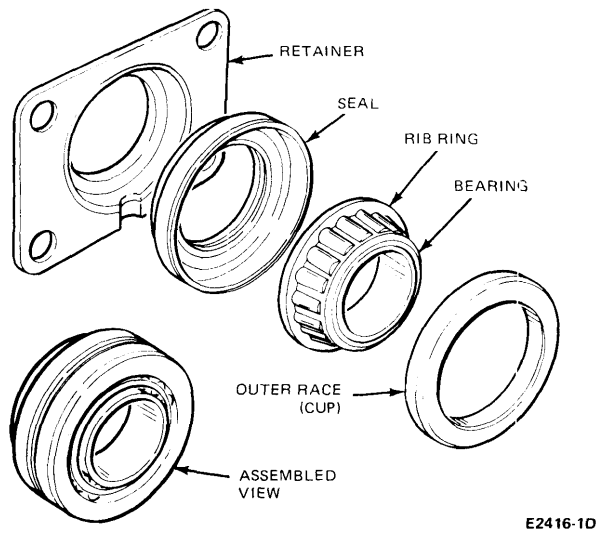


FIG. 4 Tapered Roller Bearing Assembly

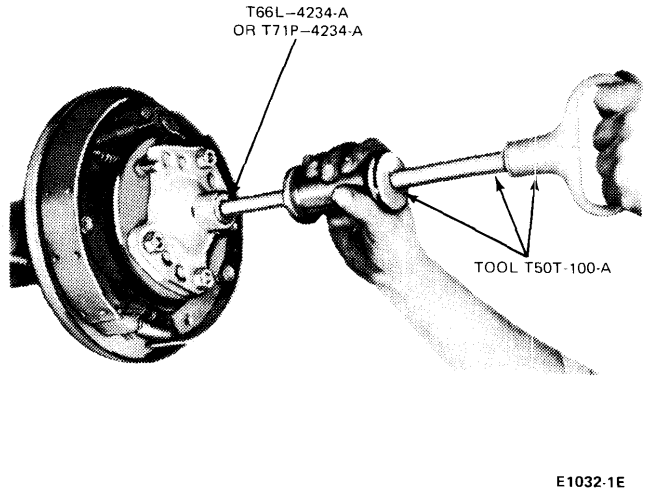


FIG. 5 Removing Axle Shaft

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irregularities which would affect the bearing action of the oil seal. Check the axle shaft splines for burrs, wear or damage. Carefully remove any burrs or rough spots. Replace worn or damaged parts.

7. If the wheel axle bearing is to be replaced, the inner retainer ring must first be loosened. Never apply heat to do this. Drill a 1/4 inch to 1/2 inch hole in the outside diameter of the inner retainer to a depth approximately 3/4 inch the thickness of the retainer ring. Do not drill all the way through the retainer ring because the drill could damage the axle shaft (Fig. 7).

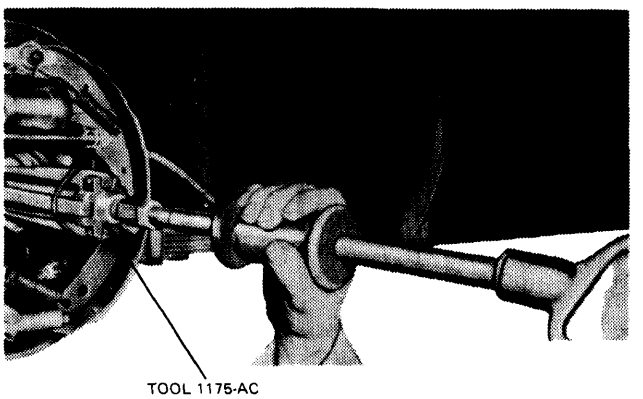


FIG. 6 Removing Rear Wheel Bearing Oil Seal

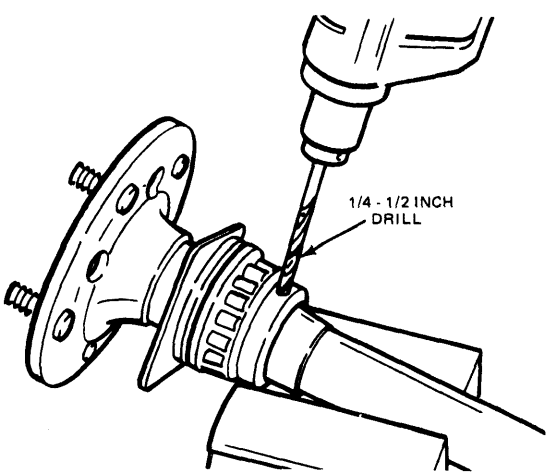


FIG. 7 Drilling Retainer Ring—(Tapered Roller Bearing Shown)

8. After drilling the retainer ring, use a chisel positioned across the drilled hole and strike sharply to split the retainer ring (Fig. 8). Retainers are not re-usable.
9. Press the bearing off the axle shaft with the tool shown in Fig. 9.

Removal of the wheel bearing from the axle shaft makes it unfit for further use.

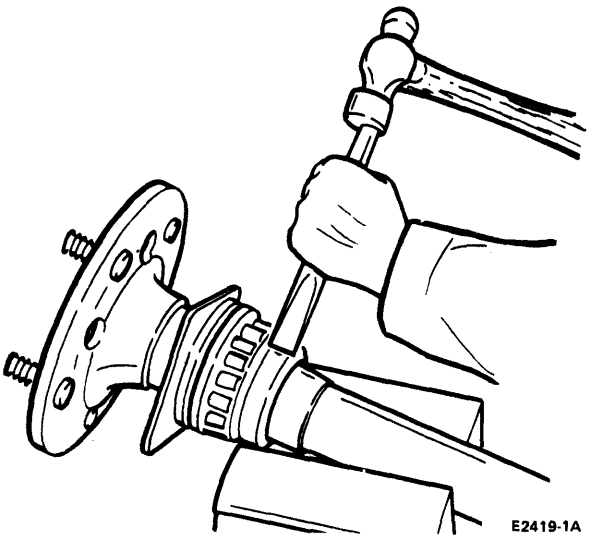


FIG. 8 Removing Rear Wheel Bearing Retainer Ring—(Tapered Roller Bearing Shown)

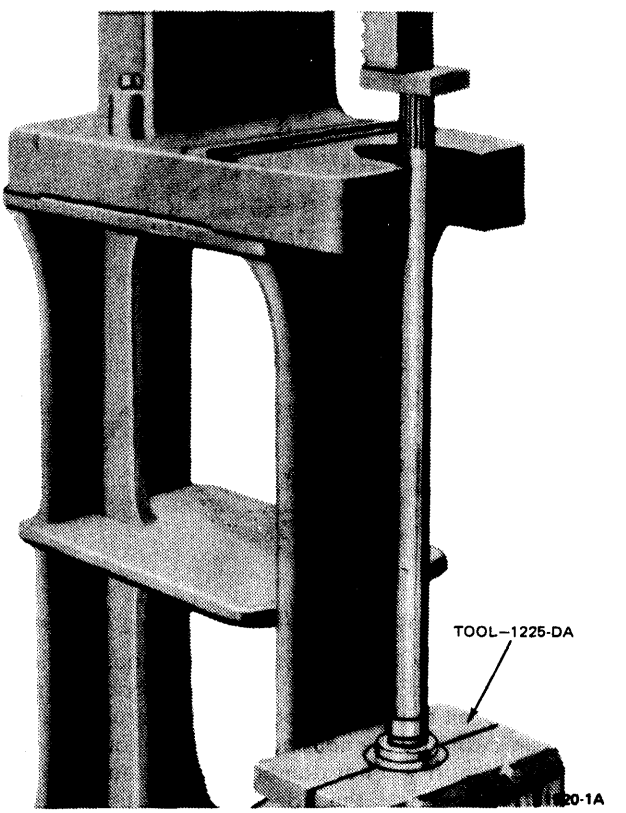


FIG. 9 Removing Rear Wheel Bearing

Installation

1. Lightly coat wheel bearing bores with axle lubricant.
2. Place the bearing retainer plate on the axle shaft and press the new wheel bearing on the shaft with Tool 4621-A (Fig. 10). Do not attempt to press on both the bearing and the inner retainer ring at the same time.
3. Using the bearing installation tool (Tool 4621-A), press the bearing inner retainer ring on the shaft until the retainer seats firmly against the bearing.

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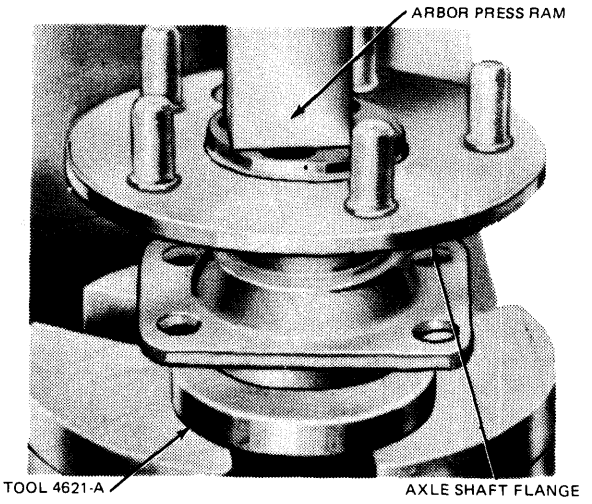


FIG. 10 Installing Rear Wheel Bearing

4. Install the new oil seal with the tools shown in Fig. 11.

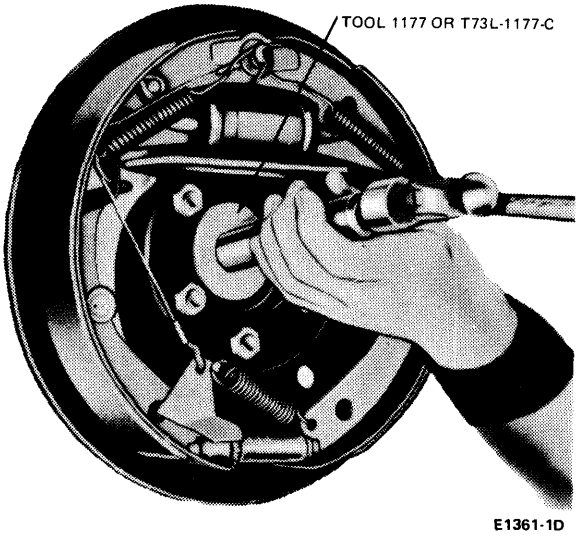


FIG. 11 Installing Rear Wheel Bearing Oil Seal

5. Place a new gasket between the housing flange and the backing plate. Install the backing plate loosely on the retainer bolts and carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the side gear and push the shaft in until the bearing bottoms in the housing.
6. Install the bearing retainer plate on the bolts and install the nuts that secure it. Tighten the nuts to 50-75 ft-lbs.
7. Install the brake drum and the three drum retainers.
8. Install the wheel and tire on the drum. Install the wheel cover.

AXLE SHAFT WITH TAPERED ROLLER BEARING

Removal

1. Remove the wheel cover or hub cap, wheel and tire from the brake drum.
2. Remove the three retainers that secure the brake drum and remove the drum from the flange.
3. Working through the hole provided in the axle shaft flange, remove the nuts that secure the wheel bearing retainer plate.
4. Pull the axle shaft assembly out of the axle housing (Fig. 5). Remove the axle shaft carefully so as not to damage the outer seal rubber. The bearing cup will normally stay in the axle housing when the axle shaft is removed. The bearing cup must be removed from the axle housing. Use a standard slide-hammer-type puller as shown in Fig. 12. Remove the brake backing plate and wire it to the frame rail.

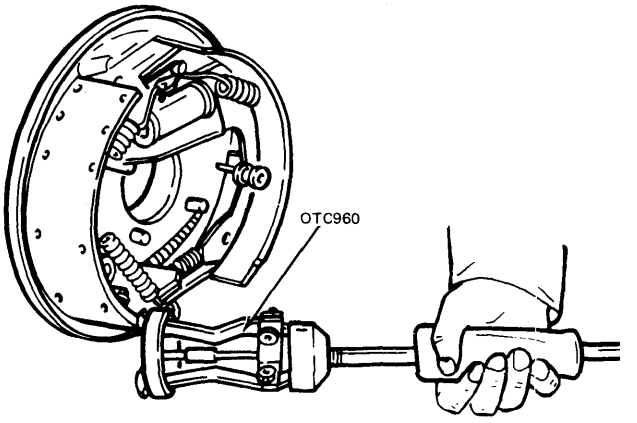


FIG. 12 Removing Tapered Bearing Cup

5. If the wheel bearing or seal is to be replaced, the inner retainer ring must first be removed. Never apply heat to do this.

   Drill a 1/4 inch to 1/2 inch hole in the outside diameter of the inner retainer to a depth approximately 3/4 the thickness of the retainer ring. Do not drill all the way through the retainer ring because the drill could damage the axle shaft (Fig. 7).
6. After drilling the retainer ring, use a chisel positioned across the drilled hole and strike sharply to split the retainer ring (Fig. 8).

   Although the retainer must be scrapped, the bearing can be reused provided Tool T75L-1165-ABC is used to remove it. **IF THIS TOOL IS NOT USED, THE BEARING MUST BE SCRAPPED.**
7. Put the outer bearing cup on the axle shaft assembly and place the axle shaft in the Tool (T75L-1165-A,B,C) as shown in Fig. 13.
8. Assemble the two halves of the Remover Collet and tighten the bolts.
9. Press the bearing assembly off the shaft. **Never use heat as this would damage the axle shaft.**

Installation

1. Install the outer retainer plate (if it had been removed) making sure it is not put on backwards.

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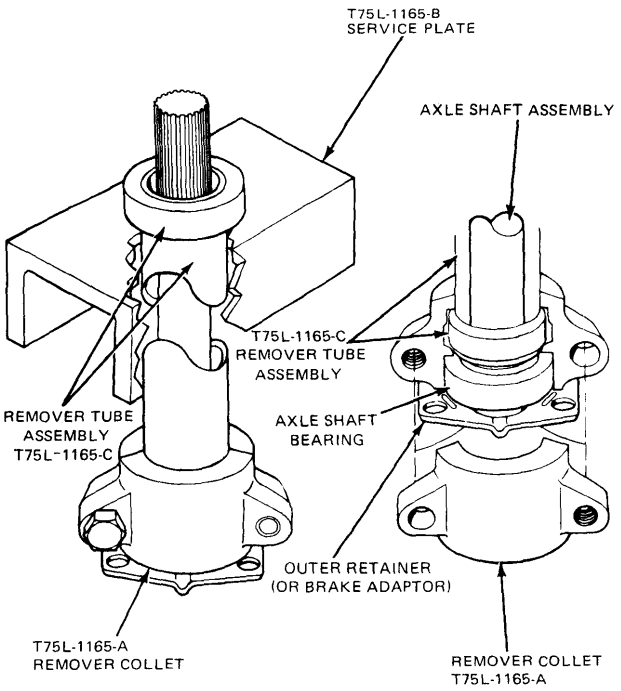


FIG. 13 Removing Bearing Cone Assembly

2. Place the lubricated seal and bearing on the axle shaft making sure the cup rib ring is facing the axle flange. It should be noted that the seal used on a drum brake vehicle is different than that used on rear disc brake equipped cars. The seals are not interchangeable. To identify the seals, examine the outer rim. Those used with drum brakes have a gray metal appearance. Those used for disc rear brakes have an orange-colored appearance.
3. Press the tapered-bearing and seal assembly on to the axle shaft. Apply sufficient pressure to seat the bearing against the axle shaft shoulder. Do not attempt to press on the bearing retainer at the same time (Fig. 14).
4. Position a **NEW** bearing retainer on the shaft, then press it into position firmly against the bearing.
5. Apply lubricant to the outer diameter of the cup and the seal. Install the brake backing plate and attaching bolts.
6. Before sliding the shaft assembly into the axle housing, ensure that the outer seal is not fully mounted on the bearing.
7. Carefully slide the axle shaft into the housing. Start the axle splines into the side gear, and push the shaft in until the bearing bottoms in the housing.
8. Install the bearing retainer plate and the nuts that secure it. Tighten the nuts to 50-75 ft-lbs.
9. Install the brake drum and three drum retainers.
10. Install the wheel and tire on the drum. Install the wheel cover.

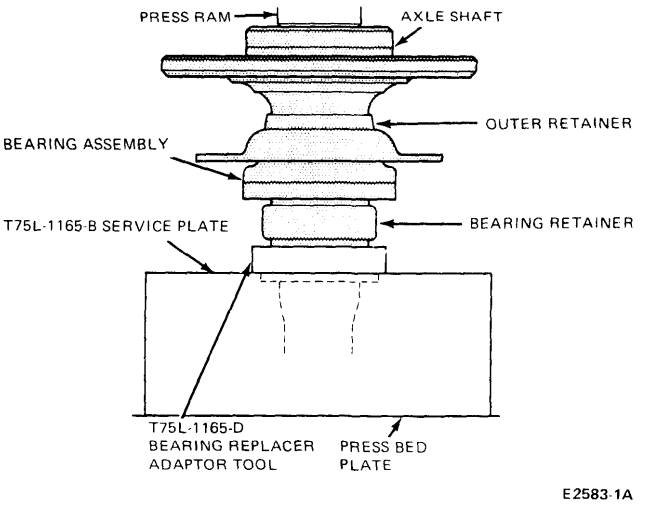


FIG. 14 Installing Seal and Bearing

DRIVE PINION OIL SEAL

COLLAPSIBLE SPACER

Synthetic seals must not be cleaned, soaked or washed in cleaning solvent.

The drive pinion oil seal can be replaced without removing the differential carrier assembly from the axle housing.

1. Raise the vehicle and install safety stands. Remove both rear wheels and brake drums.
2. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper positioning of the drive shaft at re-assembly (Fig. 15). Disconnect the drive shaft from the axle U-joint flange. **Be careful to avoid dropping the loose U-joint bearing cups.** Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are reassembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the housing to prevent transmission fluid leakage. Refer to the Transmission Group for the appropriate tool.

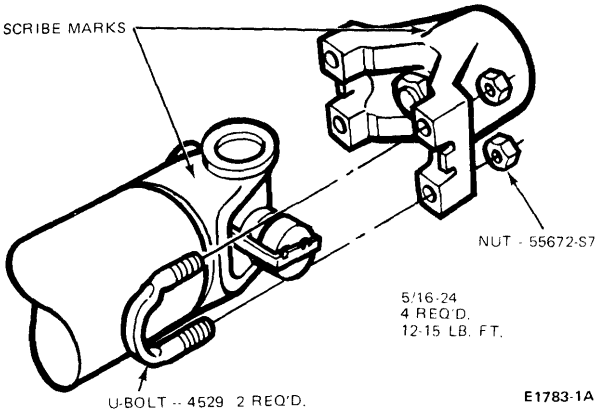


FIG. 15 Drive Shaft-to-U-joint Connections

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3. Install an in-lb torque wrench on the pinion nut. Record the torque required to maintain rotation of the pinion shaft through several revolutions.
4. Scribe the pinion shaft and the U-joint flange inner surface for assembly re-alignment. While holding the flange with the tool shown in Fig. 16, remove the integral pinion nut and washer.

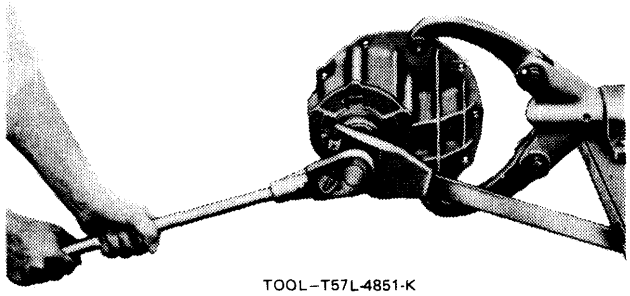


FIG. 16 Removing Pinion Shaft Nut

5. Clean the front drive pinion bearing retainer around the oil seal. Place a drain pan under the seal, or raise the front of the vehicle higher than the rear.
6. Using the tool shown in Fig. 17, remove the U-joint flange.

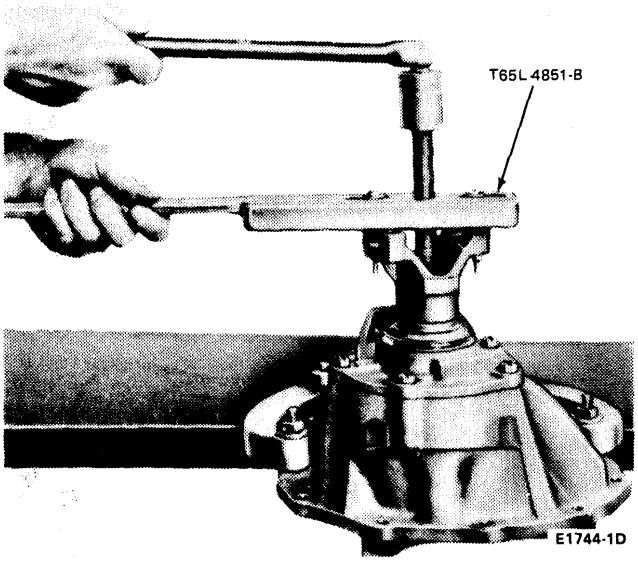


FIG. 17 Removing U-Joint Flange

7. Using the tool shown in Fig. 18, remove the drive pinion oil seal.
8. Clean the oil seal seat.
9. Install the seal in the retainer, using the applicable tool shown in Fig. 19.
10. Check the splines on the drive pinion shaft to be sure they are free of burrs. If burrs are evident, remove them by using a fine crocus cloth, working in a rotational motion, then wipe clean. Apply a small amount of lubricant to the U-joint splines. Align scribe marks on U-joint flange and pinion shaft.

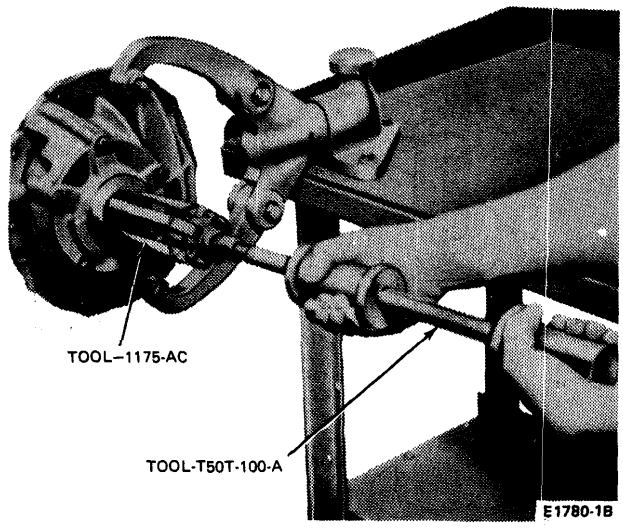


FIG. 18 Removing Pinion Seal

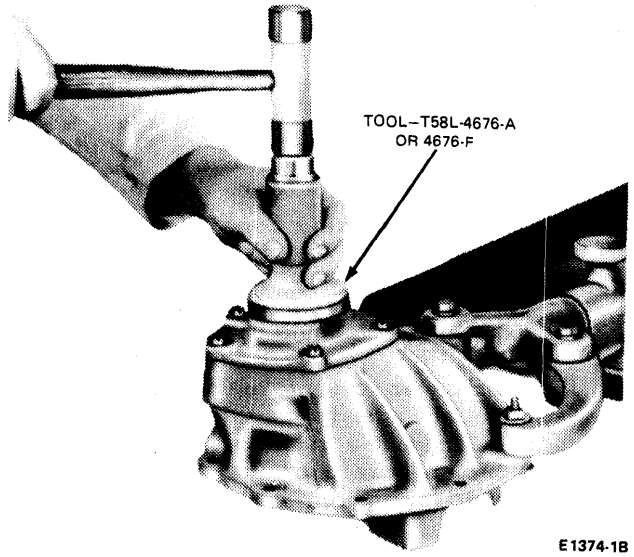


FIG. 19 Installing Pinion Seal

11. Install the U-jount flange using the tool shown in Fig. 20.
12. Install a new integral nut and washer on the pinion shaft. (Apply a small amount of lubricant on the washer side of the nut.)
13. Hold the flange with the tool shown in Fig. 20 while tightening the nut.
14. Tighten the pinion shaft nut, rotating the pinion occasionally to insure proper bearing seating, and take frequent preload readings.
15. If the recorded preload is less than specification, as outlined at the end of this Part, tighten to specification. If the preload is higher than specification, tighten to original reading.

Under no circumstances should the pinion nut be backed off to lessen the preload. If this is done, a new collapsible spacer must be installed. In

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addition, the U-joint flange must never be hammered on, or pneumatic tools used.

16. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft.
17. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange (Fig. 15).
18. Check the lubricant level. **Make sure the axle is in running position. Add whatever amount of specified lubricant is required to reach the lower edge of the filler plug hole.**
19. Install the brake drum and the drum attaching nuts.
20. Install the wheels and tires on the drums.

ORIGINAL AND NEW U-JOINT FLANGE—REMOVAL AND INSTALLATION

Use the procedure outlined under Drive Pinion Oil Seal Removal and Installation except the U-joint flange need not be marked for installation.

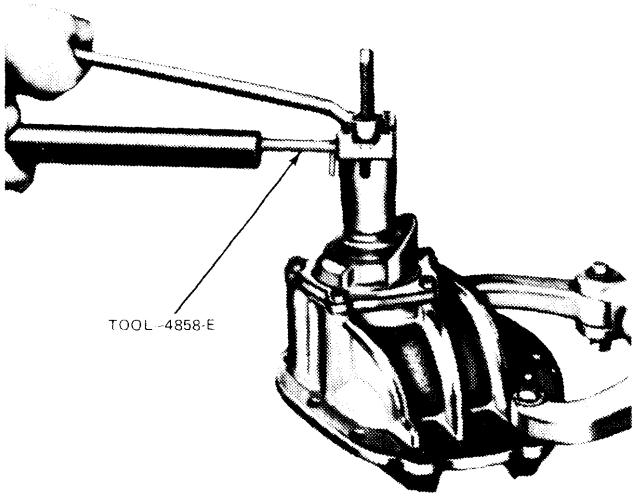


FIG. 20 Installing U-Joint Flange

REMOVAL AND INSTALLATION

CARRIER ASSEMBLY

Removal

1. Raise the vehicle on a hoist and remove the two rear wheel and tire assemblies.
2. Remove the two brake drums (three shakeproof retainers at each drum) from the axle shaft flange studs. If difficulty is experienced in removing the drums, back off the brake shoes as explained in Part 12-02, Drum Brakes-Single Cylinder, Dual Piston.
3. Working through the access hole provided in each axle shaft flange, remove the nuts that secure the rear wheel bearing retainer plate. Pull each axle shaft assembly out of the axle housing using axle shaft remover, Tool T66L-4234-A or T71P-4234-A (Fig. 5). **Care must be exercised to prevent damage to the oil seal. Any roughing or cutting of the seal element during removal or installation can result in early seal failure.** Wire the brake backing plate to the frame rail. Remove the gasket and discard if so equipped.

   Whenever a rear axle shaft is replaced, the wheel bearing oil seals must be replaced. Remove the seals with Tool 1175AB (if roller bearing equipped this need not be done).
4. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position at assembly. Disconnect the drive shaft at the rear axle U-joint. Hold the cups on the spider with tape. Mark the cups so that they will be in their original position relative to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the housing to prevent transmission leakage. Refer to Transmission Group 17 for the appropriate tool.
5. Clean area around carrier to housing surfaces with a wire brush and wipe clean, to prevent dirt entry into the housing. Place a drain pan under the carrier and housing, remove the carrier attaching nuts and washers, and drain the axle. Remove the carrier assembly from the axle housing.

Installation

1. **Synthetic-Type wheel bearing seals must not be cleaned, soaked or washed in cleaning solvent.** Clean the axle housing and shafts using kerosene and swabs. To avoid contamination of the grease in the sealed ball bearings, do not allow any quantity of solvent directly on the wheel bearings. Clean the mating surfaces of the axle housing and carrier.
2. Position the differential carrier on the studs in the axle housing using a new gasket between the carrier and housing. Install the carrier-to-housing attaching nuts and washers, tighten them to specifications.
3. Remove the oil seal replacer tool from the transmission extension housing. Position the drive shaft so that the front U-joint slip yoke splines to the transmission output shaft.
4. Connect the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange during the removal procedure. Install the U-bolts and nuts and tighten them to specifications. (Refer to Specifications at the end of either Part 15-60 or 15-66.)
5. **Install the axle oil seals in the ends of the rear axle housing with tool shown in Fig. 11, if so equipped.**

   Prior to installing an axle shaft, place a new gasket between the housing flange and the brake backing plate, if so equipped.

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6. Install the two axle shaft assemblies in the axle housing. Care must be exercised to prevent damage to the oil seals.

   Carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Timken bearing axle shafts do not require a gasket. Start the axle splines into the differential side gear, and push the shaft in until the bearing bottoms in the housing.
7. Install the bearing retainer plates on the attaching bolts on the axle housing flanges. Install the nuts on the bolts and tighten them to 50-75 ft-lbs.
8. Install the two rear brake drums and the drum attaching nuts.
9. Install the rear wheel and tire assemblies.
10. If the rear brake shoes were backed off, adjust the brakes as outlined in Part 12-01, General Brake Service.
11. Fill the rear axle with the specified lubricant (6AZ-19580-E or equivalent).

AXLE HOUSING

Removal

1. Remove the carrier assembly from the axle housing as outlined in the foregoing procedure.
2. Position safety stands under the rear frame members, and support the housing with either a floor jack or hoist.
3. Disengage the brake line from the clips that retain the line to the housing.
4. Disconnect the vent tube from the housing.
5. Remove the brake backing plate assemblies from the housing, and support them with wire. Do not disconnect the brake line.
6. Disconnect each rear shock absorber from the mounting bracket stud on the housing.
7. Lower the axle slightly to reduce some of the spring tension. At each rear spring, remove the spring clip (U-bolt) nuts, spring clips, and spring seat caps.
8. Remove the housing from under the vehicle.

Installation

If the axle housing is new, install a new vent. The hose attaching portion must face toward the front of the vehicle.

1. Install new rear wheel bearing oil seals in the ends of the axle housing with tools shown in Fig. 11, if so equipped.
2. Position the axle housing under the rear springs. Install the spring clips (U-bolts), spring seat caps, and nuts. **Tighten the spring clip nuts evenly to specifications.** (Refer to Specifications at the end in the appropriate Suspension Section in Group 14).
3. If a new axle housing is being installed, remove the bolts that attach the brake backing plate and bearing retainer from the old housing flanges. Position the bolts in the new housing flanges to hold the brake backing plates in position. Install the backing plates with new gaskets between the housing flange and the brake backing plate if so equipped.
4. Connect the vent tube to the housing.
5. Position the brake line to the housing, and secure it with the retaining clips.
6. Raise the axle housing and springs enough to allow connecting the rear shock absorbers to the mounting bracket studs on the housing.
7. Install the carrier assembly and the two axle shaft assemblies in the housing as outlined in this section.

DISASSEMBLY AND ASSEMBLY

DIFFERENTIAL CARRIER

After mounting the carrier in a holding fixture, perform the Inspection before Disassembly of Carrier as explained in Part 15-01, General Driving Axle and Driveshaft Service under Cleaning and Inspection. Then disassemble the carrier as outlined in the following procedures. A disassembled view of the rear axle assembly is shown in Fig. 2.

Disassembly

1. Mark one differential bearing cap and the mating bearing support with punch marks to help position the parts properly during re-assembly of the carrier.
2. Remove the adjusting nut locks, bearing caps, and adjusting nuts. Then lift the differential case assembly out of the carrier. (Remove the bearing caps by tapping the caps lightly with a soft mallet.)
3. Remove the differential bearings with the tools shown in Fig. 21.
4. Mark the differential case, cover, and ring gear for assembly in the original position.
5. Remove the bolts that attach the ring gear to the differential case and discard them. Press the gear from the case or tap it off with a soft-faced hammer.

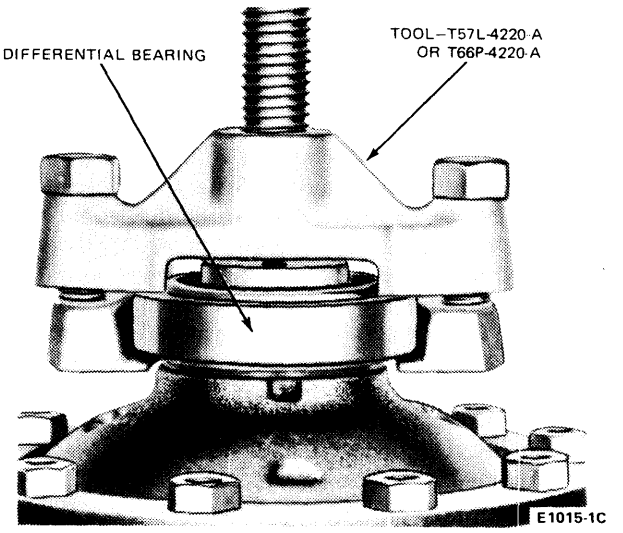


FIG. 21 Removing Differential Bearing

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6. Seperate the two-piece differential case, then with a drift, drive out the differential pinion shaft lock pin, (Fig. 22).
7. Drive the differential pinion shaft out with a brass drift (Fig. 23).

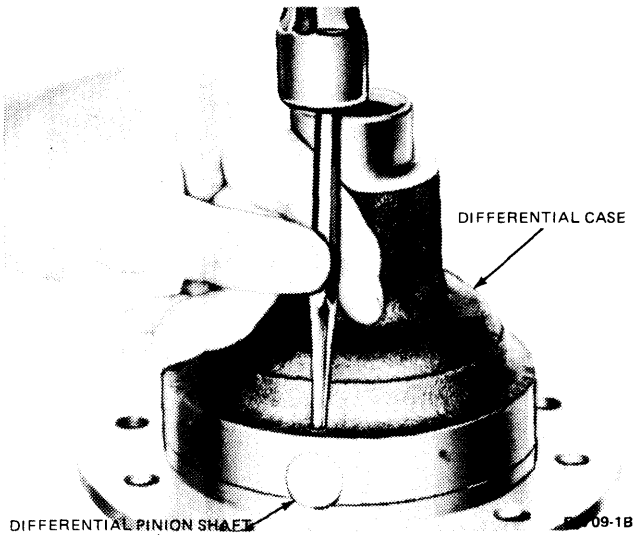


FIG. 22 Removing Differential Pinion Shaft Lock Pin

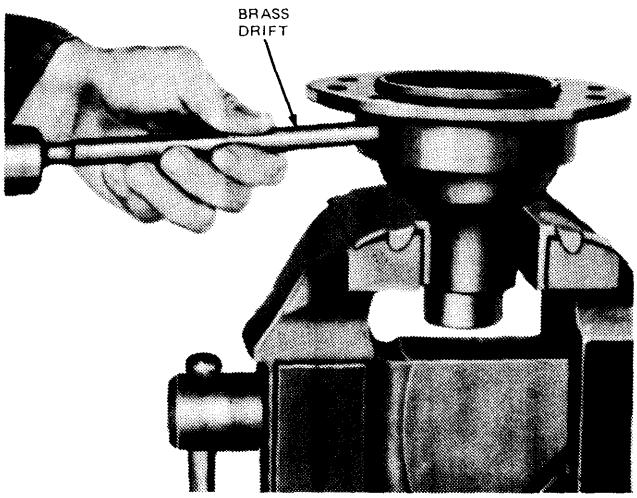


FIG. 23 Driving Out Differential Pinion Shaft

8. Remove the differential side gears, differential pinion gears, and thrust washers (Fig. 2).

DRIVE PINION AND BEARING RETAINER

Removal and Disassembly

1. Position the carrier assembly and remove the drive pinion shaft nut (Fig. 16).
2. Remove the U-joint flange from the drive pinion shaft (Fig. 17).
3. Remove the pinion seal (Fig. 18).
4. Remove the pinion, and retainer assembly from the carrier housing, (Fig. 36). With a micrometer measure the original shim thickness and record it. If a new gear set is installed a new shim will have to be installed. The original shim thickness is one of the factors necessary in determining the new shim thickness. **Extreme care must be taken not to damage the MOUNTING surfaces of the retainer and carrier.**
5. Place a protective sleeve (hose) on the pinion pilot bearing surface. Press the drive pinion shaft out of the pinion (Fig. 24).

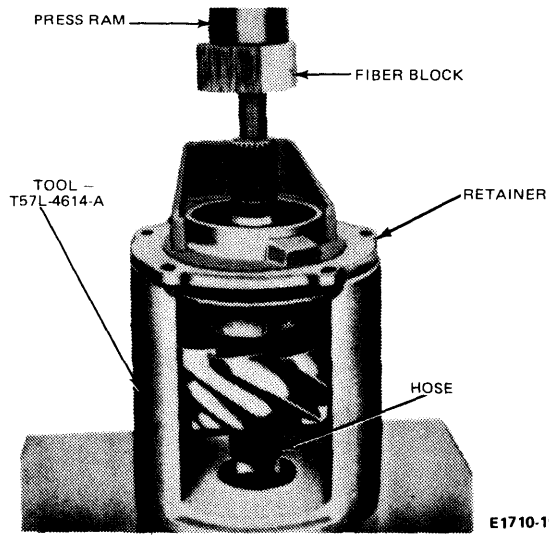


FIG. 24 Removing Pinion Front Bearing Cone

6. Press the pinion shaft out of the pinion rear bearing cone (Fig. 25).

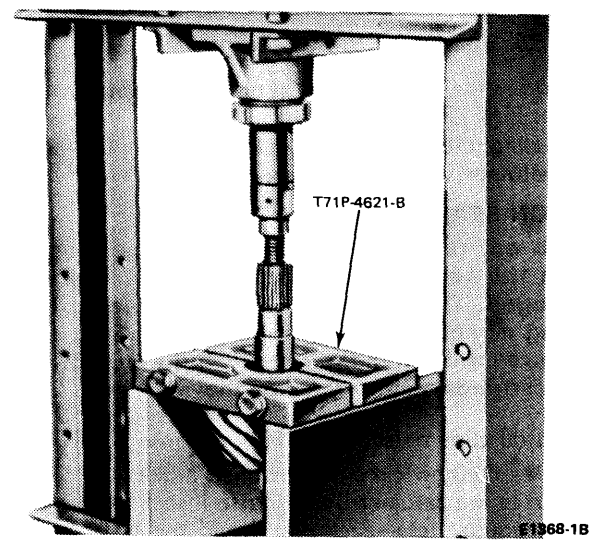


FIG. 25 Removing Pinion Rear Bearing Cone

PARTS REPAIR

Clean and inspect all the parts as outlined in Part 15-01 under Adjustments. Before re-assembling the carrier, repair or replace parts as indicated by the inspection.

The principal replacement operations are covered in the following procedures. All other repair or removal and installation operations are performed during Cleaning and Inspection Part 15-01, General Driving Axle and Driveshaft Service, Adjustments, or during the

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Assembly of the Carrier in this Section.

PILOT BEARING

1. Remove the pilot bearing as shown in Fig. 26. Drive out the bearing and the bearing retainer together.

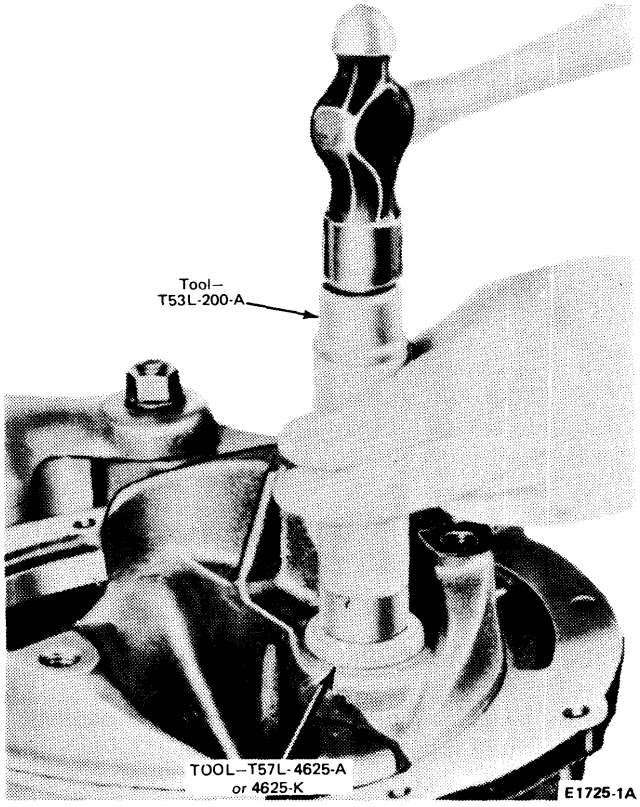


FIG. 26 Removing Pilot Bearing

2. Drive the new bearing in until it bottoms as shown in Fig. 27.
3. Using the same tool, install a new pilot bearing retainer with the concave side up.

PINION BEARING CUPS

Do not remove the drive pinion bearing cups from the retainer unless the cups are worn or damaged. The pinion bearing cups are machined during manufacture by locating on these cups after they are installed in their bores. If the cups are worn or damaged, remove them as shown in Figs. 28 and 29.

Install cups as shown in Figs. 30 and 31.

After the new cups are installed make sure they are seated in the retainer by trying to insert a 0.0015-inch feeler gauge between the cup and the bottom of the bore.

Whenever the cups are replaced, the cone and roller assemblies should also be replaced.

ASSEMBLY

DRIVE PINION AND RING GEAR SET

When replacing a ring gear and drive pinion, note that the original factory-installed shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the original gear set dimension. Therefore, to select the correct shim thickness for the new gear set to be installed, follow these steps:

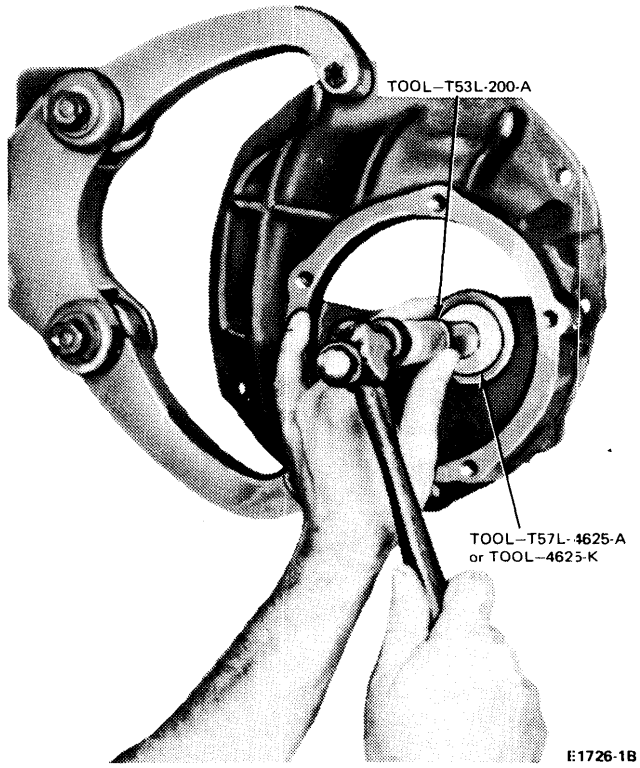


FIG. 27 Installing Pilot Bearing

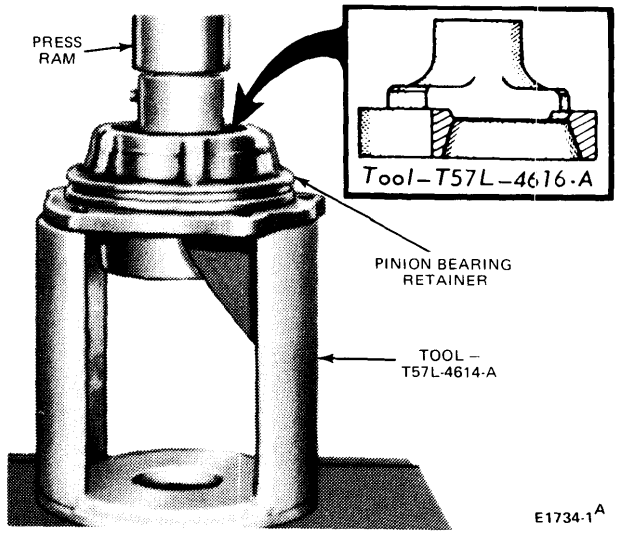


FIG. 28 Removing Pinion Front Bearing Cup

1. Use a micrometer to measure the thickness of the original shim removed from the axle. Use the same thickness when installing the replacement carrier assembly or drive pinion. If further shim change is necessary, it will be indicated in the tooth pattern check.
2. If the original shim is lost, substitute a nominal shim for the original and use the tooth pattern check to determine if further shim changes are required. Nominal shim thicknesses are indicated in Specifications.

A new ring gear and drive pinion should always be installed in an axle as a matched set (never

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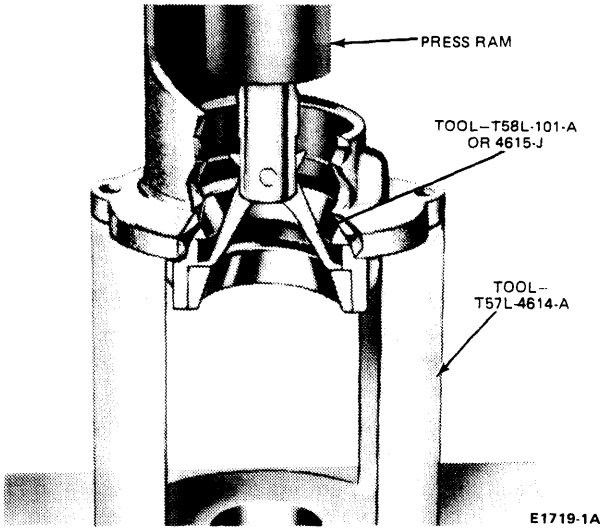


FIG. 29 Removing Pinion Rear Bearing Cup

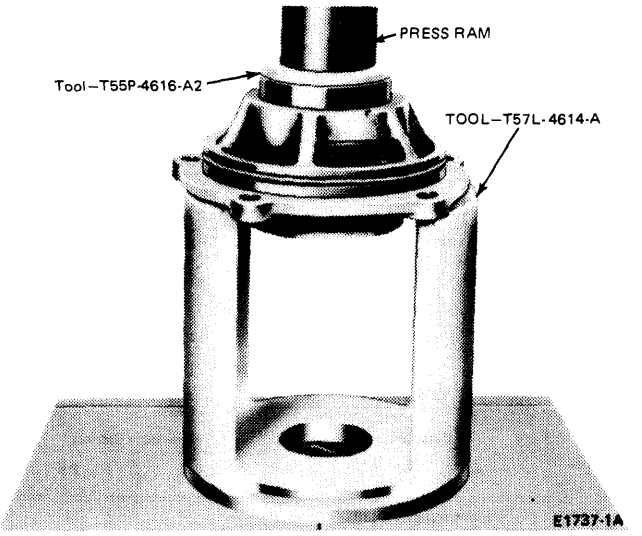


FIG. 31 Installing Pinion Rear Bearing Cup

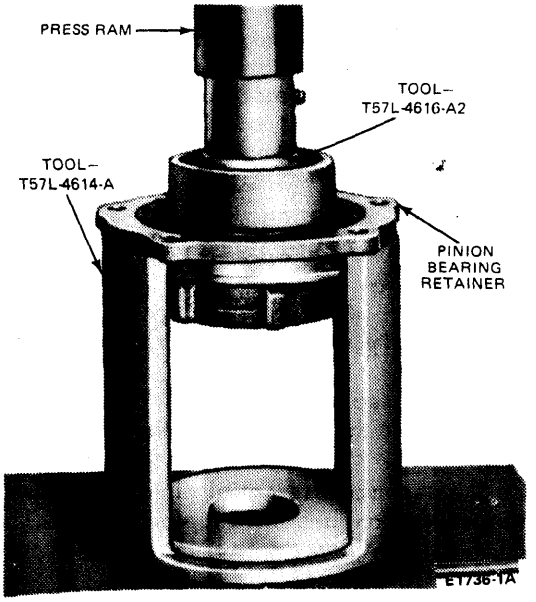


FIG. 30 Installing Pinion Front Bearing Cup

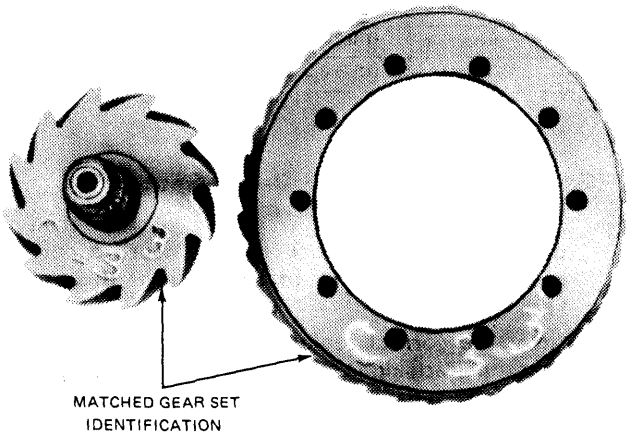


FIG. 32 Pinion and Ring Gear Markings

separately). **Be sure the same identifying (matching) number appears on the ring gear and on the head of the drive pinion (Fig. 32).**

3. After determing the correct shim thickness as explained in the foregoing Steps, install the new drive pinion and ring gear as follows.

DRIVE PINION AND GEAR SET

Alternate procedure using Tool T75P-4020-A.:

NOTE: A tooth pattern check using the gear marking compound supplied with the ring and pinion gear kit is not required when this tool is used.

1. Refer to the chart shown in Fig. 33 and select the proper rear pinion bearing Aligning Adapter and Gauge Disc, corresponding to the axle size, (nine inch ring gear). Slide these adapters over the screw or threaded shaft shown in Fig. 33. Install the Gauge Block on the threaded shaft and tighten securely as shown in Fig. 34.
2. Place this assembly, along with a **new** rear drive pinion bearing, into the pinion bearing retainer assembly. Install the front pinion bearing, (new, or used, if in good condition), and screw the handle onto the threaded shaft, with the tapered end into the front pinion bearing. (See Steps 1 and 2 in Fig. 34.) The flat end of the handle has a 3/8 inch square hole broached in it. This is designed so that an inch-pound torque wrench may be used to obtain proper pinion bearing preload.
3. Install the pinion bearing retainer assembly into the carrier (without a pinion shim) and tighten the attaching bolts to 30 - 45 ft-lb torque.
4. Rotate the Gauge Block so that it rests against the pilot boss (Step 3 in Fig. 34).
5. Place the differential Gauge Tube into the differential bearing bore and tighten the bearing caps to the specified torque (Step 4 in Fig. 34).
6. Using a feeler gauge tool, select the thickest feeler blade that will enter the space between the differential bearing Gauge Block and Gauge Tube (Step 4 in Fig. 34). Insert the feeler blade directly

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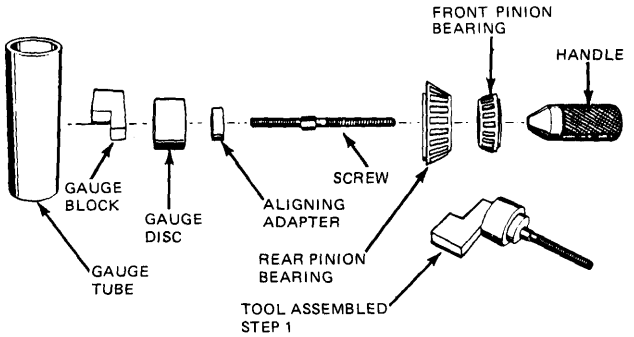


CHART I

Dash Number	Description	Removable Carriers	
		8.0	9.0
-A1	Aligning Adapter (1.300 O.D.)		X
-A8	Gauge Tube (2.892 O.D.)	X	X
-A9	Screw	X	X
-A10	Gauge Block (1.700 Thick)	X	X
-A11	Handle	X	X
-A12	Gauge Disc (.820 Thick)	X	
-A13	Gauge Disc (1.189 Thick)		X
-A14	Aligning Adapter (1.175 O.D.)	X	

F2517-1A

FIG. 33 Rear Axle Pinion Depth Gauge Tool—(T75P-4020-A)

along the Gauge Block top to insure a correct reading. The fit should be a slight drag-type feeling.

7. After the correct feeler gauge feel is obtained, check the reading in the conversion chart in Fig. 34. The chart indicates the shim thickness required according to the feeler gauge reading.

   NOTE: Inspect the service pinion gear that will be used for this build-up. If the drive pinion head is marked with a plus (+) or a minus (-) number, the amount shown as plus must be added and the amount shown as minus must be subtracted from the shim thickness as determined above. In addition, the same new rear pinion bearing used in determining shim thickness must be used in final assembly.

8. After determining the correct shim thickness as explained in the foregoing steps, install the new drive pinion and ring gear.

DRIVE PINION AND BEARING RETAINER—COLLAPSIBLE SPACER

1. Install the pinion rear bearing cone on the pinion shaft (Fig. 35). Place a new spacer on the pinion shaft (Fig. 36).
2. Place the bearing retainer on the drive pinion shaft, and install the front bearing cone and roller. Press the front bearing cone and roller into position as shown in Fig. 37. Be careful not to crush the collapsible spacer.
3. Lubricate the O-ring with axle lubricant and install it in its groove in the pinion retainer. Be careful not to twist it. Snap the O-ring into position. Also lubricate both front and rear pinion bearings.
4. Place the proper shim on the carrier housing and install the pinion and retainer assembly, being careful not to pinch the O-ring, (Fig. 38).
5. Install the pinion retainer attaching bolts. Tighten the bolts to specification, install the oil slinger, if so equipped.
6. Install a new pinion oil seal in the bearing retainer (Fig. 19).
7. Install the U-joint flange (Figs. 20 and 36).
8. Start a new integral nut and washer on the drive pinion shaft. Apply a small amount of lubricant to the washer side of the nut.
9. Hold the flange with the tool shown in Fig. 16, and tighten the drive pinion shaft nut.
10. Check the pinion bearing preload as shown in Fig. 39. The correct preload will be obtained when the torque required to rotate the pinion in the retainer is as specified in the Specifications. If the torque required to rotate the pinion is less than specified, tighten the pinion shaft nut a little at a time until the proper preload is established. **Do not over-tighten the nut. If excessive preload is obtained as a result of over-tightening, replace the collapsible bearing spacer.**

    Do not back off the pinion shaft nut to establish pinion bearing preload.

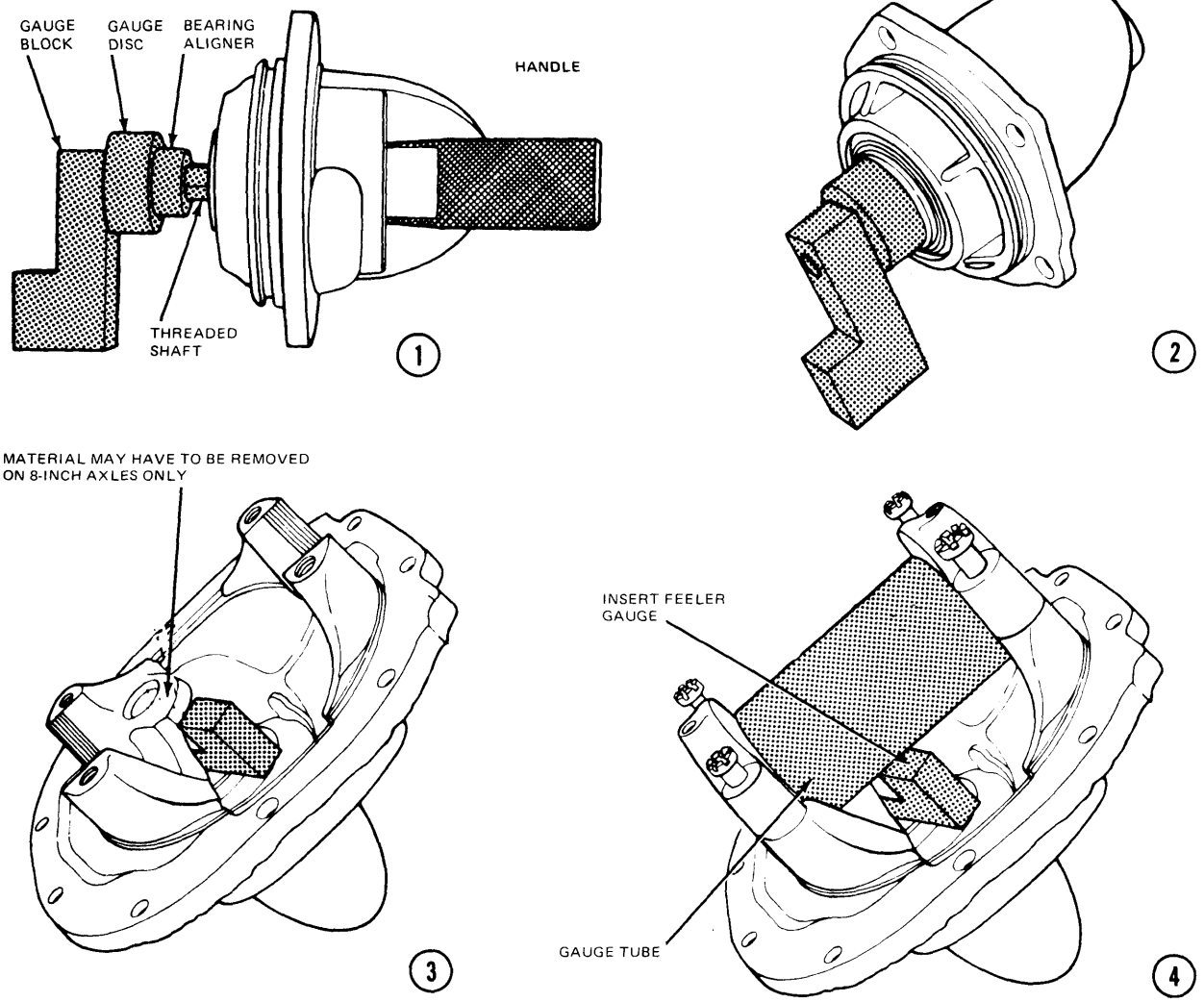
DIFFERENTIAL CASE

1. Place a side gear thrust washer in the differential case bore (Fig. 40). **Lubricate all differential parts liberally with axle lubricant during assembly.**
2. With a soft-faced hammer, drive the differential pinion shaft into the case only far enough to retain a pinion thrust washer and pinion gear.
3. Place the second differential pinion and thrust washer in position, and drive the pinion shaft into place. **Carefully line up the pinion shaft lock pin holes.**
4. Place the second side gear and thrust washer in position (Fig. 40), and install the pinion shaft lock pin and the cover on the differential case. An axle shaft spline can be inserted in the side gear spline to check for free rotation of the differential gears.
5. Clean the tapped holes in the ring gear with a suitable solvent.

   Insert two 7/16 (N.F.) bolts two inches long through the differential case flange, and thread them three or four turns into the ring gear as a guide in aligning the ring gear bolt holes. Press or tap the ring gear into position.
6. If the new bolts to be used show a green coating of approximately 1/2-inch or over the threaded area, use as is. If not coated, apply a small amount of Loctite C3AZ-19554-A or equivalent. Tighten to specification. **It is mandatory that bolts used once should not be used again.**
7. If the differential bearings have been removed, press them on as shown in Fig. 41.
8. Wipe a thin coating of lubricant on the bearing bores so that the differential bearing cups will move

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Feeler Gauge Reading	Shim Required	Feeler Gauge Reading	Shim Required	Feeler Gauge Reading	Shim Required
.035	.005	.023	.017	.011	.029
.034	.006	.022	.018	.010	.030
.033	.007	.021	.019	.009	.031
.032	.008	.020	.020	.008	.032
.031	.009	.019	.021	.007	.033
.030	.010	.018	.022	.006	.034
.029	.011	.017	.023	.005	.035
.028	.012	.016	.024	.004	.036
.027	.013	.015	.025	.003	.037
.026	.014	.014	.026	.002	.038
.025	.015	.013	.027		
.024	.016	.012	.028		

F2518-2A

FIG. 34 Using Pinion Depth Gauge Tool—(T75P-4020-A)

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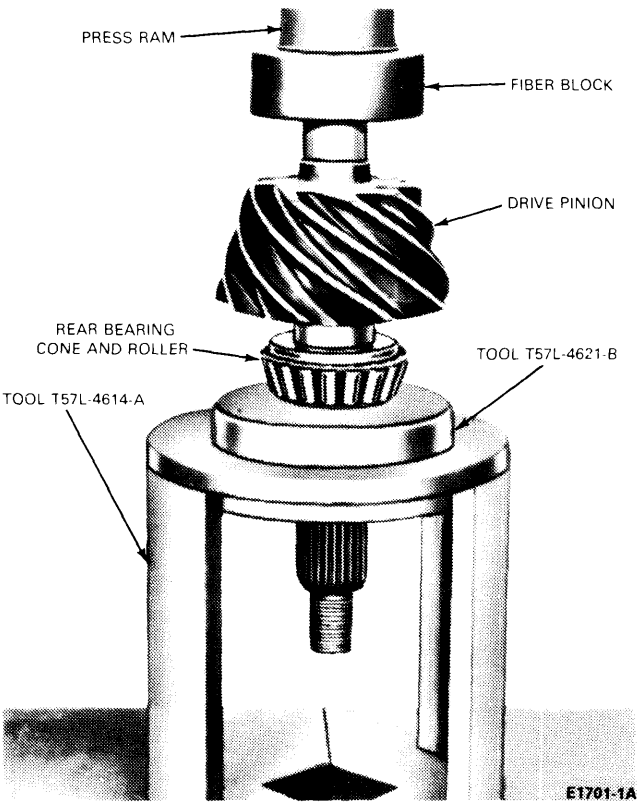


FIG. 35 Installing Pinion Rear Bearing Cone

easily. Place the cups on the bearings and set the differential case assembly in the carrier.

9. If the gear set is of the **nonhunting or partial nonhunting** type, assemble the differential case and ring gear assembly in the carrier so that the marked tooth on the drive pinion indexes between the marked teeth on the ring gear as shown in Fig. 42.

   Be sure to match marked gears as indicated. When assembled out of time, the result is noise and improper mating.

   When installing the hunting type gear set (no timing marks), assemble the differential case and ring gear assembly in the carrier without regard to the matching of any particular gear teeth.

10. Slide the assembly along the bores until a slight amount of backlash is felt between the gear teeth.
11. Set the adjusting nuts in the bores so that they just contact the bearing cups. The nuts should be engaged about the same number of threads on each side.
12. Carefully position the differential bearing caps on the carrier. Match the marks made when the caps were removed.
13. Install the bearing cap bolts and alternately tighten them to 70-80 ft-lb.
14. If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the differential bearing caps and again inspect for damaged threads or incorrectly positioned caps. Tightening the bolts to the specified torque is done to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and tighten them to only 25 ft-lb before making adjustments.
15. Adjust the backlash between the ring gear and pinion and the differential bearing preload as outlined in the following procedure.
16. Be sure to make a final tooth pattern check before installing the carrier assembly in the axle housing.

BACKLASH AND DIFFERENTIAL BEARING PRELOAD ADJUSTMENT

1. Remove the adjusting nut locks, loosen the differential bearing cap bolts, then tighten the bolts to 15 ft-lb on integral carrier-type axle; 20 ft-lb on removable carrier-type axles before making adjustments.
2. **The left adjusting nut is on the ring gear side of the carrier. The right nut is on the pinion side.** Loosen the right nut until it is away from the cup. Tighten the left nut until the ring gear is just forced into the pinion with 0.000 backlash, then rotate the pinion several revolutions to be sure no binding is evident. (Recheck the right nut at this time to be sure that it is still loose. **Tightening the left nut moves the ring gear into the pinion to decrease backlash, and tightening the right nut moves the ring gear away (Fig. 43).**
3. Install a dial indicator as shown in Fig. 44.
4. Tighten the right nut until it first contacts the bearing cup. Then, preload the bearings from 0.008 to 0.012-inch case spread. Turn the pinion gear

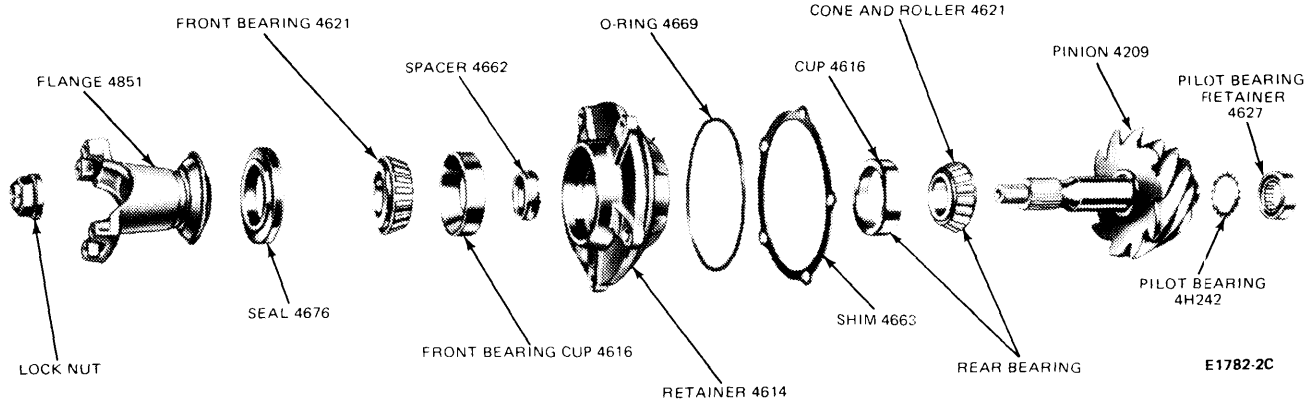


FIG. 36 Pinion and Bearing Retainer

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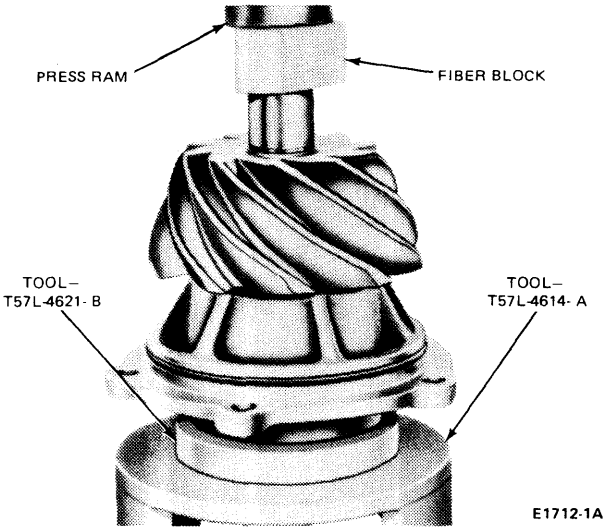


FIG. 37 Installing Pinion Front Bearing

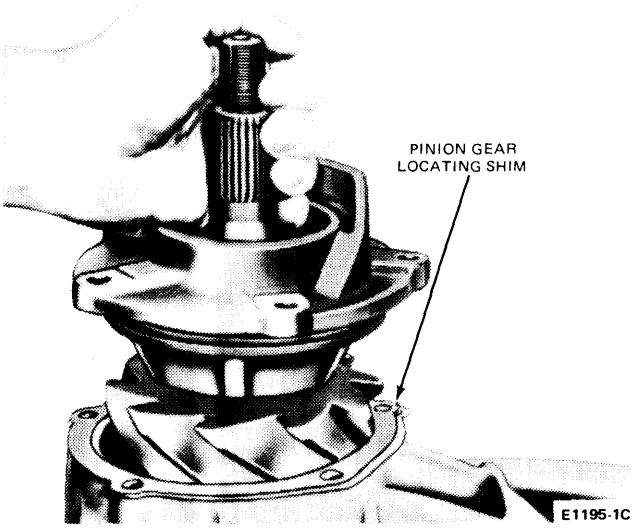


FIG. 38 Removing or Installing Pinion and Retainer Assembly

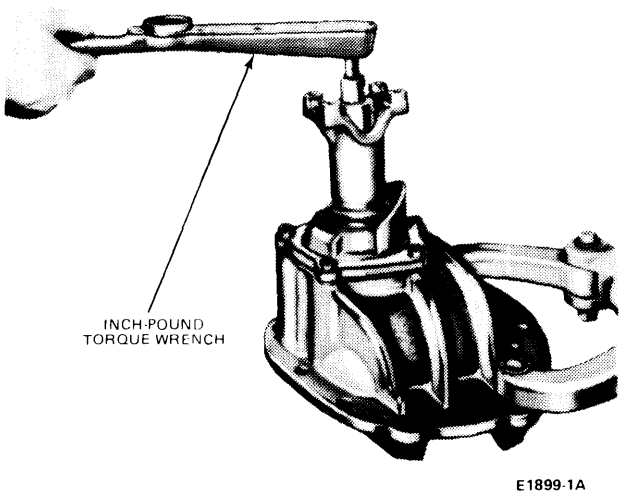


FIG. 39 Pinion Bearing Preload Check

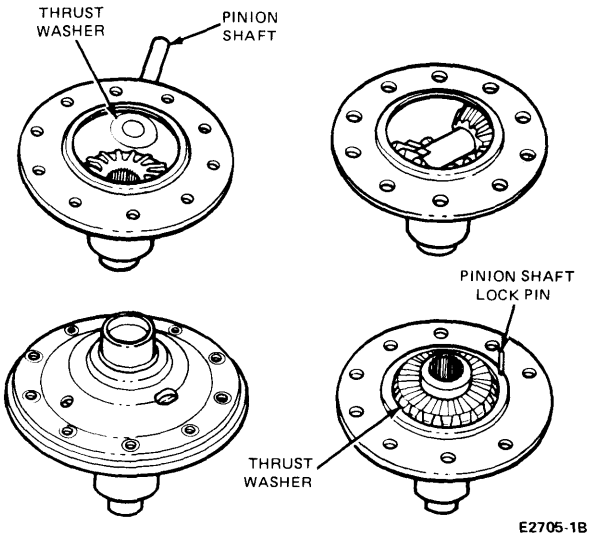


FIG. 40 Assembly of Differential Case

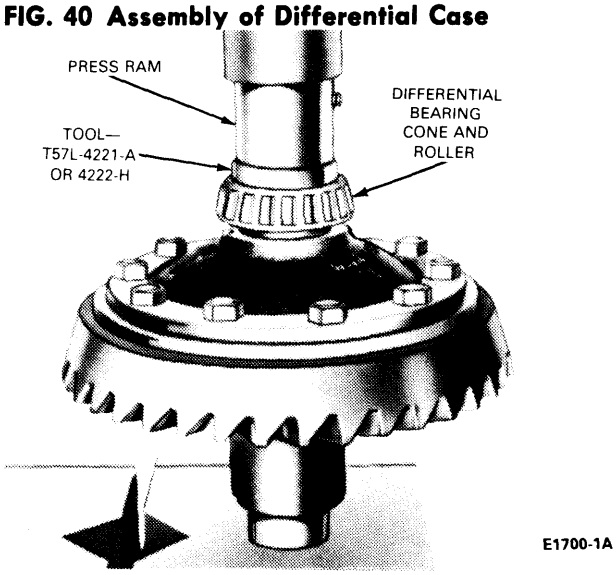


FIG. 41 Installing Differential Bearing

several times in each direction to seat the bearings in the cups and be sure no bind is evident. **This step is important.**

5. Tighten the differential cap bolts to specification.
6. Measure the backlash on several teeth around the ring gear (Fig. 45). If the measurements vary more than 0.003 inch (both integral and removable carrier), there is excessive runout in the gears or their mountings, which must be corrected to obtain a satisfactory unit. If the backlash is out of specification, loosen one adjusting nut and tighten the opposite nut an equal amount, to move the ring gear away from or toward the pinion. **When moving the adjusting nuts, the final movement should always be made in a tightening direction. For example, if the left nut had to be loosened one notch, loosen the nut two notches, then tighten it one. This insures that the nut is contacting the bearing cup, and that the cup cannot shift after being put in service.** After all such adjustments, check to be sure that the case spread remains as specified for the new or original bearings used.

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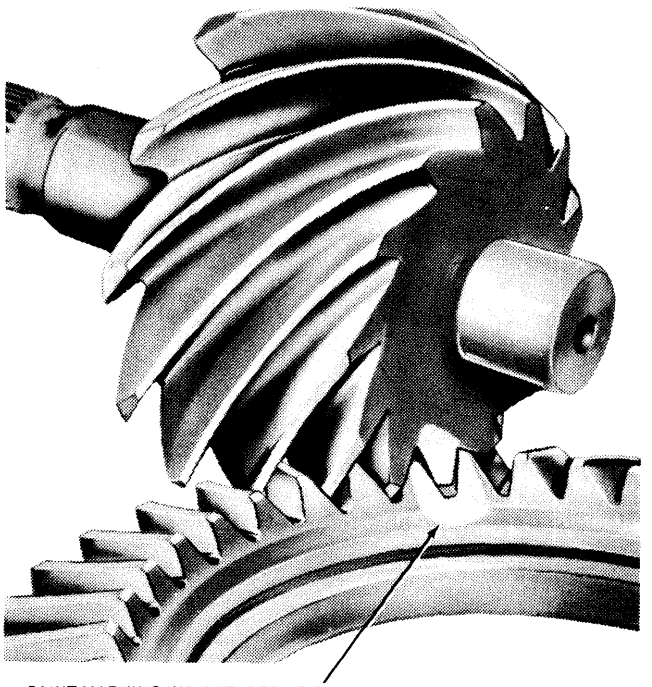


FIG. 42 Gear Set Timing Marks

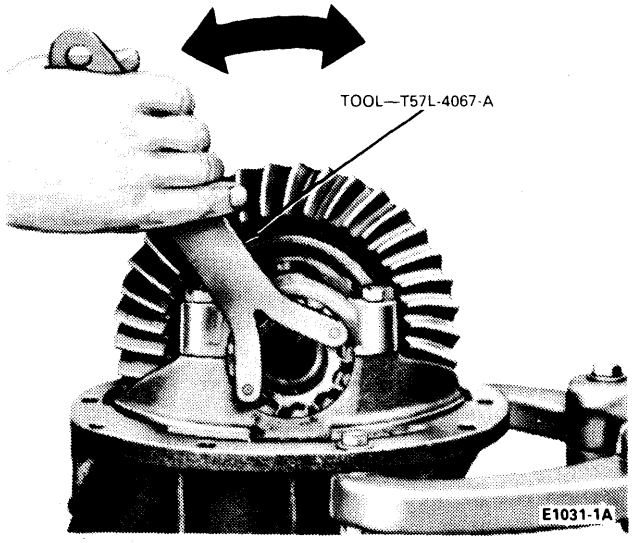


FIG. 43 Backlash Adjustments

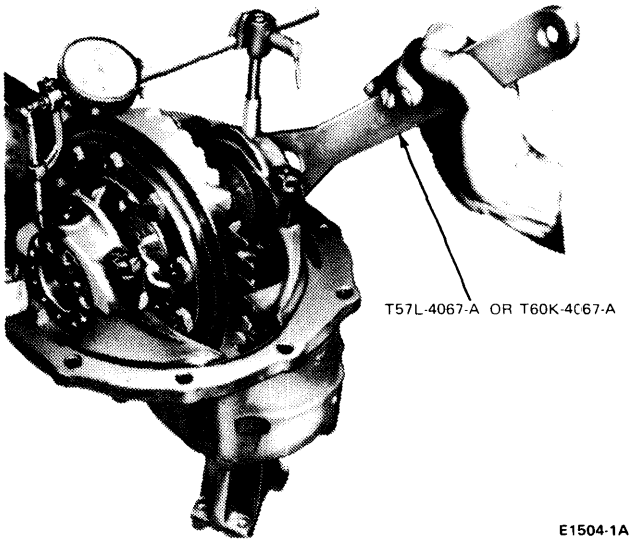


FIG. 44 Adjusting Side Bearing Preload

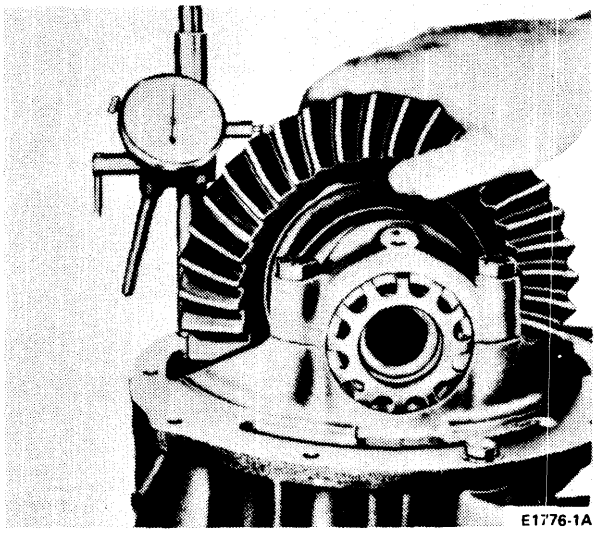


FIG. 45 Checking Backlash

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SPECIFICATIONS

FORD REAR AXLE RATIOS GEAR AND CODE IDENTIFICATION

Identification Tag	Ratio	Ring Gear Dia. (Inches)	Diff. Type	Identification Tag	Ratio	Ring Gear Dia. (Inches)	Diff. Type
WDM-CF	3.00:1	9	C4	WDM-CN	3.50:1	9	C4
WDM-CG	2.75:1	9	C4	WEV-AH	2.75:1	9	C4
WDM-CJ	2.75:1	9	C4	WEV-AJ	3.00:1	9	C4
WDM-CK	3.25:1	9	C4	WEV-AK	2.75:1	9	C4
WDM-CL	2.75:1	9	C4	WEV-AL	3.25:1	9	C4
WDM-CM	2.75:1	9	C4				
Type C4 — Conventional 4-Pinion							

REAR AXLE ADJUSTMENTS — Ford

Description	Inch	Description	Inch
Backlash Between Ring Gear and Pinion	0.008-0.012	Nominal Locating Shim (Continued) Removable Carrier	0.015
Maximum Backlash Variation Between Teeth	0.003		
Maximum Runout of Backface of Ring Gear	0.003	Shims Available (Steps of 0.001) Removable Carrier	0.010-0.029
Differential Side Gear Thrust Washer Thickness	0.030-0.032		
Differential Pinion Gear Thrust Washer Thickness	0.030-0.033	Differential Bearing Preload	
		New Bearings	0.008-0.012
		Original Bearings	0.005-0.008

CE2154-2D

LUBRICANT AND CAPACITY — FORD

Axle	Lubricant	Specification	Capacity		
			U.S. Measure (Pints)	Imperial Measure (Pints)	Litres
Ford	C6A7-19580-E ①	ESW-M2C105-A ①	6.5	5.4	3

① Or use an equivalent lubricant.

CE3750-2A

TORQUE SPECIFICATIONS

Description	(ft-lbs)	N•m
Pinion Retainer to Carrier Bolts	30-45	41-60
Ring Gear Attaching Bolts	70-85	95-115
Bearing Cap Bolts	70-85	95-115
Carrier to Housing Bolts	25-40	34-54
Adjusting Nut Lock Bolts	12-25	17-33
Axle Shaft Retainer Bolts	50-70	68-94
	(in-lbs)	N•m
Pinion Bearing Preload — Original Bearing	8-14	1.0-1.5
Pinion Bearing Preload — New Bearing	17-27	2-3

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SPECIAL TOOLS

Tool Number	Description
T71P-4621-B	Pinion Rear Bearing Service Plate
T53L-2000-A or T57L-4625-A	Pilot Bearing Removal-Installation Tool
T56L-4616-A	Front Drive Pinion Bearing Cup Remover
T58L-101-A or Tool 4615-J	Drive Pinion Rear Bearing Cup Remover
T55P-4616-A2	Drive Pinion Rear Bearing Cup Installer
T57L-4614-A	Press Collet for Bearing Cup Removal-Installation
T57P-4020-A	Rear Axle Pinion Depth Gauge Tool
T57L-4621-B	Rear Bearing Cup Installer
T57L-4221-A or 4222-H	Differential Bearing Installer
T57L-4067-A	Backlash-Preload Adjuster Wrench
Tool 1175-AB	Axle Flange
T50T-100-A	Slide Hammer
Tool 4221-A	Wheel Bearing Press Tool
T75L-1165-B	Service Plate
T75L-1165-A	Remover Collet
T75L-1165-D	Bearing Replacer Adapter Tool
T60K-1225-A	Bearing Press Tool
T53T-4851-A	U-Joint Flange Remover
T57L-4851-A	Flange Remover
Tool 1175-AB or AC	Drive Pinion Oil Seal Remover
Tool 4858-E	U-Joint Flange Installer
T66L-4234-A or T71P-4234-A	Axle Flange Holder
T57L-4220-A or T66P-4220-A	Differential Bearing Remover
T66L-4234-A or T71P-4234-A	Axle Shaft Removal Tool
Tool 4621-A	Bearing Installation Tool
Tool 1225-DA	Bearing Removal Tool
T73L-1177-C or Tool 1177	Seal Installation Tool
T75L-1165-C	Remover Tube Assembly
T58L-4676-A or F	Pinion Seal Installation Tool
T57L-4616-A2	Pinion Front Bearing Cup Installation Tool

CE3678-2B

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Front Driving Axle — 44-9F Dana

PART 15-30

APPLIES TO BRONCO, F-150, F-250 (4x4)

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DISASSEMBLY AND ASSEMBLY	
ASSEMBLY	
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Drive Pinion Installation and Depth Adjustment	30-8
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DESCRIPTION AND OPERATION

DANA DESIGN FRONT FOUR-WHEEL DRIVE AXLE

An open-yoke design axle is used with the yoke welded to the outer ends of the axle housing. Power to drive the front wheels is transmitted through open single Carden-type U-joints. Sealed ball and socket joints are used as knuckle joints. The spindle bore seal is installed on the axle shaft rather than being retained in the spindle. Due to its special design, the seal acts as a slinger as well as a seal (see Fig. 1 and 3).

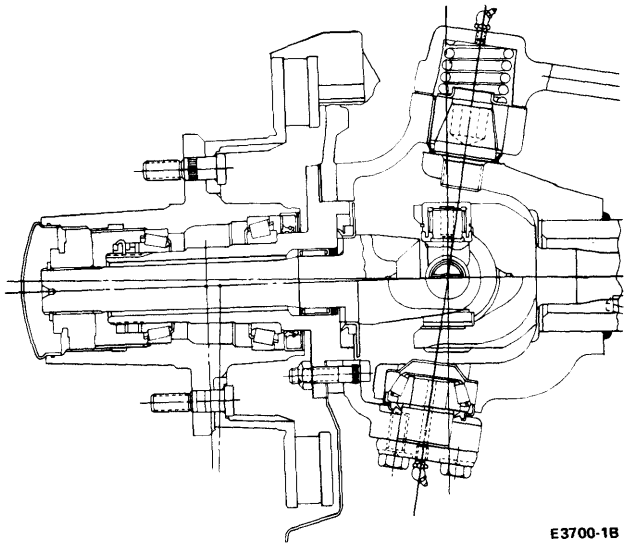


FIG. 1 Ball Joint and Seal Assemblies

The differential section of the Dana Model 44-9F axle is similar in design to the other Dana units used on Ford vehicles (Fig. 2). The differential carrier is integral with the axle housing. Adjustment of the side carrier bearings is accomplished by means of shims placed between the bearings and the differential case. The carrier side bearings are preloaded by the squeezing action of the housing. A spreader must be used (Fig. 12) on the axle housing to relieve the tension on the differential bearings and permit removal or installation of the differential. Pinion depth is controlled by a shim pack located to the rear of the pinion bearing. Pinion bearing preload is controlled by variable-sized shims.

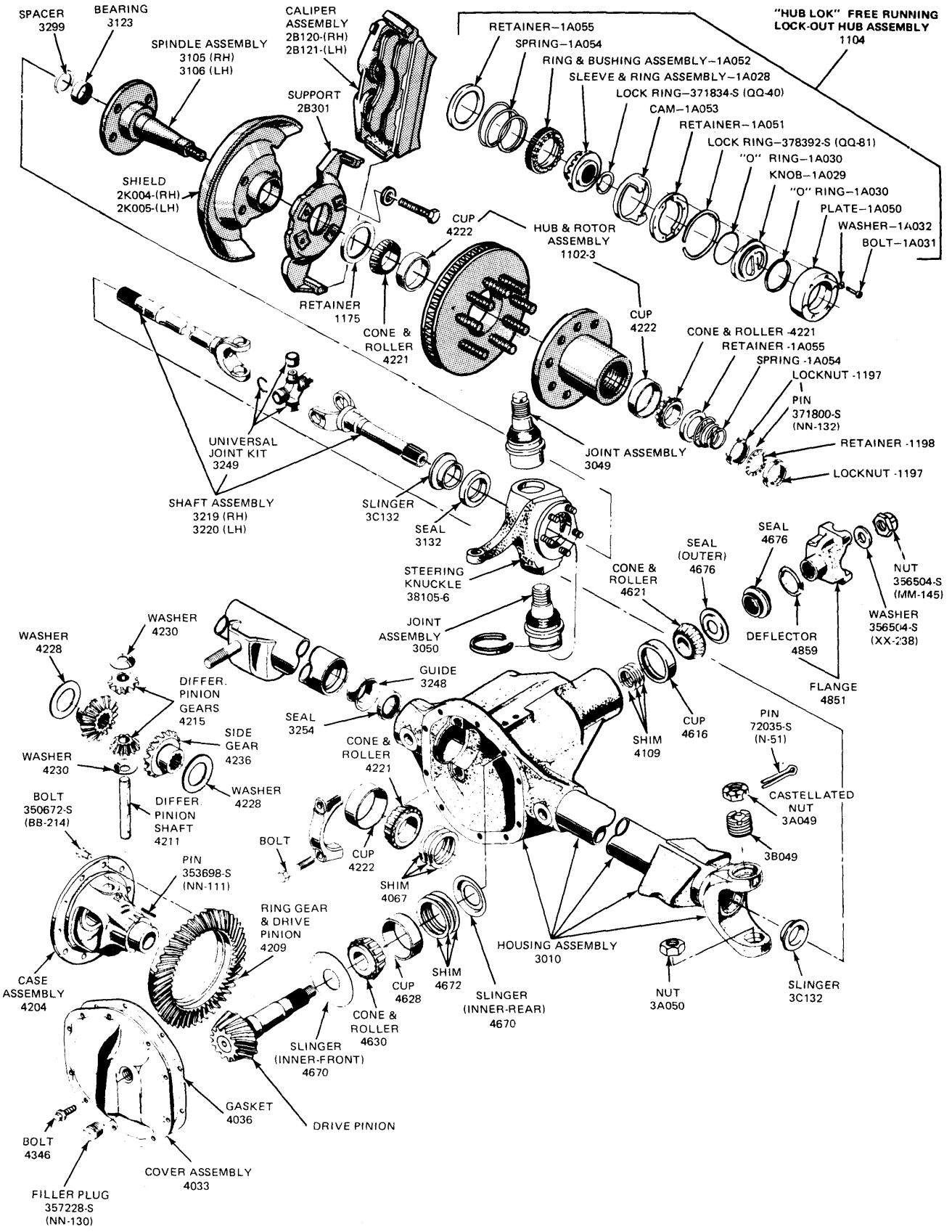
The front axle is of the integral carrier-housing, hypoid-gear type, in which the centerline of the drive pinion is mounted below the centerline of the ring gear.

The integral drive pinion gear and shaft is supported by two opposed tapered roller bearings which are assembled in the side of the carrier housing. Pinion locating shims, installed between the bearing cup and the cup seat, control the drive pinion depth adjustment. The pinion bearing preload is controlled by shims located between the pinion bearing and the shoulder on the drive pinion shaft.

The differential case assembly is supported by two opposed tapered roller (side) bearings and cups, which are retained in the housing by removable caps. Shims, installed between each differential side bearing and the shoulder on the case, perform three functions: they take up the differential case side clearance; they adjust the

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E2337-2G

FIG. 2 Front Axle Assembly Complete—Exploded View

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backlash between ring gear and drive pinion, and they establish differential side bearing preload.

A cover on the front of the carrier housing provides access for inspection, removal and installation of the differential assembly and drive pinion. A metal tag, stamped with the gear ratio and part number is secured to the housing by one of the cover bolts (Fig. 2 Part 15-01, General Driving Axle and Driveshaft Service).

FRONT-WHEEL DRIVE FREE RUNNING HUB

The free-running hub is standard equipment for the Dana front axle of the Bronco and F-150-250 (4x4). It is the internal locking type.

LOCK POSITION

When the transfer case is to be shifted into the position for driving the front axle, the pointer on the center bar of the hub must point to the notch under the word LOCK on the retaining plate. If the clutch teeth do not engage with the knob turned to this position, the clutch teeth are butted and a slight movement of the wheel in either direction will complete the lock. The front axle will now drive the wheels. Do not operate in four-wheel drive with the hubs disengaged.

FREE RUNNING POSITION

When the transfer case is to be shifted into the position for driving the rear axle only, turn the pointer on the center bar of the hub so it points to the notch under the word FREE on the retaining plate. This will disengage the clutch teeth and thus unlock the wheel hubs from the axle shafts. The wheels will turn freely on the axles.

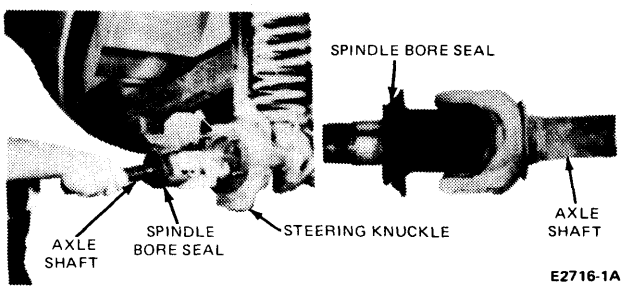


FIG. 3 Removing or Installing Axle Shaft—Typical

Be certain that the transfer case is shifted into two-wheel drive position before disengaging the free running hubs.

If difficulty is experienced in disengagement of the free running hubs, a slight movement of the vehicle in either direction with the transfer case in 2 wheel drive position, will reduce driveline wrap-up and ease disengagement.

DIAGNOSIS AND TESTING

Refer to Part 15-01, General Driving Axle and Driveshaft Service Under Diagnosis and Testing.

REMOVAL AND INSTALLATION

FRONT AXLE SHAFT AND STEERING KNUCKLE

Removal

1. Raise the vehicle on a hoist.
2. Remove each front wheel free-running hub; then remove each front wheel caliper assembly and hub and rotor assembly. Secure the brake assembly to one side to avoid damaging the brake hose. Refer to Part 12-24, Disc Brakes—Light and Heavy Duty Sliding Caliper, for procedures.
3. Remove the nuts that attach the brake support bracket, dust shield and spindle to the steering knuckle (housing). Carefully remove the spindle.
4. Pull the axle shaft assembly from the axle housing, working the U-joint through the bore of the steering knuckle (Fig. 3). **Use care to prevent damage to the seal. If it is bumped against the knuckle bore it can be damaged.** (At this point, the following parts can be replaced without further disassembly of the axle: axle shafts; U-joints; spindle bore seals and deflectors, and spindle bore needle bearings. If necessary to install new axle shaft U-joints, follow the procedure shown in Part 15-60, Driveshaft-Single Snap Ring Type U-Joint.
5. To remove the steering knuckle (housing), disconnect the steering connecting rod end from the steering knuckle.
6. Remove the cotter key from the upper ball socket. Loosen the nuts from the upper and lower ball sockets (Fig. 4). Discard the nut from the bottom socket after the knuckle breaks loose from the yoke. This nut is of the torque-prevailing design and is not to be reused.
7. Remove the knuckle from the yoke.

   In the event that the top socket should remain in the yoke, remove it by hitting on top of the stud with a rawhide hammer (Fig. 5). Discard the socket and remove and discard the adjusting sleeve.
8. Remove the bottom socket by removing the clamps and puller jaws from the T of the puller T71T-3010-P using only the T forcing screw and step plate. Tighten the forcing screw (T71T-3010-N) to push out the bottom socket. Discard the socket (Fig. 6).

   Remove the adjusting sleeve and discard it. Use spanner wrench T71T-3010-G.
9. If the top socket did not remain in the yoke, remove it from the knuckle as in previous step (Fig. 6).

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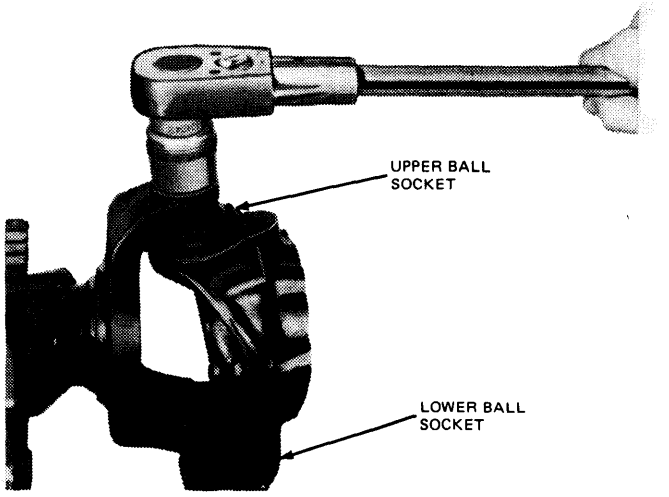


FIG. 4 Nut Removal

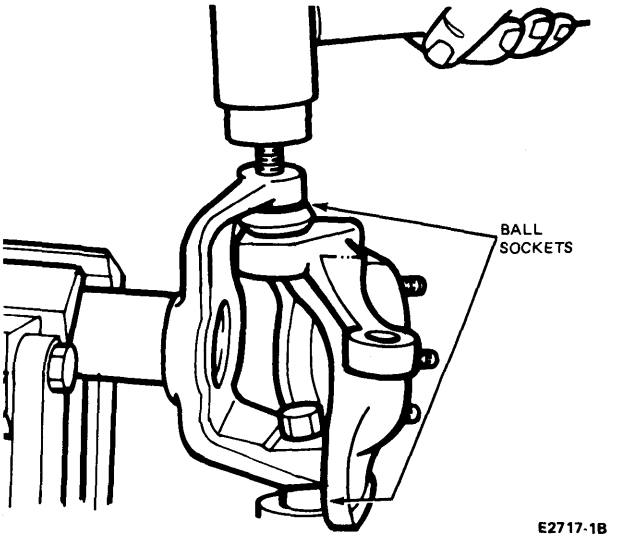


FIG. 5 Knuckle Removal

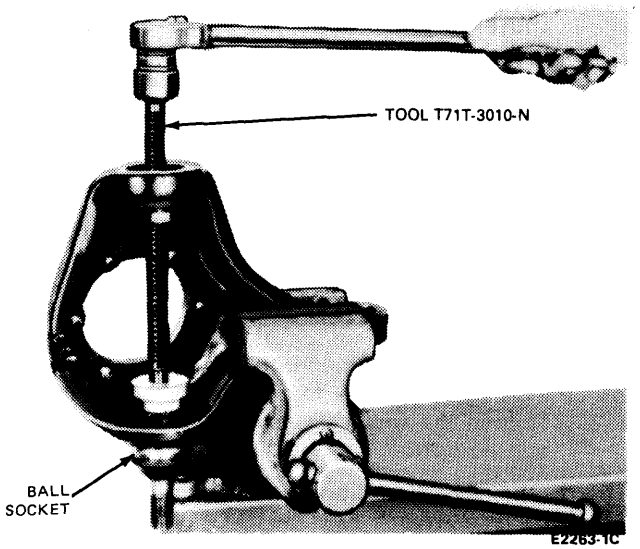


FIG. 6 Socket Removal

Installation

1. Place the knuckle in a vise and assemble the bottom socket. Place a new socket into the knuckle making sure it is not cocked; place the driver over the socket; place the forcing screw into the driver as shown. Apply torque to the screw and force the socket in the knuckle (Fig. 7).

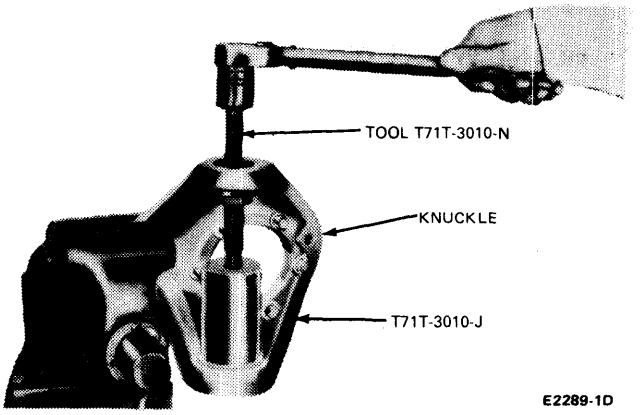


FIG. 7 Bottom Socket Installation

2. Make sure that the socket shoulder is seated against the knuckle. Use a 0.0015 feeler gauge between the socket and knuckle. The gauge is not to enter at minimum area of contact. Install the snap ring.
3. Assemble the top socket into the knuckle. Assemble the holding plate onto the backing plate screw. Tighten the nuts snugly. Place a new socket into the knuckle. Be sure that the socket is straight and not in a cocked position. Place a driver over the socket. Assemble the puller tool exactly as shown in Fig. 8.

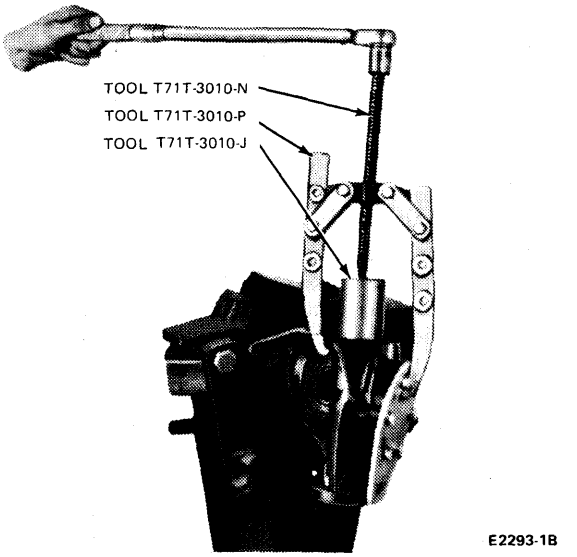


FIG. 8 Top Socket Installation

4. Make sure that the socket shoulder is seated against the knuckle. Use a 0.0015 inch feeler gauge between the socket and knuckle. The gauge is not to enter at minimum area of contact.
5. Assemble a new adjusting sleeve into the top of the yoke. Leave approximately two threads exposed. This will protect the threads in the yoke.

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6. Assemble the knuckle with the sockets to the yoke. Assemble a new nut to the bottom socket. Tighten the nut finger loose. This will serve as a holding device.
7. Place a spanner wrench and step plate over the adjusting sleeve. Locate the puller exactly as shown, and turn the forcing screw. This will pull the knuckle assembly into the yoke. With torque still applied, tighten the bottom nut on the socket. Tighten the nut to 70-90 ft-lb (Fig.9).

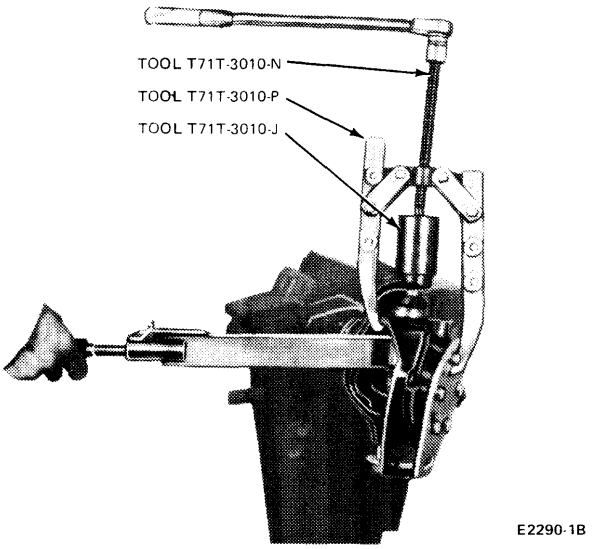


FIG. 9 Assembly of Knuckle to Yoke

If the bottom stud should turn with the nut, add more torque to the puller forcing screw. This will eliminate the turning of the stud because it should now be seated into the tapered hole of the yoke. Remove the puller, step plate, and holding plate.

8. Tighten the adjusting sleeve to 40 ft-lb, using T71T-3010-G. Remove the spanner wrench.
9. Assemble the top socket nut. Tighten it to 100 ft-lb. Line up the cotter key hole of the stud with the castellation or slot of the nut. Tighten the nut when lining it up with the hole of the stud. Do not loosen the nut. Assemble a new cotter key. Before connecting the steering linkage to the knuckle, test the turning effort. The spring scale pull should not exceed 26 pounds. If it exceeds 26 pounds, the ball joints should be replaced.
10. Connect the steering linkage to the steering knuckle. Tighten it to 50-75 ft-lbs.
11. Make sure the seal and deflector are properly installed on the axle shaft assembly (see inset on Fig. 3 for assembly sequence and position of parts). Assemble the seal on the shoulder of the deflector. Position the wheel bearing spacer, and apply a small amount of lubricant C1AZ-19590-B or equivalent to the exposed face of the spacer; then slide the axle shaft back into the housing, using care not to damage the seal.
12. Install the backing plate, lubricate the spindle using C1AZ-19590-B lubricant or equivalent (see Fig. 10), install the spindle, and tighten the retaining screws to 50-60 ft-lb.

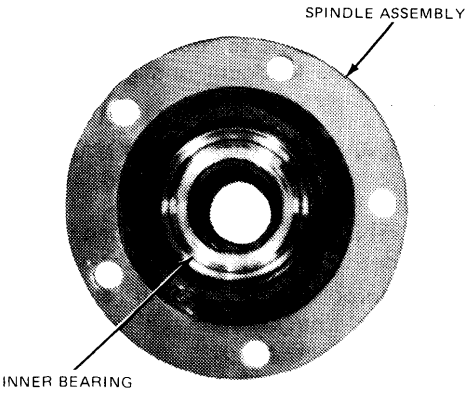


FIG. 10 Spindle Lubrication

13. Install the wheel, hub and drum as an assembly. Then install the free-running hubs (refer to Part 11-12, Wheel Hubs and Bearings—Front Wheel Drive).
14. Fill the axle with the proper grade and quantity of lubricant, as required.

DRIVE PINION OIL SEAL

The drive pinion oil seal can be replaced without removing the axle assembly from the vehicle. Compounded or synthetic rubber seals do not require soaking. Apply a light coat of axle lubricant to the seal on the shaft contact area.

Removal

1. Raise the vehicle on a hoist or raise the front end of the vehicle with a jack. Install safety stands under the frame rails and lower the jack or hoist far enough to allow the axle to drop into the rebound position for working clearance.
2. Scribe marks on the companion flanges and U-joints for correct positioning at reassembly, and remove the drive shaft.
3. Using Tool 4851-K to hold the pinion companion flange, remove the pinion shaft nut.
4. Using Tool T53T-4851-A, remove the companion flange.
5. Using Tool-1175-AB, puller, in combination with slide hammer T50T-100-A, remove the pinion oil seal.

Installation

1. Clean the drive pinion oil seal seat. Coat the seating edge of the new seal with a small amount of oil-resistant sealer. **Do not put sealer on the sealing lip.** Drive the seal into the housing, using Tool T55P-5676-A.
2. Coat the inside of the pinion flange with a small quantity of rear axle lubricant and install the flange on the pinion shaft, using Tool-4858-E.
3. Install the pinion attaching nut on the pinion shaft and tighten it to 175-225 ft-lb.
4. Position the drive shaft in the original location, matching the previously made scribe marks, and install the attaching parts.
5. Tighten the U-joint U-bolt attaching nuts to 8-15 ft-lb.

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6. Raise the vehicle, remove the safety stands, and then lower the vehicle to road position. Check the level of the axle lubricant and add the specified lubricant as necessary.

DANA FOUR-WHEEL DRIVE FRONT AXLE

Removal

1. Raise the vehicle on a hoist or jack and install safety stands under the radius arm brackets.
2. Follow the procedure detailed in Front Axle Shaft and Steering Knuckle Removal and remove the front wheels, tires, calipers, hub and rotor, dust shields, spindles and axle shafts, and brake backing plates.
3. Remove the hydraulic brake line brackets from each end of the axle without breaking the hydraulic connection. Disengage the hydraulic lines from the axle clips. Tie the lines to the frame to keep them out of the working area.
4. Disconnect the steering linkage at the knuckle connecting rod ends and tie it out of the working area. Disconnect the axle stabilizer bar.
5. Disconnect the front drive shaft at the pinion companion flange and U-joint. Secure the drive shaft out of the working area.
6. Lower the vehicle onto the safety stands and place a jack under the axle to support it while disconnecting it from the radius arms.
7. Each radius arm and cap is numbered from 1 through 100 for proper assembly, since they are manufactured as matched pairs. Remove the bolts attaching the radius arms to the radius arm caps. Remove the rubber insulators and roll the axle from under the vehicle, using the jack positioned in Step 6, above.

Installation

1. Position the front-drive axle under the vehicle, using a floor jack, and install the radius arms, insulators and caps to the axle. The numbers enscribed on each cap and arm should agree and be matched together. Tighten the attaching bolts to 50-75 ft-lbs, tightening them diagonally in pairs.
2. Raise the vehicle to working height and install the drive shaft to the pinion companion flange at the U-joint. Tighten the U-joint U-bolt nuts to specification.
3. Connect the axle stabilizer bar. Connect the steering tie rod to the steering knuckle by means of the steering connecting rod ends. Tighten the attaching nuts to 50-75 ft-lbs and install cotter pins.
4. Follow the procedure detailed in Front Axle Shaft and Steering Knuckle Installation and install the axle shafts, spindles and brake backing plates.
5. Position the hydraulic brake lines and brackets and install the retaining clips.
6. Install the front hub and rotor assemblies, calipers, wheels and tires. Adjust the front wheel bearings to specification. Install the dust cap or locking hub cap and the wheel cover on each front wheel.
7. Lower the vehicle to running position and fill the axle housing with the specified lubricant.

DISASSEMBLY AND ASSEMBLY

If the ring gear and drive pinion are to be replaced, they must be replaced in matched sets. When the new gear set is obtained, check the markings stamped on each gear (Fig. 11).

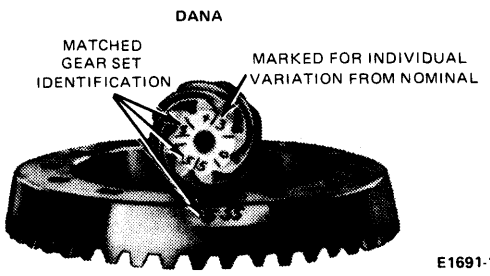


FIG. 11 Pinion and Ring Gear Markings—Dana

DISASSEMBLY

1. Remove the front drive axle from the vehicle as detailed in Dana Design Front 4-Wheel Drive Axle Removal.
2. Clean around the differential housing cover, and remove it. Discard the cover gasket. Remove the differential bearing caps.
3. Install the housing spreader and adapter (Fig. 12) making sure the tool hold-down clamp screws are tight. Spread the housing until the differential assembly can be forced out with a small pry bar. Do not spread the housing more than 0.020 inch to remove the differential assembly. Loosen the spreader thread, immediately after lifting out the differential assembly, to prevent springing the housing.

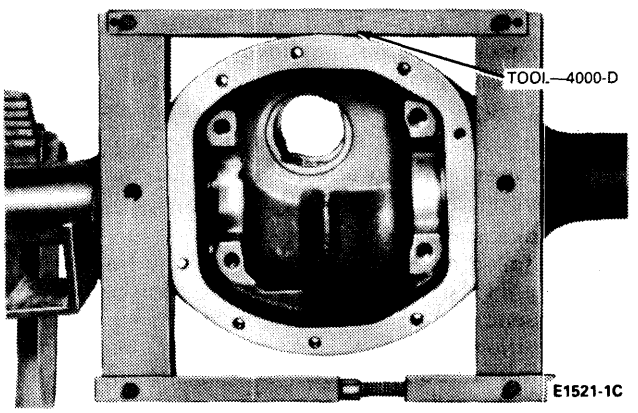


FIG. 12 Spreading Differential Housing

4. If the differential bearings are to be removed, refer to Specifications for the proper tool.

A shim pack will be found behind each differential bearing cone. These shim packs control

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differential bearing preload and pinion and ring gear backlash. When the differential bearing cones are removed, these shim packs are usually damaged by the puller jaws and should be replaced with new shims. Measure each shim pack with a micrometer, shim by shim, and write down the total thickness and location of each pack.

5. Remove the ring gear from the differential case. With two screwdrivers, remove the differential pinion shaft locking rings. Remove the side gears and thrust washers. Seals are installed in the axle housing near the differential bearings. If these seals are to be replaced, pry them from the housing with a heavy screwdriver or similar tool.

Use Tool T71T-3010-L to replace both seals at once. Position the seals in the respective bores and insert the tool, as shown in Fig. 13. Use a wrench to expand the tool until the seals are fully seated in the bores.

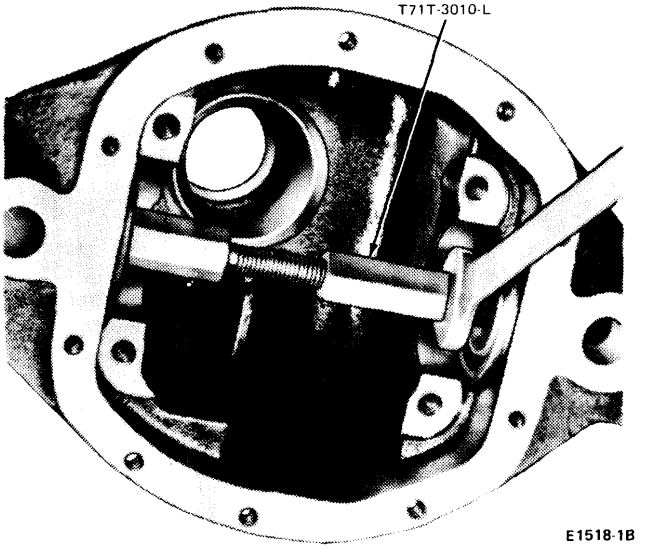


FIG. 13 Installing Inner Seals

6. Hold the pinion shaft flange and remove the pinion shaft nut. Remove the flange.
7. Tap the pinion shaft out of the front bearing cone, using a rawhide mallet.
8. Remove the pinion bearing preload shim pack from the pinion shaft or from the housing.
9. If the pinion rear bearing cone is to be replaced, use the type of tool shown in Fig. 14.
10. Attach a slide hammer puller tool to the pinion outer bearing cone and remove the bearing cone, slinger, and oil seal from the housing.
11. If the drive pinion bearing cups are to be replaced or the rear bearing cup removed from shim adjustment, refer to Specifications for the proper remover tools.
12. Clean and inspect the axle parts as detailed in Part 15-01, General Driving Axle and Driveshaft Service under Cleaning and Inspection.

ASSEMBLY

CONVENTIONAL DIFFERENTIAL

1. Install the side gears and thrust washers, differential pinions and thrust washers, and the pinion shaft in the differential case. Install the differential shaft locking pin.
2. Install the ring gear on the differential case, and tighten the attaching bolts to 45-65 ft-lbs.

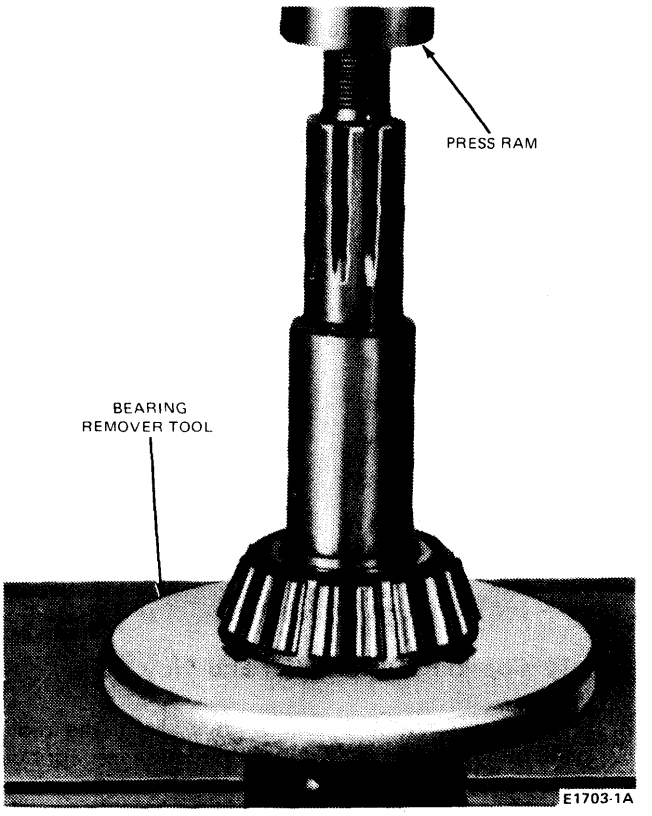


FIG. 14 Removing Pinion Bearing

DIFFERENTIAL BEARING END PLAY Measurement

1. Press the differential bearings onto the case without shims (Fig. 15). The bearings must bottom on the case shoulder.

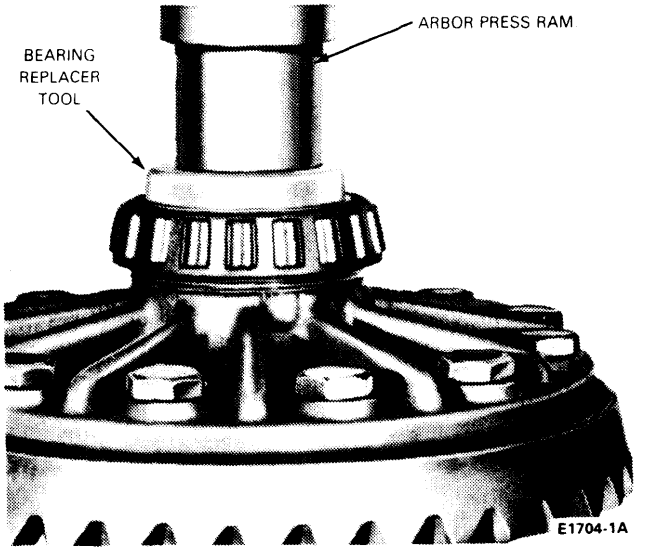


FIG. 15 Installing Differential Bearing

2. Place the cups on the differential bearings and install the assembly in the housing. Install the bearing caps and tighten the cap bolts just enough to keep the bearing caps in place.

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3. Mount a dial indicator on the axle housing, with the indicator button against the ring gear (Fig. 16).

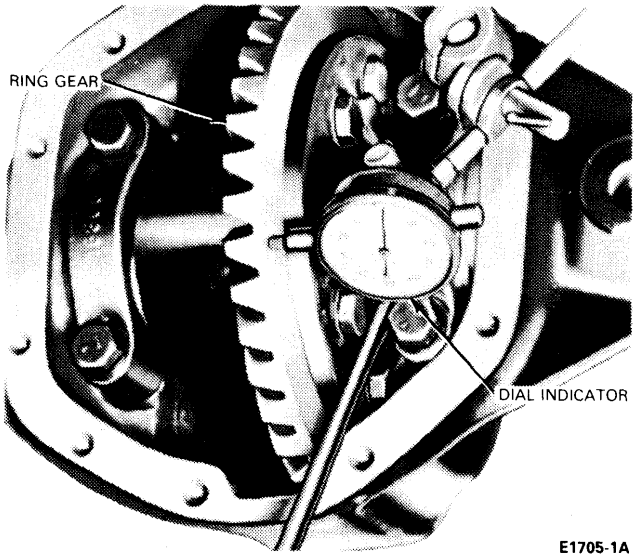


FIG. 16 Checking Differential End Play

4. Pry the differential assembly away from the dial indicator, using a screwdriver between the bearing cup and the case, and set the indicator at zero. Pry the differential assembly toward the indicator and note the indicator reading. This reading indicates the amount of shims needed behind the differential side bearings to take up the total clearance between the differential bearing cups and the case. Record this reading.
5. Remove the bearing caps and lift the differential assembly from the housing. Do not install shims under the differential bearings at this time. The total-clearance reading obtained in the above step must be integrated with a second reading to be obtained after the pinion has been installed and the pinion depth has been adjusted. The two readings are used to calculate the shim thickness necessary to obtain the proper differential bearing preload and ring gear backlash, as well as end play adjustment.

DRIVE PINION INSTALLATION AND DEPTH ADJUSTMENT

Two separate adjustments affect drive pinion and ring gear tooth contact, they are pinion depth (location) and backlash. On Dana axles, the pinion locating shim pack is installed between the drive pinion rear bearing cup and the carrier housing (Fig. 17). Therefore, adding shims moves the pinion toward the ring gear and removing shims moves the pinion away from the ring gear.

If the original gear set is being installed, install the drive pinion with the original shim pack and check the pinion location with a depth gauge.

If the ring gear and drive pinion are being replaced, note that the original factory-installed pinion locating shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the original gear set dimension. Therefore, to estimate

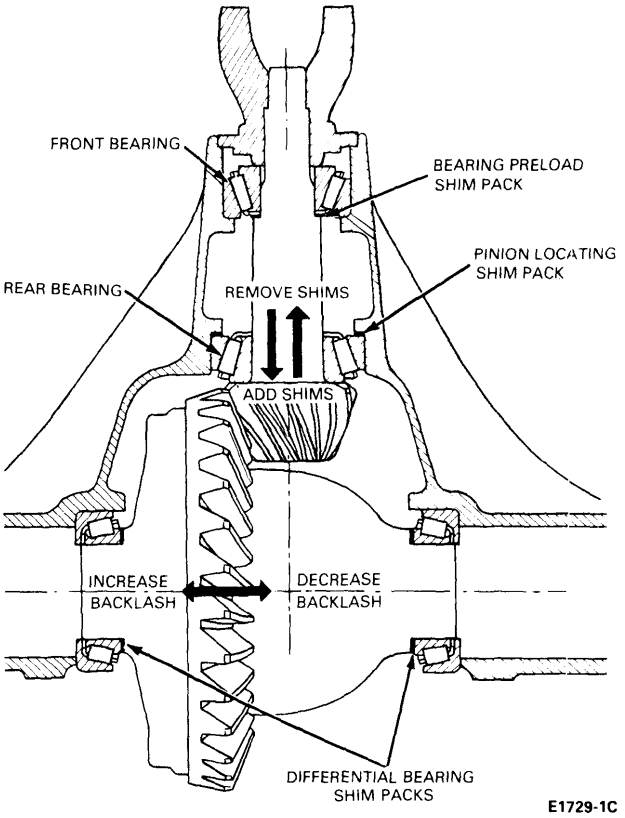


FIG. 17 Pinion and Ring Gear Tooth Contact

the correct shim thickness for the near gear set to be installed, follow these steps:

1. Measure the thickness of the original pinion locating shim with a micrometer.
2. Note the shim adjustment number on both the old pinion and the new pinion. Each drive pinion gear is marked with an adjustment number.
3. Refer to Specifications at the end of this Part, for the correct amount of shim thickness change. The amount that is shown under the new pinion shim adjustment number and in line with the old pinion number is the amount of change that should be made to the original shim thickness.

   If the old drive pinion is marked +4, for example, and the new pinion is marked-2, the table indicates that +0.006 inch of shim stock should be added to the original shim pack.

   If the original shim pack was lost or if a new axle housing is being installed, substitute a nominal 0.030 inch shim for the original, and repeat the foregoing steps for a trial buildup. If any further shim change is necessary, it will be indicated in the depth gauge check.

   A new ring gear and drive pinion should always be installed in an axle as a matched set (never separately). Be sure that the same matching number appears on both the drive pinion and the ring gear.

   Install the drive pinion with the estimated shim pack, and check the pinion location with a depth gauge as outlined in the following procedure.

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DEPTH GAUGE CHECK

1. Install the pinion locating shim pack and pinion bearing cups. Refer to Specifications for the proper tool.
2. Press the rear bearing onto the pinion shaft. Refer to Specifications for the proper tool.
3. Position the drive pinion and rear bearing assembly by inserting it from the inner side of the axle housing. Position the front bearing cone (without the preload shim pack) and the U-joint flange on the pinion shaft. Press all these parts into place under a press or with a flange replacer tool. Refer to Specifications for the proper tool.
4. Install the pinion shaft flat washer and nut, and carefully tighten the nut until pinion bearing preload is 20-40 in-lb. As the nut is tightened, rotate the pinion shaft in both directions to set the bearing rollers.
5. Check the pinion bearing preload (Fig. 18). Disregard the torque required to start the pinion rotating. The specified torque of 10 to 30 in-lb. refers to the tightening required to keep the pinion rotating after it has been started.

   With the drive pinion installed in the housing and the bearing preload within limits, check the depth setting (actual assembly dimension) with the gauge shown in Fig. 19.

   Place the gauge shaft and discs in the differential bearing pockets and securely tighten the bearing caps.
6. Attach the dial indicator to its holder and place it on the gauge block. Place the gauge block squarely on the pinion gear and squarely against the gauge shaft.
7. With the indicator button resting on the flat of the gauge block, set the dial face to read zero. Swing the indicator (Fig. 19) to the highest point on the gauge shaft and note the reading at the highest point. The highest point on the gauge shaft is the point of highest indicator reading while the indicator hand is moving clockwise. When the hand reverses and starts moving counterclockwise the highest point has been passed.

   The indicator reading at the highest point on the gauge shaft shows the actual assembly dimension with reference to the nominal assembly dimensions for this axle to be 2.625 inches. The nominal dimension is the distance from the ground surface on the pinion gear rear face to the center line of the ring gear. The highest point on the installed gauge shaft is exactly 1/2 inch higher than the ring gear centerline. The installed gauge block height is exactly 1/2 inch greater than the nominal assembly dimensions for the axle.

   When the gauge block is resting on a zero-marked pinion installed exactly at the nominal assembly dimension, the top of the gauge block and the highest point on the gauge shaft are exactly the same distance from the pinion gear rear face. In this case, the indicator, having been set at zero on the gauge block, will read zero when moved to the highest point on the gauge shaft. A plus or minus reading on the indicator at the

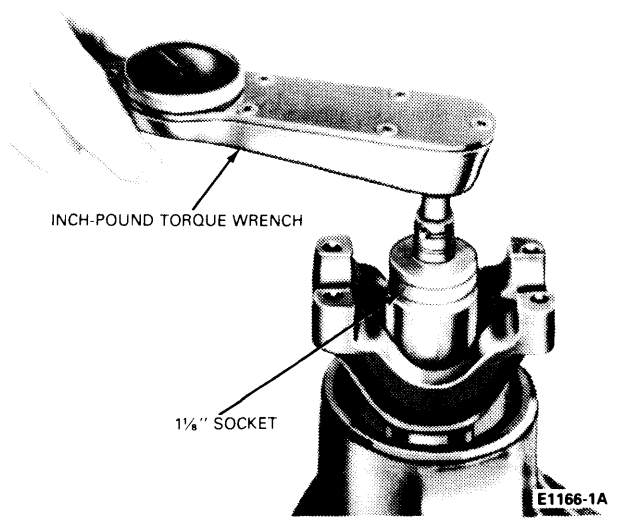


FIG. 18 Checking Pinion Bearing Preload

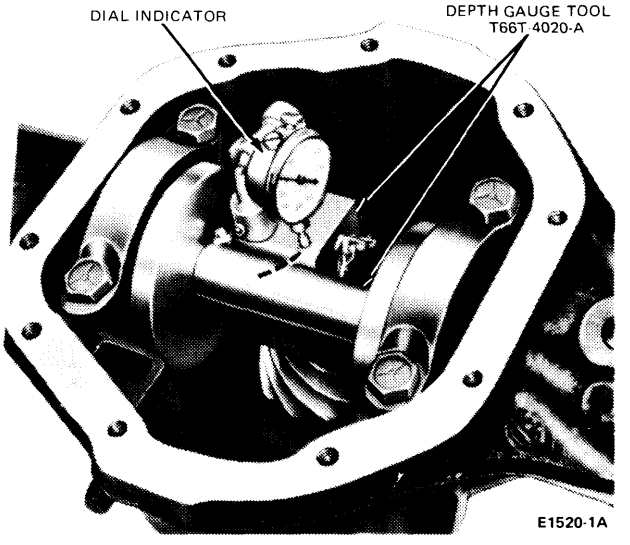


FIG. 19 Checking Pinion Depth

hightest point on the gauge shaft indicates, therefore, that the actual assembly dimension is not the same as the nominal assembly dimension. The plus and minus indicator readings are translated directly into plus and minus variations from the nominal assembly dimension.

The indicator reading at the highest point on the gauge shaft must correspond with the drive pinion gear marking, if the actual assembly dimension is correct. For example, a pinion marked minus 3 is installed at the proper depth when the indicator reads minus 3 at the highest point on the gauge shaft. Likewise, a pinion marked plus 3 is installed at the proper depth when the indicator reads plus 3 at the highest point on the gauge shaft.

A plus reading (clockwise from zero) at the highest point on the gauge shaft with a zero-marked drive pinion, means that the actual assembly dimension is too great in the amount of the plus reading. To correct, add shims in thousandths of an inch that correspond to the plus reading. For example, an indicator reading of plus

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10 with a zero marked pinion means that 0.010 inch in shims must be added to the rear bearing cup pack. The addition of shims will move the pinion gear closer to the ring gear and decrease the actual assembly dimension (Fig. 17).

Likewise a minus reading (counterclockwise from zero) at the highest point on the gauge shaft with a zero-marked pinion, means that the actual assembly dimension is deficient in the amount of the minus reading. To correct, remove shims in thousandths of an inch equal to the minus reading. This will increase the actual assembly dimension.

Whenever the drive pinion rear bearing cup shim pack is changed, install the drive pinion and recheck the pinion depth.

8. After the pinion depth has been adjusted and checked, remove the U-joint flange and front bearing. Add or subtract from the original front pinion bearing preload shim pack the same amount in thousandths of an inch that was added or subtracted from the shim pack behind the rear bearing cup (Fig. 17). Install the bearing preload shim pack, the outer bearing, the U-joint flange, washer and nut. Tighten the flange nut to 200-220 ft-lb on all models.
9. Check the pinion bearing preload (Fig. 18). The preload should be 20 to 40 in-lb. Add shims to decrease the preload and remove shims to increase the preload.

   If the original bearing preload shim pack has been lost or there is reason to believe that it was not correct, install a 0.065-inch shim pack for a trial build-up. Check the pinion bearing preload and adjust as necessary to obtain a 15-35 in-lb preload on new bearings or 10-25 in-lb on used bearings.
10. When the pinion bearing preload is correct, remove the U-joint flange. Install the oil slinger on the outer side of the front pinion bearing and install the oil seal. Refer to Fig. 13 for the proper seal installer tool.

DIFFERENTIAL BEARING PRELOAD AND RING GEAR BACKLASH ADJUSTMENT

1. Refer to the reading taken in Step 4 under Differential Bearing End Play Measurement. This reading (taken before the pinion was installed) represents the total clearance between the differential side bearing cups and the case.
2. Again install the differential assembly in the housing (this time with the pinion installed), and tighten the bearing caps lightly. Install the dial indicator with the button against the back face of the ring gear. Move the differential and ring gear assembly tightly against the drive pinion gear and then set the dial indicator to zero. Move the differential and drive gear assembly toward the indicator, and note the reading.
3. This reading indicates the amount of shims necessary to take up the clearance between the bearing cup and the case at the ring gear side of the differential assembly. Subtract this reading from the previously recorded total reading to obtain the amount of shims necessary to take up the clearance between the bearing cup and the case at the pinion side of the differential. Increase this pinion-side shim pack by an additional 0.015 to 0.020 inch in order to provide the correct bearing preload and backlash.

   Example (Fig. 20): Total clearance previously recorded . . . 0.070 inch. Less reading in foregoing Step 2 (Amount of shims necessary to take up clearance at ring gear side) . . . 0.038 inch. Shims necessary to take up clearance at pinion side . . . 0.032 inch. Plus 0.015 inch shims for preload and backlash. Total amount of shims at pinion side . . . 0.047 inch.

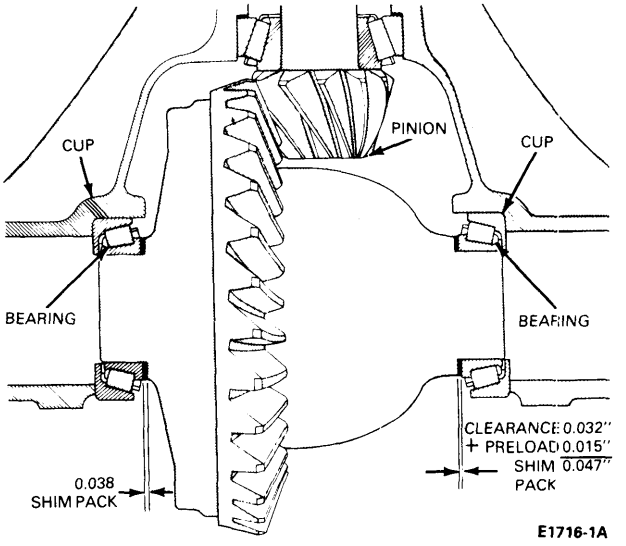


FIG. 20 Differential Bearing Preload and Ring Gear Backlash

4. Remove the differential bearing caps, and lift the differential assembly from the housing. Remove the differential side bearings, and install the proper amount of shims on each side of the differential case. Press the side bearings onto the case until they are firmly seated against the shims.
5. Install the housing spreader, spread the housing not more than 0.020 inch, and install the differential assembly. Install the bearing caps, and remove the spreader. Install and tighten the cap bolts to 70-90 ft-lbs.
6. Install a dial indicator to check the backlash at four equally spaced points around the ring gear. The backlash must be held to 0.005-0.009 inch and cannot vary more than 0.003 inch between the positions checked. If the backlash does not fall within these specifications, change the shim packs behind both differential side bearings, as required.
7. Check the gear tooth contact pattern as given in Fig. 3 in Part 15-01, General Driving Axle and Driveshaft Service under Diagnosis and Testing.
8. Position a new gasket on the rear face of the axle housing, and install the rear cover and ratio identification tag. Tighten the cap-screws to 30-40 ft-lb.
9. Install the axle in the vehicle according to the instructions under Removal and Installation.

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SPECIFICATIONS

DRIVE PINION ADJUSTING SHIM THICKNESS CHANGES DANA

Old Pinion Marking*	New Pinion Marking								
	.4	.3	.2	.1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	+0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

DANA AXLE ADJUSTMENTS

Description	Inch	Description	Scale Pull Lb
Backlash Between Ring Gear and Pinion	.005-.009	Steering knuckle Turning Effort — Tie Rod Disconnected (1 Knuckle)	26
Backlash Maximum Variation Between Teeth	.003		
Pinion Bearing Preload	15-35 in.-lbs.		

DANA AXLE TORQUE LIMITS

Description	Torque Limits (ft-lbs)	Torque Limits N•m	Description	Torque Limits (ft-lbs)	Torque Limits N•m
Pinion Shaft Nut	175-225	238-305	Ball Joint Nut — Top	110-140	150-189
Differential Bearing Cap Bolts	70-90	95-122	— Bottom	100	135
Ring Gear Attaching Bolts	45-65	62-88	Oil Filler Plug	40	54
Cover to Housing Bolts	30-40	41-54	U-Joint Bolts	8-15	11-20
Spindle Nut to Wheel Hub — Inner	50①	68	Backing Plate and Spindle to Steering Knuckle		
— Outer	50-80	68-108	Retainer Bolts	50-60	68-81

① Torque to 50 ft-lbs (00 N•m), then back off 90 degrees and rotate to closest pin hole.

CE2235-2J

SPECIAL TOOLS

Number	Description
T71T-3010-P	Puller
T71T-3010-N	Forcing Screw
T71T-3010-J	Step Plate
T71T-3010-G	Spanner Wrench
Tool 4851-K	Universal Joint Flange Holder Tool
T53T-4851-A	Companion Flange Remover
Tool 1175-AB	Pinion Oil Seal Puller
T50T-100-A	Slide Hammer
T55P-5676-A	Pinion Seal Installer
Tool 4858-E	Flange Installer
Tool 4000-D	Differential Housing Spreader
T71T-3010-L	Axle Shaft Seal and Guide Installer
T66-4020-A	Depth Gauge Tool

CE3701-1B

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Front Driving Axle — 60-7F — Dana

PART 15-32

APPLIES TO F-250 — F-350 (4x4)

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DESCRIPTION

Dana Model 60-7F front drive axle is used on the F-250H—D, 4x4 and F-350, 4x4 vehicles and has open yoke design (Figs. 1 and 2).

Other than the unique parts required for front-wheel drive, these axles are mechanically identical to Model 60 rear axles. It should be noted that the free-running hub is standard on the 4x4 vehicles with part time transfer case.

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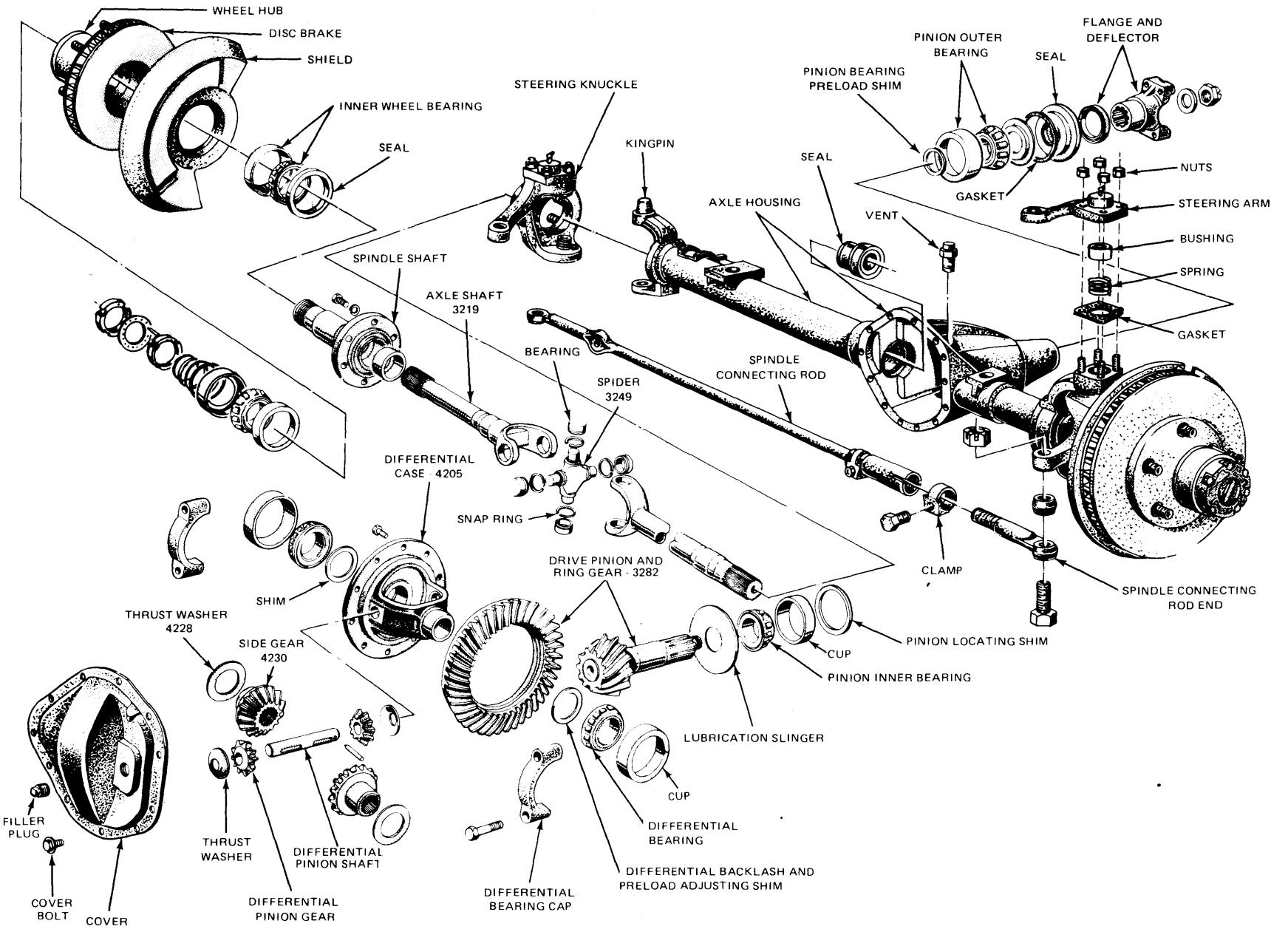


FIG. 1 Front Drive Axle—Exploded View—Dana Model 60-7F, F-250 and F-350 4x4

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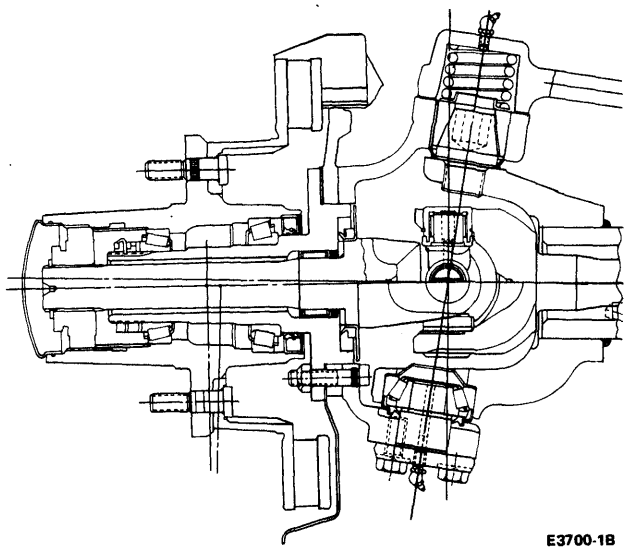


FIG. 2 Spring Loaded King Pin Assembly

DIAGNOSIS AND TESTING

Refer to Part 15-01, General Driving Axle and Driveshaft Service.

ADJUSTMENTS

FRONT WHEEL BEARING ADJUSTMENT

Refer to Part 11-12 wheel Hubs and Bearings—Front Wheel Drive for front wheel bearing adjustment procedures.

OPERATION

FRONT-WHEEL DRIVE FREE RUNNING HUB

The free-running hub is standard equipment for the Dana 60-7F front axle on F-250—F-350 (4x4) vehicles equipped with part time transfer case. It is the internal locking type.

LOCK POSITION

When the transfer case is to be shifted into the position for driving the front axle, the pointer on the center bar of the hub must point to the notch under the word LOCK on the retaining plate. If the clutch teeth do not engage with the knob turned to this position, the clutch teeth are butted and a slight movement of the wheel in either direction will complete the lock. The front axle will now drive the wheels. Do not operate in four-wheel drive with the hubs disengaged.

FREE RUNNING POSITION

When the transfer case is to be shifted into the position for driving the rear axle only, turn the pointer on the center bar of the hub so it points to the notch under the word FREE on the retaining plate. This will disengage the clutch teeth and wheel hubs from the axle shafts. The wheels will turn freely on the axles.

Be certain that the transfer case is shifted into two-wheel drive position before disengaging the free running hubs.

If difficulty is experienced in disengagement of the free running hubs, a slight movement of the vehicle in either direction with the transfer case in 2 wheel drive position, will reduce driveline wrap-up and ease disengagement.

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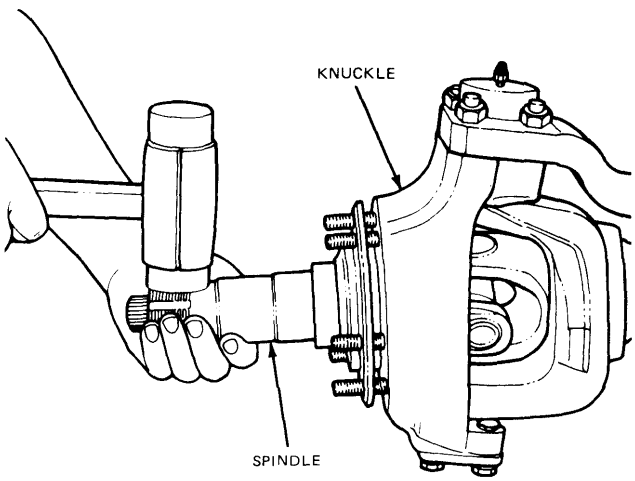
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REMOVAL AND INSTALLATION

FRONT AXLE SHAFT AND STEERING KNUCKLE

Removal

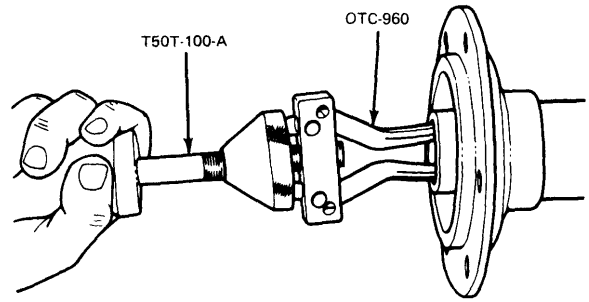
1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly.
3. Remove the caliper assembly from the rotor and hold it out of the way with wire. Refer to Caliper Removal instructions in Part 12-24, Disc Brakes—Light and Heavy Duty Sliding Caliper.
4. Remove the hub assembly as described in Part 11-12, Wheel Hubs and Bearings—Front Wheel Drive.
5. Remove the inner wheel bearing and seal.
6. Remove the nuts attaching the spindle shaft to the knuckle.
7. Remove the spindle by lightly tapping with a rawhide hammer to break the spindle loose from the knuckle (Fig. 3).



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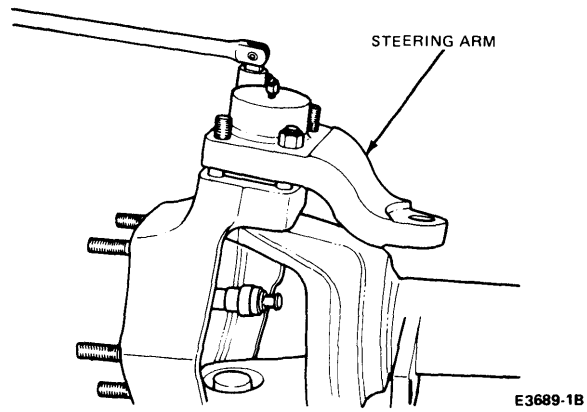
FIG. 3 Removing Spindle

8. Place the spindle in a vise and remove the needle bearing using tool OTC 960, needle bearing remover, and a five-pound slide hammer, T50T-100-A (Fig. 4).
9. Remove axle shaft joint assembly. Remove tie rod (if necessary to install new Axle Shaft "U"—joints follow the procedure in Part 15-60, Driveshaft—Single Snap Ring Type U-joint).
10. Remove four nuts on steering arm. Remove nuts alternately as compression spring will force steering arm up (Fig. 5).
11. Remove steering arm, compression spring, and gasket. Discard gasket, replace with new one at time of assembly (Fig. 6).
12. Remove four cap screws on bearing cap. Remove bearing cap.
13. Remove king pin tapered bushing and knuckle from yoke. Remove king-pin felt seal (Fig. 7).
14. Remove king-pin from steering knuckle.
15. Remove king pin bearing cup, grease retainer, and seal all at the same time. Discard seal and replace with new one at time of assembly. If grease retainer is damaged, replace with new ones at time of assembly.



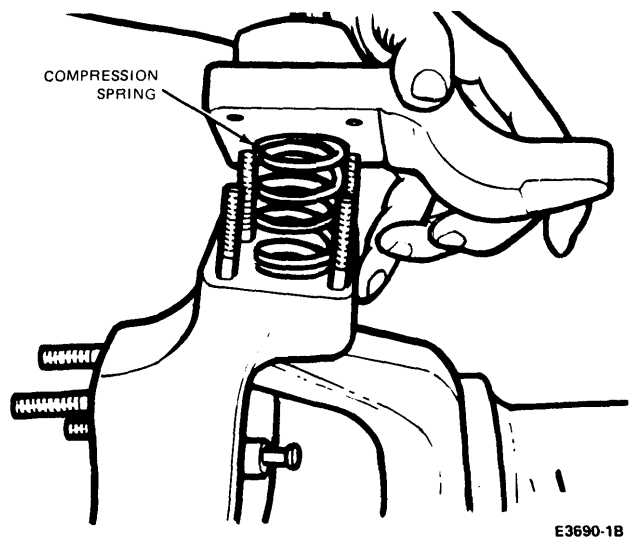
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FIG. 4 Removing Needle Bearing from Spindle



E3689-1B

FIG. 5 Removing Nuts from Steering



E3690-1B

FIG. 6 Removing Steering Arm, Compression Spring, and Gasket

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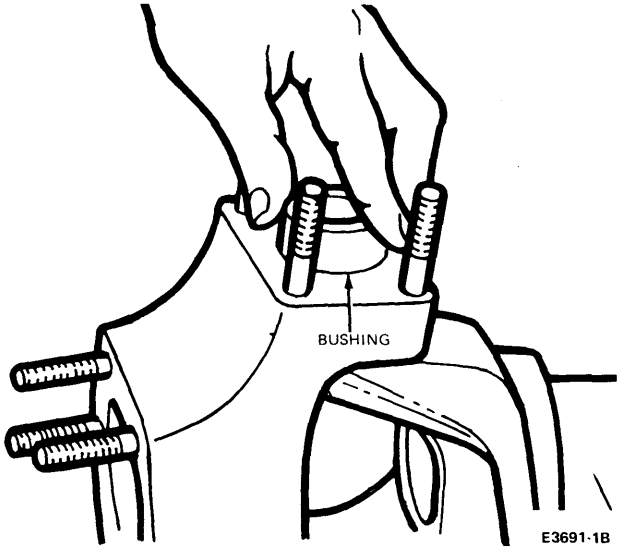


FIG. 7 Removing King Pin Tapered Bushing

Installation

1. Assemble new grease retainer and king pin bearing cup.
2. Fill the area in the grease retainer with Ford lubricant specification ESA MIC92-A or equivalent, grease the bearing cone and install. Install new king pin bearing oil seal.
3. Install king pin. Tighten king pin to 500-600 ft-lbs (Fig. 8).

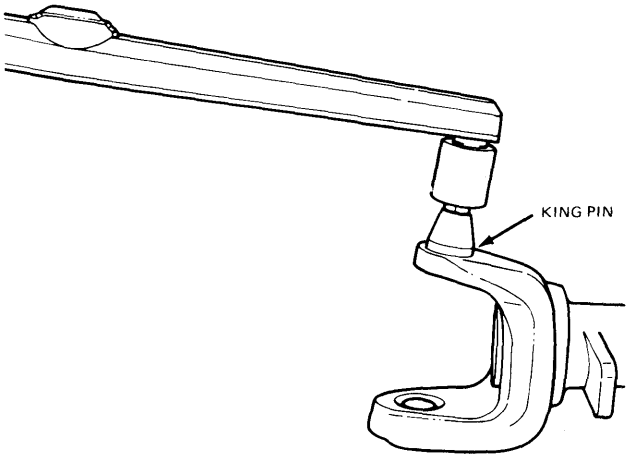


FIG. 8 Installing King Pin

4. Assemble felt seal to king pin. Assemble knuckle. Assemble tapered bushing over king pin (Fig. 9).
5. Assemble bearing with four cap screws. Tighten cap screws alternately and evenly. Tighten cap screws to 70 to 90 ft-lbs (Fig. 10).
6. Assemble compression spring on king pin bushing. Assemble steering arm, with new gasket, over four studs. Tighten nuts alternately and evenly. Tighten to 70-90 ft-lbs (Fig. 11).
7. Assemble new needle bearing into spindle.

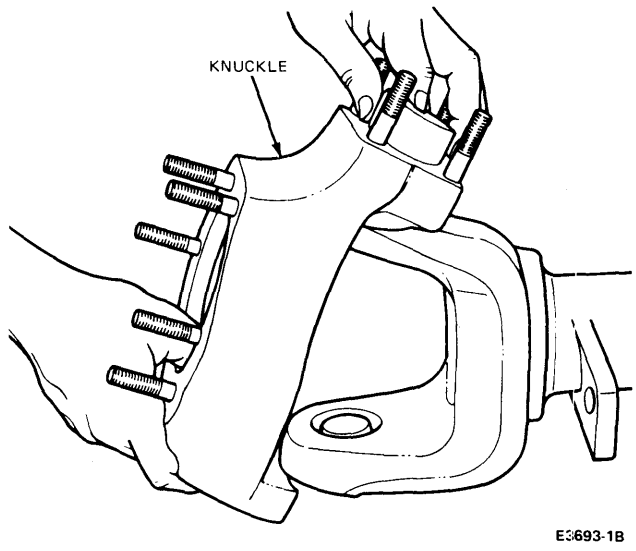


FIG. 9 Installing knuckle and Tapered Bushing Over King Pin

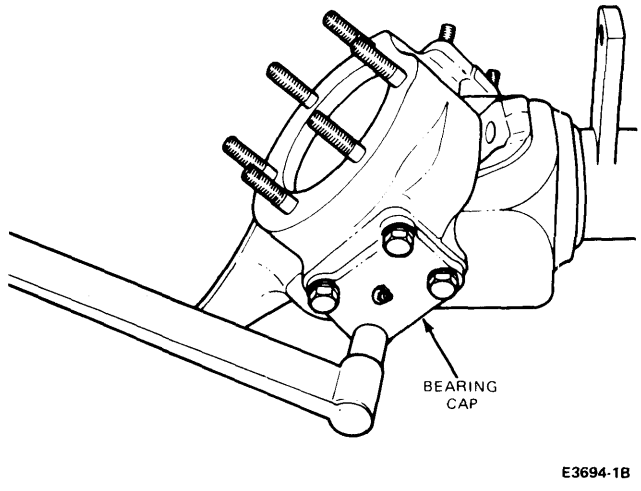


FIG. 10 Tightening the Cap Screws of the Bearing Cap

8. Some axles are equipped with a "V" seal which is assembled to the axle shaft stone shield. If seal is worn, remove and replace with a new one (Fig. 12).
9. Assemble "V" seal to axle shaft stone shield. Lip of the seal is directed towards the spindle (Fig. 13).
10. Pack the thrust face area of the shaft and seal with grease meeting Ford specification ESA-M1C92-A or equivalent. Fill the seal area of the spindle with grease meeting Ford specification ESA M1C92-A or equivalent (Fig. 14).
11. Assemble axle shaft joint assembly into housing (Fig. 15).
12. Assemble new bronze spacer and spindle.

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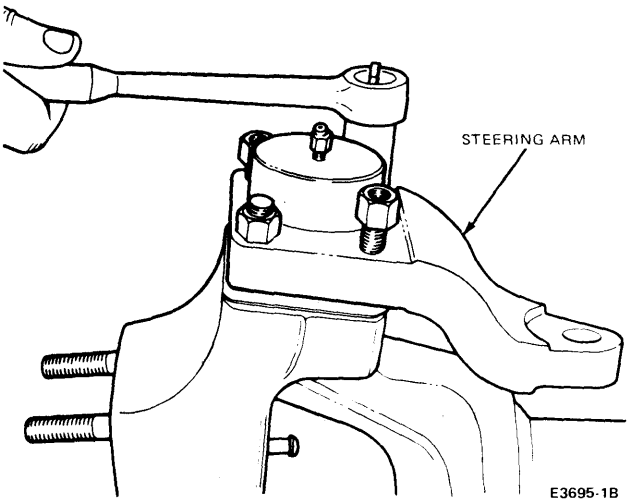


FIG. 11 Tightening Bolts on Steering Cap Over Compression Spring and Gasket

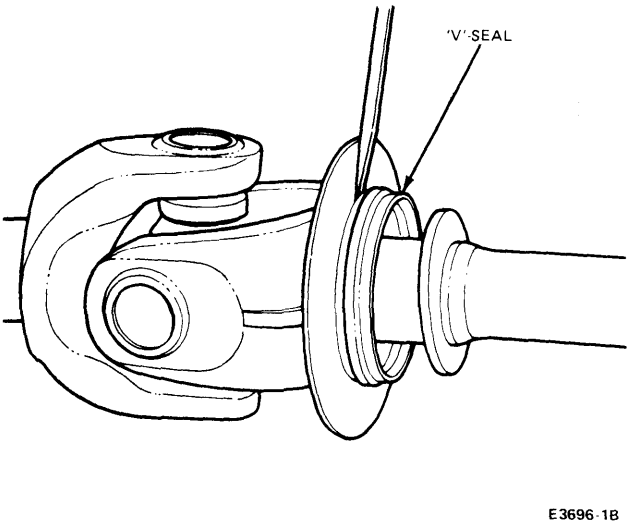


FIG. 12 Removing "V" Seal on Front Axle Shaft

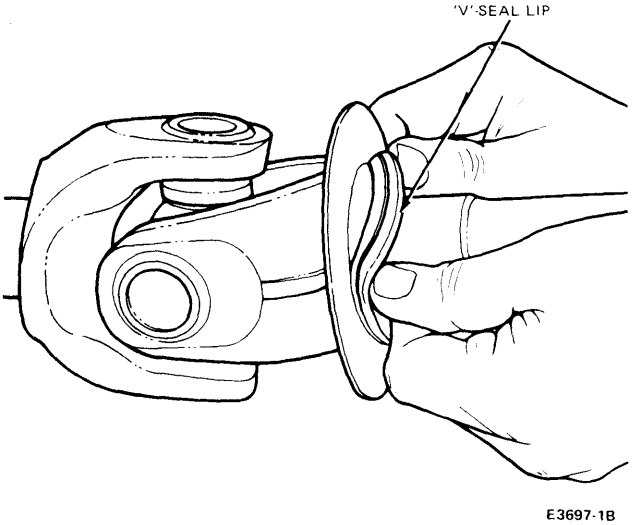


FIG. 13 Installing "V" Seal on Front Axle Shaft

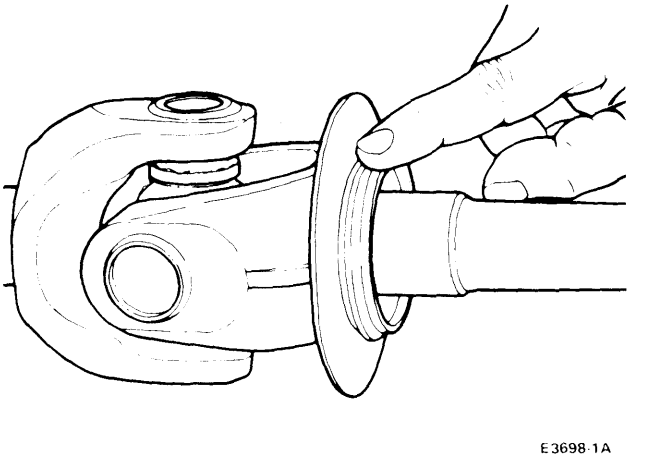


FIG. 14 Greasing Front Axle Shaft and "V" Seal

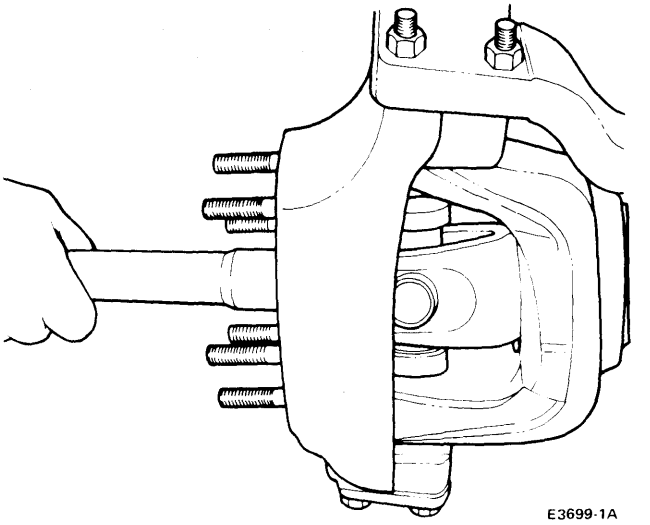


FIG. 15 Installing Front Axle Shaft

F-250 4x4 FRONT AXLE

Removal

1. Raise the vehicle on a hoist so that the vehicle weight is supported by the front axle.
2. Remove the tire and wheel assembly.
3. Remove the caliper assembly from the rotor and hold it out of the way with wire. Refer to Caliper Removal instructions Part 12-24, Disc Brakes—Light and Heavy Duty Sliding Caliper.
4. Remove the rotor and axle shaft assembly as given in Front Axle Shaft and Steering Knuckle in this Part.
5. Disconnect both front axle shock absorbers at their lower ends.
6. Disconnect the front axle drive shaft at the pinion flange.
7. Support the front axle on a transmission jack and then remove the spring clip (U-bolt) nuts and the spring seats.

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8. Lower the axle assembly and roll it from under the vehicle.

Installation

1. Roll the axle under the vehicle and raise it so that the spring clips and spring seats can be installed.
2. Connect the front axle shock absorbers.
3. Connect the front axle drive shaft.
4. Complete the assembly as given in Front Axle Shaft and Steering Knuckle Removal and Installation in this Part.

DRIVE PINION OIL SEAL

Removal

The drive pinion oil seal can be replaced without removing the axle assembly from the vehicle. Compounded or synthetic rubber seals do not require soaking.

1. Raise the vehicle on a hoist or raise the front end of the vehicle with a jack. Install safety stands under the frame rails and lower the jack or hoist far enough to allow the axle to drop into the rebound position for working clearance.
2. Scribe marks on the companion flanges and U-joints for correct position at reassembly, and remove the drive shaft.
3. Using Tool T57T-4851-B to hold the pinion companion flange, remove the pinion shaft nut.
4. Using Tool T56L-4851-C, remove the companion flange.
5. Using Tool 1175-AB, puller, in combination with slide hammer T50T-100A, remove the pinion oil seal.

Installation

1. Clean the pinion oil seal seat. Coat the sealing edge of the new seal with a small amount of oil-resistant sealer. **Do not put sealer on the sealing lip.** Drive the seal into the housing, using Tool T55P-4676-A.
2. Coat the inside of the pinion flange with a small quantity of rear axle lubricant and install the flange on the pinion shaft, using Tool-4858-B.
3. Install the pinion attaching nut on the pinion shaft and tighten it to 200-220 ft-lb.
4. Position the drive shaft in the original location, matching the previously made scribe marks, and install the attaching parts.
5. Tighten the U-joint U-bolt attaching nuts to 15-20 ft-lb.
6. Raise the vehicle, remove the safety stands and then lower the vehicle to road position. Check the level of axle lubricant and add the specified lubricant as necessary.

DISASSEMBLY AND ASSEMBLY

PINION, DRIVE GEAR AND DIFFERENTIAL REPAIR

For major repair operations, refer to procedures outlined in Part 15-05, Integral Carrier Axle—Dana and 15-30, Front Driving Axle—44-9F Dana.

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SPECIFICATIONS

DRIVE PINION ADJUSTING SHIM THICKNESS CHANGES—DANA

Old Pinion Marking	New Pinion Marking								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

DANA AXLE ADJUSTMENTS

Description	Inch	Description	Ft-Lb.
Backlash Between Ring Gear and Pinion	.004-.009	Steering Knuckle Turning Torque (Starting)	
Backlash Maximum VAriation Between Teeth	0.002		
Pinion Bearing Preload	20-40 in-lbs	446CF-HD	10-15

DANA AXLE TORQUE LIMITS

Description	Torque Limits		Description	Torque Limits	
	(ft-lbs)	N•m		(ft-lbs)	N•m
Pinion Shaft Nut	240-300	326-406	King Pin Bearing Cap Bolts	70-90	95-122
Differential Bearing Cap Bolts	70-90	95-122	Spindle Nut to Wheel Hub — Inner	50-70	68-94
Ring Gear Attaching Bolts	100-120	136-162	— Outer	50-70	68-94
Cover to Housing Bolts	30-40	41-54	Spindle to Spindle Arm Bolts	50-60	68-81
Ball Joint Nut — Upper	100	136	Oil Filter Plug	40	54
— Lower	70-90	95-122	U-Joint Plug	8-15	11-20
Back Plate/Spindle/Knuckle	50-60	68-81			

CE2402-2E

SPECIAL TOOLS

Tool	Description
OTC 960	Puller Attachment
T50T-100-A	Slide Hammer with Optional Five Pound Weight
T57T-4851-B	Pinion Companion Flange Holder
T56L-4851-C	Companion Flange Remover
Tool 1175-AB	Puller Attachment
T55P-4676-A	Seal Driver
Tool 4858-B	Flange Installation Tool

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LUBRICANT AND CAPACITY

Axle	Lubricant	Ford Specification	Capacity		
			U.S. Measure (Pints)	Imperial Measure (Pints)	Litres
Dana 60-7F ①	C6AZ-19580-B or E ①	ESW-M2C105-A①	6.0	5.0	2.8

① Or use an equivalent lubricant.

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Traction-Lok Limited-Slip Differential — Ford

PART 15-40

APPLIES TO BRONCO, E-100, E-150, F-100 (4x2), F-150 (4x2)

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	40-1	REMOVAL AND INSTALLATION	40-2
OPERATION	40-1	DISASSEMBLY AND ASSEMBLY	40-2
DIAGNOSIS AND TESTING	40-2	SPECIFICATIONS	40-6
ADJUSTMENTS	40-2		

DESCRIPTION

The Traction-Lok differential (Fig. 1) employs a multiple disc clutch to control differential action. Shim(s), which control side gear mounting distance, four steel, four friction and one composite plate (steel on one side and friction material on the other) stacked on a clutch hub, and four ear guides are housed in the differential cover. Located in the differential case between the side gears is a one-piece preload plate and block and four calibrated preload springs, which apply an initial force to the clutch pack. Additional clutch capacity is derived from the side gear thrust loads. The four friction plates are splined to the clutch hub which in turn is splined to the left axle shaft, and the eared steel plates are dogged to the case; thus, the clutch is always engaged.

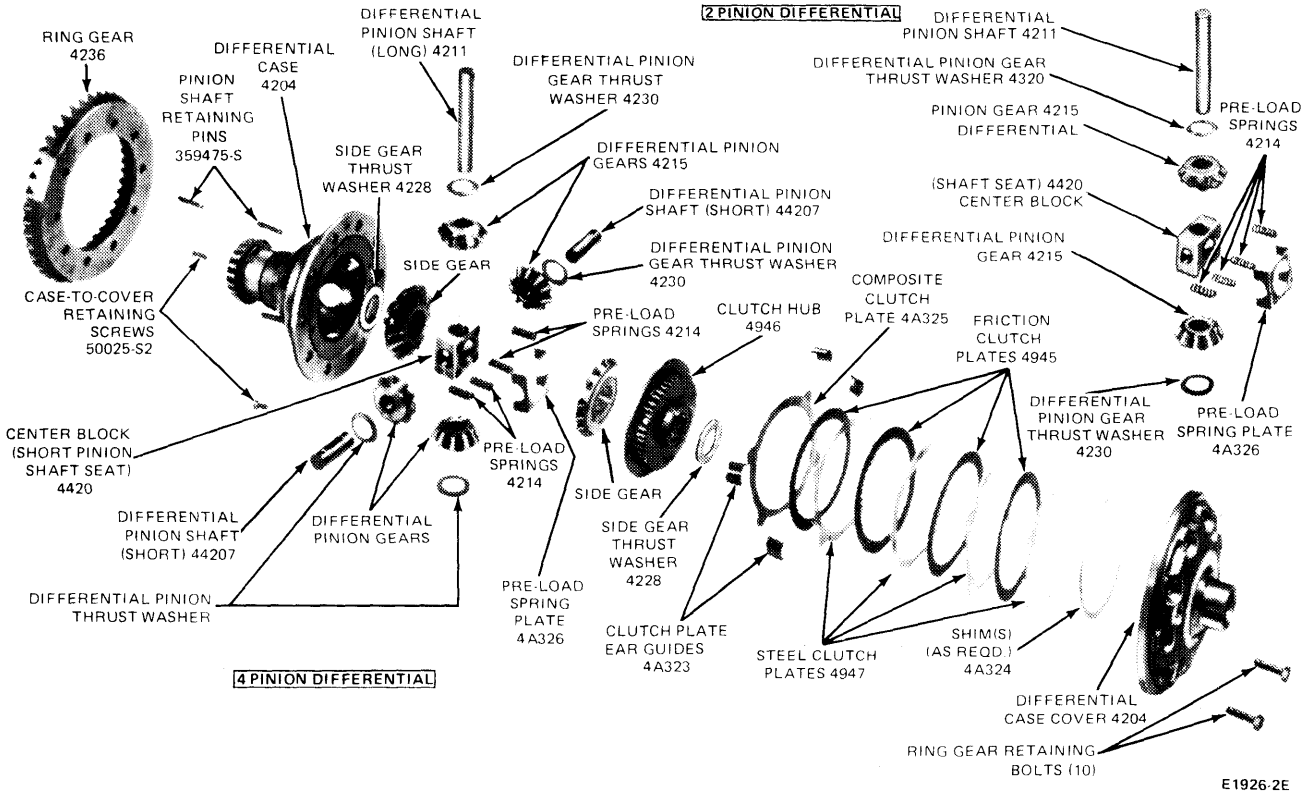


FIG. 1 Ford Traction-Lok Differential—Exploded View

OPERATION

The pressure between clutch plates opposes differential action at all times. When the vehicle turns a corner the clutch slips allowing normal differential action to take place. Under adverse weather conditions, where one or both wheels may be on a low-traction surface such as snow, ice or mud, the friction between the clutch plates will transfer a portion of the usable torque to the wheel with the most traction. Thus, the

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wheel that is on ice or snow will not spin, but will have a tendency to operate with the opposite wheel in a combined driving effort.

DIAGNOSIS AND TESTING

Refer to Part 15-01, General Driving Axle and Driveshaft Service.

ADJUSTMENTS

No in-vehicle adjustments are possible on this unit. Refer to the applicable axle section for Adjustments to the axle in which it is installed.

REMOVAL AND INSTALLATION

This differential is removed and installed in the same manner as a conventional differential. Refer to Part 15-10, Removable Carrier Axle—Ford.

DISASSEMBLY AND ASSEMBLY

Removal and installation procedures for the differential (removable carrier) are the same as for the conventional Ford axle, except in the area of the differential case disassembly and assembly which follows:

Disassembly

1. Remove the ten bolts and flat washers that secure the ring gear to the differential case assembly. The ring gear must be removed in order to separate the case halves.
2. Remove the ring gear by tapping the gear with a soft hammer or press the gear from the case.
3. Place the differential case in a press to load the case at the bearing journals so that the preload of the springs is overcome (approx. 1,500 lb). **If a press is not available, two 7/16 inch bolts and nuts can be used in the ring gear mounting holes (one on each side) to compress the case halves together and overcome preload spring tension.** Then, while the case is still under pressure, loosen the two Allen or Phillips head screws which hold the case halves together until one or two threads of the screws remain engaged. Remove the case assembly from the press. Tap on the cover to spring it loose; then, remove both screws.
4. With the cover facing downward, lift off the case. Remove the preload spring plate and four preload springs.
5. From the cover, remove the side gear, four clutch plate ear guides, clutch hub, friction and steel clutch plates and shim(s).
6. With a suitable drift, drive out the differential pinion shaft lock pins from the case.
7. With a brass drift, drive out the long pinion shaft from the case. Drive from the end opposite the lock pin hole.
8. Remove the two short differential pinion shafts. Using a drift, drive each shaft from the center outward. Lift out the center block, then remove the differential pinion gears, thrust washers and side gear and thrust washer.
9. If the differential bearings are removed, the bearings can be installed in one of the following ways:
   a. With the differential case and cover completely assembled.
   b. On the case or cover when disassembled; however, when pressing the bearing on the cover, a block of wood or fiber must be used as shown in Fig. 2 in order to avoid damage to the cover.

Assembly

When new clutch plates are used, soak the plates in Ford Hypoid Lubricant (C9AZ-19580-A) or equivalent, for approximately 30 minutes before installation.

1. **Lubricate all parts with Ford Hypoid Lubricant (C9AZ-19580-A) or equivalent during assembly.**
2. Mount the differential case in a soft jaw vise and place a side gear thrust washer and side gear in the counterbore of the case.
3. Install the differential pinion thrust washers and place the pinion gears on the side gear, aligning the holes in the washers and gears with the holes in the case.

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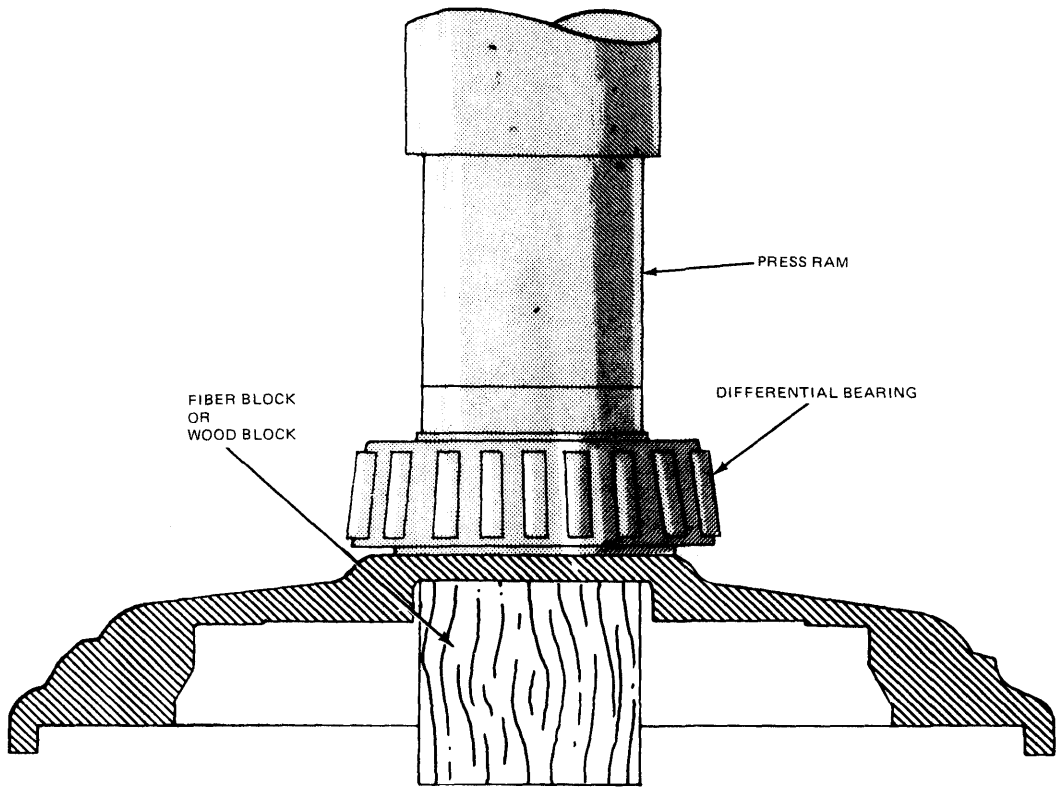


FIG. 2 Installing Differential Bearing

4. Install the center block so that the shaft holes are aligned with the holes in the pinion gears and case.

   The center block has two machined sides and two rough sides.

5. With a brass drift, drive in the long differential pinion shaft from the outside of the case aligning the lock pin holes in the shaft with the holes in the case.

   The center block should be positioned so the long shaft is driven through the rough side and the short shaft driven through the machined side (Fig. 3).

6. With a suitable drift, install the shaft lock pins. Make sure the differential pinion and side gears move freely.
7. Place the four preload springs in the holes provided in the center block.
8. Position the preload plate over the four springs, making sure the springs are properly seated. The preload plate straddles the center block over its narrower or machined width.
9. Mount the differential cover in a soft jawed vise or holding fixture.
10. Insert shim(s) of 0.050 inch total thickness in the cover cavity.
11. Install the composite plate (friction material on one side and steel on the opposite) on the back side of the clutch hub with the friction material against the hub; next, install a friction plate, then steel, friction, steel, friction, steel, friction, and lastly a steel plate (Figs. 1 and 4).
12. Place the clutch hub with the clutch plates into the clutch gear cavities in the differential cover. Make sure that the splines on the last friction plate are engaged on the hub.
13. Obtain locally a 5/8 inch x 2-1/2 inch or 9/16 inch x 2-1/2 inch bolt, nut, and two 1-1/2 inch outside diameter flat washers approximately 1/8 inch in thickness. These parts are required to compress the clutch pack in order to obtain the proper shim selection. Install a flat washer on the bolt, and place the bolt through the clutch hub. Hold the bolt in position and turn the cover over. Place a flat washer on the bolt and the install the nut. Be sure the washers are centered, and tighten the nut 10 or 15 ft-lb (Fig. 5).
14. Place the shim template tool (T68P-4946-A) in the clutch hub (Fig. 5). Some clearance should be observed between the shim tool and the cover-to-case mating surface. **Using a feeler gauge, determine the exact amount of clearance.** The shim pack thickness chart will indicate the correct amount of shim(s) to subtract from the 0.050 inch shim originally installed. **In order to correctly select the proper shim(s), the shim template tool and the chart must be used. Refer to Specifications, at the end of this Part.**
15. After the proper shim selection is determined, remove the bolt, nut and flat washers. If it is necessary to revise the shim thickness, remove the clutch hub and clutch plates.
16. Install the selected shim(s) in the cover cavity, and re-install the components as outlined in Steps 11 and 12.

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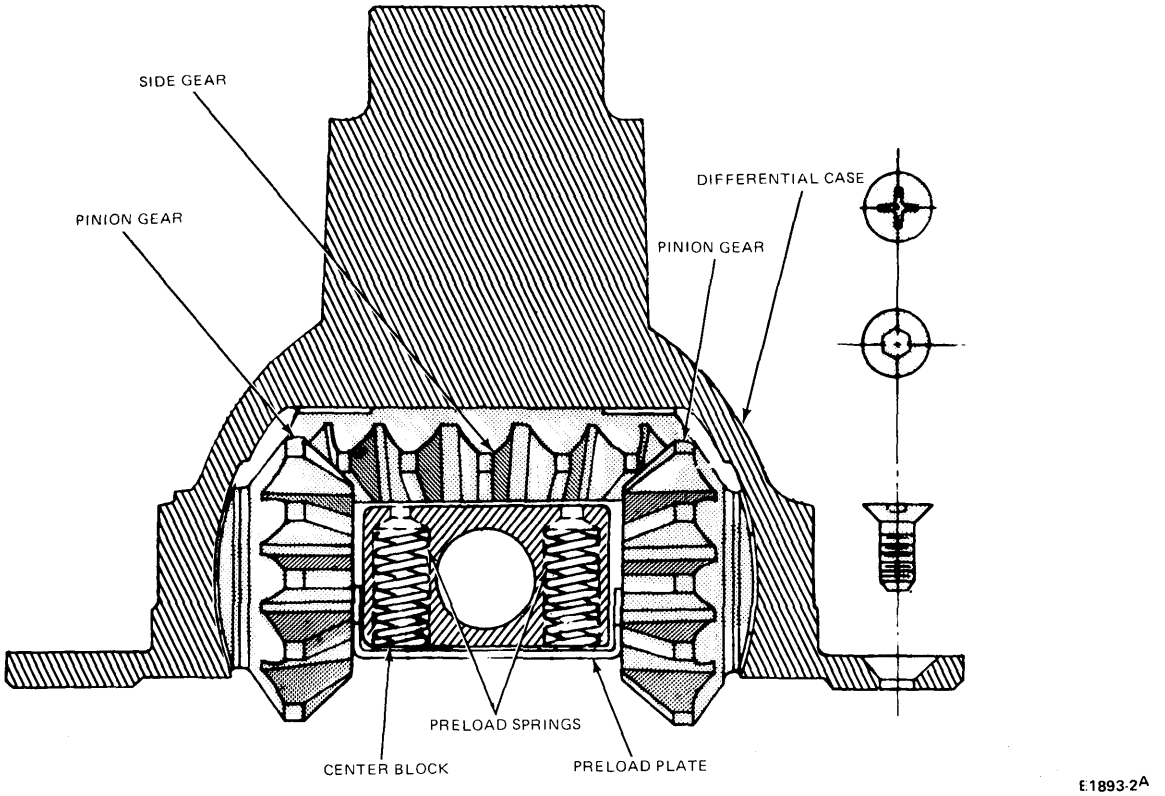


FIG. 3 Center Block and Preload Springs Installation

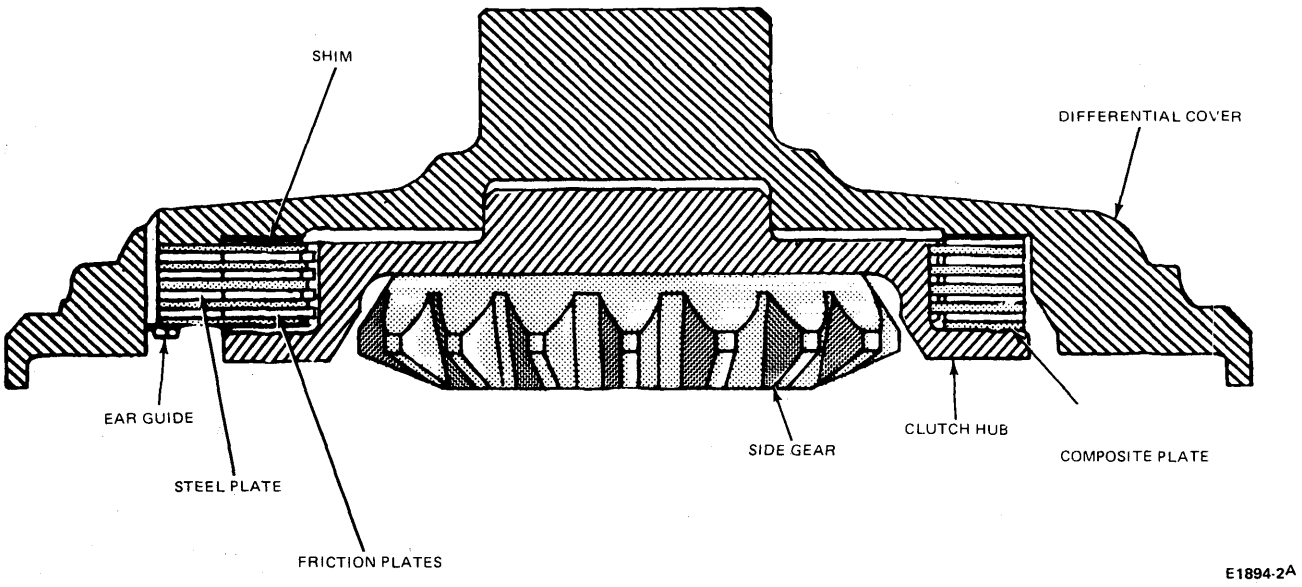


FIG. 4 Clutch Pack Installation

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17. Install the four steel clutch ear guides and side gear.
18. Place both assemblies in a press, and press the two halves together; then, insert the two Allen head or Phillips head screws, and tighten evenly until tight. If a press is not available, any two stock bolts and nuts may be used opposite each other in the ring gear retaining holes to compress both halves.
19. Install the ring gear and ring gear bolts and washers. Tighten the bolts evenly and alternately across the diameter of the ring gear. Tighten the bolts to 70-80 ft-lb.
20. Prior to installation of the torque-sensitive locking differential into a vehicle, a bench torque check must be made. With currently released locker tools, check the torque required to rotate one side gear while the other is held stationary. The initial breakaway torque may exceed 250 ft-lb. The rotating torque required to keep the side gear turning with new clutch plates is 100 to 250 ft-lb. With reused clutch plates, the minimum torque required is 40 ft-lb. (The torque may fluctuate 10-40 ft-lb)

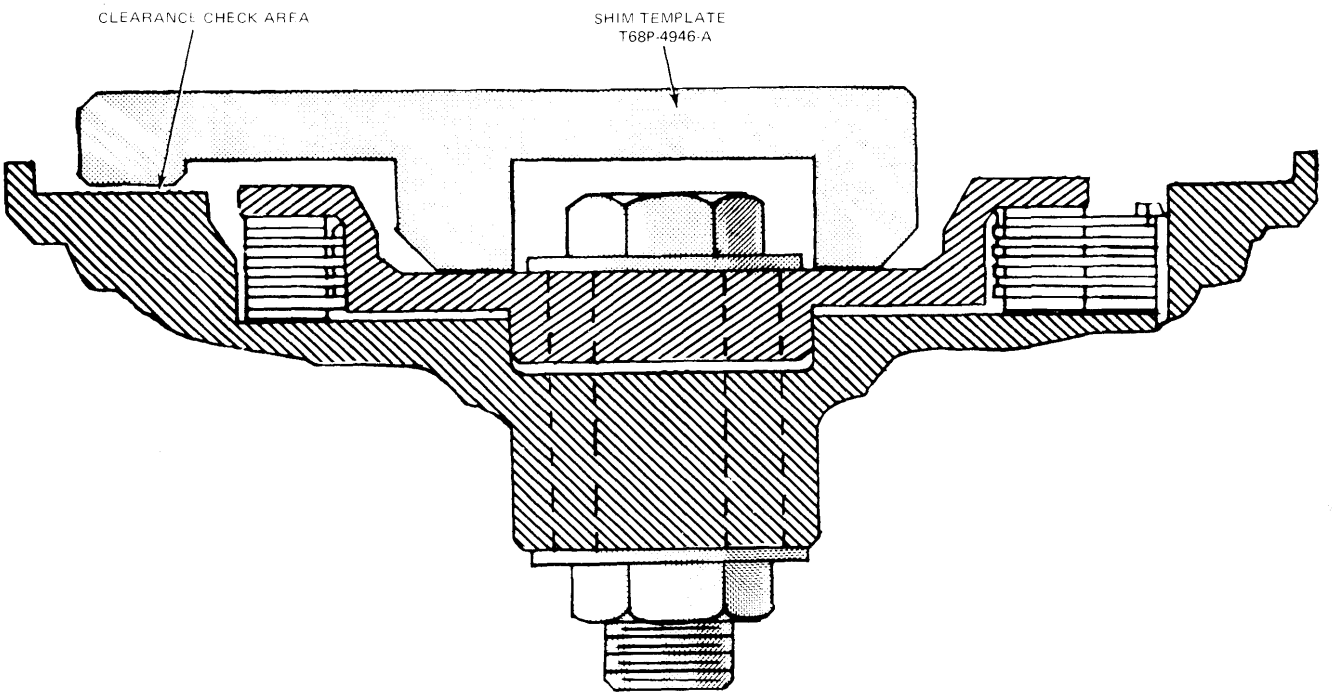


FIG. 5 Shim Template Tool Application

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SPECIFICATIONS

TRACTION-LOK DIFFERENTIAL SHIM PACK THICKNESS CHART

Feeler Gauge Reading (Inches) (1)	Remove Shim(s) From Normal	Total Req'd. Shim Pack Thickness (Inches) (2)	Feeler Gauge Reading (Inches) (1)	Remove Shim(s) From Nominal	Total Req'd. Shim Pack Thickness (Inches) (2)
0.001-0.002	None	0.050	0.028-0.032	0.030	0.020
0.003-0.007	0.005	0.0045	0.033-0.037	0.035	0.015
0.008-0.012	0.010-	0.040	0.038-0.042	0.040	0.010
0.013-0.017	0.015	0.035	0.043-0.047	0.045	0.005
0.018-0.022	0.020	0.030	0.048-0.050	0.050	0.000
0.023-0.027	0.025	0.025			

(1) With clutch hub, shims and clutch plates compressed 10-15 ft. lb.

(2) Service shims are available in 0.010 inch and 0.005 inch thicknesses.

FORD REAR AXLE RATIOS GEAR AND CODE IDENTIFICATION

Identification Tag	Ratio	Ring Gear Dia. (Inches)	Diff. Type
WFE-AW	3.50:1	9	T4
WFE-AX	4.11:1	9	T4
WFE-AU	3.25:1	9	T4
WFE-AV	3.25:1	9	T4
WFT-L	2.75:1	9	T4
WFT-M	3.25:1	9	T4

Type T4 — Traction-Lok 4-Pinion

SPECIAL TOOLS

Tool No.	Description
T59L-4204-A	Locking Differential Torque Check
T66L-4204-A	Locking Diferential Torque Check
T68P-4946-A	Locking Differential Gauge

CE2432-2E

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Limited-Slip Differential — Dana

PART 15-42

APPLIES TO E-250, E-350, F-250, F-350

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DIAGNOSIS AND TESTING	42-3
REMOVAL AND INSTALLATION	42-3
DISASSEMBLY AND ASSEMBLY	
Dana Limited-Slip Axles	
Model 60 (2-Pinion)	42-4
Model 70 (4-Pinion)	42-6
SPECIFICATIONS	42-9

DESCRIPTION AND OPERATION

The limited-slip Dana Trac-Lok Model 60 two pinion axle (Fig. 1) and the four pinion Dana Power-Lok Model 70 (Figs. 2 and 4) have a power flow identical to the conventional rear axle, plus a more direct power flow which automatically takes effect as driving conditions demand. This more direct power flow is from the differential case to each axle shaft through clutches (Fig. 3).

A conventional differential transmits all of the ring gear torque through the differential gears to the axle shafts. Torque is at all times equal on the axle shafts, and if one wheel slips, the other wheel can only put out as much torque as the slipping wheel. The limited-slip differential is similar, except that part of the torque from the ring gear is transmitted through clutch packs between the side gears and differential case. The multiple disc clutches with radial grooves on the plates and concentric grooves on the discs are engaged by a preload from Belleville springs, plus separating forces from the side gears, as torque is applied through the ring gear.

Each clutch plate and disc pack consists of steel plates, set between the case and the side gear ring. The clutch plates, having external lugs, are locked to the differential case by the external lugs. The clutch plate that is installed next to the case is a Belleville spring plate. This plate is installed with the concave (dished) side against the case. The remaining clutch discs have internal spline teeth which lock to the splined hub on the side gear ring. The side gear ring is, in turn, splined to the axle shaft and acts as a pressure plate against the clutch pack. Since the side gear ring fits against the pinions on the cross shaft (mate shaft), any outward force exerted by the mate shaft and its pinions will press the ring against the clutch pack and thus connect the differential case directly to the axle shaft.

Unlike the cross shafts of the conventional unit the 4 pinion limited-slip differential mate shafts are not

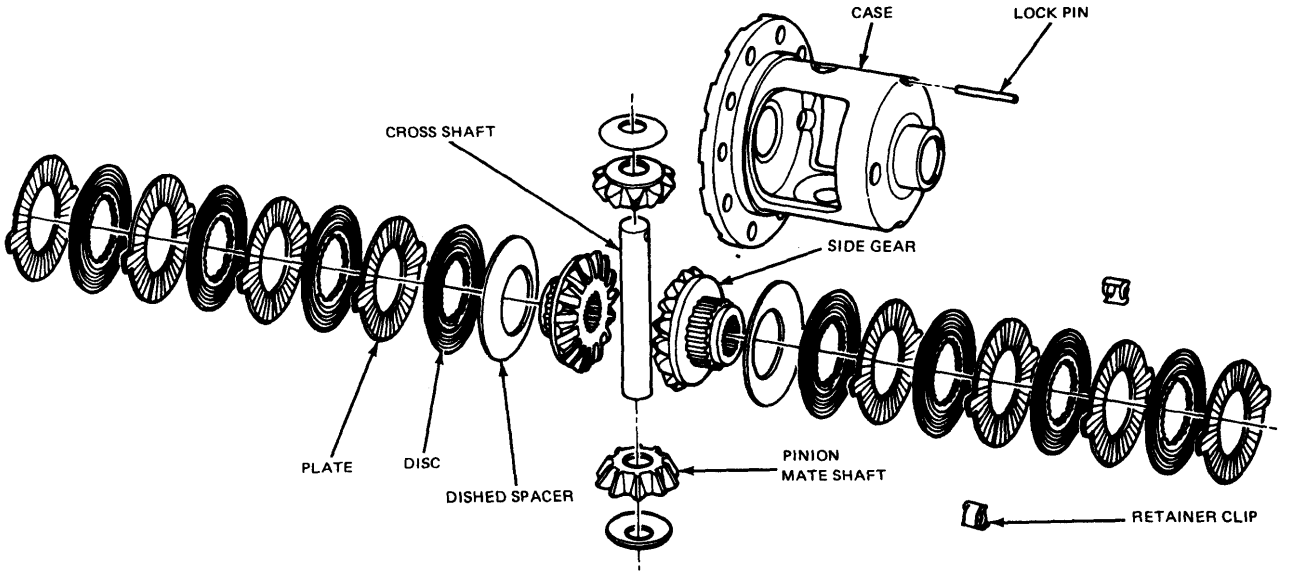


FIG. 1 Two Pinion Limited-Slip Differential—Model 60 Trac Lok

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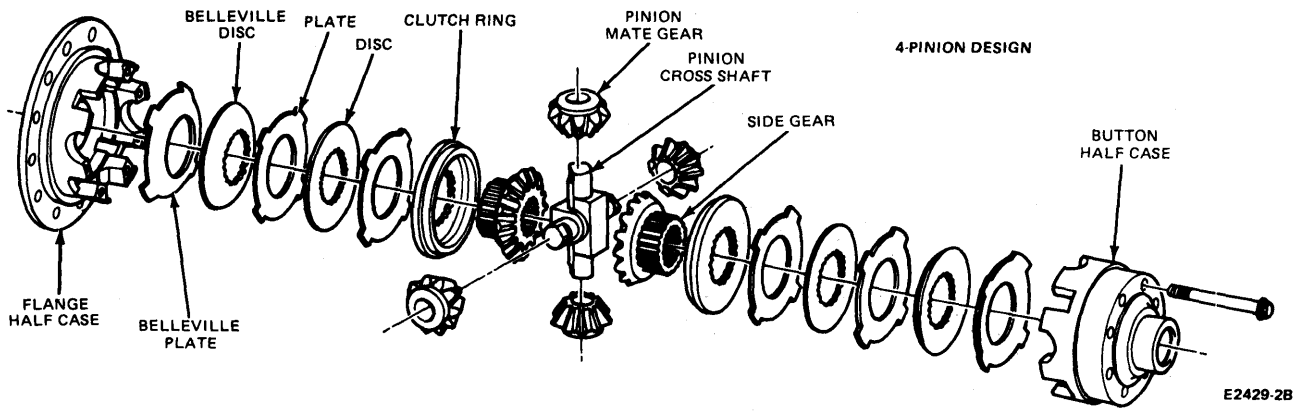


FIG. 2 Four Pinion Limited-Slip Differential—Model 70 Power Lok

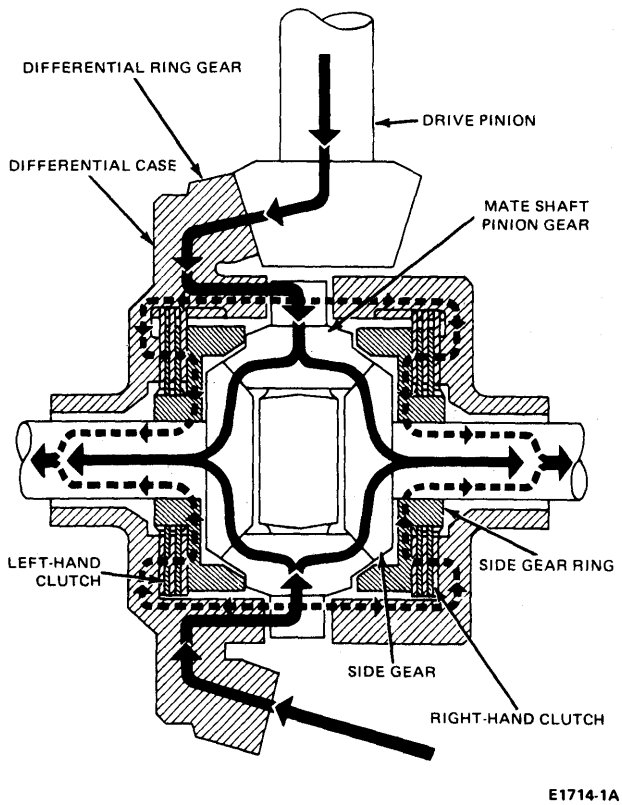


FIG. 3 Limited-Slip Differential Power Flow with Both Wheels Driving

rigidly attached to the differential case, nor are they attached to each other. At both ends of the mate shafts there are two flat surfaces so arranged that they form a V which mates with corresponding V-shaped surfaces (ramps) cut in the shaft openings of the differential case. The mate shafts are assembled in the case with enough clearance so that when the case tries to rotate the mate shafts and the mate shafts resist rotation, they will be forced to bear against one side of their V ramps. Since the two V ramps of one mate shaft point in a direction opposite to that of the two V ramps of the other mate shaft, the two shafts with their pinions will be forced apart as they resist rotation. This mate shaft movement compresses the clutch pack through the pinion gears and side gear rings.

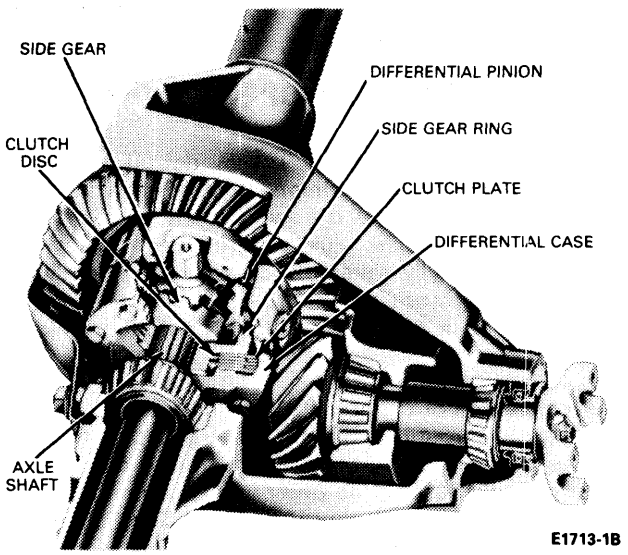


FIG. 4 Limited-Slip Differential—Model 70

When the differential case rotates in the opposite direction, the mate shafts will be forced to bear against the opposite side of their V ramps and will again be forced apart to apply against the clutch packs.

Therefore, since the ramps are V shaped, the clutches will apply during either forward or reverse operation. Likewise, the clutches will apply whether the power flow is from the differential case to the axle shafts, or from the axle shaft to the differential case.

The amount of compression on the clutch plates will be proportionate to the load applied to the differential case and the resistance to turning offered by each mate shaft. For example, if the vehicle is driven straight ahead and the traction or load on both wheels is equal, both mate shafts will give equal resistance to the rotating differential case and will thus bear against their respective ramps with equal force. This equal movement of the mate shafts will cause them to exert equal pressure against both right and left clutch packs. Both axle shafts will, therefore, be locked directly to the case with equal force. Fig. 3 shows a cutaway view of a Model 70 axle assembly.

The limited-slip differential prevents momentary spinning of one of the wheels when it leaves the road

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because of a bump, or encounters poor traction because of a slippery road. Under these conditions, even though the traction load is relieved on the one wheel, the acceleration load is simultaneously applied to the differential case as the engine tries to spin the wheel.

When the rear axle is in a turn, the appropriate clutch releases automatically to allow normal differential operation as required. In the straight-ahead position, the differential case is driving both wheels and thus applies an equal load against both mate shafts. Since both mate shafts offer resistance to this load, both clutches are applied. On a turn, however, the outside wheel turns faster than the inside wheel. The outside wheel, instead of being driven by the case, now tends to drive the case. With the power thus relieved, the differential case releases its load against the outside wheel mate shaft which, in turn, releases its pressure against the outside wheel clutch pack. With the clutch released, normal differential action will take effect.

For a complete understanding of limited-slip operation, it is important to recognize two things:

1. If with equal traction, both wheels slip, the axle has done all it can do.
2. In extreme cases of differences of traction, the wheel with the least traction may spin after the axle has transferred as much torque as possible to the non-slipping wheel.

DIAGNOSIS AND TESTING

If noises or roughness, such as chatter are present in turning corners, the probable cause is incorrect or contaminated lubricant.

Before any differential is removed and dissassembled for chatter complaints, the correctness of lubricant can and should be determined.

Refill the axle with the specified quantity of ESW-M2C105-A or equivalent and add four ounces of EST-M2C118-A or equivalent friction modifier for rear axles and two ounces of EST-M2C118-A or equivalent friction modifier for front drive axles. Warm the axle up and recheck for chatter by making a minimum of ten figure-eight type turns.

If this is unsuccessful, a complete lubricant drain, flush and refill will usually correct chatter. The following procedure is recommended to ensure flushing the system of old lubricant.

1. Warm the lubricant by vehicle road operation or five minutes of operation in gear with both rear wheels off the ground on a hoist. Caution: Never place the transmission in gear with the engine running when only one wheel of a limited slip differential equipped vehicle is raised. The vehicle might drive itself off the jack and cause damage or injury.
2. Drain lubricant while warm. Remove drain plug or cover plate to drain completely. If cover plate is removed, it may be necessary to replace gasket at this time.
3. Refill axle with specified lubricant.
4. Operate the vehicle for approximately ten miles, making at least ten figure eight turns to flush the old lubricant out of the clutch packs.
5. Repeat steps 2, 3 and 4, making sure to replace cover gasket, if required, in Step 2.
6. It is possible that a slight chatter, requiring additional vehicle operation may remain after Step 5. If chatter still persists after one hundred miles of operation, or remains severe after Step 5 above, disassembly and repair will be necessary.

For further diagnostic and testing procedures refer to Part 15-01, General Driving Axle and Driveshaft Service.

REMOVAL AND INSTALLATION

For Dana Models 60, or 70 limited-slip differential rear axle Removal and Installation procedures, refer to Part 15-05 Integral Carrier Axle-Dana.

DISASSEMBLY AND ASSEMBLY

DANA LIMITED-SLIP AXLES

Service procedures for the Dana Model 60, and 70 axles with limited-slip differentials are covered separately in this Section.

The Dana limited-slip differential assembly is removed and installed in exactly the same manner as the conventional differential assembly. For these service procedures refer to Part 15-05 Integral Carrier Axle-Dana. EST-M2C118-A or equivalent (friction modifier) is the only authorized additive which may be used with these axles.

When axle lubricant has been drained for front or rear axle repair (limited-slip only), refill the axle with the specified quantity of ESW-M2C105-A or equivalent and add four ounces of EST-M2C118-A or equivalent friction modifier for rear axles and two ounces of EST-

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M2C118-A or equivalent friction modifier for front-drive axles.

MODEL 60—2 PINION

Disassembly

The differential bearings need not be removed to overhaul the limited-slip differential.

To remove and install the side gears, washers and clutch packs during disassembly and assembly requires special procedures and tooling.

For Model 60 use Kit T71T-4205-A (part of the 1971 Essential Kit, TKIT-1971-F, FX or equivalent and also available separately).

An axle shaft placed in a vise, with the splines extending above the jaws of the vise not more than three inches, makes an excellent holding fixture after the case has been removed from the housing.

1. Using a small drift, remove the roll pin retaining the cross pin.
2. Remove the cross pin with a hammer and drift (Fig. 5).

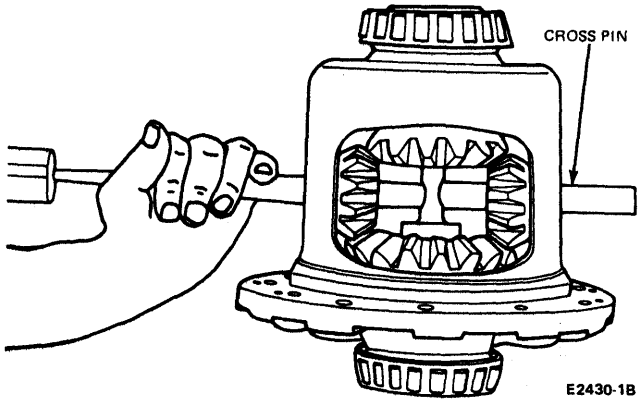


FIG. 5 Removing Cross Pin

3. Position the step plate into the bottom side gear (Fig. 6). Apply grease to the centering hole of the step plate.
4. Position the gear rotating tool into the top side gear (Fig. 7).
5. Lubricate the threads of the forcing screw and thread it into the gear rotating tool. Guide the forcing screw into the step plate (Fig. 8).
6. Tighten the forcing screw tightly. This will move the side gears away from the differential pinion gears, and relieve the normal loaded condition. Using a piece of 0.030 inch thick shim or gauge stock, push out the differential spherical washers (Fig. 9).
7. Momentarily, loosen the forcing screw. This step is very important to relieve the pressure of the clutch pack.
8. Re-tighten the forcing screw until a very slight movement of the differential pinion gears is seen.
9. Slide the pawl of the gear rotating tool (Fig. 10) between two of the side gear teeth. Pull the handle so the top side gear will rotate and also allow the differential pinion gears to rotate. Continue this until the differential pinion gears can be removed through the large openings in the case. When attempting to rotate the side gear, some tightening or loosening of the forcing screw will probably be required to permit the gear movement.
10. Retain the top side gear and clutch pack in the case with the hand and remove the forcing screw. Continue to hold the side gear and clutch pack and remove the gear rotating tool (Fig. 11). Remove the

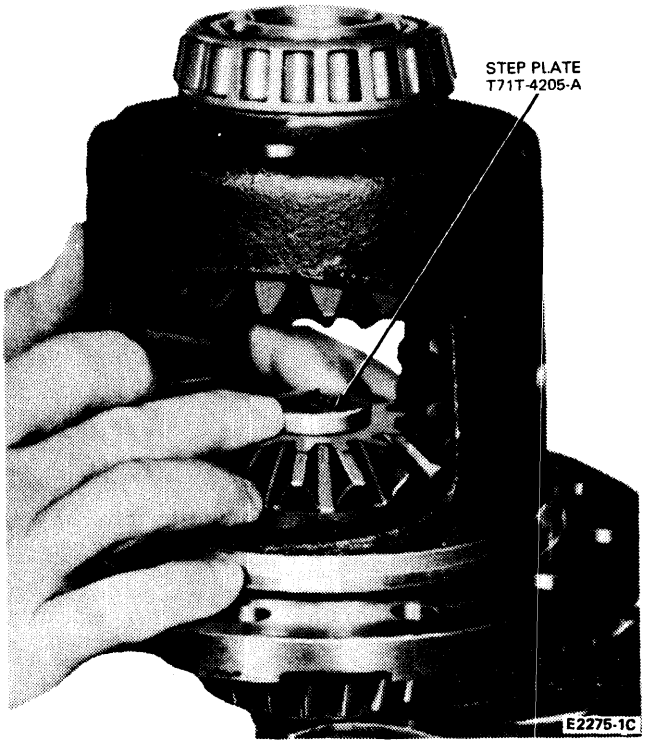


FIG. 6 Step Plate in Position

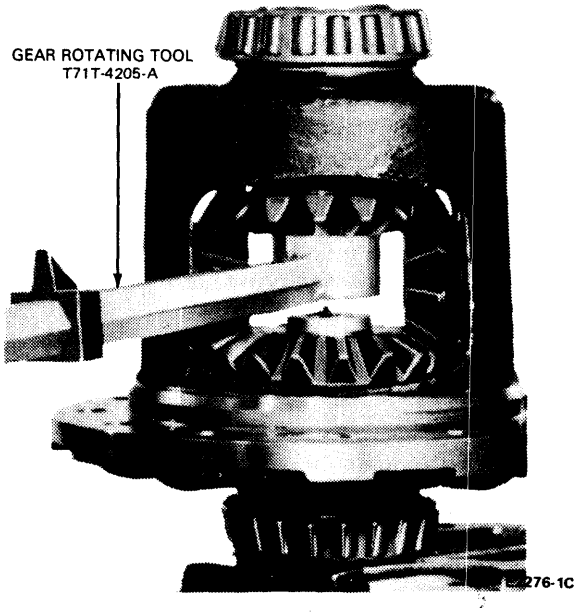


FIG. 7 Gear Rotating Tool in Position

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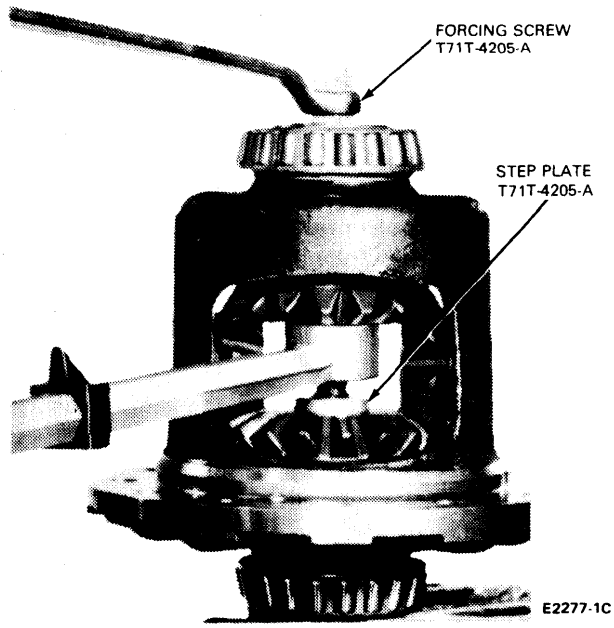


FIG. 8 Guiding Forcing Screw into Step Plate

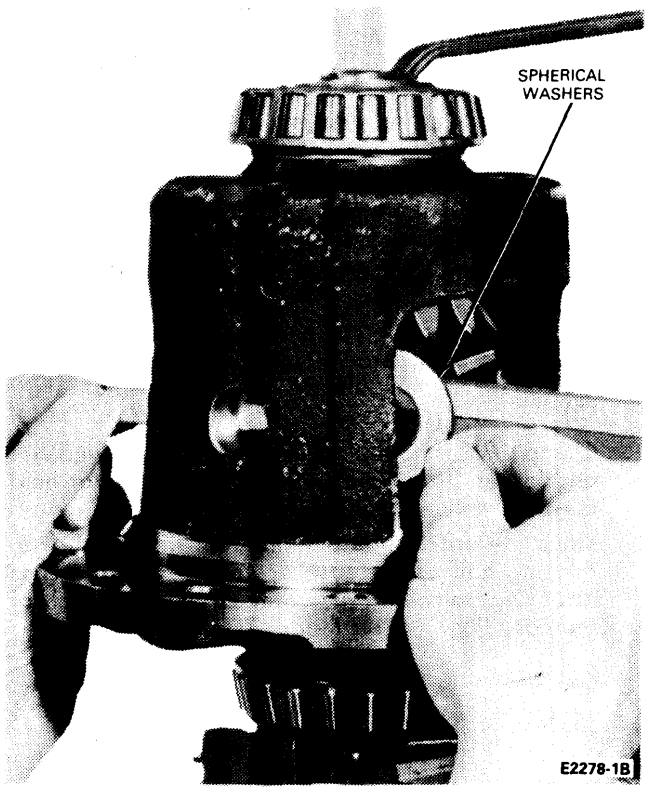


FIG. 9 Removing Spherical Washers

top side gear and clutch pack. Keep the stack of plates and discs in exact order.

11. Turn this case so the flange, or ring gear side is up. As this is done, ease the step plate, side gear and clutch pack out of the case.
12. Remove the retainer clips from both clutch packs to allow separation of the discs and plates for cleaning and inspection. **Be sure to keep them in the exact order (Fig. 12).**

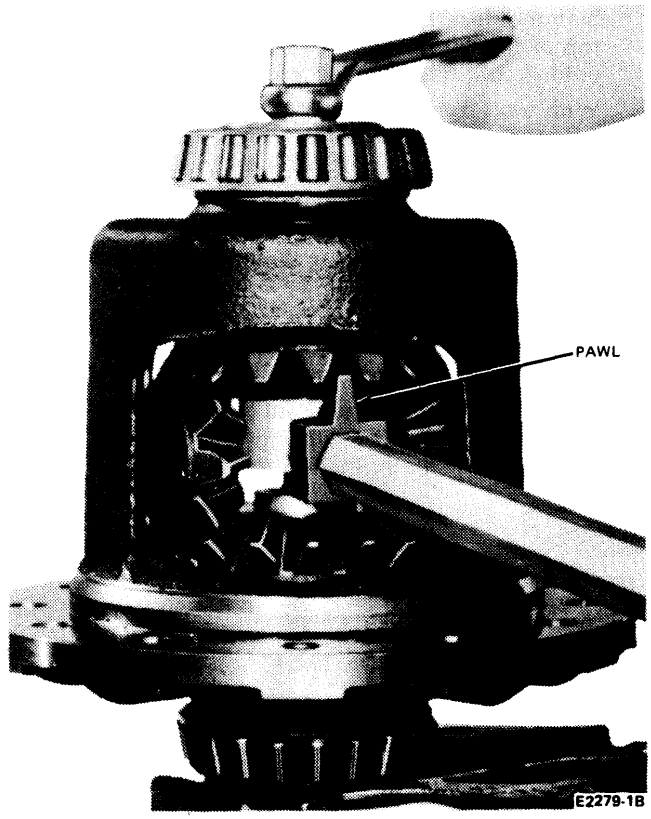


FIG. 10 Rotating Tool Pawl in Position

Assembly

1. Install the side gears and thrust washers. To do this, whether the original plates and discs or new ones are used, assemble them in exactly the same order as the originals. Refer back to illustrations used during disassembly for guidance in subsequent re-assembly operations.
2. Prelubricate the thrust face of the side gear and assemble the plates and discs to the side gear splines, prelubricating each part with ESW-M2C105-A or equivalent or with EST-M2C118-A or equivalent friction modifier lubricant, both stacks.
3. Assemble the retainer clips to the ears of the plates. Make sure both clips are completely assembled or seated onto the ears of the plates.

   With the differential case positioned as shown, assemble the clutch pack and side gear into the case. Make sure the clutch pack stays assembled to the side gear splines, and that the retainer clips are completely seated into the pockets of the case. To prevent the pack from falling out of the case, hold them in place by hand while re-positioning the case on a bench.
4. Re-position the case on the bench and assemble the step plate into the side gear. Apply a small amount of grease into the centering hole of the step plate.
5. Assemble the other clutch pack and side gear. Make sure the clutch pack stays assembled to the side gear splines, and that the retainer clips are completely seated into the pockets of the case.
6. Position the gear rotating tool into the top side gear and hold the side gear and rotating tool in position

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by hand. Insert the forcing screw down through the top of the case, and thread it into the rotating tool until it contacts the step plate.

7. With tools assembled to the case, position the case onto the axle shaft (as a holding fixture) by aligning the splines of the side gear with those of the shaft.
8. Position both differential pinion gears opposite one another through the openings in the case. Be sure the holes of the gears are lined up with each other. Hold the gears in place by hand.

   Tighten the forcing screw so that the side gears will move away from the differential pinion gears and relieve the loaded condition.
9. While holding the differential pinion gears in place, insert the pawl of the rotating tool between two of the side gear teeth. Pull on the handle so that the top side gear will rotate and allow the differential pinion gears to rotate and enter into the case.

   As mentioned under Disassembly, it will probably be necessary to adjust the forcing screw by very slightly loosening or tightening it until the required load is applied to allow the side gear and differential pinion gears to rotate.
10. Pull on the tool until the handle hits the gear. Remove the pawl from between the gear teeth and re-position the handle and the pawl. Repeat the same operation until the holes of both differential pinion gears are lined up exactly with those of the case.

    Prelubricate both sides of the pinion spherical washers with the specified lubricant.
11. Apply torque to the forcing screw to allow clearance to assemble the spherical washers.

    Assemble washers into the case. Use a very small screwdriver to push the washers into place. **Be sure the holes of the washers and gears are lined up exactly with those of the case.** Remove the forcing screw, rotating tool, and step plate.

    Install the pinion shaft in the differential case. Install the cross shaft locking pin.
12. Install the ring gear on the differential case, and tighten the attaching bolts to specification. Refer to Specifications 15-05 Integral Carrier Axle-Dana.

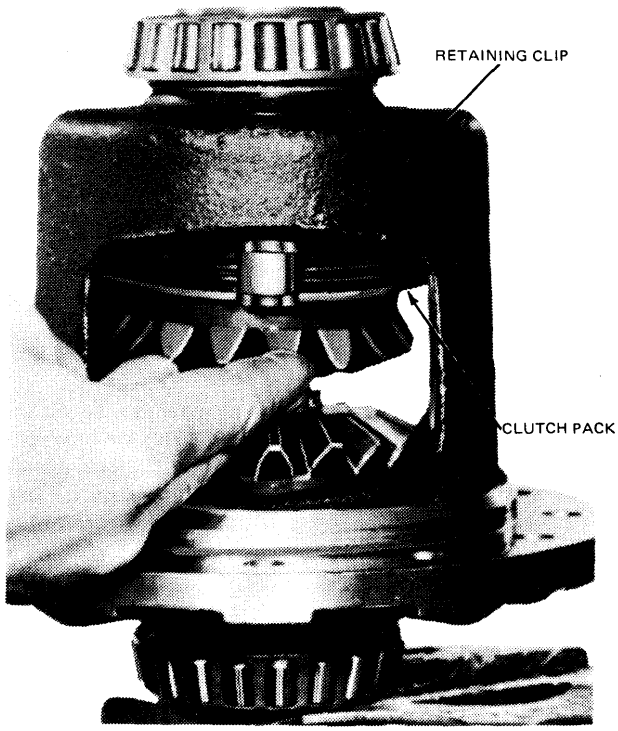


FIG. 11 Holding Clutch Pack

MODEL 70 (4-PINION) POWER LOK

Disassembly

The differential bearings need not be removed to overhaul the limited-slip differential.

1. Mark the ring gear half and cover half of the differential case so that they can be re-assembled in the same relative positions. Mark the pinion mate shafts and their corresponding ramps so that they too can be re-assembled in the same positions (Fig. 13).
2. Clamp the differential assembly in a soft-jawed vise and loosen but do not remove the bolts that hold the case halves together.
3. Place the differential assembly on the bench with the ring half of the case down. Remove the case attaching bolts, and then remove the cover half of the case (Fig. 14) on Model 70 differentials.

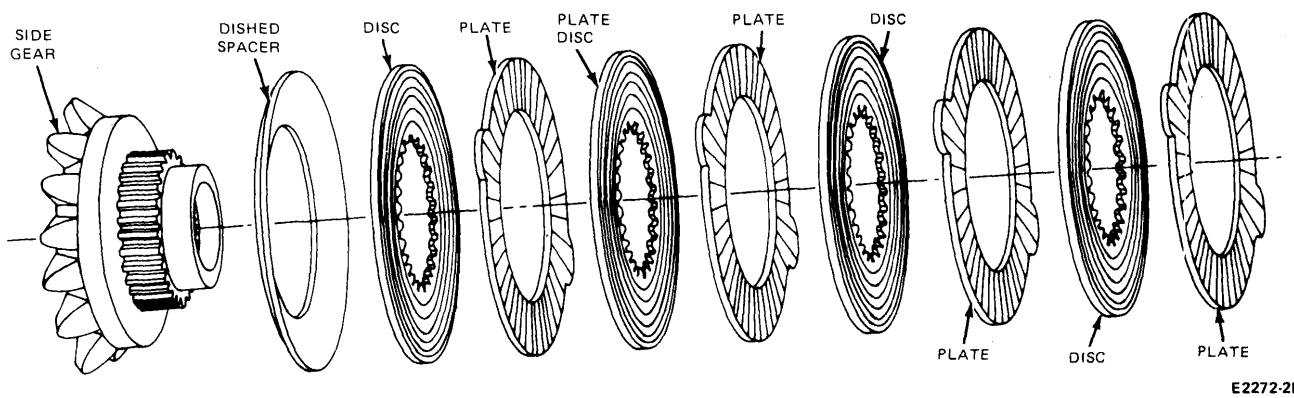


FIG. 12 Plates and Discs to Side Gear—Exploded View

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4. Remove the upper mate shaft, side gear, side gear ring, and clutch pack (Fig. 15). Keep these parts with the cover half of the case so that they can be re-installed in their original positions.

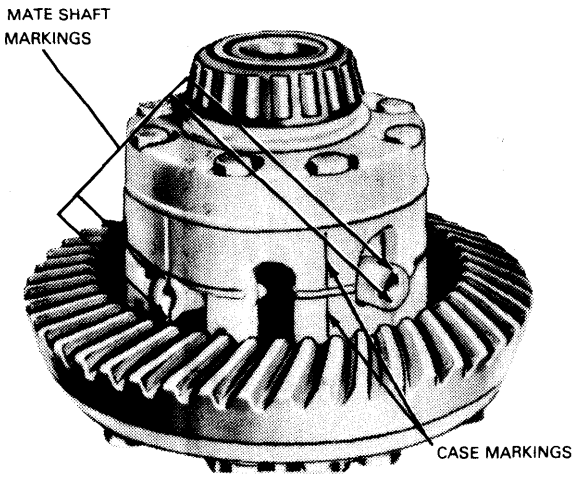


FIG. 13 Case and Mate Shaft Markings (Model 70)

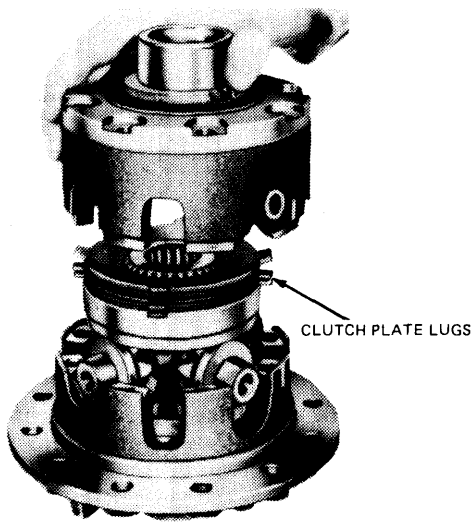


FIG. 14 Removing Cover Half of Case

5. On Model 70 differentials, remove the corresponding parts from the drive gear half of the case.
6. On all models, clean all parts thoroughly and dry them with compressed air.
7. Inspect the clutch plates and discs for cracks, excessive wear, and distortion. Both the discs and the plates, except the two Belleville spring plates should be flat. Any dished plates or discs, other than the spring plates, must be replaced. If one or more of the plates, discs, or spring plates or discs need replacing, it is suggested that the entire stack of clutch plates on each side be replaced.

   Inspect all other parts and replace any part that appears to be worn or damaged (Fig. 16).
8. Inspect the pinion mate shaft surfaces and the ramp surfaces on the case for excessive wear or pitting.
9. Inspect the side gear and pinion gear teeth. Inspect the pinion gear races that bear on the side gear rings. Inspect the corresponding surfaces on the side gear rings.

Assembly

1. Place the side gear ring from the drive gear half of the case on a pinion flange (Fig. 17) or something similar, so that it is about four inches above the bench. Coat the clutch plates with axle lubricant.
2. Refer to Fig. 17 and assemble the parts in the order indicated for the particular axle model being repaired.
3. Place the ring gear half of the case over the clutch pack and side gear ring. Make sure that the clutch plate lugs enter the slots in the case and that the case bottoms on the clutch pack (Fig. 17).
4. Grasp the flange and the case to hold the assembly together, and then turn the case half upside down.
5. Place the proper side gear in the side gear ring.
6. Install the axle shaft spacer in the cross shaft. See Fig. 17 for proper placement of the spacers.
7. Place the mate shaft and pinions on the side gear ring (Fig. 18). Align the mate shaft and case markings.

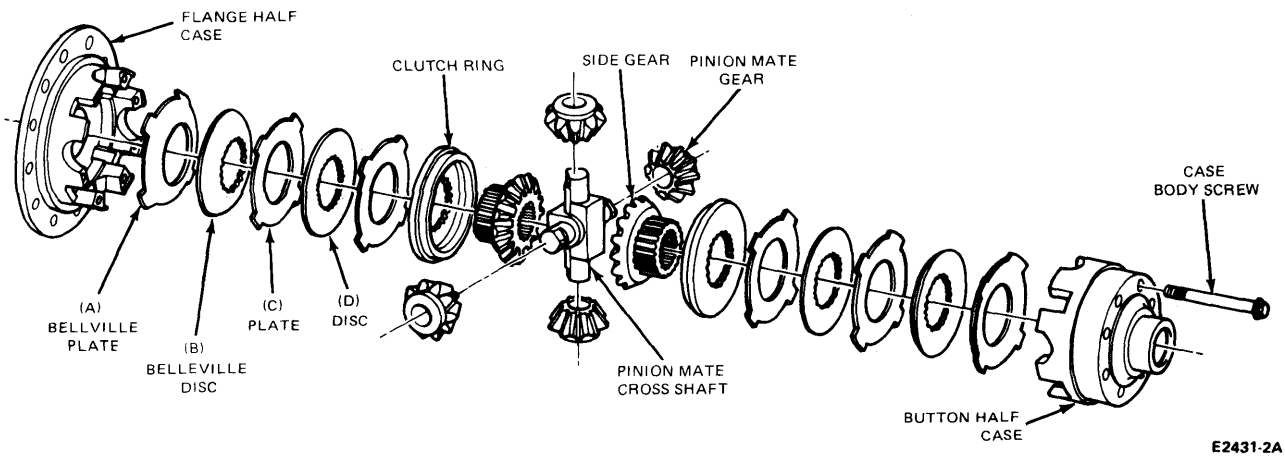


FIG. 15 Limited-Slip Differential (Model 70)—Exploded View

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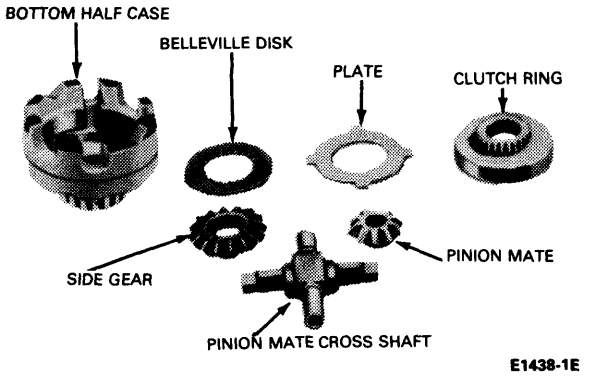


FIG. 16 Components to Check for Excessive Wear or Scoring

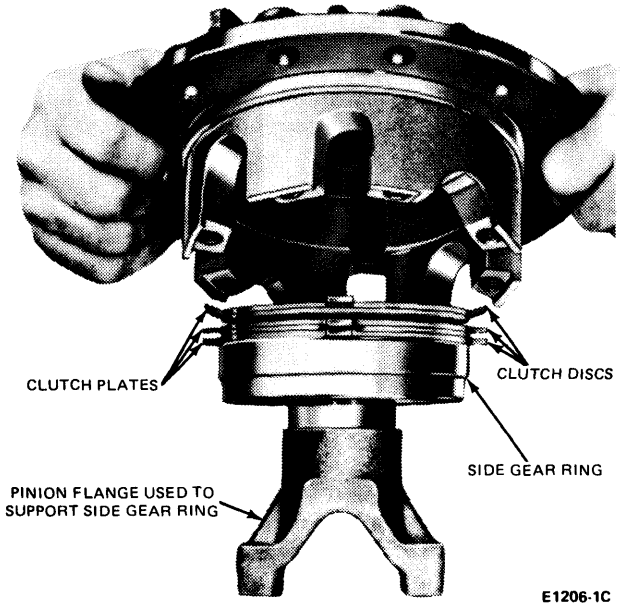


FIG. 17 Clutch Installed in Drive Gear Case Half—Model 70

8. Install the cover half mate shaft and pinions. Align the point markings.
9. Place the side gear on the pinions, and then place the side gear ring on the side gear and pinions.
10. Assemble the clutch pack on the side gear according to the arrangement shown in Fig. 19. Align the clutch plate lugs, and install all parts in the case.
11. Place the cover half of the case over the assembly (Fig. 14). Align the case marks made before disassembly.
12. Install all the case bolts and turn each one on a few threads. Using both axle shafts, align the splines of the side gear and the side gear ring (Fig. 15) on both sides of the case. With the axle shafts in position, tighten the case bolts evenly and alternately to 65-70 ft-lb (Fig. 20).
13. Remove the axle shafts. **If the assembly has been properly assembled, each pinion mate cross shaft should be tight on its ramp; or, if there is clearance between the cross shaft and the ramp, it should be not more than 0.010 inch and equal at all four cross shaft ends.**

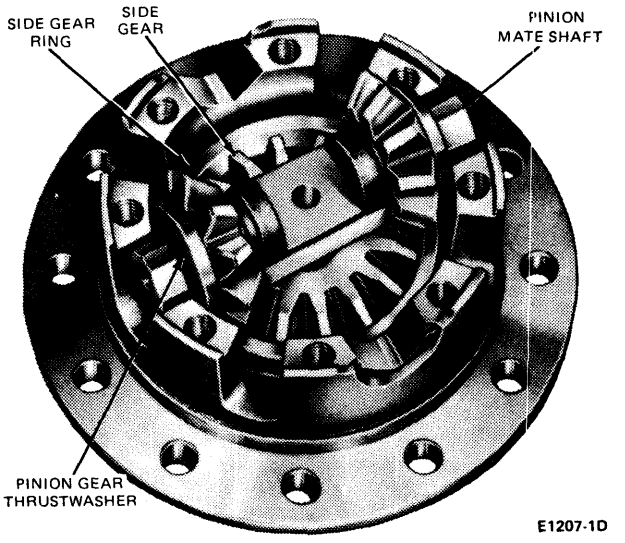


FIG. 18 Mate Shaft Installed—Model 70

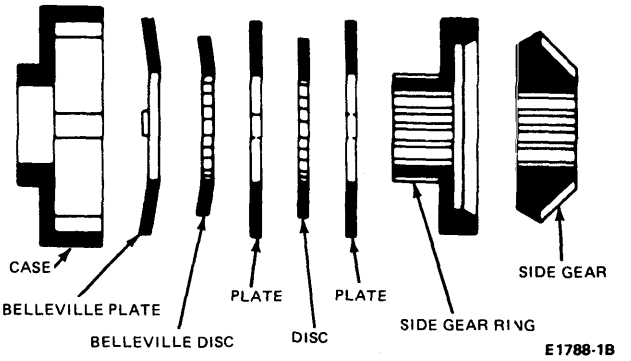


FIG. 19 Plate and Disc Arrangement—One Side of Model 70— Limited-Slip

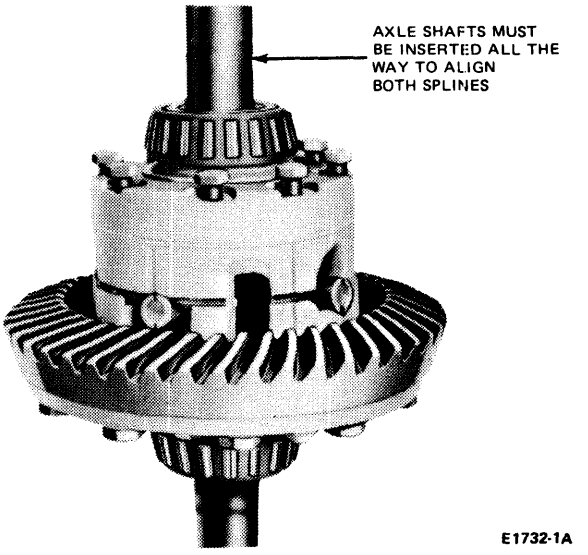


FIG. 20 Spline Alignment of Side Gear and Side Gear Ring

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SPECIFICATIONS

Refer to Part 15-01, General Driving Axle and Driveshaft Service and Part 15-05, Integral Carrier Axle-Dana for Specifications.

SPECIAL TOOLS

Number	Description
T71T-4205-A (Part of 1971 Essential Tool Kit TKIT-1971-F, FX)	Axle Disassembly Tools

CE3787-1A

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Driveshaft — Single Snap Ring Type U-Joint

PART 15-60

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DESCRIPTION

The drive shaft or coupling shaft is composed of the universal joints (U-joints), connecting shafts, attaching flanges, and slip yokes. The number of shafts and U-joints used depends on the vehicle type.

Some vehicles use a one piece slip-yoke type drive shaft (Fig. 1). A universal joint and splined slip yoke are located at the transmission end of the shaft, where they are held in alignment by a bushing in the transmission rear extension. The slip yoke permits fore and aft movement of the driveshaft as the differential assembly moves up and down. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt and other harmful material. A second universal joint attached by two U-bolts or two straps is used where the drive shaft mates with the companion flange at the rear.

Others use a coupling shaft in conjunction with a driveshaft (Figs. 2 and 3). Care must be taken to align the shafts as shown in the Figures. The two-piece driveline system incorporates a "necked down" coupling shaft stub with a "blindspline" feature which assures positive phasing action (Fig. 2). The "fixed yoke" system incorporates a U-joint assembly between the center bearing assembly and the slip yoke (Fig. 3).

All two piece drive shaft vehicles are equipped with center support bearings that are prelubricated and sealed for the bearing life.

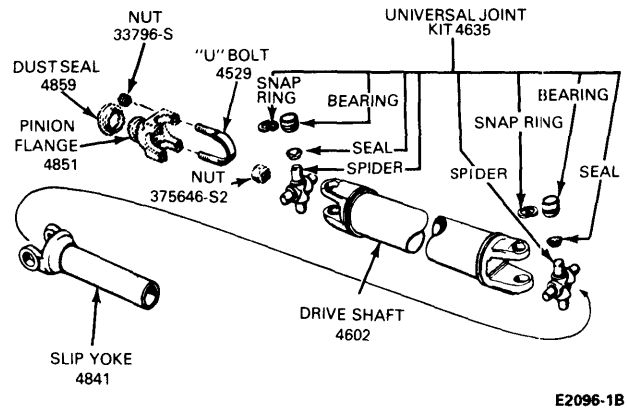


FIG. 1 One Piece Driveshaft Slip-Yoke Design

All U-joints are of the lubed for life needle-bearing type. The U-joint bearings are retained on the U-joint spiders by snap rings or U-bolts.

Drive shafts and coupling shafts are balanced; therefore, if the vehicle is being undercoated, the shafts and all open spline areas must be covered to prevent undercoating material from getting on the shafts.

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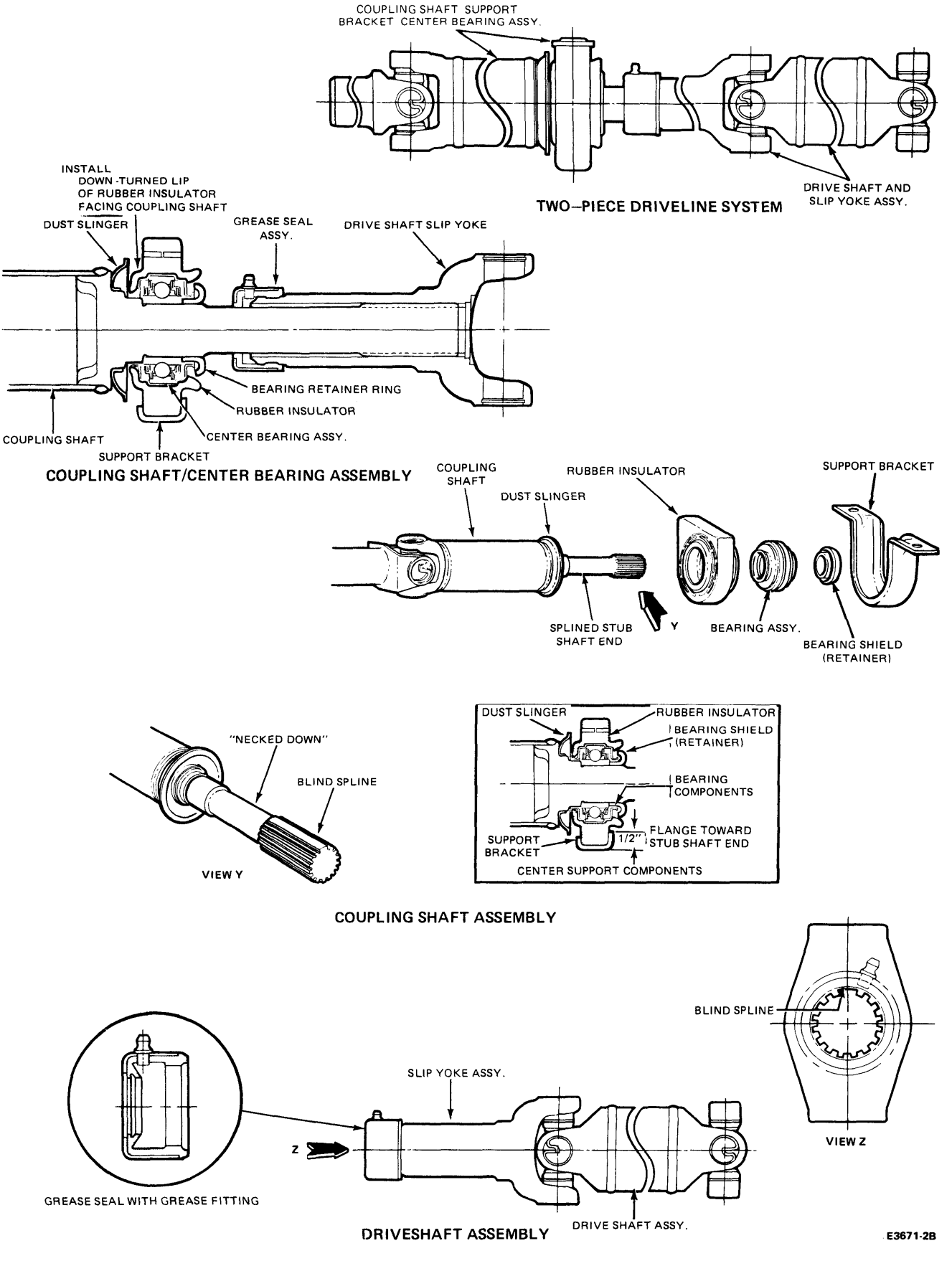


FIG. 2 Two Piece Driveshaft with U-Bolt Attachment to the Transmission

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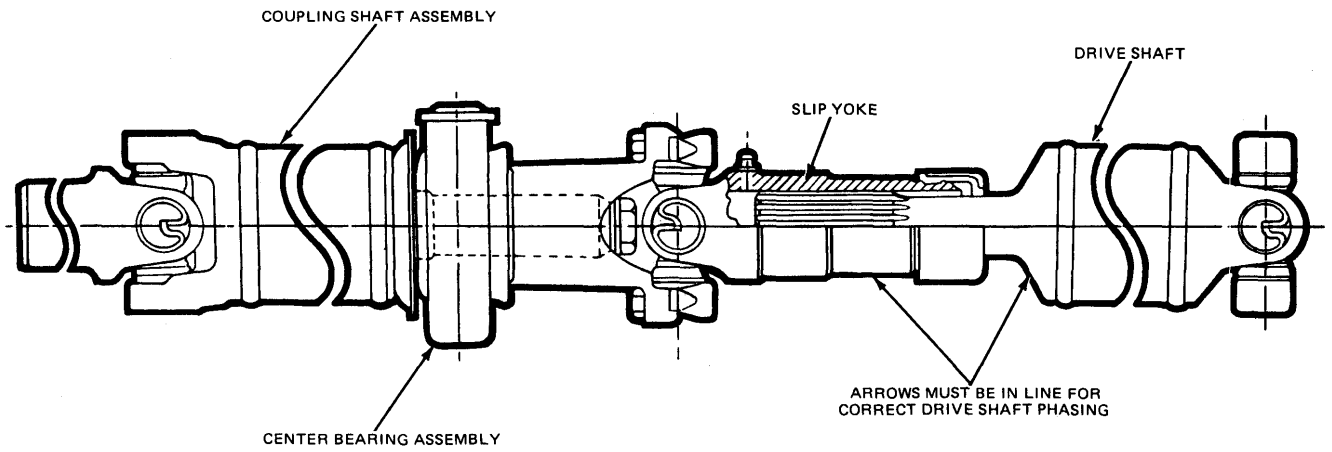


FIG. 3 Fixed Yoke at Center Bearing—2-Piece Driveline System

DIAGNOSIS AND TESTING

Refer to Part 15-01, General Driving Axle and Driveshaft Service.

ADJUSTMENTS

DRIVESHAFT BALANCING

Refer to Part 15-01 for driveshaft balancing.

DRIVESHAFT ALIGNMENT ALL EXCEPT FORD DESIGN

To properly adjust driveline angles, a spirit level protractor is necessary. When the angles are read from the 0 degree mark record and use the angle shown on the protractor since the 90 degree mark must be treated as 0 degree. For example, a protractor reading of 85 degrees is actually 5 degrees (Figs. 4 and 5).

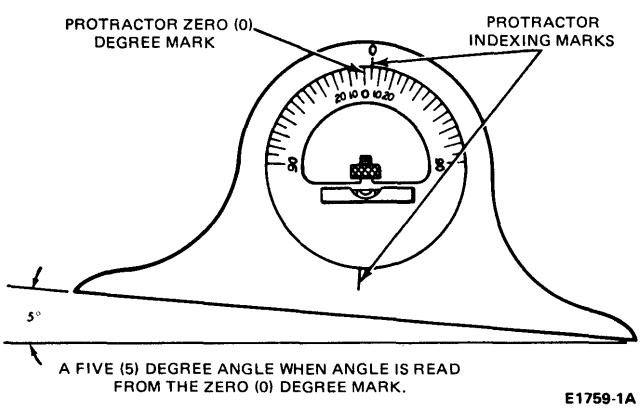


FIG. 4 Driveshaft Angle Read From Zero Mark—Horizontal Position

All angles should be read within 1/2 degree and should be measured with the protractor held plumb on a clean, flat surface. Driveline angles are shown in the specifications section at the end of this part.

1. With the vehicle at curb load condition use a drive-on hoist, a two post axle contact type hoist or back the vehicle on a front end alignment machine.
2. Set the vehicle to HORIZONTAL by taking a protractor reading on the lower frame flange forward of the rear spring front shackle and using this reading as 0 or Horizontal. All angles will then be read relative to this "0" (Horizontal) angle.
3. Check and record the engine-transmission angle. If this angle differs from specifications neutralize the engine front mounts, and check the rear mount for proper installation.
4. Check coupling shaft angle (if so equipped) and adjust to specifications by shimming the center support bearing.
5. Check the drive shaft(s) angle and adjust to specifications by shimming between the springs and the spring seats.
6. Check the pinion(s) angle and adjust to specifications by shimming with tapered shims between the springs and the spring seats.
7. Road test.

U-JOINT PHASING AND DRIVESHAFT RUNOUT

Refer to Part 15-01 for General Driving Axle and Driveshaft Service U-joint phasing and driveshaft runout.

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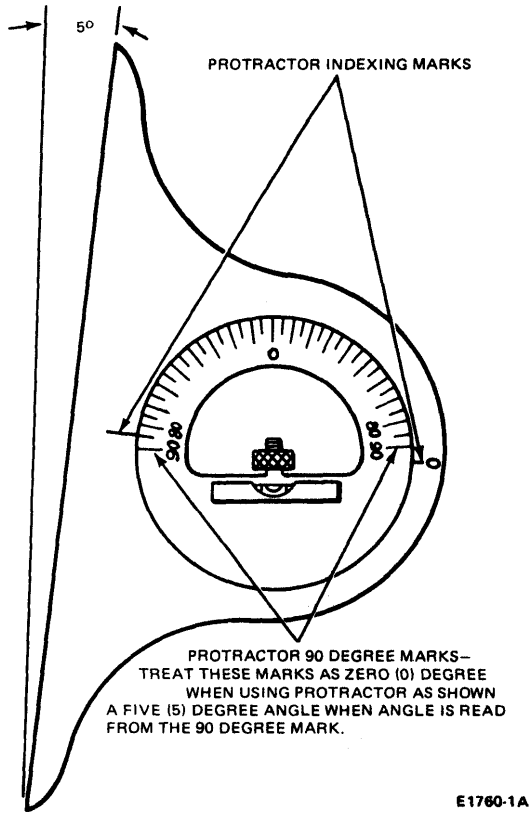


FIG. 5 Driveshaft Angle Read From Mark—Vertical Position

REMOVAL AND INSTALLATION

DRIVESHAFT/COUPLING SHAFT (ALL EXCEPT ONE PIECE DRIVESHAFT MODELS)

To maintain driveline balance, mark the relationship of the rear driveshaft yoke and the rear axle pinion flange before disassembly.

Removal

1. Disconnect the driveshaft from the rear axle flange and disconnect the driveshaft slip yoke from the coupling shaft yoke. Wrap tape around the loose bearing caps to prevent the bearings from falling off the universal joint spiders.
2. Remove the two center bearing support brackets (coupling shaft) to the frame crossmember attaching bolts. Remove the coupling shaft assembly from the transmission extension. Install the appropriate tool in the transmission housing to prevent leakage.
3. Slide the slip yoke off of the driveshaft. Remove the dust cap, cork seal and spacers from the slip yoke.
4. Clean the male splines of the driveshaft with a wire brush and a suitable solvent. Remove all hardened grease deposits, dirt or rust. Inspect for worn or galled splines. Remove any nicks, gouges or burrs using a file or emery cloth. If the driveshaft is worn, warped, or cracked, replace the driveshaft and slip yoke assembly.
5. Using a suitable cleaning fluid, clean all dirt from the slip yoke internal splines and the slip yoke assembly. Carefully inspect the slip yoke splines for wear or evidence of twisting. Check the clearance between the slip yoke splines and the driveshaft splines.
6. Wash all parts except the sealed center bearing and rubber insulator in suitable cleaning fluid. Do not immerse the sealed bearing in the cleaning fluid. Wipe the bearing and rubber insulator clean with a cloth dampened with cleaning fluid.

Note: Inspect the slip yoke cork seal, replace if necessary.

7. Check the center support bearing for wear or rough action by rotating the inner race while holding the outer race. If any wear or roughness is evident, replace the bearing.
8. Examine the rubber insulator for evidence of hardening, cracking, or deterioration. Replace if damaged in any way.

Installation:

1. Lubricate the coupling shaft front slip yoke splines with ESA-M1C75-B lubricant or equivalent. The splines are sealed so that the transmission fluid does not wash away the spline lubricant. Remove the tool preventing leakage from the transmission housing. Install the front yoke of the coupling shaft

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assembly on the transmission output shaft. Do not allow the slip yoke assembly to bottom on the output shaft with excessive force.

2. Secure the center bearing support bracket to the frame crossmember with the center supporting attaching bolts. Tighten the bolts to specifications.
3. Slide the dust cap, cork seal, and spacers onto the splined shaft of the driveshaft. Apply a coating of ESA-M1C75-B or equivalent to the entire splined stub shaft end of the driveshaft assembly prior to the assembling of the driveshaft and the slip yoke.
4. Using a clean long handle (stencil type) brush apply long life lubricant ESA-M1C75-B or equivalent, spread evenly on all the female splines of the slip yoke.
5. Assemble the driveshaft slip yoke to the coupling shaft. Tighten the U-bolt nuts to specifications.
6. Slide the splined end (front) of the driveshaft into the slip yoke (rear) on the coupling shaft, being certain that the splines are in "phase"; the arrow stamped on the slip yoke must be aligned with the arrow stamped on the stub shaft (splined) end of the driveshaft.
7. Connect the rear U-joint of the driveshaft to the rear axle pinion flange and tighten the U-bolt nuts to specification.
8. Using a hand type grease gun, lubricate the driveshaft slip yoke through the zerk fitting with ESA-M1C75-B long life lubricant or equivalent.

Note: To assure complete lubrication of the slip yoke splines, temporarily plug the vent hole in the "welch" type plug located at the yoke-end of the slip yoke while applying grease through the zerk fitting.

DRIVESHAFT (ONE PIECE MODELS)

Refer to Fig. 1.

Removal

1. To maintain driveline balance, if the yellow alignment marks are not visible, mark the relationship of the rear drive shaft yoke and the drive pinion flange of the axle in line with the drive shaft so that they may be re-installed in their original positions.
2. Disconnect the rear U-joint from the companion flange. Wrap tape around the loose bearing caps to prevent them from falling off the spider. Pull the drive shaft toward the rear of the vehicle until the slip yoke clears the transmission extension housing and the seal. Install the appropriate tool in the housing to prevent lubricant leakage.

Installation

1. If either the rubber seal on the output shaft or the seal in the end of the transmission extension housing is damaged in any manner, replace the seal or seals as required (Fig. 6—automatic transmission only). Also if the lugs on the axle pinion flange are shaved or distorted so that the bearings slide, replace the flange.

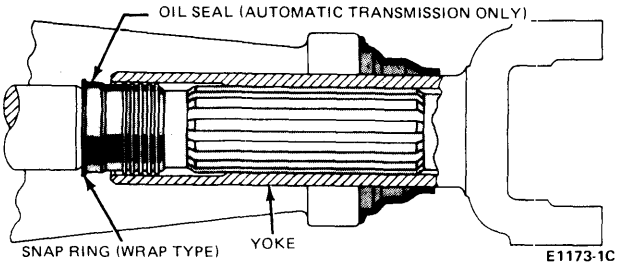


FIG. 6 Output Shaft Spline Seals

2. Lubricate the yoke spline with ESA-M1C75-B lubricant or equivalent. This spline is sealed so that the transmission fluid does not wash away the spline lubricant (Fig. 6—automatic transmission only). Remove the tool from the extension housing. Install the yoke on the transmission output shaft. Do not allow the yoke assembly to bottom on the output shaft with excessive force.

   Install the drive shaft so that the index marks or the yellow mark (if visible) on the yoke (light side) is in line with the yellow mark on the companion flange. This prevents vibration which occurs when the balance of the shaft and balance of the axle pinion flange become additive instead of neutralizing. If a vibration exists, the drive shaft should be disconnected from the axle, rotated 180 degrees and re-installed.
3. Install the U-bolts and nuts that attach the U-joints to the drive pinion flange. Tighten the U-bolt nuts to 8-15 ft-lb.

SNAP RING TYPE U-JOINT

Removal

1. Place the drive shaft in a vise, being careful not to damage it.
2. Remove the snap rings that retain the bearings in the yoke and in the drive shaft or coupling shaft.
3. Position the tool shown in Fig. 7 on the shaft and press the bearing out of the yoke. If the bearing cannot be pressed all the way out of the flange, remove it with vise grip or channel lock pliers. Mark the yoke and the shaft to be sure that they will be reassembled in the same relative position.
4. Re-position the tool to press on the spider in order to remove the bearing from the opposite side of the flange.
5. Remove the flange from the spider.
6. Remove the bearings and spider from the drive shaft or coupling shaft in the same manner.

Installation

1. Start a new bearing into the yoke at the rear of the drive shaft.
2. Position the spider in the rear yoke and press the bearing 1/4 inch below the surface (Fig. 8).
3. Remove the tool and install a new snap ring.
4. Start a new bearing into the opposite side of the yoke.
5. Install the tool and press on the bearing until the opposite bearing contacts the snap ring.

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6. Remove the tool and install a new snap ring.
7. Re-position the drive shaft or coupling shaft and install the new spider and two new bearings in the front yoke in the same manner as the rear yoke.
8. Position the flange on the spider and install two new bearings and snap rings.
9. Check the joint for freedom of movement. If a bind has resulted from misalignment during the foregoing procedures, tap the ears of the drive shaft sharply to relieve the bind. Do not install the drive shaft unless the U-joints are free of bind.

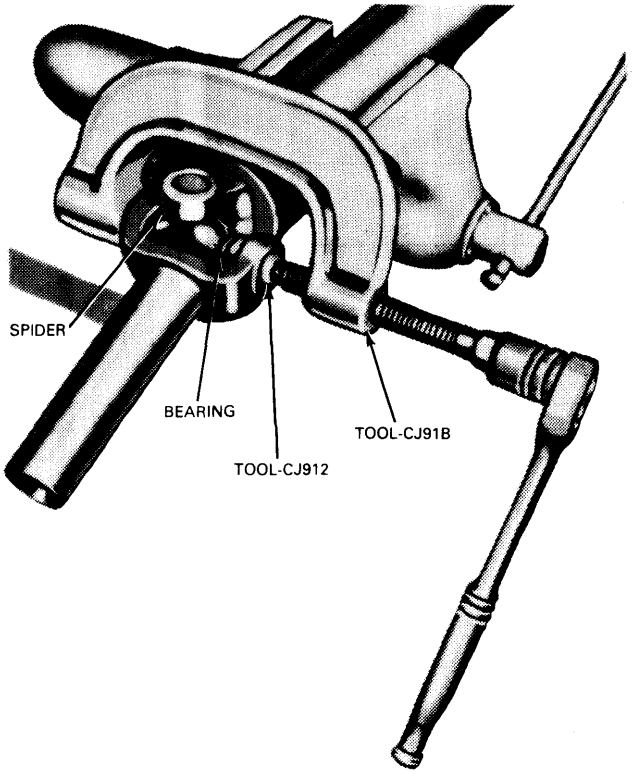


FIG. 7 Removing U-Joint Bearing—Typical

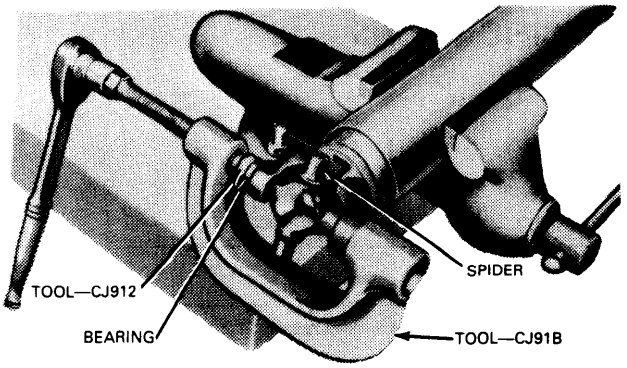


FIG. 8 Installing U-Joint Bearing—Typical

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SPECIFICATIONS

DRIVESHAFT — TORQUE LIMITS

Description	Bolt Size	Torque Limits (ft-lb)	Torque Limits N•m
Bolt Yoke to Coupling Shaft or Intermediate Shaft	5/8-18	148-164 ②	201-222 ②
	3/4-16	175-240 ①	238-325 ①
	7/8-14	250-300 ③	339-406
	1-20	160 ④	216
Nut-U-Joint Flange to Main and Auxiliary Input or Output Shaft	1-20	90-130	123-176
	1 1/4-18	350-420	475-569
	1 1/2-18	380-470	516-637
	1 1/2-16	425-525	577-711
Nut-U-Joint — U-Bolt	5/16-18	8-15	11-20
	3/8-18	17-26	24-35
	7/16-20	30-40	41-54
Bolt and Nut — Parking Brake Drum to Universal Joint Flange	3/8-24	37-50 ①	51-67 ①
	7/16-20	37-49	51-66
		58-78 ③	79-105 ③
	1/2-20	55-75	75-101
		100-115 ①	136-155 ①
Coupling Shaft Center Bearing Bracket to Support	7/16-20	40-50	55-67
Bolt — Drive Shaft U-Joint to Rear Yoke	1/2-20	90-110 ①	123-149 ①
Bolt and Nut — U-Joint Adapter to Rear Axle	1/2-20	60-70	82-94

① Mechanics ② Dana ③ Rockwell ④ Cleveland

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DRIVELINE ANGLES

ENGINE ANGLES TO HORIZONTAL

(4x2) Engine, Couplingshaft, Driveshaft & Rear Axle Pinion Angles

Model	Wheelbase	Engine	Transmission	Angles
F-100-350 (4x2)	All	5.0L (300 CID) I-6, 4.9L (302 CID) V-8	All	5°
F-100-350 (4x2)	All	7.5L (460 CID) V-8	All	5¾°

COUPLINGSHAFT ANGLES TO HORIZONTAL

F-100	133	4.9L (300 CID) I-6 5.0L (302 CID) V-8	3 Speed 4 Speed O.D. C-6 (Auto)	6½° 7° 7¼°
		5.8L (351 CID) V-8	3 Speed 4 Speed O.D.	6½° 6½°
F-150	133	4.9L (300 CID) I-6 5.0L (302 CID) V-8	3 Speed 4 Speed O.D. C-6 (Auto)	6½° 7° 6½°
		5.8L (351 CID) V-8	3 Speed 4 Speed O.D. 4 Speed C-6 (Auto)	6½° 6½° 6½° 6½°
		6.6L (400 CID) V-8	C-6 (Auto)	6½°
		7.5L (460 CID) V-8	C-6 (Auto)	6½°
F-250	133	4.9L (300 CID) I-6	3 Speed 4 Speed O.D. C-6 (Auto) 4 Speed 3 Speed	5° 7° 5° 5° 4¾°
		5.8L (351 CID) V-8 6.6L (400 CID) V-8	4 Speed O.D. C-6 (Auto) 4 Speed	4¾° 4° 4¾°
		7.5L (460 CID) 4-V V-8	C-6 (Auto)	4°
F-350	137 & 140	5.8L (351 CID) V-8 6.6L (400 CID) V-8	4 Speed C-6 (Auto)	5¼° 5°
		7.5L (460 CID) V-8	C-6 (Auto)	5°
		4.9L (300 CID) I-6	C-6 (Auto) 4 Speed	5½° 5½°
	161	4.9L (300 CID) I-6	4 Speed C-6 (Auto)	5° 5°
		5.8L (351 CID) V-8 6.6L (400 CID) V-8	4 Speed C-6 (Auto)	5° 4¾°
		7.5L (460 CID) V-8	C-6 (Auto)	4¾°

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DRIVESHAFT ANGLES — TO HORIZONTAL — REGULAR CAB

Model	WB	Engine	Combined Spring Capacity at Ground	Transmission	Curb Load Empty
F-100	116 ①	4.9L (300 CID) I-6 5.0L (302 CID) V-8	2950# 3350#	All	9° 9¼°
	116 ①	5.8L (351 CID) V-8 6.6L (400 CID) V-8	2950# 3350#	All	8¾° 9°
F-100/150	133	4.9L (300 CID) I-6 5.0L (302 CID) V-8	1650# 2550# 2950# 3350#	All	7½° 5° 7½° 7½°
F-100/150	133	5.8L (351 CID) V-8	1650# 2550# 2950# 3350#	All Manual	7½° 5¼° 7¼° 7½°
F-100	133 ①	4.9L (300 CID) I-6 5.0L (302 CID) V-8	2550# 2950# 3350#	All	5¾° 7° 7°
F-150	133 ①	5.8L (351 CID) V-8 6.6L (400 CID) 4-V V-8	3750#	C-6 & 3 Speed	7¼°
F-250	133	4.9L (300 CID) I-6	1750# 2050# 2450#	All	7¾° 8¼° 8¾°
	133	5.8L (351 CID) V-8	1750# 2050# 2450#	3 Speed	7¾° 8½° 8¾°
	133	5.8L (351 CID) V-8	1750# 2050# 2450#	4 Speed	7¾° 8½° 8¾°
	133	5.8L (351 CID) V-8	1750# 2050# 2450#	C-6	8° 8¾° 9°
	133	5.8L (351 CID) V-8	1050# 2030# 2450#	4 Speed O.D.	7¾° 8½° 8¾°
	133	6.6L (400 CID) V-8	1750# 2050# 2450#	4 Speed	8° 8¼° 8¾°
	133	6.6L (400 CID) V-8	1750# 2050# 2450#	C-6	8° 8¾° 9°
	133	7.5L (460 CID) 4-V V-8	4610# 5480#		8½° 9°
F-250	133 ①	5.8L (351 CID) V-8 6.6L (400 CID) V-8	4000# 4610# 5480#	C-6	6½° 6¾° 7°
F-350	137	4.9L (300 CID) I-6 4.9L (300 CID) 1-V I-6 5.8L (351 CID) V-8 6.6L (400 CID) 4-V V-8	4050# 7050#	All	8° 9°
F-350	140	7.5L (460 CID) 4-V V-8 5.8L (351 CID) V-8 6.6L (400 CID) V-8	5900#	All	7¼°
F-350	161	4.9L (300 CID) 1-V I-6 5.8L (351 CID) V-8 6.6L (400 CID) V-8 7.5L (460 CID) 4-V V-8	4050# 7250#	All	5¾° 6½°

① One Piece Driveshaft

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REAR AXLE PINION ANGLES TO HORIZONTAL

Model	Wheelbase	Spring Capacity at Pad	Spring Part Number (5560)	Curb Load Empty
F-100	117 & 133	1050#	D2TA-GB	6°
		1250#	D2TA-HB	6°
		1450#	D2TA-JA	6°
	138.8 & 155	1250#	D2TA-HB	6¼°
		1450#	D2TA-JA	6°
F-150	133	1650#	D5TA-AKA	6°
	138.8 & 155	1650#	D5TA-AKA	6°
F-250	133	1735#	D2TA-KB	5¾°
		2030#	D2TA-LB	5°
		2450#	D2TA-MB	6°
	138.8 & 155	1735#	D2TA-KB	5¾°
		2030#	D2TA-LB	5½°
		2450#	D2TA-MB	5½°
F-350	137 & 161	2725#	D9TA-CB	4°
		3225#	D3TA-DA	4°
	140	2800#	D4TA-KA	
	155	2700#	D4TA-VA	

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ENGINE ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Transmission	Angle
F-150/250 (4x4) P.T.	All	4.9L (300 CID) I-6	Manual	5°
F-150/250/350 (4x4) P.T.	All	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	All	5¾°
F-150 (4x4) F.T.	All	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7°
F-250/350 (4x4) F.T.	All	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7°

CE3673-2B

REAR AXLE PINION ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Spring Rating at Pad	Spring Part No. 5560	Curb Load Empty
F-150 (4x4) P.T.	116.8"	1735	D2TA-KB	12¾°
F-150 (4x4)	116.8"	1735	D2TA-KB	7¾°
F-150 (4x4) F.T.	133"	1735	D2TA-KB	5¾°
F-250 (4x4) P.T., F.T. F-350 (4x4) P.T., F.T.	133"	1735	D2TA-KB	5½°
	133"	2030	D2TA-LB	5¾°
	133"	2450	D2TA-MB	5¾°
F-150 (4x4) P.T., F.T.	155"	1735	D2TA-KB	5¼°
F-250 (4x4) P.T., F.T. F-350 (4x4) P.T., F.T.	155"	1735	D2TA-KB	6°
	155"	2030	D2TA-LB	6¼°
	155"	2450	D2TA-MB	6¼°

FRONT DRIVESHAFT ANGLES TO HORIZONTAL (DANA 44 AXLE) — F-150/F-250 (4x4)

Model	Wheelbase	Engine	Transmission	Curb Load Empty
F-150 (4x4) P.T.	116.8", 133", 155"	*4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual & Automatic	2¼°
F-150 (4x4) F.T.	116.8", 133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	4¾°
F-250 (4x4) P.T.	133", 155"	*4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	8°
F-250 (4x4) P.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	6½°
F-250 (4x4) F.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7½°

*4.9L (300 CID) I-6 engine not available with 155" wheelbase.

FRONT DRIVESHAFT ANGLES TO HORIZONTAL (DANA 60 AXLE) — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Transmission	Curb Load Empty
F-350 (4x4) P.T.	133", 155"	6.6L (400 CID) V-8	Manual	5¼°
F-250 (4x4) P.T.	133", 155"	*4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	5¼°
F-250/350 (4x4) P.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	4°
F-250/350 (4x4) F.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	5½°

*4.9L (300 CID) I-6 engine not available with 155" wheelbase.

FRONT AXLE PINION ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Axle	Wheelbase	Curb Load Empty
F-150 (4x4) P.T.	Dana 44	116.8", 133", 155"	8½° ①
F-150 (4x4) F.T.	Dana 44	116.8", 133", 155"	4¾° ①
F-250 (4x4) P.T., F.T.	Dana 44	133", 155"	4½° ①
F-250/350 (4x4) P.T., F.T.	Dana 60	133", 155"	5° ①

① Above horizontal F.T. — Full time P.T. — Part time

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ENGINE ANGLES TO HORIZONTAL

F-100-350 Engine, Rear Axle Pinion, Couplingshaft & Driveshaft Angles — Supercab Models Only

Model	Wheelbase	Engine	Transmission	Angles
F-100-350	All	4.9L (300 CID) I-6 5.0L (302 CID) V-8 5.8L (351 CID) V-8 6.6L (400 CID) V-8 7.5L (460 CID) V-8	All	5° 5¾°

COUPLINGSHAFT ANGLES TO HORIZONTAL (SUPERCAB)

F-100/150	138.8	4.9L (300 CID) I-6 5.0L (302 CID) V-8	3 Speed & 4 Speed 4 Speed O.D. C-6 Auto 4 Speed O.D.	6° 6° 6½° 6°
		5.8L (351 CID) V-8 6.6L (400 CID) V-8 7.5L (460 CID) V-8	3 Speed/4 Speed/C-6 Auto Auto	6°
	155	4.9L (300 CID) I-6 5.0L (302 CID) V-8	3 Speed & 4 Speed 4 Speed O.D. C-6 Auto	5° 5° 5°
		5.8L (351 CID) V-8 5.8L (351 CID) V-8 6.6L (400 CID) V-8	3 Speed & 4 Speed C-6 Auto	5° 4¾°
F-250	138.8	4.9L (300 CID) I-6	3 Speed & 4 Speed 4 Speed O.D. C-6 Auto.	6° 6° 6½°
		5.8L (351 CID) V-8 6.6L (400 CID) V-8 7.5L (460 CID) V-8	3 Speed/4 Speed/C-6 Auto	6°
	155	4.9L (300 CID) I-6	3 Speed & 4 Speed C-6 Auto	5° 5°
		5.8L (351 CID) V-8 6.6L (400 CID) V-8 5.8L (351 CID) V-8 6.6L (400 CID) V-8 7.5L (460 CID) V-8	3 Speed & 4 Speed C-6 Auto	5° 4¾°
F-350	155	5.8L (351 CID) V-8 6.6L (400 CID) V-8 5.8L (351 CID) V-8 6.6L (400 CID) V-8 7.5L (460 CID) V-8	4 Speed C-6 Auto	5° 4¾°

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COUPLING SHAFT ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Transmission	Curb Load Empty
F-150/250/350 (4x4) P.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	7¼°
F-150/250/350 (4x4) P.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7½°
F-150/250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	5°

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DRIVESHAFT ANGLES TO HORIZONTAL
(SUPER CAB)

Model	WB	Axle	Spring	Empty Angles
F-100	138.8	3750	1250	6-3/4°
		3300	1450	7°
		3750	1450	7-1/4°
	155	3300	1250	5-3/4°
		3750	1250	6°
		3300	1450	6-1/4°
		3750	1450	6-1/4°
F-150	138.8	3750	1650	7-1/4°
	155	3750	1650	
F-250	138.8	D-60 & D-61	1735	5-3/4°
			2030	6-1/2°
			2450	6-3/4°
	155	D-60 & D-61	1735	4-3/4°
			2030	5-1/2°
			2450	6°
F-350	155	D-70	2900	6°

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REAR DRIVESHAFT ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Spring Rating at Pad	Transmission	Curb Load Empty
F-150 (4x4) P.T.	116.8"	4.9L (300 CID) I-6	1735	Manual	12½°
F-150 (4x4) P.T.	116.8"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	12¼°
F-150 (4x4) P.T.	133"	4.9L (300 CID) I-6	1735	Manual	10½°
F-150 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	10¼°
F-150 (4x4) F.T.	116.8"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	12½°
F-150 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	9½°
F-250 (4x4) P.T.	133"	4.9L (300 CID) I-6	1735	Manual	9½°
F-250 (4x4) P.T.	133"	4.9L (300 CID) I-6	2030	Manual	9¾°
F-250 (4x4) P.T.	133"	4.9L (300 CID) I-6	2450	Manual	10°
F-250/350 (4x4) P.T.	133"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual	9¼°
F-250/350 (4x4) P.T.	133"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Manual	9¾°
F-250/350 (4x4) P.T.	133"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Manual	9¾°
F-250/350 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	9¼°
F-250/350 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Automatic	9¾°
F-250/350 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Automatic	10°
F-250/350 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	8¼°
F-250/350 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Automatic	8¾°
F-250/350 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Automatic	9°
F-150 (4x4) P.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	8½°
F-150 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	9°
F-250 (4x4) P.T.	155"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	7°
F-250 (4x4) P.T.	155"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Manual & Automatic	7½°
F-250 (4x4) P.T.	155"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Manual & Automatic	7½°
F-250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	7¼°
F-250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Automatic	7¾°
F-250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Automatic	7¾°

*5.8L (351 CID) V-8, Manual Transmission not available on F-350 (4x4) models.

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REAR AXLE PINION ANGLES TO HORIZONTAL

F-100-350 (4x2) SUPERCAB (Continued)

Model	WB	Spring Capacity at Pad	Spring Part Number (5560)	Curb Load Empty
F-100	138.6 & 155	1250#	D2TA-HB	6¼°
		1450#	D2TA-JA	6°
F-150	138.8 & 155	1650#	D5TA-AKA	6°
F-250	138.8 & 155	1735#	D2TA-KB	5¾°
		2030#	D2TA-LB	5½°
		2450#	D2TA-MB	5½°
F-350	155	2900#	D4TA-VA	6½°

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E-100 — E-350 ENGINE, COUPLINGSHAFT, DRIVESHAFT AND REAR AXLE PINION ANGLES

ENGINE ANGLE TO HORIZONTAL

Model	WB	Engine	Transmission	Angle
All	All	All	All	4°

COUPLINGSHAFT ANGLES TO HORIZONTAL

Model	WB	Engine	Transmission	Angle
E-100/150	138	4.9L (300 CID) I-6	4 Speed O.D. Man.	4¾°
E-100/150/250	138	5.8L (351 CID) V-8	3 Speed Man.	4½°
E-250/350	138	4.9L (300 CID) I-6	3 Speed Man.	4½°
E-250/350	138	4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 7.5L (460 CID) V-8	C-6 (Auto.)	5°
E-350	158	5.8L (351 CID) V-8, 7.5L (460 CID) V-8	C-6 (Auto.)	3½°

DRIVESHAFT ANGLES TO HORIZONTAL AT CURB LOAD

Model	WB	Engine	Transmission	Spring Capacity	Spring Part No.* D5UA-5560-	Angle
E-100/150	124	4.9L (300 CID) I-6 5.8L (351 CID) V-8 5.0L (302 CID) V-8	3 Speed Manual	1250# 1450# 1685# 1750#	ABB ACB AGC ASB	6° 6-1/2° 6-3/4° 7°
E-100/150	124	4.9L (300 CID) I-6 5.0L (302 CID) V-8	4 Speed O.D. Man.	1250# 1450# 1685# 1750#	ABB ACB AGC ASB	6° 6-1/2° 6-3/4° 7°
E-100/150	124	4.9L (300 CID) I-6 5.0L (302 CID) V-8 5.8L (351 CID) V-8	C-6 Auto	1250# 1450# 1685# 1750#	ABB ACB AGC ASB	6° 6-3/4° 7° 7°
E-100/150	138	4.9L (300 CID) I-6 5.0L (302 CID) V-8	3 Speed Manual	1250# 1450# 1685# 1750#	ALC AFB AHB ATB	4-1/2° 4-1/2° 5° 4-3/4°
E-100/150	138	4.9L (300 CID) I-6 5.0L (302 CID) V-8	4 Speed O.D. Man.	1250# 1450# 1685# 1750#	AEC AFB AHB ATB	4-1/2° 4-3/4° 5-1/2° 5-1/4°
E-100/150	138	5.8L (351 CID) V-8 5.0L (302 CID) V-8	3 Speed Manual	1250# 1450# 1685# 1750#	AEC AFB AHB ATB	4-1/2° 4-3/4° 5-1/2° 5-1/4°
E-100/150	138	4.9L (300 CID) I-6 5.8L (351 CID) V-8 5.0L (302 CID) V-8	C-6 Auto	1250# 1450# 1685# 1750#	AEC AFB AHB ATB	4-3/4° 4-3/4° 5-1/4° 5°
E-250	138	4.9L (300 CID) I-6 5.8L (351 CID) V-8 5.0L (302 CID) V-8	4 Speed O.D. Man.	1825# 2100# 2450# 2700# 1785# 2075# 2365#	HB JB KB AJB ASA ATA AUA	5-1/2° 6° 6-1/2° 6-3/4° 5-3/4° 6° 5-3/4°
E-250	138	4.9L (300 CID) I-6 5.8L (351 CID) V-8 5.8L (302 CID) V-8	C-6 Auto	1825# 1825# 2100# 2100# 2450# 2450# 2700# 2700# 1785# 1785# 2075# 2075# 2365# 2365#	HB HB JB JB KB KB AJB AJB ASA** ASA** ATA** ATA** AUA** AUA**	5-1/2° 1 5-1/2° 2 5-1/2° 1 6° 2 6° 1 6-1/2° 2 6-1/2° 1 6-3/4° 2 5-1/2° 1 5-3/4° 2 5-3/4° 1 6° 2 5-1/2° 1 5-3/4° 2
E-250	138	7.5L (460 CID) V-8	C-6 Auto	1825# 2100# 2450# 2700# 1785# 2075# 2365#	HB JB KB AJB ASA** ATA** AUA**	5-1/2° 6° 6-1/2° 6-3/4° 5-3/4° 6° 5-3/4°
E-350	138	4.9L (300 CID) I-6	3 Speed Manual	2450# 2900# 3235#	SB LB ZA***	7-1/4° 8° 7-1/2°

*Spring Part Numbers Are Stamped On The Bottom Leaf
**Prefix is D7UA-5560
1 One Piece Driveshaft
2 Two Piece Driveshafts
***Prefix is D8TA-5560

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DRIVESHAFT ANGLES TO HORIZONTAL AT CURB LOAD

Model	WB	Engine	Transmission	Spring Capacity	Spring Part No.* D5UA-5560-	Angle
E-350	138	300/351	C-6 Auto	2450#	SB	6-1/2° - ①
				2450#	SB	7-1/4° - ②
				2900#	LB	7° - ①
				2900#	LB	8° - ②
				3300#	MC***	7° - ①
				3235#	MC***	7-1/2° - ②
E-350	158	351	C-6 Auto	3235#	TA**	6°

REAR AXLE PINION ANGLES — TO HORIZONTAL AT CURB LOAD

Model	WB	Spring Capacity	Spring Part No. D5UA-5560*	Angle
E-100/150	124	1250#	ABB	2-3/4°
		1450#	ACA	3°
		1685#	AGB	3°
		1750#	ASB	3°
E-100/150	138	1250#	AEC	4-1/2°
		1450#	AFB	4-1/2°
		1685#	AHB	4-3/4°
		1750#	ATB	4-1/2°
		1785#	ASB**	6°
		1825#	HB	4-3/4°
		2075#	ATA**	4-1/2°
		2100#	JB	4-3/4°
E-250	138	2365#	AUA**	4-1/2°
		2450#	KB	4-3/4°
		2700#	AJB	5°
E-350	138	2450#	SB	5°
		2900#	LB	5-1/4°
		3235#	ZA***	3-3/4°
E-350	158	3300#	TA**	3-3/4°

*Spring Part Numbers Are Stamped On The Bottom Leaf
**Prefix is D7UA-5560 ① - One Piece Driveshaft
***Prefix is D8TA-5560 ② - Two Piece Driveshafts

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DRIVELINE ANGLES (4x2) 6-MAN CREW CAB

ENGINE ANGLES TO HORIZONTAL

Model	WB	Engine	Transmission	Angle
F-250/350	All	300	All	5°
F-250/350	All	351/400	All	5¾°

COUPLING SHAFT ANGLES TO HORIZONTAL

F-250	150.3	300	3 Speed	5½°
			4 Speed	5½°
			C-4 (Auto)	5¾°
F-250	150.3	351/400	3 Speed	5¼°
			4 Speed	5¼°
			C-6 (Auto)	5°
F-250	150.3	460-4V	C-6 (Auto)	5°

DRIVESHAFT ANGLES TO HORIZONTAL

Model	WB	Engine	Combined Spring Capacity @ Grnd.	Transmission	Curb Load Empty
F-250	150.3	All	3950#	All	5½°
			4500#		6¾°
			5400#		6½°
F-350	166	All	4050#	All	3½°
			5450#		5°
			7250#		5½°

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DRIVELINE ANGLES (4x4) 6-MAN CREW CAB

ENGINE ANGLES TO HORIZONTAL

Model	WB	Engine	Transmission	Angle
F-250 (4x4)	150.3	300	4 Speed	5°
			All	5¾°

COUPLING SHAFT ANGLES TO HORIZONTAL

F-250 (4x4)	150.3	300	4 Speed	9½°
		360	All	9½°

REAR DRIVESHAFT ANGLES TO HORIZONTAL

Model	WB	Engine	Spring Capacity @ Pad	Transmission	Curb Load Empty
F-250 (4x4)	150.3	All	3950# 5400#	All	8¼° 10°

REAR AXLE PINION ANGLES TO HORIZONTAL

Model	WB	Combined Spring Capacity @ Grnd.	Spring Part No. (5560)	Curb Load Empty
F-250 (4x4)	150.3	3950# 5400#		11° 11°

FRONT DRIVESHAFT ANGLES TO HORIZONTAL

Model	WB	Engine	Transmission	Curb Load Empty
F-250 (4x4)	150.3	All	All	6°

FRONT AXLE PINION ANGLES TO HORIZONTAL

Model	WB	Curb Load Empty
F-250 (4x4)	150.3	5°

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SPECIAL TOOLS

Number	Description
Tool CJ-91B Tool CJ-912	U-Joint Bearing Remover and Installer

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Driveshaft — Double Cardan Type U-Joint

PART 15-66

APPLIES TO F-150 — F-250 (4x4), BRONCO

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Driveshaft Balance, Runout and	
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DESCRIPTION

The front and/or rear driveshaft assemblies of the Bronco and F-150, F-250 (4x4) vehicles are of the double Cardan type which incorporates two U-joints, a centering socket yoke, and a center yoke at the transfer case end of each shaft (Fig. 1). A single U-joint is used at the axle end of the shafts.

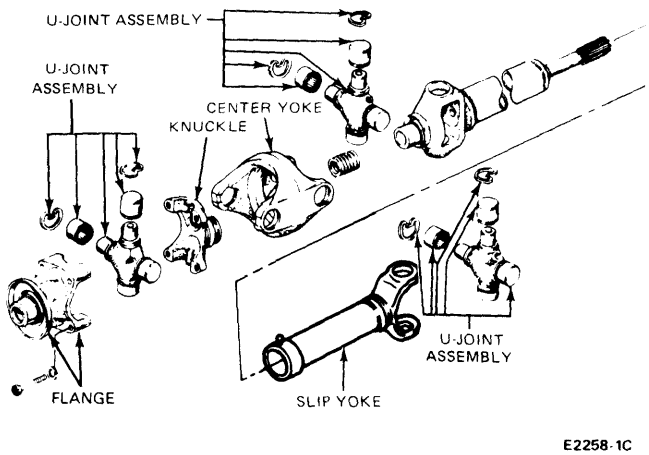


FIG. 1 Driveshaft Disassembled—F-150—F-250 (4x4) Bronco

There is only one flush type fitting for the centering device (Fig. 2). The slip yoke only has one lube fitting. They should be lubricated periodically with lithium grease ESA-M1C75-B or equivalent.

All driveshafts are balanced. Therefore, if the vehicle is to be undercoated, cover the driveshaft to prevent undercoating material from getting on the shaft.

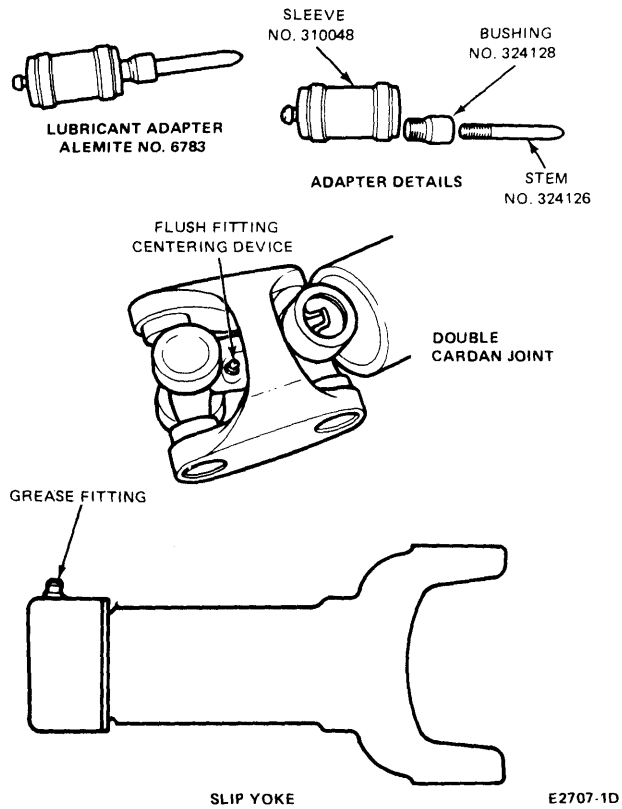


FIG. 2 Lubrication Adapters—Double Cardan Universal Joint

DIAGNOSIS AND TESTING

Refer to Part 15-01, General Driving Axle and Driveshaft Service.

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ADJUSTMENTS

DRIVESHAFT ALIGNMENT

To properly adjust driveline angles, a spirit level protractor is necessary. When the angles are read from the 0 degree mark (for example, measuring inter-axle shaft angle), record and use the angle shown on the protractor since the 90 degree mark must be treated as 0 degree. For example, a protractor reading of 85 degrees is actually 5 degrees (Figs. 3 and 4).

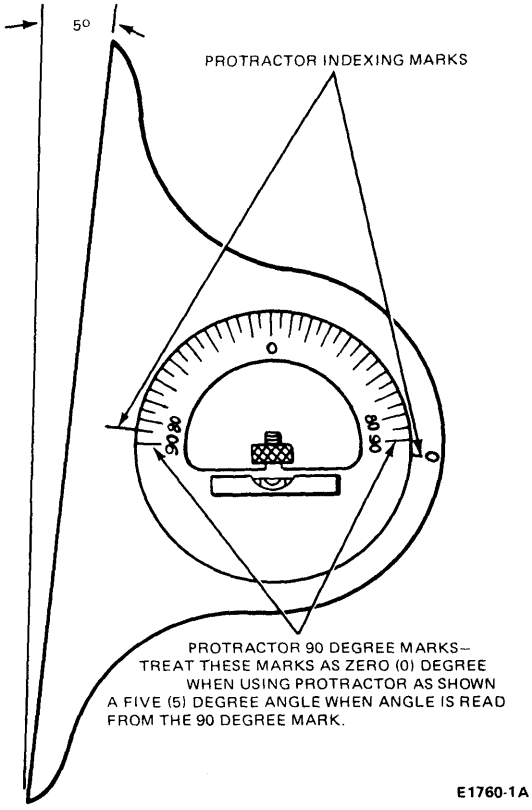


FIG. 3 Driveshaft Angle Read From Zero Mark—Vertical Position

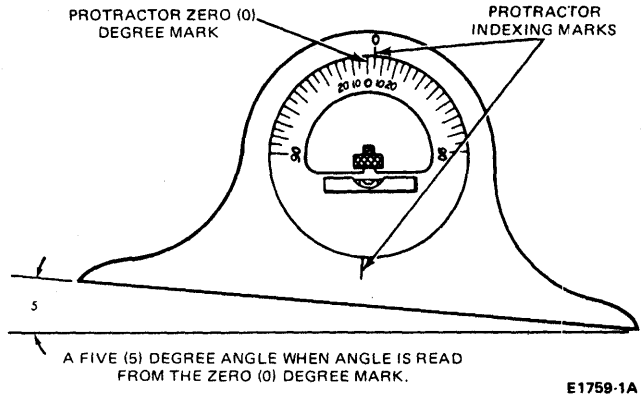


FIG. 4 Driveshaft Angle Read From Zero Mark—Horizonal Position

All angles should be read within 1/2 degree and should be measured with the protractor held plumb on a clean, flat surface. Driveline angles are shown in the specifications section of this part.

DRIVESHAFT BALANCE, RUNOUT AND U-JOINT PHASING

Refer to Part 15-01, General Driving Axle and Driveshaft Service for driveshaft balance, runout and U-joint phasing.

REMOVAL AND INSTALLATION

Removal

1. To remove the rear driveshaft, disconnect the double Cardan joint from the flange at the transfer case and the single U-joint from the flange at the rear axle. Remove the driveshaft.
2. To remove the front driveshaft, disconnect the double Cardan joint from the flange at the transfer case and the single U-joint from the flange at the front axle. Remove the driveshaft.

Installation

1. To install the front driveshaft, position the single U-joint end of the drive to the front axle and install the U-bolts and nuts.
2. Position the double Cardan joint to the transfer case and install the four bolts and lockwashers.
3. Tighten all the bolts and nuts to specification at the end of this part.
4. To install the rear driveshaft, position the single U-joint end of the driveshaft to the rear axle and install the U-bolts and nuts.
5. Position the double Cardan joint to the transfer case and install the four bolts and lockwashers.
6. Tighten all the bolts and nuts to specification at the end of this part.

DISASSEMBLY AND ASSEMBLY

Disassembly

1. Position the driveshaft in a vise.
2. Mark the positions of the spiders, the center yoke, and the centering socket yoke as related to the stud

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yoke which is welded to the front of the driveshaft tube. **The spiders must be assembled with the bosses in their original position to provide proper clearance.**

3. Remove the snap rings that secure the bearings in the front of the center yoke.
4. Position the tool CJ91B as shown in Fig. 5. Thread the tool clockwise until the bearing protrudes approximately 3/8 inch out of the yoke.

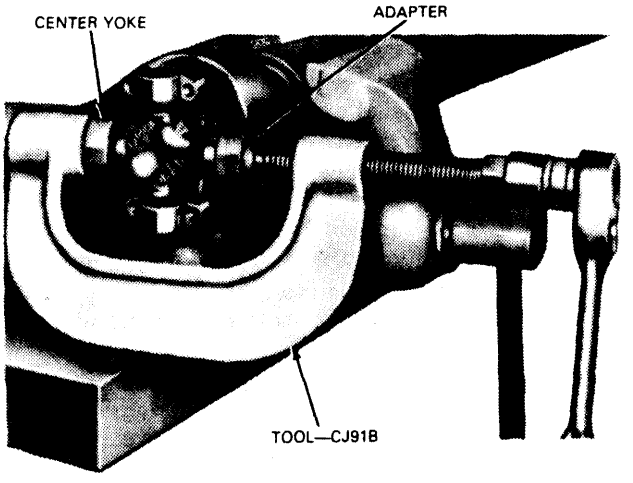


FIG. 5 Partially Pressing Bearing from Center Yoke

5. Remove the driveshaft from the vise.
6. Tighten the bearings in the vise and drive on the center yoke as shown in Fig. 6 to free it from the bearing.

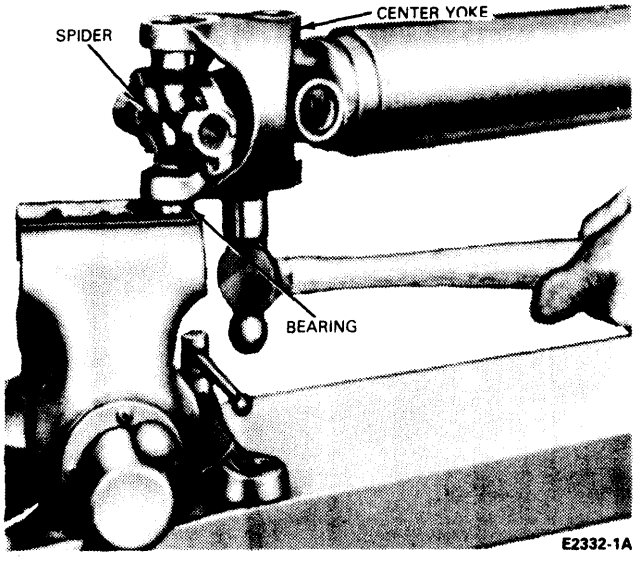


FIG. 6 Removing Bearing from Center Yoke

7. Lift the two bearings from the spider (Fig. 7).
8. Re-position the tool on the yoke and move the remaining bearing in the opposite direction so that it protrudes approximately 3/8 inch out of the yoke.

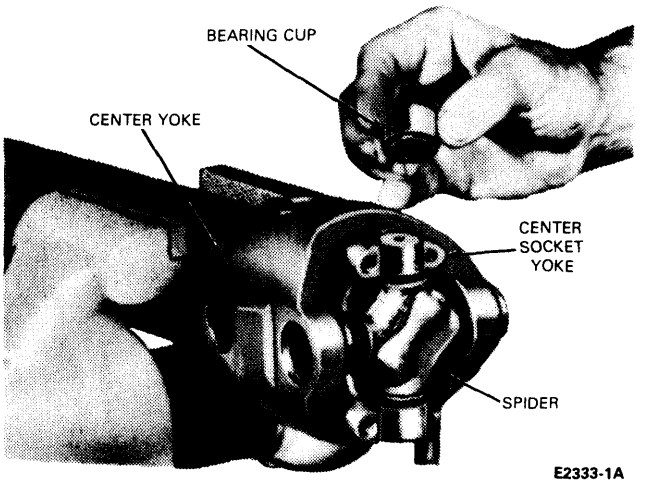


FIG. 7 Removing Bearing Cup from Centering Yoke Socket

9. Grip the bearing in a vise. Drive on the center yoke to free it from the bearing (Fig. 6).
10. Remove the spider from the center yoke.
11. Pull the centering socket yoke off the center stud (Fig. 8). Remove the rubber seal from the centering ball stud.

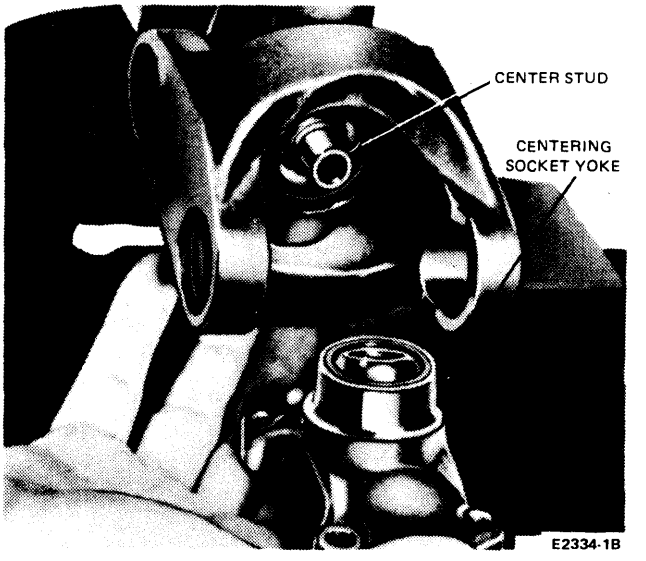


FIG. 8 Removing Center Socket Yoke

12. Remove the snap rings from the center yoke and from the driveshaft yoke.
13. Position the tool on the driveshaft yoke (Fig. 9) and press the bearing outward until the inside of the center yoke almost contacts the slinger ring at the front of the driveshaft yoke. Pressing beyond this point can distort the slinger ring. The arrow in Fig. 10 illustrates the interference point.
14. Clamp the exposed end of the bearing in a vise and drive on the center yoke with a soft-faced hammer to free it from the bearing.
15. Re-position the tool and press on the spider to remove the opposite bearing.
16. Remove the center yoke from the spider.

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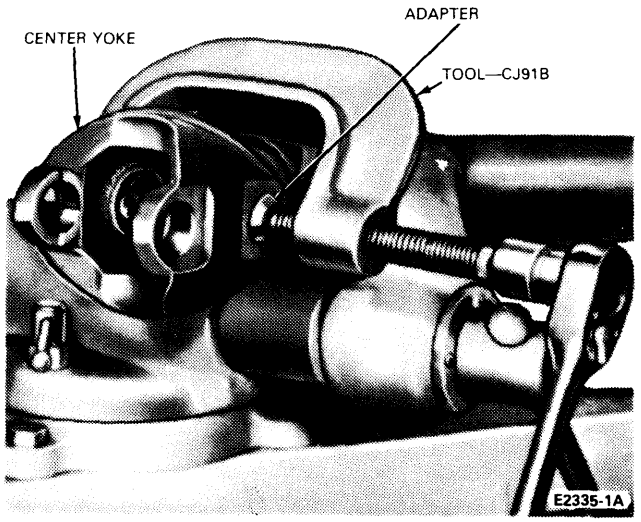


FIG. 9 Removing Bearing from Rear of Center Yoke

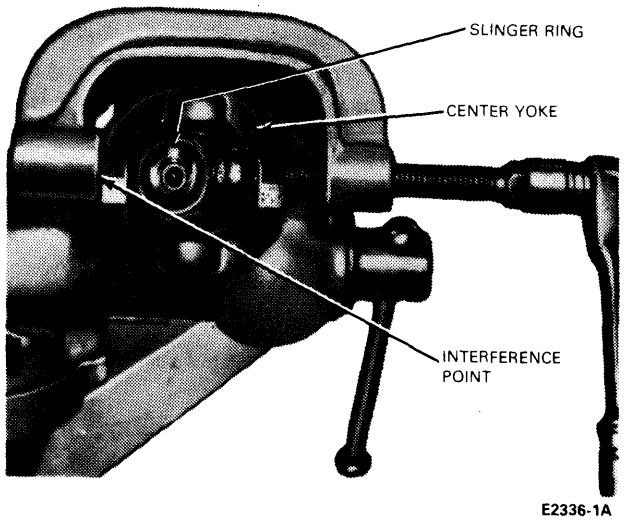


FIG. 10 Center Yoke Interference Point

17. Remove the spider from the driveshaft yoke in the same manner.
18. Clean all serviceable parts in cleaning solvent. If using a repair kit, install all of the parts supplied in the kit. If the driveshaft is damaged, replace the complete shaft to be assured of a balanced assembly.

Assembly

1. To assemble the double Cardan joints, position the spider in the driveshaft yoke. Make sure the spider bosses (or lubrication plugs on kits) will be in the same position as originally installed. Press in the bearing using Tool CJ91B. Install the snap rings.
2. Pack the socket relief and the ball with the specified lubricant C2AZ-19590-B or equivalent, then position the center yolk over the spider ends and press in the bearing. Install the snap rings.
3. Install a new seal on the centering ball stud. Position the centering socket yoke on the stud.
4. Place the front spider in the center yoke. Make sure the spider bosses (or lubrication plugs on kits) are properly positioned.
5. With the spider loosely positioned on center stop, proceed to seat the first pair of bearings into the centering socket yoke, then press the second pair into the centering yoke. Install the snap rings.
6. Apply pressure on the centering socket yoke and install the remaining bearing cup.
7. On kits, remove the plug from each spider and lubricate the U-joints. Re-install the plug in each spider.

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SPECIFICATIONS

REAR AXLE PINION ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Spring Rating at Pad	Spring Part No. 5560	Curb Load Empty
F-150 (4x4) P.T.	116.8"	1735	D2TA-KB	12¾°
F-150 (4x4)	116.8"	1735	D2TA-KB	7¾°
F-150 (4x4) F.T.	133"	1735	D2TA-KB	5¾°
F-250 (4x4) P.T., F.T.	133"	1735	D2TA-KB	5½°
F-350 (4x4) P.T., F.T.	133"	2030	D2TA-LB	5¾°
	133"	2450	D2TA-MB	5¾°
F-150 (4x4) P.T., F.T.	155"	1735	D2TA-KB	5¼°
F-250 (4x4) P.T., F.T.	155"	1735	D2TA-KB	6°
F-350 (4x4) P.T., F.T.	155"	2030	D2TA-LB	6¼°
	155"	2450	D2TA-MB	6¼°

FRONT DRIVESHAFT ANGLES TO HORIZONTAL (DANA 44 AXLE) — F-150/F-250 (4x4)

Model	Wheelbase	Engine	Transmission	Curb Load Empty
F-150 (4x4) P.T.	116.8", 133", 155"	*4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual & Automatic	2¼°
F-150 (4x4) F.T.	116.8", 133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	4¾°
F-250 (4x4) P.T.	133", 155"	*4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	8°
F-250 (4x4) P.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	6½°
F-250 (4x4) F.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7½°

*4.9L (300 CID) I-6 engine not available with 155" wheelbase.

FRONT DRIVESHAFT ANGLES TO HORIZONTAL (DANA 60 AXLE) — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Transmission	Curb Load Empty
F-350 (4x4) P.T.	133", 155"	6.6L (400 CID) V-8	Manual	5¼°
F-250 (4x4) P.T.	133", 155"	*4.9L (300 CID) I-6, 5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	5¼°
F-250/350 (4x4) P.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	4°
F-250/350 (4x4) F.T.	133", 155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	5½°

*4.9L (300 CID) I-6 engine not available with 155" wheelbase.

FRONT AXLE PINION ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Axle	Wheelbase	Curb Load Empty
F-150 (4x4) P.T.	Dana 44	116.8", 133", 155"	8½° ①
F-150 (4x4) F.T.	Dana 44	116.8", 133", 155"	4¾° ①
F-250 (4x4) P.T., F.T.	Dana 44	133", 155"	4½° ①
F-250/350 (4x4) P.T., F.T.	Dana 60	133", 155"	5° ①

① Above horizontal F.T. — Full time P.T. — Part time

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COUPLING SHAFT ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Transmission	Curb Load Empty
F-150/250/350 (4x4) P.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	7¼°
F-150/250/350 (4x4) P.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7½°
F-150/250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	5°

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ENGINE ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Transmission	Angle
F-150/250 (4x4) P.T.	All	4.9L (300 CID) I-6	Manual	5°
F-150/250/350 (4x4) P.T.	All	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	All	5¾°
F-150 (4x4) F.T.	All	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7°
F-250/350 (4x4) F.T.	All	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	7°

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REAR DRIVESHAFT ANGLES TO HORIZONTAL — F-150/F-250/F-350 (4x4)

Model	Wheelbase	Engine	Spring Rating at Pad	Transmission	Curb Load Empty
F-150 (4x4) P.T.	116.8"	4.9L (300 CID) I-6	1735	Manual	12½°
F-150 (4x4) P.T.	116.8"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	12¼°
F-150 (4x4) P.T.	133"	4.9L (300 CID) I-6	1735	Manual	10½°
F-150 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	10¼°
F-150 (4x4) F.T.	116.8"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	12½°
F-150 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	9½°
F-250 (4x4) P.T.	133"	4.9L (300 CID) I-6	1735	Manual	9½°
F-250 (4x4) P.T.	133"	4.9L (300 CID) I-6	2030	Manual	9¾°
F-250 (4x4) P.T.	133"	4.9L (300 CID) I-6	2450	Manual	10°
F-250/350 (4x4) P.T.	133"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual	9¼°
F-250/350 (4x4) P.T.	133"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Manual	9¾°
F-250/350 (4x4) P.T.	133"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Manual	9¾°
F-250/350 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	9¼°
F-250/350 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Automatic	9¾°
F-250/350 (4x4) P.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Automatic	10°
F-250/350 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	8¼°
F-250/350 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Automatic	8¾°
F-250/350 (4x4) F.T.	133"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Automatic	9°
F-150 (4x4) P.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	8½°
F-150 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	9°
F-250 (4x4) P.T.	155"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Manual & Automatic	7°
F-250 (4x4) P.T.	155"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Manual & Automatic	7½°
F-250 (4x4) P.T.	155"	*5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Manual & Automatic	7½°
F-250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	1735	Automatic	7¼°
F-250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2030	Automatic	7¾°
F-250/350 (4x4) F.T.	155"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	2450	Automatic	7¾°

*5.8L (351 CID) V-8, Manual Transmission not available on F-350 (4x4) models.

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ENGINE ANGLE TO HORIZONTAL — BRONCO

Model	Wheelbase	Engine	Transfer Case	Engine Angle
Bronco	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Part Time	5¾°
	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Full Time	7¼°

FRONT DRIVESHAFT ANGLE TO HORIZONTAL — BRONCO

Model	Wheelbase	Engine	Transmission	Transfer Case	Front Driveshaft Angle
Bronco	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	Part Time	4¼°
	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	Part Time	3¼°
	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	Full Time	5°

REAR DRIVESHAFT ANGLE TO HORIZONTAL — BRONCO

Model	Wheelbase	Engine	Transmission	Transfer Case	Rear Driveshaft Axle	
					3350#	3750#
Bronco	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Manual	Part Time	15°	14°
	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	Part Time	16°	15°
	104"	5.8L (351 CID) V-8, 6.6L (400 CID) V-8	Automatic	Full Time	15°	13½°

REAR AXLE PINION ANGLE TO HORIZONTAL — BRONCO

Model	Spring Capacity Pad	Spring Part No. 5560	Curb Load Empty
Bronco	1650#	D8TA-DB	12¼°

FRONT AXLE PINION ANGLE TO HORIZONTAL — BRONCO

Model	Transfer Case	Front Axle Pinion Angle
Bronco	All	4¾°

CE3675-2B

TORQUE LIMITS

Nomenclature	Bolt Size and (ft-lbs)
Drive Shaft-to-Transfer Case Bolts	5/16-24 20-25 (28-33 N•m)
Drive Shaft-to-Front and Rear Axle U-Bolt Nuts	5/16-24 8-15 (11-20 N•m)

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SPECIAL TOOLS

Tool Number	Description
Tool CJ91B	U-Joint Bearing Removal-Installation Tool

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CLUTCH AND MANUAL TRANSMISSION

GROUP 16 (7000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Clutch	16-02	Mechanical Clutch Linkage	16-03
Ford 3.03 Three-Speed Transmission	16-11	New Process 203 Full Time Transfer Case	16-85
Four-Speed Overdrive Transmission	16-30	New Process Part Time 205 Transfer Case	16-84
General Clutch Service	16-01	New Process 435 Four-Speed Transmission	16-25
General Manual Transmission Service	16-10	Warner T-18 Four-Speed Transmission	16-23

General Clutch Service

PART 16-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS GUIDES	01-2	CLEANING AND INSPECTION	
ADJUSTMENTS		Clutch Release Bearing	01-12
Correction	01-11	Clutch Disc	01-13
Flywheel Housing Alignment	01-10	Pilot Bearing (Ball Type)	01-13
Inspection and Alignment Procedures — All Models	01-10	Pressure Plate and Cover	01-13
		SPECIFICATIONS	01-15

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DIAGNOSIS GUIDES

The following guides can be used as an aid in clutch diagnosis.

CONDITION	POSSIBLE CAUSE	CORRECTION
• Clutch pedal hang-up	• Check pedal binding in pedal support due to lack of lubrication.	• Lubricate pedal shaft and bushings in pedal support.
	• Improper clutch adjustment. Excessive clutch pedal free play.	• Adjust clutch.
	• Release bearing and hub assembly binding on transmission input shaft retainer.	• Lubricate bearing hub with M1C75B lubricant or equivalent. Replace transmission input shaft retainer if worn.
	• Broken or missing clutch pedal assist spring.	• Replace spring.
	• Clutch linkage binding due to linkage misadjustment.	• Align clutch linkage.
	• Worn equalizer bar assembly spherical nylon ball bearing.	• Replace spherical nylon ball bearing.
• Clutch thud	• Excessive engine crankshaft end play.	• Repair engine per specifications.
• Clutch vibration (torsional) vehicle moving — 8 cyl. engine @ road speed 30-60 MPH 6 cyl. engine @ 60-30 MPH	• Incorrect clutch disc installed (wrong friction lag specifications).	• Install specified clutch disc.
	• After market (off-brand) clutch disc installed.	• Install specified clutch disc.
	• Malfunctioning engine.	• Check engine performance, tune up engine.
	• Incorrect installation of coupling shaft or drive shaft assembly.	• Install correct parts. Align driveline.
• Clutch linkage clicking (popping noise)	• Clutch adjusting rod movement in conical seat of the release lever — override clutch spring not seating.	• Lubricate conical seat of release lever with M1C75B lubricant or equivalent. Reposition override spring.
• Transmission related problems	• Insufficient clutch reserve (excessive clutch pedal freeplay).	• Adjust clutch pedal freeplay to specifications.
• Gear clash	• Clutch disc warped or bent preventing full release.	• Replace clutch disc.
	• Clutch housing misalignment.	• Realign clutch housing.
• Gear clash	• Pressure plate release finger hang-up.	• Replace pressure plate.
	• Nicked or galled splines on clutch disc or transmission input shaft. Heavy or dried grease rust on input shaft splines.	• Clean disc hub splines and transmission input shaft splines of grease, dirt or rust. Remove nicks or galled areas with file or emery cloth.
• Gear jump-out	• Clutch housing misalignment.	• Realign clutch housing per Shop Manual.
• Noise — clutch fully engaged	• Transmission problem.	• Refer to transmission problems diagnosis for corrective action.
• Low pedal effort and feel and clutch modulation — F Series	• Low effort is normal with new design pressure plate (Belleville).	• None required; however, higher pedal effort can be realized by the removal of the (TB572) over-center spring.
• Start-up chatter during light clutch engagement in low or reverse	• Engine roughness.	• Tune engine. Set idle speed to specifications.
	• Throttle linkage improperly adjusted.	• Readjust.
	• Equalizer bar misalignment and/or excessive end play or wrong parts installed.	• Loosen the clutch equalizer bar to frame bracket assembly and equalizer bar to engine bracket assembly. Adjust frame bracket until the equalizer bar assembly assumes a parallel position to the cowl panel face and to the ground and perpendicular to the crankshaft centerline. Tighten frame bracket and engine bracket attaching bolts to specifications.
	• Engine misaligned. Not properly seated on mounts.	• Loosen engine mount bolts, align and center engine so engine mounts center in teardrop holes.
	• Body mounts improperly torqued.	• Check for correct front and rear body mounts, proper installation and bolt torque.
	• Oil on clutch disc.	• Correct leak, replace disc, clean pressure plate and flywheel friction surfaces with clean solvent (alcohol base). Deglaze flywheel.
	• Glazed flywheel surface.	• Deglaze flywheel surface with coarse emery cloth, stroke parallel to machining lines.
	• Clutch disc warped or bent (little or no reserve).	• Replace clutch disc.
	• Pressure plate attaching bolts loose or missing.	• Replace broken or missing bolts-torque to specification.

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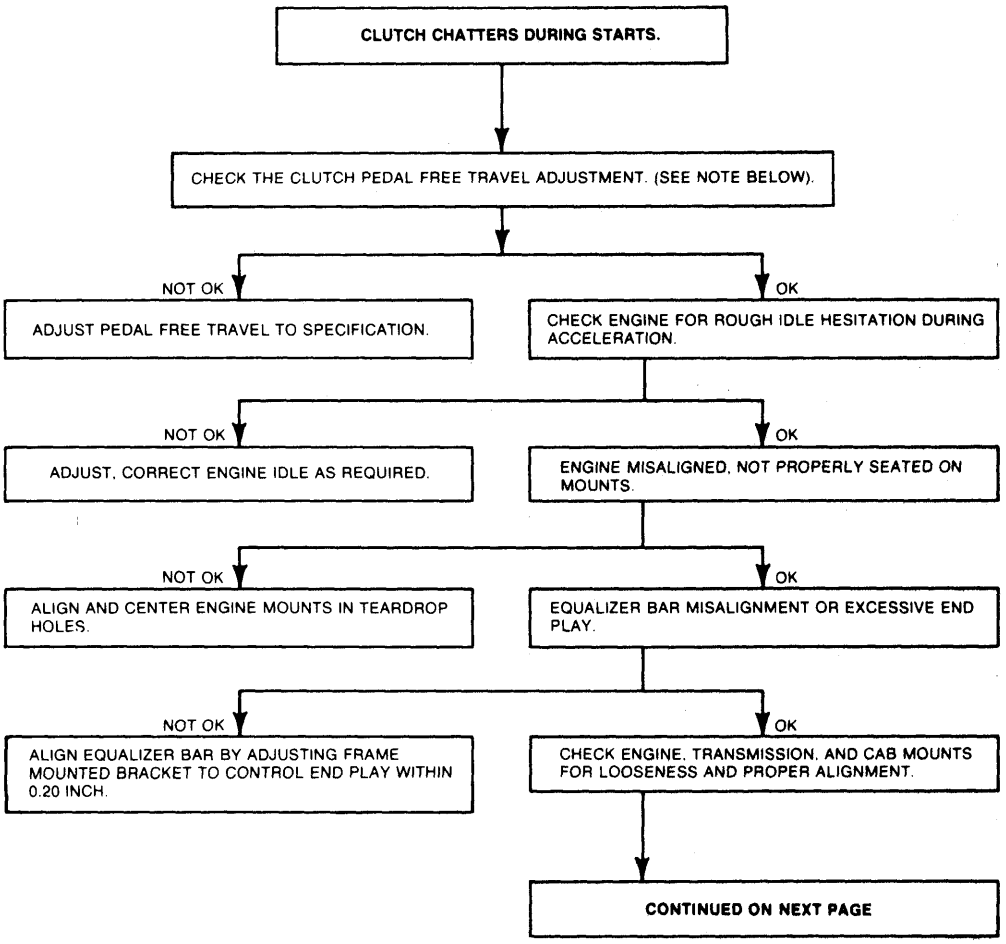
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CONDITION	POSSIBLE CAUSE	CORRECTION
• Start-up chatter during light clutch engagement in low or reverse	• Clutch housing loose or misaligned. • Pressure plate fingers bent, out-of-plane or sticking (will not return hung-up). • Improper clutch adjustment. • Release lever (fork) bent, broken or cracked.	• Realign. • Replace pressure plate. • Adjust clutch. • Replace release lever.
• Clutch inoperative • Clutch noise squeal (engine idling — clutch released when cold). Squeal upon clutch engagement	• Release lever fulcrum bracket broken. • Pilot bearing in crankshaft not square with crankshaft (misaligned). • Clutch housing misalignment (pilot bore and face runout).	• Replace fulcrum bracket in clutch housing. • Replace pilot bearing — seat properly in crankshaft, **do not grease**, clean input shaft pilot and apply coat of light oil for initial lube only. • Align housing.
• Squeak (engine off)	• No lube on equalizer bar bearings. • No lube on release rod bushings or clutch pedal shaft bushings. • No lube on release lever at fulcrum and/or release bearing hub retaining clips. • Loose steering column cover or brake and clutch pedal support bracket at instrument panel. • Clutch rod rubbing in rubber boot.	• Remove equalizer bar, pack ends with M1C75B lubricant or equavalent and replace spherical bearings if worn. • Replace all worn bushings. Apply M1C75B lubricant or equivalent to inside and outside of bushing prior to assembly. • Remove release lever and bearing. Daub M1C75B lubricant or equivalent under leading edge of retaining clips of release bearing and in fulcrum seat of release lever. • Torque all attaching parts to specifications. • Lubricate boot with silicon lubricant spray.
• Scrubby pedal action and feel	• No lube at release lever fingers or rear face of release bearing (under clips). • No lube in release bearing hub. Scored transmission input shaft retainer. • Clutch linkage rubbing on floor pan. • Clutch pedal binding in pedal support. • Worn/binding clutch linkage due to lack of lubrication. • Rusty or galled splines on clutch disc or transmission input shaft retainer.	• Daub ESW-M1C75B lubricant or equivalent under leading edge of hub retaining clips. If clips are open or bent, replace hub and bearing assembly. • Replace release bearing and transmission input shaft retainer. Fill annular groove of release bearing hub with M1C75B lubricant or equivalent. • Align clutch linkage. • Lubricate clutch pedal shaft, bushings and pedal support. • Replace worn or defective parts. Lubricate all linkage components with ESA-M1C75-B long life lubricant or equivalent. • Remove rust and/or galled condition with emery cloth.
• Rattle — engine idling clutch engaged or on light engagement	• No freeplay (constant running release bearing). • Pedal hang-up (pedal does not return to stop). • Failed release bearing.	• Check and adjust pedal freeplay. • Dry pedal shaft — lube pedal shaft and bushings. Check for broken or missing clutch assist spring. Replace if necessary. • Replace release bearing — daub grease under leading edge of hub retaining clips.
• Slipping clutch	• Insufficient clutch pedal freeplay. (Excessive slippage will cause burned out clutch). • Oil on disc assembly. (Also caused clutch chatter).	• Adjust pedal freeplay. • Replace disc after washing flywheel and pressure plate friction surfaces with clean solvent. Deglaze flywheel and pressure plate.
• Clutch slipping (two plate clutch)	• Weak pressure springs. • No free pedal. • Worn clutch facings. • Release mechanism binding. • Grease or oil on facings.	• Replace spring. • Readjust clutch. • Replace facings or complete driven disc assembly. • Free up mechanism and adjust clutch. • Replace facings or complete driven disc assembly.

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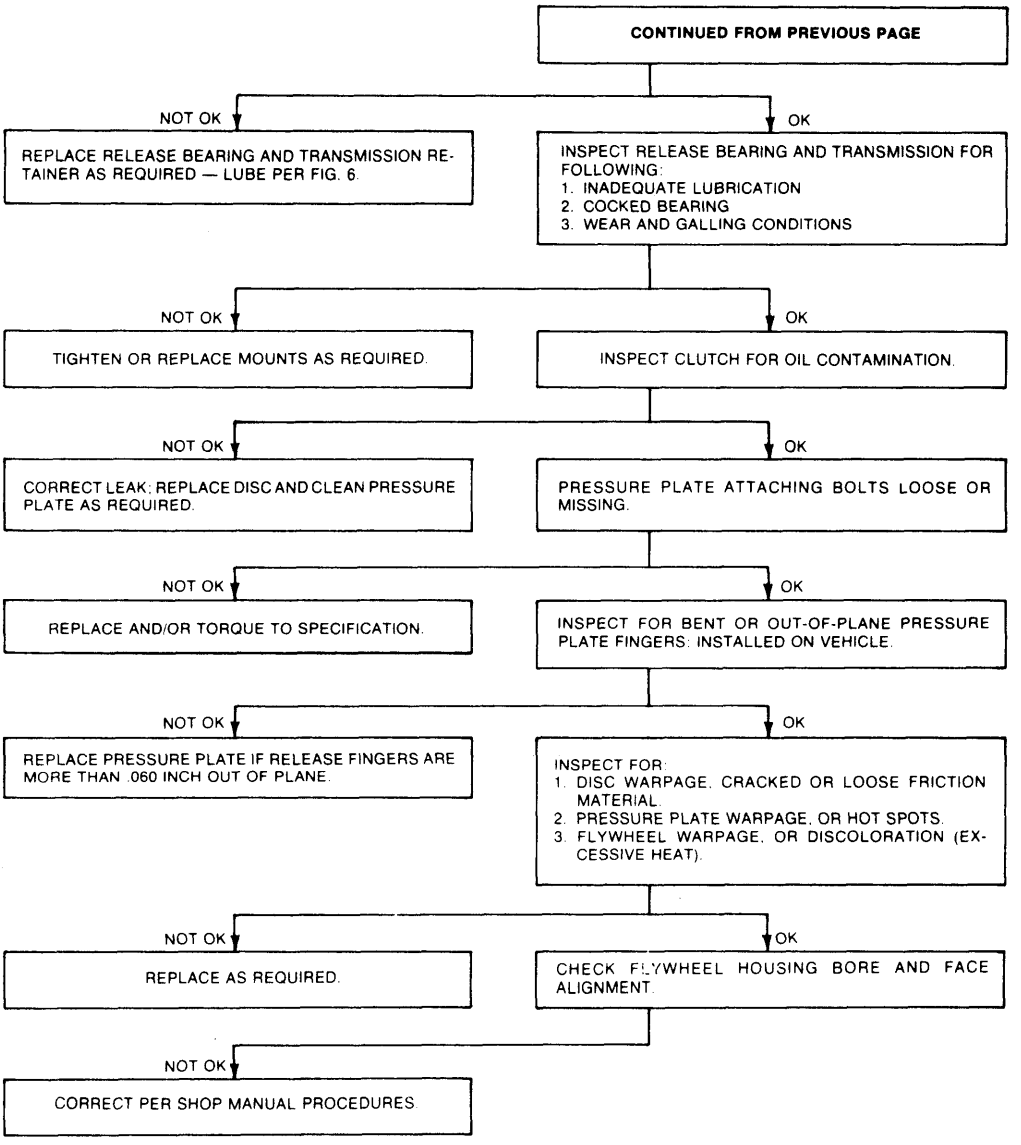


NOTE: A LIGHT CHATTER OR SHUDDER IN THE VEHICLE WHEN ENGAGING THE CLUTCH AT LIGHT THROTTLE IS A NORMAL OCCURRENCE. THIS CONDITION RESULTS FROM THE NEW LOWER NUMERICAL AXLE RATIO. IT MAY BE MORE PRONOUNCED IN HEAVILY LOADED VEHICLES. DRIVE TRAIN FUNCTION AND DURABILITY ARE NOT AFFECTED BY THIS CHATTER CONDITION. THEREFORE, DRIVE TRAIN COMPONENTS, PARTICULARLY CLUTCHES, SHOULD NOT BE REPLACED OR REBUILT IN ATTEMPTS TO ELIMINATE THIS CONDITION.

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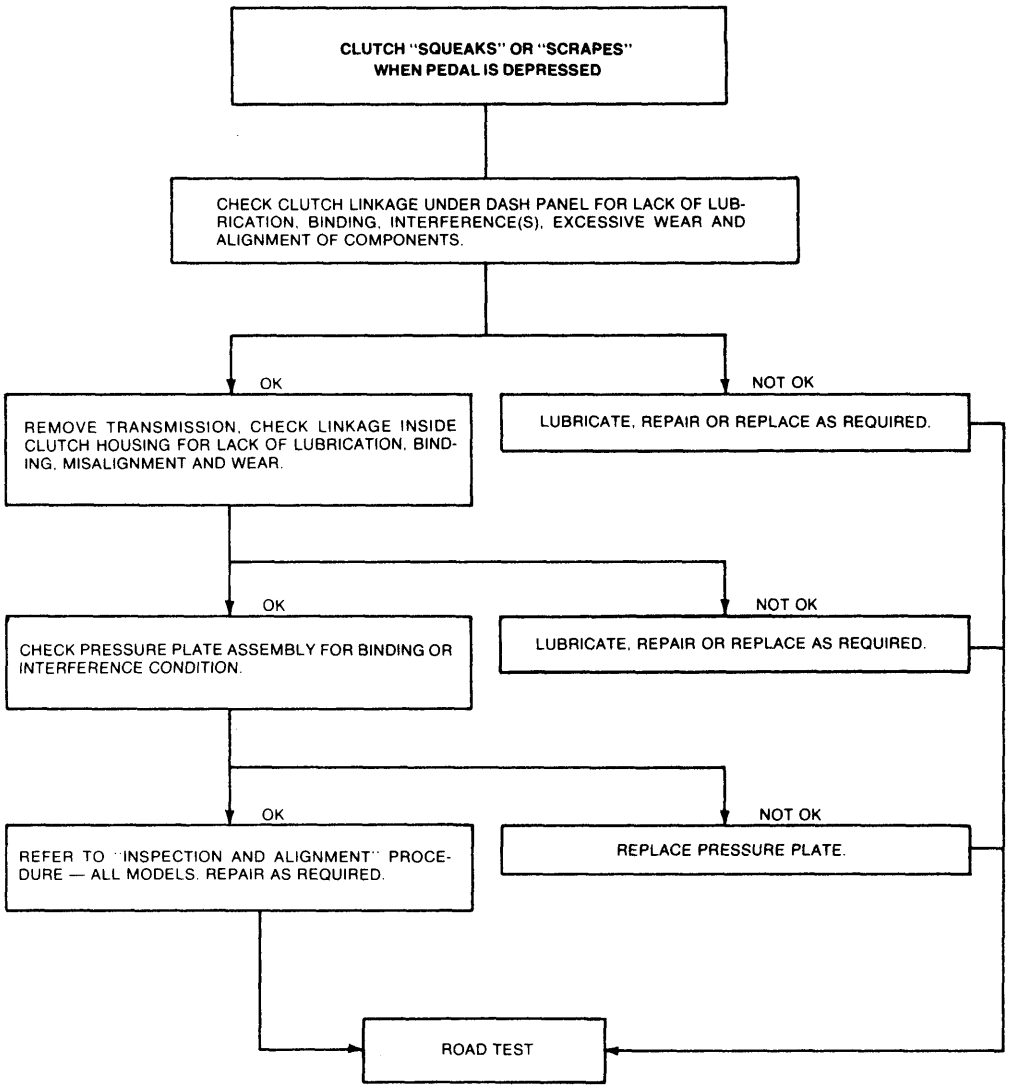
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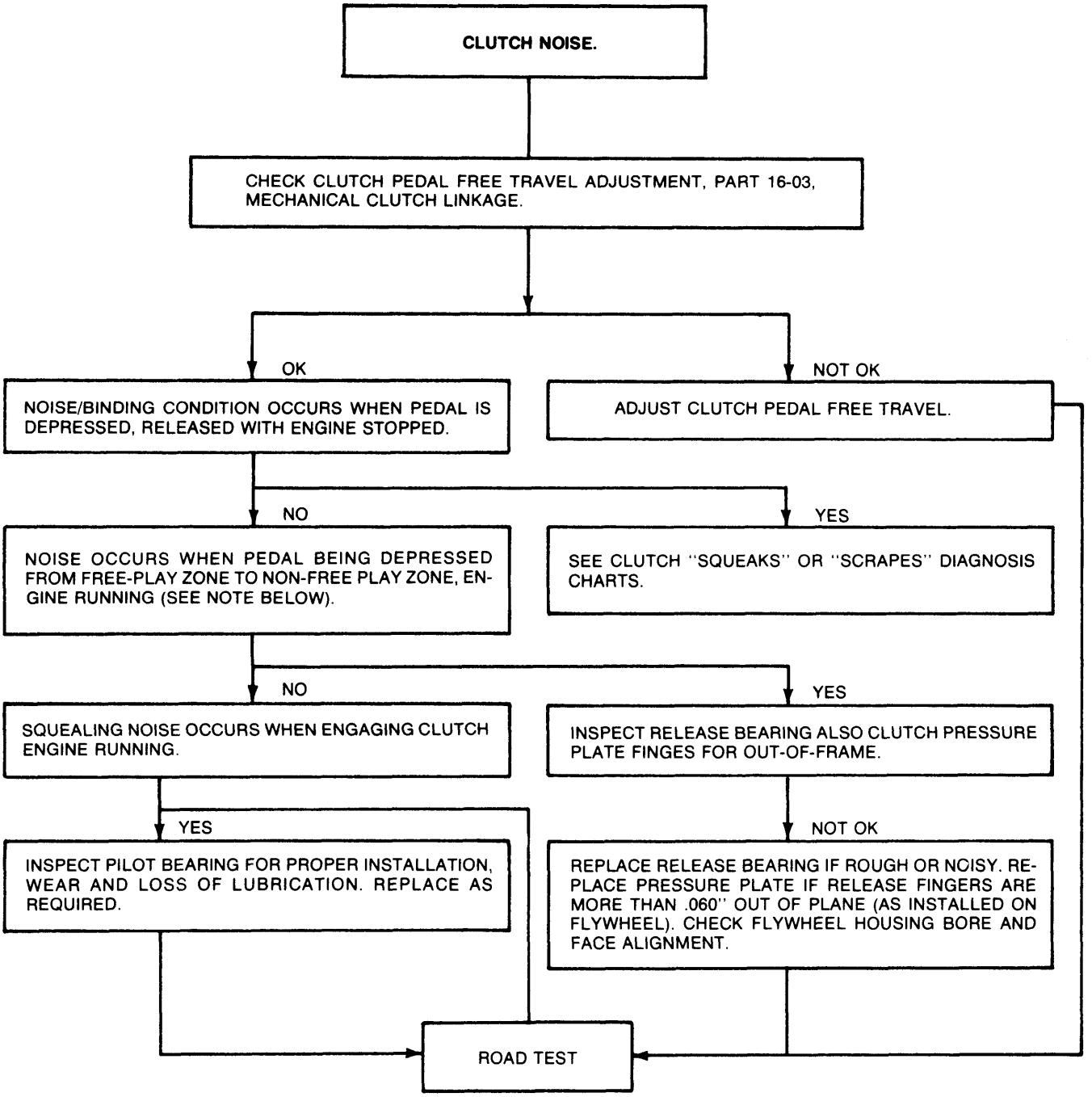
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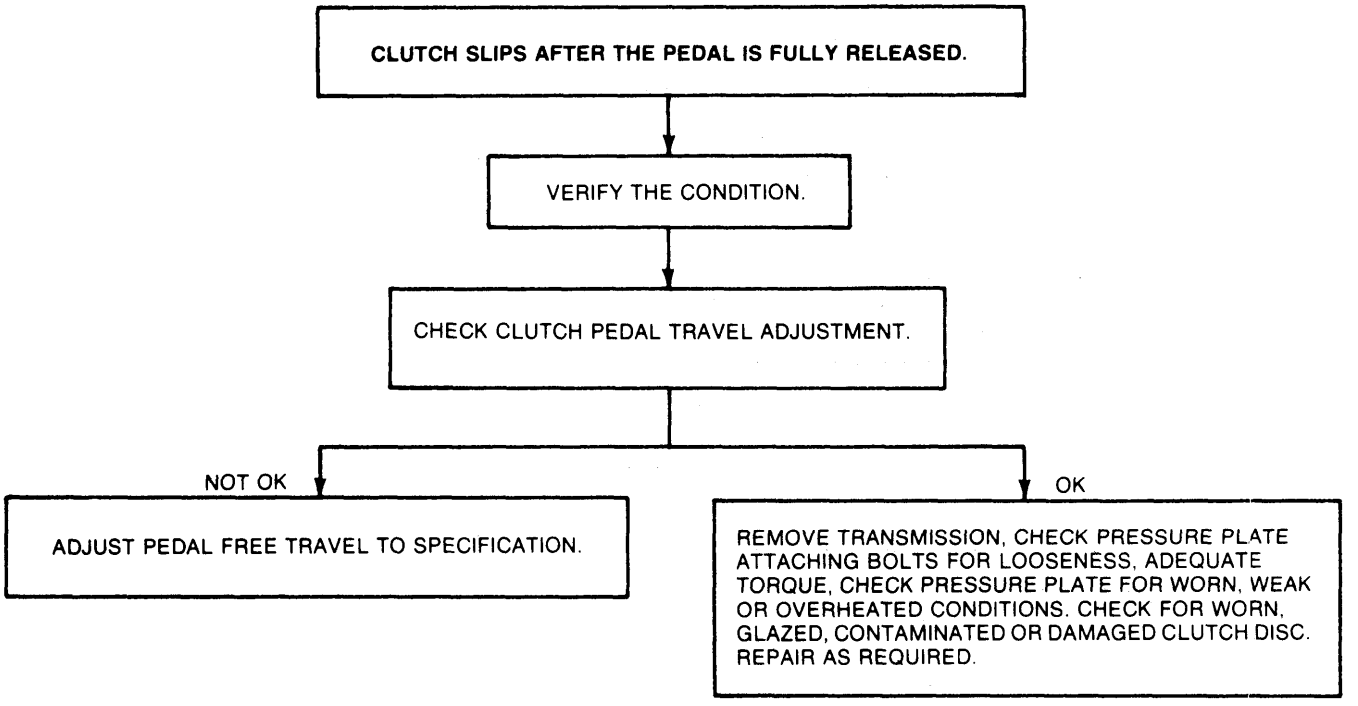


NOTE: A LIGHT INTERMITTENT CLICKING NOISE MAY RESULT DURING PEDAL APPLICATION (TO LIMIT OF PEDAL FREE-TRAVEL) AND UPON FURTHER PEDAL DEPRESSION, A NORMAL BEARING NOISE MAY BE AUDIBLE. SOME NOISE UNDER THESE SITUATIONS WILL NOT ADVERSELY AFFECT CLUTCH FUNCTION AND DOES NOT NECESSARILY INDICATE A FAILED RELEASE BEARING OR OUT-OF-PLANE PRESSURE PLATE RELEASE FINGERS. INSPECTTION OF THESE COMPONENTS IS NOT REQUIRED UNLESS THE NOISE IS EXCESSIVE.

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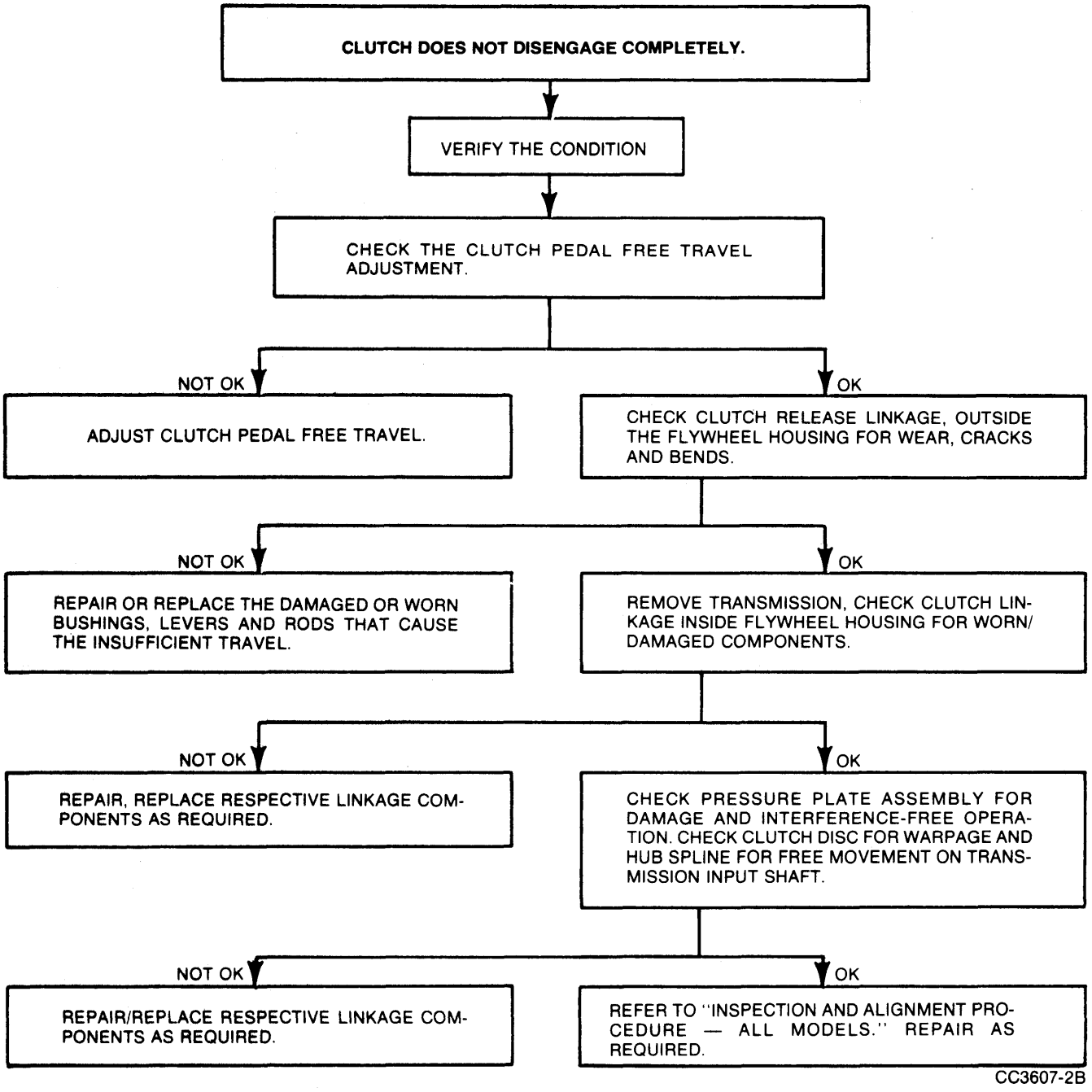
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ADJUSTMENTS

FLYWHEEL HOUSING ALIGNMENT

Inspection and/or alignment of the flywheel housing is indicated when symptoms exist of excessive transmission gear wear, transmission jumping out of gear, driveline vibration, clutch pedal vibration or scrubby feel, pilot bearing noise, release bearing noise, or excessive clutch spin time. Common complaint areas or obvious misadjustment should always be checked and corrected prior to checking alignment, to be sure the basic system is in working order.

INSPECTION AND ALIGNMENT PROCEDURE-ALL MODELS

1. Remove the transmission and fly wheel housing from the vehicle as outlined in the appropriate transmission part Group 16.
2. Inspect, clean and/or remove all nicks, burrs, paint and all other foreign material from the following:
   a. Front and rear face of flywheel housing.
   b. Flywheel housing bore surface.
   c. Rear face of engine block.
   d. Rear engine plate.
   e. Flywheel and engine block dowels (missing or damaged dowels must be replaced).
3. Install the flywheel housing and rear engine plate to the engine less the transmission and tighten the mounting bolts to specification. Refer to the appropriate transmission part in Group 16.
4. Install alignment tool post assembly (Tool T75L-6392-A), with dial indicator base post attached (Fig. 1) through the flywheel housing bore into the clutch disc. Tighten the nut on the end of the post assembly until the clamp (split collet) on the opposite end of the assembly grips the clutch disc splined hub tightly (Fig. 2). Up, down, or side movement of the post assembly must not be evident during the bore and runout test procedure. If any movement is detectable, the nut should be further tightened until movement is stopped, otherwise erratic readings will result. To facilitate installation of the collet to the clutch disc hub, place a short piece of masking tape halfway around the collet to hold it at its smallest diameter until it can be inserted and tightened (Fig. 1).
5. To check face runout, install a dial indicator on the base post using the universal bracket and short extension bar (Tool T75L-4201-B) provided with the alignment kit (Fig. 1). Position the dial indicator so that the indicator button contacts a circumference just outside the transmission pilot hole. Tighten the universal clamp securely (Fig. 3).
6. Push the crankshaft rearward to remove any end play. Set the dial indicator to zero.
7. Holding the crankshaft in the rearward position, rotate the crankshaft through one complete revolution by using a wrench on the crankshaft pulley attaching nut. The dial indicator should return to zero after one revolution unless end play or a loose alignment post has affected the reading.
8. During Step 7, the greatest variation between indicator readings for one revolution should be recorded. A small mirror will be necessary during this procedure through its complete rotation.
9. To verify the reading in Step 8, the procedure should be repeated a second time.
10. After completion of the face runout check, install the dial indicator lever attachment to the dial

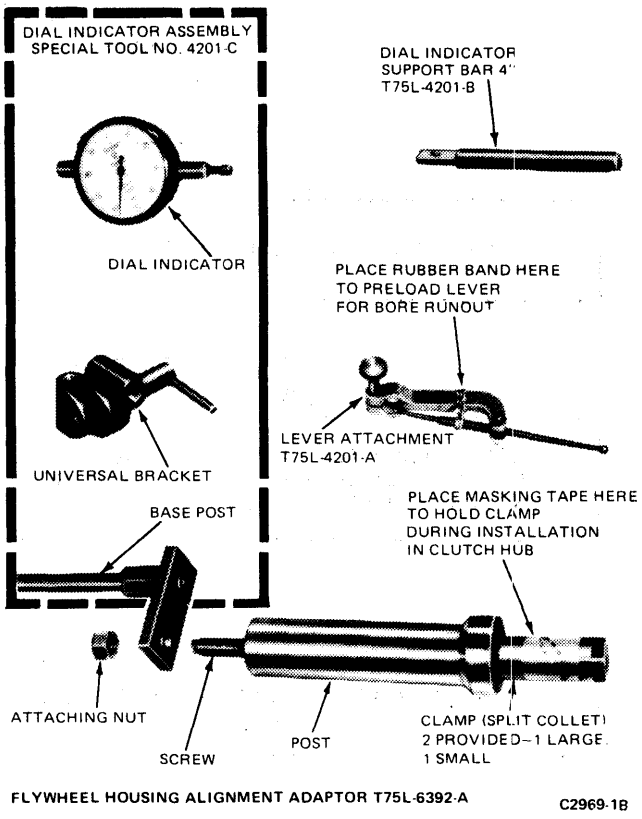


FIG. 1 Special Tools—Flywheel Housing Inspection and Alignment

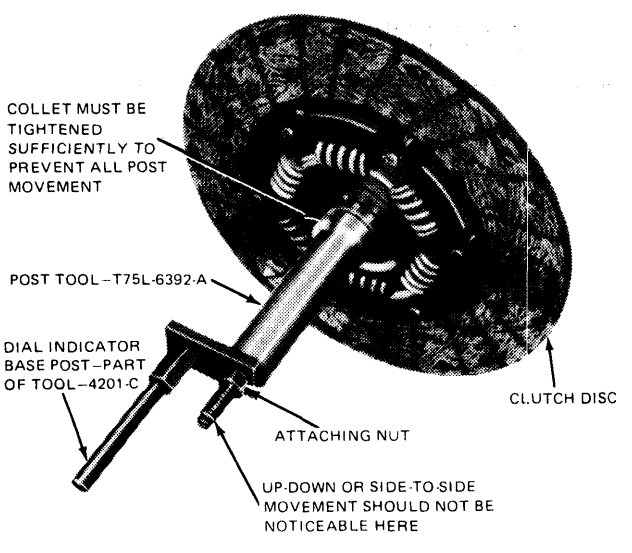


FIG. 2 Installation of Post Assembly

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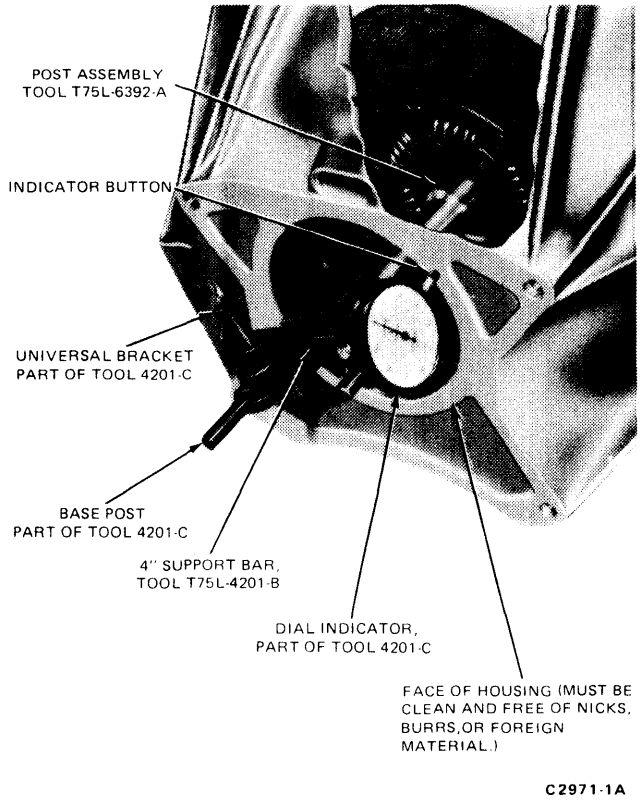


FIG. 3 Installing Dial Indicator For Face Runout Check

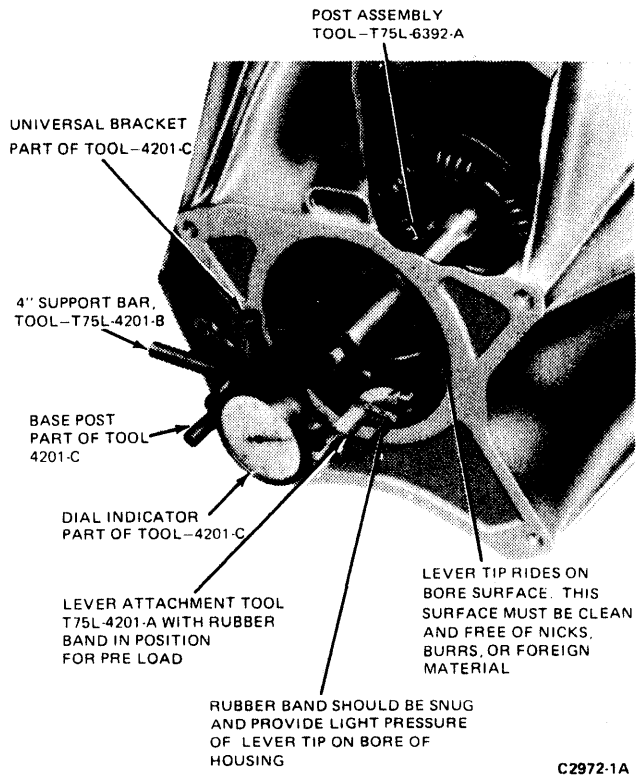


FIG. 4 Installing Dial Indicator For Bore Runout Check

indicator (Fig. 1) and position the assembly to check bore runout (Fig. 4). The rubber band shown attached to the lever (Figs. 1 and 4) must be installed as indicated, prior to installation of the lever, to preload the dial indicator for bore readings.

NOTE: The rubber band should be installed just snug enough to provide a light pressure of the lever tip on the bore of the housing. If the rubber band is too tight, it may bind the dial indicator or distort the reading.

11. Zero the dial indicator and rotate the crankshaft through one revolution as in Step 7. Record the greatest variation between the indicator readings for the complete crankshaft revolution. The reading should be verified by repeating the procedure a second time.
12. If the maximum variation measurements obtained in Step 8 and 11 show that face runout exceeds 0.010 inch and/or bore runout exceeds 0.015 inch, refer to "Correction" below.

Before re-assembly of the transmission to the flywheel housing, the front mounting face of the transmission should be inspected and cleaned. Any nicks, burrs, paint or foreign material must be removed to be sure of alignment between the components. Transmission Welsh plugs should also be checked for proper installation. If the dowels on the flywheel or rear face of the engine are missing or damaged, refer to dowel removal and installation in this Part for instructions.

CORRECTION

Since any change in face alignment will change bore alignment, it may be possible to correct bore alignment by changing the face alignnent. Face alignment can be changed by shimming between the flywheel housing and engine. Fig. 5 shows the type of shim which can be fabricated.

The shim required is one half the maximum (minus) indicator reading, and should be located at the point of maximum (minus) indicator reading.

If both the bore and face alignment are out of limits, shim between the flywheel housing and engine to bring the face alignment within limits. Check the bore alignment.

If the bore alignment is out of limits and face alignment is within limits, shim the flywheel housing to the limit of face misalignment and check the bore alignment. If it is not within limits, replace the housing.

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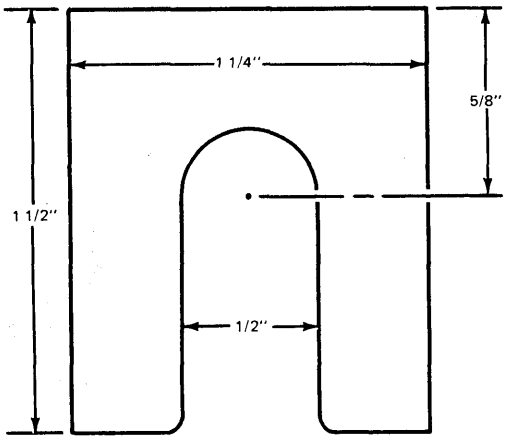


FIG. 5 Fabricated Flywheel Housing Shim

CLEANING AND INSPECTION

CLUTCH RELEASE BEARING

Wipe all oil and dirt off the release bearing. The bearing is prelubricated and should not be cleaned with solvent. On all F-100, F-350, E-100, E-350 and Bronco Series vehicles, the clutch release bearing and hub are serviced as a single unit. Do not disassemble them for inspection or replacement.

Inspect the release bearing as follows:

1. Hold the bearings, hub and back plate and rotate the outer race while applying a compressive pressure. If the bearing rotation is rough, replace the bearing.
2. Inspect/remove any surface scoring or burrs that may impend on the sliding motion of the release bearing on the transmission input shaft retainer. Any scoring or burrs should be polished off with a fine grade emery paper.
3. Inspect retention of release bearing spring clips on clutch release lever for a snug fit. Replace the bearing only if both spring clips do not provide a snug fit.

Prior to re-installation, lubricate for release bearing operation with lithium base grease ESA-M1C75-B or equivalent, at the following points:

1. Fill annular groove of release bearing.
2. Thin coat on inside diameter of release bearing.
3. Release bearing retention clips and fingers of clutch release lever.
4. Fulcrum point of clutch release lever (except E-Series).

Failure situations for release bearing operation:

1. Too little clutch pedal free play may allow contact of clutch fingers on bearing and thus resulting in a continuous running bearing.
2. "Riding the clutch pedal" has the same effect as above.
3. Misalignment of clutch release lever.
4. Misalignment between engine and the transmission. This condition will exhibit symptoms as transmission jumping out of gear, driveshaft vibration, excessive spin time resulting in gear clash, and clutch chatter or start-up.

PRESSURE PLATE AND COVER

The coil spring design pressure plate assembly does not need to be lubricated. The Belleville design pressure plate assembly does not require lubrication.

Inspect the surface of the pressure plate for burn marks, scores, flatness or ridges (Fig. 6). If the pressure plate is badly heat-checked or deeply scored, replace the pressure plate and cover assembly. Clean the pressure plate and flywheel surfaces with a suitable commercial solvent to be sure that surfaces are free from any oil film. **Do not use cleaners with a petroleum base, and do not immerse the pressure plate in the solvent.**

If a substantial difference in finger wear exists, the heavily worn finger is binding. Replace the pressure plate.

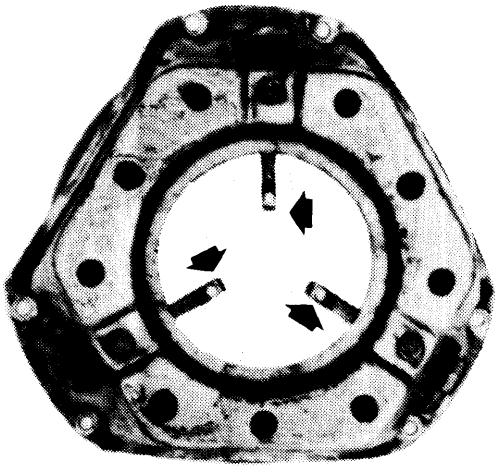
CLUTCH DISC

Inspect the clutch disc facings for oil or grease. ***Eliminate the source of any oil or grease before replacing the disc.*** An excessive amount of grease on the bearing hub will find its way to the disc facings. Too much lubricant in the transmission or a plugged transmission vent will force the transmission lubricant out the input shaft and onto the disc facings. Leaking rear engine seals or loose or unsealed flywheel attaching bolts will allow engine oil to flow onto the disc facings.

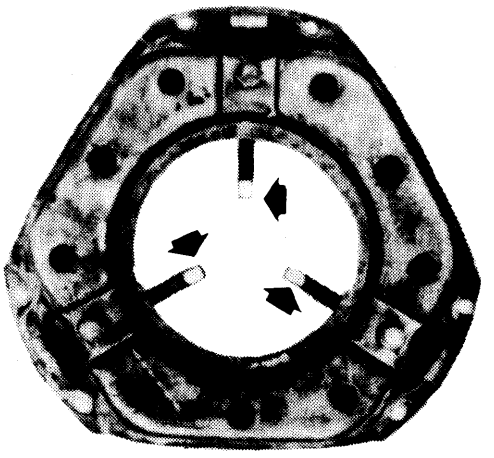
Inspect the clutch disc for worn or loose facings (Fig. 7). Check the disc for warpage and for loose rivets at the hub. Check for broken springs. **Springs loose**

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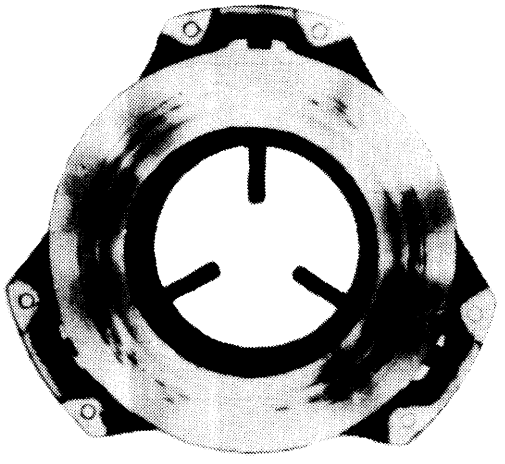
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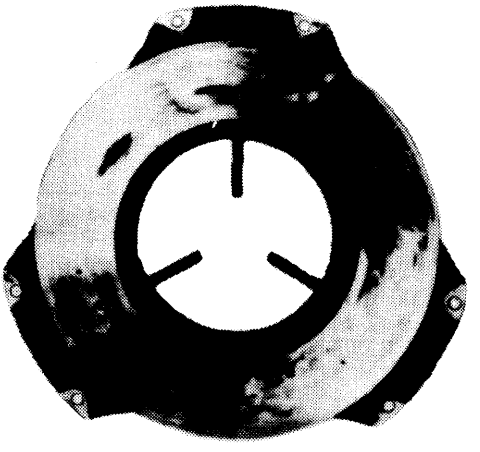
NORMAL FINGER WEAR



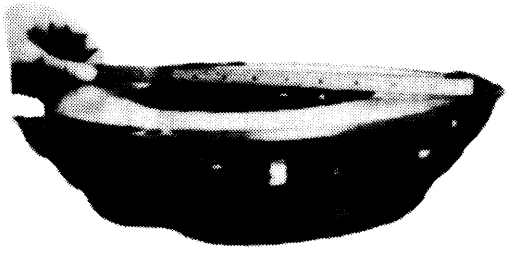
EXCESSIVE FINGER WEAR



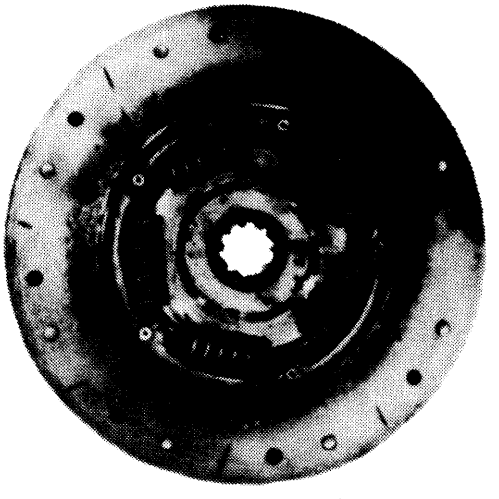
SLIGHT CHATTER MARKS



EXCESSIVE BLUEING AND CHATTER



EXCESSIVE WARPAGE



WEAR PATTERN FROM WARPED PRESSURE PLATE

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FIG. 6 Clutch Inspection

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enough to rattle will not cause noise when the vehicle is operating.

Replace the disc if any of these conditions are present. When installing a new disc, be careful upon handling as not to drop it or contaminate it with oil or grease.

PILOT NEEDLE BEARING ASSEMBLY

Refer to Fig. 6.

Check the fit of the clutch pilot bearing in the bore of the crankshaft. The bearing is pressed into the crankshaft and should not be loose.

Check the pilot bearing (needle type) assembly for mis-alignment and press fit condition in the crankshaft. Visibly inspect the bearing surfaces (needle rollers and transmission input shaft) for scoring, worn or broken rollers, inadequate grease and discoloration due to heating. Check the condition of the bearing's seal. There should be no visible grease leakage on the bearing retainer or the crankshaft.

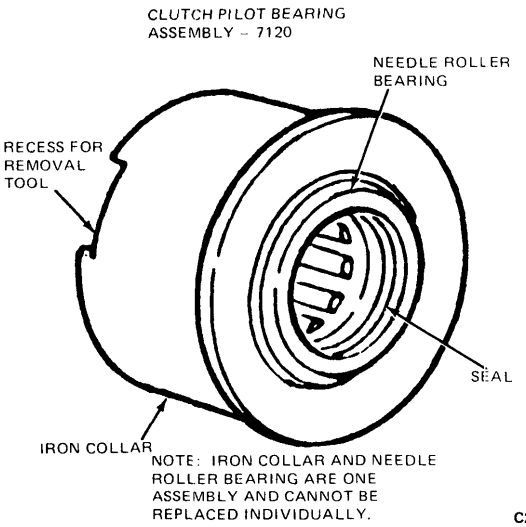


FIG. 7 Needle-Roller Pilot Bearing

SPECIFICATIONS

SPECIAL TOOLS

Tool No.	Description	Tool No.	Description
T64T-7550-A	Clutch Disc Pilot	T58L-101-A	Universal Puller Attachment
T58T-7550-A	Clutch Disc Pilot (Double Disc)	Tool-7660-G	Clutch Pilot Bearing Replacer
T61T-7550-A	Clutch Disc Pilot (Double Disc)	T65L-7660-A	Installer — Clutch Pilot Bearing
T59L-100-B	Remover — Clutch Pilot Bearing	T75L-4201-A	Lever Attachment
Tool-4201-C	Dial Indicator Assembly	T75L-6392-A	Flywheel Housing Alignment Adaptor
T75L-4201-B	Dial Indicator Support Bar		

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Clutch

PART 16-02

APPLIES TO ALL MODELS

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Single Disc Type Clutch	
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11.0 Inch/12.0 Inch	02-2
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DIAGNOSIS AND TESTING

Refer to Part 16-01, General Clutch Service.

REMOVAL AND INSTALLATION

CLUTCH PILOT BEARINGS

A needle roller bearing and adaptor assembly is used as a clutch pilot bearing on E100-E350, E-100-F350, and Bronco vehicles (Fig. 1). It is inserted directly into the engine crankshaft. The bearing and adaptor assembly is used with the bearing and adaptor comprising an assembly that cannot be serviced separately. The needle bearing clutch pilot can only be installed with the seal end of the bearing facing the transmission. The bearing and seal are pregreased and do not require additional lubrication. A new bearing must be installed whenever a bearing is removed.

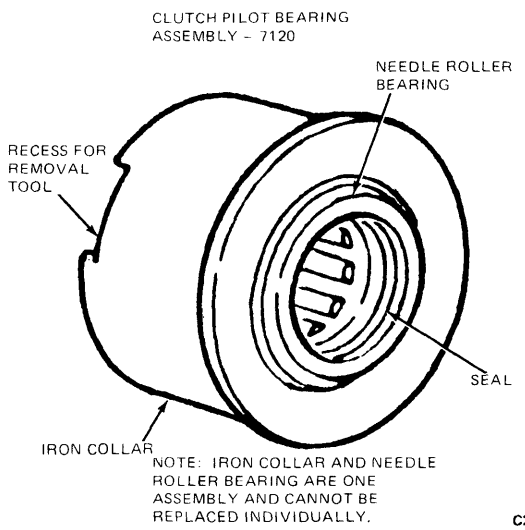


FIG. 1 Needle Pilot Bearing Assembly

Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Group 16.
2. Using Tools T59L-100B and T58L-101-A, remove the pilot bearing (Fig. 2).

Installation

1. Using Tools T74P-7137-A and T74P-7137-H, install the pilot bearing with the seal facing the transmission (Fig. 3) so that the adaptor is not cocked.

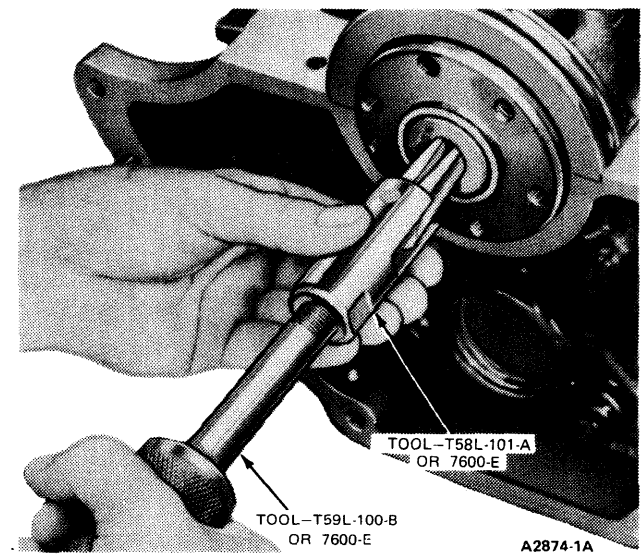


FIG. 2 Removing Clutch Pilot Needle Bearing Assembly

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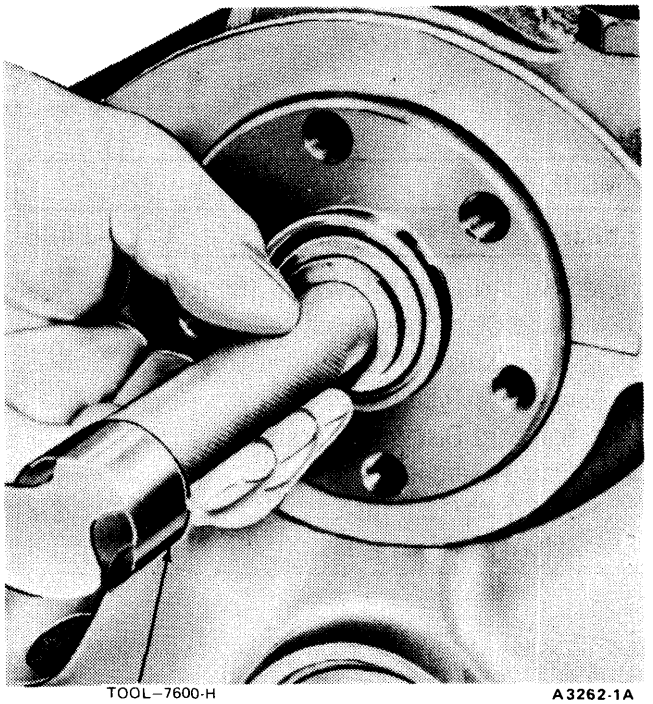


FIG. 3 Installing Clutch Pilot Bearing Assembly

2. Install the clutch pressure plate, disc, and transmission following the procedure in this part and the appropriate transmission part in Group 16.

Note: Care must be taken not to damage the bearing during transmission installation while the transmission input shaft is being inserted into the bearing.

SINGLE-DISC-TYPE CLUTCH

STANDARD DISC AND PRESSURE PLATE ASSEMBLY—11.0 INCH/12.0 INCH

Removal

1. Disconnect the release lever retracting spring and push rod assembly at the lever.
2. Refer to the appropriate transmission Part of this Manual for instructions and remove the transmission from the vehicle.
3. If the clutch housing is not provided with a dust cover, remove the starting motor. Remove the flywheel housing attaching bolts and remove the housing, (Figs. 4, 5 and 6).
4. If the flywheel housing is provided with a dust cover, remove it from the housing. Remove the release lever and release bearing from the clutch housing on F-100-F-350 vehicles. On E-100—E-350 vehicles, the release lever assembly does not need to be removed.
5. Loosen the pressure plate and cover attaching bolts evenly until the pressure plate springs are expanded, and remove the bolts.
6. Remove the pressure plate and cover assembly and the clutch disc from the flywheel or through the opening in the bottom of the clutch housing. **Remove the pilot bearing only for replacement.**

Installation

1. Position the clutch disc on the flywheel so that the pilot tool, T58T-7550-A can enter the clutch pilot bearing and align the disc.

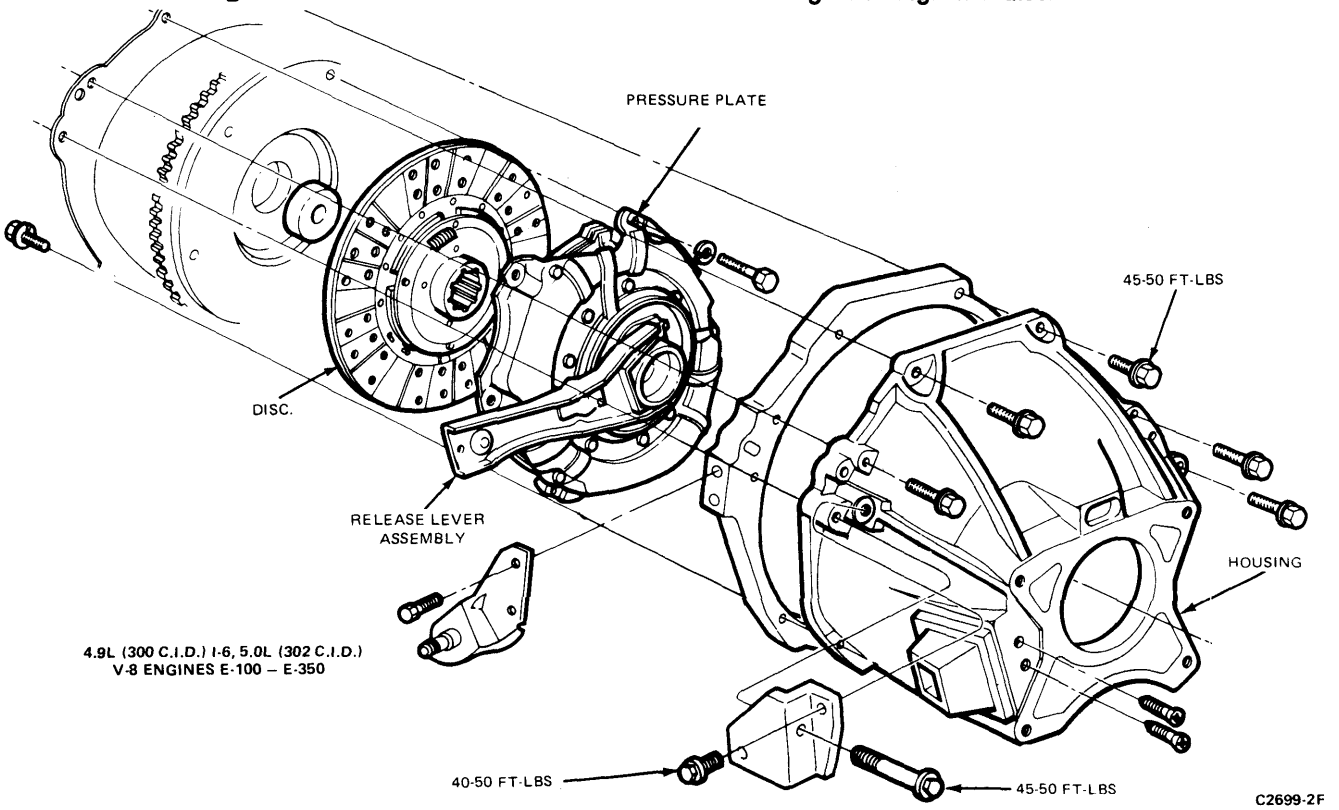


FIG. 4 Clutch Installation—One-Piece Flywheel Housing—E-100—E-350

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2. When re-installing the original pressure plate and cover assembly, align the assembly and flywheel according to the marks made during the removal operations. Position the pressure plate and cover assembly on the flywheel, align the pressure plate and disc, and install the retaining bolts that fasten the assembly to the flywheel. Tighten the bolts to specification (refer to the appropriate transmission Part in this Group), and remove the clutch disc pilot tool.
3. Position the clutch release bearing and the bearing hub on the release lever. Install the release lever on the trunnion in the flywheel housing. Apply a light film of lithium-base grease ESA-M1C75-B or equivalent to the release lever fingers and to the lever trunnion or fulcrum (Fig. 7). Do not grease E-100—E-350 release lever pivot assembly. Fill the annular groove of the release bearing hub with grease.
4. If the flywheel housing has been removed, position it against the engine rear cover plate and install the attaching bolts. Tighten the bolts to specification. Refer to the appropriate transmission part in this group.
5. Check the flywheel housing alignment and adjust the housing as detailed in Part 16-01, General Clutch Service under adjustments.
6. Install the starter motor. Install the transmission assembly on the clutch housing. Tighten the bolts to specification.
7. Adjust the release lever push rod assembly. Connect the release lever retracting spring.
8. Install the clutch housing dust cover if so equipped.

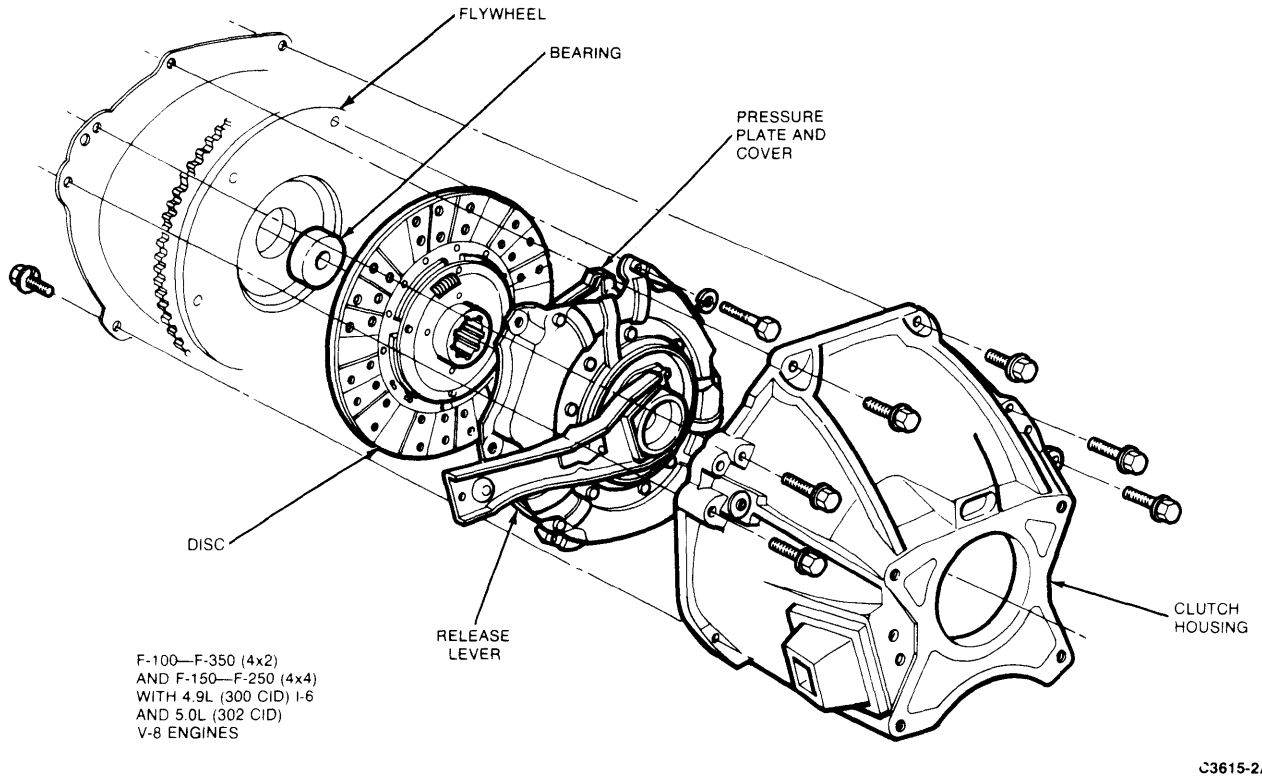


FIG. 5 Clutch Installation—One Piece Flywheel Housing—F-100—F-350 (4x2), F-150, F-250 (4x4)

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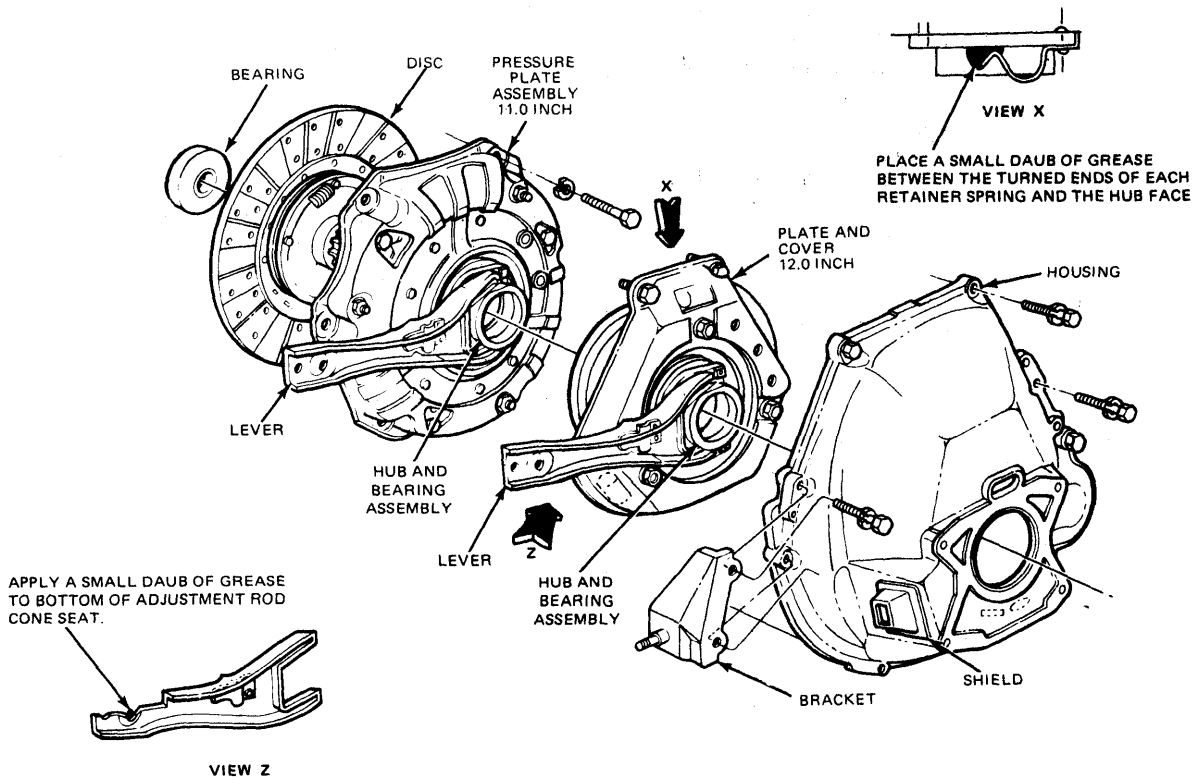


FIG. 6 Clutch Installation—One Piece Flywheel Housing—F-100—F-350, F-150—F-350 (4x4), Bronco

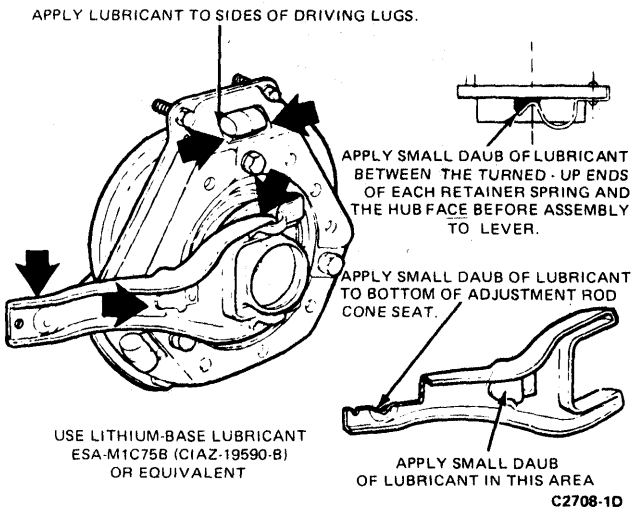


FIG. 7 Clutch Lubrication Points, Bronco, F-100—F-350

SPECIFICATIONS

SPECIAL TOOLS

Number	Description
T59L-100-B or 7600-E	Slide Hammer
T58L-101-A or 7600-E	Pilot Bearing Removal Tool
T74P-7137-A or H	Pilot Bearing Installation Tool
T58T-7550-A	Clutch Alignment Tool

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Mechanical Clutch Linkage

PART 16-03

APPLIES TO All MODELS

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Clutch Equalizer Bar and/or Bushing	
E-100 — E-350	03-15
REMOVAL AND INSTALLATION (Cont'd.)	
Clutch Equalizer Bar and/or Bushing (Cont'd.)	
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Clutch Pedal and/or Bushing	
E-100 — E-350	03-5
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SPECIFICATIONS	03-6

DIAGNOSIS AND TESTING

Refer to Part 16-01, General Clutch Service.

ADJUSTMENTS

CLUTCH PEDAL

E-100—E-350

Refer To Fig. 1 and 2 for adjustment points. Pedal total travel is fixed and is not adjustable.

1. Measure the clutch pedal free travel using a steel tape (Fig. 4). Measure the distance from the clutch pedal pad to the steering wheel rim. Depress the pedal slowly until the free travel between the release bearing assembly and the pressure plate

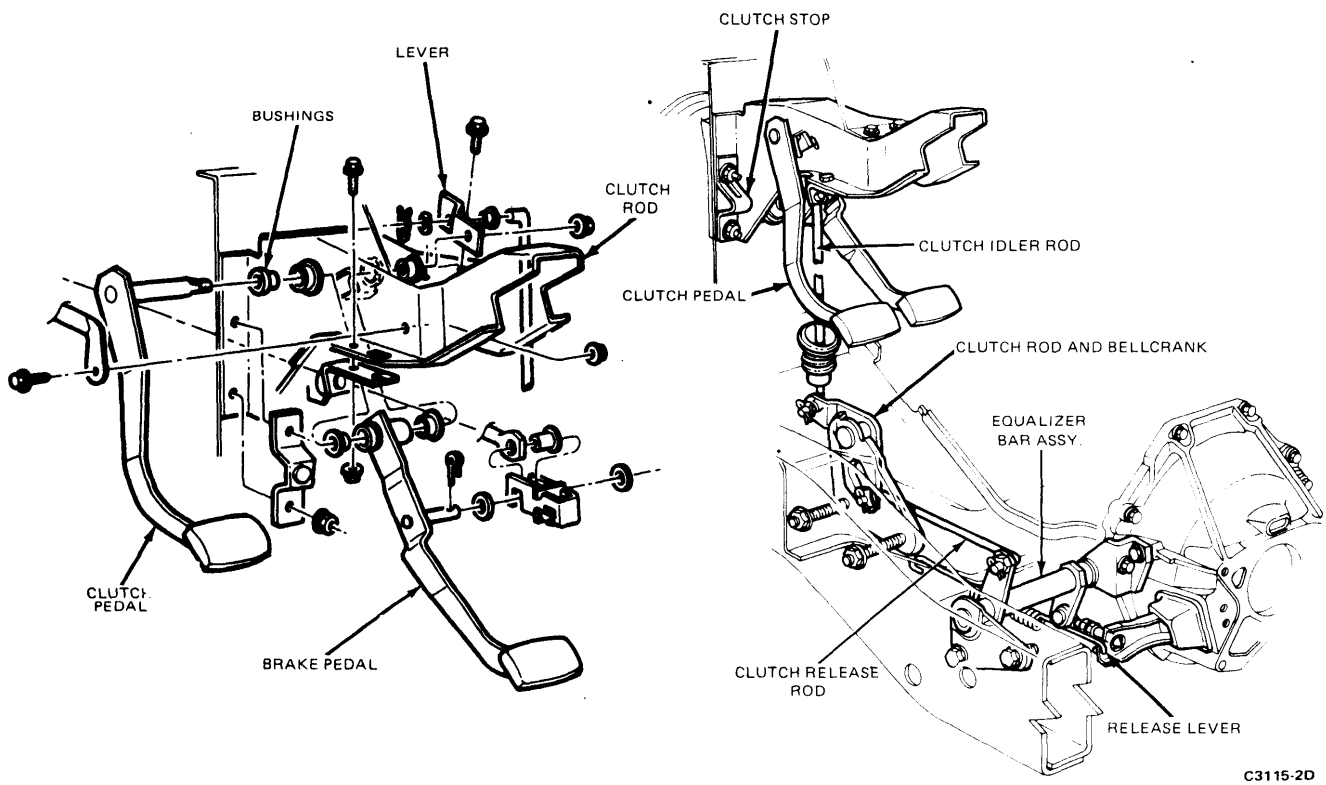


FIG. 1 Clutch Mounting and Linkage—E-100—E-350

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assembly is taken up. Note this measurement. The difference between the two measurements is the free travel.

2. If the free travel measurement is less than 3/4 inch or more than 1 1/2 inch, the clutch linkage must be adjusted.
3. Remove the retracting spring.
4. Loosen the two jam nuts on the release rod assembly (Fig. 2) and back off both nuts several turns.
5. Slide the release rod extension (bullet) firmly against the release lever. Push the release rod forward against the equalizer bar lever to eliminate all freeplay from the linkage system.
6. Insert a .135 inch thick gauge between the jam nut and bullet. Tighten the first jam nut finger tight against the gauge with all freeplay eliminated.
7. Tighten the second jam nut finger tight against the first jam nut. Hold the second nut and tighten the first jam nut to 15-20 ft-lbs. Freeplay should measure 3/4 to 1-1/2 inches at the pedal.
8. With the recommended free travel obtained, and holding the first jam nut, position and securely tighten the second jam nut against the first jam nut.
9. Re-check the pedal free travel.

F-100—F-350, BRONCO

Refer to Fig. 3 for adjustment points. Pedal total travel is fixed in this Series and is not adjustable.

1. Measure the clutch pedal free travel using a steel tape (Fig. 4). Measure the distance from the clutch pedal pad to the steering wheel rim. Depress the pedal slowly until the free travel between the release bearing assembly and the pressure plate assembly is taken up. Note this measurement. The difference between the two measurements is the free travel.
2. If the free-travel measurement is less than 3/4 inch or greater than 1 1/2 inches, the clutch linkage must be adjusted.
3. With retracting spring removed, hold the release rod firmly against release lever, eliminating lever free play.
4. Position first jam nut .062 inches from the bar while holding needle firmly against release lever (Fig. 5).
5. Position second jam nut finger tight against the first nut, while holding second nut. Lock the first nut with 15-20 ft-lbs torque. This gives (3/4 to 1-1/2 inch) at pedal pad with 1-1/2 inches prefered.
6. Check adjustment with retracting spring in place.

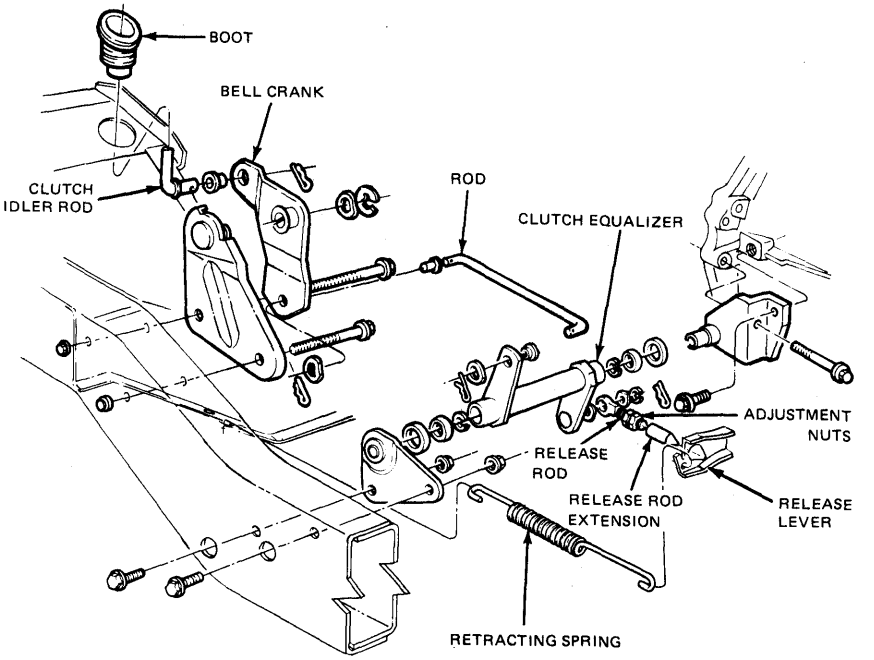


FIG. 2 Clutch Equalizer Shaft—E-100—E-350

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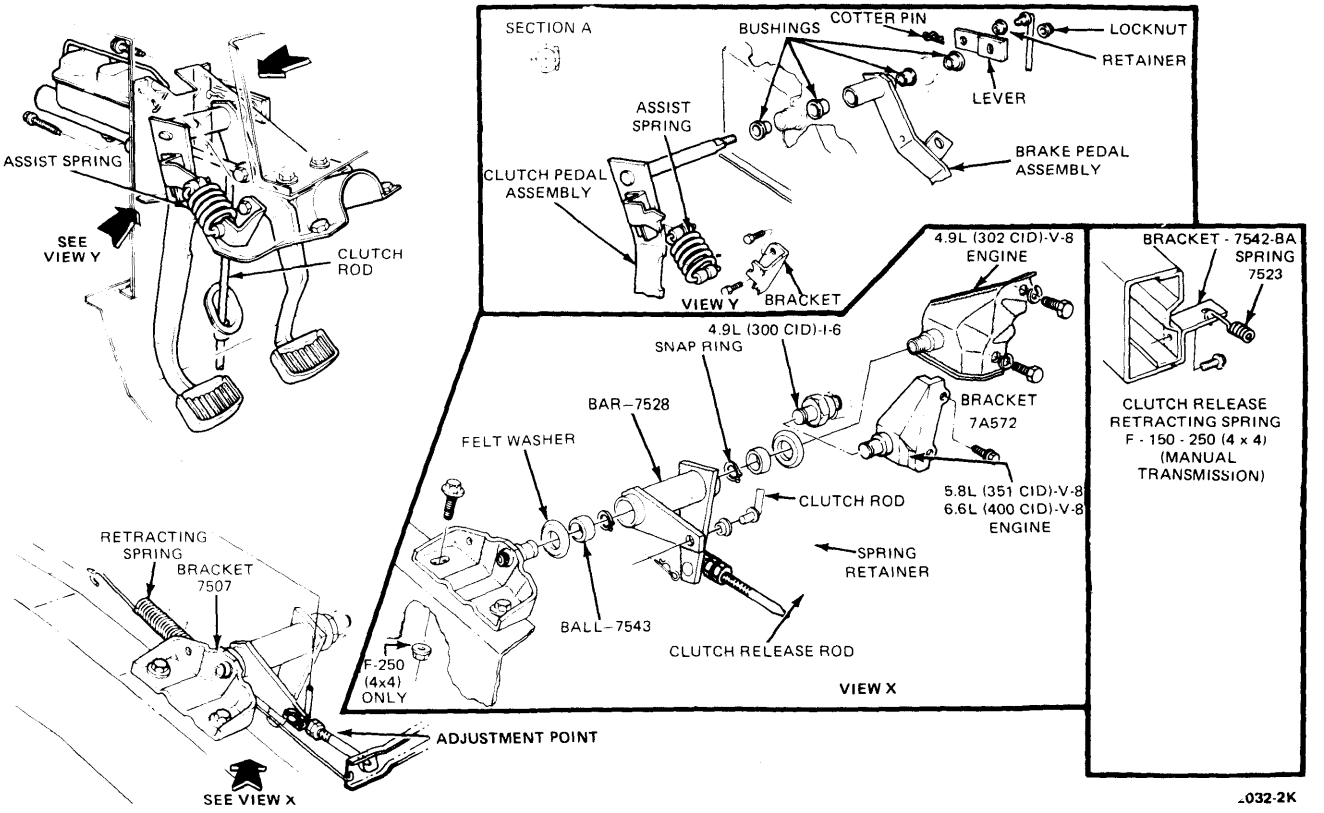


FIG. 3 F-100—F-350, Bronco Series Clutch System

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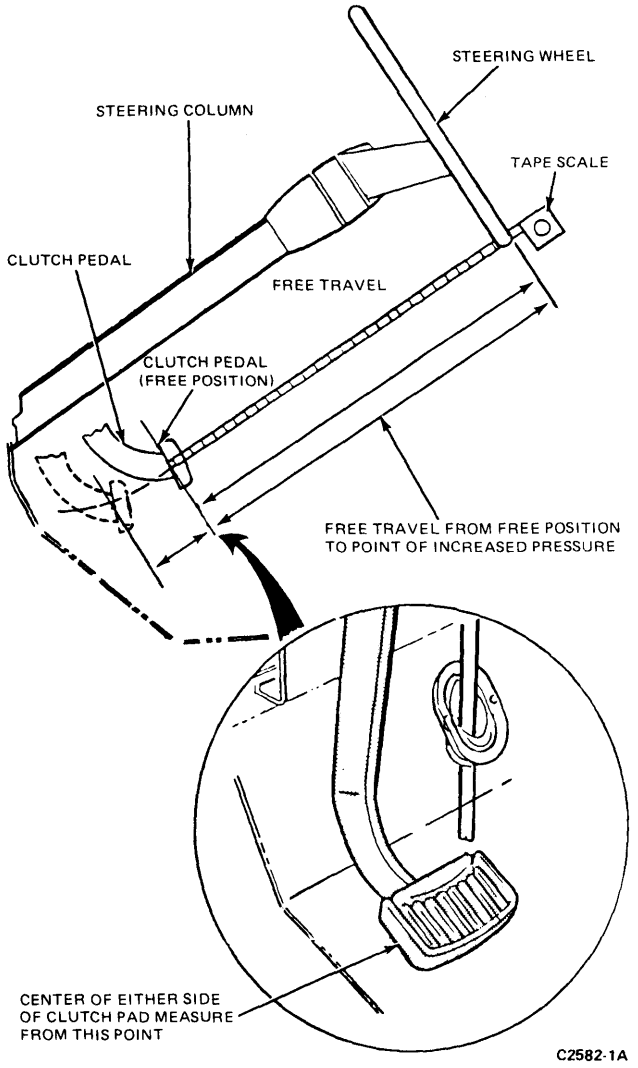


FIG. 4 Measuring Free Travel

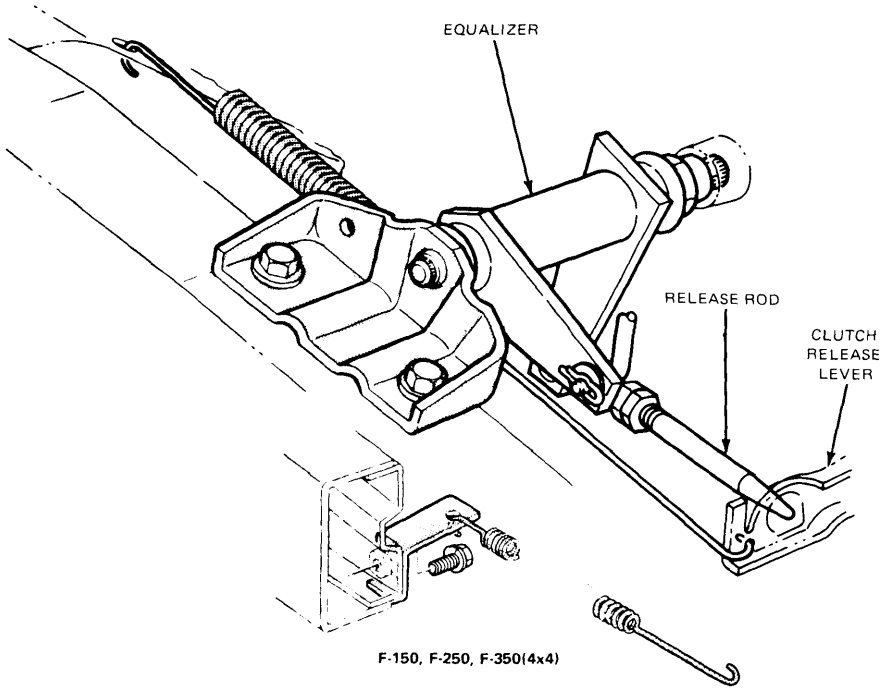


FIG. 5 Clutch Pedal Free Travel Adjustment—F-100—F-350 Bronco Series

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REMOVAL AND INSTALLATION

CLUTCH PEDAL AND/OR BUSHING

E-100—E-350

Removal

Refer to Figs. 1 and 2.

1. Remove retracting spring from clutch release lever.
2. Working under the dash, remove the cotter pin, washer and bushing holding the clutch pedal rod to the clutch pedal lever.
3. Remove the locknut holding the clutch lever and the clutch pedal shaft to the bracket assembly.
4. Remove the clutch pedal and shaft assembly and the brake pedal assembly from the clutch/brake pedal bracket assembly.
5. Remove the clutch pedal bushings from the clutch/brake pedal support bracket.

Installation

1. Reverse the above procedure for installation after lubricating the clutch pedal shaft and bushings with ESA-M1C75-B, lithium base grease or equivalent.
2. Tighten the locknut to 21-30 ft-lbs.
3. Check the clutch pedal free travel as described in this Part. Adjust if necessary.

F-100—F-350, Bronco

Removal

Refer to Fig. 3.

1. Remove the retracting spring from the clutch release lever.
2. Working under the dash with the assist spring in place, temporarily wire the spring coil to prevent it from expanding beyond its installed length.
3. Remove the rod retainer clip and disconnect the clutch pedal-to-equalizer bar rod, (Fig. 3).
4. Removal of the assist spring when wired as in step 2 above:
   a. Push pedal to floor.
   b. Remove lower bolt on assist spring bracket. Loosen upper bolt to allow bracket to pivot.
   c. Remove the assist spring.
   d. Clip and remove the coil retaining wires, step 2 above.
5. Remove the locknut attaching the clutch lever to the clutch pedal assembly shaft and remove the lever.
6. Remove the shoulder bolt bushing and locknut attaching the brake pedal to the master cylinder push rod.
7. Pull the clutch pedal and shaft outboard and remove the brake pedal and bushings along with the clutch pedal and shaft.

Installation

1. Lubricate the clutch pedal shaft and bushings with lithium-base grease, ESA-M1C75-B or equivalent.
2. Position the bushings and brake pedal as shown in Fig. 3 and install the clutch pedal and shaft.
3. Connect the brake pedal to the brake master cylinder push rod using the shoulder bolt bushing locknut. Lubricate the bushing with ESA-M1C75-B or equivalent. Tighten the locknut to 18 to 25 ft-lb.
4. Install the clutch pedal assist spring:
   a. Compress the assist spring and wire the coil to maintain 2.5 inches compressed length across the end rollers, (do not compress solid as spring damage will occur and pedal effort will increase).
   b. Re-install lower fastener on assist spring bracket and tighten the lower and upper bracket fasteners to specifications, (12-18 ft-lbs torque).
   c. Push the pedal to the floor and place the assist spring into its brackets.
   d. Clip and remove the coil retaining wires, (step 4a above).
   e. Pull the pedal up until it hits the step.
5. Position the clutch lever on the clutch pedal shaft and install the locknut. Tighten the lock nut to 21 to 30 ft-lb.
6. Position the clutch pedal-to-equalizer bar rod and bushing in the clutch lever and install the retaining spring clip. Lubricate the bushing with ESA-M1C75-B or equivalent.
7. Check clutch pedal free travel as described in this Part and adjust it if necessary (Fig. 3).

CLUTCH EQUALIZER BAR AND/OR BUSHING

E-100—E-350

Refer to Figs. 1 and 2.

Removal

1. Remove retracting spring from clutch release lever.
2. On outboard side of equalizer bar, disconnect rod.
3. Remove equalizer bar assembly after removing bolts (2) that secure bracket to engine.
4. Replace bushings on equalizer pivot brackets as required.

Installation

1. Reverse the above procedure after lubricating the equalizer bar bores and bushings on the outside and inside diameter with lithium-base ESA-M1C75-B or equivalent.
2. With the equalizer to engine bracket firmly seated, tighten bolts (2), to 45-50 ft-lb.
3. Check the clutch pedal free travel as described in this Part and adjust it if necessary.

F-100—F-350, BRONCO

Removal

Refer to Figs. 3 and 5.

1. Raise the front of the vehicle and install safety stands.
2. Disconnect the clutch release lever retracting spring.
3. Remove the retainer spring clip and disconnect the clutch pedal-to-equalizer bar rod and bushing from the equalizer outer arm (Fig. 3).

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4. Remove the clutch adjuster assembly from the equalizer bar swivel (Fig. 3).
5. Remove the capscrews attaching the outer equalizer bar pivot bracket to the chassis frame and remove the bracket and equalizer bar.
6. Remove the snap rings holding the equalizer bar bushings to the inner and outer pivot brackets and remove the bushings and washers.

Installation

1. Lubricate all bushings and pivot points with lithium-base grease, ESA-M1C75-B or equivalent. Position felt washers and ball-shaped bushings on the inner and outer pivot brackets as shown in Fig. 3 and install the snap rings.
2. Pack the cavities in the ends of the equalizer bar with lubricant ESA-M1C75-B or equivalent. Position the equalizer bar over the inner pivot and install the outer pivot and bracket to the frame. Tighten the attaching capscrews to specification (20 to 30 ft-lb). **The equalizer bar assembly should be parallel to the dash panel and the ground, and perpendicular to the engine crankshaft centerline.**
3. Position the clutch adjusting rod assembly on the equalizer bar assembly swivel.
4. Connect the clutch pedal-to-equalizer bar rod and bushing to the equalizer bar and install the cotter pin. Lubricate the bushing with lithium-base grease ESA-M1C75-B or equivalent.
5. Position the clutch adjusting rod assembly to the clutch release lever and connect the retracting spring. Lubricate the release lever and adjusting rod assembly with ESA-M1C75-B or equivalent.
6. Check the clutch pedal free travel as described in this Part and adjust it as necessary (Fig. 3).
7. Remove the safety stands and lower the vehicle.

SPECIFICATIONS

Models	Free Travel
E-100—E-350	3/4—1-1/2
F-100—F-350, Bronco	3/4—1-1/2

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General Manual Transmission Service

PART 16-10

APPLIES TO ALL MANUAL TRANSMISSIONS

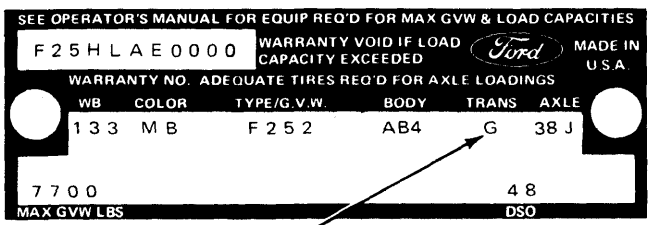
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DESCRIPTION

IDENTIFICATION

See Fig. 1 for the codes used to identify the various manual and auxiliary transmissions available in 1979 vehicles.

1979 model manual transmissions have service identification tag's to identify assemblies for service purposes, (Fig. 2).



TRANSMISSION CODES

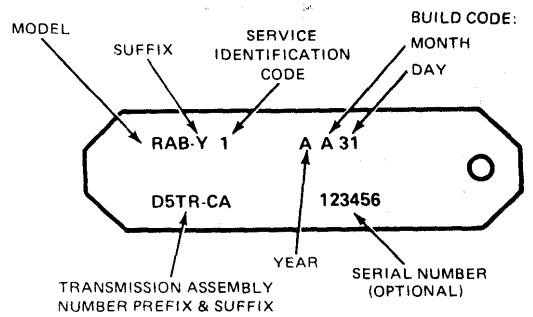
Code	Description
Econoline — Club Wagon	
C	3-Speed Manual
G	Automatic Transmission
B	Ford Manual 4-Speed Overdrive
Bronco — F-100-350	
G	Automatic
C	Ford Manual 3-Speed
F	Warner 4-Speed Manual
A	New Process 4-Speed Manual
B	Ford Manual 4-Speed Overdrive

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FIG. 1 Transmission Identification

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CODE FOR DATE OF MANUFACTURE:

MONTH

A- JANUARY	E- MAY	J- SEPTEMBER
B- FEBRUARY	F- JUNE	K- OCTOBER
C- MARCH	G- JULY	L- NOVEMBER
D- APRIL	H- AUGUST	M- DECEMBER

C3185-1B

FIG. 2 Transmission Identification Tag—3-Speed Manual

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DIAGNOSIS

DIAGNOSIS GUIDES

The following guides can be used as an aid when diagnosing manual transmissions.

CONDITION	POSSIBLE CAUSE	CORRECTION
• Shift lever — improper operation	• Shift rods out of adjustment.	• Check crossover operation. Hand lever must move freely through neutral gate without catch or drag. Adjust shift rods.
	• Steering column shift tube out of alignment.	• Check lever position for proper transmission gear selection. Replace steering column shift tube if necessary.
• Transmission shifts hard.	• Clutch pedal free-travel out of adjustment.	• Adjust clutch pedal free-travel.
	• Clutch does not completely release.	• Refer to "Clutch does not disengage completely," Part 16-01, general clutch service.
	• Transmission fluid low or improper type.	• Add lubricant or change lubricant as required.
	• Shift lever binding or worn.	• Remove cap from shift tower. Eliminate binding condition or replace components as required.
	• Worn or damaged internal shift mechanism.	• Remove transmission cover. Check internal shift mechanism by shifting into and out of all gears. Repair or replace as required.
	• Binding of sliding gears and/or synchronizers.	• Check for free movement of gears and synchronizers. Repair or replace as required.
	• Housings and/or shafts out of alignment.	• Remove transmission and check for binding condition between input shaft and engine crankshaft pilot bearing or bushing. Check flywheel housing alignment. Repair or replace as required.
• Noisy in forward gears.*	• Lubricant level low, or improper type.	• Add lubricant, or refill with specified lubricant.
	• Components grinding on transmission.	• Check for screws, bolts, etc., of cab or other components grinding. Correct as required.
	• Component housing bolts loose.	• Check torque on transmission to flywheel housing bolts, output shaft flange nut and flywheel housing to engine block bolts. Tighten bolts to specification.
	• Flywheel housing to engine crankshaft alignment.	• Check and align flywheel housing to engine crankshaft.
	• Noisy bearings or gears.	• Remove and disassemble transmission. Inspect input, output and countershaft bearings. Inspect speedometer gear and gear teeth for wear or damage. Replace as required.
• Gears clash when shifting from one forward gear to another.	• Engine idle speed too high.	• Adjust engine idle speed.
	• Clutch pedal free-travel incorrect.	• Check clutch for pedal free-travel, complete release and spin time. Adjust as required.
	• Improper manual-shift linkage.	• Adjust and repair manual-shift linkage as required.
	• Pilot bushing or bearing binding.	• Remove transmission and check for a binding condition between input shaft and engine crankshaft pilot bushing or bearing. Replace as required.
	• Damaged gear teeth and/or synchronizer.	• Disassemble transmission, repair or replace as required.
• Transmission jumps out of gear.	• Manual-shift linkage binding, out of adjustment. Stiff shift boot.	• Adjust linkage. If necessary align steering column to truck body. Replace shift boot if exceptionally stiff.
	• Loose transmission to engine mounting bolts, or loose levers.	• Tighten transmission to flywheel housing, and flywheel housing to engine block bolts to specifications. Loosen all bolts and reseat flywheel housing. Tighten all bolts. Tighten levers if necessary.
	• Flywheel housing to engine crankshaft out of line.	• Shim or replace housing as required.
	• Crankshaft pilot bushing or bearing worn.	• Replace bushing or bearing.
	• Interior components damage.	• Disassemble transmission. Inspect the synchronizer sleeves for free movement on their hubs. Inspect the synchronizer blocking rings for widened index slots, rounded clutch teeth and smooth internal surface. Check countershaft cluster gear for excessive end play. Check shift forks for loose mounting on shift rails. Inspect synchronizer sliding sleeve and gear clutch teeth for wear or damage. Repair or replace as required.
• Transmission will not shift into one gear — all others OK.	• Manual linkage out of adjustment.	• Adjust manual linkage.
	• Manual-shift linkage damaged or worn.	• Lubricate, repair or replace parts as required.
	• Back-up switch ball frozen.	• If reverse is problem, check back-up switch for ball frozen in extended position (if so equipped).
	• Internal components.	• Remove transmission. If transmission will not shift into reverse, remove transmission, check for damaged reverse gear train, in single rail shift transmission. Also, check for misaligned reverse relay lever. Inspect shift rail and fork system synchronizer system and gear clutch teeth for restricted travel. Repair or replace as required.

*While verifying the condition, determine whether the noise is gear roll-over noise, release bearing rub or some other transmission related noise.
Gear roll-over noise, inherent in manual transmissions, is caused by the constant mesh gears turning at engine idle speed, while the clutch is engaged and the transmission is in neutral; and release bearing rub are sometimes mistaken for mainshaft bearing noise.
Gear roll-over noise will disappear when the clutch is disengaged or when the transmission is engaged in gear. Release bearing rub will disengage when the clutch is engaged in the event that a bearing is damaged, the noise is more pronounced while engaged in gear under load or coast than in neutral.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• Transmission is locked in one gear. It cannot be shifted out of that gear.	• Manual-shift linkage out of adjustment, binding or damaged. • Internal components. • Neutral sensing switch. • Loose fork on rail.	• Disconnect the problem shift rod from transmission shift lever. Try to shift the transmission lever into and out of gear position. If OK, repair or replace linkage parts. • Remove transmission. Inspect problem gears, shift rails and forks and synchronizer for wear or damage. Repair as required. Check for broken fork slot tabs on single rail transmissions. • Check neutral sensing TRS switch (if so equipped) for ball frozen in extended position. Replace if necessary. • On single rail shift, check for broken selector arm pin. Repair or replace as necessary.
• Transfer case makes noise. (New Process gear models 203 and 205.	• Incorrect tire inflation pressures and/or incorrect size tires and wheels. • Excessive tire tread wear. • Internal components.	• Assure that all tires and wheels are the same size, and that inflation pressures are correct. • Check tire tread wear to see if there is more than .06 inch difference in tread wear between front and rear. Interchange one front and one rear wheel. Re-inflate tires to specifications. • Operate vehicle in all transmission gears with transfer case in 2HI, or Hi range (203). — If there is noise in transmission in neutral gear, or in some gears and not in others, remove and repair transmission. — If there is noise in all gears, operate vehicle in all transfer case ranges. If noisy in all ranges or HI range only, disassemble transfer case. Check input gear, intermediate and front output shift gear for damage. Replace as required. If noisy in LO range only, inspect intermediate gear and sliding gears for damage. Replace as required.
• 4-wheel drive transfer case jumps out of gear (New Process gear models — 203 full time, 205 part time).	• Incomplete shift linkage travel. • Loose mounting bolts. • Front and rear driveshaft slip yokes dry or loose. • Internal components.	• Adjust linkage to provide complete gear engagement. • Tighten mounting bolts. • Lubricate and repair slip yokes as required. Tighten flange yoke attaching nut to specifications. • Disassemble transfer case. Inspect sliding clutch hub and gear clutch teeth for damage. Replace as required.
• Transmission leaks.	• Improper amount of lubricant — wrong type. • Other component leaking. • False report. • Internal components.	• Check level and type. Fill to bottom of filler plug hole. • Identify leaking fluid as engine, power steering or transmission. Repair as required. • Remove all traces of lube on exposed transmission surfaces. Check vent for free breathing. Operate transmission and inspect for new leakage. Repair as required. • Remove transmission. Inspect for leaks at the input shaft bearing retainer seal and gasket, and shift rail expansion plug. Inspect for leaks at the top cover gasket. Inspect case for sand holes. Repair or replace as required.

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REMOVAL AND INSTALLATION

REAR SEAL

E-100—E-350, F-100—F-350

Removal

1. Remove the drive shaft.
2. Remove the seal from the extension housing with the tool shown in Fig. 3.

Installation

1. Install a new seal in the extension housing with tool shown in Fig. 4. Lubricate seal with C1AZ-19590-B, or equivalent.
2. Install the drive shaft.

REAR BUSHING AND SEAL

E-100—E-350, F-100—F-350

Removal

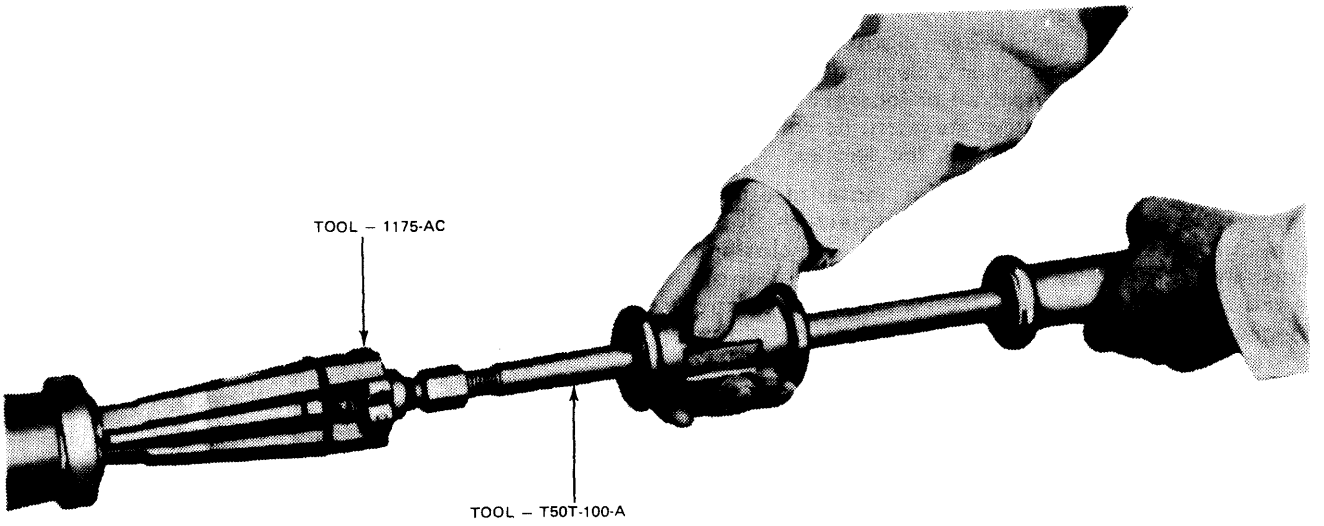
1. Disconnect the drive shaft from the transmission. Remove the seal as shown in Fig. 3.
2. Insert the tool shown in Fig. 5 into the extension housing until it grips on the front side of the bushing.
3. Turn the screw clockwise until the bushing is free of the housing.

Installation

1. Lubricate with C1AZ-19590-B or equivalent. Then drive a new bushing into the extension housing with the tool shown in Fig. 6.

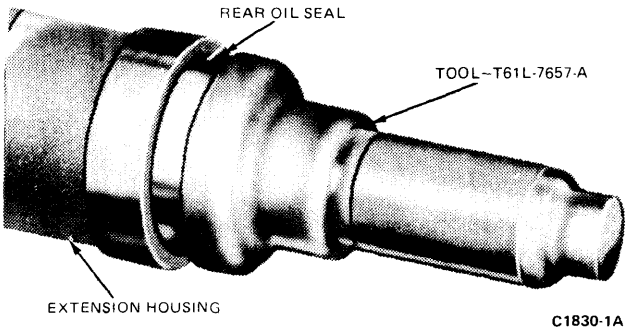
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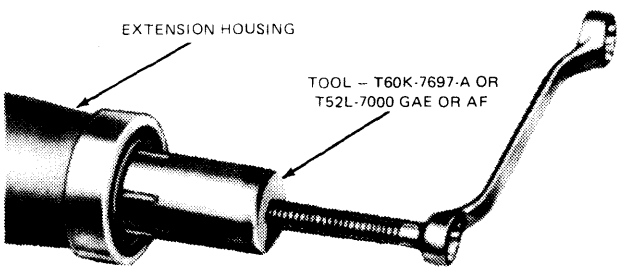
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FIG. 3 Removing Extension Housing Seal



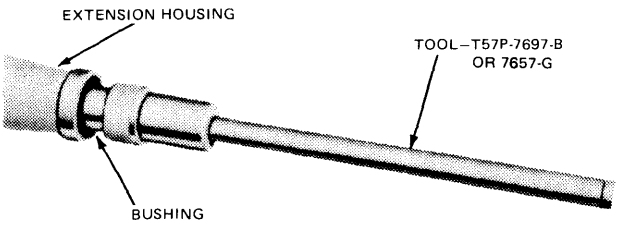
C1830-1A

FIG. 4 Installing Extension Housing Seal



C1028-1F

FIG. 5 Removing Extension Housing Bushing



C1832-1A

FIG. 6 Installing Extension Housing Bushing

2. Install a new seal in the housing as shown in Fig. 4. Lubricate the seal with C1AZ-19590-B or equivalent.
3. Connect the drive shaft to the transmission.

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CLEANING AND INSPECTION

TRANSMISSION

CLEANING

After the transmission has been disassembled, soak the parts except the bearings, in a cleaning solvent until all the old lubricant is dissolved or loosened. Brush or scrape all foreign matter from the parts. Be careful not to damage any of the parts with the scraper.

An excessive amount of foreign material usually results from a bearing failure, gear seizure, tooth breakage, extreme synchronizer wear, or clashing gears. **In such cases, the input and output shaft bearings should be carefully inspected and replaced if necessary. Since countershaft bearings, output shaft pilot bearings, and reverse idler bearings are not so susceptible to damage from foreign material in the lubricant, they need not be replaced if they seem satisfactory.**

Wipe the parts or blow compressed air on them until they are thoroughly dry.

To clean the bearings, rotate them in clean solvent until all lubricant is removed. Hold the bearing assembly, to prevent it from rotating, and dry it with compressed air.

When the bearings are dry, lubricate them thoroughly with transmission lubricant, and cover them with a clean, lint-free cloth until ready for use.

INSPECTION

Inspect all transmission parts before reassembly to determine if they should be replaced.

SUB-ASSEMBLIES

GEAR SHIFT HOUSING

Check the operation and condition of the shift levers, forks, and shift rails. If binding occurs when the levers are operated, disassemble the housing assembly, and replace the worn or damaged parts. Lubricate the shift lever ball seat and trunnion with Chassis Lubricant, C1AZ-19590-B or equivalent. Replace cover if it is bent or distorted. Make sure that the vent hole in the case is open.

TRANSMISSION CASE

Inspect the case for cracks, worn or damaged bearing bores, damaged threads, or similar damage. If such is found, replace the case. However, cases may be welded or brazed if the cracks do not extend into bearing bores or bolt holes in machined surfaces.

Holes smaller than 1/4 inch diameter, such as sand holes or casting porosity can be repaired using Metallic Plastic Repair Kit, Part No. C6AZ-19554-A or equivalent as directed.

Holes larger than 1/4 inch can be repaired by drilling, tapping and plugging.

The recommended procedure for using the Metallic Plastic Repair Kit is as follows:

Steam clean the transmission or transfer unit case to remove grease, oil, or road dirt. Clean the repair area thoroughly. Metallic plastic will not stick to a dirty or oily surface.

1. Prepare the surface to be repaired by grinding or rotary filing to a clean bright metal surface. Chamfer or undercut the hole or porous area to a greater depth than the rest of the cleaned surface. Solid metal must surround the hole.
2. Mix the metallic plastic base and hardener as directed on the container. Stir thoroughly until uniform.
3. Apply the repair mixture with a suitable clean tool (putty knife, wood spoon, etc.), forcing the mixture into the hole or porosity.
4. Allow the repair mixture to harden by either of two methods: heat cure with a 250-watt lamp placed 10 inches from the repaired surface, or air dry for 10 to 12 hours at temperatures above 50 degrees F.
5. Sand or grind the repaired area, blending it with the general contour of the surrounding surface. **Do not use this method to repair casting cracks.**
6. Inspect the front face of the case, and file or grind off any minor nicks or burrs that could cause misalignment of the transmission with the clutch housing.

BEARINGS

Examine the bearing assemblies (Fig. 7) for cracked cups or races. Check the races for roughness. Inspect the balls and rollers for looseness, wear, chipping, flaking or other damage. Check the bearings for binding on the shafts or looseness in the bores. If any of these conditions are present, replace the bearings.

GEARS

Some forms of grind marks and tooth wear contact patterns are acceptable and should not be considered as a source of gear noise. Grind marks are distinctive from defects which are local swells (polished raised projections), nicks and chips. All gears have possible factory repair grind marks. Phosphate coated gears are especially easy to recognize since the grind operation removes a patch of phosphate and base metal exposing the lighter metallic color. Figs. 8, 9 and 10 show normal and abnormal gear tooth contact patterns, normal tooling marks, and approved and unapproved chip/nick removal procedures.

REVERSE IDLER GEAR

Replace the reverse idler gear if the gear or bushing is badly worn or if the teeth are chipped or burred. Replace the reverse idler gear shaft if it is excessively worn or scored.

INPUT SHAFT

Replace the input shaft if it is worn, bent, or twisted, if the gear has chipped, worn, or missing teeth, or if the cone surface is damaged. If the pilot bearing bore is scored, replace the gear and gear rollers.

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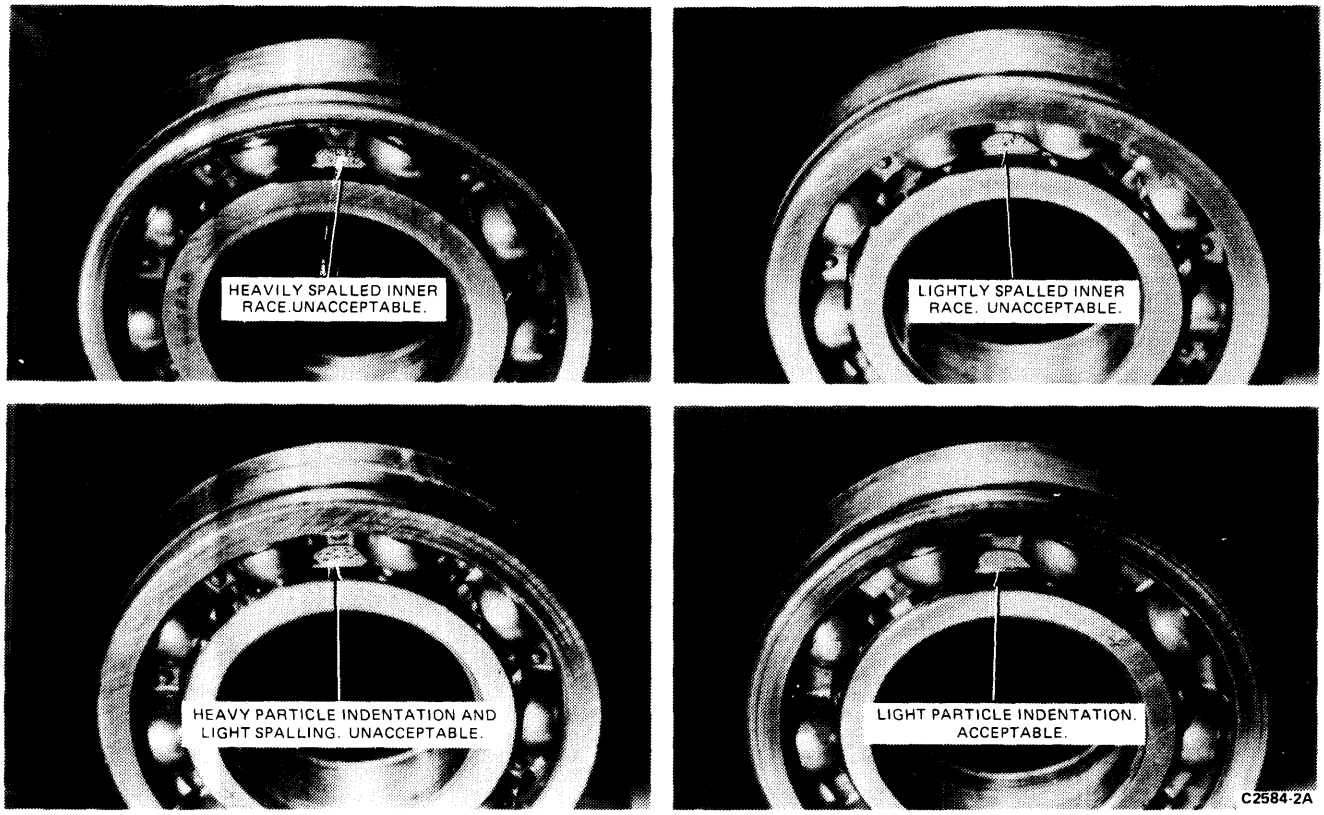
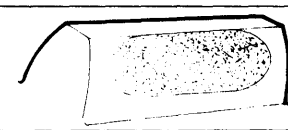
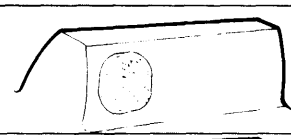
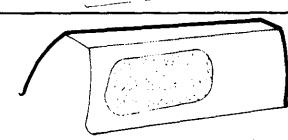
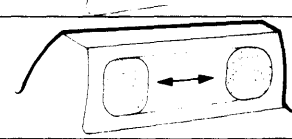
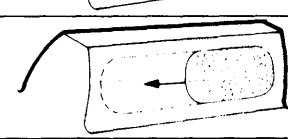
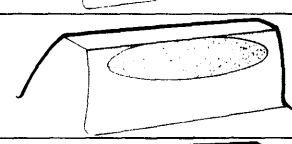
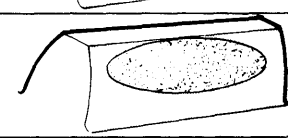
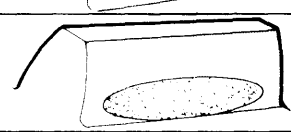
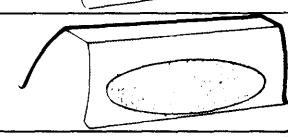


FIG. 7 Ball Bearing Inspection

CONTACT PATTERN	UNACCEPTABLE	ACCEPTABLE
1. DESIRED PATTERN (CONTACT)		
2. END CONTACT PATTERN		
3. TRAVELING CONTACT (PATTERN MOVES FROM SIDE TO SIDE ON FACE OF GEAR)		
4. HIGH CONTACT PATTERN		
5. LOW CONTACT PATTERN		

C3187-2A

FIG. 8 Four-Speed Transmission Gear Tooth Contact Pattern Chart—F-100—F-350, Bronco

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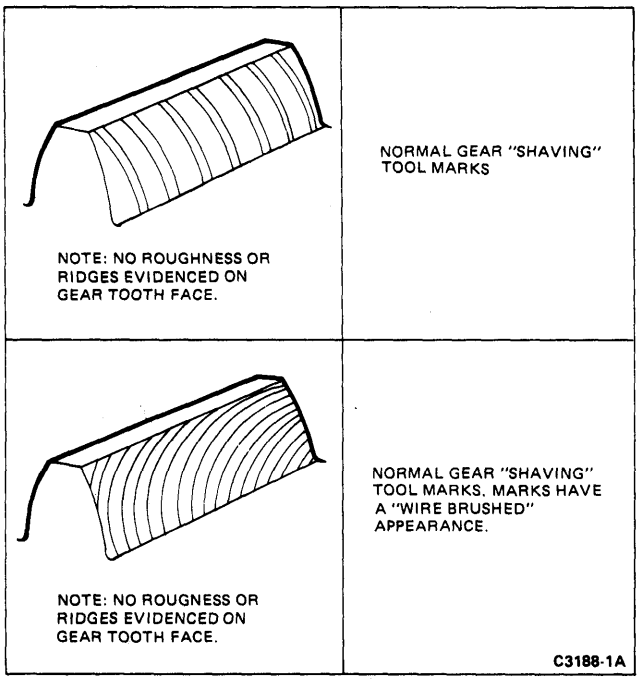


FIG. 9 Normal Tool Marks—Four-Speed Transmission Gear Teeth—F-100—F-350, Bronco

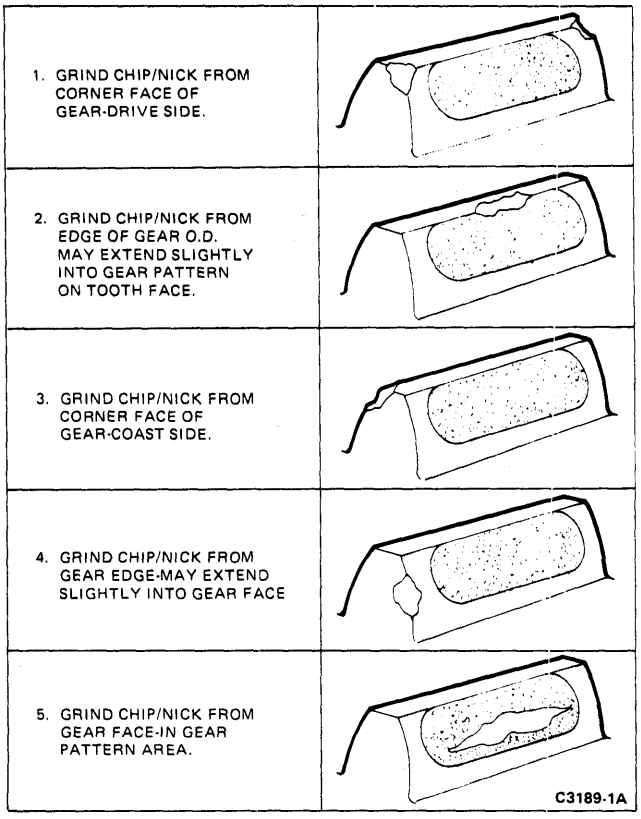


FIG. 10 Approved Four-Speed Transmission Gear Tooth Chip/Nick Removal Procedure—F-100—F-350, Bronco

OUTPUT SHAFT

Replace all output shaft gears that are chipped, burred, or badly worn. Check the intermediate gear end play, and replace the gear if the end play is not within specifications. Replace the output shaft if it is out of round or worn, or if the pilot bearing surface is scored.

Replace the speedometer drive gear if the gear teeth are worn or broken. Be sure to install the correct replacement gear.

THRUST WASHERS, SYNCHRONIZER DISCS, BEARING COVERS

Check the surfaces of all thrust washers. Replace washers that are scored and/or reduced in thickness.

Replace synchronizer discs that are scored, burned, or warped. Also replace bearing covers that are grooved or showing wear from the thrust or adjacent bearings. Check the oil return threads in the bearing covers. If the sealing action of the threads has been destroyed by contact from the input or output shafts, replace the covers.

SYNCHRONIZER BLOCKING RINGS

Inspect the synchronizer blocking rings for widened index slots, rounded clutch teeth and smooth internal surfaces (must have machined grooves). With the blocker ring on the cone, the distance between the face of the gear must not be less than 0.010 inch, (.025 inch in the 3-speed L.D. transmission).

Check the synchronizer sleeves for free movement on the hubs. Make sure the alignment marks (etched marks) are properly indexed.

Replace the seal in the input shaft bearing retainer.

Replace the seals on the cam and shafts.

SEALS AND GASKETS

Examine and replace if necessary, input and output shaft bearing retainer seals and gaskets.

SPECIFICATIONS

SPECIAL TOOLS

Number	Description
T50T-100-A	Slide Hammer
TOOL 1175-AC	Seal Removal Tool
T61L-7657-A	Seal Installation Tool
T60K-7697-A or T52L-7000-GAE or AF	Bushing Removal Tool
T57P-7697-B or 7657-G	Bushing Installation Tool

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TORQUE SPECIFICATIONS

Description	Size	Torque Limits	
		(ft-lbs)	N•m
U-Joint Flange Nut	1.00-20	110-150	150-203
Transmission Output Shaft	1.25-18	350-420	475-569

Unless otherwise specified, the following torque ranges are to be used for fitting or fastener diameters as indicated.

Bolt or Nut Size (in)	Torque Limits	
	(in-lbs)	N•m
1/4	85-115	9.7-12.5
	(ft-lbs)	
5/16	12-17	17-23
3/8	31-42	43-56
7/16	50-70	68-94
1/2	75-105	102-142
9/16	110-150	150-203
5/8	150-205	204-277
3/4	220-300	299-406
7/8	360-480	489-650
1.0	540-730	733-989

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Ford 3.03 Three-Speed Transmission

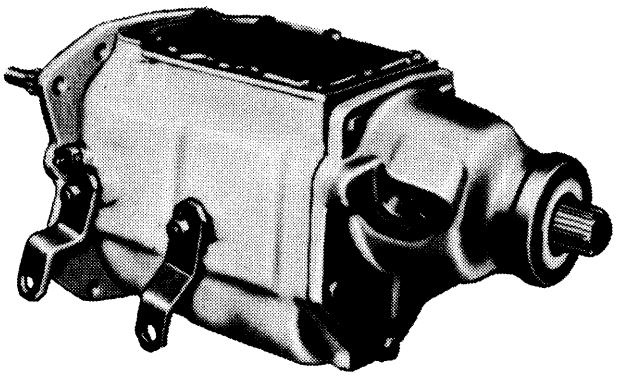
PART 16-11

APPLIES TO F-100 THRU F-250, E-100 THRU E-350

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DESCRIPTION

The 3.03 three-speed transmission (Fig. 1) is available in the F-100—F-250, E-100—E-350 vehicles.

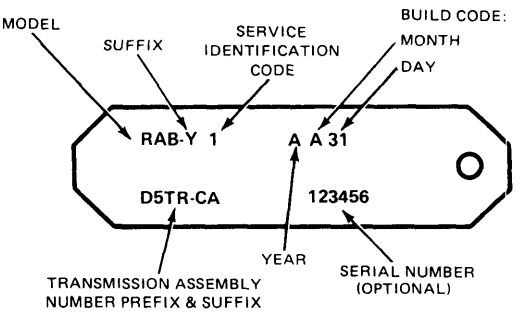


C1838-1B

FIG. 1 Three-Speed Transmission (Short Extension Housing)

A transmission service identification tag is located on the right front side of the case (Fig. 2). The tag shows the transmission model and service identification code (when required). The second line shows the transmission serial number.

The transmission is of the fully synchronized type with all gears except the reverse gear and sleeve being in constant mesh. All forward speed changes are accomplished with synchronizer sleeves. The synchronizers permit quicker shifts, greatly reduce gear clash and permit down-shifting from high to intermediate between 40 and 15 mph and from intermediate to low, below 20 mph.



CODE FOR DATE OF MANUFACTURE:

MONTH

A- JANUARY	E- MAY	J- SEPTEMBER
B- FEBRUARY	F- JUNE	K- OCTOBER
C- MARCH	G- JULY	L- NOVEMBER
D- APRIL	H- AUGUST	M- DECEMBER

C3185-1B

FIG. 2 Transmission Identification Tag

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DIAGNOSIS AND TESTING

Refer to Part 16-10, General Manual Transmission Service.

ADJUSTMENTS

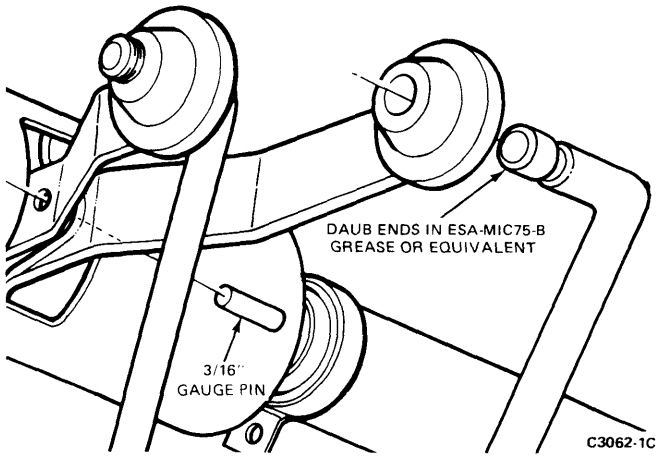


FIG. 3 Gauge Pin Installation—E-100—E-350

GEAR SHIFT LINKAGE

F-100—F-250, E-100—E-350

1. Install a gauge pin of 3/16-inch diameter through the steering column shift levers and the locating hole in the plastic spacer, (Figs. 3 through 5).
2. Loosen nuts A and B and position the transmission shift levers in the neutral detents.
3. Tighten nuts A and B to 12 to 18 ft-lb, using care to prevent motion between the stud and rod.
4. Remove the gauge pin.
5. Check the linkage operation.

Always use new retaining rings and new insulators when making transmission control attachments. The concave side of the retaining ring must be toward the lever.

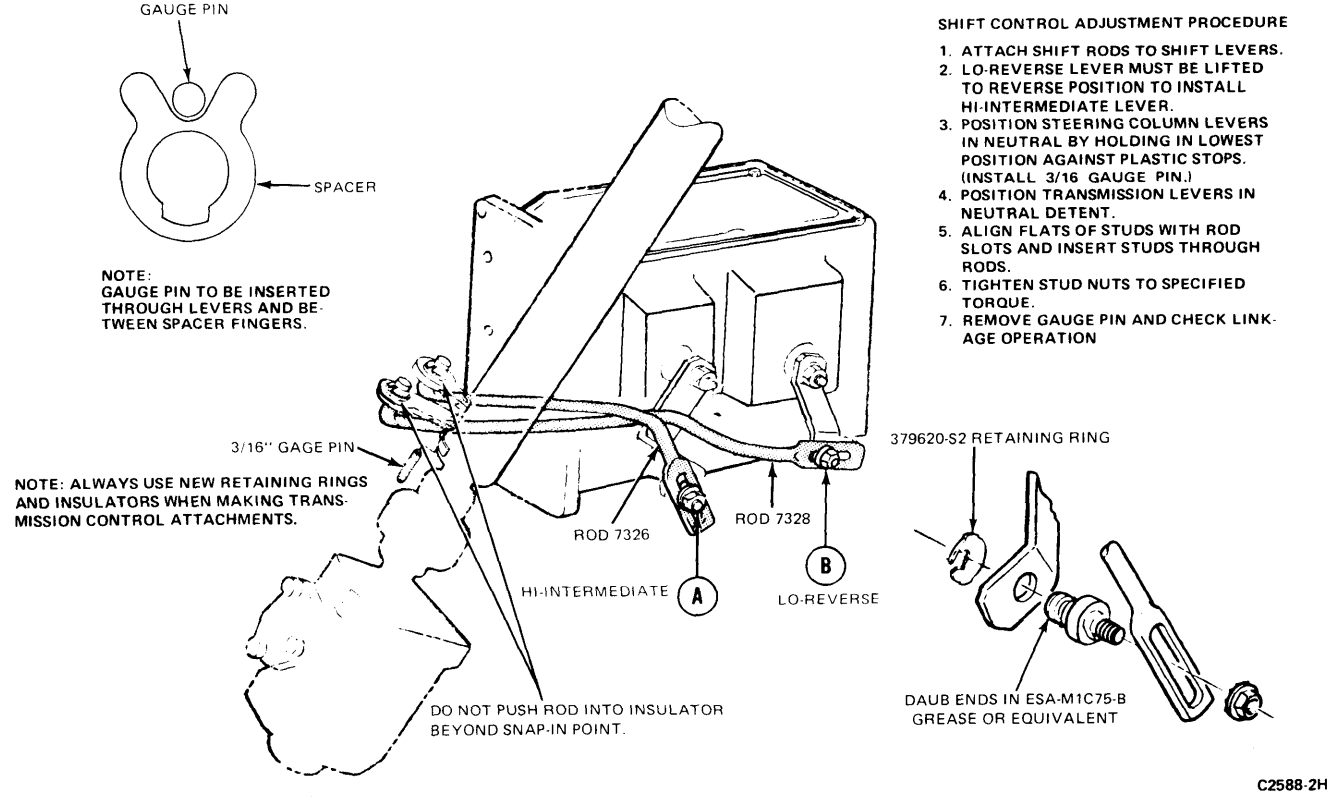


FIG. 4 Gearshift Linkage Adjustment—F-100—F-250

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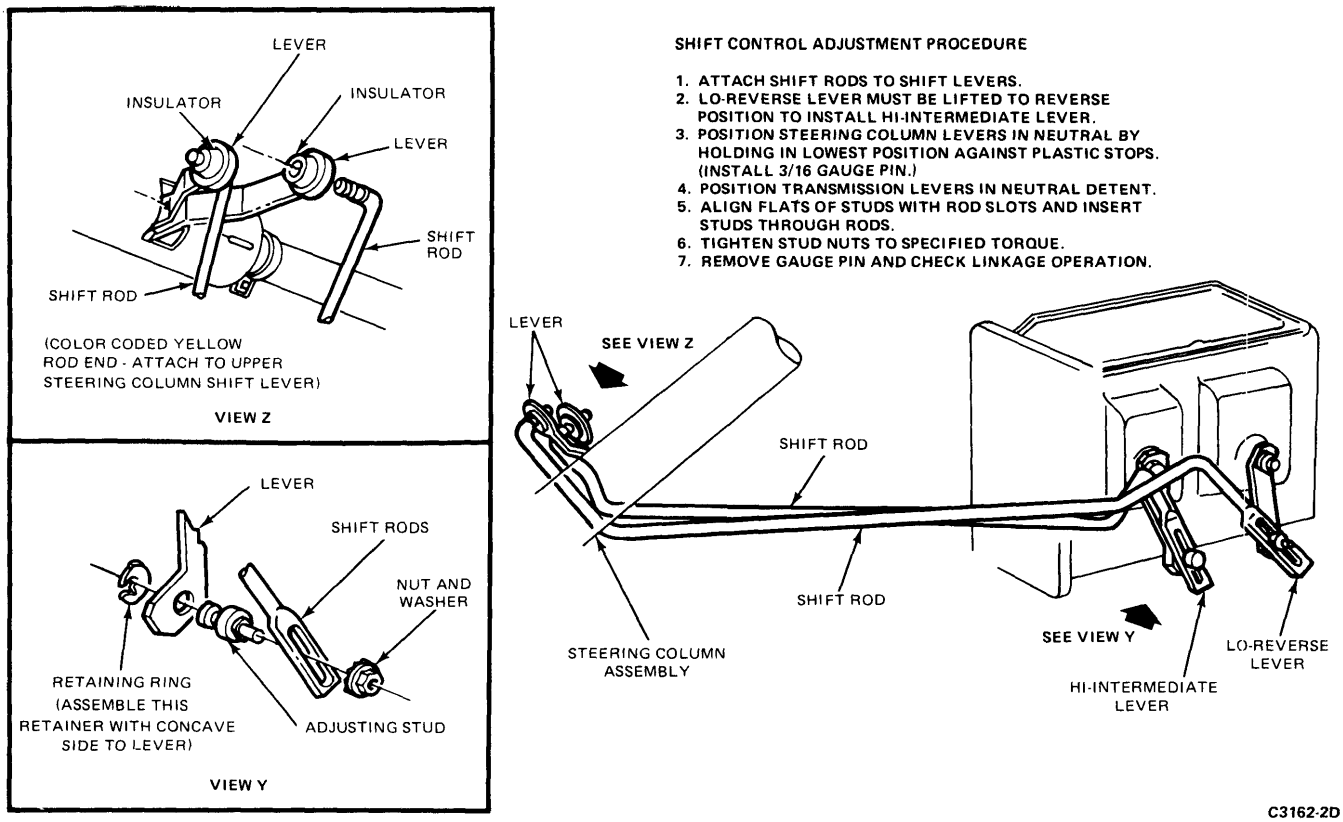


FIG. 5 Gearshift Linkage Adjustment—E-100—E-350

REMOVAL AND INSTALLATION

GEARSHIFT TUBE

F-100—F-250, E-100—E-350

Removal and Installation

1. Working from under the instrument panel, disconnect the horn and directional signal wires at the connectors.
2. Remove the horn pad and steering wheel from the steering column.
3. Carefully remove the pin that secures the selector lever to the hub and remove the lever.
4. Loosen the two flange attaching nuts enough to apply pressure on them (toward the center) to release the bolt heads from the steering column tube.
5. Carefully work the flange and selector hub and wires over the upper end of the steering shaft.
6. Slip the shift tube out of the steering column.
7. Apply lubricant to each end of the new shift tube.
8. Slip the shift tube into the upper end of the steering column making sure that the lower end of the tube engages the shift lever or levers, (Fig. 6).
9. Place the selector lever hub and flange on the steering column tube and carefully pull the wires downward into place.
10. Engage the flange attaching bolt heads into the steering column tube and tighten the two nuts.

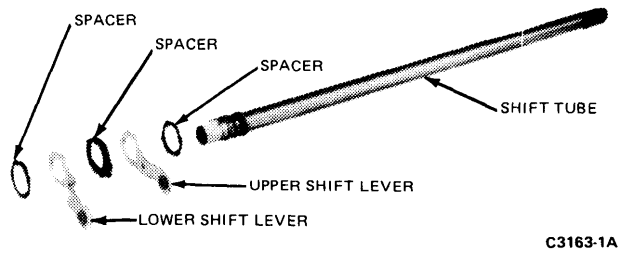


FIG. 6 Shift Levers Disassembled—E-100—E-350, F-100—F-250

11. Connect the directional signal and horn wires to their connectors.
12. Adjust the shift rods as required.
13. Install steering wheel and horn switch.

COLUMN-MOUNTED SHIFT LINKAGE GROMMET

Removal

The column-mounted shift lever assembly incorporates an oil-impregnated plastic grommet in the end of each lever arm. A special tool (Fig. 7) is required to install the grommet in the shift lever, and to install

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the shift linkage rod into the grommet. Remove and install the grommet as follows:

1. Place the lower jaw of the tool between the shift lever and the shift rod. Position the stop pin against the end of the shift rod (Fig. 7) and force the rod out of the grommet. Remove the grommet from the shift lever by cutting off the large shoulder with a sharp knife. **The grommet must be removed from the shift lever and a new one installed each time the rod is disconnected.**

Installation

1. Before installing a new grommet, adjust the stop pin as necessary to properly install the grommet, and coat the outside of the grommet with lubricant. Then, place the grommet on the stop pin and force it into the shift lever hole. Turn the grommet several times to be sure it is properly seated.
2. Re-adjust the stop pin to a length which is sufficient to install the shift rod into the grommet (Fig. 7). If the pin height is not adjusted, the shift rod may be pushed too far through the grommet, causing damage to the grommet retaining lip.
3. With the pin height properly adjusted, position the shift rod on the tool and force the rod into the grommet until the groove in the rod seats on the inner retaining lip of the grommet.

TRANSMISSION

F-100—F-250

Removal

1. Raise the vehicle and position safety stands. Support the engine with a jack and wood block placed under the oil pan.
2. Drain the transmission lubricant by removing the lower extension housing-to-transmission bolt.
3. Position a transmission jack under the transmission.
4. Disconnect the gear shift linkage at the transmission.
5. Disconnect the speedometer cable.
6. Disconnect the drive shaft from the transmission.
7. Raise the transmission if necessary and remove the rear support (Fig. 8).
8. Remove the transmission-to-clutch housing attaching bolts.
9. Move transmission to the rear until input shaft clears clutch housing, and lower the transmission. **Do not depress the clutch pedal while removing the transmission.**

Installation

Before installing the transmission, apply a light film of lubricant, (ESA-MIC75-B or equivalent), to the release bearing inner hub surfaces, release lever fulcrum and fork, and the transmission front bearing retainer. Exercise care to avoid contaminating the clutch disc with excessive grease.

1. Place the transmission on a transmission jack. Raise the transmission until the input shaft splines are in line with the clutch disc splines. The clutch release bearing and hub must be properly positioned in the release lever fork.
2. Install a guide stud in each lower clutch housing-to-transmission case mounting bolt and align the splines on the input shaft with the splines on the clutch disc.

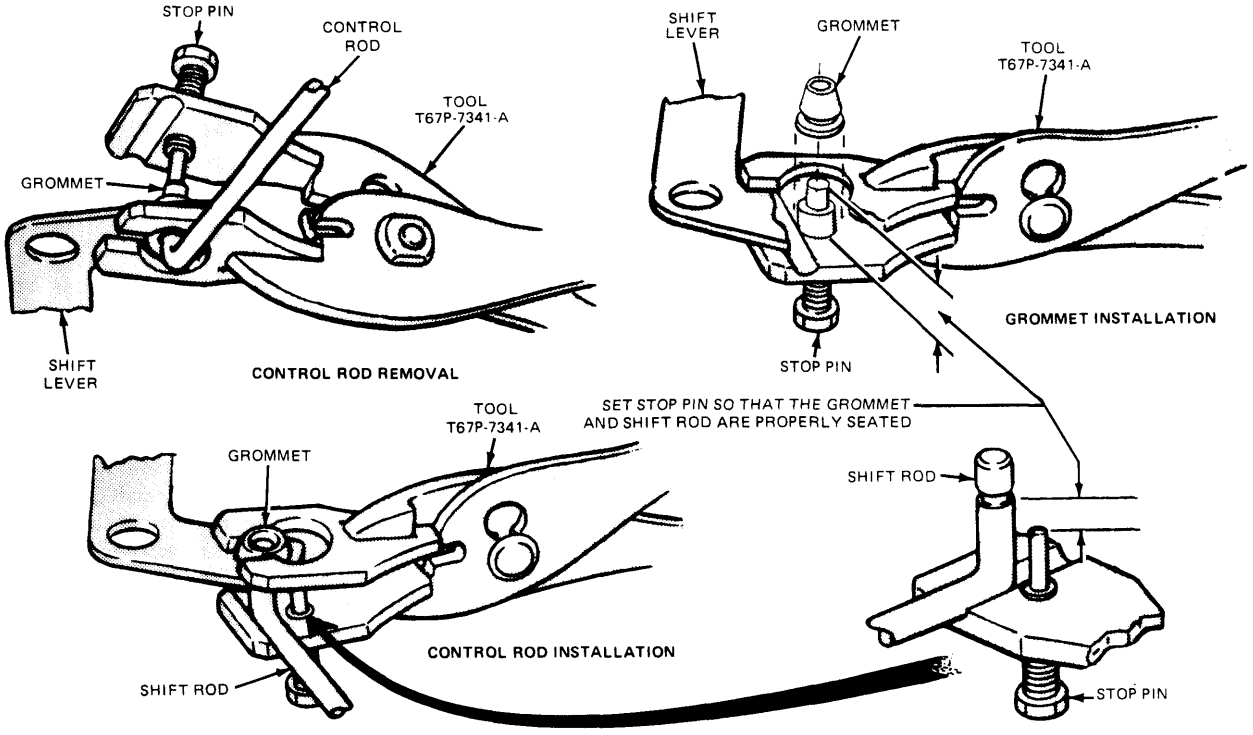


FIG. 7 Removing or Installing Shift Linkage Grommet

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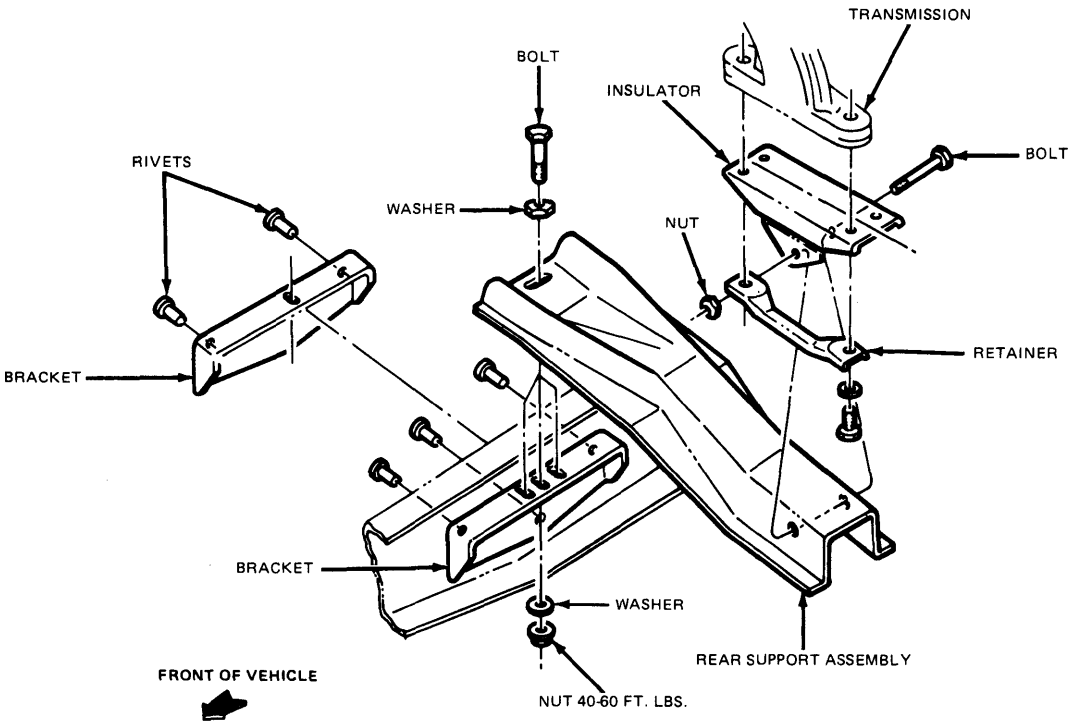


FIG. 8 Removing and Installing Crossmember—F-100—F-250 (4 x 2)

3. Slide the transmission forward on the guide studs until it contacts the clutch housing.
4. Install the two transmission- to-flywheel housing upper mounting bolts and nuts. Remove the two guide studs and install the lower mounting bolts. Tighten the four mounting bolts to 42-50 ft-lbs. Install the rear support and tighten the attaching bolts and nuts to 40-60 ft-lbs (Fig. 8). Remove the transmission jack and engine jack.
5. Connect the speedometer cable and the driven gear.
6. Install the drive shaft.
7. Connect each shift rod to its respective lever on the transmission, and adjust if required.
8. Install the lower extension housing-to-transmission bolt. Fill the transmission to the proper level with an approved lubricant.
9. Connect gear shift linkage and adjust the clutch pedal free travel and shift linkage as required.

E-100—E-350

Removal

1. Raise the vehicle on a hoist and drain the lubricant from the transmission by removing the lower extension housing-to-transmission bolt.
2. Disconnect the drive shaft from the flange at the transmission. Secure the front end of the drive shaft out of the way with lock wire.
3. Disconnect the speedometer cable from the extension housing and disconnect the gear shift rods from the transmission shift levers.
4. Position a transmission jack under the transmission. Secure the transmission to the jack.
5. Raise the transmission slightly and remove the four bolts retaining the transmission extension housing to the crossmember (Figs. 9 and 10).
6. Remove the four transmission- to-flywheel housing bolts.
7. Position the engine support bar (Tool T65E-6000-J) to the frame (Fig. 11).
8. Lower the transmission.

Installation

1. Make certain that the machined surfaces of the transmission case and the flywheel housing are free of dirt, paint, and burrs.
2. Install a guide pin in each lower mounting bolt hole.
3. Start the input shaft through the release bearing. Align the splines on the input shaft with the splines in the clutch disc. Move the transmission forward on the guide pins until the input shaft pilot enters the bearing or bushing in the crankshaft. If the transmission front bearing retainer binds up on the clutch release bearing hub, work the release bearing lever until the hub slides onto the transmission front bearing retainer. Install the two upper mounting bolts and lockwashers that attach the flywheel housing to the transmission. Remove the two guide pins and install the lower mounting bolts and lockwashers. Tighten the four mounting bolts to 40-50 ft-lbs.
4. Raise the jack slightly and remove the engine support bar.

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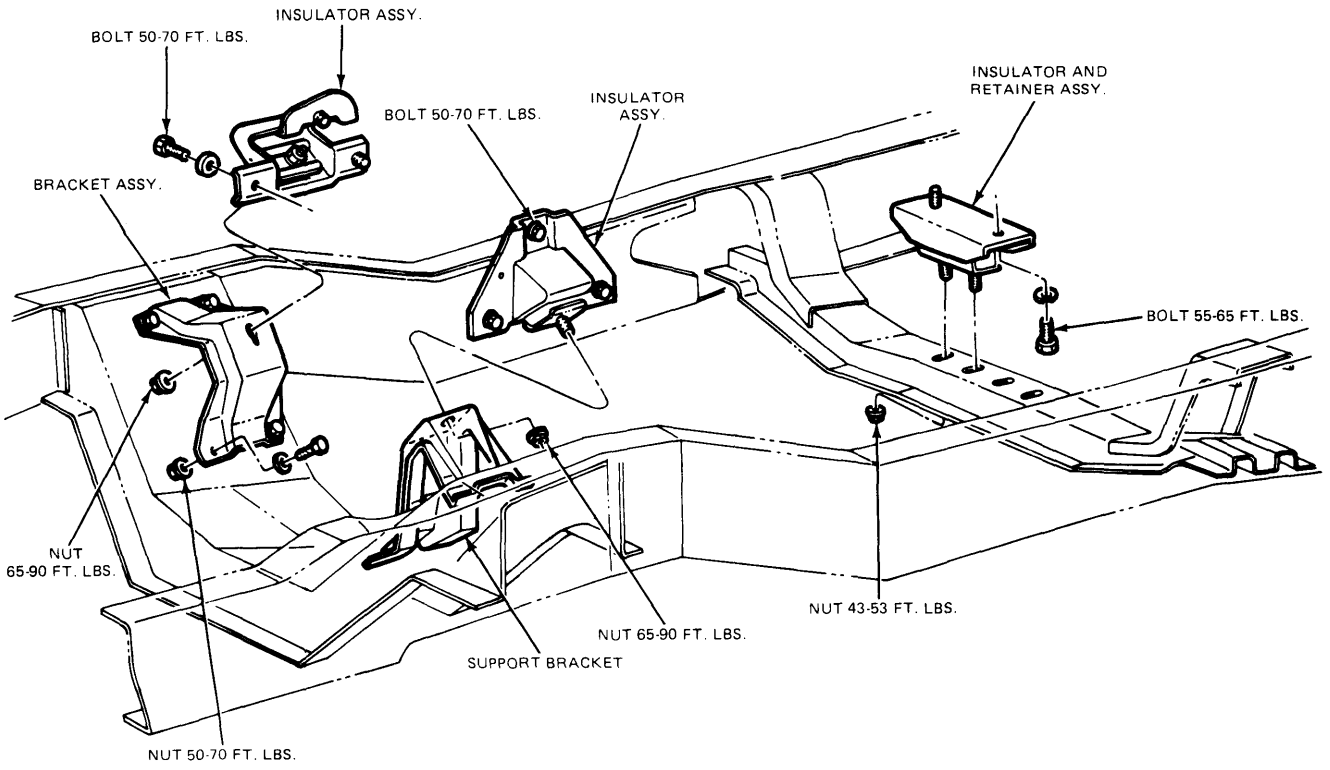


FIG. 9 E-100—E-350 Rear Crossmember and Transmission Support 4.9L (300 CID) I-6 Engine

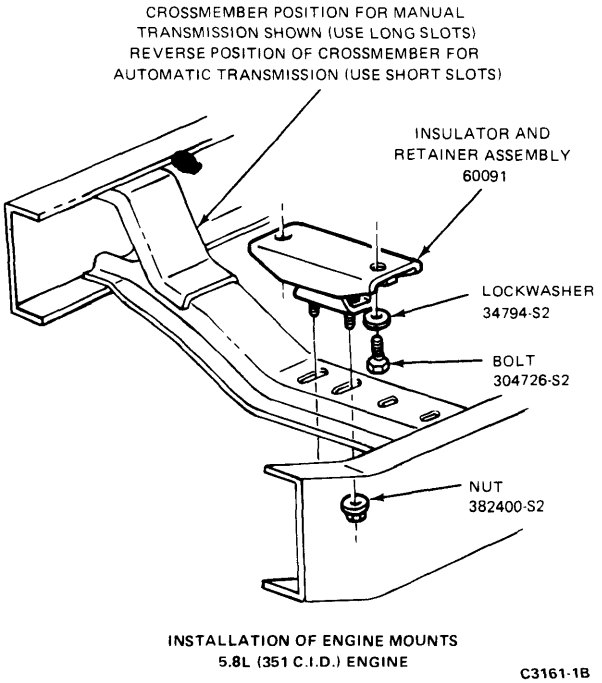


FIG. 10 E-100—E-350 Rear Crossmember and Transmission Support 5.8L (351 CID) V-8 Engine

5. Install the extension housing-to-crossmember retaining bolts. Tighten all retaining bolts to specification listed at the end of this part.

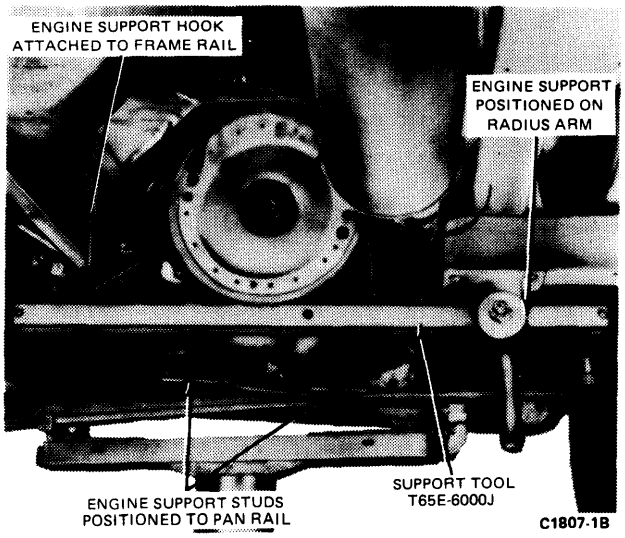


FIG. 11 Installing Engine Support Bar—E-100—E-350

6. Connect the gear shift rods and the speedometer cable.
7. Install the drive shaft.
8. Install the lower extension housing-to-transmission bolt. Fill the transmission to the bottom of the filler hole with the recommended lubricant.
9. Connect gear shift linkage and the clutch pedal free travel and shift linkage as required.

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DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Disassembly

1. Mount the transmission in a holding fixture and drain the lubricant by removing the lower extension housing bolt.
2. Remove the capscrews that attach the cover to the case. Remove the cover and the gasket (Fig. 12) from the case.

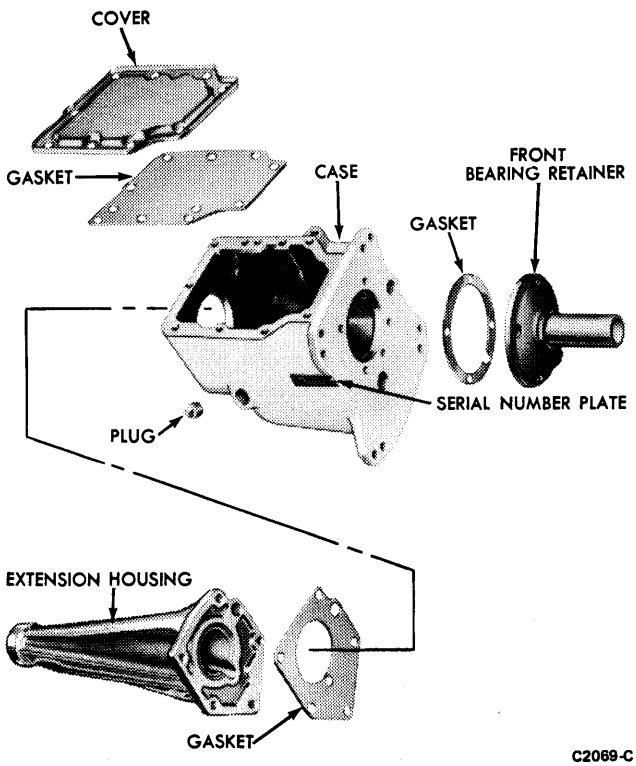


FIG. 12 Transmission Case and Related Parts

3. Remove a long spring that retains the detent plug in the case (Fig. 17). Remove the detent plug with a small magnet.
4. Remove the capscrews and lockwashers that attach the extension housing to the case. Remove the extension housing and gasket from the case.
5. Remove the capscrews and lockwashers that attach the front bearing retainer to the case. Remove the front bearing retainer and gasket from the case.
6. Remove the lubricant filler plug from the right side of the case. Working through the plug opening, drive the roll pin out of the case and countershaft with 1/4-inch punch (Fig. 13).
7. Hold the countershaft gear with a hook and, with tool shown in Fig. 14, push the countershaft out of the rear of the case.

   The countershaft (cluster) gear and thrust washers can now be lowered to the bottom of the case.
8. Remove the snap ring that secures the speedometer drive gear on the output shaft. Slide the gear off the shaft. Remove the gear lock ball from the shaft.

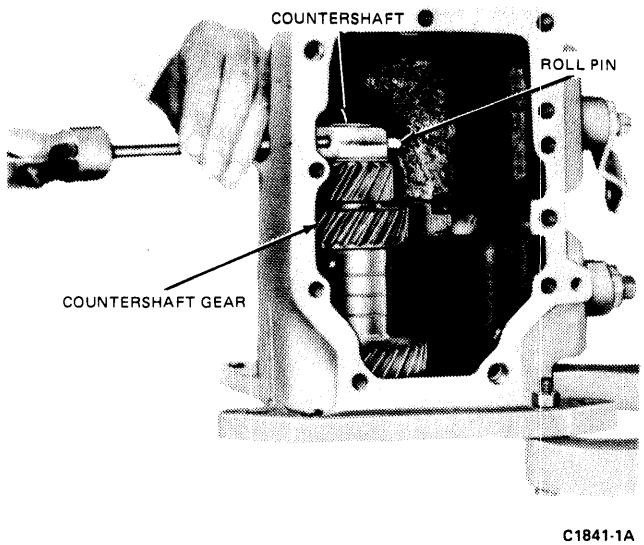


FIG. 13 Removing Countershaft Roll Pin

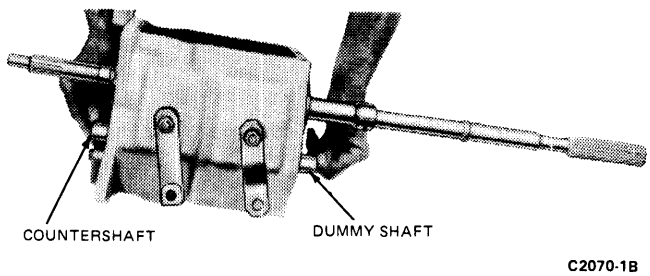


FIG. 14 Removing Countershaft

9. Remove the snap ring that retains the output shaft bearing on the shaft. Remove the bearing from the case and shaft as shown in Fig. 15.
10. Place both shift levers in the neutral (center) position.

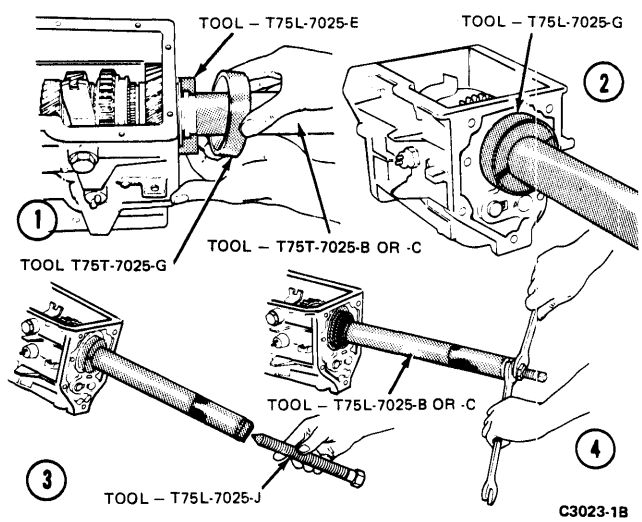


FIG. 15 Removing Output Shaft Bearing

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11. Remove the set screw that secures the first-and-reverse shift fork to the shift rail. Slide the first-and-reverse shift rail out through the rear of the case.
12. Slide the first-and-reverse synchronizer forward as far as possible, and rotate the first-and-reverse shift fork upward. Then lift it from the case.
13. Move the second-and third-speed shift fork to the second-speed position to gain access to the set screw. Remove the set screw from the fork. Rotate the shift rail 90 degrees as shown in Fig. 16.

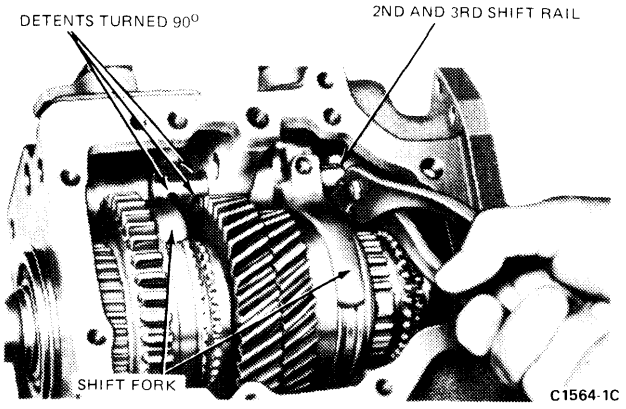


FIG. 16 Rotating Second- and Third-Speed Shift Rail

14. Lift the interlock plug (Fig. 17) from the case with a magnet.

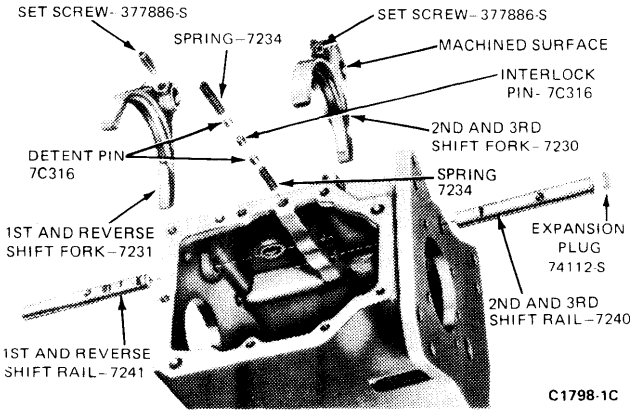


FIG. 17 Shift Rails and Forks—Disassembled

15. Tap on the inner end of the second- and third-speed shift rail to remove the expansion plug (Fig. 17) from the front of the case. Remove the shift rail.
16. Remove the second- and third-speed shift rail detent plug and spring from the detent bore.
17. Pull the input gear and shaft from the case.
18. Rotate the second- and third-speed shift fork upward, and lift it from the case.
19. Carefully lift the output shaft assembly out through the top of the case.
20. Lift the reverse idler gear and two thrust washers (Fig. 18) from the case. Lift the countershaft gear, thrust washer, and dummy shaft from the case.

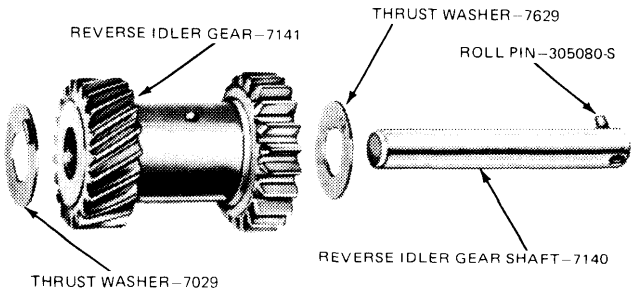


FIG. 18 Reverse Idler Shaft—Disassembled

21. Remove the snap ring from the front of the output shaft, and slide the synchronizer and the second-speed gear (Fig. 19) off the shaft.
22. Remove the next snap ring and tabbed thrust washer from the output shaft. Then slide the first gear and blocking ring off the shaft.
23. Remove the next snap ring from the output shaft. The first-and-reverse synchronizer hub is a press fit on the output shaft. To avoid damaging the synchronizer assembly, remove the synchronizer hub using an arbor press as shown in Fig. 20. **Do not attempt to remove or install the hub by *hammering or prying*.**

Assembly

1. Coat the reverse idler gear thrust surfaces in the case with a thin film of lubricant and position the two thrust washers in place.
2. Position the reverse idler gear and shaft in place. Align the gear bore and thrust washers with the case bores and install the reverse idler shaft.
3. Measure the reverse idler gear end play with a feeler gauge. If the end play is not within specification (see Specifications at the end of this part), replace the thrust washers. If the end play is within limits, leave the reverse idler gear installed.
4. Lubricate the output shaft splines and machined surfaces with transmission lubricant.
5. The first-and-reverse synchronizer hub is a press fit on the output shaft. To eliminate the possibility of damaging the synchronizer assembly, install the synchronizer hub with the teeth-end of the gear facing toward the rear of the shaft, using an Arbor Press as shown in Fig. 20. **Do not attempt to remove or install the hub by hammering or prying.**
6. Place the blocking ring on the tapered machined surface of the first gear.
7. Slide the first gear onto the output shaft with the blocking ring toward the rear of the shaft. Rotate the gear as necessary to engage the three notches in the blocking ring with the synchronizer inserts. Secure the first gear with the thrust washer and snap ring.
8. Slide the blocking ring onto the tapered machined surface of the second gear. Slide the second gear with blocking ring and the second-and-third gear synchronizer onto the mainshaft. The tapered machined surface of the second gear must be

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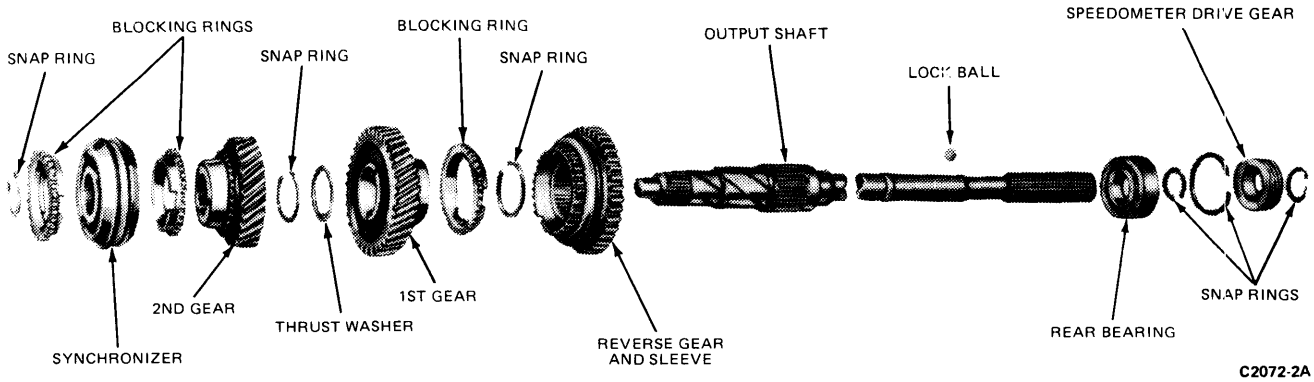


FIG. 19 Output Shaft—Disassembled

toward the front of the shaft. Make sure that the notches in the blocking ring engage the synchronizer inserts. Secure the synchronizer with a snap ring.

9. Coat the bore of the input shaft and gear with a thin film of grease. **A thick film of grease will plug the lubricant holes and prevent lubrication to the bearings.** Install the 15 bearings (Fig. 23) in the bore.
10. Install the input shaft through the front of the transmission. Install the snap ring in the bearing groove.
11. Position the output shaft assembly in the case. Position the second- and third-speed shift fork on the second- and third-speed synchronizer.
12. Place a detent plug spring and a plug in the case (Fig. 17). Place the second- and third-speed synchronizer in the second-speed position (toward rear of transmission). Align the fork and install the second- and third-speed shift rail. It will be necessary to depress the detent plug to enter the rail in the bore. Move the rail inward until the detent plug engages the forward notch (second-speed position).
13. Secure the fork to the shaft with the set screw. Move the synchronizer to the neutral position.
14. Install the interlock plug in the case. If the second- and third-speed shift rail is in the neutral position, the top of the interlock will be slightly lower than the surface of the first-and-reverse shift rail bore.
15. Move the first-and-reverse synchronizer forward to the first-speed position. Place the first-and-reverse shift fork in the groove of the first-and-reverse synchronizer. Rotate the fork into position and install the first-and-reverse shift rail. Move the rail inward until the center notch (neutral) is aligned with the detent bore. Secure the fork to the shaft with the set screw.
16. Install a new shift rail expansion plug in the front of the case.
17. Hold the input shaft and blocking ring in position. Then move the output shaft forward to seat the pilot in the roller bearings of the input gear.
18. Tap the input gear bearing into place in the case while holding the output shaft to prevent the roller bearings from dropping. Install the front bearing retainer and new gasket making sure that the oil return slot is at the bottom of the case. Install and tighten the attaching screws to specification.
19. Install the large snap ring on the rear bearing. Place the bearing on the output shaft with the snap ring end toward the rear of the shaft. Press the bearing into place with the tool shown in Fig. 21. Secure the bearing to the shaft with a snap ring.

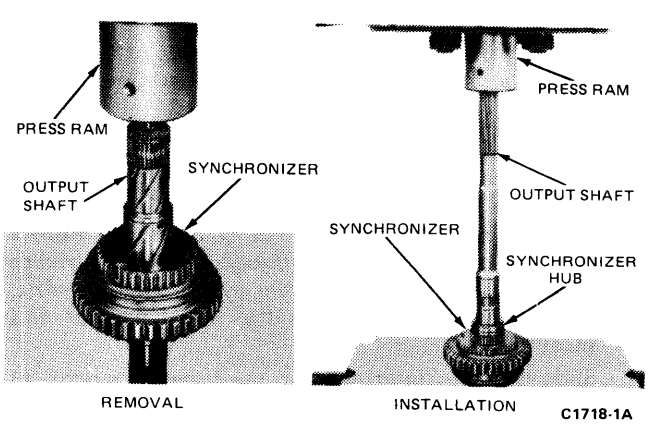


FIG. 20. Removing and Installing First and Reverse Synchronizer

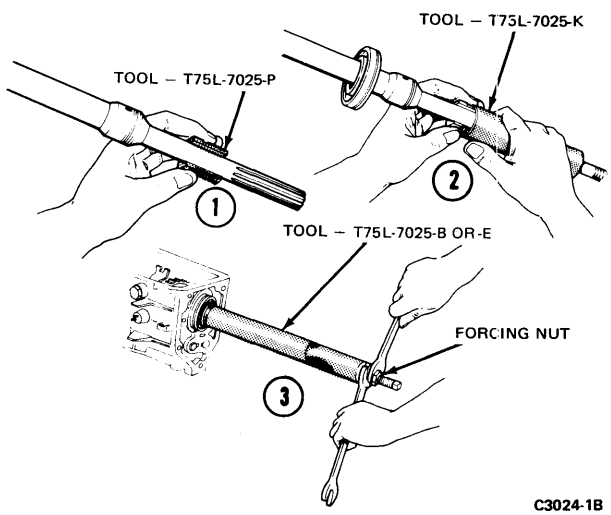


FIG. 21 Installing Output Shaft Rear Bearing

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20. Hold the speedometer drive gear lock ball in the detent and slide the speedometer drive gear into place. Secure the gear with a snap ring.
21. Place the transmission in the vertical position. Working with a screwdriver through the drain hole in the bottom of the case, align the bore of the countershaft gear, and the thrust washers, with the bore of the case.
22. Working from the rear of the case, push the dummy shaft out of the countershaft gear with the countershaft. Make sure the hole that accommodates the roll pin is aligned with the hole in the case, before completely inserting the countershaft in the bore. Drive the shaft into place and install the roll pin.
23. Coat a new extension housing gasket with sealer and position it on the case.
24. Install lockwashers on the five attaching screws. Dip the threads of the capscrews in the sealer. Secure the housing to the case and tighten the capscrews to 42-50 ft-lbs.
25. Place the transmission in gear. Pour lubricant over the entire gear train while rotating the input or output shaft.
26. Install the remaining detent plug in the case. Install the long spring (which is retained by the cover) to secure the detent plug.
27. Coat a new cover gasket (Fig. 12) with sealer. Secure the cover with capscrews. Tighten the screws to 20-25 ft-lbs.
28. Check the operation of the transmission in all of the gear positions.

SUB-ASSEMBLIES

SHIFT LEVERS AND SEALS

1. Remove the nut, lockwasher, and flat washer that secure each shift lever (Fig. 22) to the lever and shaft in the transmission case. Lift the levers off the shaft. Slide each lever and shaft out of the case. Discard the O-ring from each shaft.
2. Lubricate the new seals with transmission lubricant and install them on the shafts.
3. Install the lever and shafts in the case.
4. Position a shift lever on each shaft and secure them with a flat washer, lockwasher, and nut.

INPUT SHAFT BEARING

1. Remove the snap ring securing the input shaft bearing (Fig. 23), and press the input shaft out of the bearing.
2. Press the input shaft bearing onto the input shaft with the tool shown in Fig. 24 and install the snap ring on the shaft.

SYNCHRONIZERS

1. Punch or etch alignment marks on the hub and sleeve of the synchronizer before disassembly. Push the synchronizer hub from each synchronizer sleeve.
2. Separate the inserts and insert springs from the hubs. Do not mix parts from the second-and third-speed synchronizer with those of the first-and-reverse synchronizer (Figs. 25 and 26).

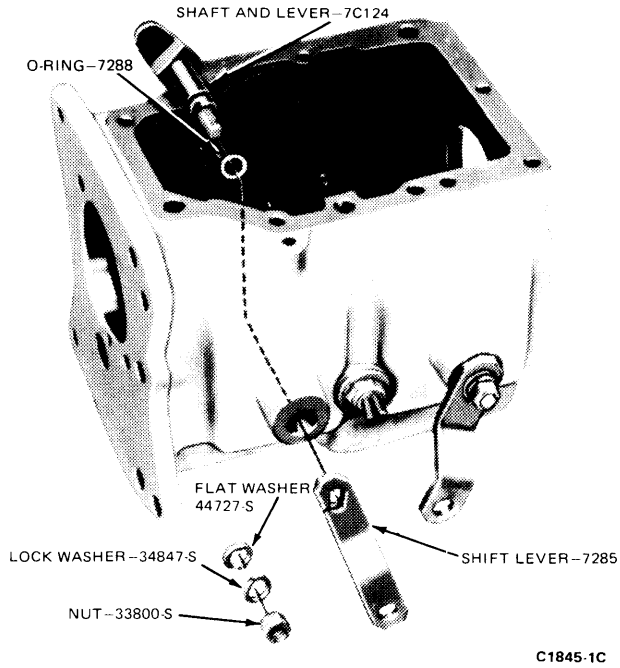


FIG. 22 Shift Lever and Shaft—Disassembled

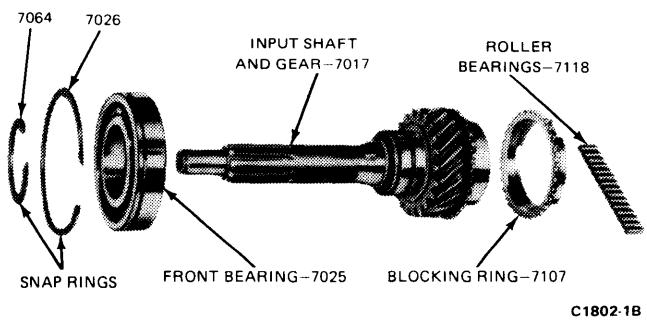


FIG. 23 Input Shaft Gear—Disassembled

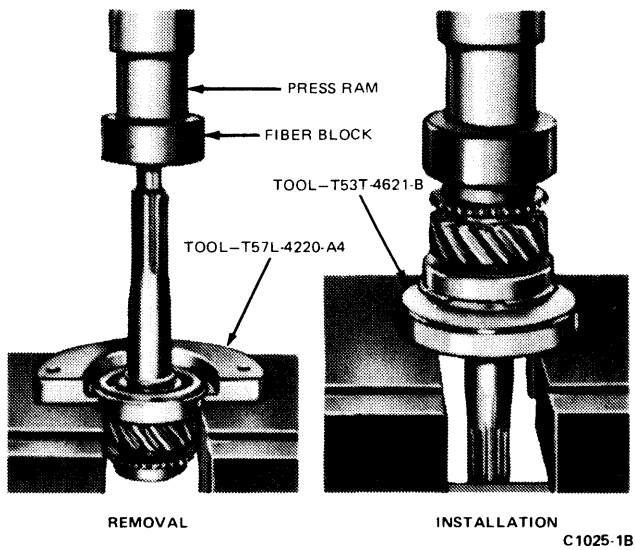


FIG. 24 Replacing Input Shaft Bearing

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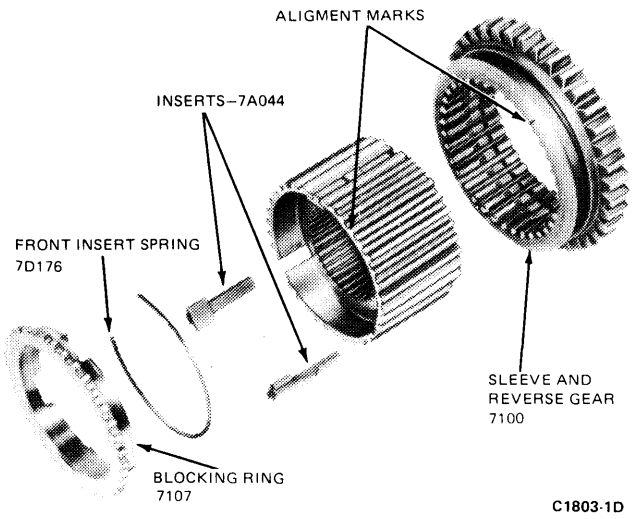


FIG. 25 First-and-Reverse Synchronizer—Disassembled

3. Install the insert spring in the hub of the first-and-reverse synchronizer (Figs. 25 and 27). Make sure that the spring covers all the insert grooves. Start the hub on the sleeve, making sure that the alignment marks are properly indexed. Position the three inserts in the hub, making sure that the small end is on the inside of the hub. Slide the sleeve and reverse gear onto the hub.
4. Install one insert spring (Fig. 26) into a groove of the second- and third-speed synchronizer hub, making sure that all three insert slots are fully covered. With the alignment marks on the hub and sleeve aligned, start the hub into the sleeve. Place the three inserts on top of the retaining spring and push the assembly together. Install the remaining insert spring so that the spring ends cover the same slot as does the other spring. Do not stagger the springs. Place a synchronizer blocking ring on each end of the synchronizer sleeve.

COUNTERSHAFT GEAR BEARINGS

1. Remove the dummy shaft, fifty needle bearings, and the two bearing retainer washers from the countershaft gear (Fig. 28).

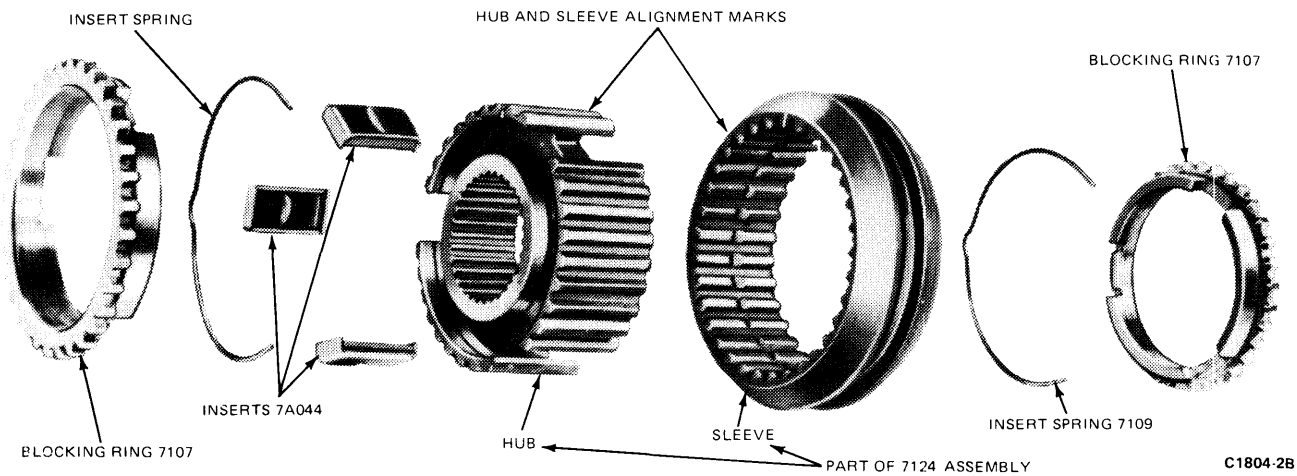


FIG. 26 Second-and-Third Synchronizer—Disassembled

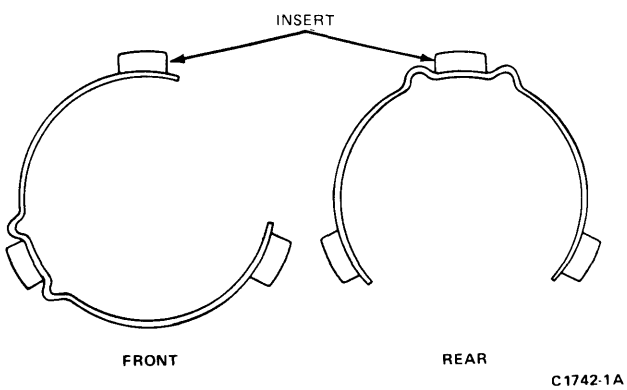


FIG. 27 First-and-Reverse Synchronizer Insert Spring Installation

2. Coat the bore in each end of the countershaft gear with grease.
3. Hold the dummy shaft in the gear and install the 25 needle bearings and a retainer washer in each end of the gear.
4. Position the countershaft gear, dummy shaft, and needle bearings in the case.
5. Place the case in a vertical position. Align the gear bore and the thrust washers with the bores in the case and install the countershaft.
6. Place the case in a horizontal position and check the countershaft gear end play with a feeler gauge. If the end play is not within specification (see Specification chart), replace the thrust washers.
7. After establishing the correct end play, install the dummy shaft in the countershaft gear and leave gear at the bottom of the case until the output and input shafts have been installed.

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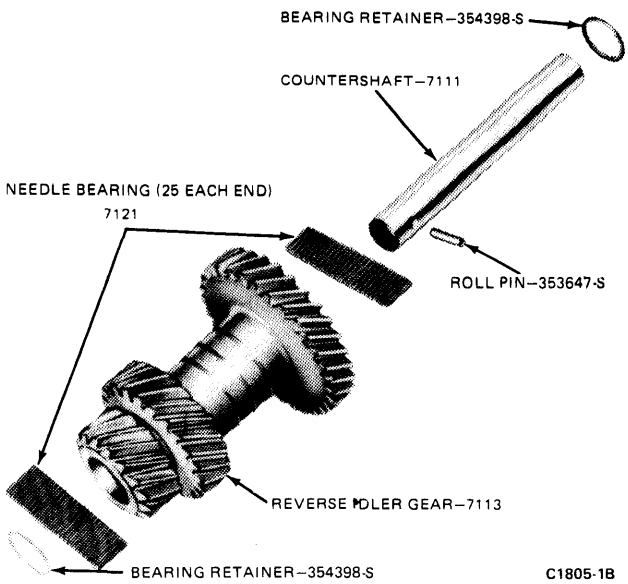


FIG. 28 Countershaft Gear—Disassembled

SPECIFICATIONS

TRANSMISSION GEAR RATIOS

Engine	Ratios		
CID	1st	2nd	Rev.
4.9L (300 CID) I-6 4.9L (302 CID) V-8	2.99	1.75	3.17
4.9L (300 CID) I-6 4.9L (302 CID) V-8 Wide Ratio Opt.	3.26	1.91	3.46

ADJUSTMENTS

Transmission	
End Play — Reverse Idler	0.004-0.018 inch
End Play — Countershaft Gear	0.004-0.018 inch

APPROXIMATE LUBRICANT REFILL CAPACITY (PINTS)

Transmission — Ford 3.03	U.S.	Imperial	Litres
ESP-M2C83-C or equivalent	3.5	3.0	1.6

TORQUE LIMITS

Item	Torque (ft-lbs)	Torque N•m
Input Shaft Gear Bearing Retainer to Transmission Case	30-36	41-48
Transmission to Flywheel Housing	42-50	57-67
Transmission Cover to Transmission Case	20-25	28-33
Speedometer Cable Retainer to Transmission Extension	3-4.5	4.7-6.5
Transmission Extension to Transmission Case	42-50	57-67
Flywheel Housing to Engine	40-50	55-67

Item	Torque (ft-lbs)	Torque N•m
Gear Shift Lever to Cam & Shaft Assembly Lock Nuts	18-23	25-31
U-Joint Flange to Output Shaft	60-80	82-108
Filler Plug	10-20	14-27
Shifter Fork Set Screw	10-18	14-24
Rear Support to Frame	40-60	55-81

CC1039-2F

SPECIAL TOOLS

Tool Numbers	Description
T50T-100A	Impact Hammer—Long
T59L-100B	Impact Hammer—Short
Tool-1175AC	Grease Seal Remover
T57L-4220-A	Differential Side Bearing Cone Replacer or Input Shaft Bearing Remover
T52L-7000-GAE	Extension Housing Bushing and Seal Remover
T63P-7025-A	Output Shaft Bearing Remover and Replacer
Tool-7025-B	Rear Main Shaft Bearing Remover
Tool-7025-G	Main Shaft Bearing Remover and Replacer
Tool T65E-6000-J	Engine Support Bar
T53T-4621-B	Input Shaft Bearing Replacer

SPECIAL TOOLS (Continued)

Tool Numbers	Description
T64P-7111-A	Cluster Gear Roller Retainer Shaft
T63P-7111-B	Cluster Gear Roller Retainer Shaft
T64P-7140-A	Reverse Idler Shaft Remover
T61L-7657-A	Transmission Extension Housing Oil Seal Replacer
T57P-7697-B	Extension Housing Bushing Replacer
T57P-7697-B	Extension Housing Bushing Replacer
T57P-7657-G	Shift Linkage Grommer Replacer
T67P-7341-A	Input Shaft Seal Installer
Tool-3583-J	

CC3164-2C

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Warner T-18 Four-Speed Transmission

PART 16-23

APPLIES TO F-150 — F-350 (4x2) (4x4)

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DESCRIPTION

The four-speed Model T-18 transmission, (Fig. 1), is equipped with a center, floor-mounted gear shift lever.

The first and reverse gears are spur gears and the second, third and fourth speed gears are helical and are synchronized for ease in shifting.

The input shaft is supported by a ball bearing (Fig. 2), which is pressed onto the shaft and into the transmission case.

The front end of the output shaft is supported by a pilot bearing installed in the input shaft. The rear end of the output shaft is supported by a ball bearing which is pressed onto the shaft and into the transmission case. The bearing and shaft are retained in the case by a snap ring. The rear oil seal, speedometer gear, and rear bushing are contained in the extension housing, which is bolted to the rear of the case.

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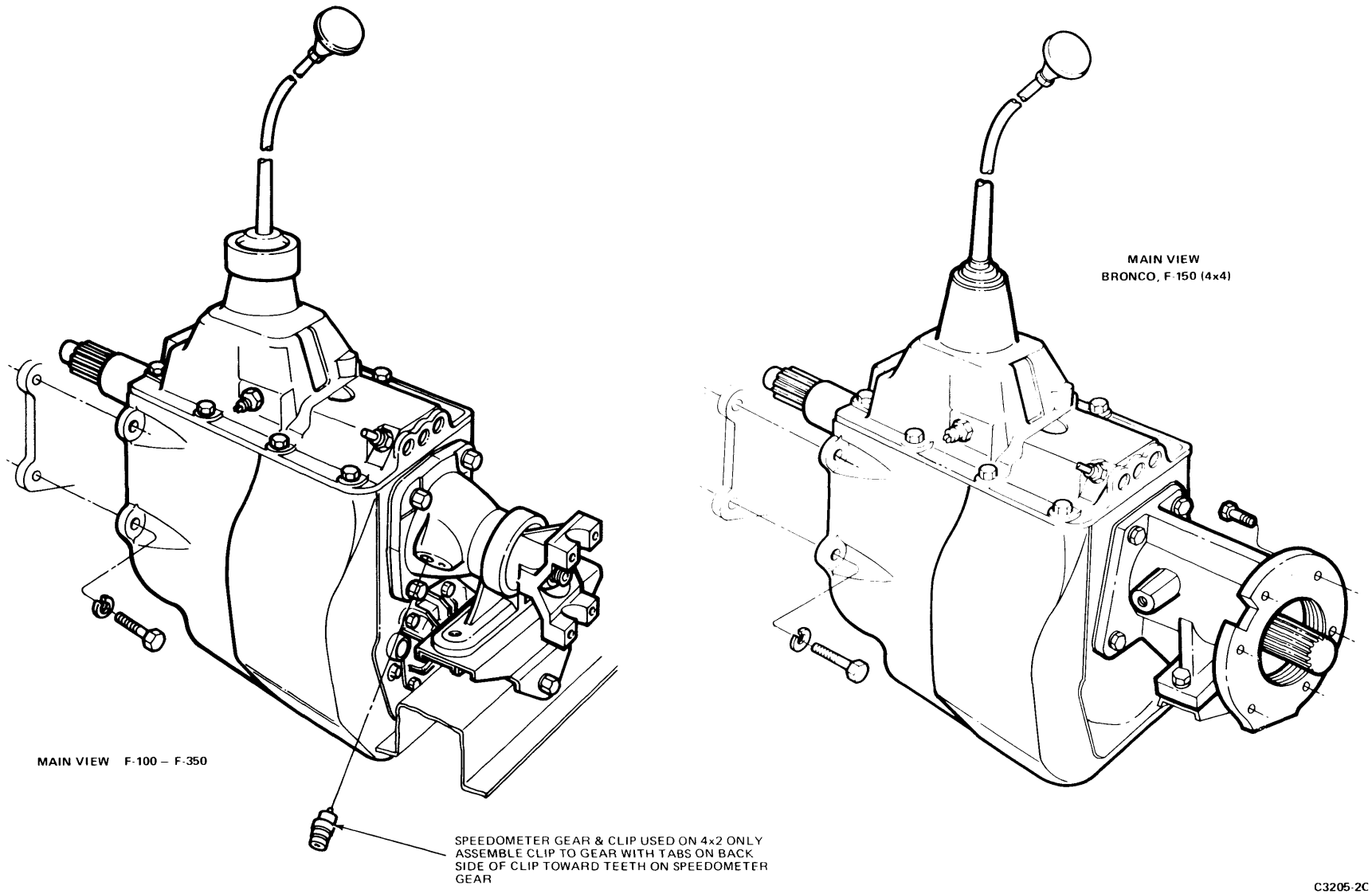


FIG. 1 Warner T-18 Four Speed Transmission

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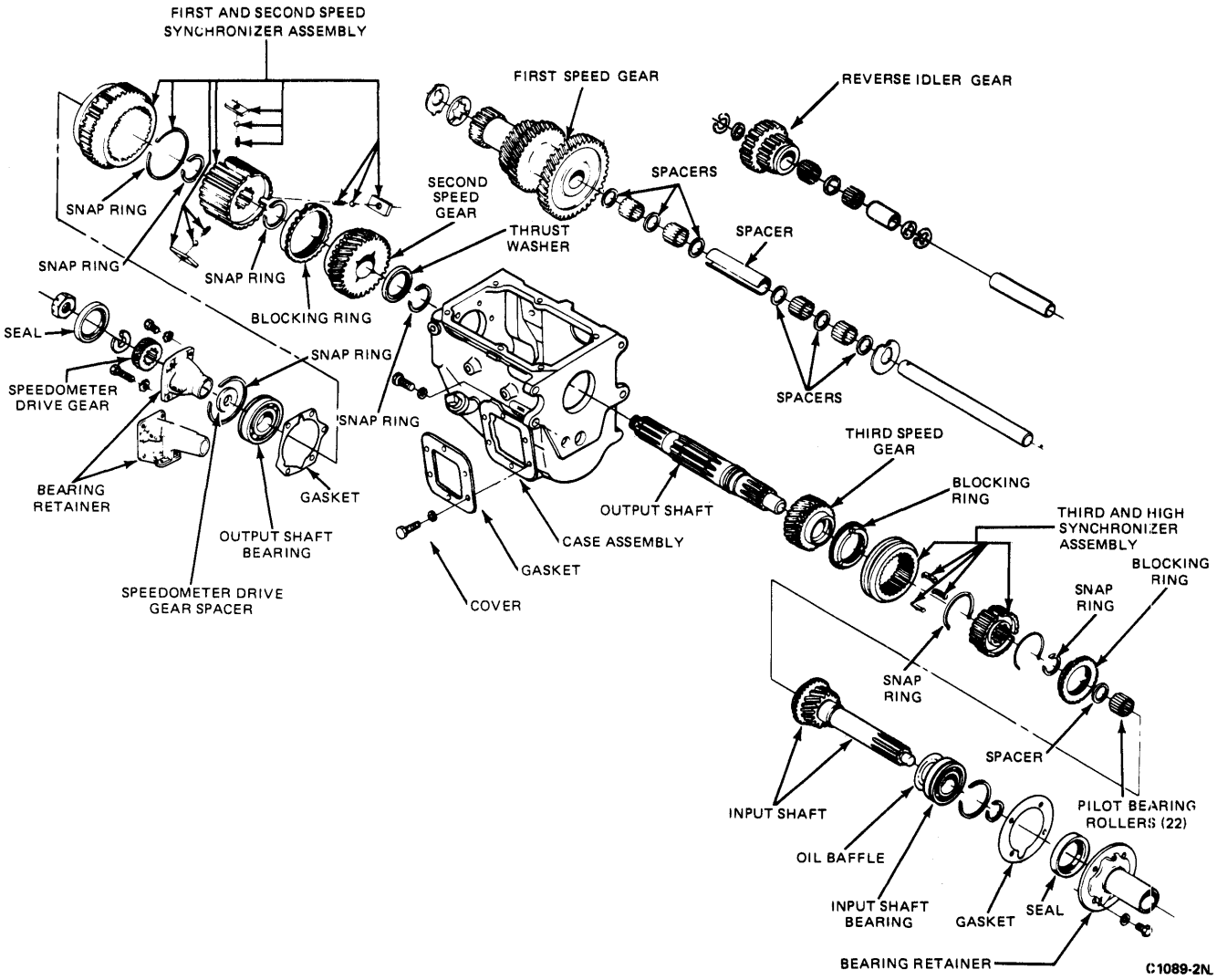


FIG. 2 Typical Warner Four-Speed Transmission

DIAGNOSIS AND TESTING

Refer to Part 16-10, General Manual Transmission Service.

REMOVAL AND INSTALLATION

F-150—F-250 (4X2)

Removal

1. Disconnect the back-up lamp switch located at the rear of the gear shift housing cover.
2. Remove the rubber boot, floor mat, and the body floor pan cover, and remove the gearshift lever. Remove the weather pad.
3. Raise the vehicle and position safety stands. Position a transmission jack under the transmission, and disconnect the speedometer cable.
4. Disconnect the drive shaft or coupling shaft and clutch linkage from the transmission and wire it to one side.
5. Remove the transmission rear support.
6. Remove the transmission attaching bolts.
7. Move the transmission to the rear until the input shaft clears the clutch housing. Lower the transmission.

Installation

Before installing the transmission, apply a light film of lubricant ESA-M1C75-B or equivalent to the clutch release bearing inner hub surfaces, release lever fulcrum and forks, and the transmission front bearing retainer.

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Avoid excessive grease, as it would contaminate the clutch disc.

1. Place the transmission on a transmission jack, and raise the transmission until the input shaft splines are aligned with the clutch disc splines. The clutch release bearing and hub must be properly positioned in the release lever fork.
2. Install guide studs in the clutch housing and slide the transmission forward on the guide studs until it is in position on the clutch housing. Install the attaching bolts and nuts and tighten them to specifications. Remove the guide studs and install the two lower attaching bolts.
3. Connect the speedometer cable and driven gear and clutch linkage.
4. Install the bolts attaching the front U-joint of the coupling shaft to the transmission output shaft flange. Tighten the bolts and nuts to specifications. Install the transmission rear support.
5. Connect the back-up lamp switch.
6. Install the shift lever and lubricate the spherical ball seat with lubricant ESA-M1C75-B or equivalent.
7. Install the weather pad. Install the floor pan cover, floor mat and boot.

F-150—F-250 (4X4)

Removal

1. Open door cover seat.
2. Remove shift knobs.
3. Remove the four screws attaching the transmission shift lever boot assembly.
4. Remove the four screw holding the floor mat.
5. Remove the eleven screws holding the access cover to the floor pan. Place the shift lever in the reverse position and remove the cover.
6. Remove the insulator and dust cover.
7. Remove the transfer case shift lever.
8. Remove the eight bolts holding the shift cover and gasket.
9. Use cardboard or heavy paper to fabricate a suitable cover for the shift cover opening to protect the transmission from dirt during removal.
10. Raise the vehicle on a hoist.
11. Remove the drain pan and drain the transmission.
12. Disconnect the rear driveshaft from the transfer case and wire it out of the way.
13. Disconnect the front driveshaft from the transfer case and wire it out of the way.
14. Remove the cotter key that holds the shift link in place and remove the shift link.
15. Remove the speedometer cable from the transfer case.
16. Position a transmission jack under the transfer case. Remove the six bolts holding the transfer case to the transmission and lower the transfer case from the vehicle.
17. Remove the eight bolts that hold the rear support bracket to the transmission.
18. Position a transmission jack under the transmission and remove the rear support bracket and brace.
19. Remove the four bolts that hold the transmission to the bell housing.
20. Remove the transmission from the vehicle.

Installation

1. Place the transmission on a transmission jack and install it in the vehicle installing two guide studs in the bell housing top holes, to guide the transmission into position.
2. Install the two lower bolts. Remove the guide studs and install the upper bolts.
3. Place the rear support bracket in position and install the eight retaining bolts.
4. Install the two bolts at the rear support insulator bracket. Remove the transmission jack.
5. Position the transfer case on the transmission jack and install the six retaining bolts and gasket. Position the transfer case on the transmission and tighten the bolts to specification.
6. Install the transfer case shift link and cotter pin.
7. Position and install the speedometer cable.
8. Remove wire and connect front driveshaft.
9. Remove wire and connect rear driveshaft.
10. Fill transfer case and manual transmission with lubricant.
11. Lower vehicle.
12. Remove fabricated dirt shield and prepare gasket area.
13. Position gasket and shift cover.
14. Install two pilot bolts, then install remaining shift cover retaining bolts.
15. Install transfer case shift handle.
16. Install dust cover and insulator.
17. Install access cover to floor pan screws.
18. Install the four floor mat screws.
19. Install the four boot area screws.
20. Install the shift knobs.

DISASSEMBLY AND ASSEMBLY

Disassembly

1. Position the transmission assembly in a suitable holding fixture, (Fig. 3). Drain the transmission and remove the gearshift housing assembly.
2. Lock the transmission in two gears; then, remove the U-joint flange and oil seal.
3. Remove the speedometer driven gear and bearing assembly.
4. Remove the output shaft bearing retainer (or extension housing).

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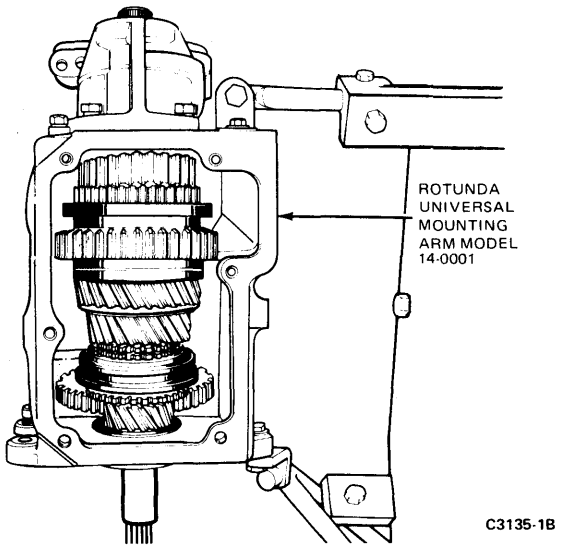


FIG. 3 Transmission in Holding Fixture

5. Remove the speedometer drive gear snap ring retainer. Slide the speedometer drive gear and spacer off the output shaft.
6. Remove the output shaft bearing snap ring retainers from the output shaft and from the bearing, (Fig. 4).
7. Install tool on the output shaft and over the output shaft bearing (Fig. 5). Remove the output shaft bearing and remove bearing spacer.
8. Remove the input shaft bearing snap ring retainers from the input shaft and from the bearing, (Fig. 6).
9. Install tool on the input shaft and over the input shaft bearing. Remove the input shaft bearing.
10. Remove the input shaft oil baffle (Fig. 7).
11. Remove the output shaft assembly from the case (Fig. 8).
12. Remove the input shaft assembly from the case (Fig. 9). Do not lose the 22 pilot bearing rollers from the inner end of the shaft.

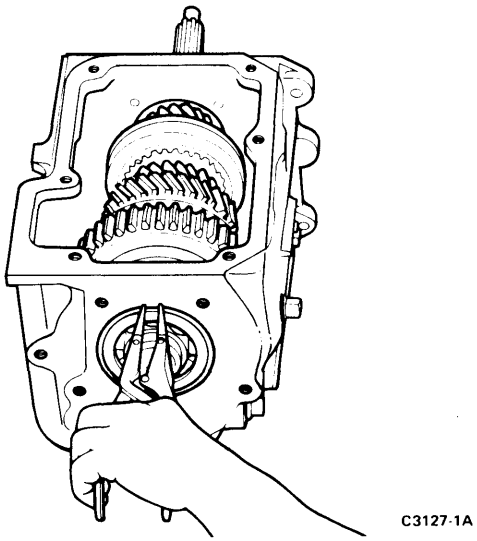


FIG. 4 Removing Output Shaft Bearing Snap Ring

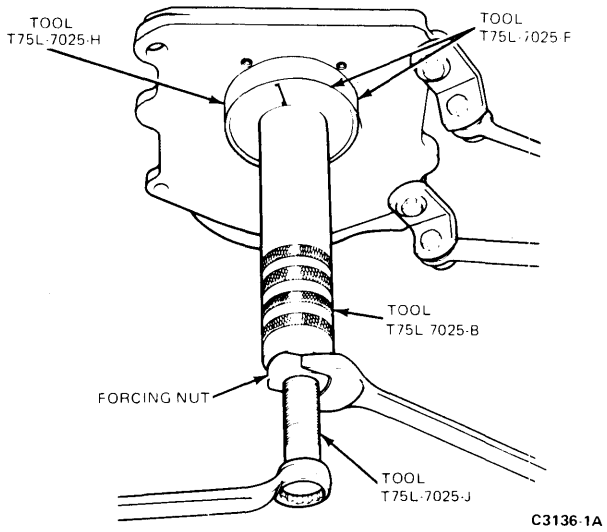


FIG. 5 Removing Output Shaft Bearing

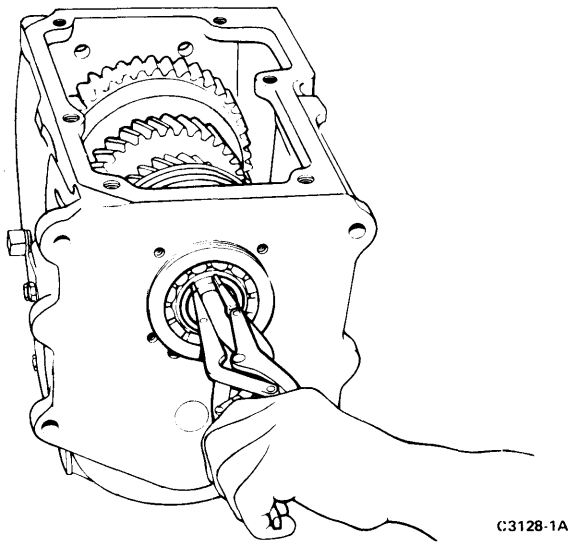


FIG. 6 Removing Input Shaft Bearing Snap Ring

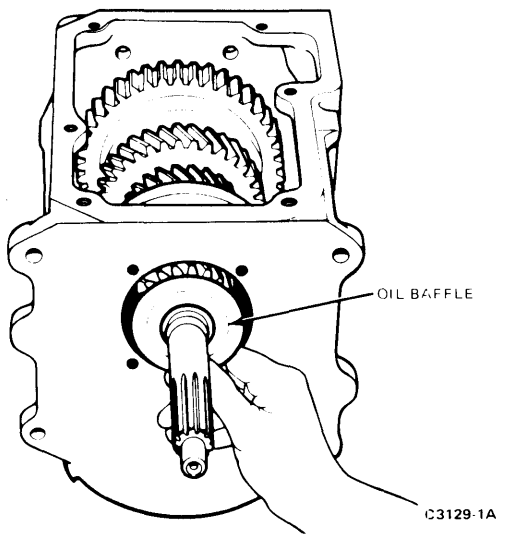


FIG. 7 Removing Input Shaft Oil Baffle

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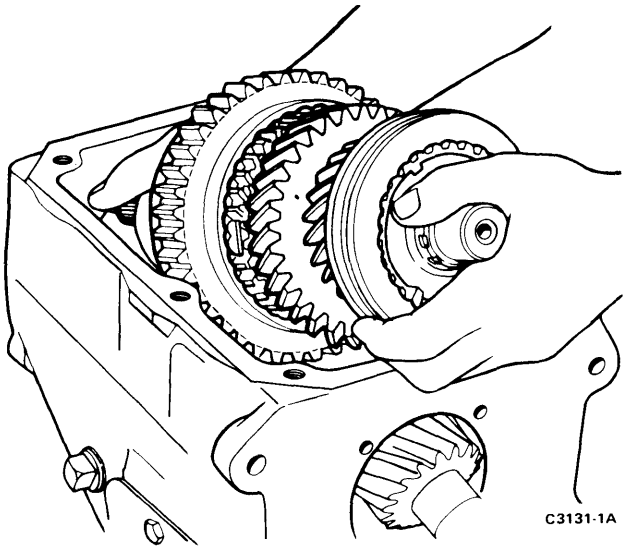


FIG. 8 Removing Output Shaft Assembly

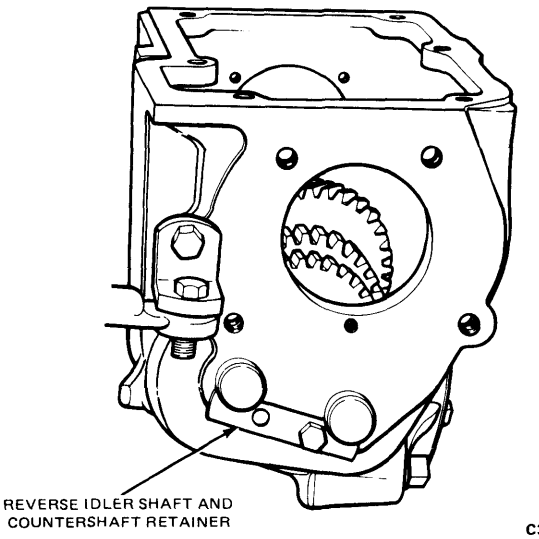


FIG. 10 Reverse Idler Gear Shaft and Countershaft Retainer

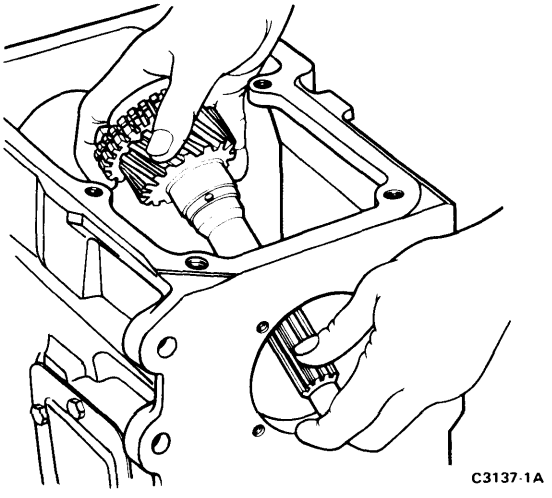


FIG. 9 Removing Input Shaft Assembly

13. Remove the reverse idler gear shaft and the countershaft retainer from the end of the transmission case (Fig. 10).
14. Remove the reverse idler gear shaft, using the tools shown in Fig. 11.
15. Remove the reverse idler gear from the case.
16. Remove the countershaft with the same tools used to remove the reverse idler gear shaft.
17. Remove the countershaft gear assembly from the case. Guide to bearing shaft (tool into the gear assembly here as the countershaft is being removed). Use care so that the roller bearings and spacers which remain in the countershaft gear here are not lost.

Assembly

1. Coat all parts, especially the bearings, with specified transmission lubricant to prevent scoring when the transmission is first put into operation.

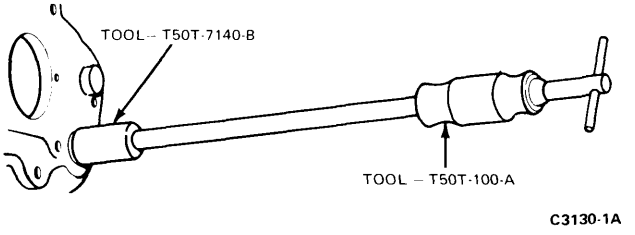


FIG. 11 Removing Reverse Idler Gear Shaft

2. Position the countershaft gear assembly thrust washers in the transmission case.
3. Position the countershaft gear assembly (with dummy shaft tool installed) in the transmission case. **Use care so that no roller bearings are lost, and so that the thrust washers are not moved out of position.**
4. Carefully, drive out the countershaft gear assembly dummy shaft by installing the countershaft from the rear of the transmission case. **Position the slot in the rear of the countershaft so that it can be engaged by the shaft retainer.**
5. Check the countershaft gear end play. End play should be 0.006 to 0.020 inches. If necessary, remove the countershaft gear assembly and re-install it using thrust washers which will provide the proper end play.
6. Position the reverse idler gear assembly in the transmission case, and install the reverse idler gear shaft. **Position the slot in the rear of the shaft so that it can be engaged by the shaft retainer.**
7. Install the countershaft and reverse idler gear shaft retainer.
8. Load the 22 pilot bearing rollers in the inner end of the input shaft (use petroleum jelly to keep the pilot bearings in position). Position the input shaft assembly in the transmission case and install the blocking ring on the input shaft.
9. Install the output shaft assembly in the transmission case. **Use care so that the pilot bearing rollers**

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are not permitted to drop out of the input shaft.

10. Install the input shaft oil baffle.
11. Install a dummy bearing (Tool T75L-7025-Q) on the transmission input shaft. This tool is necessary to keep the input and output shafts in alignment when installing the output shaft bearing.
12. Install the output shaft bearing using tools as shown in Fig. 12.

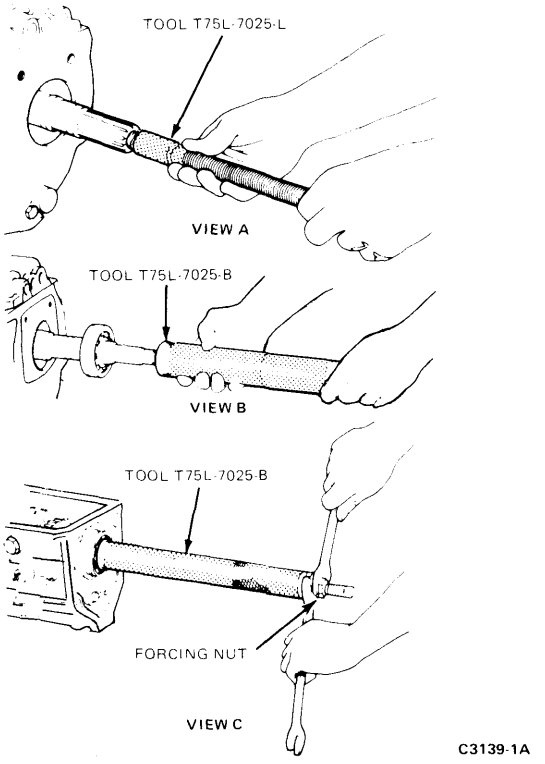


FIG. 12 Installing Output Shaft Bearing

13. Install the output shaft bearing retainer snap rings. Use the thickest select fit snap rings which will fit on the bearing.
14. Remove the dummy bearing from the input shaft.
15. Install the input shaft bearing using the tools shown in Fig. 13 and install the snap ring.
16. Install the input shaft bearing retainer gasket and retainer. Tighten the bolts to specification.
17. Position the speedometer drive gear (and spacer, if used) on the output shaft over lock ball and install the speedometer drive gear retaining snap ring.
18. Using a new gasket install the output shaft bearing retainer (or extension housing). Tighten the bolts to specification.
19. Lubricate the extension housing bushing and seal and the U-joint flange with ball joint grease.
20. Install the U-joint flange. Lock the transmission in two gears and tighten the retaining nut to specifications.
21. Install the gear shift housing assembly on the transmission and tighten the cover bolts to specification.

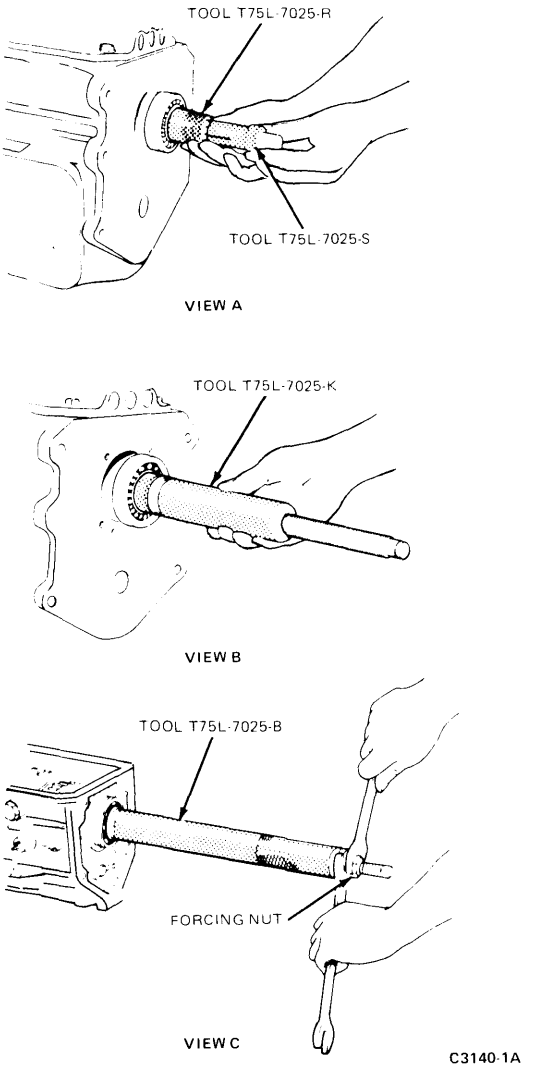


FIG. 13 Installing Input Shaft Bearing

22. Fill the transmission to the proper level with recommended lubricant ESW-M2C38B or C or equivalent. Add 1/2 pint of lubricant through the speedometer cable hole in the rear transmission extension housing.

SUB-ASSEMBLIES

OUTPUT SHAFT

Disassembly

1. Remove the third- and high-speed synchronizer hub snap ring from the output shaft, and slide the third- and high-speed synchronizer assembly and the third-speed gear off the shaft.
2. Before removing the two snap rings from the ends of the hub, check the end play of the second speed gear. There should be 0.005 to 0.024 inches of end play.
3. Remove the synchronizer sleeve and the inserts from the hub.
4. Remove the second-speed synchronizer snap ring. Slide the second-speed synchronizer gear off the hub, (Figs. 14 and 15).

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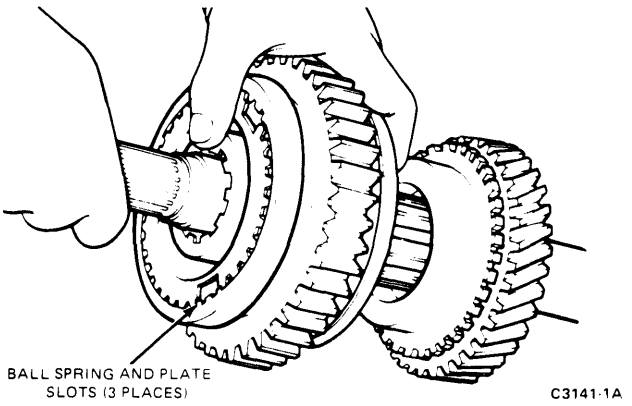


FIG. 14 Removing Second Gear Synchronizer—Assembly

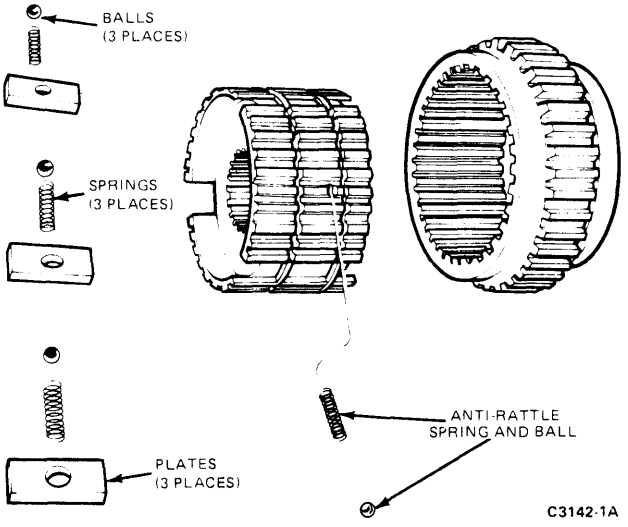


FIG. 15 Second Speed Synchronizer—Disassembled

Be careful not to lose any of the balls, springs or plates, nor the anti-rattle spring and ball. Pull the hub synchronizer off the shaft, and remove the second-speed synchronizer from the second-speed gear.

If the shift plate balls and springs become dislocated during disassembly, use a 1/4 socket to press on the shift plate balls when assembling them into the hub and synchronizer.

5. Remove the snap ring from the rear of the second-speed gear, and remove the gear and the thrust washer from the output shaft, (Fig. 16).

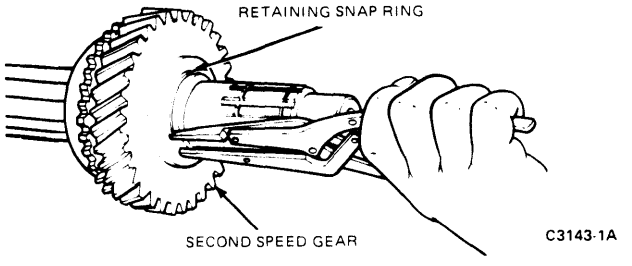


FIG. 16 Removing Second Speed Gear Retaining Snap Ring

Assembly

1. Install the second-speed gear thrust washer and snap ring on the output shaft. Hold the shaft in a vertical position, and slide the second-speed gear onto the shaft.
2. Install the snap ring on the output shaft at the rear of the second-speed gear. Position the blocking ring on the second-speed gear.
3. Press the second-speed synchronizer and hub assembly onto the shaft, and install the snap ring.
4. Remove the output shaft from the vise, and install the third-speed gear and synchronizer blocking ring on the shaft. Install the snap ring.
5. Place the inserts in the synchronizer sleeve, and position the sleeve on the hub.
6. Slide the synchronizer assembly onto the output shaft. The slots in the blocking ring must be in line with the synchronizer inserts. Install the snap ring at the front of the synchronizer assembly.

COUNTERSHAFT GEAR

Disassembly

Remove the dummy shaft, pilot bearing rollers, bearing spacers, and the center spacer from the countershaft gear.

Assembly

1. Slide the long bearing spacer (Fig. 2) into the countershaft gear bore, and insert the dummy shaft in the spacer.
2. Apply a film of petroleum jelly to the countershaft gear bore and install one of the bearing spacers. Position the 22 bearing rollers in the gear bore.
3. Place a spacer on top of the rollers, and install 22 more rollers and another spacer.
4. Hold a large thrust washer against the end of the countershaft gear to prevent the rollers from dropping out, and turn the assembly over. Install bearing spacer, 22 rollers, spacer, 22 rollers and spacer.

REVERSE IDLER GEAR

Disassembly

Replace the reverse idler gear if the gear or bushing is badly worn or if the teeth are chipped or burred. Replace the reverse idler gear shaft if it is excessively worn or scored.

GEAR SHIFT HOUSING

Disassembly

1. Remove the floor mat or carpet, rubber boot cover and floor pan cover. Remove front seat assembly if necessary.
2. Remove the foam weather pad from the gear shift housing.
3. Remove the gear shift lever from the transmission. Then, disconnect the back-up lamp switch from the connector and remove the back-up lamp switch from the rear of the gear shift housing.
4. Position the three shift rails and forks so that the three shift gates are in the normal "neutral" position in the gear shift housing assembly. Then,

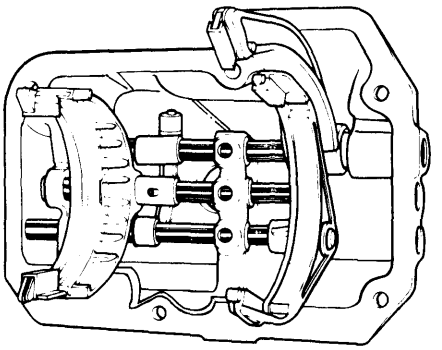
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shift the transmission into "Second Gear" (Fig. 17). This will allow the shift housing tower to be removed from the transmission.

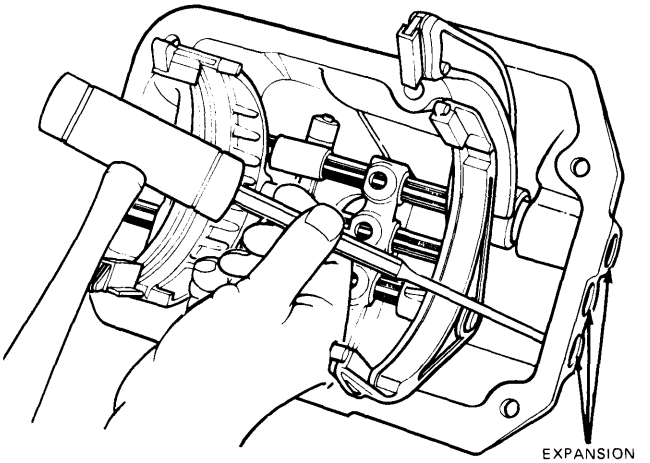
NOTE: After the shift housing tower is removed, inspect all internal transmission components for damage, chips and/or foreign material within the transmission case assembly.

5. Remove the three expansion plugs from the forward end of the shift housing (Fig. 18). Using a pin punch, remove the three lock pins from the shift forks and the three lock (roll) pins from the gear shifter shaft gates.



C3144-1A

FIG. 17 Shift Housing Removed—Second Gear Position



C3145-1A

FIG. 18 Removing Expansion Plugs from Shift Housing

6. Tap the shifter shaft(s) out of the housing (forward) while holding a shop towel over the poppet ball(s), (Fig. 19), and spring hole(s) in the housing to prevent loss of spring(s) and/or poppet ball(s).
7. Remove the interlock pins from the shift rails (Fig. 19).
8. Remove the shift forks and shift gates.
9. Remove the poppet balls and springs from the housing. Then, remove the interlock plungers from the housing.

Assembly

1. Install the spring and plunger in the reverse gate, press the plunger through the gate and fasten it in place with the clip, if the reverse gate assembly has been disassembled.
2. Place the poppet spring and ball in the reverse shifter shaft hole in the gear shift housing. Install the reverse shift fork on the shaft (reverse shifter) then, press down on the poppet ball and spring with a long thin drift and position the reverse shifter ball notch so that it does not slide over the ball. Insert the shaft part way into the housing.
3. Slide the reverse gate onto the shaft (long end forward), and drive the shaft into the housing until the ball snaps into the groove of the shaft. Install the lock pin that fastens the gate to the shaft.
4. Insert the two interlocking plungers in the pockets between the shifter shaft holes. Place the poppet spring and ball in the low-and-second shifter shaft hole. Press down on the poppet ball and spring with a long thin drift and insert the shifter shaft part way into the housing.
5. Slide the low-and-second shifter shaft gate onto the shaft, and install the low-and-second shifter fork on the shaft so that the off-set of the fork is toward the rear of the housing. Push the shaft all the way into the housing until the poppet ball snaps into the shaft groove. Then, install the lock pins that fastens the fork and gate to the shaft.
6. Insert the three-four shifter shaft through the center rear hole of the housing. Then, insert the interlock pin into the interlock pin hole in the shifter shaft.

   Note: Apply a daub of petroleum jelly to hold the pin in position.
7. Apply a coating of petroleum jelly to the interlock plungers and insert them into their respective holes in the housing.
8. Place the poppet spring and ball in the center shifter shaft hole in the housing. Press down on the poppet ball with a long thin drift, and carefully push the shifter shaft into the housing over poppet ball and spring.
9. Position the third-fourth shift gate onto the shifter shaft.

   Note: It is extremely important that the shift gate be installed on the shifter shaft with the long flat "tang" end of the gate area facing forward of the gear shift housing. To insure proper installation, measure the two flat "tangs" of the shift gate, note the longer dimension 23/32 inch and apply a daub of bright paint. This tang should be installed facing forward on the shifter shaft.
10. Position the three-four shifter fork on the shifter shaft so that the lockpin hole in the shifter fork is toward the rear of the housing. Push the shifter shaft into the housing until the poppet ball seats into the second detent (neutral). Install the lock pins attaching the shifter fork and shifter gate to the shifter rail.

    Note: Install the shifter gate lock pin so that the pin is flush with the bottom of the notch in the shifter gate.

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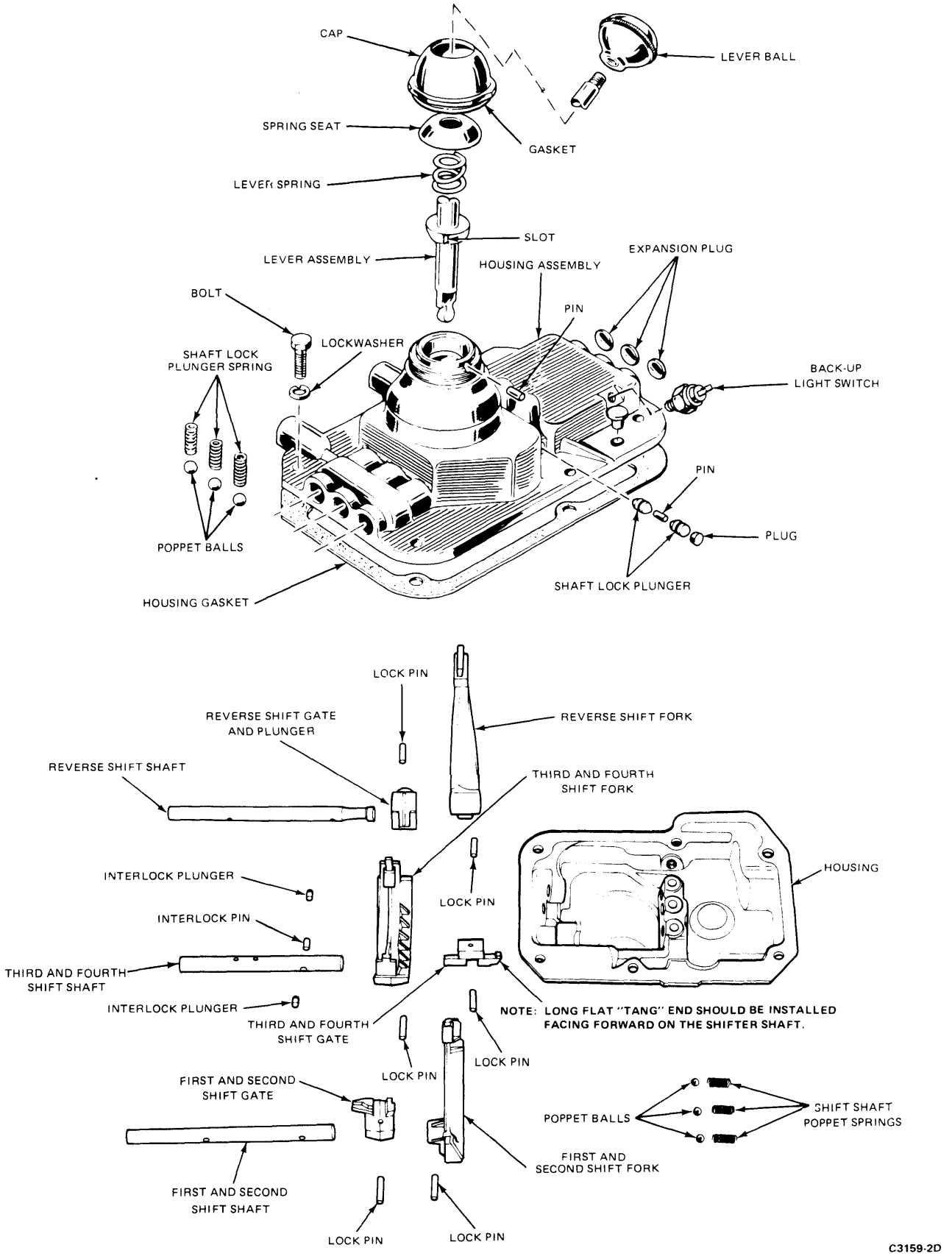


FIG. 19 Shift Housing—Disassembled

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11. Install new expansion plugs in front and rear of transmission housing.
12. Shift the gear shift housing into the "second gear" position. Shift the transmission gears into the "second gear" position. Install the back-up lamp switch and connect the wiring. Then, place the transmission gear shift housing onto the transmission.
13. Apply Loctite Sealer (19554 ESG-M4G-194-A or equivalent) to the six shift gear housing-to-transmission case attaching bolts. Tighten the bolts to 17-20 ft-lb torque.
14. Position the foam weather pad on the gear shift housing. Install the gear shift lever. Install cab floor pan cover, rubber boot and floor mat or carpet. Install front seat.
15. Fill transmission with specified lubricant, ESW-M2C83-B or equivalent, ADD 1/2 pint of lubricant through the speedometer cable hole in the rear transmission retainer.

SPECIFICATIONS

SPECIAL TOOLS

Tool Number	Description
T75L-7025-B	Output Shaft Bearing Installation-Removal Tool
T75L-7025-F	Output Shaft Bearing Removal Tool
T75L-7025-H	Output Shaft Bearing Removal Tool
T75L-7025-K	Input Shaft Bearing Installation Tool
T75L-7025-L	Output Shaft Bearing Installation Tool
T75L-7025-R	Input Shaft Bearing Installation Tool
T75L-7025-S	Input Shaft Bearing Installation Tool
T50T-100-A	Slide Hammer
T50T-7140-B	Reverse Idler Gearshaft Removal Tool
T75L-7025-J	Output Shaft Bearing Removal Tool
T75L-7025-Q	Dummy Bearing
14-0001	Universal Mounting Arm

CC3592-2B

APPROXIMATE REFILL CAPACITY — WARNER T-18

Transmission Type and Make	Approximate Capacity		
	U.S. (Pints)	Imperial (Pints)	Litres
Warner T-18 Four-Speed (ESW-M2C83-B or C or equivalent)	7.0	5.5	3.3

CC3593-2B

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New Process 435 Four-Speed Transmission

PART 16-25

APPLIES TO F-100 — F-350, BRONCO, F-150-F-250-F-350 (4x4)

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DESCRIPTION

The Model 435 four-speed transmission (Fig. 1), is provided with a floor-mounted shift lever.

The first and reverse gears are spur cut (Fig. 2). The second, third and fourth gears are helical cut and are synchronized to permit easier shifting.

The input shaft is supported by a tapered roller bearing. The input shaft end play is controlled by the thickness of gaskets between the case and the front bearing retainer.

The front end of the output shaft is supported by a pilot bearing that is located in the input shaft. The rear end of the output shaft is supported by a ball bearing that is pressed onto the shaft. The bearing and shaft are held in the case by a snap ring and a bearing retainer. Retention of the output shaft in the case may vary, depending on application, with the various extension housings that are used (Figs. 2 and 4) to fit several vehicle models.

The third- and fourth-speed synchronizer is mounted on the forward end of the output shaft and is held in place by the gear end of the input shaft and the third-speed gear. The third- and second-speed gears are located between the shoulder and the third- and fourth-speed synchronizer on the output shaft.

The second-speed synchronizer and the first-speed sliding gear are located toward the rear of the output shaft (Fig. 2). A spacer is provided to prevent the first-speed sliding gear from contacting the case.

The countershaft gear is supported by roller bearings installed at both ends of the gear. A roller-type thrust bearing and a bearing race are provided at the rear end of the gear. A thrust washer is also provided at the front of the gear. Uncaged rollers are used in production, but caged roller assemblies are available for service.

The reverse idler gear uses a bronze bushing in the Bronco F-100, F-350 installation. A roller bearing-type gear is supplied for service replacement, however. The bearings are installed between the gear and a sleeve on the reverse idler shaft. The sets of bearings are separated by a snap ring and bearing race retainer spacer. Snap rings, installed in the center of the reverse idler gear, hold the entire assembly in position.

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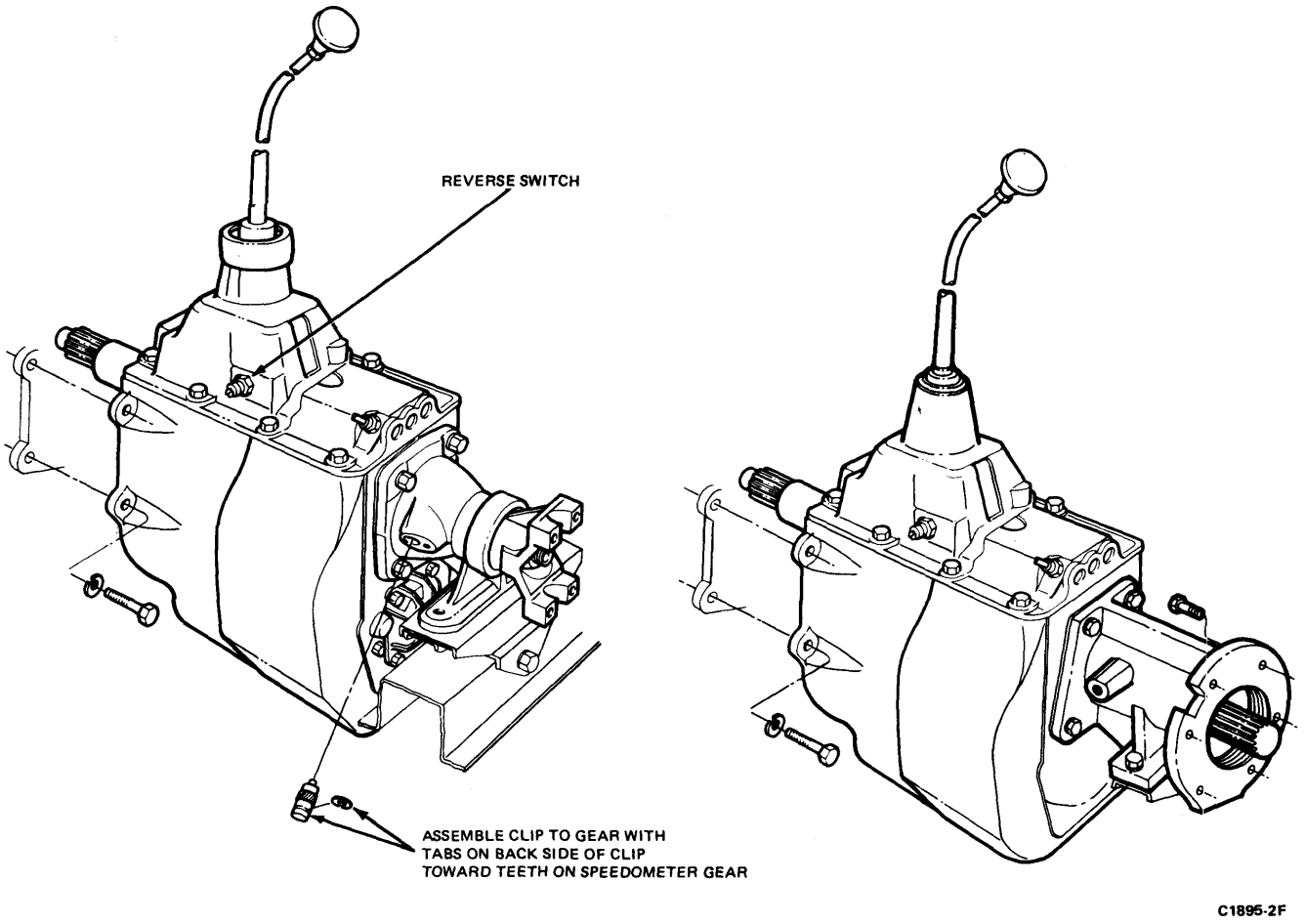


FIG. 1 New Process 435 Four-Speed Transmission—F-100—F-350, F-150—F-250 (4x4), Bronco

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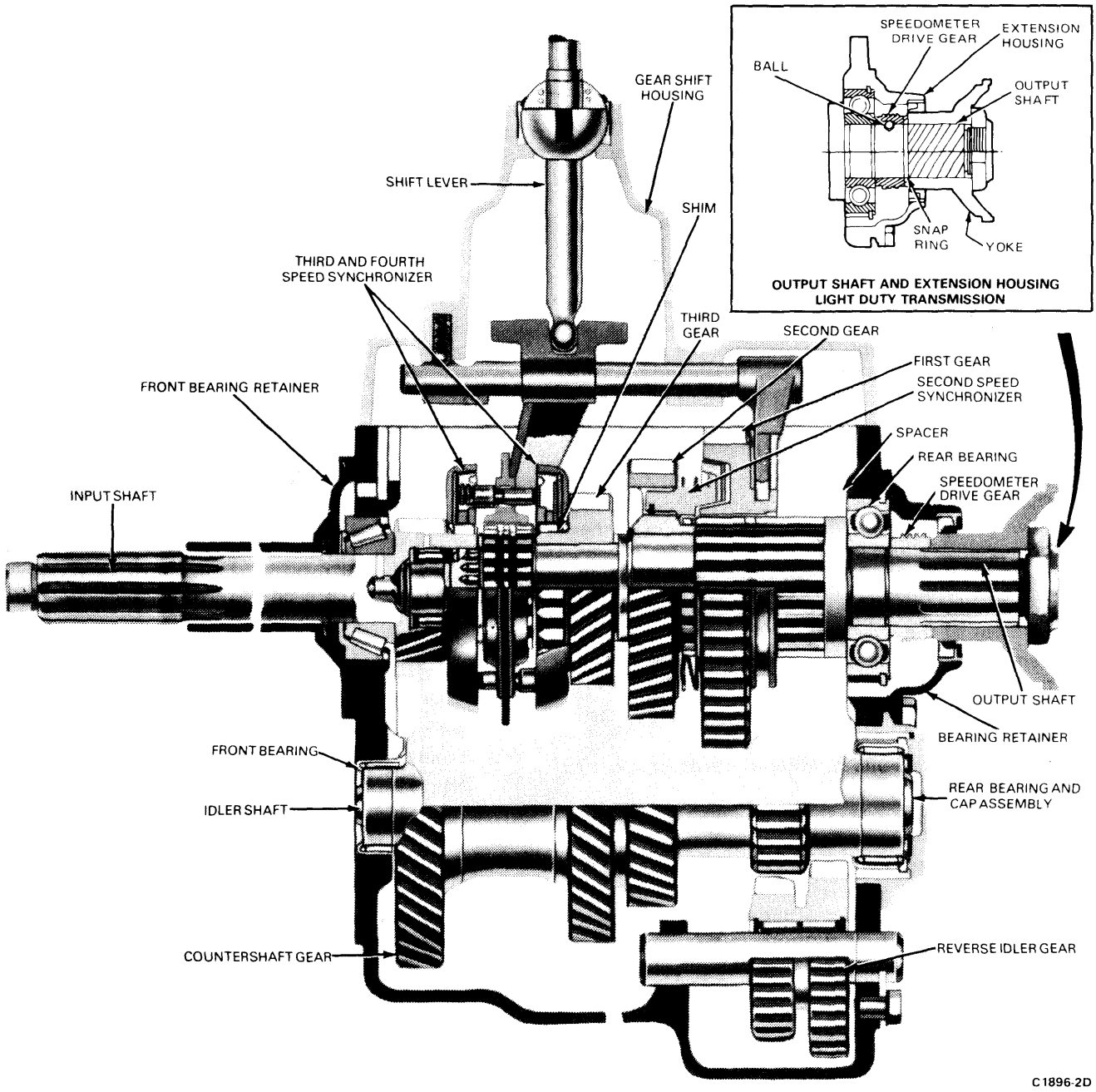


FIG. 2 Transmission Sectional View

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REMOVAL AND INSTALLATION

Refer to Figs. 2 and 3 for various installation views.

Removal

1. Remove the rubber boot from the shift lever and floor mat. On 4x4 vehicles, remove the transfer case shift lever rubber boot.
2. Remove the floor pan transmission cover. Remove the weather pad on F-100—F-350. It may be necessary to remove the seat assembly.
3. Remove the gearshift lever by first removing the inner cap (Fig. 12) with the use of Kent-Moore tool J-3108 or equivalent. Then remove the spring seat and spring. Remove the gearshift lever from the housing.
4. Disconnect the back-up light switch located on the left hand side of the gearshift housing cover.
5. Raise the vehicle and position safety stands. Disconnect the speedometer cable. Remove the rear driveshaft and wire it out of the way. On 4-wheel drive vehicles follow steps 6 through 11.
6. Drain the transfer case.
7. Remove the front driveshaft from transfer case and wire out of the way.
8. Remove the cotter key holding the shift link and remove the shift link.
9. Remove the speedometer cable from the transfer case.
10. Remove three bolts holding support bracket to transfer case.
11. Position a transmission jack under the transfer case. Remove the six bolts holding the transfer case to the transmission. Remove the transfer case from the vehicle.
12. Place a transmission jack under the transmission and remove the rear support.
13. Remove the transmission attaching bolts at the clutch housing and remove the transmission.

Installation

Before installing the transmission, apply a light film of lubricant, C1AZ-19590-B or equivalent to the release lever fulcrum and fork. Do not apply a thick coat of grease to these parts, as it will work out and contaminate the clutch disc. Make sure that the gasket contact area between the transmission and transfer case is clean.

1. Place the transmission on a transmission jack and raise the transmission until the input shaft splines are aligned with the clutch disc splines. The clutch release bearing and hub must be properly positioned in the release lever fork.
2. Install guide studs in the clutch housing and slide the transmission forward on the guide studs until it is in position on the clutch housing. Install the attaching bolts or nuts and tighten them to specification. Remove the guide studs and install the two lower attaching bolts. On vehicles equipped with 4-wheel drive, follow steps 3 thru 7.
3. Place the transfer case on a transmission jack. Install the six retaining bolts and gasket. Position the transfer case on the transmission and tighten bolts to specification.
4. Install transfer case shift link and cotter key.
5. Position and install speedometer cable.
6. Position and install support bracket with three retaining bolts. Tighten to specification.
7. Remove wires and connect front driveshaft.
8. Remove wires and connect rear driveshaft. Install the transmission rear support.
9. Connect the back-up light switch.
10. On vehicles equipped with 4-wheel drive, fill the transfer case with lubricant.
11. Install the transmission cover plate. Install the seat assembly if it was removed.
12. Install weather pad, gearshift lever, floor mat and rubber boot as applicable.

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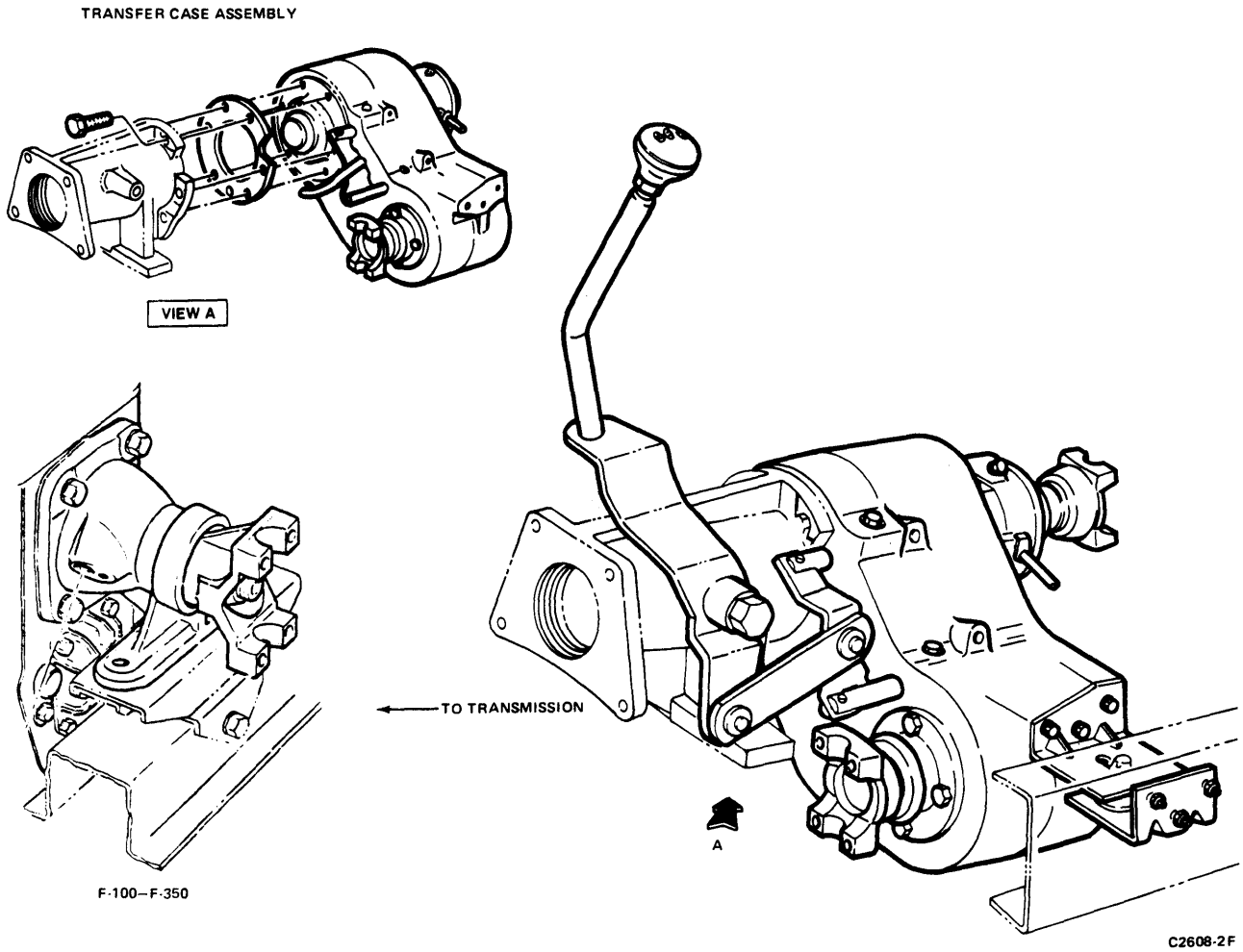


FIG. 3 Light Truck Installations—Model 435 Transmission

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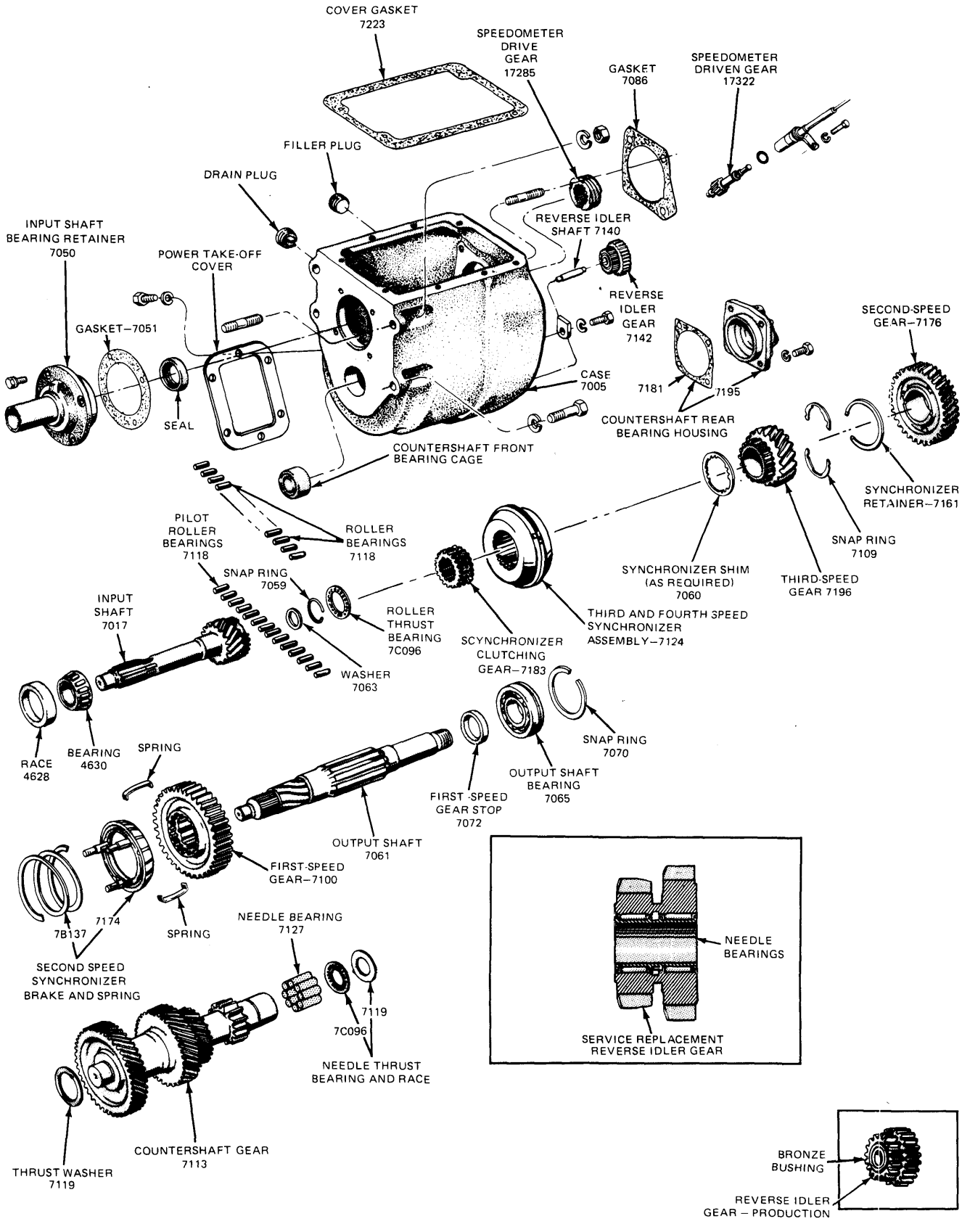


FIG. 4 Transmission Disassembled—F-100-F-350, Bronco

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DISASSEMBLY AND ASSEMBLY

Disassembly

1. Place the gearshift lever in the neutral position, remove the gearshift housing attaching bolts, and remove the housing.
2. Lock the transmission in two gears, and remove the output flange nut.
3. Remove the extension housing attaching bolts or nuts. Remove the extension housing from the output shaft.
4. Slip the speedometer drive gear off the output shaft.
5. Remove the front bearing retainer attaching bolts. Remove the retainer and gasket.
6. Rotate the input gear as required to align the notch in the input gear clutch teeth with the countershaft drive gear teeth. Remove the input gear and tapered roller bearing from the transmission (Fig. 4).
7. Remove the output shaft bearing (Fig. 5).

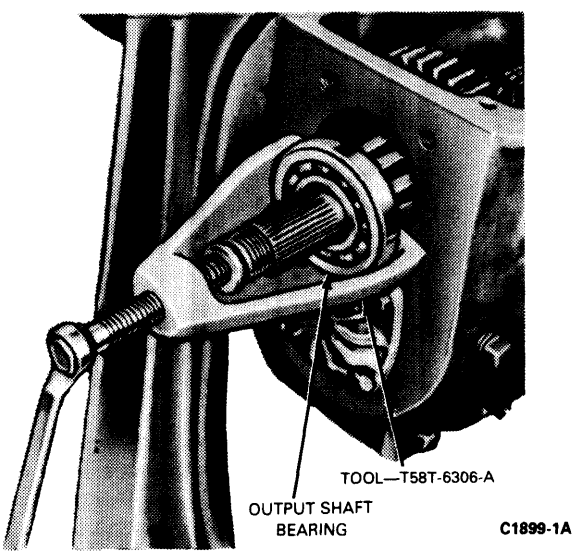


FIG. 5 Removing Output Shaft Bearing

8. Remove the roller-type thrust bearing from the front of the output shaft.
9. Slide the third- and fourth-speed synchronizer off the output shaft and remove it from the case.
10. Lift the output shaft from the case as shown in Fig. 6.
11. Remove the reverse idler gear shaft retainer from the rear of the case (Fig. 5). Secure the puller T50T-100-A and adapter T50T-7140-B to the shaft. Hold the gear to prevent it from dropping, and then remove the idler shaft.
12. With the front of the transmission in the downward position, remove the attaching bolts from the countershaft gear rear bearing cap. Tap the cap with a soft-faced hammer to free it from the case. Remove the cap, race thrust bearing, and gasket (Fig. 7). Lift the gear from the case.

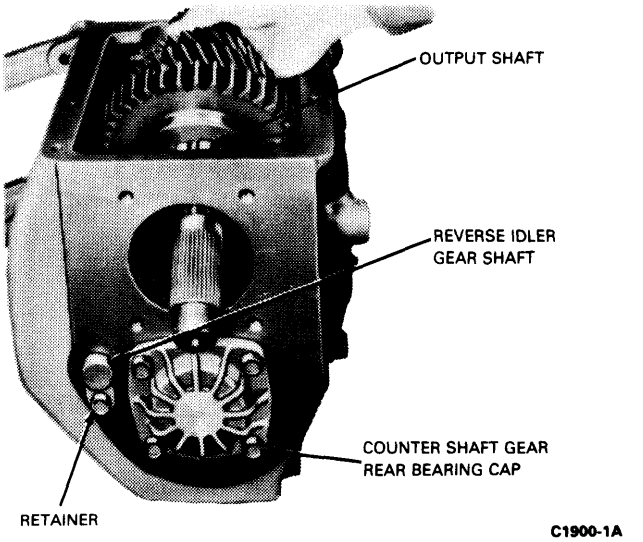


FIG. 6 Removing Output Shaft

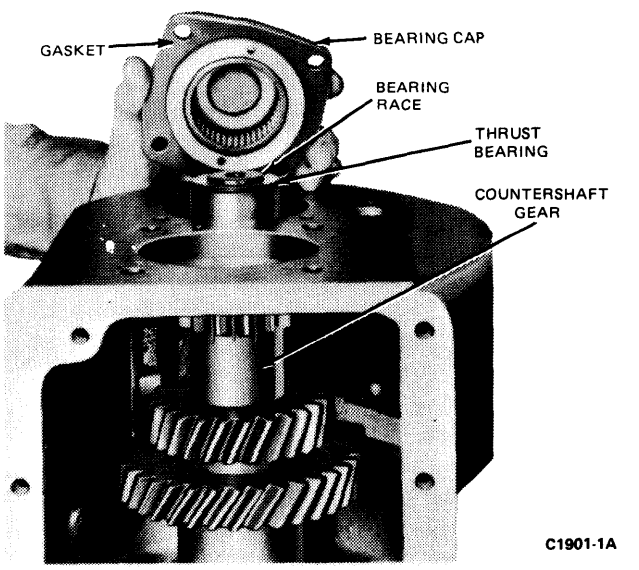


FIG. 7 Removing or Installing Countershaft Rear Bearing

Assembly

Coat all parts with the specified transmission lubricant to prevent scoring when the transmission is first operated.

1. Place the input shaft, third/fourth speed synchronizer assembly clutch gear and thrust bearing on the output shaft and secure the complete assembly in a vise as shown in Fig. 8.

   On F-100-F-350 and Bronco check the distance between the synchronizer and input shaft gear. If the distance is more than .070 to .095 inch, install the necessary thickness of shims between the third-speed gear and the synchronizer brake drum. After the proper thickness of shims has been established, remove the input shaft from the output shaft.

   The third- and fourth-speed synchronizer is a one-piece assembly consisting of a sliding clutch hub,

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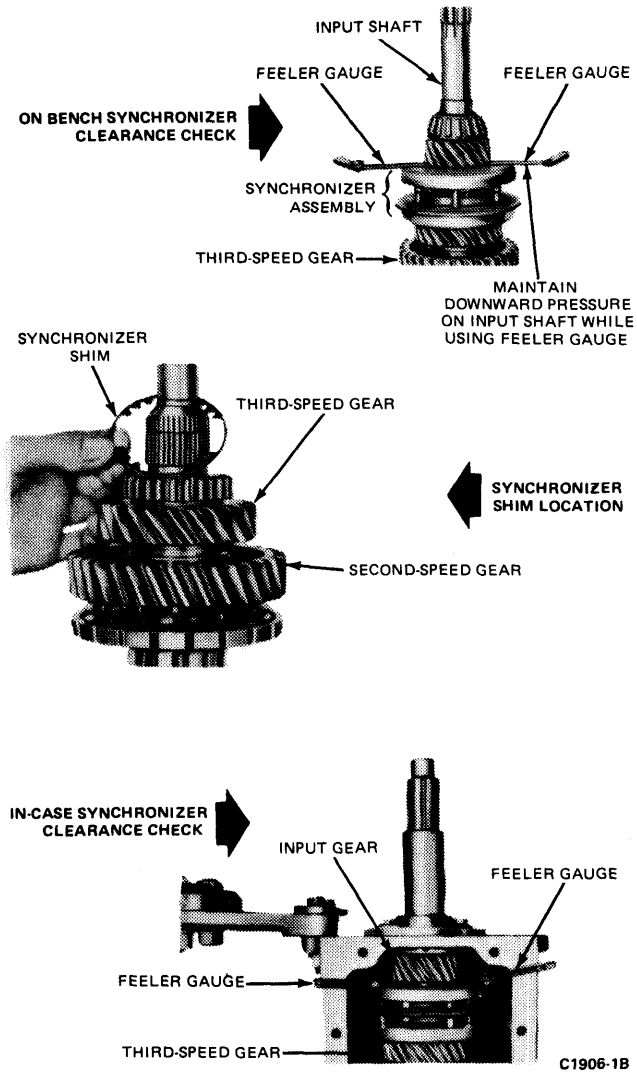


FIG. 8 Measuring Input Shaft-To-Synchronizer Clearance

three energizing pins, two energizing springs, three blocking ring pins, and two aluminum inner stop rings assembled as an integral unit. In addition, there are two outer stop rings.

Note: The two oil slots in the clutching gear must be installed facing the third speed gear. The oil slot must not face against the thrust bearing.

When replacing the third- and fourth-speed synchronizer, use the new assembly (D3TZ-7124-B/NPG No.11338). Also, be sure to use the new outer stop rings, which are necessary to protect the inner stop rings against premature failure. Never mix old and new parts nor use old-style or worn outer stop rings.

2. Position the transmission case with the front in the downward position.
3. Apply a thin film of grease on the front thrust washer and position it in the front of the case. The thrust washer is bored off-center, therefore, make sure that the tangs match the slots in the case boss.
4. Place the countershaft gear in the case.
5. Place the rear thrust bearing and then the bearing race on the rear of the countershaft gear (Fig. 7).
6. Install a new gasket on the bearing cap. Then coat the bore of the bearing cap with grease to retain the roller bearings and insert the bearings. Install the bearing cap on the rear of the case. Tighten the attaching bolts to specification found at the end of this part.
7. Install the reverse idler gear in the case with the larger gear toward the rear of the case. Coat the rear of the reverse idler gear shaft with sealer before installing the retainer. Press idler shaft into position. Secure the idler shaft retainer with a bolt.
8. Position the output shaft assembly in the case.
9. Place a wood block in the front of the case as shown in Fig. 9. Drive the bearing onto the rear of the output shaft while holding the front of the shaft against the block.

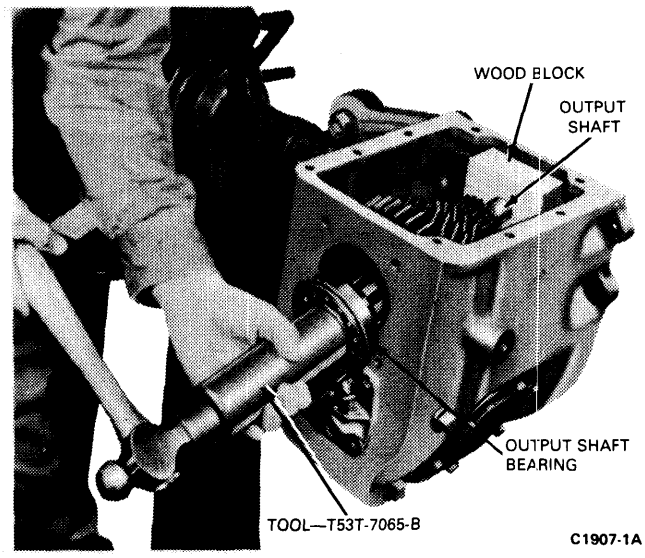


FIG. 9 Installing Output Shaft Rear Bearing

10. Install the rear extension housing on the transmission. Do not install the yoke until the output shaft end play has been checked. On transmissions equipped with a parking brake support, the yoke and retaining nut must be installed before the input shaft end play is checked.
11. With the cutaway portion of the clutch teeth in the downward position on the input shaft, install the gear in the case.
12. Install the input shaft bearing retainer with no gasket or capscrews.

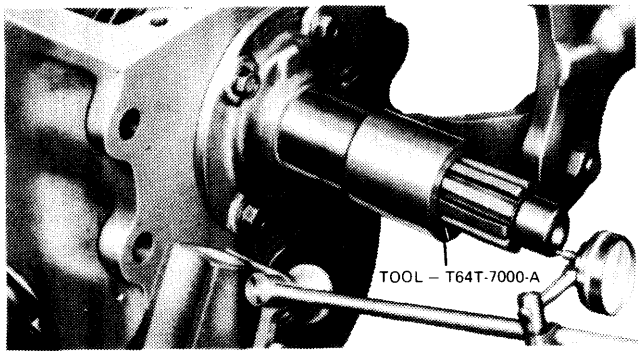
Using Tool T-64T-7000-A to hold the shaft and retainer concentric, measure the clearance between the retainer and the case (Fig. 10). Install a gasket shim pack 0.010 to 0.015 inch between the retainer and the case to obtain the required 0.007 to 0.014 inch input shaft end play. Tighten the front retainer bolts, then re-check the end play.

When the input shaft end play has been established, re-check the synchronizer clearance. It should be 0.070-0.095 inch. Adjust, if required.

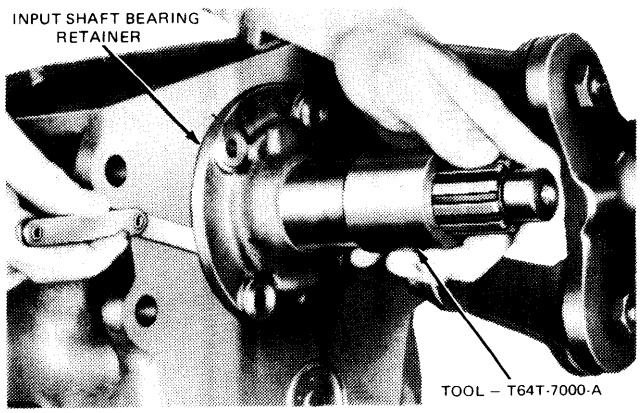
13. Install the parking brake shoes.
14. Lubricate the extension housing bushing and seal and U-joint flange with ball joint grease.

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INPUT SHAFT BEARING END PLAY ADJUSTMENT



INPUT SHAFT BEARING END PLAY CHECK C1908-1A

FIG. 10 Checking Input Shaft End Play

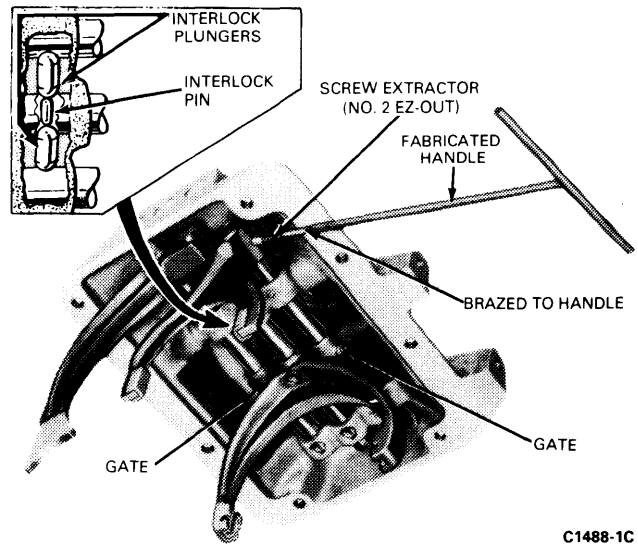
15. Install the speedometer drive gear, brake companion flange, brake drum, and the flange attaching nut. Lock the transmission in gear and tighten the nut to specification.
16. Place the transmission gears in neutral.
17. Install a new gasket and the gear shift housing.
18. Install two (2) Cover (shoulder aligning bolts and lockwashers finger tight.
19. Install the rest of housing attaching bolts. Tighten all bolts to specification found at the end of this Part.
20. Fill the transmission with lubricant, through the speedometer cable attachment opening in the rear bearing retainer, until the lubricant reaches the lower level of the regular filler opening.

SUB-ASSEMBLIES

GEARSHIFT HOUSING

Disassembly

1. The gearshift housing should be disassembled only if it is necessary to replace a shift fork, shift rail, or the cover itself.
2. Slide the boot off the cap (if so equipped).
3. Using special Tool T73T-7220-A, turn the cap counterclockwise and remove the lever from the cover.
4. Remove the back-up lamp switch from the housing (Fig. 12).
5. Remove the spiral pin from the first- and second-speed shift fork and the gate with screw extractor shown in Fig. 11. To insert the screw extractor into the spiral pin, tap lightly on fabricated handle while slowly turning counterclockwise. When extractor grips the pin, stop tapping and continue turning until spiral pin is removed.



C1488-1C

FIG. 11 Removing Shift Fork Spiral Pin

6. Push the shifter shaft out through the rear to force the plug out of the housing. Cover the detent ball access hole to prevent the ball and spring from flying out as the shaft clears the hole. Remove the shaft fork and gate.
7. Remove the third- and fourth-speed shifter shaft in the same manner, then the reverse shifter shaft.
8. Compress the reverse gear plunger and remove the retaining clip. Remove the plunger and the spring from the gate (Fig. 12).

Assembly

1. Assemble the spring on the reverse gear plunger (Fig. 12) and hold it in the reverse shift gate. Compress it in the gate and install the retaining clip.
2. Enter the reverse shifter shaft in the cover and place the detent spring and ball in position. Depress the ball and slide the shifter shaft over it.
3. Install the gate and fork on the shaft. Install new spiral pins in the gate and fork.
4. Apply a film of sealer in the plug seat at the rear of the cover. Install a new plug in the reverse shifter shaft bore.
5. Place the reverse fork in the neutral position.
6. Install the two interlock plungers in the bores (Fig. 12).
7. Insert the interlock pin in the third- and fourth-speed shifter shaft. Install the shaft in the same manner as the reverse shifter shaft mechanism.
8. Install the first- and second-speed shifter shaft in the same manner, making sure that the interlock plunger is in place.
9. Lubricate the spherical ball seat. Position the shift lever and cap in place.
10. Install the back-up lamp switch, and tighten to specification.

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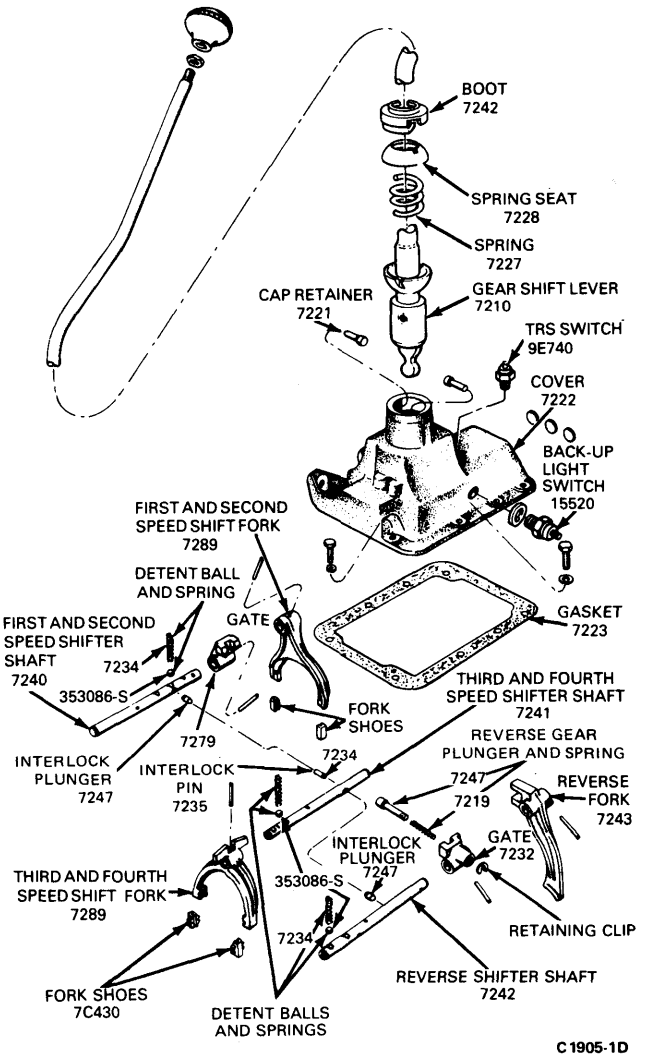


FIG. 12 Gearshift Housing Disassembled

COUNTERSHAFT GEAR FRONT BEARING

Disassembly

Drive the countershaft gear front bearing cage from the case, being careful not to lose any of the roller bearings. The bearing can be driven out from the outside of the case.

Assembly

Carefully press the bearing cage into the case until it is flush with the front of the case. Retain the roller bearings in the bearing cage with grease.

COUNTERSHAFT GEAR REAR BEARING

1. Position the transmission so the front of the case is facing downward.
2. If uncaged bearings are re-used, the loose rollers (or needles) can be held in place with suitable grease.(This is not required with the caged-type bearing used for service replacement.) Position the bearings in the cap.
3. Position the race thrust bearing and the cap. Tighten the attaching bolts to specification found at the end of this part.

INPUT SHAFT BEARING RACE

Disassembly

Pull the bearing race from the front bearing retainer with Puller T50T-100-A and OTC-943.

Assembly

Press a new race into the front bearing retainer with the tool shown in Fig. 13.

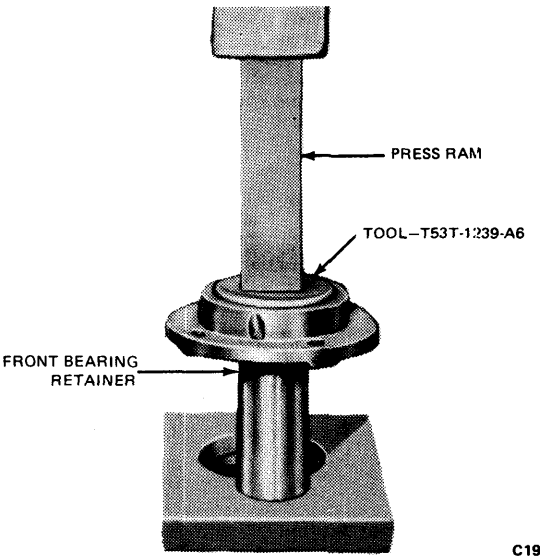


FIG. 13 Installing Front Bearing Race

INPUT SHAFT SEAL

Disassembly

Pull the input shaft seal (Fig. 4) with Tool T58L-101-A and slide hammer T50T-100-A.

Assembly

Press a new seal into place in the retainer making sure that the lip of the seal is toward the mounting surface.

INPUT SHAFT BEARING

Disassembly

Remove the tapered roller bearing from the input shaft with Tool T64T-7025-A and T54T-4625-B1.

Assembly

1. Position Tool 4621-BA in an arbor press as shown in Fig. 14. Place a wood block on the input gear and press the gear into the bearings until it contacts the bearing inner race.

INPUT SHAFT ROLLER BEARINGS

Disassembly

1. Remove the snap ring and retaining washer from the shaft.
2. Remove the bearings from the input shaft bore.

Assembly

1. Coat the bore of the input shaft gear with a thin film of grease.
2. Install the 14 roller bearings in the bore of the input shaft. Slide the final roller axially into place. Secure

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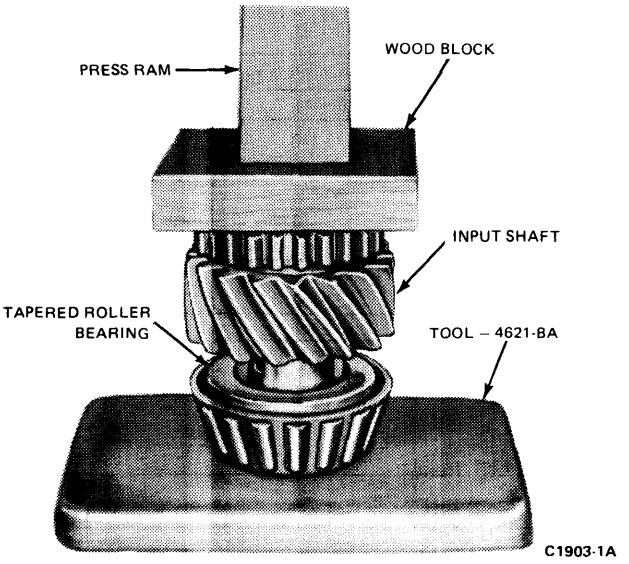


FIG. 14 Installing Input Shaft Bearing

the bearings with the retaining washer and the snap ring.

REVERSE IDLER GEAR BEARINGS

On the F-100—F-350 and Bronco trucks an idler gear and an integral bronze bushing is used (Fig. 4). For service replacement of the reverse idler gear on these models, a gear and roller bearing assembly is available. The service reverse idler gear and bearings are serviced only as an assembly. Once the bearing lock ring snaps into place, it cannot be removed without destroying either the gear or the bearing.

FIRST SPEED GEAR

Disassembly

1. Remove both the sliding first-speed gear and the output shaft from the transmission.
2. Mark the gear and output shaft so the gear and shaft splines can be assembled in the same position. Remove gear from output shaft. Do not lose the spline springs.

Assembly

1. **If a new gear and/or shaft is being installed, select-fit the gear to the shaft for the best sliding action. Do the same if the first-speed gear has been sticking on the shaft splines.** Position the spline springs on the coast side of the spline teeth of the first speed gear. To facilitate assembly, use a daub of grease to retain the springs on the sides of the spline teeth. Two notches on the hub of the first speed gear identify the location of the relieved splines.
2. Place the new first speed gear assembly in its position on the output shaft.

SECOND SPEED GEAR

Disassembly

1. Slide the third-speed gear, first-speed gear stop, and the first-speed gear off the output shaft. Do not lose the slider gear springs.
2. Carefully pry up on one end of the two-piece snap ring and remove it from the shaft. **If any damage to the ring results from this, it should not be re-used.**
3. Slide the second-speed gear and synchronizer brake off the shaft.
4. Remove the snap ring from the synchronizer brake pins. Separate the brake and spring from the second-speed gear.

Assembly

1. Assemble the spring and synchronizer brake to the second-speed gear. Secure the brake with the snap ring, making sure that the snap ring tangs are away from the gear.
2. Slide the second-speed gear onto the front of the output shaft, being sure that the synchronizer brake is toward the rear. Secure the gear to the shaft with the two-piece snap ring.
3. Slide the spring-loaded first-speed gear and the gear stop (Fig. 4) onto the rear of the shaft.
4. Slide the third-speed gear, synchronizer shim (if required), the third- and fourth-speed synchronizer, and the roller-type thrust bearing onto the front of the shaft.

SPECIFICATIONS

TRANSMISSION LUBRICANT AND TYPE

	U.S. (Pints)	Imperial (Pints)	Litres
ESW-M2C83-B or ESP-M2C83-C or equivalent			
With extension	7.0	5.5	5.3
Without extension	6.5	5.2	3.0

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GENERAL TORQUE GUIDE

Description	Size	Torque Limits	
		(ft-lbs)	N•m
Bearing Retainer to Transmission (Aux.)	5/8-18	115-140	156-189
	1/2-13	60-80	82-108
Bearing Retainer to Transmission (Main w/o Aux.)	1/2-13	60-80	82-108
	5/8-18	120-150	163-203
Bellcrank to Transmission	3/8-16	25-32	34-43
Bellcrank Bracket to Transmission	3/8-16	25-32	34-43
	9/16-12	120-150	163-203
Clutch Housing to Engine Block	7/16-14	33-45	45-61
Clutch Housing to Transmission Case	7/16-14	40-50	55-67
	5/8-11	120-150	163-203
	9/16-12	90-115	123-155
	5/8-18 (coarse)	120-150	163-203
	9/16-18 (coarse)	90-115	123-155
Clamp Trunnion to Auxiliary Transmission	1/2-20	50-55	68-74
	1/2-20	60-70	82-94
Countershaft and Reverse Idler Shaft Retainer	1/2-13	60-70	82-94
	5/16-18	25-30	34-40
	3/8-16	25-37	34-50
	3/8-16	18-25	25-33
	7/16-14	40-45	55-61
	1/2-13	80-85	109-115
Gearshift Lever Tower to Gearshift Housing	3/8-16	20-25	28-33
	5/16-18	11-16	15-21
	7/16-14	40-45	55-61
Transmission Insulator to Frame Support	5/8-11	25-30	34-40
Input Shaft Bearing Retainer to Transmission Case	5/16-18	25-30	34-40
	3/8-16	25-30	34-40
	7/16-14	40-45	55-61
Output Shaft Bearing Retainer to Transmission Case	3/8-16	20-25	28-33
	7/16-14	30-38	41-51
	1/2-13	50-62	68-84
	5/8-11	96-120	131-162
Parking Brake to Transmission Bearing Retainer	1/2-20 (coarse)	45-55	62-74
	5/8-18	180-220	245-298
	7/16-20	50-70	68-94
Rear Cross Shaft Housing to Adapter or Transmission Assembly	7/16-14	30-38	41-51
Remote Transmission Control Bracket to Frame	9/16-12	110-130	150-176
Remote Transmission Control Bracket to Upper Shift Control	7/16-14	26-32	36-43
Transmission Support Bracket to Transmission	3/8-16	20-25	28-33
	5/8-11	135-165	184-223
	7/16-14	53-65	
Transmission Support Bracket and Bearing Retainer to Transmission	5/8-11	96-120	131-162
	5/8-11	115-140	156-189
Transmission Front Support Bracket and Trunnion to Transmission	5/8-11	135-165	184-223
Trunnion Clamp to Bearing Retainer	1/2-20	50-62	68-84
Adjusting Height Main Transmission Nut		150-200	204-271
Bellcrank to Transmission Nut	9/16-18	70-90	95-122
	3/8-16 (coarse)	20-25	28-33
Bearing Retainer to Transmission (Main w/o Aux.)	1/2-20	50-62	68-84
	5/8-18	115-140	156-189
Parking Brake Drum to Companion Flange	3/8-24	37-50	51-67
	7/16-20	40-55	55-74
	1/2-20	74-86	101-116
Handbrake Anchor Bar to Transmission Case (Except 5-Speed Extra-Heavy Duty)	9/16-18	100-110	136-149
Handbrake Drum to U-Joint Flange (Engine End)	7/16-20	45-50	62-67
	1/2-20	75-80	102-108
	3/8-24	30-35	41-47
Input Shaft Yoke to Auxiliary Transmission	1¼-18	500-550	678-945
Insulators — Transmission Rear Support to Frame Brackets	3/4-16	75-100	102-135

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GENERAL TORQUE GUIDE (Continued)

Description	Size	Torque Limits	
		(ft-lbs)	N•m
Insulator — Transmission Mounting Brackets to Transmission Support Bracket — Rear	3/4-16	90-110	123-149
Insulator — Auxiliary Transmission to Frame Brackets	3/4-16	195-235	265-318
	7/16-20	40-55	55-74
	7/8-14	150-200	204-271
Output Flange to Shaft (4-Speed Auxiliary Transmission)		500-550	678-745
Parking Brake Support and Transmission Support to Transmission	5/8-18	115-140	156-189
Rear Support Plate to Transmission Auxiliary Case	5/8-18	115-140	156-189
U-Joint Flange to Transmission Output Shaft	1.00-20	250-300	339-406
	1¼-18	500-550	678-745
	1½-18	550-600	746-813
Adjusting Height Auxiliary Transmission Bolt and Nut		150-200	203-271
Bellcrank Bracket to Crossmember	3/8-16	20-25	28-33
	3/8-24	24-30	33-40
Bellcrank to Mounting Bracket	9/16-18	100-200	136-271
Brake Support Plate to Transmission Support Plate	1/2-20	58-72	79-97
Insulator Adjusting Studs to Crossmember	3/4-16	195-235	265-318
Transmission Frame Brackets Mounting to Frame	1/2-20	58-72	79-97
Transmission to Support Bracket — Rear	7/8-14	150	203

CC1040-2D2

SPECIAL TOOLS

Number	Description
T50T-100-A	Puller
T50T-7140-B	Reverse Idler Gearshaft Adapter
T53T-1239-A6	Input Shaft Bearing Race Installation Tool
T53T-7065-B	Output Shaft Bearing Installation Tool
T54T-4625-B1	Tapered Roller Bearing Removal Tool
T58L-101-A	Input Shaft Seal Puller
T58T-6306-A	Output Shaft Bearing Removal Tool
T64T-7000-A	Input Shaft Seal Holder
T64T-7025-A	Tapered Roller Bearing Removal Tool
T73T-7220-A	Cap Remover
OTC-943	Input Shaft Bearing Retainer Removal Tool
Tool 4621-BA	Input Shaft Bearing Removal Tool

CC3595-1B

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Four-Speed Overdrive Transmission

PART 16-30

APPLIES TO F-SERIES AND E-100 — E-350

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DESCRIPTION

The 4-speed overdrive transmission (Fig. 1) is of the fully synchronized type with all gears except the reverse sliding gear being in constant mesh. All forward-speed changes are accomplished with synchronizer sleeves.

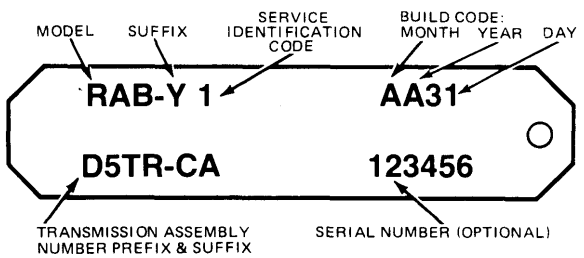


FIG. 1 Transmission Identification Tag

All forward-speed gears in the transmission are helical-type. However, the reverse sliding gear and the external teeth of the first- and second-speed synchronizer sleeve are spur-type. The specifications section lists the transmission model numbers and vehicles in which they are used.

A transmission service identification tag is located on the right side of the case at the front (Fig. 1). The first line on the tag will show the transmission model and service identification code when required. The second line will show the transmission serial number. Additionally, a serial number is stamped on the top side of the flange on the case for further identification.

The 4-speed shift control unit is serviced as a unit only. It is not to be disassembled. The only parts to be removed from the shifter assembly are the 3 shift rods, the in-cab shift lever, back-up switch bracket, and the back-up light switch. The shift pattern for the control unit is imprinted on the shift knob. The automatically adjusted back-up light switch is assembled to the backside of the shift control unit.

DIAGNOSIS AND TESTING

Refer to Part 16-10, General Manual Transmission Service.

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ADJUSTMENTS

LINKAGE ADJUSTMENT PROCEDURES

Refer to Fig. 3.

1. Disconnect the 3 shift rods from the shifter assembly.
2. Insert a .25" diameter pin through the alignment hole in the shifter assembly. Make sure the levers are in the neutral position.
3. Align the 3 transmission levers as follows: forward lever (3rd-4th lever) in the mid-position (neutral), rearward lever (1st-2nd lever) in the mid-position (neutral), and middle lever (reverse lever) rotate counterclockwise to the neutral position.
4. Rotate the output shaft to assure that the transmission is in neutral.
5. Attach the slotted end of the shift rods over the slots of the studs in the shifter assembly. Install and tighten the locknuts to 15-20 ft-lbs.
6. Remove the alignment pin. Check for proper operation.

REMOVAL AND INSTALLATION

FLOOR MOUNTED SHIFT CONTROL

Refer to Figs. 2 and 3.

Removal

1. Remove the shift knob and jam-nut from the in-cab shift lever.
2. From under the vehicle, remove the locknuts attaching the 3 shift rods to the shifter assembly. Disconnect rods from the shifter assembly.
3. Disconnect the electrical connector from the back-up light switch.
4. Remove the nut attaching the shifter assembly to the front part of the transmission extension housing.
5. Remove the two bolts attaching the shifter assembly to the rear part of the transmission extension housing.
6. Remove the shifter assembly and the in-cab shift lever from the vehicle by sliding it down and rearward from the vehicle position. The in-cab shift lever will slip through the hole in the rubber boot.
7. Place the shifter assembly on a bench or in a vise and remove the back-up switch and bracket from the back side of the shifter assembly.
8. Remove the in-cab shift lever from the shifter assembly by depressing the retainer clip and hammering out the lever from the top portion of the shifter.

Installation

1. With the shifter assembly on a bench or in a vise, attach the in-cab shift lever. The lever is secured when the retaining clip snaps into the slot in the top portion of the shifter.
2. Attach the back-up switch and bracket to the back side of the shifter assembly.
3. Insert a .25" diameter pin through the alignment hole in the shifter assembly. Make sure the levers are in the neutral position.
4. From under the vehicle, position the shifter assembly and in-cab shift lever to allow the lever to slip through the hole in the rubber boot. Move the shifter assembly into vehicle position. Install and hand-tighten the two attaching bolts. Make sure the bolts are placed in the proper holes in the transmission extension housing for either 6 or 8 cylinder engine application.
5. Install and tighten the front attaching nut first, then tighten the two rear attaching bolts to specifications. Do not remove the alignment pin.
6. Align the 3 transmission levers as follows: forward lever (3rd-4th lever) place in mid-position (neutral, rearward lever (1st-2nd lever) place in mid-position (neutral), and middle lever (reverse lever) rotate counterclockwise to the neutral position.
7. Rotate the output shaft to assure that the transmission is in neutral.
8. Position the 3 shift rods to the corresponding levers of the shifter assembly. Assemble the 3 locknuts and tighten to specifications.
9. Remove the alignment pin.
10. Install the jam nut and shift knob to the in-cab shift lever.
11. Check shifter assembly through all positions. Look for 'catchy' crossover between the 1-2 and 3-4 planes. Check for full gear engagement, and the back-up lights for proper functioning.

TRANSMISSION

Removal

1. Raise the vehicle on a hoist.
2. Mark the driveshaft so that it may be installed in the same relative position. Disconnect the drive shaft from the rear U-joint flange. Slide the driveshaft off the transmission output shaft and install the extension housing seal installation tool into the extension housing to prevent lubricant leakage.
3. Disconnect the speedometer cable from the extension housing.
4. Remove the retaining clips, flat washers, and spring washers that secure the shift rods to the shift levers. Remove the bolts connecting the shift control to the transmission extension housing. Remove the nut connecting the shift control to the transmission case.

   Note: A '6' and '8' is stamped on transmission extension housing by the shift control plate bolt holes. The '6' and '8' refer to either a 6 or 8 cylinder engine application. The shift control plate bolts must be placed in the right holes for proper plate positioning dependent upon engine application.

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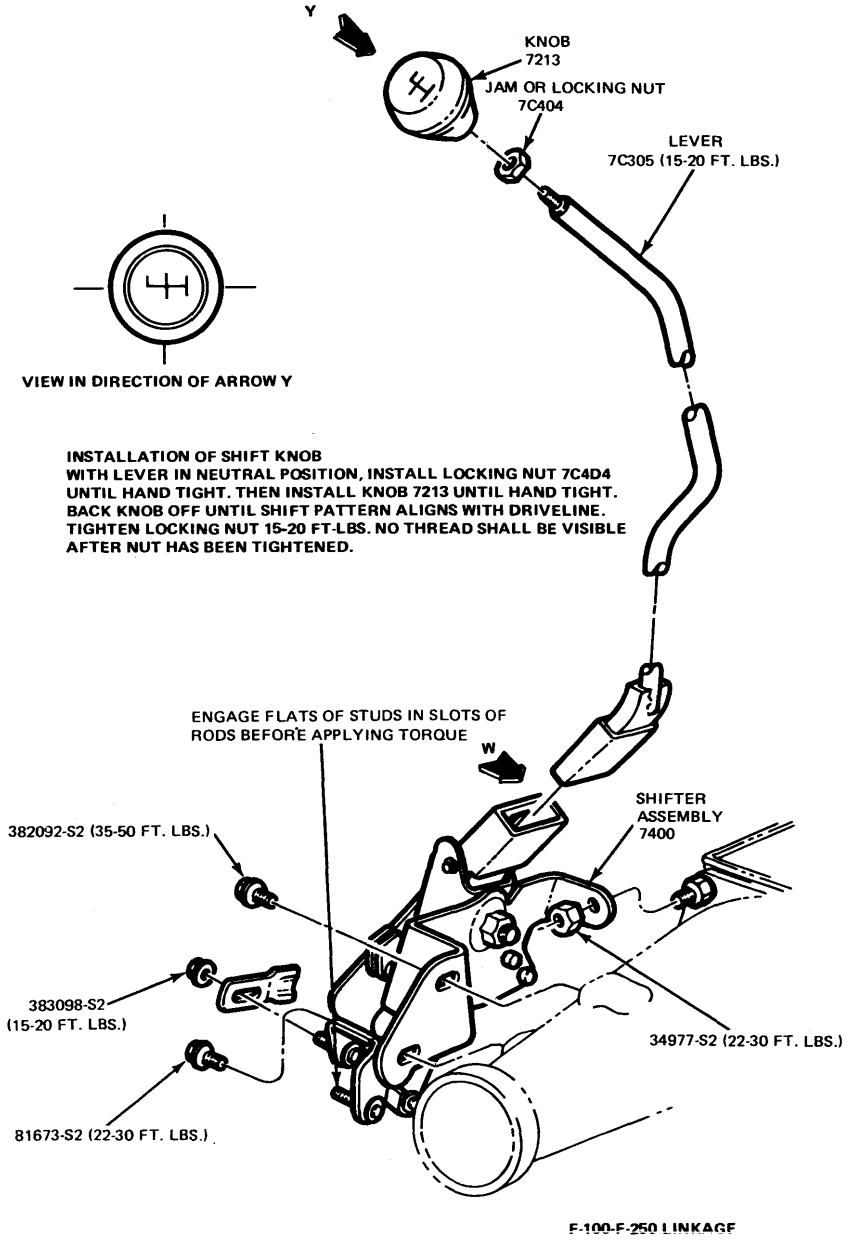


FIGURE C

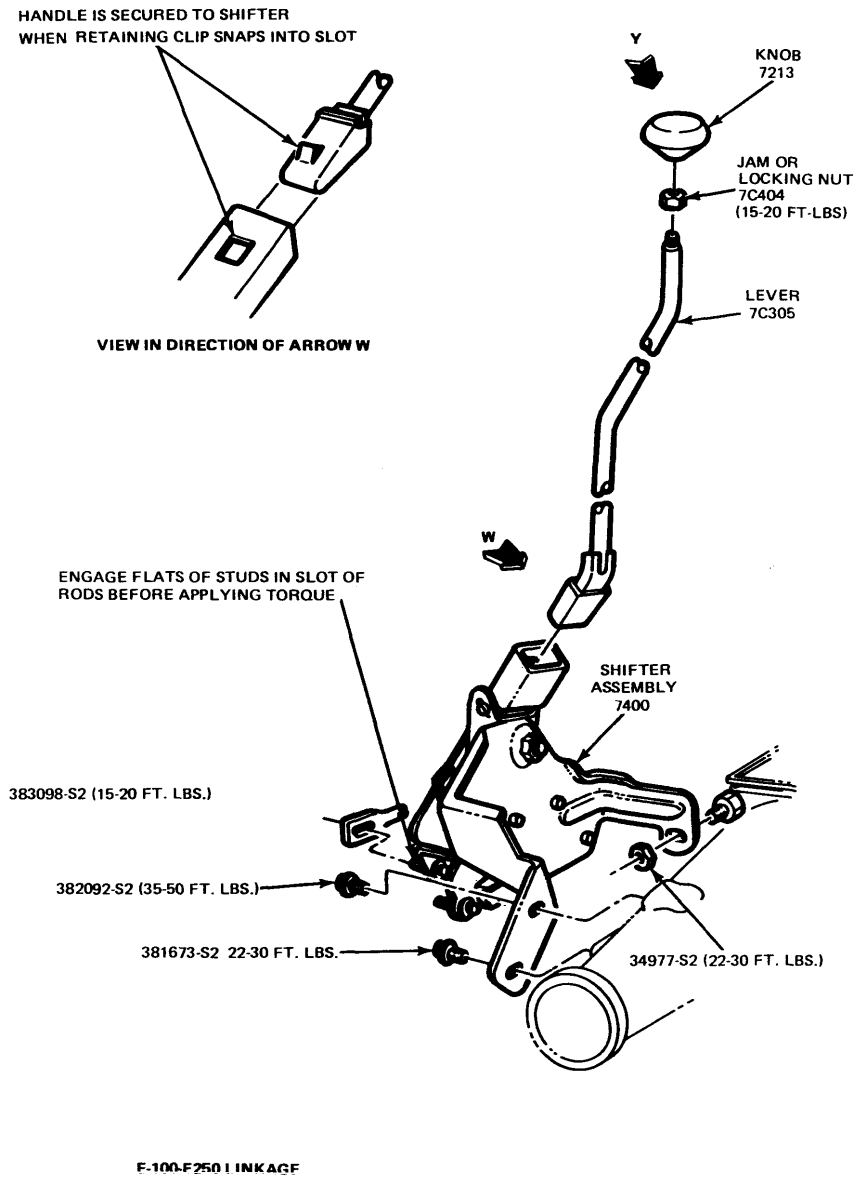


FIGURE D

C3600-2B

FIG. 2 Shift Linkage

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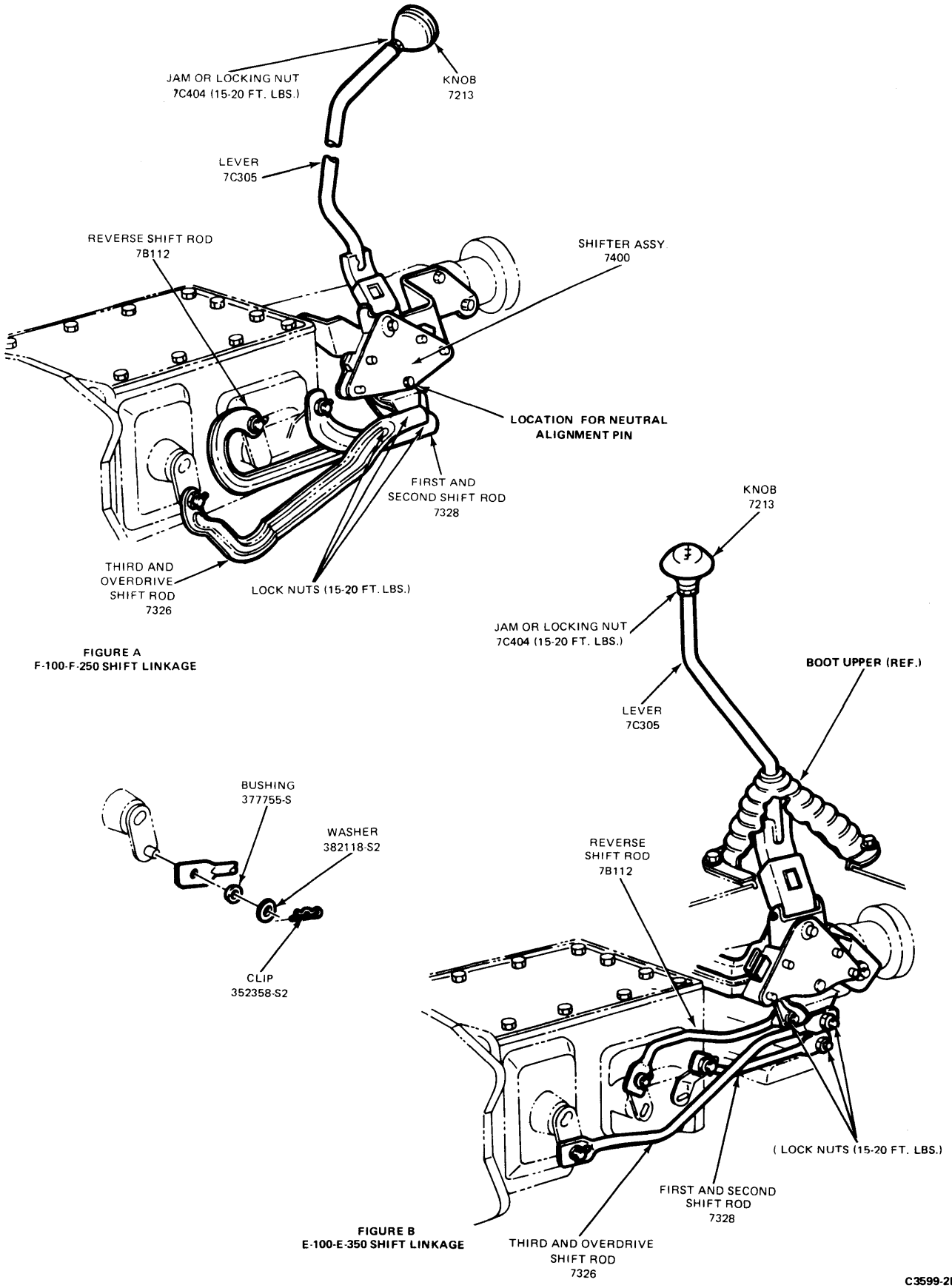


FIG. 3 Shift Linkage Adjustments

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5. Remove the rear transmission support connecting bolts attaching the support on the crossmember to the transmission extension housing.
6. Support the engine with a transmission jack and remove the extension housing-to-engine rear support attaching bolts.
7. Raise the rear of the engine high enough to remove the weight from the crossmember. Remove the bolts retaining the crossmember to the frame side supports and remove the crossmember.
8. Support the transmission on a jack and remove the bolts that attach the transmission to the flywheel housing.
9. Move the transmission and jack rearward until the transmission input shaft clears the flywheel housing. If necessary, lower the engine enough to obtain clearance for transmission removal. **Do not depress the clutch pedal while the transmission is removed.**

Installation

1. Make sure that the mounting surfaces of the transmission and the flywheel housing are free of dirt, paint, and burrs. Install two guide pins in the flywheel housing lower mounting bolt holes. Move the transmission forward on the guide pins until the input shaft splines enter the clutch hub splines and the case is positioned against the flywheel housing.
2. Install the two upper transmission to flywheel housing mounting bolts snug, and then remove the two guide pins. Install the two lower mounting bolts. Tighten all mounting bolts to specifications found at the end of this part.
3. Raise the rear of the engine and install the crossmember. Install and torque the crossmember attaching bolts to specifications, then lower the engine.
4. With the transmission extension housing resting on the engine rear support, install the transmission extension housing attaching bolts. Tighten the bolts to specifications found at the end of this part.
5. Install the transmission support bolts and tighten to specifications.
6. Position the shift control bracket on the stud on the transmission case and on the bolt attaching holes (holes marked either '6' or '8' dependent upon 6 or 8 cylinder engine application) on the transmission extension housing. Install and hand tighten connecting bolts.

   Note: The bracket must be placed in the proper position for correct shift control operation.

   Tighten the nut connecting the bracket to the transmission case to 22-30 ft-lbs. Tighten the bolts to 22-30 ft-lbs.
7. Secure each shift rod to its respective lever with the spring washer, flat washer, and retaining pin.
8. Connect the speedometer cable to the extension housing.
9. Remove the extension housing installation tool and slide the forward end of the drive shaft over the transmission output shaft. Connect the driveshaft to the rear U-joint flange. Adjust the linkage following the instructions in Fig. 3.
10. Fill the transmission to the proper level with the specified lubricant.
11. Lower the vehicle. Check the shift and crossover motion for full shift engagement and smooth crossover operation.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Disassembly

1. Mount the transmission in a holding fixture and drain the lubricant by removing the lower extension to case screw and washer.
2. Remove the cover attaching screws from the case. Lift the cover and gasket from the case.
3. Remove the long spring that retains the detent plug in the case (Fig. 5). Remove the detent plug with a small magnet.
4. Remove the extension housing attaching screws and lockwashers. Remove the housing and the gasket. Discard gasket.
5. Remove the input shaft bearing retainer attaching screws. Slide the retainer off the input shaft.
6. Support the countershaft gear with a wire hook. Working from the front of the case, push the countershaft out the rear of the case as shown in Fig. 4. Lower the countershaft to the bottom of the case with the wire hook. Remove the hook.
7. Remove the set screw from the first and second-speed shift fork (Fig. 5). Slide the first and second-speed shift rail out the rear of the case.

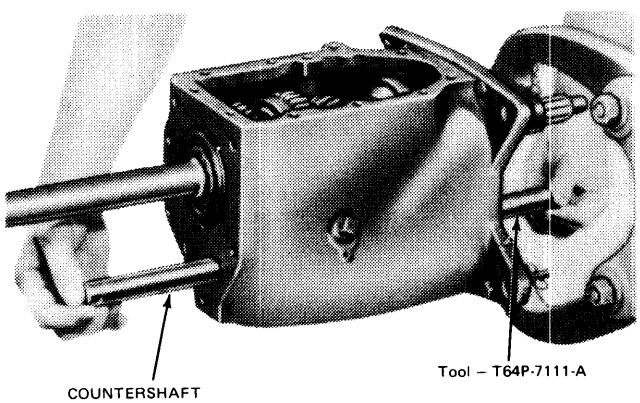


FIG. 4 Removing Countershaft From Case

8. Using a magnet, remove the interlock detent from between the first-second and third-overdrive shift rails.
9. Shift the transmission into overdrive position. Remove the set screw from the third and overdrive shift fork. Remove the side detent bolt, detent plug and spring. Rotate the third and overdrive speed

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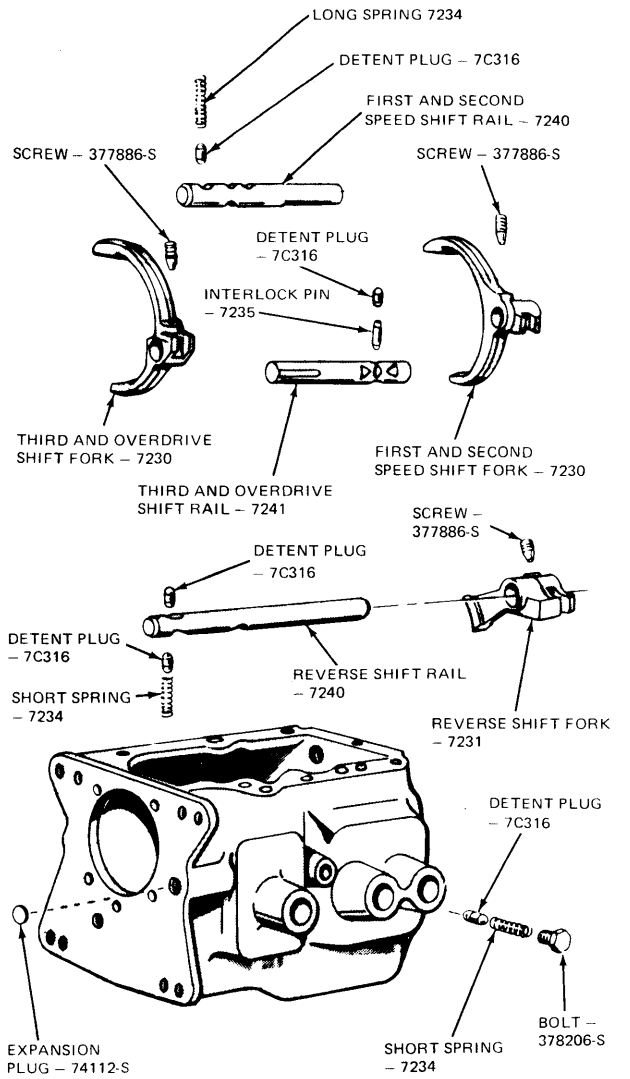


FIG. 5 Shift Rails and Forks Disassembled

shift rail 90 degrees clockwise and tap it out through the front of the case using a punch and hammer.

10. Remove the interlock plug from the top of the case with a magnet.
11. Remove the snap ring that secures the speedometer drive gear to the output shaft. Slide the gear off the shaft, then remove the speedometer gear drive ball.
12. Remove the snap ring that secures the output shaft bearing to the shaft. Remove the snap ring from the outside diameter of the output shaft bearing (Fig. 12).
13. Assemble the special service tools and remove the output shaft bearing from the output shaft as shown in Fig. 6.
14. Remove the snap ring that secures the input shaft bearing to the input shaft. Remove the snap ring from the outside diameter of the input shaft bearing.
15. Assemble the special service tools shown in Fig. 7 and remove the input shaft bearing from the input shaft and the transmission case.

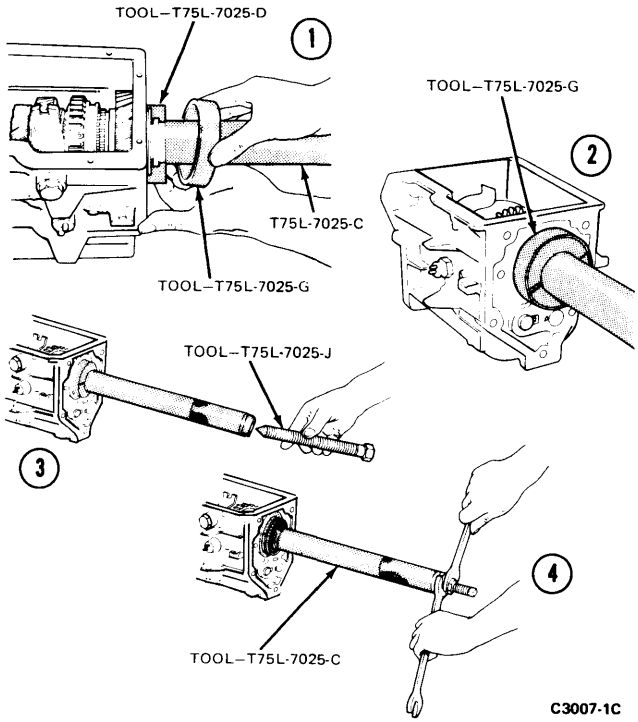


FIG. 6 Remove Output Shaft Bearing—Typical Transmission

16. Remove the input shaft and the blocking ring from the front of the case.
17. Move the output shaft to the right side of the case to provide clearance for the shift forks. Rotate the forks as shown in Fig. 8, then lift them from the case.
18. Support the thrust washer and first-speed gear to prevent them from sliding off the shaft, then lift the output shaft assembly from the case as shown in Fig. 9.

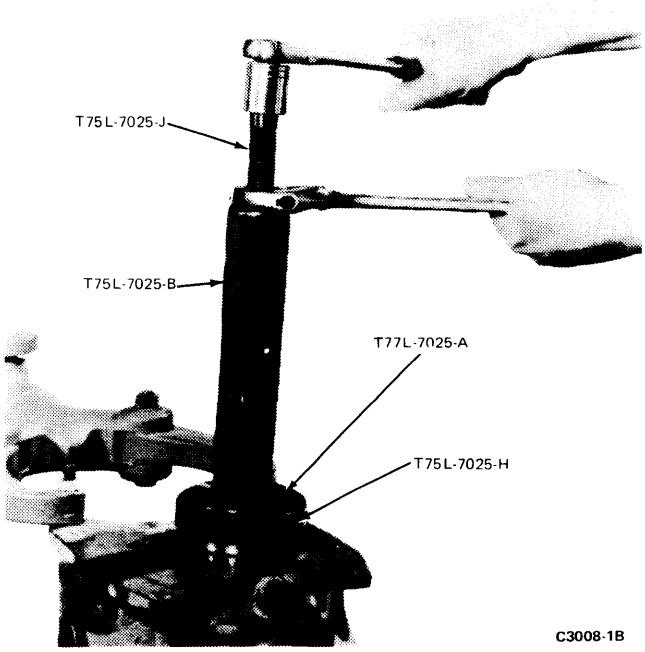


FIG. 7 Removing Input Shaft Bearing

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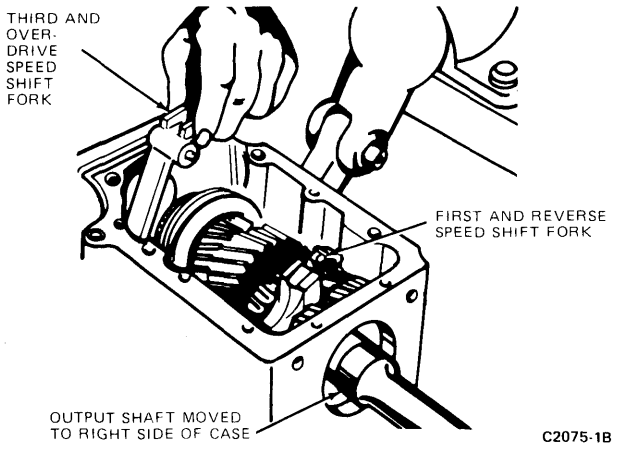


FIG. 8 Removing Shift Fork from Case

19. Remove the reverse gear shift fork set screw. Rotate the reverse shift rail 90 degrees as shown in Fig. 10. Slide the shift rail out of the rear of the case. Lift the reverse shift fork from the case.
20. Remove the reverse detent plug and spring from the case with a magnet.
21. Remove the reverse idler gear shaft from the case as shown in Fig. 11.
22. Lift the countershaft gear and the thrust washers from the case. Be careful not to drop the bearings or the dummy shaft from the countershaft gear.
23. Lift the reverse idler gear and the thrust washers from the case. Be careful not to drop the bearings and the dummy shaft from the gear.
24. Remove the snap ring from the front of the output shaft. Slide the third and overdrive synchronizer (Fig. 12) blocking ring and the gear off the shaft.

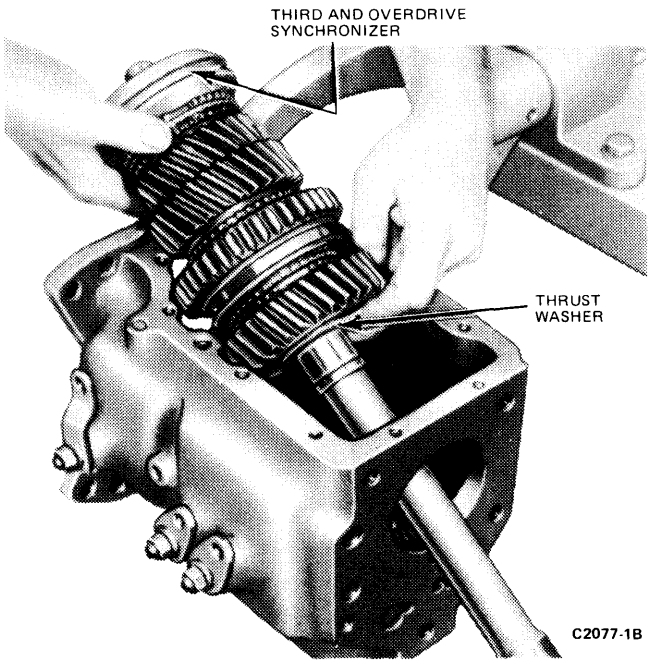


FIG. 9 Removing and Installing Output Shaft Assembly

25. Remove the next snap ring and the second-speed gear thrust washer from the shaft. Slide the second-speed gear and the blocking ring off the shaft.
26. Remove the next snap ring.
27. Remove the thrust washer, first speed gear and blocking ring from the rear of the shaft. The first and second synchronizer hub is a slip fit on the output shaft.

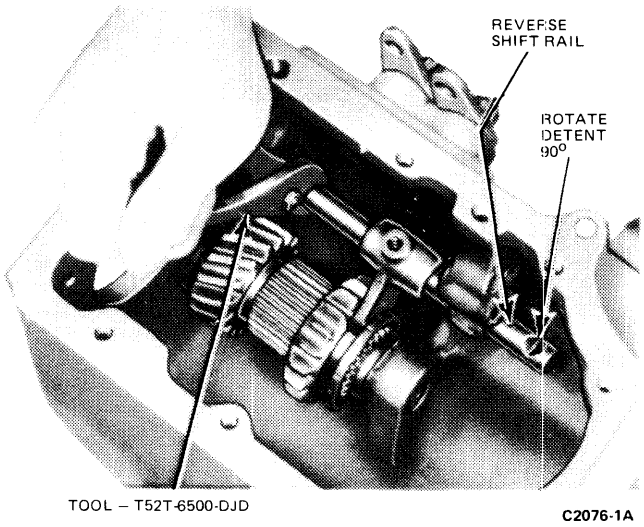


FIG. 10 Rotating Reverse Shift Rail

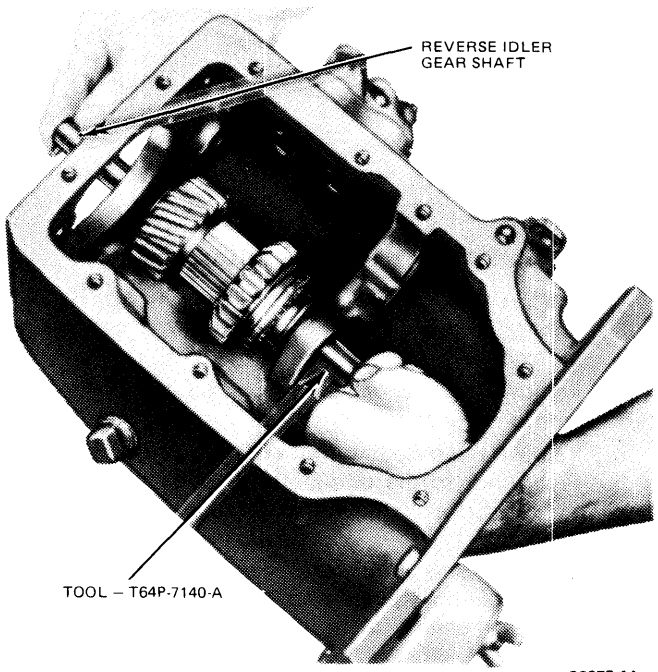


FIG. 11 Removing Reverse Idler Gear Shaft

Assembly

1. Coat the countershaft gear thrust surfaces in the case with a thin film of lubricant and position a thrust washer (Fig. 20) at each end of the case.
2. Position the countershaft gear, dummy shaft, and roller bearings in the case.

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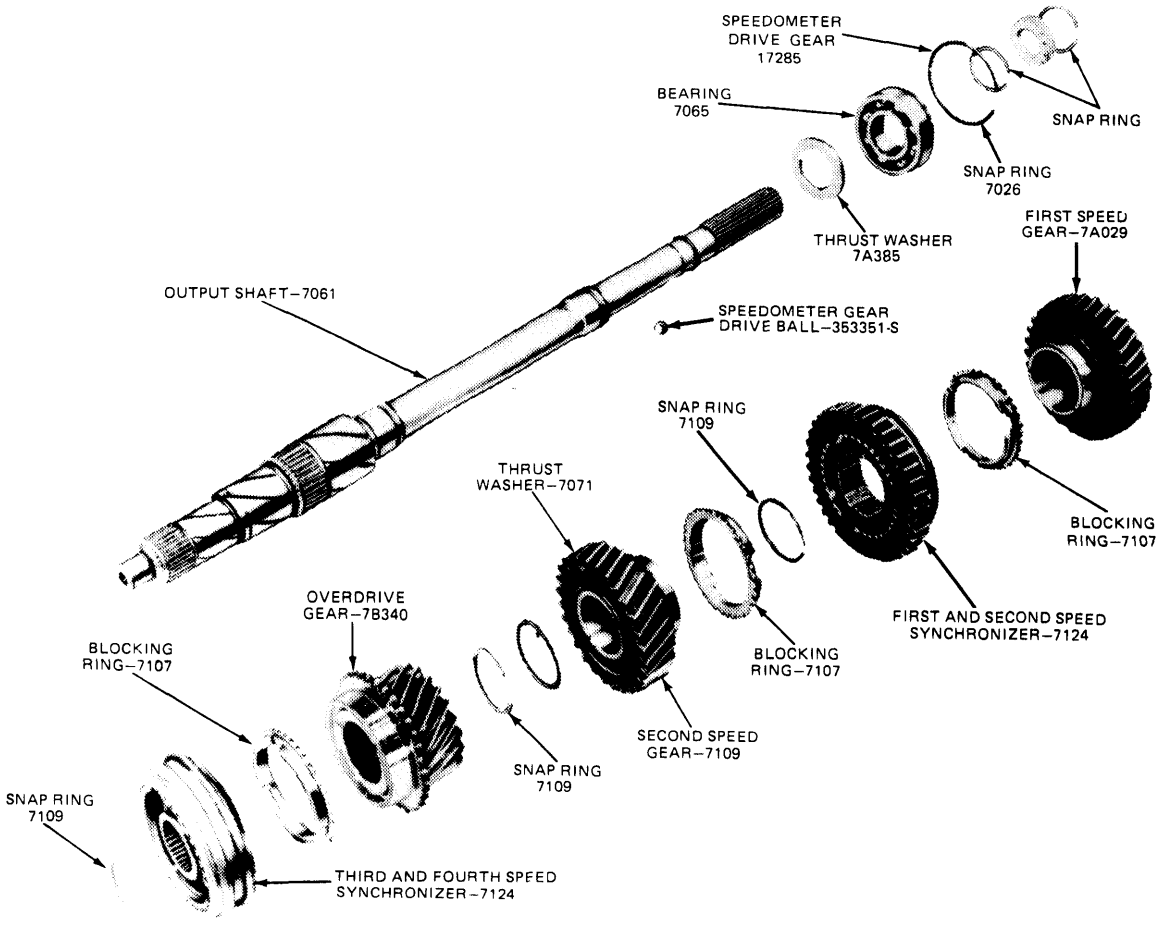


FIG. 12 Output Shaft Disassembled

3. Place the case in a vertical position. Align the gear bore and the thrust washers with the bores in the case and install the countershaft.
4. Place the case in a horizontal position and check the countershaft gear end play with a feeler gauge. The end play should be within specification. If not within limits, replace the thrust washers.
5. After establishing the correct end play, install the dummy shaft in the countershaft gear and allow the gear to remain at the bottom of the case.
6. Coat the reverse idler gear thrust surfaces in the case with a thin film of lubricant and position the two thrust washers (Fig. 21) in place.
7. Position the reverse idler gear, sliding gear, dummy shaft and the roller bearings in place making sure that the shift fork groove in the sliding gear is toward the front of the case.
8. Align the gear bore and thrust washers with the case bores and install the reverse idler shaft.
9. Measure the reverse idler gear end play with a feeler gauge. End play should be within specification. If the end play is not within limits, replace the thrust washers. If the end play is within limits, leave the reverse idler gear installed.
10. Position the reverse gear shift rail detent spring and detent plug in the case. Hold the reverse shift fork in place on the reverse idler sliding gear and install the shift rail from the rear of the case. Secure the fork to the rail with the Allen head set screw.
11. Install the first and second-speed synchronizer (Fig. 19) into the front of the output shaft, making sure that the shift fork groove is toward the rear of the shaft. The first and reverse synchronizer hub is a slip fit on the output shaft. Install the synchronizer hub with the teeth end of the gear facing toward the rear of the shaft.
12. Position the blocking ring on the second-speed gear.
13. Slide the second-speed gear onto the front of the shaft, making sure that the inserts in the synchronizer engage the notches in the blocker ring.
14. Install the second-speed gear thrust washer and snap ring.
15. Slide the overdrive gear onto the shaft with the synchronizer coned surface toward the front.
16. Place a blocking ring on the overdrive gear.
17. Slide the third and overdrive gear synchronizer onto the shaft making sure that the inserts in the synchronizer engage the notches in the blocking ring and the thrust surface is toward the overdrive gear.
18. Install the snap ring on the front of the output shaft.
19. Position the blocking ring on the first-speed gear.
20. Slide the first-speed gear onto the rear of the output shaft making sure that the notches in the blocking ring engage the synchronizer inserts.

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21. Install the heavy thrust washer on the rear of the output shaft.
22. Support the thrust washer and first-speed gear to prevent them from sliding off the shaft and carefully lower the output shaft assembly into the case as shown in Fig. 9.
23. Position the first and second-speed shift fork and the third and overdrive shift fork in place on their respective gears and rotate them into place.
24. Place a spring and a detent plug (Fig. 5) in the detent bore. Place the reverse shift rail into neutral position.
25. Coat the third and overdrive shift rail interlock pin (tapered ends) with grease and position it in the shift rail.
26. Align the third and overdrive shift fork with the shift rail bores and slide the shift rail into place making sure that the three detents are facing toward the outside of the case. Place the front synchronizer into overdrive position and install the set screw in the third and overdrive shift fork. Move the synchronizer to the neutral position. Install the third and overdrive shift rail detent plug, spring and bolt in the left side of the transmission case. (Fig. 5). Place the detent plug (tapered ends) in the detent bore in the case.
27. Align the first and second-speed shift fork with the case bores and slide the shift rail into place. Secure the fork with the set screw.
28. Coat the input gear bore with a thin film of grease, then install the 15 roller bearings in the bore. A thick film of grease could plug the lubricant holes and restrict lubrication of the bearings.
29. Position the front blocking ring in the third and overdrive synchronizer.
30. Position the dummy bearing, Tool T77L-7025-B, on the output shaft to support and align the shaft assembly in the case (Fig. 13).
31. Place the input shaft gear into the transmission case, making sure that the output shaft pilot enters the roller bearings in the input gear pocket.

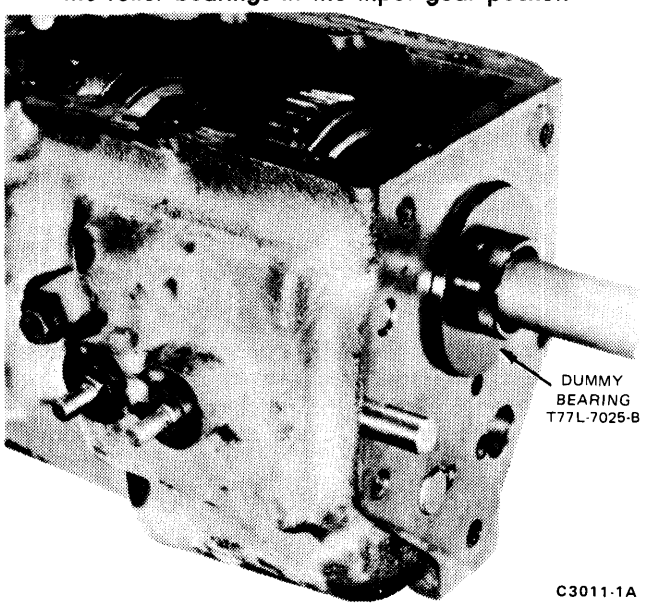


FIG. 13 Dummy Bearing Installed

32. Position the input shaft bearing on the input shaft along with the Clamp, Tool T77L-7025-D, the Sleeve, Tool T75L-7025-K, and the bearing Replacer Tube, T77L-7025-C. Press the bearing onto the shaft and into the transmission case as shown in Fig. 14.

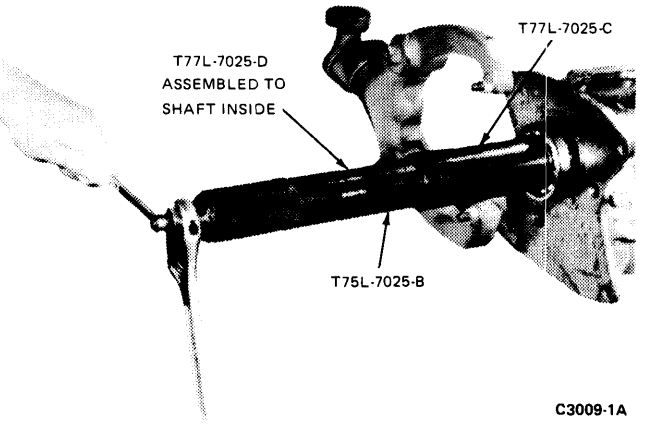


FIG. 14 Installing Input Shaft Bearing

33. Remove the special service tools and install the snap rings on the input shaft and the input shaft bearing.
34. Place a new gasket on the input shaft bearing retainer. Dip the attaching bolts in sealer and install and tighten to 19-25 ft-lbs.
35. Remove the dummy bearing from the output shaft. Assemble the special service tools to the output shaft as shown in Fig. 15. **Before pressing the bearing onto the output shaft, be sure that the output shaft bearing is aligned with the transmission case bore and that the countershaft is not interferring with the output shaft assembly.**

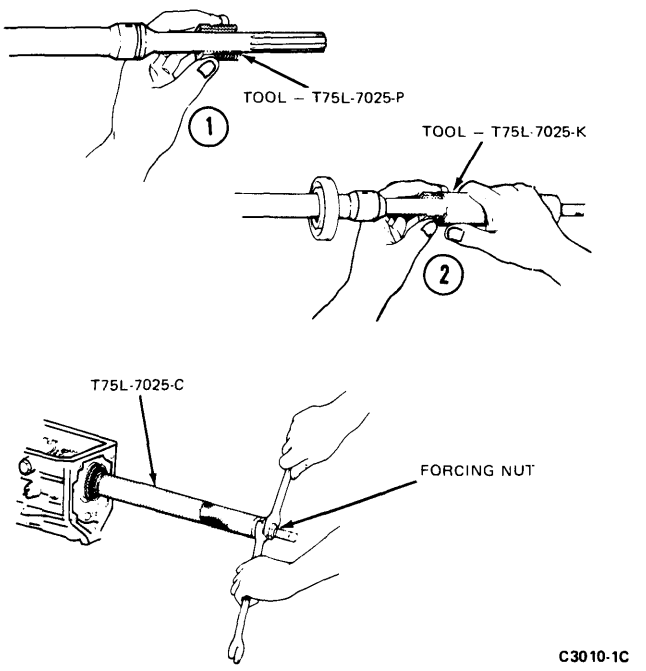


FIG. 15 Installing Output Shaft Bearing—Typical Transmission

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36. Install the output shaft bearing onto the output shaft and into the transmission case using the special service tools. Remove the special service tools and install the snap rings on the output shaft and the output shaft bearing.
37. Place the transmission in a vertical position as shown in Fig. 16. Align the countershaft gear bore and thrust washers with the bore and thrust washers with the bore in the case. Install the countershaft.

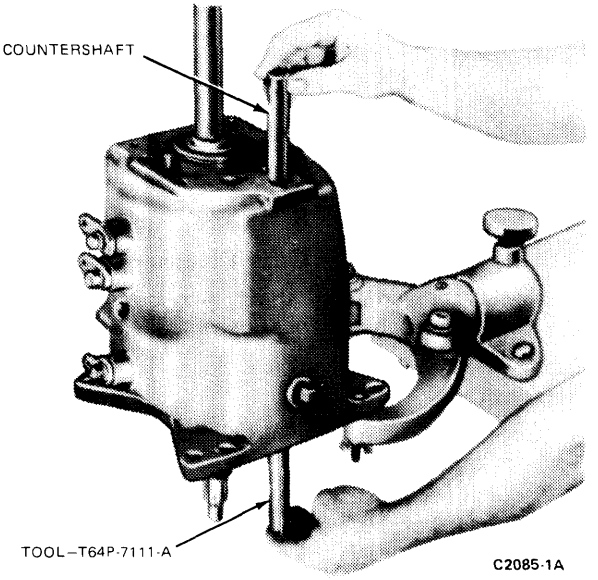


FIG. 16 Installing Countershaft

38. Use a new gasket and secure the extension housing to the case with the attaching bolts. Use a sealer on the extension housing attaching bolts. Tighten to 42-50 ft-lbs.
39. Install the filler plug in the case if it was removed.
40. Pour the specified lubricant over the entire gear train while rotating the input shaft.
41. Place each shift fork in all positions to make sure that it operates properly.
42. Install the remaining detent plug in the case. Install the long spring (which is retained by the case) to secure the detent plug.
43. Use a new cover gasket and install the cover. Coat the cover attaching screws with sealer and install and tighten them to 20-25 ft-lbs.
44. Coat the third and overdrive shift rail plug bore with a sealer and install a new expansion plug.
45. If the extension housing bushing and seal are to be replaced, refer to Section 1.

SUB-ASSEMBLIES

CAM AND SHAFT SEALS

Removal

1. Remove the attaching nut, lockwasher and the flat washer from each shift lever and remove the three levers.
2. Remove the three cam and shafts from inside the case.
3. Remove and discard the O-ring from each cam and shaft (Fig. 17).

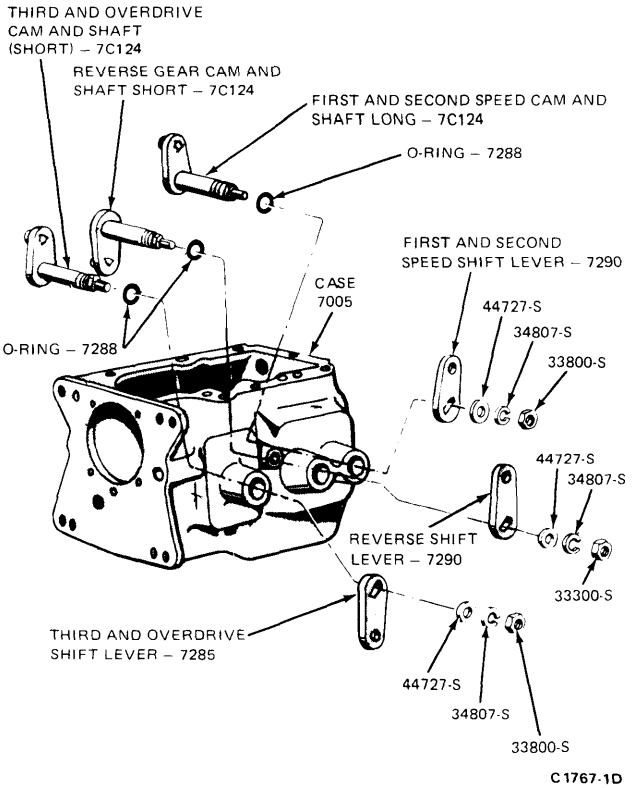


FIG. 17 Cam and Shafts and Shift Levers

Installation

1. Dip the new O-rings in gear lubricant and install them on the cam and shafts.
2. Slide each cam and shaft into its respective bore in the transmission case.
3. Secure each shaft lever with a flat washer, lockwasher and nut.

SYNCHRONIZERS

Removal

1. Punch or etch alignment marks on the hub and sleeve of the synchronizer before disassembly. Push the synchronizer hub from each synchronizer sleeve (Fig. 18).
2. Separate the inserts and insert springs from the hubs. Do not mix the parts of the first and second-speed synchronizer with the third and fourth-speed synchronizer.

Installation

1. Position the hub in the sleeve, making sure that the alignment marks are properly indexed.
2. Place the three inserts into place on the hub. Install the insert springs making sure that the irregular surface (hump) is seated in one of the inserts. Do not stagger the springs.

COUNTERSHAFT GEAR BEARINGS

Removal

1. Remove the dummy shaft, two bearing retainer washers and the 21 roller bearings (Fig. 19) from each end of the countershaft gear.

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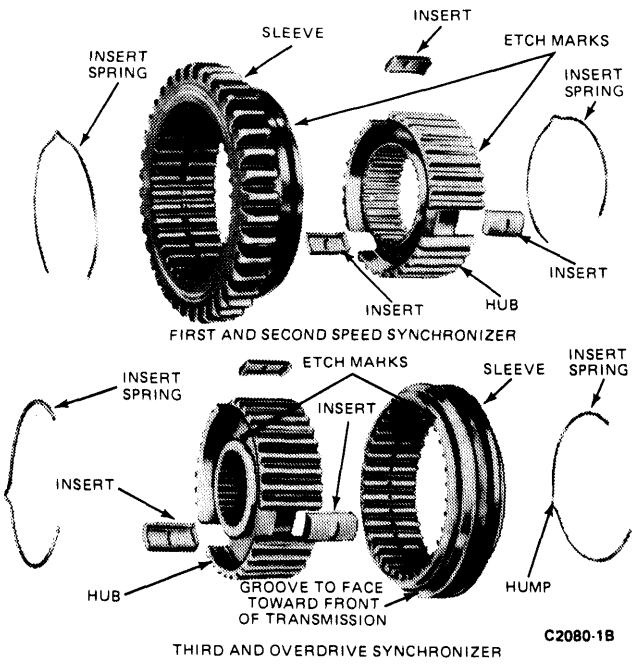


FIG. 18 Synchronizers Disassembled

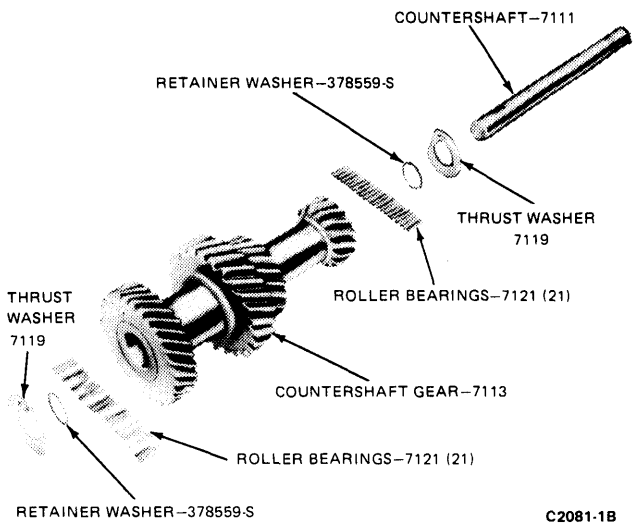


FIG. 19 Countershaft Gear Disassembled

Installation

1. Coat the bore in each end of the countershaft gear with grease.
2. Hold the dummy shaft in the gear and install the 21 roller bearings and a retainer washer in each end of the gear.

REVERSE IDLER GEAR BEARINGS

Removal

1. Slip the reverse idler sliding gear off the reverse idler gear (Fig. 20).

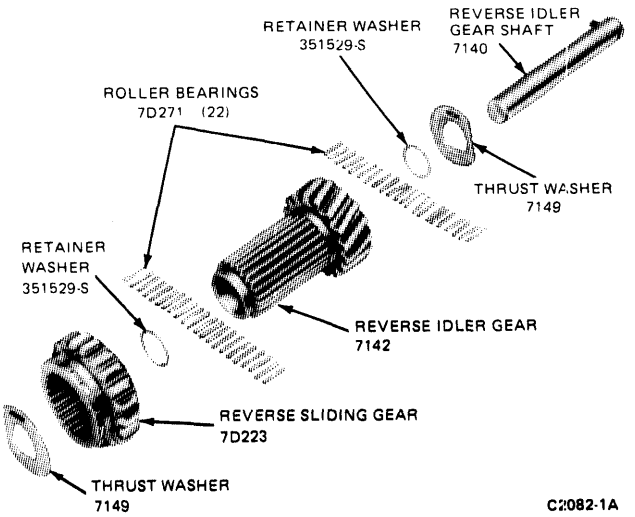


FIG. 20 Reverse Idler Gear Disassembled

2. Remove the dummy shaft, two bearing retainer washers and the 44 roller bearings from the reverse idler gear.

Installation

1. Coat the bore in each end of the reverse idler gear with grease.
2. Hold the dummy shaft in the gear and install the 22 roller bearings and the retainer washer in each end of the gear.
3. Install the reverse idler sliding gear on the reverse idler gear making sure that the shift fork groove is toward the front (Fig. 20).

INPUT SHAFT SEAL

Removal

1. Remove the seal from the input shaft bearing retainer as shown in Fig. 21.

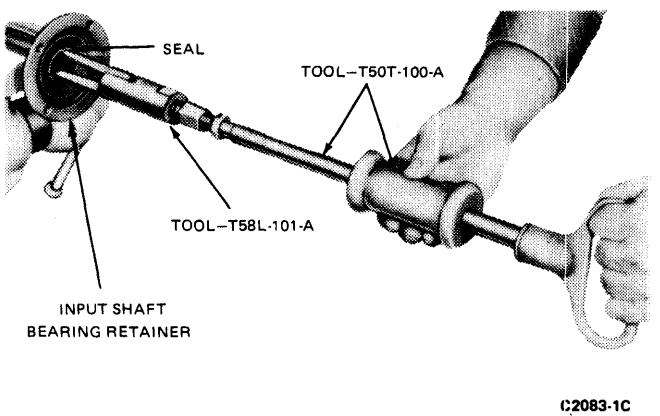


FIG. 21 Removing Input Shaft Seal

Installation

1. Coat the sealing surface with lubricant.
2. Install the seal as shown in Fig. 22.

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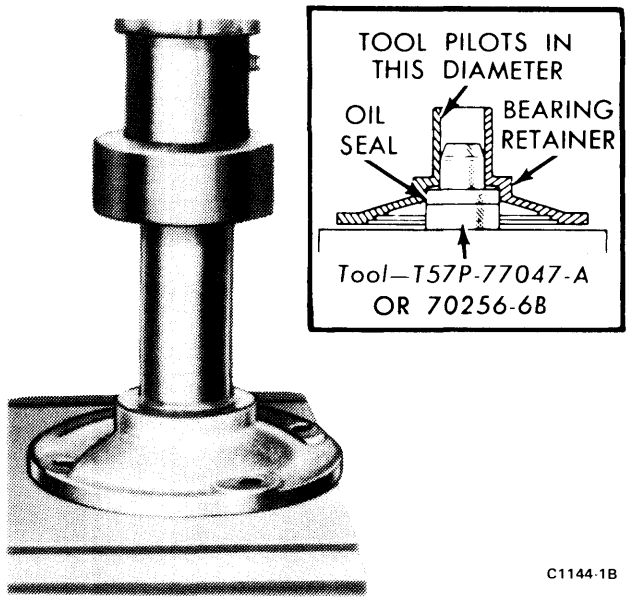


FIG. 22 Installing Input Shaft Seal

SPECIFICATIONS

SPECIAL TOOLS

Number	Description
T75L-7025-B	Remover-Replacer Tube
T75L-7025-C	Remover-Replacer Tube
T75L-7025-D	Collet—Bearing, Remover
T75L-7025-G	Sleeve—Collet
T75L-7025-J	Screw
T75L-7025-K	Sleeve—Replacer
T64P-7111-A	Countershaft Removal Tool
T52T-6500-DJD	Rail Rotation Tool
T64P-7140-A	Reverse Idler Gear Shaft Removal Tool
T50T-100-A	Slide Hammer
T58T-101-A	Input Shaft Seal Puller
T75L-7025-P	Collar—Shaft
T77L-7025-A	Collet—Bearing Remover
T77L-7025-B	Dummy Bearing
T77L-7025-C	Replacer Tube
T77L-7025-D	Clamp—Shaft

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4-SPEED TRANSMISSIONS

Engine	Transmission Model	Gear Ratios				
		First	Second	Third	Overdrive	Reverse
5.0L (302 2-V CID)	RUG-BP	3.29	1.84	1.0	0.8	3.29

LUBRICANT REFILL CAPACITY

Transmission Type	Lubricant Specification	Refill Capacity		
		U.S. (Pints)	Imperial (Pints)	Litres
4-Speed with Overdrive	ESP-M2C83-C or ESW-M2C83-B or equivalent	5.0*	4.1*	2.3*

*To bottom of filler hole

TRANSMISSION COMPONENT END PLAY

Component	Inches
Cluster Gear to Case	.004- 018
Reverse Idler Gear to Case	.004- 018

TORQUE SPECIFICATIONS

Application	Torque — 4-Speed	
	(ft-lbs)	N•m
Input Shaft Bearing Retainer to Case Bolt	19-25	26-33
Extension Housing to Case Bolt	42-50	57-67
Access Cover to Case Screw	20-25	28-33

Application	Torque — 4-Speed	
	(ft-lbs)	N•m
Outer Gear Shift Levers to Cam and Shaft Nut	18-23	25-31
Filler Plug to Case	10-20	14-27
Detent Bolt to Case	10-15	14-20

SHIFTER TORQUE LIMIT (FT-LBS)

Description	Size	Torque	
		(ft-lbs)	N•m
Shift control upper mounting bolt	7/16-14 x 3 hex head	20-30	28-40
Shift control lever mounting bolt	3/8-16 x 2.75 UBS hex head	20-30	28-40

Description	Size	Torque	
		(ft-lbs)	N•m
Transmission shift control rod to shift	5/16-18 nut and washer assembly	10-20	14-27
Control lever attaching nuts		10-20	14-27

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New Process Part Time 205 Transfer Case

PART 16-84

APPLIES TO F-150 — F-250 (4 x 4), BRONCO

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Sub-Assemblies	
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DESCRIPTION

TRANSFER CASE

This manually-shifted unit provides two-speed operation by means of a constant-mesh helical gear train (Fig. 1). Speeds are changed by using sliding clutch gears. A single shift lever controls the integrated shift linkage system.

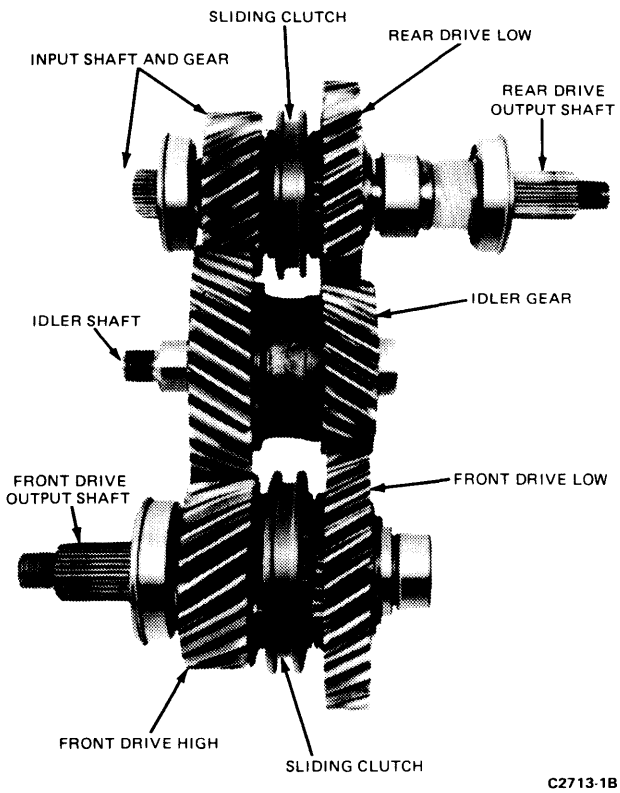


FIG. 1 Gear Train—Model 205 Transfer Case

DIAGNOSIS AND TESTING

Refer to Part 16-10, General Manual Transmission Service.

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REMOVAL AND INSTALLATION

TRANSFER CASE

Removal (Refer to Fig. 2)

1. Drain the transfer case. Disconnect the rear axle drive shaft and front drive shaft from the flange at the transfer case.
2. Disconnect the shift selector rod steady rest and the speedometer cable at the transfer case.
3. Secure the transfer case to a transmission jack, and remove the mounting bolts.
4. Remove transfer case, and place it on a floor stand or work bench.

Installation

1. Remove the transfer case from the floor stand or bench and place it on the transmission jack.
2. Raise the transfer case into position and attach the mounting bolts. Tighten the bolts and nuts to specification, listed at the end of this part and remove the jack.
3. Connect the shift selector rod, the speedometer cable, and steady rest.
4. Connect the front and rear axle drive shafts and tighten the universal joint U-bolt nuts.
5. Fill the transfer case to filler plug level with specified lubricant. Tighten drain plug to specifications, listed at the end of this part.

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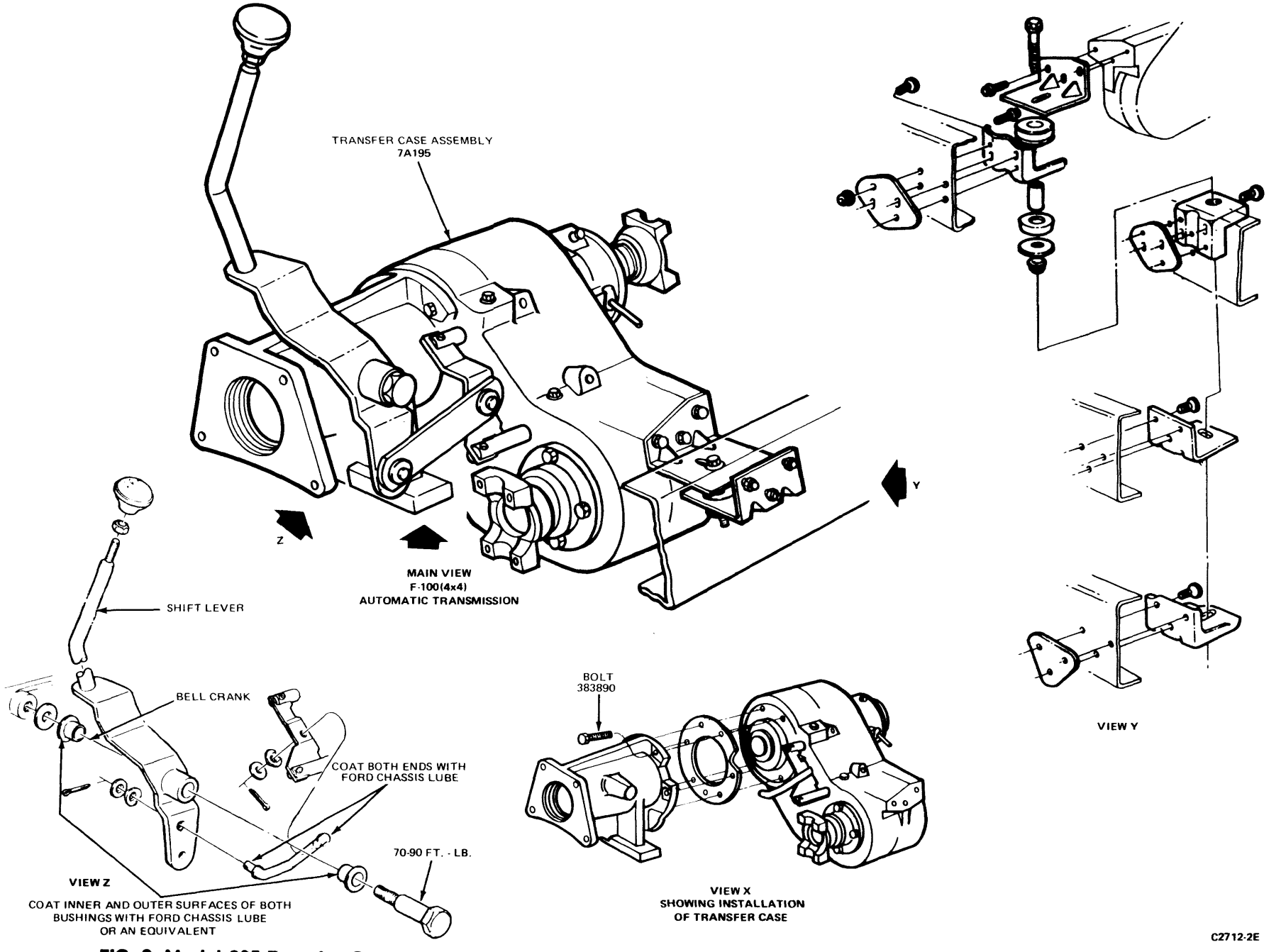


FIG. 2 Model 205 Transfer Case Installation—F-150—F-250 (4x4), Bronco

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DISASSEMBLY AND ASSEMBLY

TRANSFER CASE

Disassembly

1. Clean the exterior of the case.
2. Using a flange-holding tool, loosen the lock nuts and universal joint flanges.
3. Remove front output shaft rear bearing retainer (large aluminum plate), front seal retainer, and drive flange (Fig. 3).

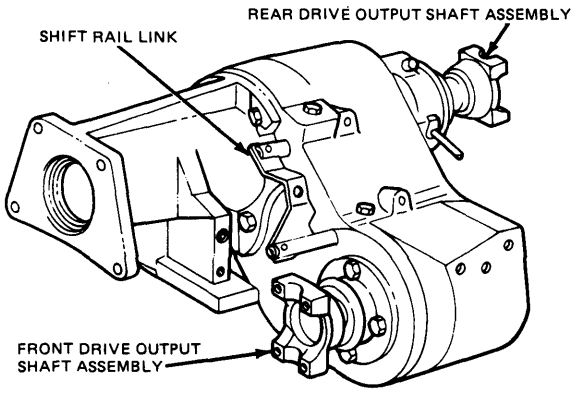


FIG. 3 Model 205 Transfer Case—Front View

4. Using a soft-faced hammer, tap the front output shaft assembly from the case (Fig. 4). Remove the sliding clutch, front output high gear, washer and bearing from the case.

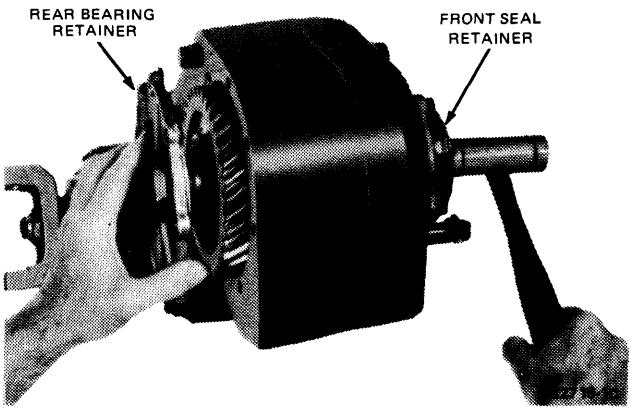


FIG. 4 Removing Front Output Shaft

5. Remove rear output shaft bearing retainer attaching bolts. Then remove the bearing retainer, output shaft, seal retainer and the speedometer gear (Fig. 5).
6. Slide the rear output shaft from the bearing retainer. Be careful not to lose 15 roller bearings.
7. Using a blunt punch, drive the two 1/4-inch shift rail pin access hole plugs into the case.
8. Remove the two shift rail poppet (detent) nuts and springs from the case. Using a magnet, remove the two poppet balls.
9. Position both shift rails in neutral. Using a longhandled screw extractor or punch, remove the shift fork retaining roll pins.

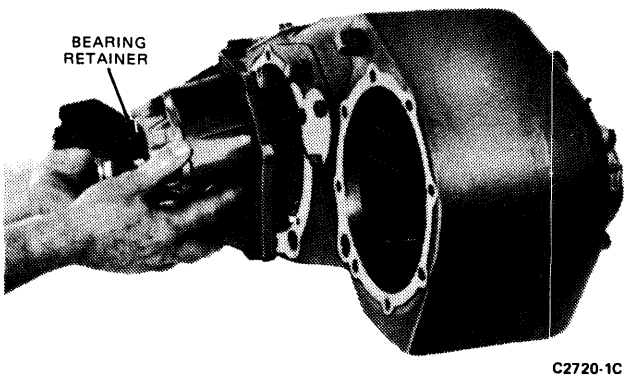


FIG. 5 Removing or Installing Rear Output Shaft

10. Remove clevis pin from one shift rail and the rail link.
11. Remove the range shift rail first, then the four-wheel shift rail (Fig. 6).

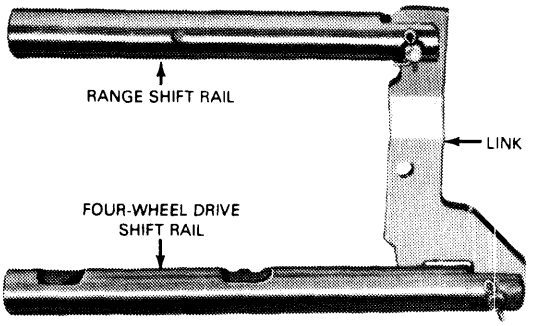


FIG. 6 Shift Rails

12. Remove shift forks and sliding clutch from case. Remove input shaft seal retainer, bearing and gear.
13. Remove the cup plugs and rail pins (if driven out) from the case.
14. Remove idler gear shaft lock nut.
15. Remove idler gear shaft rear cover.
16. Remove idler gear shaft using Tool J-23429 and a soft-faced hammer.
17. Roll idler gear assembly to front output shaft hole and remove from case (Fig. 7).

Assembly

1. Assemble idler shaft, bearings, spacer and shims to the dummy shaft Tool J-23429. Install the assembly into the case through the front output shaft rear retainer opening, large end first.
2. Install idler shaft from large bore side and drive into position, while driving out dummy shaft Tool J-23429, using a soft-faced hammer (Fig. 8).
3. Install washer and new lock nut. Check for free idler gear rotation. Tighten the lock nut to 90-130 ft-lbs.
4. Position the idler shaft cover so that the flat side faces the rear bearing retainer (cover) of the front

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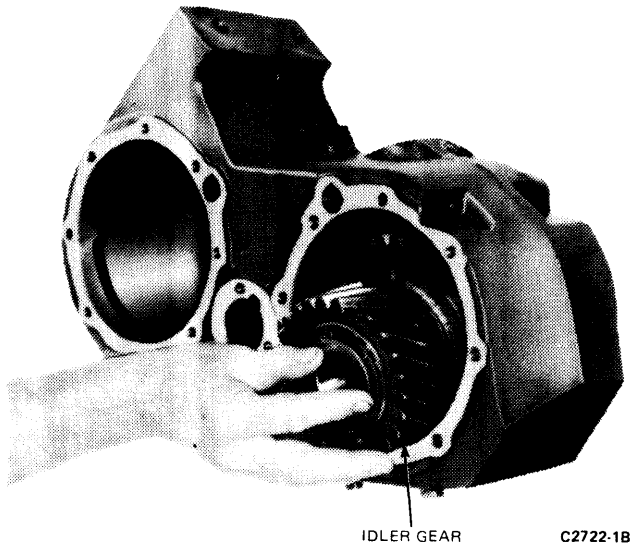


FIG. 7 Removing Idler Gear

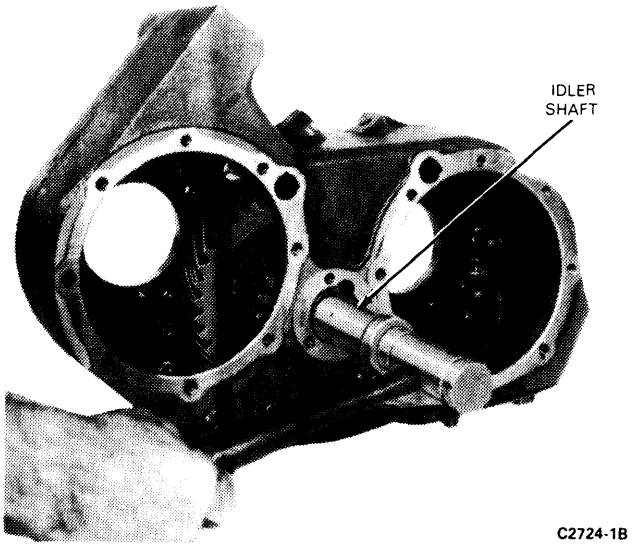


FIG. 8 Installing Idler Gear

output shaft. Install a new gasket and the retaining capscrews. Tighten as to 15-25 ft-lbs.

5. If removed, install interlock pins into the inter-lock bore, working through the front output shaft opening.
6. Start four-wheel drive shift rail into the case from the front, solid end first, with detent notches up.
7. Position shift fork onto the shift rail with the long end facing inward. Push the rail through the fork and into neutral position.
8. Position input gear and bearing into case (Fig. 9).
9. Start the range shift rail into case from front, with detent notches up.
10. Position sliding clutch to fork. Position the sliding clutch on the input gear and align fork with shift rail. Push rail through fork into neutral position.
11. Using a long punch, install the roll pins locking the shift forks to the shift rails.
12. Position front wheel high gear and thrust washer in case. (Fig. 10). Position the sliding clutch in the shift fork. Shift the rail and fork into front-wheel drive (4-Hi) position, while meshing the internal teeth of the sliding clutch with the mating teeth on the front-wheel high gear.
13. Line up thrust washer, high gear and sliding clutch with bearing bore in case and insert front output shaft and low gear into the high gear assembly (Fig. 11).
14. Install a new seal in front seal retainer of the front output shaft (Fig. 11), and install bearing and retainer and new gasket in case. Tighten capscrews to 20-40 ft-lbs.
15. Lubricate the roller bearing in the front output shaft rear bearing retainer (aluminum cover) and position to shaft and case, using two new gaskets.
16. Position range shift rail in High and install rear output shaft and seal retainer assembly to bearing retainer and input gear, (Figs. 5 and 6), using one or two new gaskets as required for clearance on the input gear pilot.
17. Install rear output shaft bearing retainer bolts, and tighten to 20-40 ft-lbs.
18. Install shift rail pin access plugs, using a punch and sealing compound.
19. Install drain and fill plugs and tighten to 25-35 ft-lbs.
20. Install cross-link clevis pin.

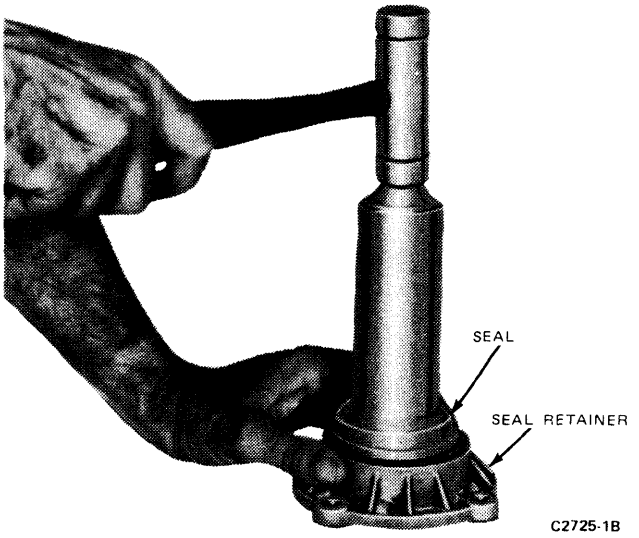


FIG. 9 Installing Seal

SUB-ASSEMBLIES

REAR OUTPUT SHAFT

Disassembly

Refer to Fig. 10.

1. Remove snap ring from the rear output shaft, slide off the thrust washer, and remove the washer-positioning pin.
2. Remove tanged thrust washer from shaft and slide off the low-speed gear, being sure to catch the two rows of roller bearings (32 per row) and spacer.
3. Remove remaining tanged thrust washer.

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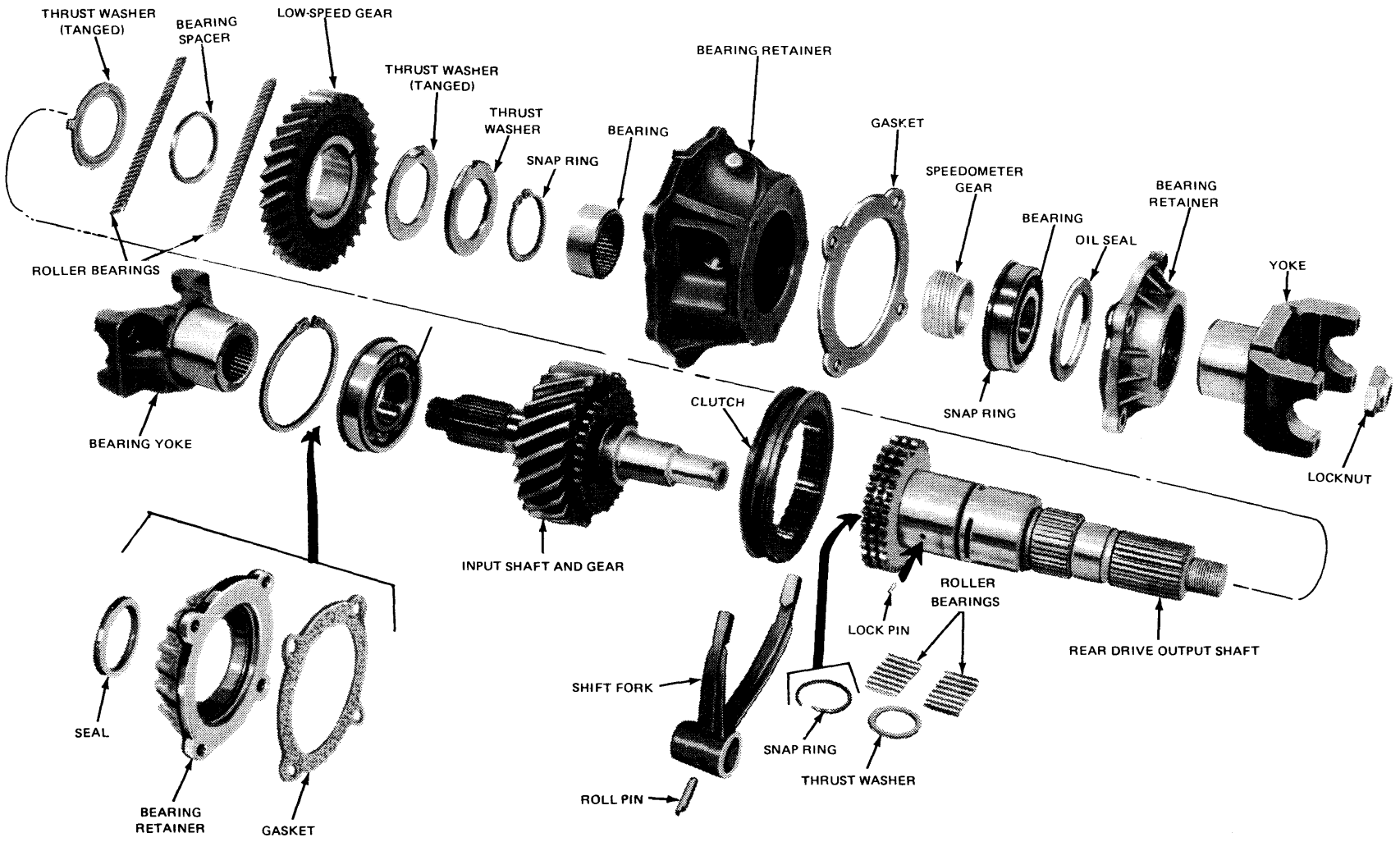


FIG. 10 Disassembled View—Input and Rear Output Shafts

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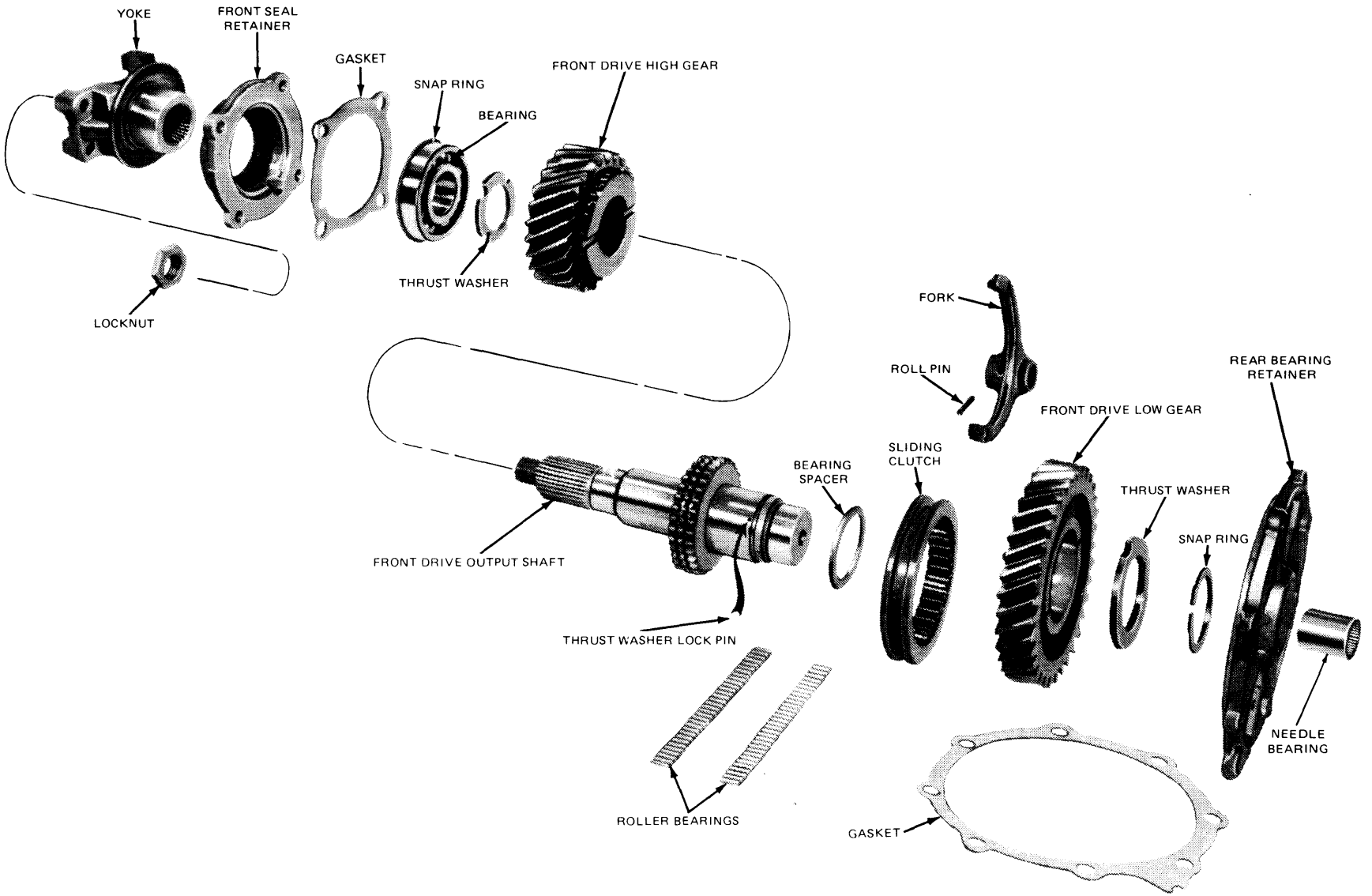


FIG. 11 Disassembled View—Front Output Shaft

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4. Using a hooked tool, remove the retainer ring, washer and needle bearings from the pilot bore of the rear output shaft.
5. Remove rear bearing retainer and ball bearing from the rear output shaft bearing retainer.
6. Remove the caged roller bearing from the retainer only if bearing is to be replaced.

Assembly

1. Install new oil seal into the seal retainer.
2. Install a new caged roller bearing into the bearing retainer, if required.
3. Install the roller bearings, washer and retainer ring in the pilot bore of the rear output shaft, using low melting point petrolatum or equivalent.
4. Install tanged thrustwasher onto output shaft with the tang indexing in the groove in the clutch teeth.
5. Position the output shaft low gear on the output shaft and, using the shaft and petrolatum as assembly aids, insert the two rows of roller bearings and the spacer into the gear.
6. Install the second tanged thrust washer on the output shaft with the tang facing away from the gear.
7. Install washer positioning pin and thick thrust washer on the shaft. Rotate the thick washer until the tang on the thin washer (Step 6) fits into slot about 90 degrees away from the positioning pin.
8. Install retaining snap ring.
9. Check end play between the snap ring and the thick thrust washer. It should be 0.002 to 0.027 inch.
10. Position the rear output shaft assembly in the output shaft bearing housing, and install the speedometer gear and rear ball bearing.
11. Install the rear bearing retainer with new gasket and tighten attaching cap screws to 20-40 ft-lbs.
12. Install the output drive flange, and a new lock nut. Using a flange holding tool, tighten the lock nut to 90-130 ft-lbs.

FRONT OUTPUT SHAFT

Disassembly

Refer to Fig. 11.

1. Remove the snap ring retaining the thrust washer and the low gear to the shaft.
2. Remove the thick thrust washer and positioning pin.
3. Make provision to catch the roller bearings (two rows of 32 each) and slide the gear off the shaft along with the roller bearing spacer.
4. If necessary to replace the roller bearing in the rear bearing retainer, (aluminum cover) replace the entire assembly.

Assembly

1. Using petrolatum or equivalent, install the two rows of roller bearings (32 each) and the spacer in the front output shaft low gear.
2. Place the front output shaft in a soft-faced vise with the spline end down. Position the front low gear and bearing assembly on the shaft with the clutch gear facing down.
3. Install thrust washer positioning pin, thrust washer and a new snap ring. Position the snap ring so that the opening is opposite the pin.

IDLER GEAR

Disassembly (Refer to Fig. 12)

1. If necessary to replace bearings, drive out the bearing cups using the drive slot provided in the gear bore.

CHECKING END PLAY—PRESS METHOD

1. Press in new bearing cups if removed.
2. Assemble the idler gear, bearings, spacer and shims using the dummy shaft, Tool No. J-23429 or equivalent.
3. Place the assembly in a press and using a piece of pipe or suitable sleeve that will clear the dummy shaft, apply enough pressure to the bearing cones

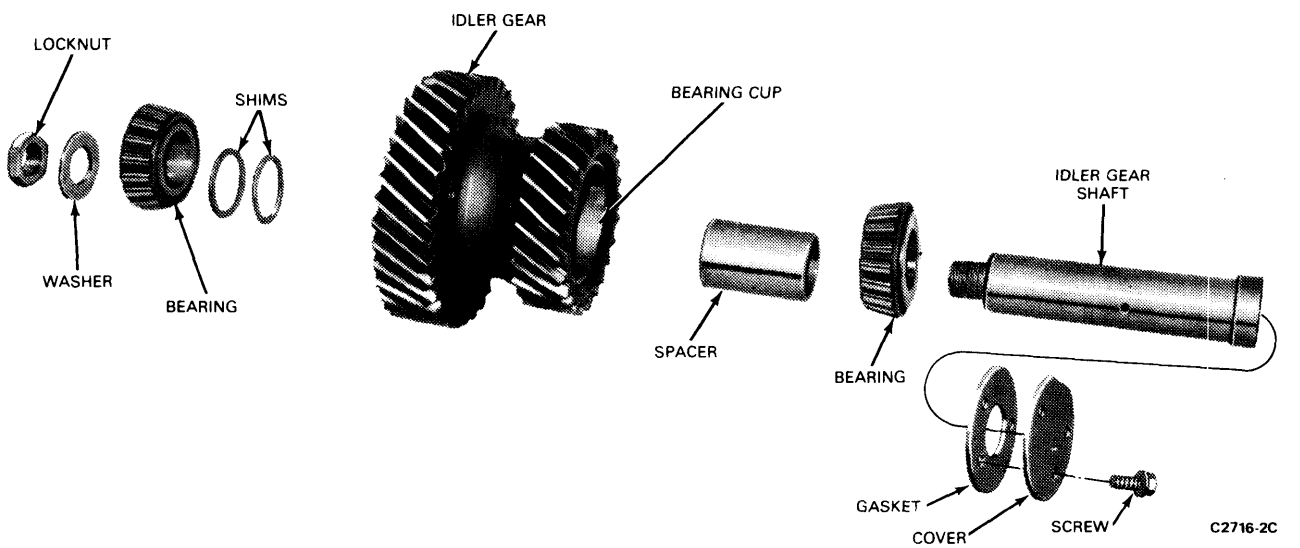


FIG. 12 Disassembled View—Idler Gear

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to remove looseness between the bearing spacer and shims (Fig. 13). Using a dial indicator, check the end play between the bearing cones and cups. Tolerance should be 0 to 0.002 inch. Adjust this tolerance by adding or subtracting shims between the bearings and the bearing spacer.

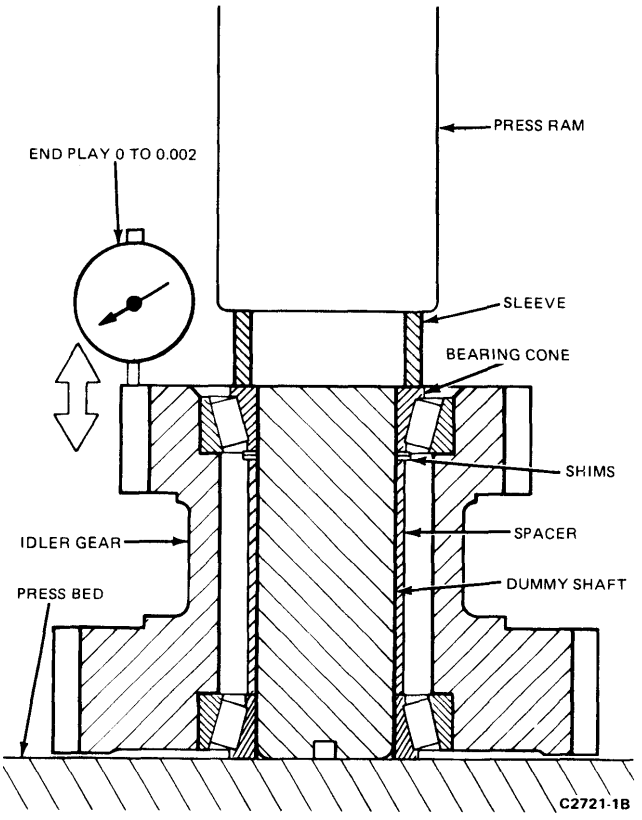


FIG. 13 Checking Idler Gear End Play Using Dummy Shaft

CHECKING END PLAY (VISE METHOD)

1. Assemble the idler shaft, bearing spacer and shims on the idler shaft.
2. Clamp the large end of the shaft in a vise (Fig. 14).
3. Using a suitable sleeve or short piece of pipe, assemble the locknut and washer on shaft as shown (Fig. 14), and tighten locknut to 90-130 ft-lbs.
4. Using a dial indicator, check the end play between the bearing cones and cups. Tolerance should be 0 to 0.002 inch. Adjust this tolerance by adding or subtracting shims between the bearings and the bearing spacer.

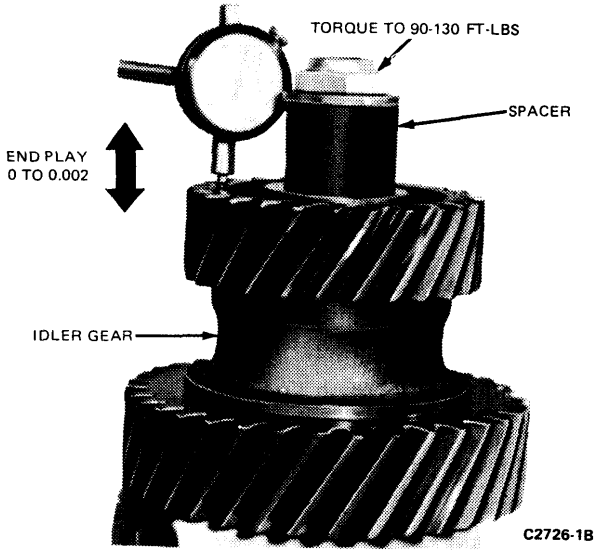


FIG. 14 Checking Idler Gear End Play Using Idler Shaft and Sleeve

SPECIFICATIONS

APPROXIMATE LUBRICANT REFILL CAPACITY — PINTS

Transfer Case — New Process	U.S.	Imp.	Litre
ESP-MC83-C or equivalent	4.5	3.75	2.1

SPECIAL TOOLS — NEW PROCESS TRANSFER CASE

Number	Description
Tool 4625-AB	Bearing Retainer Seal Installer
J-23429	Dummy Shaft (Idler Gear)
OTC-630-15	Idler Gear Bearing Cup Installer
Manzel 77288	Shift Rail Seal Installer

TORQUE LIMITS — NEW PROCESS TRANSFER CASE

Description	ft-lbs	N•m
Bearing Retainer Bolts — Front Output Shaft — Front	20-40	28-54
Bearing Retainer Bolts — Rear Output Shaft	20-40	28-54
Bearing Retainer Bolts — Input Shaft	15-25	21-33
Bearing Retainer Bolts — Front Output Shaft — Rear	20-40	28-54
Drain and Filler Plugs	25-35	34-47
Extension Housing to Case Bolts	20-40	28-54
Idler Shaft Cover Bolts	15-25	21-33
Idler Shaft Locknut	90-130	123-176
Poppet Ball Retainer	15-25	21-33
P.T.O. Cover Bolts	12-18	17-24
Yoke (Companion Flange) Locknut	90-130	123-176
Seal Retainer Bolts, Rear Output	20-40	28-54

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New Process 203 Full-Time Transfer Case

PART 16-85

APPLIES TO BRONCO, F-150 — F-250, F-350 (4x4)

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DESCRIPTION AND OPERATION

(Refer to Figs. 1 and 2).

The Model 203 full-time transfer case incorporates a differential that is similar in operation to the axle differentials, and compensates for different speeds of the front and rear axles resulting from varying speeds while turning and operating over different terrains thus permitting continuous four-wheel drive on dry, hard surfaced highways. Refer to Fig. 3 for shift pattern.

OPEN DIFFERENTIAL—HI OR LO POSITION

TRACTION AVAILABLE TO BOTH AXLES

Torque is equally divided between the front and rear axle assemblies through the differential of the transfer case.

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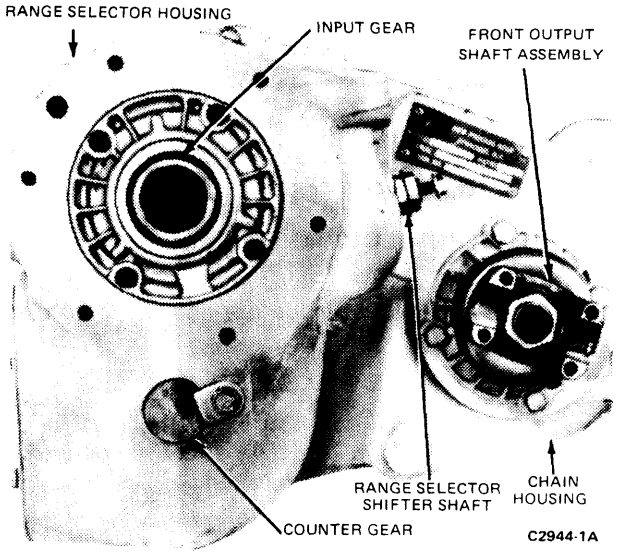


FIG. 1 New Process Model 203 Transfer Case—Front View

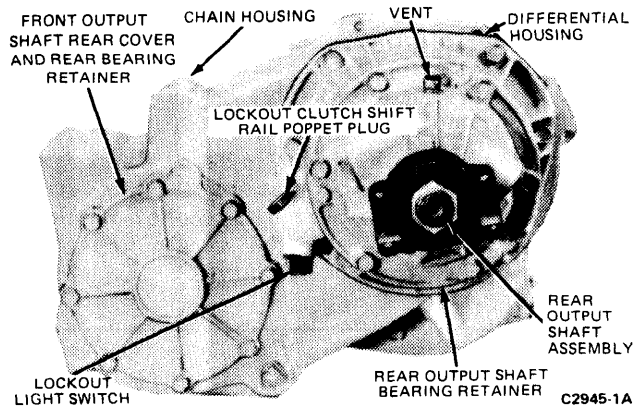


FIG. 2 New Process Model 203 Transfer Case—Rear View

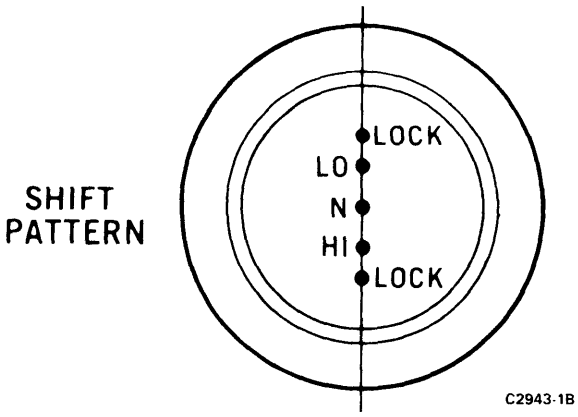


FIG. 3 Shift Pattern—Full-Time Transfer Case

ONE WHEEL INSUFFICIENT TRACTION (EITHER AXLE)

If torque to a slipping wheel is less than that required to move the vehicle, the wheel will continue to slip. Transfer case will require shifting to either lock position to keep the vehicle moving. If torque to slipping wheel is sufficient to move vehicle, the shift to lock position is not required.

ONE WHEEL SUSPENDED IN AIR

If one side of either axle causes a wheel to be suspended, the transfer case will have to be shifted to lock position to move the vehicle. If the vehicle still cannot pull itself free after shifting the transfer case in the Lo lock position, it will have to be free from the obstruction by towing with a winch or other means.

DIFFERENTIAL LOCK-UP LOCK IN EITHER HI OR LO

Shifting the transfer case to lock position, locks the differential so that both front and rear axles cannot rotate independently of each other. When insufficient traction is encountered under one wheel of either axle, the vehicle will move as long as traction is available to the other axle. Should one wheel under each axle have insufficient traction, the vehicle will not move.

FOUR-WHEEL DRIVING

First, select the transfer case position best suited to ground conditions. The shift lever on the floor has the positions displayed on the shift knob. After selecting the transfer case position, use the transmission shift lever (on the steering column) as used for normal driving.

LOCK POSITION (HI AND LO) INDICATOR LIGHT

A lock position indicator signal lamp is mounted on the under side of the instrument panel slightly to the right of center. The lamp is activated by a contact switch that is installed on the left side of the differential cover (Fig. 2). When the transfer case shift lever is in the full Hi or Lo lock position, the lock rail contacts and energizes the electrical switch. The word LOCK is printed on the lamp assembly.

When the shift lever is moved from lock position, the indicator lamp will be extinguished but the transfer case differential will not be released from the lock-up condition until all the torque has been completely released. Under normal highway speeds, the release would occur as soon as the wheels bounced sufficiently to release the torque. Under slow speed and off-highway conditions, stop the vehicle and shift the transmission into reverse; driving in reverse for a few feet may be required. A front wheel hard kick during maximum turns at slow speed during off-highway operation after shifting from lock to Hi or Lo is normal and indicates that the torque has not permitted the differential to be released from the lock-up position.

TRANSFER CASE POSITIONS

Do not use lock positions on dry hard surface roads. If this is done, it may be necessary to back the vehicle a few feet to unlock the differential.

HI—High ratio (1 to 1). Use this gear for all normal driving.

LO—Low ratio (2 to 1). Use when only increased torque is needed.

LOCK—(Lo Position): Use when both extra traction and increased torque are required; for instance, in climbing or descending steep grades or carrying heavy loads off the road, or when entering deep sand, snow or mud.

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LOCK—(Hi Position): Use when extra traction only is needed. For example when the wheels would slip in Hi.

When shifting from lock to either high or low range, a shift rail is moved inside the transfer case which will allow the lock-disengage mechanism to function at the next moment when driveline torque is reduced to zero. This will occur within a short distance in normal driving, although it can be made to occur by driving in reverse for a few feet. The LOCK indicator lamp under the instrument panel is activated when the mechanism has been shifted to the engaged position. Shifting out of lock, disengages the mechanism and deactivates the lamp but actual lock-disengagement requires the torque release described above.

TRANSFER CASE SHIFTING

SHIFTING FROM HIGH TO HIGH LOCK

This can be accomplished while the vehicle is in motion. With transfer case in high position, move lever from high position to high lock position.

SHIFTING FROM HIGH LOCK TO HIGH

This can be accomplished while the vehicle is in motion. With transfer case in high lock position, move lever from high lock position to high position.

SHIFTING FROM HIGH TO LOW

Vehicle must be stopped or moving slower than 3 mph. With the automatic transmission in the neutral position and the transfer case in the high position. Move the shift lever forward into the low position following the shift pattern.

If during this shift, resistance or blockage is encountered before the shift is completed, return the shift lever to the high position, put the automatic transmission in drive position and move the vehicle. Repeat the original shift instruction.

SHIFTING FROM LOW TO LOW LOCK

This can be accomplished while the vehicle is in motion. With the vehicle in low position, move shift lever forward to low lock position.

SHIFTING FROM LOW LOCK TO LOW

This can be accomplished while the vehicle is in motion. With vehicle in low lock position, move the shift lever backward to the low position.

SHIFTING FROM LOW TO HIGH

Vehicle must be stopped. With the automatic transmission in the neutral position and the transfer case in the low position, move the shift lever backward all the way into the high position. When high position is reached and before the shift is completed, a slight resistance (detent) will be encountered. The shift lever should be moved all the way through this resistance to complete the shift pattern.

If during this shift, resistance or blockage is encountered before the shift is complete, return the shift lever to the low position, put the automatic transmission in drive position, and move the vehicle. Repeat the original shift instruction.

DIAGNOSIS AND TESTING

Refer to Part 16-10, General Manual Transmission Service.

ADJUSTMENTS

SHIFT LINKAGE ADJUSTMENT

Refer to Fig. 4.

1. Place in cab shift lever in neutral position.
2. Remove two adjusting stud nuts.
3. Install 0.25 inch diameter alignment pin (1.25 inches long) through shifter assembly.
4. Align the two transfer case levers as follows:
   a. Bottom lever, (Lock lever)—Rotate clockwise to the forward position.
   b. Top lever, (Range lever)—Place in the Mid-position or Neutral position.
5. Re-position the two shift rods and tighten new adjusting stud nuts to 15-20 ft-lbs.
6. Remove alignment pin from shifter assembly.

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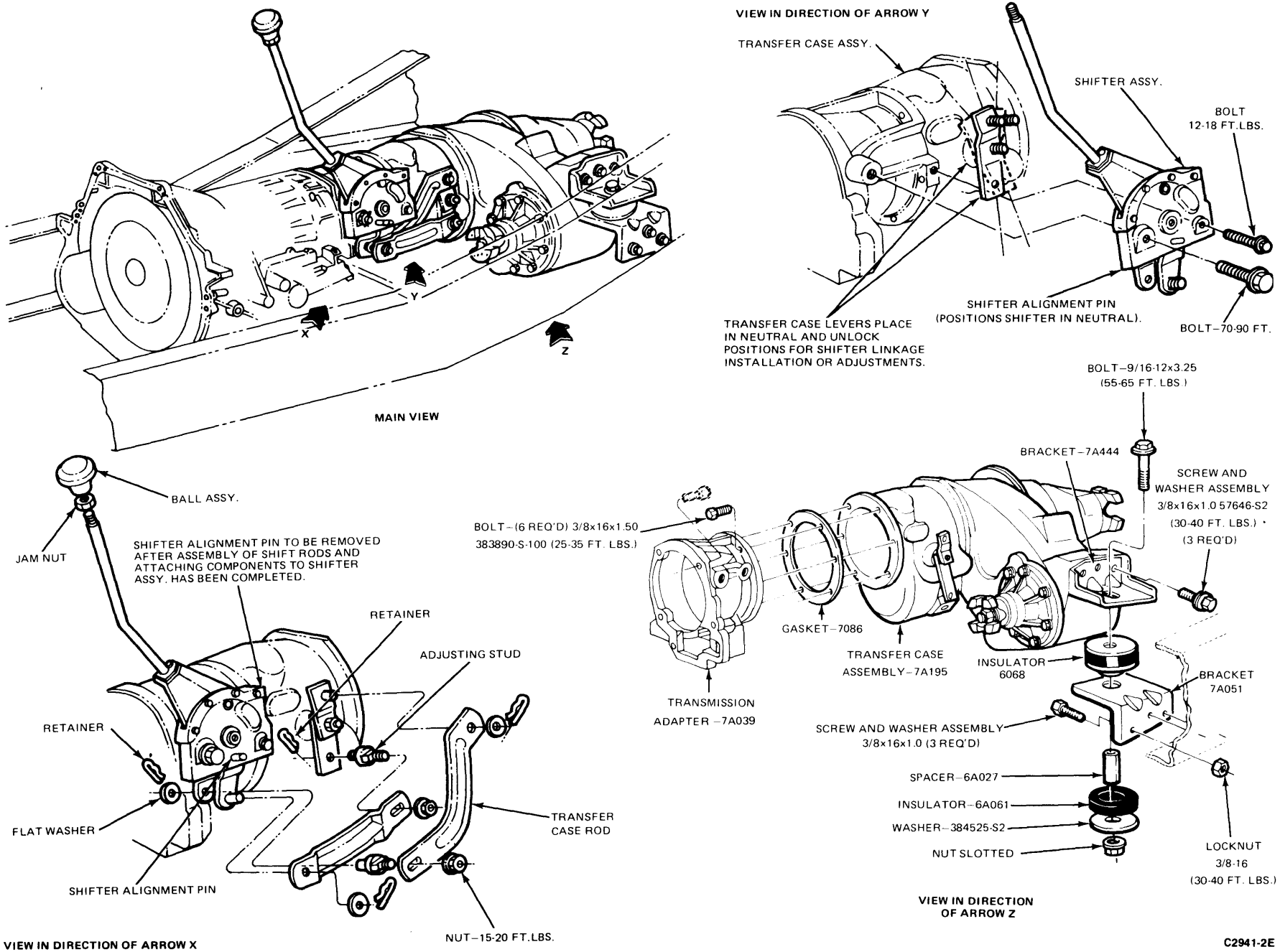


FIG. 4 New Process Model 203 Transfer Case Installation—Bronco, F-150—F-250 (4x4)

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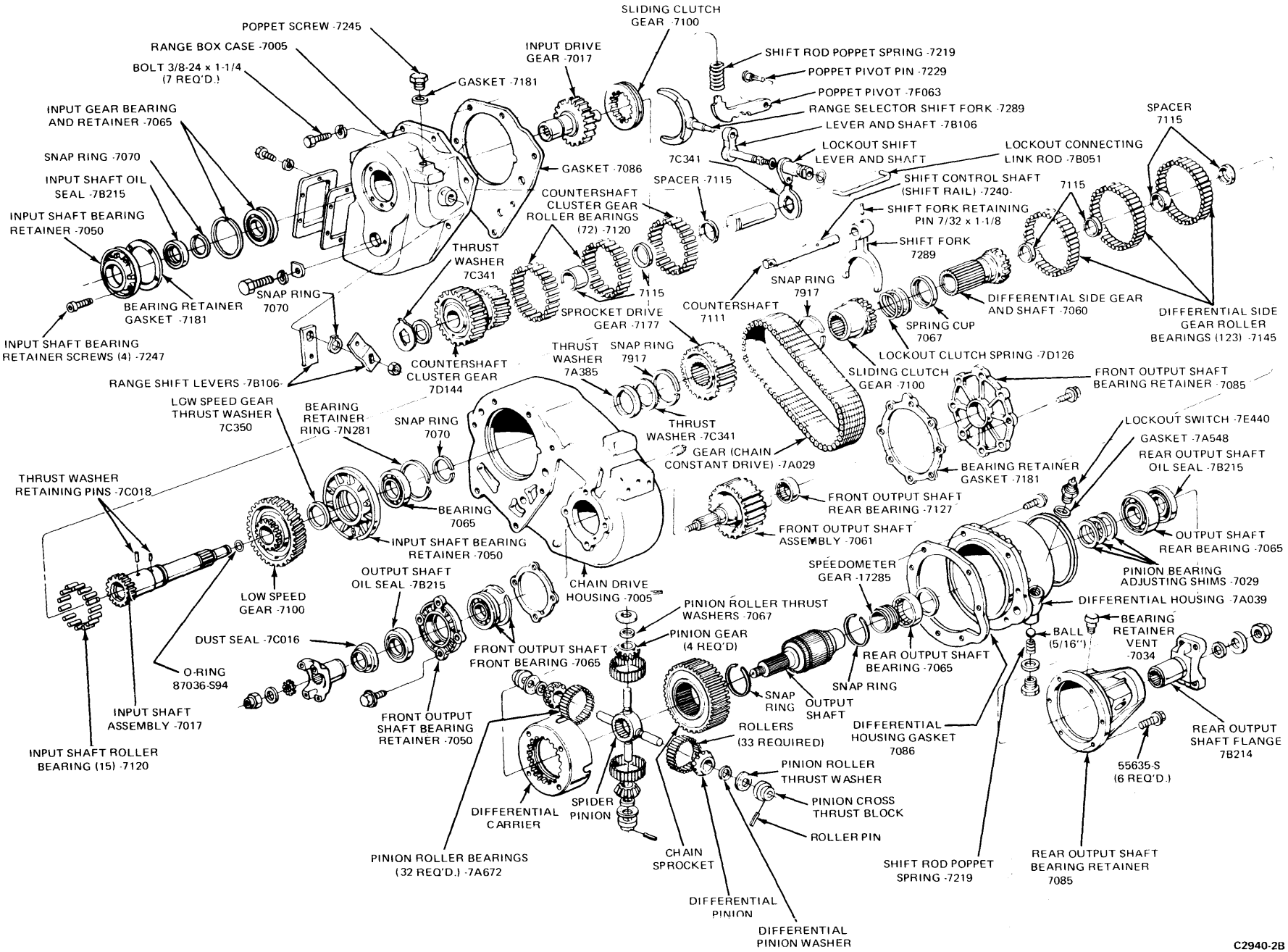


FIG. 5 New Process Model 203 Transfer Case Exploded View

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REMOVAL AND INSTALLATION

Removal

1. Drain the transfer case by removing the power take-off lower bolts and the front output rear cover lower bolts.
2. Disconnect the front axle drive shaft from the flange at the transfer case.
3. Disconnect the shift rods from the transfer case.
4. Disconnect the speedometer cable and lockout lamp switch wire from the transfer case rear output shaft housing.
5. Remove the transfer case-to-transmission adapter attaching bolts (Fig. 4). Disconnect the rear axle drive shaft at the transfer case flange.
6. Position a transmission jack under the transfer case and secure it to the jack.
7. Remove the transfer case mounting bracket support to frame crossmember nuts, bolts, spacers and upper absorbers and remove the transfer case.
8. Using a chain fall, place the transfer case on a suitable work bench.

Installation

1. Using a chain fall, secure the transfer case on a transmission jack.
2. Position the transfer case in the truck, aligning the mounting bracket supports with the lower absorbers. Align the transfer case-to-transmission attaching bolts.
3. Install the transfer case mounting bracket support to frame crossmember bolts with upper absorbers and spacers. Tighten all mounting bolts to specifications listed at the end of this part.
4. Remove the transmission jack.
5. Connect the speedometer cable and the lockout switch wire to the transfer case.
6. Connect the rear axle drive shaft to the transfer case rear output flange.
7. Install the shift rods on the transfer case and adjust the shift linkage as described in this part.
8. Connect the front axle drive shaft to the transfer case flange.
9. Fill the transfer case with specified lubricant ESP-M2C83-C or equivalent. Tighten the filler plug to 25-35 ft-lbs.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

Refer to Fig. 5 for an exploded view of the transfer case.

1. Position transfer case on work bench or suitable work table. If lubricant was not drained from unit prior to removal from vehicle, remove front output rear cover and P.T.O. cover lower bolts and drain lubricant into waste container.
2. Using Tool 4851-K loosen rear output shaft flange retaining nut (Fig. 6).

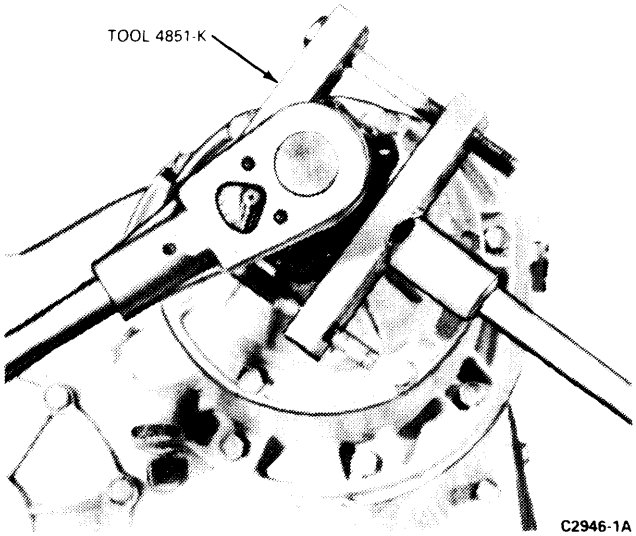


FIG. 6 Removing Rear Output Shaft Flange Nut

3. Using Tool 4851-K, remove front output shaft flange retaining nut, washer and flange (Fig. 7).

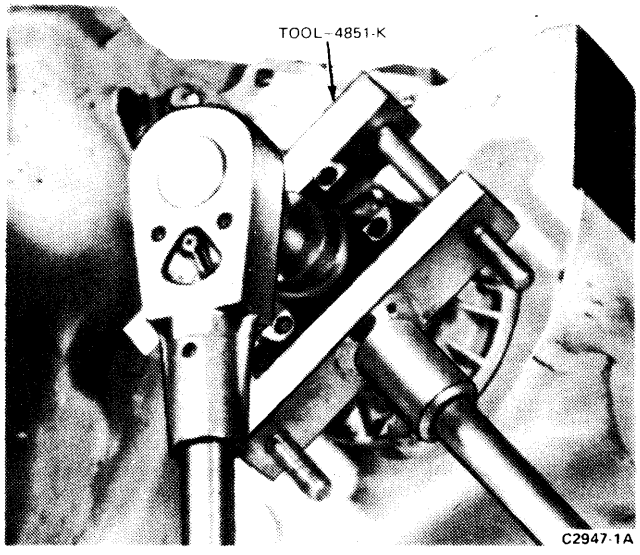


FIG. 7 Removing Front Output Shaft Flange Nut

4. Remove bolts retaining front output shaft front bearing retainer (Fig. 8). Remove bearing retainer and gasket from transfer case. Discard gasket.
5. Using a hoist or other suitable lifting tool, position the assembly on blocks with the input shaft facing downward.

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6. Remove the bolts which retain the rear output shaft rear bearing retainer to the differential housing and remove the rear output shaft rear bearing retainer (Fig. 9).

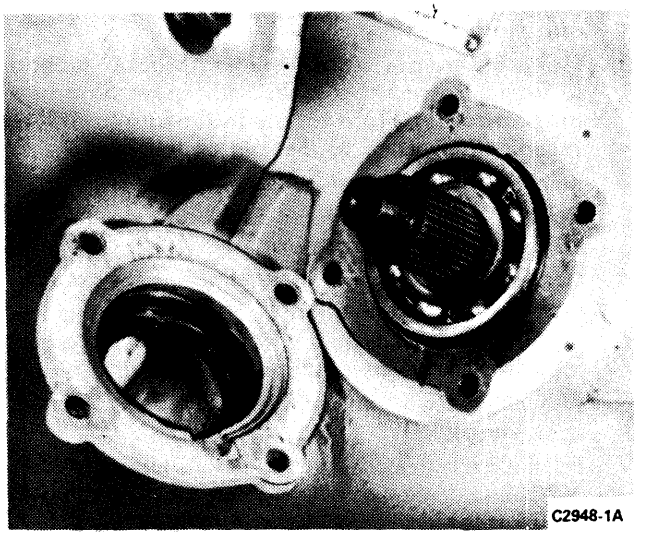


FIG. 8 Front Output Shaft Bearing Retainer Removal

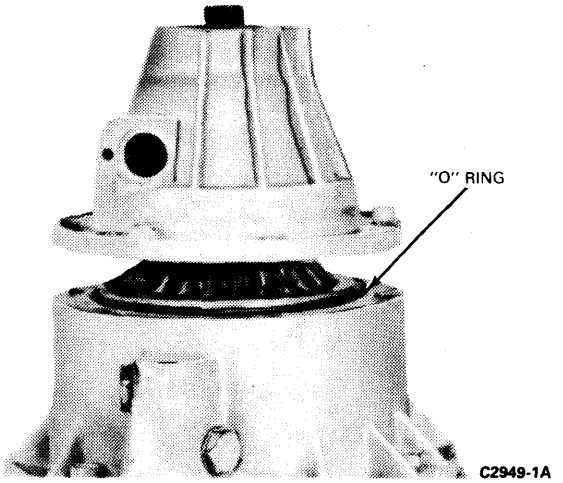


FIG. 9 Rear Output Shaft Rear Bearing Retainer Removal

7. Remove the shift rail poppet ball plug, gasket, spring and ball from the differential housing. A small magnet may be used to remove the ball from the housing.
8. Remove the lockout lamp switch from the differential housing.
9. Remove the bolts which retain the differential housing to the chain drive housing and remove the differential housing (Fig. 10).
10. Remove the rear output shaft (Fig. 11) and remove the differential carrier assembly. Place a rubber band around the roller bearings as shown in Fig. 11 to prevent dropping or losing bearings (15).
11. Slide the differential carrier assembly from the input shaft.

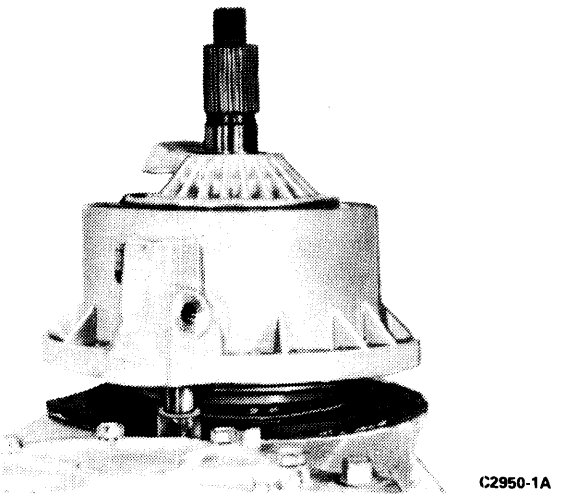


FIG. 10 Differential Housing Removal

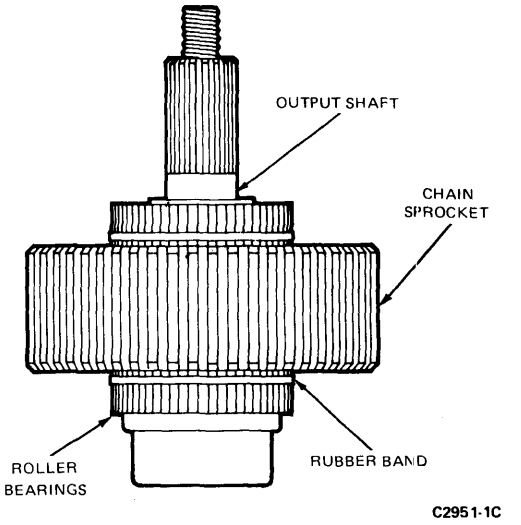


FIG. 11 Removing Rear Output Shaft Assembly

12. Raise the shift rail and drive out the pin which retains the shift fork to shift rail (Fig. 12).

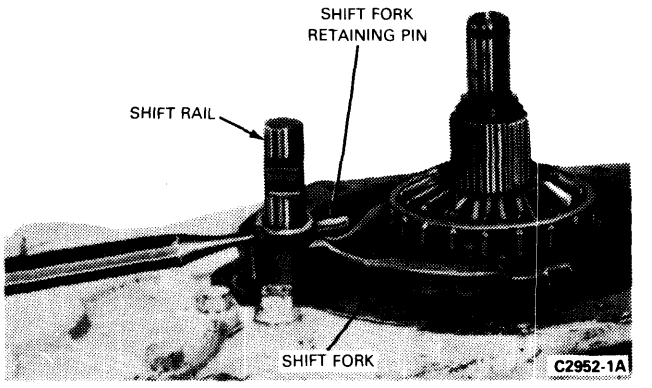


FIG. 12 Removing Shift Fork Retaining Pin

13. Loosen, but do not remove the bolts attaching the chain housing to the range box. Using a chain fall, raise the chain housing approximately 1/2 inch to

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provide access to the lockout connecting link. With a screwdriver, or other suitable tool, disengage the lockout connecting link from the shift rail (Fig. 13).

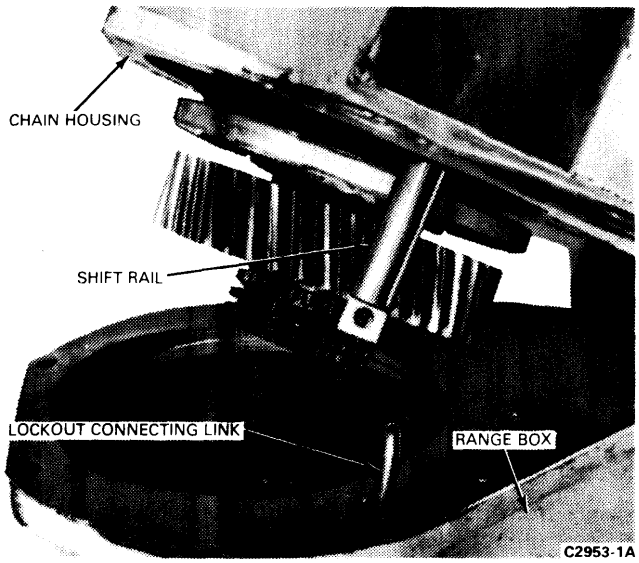


FIG. 13 Disengaging Lockout Connecting Link From Shift Rail

14. Lower the chain housing assembly and remove the shift rail.
15. Lift up on the lockout clutch and remove the shift fork from the clutch assembly.
16. Remove the bolts retaining the front output shaft rear bearing retainer to the transfer case. Tap on front of the shaft or carefully pry the retainer away from the case. Remove the retainer from shaft and discard the gasket. **Recover any roller bearings which may fall from the rear cover.**

    If necessary to replace the rear bearing, support the cover and press the bearing from the cover. Position a new bearing to the outside face of the cover and press bearing into the cover until it is flush with the opening.
17. From the lower side of the case, remove (pry) the output shaft front bearing.
18. Disengage the front output shaft from chain and remove shaft from the transfer case.
19. Remove the bolts attaching the intermediate chain housing to the range box. Lift, or using a chain hoist, remove the intermediate housing from the range box.
20. Remove the chain from the intermediate housing.
21. Remove the lockout clutch, drive gear and input shaft assembly from the range box. **Install a 1-1/2 inch to 2 inch hose clamp on the end of the input shaft to prevent losing the roller bearings (123) which may fall out of the clutch assembly if it is pulled off the input shaft (Fig. 14).**
22. Remove (lift) the input shaft assembly from the range box. At this point, the transfer case is completely disassembled into its subassemblies. Each of these subassemblies should then be disassembled for cleaning and inspection.

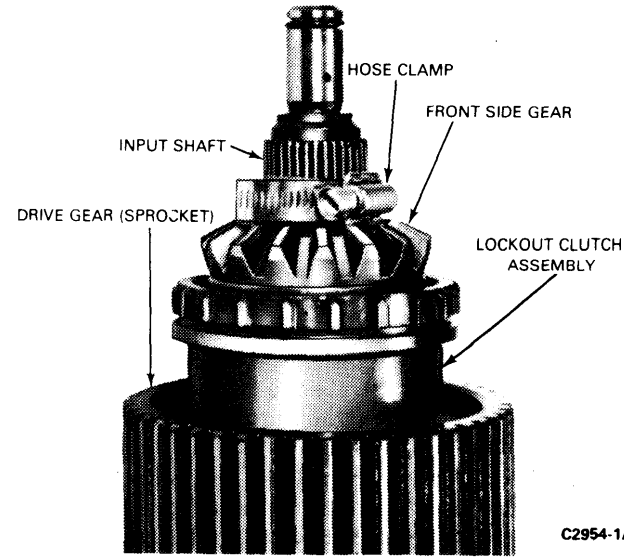


FIG. 14 Hose Clamp Installed On Input Shaft Assembly

ASSEMBLY

Refer to Fig. 5.

1. Place the range box on blocks, with the input gear side toward bench.
2. Position the range box-to-transfer case housing gasket on the input housing.
3. Install the lockout clutch and drive sprocket assembly on the input shaft assembly.

   Install a two inch hose band clamp on the end of the shaft to prevent loosing bearings from the clutch assembly.
4. Install the input shaft, lockout clutch and drive sprocket assembly in the range box, aligning the tab on the bearing retainer with the notch in the gasket.
5. Connect the lockout clutch shift rail to the connector link and position rail in the range box housing bore. Rotate the shifter shaft lowering shift rail into the housing, to prevent the link and rail from being disconnected.
6. Install the drive chain in the chain housing, positioning the chain around the outer wall of the housing.
7. Install the chain housing on the range box. Position the chain on the input drive sprocket.
8. Install the front output sprocket in the case, engaging the drive chain to the sprocket. Rotate the clutch drive gear to assist in positioning the chain on the drive sprocket.
9. Install the shift fork on the clutch assembly, then push the clutch assembly fully into the drive sprocket. Install the roll pin retaining the shift fork to the shift rail.
10. Install the front output shaft bearing.
11. Install the front output shaft bearing retainer, gasket and retaining bolts.
12. Install the front output shaft flange, gasket, seal, washer and retaining nut. Tap the dust shield back in place after installing bolts in the flange.

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13. Install the front output shaft rear bearing retainer, gasket and retaining bolts. If the rear bearing was removed, position a new bearing to the outside face of the cover and press it into the cover until the bearing is flush with the cover opening.
14. Install the differential carrier assembly on the input shaft. The carrier bolt heads should face the rear of the shaft.
15. Install the differential housing assembly, gasket and retaining bolts. (Load bearings in pinion shaft).
16. Temporarily install the rear output shaft bearing retainer and loosely install the output shaft flange on the output shaft. (Leave at least 0.060 inch movement between the retaining nut and the output flange).
17. **Check the rear output shaft end play.** Install a dial indicator on the rear housing (Fig. 15) so that it contacts the end of the output shaft. Hold the rear flange. Apply thumb pressure on the end of the rear (output) shaft and rotate the front output shaft to determine the highest point of gear hop out on the rear shaft. Zero the indicator and with the rear shaft set at this high point, pull up on end of shaft (pry upward on the output shaft flange) to determine end play (gap between bearing shoulders of shaft and the housing). Record this reading.
18. Remove the dial indicator.
19. Remove the output shaft flange and remove the output shaft rear bearing retainer.
20. Install a shim pack onto the shaft in front of the rear bearing, to control end play to within 0 to 0.010 inch.
21. Re-install the rear output shaft bearing retainer and rear output flange: Hold the rear flange and rotate the front output shaft to check for binding of the rear output shaft.
22. Install the lockout clutch shift rail poppet ball, spring and screw plug in the case.
23. Install the poppet plate spring, gasket and plug if not installed during reassembly of the range box.
24. Install the shift levers on the range box shifter shaft if not left on linkage in the vehicle.
25. Tighten all bolts, locknuts and plugs (except filler plug) to specifications.
26. Fill the transfer case to proper level with specified lubricant ESP-M2C83-C or equivalent.
27. Install and tighten the filler plug to 25-35 ft-lbs.

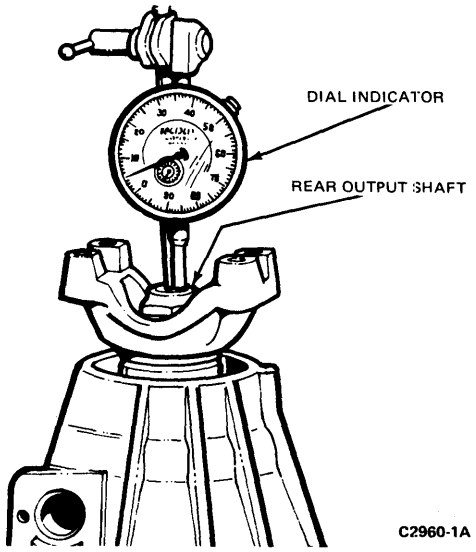


FIG. 15 Checking Rear Output Shaft End Play

CLEANING AND INSPECTION

Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be moved up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove the bearings and blow dry with compressed air, being careful to direct air across the bearings so that they do not spin.

Clean all shafts and gears in cleaning solution to remove all accumulations. Dry with compressed air.

Transfer case, cover, and housings must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surfaces where used.

Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render them unfit for further service. Bearings are non-adjustable and if worn or damaged, must be replaced with new parts. Inspect shaft splines, drive chain and gears. If any indication of damage, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

SUBASSEMBLY REPAIRS

Refer to Fig. 5 for exploded view of subassemblies.

DIFFERENTIAL CARRIER

Disassembly

1. Remove the four roll-pins from the pinion spider.
2. Slide the pinion spider assembly out of the slots in the stamped carrier case.
3. Remove the pinion cross thrust block thrust washers, pinion roller thrust washers, pinion gears and roller bearings from the pinion spider.
4. Clean and inspect all components. Replace all worn or damaged parts.

Assembly

1. Using petrolatum jelly, as a retention aid, load roller bearings into the pinion gear.

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2. Install pinion gears, roller washer, thrust washer and pinion cross thrust block on each pinion pin of the spider.
3. Position the spider assembly in the carrier with the under-cut surface of the spider hub surface facing toward the female clutch teeth.
4. Install the roll-pin in each pinion.

LOCKOUT CLUTCH

Disassembly

1. Remove the front side gear from the input shaft assembly and remove the thrust washer, roller bearings (132) and spacers from the front side gear bore. Note the position of the spacers to facilitate re-assembly.
2. Using snap ring pliers, remove the snap ring which retains the drive sprocket to the clutch assembly. Slide the drive sprocket from the front side gear.
3. Using snap ring pliers, remove the lower snap ring.
4. Remove the sliding gear, spring and spring cup from the front side gear.
5. Clean and inspect all components. Replace all worn or damaged parts.

Assembly

1. Install the spring cup, spring and sliding clutch gear on the front side gear.
2. Install snap ring which retains sliding clutch to the front side gear.
3. Using a petroleum jelly, load roller bearings (132) and spacers in the front side gear or on the input shaft as shown in Fig. 16.

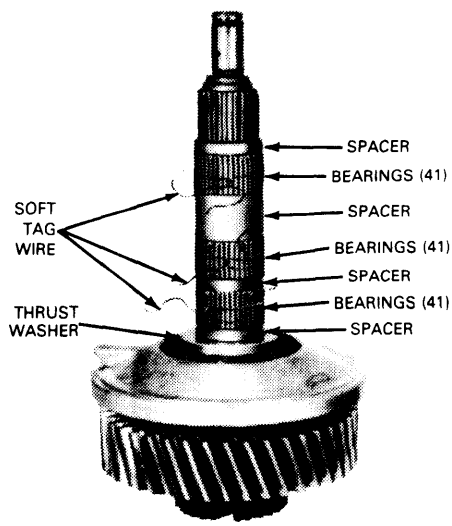


FIG. 16 Assembling Bearings and Spacers on Input Shaft

4. Install the thrust washer in the gear end of the front side gear.
5. If used, remove soft tag wires, slide the drive sprocket onto the clutch splines and install the retaining ring.

INPUT SHAFT

Disassembly

1. Slide the thrust washer and spacer from the shaft.
2. Using snap ring pliers, remove the snap ring which retains the input bearing retainer assembly to the shaft and remove the bearing retainer assembly from the shaft.
3. Support the low speed gear (large gear) and tap the shaft from the gear and thrust washer.

   Observe thrust washer pin(s) located in shaft (Fig. 17).

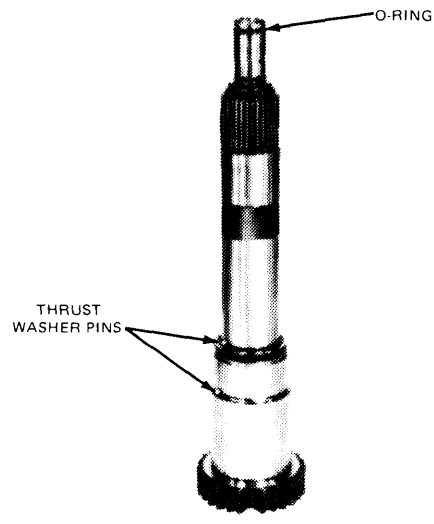


FIG. 17 Thrust Washer Pin Locations On Input Shaft

4. Using a screwdriver, pry behind the open end of the large snap ring which retains the input bearing in the bearing retainer and remove the ring from the retainer. Tap the bearing from the retainer.
5. Remove the pilot roller bearings (15) from end of the input shaft.
6. Remove the O-ring from the end of the shaft and discard.
7. Clean and inspect all components. Replace as required.

Assembly

1. Position the bearing to retainer and tap or press it into place. Ball loading slots should be toward the concave side of the retainer.
2. Install the large snap ring which secures the bearing in the retainer. **The snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.**
3. Install the low speed gear on the shaft with the clutch end toward the gear end of the shaft.
4. Position the thrust washers on shaft, aligning the slot in the washer with pin in the shaft. Slide or tap the washer into place.
5. Position the input bearing retainer on the shaft and install the snap ring, holding the bearing in place on the shaft. **The snap ring is a select fit. Use size A, B, C, or D as required to provide tightest fit.**

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6. Slide the spacer and thrust washer onto the shaft. Align the spacer with the locator pin.
7. Using petroleum jelly, install the roller bearings (15) in the end of the shaft.
8. Install a new rubber O-ring on the end of the shaft.

RANGE SELECTOR HOUSING (RANGE BOX)

REMOVING SHIFTER ASSEMBLY

Disassembly

1. Remove the poppet pivot spring, plug and gasket, (Fig. 18). Discard the gasket.

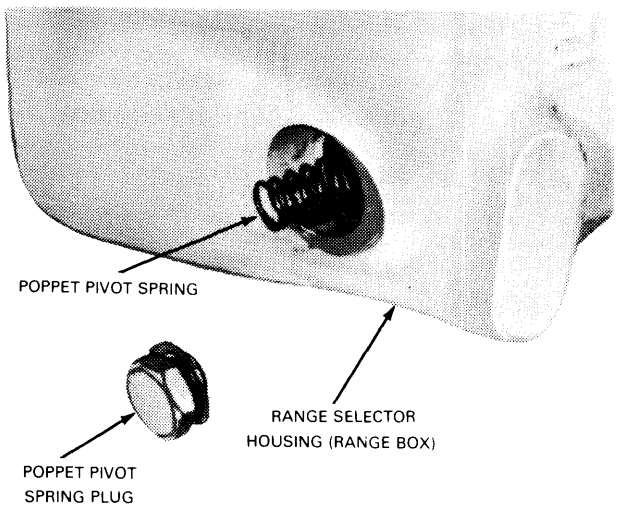


FIG. 18 Removing Poppet Pivot Plug and Spring

2. Disengage the sliding clutch gear from the input gear and remove the clutch fork and sliding gear from the case (Fig. 19).

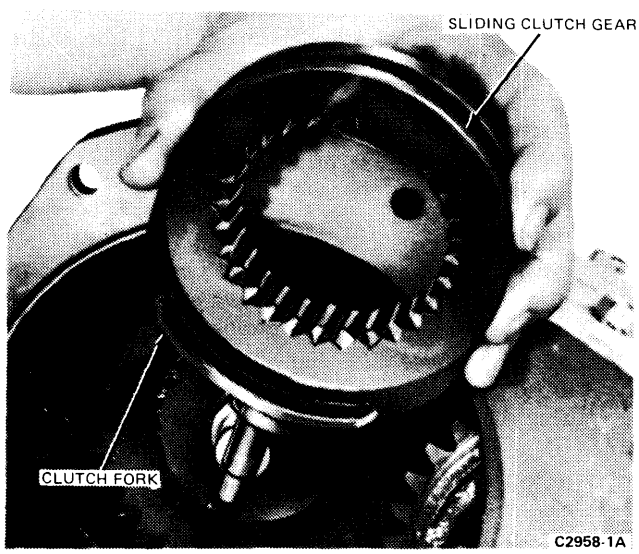


FIG. 19 Removing Clutch Fork and Sliding Clutch Gear

3. Remove the shift lever assembly retaining nut and upper shift lever from the shifter shaft.
4. Remove the shift lever snap ring and lower lever.
5. Push the shifter shaft assembly downward and remove the lockout clutch connector link. **The long end of connector link engages the poppet pivot.**
6. Remove the shifter shaft assembly from the case and separate the inner and outer shifter shafts. Remove and discard the O-rings.
7. Inspect poppet pivot for damage. If necessary to remove it, drive the pivot shaft from the case. Remove the poppet plate and spring from the bottom of case.

REMOVING INPUT GEAR ASSEMBLY

8. Remove the input gear bearing retainer and seal assembly. Discard the gasket.
9. Remove the large snap ring from the bearing outer diameter.
10. Tap the input gear and bearing from the case.
11. Remove snap ring which retains the input shaft bearing to the shaft and remove the bearing from the input gear.

    This is a select fit snap ring. Snap rings, size A, B, C, and D are released for service. Select the tightest fit.

REMOVING CLUSTER GEAR ASSEMBLY

12. From the intermediate case side, remove the countershaft from cluster gear and case using Tool J-24745 (Fig. 20). Remove the cluster gear assembly from the case.

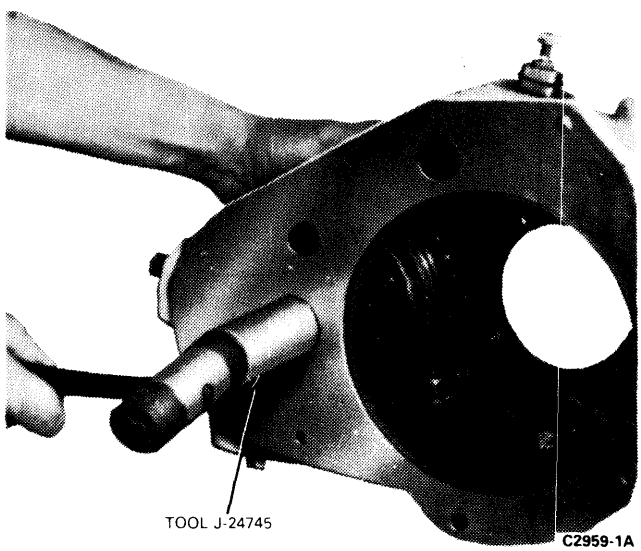


FIG. 20 Removing Cluster Gear Shaft

13. Remove the cluster gear thrust washers from the case.
14. Clean and inspect all components. Replace worn or damaged parts.

INSTALLING COUNTERGEAR ASSEMBLY

Assembly

1. Using Tool J-24745 and petroleum jelly, install roller bearings (72 required) and spacers in cluster gear bore. Refer to disassembled view (Fig. 5).

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2. Using petroleum jelly, position countershaft thrust washers in case. Engage the tab on the washers with a slot in the case thrust surface.
3. Position the cluster gear assembly in case and install the countershaft through the front face of the range box and through the gear assembly. **The countershaft face with flat should face forward and must be aligned with the case gasket.**

INSTALLING INPUT GEAR ASSEMBLY

4. Install the bearing (without large snap ring) on the input gear shaft, positioning the snap ring groove outward and install a new retaining ring on the shaft. Position the input gear and bearing in the housing. **The retaining ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.**
5. Install the snap ring in outside diameter of the bearing.
6. Align oil slot in the retainer with the drain hole in the case and install the input gear bearing retainer, gasket and retaining bolts. Tighten the bolts to 15-25 ft-lbs.

INSTALLING SHIFTER SHAFT ASSEMBLY

7. If removed, install the poppet plate and pivot pin assembly in the housing. Use sealant on pin.
8. Install new O-rings on the inner and outer shifter shafts. Lubricate O-rings and assemble the inner shaft in the outer shaft.
9. Push the shifter shafts into the housing, engaging the long end of the lockout clutch connector link to the outer shifter shaft before the shaft assembly bottoms out.
10. Install the lower shift lever and retaining ring.
11. Install the upper shift lever and shifter shaft retaining nut.
12. Install the shift fork and sliding clutch gear. Push the fork up into the shifter shaft assembly to engage the poppet plate, sliding the clutch gear forward onto the input shaft gear.
13. Install the poppet plate spring, gasket and plug in the top of the housing. Check spring engagement with the poppet plate.

INPUT GEAR BEARING REPLACEMENT

1. Remove the bearing retainer attaching bolts, retainer and gasket from the housing. Discard the gasket.
2. Using snap ring pliers, remove the snap ring which retains bearing on the shaft. Discard the snap ring.
3. Using a screwdriver or other suitable tool, pry the bearing from the case and remove it from the shaft.

   Inspect input gear for damage such as burrs, scoring, heat discoloration, etc. Inspect seal in bearing retainer. Replace as required.
4. Install a new bearing with snap ring on the input gear shaft. Position the bearing to the case and tap it into place with a soft hammer. **Select a service ring, size A, B, C or D, that will provide the tightest fit.**
5. Install a new snap ring to retain the bearing on the shaft.
6. Position a new gasket and the bearing retainer to the housing. Install the retaining bolts, tighten to specifications.

INPUT GEAR BEARING RETAINER SEAL

Replacement

1. Remove the bearing retainer attaching bolts, retainer and gasket from the housing. Discard the gasket.
2. Pry the seal out of the retainer and discard.
3. Position a new seal to the retainer and install it, using Tool J-21359.
4. Position the bearing retainer and gasket to the housing. Install the attaching bolts and tighten to specifications.

FRONT OUTPUT SHAFT BEARING RETAINER SEAL

Replacement

1. Pry or drive out both existing seals from the retainer bore.
2. Clean and inspect the retainer.
3. Apply sealer to the outer diameter of a new seal.
4. Position both seals to the retainer bore and using Tool J-22836 or equivalent, install the seal in the retainer.

FRONT OUTPUT SHAFT REAR BEARING

Replacement

1. Remove the rear cover from the transfer case. Remove gasket and discard.
2. Support the rear cover and press the bearing from the cover.
3. Position a new bearing to the outside face of the cover and using a piece of wood, press the bearing into the cover until it is flush with the opening.
4. Position the gasket and cover to the transfer case and tap into place.
5. Install the cover retaining bolts and tighten them to specifications.

DIFFERENTIAL CARRIER HOUSING

Disassembly

1. Remove the rear output shaft front bearing from the housing by inserting a drift through the rear opening and driving the bearing from the housing.
2. Remove and discard the seal.

Assembly

1. Position a new seal in the housing bearing bore. Use petroleum jelly to hold it in place.
2. Position the rear output shaft front bearing in the bearing bore. Press the bearing into the bore until it bottoms out in the housing.

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REAR OUTPUT SHAFT REAR BEARING RETAINER

Disassembly

1. Pry the seal out of its bore with a screwdriver or other suitable tool.
2. Remove the snap ring which retains the bearing in the housing. Pull or tap the bearing from the housing.

Assembly

1. Position the bearing in the bearing bore and tap it into place. Install the bearing retaining snap ring.
2. Position the rear seal in the housing bore and drive it into place with Tool J-22388, or other suitable tool, until the seal is approximately 1/8 inch to 3/8 inch below the housing face.

DRAIN AND REFILL INFORMATION

FILLER PLUG LOCATION

On rear of transfer case (chain case).

DRAIN PLUG

None.

DRAIN

1. Remove the two lower bolts of the front output shaft rear bearing cover.
2. Remove the 2 lower bolts of the power take-off cover.

Re-install bolts and tighten to 12-18 ft-lbs. Refill transfer case assembly to specifications.

SPECIFICATIONS

TORQUE LIMITS — MODEL 203 TRANSFER CASE

Part Name	Thread Size	Torque (ft-lbs)	Torque N•m	Part Name	Thread Size	Torque (ft-lbs)	Torque N•m
Idler Cover Screw	5/16-18	15-25	21-33	Light Switch	5/8-18	15-25	21-33
Bearing Retainer Screw	3/8-16	20-40	28-54	Input Retainer Bolts	5/16-18	15-25	21-33
PTO Cover Screw	3/8-16	12-18	17-24	Flange Nut	3/4-16	90-150	123-203
Poppet Screw	1/2-13	15-25	21-33	Shift Lever Nut	5/16-24	14-20	19-27
Front Retainer Nut	7/16-20	34-55	47-74	Carrier Bolts	3/8-24	50-60	68-81
Filler Plug	1/2-14 NPTF	25-35	34-47				
Flange and Idler Shaft Nut (Self-Locking)	7/8-20	90-150	123-203				

CC2974-2B

SPECIAL SERVICE TOOLS — MODEL 203 TRANSFER CASE

Number	Description
J-21359 ①	Input Gear Bearing Retainer Seal Installer
J-22388 ①	Rear Output Shaft Seal Installer
J-22836 ①	Front Output Shaft Bearing Retainer Seal Installer
J-24725 ①	Cluster Gear Loading Tool (Dummy Shaft)
J-24745 ①	Cluster Gear Shaft Remover
Tool 4851-K	Flange Holder

① Commercially available from Kent-Moore Corporation, 1501 S. Jackson Street, Jackson, Michigan 49203.

CC2975-1B

APPROXIMATE LUBRICANT REFILL CAPACITY — PINTS

Transfer Case — New Process Model 203	U.S.	Imperial	Litre
ESP-M2C83-C or equivalent	9	7.4	4.2

CC2976-1B

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AUTOMATIC TRANSMISSION

GROUP 17

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C-6 Automatic Transmission	17-10
General Automatic Transmission Service	17-01
Shift Control Linkage	17-02

CD2822-A

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General Automatic Transmission Service

PART 17-01

APPLIES TO AUTOMATIC TRANSMISSIONS

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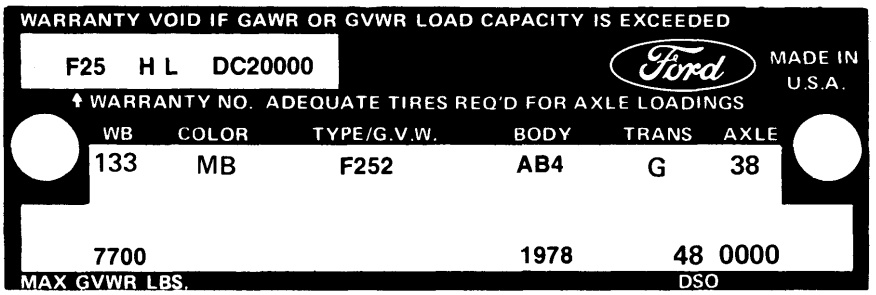
GENERAL INFORMATION

TRANSMISSION IDENTIFICATION

All vehicles are equipped with a rating plate, and a Vehicle Certification Label affixed to the left (driver's) side door lock post. Refer to the stamped code in the space marked "Trans." and to Fig. 1 below for proper transmission identification.

All C4 and C6 automatic transmissions are equipped with high temperature resistant seals. This includes those seals used on the manual and kickdown levers, the O-rings and oil pan gasket. Under no conditions should older design seals be used on the 1979 transmissions, except the regular service replacement oil pan gasket, which is of special leak prevention design. This should still be used.

RATING PLATE



Transmission	Code
Automatic (C4)	G
Automatic (C6)	G
Automatic (AT-540)	L
Automatic (MT-643)	8
Automatic (MT-653)	H

D2170-2K

FIG. 1 Typical Vehicle Certification Label—Transmission Identification

DIAGNOSIS AND TESTING

Troubleshooting the automatic transmission is simplified by using the proven methods of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

The following procedures are recommended for checking and/or verifying that the various components are adjusted and operating properly.

AUTOMATIC TRANSMISSION TESTS

LINKAGE CHECK

Accelerator Linkage and Operation

The linkage must be free and must return to idle when released. Refer to Part 24-60—Throttle Linkage for linkage adjustment and this part for dashpot adjustment.

Kickdown Linkage

Check for wide-open carburetor and linkage travel at full throttle. The carburetor full-throttle stop must be contacted by the throttle linkage and there must be a slight amount of movement left in the downshift linkage. Be sure the downshift linkage return spring is connected and the downshift lever returns to a closed position.

Manual Linkage

Correct manual linkage adjustment is necessary to position the manual valve for proper fluid pressure direction to the different transmission components. Improperly adjusted manual linkage may cause cross-leakage and subsequent transmission failure. Refer to Linkage Adjustments in Part 17-02, Shift Control Linkage for detailed manual linkage adjustment procedures.

TRANSMISSION FLUID LEVEL CHECK

The automatic transmission is designed to operate with the fluid level between the 'add' and 'full' mark on the dipstick, at an operating temperature of 150°F to 170°F (65° to 76°C) and should be checked under these conditions. The operating temperatures may be obtained by driving 15 to 20 miles of city type driving with the outside temperature above 50°F (10°C).

If the transmission is not at an operating temperature of 150° to 170°F (65° to 76°C) and it becomes necessary to check the fluid level, the fluid may be checked at room temperature 70° to 95°F (21° to 35°C). (Dipstick cool to touch).

ROOM TEMPERATURE FLUID LEVEL CHECKING PROCEDURES

1. With the transmission in Park, 'P' position, engine at curb idle RPM, foot brakes applied, and vehicle on level surface, move the transmission selector lever through each range, allowing time in each range to engage transmission. Return to Park, 'P' position and apply parking brake.
2. Clean all dirt from the transmission fluid dipstick cap before removing the dipstick from the filler tube.
3. Pull the dipstick out of the tube, wipe it clean and push it all the way back in the tube. Be sure it is fully seated.
4. Pull the dipstick out of the filler tube again and check the fluid level. The level should be between the middle and top holes of the dipstick. If the level is below the middle hole or above the top hole:

   On C4 Transmissions : Add or remove fluid to bring level between the middle hole and 'Add' mark.

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On C6 Transmissions : Add or remove fluid to bring level between the middle hole and the top hole.

5. If it becomes necessary to add fluid to a transmission, be sure to use the correct fluid, as specified on the transmission dipstick. C6 Automatic Transmissions can also use Dexron II Series D fluid alternately.
6. Install the dipstick, making sure it is fully seated in the tube.

If the transmission fluid level is correctly established at 70°F to 95°F (21° to 35°C), it will appear between the 'Add' and 'Full' mark on the dipstick when the transmission reaches an operating temperature of 150°F to 170°F (65° to 76°C). Do not over-fill or under-fill.

Overfill can cause the fluid to foam and spill out through the transmission vent with resultant transmission malfunction.

Underfill can result in transmission loss of engagement or slipping. This condition is most evident in cold weather or when the vehicle is parked or being driven on a hill.

If the transmission fluid level is checked when the fluid is cold, the dipstick could indicate that fluid should be added. If the fluid is added at this time, an overfill condition could result when the fluid reaches an operating temperature of 150°F to 170°F (65°F to 76°C) (Dipstick hot to touch).

TRANSMISSION FLUID CONDITION CHECK

1. Make the normal fluid check according to the above procedure.
2. Observe color and odor of the fluid. It should be red not brown or black. A burnt odor can sometimes indicate that there is an overheating condition or clutch disc or band failure.
3. Use an absorbent white paper (kleenex, etc.) to wipe the dipstick. Examine the stain for evidence of solids (specks of any kind) and for antifreeze signs (gum or varnish on dipstick).

   If specks are present in the oil or there is evidence of antifreeze, the transmission oil pan must be removed for further inspection. If fluid contamination or transmission failure is confirmed by further evidence of coolant or excessive solids in the oil pan, the transmission must be disassembled and completely cleaned and repaired. This includes cleaning the torque converter and transmission cooling system. It would be a waste of time to perform any further checks before cleaning and repairing the transmission. During disassembly and assembly, all overhaul checks and adjustments of clearances and end play must be made.

HIGH OR LOW FLUID LEVEL

A fluid level that is too high will cause the fluid to become aerated. Aerated fluid will cause low control pressure, and the aerated fluid may be forced out the vent.

A fluid level that is too low can affect the operation of the transmission. Low level may indicate fluid leaks that could cause transmission damage.

FLUID LEVEL HIGH BEFORE STARTING ENGINE—OK DURING NORMAL CHECK

C4 or C6

1. Check for correct operation of drainback valve in stator support.
2. Check pump bushing.
3. Replace or repair pump if required.

TRANSMISSION FLUID LEAKAGE CHECKS

Check the speedometer cable connection at the transmission. Replace the rubber seal if necessary (if so equipped).

Leakage at the oil pan gasket often can be stopped by tightening the attaching bolts to the proper torque. If necessary, replace the gasket.

Check the fluid filler tube connection at the transmission case or pan. If leakage is found, install a new O-ring or tighten the fitting to the specified torque as listed at the end of this Part.

Check the fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage is found, tighten the fitting, or replace the damaged parts.

Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines from the cooler fittings and applying 50-75 psi air pressure to the fittings. Remove the radiator cap to relieve the pressure build up at the exterior of the oil cooler tank. If the cooler is leaking and/or will not hold pressure, the cooler must be replaced. Cooler replacement is described in the Cooling System Section of Group 27.

If leakage is found at either the downshift control lever shaft or the manual lever shaft, replace either or both seals.

Inspect the pipe plug on the left front side of the transmission case. If the plug shows leakage, tighten the plug to specifications. If leakage continues, replace the plug. On a C6 transmission, inspect the TV pressure plug on the right rear side of the case. If the plug shows leakage, coat the threads with Motorcraft Sealing Compound or equivalent and tighten the plug to specification as listed at the end of the appropriate transmission part. If leakage continues, replace the plug.

When a converter drain plug leaks, remove the drain plug with a six-point wrench. Coat the threads with Motorcraft Sealing Compound or equivalent and install the plug. Tighten the drain plug to specification as listed at the end of this Part. **Fluid leakage from the converter housing may also be caused by engine oil leaking past the rear main bearing, or from oil galley plugs, or power steering oil leakage from steering system. Be sure to determine the exact cause of the leak before starting repair procedures.**

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Oil-soluble aniline or fluorescent dyes premixed at the rate of 1/2 teaspoon of dye powder to 1/2 pint of transmission fluid have proved helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the oil cooler leaks into the engine coolant system. A black light must be used with the fluorescent dye solution.

FLUID LEAKAGE IN CONVERTER AREA

In diagnosing and correcting fluid leaks in the front pump and converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, is evidenced by fluid around the converter housing, may have several sources. By careful observation, it is possible in many instances, to pinpoint the source of the leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the converter housing are shown in (Fig. 2).

1. Fluid leaking by the front pump seal lip will tend to move along the drive hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the converter housing only, near the outside diameter of the housing.
2. Fluid leakage by the outside diameter of the seal and front pump body will follow the same path which the leaks by the front pump seal follow.
3. Fluid that leaks by a front pump-to-case bolt will be deposited on the inside of the converter housing only. Fluid will not be deposited on the back of the converter.
4. Leakage by the front pump-to-case gasket may cause fluid to be deposited inside the converter housing, or it may seep down between the front of the case and converter housing. Fluid on the front of the case above the pan gasket on C4 transmissions is evidence that the front pump-to-case gasket or seal could be leaking.
5. Fluid leakage from the converter drain plugs will appear at the outside diameter of the converter on the back face of the flywheel, and in the converter housing only near the flywheel.
6. Converter-to-flywheel stud weld leak.

Engine oil leaks are sometimes improperly diagnosed as transmission front pump seal leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the problem.

a. Leakage at the rocker arm cover (valley cover) may allow oil to flow over the converter housing or seep down between the converter housing and cylinder block, causing oil to be present in or at the bottom of the converter housing.
b. Oil galley plug leaks will allow oil to flow down the rear face of the block to the bottom of the converter housing.
c. Leakage by the crankshaft seal will work back to the flywheel, and then into the converter housing.

Fluid leakage from other areas, such as the power steering system forward of the tranmission, could cause fluid to be present around the converter housing due to blow back or road draft. The following procedures should be used to determine the cause of the leakage before any repairs are made.

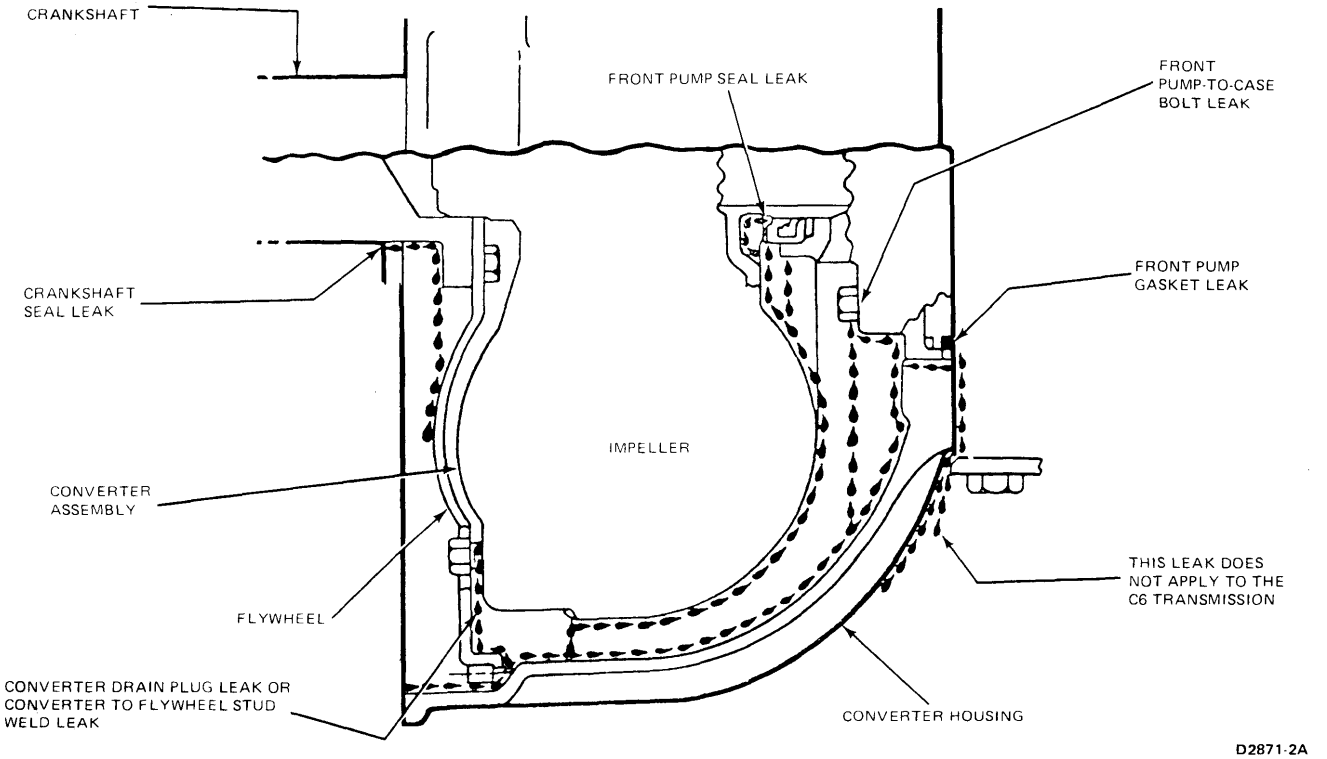


FIG. 2 Converter Leakage—Fluid Path

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a. Remove the transmission dipstick and note the color of the fluid. Original factory-fill fluid is dyed red, on C4 and C6 transmission fluid shows clear or amber on dipstick to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak. Fluid used in the power steering system has a yellowish green dye. Since road draft may cause leaking power steering fluid to be present on the transmission, this leakage, if present, should be eliminated before checking the transmission for fluid leakage.
b. Remove the converter housing cover. Clean off any fluid from the top and bottom of the converter housing, front of the transmission case, and rear face of the engine and engine oil pan. Clean the converter area by washing with a suitable non-flammable solvent, and blow dry with compressed air.
c. Wash out the converter housing, the front of the flywheel, and the converter drain plugs. The converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.
d. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the block and top of the converter housing for evidence of fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the drive and reverse ranges to increase pressure within the transmission. Observe the front of the flywheel, back of the block (in as far as possible), and inside the converter housing and front of the transmission case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

CONVERTER LEAKAGE CHECK

If welds on the torque converter indicate leakage, remove the converter and make the following check.

Assemble a Rotunda 72-0004 Torque Converter Leak Detector (Fig. 3) to the converter in Fig. 4. Test the converter for leaks following the directions supplied with the detector kit.

ENGINE IDLE SPEED CHECK

If the idle speed is too low, the engine will run roughly. An idle speed that is too high will cause the vehicle to creep, have harsh engagements and harsh closed-throttle downshifts.

Check and, if necessary, adjust engine idle speed to specification shown on the engine decal with the headlights on, A/C turned off and transmission in drive range, using the procedure given in the appropriate carburetor part in Group 24.

On vehicles equipped with an Exhaust Gas Recirculation (EGR) system, it is important to check the system for proper operation and for a possible restricted condition.

ANTI-STALL DASHPOT CLEARANCE CHECK

After the engine idle speed has been properly adjusted, check the anti-stall dashpot clearance. Follow the procedure given in Group 24 for checking and adjusting this clearance.

CONTROL PRESSURE TEST

There are two methods of performing the control pressure test. One is to perform the test using the engine vacuum. The second method is to use a remote vacuum source such as the one provided in the distributor tester.

When the vacuum diaphragm unit is operating properly and the manual and downshift linkage is adjusted properly, all the transmission shifts (automatic and kickdown) should occur within the road speed limits listed in the 1979 Performance Specifications book.

If the shifts do not occur within limits, or the transmission slips during shift point, use the following procedure to determine whether the engine, transmission, linkage, vacuum diaphragm unit or valve body is causing the condition.

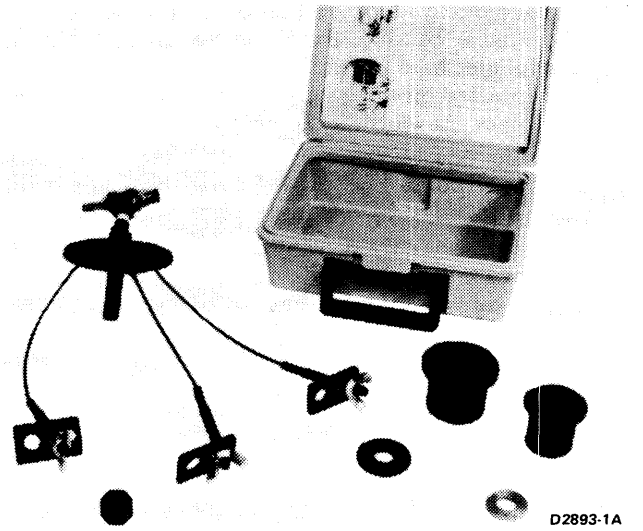


FIG. 3 Rotunda Torque Converter Leak Detector Kit—72-0004

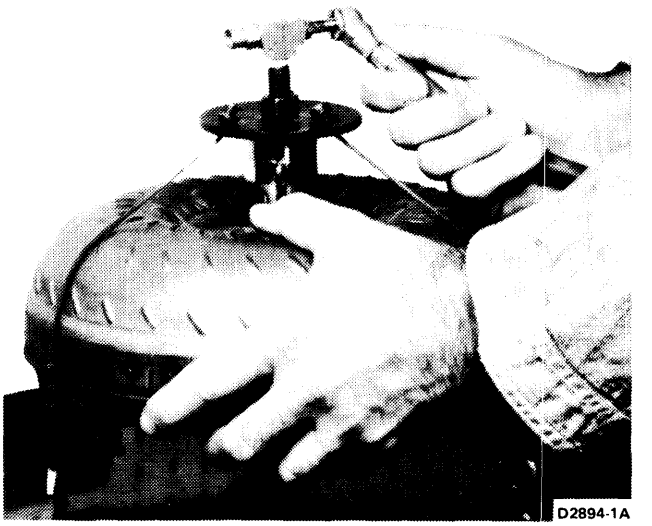


FIG. 4 Torque Converter Leak Detector Installed

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ENGINE VACUUM PROCEDURE

1. Using the automatic transmission tester (Fig. 5), attach the tachometer to the engine and the vacuum gauge to the transmission vacuum line at the manifold vacuum port (Fig. 6).

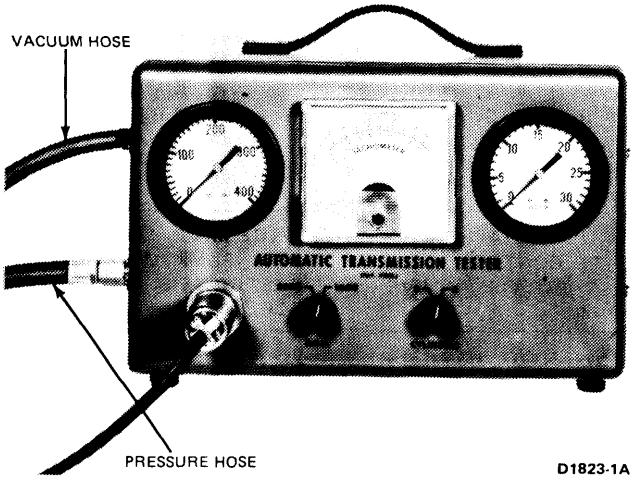


FIG. 5 ARE-29-05 Automatic Transmission Tester

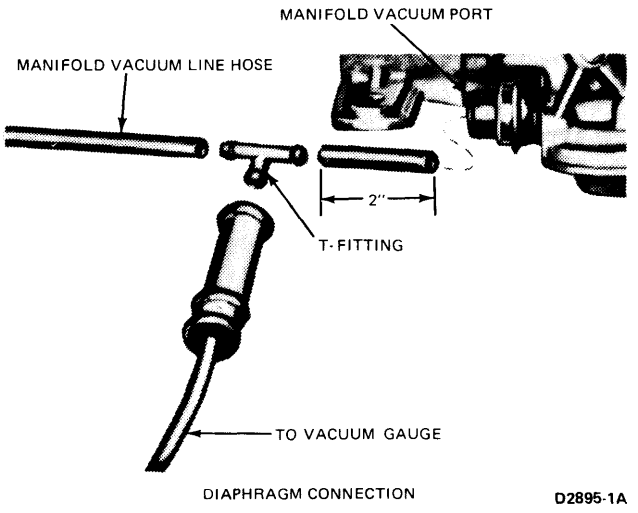


FIG. 6 Typical Vacuum Test Line Connections

2. Attach the pressure gauge to the control pressure outlet at the transmission (Figs. 7 and 8).
3. Firmly apply the parking brake and start the engine.
4. Adjust the engine idle speed to the specified rpm, using the carburetor idle adjustment screw. If the engine idle speed cannot be brought within limits, check the throttle and downshift linkage for a binding condition. If linkage is satisfactory, check for vacuum leaks in the transmission diaphragm unit (Fig. 9) and its connecting tubes and hoses. Check all other vacuum operated units (such as the power brake) for vacuum leaks. Refer to Brake-Section Group 12.

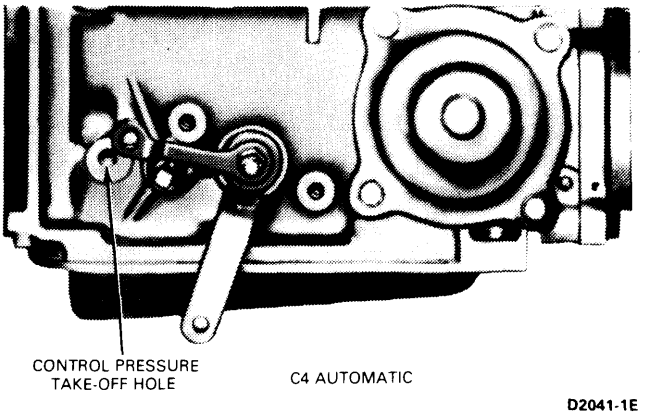


FIG. 7 Typical Vacuum Diaphragm and Control Pressure Connecting Point

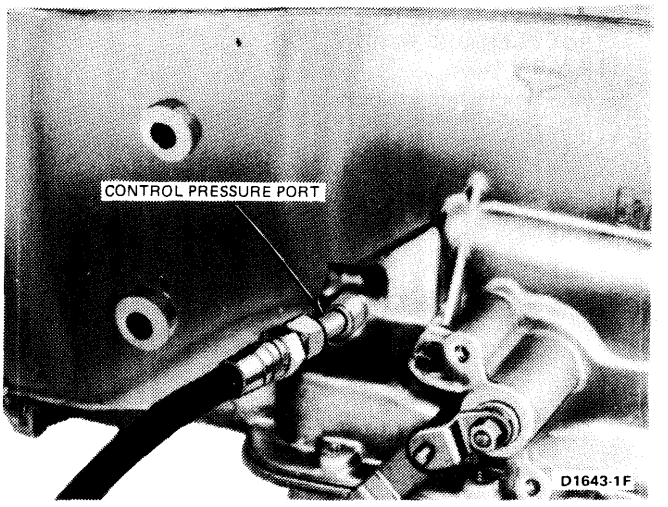


FIG. 8 Control Pressure Connecting Point—C6 Transmission

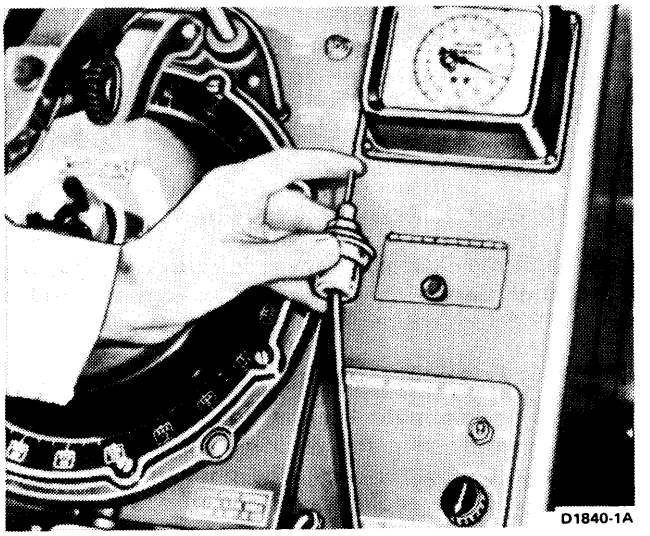


FIG. 9 Testing Transmission Vacuum Unit for Leakage

Refer to the two control pressure diagnostic guides in Fig. 10 to show what components are inoperative when the control pressure test is not within specifications. Do not proceed with the main diagnosis

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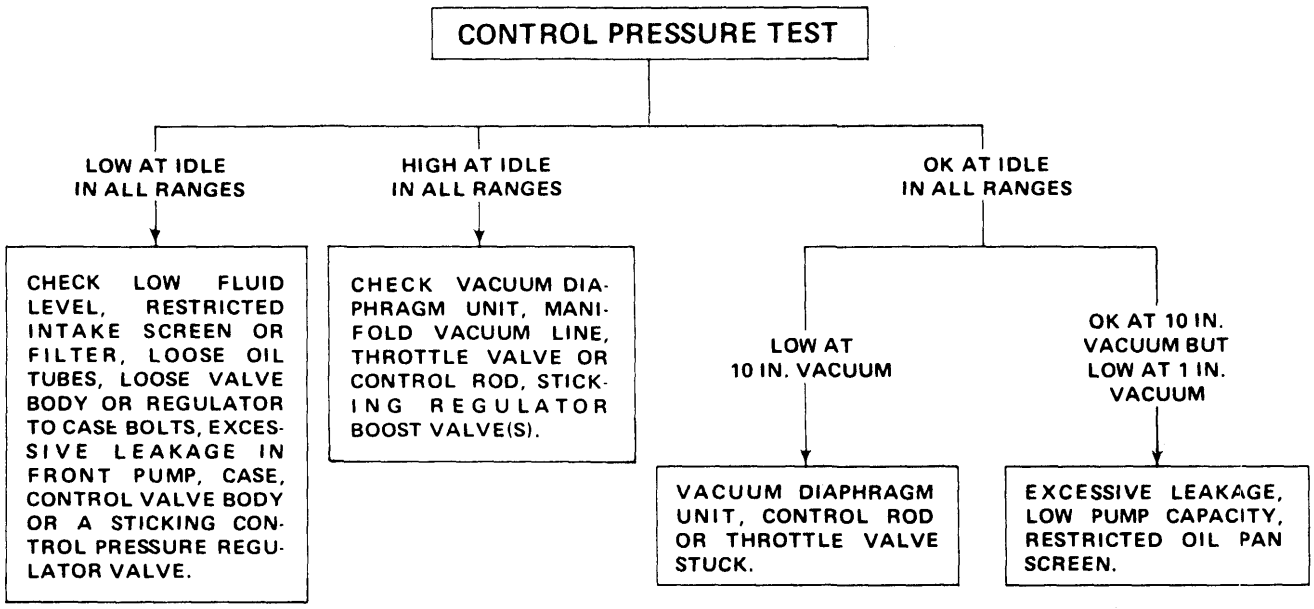


FIG. 10 Control Pressure Test Charts

guide until you have made any repairs, as required, and the control pressure is within specifications as listed in the 1979 Specifications Book.

VACUUM PUMP METHOD

Install the Automatic Transmission Tester. Disconnect and temporarily plug the vacuum line at the vacuum diaphragm unit. Apply both the parking and service brakes. Start the engine and vacuum pump. Set the vacuum at 15 inches, read and record the control pressure in all selector positions. Run the engine up to 1000 rpm, and reduce the vacuum to 10 inches. Read and record the control pressure in D, 2 and 1. Keep the engine rpm at 1000 and reduce the vacuum to 1 inch. Read and record the control pressure in D, 1, 2 and R.

Refer to the two control pressure diagnostic guides in Fig. 10 to show what components are inoperative when the control pressure test is not within specifications. Do not proceed with the main diagnosis guide until you have made any repairs, as required, and the control pressure is within specifications as listed in the 1979 Performance Specifications Book.

VACUUM SUPPLY TEST

The vacuum supply to the vacuum diaphragm unit and the diaphragm itself must be checked. To check the supply, disconnect the vacuum line at the diaphragm unit and connect it to a vacuum gauge. With the engine idling, the gauge must have a steady acceptable vacuum reading for the altitude at which the test is being performed. If the vacuum reading is low, check for a vacuum leak or poor engine vacuum. If the vacuum reading is OK, rapidly accelerate the engine momentarily. The vacuum reading must drop rapidly at

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acceleration and return immediately upon release of the accelerator. If the vacuum reading does not change or changes slowly, the transmission vacuum line is plugged, restricted or connected to a reservoir supply. Correct as required.

VACUUM DIAPHRAGM TEST—ON VEHICLE

To check the vacuum diaphragm unit, start the vacuum pump and set the regulator knob so that the vacuum gauge reads 18 inches with the end of the vacuum hose blocked off. Then connect the vacuum hose to the diaphragm unit. If the gauge still reads 18 inches, the vacuum diaphragm unit is not leaking. If the reading does not remain at 18 inches, but drops, the vacuum diaphragm unit is leaking. Replace the vacuum diaphragm unit. Also, if automatic transmission fluid is present in the vacuum side of the diaphragm or in the vacuum hose, the diaphragm is leaking and must be replaced.

VACUUM DIAPHRAGM TEST—OFF VEHICLE

To check the vacuum unit for diaphragm leakage, remove the unit from the transmission. Use a distributor tester equipped with a vacuum pump (Fig. 9). Set the regulator knob until the vacuum gauge reads 18 inches with the end of the vacuum hose blocked off.

Connect the vacuum hose to the manifold vacuum port as shown in Fig. 9. If the gauge still reads 18 inches, the vacuum unit diaphragm is not leaking. A second leakage check can be made as the hose is removed from the transmission vacuum unit. Hold a finger over the end of the control rod. When the hose is removed, the internal spring of the vacuum unit should push the control rod outward. If the vacuum diaphragm needs replacing, install a new unit that has been released for service. Vacuum diaphragm assembly identification is given at end of this Part.

STALL TEST

Refer to Fig. 11.

Start the engine to allow it to reach normal operating temperature. Apply both the parking and service brakes while making tests.

The stall test is made in D (DRIVE), 1 (FIRST) or R (REVERSE) at full throttle to check engine performance, converter clutch operation or installation, and the holding ability of the forward clutch, reverse-high clutch and low-reverse band or low-reverse clutch, and the gear train one-way clutch.

While making this test, do not hold the throttle open for more than five seconds at a time. After test, move the selector lever to N (NEUTRAL) and run engine at 1000 rpm for about 15 seconds to cool the converter before making the next test. If the engine speed recorded by the tachometer exceeds the maximum limits listed in the 1979 Performance Specifications Book, release the accelerator immediately because clutch or band slippage is indicated.

GOVERNOR CHECK

The governor can be checked at the same time as the Control Pressure Test is performed and in the same manner.

Raise the vehicle with an axle or frame hoist so that the rear wheels are clear of the floor. Disconnect and plug the vacuum line to the vacuum diaphragm unit. Connect the line from the distributor tester to the vacuum diaphragm unit. Install the Automatic Transmission Tester.

CAUTION: Never exceed 60 mph (96 km) speedometer speed.

Place the transmission in manual 2, no load on the engine and apply 10 inches of vacuum to the vacuum diaphragm unit. Increase the speed slowly and watch the speedometer. Check the mph at which the control pressure cutback occurs. It should occur between 10-20 mph (16-32 km).

Decrease the vacuum at the vacuum diaphragm to 0.2 inches. Repeat the check. Control pressure cutback should occur between 30-50 mph (48-80 km).

The governor is good if the cutback occurs within these specifications. If the cutback does not occur within specifications, check shift speeds to verify that it is the governor and not a stuck cutback valve, then repair or replace the governor.

TRANSMISSION FLUID COOLER FLOW CHECK

The linkage, fluid level and control pressure must be within specifications before performing this flow check.

Remove the transmission dipstick from the filler tube. Place a funnel in the transmission filler tube. Raise the vehicle, remove the cooler return line from its fitting in the case. Attach a hose to the cooler return line and fasten the free end of the hose in the funnel installed in the filler tube.

Start the engine and set idle speed at 1000 rpm with the transmission in neutral.

Observe the fluid flow at the funnel. When the flow is "solid" (air bleeding has been completed), the flow should be liberal. If there is not a liberal flow at 1000 rpm in neutral, low pump capacity, main circuit system leakage, or cooler system restriction is indicated.

To separate transmission trouble from cooler system trouble, observe the flow at the transmision case converter-out fitting.

SHIFT POINT CHECKS

ROAD TEST

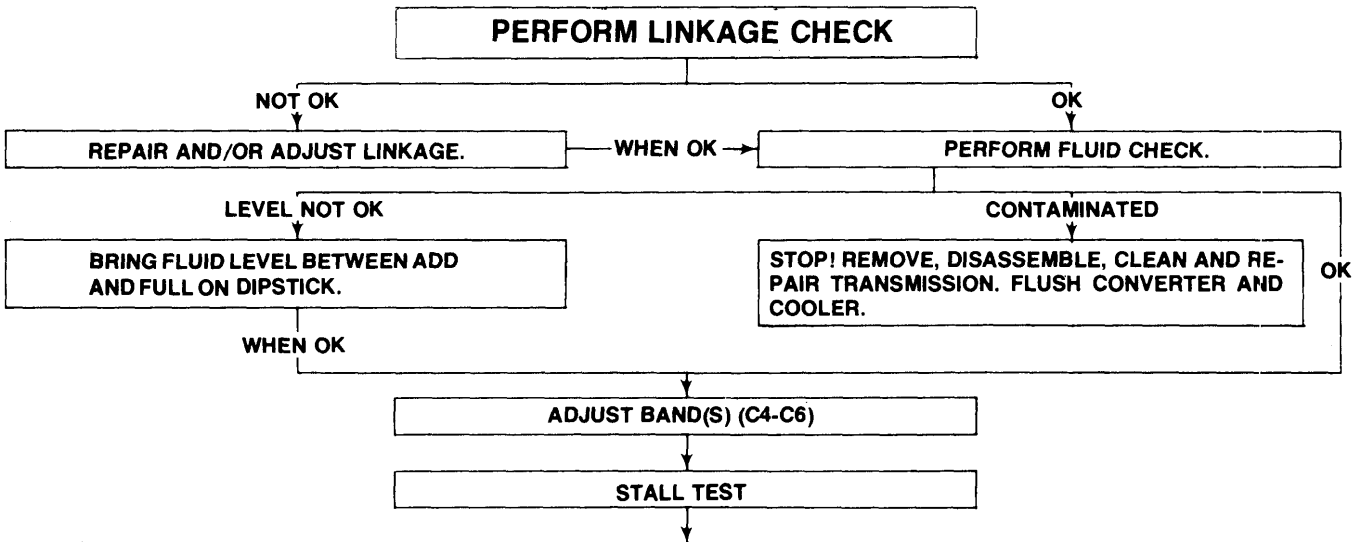
Check the minimum throttle upshifts in D (DRIVE). The transmission should start in first gear, shift to second, and then shift to third, within the shift points listed in the 1979 Performance Specifications Book.

With the transmission in third gear, depress the accelerator pedal through the detent (to the floor). The transmission should shift from third to second or third to first, depending on the vehicle speed.

Check the closed throttle downshift from third to first by coasting down from about 30 mph (48 km) in third gear. The shift should occur within the limits listed in the Specifications.

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SELECTOR POSITION	STALL SPEEDS HIGH	STALL SPEEDS LOW
D ONLY	ONE-WAY CLUTCH	
D, 2 & 1	FORWARD CLUTCH	
D, 2, 1 & R	GENERAL PROBLEMS PRESSURE TEST	CONVERTER STATOR ONE-WAY CLUTCH OR ENGINE PERFORMANCE
R ONLY	HIGH AND/OR REVERSE CLUTCH OR REVERSE BAND OR LOW/REVERSE CLUTCH	

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FIG. 11 Stall Diagnosis Test

When the selector lever is at 2 (SECOND), the transmission can operate only in second gear.

With the transmission in third gear and road speed over 30 mph (48 km) the transmission should shift to second gear when the selector lever is moved from D (DRIVE) to 2 (SECOND) to 1 (FIRST). **This check will determine if the governor pressure and shift control valves are functioning properly.**

The transmission will downshift from second or third to first gear when this same manual shift is made below approximately 25 mph (40 km) with a C4 transmission, 30 mph (48 km) with a C6 transmission.

SHIFT TEST

A shift test can be performed to check shift valve operation, governor circuits, shift delay pressures, throttle boost and downshift valve action.

Raise the vehicle with an axle or frame hoist so that the rear wheels are clear of the floor. Disconnect and plug the vacuum line to the vacuum diaphragm unit. Connect the line from the distributor tester vacuum pump to the vacuum diaphragm unit.

CAUTION: Never exceed 60 mph (96 km) speedometer speed.

1. To check the shift valves and governor circuits, apply 18 inches of vacuum to the transmission vacuum diaphragm unit. Place the transmission in Drive and make a minimum throttle 1-2 and 2-3 shift test. At the point of shift you will see the speedometer needle make a momentary surge and feel the driveline bump. If the shift points are within specifications, the 1-2 and 2-3 shift valves and governor are OK. If the shift points are not within specifications, perform a "Governor Check" to isolate the problem.

   NOTE: After each test, move the selector lever to neutral and run the engine at 1000 rpm to cool the transmission.

2. To check the shift delay pressures and throttle boost, decrease the vacuum at the vacuum diaphragm to 0-2 inches. Make a 1-2 shift test. If the shift point raises to specifications, the throttle boost and shift delay systems are functioning.

   NOTE: After each test, move the selector lever to neutral and run the engine at 1000 rpm to cool the transmission.

3. To check downshift valve action, leave the vacuum to the vacuum diaphragm at 0-2 inches. Position the downshift linkage in the wide open throttle position (through the detent) and repeat the 1-2 shift test. The speed at the shift point should be higher.

AIR PRESSURE CHECKS

A NO DRIVE condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. On automatic transmissions, an erratic shift can be caused by a stuck governor valve. The inoperative units can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the malfunction.

When the selector lever is at 2, a NO DRIVE condition may be caused by an inoperative forward clutch. A NO DRIVE condition at D may be caused by

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an inoperative forward clutch or one-way clutch. When there is no drive in 1, the difficulty could be caused by improper functioning of the forward clutch or simultaneous malfunction of the low-reverse band and the one-way clutch. Failure to drive in reverse range could be caused by a malfunction of the reverse-high clutch or low-reverse band or clutch.

When you have a slip problem but don't know whether it is in the valve body or in the hydraulic system beyond the valve body, the air pressure tests can be very valuable.

To make the air pressure checks, drain the transmission fluid and remove the oil pan and the control valve body assembly. The inoperative clutches or bands can be located by introducing air pressure into the various transmission case passages (Figs. 12 and 13).

FORWARD CLUTCH (C4 AND C6)

Apply air pressure to the transmission case forward clutch or front clutch passages (Figs. 12 or 13). A dull thud can be heard when the clutch piston is applied. If no noise is heard, place the finger tips on the input shell and again apply air pressure to the forward or front clutch passage. Movement of the piston can be felt as the clutch is applied.

GOVERNOR

Apply air pressure to the control pressure to governor passage (Figs. 12 or 13) and listen for a sharp clicking or whistling noise. The noise indicates governor valve movement.

REVERSE-HIGH CLUTCH (C4 AND C6)

Apply air pressure to the reverse-high clutch (Figs. 12 or 13). A dull thud indicates that the reverse-high or rear clutch piston has moved to the applied position. If no noise is heard, place the finger tips on the clutch drum and again apply air pressure to detect movement of the piston.

INTERMEDIATE SERVO

Hold the air nozzle in the front servo apply tube or the intermediate servo apply passages (Figs. 12 or 13). Operation of the servo is indicated by a tightening of the front or intermediate band around the drum on C4 and C6 transmissions. Continue to apply air pressure to the servo apply tube or passage, and introduce air pressure into the front release tube or the intermediate servo release pressure. The front or intermediate servo should release the band against the apply pressure.

LOW-REVERSE SERVO (C4)

Apply air pressure to the low-reverse servo (Fig. 12). On C4 transmission, the low-reverse band should tighten around the drum if the servo is operating properly.

If the servos do not operate, disassemble, clean, and inspect them to locate the source of the trouble.

If air pressure applied to either of the clutch passages fails to operate a clutch or operates both clutches at once, remove, and with air pressure, check the fluid passages in the case and front pump to detect obstructions.

LOW-REVERSE CLUTCH C6 ONLY

Apply air pressure to the low-reverse clutch apply passage (Fig. 13). A dull thud should be heard if the clutch is operating properly. If the passages are clear, remove the clutch assemblies, and clean and inspect the malfunctioning clutch to locate the trouble.

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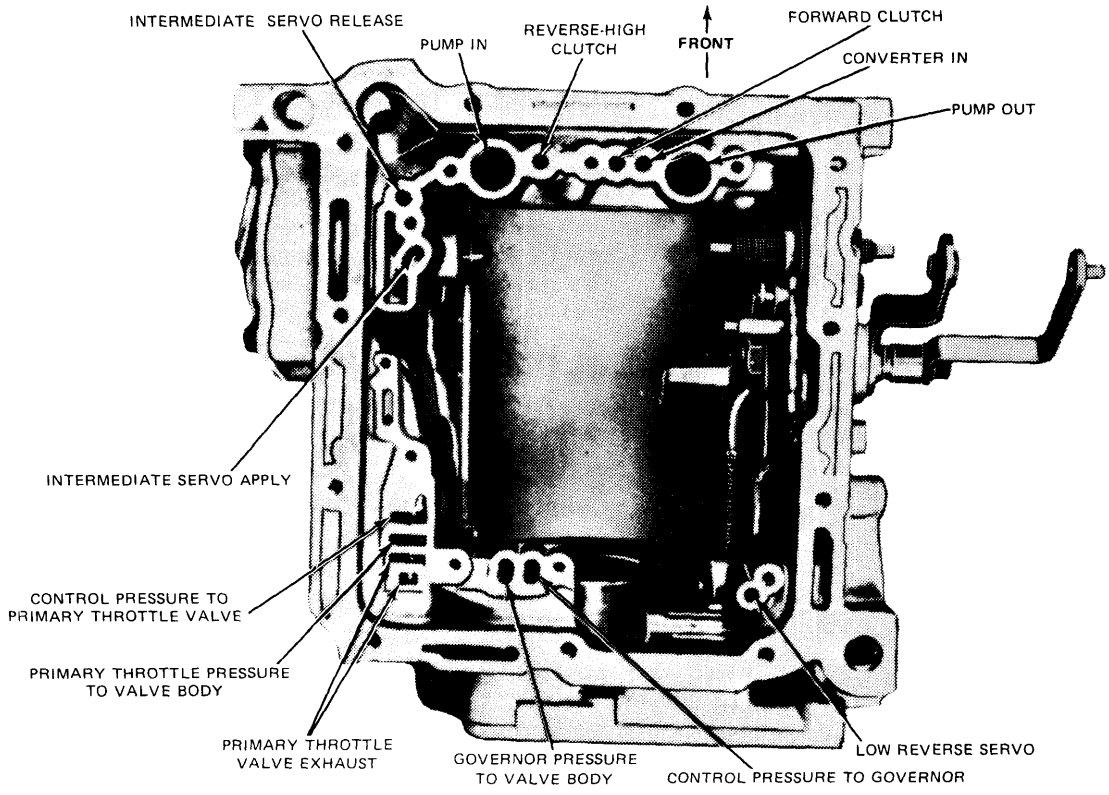


FIG. 12 Case Fluid Passage Hole Identification—C4 Automatic

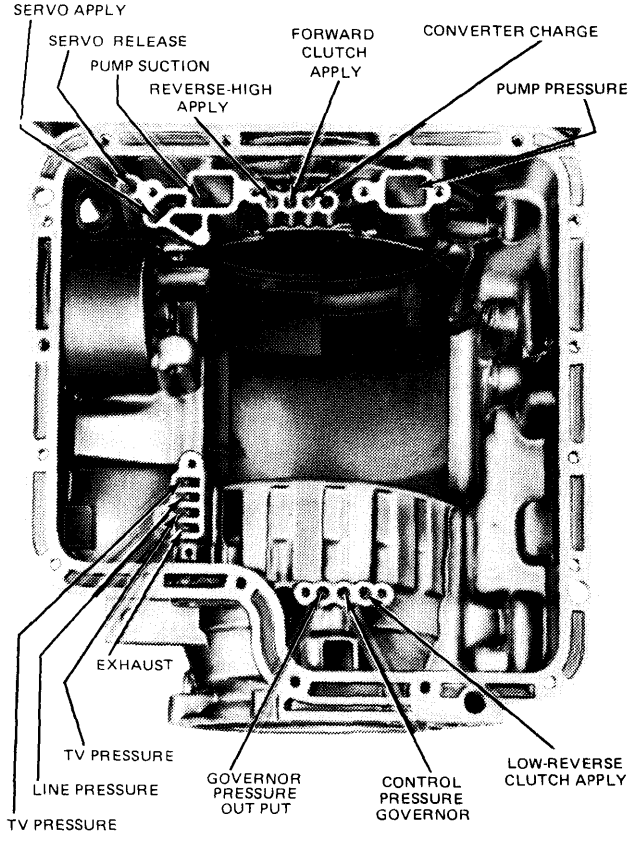


FIG. 13 Case Fluid Passage Hole Identification—C6 Automatic

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DIAGNOSIS GUIDES

The following guides can be used as an aid when diagnosing automatic transmissions.

CONDITION	POSSIBLE CAUSE	CORRECTION
• Slow initial engagement.	• Fluid level. • Linkage adjustment. • Clutch and band application, or oil control system.	• Perform fluid level check. • Perform linkage check. • Perform control pressure test.
• Rough initial engagement in either forward or reverse.	• High engine idle. • Looseness in the driveshaft U-joints or engine mounts. • Linkage adjustment. • Fluid level or contaminated fluid. • Clutch or band application, or oil pressure system. • Excessive transmission end play. • Clutch pack free play. • Sticking or dirty valve body.	• Perform engine idle check. • Repair as required. • Perform linkage check. • Perform fluid level check. • Perform control pressure check. • Adjust end play. Examine check ball in clutch pistons during repair. • Repair clutch pack free play. • Clean, repair or replace valve body.
• No drive in any gear.	• Linkage adjustment. • Fluid level or contaminated fluid. • Clutch or band application, or oil pressure system. • Internal leakage. • Valve body loose. • Clutches. • Sticking or dirty valve body. • Other components.	• Check linkage. • Perform fluid level check. • Perform control pressure check. • Repair internal leakage. • Tighten valve body bolts. • Perform air pressure check. • Clean, repair or replace valve body. • Check input shaft converter splines, broken flywheel or output shaft, etc. Repair as necessary.
• No drive forward — reverse OK.	• Linkage adjustment. • Fluid level. • Clutch or band application, or oil pressure control system. • Forward clutch. • Dirty or sticking valve body.	• Perform linkage check. • Perform fluid level check. • Perform control pressure test. • Perform air pressure check of forward clutch and governor. • Clean, repair or replace valve body.
• No drive, slips or chatters in reverse — forward OK.	• Linkage adjustment. • Fluid level. • Looseness in the driveshaft, U-bolts, engine mounts or rear suspension. • Reverse bands out of adjustment or low reverse clutch slipping. • Oil pressure control system. • Rear clutch or servo. • Dirty or sticking valve body.	• Perform linkage test. • Perform fluid level check. • Repair as required. • For C-4 adjust rear band. For C-6 check and repair the low-reverse clutch. • Perform control pressure test. • Perform air pressure check of rear clutch or servo. • Clean, repair or replace valve body.
• No drive, slips or chatters in first gear — in D. All other gears normal. • No drive, slips or chatters in second gear.	• One-way clutch. • Linkage adjustment. • Fluid level, or contaminated fluid. • Band or clutch application, or oil pressure control system. • Intermediate band out of adjustment. • Servo and/or internal leaks. • Dirty or sticking valve body.	• Repair or replace rear planet carrier one-way clutch. • Perform linkage check. • Perform fluid level check. • Perform control pressure test. • Adjust intermediate band. • Perform air pressure test. • Clean, repair or replace valve body.
• Starts in high in D — drag or lockup at 1-2 shift point or in 2 or 1.	• Linkage adjustment. • Fluid level. • Governor. • Internal transmission problem. • Mating of valve body to case mating surfaces.	• Perform linkage check. • Perform fluid check. • Perform governor check. • Perform air pressure check. • Examine valve body and case mating surfaces for cross leaks. Replace as required.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• Starts up in 2nd or 3rd but no lockup at 1-2 shift points.	• Linkage adjustment. • Fluid level. • Band or clutch application, or oil pressure control system. • Governor • Mating of valve body to case mating surfaces.	• Perform linkage check. • Perform fluid check. • Perform control pressure check. • Perform governor check. • Replace valve body and/or case as required.
• Shift points incorrect.	• Linkage adjustment. • Fluid level. • Speedometer driven gear. • Clutch or band application, or oil pressure control system. • Governor. • Dirty or sticking valve body.	• Perform linkage check. • Perform fluid check. • Inspect, replace gear if necessary. • Perform control pressure test. • Perform governor check. • Clean, repair or replace valve body.
• No upshift at any speed in D.	• Vacuum leak in line to diaphragm unit. • Linkage adjustment. • Fluid level. • Clutch or band application, or oil pressure control system. • Governor. • Dirty or sticking valve body.	• Repair vacuum line or hose. • Perform linkage check. • Perform fluid check. • Perform control pressure test. • Perform governor check. • Clean, repair or replace valve body.
• Shifts 1-3 in D.	• Intermediate band worn or out of adjustment. • Governor. • Front servo and/or internal leaks. • Dirty or sticking valve body.	• Adjust or replace band. • Perform governor check. • Perform air pressure check. • Clean, repair or replace valve body.
• Rough 2-3 shift.	• Band or clutch application, or oil pressure control system. • Intermediate servo, apply and release and high clutch piston check ball. • Dirty or sticking valve body.	• Perform control pressure test. • Perform air pressure check. • Clean, repair or replace valve body.
• Rough 3-1 shift at closed throttle in D.	• Linkage adjustment. • Engine idle or performance. • Clutch or band application, or oil pressure control system. • Dirty or sticking valve body.	• Perform linkage check. • Perform engine idle test. Adjust idle and dashpot. • Perform control pressure test. • Clean, repair or replace valve body.
• No forced downshifts.	• Linkage adjustment. • Fluid level. • Clutch or band application, or oil pressure control system. • Internal kickdown linkage. • Dirty or sticking valve body.	• Perform linkage check. • Perform fluid check. • Perform control pressure test. • Repair internal kickdown linkage. • Clean, repair or replace valve body.
• No 3-1 shift in D.	• Engine idle or performance. • Governor. • Dirty or sticking valve body.	• Tune, and adjust engine idle. • Perform governor check. • Clean, repair or replace valve body.
• Runaway engine on 3-2 downshift.	• Linkage out of adjustment. • Fluid level. • Intermediate band out of adjustment. • Band or clutch application, or oil pressure control system. • Intermediate servo. • Polished or glazed intermediate band or drum. • Dirty or sticking valve body.	• Perform linkage check. • Perform fluid check. • Adjust band. • Perform control pressure test. • Air pressure check the intermediate servo. • Repair or replace as required. • Clean, repair or replace valve body.
• No engine braking in manual first gear.	• Linkage out of adjustment. • Fluid level. • Reverse band out of adjustment. • Oil pressure control system. • Intermediate servo internal leakage. • Reverse clutch or rear servo. • Clutches and/or bands worn or glazed.	• Perform linkage check. • Perform fluid check. • Adjust reverse band. • Perform control pressure test. • Perform air pressure check. • Repair as required. • Repair or replace as required.

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CONDITION	POSSIBLE CAUSE	CORRECTION
• No engine braking in manual second gear.	• Linkage out of adjustment. • Fluid level. • Intermediate band out of adjustment. • Band or clutch application, or oil pressure control system. • Intermediate servo internal leaks. • Polished or glazed band or drum.	• Perform linkage check. • Perform fluid check. • Adjust band. • Perform control pressure test. • Perform air pressure check. • Repair or replace as required.
• Transmission noisy — valve resonance.	• Linkage out of adjustment. • Fluid level. • Cooler lines grounding. • Internal leakage or pump cavitation. • Springs in valve body. • Restricted passages in case and stator support.	• Perform linkage check. • Perform fluid check. • Free up cooler lines. • Repair or replace as required. • Inspect. Replace valve body if necessary. • Repair and/or replace as required.
• Transmission noisy — other than valve resonance.	• Linkage out of adjustment. • Fluid level. • Noisy pump. • Transmission gears.	• Perform linkage check. • Perform fluid check. • Check initial engagement in stall. If noise is still evident examine converter and pump. Repair or replace as necessary. • Run transmission in all gears. — If noisy in all gears, remove speedometer gear. If noise does not stop, check extension bushing seal or driveshaft. If noise stopped, replace driven speedometer gear. — If noise stops in low and R gear only, repair front planetary and/or one way clutch. — If noise stops in 2, HIGH and R only, repair rear planetary. — If noise stops in HIGH only, repair both planetaries.
• Transmission overheats.	• Engine coolant low. • Fluid level. • Band or clutch application, or oil pressure control system. • Restriction in oil cooler lines. • One-way clutch seized. • Restriction in case pump stator support or fitting. • Dirty or sticking valve body.	• Check and refill as necessary. • Perform fluid check. • Perform control pressure test. • Check fluid flow to and from cooler. Repair any restriction. • Replace one-way clutch. • Repair as required. • Clean, repair or replace valve body.
• Transmission fluid leaks.	• Fluid level. • Leakage at gasket, seals, etc. • Vacuum diaphragm unit leaking.	• Perform fluid check. • Remove all traces of lube on exposed surfaces of transmission. Check the vent for free breathing. Operate transmission at normal temperatures and inspect for leakage. Repair as required. • Replace diaphragm.
• Severe transmission engagement after cold engine start.	• Fast idle cam setting. • Binding or sticking throttle linkage. • Dashpot setting.	• Check for throttle operating on starting step (high idle) of fast idle cam. Adjust fast idle as required. • Repair or adjust throttle linkage. • Adjust dashpot.
• PRND21 pointer misaligned.	• Shift rod out of adjustment.	• Pointer edge must touch (at a minimum) the edge of each latter number. Readjust pointer by adjusting shift rod length at transmission.

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REMOVAL AND INSTALLATION

VACUUM DIAPHRAGM

Removal and Installation

1. Disconnect the hoses from the vacuum unit.
2. On C4 and C6 transmissions remove the vacuum unit retaining bracket bolt and bracket (Fig. 14). **Do not pry or bend the bracket.** Pull the vacuum unit from the transmission case.

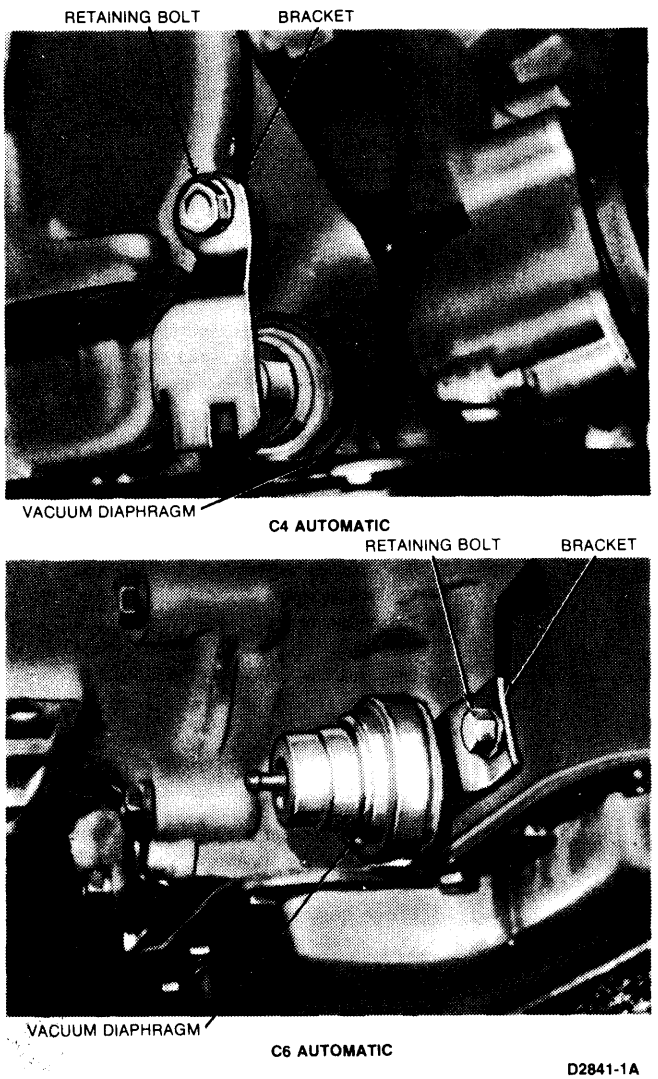


FIG. 14 Vacuum Diaphragm Installed—C-4 and C-6 Transmission

3. Remove the vacuum unit control rod from transmission case.
4. Install the vacuum unit control rod in transmission case.
5. On C4 and C6 transmissions, push the vacuum unit into the case and secure with the retaining bracket and bolt. Tighten the bolt 28-40 ft-lbs on C4-transmissions and 12-16 ft-lbs on C6 transmissions.
6. Install the vacuum unit hoses to their respective connectors.

TRANSMISSION FLUID DRAIN AND REFILL

Normal maintenance and lubrication requirements do not necessitate periodic automatic transmission fluid changes.

If a major repair, such as a clutch band, bearing, etc., is required in the transmission, it will have to be removed for service. At this time the converter, transmission cooler and cooler lines must be thoroughly flushed to remove any dirt.

On light trucks equipped with C4, or C6 automatic transmissions the following should apply:

When used under continuous or severe conditions the transmission and the torque converter should be drained and refilled with the specified fluid at intervals directed in the maintenance or owners manual.

When filling a dry transmission and converter, install five quarts of fluid in C4 transmissions and eight quarts in C6 transmissions.

Procedures for partial drain and refill, due to in-vehicle repair operation, are as follows:

C4 TRANSMISSION

1. Disconnect the fluid filler tube from the transmission oil pan to drain the fluid.
2. When all fluid has drained from the transmission, remove and thoroughly clean the pan and screen. Discard the pan gasket.
3. Place a new gasket on the pan, and install the pan on the transmission.
4. Connect the filler tube to the pan and tighten the fitting to specification.
5. Add three quarts of fluid to the transmission through the filler tube.
6. Check the fluid level.

C6 TRANSMISSIONS

1. Raise the vehicle on a hoist or jack stands.
2. Place a drain pan under the transmission.
3. Loosen the pan attaching bolts and drain the fluid from the transmission.
4. When fluid has drained to the level of the pan flange, remove the rest of the pan bolts working from the rear and both sides of the pan to allow it to drop and drain slowly.
5. When all fluid has drained from the transmission, remove and thoroughly clean the pan and the screen. Discard the pan gasket.
6. Place a new gasket on the pan, and install the pan on the transmission.
7. Add three quarts of fluid to the transmission through the filler tube.
8. Check the fluid level.

OIL COOLER TUBE

When fluid leakage is found from the oil cooler, the cooler must be replaced. Cooler replacement is described in the Cooling System Section of Part 27.

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When one or more of the fluid cooler steel tubes must be replaced, each replacement tube must be fabricated from the same size steel tubing as the original line.

Using the old tube as a guide, bend the new tube as required. Add the necessary fittings, and install the tube.

After the fittings have been tightened, add fluid as needed, and check for fluid leaks.

CLEANING AND INSPECTION

TRANSMISSION

Clean the parts with suitable solvent and use moisture-free air to dry off all the parts and clean out fluid passages.

The composition clutch plates, control valve body-to-screen gasket, bands and synthetic seals should not be cleaned in a vapor degreaser or with any type of detergent solution. To clean these parts, wipe them off with a lint-free cloth. New clutch plates or bands should be soaked in transmission fluid specified for that transmission type for fifteen minutes before being assembled.

CONTROL VALVE BODY

1. Clean all parts thoroughly in clean solvent, and blow dry with moisture-free compressed air. **If the valve body-to-screen gasket is removed on a C4 or C6 Automatic, the gasket should not be cleaned in a degreaser, solvent or any type of detergent solution. To clean the gasket, wipe it off with a lint-free cloth.**
2. Inspect all valve and plug bores for scores. Check all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs or distortion. Inspect all plugs and valves for burrs or scores. Use crocus cloth to polish valves and plugs. Avoid rounding the sharp edges of the valves and plugs with the cloth.
3. Inspect all springs for distortion. Check all valves and plugs for free movement in their respective bores. Valves and plugs, when dry, must fall from their own weight in their respective bores.
4. On a C6 transmission, inspect the separator plate screen for obstructions. The screen must be clean and free of foreign material. If contaminated, remove it from separator plate, clean in a suitable solvent, and thoroughly blow clean with compressed air.
5. Roll the manual valve on a flat surface to check for bent condition.

INTERMEDIATE SERVO

1. Inspect the servo bore for cracks and the servo piston for damage, and the piston bore and the servo piston stem for scores. Check fluid passages for obstructions. Replace damaged seals.
2. Check the servo spring and servo band strut(s) for distortion.
3. Inspect the cover seal and gasket cover sealing surface for damage.

LOW-REVERSE SERVO (C4 TRANSMISSION)

1. Inspect the servo body for cracks and the piston bore for scores.
2. Check the fluid passages for obstructions.
3. Inspect the band and the struts for distortion. Inspect the band ends for cracks.
4. Inspect the servo spring for distortion.
5. Inspect the band lining for excessive wear and bonding to the metal band.
6. Replace damaged seals.

EXTENSION HOUSING

1. Inspect the housing for cracks. Inspect the gasket surface for burrs or warpage.
2. Inspect the bushing for scores or wear. Replace if required.
3. Inspect the rear seal for hardness, cracks, or wear. If the seal shows wear or deterioration, replace the seal.
4. Inspect the seal counterbore and remove all burrs and scores with crocus cloth.

GOVERNOR

1. Inspect the governor valves and bores for scores. Minor scores may be removed from the valves with crocus cloth. Replace the governor if the valves or body is deeply scored.
2. Check for free movement of the valves in the bores. The valves should slide freely of their own weight in the bores when dry. Inspect fluid passages in the valve body and counterweight for obstructions. **All fluid passages must be clean.**
3. Inspect the mating surfaces of the governor body and governor distributor (C4 or C6 Automatic) for burrs and distortion. Mating surfaces must be smooth and flat.

FRONT PUMP

1. Inspect the mating surfaces of the pump body and cover for burrs.
2. Inspect the drive and driven gear bearing surface for scores and check gear teeth for burrs.
3. Check the fluid passages for obstructions.
4. If any parts are found damaged or worn, replace the pump as a unit. Minor burrs and scores may be removed with crocus cloth.
5. On a C6 transmission, check the large seal ring groove of the pump body for damage. Check the

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gasket mating surface of the pump body for damage.

REVERSE-HIGH CLUTCH

1. Inspect the drum band surface, the bushing, and thrust surfaces for scores. Minor scores may be removed with crocus cloth. **Badly scored parts must be replaced.**
2. Inspect the clutch piston bore and the piston inner and outer bearing surfaces for scores. Check the air bleed ball valve in the clutch piston for free movement.
3. Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
4. Inspect the clutch plates for wear, scoring, and fit on the clutch hub serrations. Replace all plates that are badly scored, worn, or do not fit freely in the hub serrations.
5. Inspect the clutch pressure plate for scores on the clutch plate bearing surface. Check the clutch release spring(s) for distortion.

FORWARD CLUTCH

1. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the clutch cylinder if it is badly scored or damaged.
2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and replace if necessary. Inspect the piston check ball for freedom of movement and proper seating (Fig. 15).

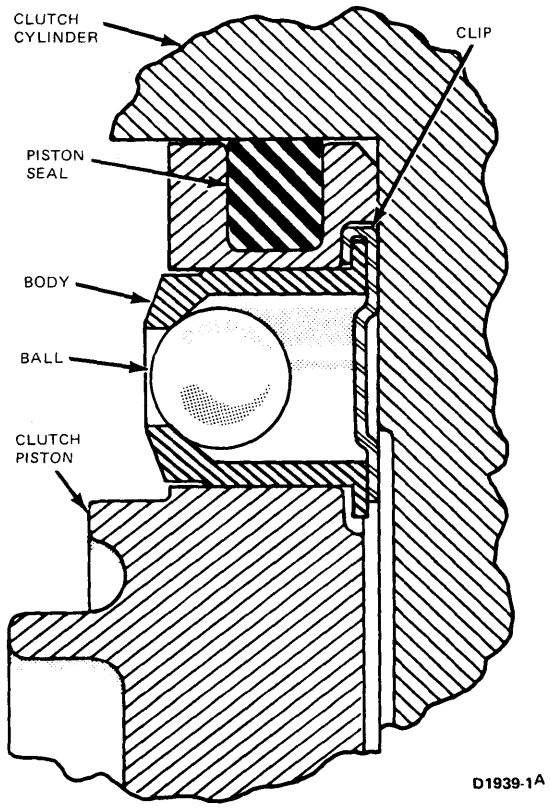


FIG. 15 Clutch Piston Check Valve

3. Check the clutch release spring (C4 only) for distortion and cracks. Replace the spring if it is distorted or cracked.
4. Inspect the composition clutch plates, steel clutch plates, and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored.
5. On C4 transmissions, check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat.
6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.
7. Check the splines on the stator support for wear. Replace shaft if the splines are excessively worn. Inspect the bushing in the stator support for scores. Check the input shaft for damaged or worn splines.

LOW—REVERSE CLUTCH (C6 TRANSMISSION)

1. Inspect the clutch cylinder piston bore (in the case) and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the case if it is badly scored or damaged.
2. Check the fluid passage in the case for obstructions (Fig. 13). Clean out all fluid passages. Inspect the clutch piston for scores and replace if necessary.
3. Check the piston return springs for distortion. Check the piston return spring retainer for flatness.
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored.
5. Check the clutch hub splines.

CONVERTER AND OIL COOLER

When internal wear or damge has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the converter and oil cooler. These contaminants are a major cause of recurring transmission troubles and MUST be removed from the system before the transmission is put back into service.

Whenever a transmission has been disassembled to replace worn or damaged parts or because the valve body sticks from foreign material, the converter and oil cooler MUST be cleaned by using the Rotunda torque Converter Cleaner (model 140028) or equivalent. Under NO circumstances should an attempt be made to clean converters by hand agitation with solvent.

CONVERTER END PLAY AND ONE WAY CLUTCH CHECK

The tools shown in Fig. 16 are used to check the converter one-way clutch.

END PLAY CHECK

1. Insert Tool T77L-7902-D into the converter pump drive hub until it bottoms.
2. Expand the sleeve in the turbine spline by tightening the threaded inner post, (Fig. 17), until the tool is securely locked into the spline.

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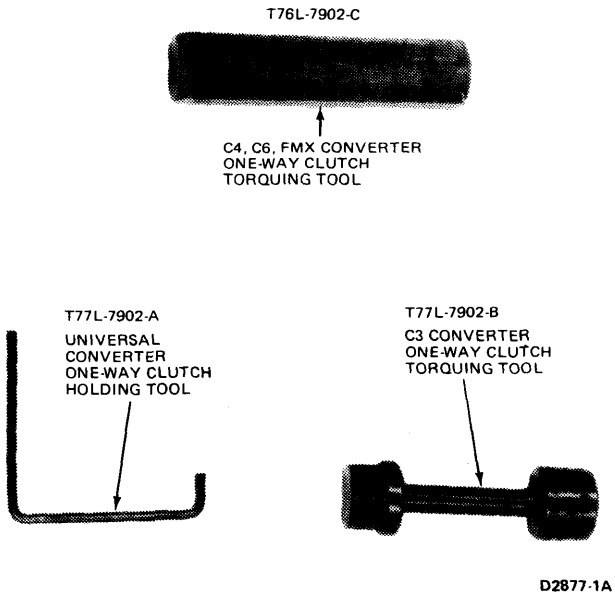


FIG. 16 Converter One Way Clutch Check Tools

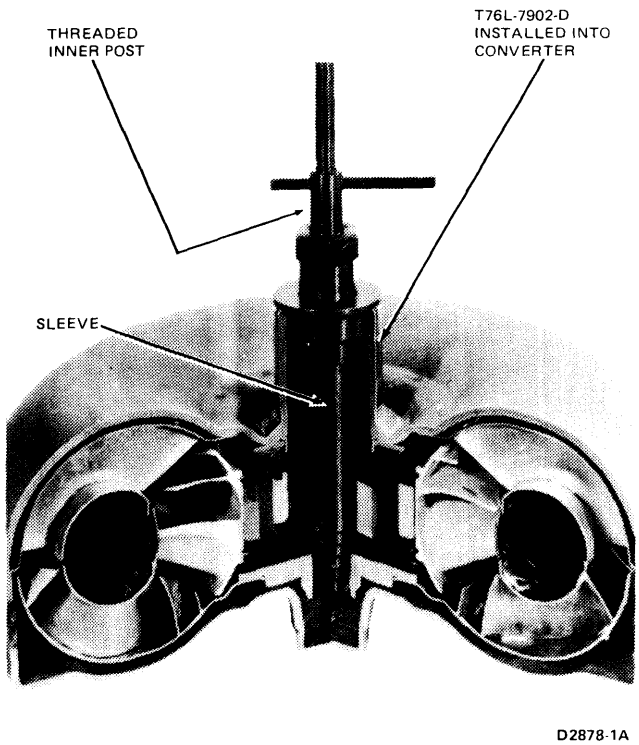


FIG. 17 End Play Checking Tool Installed

3. Attach a dial indicator to the tool (Figs. 17 and 18). Position the indicator button on the converter pump drive hub, and set the dial face at 0 (zero).
4. Lift the tool upward as far as it will go and note the indicator reading. The indicator reading is the total end play which the turbine and stator share.

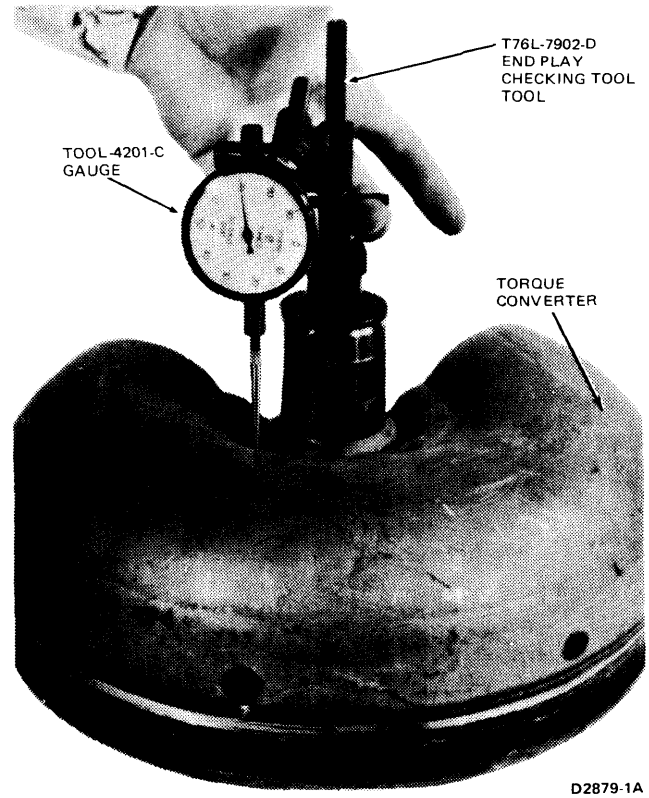


FIG. 18 Checking Stator and Turbine End Play

Replace the converter unit if the total end play exceeds the limits. End play specifications are listed at the end of each transmission Part.

5. Loosen the threaded inner post to free the tool, and then remove the tool from the converter.

CONVERTER ONE-WAY CLUTCH CHECK

1. Insert the one way clutch holding tool, (Fig. 19), in one of the grooves in the stator thrust washer.
2. Insert the one way clutch torquing tool, (T77L-7902-B) in the converter pump drive hub so as to engage the one way clutch inner race, (Fig. 18).
3. Attach a torque wrench to the one way clutch torquing tool. With the one way clutch holding tool held stationary, turn the torque wrench counterclockwise. The converter one way clutch should lockup and hold a 10 ft-lb force. The converter one way clutch should rotate freely in a clockwise direction. Try the clutch for lockup and hold in at least five different locations around the converter.
4. If the clutch fails to lock up and hold at 10 ft-lb torque, replace the converter unit.

STATOR TO IMPELLER INTERFERENCE CHECK

1. Position the front pump assembly on a bench with the spline end of the stator shaft pointing up (Fig. 20).
2. Mount a converter on the pump with the splines on the one-way clutch inner race engaging the mating splines of the stator support. The converter hub will then engage the pump drive gear.

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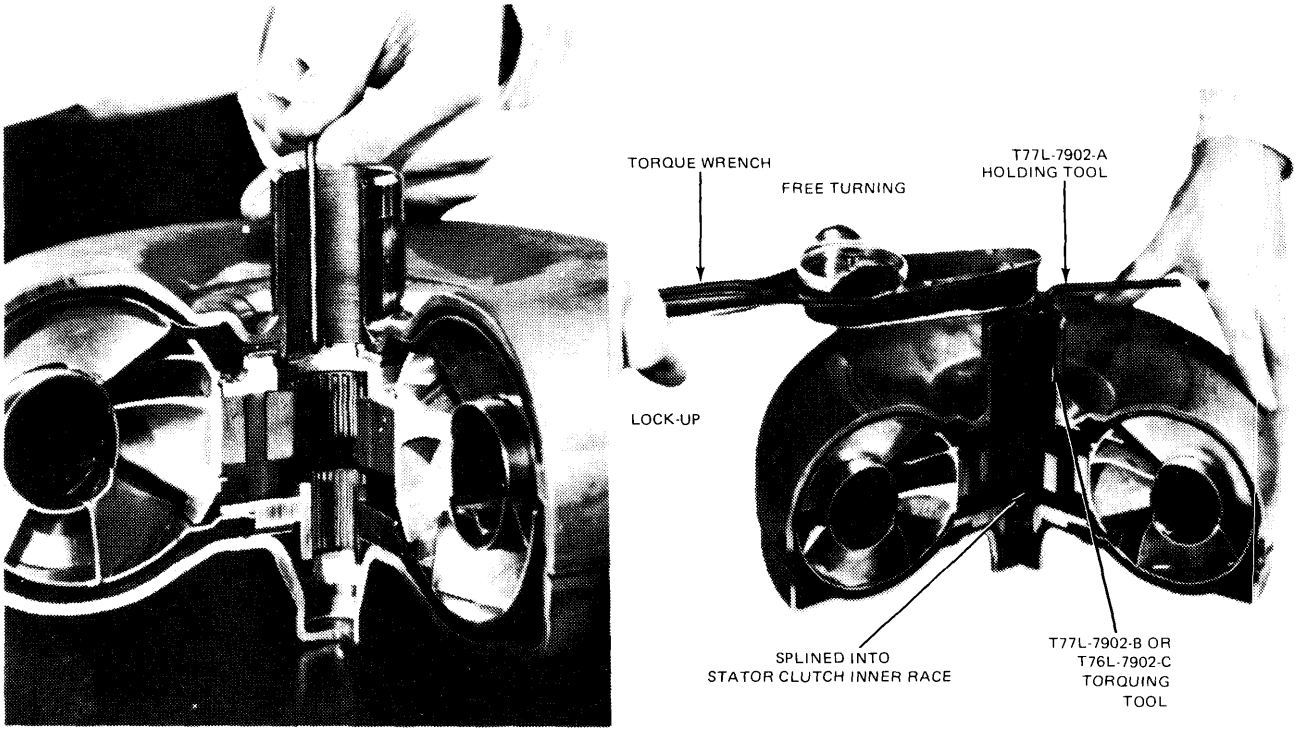


FIG. 19 Checking Converter One-Way Clutch

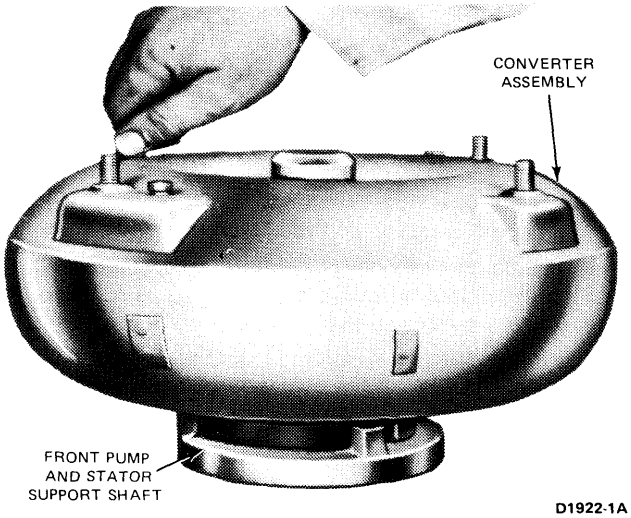


FIG. 20 Stator to Impeller Interference Check

3. Hold the pump stationary and try to rotate the converter counterclockwise. The converter should rotate freely without any signs of interference or scraping within the converter assembly.
4. If there is an indication of scraping, the trailing edges of the stator blades may be interfering with the leading edges of the impeller blades. In such cases, replace the converter.

STATOR TO TURBINE INTERFERENCE CHECK

1. Position the converter on the bench front side down.
2. Install a front pump assembly to engage the mating splines of the stator support and stator, and pump drive gear lugs.
3. Install the input shaft, engaging the splines with the turbine hub (Fig. 21).

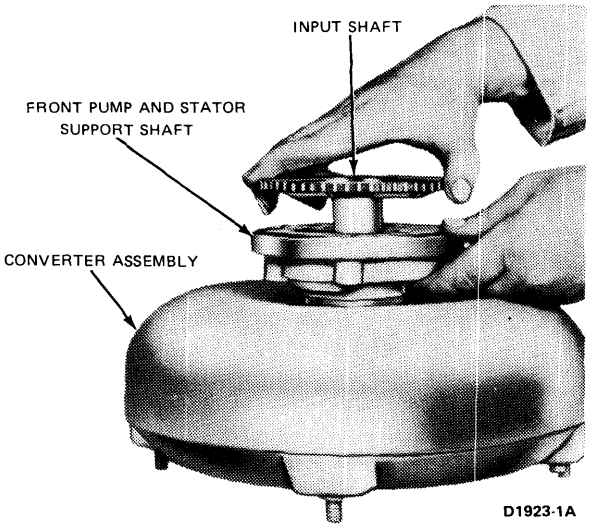


FIG. 21 Stator to Turbine Interference Check

4. Hold the pump stationary and attempt to rotate the turbine with the input shaft. The turbine should rotate freely in both directions without any signs of interference or scraping noise.
5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, the converter must be replaced.

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Check the converter crankshaft pilot for nicks or damaged surfaces that could cause interference when installing the converter into the crankshaft. Check the converter front pump drive hub for nicks or sharp edges that would damage the pump seal.

PINION CARRIERS

Individual parts of the planet carriers are not serviceable.

1. Check the pins and shafts in the planet assemblies for loose fit and/or complete disengagement. Use a new planet assembly if either condition exists. Before installing a planet assembly, the shaft retaining pins should be checked for adequate staking. If necessary, restake the pins before installation. When restaking, the retaining pins must not be driven into the carrier any further than 0.040 inch below the surface of the carrier.
2. Inspect the pinion gears for damaged or excessively worn teeth.
3. Check for free rotation of the pinion gears.

STATOR SUPPORT

1. Inspect the stator support splines for burrs and wear.
2. Check the oil ring grooves in the stator support for nicks, burrs or damaged edges.

CASE

Inspect the case for cracks and stripped threads. Inspect the gasket surfaces and mating surfaces for burrs. Check the vent for obstructions, and check all fluid passages for obstructions and leakage (Figs. 12 and 13).

Inspect the case bushing for scores. Check all parking linkage parts for wear or damage.

If a tranmission case thread is damaged, service kits may be purchased from local jobbers. To repair a damaged thread, the following procedures should be carefully followed.

1. Drill out the damaged threads **using the same drill size as the thread outside diameter.** For example, use a 5/16 inch drill for a 5/16-18 thread.
2. Select the proper special tap and tap the drilled hole. The tap is marked for the size of the thread being repaired. Thus, the special tap marked 5/16-18 will not cut the same thread as a standard 5/16-18 tap. It does cut a thread large enough to accommodate the insert, and after the insert is installed, the original thread size (5/16-18) is restored.
3. Select the proper coil inserting tool. These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is 1/2 turn below the face.
4. Working through the insert, bend the insert tang straight up and down until it breaks off at the notch.
5. Improperly installed inserts can be removed with the extractor tool. Place the extractor tool in the insert with the blade resting against the top coil 1/4 to 1/2 turn away from the end of the coil. Tap the tool sharply with a hammer until the blade cuts into the insert. Exert downward pressure on the tool and turn it counterclockwise until the insert is removed.

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SPECIFICATIONS

1979 AUTOMATIC TRANSMISSION VACUUM DIAPHRAGM ASSEMBLY SPECIFICATIONS

Transmission Type	Single or Dual Area	Diaphragm Part No.	Identification	Throttle Valve Rod
C4	SAD	D3FP-7A377-BA	1 Yellow Stripe	#D3AP-7A380-JA: 1.5925-1.5875 Green Daub #D3AP-7A380-HA: 1.6075-1.6025 Blue Daub #D3AP-7A380-KA: 1.6225-1.6175 Orange Daub #D3AP-7A380-LA: 1.6375-1.6325 Black Daub #D3AP-7A380-MA: 1.6585-1.6535 Pink & White Daub
	S-HAD	D70P-7A377-AA	None	
	HAD	D7BP-7A377-AA	Rear Cover Blue	
	DAD	D30F-7A377-AB	1 Red Stripe	
C6	HAD	D7AP-7A377-AA	Part No. Standard	ØD3AP-7A380-DA: 1.611-1.601 Yellow Daub ØD3AP-7A380-EA: 1.644-1.634 Blue Daub ØD3AP-7A380-FA: 1.660-1.650 Green Daub ØD3AP-7A380-GA: 1.710-1.700 White Daub ØC4AP-7A380-A: 1.677-1.667 No Color Code D8AP-7A380-AA 1.694-1.684 Brown Daub D1AP-7A380-BA 1.727-1.717 Purple Daub
	SAD	D7OP-7A377-B1	1 Green Stripe	
	SAD	D4TP-7A377-BA	1 Black Stripe	
	SAD	D5AP-7A377-AA	1 Purple Stripe	

CD2356-2H

Selective
Ø Selective
SAD — Single Area Diaphragm

SPECIAL TOOLS

Number	Description
T76L-7902-C T77L-7902-A T77L-7902-B	Torque Converter One-Way Clutch Tool
T77L-7902-D or T76L-7902-D	Torque Converter End Play Checking Tool
ARE-2905	Automatic Transmission Tester
140028	Torque Converter Cleaner

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Shift Control Linkage

PART 17-02

APPLIES TO BRONCO, F-100-F-350, E-100-E-350, F-100-F-250 (4x4)

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ADJUSTMENTS	02-1
Automatic Linkage Adjustments	
Bronco, E-100 — E-350,	
F-100 — F-350, F-150 — F-250 (4x4)	02-1
Neutral Start Switch Adjustment	
E-100 — E-350, F-100 — F-350	
and Bronco	02-4
REMOVAL AND INSTALLATION	
Manual Shift Linkage Grommet	02-3
Neutral Start Switch	
E-100 — E-350,	
F-100 — F-350 and Bronco	02-4
SPECIFICATIONS	02-4

ADJUSTMENTS

Perform the transmission control linkage adjustments in the order in which they appear in this part of the manual. Before the linkage is adjusted, be sure the engine idle speed and anti-stall dashpot are properly adjusted. Refer to the appropriate carburetor part in Group 24 for the procedure.

AUTOMATIC LINKAGE ADJUSTMENTS

BRONCO, E-100-E350, F100-F350, F150—F-250 (4x4)

1. With the engine stopped and the parking brake applied, place the transmission selector lever at the steering column in the D (DRIVE) position and hold against the D stop by applying an eight pound weight to the selector lever knob.
2. Loosen the shift rod adjusting nut at point A (Figs. 1, 2 or 3).
3. Shift the manual lever at the transmission into the D (DRIVE) position, by moving the lever all the way rearward, then forward two detents.
4. With the selector lever and transmission manual lever in the D position, tighten the nut at point A to 12 to 18 ft-lbs torque (Figs. 1, 2 or 3). Use care to prevent motion between the stud and rod.
5. Remove the eight pound weight from the steering column selector lever knob.
6. Operate the shift lever in all positions to make certain that the manual lever at the transmission is in full detent in all gear ranges. Re-adjust the linkage if required.
7. Verify neutral start switch adjustment. Error must not exceed 1/8 detent.

Under no circumstances will it be permissible to adjust linkage in any position other than the D position.

NEUTRAL START SWITCH ADJUSTMENT

E-100-E-350, F-100-F-350 AND BRONCO

1. With the manual linkage properly adjusted, loosen the two switch attaching bolts (Fig. 4).
2. Place the transmission manual lever in neutral. Rotate the switch and insert the gauge pin (No. 43 drill shank end) into the gauge pin holes of the switch. The gauge pin has to be inserted a full 31/64 inch into the three holes of the switch (Fig. 4).
3. Tighten the two neutral start switch attaching bolts to 55-75 in-lbs. Remove the gauge pin from the switch.
4. Check the operation of the switch. The engine should start only with the transmission selector lever in neutral or park.

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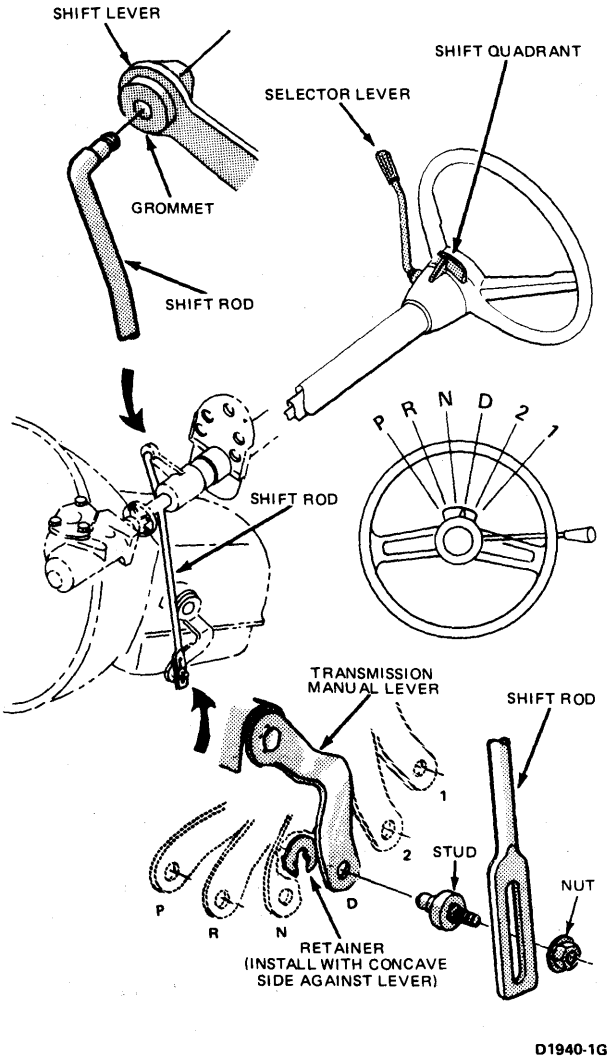


FIG. 1 Automatic Transmission—Shift Linkage Adjustment—F-100-F-350

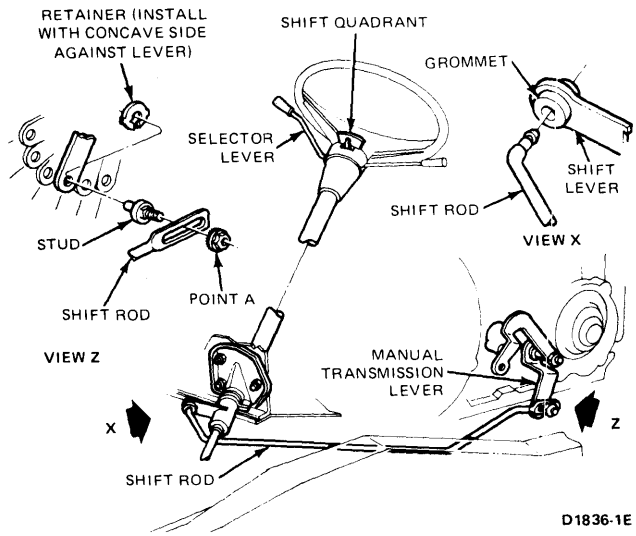


FIG. 2 Automatic Transmission—Shift Linkage Adjustment—E100-E350

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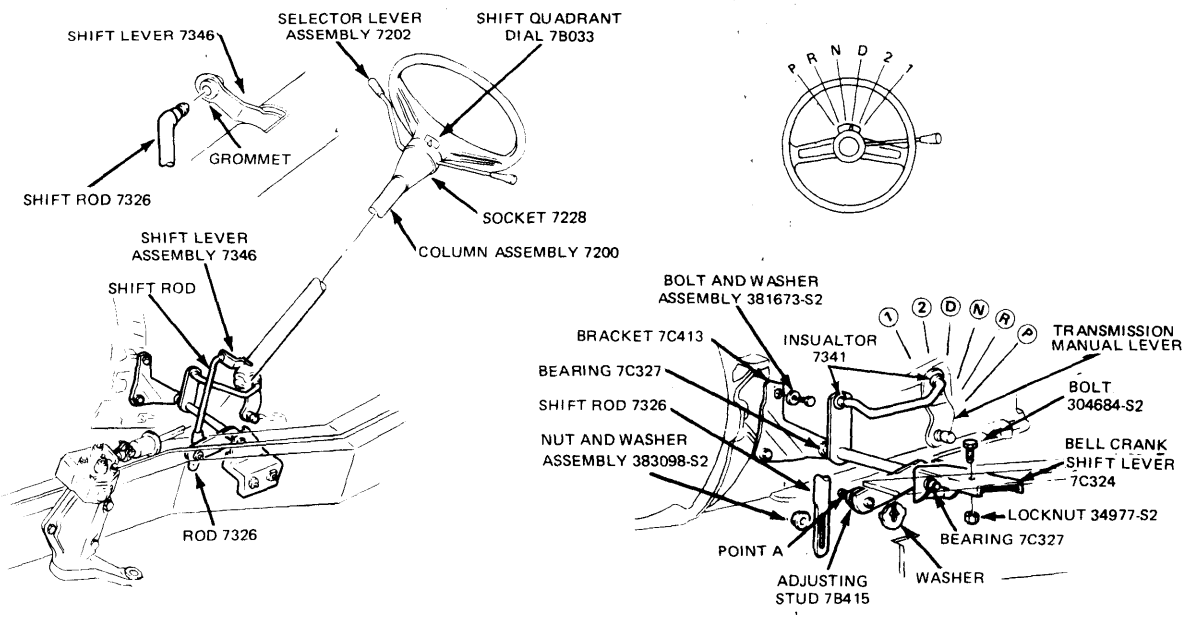


FIG. 3 Automatic Transmission—Shift Linkage Adjustment—Bronco, F-150—F-250 (4x4)

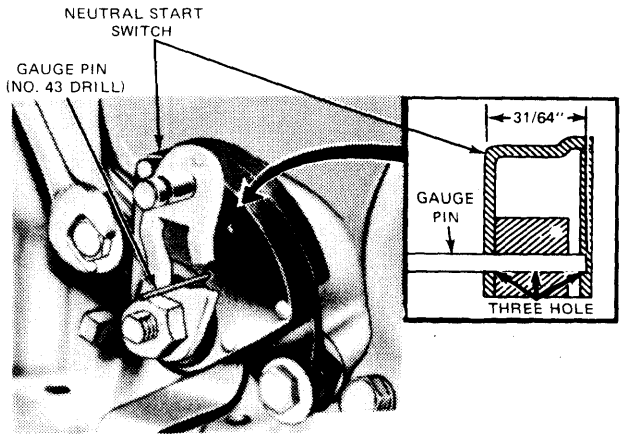


FIG. 4 Neutral Start Switch—E-100-E-350, F-100-F-350 and Bronco

REMOVAL AND INSTALLATION

MANUAL SHIFT LINKAGE GROMMET

The automatic transmission linkage systems make use of an oil impregnated plastic grommet to connect the various rods and levers. Whenever a rod is disconnected from a grommet type connector, the old grommet must be removed and a new one installed. Remove and install the grommet as follows:

1. Place the lower jaw of the tool between the lever and the rod (Fig. 5). Position the stop pin against the end of the control rod (Fig. 5) and force the rod out of the grommet. Remove the grommet from the lever by cutting off the large shoulder with a sharp knife. **The grommet must be removed from the lever and a new one installed each time the rod is disconnected.**
2. Adjust the stop pin to 1/2 inch and coat the outside of the grommet with lubricant. Place a new grommet on the stop pin and force it into the lever hole. Turn the grommet several times to be sure it is properly seated.
3. Readjust the stop pin to the height shown in Fig. 6. The pin height is determined by the length of the rod end which is to be installed into the grommet. If the pin height is not adjusted, the rod may be

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pushed too far through the grommet causing damage to the grommet retaining lip.

4. With the pin height properly adjusted, position the rod on the tool and force the rod into the grommet until the groove in the rod seats on the inner retaining lip of the grommet.

NEUTRAL START SWITCH

E-100-E-350, F-100-F-350 AND BRONCO

1. Remove the downshift linkage rod return spring at the low-reverse servo cover.
2. Apply penetrating oil to the outer lever attaching nut to prevent breaking the inner lever shaft. Remove the transmission downshift outer lever attaching nut and lever.
3. Remove the two neutral start switch retaining bolts (Fig. 4).
4. Disconnect the two multiple wire connectors.
5. Remove the neutral start switch from the transmission.
6. Install the neutral start switch on the transmission. Install the two retaining bolts.
7. With the transmission manual lever in neutral, check the location of the switch with the gauge pin. Install gauge pin (No. 43 drill) into the gauge pin holes (Fig. 4).
8. Tighten the switch attaching bolts to 55-75 in-lbs. Remove the gauge pin.
9. Install the outer downshift lever and retaining nut, and tighten the nut to specification as listed at the end of this Part. Install the downshift linkage rod return spring between the lever and retaining clip on the low-reverse servo cover.
10. Connect the wire multiple connectors. The red connector has to be inserted into the red connector and the blue connector inserted into the blue connector. Check the operation of the switch in each detent position. The engine should start only with the transmission selector lever in N (NEUTRAL) or P (PARK).

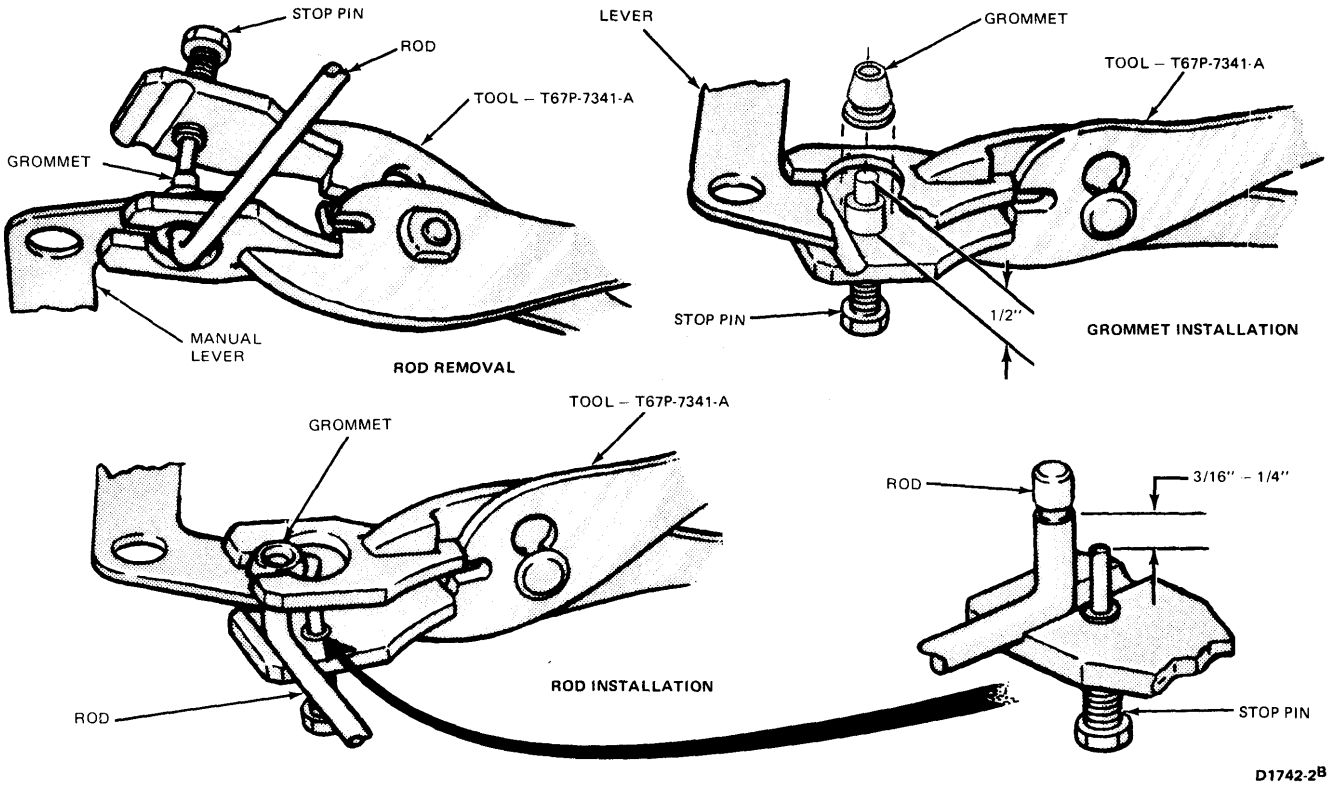


FIG. 5 Removing or Installing Shift Linkage Grommet

SPECIFICATIONS

TORQUE LIMITS

Description	(in-lbs)	N•m
Neutral Start Switch to Case	55-75	6.3-8.4

CD2322-1D

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C-4 Automatic Transmission

PART 17-05

APPLIES TO F-100 — F-150

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DESCRIPTION

The C4 automatic transmission is a three speed unit capable of providing automatic upshifts and downshifts through the three forward gear ratios. The transmission is also capable of providing manual selection of first and second gears.

Fig. 1 shows the location of the converter, front pump, clutches, gear train, and most of the internal parts used in the C4 automatic transmission. The identification tag (Fig. 2) is located under the lower front intermediate servo cover bolt. The tag shows the model prefix and suffix, assembly part numbers, and the built date code. The first line on the tag shows the transmission model prefix and suffix. A number appearing after the suffix (Fig. 2) indicates that internal parts have been changed after initial production start-up. For example, a PEA-CE1 model transmission that has been changed internally would read PEA-CE2. Both transmissions are basically the same, but some service parts in the PEA-CE1 transmission are slightly different than the PEA-CE2 transmission. **Therefore, it is important that the codes on the transmission identification tag be checked when ordering parts or making inquiries about the transmission.**

The transmission consists essentially of a torque converter, planetary gear train with two bands, two multiple disc clutches, a one-way clutch and a hydraulic control system (Fig. 3).

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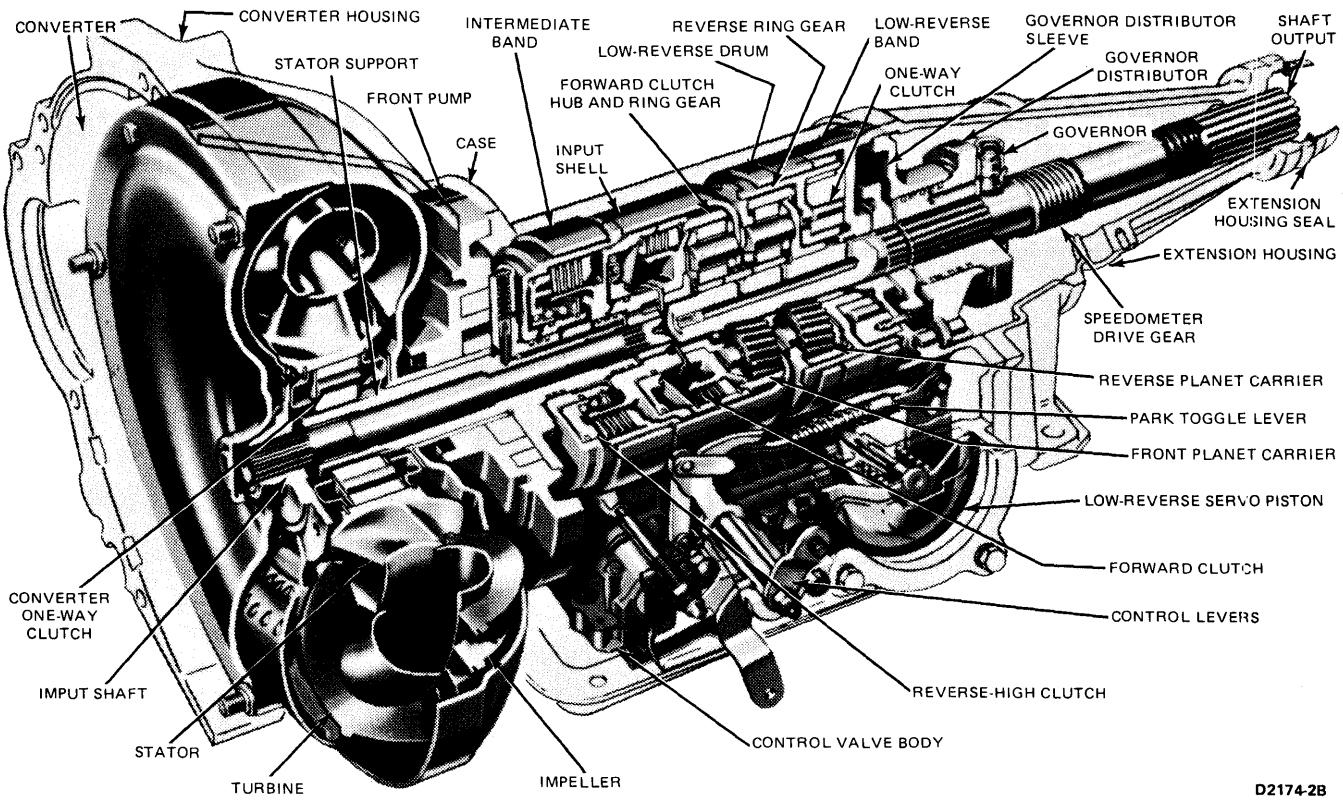


FIG. 1 C-4 Automatic Transmission

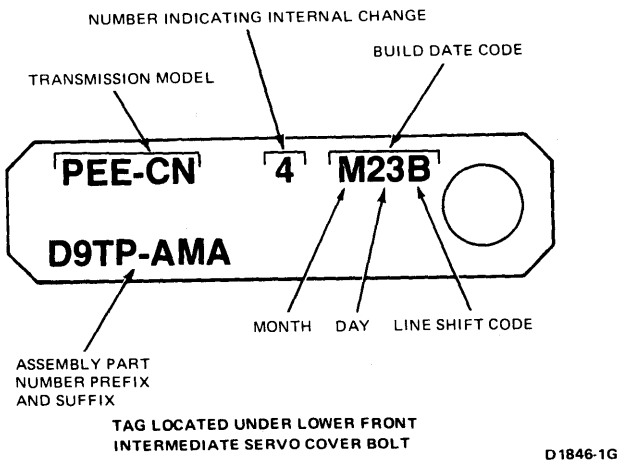
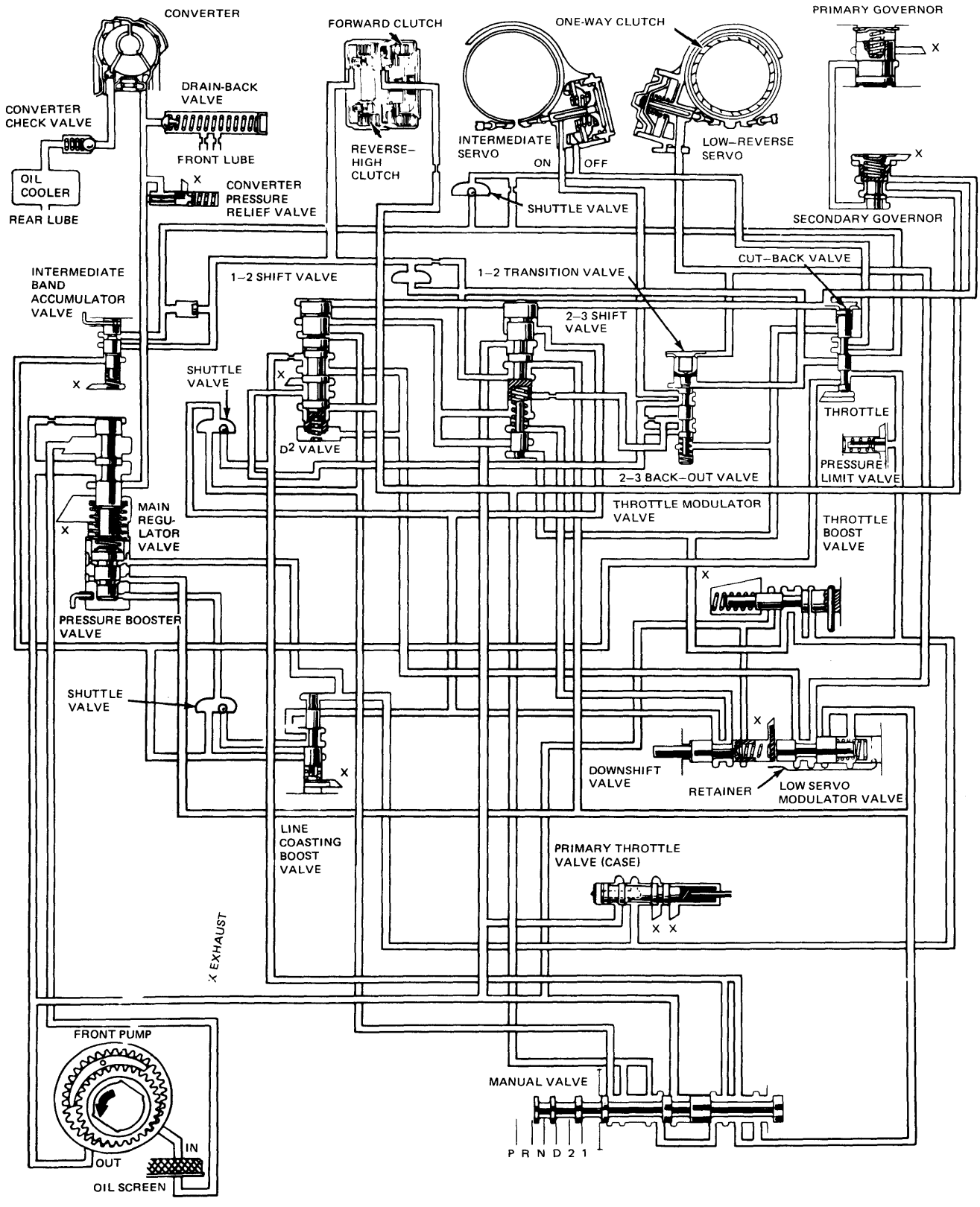


FIG. 2 Identification Tag

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D2072-2D

FIG. 3 Hydraulic Control System—C-4 Transmission

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DIAGNOSIS AND TESTING

Refer to Part 17-01, General Automatic Transmission Service.

ADJUSTMENTS

The only adjustments on the transmission are the intermediate and low-reverse bands.

To prevent damage to the transmission and to assure proper band adjustment, it is essential that the tools and procedures described below are used whenever the bands are adjusted.

INTERMEDIATE BAND ADJUSTMENT

1. Clean all the dirt from the band adjusting screw area. Remove and discard the locknut.
2. Install a new locknut on the adjusting screw. With the tool shown in Fig. 4, tighten the adjusting screw until the tool handle clicks. The tool is a pre-set torque wrench which clicks and breaks when the torque on the adjusting screw reaches 10 ft-lb.

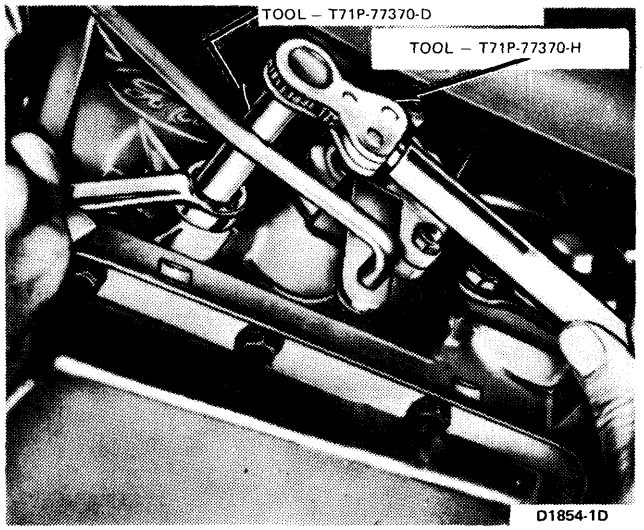


FIG. 4 Adjusting Intermediate Band

3. **Back off the adjusting screw exactly 1-3/4 turns.**
4. Hold the adjusting screw from turning and tighten the locknut to specifications as listed at the end of this Part.

LOW-REVERSE BAND ADJUSTMENT

1. Clean all the dirt from the band adjusting screw area. Remove and discard the locknut.
2. Install a new locknut on the adjusting screw with the tools shown in Fig. 5 and tighten the adjusting screw until the tool handle clicks. The tool is a pre-set torque wrench which clicks and breaks when the torque on the adjusting screw reaches 10 ft-lb.

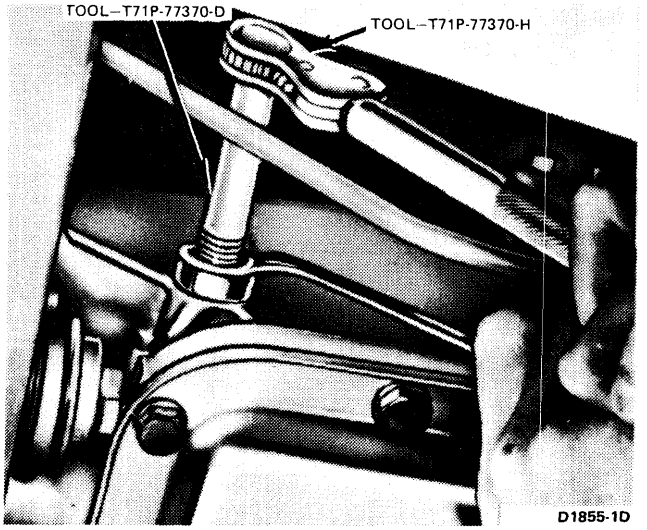


FIG. 5 Adjusting Low-Reverse Band

3. **Back off the adjusting screw exactly 3 full turns.**
4. Hold the adjusting screw from turning and tighten the locknut to specifications as listed at the end of this Part.

REMOVAL AND INSTALLATION

TRANSMISSION

Removal

1. Raise the vehicle on a hoist.
2. Place the drain pan under the transmission fluid pan on pan fill transmissions. Remove the fluid filler tube from the pan and drain the transmission fluid. On case fill transmissions loosen the pan attaching bolts and allow fluid to drain.
3. Remove the converter drain plug access cover from the lower end of the converter housing.
4. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
5. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug and remove the plug (Fig. 6). Place a drain pan under the converter to catch the fluid. With fluid drained, reinstall the plug.
6. Remove the drive shaft.

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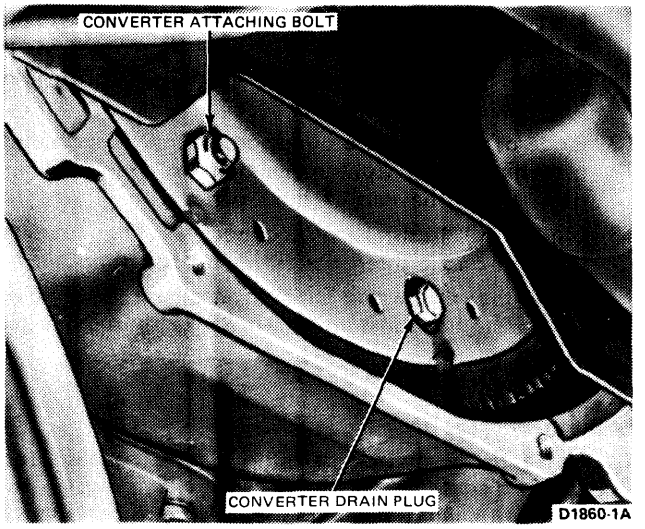


FIG. 6 Converter Drain Plug Location—Typical

7. Disconnect the oil cooler lines from the transmission.
8. Disconnect the manual and downshift linkage rods from the transmission control levers.
9. Remove the speedometer gear from the extension housing.
10. Disconnect the neutral start switch wires from the retaining clips and retainer.
11. Disconnect the starter cable. Remove the three starter-to-converter housing attaching bolts and remove the starter.
12. Remove the vacuum line hoses from the transmission vacuum unit. Disconnect the vacuum lines from the retaining clip.
13. Position the transmission jack to support the transmission. Install the safety chain to hold the transmission on the jack.
14. Remove the two engine rear support crossmember-to-frame attaching bolts.
15. Remove the two engine rear support-to-extension housing attaching bolts.
16. Raise the transmission and remove the rear support. Remove the six converter housing-to-engine attaching bolts.
17. Move the converter and transmission assembly away from the engine. Lower the transmission and remove it from under the vehicle.

Installation

1. Tighten the converter drain plug to specifications as listed at the end of this Part.
2. Position the converter on the transmission making sure the converter drive flats are fully engaged in the pump gear.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with the safety chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.
5. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install the six converter housing-to-engine attaching bolts. Tighten the bolts to specification as listed at the end of this Part.
7. Install the converter-to-flywheel attaching nuts. Tighten the nuts to specifications as listed at the end of this Part. Remove the safety chain from the transmission.
8. Install the rear support. Install the rear support-to-extension housing attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
9. Position the starter into the converter housing and install the three attaching bolts. Tighten the bolts to specifications as listed at the end of this Part. Install the starter cable.
10. Remove the transmission jack.
11. Connect the transmission filler tube to the transmission pan. Connect the oil cooler lines to the transmission.
12. Attach the Neutral start switch wires to the connector clip.
13. Install the speedometer driven gear in the extension housing. Tighten the attaching bolt to specifications as listed at the end of this Part.
14. Connect the transmission linkage rods to the transmission control levers.

    When making transmission control attachments, new retaining rings and grommets should always be used (see Removal and Installation in Part 17-02, Shift Control Linkage). Note precautions necessary to prevent grommet damage.

    Attach the shift rod to the steering column shift lever (refer to Fig. 1, Part 17-02). Align the flats of the adjusting stud with the flats of the rod slot and insert the stud through the rod. Assemble the adjusting stud nut and washer to a loose fit. Perform a linkage adjustment as outlined in Part 17-02, Shift Control Linkage.
15. Install the drive shaft.
16. Install the vacuum lines in the retaining clip. Connect the vacuum lines to the diaphragm unit.
17. At the front lower area of the converter housing, install the lower cover and the control lever dust shield. Install the attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
18. Secure the fluid filler tube to the pan. Tighten the fitting to specifications as listed at the end of this Part.
19. Lower the vehicle.
20. Fill the transmission to the proper level with the specified fluid. Refer to Part 17-01, General Automatic Transmission Service.
21. Raise the vehicle and check for transmission fluid leakage. Lower the vehicle and adjust the throttle and manual linkage. Refer to Part 17-02, Shift Control Linkage.

CONTROL VALVE BODY

1. Raise the vehicle until transmission oil pan is accessible.

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2. On pan fill transmissions, disconnect the fluid filler tube from the pan and allow the fluid to drain into a container. **On case fill transmissions, loosen the pan attaching bolts to drain the Fluid. The same fluid is to be used again, filter the fluid through a 100 mesh screen. Reuse the fluid only if it is in good condition.**
3. Remove the transmission fluid pan attaching bolts, pan and gasket.
4. Shift the transmission manual lever to the P position and remove the two bolts that attach the detent spring to the valve body and case (Fig.7).

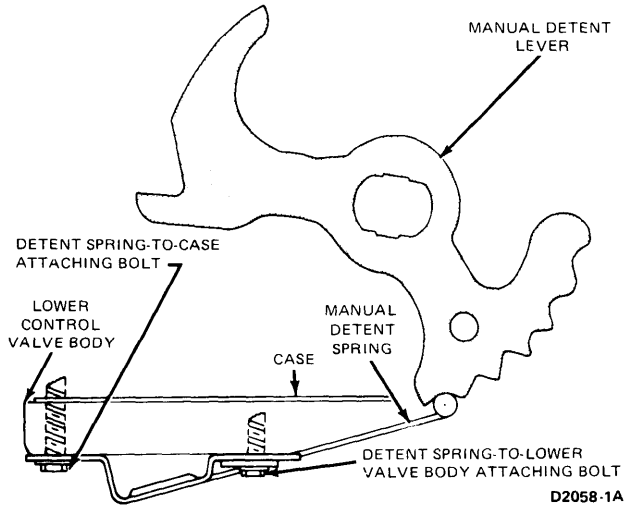


FIG. 7 Control Valve Body Detent Spring Installed

5. Remove the remaining valve body-to-case attaching bolts. Hold the manual valve in the valve body and remove the valve body from the case. **Failure to hold the manual valve while removing the control assembly, could cause the manual valve to become bent or damaged.**
6. Refer to Disassembly and Assembly in this Part for the control valve body repair operations.
7. Thoroughly clean and remove all gasket material from the pan and pan mounting face of the case. Remove and discard the nylon shipping plug from the oil pan filler tube hole. This plug is used to retain transmission fluid within the transmission during shipment and should be discarded when the oil pan is removed.
8. Shift the manual lever at the transmission into the P detent position. Install the valve body to the case. Position the inner downshift lever between the downshift lever stop and the downshift valve. **Make sure the two lands on the end of the manual valve engage the actuating pin on the manual detent lever.** Install seven valve body-to-case bolts. Do not tighten the bolts at this time.
9. Position the detent spring to the lower valve body and install the spring-to-case bolt finger tight (Fig. 7).
10. Hold the detent spring roller in the center of the manual detent lever and install the detent spring-to-lower valve body bolt (Fig. 7). Tighten the bolt to 80-120 in-lb torque.
11. Tighten all the control valve body-to-case attaching bolts to 80-120 in-lb torque.
12. Place a new gasket on the pan. Install the pan and attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
13. On pan fill transmission, connect the filler tube to the pan and tighten the fitting to specification.
14. Lower the vehicle and fill the transmission with fluid. Check the transmission pan area for fluid leakage.

INTERMEDIATE SERVO

(Refer to Fig. 51.)

1. Raise the vehicle and remove the transmission forward cooler line. Remove the four servo cover-to-case attaching bolts. Remove the identification tag.
2. Remove the vacuum lines at the transmission. Remove the servo cover, gasket, piston, and piston return spring. Remove the piston from the cover (Fig. 51).
3. Remove the piston seals and cover gasket.
4. Install new piston seals on the piston. Lubricate the piston seals with clean transmission fluid. Install the servo piston in the cover.
5. Install the piston return spring in the case. Place a new gasket on the cover. Install the piston and cover into the transmission case.
6. Use two 5/16-18 x 1-1/4 bolts, 180 degrees apart to position the cover against the case.
7. Install the transmission identification tag. Install the two servo cover attaching bolts. Remove the two 1-1/4 inch bolts and install two attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
8. Install the vacuum and oil cooler lines.
9. Adjust the intermediate band. Refer to the Adjustment Section, this Part. Lower the vehicle and check the transmission fluid level.
10. If the band can not be adjusted properly, the intermediate band struts are not in position. Remove the pan and valve body. Install the struts, valve body, pan, and adjust the band. Refill the transmission with fluid.

LOW-REVERSE SERVO

(Refer to Fig. 52.)

1. Raise the vehicle on a hoist.
2. Loosen the reverse band adjusting screw locknut. Tighten the reverse band adjusting screw to 10 ft-lb torque. (Tightening the screw will insure that the band strut will be held against the case by the band, preventing it from falling down when the reverse servo piston assembly is removed.)
3. Remove the four servo cover-to-case attaching bolts. Remove the vent tube retaining clip. Remove the servo cover and seal from the case.
4. Remove the servo piston from the case (Fig. 52). **The piston seal cannot be replaced, without replacing the piston. The seal is bonded to the piston.**

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5. Install the piston into the case. Install a new seal on the cover. Install the cover by using two 5/16-18 bolts, 1-1/4 inch long, at 180 degrees apart to position the servo cover on the case. Install the vent tube retaining clip. Install two cover attaching bolts. Remove the two installing bolts and install the last two attaching bolts. Tighten the cover-to-case attaching bolts to specifications as listed at the end of this Part.
6. Adjust the low-reverse band. Refer to the Adjustment Section, this Part. Lower the vehicle and check the transmission fluid level.
7. If the band cannot be adjusted properly, the low-reverse band struts are not in position. Remove the fluid pan and valve body. Install the struts, valve body, pan, and adjust the band. Refill the transmission with fluid.

EXTENSION HOUSING BUSHING AND REAR SEAL

1. Raise the vehicle and disconnect the drive shaft from the transmission.
2. When only the rear seal needs replacing, carefully remove it with a tapered chisel or the tools shown in Fig. 8. Remove the bushing as shown in Fig. 9. **Use the bushing remover carefully so that the spline seal is not damaged.**

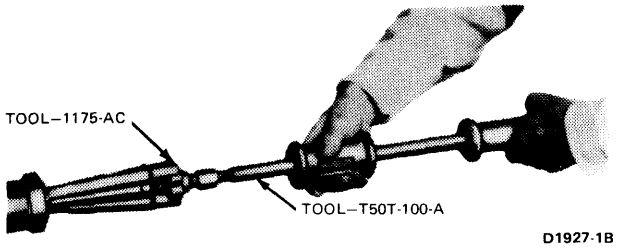


FIG. 8 Removing Extension Housing Seal

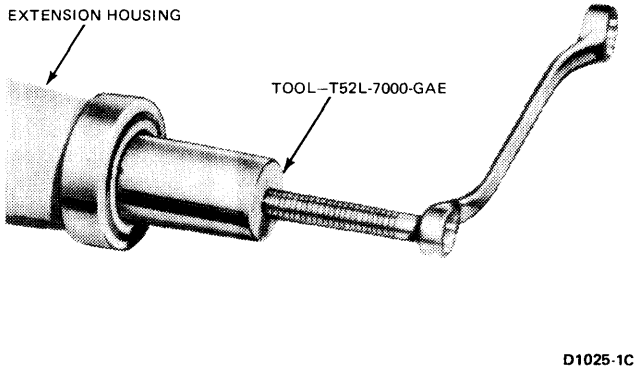


FIG. 9 Removing Extension Housing Bushing

3. When installing a new bushing use the special tool shown in Fig. 10.

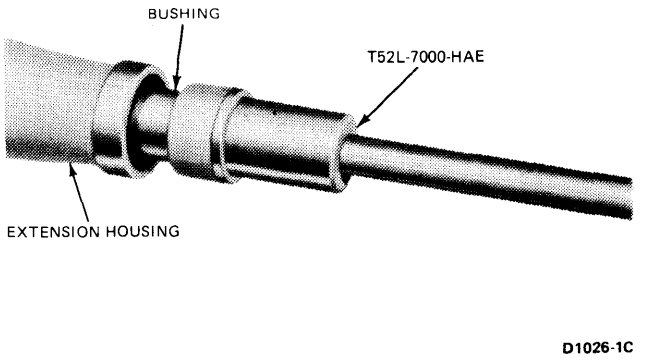


FIG. 10 Installing Extension Housing Bushing

4. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.
5. Inspect the counterbore of the housing for burrs. Remove with crocus cloth.
6. Install the seal into the housing with the tool shown in Fig. 11. The seal should be firmly seated in the bore. Coat the inside diameter of the fiber portion of the seal with C1AZ-19590-B or an equivalent lubricant.

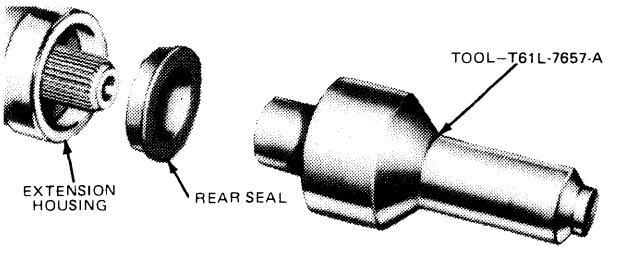


FIG. 11 Installing Extension Housing Seal

7. Coat the front universal joint spline with C1AZ-19590-B or an equivalent lubricant and install the drive shaft.

EXTENSION HOUSING

1. Raise the vehicle on the hoist.
2. Remove the drive shaft. Position the transmission jack to support the transmission.
3. Remove the speedometer cable from the extension housing.
4. Remove the crossmember-to- extension housing bolts.
5. Lower the transmission until the extension housing mount clears the body area.
6. Loosen the extension housing attaching bolts to drain the transmission fluid.
7. Remove the six extension housing-to-case attaching bolts and remove the extension housing and gasket.

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8. Install a new extension housing gasket on the case. Install the extension housing and six attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
9. Raise the transmission and install the extension housing-to-crossmember mounting bolts. Tighten the bolts to specifications as listed at the end of this Part. Remove the transmission jack.
10. Install the speedometer cable in the extension housing. Install the drive shaft.
11. Lower the vehicle and fill the transmission with fluid. Refer to Part 17-01, General Automatic Transmission Service.
12. Check the extension housing area for fluid leakage.

GOVERNOR

(Refer to Fig. 53.)

1. Remove the extension housing as outlined in this section of the manual.
2. Remove the governor housing-to-governor distributor attaching bolts Remove the governor housing from the distributor.
3. Refer to Disassembly and Assembly in this Part for governor repair operations.
4. Install the governor housing on the governor distributor. Install the attaching bolts and tighten the bolts to specifications as listed at the end of this Part.
5. Reinstall the extension housing.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts. During the repair operation, refer to Part 17-01, General Automatic Transmission Service for cleaning and inspection procedures.

During the transmission disassembly or assembly operations, ten thrust washers located between the subassemblies must be removed and installed. **It is important that each thrust washer be installed in the correct position during the assembly operation.** To properly locate and identify the thrust washers, the various positions of the thrust washers are shown in the illustrations and are numbered 1 through 10. No. 1 is the first thrust washer located at the front pump. The last thrust washer, No. 10, is located at the parking pawl gear.

During the repair of the subassemblies, certain general instructions which apply to all units of the transmission must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission before assembly with clean automatic transmission fluid. **Do not use any other lubricants except on gaskets and thrust washers which may be coated with petroleum jelly to facilitate assembly.** Always install new gaskets when assembling the transmission.

Tighten all bolts and screws to the recommended torque as outlined in the Specifications as listed at the end of this Part.

Disassembly

1. Remove the converter from the transmission front pump and converter housing.
2. Remove the transmission vacuum unit and remove the vacuum unit control rod.
3. Remove the primary throttle valve (Fig. 12) from the opening at the rear of the case.

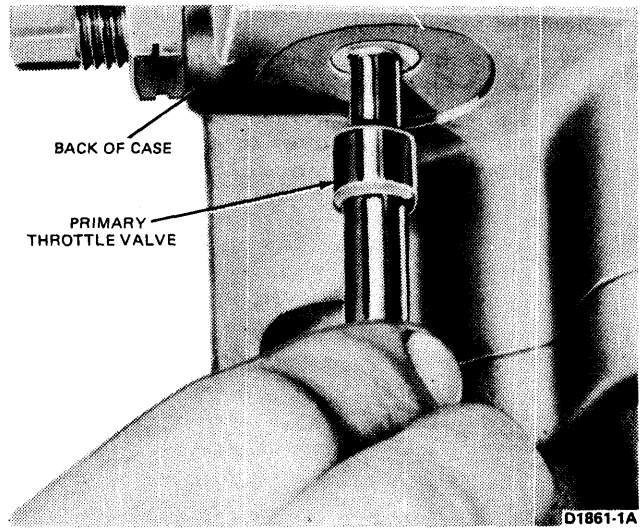


FIG. 12 Removing or Installing Primary Throttle Valve

4. Remove the two extension housing-to-case bolts shown in Fig. 13 and mount the transmission in the holding fixture.
5. Remove the transmission pan attaching bolts, pan and gasket.
6. Remove the control valve body attaching bolts (Fig. 14). Remove the control valve body from the case.
7. Loosen the intermediate band adjusting screw (Fig. 15) and remove the intermediate band struts from the case. Loosen the low-reverse band adjusting screw and remove the low-reverse band struts.

END PLAY CHECK

1. To keep the output shaft in alignment during the end play check, install the extension housing oil seal replacer tool or a front universal joint yoke in the extension housing.
2. Remove one of the converter housing-to-case attaching bolts and mount the dial indicator as shown in Fig. 16.

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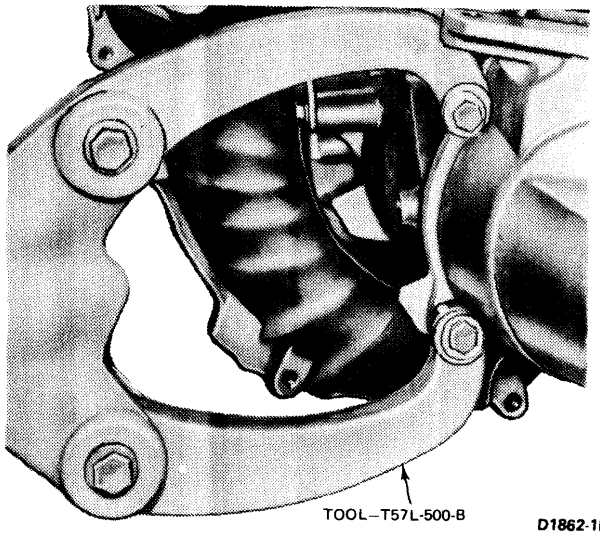


FIG. 13 Transmission Mounted in Holding Fixture

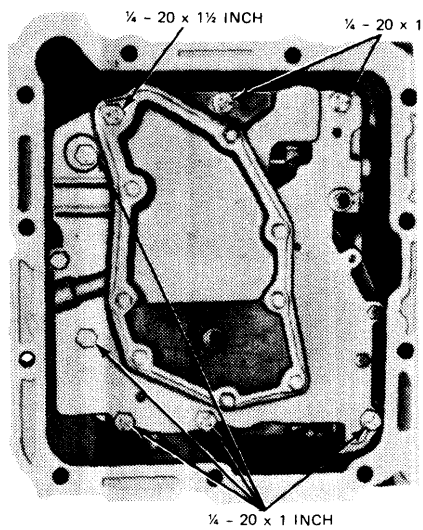


FIG. 14 Control Valve Body-to-Case Attaching Bolts—Typical

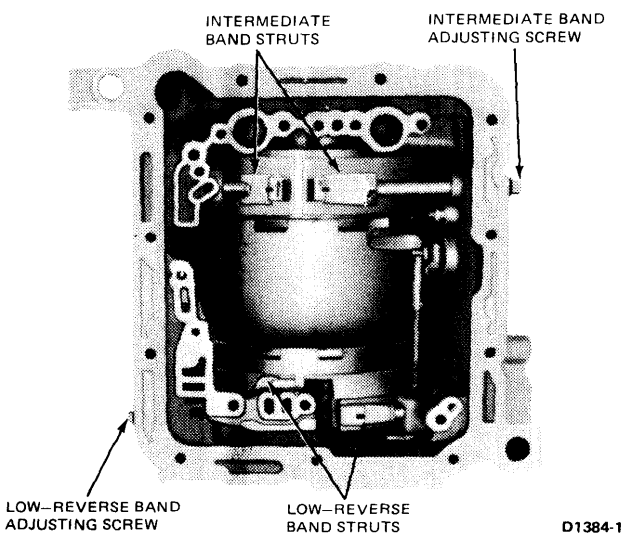


FIG. 15 Band Adjusting Screws and Struts—Typical

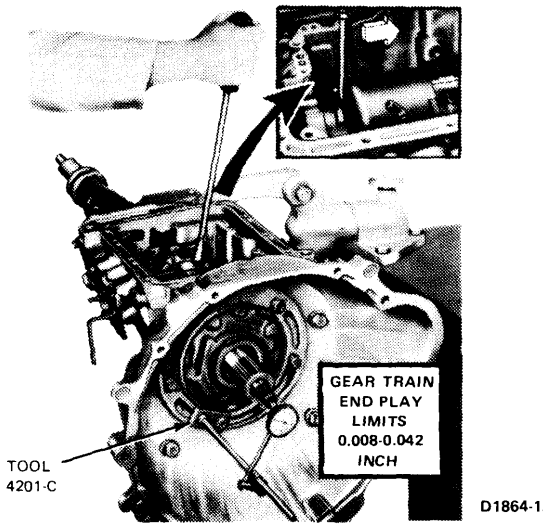


FIG. 16 Checking End Play

3. **The input shaft is a loose part and has to be properly engaged with the spline of the forward clutch hub during the end play checking procedure.** Move the input shaft and gear train toward the rear of the transmission case.
4. With the dial indicator contacting the end of the input shaft, set the indicator at zero (Fig. 16).
5. Insert a screwdriver behind the input shell (Fig. 16). Move the input shell and the front part of the gear train forward.
6. Record the dial indicator reading. The end play should be 0.008 to 0.042 inch. If the end play is not within specification, the selective thrust washers (Fig. 17) must be replaced as required. The selective thrust washers (No. 1 and 2) can be replaced individually to obtain the specified end play.
7. Remove the dial indicator and remove the input shaft from the front pump stator support (Fig. 18).

CASE AND EXTENSION HOUSING PARTS

Removal

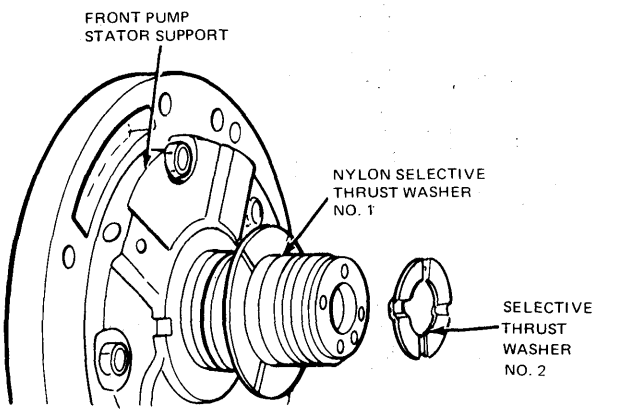
1. Rotate the holding fixture to put the transmission in a vertical position with the converter housing up.
2. Remove the converter housing-to-case attaching bolts. Remove the converter housing from the transmission case.
3. Remove the seven front pump attaching bolts. Insert a screwdriver behind the input shell (Fig. 19) and move the input shell forward until the front pump seal is above the edge of the case. Remove the front pump and gasket from the case. If the selective thrust washer No. 1 did not come out with the front pump, remove it from the top of the reverse-high clutch.
4. Remove the intermediate and low-reverse band adjusting screws from the case. Rotate the intermediate band to align the band ends with the clearance hole in the case (Fig. 20). Remove the intermediate band from the case. **If the intermediate band is to be re-used, it must not be cleaned in a vapor degreaser or with a**

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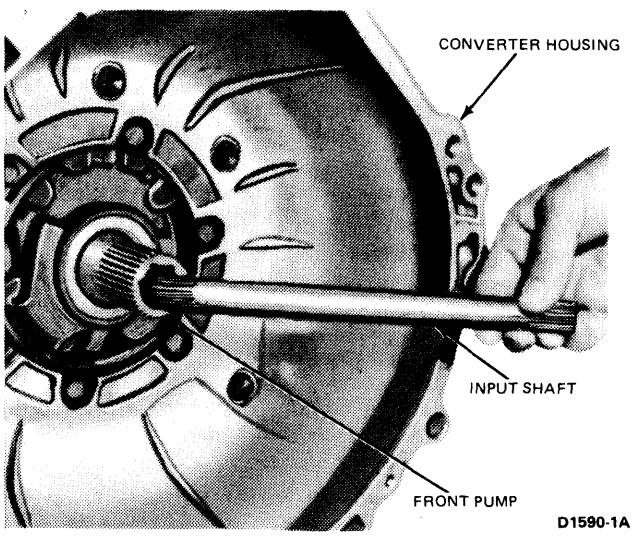
SELECTIVE THRUST WASHERS
(FOR END PLAY CORRECTION)

THRUST WASHER NO. 1		THRUST WASHER NO. 2	
0.053-0.0575	Red	No. Stamped Washer	Metal Thrust Washer
0.070-0.0745	Green	2	0.058-0.056
0.087-0.0915	Natural	3	0.075-0.073
		SPACER	0.036-0.032
		(This is a selective spacer used with washer 2 or 3. When used, install next to stator support.)	



D1865-1F

FIG. 17 Selective Thrust Washer Locations

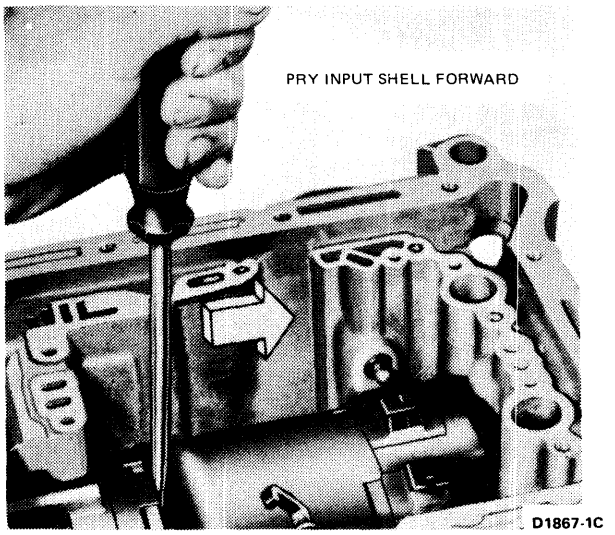


D1590-1A

FIG. 18 Removing or Installing Input Shaft

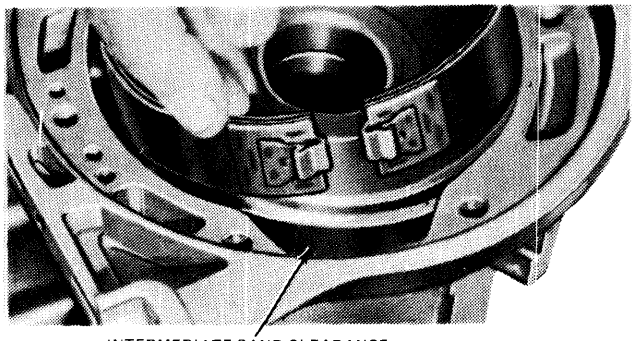
detergent solution. Wipe it clean with a lint-free cloth.

5. Using a screwdriver between the input shell and rear planet carrier (Fig. 21), lift the input shell upward and remove the forward part of the gear train as an assembly (Fig. 22).
6. Place the forward part of the gear train on a bench (Fig. 23).
7. Remove the reverse-high clutch and drum from the forward clutch (Fig. 24).
8. If thrust washer No. 2 (Fig. 17) did not come out with the front pump, remove the thrust washer from



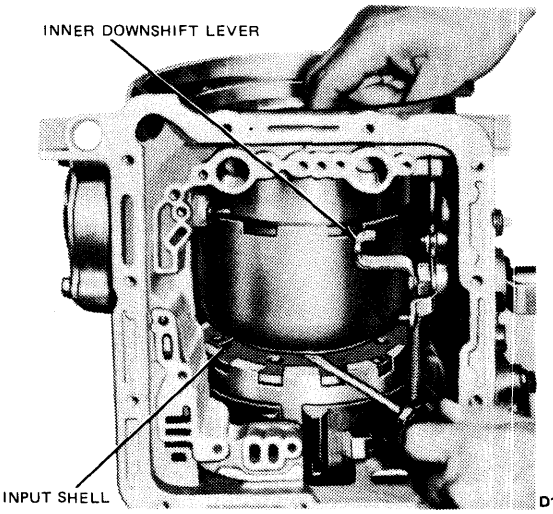
D1867-1C

FIG. 19 Removing Front Pump



D1868-1A

FIG. 20 Position of Intermediate Band for Removal or Installation



D1869-1C

FIG. 21 Lifting Input Shell and Gear Train

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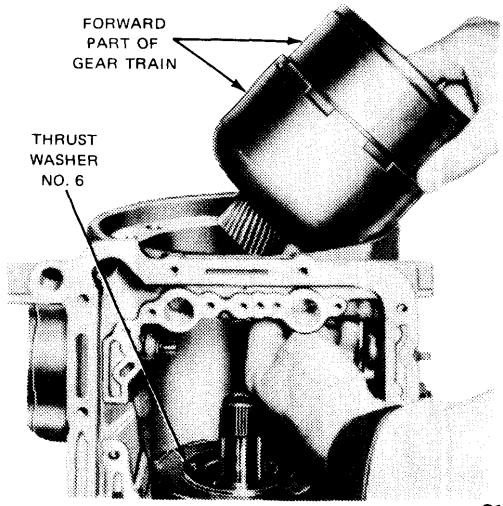


FIG. 22 Removing or Installing Forward Part of Gear Train

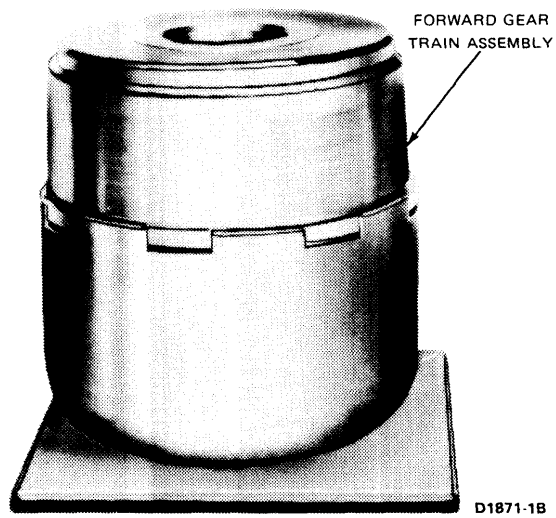


FIG. 23 Forward Part of Gear Train

the forward clutch cylinder. If a selective spacer was used, remove the spacer. Remove the forward clutch from the forward clutch hub and ring gear (Fig. 24).

9. If thrust washer No. 3 (Fig. 24) did not come out with the forward clutch, remove the thrust washer from the forward clutch hub.
10. Remove the forward clutch hub and ring gear from the front planet carrier (Fig. 24).
11. Remove thrust washer No. 4 and the front planet carrier from the input shell.
12. From inside the transmission case (Fig. 22) remove thrust washer No. 6 from the top of the reverse planet carrier.
13. Remove the reverse planet carrier and thrust washer No. 7 from the reverse ring gear and hub (Fig. 25).
14. Move the output shaft forward and with the tool shown in Fig. 26, remove the reverse ring gear hub-to-output shaft snap ring.
15. Remove the reverse ring gear and hub from the output shaft. Remove thrust washer No. 8 from the low and reverse drum (Fig. 25).
16. Remove the low-reverse band from the case (Fig. 27).
17. Remove the low-reverse drum from the one-way clutch inner race (Fig. 27).
18. Rotate the one-way clutch inner race clockwise and remove race from the outer race (Fig. 25).
19. Remove the 12 one-way clutch rollers, springs and the spring retainer from the outer race (Fig. 25). **Do not lose or damage any of the 12 springs or rollers. The outer race of the one-way clutch cannot be removed from the case until the extension housing, output shaft and governor distributor sleeve are removed.**
20. Remove the transmission from the holding fixture. Position the transmission on the bench in a vertical position with the extension housing up. Remove the four extension housing-to-case attaching bolts. Remove the extension housing and gasket from the case.
21. Pull outward on the output shaft and remove the output shaft and governor distributor assembly from the governor distributor sleeve (Fig. 28).
22. Remove the governor distributor snap ring from the output shaft (Fig. 29). Remove the governor distributor from the output shaft.
23. Remove the four distributor sleeve-to-case attaching bolts. Remove the distributor sleeve from the case. **Do not bend or distort the oil tubes as the tubes are removed from the case with the distributor sleeve.**
24. Remove the parking pawl return spring, pawl, and pawl retaining pin from the case (Fig. 30).
25. Remove the parking gear and thrust washer No. 10 (Fig. 30) from the case.
26. Remove the six one-way clutch outer race-to-case attaching bolts with the tool shown in Fig. 31. As the bolts are removed, hold the outer race located inside the case in position. Remove the outer race and thrust washer No. 9 from the case (Fig. 25).
27. If the transmission case bushing is worn or damaged, replace it with the tools shown in Fig. 32.

Assembly

When assembling the transmission subassemblies (Fig. 33), make sure that each thrust washer is installed in the correct position. Lubricate internal parts with transmission fluid. Petroleum jelly should be used to hold the thrust washers in their proper location. If the end play is not within specifications after the transmission is assembled, either the wrong selective thrust washers (No. 1 and 2) were used, or a thrust washer came out of position during the transmission assembly operation.

1. Install thrust washer No. 9 inside the transmission case (Fig. 34).
2. Place the one-way clutch outer race inside the case. From the back of the case install the six outer race-to-case attaching bolts. Tighten the bolts with the

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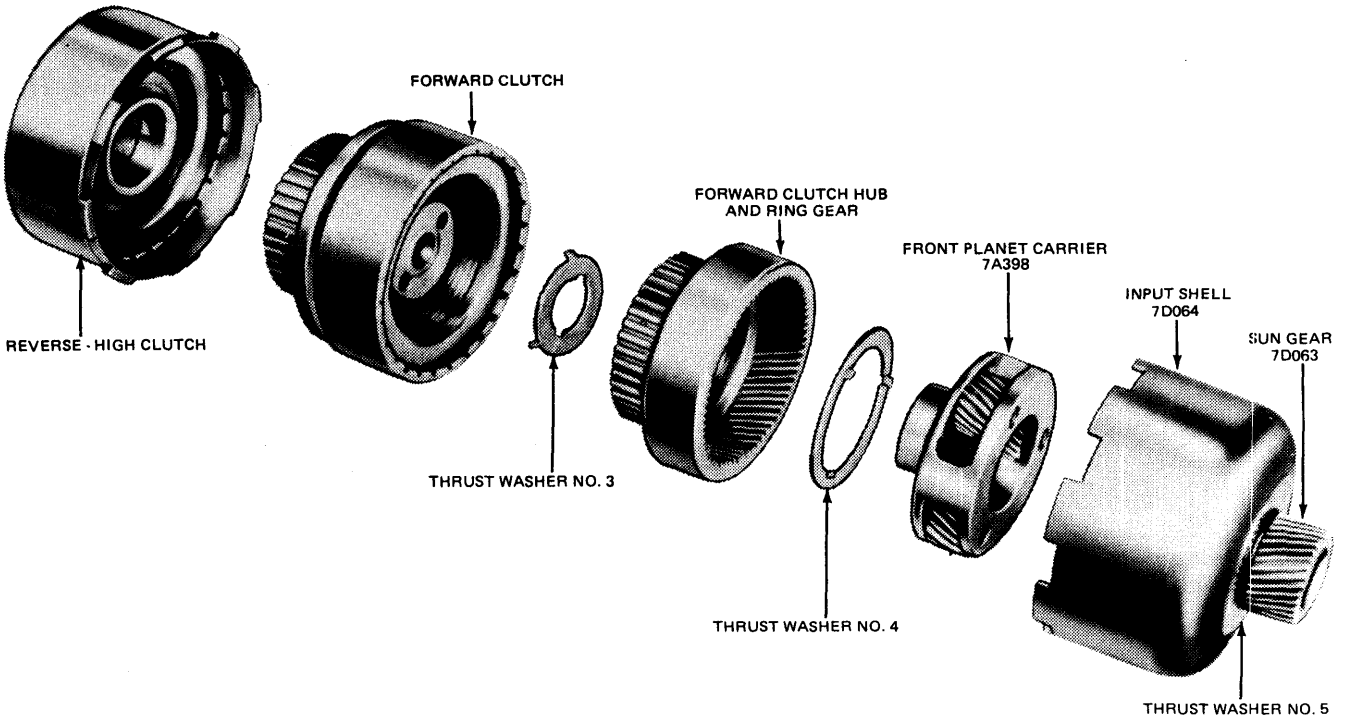


FIG. 24 Forward Part of Gear Train Disassembled

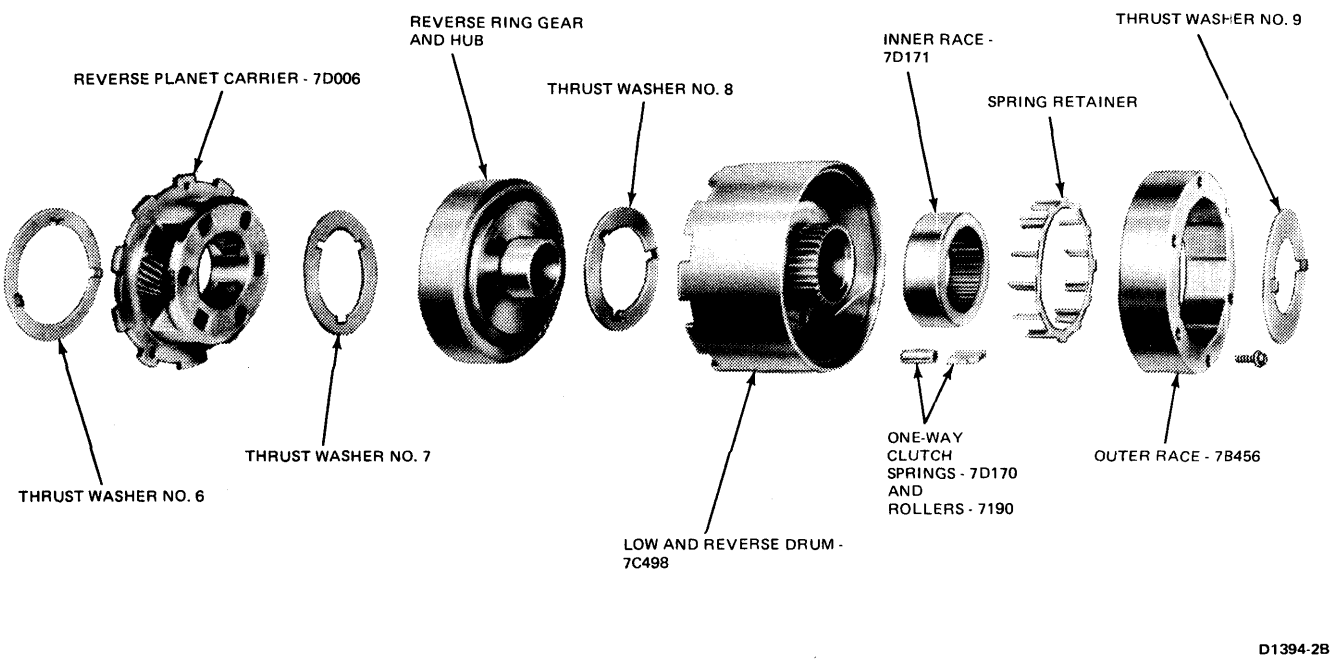


FIG. 25 Lower Part of Gear Train Disassembled

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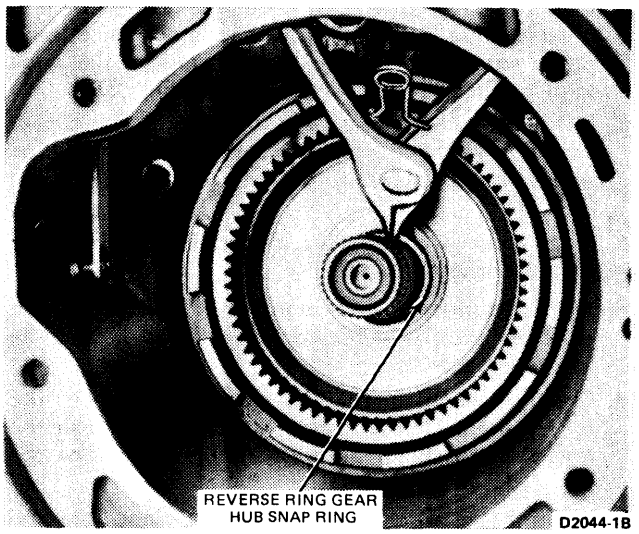


FIG. 26 Removing or Installing Reverse Ring Gear Hub Snap Ring

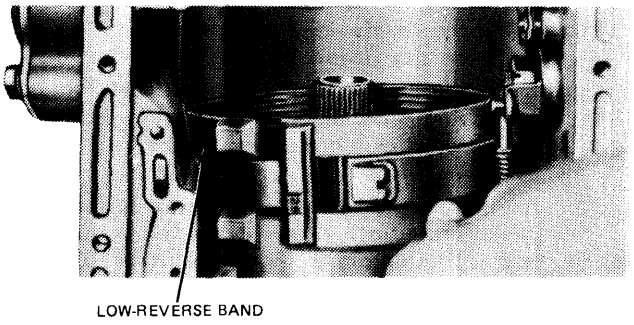


FIG. 27 Removing or Installing Low-Reverse Band

tools shown in Fig. 35 to specifications as listed at the end of this Part.

3. Place the transmission case in a vertical position with the back face of the case upward. Install the parking pawl retaining pin in the case (Fig. 36). Install the parking pawl on the case retaining pin and parking pawl return spring as shown in Fig. 36.
4. Install thrust washer No. 10 on the parking gear (Fig. 37). Place the gear and thrust washer on the back face of the case (Fig. 36).
5. Place the two distributor tubes in the governor distributor sleeve. Install the distributor sleeve on the case. As the distributor sleeve is installed, insert the tubes in the two holes in the case and the parking pawl retaining pin in the alignment hole in the distributor sleeve.
6. Install the four governor distributor sleeve-to-case attaching bolts and tighten the bolts to specifications as listed at the end of this Part.

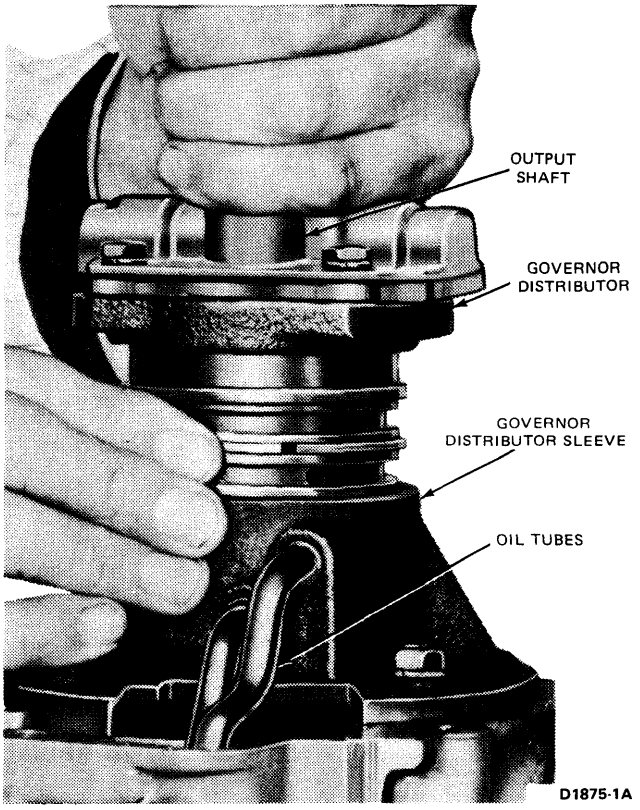


FIG. 28 Removing or Installing Output Shaft and Governor Distributor

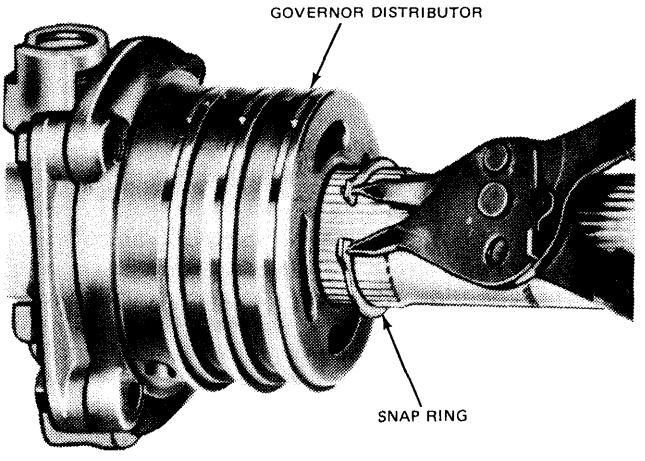


FIG. 29 Removing or Installing Governor Distributor Snap Ring

7. Install the governor distributor assembly on the output shaft. Install the distributor snap ring (Fig. 29).
8. Make sure the governor distributor rings are fully inserted in the ring grooves and will rotate freely. Install the output shaft and governor distributor assembly in the distributor sleeve (Fig. 28).
9. Place a new extension housing gasket on the case. Install the extension housing and the extension housing-to-case attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.

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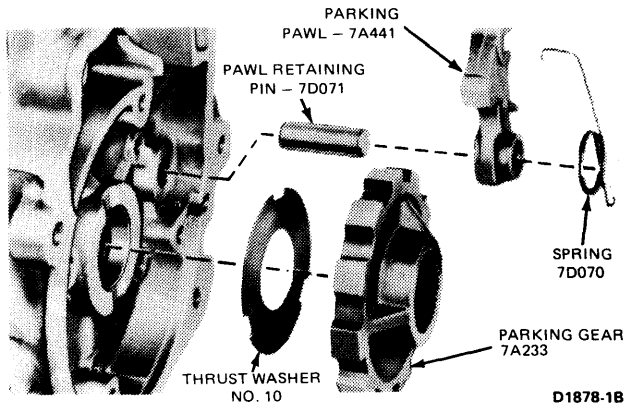


FIG. 30 Parking Pawl, Return Spring Retaining Pin and Gear

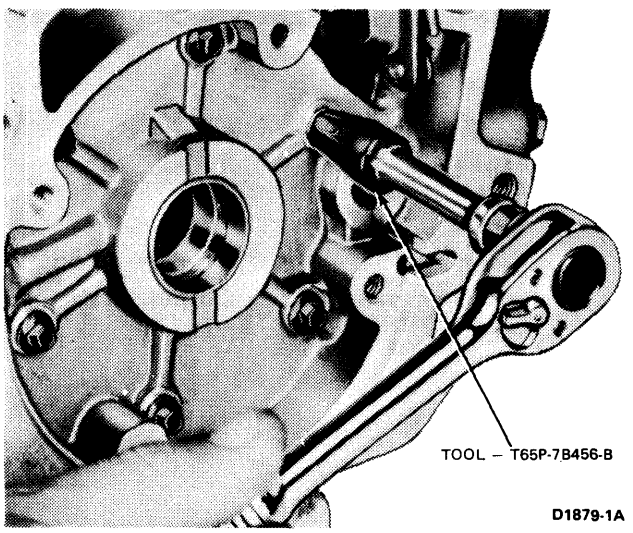


FIG. 31 Removing One-Way Clutch Outer Race Attaching Bolts

10. Place the transmission in the holding fixture. Rotate the holding fixture to put the transmission in a vertical position with the front pump mounting face up. **Make sure thrust washer No. 9 is still located at the bottom of the transmission (Fig. 34).**
11. Install the one-way clutch spring retainer into the outer race (Fig. 38). Install the inner race inside of the spring retainer. **Be sure the face with the step is installed toward the rear of the case, mating with the thrust washer.**
12. Install the 12 springs between the inner and outer race as shown in Fig. 38. Install the 12 one-way clutch rollers by slightly compressing each spring and positioning the roller between the spring and the spring retainer. Rotate the inner race clockwise to center the rollers and springs.
13. Install the low and reverse drum (Fig. 25). The splines of the drum have to engage with the splines of the one-way clutch inner race. Check the one-way clutch operation by rotating the low and reverse drum. **The drum should rotate clockwise but should not rotate counterclockwise.**
14. Install thrust washer No. 8 on top of the low and reverse drum (Fig. 39). Install the low-reverse band in the case, with the end of the band for the small strut toward the low-reverse servo (Fig. 27).
15. Install the reverse ring gear and hub on the output shaft. Move the output shaft forward and install the reverse ring gear hub-to-output shaft snap ring (Fig. 26).
16. Place thrust washers Nos. 6 and 7 on the reverse planet carrier (Fig. 40).
17. Install the planet carrier in the reverse ring gear and engage the tabs of the carrier with the slots in the low-reverse drum.
18. On the bench, install the forward clutch in the reverse-high clutch. Rotate the units to mesh the reverse-high clutch plates with the splines of the forward clutch (Fig. 41).
19. Using the recorded dial indicator readings obtained during the transmission disassembly, determine which No. 2 steel backed thrust washer is required and proceed as follows:
    a. Position the stator support vertically on the work bench and install the correct No. 2 thrust washer, or combination of washer and spacer, as required to bring the end play within specifications as listed at the end of this Part.
    b. Install the reverse-high clutch and the forward clutch on the stator support.
    c. Invert the complete unit making sure that the intermediate brake drum bushing is seated on the forward clutch mating surface.
    d. Select the thickest plastic washer (No. 1) that can be inserted between the stator support and the intermediate brake drum thrust surfaces and still maintain a slight clearance. **Do not select a washer that must be forced between the stator support and intermediate brake drum.**
    e. Remove the intermediate brake drum and forward clutch unit from the stator support.
    f. Install the selected thrust washers (Nos. 1 and 2) on the front pump stator support (Fig. 17) using enough petroleum jelly to hold the thrust washers in position during the front pump installation.
20. Install thrust washer No. 3 on the forward clutch (Fig. 42).
21. Install the forward clutch hub and ring gear in the forward clutch. Rotate the units to mesh the forward clutch plates with the splines on the forward clutch hub (Fig. 43).
22. Install thrust washer No. 4 on the front planet carrier (Fig. 44). Install the front planet carrier into the forward clutch hub and ring gear (Fig. 45). **Check the forward thrust bearing race inside the planet carrier for proper location against the thrust bearing. Make sure the race is centered for alignment with the sun gear on the input shell (Fig. 46).**
23. Install the input shell and sun gear on the gear train (Fig. 46). Rotate the input shell to engage the drive lugs of the reverse-high clutch. **If the drive lugs will not engage, the outer race inside the**

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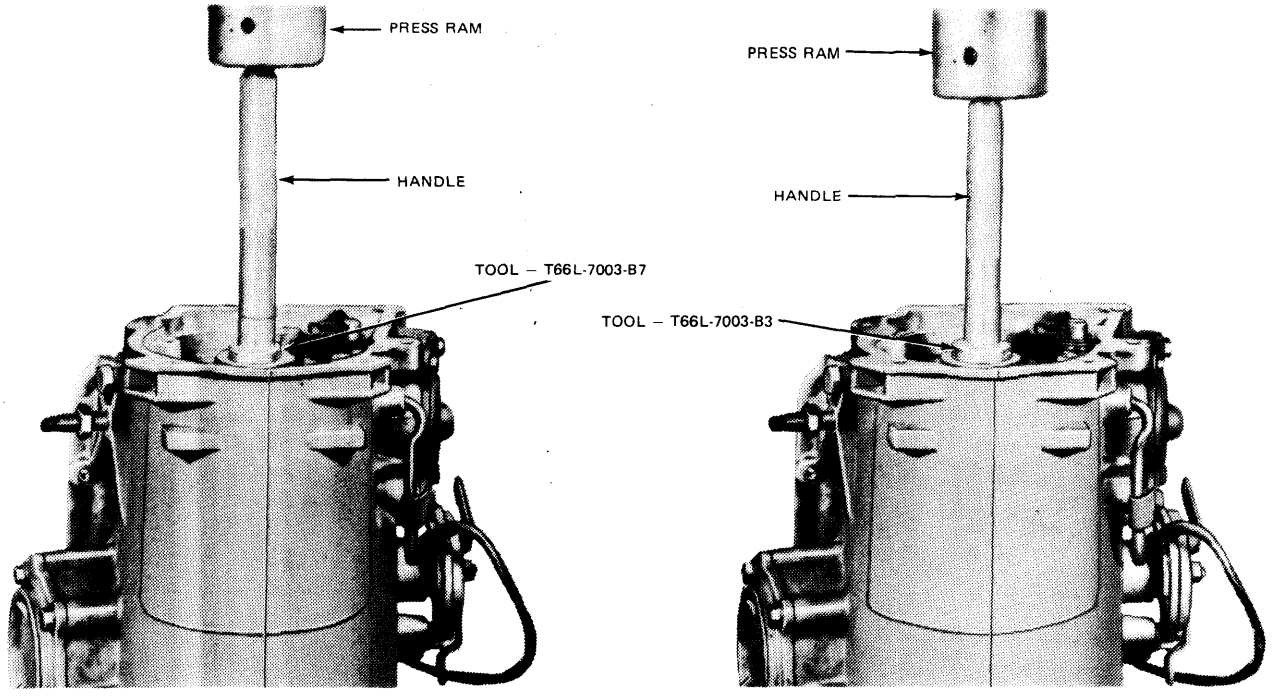


FIG. 32 Replacing Transmission Case Bushing

forward planet carrier is not centered to engage the end of the sun gear inside the input shell. Center the thrust bearing race and install the input shell.

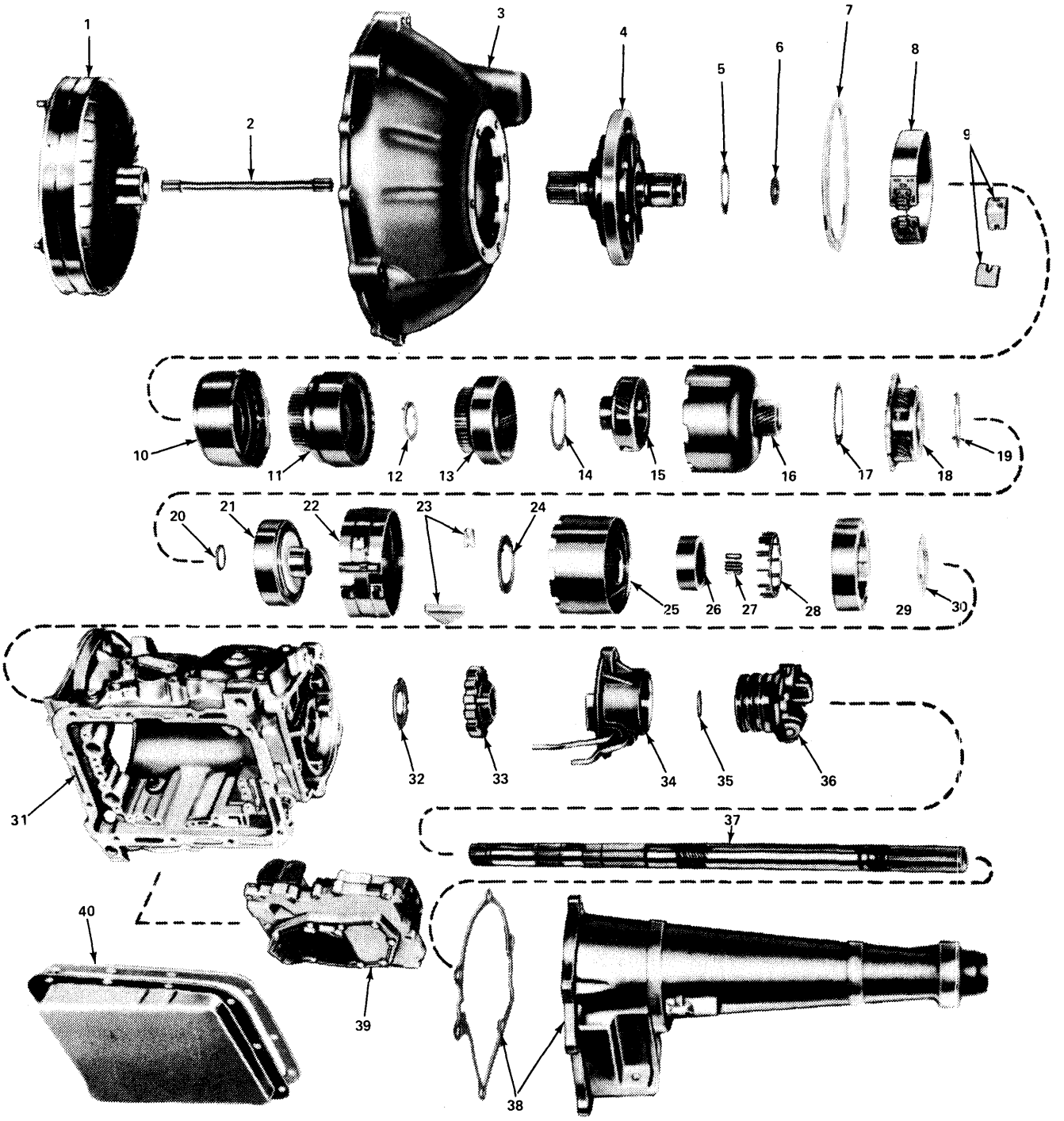
24. Hold the gear train together and install the forward part of the gear train assembly in the case (Fig. 22).

    The input shell sun gear must mesh with the reverse pinion gears. The front planet carrier internal splines must mesh with the splines on the output shaft.

25. A new band should be soaked in transmission fluid for fifteen minutes before it is installed. **Install the intermediate band through the front of the case (Fig. 20).**
26. Install a new front pump gasket on the case. Line up the bolt holes in the gasket with the holes in the case.
27. Install the front pump stator support into the reverse-high clutch. Align the pump-to-case attaching bolt holes. Install the front pump-to-case attaching bolts and tighten to specifications as listed at the end of this Part.
28. Install the input shaft (Fig. 18). **Be sure the short splined end is installed toward the rear of the transmission.** Rotate the holding fixture to place the transmission in a horizontal position. Check the transmission end play as shown in Fig. 16. If the end play is not within specification, either the wrong selective thrust washers (Fig. 17) were used, or one of the 10 thrust washers (Fig. 33) is not properly positioned.
29. Remove the dial indicator used for checking the end play and install the one front pump-to-case attaching bolt. Tighten the bolt to specifications as listed at the end of this Part.
30. Place the converter housing on the transmission case. Install the five converter housing-to-case attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
31. Install the intermediate and low-reverse band adjusting screws in the case. Install the struts for each band (Fig. 15).
32. Adjust the intermediate and low-reverse band. Refer to Adjustments in this Part for band adjusting procedures.
33. Install a universal joint yoke on the output shaft. Rotate the input and output shafts in both directions to check for free rotation of the gear train.
34. Install the control valve body (Fig. 14). Refer to Removal and Installation of this Part for the control valve body installation procedures.
35. Place a new pan gasket on the case and install the pan and pan-to-case attaching bolts. Tighten the attaching bolts to specifications as listed at the end of this Part.
36. Remove the transmission from the holding fixture. Install the two extension housing-to-case attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
37. Install the primary throttle valve in the transmission case (Fig. 12).
38. Install the vacuum unit and control rod in the case.
39. **Make sure the input shaft is properly installed in the front pump stator support and gear**

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1. CONVERTER – 7902
2. INPUT SHAFT – 7D15
3. CONVERTER HOUSING – 7976
4. FRONT PUMP – 7A103
5. THRUST WASHER NO. 1
6. THRUST WASHER NO. 2
7. FRONT PUMP GASKET – 7A136
8. INTERMEDIATE BAND – 7D034
9. BAND STRUTS – 7D029
10. REVERSE AND HIGH CLUTCH DRUM
11. FORWARD CLUTCH AND CYLINDER
12. THRUST WASHER NO. 3
13. FORWARD CLUTCH HUB – 7B067 AND RING GEAR – 7A153
14. THRUST WASHER NO. 4
15. FRONT PLANET CARRIER – 7A398
16. INPUT SHELL – 7D064, SUN GEAR – 7D063 AND THRUST WASHER NO. 5
17. THRUST WASHER NO. 6
18. REVERSE PLANET CARRIER - 7D106
19. THRUST WASHER NO. 7
20. SNAP RING
21. REVERSE RING GEAR – 7A153 AND HUB – 7D164
22. LOW AND REVERSE BAND – 7D095
23. BAND STRUTS – 7A125
24. THRUST WASHER NO. 8
25. LOW AND REVERSE DRUM – 7C498
26. ONE-WAY CLUTCH INNER RACE – 7D171
27. ROLLER (12) – 7190 AND SPRING (12) – 7D170
28. SPRING AND ROLLER CAGE – 7D191
29. ONE-WAY CLUTCH OUTER RACE – 7B456
30. THRUST WASHER NO. 9
31. CASE – 7005
32. THRUST WASHER NO. 10
33. PARKING GEAR – 7A233
34. GOVERNOR DISTRIBUTOR SLEEVE – 7C232
35. SNAP RING
36. GOVERNOR AND DISTRIBUTOR ASSY – 7C053 (AUTOMATIC ONLY)
37. OUTPUT SHAFT – 7060
38. EXTENSION HOUSING – 7A039 AND GASKET – 7086
39. CONTROL VALVE BODY – 7A100
40. OIL PAN – 7A194 AND GASKET – 7A191

D1378-2F

FIG. 33 Transmission Sub-Assemblies—Typical

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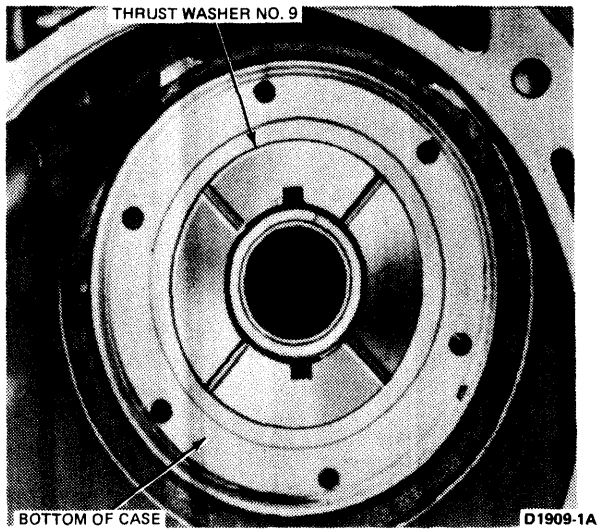


FIG. 34 Number 9 Thrust Washer Location

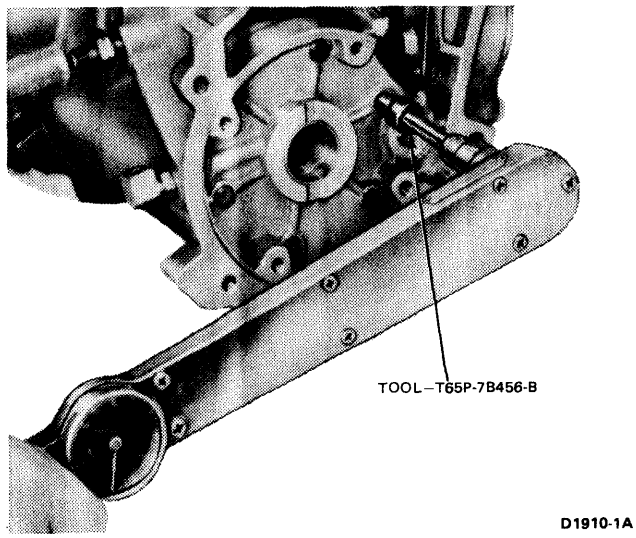


FIG. 35 Installing One-Way Clutch Outer Race Attaching Bolts

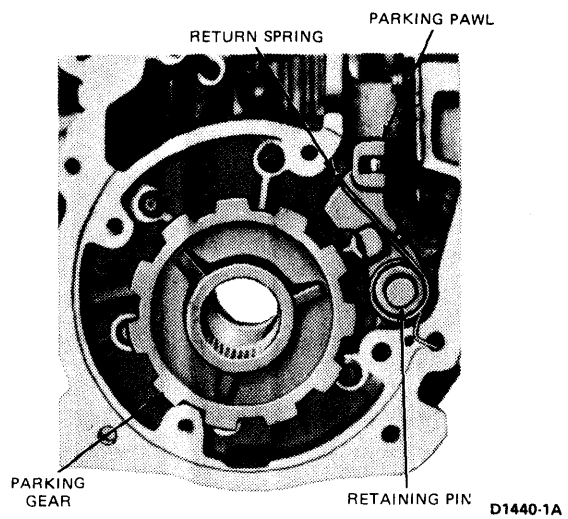


FIG. 36 Parking Pawl and Gear

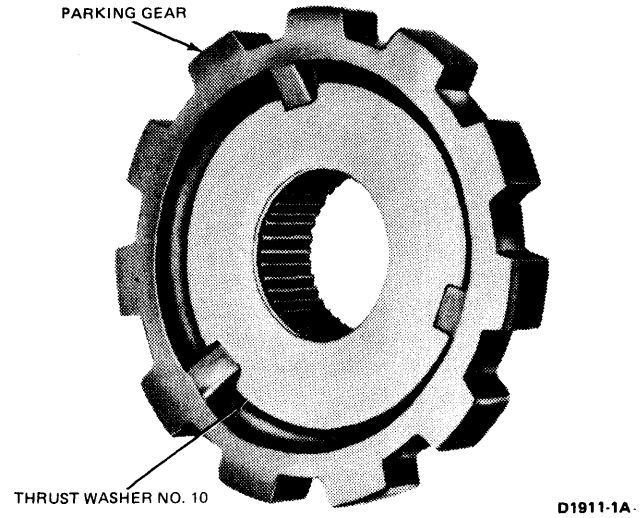


FIG. 37 Number 10 Thrust Washer Location

train. The short splined end of the shaft should be installed toward the rear of the transmission. Install the converter in the front pump and the converter housing.

CONTROL VALVE BODY

Disassembly

When the main control is disassembled and the valve body-to-screen gasket is removed, the gasket should not be cleaned in a degreaser, solvent or any type of detergent solution. To clean the gasket, wipe it off with a lint-free cloth.

1. Remove the eight 10-24 x 1-3/8 inch screws that attach the oil screen to the body (Fig. 47) and remove the screen and gasket (Fig. 48). **Be careful not to lose the throttle pressure limit valve and spring when separating the oil screen from the valve body.**
2. Remove the two 1/4-20 x 1-1/2 inch attaching screws from the upper valve body and the nine 10 x 24 x 7/8 inch attaching screws from the underside of the lower valve body (Fig. 47). Separate the lower valve body, gasket and separator plate (Fig. 49) from the upper valve body. **Be careful not to lose the upper valve body shuttle valve and check valve when separating the upper and lower valve bodies.**
3. Remove the manual valve retaining ring and slide the manual valve out of the body. The retaining ring is used to hold the manual valve in its bore during shipment and should be removed and discarded before sliding the manual valve out of the control valve body.
4. Carefully pry the low servo modulator valve retainer from the body and remove the retainer plug, spring and valve from the body. While working in the low servo modulator valve bore, pry the downshift valve retainer from the body and remove the spring and downshift valve (Fig. 50).
5. Using side cutters, carefully pry the throttle booster valve plug retaining pin from the valve body. Remove the plug, valve and spring (Fig. 50).

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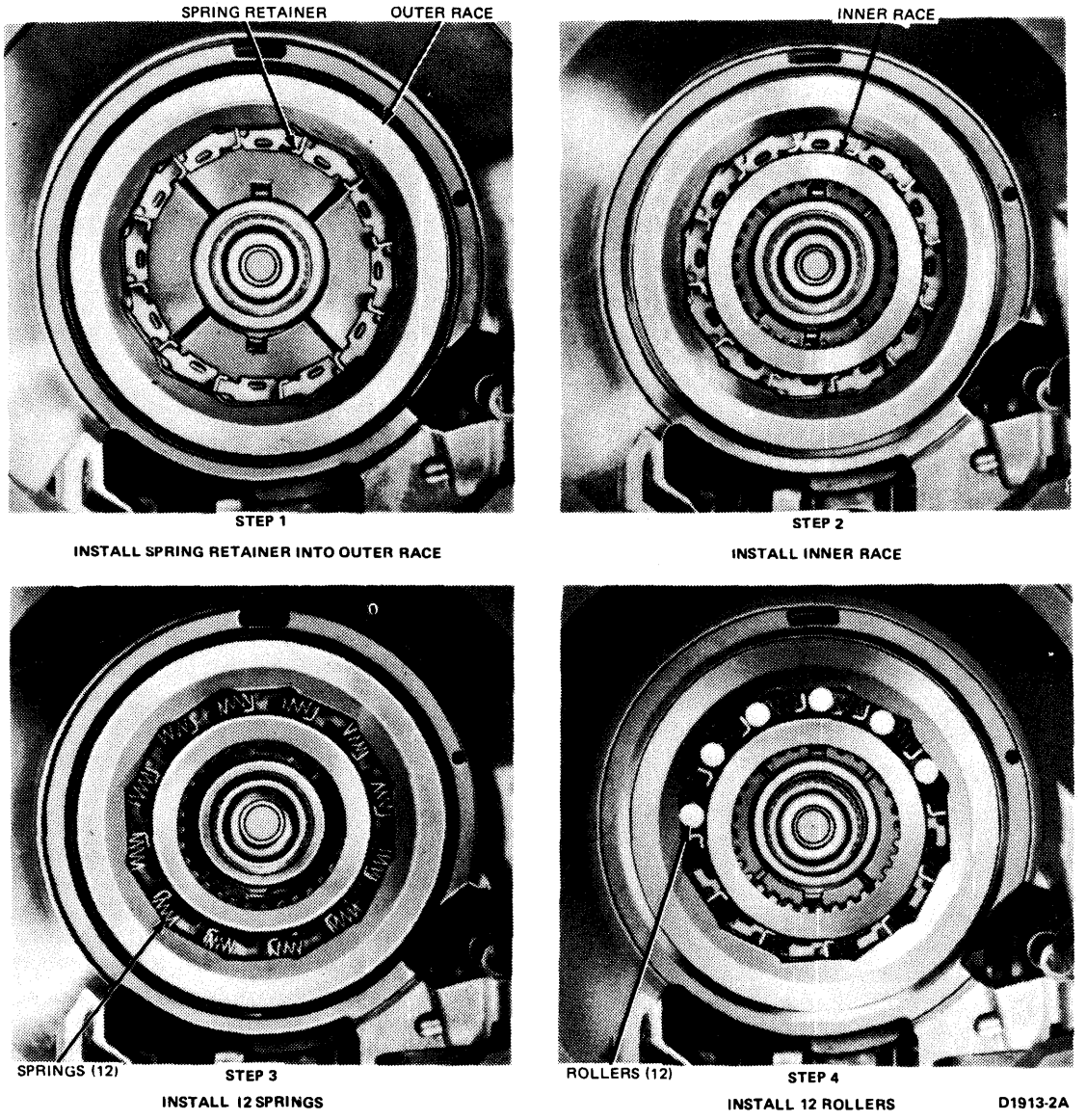


FIG. 38 Installing One-Way Clutch

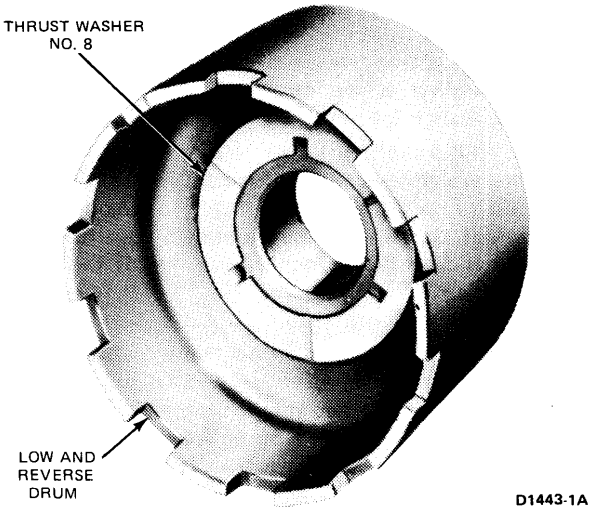


FIG. 39 Number 8 Thrust Washer Location

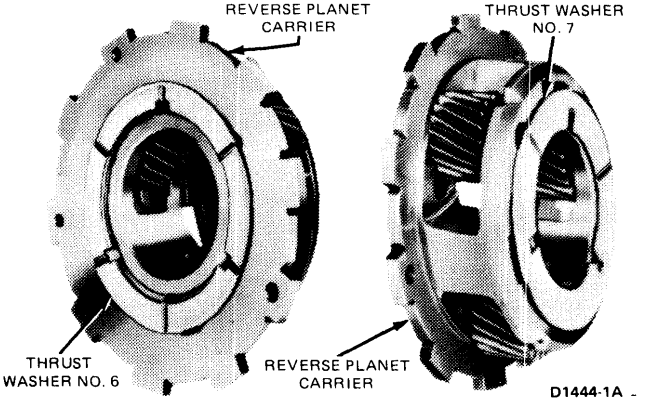


FIG. 40 Number 6 and 7 Thrust Washer Location

6. Remove the cut-back valve and transition valve cover plate from the valve body (Fig. 50).
7. Remove the cut-back valve from the body.

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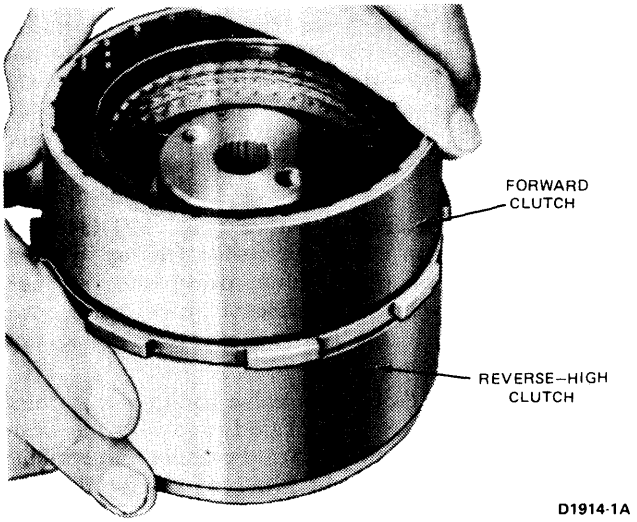


FIG. 41 Installing Clutch Units

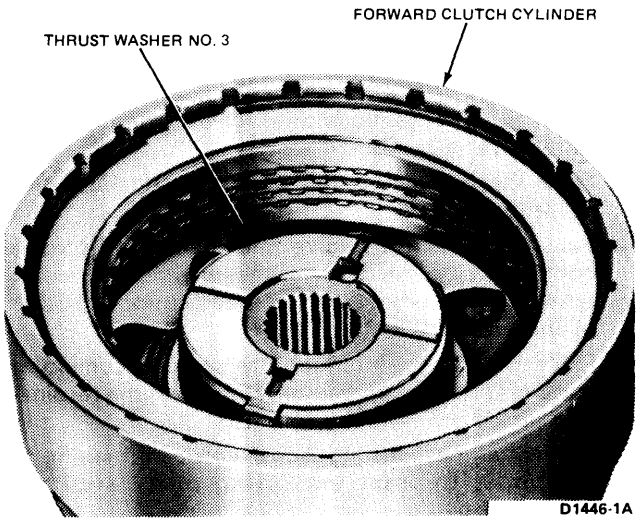


FIG. 42 Number 3 Thrust Washer Location

8. Remove the transition valve, 2-3 back-out valve and spring from the body.
9. Remove the 1-2 shift valve and 2-3 shift valve cover plate from the body.
10. Remove the 2-3 shift valve, spring and throttle modulator valve from the body (Fig. 50).
11. Remove the 1-2 shift valve, D-2 valve and spring from the body.
12. Remove the intermediate servo retaining pin and remove the intermediate accumulator retainer, valve and spring from the body.
13. Press the main oil pressure booster valve inward and remove the retaining pin. Remove the main oil pressure booster valve, sleeve, springs, retainer and the main oil pressure regulator valve (Fig. 50).
14. Remove the line coasting boost valve retainer from the body and remove the spring and line coasting boost valve (Fig. 50).

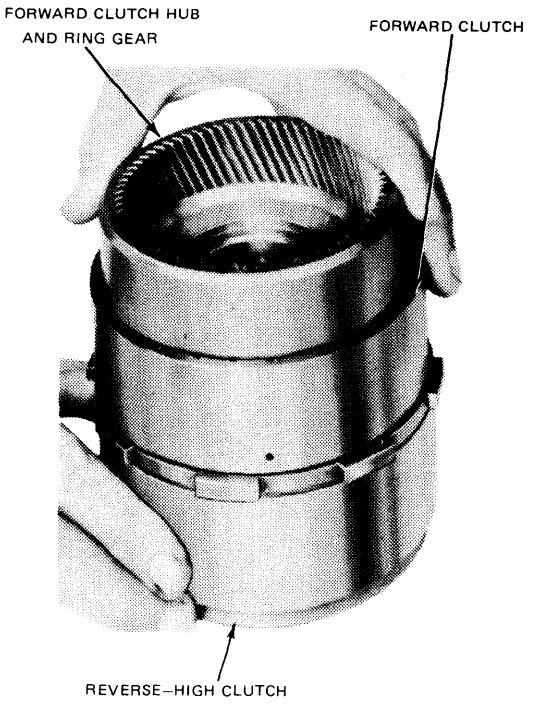


FIG. 43 Installing Forward Clutch Hub and Ring Gear

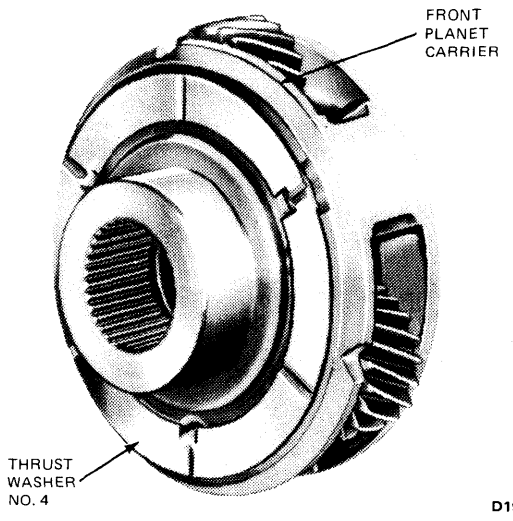


FIG. 44 Number 4 Thrust Washer Location

Assembly

1. Place the shuttle valves in the upper and lower bodies as shown in Fig. 49. Position a new gasket and the separator plate on the lower body and install but do not tighten the attaching screw.
2. Place the lower body and plate assembly on the upper valve body and install the eleven attaching screws finger tight (Fig. 47).
3. Install the oil screen screws loosely, without the screen, to properly align the upper and lower valve bodies, gasket and separator plate.

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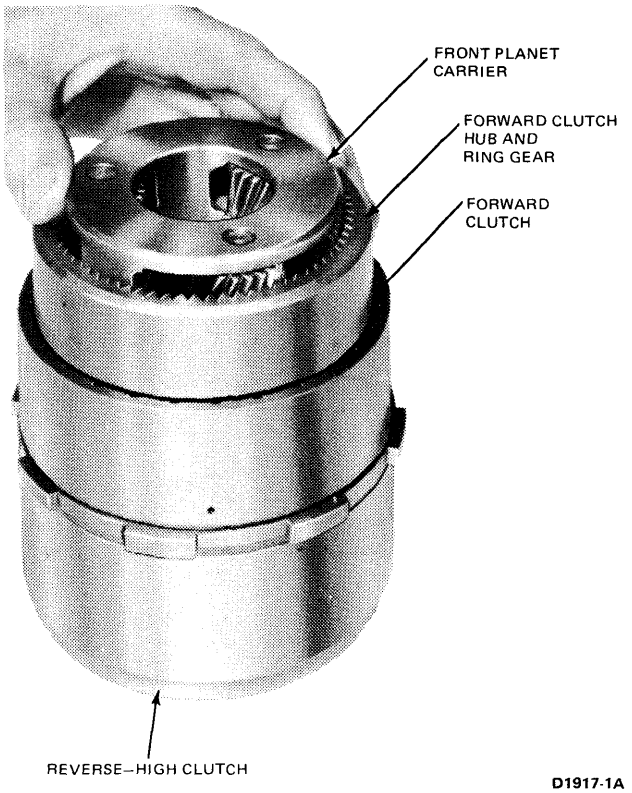


FIG. 45 Installing Front Planet Carrier

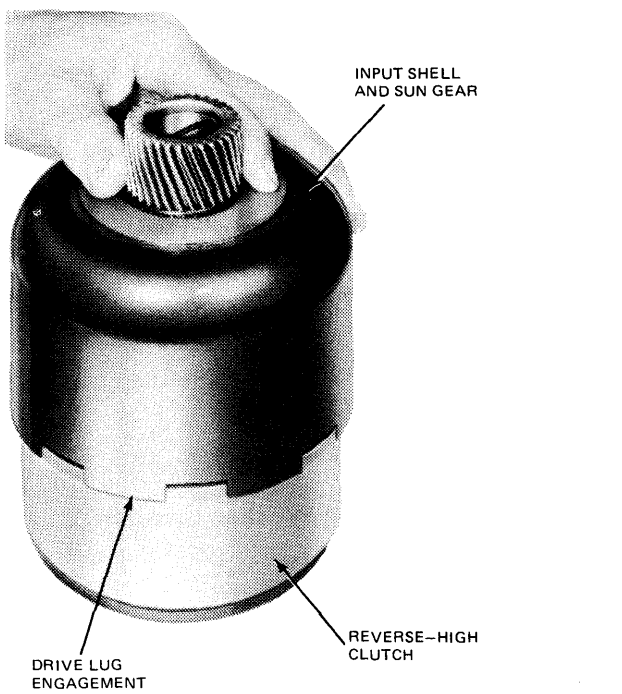


FIG. 46 Installing Input Shell and Sun Gear

4. Tighten the four bolts that are covered by the screen to specifications as listed at the end of this Part.
5. Position the throttle pressure limit valve and spring in the lower valve body (Fig. 48). Remove the oil screen attaching screws and place the gasket and oil screen in position on the lower valve body. Reinstall the screen attaching screws (Fig. 47). Tighten all the valve body and screen attaching screws to specifications as listed at the end of this Part.
6. **Insert the downshift valve (Fig. 50) into the body with the small diameter facing inward.** Install the downshift valve spring and retainer. Insert the low servo modulator valve, spring and retainer plug in the body. Depress the plug and install the retainer.
7. Place the throttle booster valve spring, valve (small diameter end into spring) and plug into the body (Fig. 50). Depress the plug and press in the retaining pin. **Be sure the three grooves are at the top of the pin as it is installed.**
8. Place the spring, 2-3 back-out valve and the transition valve and spring in the body.
9. Place the cut-back valve in the body. Secure the cut-back and the transition valve cover plate to the body with the two attaching screws. Tighten the screws to specifications as listed at the end of this Part.
10. Place the throttle modulator valve, spring and 2-3 shift valve in the body.
11. Place the spring, D-2 valve and the 1-2 shift valve in the body.
12. Secure the 1-2 shift valve and the 2-3 shift valve cover plate to the body with the three attaching screws. Tighten the screws to specifications as listed at the end of this Part.
13. Place the spring, intermediate servo accumulator valve and retainer in the body. Depress the retainer and install the retaining pin (Fig. 50).
14. Insert the line coasting boost valve and spring in the body. Depress the spring and install the retainer.
15. Insert the main oil pressure regulator valve and spring retainer in the body (Fig. 50). Install the two springs, sleeve and the main oil pressure booster valve in the body.
16. Hold the main oil pressure booster valve in place and install the retaining pin.
17. Slide the manual valve into the valve body. Make sure that the end with the two lands closest together is inserted first.

INTERMEDIATE SERVO

Refer to Fig. 51.

Disassembly

1. Remove the transmission identification tag and the four servo cover to case attaching bolts.
2. Remove the servo cover, gasket, and piston return spring from the case (Fig. 51).
3. Remove the intermediate servo piston from the cover.
4. Remove the seal rings from the servo piston and cover.

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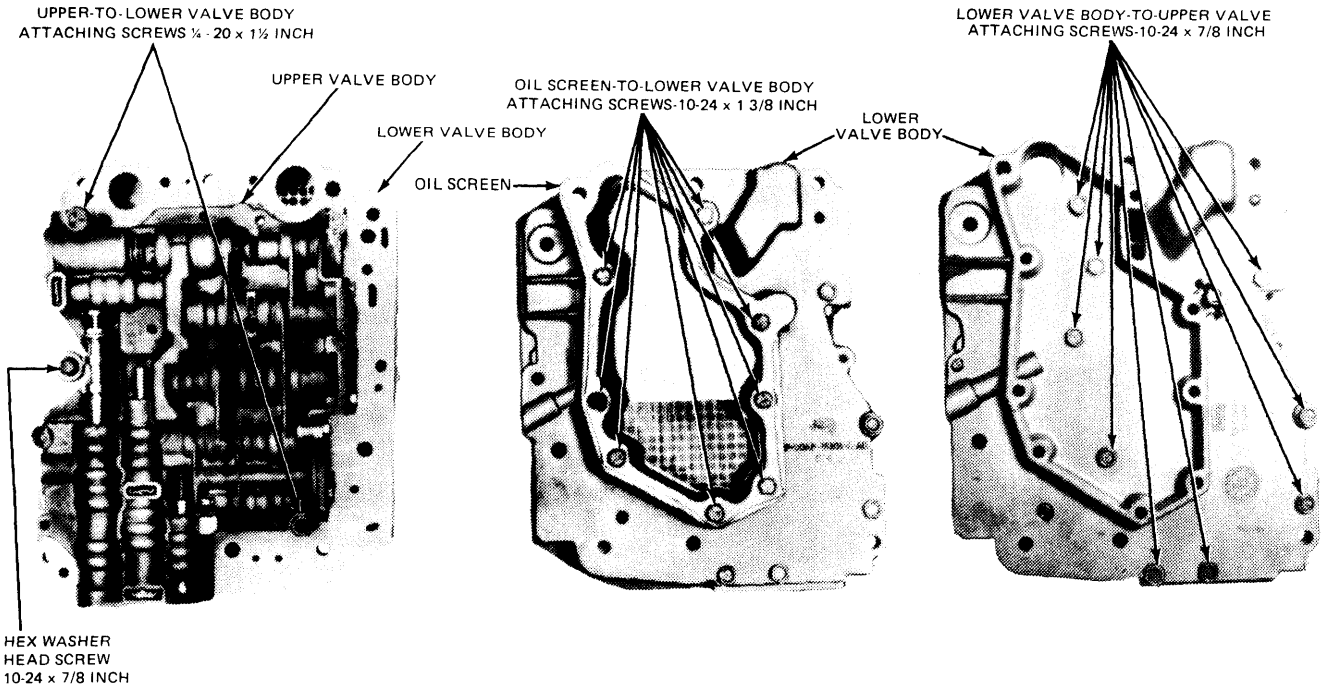


FIG. 47 Control Valve Body and Screen Attaching Screws

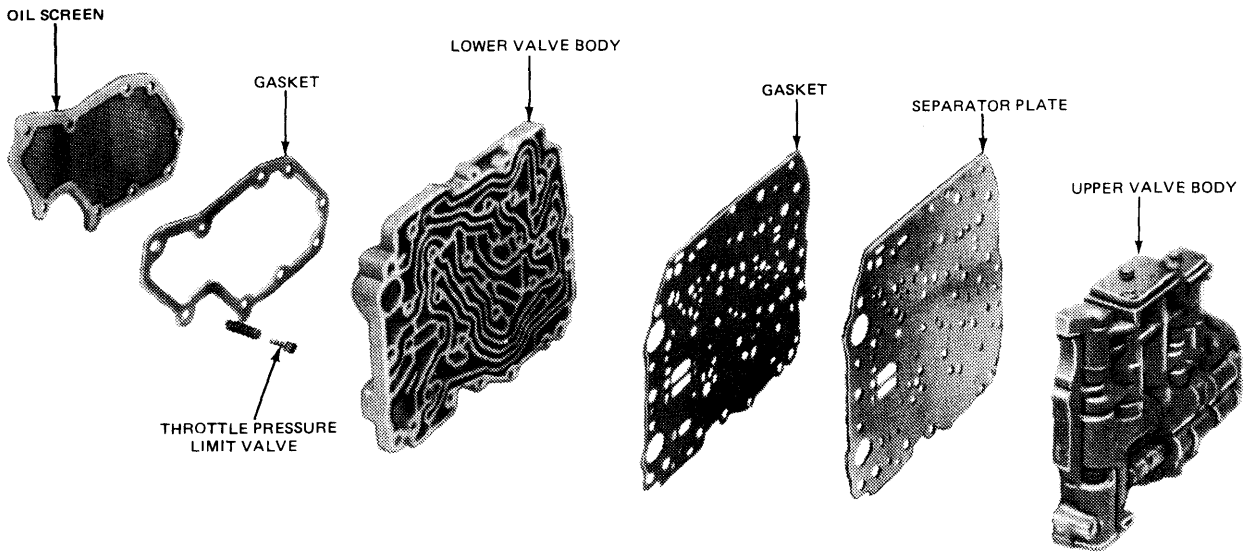


FIG. 48 Upper and Lower Valve Bodies Disassembled

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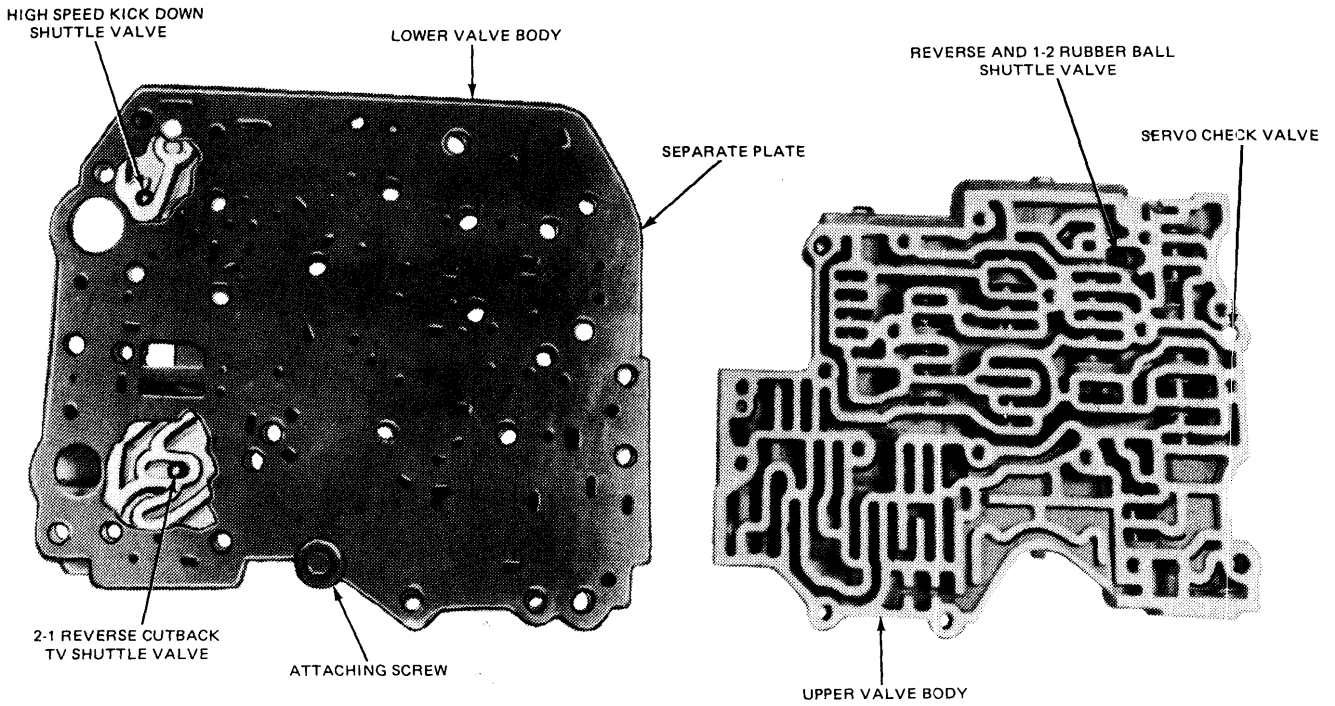


FIG. 49 Separating Upper and Lower Valve Bodies

Assembly

1. Install a new seal on the cover and servo piston. Lubricate the seals with clean transmission fluid. Install the piston into the cover. Be careful not to damage the piston seal.
2. Install the piston return spring in the servo bore of the case.
3. Place a new gasket on the servo cover. **Position the servo piston and cover assembly into the case with the piston stem slot in a horizontal position to engage the strut.** Use two 5/16-18 bolts, 1-1/4 inch long, 180 degrees apart, to position the cover against the case. Install two cover attaching bolts. Remove the two 1-1/4 inch bolts and install the transmission identification tag and the other two cover attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.

LOW-REVERSE SERVO

Disassembly

Refer to Fig. 52.

1. Remove the four servo cover-to-case attaching bolts.
2. Remove the servo cover, cover seal, servo piston and piston return spring from the case (Fig. 52).
3. The servo piston seal is bonded to the piston. If the seal has to be replaced, replace the piston assembly which includes the seal.

Assembly

1. Place the piston return spring in the servo bore of the case (Fig. 52). Lubricate the piston seal with clean transmission fluid and install the servo piston into the bore of the case.
2. Place a new cover seal on the cover and install the servo cover. Install the four cover attaching bolts. Tighten the cover-to-case retaining bolts to specifications as listed at the end of this Part.

GOVERNOR

Disassembly

Refer to Fig. 53.

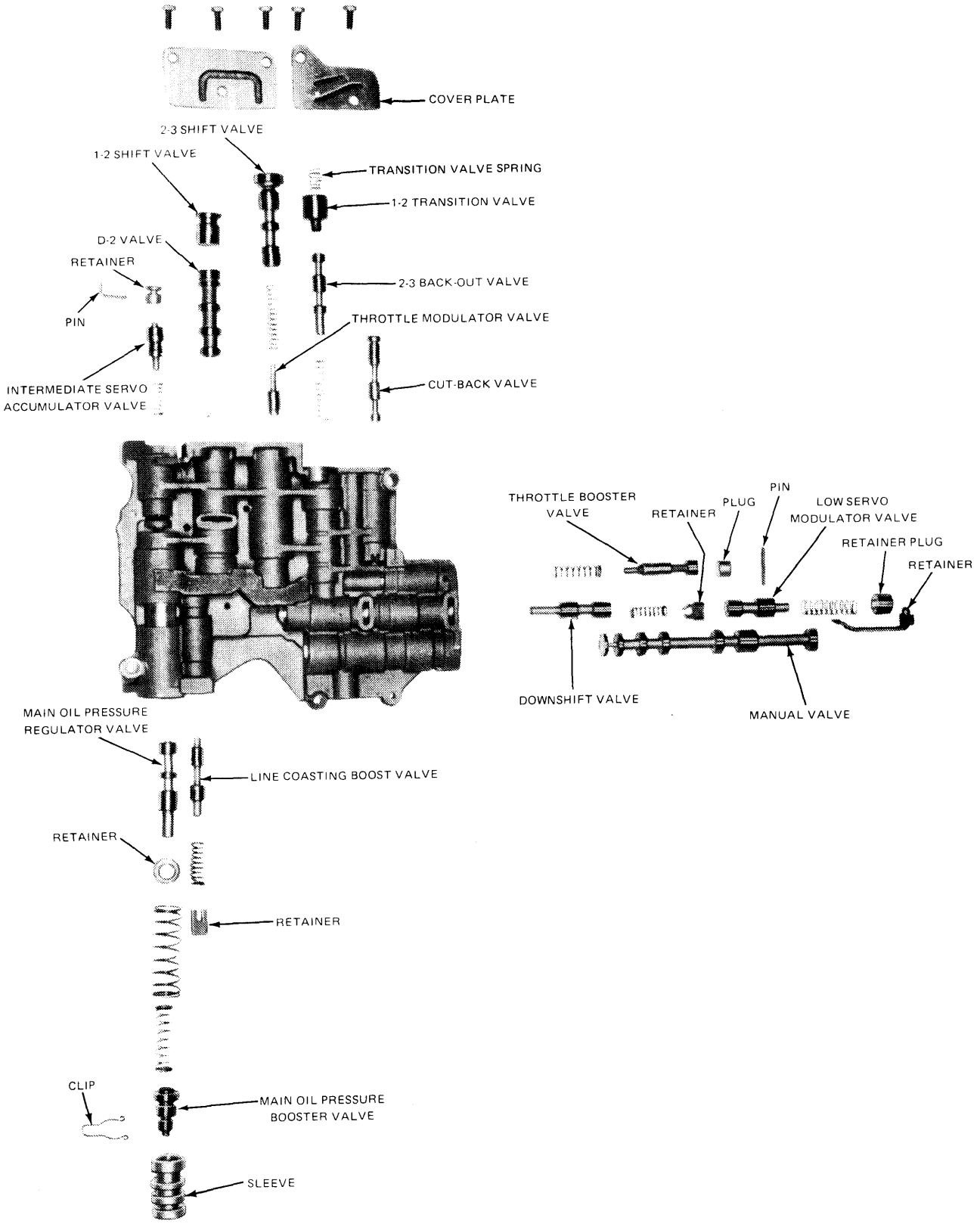
1. Remove the oil rings from the governor oil distributor (Fig. 53).
2. Remove the governor housing- to-distributor attaching bolts. Remove the governor housing from the oil distributor.
3. Remove the primary governor valve snap ring (Fig. 54). Remove the washer, spring, and primary governor valve from the housing.
4. Remove the secondary governor valve spring retaining clip, spring, and governor valve from the housing.

Assembly

1. Install the secondary governor valve in the housing. Install the spring and retaining clip. **Make sure the clip is installed with the small concaved area facing downward, to hold the spring in the correct position.**
2. Install the primary governor valve in the housing. Install the spring, washer and snap ring. **Make sure the washer is centered in the housing on top of the spring and the snap ring is fully seated in the ring groove of the housing.**

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D2075-2E

FIG. 50 Upper Valve Body Disassembled

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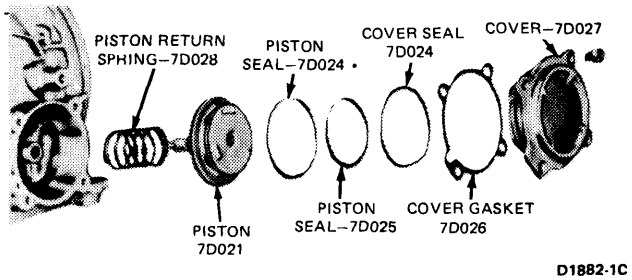


FIG. 51 Intermediate Servo Disassembled

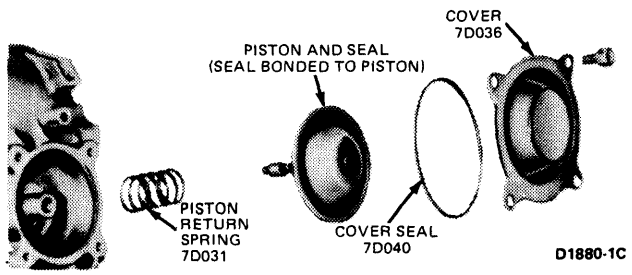


FIG. 52 Low-Reverse Servo Disassembled

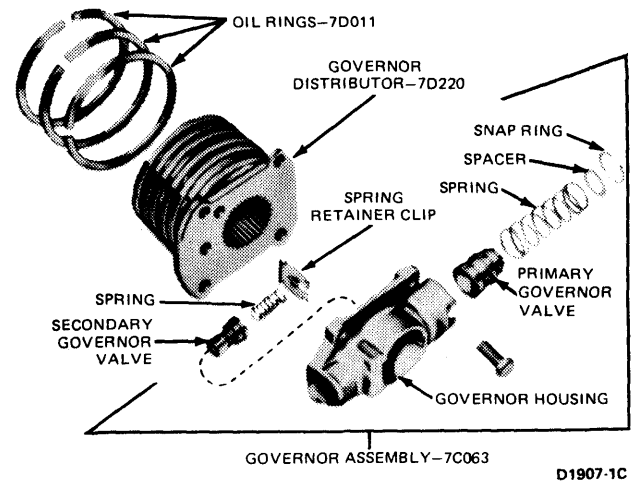


FIG. 53 Governor Disassembled

3. Install the governor assembly on the oil distributor and tighten the attaching bolts to specifications as listed at the end of this Part.
4. Install the oil rings on the distributor. Check the oil rings for free rotation in the ring grooves on the oil distributor.

DOWNSHIFT AND MANUAL LINKAGE

Disassembly

1. Apply penetrating oil to the outer lever attaching nut to prevent breaking the inner lever shaft. Remove the downshift outer lever nut and remove the downshift outer and inner levers.
2. On vehicles equipped with a case mounted neutral start switch, place a screwdriver behind the switch and carefully pry the switch off the lever.

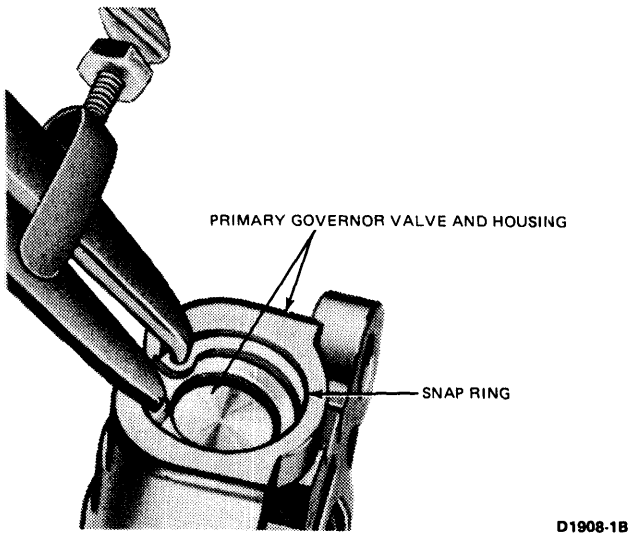


FIG. 54 Removing or Installing Governor Valve Snap Ring

3. From inside the transmission case, remove the upper retaining ring from the manual lever link (Fig. 55). Remove the upper end of the lever link from the case retaining pin.
4. From the back of the transmission case, remove the lower retaining ring and flat washer from the parking pawl link (Fig. 56). Remove the pawl link from the case retaining pin.
5. From the back of the transmission case, remove the parking pawl link, toggle rod, and manual lever link as an assembly (Fig. 57).
6. Remove the rear parking pawl link upper retaining ring, flat washer and link from the toggle rod (Fig. 55).
7. Remove the manual lever link, lower retaining ring, flat washer, and link from the toggle rod.
8. Remove the inner manual lever attaching nut and lever. Remove the outer manual lever from the case.
9. To remove the manual lever seal, use the tools shown in Fig. 58. To install the new seal, use the tool shown in Fig. 59.

Assembly

1. Install the manual and parking pawl links, flat washers and retaining rings to the toggle rod.
2. Install the outer manual lever in the case. Install the inner manual lever and attaching nut with the chamfer facing toward the lever (Fig. 55). Tighten the nut to specifications as listed at the end of this Part.
3. From the back of the transmission case, install the parking toggle rod and link assembly into the case (Fig. 57).
4. Install the parking pawl link on the case retaining pin. Install the flat washer and link retaining ring (Fig. 56).
5. Position the inner manual lever behind the manual lever link, **with the cam on the lever contacting the lower link pin.**
6. Install the upper end of the manual lever link on the case retaining pin. Install the retaining ring.

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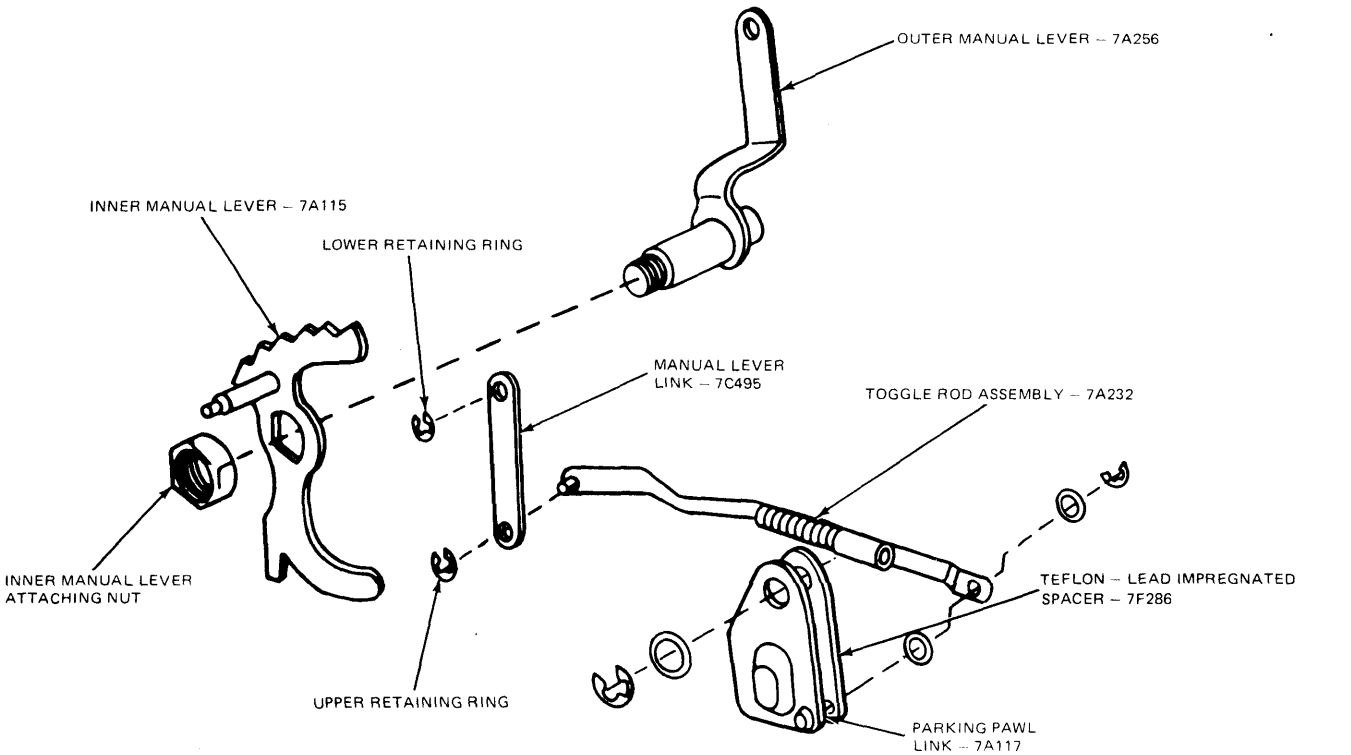


FIG. 55 Transmission Case Internal Linkage

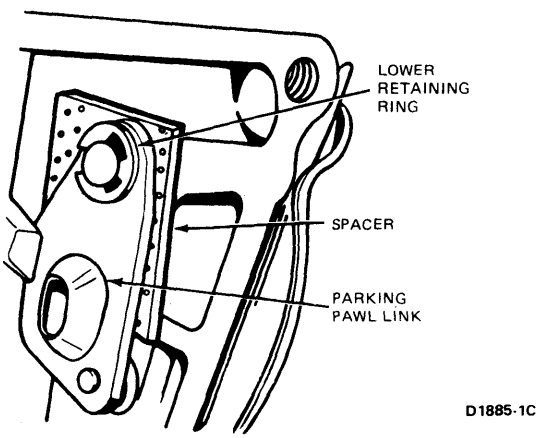


FIG. 56 Parking Pawl Link

7. Operate the manual lever and check for correct linkage operation.
8. On vehicles equipped with a case mounted neutral start switch, reinstall the switch. Adjust the switch after the control valve body has been installed. Tighten the attaching bolts to specifications as listed at the end of this Part.
9. Install the inner and outer downshift levers. Tighten the attaching nut to specifications as listed at the end of this Part.

FRONT PUMP

Disassembly

1. Remove the four seal rings from the stator support.
2. Remove the five bolts that attach the stator support to the front pump housing. Remove the stator support from the pump housing (Fig. 60).

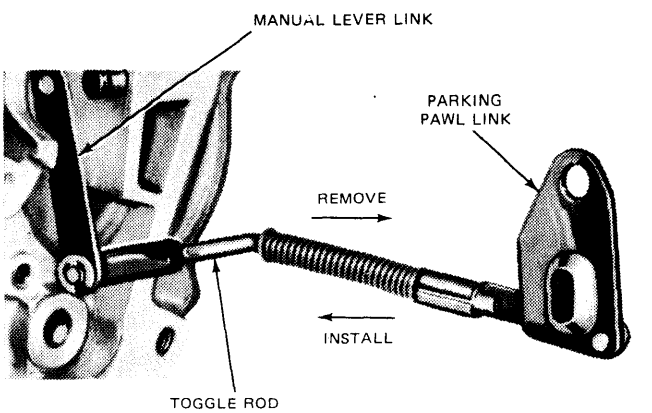


FIG. 57 Removing or Installing Parking Pawl Link

3. Remove the front and rear stator bushings if they are worn or damaged. Use the cape chisel (Fig. 61) and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.
4. Remove the drive and driven gears from the front pump housing.
5. Press the bushing from the front pump housing with the handle and tool as shown in Fig. 62.

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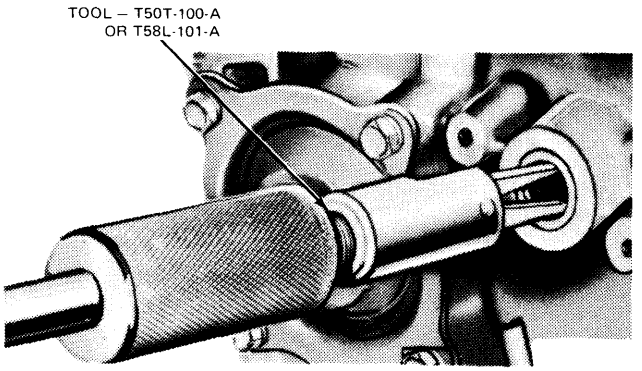


FIG. 58 Removing Manual Lever Seal

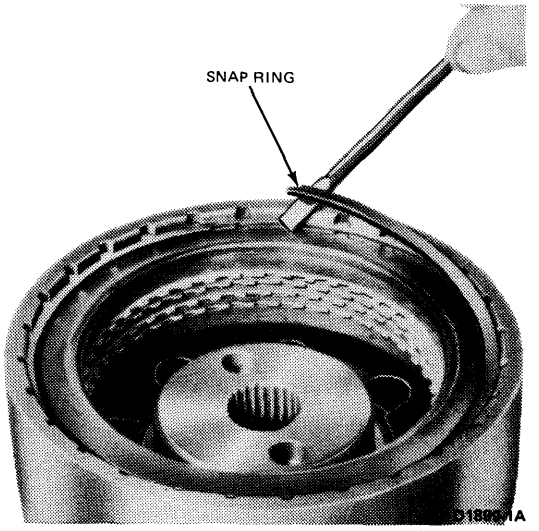


FIG. 59 Installing Manual Lever Seal

Assembly

1. Press a new bushing into the pump housing with the handle and tool shown in Fig. 62. **Make sure the bushing is installed with the slot and groove positioned to the rear of the pump body and 60 degrees below the horizontal center line.**

2. Install the drive and driven gears in the pump housing. **Each gear has an identification mark on the side of the gear teeth that are chamfered. The chamfered side with the identification mark has to be positioned downward against the face of the pump housing.**

3. Press new bushings into the stator support with the tool shown in Fig. 63. Use the long end of the tool for the front bushing and the short end for the rear bushing. **When installing the rear bushing, be sure the hole in the bushing is lined up with the lube hole in the stator support.**

4. Place the stator support in the pump housing and install the five attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.

5. Install the four seal rings on the stator support. **The two large oil rings are assembled first in the oil ring grooves toward the front of the stator support (Fig. 60).**

6. Check the pump gears for free rotation by placing the pump on the converter drive hub in its normal running position and turning the pump housing.

7. If the front pump seal must be replaced, mount the pump in the transmission case and remove the seal with the tool shown in Fig. 64. To install the new seal, use the tool shown in Fig. 65.

REVERSE-HIGH CLUTCH

Disassembly

1. Remove the pressure plate retaining snap ring (Fig. 66).

2. Remove the pressure plate, and the drive and driven clutch plates (Fig. 67). **If the composition clutch plates are to be reused, do not clean them in a vapor degreaser or with a detergent solution. Wipe the plates with a lint-free cloth.**

3. Place the reverse and high clutch drum in an arbor press. With the tools shown in Fig. 68, compress the piston return springs and remove the snap ring. When the arbor press ram is released, guide the spring retainer to clear the snap ring groove of the drum.

4. Remove the spring retainer and piston return spring.

5. Remove the piston by inserting air pressure in the piston hole of the clutch drum (Fig. 69).

6. Remove the piston outer seal from the piston and the piston inner seal from the clutch drum (Fig. 67).

Assembly

1. Install a new inner seal in the clutch drum and a new outer seal on the clutch piston. Lubricate the seals with clean transmission fluid and install the piston into the clutch drum.

2. Place the clutch piston spring into position on the clutch piston. Place the spring retainer on top of the spring and install assembled parts in reverse-high clutch drum. To install the snap ring use the tools shown in Fig. 68 and place assembled clutch drum in an arbor press.

   As the press ram is moved downward, make sure the spring retainer is centered to clear the snap ring goove. Install the snap ring.

3. When new composition clutch plates are used, soak the plates in transmission fluid for fifteen minutes before installing them. Install the clutch plates alternately starting with a steel plate, then a non-metallic plate (Fig. 67). The last plate installed is the pressure plate. For the correct number of clutch plates required for each transmission model, refer to the Specifications as listed at the end of this Part.

4. Install the pressure plate retaining snap ring (Fig. 67). Make sure the snap ring is fully seated in the snap ring groove of the clutch hub.

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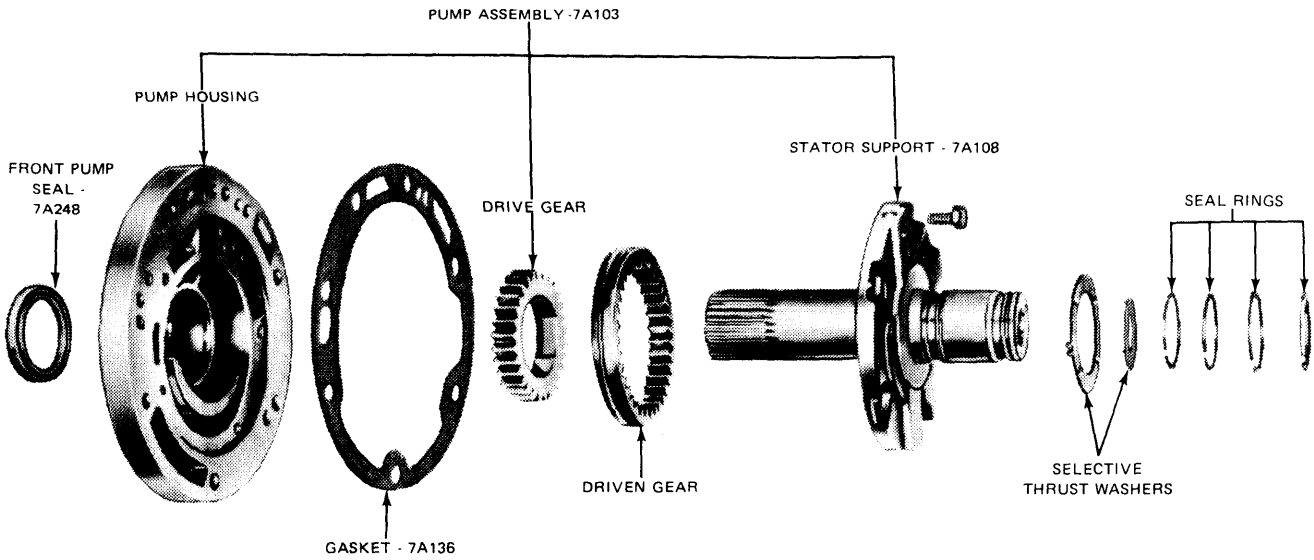


FIG. 60 Front Pump and Stator Support Disassembled

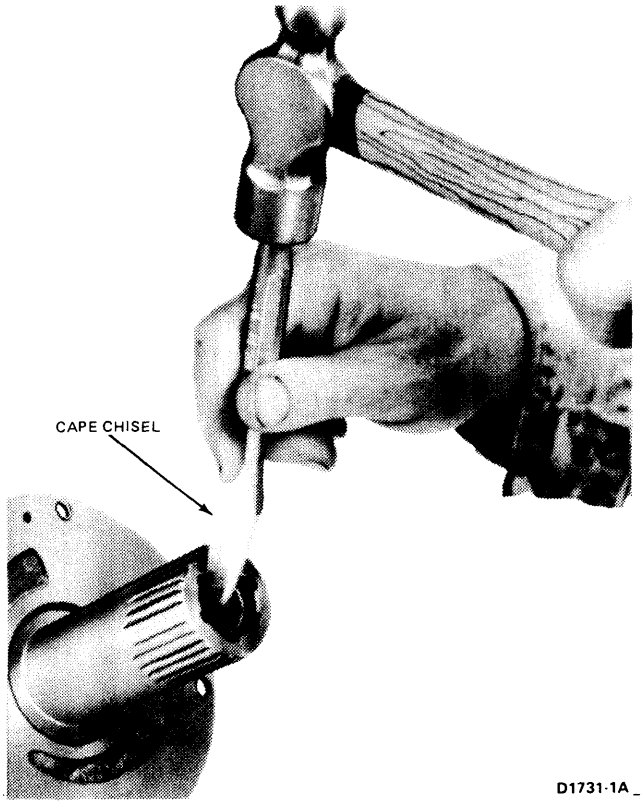


FIG. 61 Removing Stator Support Bushing

5. With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 70).

FORWARD CLUTCH

Disassembly

1. Remove the clutch pressure plate snap ring (Fig. 71).
2. Remove the pressure plate, and the drive and driven clutch plates from the clutch hub (Fig. 72).
3. Remove the disc spring snap ring (Fig. 74).
4. Apply air pressure at the clutch piston pressure hole (Fig. 75) to remove the piston from the clutch hub.
5. Remove the clutch piston outer seal and inner seal from the clutch hub (Fig. 72).

Assembly

1. Install new clutch piston seals on the clutch piston and drum. Lubricate the seals with clean transmission fluid.
2. On transmissions incorporating lip seals on forward clutch pistons, install the piston into the clutch hub with a seal protector (Tool T78P-77548-A). Install the disc spring and retaining snap ring (Fig. 67).
3. **Install the lower pressure plate with the flat side up and the radius side downward.**
4. Install one non-metallic clutch plate and alternately install the drive and driven plates. Before installing new composition clutch plates, soak them in transmission fluid for fifteen minutes. The last plate installed will be the upper pressure plate. Refer to the Specification as listed at the end of this Part for the correct number of clutch plates for the applicable model transmission.
5. Install the pressure plate snap ring (Fig. 71). Make sure the snap ring is fully seated in the ring groove of the clutch hub.

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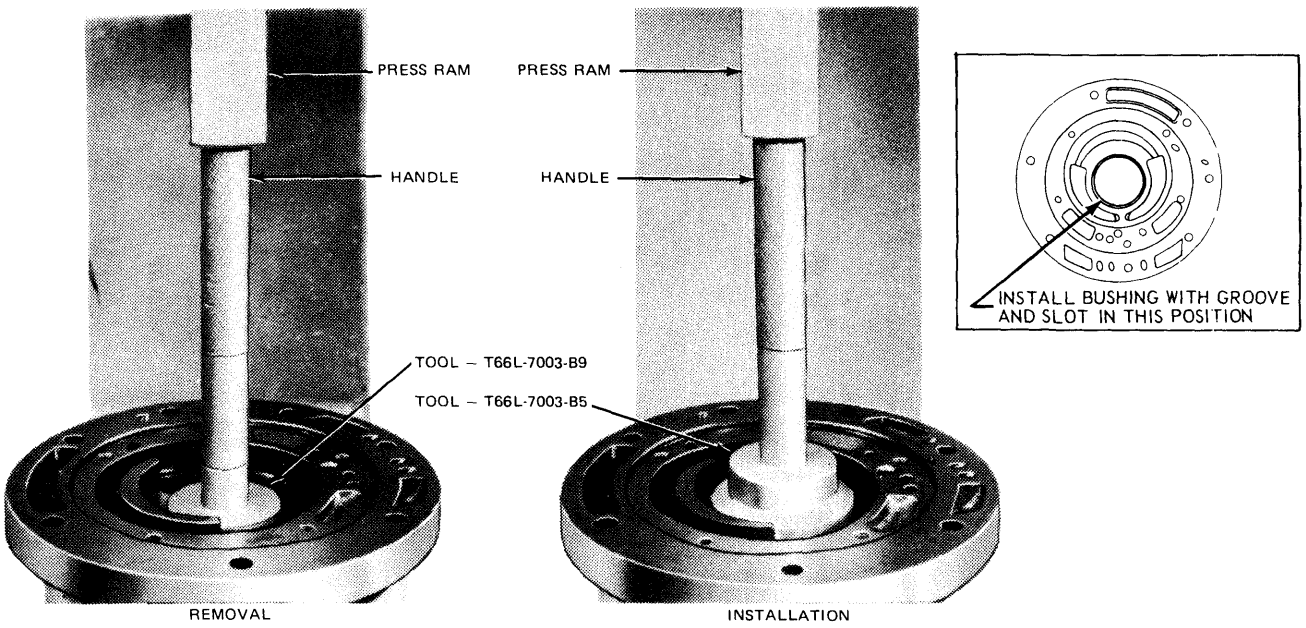


FIG. 62 Replacing Front Pump Housing Bushing

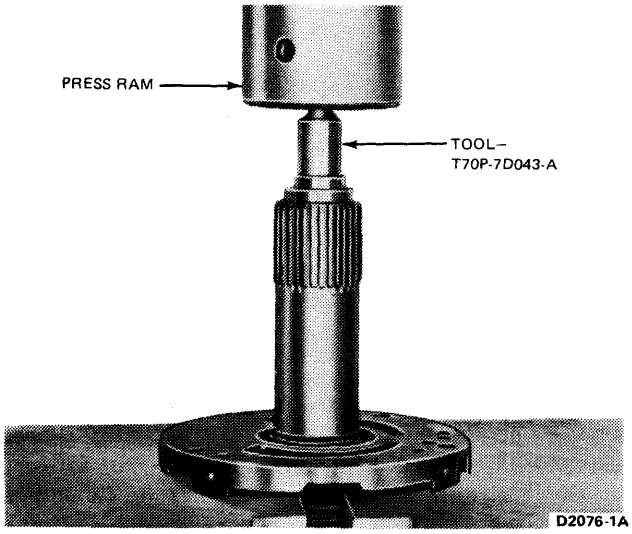


FIG. 63 Installing Stator Support Bushings

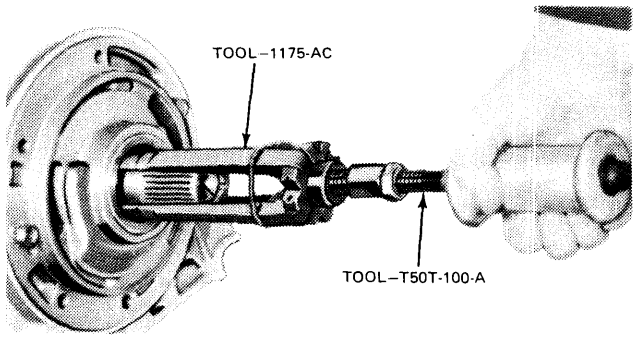


FIG. 64 Removing Front Pump Seal

6. With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 76). Downward pressure on the plate should be used when making this check. The clearance should be 0.025-0.050 inch.

7. If the clearance is not within limits, selective snap rings are available in the following thicknesses: 0.050-0.054, 0.064-0.068, 0.078-0.082 and 0.092-0.096 inch. Insert the correct size snap ring and recheck the clearance.

FORWARD CLUTCH HUB AND RING GEAR

Disassembly

1. Remove the forward clutch hub snap ring (Fig. 77).
2. Remove the forward clutch hub from the ring gear.
3. Press the bushing from the clutch hub as shown in Fig. 78.

Assembly

1. Install a new bushing into the clutch hub as shown in Fig. 78.

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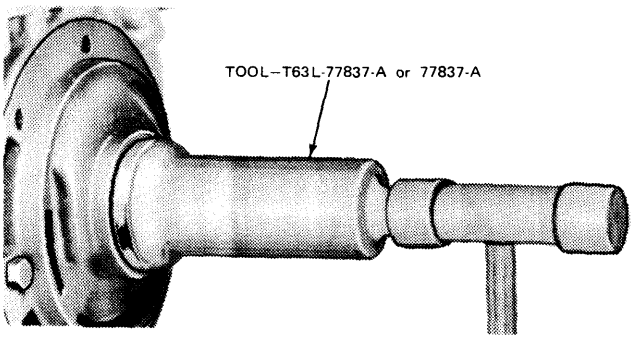


FIG. 65 Installing Front Pump Seal

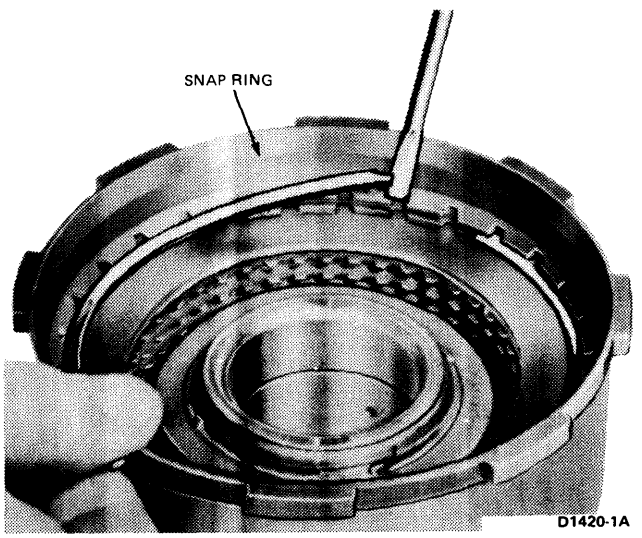


FIG. 66 Removing or Installing Reverse-High Pressure Plate Snap Ring

2. Install the forward clutch hub in the ring gear. Make sure the hub is bottomed in the groove of the ring gear.
3. Install the front clutch hub snap ring. Make sure the snap ring is fully seated in the snap ring groove of the ring gear.

INPUT SHELL AND SUN GEAR

Disassembly

1. Remove the external snap ring from the sun gear (Fig. 79).
2. Remove thrust washer No. 5 from the input shell and sun gear (Fig. 80).
3. From inside the input shell, remove the sun gear. Remove the internal snap ring from the sun gear.
4. If the sun gear bushings are to be replaced, use the tool shown in Fig. 81 and press both bushings through the gear.

Assembly

1. Press a new bushing into each end of the sun gear with the tool shown in Fig. 81.
2. Install the internal snap ring in the sun gear. Install the sun gear in the input shell.
3. Install thrust washer No. 5 on the sun gear and input shell (Fig. 80).
4. Install the external snap ring on the sun gear (Fig. 79).

REVERSE RING GEAR AND HUB

Disassembly

1. Remove the hub snap ring from the reverse ring gear.
2. Remove the hub from the reverse ring gear (Fig. 82).

Assembly

1. Install the hub in the reverse ring gear. Make sure the hub is fully seated in the groove of the ring gear.
2. Install the snap ring in the reverse ring gear. Make sure the snap ring is fully seated in the snap ring groove of the ring gear.

LOW-REVERSE BRAKE DRUM BUSHING

1. Replace the low-reverse brake drum bushing if it is worn or damaged. To remove the bushing, use the cape chisel and cut along the bushing seal until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.
2. Install a new bushing with the tool shown in Fig. 83.

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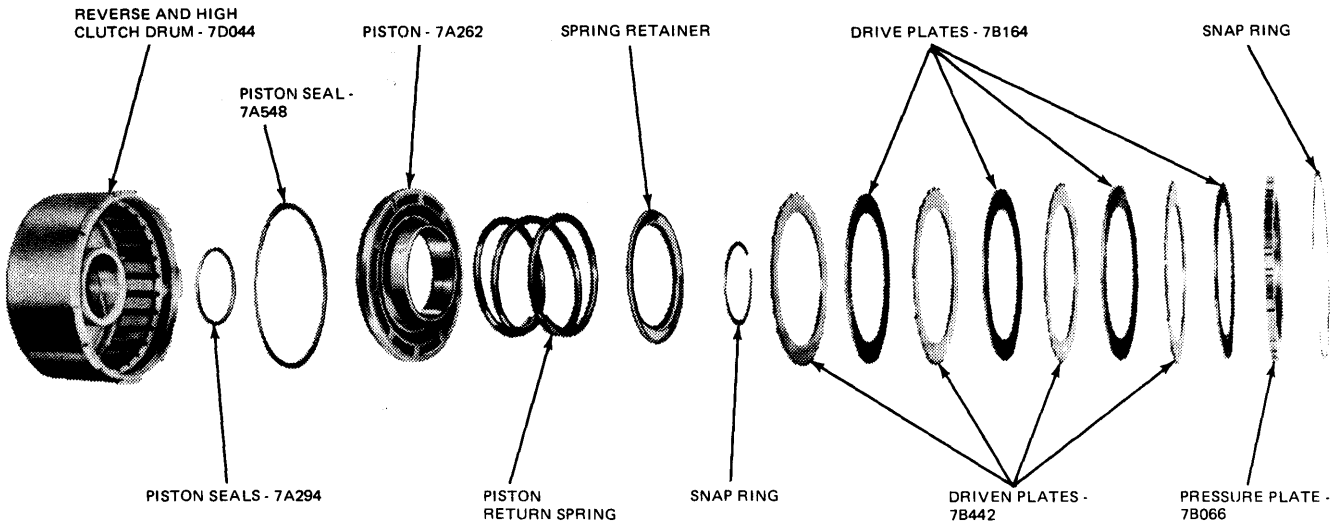


FIG. 67 Reverse-High Clutch Disassembled—Typical

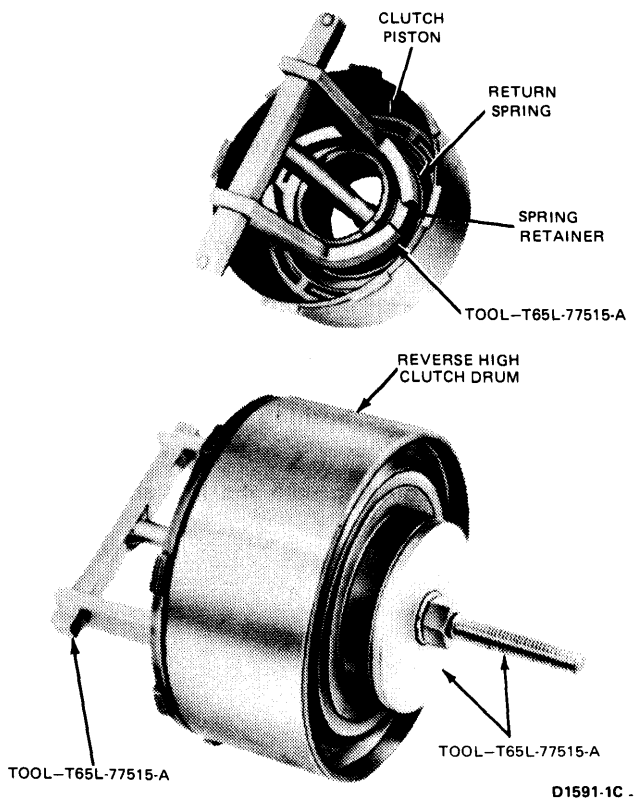


FIG. 68 Removing or Installing Reverse-High Clutch Piston Spring Snap Ring

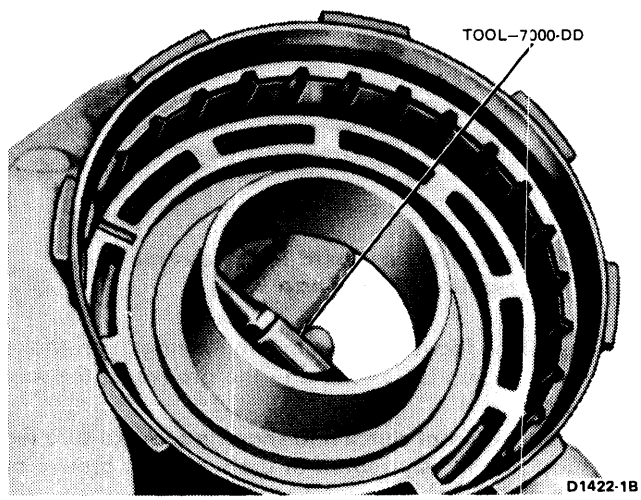
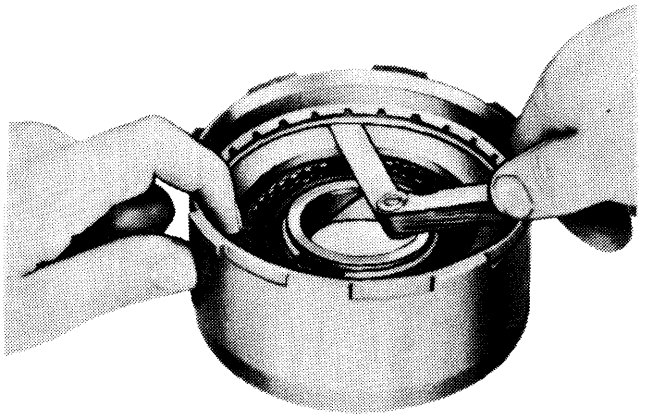


FIG. 69 Removing Reverse-High Clutch Piston

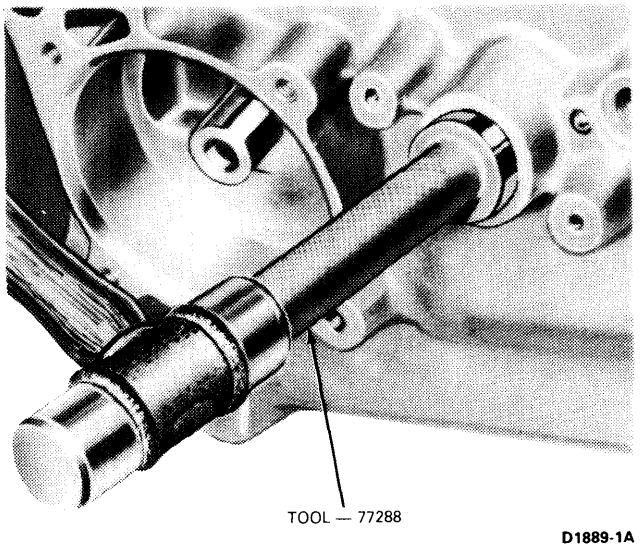
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D1898-1A

FIG. 70 Checking Reverse-High Clutch Snap Ring Clearance



D1889-1A

FIG. 71 Removing or Installing Forward Clutch Pressure Plate Snap Ring

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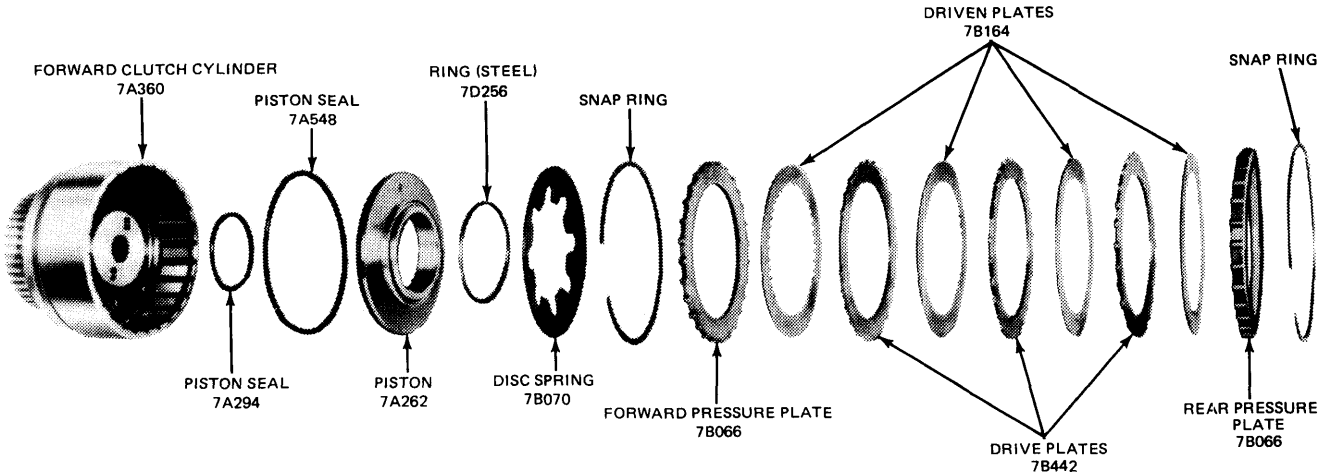


FIG. 72 Forward Clutch Disassembled—Typical

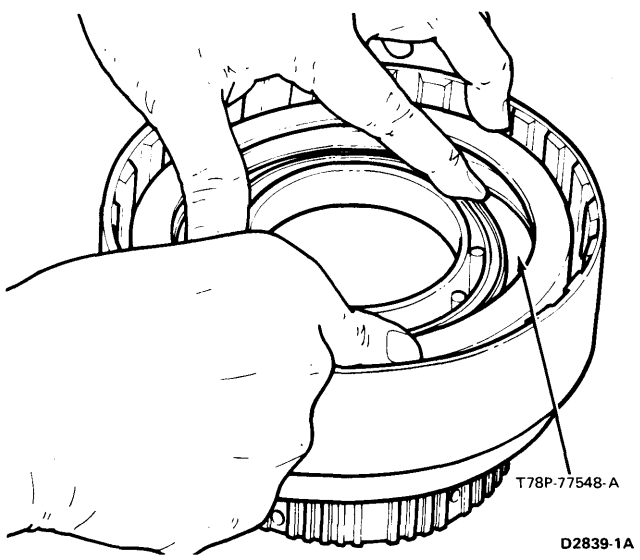


FIG. 73 Installing Clutch Piston Seal Protector Tool

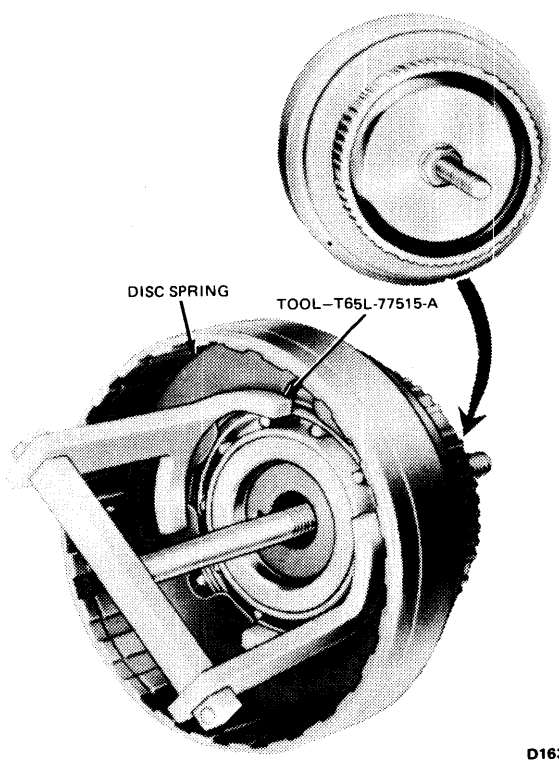


FIG. 74 Removing or Installing Disc Spring Snap Ring

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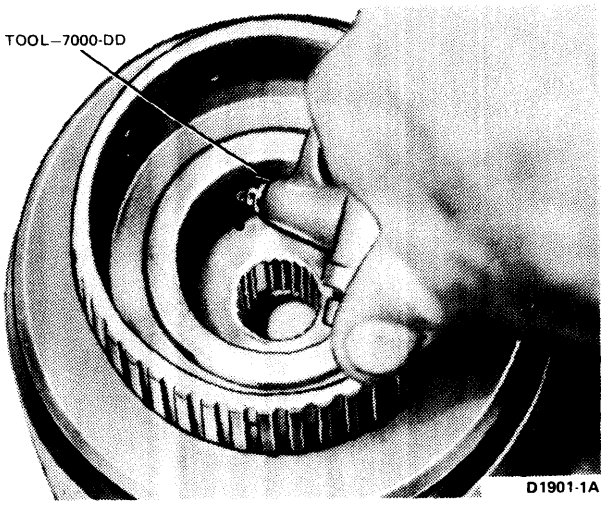


FIG. 75 Removing Forward Clutch Piston

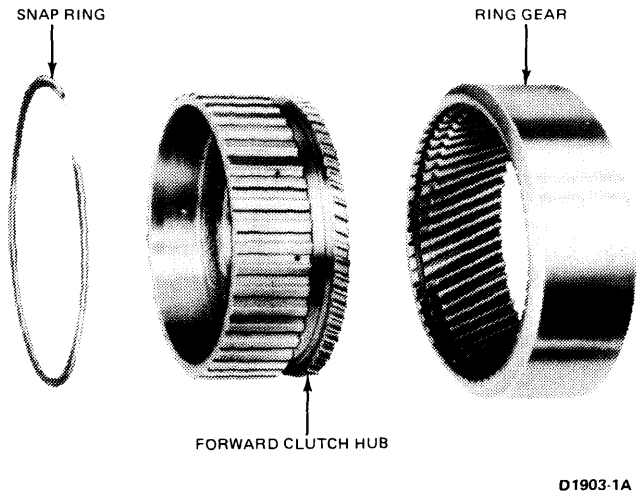


FIG. 77 Forward Clutch Hub and Ring Gear Disassembled

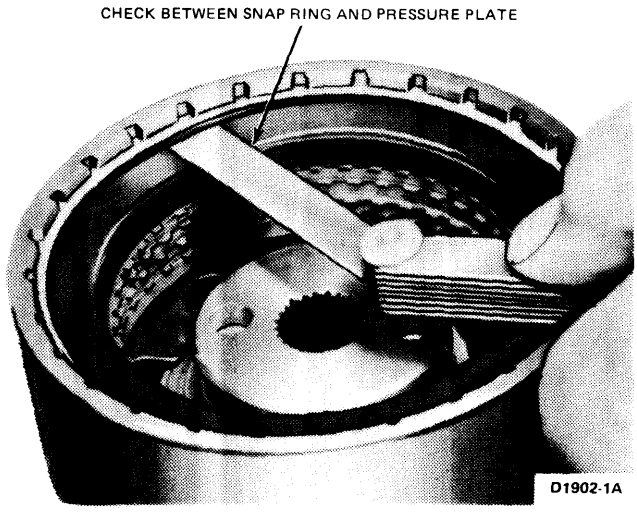


FIG. 76 Checking Forward Clutch Snap Ring Clearance

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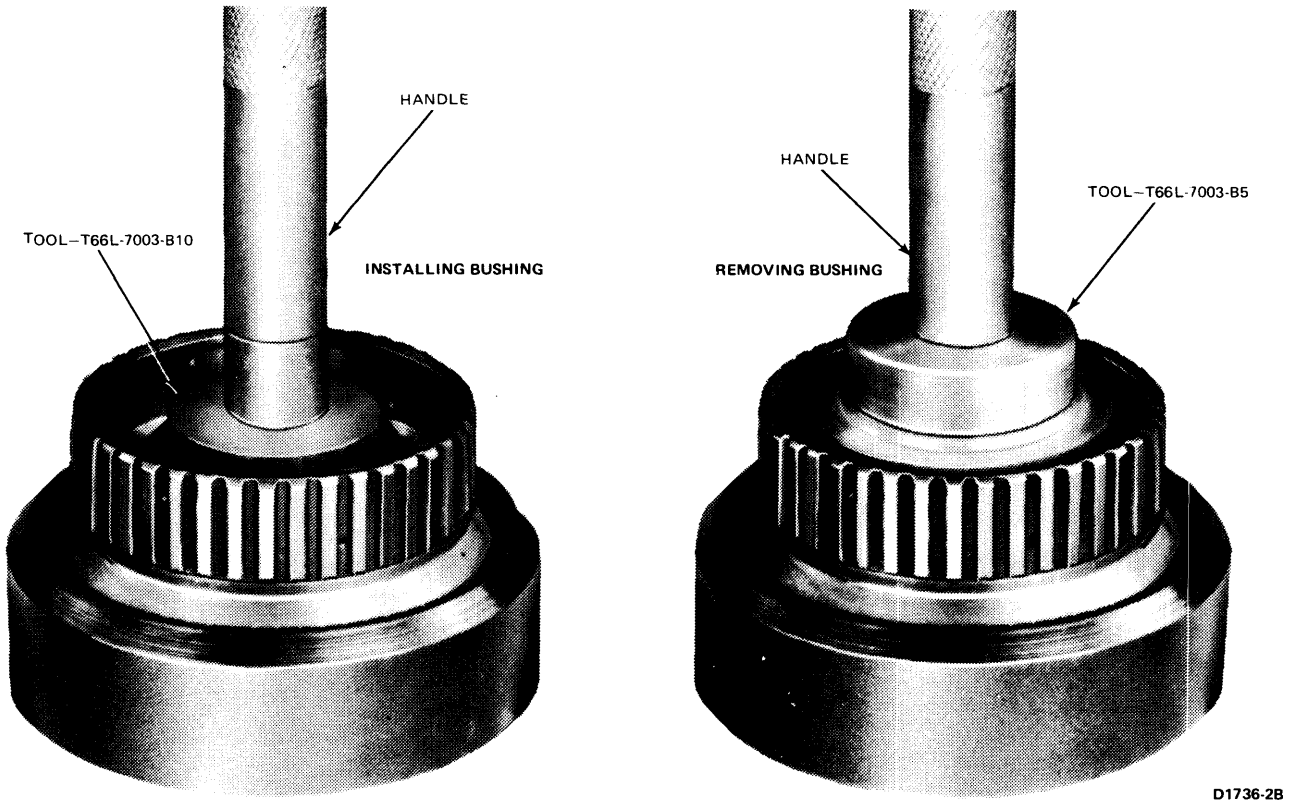


FIG. 78 Replacing Forward Clutch Hub Bushing

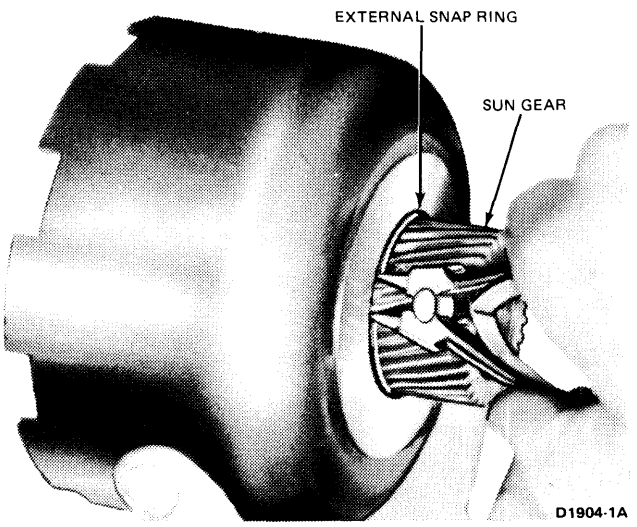


FIG. 79 Removing or Installing Sun Gear External Snap Ring

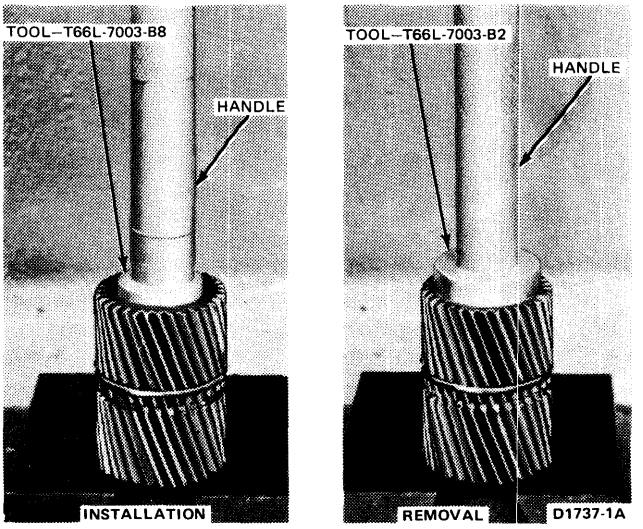


FIG. 81 Replacing Sun Gear Bushing

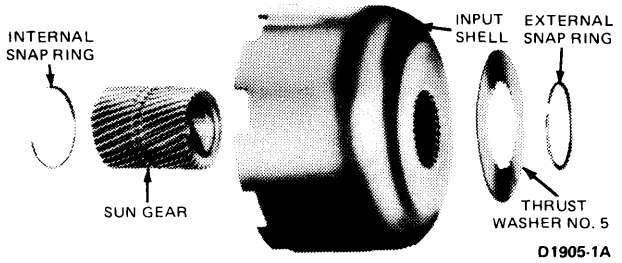


FIG. 80 Input Shell and Sun Gear Disassembled

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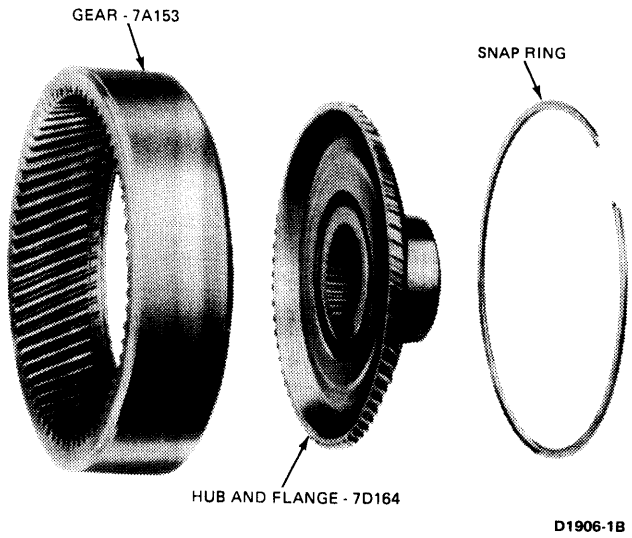


FIG. 82 Reverse Ring Gear and Hub Disassembled

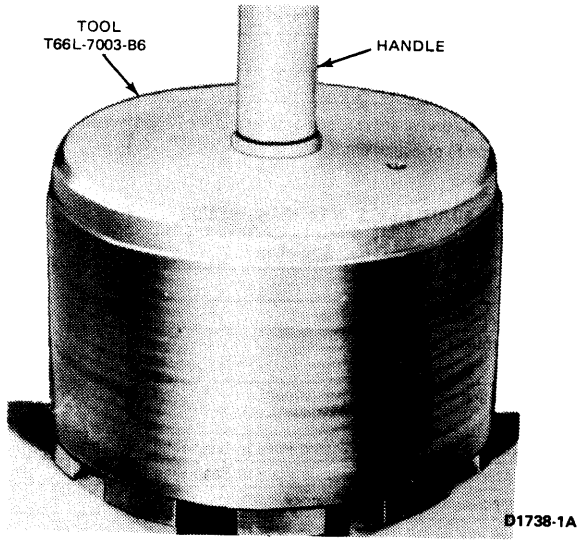


FIG. 83 Installing Low and Reverse Brake Drum Bushing

SPECIFICATIONS

STALL SPEEDS

Trans.	Engine	Converter Ident. On Cover	Converter Size	Stall Ratio	Stall Speed RPM ①	Model Application
C-4	300-1V	DC/DD	12	2.04	1490-1760 1460-1710	F-100, F-150

①Stall speeds shown above are for vehicles operating in areas at or near sea level. Stall speeds at higher altitudes may be slightly lower because of changes in engine output.

CD2824-2B

TORQUE LIMITS — C4 TRANSMISSION

Item	(In-lbs)	N•m
Lower to Upper Valve Body	40-55	5-6
Reinforcement Plate to Body	40-55	5-6
Screen and Lower to Upper Valve Body	40-55	5-6
Neutral Switch to Case	55-75	6.5-8
Neutral Switch to Column	20	2.5
Separator Plate to Lower Valve Body	40-55	5-6
Control Assembly to Case	80-120	9.5-13.5
Gov. Body to Collector Body	80-120	9.5-13.5
Cooler Line Fittings	80-120	9.5-13.5
Detent Spring to Lower Valve Body	80-120	9.5-13.5
Upper Valve Body to Lower Valve Body	80-120	9.5-13.5
Oil Tube Connector	80-120	9.5-13.5
End Plates to Body	25-40	3-4.5
Pump Assembly to Case	20-35	2.5-3.9

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APPROXIMATE REFILL CAPACITIES — C4 TRANSMISSION ①

Transmission Model	U.S. Measure	Imperial Measure	Litre
F-100-150	10 qts.	8¼ qts.	9.4

① Approximate dry capacity including cooler and lines. Fluid level indicator should be used to determine actual fluid requirements. Use fluid meeting Ford specification ESW-MC233-F (Type F) or equivalent.

CHECKS AND ADJUSTMENTS — C4 TRANSMISSION

Operation	Specification
Transmission End Play	0.008-0.042 inch (Selective Thrust Washers Available)
Turbine and Stator End Play	New or Rebuilt 0.023 Max. Used 0.050 Max.
Intermediate Band Adjustment	Remove and discard lock nut. Adjust screw to 10 ft-lbs. torque, then back off 1¾ turns. Install new lock nut and torque to 40 ft-lbs.
Low and Reverse Band Adjustment	Remove and discard lock nut. Adjust screw to 10 ft-lbs. torque, then back off 3 turns. Install new lock nut and torque to 40 ft-lbs.
Forward High Clutch Pressure Plate to Snap Ring Clearance	0.025-0.050
Reverse High Clutch Pressure Plate to Snap Ring Clearance	0.050-0.071
Selective Snap Ring Thickness	0.050-0.054, 0.064-0.068, 0.078-0.082, 0.092-0.096

CLUTCH PLATES — C4 TRANSMISSION

	Forward Clutch			High Clutch		
Transmission Model	External Spline	Internal Spline (Comp.)	Free Pack Clearance (Inches)	External Spline (Steel)	External Spline (Comp.)	Free Pack Clearance (Inches)
PEA	4	5	0.025-0.050	4	4	0.050-0.071

SPECIAL SERVICE TOOLS — C4 TRANSMISSION

Tool Number	Description
T50T-100-A	Impact Hammer
T58L-101-A	Puller Attachment
TOOL-1175-AC	Oil Seal Remover (Head)
TOOL-4201-C	Diff. Backlash & Runout Ga.
T57L-500-B	Trans. Holding Fixture
T65E-6000-J	Engine Support Bar
TOOL-7000-DD	Air Nozzle Rubber Tip Assy.
T66L-7003-B	Auto. Trans. Bushing Kit — Remover and Replacer
T70P-7D043	Stator Support Bushing Installer
T64E-7052-A	Transmission Ext. Hsg. Oil Seal Repl.
T65P-7B456	Clutch Race to Case Bolts Socket
T71P-77370-A	Band Adjustments Socket

Tool Number	Description
Tool 61L-7657-A	Seal Installation Tool
T78P-77548-A	Forward Clutch Piston Lip Seal Prot. Tool
T52L-7000-GAE	Transmission Extension Housing Bushing Remover
T52-7000-HAE	Transmission Extension Housing Bushing Replacer
T59P-77067	Dial Indicator Support Fixture
TOOL-77288	Control Shaft Seal Replacer
T71P-77370-D	Band Adjustment Socket
T71P-77370-H	Front Band Adjust. Torque Wrench
TOOL-77530-A	Clutch Assembly Fixture
T65L-77515-A	Auto. Trans. Clutch Spring Compr.
T57L-77820-A	Auto. Trans. 400 Lb. Pressure Gauge
T63L-77837-A	Front Pump Seal Replacer

TORQUE LIMITS — C4 TRANSMISSION

Item	(ft-lbs)	N•m
Converter to Flywheel	20-30	28-40
Converter Housing to Trans. Case	28-40	38-54
Front Pump to Trans. Case	28-38	38-51
Overrunning Clutch Race to Case	13-20	18-27
Oil Pan to Case	12-16	17-21
Rear Servo Cover to Case	12-20	17-27
Stator Support to Pump	12-20	17-27
Converter Cover to Converter Housing	12-16	17-21
Intermediate Servo Cover to Case	16-22	22-29
Diaphragm Assembly to Case	15-23	21-31
Extension Assembly to Trans. Case	28-40	38-54
Engine to Transmission	40-50	55-67
Starter Attaching Body	20-30	28-40
Engine Support-to-Crossmember	40-60	55-81
Engine to Converter Housing	28-38	38-51
Plug-Case Front Pump or Line Pressure	6-12	9-16

Item	(ft-lbs)	N•m
Pressure Gauge Tap	6-12	9-16
Band Adj. Screw Locknut to Case	35-45	48-61
Yoke to Output Shaft	60-120	82-162
Reverse Servo Piston to Rod	12-20	17-27
Converter Drain Plug	20-30	28-40
Manual Valve Inner Lever to Shaft	30-40	41-54
Downshift Lever to Shaft	12-16	17-21
Filler Tube to Engine	23-33	32-44
Filler Tube to Pan	32-42	44-56
Transmission to Engine	40-50	55-67
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Transfer Case to Transmission	21-30	29-41
Crossmember Attaching Bolts	14-24	19-32
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C-6 Automatic Transmission

PART 17-10

APPLIES TO E-100 — E-350, F-100 — F-350, F-150 — F-250 (4x4), BRONCO

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DESCRIPTION

The C6 transmission is a three speed unit capable of providing automatic upshifts and downshifts through the three forward gear ratios. The transmission is also capable of providing manual selection of first and second gears.

Fig. 1 shows the location of the converter, front pump, clutches, gear train and most of the internal parts used in the C6 transmission. The identification tag (Fig. 2), attached to the intermediate servo lower front cover bolt, includes the model prefix, suffix and serial number. The first line on the tag shows the transmission model prefix and suffix. A number appearing after the suffix indicates that the internal parts in the transmission have been changed after initial production start-up. For example, a PGD-BN model transmission that has been changed internally would read PGD-BN1. Both transmissions are basically the same, but some service parts in the PGN-BN transmission are slightly different than the PGD-BN1 transmission. **Therefore, it is important that the codes on the transmission identification tag be checked when ordering parts or making inquiries about the transmission.**

The hydraulic control system schematic is shown in Fig. 3. The converter housing and the fixed splines which engage the splined outside diameter of the low-reverse clutch steel plates, are both cast integrally into the case.

Only one (intermediate) band is used in the C6 transmission. This along with the forward clutch is used to obtain intermediate gear.

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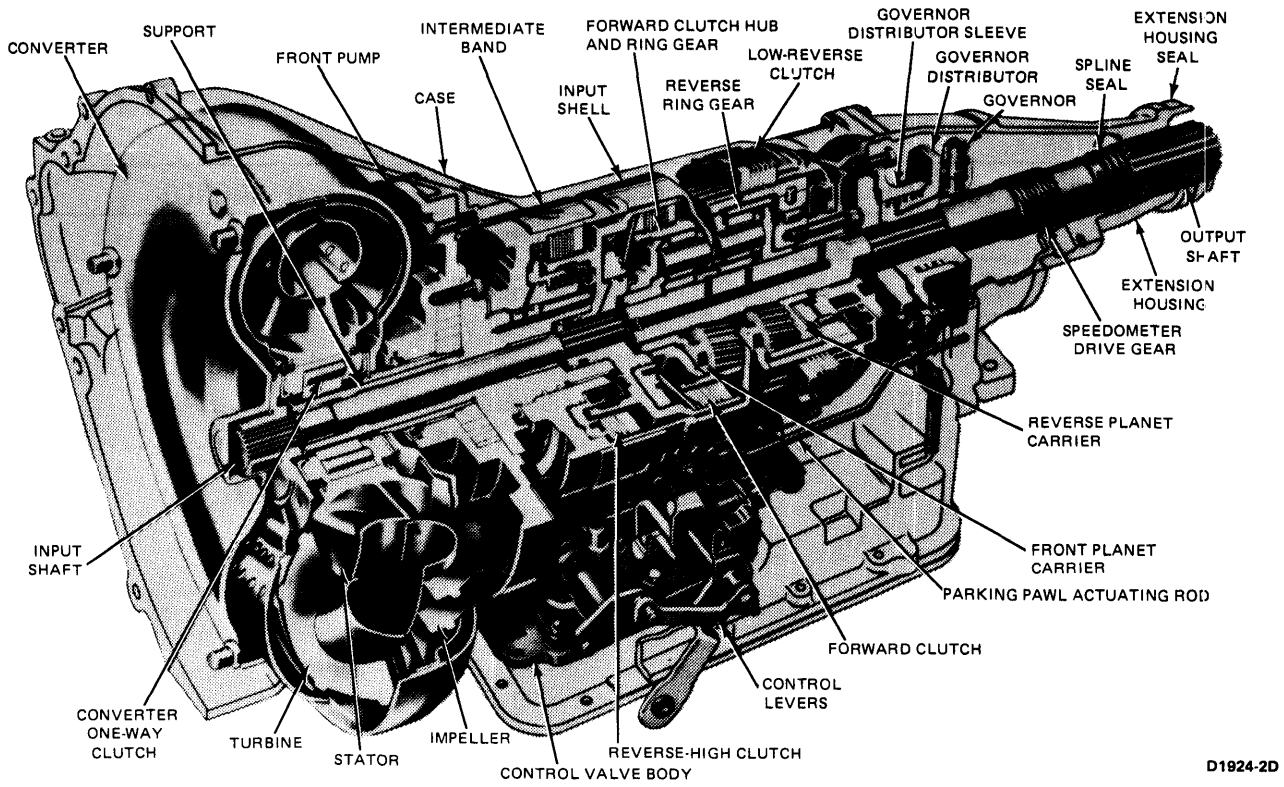


FIG. 1 C-6 Automatic Transmission—Sectional

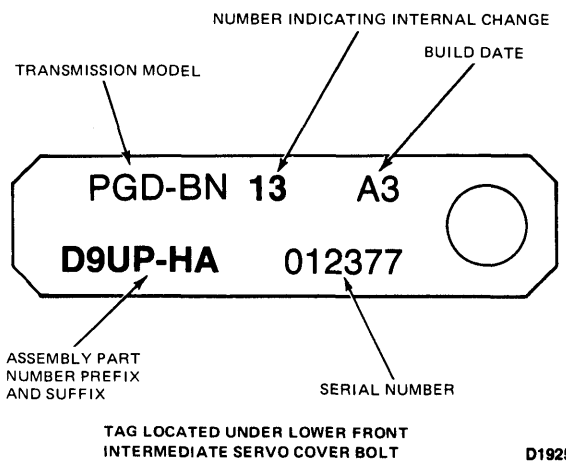


FIG. 2 Identification Tag

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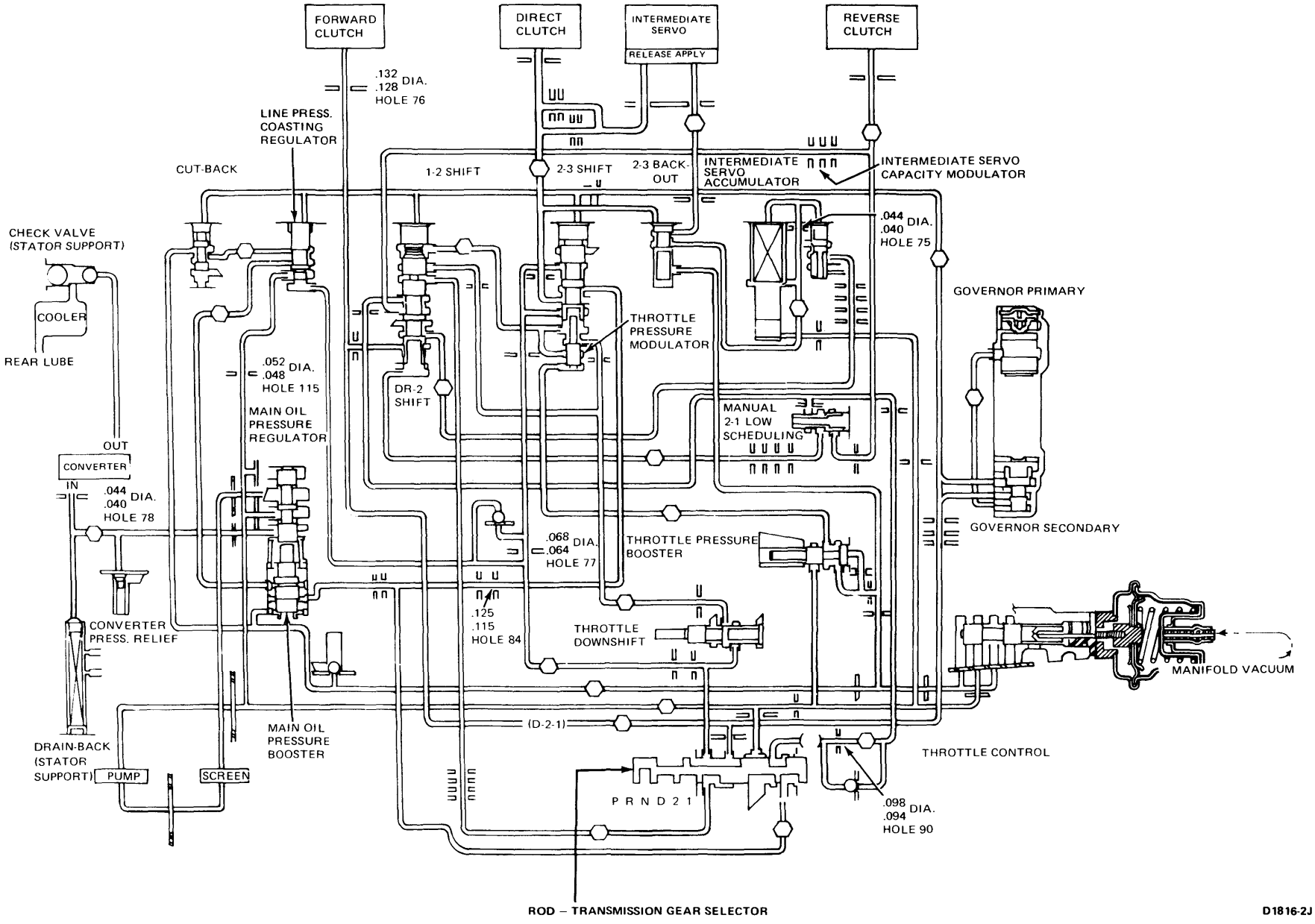


FIG. 3 Hydraulic Control System—C-6 Transmission

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DIAGNOSIS AND TESTING

Refer to Part 17-01, General Automatic Transmission Service.

ADJUSTMENTS

The only adjustment on the transmission is the intermediate band.

To prevent damage to the transmission and to assure proper band adjustment, it is essential that the tools and procedures described here are used whenever the band is adjusted.

INTERMEDIATE BAND ADJUSTMENT

1. Raise the vehicle on a hoist or jack stands.
2. Clean all the dirt from the band adjusting screw.
3. Install a new locknut and tighten the adjusting screw to 10 ft-lb torque (Fig. 4).
4. **Back off the adjusting screw exactly 1-1/2 turns.**
5. Hold the adjusting screw from turning and tighten the locknut to specifications as listed at the end of this Part.
6. Lower the vehicle.

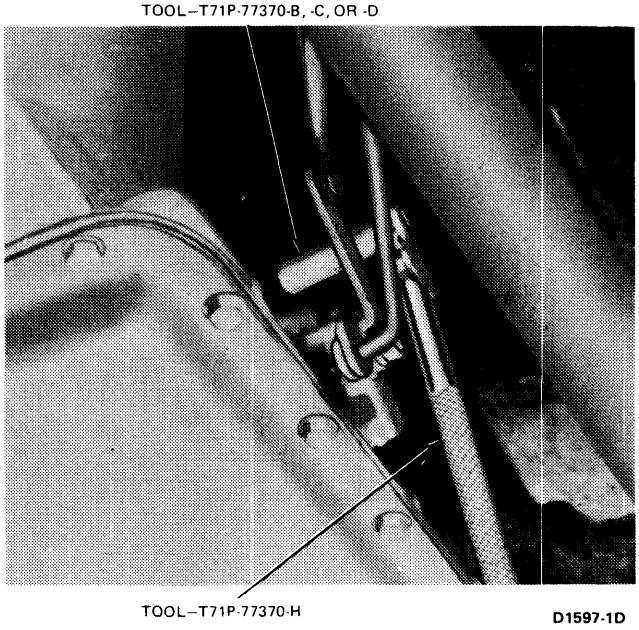


FIG. 4 Adjusting Intermediate Band

REMOVAL AND INSTALLATION

TRANSMISSION

F-100—F-350 AND BRONCO

Removal

1. Drive the vehicle on a hoist, but do not raise at this time.
2. Remove the two upper converter housing-to-engine bolts.
3. Remove the bolt securing the fluid filler tube to the engine cylinder head.
4. Raise the vehicle on a hoist or stands.
5. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
6. Remove the converter drain plug access cover from the lower end of the converter housing.
7. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
8. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug and remove the plug. Place a drain pan under the converter to catch the fluid. After the fluid has been drained, re-install the plug.
9. Disconnect the driveshaft from the rear axle and slide shaft rearward from the transmission. Install a seal installation tool in the extension housing to prevent fluid leakage.
10. Disconnect the speedometer cable from the bearing retainer.
11. Disconnect the throttle and manual linkage rods from the levers at the transmission.
12. Disconnect the oil cooler lines from the transmission.
13. Remove the vacuum hose from the vacuum unit. Remove the vacuum line retaining clip.
14. Disconnect the cable from the terminal on the starter motor. Remove the three attaching bolts and remove the starter motor.
15. On F-150—F-250 (4x4) and Bronco vehicles, remove the transfer case. Refer to Part 16-84, New Process Part Time 205 Transfer Case or Part 16-85, New Process 203 Full Time Transfer Case.
16. Remove the two engine rear support crossmember-to-frame attaching bolts.
17. Remove the two engine rear support-to-extension housing attaching bolts.
18. Remove the eight bolts securing the No. 2 crossmember to the frame side rails.

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19. Raise the transmission with a transmission jack and remove both crossmembers.
20. Secure the transmission to the jack with the safety chain.
21. Remove the remaining converter housing-to-engine attaching bolts.
22. Move the transmission away from the engine. Lower the jack and remove the converter and transmission assembly from under the vehicle.

Installation

1. Tighten the converter drain plug to specifications as listed at the end of this Part.
2. Position the converter on the transmission making sure the converter drive flats are fully engaged in the pump gear.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with the chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.
5. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install and tighten the converter housing-to-engine attaching bolts to specifications as listed at the end of this Part.
7. Remove the transmission jack safety chain from around the transmission.
8. Position the No. 2 crossmember to the frame side rails. Install and tighten the attaching bolts to specifications as listed at the end of this Part.
9. Install transfer case on F-150—F-250 (4x4) and Bronco. Refer to Part 16-84, New Process Part Time 205 Transfer Case or Part 16-85, New Process 203 Full Time Transfer Case.
10. Position the engine rear support crossmember to the frame side rails. Install the rear support-to-extension housing mounting bolts and tighten the bolts to specifications as listed at the end of this Part.
11. Lower the transmission and remove the jack.
12. Secure the engine rear support crossmember to the frame side rails with the attaching bolts and tighten them to specifications as listed at the end of this Part.
13. Connect the vacuum line to the vacuum diaphragm making sure that the line is in the retaining clip.
14. Connect the oil cooler lines to the transmission.
15. Connect the throttle and manual linkage rods to their respective levers on the transmission.
16. Connect the speedometer cable to the bearing retainer.
17. Secure the starter motor in place with the attaching bolts. Connect the cable to the terminal on the starter.
18. Install a new O-ring on the lower end of the transmission filler tube and insert the tube in the case.
19. Secure the converter-to-flywheel attaching nuts and tighten them to specifications as listed at the end of this Part.
20. Install the converter housing dust shield and secure it with the attaching bolts.
21. Connect the drive shaft.
22. Adjust the shift linkage as required. Refer to Part 17-02, Shift Control Linkage.
23. Lower the vehicle. Then install the two upper converter housing- to-engine bolts and tighten them to specifications as listed at the end of this Part.
24. Position the transmission fluid filler tube to the cylinder head and secure with the attaching bolt.
25. Fill the transmission to the correct level with the specified fluid.

E-100—E-350

Removal

1. Working from inside the vehicle, remove the engine compartment cover.
2. Disconnect the neutral start switch wires at the plug connector.
3. If the vehicle is equipped with a V-8 engine, remove the flexhose from the air cleaner heat tube.
4. Remove the upper converter housing-to-engine attaching bolts (three bolts on 6-cylinder engine; four bolts on 8-cylinder engines).
5. Raise the vehicle on a hoist.
6. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
7. Remove the converter drain plug access cover from the lower end of the converter housing.
8. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
9. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug. Place a drain pan under the converter to catch the fluid. Then, remove the plug. With fluid drained, re-install the plug.
10. Disconnect the drive shaft.
11. Remove fluid filler tube.
12. Disconnect the starter cable at the starter. Remove the starter- to-converter housing attaching bolts and remove the starter.
13. Position the engine support bar (Tool T65E-6000-JO) to the side rail and engine oil pan flanges.
14. Disconnect the cooler lines from the transmission. Disconnect the vacuum line from the vacuum diaphragm unit. Remove the vacuum line from the retaining clip at the transmission.
15. Remove the speedometer driven gear from the extension housing.
16. Disconnect the manual and downshift linkage rods from the transmission control levers.

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17. Position a transmission jack to support the transmission. Install the safety chain to hold the transmission.
18. Remove the bolt and nut securing the rear mount to the crossmember. Remove the six bolts retaining the crossmember to the side rails and remove the two support gussets. Raise the transmission with the jack and remove the crossmember.
19. Remove the bolt that retains the transmission filler tube to the cylinder block. Lift the filler tube and dipstick from the transmission.
20. Remove the remaining converter housing-to-engine attaching bolts. Lower the jack and remove the converter and transmission assembly from under the vehicle.
21. Remove the converter and mount the transmission in a holding fixture.

Installation

1. Tighten the converter drain plug to specification as listed at the end of this Part.
2. Position the converter on the transmission making sure the converter drive flats are fully engaged in the pump gear.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with the safety chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.
5. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot.

   The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.
6. Install the lower converter housing-to-engine attaching bolts. Tighten the bolts to specifications as listed at the end of this Part. Install the converter-to-flywheel attaching nuts. Tighten the nuts to specifications as listed at the end of this Part.
7. Install the crossmember. Install the rear mount-to-crossmember attaching bolt and nut. Tighten the bolts to specifications as listed at the end of this Part.
8. Remove the safety chain and remove the jack from under the vehicle. Remove the engine support bar.
9. Install a new O-ring on the lower end of the transmission filler tube and insert the tube in the case.
10. Connect the vacuum line to the vacuum diaphragm making sure the line is secured in the retaining clip.
11. Connect the cooler lines to the transmission.
12. Install the speedometer driven gear into the extension housing. Tighten the attaching bolt to specifications as listed at the end of this Part.
13. Connect the transmission linkage rods to the transmission control levers. When making transmission control attachments new retaining ring and grommet should always be used (see Removal and Installation in Part 17-02, Shift Control Linkage). Note precautions necessary to prevent grommet damage. Attach the shift rod to the steering column shift lever (refer to Fig. 2, Part 17-02, Shift Control Linkage). Align the flats of the adjusting stud with the flats of the rod slot and insert the stud through the rod. Assemble the adjusting stud nut and washer to a loose fit. Perform a linkage adjustment as outlined in Part 17-02, Shift Control Linkage.
14. Install the converter housing cover and tighten the attaching bolts to specifications as listed at the end of this Part.
15. Position the starter into the converter housing and install the attaching bolts. Tighten the bolts to specifications as listed at the end of this Part. Install the starter cable.
16. Install the drive shaft.
17. Lower the vehicle.
18. Install the upper converter housing-to-engine attaching bolts. Tighten the bolts to specifications as listed at the end of this Part.
19. On V-8 engines, install the flex hose to the air cleaner heat tube.
20. Connect the neutral start switch wires at the plug connector.
21. Fill the transmission to the proper level with the specified fluid.
22. Raise the vehicle and check for transmission fluid leakage. Lower the vehicle and adjust the throttle and manual linkage. Refer to Part 17-02, Shift Control Linkage.
23. Install the engine compartment cover.

CONTROL VALVE BODY

Refer to Fig. 21.

Removal

1. Raise the vehicle on a hoist or jack stands.
2. Place a drain pan under the transmission and loosen the bolts to drain the fluid from the transmission.
3. Remove the transmission pan attaching bolts from both sides and the rear to allow the fluid to drain further. Finally, remove the remainder of the attaching bolts. Remove the pan and gasket. Remove and discard the nylon shipping plug from the filler tube hole. This plug is used to retain transmission fluid within the transmission during shipment and should be discarded when the oil pan is removed.
4. Remove the valve body attaching bolts and remove the valve body from the case.

Installation

1. Position the valve body to the case making sure that the selector and downshift levers are engaged. Install and tighten the attaching bolts to specifications as listed at the end of this Part.
2. Clean the transmission pan and gasket surfaces thoroughly.
3. Using a new pan gasket, secure the pan to the transmission case. Tighten the attaching bolts to specifications as listed at the end of this Part.
4. Lower the vehicle and fill the transmission to the correct level with the specified fluid.

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INTERMEDIATE SERVO

(Refer to Fig. 5.)

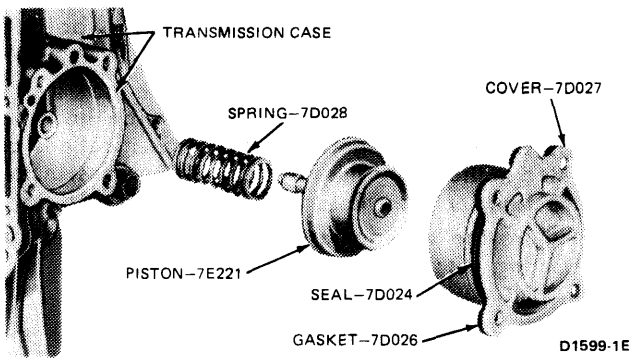


FIG. 5 Intermediate Servo Disassembled—Typical

Removal

1. Raise the vehicle on a hoist or stands.
2. Remove the bolt that secures the engine rear support to the crossmember.
3. Remove the two crossmember- to-frame attaching bolts.
4. Raise the transmission high enough to remove the weight from the crossmember and remove the crossmember.
5. Disconnect the muffler inlet pipe from the exhaust manifolds and allow the pipe to hang.
6. Place a drain pan under the servo. Remove the bolts that attach the servo cover to the transmission case.
7. Remove the cover, piston, spring and gasket from the case, screwing the band adjusting screw inward as the piston is removed. This places enough tension on the band to keep the struts properly engaged in the band end notches while the piston is removed.
8. Apply air pressure to the port in the servo cover to remove the piston and rod.
9. Replace the complete piston and rod assembly if the piston or piston sealing lips are damaged, (Fig. 5).
10. Remove the seal from the cover.

Installation

1. Dip the new seals in transmission fluid.
2. Install a new seal on the cover.
3. Coat new gasket with petroleum jelly, and position on the servo cover.
4. Dip the piston in transmission fluid and install it in the cover.
5. Position the servo spring on the piston rod.
6. Insert the servo piston in the case. Secure the cover with the attaching bolts, taking care to back off the band adjusting screw as the cover bolts are tightened. **Make sure that the service identification tag is in place.**
7. Connect the muffler inlet pipe to the exhaust manifolds.
8. Raise the transmission high enough to install the crossmember. Secure the crossmember to the rear support with the attaching bolt. Lower the transmission as required to install the crossmember to frame attaching bolts. Tighten the attaching bolts to specifications as listed at the end of this Part.
9. Remove the jack from the transmission. Adjust the band as detailed in the Adjustment section of this Part.
10. Lower the vehicle and replenish the fluid as required. Refer to Part 17-01 General Automatic Transmission Service.

EXTENSION HOUSING BEARING OR BUSHING AND REAR SEAL

E-100—E-350, F-100—F-350

Removal

1. Raise the vehicle and disconnect the drive shaft at the transmission.
2. When only the rear seal needs replacing, carefully remove it with a tapered chisel or the tools shown in Fig. 6. Remove the bushing as shown in Fig. 7. **Use the bushing remover carefully so that the spline seal is not damaged.**

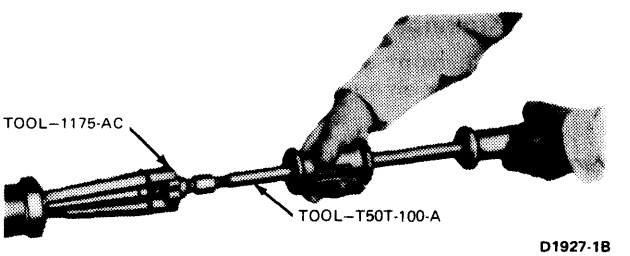


FIG. 6 Removing Extension Housing Seal

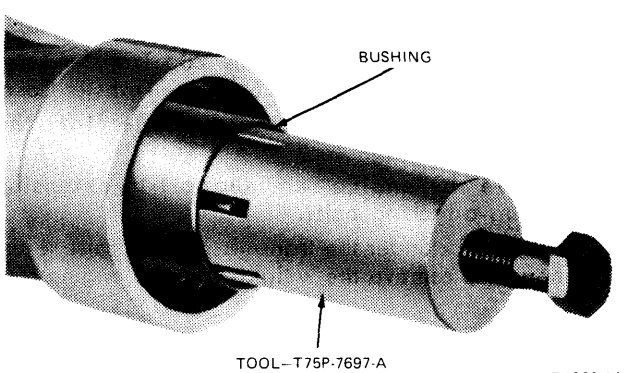


FIG. 7 Removing Extension Housing Bushing

Installation

1. When installing a new bushing use the special tool shown in Fig. 8.
2. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.
3. Inspect the counterbore of the housing for burrs. Remove burrs with crocus cloth.

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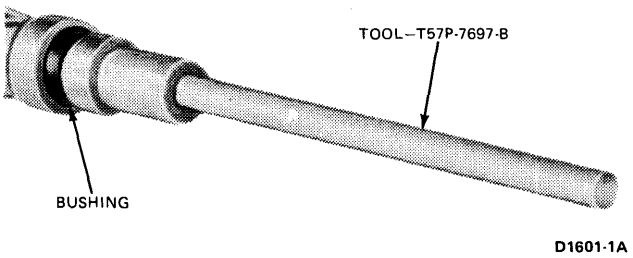


FIG. 8 Installing Extension Housing Bushing

4. Install the seal into the housing with the tool shown in Fig. 9. The seal should be firmly seated in the bore. Coat the inside diameter of the end of the seal with ESA-M1C75-B or an equivalent lubricant.

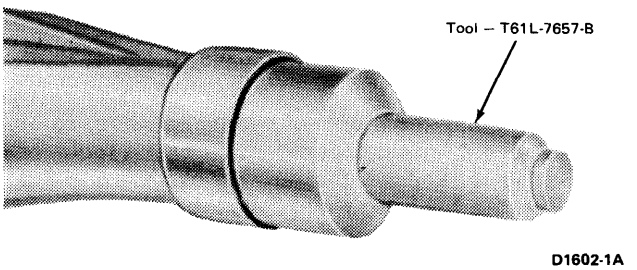


FIG. 9 Installing Extension Housing Seal

5. Coat the front universal joint spline with ESA-M1C75-B or an equivalent lubricant and install the drive shaft.

EXTENSION HOUSING

E-100—E-350, F-100—F-350

Removal

1. Raise the vehicle on a hoist or stands.
2. Disconnect the drive shaft from the rear axle flange and remove it from the transmission. On 4x4 vehicles, remove the transfer case. Refer to Part 16-84, New Process Part Time 205 Transfer Case or 16-85, New Process 203 Full Time Transfer Case.
3. Disconnect the speedometer cable from the extension housing.
4. Remove the engine rear support-to-extension housing attaching bolts.
5. Place a jack under the transmission and raise it just enough to remove the weight from the engine rear support.
6. Remove the bolt that secures the engine rear support to the crossmember and remove the support.
7. Place a drain pan under the rear of the transmission case.
8. Lower the transmission and remove the extension housing attaching bolts. Slide the extension housing off the output shaft and allow the fluid to drain.

Installation

1. Clean the mounting surface on the transmission case and on the extension housing. Position a new gasket on the transmission case.
2. Hold the extension housing in place and secure it with the attaching bolts.
3. Raise the transmission high enough to position the engine rear support on the crossmember.
4. Secure the support to the crossmember with the attaching bolt and nut. Tighten the bolt to specifications as listed at the end of this Part.
5. Lower the transmission and remove the jack. Install the engine rear support-to-extension housing attaching bolts. Tighten bolts to specifications as listed at the end of this Part. On 4x4 vehicles, install the transfer case. Refer to Part 16-84 or 16-85.
6. Secure the speedometer cable to the extension housing with the attaching bolt.
7. Install the drive shaft.
8. Fill the transmission to the correct level with the specified fluid.

GOVERNOR

Removal

1. Remove the extension housing as outlined in this section of the manual.
2. Remove the governor-to-distributor attaching bolts (Fig. 10).

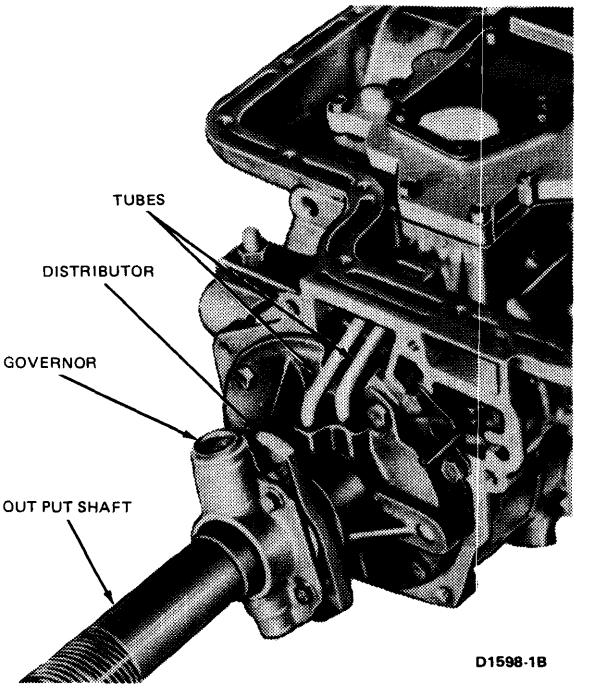


FIG. 10 Governor Installed

3. Remove the governor from the flange.
4. Refer to the Disassembly and Assembly section of this Part for Governor repair operations.

Installation

1. Secure the governor (Fig. 10) to the distributor flange with the attaching bolts. Tighten the bolts to specification.
2. Re-install the extension housing as outlined in this Part of the Manual.

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DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts.

During the repair of the subassemblies, certain general instructions which apply to all units of the transmission must be followed. Following these instructions will avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces. Lubricate all internal parts of the transmission with clean automatic transmission fluid before assembly.

Do not use any other lubricants except on gaskets and thrust washers. These may be coated with petroleum jelly to facilitate assembly. Always use new gaskets and seals when assembling a transmission. Refer to Part 17-01, General Automatic Transmission Service for Cleaning and Inspection Procedures.

Tighten all bolts and screws to the recommended torque as outlined in specifications at end of this Part.

Disassembly

1. Mount the transmission in holding fixture T64L-6001-A, (Fig. 11).

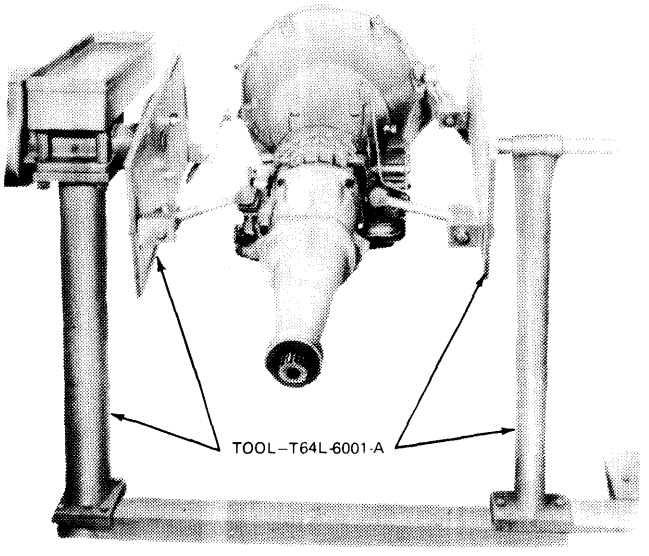


FIG. 11 Transmission Mounted in Holding Fixture

2. Remove the 17 fluid pan attaching bolts. Remove the pan and gasket.
3. Remove the eight valve body attaching bolts. Lift the valve body (Fig. 12) from the transmission case.
4. Attach a dial indicator to the front pump as shown in Fig. 13. Install Tool T61L-7657-B in the extension housing to center the output shaft.
5. Pry the gear train to the rear of the case and at the same time, press the input shaft inward until it bottoms, (Fig. 13). Set the dial indicator to read zero.

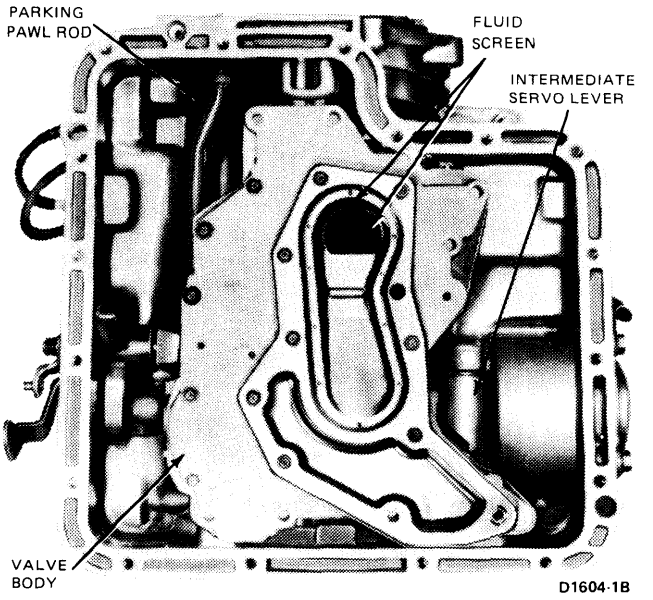


FIG. 12 Transmission With Pan Removed

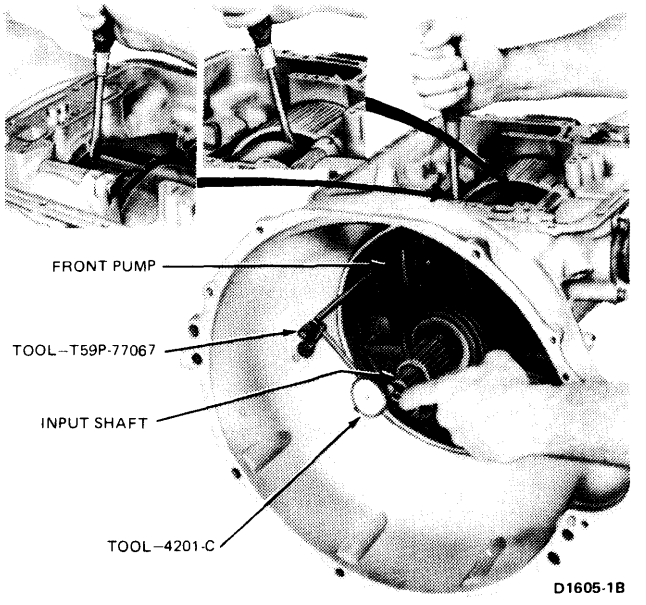


FIG. 13 Checking Gear Train End Play

6. Pry the gear train forward, (Fig. 13), and note the amount of gear train end play on the dial indicator. Record the end play to facilitate assembling the transmission. Remove the dial indicator from the pump and the tool from the extension housing.
7. Remove the vacuum diaphragm, rod and the primary throttle valve from the case. Slip the input shaft out of the front pump.
8. Remove the front pump attaching bolts. Pry the gear train forward as shown in Fig. 14 to remove the pump.

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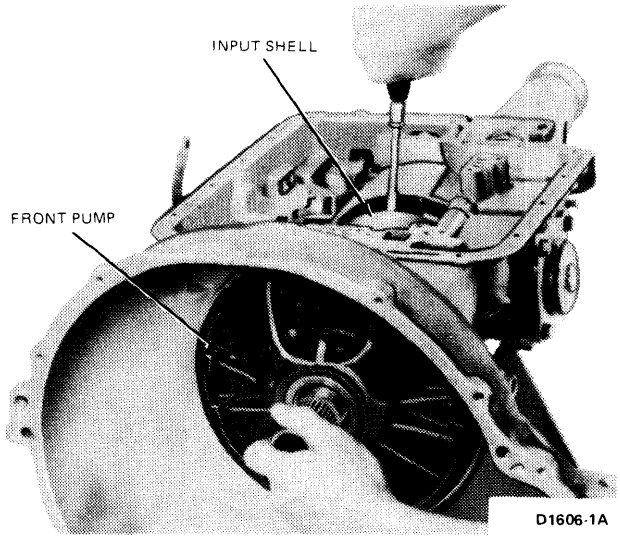


FIG. 14 Removing Front Pump

9. Loosen the band adjustment screw and remove the two struts.
10. Rotate the band 90 degrees counterclockwise to align the ends with the slot in the case (Fig. 15). Slide the band off the reverse-high clutch drum.

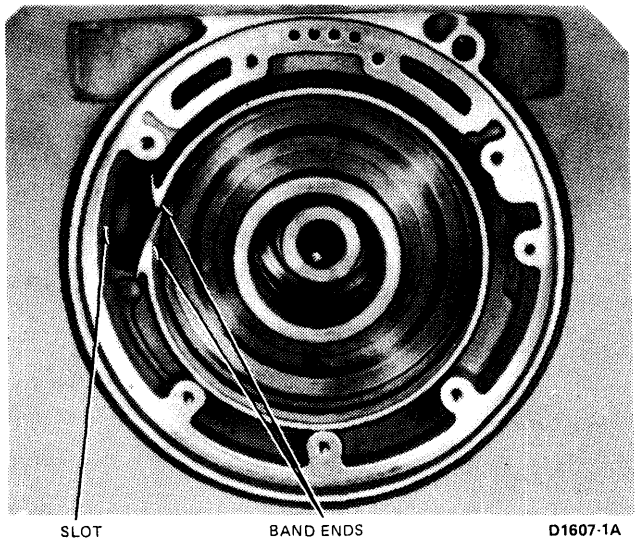


FIG. 15 Removing or Installing Band

11. Remove the forward part of the gear train as an assembly as shown in Fig. 16.
12. Remove the bolts that attach the servo cover to the transmission case.
13. Remove the cover, piston, spring and gasket from the case.
14. Remove the large snap ring that secures the reverse planet carrier in the low-reverse clutch hub. Lift the planet carrier from the drum.
15. Remove the snap ring, (Fig. 17), that secures the reverse ring gear and hub on the output shaft. Slide the ring gear and hub off the shaft.
16. Rotate the low-reverse clutch hub in a clockwise direction and at the same time, withdraw it from the case.

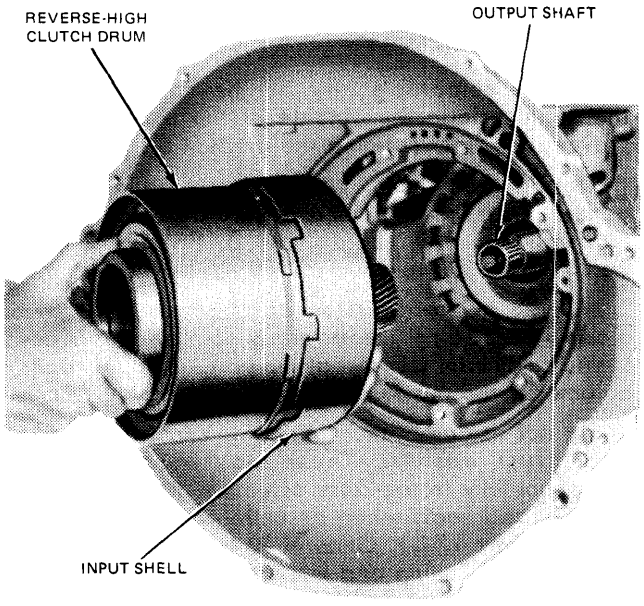


FIG. 16 Removing or Installing Forward Part of Gear Train

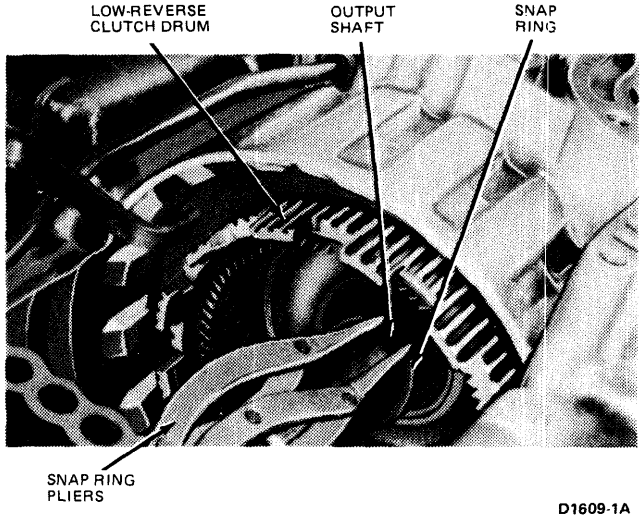


FIG. 17 Removing or Installing Reverse Ring, Gear Hub, Snap Ring

17. Remove the reverse clutch snap ring from the case, then remove the clutch discs, plates and pressure plate from the case.
18. Remove the extension housing attaching bolts and vent tube from the case. Remove the extension housing and gasket.
19. Slide the output shaft assembly from the transmission case.
20. Remove the distributor sleeve attaching bolts and remove the sleeve, parking pawl gear and the thrust washer.

    If the thrust washer is staked in place, use a sharp chisel and cut off the metal from behind the thrust washer. Be sure to clean the rear of the case with

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air pressure or a suitable solvent to remove any metal particles.

21. Compress the reverse clutch piston release spring with Tool T65L-77515-A (Fig. 18). Remove the snap ring. Remove the tool and the springs and retainer assembly.

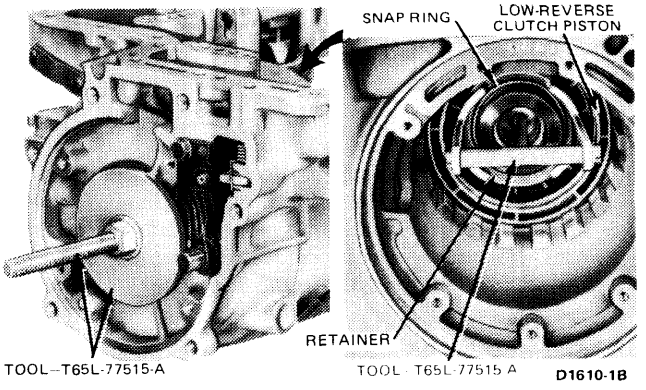


FIG. 18 Compressing Reverse Clutch Springs

22. Remove the one-way clutch inner race attaching bolts from the rear of the case. Remove the inner race from inside of the case.
23. Remove the low-reverse clutch piston from the case as shown in Fig. 19.

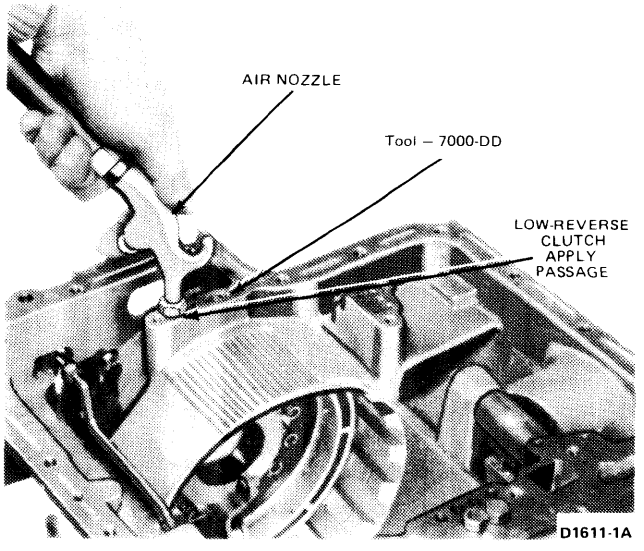


FIG. 19 Removing Low-Reverse Clutch Piston

Assembly

1. Place the transmission case in a holding fixture.
2. Tap the low-reverse piston into place in the case with a clean rubber hammer.
3. Hold the one-way clutch inner race in position and install the attaching bolts. Tighten bolts to specifications at the end of this Part.
4. Install the low-reverse clutch return spring and retainer assembly in the clutch piston.
5. Position the retainer snap ring in place on the one-way clutch inner race.
6. Install the compressing tool shown in Fig. 18 and compress the springs just enough to install the low-reverse clutch piston snap ring.
7. Install the snap ring, then remove the compressing tool.
8. Place the transmission case on the bench with the front end facing downward.
9. Position the parking gear thrust washer and the gear on the case (Fig. 29). **Do not re-stake the thrust washer.**
10. Position the oil distributor and tubes in place on the rear of the case. Install the attaching bolts and torque to specifications as listed at the end of this Part.
11. Install the output shaft, and governor as an assembly.
12. Place a new gasket on the rear of the transmission case. Position the extension housing on the case and install the attaching bolts. Tighten the attaching bolts to specifications as listed at the end of this Part.
13. Place the transmission case in the holding fixture.
14. Coat two new gaskets with petroleum jelly and position them on the servo cover.
15. Position the servo spring on the piston rod.
16. Insert the servo piston rod in the case. Install the attaching bolts, making sure that the identification tag is in place. Tighten the attaching bolts to specifications as shown at the end of this Part.
17. Align the low-reverse clutch hub and one-way clutch with the inner race at the rear of the case. Rotate the low-reverse clutch hub clockwise while applying pressure to seat it on the inner race.
18. Install the low-reverse clutch plates, starting with the wave plate next to the piston and following with steel and friction plates alternately. Retain them with petroleum jelly. Five (5) steel and five (5) friction plates are required for all models. If new composition plates are being used, soak them in clean transmission fluid, (ESP-M2C138 CJ, Dexron II, Series D, or equivalent), for fifteen minutes before installation. Install the pressure plate and the snap ring. Test the operation of the low-reverse clutch by applying air pressure at the clutch pressure apply hole in the case.
19. Install the reverse planet ring gear thrust washer and the ring gear and hub assembly. Insert the snap ring in the groove in the output shaft.
20. Assemble the front and rear thrust washers onto the reverse planet assembly; retain with petroleum jelly. Insert the assembly into the ring gear and install the snap ring.
21. Set the reverse-high clutch on the bench, with the front end facing down. Install the thrust washer on the rear end of the reverse-high clutch assembly. Retain the thrust washer with petroleum jelly and insert the splined end of forward clutch into the open end of the reverse-high clutch with splines engaging the direct clutch friction plates (Fig. 38).
22. Install the thrust washer and retain it with petroleum jelly, on the front end of the forward planet ring gear and hub. Insert the ring gear into the forward clutch.

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23. Install the thrust washer on the front end of the forward planet assembly. Retain the washer with petroleum jelly and insert the assembly into the ring gear. Install the input shell and sun gear assembly.
24. Install the reverse-high clutch, forward clutch, forward planet assembly and drive input shell, and sun gear as an assembly into the transmission case.
25. Insert the intermediate band into the case around the direct clutch cylinder. Install the struts and tighten the band adjusting screw sufficiently to retain the band.
26. Place a selective thickness bronze thrust washer on the rear shoulder of the stator support and retain it with petroleum jelly. If the end play was not within specification when checked prior to disassembly, replace the washer with one of proper thickness. Refer to specifications at the end of this Part for selective thrust washer thicknesses.

    Using two 5/16-inch bolts three inches long, make two alignment studs. Cut the heads from the bolts and grind a taper on the cut end. Temporarily install the two studs opposite each other in the mounting holes of the case. Slide a new gasket onto the studs. Position pump on case, being careful not to damage the large seal on the outside diameter of the pump housing, (removing the aligning studs).

    Install six of the seven mounting bolts and tighten to specifications as listed at the end of this Part.
27. Adjust the intermediate band as detailed under Adjustments and install the input shaft with the long splined end inserted into the forward clutch assembly.
28. Install Tool 4201-C at the seventh pump mounting bolt (Fig. 13) and check the transmission end play. (See specifications at the end of this Part.) Remove the tool.

    Install the seventh pump mounting bolt and tighten to specifications.
29. Install the main control on the case, making sure that the levers engage the valves properly. Install the primary throttle valve, rod, and the vacuum diaphragm in the case.
30. Install a new pan gasket and the pan. Tighten the bolts to specifications.
31. Install the converter assembly.
32. Install the transmission in the vehicle as detailed under Removal and Installation.

CONTROL VALVE BODY

Disassembly

The valve body-to-screen gasket should not be cleaned in a degreaser solvent or any type of detergent solution when disassembling the main control. To clean the gasket, wipe it off with a lint-free cloth.

1. Remove the nine screws that attach the screen to the lower valve body (Fig. 20) and remove screen and gasket (Fig. 21).
2. Remove the five upper-to-lower valve body and hold-down plate attaching screws. Remove the seven attaching screws from the underside of the lower valve body (Fig. 20).
3. Separate the bodies and remove the separator plate and gasket. **Be careful not to lose the check valves and springs.** Remove and clean the separator plate screen if necessary (Fig. 21).
4. Remove the manual valve plunger retaining pin from the upper valve body and remove the plunger.
5. Slide the manual valve (Fig. 22) out of the valve body.
6. Cover the downshift valve port with a finger, then working from the underside of the body remove the downshift valve retainer. Remove the spring and downshift valve (Fig. 22).
7. Apply hand pressure on the pressure boost valve sleeve end and remove the sleeve retaining clip from the under side of the body. Slowly release hand pressure and remove the sleeve and the pressure boost valve. Remove the two springs, the spring retainer and the main regulator valve from the bore.
8. Apply pressure on the throttle boost valve retaining plate and remove the two attaching screws. Slowly release the pressure and remove plate, throttle boost valve and spring, and the manual low 2-1 scheduling valve and spring from the body (Fig. 22).
9. Apply pressure on the remaining valve retaining plate and remove the eight attaching screws.
10. Hold the valve body so that the plate is facing upward. Slowly release the pressure and remove the plate.
11. When removing the various valves from the control valve body, keep all ports covered with your fingers except the bore the valve is being removed from. Remove the spring and the intermediate servo modulator valve (Fig. 22) from the valve body.
12. Remove the intermediate servo accumulator valve and springs.
13. Remove the 2-3 back-out valve, spring and 3-2 shift timing valve plug. Do not remove the 3-2 shift timing valve plug, (Fig. 22) if it is found to be peened, preventing its removal. This condition will not affect transmission operation and is not cause for replacement of the main control.
14. Remove the 2-3 shift valve, spring and the throttle modulator valve.
15. Remove the 1-2 shift valve, DR-2 shift valve and the spring from the valve body.
16. Remove the coasting regulator valve, (Fig. 22) from the body.
17. Remove the cutback control valve to complete the disassembly of the control valve.

Assembly

1. Place the 3-2 shift timing valve plug in the valve body if it was previously removed.
2. Place the downshift valve and spring in the valve body. Compress the spring and install the retainer from the underside of the body (Fig. 23).
3. Place the valve body on a clean surface with the passage side facing up. Place the converter relief valve spring in its bore (Fig. 23). Coat the converter relief valve check valve with petroleum jelly and place it on top of the spring. Place the 2-3 shift

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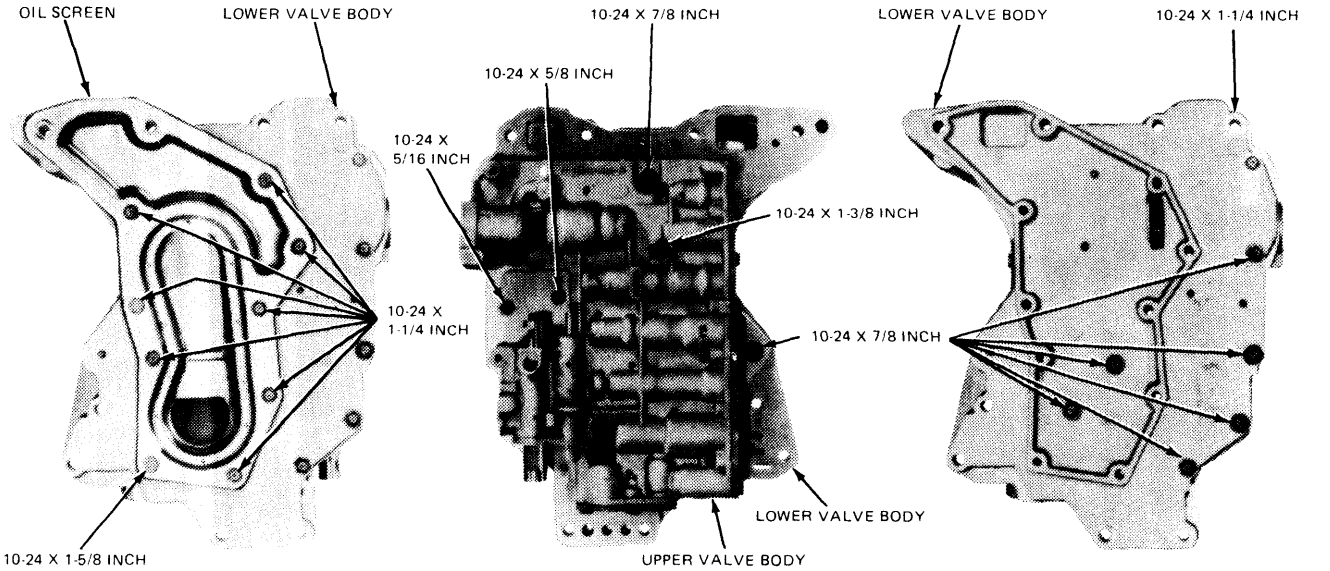


FIG. 20 Control Valve Body and Screen Attaching Screws

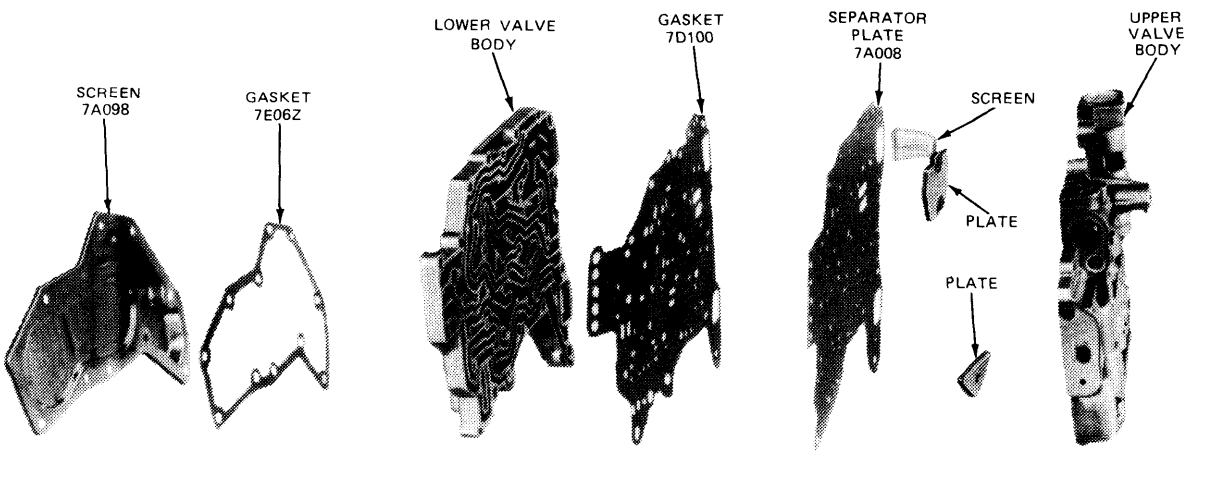


FIG. 21 Upper and Lower Valve Bodies Disassembled

check valve ball in its cavity. Place the throttle pressure relief valve spring in its bore (Fig. 23). Coat the throttle pressure relief valve check ball with petroleum jelly and place it on top of the spring.

4. Install the separator screen in the separator plate if it was previously removed. **Be sure the screen tabs are flush with the separator plate surface.** Carefully position the separator plate and new gasket on the lower valve body. Place the two hold-down plates on the separator plate and install the attaching screws finger tight.
5. Place the lower body and plate assembly on the upper valve body (Fig. 20) and install the attaching screws finger tight.
6. Install the oil screen screws loosely, without the screen, to properly align the upper and lower valve bodies, gasket and separator plate.
7. Tighten the two bolts that are covered by the screen to specifications as listed at the end of this Part.
8. Remove the oil screen attaching screws and place the gasket and oil screen in position on the lower valve body. Re-install the screen attaching screws (Fig. 20).
9. Tighten all the valve body and screen attaching screws to specifications as listed at the end of this Part.
10. Place the cutback control valve (Fig. 22) and the coasting regulator valve in the valve body.

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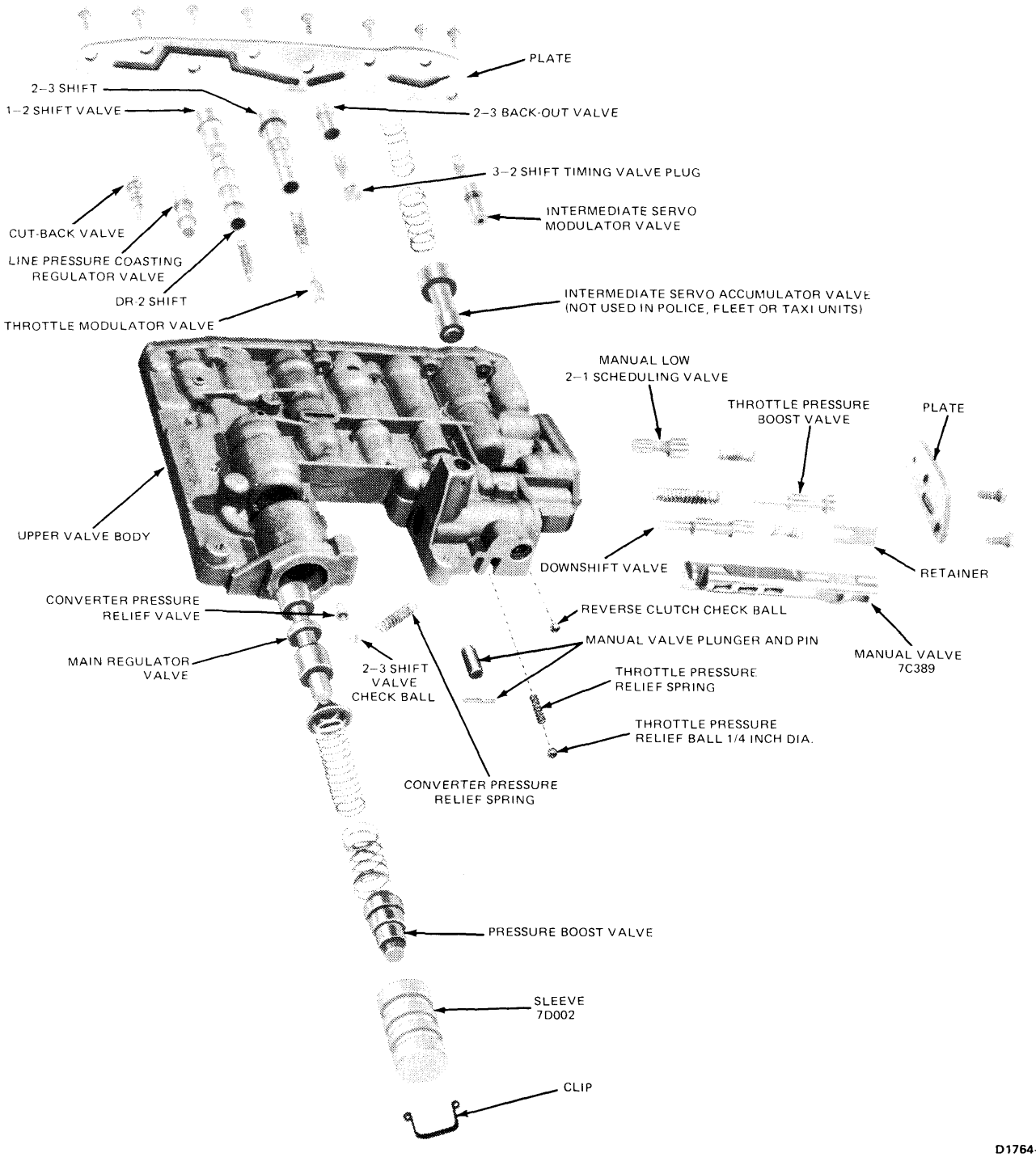


FIG. 22 Upper Valve Body Disassembled

11. Place the spring DR-2 shift valve and the 1-2 shift valve in the body.
12. Place the throttle modulator valve and spring and the 2-3 shift valve in the valve body.
13. Place the spring and the 2-3 backout valve in the valve body.
14. Place the two springs and the intermediate servo accumulator valve in the valve body.
15. Place the intermediate servo modulator valve and spring in the body.
16. Carefully place the valve retaining plate on the body and secure it with the eight attaching screws. Tighten the screws to specifications as listed at the end of this Part.
17. Place the throttle pressure boost valve and spring in the valve body. Place the manual low 2-1 scheduling valve and spring in the valve body and install the retaining plate. Tighten the attaching screws to specifications as listed at the end of this Part.

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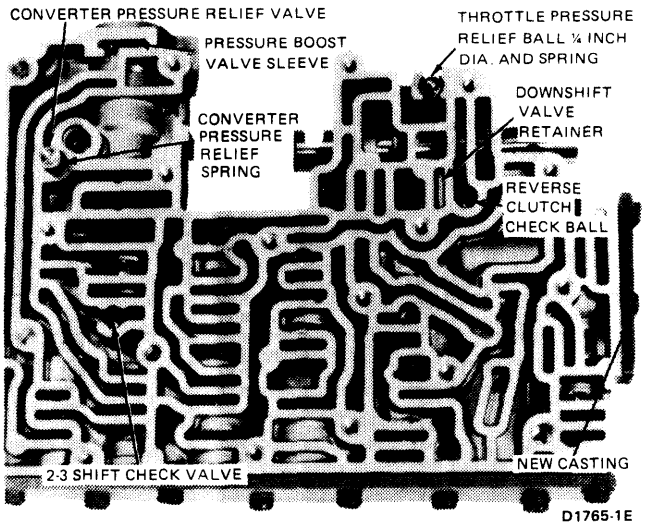


FIG. 23 Converter Pressure Relief Valve, Throttle Pressure Relief Valve, and 2-3 Shift Check Valve Locations

18. Place the spring retainer on the stem of the main regulator valve so that the retainer flange is next to the valve shoulder. Place the main regulator valve, spring retainer, two springs, pressure boost valve and sleeve in the bore. Apply hand pressure on the end of the pressure boost valve sleeve and install the spring clip retainer in the groove on the under side of the body so that the clip is inserted into the end groove in the sleeve. Be sure that the pressure boost valve sleeve is free in its bore.
19. Place the manual valve in the valve body and install the plunger and the retaining pin in the body.

INTERMEDIATE SERVO

(Refer to Fig. 5.)

Disassembly

1. Apply air pressure to the port in the servo cover to remove the piston and rod.
2. Replace the complete piston and rod assembly if the piston or piston sealing lips are unserviceable or damaged.
3. Remove the seal from the cover.

Assembly

1. Dip the new seals in transmission fluid.
2. Install new seals on the cover. Fig. 24 shows the correct servo piston and cover for the transmission.
3. Dip the piston in transmission fluid and install it in the cover.

GOVERNOR

Disassembly

1. Remove the governor attaching bolts and remove the governor.
2. Remove the snap ring that secures the governor distributor on the output shaft (Fig. 25) and slide it off the front of the shaft.
3. Remove the seal rings from the distributor.

Assembly

1. Carefully install new seal rings on the distributor.
2. Working from the front end of the output shaft, slide the governor distributor into place on the shaft. Install the snap ring to secure it. Make sure that the snap ring is seated in the groove.
3. Position the governor on the distributor (Fig. 25) and secure with the attaching screws.

DOWNSHIFT AND MANUAL LINKAGE

Disassembly

1. Remove the nut and lockwasher that secures the outer downshift lever to the transmission and remove the lever.
2. Slide the downshift lever out from the inside of the case (Fig. 26). Remove the seal from the recess in the manual lever shaft.
3. On E-100—E-350, remove the two bolts retaining the neutral start switch, and remove the switch, (Fig. 27).
4. Remove the C-ring securing the parking pawl actuating rod to the manual lever. Remove the rod from the case.
5. Remove the nut securing the inner manual lever to the shaft. Remove the inner lever from the shaft. Slide the outer lever and shaft from the case.
6. Remove the seal from the case with Tools T59L-100-B and T58L-101-A.
7. Dip the new seal in transmission fluid and install it in the case as shown in Fig. 28.

Assembly

1. Slide the outer manual lever and shaft in the transmission case.
2. Position the inner lever on the shaft, making sure the leaf spring roller is positioned in the inner manual lever detent. Install the attaching nut. Tighten the nut to specifications as listed at the end of this Part. Install the parking pawl actuating rod and secure it to the inner manual lever with a C-washer.
3. On E-100—E-350 slide the neutral start switch on the outer lever shaft and install the bolts in the case.
4. With the transmission manual lever in neutral, rotate the switch and install the gauge pin (No. 43 drill) into the gauge pin hole (Fig. 27). Tighten the bolts to specifications as listed at the end of this Part.
5. Install a new downshift lever seal in the recess of the outer lever shaft. Slide the downshift lever and shaft into position.
6. Place the outer downshift lever on the shaft and secure it with a lockwasher and nut.

PARKING PAWL LINKAGE

Disassembly

1. Remove the bolts securing the parking pawl guide plate to the case (Fig. 29). Remove the plate.
2. Remove the spring, parking pawl and shaft from the case.

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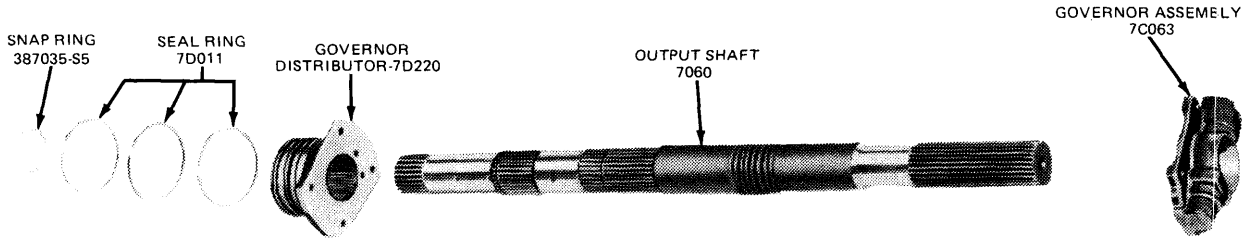
INTERMEDIATE SERVO PISTON AND COVER IDENTIFICATION — 1979

Transmission	Piston		Cover		
	Dia. C	Dia. D	Dia. A	Dia. B	% Letter Ident.*
PGD — A, N, C, R, Y, Z, AC, AD, AE, AL, AW, BC, BD, BE, BF, BN, BS, CJ, CK, CL, CM, CN, CP PJA — Z, AE, AJ, BY, CJ	2.960 2.940	1.989 1.969	1.947 1.944	2.917 2.914	N
PJD — J, L, W, Z	2.909 2.899	2.140 2.122	2.100 2.097	2.866 2.863	P
PGD — BG, BZ, CG PJA — AG, AL, AH, BT, BW, BZ, CA, DA DB, DC, DD, DE, DF, DG, DH, DJ	2.909 2.889	2.056 2.036	2.014 2.011	2.866 2.863	S

* Letter cast in servo cover.

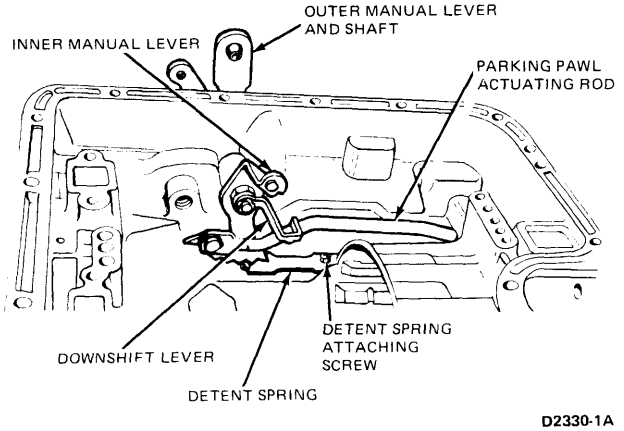
D1969-2L

FIG. 24 Intermediate Servo Cover and Piston



D1623-2C

FIG. 25 Output Shaft Disassembled



D2330-1A

FIG. 26 Downshift and Manual Linkage

3. Working from the pan mounting surface, drill a 1/8 inch diameter hole through the center of the cupped plug. Pull the plug from the case with a wire hook.
4. Unhook the end of the spring from the park plate slot to relieve the tension.
5. Thread a 1/4-20 inch or 8-32 x 1-1/4 inch screw (Fig. 30) into the park plate shaft. Pull the shaft from the case with the screw.

Assembly

1. Position the spring and park plate in the case and install the shaft. Place the end of the spring into the slot of the park plate.
2. Install a new cupped plug to retain the shaft.
3. Install the parking pawl shaft in the case. Slip the parking pawl and spring into place on the shaft.
4. Position the guide plate on the case, making sure that the actuating rod is seated in the slot of the plate. Secure the plate with two bolts and lockwashers.

SERVO APPLY LEVER

Disassembly

1. Working from inside of the transmission case, carefully drive on the servo apply lever shaft to

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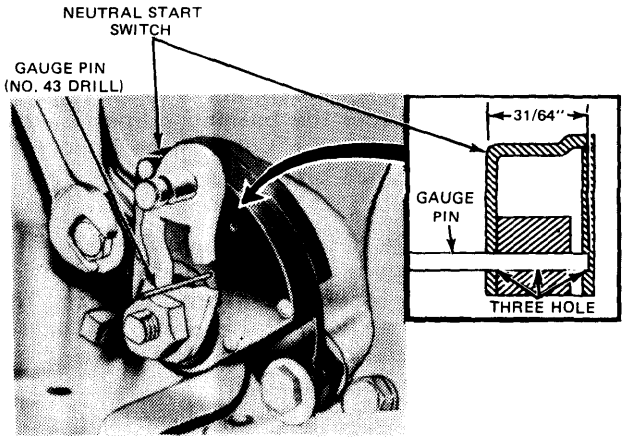


FIG. 27 Downshift Linkage

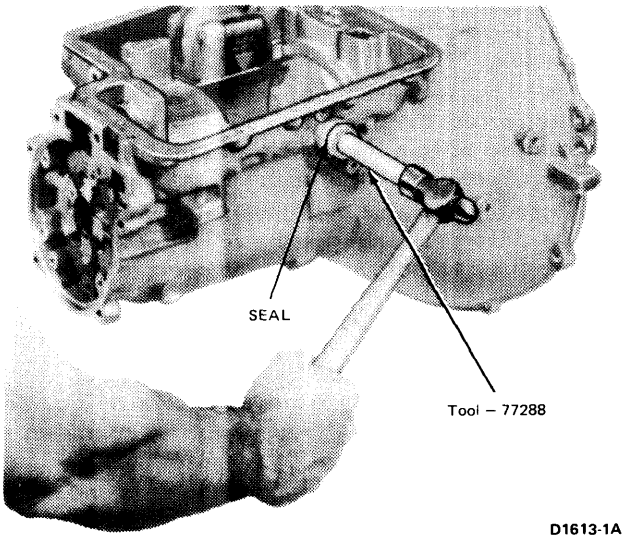


FIG. 28 Installing Manual Lever Seal

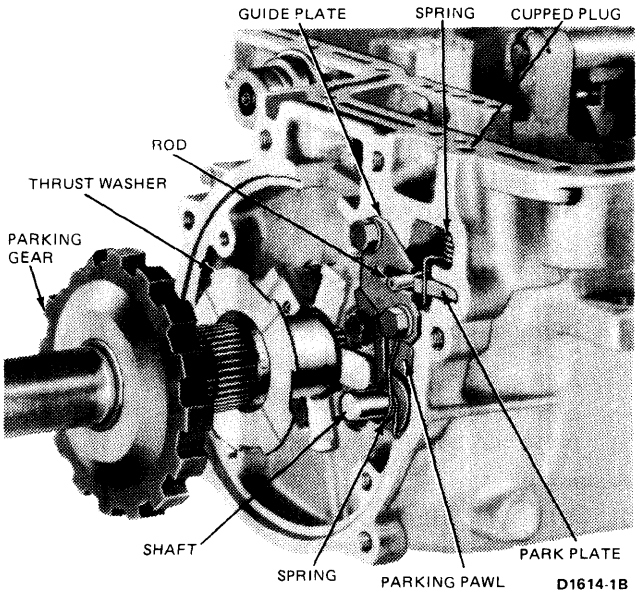


FIG. 29 Parking Pawl Mechanism

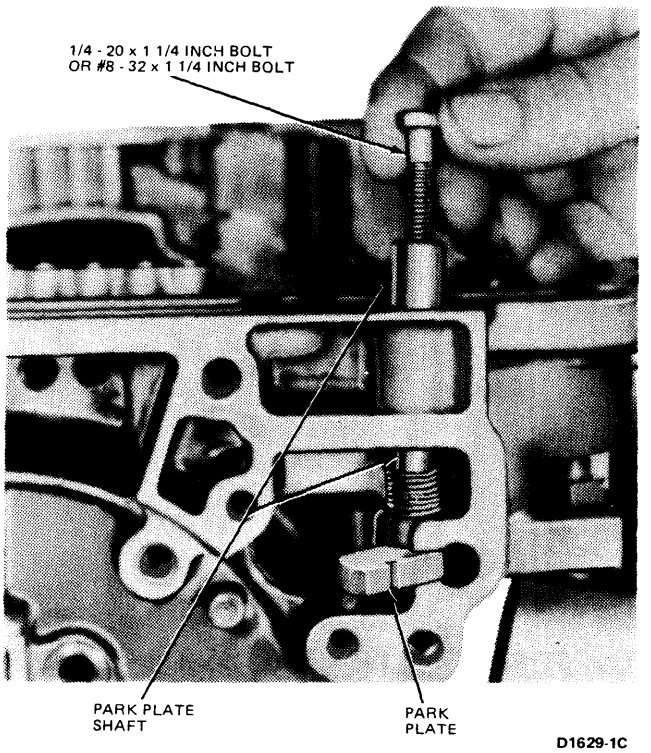


FIG. 30 Removing Park Plate

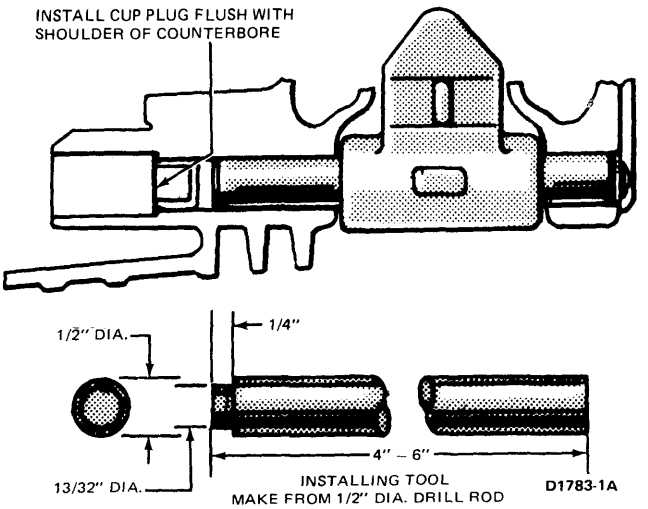


FIG. 31 Servo Apply Lever Installation

remove the cup plug. The shaft (Fig. 31) can be withdrawn from the case by hand.

Assembly

1. Hold the servo apply lever in position and install the new shaft.
2. Using the fabricated tool shown in Fig. 31, drive the cup plug into position in the case. Be sure the plug is flush with the shoulder of the counterbore. The cup plug may be coated with Loctite, Part No. C3AZ-19554-A or equivalent, before installation.

FRONT PUMP

The front seal can be replaced after the pump has been installed on the transmission (Figs. 32 and 33).

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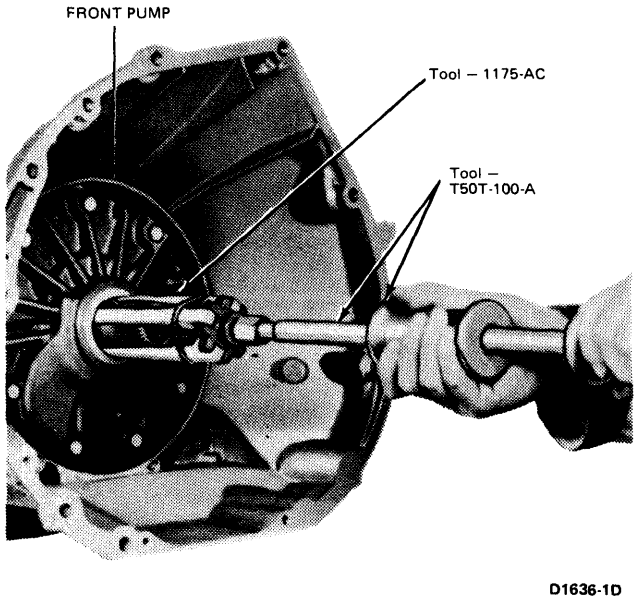


FIG. 32 Removing Front Pump Seal

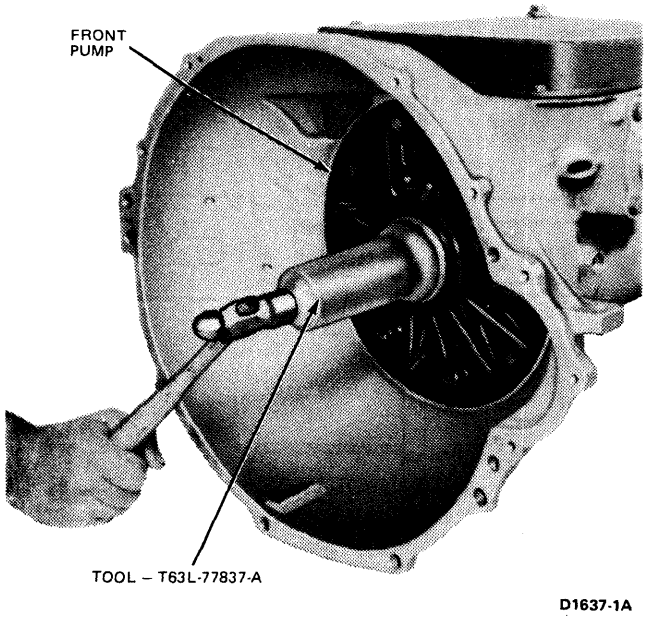


FIG. 33 Installing Front Pump Seal

Disassembly

1. Remove the two seal rings and the selective thrust washer (Fig. 34).
2. Remove the large square-cut seal from the outside diameter of the pump housing.
3. Remove the five bolts that secure the stator support to the pump housing. Lift the support from the housing.
4. Remove the drive and the driven gear from the housing.
5. If the pump housing bushing is worn or damaged, replace it using the handle and tool shown in Fig. 35.

Place the new bushing in position, making sure the half moon slot in the bushing is on top and in line with the oil lube hole near the seal bore. Press the bushing in 0.060-0.080 inches below the front face of the bushing bore. Use Tool T66L-7003-B9 and handle to seat the bushing properly. After assembly, the half moon slot must be in past the lube hole to provide proper lubrication.

Assembly

1. Install the drive and driven gears in the pump housing. **Each gear has either an identification mark or chamfered teeth on one face. The identification mark or the chamfered surface on each gear must be installed toward the front of the pump housing.**
2. Position the stator support in the pump housing and install the five attaching bolts. Torque bolts to specifications as listed at the end of this Part.
3. Carefully install two new seal rings on the pump support. Make sure that the ends of the rings are engaged to lock them in place. Install a new square-cut seal on the outside diameter of the pump housing.
4. Install the selective thrust washer. **Make sure that the correct thickness selective washer is being used to obtain the specified end play.** Refer to Specifications at end of this Part.
5. Place the pump on the converter, making sure that the drive gear engages the converter hub. Rotate the pump to make sure that the gears rotate freely.

REVERSE-HIGH CLUTCH

Disassembly

1. Separate the drive train as shown in Fig. 36. Remove the pressure plate snap ring as shown in Fig. 37.
2. Remove the pressure plate and the drive and driven clutch plates (Fig. 38).
3. Install Tool T65L-77515-A (Fig. 39) on the reverse-high clutch drum. Make sure that the legs clear the snap ring enough to remove it. Remove the snap rings and remove the tool.
4. Remove the spring retainer and the piston return springs.
5. Apply air pressure to the piston apply hole in the clutch hub (Fig. 40) and remove the piston.
6. Remove the piston outer seal from the piston and the inner seal from the clutch drum (Fig. 38).
7. Remove the front and rear bushings from the clutch drum if they are worn or damaged. To remove the front bushing, use a cape chisel and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing. To remove the rear bushing, use the tool shown in Fig. 41, and press the bushing from the drum.

Assembly

1. If the clutch drum bushings were removed, position the drum in a press and press new bushings into the drum with the tools shown in (Fig. 41 or 42).
2. Dip the new seals in transmission fluid and install one on the drum and one on the piston.

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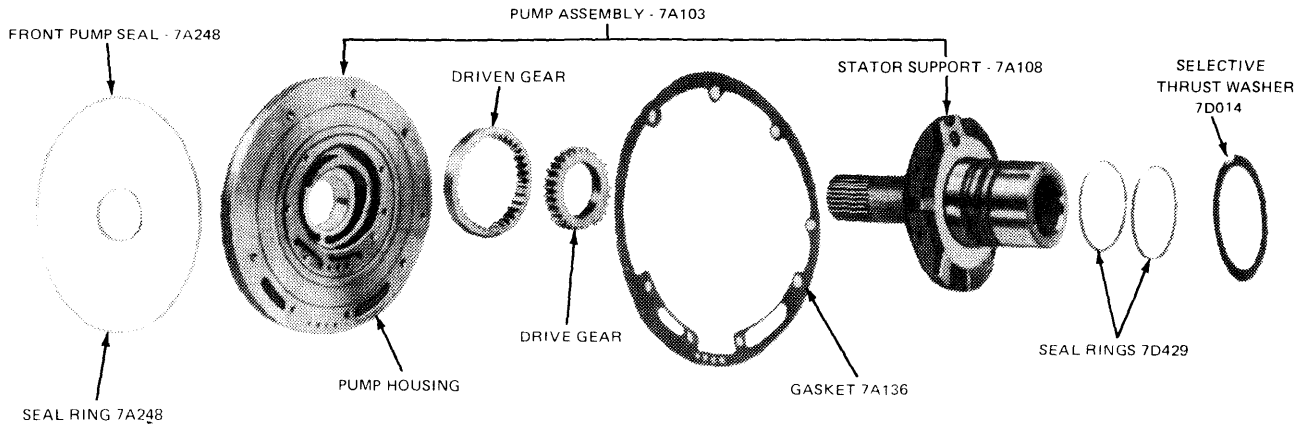


FIG. 34 Front Pump Disassembled

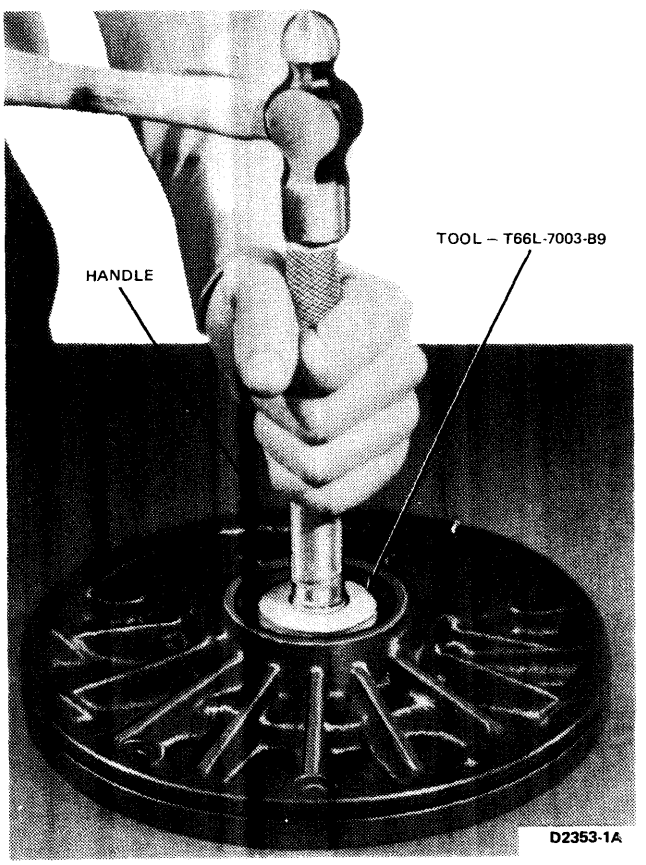


FIG. 35 Replacing Front Pump Housing Bushing

3. Install the piston in the clutch drum.
4. Position the piston return springs in the piston sockets (Fig. 43). Place the spring retainer on the springs.
5. Install Tool T65L-77515-A (Fig. 39) and compress the springs. Make certain that the spring retainer is centered while compressing the springs. Install the snap ring. **Before releasing the pressure on the tool, make certain that the snap ring is positioned inside of the four snap ring guides on the spring retainer.**
6. Clutch plate usage varies with each model, refer to the specifications at end of this Part for the number of plates required. Dip the clutch plates in clean transmission fluid. Install the clutch plates alternately starting with a steel drive plate (Fig. 38). When new composition clutch plates are used, soak the plates in automatic transmission fluid, (Spec. ESP-M2C138-CJ or equivalent), for 15 minutes before they are assembled.
7. After all clutch plates have been installed, position the pressure plate in the clutch drum. Install the pressure plate snap ring.
8. With a feeler gauge, check the clearance between the pressure plate and snap ring (Fig. 44).
9. The pressure plate should be held downward as the clearance is checked. Refer to the specification at end of this Part for the proper clearance. If the clearance is not within specifications, selective thickness snap rings are available in the following thicknesses: 0.056-0.060, 0.065-0.069, 0.074-0.078, 0.083-0.087, 0.092-0.096, 0.110-0.114, and 0.128-0.132 inch. Install the correct size snap ring and re-check the clearance.

FORWARD CLUTCH

Disassembly

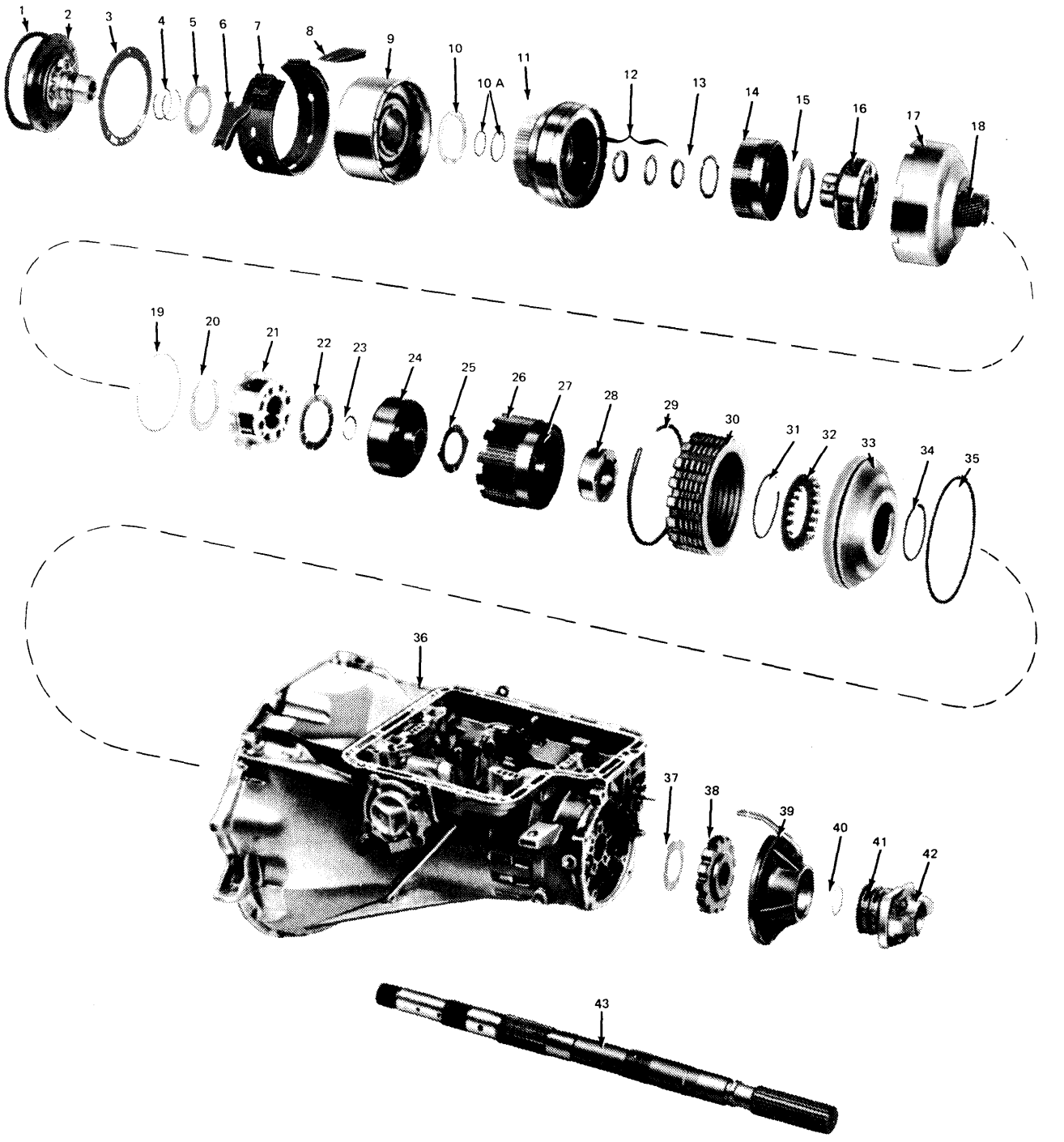
1. Remove the clutch pressure plate snap ring (Fig. 45).
2. Remove the rear pressure plate, the drive and driven plates and the forward pressure plate from the clutch hub (Fig. 46).
3. Remove the snap ring (Fig. 47) that secures the disc spring in the clutch cylinder. Remove the disc spring.
4. Apply air pressure to the clutch cylinder (Fig. 48) to remove the piston.
5. Remove the seal from the piston and the seal from the clutch hub (Fig. 46).

Assembly

1. Dip two new seals in transmission fluid. Install the smaller seal on the clutch hub and the lip seal on the clutch piston.
2. Install the clutch piston and lip seal with installation tool (T77L-77548-A), (Fig. 49).

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1. FRONT PUMP SEAL RING - 7A248
2. FRONT PUMP - 7A103
3. GASKET - 7A136
4. SEAL
5. NUMBER 1 THRUST WASHER (SELECTIVE)
6. STRUT INTERMEDIATE BRAKE BAND - 7D029
7. INTERMEDIATE BRAKE BAND ASSEMBLY - 7D029
8. STRUT INTERMEDIATE BRAKE BAND ANCHOR - 7D430
9. REVERSE – HIGH CLUTCH ASSEMBLY
10. NUMBER 2 THRUST WASHER
10a. FORWARD CLUTCH SEAL RINGS
11. FORWARD CLUTCH ASSEMBLY
12. NUMBER 3 THRUST WASHER
13. NUMBER 4 THRUST WASHER
14. FORWARD CLUTCH HUB ASSEMBLY - 7D392
15. NUMBER 5 THRUST WASHER
16. FORWARD PLANET ASSEMBLY - 7A398
17. INPUT SHELL - 7D064 AND SUN GEAR ASSEMBLY - 7D063
18. NUMBER 6 THRUST WASHER
19. SNAP RING
20. NUMBER 7 THRUST WASHER
21. REVERSE PLANET ASSEMBLY - 7D006
22. NUMBER 8 THRUST WASHER
23. REVERSE RING GEAR AND HUB RETAINING RING
24. REVERSE RING GEAR - 7A153 AND HUB - 7D164
25. NUMBER 9 THRUST WASHER
26. LOW–REVERSE CLUTCH HUB - 7B067
27. ONE-WAY CLUTCH - 7A089
28. ONE-WAY CLUTCH INNER RACE - 7D171
29. SNAP RING
30. LOW–REVERSE CLUTCH
31. SNAP RING
32. LOW–REVERSE PISTON RETURN SPRING AND RETAINER - 7D406
33. LOW-REVERSE PISTON - 7D402
34. INNER SEAL
35. OUTER SEAL
36. CASE - 7005
37. NUMBER 10 THRUST WASHER
38. PARKING GEAR - 7A233
39. GOVERNOR DISTRIBUTOR SLEEVE - 7C232
40. SNAP RING
41. GOVERNOR DISTRIBUTOR - 7D220
42. GOVERNOR - 7C063
43. OUTPUT SHAFT - 7060

D1620-2E

FIG. 36 Drive Train Disassembled—Typical

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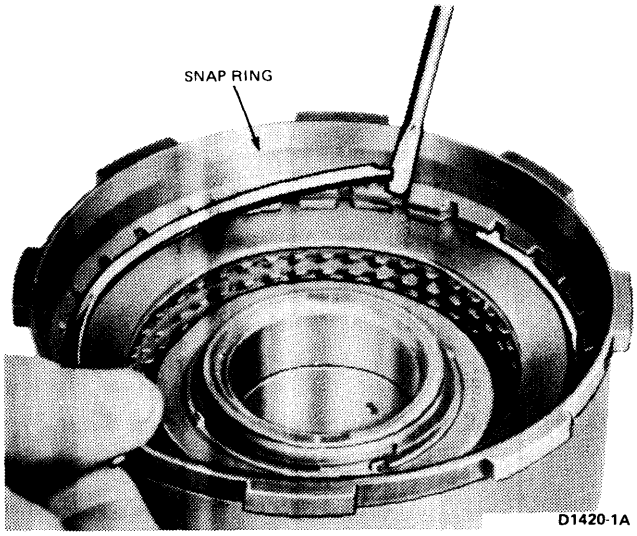


FIG. 37 Removing or Installing Reverse-High Clutch Pressure Plate Snap Ring

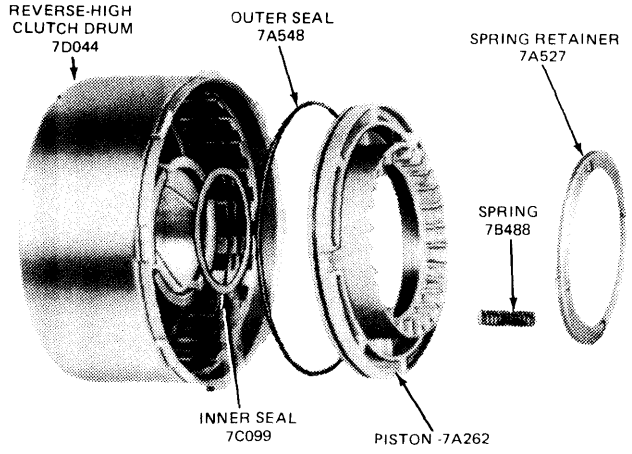


FIG. 38 Reverse-High Clutch Disassembled

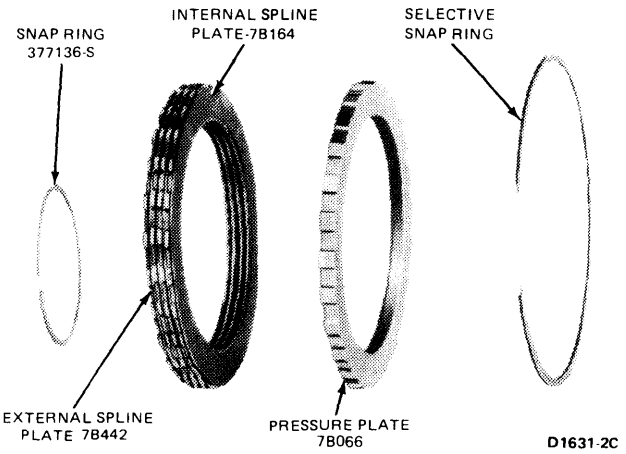
3. Position the installation tool into the forward clutch cylinder, so that the bore of the tool is aligned with the piston bore in the cylinder. Press the piston into the cylinder until it bottoms in the bore. Remove the installation tool.
4. Make sure that the steel pressure ring is in the groove on the piston. **Position the disc spring in the cylinder with the dished face downward.** Install the spring as shown in Fig. 47. Secure the disc with the retaining snap ring.

   Refer to the Specification at end of this Part for the number of plates required. The last plate installed will be the rear pressure plate. Install the snap ring and make certain that it seats fully in the groove. When new composition clutch plates are used, soak the plates in automatic transmission fluid for 15 minutes before they are assembled.
5. Install the forward pressure plate with the flat side up and the beveled side downward. Dip the clutch plates in clean transmission fluid (Specification ESP-M2C 138-J or equivalent). Next, install the wave plate, then a steel plate and a composition driven plate. Install the remaining plates in this sequence (Fig. 46).
6. With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 50). Downward pressure on the plate should be maintained when making this check. Refer to Specifications at end of this Part for the proper clearance.
7. If the clearance is not within specifications, selective snap rings are available in the following thicknesses: 0.056 to 0.060, 0.065 to 0.069, 0.074 to 0.078, 0.083 to 0.087, 0.092 to 0.096, 0.110 to 0.114, and 0.128 to 0.132 inch. Insert the correct size snap ring and recheck the clearance.

INPUT SHELL AND SUN GEAR

Disassembly

1. Remove the external snap ring from the sun gear as shown in Fig. 51.
2. Remove the thrust washer from the input shell and sun gear (Fig. 52).



3. Working from inside the input shell remove the sun gear. Remove the internal snap ring from the gear.

Assembly

1. Install the forward snap ring on the forward end (short end) of the sun gear (Fig. 52). Working from inside the input shell, slide the sun gear and snap ring into place making sure that the longer end is at the rear (Fig. 52).
2. Place the No. 6 thrust washer on the sun gear and install the rear snap ring.

OUTPUT SHAFT HUB AND RING GEAR

Disassembly

1. Remove the hub snap ring (Fig. 53) from the ring gear.
2. Lift the hub from the ring gear.

Assembly

1. Position the hub in the ring gear.
2. Secure the hub with the snap ring. Make certain that the snap ring is fully engaged with the groove.

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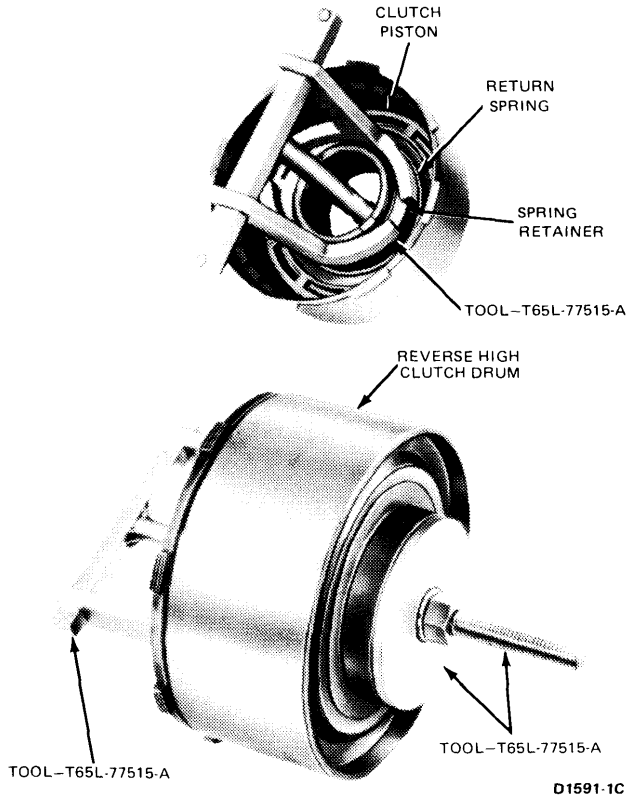


FIG. 39 Removing or Installing Reverse—High Clutch Piston Snap Ring

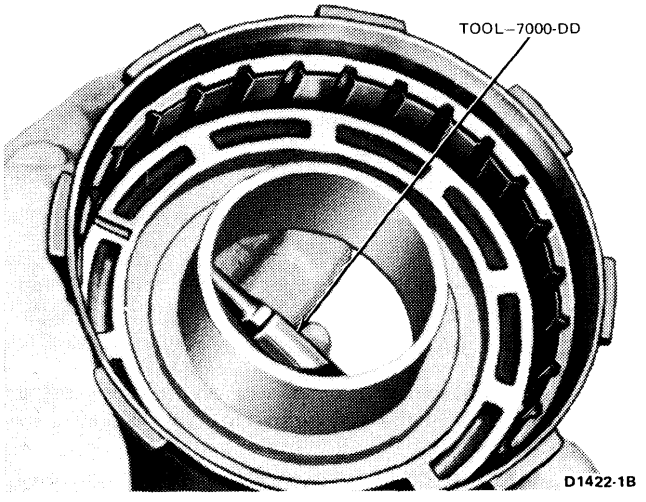


FIG. 40 Removing Reverse-High Clutch Piston

ONE-WAY CLUTCH

Disassembly

1. Remove the snap ring and bushing from the rear of the low-reverse clutch hub (Fig. 54).
2. Remove the rollers from the spring assembly and lift the spring assembly from the hub.
3. Remove the remaining snap ring from the hub.

Assembly

1. Install a snap ring in the forward snap ring groove of the low-reverse clutch hub.

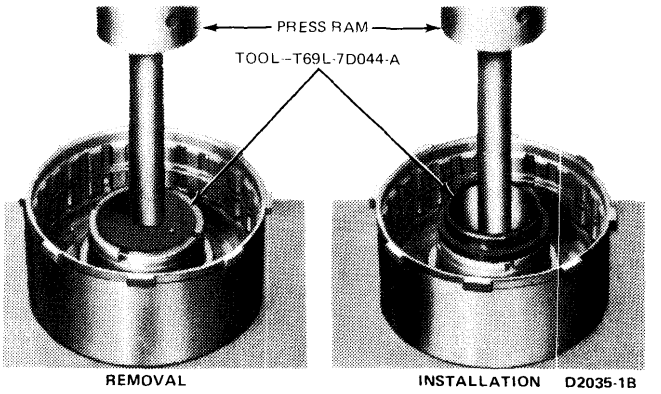


FIG. 41 Replacing Reverse-High Clutch Rear Bushing

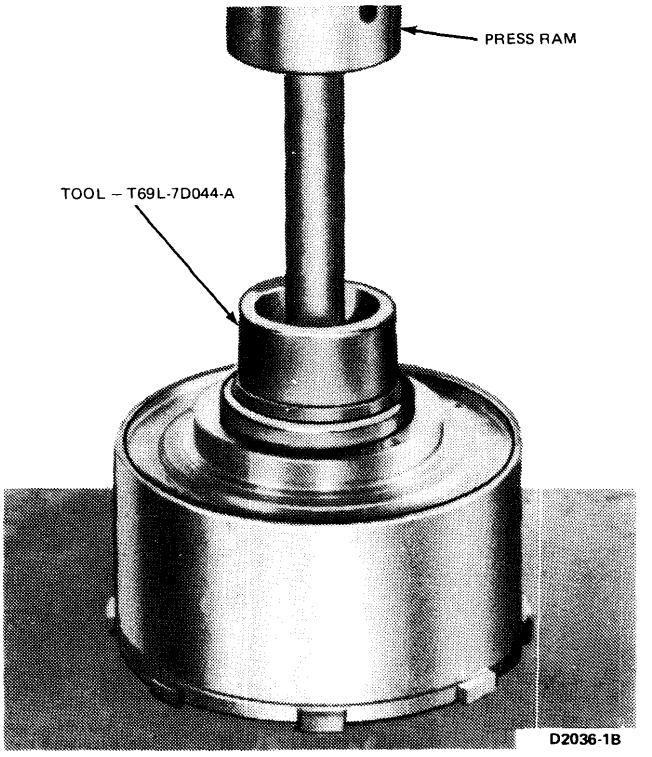


FIG. 42 Installing Reverse-High Clutch Front Bushing

2. Place the low-reverse clutch hub on the bench with the forward end down (Fig. 55).
3. Install the one-way clutch spring assembly on top of the snap ring.
4. Install a roller into each of the spring assembly compartments (Fig. 54).
5. Install the bushing on top of the spring assembly.
6. Install the remaining snap ring at the rear of the low-reverse clutch hub to secure the assembly (Fig. 54).

LOW-REVERSE CLUTCH PISTON

Disassembly

1. Remove the inner and the outer seal from the low-reverse clutch piston (Fig. 36).

Assembly

1. Dip the two new seals in clean transmission fluid.
2. Install the seals on the piston.

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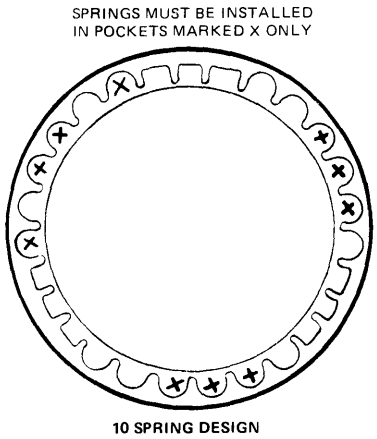


FIG. 43 Reverse-High Clutch Piston Return Spring Locations

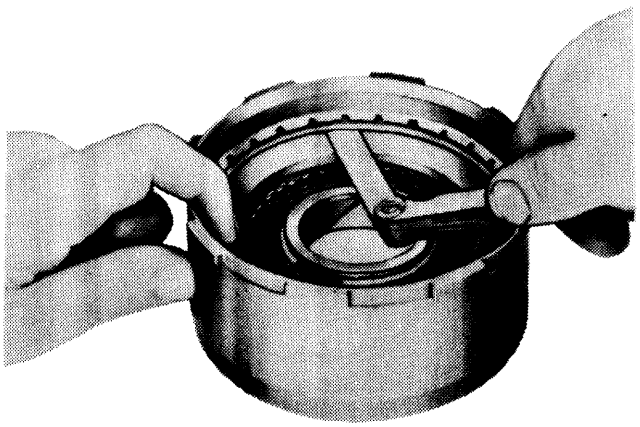


FIG. 44 Checking Reverse-High Clutch Snap Ring Clearance

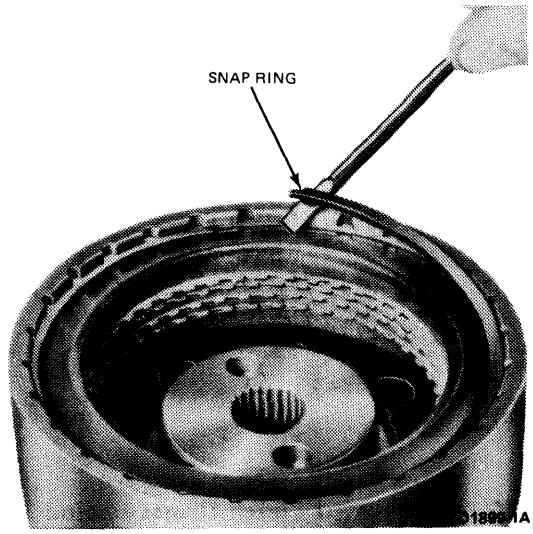


FIG. 45 Removing Forward Clutch Pressure Plate Snap Ring

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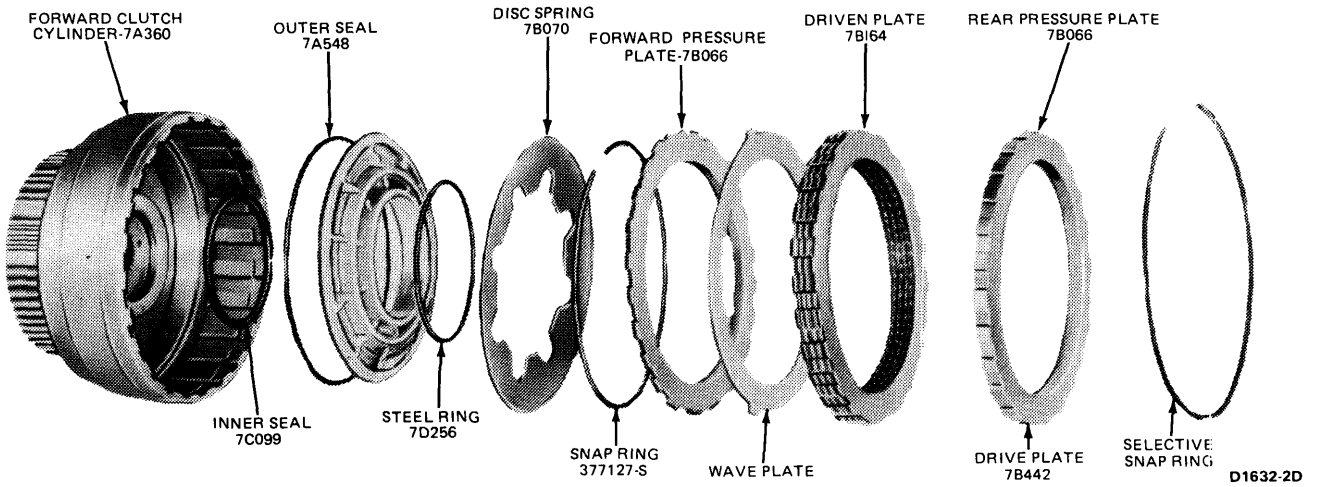


FIG. 46 Forward Clutch Disassembled

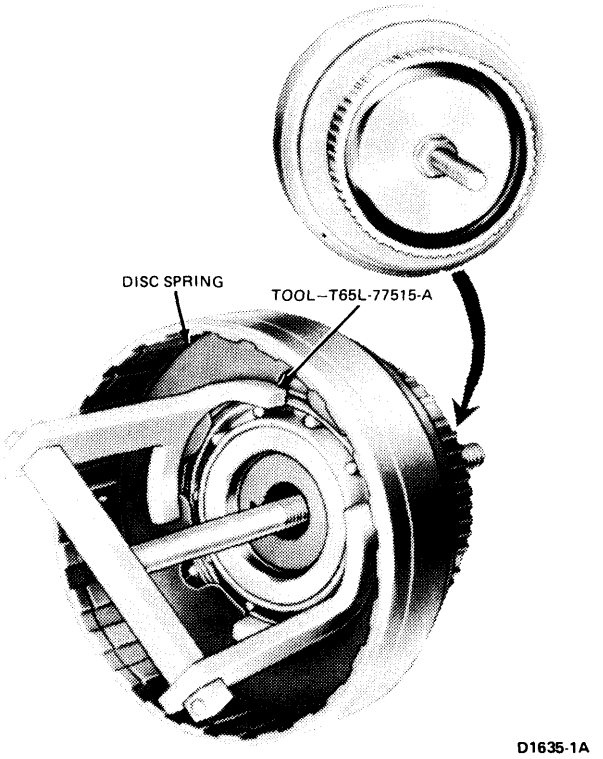


FIG. 47 Removing or Installing Disc Spring

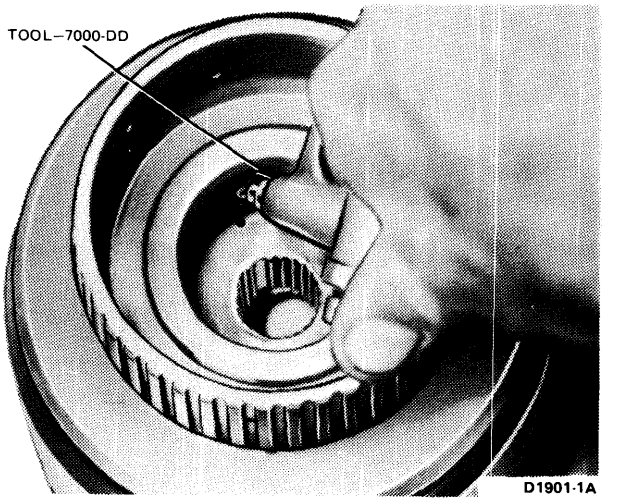


FIG. 48 Removing Forward Clutch Piston

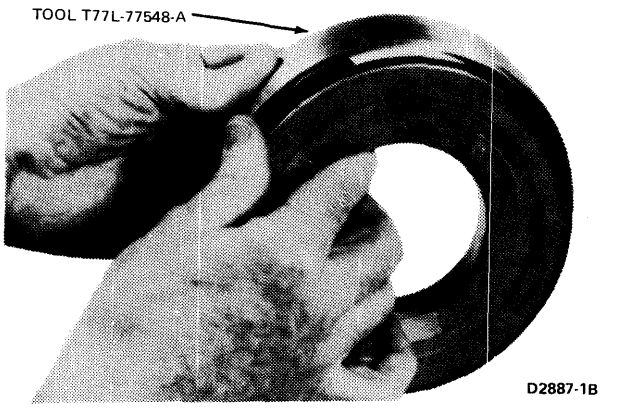


FIG. 49 Installing Forward Clutch Piston and Lip Seal

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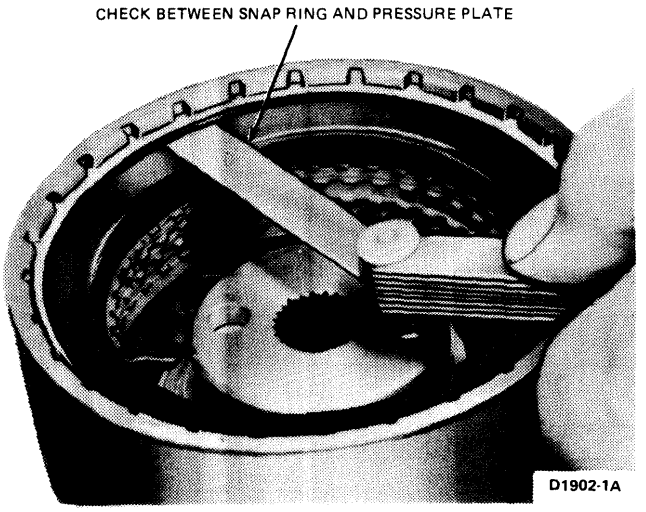


FIG. 50 Checking Forward Clutch Clearance

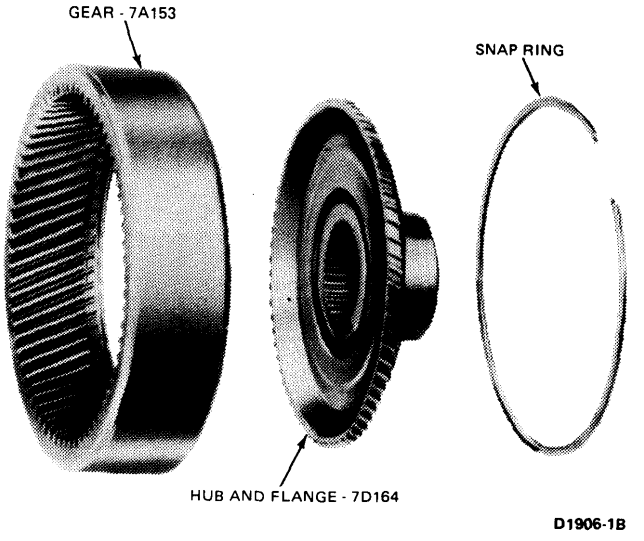


FIG. 53 Output Shaft Hub and Ring Gear

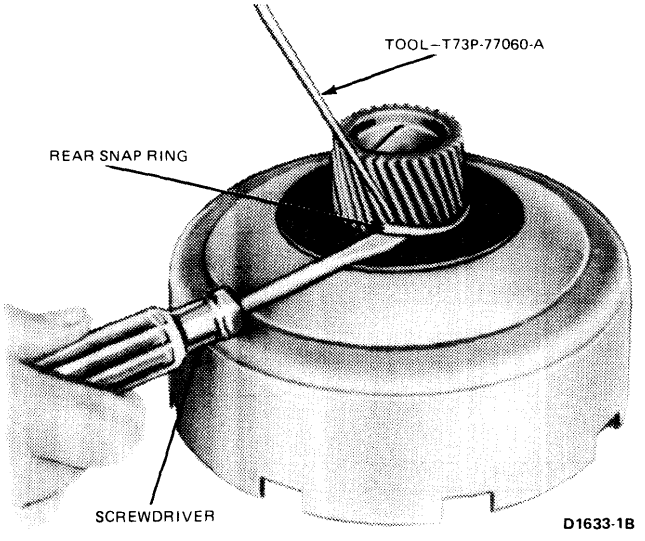


FIG. 51 Removing Sun Gear Snap Ring

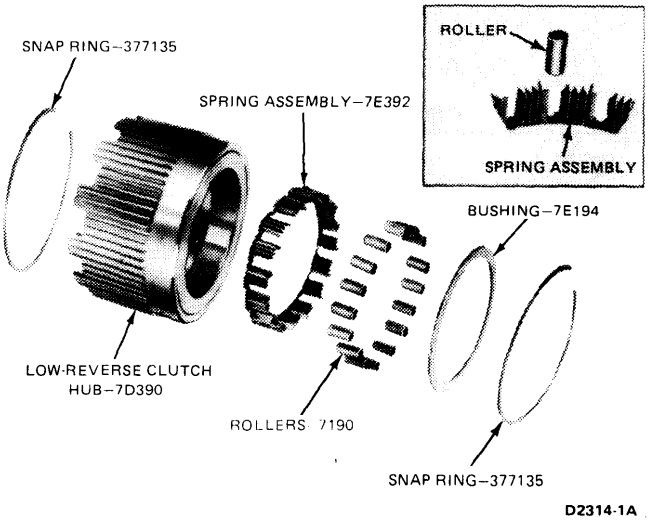


FIG. 54 One-Way Clutch Disassembled

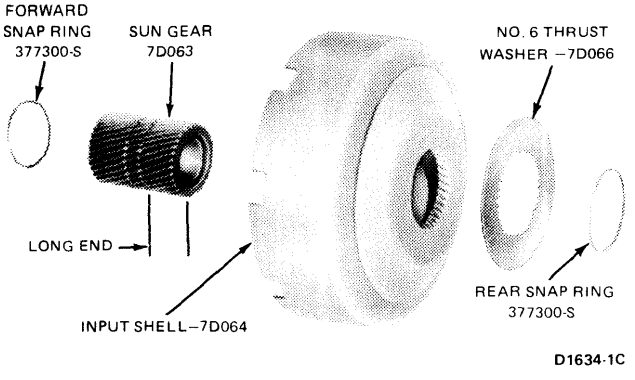


FIG. 52 Input Shell and Sun Gear Disassembled

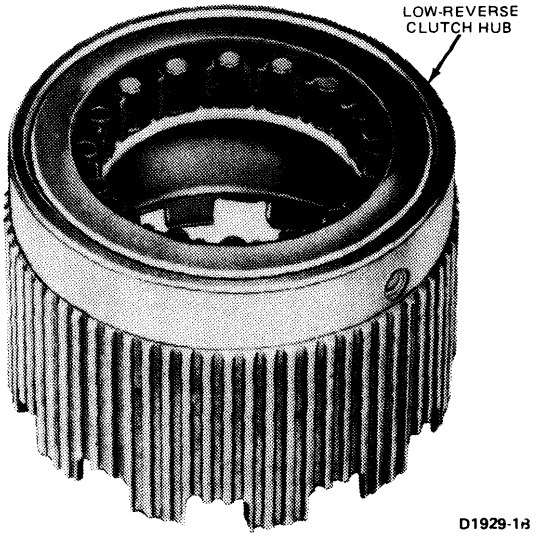


FIG. 55 One-Way Clutch Installed

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SPECIFICATIONS

C6 TRANSMISSION

APPROXIMATE REFILL CAPACITIES

Trans. Model	U.S. Quarts	Imperial Quarts	Litres
All [1]	11¾	9¾	11.1

[1] Truck 4x4 with 5.8L (351 CID) V-8, 6.6L (400 CID) V-8 or 7.5L (460 CID) V-8 — 13⅜ U.S., 11¼ Imperial, 10.6 litres.

Fluid meets Ford Specification ESP-M2C138-CJ, Dexron II, Series D or equivalent.

SELECTIVE THRUST WASHERS

Identification Color	Thrust Washer Thickness — Inch
Blue	0.056-0.060
Natural (White)	0.073-0.077
Red	0.088-0.092

TRANSMISSION CLUTCH PLATE USAGE

Forward Clutch

Transmission Model	Steel	Friction	Clearance
PJD, PGD, PJA	4 ②	4	.021/.046

High Clutch

Transmission Model	Steel	Friction	Clearance
PJA ,PGD, PJD	3	3	.002/.036

② Plus a waved plate (7E457) next to inner pressure plate.

Reverse Clutch

	Steel Plates		Friction Plates
PGB, PGD, PJD, PJA	5 ③	5	5

③ Plus a waved plate next to piston.

Clutch Snap Rings

Part Number	Thickness	Forward	High
377437-S	.060-.056	X	X
377126-S	.069-.065	X	X
377127-S	.078-.074	X	X
377128-S	.087-.083	X	X
377444-S	.096-.092	X	X
386841	.114-.110	X	
386842	.132-.128	X	

CHECKS AND ADJUSTMENTS

Operation	Specification
Transmission End Play	0.008-0.042 inch (Selective Thrust Washers Available)
Torque Converter End Play	New or Rebuilt 0.021 Max. Used. 0.040 Max ①
Intermediate Band Adjustment	Remove and discard lock nut. Adjust screw to 10 ft-lbs torque, then back off 1½ turns, install new lock nut and tighten lock nut to specification.
Forward Clutch Pressure Plate-to-Snap Ring Clearance	0.021-0.046
Selective Snap Ring Thickness	0.056-0.060 0.065-0.069 0.074-0.078 0.083-0.087 0.092-0.096
Reverse-High Clutch Pressure Plate-to-Snap Ring Clearance	0.022-0.036
Selective Snap Ring Thickness	0.056-0.060 0.065-0.069 0.074-0.078 0.083-0.087 0.092-0.096

① To check end play, exert force on checking tool to compress turbine to cover thrust washer wear plate. Set indicator at zero.

TORQUE LIMITS

Item	(ft-lbs)	N•m	Item	(ft-lbs)	N•m
Converter to Flywheel	20-30	28-40	Pressure Gauge Tap	9-15	12.5-20
Front Pump to Trans. Case	16-30	22-40	Band Adj. Screw Locknut to Case	35-45	48-61
Overrunning Clutch Race to Case	18-25	25-33	Cooler Tube Connector Lock	20-35	28-47
Oil Pan to Case	12-16	17-21	Converter Drain Plug	14-28	19-37
Stator Support to Pump	12-16	17-21	Manual Valve Inner Lever to Shaft	30-40	41-54
Converter Cover to Converter Housing	12-16	17-21	Downshift Lever to Shaft	12-16	17-21
Guide Plate to Case	12-16	17-21	Filler Tube to Engine	20-25	28-33
Intermediate Servo Cover to Case	14-20	19-27	Transmission to Engine	40-50	55-67
Diaphragm Assy. to Case	12-16	17-21	Rear Engine Support to Transmission	55-65	75-88
Distributor Sleeve to Case	12-16	17-21	Extension Housing to Bearing Retainer Stud	35-50	48-67
Extension Assy. to Trans. Case	25-35	34-47	Bearing Retainer to Extension Assy.	35-45	48-61
Rear Cover Plate to Converter Housing	20-30	28-40	Plug Case — Throttle Pressure	6-12	8.5-16
Plug — Case TRS Switch Port	6-12	8.5-16	5/16" Fitting — Cooler Line Connector to Case — Front and Rear (Case Fitting)	10-16	14-16
Plug — Case Front Pump or Line Pressure	6-12	8.5-16	5/16" Tube Nut — Cooler Line to Trans. Case Fitting	12-18	17-24
	(in-lb)			(in-lb)	
End Plates to Body	20-45	2.5-5	Converter Hsg. Cover to Converter Hsg.	30-60	3.5-6.5
Inner Downshift Lever Stop	20-45	2.5-5	Control Assy. to Case	95-125	11-14
Reinforcement Plate to Body	20-45	2.5-5	Gov. Body to Collector Body	80-120	9.5-13.5
Screen and Lower to Upper Valve Body	40-55	5-6.2	Oil Tube Connector	60-120	7-13.5
Yoke to Output Shaft (4x4)	100-150	11.5-16.5	Detent Spring to Case	80-120	9.5-13.5
Shift Valve Plate to Upper Body	20-45	2.5-5	Rear Engine Support to Frame	40-60	5-6.5
Upper to Lower Body	40-55	5-6.2	Neutral Switch to Case	55-75	6.5-8
Reinforcing Right Side Plate to Lower Body	20-45	2.5-5			

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SPECIAL TOOLS

Number	Description	Number	Description
T50T-100-A or T59L-100-B	Impact Hammer	TOOL-77288	Control Shaft Seal Replacer
T58L-101-A	Puller Attachment	T71P-77370-A	Band Adjustment Socket
TOOL-1175-AB	Oil Seal Remover (Head)	T71P-77370-H	Band Adjustment Torque Wrench
TOOL-4201-C	Diff. Backlash and Runout Gauge	TOOL-77530-A	Clutch Assembly Fixture
T64L-6001-A	Portable Twist Post Stand	T65L-77515-A	Automatic Transmission Clutch Spring Compressor
TOOL-7000-DD	Air Nozzle Rubber Tip	T63L-77837-A	Front Pump Seal Replacer
T69P-7D044-A	Trans. Bushing Kit Remover and Replacer	TOOL-S8695-A	Vacuum Unit Wrench (Snap-On)
T77L-77545-A	Forward Clutch Lip Seal Installer	T75P-7697-B	Exterior Housing Bushing Installer
T61L-7657-B	Transmission Extension Housing Oil Seal Replacer	T57P-76974	Exterior Housing Bushing Remover
T59P-77067	Dial Indicator Support Fixture	T66P-7003-B9	Front Pump Housing Bushing Replacer
		T65E-6000-JO	Engine Support Bar
		T53T-7065-B	Bearing Installer

STALL SPEEDS

Trans.	Engine	Converter Ident. On Cover	Converter Size	Stall Ratio	Stall Speed RPM ①	Model Application
C6	6.6L (400 CID) 2-V, V-8	91	12	1.87	1600-1900	F-150, F-250
	5.8L (351 CID) 2-V, M V-8	94	12	1.87	1475-1775	F-150, F-250, F-350
	5.8L (351 CID) 2-V, M V-8	94	12	1.87	1550-1800	F-100
	4.9L (300 CID) 1-V, V-8	94	12	1.87	1350-1600	E-100, E-150, E-250, F-150, F-250, F-350
	4.9L (300 CID) 1-V, V-8	94	12	1.87	1375-1650	F-100
	7.5L (460 CID) 4-V, V-8	89	12	1.87	1610-1970	F-150, F-250, F-350, E-250, E-350
	5.8L (351 CID) 2-V, W V-8	94	12	1.87	1440-1750	E-100, E-150, E-250, E-350
	4.9L (302 CID) 2-V, V-8	94	12	1.87	1290-1580	F-100, F-150

① Stall speeds shown are for vehicles operating in areas at or near sea level. Stall speeds at higher altitudes may be slightly lower because of changes in engine output.

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NOISE, VIBRATION, AND HARSHNESS DIAGNOSIS

GROUP 18

Noise, Vibration and Harshness Diagnosis

PART 18-01

APPLIES TO ALL MODELS

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DESCRIPTION

NOISE

Noise is generally defined as a problem that results in an unpleasant sound. They may be described as tapping, whistling, buzzing, clunking and booming sounds that are distinguishable from the balance of the vibration range. Of course, there are many descriptive variations of noise that the individual must associate with a probable cause. Based on his experience, it will assist him in isolating and correcting the source of the problem.

VIBRATION

Vibration, technically, is a high-frequency trembling or shaking condition that is usually constant in level and occurs during a portion of the total operating speed range. The types of vibrations that can be felt in the vehicle can be divided into two groups:

1. Vibrations of various unbalanced rotating parts of the vehicle.
2. Resonance vibrations of the body and frame structures caused by rotation of these unbalanced parts.

These vehicle vibrations can also be subdivided into those that occur at low speeds and those that are most pronounced at higher speeds. Since the dividing line between low and higher speed vibrations is somewhat indefinite, there will be vibrations that overlap the two ranges.

TYPICAL LOW SPEED VIBRATIONS (LESS THAN 50 MPH OR 80 KM/H)

Exhaust Vibration
Engine harshness
Power steering pump disturbances
Air conditioner compressor or drive belt vibrations
Take-off shudder
Brake roughness
Tire roughness or harshness
Improper driveline angles and phasing
Worn Suspension Components

TYPICAL HIGH-SPEED VIBRATIONS (ABOVE 50 MPH OR 80 KM/H)

Excessive tire-wheel and drum assembly imbalance
Excessive tire and wheel runout
Tire roughness due to high non-uniformity (force variation) (low speed)
Companion flange runout or imbalance
Driveshaft imbalance
Improper driveline angles and phasing
Galled, dirty, rusty, worn or improperly lubricated driveline slip yoke splines or U-joint bearings
Clutch torsion vibration
Worn suspension components

HARSHNESS

Harshness is the term commonly used to describe the ride quality of the vehicle. Hard ride or harshness is usually caused by the tires or suspension system, namely:

Over-inflated, wrong size or wrong type tire installed on the vehicle.
Suspension not sufficiently lubricated.
Worn suspension components.
Suspension components installed with prelaod on pivot points, bearings and bushings.
Units equipped with tires not specified by the manufacturer. (Different brand tires often give different ride qualities to the vehicle.)
Bent or bound-up shock absorbers.
Heavy-duty components installed on vehicle.
Improper cab mounting

Other vehicle ride motions, may be summarized as follows:

Vehicle Bounce—an up-and-down motion in the front of the cab.
Vehicle Pitch—a fore-and-aft motion of the cab. During this pitch vibration, the rear of the cab goes up and forward and appears to be rocking or pivoting at the front axle.
Vehicle Roll—a side-to-side motion of the cab. It is best to observe and evaluate this motion from another vehicle while the truck being inspected is experiencing the vibration.

WEIGHT DISTRIBUTION

Weight properly distributed to front and rear axles gives the best ride and steerability, eliminates premature failures due to overloaded axles, springs, tires, etc.

Payload distribution on a truck has a definite bearing on vehicle performance. Even though the vehicle is not loaded beyond the recommended maximum gross vehicle weight, this does not mean that it may not be overloaded.

Overloading can be due to improperly positioning of heavy materials so that the load is centered over one rear tire or so far forward in the body that the front axle and tires are overloaded.

Unloaded or diminishing load type operations also affect the ride characteristics of a vehicle. Road vibrations and shock, for example, are not dampened to the extent that they are under heavily loaded conditions.

DIAGNOSIS AND TESTING

Noise, vibration, and harshness usually occur in four areas: tires, engine accessories, suspension and drive line.

It is important, therefore, that a N.V.H. problem be isolated into its specific area as soon as possible. The easiest and quickest way to do this, is to perform a

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thorough road test if a visual inspection does not readily pinpoint the problem. After you have performed the road test, refer to the N.V.H. Master Diagnosis Guide in this Part, to determine what diagnostic procedure to use.

N.V.H. TESTS AND OPERATIONS

A gradual appearance of the problem indicates a deterioration of a component, such as tires, U-joints, an accessory drive belt, or a wheel bearing.

A sudden appearance of the problem could indicate a lost wheel balance weight or lost driveshaft balance weight.

NOTE: Information gained from the problem description should never be used in place of facts gained from diagnosis, nor should it be used in an attempted short cut fix. In the long run, time will be saved by adhering to the diagnositic procedures shown in this Part.

VEHICLE VIBRATION ROAD TEST

The engine run-up test is performed first with the vehicle stationary and the transmission and transfer case in neutral. Accelerate the engine gradually to 3000 rpm and note any vibration speeds. If a vibration occurs, proceed to Engine Run-up, Engine Accessory and Tip-in N.H.V. Diagnostic procedure. If no vibrations are noted, proceed with the road test.

The initial road test is the most important step in the diagnosis and subsequent correction of vehicle vibrations. Before performing a road test, check to see that all tires are inflated to the specified air pressure. Select a road test area with as smooth a road surface as possible and where a speed of 55 mph (88 Km/h) is permitted.

Refer to the Diagnosis Guides to assist in diagnosing vibrations. During the roat test, take special care to note the vehicle reaction to the following conditions:

1. Light acceleration between 25 and 50 mph (41-80 Km/h). If a moan is heard, with a possible vibration felt in the floor pan, a tip-in moan condition should be recorded, and the speed noted. Proceed to Engine Run-up, Engine Accessory and Tip-in N.H.V. Diagnostic Procedures.
2. Steady or heavy acceleration or deceleration between 25 and 45 mph (41-73 Km/h). A rumble type noise indicates a driveshaft out of phase, driveline or pinion angles out of specification. Proceed to Driveline N.H.V. Diagnostic Procedure.
3. Slowly accelerate and decelerate between 45 and 55 mph (73-88 Km/h). If a shake is noticed in the steering wheel/column, seats, floor pan, trim panels or front end sheet metal, the vibration is probably caused by out of round or out of balance wheel/tire assemblies, brake drums out of balance, tires with excessive cupping or force variation (non-uniform construction). Proceed to Wheel and Tire Diagnostic Procedure.
4. At 30 to 55 mph (49-88 Km/h) if a vibration is felt in the floor pan or seats, with no visible shake of vehicle components with an accompanying sound, or sensation of sound (rumble, buzz, hum, drone, or booming noise) the probable cause is driveline runout, balance, out of phase or incorrect angles. Proceed to Driveline and Rear Axle Diagnostic Procedures.
5. A neutral coast test is a good method to determine if the engine/accessories or driveline, wheels, tires, or brake drums are causing the vibration. To do this, accelerate to 55 mph (88 Km/h) and place transmission selector in NEUTRAL and allow engine to return to idle speed. If the vibration exists in this condition, the investigation can be confined to the transmission output shaft, driveshaft, axle, wheels, tires or out of balance brake drums.
6. Vehicle surge or pedal pulsation during brake application at slow speed can be caused by out of round, or distorted brake drums. Out of round can be caused by warping, or machining; distortion is caused by wheel contact to drum in other than the designed contact area.

ENGINE RUN-UP DIAGNOSTIC PROCEDURE

This procedure is useful in separating driveline and tire vibration from engine and accessory vibration. A tachometer is required to correlate engine speed with vehicle speed. Run the engine up to the problem rpm (encountered on the road) with the vehicle stationary and the transmission in PARK or NEUTRAL and then in DRIVE range (stall test), with the wheels blocked and brakes applied.

CAUTION: While making this test in the DRIVE range on automatic transmission equipped vehicles, do not hold the throttle open for more than five (5) seconds at a time. Then move the selector lever to NEUTRAL and run the engine at 1000 rpm for 15 seconds to cool the converter.

On standard transmission equipped units, run the engine up to the vibration rpm (transmission in neutral) with the clutch engaged and disengaged. With automatic transmissions, if the vibration persists in either PARK or NEUTRAL, the disturbance may be caused by the engine, or accessory such as the A/C compressor when engaged, the flywheel or flex plate, clutch or torque converter, or an input component within the transmission. However, if the vibration exists in DRIVE range, then the disturbance may be caused by bound-up engine mounts and/or exhaust system components.

NOTE: Because the vehicle is stationary during the engine run-up checks, other noises and/or vibrations will become evident which were not evident under normal driving conditions. For instance, all engines have a natural vibration frequency which can be felt in neutral but not under normal driving conditions. For this reason, the use of a tachometer is mandatory to verify the presence of the actual condition.

ENGINE ACCESSORY AND TIP-IN MOAN

CHECK ACCESSORY BOLT TORQUE AND DRIVE BELT TENSIONS

In many instances, a vibration verified by the engine run-up check is simply due to a loose accessory bracket or drive belt. For this reason, all accessory attaching

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bolts should be checked for proper torque and all drive belts checked for proper tension with a belt tension gauge.

ACCESSORY VIBRATION DIAGNOSTIC PROCEDURE

Visually inspect all drive pulleys, belts, and pulley alignments. Any of the above conditions in the accessory drive systems could initiate a vibration. Bent or nicked pulleys may require replacement. Badly worn, frayed, or nicked belts must be replaced. Pulleys must be properly aligned. Inspect the fan, fan spacer or clutch, and water pump pulley for damage and burrs or foreign material that may cause poor seating between any of the components.

Watch the drive belts with the engine running in NEUTRAL at the vibration speed. If one of the belts experiences severe "belt whip" at this speed, this accessory or drive system may be contributing to the condition.

Watch the drive pulleys with the engine running at idle. Replace any pulley which exhibits radial or axial runout in excess of 1/8 inch.

Watch the belts ride in the pulleys at idle speed. If the belt appears to ride up and down the pulley, the sheave width is not constant and the pulley must be replaced.

A stethoscope or other probing device may save time in diagnosing an accessory vibration. Probing at the vibration speed with the engine running in NEUTRAL will often immediately pinpoint the condition. If this proves unsatisfactory, remove the drive belts one at a time until the vibration is reduced or eliminated. The last belt removed thus pinpoints the accessory or drive system contributing to or causing the condition. In some cases belt removal will not eliminate an accessory vibration and it becomes necessary to remove the accessory from its mountings.

Once the vibration area has been located, the drive belt should be replaced first, as construction variations in the belt may not be evident upon visual inspection and can set up a vibration.

When the belt and related pulleys and accessory attachments are determined to be acceptable, replacement of the accessory may be necessary.

If the vibration is traced to the water pump and fan area, removal of the fan will further define the condition. If the vibration is corrected, try reseating the assembly before replacing any parts. Make certain there are no burrs or foreign material on any of the mating surfaces. Road test to verify resolution of condition.

NEUTRALIZE ENGINE MOUNTS AND EXHAUST SYSTEM

An abnormal vibration is often caused by a component, such as an engine mount, which is acting in a rigid manner because of a distorted or twisted mounting position. As a result, the mount does not absorb vibrations as it should. Grounded or abnormally strained exhaust system and hangers will also lead to this condition.

To neutralize the engine mounts, loosen the attaching bolts of all three mounts, start the engine, shift to DRIVE while idling, then shift back to NEUTRAL. Shut off the engine and re-tighten the bolts. The No. 3 crossmember can be neutralized in the same manner by loosening the outer bolts. Road test to verify resolution of condition.

The exhaust system must be neutralized while it is hot because the thermal expansion of the pipes will otherwise place a strain on the hangers. While the exhaust system is at its normal operating temperature, loosen all hangers and reposition as required so that they hang free and straight. Next, loosen the flanges at the manifolds, start the engine, shift to DRIVE while idling and shift back to NEUTRAL, then shut off the engine and re-tighten all flange and hanger bolts. Be certain that no grounding condition exists and that adequate clearance exists along the entire length of the exhaust system starting at manifold working rearward. Road test to verify resolution of condition.

TIP-IN MOAN

The term tip-in moan is used to describe a moan noise condition which may or may not be accompanied with a floor pan vibration in the speed range of 25-50 mph (41-80 Km/h) under light to medium acceleration and disappear when you back off the accelerator.

Tip-in moan is confined to the following three areas: 1—Powertrain grounding; 2—Exhaust system; 3—Engine accessories.

NOTE: In some cases, tip-in moan can be induced (for diagnostic purposes) by performing a stall test in drive on automatic transmission equipped vehicles. Do not stall test for more than 5 seconds at a time. After stall test, run the engine in neutral at 1000 rpm for 15 seconds to cool the torque converter.

The following procedure is recommended for test purposes only to determine if a powertrain grounding condition exists.

1. Loosen the transmission bell housing-to-engine attaching bolts.
2. Test drive vehicle in vibration speed range. (Retighten bolts after test is made).
3. If vibration is eliminated or greatly reduced, the drive train is grounded externally or through the engine mounts. Visually inspect the drivetrain for grounding to the frame or cab.
4. If the condition is not significantly reduced, the exhaust system and engine accessories should be checked.

WHEEL AND TIRE VIBRATION DIAGNOSIS AND SERVICE PROCEDURE

NOTE:

1. Mud and snow type tire vibrations are often mistaken for driveline conditions, especially when used on all four positions on four-wheel drive models.
2. **Truck type tires with nylon construction will experience flat spotting when vehicle is parked for extended periods. To eliminate this problem, road testing should be**

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conducted for a minimum of 10 miles or until tires become warm.

3. **Radial type tires should be road tested for 10-15 miles (17-24 Km) to normalize and warm up the tires.**

1. Promptly after road test, raise vehicle on a hoist to prevent tire flat-spotting. Check tires for excessive wear or cupping. Check inflation pressure, alignment or suspension components if indicated by tire wear or results of road test.
2. Spin front wheels fast enough by hand to check bearings for roughness. Replace worn bearings.
3. Check bearing end play and adjust as required. Check for visible wheel or tire wobble. Service as required.
4. Check tire and wheel balance. Service if necessary using Rotunda wheel balancing equipment or equivalent.

   NOTE: 2-piece rim wheels should be balanced by installing weights on inside rim flange only.

   Non-powered wheels may be balanced on the vehicle using a mechanical or strobe type balancer or off the vehicle using a dynamic computer balancer.

BALANCING NON-POWERED WHEELS

See instructions provided with the particular wheel balancing machine available.

Make certain that the brakes are not dragging and wheel bearings are properly adjusted before attempting to spin the wheels. On vehicles equipped with disc brakes, push the brake pads into the caliper to free the rotor.

BALANCING POWERED WHEELS

SEMI-FLOATING CONVENTIONAL AXLES

Don't use the spinner on any powered wheels. Jack up one wheel at a time, locate the jack securely under the frame, approximately one foot from the wheel. Make sure the jack is secure and safe.

Raise the rear end of the vehicle taking proper precautions.

Spin the wheel with the engine and transmission in high gear at 30-40 mph (49-64 Km/h) on the speedometer. Start the wheel as gradually as possible. Take care to avoid jerking condition on trucks equipped with automatic transmission. Use an accelerator pedal prop on vehicles not equipped with a hand throttle.

Use Rotunda on the mechanical or strobe type Balancing Equipment or equivalent.

To balance, place the pick-up as close to the wheel as possible. With the wheel spinning at the speed where the maximum vibration is showing, read the strobe and follow the same procedure as balancing the front wheels.

SEMI-FLOATING AXLES WITH LIMITED SLIP DIFFERENTIALS

Use one of the following methods to balance wheels:

1. Raise the vehicle taking proper precautions. Use Rotunda on vehicle balancing equipment or equivalent. Place the pick-up under the wheel. Spin the wheel by operating the vehicle to 55-60 mph (88-96 Km/h) to where the vibration occurs the most. Read the strobe and follow the same procedure required for balancing non-powered wheels.
2. Raise the rear end of the vehicle taking proper precautions. Use Rotunda on the vehicle wheel balancing equipment or equivalent. Remove the wheel opposite the wheel to be balanced. Balance the wheel and reinstall the removed wheel. Balance the wheel but do not remove the opposite wheel that was previously balanced.

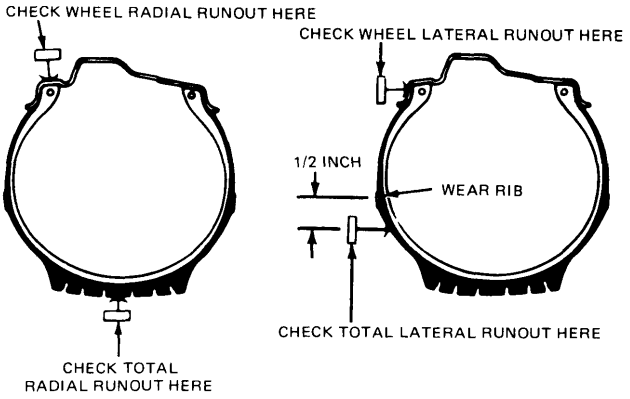
FULL FLOATING AXLES WITH CONVENTIONAL AND LIMITED-SLIP DIFFERENTIALS

Raise the rear end of the vehicle, taking proper precautions, so the wheels are raised 1 1/2 inches off the floor.

Disconnect the wheel from the axle drive by removing the hub flange screws. Pull the hub flange out to clear the studs at least 1/2 inch.

Spin the wheels with Rotunda Heavy Duty Truck Spinner or equivalent. Balance according to instructions.

If problem still exists after balancing, check the radial and lateral runout of the tire and wheel assembly (refer to Fig. 1). If runout is more than .090 inch, do one of the following:



PLACEMENT OF RUNOUT INDICATOR PICKUP

NOTE: To insure an accurate reading, rotate the tire and wheel assembly by hand slowly, so that the indicator pickup roller does not vibrate or chatter.

Y1841-1A

FIG. 1 Correct Placement of Runout Indicator

1. Reindex the tire 180° on the wheel assembly.
2. Mark the high point of radial runout of the tire and also mark the low point of radial runout on the wheel. Demount the tire from the wheel and align the high point of the tire, with the low point of the wheel. Remount the tire and inflate to specifications. Check radial runout. If it is still more than .090 inch T.I.R., check the wheel runout. If runout is more than .070, replace the wheel. If less than .070, replace the tire. Rebalance the reworked assembly.

Note: When remounting the tire on the wheel, use ample tire mounting lubricant or soap solution on the

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tire and wheel bead seat area. Inflate tires to 80 psi and bleed down to specified pressure.

REAR BRAKE DRUM BALANCE DIAGNOSIS AND CORRECTION PROCEDURE

Rear brake drum imbalance can cause a vibration condition on light trucks that sometimes cannot be compensated for by wheel balancing.

If rear brake drum imbalance is suspected, raise the rear end of the vehicle taking proper precautions. Remove the rear wheel and tire assembly.

Before testing, install all five lug nuts with flat washers on them to retain the drums to axle flanges. If drums do not have brake weights, run the vehicle up to the speed where vibration occurred during road test.

If the drums exhibit out of balance symptoms, they should be removed from the vehicle and balanced as follows:

1. Position the brake drum on a "bubble-type" balancer and noting the "heavy" side of the drum, place a wheel balance weight on the drum directly opposite the heavy point. Select the appropriate number of weights until the bubble balance indicates a 'balanced' condition. Mark the location of the 'light' side of the drum, and note the total amount of the balance weight needed to balance the drum.

Note: A drum which already has a balance weight attached or requires less than 2 oz. of weight to balance is not the prime cause of the vibration.

2. Fabricate a piece of mild steel to fit the curvature of the drum face and equal to the balance weights required to balance the brake drum (an old flywheel ring gear can be cut and used as a balance weight).

Note: A small postal scale may be used for determining the weight of both the balance weights used and the weight of the fabricated drum balance weight needed.

3. Position the drum balance weight on the drum face in the location on the lightside of the drum indicated, as shown in Fig. 2. Arc weld (tacweld 1/4 inch long) the balance weight to the drum face.

Note: Under no condition should any other welding method be used other than arc welding. To prevent drum distortion, do not use a current setting of more than 100 amps.

4. Replace the balanced drum on the vehicle.
5. Static balance both rear wheels and tires and install on the vehicle.
6. Road test to verify correction.

BRAKE MOAN OR SHUDDER IN TURNS DURING LIGHT BRAKE APPLICATION

A moaning condition may be observed at speeds of 8-40 (13-64 Km/h) mph with extremely light or no brake application. The symptom is a low frequency moan/noise/vibration that occurs at a specific turn radius and vehicle speed. Proper front wheel bearing end play adjustment will eliminate the condition.

Adjustment is made in the following manner:

Remove wheel and tire assembly, disc brake caliper and pads, dustcap, retainer, and cotter pins. Tighten the rotor retention nut to 22-25 ft-lbs while rotating the disc brake rotor in the opposite direction. Back off the wheel retention nut 1/8 turn and install the retainer and cotter pin without additional movement of the wheel nut. Reinstall dustcap, caliper, pads and wheel and tire assembly. The procedure will adjust bearing end play to below .005".

DRIVELINE DIAGNOSTIC PROCEDURE

DRIVE SHAFT NOISE AND VIBRATION

Truck drivelines are subject to the same noise and vibration problems of other vehicles. On slow running vehicles, the noise and vibration may not be so noticeable. But on the other hand, because of the multiple components: front and rear drive shafts, intermediate shafts, coupling shafts, multiple universal joints, phasing, angle settings, multiple transmissions, multiple axles and several different types of suspension, the noise and vibration problem on trucks may be many times greater than on passenger cars.

Drive shaft noise and vibration can be found by using procedures similar to those used for finding axle noises.

A frequent cause for driveline noise is incorrect driveline angles. See adjustments for proper driveline angles and adjusting procedures.

Driveline noise or vibration can be caused by the following conditions:

Worn U-joint components.

Incorrect driveline phasing.

Incorrect installation of coupling shaft center support bearing insulator.

Incorrect parts usage relative to specific engines, transmissions, etc.

Slip yoke not lubricated.

Bent or out-of-balance shaft.

Transmission output flange runout.

A "clunking" noise which occurs as soon as the vehicle starts to move at normal throttle can be caused by the drive shaft slip yoke. This should not be confused with an automatic transmission engagement (neutral to drive, neutral to reverse) or automatic transmission upshift engagement.

DRIVELINE VIBRATION VERIFICATION

Driveline runout and/or balance can cause a vibration of a higher frequency than a vibration which originates in the tire and wheel assembly. To determine whether a driveline vibration is present, the rear of the vehicle should be supported on stands or twin-post hoist under the rear axle.

NOTE: Before you remove the wheels, make sure that they are properly marked for re-assembly in the same position.

F-100/150—E-100/150 REAR AXLES

Remove the rear wheels and reinstall the lug nuts with flat washers to retain the brake drums. Run the vehicle

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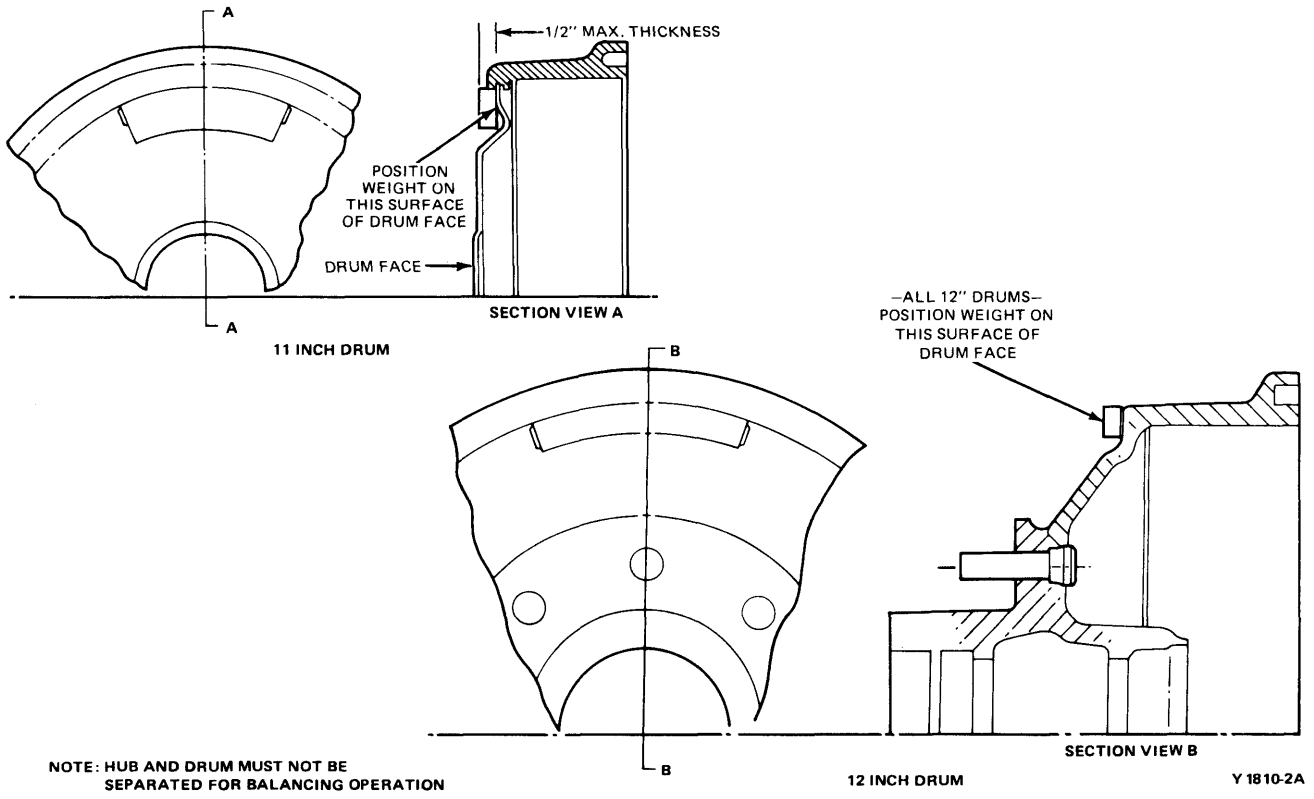


FIG. 2 Drum Weight Weld Pattern

up to the speed range that the vibration was experienced during road test.

If the vibration condition is eliminated, refer to the WHEEL AND TIRE DIAGNOSIS AND SERVICE PROCEDURE.

If the vibration is still present, remove the brake drums and again run the vehicle up to the vibration speed range.

If the vibration is eliminated, refer to the REAR BRAKE DRUM BALANCE DIAGNOSIS AND SERVICE PROCEDURE.

If the vibration is still present, proceed to item 1 below.

F-250/350—E-250/350 REAR AXLES

Remove the rear axle flange retaining bolts and remove the rear axle shafts. (Always use new gaskets and retaining bolts when the axle shafts are reinstalled.) Run the vehicle up to the speed range that the vibration was experienced during road test.

If the vibration is eliminated, refer to the WHEEL AND TIRE DIAGNOSIS AND SERVICE PROCEDURE.

If the vibration is still present, proceed to item 1 below.

1. Check coupling shaft for proper phasing as shown in Figs. 11, 12 and 13.
2. Check the runouts of the shafts at area "A" through "F" as shown in Figs. 3, 4, 5 and 6.
3. Check the fit of the U-joint cups in the axle pinion flange and transfer case output flange (should seat completely and not exceed .005" side shake between locating tabs).

NOTE: Turn the rear wheel/drum to rotate the coupling shaft and driveshaft when checking runouts.

4. Mark the points of the greatest runouts on the coupling shaft and driveshaft. If the runout is .035 inch or more at areas "A", "B", or "C", replace the coupling shaft.
5. If the runout at area "D", or "E" is more than .035 inch, replace the driveshaft.
6. If the runout at the rear of the driveshaft is less than .035 inch (and the front and center runouts are also less than .035 inch) proceed to driveshaft balance.
7. If the runout at area "F" is more than .035 inch, mark the point of greatest runout on the shaft.

NOTE: The runout at the rear of the driveshaft can be caused by either the driveshaft or the companion flange.

8. To determine the cause of the runout at the rear of the driveshaft, remove and rotate the driveshaft 180° to the companion flange and check and mark the greatest runout at the rear of the driveshaft. If the runout is less than .035 inch, proceed to Step 8.
9. Compare the first and second marks at the rear of the driveshaft to determine the cause of the runout. If the marks are within approximately 1 inch, replace the driveshaft. If the marks are approximately on opposite side of the shaft, replace the companion flange. (Refer to Fig. 7).

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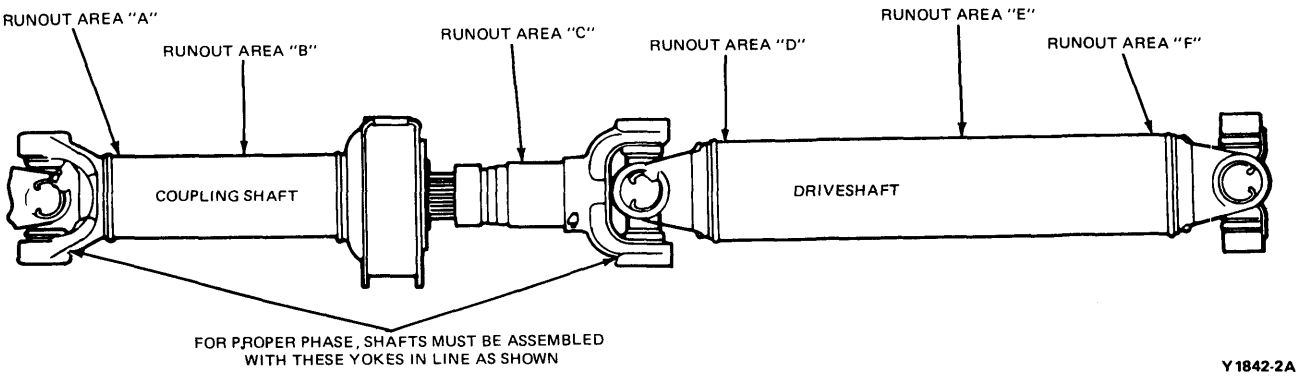


FIG. 3 Runout Areas—Two Piece Driveshaft

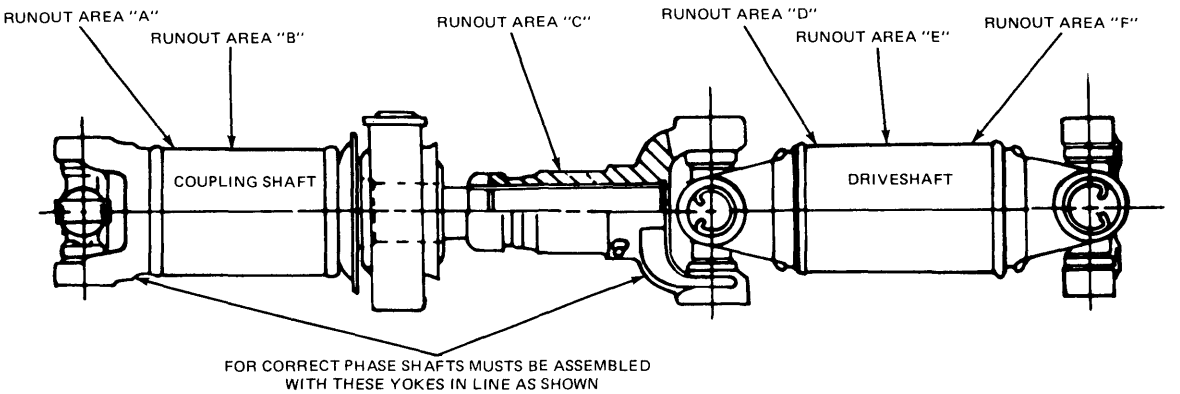


FIG. 4 Runout Areas—Two Piece Driveshaft "Blind Spline" with Necked Down Coupling Shaft

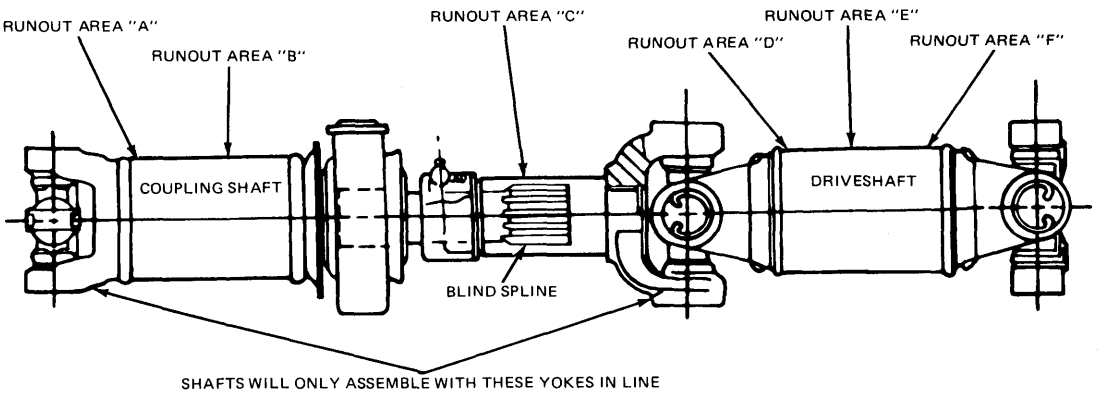


FIG. 5 Runout Areas—Two Piece "Blind Spline" Driveshaft

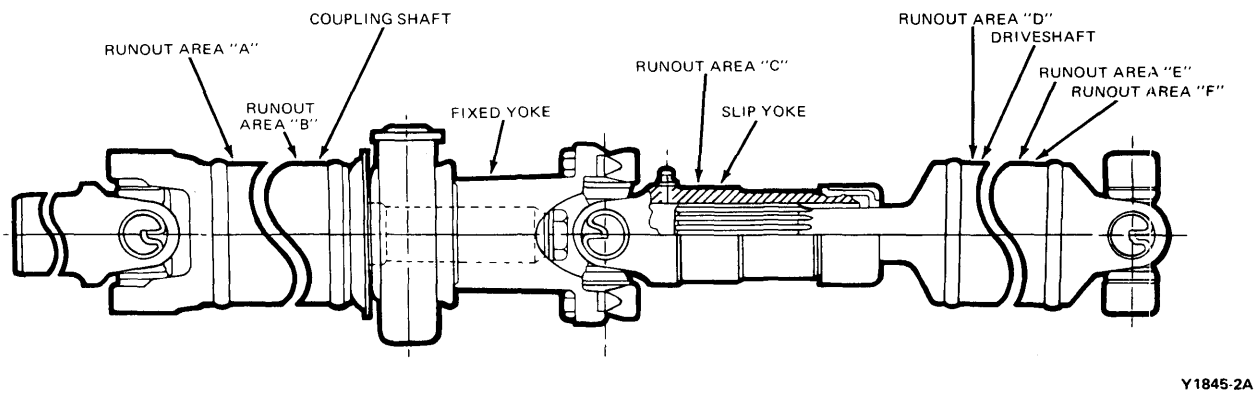


FIG. 6 Runout Areas—Two Piece "Fixed Yoke" Driveshaft

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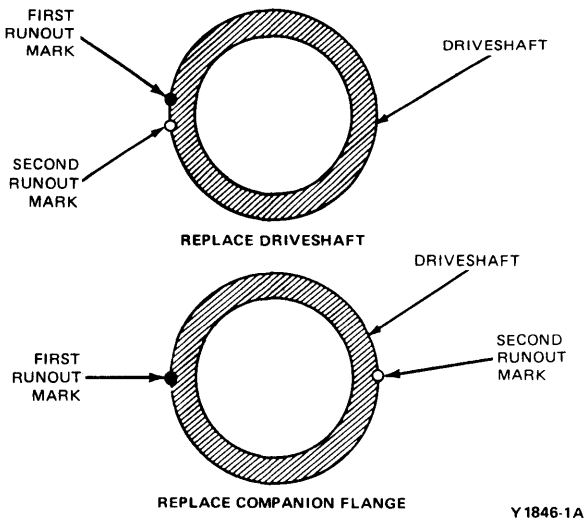


FIG. 7 Reading Runout Marks

10. After replacing either the driveshaft or companion flange, recheck runouts. If the excessive runout is still evident after replacement of the companion flange, it will be necessary to replace the ring gear and pinion and repeat the above checks until runout is within specification.
11. Evaluate on hoist. If the vibration is still present, proceed to driveline balance.

If not corrected, balance the driveshaft as follows:

1. Remove and rotate the driveshaft 180° on the companion flange, and evaluate the vibration, unless the driveshaft was previously rotated and evaluated during runout check.
2. If the vibration was increased by rotating the driveshaft 180°, return to the original position.
3. Light trucks equipped with a two-piece driveline (e.i., driveshaft plus coupling shaft) are most sensitive to driveshaft unbalance at the front of the shaft.

   Mark into four equal parts the end of the driveshaft which is most sensitive to unbalance. Number the parts 1, 2, 3, and 4. (See Fig. 8.)

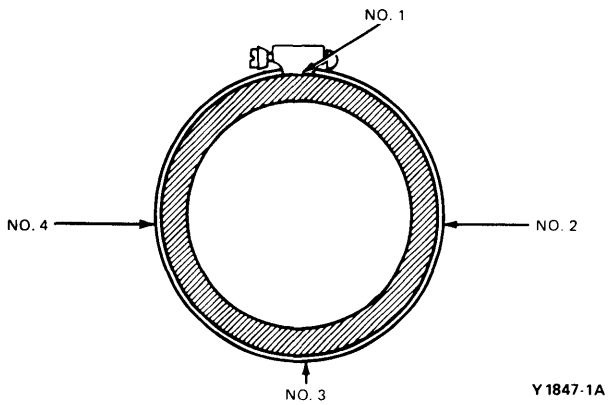


FIG. 8 Marking Driveshaft for Unbalance

NOTE: In Steps 4, 5, and 6—during four evaluations with the hose clamp in different positions, determine the position (1 through 4) which has the lowest vibration or sound level.

4. Install one screw type hose clamp with the screw of the clamp at position number 1. Evaluate the driveline vibration and/or sound level by running the driveshaft in the vibration mph range. Note any change in the initial vibration (better-worse).
5. Move the hose clamp screw to position number 2 and re-evaluate the vibration and/or sound level and note any change.
6. Repeat Step 5 with the hose clamp screw in positions number 3 and number 4.
7. Move the hose clamp screw to the best position (180° from the worse position).

NOTE: If two adjacent positions are equally good, move the hose clamp screw between the two positions and evaluate the vibration and/or sound level.

8. If unbalance is still present with the one hose clamp in the best position, install one more hose clamp, with the screw at the best position and evaluate the vibration and/or sound level.
9. If unbalance still exists, the combined weight of the two hose clamp heads may be excessive. To reduce this excess rotate the clamp heads away from each other approximately 1/2 inch (one each way from the best position). See Fig. 9. Evaluate and note if balance has improved.

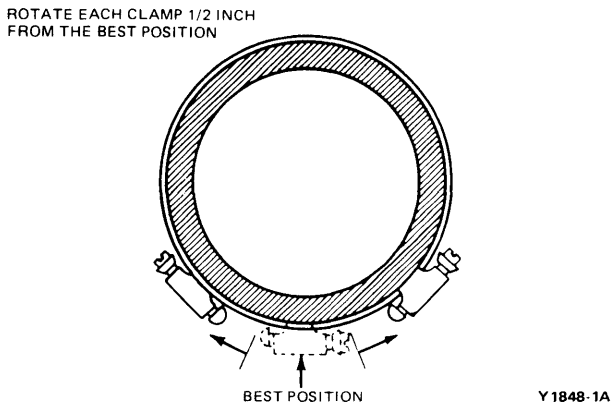


FIG. 9 Positioning Clamps for Unbalanced Driveshaft Correction

10. Continue to rotate the clamps apart equally in small increments until the balance is best.
11. To completely eliminate driveline vibration, it may be necessary to balance the coupling shaft. Install the hose clamp at the rear of the shaft and follow the same procedure as above.

NOTE: Do not road test until you are reasonably sure the vibration has been eliminated. However, a slight vibration still felt on the hoist may not be felt during road test.

12. Install the rear wheels in the same position as removed from the vehicle.

Road test to verify resolution of condition.

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REAR AXLE DIAGNOSTIC PROCEDURE

GENERAL

Certain rear axle and drive shaft trouble symptoms are also common to the engine, transmission, tires and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the rear axle before adjusting, repairing, or replacing any of the axle parts.

REAR AXLE NOISE

Noise characteristics in a rear axle are more difficult to diagnose and repair than mechanical failures. Slight axle noise heard only at a certain speed or under remote conditions must be considered normal. Axle noise tends to peak or be more pronounced at specific speeds and the noise is in no way a sign of trouble in the axle.

Axle noises fall into two basic categories: gear noise and/or bearing noise.

GEAR NOISE

Abnormal gear noise can be recognized since it produced a cycling pitch and will be very pronounced in the speed range at which it occurs, usually under drive, float, cruise or coast conditions. Gear noise tends to peak in a narrow speed range or ranges, while bearing noise will tend to remain constant at all speeds.

BEARING NOISE

Worn or damaged bearings will produce a whine that is constant in pitch and varies with vehicle speed. This fact will help distinguish between bearing and/or gear noise.

Pinion bearing noise can be identified as a constant grinding noise. Pinion bearings rotate at a higher speed than differential side bearings or axle shaft bearings. The noise is most noticeable at a slight pull between 18 to 25 mph (29-40 Km/h).

Wheel bearing noise may be confused with rear axle noise. To differentiate between wheel bearing and rear axle noise, drive the vehicle on a smooth road at medium low speed. With traffic permitting, turn the vehicle sharply right and left. If noise is caused by wheel bearings, the noise will increase on the defective bearing because of side loading. When the noisy bearing stops rotating, the noise stops.

Rear wheel bearing noise can also be diagnosed on an axle contact hoist. With the engine running and the transmission in gear, run the rear wheels fast enough to bring out the wheel bearing noise. Stop one wheel and then the other by pulling the individaul parking brake cable if so equipped.

Side (differential case) bearings will produce a constant grinding noise of a slower nature than pinion bearing (side bearing noise cannot be determined by the wheel bearing test), but will be in the same frequency as axle shaft bearings.

Also, certain trouble symptoms are common to both the conventional and limited-slip differential axles while still other symptoms are found only in the limited-slip and Traction-Lok differentials.

To determine whether the vehicle is equipped with a conventional or a limited-slip differential, check the vehicle warranty plate and the axle ratio tag.

FRONT DRIVING AXLE NOISE

Front wheel drive axles are susceptible to the same noise characteristics as the rear axles. Additional noises may be introduced because of the driving action through universal joints and the constant turning of the drive shaft between the axle and the transfer case. Most front axle problems can be resolved by using the same diagnostic techniques used for finding the cause of rear axle problems.

DIAGNOSIS GUIDES

The following guides can be used when diagnosing Noise, Harshness and Vibration areas.

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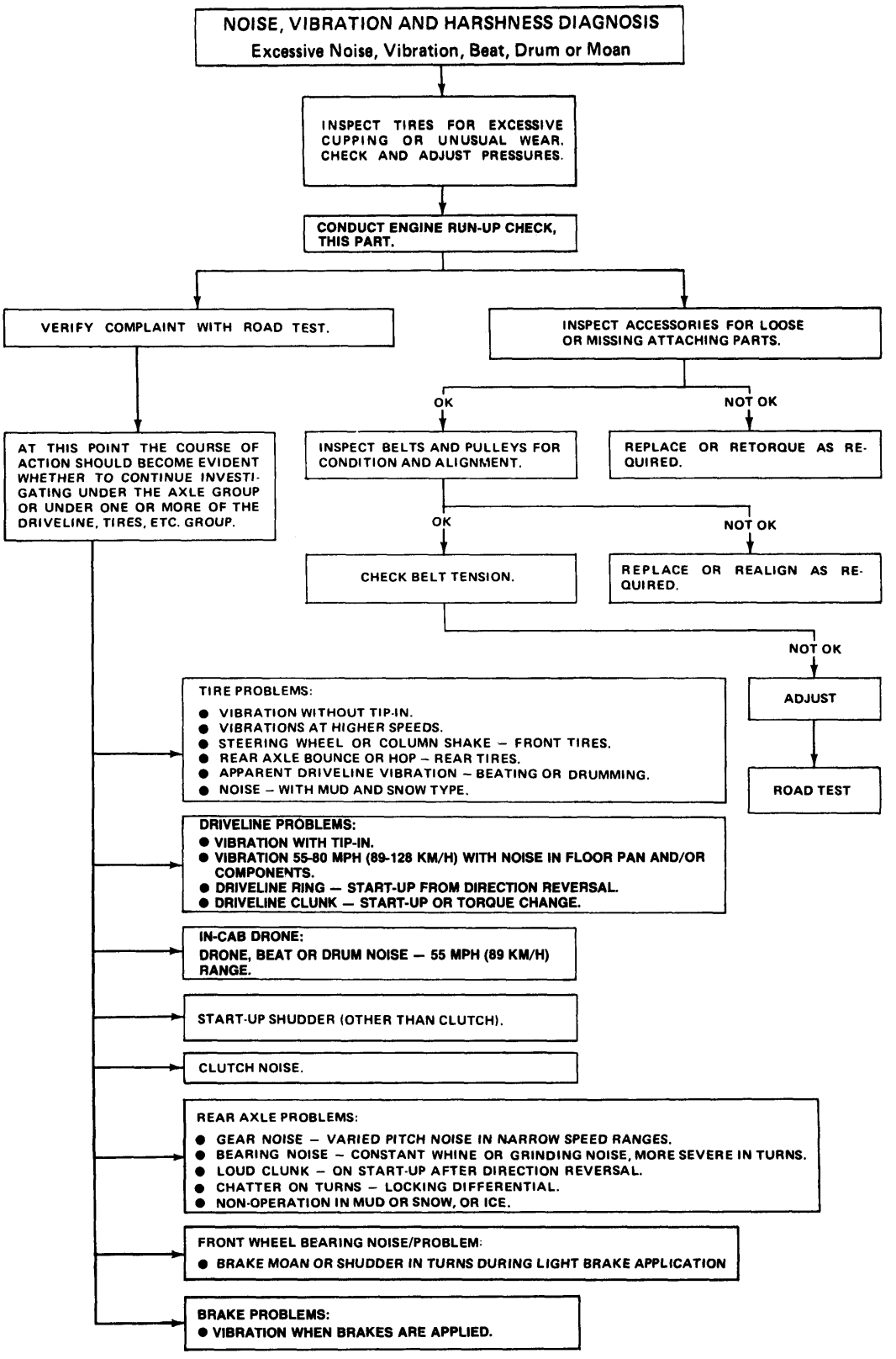
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CONDITION	POSSIBLE CAUSE	CORRECTION
• Cab boom or drone — a low pitched pulsating or drumming noise heard inside cab usually between 35-50 mph (57-80 km/h).	• Cab back panel pulsations.	• Refer to Cab Back Panel Vibration (Boom or Drone) this Part.
• Drive away shudder — vibration shudder on acceleration from the time the vehicle starts to move to 25 mph on vehicles equipped with two-piece driveshafts. More noticeable on hard acceleration.	• Driveshaft out-of-phase. • Incorrect driveline angularity. • Universal joints binding. • Slip yoke spline binding.	• Place two-piece driveshaft in phase. Refer to Two-Piece Driveshaft Phasing Procedure. • Add shims to correct angularity. Refer to Driveline Angle Checking and Service Procedure. • Replace universal joints. • Install splash shield. Refer to Slip Yoke Spline Binding, this Part.
• Vibration "grunt" on acceleration or end of a brake stop on vehicles equipped with two-piece driveshafts.	• Slip yoke spline seized. • Misaligned center bearing.	• Clean and lubricate. • Clean and lubricate.
• Low frequency, high amplitude vibration (shake) felt in the steering wheel, accelerator pedal, floor pan or seat at speeds above 45 mph (72 km/h) in all drive modes.	• Cupped or abnormally worn tires. • Wheel bearing end play or roughness condition. • Wheel/tire imbalance. • Wheel tire runout in excess of specification. • Rear brake drum imbalance.	• Replace tires. Check alignment, suspension, shock mount, etc. Repair as required. • Adjust as necessary. • Spin balance as required. • Correct as necessary. Refer to Wheel Balance, this Part. • Correct as necessary. Refer to Rear Brake Drum Balance Diagnosis and Correction Procedure, this Part.
• Tip-in moan — moan noise with possible accompanying vibration in the floor pan on light acceleration between 25 to 50 mph (41-80 km/h) and disappears when accelerator is let off.	• Drive train components grounding against cab or frame. • Engine mounts position condition. • Exhaust system position condition. • Engine accessory induced.	• Service as required. • Correct as necessary. Refer to Neutralize Engine Mounts and Exhaust System, this Part. • Correct as necessary. Refer to Neutralize Engine Mounts and Exhaust System, this Part. • Correct as necessary. Refer to Engine Accessory and Tip-In Moan, this Part.
• Engine vibration — vibration felt on engine run up in neutral within the same rpm range as the vibration was experienced during road test.	• Drive train components grounding against frame or cab. • Engine mounts position condition. • Engine accessory induced. • Engine rotating parts out-of-balance including clutch or torque converter.	• Service as required. • Correct as necessary. Refer to Neutralize Engine Mounts and Exhaust System, this Part. • Correct as necessary. Refer to Neutralize Engine Mounts and Exhaust System, this Part. • Correct as necessary. Refer to Clutch, this Part.
• Brake moan or shudder in turns during light brake applications at 8-40 mph (13-64 km/h).	• Front wheel bearing end play condition.	• Correct as necessary. Refer to Brake Moan or Shudder on Turns During Light Brake Application.
• Driveline vibration — a high frequency, low amplitude vibration felt in the seats and/or floor pan with accompanying rumble sound at speeds above 30 mph (49 km/h) — all drive modes. Can be duplicated with rear axle on jack stands or twin post hoist.	• Driveshaft runout/balance beyond specification. • Axle/transmission/transfer case yokes with runout beyond specification. • Universal joint binding or loose. • Excessive center bearing insulator compression. • Ring gear and pinion induced.	• Correct as necessary. Refer to Driveline Vibration Diagnosis and Service Procedure, this Part. • Correct as necessary. Refer to Driveline Vibration Diagnosis and Service Procedure, this Part. • Replace universal joint. • Correct as necessary. Refer to Coupling Shaft/ Center Bearing Alignment, this Part. • Replace ring gear and pinion. Refer to Ring Gear and Induced Pinion, this Part.
• Torsional vibration — high frequency, low amplitude vibration felt in the seats and/or floor pan with accompanying rumble sound on steady heavy acceleration or deceleration between 25 and 45 mph (41-72 km/h).	• Driveline angles condition.	• Correct as necessary. Refer to Driveline Angle Service.

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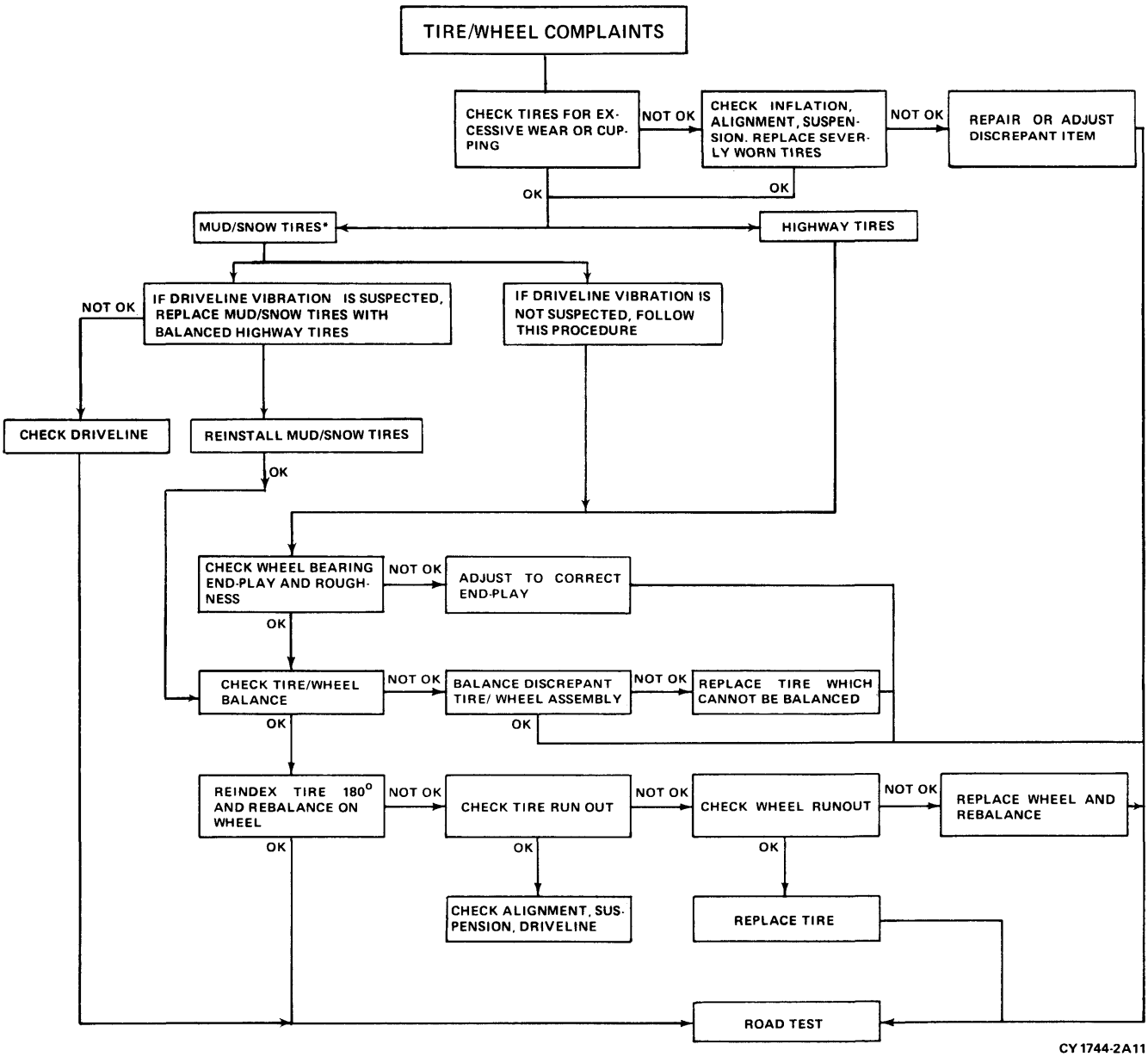
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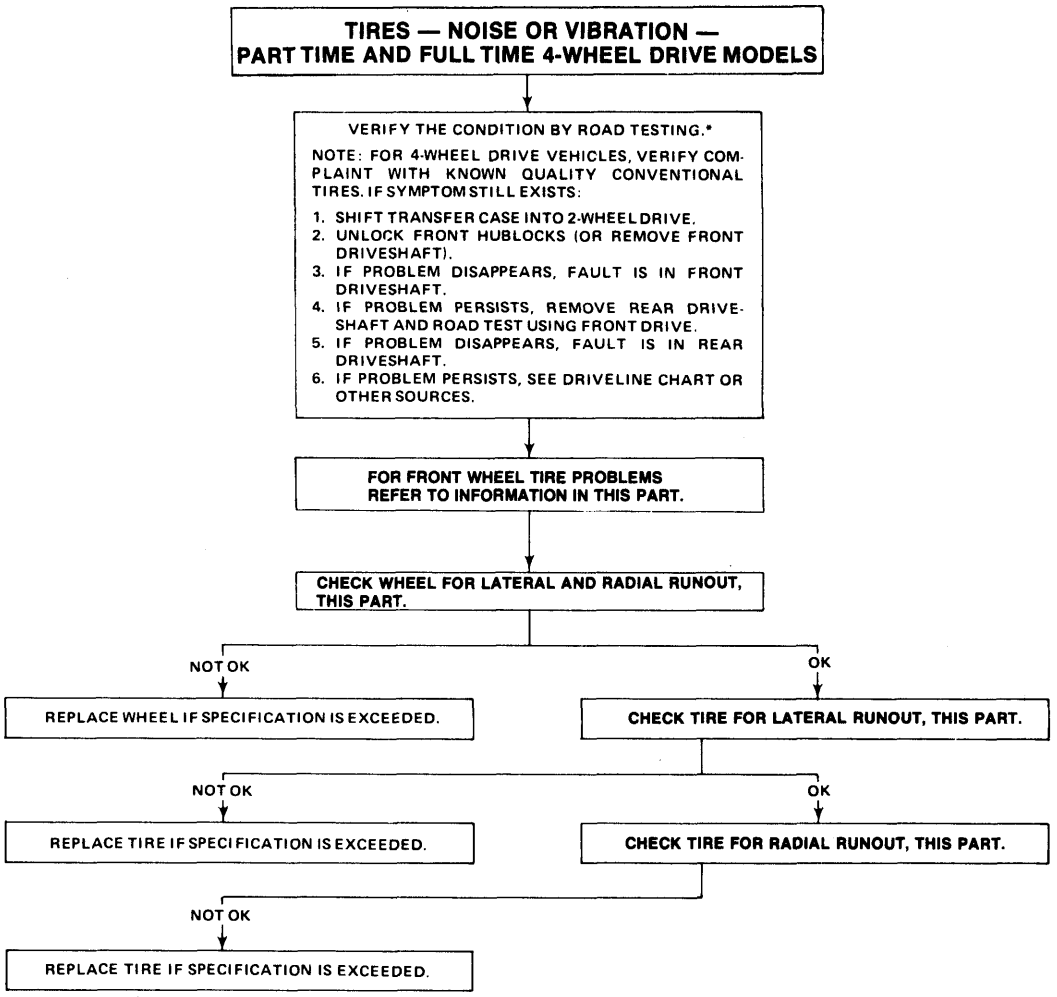
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* FULL TIME DRIVE EXCEPTIONS:

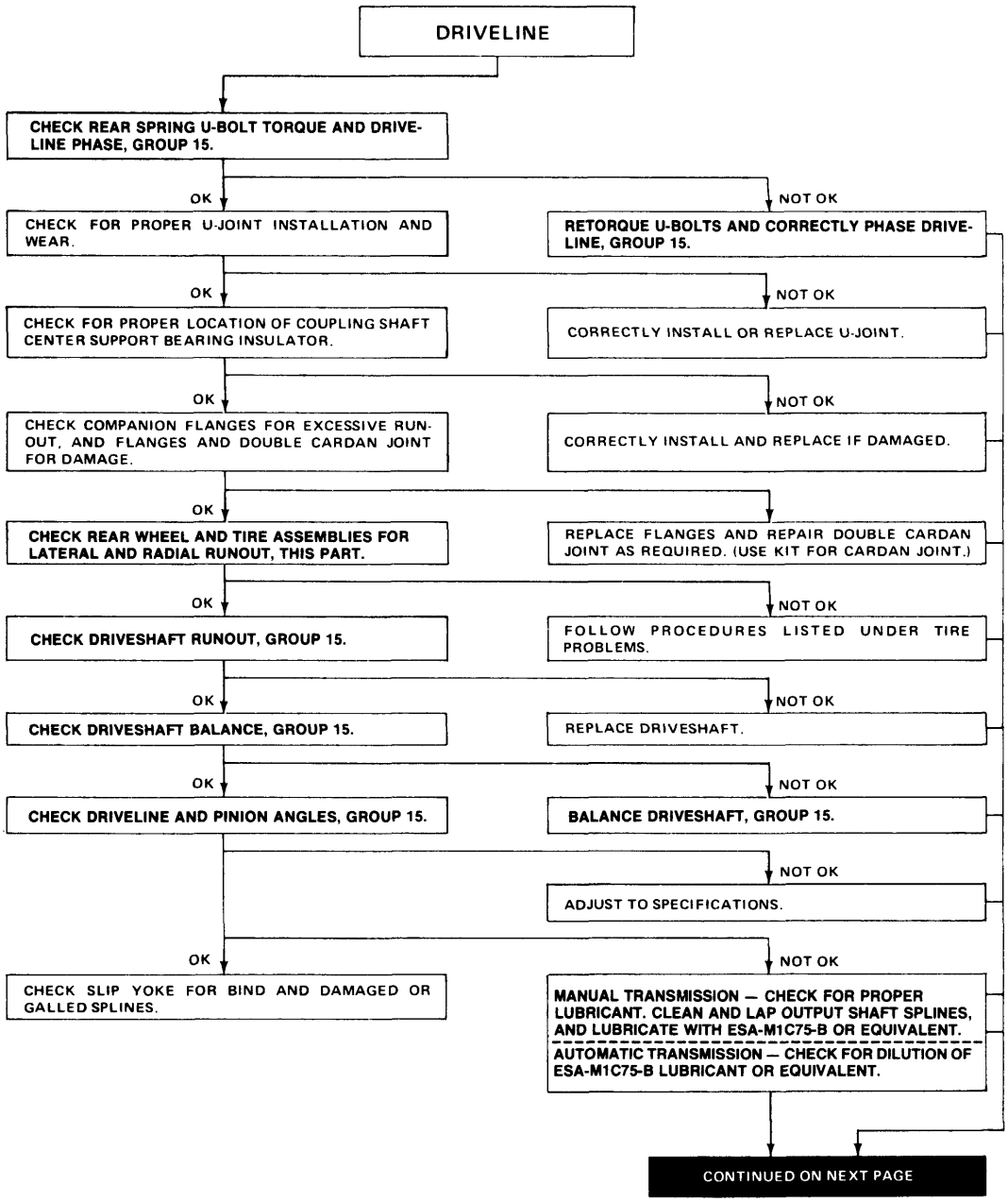
1. REMOVE FRONT DRIVE SHAFT.
2. SHIFT TRANSFER CASE INTO HI LOCK AND ROAD TEST.
3. IF PROBLEM PERSISTS, REMOVE REAR DRIVE SHAFT, SHIFT TRANSFER CASE TO HI LOCK AND ROAD TEST USING FRONT DRIVE AXLE.

ALL OTHER INFORMATION APPLIES TO FULL AND PART TIME 4-WHEEL DRIVE.

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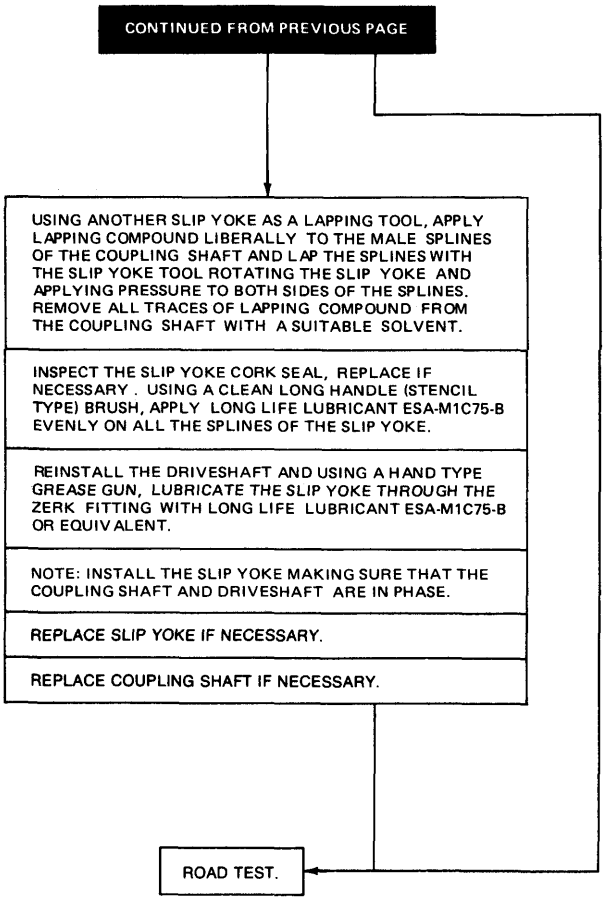
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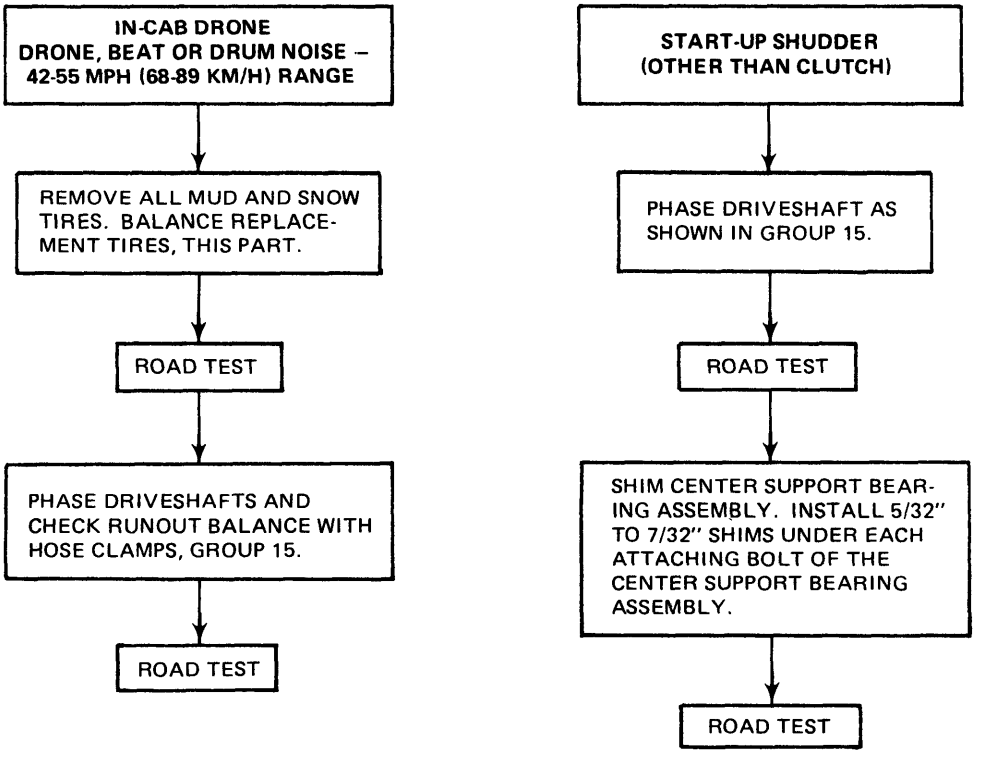
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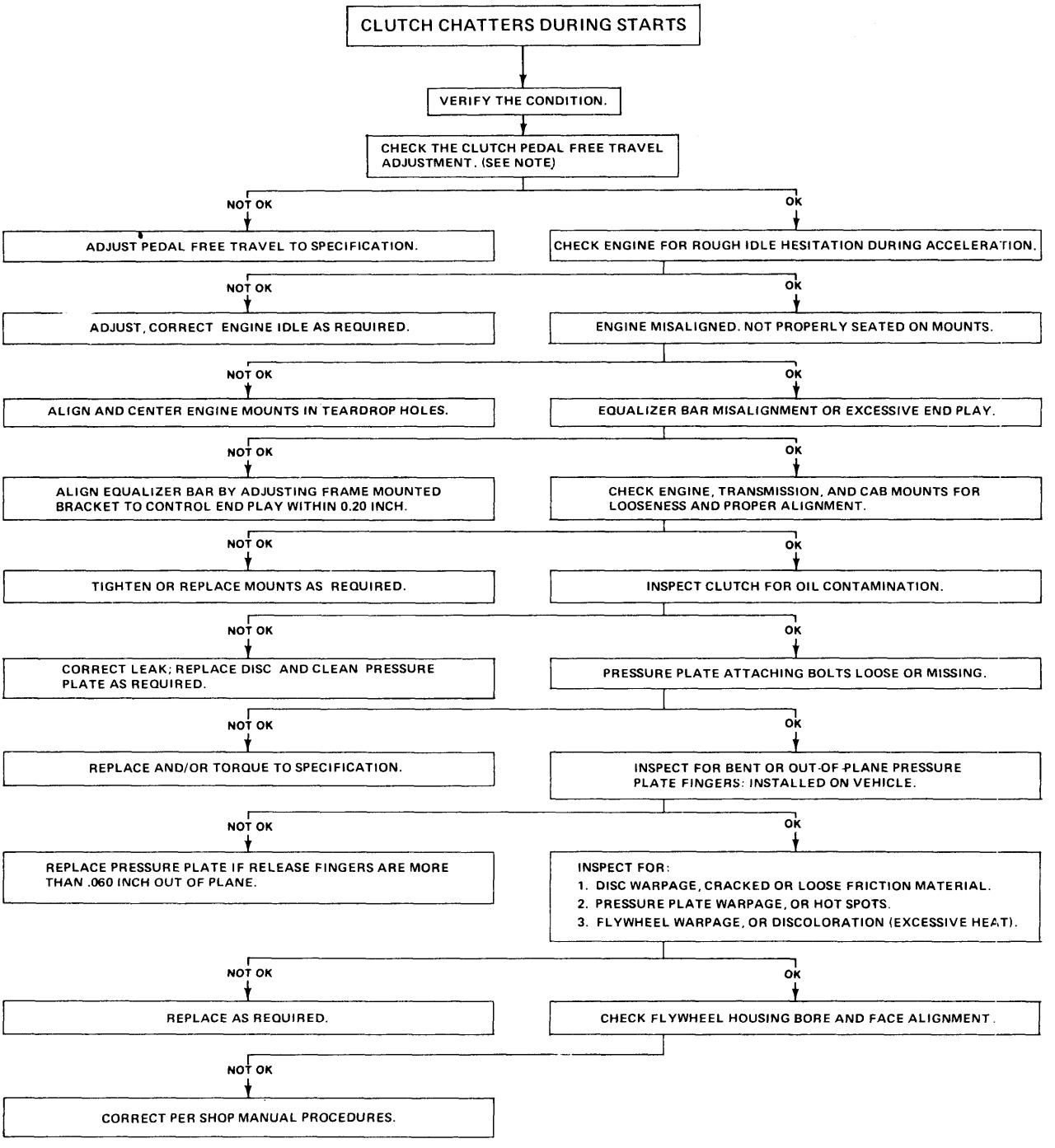
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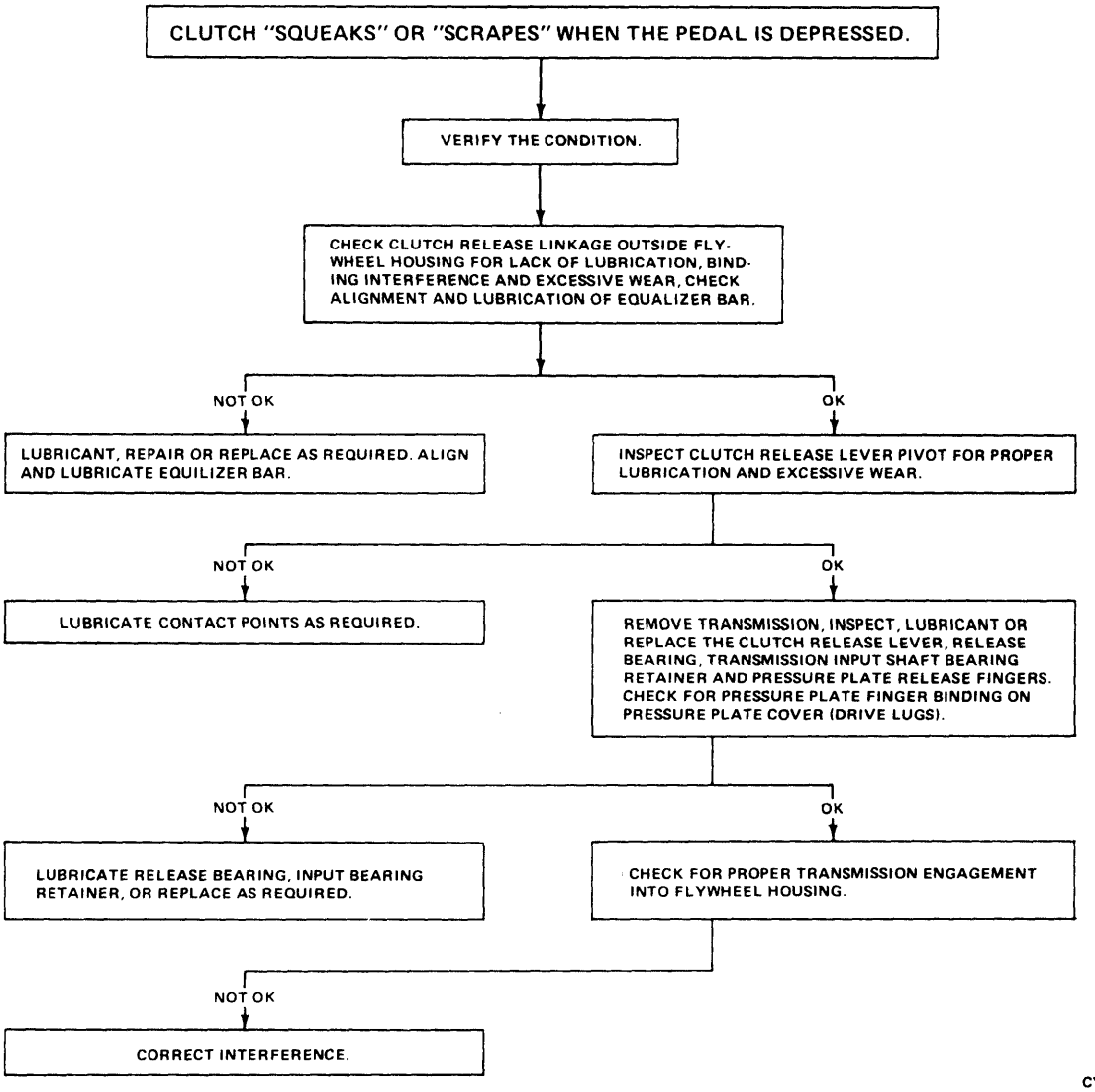


NOTE: A LIGHT CHATTER OR SHUDDER IN THE VEHICLE WHEN ENGAGING THE CLUTCH AT LIGHT THROTTLE IS A NORMAL OCCURANCE ON SUBJECT VEHICLES. THIS CONDITION RESULTS FROM THE NEW LOWER NUMERICAL AXLE RATIO (STANDARD ON BASE MODELS). IT MAY BE MORE PRONOUNCED IN HEAVILY LOADED VEHICLES. DRIVE TRAIN FUNCTION AND DURABILITY ARE NOT AFFECTED BY THIS CHATTER CONDITION. THEREFORE, DRIVE TRAIN COMPONENTS, PARTICULARLY CLUTCHES, SHOULD NOT BE REPLACED OR REBUILT IN ATTEMPTS TO ELIMINATE THIS CONDITION.

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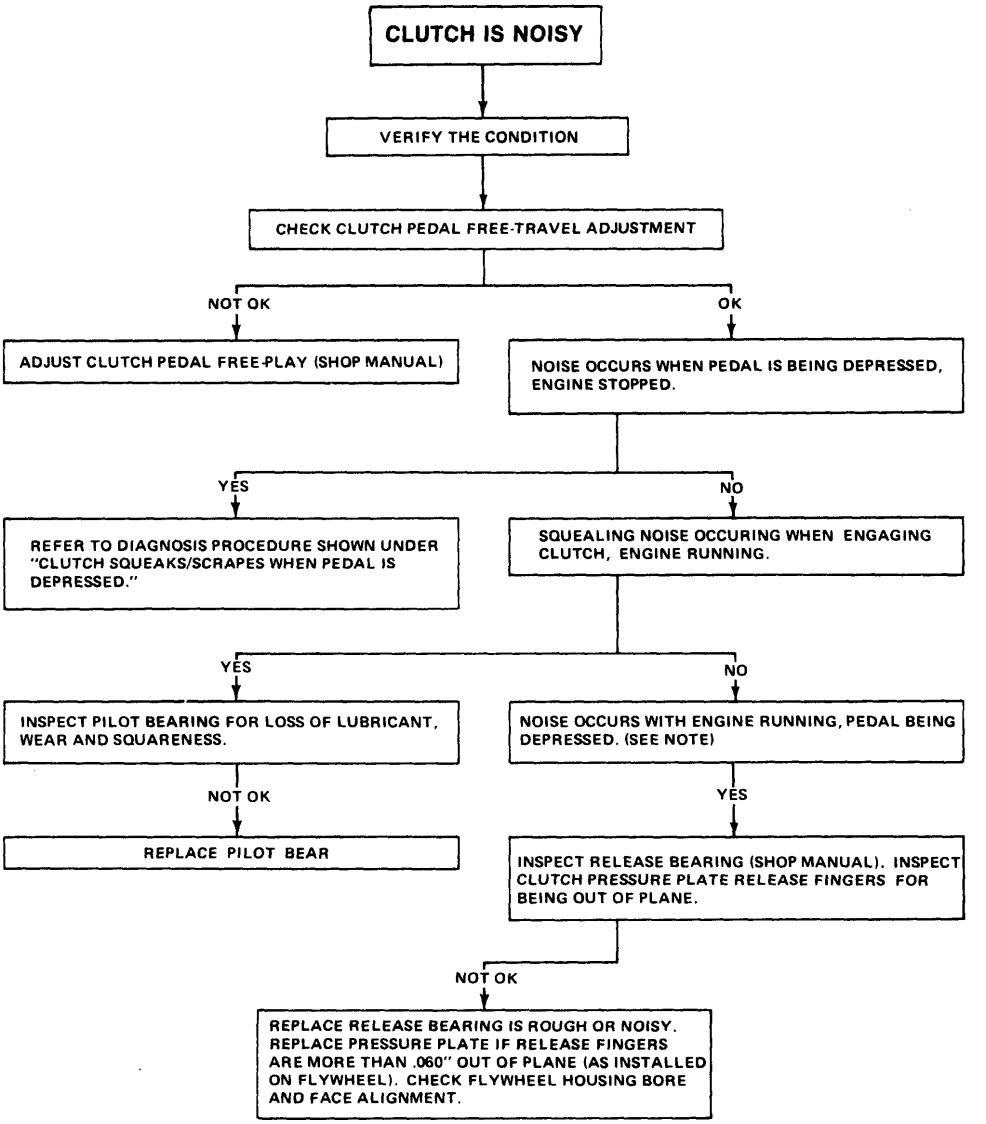
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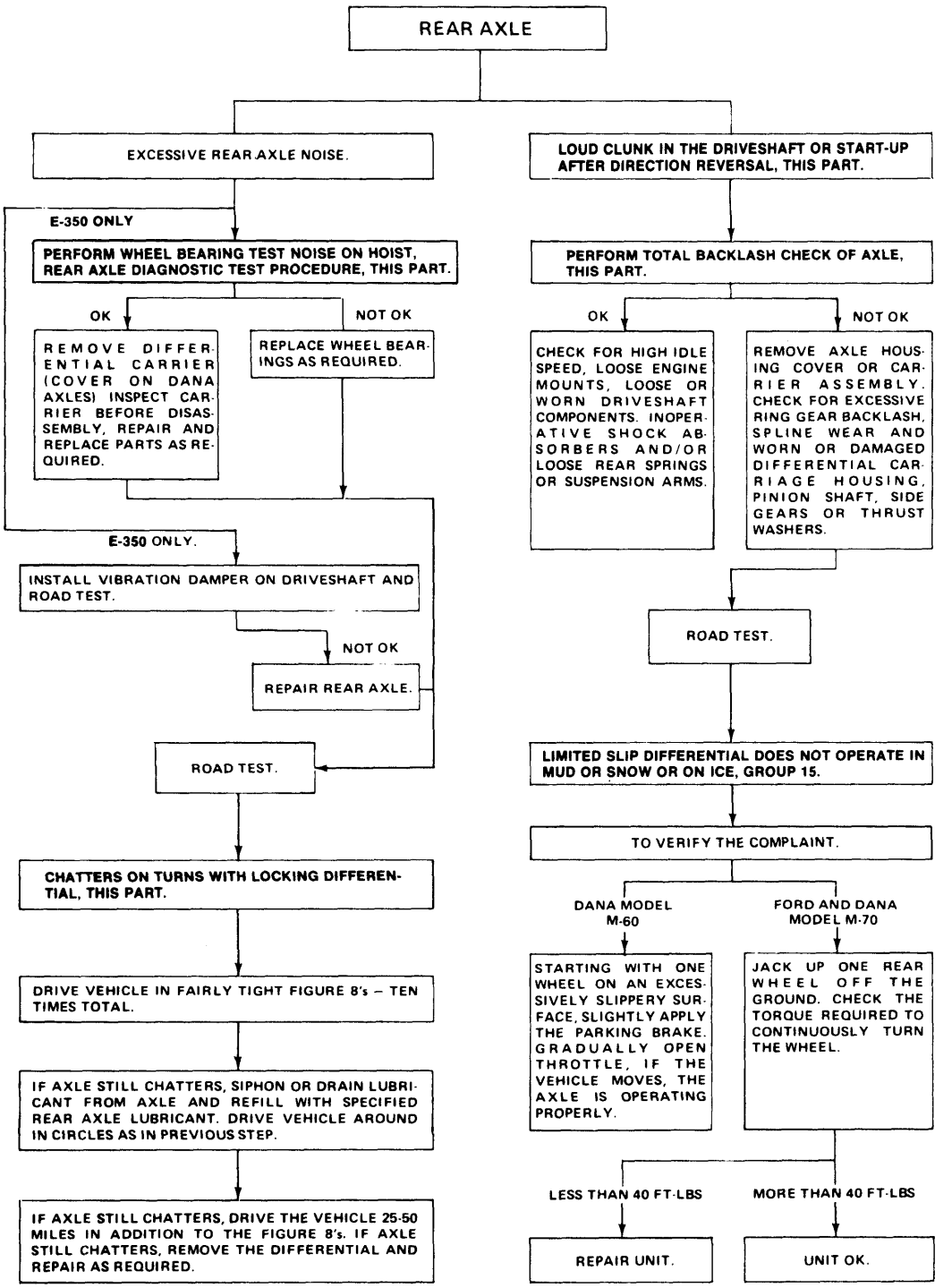


NOTE: A LIGHT INTERMITTENT CLICKING OR RATTLING NOISE MAY RESULT DURING PEDAL APPLICATION (TO LIMIT OF PEDAL FREE -TRAVEL) AND UPON FURTHER PEDAL DEPRESSION, A NORMAL BEARING NOISE MAY BE AUDIBLE. SOME NOISE UNDER THESE CONDITIONS WILL NOT ADVERESLY AFFECT CLUTCH FUNCTION AND DOES NOT NECCESSARILY INDICATE A FAILED RELEASE BEARING OR OUT OF PLANE PRESSURE PLATE RELEASE FINGERS. INSPECTION OF THESE COMPONENTS IS NOT REQUIRED UNLESS THE NOISE IS EXCESSIVE.

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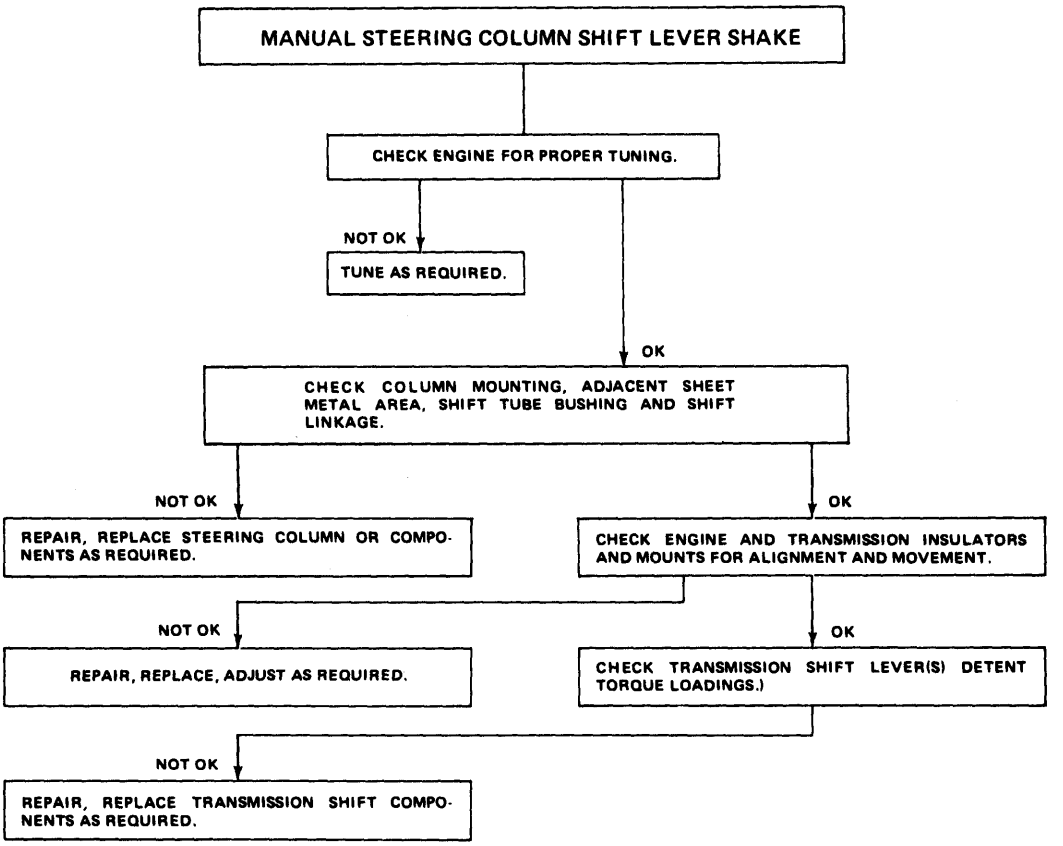
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ADJUSTMENTS

REAR AXLE

LOUD CLUNK IN THE DRIVE SHAFT ON START-UP OR DIRECTION REVERSAL—TOTAL BACKLASH CHECK

FORD AXLES

Raise vehicle on hoist. Use a rigid bar or pipe of suitable length and clamp one end to the axle companion flange and the other end to the frame or body member in order to prevent all movement of the companion flange.

Lower the vehicle so that one rear wheel is resting on a wheel chock to prevent it from turning. The other rear wheel will then be used to measure total axle backlash.

Rotate the free wheel slowly until a feel of driving the axle is encountered. Position a crayon or chalk firmly on the side wall of the tire 12 inches from the center of the wheel. Rotate the wheel slowly in the opposite direction until the feel of driving the axle is encountered again.

Measure the length of the crayon or chalk mark in the tire. If the length of the mark is 1.0 inch or less, the axle backlash is within allowable limits.

DANA AXLES

Apply parking brake to keep both rear wheels from turning. Mount a dial indicator on the carrier housing with the indicator point positioned to contact the pinion yoke 1-1/2 inch from the center line of the pinion shaft.

With the transmission in neutral and engine not running, check the total rotational movement of the pinion yoke. If the total reading on the dial indicator is .075 inch or less, the axle backlash is within allowable limits.

RING GEAR AND PINION INDUCED VIBRATION

FORD DESIGN REAR AXLES

In some rare cases, a vibration can be felt between 35 to 45 mph (57-72 Km) with the same symptoms as driveline induced vibration that can be attributed to the ring gear and pinion.

The ring gear and pinion should not be suspect until a driveline type vibration cannot be eliminated by following the DRIVELINE VIBRATION DIAGNOSIS AND SERVICE PROCEDURE.

There is not an exact diagnosis method for this condition. However, it is recommended that these additional diagnostic steps be followed:

1. Remove the rear driveshaft (if equipped) and run the vehicle up to the vibration speed range to assure that the vibration is eliminated.
2. If the rear driveshaft runouts are not well below the published maximum specification (.035), install one that is to see if the vibration is eliminated.

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3. If the vibration is not eliminated, remove the axle shafts and again run the vehicle up to the vibration speed range.
4. If the vibration is still present, the ring gear and pinion could be the cause and should be replaced.

NOTE: As in all cases where a vibration condition does not respond to normal diagnostic procedures, contact your Ford Parts and Service Division District Office for assistance.

DANA LIMITED SLIP DIFFERENTIAL REAR AXLES

CHATTER ON TURNS WITH LIMITED SLIP DIFFERENTIAL

There are two limited slip differential designs released, a 2-pinion (1-piece case) design and a 4 pinion (2-piece case) design. Because of the difference in design, interchangeability, problem diagnosis, and repair procedures are affected. Positive identification must be made before servicing or repairing, to assure correct axle problem definition and repair procedures.

The axle code stamped on the rating plate does not necessarily indicate the truck axle model installed in any truck specifically noted above, and before repairing or servicing the axle, the axle type must be identified to assure correct repair procedures and parts usage.

To identify the type of axle installed, visually inspect the axle assembly. The Dana axle has a one-piece cast axle housing with a brass tag affixed to two cover attaching screws showing part number and ratio, and whether or not it is a standard or limited slip differential.

Operation characteristics of these axles are:

The standard 2-pinion differential transmits all the ring gear torque through the differential gears to the axle shafts. Torque is at all times equal on the axle shafts, and if one wheel slips, the other wheel can only put out as much torque as the slipping wheel.

The 2-pinion limited slip differential is similar, except that part of the torque from the ring gear is transmitted through clutch packs between the side gears and differential case. Multiple disc clutches are engaged by a preload from Belleville springs, plus separating forces from the side gears, as torque is applied through the ring gear.

The 4-pinion limited slip differential has the same power flow as the standard differential, plus a more direct flow which automatically takes effect as driving conditions demand. This more direct power flow is from the differential case to each axle shaft through a clutch plate and disc arrangement.

Both limited slip designs permit differential action when required for turning corners and transmits equal torque to both wheels when driving straight ahead. However, when one wheel tries to spin due to leaving the ground, a patch of ice, etc., the clutch packs automatically provide more torque to the wheel which is not trying to spin.

In diagnosis it is important to recognize two things:

1. If, when unequal traction, both wheels slip, the limited slip axle has done all it can possibly do.
2. In extreme cases of differences in traction, the wheel with the least traction may spin after the limited slip has transferred as much torque as possible to the non-slipping wheel.

Proper performance and capabilities of limited slip differential are often misunderstood.

No precise methods of measuring 2-pinion limited slip differential performance is available; however, a functioning unit can be determined by these relatively simple vehicle operational tests.

1. Place one wheel on good dry pavement, and the other on ice, mud, grease, etc.
2. Gradually open throttle to obtain maximum traction prior to "break-away". The ability to move the vehicle will demonstrate proper performance of a limited slip axle.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the limited slip feature of the Dana axle. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.

The 2-pinion design limited slip differential does not have any internal residual torque. This will allow either rear wheel to be rotated with no noticeable effort (truck on jack). To check the 2-pinion design, follow the functioning test, noted above, to determine if limited slip is working.

The 4-pinion design limited slip differential has an internal residual torque and may be checked for malfunctioning as follows:

1. If noises or roughness, such as chatter, are present in turning corners, the probable cause is incorrect or contaminated lubricant. Before any differential is removed and disassembled for chatter complaints, the correct lubricant must be installed. ESW-M2C105-A plus EST-M2C118-A Friction Modifier or equivalent (4 oz. Rear Axle—2 oz. Front Axles) is specified.
2. If inadequate or excessive lock-up is suspected, drive the vehicle far enough to warm up the axle lubricant, and exercise the unit by operating the vehicle through at least three figure eight turns.
3. With engine shut off, transmission in neutral, and parking brake off, place a block of wood in front and back of both front wheels. Jack up one rear wheel until it is completely off the ground and remove hub cap. Check both rear wheels.

   CAUTION: Do not jack up one wheel to check for torque while engine is running and transmission is in gear. This could cause damage to the vehicle and personal injury if the vehicle jumped off the jack.
4. Apply a torque wrench with a special tool to each rear wheel. Disregard break-away torque and observe only the torque required to continuously turn the wheel. If torque reading is less than 40 ft-lbs or greater than 200 ft-lbs on either wheel, the unit should be disassembled and the necessary repairs made.

   Tool can be made of 1/4 inch flat steel 5 inches long and 1-1/4 inches wide, with slots on each end

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5/8 inch wide and 1 inch from each end. A 1 inch nut is welded in the center. Tool is attached to rear axle shaft flange attaching bolts.

DANA LIMITED SLIP AXLE NOISE OR "CHATTER"

When diagnosis indicates noise or roughness, such as chatter, emanating from a limited slip axle in turning corners, the following procedure should be followed:

1. Check the axle for proper fill. The lubricant level should be to the bottom of the filler plug hole. If the level is low, add the necessary amount of ESW-M2C105-A or equivalent.
2. Drive the vehicle far enough to warm the axle lubricant and exercise the differential unit by operating the vehicle through 5 to 10 figure eight turns. This will properly work in the limited slip axle additive.
3. If the chatter is still evident, incorrect axle lubricant is suspected.
4. Drain all the lubricant from the axle.
5. Refill the axle with the specified lubricant, ESW-M2C105-A or equivalent. Drive the truck for another 10 miles, at which time operate the truck through a minimum of 10 figure eight patterns to allow the new axle lubricant to be forced between the clutch plates, discs, bearings, etc., purging the incorrect lubricant from these parts and holding it in solution.

   Drain the axle lubricant from the axle a second time and refill it with ESW-M2C105-A or equivalent and EST-M2C118-A or equivalent as shown in Fig. 10.

Model	Axle	ESW-M2C105-A or Equivalent	ESW-M2C118-A or Equivalent
Bronco	Front	3.5 Pints	2 Oz.
F-250	Rear	6 Pints	4 Oz.
F-350	Rear	6.5 Pints	4 Oz.
E-350	Rear	5.5 Pints	4 Oz.

CE2720-1B

FIG. 10 Axle Refill Capacities

Within 200 miles of driving the truck with the correct lubricant, the chatter noise should be corrected.

This procedure should be adhered to before axle teardown is contemplated when servicing for chatter complaints.

A temporary or slight chatter noise can be expected in any limited slip differential axle after a truck is driven at a sustained expressway speed (60-80 mph) and then enters a long curve-type exit ramp. A chatter noticed at this time is the result of an inadequate film of lubricant between the clutch plates, discs, clutch rings, and other internal components of the differential assembly due to the lubricant "spinning off" due to high speed slinging action of the clutch plates and discs. After a turn is completed (after sustained high speed) the normal differential action forces axle lubricant between the clutch plates allowing normal clutch pack slippage which eliminates the chatter. This condition is considered normal and does not indicate a need for differential repair.

DRIVELINE SERVICE

TWO-PIECE DRIVESHAFT PHASING PROCEDURE

VEHICLES EQUIPPED WITH TWO PIECE DRIVESHAFTS

"Out of phase" driveshafts has been identified as the prime cause of drive away shudder. To assure proper driveshaft phasing, visually check the coupling shaft to determine if the drive shaft slip yoke is in a straight line with the coupling shaft front yoke as shown in Figs. 11 and 12. To correct an "out of phase" condition, re-position the driveshaft slip yoke on the coupling shaft as required. Road test to verify correction. Fig. 13 shows the "blind spline" 2 piece driveline system which cannot be assembled out of phase. Fig. 14 shows the "fixed yoke" 2 piece driveline system which must be phased as shown.

DRIVELINE ANGLE DIAGNOSIS AND SERVICE PROCEDURE

Drive-away shudder is the predominant symptom associated with driveline angles condition on F-100-250 vehicles with two piece drveshafts. After eliminating coupling shaft phasing condition as the possible cause, drive away shudder can usually be serviced by shimming down the center support beating in 1/4 inch increments using flat spacer plates per Fig. 15 until the drive away shudder is eliminated. Plate stock must be used to maintain proper preload compression of the rubber insulator.

Replace the existing bolts with the appropriate length 7/16-14 hex head bolts.

Tighten bolts to 37-54 ft-lbs.

Road test to verify resolution of condition.

If the drive away shudder cannot be serviced by shimming down the center support bearing on other symptoms exist that can be contributed to driveline angles condition, proceed to the driveline angle checking and service procedure in the following paragraphs.

DRIVELINE ANGLE CHECKING AND SERVICE PROCEDURE

Driveline angle charts showing the optimum setting for engine transmission coupling shaft, driveshaft, and rear axle pinion angles should be taken from the applicable model year truck shop manual.

Use the following procedure when checking driveline angles.

1. With the vehicle at curb load (empty) condition, use a drive on hoist, a two post axle contact type hoist and/or back the vehicle on a front end alignment machine.
2. All driveline angles are read horizontal relative to the frame angle. Therefore, measure the frame angle by taking a protractor reading at the lower frame flange forward of the rear spring front

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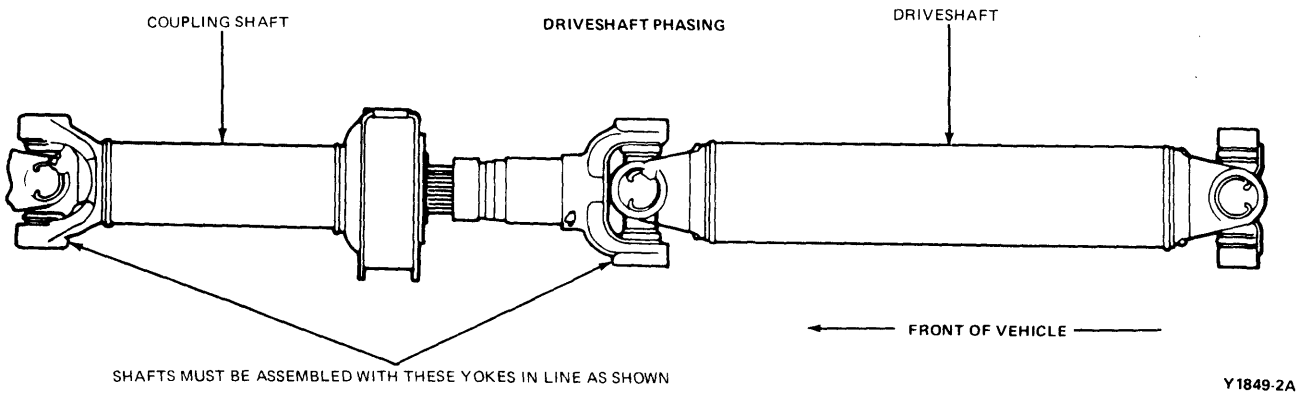


FIG. 11 Driveshaft Phasing—Two-Piece Driveshaft

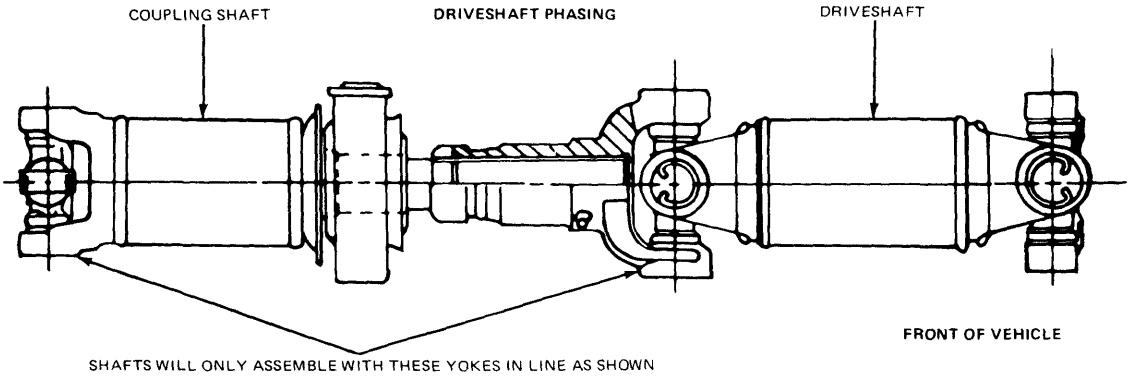


FIG. 12 Driveshaft Phasing—Two-Piece Driveshaft, Blindspline with Necked Down Coupling Shaft

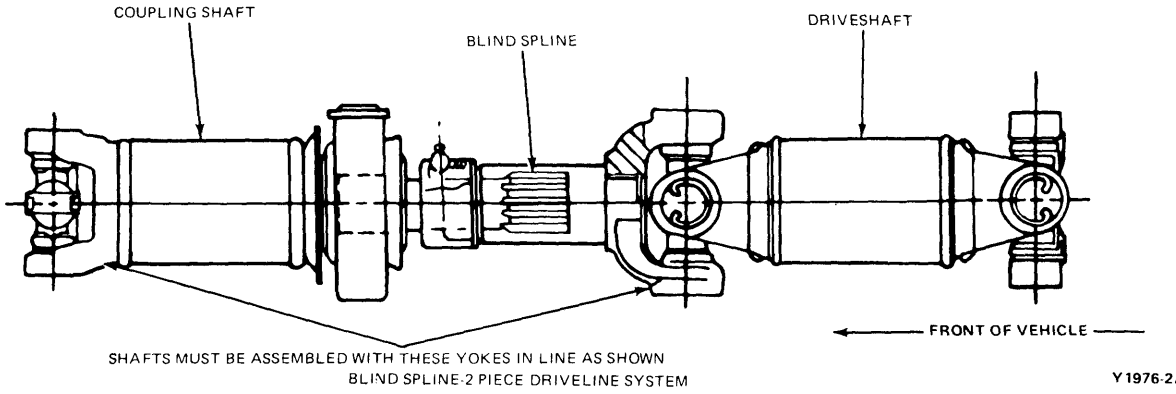


FIG. 13 Driveshaft Phasing—Two Piece "Blind Spline" Driveshaft

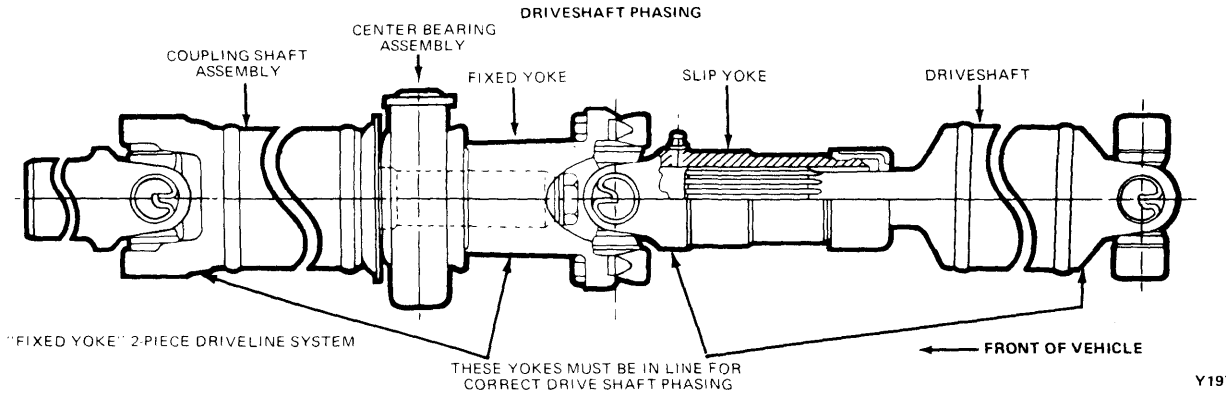


FIG. 14 Driveshaft Phasing—"Fixed Yoke" Two Piece Driveshaft

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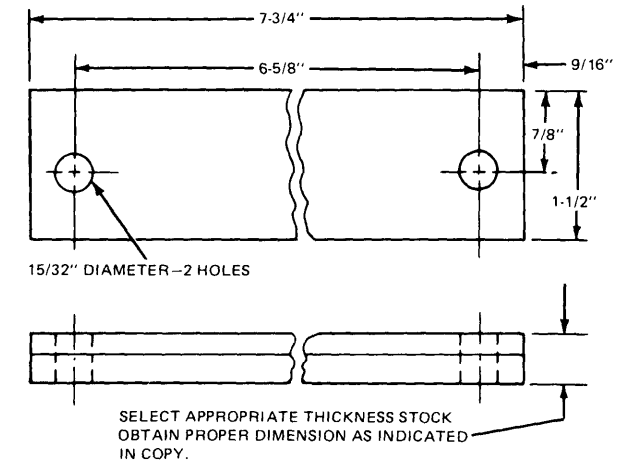
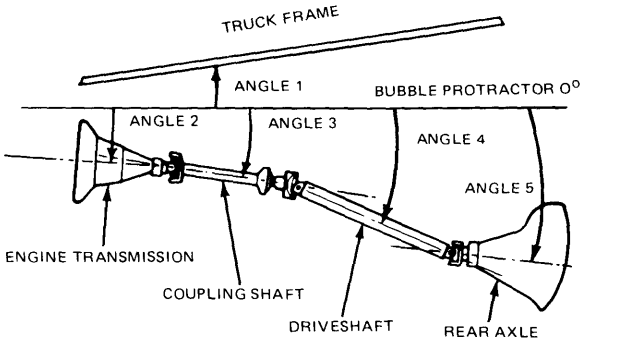


FIG. 15 Center Support Shim Dimensions

shackle. The protractor readings for the driveline components are then added to the frame reading as indicated in Fig. 16 to obtain the angles listed in the charts.

NOTE: By adjusting the twin post hoist so that the frame angles read "O", the driveline component angles can be read direct (actual).



NOTE:
Figure shown is typical of a 4x2 F-Series truck with a two piece driveshaft. All other F-Series,Econolines and Bronco vehicle drivelines are measured in a similar manner.

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FIG. 16 Checking Driveline Angles

3. Check and record the engine transmission angle. If this angle differs from specification, neutralize the engine front mounts and check the rear mount for proper installation.
4. Check coupling shaft angle (if so equipped) and adjust to specification by shimming the center support bearing.
5. Check the driveshaft angle and adjust to specifications by shimming between the springs and the spring seats.
6. Check the pinion angle and adjust to specifications by shimming with tapered shims between the springs and the spring seats.
7. Road test to verify resolution of condition.

COUPLING SHAFT/CENTER BEARING ALIGNMENT

F-100-E350 AND E-100-350 VEHICLES WITH TWO PIECE DRIVESHAFT PRIOR TO 1977—1/2 MODEL YEARS

Vehicle noise and vibration can be caused by dislocated and/or failed center bearing rubber isolator, contaminated center bearing or excessive compression of the rubber insulator (See Fig. 17).

The service for this condition is as follows:

1. Remove the coupling shaft assembly from the vehicle.
2. Perform the following steps:
   A. Remove the support bracket and retainer
   B. Remove the rubber isolator.
   C. Press center bearing assembly and bearing retainer off the coupling shaft.
   D. Press the dust slinger off the coupling shaft.
3. Replace with center bearing assembly kit D7TZ-4800-A.
4. Reassemble the coupling shaft as shown in Fig. 17.
   NOTE: First install bearing in rubber isolator and press bearing on shaft with the turned in lip toward the dust slinger (forward). The support bracket must be installed with the deep flange rearward.
5. Reinstall the driveline in the vehicle with the yokes phased properly as shown in Figs. 11 through 14.
6. Road test to verify resolution of condition.
7. If vibration still exists, insert 1/16 inch shims between support bracket and support plate (on bolt ends of support bracket) to reduce compression of the rubber isolator as required.

SLIP YOKE SPLINE

E-150-350 AND F-100-F-350 VEHICLES WITH TWO PIECE DRIVESHAFT (PRIOR TO 1977 1/2 MODEL YEAR)

Vehicle noise and vibration can be caused by a seized driveshaft slip yoke spline resulting in the rubber isolator being pulled out of the center bearing support.

The service resolution to minimize slip yoke spline contamination and ultimate seizure, and installation of a splash shield is as follows:

1. Disconnect the driveshaft from the rear axle yoke and remove it from the truck.
2. Clean the male splines of the coupling shaft using care not to damage the plastic coating. Fine abrasive cloth may be required to dress and polish the male spline. Remove all hardened grease deposits, dirt, or rust. Inspect for worn or galled splines. The plastic coating on the stub spline must not be removed. Replace coupling shaft if necessary.
3. Clean and inspect the female splines of the slip yoke, removing any hardened grease deposits, dirt or rust. Inspect splines for worn or galled conditions, replace slip yoke if necessary.
4. Apply a coating of ESA-M1C75B long life lubricant to the entire splined stub end of the coupling

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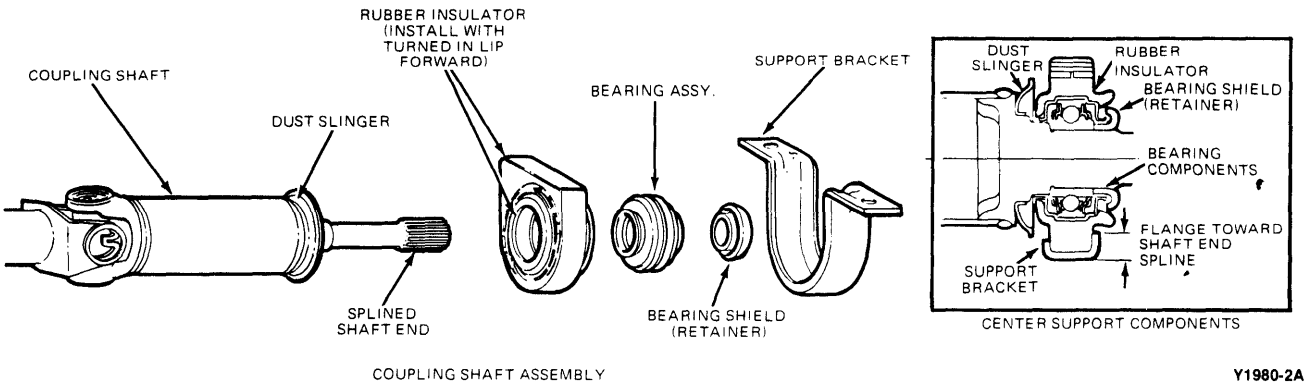


FIG. 17 Coupling Shaft Center Bearing

shaft assembly prior to the assembling of the driveshaft to the coupling shaft.

5. Using a clean long handle (stencil type) brush apply long life lubricant, ESA-M1C75B spread evenly on all the female splines of the slip yoke. The spline joint must side freely by hand.

   NOTE: Inspect the slip yoke cork seal. Replacement is recommended.

6. Before assembling the driveshaft slip yoke to the coupling shaft, slip the splash sleeve over the driveshaft slip yoke. Refer to Fig. 18 (Splash shield can only be installed on 2 piece drivelines as shown in Figs. 11 and 12.
7. Assemble the driveshaft to the coupling shaft with the yokes phased properly (See Figs. 11, 12 and 13). Attach driveshaft to rear axle yoke.
8. Tighten the dust cap of the driveshaft slip yoke finger tight. (Fig. 11, 12 and 13).
9. Position the splash sleeve over the center bearing retainer ring, all three tabs must be snapped and engaged to the retainer ring. The splash sleeve must also be parallel to the coupling shaft (Figs. 11 and 12).
10. Using a hand type grease gun, lubricate the driveshaft slip yoke through the zerk fitting with ESA-M1C75-B lubricant.

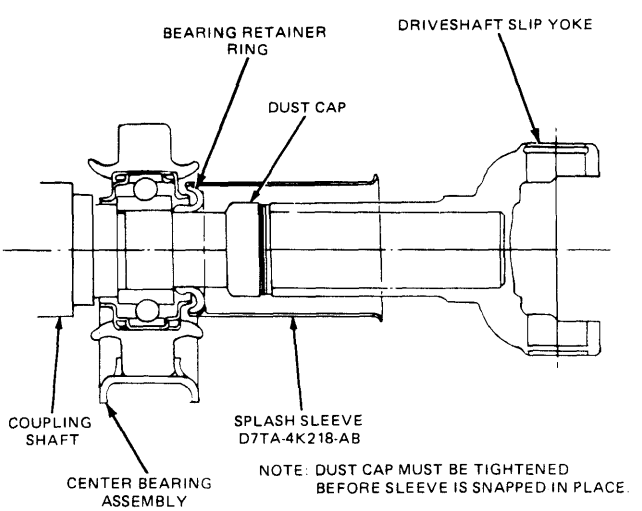


FIG. 18 Splash Shield Installation

DRIVELINE START-UP SHUDDER

F-150 (4x4) 133" W.B. AND 205 P/T TRANSFER CASE VEHICLES WITH TWO PIECE DRIVESHAFT

Driveline start-up shudder can be improved by indexing the rear couplingshaft yoke.

This service resolution can be accomplished as follows:

1. Remove the rear driveshaft assembly from the coupling shaft assembly.
2. Remove bolt, flat washer and lockwasher from the coupling shaft flange yoke. Remove flange yoke and rotate 109 degrees (three spline teeth) in the direction of engine rotation and reinstall on coupling shaft spline.
3. Install flat washer, lockwasher and bolt and retorque bolt to 104-156 ft-lbs.
4. Assure that driveshaft U-joint and splines are free and well lubricated.
5. Road test to verify resolution of condition.
6. If no noticeable improvement has been achieved, then follow procedure for coupling shaft/center bearing alignment.

BODY

CAB BACK PANEL VIBRATION (BOOM OR DRONE)—F-SERIES, F-100-350 STANDARD CAB AND SUPER CAB

Truck cab noise diagnosed as back panel boom or drone, can be effectively decreased by installing a D4TZ-10110A14-A or equivalent rear vibration kit.

Refer to Fig. 19 for installation information.

The kit will include the damper, two screw and washer assemblies, two spring nuts, locating template, caulking cord and detailed instructions for mounting the damper.

CLUTCH

CLUTCH START-UP SHUDDER OR CHATTER CORRECTION PROCEDURE

Clutch start-up shudder or chatter can originate from any one or combinations of the listed components:

Engine Mounts—

Incorrect part

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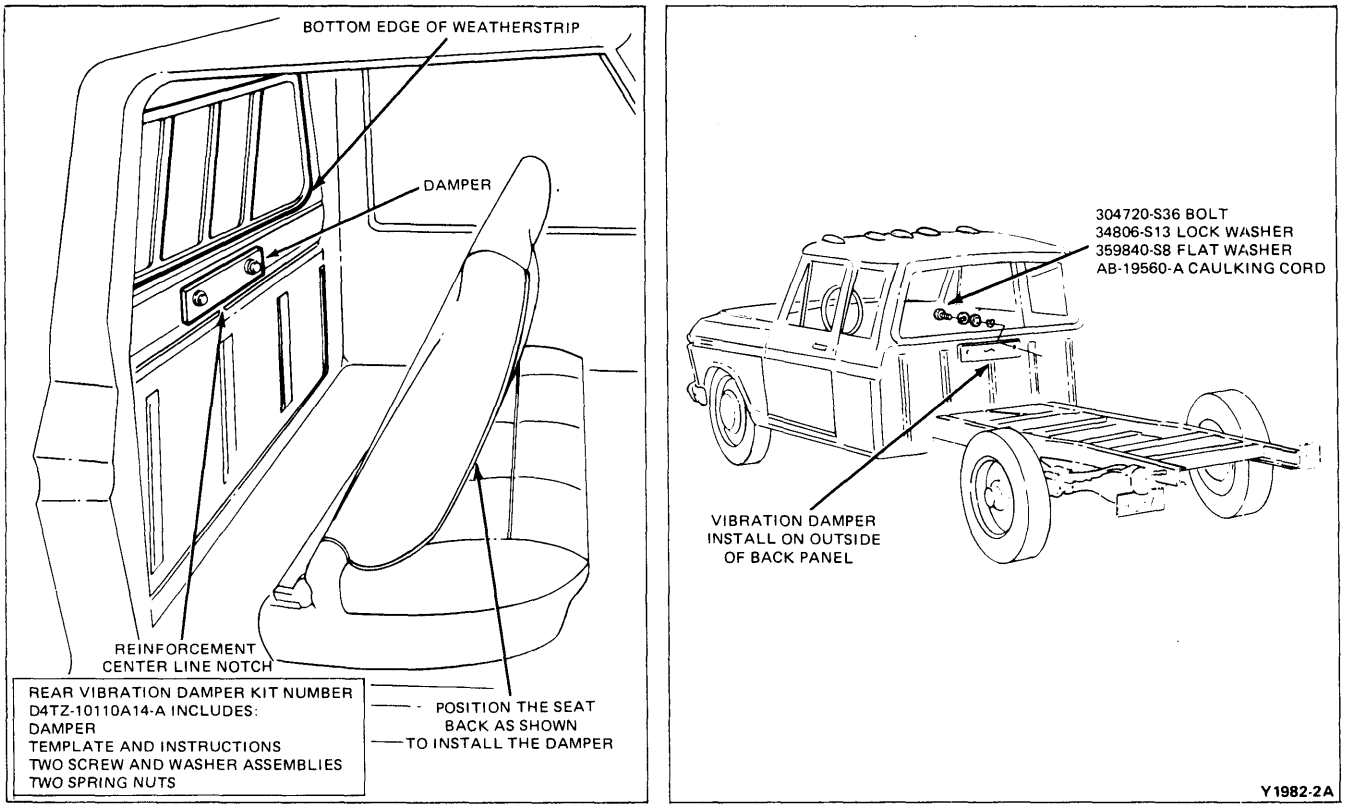


FIG. 19 Vibration Damper Installation

Damaged
Misaligned
Drive Shaft—
Bent or out-of-balance
Slip yoke not lubricated
U-joints worn or improperly seated
Phasing incorrect
Angles incorrect
Center support bearing insulator improperly installed
Body Mounts Loose
Rear shock absorbers damaged or worn
Clutch—
Linkage—
Worn
Misaligned
Binding
Equalizer bar misaligned or not lubricated
Release lever cocked, retainer clips broken or missing
Pilot bearing worn or missing
Disc worn, contaminated, overheated or incorrect part
Housing face and bore misalignment with transmission
Pressure Plate—
Contact surface contaminated
Release fingers bent, broken, misaligned resulting in uneven contact with the release bearing

Refer to the diagnosis guide in this Part for corrective action to pursue.

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CHARGING SYSTEM

GROUP 31 (10000)

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Alternator Electronic Regulator	31-43
Batteries	31-02
Charging System General Service	31-01
Rear Terminal Alternator	31-10
Side Terminal Alternator	31-12

Charging System General Service

PART 31-01

APPLIES TO ALL MODELS

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DESCRIPTION AND OPERATION

The alternator charging system is a negative ground system, and consists of an alternator, regulator, charge indicator, storage battery, fuse link and associated wiring. Refer to the Wiring Diagram Manual for schematics and locations of wiring harnesses.

FUSE LINK

The fuse link used on the Bronco, E-100—E-350, Club Wagons and light trucks, is a short length of insulated wire integral with the engine compartment wiring harness. It is several wire gauges smaller than the circuit that it protects and is the color of the circuit being supplied by the fuse link. Service fuse links are green or black depending on usage. All fuse links have a flag moulded on the wire or on the terminal insulator. Color identification of the flag or connector is Red—18 gauge wire, Orange—16 gauge wire, or Green—14 gauge wire.

The fuse link is designed to burn out, thus protecting the alternator and wiring when heavy reverse current flows, such as when a booster battery is connected incorrectly, or a short to ground occurs in the wiring harness.

A burned out link may have bare wire ends protruding from the insulation, or it may only have expanded or bubbled insulation. If it is hard to determine if the link is burned out, perform a continuity test.

Refer to Part 34-31 for testing procedures for fuse links used in the charging system.

DIAGNOSIS

Certain tests outlined in the Parts within this Group are illustrated in the schematic and in pictorial form. The schematic illustrates the internal connections of the Rotunda or equivalent equipment so these connections can be duplicated when this equipment is not available. The various circuits involved in the tests can be selected by means of switches without the necessity of changing connections when the illustrated equipment is used. This reduces the time required to test units and circuits on the vehicle.

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PRELIMINARY INFORMATION

Before performing charging or starting system tests on the vehicle, note the complaint such as: slow cranking, battery dead or using an excessive amount of water, top of battery wet, ammeter shows charge at all times and/or no charge, alternator warning lamp does not come on and/or never goes out. This information will aid in isolating the part of the system causing the symptom.

Next, visually inspect as follows:

1. **Check the fuse link located between the starter solenoid and the alternator. Replace the fuse link if burned.**

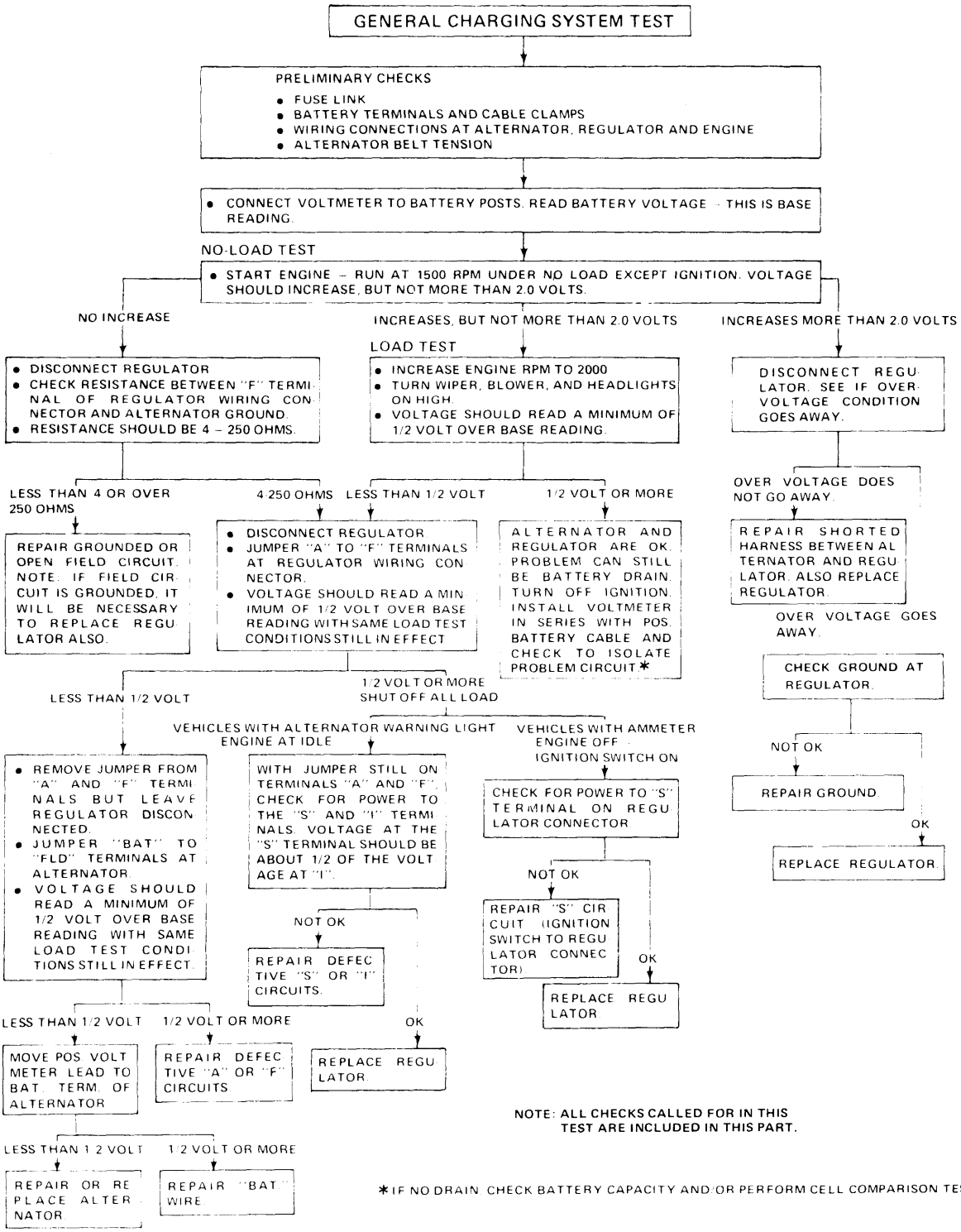
DIAGNOSIS GUIDES

CONDITION	POSSIBLE CAUSE	CORRECTION
• Battery does not stay charged — engine starts OK	• Worn or damaged battery • Loose or worn alternator belt • Worn or damaged wiring or cables • Alternator or regulator • Other vehicle electrical systems	• Test battery, replace if necessary • Adjust or replace belt • Clean, repair as required • Perform general charging systems test. Repair or replace as required. • Check other systems for current draw. Repair as required
• Battery uses excessive water — lights burn out frequently	• Alternator regulator • Worn or damaged wiring • Worn or damaged battery	• Perform alternator tests, replace if necessary • Tighten all ground connections. Repair as required • Test battery, replace if necessary
• Alternator noisy	• Loose or worn alternator belt • Bent pulley flanges • Alternator	• Adjust or replace belt • Replace pulley • Perform alternator tests. Repair or replace as required
• Charge indicator light does not light when the ignition switch is turned on	• Loose or improper wiring connections • Bulb burnt out • Worn or damaged regulator or wiring	• Repair as required • Replace bulb • Disconnect regulator plug connector. Connect jumper wire from "I" terminal of connector to ground. Indicator should light. Connect jumper wire from "I" to "F" Indicator light should light. Check regulator to alternator wiring for continuity. Repair or replace as required
• Charge indicator light stays on — engine running	• Loose or worn alternator belt • Alternator regulator • Alternator	• Adjust or replace belt • By-pass regulator. If light goes out, replace regulator • Perform general charging systems test. Repair or replace as required
• Charge light stays on — key off	• Worn or damaged wiring • Alternator or regulator	• Check and repair as required • Disconnect connect plug from regulator. Check for voltage at "S" terminal of plug. If no volts and light goes out, replace regulator. If volt reading, repair or replace alternator
• Charge indicator gauge shows steady charge	• Worn or damaged battery • Poor regulator ground • Loose wiring connections • Alternator or regulator	• Check battery. Replace if necessary • Assure good ground • Tighten all wiring connections • Perform general charging systems test. Repair or replace as required
• Charge indicator light flickers while vehicle is being driven	• Loose or worn alternator belt • Loose or improper wiring connections • Alternator or regulator	• Adjust or replace belt • Assure good proper connections • Perform general charging systems test. Repair or replace as required
• Charge indicator gauge shows discharge (if constant high reading, see "Battery Uses Excessive Water")	• Loose or worn alternator belt • Worn or damaged wiring • Alternator or regulator • Charge indicator gauge wiring and connections • Worn or damaged gauge • Other vehicle electrical systems malfunction	• Adjust or replace belt • Check battery to alternator wiring for ground or open. Repair if necessary • Perform general charging systems test. Repair or replace as required • Repair as required • Replace gauge • Check and repair as required

CJ1910-2C1

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CJ1910-2B

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2. Check battery posts and battery cable terminals for clean and tight connections. Remove the battery cables (if corroded), clean and install them securely.
3. Check for clean and tight wiring connections at the alternator, regulator and engine.
4. Check the alternator belt tension using a belt tension gauge (model 210019 or 210020 or equivalent) and tighten to specification (if necessary), as described in Part 31-10.

ISOLATING THE PROBLEM

Battery, starting system, and light systems problems can be caused by poor charging system performance. It is also possible to suspect the charging system because of an overload in another area of the electrical system.

To avoid guesswork, it is necessary to isolate the battery, the charging system, and the electrical circuits to correctly identify the area where the difficulty lies. The best method to do this is to check the battery first before any electrical system diagnosis. The battery must be in proper state of charge. The battery must be operating properly before the other areas of the electrical system can perform normally.

BATTERY CHECK

The battery should be checked to see if it has the capacity and ability to accept and hold a charge (Part 31-02). If the battery is good, then the charging system should be checked to see that it performs its function of keeping the battery charged.

The battery capacity, specific gravity and cell comparison test will determine the ability of a battery to accept and hold a charge. If the battery cannot meet the specifications it should be replaced and the new battery fully charged before further diagnosis of other areas of the electrical system.

If the battery is found to meet the required specifications, it should be fully charged before proceeding with the diagnosis of other electrical system components.

CHARGING SYSTEM CHECK

The General Charging System Test should be performed before testing any of the individual charging system components. It's "road-map" type of layout should reduce confusion in determining "what to do next" and speed up diagnosis. The component tests will determine the type of component repairs to be made.

The test instruments used in the General Charging System Test are a voltmeter (0-20 or 0-30 volt scale) and an ohmmeter. Special care should be given when using the ohmmeter near "hot" circuits. The component to be checked should be disconnected from the circuit or the battery terminals should be disconnected.

Continue through the Diagnosis Guides until a repair has been made. Then, again test the system to see if the repair has corrected the system problem.

TESTING

A voltmeter (0 to 20 volt scale), ohmmeter, jumper wire and a test light (12 volt) are the only tools required to perform an accurate check of the complete charging system. The meters should be calibrated once a year and the date of calibration stamped on the meter face. It is recommended that this practice be followed by all technicians to maintain their meters at acceptable accuracy.

The tests are divided into On Vehicle and On Bench Test procedures.

Troubleshooting or diagnosis is required before actual repairs can be made in the electrical system. Even where an obvious fault makes the replacement of a unit necessary, find out why the unit failed. Refer to the Diagnosis Guide in this Part. When a trouble is diagnosed correctly, unnecessary repairs are prevented, the time the vehicle is out of service will be decreased, and the repairs that are made will be permanent.

ON VEHICLE TESTS

Before performing charging system tests on the vehicle, note the complaint such as: slow cranking, battery dead or using an excessive amount of water, top of battery wet, ammeter shows charge at all times or no charge, alternator warning lamp does not come on or never goes out. This information will aid in isolating the part of the system causing the symptom.

VISUAL INSPECTION

1. Check the fuse link located between the starter relay and the alternator. If burned, determine cause, repair system and replace fuse link.
2. The battery must be in proper state of charge (at least 1.200 specific gravity). Check the battery posts and battery cable terminals for clean and tight connections. Remove the battery cables (if corroded), clean and install them securely.
3. Check for clean and tight wiring connections at the alternator, regulator and engine.
4. Check the alternator belt tension and tighten to specification (if necessary). Refer to Part 31-10.

BATTERY DRAIN TEST

1. Connect a 12-volt test light in-series between the battery positive cable clamp and the positive terminal of the battery. Test with all switches OFF. Do not be misled by clock-winding current. Touch cable clamp to terminal to wind clock.
2. If light glows, pull fuses, one at a time, and check each circuit for short. Repair wiring harnesses or components as required.

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ALTERNATOR INDICATOR LIGHT (ALT) TEST

NORMAL CHARGE INDICATOR

With Ignition switch off, lamp is off.

With Ignition switch on (engine not running), charge indicator (ALT) lamp is on.

With Ignition switch on (engine running), charge indicator (ALT) lamp is off.

1. If the charge indicator lamp does not come on with the ignition key in the ON position and the engine not running, check the I wiring circuit (ignition switch to regulator I terminal), for an open circuit or burned out charge indicator lamp.
2. If the charge indicator light does not come on, disconnect the wiring plug connector at the regulator and connect a jumper wire from the I terminal of the regulator wiring plug to the negative battery post cable clamp.
3. The charge indicator lamp should go on with the ignition key turned to the ON position.
4. If the charge indicator bulb does not go on, check the bulb for continuity and replace (if burned out).
5. If the bulb is not burned out, an open circuit exists between the ignition switch and the regulator.

AMMETER TEST

NORMAL CHARGE INDICATION

With ignition switch off and no electrical load . . . Ammeter should show O or center scale.

With ignition switch ON and the engine running (fully charged battery), needle deflects towards charge and returns toward center scale in time.

With ignition switch off and headlamps on . . . Ammeter should show discharge. If the ammeter does not register a discharge, check for loose connections at the ammeter prior to replacing the gauge.

GENERAL CHARGING SYSTEM TESTS

When performing charging system tests with a voltmeter, turn OFF all lights and electrical components. Place the transmission in neutral and apply the parking brake.

BASE VOLTAGE TEST

1. Connect the negative lead of the voltmeter to the negative battery cable clamp.
2. Connect the positive lead of the voltmeter to the positive battery cable clamp (Fig. 1). Record the battery voltage reading shown on the voltmeter scale, (this is called the base voltage).

NO LOAD TEST

3. Connect a tachometer to the engine.
4. Start the engine and increase speed to approximately 1500 rpm. With no other electrical load (foot off brake pedal and doors closed), the voltmeter pointer should move upward (increase), but not more than 2 volts above the base voltage (first recorded battery voltage reading). The reading should be taken when the voltmeter pointer stops rising. It may take a few minutes to reach this point. If the pointer continues to rise, perform the OVER VOLTAGE TESTS described below.
5. With the engine running, turn the heater or air conditioner blower motor ON (high speed) and headlights on high beam.

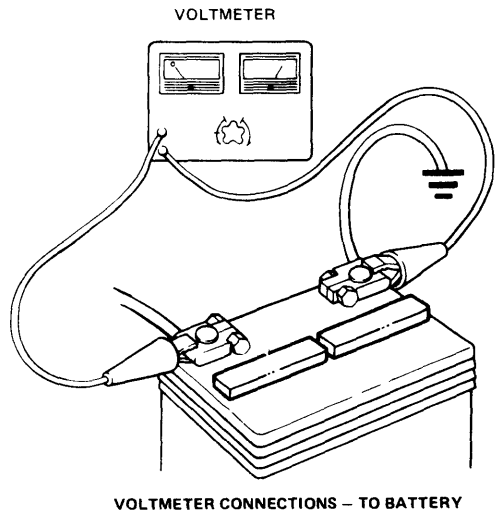


FIG. 1 Voltmeter—To—Battery Connections

LOAD TEST

6. Increase the engine speed to approximately 2000 rpm. The voltmeter should indicate a minimum of 0.5 volt above the base voltage. If not, perform the UNDER VOLTAGE TEST described below.

If the above tests indicate proper voltage readings, the charging system is operating normally. Proceed to the tests below if one or more of the readings is different than shown above and use a test light and check for battery drain.

OVER VOLTAGE TESTS

1. If the voltmeter reading indicates more than 2.0 volts above the base voltage, connect a jumper wire between the regulator base and the alternator frame. Repeat the NO LOAD test. This will check the ground connections between the regulator and alternator and/or regulator to engine. If an over voltage condition appears, clean and tighten connections securely.
2. If over voltage condition still exists, disconnect the regulator wiring plug from the regulator and repeat the NO LOAD test.
3. If over voltage condition disappears (voltmeter reads battery voltage), replace voltage regulator.
4. If over voltage still exists with the regulator wiring plug disconnected, repair the short in the wiring harness between the alternator and regulator. Replace the regulator and connect the regulator wiring plug to the regulator.

UNDER VOLTAGE TESTS

1. To determine if the jumping procedure is safe, the field circuit should be checked with the regulator wiring plug disconnected and an ohmmeter connected from the F terminal of the regulator wiring plug to the battery ground. The ohmmeter should indicate more than three ohms (Fig. 2).

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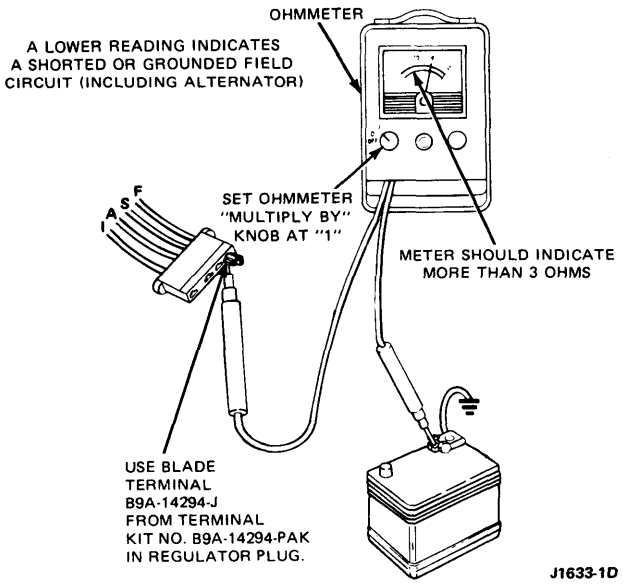


FIG. 2 Field Circuit Test

2. If the load voltage did not increase 1/2 volt above the base voltage, connect a jumper across the A and F terminals of the plug and repeat the LOAD TEST (Fig. 3).

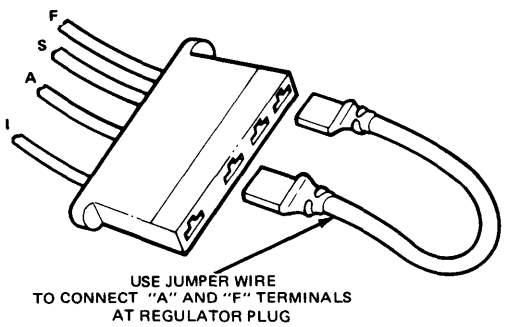


FIG. 3 Regulator Plug Jumper Wire Connections

3. If the Voltmeter still indicates under voltage, remove the jumper wire from the regulator plug and leave the plug disconnected from the regulator. Connect a jumper wire to the FLD and BAT terminals on the alternator (Fig. 4) and repeat the LOAD TEST. If the voltmeter now indicates more than 1/2 volt above the base voltage, repair the wiring harness from the alternator to the regulator.
4. If the voltmeter still indicates under voltage, stop the engine and move the positive voltmeter lead to the alternator BAT terminal.
5. If the voltmeter now indicates the base voltage reading, repair the alternator. If the voltmeter indicates zero volts, repair the BAT wire (circuit 38).

REGULATOR I AND S CRCUIT TESTS S—CIRCUIT WITH AMMETER

1. Connect the positive lead of the voltmeter to the S terminal of the regulator wiring plug. (Negative lead of voltmeter is still connected to battery negative post.) Then, turn the ignition switch to the ON position. Do not start the engine.
2. The voltmeter should indicate battery voltage.
3. If there is no voltage reading, repair the S wire lead from the ignition switch to the regulator wiring plug.
4. Connect the positive voltmeter lead to the positive battery cable terminal, connect regulator wiring plug to regulator and repeat the LOAD TEST.

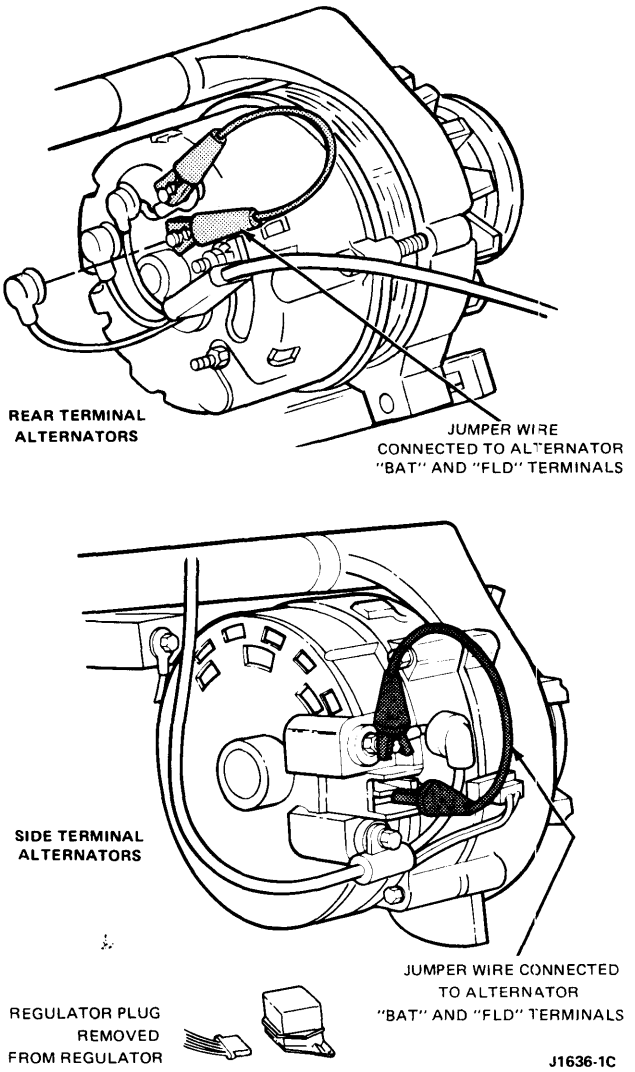


FIG. 4 Jumper Wire Connections

S AND I CIRCUIT—WITH INDICATOR LIGHT

1. Disconnect the regulator wiring plug and install a jumper wire between the A and F terminals (Fig. 3).
2. With the engine idling, connect the positive lead of the voltmeter to the S terminal and then to the I terminal of the regulator wiring plug. The voltage of the S circuit should read approximately 1/2 of the I circuit.
3. If no voltage is present, repair the wiring circuit. Reconnect the positive voltmeter lead to the positive battery cable terminal.
4. If the above circuit tests are satifactory, install a new regulator.

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5. Then, remove the jumper wire from the regulator wiring plug and connect the wiring plug to the regulator. Repeat the LOAD TEST.

DIODE TEST—ON VEHICLE

1. Disconnect the electric choke.
2. Disconnect voltage regulator wiring plug.
3. Connect a jumper between A and F terminal of voltage regulator wiring plug (Fig. 3).
4. Connect voltmeter to battery cable clamps.
5. Start engine—let engine run at idle.
6. Read and record the system voltage.
7. Move positive voltmeter lead to S-terminal of the alternator
8. Note the voltmeter reading.
9. Run the engine as described under NO LOAD TEST.

TEST RESULTS

1. If the voltmeter reads 1/2 of the system voltage, the diodes are OK.
2. If voltmeter reads approximately 1.5 volts, alternator has shorted negative diode, or a grounded stator winding.
3. If voltmeter reads approximately 1.5 volts less than battery voltage, alternator has shorted positive diode.
4. If voltmeter reads about 1.0 to 1.5 volts less than 1/2 battery voltage, alternator has an open positive diode.
5. If voltmeter reads about 1.0 to 1.5 volts more than 1/2 battery voltage, alternator has an open negative diode.
6. Connect the electric choke into the circuit after the test is completed.

BENCH TESTS

RECTIFIER SHORT OR GROUNDED AND STATOR GROUNDED TEST

These tests are performed with an ARE 27-42 ohmmeter or equivalent. Set the Multiply By Knob at 10, and calibrate the ohmmeter as directed inside the instrument cover.

1. Contact one ohmmeter probe to the alternator BAT terminal (Fig. 5) and the other probe to the STA terminal (rear blade terminal). Then, reverse the ohmmeter probes and repeat the test. A reading of about 60 ohms should be obtained in one direction and no needle movement with the probes reversed. A reading in both directions indicates a bad positive diode, a grounded positive diode plate or a grounded BAT terminal.
2. Perform the same test using the STA and GND (ground) terminals of the alternator. A reading in both directions indicates either a bad negative diode, a grounded stator winding, a grounded stator terminal, a grounded positive diode plate, or a grounded BAT terminal.
3. Infinite readings (no needle movement) in all four probe positions in the preceeding tests indicates an open STA terminal lead connection inside the alternator.

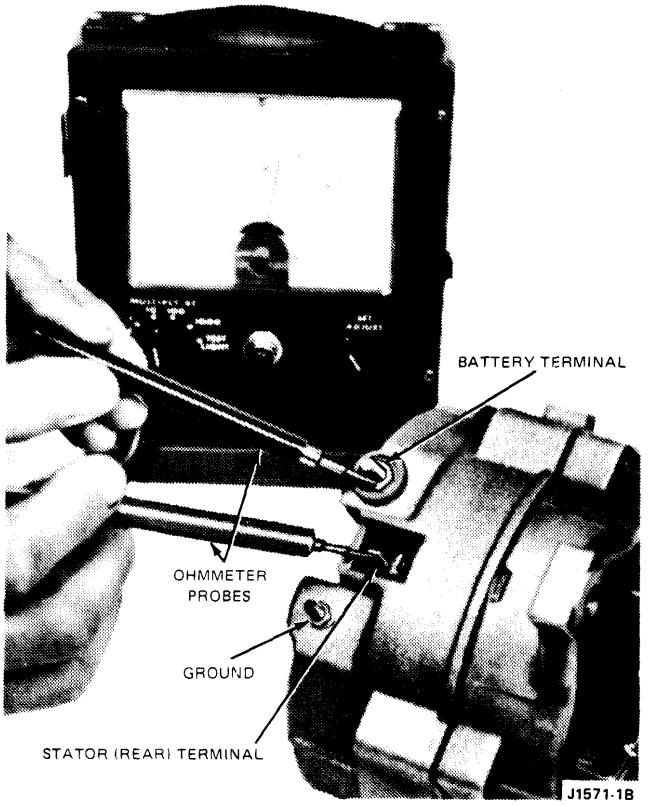


FIG. 5 Rectifier Short or Grounded and Stator Grounded Test

FIELD OPEN OR SHORT CIRCUIT TEST

This test is performed with an ARE 27-42 ohmmeter or equivalent. Set the ohmmeter Multiply By Knob at 1 and calibrate the ohmmeter as directed inside the instrument cover.

1. Contact the alternator field terminal with one probe and the ground terminal with the other probe (Fig. 6). Then, spin the alternator pulley. The ohmmeter reading should be between 2.4 and 200 ohms and should fluctuate while the pulley is turning.
2. An infinite reading (no meter movement) indicates an open brush lead, worn or stuck brushes, or a bad rotor assembly.
3. An ohmmeter reading less than 2.4 ohms indicates a grounded brush assembly, a grounded field terminal or a bad rotor.

DIODE TEST

Remove the rectifier assembly from the alternator as outlined in the appropriate Part in Group 31. Set the ohmmeter Multiply By Knob at 10 and calibrate the meter as directed inside the cover.

1. To test one set of diodes, contact one probe to the diode plate as shown in Fig. 7 and contact each of the three stator lead terminals with the other probe. Reverse the probes and repeat the test. All diodes should show a low reading of about 60 ohms in one direction, and an infinite reading (no needle movement) with the probes reversed.
2. Repeat the preceeding tests for the other set of diodes except that the other diode plate is used.

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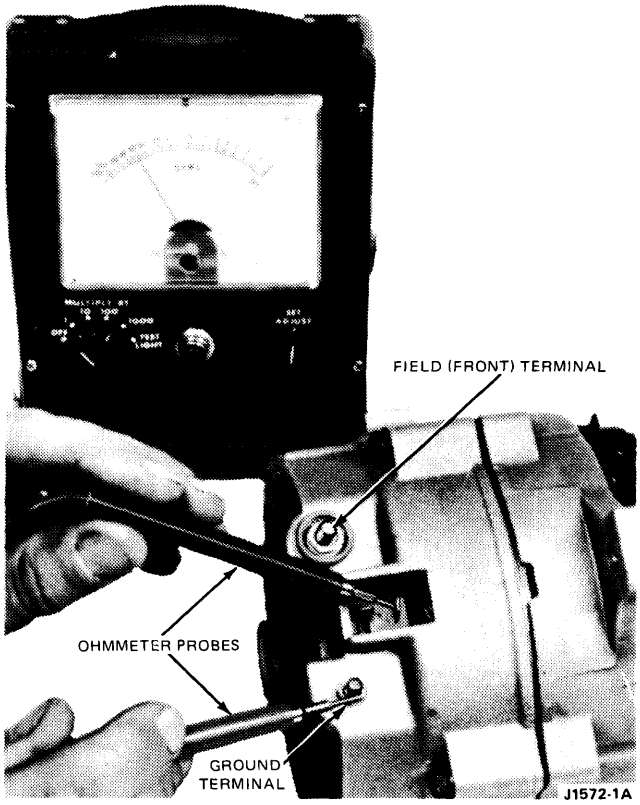


FIG. 6 Field Open or Short Circuit Test

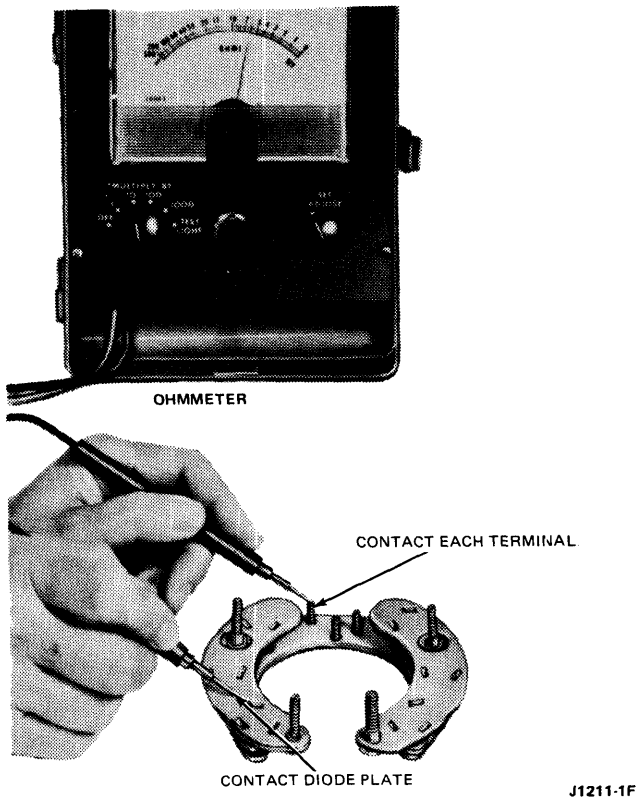


FIG. 7 Diode Test—Rear Terminal Alternator

3. If the meter readings are not as specified, replace the rectifier assembly.

STATOR COIL OPEN OR GROUNDED TEST

These tests are made to determine if the stator coil is operating properly. Disassemble the stator from the alternator as outlined under Disassembly in the appropriate alternator Part in Group 31.

Set the ARE 27-42 ohmmeter or equivalent Multiply By Knob at 1, and calibrate the meter as directed inside the cover.

1. Connect the ohmmeter probes between each pair of stator leads (3 different ways). The ohmmeter must show equal readings for each pair of stator leads. Replace the stator if the readings are not the same.
2. Set the ohmmeter Multiply By Knob at 1000. Connect the ohmmeter probes to one of the stator leads and to the stator laminated core. Be sure that the probe makes a good electrical connection with the stator core. The meter should show an infinite reading (no meter movement).
3. If the meter does not indicate an infinite reading (needle moves), the stator winding is shorted to the core and must be replaced. Repeat this test for each of the stator leads.

ROTOR OPEN OR SHORT CIRCUIT TEST

Disassemble the front housing and rotor from the rear housing and stator as outlined under Disassembly in the appropriate alternator part in Group 31. Set the ohmmeter Multiply By Knob at 1 and calibrate the meter as directed inside the ohmmeter cover.

1. Contact each ohmmeter probe to a rotor slip ring. The meter reading should be 2.4 to 4.9 ohms. A higher reading indicates a weak or broken slip ring solder connection or a broken wire. A lower reading indicates a shorted wire or slip ring. Replace the rotor if it cannot be repaired.
2. Contact one ohmmeter probe to a slip ring and the other probe to the rotor shaft. The meter reading should be infinite (no deflection).
3. A reading other than infinite indicates the rotor is shorted to the shaft. Inspect the slip ring soldered terminals to be sure they are not bent and touching the rotor shaft, or that excess solder is not grounding the rotor coil connections to the shaft. Replace the rotor if it is shorted and cannot be repaired.

CHARGING SYSTEM FUSE LINK

Fuse links are included in the charging system wiring. Refer to Part 34-31 for fuse link repair procedures.

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Batteries

PART 31-02

APPLIES TO ALL MODELS

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TESTING

CAUTION: Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames, sparks or lighted tobacco are brought near the battery. When charging or using a battery in an enclosed space, always provide ventilation and shield your eyes.

WARNING—Keep out of reach of children. Batteries contain SULFURIC ACID. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin, eyes, or clothing, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. If acid is swallowed, drink large quantities of milk or water, followed by milk of magnesia, a beaten egg, or vegetable oil. CALL A PHYSICIAN IMMEDIATELY.

TO JUMP START: (Negative grounded battery)

1. Be sure all switches are in OFF position.
2. Shield eyes. Use safety goggles or similar eye protection.
3. Connect ends of one cable to positive (+) terminals of each battery.
4. Connect one end of the other cables to negative (-) terminal of "good" battery.
5. Connect other end of cable to engine bolthead or similar good contact spot on the vehicle being started (NOT to negative (-) terminal of battery).
6. To prevent damage to other electrical components on vehicle being started, make certain that engine is at idle speed before disconnecting jumper cables.

NOTE: Batteries are heavy, weighing 30 lbs. or more. Lift them with your legs rather than your back to prevent muscle strains, and be careful not to drop them (possible breakage) nor to spill the contents (sulfuric acid).

NOTE: 12-volt starting motors can be damaged beyond repair if connected to a 24-volt power supply (two 12-volt batteries in series, or a 24-volt motor-generator set), even when cranking loads are relatively light. Extensive starting motor damage is more likely if the starter is connected to a 24-volt supply while being subjected to prolonged heavy cranking loads such as attempting to start an engine in subzero temperatures.

Tests are made on a battery to determine the state of charge and also its capacity or ability to crank an engine. The ultimate result of these tests is to show that the battery is good, needs recharging, or must be replaced.

Before attempting to test a battery, it is important to give it a thorough examination to determine if it has been damaged. Remove battery cable clamps, negative terminal first. Check for dirty or corroded connections and loose battery posts. Remove hold downs and heat shields and inspect for broken or cracked case or cover. If worn or damaged, loose or broken post, or cracked case or cover, replace battery.

The battery capacity test should be run next to remove any surface charge prior to determining state of charge of a maintenance free battery.

TESTS USING THE CHRISTIE TESTER 41-0002 (OR EQUIVALENT)

Follow instructions supplied with tester.

TESTS USING THE ROTUNDA BATTERY-STARTER TESTER (02-0204 OR EQUIVALENT)

BATTERY CAPACITY TEST

A high rate discharge tester (Rotunda Battery-Starter Tester 02-0204) or equivalent in conjunction with a voltmeter is used for this test.

1. Turn the control knob on the Battery-Starter Tester to the off position.
2. Turn the voltmeter selector switch to the 20-volt position.
3. Connect both positive test leads to the positive battery post and both negative leads to the

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negative battery post. The voltmeter clips must contact the battery posts and not the high-rate discharge tester clips. Unless this is done, the actual battery terminal voltage will not be indicated.

4. Turn the load control knob in a clockwise direction until the ammeter reaches the applicable discharge rate specified in the discharge rate table.
5. With the ammeter reading the required load for 15 seconds, note the voltmeter reading. Avoid leaving the high discharge load on the battery for periods longer than 15 seconds.

   If the voltmeter reading is above the minimum specified in the table for that temperature, the battery has a good output capacity and will readily accept a charge, if required. Check the state of charge.

   If the voltage reading obtained during the capacity test is below the minimum specified in the table, check the state of charge.

BATTERY STATE OF CHARGE

MAINTENANCE FREE BATTERIES ONLY

Read battery open circuit terminal voltage with a digital voltmeter capable of reading 1/100 of a volt. If the open circuit voltage of the battery is below 12.40 and has passed the capacity test—charge the battery according to the BATTERY CHARGE TIME SCHEDULE. If the battery fails the capacity test—charge the battery for 20 minutes at 35 amperes and repeat the CAPACITY TEST. If the battery fails the second time, replace the battery. Fully charge good batteries before returning to service.

NON-MAINTENANCE FREE BATTERIES ONLY

In order to obtain an accurate specific gravity reading it must be corrected to the standard temperature of 80°F. The correction factor of 4 points (0.004) is used for each 10°F change in temperature. Four points (0.004) are added to the indicated reading for each 10°F increment above 80°F and four points (0.004) are subtracted for each 10°F increment below 80°F.

If the battery passed the capacity test check the specific gravity. If below 1.230 charge the battery according to the charge time schedule.

If the battery failed the capacity test check the specific gravity of all cells. If the difference between any two cells is more than 50 points (0.050), the battery is not satisfactory for service and should be replaced.

If the difference between cells is less than 50 points (0.050), charge the battery for 20 minutes at 35 amperes and repeat the capacity test. If the battery fails the second time replace the battery. If the battery passes, add water if necessary and charge according to the charge time schedule.

In some cases the electrolyte level may be too low to obtain a specific gravity reading. In such cases, conduct the capacity tests as indicated. If the battery passes the capacity test, charge for the maximum charging time indicated in the charge time schedule.

Batteries that are completely discharged may not accept a fast charge. If this is found, the battery should be slow charged at approximately 5 amperes for 2 hours so the battery will be capable of accepting a fast charge. A specific gravity reading taken at this time will show no change from the original reading, but the battery should be charged according to the charge time schedule.

If the battery has failed, is low in charge, or requires water frequently it may be necessary to refer to Part 31-01 (Charging System Troubleshooting Procedure) to locate the cause.

SPECIFICATIONS

BATTERY DISCHARGE RATES

Ampere Hours	Discharge Rate Amperes
36	155
41	145
45	190
53	175
53*	200
54	225
63	205
63*	215
68	220
68*	235
71	235
77	225

*Maintenance Free Battery

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BATTERY HIGH RATE CHARGE TIME SCHEDULE — MAINTENANCE FREE BATTERIES

Open Circuit Terminal Voltage	Amp. Hours	Charge Rate Amperes			
		5A	10A	20A	30A
Below 11.85	53	11 Hrs.	5.5 Hrs.	2.75 Hrs.	1.75 Hrs.
	63 68	13 Hrs.	6.5 Hrs.	3.25 Hrs.	2 Hrs.
11.85-12.00	53	8 Hrs.	4 Hrs.	2 Hrs.	1.5 Hrs.
	63 68	10 Hrs.	5 Hrs.	2.5 Hrs.	1.5 Hrs.
12.00-12.10	53	6 Hrs.	3 Hrs.	1.5 Hrs.	1 Hr.
	63 68	8 Hrs.	4 Hrs.	2 Hrs.	1.25 Hrs.
12-10-12.25	53	5 Hrs.	2.5 Hrs.	1.25 Hrs.	.75 Hrs.
	63 68	6 Hrs.	3 Hrs.	1.5 Hrs.	1 Hr.
12.25-12.35	53	3 Hrs.	1.5 Hrs.	.75 Hrs.	.5 Hrs.
	63 68	4 Hrs.	2 Hrs.	1 Hr.	.5 Hrs.
Above 12.35	53	2 Hrs.	—	—	—
	63 68	2.5 Hrs.	—	—	—

CAUTION: Do not exceed 30 ampere charge rate if gassing or spewing of the electrolyte occurs during charging, the charge rate must be reduced. Battery must be at a temperature of at least 40°F before charging.

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BATTERY HIGH RATE CHARGE TIME SCHEDULE — NON-MAINTENANCE FREE BATTERIES

Specific Gravity Reading	Charge Rate Amperes	Battery Capacity — Ampere-Hours ③			
		36	41-45	53-54	63, 68, 71, 77
1.125-1.150 ①	35	50 min.	65 min.	80 min.	115 min.
1.150-1.175	35	40 min.	50 min.	65 min.	95 min.
1.175-1.200	35	30 min.	40 min.	50 min.	70 min.
1.200-1.225	35	25 min.	30 min.	35 min.	50 min.
Above 1.225	5	②	②	②	②

① If the specific gravity is below 1.125, use the time indicated for the 1.125 specific gravity, then charge at 5 amperes until the specific gravity reaches 1.250 at 80°F.
② Charge at 5 ampere rate only until the specific gravity reaches 1.250 at 80°F.
③ At no time during the charging operation should the electrolyte temperature exceed 130°F.

NOTE: BATTERY MUST BE AT A TEMPERATURE OF AT LEAST 40°F BEFORE CHARGING.

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BATTERY HIGH RATE CHARGE TIME SCHEDULE — NON-MAINTENANCE FREE BATTERIES

Specific Gravity Reading	Charge Rate Amperes	Battery Capacity — Ampere/Hours ③			
		36	41-45	53-54	63 68 71 77
1.125-1.150 ①	35	50 Min.	65 Min.	80 Min.	115 Min.
1.150-1.175	35	40 Min.	50 Min.	65 Min.	95 Min.
1.175-1.200	35	30 Min.	40 Min.	50 Min.	70 Min.
1.200-1.225	35	25 Min.	30 Min.	35 Min.	50 Min.
Above 1.225	5	②	②	②	②

① If the specific gravity is below 1.125, use the time indicated for the 1.125 specific gravity, then charge at 5 amperes until the specific gravity reaches 1.250 at 80°F.
② Charge at 5 ampere rate only until the specific gravity reaches 1.250 at 80°F.
③ At no time during the charging operation should the electrolyte temperature exceed 130°F.

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Rear Terminal Alternator

PART 31-10

APPLIES TO ALL MODELS

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DIAGNOSIS AND TESTING	10-2	DISASSEMBLY AND OVERHAUL	
ADJUSTMENTS		Rear Terminal Alternator	10-3
Belt Adjustment	10-2	SPECIFICATIONS	10-6

DESCRIPTION AND OPERATION

The alternator charging system is a negative ground system, and consists of an alternator, a regulator, a charge indicator, a storage battery, a fuse link on all models and associated wiring.

The alternator is belt driven from the engine. Current is supplied from the alternator-regulator system to the rotating field of the alternator through two brushes to two slip rings.

The alternator produces power in the form of alternating current. The alternating current is rectified to direct current by diodes. The alternator regulator automatically adjusts the alternator field current to maintain the alternator output voltage within prescribed limits to correctly charge the battery.

If a charge indicator lamp is used in the charging system (Fig. 1), the system operation is as follows: When the ignition switch is turned ON, a small electrical current flows through the lamp filament (turning the lamp ON) and through the alternator regulator to the alternator field. When the engine is started, the alternator field rotates and produces a voltage in the stator winding. When the voltage at the alternator stator terminal reaches about 3 volts, the regulator field relay closes. This puts the same voltage potential on both sides of the charge indicator lamp causing it to go out. When the field relay has closed, current passes through the regulator A terminal and is metered to the alternator field.

If an ammeter is used in the charging system (Fig. 2), the regulator I terminal is not used. When the ignition switch is turned ON, the field relay closes and electrical current passes through the regulator A terminal and is metered to the alternator field. When the engine is

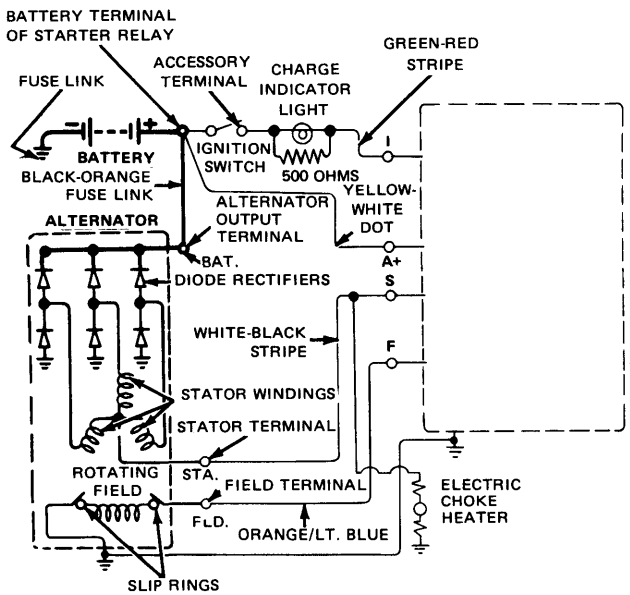


FIG. 1 Alternator Charging System—Indicator Light

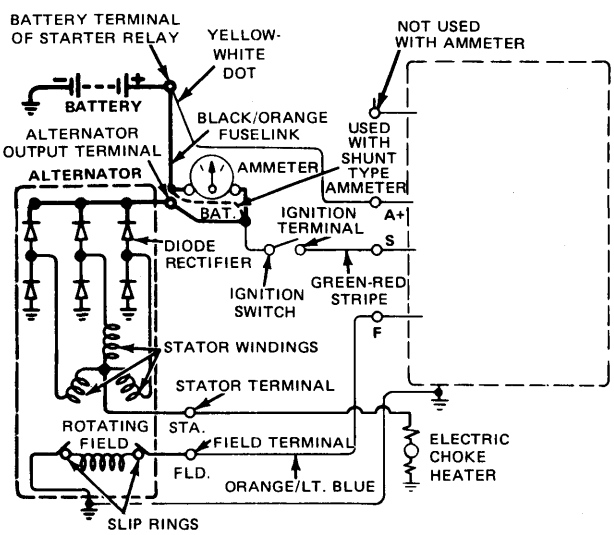


FIG. 2 Alternator Charging System—Ammeter

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started, the alternator field rotates causing the alternator to operate. The ammeter indicates current flow into (charge) or out of (discharge) the vehicle battery.

Fuse links are included in the charging system wiring on all models (Part 34-31). This fuse link is used to prevent damage to the wiring harness and alternator if the wiring harness should become grounded, or if a booster battery is connected to the charging system with the wrong polarity.

DIAGNOSIS AND TESTING

Testing and diagnosis procedures for the charging system are given in Part 31-01 of this manual. Check the alternator drive belt and adjust it to specification (Specifications at end of this Part), before proceeding with any tests. Check and tighten all connectors at the starter relay and battery. DO NOT OPERATE THE ENGINE WITH THE BATTERY DISCONNECTED.

ADJUSTMENTS

BELT ADJUSTMENT

1. Check the belt tension with Tool T63L-8620-A or equivalent. The belt should be within specifications (Specifications Section at end of this Part).
2. If the belt is not within specification, loosen the alternator mounting pivot bolt to a snug position and loosen the adjusting arm bolt.
3. **Apply pressure on the alternator front housing adjusting ear** and tighten the adjusting arm to alternator bolt.
4. Check the belt tension using Tool T63L-8620-A or equivalent. Adjust the belt for specified tension.
5. Tighten the adjusting arm bolt to 22-32 ft-lb torque. Tighten the pivot bolt to 55-70 ft-lb torque.

REMOVAL AND INSTALLATION

Removal

1. Disconnect the battery ground cable.
2. Loosen the alternator mounting bolts and remove the adjustment arm-to-alternator attaching bolt.
3. Remove the electrical connectors from the alternator. The stator and field connectors are the push-on type. Pull them straight off the terminal studs to prevent damage to them.
4. Disengage the alternator belt. Remove the alternator mounting pivot bolt, and remove the alternator.

Installation

1. Install the alternator wiring harness (Fig. 3). Position the alternator to the engine, and install the spacer (if used) and the alternator mounting pivot bolt. Tighten the bolt only finger tight.
2. Install the adjustment arm-to-alternator attaching bolt.
3. Adjust the belt tension using Tool T63L-8620-A or equivalent. Apply pressure on the alternator front housing adjusting ear, when tightening the belt.

   Tighten the adjusting arm bolt to 22-32 ft-lb torque, and the mounting bolt to 55-70 ft-lb torque.
4. Connect the battery ground cable.

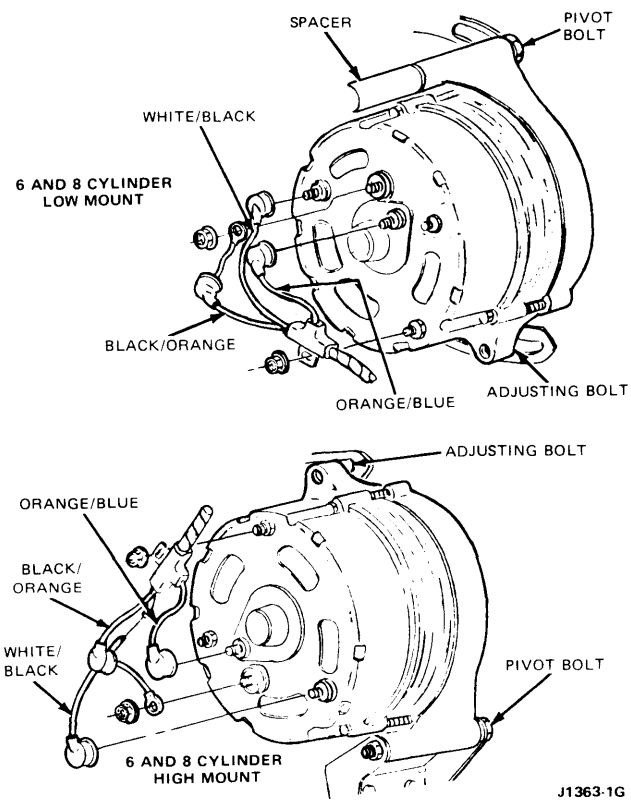


FIG. 3 Wiring Harness Connections—Typical

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DISASSEMBLY AND OVERHAUL

REAR TERMINAL ALTERNATOR

Disassembly

Fig. 4 shows a disassembled view of the E.E.D. rear terminal alternator.

1. Mark both end housings and the stator with a scribe mark for assembly.
2. Remove the three housing through bolts.
3. Separate the front housing and rotor from the stator and rear housing.
4. Remove all the nuts and insulators from the rear housing and remove the rear housing from the stator and rectifier assembly.
5. Remove the brush holder mounting screws and remove the holder, brushes, brush springs, insulator and terminal.
6. If replacement is necessary, press the bearing from the rear housing supporting the housing near the bearing boss.
7. If the rectifier assembly is being replaced, unsolder the stator leads from the printed-circuit board terminals, and disconnect the center tap pigtail from the stator terminal. Separate the stator from the rectifier assembly. Work quickly to prevent overheating the rectifier.
8. Original production alternators will have one of two types of rectifier assembly circuit boards (Fig. 5); one has the circuit board spaced away from the diode plates with the diodes exposed. The other type is a single circuit board with built-in diodes.

   If the alternator rectifier has an exposed diode circuit board, remove the screws from the rectifier by rotating the bolt heads 1/4 turn clockwise to unlock them and then remove the screws (Fig. 5). Push the stator terminal straight out on a rectifier with the diodes built into the circuit board (Fig. 5). Avoid turning the screw while removing, to make certain that the straight knurl will engage the insulators when installing. Do not remove the grounded screw (Fig. 6).
9. Remove the drive pulley nut with the tool shown in Fig. 7; then, pull the lock washer, pulley, fan, fan spacer, rotor and rotor stop from the rotor shaft.
10. Remove the three screws that hold the front end bearing retainer, and remove the retainer. If the bearing is damaged or has lost its lubricant, support the housing close to the bearing boss, and press out the old bearing from the housing.
11. Perform a diode test and a field open or short circuit test (Refer to Part 31-01).

Assembly

1. The rotor, stator and bearings must not be cleaned with solvent. Wipe these parts off with a clean cloth.
2. Press the front bearing in the front housing bearing boss (put pressure on the bearing outer race only), and install the bearing retainer (Fig. 4).
3. If the stop-ring on the rotor drive shaft was damaged, install a new stop-ring. Push the new ring on the shaft and into the groove. **Do not open the ring with snap ring pliers as permanent damage will result.**
4. Position the rotor stop on the drive shaft with the recessed side against the stop-ring.
5. Position the front housing, fan spacer, fan, pulley and lock washer on the rotor shaft and install the retaining nut. Tighten the retaining nut with the tool shown in Fig. 7 to the specified torque (Specifications Section in this Part).

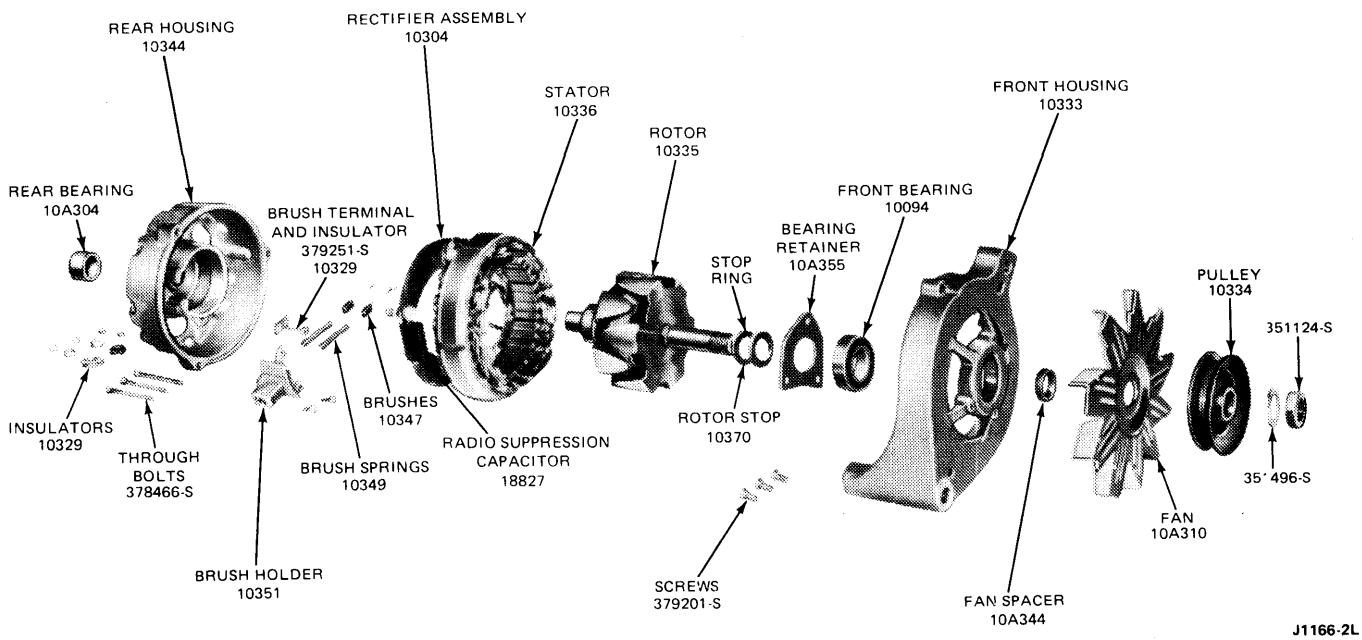


FIG. 4 Disassembled Alternator

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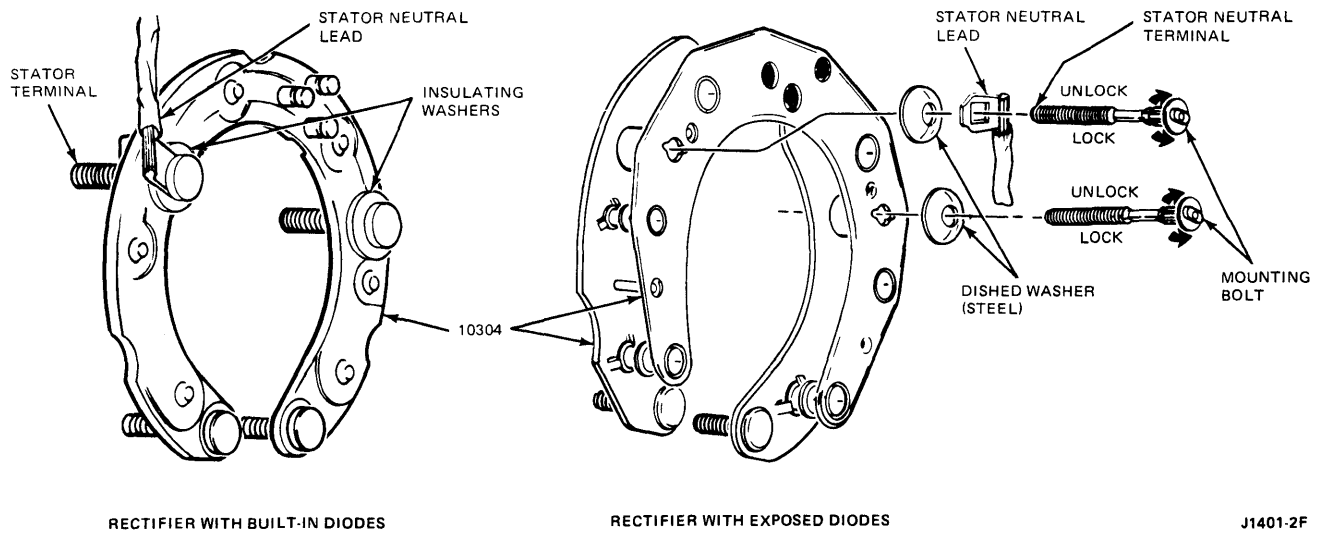


FIG. 5 Rectifier Assemblies

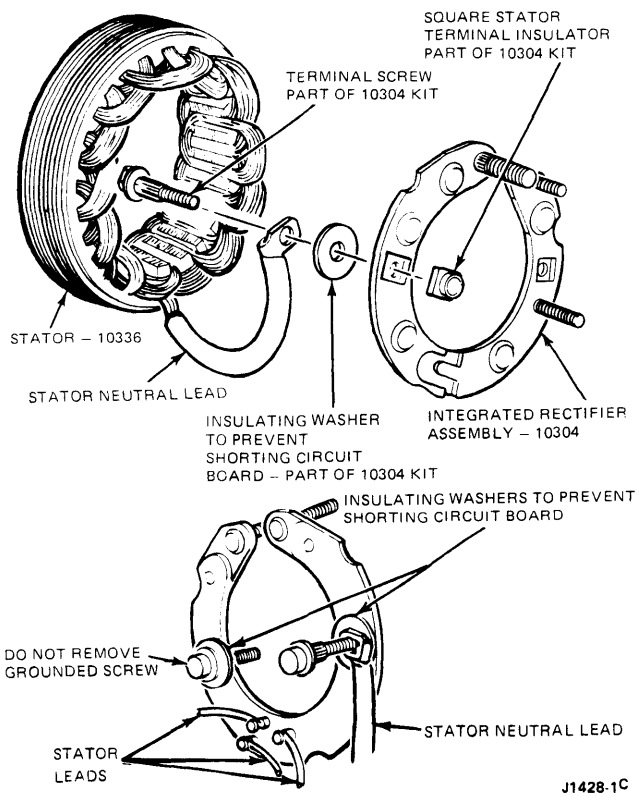


FIG. 6 Stator Terminal Installation—Rectifier with Built-In Diodes

6. If the rear housing bearing was removed, support the housing near the bearing boss and press in a new bearing flush with the outer end surface.
7. Place the brush springs, brushes, brush terminal and terminal insulator in the brush holder and hold the brushes in position by inserting a piece of stiff wire in the brush holder as shown in Fig. 8.
8. Position the brush holder assembly in the rear housing and install the mounting screws. Position the brush leads in the brush holder as shown in Fig. 9.

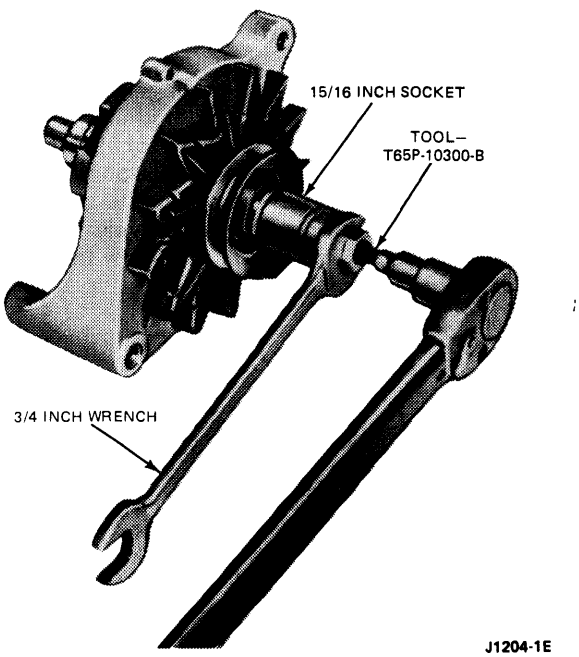


FIG. 7 Pulley Removal

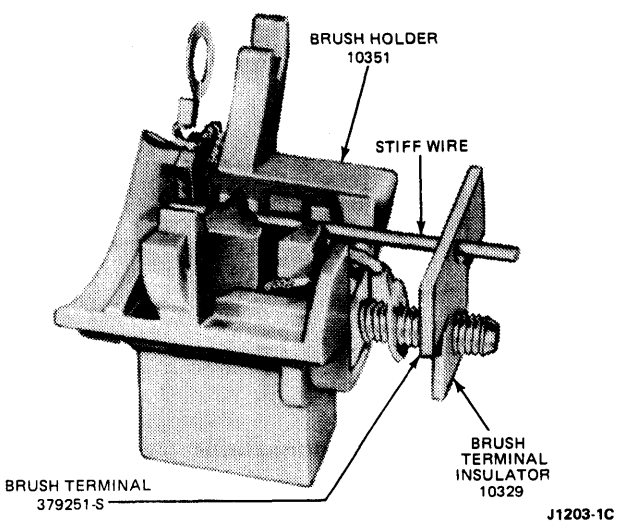


FIG. 8 Brush Holder Assembly

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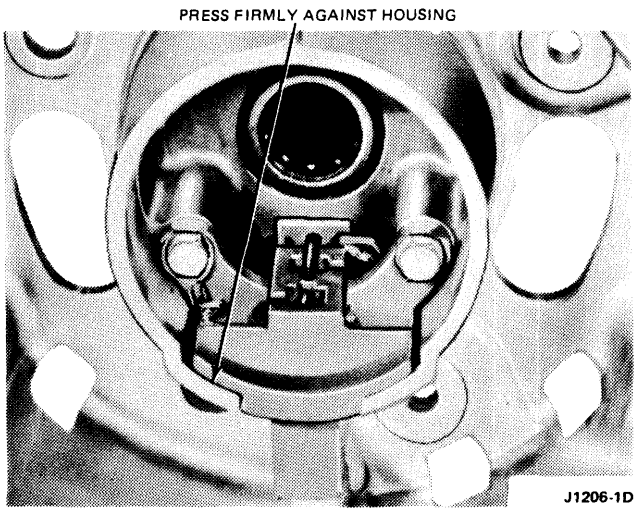


FIG. 9 Brush Lead Positions

9. Wrap the three stator winding leads around the rectifier terminals and solder them. On 65 amp alternators, push the terminals of the stator wires onto the circuit board terminals and solder them. Work quickly to prevent overheating the rectifier. Position the stator neutral lead eyelet on the stator terminal screw and install the screw in the rectifier assembly (Fig. 10).

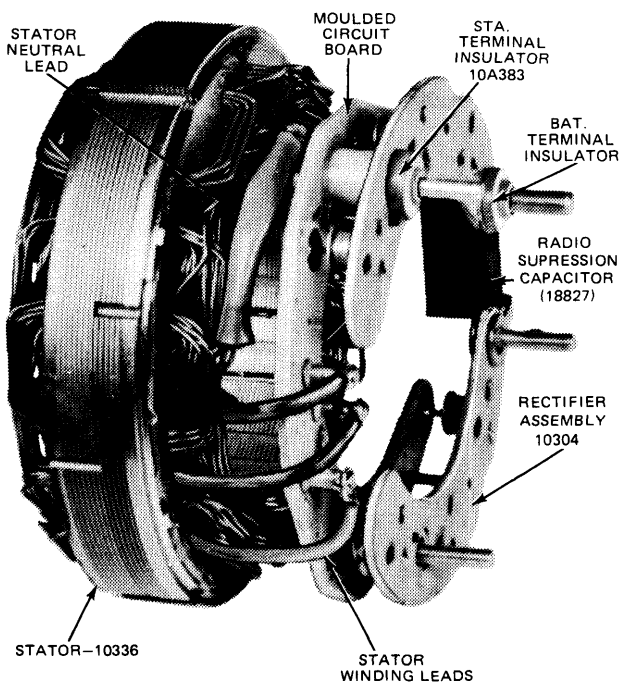


FIG. 10 Stator Lead Connections

10. For a rectifier with the diodes exposed, insert the special screws through the stator neutral wire lug, dished washers and circuit board (Fig. 5). Turn them 1/4 turn counterclockwise to lock them. For single circuit boards with built-in diodes, insert the screws straight through the wire lug, insulating washer and rectifier into the insulator (Fig. 6).

    The dished washers are to be used only on the circuit board with exposed diodes (Fig. 5). If they are used on the single circuit board, a short circuit will occur. A flat insulating washer is to be used between the stator terminal and the board, when a single circuit board is used (Fig. 6).

11. Position the radio noise suppression capacitor on the rectifier terminals. On the circuit board with exposed diodes, install the STA and BAT terminal insulators (Fig. 10). On the single circuit board, position the square stator-terminal insulator in the square hole in the rectifier assembly (Fig. 6). Position the BAT terminal insulator (Fig. 11) on the BAT terminal.

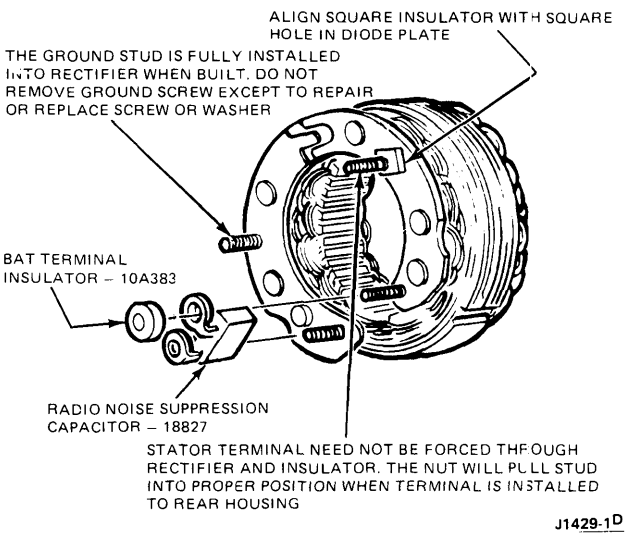


FIG. 11 Terminal Insulators—Fiber-Glass Circuit Board

Position the stator and rectifier assembly in the rear housing. Make certain that all terminal insulators are seated properly in their recesses (Fig. 11). Position the STA (black), BAT (red), and FLD (orange) insulators, on the terminal bolts, and install the retaining nuts (Fig. 12).

12. Wipe the rear end bearing surface of the rotor shaft with a clean lint-free rag.
13. Position the rear housing and stator assembly over the rotor and align the scribe marks made during disassembly. Seat the machined portion of the stator core into the step in both end housings. Install the housing through bolts. Remove the brush retracting wire, and put a daub of water-proof cement over the hole to seal it.

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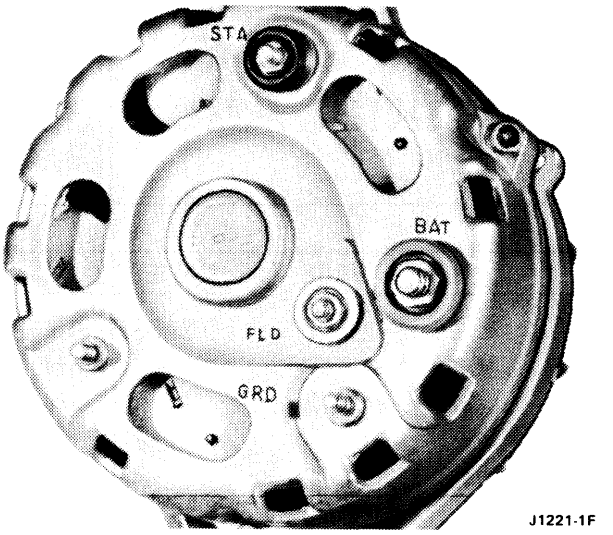


FIG. 12 Alternator Terminal Locations

SPECIFICATIONS

ALTERNATOR — E.E.D

Rating			Field	Slip-Ring Turning (Inches)		Brush Length (Inches)		Pulley Nut	Belt
Identification Plate Color	Amperes @ 15V	Watts @ 15V	Current Amps @ 12V	Min. Dia.	Max. Runout	New	Wear Limit	Torque (Ft-Lbs)	Tension (Lbs)①
Orange	40	600	4.0	1.22	0.0005	½	5/16	60-100	70-110
Green	60	900	4.0	1.22	0.0005	½	5/16	60-100	70-110
Green	60	900	4.0	1.22	0.0005	½	3/16	60-100	70-110

① Used belt. New Belt 150. A used belt is one that has been in operation for more than 10 minutes. If belt tension is not within specification, or belt has been removed, reset to 110 lbs.

SPECIAL TOOLS

Tool No.	Description
T65P-10300-B	Alternator Pulley Remover

Tool No.	Description
Rotunda 210019 210020 (or equivalent)	Belt Tension Gauge

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Side Terminal Alternator

PART 31-12

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DESCRIPTION AND OPERATION

The operation of the side terminal alternator is the same as that for the rear terminal alternator given in Part 31-10. However, the internal wiring is different and is shown in Figs. 1 and 2.

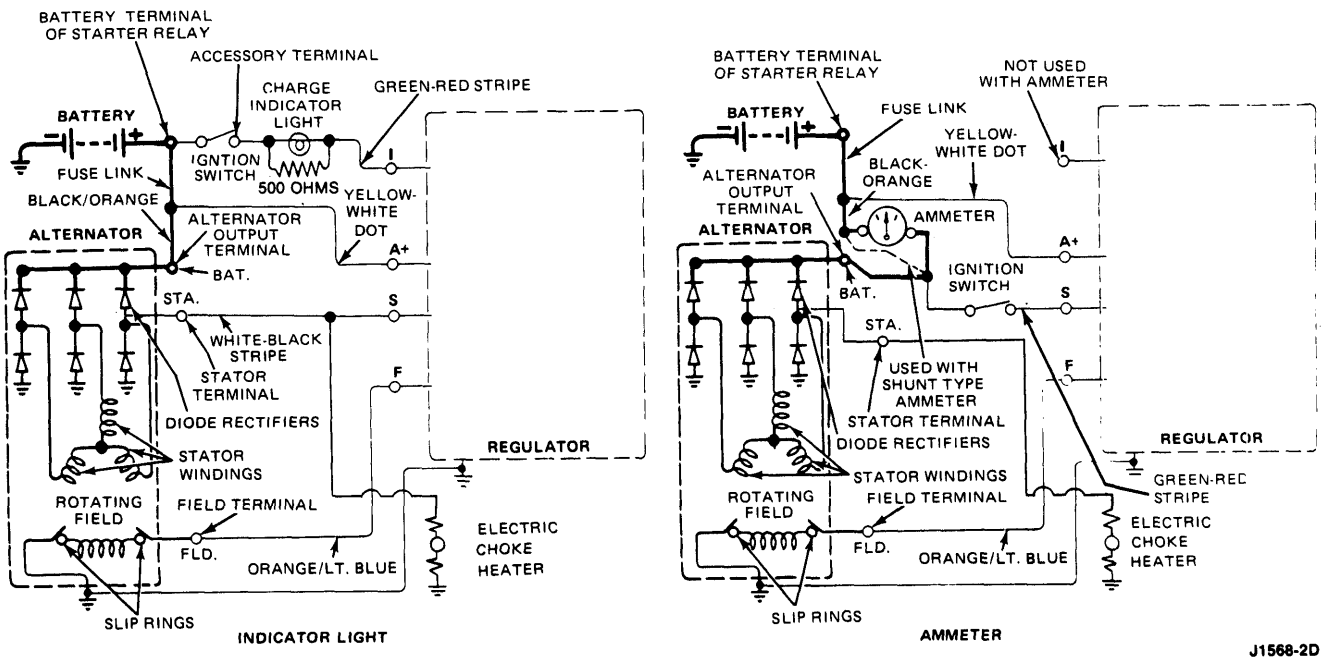


FIG. 1 70-Ampere Side Terminal Alternator Charging System

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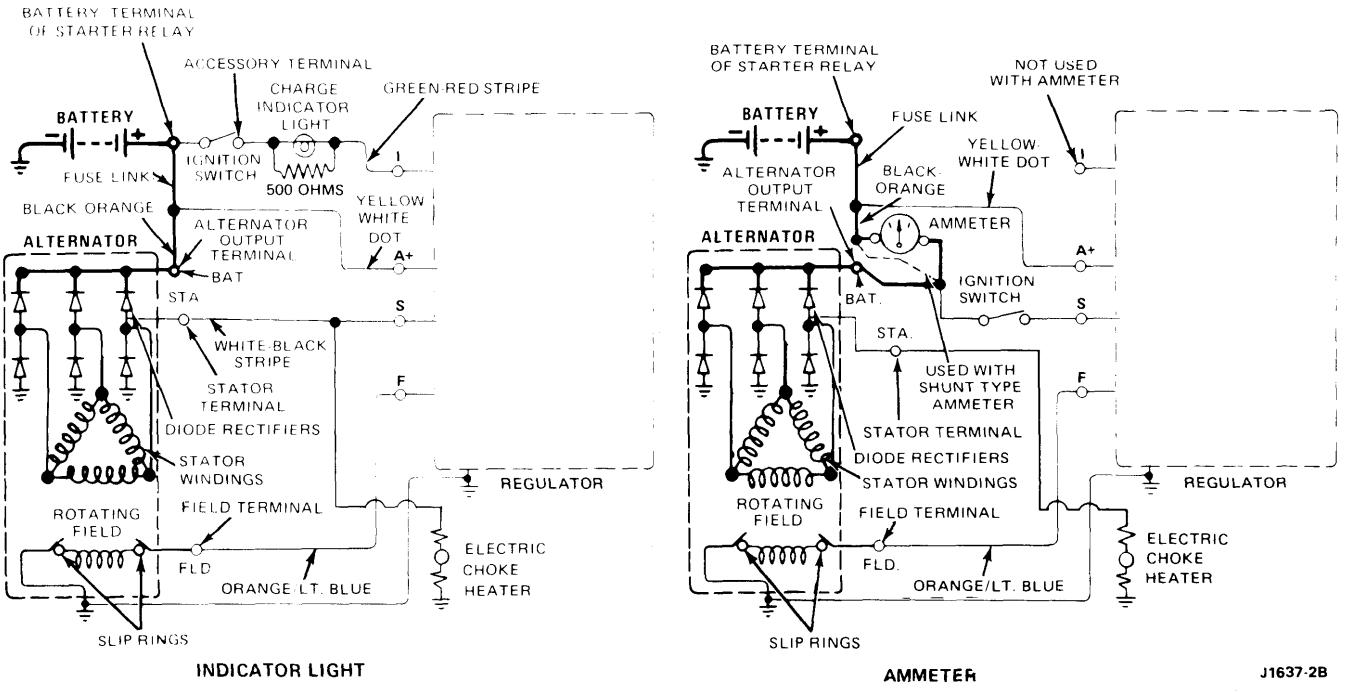


FIG. 2 100-Ampere Side Terminal Alternator Charging System

DIAGNOSIS AND TESTING

ON VEHICLE TESTS

Check the alternator drive belt and adjust it to specification, if necessary, before proceeding with any tests. **Do not run the engine with the battery disconnected.**

Refer to Part 31-01 for Charging System Test and Diagnosis Procedures.

ADJUSTMENTS

BELT ADJUSTMENT

1. Check the belt tension with the Rotunda belt tension gauge 210019 and 210020, or equivalent. The belt tension should be within specification.
2. If the belt is not within specification, loosen the alternator mounting bolt to a snug position and loosen the adjusting arm bolt.
3. Apply pressure to the alternator front housing adjusting ear with 1-1/8 inch open end wrench to increase the bolt tension. Then, tighten the adjusting arm-to-alternator bolt.
4. Check the belt tension with the Rotunda belt tension gauge 210019 and 210020, or equivalent. Repeat the procedure until the belt tension is within specification. Tighten alternator mounting bolt.

REMOVAL AND INSTALLATION

SIDE TERMINAL ALTERNATOR

Removal

1. Disconnect the battery ground cable.
2. Loosen the alternator mounting bolt and remove the adjustment arm-to-alternator attaching bolt. Then, disengage the drive belt from the alternator pulley.
3. Remove the electrical connectors from the alternator (Fig. 3). The stator and field connectors are the push-on blade type with a lock that engages with the alternator housing. Depress the lock tab and pull the connector straight off the terminals to prevent damage to them and the connector.
4. Remove the alternator mounting bolt, bolt spacer (if used), and remove the alternator.

Installation

1. Position the alternator to the engine, and install the spacer (if used) and the alternator mounting bolt. Tighten the bolt to a snug position.
2. Install the adjustment arm-to-alternator attaching bolt and tighten until snug.
3. Position the drive belt on the alternator pulley and adjust the belt tension to specification with the Rotunda belt tension gauge 210019 and 210020 or equivalent. **Apply pressure on the alternator front housing adjusting ear with 1 1/8 inch open end wrench when tightening the belt.** Tighten the adjusting arm bolts and the alternator mounting bolt.
4. Connect the electrical connectors to the alternator (Fig. 3). Be sure each connection is clean and tight.
5. Connect the battery ground cable.

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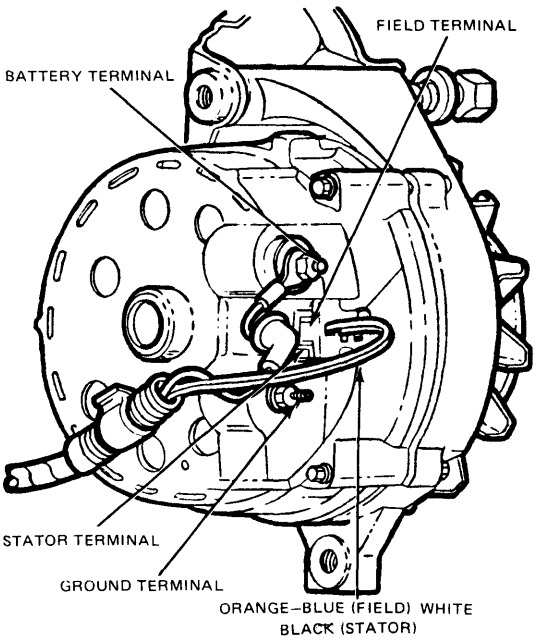


FIG. 3 Typical Wiring Connections—Side Terminal Alternator 4.9L (300 CID) Engine Connections Shown

DISASSEMBLY AND ASSEMBLY

SIDE TERMINAL ALTERNATOR

Disassembly

Fig. 4 shows a disassembled view of the side terminal alternator.

1. Mark both end housings and the stator with a scribe mark for assembly.
2. Remove the four housing through bolts, and separate the front housing and rotor from the rear housing and stator. Slots are provided in the front housing to aid in disassembly. **Do not separate the rear housing from the stator at this time.**
3. Remove the drive pulley nut with the Tool shown in Fig. 5. Then, remove the lockwasher, pulley, fan and fan spacer from the rotor shaft.
4. Pull the rotor and shaft from the front housing, and remove the spacer from the rotor shaft.
5. Remove three screws retaining the bearing to the front housing. If the bearing is damaged or has lost lubricant, remove the bearing from the housing. To remove the bearing, support the housing close to the bearing boss and press the bearing from the housing.
6. Unsolder and disengage the three stator leads from the rectifier (Fig. 6). **Use a 200-watt solder iron.**

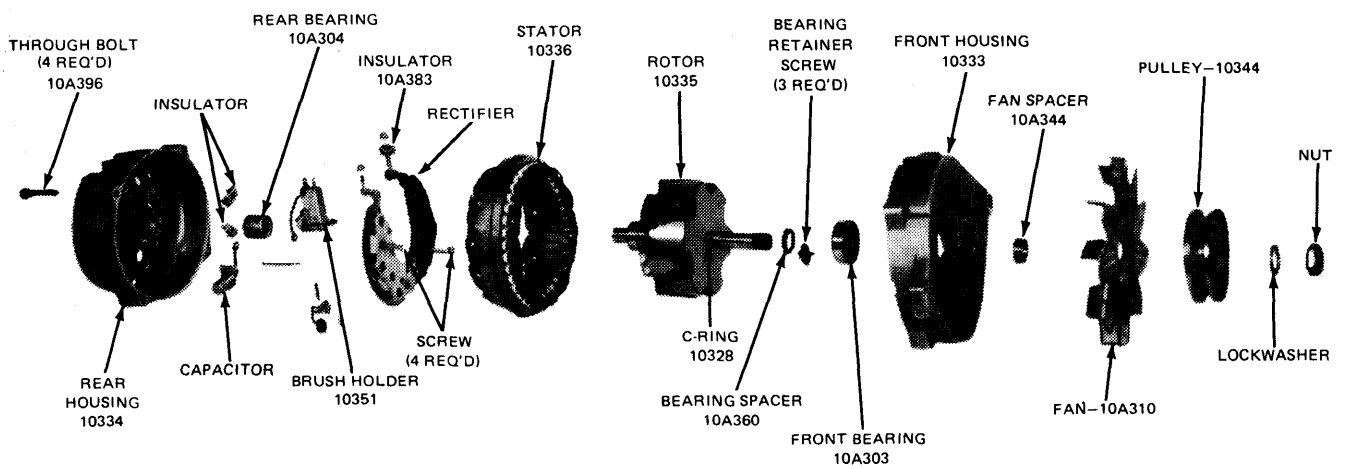


FIG. 4 Disassembled Side Terminal Alternator

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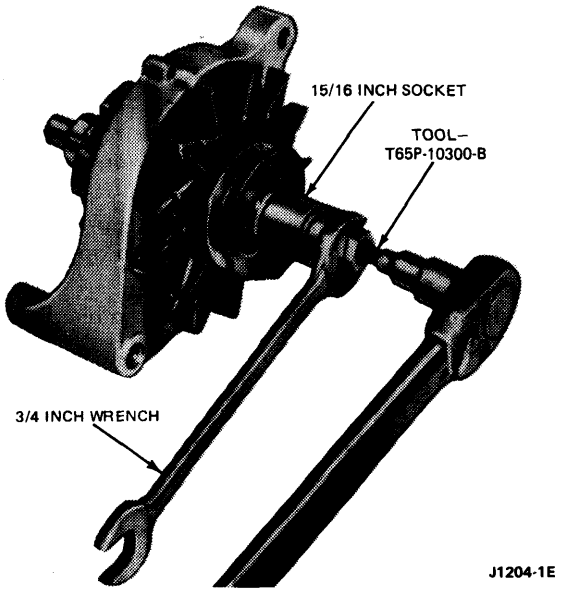


FIG. 5 Pulley Removal—Typical

7. Lift the stator from the rear housing.
8. Unsolder and disengage the brush holder lead from the rectifier. **Use 200-watt solder iron.**
9. Remove the screw attaching the capacitor lead to the rectifier.
10. Remove four screws attaching the rectifier to the rear housing (Fig. 6).

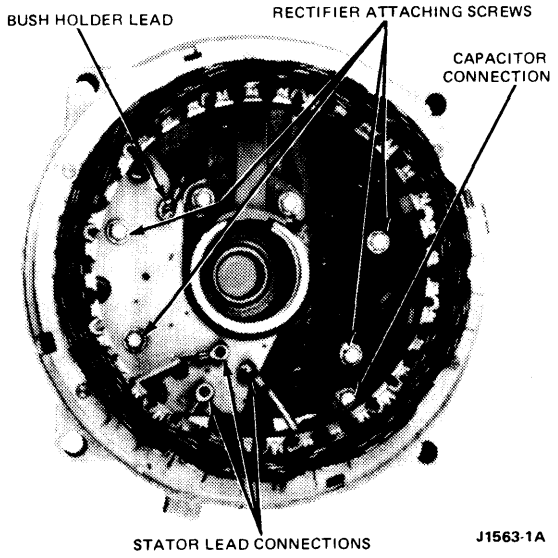


FIG. 6 Stator Lead Connections

11. Remove the two terminal nuts and insulator from outside the housing, and remove the rectifier from the housing.
12. Remove two screws attaching the brush holder to the housing and remove the brushes and holder.
13. Remove the two rectifier insulators from the bosses in the housing (Fig. 8).
14. Remove any sealing compound from the rear housing and brush holder.
15. Remove one screw attaching the capacitor to the rear housing and remove the capacitor.
16. If bearing replacement is necessary, support the rear housing close to the bearing boss and press the bearing out of the housing from the inside.

Assembly

The rotor, stator and bearings must not be cleaned with solvent. Wipe these parts with a clean cloth.

1. If the front housing bearing is being replaced, press the new bearing in the housing. **Put pressure on the bearing outer race only.** Then, install the bearing retaining screws.
2. Place the inner spacer on the rotor shaft and insert the rotor shaft into the front housing and bearing.
3. Install the fan spacer, fan, pulley, lockwasher and nut on the rotor shaft. Use the Tool shown in Fig. 5 to tighten the pulley nut.
4. If the rear bearing is being replaced, press a new bearing in from inside the housing until it is flush with the boss outer surface.
5. Position the brush terminal on the brush holder (Fig. 7). Install the springs and brushes in the brush holder, and insert a piece of stiff wire to hold the brushes in place (Fig. 7).

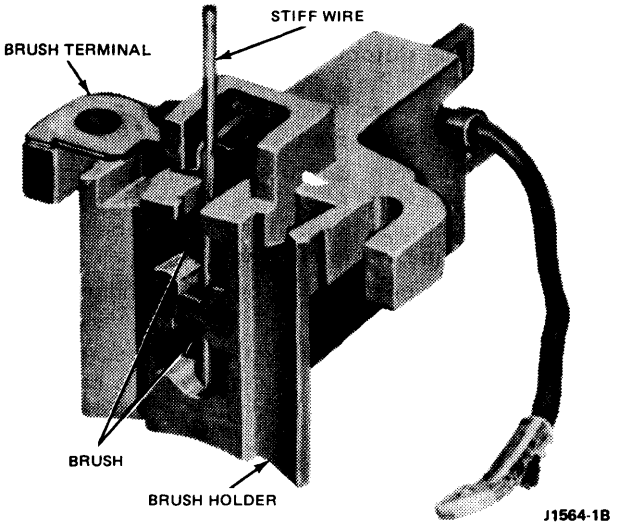


FIG. 7 Brush Holder Assembly

6. Position the brush holder in the rear housing and install the two attaching screws. Push the brush holder toward the rotor shaft opening and tighten the brush holder attaching screws.
7. Position the capacitor to the rear housing and install the attaching screw.
8. Place the two (rectifier) insulators on the bosses inside the housing (Fig. 8).
9. Place the insulator on the BAT (large) terminal of the rectifier, and position the rectifier, in the rear housing. Place the outside insulator on the BAT terminal, and install the nuts on the BAT and GRD terminals **finger tight,** (Fig. 3).
10. Install but do not tighten the four rectifier attaching screws, (Fig. 6).
11. Tighten the BAT and GRD Terminal nuts on the outside of the rear housing. Then, tighten the four rectifier attaching screws.

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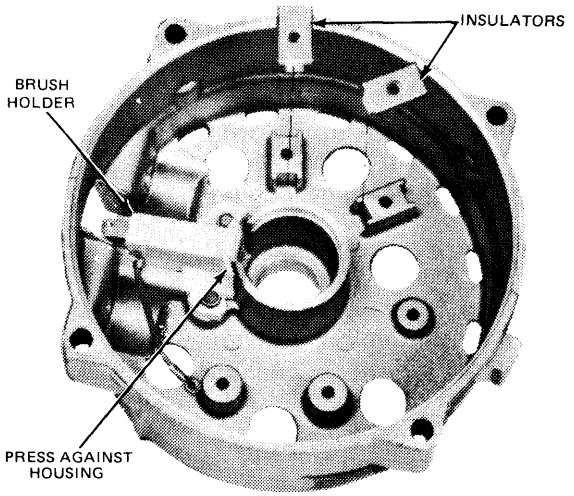


FIG. 8 Brush Holder and Rectifier Insulators Installed

12. Position the capacitor lead to the rectifier and install the attaching screw.
13. Press the brush holder lead on the rectifier pin and solder securely (Fig. 6). **Use a 200-watt solder iron.**
14. Position the stator in the rear housing and align the scribe marks. Press the three stator leads on the rectifier pins and solder securely (Fig. 6). **Use a 200-watt solder iron.**
15. Position the rotor and front housing into the stator and rear housing. Align the scribe marks and install the four through bolts. Tighten two opposing bolts and then the two remaining bolts.
16. Spin the fan and pulley to be sure nothing is binding within the alternator.
17. Remove the wire retracting the brushes, and place a daub of waterproof cement over the hole to seal it. (Note: Do not use R.T.V.).

BRUSH REPLACEMENT

Removal

1. Mark both end housings and the stator with a scribe mark for use during assembly.
2. Remove the four housing through bolts, and separate the front housing and rotor from the rear housing and stator. Slots are provided in the front housing to aid in disassembly. **Do not separate the rear housing and stator.**
3. Unsolder and disengage the brush holder lead from the rectifier. **Use a 200-watt solder iron.**
4. Remove the two brush holder attaching screws and lift the brush holder from the rear housing. Remove the brushes and springs from the brush holder.
5. Remove any sealing compound from the rear housing and brush holder.

Installation

1. Position the springs and brushes in the holder and retain with a stiff wire (Fig. 7).
2. Position the brush holder to the rear housing, inserting the wire used to retract the brushes through the hole in the rear housing.
3. Install the brush holder attaching screws. Push the brush holder toward the rotor shaft opening and tighten the attaching screws.
4. Press the brush holder lead on the rectifier pin and solder securely. **Use a 200-watt solder iron.**
5. Position the rotor and front housing into the stator and rear housing. Align the scribe marks and install the four through bolts. Tighten two opposing bolts and then the two remaining bolts.
6. Spin the fan and pulley to be sure nothing is binding within the alternator.
7. Remove the wire retracting the brushes, and place a daub of waterproof cement over the hole to seal it. (Note: Do not use R.T.V.).

RECTIFIER REPLACEMENT

Removal

1. Mark both end housings and the stator with a scribe mark for assembly.
2. Remove the four housing through bolts, and separate the front housing and rotor from the rear housing and stator. Slots are provided in the front housing to aid in disassembly. **Do not separate the rear housing and stator at this time.**
3. Unsolder and disengage the three stator leads from the rectifier (Fig. 6). **Use a 200-watt solder iron.** Then, lift the stator from the rear housing.
4. Unsolder and disengage the brush holder lead from the rectifier. **Use a 200-watt solder iron.**
5. Remove the screw attaching the capacitor lead to the rectifier.
6. Remove four screws attaching the rectifier to the rear housing (Fig. 6).
7. Remove two terminal nuts and insulator from outside the housing, and remove the rectifier from the housing.
8. Remove the two insulators from the housing (Fig. 8).

Installation

1. Insert a piece of wire through the hole in the rear housing to hold the springs and brushes in the retracted position (Fig. 7).
2. Place the two rectifier insulators on the bosses inside the housing (Fig.8).
3. Place the insulator on the BAT (large terminal) of the rectifier, and position the rectifier in the rear housing. Place the outside insulator on the BAT terminal, and install the nuts on the BAT and GRD terminals finger tight, (Fig. 3).
4. Install but do not tighten the four rectifier attaching screws.
5. Tighten the BAT and GRD terminal nuts on the outside of the rear housing. Then, tighten the four rectifier attaching screws.
6. Position the capacitor lead to the rectifier and install the attaching screw.
7. Press the brush holder lead on the rectifier pin and solder securely (Fig. 6). **Use a 200-watt solder iron.**
8. Position the stator in the rear housing and align the scribe marks. Press the three stator leads on the

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rectifier pins and solder securely (Fig. 6). **Use a 200-watt solder iron.**

9. Position the rotor and front housing into the stator and rear housing. Align the scribe marks and install. Partially tighten all four through bolts. Then, tighten two opposing bolts and then the two remaining bolts.
10. Spin the fan and pulley to be sure nothing is binding within the alternator.
11. Remove the wire retracting the brushes in the brush holder, and place a daub of waterproof cement over the hole in the rear housing to seal it. (Note: Do not use R.T.V.).

SPECIFICATIONS

SIDE TERMINAL ALTERNATOR

Rating		Field Current Amps. @ 12V	Rated Output Speed (Alternator RPM)	Slip-Ring Turning (Inches)		Brush Length (Inches)		Pulley Nut Torque (ft-lbs)	Belt ① Tension (lbs)
Amperes @ 15V	Watts @ 15V			Min. Dia.	Max. Runout	New	Wear Limit		
70 100	1050 1350	4.0	5000	1.22	0.0005	1/2	5/16	60-100	90-110

① Used Belt. New Belt 150. A used belt is one that has been in operation more than 10 minutes. If belt tension is out of specification, or belt has been removed, reset to 110 lbs.

SPECIAL TOOLS

Tool Number	Description
210019 and 210020 T65P-10300-B	Belt Tension Gauge Alternator Pulley Remover

CJ2033-2A

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Alternator Electronic Regulator

PART 31-43

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Indicator Lamp Regulators	43-1
DESCRIPTION (Cont'd)	
Regulator Application	43-1
Visual Inspections	43-1
REMOVAL AND INSTALLATION	43-4

DESCRIPTION

The electrical charging systems incorporate a new electronic voltage regulator. These regulators are 100 percent solid state, consisting of transistors, diodes, and resistors. The working functions are achieved using electronic components arranged in basically three (3) circuit divisions as follows: The output stage, the voltage stage, and the solid state relay.

The new regulator will be released under two (2) separate part numbers with two color codes. The units will look alike, but are not interchangeable with the new regulator wiring harness due to different connector plugs. One of these units will be used on vehicles equipped with an ammeter and the other used for alternator warning-indicator-lamp equipped cars. The regulators are calibrated and preset by the manufacturer. No readjustment is required or possible on these units.

INDICATOR LAMP REGULATORS (FIG. 1)

Closing the ignition switch energizes the warning lamp and turns on the regulator output stage. The alternator is now receiving maximum field current and is ready to generate an output voltage. Once the alternator rotor speed increases from zero, its output terminal voltages increase from zero to system regulation level determined by the voltage control stage. The stator terminal voltage is 1/2 the output voltage and de-energizes the indicator lamps through the action of the solid state relay circuit.

When the ignition switch is turned off, the solid state relay circuit causes the output stage to be turned off, interrupting all current flow through the regulator so that there is no stand-by current drain on the battery.

AMMETER REGULATORS (FIG. 2)

The operating principle for the regulator used in ammeter equipped vehicles is much the same as the indicator lamp type.

REGULATOR APPLICATION—COMPONENTS

The new solid state regulators are being used in conjunction with other new components in the charging system and must be properly matched to prevent damage to the regulator or alternator. New components in the charging system are as follows: (Figs. 3 and 4).

1. A new alternator with higher field current requirement.
2. A new warning indicator lamp shunt resistor.
3. The alternator to regulator wiring harness is changed to incorporate a new regulator connector plug. The new plug is designed so that the connector will not index with the regulator terminals when the wrong regulator is inadvertently installed in the vehicle.

APPLICATION

Whenever the system components are being replaced, the following precautions should be followed so that the charging system will work properly and components will not be damaged.

1. Always use the proper alternator in the system being serviced. Older model alternators, if used in the new system, will have a slightly reduced output. The older model alternator with the 3.80 hm field will be used as replacement for vehicles with electro-mechanical and electronic regulators. Only the older model will be serviced.
2. Never use an electro-mechanical regulator in the new charging system. The connector plug on the new system wiring harness will not index properly with the electro-mechanical regulator.
3. The new electronic regulators are color coded for proper installation. Always use the black color coded regulator in systems which use the warning lamp indicator. The blue color coded regulators must be used in ammeter gauge systems.
4. The new charging systems use a 500 Ohm resistor on the back of the instrument cluster on cars with warning indicator lamp. Do not replaced this item with the old 15 Ohm resistance wire.

VISUAL INSPECTIONS

1. Check battery for proper state of charge (at least 1.200 specific gravity) using rotunda battery tester 41-0002 or equivalent.

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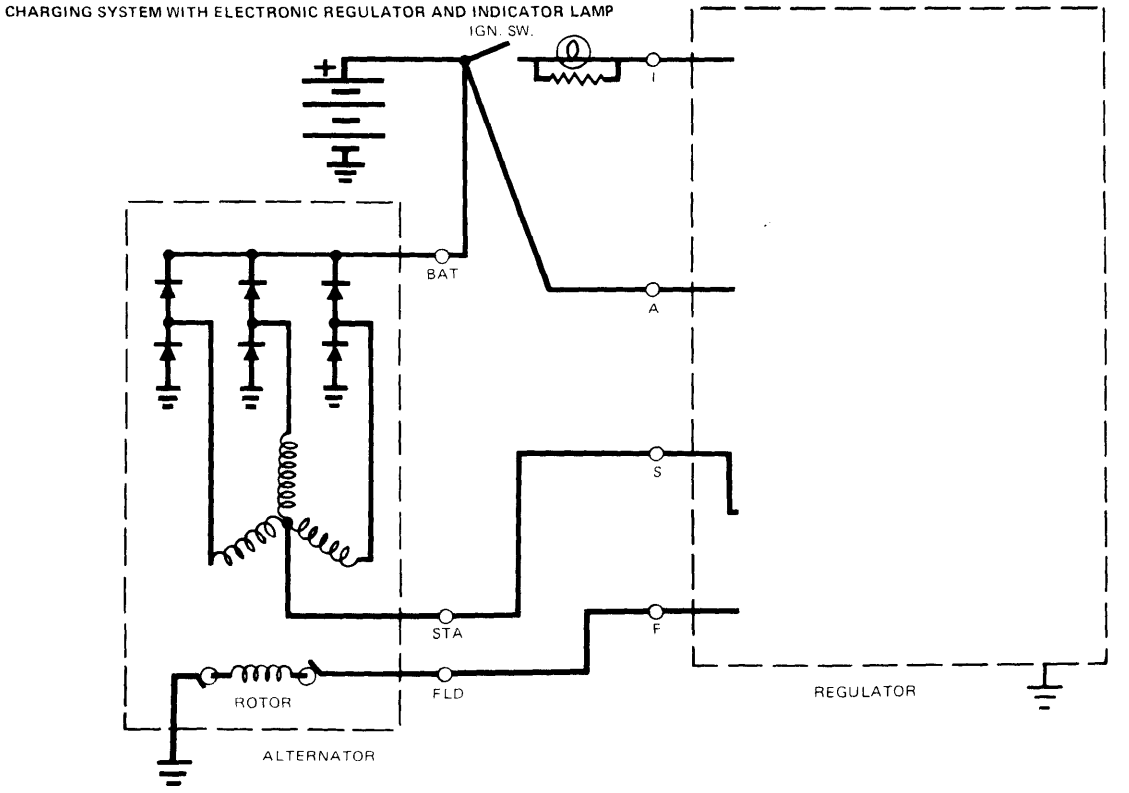


FIG. 1 Charging System with Electronic Regulator and Indicator Lamp Schematic

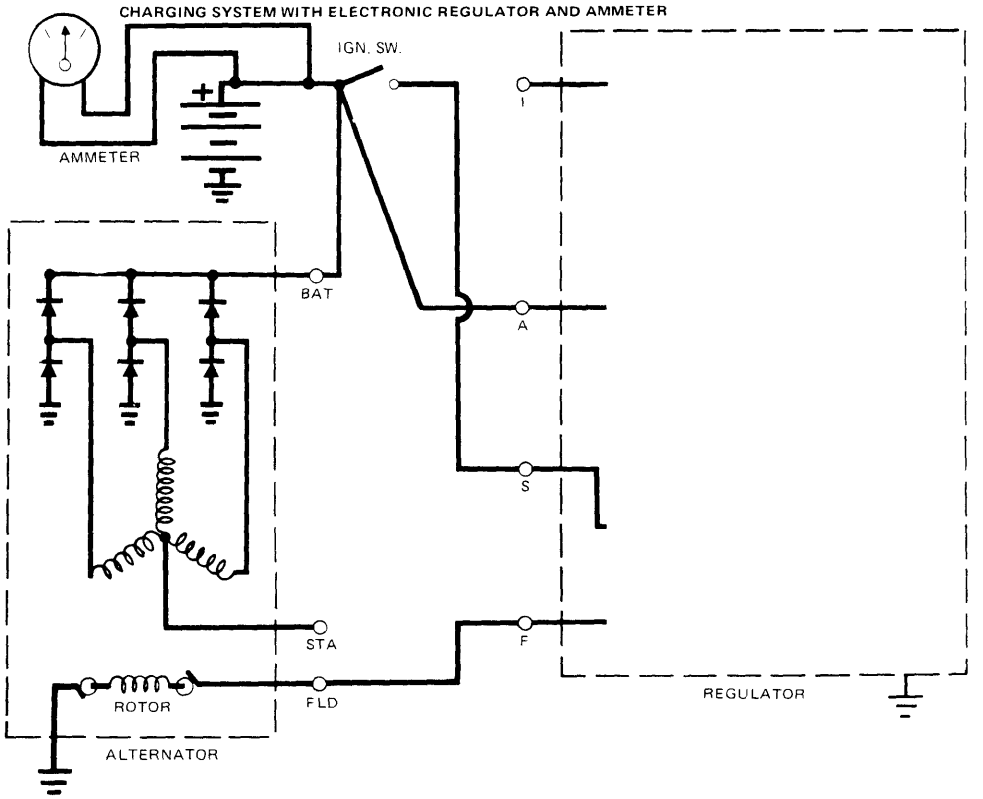


FIG.2 Charging System with Electronic Regulator and Ammeter Schematic

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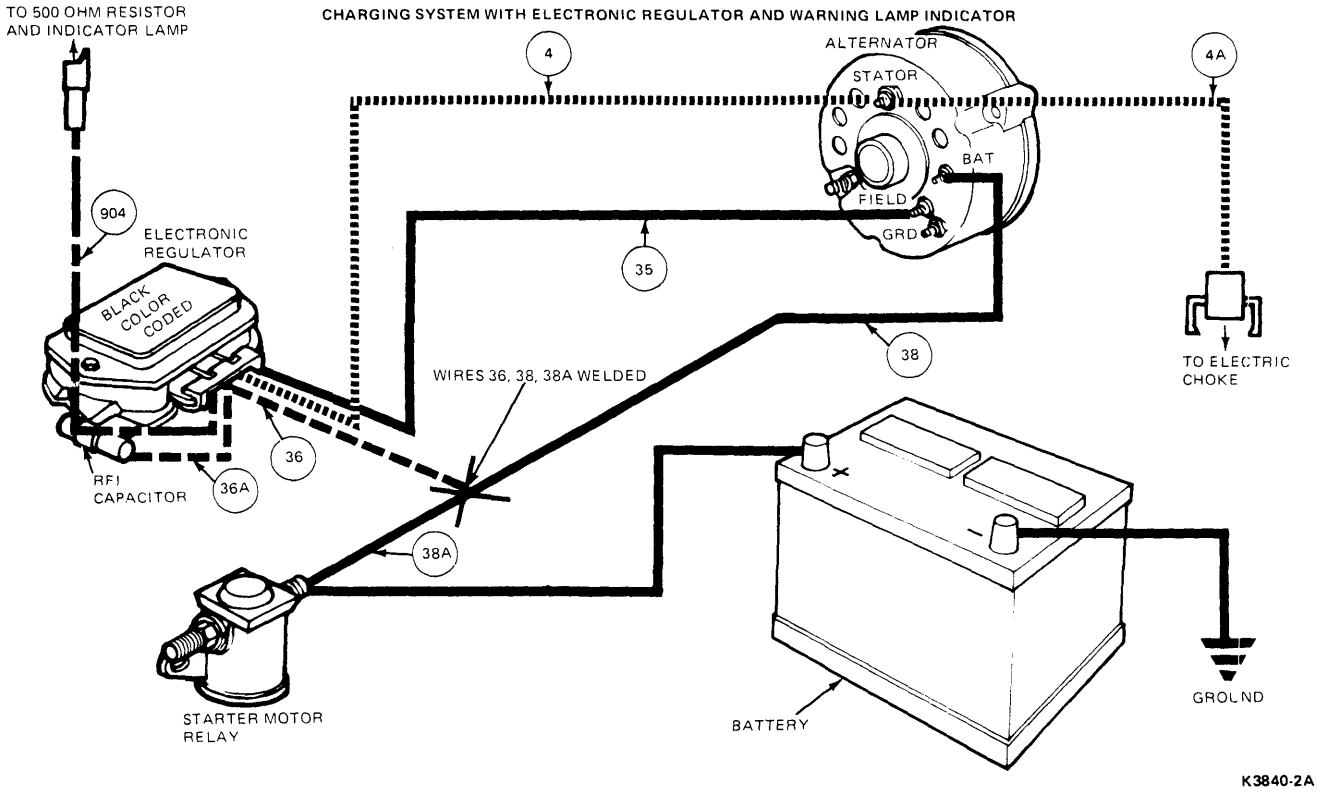


FIG. 3 Charging System with Electronic Regulator and Warning Lamp Indicator

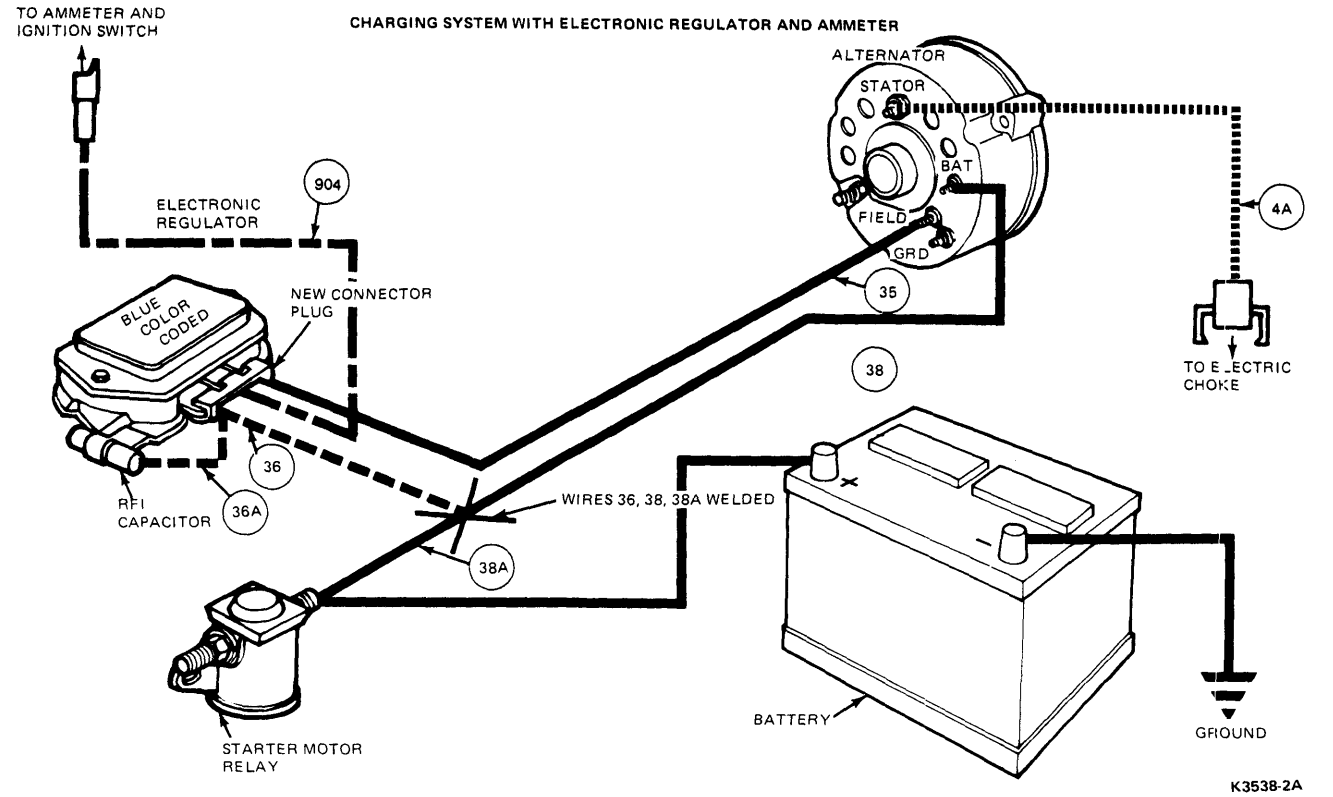


FIG. 4 Charging System with Electronic Regulator and Ammeter

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2. Check and clean all terminal connections at battery, alternator, and regulator.
3. Check fuse link between starter relay and alternator.
4. Check alternator drive belt for proper tension using rotunda belt tension gauge 21-0019 or 21-0020 or equivalent.

CAUTION: BE SURE FIELD TERMINAL CONNECTOR (PUSH ON TYPE) IS INSTALLED ON THE "FIELD" TERMINAL STUD AT ALTERNATOR AND NOT THE GROUND STUD.

ALWAYS DISCONNECT THE CONNECTOR PLUG FROM THE REGULATOR BEFORE CHECKING ALTERNATOR OUTPUT WITH TEST PROBES OR A JUMPER WIRE.

ALWAYS DISCONNECT THE CONNECTOR PLUG FROM THE REGULATOR BEFORE REMOVING THE REGULATOR MOUNTING SCREWS. REMOVING THE CONNECTOR FROM AN UN-GROUNDED REGULATOR WITH THE IGNITION SWITCH ON WILL DESTROY THE REGULATOR.

BE SURE TO DISCONNECT ELECTRIC CHOKE WIRE FROM STATOR TERMINAL OR ALTERNATOR WHEN TROUBLE-SHOOTING CHARGING SYSTEM. CHECK ELECTRIC CHOKE WIRE FOR A GROUND CONDITION.

NEVER ATTEMPT TO POLARIZE OR TEST THE ALTERNATOR BY GROUNDING THE FIELD CIRCUIT, AS THIS WILL DESTROY THE REGULATOR.

REMOVAL AND INSTALLATION

Remove the battery ground cable. Disconnect the regulator from the connector plug in the wiring harness (Fig. 1). Remove the regulator mounting screws. Connect the new regulator to the wiring harness. Mount the regulator. Connect the battery ground cable, and test the system for proper voltage regulation.

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LIGHTING SYSTEM

GROUP 32 (13000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Headlight System	32-03	Parking, Rear and Marker Lamps	32-21
Interior Lights	32-61	Turn Signals and Hazard Flashers	32-41
Lighting System General Service	32-01		

Lighting System General Service

PART 32-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING	01-1	DIAGNOSIS GUIDES	01-2

DIAGNOSIS AND TESTING

Before performing any Lighting System tests, be sure the battery is in a fully charged condition and all battery cable connections are clean and tight.

A visual inspection is an important part of the Lighting System test. Check for wires with frayed or damaged insulation, loose connections and proper harness routing.

Any problems found by the visual inspection should be corrected before performing further tests of the Lighting System.

For example, a loose ground strap between the engine and body dash panel may cause an intermittent operation of the lamps and gauges. Inspect and tighten (if necessary) the ground strap attaching screws at the back of the engine and the body dash panel. **NOTE: Any screws or bolts used for attaching the engine-to-body ground strap must have an "S36" finish (zinc plate plus dichromate dip).** If a No. 10 screw is required, use Part No. 42367-S36 or an equivalent hex washer head tapping screw.

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DIAGNOSIS GUIDES

The following diagnosis guides provide steps to take when you are trying to isolate lighting system problems.

CONDITION	POSSIBLE CAUSE	CORRECTION
HEADLIGHTS		
• All exterior lights do not light.	• Loose wiring connections.	• Check and secure connections at headlight switch and dash panel connector.
	• Open circuit in wiring.	• Check power to and from headlight switch. Repair as necessary.
	• Worn or damaged headlight switch.	• Replace headlight switch.
• One headlight does not work.	• Loose wiring connections.	• Secure connections to headlight, and ground.
	• Sealed beam bulb burnt out.	• Replace sealed beam.
	• Corroded socket.	• Repair or replace as required.
• All headlights out — park and taillights OK.	• Loose wiring connections.	• Check and secure connections at dimmer switch and headlight switch.
	• Worn or damaged dimmer switch.	• Check dimmer switch operation. Inspect for corroded connector. Replace as required.
	• Open circuit in wiring or poor ground.	• Repair as required.
• Both low beam or all high beam headlights do not work.	• Loose wiring connections.	• Check and secure connection at dimmer switch and headlight switch.
	• Worn or damaged dimmer switch.	• Check dimmer switch operation. Inspect for corroded connector. Replace as required.
	• Open circuit in wiring.	• Repair as required.
TAILLIGHTS		
• One taillight out.	• Bulb burnt out.	• Replace bulb.
	• Open wiring or poor ground.	• Repair as necessary.
	• Corroded bulb socket.	• Repair or replace socket.
• All taillights and marker lights out — headlights OK.	• Loose wiring connections.	• Secure wiring connections where accessible.
	• Open wiring or poor ground.	• Check operation of front park and marker lights. Repair as necessary.
	• Damaged headlight switch.	• Replace headlight switch.
STOPLIGHTS		
• Stoplights do not work.	• Fuse or C.B. burnt out.	• Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Part 34-31).
NOTE: Speed Control equipped vehicles have 2 stoplamp switches in parallel (F-100-F-350, Bronco).	• Worn or damaged turn signal circuit.	• Check turn signal operation. Repair as necessary.
	• Loose wiring connections.	• Secure connection at stoplight switch.
	• Worn or damaged stoplight switch.	• Replace stoplight switch.
	• Open circuit in wiring.	• Repair as required.
• Stoplights stay on continuously. NOTE: Speed control equipped vehicles have 2 stoplamp switches in parallel (F-100-F-350, Bronco).	• Damaged stop light switch.	• Disconnect wiring connector from switch. If light goes out, replace switch.
	• Internal short circuit in wiring.	• If light stays on, check for internal short circuit. Repair as necessary.
	• Improperly adjusted stoplamp switch.	
SIDE OR ROOF MARKER LIGHTS		
• Side or roof marker light does not light.	• Bulb burnt out.	• Replace bulb.
	• Open circuit or poor ground.	• Check socket for corrosion and good ground. Repair as required.
TURN SIGNAL LIGHTS		
• All turn signal lights do not light.	• Fuse or C.B. burnt out.	• Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Part 34-31).
	• Worn or damaged turn signal flasher.	• Substitute a known good flasher. Replace if required.
	• Loose wiring connections.	• Secure connections where accessible.
	• Open circuit in wiring or poor ground.	• Repair as required.
	• Damaged turn signal switch.	• Check continuity of switch assembly. Replace turn signal switch and wiring assembly if necessary.
• Turn signal lights light but do not flash.	• Worn or damaged turn signal flasher.	• Substitute a known good flasher. Replace if required.
	• Poor ground.	• Repair ground.
• Front turn signal lights do not light.	• Loose wiring connector or open circuit.	• Repair wiring as required.
• Rear turn signal lights do not light.	• Loose wiring connector or open circuit.	• Repair wiring as required.
• One turn signal light does not light.	• Bulb burnt out.	• Replace bulb.
	• Open circuit in wiring or poor ground.	• Repair as required.

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CONDITION	POSSIBLE CAUSE	CORRECTION
HAZARD FLASHER LIGHTS		
• Hazard flasher lights — lights do not flash.	• Worn or damaged turn signal operation.	• Repair turn signal system.
	• Fuse or C.B. burnt out.	• Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Part 34-31).
	• Worn or damaged hazard flasher.	• Substitute a known good flasher. Replace flasher if necessary.
	• Open circuit in wiring.	• Repair as required.
	• Worn or damaged hazard flasher switch.	• Repair or replace the turn signal switch and wiring assembly which includes the hazard flasher switch.
BACK-UP LIGHTS		
• Back-up lights — one light does not function.	• Bulb burnt out.	• Replace bulb.
	• Loose wiring connections.	• Secure connections where accessible.
	• Open circuit in wiring.	• Repair as required.
• Back-up lights — both lights do not function.	• Fuse or C.B. burnt out.	• Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Part 34-31).
	• Back-up light switch out of adjustment.	• Adjust switch.
	• Worn or damaged back-up light switch.	• Replace switch.
	• Loose wiring connections.	• Secure connections where accessible.
	• Open wiring or poor ground.	• Repair as required.
	• Bulbs burnt out.	• Replace bulbs.
INSTRUMENT PANEL LIGHT		
• Instrument panel light does not light.	• Bulb burnt out.	• Replace bulb.
	• Fuse or C.B. burnt out.	• Replace fuse or C.B. If fuse or C.B. blows again, (See Part 34-31).
	• Open circuit in wiring, rheostat or printed circuit board.	• Check for a short circuit.
		• Repair as required.
DOME LIGHT		
• Dome light does not come on when door is opened.	• Connector loose.	• Secure and/or replace.
	• Blown fuse.	• Replace fuse. If fuse blows again, check for short circuit. (See Part 34-31).
	• Bulb burnt out.	• Replace bulb.
	• Open circuit in wiring.	• Repair as required.
	• Worn or damaged door jamb switch.	• Replace door jamb switch.
• Dome light stays on.	• Worn or damaged door jamb switch.	• Replace switch.
	• Worn or damaged main lighting switch.	• Replace main lighting switch.
	• Worn or damaged dome or cargo light switch.	• Replace switch.
PRND21 LIGHTING		
• Poor PRND21 lighting.	• Weak bulb.	• Replace bulb.
	• Wiring.	• Check wiring for high resistance. If resistance is high, repair or replace as required.
	• Worn or damaged dial.	• Check for total lens illumination. Replace dial if necessary.
	• Worn or damaged pointer.	• Check for pointer illumination at all dial positions. Replace pointer if necessary.
	• Paint overspray.	• Replace dial

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Headlight System

PART 32-03

APPLIES TO ALL MODELS

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Headlight Switch	03-1	Headlight Bulb	03-2
ADJUSTMENTS		Headlight Switch	03-2
Headlight Aim	03-1		

DESCRIPTION AND OPERATION

HEADLIGHTS

Two type 2B Rectangular headlamps are used. The lights have two filaments each, one for low beam and one for high beam, and are identified by the numeral 2 or 2B molded in the glass lens. Headlights are controlled by the headlight switch on the instrument panel and the foot-operated dimmer switch on the floorboard to the left of the clutch pedal.

HEADLIGHT SWITCH

The headlight switch (Fig. 1) is a combination three-position switch that controls the circuits to the headlights, exterior lights (except stop lights and turn signal/hazard warning lights), instrument panel lights and other interior lights. A typical headlight switch is shown in Fig. 1. Circuits are connected to the switch by a molded multiconnector.

The interior light circuit is routed through a rheostat on the switch, which is controlled by rotating the switch control knob. This circuit is protected by a fuse in the fuse panel.

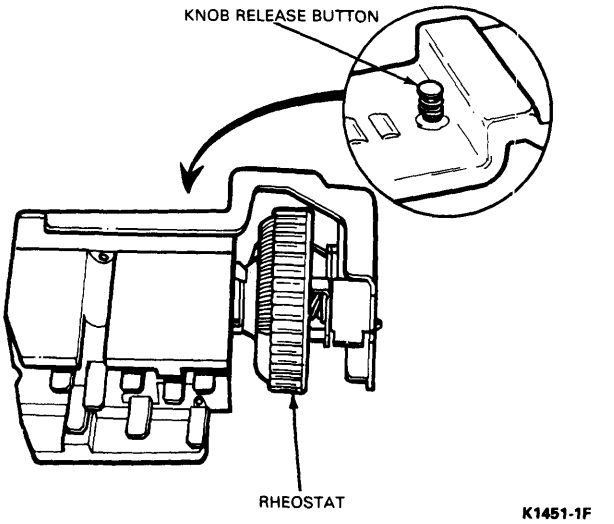


FIG. 1 Typical Headlight Switch

ADJUSTMENTS

HEADLIGHT AIM

Before making any headlight adjustments, perform the following preparatory steps:

1. Remove ice or mud from under fenders.
2. See that all tires are inflated to recommended pressures.
3. Check springs for sag or broken leaves.
4. Take into consideration faulty wheel alignment or improper tracking of the rear axle.
5. See that there is no load in the vehicle other than the fuel tank one-half full.
6. Clean lenses and aiming pads.
7. Check for bulb burn-out and proper beam switching.
8. See that light output is well towards normal new lamp value.
9. Bounce the vehicle and allow to settle.

Headlight aim adjustment should be made with the Rotunda Headlight Aiming Kit—Model 04-0164 or it's equivalent. Use the latest instructions.

The kit equipment can be calibrated to accommodate a slight slope in the floor, making it usable almost any place in the garage.

Each headlight is adjusted by means of two screws located under the headlamp door or trim ring as shown in Fig. 2.

NOTE: Access doors are provided to allow headlamp adjustment without removing the headlamp door.

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Always bring each beam into final position by turning the adjusting screws clockwise so that the headlight will be held against the tension springs when the operation is completed.

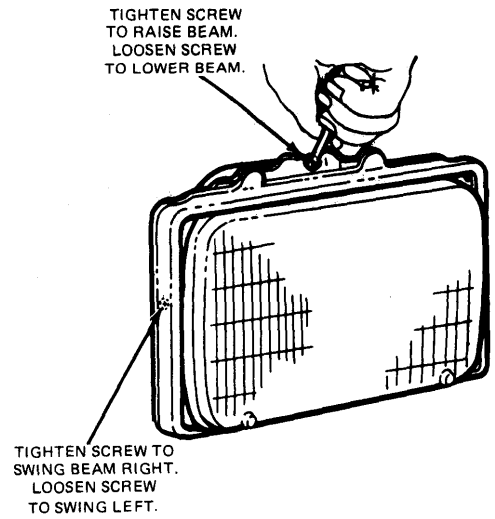


FIG. 2 Headlight Adjustment Shown Without Headlamp Door or Trim Ring

REMOVAL AND INSTALLATION

HEADLIGHT BULB

1. Remove the attaching screws and remove the headlamp door attaching screws and remove the headlamp door.
2. Remove the headlight retaining ring screws (Fig. 2), and remove the retaining ring. Do not disturb the adjusting screw settings.
3. Pull the headlight bulb forward and disconnect the wiring assembly plug from the bulb.
4. Connect the wiring assembly plug to the new bulb. Place the bulb in position, making sure that the locating tabs of the bulb are fitted in the positioning slots.
5. Install the headlight retaining ring (Fig. 3 or 4).
6. Place the headlight trim ring or door into position, and install the retaining screws.
7. Adjust the headlamp aim using the Rotunda 04-0164 Aimer or equivalent.

HEADLIGHT SWITCH

1. Disconnect the battery ground cable.
2. Remove the control knob and shaft by pressing the knob release button on the switch housing (Fig. 1), with the knob in the full **ON position. Pull the knob and shaft assembly out of the switch. Unscrew the mounting nut, remove the bezel and switch, then remove the wiring connector from the switch.**
3. To install the switch, connect the wiring connector to the headlight switch, position the switch in the instrument panel, and install the bezel and mounting nut.
4. Install the knob and shaft assembly by inserting it all the way into the switch until a distinct click is heard. In some instances it may be necessary to rotate the shaft slightly until it engages the switch-contact carrier.
5. Connect the battery ground cable.

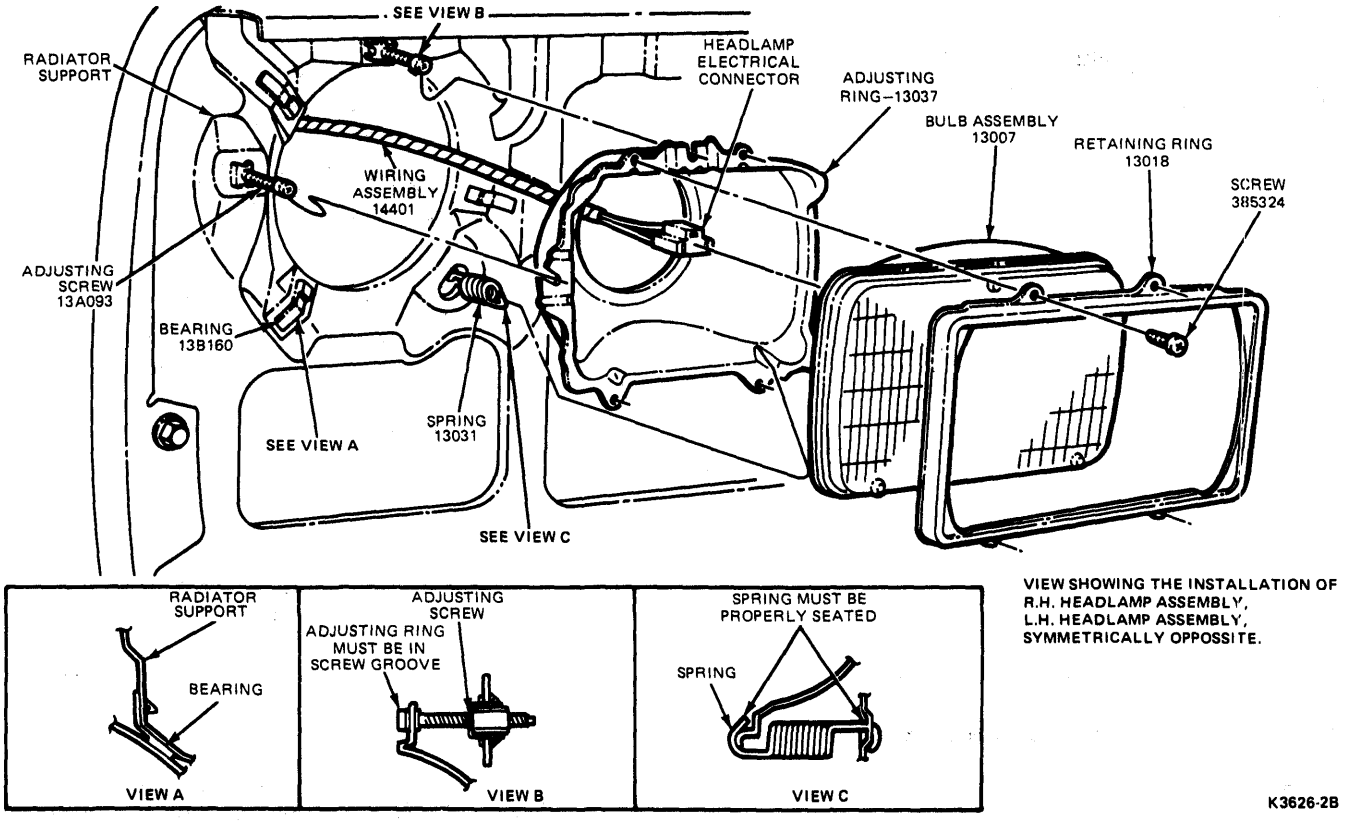
DIMMER SWITCH

Lay the floor mat back in the area of the switch, and remove the mounting screws (Fig 4). Disconnect the wire terminal block from the switch.

Install the switch to the floor, and connect the terminal block to the switch. Replace the floor mat.

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VIEW SHOWING THE INSTALLATION OF R.H. HEADLAMP ASSEMBLY, L.H. HEADLAMP ASSEMBLY, SYMMETRICALLY OPPOSITE.

FIG. 3 Square Headlight—Econoline Shown

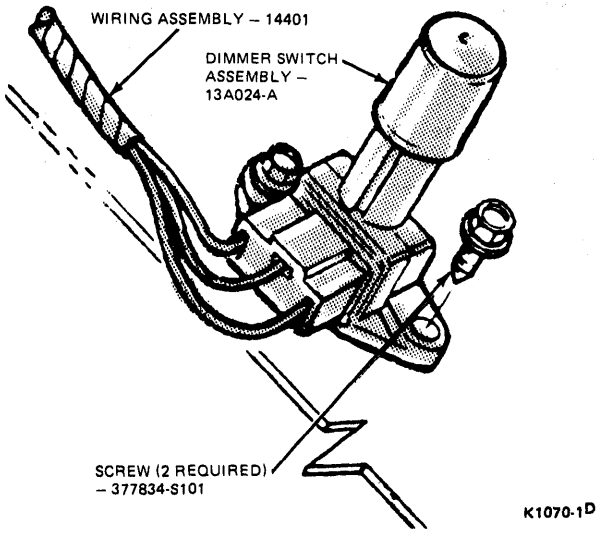


FIG. 4 Headlight Dimmer Switch

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Parking, Rear and Marker Lamps

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DESCRIPTION AND OPERATION

STOP LAMP SWITCH

F-100-350 AND BRONCO W/SPEED CONTROL

In addition to the plunger stop lamp switch, speed control equipped vehicles have a mechanical stop lamp switch. Both switches are connected electrically in parallel and both will operate the stop lamps and/or shut down the speed control. The mechanical stop lamp installation is similar to the E-100—E-350 (Fig. 1).

F-100 THROUGH F-350 SERIES AND BRONCO (WITHOUT SPEED CONTROL)

F-100 through F-350 and Bronco vehicles have a plunger stop lamp switch (Fig. 2) mounted to the brake pedal arm. When the brake pedal is at rest (brakes not applied), the switch plunger contacts a stationary stop which depresses the plunger. In this position, the switch is open and no voltage is supplied to the stop lamp. When the pedal is depressed to apply the brakes, the switch moves with the pedal arm away from the

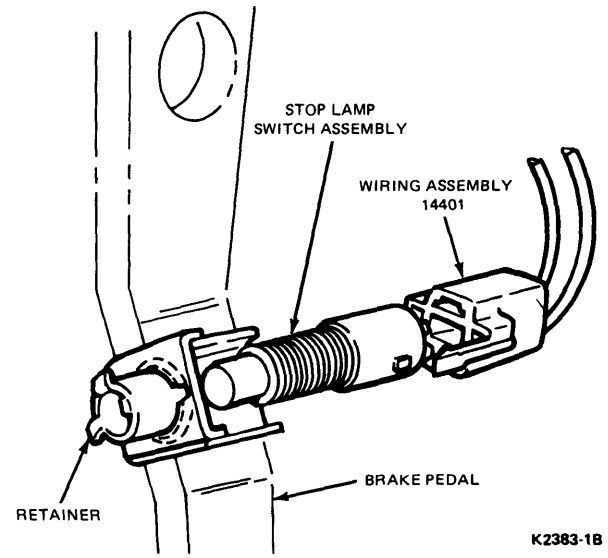


FIG. 1 Stop Lamp Switch—Bronco, E-100—E-350 and F-100—F-350 w/Speed

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stationary stop. This allows the switch plunger spring to extend the plunger and close the switch contacts, illuminating the stop lamps.

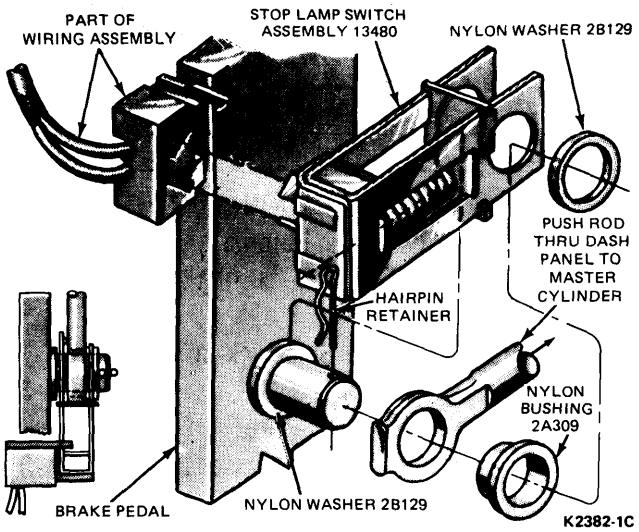


FIG. 2 Stop Lamp Switch—F-100 Through F-350 and Bronco

E-100—E-350

The mechanical stop lamp switch assembly, installed on the pin of the brake pedal arm, straddles the master cylinder push rod, but is not attached directly to the push rod (Fig. 2). The switch assembly moves with the pedal arm when the brake pedal is depressed.

The switch actuating pin is held by spring pressure against the rear end of the push rod. Because of the slight clearance between the eye of the master cylinder push rod and the brake pedal arm pin, the pin and the switch move forward slightly before the push rod moves when the pedal is depressed. This relative movement between the switch and the end of the push rod moves the actuating pin rearward in the switch, closing the switch contacts and completing the circuit to the stop lamps.

When the brake pedal is released, the switch moves rearward in relation to the push rod. The spring in the switch returns the actuating pin to its normal position, opening the switch contacts and interrupting the circuit to the stop lamps.

REMOVAL AND INSTALLATION

PARKING LAMPS

LIGHT TRUCKS

If lamp body replacement is required, remove the lamp assembly by removing two mounting screws and/or nuts and disconnecting the socket from the lamp body (Figs. 3 and 4).

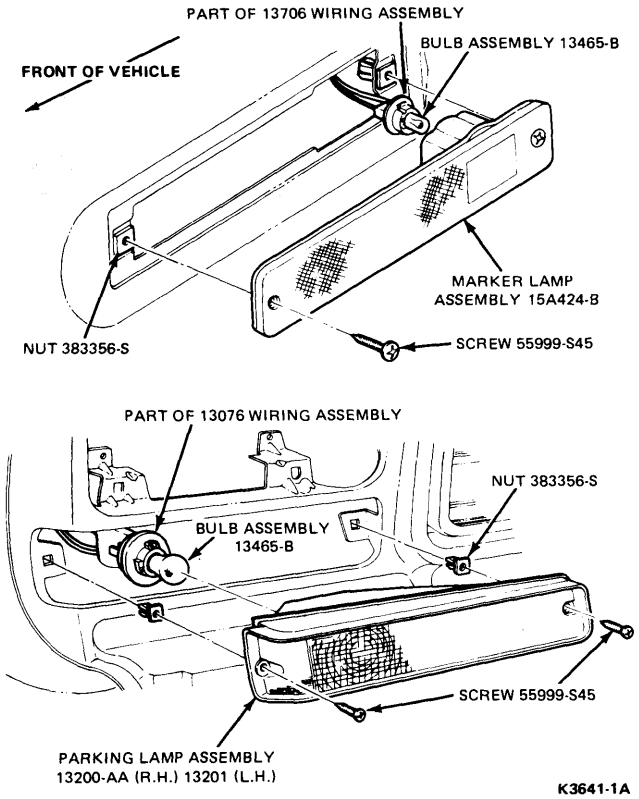


FIG. 3 Parking Lamps and Side Marker Lamps—F-100—F-350 and Bronco

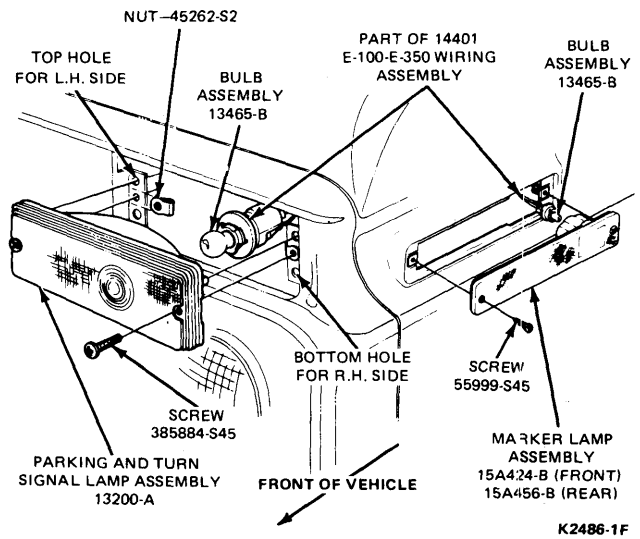


FIG. 4 Parking Lamp and Side Marker Lamp—E-100—E-350

REAR LAMPS

F-100 THROUGH F-350 STYLE SIDE PICK-UP, BRONCO AND E-100—E-350

To replace a bulb of the combination tail lamp, stop lamp, reflex and back up lamp, remove the two screws that retain the lamp assembly to the vehicle. Turn the socket with the burned out or broken bulb counterclockwise and replace the bulb. Re-install by turning clockwise into housing. Install lamp to vehicle.

NOTE: If lamp body or lens is damaged, replace entire lamp assembly, lens and body are not serviced separately (Figs. 5 and 6).

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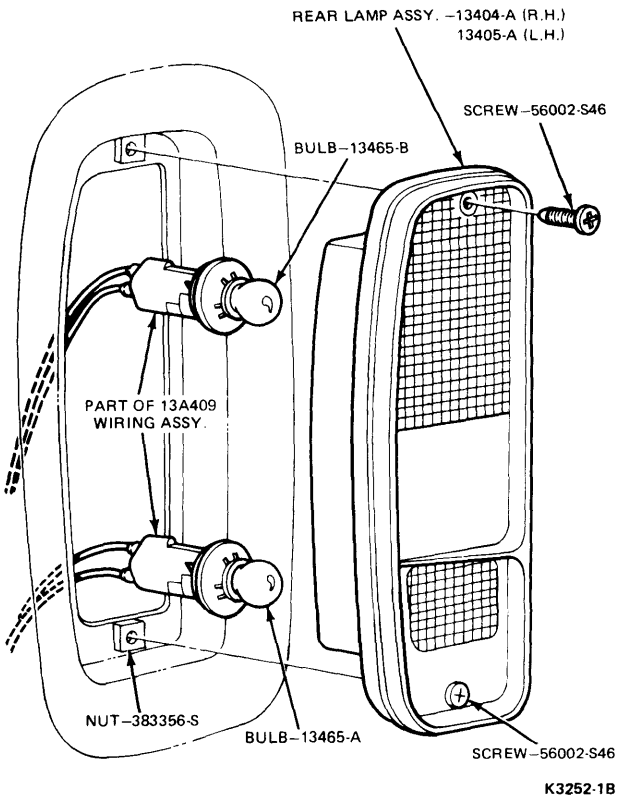


FIG. 5 Rear Lamp—E-100—E-350

F-100 THROUGH F-350 FLARE SIDE PICK-UP

The bulbs in the rear lamp body can be replaced by removing the lens (4 screws).

To replace the lamp assembly, remove the three nuts from the mounting studs. Disconnect the two connectors (red-black stripe wire and wire with green insulator) inside the frame side rail (Fig. 7). Unhook the wires from the retaining clip and pull the wires out. Insert the studs of the replacement lamp body into the holes of the lamp mounting bracket, and tighten the stud nuts.

MARKER LAMPS

F-100-F-350 STYLE SIDE PICK-UP, BRONCO AND E-100—E-350

Replacement of the bulb, the light assembly, or the socket and wiring assembly requires removal of the lamp assembly from the side of the vehicle (2 screws) as shown in Figs. 3, 4 and 6. Disengage the bulb socket from the rear of the lamp assembly by turning counter clockwise. With the socket disengaged the lamp bulb can be replaced. If the socket and wiring assembly is to be replaced, disconnect the wiring at the connector and ground screw.

F-100 THROUGH F-350 FLARE SIDE PICK-UP

The front marker lamp is removed in the same manner as described in previous paragraph for style side pick-up. The rear marker lamp is part of the rear lamp assembly and is removed as part of that assembly.

STAKE AND PLATFORM

Depending upon the particular vehicle, marker lamps vary in number and location, but are all of the same basic design.

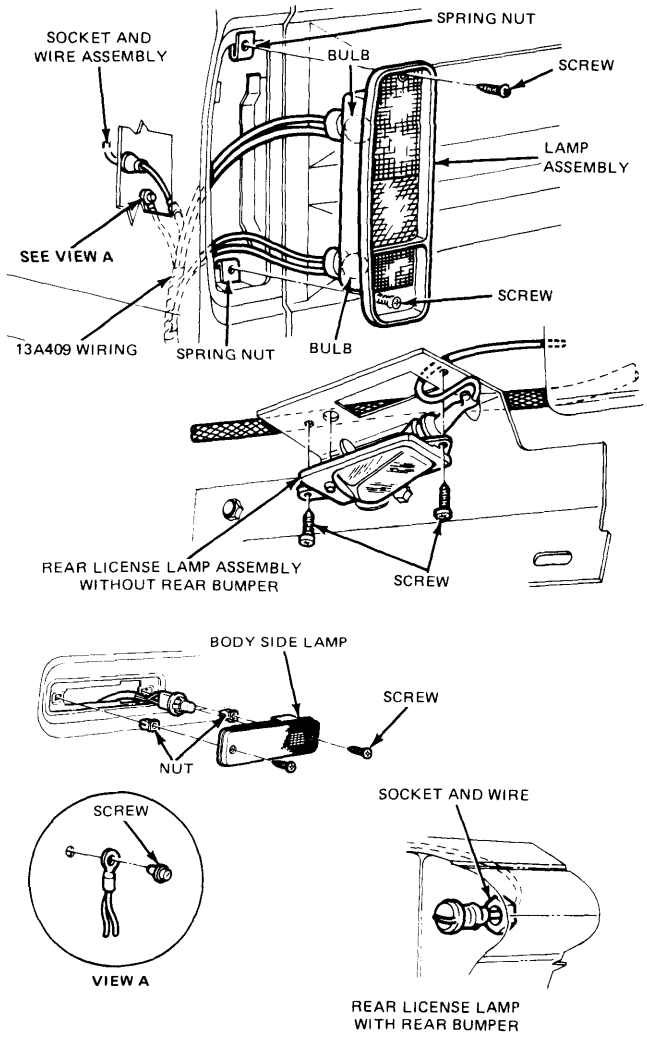


FIG. 6 Rear Lamps And Side Marker Style Side Pick-Up

To replace the bulb, pop the lens off with a screwdriver, press in on the bulb and turn it counterclockwise.

To remove the lamp body, remove the retaining nuts from the two mounting studs, disconnect the lead wire from the connector and withdraw the lamp body and wire assembly from the vehicle.

STOP LAMP SWITCH

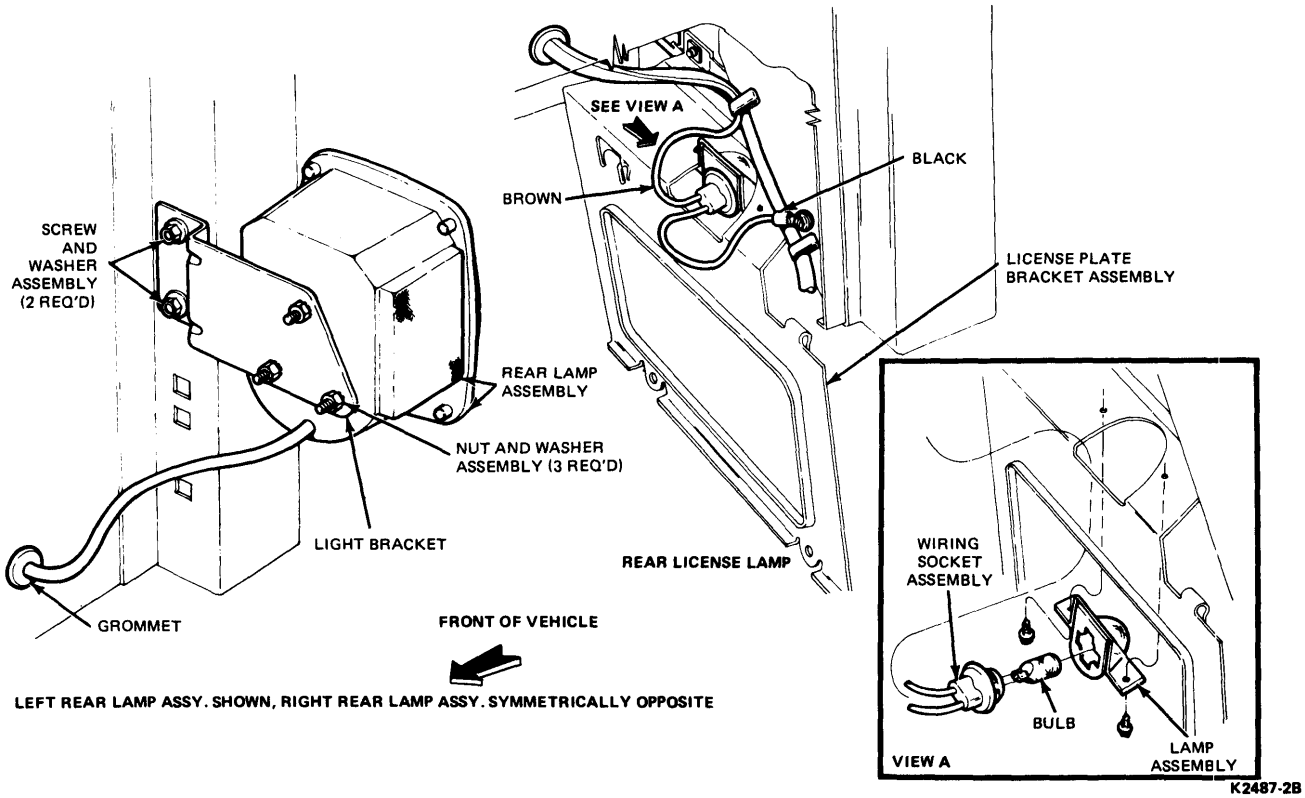
F-100 THROUGH F-350 AND BRONCO

The F-100 through F-350 and Bronco vehicle plunger stop lamp switches (Fig. 2) are pushed into a retainer on the brake pedal arm. Remove the wiring harness by spreading the plastic connector tabs and pull the electrical connector from the end of the switch body. Then unscrew the switch assembly from the retainer.

To install, push the switch assembly into the retainer until it bottoms out. Assemble the wire harness connector to the switch. Adjust the switch by pulling the brake pedal firmly back to normal rest position. If the stop lamps remain on after the adjustment, rotate the switch assembly one turn towards plunger.

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LEFT REAR LAMP ASSY. SHOWN, RIGHT REAR LAMP ASSY. SYMMETRICALLY OPPOSITE

FIG. 7 Rear Side Marker Lamps—F-100, F-150, and F-250, Flare Side Pick-Up

BRONCO, E-100—E-350 AND F-100 THROUGH F-350 WITH SPEED CONTROL

To remove the mechanical stop lamp switch, disconnect the switch wiring connector from the switches. Remove the hairpin retainer, slide the stop lamp switch, the push rod and the nylon washers and bushings away from the pedal, and remove the switch (Fig. 1).

Position the switch, pushrod, and bushing and washers, on the brake pedal pin, as shown in Fig. 1. Install the hairpin retainer.

Assemble the connector to the switch and install the wires and the retaining clip. (Fig. 1).

LICENSE PLATE LAMP

ALL PICK-UP TRUCKS (WITH REAR BUMPER) AND BRONCO

To replace the rear license lamp bulb, (Fig. 8), rotate the lamp bezel counterclockwise, and remove the bulb.

To remove the lamp assembly disconnect the wire lead from the harness plug, and remove the retaining nut from behind the rear bumper assembly.

ALL TRUCKS (WITHOUT REAR BUMPER)

Refer to Figs. 6 and 7 for Removal and Installation procedures.

E-100—E-350

To replace the bulb of the E-100—E-350 license plate lamp assembly (Fig. 9) remove the lamp socket out of the assembly from inside the left rear door by twisting counterclockwise. Remove the bulb, install a new bulb and twist the socket into the lamp assembly.

To replace the lamp assembly, remove the three screws accessible from rear door filler that retain the assembly to the door. Pull the lamp sockets out of the lamp assembly and remove the assembly from the door.

BACK-UP LAMP SWITCH

E-100—E-350

To remove the switch located in the engine compartment, disconnect the wire connector from the switch terminals, and remove the switch retaining clip (Fig. 10). To install the switch, position the switch to the D-hole in the bracket and install the retaining clip. Then connect the wire connector to the switch terminals.

If adjustment is needed, loosen the clamp screw on the mounting bracket assembly on the shift tube. Shift the selector lever into Reverse and move the mounting bracket so that it depresses the switch plunger. While holding the actuator assembly in this position, tighten the clamp screw. Check the operation of the switch. It must not be actuated in Second gear. Reposition switch and bracket assembly upward to eliminate switch operation in Second gear.

F-100-350 AND BRONCO WITH FORD 3-SPEED TRANSMISSION

The back-up lamp switch is mounted in the engine compartment, in a bracket secured to the forward end of the steering column tube by a clamp (Fig. 12). To remove the switch, place the transmission selector lever in some position other than reverse, and disconnect the connector from the switch terminals. Remove the switch retaining clip. To install the switch, set it in position and install the retaining clip. Connect the wire connectors to the switch terminals.

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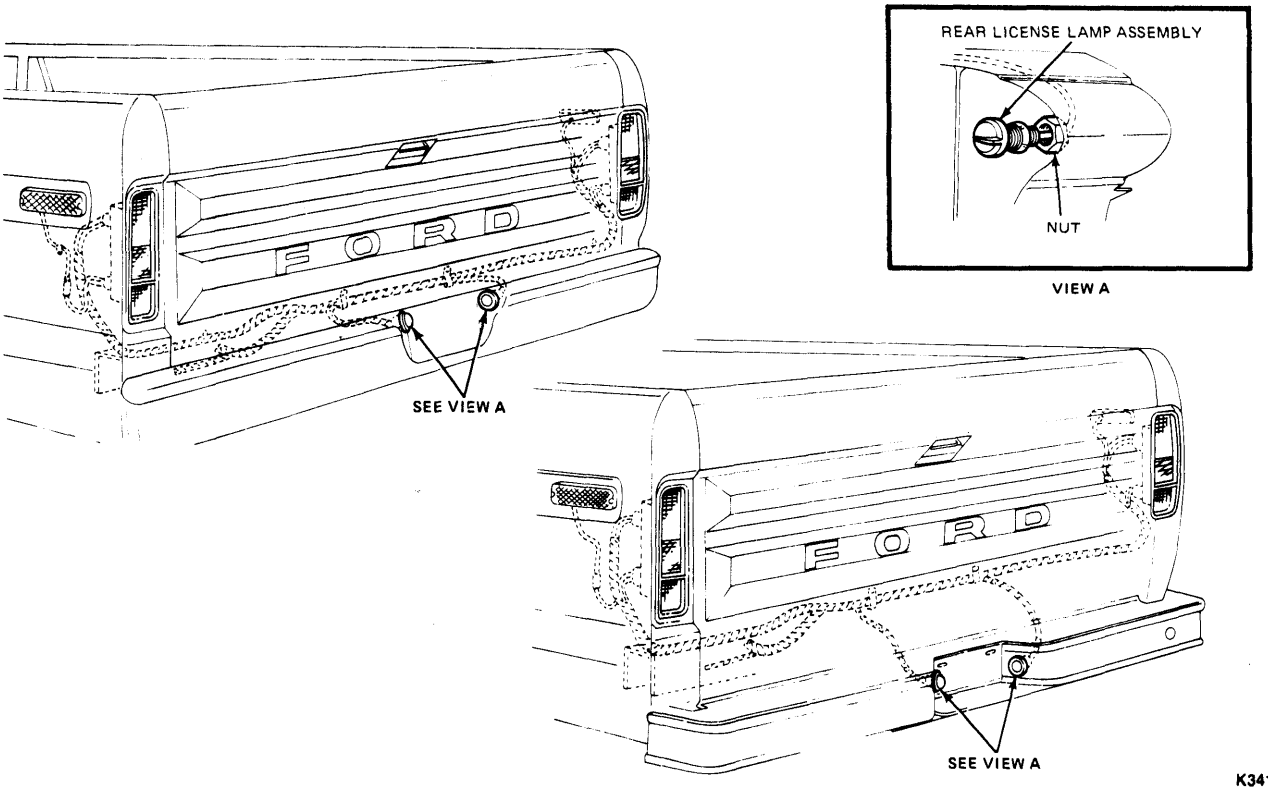


FIG. 8 License Plate Lamp—F-100-350 and Bronco With Rear Bumper

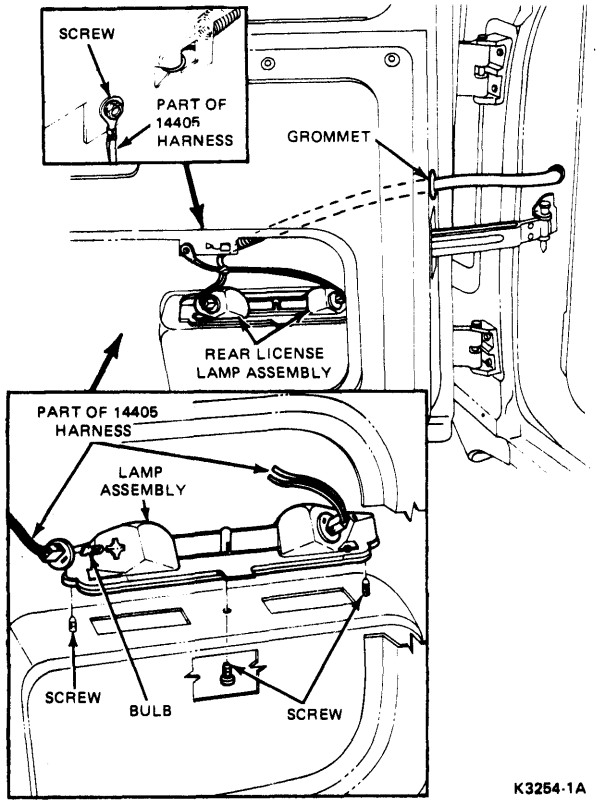


FIG. 9 License Plate Lamp—E-100—E-350

If adjustment is needed, loosen the clamp screw on the mounting bracket on the shift tube. Shift the selector lever into reverse and move the mounting bracket so it depresses the switch plunger. While holding the actuator assembly in this position, tighten the clamp screw. Check the operation of the switch. It must not be actuated in second gear. Re-position switch and bracket assembly upward to eliminate switch operation in second gear.

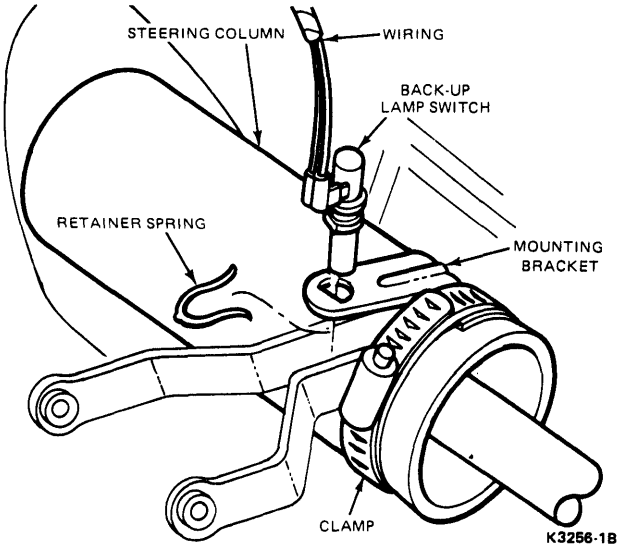


FIG. 10 Back-Up Switch—E-100—E-350—Manual Transmission Shown

ALL TRUCKS OTHER THAN BRONCO, E-100—E-350 AND F-100-350 WITH FORD 3-SPEED TRANSMISSION

The back up lamp switch on all of these vehicles is a part of the transmission assembly. Refer to Group 16.

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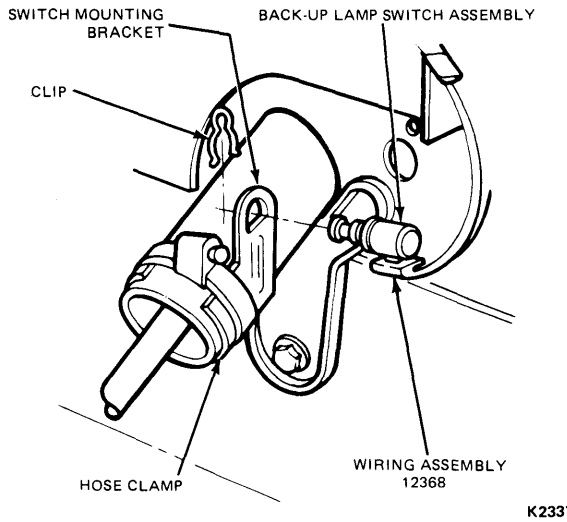


FIG. 11 Back-Up Lamp Switch—Bronco, Typical of F-100—F-350

ALL F-100—F-250 AND E-100—E-350 WITH 4 SPEED MANUAL OVERDRIVE TRANSMISSION

The back-up lamp switch is mounted to the floor shift mechanism on the transmission extension. The switch is not adjustable. To remove the switch, place the transmission selector lever in some position other than reverse and disconnect the electrical connector from the switch. Remove one bolt and the switch and bracket assembly can be removed from the shift mechanism. Install new switch and bracket assembly in reverse order.

FOG LAMPS

To remove the fog lamp assembly, disconnect connector at the wiring assembly. Remove nut securing lamp assembly to bracket (Figs. 12-16) and remove lamp assembly from vehicle.

To install fog lamp assembly, position lamp assembly to bracket and loosely hold in place with nut. Connect electrical connector (Figs. 12-16).

After installation, aim fog lamps using "VACU—LITE" system, or equivalent and tighten retainer nut to 20-30 ft-lbs.

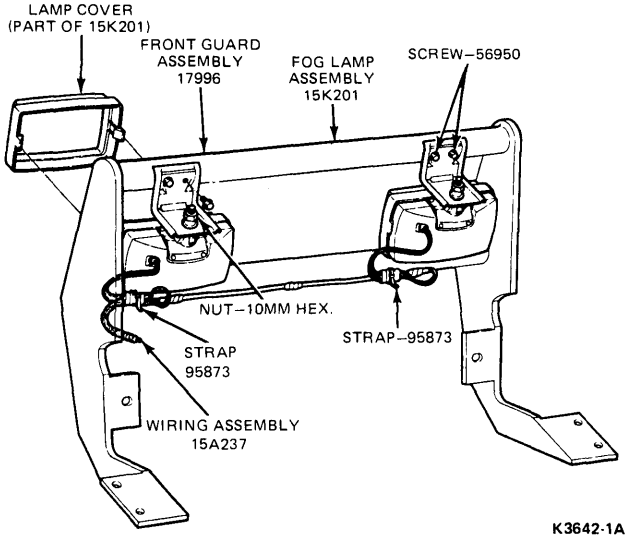


FIG. 12 Fog Lamp Assembly—E-100—E-350

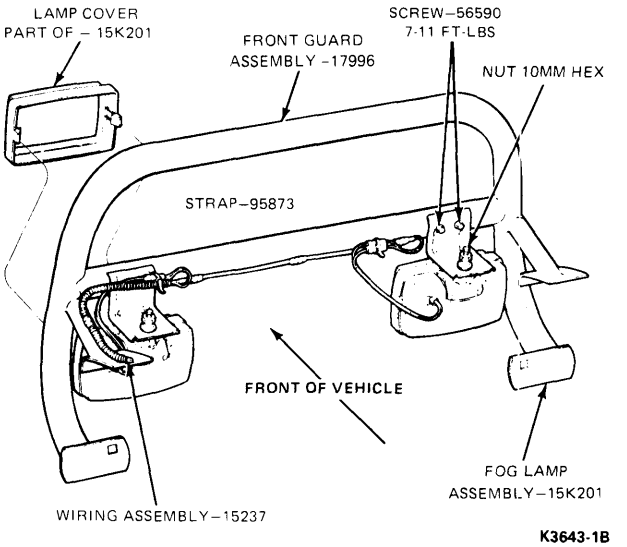


FIG. 13 Fog Lamp Assembly—F-150—F-350 (4x4)

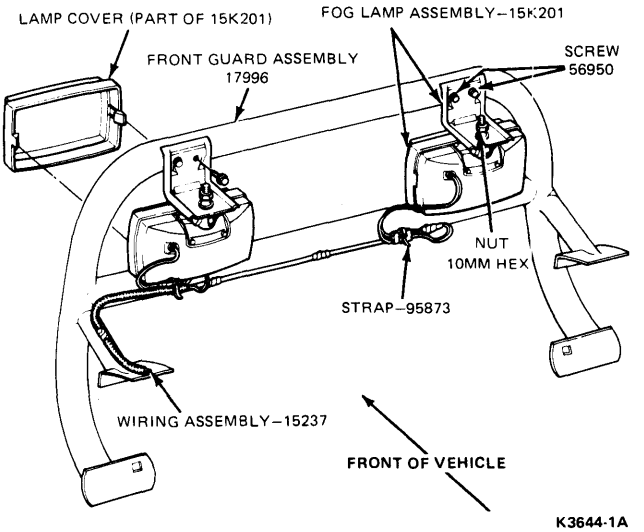


FIG. 14 Fog Lamp Assembly—F-100—F-350 (4x2)

FOG LAMPS SWITCH ASSEMBLY

To remove the fog lamp switch, disconnect connector at the switch (Figs. 15 and 16). Remove nut(s) securing switch to instrument panel and remove switch assembly from vehicle.

To install, position switch assembly to instrument panel and secure with nut(s). Connect electrical connector to switch assembly.

ROOF MARKER LAMPS

To remove roof marker lamps (Fig. 17), remove two screws securing marker to roof and lift lamp enough to see electrical connector. Tape wiring assembly 15A404 to roof of vehicle and disconnect electrical connector. Remove marker lamp from vehicle.

To install roof marker lamps position pad over electrical wires and connect electrical connector. Remove tape from wiring assembly. Position marker lamp to roof and secure with two screws tightened to 8-20 in-lbs.

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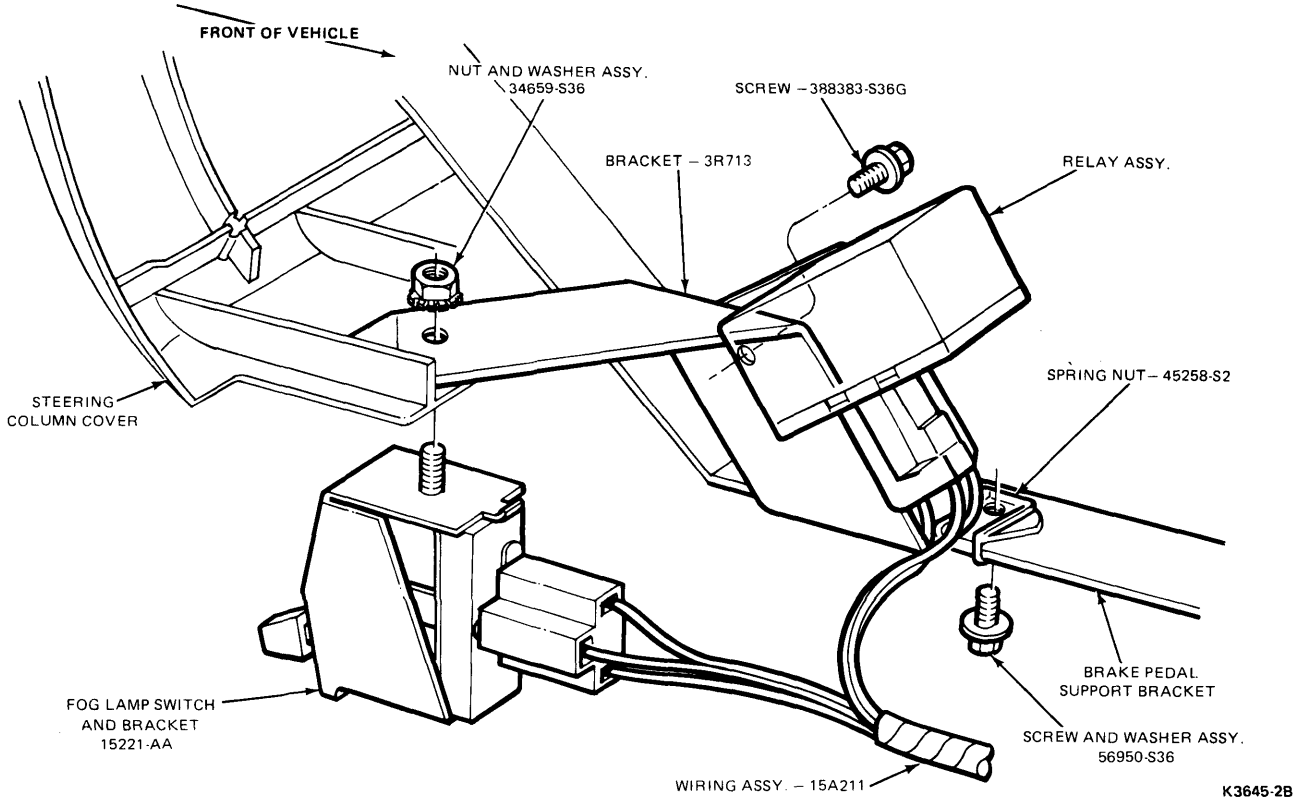


FIG. 15 Fog Lamp Switch—E-100—E-350

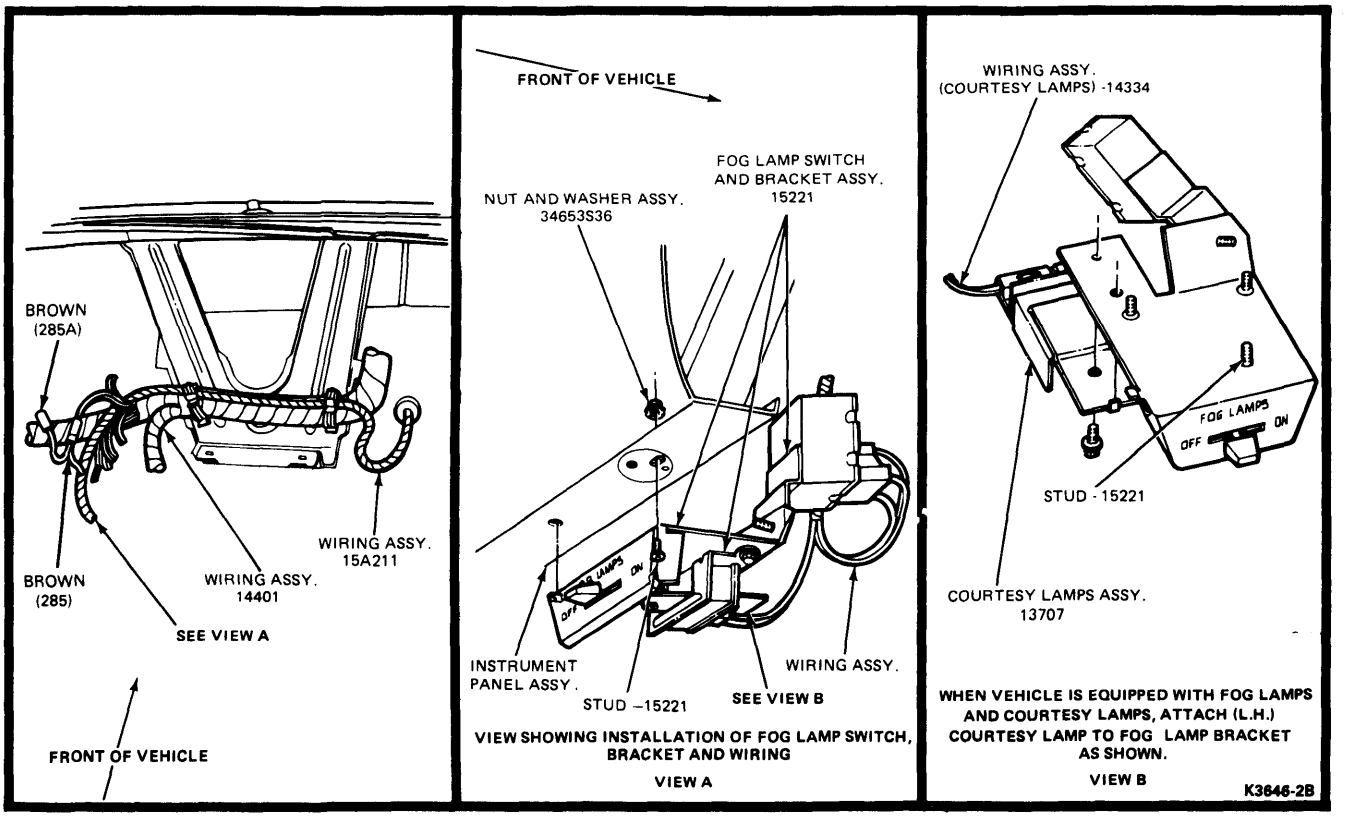


FIG. 16 Fog Lamp Switch—F-100—F-350

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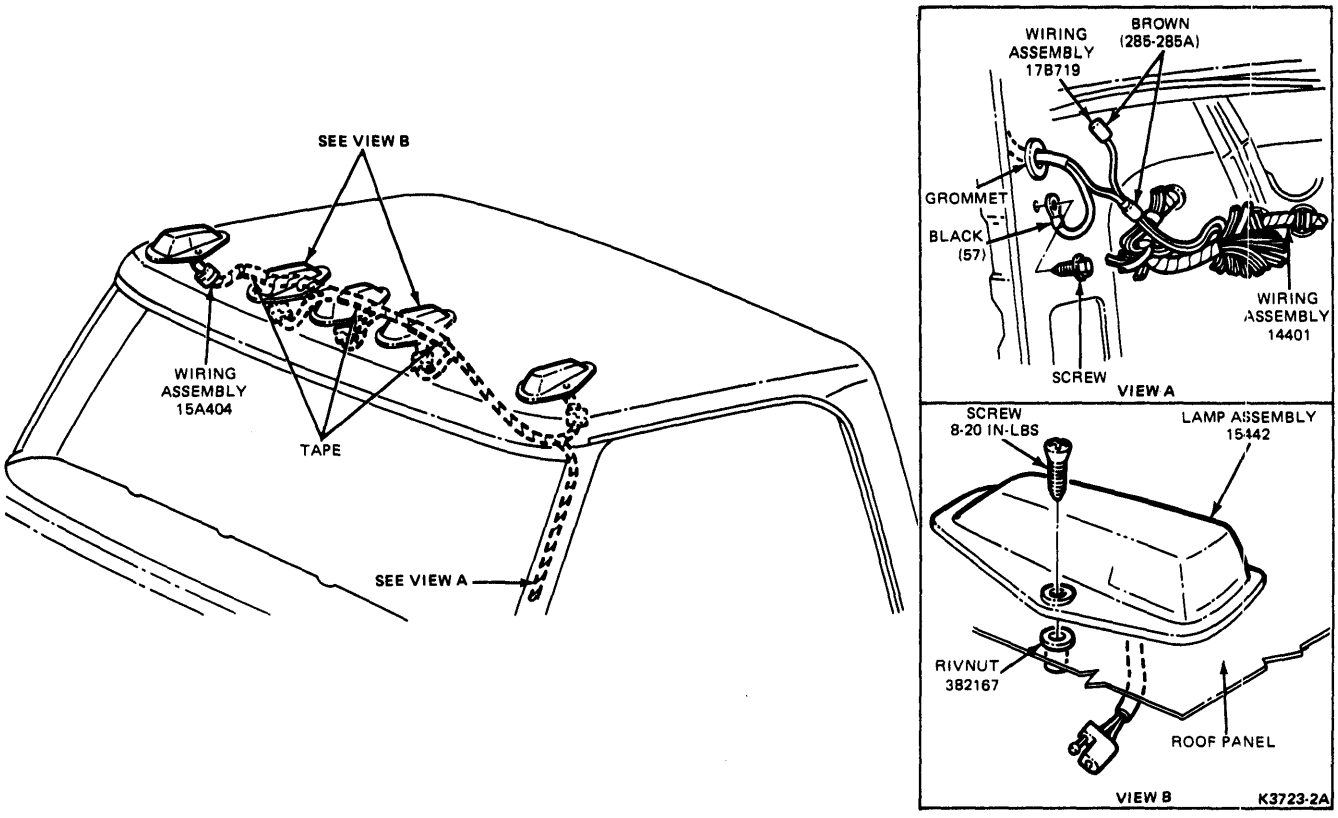


FIG. 17 Roof Marker Lamps—F-100—F-350

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Turn Signal and Hazard Flashers

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DESCRIPTION AND OPERATION

The turn signal/hazard flasher switch is located in the upper steering column hub. The turn signal switch is operated by a lever on the left side of the hub. The hazard flasher switch is located on the right side of the hub. Two flasher units are used, one for the turn signal circuit and the other for the hazard flasher circuit. The turn signal flasher unit is attached to the left side cowl. The hazard flasher unit is taped to the wiring harness.

TESTING

Common point diagnosis should be used to isolate or pinpoint the most probable cause of a problem in a multi-load circuit (a circuit with more than one operating component) without making any tests. If one system functions properly but another does not, the problem must be in the part of the circuit unique to the inoperative system. (See Fig. 1).

If more than one circuit does not operate, check for blown fuses (Group 34).

TURN SIGNAL FLASHER POWER TEST

1. Turn ignition switch to ON or ACC position.
2. Connect 12-volt test light to a good ground (Fig. 2).
3. Contact probe of test light to the wire connection at the flasher as shown in Fig. 2 (orange/yellow wire). If test light illuminates, power flow to flasher is good. If test light does not illuminate, power is disrupted between flasher and power source. Feed circuit must be repaired.

TURN SIGNAL SWITCH POWER TEST

1. Turn ignition switch to ON or ACC position.
2. Connect 12-volt test light to a good ground (Fig. 3).

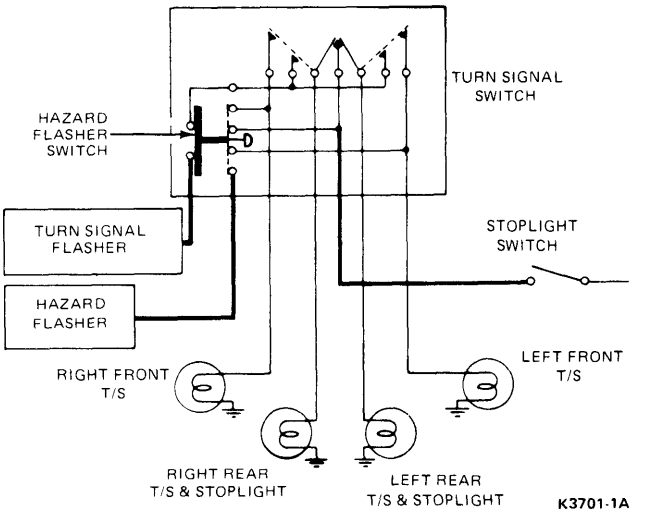


FIG. 1 Circuit Common Points

3. Contact probe of test light to the wire connection at the switch (blue wire, circuit No. 44) as shown Fig. 3. If test light illuminates, power flow to switch is good. If test light does not illuminate, power flow is disrupted between turn signal flasher and switch. Feed circuit No. 44 (blue wire), or flasher must be repaired.

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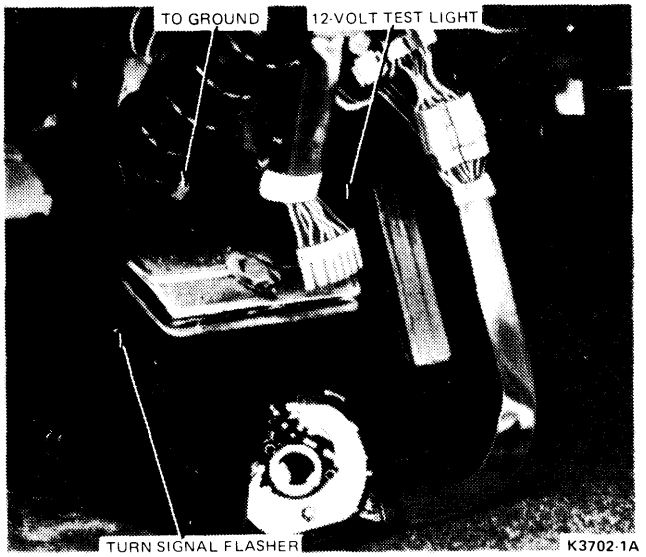


FIG. 2 Turn Signal Flasher Power Test

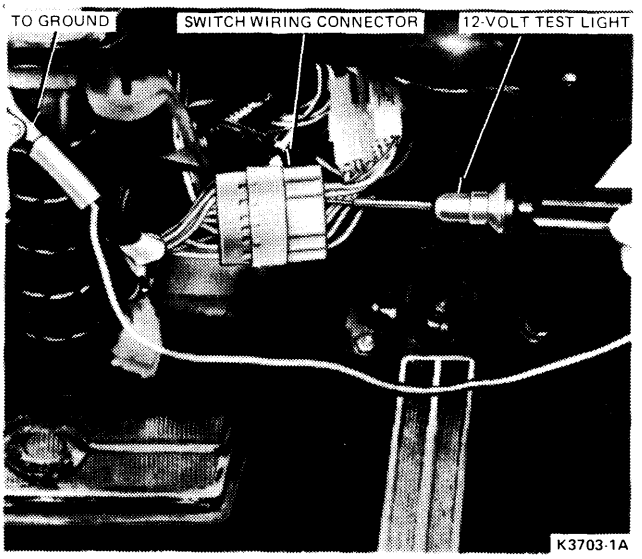


FIG. 3 Turn Signal Switch Power Test

TURN SIGNAL SWITCH POWER OUT TEST

1. Turn ignition switch to ON or ACC position.
2. Position turn signal switch lever to ON position for left and right turns as required.
3. Connect 12-volt test light to a good ground (Fig. 4).
4. Contact probe of test light to the wire connection at the switch (Fig. 4) to check for continuity to the following turn signal lights:

   Left-Front (green wire with white strip—Circuit No. 3).

   Left-Rear (yellow with black stripe—Circuit No. 283).

   Right-Front (white wire with blue stripe—Circuit No. 2).

   Right-Rear (green wire—Circuit No. 282).

If the continuity through switch is not okay, repair or replace the switch as required.

It is important to note that the turn signal switch can also be tested by substitution.

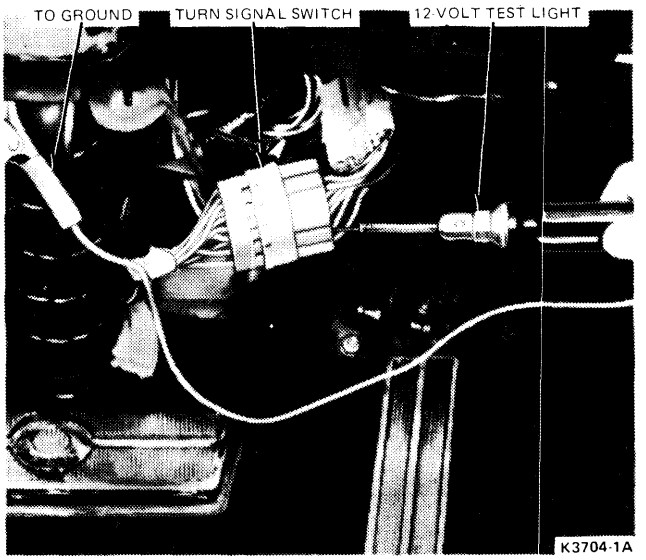


FIG. 4 Turn Signal Switch Power Out Test

TURN SIGNAL SWITCH TEST BY SUBSTITUTION

The turn signal switch can also be checked by plugging a new unit into the main wiring harness (Fig. 5).

Operate the controls to determine if the circuits (including the hazard flasher) function. If not, repair or replace the turn signal switch as necessary.

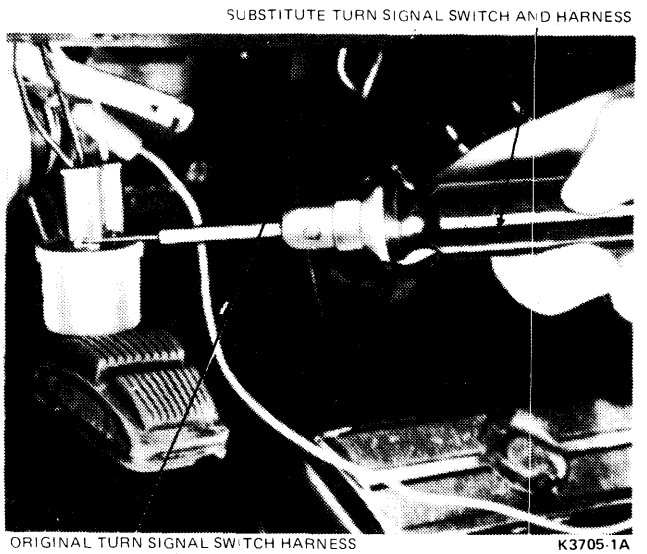


FIG. 5 Signal Switch Test By Substitution

BULB SOCKETS POWER TEST

1. Turn ignition switch to ON or ACC position.
2. Position turn signal switch lever to ON position for left or right turn as required.
3. Connect 12-volt test light to a good ground (Fig. 6).
4. Contact probe of test light to the wire connection at the bulb socket (Fig. 6) to check for continuity to the following turn signal lights:

   Left-Front (green wire with white stripe—Circuit No. 3).

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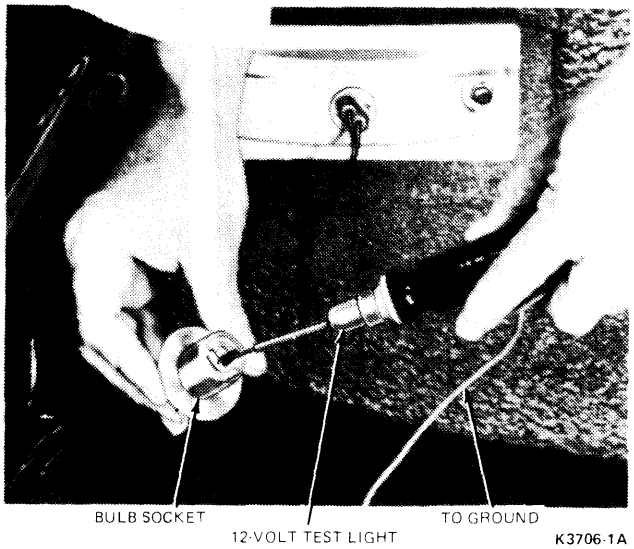


FIG. 6 Bulb Sockets Power Test

Left-Rear (yellow wire with black stripe—Circuit No. 283).

Right-Front (white wire with blue stripe—Circuit No. 2).

Right-Rear (green wire—Circuit No. 282).

If the continuity to bulb-socket is not okay, repair circuit(s) between turn signal switch and bulb sockets.

BULB SOCKET GROUND TEST

1. Turn ignition switch to ON or ACC position.
2. Position turn signal switch lever to ON position for left or right turn as required.
3. Connect 12-volt test light to ground strap on bulb socket (Fig. 7).
4. Contact probe of test light to the wire connection at the bulb socket to check for continuity to ground.

   If test light illuminates, ground is good.

   If test light does not illuminate, ground circuit is incomplete and must be repaired.

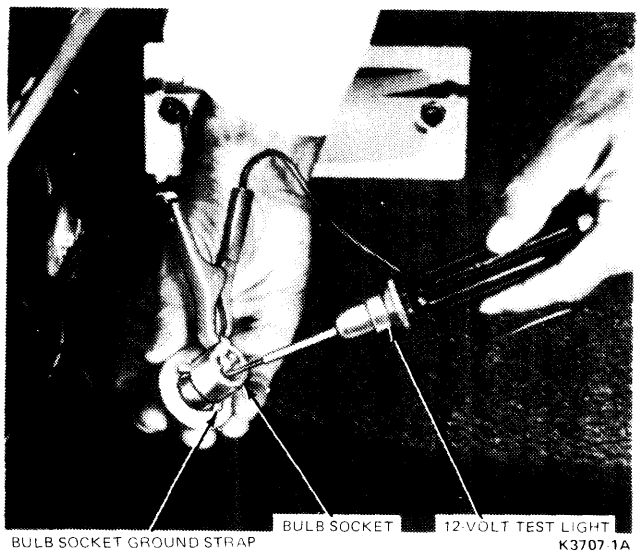


FIG. 7 Bulb Socket Ground Test

HAZARD FLASHER POWER TEST

1. Connect a 12-volt test light to a good ground.
2. Contact probe of test light to the wire connection at hazard flasher socket (red wire with white stripe—Circuit No. 383). Hazard warning flasher is taped to windshield wiper-washer wiring behind wiper/washer switch.

   If test light illuminates, power flow to hazard flasher is good.

   If test light does not illuminate, power flow is disrupted between fuse and flasher. Feed circuit (red wire with white stripe—Circuit No. 383) must be repaired.

HAZARD FLASHER SWITCH TEST IN TURN SIGNAL SWITCH ASSEMBLY POWER TEST

1. Connect a 12-volt test light to a good ground (Fig. 8).
2. Contact probe of test light to the wire connection at the turn signal switch (white wire with red stripe—Circuit No. 385) as shown in Fig. 8.

   If test light illuminates, power flow to switch is good.

   If test light does not illuminate, power flow is disrupted between the flasher and the switch. Feed circuit (white wire with red stripe—Circuit No. 385), or flasher must be repaired.

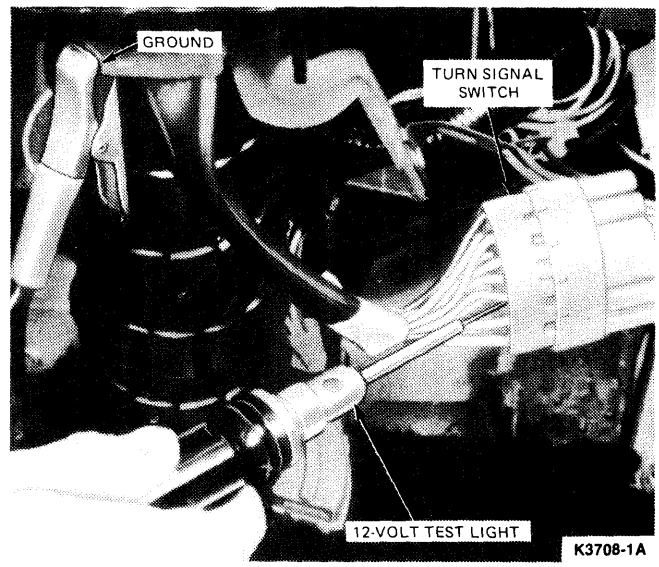


FIG. 8 Hazard Flasher Switch In Turn Signal Switch Assembly Power Test

Two types of turn indicators are used on the F-100—F-350 and Bronco. The turn signal flasher is attached to the left side cowl panel. On the E-100—E-350, the turn signal flasher is attached to the lower reinforcement of the instrument panel to the left of the steering column. One type has the front indicator lamps mounted on the front fenders. The other unit uses the dual filament parking lamps for the indicator lamps.

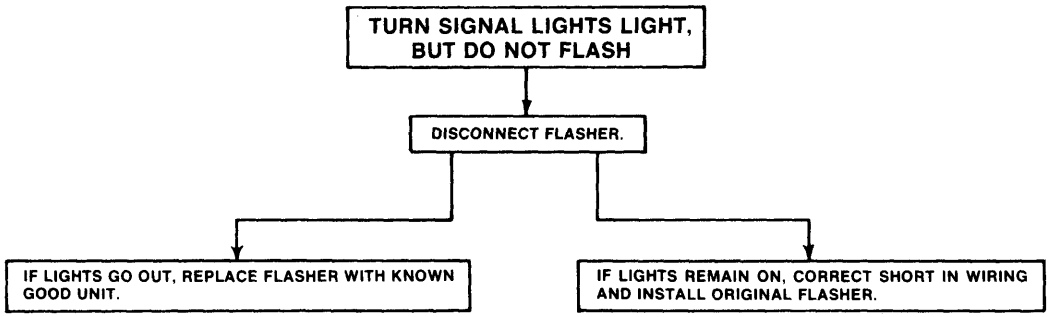
To operate the turn signals, the ignition switch must be in either the ACC or ON positions. The hazard flasher system is operated independently of the ignition switch by activating the hazard flasher switch.

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DIAGNOSIS GUIDES

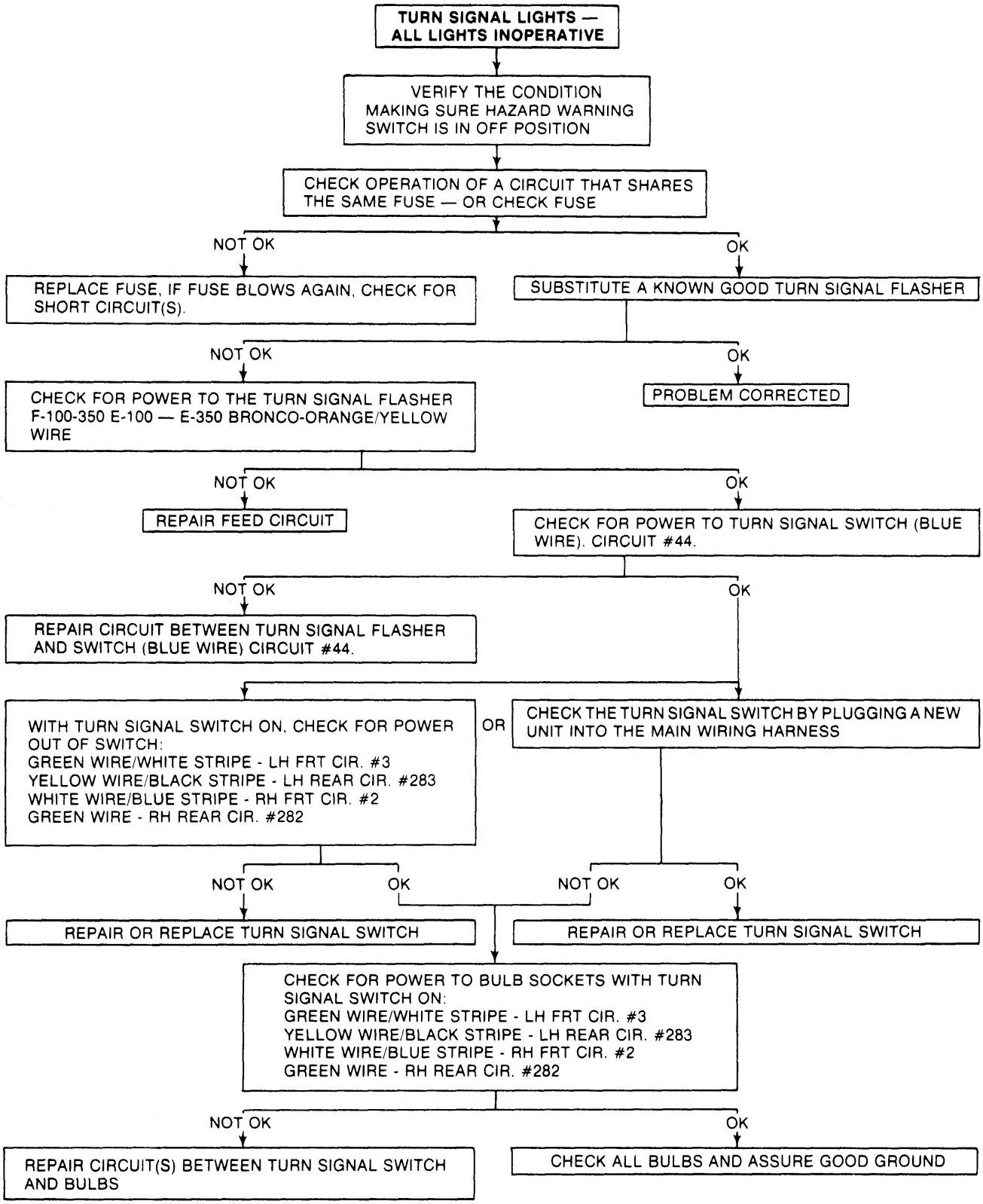
The following guides can be used with the test procedures described above as an aid when diagnosing the turn singal and hazard flasher systems.



CK3508-2A

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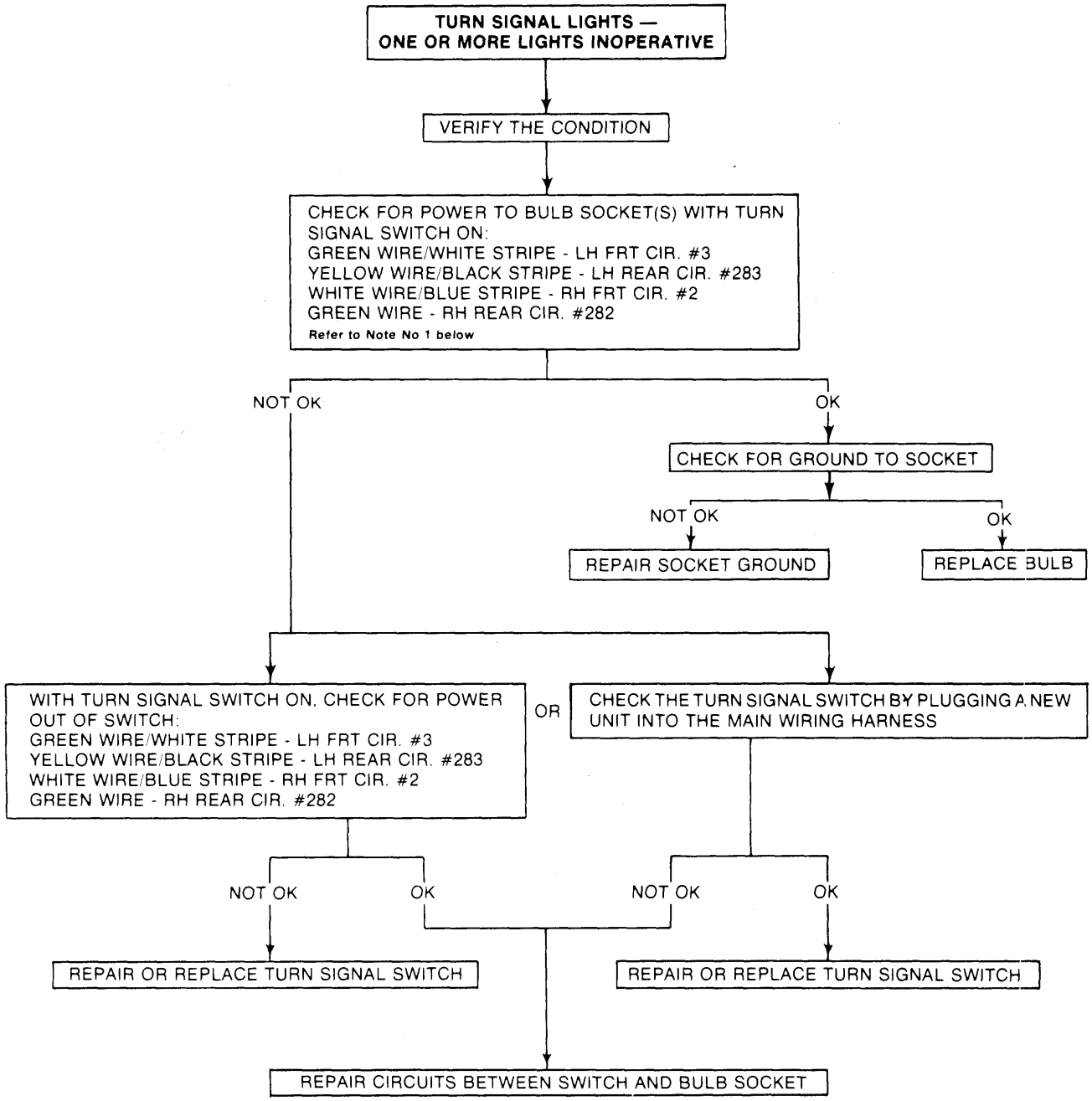
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CK3709-2A

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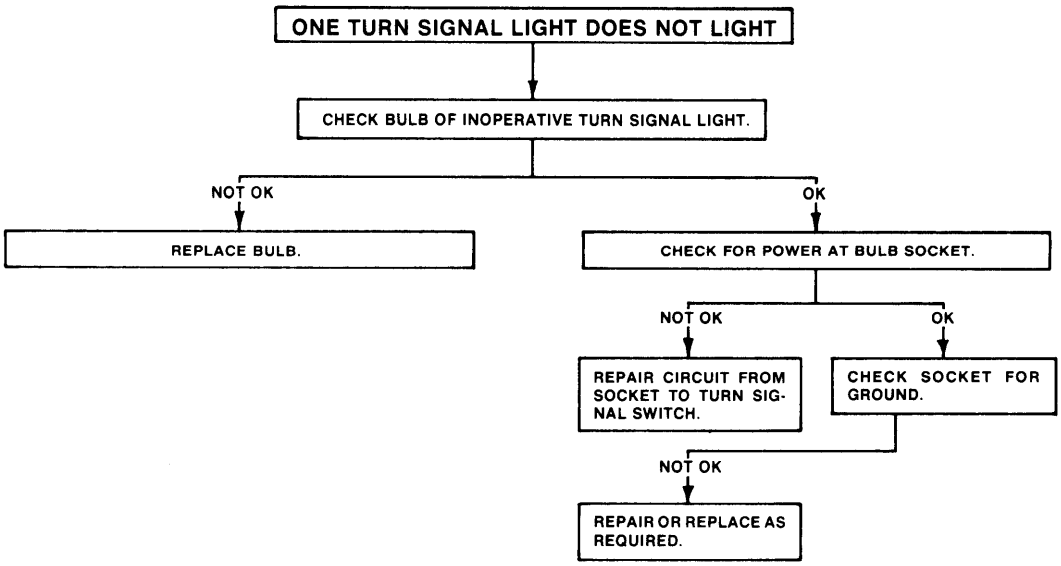


NOTE NO. 1: IF ONE OR BOTH OF THE INSTRUMENT PANEL BULBS DO NOT FLASH, CHECK FOR POWER TO THE BULBS, CHECK THE BULB, AND/OR GROUND.

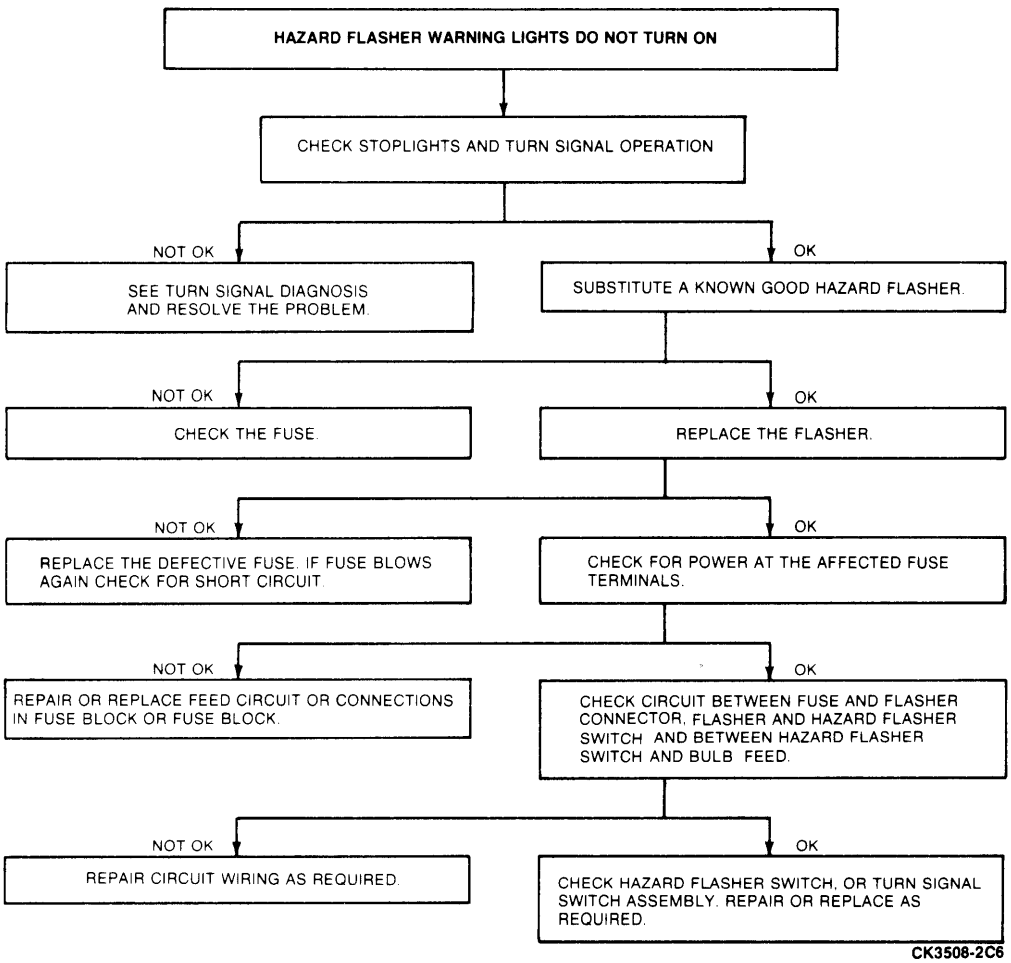
CK3710-2A

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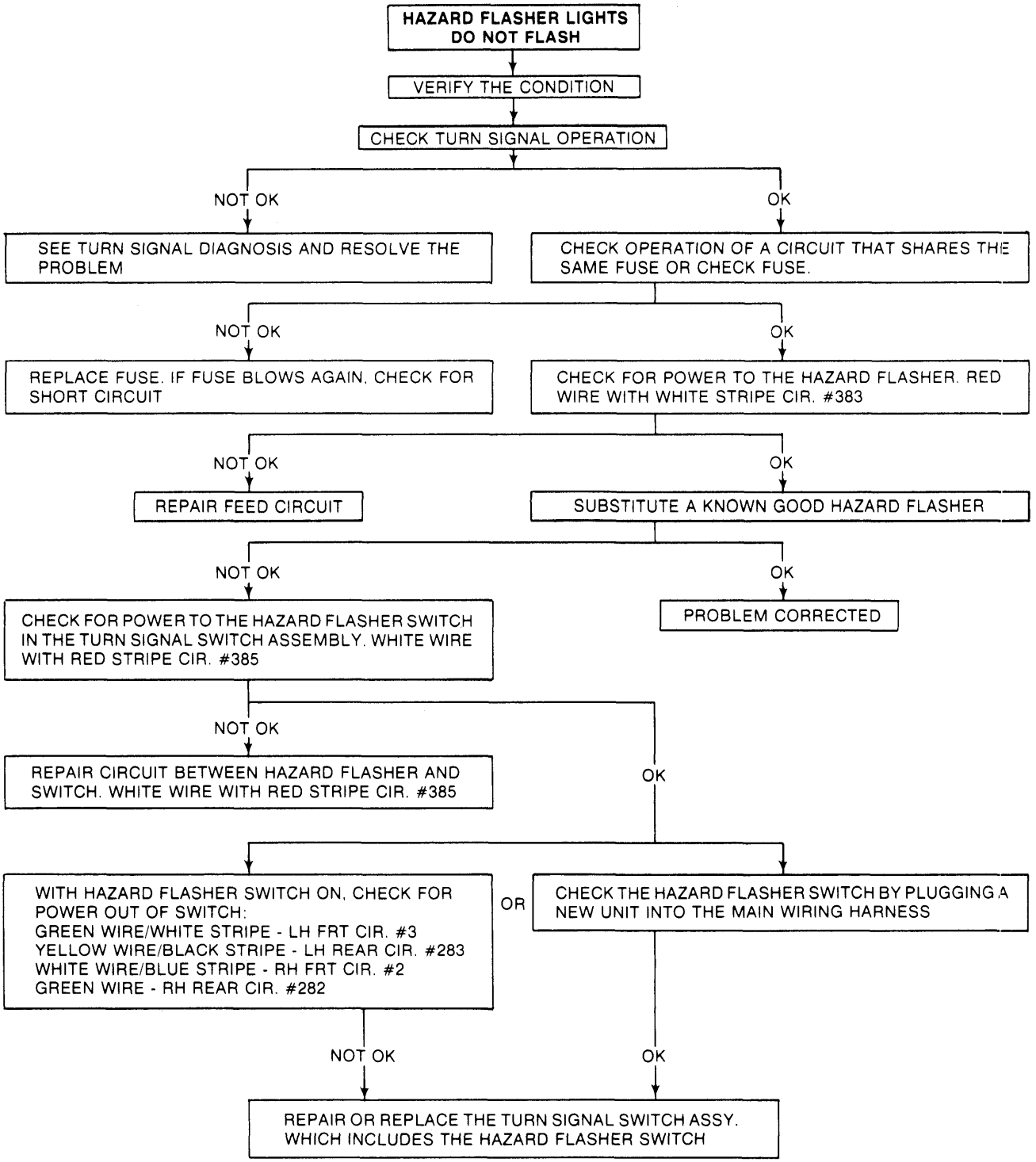
CK3508-2A3



CK3508-2C6

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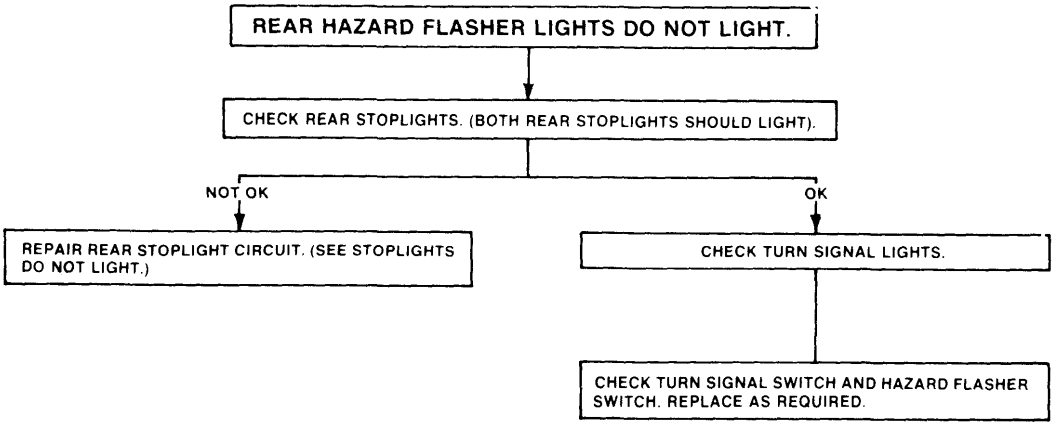
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CK3711-2A

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REMOVAL AND INSTALLATION

TURN SIGNAL/HAZARD FLASHER SWITCH (TILT AND NON-TILT COLUMN)

F-100-350, F-150-250 (4x4) BRONCO AND E-100—E-350

Removal

1. Disconnect the battery ground cable.
2. Remove the horn switch.
3. Remove the steering wheel retaining nut and using Tool 3600AA, remove the steering wheel from the shaft.
4. Remove the turn signal switch lever by unscrewing it from the steering column.
5. Disconnect the turn indicator switch wiring connector plug by lifting up on the tabs and separating (Fig. 10) and remove the screws that secure the switch assembly to the column.

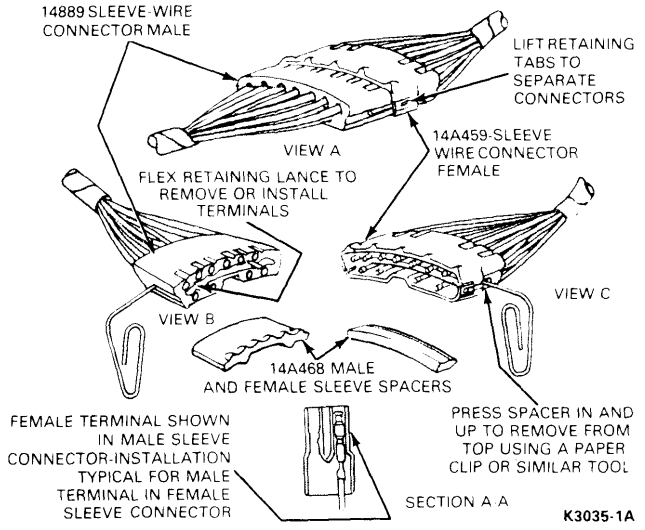


FIG. 9 Wire Connector—Removal

6. Remove the wires and terminals from the steering column wiring connector plug (Fig. 9). Record the color code and location of each wire before removing it from the connector plug.
7. Connect pull through wire to end of wiring harness with tape.
8. Remove the protective wire cover from the wiring harness and remove the switch and wires through the top of the column (Fig. 11).

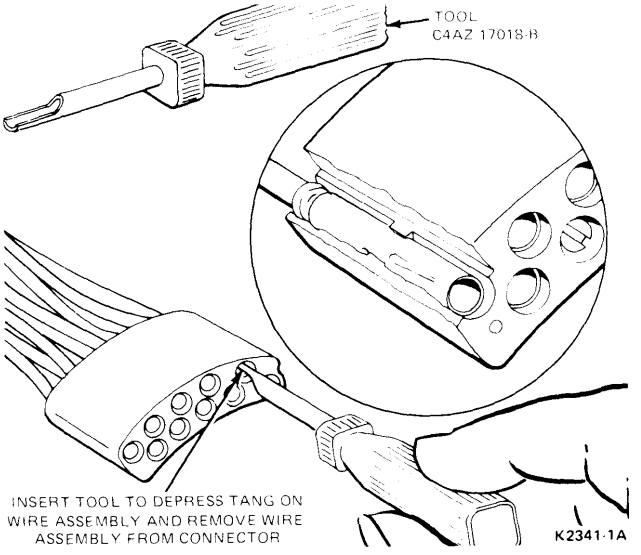


FIG. 10 Wire Terminal Removal

Installation

1. Tape the loose ends of the new turn signal switch wires to the pull-through wire or cord. Carefully pull the wires through the steering column while guiding the turn signal switch into position.
2. Install switch assembly retaining screws to column.
3. Install wires into steering column wire connector terminal and connect terminals.

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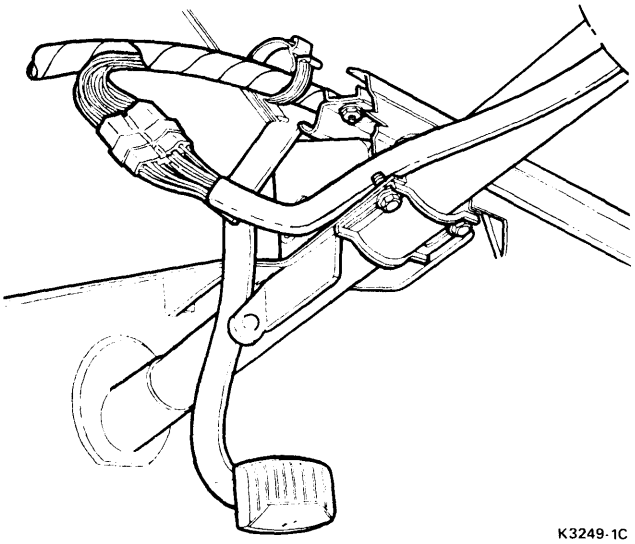


FIG. 11 Light Truck, Bronco, E-100—E-350—Turn Signal and Hazard Flasher

4. Install turn signal lever. Hand-tighten the lever (on flat side) to 10-20 in-lb. Test turn signal operation, hazard signal operation and PRND21 dial-lamp (if so equipped).
5. Install steering wheel.
6. Install horn switch.
7. Connect battery ground cable.

FLASHER UNITS

Refer to Part 34-02 for Flasher Locations .

To remove a conventional turn signal flasher unit from F-100-350 trucks, Bronco and E-100—E-350, twist the flasher unit 90 degrees counter-clockwise, remove and disconnect the wiring connector. Install by connecting the connector and inserting the flasher unit into the retaining hole and twist 90 degrees clockwise.

To replace a hazard warning flasher, simply disconnect the old and replace with new one.

To remove a combined flasher unit, disconnect the battery ground cable. Then remove the two screws retaining the flasher unit, disconnect the push-on terminals and remove the flasher unit. To install, position the flasher unit to the L.H. side of the cowl and install the two retaining screws. Connect the push-on connections. Connect the battery ground cable.

When replacing a turn signal flasher unit, be sure to install a new flasher unit having the same color code and number as the one removed. NOTE: Do not replace turn signal switch or wiring if:

Turn signal lamps do not flash on demand with ignition key turned on, and

Turn signal flasher makes normal pulsing noise, and

Turn signal lamps prove satisfactory when bench-tested or checked by activating brake stop lamp switch for rear only.

1. Check for power at the turn signal flasher output connector (pulsing noise indicates power is coming into the flasher).
2. If there is **no or very weak power** at the flasher output connector (12 volt test lamp will not light or is dim), **replace the turn signal flasher.**

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Interior Lights

PART 32-61

APPLIES TO ALL MODELS

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DESCRIPTION AND OPERATION	
Dome and Map Lamp Combination — Bronco	61-1
Interior Lamps.	
Bronco and F-Series	61-1
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Cargo Lamp Switch	61-5
REMOVAL AND INSTALLATION (Cont'd)	
Courtesy Lamp	61-5
Courtesy Lamp Switch—Door Jam	61-5
Dome Lamp	
Bronco	61-4
F-100 — F-350 and E-100 — E-350	61-4
Engine Compartment Lamp	61-4

DESCRIPTION AND OPERATION

INTERIOR LAMPS

E-100—E-350

The overhead dome lamp and cargo lamp for E-100—E-350 (Fig. 1) is controlled by the headlamp switch and switches located in the door jams.

The bulbs are energized when the headlamp switch knob is turned fully counterclockwise and also when the door is opened.

BRONCO AND F-SERIES TRUCK

The dome lamp is located above the rear window and is energized when the headlamp switch knob is turned fully counterclockwise (Figs. 2 and 3).

All models of the F-100 through F-350 series are equipped with door jam switches which also control the dome lamp (Fig. 4).

The cargo lamp on F-100 through F-350 series is located outside above the rear window and is controlled by a switch mounted behind the drivers door on the upper inner finish panel (Fig. 2).

The cargo lamp switch (Fig. 5) simultaneously operates the dome lamp, which serves as an indicator that the cargo lamp is on.

The engine compartment lamp is located on the bottom center of the hood and is energized when the hood is raised (Fig. 7).

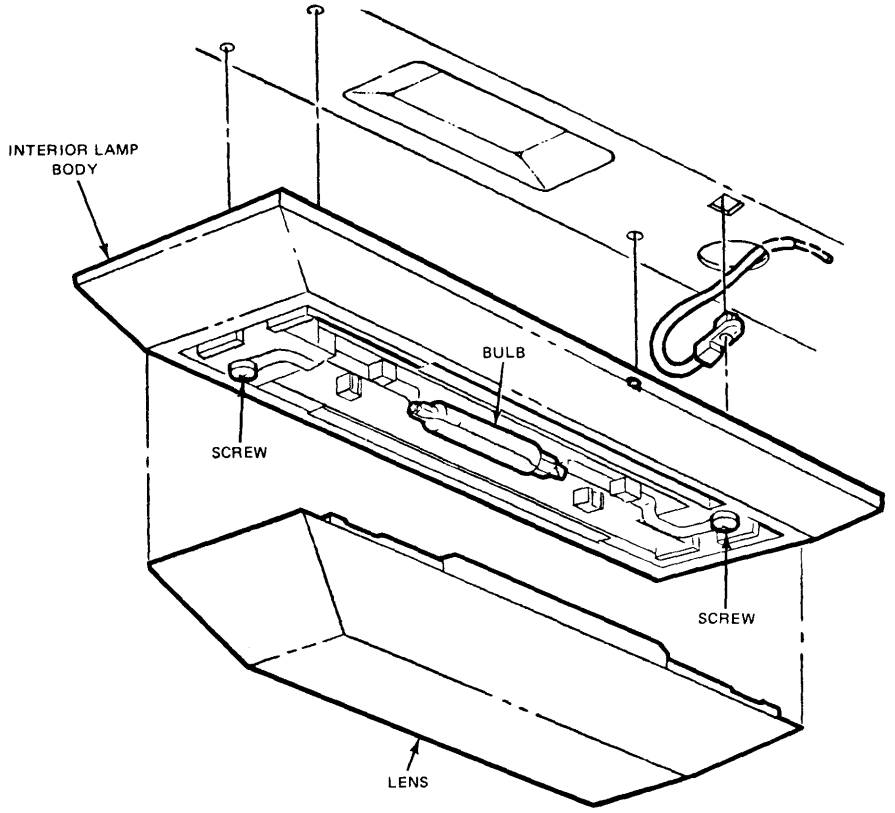
The courtesy lamps for the Bronco and F-100 through F-350 are located under the instrument panel on the right and left sides (Fig. 6). These lamps are energized by door jam switches and by turning the headlamp switch fully counterclockwise.

DOME AND MAP LAMP COMBINATION—BRONCO

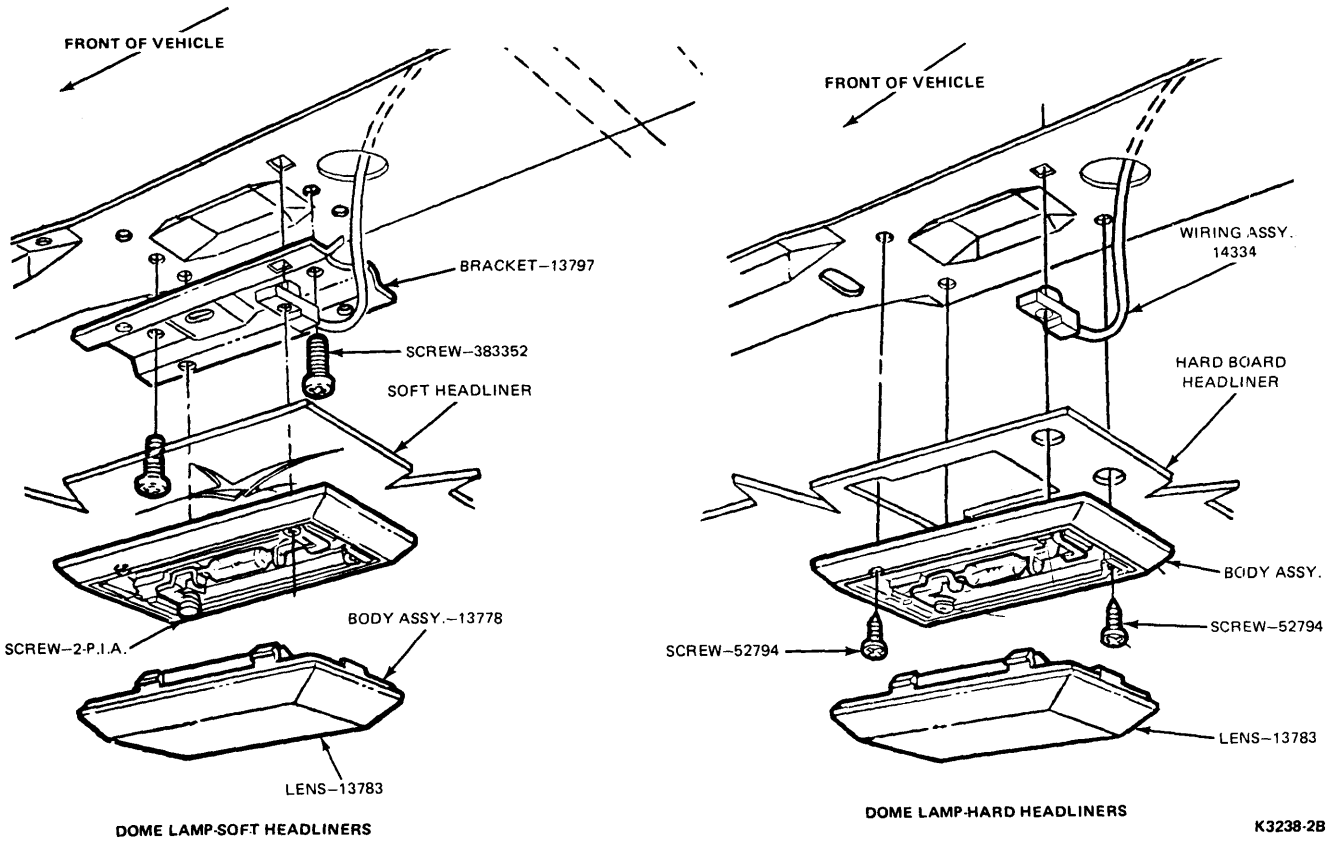
The two map lamps are located on each side of the dome lamp housing (Fig. 3). The map lamps are operated independently of the dome lamp by two switches located at each map lamp housing. The dome lamp is actuated by turning the headlamp switch control knob fully counterclockwise. The dome lamp also illuminates when the doors are opened, by the switch in the pillar.

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ECONOLINE CARGO LAMP-TYPICAL



DOME LAMP-SOFT HEADLINERS

DOME LAMP-HARD HEADLINERS

K3238-2B

FIG. 1 E-100—E-350 Dome and Cargo Lamp—Typical

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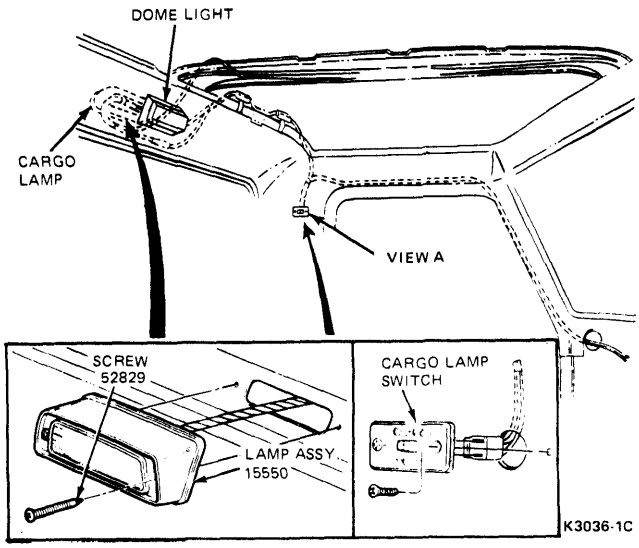


FIG. 2 Cargo and Dome Lamp—F-100—F-350

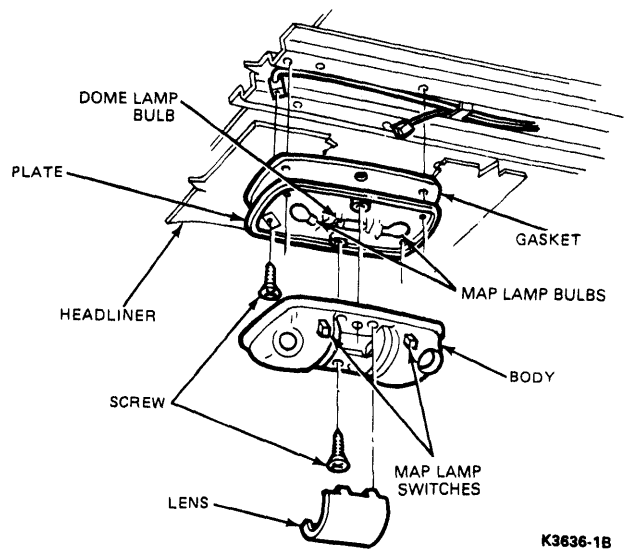


FIG. 3 Map/Dome Lamp—Bronco

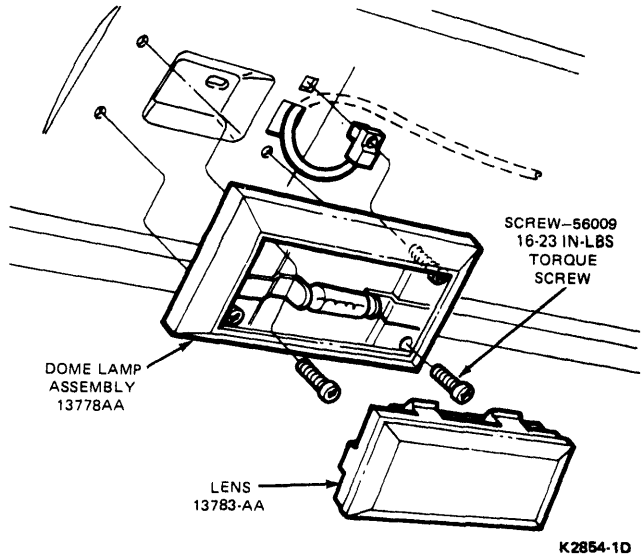


FIG. 4 Dome Lamp—F-Series

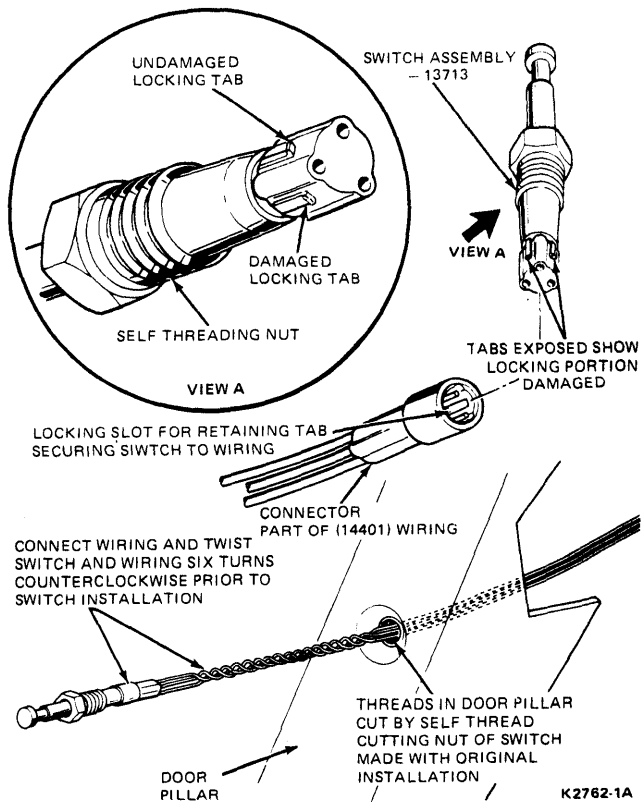


FIG. 5 Courtesy Lamp Switch Installation

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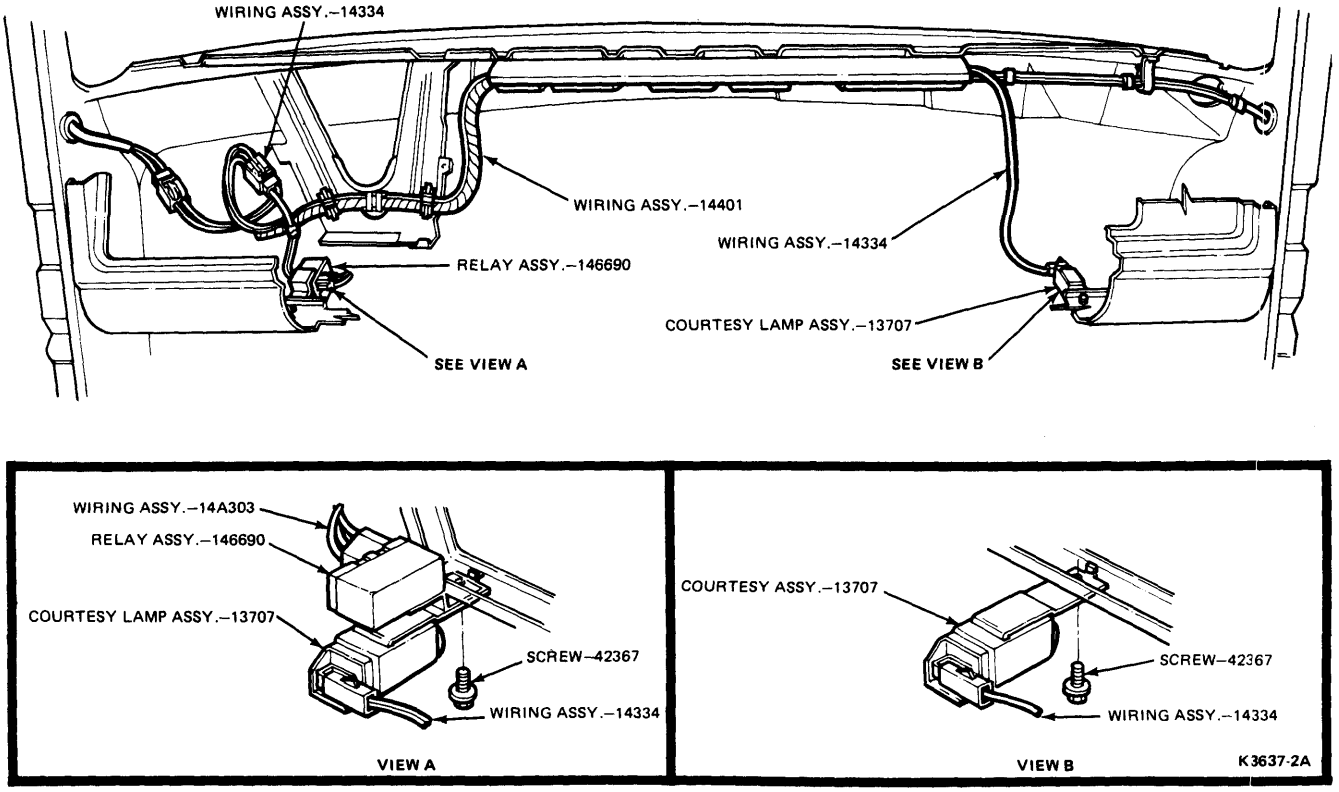


FIG. 6 Bronco and F-100 Through F-350 Courtesy Lamps and Wiring

REMOVAL AND INSTALLATION

ENGINE COMPARTMENT LAMP

BRONCO AND F-100—F-350

Bulb replacement requires only removal of the bulb and installation of the new bulb. No lens or door is used on the engine compartment lamp. To remove the lamp assembly, remove the retaining screw and disconnect the lead (Fig. 7).

DOME LAMP

BRONCO

Carefully pry the dome lamp lens, at the corners from the housing (Fig. 3). Remove the two screws retaining the map lamp lens housing to the lamp base and remove the bulbs. To remove the lamp base, remove the four retaining screws.

F-100—F-350, E-100—E-350 AND BRONCO

To replace bulb, snap lens out of lamp body and remove bulb from retainers, (Figs. 2 and 4).

To remove lamp body, remove four retaining screws.

To install, position lamp body over screw holes and install four screws. Push on lens to snap into position.

CARGO LAMP

To remove the cargo lamp assembly on the F-100 through F-350 series trucks, remove the two lens and door retaining screws and remove the lamp assembly (Fig. 2).

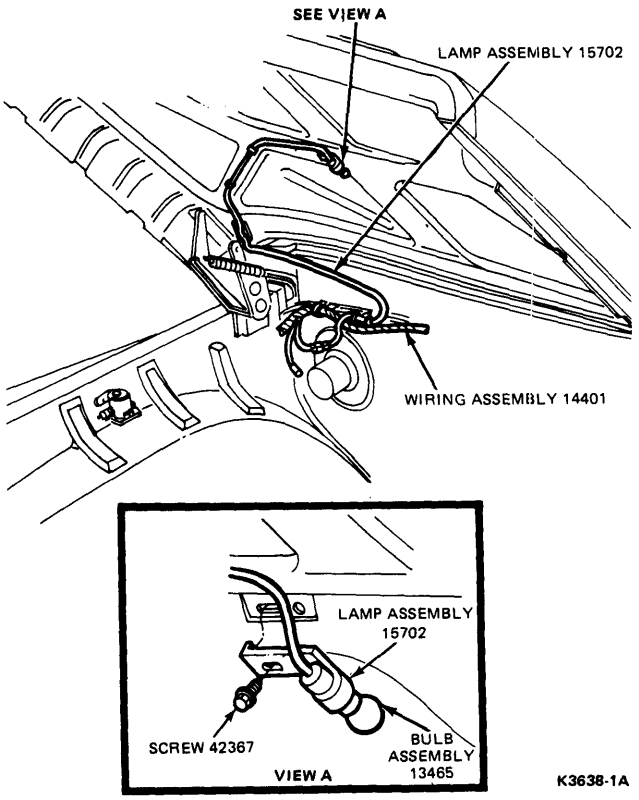


FIG. 7 Engine Compartment Lamp

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On the E-100—E-350, unsnap the lens, remove the two lamp body attaching screws, disconnect the wiring assembly and remove the lamp body (Fig. 1).

CARGO LAMP SWITCH

Remove the two screws retaining the switch assembly. Disconnect the wire connector and remove the switch (Fig. 2).

COURTESY LAMP

To remove courtesy lamp on Bronco and F-100 through F-350 vehicles, remove screw securing lamp to bottom of instrument panel, disconnect electrical connector and remove lamp assembly from vehicle (Fig. 6).

COURTESY LAMP SWITCH—DOOR JAM

Removal

Unscrew the hex sleeve nut from the pillar, extract the switch and pull the wiring connector off the switch (Fig. 5).

Retention of courtesy lamp switch to the (14401) wiring connector is by one of three tabs positioned 120 degrees apart on the switch. If, when the switch is disconnected from the wiring connector, the engaged locking tab breaks off the switch must be rotated 120 degrees to engage a new tab. When all three tabs have been broken, the switch must be replaced (Fig. 5).

Installation

To install the switch in the pillar, pull the wiring connector and wiring through the switch mounting hole in the pillar and connect the switch to the connector (Fig. 5). Then, twist the wiring and switch six turns counterclockwise, push the wiring and connector back through the mounting hole and screw the switch into the pillar until it is seated. Close and open the door to assure that the courtesy lamp is operating properly.

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INSTRUMENTS, CLUSTERS AND CONTROLS

GROUP 33 (10000 — 19000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Charge Indicator — Ammeter	33-12	Instrument Cluster and Printed Circuit	33-51
Charge Indicator — Light	33-10	Oil Pressure Gauge	33-32
Fuel Indicating System	33-20	Oil Pressure Indicator — Light	33-30
Ignition Switch	33-71	Speedometer	33-02
Instruments, Clusters and Controls — General Service	33-01	Temperature Indicator	33-41

Instrument, Clusters, and Controls General Service

PART 33-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING	01-1	DIAGNOSIS GUIDES	01-1

DIAGNOSIS AND TESTING

The diagnosis procedures contained in this Part pertain to all components making up the truck instruments, clusters and controls. After isolating problem, proceed to the appropriate Part in this Group to effect the necessary repairs.

The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument clusfer lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, Ethyl Alcohol and/or Cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior clean-up to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Glass Cleaner C8AZ-19C507-A or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. This Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

DIAGNOSIS GUIDES

The following diagnosis guides are provided to aid in diagnosing instruments, clusters and control systems.

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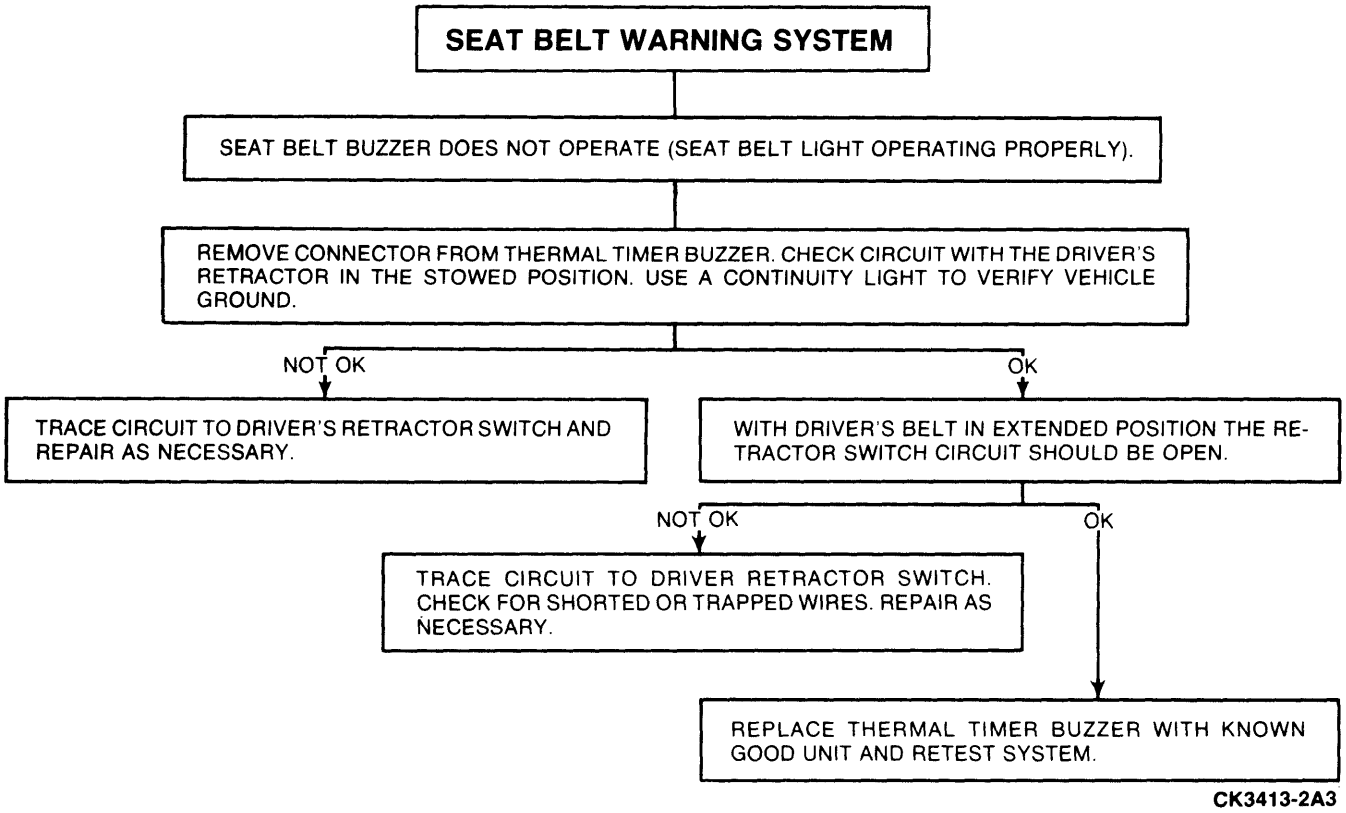
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CONDITION	POSSIBLE CAUSE	CORRECTION
• Speedometer is noisy.	• Improper cable connection or routing.	• Check for proper connections at head. Check cable for kinks or bends. Check cable connections at sensor and/or speedometer adapter if so equipped. Repair or replace as required.
	• Cable core dry.	• Clean and lubricate core.
	• Cable core kinked, burred or bent.	• Replace as required.
	• Damaged driven gear.	• Replace driven gear.
	• Worn or damaged speedometer.	• Replace as required.
• Speedometer inoperative.	• Cable disconnected.	• Connect cable.
	• Cable core broken.	• Replace cable and core.
	• Bind in speedometer or tachometer.	• Replace as required.
	• Damaged driven gear.	• Replace as required.
• Speedometer/odometer inaccurate.	• Incorrect driven gear.	• Check speedometer and odometer over a measured mile. Check for proper driven gear to match axle ratio and tire size. Replace gear if necessary.
	• Incorrect drive gear.	• Check for proper drive gear for axle ratio and tire size. Replace gear if necessary.
	• Worn or damaged speedometer.	• Replace speedometer.
• Gauge reading inaccurate with IVR (instrument voltage regulator).	• Worn or damaged sender unit or poor ground.	• Perform gauge calibration test. Assure a good ground. Replace sender unit if necessary.
	• Worn or damaged IVR.	• Perform calibration test.
	• Worn or damaged gauge.	• Replace if necessary.
• Gauge inoperative with IVR (instrument voltage regulator). (Vehicle equipped with one gauge only)	• Poor sender unit ground.	• Assure good ground.
	• Worn or damaged sender unit.	• Perform IVR gauge calibration test. Replace sender unit.
	• Open circuit in wiring.	• Repair as required.
	• Open IVR.	• Replace IVR.
	• Worn or damaged gauge.	• Replace gauge.
• Gauge inoperative with IVR (instrument voltage regulator). (Vehicle equipped with more than one gauge.)	• If only one gauge inoperative:	• Perform gauge calibration test on inaccurate unit.
	• Poor sender unit ground.	• Assure good ground.
	• Worn or damaged sender unit.	• Replace sender unit.
	• Worn or damaged gauge.	• Replace gauge.
	• If all gauges inoperative or erratic, check IVR.	• Replace IVR.
• Brake warning light will not go out with ignition switch in on position.	• Low fluid levels in master cylinder.	• Add fluid as required, bleed brakes, check for leaks.
	• Grounded circuit.	• Remove connector from brake warning light switch — light should go out. If not repair grounded circuit.
	• Worn or damaged switch valve.	• Check to see if switch valve is centered. If not center switch valve.
	• Grounded switch terminals.	• Check switch terminals — should not be grounded. Replace if necessary.
	• Worn or damaged ignition switch.	• Perform ignition switch continuity test.
• Brake warning light does not light with ignition switch in start position.	• Worn or damaged brake warning switch.	• Replace switch.
	• Bulb burnt out.	• Replace bulb.
	• Open circuit in wiring.	• Repair as required.
	• Ignition switch.	• Adjust if possible. If not, replace switch.

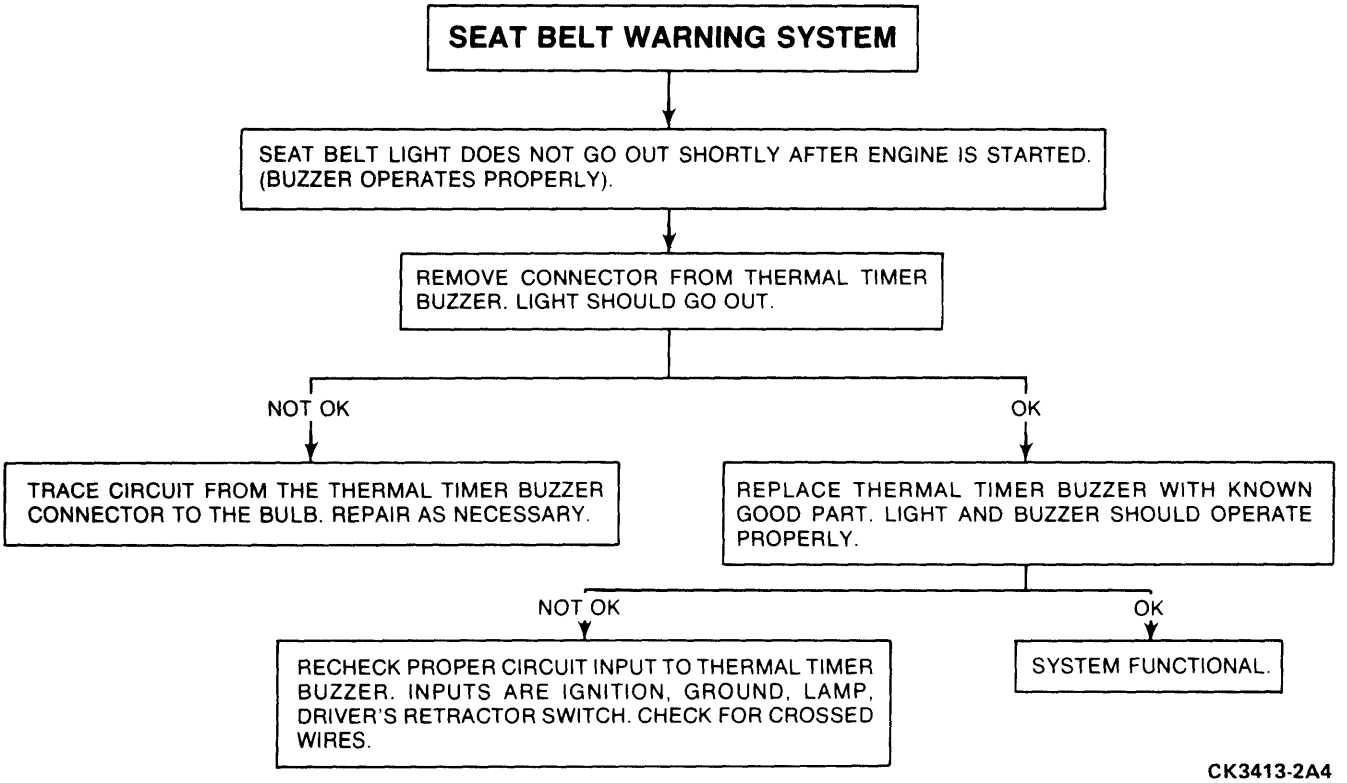
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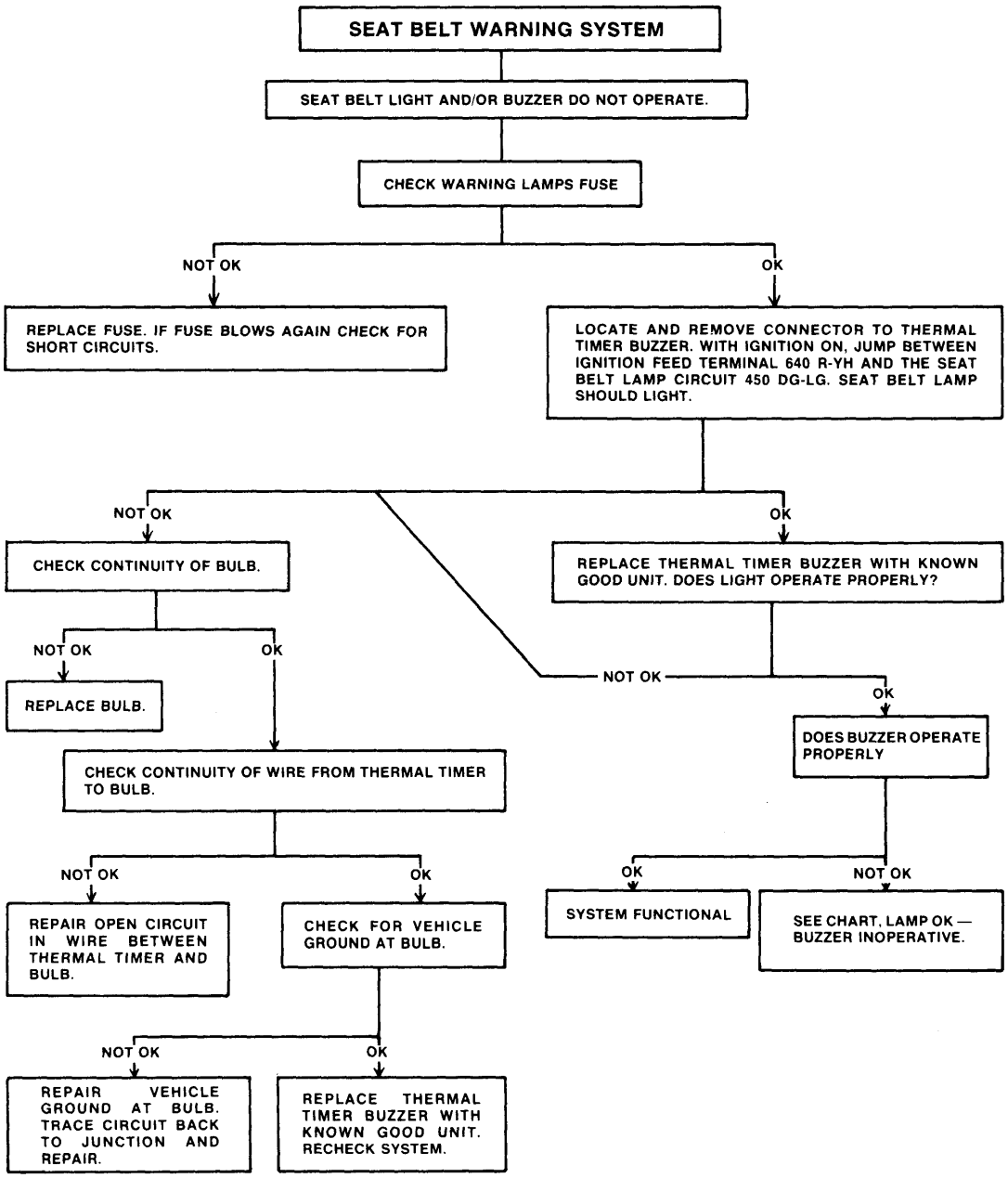
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Speedometer

PART 33-02

APPLIES TO BRONCO, F-100 — F-350 and E-100 — E-350

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Speedometer Core	02-2
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Speedometer Head F-100 through F-350, Bronco and E-100 — E-350	02-2
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DESCRIPTION AND OPERATION

SPEEDOMETER SYSTEM

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft (core), and a drive gear located inside the transmission. The core drives the speedometer which registers speed in miles per hour (also in Kilometers per hour) and also drives an odometer which records distance traveled in miles and tenths of a mile.

DIAGNOSIS AND TESTING

SPEEDOMETER ACCURACY TEST

To test the odometer accuracy, drive the truck over a measured mile. Speedometer accuracy can be checked by comparing the speedometer in question against one known to be accurate, while the two trucks are moving at the same speed or by timing the truck on a measured mile. The parts catalog shows the proper speedometer gears to use for various rear axle and tire size combinations.

SPEEDOMETER

Before removing a speedometer head, if possible, disconnect the cable at the head and insert a short section of cable core in the head. Rotate the section of core to check for any dragging or noise. If the rotation drags, is noisy, or does not turn freely and evenly, replace the speedometer.

SPEEDOMETER CABLE AND CORE

1. Visually inspect the speedometer cable for kinks, burrs, or abrasion. If evidence of any such damage is observed replace the speedometer cable.
2. Check the speedometer cable function as follows.
   a. Disconnect the speedometer cable at the speedometer head.
   b. Jack up the rear wheels, start the engine and check the speedometer core rotation at the meter end.
   c. If the core does not rotate, disconnect the cable from the transmission end.
   d. Twist the core, if it will not rotate or is binding replace the speedometer cable.
   e. Examine the driven gear. A scored, nicked or gouged, driven gear is usually indicative of a damaged drive gear on those vehicles that have the driven gear integral with the transmission output shaft. The output shaft should be carefully inspected for imperfections and replaced if necessary. A driven gear with two or three adjoining teeth badly scored is indicative of improper assembly procedure. The gear should be inserted in the transmission while simultaneously turning the driveshaft. This will ensure initial engagement and prevent gear damage. Force should never be used. Whenever a drive gear is replaced, a new driven gear should also be installed regardless of its apparent condition.
   f. Examine the core tip for breaking or fraying. If damaged replace.

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REMOVAL AND INSTALLATION

SPEEDOMETER HEAD

F-100 THROUGH F-350, BRONCO AND E-100—E-350 (Figs. 1, 2 and 3)

Removal

1. Remove the instrument cluster as outlined in Part 33-51.
2. Remove the lens and mask from the cluster. Disconnect the speedometer cable as described below. Remove the two speedometer attaching screws and remove the speedometer.

Installation

Position the speedometer to the back plate and install the two attaching screws. Install the mask and lens, then the instrument cluster. If a new speedometer is being installed, examine the square drive hole for sufficient lubrication. If lubricant is needed, apply a 3/16 inch diameter dab of B5AZ-19581-A lubricant or equivalent in the drive hole. Re-connect speedometer cable as described below.

SPEEDOMETER CABLE

VEHICLES WITHOUT SPEED CONTROL

Removal

1. Disconnect the speedometer cable from the speedometer (Fig. 4).
2. Push the cable and grommet through the dash panel opening, (Figs. 1, 2 and 3).
3. Disengage all cable clips in the engine compartment.
4. Raise the vehicle on a hoist.
5. Disengage all remaining cable clips.
6. Disengage the cable assembly from the transmission and remove from the vehicle.

Installation

1. Raise the vehicle on a hoist.
2. Select the proper cable for the vehicle, engine, and transmission as identified in the Truck Chassis Installation Manual.
3. Lubricate the cable core exposed at the transmission ferrule with B5AZ-19581-A lubricant or equivalent.
4. Apply a coating of ESA-M1C45-A or equivalent to the O-ring on the ferrule.
5. Install the driven gear on the ferrule.
6. Assemble the driven gear retainer to the driven gear with the retainer tabs towards the transmission end of the cable (Fig. 5).
7. Insert the driven gear into the transmission and retain by tightening the retaining screw to 20 to 25 in-lbs.
8. Engage the cable with clips/clamps at locations indicated by tape on the cable.
9. Lower the vehicle.
10. Route the cable through the dash panel opening.
11. Connect the speedometer cable to the speedometer head (Fig. 4).
12. Press the grommet into the dash panel opening and pull the excess cable from behind the instrument.
13. Secure the cable to the fender apron or firewall with the clip.

NOTE: The speedometer cable routing should avoid sharp bends; the cable should be straight for approximately 8 inches from the speedometer.

VEHICLES WITH SPEED CONTROL

Removal

1. Disengage the upper speedometer cable from the speedometer (Fig. 4).
2. Disengage the upper cable from the speed sensor (Figs. 1 through 3).
3. Push the cable and the grommet through the dash panel opening and remove from the vehicle.
4. Disengage all lower speedometer cable clips in the engine compartment.
5. Disengage the lower speedometer cable from the speed sensor.
6. Raise the vehicle on a hoist.
7. Disengage all remaining cable clips.
8. Disengage the cable assembly from the transmission and remove from the vehicle.

Installation

1. Perform steps 1 through 9 as described above for vehicles without speed control.
2. Attach lower speedometer cable to speed sensor, tighten to 30-40 in-lbs.
3. Push upper speedometer cable through the dash panel opening.
4. Secure the speedometer cable to the speedometer (Fig. 4).

   Routing of the speedometer cable should avoid sharp bends; the cable should be straight for approx. 8 inches from the speedometer.
5. Press the grommet into the dash panel opening and pull the excess cable from behind the instrument.
6. Attach the upper speedometer cable to the speed sensor. Tighten to 30-40 in-lbs.

SPEEDOMETER CORE

Removal

1. Disconnect the speedometer cable (core and casing assembly) from the speedometer head (Fig. 4).
2. Pull the speedometer core out of the upper end of the casing.
3. If the core is broken, raise the vehicle on a hoist and remove the bolt retaining the speedometer cable mounting clip to the transmission.
4. Remove the shaft and driven gear from the transmission (Fig. 5). Remove the driven gear retainer, and remove the driven gear and shaft from the cable.
5. Remove the lower part of the core (if it is broken) from the lower end of the casing.

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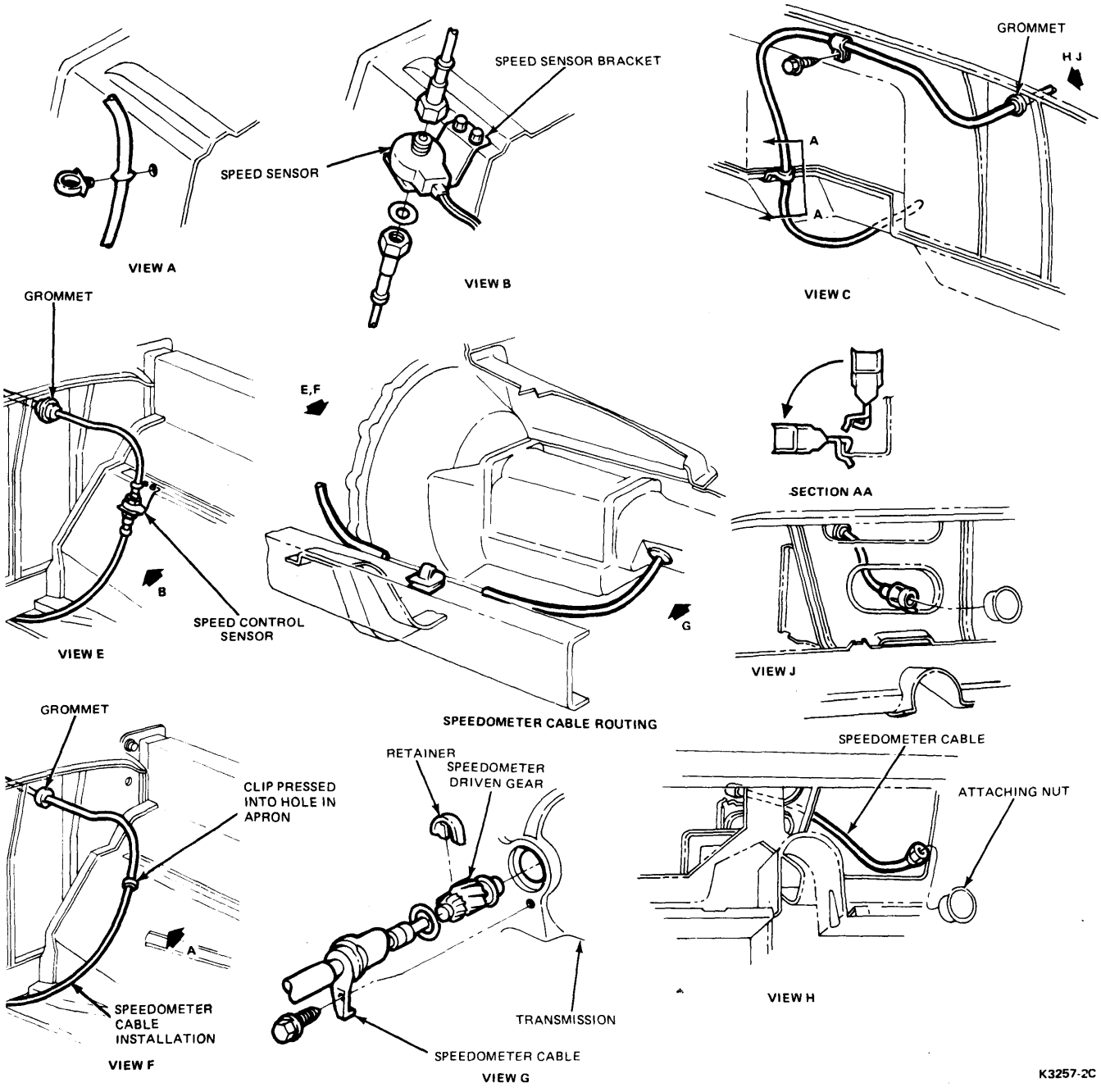


FIG. 1 F-100—F-350 (4x2) Speedometer Cable Installation

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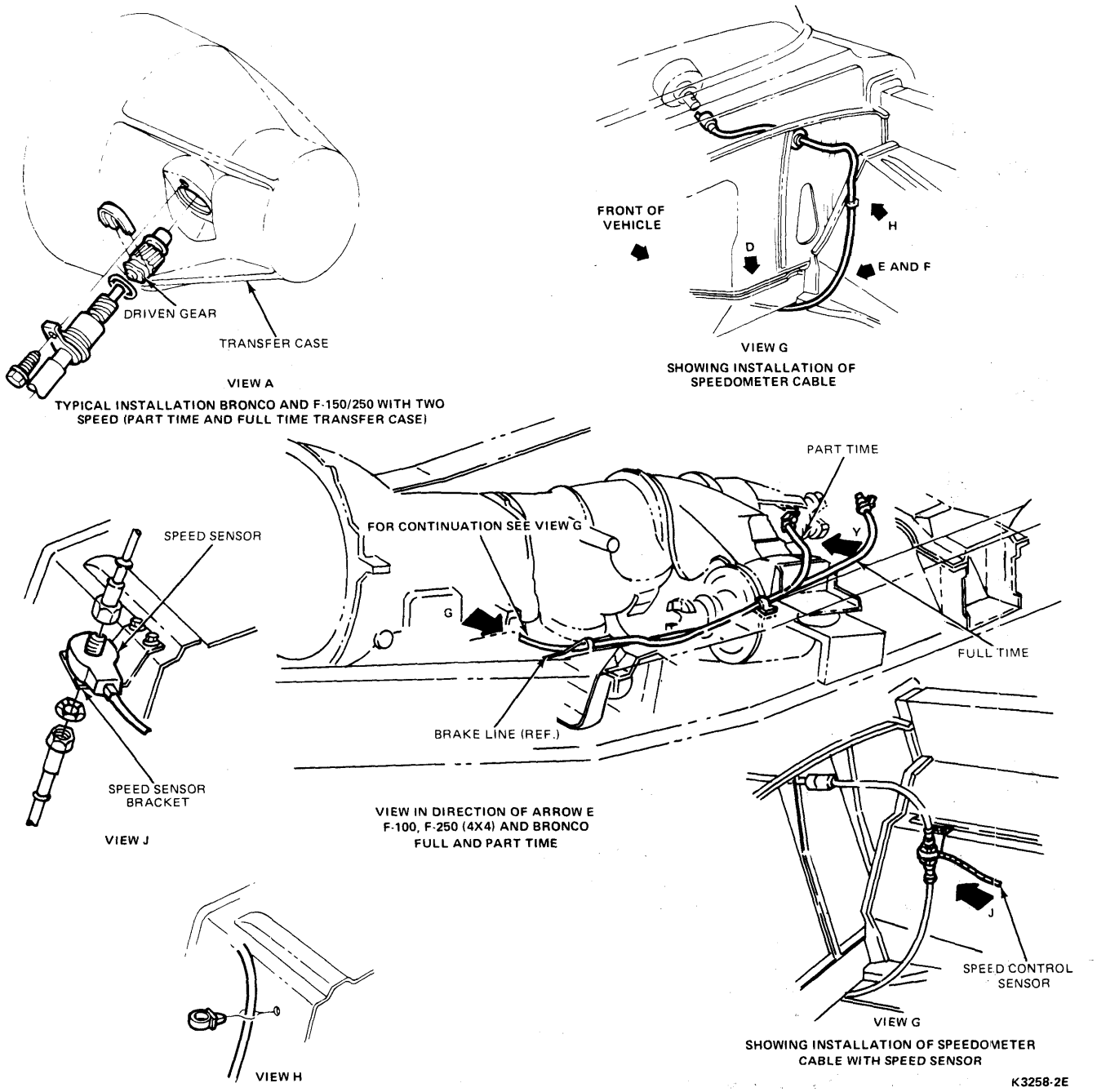


FIG. 2 F-150—F-250 (4X4) and Bronco Speedometer Cable Installation

Installation

1. Position the driven gear to the casing and install the gear retainer (Fig. 5). Install the driven gear and casing in the transmission, and install the retaining bolt. Lower the vehicle.
2. Using the Motor Craft Core Repair Kit, or equivalent, determine the exact length of the old core and cut the new core so that it is 13/16 inch shorter than the old core. (Do not cut from the squared end of the core.) Remove any burrs or frayed edges.
3. Install the tip on the core, making certain to seat the core in the bottom of the tip.
4. Place the core and tip in a crimping die, place the die on a solid surface and strike it squarely with a hammer to crimp it.
5. Remove the crimping die.
6. Lubricate the core with cable lubricant B5AZ-19581-A or equivalent (do not over lubricate). Install the core (square end first) into the upper end of the casing and push it all the way through to the transmission (Fig. 5). When the cable is nearly seated, twist it slightly to make sure that the squared end is engaged in the speedometer driven gear at the transmission.

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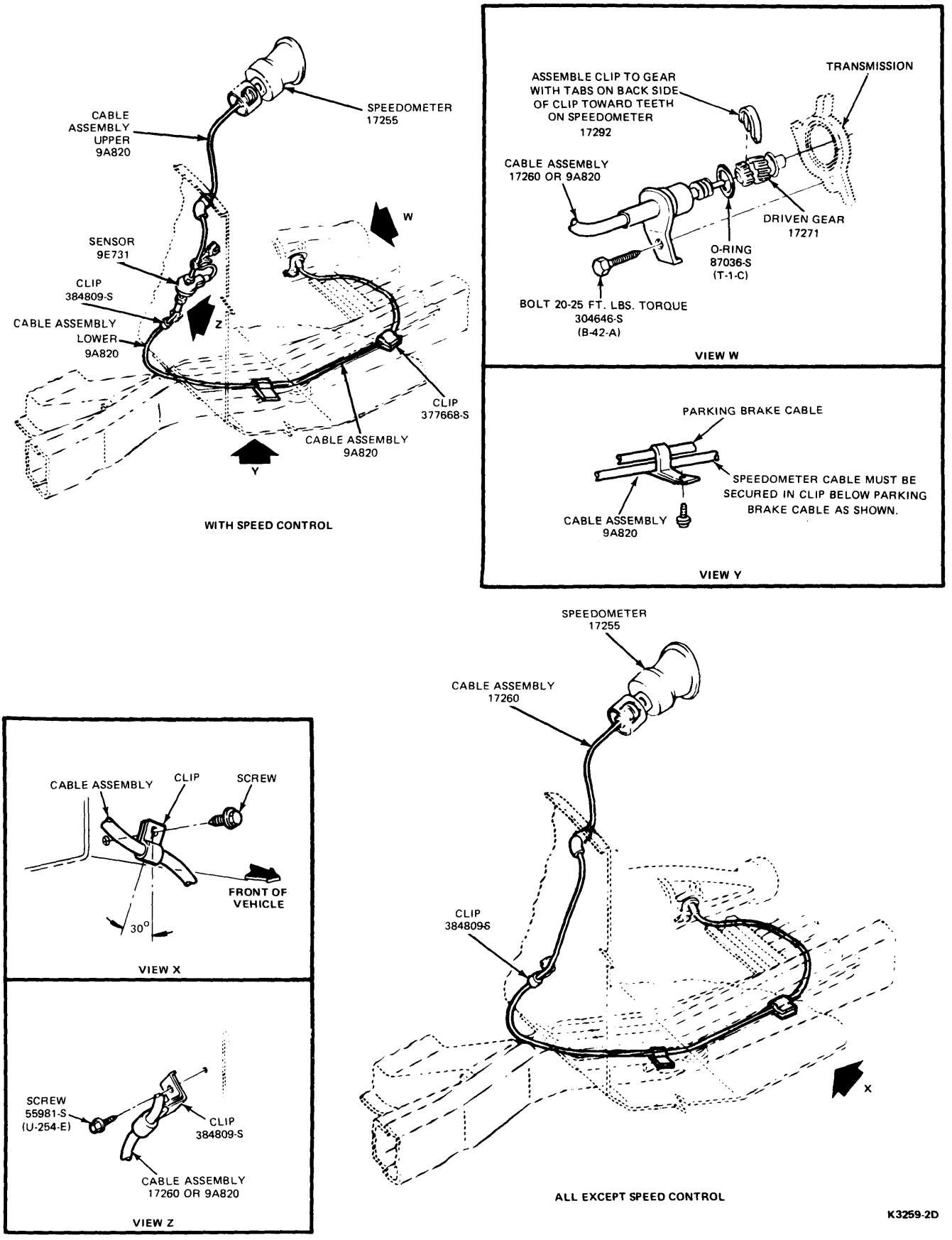


FIG. 3 E-100—E-350—Speedometer Cable Installation

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7. Connect the cable assembly to the speedometer, being sure to eliminate any kinks in the housing and shaft (Fig. 4). Check the operation of the speedometer.

SPEEDOMETER CORE AND CASING

F-100 THROUGH F-350, BRONCO, AND E-100—E-350

Disconnect the speedometer cable casing from the speedometer head, (Figs. 1, 2 and 3) and push the cable and grommet through the opening in the dash panel. Raise the vehicle on a hoist and disengage the cable from all retaining clips and/or clamps. Note the location of the various mounting clips, clamps, bolts and nuts and their relationship to the cable for reference during installation. Disconnect the cable assembly from the transmission (Fig. 5). Remove the assembly from the vehicle.

Lubricate the cable core sparingly with B5AZ-19581-A lubricant or equivalent and insert the core into the casing.

On vehicles where the cable is retained to the transmission by a mounting clip and bolt, transfer the driven gear and O-ring and coat with COAZ-19584-A lubricant or equivalent. Tighten the mounting clip bolt to Specifications.

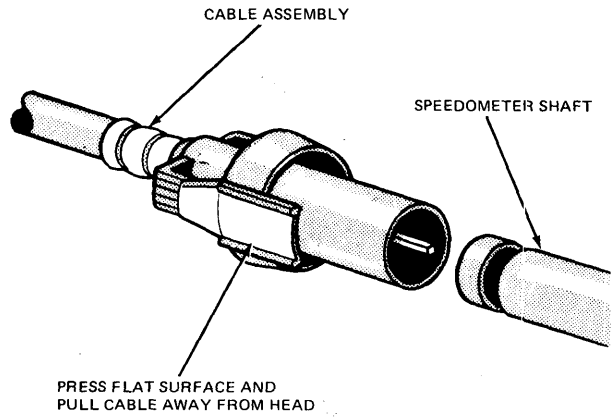


FIG. 4 Speedometer Cable Quick-Connect

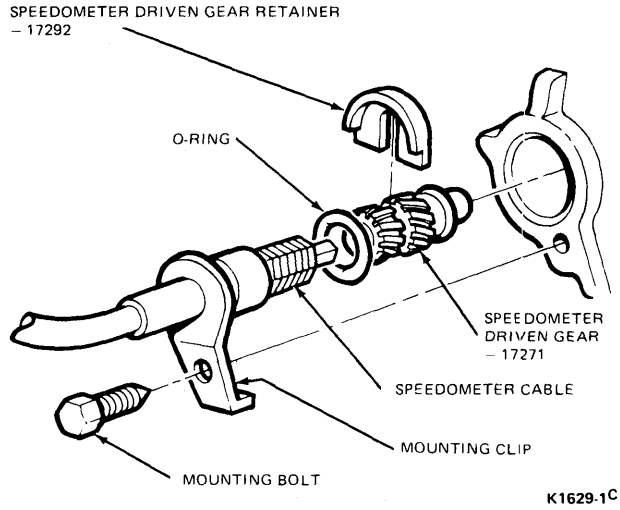


FIG. 5 Speedometer Driven Gear Mounting at Transmission

SPECIFICATIONS

SPEEDOMETER NUT TORQUE

Cable Nut at Speedometer Head, and Drive Adaptor at Transmission or Right Front Wheel	18-25 In-Lbs
Transmission Mounting Clip Bolt Torque	20-25 In-Lbs

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Charge Indicator — Light

PART 33-10

APPLIES TO BRONCO, F-100-F-350 AND E-100-E-350

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	10-1	REMOVAL AND INSTALLATION	10-1

DESCRIPTION AND OPERATION

CHARGE INDICATOR LIGHT SYSTEM

F-100 THRU F-350, BRONCO AND E-100—E-350

The Battery, Alternator, and Electronic Voltage Regulator make up the Charging System.

With the Ignition Switch in START or RUN, Battery current flows through the Alternator Warning Indicator into the Regulator at terminal 1, and to ground through the solid-state Indicator Switch. The Electronic Control measures a low voltage at Regulator terminal A, and closes the Field Switch. This applies battery voltage to the Field through Alternator terminal F.

With current in the Field and the rotor turning, the Alternator Stator produces a DC voltage at terminal B (to Battery) and terminal S. (Voltage at S is one-half voltage at B.)

A pre-set voltage at terminal S operates the Electronic Control to open the Indicator Switch, which removes ground from the Alternator Warning Indicator.

The Alternator output is controlled by the current in the Field. The average voltage on the Field depends on the percentage of time the Field Switch is closed. The Electronic Control closes the Field Switch when the voltage at A is low, and opens the switch when the voltage at A is high.

The Voltage Regulator holds the system voltage at about 14 volts. The average Alternator output is then any required value between zero and full current, depending on conditions sensed by the Voltage Regulator.

REMOVAL AND INSTALLATION

INDICATOR LIGHT

F-100 THRU F-350, BRONCO AND E-100—E-350

To remove the indicator bulb, reach up behind the instrument cluster, turn the bulb and socket assembly 1/4 turn counterclockwise and remove. To install, position the new bulb and socket assembly to the printed circuit and turn it clockwise 1/4 turn.

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Charge Indicator — Ammeter

PART 33-12

APPLIES TO ALL MODELS

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TESTING		E-100 — E-350	12-1
Shunt Type	12-1	F-100 — F-350 and Bronco	12-1

DESCRIPTION AND OPERATION

The ammeter is a gauge which senses the direction and rate of flow of electrical current to or from the battery to indicate whether the battery is being charged or discharged. A Shunt-type ammeter is used in Bronco, F-100 through F-350 and E-100—E-350.

TESTING

To test the ammeter, turn the headlights on with engine stopped. The meter pointer should move toward the D or discharge scale. If no movement of the needle is observed, check the battery to circuit breaker wire connections. If the connections are tight, and the meter does not indicate either a charge or a discharge, the meter is inoperative. Replace the meter.

SHUNT TYPE

If the meter pointer moves toward the C or charge scale when the headlights are turned ON, the wire connections at the meter are reversed. Connect the wires to the ammeter correctly after checking first to make sure that the battery is not reversed.

REMOVAL AND INSTALLATION

F-100 THROUGH F-350 AND BRONCO

Removal

1. Disconnect the battery ground cable.
2. Remove the instrument cluster assembly, as outlined in Part 33-51.
3. Remove the four screws that retain the mask and lens to the cluster backplate and remove the mask and lens.
4. Remove the insulator and two gauge retaining nuts and remove the gauge.

Installation

1. Position the gauge to the cluster backplate and install the two retaining nuts and insulator.
2. Position the lens and mask to the cluster backplate and install the four retaining screws.
3. Install the instrument cluster assembly as outlined in Part 35-51.
4. Connect the battery ground cable and check the operation of the gauge.

E-100—E-350

Removal

1. Disconnect the battery ground cable.
2. Remove the instrument cluster as outlined in Part 33-51.
3. Then remove the housing, lens and mask from the front of the cluster by removing the six retaining screws.
4. Remove the insulator from the ammeter terminals and the two retaining nuts.
5. Remove the ammeter from the backplate assembly.

Installation

1. Position the ammeter to the backplate assembly and install the two retaining nuts.
2. Insert the plastic insulator over the gauge terminals.
3. Install the mask, lens and housing with the eight retaining screws.
4. Install the instrument cluster to the instrument panel (Part 33-51).
5. Connect the battery ground cable and check the operation of the gauge.

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Fuel Indicating System

PART 33-20

APPLIES TO ALL MODELS

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DESCRIPTION AND OPERATION

FUEL LEVEL INDICATING SYSTEM

ALL MODELS

The fuel indicating system is a bimetal-resistance type system. It consists of an instrument voltage regulator, fuel indicator (gauge) mounted in the instrument cluster and a sender located in the fuel tank, (Fig. 1).

INSTRUMENT VOLTAGE REGULATOR

The instrument voltage regulator (IVR) used with the fuel indicator (gauge) controls and maintains an average pulsating voltage of 5.0 volts at the gauge terminals.

FUEL INDICATOR (GAUGE)

The fuel indicator gauge pointer is attached to a wire wound bimetal strip which when heated by the flow of electrical current controlled by the sender unit, produces the appropriate indication.

FUEL SENDER

The fuel sender consists of a variable resistor, controlled by the action of an attached float in the fuel tank. When the fuel is low, resistance in the sender is high and allows only a low current to flow through the indicator (gauge) windings, causing the pointer to move a short distance. When the fuel is high, the resistance in the sender is low and allows a higher current flow and a greater heating effect causing the pointer to move a greater distance.

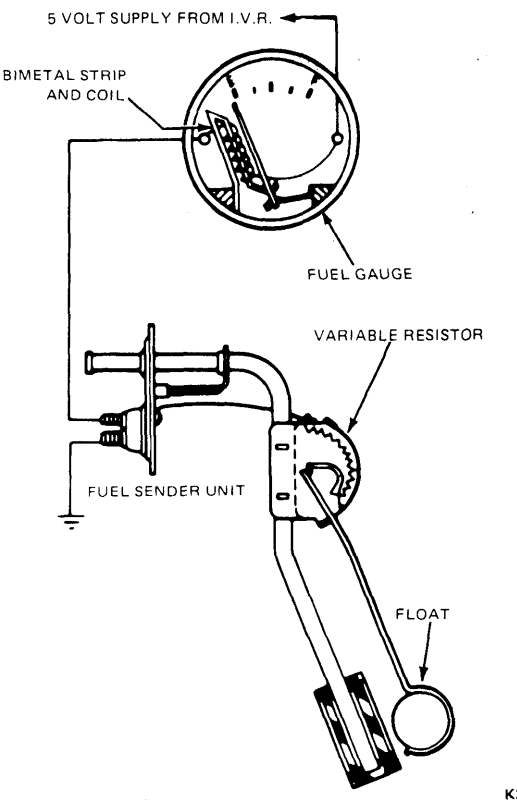


FIG. 1 Fuel Indicating System Using a Bimetal Gauge

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DIAGNOSIS AND TESTING

ALL MODELS

The Rotunda Instrument Gauge System Tester Model 21-0015 or equivalent is used to diagnose problems in all fuel indicating systems using the bimetal fuel indicator gauge and instrument voltage regulator (IVR).

Prior to performing fuel system test the following tester checks should be made.

1. Set tester switch at IVR Check position.
2. Attach tester ground wire to the negative (-) terminal of 12-volt battery and touch one of the tester terminals marked with an arrow to the positive (+) battery terminal.
3. If the IVR Check light does not come on return tester for service or replacement.

TEST SET-UP

Caution: During in-vehicle tests, do not let tester terminal studs designated by arrows come in contact with vehicle ground. The fuel gauge will be shorted to ground, preventing an accurate test and possibly damaging the IVR or gauge.

1. Disconnect connector from fuel sender and hook onto the matching terminals on the tester, (Fig. 2).
2. Turn vehicle ignition switch to accessory position.

FUNCTIONAL TEST

NOTE: The IVR also supplies a common regulated voltage for the temperature gauge indicating system and oil gauge indicating system (when applicable) therefore, the IVR can only be worn or damaged if the other gauges exhibit similar problems (fluctuating movement or high or low indications at the upper calibration band). The IVR has little affect on the lower calibration band indicator.

1. Set tester switch to IVR Check position.
2. If IVR Check light flashes on and off, the IVR and wiring are functional. Proceed to calibration check.
3. If IVR Check light is on steady, check IVR ground screw. If ground screw is secure, replace IVR.
4. If IVR Check light does not come on check for open circuit in gauge and/or circuit wiring.

   Note: If IVR Check light does not come on also check plug-in connector at the instrument cluster printed circuit for proper insertion. A poor tester ground connection will prevent the IVR Check light from coming on. Also check for rusted or corroded terminals on the connector at the fuel sender and on the fuel sender-unit terminals.

CALIBRATION CHECK

With the tester switch in either the High or Low position, the center line of the gauge pointer should be within the "F" or "E" white band of the graphics for the fuel test function as shown on the tester. If the center line of the pointer registers in the white bands, the fuel indicating system is operating properly and replacement of the fuel sender is necessary. If the pointer center line falls outside the "E" white band, replace the fuel gauge. If the pointer center line falls outside the "F" white band, replace the IVR and retest. If still outside the upper white band, replace the fuel gauge and re-install the original IVR.

FUEL TANK DAMAGE

If fuel indicating system components are functioning properly and inaccurate indications continue, check the fuel tank for damage which may have changed the fuel sender mounting angle and/or damaged the fuel sender.

FUEL SELECTOR VALVE

F-100-F-350, BRONCO AND E-100—E-350 WITH AUXILIARY FUEL TANK

The electrically actuated fuel selector valve is spring loaded to feed the main tank to pump outlet operating mode when activated by a minimum of 9.5 volts direct current. When using the following Diagnosis Guide, make certain that both tanks contain some useable fuel.

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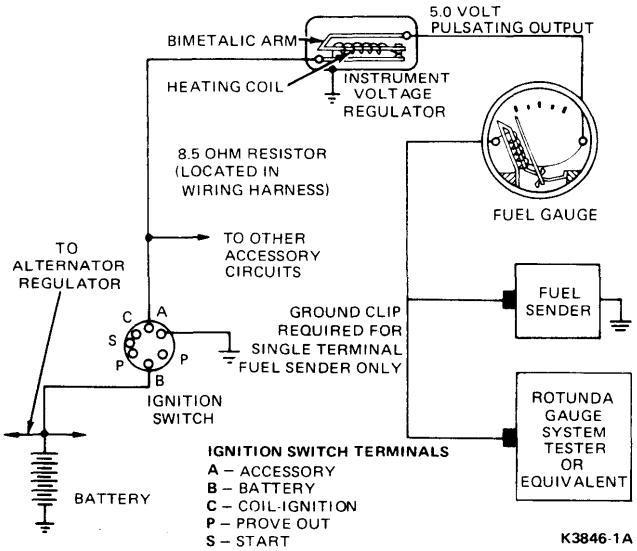
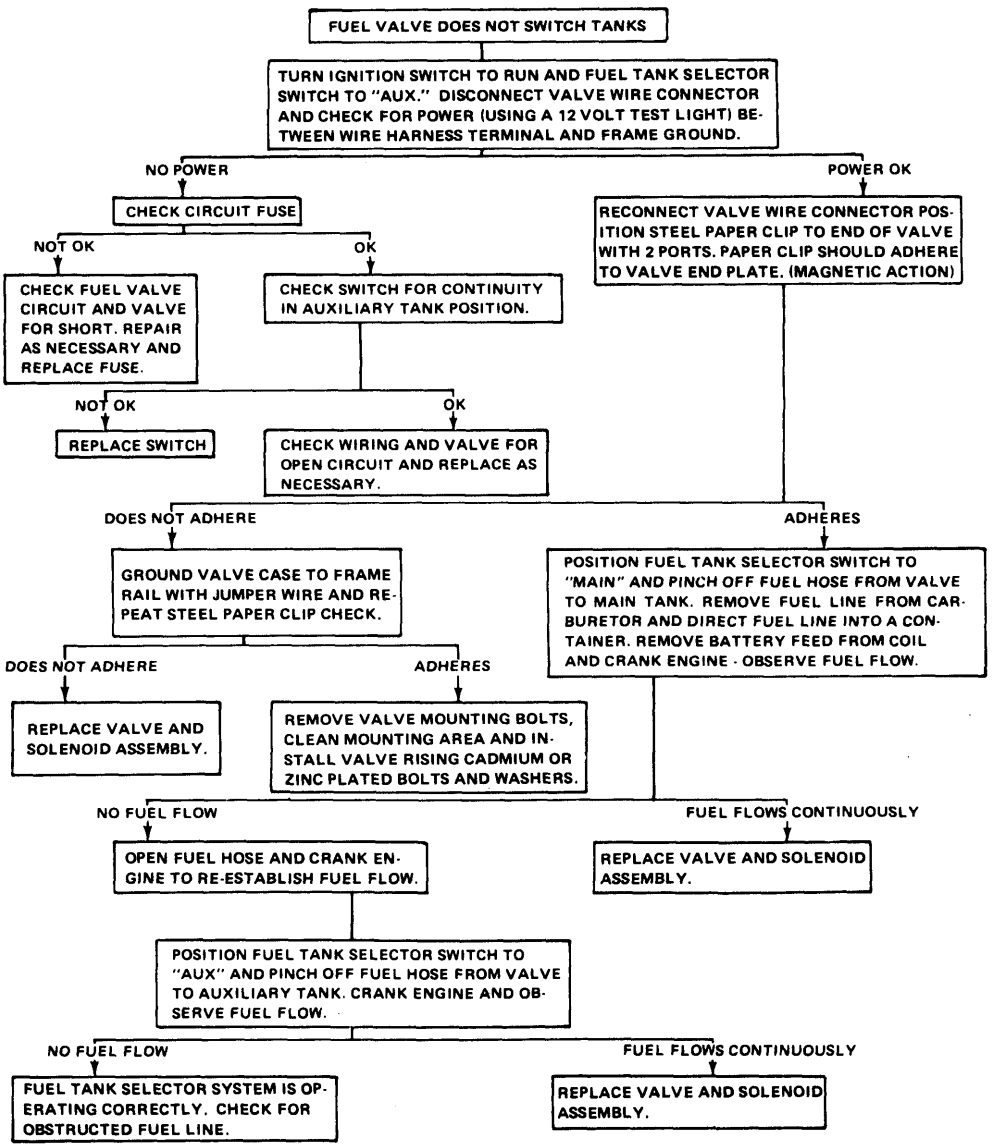


FIG. 2 Fuel Indicating System Test

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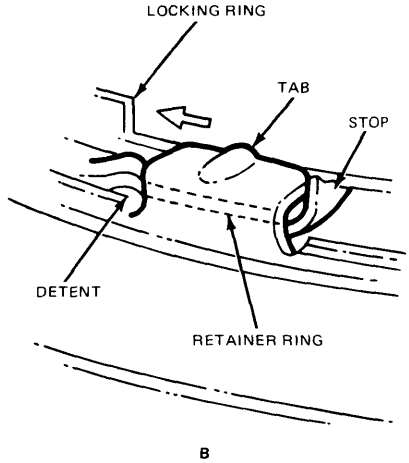
REMOVAL AND INSTALLATION

SENDING UNITS SECURED WITH METAL LOCKING RING

1. Remove the fuel from the fuel tank.
2. Disconnect the wiring connector from the fuel system sender.
3. Remove any dirt that has accumulated around the sender so that it will not enter the tank or lines.
4. Loosen the hose clamp and disconnect the fuel tank line at the sender.
5. Turn the fuel sender locking ring counterclockwise with Tool No. T74P-9275-A (or equivalent) and remove the locking ring, sender and sealing gasket.
6. Clean the fuel sender mounting surface on the fuel tank.
7. Place a new sealing gasket in the groove of the fuel tank. Install the fuel sender into the fuel tank so that the tabs of the sender are positioned into slots of the fuel tank. The sealing gasket must remain in place during and after fuel sender installation (Fig. 3-A).
8. Holding the fuel sender and sealing gasket in place, install and rotate the locking ring clockwise until the stop is against the retainer ring tab (Fig. 3-B).
9. Connect the fuel sender wire and the fuel tank line.
10. Fill the tank with the fuel removed and check the fuel gauge operation while filling the tank, check for leaks.

SENDING UNITS SECURED WITH PLASTIC LOCKING RING

1. Remove fuel from the fuel tank.
2. Disconnect the wiring connector from the fuel sender.
3. Remove any dirt that has accumulated around the sending unit so that it will not enter the tank or lines.
4. Loosen the hose clamp and disconnect the fuel line at the sender.
5. Turn the fuel sending locking ring counterclockwise with a band-type oil filter wrench, or equivalent. Remove the locking ring fuel sender and sealing gasket.
6. Clean the fuel gauge sending unit mounting surface at the fuel tank.
7. Place a new sealing gasket in the groove of the fuel tank. Install the fuel sender into the fuel tank so that the tabs of the sender are positioned into the slots of the fuel tank. The sealing gasket must remain in place during and after fuel sender installation (Fig. 4).
8. Holding the fuel sender and sealing gasket in place, install and rotate the plastic locking ring clockwise until handtight. Using the service wrench, rotate the locking ring further until a torque of 13-20 ft-lbs is obtained.
9. Connect the wire and the fuel line.



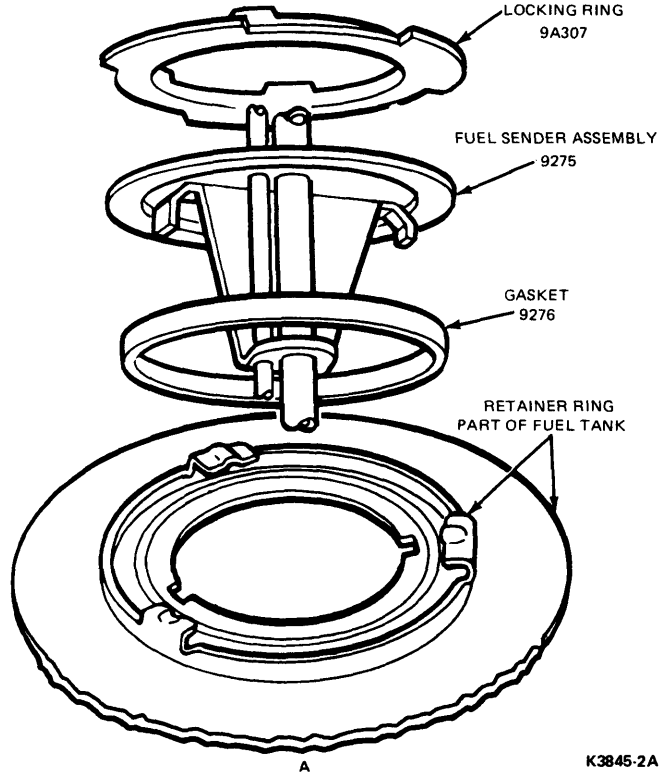


FIG. 3 Fuel Tank Sender Installation (Metal Lock Ring Type)

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10. Fill the tank with the fuel removed and check the fuel gauge operation. While filling the tank, check for leaks.

FUEL GAUGE

F-100 Thru F-350 Bronco and E-100—E-350

Disconnect the battery ground cable. Remove the instrument cluster as outlined in Part 33-51. Remove the lens and mask from the cluster. Remove the two nuts attaching the gauge to the cluster, and remove gauge. To install, reverse the removal procedure and check gauge operation.

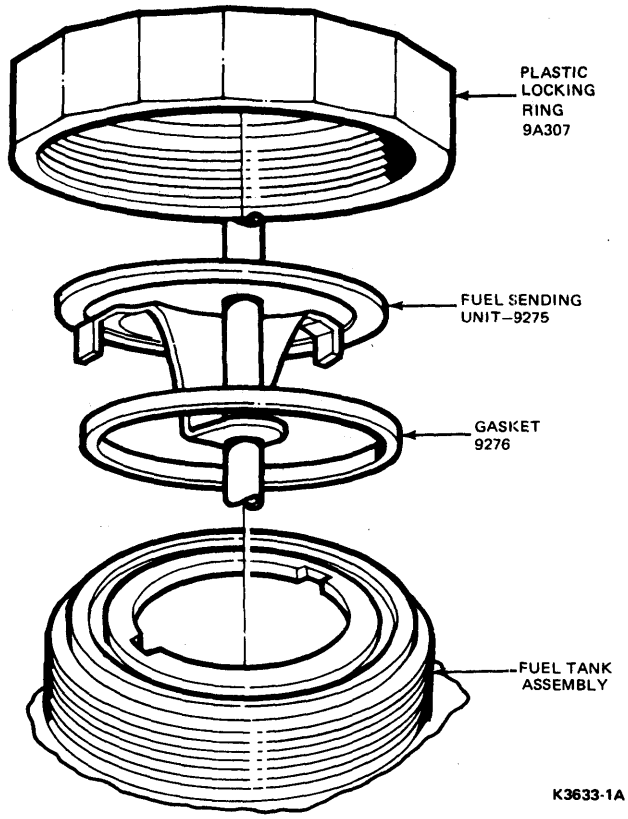


FIG. 4 Fuel Tank Sender Installation (Plastic Locking Ring Type)

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Oil Pressure Indicator — Light

PART 33-30

APPLIES TO ALL MODELS

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System Testing	30-1
REMOVAL AND INSTALLATION	
Indicator Light	30-2
Sending Unit Switch	30-1

DESCRIPTION AND OPERATION

SYSTEM OPERATION

A red indicator light glows when the oil pressure is below a safe value. The light should come on when the ignition switch is first turned to the R or run position. The indicator light should go out after the engine is started, indicating that the oil pressure has reached a safe value.

The light is connected between the oil pressure switch unit (mounted on the engine) and the coil terminal of the ignition switch (Fig. 1).

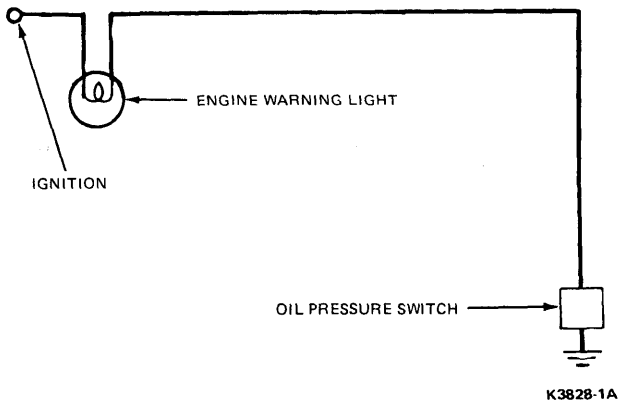


FIG. 1 Oil Pressure Indicator—Light System

TESTING

SYSTEM TESTING

To test the indicator light, turn on the ignition switch. Do not start the engine. The light should come on. Start the engine. The light should go out "within a few seconds after the engine starts," indicating that the oil pressure has built up to a safe value.

To test the oil pressure switch on the engine, turn the ignition switch on with the engine not running. The indicator light should come on. If the indicator light does not come on, "disconnect the wire from the oil pressure switch terminal and connect this wire to the ground." If the light now comes on, the oil pressure switch is inoperative. Replace the oil pressure switch. **If the light does not come on, with the wire to ground, either the bulb is burned out, there is no power to the bulb or the circuit is open somewhere between the ignition switch and the oil pressure switch.**

REMOVAL AND INSTALLATION

SENDING UNIT SWITCH

The oil pressure switch units are mounted in different ways and locations. Figs. 2 and 3 are typical examples.

To remove the switch unit, disconnect the wire at the unit terminal and unscrew the unit from its mounting. Install the new switch unit (tighten to 8-18 ft-lbs) connect the wire to the unit terminal, and check the operation of the unit. **Be sure to use Teflon tape (D0AZ-19554-C or equivalent), or electrically conductive water resistant sealer C3AZ-19554-B or equivalent, on the threads of the unit. The pressure switch type unit used with the indicator light system is not interchangeable with the variable resistance type unit, "called a sender," used with the gauge system. Refer to the parts catalog for proper parts usage. Installation of the wrong part will result in an inoperative oil pressure indicating system and a damaged sender unit or gauge.**

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INDICATOR LIGHT

To remove the indicator bulb, turn the bulb and socket assembly 1/4 turn counterclockwise and remove.

To install, position the new bulb and socket assembly to the printed circuit and turn it clockwise 1/4 turn.

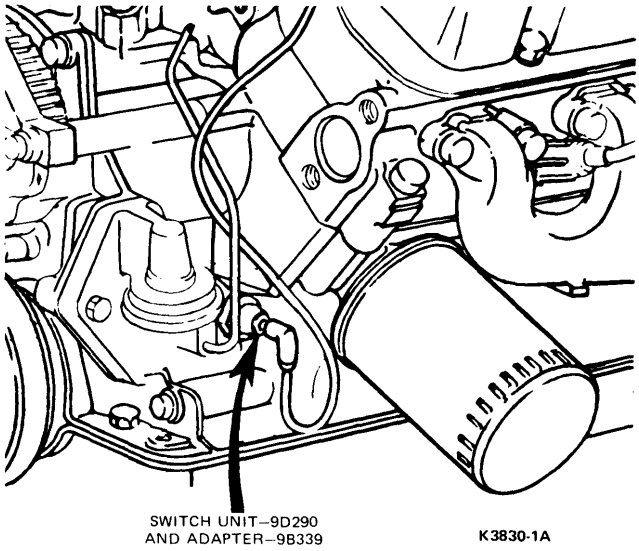


FIG. 2 Oil Pressure Switch—8-Cylinder Typical

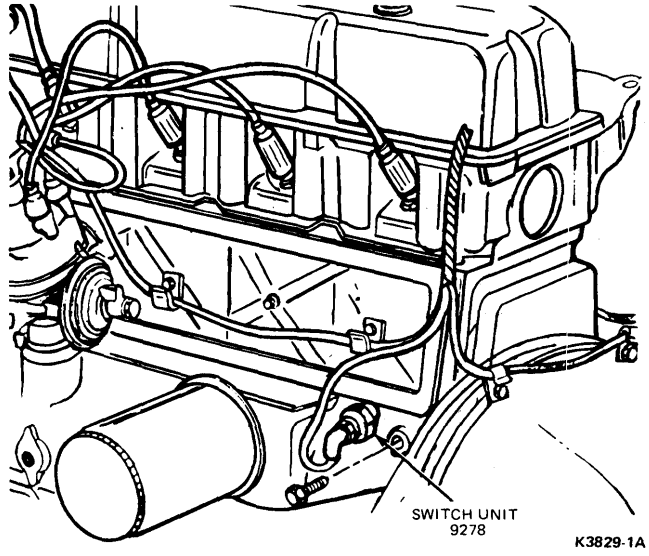


FIG. 3 Oil Pressure Switch 6-Cylinder Typical

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Oil Pressure Gauge

PART 33-32

APPLIES TO ALL MODELS

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Calibration Check	32-2
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Oil Pressure Gauge	
E-100 — E-350	32-2
F-100 — F-350 and Bronco	32-2
Sending Unit	32-2
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DESCRIPTION AND OPERATION

SYSTEM OPERATION

ELECTRICAL GAUGE SYSTEM

The oil pressure gauge indicating system consists of the instrument voltage regulator (IVR), an oil pressure indicating gauge and an oil pressure sending unit, all connected in series. The sending unit consists of a diaphragm, a contact and a variable resistor. The oil pressure causes the diaphragm to move the contact on the variable resistor thus controlling the flow of current through the gauge.

When the oil pressure is low, the resistance of the sending unit is high, thus restricting the flow of current through the gauge which moves the pointer only a short distance. As the oil pressure increases, the resistance of the sending unit decreases, causing a proportionately increased flow of current and movement of the pointer.

DIAGNOSIS AND TESTING

ELECTRICAL GAUGE SYSTEM

The Rotunda Instrument Gauge System Tester (model 210015) or equivalent is used to diagnose problems in all oil pressure indicating systems using a gauge and instrument voltage regulator (IVR).

Prior to performing oil pressure system test the following tester checks should be made:

1. Set tester switch at IVR Check position.
2. Attach tester ground wire to the ground terminal (-) of 12-volt battery and touch one of the tester terminals marked with an arrow to the positive terminal (+) of the battery.
3. If the IVR Check light does not come on return tester for service or replacement.

TEST SETUP

Caution: During test do not let tester terminal studs designated by arrows come in contact with vehicle ground. The oil pressure gauge will be shorted to ground, preventing an accurate test and possibly damaging the IVR or the gauge.

1. Disconnect connector for oil pressure sender and connect the matching terminals on the tester (Fig. 1).
2. Attach tester ground wire to vehicle frame.
3. Turn vehicle ignition switch to accessory position.

FUNCTIONAL TEST OF IVR

NOTE: The IVR is common to Fuel Gauge and Temperature Gauge so that if it is damaged, all Systems will show the same fault.

1. Position tester switch to IVR check.
2. If IVR Check light flashes on and off the IVR and wiring are functional, proceed to calibration check.
3. If IVR Check light is on steady check IVR ground screw. If ground screw is secure replace IVR.
4. If IVR Check light does not come on gauge and/or wiring is open circuit.

NOTE: If IVR Check light does not come on also check plug-in connector at printed circuit for proper insertion. A poor tester ground connection will prevent the IVR Check light from coming on. Also

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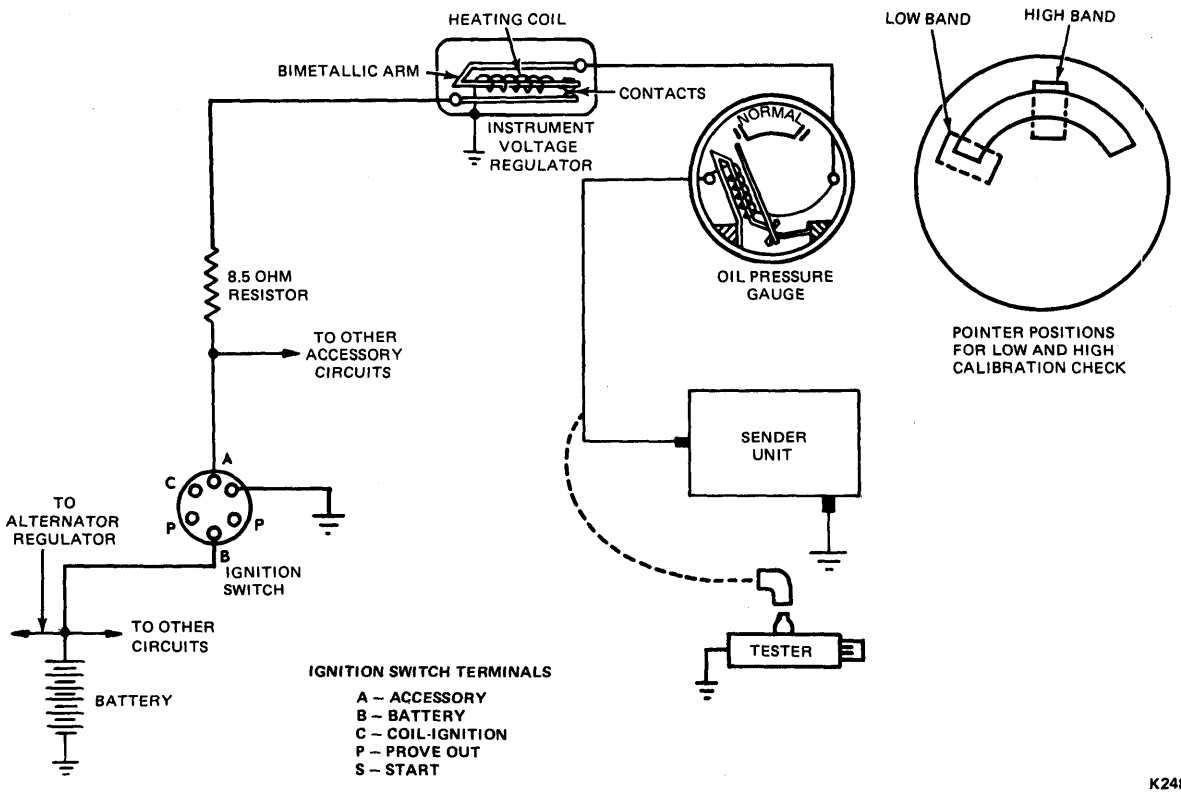


FIG. 1 Instrument Voltage Regulator and Gauge System Test

check for rusted or corroded terminals on the connector at the oil pressure sender.

CALIBRATION CHECK

With the tester switch in either the High or Low position the center line of the gauge pointer should be within the designated white band of the graphics for the oil pressure test function as shown on the tester after two minutes (Fig. 1). If the center line of the pointer registers in the white band the oil pressure indicating system is operating properly and replacement of the oil pressure sending unit is necessary. If the pointer line falls outside the low band, replace the gauge. If the pointer centerline falls outside the HIGH band, replace the IVR and repeat the test. If the centerline is still outside the HIGH band, replace the gauge.

Note: If a tester is not available, a 73 ohm resistor may be used to check the LOW band and a 22.8 ohm resistor to check the HIGH band.

REMOVAL AND INSTALLATION

SENDING UNIT

The oil pressure sending units are mounted in different ways and locations. Figs. 2 and 3 are typical examples.

To remove the sending unit, disconnect the wire at the unit terminal and unscrew the unit from its mounting. Install the new sending unit and tighten to 8-18 ft. lbs. Connect the wire to the unit terminal and check the operation of the unit. **Be sure to use electrically conductive water resistant sealer C3AZ-19554-B or equivalent on the threads of the unit. The pressure switch type unit used with the indicator light system is not interchangeable with the variable resistance type unit called a sender, which is used with the gauge system. Refer to the parts catalog for proper parts usage. Installation of the wrong part will result in an inoperative oil pressure indicating system and a damaged sender unit, IVR or gauge.**

OIL PRESSURE GAUGE

E-100—E-350

Remove the instrument cluster as outlined in Part 33-51. Then remove the housing, mask and lens from the front of the cluster by removing the retaining screws. Remove the oil pressure gauge retaining nuts and remove the gauge. To install, position the oil pressure gauge and install the retaining nuts. Install the mask, lens and housing to the front side of the cluster and install the retaining screws.

F-100 Through F-350 and Bronco

Remove the instrument cluster as outlined in Part 33-51. Then, remove the lens and mask from the cluster. Remove the plastic insulation and the two nuts attaching the gauge to the cluster, and remove the gauge. To install, reverse the removal procedure.

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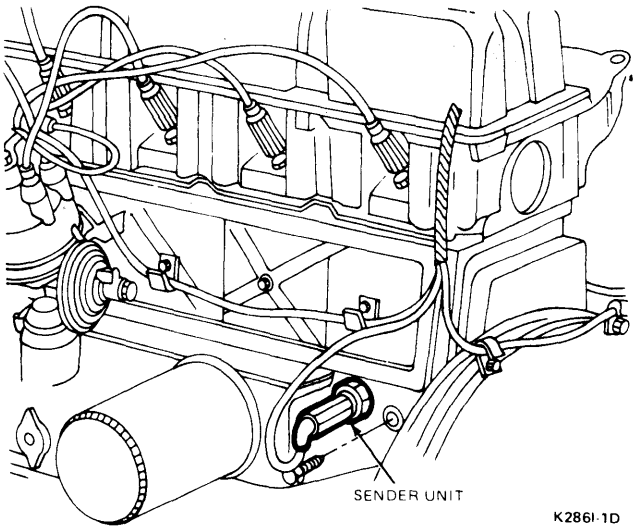


FIG. 2 Oil Pressure Sender Unit—6-Cylinder Typical

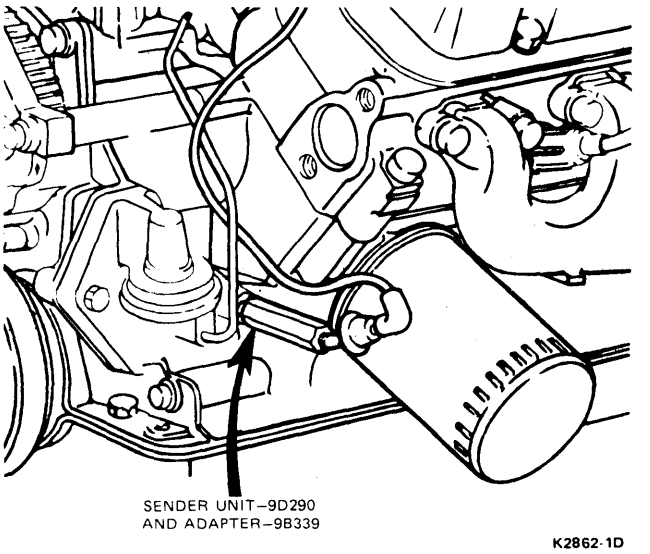


FIG. 3 Oil Pressure Sender Unit 8-Cylinder Typical

SPECIFICATIONS

SPECIAL SERVICE TOOL

Model	Description
210015	Instrument Gauge System Tester

CK3844-1A

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Temperature Indicator

PART 33-41

APPLIES TO ALL MODELS

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REMOVAL AND INSTALLATION	
Temperature Gauge F-100 — F-350 and Bronco	41-2
Temperature Sending Unit	41-2
SPECIFICATIONS	41-3

DESCRIPTION AND OPERATION

TEMPERATURE GAUGE SYSTEM

The temperature indicating system consists of a sending unit mounted in the cylinder head, the engine block, or the intake or in the manifold, and a temperature gauge mounted on the instrument panel. When the engine temperature is low, the resistance of the sending unit is high, thus restricting the flow of current through the gauge which moves the pointer only a short distance (Fig. 1). As the temperature of the engine increases, the resistance of the sending unit decreases causing a proportionately increased flow of current and movement of the pointer.

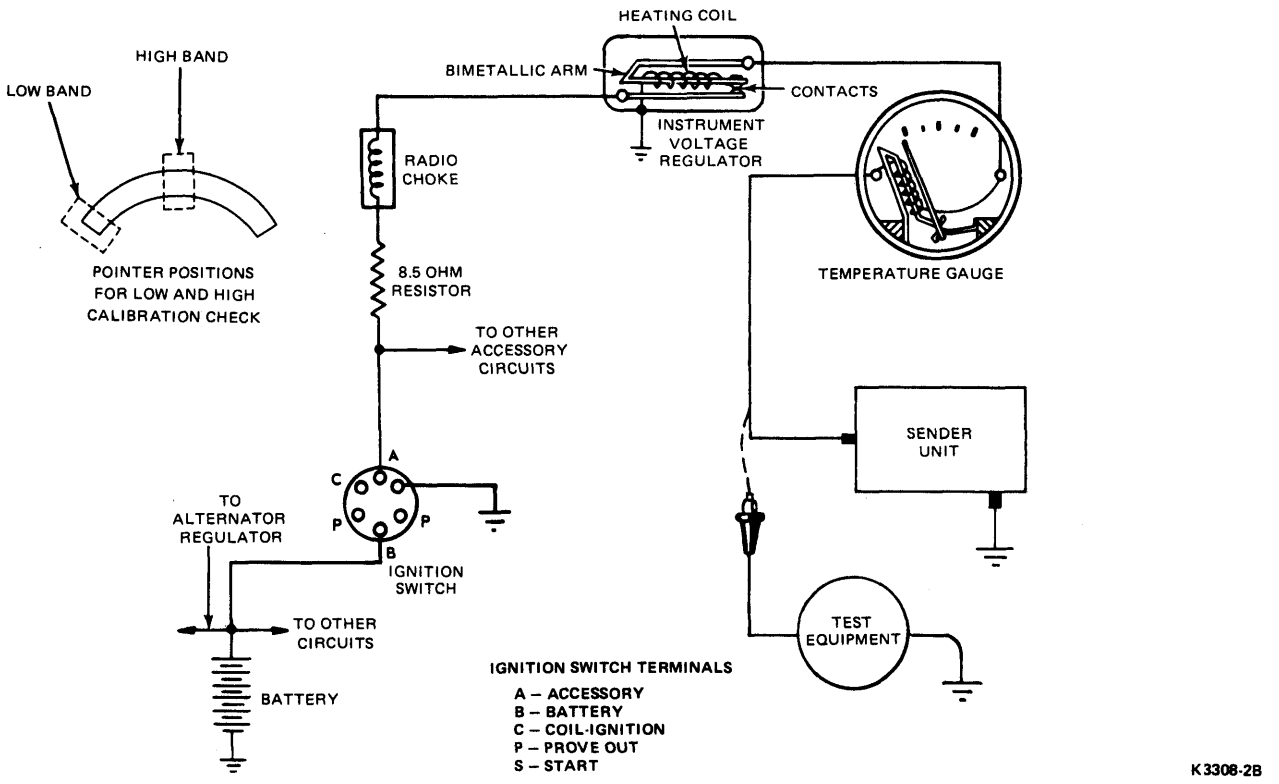


FIG. 1 Instrument Voltage Regulator and Temperature Gauge Test

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DIAGNOSIS AND TESTING

The Rotunda Instrument Gauge System Tester (model 210015) or equivalent is used to diagnose problems in all temperature indicating systems using the bimetal fuel indicator gauge and instrument voltage regulator (IVR).

Prior to performing temperature indicating system test the following tester checks should be made:

1. Set tester switch at IVR Check position.
2. Attach tester ground wire to one side of 12-volt battery and touch one of the tester terminals marked with an arrow to the other battery terminal.
3. If the IVR Check light does not come on return tester for service or replacement.

TEST SETUP

Caution: During test do not let tester terminal studs designated by arrows come in contact with vehicle ground. The temperature gauge will be shorted to ground, preventing an accurate test and possibly damaging the gauge.

1. Disconnect connector for temperature sender and hook onto the matching terminals on the tester (Fig. 1).
2. Attach tester ground wire to vehicle frame.
3. Turn vehicle ignition switch to accessory position.

FUNCTIONAL TEST OF IVR

NOTE: The IVR is common to fuel and oil gauge (when present) so that if it is damaged all systems will show the same fault.

1. Position tester switch to IVR Check.
2. If IVR Check light flashes on and off the IVR and wiring are functional, proceed to calibration check.
3. If IVR Check light is on steady check IVR ground screw. If ground screw is secure replace IVR.
4. If IVR Check Light does not come on gauge and/or wiring is open circuit.

Note: If IVR Check light does not come on also check plug-in connector at printed circuit for proper insertion. A poor tester ground connection will prevent the IVR Check light from coming on. Also check for rusted or corroded terminals on the connector at the temperature sender and on the fuel sender terminals.

CALIBRATION CHECK

With the tester switch in either the High or Low position the center line of the gauge pointer should be within the white band of the graphics for the temperature level test function as shown on the tester. If the center line of the pointer registers in the white band the temperature indicating system is operating properly and replacement of the temperature sender unit is necessary. If the center line falls outside the high white band replace IVR and retest. If the pointer is outside the low white band, replace the gauge and retest.

COOLANT WARNING

If the temperature indicating system is still not indicating properly check the engine coolant level to make certain that coolant level is still at full point. Also verify that thermostat is operating and that fan belt tension is within specification.

GAUGE BENCH TEST FOR OPEN WINDINGS

To test the gauge for open windings, remove the gauge from the vehicle. Connect the gauge to an ohmmeter and read the resistance. An upward movement of the needle from 10 to 14 ohms is normal, because the current increases the temperature of the gauge coil (windings). If the ohmmeter reads below 10 ohms or above 14 ohms, replace the gauge.

REMOVAL AND INSTALLATION

TEMPERATURE SENDING UNIT

1. Remove cap from radiator to relieve any pressure and then replace cap. This reduces coolant loss during sender replacement.
2. Disconnect the temperature sending unit wire at the sending unit.
3. Prepare the new temperature sending unit for installation by applying Teflon tape D0A2-19554-2 or equivalent, or a small amount of electrically conductive sealer C3AZ-19554-B or an equivalent sealer to the threads.
4. Remove the temperature sending unit from the cylinder head and immediately install the new temperature sending unit. Tighten to 8-18 ft-lbs.
5. Connect the wire to the temperature sending unit.
6. Refill cooling system to replace lost coolant.
7. Start the engine and check the sending unit operation.

TEMPERATURE GAUGE

F-100 THROUGH F-350 AND BRONCO

Remove the instrument cluster as outlined in Part 33-51. Then, remove the lens and mask from the cluster. Remove the two nuts attaching the gauge to the cluster, and remove gauge. To install, reverse the removal procedure.

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SPECIFICATIONS

SPECIAL SERVICE TOOL

Model	Description
210015	Instrument Gauge System Tester

CK3844-1A

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Instrument Cluster and Printed Circuit

PART 33-51

APPLIES TO ALL MODELS

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Instrument Voltage Regulator and Printed Circuit	
F-100-350, Bronco and E-100 — E-350	51-3

REMOVAL AND INSTALLATION

CLUSTER ASSEMBLY

E-100—E-350

Removal

1. Disconnect the battery ground cable.
2. Remove two steering column shroud to panel retaining screws and remove shroud.
3. Loosen bolts which attach the column to the Band C Support to provide sufficient clearance for cluster removal. (Required for tilt steering column vehicles only).
4. Remove seven instrument cluster to panel retaining screws (Fig. 1).
5. Position cluster part away from the panel for access to the back of the cluster to disconnect the speedometer.

   If there is not sufficient access to disengage the speedometer cable from the speedometer; it may be necessary to remove the speedometer cable at the transmission and pull cable through cowl, to allow room to reach the speedometer quick disconnect.
6. Disconnect the harness connector plug from the printed circuit board and remove the cluster assembly from the instrument panel.

Installation

1. Apply approximately 3/16 inch diameter ball of C5AF-19581-A Silicone lubricant or equivalent in the drive hole of the speedometer head.
2. Position the cluster near its opening in the instrument panel.
3. Connect the harness connector plug to the printed circuit board.
4. Connect the speedometer cable (quick disconnect) to the speedometer head.

   Connect the speedometer cable and housing assembly to the transmission (if removed).
5. Install the seven instrument cluster-to-panel retaining screws and connect the battery ground cable.
6. Check operation of all gauges, lights, and signals.
7. Reinstall the steering column following instructions as detailed in Part 13-42.
8. Position steering column shroud to instrument panel and install two screws.

F-100 THROUGH F-350 AND BRONCO

Removal

1. Disconnect the battery ground cable.
2. Remove the radio knobs from the radio shafts (if so equipped).
3. Remove the fuel gauge switch knob (if so equipped), heater control knobs and wiper-washer knob. Use a hook tool to release each knob lock tab.
4. Remove the knob and shaft from the lights switch.
5. Remove one nut and washer from each radio control shaft, and remove the radio bezel.
6. Remove the cluster trim cover (Fig. 2). The attaching screws are located as follows: four screws along top of bezel; one screw between the lights and wiper-washer switch, and two screws below the radio. Then, disconnect the A/C duct (if so equipped), and illumination light from the bezel. The illumination light is located between the lights and wiper-washer switches. Remove four cluster attaching screws, disconnect the speedometer cable and wire connector from the printed circuit, and remove the cluster (Figs. 2, 3 and 4).

Installation

1. Position cluster to opening and connect the multiple connector and the speedometer cable. Install the four cluster retaining screws.
2. Install A/C duct and illumination light.

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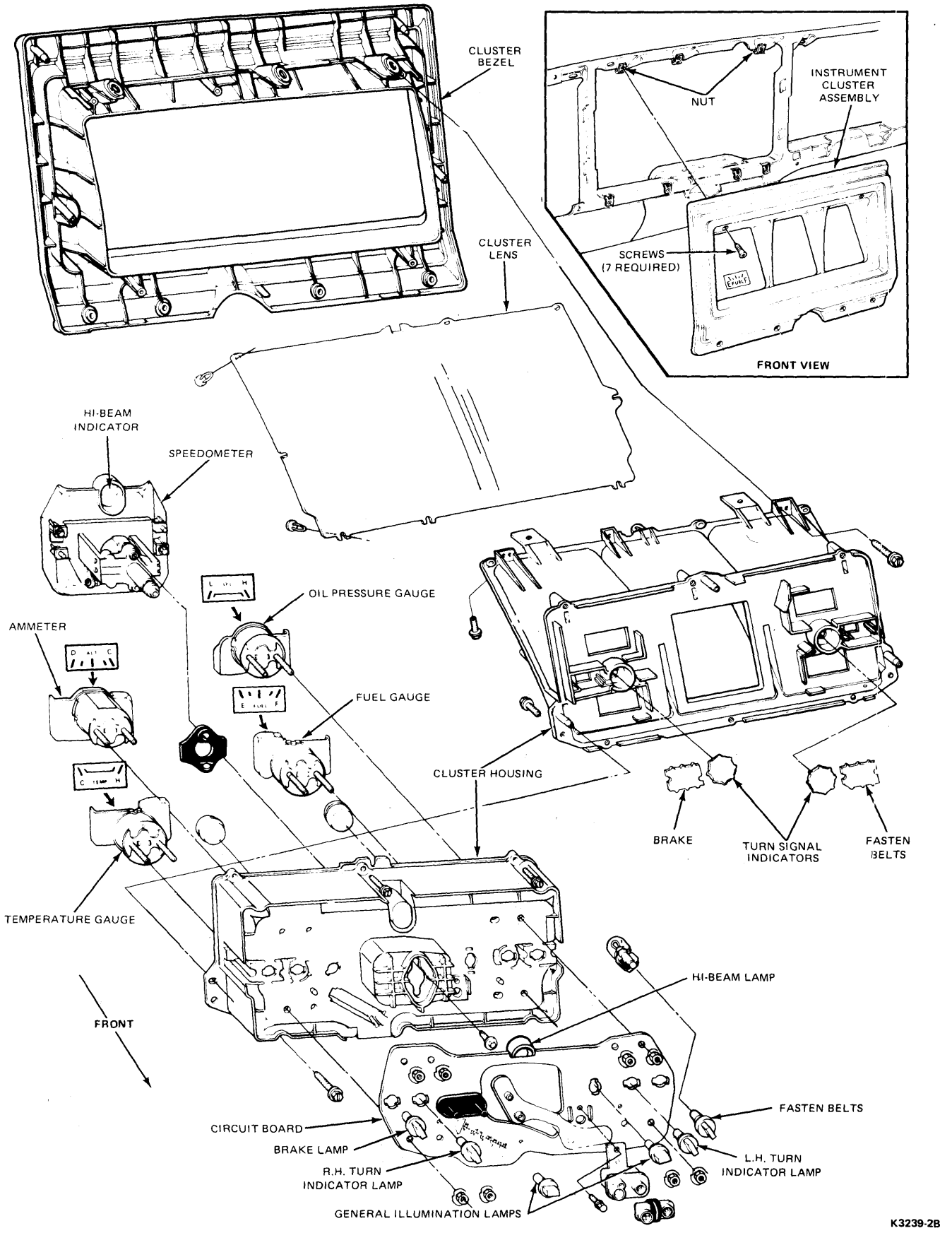


FIG. 1 Instrument Cluster Back View—E-100—E-350

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3. Install the trim cover.
4. Install the radio bezel (if so equipped).
5. Install the light switch knob and shaft.
6. Install the heater control knobs and the wiper-washer control knobs.
7. Install the radio knobs, (if so equipped).
8. Connect the battery cable, and check the operation of all gauges, lights and signals.

INSTRUMENT VOLTAGE REGULATOR AND PRINTED CIRCUIT

F-100—F-350, BRONCO AND E-100—E-350

Removal

1. Remove the instrument cluster assembly from the instrument panel as described in this Section.
2. Disconnect (snap off) the printed circuit connector buttons from the instrument voltage regulator (Fig. 4).
3. Remove plastic insulator from alternator gauge studs.
4. Remove the voltage regulator (one screw).
5. Remove the gauge retaining nuts and light bulbs, and remove the printed circuit.

Installation

1. When installing the printed circuit, carefully position it to the back of the cluster and engage it to the plastic locating pins.
2. Install the gauge retaining nuts and light bulbs.
3. Install the voltage regulator (one screw).
4. Reposition the plastic insulator to the alternator gauge studs.

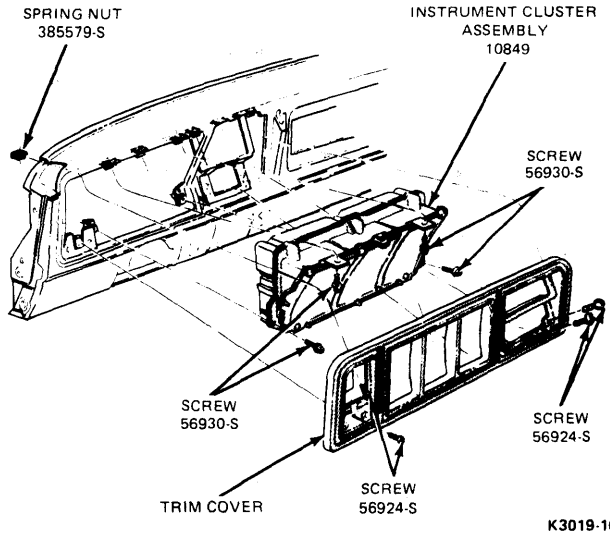


FIG. 2 Instrument Cluster—F-100—F-350 and Bronco

5. Connect (snap on) the connector buttons to the instrument voltage regulator.
6. Install the cluster assembly as outlined in this Section and check the operation of all gauges, lights and signals.

INSTRUMENT CLUSTER ILLUMINATION AND INDICATOR BULBS

Most cluster illumination and indicator bulbs can be replaced by reaching under the instrument panel. If the bulb cannot be reached from under the panel, access can be gained by removing the instrument cluster as outlined in this Part.

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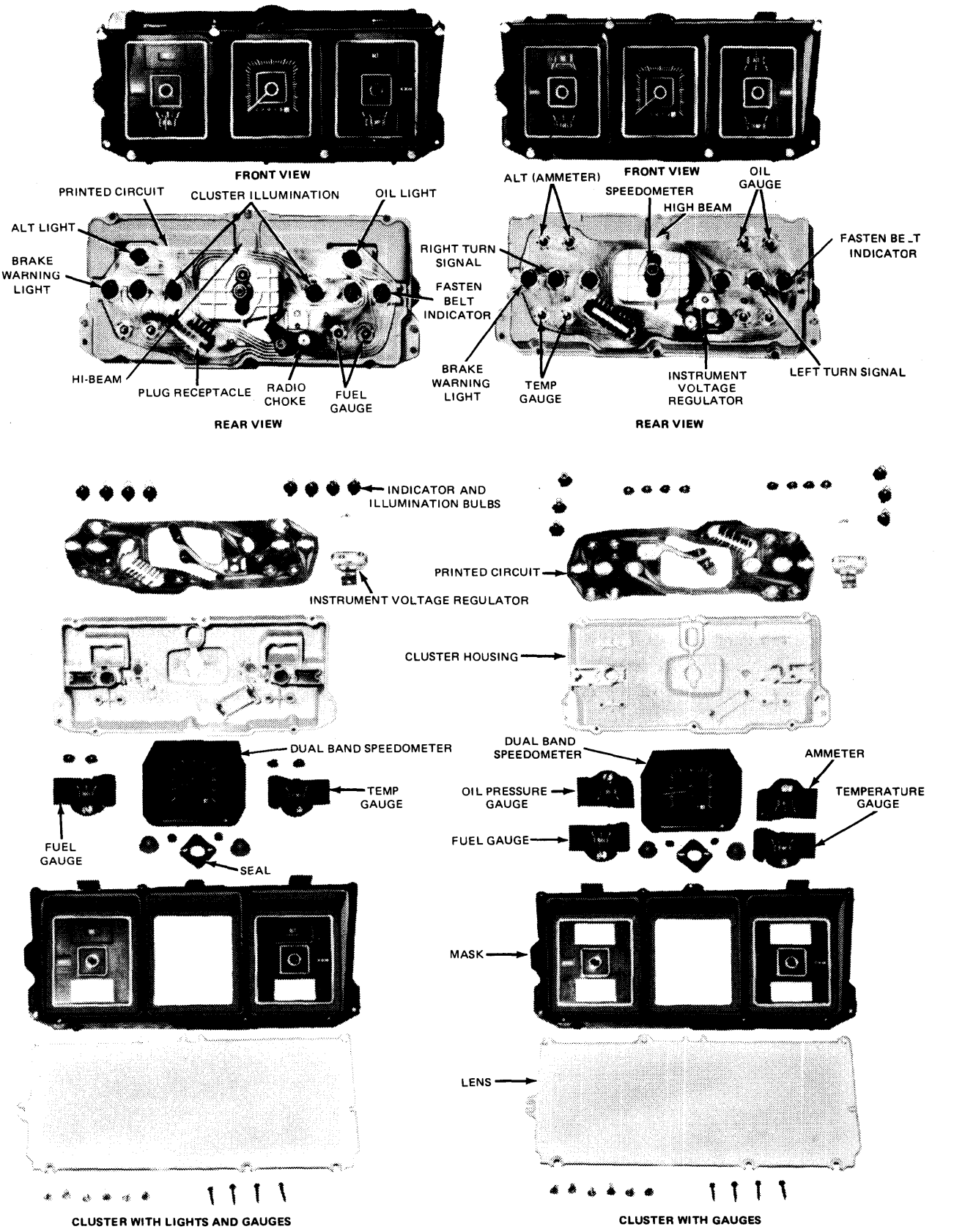


FIG. 3 Instrument Cluster Disassembled—F-100—F-350 and Bronco

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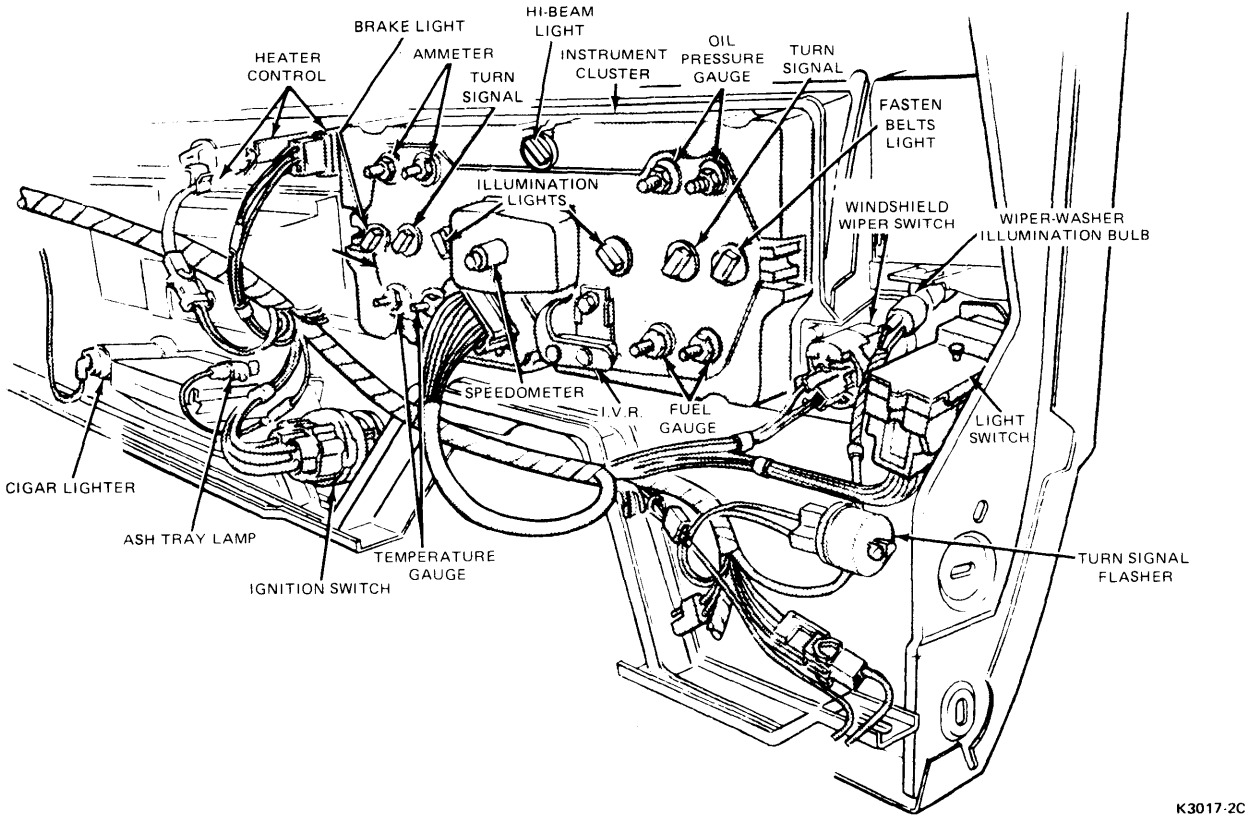


FIG. 4 Instrument Cluster Rear View—F-100—F-350 and Bronco

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Ignition Switch

PART 33-71

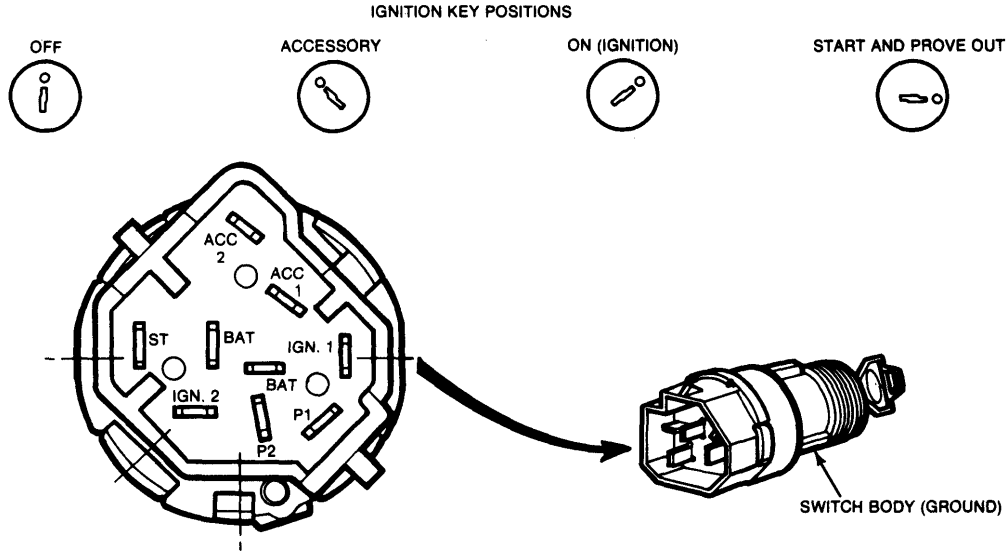
APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING	71-1	REMOVAL AND INSTALLATION	71-1

DIAGNOSIS AND TESTING

IGNITION SWITCH

To test the continuity of the ignition switch, remove the switch from the instrument panel. Insert the ignition key in the switch. **Do not use anything but the key to actuate the switch to the various positions because of possible damage to the switch.** Using a self-powered test light or ohmmeter, check the continuity through the switch as illustrated in Fig. 1. If the switch does not meet all of the continuity tests, the switch should be replaced.



IGNITION KEY POSITION	CONTINUITY SHOULD EXIST ONLY BETWEEN
ACCESSORY	BATTERY AND ACC 1
OFF	NO CONTINUITY BETWEEN ANY TWO TERMINALS EXCEPT BATTERY AND BATTERY
ON (IGNITION)	CONTINUITY SHOULD EXIST BETWEEN ANY OF THE FOLLOWING TERMINALS — BAT, ACC 1, ACC 2, IGN. 1, IGN. 2
START	BATTERY AND ST, BAT AND IGN. 1, BAT AND IGN. 2
PROVE OUT	P1 AND SWITCH BODY, P2 AND SWITCH BODY

K3648-2A

FIG. 1 Ignition Switch Continuity Test—Bronco, E-100 Thru E-350 and F-100 Thru F-350

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REMOVAL AND INSTALLATION

IGNITION SWITCH

E-100 THROUGH E-350, F-100 THROUGH F-350, AND BRONCO

Removal

1. Disconnect the battery ground cable.
2. Insert the ignition key in the switch. Turn the key to the accessory position and insert a wire pin in the hole in the lock cylinder. Slightly depress the pin while turning the key counterclockwise past the accessory position to the lock cylinder release position. Pull the lock cylinder from the switch with the key. If only the lock cylinder is to be replaced proceed to step 3 of the installation procedure.
3. Remove the bezel nut retaining the switch to the instrument panel and lower the switch.
4. Insert the tip of a screwdriver under the finger lift (heavy side) of the connector locking arms. Pull the connector from the switch.

Installation

1. Line up the indexing slot on the connector with the tab on the switch assembly. Push the connector onto the switch assembly.
2. Position the switch to the instrument panel and install the bezel nut.
3. Insert the key in the lock cylinder and turn the key to the lock cylinder release position as described in Step 2 of the removal procedure. Place the cylinder and key in the switch. Push the cylinder into the switch until it is fully seated, then turn the key clockwise to lock the cylinder in place. Turn the key to check the operation of the lock cylinder.
4. Connect the battery ground cable to the battery and check the operation of the switch assembly.

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MAIN WIRING HARNESSES, CIRCUIT PROTECTION AND CONNECTORS

GROUP 34 (14000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Connector Disengagement	34-01	Instrument Panel-to-Dash Wiring Harness	34-02
Fuses and Circuit Breakers and Fuse Links	34-31		

Connector Disengagement

PART 34-01

SUBJECT	PAGE	SUBJECT	PAGE
All Truck Model Applications	01-1		

ALL MODEL APPLICATIONS

The various truck connector disengagement procedures are shown in Figs. 1 and 2 and should be used when disconnecting the various types of connectors.

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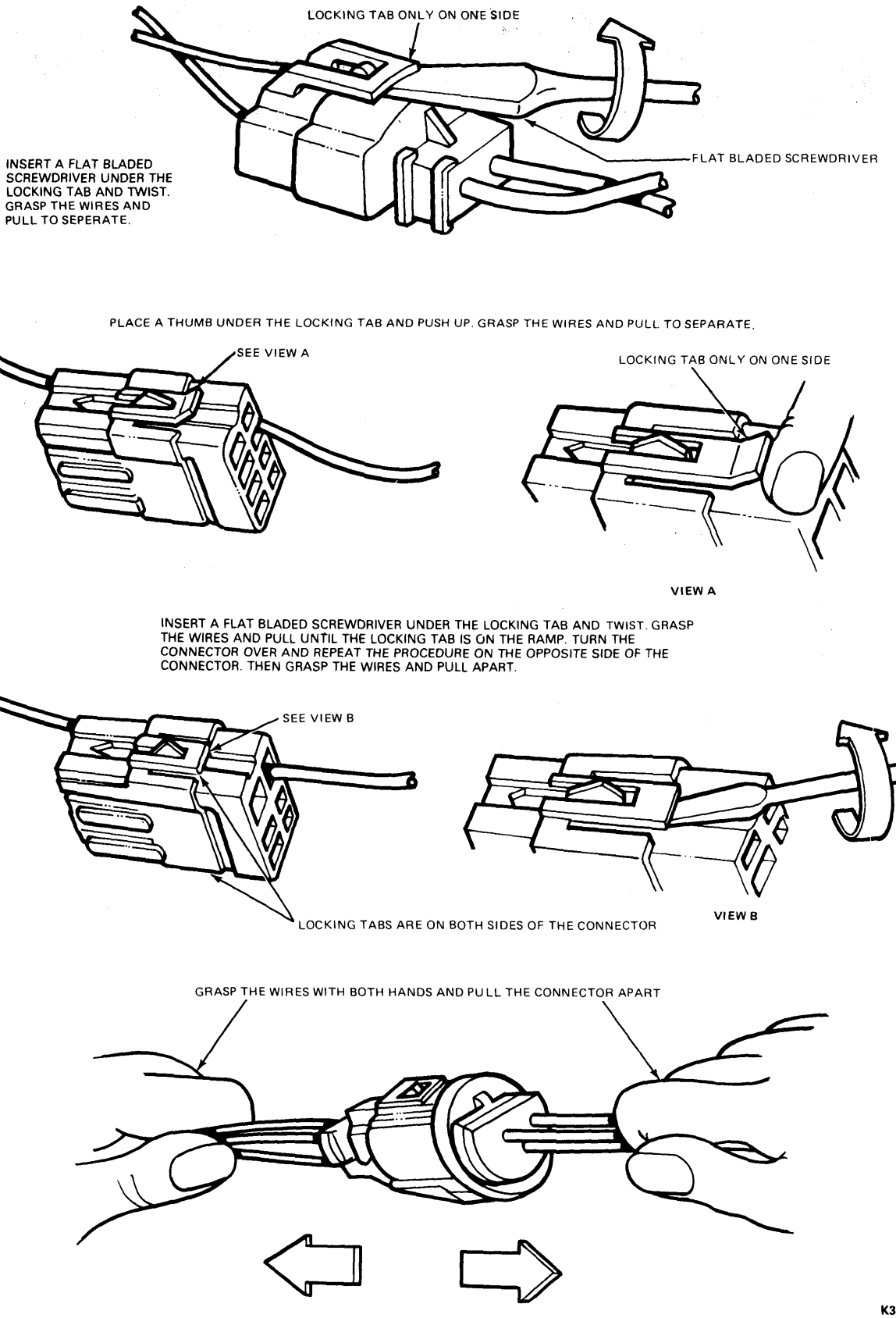


FIG. 1 Connector Disengagement—Inline Connectors

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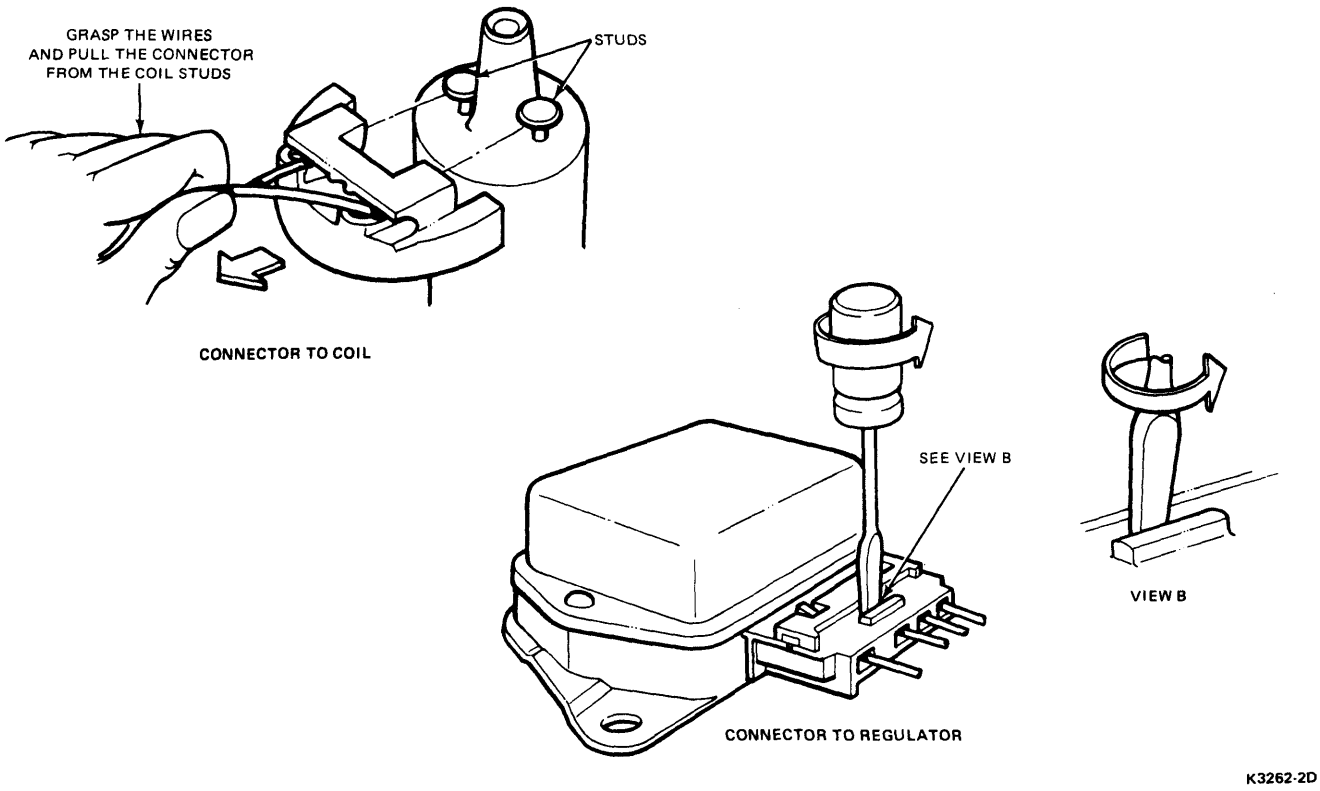


FIG. 2 Connector Disengagement—Component Connectors

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Instrument Panel-to-Dash Wiring Harness

PART 34-02

APPLIES TO E-100 — E-350, F-100 — F-350 AND BRONCO

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION		REMOVAL AND INSTALLATION (Cont'd)	
E-100 — E-350	02-1	F-100 — F-350 and Bronco	02-2

REMOVAL AND INSTALLATION

E-100—E-350

Starting at the left headlight, the 14401 wire assembly routes rearward along the left fender apron to a grommet at the left dash panel. From the grommet the 14401 wiring assembly splits; one portion routes rearward through the grommet into the passenger compartment and the other routes across the engine compartment cowl flange to the right fender apron and forward to the right headlight. Thus, the 14401 wiring assembly combines three main wiring functions into one harness (instrument panel-to-dash, left-side-dash-to-headlight, and right-side-to-headlight), (Figs, 1 and 2).

Removal

1. Disconnect the battery ground cable.
2. Starting at the left forward engine compartment, disconnect the wiring assembly connector to the left headlight and "twist-out" the left park light and left side marker sockets. Remove the left head light system ground screw.
3. Disconnect the 14401 wiring assembly horn, horn relay, and windshield washer reservoir connectors.
4. Disconnect the two breakerless ignition connectors from the breakerless ignition module.
5. Disengage all 14401 wiring assembly left side locator clips and/or retaining straps. Then separate the two connections joining the 14405 wiring assembly to the 14401 wiring assembly.
6. Disconnect the 14401 wiring assembly connector to the right headlight and "twist-out" the right park light and right side marker sockets. Remove the right headlight system ground screw.
7. Disconnect the 14401 wiring assembly wires from the starter motor relay. Note the color code and terminals for correct installation.
8. Disconnect the 14401 wiring assembly multiple connectors to the 14305 wiring assembly (Alternator regulator wire assembly).
9. Disengage all 14401 wiring assembly right side locator clips and/or retaining straps.
10. Remove wiring assembly from the engine compartment cowl flange clips and wire retainer.
11. Disconnect the 14401 wiring assembly multiple connectors to the 14289 wiring assembly (engine wire assembly) and the connector to the 15A545 wiring assembly or 12638 wiring assembly (manual transmission back up lamp switch or automatic transmission neutral start switch, respectively).
12. Remove the screws retaining the instrument cluster finish panel assembly to the instrument panel. Pull the cluster rearward and allow it to rest against the steering column. Disconnect the speedometer cable and the cluster wiring assembly multiple connector (Figs. 1 and 2).
13. Remove the screws retaining the left hand instrument finish panel to the instrument panel. Pull the LH finish panel rearward and disconnect the windshield wiper connector, the ignition/headlight nomenclature light connector, the ignition switch connectors and the headlight switch connector.
14. Remove the screws retaining the right hand instrument finish panel to the instrument panel. Pull the RH finish panel rearward and disconnect cigar lighter connector if applicable.
15. Remove the screws retaining the heater or air conditioner control to the instrument panel. Pull control head rearward and disconnect heater or A/C light and blower motor connectors.
16. Remove the screws retaining the radio to the instrument panel—if applicable. Pull radio rearward and disconnect antenna and power connectors.
17. Remove the turn signal flasher connector.
18. Remove instrument panel.
19. Disconnect the multiple connector to the steering column wiring, the stop lamp switch connector and the stop lamp wire locator clip to the brake pedal and clutch support bracket.
20. Disengage/remove 14401 wiring assembly locator clip and ground wire from the Y-brace.
21. Remove 14401 wiring assembly from instrument panel cowl top wire retainer.
22. Disconnect headlamp dimmer switch connector.
23. Remove fuse panel bracket from the dash panel.
24. Disconnect the two windshield wiper motor connectors.
25. Disengage all 14401 wiring assembly locator clips and/or retaining straps.

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26. Pull the engine portion of the 14401 wiring assembly through the left dash panel into the passenger compartment.
27. Remove fuse panel from the fuse panel bracket.

Installation

1. Install the fuse panel (Fig. 1).
2. Push the engine portion of the 14401 wire harness from the left side of the passenger compartment into the engine compartment.
3. Place the 14401 harness in all of the appropriate locator clips and retaining straps.
4. Connect the windshield wiper motor connectors.
5. Install the fuse panel bracket on the dash panel.
6. Connect the headlight dimmer switch.
7. Install the 14001 wiring assembly to the instrument panel cowl retainer.
8. Replace the ground wire to the "Y" brace.
9. Connect the multiple connector to the steering column wiring, the stop lamp switch connector and the stop lamp wire locator clip to the brake pedal and clutch support bracket.
10. Install the instrument panel.
11. Install the turn signal flasher connector.
12. Connect the radio antenna and power connector and install the radio (Fig. 2).
13. Install the heater or air conditioning control and blower motor connector.
14. Connect the cigar lighter and install the finish panel.
15. Connect the windshield wiper connector, ignition/ headlight switch connectors and install the left instrument finish panel.
16. Connect the speedometer cable and cluster wiring assembly multiple connector.
17. Install the instrument cluster finish panel assembly to the instrument panel.
18. Connect the 14401 wiring assembly multiple connectors to the 14289 engine wire assembly and the connector to the 15A545 wiring assembly or the 12638 wiring harness, (manual transmission backup lamp switch or automatic transmission neutral start switch respectively).
19. Install the 14401 wiring assembly to the engine compartment cowl flange clips and wire retainer.
20. Engage all 14401 wire assembly right side locator clips and/or retainer straps.
21. Connect the 14401 wiring assembly multiple connectors to the 14305 wiring assembly (alternator regulator wire assembly).
22. Connect the 14401 wiring assembly wires from the starter motor relay.
23. Connect the 14401 wiring assembly connectors to the right headlamp and "twist-in" the right park light; right side marker sockets. Install the right headlamp system ground screw.
24. Engage all 14401 wiring assembly left side locator clips and/or retaining straps. Connect the two connectors joining the 14405 wiring assembly and the 14401 wiring assembly.
25. Connect the two breakerless ignition connectors to the breakerless ignition module.
26. Connect the 14401 wiring assembly horn, horn relay, and the windshield washer reservoir connectors.
27. Connect the wiring assembly connector to the left headlamp and "twist-in" the left park light and left side marker sockets. Install the left headlamp system ground screw.
28. Connect the battery cable.

F-100-350 AND BRONCO

The 14401 wiring harness starts at the front of the left fender apron where it plugs into another harness that goes to the left headlamp. From this point, it runs back through a grommet in the left side of the dash panel into the passenger compartment. From the left grommet, the harness continues across the instrument panel to a similar grommet at the right of center of the dash panel where it returns to the engine compartment and terminate in several connections on the right fender apron (Figs. 3, 4 and 5).

Removal

1. Disconnect the battery ground cable.
2. Starting at the front of the left fender apron disconnect the harness plug from the left headlight wiring harness.
3. Disconnect the harness plug from the windshield washer motor and remove the loom under the motor.
4. Disconnect the harness multiple plug from the 14405 harness at the engine side of the dash panel. Disconnect the leads to the breakerless ignition module.
5. Disengage the harness grommet from the hole at the left side of the dash, and push the grommet through the hole so that the left section of the harness can later be pulled into the passenger compartment.
6. Starting at the front of the right fender apron, disconnect the three harness multiple plugs from their connectors (to the relay assembly, to the right headlamp wiring harness, and to the engine and regulator wiring harness).
7. Disconnect the harness wires from the starting motor relay. Note the color code and terminals for correct installation.
8. Pull the harness locator from the hole in the right fender apron, and disengage the harness from the straps and clips. Remove the wire clip on dash panel retaining takeout to hold dimmer switch. Disconnect the harness from the engine harness at the rear of the engine. Disengage the harness grommet from the hole in the right center side of the dash panel and push the grommet through the hole so that the right section of the harness can later be pulled into the passenger compartment. Disconnect the heater A/C connection.
9. Remove the instrument cluster (Part 33-51) and the glove compartment liner.
10. Disconnect the harness wiring from the right door jamb (courtesy light) switch and pull the wire up through the hole in the right cowl panel.

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11. Pull the right section of the harness (that was disconnected at the right fender apron in Steps 6 through 8) through the grommet hole at the right center side of the dash.
12. Remove the wiring harness from the hook-shaped clip under the right side of the instrument panel pad (not used on cowl-chassis models). Open the harness retainer along center of the dash panel, and remove the harness from the retainer (Fig. 3).
13. Disconnect the stop lamp switch connector.
14. Disconnect the dimmer switch connector.
15. Remove the screws retaining the fuse panel to the dash panel.
16. Disconnect the harness connectors to the steering column wiring, ignition switch, headlamp switch, windshield wiper switch and cigar lighter and ash tray light, if installed. Remove the wiper switch illumination bulb from the rear side of the instrument panel (Fig. 5). Remove the screw retaining the grounded black wire terminal to the body structure. Disengage the harness from the retaining clips (Fig. 5).
17. Disconnect the harness from the turn signal flasher, seat belt buzzer, fuel sender wire(s), domelamp wire, heater control assembly.
18. Disconnect the harness wiring from the left door jamb (courtesy light) switch, and pull the wire up through the hole in the left cowl panel.
19. Pull the left section of the harness from the engine compartment through the grommet hole at the left side of the dash into the passenger compartment. Remove the harness from the vehicle.

Installation

1. If installing a new wiring harness, transfer fuses, clips and wiper switch illumination bulb components to the new assembly as required.
2. Position the harness under the instrument panel. Push the right section of the harness (the end with three multiple connectors and three push-on connectors) through the grommet hole (at the right center side of the dash panel) into the engine compartment as far as the grommet. Engage the grommet in the hole.
3. Route the other right branch of the harness through the opening in the right cowl panel and connect it to the right door jamb (courtesy light) switch.
4. Install the wiring harness in the retainers at the right side of the instrument panel. Engage the wiring assembly in the hook-shaped clip at the extreme right of the panel.
5. Install the glove compartment liner.
6. Continuing from right to left, install the remainder of the wiring harness clips. On all except cowl-chassis models, engage the wiring harness in the clips on the steering column support.
7. Push the left section of the harness (with connectors) through the hole at the left side of the dash panel and into the engine compartment as far as the grommet. Engage the grommet in the hole.
8. Connect the harness connectors to the steering column wiring, ignition switch, headlamp swifch, windshield wiper switch, cigar lighter and ash tray light as applicable. Install the wiper switch illumination lamp to the instrument panel. Install the black grounded wire terminal to the instrument panel structure with the screw.
9. Connect the harness to the turn signal flasher, seat belt buzzer, fuel sender wire(s), dome lamp wire and the heater control assembly.
10. Install the fuse panel to the dash panel with two retaining screws.
11. Connect the harness connector to the dimmer switch.
12. Connect the stop lamp switch connector.
13. Route the left branch of the wiring harness through the opening in the left cowl panel, and connect it to the left door jamb (courtesy light) switch.
14. Install the instrument cluster (Part 33-51).
15. Now working in the engine compartment, route the left section of the harness along the left fender apron, and connect the harness multiple plug to the 14405 harness near the dash panel.
16. Connect the harness plug to the windshield washer motor and route wiring under windshield washer reservoir. Install locators in holes in fender apron.
17. Connect the harness plug to the left headlight harness connector at the center of the left fender apron.
18. Connect the two harness looms coming out of the grommets at the left center area of the dash (multiple plug and bullet connectors). Route wiring through dash panel shield.
19. Engage the locators of the harness right section in the holes in the right fender apron.
20. Connect the three harness wires to the starting motor relay terminals. Follow the color code and terminal connections as noted during the removal procedure.
21. At the center of the right fender apron, connect the three harness multiple plugs to their respective connectors (from the relay assembly, from the right headlight wiring harness, and from the engine and regulator wiring harness).
22. Connect the battery ground cable and check the operation of all switches, gauges and other electrical equipment connected to the dash panel-to-instrument panel wiring harness.

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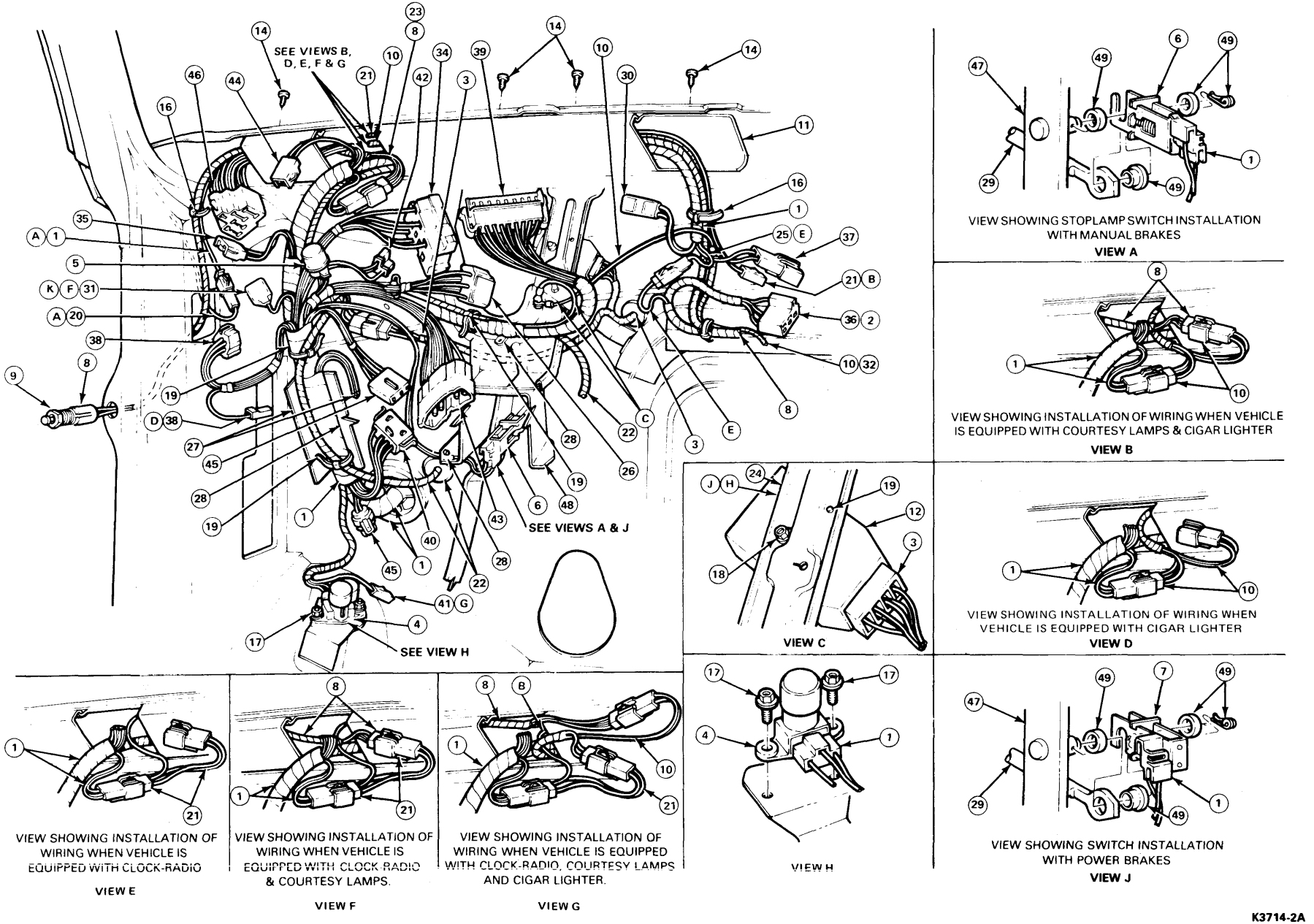


FIG. 1 E-100—E-350 Dash and Instrument Panel Wiring—Installation

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1. 14401—WIRING ASSEMBLY
2. 18B604—WIRING ASSEMBLY (HEATER)
3. 9E724—WIRING ASSEMBLY
4. 13A024—HEADLAMP DIMMER SWITCH
5. 13350—EMERGENCY WARNING FLASHER ASSEMBLY
6. 13480—STOPLAMP SWITCH ASSEMBLY
7. 13480—STOPLAMP SWITCH ASSEMBLY
8. 13A709—COURTESY LAMP SWITCH LAMP WIRING ASSEMBLY
9. 13713—DOOR JAM SWITCH ASSEMBLY
10. 14K006—WIRING ASSEMBLY (CIGAR LIGHTER)
11. 14A282—RETAINER ASSEMBLY
12. 9F441—THROTTLE KICKER MODULE ASSEMBLY
13. 95873-S—STRAP (3 REQ'D.) R.P.O. FOG LAMPS
14. 55927-S2 SCREW (4 REQ'D.)
15. 42367-S36 SCREW
16. 95873-S STRAP (2 REQ'D.)
17. 377834—S101 SCREW (2 REQ'D.)
18. 55914-S2 SCREW
19. LOCATOR, PART OF MODULE ASSEMBLY
20. 14334—WIRING ASSEMBLY, DOME LAMP
21. 15A006—WIRING ASSEMBLY (R.P.O. CLOCK RADIO)
22. 15A211—WIRING ASSEMBLY (R.P.O. FOG LAMPS)
23. CONNECTION AS SHOWN, FOR VEHICLES EQUIPPED WITH COURTESY LAMPS LESS CIGAR LIGHTER
24. "Y" BRACE
25. WHEN VEHICLE IS EQUIPPED WITH R.P.O. AIR CONDITIONING
26. TO DUAL FUEL SELECTOR SWITCH
27. FUSE PANEL BRACKET
28. LOCATOR, PART OF 14401 WIRING ASSEMBLY
29. MASTER BRAKE CYLINDER ASSEMBLY
30. RADIO FEED
31. TO ACCESSORY FEED
32. TO CIGAR LIGHTER
33. TO FUSE PANEL ASSEMBLY
34. TO HEADLAMP SWITCH ASSEMBLY
35. TO HEADLAMP SWITCH & IGNITION SWITCH ILLUMINATION
36. TO HEATER CONTROLS
37. TO HEATER CONTROL ILLUMINATION
38. TO IGNITION SWITCH ASSEMBLY
39. TO INSTRUMENT CLUSTER ASSEMBLY
40. TO SEAT BELT WARNING BUZZER
41. TO SEAT BELT ASSEMBLY
42. TO TURN SIGNAL FLASHER
43. TO TURN SIGNAL SWITCH
44. TO WINDSHIELD WIPER ILLUMINATION
45. TO WINDSHIELD WIPER MOTOR
46. TO WINDSHIELD WIPER SWITCH
47. BRAKE PEDAL ASSEMBLY
48. BRAKE PEDAL SUPPORT ASSEMBLY
49. CHASSIS PARTS, SEE CHASSIS INSTALLATION MANUAL

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FIG. 1A E-100—E-350 Dash and Instrument Panel Wiring Index

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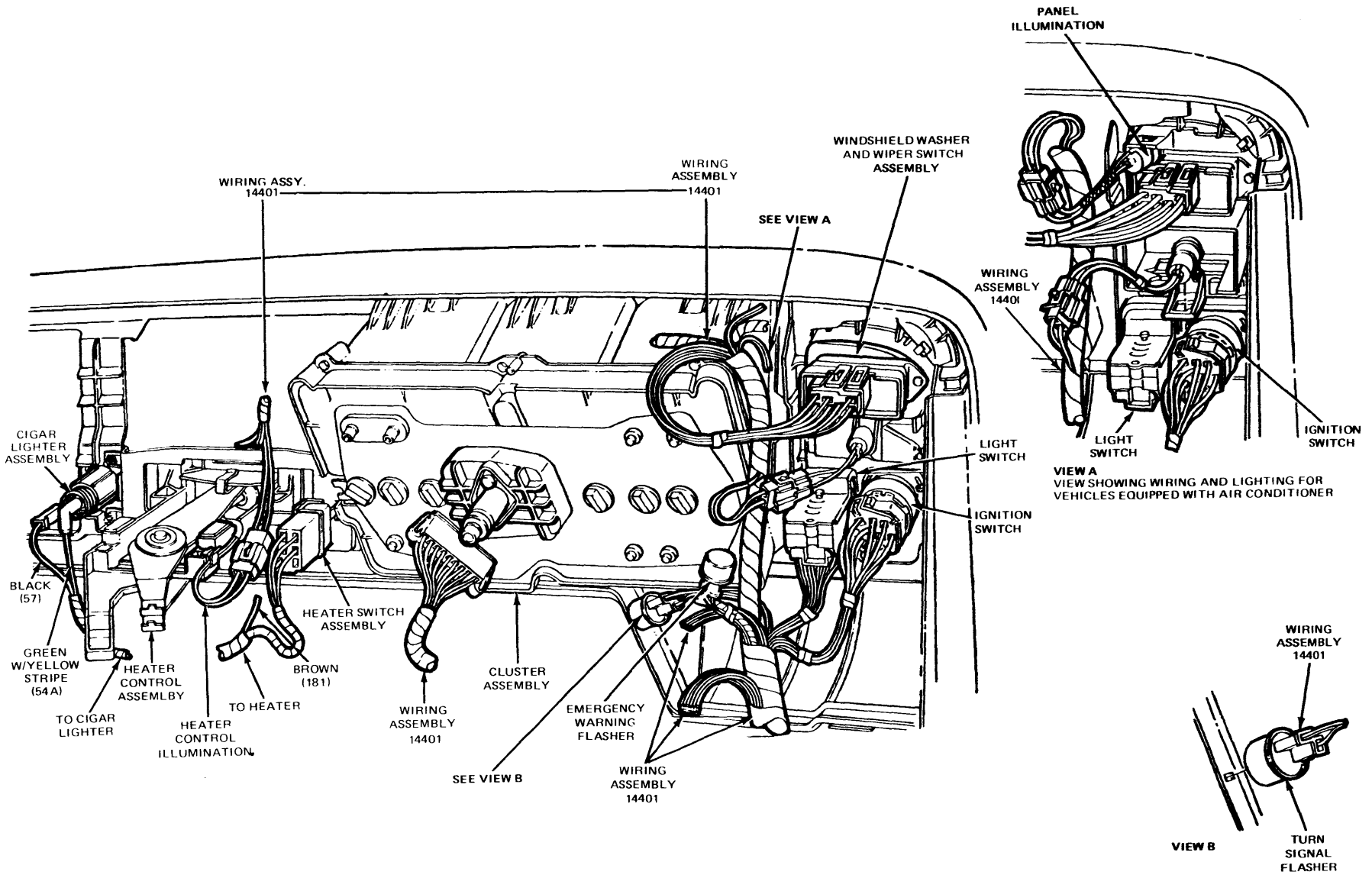


FIG. 2 E-100—E-350 Instrument Cluster Wiring Installation

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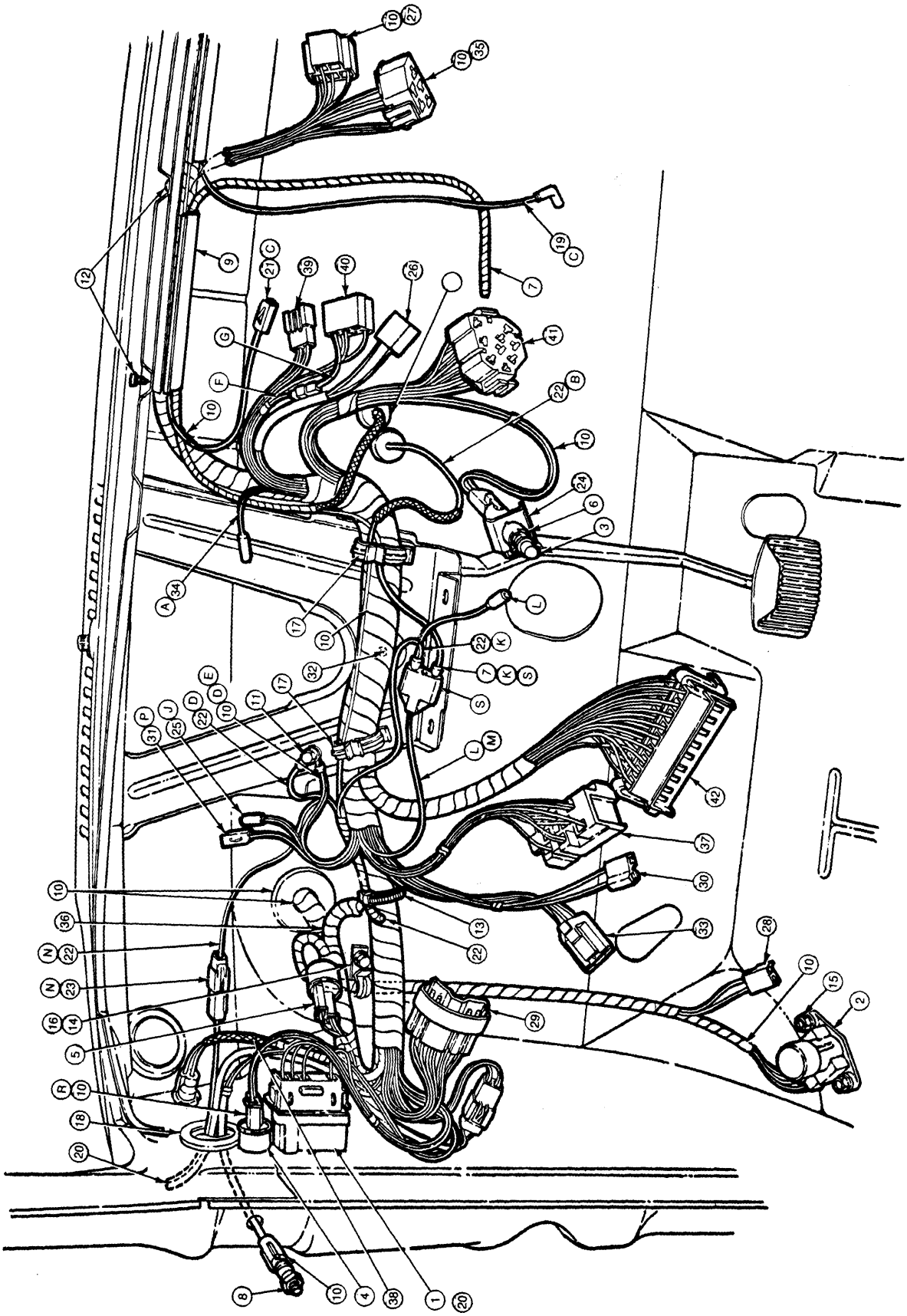


FIG. 3 F-100-F350 and Bronco—Dash and Instrument Panel Wiring Installation—Left Side

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1 10B924 SEAT BELT WARN. BUZZER ASSY.
2 13A024 DIMMER SWITCH ASSY.
3 13480 STOPLAMP SWITCH ASSY.
4 TURN SIGNAL FLASHER ASSY.
5 13350 EMERGENCY WARNING FLASHER.
6 13A629 RETAINER.
7 13A705 WIRING ASSY. (FULL TIME 4x4 WARNING LIGHT).
8 13713 COURTESY LAMP SWITCH ASSY.
9 14A282 RETAINER ASSY.
10 14401 WIRING ASSY.
11 383383-S36G SCREW
12 55927-S2 SCREW (2-REQD.)
13 95873-S STRAP (CONVENTIONAL ONLY)
14 377537-S36X SCREW
15 377834-S101 SCREW (2-REQD.)
16 381636-S100 CLIP
17 384386-S CLIP (2-REQD.)
18 388011 GROMMET
19 14A009 WIRING ASSY. (CIGAR LIGHTER)
20 14334 WIRING ASSY., TO CARGO AND/OR DOME LAMPS
21 15A006 WIRE ASSY. (R.P.O. CLOCK-RADIO)
22 18C617 WIRING ASSY. (R.P.O. BACK WINDOW HEAT CONTROL) (CONVENTIONAL ONLY).
23 18C619 WIRE ASSY. (R.P.O. BACK WINDOW HEAT CONTROL) (CONVENITIONAL ONLY).
24 BRACKET, PART OF BRAKE PEDAL ASSY.
25 TO MARKER LAMPS
26 TO RADIO
27 TO REAR WINDOW CONTROL SWITCH (BRONCO ONLY)
28 TO SEAT BELT RETRACTOR SWITCH
29 TO TURN SIGNAL SWITCH
30 TO WINDSHIELD WASHER SWITCH
31 TO WINDSHIELD WIPER MOTOR
32 LOCATOR, PART OF 14401 WIRING ASSY.
33 TO ACCESSORY RELAY (BRONCO II ONLY)
34 TO ASH TRAY ILLUMINATION
35 TO R.P.O. AUX. FUEL TANK SWITCH (CONVENT. ONLY)
36 TO FUSE PANEL
37 TO HEADLAMP SWITCH
38 TO HEADLAMP & WINDSHIELD WIPER ILLUMINATION
39 TO HEATER SWITCH ILLUMINATION
40 TO HEATER SWITCH
41 TO IGNITION SWITCH
42 TO INSTRUMENT PANEL CLUSTER

A 19G BLUE-RED STRIPE
B 37 BLACK-YELLOW STRIPE
C 54 GREEN-YELLOW STRIPE
D 57 BLACK (CONVENTIONAL ONLY).
E 57 & 57H BLACK (BRONCO ONLY)
F 181 ORANGE
G 181A ORANGE
H 210 BLUE
J 285 & 285A BROWN
K 297 BLACK-GREEN STRIPE
L 297B BLACK-GREEN STRIPE
M 297D BLACK-GREEN STRIPE(BRONCO ONLY)
N 687 GREEN-YELLOW STRIPE
P 763 ORANGE-WHITE STRIPE
R BLUE CONNECTOR
S YELLOW CONNECTOR

K3718-2A

FIG. 3A F-100—F-350 and Bronco—Dash and Instrument Cluster Wiring Index—Left Side

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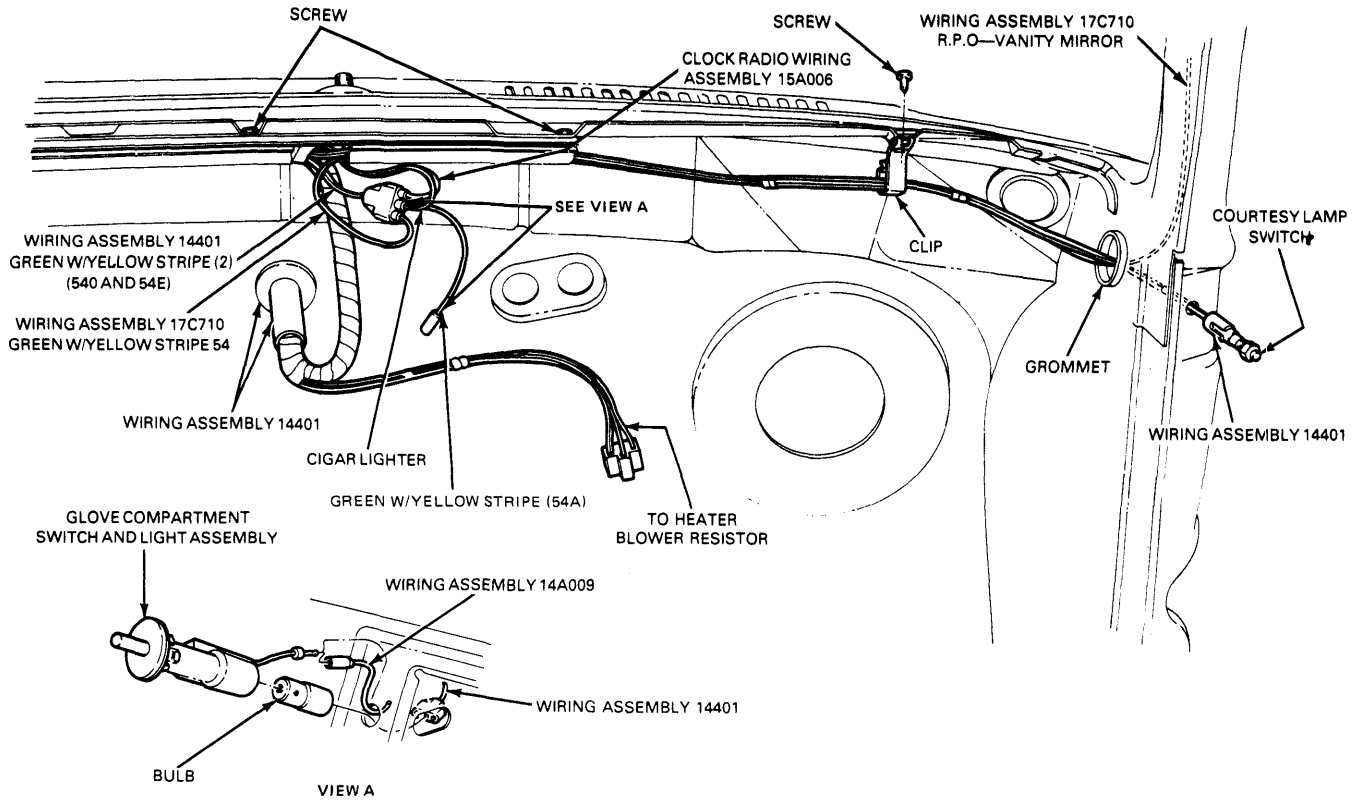


FIG. 4 F-100—F-350 and Bronco—Dash and Instrument Panel Wiring Installation—Right Side

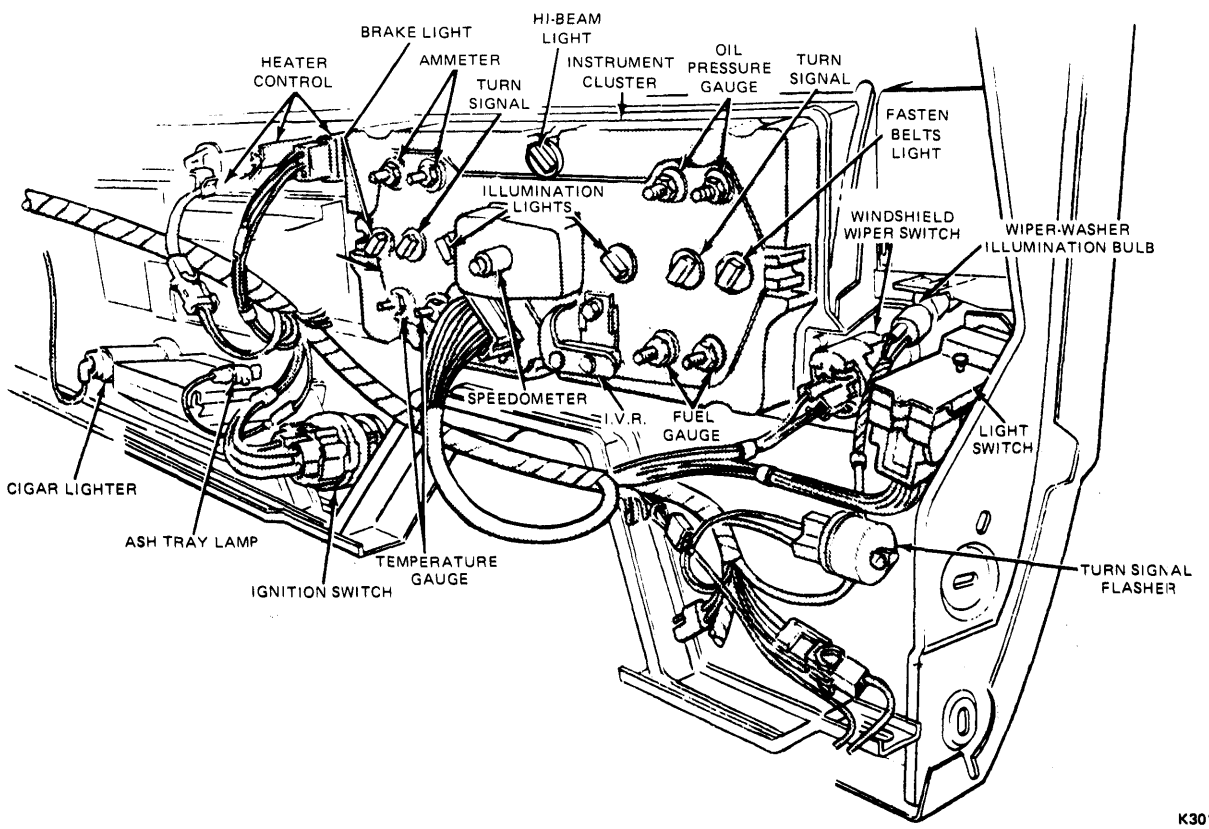


FIG. 5 F-100—F-350 and Bronco Instrument Panel Wiring

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Fuses, Circuit Breakers and Fuse Links

PART 34-31

APPLIES TO ALL MODELS

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Fuse Link Continuity Test	31-2
REMOVAL AND INSTALLATION	
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DISASSEMBLY AND ASSEMBLY	
Fuse Link	31-3
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GENERAL INFORMATION

FUSE PANELS

Each vehicle has a fuse panel which contains most of the fuses used in the electrical system. The fuse panels are located in various positions depending upon the vehicle as shown in Figs. 1 and 2 which show the fuse panels for each vehicle line.

The circuit protection charts in Specifications of this Part give the location and values of all the circuits containing fuses or circuit breakers for the various vehicle lines.

FUSE LINK

The fuse link is a short length of special, Hypalon (high temperature) insulated wire, integral with the engine compartment wiring harness and should not be confused with standard wire. It is several wire gauges smaller than the circuit which it protects. Under no circumstances should a fuse link replacement repair be made using a length of standard wire cut from bulk stock or from another wiring harness.

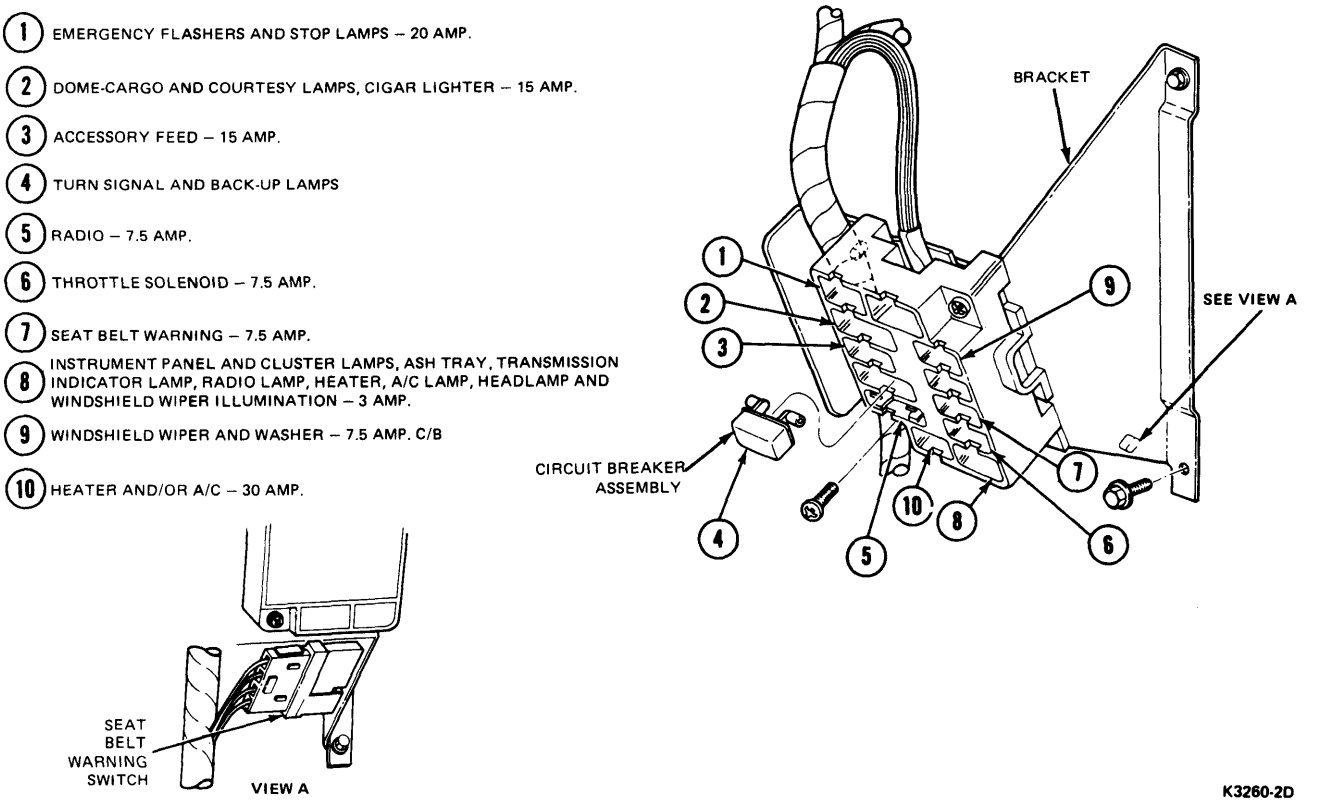


FIG. 1 Fuse Panel—E-100—E-350

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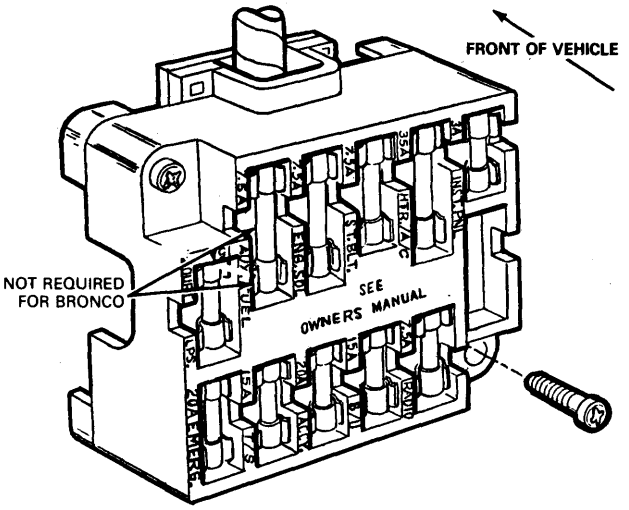


FIG. 2 Fuse Panel—F-Series and Bronco

The higher melting temperature properties and additional thickness of the Hypalon insulation will usually allow the undersized internal fuse wire to melt and disintegrate within the Hypalon casing with little damage to the high temperature insulation other than discoloration and/or bubbling of the insulation surface. In extreme cases of excessive circuit current the insulation may separate after the fuse wire has disintergrated. However, the bare wire will seldom be exposed. When it becomes difficult to determine if the fuse link is burnt open, perform a continuity test. When heavy current flows, such as when a booster battery is connected incorrectly or when a short to ground occurs in the wiring harness, the fuse link burns out and protects the alternator and/or wiring.

Production fuse links have a flag moulded on the wire or on the terminal insulator. Color identification of the flag or connector is Blue-20 Ga. wire, Red-18 Ga. wire, Yellow-17 Ga. wire, Orange-16 Ga. wire, or Green-14 Ga. wire. Fig. 3 shows typical fuse link installations.

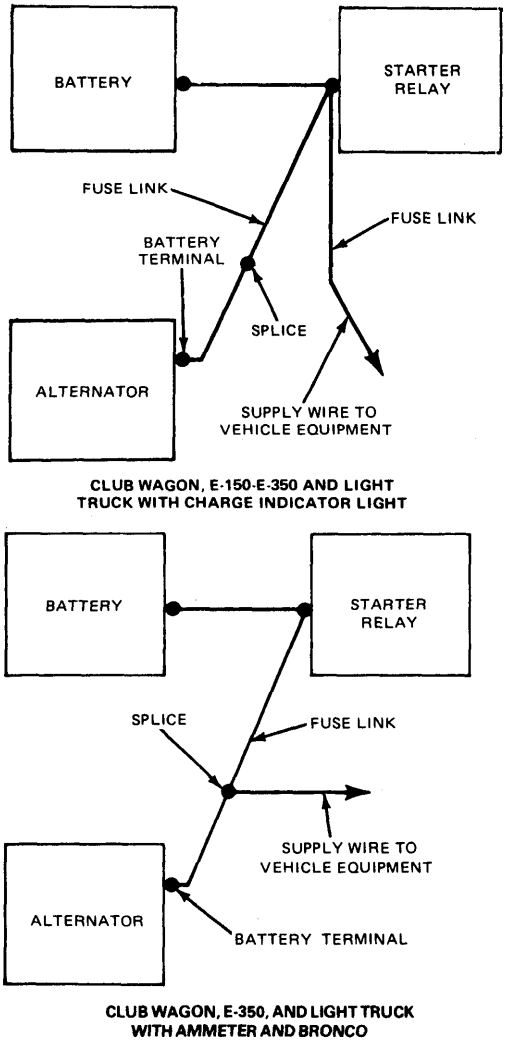


FIG. 3 Fuse Link Installation

DIAGNOSIS AND TESTING

FUSE LINK CONTINUITY TEST

1. Make certain first that the battery is OK, then turn on the headlights or any accessory. If the headlights or an accessory do not operate, a fuse link is probably burned out.
2. Where there are two fuse links (Fig. 3). Use the same procedure as in Step 1 to test the fuse link that protects the vehicle equipment.

To test the fuse link that protects the alternator, make certain that the battery is OK, then check with a voltmeter or 12 volt test light for voltage at the BAT terminal of the alternator. No voltage indicates that the alternator fuse link is probably burned out.

REMOVAL AND INSTALLATION

CHARGING SYSTEM FUSE LINK

If it becomes necessary to replace a fuse link in a wiring assembly, make sure the replacement fuse link is a duplicate of the one removed with respect to gauge, length and insulation. Original and Ford replacement fuse links have insulation that is flame proof. Do not fabricate a fuse link from ordinary wire because the insulation may not be flame proof.

If a circuit protected by a fusible link becomes inoperative, inspect for a blown fuse link. If the fuse link wire insulation is burned or opened, disconnect the feed wire part of the wiring and cut out the damaged portion as close as possible behind the splice in the harness. If the damaged fuse link is between two splices (weld points in the harness), cut out the damaged portion as close as possible to the weld points.

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Two examples are the air conditioner feed and high speed blower motor switch feed circuits, which use special 17 gauge wire fuse links to meet the special protection requirements. These two fuse links are located in the engine compartment, one near the large rubber grommet in the center area of the dash panel, the other near the starter motor relay on the right fender apron. They are covered with a special vinyl tube shielding which must slide freely between the two welded ends. The shielding is necessary to prevent fumes, oil or fuel from saturating the fuse link area.

When replacing one or both air conditioner fuse links, carefully remove the existing shielding after cutting out the damaged wire. Reinstall the shielding over the new fuse link(s) before crimping the fuse links to the wire ends. Some wiring assemblies have more than one fuse link fed from a single heavy gauge wire in the same location.

To Replace the Fuse Link Proceed as Follows:

1. Some fuse links shown have an eyelet terminal for a 5/16 inch stud on one end. When the terminal is not required, use one of the fuse links shown in Figs. 4 and 5, with the insulation stripped from both ends.
2. Disconnect the battery ground cable.
3. Disconnect the fuse link and/or fuse link eyelet terminal from the battery terminal of the starter relay. On some vehicle applications, the fuse link is looped outside of the wire harness behind the point at which the harness is clipped to the right rocker cover above the starter.
4. Cut the fuse link and the splice(s) from the wire(s) to which it is attached.

   Disconnect the feed wire part of the wiring and cut out the damaged portion as close as possible behind the splice in the harness. If the damaged fuse link is between two splices (weld points in the harness), cut out the damaged portion as close as possible to the weld points.
5. Splice and solder the new fuse link to the wire(s) from which the old link was cut. Use rosin core solder. Wrap the splice(s) completely with vinyl electrician's tape.
6. Securely connect the eyelet terminals (if any) to the battery stud on the starter relay.
7. Install the repaired wiring as before, using existing clips, if provided.
8. Connect the ground cable to the battery.

DISASSEMBLY AND ASSEMBLY

FUSE LINK

To repair any blown fuse link use the following procedure:

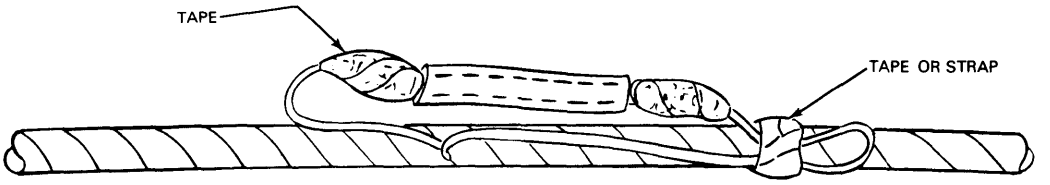
1. Determine which circuit is damaged, it's location and the cause of the open fuse link. If the damaged fuse link is one of three fed by a common No. 10 or 12 gauge feed wire, determine the specific affected circuit.
2. Disconnect the negative battery cable.
3. Cut the damaged fuse link from the wiring harness and discard it. If the fuse link is one of three circuits fed by a single feed wire, cut it out of the harness at each splice end and discard it.
4. Identify and procure the proper fuse link and butt connectors (Figs. 4 and 5) for attaching the fuse link to the harness.
5. To repair any fuse link in a 3-link group with one feed:
   a. After cutting the open link out of the harness, cut each of the remaining undamaged fuse links close to the feed wire weld.
   b. Strip approximately 1/2 inch of insulation from the detached ends of the two good fuse links. Then insert two wire ends into one end of D3AZ-14488-Y Butt Connector (Fig. 5) and carefully push one stripped end of the replacement fuse link into the same end of the butt connector and crimp all three firmly together.

      Note: Care must be taken when fitting the three fuse links into the butt connector as the internal diameter is a snug fit for three wires. Make sure to use a proper crimping tool (No. B9A-17018-A or equivalent). Pliers, side cutters, etc. will not apply the proper crimp to retain the wires and withstand a pull test.

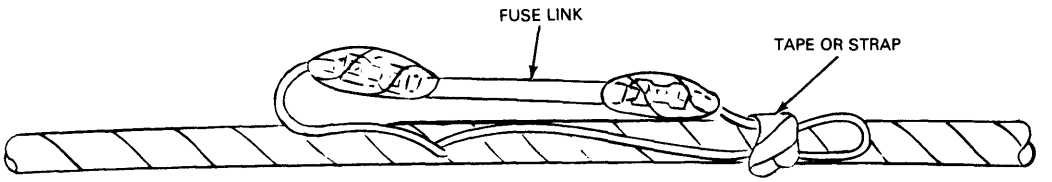
   c. After crimping the butt connector to the three fuse links, cut the weld portion from the feed wire and strip approximately 1/2 inch of insulation from the cut end. Insert the stripped end into the open end of the butt connector and crimp very firmly.
   d. To attach the remaining end of the replacement fuse link, strip approximately 1/2 inch of insulation from the wire end of the circuit from which the blown fuse link was removed, and firmly crimp a D3AZ-14488-Z Butt Connector or equivalent (Fig. 5) to the stripped wire. Then, insert the end of the replacement link into the other end of the butt connector and crimp firmly.
   e. Using rosin core solder with a consistency of 60 percent tin and 40 percent lead, solder the connectors and the wires at the repairs and insulate with electrical tape (Fig. 5).
6. To replace any fuse link on a single circuit in a harness, cut out the damaged portion, strip approximately 1/2 inch of insulation from the two wire ends and attach the appropriate replacement fuse link to the stripped wire ends with two proper size butt connectors. Solder the connectors and wires and insulate with tape, as in Step 5.
7. To repair any fuse link which has an eyelet terminal on one end such as the charging circuit (Fig. 5), cut off the open fuse link behind the weld, strip approximately 1/2 inch of insulation from the cut

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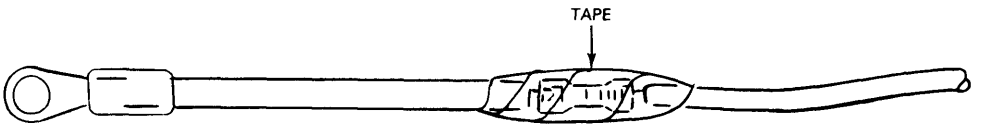
REMOVE EXISTING VINYL TUBE SHIELDING
REINSTALL OVER FUSE LINK BEFORE CRIMPING
FUSE LINK TO WIRE ENDS



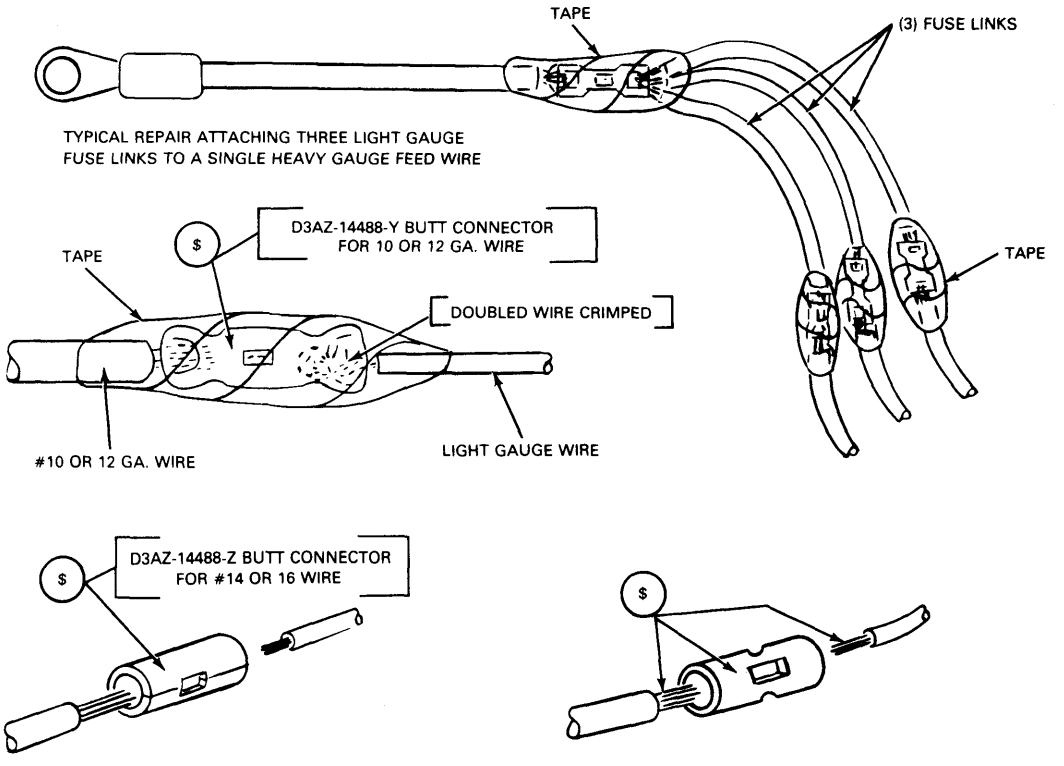
TYPICAL REPAIR USING THE SPECIAL #17 GA. (9.00" LONG-YELLOW) FUSE LINK REQUIRED FOR THE AIR/COND. CIRCUITS (2) #687E AND #261A LOCATED IN THE ENGINE COMPARTMENT



TYPICAL REPAIR FOR ANY IN-LINE FUSE LINK USING THE SPECIFIED GAUGE FUSE LINK FOR THE SPECIFIC CIRCUT



TYPICAL REPAIR USING THE EYELET TERMINAL FUSE LINK OF THE SPECIFIED GAUGE FOR ATTACHMENT TO A CIRCUIT WIRE END



FUSIBLE LINK REPAIR PROCEDURE

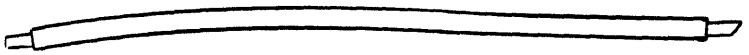
J1704-2D

FIG. 4 Fuse Link Repair Procedure

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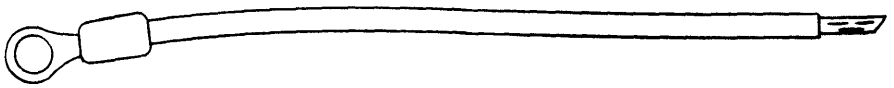
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WIRING ASSEMBLY–FUSE LINK (WITH INSULATION STRIPPED BOTH ENDS)



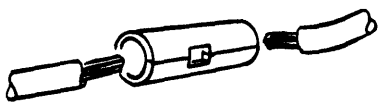
D3AZ–14A526-H	# 14 GA. WIRE - 9.00" ± .50 LENGTH (GREEN INSULATION)
D3AZ–14A526-J	# 16 GA. WIRE - 9.00" ± .50 LENGTH (ORANGE INSULATION) AS REQ'D.
D3AZ–14A526-K	# 17 GA. WIRE - 9.00" ±.50 LENGTH(YELLOW INSULATION) AS REQ'D. (SPECIAL USED WITH AIR CONDITIONING SYSTEM)
D3AZ–14A526-L	# 18 GA. WIRE - 9.00" ± .50 LENGTH (RED INSULATION) AS REQ'D
D3AZ–14A526-M	# 20 GA. WIRE – 9.00" ± .50 LENGTH (BLUE INSULATION) AS REQ'D.

WIRING ASSEMBLY–FUSE LINK (WITH EYELET TERMINAL AND ONE END STRIPPED)



D3AZ–14A526–D	# 14 GA. WIRE - 9.00" ± .50 LENGTH (GREEN INSULATION) AS REQ'D.
D3AZ–14A526-E	# 16 GA. WIRE - 9.00" ± .50 LENGTH (ORANGE INSULATION) AS REQ'D.
D3AZ–14A526-F	# 18 GA. WIRE – 9.00" ± .50 LENGTH (RED INSULATION) AS REQ'D.
D3AZ–14A526-G	# 20 GA. WIRE-9.00 ± .50 LENGTH (BLUE INSULATION) AS REQ'D.

BUTT CONNECTOR –WIRING SPLICE



D3AZ–14488-Y	FOR # 10 AND 12 GA. WIRE (LOAD CIRCUIT) AS REQ'D.
D3AZ–14488-Z	FOR #14 AND 16 GA. WIRE (LOAD CIRCUIT) AS REQ'D.

J1707-2D

FIG. 5 Fuse Link and Butt Connector Identification

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end and attach the appropriate new eyelet fuse link to the cut stripped wire with an appropriate size butt connector (Fig. 5). Solder the connectors and wires at the repair and insulate with tape, as in Step 5.

8. Connect the negative battery cable to the battery and test the system for proper operation.

Note: Do not mistake a resistor wire for a fuse link. The resistor wire is generally longer and has print stating, "Resistor-don't cut or splice."

Note: When attaching a single No. 16, 17, 18 or 20 gauge fuse link to a heavy gauge wire, always double the stripped wire end of the fuse link before inserting and crimping it into the butt connector for positive wire retention.

SPECIFICATIONS

CIRCUIT PROTECTION — E-100 — E-350

Circuit	Location	Protective Device (1)
Air Conditioner, Clutch, Blower Relay	Fuse Panel	30 Amp.
Air Conditioner	Starter Motor Relay	16 Gauge Fuse Link
Alternator	Starter Motor Relay	16 Gauge (3) Fuse Link
Alternator	Electric Choke	20 Gauge Fuse Link
Auxiliary Heater Blower Relay	Fuse Panel	30 Amp.
Back-up Lights, Turn Signal	Fuse Panel	15 Amp.
Dome, Courtesy, Map, Cargo Lights and Cigar Lighter	Fuse Panel	15 Amp.
Dual Batteries	Starter Motor Relay	14 Gauge Fuse Link
Hazard Flasher System and Stop Lights (2)	Fuse Panel	20 Amp.
Fog Lights	In Feed Line	AGC 10
Headlights	Headlight Switch	18 Amp.
Heater	Fuse Panel	30 Amp.
Instrument Panel Lights	Fuse Panel	3 Amp.
Radio	In Feed Line	7.5 Amp.
Spotlight	In Feed Line	—
Tail, License, Parking, Marker Lights and Horns	Headlight Switch	15 Amp. C.B.
Windshield Wiper and Washer System	Fuse Panel	7.5 Amp. C.B.
Throttle Solenoid	Fuse Panel	7.5 Amp.
Seat Belt Warning	Fuse Panel	7.5 Amp.
Accessory Feed	Fuse Panel	7.5 Amp.

(1) Fuse or Circuit Breaker (C.B.) in Amperes.
(2) Under NO circumstance use more than an 8.5 ampere load across the ignition switch terminals for the rear light circuit on ANY truck or bus which uses the hydraulic stoplight switch.
(3) 16 Gauge Fuse Link for 40, 60, 65 Amp. Alternators.
14 Gauge Fuse Link for 70 and 100 Amp. Alternators.

CK2520-2E

CIRCUIT PROTECTION — F-100 THROUGH F-350 AND BRONCO

Circuit	Location	Protective Device (1)
Air Conditioner and/or Heater Comb. 30 Amp.	Starter Motor Relay	16 Gauge Fuse Link
Alternator	Starter Motor Relay	14 Gauge (2) Fuse Link
Alternator	Electric Choke	20 Gauge Fuse Link
Back-up Lights, Windshield Washer, and Turn Signals	Fuse Panel	15 Amp.
Dome, Underhood Courtesy, Map, Cargo Lights, and Cigar Lighter	Fuse Panel	15 Amp.
Headlights	Headlight Switch	12 Amp. C.B.
Heater	Fuse Panel	30 Amp.
Instrument Panel Lights	Fuse Panel	3 Amp.
Marker Lights — F-250-350 Camper Special F-350 Dual Rear Wheels F-250 Model 84	Instrument Panel	25 Amp. C.B. 15 Amp. C.B. 20 Amp. C.B.
Marker Lights	Starter Relay	20 Gauge Fuse Link
Speed Control — Full Time — 4x4 — Dual Battery	Fuse Panel	20 Amp.
Stop and Emergency Flasher Lights	Fuse panel	20 Amp.
Tail, Parking, License, Marker Lights and Horn	Headlight Switch	15 Amp. C.B.
Trailer Tow	Starter Relay	16 Gauge Fuse Link
Windshield Wiper	Integral with Wiper Switch	C.B.

① Fuse or Circuit Breaker (C.B.) in Amperes.
② 16 Gauge Fuse Link for 40, 60, 65 Amp. Alternator.
14 Gauge Fuse Link for 70 and 100 Amp. Alternator.

NOTE: Also See Owner's Manual.

CK2522-2H

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AUXILIARY EQUIPMENT

GROUP 35 (17000 & 18000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Antennas	35-11	Radio	35-02
Ash Receptacles and Cigar Lighter	35-40	Speakers	35-31
Horns	35-80	Windshield Washers	35-70
Mirrors — Inside and Outside	35-50	Windshield Wipers — Electric	35-60

Radio

PART 35-02

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
AM-FM Radio	02-1	Tuning	02-8
Chassis Connectors		Stereo Tape Player	02-8
AM-FM Radio	02-5	ADJUSTMENTS	
CB Radio	02-5	Antenna Trimming	02-17
CB Radio Microphone Controls	02-5	Push Buttons	
DIAGNOSIS AND TESTING		AM Radio	02-17
CB Radio	02-9	AM-FM-MPX Stereo Radio	02-17
Diagnosis Guides	02-9	AM-FM Stereo Radio and Stereo Tape Player	02-17
Radio	02-8	REMOVAL AND INSTALLATION	
Radio Reception		AM and FM Radio	
Antenna Position	02-8	E-100 — E-350	02-17
Electrical Accessories	02-8	F-100 — F-350 and Bronco	02-17
FM Capture and Overloading	02-9	CB Radio Microphone	02-18
FM Flutter	02-9	CB Radio Receiver/Transmitter	02-18
FM Multi-Path Cancellation	02-9	Radio Suppression Equipment	02-21
Interfering Noise	02-8		
Receiving FM Multiplex	02-9		
Tone Control	02-8		

DESCRIPTION AND OPERATION

AM AND FM RADIO

The radio is optional and is available on all models (Figs. 1 and 2). An AM radio with a digital clock is available on F-100—F-350, Bronco and E-100—E-350 model vehicles. An AM-FM-MPX radio is also available on F-100 through F-350, Bronco and E-100—E-350 model vehicles. Also, an AM-FM-MPX radio with stereo tape player (8-track or cassette) is available on the E-100—E-350 Series. A premium sound option with power switch and amplifier is available conjunction with the AM-FM MPX/Stereo tape player option on E-100—E-350 models (Fig. 3). They are equipped with a combination ON—OFF switch and volume control, a tone control, and a manual tuning control. All models have the five station selecting push buttons. The push buttons, which are located below the radio dial, can be pre-set to any stations desired.

CB RADIO

A CB radio is available on F-100—F-350, Bronco and E-100—E-350 Models (Figs. 4 and 5).

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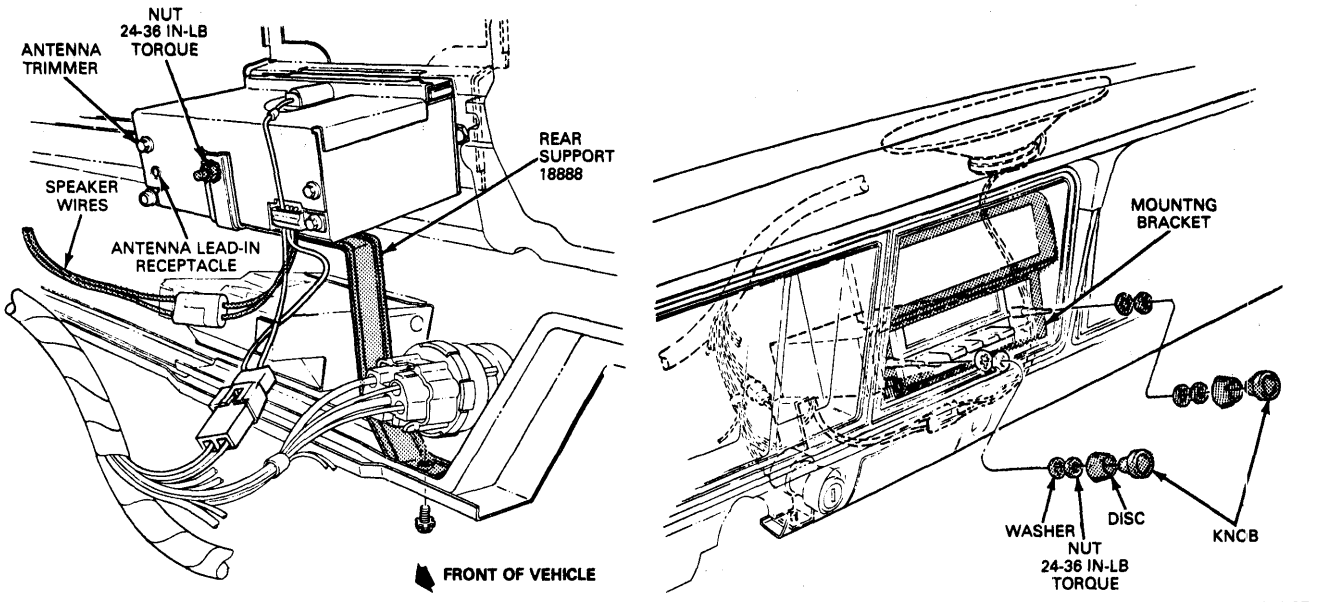


FIG. 1 Radio Installation—F-100—F-350 and Bronco—AM Shown, AM w/Digital Clock, AM-FM and AM-FM-MPX Similar Except for Wiring.

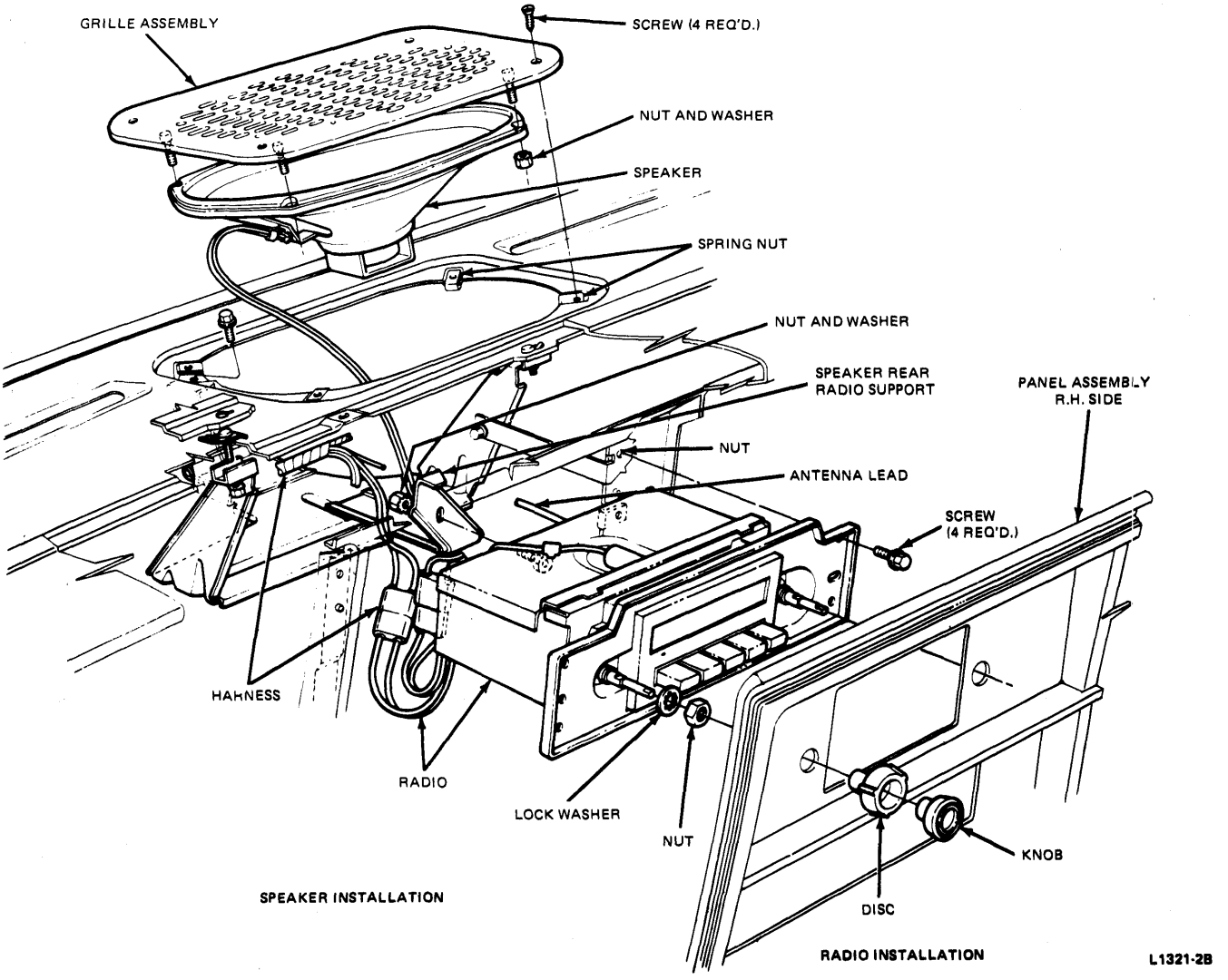


FIG. 2 Radio Installation—E-100—E-350

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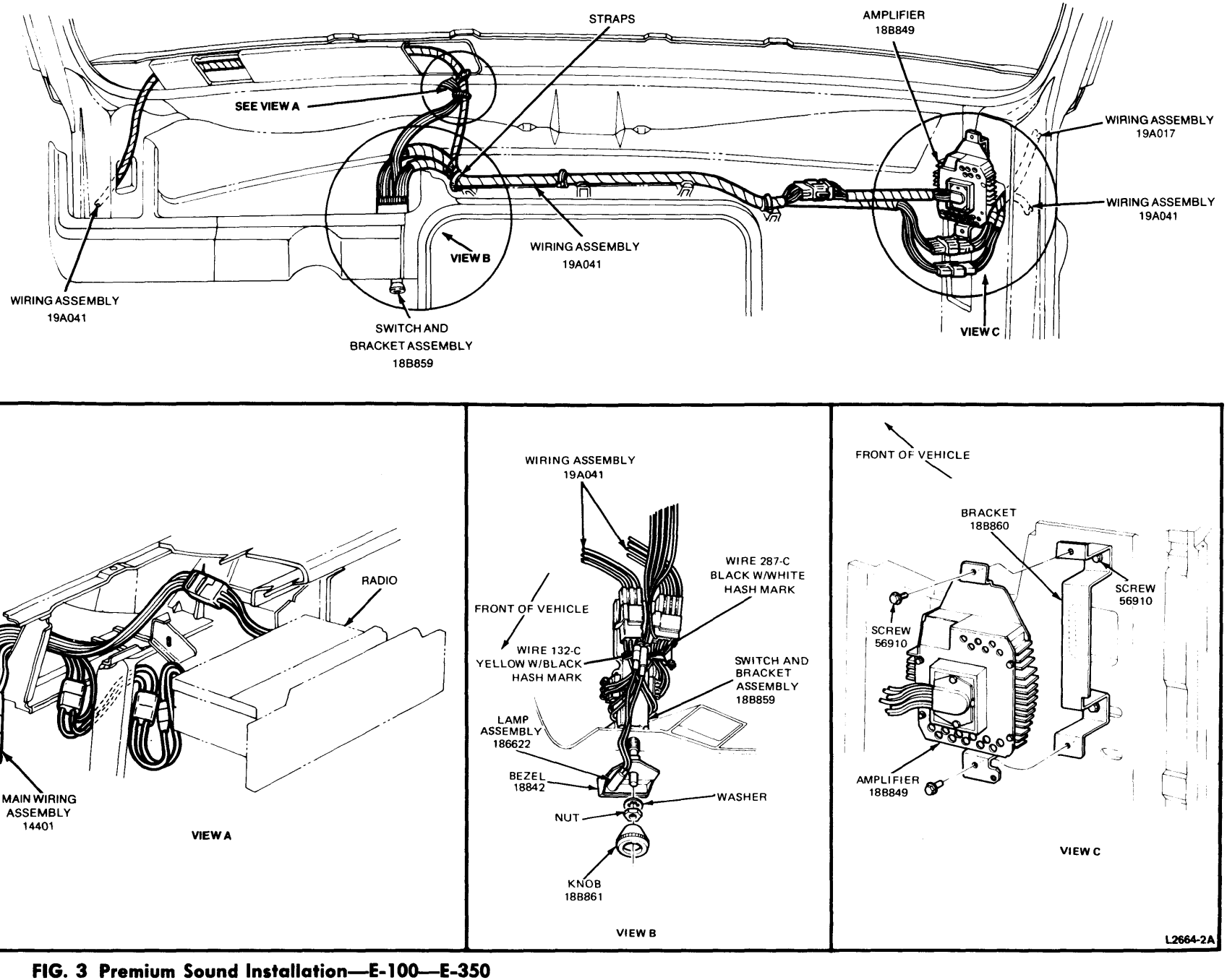
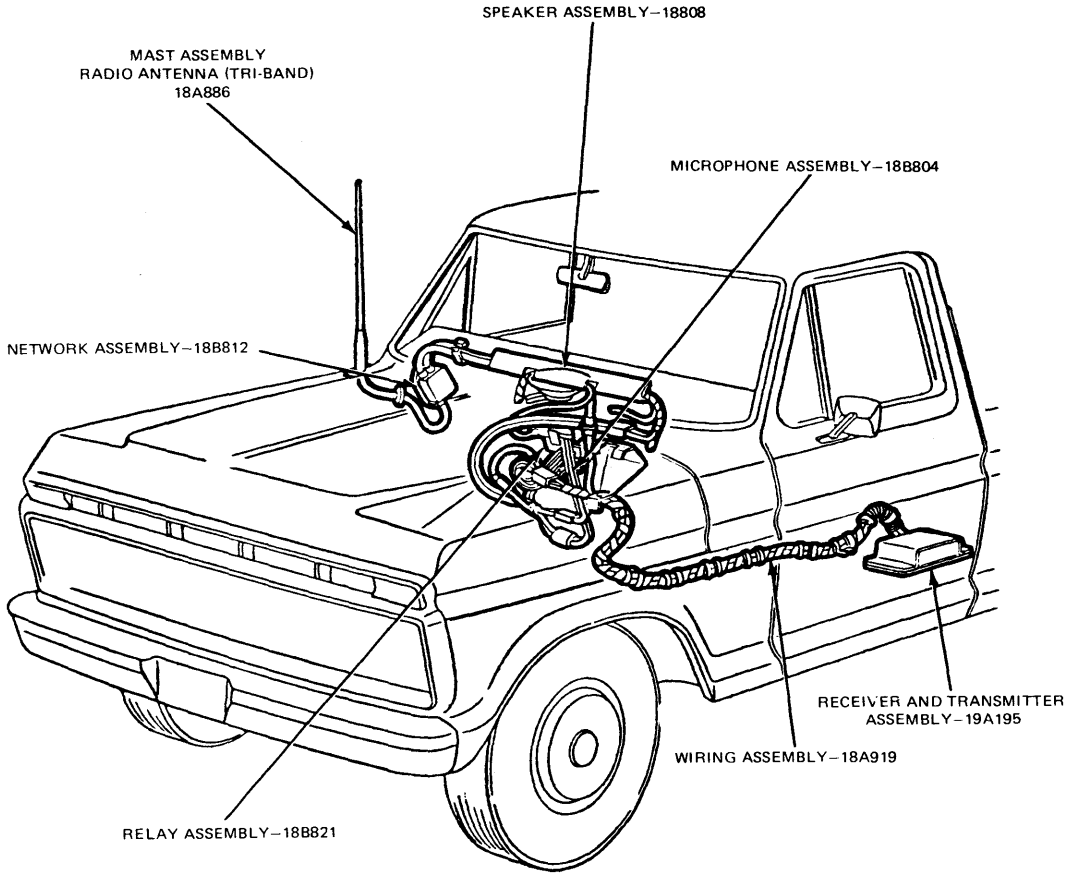


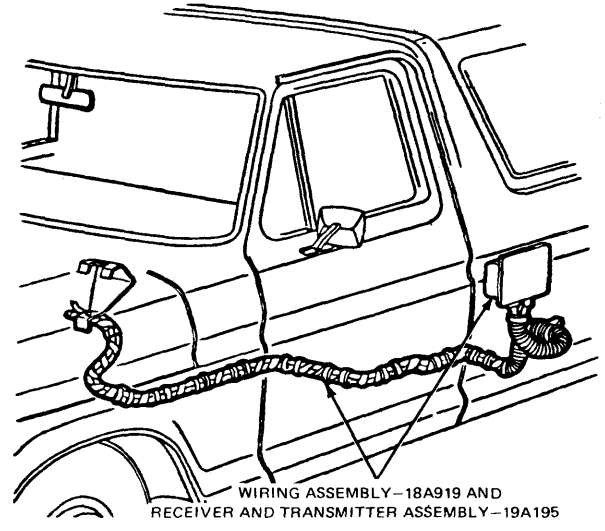
FIG. 3 Premium Sound Installation—E-100—E-350

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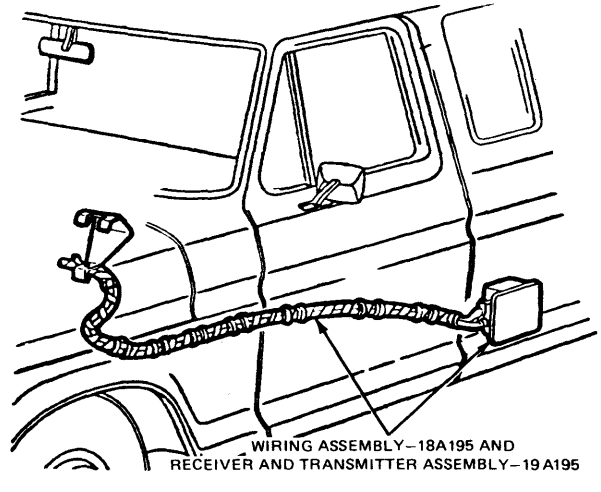
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MAIN VIEW FOR F-100–F-350 WITH STANDARD CAB



VIEW FOR BRONCO RECEIVER AND TRANSMITTER
OTHERWISE SAME AS MAIN VIEW



VIEW FOR F-100–F-350 WITH SUPER CAB
RECEIVER AND TRANSMITTER–OTHERWISE SAME AS MAIN VIEW

L2663-2A

FIG. 4 CB Radio, Antenna and Wiring Installation—F-100—F-350 and Bronco

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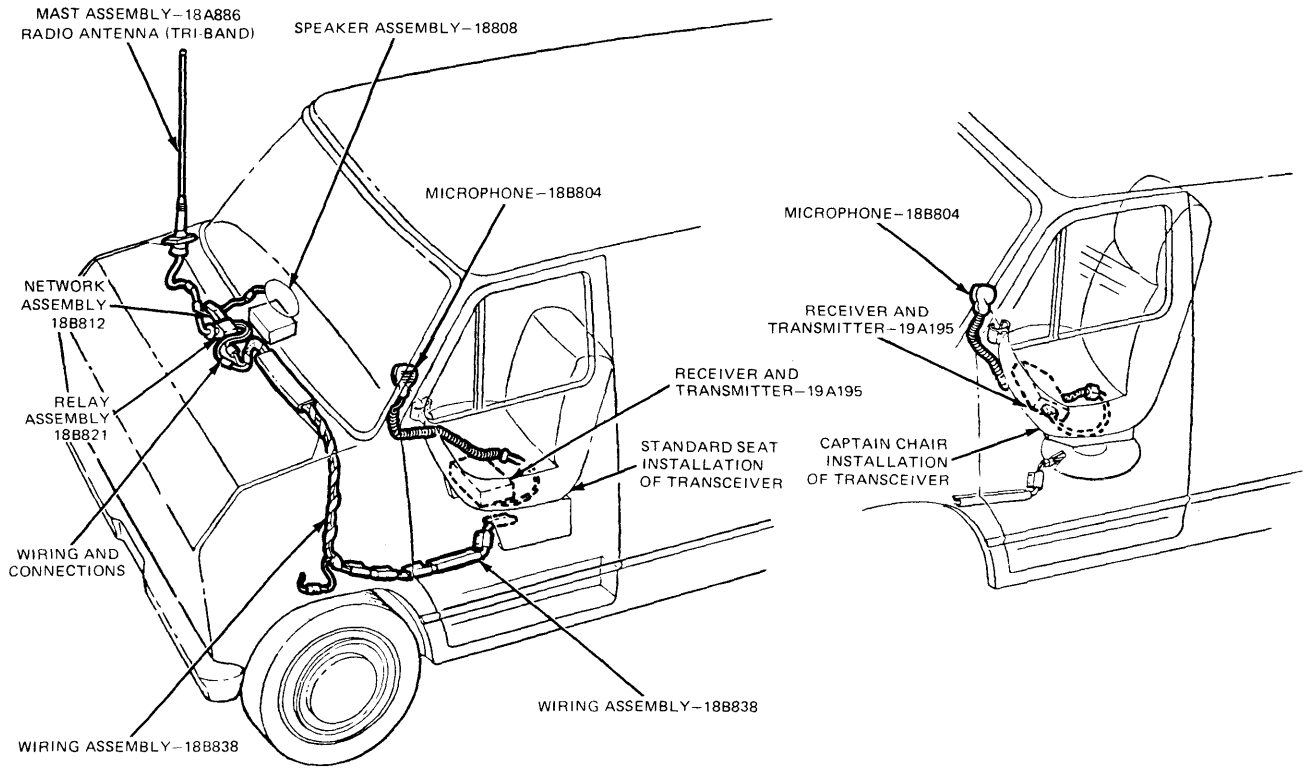


FIG. 5 CB Radio, Antenna and Wiring Installation—E-100—E-350

CHASSIS CONNECTORS

AM AND FM RADIO

The antenna lead-in receptacle is located on the back of the radio at the right lower corner (Figs. 1 and 2). The antenna trimmer is located just above the antenna receptacle. The power and speaker leads are located on the back side of the radio at the left corner.

A permanent magnet speaker is mounted to the instrument panel above the radio. It is connected to the radio by two wires and a plug connector.

Do not operate the radio without the speaker connected as it may damage the power transistor.

CB RADIO

CB radio connectors are shown in Figs. 6 and 7. Antenna signal inputs are split at a network assembly to separate the signals to the AM-FM radio and CB radio. The CB radio uses the same front speaker used for monaural AM-FM radio. When a stereo radio is used, the CB and stereo radio operate independently.

Do not operate the radio without the speaker connected or without the antenna properly adjusted as damage may result to the receiver/transmitter.

CB RADIO MICROPHONE CONTROLS

The CB radio microphone is shown in Fig. 8. All controls for the CB radio are on the microphone. Each control shown (Fig. 8) is described below:

1. Push-to-talk Switch—This switch activates the transmitter and microphone and turns-off the speaker.
2. Microphone—Applies the voice audio to the transmitter when the push-to-talk switch is pressed. The radio will not operate without the microphone control head connected to the connector on the instrument panel (F-100—F-350 and Bronco) or under the driver's seat (E-100—E-350).
3. ON/OFF—Volume Control—Turns reciever/transmitter ON and OFF and controls speaker volume.
4. Squelch Control—Sets receiver squelch to a level that allows only signals above the squelch to be heard. Weaker signals and background noise are eliminated.
5. Noise Blanker—When activated (up position), eliminates unwanted noise.
6. Automatic Scan Indicator Light—Light illuminates when in the automatic scan mode. (See operating instructions provided with CB radio.)
7. Channel Selection Switches—Manually raises (UP) or Lowers (DN) channel selection or automatically scans (SCAN) the channels until a signal is heard which overrides the squelch setting. Automatic scanning continues when the signal drops below the squelch setting. (See operating instructions provided with the CB radio.)
8. Channel Indicator—Displays channel selected.

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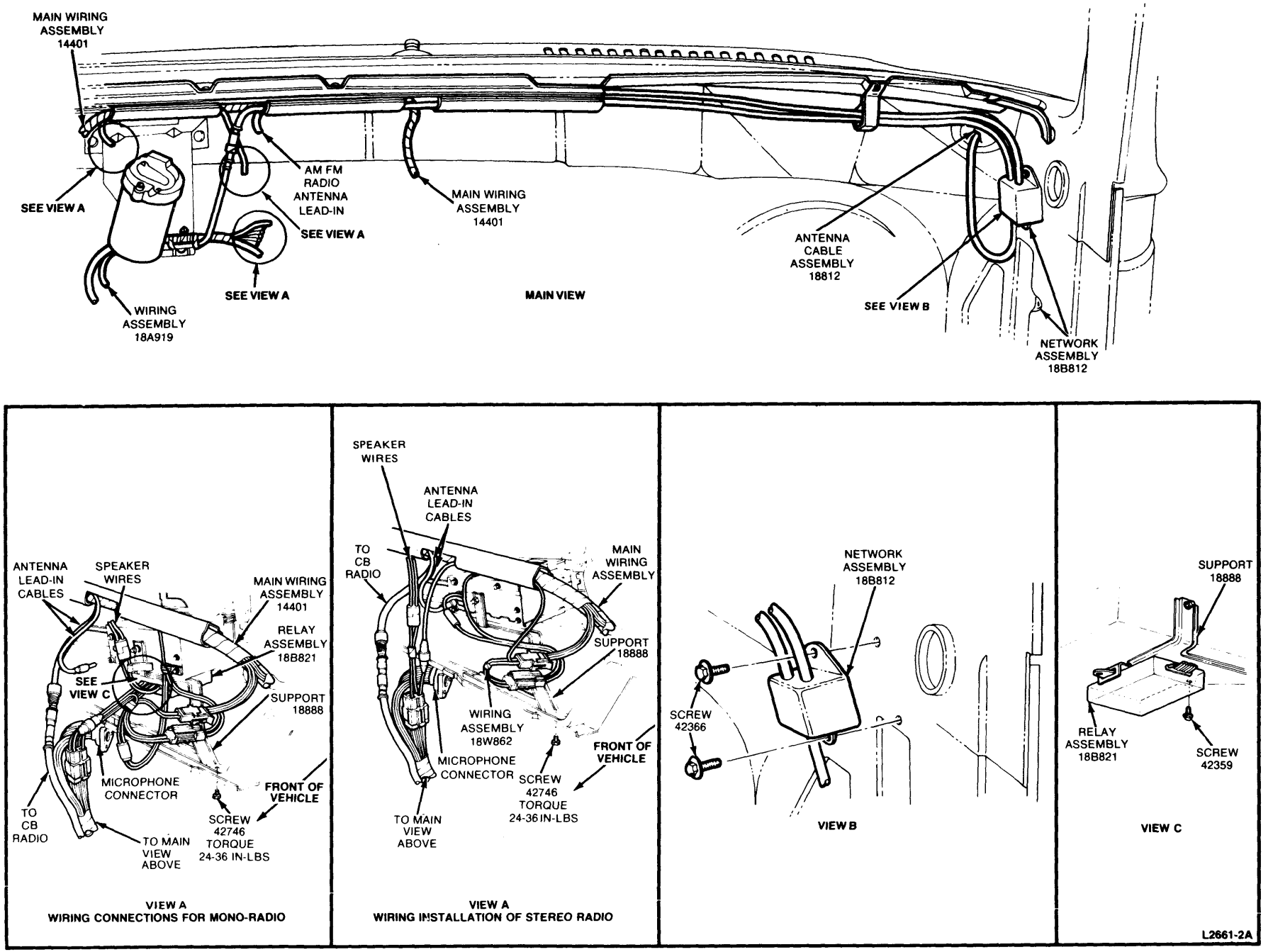


FIG. 6 CB Radio Relay and AM-FM Radio Antenna Lead-In Inone—F-100—F-350

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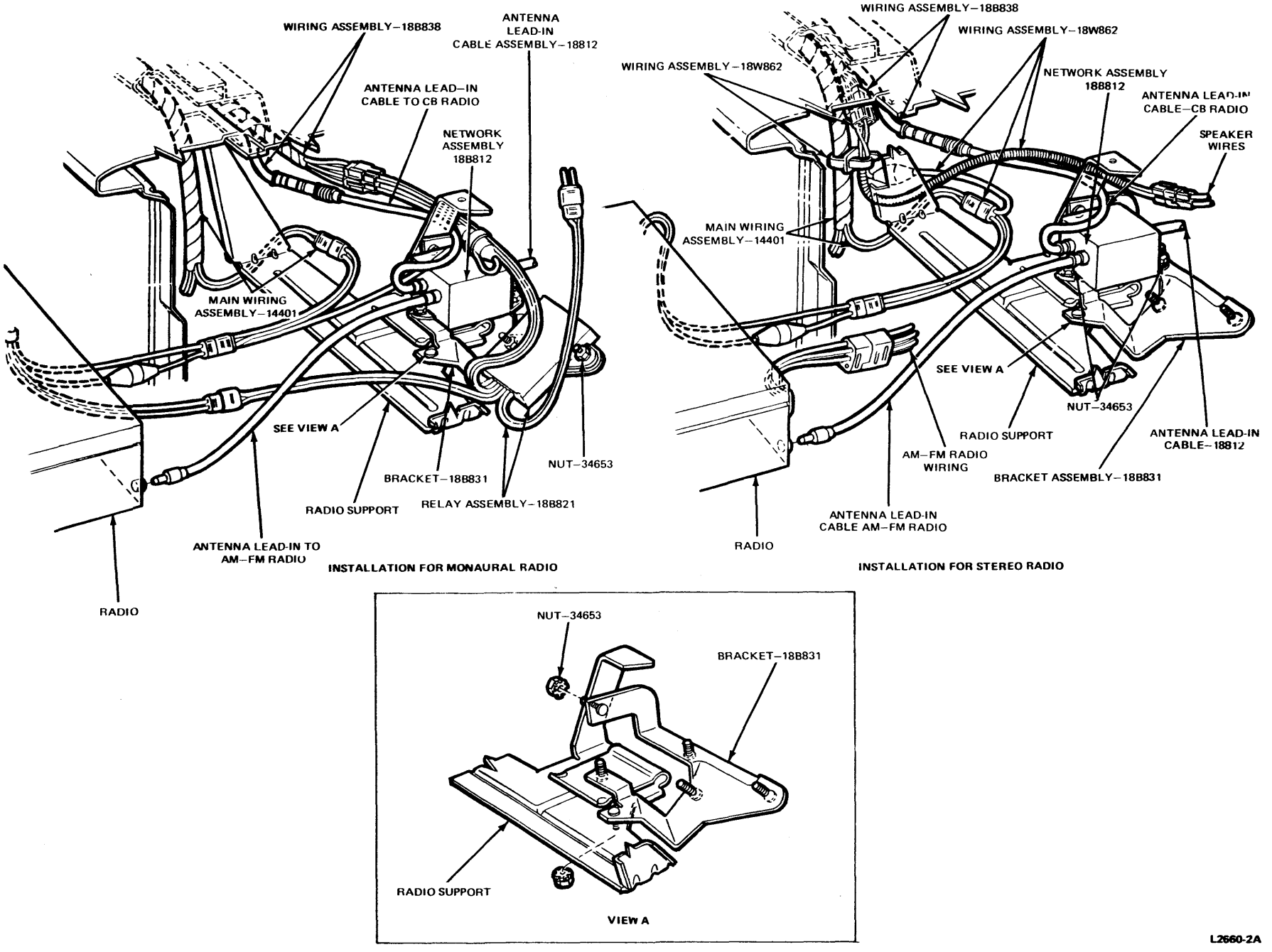


FIG. 7 CB Radio Network Wiring E-100—E-350

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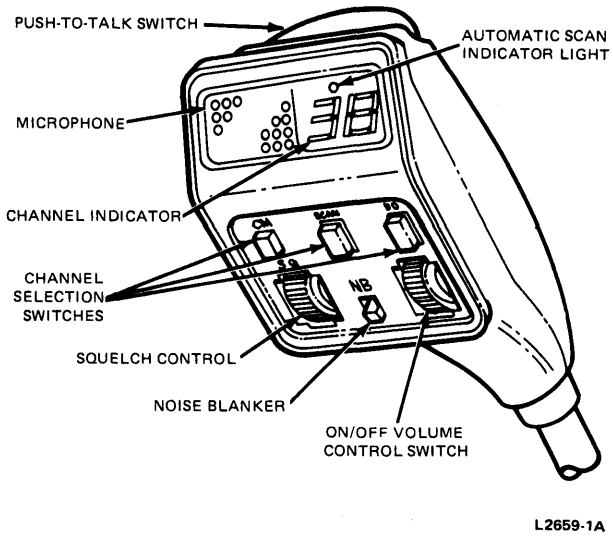


FIG. 8 CB Radio Microphone Controls

DIAGNOSIS AND TESTING

RADIO

A radio tester, Tool T65P-18805-A, is designed for in vehicle usage to rapidly diagnose radio malfunctions and determine if the problem is in the radio, antenna, or the speaker. Testing instructions are located on the side of the tester housing.

The radio tester can save considerable time in servicing all models and makes of radios. Use of the tester eliminates the need for substituting known quality components.

STEREO TAPE PLAYER

During extremely cold weather operation, allow the unit to warm up before testing.

Turn the player on by rotating the volume control (left knob) clockwise approximately 1/2 turn. Insert tool aid cartridge label side up, into the player. Set the tone control (ring knob behind the volume control) at full clockwise rotation. Let the tape run until music starts playing, then re-adjust the controls for desired volume, tone and fader. Listen for continuous music on all four programs. Recording will be heard for two seconds on Left channel, with Right channel blank, then for two seconds on the Right channel, with Left channel blank. Absence of recording on either channel constitutes a malfunction of that channel. Adjust the fader control for full rear, to insure operation of all four speakers. By successively pressing in on the volume control knob, the channels should switch in order 1 to 2 to 3 to 4 to 1 etc.

The Diagnosis Guides at the end of this diagnosis and testing section should be used along with a radio tester to diagnose and repair the radio system.

RADIO RECEPTION

ANTENNA POSITION

Adjust the antenna to full height.

TUNING

Always fine tune the radio with the hand control knob after depressing a push button. This assures that the radio will be set in the center of the station where it will obtain minimum noise and the best possible reception. If a particular station has too much interference, try tuning to a stronger station.

FM multiplex has a range of about 20 miles before reception noises are heard. This means that in problem areas with tall buildings or hills it is necessary to select the strongest possible station.

Experience will dictate which FM stations are best for your area.

TONE CONTROL

If any particular area is full of interference, use the tone control to cut out some of the noise by turning it toward the bass position (counterclockwise).

IINTERFERING NOISES

Located within a few feet of the radio is the powerful electrical ignition system. The high voltage of this system produces noisy side effects that can interfere with both the AM and FM stations. Although precautions have been taken to minimize ignition noise, a certain amount can be heard on FM when the station is not quite tuned. Ignition noise from passing vehicles can occasionally be heard if they do not have proper suppression equipment installed. These same vehicles produce interference in television sets. Very little can be done with the radio receiver to protect against this type of external interference.

ELECTRICAL ACCESSORIES

Some of the many electrical accessories being added on today's vehicles contribute to additional radio interference. These devices are constantly tested to establish their electrical compatibility with the radio.

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Add-on or faulty accessories can cause radio noise problems.

FM FLUTTER

Flutter can best be described as repeated pops and hissing bursts heard in the speaker, during an otherwise good broadcast. Usually this condition exists while traveling in the fringe area of the station. Flutter will become more severe within approximately 25 miles of the station. The signal loss becomes greater away from the station, until finally noise takes over and you can no longer receive the station. Flutter may also be noticed near the station because of the "line-of-sight" characteristic of FM radio waves. This condition can happen when a building or large structure is between the radio receiver and the station you are trying to receive. Some of the FM signal "bends" around the building, but certain spots have almost no signal. Some of these signal losses are only a few inches wide and if the vehicle is parked in one of these "dead spots" you will only hear noise from the speaker. As you move out of the shadow of the structure, the station will return to normal. Flutter will not occur on AM, becuase the AM radio waves are much longer than FM waves.

FM MULTI-PATH CANCELLATION

Another effect caused by the "line-of-sight" characteristic is called Cancellation. This condition exists when the radio waves are reflected from objects or structures. The noises produced by Cancellation are similar to Flutter, with the addition of distortion in the program. A more familiar description of Cancellation is its similarity to the multiple ghosts and picture jumping that occur on television when a low flying plane passes. The same condition exists in the vehicle, except that the vehicle is moving and the reflecting structure is stationary. The reflected signal cancels the normal signal, causing the antenna to pick up noise and distortion. Cancellation effects are most prominent in metropolitan areas, but can also become quite severe in hilly terrain and depressed roadways.

FM CAPTURE AND OVERLOADING

FM Capture is an unsual condition that occurs when traveling in the vicinity of a broadcast tower. If listening to a weak FM station, when passing the broadcast tower, a stronger station occurs without changing the radio dial. When passing the tower, the station may switch back and forth a few times before returning to the station originally tuned. When several braodcast towers are present (common in metropolitan areas) several stations may overload the receiver resulting in considerable station changing, mixing and distortion. Fortunately this condition is localized and it will not harm the receiver. Some overloading may also be noticed on AM, but usually to a lesser degree.

RECEIVING FM MULTIPLEX

Because more data is carried in the FM multiplex waves than in the monaural FM broadcasts, Flutter, Cancellation and Capture are even more noticeable. The FM Multiplex noise-free broadcast range is approximately five miles less than that received with the monaural FM radio. The AM/FM, FM Multiplex radio may never encounter any of these troublesome problems, as they are more prominent in metropolitan areas, hilly terrain and depressed roadways. However, when diagnosing FM Multiplex, it is recommended to accurately tune to the strongest FM Multiplex station.

CB RADIO

CB radio checkout procedures are as follows:

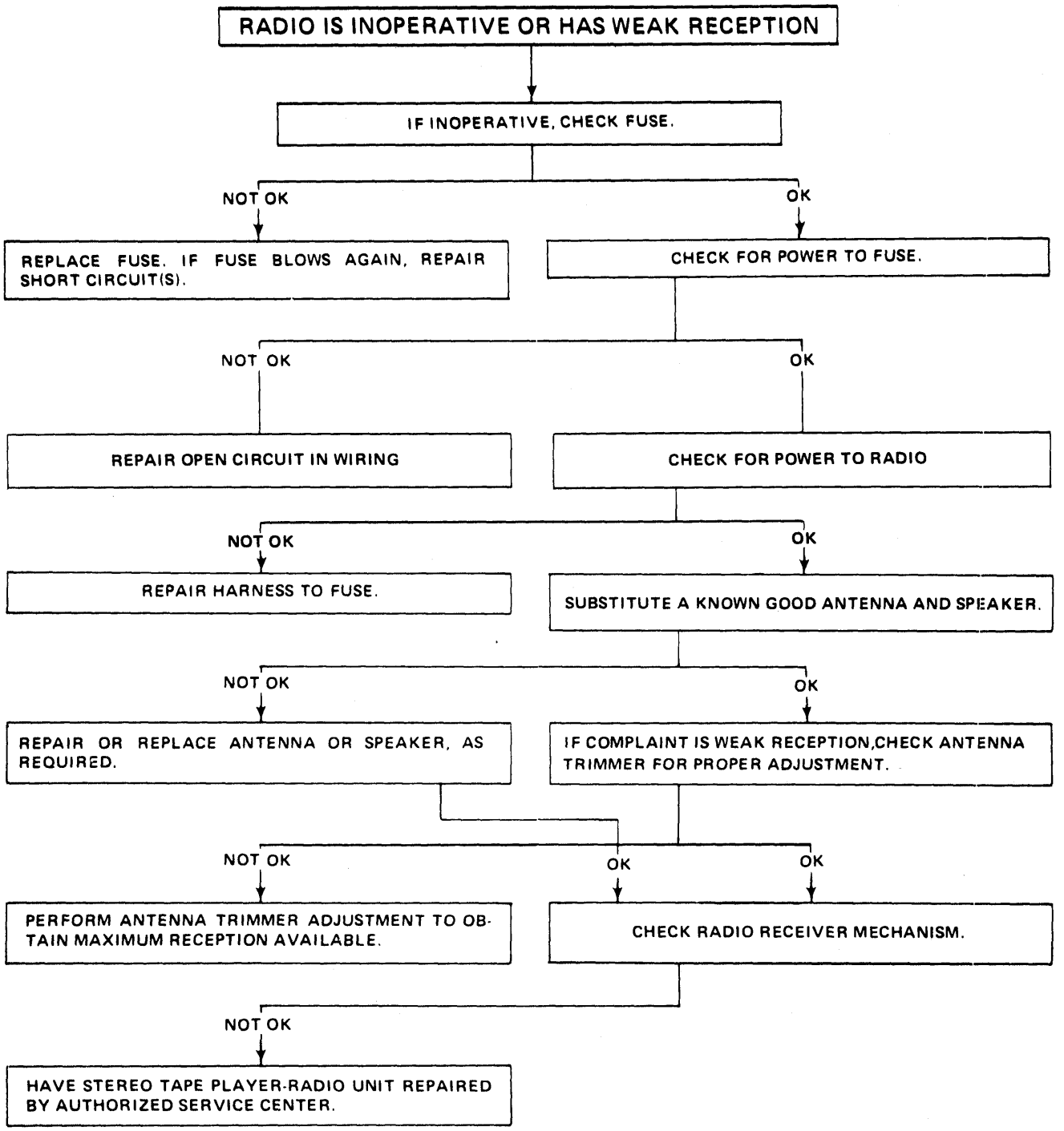
1. Make certain that microphone is connected.
2. On monaural entertainment systems, turn radio to listenable level.
3. Turn on CB receiver/transmitter by rotating volume control.
4. Rotate squelch control upward until signals or background noise is heard. Entertainment radio speaker will be muted.
5. Increase and decrease channel selection by depressing these buttons will result in a continuous (at 4 channels per second) increase or decrease in the channel selected. A slight delay will be noted before a continuous increase or decrease begins.
6. Verify operation of the automatic scan feature by depressing the SCAN button. The SCAN indicator light will illuminate. The SCAN mode, after a short pause, automatically increases channel selection at a rate of approximately 4 channels per second. Channel selection will halt when one of the following occurs:
   - A signal of sufficient strength to override the squelch setting is received.
   - Depressing the push-to-talk switch or depressing the SCAN button.
7. Verify that transmitter is operative by checking operation with another CB or local walkie talkie. Do not transmit on channel 9 as that channel is reserved for emergency use.
8. Turn ON/OFF—Volume control upwards until a click is heard.

DIAGNOSIS GUIDES

The following guides are provided to use, along with a radio tester, to diagnose and repair the radio system.

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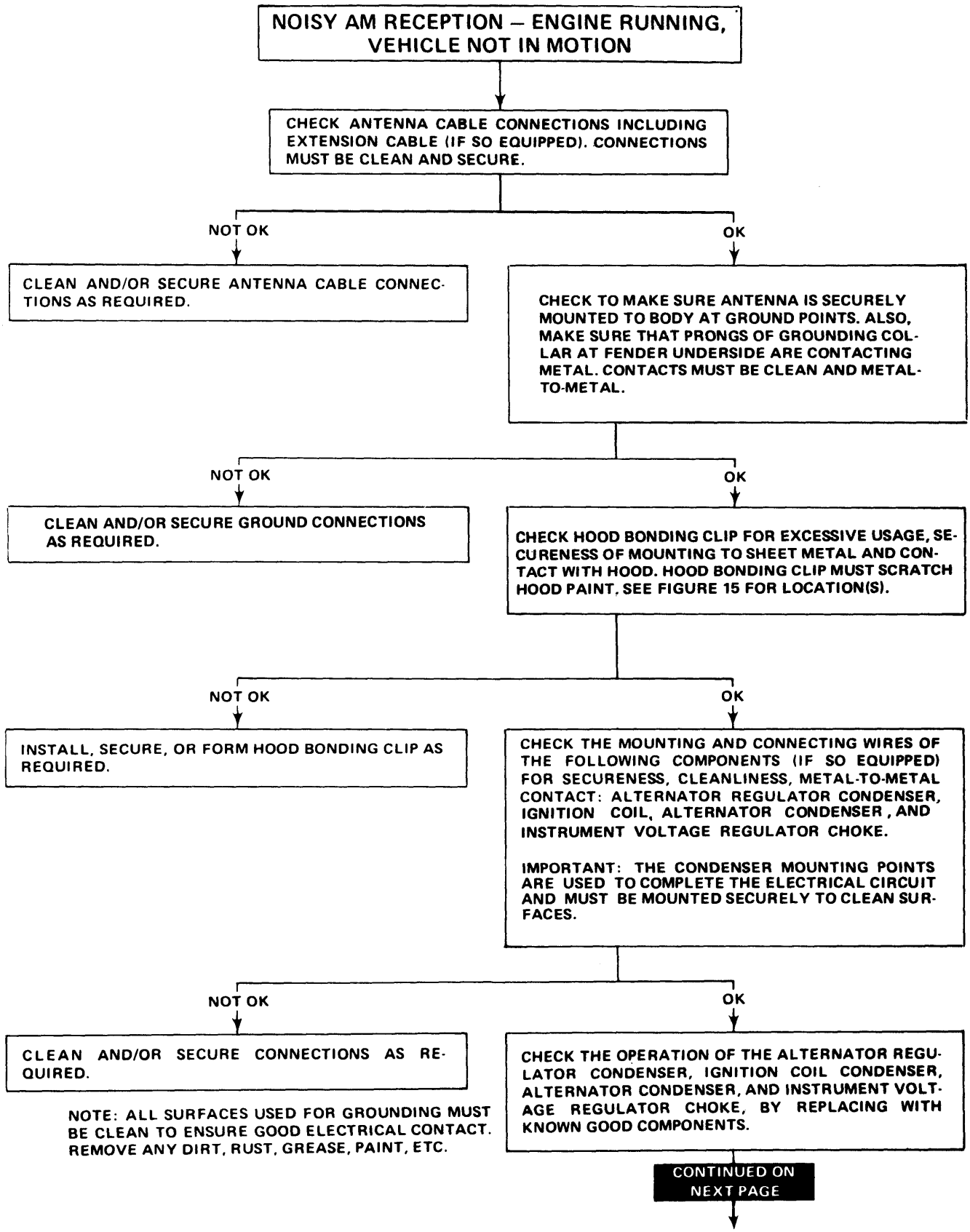
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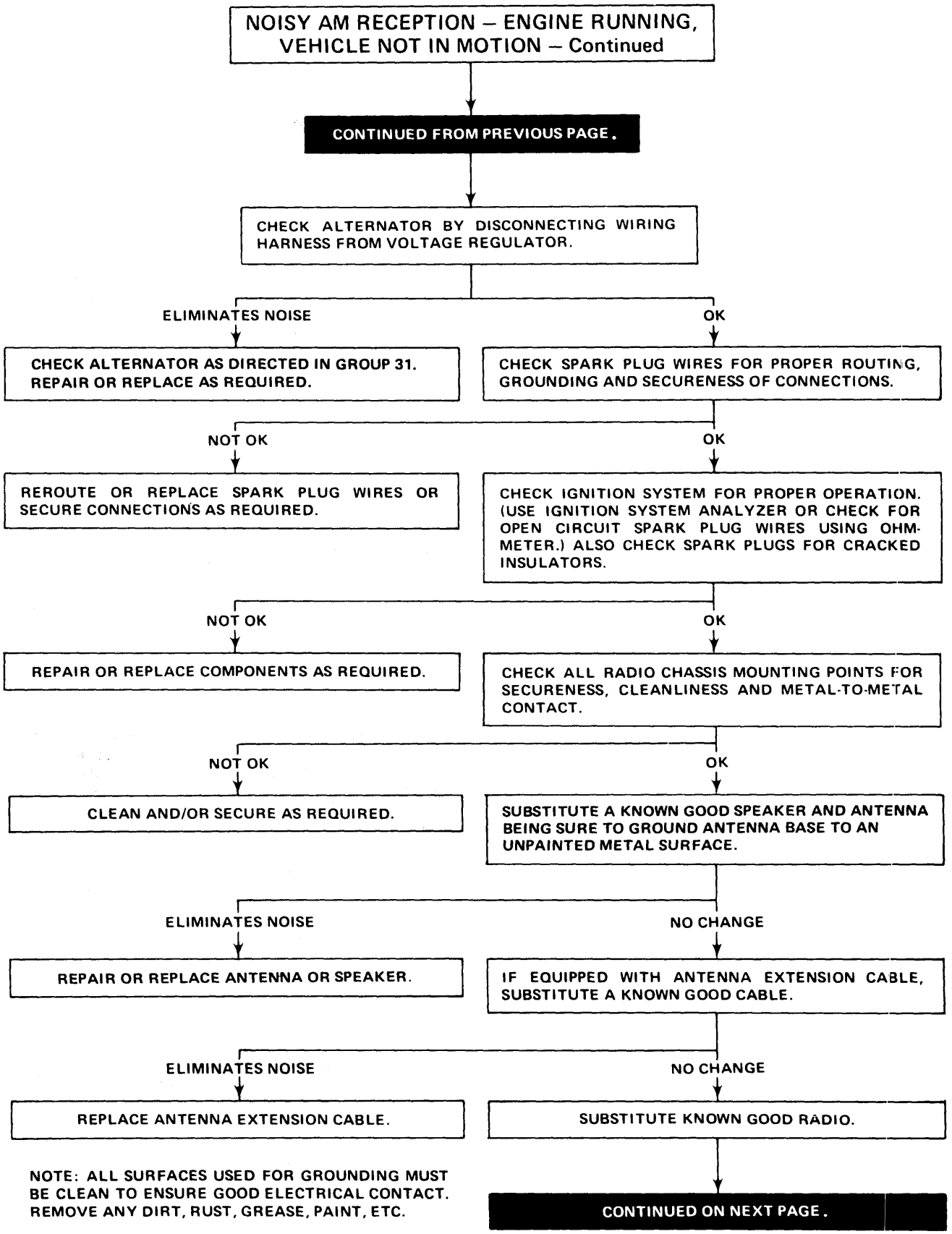
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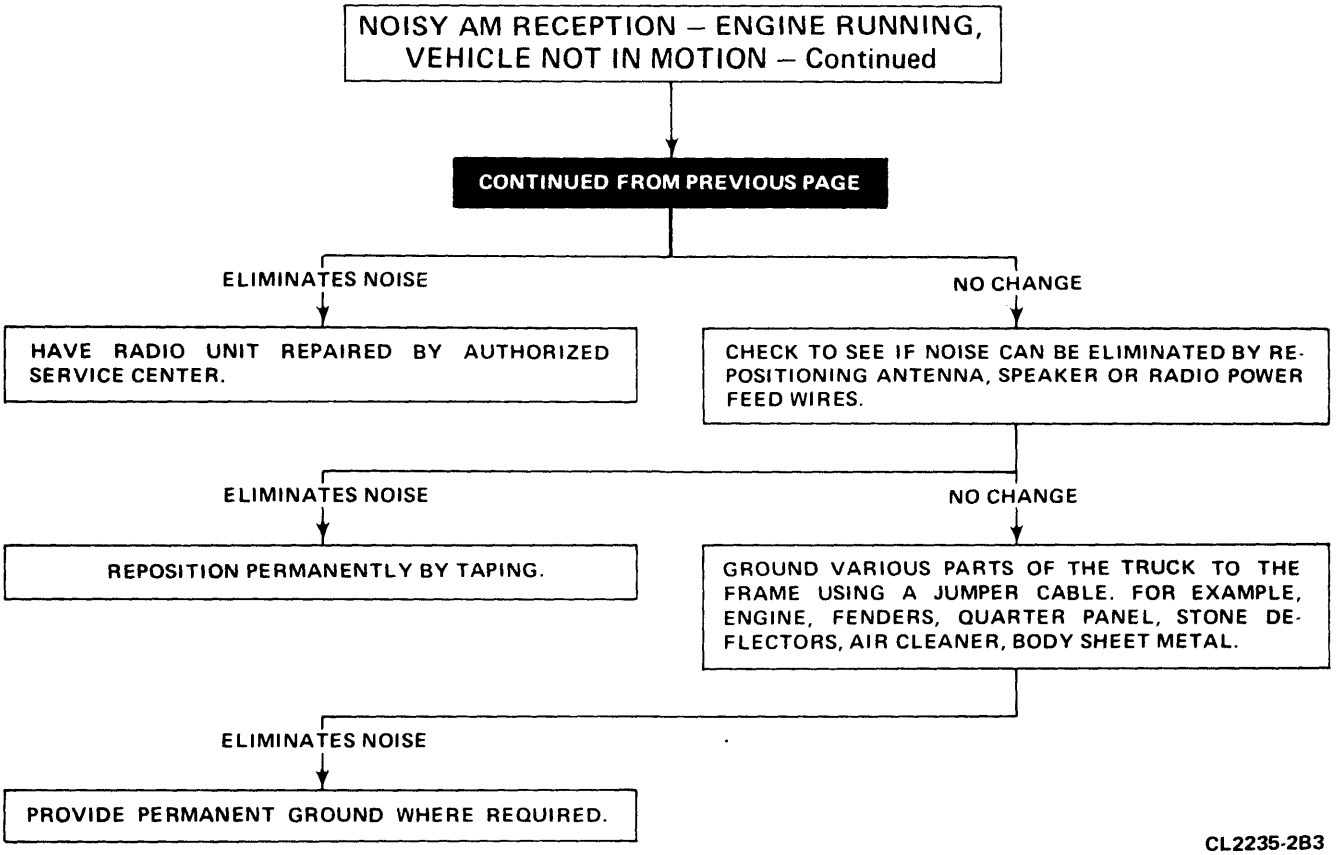
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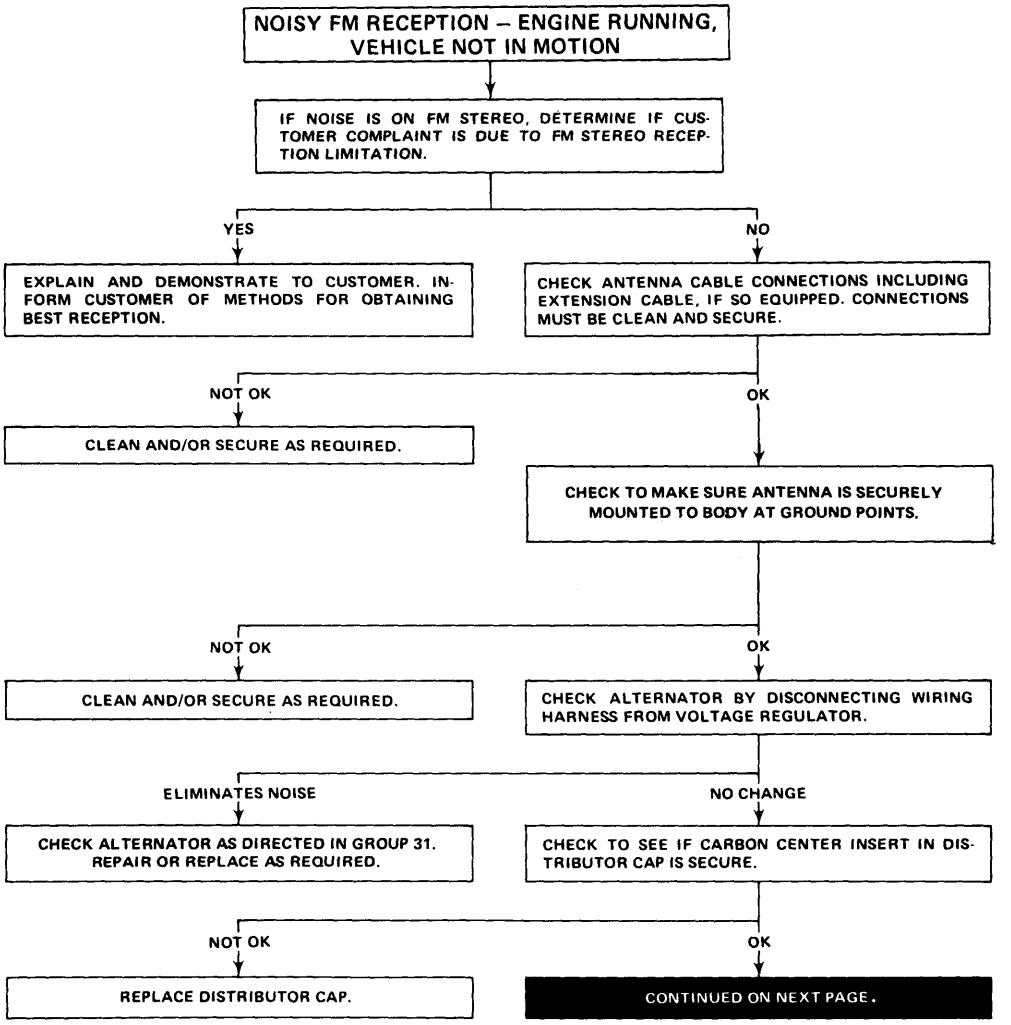
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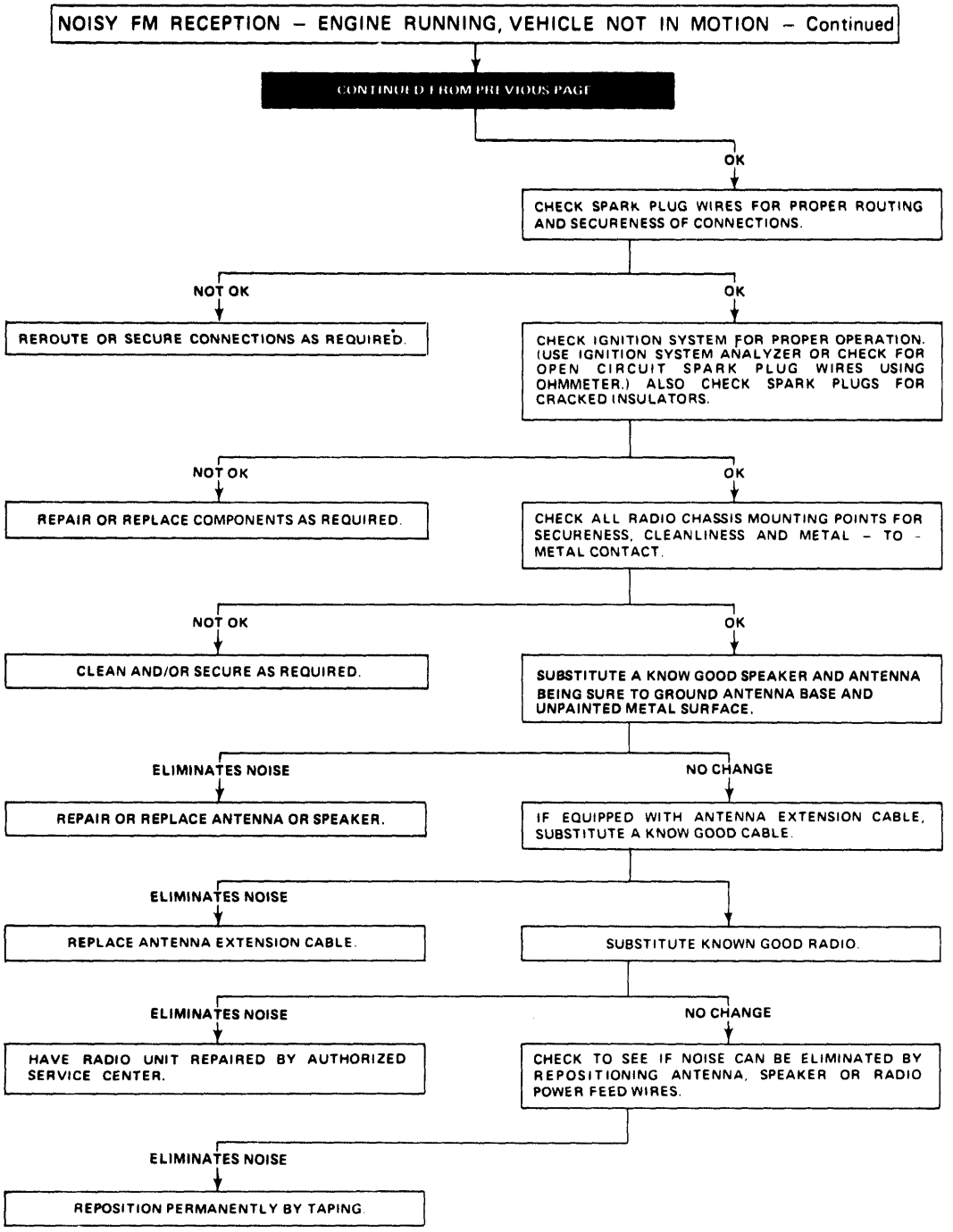


NOTE: ALL SURFACES USED FOR GROUNDING MUST BE CLEAN TO ENSURE GOOD ELECTRICAL CONTACT. REMOVE ANY DIRT, RUST, GREASE, PAINT, ETC.

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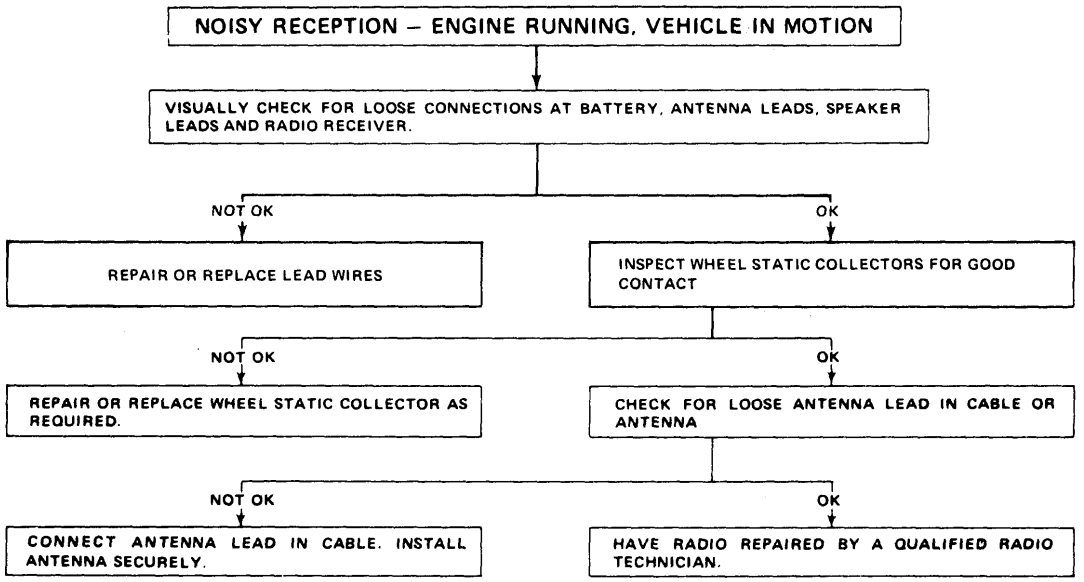


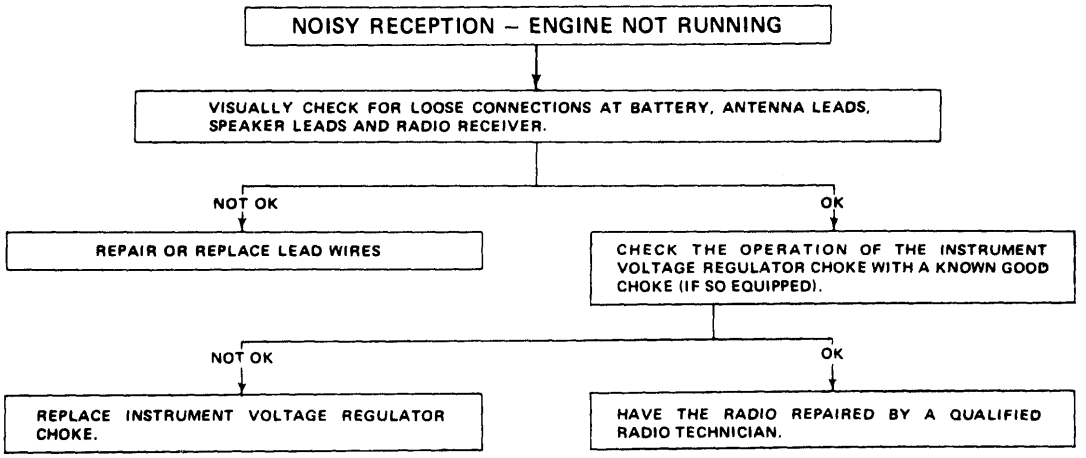
NOTE – ALL SURFACES USED FOR GROUNDING MUST BE CLEAN TO ENSURE GOOD ELECTRICAL CONTACT. REMOVE ANY DIRT,RUST,GREASE,PAINT, ETC.

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ADJUSTMENTS

PUSH BUTTONS

AM RADIO

Turn the radio on, and allow it to warm up for 15 minutes. Extend the antenna to its maximum length.

Pull out the push button to be set to unlock the push button mechanism. Tune in the desired station with the manual tuning knob. After the station is clearly tuned in, push the button straight in until it stops, then release it.

Repeat this procedure for the remaining buttons.

ANTENNA TRIMMING

Each radio assembly has an antenna trimmer located in the body of the assembly. The purpose of the trimmer is to adjust the antenna circuit for variations of length, so that many types of antennas may be matched perfectly to the requirements of each radio assembly.

The antenna trimmer should be re-adjusted when a new antenna or lead-in cable is installed. To trim the antenna, proceed as follows:

1. Inspect the antenna lead-in plug and socket to be sure that they are clean. Clean them if required.
2. Extend the antenna to its maximum length and position the vehicle in an open area away from steel buildings.
3. Turn the radio on.
4. Tune the radio to a weak station around 1600 KC (16 on the dial). Adjust the volume control so that the station is barely audible.
5. Adjust the antenna trimmer to obtain maximum volume from the station.

AM-FM-MPX STEREO RADIO

CAUTION: DO NOT OPERATE THE BAND SELECTOR BAR IF ANY PUSHBUTTON IS PULLED OUT.

Allow radio to warm up for five minutes.

Slide the band selector bar to the left for AM station selection and follow the push button setting procedure described under AM radio. Slide the band selector bar to the right for FM and FM stereo station selections and once again, follow the push button setting procedure described under AM radio.

AM-FM STEREO RADIO AND STEREO TAPE PLAYER

Speaker Balance Adjustment

The speaker balance adjustment on the AM-FM Stereo Radio and Stereo Tape player can be made through the tape cartridge door. However, only in extreme cases of speaker unbalance, should a speaker balance adjustment be made.

1. Properly adjust the receiver to a FM-Stereo broadcast and allow unit to operate for five minutes. The stereo jewel should be illuminated.
2. Open the tape cartridge door and with a screwdriver, slowly rotate the adjusting screw. Turning the screw to the right increases the volume of the right speakers. Turning the screw to the left increases the volume of the left speakers.
3. Test speaker balance with a quality tape.

REMOVAL AND INSTALLATION

AM AND FM RADIO

F-100 THROUGH 350—AND BRONCO

Removal

1. Disconnect the battery ground cable.
2. Remove the ash tray and bracket.
3. Disconnect the antenna lead-in cable, speaker wires and radio feed (Power) wire (Fig. 1).
4. Remove the bolt attaching the radio rear support to the lower edge of the instrument panel (Fig. 1).
5. Remove the knobs and discs from the radio control shafts.
6. Remove the retaining nuts from the radio control shafts, and remove the cluster bezel.
7. Remove the nuts and washers from the radio control shafts, and remove the radio from the instrument panel.

Installation

1. Position the radio to the instrument panel, and install the nuts and washers on the radio control shafts.
2. Position the radio rear support to the lower edge of the instrument panel, and install the attaching bolt.
3. Connect the antenna lead-in cable, speaker wires and feed (Power) wires to the radio.
4. Position the cluster bezel to the opening, and install the screws and washers and the nuts on the radio control shafts. Install the knobs and discs on the radio control shafts.
5. Connect the battery ground cable.
6. Check the radio operation.
7. Install the ash tray bracket and ash tray.

E-100—E-350

Removal

1. Disconnect the battery ground cable from the battery.
2. Remove the heater and A/C control knobs.
3. Remove cigar lighter (if so equipped).
4. Remove the radio knobs and discs.
5. If equipped with cigar lighter, snap out the name plate (right side of panel) to gain access to one

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panel attaching screw and remove the screw.
6. Remove the remaining finish panel attaching screws (five).
7. Being careful not to mar or scratch the instrument panel, insert a screw driver or similar tool and pry (pop out) the cluster panel at two locations.
8. Disconnect the antenna lead in cable and speaker connectors.
9. Remove the radio mounting plate (two nuts and washers).
10. Remove the front radio-to-instrument panel attaching screws (four) and remove the radio.
11. Remove the rear radio support nut and washer (Fig. 2).

Installation

1. Install the rear radio support washer and nut.
2. Position the radio to the instrument panel and install the four attaching screws (front of radio).
3. Install the radio mounting plate to the radio (two washers and nuts).
4. Connect the radio antenna lead to the radio and speaker wires to the connectors.
5. Position the right hand finish panel to the instrument panel and (snap-in) the two retaining clips (Fig. 2).
6. Install the finish panel attaching screws and name plate (if removed).
7. Install the radio discs and knobs.
8. Install the cigar lighter assembly (if removed).
9. Install the heater and A/C control knobs.
10. Connect the battery ground cable.
11. Check the operation of the antenna.

CB RADIO MICROPHONE

To remove microphone, disconnect microphone connector at mounting bracket (Figs. 9, 13 and 14) and remove microphone assembly. To install microphone, connect microphone connector at mounting bracket (Figs. 9, 13 and 14) and set microphone head in holder (E-100—E-350) or on retainer bracket (F-100—F-350 and Bronco).

CB RADIO RECEIVER/TRANSMITTER

To remove receiver/transmitter, disconnect electrical connector and antenna lead-in at receiver/transmitter, remove attaching screws (Figs. 10 thru 14), and remove receiver/transmitter from vehicle. To install receiver/transmitter, position as shown in Figs. 10 thru 14, secure with attaching screws, and connect electrical connector and antenna lead-in. Make certain ground strap is connected on F-100—F-350 standard cab.

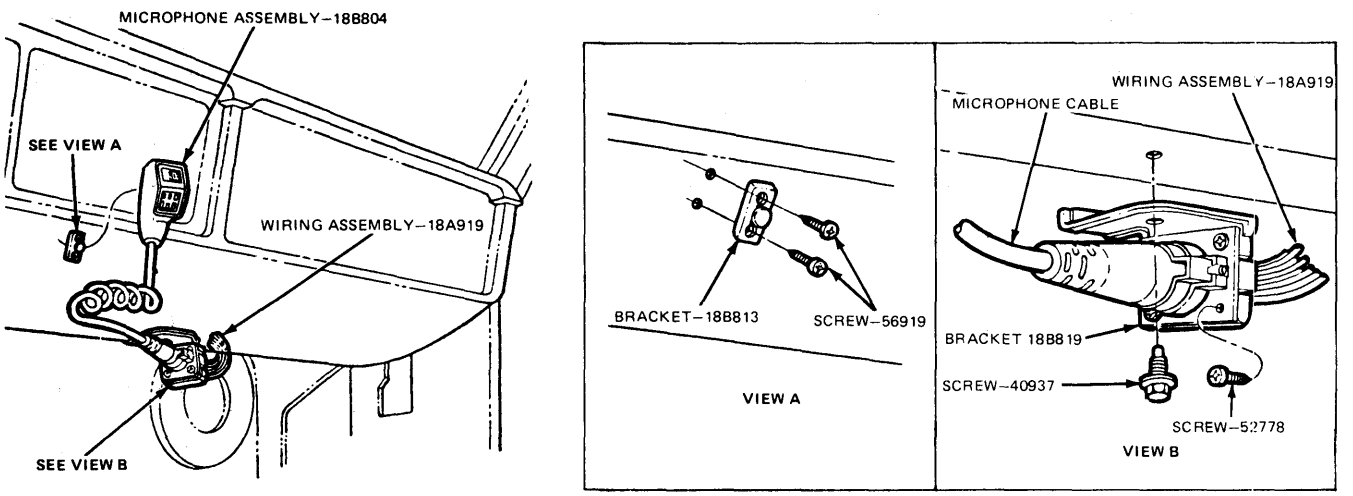


FIG. 9 CB Radio Microphone Installation—F-100—F-350 and Bronco

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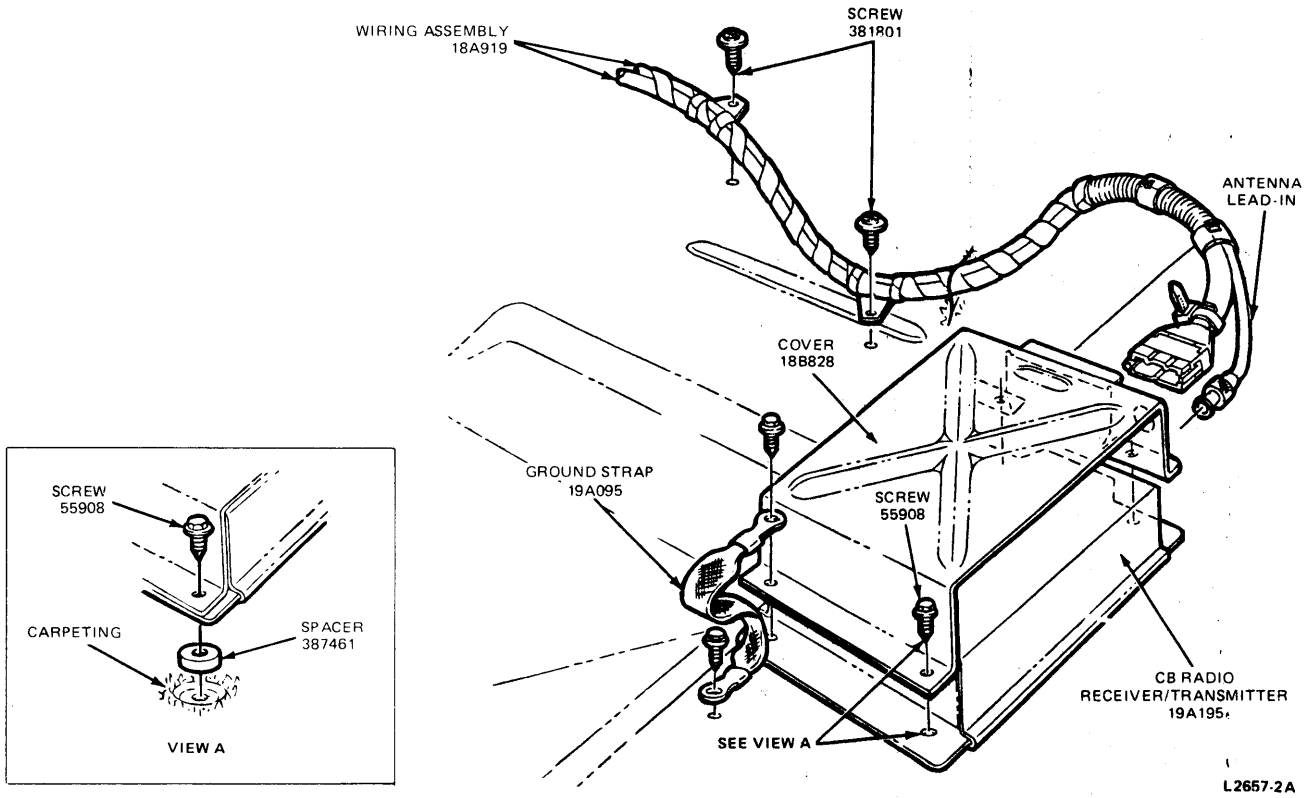


FIG. 10 CB Radio Installation—F-100—F-350 Standard Cab

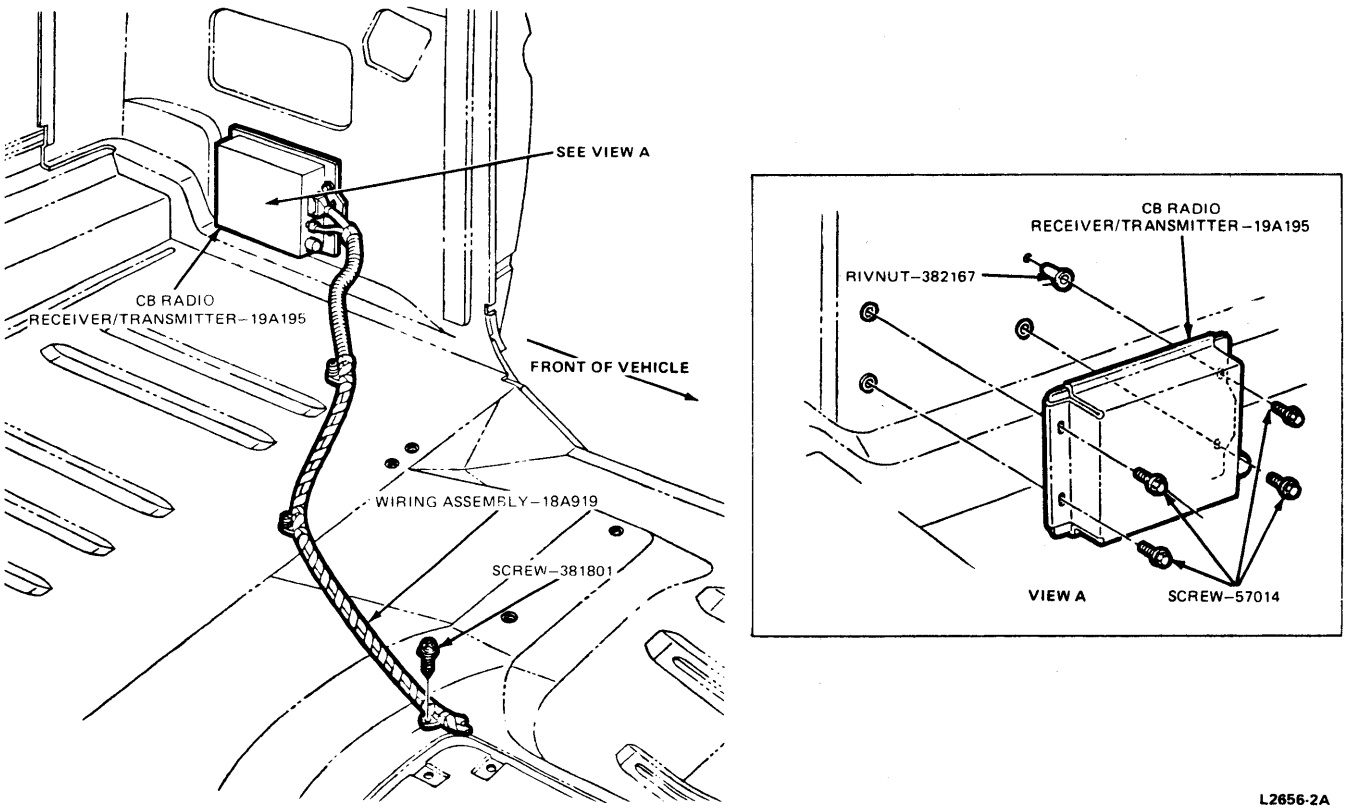


FIG. 11 CB Radio Installation—F-100—F-350 Super Cab

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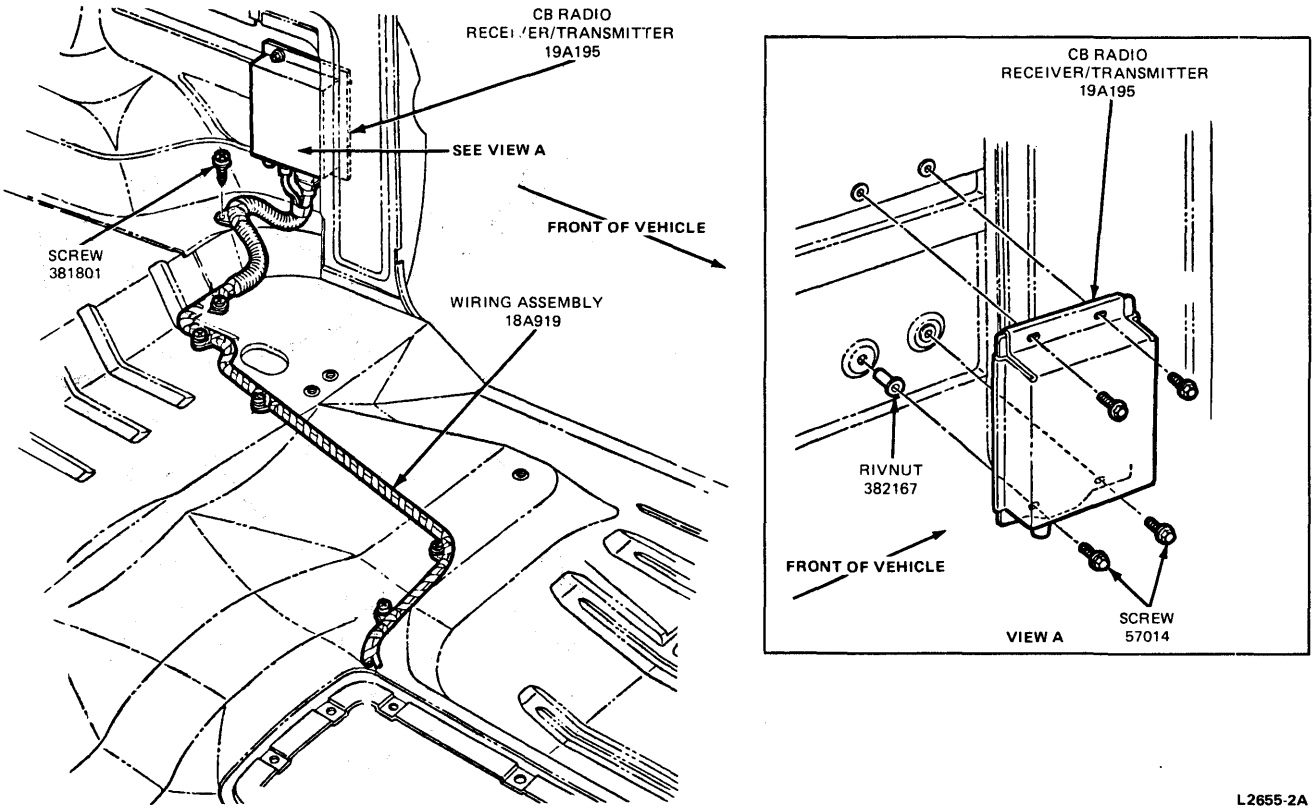


FIG. 12 CB Radio Installation—Bronco

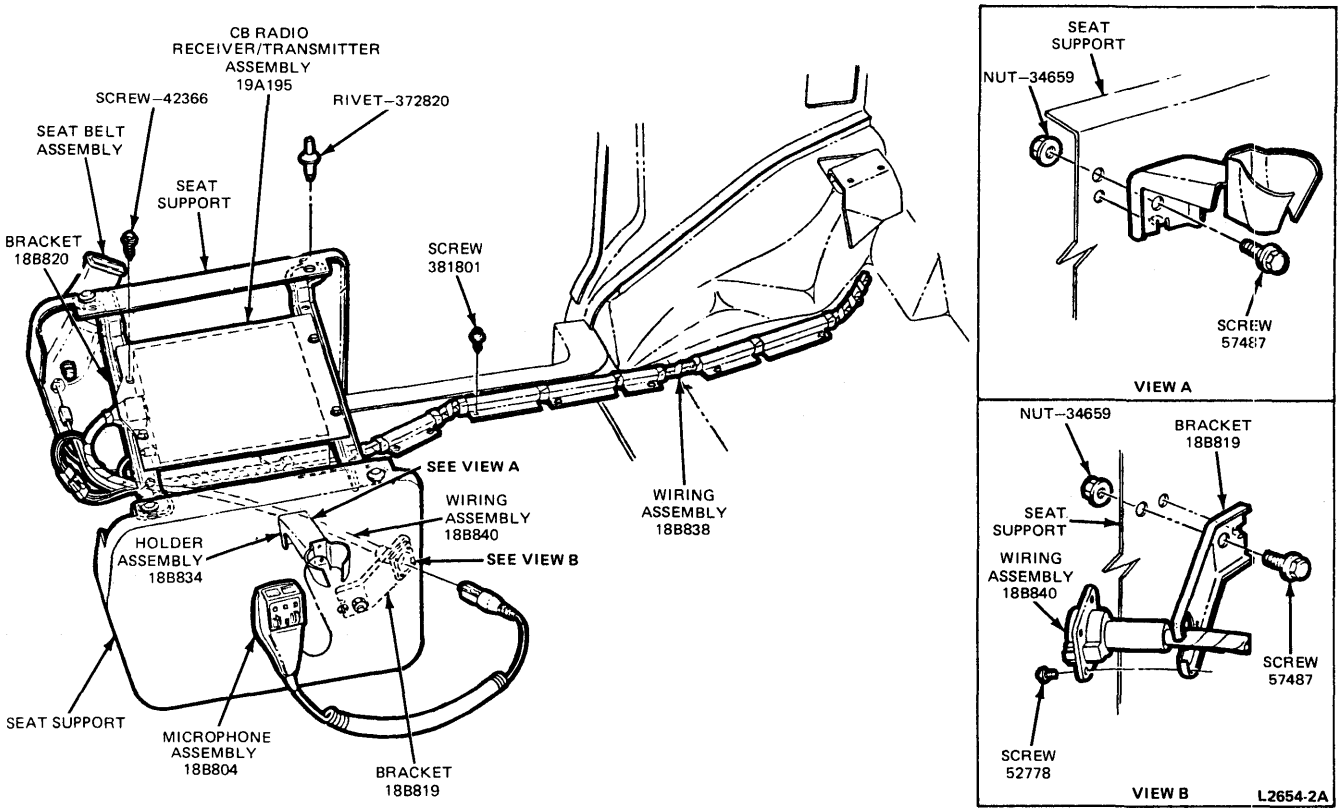
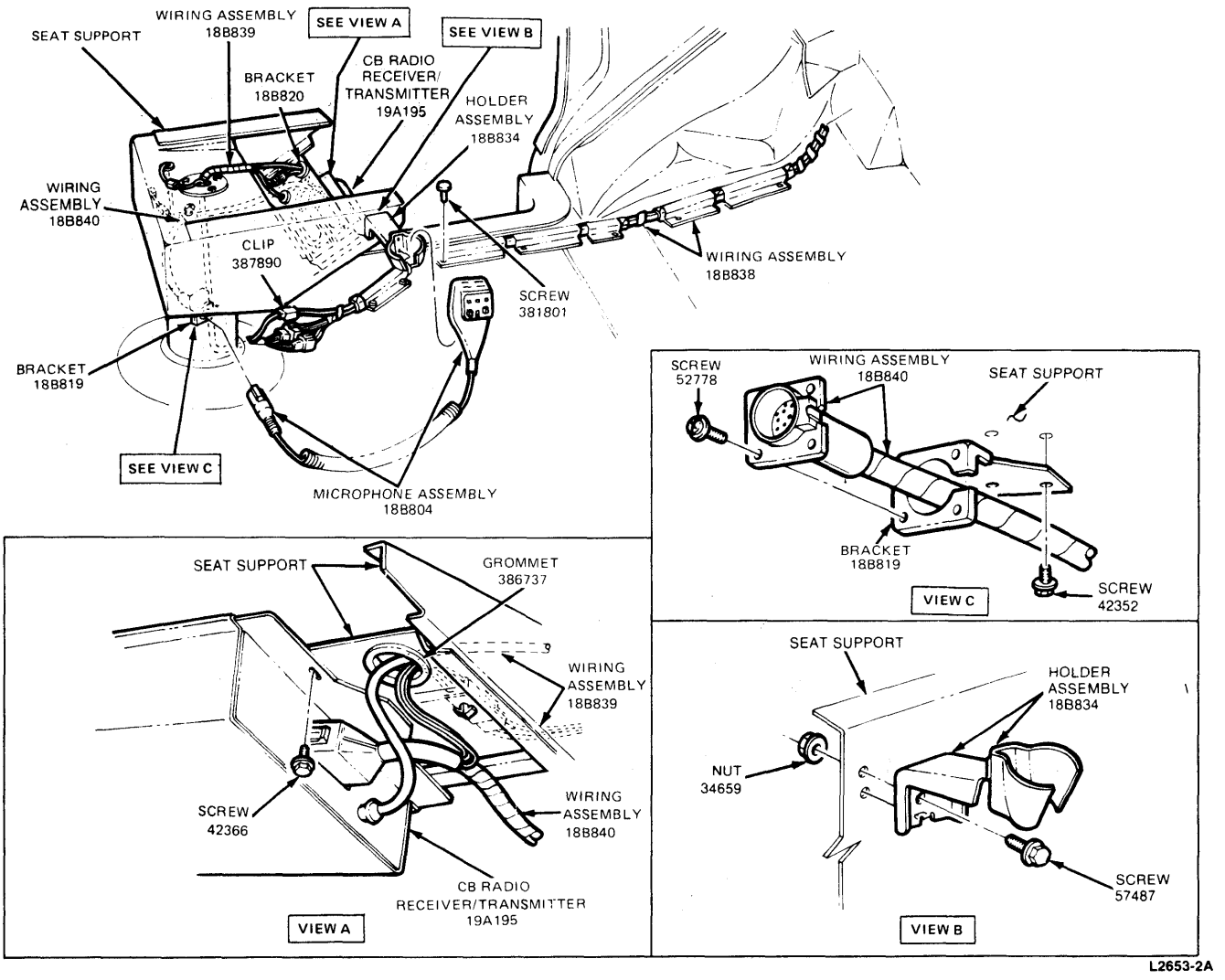


FIG. 13 CB Radio Installation—E-100—E-350 Standard Seat

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FIG. 14 CB Radio Installation—E-100—E-350 Captain Chair

RADIO SUPPRESSION EQUIPMENT

The radio suppression equipment used on the different models is shown in Figs. 15 and 16. When replacing any radio suppression equipment components, be sure that a good contact is made at all attachments. Remove any paint or dirt from between a condenser and its ground. Tighten all nuts and bolts securely.

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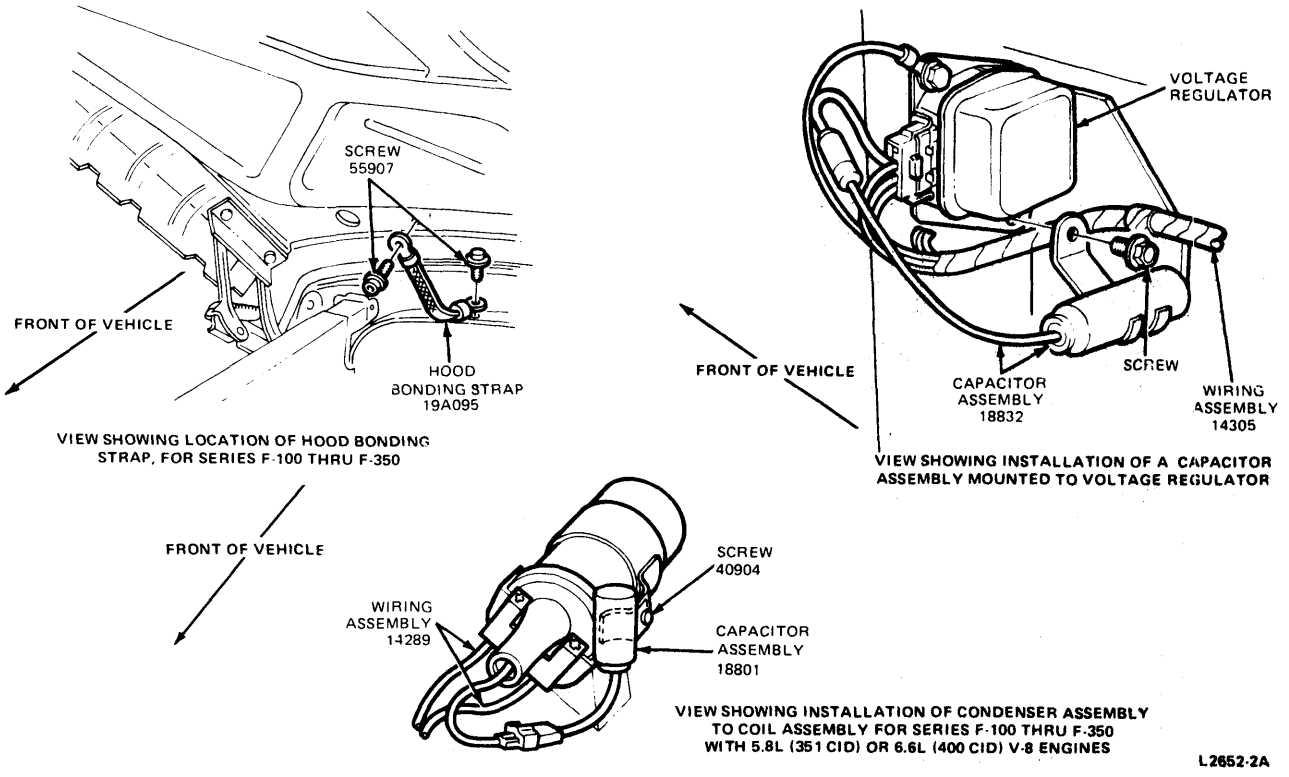


FIG. 15 Radio Suppression Equipment—F-100—F-350—and Bronco

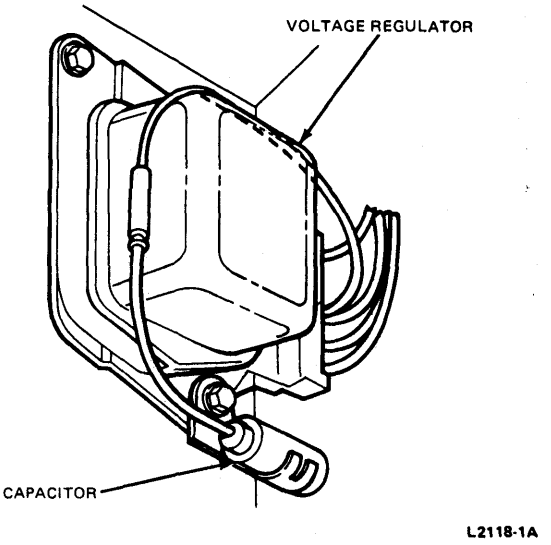


FIG. 16 Radio Suppression Equipment—E-100—F-350

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Antennas

PART 35-11

APPLIES TO ALL MODELS

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Antenna	
E-100 — E-350	11-2
REMOVAL AND INSTALLATION (Cont'd)	
F-Series and Bronco	11-1

REMOVAL AND INSTALLATION

ANTENNA

F-SERIES AND BRONCO

Removal

The antenna mast in the F-Series and Bronco is detachable as shown in Fig. 1. To remove the base and cable assembly:

1. Disconnect the antenna lead-in cable from the radio.
2. Disengage the cable from the retainer along the top edge of the instrument panel.

   NOTE: It may be necessary to remove the glove box to gain access to the antenna lead-in cable.
3. Unsnap the cap from the antenna base and remove the cap.
4. Remove four antenna attaching screws and remove the antenna and lead-in cable from the vehicle.

Installation

1. Place the gasket on the cowl panel over the antenna opening (Fig. 1).
2. Insert the antenna lead-in cable into the antenna hole in the cowl until the antenna base is seated on the cowl.
3. Install the four antenna attaching screws.

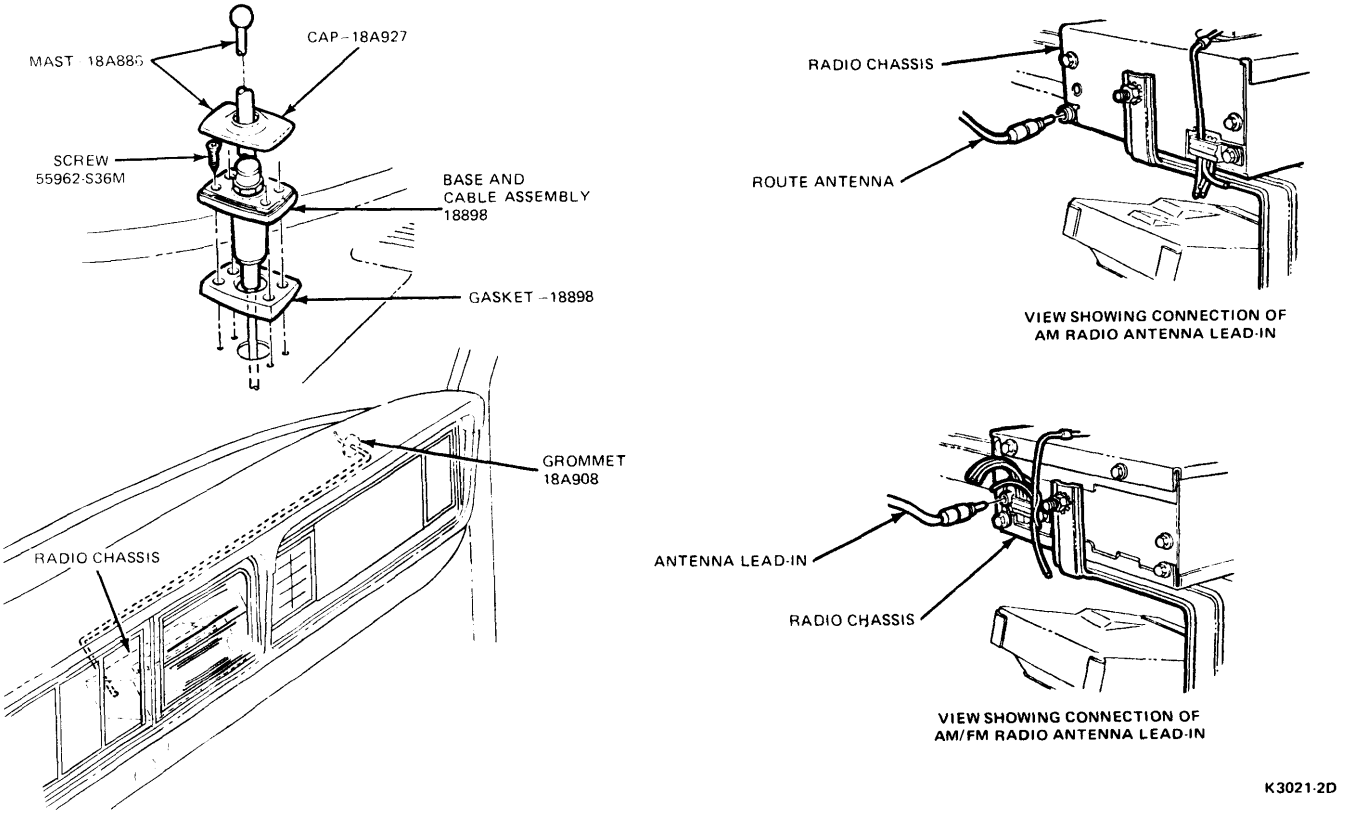


FIG. 1 Antenna Installation—F-100 Through F-350 and Bronco

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4. Place the cap in position over the antenna base and snap the cap onto the base.
5. Route the antenna lead-in cable along the retainer at the top of the instrument panel.
6. Connect the antenna lead-in cable to the radio and check the radio operation.

E-100—E-350

Removal

The antenna mast on the E-100—E-350 is detachable as shown in Fig. 2.

1. Remove the cowl top grille panel above the radio.
2. Disconnect the antenna lead-in cable from the radio (Fig. 2).
3. Unsnap the two retaining clips from the antenna cable.
4. Unsnap the stanchion from the antenna base and remove the stanchion.
5. Remove the four antenna attaching screws and remove the base and cable assembly from the vehicle.

Installation

1. Insert the tip of the new antenna cable through the fender opening and thread the antenna cable to the antenna base. Plug the antenna in to the base.
2. Install the four attaching base-to-vehicle screws.
3. Install the stanchion to the antenna base.
4. Inside the vehicle snap the antenna cable to the two retaining clips, along the cowl top (Fig. 2).
5. Insert the antenna cable through the hole in the dash panel (Fig. 2) and, from inside the vehicle, pull the cable to tightly seat the rubber grommet and seal the cable entry hole.
6. Connect the antenna lead-in cable to the radio and install the cowl top grille panel.

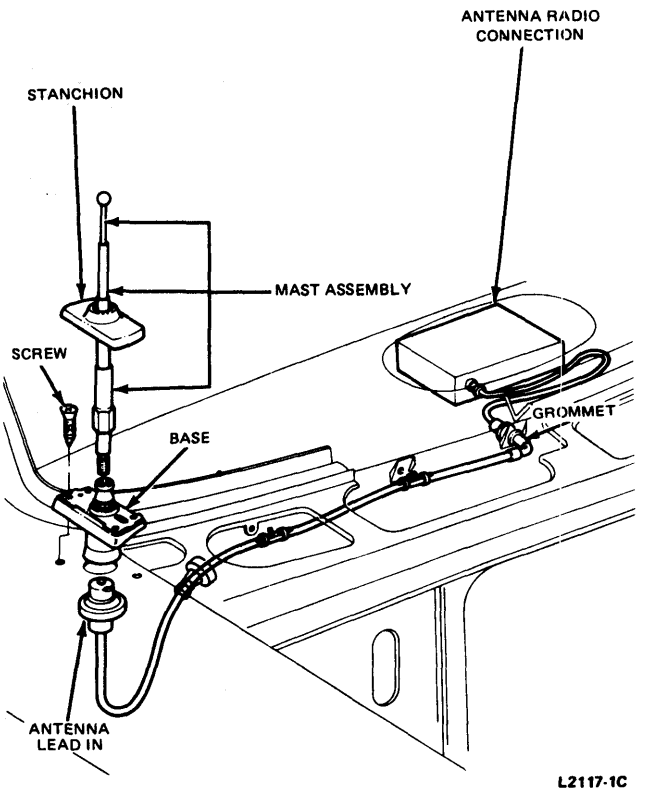


FIG. 2 Antenna Installation—E-100—E-350

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Speakers

PART 35-31

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	31-1	REMOVAL AND INSTALLATION (Cont'd.)	
REMOVAL AND INSTALLATION		Door and Rear Speakers	31-1
Front Speaker	31-1		

DESCRIPTION

The radio speakers used in all vehicles have 3.2 ohms impedance.

REMOVAL AND INSTALLATION

FRONT SPEAKER

F-100 THROUGH F-350 AND BRONCO

Removal

1. Disconnect the speaker wires at the connector behind the radio. **Do not operate the radio with the speaker disconnected.**
2. Remove two screws attaching the speaker to the cowl top inner panel (Fig. 1), and remove the speaker from under the cowl top inner panel.

Installation

1. To install, position the speaker to the underside of the cowl top panel and install the two attaching screws.
2. Connect the speaker wires to the radio and check the operation of the speaker.

E-100—E-350

1. Remove four screws attaching the grille and speaker assembly to the instrument panel (Fig. 2).
2. Disconnect the speaker wires at the connector. **DO NOT OPERATE THE RADIO WITH THE SPEAKER DISCONNECTED.**
3. Remove four nuts and washers and separate the grille from the speaker (entertainment radio only).
4. To install, reverse the above procedure.

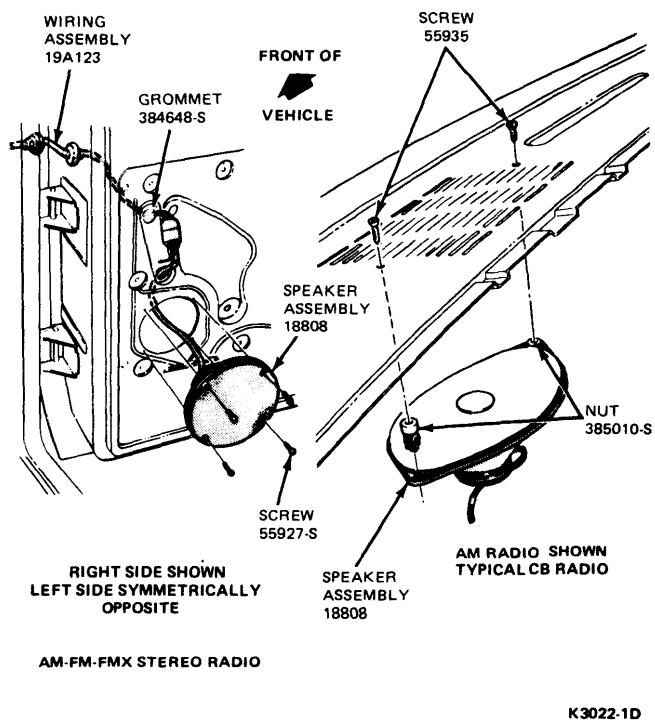


FIG. 1 Speaker Installation—F-100 Through F-350 and Bronco

DOOR AND REAR SPEAKERS

E-100—E-350

Remove and install door and rear speakers as shown in Fig. 3.

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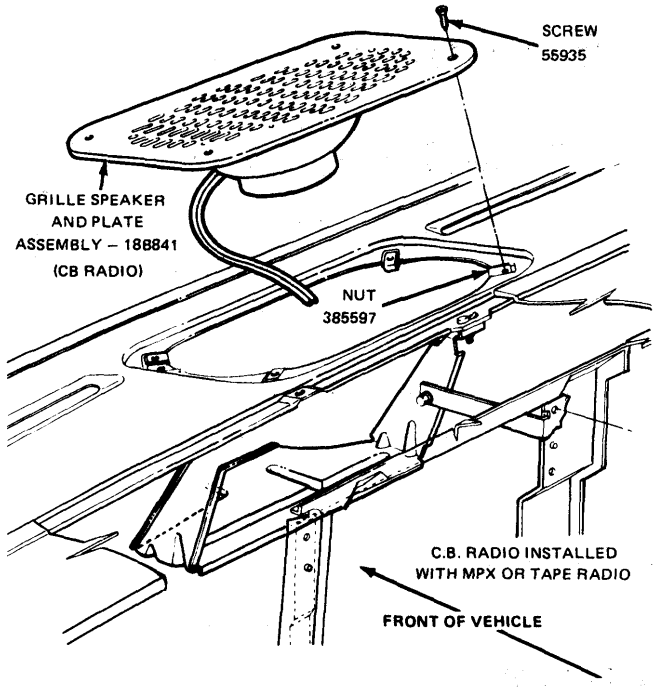


FIG. 2 Speaker Installation—E-100—E-350

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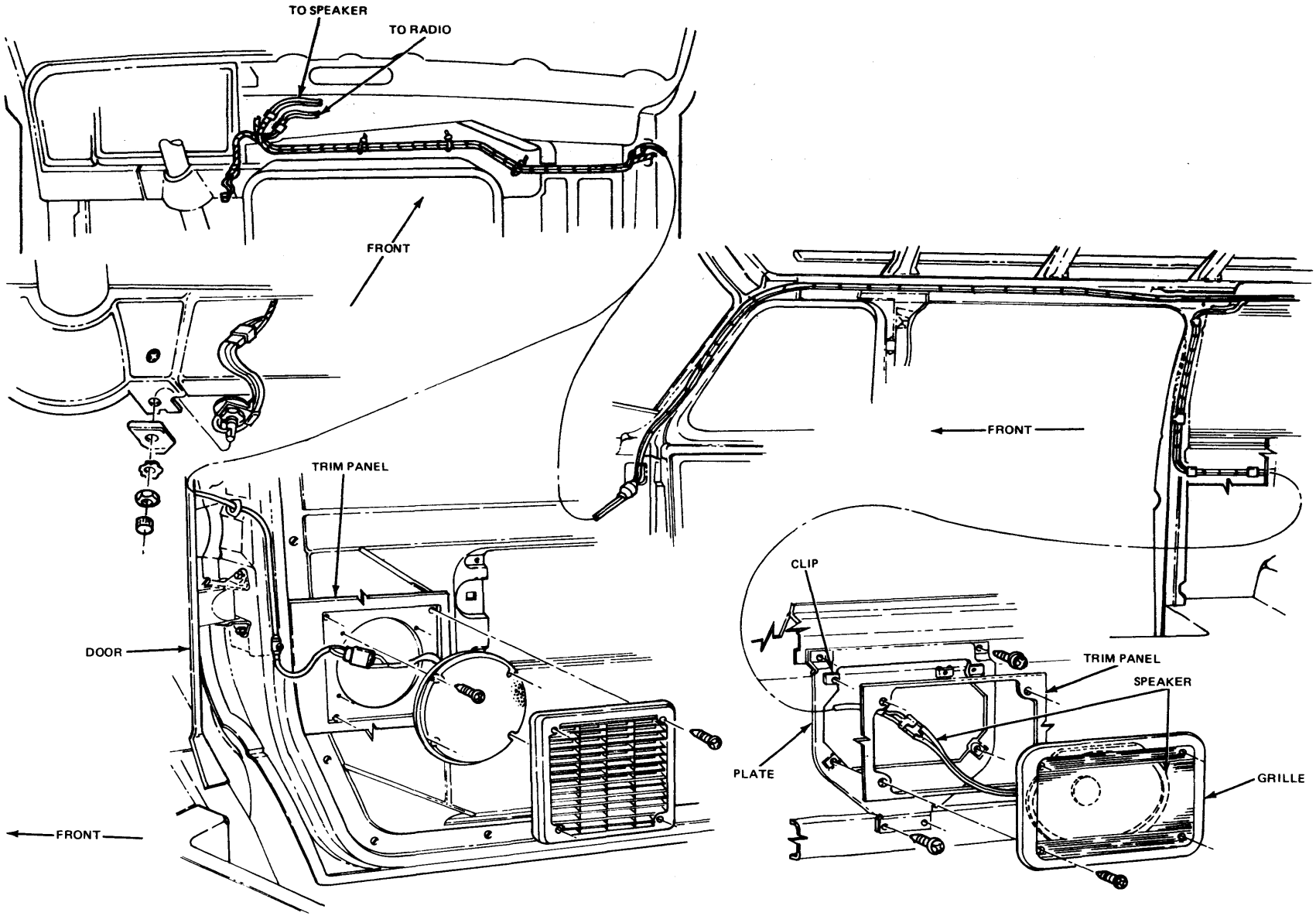


FIG. 3 Door and Rear Speakers—E-100—E-350

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Ash Receptacles and Cigar Lighter

PART 35-40

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING		REMOVAL AND INSTALLATION	
Diagnosis Guide	40-1	Ash Receptacles	40-1
		Cigar Lighters	40-1

DIAGNOSIS AND TESTING

Possible problems associated with the cigar lighter are listed in the following Diagnosis Guide along with possible causes and correction steps.

DIAGNOSIS GUIDE

CONDITION	POSSIBLE CAUSE	CORRECTION
• Cigar lighter — knob pops out before adequate heating.	• Cigar lighter element. • Cigar lighter socket.	• Substitute another element. Replace if necessary. • Replace socket.
• Cigar lighter — element stays in, will not heat up.	• Fuse burnt out. • Open circuit in wiring. • Cigar lighter element. • Cigar lighter socket.	• Replace fuse. If fuse blows again, check for short circuit. • Check for power to socket. Repair if necessary. • Substitute another element. Replace if necessary. • Replace socket.

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REMOVAL AND INSTALLATION

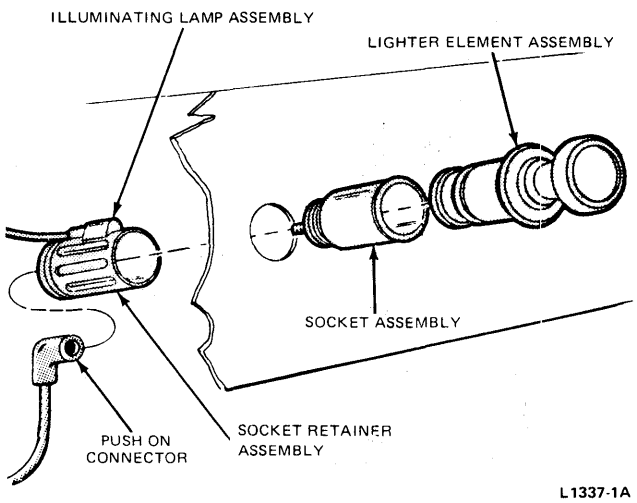
ASH RECEPTACLES

Ash receptacle shield assemblies that retain the ash receptacles may be easily removed by first removing the ash receptacle. The shield assembly may then be removed by removing the shield assembly mounting screws.

CIGAR LIGHTERS

Removal

1. Disconnect the battery ground cable.
2. Remove the lighter element (Fig. 1).
3. Disconnect the push-on connector from the base of the lighter socket.
4. Remove the illuminating lamp socket (if so equipped) from the side of the lighter socket retainer by depressing both sides of the illuminating lamp socket and pulling away from the lighter socket retainer.
5. Unscrew and remove the socket retainer.
6. Remove the socket from the front of the instrument panel.



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FIG. 1 Cigar Lighter Installation

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Installation

1. Replace the socket in the instrument panel, from the front.
2. Reinstall the socket retainer.
3. Replace the illuminating lamp socket (if so equipped) from the side of the lighter socket retainer by depressing both sides of the lamp socket and pushing toward the lighter socket retainer.
4. Reconnect the push-on connector to the base of the lighter socket.
5. Replace the lighter element and reconnect the battery ground cable.
6. Test for proper operation.

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Mirrors — Inside and Outside

PART 35-50

APPLIES TO ALL MODELS

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REMOVAL AND INSTALLATION

INSIDE REAR VIEW MIRROR

Mirror Removal

1. Loosen the mirror assembly-to-mounting bracket set screw (Fig. 1).

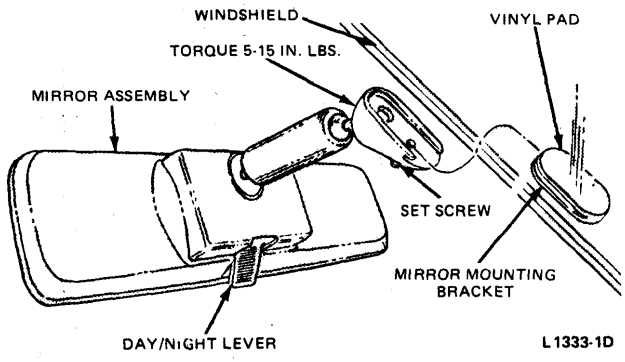


FIG. 1 Inside Rear View Mirror Installation

2. Remove the mirror assembly by sliding upward and away from the mounting bracket.

Mounting Bracket Installation

1. Locate and mark the mirror mounting bracket location on the outside surface of the windshield with a wax pencil (Fig. 1).
2. Thoroughly clean the inside of the windshield with mild abrasive cleaning powder and a clean cloth saturated in alcohol. Then, use a paper towel and remove all cleaner from the windshield.
3. Roughen the bonding surface of the mounting bracket with fine grit sandpaper. Then, wipe the surface clean with a paper towel soaked in alcohol.
4. Using the applicator, apply a generous amount of Loctite Minute Bond Accelerator or an equivalent bonding adhesive to the bonding surface of the mounting bracket. Allow the bonding material to dry for five minutes. Do not touch the mounting surface.
5. Apply a thin film of Accelerator to the mounting surface of the windshield. Allow the bonding material to dry for one minute.
6. Apply two drops of Loctite Minute Bond or equivalent to the mounting surface of the bracket. Using a clean toothpick or wooden match, quickly spread the adhesive evenly over the mounting surface of the bracket.
7. Quickly position the mounting bracket on the windshield. The 3/8 inch circular depression in the bracket must be toward the bottom edge. Press the bracket against the windshield for about one minute.
8. Allow the bond to set for five minutes. Then, remove any excess bonding material from the windshield with an alcohol dampened rag.

Mirror Installation

1. Attach the mirror to the mounting bracket and tighten the set screw to 5-15 in-lbs.

OUTSIDE REAR VIEW MIRROR

CONVENTIONAL TYPE—BRONCO, E-100—E-350 AND F-100-350

The conventional outside rear view mirror is mounted on the door. To remove the mirror, remove the attaching screws and lift off the mirror and gasket (Fig. 2).

WESTERN TYPE

The western type outside rear view mirrors are usually mounted on both doors. The mirrors may be removed from the mounting bracket by removing the attaching nuts (Figs. 3 and 4). Broken mirror glass may be replaced on the mounting bracket using Dow RTV732 Silastic Adhesive Sealant (D6AZ-19562-A or B), or equivalent and following the procedures listed below.

1. Break out and discard the larger fragments of the broken mirror glass.
2. Remove the smaller fragments from around the perimeter with a flat bladed knife.
3. If dust or dirt has accumulated inside the mirror base, wash it and allow it to dry thoroughly before proceeding.

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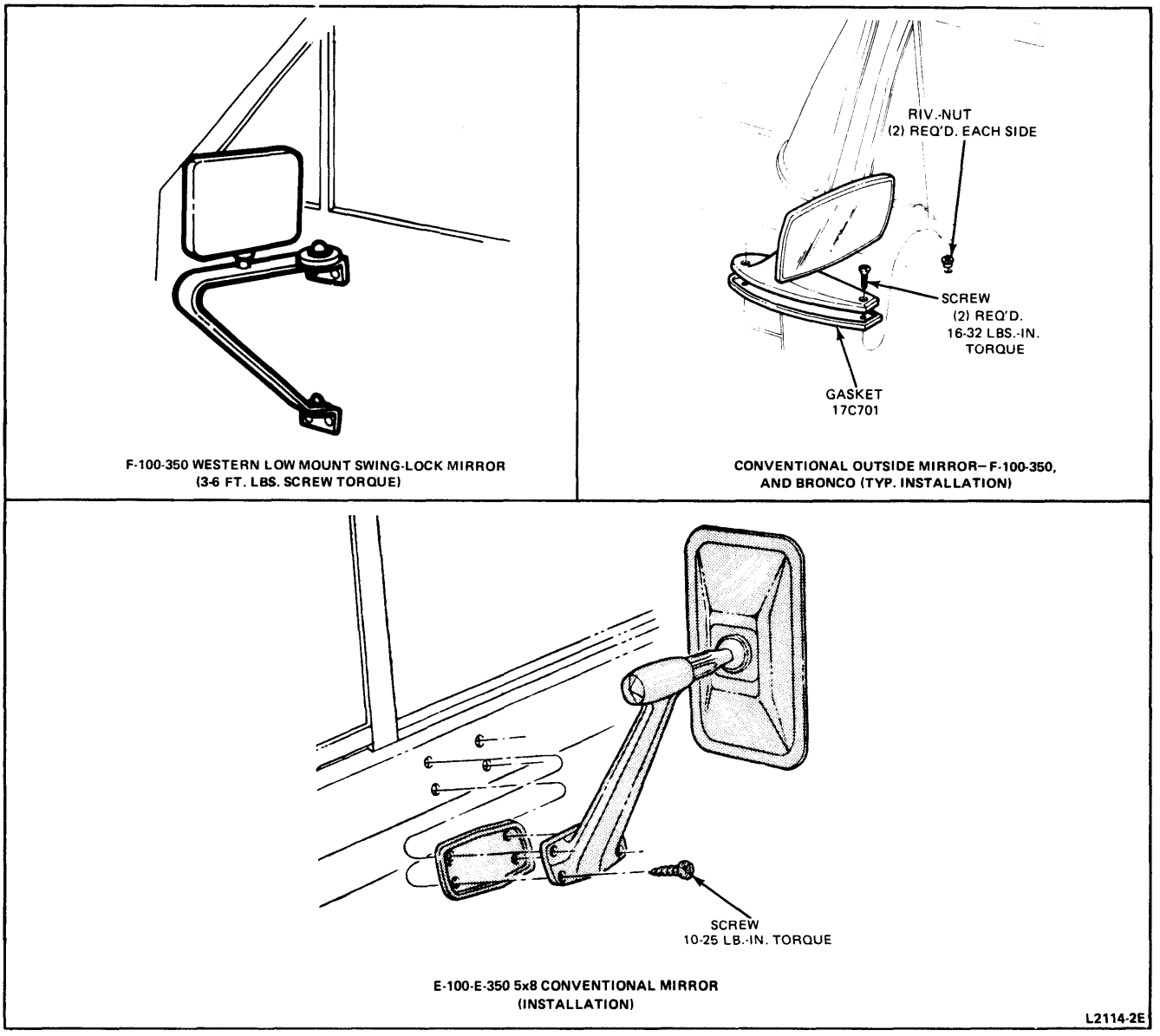


FIG. 2 Conventional Outside Mirrors

4. Locally procure a tube of "GE-RTV-108 or 102", or "DOW-RTV-732 Silastic Adhesive Sealant or equivalent. Apply a continuous 1/8 inch diameter bead of silastic along all four sides of the mirror base.
5. Press the glass firmly into the case **PRIMARY SIDE OUT,** and secure with a rubber band pressing a small pad of styrofoam against the center of the glass. The rubber band should remain in place for a minimum of 24 hours to retain the glass until the silastic is cured.

   WARNING: The mirror glass must be installed with the primary side exposed, to assure compliance with FMVSS Regulations.

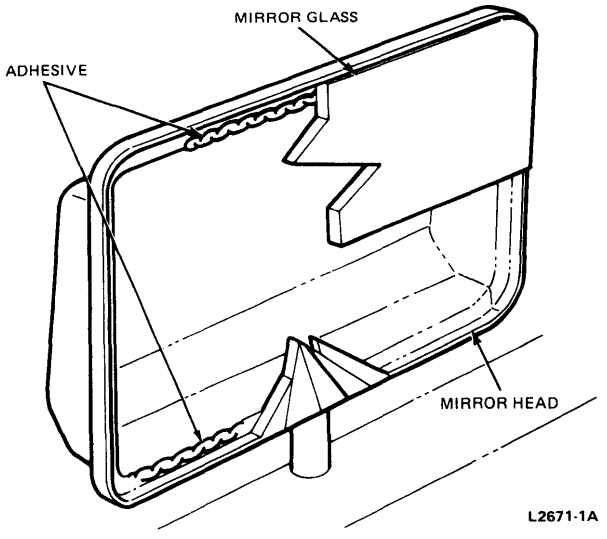


FIG. 3 Mirror Glass Replacement

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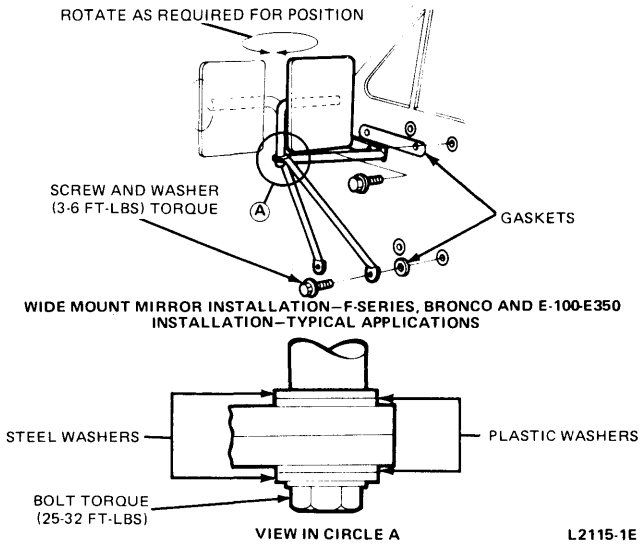


FIG. 4 Mirror Installations—Mounting Bracket—Typical

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Windshield Wipers — Electric

PART 35-60

APPLIES TO ALL MODELS

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DESCRIPTION AND OPERATION

The two speed, permanent magnet, three brush electric windshield wiper motor (excluding E-100—E-350 truck wiper motors) has a brush rigging that permits selection of low or high speed. When the control selector is in low position, the grounded brush and the white wire brush are used, and the motor operates at low speed. When the control selector is in high position, the grounded brush and the blue wire brush are used. Current by-passes a portion of the armature winding, causing the motor to run faster. When the control selector is moved to the park position, the motor will continue at low speed until the park switch lower contacts open, stopping the motor in the park position.

INTERVAL WIPERS

Optional interval wipers are available on E-100—E-350, Bronco and F-100 through F-350.

E-100—E-350

The intermittent operation of the windshield wiper motor is controlled by a variable resistor in the windshield wiper control switch, which in conjunction with the electronic governor, allows a variable pause between wiping cycles.

For normal operation of the control switch, slide the wiper-washer knob toward the right. The first position (about 3/4 inch long) is for intermittent, the second is for low speed and the third is for high speed.

When the control knob is placed at the left side of the intermittent position, the time interval between wiper blade sweeps is at maximum. As the control is moved toward the right side of the intermittent position (before the detent is felt) the time interval between sweeps is reduced.

When the detent position is felt as the switch is moved toward the right, the wiper system will go into low speed and the next detent position, on the extreme right, is high speed.

The variable resistor in the switch controls the amount of current to the electronic pause control which, in turn, regulates the operation of the motor for the desired time interval.

The governor has a unique feature: Operation of the windshield washers while the switch is in the intermittent position, electrically overrides the governor, causing the wipers to operate at low speed.

Normal intermittent wiper operation resumes when the wash knob is released.

BRONCO AND F-100 THRU F-350

This system is a two-speed wiper system with an interval feature. For normal wiper operation, turn the wiper control knob clockwise to any one of two detents (Low and High speed).

For interval operation of the wiper switch, rotate the wiper control knob counterclockwise. The more the knob is rotated counterclockwise the longer the time interval between wiper blade sweeps.

The governor for the interval wiper system is mounted on the lower flange of the instrument panel below the wiper-washer switch.

TESTING

NON-INTERVAL WINDSHIELD WIPER SYSTEM "A" TEST BRONCO AND F-100—F-350

HIGH-SPEED TEST

With the wiper switch in high position, the current flows from the ignition switch through the wiper switch to the wiper motor high terminal, (Fig. 1). To check high-speed operation, separate four-way connector at the wiper motor approximately 1/8 inch without breaking the circuit, turn ignition switch in high position. Check for voltage at the circuit 56 pin at four-way connector. If no voltage is present, trace circuit back to source to determine problem. If voltage is present and motor does not run, ground the motor case to the body. If motor runs, repair ground. If motor does not run, replace motor.

LOW-SPEED TEST

With the wiper switch in low position, the current flows from the ignition switch through the wiper switch to the wiper motor low terminal, (Fig. 1). To check low-speed operation, separate four-way connector at the wiper motor approximately 1/8 inch without breaking the circuit, turn ignition switch "ON" and place wiper switch in low position. Check for voltage at the circuit 58 pin at four-way connector. If no voltage is present, trace circuit back to source to determine problem. If voltage is present, and motor does not run, ground motor case to the body. If motor runs, repair ground. If motor does not run, replace motor.

PARK-OPERATION TEST

With the wiper switch off, the wipers will complete one cycle through the wiper motor park switch. Current flows from the ignition switch through the wiper switch to the wiper motor oscillating park switch (run) for 9/10th of one cycle, (Fig. 1). The low-speed run circuit is from the wiper motor park switch to the motor low-speed brush, across the armature and out a common brush to ground. At the last 1/10th portion of the cycle, the oscillating park switch moves from the run position to the park (ground) position, stopping the motor in the park position.

To check the park operation, separate four-way connector at the motor approximately 1/8 inch without breaking the circuit, turn ignition switch "ON" and place wiper switch in the off position. Check for voltage at circuits 58, 28 and 63 pins at the four-way connector. If voltage is present on all three circuits and wiper blades are in non-park position, ground motor case to the body. If motor parks, repair motor ground. If motor

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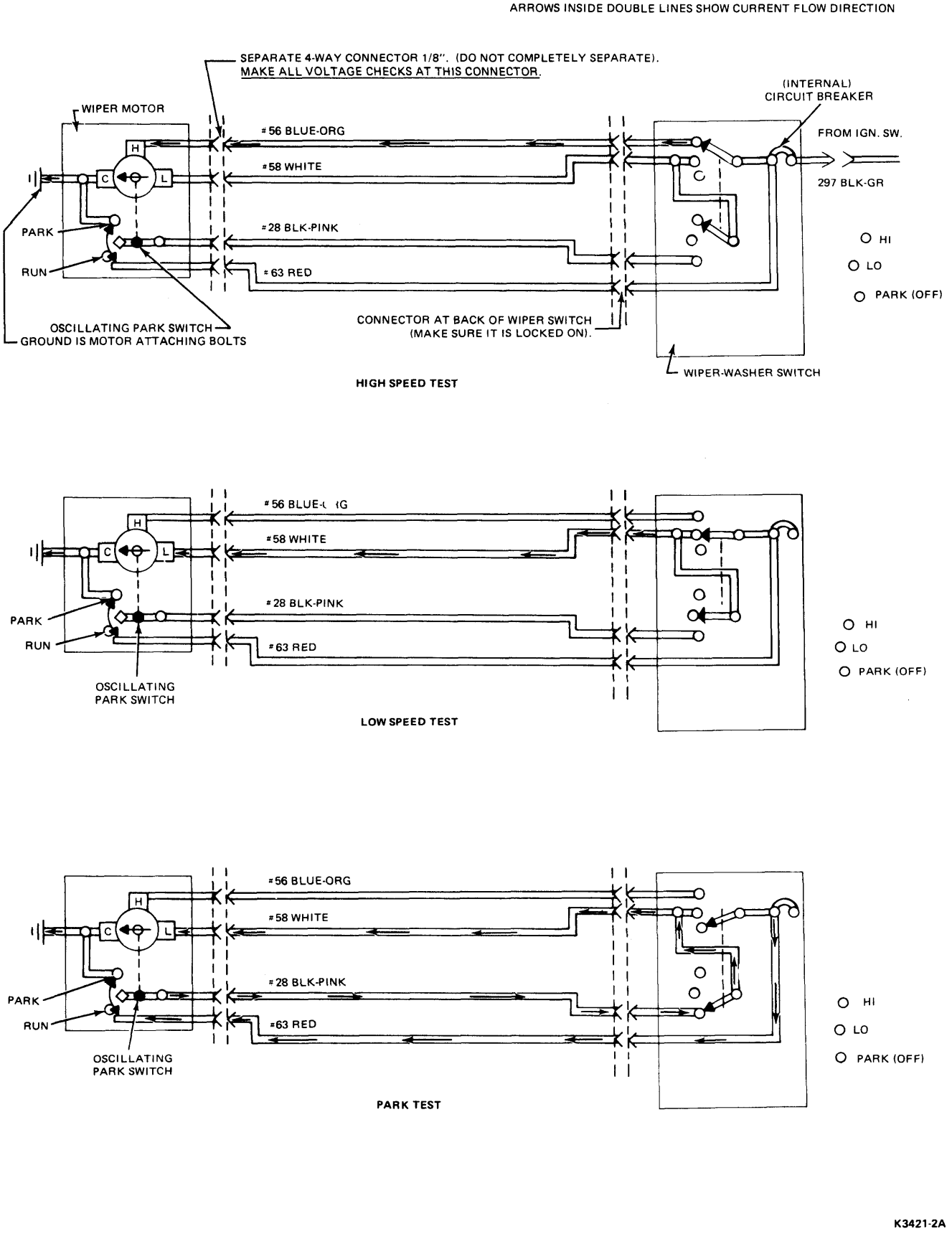


FIG. 1 Non-Internal Windshield Wiper System "A" Motor Tests

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does not move to park position, replace motor. If voltage check shows only voltage at circuit 63 pin, replace wiper motor. If voltage check shows voltage only at circuit 63 and 28 pins, trace circuits 28 and 58 back toward wiper switch to determine source of problem.

NON-INTERVAL WINDSHIELD WIPER SYSTEM "B" TEST E-100—E-350

HIGH-SPEED TEST

With the wiper switch in the high position, current flow is from the ignition switch through the circuit breaker in the fuse panel, through the wiper switch contacts through circuit 61 (yellow) to the wiper motor common brush. From the common brush, the current flows across the motor armature through circuit 58 blue to the wiper switch and across the switch contacts to ground. The wiper motor is not grounded, (Fig. 2).

To check high-speed operation, place ignition switch in "ON" position and wiper switch in the high position. If voltage is present at circuit 61 pin at wiper motor connector and motor does not run, electrically ground circuit 58. If motor runs with circuit 58 grounded, repair wiper switch ground circuit or replace wiper switch. If motor does not run with circuit 58 grounded, repair motor. If voltage is present at circuit 65 pin only, replace wiper switch. If no voltage is present at circuit 65 pin, trace problem back to source of current.

LOW-SPEED TEST

With the wiper switch in low position, current flows from ignition switch through circuit breaker in fuse panel, through circuit 61 (yellow) to the wiper motor common brush. From the motor common brush the current flows across the motor armature through circuit 56 (blue) to the wiper switch and across the wiper switch contacts to ground. The motor is not grounded.

To check low-speed operation, place ignition switch in "ON" position and wiper switch in low position. If voltage is present at circuit 61 pin at wiper motor connector and motor does not run, electrically ground circuit 56. If motor runs with circuit 56 grounded, repair wiper switch ground circuit or replace wiper switch. If wiper motor does not run with circuit 56 grounded, repair motor. If voltage is present at circuit 65 pin only, replace wiper switch. If no voltage is present at circuit 65 pin, trace problem back to source of current.

PARK-OPERATION TEST

A set of contacts attached to circuit 63 inside the wiper motor oscillate between the circuit 65 and ground when the wiper motor is running, (Fig. 2). When the wiper switch is turned off to park the wipers, the motor points are kept on the circuit 65 (Battery Voltage) for 9/10th of one cycle and at ground 1/10th of one cycle. Current flows from circuit 65 (green), through wiper motor park switch points and through the circuit 63 (red) to the wiper switch. From the wiper switch input the current flows across the wiper switch contacts, through circuit 61 circuit (yellow), through the common brush on the wiper motor out the low-speed brush on circuit 58 blue to the wiper switch. From the wiper switch input the current flows through switch contacts out circuit 28 (black-white) to ground.

To check park operation of wiper system, place ignition switch in "ON" position and wiper switch in Off position. If wipers do not park, check for voltage at circuits 63 and 61 pins at wiper motor connectors. If both pins show voltage, ground circuit 56. If motor parks, repair ground circuit or replace wiper switch. If voltage is present at circuit 65 pin but not on circuit 63 pin, repair wiper motor park switch. If no voltage is present at circuit 65 pin, trace problem back to source of current.

INTERVAL WINDSHIELD WIPER SYSTEM "A" MOTOR TEST F-100—F-350 AND BRONCO

HIGH-SPEED TEST

With the wiper switch in the high position, current flows from the ignition switch through the wiper switch and governor to the wiper motor to ground (Fig. 3).

To check high-speed operation, place ignition switch in "ON" position and wiper switch in high position. Separate four-way connector at wiper motor approximately 1/8 inch and check for presence of voltage at circuit 61 pin. If voltage is present and motor does not run, ground motor case to body. If motor runs, repair motor ground. If motor does not run, replace motor.

NOTE: If diode in governor fails, shorted wipers will only operate on one speed.

LOW-SPEED TEST

With wiper switch in low position, current flows from the ignition switch through the wiper switch and energized relay contacts of the governor to the wiper motor, (Fig. 3).

To check low-speed operation, place ignition switch in "ON" position and wiper switch in low position. Separate four-way connector at wiper motor approximately 1/8 inch and check for presence of voltage at circuit 58 pin. If voltage is present and wiper motor does not run, ground the motor case to the body. If motor runs, repair motor ground. If motor does not run, replace motor. If voltage is present at number 63 circuit pin but not at circuit 58 pin, ground control circuits at wiper switch connector. If voltage is now present on circuit 58 pin, repair governor ground circuits or replace wiper switch. If voltage is not obtained at circuit 58 pin after grounding control circuits at wiper switch, replace governor. If no voltage is present at circuit 63 pin, trace problem back to source of current.

NOTE: If diode in governor fails to open or relay is inoperative, wipers will operate in high speed and park only. Low and intermittent will not operate.

INTERVAL OPERATION TEST

When the wiper switch is placed in the "INT" mode, the wiper motor oscillating park switch contacts are at ground, (assuming wipers started in park position), and the relay is energized, (Fig. 3). Initially, current flows from the ignition switch, through a diode and energized contacts in the governor to the wiper motor low speed brush. The motor rotates 1/10th of a cycle. The wiper motor oscillating park switch contacts then change from park (ground) to run (B+) and momentarily after they

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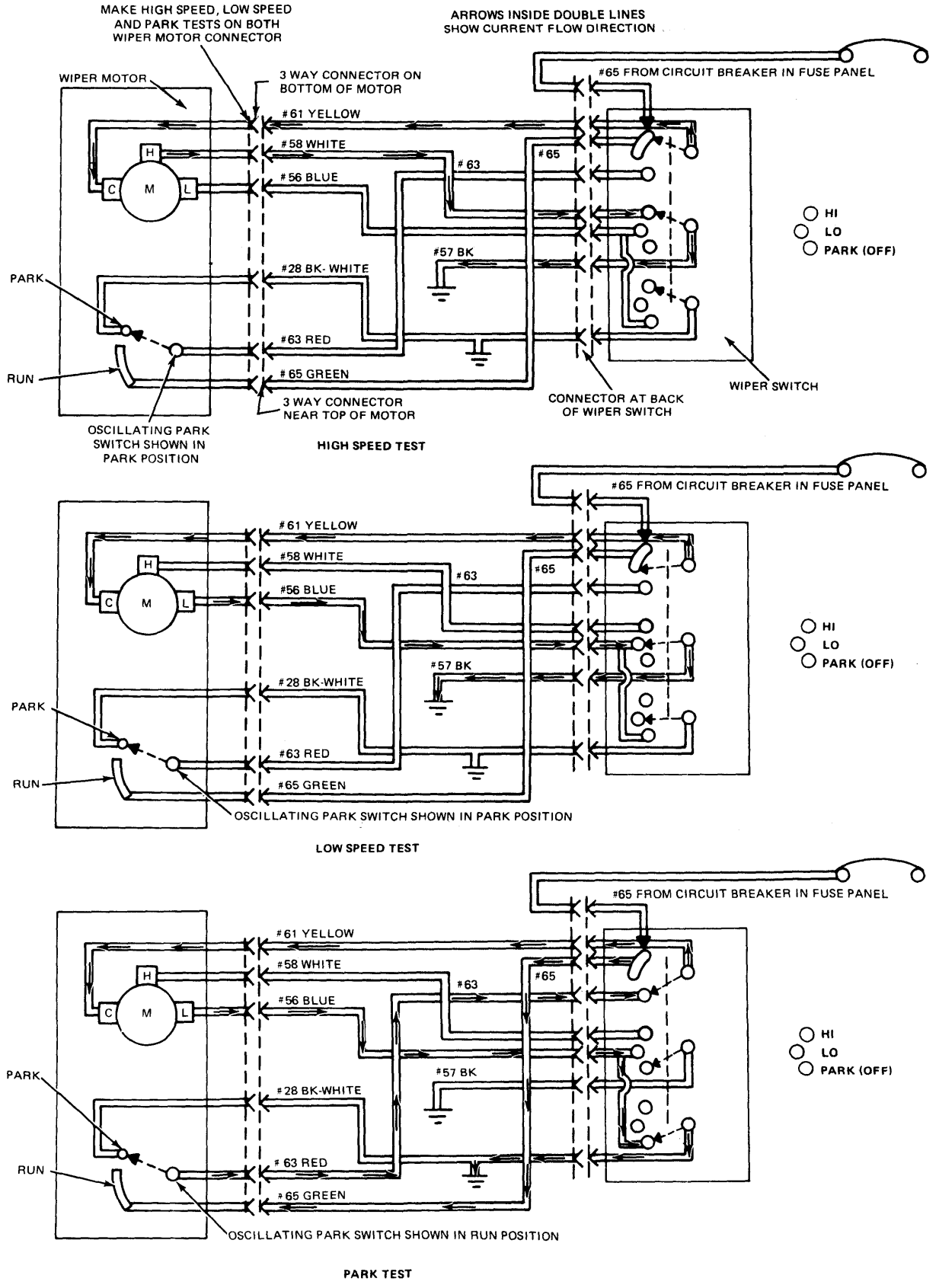


FIG. 2 Non-Interval Windshield Wiper System "B" Motor Tests

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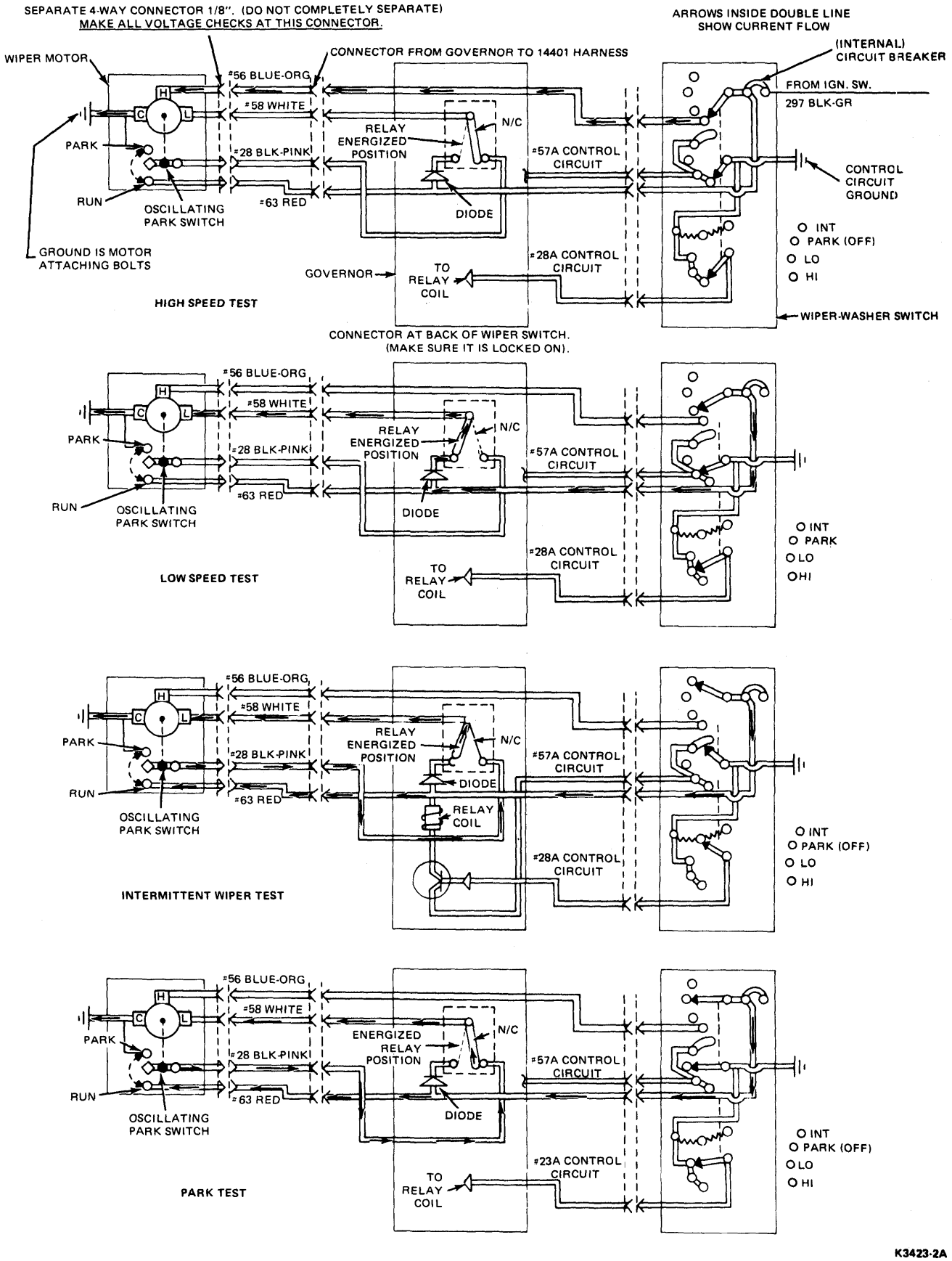


FIG. 3 Interval Windshield Wiper System "A" Motor Test

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change position the relay in the governor deenergizes. A second path to the wiper motor is shown by the arrows in Fig. 3. The motor rotates through the remaining 9/10th of one cycle. When the oscillating park switch contacts again touch ground (park), the motor parks. The governor electronic circuit delays energizing of the relay until the circuit times out. Then the relay energizer and the low-speed intermittent cycle is repeated. The discharge rate of the capacitor in the governor circuit to ground through the wiper switch controls the time delay of the system.

To check out the intermittent operation, place ignition switch in "ON" position and wiper switch in the "INT" position. Separate the four-way connector at the wiper motor approximately 1/8 inch. Check for presence of voltage at circuits 63, 28 and 58 pins. If voltage is present at circuit 58 pin and motor does not run, ground motor case to body. If motor now runs, repair motor ground. If motor does not run with circuit 58 grounded, replace motor. If voltage is present on circuits 63 and 28 pins, (wipers are out of park) but no voltage is present on circuit 58 pin, replace the governor. If wipers are in park, (and not operating), ground control circuits 57A and 28A at the wiper switch. If voltage is not present at circuit 58 pin, replace governor. If the wiper motor is out of the park position and voltage is present on circuit 63 pin but not circuit 28 pin, replace wiper motor. If no voltage is present on circuit 63 pin, trace the circuit back to source to isolate problem.

PARK OPERATION TEST

When the wiper switch is placed in the off position, the wipers complete one full cycle through the wiper motor park switch. Current flows from the ignition switch across a circuit breaker in the wiper switch to the wiper motor oscillating park switch (run). From the park switch the current flows through the normally-closed contacts of the governor relay (de-energized) to the wiper motor low-speed brush, across the armature and out a common brush to ground for 9/10th of one cycle. At the last 1/10th of the cycle, the oscillating park switch moves from run to park, stopping the motor in park position.

To check out park operation, place ignition switch in "ON" position and move wiper switch from operating mode to off position. Separate four-way connector at the wiper motor approximately 1/8 inch. Check for presence of voltage at circuit 58 pin. If voltage is present and motor does not park, ground the wiper motor case to the body. If motor parks, repair ground. If motor does not run, replace motor. If voltage is present at circuits 63 and 28 pins but not at circuit 58 pin, replace governor. If there is voltage on circuit 63 pin but not on circuit 28 pin, replace the wiper motor. If no voltage is present on circuit 63 pin, trace circuit back to source to determine problem.

INTERVAL WINDSHIELD WIPER SYSTEM "B" MOTOR TEST—E-100—E-350

LOW-SPEED TEST

With the wiper switch in the Low-speed position, the current flow is from the ignition switch through the circuit breaker through circuit 65 (green) to the governor. The wiper switch in the low-speed position causes the relay to be energized, allowing current to flow through the energized contacts of the governor and circuit 61 (yellow) to the common brush of the wiper motor. From the motor common brush the current flows across the motor armature through circuit 56 (blue) to the wiper switch and across the wiper switch contacts to ground.

To check out Low-speed operation, place the ignition switch in the ON position and wiper switch in low position. Separate two connectors at the wiper motor approximately 1/8-inch and check for presence of voltage at circuit 61 pin at the wiper motor connector and the motor does not run, electrically ground circuit 56. If motor runs with circuit 56 grounded, repair wiper switch ground circuit or replace wiper switch. If motor does not run with circuit 56 grounded, replace motor. If voltage is **not** present at circuit 61 and circuit breaker is providing voltage, ground control circuit in wiper switch. If voltage is not obtained at circuit 61 pin at wiper motor, replace governor. If voltage is obtained at circuit 61 after grounding control circuit in wiper switch, replace wiper switch.

HIGH-SPEED TEST

With the wiper switch in the high-speed position, current flows from the ignition switch through the circuit breaker in the fuse panel to the governor (Circuit 65—green). The wiper switch grounds the control circuit causing the relay to be energized. Current flows through the energized contacts of the governor through circuit 61 (yellow) to the common brush of the wiper motor. From the common brush, the current flows across the motor armature through circuit 58 (white-orange) to the wiper switch and through the wiper switch to ground.

To check out high-speed operation using the same procedures described for low-speed test above except that circuit 58 is used instead of circuit 56.

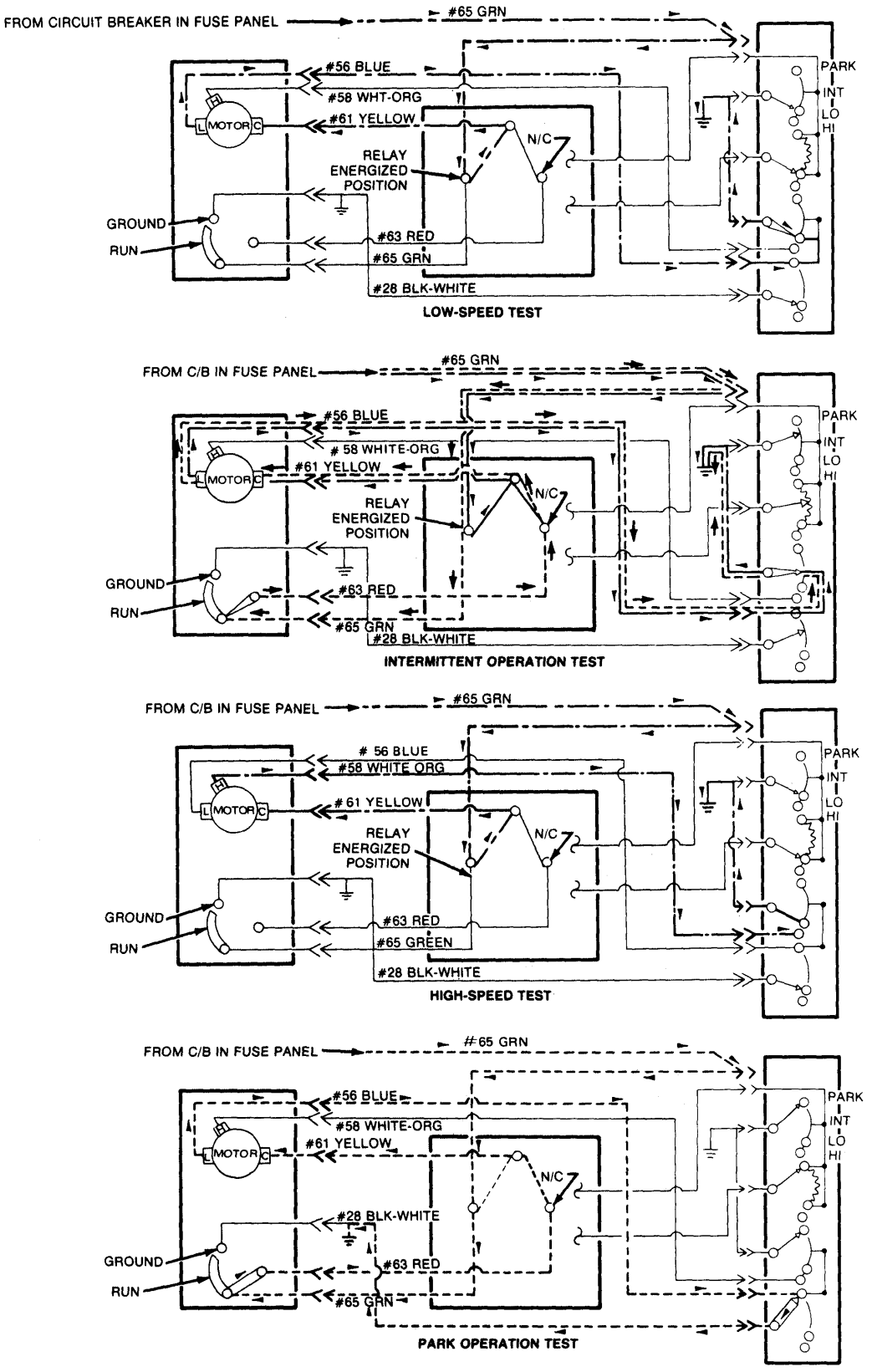
INTERVAL OPERATION TEST

When the wiper switch is placed in the INT mode, the motor's oscillating park switch contacts are at ground (assuming wipers started in park position), and the governor relay is energized. Initially, current flows from the ignition switch (circuit 65—green) through the energized contacts in the governor to the wiper motor's low speed brush (circuit 61—yellow). The motor rotates 1/10th of a cycle. The wiper motor's oscillating park switch contacts then change from park (ground) to run (battery voltage) and momentarily, after the change in switch contact position, the relay in the governor de-energizes. A second path to the wiper motor is completed by way of circuit 65 (green), the wiper motor run switch, circuit 63 (red), the normally closed contacts of the governor, and circuit 61 (yellow). The motor rotates through the remaining 9/10th of one revolution. When the oscillating park switch contacts again touch ground (park), the motor parks. The governor's electronic circuit delays energizing of the relay until the circuit times out, then the relay energizes and the low speed intermittent cycle is repeated. The discharge rate of the capacitor to ground through the wiper switch controls the time delay of the system.

To check out the intermittent operation, place the ignition switch in the ON position and the wiper switch in the INT position. Separate the two three-way

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K3826-2A

FIG. 4 Interval Windshield Wiper System "B" Motor Tests

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connectors at the wiper motor approximately 1/8-inch. Check for the presence of voltage at circuits 65 (green), 63 (red) and 61 (yellow). If voltage is present at circuit 61 pin and the motor does not run, ground motor case to body. If motor now runs, repair motor ground. If the motor does not run with the motor case grounded and voltage at circuit 61 pin, replace the motor. If voltage is present at circuits 65 and 63 (wipers are out of park) but no voltage is present at circuit 61, replace the governor. If the wipers are in park (and not operating), ground the control circuits from the wiper switch to the governor. If voltage is still not present at circuit 61 pin, replace the governor. If the wiper motor is out of the park position and voltage is present on circuit 65 pin but not circuit 63 pin, replace the wiper motor. If no voltage is present on circuit 65 pin, trace the circuit back to the source to isolate the problem.

PARK OPERATION TEST

With the wiper switch in the OFF position, the wipers will complete one cycle through the wiper motor's park switch. Current flows from the ignition switch across the circuit breaker in the fuse panel to the wiper motor's oscillating park switch (run). From the park switch through the normally closed governor relay contacts (de-energized) to the motor's common brush, across the motor armature and out the low-speed brush to ground for 9/10th of one cycle. At the last 1/10th of the cycle, the oscillating park switch moves from the run position to ground (park), stopping the motor in the park position.

To check out park operation, place the ignition switch in the ON position and move the wiper switch from an operating mode to the OFF position. Separate the two three-way connectors at the wiper motor approximately 1/8-inch. Check for presence of voltage at circuit 61 (yellow) pin. If voltage is present and the motor does not park, ground the wiper motor case to the body. If the motor parks, repair ground. If motor does not run, replace motor. If voltage is present at circuits 65 (green) and 63 (red) pins but not at circuit 61 pin, replace the governor. If voltage is present on circuit 65 pin, but not on circuit 63 pin, replace the wiper motor. If no voltage is present on circuit 65 pin, trace circuit back to source to determine problem.

WIPER MOTOR CURRENT DRAW

See Figs. 5 through 9.

NOTE: Electric wiper motors contain permanent magnets made of ceramic. This is a hard glass-like material that can shatter or crack if the motor receives a severe physical shock.

Do not handle any windshield wiper motor abusively when diagnosing wiper operations, because it will damage the magnets and make the motor inoperative. Rough handling of new replacement motors may also damage the magnets.

BRONCO AND F-100—F-350

Disconnect the linkage from the motor and disconnect the electrical plug to test the motor on the vehicle. Connect the green lead from the test equipment to the battery positive (plus) post (Fig. 5). Connect the positive (red) lead from the tester first to the low speed connection and then to the high speed connections at the connector plug as shown. In either case, the current draw should not exceed three amperes.

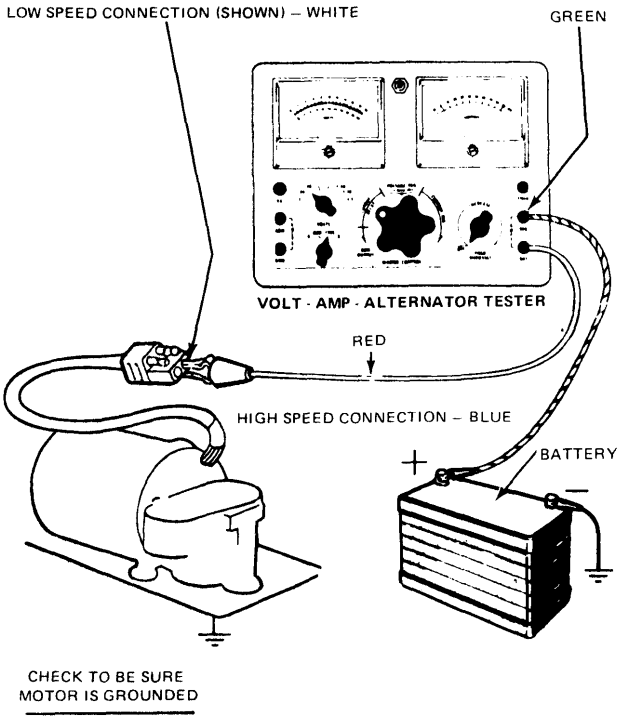


FIG. 5 Wiper Motor Current Draw Test

E-100—E-350

The windshield Wiper Motor Tests can be performed with the wiper motor installed in the vehicle with linkage disconnected or on the bench.

The motor terminals are too small to make the necessary test connections without using connector sleeves and wires between the motor terminals and the test equipment as shown in Figs. 6 and 7. The connector sleeves (available in Kit No. C4AZ-14294-B or equivalent) should be crimped onto both ends of the wires.

Connect the positive (red) lead from the test equipment to the center terminal on the motor end plate, and connect the green lead from the tester to the battery positive post, (Fig. 6). Connect a jumper wire from the battery negative post to the low speed terminal on the motor end plate and read the current draw. Move the jumper wire from the low speed terminal to the high speed terminal, and read the high speed current draw. In either case the current draw should not exceed 3.5 amperes. If the current draw does exceed 3.5 amperes, check the output arm and windlatch mechanism for binding or damage before replacing the motor.

CIRCUIT BREAKER TESTS

The circuit breaker is located in the wiper control switch on all rotary switches. For the slide wiper control switch, the circuit breaker is located in the fuse panel.

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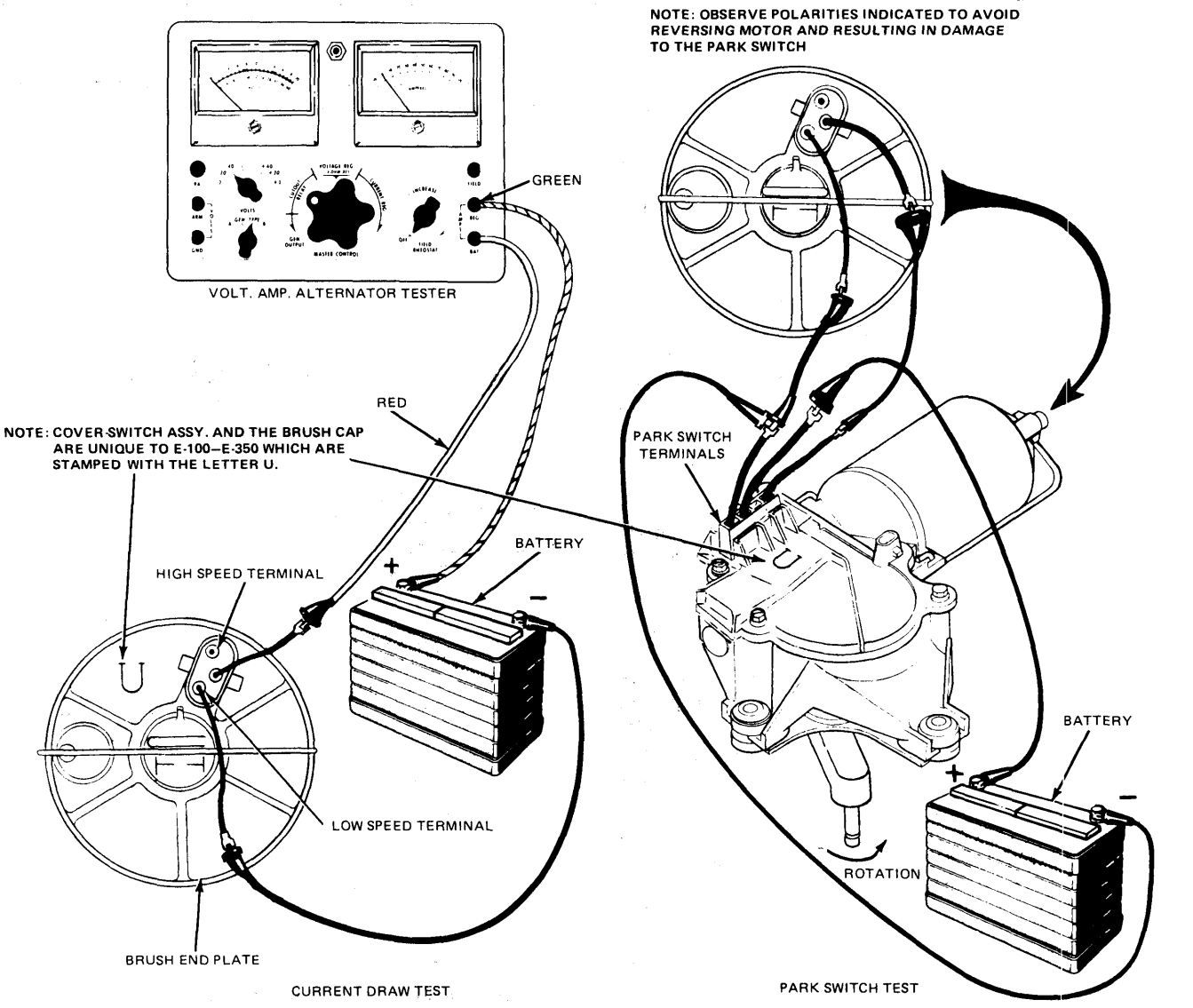


FIG. 6 Wiper Motor Tests—Depressed Park Type

All pin terminal switches have a circuit breaker rating of 8 1/4 amps and all blade terminal switches have a rating of 7 amps. The circuit breaker located in the fuse panel is rated at 7.5 Amps for E-100—E-350.

Two separate tests are necessary to check for correct circuit breaker operation when circuit breaker is part of wiper switch.

TEST 1

1. Before connecting the switch to the Rotunda volt-amp tester or equivalent as shown in Fig. 7, short the tester leads together and adjust the current draw until it equals the circuit breaker rating.
2. Connect the switch to the tester as shown in Fig. 7. Leave the switch connected to the tester for ten minutes. Hold the current reading on the ammeter at the rated current. If the circuit breaker opens during the ten minutes, replace the wiper switch assembly.

TEST 2

1. Short the tester leads together and adjust the current draw until it is twice the rated current.
2. Connect the switch. Hold the current reading on the ammeter at twice rated current. The current reading

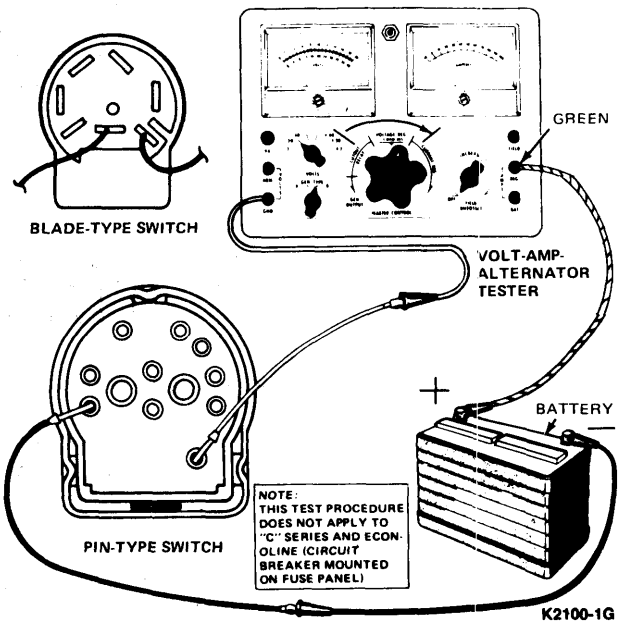


FIG. 7 Circuit Breaker Test

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on the ammeter should drop to zero within 30 seconds. If it takes longer than 30 seconds for the circuit breaker to open (current reading drops to zero) replace the wiper switch assembly.

WIPER SWITCH CONTINUITY TEST

Check the continuity between the switch terminals as shown in Figs. 8 and 9. Either a self-powered test light or an ohmmeter can be used to test a standard two speed switch. An ohmmeter must be used to test a switch used with the intermittent wiper system.

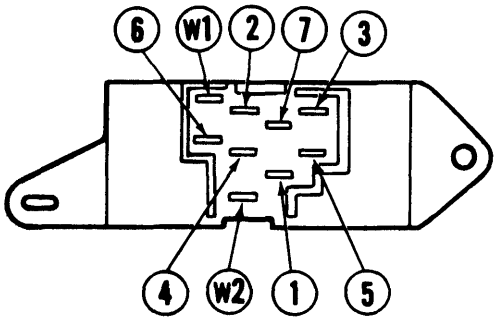
To detect marginal operation of the switch, rotate or slide the switch control knob while each reading is being taken.

If the switch does not exhibit continuity, or if poor continuity exists in any switch position, replace the switch.

WINDSHIELD WIPER INTERMITTENT GOVERNOR TEST

If intermittent operation is unsatisfactory, first check the motor current draw and the control switch and all connecting wires for continuity. If the motor, switch and connecting wires are OK, replace the electronic governor.

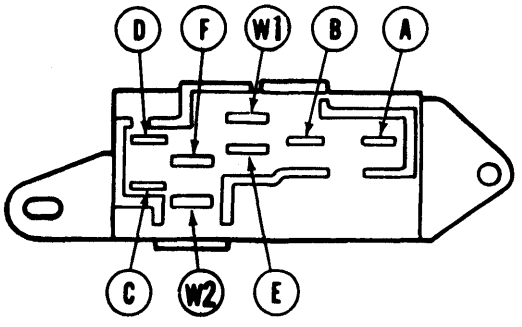
SLIDE WIPER/WASHER SWITCH CONTINUITY TEST



STANDARD SWITCH

STANDARD SWITCH		INTERMITTENT SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN TERMINALS	SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
OFF	1 – 5, 3 – 7	OFF	A – E
LO	1 – 4, 2 – 7	INT.	B – E – F, *
HI	1 – 4, 2 – 6	LO	B – E – F – C
WASH	W1 – W2	HI	D – B – F – C
		WASH	W1 – W2

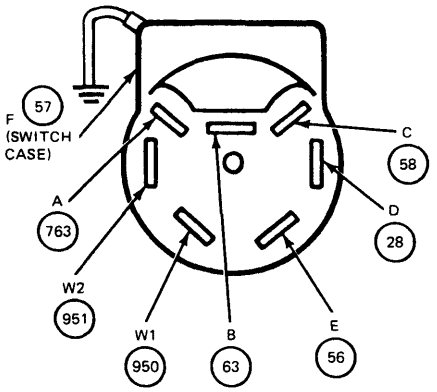
* RESISTANCE BETWEEN TERMINALS F AND C VARIES FROM 500 Ω ± 400 AT MIN. DWELL TO 10K ± 20% AT MAX. DWELL



INTERMITTENT SWITCH

K3504-1A

FIG. 8 Wiper Switch Continuity Test-E-100—E-350



INTERMITTENT SWITCH		2-SPEED SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN TERMINALS	SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
OFF (PARK)	A – B D – E	OFF (PARK)	C – D A – B
LOW	A – B D – E – F	LOW	A – B – C
HIGH	D – E – F A – B – C	HIGH	A – B – E
INTERMITTENT	63 – 763 A – B 28 – 56 – 57 D – E – F VARIABLE RESISTANCE BETWEEN D – E MIN. 100 – 900 ohms MAX. 5600 – 8400 ohms	WASH	W1 – W2
WASH	W1 – W2		

K3025-1A

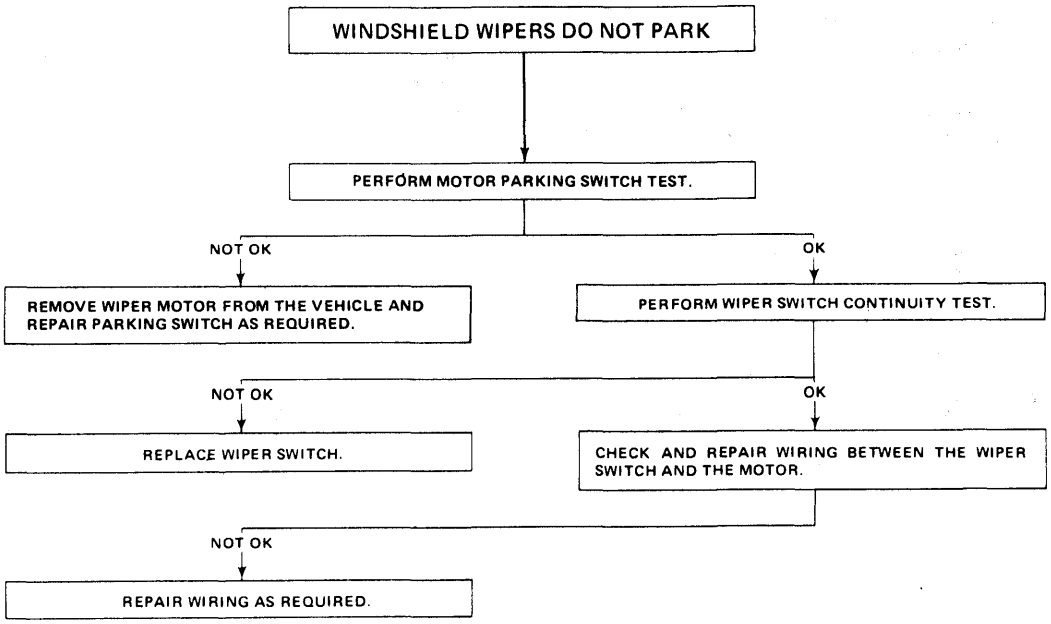
FIG. 9 Wiper Switch Continuity Test—Bronco and F-100—F-350

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DIAGNOSIS GUIDES

The diagnosis guide in this part provides steps to isolate problems in the windshield wiper system.



CK3424-2A

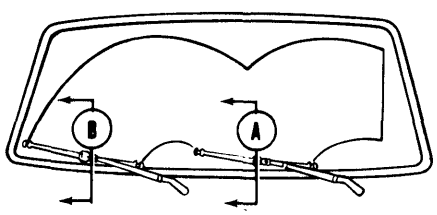
ADJUSTMENTS

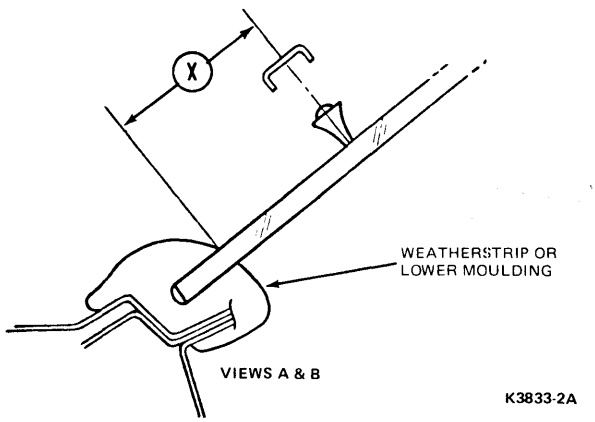
ARM AND BLADE ASSEMBLY

Remove the arm and blade assemblies from the pivot shafts. Turn on the wiper switch to allow the motor to move the pivot shafts three or four cycles, and then turn off the wiper switch. This will place the pivot shafts in park position.

Install the arm and blade assemblies on the pivot shafts to dimension X as shown in Fig. 10. Dimension X is the distance between the centerline of the blade saddle and the windshield lower moulding or weatherstrip. The value of Dimension X for each vehicle is given in Fig. 10.

Vehicle	View	Dimension X (Inches)	
		Driver's Side	Passenger Side
E-100-E-350	1	2.75-4.25	3.25-4.75
F-Series, Bronco	1	1.00-2.00	1.00-2.00





K3833-2A

FIG. 10 Wiper Arm and Blade Adjustment to Dimension "X"

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REMOVAL AND INSTALLATION

WIPER MOTOR

F-100—F-350 AND BRONCO

Removal

1. Disconnect the battery ground cable.
2. Remove the radio (if so equipped) as outlined in Part 35-02.
3. Remove the engine components attached to the lower wiper bracket bolt, if so equipped.
4. Remove the wiper motor bracket attaching bolts (Fig. 11).
5. Disconnect the wiper motor wires. Then, disconnect the wiper arm linkage from the motor shaft (Fig. 12).

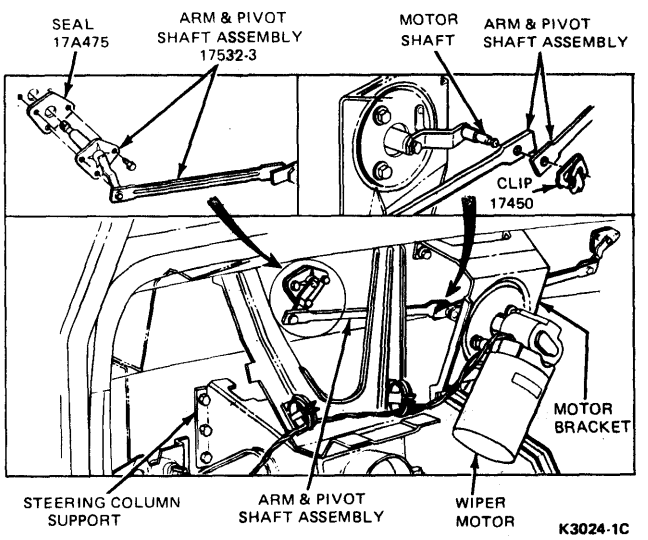


FIG. 11 Windshield Wiper Motor Installation—F-100—F-350 and Bronco

Installation

1. Connect the linkage to motor and install motor bracket attaching bolts (Figs. 11 and 12). Tighten bolts to 8-12 ft-lb, and re-install engine components to lower bracket bolts.
2. Connect wiper motor wires.
3. Install radio as outlined in Part 35-02.
4. Connect battery cable and check wiper motor operation.

E-100—E-350

Removal

1. Disconnect the battery ground cable, and remove the fuse panel and bracket assembly.
2. Disconnect the wiper motor wires at the motor brush cap and gear box cover.
3. Remove the wiper arm and blade assemblies from the pivot shaft.
4. Remove the outer air inlet cowl and remove the clip that retains the motor drive arm to the linkage mounting arm and pivot shaft assembly (Fig. 13).
5. Remove the wiper motor attaching bolts and remove the motor.

Installation

1. Check the new motor to be sure it is in the Park position.
2. Install the motor to the inner dash panel. Tighten the attaching bolts 60-85 in-lb.
3. Install the wiper arm and blade assemblies on the pivot shaft.
4. Connect the linkage mounting arm and pivot shaft assembly to the motor drive arm and install the retaining clip.
5. Install the outer air inlet cowl.
6. Connect the body harness wire plug to the motor (two places) and the ground cable to the battery. Install the fuse panel and bracket, and check the operation of the wipers.

WIPER CONTROL SWITCH

EXCEPT E-100—E-350

1. Disconnect the battery cable.
2. Remove the wiper switch knob, bezel nut, and bezel.
3. Pull out the switch from under the instrument panel. Disconnect the plug connector from the switch and remove the switch.
4. Position the switch and connect the plug connector.
5. Position the switch in the instrument panel and install the bezel, bezel nut, and knob.
6. Connect the battery cable and check the operation of the switch.

E-100—E-350

Removal

1. Disconnect the battery ground cable.
2. Remove the windshield wiper switch knob.
3. Remove the ignition switch bezel (Fig. 14).
4. Remove the headlamp switch knob and shaft (depress button on top of switch and pull knob and shaft).
5. Remove two screws at bottom of finish panel. Then, carefully pry the two upper retainers away from the instrument panel assembly.
6. Disconnect the connector from the wiper switch.
7. Remove the wiper switch attaching screws and remove the switch.

Installation

1. Install the wiper switch to the finish panel (two screws).
2. Install the connector to the wiper switch.
3. Position the ignition switch to the finish panel and install the retaining bezel.
4. Position the headlamp switch to the finish panel, install the retaining bezel and snap in the headlamp shaft and knob. Install the wiper switch knob.
5. Position the finish panel to the instrument panel and snap in the upper retaining clips.
6. Install two bottom finish panel retaining screws.

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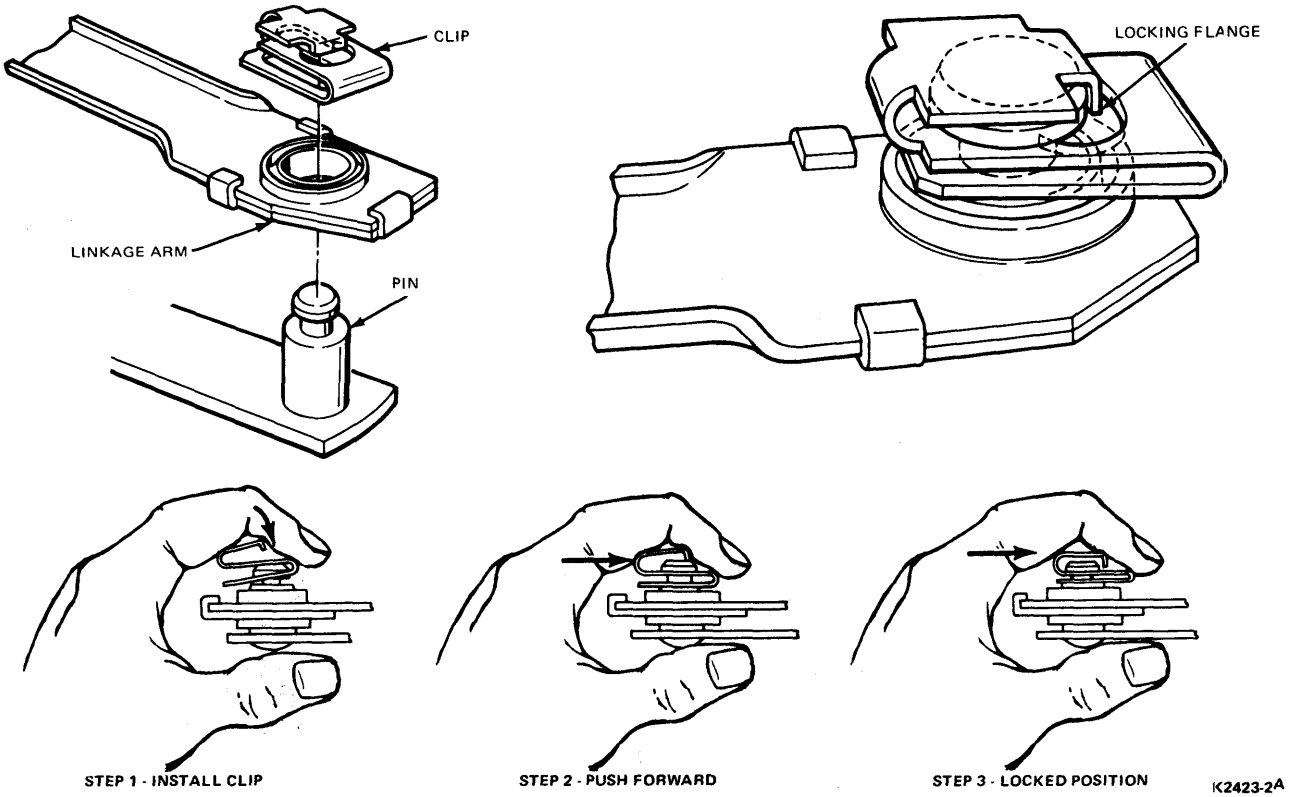


FIG. 12 Wiper Arm Connecting Clip Installation

7. Install the battery ground cable and check the operation of the wipers.

INTERMITTENT GOVERNOR

F-100 THRU F-350, BRONCO AND E-100—E-350

1. Disconnect the wire connectors from the governor.
2. Remove the two governor attaching screws (Fig. 15), and remove the governor. On F-Series and Bronco units equipped with R.P.O. electric rear window device, remove the electric device switch assembly to obtain tool clearance to governor right-hand attaching screw.
3. Position the governor to the instrument panel flange, and install the two attaching screws.
4. Connect the wire connectors, and check the operation of the wiper system.

To remove the F-100—F-350 and Bronco blade, press down on the arm to unlatch the top stud. Depress the tab on the saddle (Fig. 16) and pull the blade from the arm.

To install a new blade assembly, slide the blade saddle over the end of the wiper arm so that the locking stud snaps into place.

SIDE SADDLE BLADE PIN TYPE

To remove a pin type T-type blade, insert an appropriate tool into the spring release opening of the blade saddle, depress the spring clip and pull the blade from the arm (Fig. 17).

To install, push the blade saddle on to the pin, so that the spring clip engages the pin (Fig. 17). Be sure the blade is securely attached to the arm.

ARM AND BLADE ASSEMBLY-TO-PIVOT SHAFT

F-100—F-350—BRONCO

To remove the arm and blade assembly from the pivot shaft, swing the arm and blade away from the windshield and insert a 3/32 inch pin through the pin hole. Swinging the assembly away from the windshield will release the spring-loaded attaching clip in the arm from the pivot shaft. Inserting the pin will hold it in released position. The arm can now be pulled off the pivot shaft with removal tool. **Do not pry off with a screwdriver.**

Leave the pin in the arm until after installation. A new service replacement arm comes with a pin already installed to hold it in released position.

When installing the assembly, be sure that the pivot shaft is in park position and that the blade assembly is positioned to the correct dimension as outlined in Adjustments. Push the arm onto the pivot shaft. Lock the arm to the pivot shaft by removing the pin. Refer to Fig. 18.

E-100—E-350

Raise the blade end of the arm off of the windshield and move the slide latch (Fig. 19) away from the pivot shaft. This will unlock the wiper arm from the pivot shaft and hold the blade end of the arm off of the glass at the same time. The wiper arm can now be pulled off of the pivot shaft without the aid of any tools. Disconnect the washer hose at the wiper arm head.

To install, connect the washer hose at the wiper arm head and push the main arm head over the pivot shaft.

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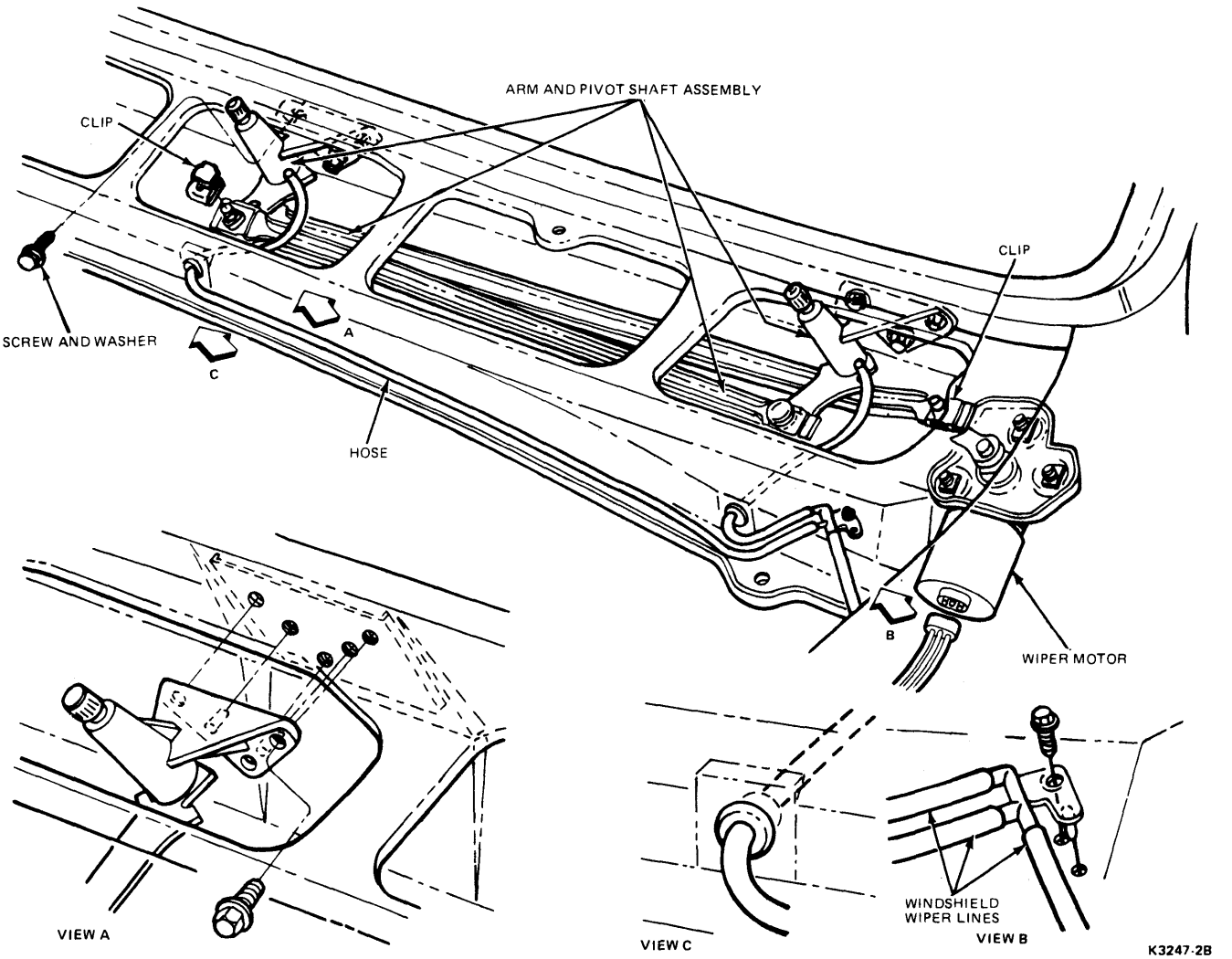


FIG. 13 Windshield Wiper Motor, Linkage, and Pivot Shaft Installation—E-100—E-350

Be sure that the pivot shaft is in park position, (refer to Adjustments) and that the blade assembly is positioned to the correct dimension. Hold the main arm head on to the pivot shaft while raising the blade end of the wiper arm and push the slide latch into the lock under the pivot shaft head. Then, lower the blade to the windshield. If the blade does not touch the windshield, the slide latch is not completely in place.

RUBBER ELEMENT TO WIPER BLADE

The rubber element in all blades can be replaced.

T-TYPE

To remove, squeeze the latch lock release and pull the element out of the lever jaws (Fig. 20).

To install, insert the new element through each of the lever jaws. Be sure the element is engaged in all of the lever jaws. Squeeze the retainer and install into final set of jaws. The element will lock in place when the retainer is released. Check to insure new element is properly installed and locked in place.

If the arm or blade assembly is bent or distorted, replace the complete blade assembly.

PIVOT SHAFT AND LINKAGE

E-100—E-350

Removal

1. Disconnect the battery ground cable.
2. Remove the wiper blade and arm assembly from the pivot shaft and disconnect the washer hose (Fig. 13).
3. Remove the cowl grille.
4. Remove the clip securing the left and right hand linkage and the clip from the wiper motor arm (Figs. 12 and 13).
5. Remove three pivot body-to-cowl panel screws and remove the arm and pivot shaft assembly.

Installation

1. Position the arm and pivot shaft assembly to the cowl panel and install the three attaching screws.
2. Install the clip to the left and right linkage and the clip linkage to motor arm (Figs. 12 and 13).
3. Install the cowl grille, washer hoses to the wiper blade and arm, and install the wiper blade and arm assembly.

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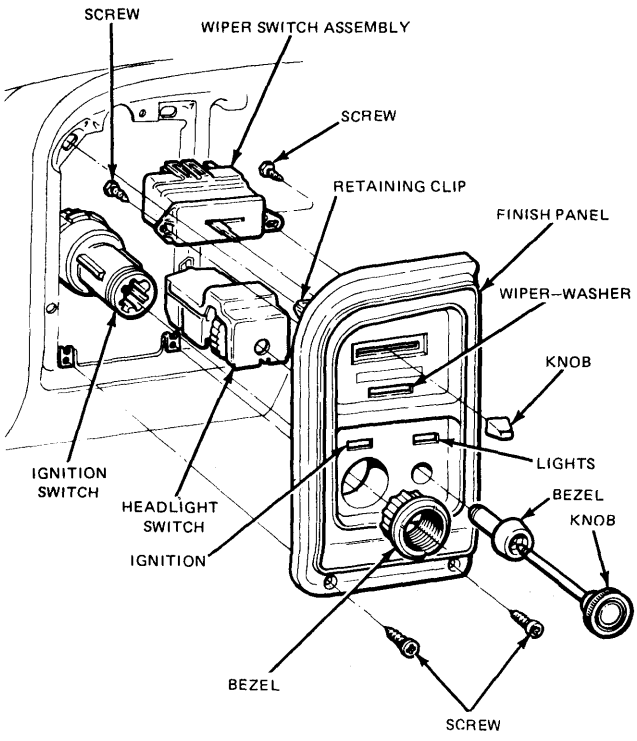


FIG. 14 Windshield Wiper Control Switch Installation—E-100—E-350

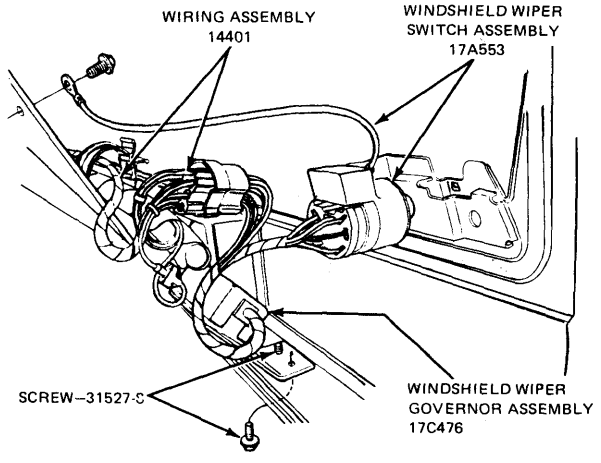


FIG. 15 Windshield Wiper Intermittent Governor—Typical

4. Connect the battery ground cable and check the operation and adjustment of the wipers.

F-SERIES AND BRONCO

Removal

1. Open the hood and disconnect the battery ground cable. Remove the arm and blade assemblies from the pivot shafts (Fig. 11).
2. Reach under the instrument panel and disconnect the speedometer cable from the rear of the instrument cluster.

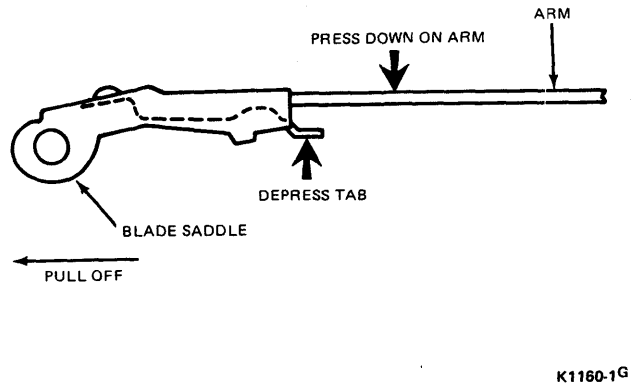


FIG. 16 Blade Removal

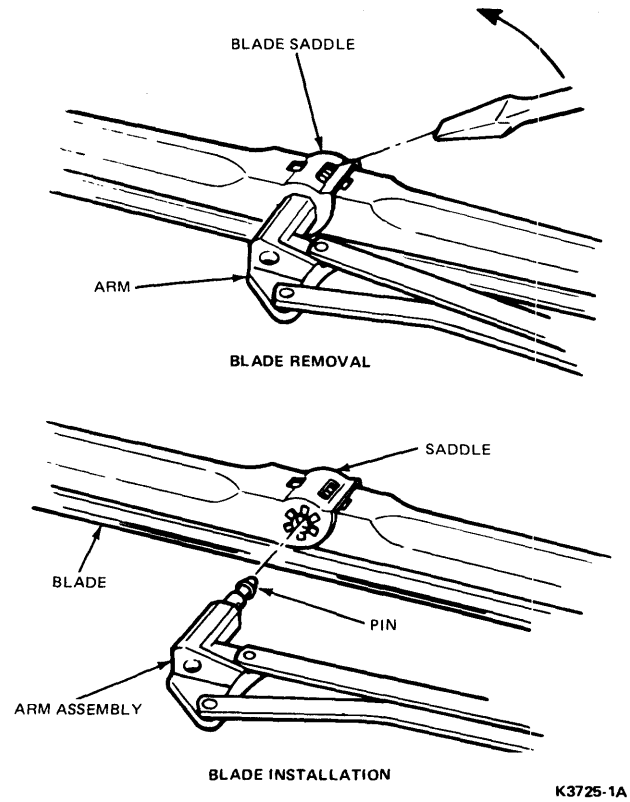


FIG. 17 Side Saddle Blade Pin Type Removal and Installation

3. Remove the instrument cluster bezel.
4. Loosen the three bolts retaining the wiper motor bracket to the cowl. This will allow access between the cowl panel and the link assembly.
5. Remove the clip retaining the motor drive arm to the link assemblies (Fig. 11).
6. Through the cluster bezel opening, remove the retaining bolts from the left pivot assembly. Disconnect the left link assembly from the motor drive arm and remove the left pivot and link assembly from under the instrument panel.

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7. Remove the glove box assembly.
8. Remove the three bolts retaining the right pivot and link assembly to the cowl panel.
9. Disconnect the right link assembly from the drive arm and remove the right pivot and link assembly.

Installation

1. Place gaskets on the pivot shafts and install linkage in reverse order from removal procedure above positioning the shafts to the cowl panel and install the retaining bolts.
2. Install the glove box assembly.
3. Position the link assemblies to the motor drive arm and install the retaining clip (Fig. 11).
4. Tighten the bolts retaining the motor bracket to the cowl and then re-install engine components to lower bracket bolt.
5. Install the wiper arm and blade assemblies.
6. Position and install the instrument cluster bezel.
7. Connect the speedometer cable.
8. Connect the battery ground cable and close the hood and check the operation and adjustment of the wipers.

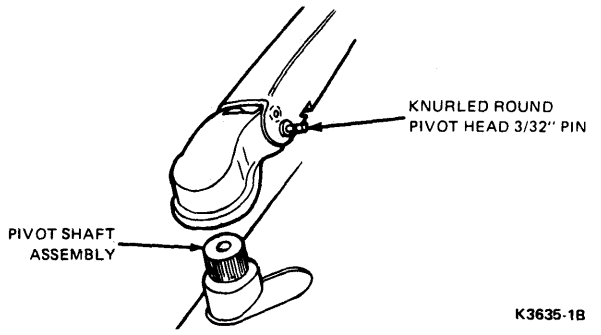


FIG. 18 Wiper Arm Removal—F-100—F-350 and Bronco

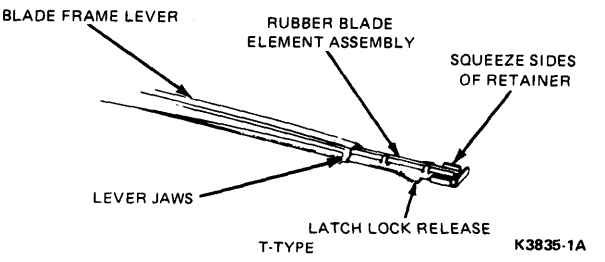


FIG. 20 Rubber Element Replacement

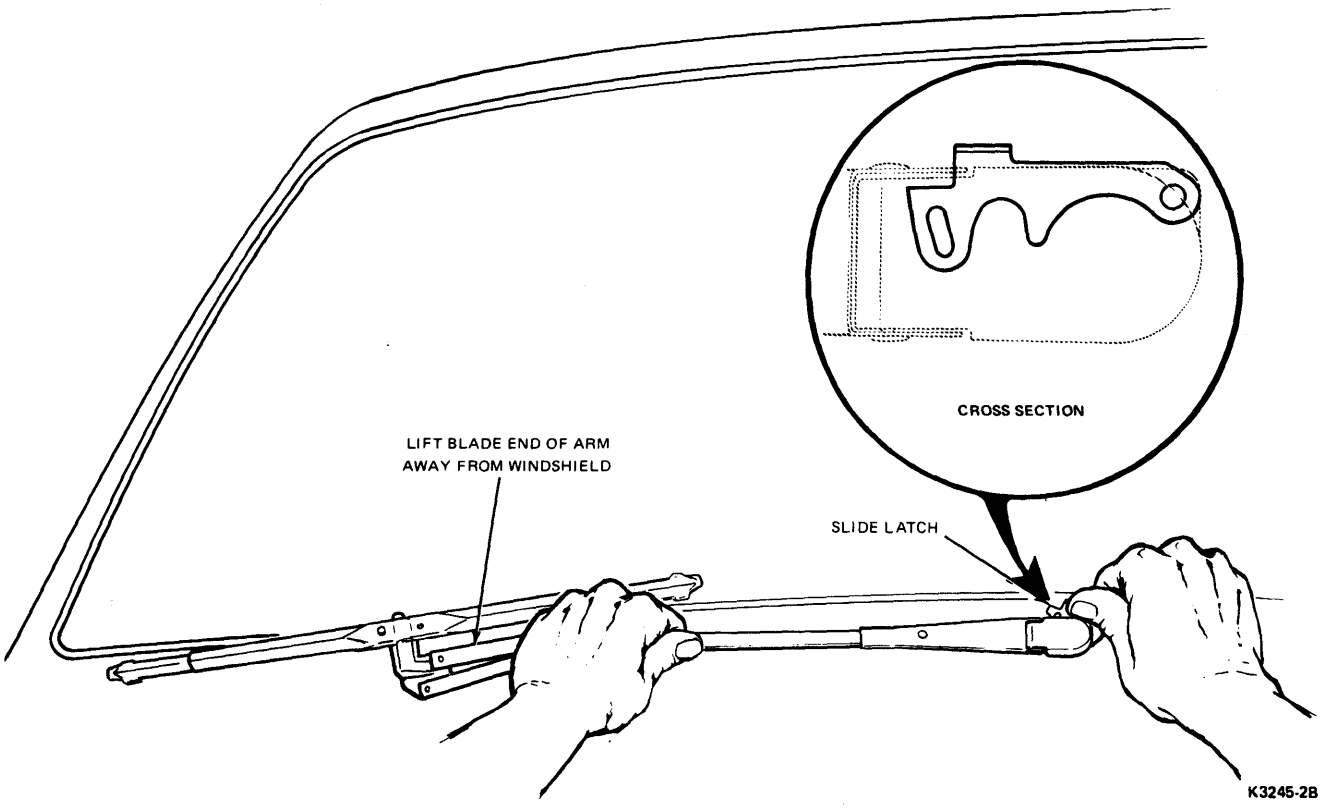


FIG. 19 Wiper Arm Installation—E-100—E-350

DISASSEMBLY AND ASSEMBLY

The wiper motor is not serviced in a complete assembly or in individual parts, but in kits of the major sub-assemblies. Removal and installation procedures are given here for the kits.

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COVER AND SWITCH ASSEMBLY

E-100—E-350

Note: the E-100—E-350 Switch assembly is identified by the letter stamped on the outside surface with ink.

Remove the four cover retaining screws to remove the assembly. Replace with the appropriate kit. Be sure to reassemble the ground strap under the cover screw. On all except E-100—E-350 use the new screws supplied with the kit and tighten to 15-25 in-lb torque.

BRUSH END PLATE

E-100—E-350

Carefully observe the original position of the bale retainer and pry it off with a screwdriver. Remove the end plate and plug. Replace it with the appropriate kit, (Fig. 21).

Note: the E-100—E-350 Switch assembly is identified by the letter "U" stamped on the outside surface with ink.

When installing the end plate, use a fine wire probe through the hub opening to position the brushes on the commutator. Rotate end plate to position the key in the notch and assemble the plug. Re-install the blade retainer carefully with a screwdriver to avoid overbending.

WINDSHIELD WIPER SYSTEM "A" MOTOR

F-SERIES AND BRONCO

Disassembly

1. Remove the gear cover retaining screws, ground terminal and cover (Fig. 22).
2. Remove the idler gear by pressing shaft with retainer out of the motor housing.
3. Remove the motor housing attaching bolts, motor housing, switch terminal insulator sleeve, and armature. Do not pound the motor housing and magnet assembly as the ceramic magnets may be damaged.
4. Mark the position of the output arm with respect to the output shaft for assembly. Remove the output arm retaining nut, output arm, spring washer, spacer washer, O-ring, output gear/shaft assembly, and parking switch lever and parking switch lever plate.
5. Remove the brushes, brush springs, and wire harness.
6. Remove the brush plate and switch assembly, and remove the switch contact to parking lever pin from the gear housing.

Assembly

It is essential that the idler gear shaft with the push-nut be re-set to the original, proper depth in the gear housing.

1. Place the housing on a flat surface with the inside of the housing facing up.
2. Position the parking switch lever and lever plate with the cam rider pointing toward the gear housing output shaft hole.
3. Apply a film of Sun Prestige grease or equivalent to the output gear teeth and shaft bearing surface. Insert the shaft in the bearing. Make certain that the parking switch lever is clear of the cam and gear assembly.
4. After installing idler gear on shaft, insert shaft through park lever and plate. Use a drift and hammer to lightly tap the gear and pinion shaft to proper depth. (Do not allow push-nut to put a pre-load on gear. A .001-.007 inch clearance is required.)
5. Position the brush springs and brushes in the holders and wrap wire around them to hold them in the fully retracted position. Push the insulated brush connector into the switch terminal.
6. Place the switch contact to parking lever pin in the gear housing. Position the brush plate assembly to the housing and install the retaining screws.
7. Apply ESF-MIC149-A grease or equivalent, to the ball bearing in the end of the armature shaft. Position the armature shaft in the gear housing and remove the brush retracting wires.
8. Holding the armature in position, install the motor housing and magnet assembly, and through bolts. Align indicator marks on motor housing and gear housing before inserting through bolts.
9. Apply ESF-MIC149-A grease or equivalent, to the worm gear and pinion and idler gear. Install end play spring in housing.
10. Apply a generous amount of ESF-MIC49-A grease or equivalent, to the area around the end of the armature shaft. Install the gear housing cover.

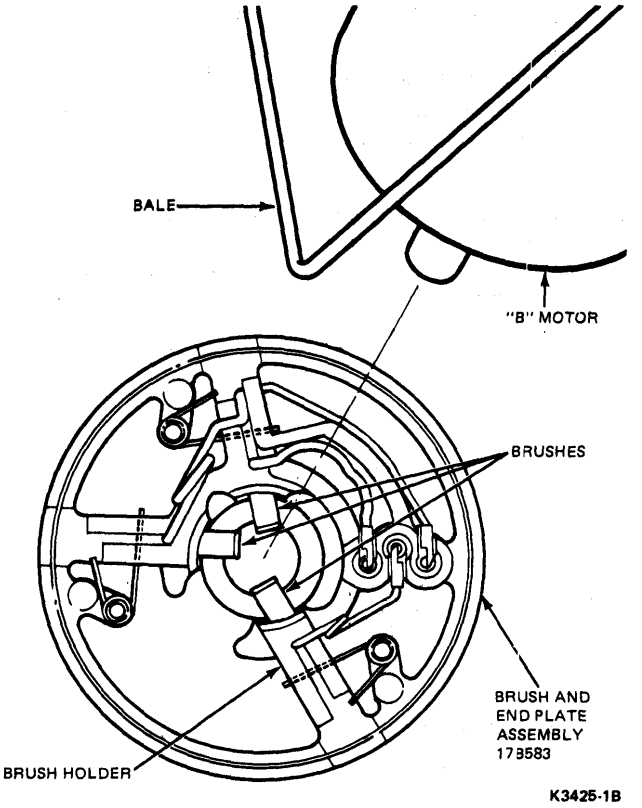


FIG. 21 "B" Motor Brush End Plate Assembly—E-100—E-350

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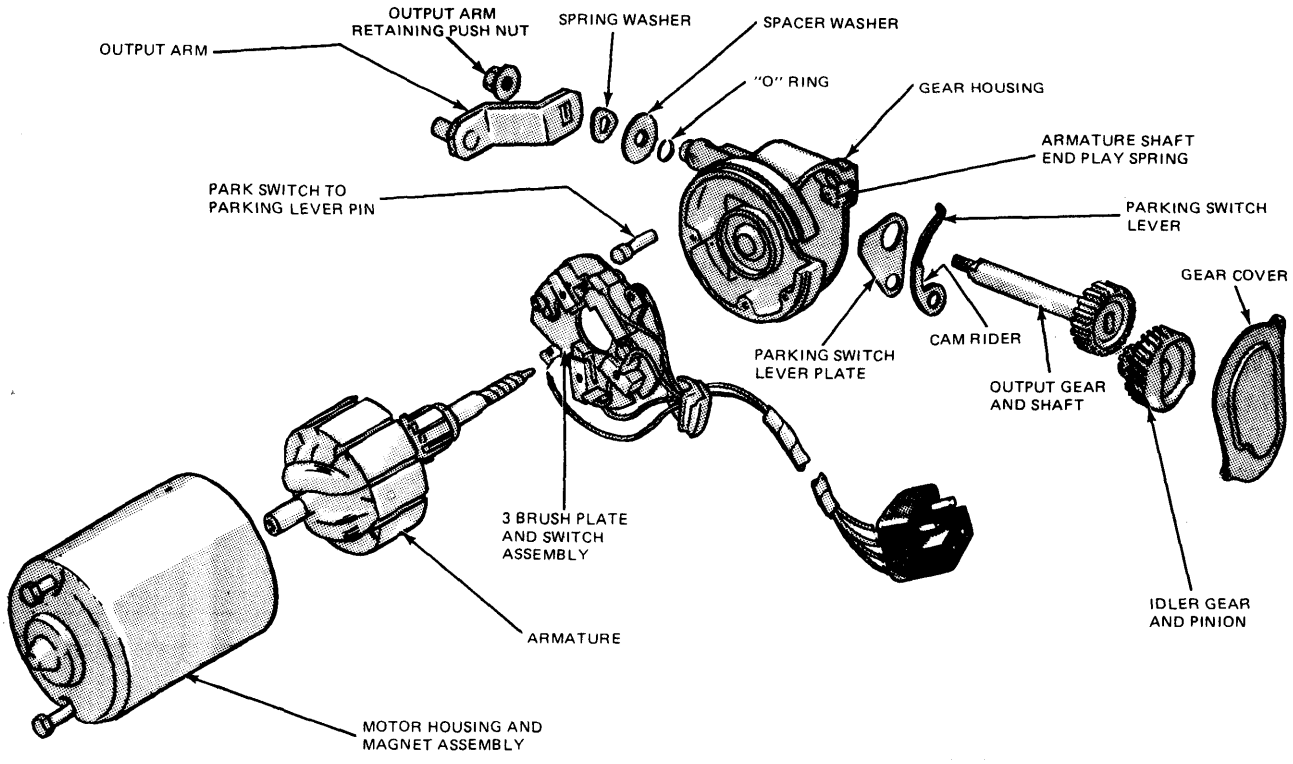


FIG. 22 Disassembled Wiper "A" Motor

CLEANING AND INSPECTION

1. Clean the gear housing of all old grease. Do not allow any cleaning fluid to contact the armature shaft and output shaft bearings.
2. Wipe all other parts with a clean cloth.
3. Inspect the gear housing for cracks or distortion. Replace a cracked or distorted housing.
4. Check all shafts, bushings, and gears for scored surfaces. Replace damaged parts, and add new ESF-MIC149-A grease or equivalent to the housing and gears.

SPECIFICATIONS

ELECTRIC WINDSHIELD WIPER MOTOR AND SWITCH TEST CURRENT LIMITS

Motor Type	Motor Current * Draw Test	Circuit Breaker/Switch Low Current Pass Test	Circuit Breaker/Switch High Current Pass Test
Non-Depressed Park	2.5 amperes	7 amperes	14 amperes
Non-Depressed Park, Heavy Duty	3.5 amperes	8.25 amperes	16.5 amperes
*Motor maximum current when operated without linkage attached.			

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Windshield Washers

PART 35-70

APPLIES TO ALL MODELS

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Motor, Seal, and Impeller Assembly	70-3
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Washer Pump — Electric	70-3

DESCRIPTION AND OPERATION

WASHER SYSTEM—ELECTRIC

The electric windshield washer system consists of an instrument panel control switch, integral with the wiper control switch, reservoir and motor assembly and the necessary hoses, nozzles and attaching parts.

DIAGNOSIS AND TESTING

WASHER PUMP CURRENT DRAW TEST

Attach the leads of the Volt-Amp Tester as shown in Fig. 1. The current draw should not exceed four amps nor be less than 1.7 amps while the washer pump is pumping fluid.

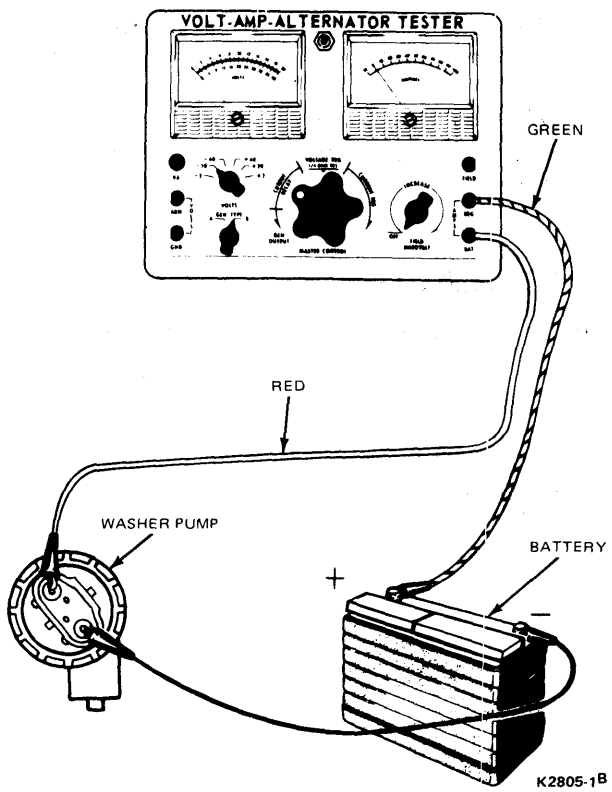


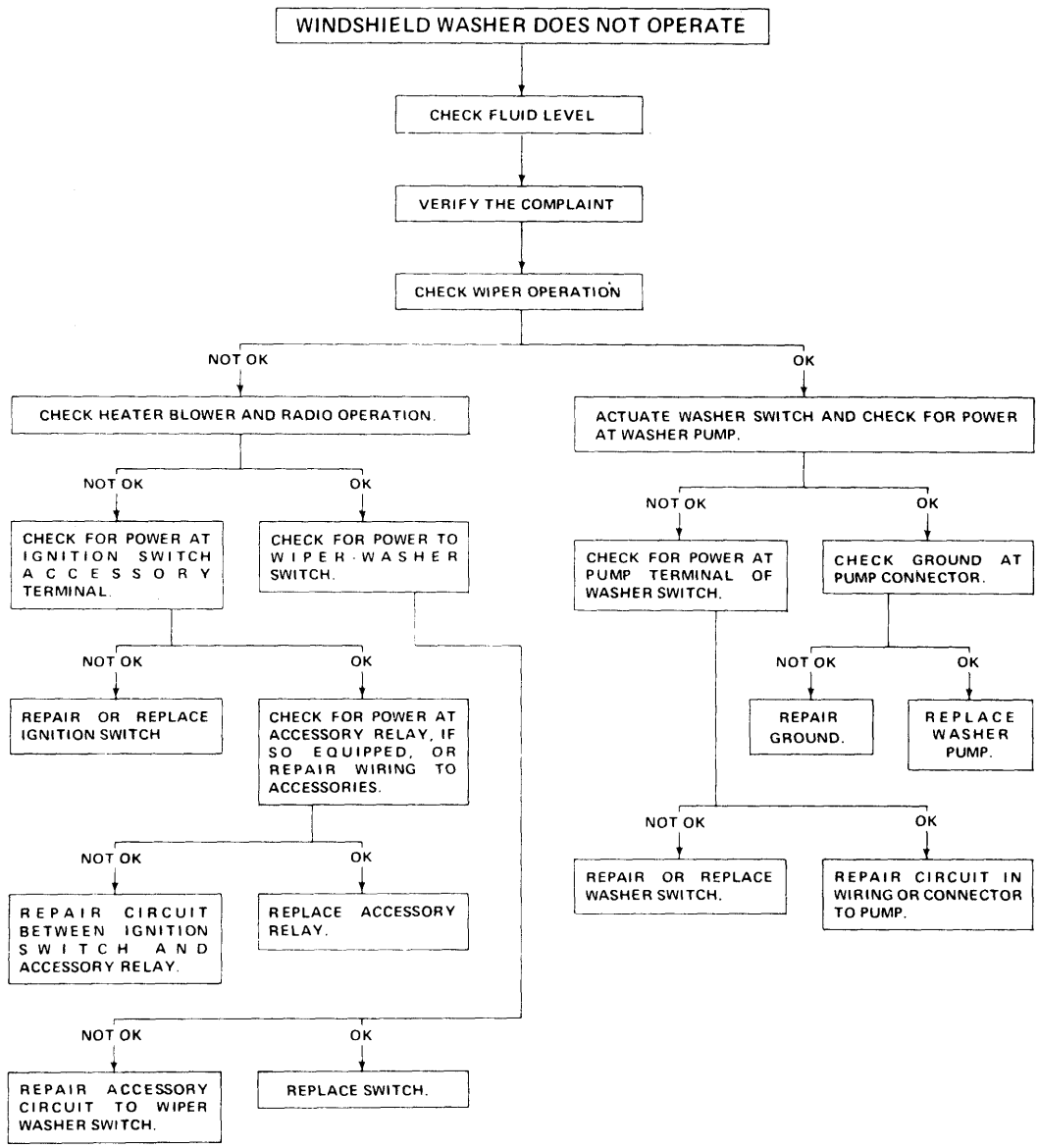
FIG. 1 Washer Pump Current Draw Test

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DIAGNOSIS GUIDES

The following guide provides steps to follow to isolate problems in the windshield washer system.



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ADJUSTMENTS

WASHER NOZZLE

F-SERIES AND BRONCO

The adjustment of either washer nozzle can be accomplished by bending the nozzle tube to provide desired windshield washer fluid distribution.

REMOVAL AND INSTALLATION

WASHER PUMP—ELECTRIC

To remove the electric windshield reservoir and motor assembly from the vehicle, disconnect the lock tab wire connector (use a small screwdriver to unlock tabs) and hose, remove the retaining screws and lift the assembly from the fender apron (or radiator support), (Fig. 2). Disconnecting the hose will drain the reservoir. The washer reservoir and cover assembly are not serviced separately. The motor retaining ring, seal and pump impeller assembly are serviced separately. **Do not make electrical connection prior to filling reservoir. Do not operate reservoir pump prior to filling reservoir.**

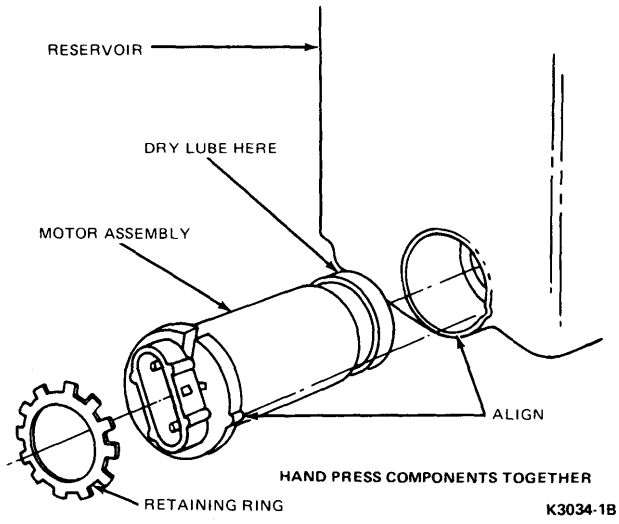


FIG. 2 Windshield Washer Motor Replacement

MOTOR, SEAL AND IMPELLER ASSEMBLY

1. Remove reservoir assembly from vehicle. Disconnect electrical plug and hose.
2. Using a small bladed screw driver, pry out retaining ring, (Fig. 2).
3. Using pliers to grip one wall around the electrical terminals, (Fig. 3), pull out the motor, seal and impeller assembly. If the impeller and seal come off when the motor is pulled, they can be reassembled. Make certain the reservoir pump chamber is free of foreign material prior to installing the old assembly in the new reservoir.

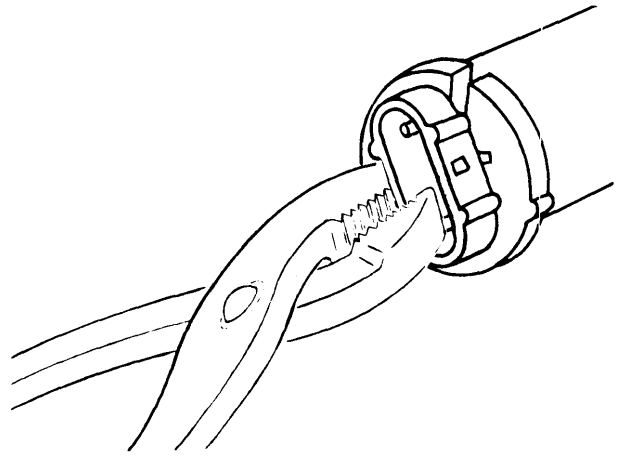


FIG. 3 Disassembling Motor, Seal and Impeller Assembly

4. Before installing the assembly, lubricate the outside diameter of the seal (Fig. 2) with a dry lubricant such as powdered graphite. This will prevent the seal from sticking to the wall of the reservoir motor cavity and make assembly easier.
5. Align small projection on the motor end cap with the slot in the reservoir (Fig. 2) and assemble so that the seal seats against the bottom of the motor cavity.
6. Using a 1 inch socket (preferably 12 point) hand press retaining ring securely against motor end plate.
7. Connect electrical plug and hose and replace the reservoir assembly in the vehicle.
8. Fill the reservoir and operate the washer system.
9. Check for leaks and align the cowl-mounted jets, if necessary.

CAUTION: Do not operate pump until fluid is added to the reservoir.

RESERVOIR

1. Disconnect hose and drain reservoir.
2. Remove the screws mounting the reservoir and remove the reservoir.
3. Position the new reservoir, attach the retaining screws, connect the hose and fill the reservoir (Fig. 4).

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JETS

F-SERIES AND BRONCO

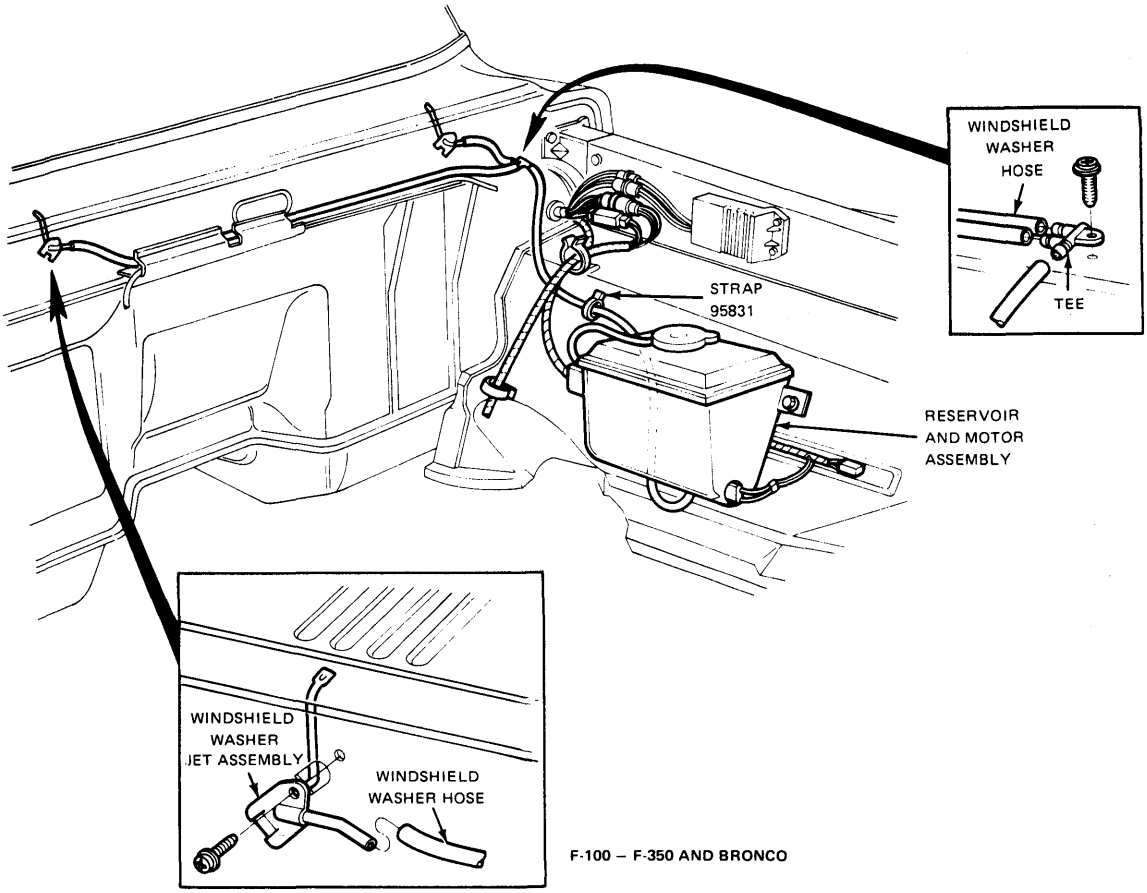
1. Remove the hose from the nozzle, the retaining screw and remove the jet assembly (Fig. 4).
2. Install the jet assembly (one screw) and connect the hose and fill the reservoir.

E-100—E-350

1. Remove the hose from the upper nozzle and remove the upper arm (Figs. 5 and 6).
2. Remove the nozzle from the wiper arm and disconnect the hose.
3. Remove the windshield washer hose shield by prying the two locking tabs out and remove the metal and rubber hose assembly.
4. Fish the rubber hose behind the two springs, connect and install the metal hose.
5. Hook the end of the windshield washer hose shield under the lip in the head and pivot into position.
6. Then, lock in position by bending the two locking tabs down.

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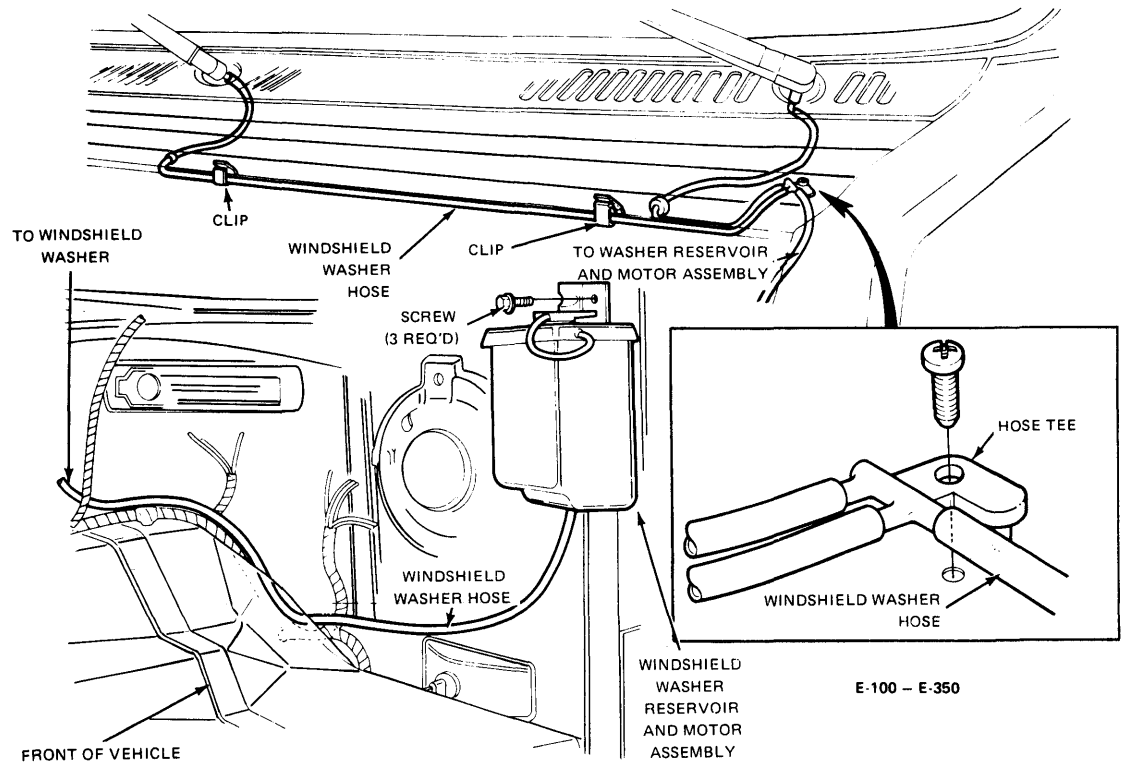


FIG. 4 Washer Pump, Reservoir and Jet Installation—F-100/350, Bronco and E-100—E-350

7. Push the hose onto the nozzle fully and install the nozzle to the arm.
8. Install the wiper arm to the shaft and connect the hose (Part 35-60).

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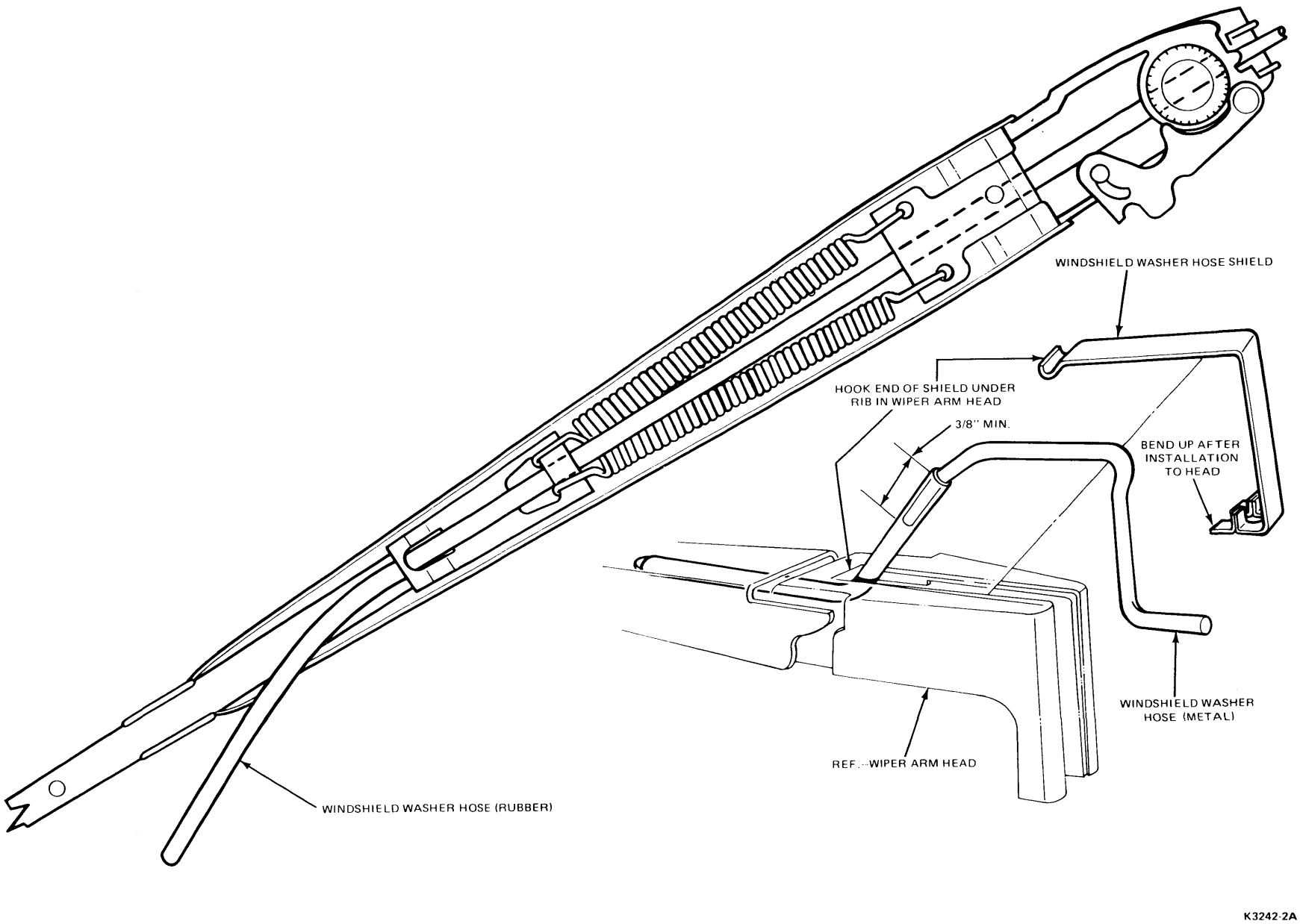


FIG. 5 Windshield Washer Nozzle Installation—E-100—E-350

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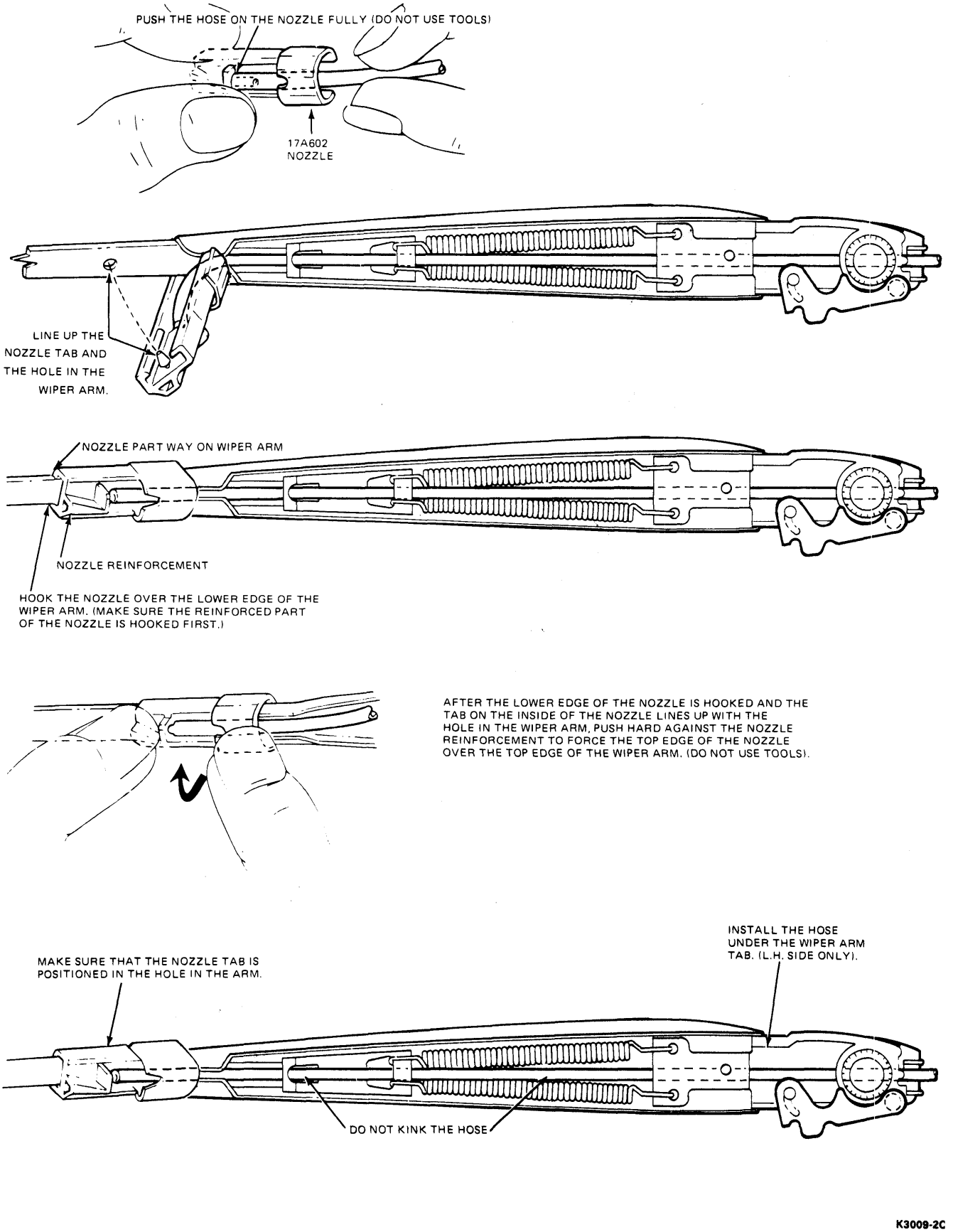


FIG. 6 Windshield Washer Hose Installation—E-100—E-350

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Horns

PART 35-80

APPLIES TO ALL MODELS

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Horn Relay	
F-100 — F-350 and Bronco	80-2
E-100 — E-350	80-2
Horn Switch	80-2

DESCRIPTION AND OPERATION

Bronco, F-100 through F-350 and E-100—E-350 models are equipped with a single horn. Dual horns are available on the Bronco, F-100 through F-350, and E-100—E-350. The horn button completes the circuit direct to the horn(s). A horn relay is used on vehicles with speed control.

TESTING

ALL VEHICLE LINES CIRCUIT CHECK

With Testing Equipment

Verify that the ground connection to the horn is good by checking that the torque on the mounting screw is 12-18 ft-lbs. Connect a wire from the positive terminal of the battery to the horn. If the horn blows normally, check the horn wiring, if it does not, proceed as follows.

Connect a voltmeter and ammeter to the horn and vehicle battery as shown in Fig. 1. If the current reads zero amps, (open circuit), turn the adjusting screw counterclockwise until the meter reads 5.0-5.5 amps. Secure screw by clinching housing extrusions with diagonals or pliers. If the current is greater than 5.5 amps, turn adjusting screw clockwise until the meter reads 5.5 amps. If you cannot adjust the horn to 5.0-5.5 amps, replace the horn.

Without Test Equipment

Connect a jumper wire from the horn and the negative (-) terminal of the battery to the horn as shown in Fig. 2. Connect another jumper wire from the horn to the positive (+) terminal of the battery, (Fig. 2). If the horn does not sound, and there is no evidence of a spark at the battery terminal, disconnect the jumper wires and turn the adjusting screw counterclockwise 1/4-3/8 turn and secure screw by clinching housing extrusions with diagonals or pliers. If the horn does not sound when the jumper wires are reconnected, replace the horn.

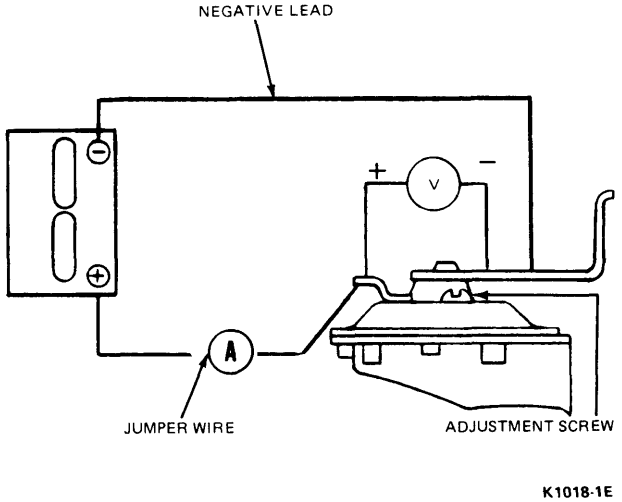


FIG. 1 Horn Current Test—With Test Equipment

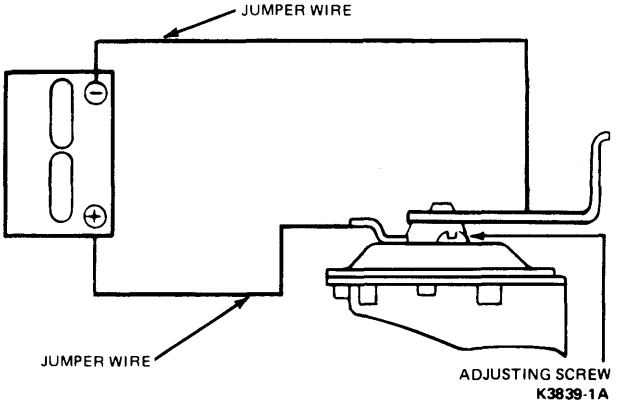


FIG. 2 Horn Current Draw Test—Without Test Equipment

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REMOVAL AND INSTALLATION

ELECTRIC HORNS

All truck horn assemblies are mounted in the engine compartment. The E-100—E-350 standard low pitch horn is mounted on the left hand side of the fender apron reinforcement, next to the R.P.O. battery. The R.P.O. high pitch horn is mounted next to the R.P.O. battery high on the left hand radiator support.

The Bronco, F-100 thru F-350 standard low pitch horn is mounted to the right hand radiator support and the RPO high pitch horn is on the left hand radiator support.

Disconnect the horn wire from the terminal and remove the mounting bolt. When installing a horn and bracket assembly, tighten the mounting bolt to 12-18 ft-lb torque.

HORN BUTTON SPORT WHEEL

The horn button assembly can be removed by pressing down evenly and turning the button counterclockwise until it lifts out. It is advisable to disconnect the connector at the horn relay or battery to prevent the horns from sounding during this operation.

Disconnect the horn button by pulling the spade terminals from the blade connectors.

HORN SWITCH

1. Remove one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel.
2. Disconnect the horn switch wires by pulling the spade terminal from the blade connector (Fig. 3). Squeeze or pinch the ground wire terminal firmly and pull it out of the hole in the steering wheel. Do not pull the ground terminal out of the threaded hole without squeezing the terminal to relieve the spring retention of the terminal in the threaded hole.
3. To install, connect the spade terminal to the blade connector, and press the ground terminal fully into the threaded hole (Fig. 3).
4. Center the horn switch (pad) on the steering wheel, and install the two attaching screws.

HORN RELAY

BRONCO AND F-100—F-350

The horn relay used only on vehicles equipped with speed control is located under the instrument panel to the left of the steering column and is mounted on the outboard attaching screw of the speed control amplifier module.

Remove the wire connector from the horn relay. Remove the retaining screws and remove the relay. Reverse the procedure to install. Test operation of horn(s) after installation of relay.

E-100—E-350

The E-100—E-350 horn relay (only used on speed control vehicles) is located under the instrument panel

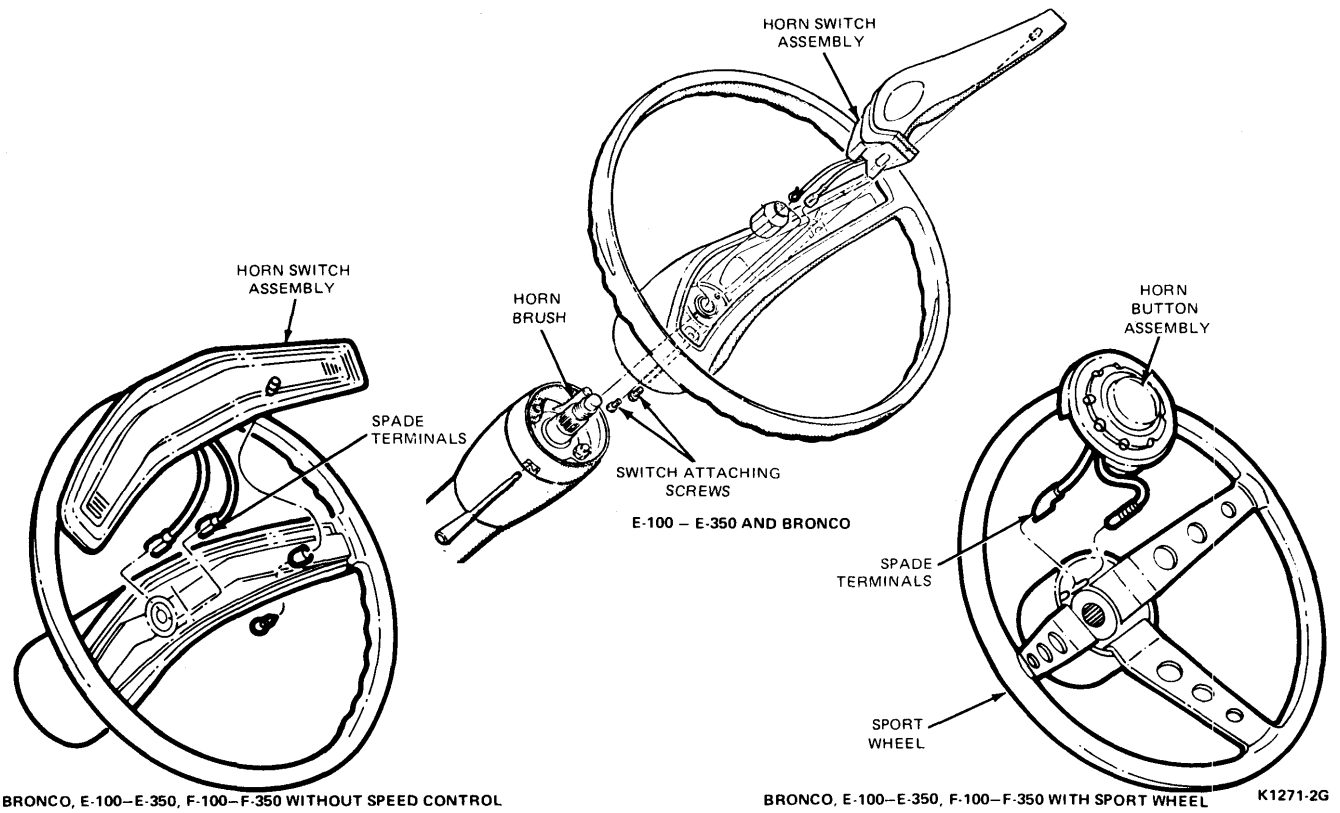


FIG. 3 Horn Contact Button

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to the left of the steering column on the fuse panel mounting bracket. To replace the relay, disconnect the wire connector and remove the retaing screw. Attach the new relay to the instrument panel with the retaining screw and connect the wire connector. Test the operation of the horns.

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VENTILATING, HEATING AND AIR CONDITIONING

GROUP 36 (18000 & 19000)

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Ventilating Systems

PART 36-02

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Right Ventilator F-100 Through F-350 and Bronco	02-2

DESCRIPTION

F-100 THROUGH F-350 AND BRONCO WITH STANDARD AND HI-OUTPUT HEATER SYSTEM ONLY

The ventilation system consists of two air inlets which, when open, allow outside air to enter the vehicle cab. One inlet is located in the left side cowl. The right inlet is located in the right side cowl and air enters the vehicle cab through an air duct attached to the side cowl and heater assembly.

E-100 THROUGH E-350

The body ventilation air vents allow outside ram air to be discharged in the side floor areas. When the control knob for the left vent is pushed in, the left air vent is closed; pulled out air is discharged to the floor. Air is discharged to the floor when the door for the right air vent is open and the temperature control lever on the heater control is in the "Cool" position.

REMOVAL AND INSTALLATION

OUTSIDE AIR VENTILATOR

LEFT VENT ASSEMBLY E-100 THROUGH E-350

Removal

1. Remove the parking brake by removing the two nuts (engine compartment side) holding the parking brake to the dash and then removing the attached screws to the instrument panel. Lay the parking brake on the floor.
2. Remove the left cowl side trim panel (Fig. 1).

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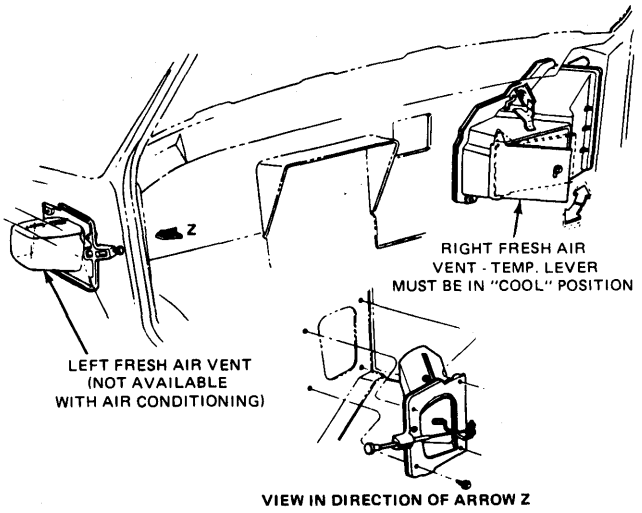


FIG. 1 E-100 Through E-350 Outside Fresh Air Vent Assembly

3. Remove the five attaching screws that hold the vent to the cowl side (Fig. 1).
4. Remove the vent assembly from the cowl side.

Installation

1. Position vent assembly to cowl side (Fig. 1).
2. Secure vent assembly to cowl side with five screws.
3. Install left cowl side trim panel.
4. Position parking brake bracket to the Instrument Panel and secure with attaching screws.
5. Secure parking brake bracket to dash with two nuts on engine compartment side.

RIGHT VENTILATOR F-100 THROUGH F-350 AND BRONCO

The right ventilator is an integral part of the heater air inlet duct. To replace, proceed as follows:

1. Remove five screws attaching the air inlet duct to the heater blower housing and remove the inlet duct.
2. To install, position the air inlet duct to the blower housing and install the five screws loosely.
3. Push the air inlet duct to the extreme right side and tighten the five attaching screws.

LEFT AIR VENT F-100 THROUGH F-350 AND BRONCO

Removal

1. Remove the parking brake pedal and position the brake pedal away from the left vent (Part 12-70).
2. Remove six screws attaching the left vent to the cowl side panel and pull the vent out from the side panel (Fig. 2).

Installation

1. Position the left vent to the cowl side panel and install the six attaching screws.
2. Install the parking brake pedal (Part 12-70).

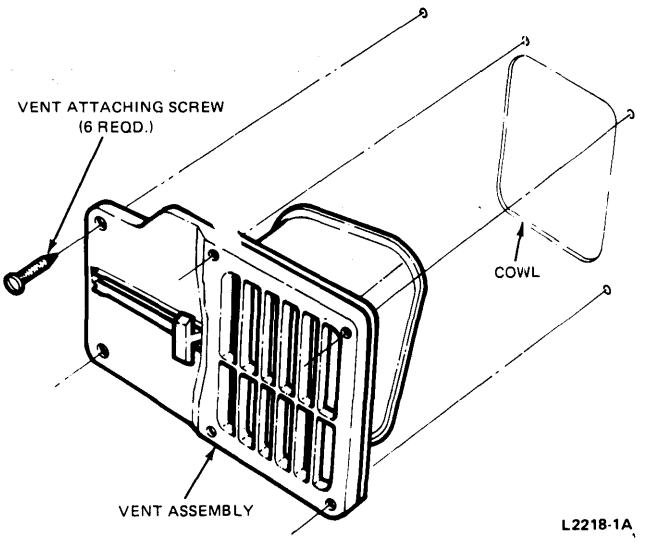


FIG. 2 F-100 Through E-350 and Bronco Left Outside Air Vent Assembly

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Heating General Service

PART 36-10

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DESCRIPTION AND OPERATION

HEATING SYSTEMS AND CONTROL DOORS

With all Ford heating systems, outside air comes through an opening at the upper cowl and into the right duct of the heater assembly. All heater assemblies contain a heater core, through which flows coolant from the engine, and a blower. The air (forced by blower or ram effect) passes through and/or around the heater core and discharges through various outlets.

Several valves or doors determine the amount of air that goes through the heater core and the particular outlet(s) through which it discharges. The number of doors used differ according to the particular vehicle model.

SAFETY PRECAUTIONS

Whenever components in the engine compartment or instrument panel areas are being serviced, the battery ground cable must be disconnected to eliminate the possibility of electrical shorts, burned-up wiring, and fires. Extreme care must be exercised when performing electrical tests where the battery must be connected to operate the system.

Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gasses outside the closed area.

DIAGNOSIS AND TESTING

The various tests to check heater system operations are included below. In addition to these tests, visual inspection of all heater system components and connections can be made to ensure proper operation.

VISUAL CHECK - BLOWER

Check to see that all blower motor connections are correct including proper ground of the blower motor. Check the resistor connection at heater case and the heater fuse. Also check the connection at the control head.

BLOWER MOTOR CURRENT DRAW TEST

STANDARD AND HI-OUTPUT HEATER SYSTEMS

1. Disconnect the blower motor orange lead at the in-line connector near the blower motor (Fig. 1).
2. Connect a 0-30 amp ammeter in the circuit as shown in Fig. 1.
3. Operate the blower with the engine OFF and a fully charged battery in all blower switch positions. Record the current draw for each switch position.
4. On Econoline models with an auxiliary heater, turn the main heater blower switch to low. Then, operate the axuliiary blower in all switch positions while recording the current draw at the auxiliary blower motor resistor (single connector plug).
5. Compare the ammeter readings with the specifications given at the end of the part covering the specific Heater system.

DELUXE HI-LO HEATER SYSTEM

1. Disconnect the blower motor orange lead at the blower motor resistor.
2. Connect a 0-30 Amp ammeter in the circuit as shown in Fig. 2. It may be necessary to use jumper wires on some models.

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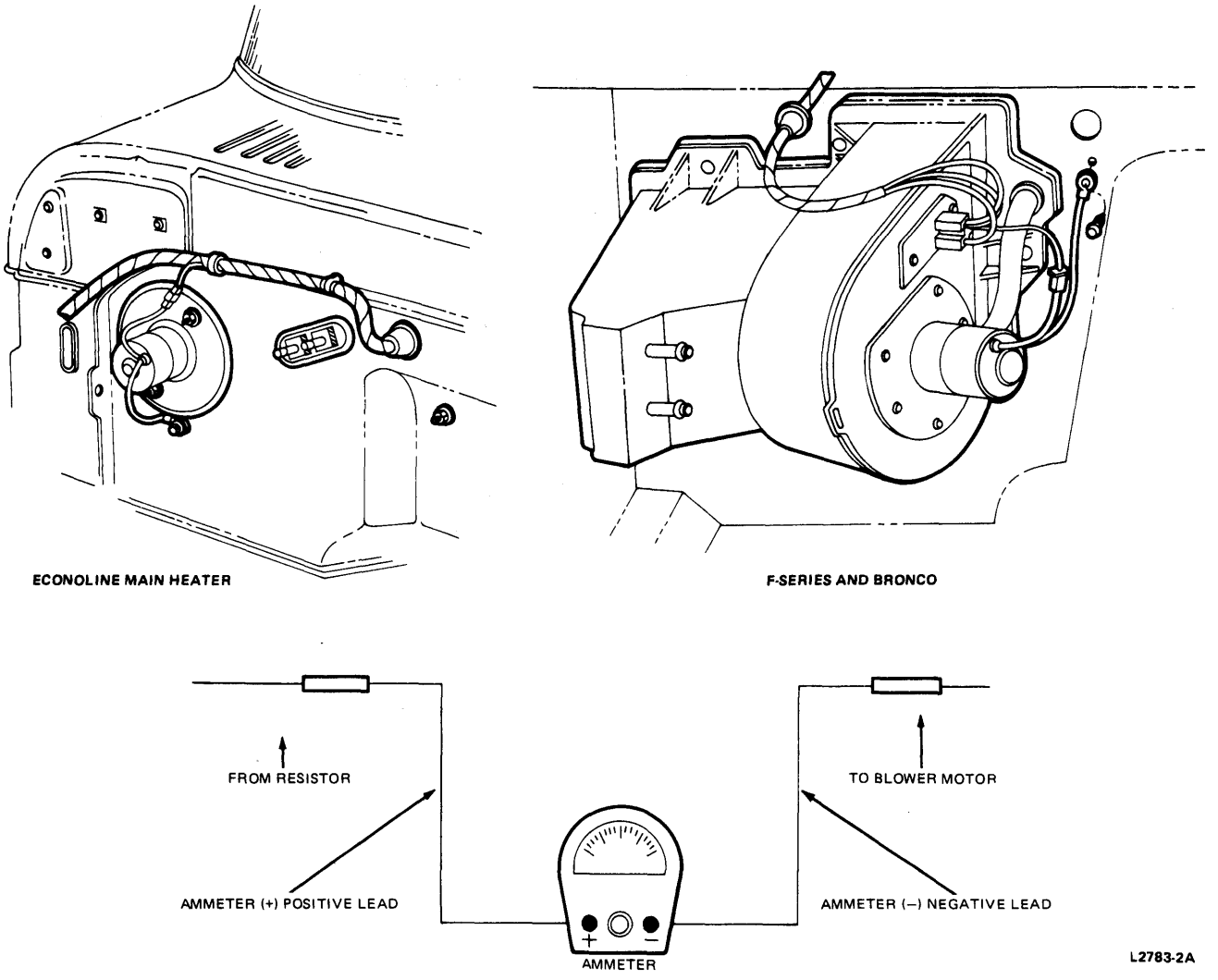


FIG. 1 Blower Motor Current Draw Test - Standard and Hi-Output Heater Systems

3. With a fully charged battery and the engine OFF, operate the blower in all blower switch positions. Record the current draw for each switch position.
4. On Econoline with an auxiliary unit, turn the main blower switch to low. Then, operate the auxiliary blower in all switch positions while recording the current draw at the auxiliary blower motor resistor (single connector plug).
5. Compare the ammeter readings with the specifications given at the end of the Part covering the specific heater system.

BLOWER MOTOR VOLTAGE TEST

STANDARD AND HI-OUTPUT HEATER SYSTEMS

1. Connect a jumper wire in the blower motor orange lead at the in-line connector (Fig. 3).
2. Connect the positive lead of the voltmeter to the jumper wire and the negative lead of the voltmeter to a good ground (Fig. 3).
3. Operate the blower with the engine OFF and a fully charged battery in all blower switch positions. Record the voltage for each switch position.
4. On Econoline models with an auxiliary heater, turn the main heater blower switch to low. Then, operate the auxiliary blower in all switch positions while recording the voltage at the auxiliary blower motor resistor (single connector plug).
5. Compare the voltmeter readings with the specifications given at the end of the part in this manual covering the specific heater system.

DELUXE HI-LO HEATER SYSTEM

1. Disconnect the blower motor orange lead at the blower motor resistor (Fig. 4).
2. Connect a jumper wire between the blower motor orange lead and the blower motor resistor (Fig. 4). Then, connect the voltmeter positive (+) lead to the jumper wire and the voltmeter negative (-) to a good ground.
3. With a fully charged battery and the engine OFF, operate the blower in all blower switch positions and record the voltage for each switch position and record the voltage for each switch position.
4. On Econoline with an auxiliary unit, turn the main blower switch to low. Then, operate the auxiliary blower in all switch positions and record the voltage

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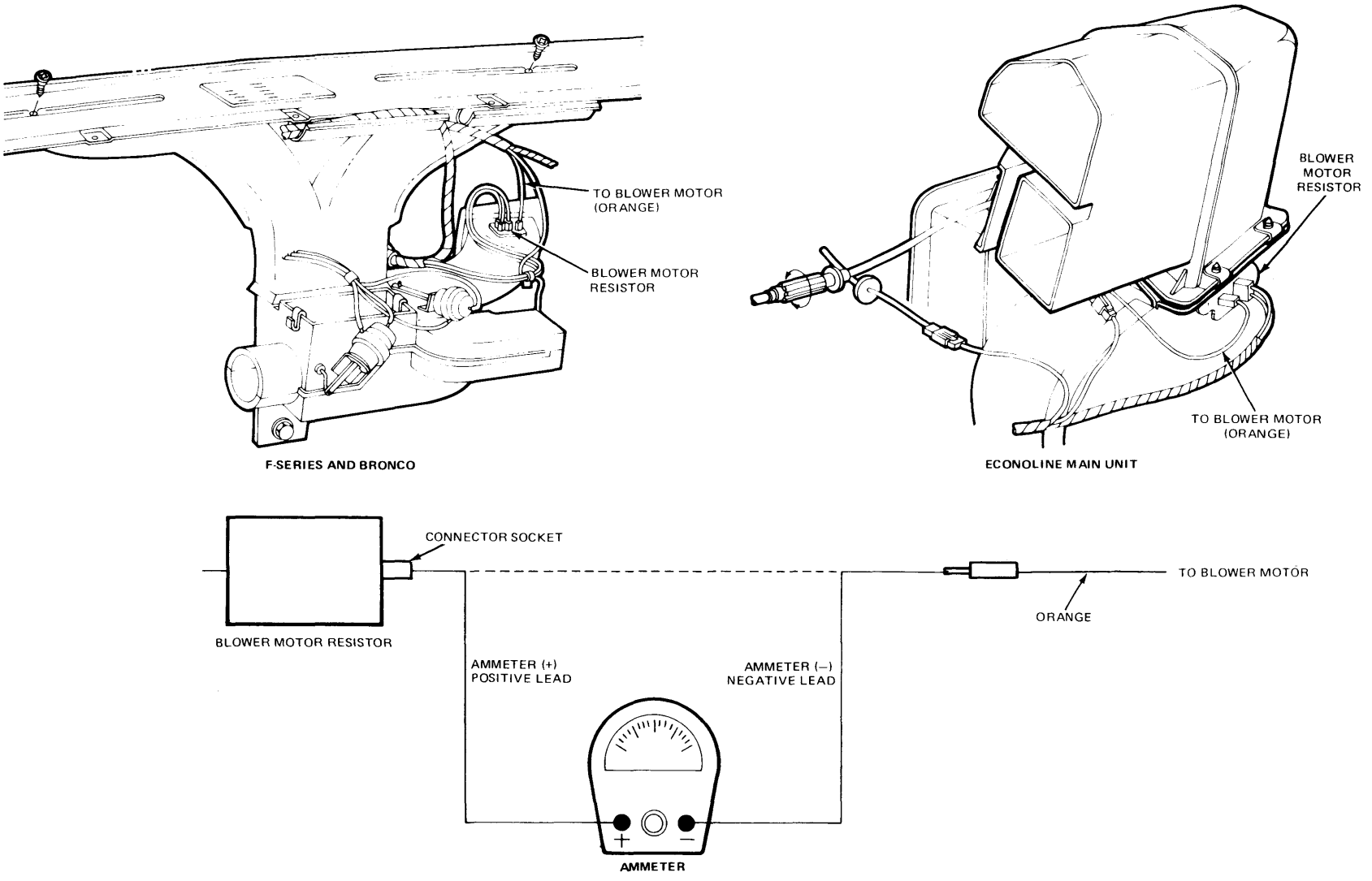


FIG. 2 Blower Motor Current Draw Test - Deluxe Hi-Lo Heater System

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for each switch position at the auxiliary blower motor resistor (single connector plug).

5. Compare the voltage readings with the specifications given at the end of the Part covering the specific system.

OPEN CIRCUIT TEST

All electrical circuits must be complete from the source of power (battery), to the unit where the power is used, and back to the source of power again. A check at each connection in a circuit, starting at the battery, will locate an open circuit or will show that the circuit is complete.

An ohmmeter or self-powered test light connected at any two points of a circuit with the power removed from the circuit, will show if the circuit between the two connections is open or complete.

If the meter does not move or has a light movement (high resistance), the circuit may have a poor connection or broken wire. If the bulb does not light, the circuit is open or has high resistance.

If the meter movement is great or full (low resistance), the circuit is complete. If the bulb lights, the circuit is complete.

BLEEDING AIR FROM HEATER CORE

Remove the hose at the outlet connection of the heater core (hose that leads to the water pump). Allow any trapped air to flow out. When a continuous flow of coolant is obtained, connect the hose to the core. Do not overtighten heater hose clamps.

HEATER CORE TEST

Start the engine and allow to warm up. Set controls for maximum heat and high blower. Operate for approximately two minutes. Feel the heater core inlet and outlet hoses. If a significant temperature difference exists between these hoses, flush or replace the heater core as necessary. (Ensure that the water valve is open and coolant hoses are not plugged or kinked).

VISUAL CHECK - VENTILATION

Check operation of cowl side vent doors ensuring that doors open and close properly. Check for cracked or broken doors, misaligned, kinked or missing seal. Check air inlet ducts for restrictions. Verify ventilation duct alignment at plenum and vacuum operation of power vent vacuum motor and door. (Deluxe Hi-Lo systems only).

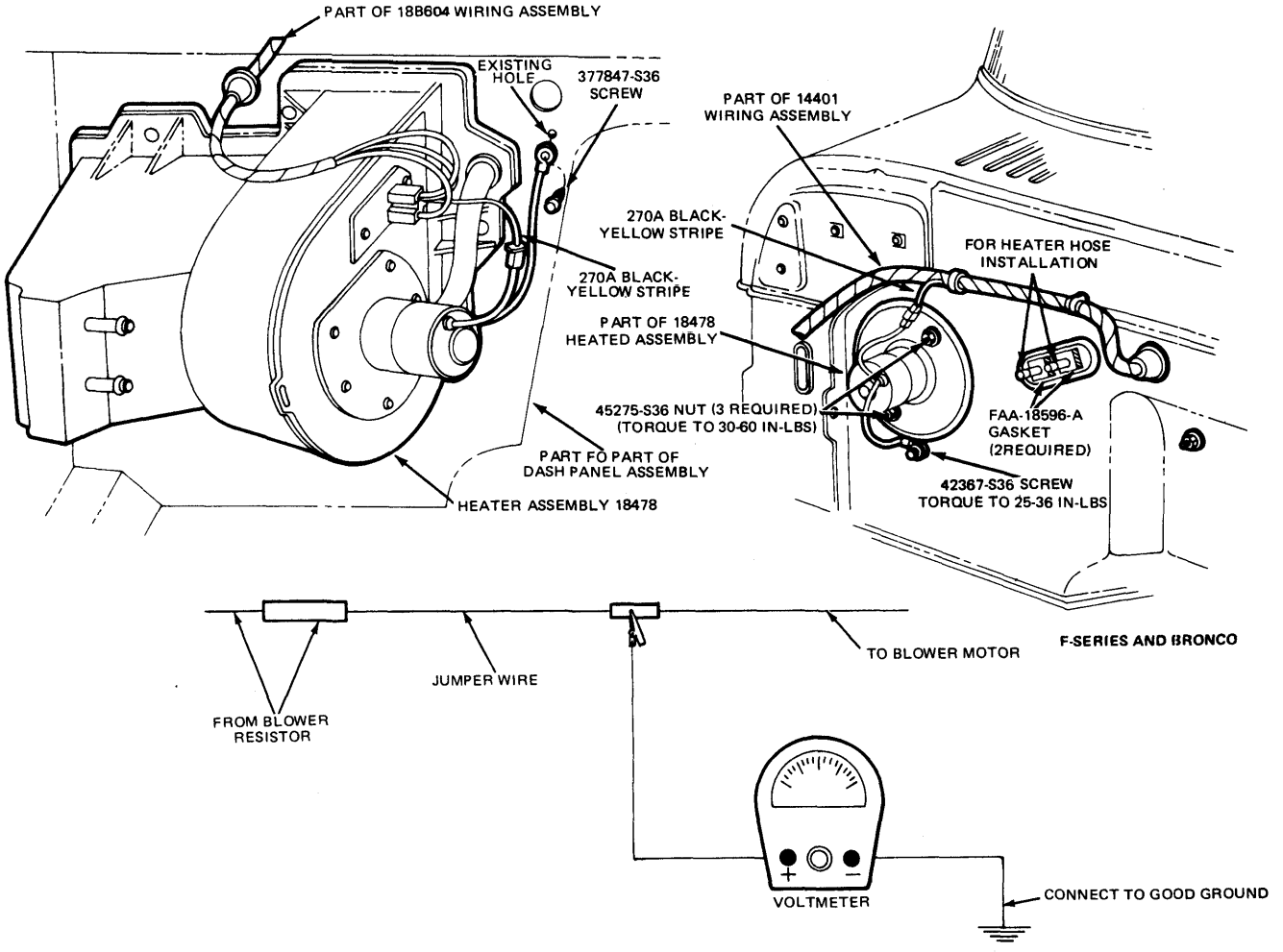


FIG. 3 Blower Motor Voltage Test—Standard and Hi-Output Heater Systems

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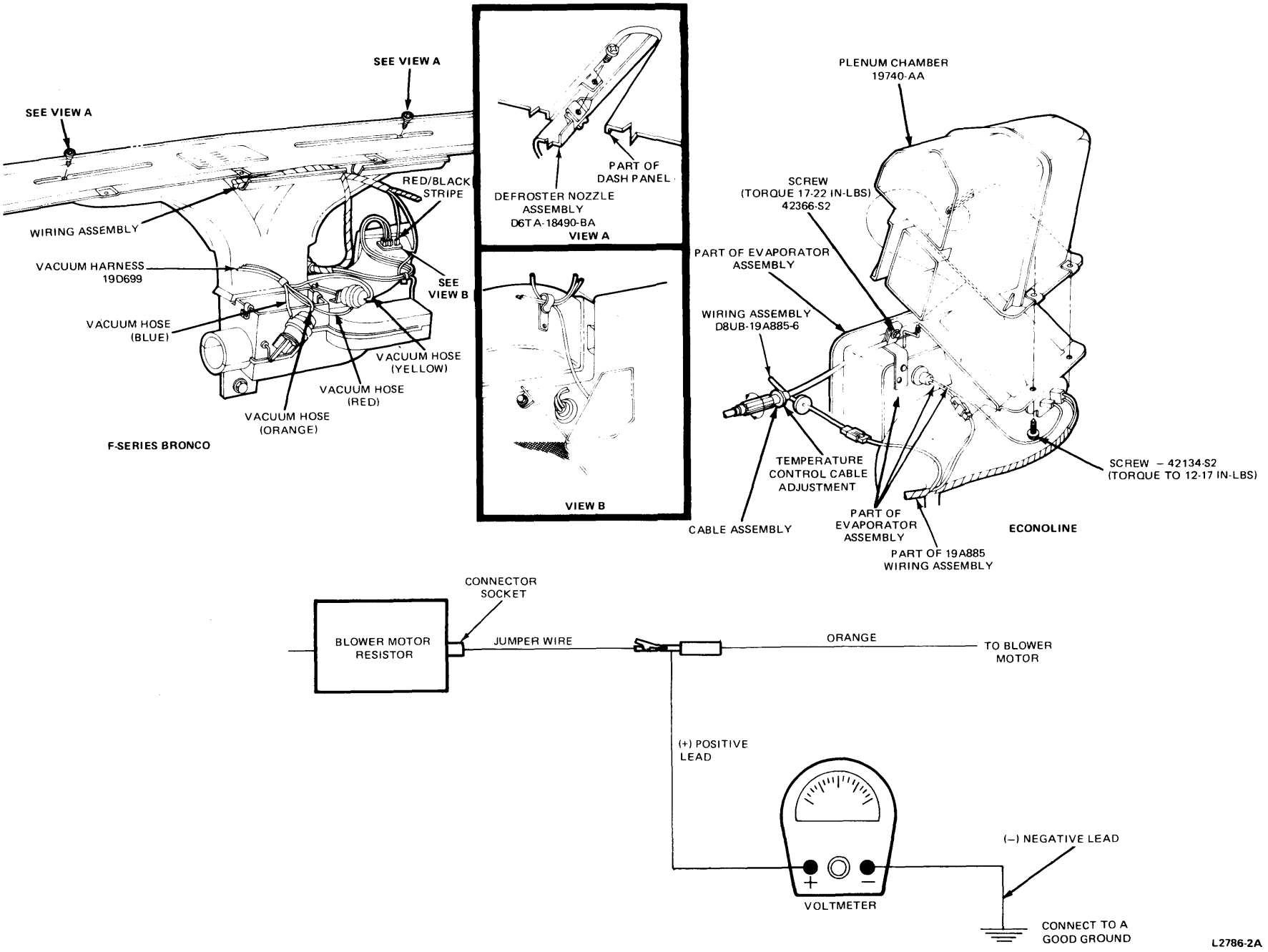


FIG. 4 Blower Motor Voltage Test—Deluxe Hi-Lo Heater System

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DIAGNOSIS GUIDES

The following heater diagnosis guides can be used to determine the system conditions for cable controlled type heater systems.

If the cause of the heater system malfunction is verified as "Insufficient, Erractic or No Heat or Defrost," refer to the applicable diagnosis guide to find the cause of the trouble.

The engine coolant level should always be checked before diagnosing a problem heater system. **It should also be determined that the thermostat is capable of maintaining the specified engine coolant temperature** .

Diagnosis guides should be used together with the appropriate wiring diagrams to accurately diagnose and correct system problems.

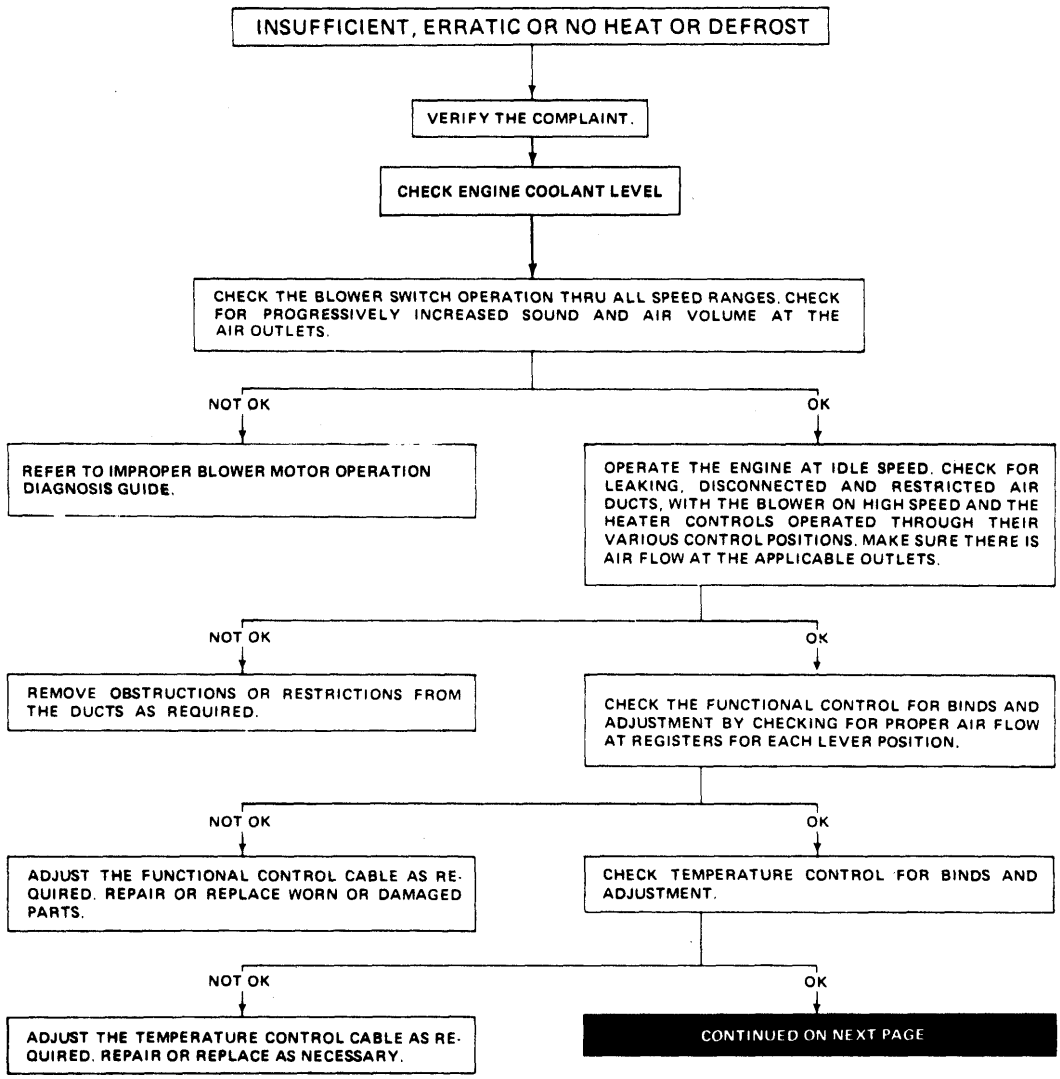
A check of the heater blower electrical circuit can be performed using the "Improper Blower Motor Operation" diagnosis guide. Use of the guides and the applicable wiring diagram(s) in the Wiring and Vacuum Diagrams Book will enable the cause of the electrical circuit problem to be quickly isolated.

On systems using a vacuum control, a hissing sound at the control assembly does not necessarily indicate a leaking vacuum selector valve. A major leak in the system, such as a faulty connection, a loose, split or disconnected vacuum hose or a leaking vacuum motor diaphragm can also cause this symptom. If a hissing sound is encountered at the control assembly, perform the "Hissing A/C-Heater Vacuum Control Assembly, Function Selector Valve or Vacuum Source Malfunctions" Diagnosis Guide.

When a repair or replacement of any component has been completed, the system should be tested again to be sure the problem has been corrected.

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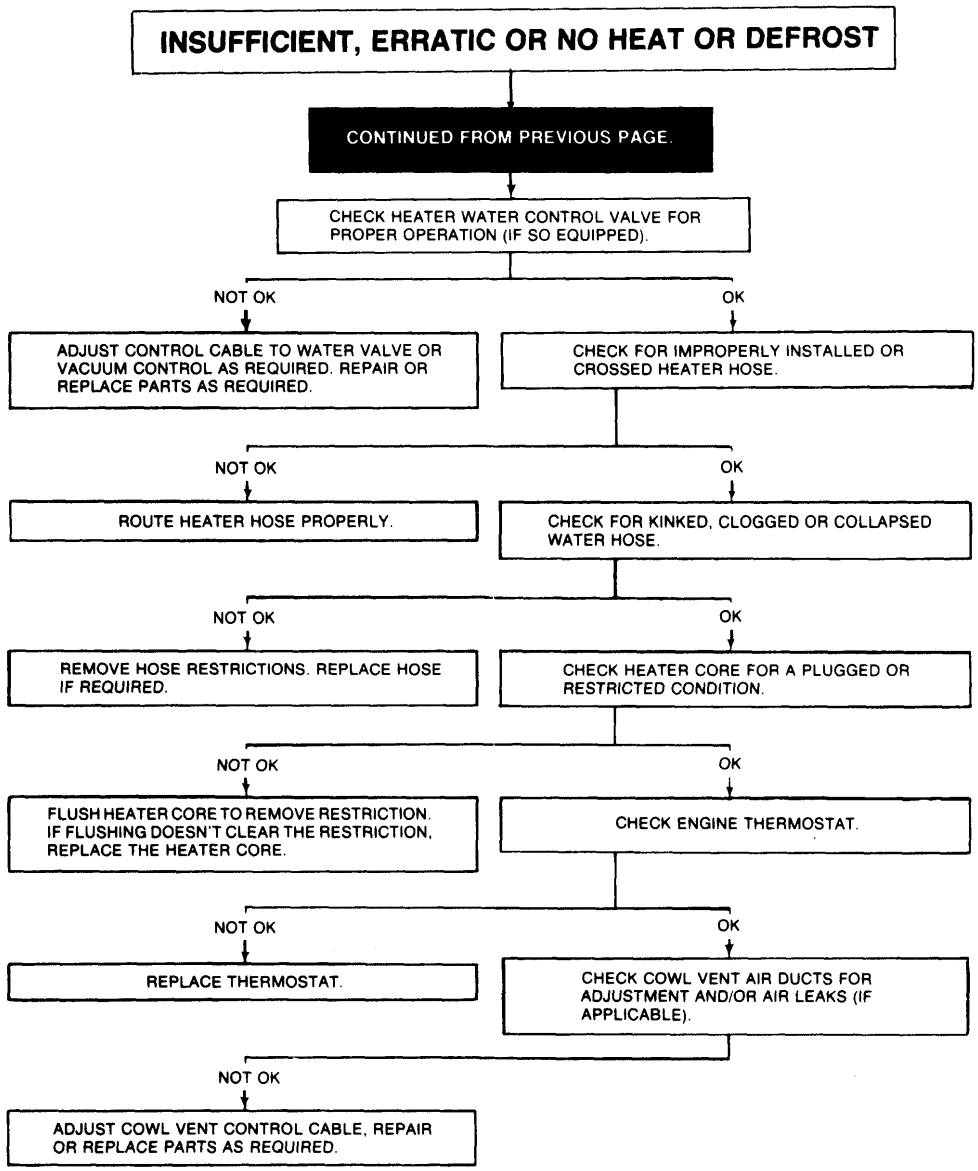
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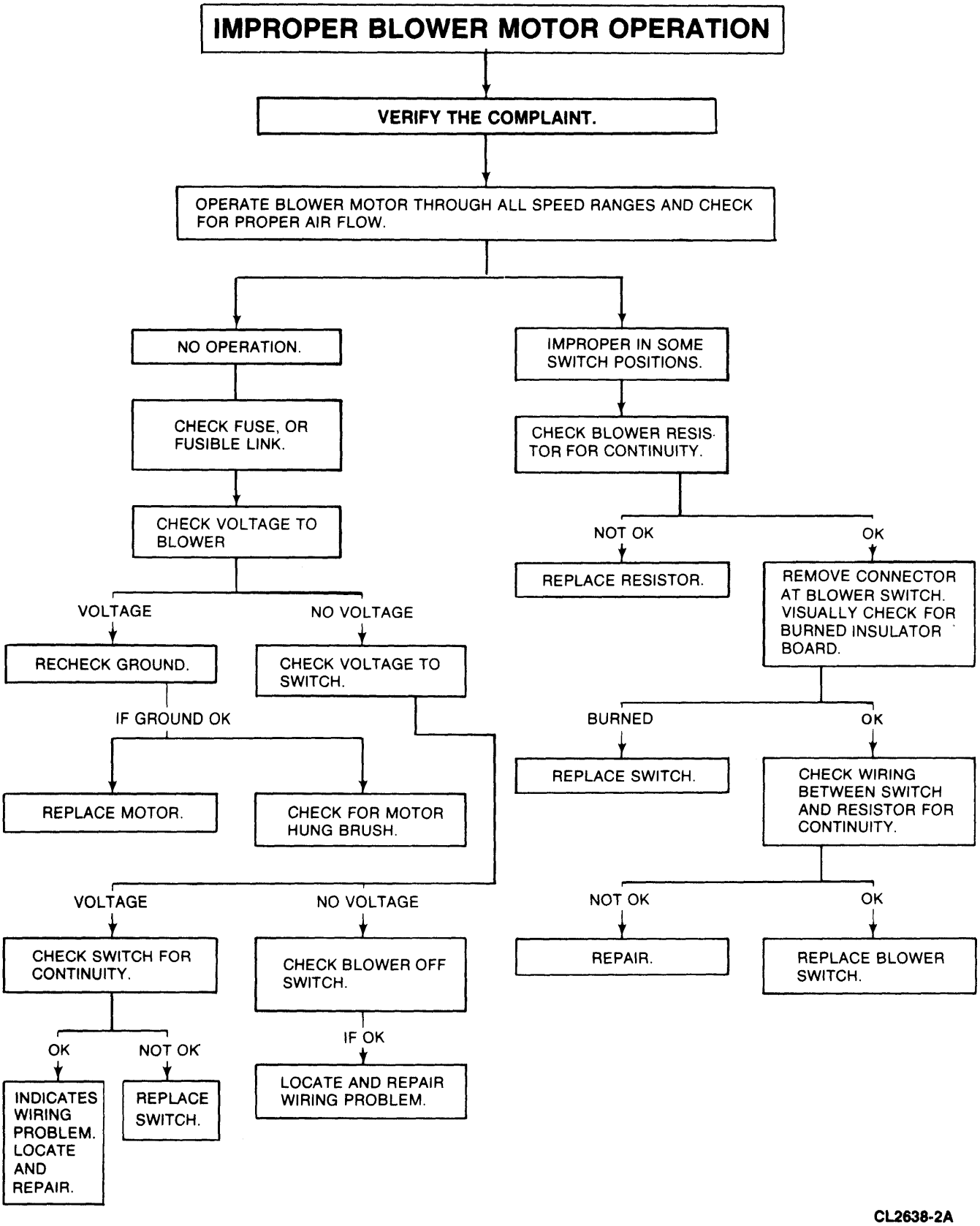
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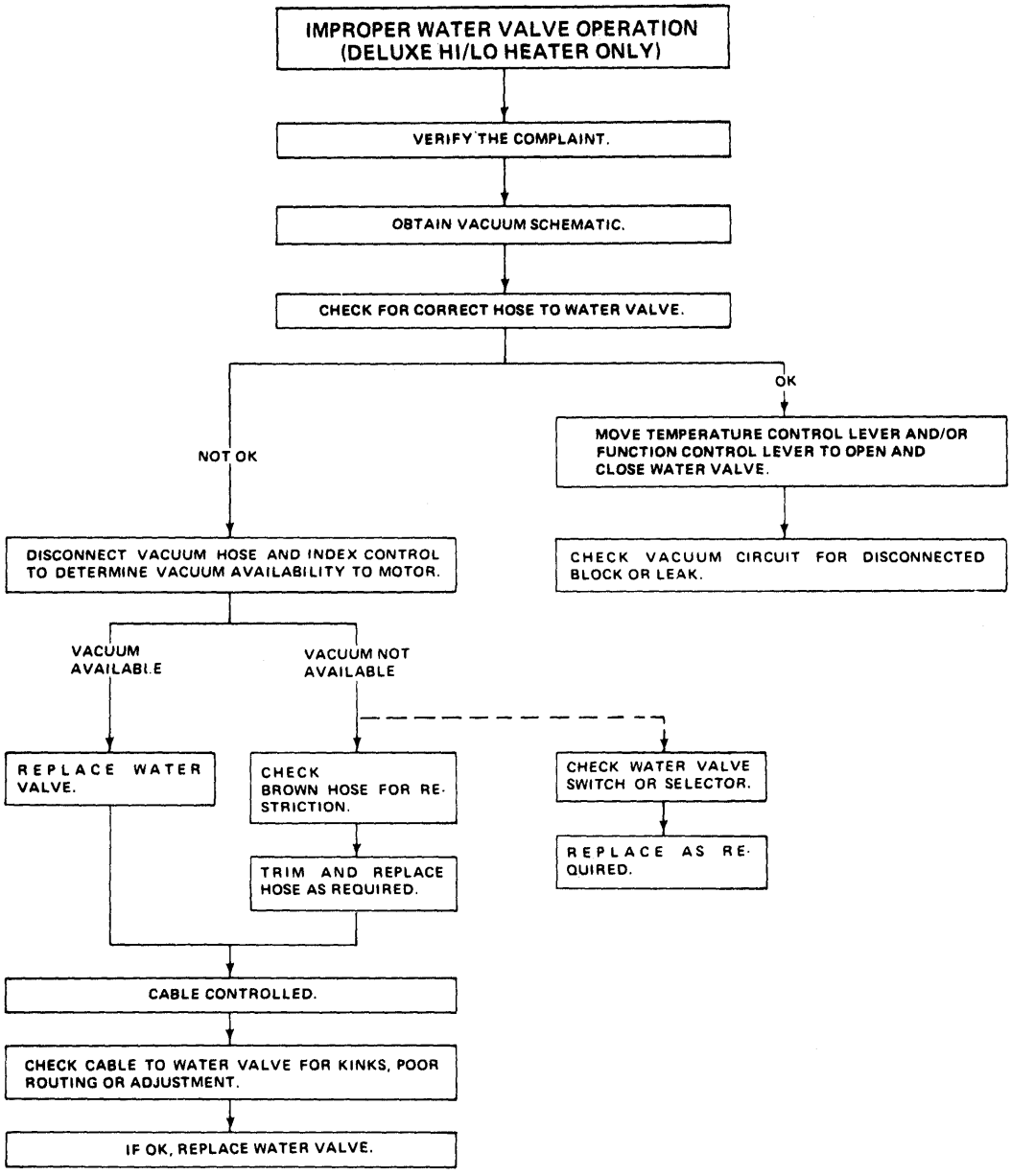
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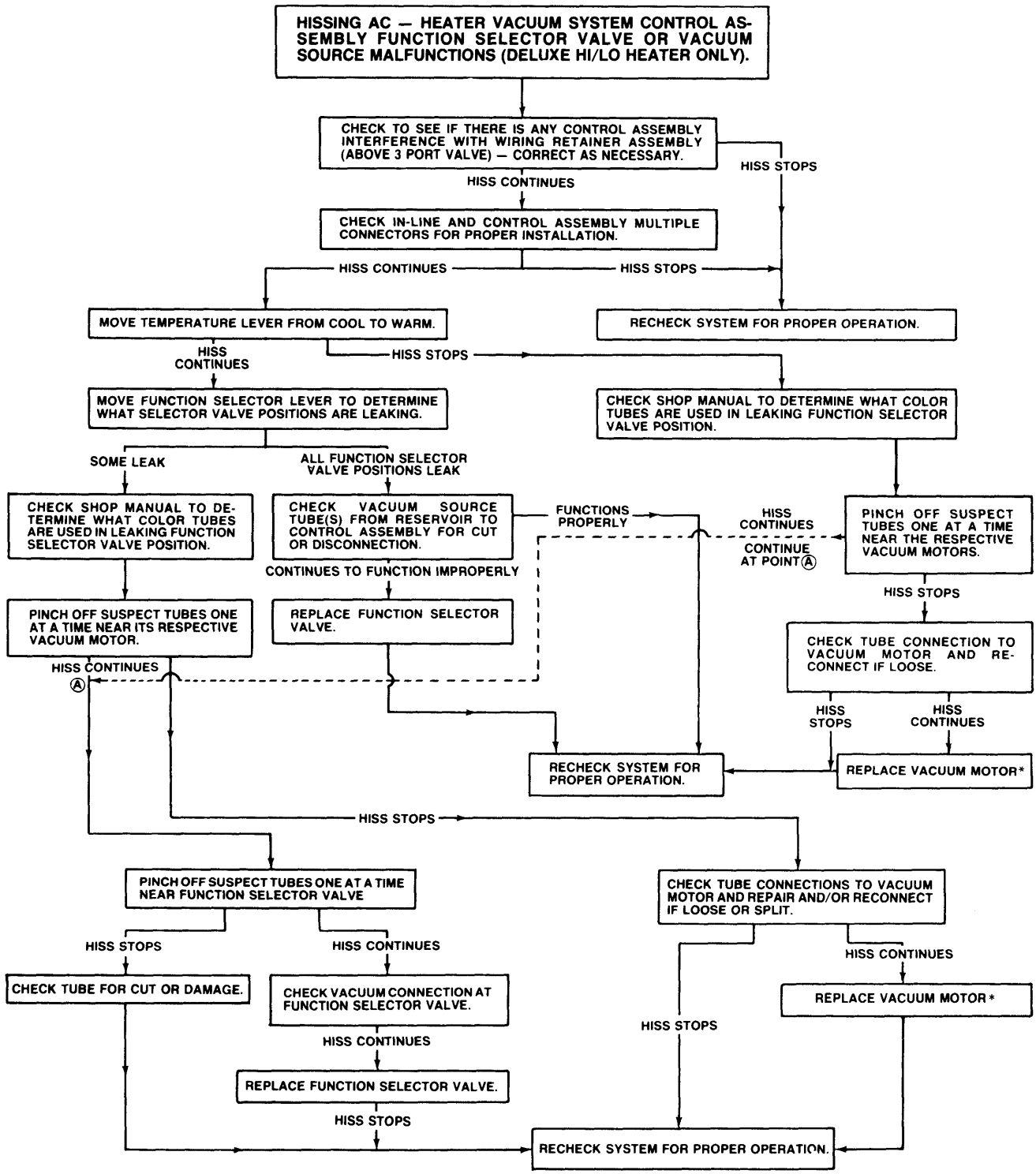
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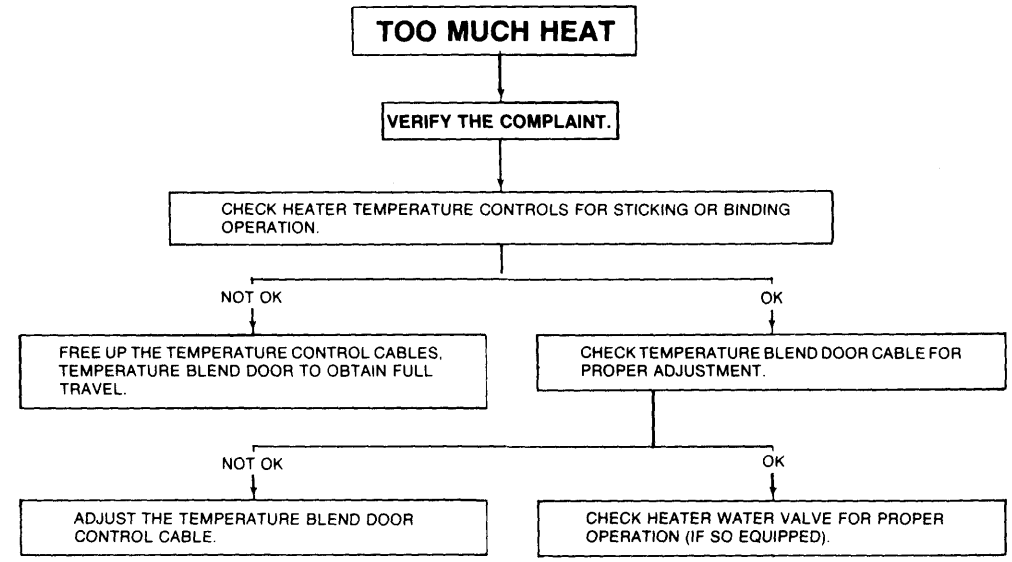


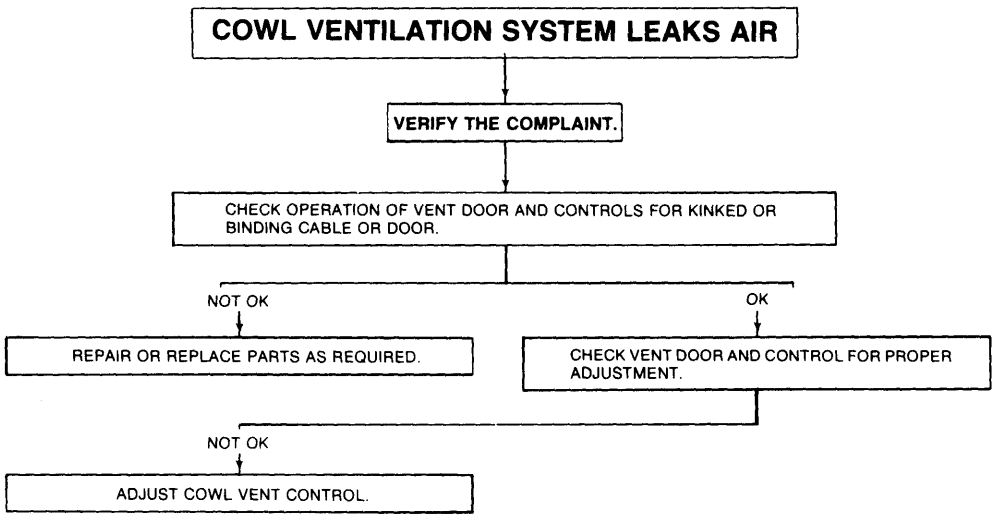
* NEVER MANUALLY OPERATE ANY VACUUM MOTOR OR VACUUM MOTOR CONTROLLED DOOR. THIS MAY CAUSE INTERNAL DAMAGE TO THE VACUUM MOTOR DIAPHRAGM.

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REMOVAL AND INSTALLATION

HEATER HOSE—ALL MODELS

To replace a heater hose, drain the coolant, remove the hose, cut a new hose to the same length as the old hose, install the hose, and replace the coolant. **Make certain that the heater hose connections to the block are installed correctly. Also that the heater hoses cannot come in contact with any part of the exhaust system, or cannot become pinched in the tilt cab mechanism.**

After the coolant has been replaced, bleed the air from the heater core.

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F-Series and Bronco Heating System

PART 36-20

APPLIES TO F-100 — F-350 AND BRONCO

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DIAGNOSIS AND TESTING	20-2
ADJUSTMENTS	
Control Cables	20-2
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REMOVAL AND INSTALLATION (Cont'd.)	
Heater Blower Motor	20-4
Heater Blower Resistor	20-4
Heater Control	20-4
Heater Core	20-4
Heater Hose Routings	20-4
SPECIFICATIONS	20-6

DESCRIPTION AND OPERATION

Fresh air heaters are available for various truck models, depending on model and engine usage. The Deluxe Hi-Lo heater system is described in Part 36-25.

FRESH AIR HEATER

The heater used in the F-100 through F-350 and Bronco vehicles is a fresh air heater drawing air from the cowl top area. The heater is mounted to the dash panel on the right side under the instrument panel (Fig. 1). The outside air source for the heater is the right outside air vent which is attached to the heater and the cowl side panel.

An air door within the heater controls the flow of air through the heater. This air door is controlled by the function (lower) control lever (Fig. 2). When the function lever is in the OFF position, all air through the heater is shut off (ram air included). Air is directed to the floor area when the function control lever is in the HEAT position, and to the windshield when the lever is in the DEFROST position. Air is directed to both the floor and windshield when the function lever is positioned between HEAT and DEFROST.

The temperature of the discharged air is controlled by the temperature (upper) control lever. Maximum cool air (fresh outside air) can be obtained by moving the temperature lever to the far left, and maximum heat when the temperature lever is at the far right. The temperature of the air can be varied by moving the lever to any position desired between COOL and WARM.

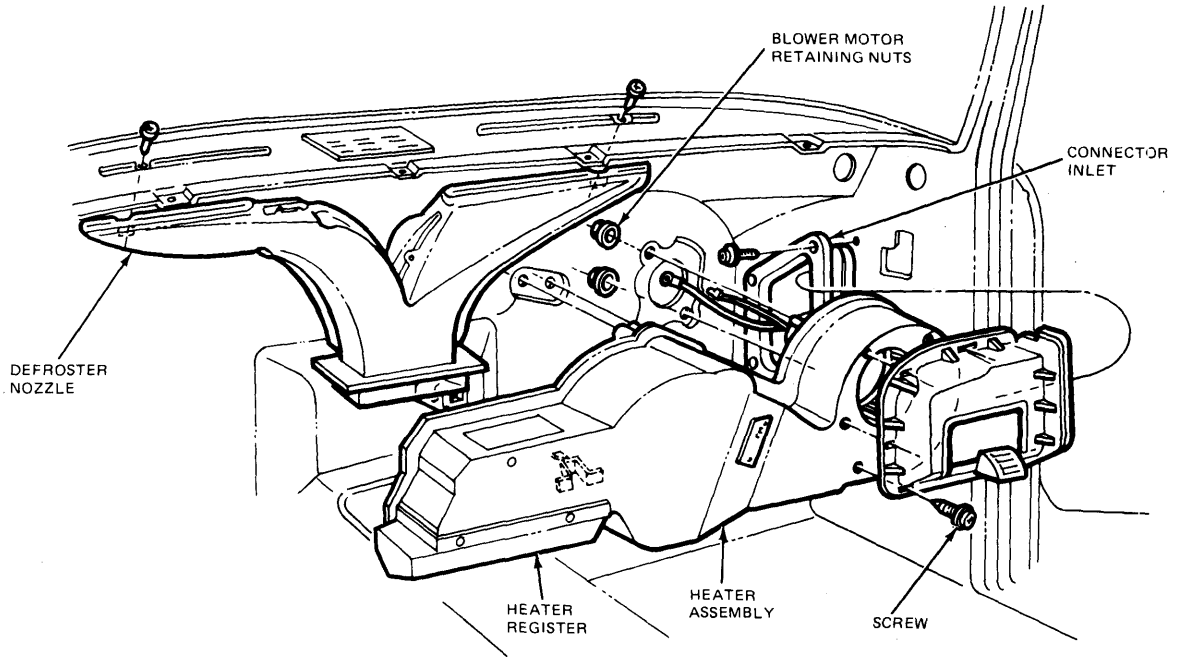


FIG. 1 Fresh Air Heater—F-100 Through F-350 and Bronco

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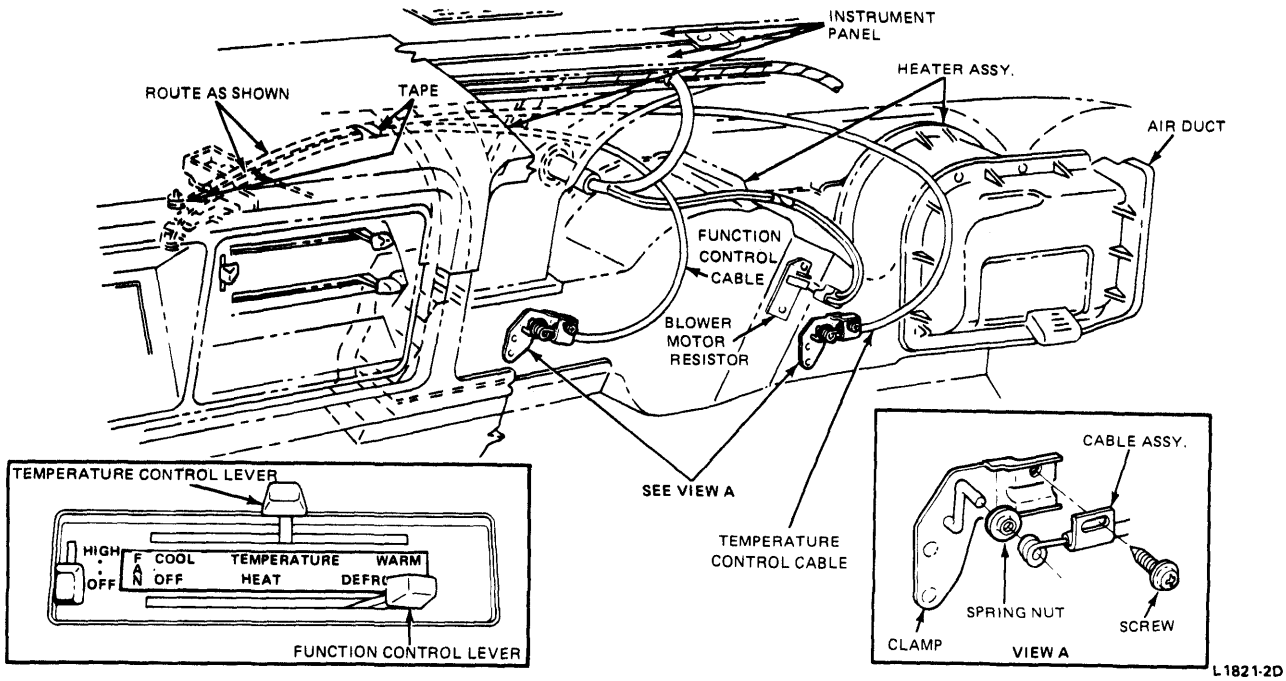


FIG. 2 Heater Control Cable Adjustment—F-100 Through F-350 and Bronco

The blower switch has four positions; OFF, two intermediate positions, and HIGH. Ram air can be obtained when the vehicle is in forward motion and the function lever is in any position other than OFF.

DIAGNOSIS AND TESTING

Refer to Part 36-10, Heating General Service, for heater diagnosis and testing procedures.

ADJUSTMENTS

CONTROL CABLES

FUNCTION CONTROL CABLE

To adjust the function control cable, loosen the cable clamp screw at the plenum. Place the function (lower) control lever in the DEFROST position. Then, push the air door crank to the extreme right position (Fig. 2), and tighten the cable clamp attaching screw.

TEMPERATURE CONTROL CABLE

To adjust the temperature control cable, loosen the cable clamp at the heater housing. Place the temperature (upper) control lever in the WARM position. Then, push the temperature door crank to the extreme right position (Fig. 2), and tighten the cable clamp attaching screw.

REMOVAL AND INSTALLATION

HEATER ASSEMBLY

Removal of the heater assembly is necessary for blower motor and/or heating core replacement.

Removal

1. Disconnect the temperature and function control Bowden cables from the heater housing. **This must be done to prevent damage to the cables.**
2. Disconnect the wires from the blower resistor (Fig. 2).
3. Remove five screws attaching the air inlet (vent) duct to the heater housing (Fig. 3).
4. Disconnect the blower wires (Fig. 4).
5. Drain the radiator and remove the heater hoses from the heater core.
6. Remove three heater stud retaining nuts and remove heater (Fig. 4).

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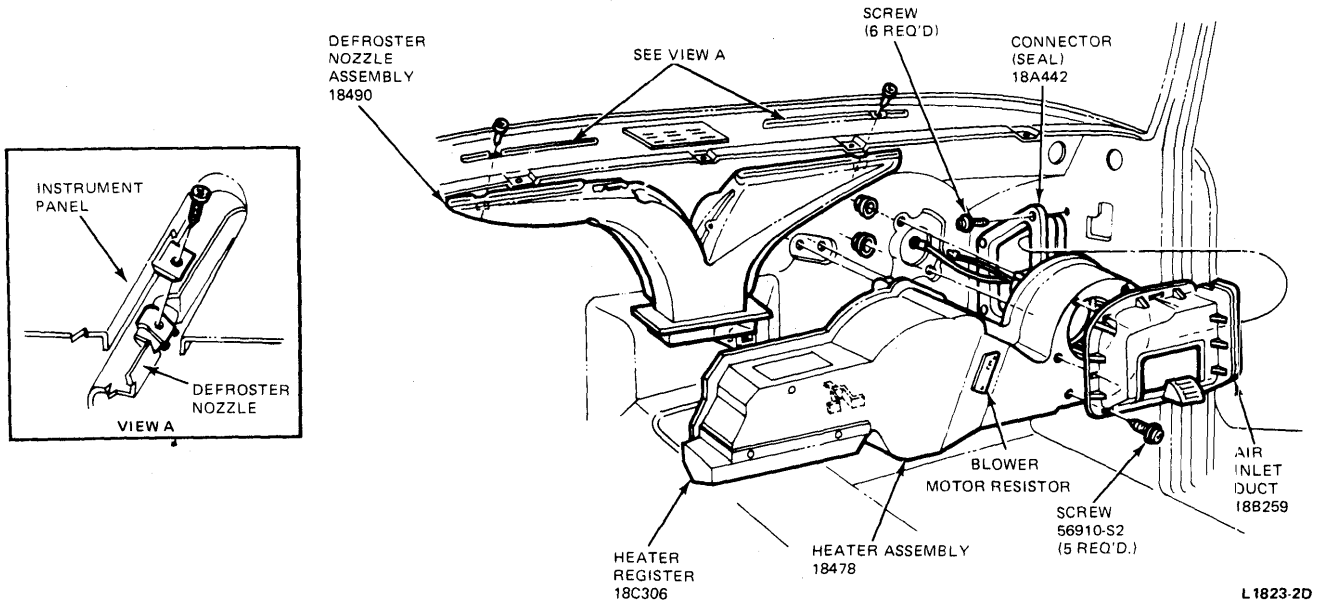


FIG. 3 Heater Installation—F-100 Through F-350 and Bronco

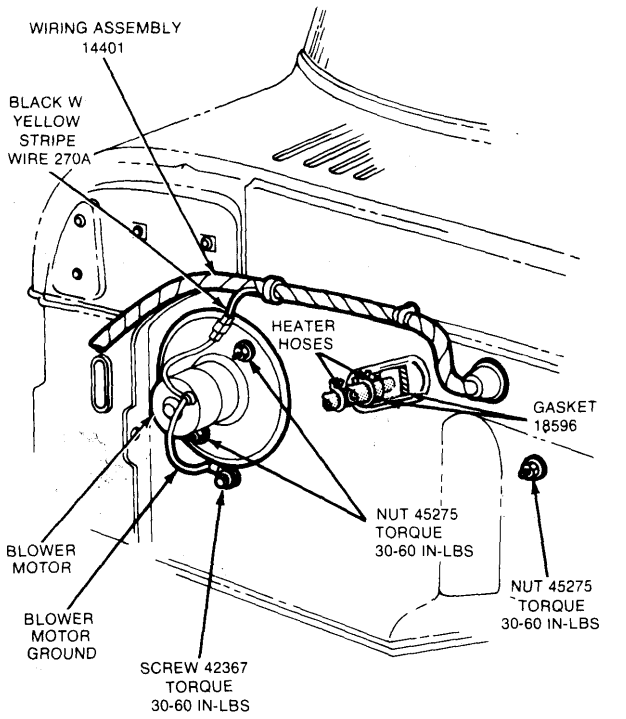


FIG. 4 Heater Attaching Stud Locations—F-100 Through F-350 and Bronco

7. Remove gasket between the heater hose ends and the dash panel at core tubes.

Installation

1. Position heater assembly in vehicle and install three stud retaining nuts.

   Connect heater hoses to heater core and fill radiator.

3. Connect blower motor wires.
4. Place defroster nozzle on heater so that the defroster and heater openings are in the up position and there is no air leak around the seal (Fig. 5).

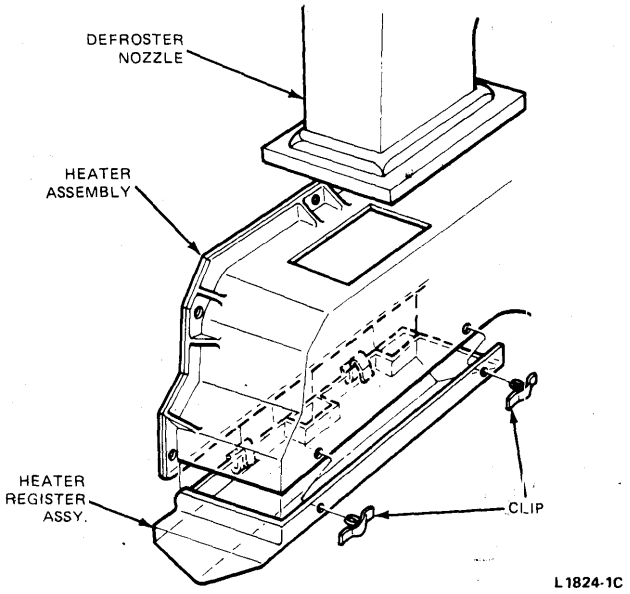


FIG. 5 Defroster Duct Attachment at Plenum—F-100—F-350 and Bronco

5. Install air inlet (vent) duct to heater. Push duct firmly against seal on side cowl and tighten five attaching screws.
6. Connect wires to blower motor resistor.
7. Connect temperature and function control cables to heater, and adjust the cables (Fig. 2).
8. Re-install gasket between the heater hose ends and the dash panel at core ends.
9. Fill Cooling System.

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10. Check heater operation.

HEATER CORE

1. Remove heater assembly.
2. Remove heater core cover and gasket (four screws).
3. Pull heater core and lower support from heater.
4. Install foam gaskets on heater core and install in heater assembly.
5. Install the core seal and cover plate.
6. Install heater in vehicle.

HEATER CONTROL

Removal

1. Disconnect the battery ground cable.
2. Pull the knob and disc off each radio control shaft.
3. Remove the knob and shaft from the headlight switch.
4. Remove the nut and washer from each radio control shaft, and remove the radio bezel.
5. Remove the cluster bezel (Group 33). The attaching screws are located as follows: four screws along top of bezel; one screw between the lights and wiper-washer switch, and two screws below the radio. Then, disconnect the illumination light from the bezel between the lights and wiper-washer switch.
6. Remove four heater control attaching screws and pull the control away from the mounting bracket. Disconnect the blower switch and illumination light wires and the two Bowden cables from the control assembly (Fig. 6).

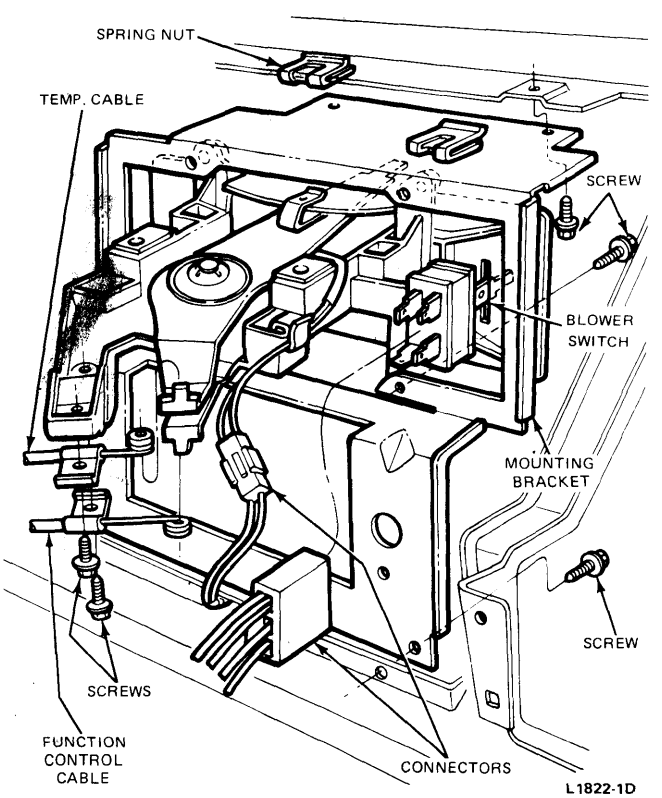


FIG. 6 Heater Control Assembly—Rear View—F-100 Through F-350 and Bronco

Installation

1. Install the Bowden cables on the control assembly as shown in Fig. 6. **The pigtail of the cable must point away from the control lever as shown.**
2. Connect the illumination light wires at the connector and the blower wire connector to the blower switch.
3. Position control assembly to mounting plate and install four screws.
4. Install the cluster bezel, radio bezel and all knobs.
5. Connect the ground cable to the battery and check operation of control assembly. Adjust the Bowden cables if necessary.

HEATER BLOWER MOTOR

1. Remove the heater assembly.
2. Remove two screws and two nuts attaching blower to heater (Fig. 1).
3. Remove blower fan from motor shaft, and remove motor from mounting plate.
4. Install new motor on mounting plate and install blower fan on motor shaft.
5. Install blower and motor in heater. Then, install the heater.

HEATER BLOWER RESISTOR

The blower resistor is mounted on the heater near the temperature door cable attachment (Fig. 2). To replace the resistor, disconnect the wire connector and remove the two 2-piece snap clips retaining the resistor to the heater. Remove the center of the snap clip first. Then, remove the rest of the clip.

HEATER HOSE ROUTINGS

The heater hose routings for the F-100 through F-350 and Bronco fresh air heaters are shown in Fig. 7.

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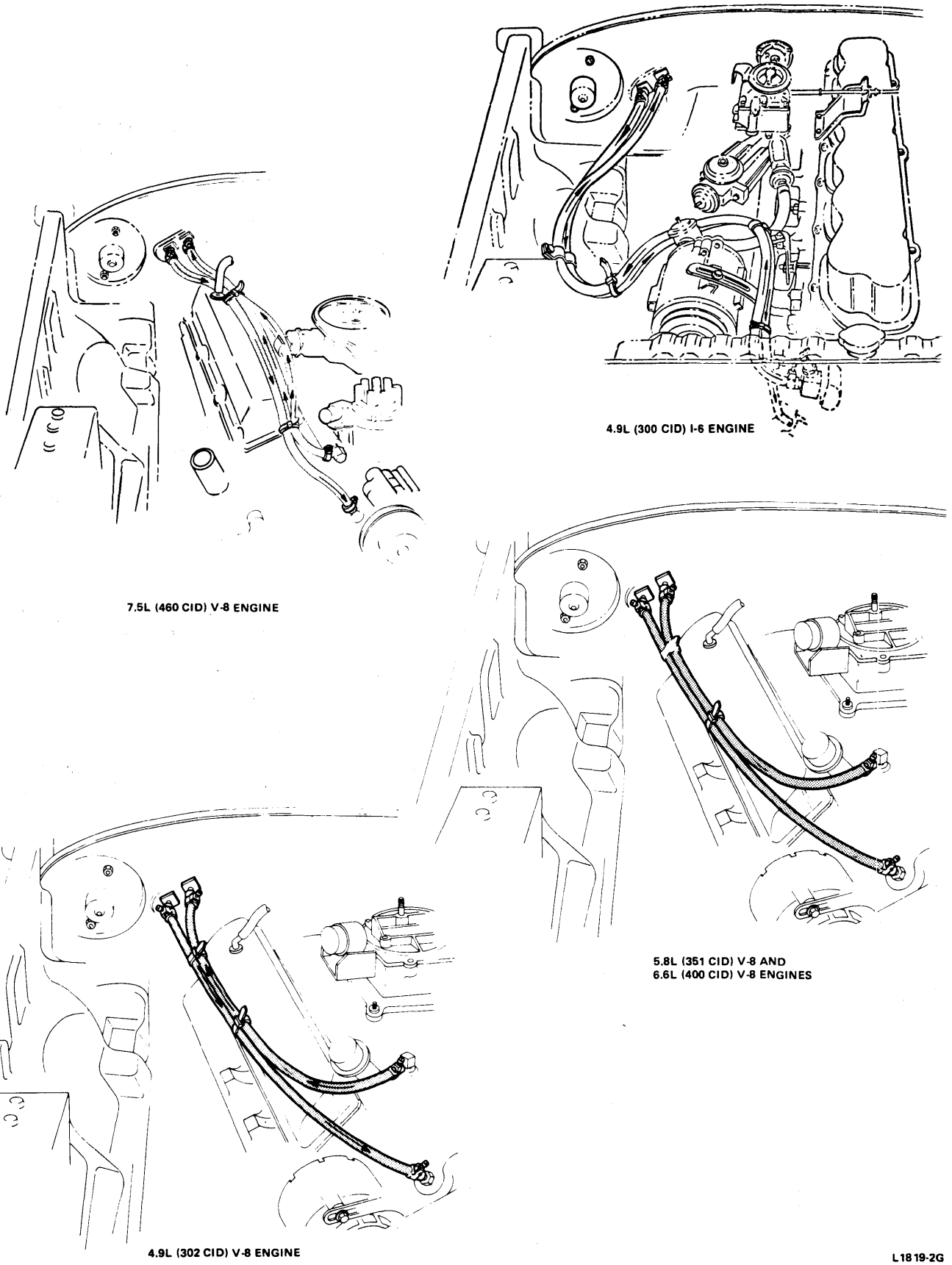


FIG. 7 Heater Hose Routings —F-100—F-350 and Bronco

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SPECIFICATIONS

Blower Motor Voltage and Current Draw @ 12.8 Volts in Max Heat Position.		
Blower Switch Position	**Voltage (Approx.)**	**Current (Approx.)**
LO	4	4
M1	6	7
M2	8	11
HI	11	17

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E-100 — E-350 Heating System

PART 36-23

APPLIES TO E-100 THROUGH E-350

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Ventilation	23-2
ADJUSTMENTS	
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Function Control Cable (Heat Defrost)	23-2
Temperature Control Cable	23-2
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Instrument Panel	23-8
Left Vent Assembly	23-6
Resistor Assembly	23-6
SPECIFICATIONS	23-10

DESCRIPTION AND OPERATION

FRESH AIR HEATER AND VENTILATION SYSTEM

The standard heater is a blend air type and receives all of its outside air from the cowl inlet. The heater control is located on the instrument panel, to the right of the steering column. It includes a blower switch with "Off" and three speed positions, two levers for adjusting discharge air temperature and discharge air direction (Off-Heat-Defrost) (Fig. 1).

The fresh air ventilation consists of a left and a right fresh air vent. Both vents receive outside air from the cowl intake and direct the air to the floor area. The right vent is part of the heater system. The left vent is not offered with air conditioning (Fig. 2). The deluxe Hi-Lo heater system for the E-100—E-350 is described in Part 36-24.

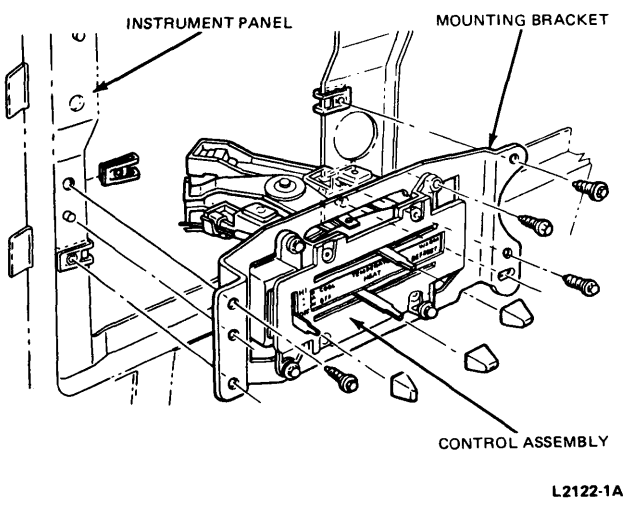


FIG. 1 E-100—E-350 Heater Control Assembly and Mounting Bracket

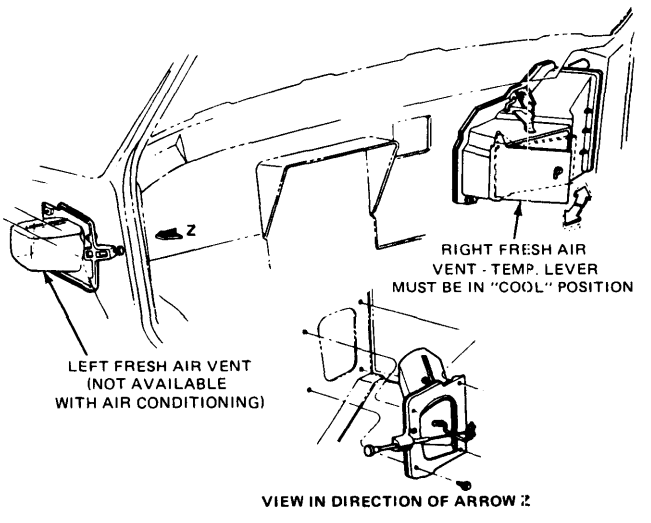


FIG. 2 Cowl Side Ventilation

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SYSTEM OPERATION

In the "Off" control position (Fig. 1), the Heat-Defrost door is closed (cable controlled) (Fig. 3).

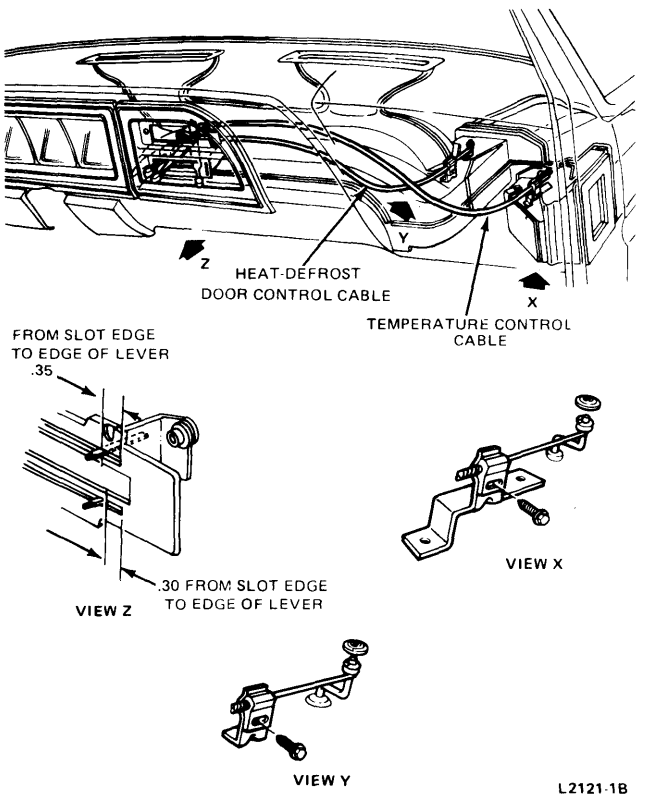


FIG. 3 Control Cable Installation and Adjustment

In the "Heat" position, the Heat-Defrost door is in a full heat position and all the air goes to the floor except a small amount of bleed air going to the defrosters.

In the "Defrost" position, the Heat-Defrost door is in a full defrost position and all the air is directed to the windshield.

Moving the function control lever between "Heat" position and "Defrost" position provides split distribution of air between the floor and defroster outlets.

When the temperature control lever is moved between the "Cool" and "Warm" positions, the temperature control cable modulates the temperature blend door in the heater assembly to provide various degrees of heated air to the floor and defrosters.

VENTILATION

The body ventilation air vents allow outside ram air to be discharged in the side floor areas. When the control knob for the left vent is pushed in, the left air vent is closed; pulled out, air is discharged to the floor (Fig. 2). To service the Left Air Vent, it is first necessary to remove the parking brake support and Left cowl side trim panel. When the door for the right air vent is shut, the right air vent is closed. When the door is opened and the temperature control lever on the main control is in the "Cool" position, air is discharged to the floor (Fig. 2).

AUXILIARY HOT WATER SYSTEM

Refer to Part 36-70 for all information pertaining to the Side Mounted Auxiliary Heater.

ADJUSTMENTS

HEATER CONTROLS

The heater control assembly includes two horizontal levers; the function control lever (lower) and the temperature control lever (upper) (Fig. 1). Three speeds are provided for the blower fan with a four position switch (3 speeds and an Off position) to the left of the control levers. The resistor assembly is located in the engine compartment on the heater assembly, above the blower motor (Fig. 6). This resistor controls low and medium blower speeds. To shut off the blower, the fan switch must be in the "Off" position (Fig. 4).

An adjustment slot is provided on each control cable at its attachment to the heater outlet to floor duct and heater air inlet duct (Fig. 3).

FUNCTION CONTROL CABLE (HEAT DEFROST)

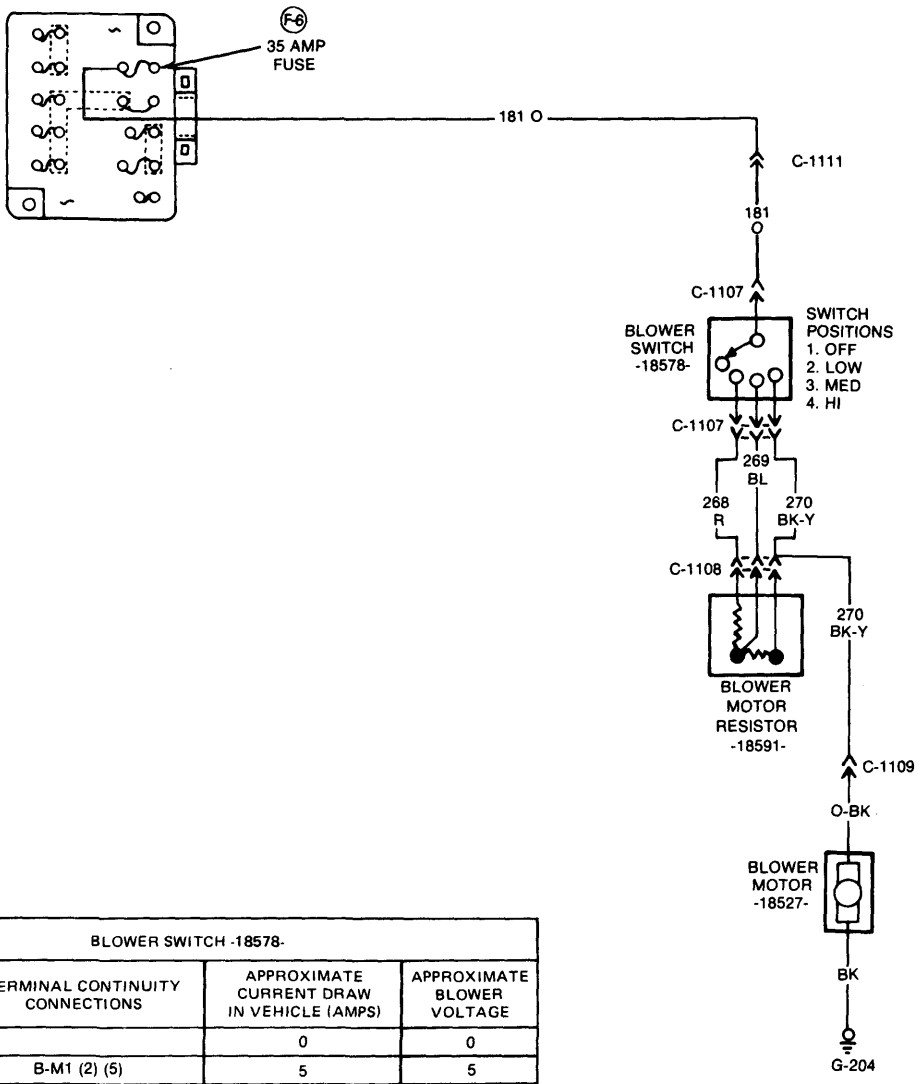
1. Rotate the heat-defrost door crank arm to the full clockwise position (Fig. 3).
2. Place the function control lever in the "DEFROST" position allowing a gap of .30 inch between the lever and the edge of the slot.
3. With door crank arm and the function control lever in these positions, secure the cable with the screw and push nut.
4. After the correct gap is obtained, it should be verified by moving the lever from "DEFROST" to "OFF" then back to "DEFROST".
5. Re-adjust cable to obtain correct gap if necessary.

TEMPERATURE CONTROL CABLE

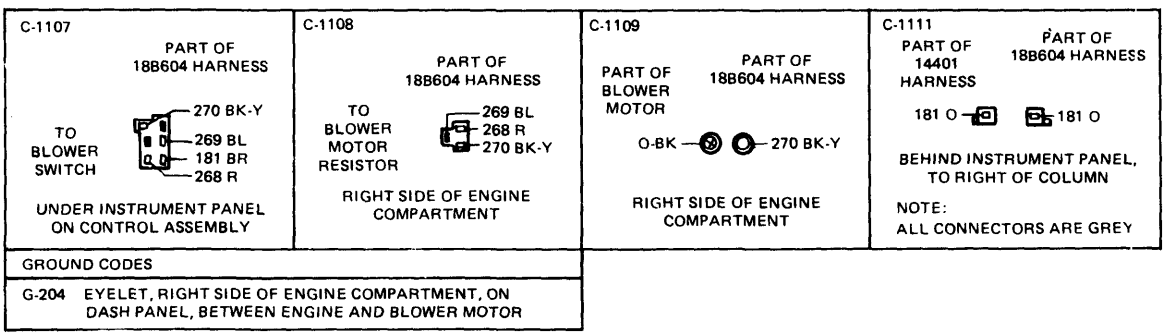
1. Rotate the temperature door crank arm to the full clockwise position (Fig. 3).
2. Place the temperature control lever in the "WARM" position allowing a gap of .35 inch between the lever and the edge of the slot.
3. With the door crank arm and the temperature lever in these positions secure the cable with the screw and push nut.
4. After the correct gap is obtained, it should be verified by moving the lever from "WARM" to "COOL" then back to "WARM".
5. Re-adjust cable to obtain correct gap if necessary.

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BLOWER SWITCH -18578-			
BLOWER SPEED	TERMINAL CONTINUITY CONNECTIONS	APPROXIMATE CURRENT DRAW IN VEHICLE (AMPS)	APPROXIMATE BLOWER VOLTAGE
Off		0	0
Low	B-M1 (2) (5)	5	5
Med	B-M1-M2 (2) (4) (5)	7	6
High	B-H-M2 (2) (1) (4)	11	9



GROUND CODES

G-204 EYELET, RIGHT SIDE OF ENGINE COMPARTMENT, ON DASH PANEL, BETWEEN ENGINE AND BLOWER MOTOR

L2793-2A

FIG. 4 Heater Electrical Wiring Diagram and Continuity Test

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REMOVAL AND INSTALLATION

HEATER CONTROL ASSEMBLY

Removal

1. Remove blower switch and control lever knobs (Fig. 1).
2. Remove applique.
3. Remove control mounting bracket from the instrument panel (4 screws).
4. Disconnect electrical wiring connectors from blower switch and illumination bulb.
5. Remove temperature and function control cables from control assembly (2 screws and 2 push nuts).
6. Remove control assembly from the mounting bracket (4 screws).

Installation

1. Install the control assembly to the mounting bracket with four attaching screws.
2. Connect the temperature and function control cables to the control assembly (2 screws and 2 push nuts).
3. Connect the electrical wiring connectors to the blower switch and illumination bulb.
4. Install the control mounting bracket to the instrument panel (4 screws).
5. Attach the trim applique.
6. Install the blower switch and control lever knobs.
7. Adjust the control cables as described under Adjustments, also see Fig. 3.

BLOWER SWITCH

Removal

1. Remove blower switch and control lever knobs (Fig. 1).
2. Remove applique.
3. Remove control mounting bracket from the instrument panel (4 screws).
4. To remove the blower motor switch, disassemble the switch mounting bracket from the control assembly (1 screw).
5. Disconnect electrical connector from blower switch and remove switch from control assembly.

Installation

1. Position blower switch to control mounting bracket and connect electrical connector to switch.
2. Secure switch mounting bracket to control assembly, (1 screw).
3. Position control mounting bracket to instrument panel and secure with 4 screws.
4. Attach trim applique.
5. Install blower switch and control lever knobs.

HEATER CORE

Removal

1. Drain engine coolant.
2. Disconnect the battery cables.
3. Remove the battery.
4. Disconnect the resistor wiring harness (Fig. 5).

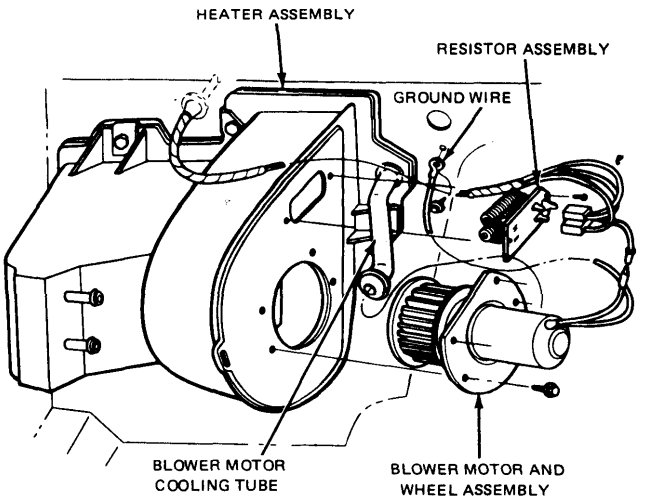


FIG. 5 Blower Motor and Wheel Assembly—Installation

5. Disconnect the blower motor lead wire (orange) at wiring harness.
6. Remove ground wire (black) mounting screw from dash panel.
7. Disconnect heater hoses from the core tubes. Remove plastic strap retaining the heater hoses to the heater assembly (Fig. 6).
8. Remove five heater mounting screws from inside of vehicle (Figs. 7 and 11).
9. Remove heater assembly.
10. Cut seal at the top and bottom edge of the heater core retainer and remove retainer (2 screws) (Fig. 7).
11. Slide core and seal assembly out of case.

Installation

1. Slide the new heater core and seal assembly into the heater core case and install the two attaching screws.
2. Install the heater assembly using the five mounting screws from inside the vehicle.
3. Connect the heater hoses to the heater core and install the plastic strap.
4. Install the ground wire (black) to the dash panel (1 screw).
5. Connect the blower motor lead wire (orange) to the wiring harness.
6. Connect the resistor wiring harness to the resistor.
7. Install the battery and connect the battery cables.
8. Refill the engine coolant to specification and check the heater operation.

BLOWER MOTOR AND WHEEL ASSEMBLY

Removal

1. Disconnect the blower motor lead wire (orange) at the wiring harness (Fig. 5).
2. Remove ground wire (black) mounting screw from dash panel.

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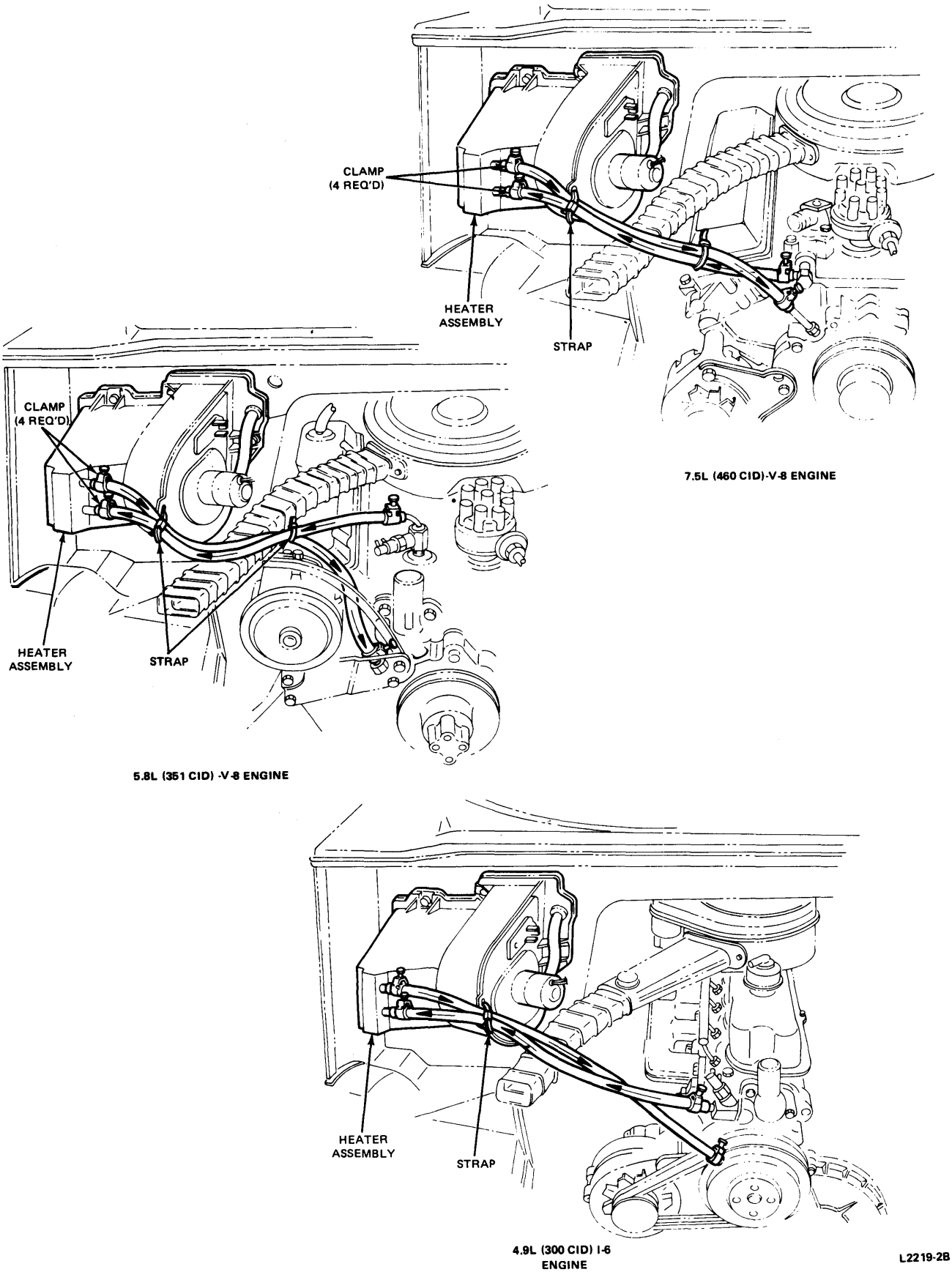


FIG. 6 Heater Hose Installation

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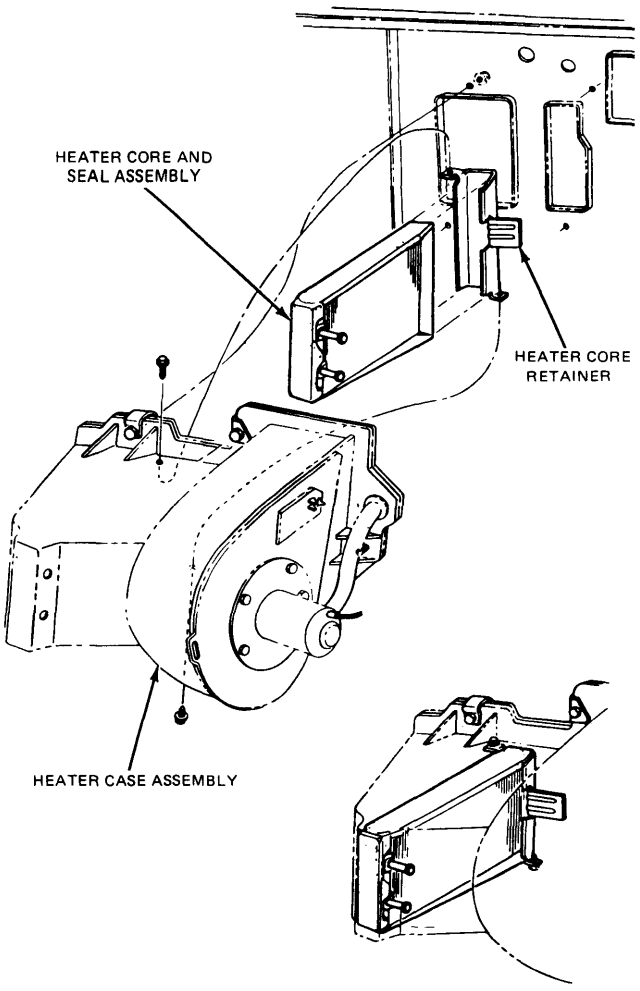


FIG. 7 Heater Core Installation

3. Disconnect blower motor cooling tube at motor.
4. Remove four blower motor mounting plate screws and carefully remove the motor and wheel assembly.

Installation

1. Position the blower motor and wheel assembly into the heater housing and install the four attaching screws.
2. Connect the blower motor cooling tube to the blower motor.
3. Install the ground wire (black) to the dash panel (1 screw).
4. Connect the blower motor lead wire (orange) to the wiring harness.
5. Check the blower motor operation.

LEFT VENT ASSEMBLY

Removal

1. Remove the parking brake by removing the two nuts (engine compartment side) holding the parking brake to the dash and then removing the attached screws to the instrument panel. Lay the parking brake on the floor.
2. Remove the left cowl side trim panel (Fig. 2).
3. Remove the five attaching screws that hold the vent to the cowl side.
4. Remove the vent assembly from the cowl side.

Installation

1. Position vent assembly to cowl side (Fig. 2).
2. Secure vent assembly to cowl side with five screws.
3. Install left cowl side trim panel.
4. Position parking brake bracket to the Instrument Panel and secure with attaching screws.
5. Secure parking brake bracket to dash with two nuts on engine compartment side.

RESISTOR ASSEMBLY

1. Disconnect the resistor wiring harness (Fig. 5).
2. Remove resistor (2 screws).
3. Clean old sealer from housing.
4. Connect the resistor wiring harness.

AIR DUCTS

To remove the heater outlet left duct (Figs. 8 and 9), it is necessary to remove the instrument panel cluster as outlined in Part 33-51.

To remove the heater outlet to floor duct, it is necessary to remove the instrument panel and control cable.

To remove the heater air inlet duct, (Fig. 10), it is necessary to remove the temperature control cable from the inlet duct (Fig. 3), loosen the defroster duct from the top cowl panel (Fig. 9), and loosen the heater assembly (Fig. 11). The heater air inlet duct has a rain baffle that extends into the cowl air intake. This prevents removing the duct in a straight rearward direction. The duct must be rotated downward to the left and then moved rearward, (Fig. 10).

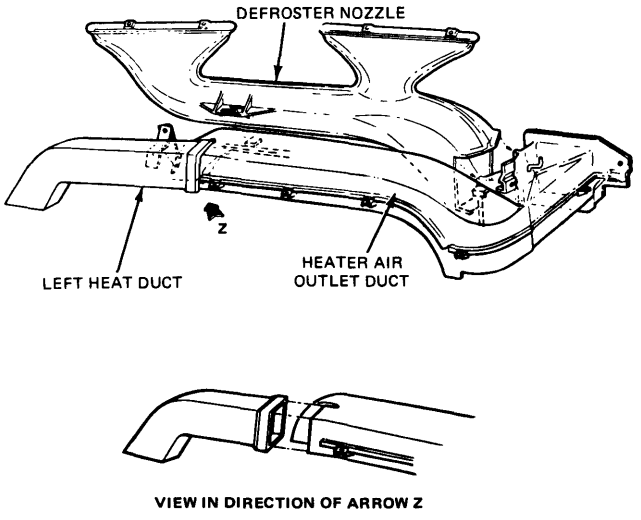


FIG. 8 Air Inlet Duct Sub-Assembly Installation

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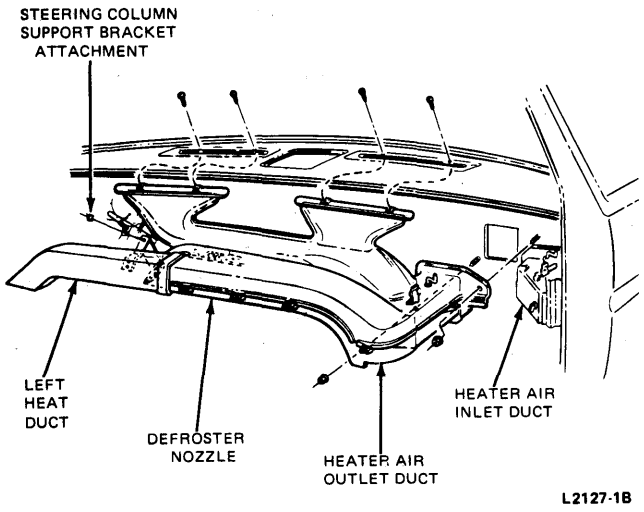


FIG. 9 Ductwork Installation

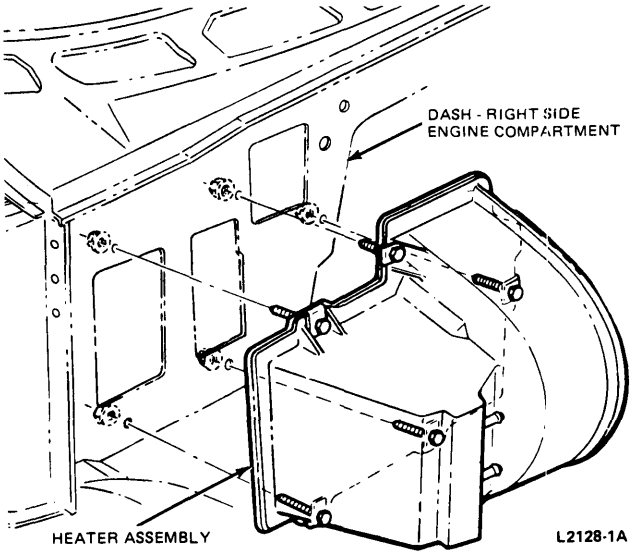


FIG. 11 Heater Assembly Installation

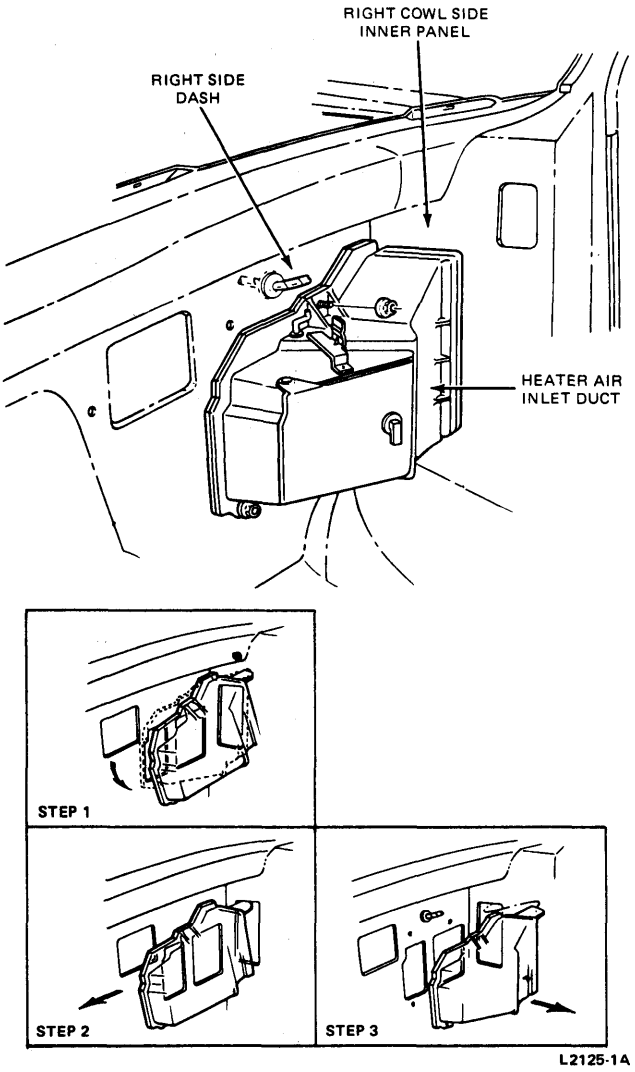


FIG. 10 Air Inlet Duct Installation

DEFROSTER NOZZLE

Removal

Refer to Figs. 8 and 9.

1. Remove the instrument panel following the procedure given in this Part.
2. Disconnect the heat-defrost door cable from the door crank arm and cable mounting bracket.
3. Disengage the wire harness locator clips from the side of the heat duct.
4. Remove one nut attaching the heat duct and floor air duct support brace to the brake pedal support.
5. Remove two screws attaching the defroster nozzle to each defroster opening.
6. Remove two nuts retaining the heat duct to the dash panel and remove the heat duct and defroster nozzle as an assembly.
7. Remove the retainer attaching the lower side of the defroster nozzle to the heat duct and disengage the defroster nozzle from the heat duct.

Installation

Refer to Figs. 8 and 9.

1. Position the defroster nozzle to the heat duct and install the retainer.
2. Position the heat duct and defroster nozzle to the vehicle.
3. Install four screws to attach the defroster nozzle at the defroster openings.
4. Install two nuts to attach the heat duct to the dash panel.
5. Install one nut to attach the support braces to the brake pedal support.
6. Route the wire harnesses along the heat duct and engage the locator clips with the heat duct.
7. Install the instrument panel following the procedure given in this Part.
8. Connect the heat-defrost cable to the heat duct and adjust the cable as outlined under adjustments.
9. Check the system for proper operation.

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INSTRUMENT PANEL

Removal and installation of several components and assemblies described below require the removal and installation of the instrument panel.

Removal

1. Remove steering wheel as described in Part 13-06.
2. Remove instruments, clusters and controls as described in Group 33.
3. Remove heater control or, if applicable heater/air conditioning control as described in Group 36.
4. Disconnect and remove cigar lighter (Part 35-40).
5. If so equipped remove radio (Part 35-02) and instrument panel mounted speaker (Part 35-31).
6. Remove eleven nuts securing pad to instrument panel (Fig. 12) and remove pad.
7. Remove steering column cover.
8. Remove instrument panel upper moulding.
9. Remove two screw and washer assemblies securing instrument panel to brake and clutch pedal support bracket assembly.
10. Remove screw and washer assembly securing the instrument panel at lower-center support bracket.
11. While supporting the instrument panel, remove two side attaching screw and washer assemblies. Carefully remove instrument panel from vehicle.

Installation

1. Carefully position instrument panel in vehicle and secure with two side attaching screw and washer assemblies tightened to 11-21 ft-lbs (Fig. 12).
2. Secure instrument panel to supports with three screw and washer assemblies tightened to 12-20 ft-lbs.
3. Install instrument panel upper moulding. Tighten screws to 10-15 in-lbs.
4. Install steering column cover. Tighten screws to 10-15 in-lbs.
5. Install instrument panel pad. Tighten nuts to 8-20 in-lbs.
6. Install all auxiliary equipment and controls removed during the removal procedure.
7. Install instruments, clusters and controls as described in Group 33.
8. Install steering wheel (Part 13-06).

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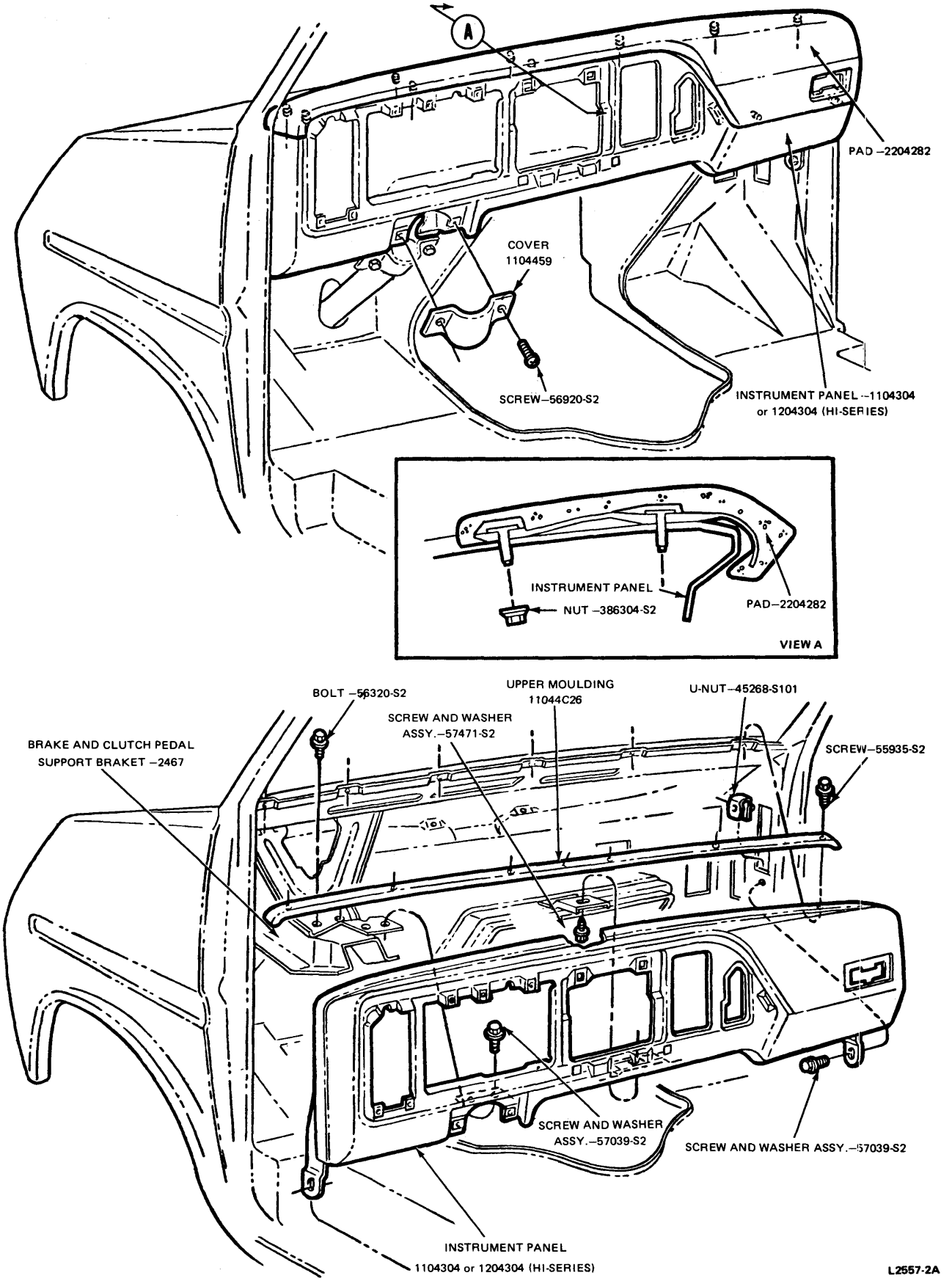


FIG. 12 Instrument Panel—Removal and Installation

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SPECIFICATIONS

HEATER

Protection Device	One 30 Amp. Fuse
Control Illumination	One 1CP 161 Bulb
Blower Motor Current Draw @ 12.8 Volts in Max. Heat Position	
High	11 Amps
Medium	7 Amps
Low	5 Amps

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Deluxe Hi-Lo Heater — E-100 — E-350

PART 36-24

APPLIES TO ALL MODELS

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Blower Speed Switch	24-3
Control Assembly	24-1
Function Selector Lever	24-3
System Operation and Control Doors	24-1
Temperature Control Lever Operation	24-1
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Heater System Check	24-8
ADJUSTMENTS	24-8
REMOVAL AND INSTALLATION	
Air Ducts	24-12
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REMOVAL AND INSTALLATION (Cont'd)	
Blower Motor and Wheel Assembly	24-15
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Instrument Panel	24-9
Outside-Recirculating Door Vacuum Motor	24-12
Plenum Chamber	24-8
Register Louver Assembly	24-12
Resistor Assembly	24-13
SPECIFICATION	24-17

DESCRIPTION AND OPERATION

SYSTEM OPERATION AND CONTROL DOORS

The heating system contains a heater core through which flows hot coolant from the engine cooling system, a water valve which controls coolant flow through the heater core tubes, a blower, and control doors to regulate air flow into the vehicle.

Outside air is drawn into the system through the air inlet duct into the heater housing (Fig. 1). Air is drawn through and/or around the heater core into the blower, air is then mixed in the plenum chamber, and discharged through defroster outlets, floor ducts, and/or instrument panel registers. The control doors determine the amount of air that goes through the heater core and the particular outlets through which the air is discharged.

CONTROL ASSEMBLY

The control assembly is located in the instrument panel to the right of the steering column. It contains a blower system OFF-ON switch combined with a vacuum control valve, a four-position blower speed control switch, a function selector lever and a temperature control lever (Figs. 2, 3 and 4). Vehicles equipped with an auxiliary heater also have an auxiliary fan switch incorporated in the control assembly (Fig. 3).

The function select lever actuates:

1. The blower system off-on switch, which is connected in series with the four-position blower speed control switch.
2. The vacuum control valve which connects vacuum to the outside-recirc. door motor and the water valve motor.
3. The vacuum motors that control the heat-defrost and the Vent heat doors.

The temperature control lever actuates the cable that controls the temperature blend door and the water valve (Fig. 1).

TEMPERATURE CONTROL LEVER OPERATION

Setting the temperature control lever at COOL position (Fig. 4) causes the temperature blend door to block off passage of the air through and direct it around the heater core into the plenum chamber (unheated). Vacuum is also applied to the water valve motor to close the valve and stop the flow of engine coolant through the heater core. Moving the lever to WARM position causes the door to direct all the air through the heater core and into the plenum chamber (heated). Vacuum application is also removed from the water valve

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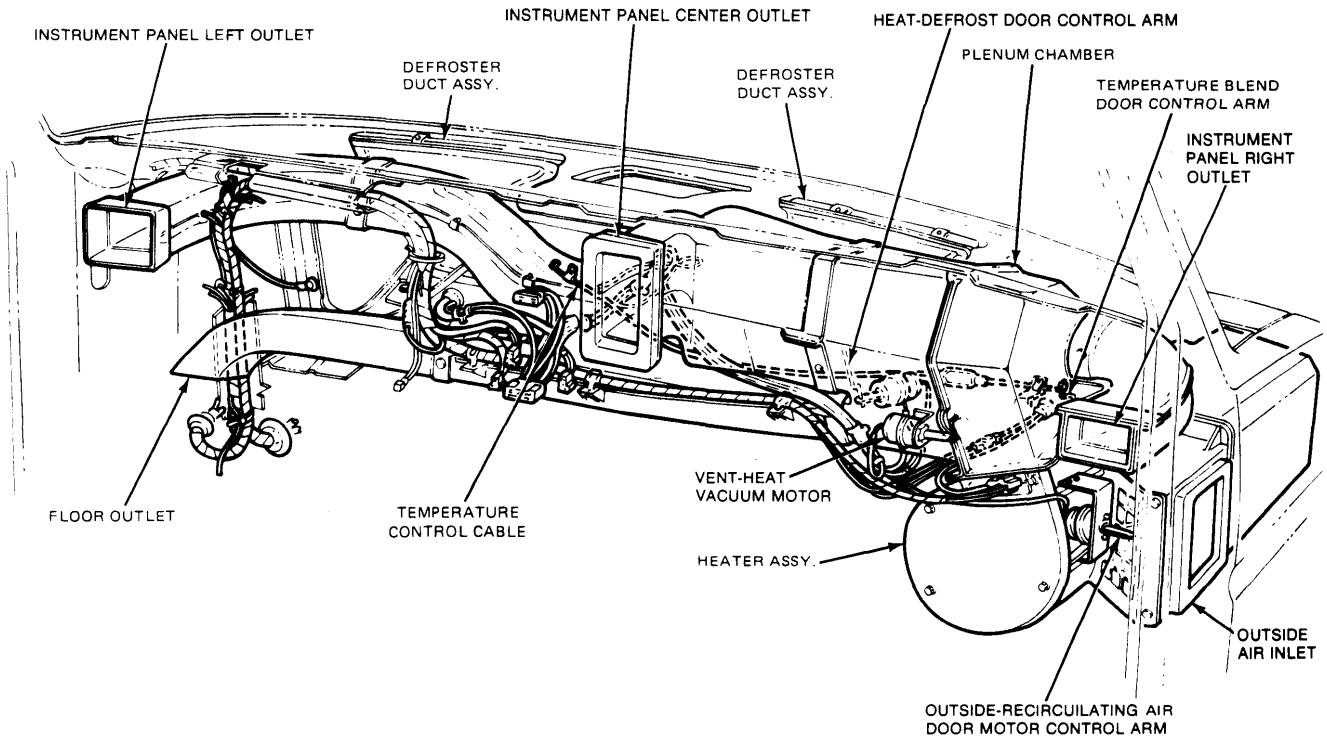


FIG. 1 Deluxe Hi-Lo Heater Installation—E-100—E-350

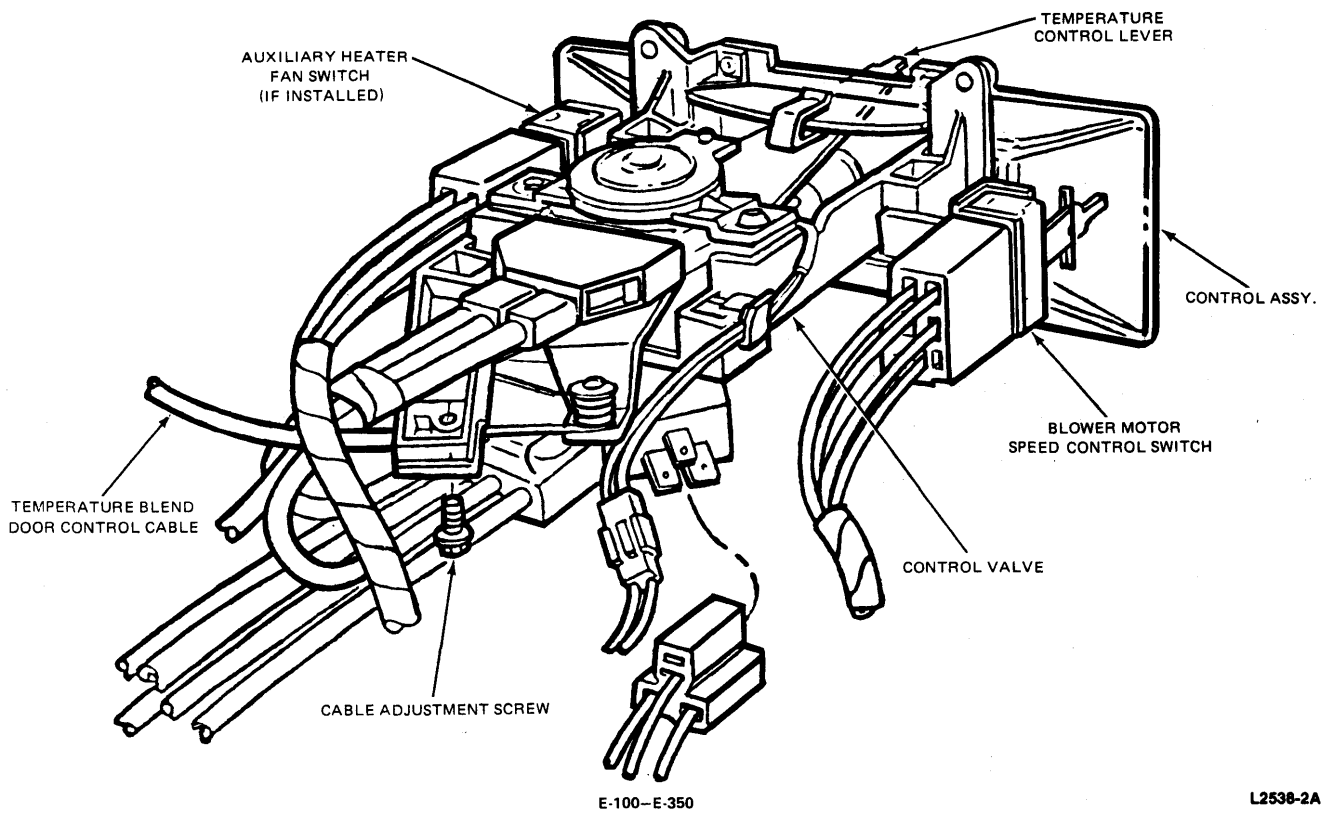


FIG. 2 Deluxe Hi-Lo Heater Control Assembly—Rear View

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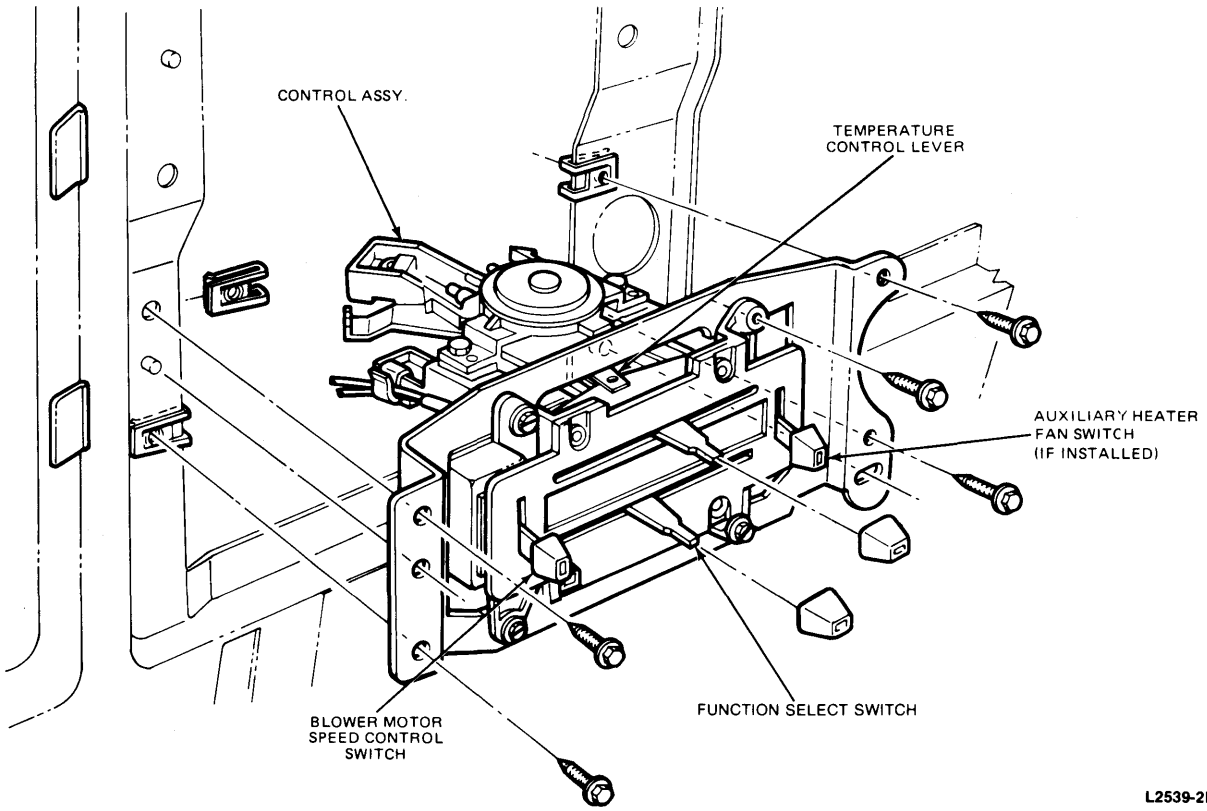


FIG. 3 Deluxe Hi-Lo Heater Controls—E-100—E-350

vacuum motor to open the water valve allowing engine coolant to flow through the heater core. At various positions between COOL and WARM, a corresponding part of the air goes through the heater core to be heated and part bypasses the core and blends with the heated air as it passes into the plenum chamber (Fig 1).

After the air enters the plenum chamber, the discharge air flow is controlled by the function selector lever.

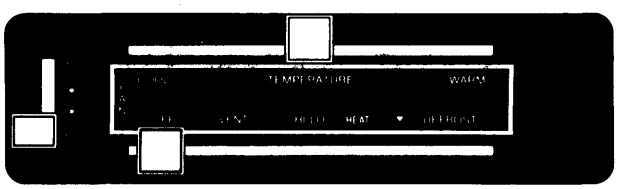


FIG. 4 Deluxe Hi-Lo Heater Control Assembly Applique

FUNCTION SELECTOR LEVER

With the function selector lever in the OFF position, the outside-recirc. door is closed to outside air, the water valve is closed and no air passes through the system. The blower motor is ON in all positions except the OFF position of the function selector lever.

In the VENT position, the outside-recirc. door is open to outside air, the water valve is closed, the heat doors are in the instrument panel outlet position and air is discharged through the instrument panel registers (Figs. 5 and 6).

In the HI-LO position, the vent-heat door is midway between the instrument panel position and floor outlet position. The air is discharged through the panel registers and floor outlet. Air flow through the heater core is controlled proportionate to the setting of the temperature control lever.

In the HEAT position, the vent-heat door restricts air flow to the panel registers and air flow is through the plenum chamber to the floor outlet with some defrost bleed.

In the ▼ (Defog) position (at index mark between HEAT and DEFROST positions) warmed air is discharged through the defrosters and floor outlets.

In the DEFROST position, air is discharged through the defrosters with some air bleed to the floor outlets.

BLOWER SPEED SWITCH

A four-position blower switch (Fig. 3) and resistor assembly provides four blower speeds to control air volume. The control valve actuates the blower ON-OFF switch on the control assembly when the function selector lever is in all positions except OFF.

AIR DISTRIBUTION SYSTEM

The air distribution system uses three doors operated by separate vacuum motors to control air flow in the heater system (Fig. 1).

One motor controls the outside recirc. air door. The door is open (outside air allowed into the system) when the function selector lever is in any position except OFF.

The other motors control the vent-heat door and heat-defrost door as described previously for the function selector lever.

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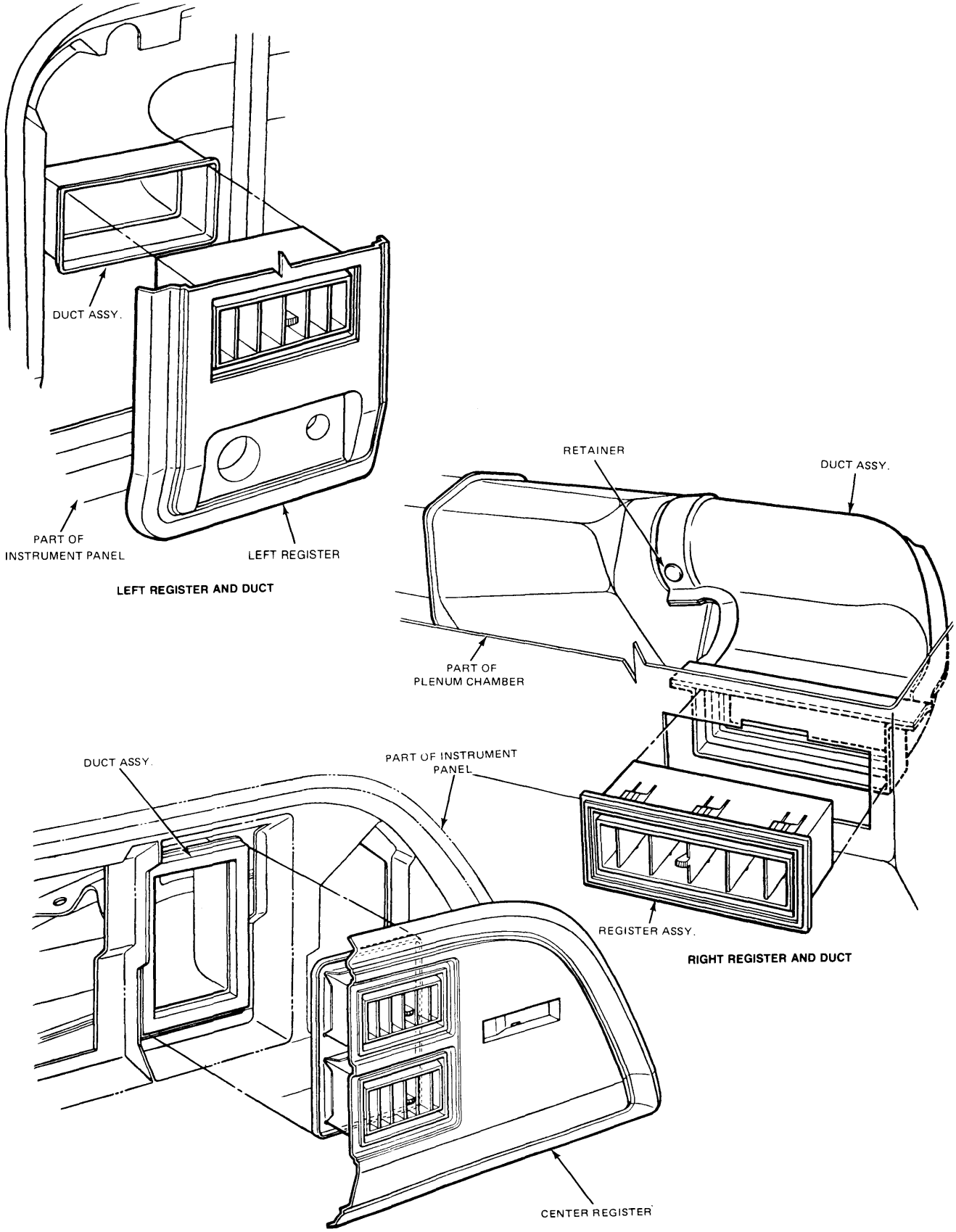
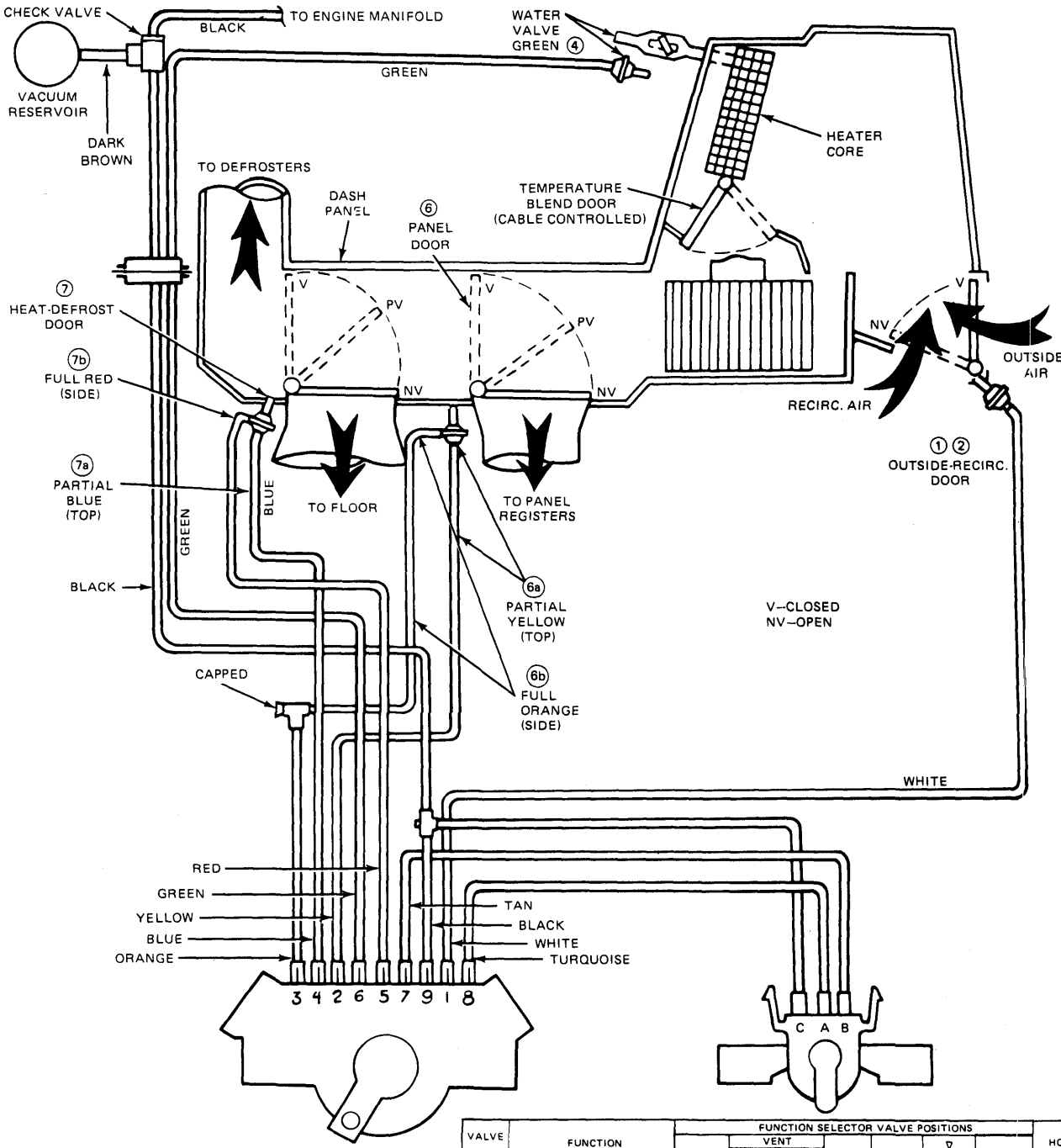


FIG. 5 Instrument Panel Registers—E-100—E-350

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VALVE PORT	FUNCTION	FUNCTION SELECTOR VALVE POSITIONS							HOSE COLOR
		OFF	VENT RIGHT DETENT	VENT LEFT DETENT	HI-LO	HEAT	▽ (DEFOG)	DEFROST	
1	Outside-Recirc.	V		To 8					White 1-2
2	Partial Vent-Heat		V	V	V				Yellow 6A
3	Full Vent-Heat		V	V					Orange 6B
4	Partial Heat Defrost		V	V	V	V	V		Blue 7A
5	Full Heat		V	V	V	V			Red 7b
6	To Engine Water Valve	V	V	To 7	To 7	To 7	To 7	To 7	Green 4
7	From Temp Valve Port B	Seal	Seal	To 6	To 6	To 6	To 6	To 6	Tan
8	From Temp Valve Port A	Seal	Seal	To 1	Seal	Seal	Seal	Seal	Turquoise
9	Source Vacuum	V	V	V	V	V	V	V	Black

PORT	FUNCTION	TEMPERATURE SELECTOR VALVE LEVER POSITIONS				HOSE COLOR
		COOL		TEMPERATURE	WARM	
C	Source Vacuum	V	V	V	V	Black
A	Outside-Recirc	V				Turquoise
B	Water Valve	V	V			Tan

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FIG. 6 Deluxe HI-LO Heater System Vacuum Schematic and Selector Test—E-100—E-350

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TESTING

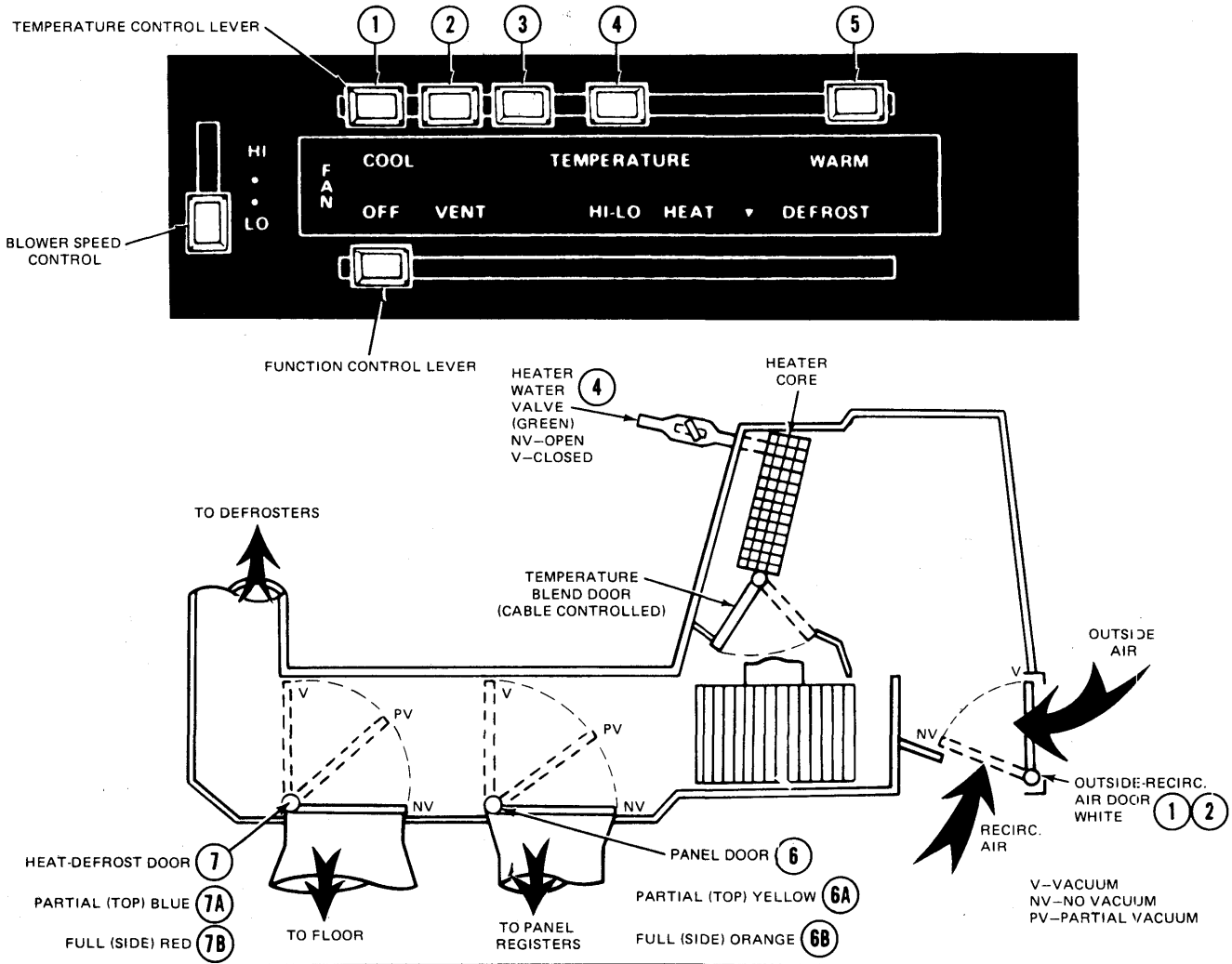
HEATER SYSTEM CHECK

Attach vacuum source to dark brown hose from engine vacuum source and perform the following operations (Figs. 6 and 7):

1. Set function selector lever in OFF position; temperature lever in COOL position, blower speed control switch in LO; and, if installed, the auxiliary fan switch in LO. Check for the following:
   - Blower(s) off.
   - Outside-recirc. air door is closed to outside air.
   - Main water valve is closed (arm pulled toward vacuum motor).
   - If installed, the auxiliary water valve is open (arm extended out from motor). (See Part 36-70).
2. Set function selector lever in either of two VENT positions; temperature control lever in COOL; blower speed control switch in LO; and, if installed, the auxiliary fan switch in OFF. Check for the following:
   - Blower is on with four speeds available (LO, Lo-medium, medium-high, and HI).
   - If installed, the auxiliary must be off, but with four speeds available. (See Part 36-70).
   - Outside-recirc. air door is open to outside air in the first VENT position and closed in the second VENT position.
   - Main water valve is closed (arm pulled in toward motor).
   - Auxiliary water valve, if installed, is closed (arm pulled in toward motor). (See Part 36-70).
   - Air is discharged through instrument panel registers.
3. Set function selector lever in HI-LO position; temperature control lever in COOL; blower speed control switch in HI; and, if installed, the auxiliary fan switch in HI. Check for the following:
   - Blower is on.
   - Outside-recirc. air door is open to outside air throughout complete travel of temperature control lever.
   - With temperature control lever in COOL, main water valve is closed (arm pulled in toward motor).
   - Move temperature control lever very slowly toward WARM. Verify that the main water valve opens and temperature blend door moves throughout full travel.
   - Air discharges through floor outlets and instrument panel registers.
4. Set function selector lever in HEAT position; temperature control lever in COOL; blower speed control switch in HI; and if installed, the auxiliary fan switch in HI. Check for the following:
   - Blower is on.
   - With temperature control lever in COOL, main water valve is closed (arm pulled in toward motor).
   - Move temperature control lever very slowly toward WARM. Verify that main water valve opens and temperature blend door moves throughout full travel while outside-recirc. recirculating air door remains open to outside air.
   - Air discharges through floor outlets.
5. Set function selector lever between HEAT and DEFROST at index mark; temperature control lever in COOL; blower speed control switch in HI; and, if installed, auxiliary fan switch in HI. Check for the same conditions as described previously with function selector lever in HEAT position except air discharge is divided between floor and defroster outlets.
6. Set function selector lever in DEFROST position; temperature control lever in COOL; blower speed control switch in HI; and, if installed, the auxiliary fan switch in HI. Check for the same conditions as described previously with function selector lever in HEAT position except air discharge is through defroster outlets.

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E-100–E-350
DELUXE HI-LO HEATER SYSTEM VACUUM MOTOR TEST CHART

FUNCTION SELECTOR LEVER POSITION	TEMPERATURE SELECTOR LEVER POSITION	VACUUM MOTORS APPLIED WITH VACUUM					
		OUTSIDE –RECIRC	WATER VALVE	PANEL		HEAT-DEFROST	
				PARTIAL	FULL	PARTIAL	FULL
OFF	Any Position	1–2	4	–	–	–	–
VENT (LEFT DETENT)	Any Position	–	4	6a	6b	7a	7b
VENT (RIGHT DETENT)	Cool - 1	1–2	4	6a	6b	7a	7b
	Cool - 2	–	4	6a	6b	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	6a	6b	7a	7b
HI - LO	Cool - 1	–	4	6a	–	7a	7b
	Cool - 2	–	4	6a	–	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	6a	–	7a	7b
HEAT	Cool - 1	–	4	–	–	7a	7b
	Cool - 2	–	4	–	–	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	7a	7b
▽ (DEFOG)	Cool - 1	–	4	–	–	7a	–
	Cool - 2	–	4	–	–	7a	–
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	7a	–
DEFROST	Cool - 1	–	4	–	–	–	–
	Cool - 2	–	4	–	–	–	–
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	–
VACUUM LINE COLOR CODE		WHITE	GREEN	YELLOW (TOP)	ORANGE (SIDE)	BLUE (TOP)	RED (SIDE)

– NO VACUUM

L2570-2B

FIG. 7 Deluxe HI-LO Heater System Air Flow Schematic and Vacuum Control Chart—E-100—E-350

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ADJUSTMENTS

The only adjustment is to the temperature control cable as described below.

1. Move the temperature control lever to maximum WARM position.
2. Rotate the cable turnbuckle the proper direction to obtain 0.35 inch between the slot edge and lever edge, (Fig. 8). The turnbuckle is located under the instrument panel to the right of the engine cover. It may be necessary to remove the right heater air duct to obtain access to the turnbuckle.
3. After proper adjustment of the cable, snap the right heater air duct back into position.

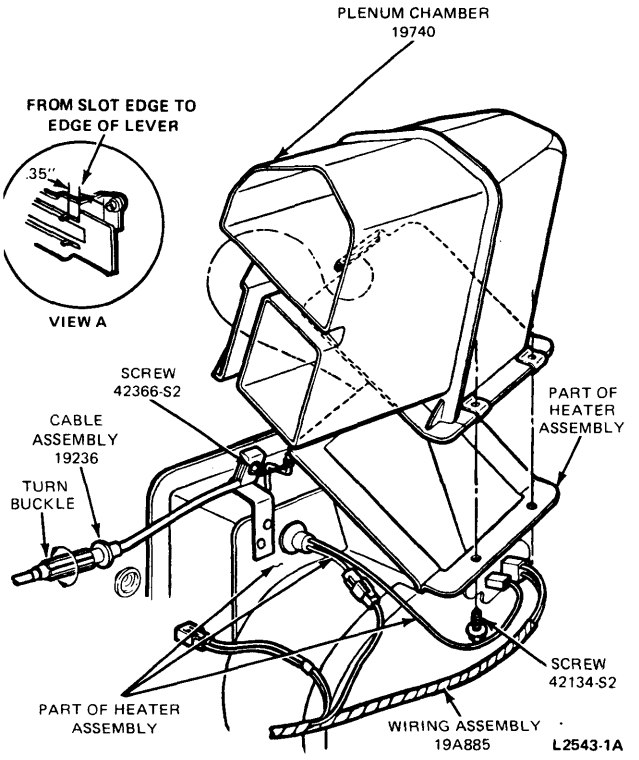


FIG. 8 Temperature Control Cable Adjustment

REMOVAL AND INSTALLATION

PLENUM CHAMBER

The plenum chamber is located under the instrument panel on top of the blower motor housing. For servicing the plenum chamber, vacuum harness, and plenum doors, it is necessary to remove the instrument panel as described in this Part. It is not required to remove the instrument panel to service the vacuum motors attached to the plenum (Figs. 1 and 9).

Removal

1. Remove the instrument panel following the procedure for Instrument Panel Removal in this Part.
2. Remove two screws attaching the plenum to the heater case.
3. Disconnect the vacuum hoses from the heat-defrost vacuum motor and the panel-heat vacuum motor.
4. Remove one (1) retainer attaching the right register duct to the plenum and remove the right register duct (Fig. 11).
5. Remove one retainer attaching the center register duct to the plenum and one retainer attaching the floor air duct to the plenum.
6. Separate the plenum from the evaporator case, center register duct, and the floor air duct and remove the plenum.
7. Remove the heat-defrost and panel-heat door vacuum motors from the plenum.

Installation

1. Install the heat-defrost and panel-heat door vacuum motors on the plenum (Fig. 9).
2. Position the plenum to the center register duct, floor air duct and the heater case.
3. Install two (2) screws to attach the plenum to the heater case.
4. Install one retainer to attach the center register duct and one retainer to attach the floor air duct to the plenum (Fig. 11).

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5. Position the right register duct to the plenum and install the retainer (Fig. 11).
6. Connect the yellow vacuum hose to the top (end) of the panel-heat door vacuum motor and the orange vacuum hose to the side of the panel-heat door vacuum motor.
7. Connect the blue vacuum hose to the top (end) of the heat-defrost door vacuum motor and the red vacuum hose to the side of the heat-defrost door vacuum motor.
8. Install the instrument panel following the procedure given in this Part for Instrument Panel Installation.
9. Check the system for proper operation.

INSTRUMENT PANEL

Removal and installation of several components and assemblies described below require the removal and installation of the instrument panel.

Removal

1. Remove steering wheel as described in Part 13-06.
2. Remove the instruments, clusters and controls as described in Group 33.
3. Remove heater control or, if applicable, heater/air conditioning control as described in this Part.
4. Disconnect the cigar lighter (Part 35-40).

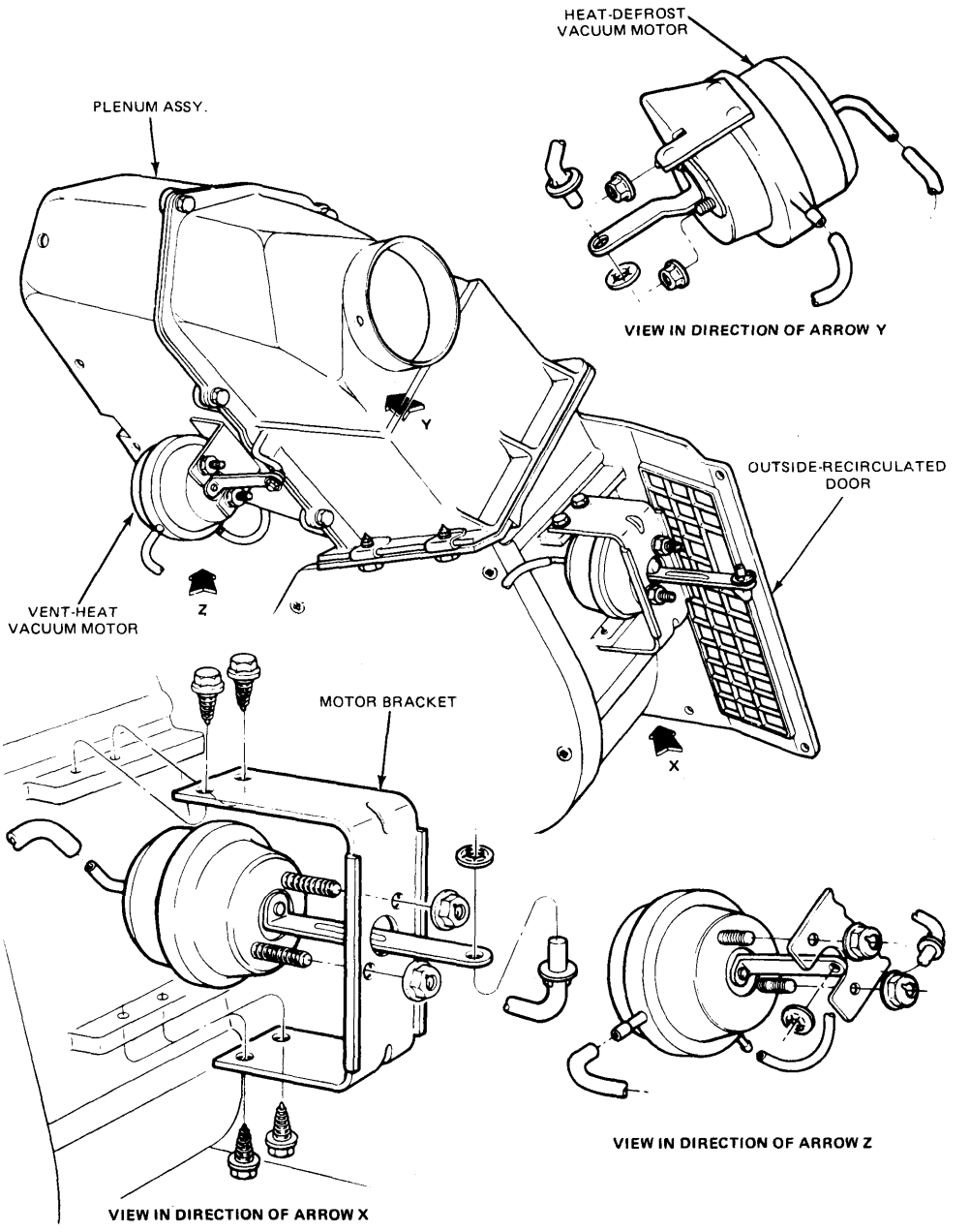


FIG. 9 Vacuum Motor Installation

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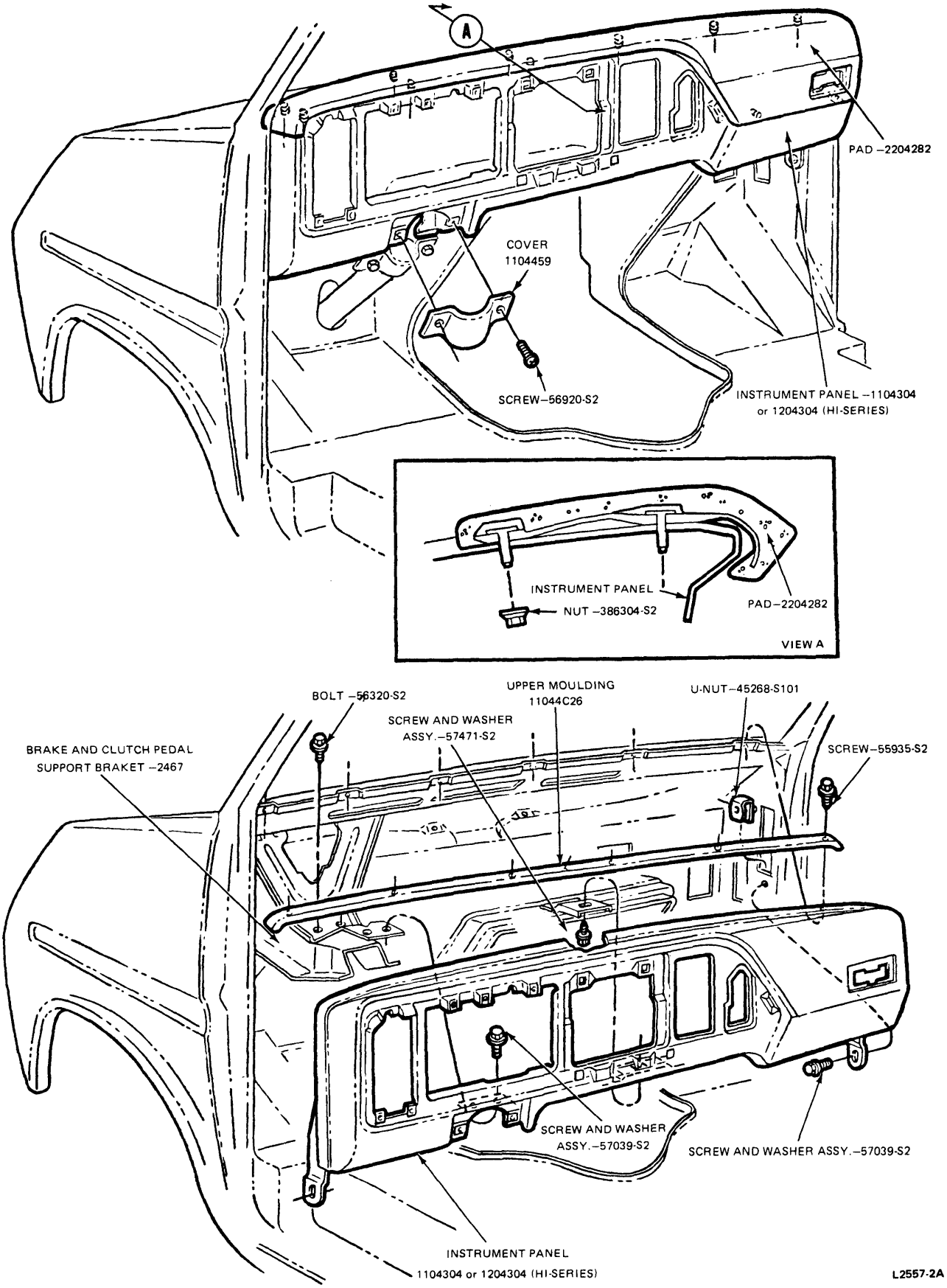


FIG. 10 Instrument Panel—Removal and Installation

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5. If so equipped remove radio (Part 35-02) and instrument panel mounted speaker (Part 35-31).
6. Remove eleven nuts securing pad to instrument panel (Fig. 10) and remove pad.
7. Remove steering column cover.
8. Remove instrument panel upper moulding.
9. Remove two screw and washer assemblies securing instrument panel to brake and clutch pedal support bracket assembly.
10. Remove screw and washer assembly securing instrument panel at lower-center support bracket.
11. While supporting instrument panel, remove two side attaching screw and washer assemblies. Carefully remove the instrument panel from the vehicle.

Installation

1. Carefully position instrument panel in vehicle and secure with two side attaching screw and washer assemblies tightened to 11-21 ft-lbs (Fig. 10).
2. Secure instrument panel to supports with three screw and washer assemblies tightened to 12-20 ft-lbs.
3. Install the instrument panel upper moulding. Tighten screws to 10-15 in-lbs.
4. Install steering column cover. Tighten screws to 10-15 in-lbs.
5. Install the instrument panel pad. Tighten nuts to 8-20 in-lbs.
6. Install all auxiliary equipment and controls removed during the removal procedure.
7. Install instruments, clusters and controls as described in Group 33.
8. Install steering wheel (Part 13-06).

DEFROSTER NOZZLE

To remove the defroster nozzle it is first necessary to remove the instrument panel, heater outlet duct, and center register duct (Fig. 11).

Removal

Refer to Figure 11.

1. Remove the instrument panel following the procedure given in this Part for Instrument Panel Removal.
2. Remove the left register duct and center register duct followig the procedures given in this Part.
3. Remove two screws attaching the defroster nozzle to each defroster opening near the windshield.
4. Pull the defroster nozzle from the plenum and remove from the vehicle.

Installation

1. Position the defroster nozzle to the plenum and the defroster openings.
2. Install two screws to attach the defroster nozzle to each defroster opening.
3. Install the center register duct and left register duct following the procedures given in this Part.
4. Install the instrument panel following the procedures given in this Part.
5. Check the system for proper operation.

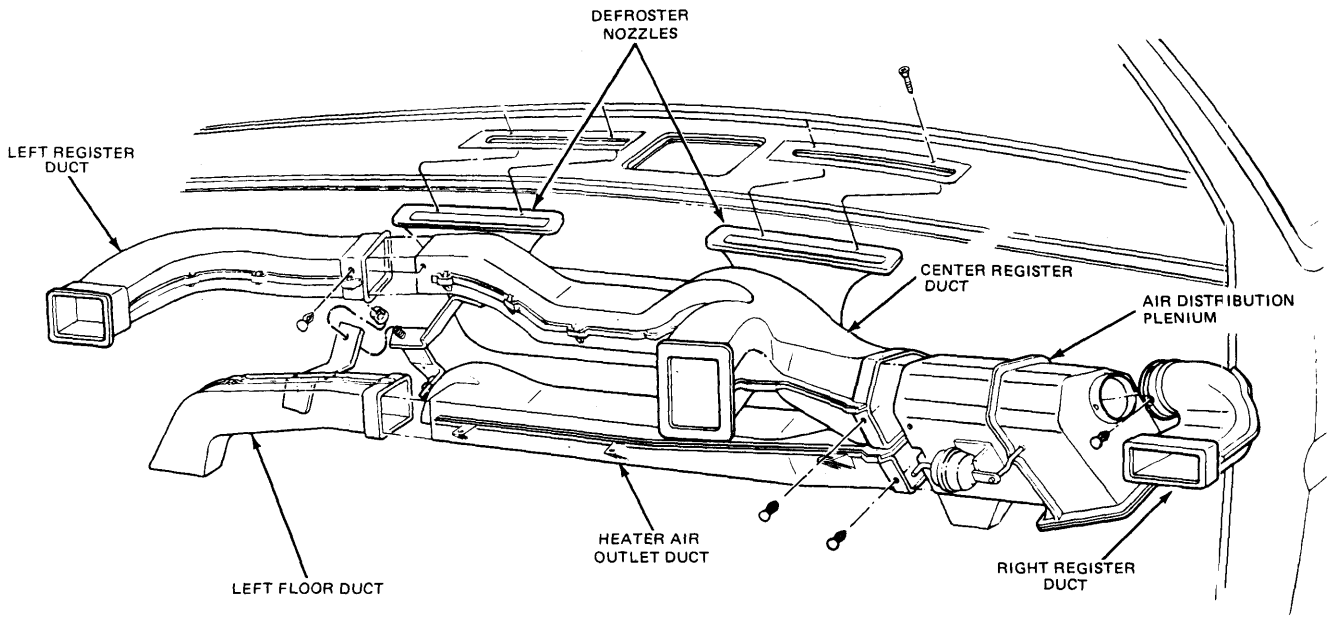


FIG. 11 Register and Heater Duct Installation

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OUTSIDE-RECIRCULATING DOOR VACUUM MOTOR

Removal

1. Remove the push nut retaining the motor arm on the door crank arm.
2. Remove the four screws attaching the motor mounting bracket to the evaporator case (Fig. 9).
3. Disconnect the vacuum hose from the outside-recirc. vacuum motor and remove the motor and bracket.
4. Remove the two nuts retaining the motor to the mounting bracket.

Installation

1. Position the vacuum motor to the mounting bracket and install the two retaining nuts.
2. Connect the vacuum hose to the vacuum motor and position the motor and bracket to the evaporator case and door crank arm.
3. Install the four screws to attach the mounting bracket.
4. Install a new push nut (Part No. 383358-S) to retain the motor arm on the door crank arm.
5. Check the system for proper operation.

AIR DUCTS

Remove the instrument panel following the procedure for Instrument Panel Removal in this Part to gain access to the air ducts.

RIGHT REGISTER DUCT

Removal

1. Remove the retainer attaching the right register duct to the plenum (Fig. 11).
2. Pull the right register duct from the plenum chamber.

Installation

1. Position the right register duct to the plenum and rotate the register duct until the retainer holes are aligned.
2. Install the retainer to attach the register duct to the plenum.

LEFT REGISTER DUCT

Removal

1. Remove the retainer attaching the left register duct to the center register duct (Fig. 11).
2. Pull the left register duct from the center register duct.

Installation

1. Position the left register duct to the center register duct and align the retainer holes.
2. Install the retainer to attach the left register duct to the center register duct.

CENTER REGISTER DUCT

Removal

1. Remove the left register duct.
2. Disengage the vacuum harness locator tab from the center register duct.
3. Remove the one (1) retainer attaching the center register duct to the plenum.
4. Remove the one nut attaching the heat duct, floor outlet duct and center register duct support braces to the brake pedal support.
5. Disengage the center register duct support brace from the clip bolt and remove the center register duct.

Installation

1. Position the right end of the center register duct to the plenum and the support brace at the left end of the duct to the clip bolt.
2. Install the floor outlet duct support brace on the clip bolt and install the retaining nut.
3. Install the retainer to attach the center register duct to the plenum (Fig. 11).
4. Connect the vacuum harness locator tab to the center register duct.
5. Install the left register duct.

FLOOR DUCTS

Removal

1. Remove the one nut attaching the heat duct, floor outlet duct and center register duct support braces to the brake pedal support.
2. Disengage the wire harness locator tabs and vacuum harness locator tab from the heat duct.
3. Remove the one (1) retainer attaching the floor outlet duct to the heat duct and remove the floor outlet duct.
4. Remove the one (1) retainer attaching the heat duct to the plenum (Fig. 11).
5. Disengage the heat duct support brace from the clip bolt on the brake pedal support and remove the heat duct.

Installation

1. Position the right end of the heat duct to the plenum and the support brace at the left end of the duct to the clip bolt on the brake pedal support.
2. Place the center register duct support brace on the clip bolt over the heat duct brace.
3. Position the floor outlet duct to the heat duct and the support brace to the clip bolt.
4. Install the nut to retain the three support braces to the clip bolt.
5. Install the one retainer to attach the heat duct to the plenum and one retainer to attach the floor outlet duct to the heat duct.
6. Install the wire harness and vacuum harness locator tabs in their respective locations on the heat duct.
7. Install the instrument panel following the procedure given in this Part for Instrument Panel Installation after all air ducts are installed.

REGISTER LOUVER ASSEMBLY

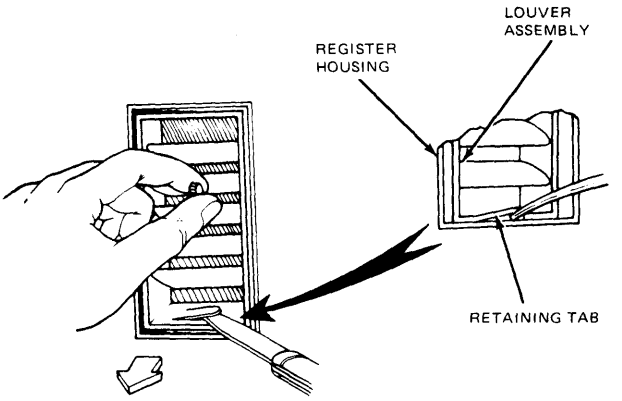
Removal

1. Insert a thin blade under the retaining tab (Fig. 12) and pry the retaining tab toward the louvers until the retaining tab clears the hole in the register assembly.

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2. Pull the louver end out from the register opening only enough to prevent the louver pivot from going back into the pivot hole.
3. Repeat Step 1 for the other retaining tab and pull the louver assembly from the register opening.



INSERT A THIN BLADE THROUGH THE LOUVER AND CAREFULLY PRY THE RETAINING TAB TOWARD THE LOUVERS TO ALLOW THE PIVOT TO CLEAR THE HOLE IN THE REGISTER OPENING.

R2184-1A

FIG. 12 Instrument Panel Register Louver Removal

Installation

The pivots on each end of some louver assemblies are different diameters and therefore determine the installed position. Other louvers have an arm extending inward on one end of the louver assembly. This end of the louver should be installed in the register assembly at the same end as the raised boss in the register assembly.

1. Position the louver assembly into the register opening.
2. Depress the retaining tabs and push the louver assembly into the register opening and engage the retaining tabs in the pivot holes.

HEATER ASSEMBLY

Removal

1. Drain the cooling system.
2. Disconnect both heater hoses at the dash panel (Fig. 13). Position or plug hoses so that the coolant will not drain out.
3. Remove plenum chamber from the vehicle.
4. Disconnect the vacuum hoses from the heater assembly.
5. Remove screws and/or nuts securing the heater assembly to the dash (Fig. 14).
6. Disconnect the control cable at the heater (Fig. 8).
7. Disconnect electrical wires from the heater assembly.
8. Carefully remove the heater and gasket from the opening in the dash panel.

Installation

1. Position heater assembly in vehicle and secure with screws and/or nuts (Fig. 14).
2. Connect the heater hoses to the heater core.
3. Connect the electrical connectors.
4. Connect the vacuum hoses to the heater assembly.
5. Connect temperature control cable to the temperature blend door and adjust the cable (Fig. 8).

HEATER CONTROL ASSEMBLY

Removal

1. Remove instrument panel bezel.
2. Remove control mounting bracket from the instrument panel (Fig. 3).
3. Disconnect electrical wiring connectors from blower switch and illumination bulb.
4. Remove temperature control cable from control assembly.
5. Disconnect vacuum hoses from the control assembly at the connectors.
6. Remove control assembly from the mounting bracket.

Installation

1. Install the control assembly to the mounting bracket with attaching screws.
2. Connect the temperature control cable to the control assembly.
3. Connect the electrical wiring connectors to the blower switch and illumination bulb.
4. Connect the vacuum hoses to the control assembly.
5. Install the control mounting bracket to the instrument panel.
6. Adjust the control cable as described under Adjustments.

CONTROL SWITCH AND VACUUM VALVES

1. Remove the knobs from the blower switch and control levers.
2. Remove applique.
3. Remove control mounting bracket (Fig. 3) from the instrument panel (four screws).
4. Carefully pull the control mounting bracket with the control assembly through the opening in the mounting bracket.
5. To remove the blower switch, disassemble the switch mounting bracket from the control assembly (one screw).
6. To remove the three port Vacuum selector or the nine port vacuum and electrical selector, disconnect the vacuum harness from the valve(s) and remove the two mounting bracket screws.

Installation

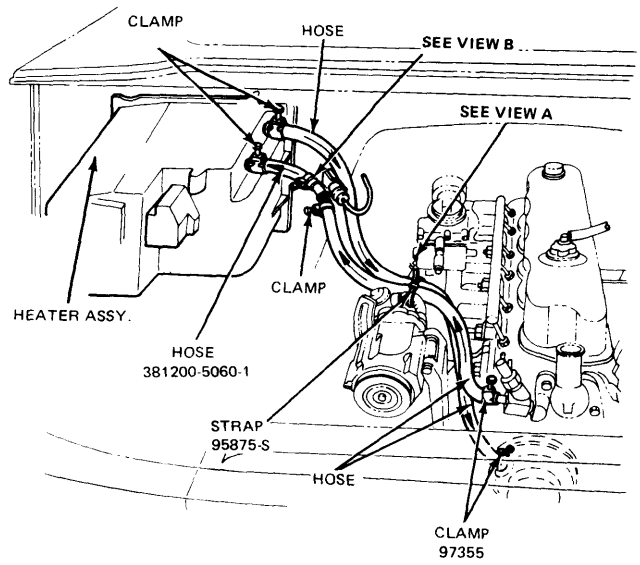
1. Follow the steps under removal in reverse order.

RESISTOR ASSEMBLY

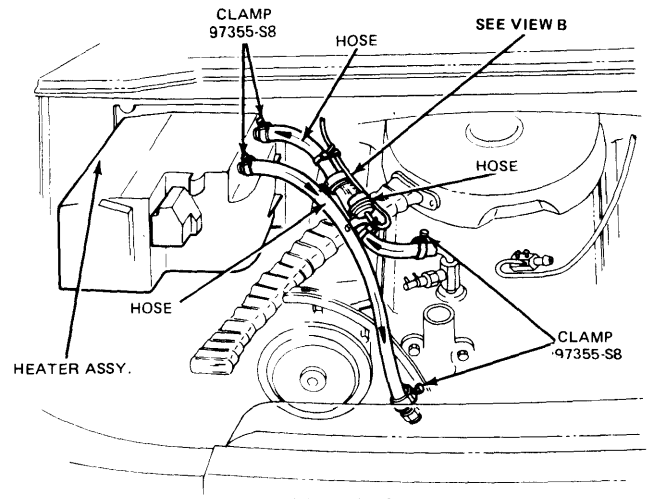
1. Disconnect the electrical leads from the resistor (Fig. 15).
2. Remove (2) plastic rivets from the resistor on front face of blower scroll cover and remove the resistor.
3. Install the resistor to the blower scroll cover with (2) new plastic rivets and connect the electrical leads.

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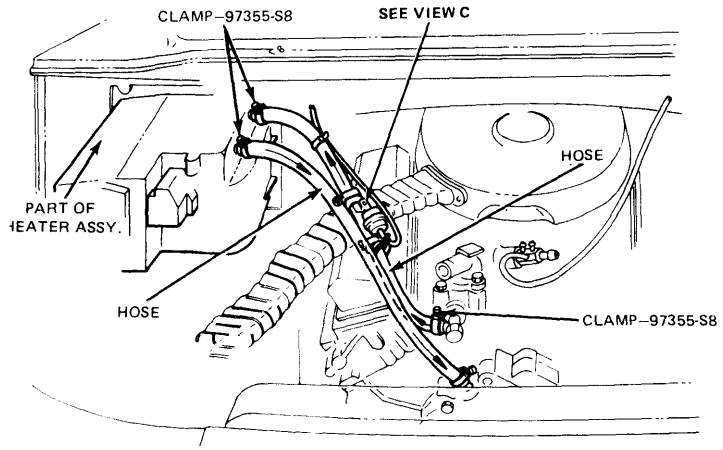
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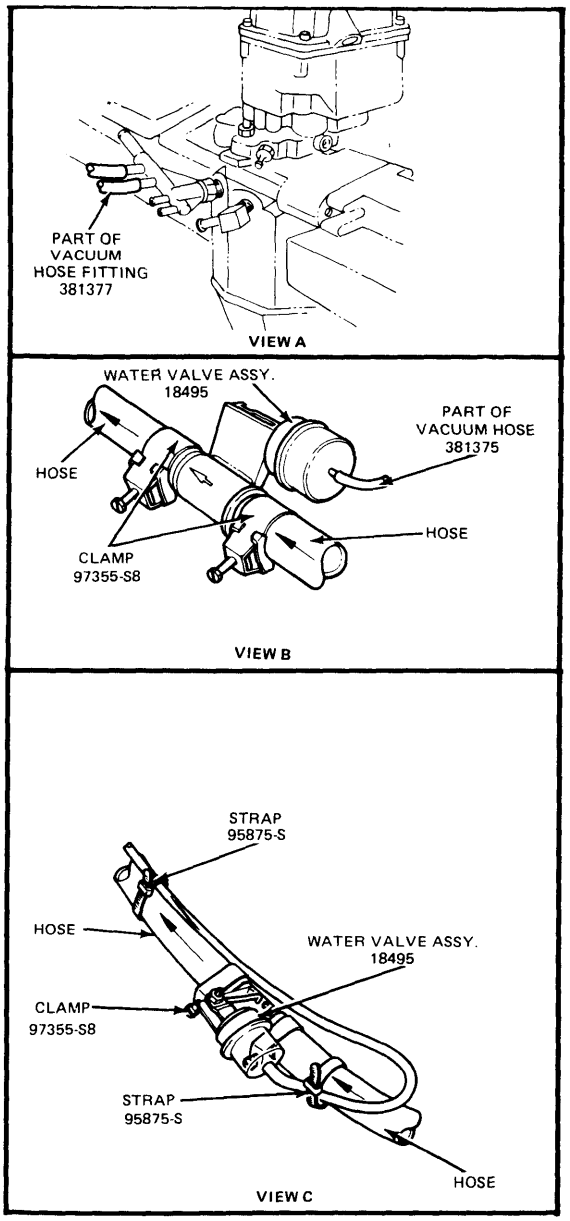
4.9L (300 CID) I-6 ENGINE



5.8L (351 CID) V-8 ENGINE



7.5L (460 CID) V-8 ENGINE



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FIG. 13 Engine Heater Hoses

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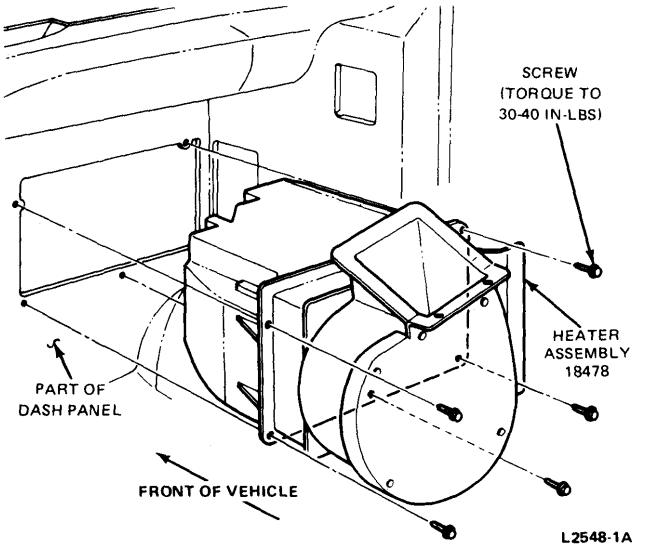


FIG. 14 Heater Assembly—E-100—E-350

BLOWER MOTOR AND WHEEL ASSEMBLY

Removal

1. Disconnect electrical leads from resistor on front face of blower scroll cover.
2. Remove blower scroll cover (5 screws plus 2 screws from blower scroll cover to housing assembly).
3. Push wiring grommet forward out of hole in blower motor housing.
4. Remove four screws from blower motor mounting plate.
5. Remove blower motor and wheel assembly.

Installation

1. Position blower motor to housing and push the wiring grommet into blower motor housing.
2. Install four blower motor attaching screws.
3. Install blower scroll cover (5 screws) and two screws blower scroll cover-to-housing assembly.
4. Connect the electrical leads to the blower motor resistor.
5. Check the blower motor operation.

BLEND AIR DOOR HOUSING AND DOOR

Removal

1. Disconnect electrical leads from resistor on front face of blower scroll cover (Fig. 15).
2. Disconnect vacuum line from outside-recirculating vacuum motor.
3. Remove blower cover (5 screws plus 2 screws from blower scroll cover to housing assembly).
4. Remove push nut and washer from outside-recirculating door shaft.
5. Remove control cable from bracket (1 screw) and slide over bracket. Remove cable wire loop from blend door shaft.
6. Remove blower motor housing (9 screws).
7. Remove the blend door and housing (3 screws).
8. Pry the blend door cable shaft upward and remove the blend door (1 screw).

Installation

1. Install the blend door to the housing (1 screw) and install the blend door shaft into the blend door housing (Fig. 13).
2. Install the blend door and housing into the plenum (3 screws).
3. Install the blower motor housing (9 screws).
4. Position control cable loop to the blend door shaft.
5. Install control cable to bracket (1 screw).

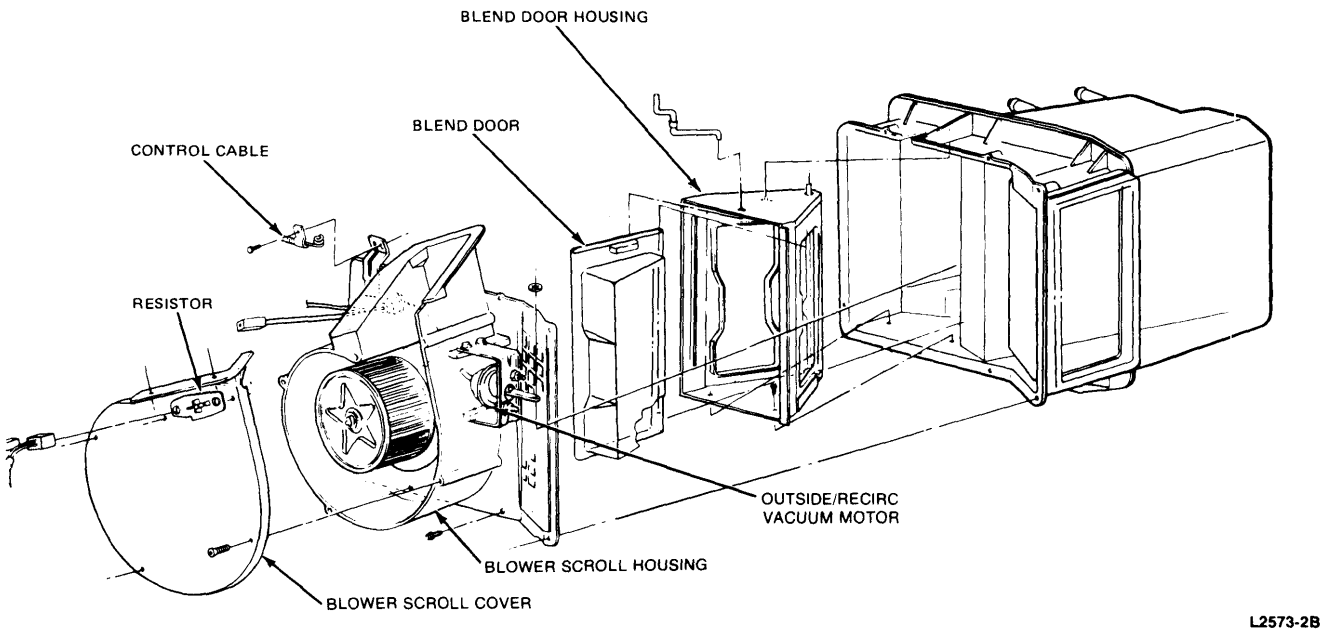


FIG. 15 Temperature Blend Door Installation

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6. Connect outside-recirculating door shaft (push nut and washer).
7. Install blower cover (5 screws plus 2 screws blower scroll cover-to-housing assembly).
8. Connect vacuum line to outside-recirculating vacuum motor.
9. Connect the electrical leads to the resistor.
10. Adjust the control cable as described under Adjustments and Figure 8.

HEATER CORE AND SEAL ASSEMBLY

Removal

1. Disconnect electrical leads from resistor on front face of blower scroll cover (Fig. 16).
2. Disconnect vacuum line from outside recirc door vacuum motor.
3. Remove blower cover (5 screws plus 2 screws from blower scroll cover to housing assembly).
4. Remove push nut and washer from outside-recirc door shaft.
5. Remove control cable from bracket (1 screw) and slide over bracket. Remove cable wire loop from blend door shaft.
6. Remove blower motor housing (9 screws).
7. Remove the blend air door housing (3 screws).
8. Partially drain cooling system.
9. Remove heater hoses from heater core (2 clamps).
10. Remove (2) heater core retaining brackets (2 screws).
11. Remove the heater core and seal assembly.

Installation

1. Position the heater core and seal assembly and install the core retaining brackets and screws (Fig. 14).
2. Install the heater hoses to the heater core (2 clamps) and fill the cooling system to specifications.
3. Install the blend door housing (3 screws).
4. Install the blower motor housing (9 screws).
5. Position control cable loop to the blend door shaft.
6. Install control cable to bracket (1 screw).
7. Connect outside recirc. door shaft (push nut and washer).
8. Install blower cover (5 screws plus 2 screws blower scroll cover-to-housing assembly).
9. Connect vacuum line to outside recirc. vacuum motor.
10. Connect the electrical leads to the resistor.
11. Adjust the control cable as described under Adjustments and Figure 8.

HEATER HOSES AND WATER VALVE ASSEMBLY

Figure 15 shows installation for the heater hoses and water valve assembly for the various engines used. Tighten the hose clamps 12-18 in-lbs.

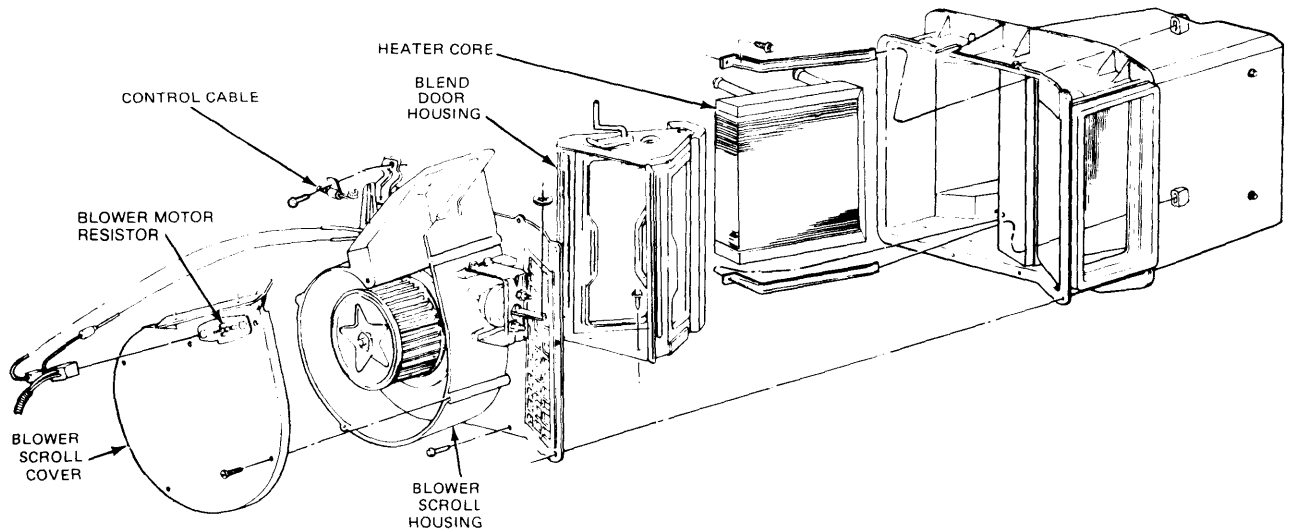


FIG. 16 Heater Core Installation

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SPECIFICATIONS

HEATER

Protective Device		One 30 Amp. Fuse
Control Illumination		One 1CP 161 Bulb
Blower Motor Current Draw @ 12.8 Volts in Max. Heat Position	**Voltage (approx.)**	**Current (approx.)**
High	10	10.0 Amps
Medium	6	6.0 Amps
Low	4	4.0 Amps

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Deluxe Hi-Lo Heater — Bronco and F-100 Through F-350

PART 36-25

APPLIES TO ALL MODELS

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DESCRIPTION AND OPERATION

SYSTEM OPERATION AND CONTROL DOORS

The heating system contains a heater core through which flows coolant from the engine cooling system, a water valve which controls coolant flow through the heater core tubes, a blower, and control doors to regulate air flow into the vehicle.

Outside air is drawn into the system through the air inlet duct and through or around the heater core (Fig. 1). From the blower housing, the air is directed into the plenum chamber, and discharged through defroster outlets, floor ducts, and/or instrument panel registers. The control doors determine the amount of air that goes through the heater core and the particular outlets through which the air flows.

CONTROL ASSEMBLY

The control assembly is located in the instrument panel to the right of the steering column. It contains a blower system OFF-ON switch combined with an 8-port vacuum control valve, a 3-port vacuum control valve, a four position blower speed control switch, a function selector lever and a temperature control lever (Fig. 2).

The function selector lever actuates:

1. The blower system off-on switch, which is connected in series with the four-position blower speed control switch.
2. The vacuum control valve which connects vacuum to the various vacuum motors.

The temperature control lever actuates the cable that controls the temperature blend door. It also operates the 3-port vacuum control valve that controls the outside-recirc. door and the water valve (Fig. 1).

TEMPERATURE CONTROL LEVER OPERATION

Setting the TEMPERATURE control lever at Cool (position 1, Fig. 5) moves the temperature door to block off air flow through the heater core and direct it around the heater core into the plenum chamber (unheated). At the same time, the three-port vacuum control valve applies vacuum to the water valve to stop coolant flow to the heater core. Vacuum is also applied to the outside-recirc. door (door closed to outside air) providing the function selector lever is not in the OFF or the first detent (left) vent position.

Moving the TEMPERATURE control lever to the WARM position (Fig. 5) moves the blend door to direct all air through the heater core and into the plenum (heated). The three-port vacuum control valve removes vacuum application from the outside-recirc. the water door (door open to outside air), and the water valve (water valve open).

When the TEMPERATURE control lever is set at the detent (position 2, Fig. 5), the outside-recirc. door opens to outside air and the blend door starts to move from blocking off air flow through the heater core. However, the water valve is still closed.

With the TEMPERATURE control lever at position 3 (Fig. 5), the outside-recirc. door is open to outside air,

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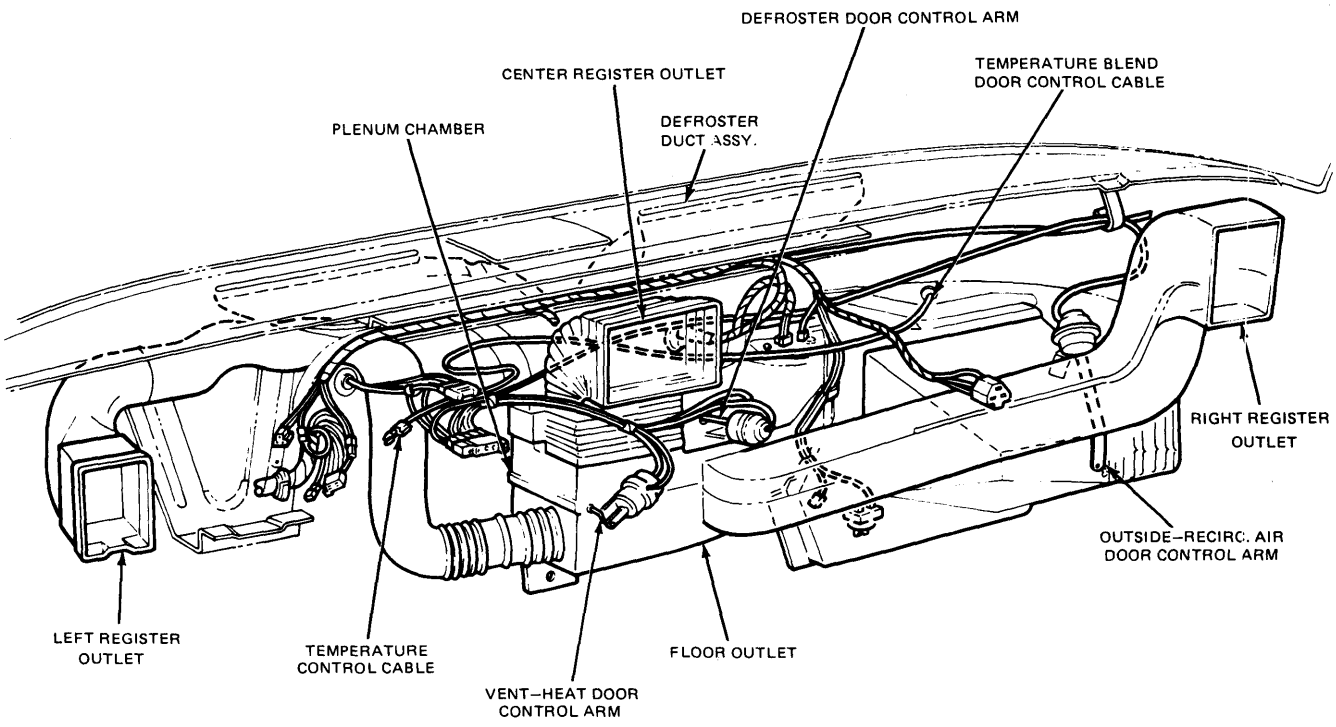


FIG. 1 Deluxe Hi-Lo Heater Installation

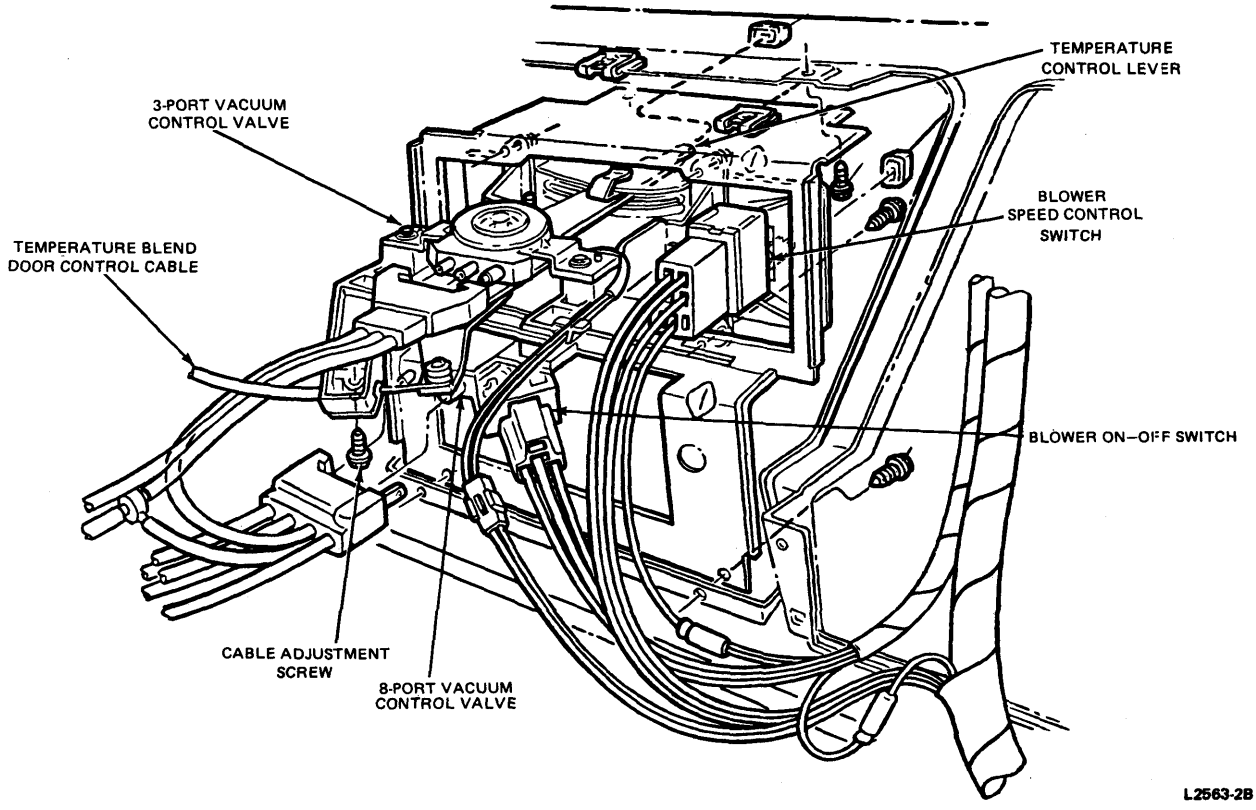


FIG. 2 Deluxe Hi-Lo Heater Control Assembly

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the water valve is open and the blend door allows more air to pass through the heater core.

With the TEMPERATURE control lever between positions 3 and 5 (Fig. 5), the outside-recirc. door is open to outside air, the water valve is open and the blend door allows a corresponding amount of air to pass through the heater core The air that by-passes the heater core blends with the heated air as it passes into the plenum.

After the air enters the plenum chamber, the discharge air flow is controlled by the position of the function selector lever. When the function selector lever is in the first VENT (left detent) position, the 8-port vacuum selector valve over-rides the 3-port vacuum selector valve and opens the outside-recirc. door to outside air regardless of the position of the TEMPERATURE control lever (Fig. 5).

FUNCTION SELECTOR LEVER

With the function selector lever in the OFF position, the outside-recirc door is closed to outside air and no air passes through the system. The blower motor is ON in all positions except the OFF position of the function selector lever.

Two VENT positions are provided on the control assembly. The left detent position and the right detent position. In the left detent position, the outside-recirc. door is open to outside air, the water valve is open only in Temp. lever positions 3, 4 and 5 (Fig. 5) and the vent-heat door is in the instrument panel position. Air is discharged through the instrument panel registers and the floor outlets (Fig. 3).

In the right detent position, the outside recirc. door is closed to outside air when the temperature lever is in the cool position and open to outside air when the temperature lever is in any other position. The water valve is closed when the temperature lever is in positions 1 and 2 (Fig. 5). The water valve is open in all other positions. The vent-heat door is positioned to discharge air through the instrument panel registers.

In the HI-LO position, the vent-heat door is midway between the instrument panel position and floor outlet position. The air is discharged through the panel registers and floor outlet. Air flow through the heater core is controlled proportionate to the setting of the temperature control lever.

In the HEAT position, the vent heat door restricts air flow to the panel registers and air flow is through the plenum chamber to the floor outlet with some defrost bleed.

In the defog position (at index mark between HEAT and DEFROST positions) air is discharged through the defrosters and floor outlets.

In the DEFROST position all air flow is through the defroster outlets.

BLOWER SPEED SWITCH

A four-position blower switch (Fig. 2 and 5) and resistor assembly provides four blower speeds to control air volume. The function selector lever closes the blower OFF/ON switch on the control assembly when the function selector lever is in all positions except OFF.

AIR DISTRIBUTION SYSTEM

The air distribution system uses three doors operated by separate vacuum motors to control air flow in the heater system (Fig. 1).

One motor controls the outside-recirc. door. The door is open (outside air allowed into the system) when the temperature control lever is in any position except COOL (Fig. 4 and 5). The outside-recirc. door is closed when the temperature control lever is in the COOL position except when the function selector lever is in the first vent (left detent) position.

The other motors control the VENT-HEAT door and the Heat-Defrost door as described previously for the function selector lever.

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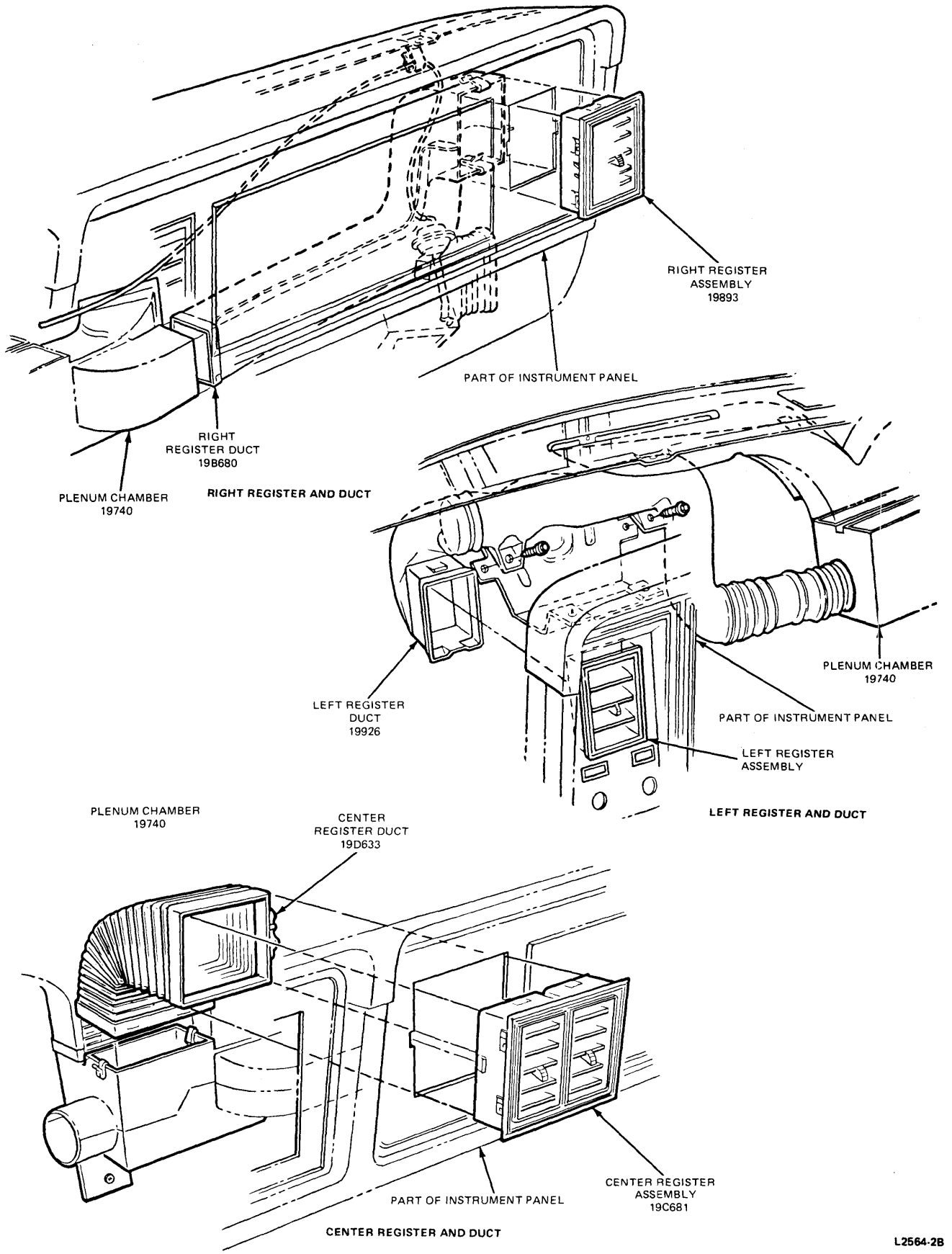
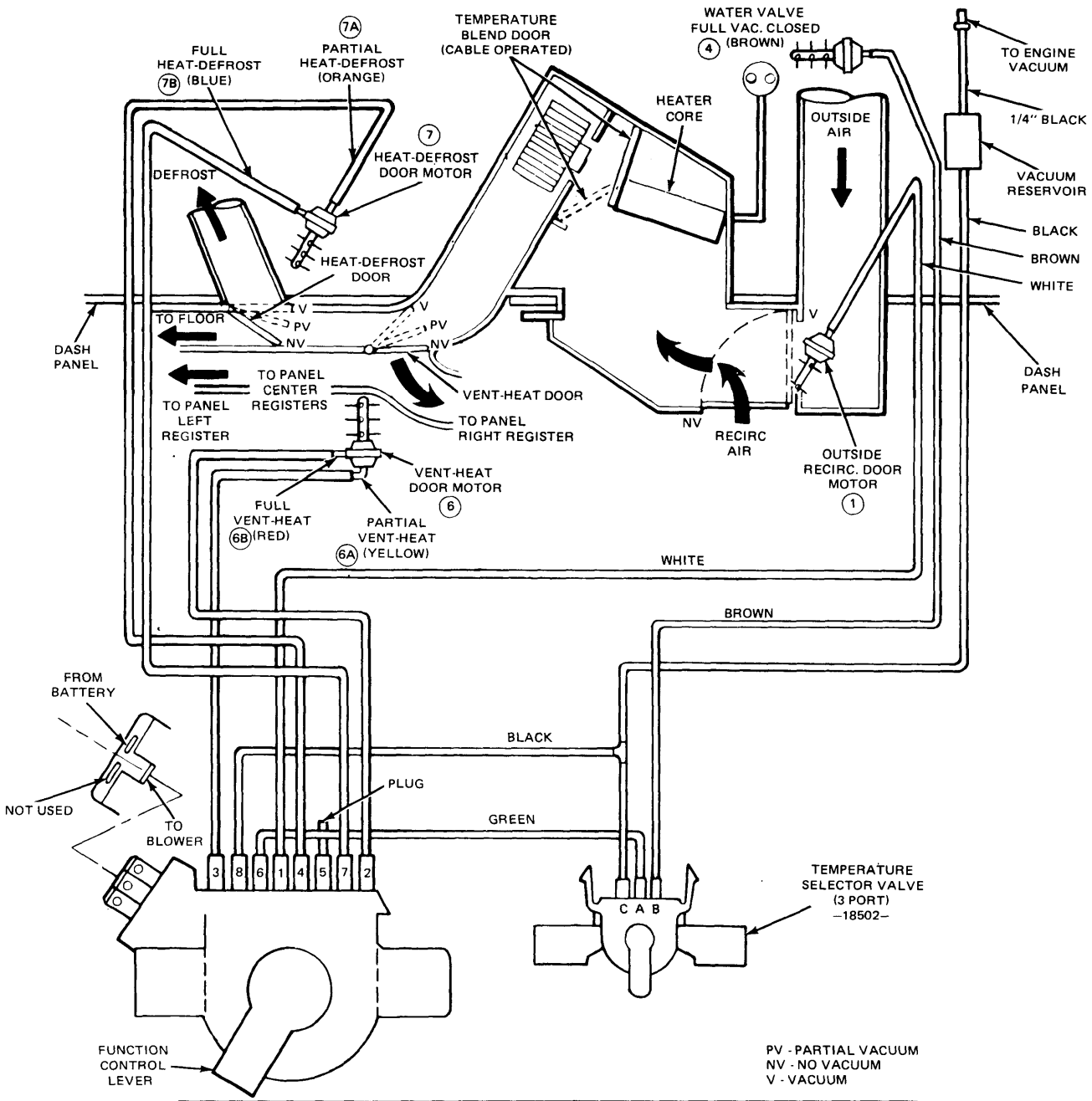


FIG. 3 Instrument Panel Outlets

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PORT	FUNCTION	FUNCTION SELECTOR VALVE POSITIONS							HOSE COLOR
		OFF	VENT	VENT	HI-LO	HEAT	(DEFOG)	DEFROST	
1	Outside-Recirc.	V		To 6	To 6	To 6	To 6	To 6	White 1-2
2	Full Vent-Heat			V					Yellow 6A
3	Partial Vent-Heat		V	V	V				Red 6B
4	Partial Heat-Defrost		V	V	V	V	V		Orange 7A
5	Sealed	Seal	Seal	Seal	Seal	Seal	Seal	Seal	
6	To Temp Port A	V	V	To 1	To 1	To 1	To 1	To 1	Green 4
7	Full Heat-Defrost	V	V	V	V	V			Blue 7B
8	Source Vacuum	V	V	V	V	V	V	V	Black

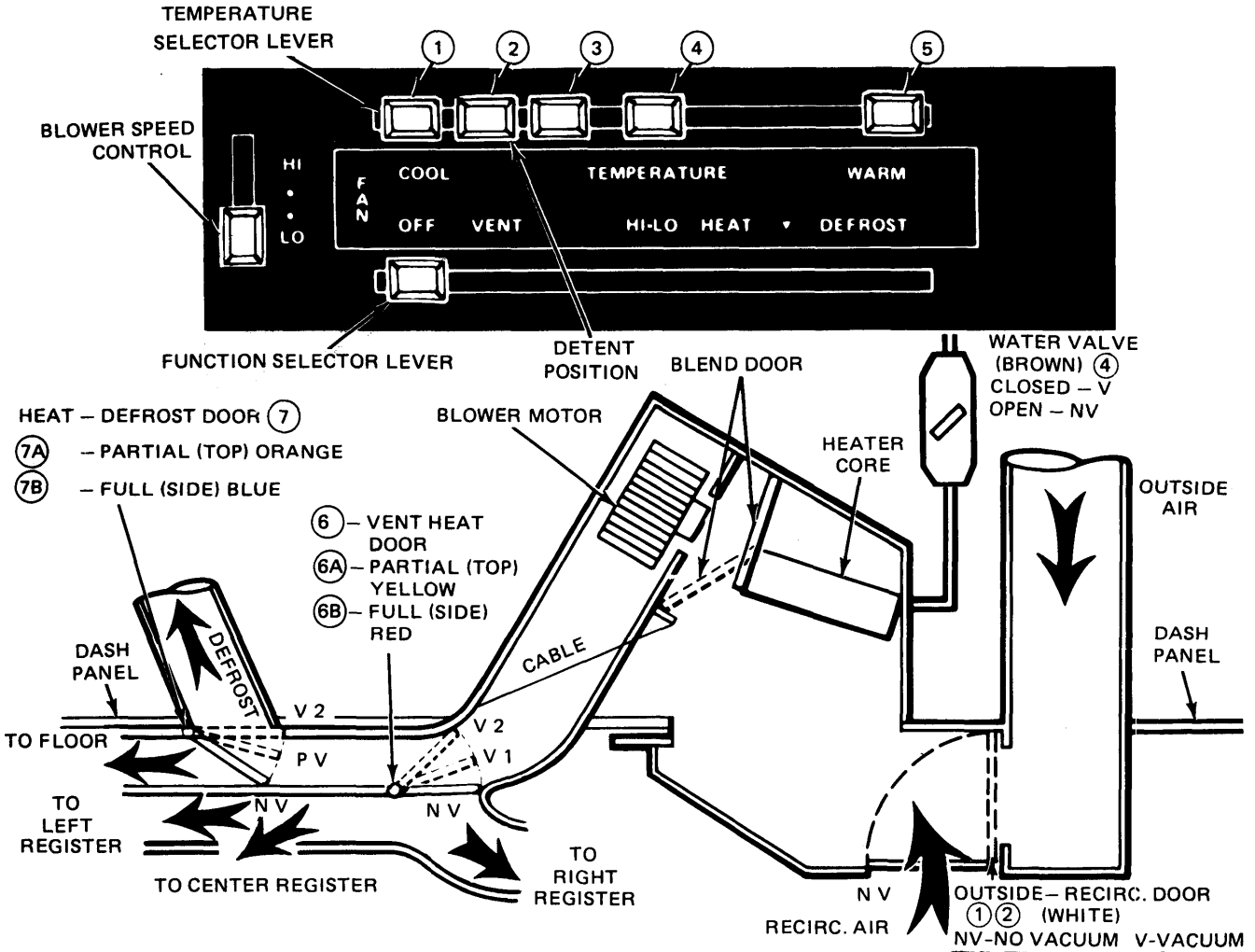
PORT	FUNCTION	TEMPERATURE SELECTOR VALVE LEVER POSITIONS				HOSE COLOR
		COOL		TEMPERATURE	WARM	
C	Source Vacuum	V	V	V	V	Black
A	Outside-Recirc. Door	V				Green
B	Water Valve	V	V			Brown

L2575-2A1

FIG. 4 Deluxe HI-LO Heater System Vacuum Schematic and Selector Test Chart—F-100—F-350 and Bronco

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F-100–F-350 AND BRONCO DELUXE HI–LO HEATER SYSTEM VACUUM MOTOR TEST CHART

FUNCTION CONTROL LEVER POSITION	TEMPERATURE CONTROL LEVER POSITION	VACUUM MOTORS APPLIED WITH VACUUM					
		OUTSIDE-RECIRC 1 2	WATER VALVE 4	VENT-HEAT 6		HEAT-DEFROST 7	
				PARTIAL 6A	FULL 6B	PARTIAL 7A	FULL 7B
OFF	Cool - 1	1—2	4	—	—	—	7b
	Cool - 2	—	4	—	—	—	7b
	Cool - 3 Temp - 4 Warm - 5	—	—	—	—	—	7b
VENT (LEFT DETENT)	Cool - 1	—	4	6a	—	7a	7b
	Cool - 2	—	4	6a	—	7a	7b
	Cool - 3 Temp - 4 Warm - 5	—	—	6a	—	7a	7b
VENT (RIGHT DETENT)	Cool - 1	1—2	4	6a	6b	7a	7b
	Cool - 2	—	4	6a	6b	7a	7b
	Cool - 3 Temp - 4 Warm - 5	—	—	6a	6b	7a	7b
HI - LO	Cool - 1	1 2	4	6a	–	7a	7b
	Cool - 2	–	4	6a	–	7a	7b
	Cool - 3 Temp - 4 Warm - 5	–		6a	–	7a	7b
HEAT	Cool - 1	1–2	4			7a	7b
	Cool - 2		4			7a	7b
	Cool - 3 Temp - 4 Warm - 5	–				7a	7b
▽ (DEFOG)	Cool - 1	1–2	4			7a	–
	Cool - 2		4			7a	
	Cool - 3 Temp - 4 Warm - 5					7a	–
DEFROST	Cool - 1	1 2	4				
	Cool - 2		4			–	
	Cool - 3 Temp - 4 Warm - 5						–
VACUUM LINE COLOR CODE		WHITE	BROWN	YELLOW (TOP)	RED (SIDE)	ORANGE (TOP)	BLUE (SIDE)

NO VACUUM

L2575-2B2

FIG. 5 Deluxe HI-LO Heater System Air Flow Schematic and Vacuum Control Chart—F-100—F-350 and Bronco

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TESTING

HEATER SYSTEM CHECK

Attach vacuum source to black hose from engine vacuum source and perform the following operations (Figs. 4 and 5):

1. Set function control lever in OFF position; temperature lever in COOL position, blower speed control switch in LO. Check for the following:
   - Blower is off.
   - Outside-recirc. door is closed to outside air.
   - Main water valve is closed (vacuum applied).
2. Set function control lever in the first VENT position (left detent); temperature control lever in COOL; blower speed control switch in LO. Check for the following:
   - Blower is on with four speeds available (LO, Lo-medium, medium-high, and HI).
   - Outside-recirc. door is open to outside air.
   - Main water valve is closed (vacuum).
   - Air is discharged through instrument panel registers and floor outlets.
3. Set the function control lever in the second VENT position (right detent); temperature control lever in COOL; blower speed switch in LO. Check for the following:
   - Blower operates with 4 speeds available.
   - Outside-recirc. door in the recirculating position.
   - Vent-heat and heat-defrost doors set to discharge air through the instrument panel registers. Move the temperature lever to position 2 as shown in Figure 5. The outside-recirc. door should move to the outside air position.

   Move the temperature lever to position 3, 4 or 5 (Fig. 5). The water valve should open.
4. Set function control lever in HI-LO position; temperature control lever in COOL; blower speed control switch in HI. Check for the following:
   - Blower is on.
   - Outside recirc. door is closed to outside air.
   - With temperature control lever in COOL, water valve is closed.
   - Move temperature control lever very slowly toward WARM. The outside-recirculating door should open to outside air at position 2 (Fig. 5). The water and the temperature blend door should move throughout the travel of the temperature control lever.
   - Air discharges through floor outlets and instrument panel registers.
5. Set function control lever in HEAT position; temperature control lever in COOL; blower speed control switch in HI. Check for the following:
   - Move temperature control lever very slowly toward WARM. The outside-recirc. door should open to outside air at position 2 (Fig. 5). Verify that main water valve opens at position 3 (Fig. 5) and temperature blend door moves throughout the travel of the temperature control lever.
   - Air discharges through floor outlets.
6. Set function control lever between HEAT and DEFROST at index mark; temperature control lever in COOL; blower speed control switch in HI. Check for the same conditions as described previously with function control lever in HEAT position except air discharge is divided between floor and defroster outlets.
7. Set function control lever in DEFROST position; temperature control lever in COOL: blower speed control switch in HI. Check for the same conditions as described previously with function control lever in HEAT positon except air discharge is through the defroster outlet.

ADJUSTMENTS

AIR BLEND DOOR

The only adjustment necessary is the air blend door. This door is connected to the temperature (upper) control lever by a Bowden cable. To adjust, loosen the cable clamp screw (Fig. 6). Move the temperature control lever to the extreme left "cool position" and hold in that position. Rotate the air blend door crank to the extreme forward position (Fig. 5), and tighten the cable clamp screw.

The loop of the Bowden cable is assembled to the door crank with the pigtail pointing away from the crank elbow (View A, Fig. 6). The cable flag is assembled to the bracket with one screw.

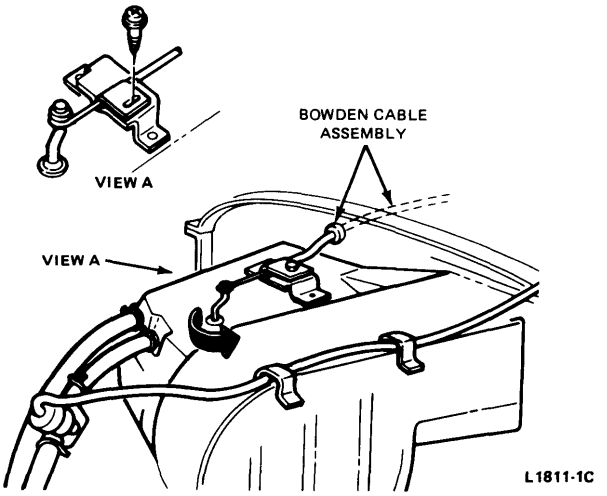


FIG. 6 Air Blend Door Cable Adjustment

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REMOVAL AND INSTALLATION

PLENUM CHAMBER

1. Remove the glove compartment and disconnect the vacuum hoses from the heat-defrost door and vent heat door vacuum motors and the two wire connectors from the blower motor resistor (Fig. 7). Remove the two wires from the clip on the right side of the plenum.
2. Remove one bolt attaching the plenum lower bracket to the dash panel (Fig. 7).
3. Remove two screws retaining the right side of the plenum to the heater assembly (Fig. 7).
4. Disconnect the right register duct and the left register hose duct from the plenum. Remove the plenum while disconnecting the center register duct and defroster nozzles from the plenum.
5. Position the plenum in the vehicle, connecting the defroster nozzle and center register duct to the plenum. Connect the right register duct to the plenum and install 2 screws to retain the plenum at the heater assembly.
6. Install one bolt attaching the plenum lower bracket to the dash panel. Connect the left register hose duct to the plenum.
7. Connect the vacuum hoses to the vacuum motors as shown in Fig. 7, and the wire connectors to the blower motor resistor.
8. Install the glove compartment liner.

DEFROSTER NOZZLE ASSEMBLY

Remove the plenum chamber as previously described and then remove defroster nozzle as shown in Fig. 7.

HEATER CORE AND/OR BLOWER MOTOR

Removal

1. Disconnect the battery cable, remove the carburetor air cleaner and partially drain the coolant system.
2. Remove the heater hoses from the heater core (Figs. 9, 10 and 11).
3. Remove the glove box liner and remove the register duct by pulling from the instrument panel register and releasing the clip at the plenum (Fig. 3).
4. Disconnect the right cowl outside air inlet vacuum hose from the outside-recirculating door vacuum motor.
5. Remove the rear housing from under the instrument panel (Fig. 8). Remove the ouside air inlet duct from the rear housing (4 nuts and 1 bolt) and install one upper nut to retain heater housing-to-dash after rear housing is removed.
6. Remove two screws retaining plenum-to-dash (above transmission tunnel) and two screws to heater housing and remove the plenum (Fig. 7).
7. Install a piece of protective tape on "A" pillar inner cowl panel, at lower right corner of instrument panel.
8. Remove the lower right instrument panel-to-"A" pillar bolt and lower the center instrument panel brace, bolt and nut.
9. Position the instrument panel rearward and install the "A" pillar bolt to hold the panel in the rearward position.

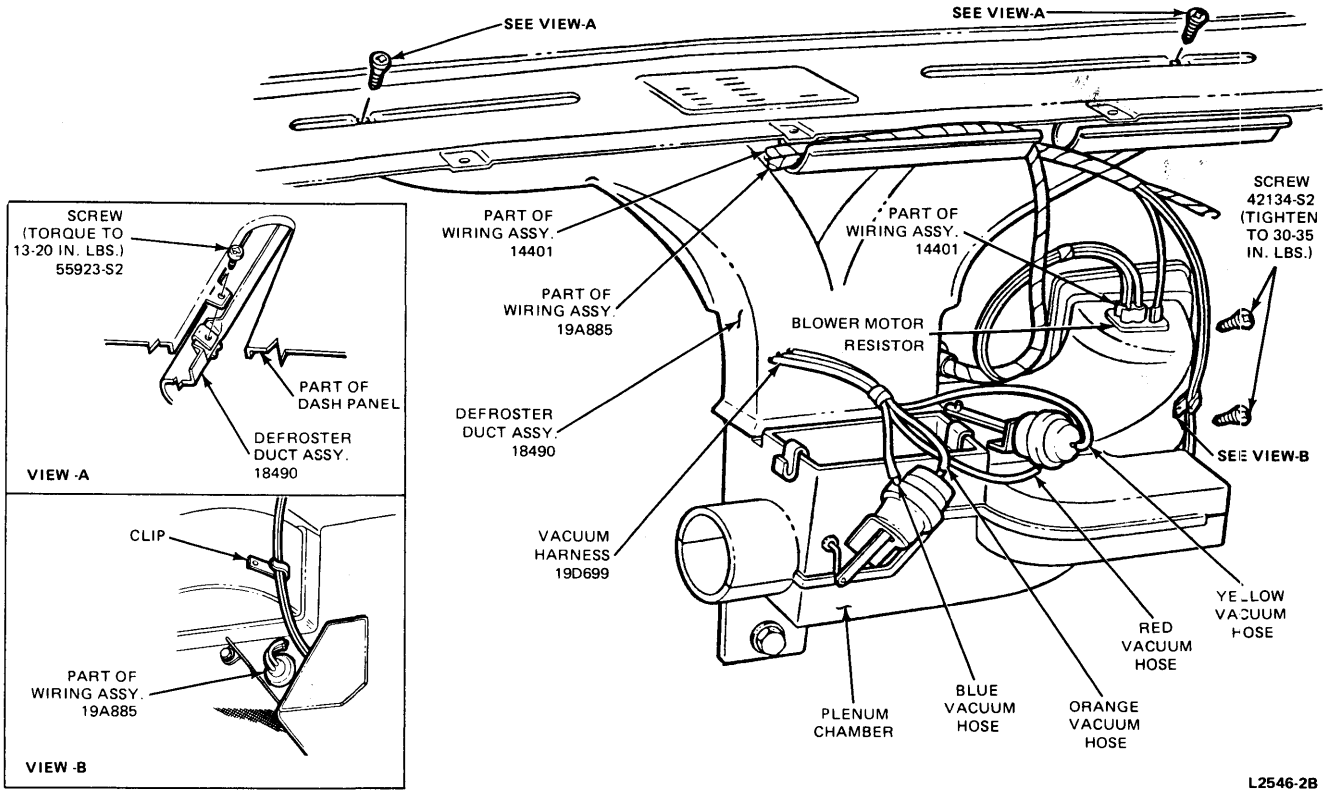


FIG. 7 Plenum Chamber and Nozzle Assembly

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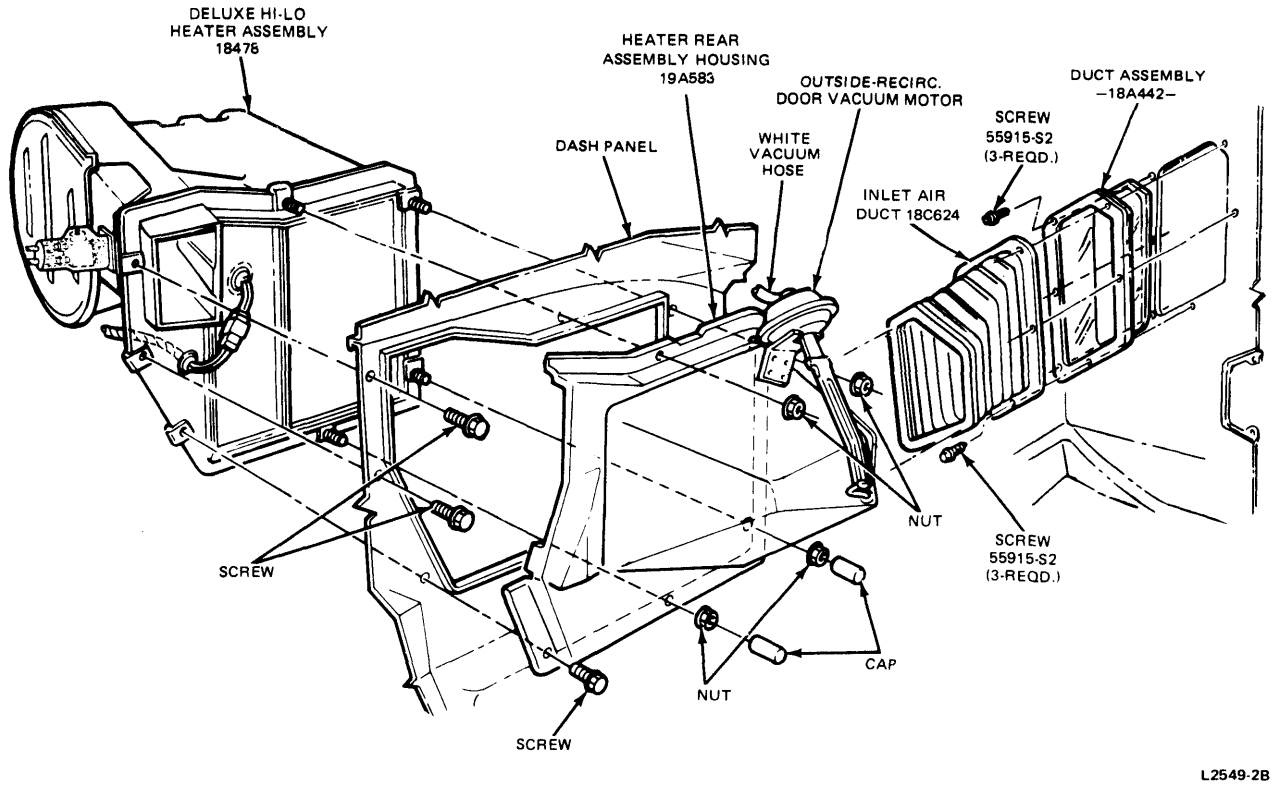


FIG. 8 Heater Rear Housing and Duct Assembly

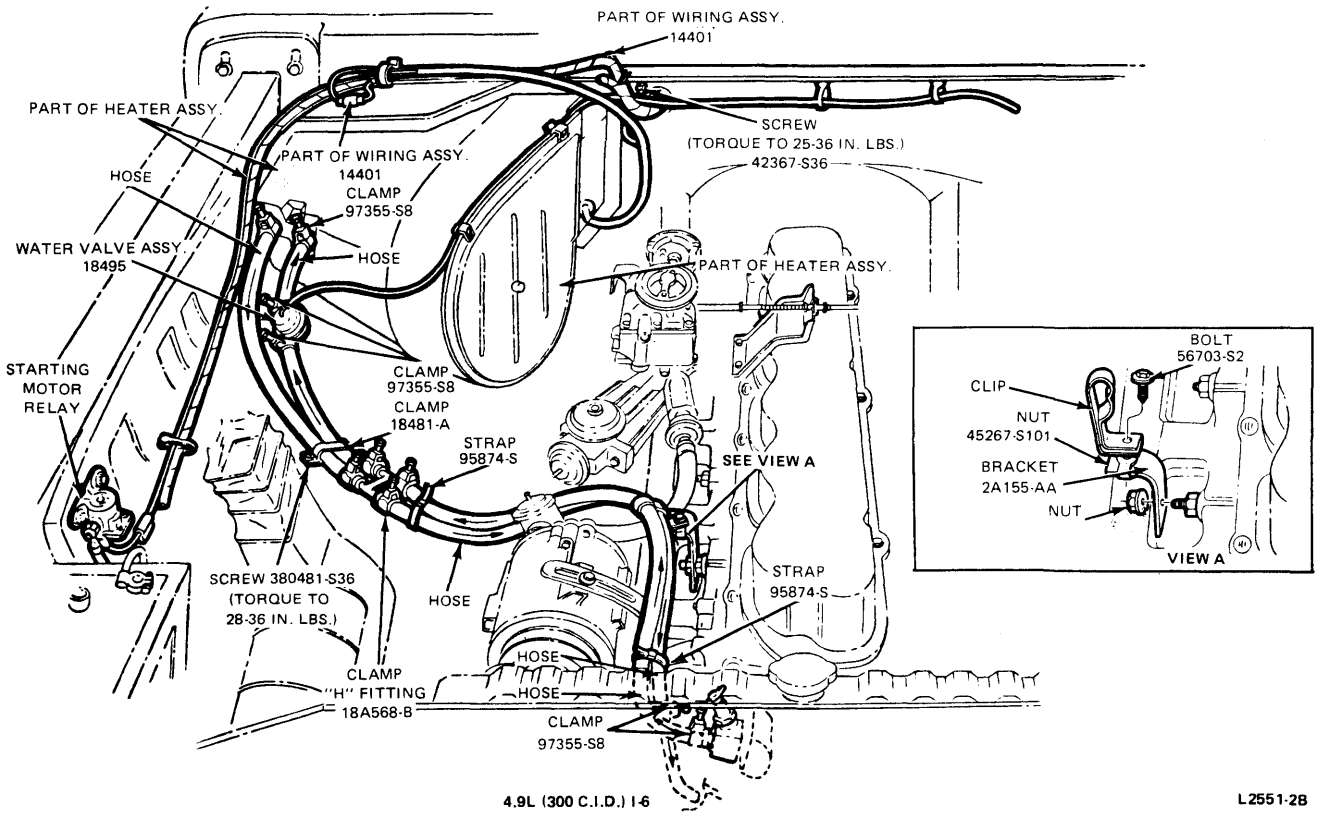


FIG. 9 Engine Heater Hoses—4.9L (300 CID) I-6 Engine

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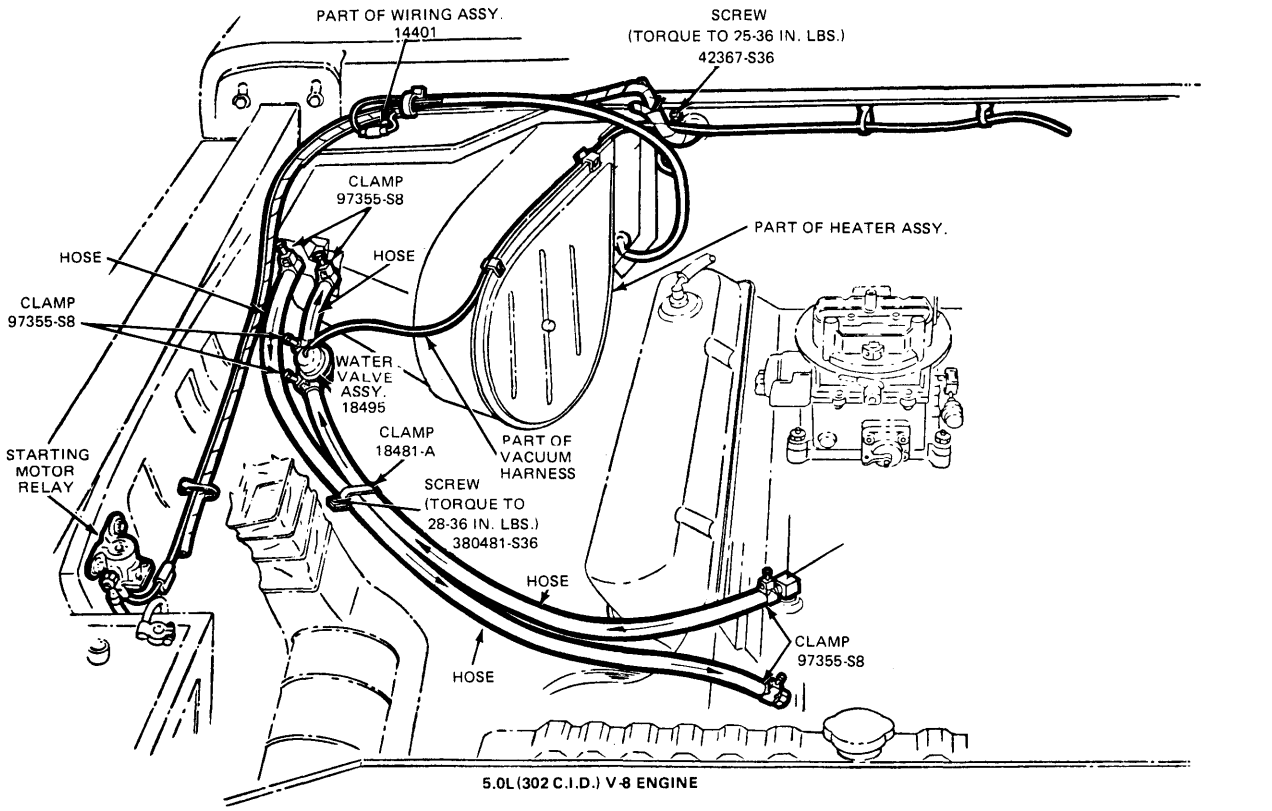


FIG. 10 Engine Heater Hoses—5.0L (302 CID) V-8 Engine

10. Remove heater core (3 screws retaining 2 plates).
11. Remove the temperature blend door (snaps off).
12. Remove the temperature blend door arm support (2 screws) and pivot arm retainer (1 screw).
13. Remove blower motor (2 screws) and remove blower wheel.

Installation

1. Transfer blower wheel to blower motor and panel assembly.
2. Install door arm pivot retainer (1 screw) and door arm support (2 screws).
3. Install the temperature blend door (snaps on).
4. Install heater core.
5. Install the plenum (4 screws).
6. Connect blower wires.
7. Remove heater housing upper retaining nut and install the heater outlet (4 nuts and 1 bolt). Position the air inlet duct.
8. Connect the white vacuum hose to the outside-recirculating door vacuum motor.
9. Reposition the instrument panel, install the retaining bolts and remove the protective tape at the "A" pillar inner cowl panel, lower right corner of instrument panel.
10. Install the right register duct assembly and install the glove box liner.
11. Connect heater hoses to the heater core assembly.
12. Fill cooling system, install the air cleaner and connect the battery cable to the battery.
13. Check blower motor operation.

CONTROL ASSEMBLY

1. Remove the instrument cluster trim as outlined in Part 33-51 of this manual.
2. Remove four screws attaching the control to the mounting plate.
3. Disconnect the wire connectors, vacuum connectors, and Bowden cable from the control (Fig. 2). Remove the control assembly.
4. To install, position the control assembly and connect the wire connectors, vacuum connectors, and Bowden cable to the control. The pigtail of the Bowden cable must be up as shown in Fig. 6, and the cable must be routed over the vacuum hoses.
5. Install four screws attaching control to mounting plate.
6. Install the instrument cluster trim as outlined in Part 33-51 and check operation of heater system.

DUCT ASSEMBLIES AND EXTENSIONS

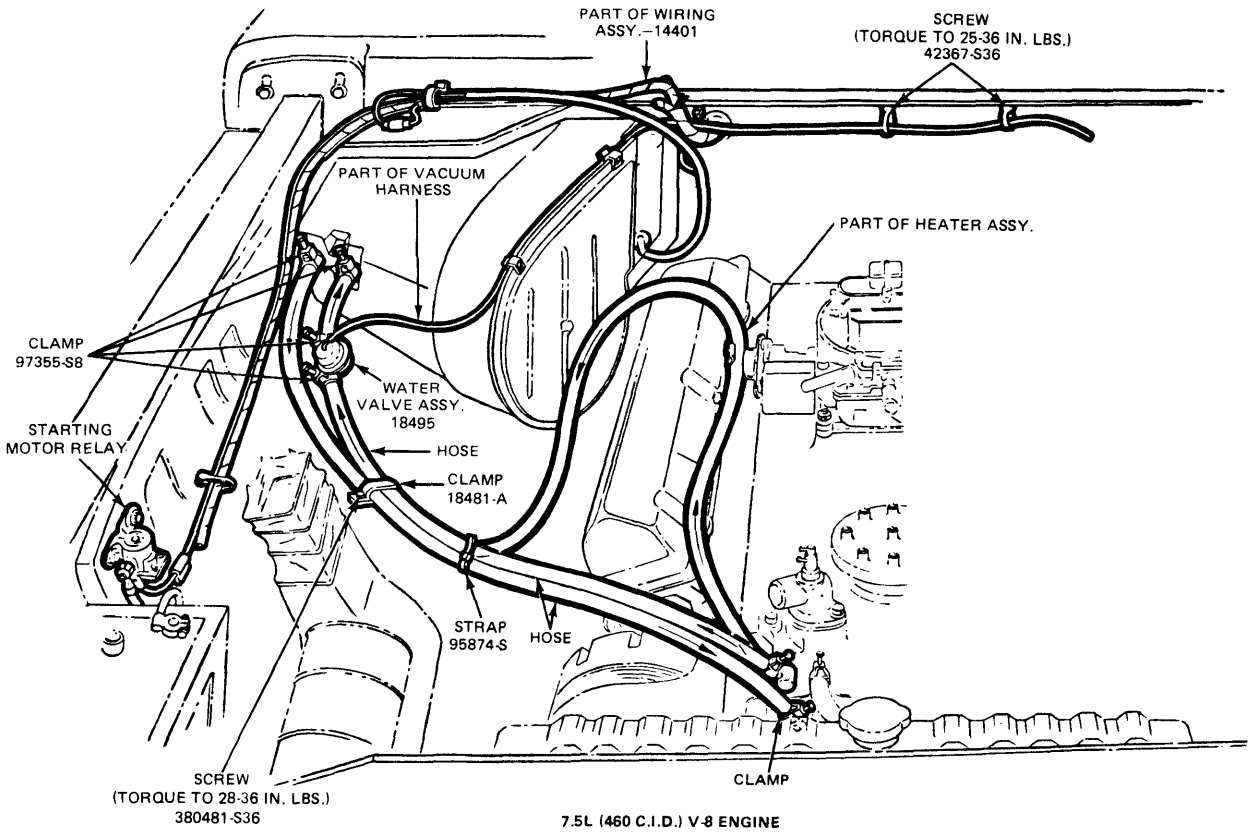
See Fig. 8 for duct assemblies and extensions removal and installation.

HEATER HOSES AND WATER VALVE ASSEMBLY

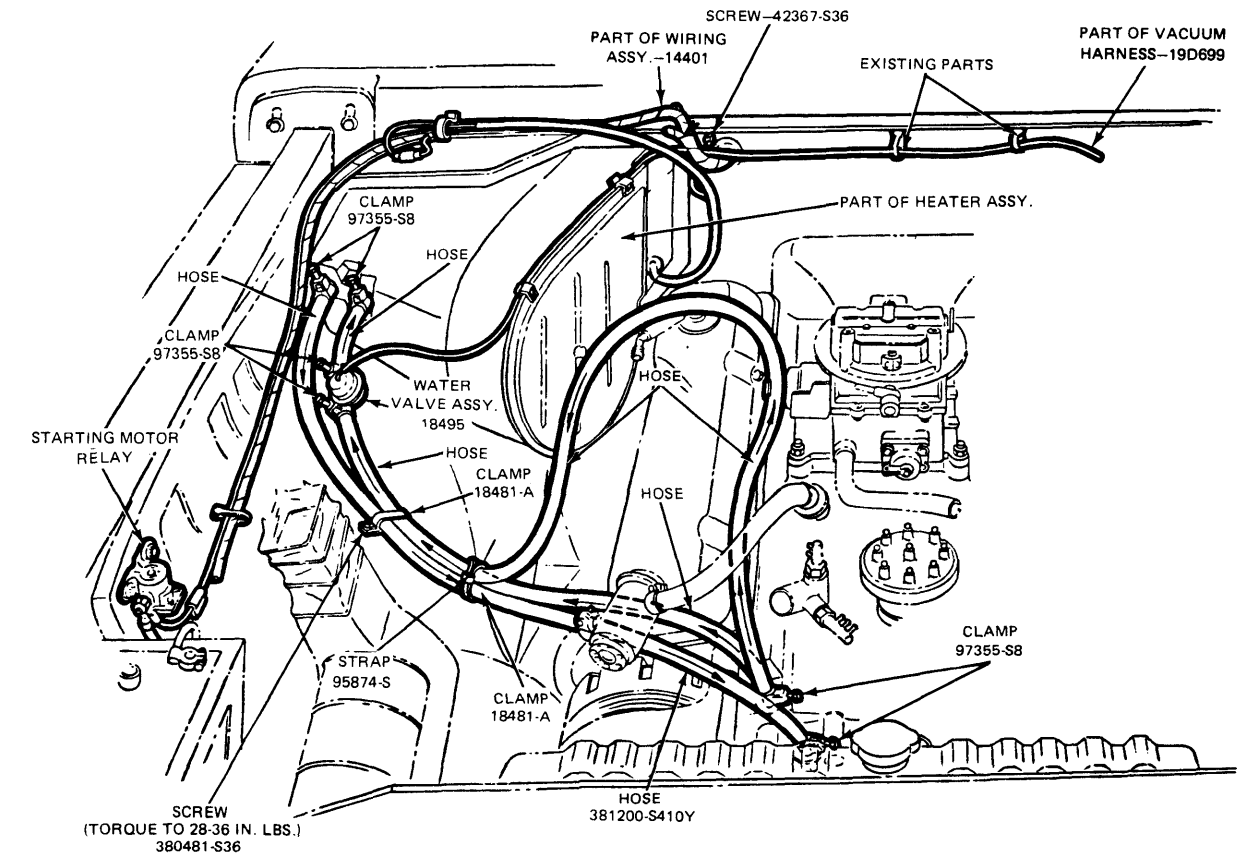
Figs. 9 thru 11 show installation of the heater hoses and water valve assembly for the various engines used. Tighten the hose clamps to 12-18 in-lbs. Do not overtighten hose clamps.

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7.5L (460 C.I.D.) V-8 ENGINE



5.8L (351 C.I.D.) W, M, V-8, 6.6L (400 C.I.D.) V-8 ENGINES

L2556-2A

FIG. 11 Engine Heater Hoses—5.8L (351 CID) V-8, 6.6L (400 CID) V-8 and 7.5L (460 CID) V-8 Engines

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SPECIFICATIONS

HEATER

Protective Device		One 30 Amp. Fuse
Control Illumination		One 1CP 161 Bulb
Blower Motor Current Draw @ 12.8 Volts in Max. Heat Position	**Voltage (approx.)**	**Current (approx.)**
High	10	10.0 Amps
Medium	6	6.0 Amps
Low	4	4.0 Amps

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Air Conditioning General Service

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This Part gives the basic principles and service procedures that apply to all Ford Light Truck Air Conditioning systems. Each of the following parts (beginning with Part 36-61) covers only those procedures that are peculiar to the indicated vehicle system. **Reference both to this Part and to the Part covering the pertinent vehicle line is necessary for complete coverage of any given system.**

DESCRIPTION AND OPERATION

BASIC PRINCIPLES

Truck air conditioning is the cooling or refrigeration of the air in the passenger compartment. Refrigeration is accomplished by making practical use of three laws of nature. These laws of nature and their practical application are outlined in the following paragraphs.

HEAT TRANSFER

If two substances of different temperature are placed near each other, the heat in the warmer substance will always travel to the colder substance until both are of equal temperature. For example, a cake of ice in an ice box does not communicate its coldness to the bottle of milk standing nearby. Rather, the heat in the warm milk automatically flows into the ice.

To determine the amount of heat that transfers from one substance to another, science uses the British Thermal Unit or BTU. One BTU is the amount of heat required to raise the temperature of one pound of water 1 degree F. For example, to raise the temperature of one pound of water from 32 degrees F to 212 degrees F, one BTU of heat must be added for each degree rise in temperature or a total of 180 BTU's of heat. Conversely, in order to lower the temperature of one pound of water from 212 degrees F to 32 degrees F, 180 BTU's of heat must be removed from the water.

LATENT HEAT OF VAPORIZATION

When a liquid boils (changes to a gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

For example, place one pound of water at 32 degrees F in a container over a flame. With each BTU of heat that the water absorbs from the flame, its temperature rises 1 degree F. Thus, after it has absorbed 180 BTU's of heat, the water reaches a temperature of 212 degrees F. Even though the flame continues to give its heat to the water, the temperature of the water remains at 212 degrees F. The water, however, starts to boil or change from the liquid to the gaseous state. It continues to boil until the water has passed off into the atmosphere as vapor. If this vapor were checked with a thermometer, it also would show a temperature of 212 degrees F. In other words, there was a rise of only 180 degrees F (from 32 to 212) in the water and vapor temperature even though the flame applied many more than 180 BTU's of heat. In this case, the heat is absorbed by the liquid in the process of boiling and disappears in the vapor. If the vapor were brought in contact with cool air, the hidden heat would flow into the cooler air as the vapor condensed back to water. Scientists refer to this natural law as the latent (hidden) heat of vaporization.

Water has a latent heat of vaporization of 970 BTU's and a boiling point of 212 degrees F. This means that one pound of water at 212 degrees F, will absorb 970 BTU's of heat in changing to vapor at 212 degrees F. Conversely, the vapor will give off 970 BTU's of heat in condensing back to water at 212 degrees F.

This tremendous heat transfer, that occurs when a liquid boils or a vapor condenses, forms the basic principle of all conventional refrigeration systems.

For a liquid to be a refrigerant, it must also have a low boiling point. That is, the temperature at which it boils must be lower than the substance to be cooled. Refrigerant 12 is the liquid most commonly used in automotive air conditioning systems because in an open container it boils at 21.7 degrees F below zero. Here is a liquid that boils or vaporizes well below passenger compartment temperatures and, in vaporizing, will absorb tremendous amounts of heat without getting any warmer itself.

EFFECT OF PRESSURE ON BOILING OR CONDENSATION

The temperature of a liquid or vapor increases or decreases according to the pressure exerted on it.

In any Ford air conditioning system, liquid refrigerant (R-12) is stored in the receiver under high pressure (Fig. 1). When the liquid R-12 is released into the evaporator by the expansion valve the resulting decrease in pressure lowers its temperature to its boiling point. As the R-12 flows **through** the evaporator coils, passenger compartment air passes over the **outside surface** of the coils. As it boils, the R-12 absorbs heat from the air and thus cools the passenger compartment. The heat from the passenger compartment is absorbed by the boiling refrigerant and hidden in the vapor. The refrigeration cycle is now under way. To complete the cycle, the following remains to be done:

1. Dispose of the heat in the vapor.
2. Convert the vapor back to liquid for re-use.
3. Return the liquid to the starting point in the refrigerant cycle.

The compressor (Fig. 1) performs these functions. It pumps the refrigerant (containing the hidden heat) out of the evaporator and forces it under high pressure into the condenser which is located in the outside air stream at the front of the vehicle. The increased pressure in the condenser raises the R-12 vapor temperature to a point higher than that of the outside air. As the heat transfers from the hot vapor to the cooler air, the R-12 condenses back to a liquid. The liquid under high pressure now returns to the reservoir where it is stored for re-use.

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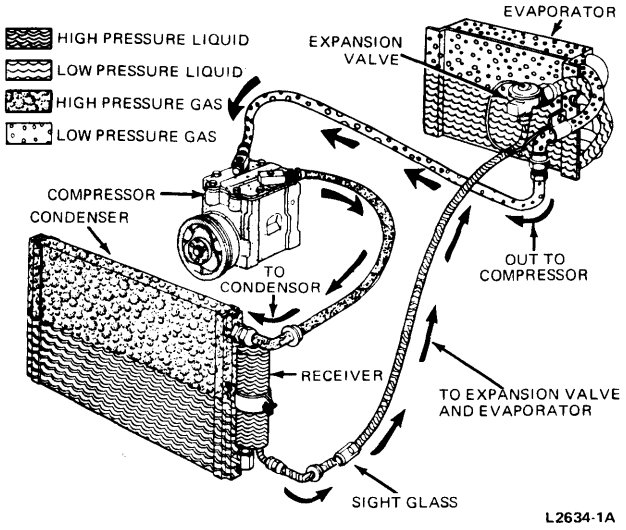


FIG. 1 Typical A/C Basic System

Heat can be transferred from a comparatively cooler passenger compartment to the hot outside air because of the difference between the refrigerant pressure in the evaporator and the pressure in the condenser. In the evaporator, the expansion valve reduces the pressure and thereby reduces the boiling point below the temperature of the passenger compartment. Thus, heat transfers from the passenger compartment to the boiling refrigerant. In the condenser, the compressor raises the condensation point above the temperature of the outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. The expansion valve and the compressor simply create pressure conditions that permit the laws of nature to function.

AIR CONDITIONER COMPONENTS

RECEIVER DEHYDRATOR UNIT

The air conditioning system stores the liquid Refrigerant-12 under pressure in a combination receiver and dehydrator (Fig. 1). The pressure in the receiver normally varies from about 80 to 300 psi, depending on the surrounding air temperature and compressor speed.

The dehydrator serves the purpose of removing any traces of moisture that may have accumulated in the system. Even one drop of moisture will cause an air cooling unit to malfunction. A pressure relief valve is located on the compressor to relieve excessive refrigerant pressures.

EVAPORATOR UNIT

When the cooling system is in operation, the liquid Refrigerant-12 flows from the receiver and dehydrator unit through a flexible hose to the evaporator (Fig. 1) where it is allowed to evaporate at a reduced pressure, to cool the evaporator. Air is blown through the evaporator fins and is thus cooled by the evaporator.

EXPANSION VALVE

The expansion valve meters refrigerant into the evaporator according to cooling requirements. The restrictive effect of the expansion valve, while limiting the refrigerant flow to the evaporator, results in the reduced evaporator pressure.

The expansion valve consists of the valve and a temperature sensing capillary tube and bulb. The valve is connected to the inlet tube of the evaporator and the sensing bulb is clamped to the outlet tube pipe of the evaporator.

The expansion valve is opened and closed by opposing pressures on either side of the diaphragm. The temperature sensing bulb which is clamped to the evaporator outlet tube usually contains R-12. As evaporator outlet temperature rises, the R-12 expands and exerts pressure against the diaphragm to open the valve further and admit more refrigerant into the evaporator for increased cooling. As evaporator outlet temperature falls, the pressure against the diaphragm is decreased. Inlet pressure on the opposite side of the diaphragm then starts closing the valve. The cycle is repeated over and over again. Actually, the expansion valve is never completely open or closed when the system is in operation.

COMPRESSOR UNIT

The evaporated refrigerant leaving the evaporator (now in the form of a gas) at a pressure of 12 to 50 psi is pumped by the compressor, located on the engine (Fig. 2), into the top of the condenser.

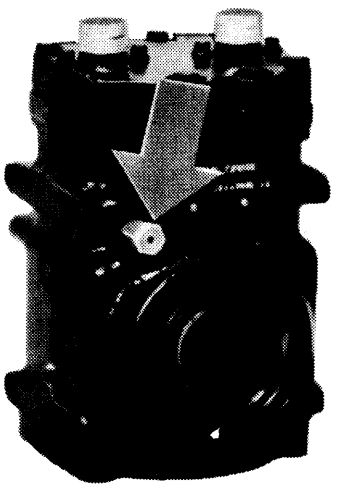


FIG. 2 Compressor

The compressor maintains a pressure on its high pressure side of from 120 to 300 psi, depending on the surrounding air temperature and compressor speed. A pressure relief valve is located on the compressor to relieve excessive refrigerant pressures.

CONDENSER

The air conditioning condenser is located in front of the radiator on light trucks and E-100—E-350. The condenser receives compressed (therefore heated) refrigerant gas from the compressor.

As the hot refrigerant gas flows down through the condenser, it is cooled by air passing between the sections of the condenser. The cooled, compressed refrigerant gas condenses to liquid refrigerant which then flows into the receiver.

LIQUID SIGHT GLASS

A liquid sight glass is mounted in the high pressure (liquid) refrigerant line between the receiver and the

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expansion valve (Fig. 1). The sight glass is used to check whether there is enough liquid refrigerant in the system.

MAGNETIC CLUTCH

The compressor is cut in and out of operation by an electrically operated magnetic clutch mounted on the compressor crankshaft. The magnetic clutch is connected in series with the clutch switch and the thermostatic de-icing switch.

THERMOSTATIC (DE-ICING) SWITCH

F-100 Through F-350, Bronco and E-100—E-350

The thermostatic (de-icing) switch is used along with the control assembly to control the operation of the compressor with the magnetic clutch. When the function control lever is in the A/C position, the electrical circuit is completed to the thermostatic switch by the clutch switch integral with the control assembly (Fig. 3).

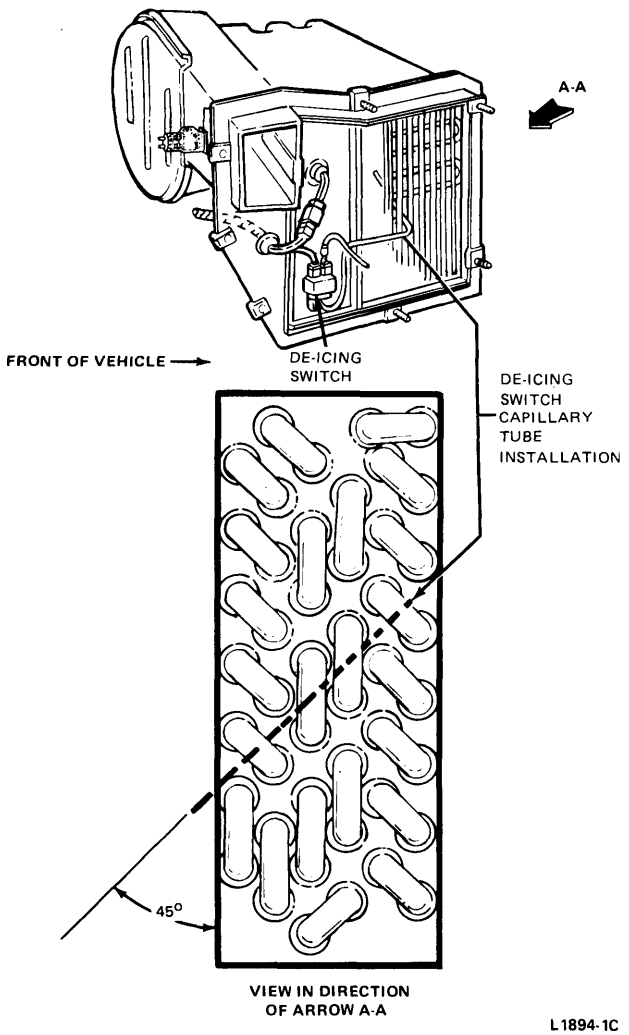


FIG. 3 Thermostatic De-Icing Switch Capillary Installation (F-Series Truck and Bronco)

The temperature sensing tube of the switch is inserted between the evaporator core fins. When the temperature of the evaporator core becomes too cold, the switch automatically opens the magnetic clutch electrical circuit which stops compressor operation. When the temperature of the evaporator rises, the thermostatic switch closes to energize the clutch for compressor operation.

SERVICE VALVES

All Except E-100—E-350

The manual service valves on the compressor are used to facilitate testing and servicing the cooling system (Fig. 4). The high pressure service valve, mounted at the outlet to the compressor, (from compressor to condenser), allows service access to the high pressure side of the system for attaching a refrigerant service hose with attached pressure gauge.

The low pressure service valve, mounted at the inlet to the compressor, allows service access to the low pressure side of the system for attaching a refrigerant service hose with attached pressure gauge.

Both service valves may be used to shut off the rest of the system from the compressor during compressor service operations.

SERVICE ACCESS GAUGE PORT VALVES—E-100—E-350

These valves are similar to a tire valve (Fig. 5). The service valve in the high pressure line, (from compressor to condenser), allows access to the high pressure side of the system for attaching a service hose and pressure gauge. The service valve in the low pressure line, (from evaporator to compressor), allows access to the low pressure side of the system for attaching a service hose and pressure gauge (Figs. 5 and 6).

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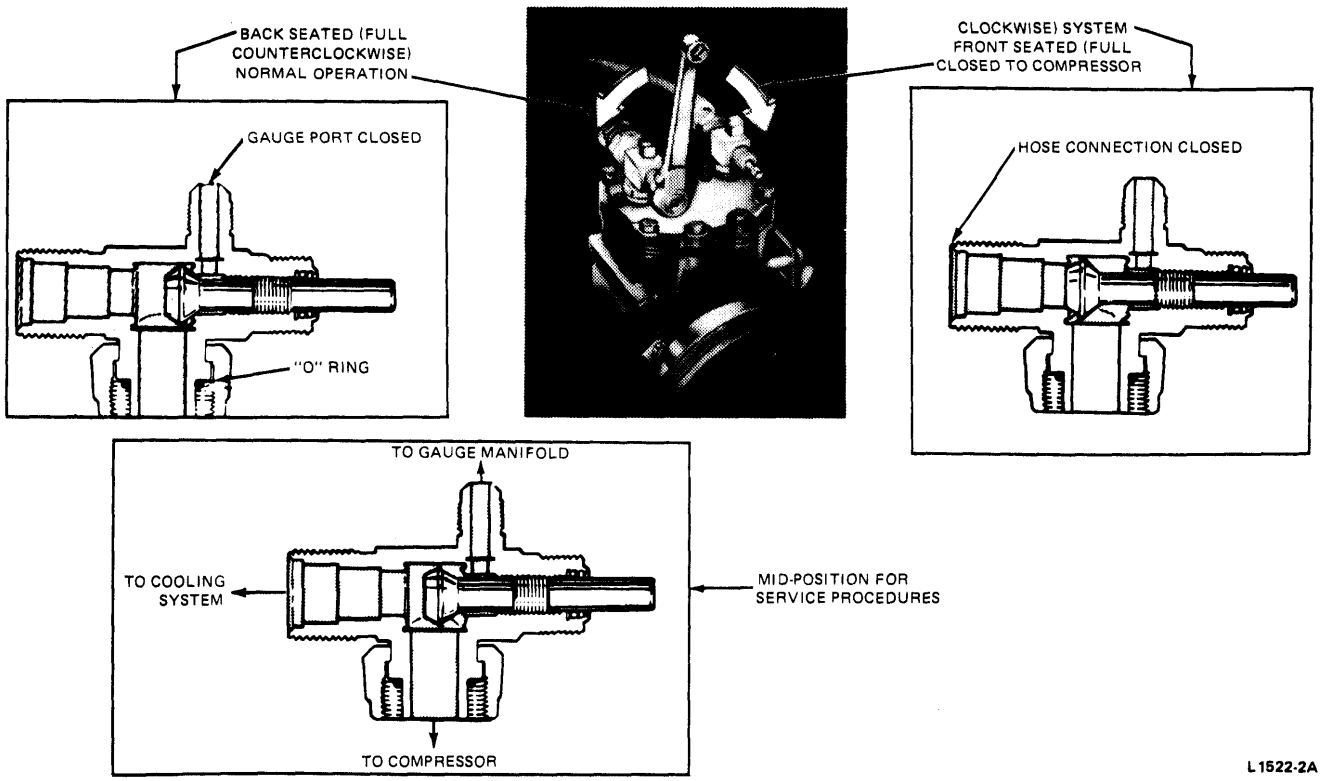


FIG. 4 Manual Service Valve Positions

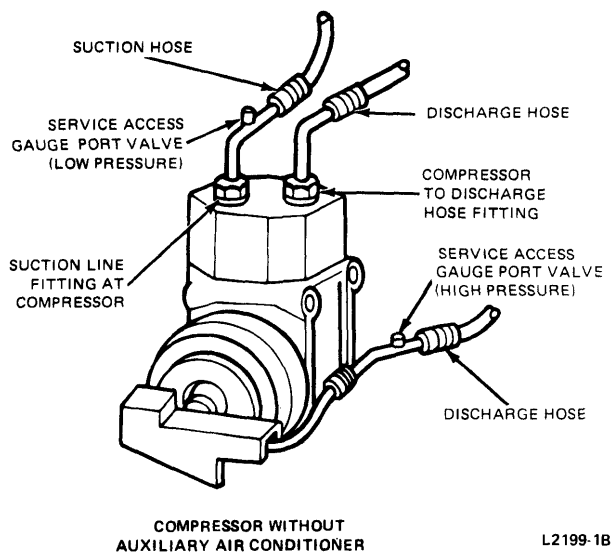


FIG. 5 Service Access Gauge Port Valve—E-100—E-350

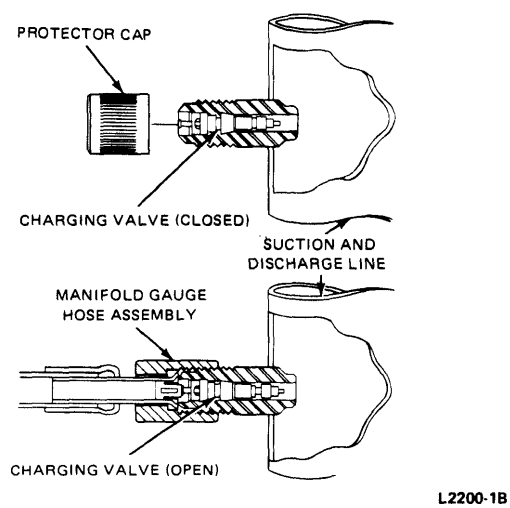


FIG. 6 Service Access Gauge Port Valve—E-100—E-350

DIAGNOSIS AND TESTING

SAFETY PRECAUTIONS

The refrigerant used in the air conditioner system is Refrigerant-12. Refrigerant-12 is non-explosive, non-flammable, noncorrosive, has practically no odor, and is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit.

Use only Refrigerant-12. Do not use refrigerant that was canned for pressure operated accessories (such as boat air horns). This type is not pure Refrigerant-12 and will cause a malfunction.

Liquid Refrigerant-12, at normal atmospheric pressures and temperatures, evaporates so quickly that it has the tendency to freeze anything it contacts. For this reason, **be very careful to prevent any liquid**

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refrigerant from coming in contact with the skin and especially the eyes.

Refrigerant-12 is readily absorbed by most types of oil. It is therefore recommended that a bottle of sterile mineral oil and a quantity of weak boric acid solution be kept nearby when servicing the air conditioning system. **Should any liquid refrigerant get into the eyes, immediately use a few drops of mineral oil to wash them out, then wash the eyes clean with a weak boric acid solution. Seek a doctor's aid immediately even though irritation may have ceased.**

Always wear safety goggles when servicing any part of the refrigerant system.

The Refrigerant-12 in the system is always under pressure. Because the system is tightly sealed, heat applied to any part would cause this pressure to build up excessively.

To avoid a dangerous explosion, never weld, use a blow torch, solder, steam clean, bake body finishes or use any excessive amount of heat on or in the immediate area of any part of the air cooling system or refrigerant supply tank, while they are closed to the atmosphere whether filled with refrigerant or not.

The liquid refrigerant evaporates so rapidly that the resulting refrigerant gas will displace the air surrounding the area where the refrigerant is released. To prevent possible suffocation in enclosed areas, always discharge the refrigerant from an air cooling system into the garage exhaust collector. Always maintain good ventilation surrounding the work area.

Although Refrigerant-12 gas, under normal conditions, is non-poisonous, the discharge of refrigerant gas near an open flame can produce a very poisonous gas. This gas will also attack all bright metal surfaces. This poisonous gas is generated when the flame-type leak detector is used. **Avoid inhaling the fumes from the leak detector. Make certain that Refrigerant-12 is both stored and installed in accordance with all state and local ordinances.**

When admitting Refrigerant-12 gas into the cooling unit, always keep the tank in an upright position. If the tank is on its side or upside down, liquid Refrigerant-12 will enter the system and damage the compressor.

VISUAL INSPECTION

Obstructed air passages, broken belts, disconnected or broken wires, loose clutch, loose or broken mounting brackets may be determined by visual inspection of the parts.

PROPER USE OF MANUAL SERVICE VALVES

The manually operated service valves are used throughout the service procedures in this section and in the following Adjustments (36-61).

When in the **Back-Seated** position, (Fig. 4), both valves are cut off from the manifold gauge port; the low pressure valve is open between the suction side of the compressor and the evaporator, and the high pressure valve is open between the discharge side of the compressor and the condenser. This is the normal operating position.

In the **Front-Seated** position, the low pressure valve cuts off the suction side of the compressor from the evaporator, and the high pressure valve cuts off the discharge side of the compressor from the condenser.

In the **Mid-Position** the valves are open between the manifold gauge port, the cooling system, and the compressor. This is the position used in performing various tests and service operations.

ATTACHING THE MANIFOLD GAUGE SET TO SCHRADER TYPE SERVICE ACCESS GAUGE PORT VALVES—E-100—E-350

When performing any of the various tests, test equipment must be connected to the system. If charge station type of equipment is used, follow the instructions of the manufacturer.

To attach a manifold gauge set to the Schrader type service access gauge port valves, proceed as follows:

1. Turn both manifold gauge set valves fully clockwise to close the high and low pressure hoses at gauge set refrigerant center outlet hoses (Fig. 7).

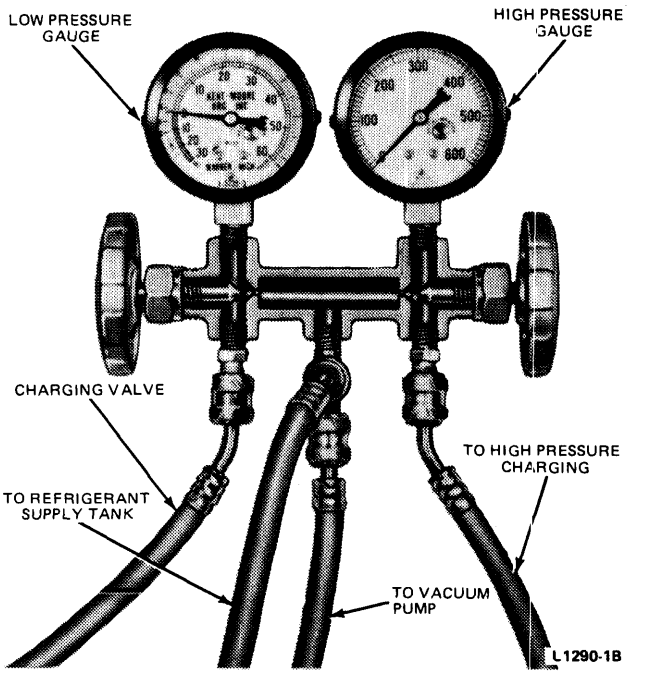


FIG. 7 Manifold Gauge Set

2. Remove the caps from the high and low pressure service (Schrader) access gauge port valves in the high and low pressure lines at the compressor (Figs. 5 and 6).
3. If the refrigerant hoses do not have the valve depressing pins in them, install fitting adapters T71P-19703-S and R on the manifold gauge set low and high pressure hoses.
4. Connect the high and low pressure refrigerant hoses with adapters, to the respective high and low pressure service access gauge port valves at the compressor.

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ATTACHING THE MANIFOLD GAUGE SET TO MANUAL SERVICE VALVES

1. Turn both manifold gauge set valves fully clockwise to close off the high and low pressure hoses of the gauge set from the manifold center hose outlet (Fig. 7).
2. Remove the caps from the high and low pressure manual service valves (Fig. 4).
3. Connect the hose attached to the manifold gauge set high pressure gauge to the high pressure (DISCHARGE) service valve.
4. Connect the hose attached to the manifold gauge set low pressure gauge to the low pressure (SUCTION) service valve.

COMPRESSOR TEST

REFRIGERANT SYSTEMS WITH MANUAL SERVICE VALVES

1. Attach the low pressure hose of the manifold gauge set (Fig. 7). It will not be necessary to attach the high pressure hose to the Refrigerant-12 tank or the vacuum pump.
2. Set both manifold gauge set valves at full clockwise (closed) position.
3. Turn the low pressure manual service valve to the Front-Seated (full clockwise) position.
4. Disconnect the bullet wire connector to the compressor clutch coil.
5. With the engine running at idle speed, set the A/C controls to maximum cooling (to engage the compressor clutch) and connect the clutch coil bullet wire connector **for 30 seconds only. Then, to avoid damaging the compressor, quickly disengage the clutch by disconnecting the clutch coil bullet wire connector.**

The low pressure (suction) gauge should reach 20 inches of vacuum within the 30 seconds of operation and should remain below zero psi for at least one minute.

If the compressor does not satisfy these two conditions after at least 3 cycles of clutch engagement, the compressor has either a blown head gasket or leaking valves. Remove the head and inspect the valve plate and gaskets for damage. Replace parts if necessary. Replace a compressor, if the cylinder walls are scored or pieces of metal are imbedded in the pistons.

CHECKING FOR LEAKS

Attach the manifold gauge set (Fig. 7). Leave both manifold gauge set valves at the maximum clockwise position. Set both manual service valves (if so equipped) at the center position. Both gauges should show approximately 60 to 80 pounds pressure at 75 degrees F with the engine not running. If very little or no pressure is indicated, leave the vacuum pump valve closed, open the Refrigerant-12 tank valve, and turn the low pressure (suction) manifold gauge set valve to the counterclockwise position. This opens the system to tank pressure. Check all connections, and the compressor head gasket, oil filler plug, and the shaft seal for leaks, using either the electronic leak detector, Rotunda Model No. 550007 or equivalent (Fig. 9), or a flame-type detector Rotunda model no. 230006 or equivalent (Fig. 8).

NOTE: Use compressed air to blow off excessive oil from the shaft seal area to reduce the possibility of an erroneous detection of freon retained in the refrigerant oil.

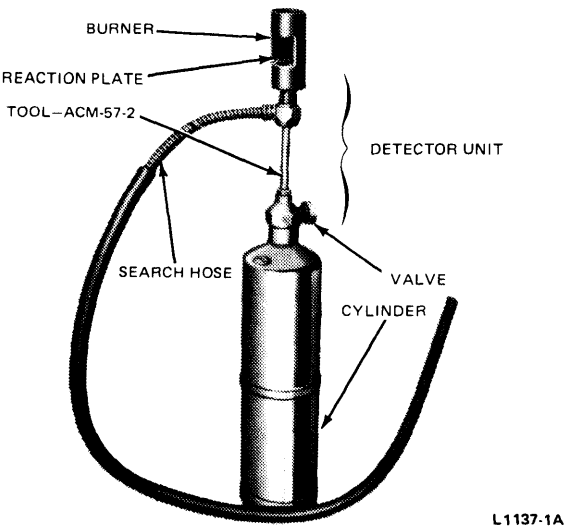


FIG. 8 Flame Type Leak Detector

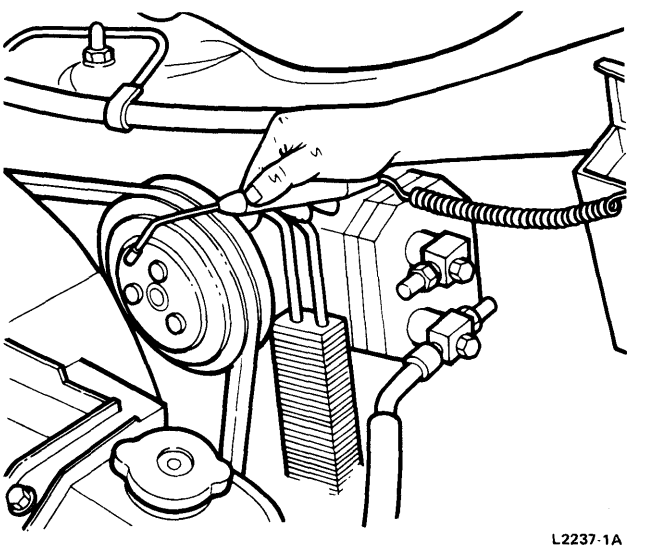


FIG. 9 Electronic Leak Detector

FLAME TYPE LEAK DETECTOR

Avoid inhaling the fumes from the leak detector. Follow the directions with the leak detector. The smaller the flame on the flame-type detector the more sensitive it is to leaks.

Therefore, to insure accurate leak indication keep the flame as small as possible. The copper element must be red hot. If it is burned away, replace the element. Hold the open end of the hose below each suspected leak point for two or three seconds. The flame will normally be almost colorless. The slightest leak will be indicated by a bright green blue color to the flame. Be sure to

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check the manifold gauge set and hoses for leaks as well as the rest of the system.

If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Good ventilation is necessary to prevent this situation. A fan, even in a well ventilated area, is very helpful in removing small traces of refrigerant vapor.

ELECTRONIC LEAK DETECTOR

The battery operated Electronic Refrigerant Leak Detector (Rotunda Model No. 550007), shown in Fig. 9, or equivalent, is an electronic instrument that will locate a much smaller type of refrigerant leak than can be detected by the flame-type leak detector. Follow the directions with the leak detector to insure absolute accuracy.

After the instrument has been calibrated, (according to the instructions), the Geiger counter ticking signal will speed up as the flexible probe head comes closer to the refrigerant leak. The toggle switch (on top, inside) should be in the **SEARCH** position when attempting to locate the general area of the leak. When the general area has been located, the unit should be switched to the **PINPOINT** mode of leak detection operation. **When the instrument is operating in the PINPOINT mode of operation, it will not signal until the tip of the probe is precisely on the refrigerant leak.**

USE OF SIGHT GLASS

Clean the sight glass before checking for a proper charge of refrigerant. Then, observe the sight glass for bubbles with the engine running at 1500 rpm and the A/C controls set at maximum cooling. A continuous or large amount of bubbles in the sight glass indicate an undercharge of refrigerant. If an undercharge of refrigerant is found, check the system for leaks. Repair any leaks, evacuate the system with a good vacuum pump, and charge the system with the proper amount of Refrigerant-12.

No bubbles in the sight glass immediately after clutch engagement indicates either too much refrigerant or a complete loss of refrigerant. While observing the sight glass, disengage and engage the bullet wire connector to the compressor clutch coil to cycle the magnetic clutch off and on, with the engine running at 1500 rpm. If a sufficient amount of refrigerant is in the system, bubbles will appear for a short period soon after the clutch is engaged and then disappear while the clutch is off and disappear when the clutch is on. If no bubbles appear during the on and off cycle of the magnetic clutch, there is no refrigerant in the system. If foam appears, it is an indication of a low charge condition. If there is little or no refrigerant in the system, it will be necessary to leak test, repair as required, and charge the system. **Under conditions of extremely high temperatures, occasional foam or bubbles may appear in the sight glass during normal system operation.**

EXPANSION VALVE TEST

In the properly operating standard refrigerant system, the expansion valve and capillary tube assembly will maintain the specified suction and discharge pressures for maximum refrigerant system efficiency.

Corrosion of the polished metal surfaces of the internal valve seat or valve stem in the expansion valve can cause erratic compressor suction and discharge pressures. This would be seen as a sudden increase in the discharge (high) pressure and, at the same time, the suction (low) pressure will suddenly decrease. The reverse might also happen; a sudden decrease in discharge (high) pressure combined with a sudden increase in the suction (low) pressure.

Refrigerant system contamination in the form of sludge or moisture may also cause a similar compressor suction and discharge pressure reaction. The blocking action of sludge in the valve seat will cause an increase in the compressor discharge pressure and a reduction of the suction pressure. When the sludge clears the valve seat opening, the discharge pressure will suddenly reduce and the suction pressure will suddenly increase. Moisture, on the other hand, may cause the valve to stick in any position. When stuck closed, the higher compressor discharge pressure and temperature will soon thaw the frozen area and release the refrigerant causing a sudden drop in compressor discharge pressure and increase in suction pressure. When stuck open, the increase in evaporator (suction) pressure and temperature aids in the thawing of the frozen area and the expansion valve begins to function again.

TO TEST THE EXPANSION VALVE:

1. Start the engine and run at fast idle (approx. 1500 RPM) with Maximum A/C and High blower speed for approximately 10 minutes.
2. Remove the insulation from the expansion valve temperature sensing bulb (Fig. 1). Remove the clamp and expose the bulb to the high engine compartment temperatures. The expansion valve should open with a resulting drop in compressor discharge pressure and an increase in compressor suction pressure.
3. Immerse the temperature sensing bulb into a container of salted, melting chipped ice or spray with liquid refrigerant. The expansion valve should close with a resulting increase in compressor discharge pressure and a reduction in compressor suction pressure.

   The compressor pressures observed in Steps 2 and 3 should be smooth and deliberate. If at any time, during the pressure change period, you should see a hesitation followed by a jump in the pressure gauge readings, the system may be contaminated and require cleaning. Corrosion of the valve stem may also be interferring with proper expansion valve operation.

   If the compressor discharge pressure does not increase when performing Step 3, the expansion valve will have to be replaced.

AIR CONDITIONER PERFORMANCE TEST

The pressures developed on the high pressure (discharge) and low pressure (suction) side of the compressor indicate whether or not the system is operating properly.

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Attach the manifold gauge set (Fig. 7). It will not be necessary to attach the Refrigerant-12 tank. Set both manifold gauge valves at the maximum clockwise, or closed, position. Set both manual service valves (if so equipped) at the mid-position.

Check the system pressures with the engine running at 1500 rpm, all controls set for maximum cooling, and the front of the vehicle at least 5 feet from any wall.

The actual pressures indicated on the gauges will depend on the temperature of the surrounding air and the humidity. Higher air temperatures along with high humidity, will give higher system pressures.

At idle speed and a surrounding air temperature of 100 to 110 degrees F, the high pressure may go as high as 300 pounds or more. If it becomes necessary to operate the air conditioner under these conditions, keep the high pressure down with a fan directed at the condenser and radiator.

Correct pressures for a normally operating system are shown in the Normal Cycling Clutch Refrigerant System Pressure Chart. Refer to the Problem Refrigeration System Pressure Evaluation Chart for systems with pressures other than shown in the normal pressure chart. Also note the Normal Center Register Discharge Air Temperature Chart.

REFRIGERANT SYSTEM MALFUNCTION DIAGNOSIS

The following refrigerant system diagnosis guides can be used to determine the system conditions for given complaints or apparent problems.

To check the refrigerant system pressures, connect the manifold set to the refrigerant system and operate the system on A/C maximum, COOL for 10-15 minutes to stabilize the pressure readings. Operate the engine at 1500 rpm to analyze the refrigerant system.

Refer to the Problem Refrigerant System Pressure Evaluation chart, the Normal Cycling Clutch Refrigerant System Pressures chart and the Normal Center Register Discharge Air Temperatures chart.

THERMOSTATIC DE-ICING SWITCH TEST

Fill a container with crushed ice, salt and water. Put enough salt in the water so that the temperature of the solution is 25 degrees F or lower (below 20°F on F-Series and Bronco).

Use a self-powered test light or ohmmeter connected to the switch terminals to check whether or not the switch is closed.

Place the sensing tube in the ice, salt and water solution. **Make certain that no salt water gets into the control.** The thermostatic (de-icing) switch (Fig. 3) contact points should open and remain open while the tube is in the solution. Remove the sensing tube from the solution. As the tube warms up, the switch contacts should close. If the switch contacts do not open and close as indicated, replace the switch.

An ohmmeter check of the contacts should show a resistance of less than one ohm. If a resistance of one ohm or more occurs, replace the switch.

RECEIVER—DRIER TEST

Operate the air conditioner for about five minutes; then, slowly move your hand across the length of the unit from one end to the other. There should be no noticeable difference in temperature. If cold spots are felt, it indicates that the unit is restricting the refrigerant flow, and the receiver-drier must be replaced.

MAGNETIC CLUTCH TEST

If the magnetic clutch does not pull in as it should, the battery should be checked for operating voltage (10.0 volts minimum). If the operating voltage is within specification, perform the following field coil tests.

MAGNETIC CLUTCH FIELD COIL CIRCUIT TEST

1. Disconnect the clutch field coil wire at the bullet connector near the compressor.
2. Connect a voltmeter between the clutch harness female connector and ground.
3. Place the A/C-Heater Control Assembly function control lever in the A/C position. Then, turn the ignition switch to ON. The system will not operate when the ignition switch is in the accessory position.
4. The voltmeter should read battery voltage.
5. If voltage is available at the clutch harness female connector, perform a Magnetic Clutch Field Coil Current Test.
6. If no voltage is available at the clutch feed wire female connector, check the de-icing switch and the clutch switch on the A/C-Heater control assembly for proper operation or disconnected wires.

   The de-icing switch should be closed when the evaporator core temperature is above approximately 45 degrees F. The clutch switch should be closed when the function control lever is in the A/C position. The internal resistance of the switches should not exceed one (1) ohm. Replace either switch if the contact resistance exceeds 1 ohm with the contacts closed.

MAGNET CLUTCH FIELD COIL CURRENT TEST

1. Disconnect the clutch feed wire at the bullet connector near the compressor.
2. Connect the negative (-) terminal of an ammeter to the field coil wire.
3. Connect the positive (+) terminal of the ammeter to the clutch feed female wire connector.
4. With the engine running and at operating temperature and the blower on High, the current draw should be between 2.7 and 3.7 amperes and an audible click should be heard to indicate clutch engagement. Maintain the current draw test for 5 minutes or longer if necessary if intermittent coil operation is suspected.
5. If the current draw is not within specification, disconnect the clutch feed female wire connector from the ammeter. Connect a jumper wire between

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PROBLEM REFRIGERANT SYSTEM PRESSURE EVALUATION CHART 1

For Cycling Clutch Systems

NOTE: Normal system conditional requirements must be maintained to properly evaluate refrigerant system pressures. Refer to chart applicable to system under test.

HIGH PRESSURE		LOW PRESSURE	POSSIBLE PROBLEM COMPONENTS
•LIQUID LINE	•COMPRESSOR		
HIGH	HIGH	HIGH	ENGINE OVERHEATING EXPANSION VALVE SENSING BULB — Poor Contact, Inadequate Insulation HEATER WATER VALVE — Insufficient Closure/ EVAPORATOR — Too Much Heat, Observe Conditional Requirements/ EXPANSION VALVE — Sticking Open
HIGH	HIGH	NORMAL TO HIGH	AIR IN REFRIGERANT SYSTEM
HIGH	HIGH	NORMAL	REFRIGERANT — Overcharge
HIGH	HIGH	LOW	COMPRESSOR-TO-CONDENSER A/C LINE — Restriction; After Service Access Valve
NORMAL TO HIGH	NORMAL TO HIGH	HIGH	CONDENSER — Inadequate Air Flow (Bent Fins, Debris, Loose Radiator Fan Belt, Slipping Fan Clutch)
NORMAL TO HIGH	NORMAL TO HIGH	NORMAL TO HIGH	HUMIDITY WELL ABOVE NORMAL EXCESSIVE REFRIGERANT OIL
NORMAL TO ERRATIC	NORMAL TO ERRATIC	NORMAL TO ERRATIC	MOISTURE IN REFRIGERANT SYSTEM — Affects Expansion Valve Function
ERRATIC	ERRATIC	ERRATIC	EXPANSION VALVE SENSING BULB — Kinked Capillary Tube
NORMAL TO LOW	NORMAL TO LOW	NORMAL TO LOW	EVAPORATOR — Restriction, Inadequate Air Flow — Reset Blower to Conditional Requirement and/or Confirm Blower Condition
LOW	HIGH	LOW	RECEIVER/DRIER — Restriction A/C LIQUID LINE — Restriction; Before Service Access Valve CONDENSER — Restriction
LOW	LOW	HIGH	A/C SUCTION LINE — Restriction; After Service Access Valve SUCTION ACCUMULATOR — Restriction; After Service Access Valve COMPRESSOR — Damaged Valves — (Inadequate compression)
LOW	LOW	LOW	A/C SUCTION LINE — Restriction; Before Service Access Valve SUCTION ACCUMULATOR — Restriction; Before Service Access Valve EVAPORATOR — Iced-up/CONDENSER — Plugged/ RECEIVER/DRIER — Plugged A/C LIQUID LINE — Restriction; After Service Access Valve/EXPANSION VALVE SENSING BULB — Perforated Bulb/EXPANSION VALVE — Sticking Closed REFRIGERANT LEAK AND/OR UNDERCHARGE COMPRESSOR-TO-CONDENSER A/C LINE — Restriction; Before Service Access Valve DE-ICING SWITCH — Sticking Closed/COMPRESSOR CLUTCH — Seized

ADDITIONAL POSSIBLE PROBLEM COMPONENTS ASSOCIATED WITH INADEQUATE COMPRESSOR OPERATION

COMPRESSOR CLUTCH — Slipping/COMPRESSOR DRIVE BELT — Loose/
CLUTCH COIL — Shorted coils; Slipping/CLUTCH COIL — Open Circuit/Blown Clutch Circuit Fuse/
DE/ICING SWITCH — Sticking Open/Improper Clutch Circuit Contact in Control Assembly Switch

ADDITIONAL POSSIBLE PROBLEM COMPONENTS ASSOCIATED WITH A WORN OR DAMAGED COMPRESSOR

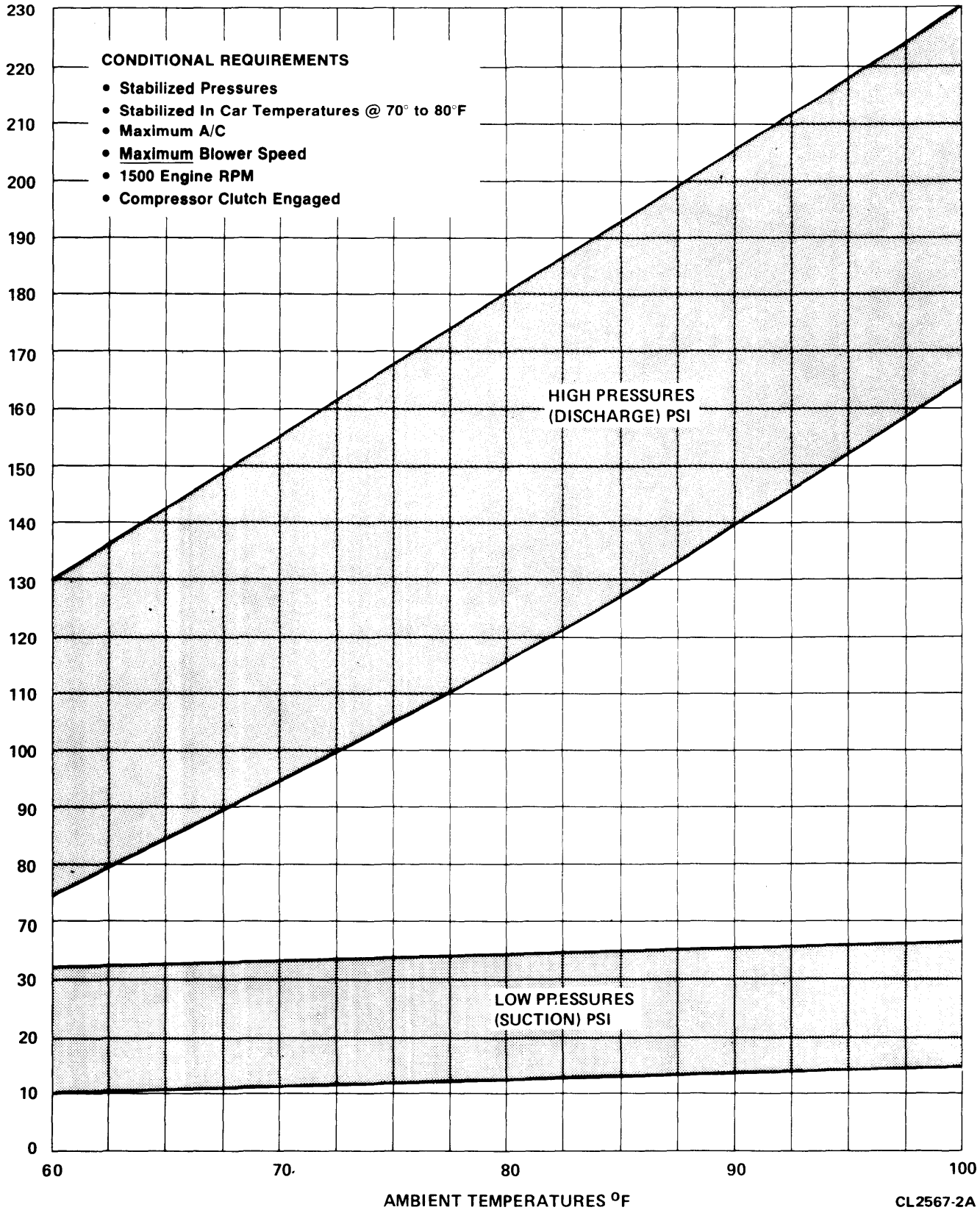
DE-ICING SWITCH — Sticking Closed/COMPRESSOR CLUTCH — Seized/REFRIGERANT LEAK

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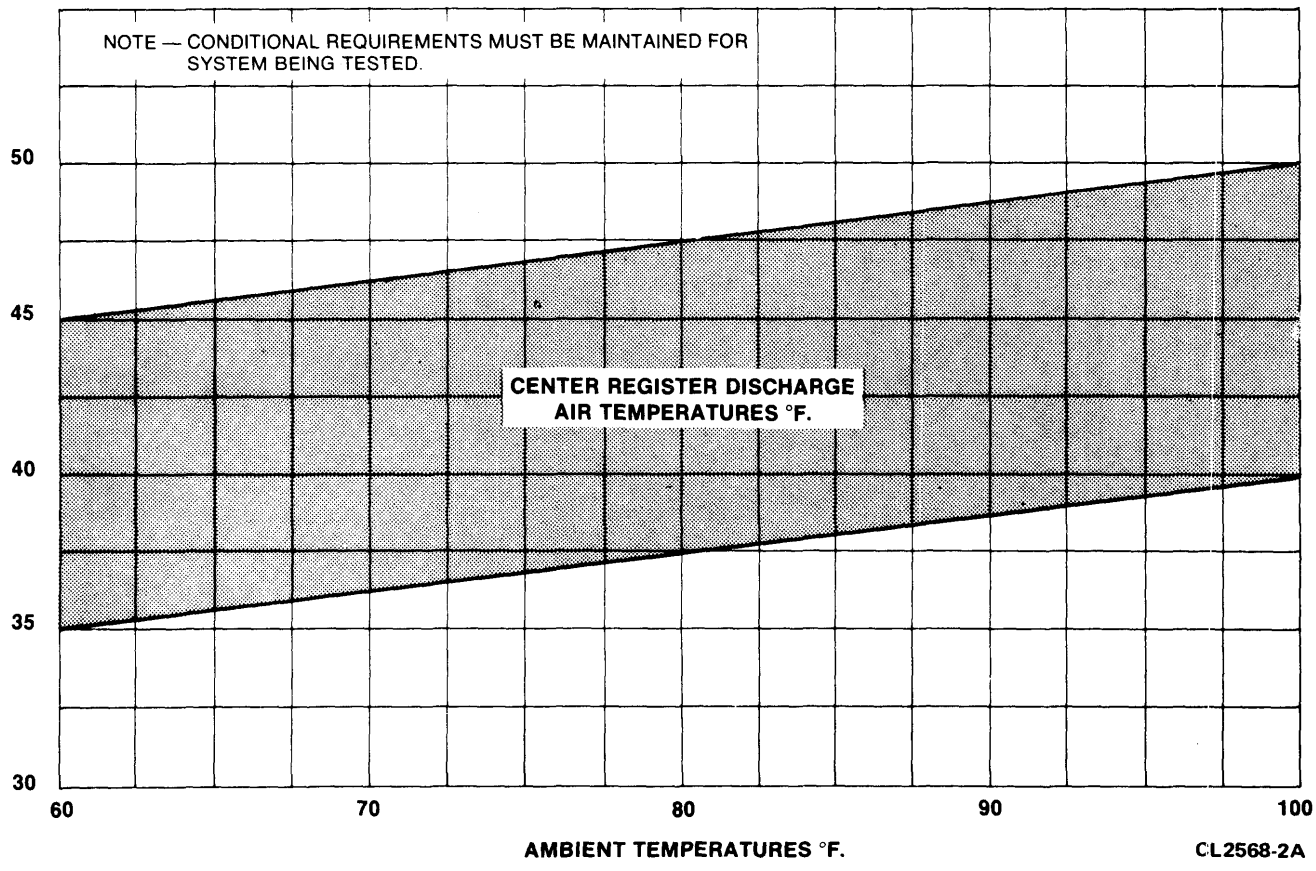
NORMAL CYCLING CLUTCH REFRIGERANT SYSTEM PRESSURES



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NORMAL CENTER REGISTER DISCHARGE AIR TEMPERATURES



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the battery positive (+) terminal and the ammeter positive (+) terminal and again check the current draw.

6. If the current draw is within specification, a high resistance is indicated in either the de-icing switch, the clutch switch or the connecting wires or connectors.
7. If the current draw is not within specification, connect a jumper wire between the clutch coil mounting plate and a good ground. Again check the clutch coil current draw.
8. If the current draw is still not between 2.7 and 3.7 amperes, replace the magnetic clutch field coil.

COMPRESSOR CRANKSHAFT SEAL LEAK TEST

The cross sectional view in Fig. 10 shows the design and the components of the seal assembly. Oil leak problems can be identified by observing the three possible leakage paths shown in Fig. 11.

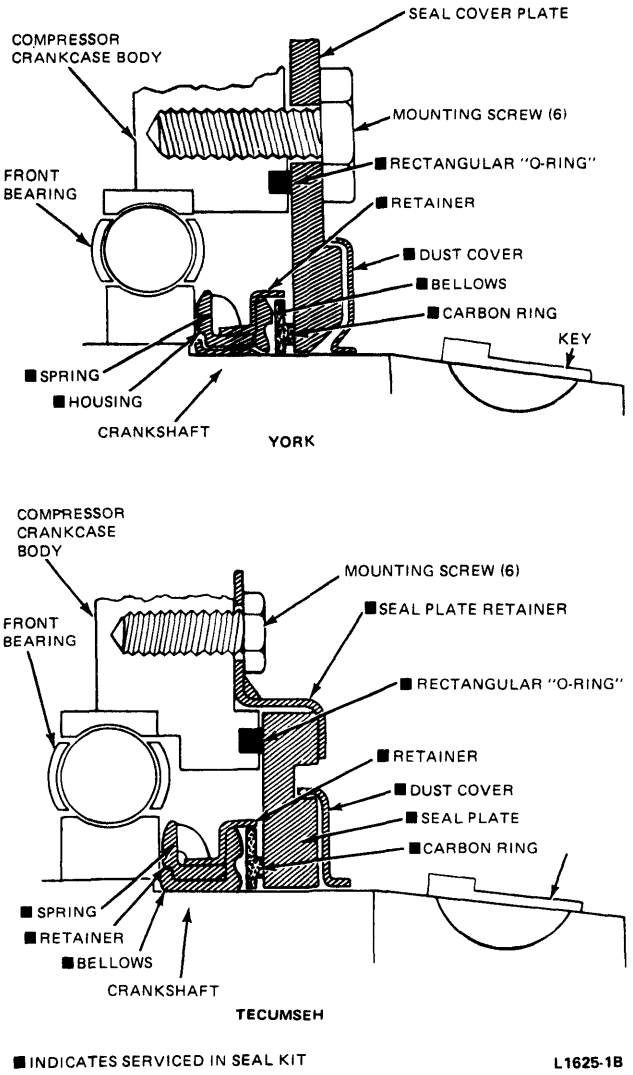


FIG. 10 Compressor Oil Seal—Cross-Sectional View

OIL LEAKAGE PAST CARBON RING

Oil weepage through the carbon ring forming a streak or drip pattern as shown in the left illustration of Fig. 11 is considered normal. However, if oil is present on the surface of the compressor beyond the clutch or has sprayed on the hood and surrounding brackets, the leakage is excessive. Replace the seal assembly.

OIL LEAKAGE THROUGH O-RING

Leakage through the O-ring type gasket on the cover plate (center illustration, Fig. 11) indicates possible cracked, pinched, split or loose mounting screws. Check the screws for good condition and proper torque (7 to 13 ft-lb). If there is heavy oil discharge with screws of good condition and correct torque, replace the oil seal assembly.

OIL LEAKAGE THROUGH DAMAGED BELLOWS

Oil will leak through the rubber bellows as shown in the right illustration of Fig. 11. If the bellows distorts or cracks due to heat, a large discharge of oil on the front of the compressor beyond the clutch indicates this type of leakage. Replace the oil seal assembly.

BLOWER MOTOR CURRENT DRAW TEST

MANUAL A/C HEATER SYSTEM

1. Disconnect the blower motor orange lead at the blower motor resistor.
2. Connect a jumper wire between the blower motor orange lead and the blower motor resistor (Fig. 12). Then, connect the voltmeter positive (+) lead to the jumper wire and the voltmeter negative (-) to a good ground.
3. With a fully charged battery and the engine OFF, operate the blower in all blower switch positions and record the voltage for each switch position.
4. On E-100—E-350 with an auxiliary unit, turn the main blower switch to low. Then, operate the auxiliary blower in all switch positions and record the voltage for each switch position at the auxiliary blower motor resistor (single connector plug).
5. Compare the voltage readings with the specifications given at the end of the Part covering the specific system.

BLOWER MOTOR VOLTAGE TEST

MANUAL A/C-HEATER SYSTEM

1. Connect a jumper wire in the blower motor orange lead at the in-line connector (Fig. 13).
2. Connect the positive lead of the voltmeter to the jumper wire and the negative lead of the voltmeter to a good ground (Fig. 13).
3. Operate the blower with the engine OFF and a fully charged battery in all blower switch positions. Record the voltage for each switch position.
4. On E-100—E-350 models with an auxiliary heater, turn the main heater blower switch to low. Then, operate the auxiliary blower in all switch positions

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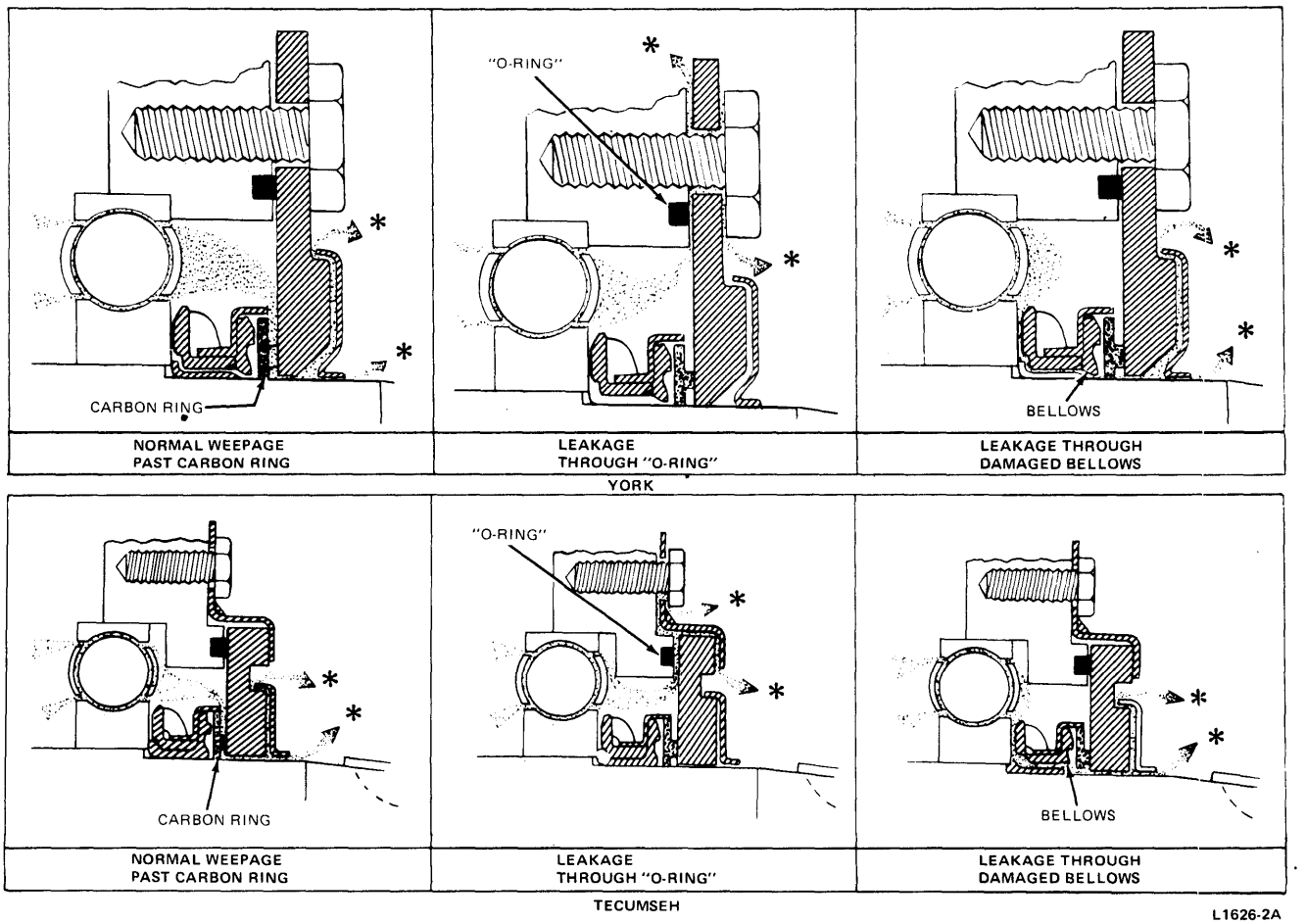


FIG. 11 Oil Leakage Paths—Compressor Oil Seal

while recording the voltage at the auxiliary blower motor resistor (single connector plug).

5. Compare the voltmeter readings with the specifications given at the end of the part in this manual covering the specific heater system.

REFRIGERANT-12 LEAKAGE

Refrigerant-12 leakage through any part of the seal can be determined only by a leak detector. **Avoid inhaling the fumes from the leak detector.** Be sure to wipe all the oil away from the seal area before using the leak detector, because the oil may contain refrigerant which would give erroneous readings. If refrigerant leakage at the seal exceeds 1 ounce per year, replace the seal as outlined in Removal and Installation.

If no leak is found at the compressor crankshaft seal, thoroughly check all system fittings and lines for leaks as outlined in this Section.

AIR CONDITIONING SYSTEM DIAGNOSIS

VACUUM SYSTEMS

To diagnose a vacuum controlled air conditioning system, install a vacuum gauge in the supply line on the system side of the check valve. Place the gauge under a wiper blade or anywhere it can be observed from the driver's seat. Move the control levers to the VENT position. Start the engine and let it run until a good vacuum gauge reading has developed. Shut-off the engine and watch the vacuum gauge. If the gauge reading falls, there is a vacuum leak in the line to or at one or more of the vacuum motors that should have vacuum applied. Move the function control lever to the HEAT position. Start the engine and build a good vacuum reading. Again, shut off the engine and watch the vacuum gauge. If the gauge reading falls, the vacuum leak will be in the supply line, the reservoir tank of the check valve. Continue this procedure through all of the control positions in the Vacuum Test Chart to isolate the vacuum motor or motors causing the problem in the system.

Refer to the specific vehicle part for the vacuum application chart on the system being tested.

ELECTRICAL OR REFRIGERANT SYSTEM

If the air conditioning problem is not a vacuum problem, follow the appropriate diagnosis guide to locate the electrical or refrigerant system problem. The Refrigerant Diagnosis System Guides can also be useful in your diagnosis. (Refer to Refrigerant System Diagnosis Section.)

To check the refrigerant system pressures, install the suction, (low pressure) gauge on the suction side of the compressor and the discharge (high pressure) gauge on the discharge side of the compressor. Operate the system on A/C, COOL and HIGH blower speed for 10-

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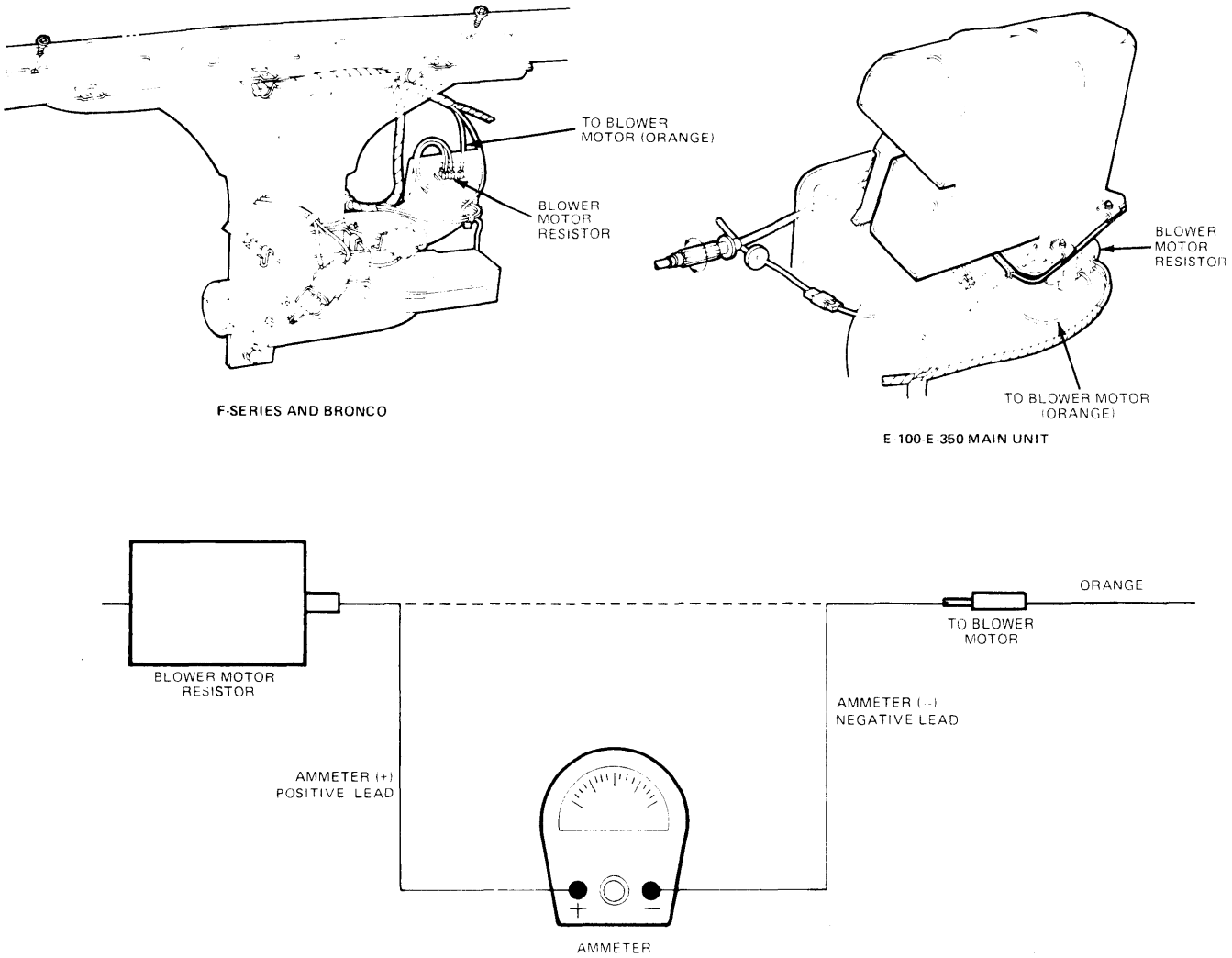


FIG. 12 Blower Motor Currrent Draw Test

15 minutes to stabilize the pressure readings. Operate the engine at 1500 rpm to analyze the refrigerant system.

If a refrigerant system has lost its charge or after making repairs to the refrigerant system, leak test, purge and then evacuate the system for at least 30 minutes with a good working vacuum pump. Refer to Refrigerant System Diagnosis for the vacuum pump test to determine the requirements of a good working vacuum pump.

Visual Check—Air Conditioning

1. Check A/C compressor drive belts for proper tension (100-120 pounds). Check compressor and pulley mounting bolts for looseness.
2. Start engine and adjust controls for A/C operation. Check to insure that compressor is operating. Check for proper air distribution and proper function of water valve.
3. Check A/C sight glass for indication of liquid. Cycle the clutch for assurance liquid is present (if there is any question about the presence of liquid, go to Step 8 below).
4. Check re-circulation inlet for air restrictions.
5. Check operation of outside/recirc. air door.
6. Check condenser for air flow restrictions.
7. Check for broken, burst, or cut hoses, and loose fittings on all A/C components.
8. Set engines RPM to between 1000 and 1200, A/C controls to max. A/C, temperature set to cool, high blower setting, doors and windows closed. Install thermometer in right register and refer to appropriate diagnosis guide if no repair has been made.

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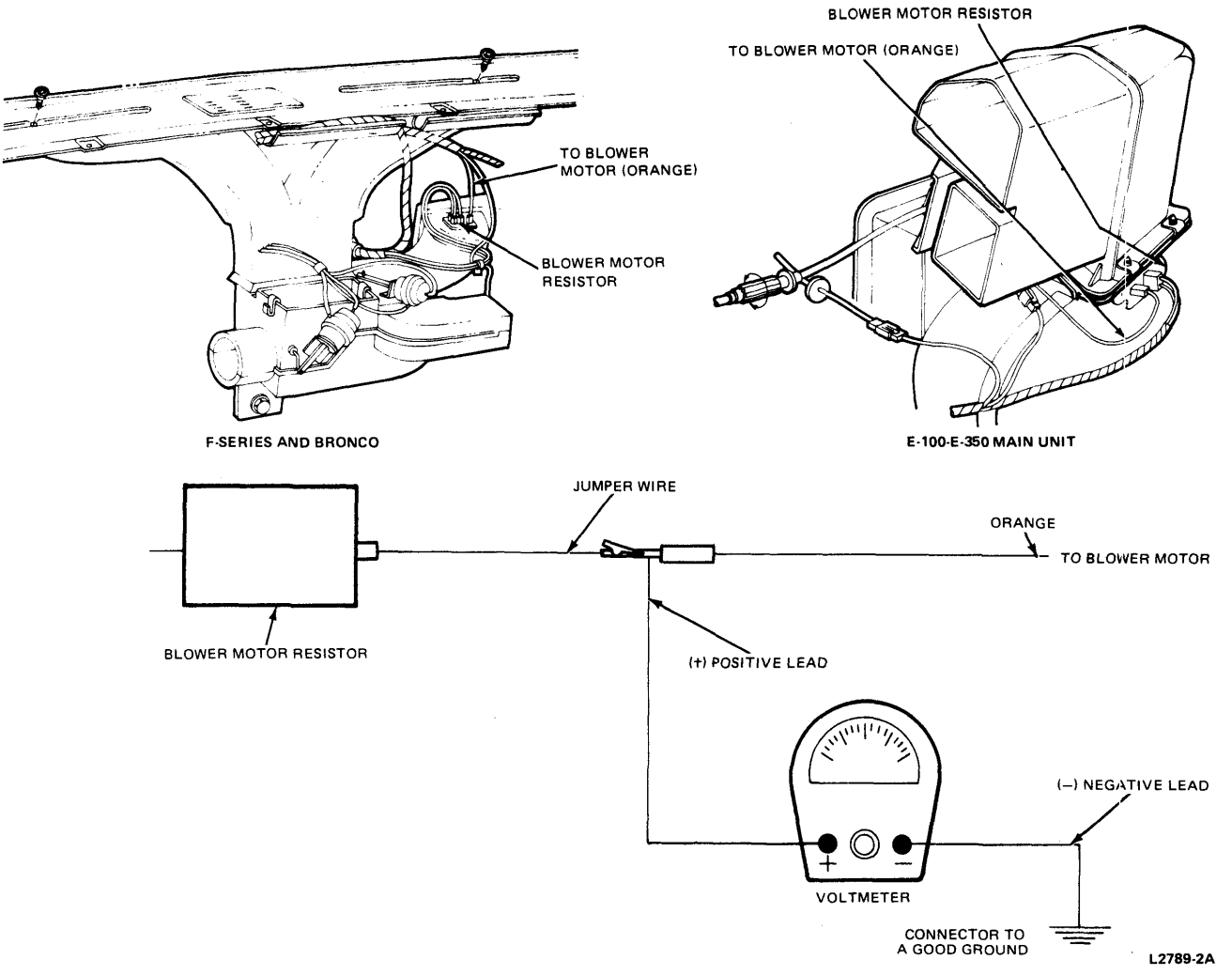
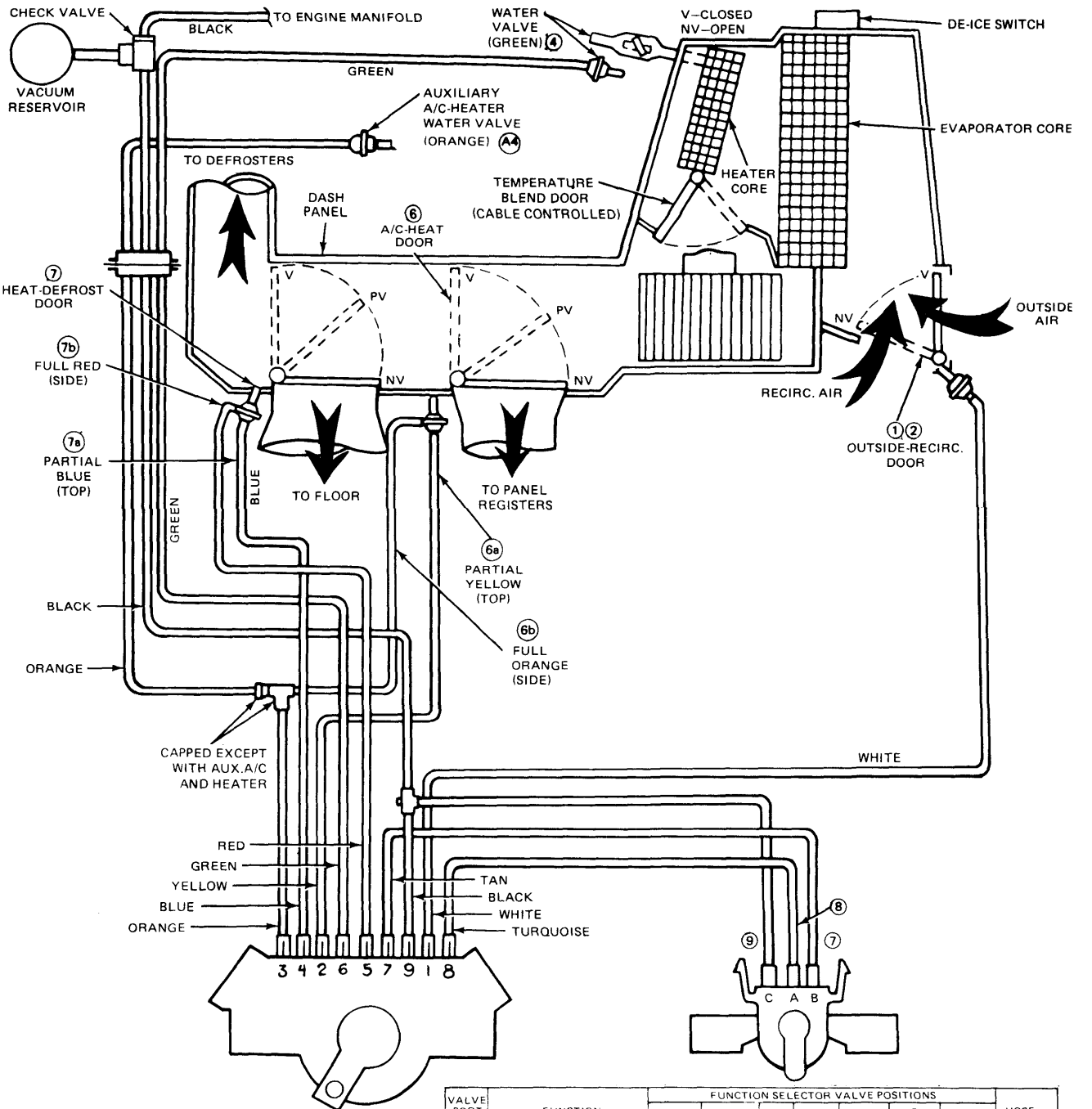


FIG. 13 Blower Motor Voltage Test

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VALVE PORT	FUNCTION	FUNCTION SELECTOR VALVE POSITIONS							HOSE COLOR
		OFF	VENT	A/C	HI-LO	HEAT	▽ (DEFOG)	DEFROST	
1	Outside-Recirc.	V		To 8					White 1-2
2	Partial A/C-Heat		V	V	V				Yellow 6A
3	Full A/C-Heat		V	V					Orange 6B
3	Aux. A/C Heater Water Valve		V	V					Orange
4	Partial Heat - Defrost		V	V	V	V	V		Blue 7A
5	Full Heat		V	V	V	V			Red 7b
6	To Engine Water Valve	V	V	To 7	To 7	To 7	To 7	To 7	Green 4
7	From Temp Valve Port B	Seal	Seal	To 6	To 6	To 6	To 6	To 6	Tan
8	From Temp Valve Port A	Seal	Seal	To 1	Seal	Seal	Seal	Seal	Turquoise
9	Source Vacuum	V	V	V	V	V	V	V	Black

PORT	FUNCTION	TEMPERATURE SELECTOR VALVE LEVER POSITIONS				HOSE COLOR
		COOL		TEMPERATURE	WARM	
C	Source Vacuum	V	V	V	V	Black
A	Outside-Recirc.	V				Turquoise
B	Water Valve	V	V			Tan

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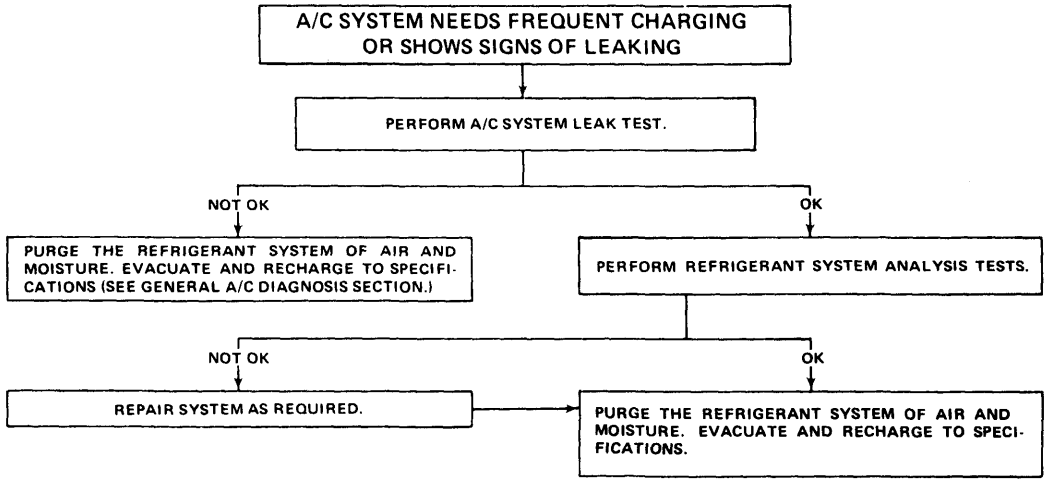
FIG. 14 Manual A/C-Heater System Vacuum Schematic and Selector Test—E-100—E-350

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DIAGNOSIS GUIDES

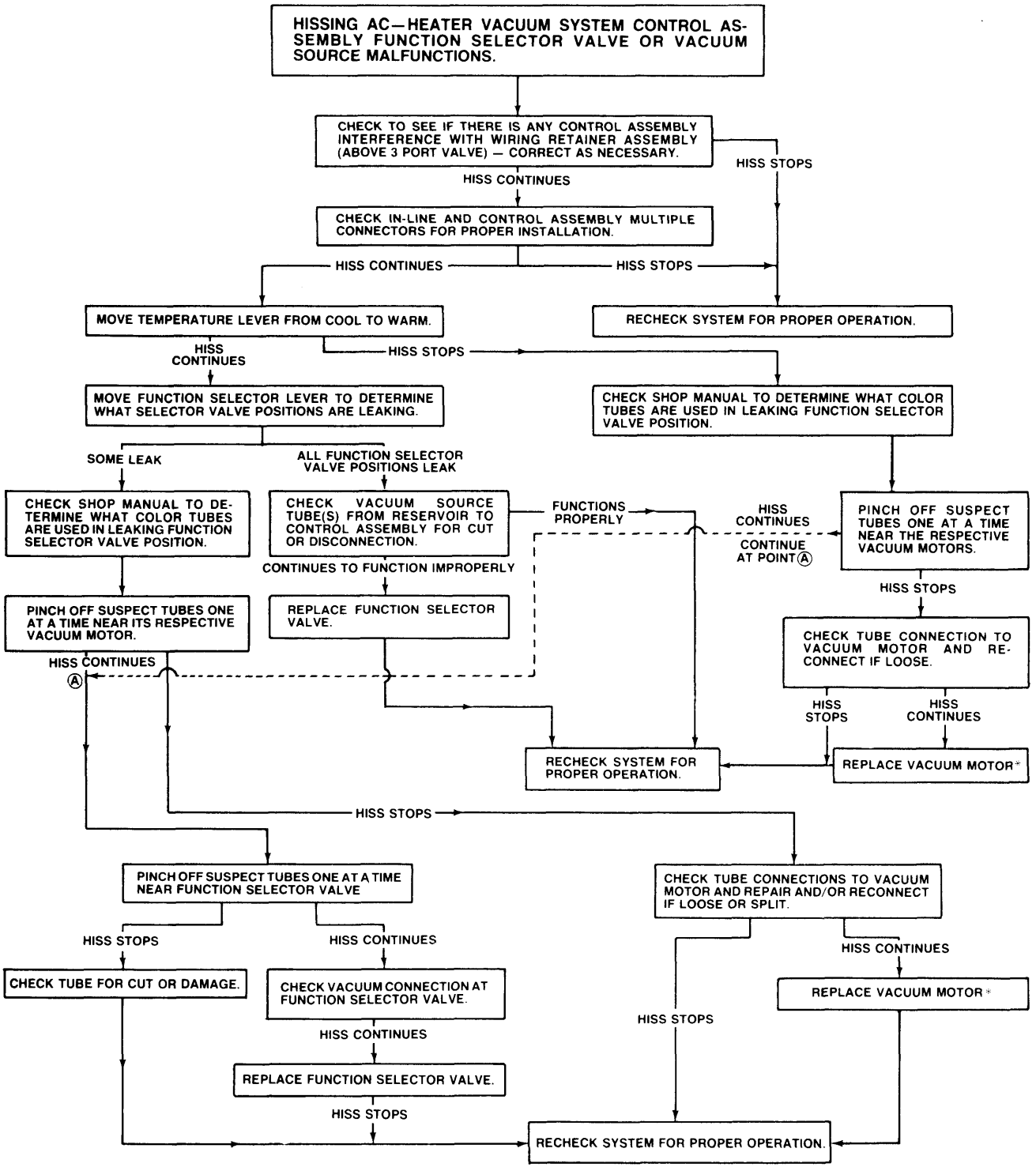
The following air conditioning system diagnosis guides can be used to determine the system conditions for given customer complaints. They should be used together with the appropriate wiring and vacuum diagrams to accurately diagnose and correct system problems.



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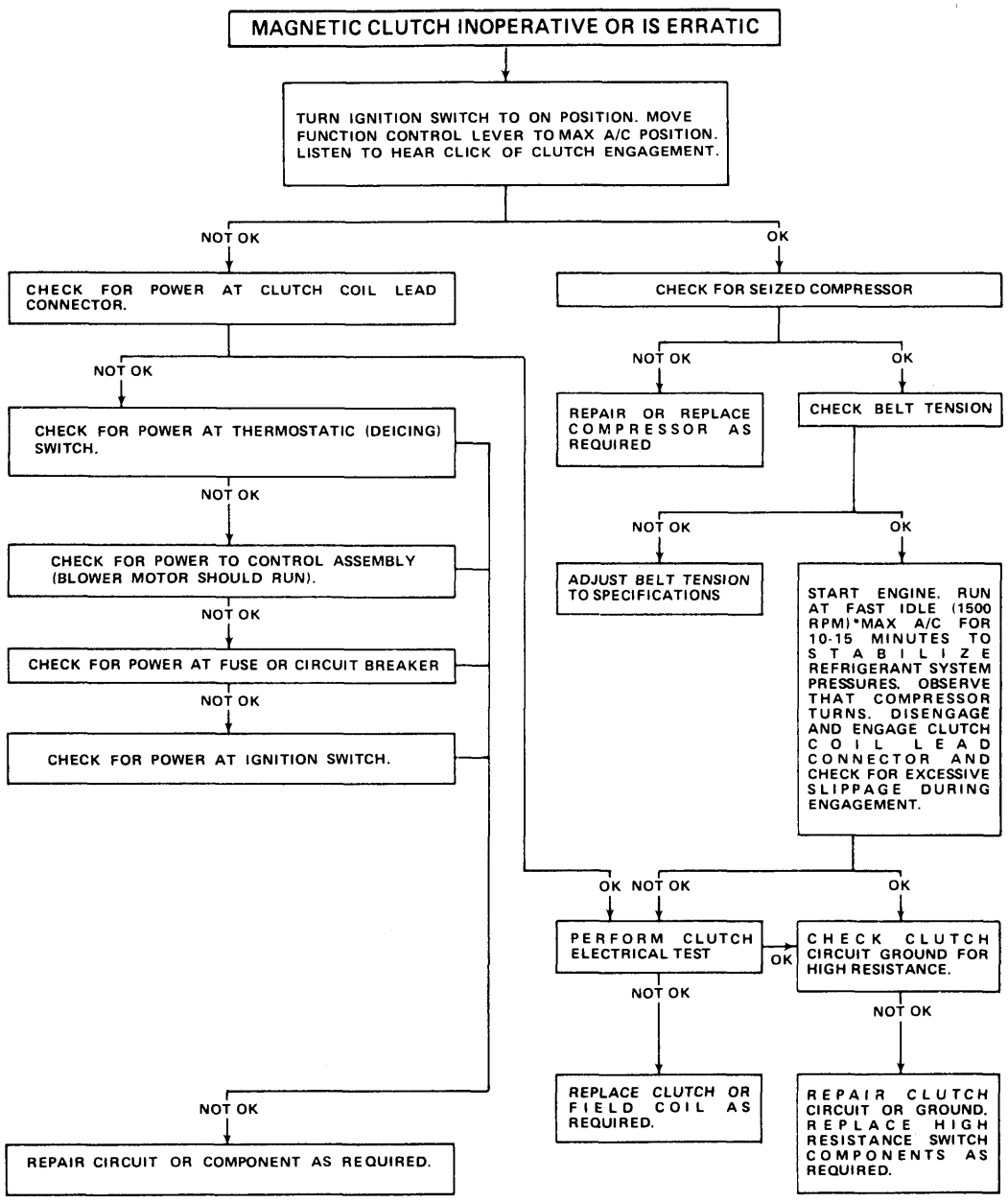


* NEVER MANUALLY OPERATE ANY VACUUM MOTOR OR VACUUM MOTOR CONTROLLED DOOR. THIS MAY CAUSE INTERNAL DAMAGE TO THE VACUUM MOTOR DIAPHRAGM.

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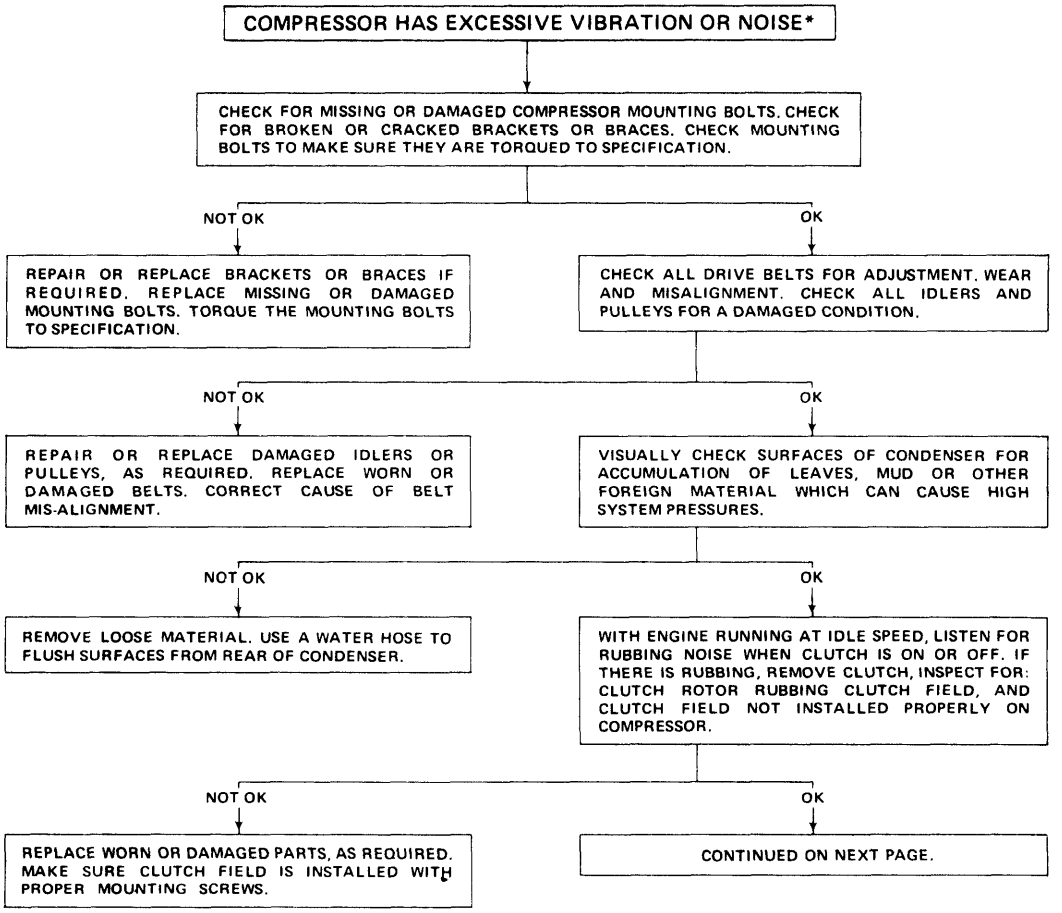
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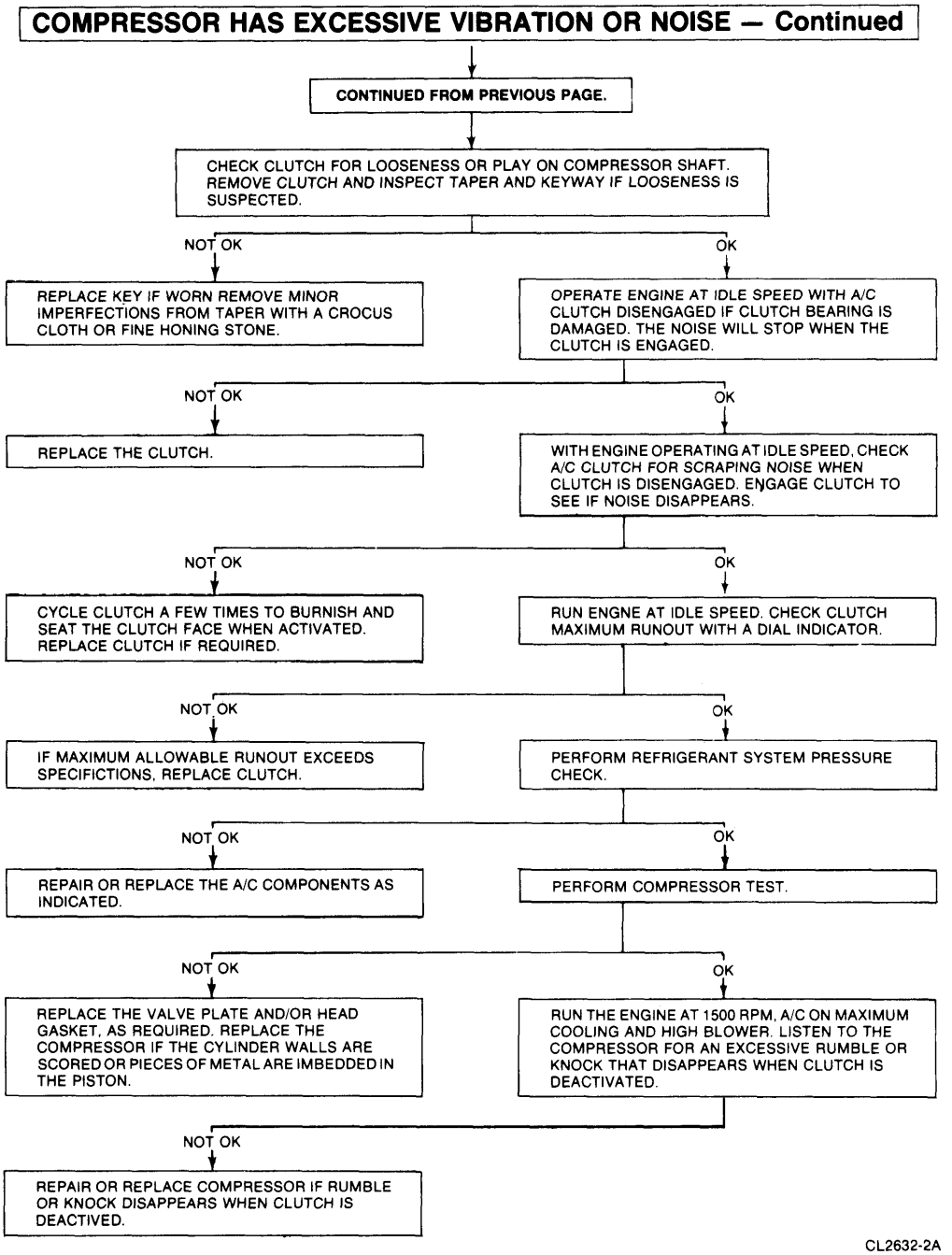


*SOME NOISE AND VIBRATION IS NORMAL IN ALL AIR CONDITIONING SYSTEMS. HIGH TEMPERATURES AND PROGRESSIVELY INCREASED SYSTEM PRESSURES WILL INCREASE THE NOISE AND VIBRATION LEVEL. THIS IS A NORMAL CONDITION. COMPARISON AND EXPERIENCE WITH AIR CONDITIONING SYSTEMS UNDER VARIOUS OPERATING CONDITIONS WILL TELL THE TECHNICIAN WHICH SYSTEMS ARE NOT CONFORMING TO THE NORMAL PUMPING SOUND AND VIBRATION PATTERNS MADE BY A PROPERLY FUNCTIONING COMPRESSOR.

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A/C-HEATER CONTROL ASSEMBLIES DIAGNOSIS

A hissing sound at the control assembly does not necessarily indicate a leaking vacuum selector valve. A major leak in the system will usually be heard at the control assembly.

If a hissing sound is heard, refer to the "Hissing A/C - heater vacuum system control assembly diagnosis guide.

ADJUSTMENTS

DISCHARGING THE SYSTEM

ALL EXCEPT E-100—E-350

Discharge the refrigerant from the system before replacing any part of the system, except the compressor.

To discharge the system, connect the manifold gauge set to the system (Fig. 7). Do not connect the manifold center connection hoses to the Refrigerant-12 tank or to the vacuum pump. Place the open end of these hoses in a garage exhaust outlet. Set both manifold gauge valves at the maximum counterclockwise or open

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position. Open both manual service valves a slight amount and allow the refrigerant to discharge slowly from the system.

Do not allow the refrigerant to rush out, because it will carry the compressor oil out with it.

E-100—E-350

When replacing any component in the air conditioning system, the system must be discharged. To discharge the system proceed as follows:

1. Remove the caps from the high and low pressure service access gauge port valves in the high and low pressure lines at the compressor (Fig. 5 and 6).
2. Turn both manifold gauge valves fully clockwise to close the gauge set to the center outlet hoses.
3. If the gauge set hoses do not have the service valve actuating pins, install fitting adapters T71P-19703-S and R, or equivalent, on the manifold gauge low and high pressure hoses.
4. Connect the high and low pressure gauge hoses with adapters, to the respective high and low pressure service access gauge port valves at the compressor.
5. Place the open end of the center hose in a garage exhaust outlet.
6. Slowly de-pressurize the refrigeration system by opening the low pressure gauge valve a slight amount and allowing the refrigerant to discharge slowly from the system.
7. After the system is nearly discharged, open the high pressure gauge valve very slowly to avoid losing an excessive amount of refrigerant oil and allow any refrigerant remaining in the compressor and high pressure line to discharge.

EVACUATING THE SYSTEM

ALL EXCEPT E-100—E-350

Attach the manifold gauge set, a tank of Refrigerant-12 and a vacuum pump to the system (Fig. 7). The Refrigerant-12 tank should be set on a scale and its weight noted so that the proper amount of refrigerant will enter the system during charging. Make certain that the Refrigerant-12 tank valve is tightly closed. Set both service valves to the mid-position (Fig. 4 or 15). Open both manifold valves (Fig. 7). To release any pressure remaining in the system after discharging, loosen a hose connection. Then re-tighten all connections. Open the vacuum pump valve and run the pump until the low pressure gauge reads at least 25 inches, and as close to 30 inches of vacuum as possible. Continue vacuum pump operation for 20 to 30 minutes to boil any moisture out of the system. Close the pump valve. Turn off the pump.

E-100—E-350

1. Discharge the system.
2. Attach the tank of Refrigerant-12 and a vacuum pump to the manifold gauge set. Make certain the Refrigerant-12 tank valve is tightly closed.
3. Open both manifold gauge set valves.
4. Run the vacuum pump until the low pressure gauge reads at least 25 inches and as close to 30 inches of vacuum as possible. Continue vacuum pump operation for 20-30 minutes. Close both gauge valves and turn the pump off.

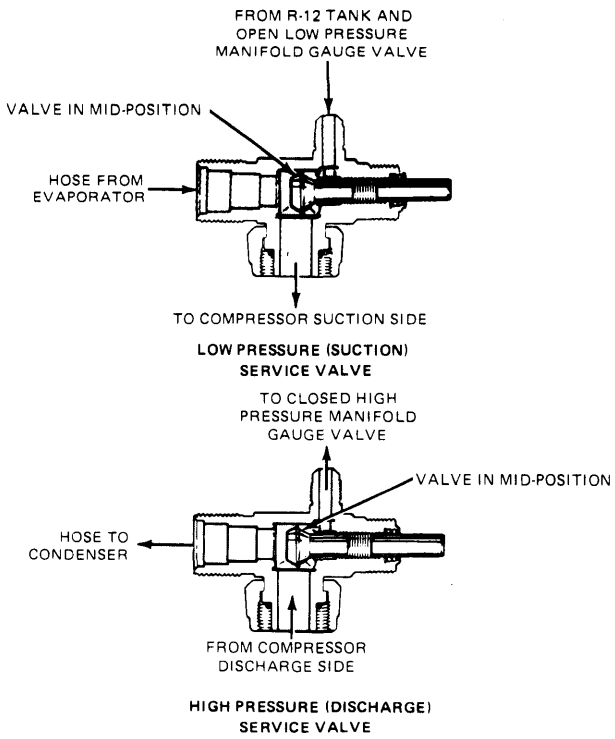


FIG. 15 Charging the Air Conditioning System—Manual Service Valves

CHARGING THE SYSTEM

ALL EXCEPT E-100—E-350

1. Evacuate the system as outlined in the foregoing procedure.

   Be sure to subtract the specified charge from the weight of the tank as registered on the scale so that you will know when to stop charging. For example, if the scale shows a total weight of 8 pounds and the specified charge is 2 1/2 pounds, you should stop charging when the scale shows 5 1/2 pounds.
2. Leave both service valves at the mid-position (Fig. 15) and the vacuum pump valve closed.
3. Leave the low pressure (suction) manifold gauge valve at the full counterclockwise or open position (Fig. 7).
4. **Set the high pressure (discharge) manifold gauge valve at the full clockwise or closed position.**
5. Open the Refrigerant-12 tank valve to allow refrigerant to enter the system, and observe the gauges. When both gauges reach 60 to 80 pounds at approximately 75 degrees F, shut off the tank valve.
6. Perform the leak test with the leak detector as outlined in this Part.
7. Set the temperature control at the maximum COLD position, the function control at the A/C position and set the blower switch at HI speed.

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8. Start the engine, and open the R-12 tank valve again to prevent drawing vacuum on the suction side. When the suction gauge shows pressure instead of vacuum, close the R-12 tank valve.
9. Run the engine at 1500 rpm for about ten minutes or until both gauge readings have stabilized. If the clutch disengages during the stabilization process, continue running the engine until the pressures again stabilize after the clutch re-engages.
10. With the engine still running, open the R-12 tank and charge the system until the scale indicates that the specified weight of R-12 refrigerant has entered the system. Then close the valve.
11. If the refrigerant will not enter the system due to low temperature, it may be necessary to place the Refrigerant-12 tank in a container of hot water at about 150 degrees F. This will increase the R-12 pressure and force the gas from the tank during charging. **Never heat the Refrigerant-12 tank with a torch. A dangerous explosion may result.**
12. During the charging, the high pressure (discharge) side may build up to an excessive value. This can be caused by an overcharge of refrigerant, or an overheated engine, in combination with high surrounding temperatures. Never allow the high pressure to exceed 240 pounds while charging. Stop the engine, determine the cause, and correct it.
13. After the proper charge has been made, close the Refrigerant-12 tank valve, and check the system pressures for proper operation as described under Air Conditioner Performance Test in this Part.
14. After satisfactory operation has been achieved, set both manual service valves at the maximum counterclockwise (gauge port closed) position (Fig. 4). Remove the manifold gauge set, and cap the manual service valve gauge ports and valve stems.

E-100—E-350

1. Discharge and evacuate the system as outlined in the foregoing procedures.
2. Leave the vacuum pump valve closed.
3. Set the low pressure (suction) manifold gauge valve at the full counterclockwise or open position.
4. Set the high pressure (discharge) manifold gauge valve at the full clockwise or closed position.
5. Open the Refrigerant-12 tank valve to allow refrigerant to enter the system, and observe the gauges. When both gauges reach 60 to 80 pounds at approximately 75 degrees F, shut off the tank valve.
6. Perform the leak test with the leak detector.
7. Set the A/C controls for maximum cooling.
8. Start the engine and open the R-12 tank valve again to prevent drawing vacuum on the suction side.
9. With the engine running at 1500 rpm, complete charging the system until the specified weight of refrigerant has entered the system.
10. If the refrigerant will not enter the system due to low temperature, it may be necessary to place the Refrigerant-12 tank in a container of hot water at about 150 degrees F. This will increase the R-12 pressure and force the gas from the tank during charging. Never heat the Refrigerant-12 tank with a torch. A dangerous explosion may result.
11. During the charging, the high pressure (discharge) side may build up to an excessive value. This can be caused by an overcharge of refrigerant, or an overheated engine, in combination with high surrounding temperatures. Never allow the high pressure to exceed 240 pounds while charging. If it does, stop the engine, determine the cause, and correct it.
12. After the proper charge has been made, close the Refrigerant-12 tank valve, and check the system pressures for proper operation. (Low pressure suction gauge 4-25 psi; high pressure discharge gauge 120-170 psi at 70 to 90 degrees F ambient).
13. After satisfactory operation has been achieved, disconnect the manifold gauge set high and low pressure hoses from the service valves (Fig. 6).
14. Install caps on the service valves and the manifold gauge set hoses.

CHARGING FROM SMALL CONTAINERS

Refrigerant-12 is available in fifteen ounce cans. **Do not open the manifold gauge set high pressure (discharge) gauge valve during the charging operation. To do so can cause the small refrigerant container to explode.**

1. A special valve and valve retainer is required for connecting the small can to the A/C system. Attach the valve retainer to the can by engaging the three tabs of the retainer to the lip at the top of the can. Turn the valve assembly into the threaded hole in the center of the valve retainer. In containers where the center of the can is deeply recessed, a washer should be inserted before installing the valve.
2. Connect the manifold gauge set to the system (Fig. 7). Connect the hose (normally connected to the large R-12 tank) to the special valve on the small can. **Make sure that the valve is closed (full clockwise position).**
3. Once the can is connected, charge the system as outlined in the foregoing procedure. When the can is empty, close the valve and remove the empty can. Connect a new can, open the valve again and continue charging until the specified weight of R-12 has entered the system.

When you need a half pound of refrigerant such as with a 2 1/2 pound charge capacity, stop charging from one can when extreme cold is felt half-way down the can. Weigh the can to make sure one-half pound of refrigerant is installed.

COMPRESSOR OIL LEVEL CHECK

Under normal conditions, when the air conditioning system is operating satisfactorily, the compressor oil level need not be checked. There is no place for the oil to go except inside the sealed system. When the engine is first started, some of the oil will be pumped into the rest of the refrigerant system. After several minutes of operation, most of the oil is returned to the compressor crankcase.

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Check the compressor oil level only if any portion of the refrigerant system is being replaced, or if there was a leak in the system and the refrigerant is being replaced.

1. After the system has been charged, operate the system for about ten minutes or until the pressures have been stabilized in a surrounding temperature of 60 degrees or above.
2. Stop the engine and isolate the compressor (F-Series and Bronco) as outlined in the following procedure, Isolating the Compressor.

   NOTE: Compressor cannot be isolated from rest of system on E-100—E-350. The entire system must be discharged.
3. Remove the oil filler plug from the vertical mounted compressor. Insert a flattened 1/8 inch diameter rod (Fig. 16) in the oil filler hole until it bottoms. The rod or dipstick fashioned for the particular compressor (Figs. 17 and 18) should be used. **The dipstick must be wiped completely clean before insertion.** If necessary, slightly rotate the compressor crankshaft by hand so that the dipstick will clear the crankshaft.

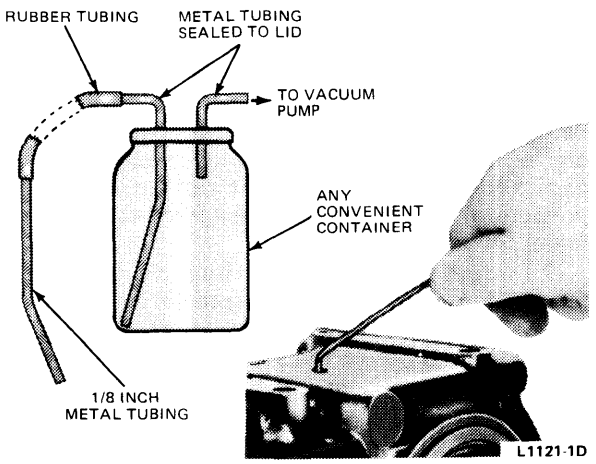


FIG. 16 Compressor Oil Level Check and Oil Trap

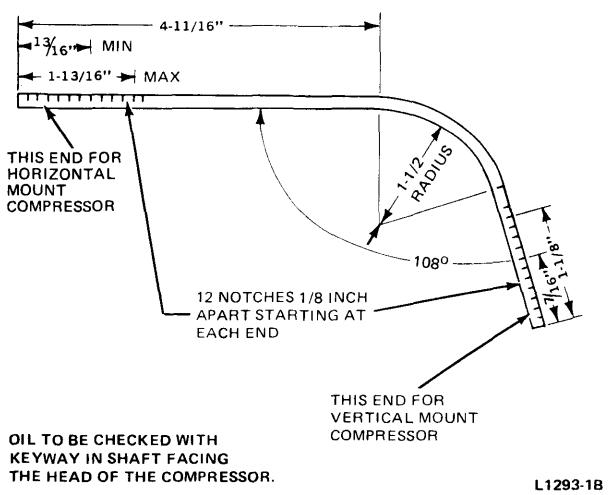


FIG. 17 York Compressor Oil Level Dipstick

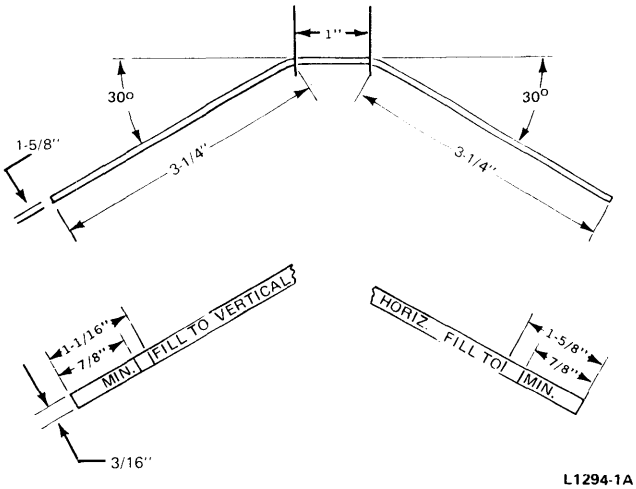


FIG. 18 Tecumseh Compressor Oil Level Dipstick

On horizontally mounted compressors, the oil check hole is located on the side of the crankcase that faces up. On the opposite or downward side, there is a corresponding boss provided on the inner wall as an alternate oil check hole for a different mounting. When checking the oil level on such a compressor, angle the dipstick so that it bottoms against the lower side of the crankcase and not against the boss.

On vehicles with the compressor installed on an angle, remove the compressor from the mounting bracket and check the oil with the compressor in a horizontal position.

4. Pull out the dipstick, and check the oil indication. It should show at least the minimum amount of oil as indicated in Figs. 17 and 18.

   If the oil level is low, add ESA-M2C31-A (Ford Part No. C9AZ-19577-A) oil or equivalent.

   If too much oil is indicated proceed as follows:

   a. Draw out all of the oil using a trap similar to that shown in Fig. 16, or remove the compressor from the vehicle and pour the oil out of the crankcase.
   b. Add approximately 4 oz. of oil to the crankcase, and replace the filler plug. Re-install the compressor, if it was removed.
5. Evacuate the compressor with the vacuum pump (both manual service valves front-seated (Fig. 4) and both manifold gauge valves open). On E-Series, leak test, evacuate and charge the system.)
6. Connect the compressor back into the system by turning both service valves to the back-seated (full counterclockwise) position (F-Series and Bronco).
7. Operate the system again for another 10 minutes as in Step 1, and re-check the oil level as in Steps 3 and 4.
8. Replace the oil filler plug. Evacuate and connect the compressor back into the system.
9. Operate the system again for five minutes and make a final oil level check.

   It is necessary to re-check the oil level a second time to be sure that all the oil has returned to the compressor.

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10. Replace the oil filler plug. Evacuate and connect the compressor back into the system.
11. Check the compressor filler plug area for leaks with a leak detector.

ISOLATING THE COMPRESSOR

This procedure can be performed only with manual service valves and is used when checking the compressor oil level or when it is desired to replace the compressor without losing the refrigerant charge. The compressor on E-Series cannot be isolated from the system.

To isolate the compressor from the system, turn both the high and the low pressure manual service valves to the extreme clockwise (front-seat) position (Fig. 6). Loosen the cap on the high pressure manual service valve gauge port, and allow the gas to escape until the compressor is relieved of refrigerant pressure.

Loosen the cap a small amount only, and do not remove it until the pressure is completely relieved.

To connect the compressor back into the system, evacuate the compressor with a vacuum pump at both manual service valve gauge ports, close the vacuum pump valve, turn both service valves to the maximum counterclockwise (back-seat) position, and cap the high pressure service valve gauge port and service valve stems.

PURGING THE REFRIGERANT SYSTEM TO REMOVE AIR AND MOISTURE VAPOR

For a system that contains only air or moisture vapor (no water) at the start of the evacuation, the Triple Evacuation Method is the fastest. This procedure involves evacuating the system three times to maximum vacuum. After the first and second evacuations, new R-12 is used to break the vacuum, bringing the system pressure up to 0 psi each time. After the third evacuation, the system is ready for charging.

The principle of the three evacuations is simple. The first pull-down removes about 90 percent of the air and moisture vapors.

The first purge with new, dry R-12 mixes with the remaining 10 percent.

With the next evacuation, this mixture will be drawn out so that only about 1 percent of the air and moisture vapors remain.

The second purge with new, dry R-12 will mix with this 1 percent...and the third evacuation will finish the job by drawing out practically all the remaining vapors.

But, if any water was present in the system at the start of this procedure most of it will still be there; because a short period of vacuum is not long enough to boil and vaporize the water. The R-12 purges, in passing over the liquid, will absorb only a relatively small amount of water.

This procedure is effective only when no water is in the system and should not be used if there is any indication of water in the system.

CLEANING A BADLY CONTAMINATED REFRIGERATION SYSTEM

A badly contaminated system presents a special problem and is the result of either using the wrong refrigerant oil, the compressor continuing to run during a refrigerant system failure, or improper cleaning following a previous failure. It may also be the result of prolonged operation with excessive moisture or water in the system.

If preliminary inspection shows that the system is badly contaminated with water, carbon and other decomposition products from the failure, it will be necessary to remove all these contaminants as well as clean and repair or replace the compressor and replace the receiver/drier.

FLUSHING REFRIGERANTS

A number of refrigerants may be used as flushing agents for cleaning a badly contaminated refrigerant system or the individual components. However, not many of them can easily be used. Some are more toxic to humans than others and serious side effects may result from exposure to them. The Safety Precautions should always be observed with handling any refrigerant.

Refrigerant as a flushing agent, must be in its liquid state in order to effectively wash the inside surfaces of the components. In its vaporized state, the vapor will not flush away the contaminant particles.

The Refrigerant Flushing Information Chart (Fig. 19) should be used to aid in the selection of the refrigerant to be used as a flushing agent. Of the four types of Refrigerants shown in the chart, two (R-12 and F-114) are better for usage when flushing equipment is **not** available for two important reasons: (1) Greater pressure at a given ambient temperature and (2) Least toxic to humans.

Remember, however, that as the ambient temperature increases, they become more difficult to use as a flushing agent because of their increased tendency to vaporize rather than remain a liquid.

The remaining two refrigerants (F-11 and F-113) listed in the Refrigerant Flushing Information Chart are better suited for usage with Special Flushing, (continuous circulation) Equipment. The lower pressure/temperature relationships will keep the closed system pressure lower and should reduce the danger of accidental discharge. F-11 is also available in pressurized containers. This makes it suitable for usage when special flushing equipment is not available; however, F-11 is more toxic than R-12 and F-114.

After the system or individual components have been cleaned, the excess flushing refrigerant should be removed. This is done by blowing out with Refrigerant-12 or nitrogen. Be sure to use a pressure regulator on the Nitrogen Supply Tank if nitrogen is used. The Nitrogen Supply Tank pressure is extremely high and serious damage can result if the supply tank is not regulated.

CLEANING THE SYSTEM COMPONENTS

Cleaning the refrigerant system components requires removal and replacement of some of the components and back flushing the condenser and evaporator assemblies. Periodic cleaning of the exterior surfaces of the condenser is helpful to permit good air circulation through the condenser fins.

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Refrigerant	Vaporizes @ °F	Approximate Closed Container Pressure @ 60° F	70° F	80° F	90° F	100° F	Adaptability
R-12	-21.6° F	57 PSI	70 PSI	84 PSI	100 PSI	117 PSI	Self Propelling
F-114	38.4° F	8 PSI	13 PSI	19 PSI	25 PSI	32 PSI	
F-11	74.7° F	8 in Hg	3 in Hg	1 PSI	5 PSI	9 PSI	*
F-113	117.6° F	22 in Hg	19 in Hg	16 in Hg	13 in Hg	8 in Hg	Pump Required

*F-11 is also available in pressurized containers. This makes it suitable for usage when special flushing equipment is not available. However, it is more toxic than R-12 and F-114.

CL2401-2B

FIG. 19 Refrigerant Flushing Information Chart

The Safety Precautions should be observed at all times. If the components in the following procedure are flushed with a refrigerant other than R-12, it is necessary to remove the excess flushing refrigerant by blowing out with Refrigerant-12 or with Nitrogen. If Nitrogen is used, a pressure regulator should be installed on the Nitrogen supply tank to reduce the extremely high Nitrogen Supply Pressure.

1. Discharge refrigerant system.
2. Remove compressor from vehicle for cleaning and repair or replacement. If the compressor is cleaned or repaired, add the specified amount of refrigerant oil to the compressor prior to installing it in the vehicle. If the compressor is replaced, the new compressor will contain the specified amount of refrigerant oil.
3. Remove expansion valve, clean out with small charge of R-12. Re-install using new "O" ring seal dipped in clean refrigerant oil.
4. Disconnect the suction line at the compressor and connect a length of 1/2 inch ID heater hose to the expansion valve connection of the evaporator core. Insert the other end of the heater hose into the garage exhaust system. From service hose components, fabricate a short refrigerant line to connect to the evaporator suction tube on one end and adapt to adaptor tool (Tool T73P-19703-A) on the other end. Then, back-flush the evaporator core with one pound of R-12.
5. Remove the fabricated hose and heater hose from the evaporator core. Install the expansion valve on the evaporator core using a new O-ring lubricated with clean refrigerant oil.
6. Remove the condenser and receiver/drier assembly. Disconnect the receiver/drier from the condenser and discard it.
7. Back-flush the condenser as follows:
   a. Install adaptor (Tool T73P-19703-A) to the condenser liquid line tube (Fig. 20).
   b. Connect a piece of 1/2 inch ID heater hose to the other end of the condenser liquid line tube and insert the hose into the garage exhaust system (Fig. 20, View B).
   c. Back-flush the liquid line with liquid Refrigerant 12.
   d. Remove the heater hose and adaptor from the condenser liquid line tube.
   e. Install the adaptor to the receiver/drier connection of the condenser.
   f. Connect a piece of 3/4 inch ID heater hose to the compressor discharge line and insert the hose into the garage exhaust system (Fig. 20, View C).
   g. Flush the condenser with one pound of liquid Refrigerant 12. Remove the adapter and heater hose.
8. Install a new receiver/drier assembly on the condenser and install the condenser and receiver/drier assembly in the vehicle. Use new O-rings lubricated with clean refrigerant oil.
9. Connect all refrigerant lines. All connections should be clean and use new O-rings lubricated with clean refrigerant oil. Tighten all connections securely with a back-up wrench to prevent component damage.
10. Connect Charging Station or Manifold Gauge Set and charge with one pound of R-12 Refrigerant **(DO NOT EVACUATE-UNTIL AFTER LEAK TEST).**
11. Leak test all connections and components with either a flame type or Electronic Leak Detector. If O.K., proceed with Step 12. If not O.K., repair leak and then proceed with Step 12.
12. Purge the system to remove air and moisture vapor.
13. Evacuate and charge the refrigerant system to specifications with R-12.
14. Perform oil level checks—after running for 10 minutes.
15. Performance Test the refrigerant system to assure quality cooling performance.

FLUSHING THE SYSTEM WITH SPECIAL FLUSHING EQUIPMENT

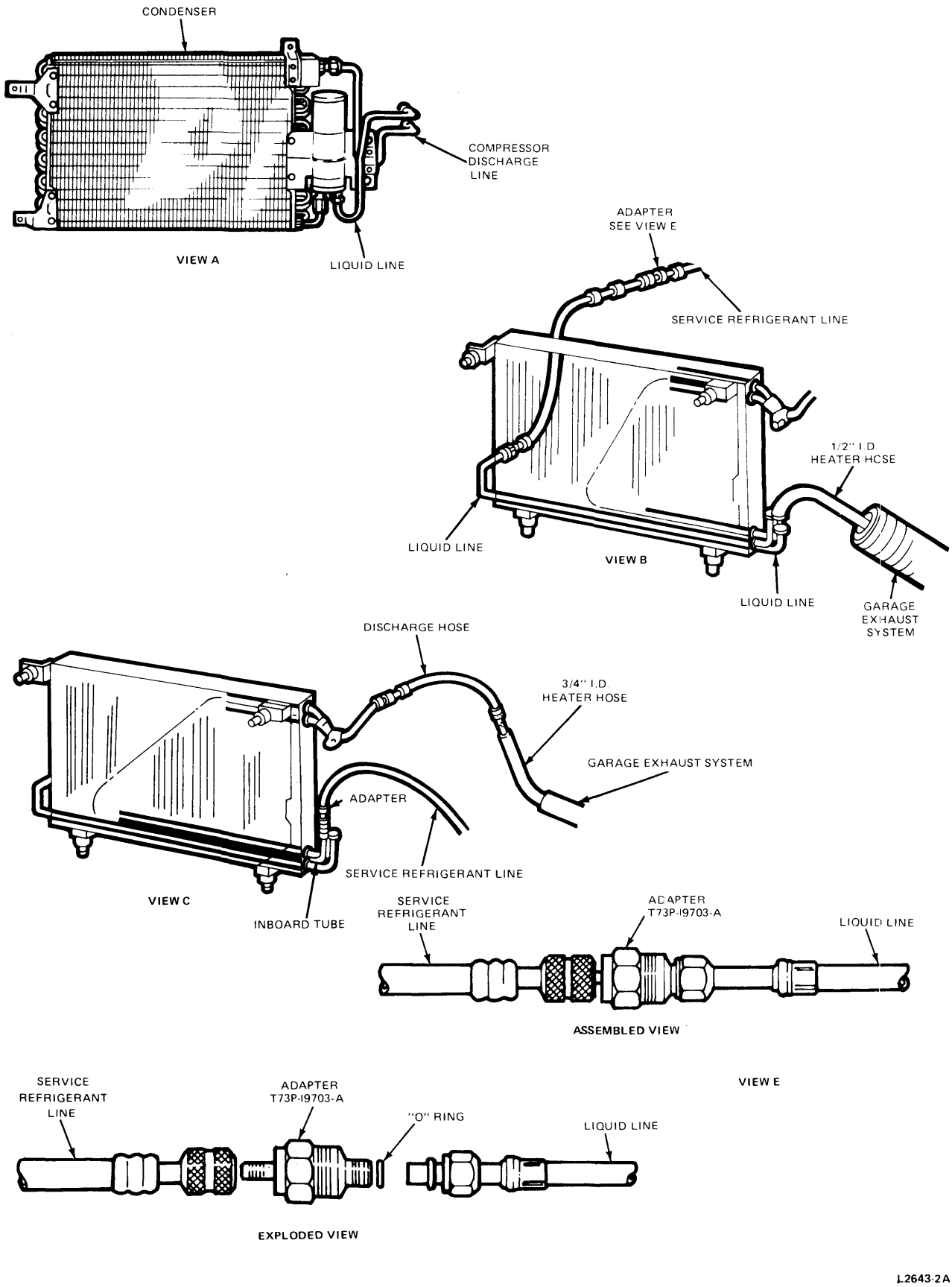
Special Refrigerant System Flushing Equipment provides a faster method of cleaning the major refrigerant system components without removing them from the vehicle. All restrictive components, however, such as the receiver/drier and the expansion valve must be removed. A temporary replacement for the restrictive components is made by using tubing such as neoprene or plastic garden hose. This allows for the continuous circulation of a refrigerant system flushing agent so that all system contaminants can be washed out of the major refrigerant system components and hose assemblies, to be trapped in an external filter/drier assembly.

Caution: Always check to be sure the flushing refrigerant is compatible with the hose material being used. Some hose materials may dissolve, swell or become brittle when used with certain refrigerants.

The Safety Precautions should be observed at all times. If the components in the following procedure are flushed with a refrigerant other than R-12, it is necessary to remove the excess flushing refrigerant by blowing out with Refrigerant-12 or with Nitrogen. If Nitrogen is used, q pressure regulator should be

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FIG. 20 Back-Flushing Condensers

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installed on the Nitrogen supply tank to reduce the extremely high Nitrogen Supply Pressure.

To thoroughly clean a contaminated refrigerant system using the continuous circulation method, follow the method as recommended by the manufacturer of the special flushing equipment. The following method of cleaning is usually suggested:

1. Discharge refrigerant system.
2. Remove compressor from vehicle for cleaning and repair or replacement.
3. Remove and discard the receiver/drier assembly.
4. Replace the restrictive components with neoprene or plastic tubing (see caution above).
5. Connect the flushing equipment into the refrigerant system and start the continuous circulation flushing procedure.
6. Clean out Expansion Valve with small charge of R-12. Check operation of Expansion Valve by immersing temperature bulb into a container of salted, melting chipped ice. Valve should close. If the Expansion Valve closed properly, cap the openings to keep out moisture and set aside for later installation.
7. After continuous circulation flushing is completed remove temporary hose connections, blow out excess flushing refrigerant with R-12 or regulated Nitrogen supply.
8. Install new receiver/drier assembly on condenser. Use new "O" ring seals.
9. Install Expansion Valve. Always install with new "O" ring seals dipped in clean refrigerant oil.
10. Connect all refrigerant hoses. Hose connections should be clean and lightly lubricated with refrigerant oil. Tighten all connections **SECURELY** to prevent refrigerant leaks.
11. Install compressor. If the compressor being installed is original compressor, fill crankcase with the specified amount of the specified refrigerant oil after cleaning and repairing compressor. If a new compressor is being installed, remove service plugs and rotate compressor shaft two or three full turns in vertical position to displace oil on top of pistons before installing. This is necessary since all new two-cylinder A/C compressors are filled with 9 to 13 fluid ounces of refrigerant oil and must be stored with service parts up.
12. Connect Charging Station or Manifold Gauge Set and charge with one pound of R-12 **(DO NOT EVACUATE UNTIL AFTER LEAK TEST).**
13. Leak test all connections and components with either a flame type or Electronic Leak Detector. If O.K., proceed with Step 16. If not O.K., repair leak and then proceed with Step 16.
14. Purge the system to remove air and moisture vapor.
15. Evacuate and charge the refrigerant system to specification with R-12.
16. Performance Test the refrigerant system to assure quality cooling performance.

REMOVAL AND INSTALLATION

COMPRESSOR

All compressor replacement operations, except belt replacement, can be performed only after the unit has been relieved of its refrigerant charge. For units with Schrader-type service valves, discharge the entire refrigerant system. For units with manual service valves, isolate the compressor from the rest of the system.

To reduce the amount of time to make a compressor replacement, the service compressors are dehydrated and the proper amount of the specified refrigerant oil is in the crankcase when received.

Removal

1. Units with Schrader-type Service Valves—Discharge the system and disconnect the two hoses from the compressor. Units with Manual Service Valves—Isolate the compressor and disconnect the two service valves and hoses from the compressor (Fig. 21).
2. Energize the clutch and loosen and remove the clutch mounting bolt.
3. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized, tighten the bolt to loosen the clutch from the shaft. Disconnect the clutch wire at the bullet connector.
4. Loosen the idler pulley or alternator and remove the drive belt and the clutch and then remove the compressor mounting bolts and the compressor.

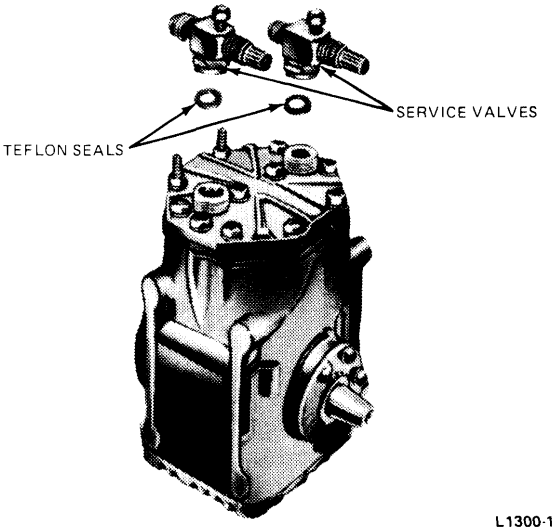


FIG. 21 Compressor Manual Service Valves Removed

Installation

Before installing the compressor, carefully remove any burrs or dirt that may be on the compressor shaft. The shaft must be dry and brightly polished.

When replacing a compressor, first check the oil level in the old compressor. Then remove oil from the new compressor in an amount that will make the new compressor oil level the same as that in the old

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compressor. This procedure will keep the amount of oil in the system constant. Failure to use this procedure is the most common reason for excessive oil in the crankcase. Refer to Compressor Oil Level Check, under Adjustments in this Part.

1. Mount the clutch on the shaft and install the mounting screw and washer finger-tight. Place the compressor on the mounting bracket and install the four mounting bolts finger-tight.
2. Connect the clutch wire, energize the clutch and tighten the clutch mounting bolt to specification. Tighten the compressor mounting bolts to specifications.
3. Install and adjust the compressor drive belt to Specification.
4. When installing manual service valves on the compressor, use new seals. Be certain to remove the rubber shipping plugs first. Tighten the service valve nuts to specification. Do not over tighten. The service valves can be rotated slightly on their seat without breaking the high pressure seal. This is not an indication of a loose valve. Leak test the compressor, then evacuate it and connect it back into the system. When Schrader-type service valves are used, connect the two hoses to the compressor, and then leak test, evacuate and charge the system.

VALVE PLATE AND HEAD GASKET

The procedure for replacing a blown head gasket is identical to the procedure for replacing the valve plate except that the old valve plate is used. If a worn or damaged valve plate has caused the cylinder walls to become scored or has imbedded pieces of metal in the pistons, the compressor should be replaced.

Removal—All Compressors

1. Discharge the system (Schrader Valves, Fig. 20 or 21), or with manual service valves, isolate the compressor and disconnect both service valves.
2. Remove the cylinder head bolts.
3. Remove the valve plate and cylinder head from the compressor by tapping upward with a fiber hammer on the overhanging edge of the valve plate.
4. Remove the valve plate from the cylinder head by holding the head and tapping against the valve plate.
5. Remove the drip pan from under the horizontally mounted compressor. Then, remove all particles of gasket, dirt and foreign material from the surface of the cylinder head and cylinder face. **Be very careful not to scratch or nick the mating surfaces or any edges.**

Installation—York Compressor

1. Apply a thin film of clean refrigerant oil to each side of the valve plate gasket (Fig. 22).
2. Place the new valve plate gasket in position on the crankcase so that the crankcase dowel pins go through the dowel pin holes in the gasket (Fig. 22).
3. Place the valve plate in position on the cylinder so that the dowel pins go through the dowel pin holes (Fig. 22).

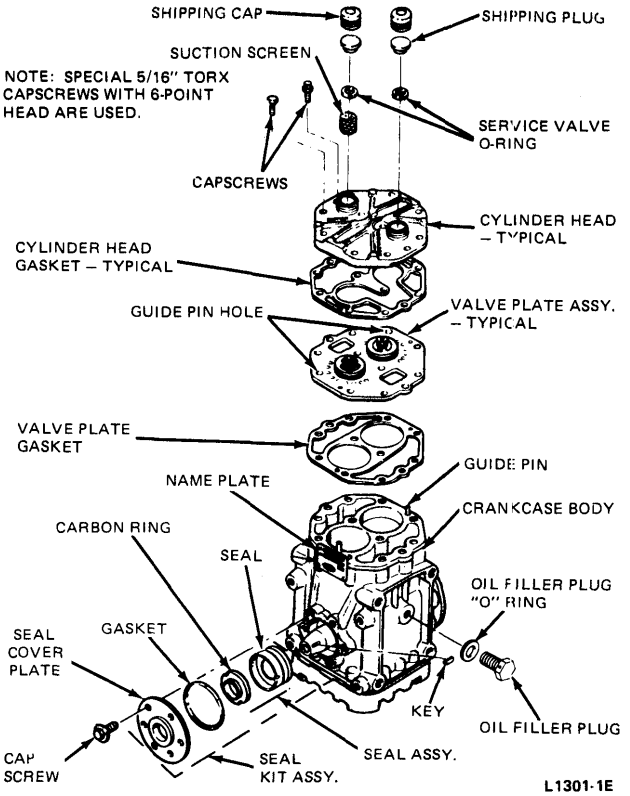


FIG. 22 York Compressor—Disassembled

4. Apply a light film of clean refrigeration oil on each side of the cylinder head gasket. Then, place the gasket and cylinder head on the cylinder with the dowel pins inserted into the dowel pin holes in the gasket and head.
5. Insert the two longer capscrews in the two center holes of the cylinder head. Then, insert the remaining capscrews in the holes around the edge of the cylinder head. The four 12 point head screws should be inserted into the four holes closest to the service ports.
6. Tighten all head cap screws until they contact the head. Then, tighten the two center screws to 15-23 ft-lb.
7. Tighten the remaining cap screws in a pattern so that the cap screws diagonally opposite each other are evenly tightened to 15-23 ft-lb. After the cylinder head has been installed 1/2 hour, re-tighten the head cap screws to 15-23 ft-lb.
8. Inspect the top of the cylinder head service valve ports to be sure that they are free of nicks and imperfections. Connect the service valves with new O-rings to the correct compressor ports and tighten to specification. Then, check the compressor oil

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level and add or remove oil as required. (See Compressor Oil Level Check in Adjustments.) Evacuate the compressor and connect it back into the system.

Installation—Tecumseh Compressor

1. Apply a thin film of clean refrigerant oil to each side of the valve plate gasket (Fig. 23).

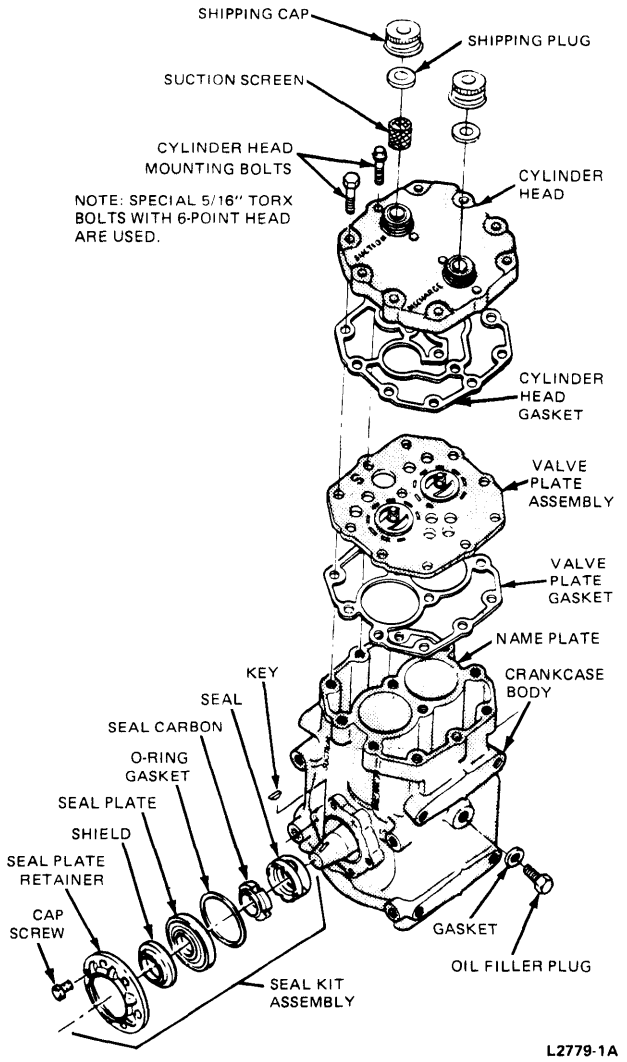


FIG. 23 Tecumseh Compressor—Disassembled

2. Place the new valve plate gasket on the crankcase cylinder face and align the bolt holes.
3. Place the valve plate on the valve plate gasket so that the letter S (stamped on the valve plate) is on the same side of the crankcase as the word SUCTION. Align the bolt holes.
4. Apply a thin film of clean refrigerant oil on each side of the head gasket.
5. Place the head gasket on the valve plate with the largest hole of the gasket over the largest hole of the valve plate. Line up the holes of the gasket with those of the valve plate.
6. Position the cylinder head on the compressor. **The word SUCTION on the head must be up and on the same side as the word SUCTION on the compressor crankcase.**
7. Align the bolt holes of the cylinder head, gaskets and valve plate with the holes in the compressor crankcase.
8. Install the cylinder head attaching bolts in the bolt holes. The four 12 point head bolts must be inserted in the four holes nearest the head service ports.
9. Tighten the bolts until they contact the top surface of the cylinder head. Then, tighten the head bolts in a sequence so that the bolts diagonally opposite each other are evenly tightened to 20-24 ft-lb of torque.

   After the cylinder head has been installed 1/2 hour, re-tighten the head bolts to 20-24 ft-lb.
10. Inspect the top of the cylinder head service valve ports to be sure that they are free of nicks and imperfections.

    Connect the service valves with new O-rings to the correct compressor ports and tighten to specification.
11. Check the compressor oil level and add or remove oil as required. (See Compressor Oil Level Check in Adjustments). Evacuate the compressor and connect it back into the system.

CRANKSHAFT SEAL

Removal—All Compressors

1. With Schrader Valves, discharge the system. With manual service valves, isolate the compressor. Then loosen and remove the compressor drive belt.
2. Remove the clutch and remove the woodruff key (see Compressor Clutch Removal).
3. Remove the four screws attaching the magnetic clutch field coil to the compressor and remove the field coil.
4. Carefully remove all accumulated dirt and foreign material from the seal plate and surrounding area of the compressor, and position a small drain pan beneath the seal plate.
5. Remove the seal plate capscrews, and gently remove the plate and gasket. Do not mar or scratch the sealing surfaces, or the polished shaft surface.
6. Remove the carbon seal ring and seal housing assembly from the crankshaft. A disassembled view of the crankshaft seal assembly is shown in Figs. 22 and 23.
7. Clean all old gasket material from the seal plate and the compressor. Make certain that the shaft, the seal plate and the compressor gasket surfaces are completely clean.
8. Check the face of the crankshaft front bearing journal in the seal housing to make certain that there are no nicks or burrs. Check the crankshaft surface to be sure it is not damaged. Check all parts of the seal assembly to be sure that they are not damaged.
9. Inspect the compressor internal components for damage.

Installation—Tecumseh Compressor

1. Wash the new seal assembly components in clean refrigerant oil.

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2. Coat the exposed surface of the crankshaft with clean refrigerant oil.
3. Place the seal (Fig. 23) over the compressor shaft with the end that fits the carbon ring facing out.
4. Position the carbon ring over the shaft and to the seal. The raised rim of the carbon ring must face outward.
5. Insert the O-ring in the crankcase mating surface for the seal plate.
6. Position the seal plate, shield and seal plate retainer to the compressor crankcase and align the cover attaching screw holes. Push the seal plate retainer against the mating surface of the crankcase and install the six attaching screws. Tighten the screws in a circular sequence to 54-78 in-lb.
7. Rotate the shaft by hand 15 to 20 revolutions to seat the seal.
8. Position the magnetic clutch field coil to the compressor and install the four attaching screws. Tighten the screws to specification.
9. Make certain that there are no burrs or dirt on the compressor shaft. Install the key and magnetic clutch on the shaft. (See Compressor Clutch Installation.)
10. Install the compressor drive belt and adjust the tension to specifications.
11. Check the compressor oil level (Adjustments).

Installation—York Compressor

1. Wash the new seal assembly components in clean refrigerant oil.
2. Position the seal over the end of the shaft with the carbon ring retainer facing out. Move the seal in and out on the shaft a few times to insure a good seal between the seal and the shaft.
3. Push the seal all-the-way on the shaft. Be sure that the seal drive ring slots engage the drive pins on the shaft bearing journal face.
4. Place the carbon ring (Fig. 22) over the shaft and in the seal ring retainer. The polished surface of the carbon ring must face out and the lugs must engage the ring retainer and be fully seated.
5. Apply a light film of clean refrigerant oil on the matching faces of the crankcase and seal cover plate. Then, place the gasket in position on the crankcase face.
6. Place the seal cover plate in position (Fig. 22), with the polished side facing the carbon ring. Then, install the capscrews. Tighten the capscrews evenly while turning the crankshaft. Be sure that the clearance between the crankshaft and the hole in the seal cover plate is even all around the shaft. If the clearance is not equal all around the shaft, gently tap the seal face into position until the clearance is equal. Then, tighten diagonally opposite cover plate capscrews evenly to 7-13 ft-lb.
7. Position the magnetic clutch field coil to the compressor and install the four attaching screws. Tighten the screws to specification.
8. Make certain that there are no burrs or dirt on the compressor shaft. Install the key and magnetic clutch on the shaft.
9. Install the compressor drive belt and adjust the tension to specification.
10. Check the compressor oil level (Adjustments).

CLUTCH PULLEY

1. Loosen and remove the compressor drive belt.
2. Energize the clutch (if possible) and loosen and remove the clutch pulley retaining bolt. If the clutch cannot be energized, use a spanner wrench to prevent the clutch from turning. Then, remove the clutch pulley retaining bolt.
3. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized or held securely with a spanner wrench, tighten the bolt to loosen the clutch from the shaft, then remove the magnetic clutch.

Never tap the clutch pulley to loosen the clutch. This will warp the pulley and damage the clutch.

4. Carefully remove any burrs or dirt that may be on the compressor shaft. The shaft must be dry and brightly polished. Install the clutch pulley, the clutch pulley retaining bolt, and the washer.
5. Energize the clutch, and tighten the bolt to specification.
6. Install and adjust the compressor drive belt.

CLUTCH BEARING

When **installing** a new bearing, be very careful to support the bearing and the clutch assembly so as not to place any pressure on the balls of the bearing.

The following procedure should be rigidly adhered to during bearing replacement. Any exceptions due to clutch design are noted. Refer to Fig. 24.

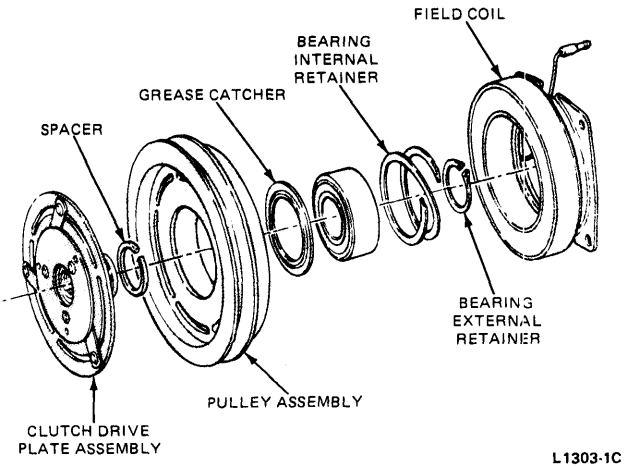


FIG. 24 A/C Clutch Assembly

Removal

1. Remove the clutch assembly from the compressor shaft as outlined in the foregoing procedure.
2. With the clutch assembly face down, remove the bearing external retainer from the drive plate shaft.
3. Support the clutch, face down, by the outer edge so as to clear the drive plate. Insert a 5/8-11 inch bolt through the drive plate shaft and hand tighten the bolt.

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4. Smoothly apply enough pressure on the bolt to free the shaft from the bearing inner race and then remove the drive plate assembly. Before proceeding, check the drive face plate for any excessive warping or breakage. Replace the entire clutch assembly if any damage is evident.
5. Remove the bearing internal retainer from the pulley assembly. Support the pulley assembly, face up, by the bearing bore making certain that there is no interference when the bearing is pressed out. With a suitable plug, force the bearing out of the pulley assembly by the inner race. **The plug should clear the metal grease catcher, but do not remove the grease catcher from the pulley assembly.**

Installation

Before installing the bearing, be sure that all bearing contact surfaces are clean.

1. Support the pulley assembly face down, near the bearing bore; but do not support it by the sides of the pulley grooves as this may bend the pulley assembly.
2. Press a new bearing into the bearing bore by the outer race. **Do not press the bearing in by the inner race.** Pressure should be uniform and in line with the axis of the bearing bore. Replace the bearing internal retainer.
3. Support the pulley assembly, face up, by the bearing inner race. Insert a 5/8-11 inch bolt into the front of the drive face plate and carefully press the shaft into the bearing inner race, exerting pressure on the bolt. Be certain that the shaft is in line with the axis of the bearing bore.
4. Replace the bearing external retainer onto the drive plate shaft. Rotate the pulley relative to the drive plate to make certain that there is free rotation and that there is no looseness of the assembly before installing the clutch onto the compressor.
5. Install the clutch assembly on the compressor shaft.

MAGNETIC CLUTCH FIELD COIL

Perform the magnetic clutch field coil tests given in this Part before replacing the field coil.

Removal

1. Remove the clutch from the compressor as outlined in this Part.
2. Disconnect the field coil wire at the bullet connector.
3. Remove four screws attaching the field coil mounting plate to the compressor and remove the field coil.

Installation

1. Clean the field coil mounting surface on the compressor to obtain good electrical contact.
2. Position the field coil to the compressor making sure the field coil wire is in a position to reach to the mating electrical connector.
3. Install four screws to attach the field coil mounting plate to the compressor.
4. Connect the field coil wire to the harness.
5. Install the clutch on the compressor as outlined in this Part.
6. Check the system for proper operation.

DRIVE BELT

1. Loosen the idler pulley or compressor and remove the belt.
2. Place the new belt in position, and adjust the belt tension (Tool T63L-8620-A or equivalent) to specification. Then, tighten the idler pulley or compressor.
3. Check the belt alignment, and adjust it if necessary.

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SPECIFICATIONS

REFRIGERANT CAPACITIES (REFRIGERANT-12)

Vehicle	Capacity (Pounds)
Light Truck and Bronco	2.75
E-100 — E-350	3½ Main
E-100 — E-350	4¼ Main and Auxiliary

REFRIGERANT SPECIFICATION

Type	Specification	Part No.
Refrigerant-12 (R-12) Dichlorodifluoromethane CCL^2F^2	ESA-M17B2-A or equivalent	D3AZ-19B519-A or equivalent

AIR CONDITIONING COMPRESSOR

Torque Limits (ft-lbs)		
Description	**Tecumseh**	**York**
Cylinder Head	20-24	15-23
Front Seal Plate	54-78 in-lb.	7-13
Service Valve (Tube-O)	20+10	20+10
Mounting Bolt	20-30	20-30
Oil Filler Plug	18-22	4-11
Clutch Mounting	20-30	20-30
Base Plate	—	14-22
Back Plate	—	9-17
Clutch Coil	6-12	6-12
Quick Disconnect	10-15	10-15

COMPRESSOR OIL CAPACITIES AND SPECIFICATIONS (1)

Description		Vertical	Horizontal
Tecumseh (3) (11 Fluid Ounces)		7/8 Inch Min. 1-3/8 Inch Min.	7/8 Inch Min. 1-5/8 Inch. Max.
York 3 (3) (10 Fluid Ounces)		7/8 Inch Min. 1-1/8 Inch Max.	13/16 Inch Min. 1-3/16 Inch Max.
Driven Belt Tension (Between Fan Pulley and Air Conditioner Compressor):	New	140 lbs.	
	Used (2)	110 lbs.	
	Minimum (2)	90 lbs.	
Belt Tension Tool		T63L-8620-A	
Compressor Clutch Run-Out		1/32 Inch. Max.	

(1) Use Specification ESA-M2C31-A, Ford Part No. C9AZ-19577-B or equivalent.
(2) Belt Operated for a Minimum of 10 Minutes is Considered a Used Belt.
(3) Do not add oil if dip stick indicates proper level of oil between minimum and maximum.
If dip stick is below minimum level, add oil up to minimum oil level only.

CL1365-2H

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Light Truck and Bronco Heater — Air Conditioning System

PART 36-61

APPLIES TO F-100 THROUGH F-350 AND BRONCO

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DESCRIPTION AND OPERATION

The manual A/C-heater is an integral unit with the evaporator housing mounted to the engine side of the dash panel. The plenum and air intake is mounted under the instrument panel. The condenser is located ahead of the radiator.

The system can be operated with either fresh or recirculated air, depending on the positions of the temperature control lever (Fig. 1).

1. With function control (lower) lever on VENT—all air is outside air regardless of the TEMPERATURE lever position.
2. With function control (lower) lever in all other positions—system operates on recirculated air with TEMPERATURE lever on COOL to about 1-1/2 inches toward WARM. Outside air is used from about 1-1/2 inches toward WARM to WARM position.

The controls are located in the upper center of the instrument panel. The controls consist of two horizontal sliding levers and a blower switch. The top sliding lever is the temperature lever which controls the air blend door, outside-recirc. door, and the water valve. The function control (lower) lever controls air distribution to the desired outlets, and also controls the blower off/on switch, and the compressor switch. The blower speed switch is located to the left of the horizontal sliding levers. This switch controls the blower motor speed only, and will not turn the blower OFF.

Air is drawn into the system through the outside-recirculating air door, through the evaporator core into the evaporator housing. From that point, air is pulled around and/or through the heater core to the blower. The diversion of air through or around the heater core is dependent on the temperature lever setting. From the blower motor, air is forced into the plenum and distributed to the floor, defrosters or registers, depending on the setting of the function control (lower) lever. Fig. 1 shows the air flow for the various function control lever settings. Fig. 2 shows the effect the temperature lever has on air flow and the water valve.

CONTROL OPERATION

The eight-port vacuum selector (located in the control assembly) is operated by the function (lower) control lever (Fig. 3). The rubber diverter plate located in the selector directs vacuum or atmospheric pressures to the ports and then to the vacuum motors as required by the system. The eight-port selector also comes equipped with a low speed blower switch that is activated when the lever is moved to any position on the control assembly except off. In the vent position the outside air door is opened and a forced air ventilation system is in operation. The switch remains closed through the remainder of the lever travel. The second switch on the selector activates the compressor clutch in the A/C position only.

In series with the clutch switch is the thermostatic de-icing switch which senses the temperature of the evaporator core through a capillary tube inserted in the core fins. Should the temperature of the core fall below 20 degrees F, the clutch is deactivated and the core is protected from icing. The de-icing switch is again activated when the core temperature reaches approximately 35 degrees F.

The three-port vacuum selector is also located on the control assembly and is operated by the temperature lever. The first 1/2 inch of travel changes the system to outside air. At 1 1/2 inch travel the water valve is opened.

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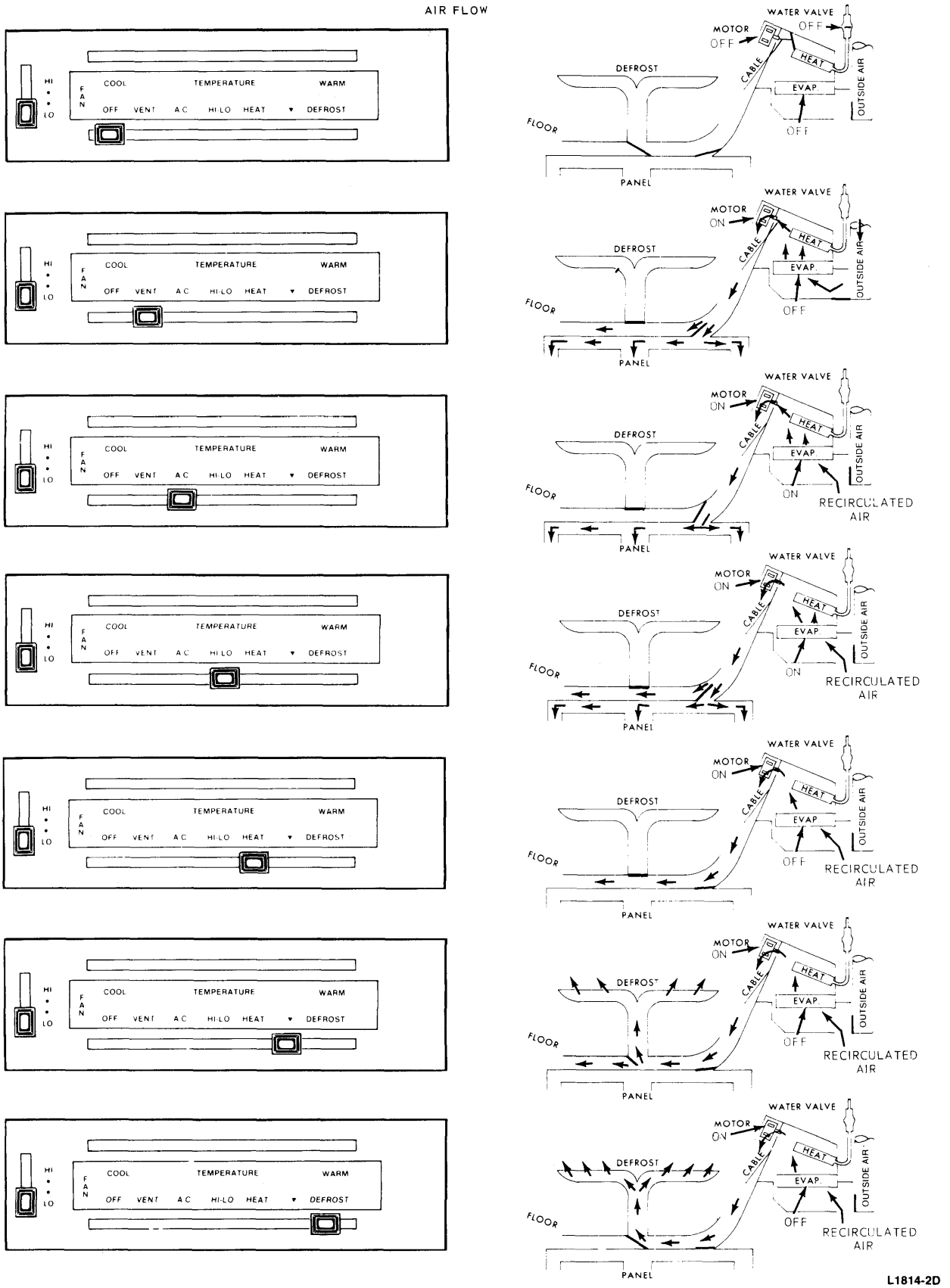


FIG. 1 Manual A/C-Heater Air Flow Chart-Function Control Lever Position

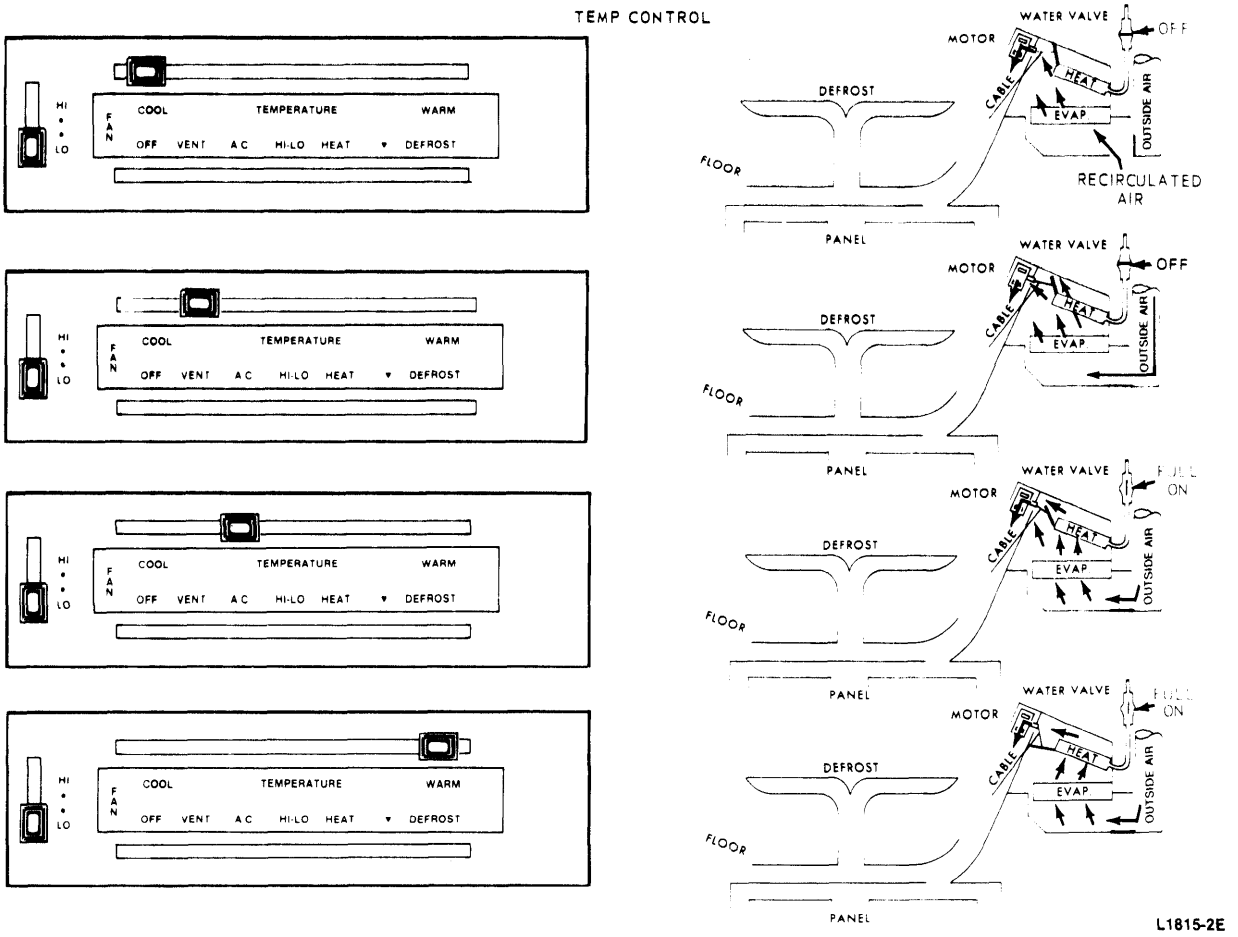
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The system temperature is further modulated by the movement of the air blend door which controls the amount of cooled air that passes through or bypasses the heater core. The blend door is connected to the temperature lever by a cable assembly.

The blower OFF/ON switch, as mentioned above, is located on the eight port selector. If higher blower speeds are desired, they can be obtained by repositioning the blower switch. This switch has four speeds, Low, two intermediate speeds and High. The blower can only be shut-off by moving the function (lower) lever to OFF.

Figs. 3 and 4 show the vacuum schematic for the system and the vacuum applications for the various function control lever positions.

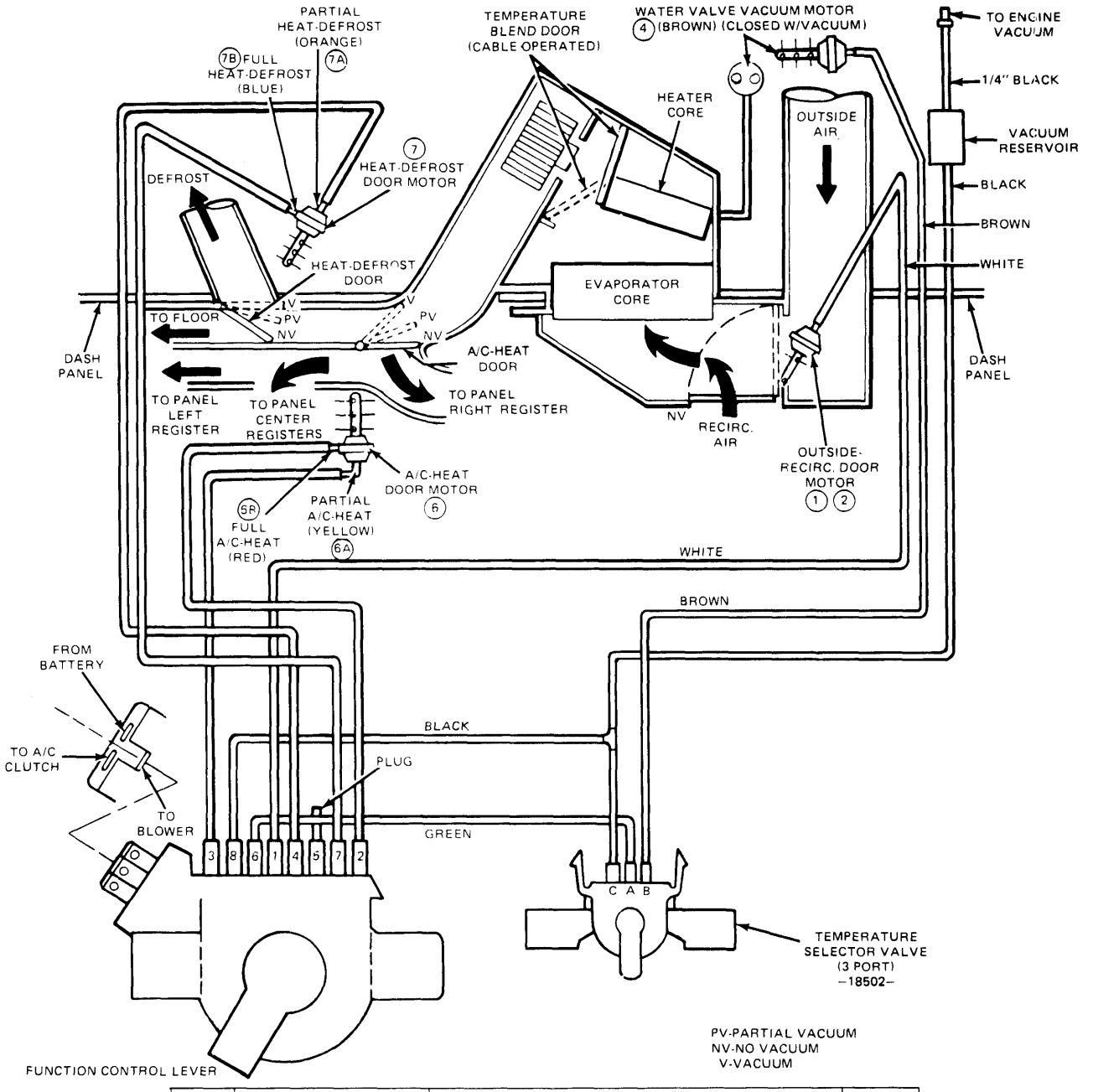


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FIG. 2 Manual A/C-Heater Air Flow Chart—Temperature Lever Position

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PORT	FUNCTION	FUNCTION SELECTOR VALVE POSITIONS							HOSE COLOR
		OFF	VENT	A/C	HI-LO	HEAT	(DEFOG)	DEFROST	
1	Outside-Recirc.	V		To 6	To 6	To 6	To 6	To 6	White 1-2
2	Full A/C–Heat			V					Red 6B
3	Partial A/C–Heat		V	V	V				Yellow 6A
4	Partial Heat–Defrost		V	V	V	V	V		Orange 7A
5	Sealed	Seal	Seal	Seal	Seal	Seal	Seal	Seal	
6	To Temp Port A	V	V	To 1	To 1	To 1	To 1	To 1	Green 4
7	Full Heat-Defrost	V	V	V	V	V			Blue 7B
8	Source Vacuum	V	V	V	V	V	V	V	Black

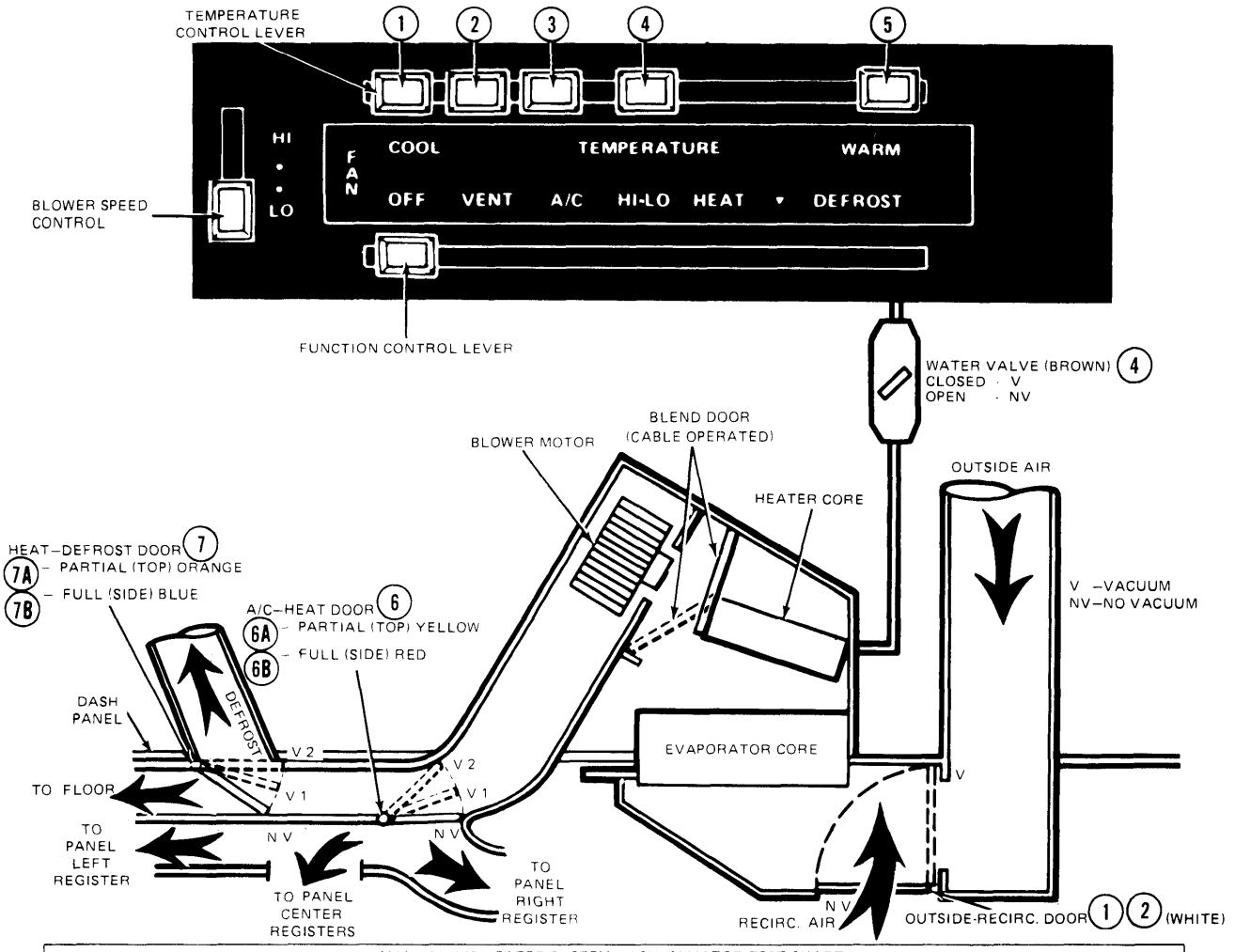
PORT	FUNCTION	TEMPERATURE SELECTOR VALVE LEVER POSITIONS				HOSE COLOR
		COOL		TEMPERATURE	WARM	
C	Source Vacuum	V	V	V	V	Black
A	Outside-Recric. Door	V			V	Green
B	Water Valve	V	V			Brown

L2558-2B

FIG. 3 Manual A/C-Heater System Vacuum Schematic

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MANUAL A/C-HEATER SYSTEM VACUUM MOTOR TEST CHART

FUNCTION CONTROL LEVER POSITION	TEMPERATURE CONTROL LEVER POSITION	VACUUM MOTORS APPLIED WITH VACUUM					
		OUTSIDE -RECIRC	WATER VALVE	A/C-HEAT		HEAT-DEFROST	
				PARTIAL	FULL	PARTIAL	FULL
OFF	Cool - 1	1–2	4	–	–	–	7b
	Cool - 2	1–2	4	–	–	–	7b
	Cool - 3 Temp - 4 Warm - 5	1–2		–	–	–	7b
VENT	Cool - 1	–	4	6a	–	7a	7b
	Cool - 2		4	6a	–	7a	7b
	Cool - 3 Temp - 4 Warm - 5	–	–	6a	–	7a	7b
A/C *	Cool - 1	1–2	4	6a	6b	7a	7b
	Cool - 2	–	4	6a	6b	7a	7b
	Cool - 3 Temp - 4 Warm - 5	–	–	6a	6b	7a	7b
HI - LO	Cool - 1	1–2	4	6a	–	7a	7b
	Cool - 2	–	4	6a	–	7a	7b
	Cool - 3 Temp - 4 Warm - 5	–	–	6a	–	7a	7b
HEAT	Cool - 1	1–2	4	–	–	7a	7b
	Cool - 2	–	4	–	–	7a	7b
	Cool - 3 Temp - 4 Warm - 5	–	–	–	–	7a	7b
▽ (DEFOG)	Cool - 1	1–2	4	–	–	7a	–
	Cool - 2	–	4	–	–	7a	–
	Cool - 3 Temp - 4 Warm - 5	–	–	–	–	7a	–
DEFROST	Cool - 1	1–2	4	–	–	–	–
	Cool - 2	–	4	–	–	–	–
	Cool - 3 Temp - 4 Warm - 5	–	–	–	–	–	–
VACUUM LINE COLOR CODE		WHITE	BROWN	YELLOW (TOP)	RED (SIDE)	ORANGE (TOP)	BLUE (SIDE)

* COMPRESSOR CLUTCH ENGAGED WHEN EVAPORATOR TEMPERATURE IS ABOVE 34° F.
– NO VACUUM

L2794-2A

FIG. 4 Manual A/C-Heater System Air Flow Schematic and Vacuum Control Chart

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DIAGNOSIS AND TESTING

Refer to Diagnosis and Testing in Part 36-30, Air Conditioning General Service.

ADJUSTMENTS

AIR BLEND DOOR

The only adjustment necessary is the air blend door. This door is connected to the temperature (upper) control lever by a Bowden cable. To adjust, loosen the cable clamp screw (Fig. 5). Move the temperature control lever to the extreme left "cool position" and hold in that position. Then, rotate the air blend door crank to the extreme forward position (Fig. 5), and tighten the cable clamp screw.

The loop of the Bowden cable is assembled to the door crank with the pigtail pointing away from the crank elbow. The cable flag is assembled to the bracket with one screw.

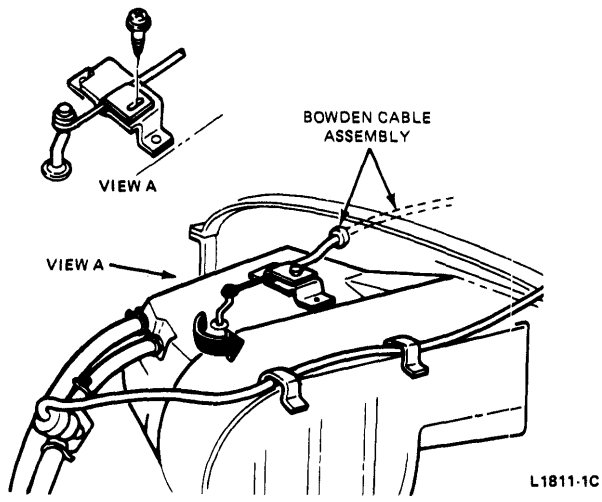


FIG. 5 Air Blend Door Cable Adjustment

REMOVAL AND INSTALLATION

COMPRESSOR AND DRIVE BELT

Refer to Part 36-30 for Removal and Installation procedures and refer to Figs. 6, 7 and 8.

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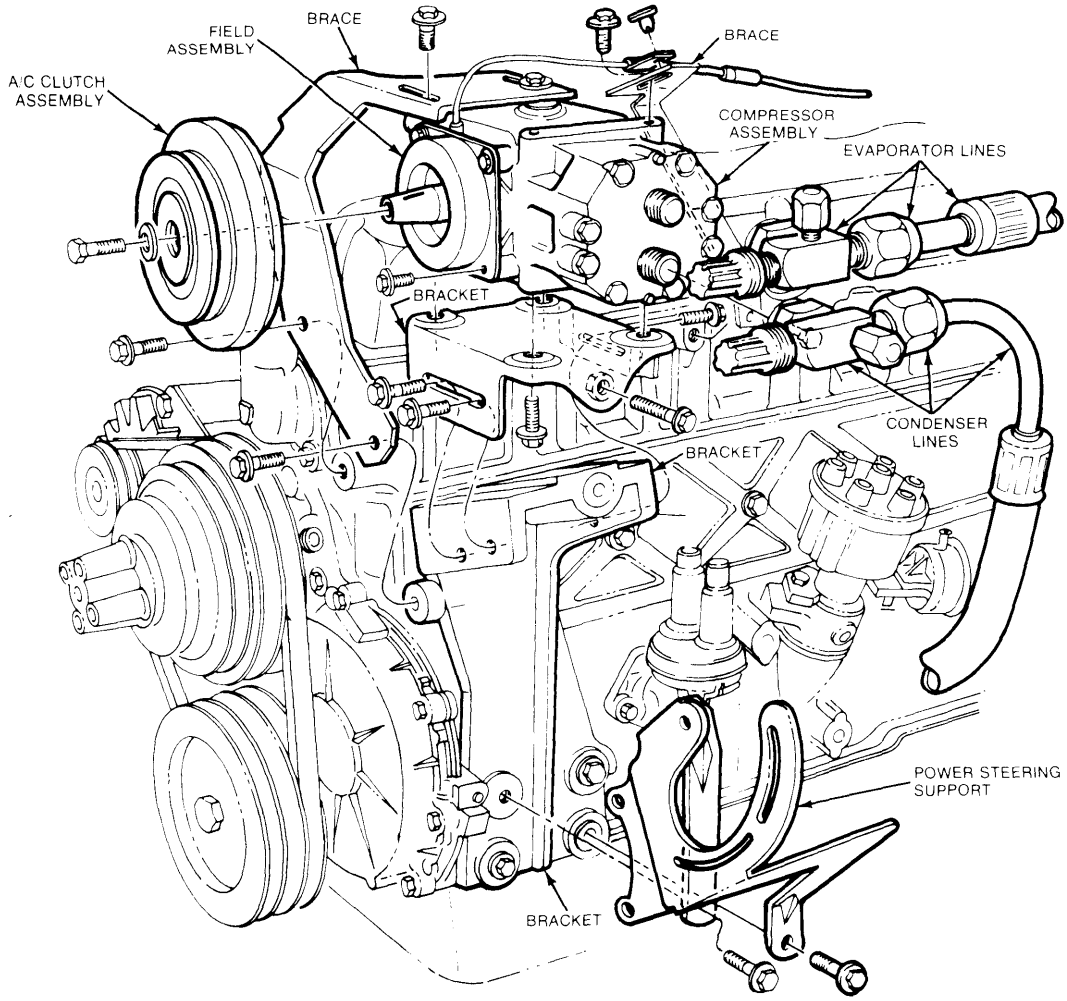


FIG. 6 A/C Compressor Installation—4.9L (300 CID) I-6 Engine

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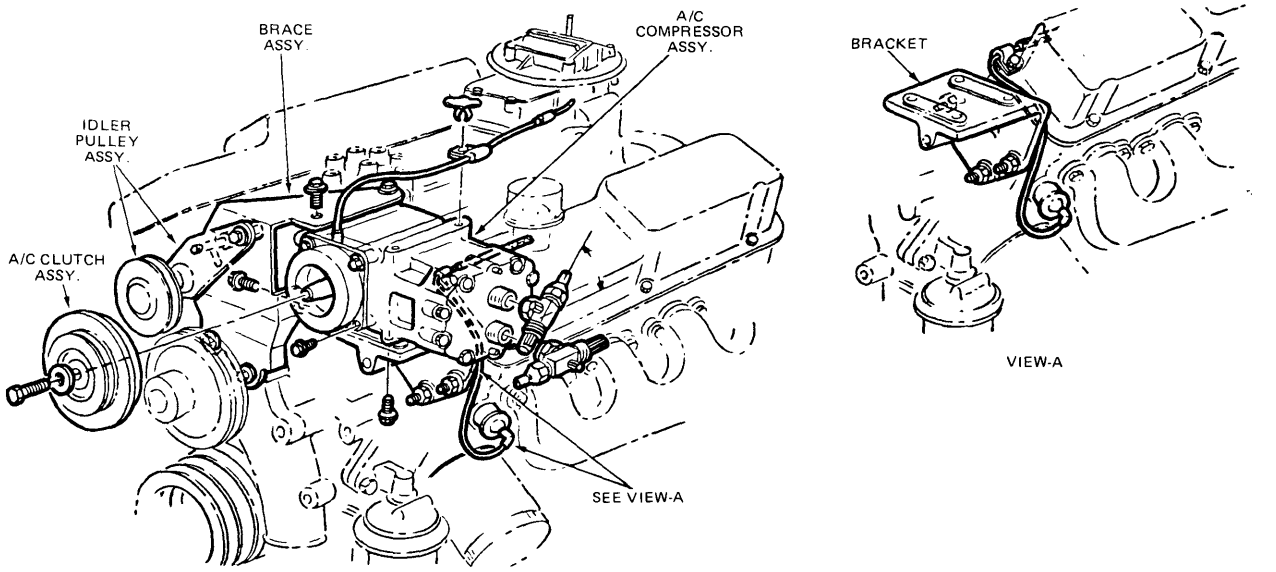


FIG. 7 A/C Compressor Installation—5.0L (302 CID) V-8 Engine

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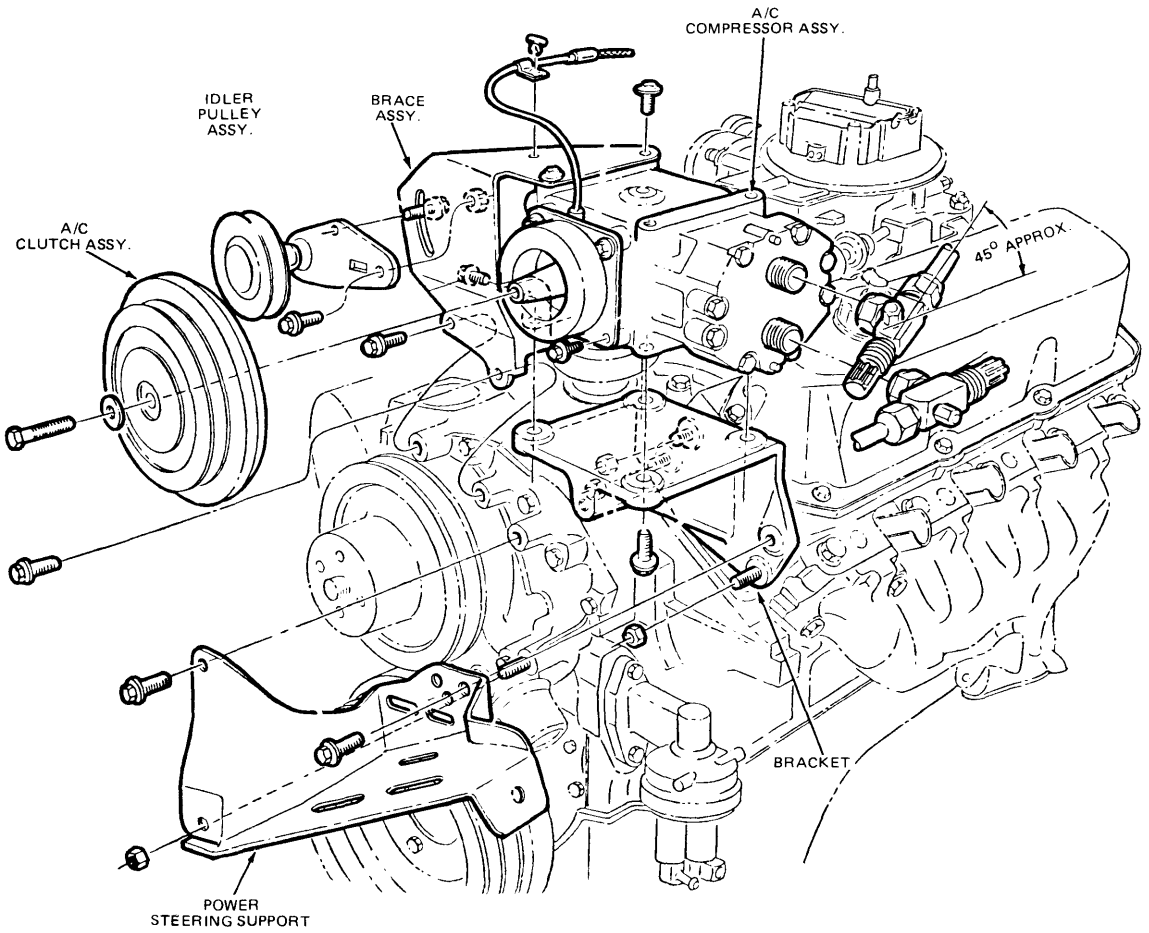


FIG. 8 A/C Compressor Installation—5.8L (351 CID)—M and 6.6L (400 CID) V-8 Engines

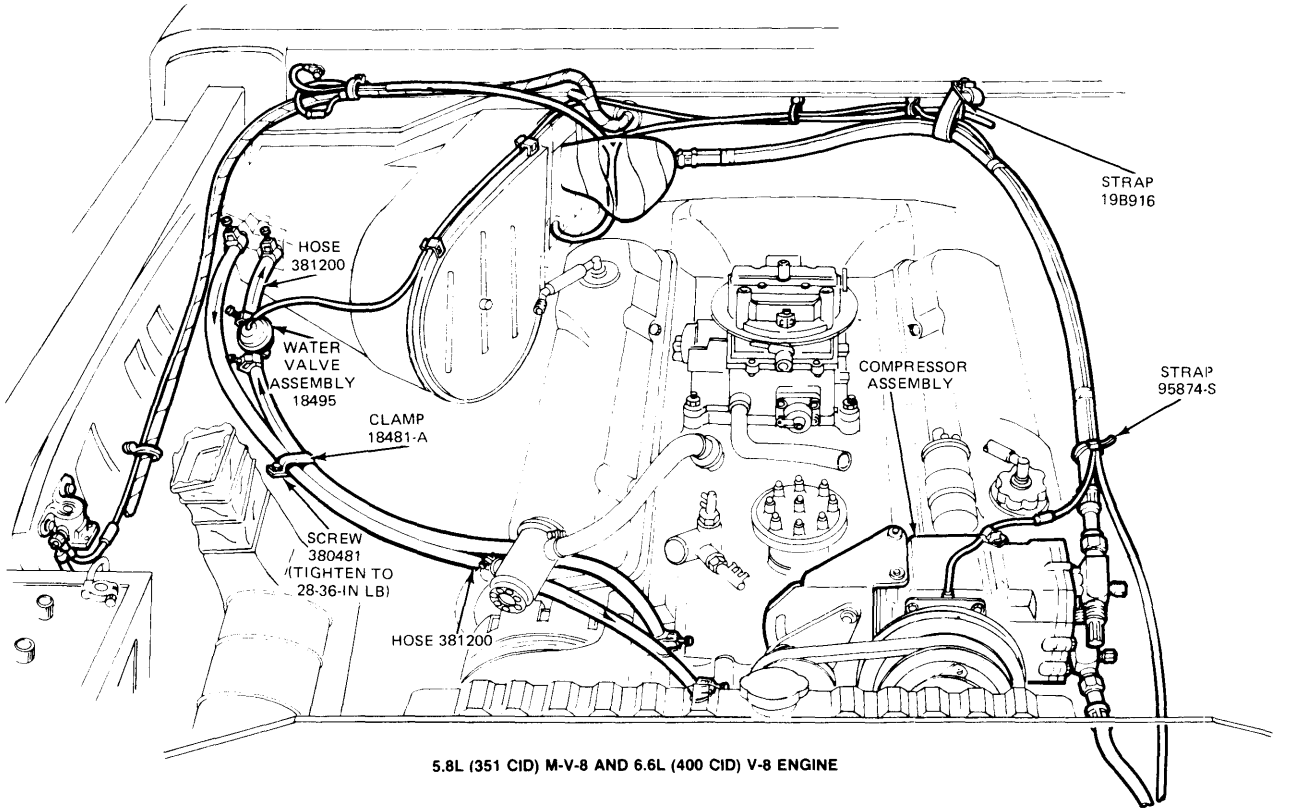
HEATER CORE AND/OR BLOWER MOTOR

Removal (without discharging A/C system)

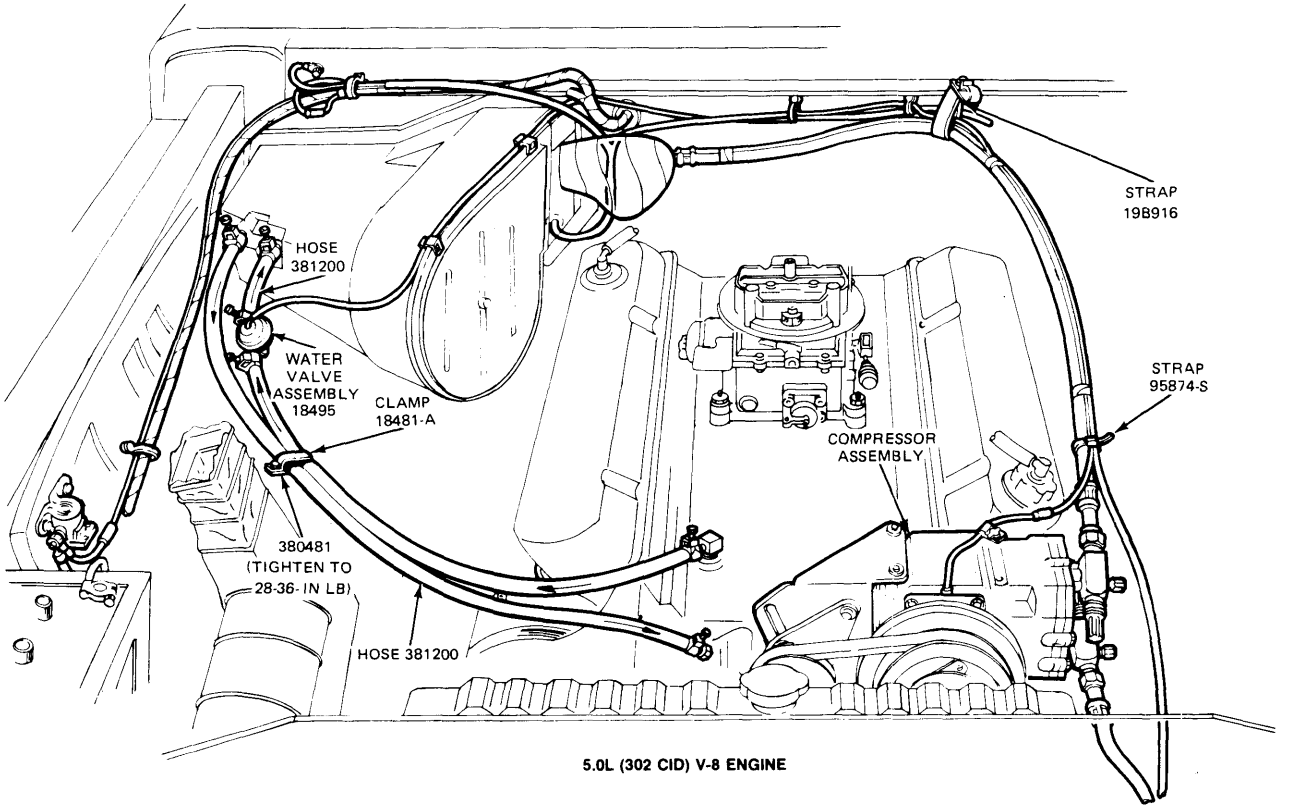
1. Disconnect the battery cable, remove the carburetor air cleaner and partially drain the coolant system.
2. Remove the heater hoses from the heater core.
3. From under the hood, remove A/C hose support bracket from the cowl (one screw). See Figs. 9 and 10.
4. Remove the insulation tape from the expansion valve and sensing bulb. Then remove the cover plate and seal from the evaporator housing at the expansion valve (two screws).
5. Remove the glove box liner and remove the A/C duct by pulling from the instrument panel register and releasing the clip at the plenum.
6. Disconnect the right cowl fresh air inlet vacuum hose from the fresh air door vacuum motor.
7. Remove the evaporator rear housing from under the instrument panel. Then, remove the fresh air inlet tube from the evaporator rear housing (4 nuts and 1 bolt) and install one upper nut to retain evaporator housing-to-dash after rear housing is removed.
8. Disconnect wires from the de-icing switch and pull capillary tube out of evaporator core (Fig. 11). Remove the de-icing switch mounting plate (four screws).
9. Remove two screws retaining plenum-to-dash (above transmission tunnel) and two screws to evaporator case and remove the plenum.
10. Install a piece of protective tape on "A" pillar inner cowl panel, at lower right corner of instrument panel.
11. Then, remove the lower right instrument panel-to-"A" pillar bolt and lower the center instrument panel brace, bolt and nut.
12. Position the instrument panel rearward and install the "A" pillar bolt to hold the panel in the rearward position.
13. Remove four evaporator retaining screws (Fig. 8).

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5.8L (351 CID) M-V-8 AND 6.6L (400 CID) V-8 ENGINE



5.0L (302 CID) V-8 ENGINE

L2185-2E

FIG. 9 Heater and A/C Hose Routings—5.0L (302 CID) V-8, 5.8L (351 CID)-M-V-8 and 6.6L (400 CID) V-8 Engines

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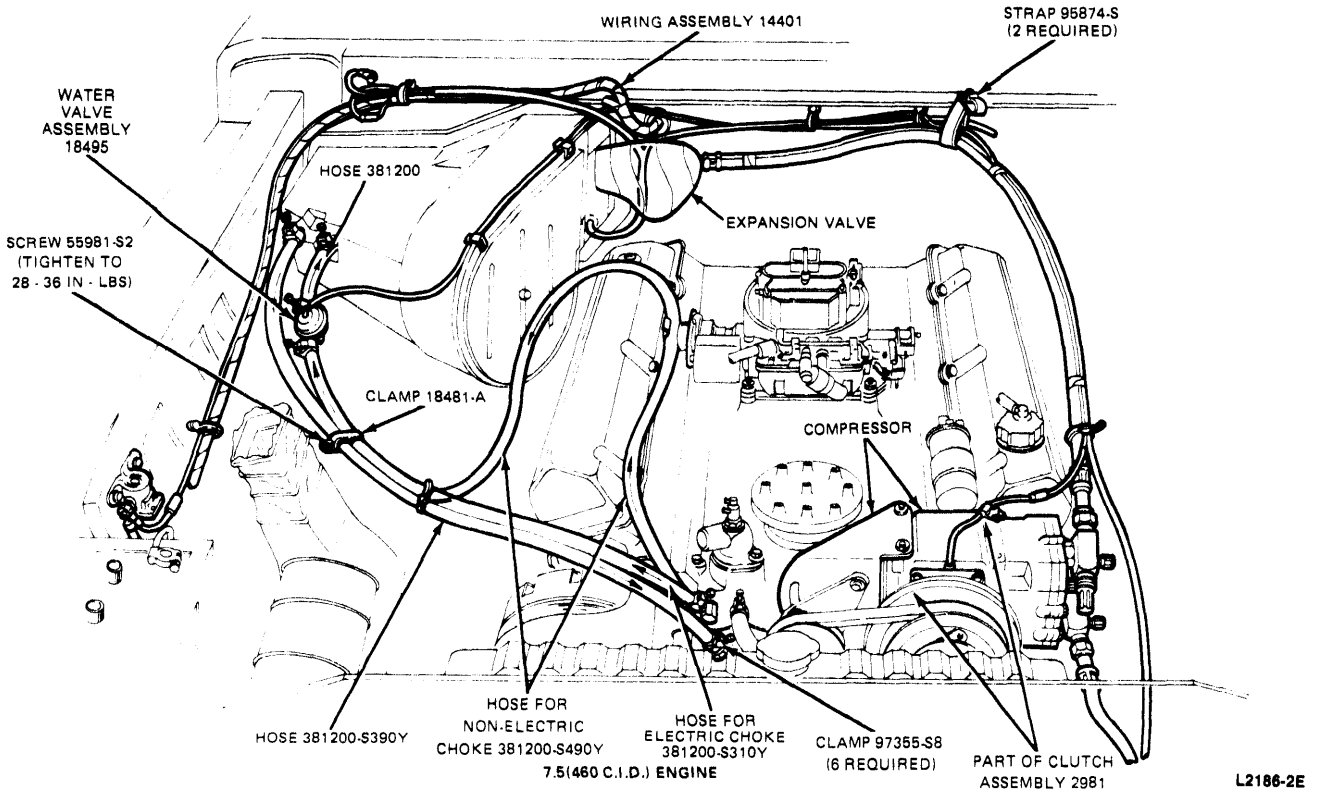


FIG. 10 Heater and A/C Hose Routings—7.5L (460 CID) V-8 Engines

14. Position the evaporator away from the case and secure it rearward and upward. Remove evaporator sealing grommet.
15. Remove heater core (3 screws retaining 2 plates).
16. Remove A/C-heat door (snaps off).
17. Remove A/C-heat door arm support (2 screws) and pivot arm retainer (1 screw).
18. Remove blower motor (2 screws) and remove blower wheel.

Installation

1. Transfer blower wheel to blower motor and panel assembly.
2. Install door arm pivot retainer (1 screw) and door arm support (2 screws).
3. Install A/C-heat door (snaps on).
4. Install heater core.
5. Remove the retainer that held the evaporator away from the case, install evaporator and tube sealing grommet.
6. Install the plenum (4 screws).
7. Install the de-icing switch mounting plate, install de-icing switch capillary tube back into evaporator core and position blower wire grommet.
8. Connect blower and de-icing switch wires.
9. Remove upper evaporator case retaining nut and install the evaporator outlet (4 nuts and 1 bolt). Then, position the air inlet bellows.
10. Connect the right cowl fresh air inlet vacuum hose to the fresh air door vacuum motor.
11. Reposition the instrument panel, install the retaining bolts and remove the protective tape at the "A" pillar inner cowl panel, lower right corner of instrument panel.
12. Install the right A/C duct assembly and install the glove box liner.
13. Install seal and cover plate to the evaporator case at the expansion valve.
14. Install insulation tape over the expansion valve and sensing bulb.
15. Install the A/C hose support bracket-to-cowl.
16. Connect heater hoses to the heater core assembly.
17. Fill cooling system, install the carburetor air cleaner and connect the battery cable to the battery.
18. Check blower motor operation.

EVAPORATOR CORE

Removal

1. Disconnect the ground cable from the battery and remove the carburetor air cleaner.
2. Discharge the refrigerant from the A/C system. Refer to Part 36-30. Observe all safety precautions.
3. Remove the A/C refrigerant line support strap from the cowl.
4. Remove the insulation tape from the expansion valve and sensing bulb. Then, remove the cover plate and seal from the evaporator housing at the expansion valve.
5. Remove the glove box liner and the right A/C duct. Pull the duct from the register and plenum chamber.

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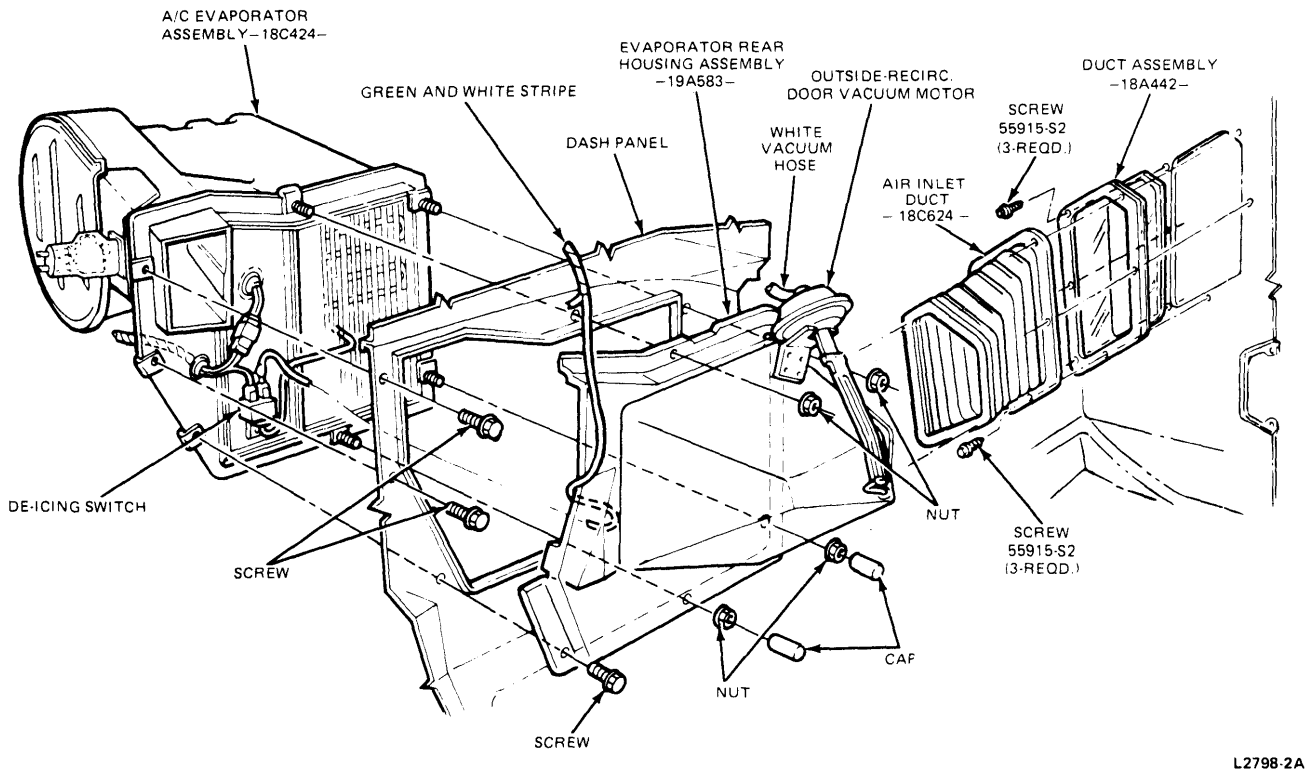


FIG. 11 Evaporator Rear Housing Removal

6. Disconnect the vacuum hose from the outside-recirc. door vacuum motor (Fig. 11).
7. Remove the evaporator rear housing from dash panel and fresh air inlet boot (Fig. 11). Install one upper nut to retain evaporator assembly to dash after rear housing is removed.
8. Remove the de-icing switch and de-icing switch mounting plate (Fig. 11). Push wire grommet out of the mounting plate.
9. Remove the plenum from the evaporator assembly and dash panel and lower the plenum down.
10. Remove the expansion valve and compressor suction line from the evaporator core.
11. Remove four screws attaching evaporator core to housing and remove the core.

Installation

1. Position core to evaporator housing and install attaching screws.
2. Connect the expansion valve and suction line to the evaporator core.
3. Install the de-icing switch and plenum. Connect the blower and de-icing switch wires.
4. Install the evaporator rear housing and connect the fresh air inlet boot to the housing.
5. Connect vacuum hose to the outside-recirc door vacuum motor.
6. Install the right A/C duct and glove box liner.
7. Install the seal and cover plate on the evaporator housing at the expansion valve.
8. Install the A/C refrigerant line support strap on the cowl.
9. Install the insulation tape on the expansion valve and sensing bulb.
10. Install the carburetor air cleaner.
11. Connect the ground cable to the battery.
12. Evacuate, charge and leak test the air conditioning system as outlined in Part 36-30. Then, check the system operation.

EXPANSION VALVE

Removal

1. Remove the carburetor air cleaner.
2. Discharge the refrigerant from the A/C system. Refer to Part 36-30.
3. Remove the A/C hose support from the cowl (Fig. 10).
4. Remove the insulation tape from the expansion valve and sensing bulb, and remove the expansion valve from the evaporator core tubes and refrigerant lines.

Installation

1. Connect the expansion valve to the evaporator core tubes and the refrigerant lines. Clamp the expansion valve sensing bulb to the evaporator inlet tube.
2. Install the insulation tape on the expansion valve and sensing bulb.
3. Install the A/C hose support at the cowl.
4. Leak test, evacuate and charge the A/C system as outlined in Part 36-30.
5. Install the carburetor air cleaner, and check the operation of the A/C system.

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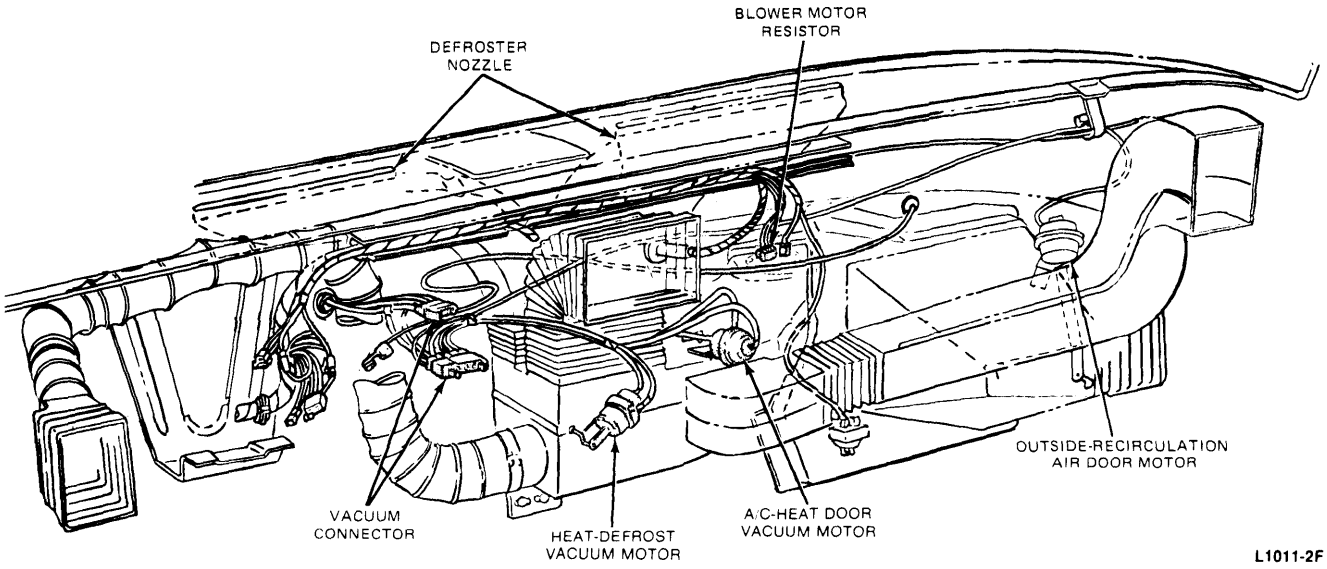


FIG. 12 A/C-Heater Installation

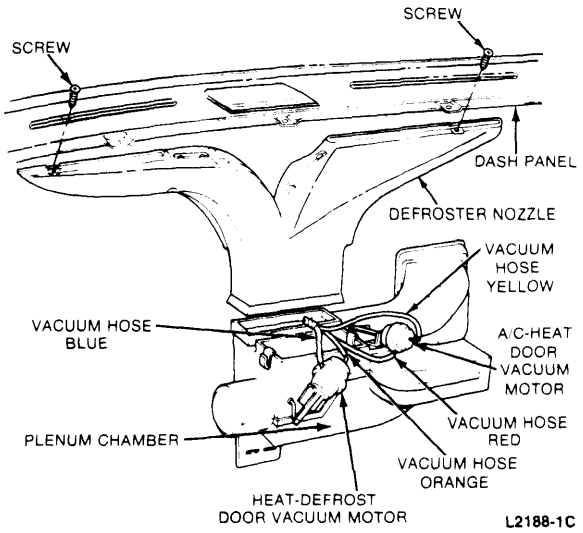


FIG. 13 A/C-Heater Control Connections

DE-ICING SWITCH

Removal

1. Disconnect the battery ground cable.
2. Remove the glove box liner and the right A/C duct. Pull the duct from the register and release the clip at the plenum for duct removal.
3. Disconnect the vacuum hose from the outside-recirc. door vacuum motor (Fig. 10).
4. Remove the evaporator rear housing from the dash panel and the fresh air inlet boot (Fig. 11). Install one upper nut to retain evaporator front housing to dash after rear housing is removed.
5. Disconnect de-icing switch wires, pull sensing tube from evaporator core, and remove two switch attaching screws.

Installation

1. Install de-icing switch screws, connect wires, and insert sensing tube 3 to 3 1/2 inches into evaporator core. Be sure sensing tube is placed in notch of housing as shown in Fig. 11.
2. Install the evaporator rear housing and connect the fresh air inlet boot to the housing.
3. Connect the vacuum hose to the outside-recirc. door vacuum motor.
4. Install the glove box liner and the right A/C duct.
5. Connect the ground cable to battery and check operation of A/C system.

CONTROL ASSEMBLY

1. Remove the instrument cluster as outlined in Part 33-51 of this manual.
2. Remove four screws attaching the control to the mounting plate.
3. Disconnect the wire connectors, vacuum connectors, and cable assembly from the control (Fig. 14). Then, remove the control assembly.
4. To install, position the control assembly near the instrument panel and connect the wire connectors, vacuum connectors, and cable assembly to the control. The pigtail of the cable wire must be up as shown in Fig. 14, and the cable must be routed over the vacuum hoses.
5. Install four screws attaching control to mounting plate.
6. Install the instrument cluster as outlined in Group 33, and check operation of heater-A/C system.

RECEIVER/DRIER

Removal

1. Discharge the refrigerant from the A/C system observing all safety precautions. Refer to Part 36-30.

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2. Disconnect the two refrigerant lines from the receiver/drier.
3. Remove two screws attaching the receiver/drier to the condenser. Then, remove the receiver/drier.

Installation

1. Position the receiver/drier to the condenser assembly and connect the refrigerant lines to the receiver/drier. Use new O-rings dipped in clean refrigerant oil.
2. Install the 2 screws to retain the receiver/drier to the condenser mounting bracket.
3. Leak test, evacuate and charge the system as outlined in Part 36-30.

CONDENSER AND/OR RECEIVER/DRIER

Removal

1. Discharge the refrigerant from the A/C system. Refer to Part 36-30 of the 1979 Truck Shop Manual. Observe all safety precautions.
2. Remove four screws attaching the grille molding upper support to the grille and the radiator support and remove the upper support.
3. Remove the radiator grille heat shield, if so equipped.
4. Remove one screw attaching the lower center of the grille to the mounting bracket.
5. Remove three screws attaching the hood latch support brace to the radiator support and remove the support brace.
6. Disconnect the compressor discharge line from the condenser. Cap the compressor discharge line to prevent the entry of dirt and excessive moisture.
7. Disconnect the liquid line tube from the receiver/drier. Cap the liquid line tube.
8. Remove the oil cooler attaching bolts (if so equipped) and position the oil cooler so as not to interfere with condenser removal.
9. Remove five screws attaching the condenser and receiver/drier to the radiator support and remove the condenser and receiver/drier from the vehicle (Fig. 15).

Installation

1. Obtain a new condenser and receiver/drier assembly. Transfer any mounting bracket spring nuts to the new condenser mounting brackets.
2. Position the condenser and receiver/drier to the radiator support and install the five attaching bolts.
3. Remove the tube bracket from the receiver/drier mounting bracket.
4. Connect the receiver/drier outlet tube assembly to the receiver/drier using a new O-ring dipped in refrigerant oil. Tighten the connection to the specified torque.
5. Obtain a new compressor discharge line (19972). Place the refrigerant lines seal retainer over the tube end of the discharge line and insert the tube end of the line through the opening in the radiator support from the engine side.

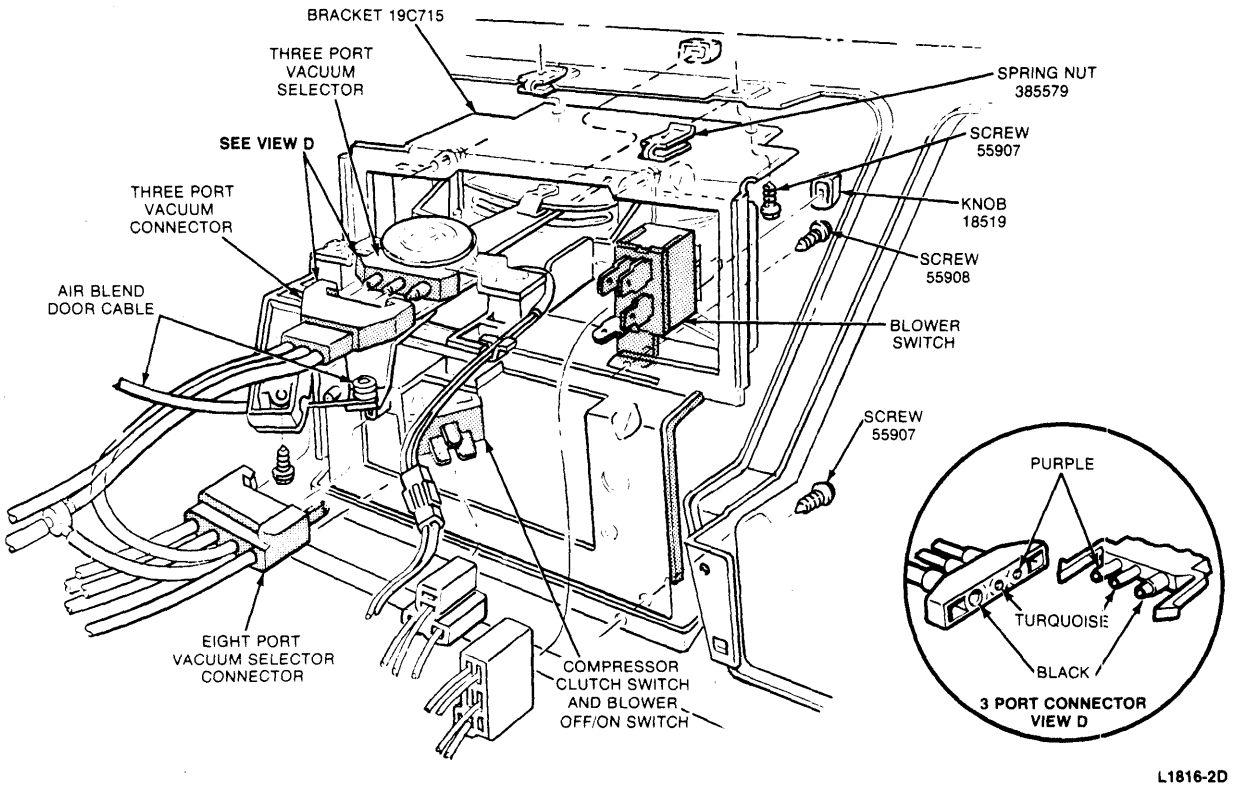


FIG. 14 A/C Heater Control Assembly Connections

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6. Remove the plug from the compressor discharge line and the condenser. Connect the refrigerant line to the condenser using a new O-ring dipped in clean refrigerant oil. Tighten the connection to the specified torque. Then, install the refrigerant line tube bracket on the receiver/drier mounting bracket, clamping both tubes with the bracket.
7. Install the hood latch support brace (3 screws).
8. Install the radiator grille lower center attaching screw.
9. Install the oil cooler attaching bolts, if so equipped.
10. Install the radiator grille molding upper support (4 screws).
11. Leak test, evacuate and charge the system to specification as outlined in Part 36-30.

REGISTERS

1. Insert a thin blade or ice-pick through the louvers and carefully pry the tabs (upper and lower) away from the housing to allow the pivots to clear housing. Then, pull louver assembly out of register housing (Fig. 16). Remove both louvers from center register assembly.
2. To remove register housing, pry four lock tabs (2 on each side) inward and pull register housing from instrument panel. The duct must be disengaged from the register housing for removal of the housing.

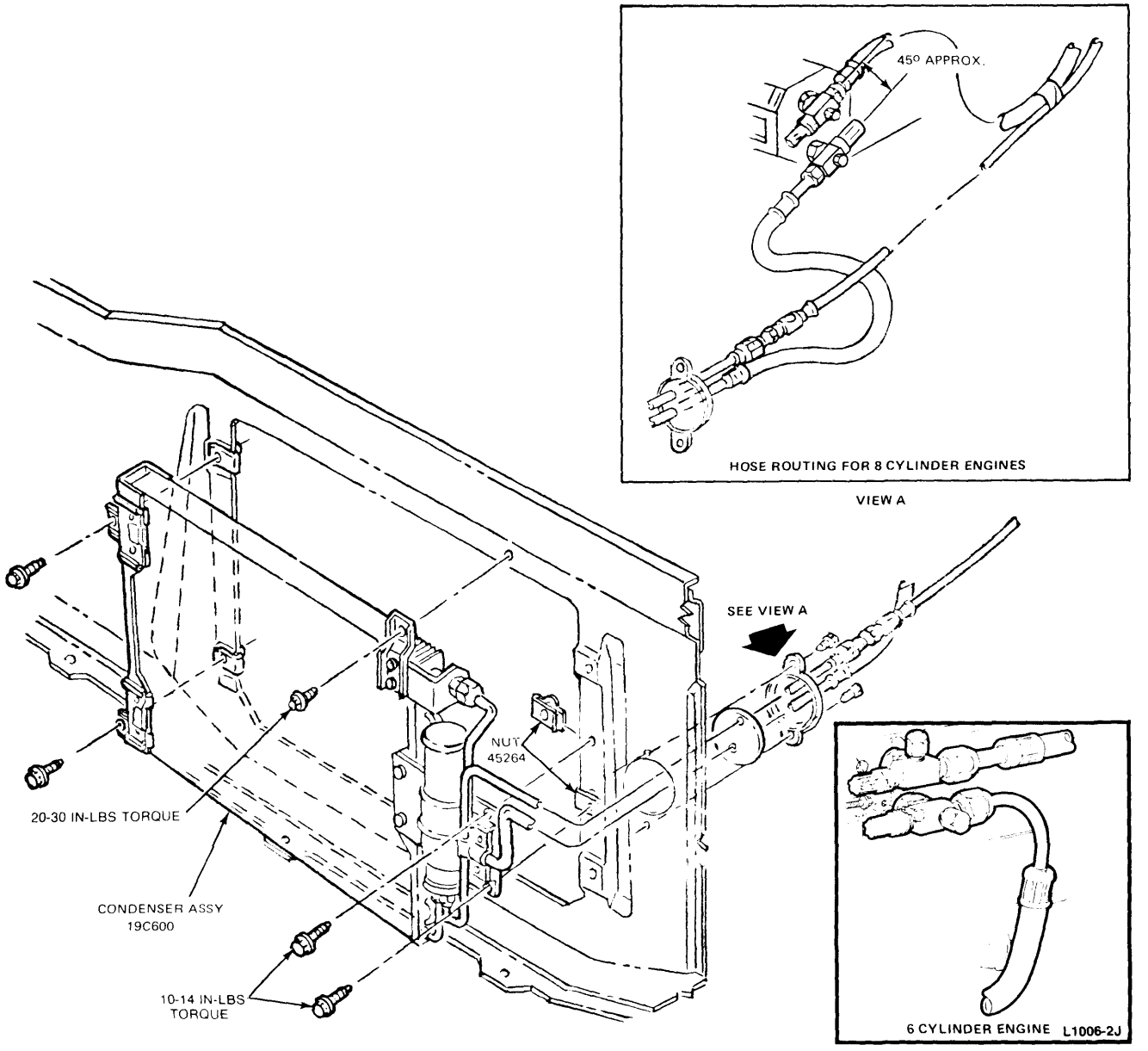


FIG. 15 Condenser and Receiver Drier Installation, 635 sq. in. Shown—Typical 505 sq. in.

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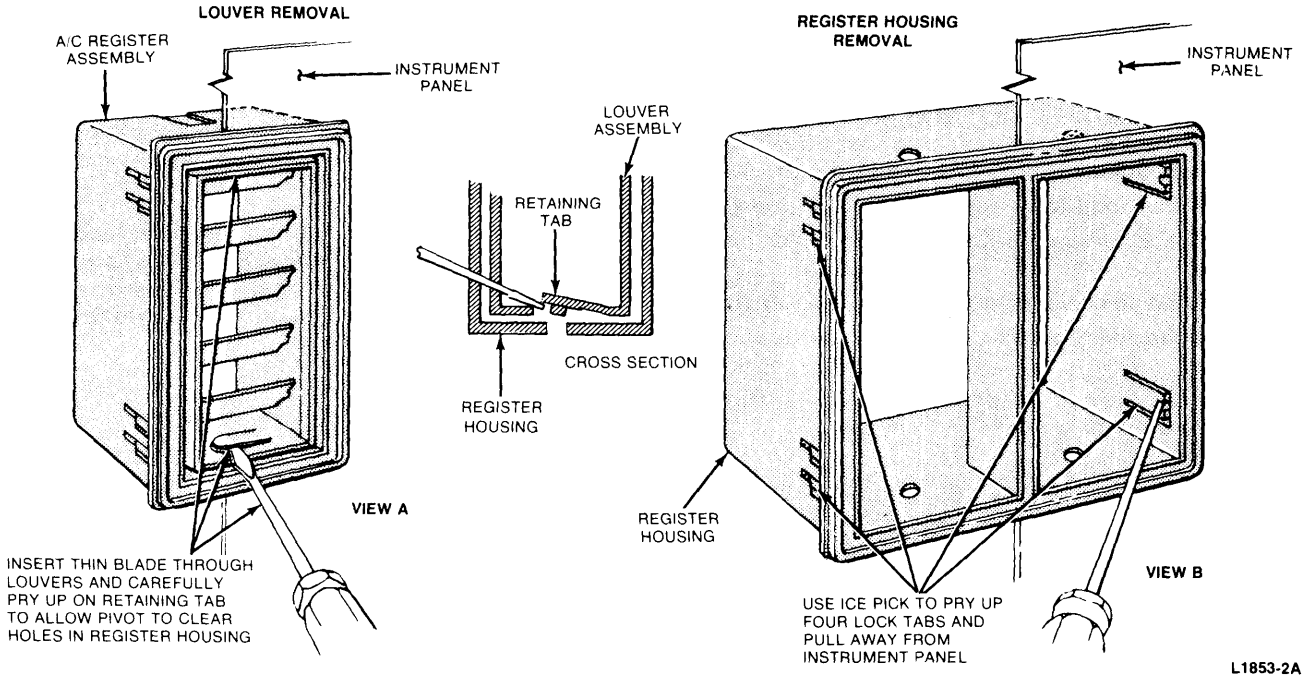


FIG. 16 Instrument Panel Register Removal

SPECIFICATIONS

SPECIFICATIONS

Refrigerant Charge	2.75 pounds
Refrigerant Type	Refrigerant 12 (R-12)
Ford Specification	ESA-M17B2-A or equivalent
Ford Part Number	D4AZ-19B519-A
Motorcraft Part No.	YN1-A and YN-7
Refrigerant Oil	
Ford Specification	ESA-M2C31-A or equivalent
Ford Part Number	C9AZ-19577-B
Motorcraft Part No.	YN-2
Capacity — York	10 Fluid Ounces
— Tecumseh	11 Fluid Ounces

TORQUE SPECIFICATIONS

NOTE: Use a back-up wrench on all refrigerant line fittings.

DESCRIPTION	TORQUE (FT-LBS)
Condenser tube to receiver/drier	10-15
Receiver/drier to outlet tube	10-15
Receiver/drier outlet tube to sight glass	10-15
Compressor discharge line to service valve	22-35
Compressor discharge line to condenser	24-29
Liquid line to expansion valve	10-15
Expansion valve to evaporator core	11-13
Suction line to evaporator core	30-35
Condenser assembly to radiator support	
Side	10-14 in-lb
Top	20-30 in-lb

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E-100 — E-350 Air Conditioning System

PART 36-65

APPLIES TO E-100 THROUGH E-350

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DESCRIPTION AND OPERATION	
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Control Assembly	65-5
Evaporator Assembly	65-5
Expansion Valve	65-5
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DIAGNOSIS AND TESTING	
Blower Motor Test	65-8
ADJUSTMENTS	65-8
REMOVAL AND INSTALLATION	
Air Ducts	65-10
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Blower Motor and Wheel Assembly	65-17
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SUBJECT	PAGE
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Outside-Recirculated Door Vacuum Motor	65-10
Plenum Chamber	65-10
Receiver/Drier	65-15
Registers	65-13
Registor Assmbly	65-16
Vacuum Motors	65-21

This part deals with the controls and components that are peculiar to the E-100—E-350 manual A/C-heater system. Part 36-30 gives the information and procedures required for servicing the refrigeration system which is common to all truck lines. Reference to both parts is necessary for complete servicing of the E-100—E-350 manual A/C-heater system.

DESCRIPTION AND OPERATION

The air conditioner used on the E-100—E-350 is an integral air conditioner-heater system (blend air design) and is composed of an A/C-heater assembly mounted in the right side of the dash panel under the hood and an air distribution plenum and ductwork located behind the instrument panel (Fig. 1). The control assembly is located on the instrument panel, to the right of the steering column. Four outlet registers are located in the instrument panel and each can be adjusted to direct air to the left, right, up, down or closed to block most of the air flow.

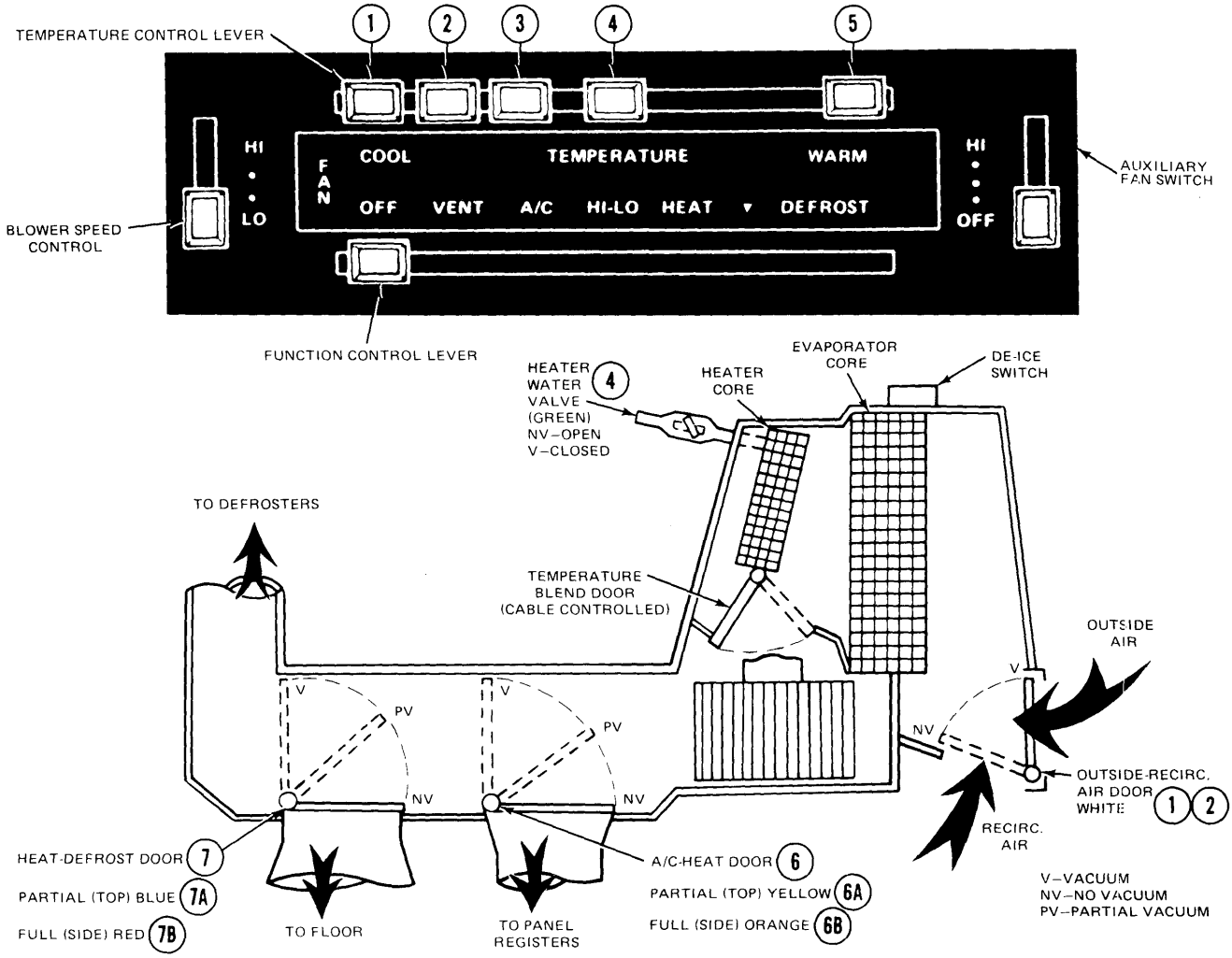
SYSTEM OPERATION

The blower is turned on by moving the function control lever (bottom lever) to any position but OFF. The A/C compressor drive clutch is actuated by placing the function selector lever in the A/C position and "cycling" of the compressor is then controlled by the de-icing switch located on the forward side of the A/C-heater assembly, in the engine compartment. Other positions of VENT, HI-LO, HEAT, ▼(defog), or DEFROST can be selected by moving the function control lever which actuates a vacuum selector valve connected to vacuum motors which operate the various doors. Air discharge temperature is controlled by the upper lever which modulates a control cable connected to the blend air door. This same lever also modulates a three-port vacuum selector valve to control the outside-recirc. door (right side of A/C-heater assembly in the passenger area) and the water valve (engine compartment—right side). A four speed blower switch is located on the left side of the control (Figs. 1, 2 and 3).

Air is drawn into the system by the blower motor and wheel through the outside-recirc. door opening. The air is then pulled through the evaporator core and heater core (when the temperature lever is moved toward the WARM position). When the cable operated (temperature blend door is in the maximum COOL position, the air bypasses the heater core. When the function control lever is in the A/C position and the temperature control lever is moved away from the maximum COOL position (approximately 1/2 inch), the

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E-100–E-350
MANUAL A/C-HEATER SYSTEM VACUUM MOTOR TEST CHART

FUNCTION CONTROL LEVER POSITION	TEMPERATURE CONTROL LEVER POSITION	VACUUM MOTORS APPLIED WITH VACUUM						
		AUXILIARY A C HEATER WATER VALVE ‡	OUTSIDE –RECIRC	WATER VALVE	A/C-HEAT PARTIAL	A/C-HEAT FULL	HEAT-DEFROST PARTIAL	HEAT-DEFROST FULL
OFF	Any Position	–	1 2	4	–	–	–	–
VENT	Any Position	A4		4	6a	6b	7a	7b
A/C *	Cool - 1	A4	1–2	4	6a	6b	7a	7b
	Cool - 2	A4	–	4	6a	6b	7a	7b
	Cool - 3 Blend - 4 Warm - 5	A4		–	6a	6b	7a	7b
HI - LO	Cool - 1	–	–	4	6a	–	7a	7b
	Cool - 2		–	4	6a	–	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	–	6a	–	7a	7b
HEAT	Cool - 1	–	–	4	–	–	7a	7b
	Cool - 2	–	–	4	–	–	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	7a	7b
▽ (DEFOG)	Cool - 1	–	–	4	–	–	7a	–
	Cool - 2	–	–	4	–	–	7a	–
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	7a	–
DEFROST	Cool - 1	–	–	4	–	–	–	–
	Cool - 2	–	–	4	–	–	–	–
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	–	–
VACUUM LINE COLOR CODE		ORANGE	WHITE	GREEN	YELLOW (TOP)	ORANGE (SIDE)	BLUE (TOP)	RED (SIDE)

* COMPRESSOR CLUTCH ENGAGED WHEN ICING SWITCH IS CLOSED
NO VACUUM
DE-ICING SWITCH SETTING – CUT-IN 42° F – CUT-OUT 28° F

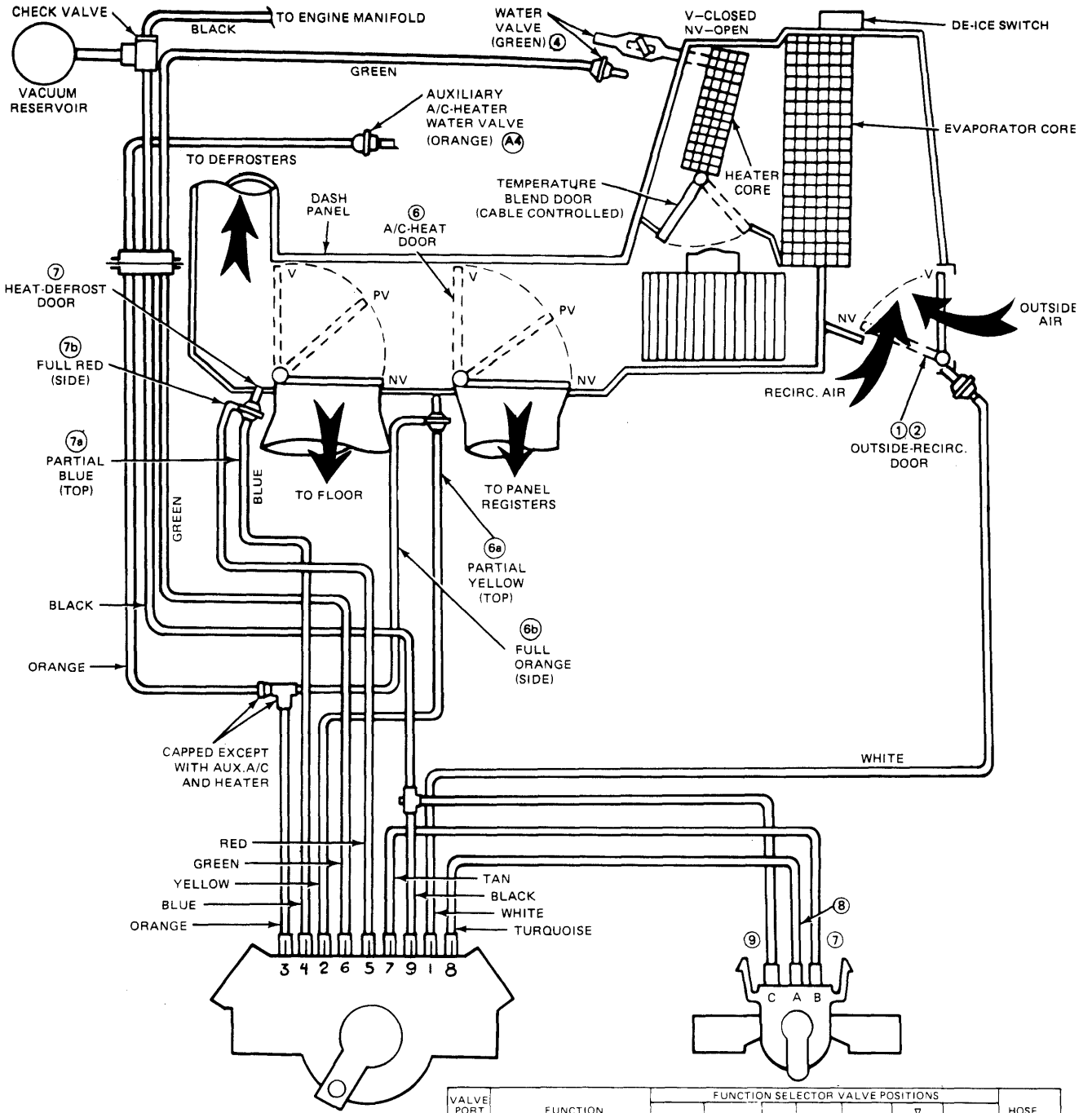
‡ NOT USED WITH AUX. HEATER ONLY

L2560-2B

FIG. 1 A/C Air Flow System

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VALVE PORT	FUNCTION	FUNCTION SELECTOR VALVE POSITIONS							HOSE COLOR
		OFF	VENT	A/C	HI-LO	HEAT	∇ (DEFOG)	DEFROST	
1	Outside-Recirc	V		To 8					White 1-2
2	Partial A/C-Heat		V	V	V				Yellow 6A
3	Full A/C-Heat		V	V					Orange 6B
3	Aux. A/C-Heater Water Valve		V	V					Orange
4	Partial Heat–Defrost		V	V	V	V	V		Blue 7A
5	Full Heat		V	V	V	V			Red 7b
6	To Engine Water Valve	V	V	To 7	To 7	To 7	To 7	To 7	Green 4
7	From Temp Valve Port B	Seal	Seal	To 6	To 6	To 6	To 6	To 6	Tan
8	From Temp Valve Port A	Seal	Seal	To 1	Seal	Seal	Seal	Seal	Turquoise
9	Source Vacuum	V	V	V	V	V	V	V	Black

PORT	FUNCTION	TEMPERATURE SELECTOR VALVE LEVER POSITIONS				HOSE COLOR
		COOL		TEMPERATURE	WARM	
C	Source Vacuum	V	V	V	V	Black
A	Outside-Recirc	V				Turquoise
B	Water Valve	V	V			Tan

L2561-2B

FIG. 2 Manual A/C System—Vacuum Control Chart

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air conditioner system changes from recirculated air to fresh air. When the temperature lever is approximately one inch away from the maximum COOL position, the water valve is opened (no vacuum) and a small percentage of air passes through the heater core, warmed, and then mixes with the cool air before it is discharged from the registers.

With the function control lever in the OFF position, the outside-recirc. door is in the recirculated air position, closed to outside air, the water valve is closed, and no air passes through the system. The blower motor is off.

In VENT position the outside-recirc. door is open to outside air (no vacuum), the water valve is closed (vacuum), and outside air is discharged through the panel registers. The compressor does not operate in this position.

In A/C position the outside-recirc. door and the water valve operation is controlled by the temperature lever (upper lever). When the temperature lever is in the maximum COOL position the outside-recirc. door is open to recirculated air (vacuum) and the water valve is closed (vacuum). Maximum air conditioner performance is obtained in this setting. All of the air discharges through the panel registers except for a small amount of floor bleed. The compressor operates in this position.

In HI-LO position the outside-recirc. door is open to outside air (no vacuum). Air flow through the heater core is controlled proportionately to the setting of the temperature lever (upper lever) which controls the blend door and the warm and cool air mixture before it enters the plenum chamber. Air is discharged through the panel registers and also the floor outlets. The compressor does not operate in this position.

In HEAT position, the outside-recirc. door is open to outside air (no vacuum). Warm air is discharged through the floor outlets plus a small amount of defroster bleed to the windshield.

In the intermediate position between HEAT and DEFROST marked ▼ air is discharged through the defrosters and also the floor outlets.

In DEFROST position the air is discharged through the defrosters to the windshield except for a small amount of floor bleed.

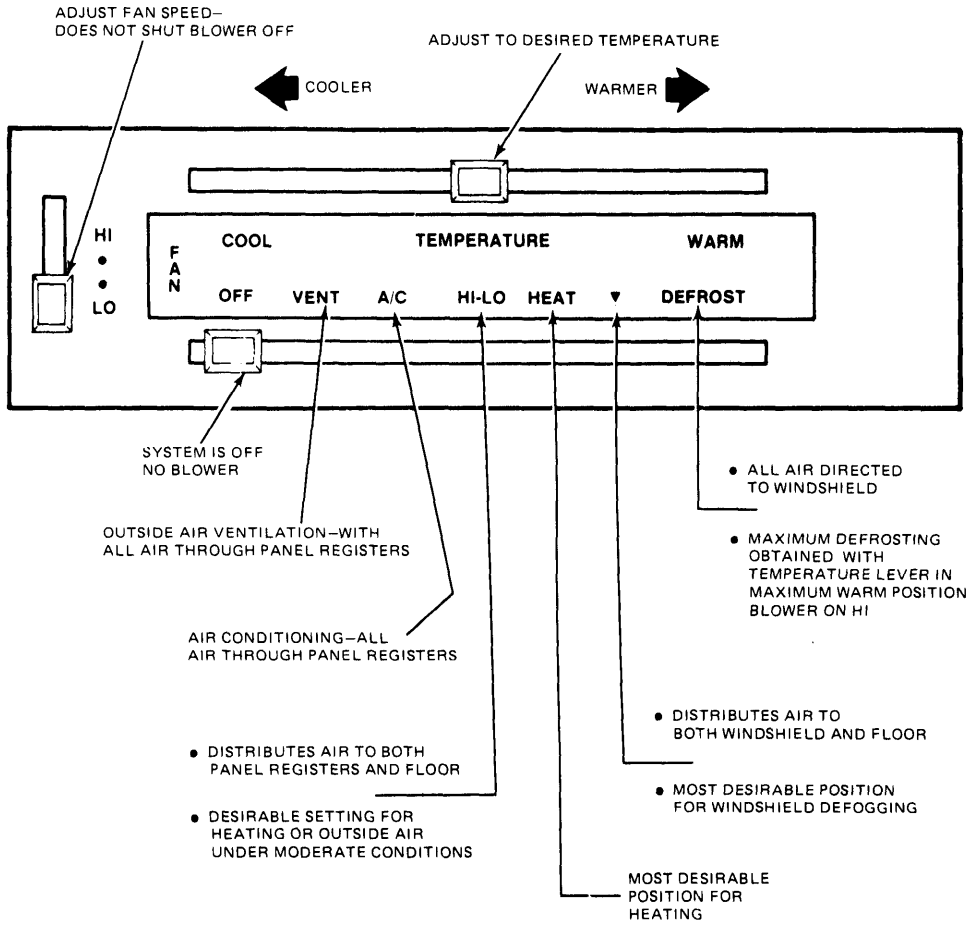


FIG. 3 Manual A/C Control Assembly Operation

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SYSTEM COMPONENTS

CONTROL ASSEMBLY

Function Control Lever (Lower Lever)

The Function Control lever actuates a nine-port vacuum selector that controls vacuum motors at the following doors: A/C-Heat door, Heat-Defrost door, and the outside-recirc. door. The Function Control lever also controls the blower switch off-on operation and activates the A/C clutch circuit in the A/C position (Figs. 2, 5, 6, and 7).

In the A/C position, the compressor operation is dependent upon the evaporator thermostat settings. The thermostat senses the temperature of the evaporator core; the cut-out temperature is 28°F ±2°F(clutch is disengaged) and the cut-in temperature is 42°F ±2°F (clutch is engaged) See Fig. 4.

The blower motor runs at all times except when the function control lever is in the OFF position. A separate four speed blower switch is used to regulate the amount of air flow but can not turn the blower motor off and on (Figs. 3 and 4).

Temperature Lever (Upper Lever)

The temperature lever actuates a three-port vacuum selector and a control cable which operates the temperature blend door. The vacuum selector controls the operation of the outside-recirc. door in the A/C position and the water valve in all positions except OFF and VENT.

In the A/C position the temperature lever actuates a three-port vacuum selector that operates both the outside-recirc. door and the water valve. When the temperature lever is in the maximum cool position the water valve is closed and the outside-recirc. door is closed to outside air and open to recirculated air, for maximum cooling. When the temperature lever is moved about 1/2 inch to the right from the extreme left position, the outside-recirc. door opens to the outside air position (no vacuum). When the temperature lever is moved about one inch to the right from the extreme left position, the water valve opens allowing coolant from the engine to flow through the heater core and the blend door opens allowing a small bleed of air to pass through the heater core (Figs. 2 and 7).

The four speed blower switch is located at the left side of the control assembly (Fig. 3). The switch controls speed only. It does not turn the blower on or off.

The water valve is located in the engine compartment in the heater coolant inlet hose (Fig. 6).

The resistor assembly is located on the blower motor scroll cover inside the vehicle (Fig. 19).

EVAPORATOR ASSEMBLY

The evaporator case assembly is mounted to the inside of the right side of the dash panel and extends into the engine compartment. The resistor, blower motor and wheel assembly, blend door, outside-recirc. door (and vacuum motor), heater core and evaporator core are serviced from the vehicle interior. When servicing any of the above components, it is not necessary to loosen or remove the Instrument Panel. The drain hose, evaporator thermostat, and right angle expansion valve are serviced from the engine compartment.

EXPANSION VALVE

The function of the expansion valve is to automatically regulate the flow of refrigerant into the evaporator, and is the dividing point in the system between high and low pressure liquid refrigerant.

The temperature sensing bulb, clamped to the suction (outlet) tube on the evaporator, measures the temperature of the refrigerant in the suction tube and transmits the temperature variation to the expansion valve. This temperature variation regulates the refrigerant (R12) flow to the evaporator core. When the

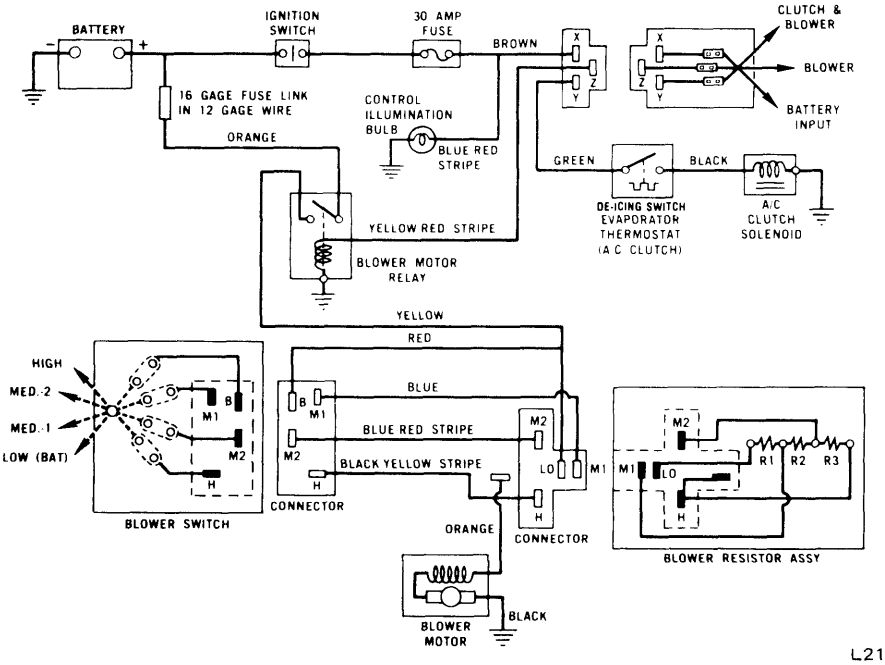


FIG. 4 Electrical Schematic

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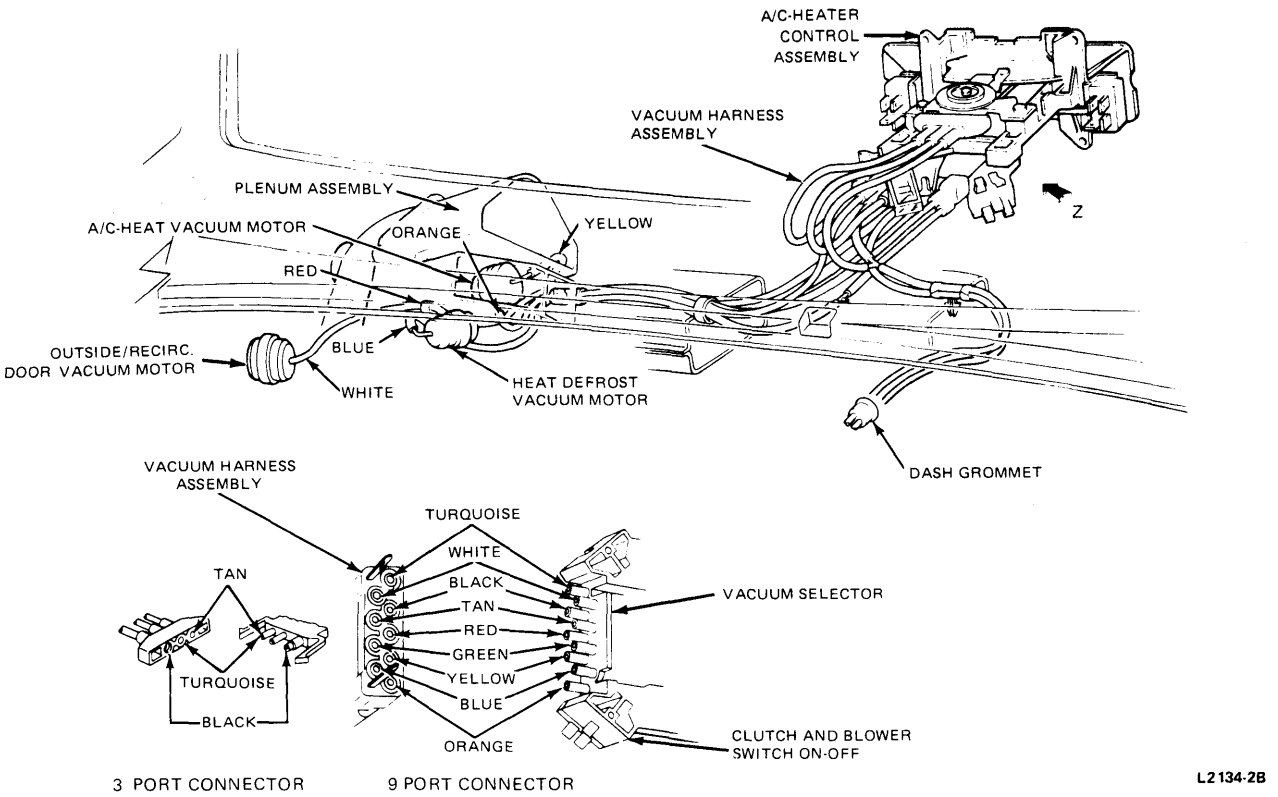


FIG. 5 A/C Vacuum System

bulb senses a high temperature the valve opens and floods refrigerant through the evaporator core. When the bulb senses a low temperature, the valve starts closing to shut off the refrigerant to the evaporator core.

SIDE MOUNTED HEATER AND/OR AIR CONDITIONING SYSTEM

Refer to Part 36-70 for information pertaining to the Side Mounted Auxiliary Heater and/or Air Conditioning System.

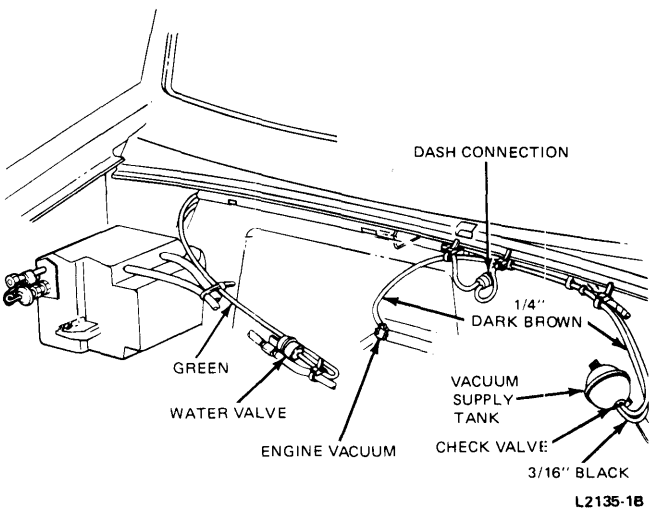


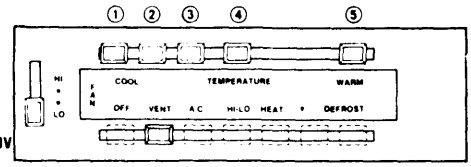
FIG. 6 A/C Vacuum System—Engine

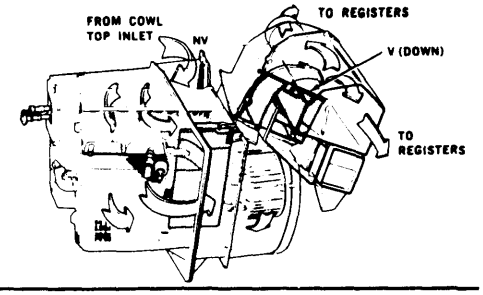
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"VENT" POSITION

① ② ③ ④ ⑤ WATER VALVE OFF-V

① ② ③ ④ ⑤ OUTSIDE AIR POSITION-NV





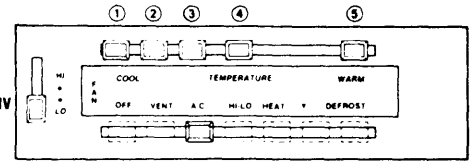
"A/C" POSITION MAXIMUM COOLING IS OBTAINED AT POSITION 1

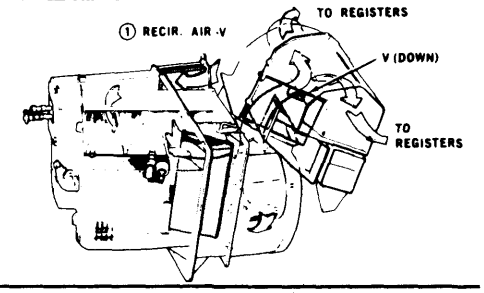
① RECIR. AIR POSITION-V

② ③ ④ ⑤ OUTSIDE AIR POSITION-NV

① ② WATER VALVE OFF-V

③ ④ ⑤ WATER VALVE ON-NV

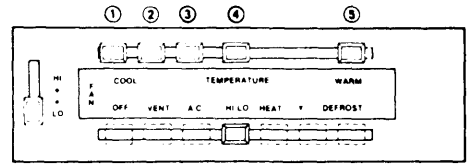


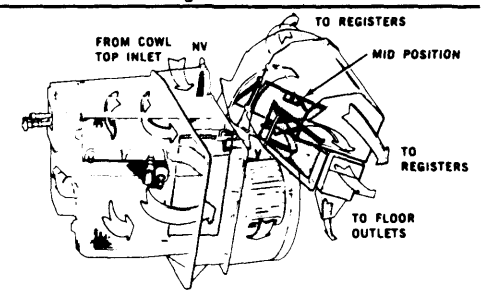


HI-LO POSITION COOL TO WARM

① ② WATER VALVE OFF-V

③ ④ ⑤ WATER VALVE ON-N

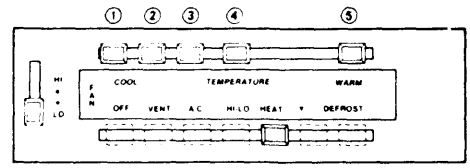


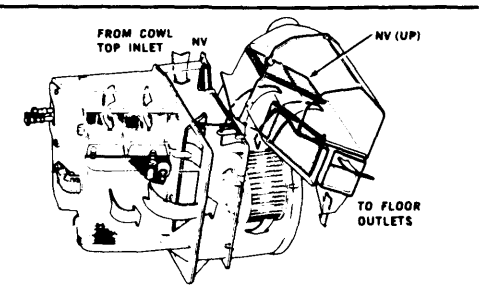


"HEAT" POSITION COOL TO WARM

① ② WATER VALVE OFF-V

③ ④ ⑤ WATER VALVE ON-NV

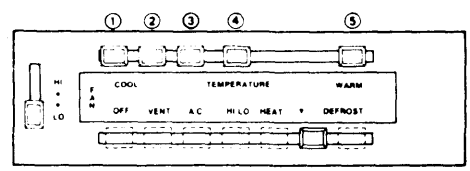


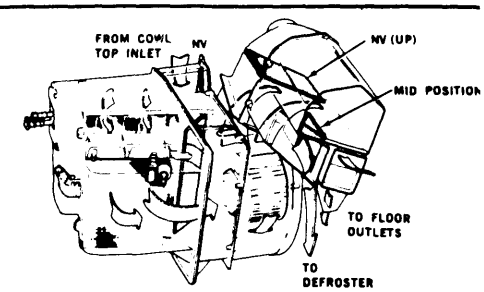


"▼" POSITION (DEFOG) COOL TO WARM

① ② WATER VALVE OFF-V

③ ④ ⑤ WATER VALVE ON-NV

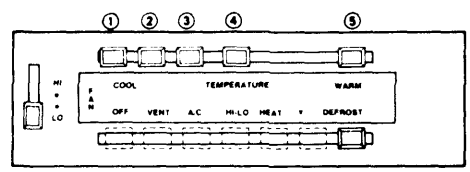


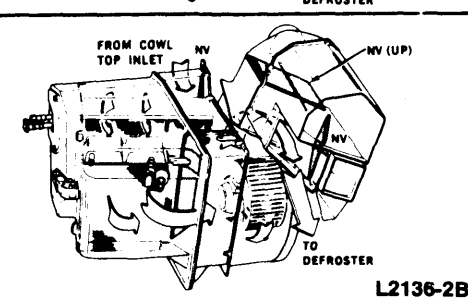


"DEFROST" POSITION COOL TO WARM

① ② WATER VALVE OFF-V

③ ④ ⑤ WATER VALVE ON-NV





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FIG. 7 A/C Heater Air Flow

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DIAGNOSIS AND TESTING

The blower motor test is described below. Refer to Parts 36-10 and 36-30 for other diagnosis and testing procedures.

BLOWER MOTOR TEST

Place the function control lever in the A/C position.

Disconnect the blower motor wire at the bullet connector, and connect it to the negative lead of an ammeter. Connect the positive lead of the ammeter to the battery positive terminal. The motor should operate and the reading on the ammeter should be to specifications listed in Part 36-30, Air Conditioning General Service.

ADJUSTMENTS

The only adjustment is to the temperature control cable as described below.

1. Move the temperature control lever to maximum WARM position.
2. Rotate the cable turnbuckle the proper direction to obtain 0.35 inch between the slot edge and lever edge, (Fig. 8). The turnbuckle is located under the instrument panel to the right of the engine cover. It may be necessary to remove the right heater outlet duct to gain access to the turnbuckle.
3. After proper adjustment of the cable, snap the right heater outlet duct back into position.

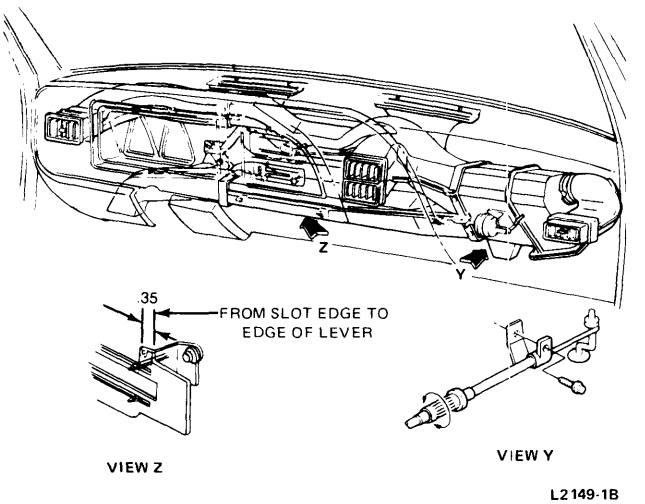


FIG. 8 Temperature Control Cable Adjustment

REMOVAL AND INSTALLATION

INSTRUMENT PANEL

Removal and installation of several components and assemblies described below require the removal and installation of the instrument panel.

Removal

1. Remove steering wheel as described in Part 13-06.
2. Remove instruments, clusters and controls as described in Group 33.
3. Remove heater control or, if applicable heater/air conditioning control as described in Group 36.
4. Disconnect and remove cigar lighter (Part 35-40).
5. If so equipped remove radio (Part 35-02) and instrument panel mounted speaker (Part 35-31).
6. Remove eleven nuts securing pad to instrument panel (Fig. 9) and remove pad.
7. Remove steering column cover.
8. Remove instrument panel upper moulding.
9. Remove two screw and washer assemblies securing instrument panel to brake and clutch pedal support bracket assembly.
10. Remove screw and washer assembly securing the instrument panel at lower-center support bracket.
11. While supporting the instrument panel, remove two side attaching screw and washer assemblies. Carefully remove instrument panel from vehicles.

Installation

1. Carefully position instrument panel in vehicle and secure with two side attaching screw and washer assemblies tightened to 11-21 ft-lbs (Fig. 9).
2. Secure instrument panel to supports with three screw and washer assemblies tightened to 12-20 ft-lbs.
3. Install instrument panel upper moulding. Tighten screws to 10-15 in-lbs.
4. Install steering column cover. Tighten screws to 10-15 in-lbs.
5. Install instrument panel pad. Tighten nuts to 8-20 in-lbs.
6. Install all auxiliary equipment and controls removed during the removal procedure.
7. Install instruments, clusters and controls as described in Group 33.
8. Install steering wheel (Part 13-06).

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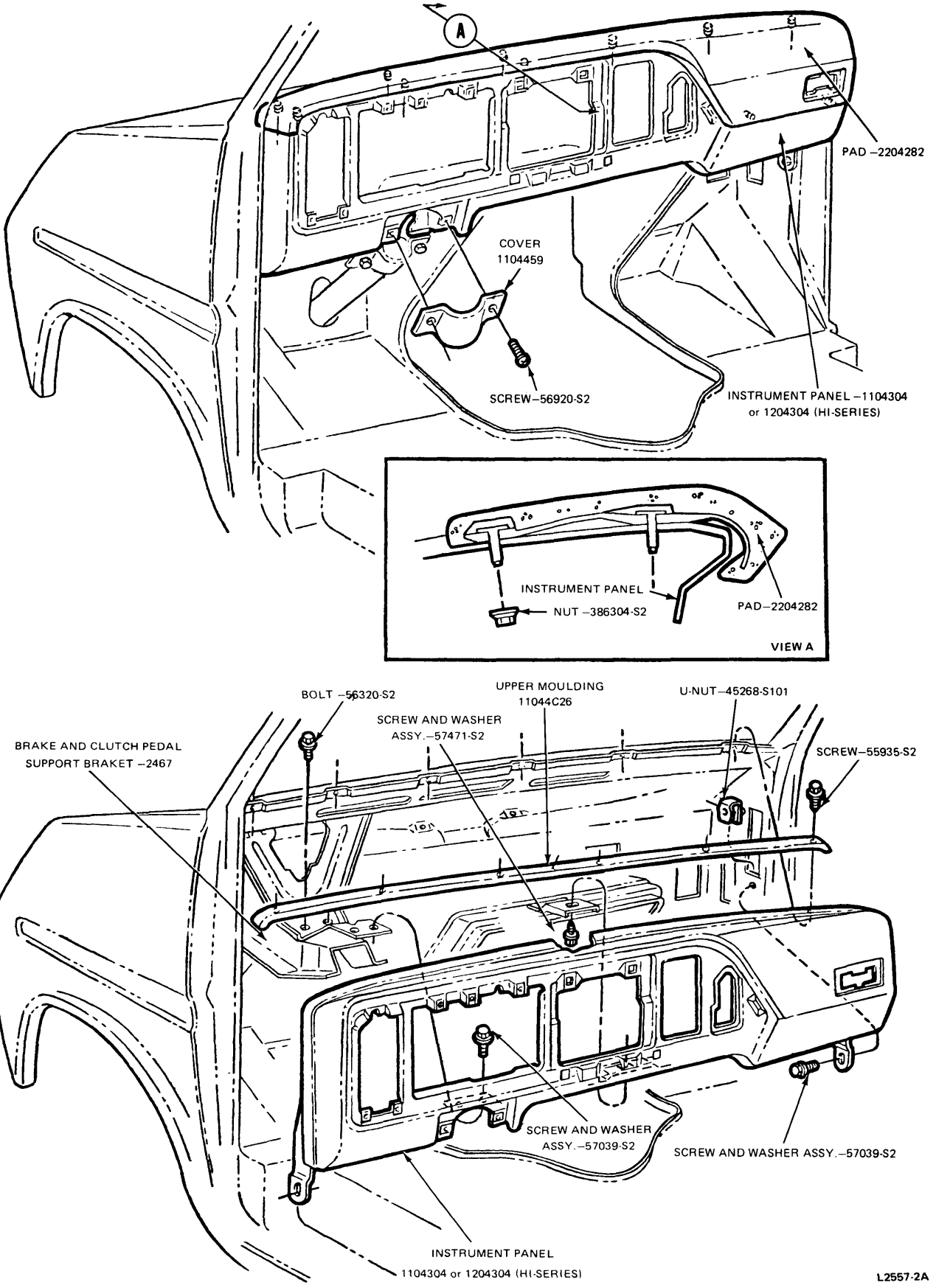


FIG. 9 Instrument Panel Removal Installation

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PLENUM CHAMBER

The plenum chamber is located under the instrument panel on top of the blower motor housing. For servicing the plenum-chamber, vacuum harness, and plenum doors, it is necessary to remove the instrument panel as previously described. It is not required to remove the instrument panel to service the vacuum motors attached to the plenum (Figs. 6 and 11).

Removal

1. Remove the instrument panel following the procedure for Instrument Panel Removal in this Part.
2. Remove two screws attaching the plenum to the evaporator case.
3. Disconnect the vacuum hoses from the heat-defrost vacuum motor and the A/C-heat vacuum motor.
4. Remove one (1) retainer attaching the right register duct to the plenum and remove the right register duct (Fig. 11).
5. Remove one retainer attaching the center register duct to the plenum and one retainer attaching the floor air duct to the plenum.
6. Separate the plenum from the evaporator case, center register duct, and the floor air duct and remove the plenum.
7. Remove the heat-defrost and A/C-heat door vacuum motors from the plenum.

Installation

1. Install the heat-defrost and A/C-heat door vacuum motors on the plenum (Fig. 10).
2. Position the plenum to the center register duct, floor air duct and the evaporator case.
3. Install two (2) screws to attach the plenum to the heater case.
4. Install one retainer to attach the center register duct and one retainer to attach the floor air duct to the plenum (Fig. 11).
5. Position the right register duct to the plenum and install the retainer (Fig. 11).
6. Connect the yellow vacuum hose to the top (end) of the A/C-heat door vacuum motor and the orange vacuum hose to the side of the panel-heat door vacuum motor.
7. Connect the blue vacuum hose to the top (end) of the heat-defrost door vacuum motor and the red vacuum hose to the side of the heat-defrost door vacuum motor.
8. Install the instrument panel following the procedure given in this Part for Instrument Panel Installation.
9. Check the system for proper operation.

DEFROSTER NOZZLE

To remove the defroster nozzle it is first necessary to remove the instrument panel as previously described, heater outlet duct and center A/C duct (Fig. 19).

Removal

Refer to Figure 11.

1. Remove the instrument panel following the procedure given in this Part for Instrument Panel removal.
2. Remove the left register duct and center register duct following the procedures given in this Part.
3. Remove two screws attaching the defroster nozzle to each defroster opening near the windshield.
4. Pull the defroster nozzle from the plenum and remove from the vehicle.

Installation

1. Position the defroster nozzle to the plenum and the defroster openings.
2. Install two screws to attach the defroster nozzle to each defroster opening.
3. Install the center register duct and left register duct following the procedures given in this Part.
4. Install the instrument panel following the procedures given in this Part.
5. Check the system for proper operation.

OUTSIDE-RECIRCULATED DOOR VACUUM MOTOR

Removal

1. Remove the push nut retaining the motor arm on the door crank arm.
2. Remove the four screws attaching the motor mounting bracket to the evaporator case (Fig. 10).
3. Disconnect the vacuum hose from the outside-recirc vacuum motor and remove the motor and bracket.
4. Remove the two nuts retaining the motor to the mounting bracket.

Installation

1. Position the vacuum motor to the mounting bracket and install the two retaining nuts.
2. Connect the vacuum hose to the vacuum motor and position the motor and bracket to the evaporator case and door crank arm.
3. Install the four screws to attach the mounting bracket.
4. Install a new push nut (Part No. 383358-S) or equivalent to retain the motor arm on the door crank arm.
5. Check the system for proper operation.

AIR DUCTS

Remove the instrument panel following the procedure for Instrument Panel Removal in this Part to gain access to the air ducts.

RIGHT REGISTER DUCT

Removal

1. Remove the retainer attaching the right register duct to the plenum (Fig. 11).
2. Pull the right register duct from the plenum chamber.

Installation

1. Position the right register duct to the plenum and rotate the register duct until the retainer holes are aligned.
2. Install the retainer to attach the register duct to the plenum.

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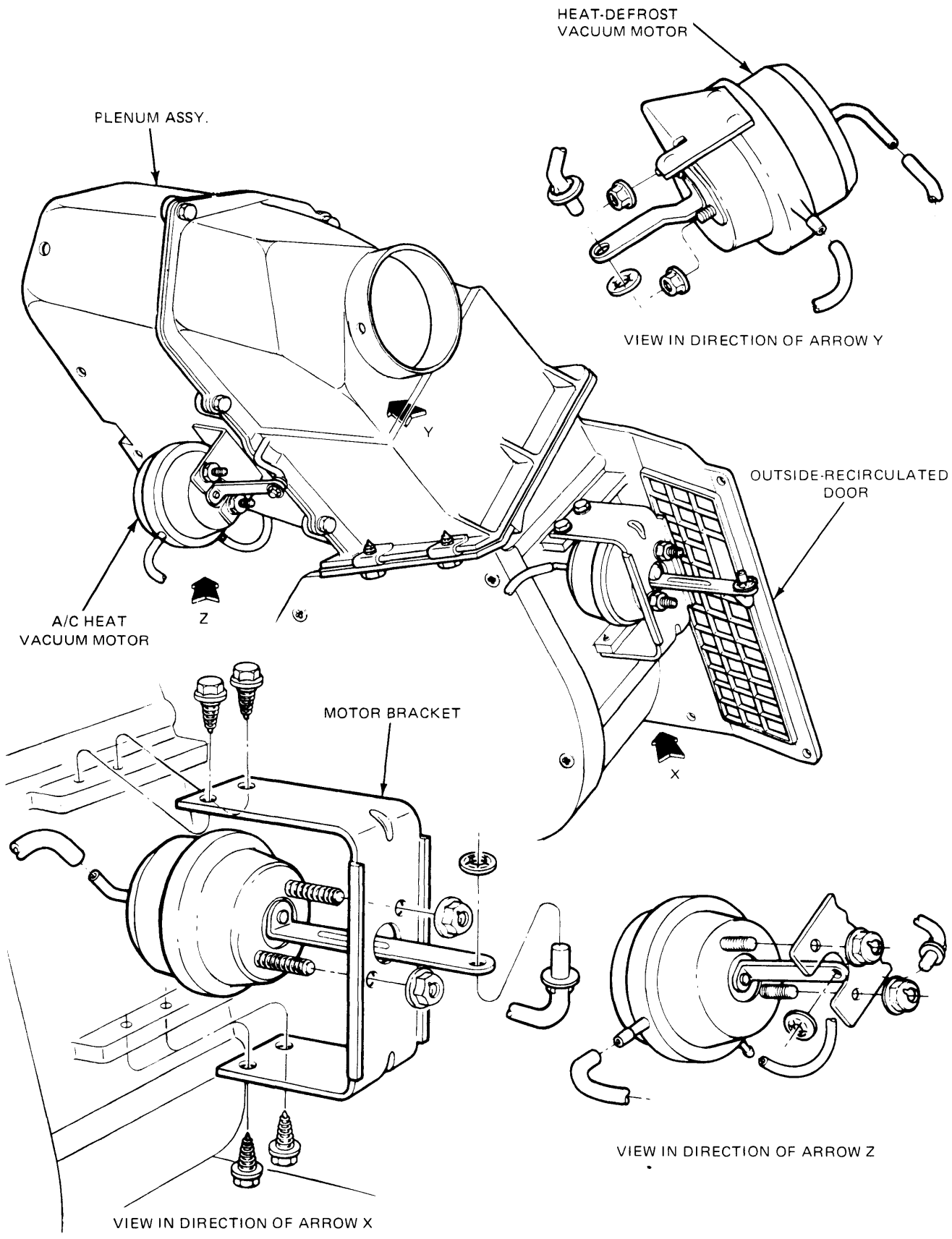


FIG. 10 A/C Vacuum Motor Installation

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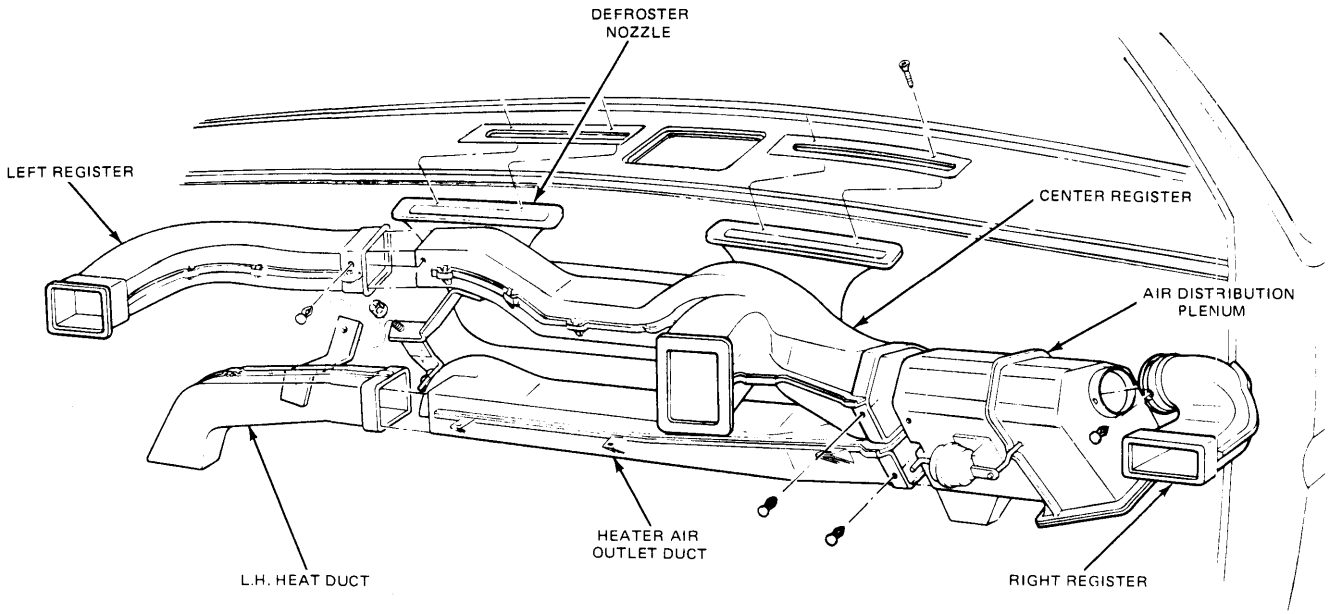


FIG. 11 A/C and Heater Duct Installation

LEFT REGISTER DUCT

Removal

1. Remove the retainer attaching the left register duct to the center register duct (Fig. 11).
2. Pull the left register duct from the center register duct.

Installation

1. Position the left register duct to the center register duct and align the retainer holes.
2. Install the retainer to attach the left register duct to the center register duct.

CENTER REGISTER DUCT

Removal

1. Remove the left register duct.
2. Disengage the vacuum harness locator tab from the center register duct.
3. Remove the one (1) retainer attaching the center register duct to the plenum.
4. Remove the one nut attaching the heat duct, floor outlet duct and center register duct support braces to the brake pedal support (Fig. 11).
5. Disengage the center register duct support brace from the clip bolt and remove the center register duct.

Installation

1. Position the right end of the center register duct to the plenum and the support brace at the left end of the duct to the clip bolt.
2. Install the floor outlet duct support brace on the clip bolt and install the retaining nut.
3. Install the retainer to attach the center register duct to the plenum (Fig. 11).
4. Connect the vacuum harness locator tab to the center register duct.
5. Install the left register duct.

FLOOR DUCTS

Removal

1. Remove the one nut attaching the heat duct, floor outlet duct and center register duct support braces to the brake pedal support (Fig. 11).
2. Disengage the wire harness locator tabs and vacuum harness locator tab from the heat duct.
3. Remove the one (1) retainer attaching the floor outlet duct to the heat duct and remove the floor outlet duct.
4. Remove the one (1) retainer attaching the heat duct to the plenum (Fig. 11).
5. Disengage the heat duct support brace from the clip bolt on the brake pedal support and remove the heat duct.

Installation

1. Position the right end of the heat duct to the plenum and the support brace at the left end of the duct to the clip bolt on the brake pedal support.
2. Place the center register duct support brace on the clip bolt over the heat duct brace.

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3. Position the floor outlet duct to the heat duct and the support brace to the clip bolt.
4. Install the nut to retain the three support braces to the clip bolt (Fig. 11).
5. Install the one retainer to attach the heat duct to the plenum and one retainer to attach the floor outlet duct to the heat duct.
6. Install the wire harness and vacuum harness locator tabs in their respective locations on the heat duct.
7. Install the instrument panel following the procedure given in this Part for Instrument Panel Installation after all air ducts are installed.

REGISTERS

RIGHT REGISTER ASSEMBLY

Removal

1. Remove the louver assembly from the register assembly.
2. Using a small blade screwdriver or an awl, pry the register assembly retaining tabs toward the register opening. Then, pull the register from the instrument panel opening and the register duct.

Installation

1. Position the register assembly to the instrument panel opening. The correct installed position is when the louvers are moved to the right to close.
2. While supporting the register duct, push the register assembly into the instrument panel opening and the register duct until the register tabs lock into place behind the instrument panel opening flange.

CENTER REGISTERS

Removal

1. Disconnect the ground cable from the battery negative cable.
2. Remove the control knobs from the radio shafts.
3. Disconnect the wire from the cigar lighter, if so equipped.
4. Unsnap the name plate from it's recessed location to the right of the registers if so equipped.
5. Remove six (6) screws (5 without nameplate) attaching the register panel assembly to the instrument panel.
6. Pull the register panel assembly from the instrument panel, unsnapping the two clips at the right end of the register panel.

Installation

1. Position the register panel assembly to the instrument panel and engage the two snap clips.
2. Install the register panel assembly attaching screws.
3. Install the nameplate (is so equipped).
4. Connect the wire to the cigar lighter (if so equipped).
5. Install the control knobs on the radio shafts (if so equipped).
6. Connect the ground cable to the battery negative terminal.

LEFT REGISTER ASSEMBLY

Removal

1. Disconnect the ground cable from the battery negative terminal.
2. Remove the ignition lock cylinder and ignition switch bezel (Part 33-71).
3. Remove the headlight switch knob and shaft. Then, remove the headlight switch bezel (Part 32-03).
4. Remove the knob from the windshield wiper switch.
5. Remove two (2) screws attaching the left register panel to the instrument panel.
6. Pull the register panel assembly away from the instrument panel to disengage the snap clips at the top of the register panel.

Installation

1. Position the register panel to the instrument panel and push to engage the snap clips.
2. Install two screws to attach the lower edge of the register panel to the instrument panel.
3. Install the headlight switch bezel and knob and shaft assembly (Part 32-03).
4. Install the ignition switch bezel and the ignition switch lock cylinder (Part 33-71).
5. Install the windshield wiper switch knob.
6. Connect the ground cable to the battery negative terminal.

REGISTER LOUVER ASSEMBLY

Removal

1. Insert a thin blade under the retaining tab (Fig. 12) and pry the retaining tab toward the louvers until the retaining tab clears the hole in the register assembly.

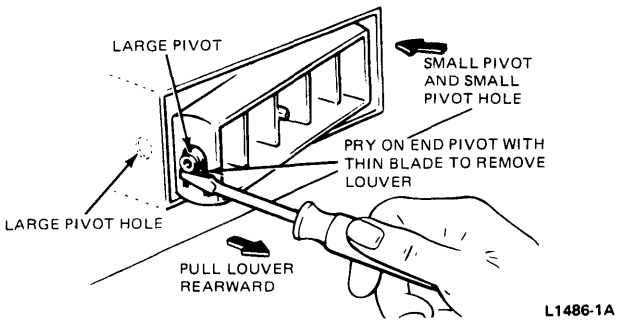


FIG. 12 Register Louver Assembly Removal

2. Pull the louver end out from the register opening only enough to prevent the louver pivot from going back into the pivot hole.
3. Repeat Step 1 for the other retaining tab and pull the louver assembly from the register opening.

Installation

The pivots on each end of some louver assemblies are different diameters and therefore determine the installed position. Other louvers have an arm extending inward on one end of the louver assembly. This end of

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the louver should be installed in the register assembly at the same end as the raised boss in the register assembly.

1. Position the louver assembly into the register opening.
2. Depress the retaining tabs and push the louver assembly into the register opening and engage the retaining tabs in the pivot holes.

CONDENSER ASSEMBLY

The condenser assembly is mounted to the engine side of the radiator support (Fig. 14).

Removal

1. Discharge the refrigerant from the system following the procedures given in Part 36-30. Observe all safety precautions.
2. Disconnect the compressor discharge line and the liquid line from the condensor. Cap the refrigerant lines to prevent the entry of excessive moisture and dirt.
3. Remove two screws attaching the hood latch to the radiator support and position the hood latch out of the way.
4. Remove the nine (9) screws attaching the top edge of the radiator grille to the radiator support.
5. Remove the one screw attaching the center area of the grille to the grille center support.
6. Remove the one screw attaching the grille center support to the radiator support.
7. Working under the vehicle, reposition the splash shields and remove the two condenser lower retaining nuts (Fig. 14).
8. Remove the two bolts attaching the top of the condenser to the radiator upper support (Fig. 14).
9. Remove the four (4) bolts attaching each end of the radiator upper support to the radiator side supports.
10. Carefully pull the top edge of the grille forward and remove the radiator upper support.
11. Lift the condenser from the vehicle.

Installation

1. If the condenser is to be replaced, add two fluid ounces of clean refrigerant oil to the condenser (one ounce for the condenser and one ounce for the receiver/drier). If only the receiver/drier is to be replaced, add one fluid ounce of oil to the condenser.
2. Position the condenser to the vehicle and install the two condenser louver retaining nuts.
3. Position the radiator upper support to the vehicle using care not to damage the radiator grille.
4. Install the four bolts to attach each end of the radiator upper support to the side supports.
5. Install the two bolts to attach the top end of the condenser to the radiator upper support.
6. Install the one screw to attach the grille center support to the radiator upper support.

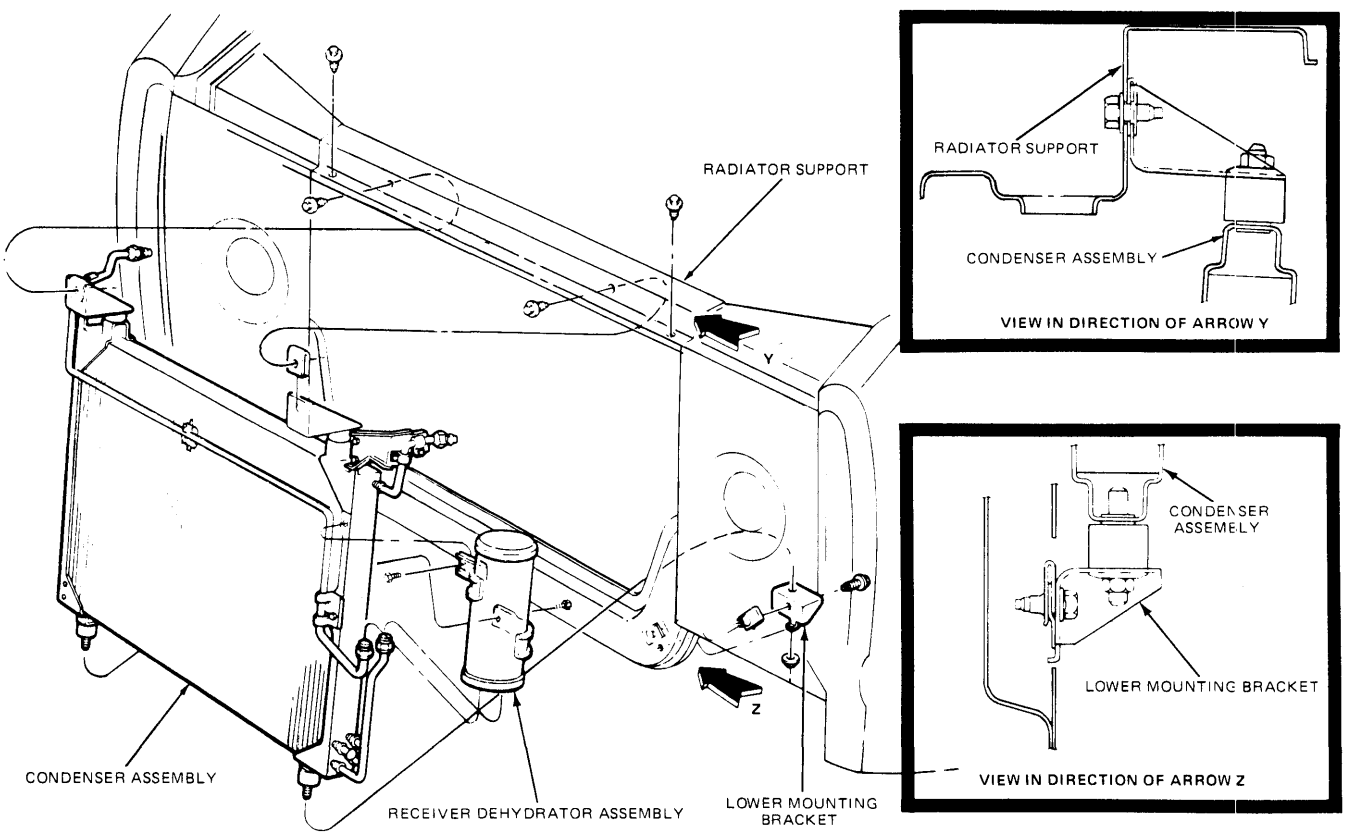


FIG. 13 A/C Condenser and Receiver Installation

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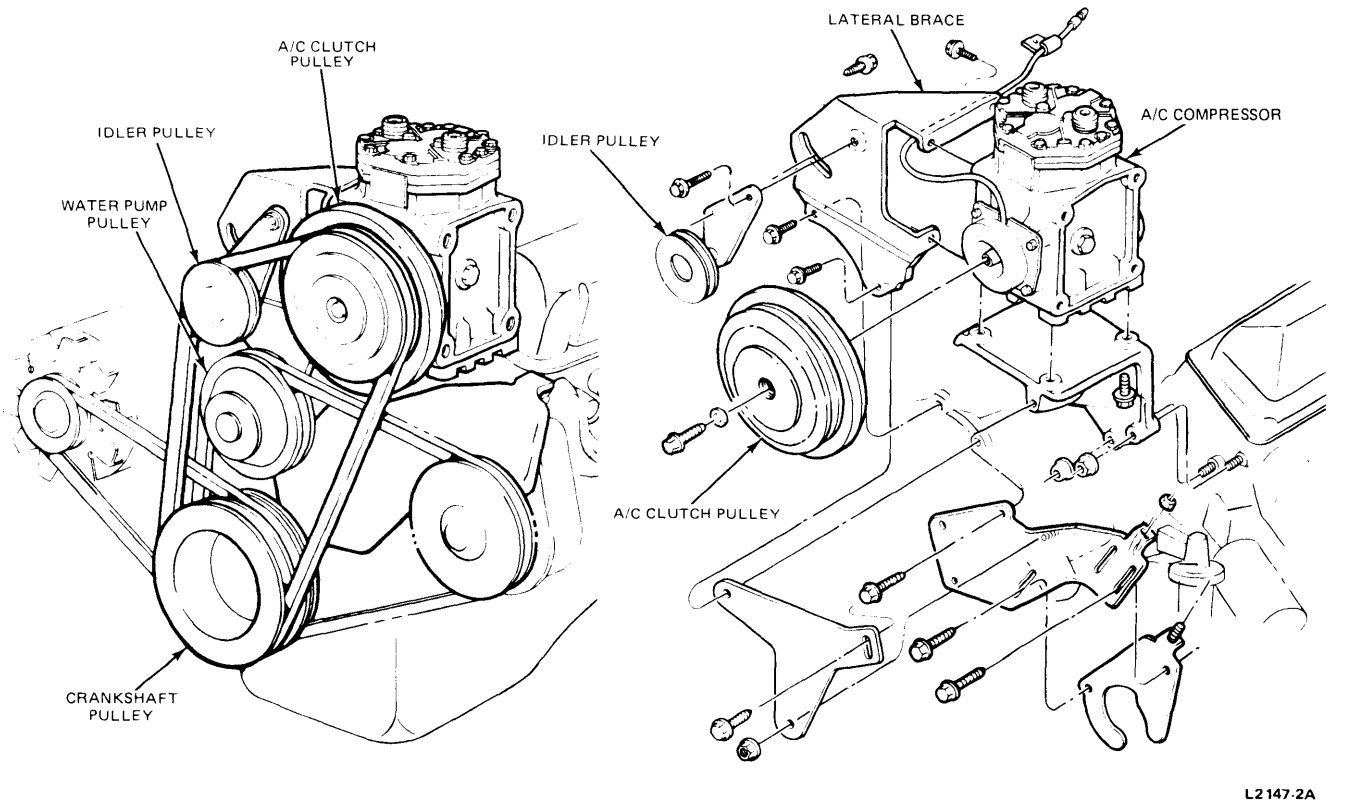


FIG. 14 A/C Compressor and Drive Belt Installation—5.8L (351 CID) V-8 Engine

7. Install the nine screws to attach the top edge of the grille.
8. Install the one screw to attach the center area of the grille to the grille center support.
9. Connect the compressor discharge line and the liquid line to the condenser. Use new O-rings lubricated with clean refrigerant oil. Tighten the connections to specification using a back-up wrench to prevent component damage.
10. Install the hood latch and adjust the latch (Part 44-11).
11. Leak test, evacuate and charge the system as outlined in Part 36-30. Observe all safety precautions.
12. Check the system for proper operation.

RECEIVER/DRIER

Removal

1. Remove the condenser assembly as outlined under Condenser Removal.
2. Disconnect the refrigerant tubes from the receiver/drier.
3. Remove the receiver/drier attaching screws and remove the receiver/drier.

Installation

1. Position the receiver/drier to the condenser refrigerant tubes and tighten the tube nuts, fingertight. Use new O-rings lubricated with clean refrigerant oil.
2. Install the receiver/drier attaching screws.
3. Tighten the refrigerant tube nuts at the receiver/drier. Use a back-up wrench to prevent component damage.
4. Install the condenser assembly as outlined under Condenser Installation.

COMPRESSOR ASSEMBLY

The A/C compressor and clutch assembly is located in a vertical position on the forward left side on the 5.0L (302 CID) and 5.8L (351 CID) V-8 engine, and in a horizonatal position on the forward left side on the 4.9L (300 CID) I-6 and 7.5L (460 CID) V-8 engines. Remove and install the compressor assembly as shown in Figs. 14, 15, 16 and 17. An adjustable idler pulley is provided to adjust belt tension on both the 5.8L (351 CID) V-8 and 7.5L (460 CID) V-8 engines. Belt tension is adjusted on the 4.9L (300 CID) I-6 engine by adjusting power steering belt tension.

A refrigerant charge tag is located on the right side of the radiator upper support. A sight glass is in the liquid line near the condenser assembly.

CONTROL ASSEMBLY

Removal

1. Remove knobs from blower switch and control levers (Fig. 18).
2. Remove applique.
3. Remove control assembly from mounting bracket (4 screws).
4. Carefully pull control assembly from opening in mounting bracket.

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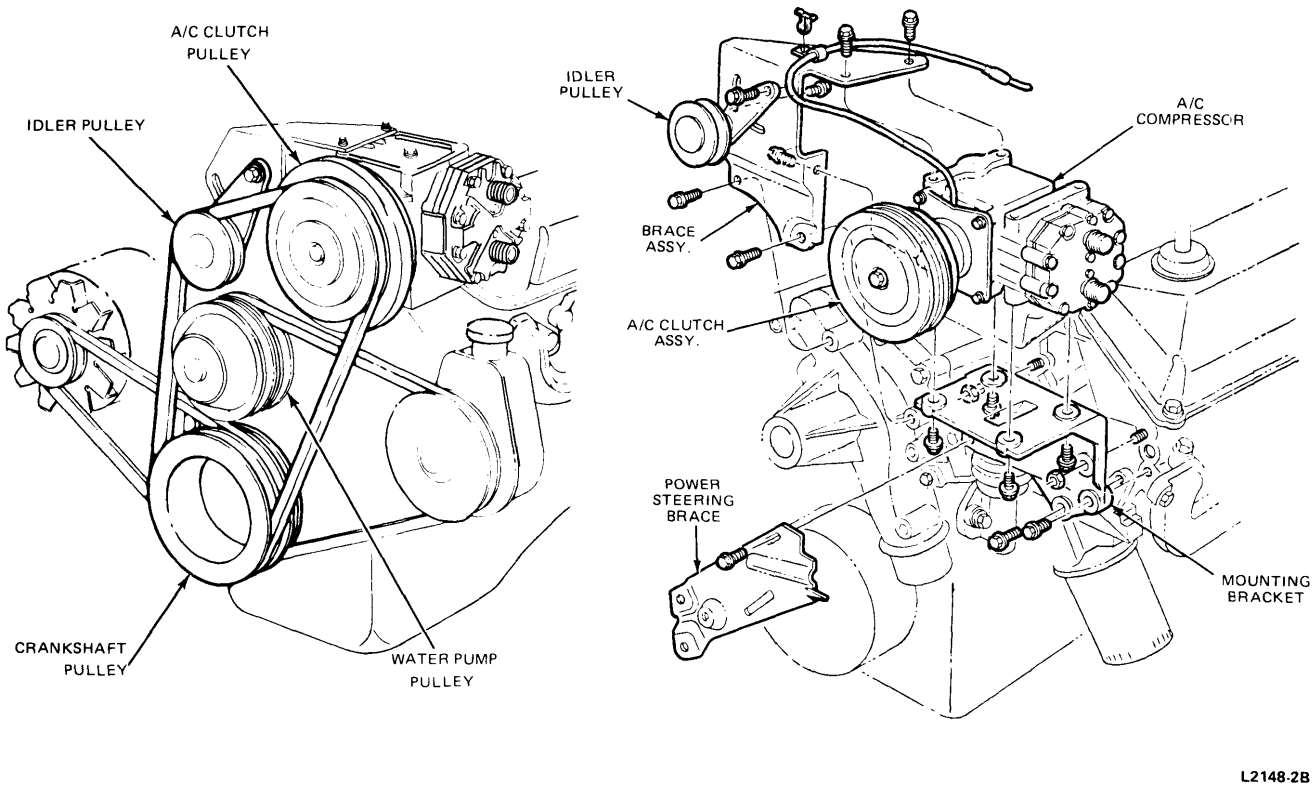


FIG. 15 A/C Compressor and Drive Belt Installation—7.5L (460 CID) V-8 Engine

5. Disconnect the electrical wiring connector from the blower switch, vacuum switch, and illumination bulb.
6. Disconnect the vacuum harness from the 9-port and 3-port vacuum selectors.
7. Remove the temperature control cable from the control assembly (1 screw and 1 push nut).

Installation

1. Install the temperature control cable to the new control assembly (1 screw and 1 push nut).
2. Connect the vacuum harness to the 3 port and the 9 port vacuum selectors.
3. Connect the illumination bulb wire and socket, vacuum and blower switch connectors.
4. Carefully position the control assembly to the mounting bracket and install the attaching screws.
5. Install the applique.
6. Install the blower switch and control lever knobs.
7. Adjust the control cable as described under Adjustments and Fig. 9.

CONTROL SWITCH AND VACUUM VALVES

Removal

1. Remove the knobs from the blower switch and control levers (Fig. 18).
2. Remove trim panel.
3. Remove control mounting bracket from the instrument panel (four screws).
4. Carefully remove the control mounting bracket with the control assembly from the opening in the instrument panel.
5. To remove the blower switch, disassemble the switch mounting bracket from the control assembly (one screw).
6. To remove the three port vacuum selector or the nine port vacuum and electrical selector, disconnect the vacuum harness from the valve(s) and remove the two mounting bracket screws.

Installation

1. Position vacuum selector(s) to the control assembly and secure mounting bracket with two screws.
2. Position blower switch and bracket to control assembly and secure with one screw.
3. Connect vacuum harness to the vacuum selectors.
4. Position control assembly and bracket to instrument panel and secure with four screws (Fig. 18).
5. Install trim panel.
6. Install knobs on switch(es) and levers.

RESISTOR ASSEMBLY

1. Disconnect the electrical leads from the resistor (Fig. 19).
2. Remove (2) plastic pop rivets from the resistor on front face of A/C blower scroll cover and remove the resistor.
3. Install the resistor to the blower scroll cover with (2) new plastic rivets and connect the electrical leads.

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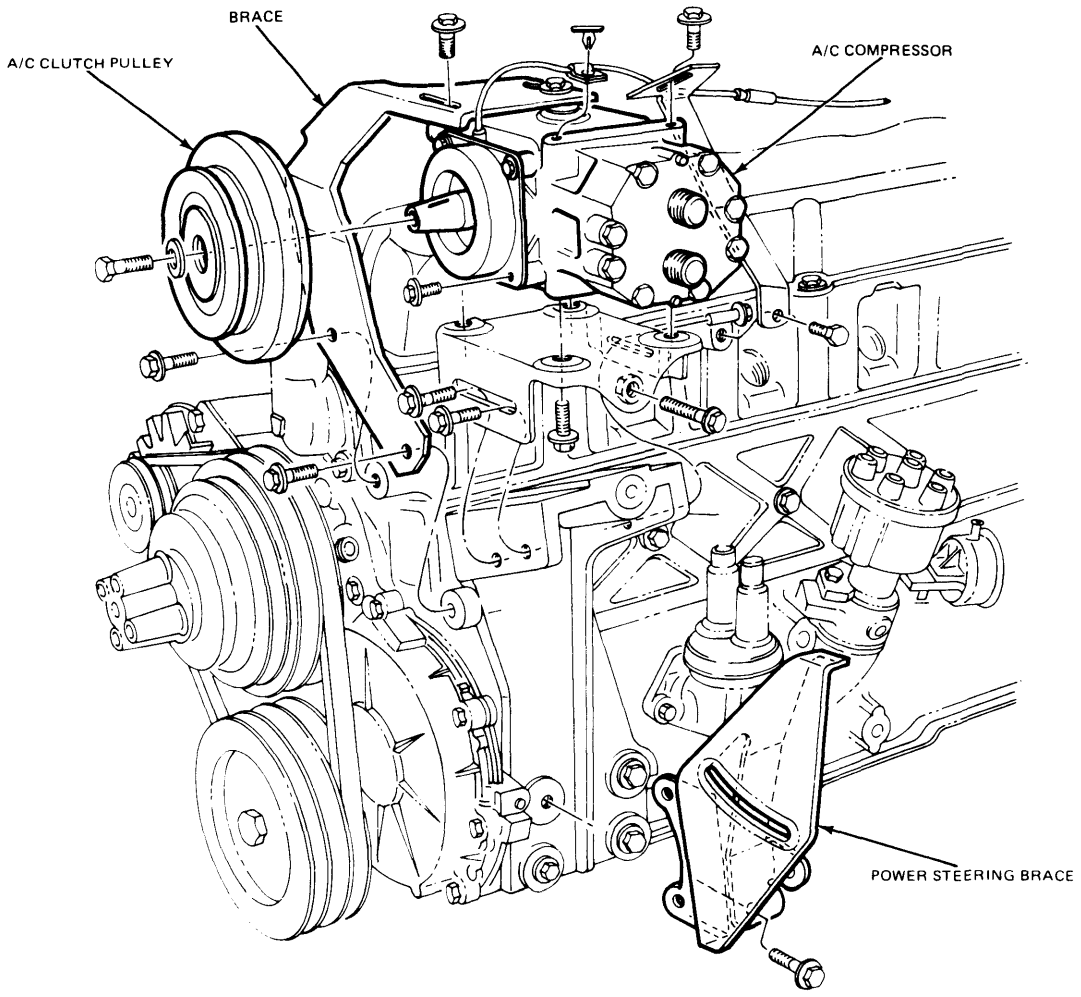


FIG. 16 A/C Compressor Installation—4.9L (300 CID) I-6 Engine

BLOWER MOTOR AND WHEEL ASSEMBLY

Removal

1. Disconnect electrical leads from resistor on front face of A/C blower scroll cover (Fig. 19).
2. Remove A/C blower scroll cover (5 screws plus 2 screws from blower scroll cover to plenum assembly).
3. Push wiring grommet forward out of hole in blower motor housing.
4. Remove four screws from blower motor mounting plate.
5. Remove blower motor and wheel assembly.

Installation

1. Position blower motor to housing and push the wiring grommet into blower motor housing.
2. Install four blower motor mounting plate attaching screws.
3. Install A/C blower scroll cover (5 screws) and two screws attaching the blower scroll cover-to-plenum assembly.
4. Connect the electrical leads to the blower motor resistor.
5. Check the blower motor operation.

BLEND DOOR HOUSING AND DOOR

Removal

1. Disconnect electrical leads from resistor on front face of A/C blower scroll cover (Fig. 20).
2. Disconnect vacuum line from the outside-recirculated vacuum motor.
3. Remove A/C blower cover (5 screws plus 2 screws that attach blower scroll cover to plenum assembly).
4. Remove push nut and washer from the outside-recirculated door shaft.
5. Remove control cable from bracket (1 screw) and slide over bracket. Remove cable wire loop from blend door shaft.
6. Remove A/C blower motor housing (9 screws).
7. Remove the blend door and housing (3 screws).
8. Pry the blend door cable shaft upward and remove the blend door (1 screw).

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Installation

1. Install the blend door to the housing (1 screw) and install the blend door shaft into the blend door housing.
2. Install the blend door and housing into the plenum (3 screws).
3. Install the A/C blower motor housing (9 screws).
4. Position control cable loop to the blend door shaft.
5. Install control cable to bracket attaching screw.
6. Connect the-outside-recirculated door shaft (push nut and washer).
7. Install A/C blower cover (5 screws plus 2 screws to attach the blower scroll cover-to-plenum assembly).
8. Connect vacuum line to the outside-recirculated vacuum motor.
9. Connect the electrical leads to the resistor.
10. Adjust the control cable as described under Adjustments and Fig. 9.

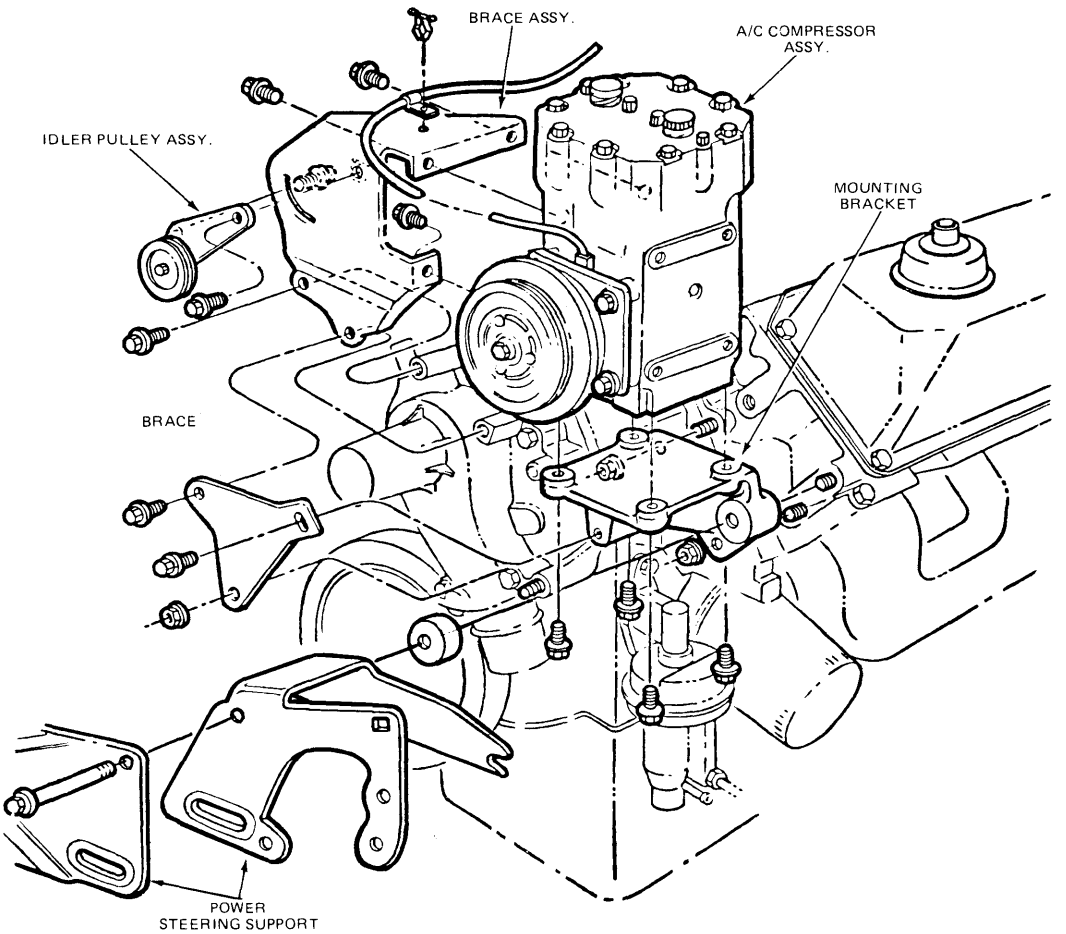
HEATER CORE AND SEAL ASSEMBLY

Removal

1. Disconnect electrical leads from resistor on front face of A/C blower scroll cover (Fig. 21).
2. Disconnect vacuum line from the outside-recirculated door vacuum motor.
3. Remove A/C blower cover (5 screws plus 2 screws attaching the blower scroll cover to plenum assembly).
4. Remove push nut and washer from the outside-recirculated door shaft.
5. Remove control cable from bracket (1 screw) and slide it over bracket. Remove cable wire loop from blend door shaft.
6. Remove A/C blower motor housing (9 screws).
7. Remove the blend door housing (3 screws).
8. Partially drain the coolant from the cooling system.
9. Remove heater hoses from heater core (2 clamps) (Fig. 22).
10. Remove the two heater core retaining brackets (2 screws).
11. Remove the heater core and seal assembly.

Installation

1. Position the heater core and seal assembly and install the core retaining brackets and screws.
2. Install the heater hoses to the heater core (2 clamps) and fill the cooling system to specifications.



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FIG. 17 A/C Compressor Installation—5.0L (302 CID) V-8 Engine

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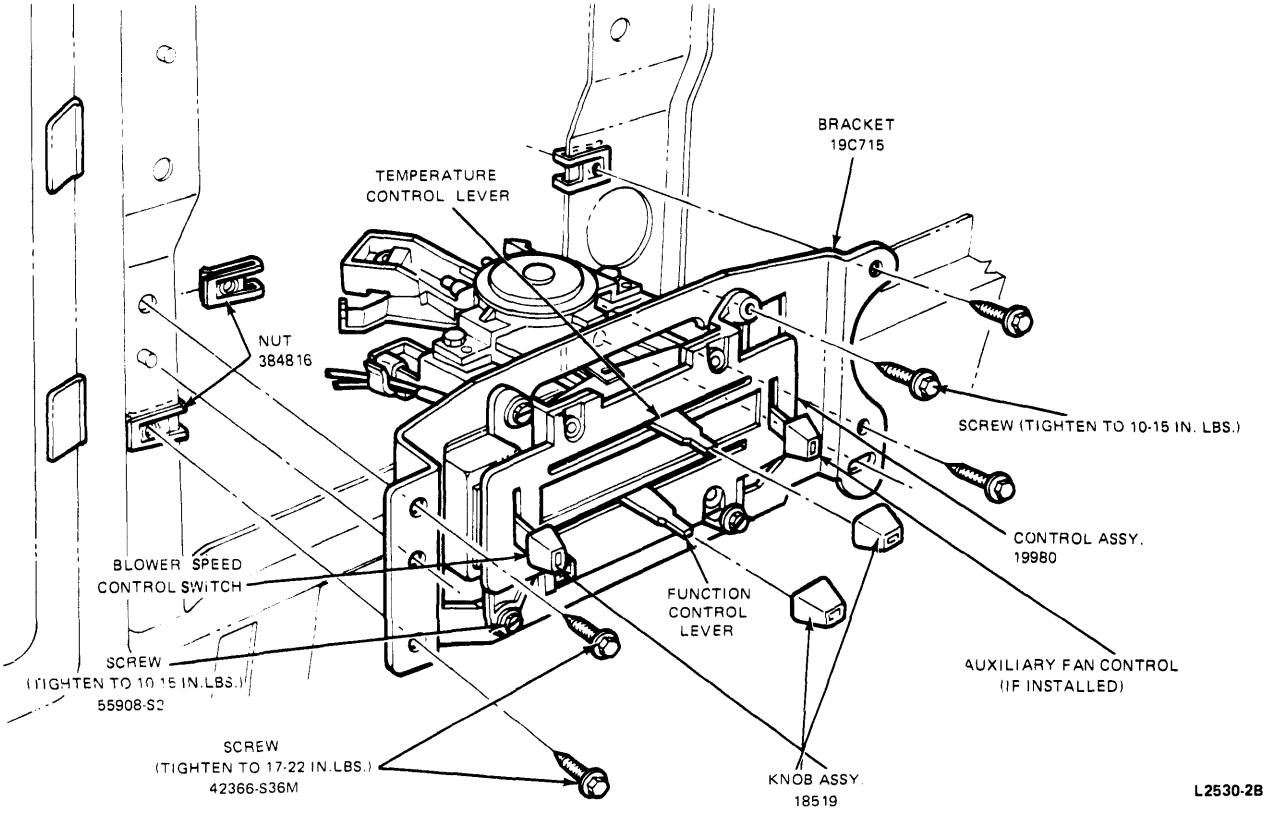


FIG. 18 A/C-Heater Control Assembly

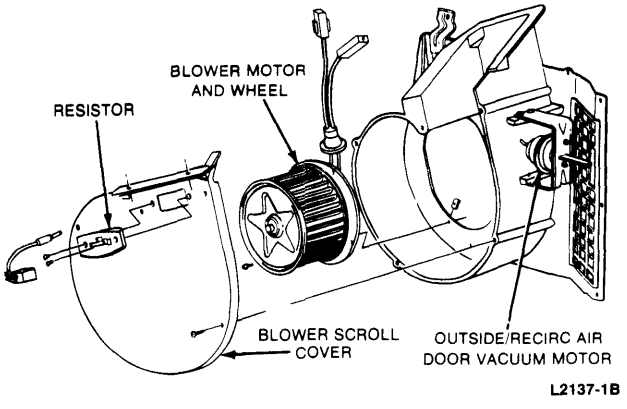


FIG. 19 A/C-Heater System—Resistor and Blower Motor and Wheel Installation

3. Install the blend door housing (3 screws).
4. Install the A/C blower motor housing (9 screws).
5. Position control cable loop to the blend door shaft.
6. Install control cable to bracket attaching screw (1 screw).
7. Install the outside-recirculated door shaft push nut and washer.
8. Install A/C blower cover (5 screws plus 2 screws attaching the blower scroll cover-to-plenum assembly).
9. Connect vacuum line to outside-recirculated vacuum motor.
10. Connect the electrical leads to the resistor.
11. Adjust the control cable as described under Adjustments and Fig. 9.

EVAPORATOR CORE ASSEMBLY

Removal

1. Disconnect electrical leads from resistor on front face of A/C blower scroll cover (Fig. 23).
2. Disconnect vacuum line from the outside-recirculated door vacuum motor.
3. Remove A/C blower cover (5 screws plus 2 screws attaching the blower scroll cover to plenum assembly).
4. Remove push nut and washer from the outside recirculated door shaft.
5. Remove control cable from bracket (1 screw) and slide it over bracket. Remove cable wire loop from blend door shaft.
6. Remove A/C blower housing (9 screws).
7. Partially drain the coolant from the cooling system.
8. Remove heater hoses from heater core (2 clamps) (Fig. 22).
9. Discharge the refrigerant from the system observing all safety precautions.
10. Disconnect battery cables and remove the battery.
11. Disconnect suction line and liquid line from the evaporator core and expansion valve (Fig. 24).
12. Remove the drain hose from the bottom of the evaporator case assembly (Fig. 22).
13. Remove evaporator assembly from dash (5 screws) (Fig. 25).

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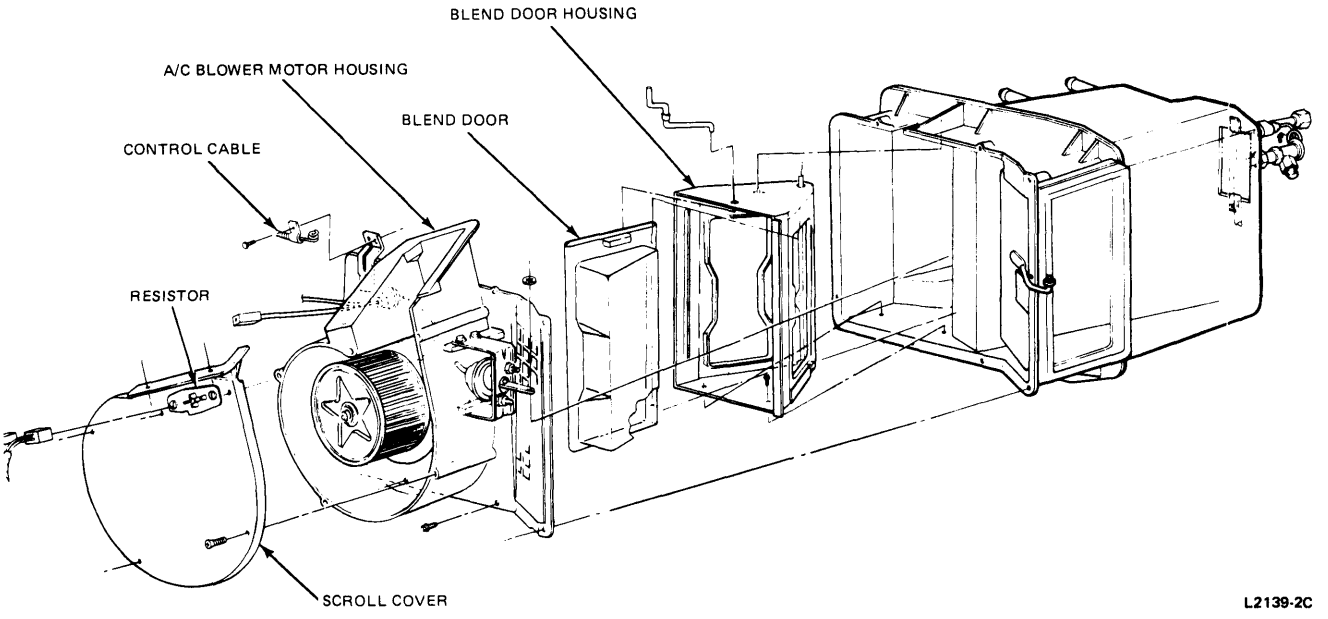


FIG. 20 Manual A/C System Blend Door Installation

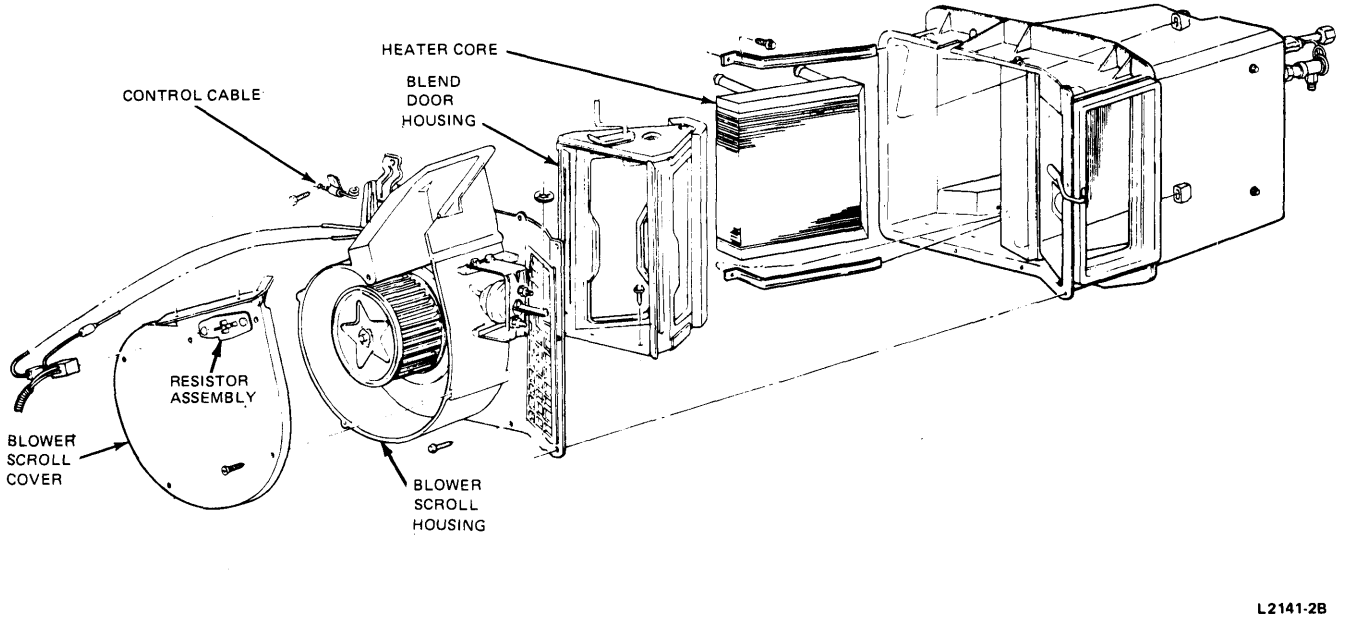


FIG. 21 Manual A/C Heater System Heater Core Installation

14. Remove blend door and housing (3 screws).
15. Remove cork insulation tape from expansion valve bulb.
16. Remove evaporator tube retainer and seal (2 screws).
17. Remove evaporator core and seal assembly (6 screws).

Installation

When installing the evaporator core and seal assembly components make sure all new "O"-ring seals are used and positioned properly in their respective locations.

CAUTION: Use care not to damage or bend fins when handling evaporator core.

1. Position evaporator core and seal assembly to the evaporator assembly and secure with six screws.
2. Install evaporator tube retainer and seal. Secure with two screws.
3. Wrap insulation tape around expansion valve bulb.
4. Install blend door and housing (3 screws).
5. Position the evaporator assembly to the dash and secure with five screws.
6. Install drain hose on bottom of evaporator case assembly (Fig. 22).

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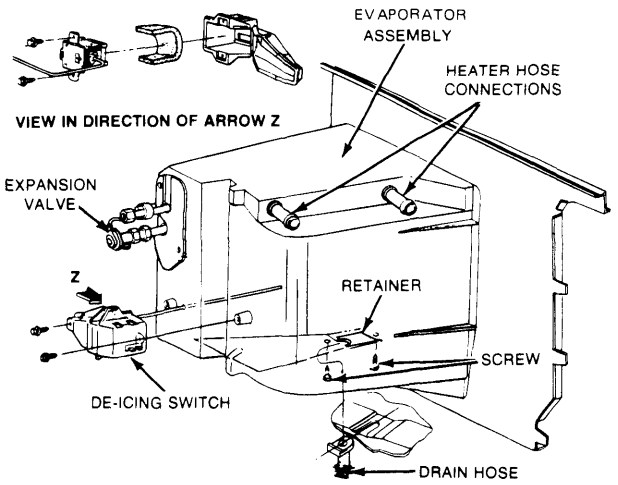


FIG. 22 A/C Thermostat (De-Icing Switch) and Drain Hose Installation

7. Connect suction line and liquid line to the evaporator core and expansion valve (Fig. 24).
8. Install battery and connect battery cables.
9. Evacuate and charge the refrigerant system with 3.50 ±1/4 -0 lbs of R-12 (or 4.25 ±1/4 -0 lbs with auxiliary system).
10. Connect heater hoses to heater core (2 clamps) (Fig. 23).
11. Refill cooling system with coolant.
12. Install A/C blower housing (9 screws).
13. Install cable wire loop on blend door shaft.
14. Slide control cable over bracket and secure to bracket with one screw.
15. Install push nut and washer on outside-recirculated door shaft.

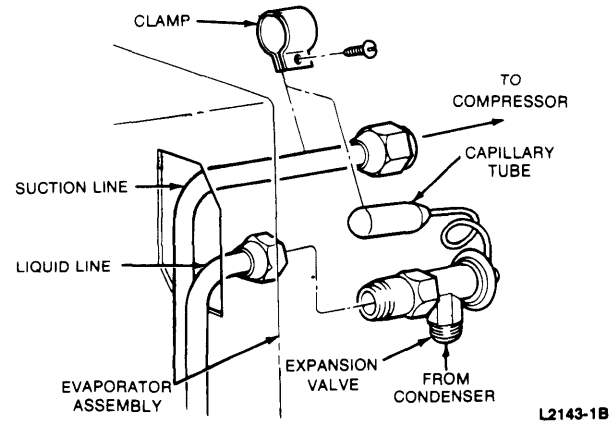


FIG. 24 A/C Expansion Valve Installation

16. Install A/C blower cover (five screws plus two screws attaching blower scroll cover to plenum assembly).
17. Connect vacuum line to outside-recirculated door vacuum motor.
18. Connect electrical leads to resistor on front face of A/C blower scroll cover (Fig. 23).
19. Leak test, evacuate and charge the refrigerant system.

VACUUM MOTORS

Remove vacuum motors as shown in Fig. 10.

EXPANSION VALVE

Removal

1. Disconnect battery cables and remove battery from the vehicle.
2. Discharge the refrigerant from the system observing all safety precautions.

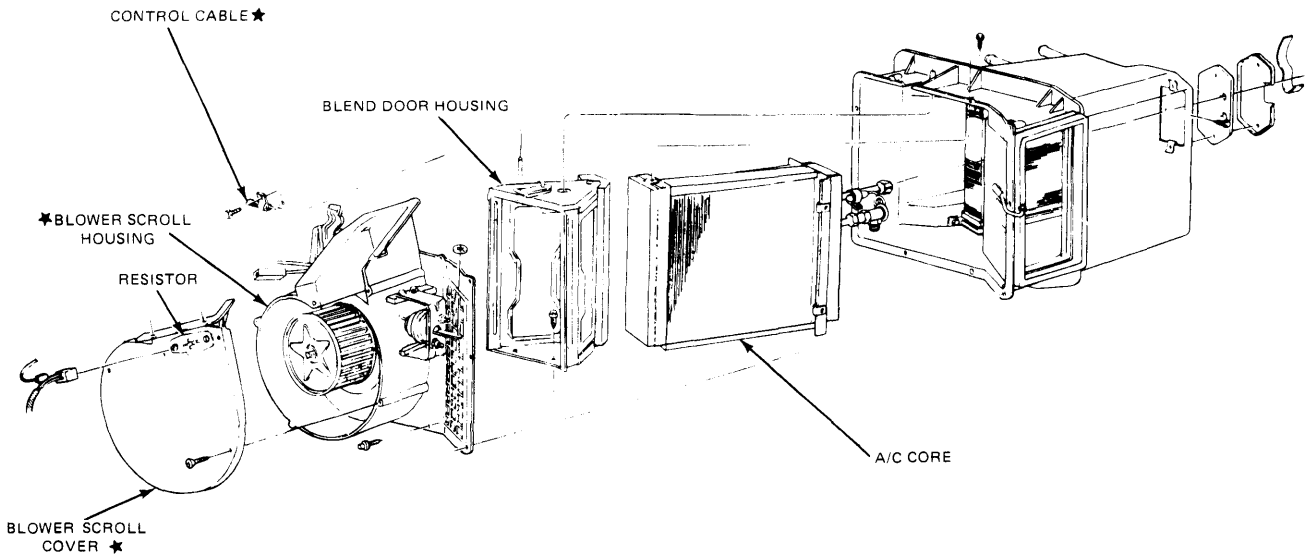


FIG. 23 Manual A/C Core Installation

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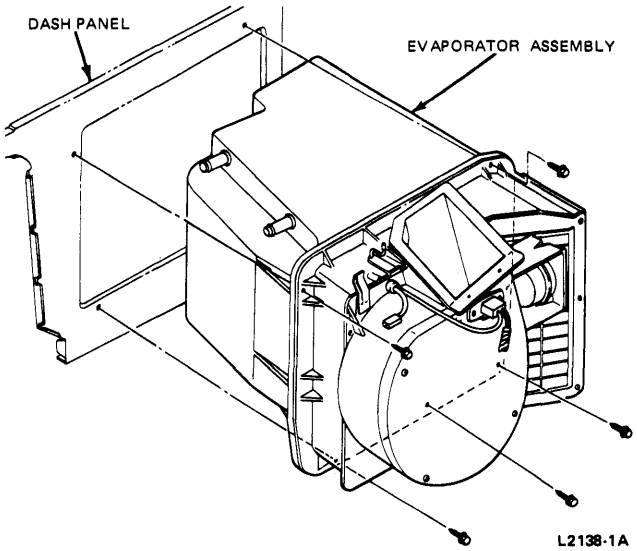


FIG. 25 Manual A/C System Header and Dash Panel Installation

3. Disconnect liquid inlet hose from expansion valve (Figs. 22 and 24).
4. Remove bulb insulation from the suction (outlet) line.
5. Remove capillary tube bulb clamp from the suction outlet line (1 screw).
6. Remove the expansion valve from the evaporator liquid inlet line.

Installation

When installing the expansion valve, make sure all O-ring seals are new and lubricated with clear refrigerant oil and are positioned properly in their respective locations.

1. Connect the expansion valve to the evaporator liquid inlet line (Figs. 22 and 24).
2. Install capillary tube bulb clamp on suction outlet line (1 screw).
3. Wrap valve bulb with insulation.
4. Connect liquid inlet hose to the expansion valve.
5. Evacuate and charge the refrigerant system with 3.50 ±1/4 -0 lbs of R-12 (or 4.25 ±1/4 -0 lbs with auxiliary system).
6. Install battery and connect battery cables.

EVAPORATOR DE-ICING SWITCH

The evaporator de-icing switch is attached to the evaporator assembly in the engine compartment (Fig. 24). In the A/C position, the de-icing switch senses the temperature of the evaporator core fins and electrically controls the cycling of the clutch assembly to prevent the core from freezing the condensation and blocking air flow. The cut-in temparature of the compressor clutch is 42°F ±2°F (clutch is operative) and the cut-out temperature is 28°F ± 2°F (clutch is inoperative).

Removal

1. Remove the battery from the vehicle.
2. Disconnect the electrical leads from the de-icing switch.
3. Remove (2) de-icing cover screws from the evaporator case (Fig. 22).
4. Pull the de-icing and cover straight forward out of the evaporator assembly.
5. Remove de-icing from cover (2 screws).

Installation

1. Install the cover to the de-icing switch (2 screws).
2. Position the de-icing and cover straight into the evaporator core's de-icing switch hole and install the two attaching screws.
3. Connect the electrical leads to the de-icing switch.
4. Install the battery and connect the battery cables.

DRAIN TUBE

Inspect the evaporator case drain tube for one or more of the following conditions.

1. Inspect the drain tube to determine if the opening is enlarged or if the tube is torn. The drain tube opening must be a slot measuring approximately 1/16 inch by 3/4 inch as shown in Fig. 26.
2. Inspect the drain tube to be sure it is not pinched between the evaporator housing and the dash panel resulting in a blocked drain tube.
3. Check to be sure the drain tube is not caught on one of the evaporator case mounting screws causing a kink in the tube.
4. Check the drain tube to be sure it is not clogged or that the lower end of the drain tube does not have excessive rubber flash at the opening (Fig. 1). Excessive rubber flash will allow the drain tube to close or partially close during Hi blower operation and restrict drainage. This can be checked by removing the drain tube and drawing air through the drain tube from the top end to see if the air flow is restricted.

If any of the preceeding conditions are found, the drain tube should be replaced.

DRAIN TUBE REPLACEMENT

1. Open the hood and locate the drain tube on the bottom of the evaporator case.

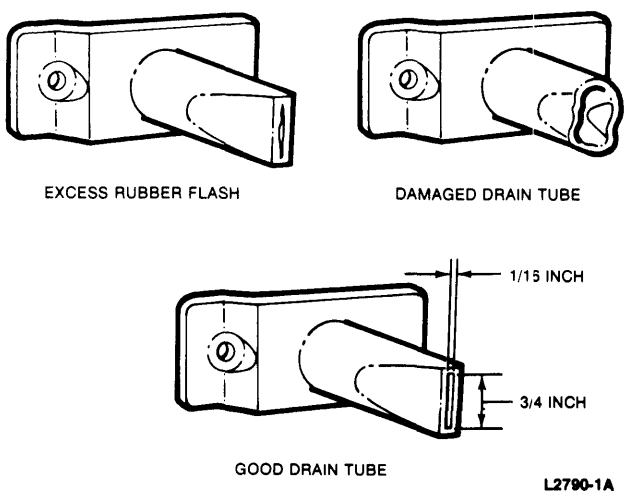


FIG. 26 Evaporator Drain Tube Inspection

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2. Remove two evaporator drain tube and retainer attaching screws using a 5/16 inch wrench or socket and remove the drain tube and retainer.
3. To install, position the drain tube and retainer to the drain hole on the bottom of the evaporator case. Be sure the tab on the drain tube is positioned as shown in Fig. 27 and is inserted into the drain hole opening.
4. Install two screws to attach the drain tube and retainer to the evaporator case.

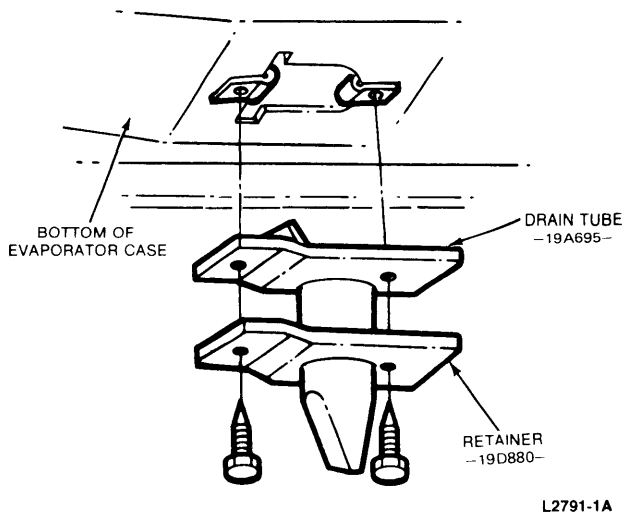


FIG. 27 Drain Tube Removal and Installation

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E-100 — E-350 Side-Mounted Auxiliary Heater and/or Air Conditioning System

PART 36-70

APPLIES TO E-100 THROUGH E-350

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Auxiliary Heater Core and Seal Assembly	70-29
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This part deals with the controls and components that are peculiar to the E-100—E-350 auxiliary heater and/or air conditioning system. Part 36-30 gives the information and procedures required for servicing the refrigeration system and Part 36-10 for general heating, which is common to all truck lines. Reference to both parts is necessary for complete servicing of the Econoline system. Also, refer to the specification chart at the end of this part.

DESCRIPTION AND OPERATION

The auxiliary heater and/or air conditioner is a recirculating air design that is located on the left side of the vehicle behind the driver. The auxiliary system is available as three options: auxiliary heater, auxiliary air conditioner, or a combination auxiliary heater and air conditioner.

The auxiliary system is comprised of an auxiliary unit assembly mounted to the left body side behind the driver, a duct assembly mounted to the left body side extending from the auxiliary unit back to the left rear wheelhouse, (bus model only), and a panel assembly covering the auxiliary unit assembly. The controls for the auxiliary consist of a function control lever and fan switch. The function control lever is located on top of the auxiliary duct and the auxiliary fan switch is located on the right side of the main heater or air conditioner control.

The following description operation and illustrations deal only with the auxiliary heater and/or air conditioner systems.

Refer to Part 36-23 for all information pertaining to the main heating system and Part 36-65 for all information pertaining to the main A/C-heater system.

With the main heater system, the blower for the auxiliary heater operates completely independent of the main blower (Fig. 1). With the A/C-heater system main heater-air conditioner, the auxiliary blower will operate only when the main system is operating.

With the main heater system, heating can be obtained from the auxiliary heater by moving the function control lever (Fig. 2) on the auxiliary duct to FLOOR and the auxiliary fan switch to HI or any of the lower blower speeds. The air can be directed either to the floor, through the registers, or split between the two positions at the rear as shown in Fig. 2. The registers can be adjusted to direct air as desired. Also, the register louvers can be closed to block most of the air flow. The front register barrel can be rotated 90 degrees to block the air flow (Figs. 3, 4 and 5).

With the main heater-air conditioner system, heating can be obtained from the auxiliary heater by moving the function control selector lever on the main control assembly to the HI-LO, HEAT, or DEFROST position, the function control lever on the auxiliary duct to FLOOR, and the auxiliary fan switch to HI or any other blower speed (Fig. 1).

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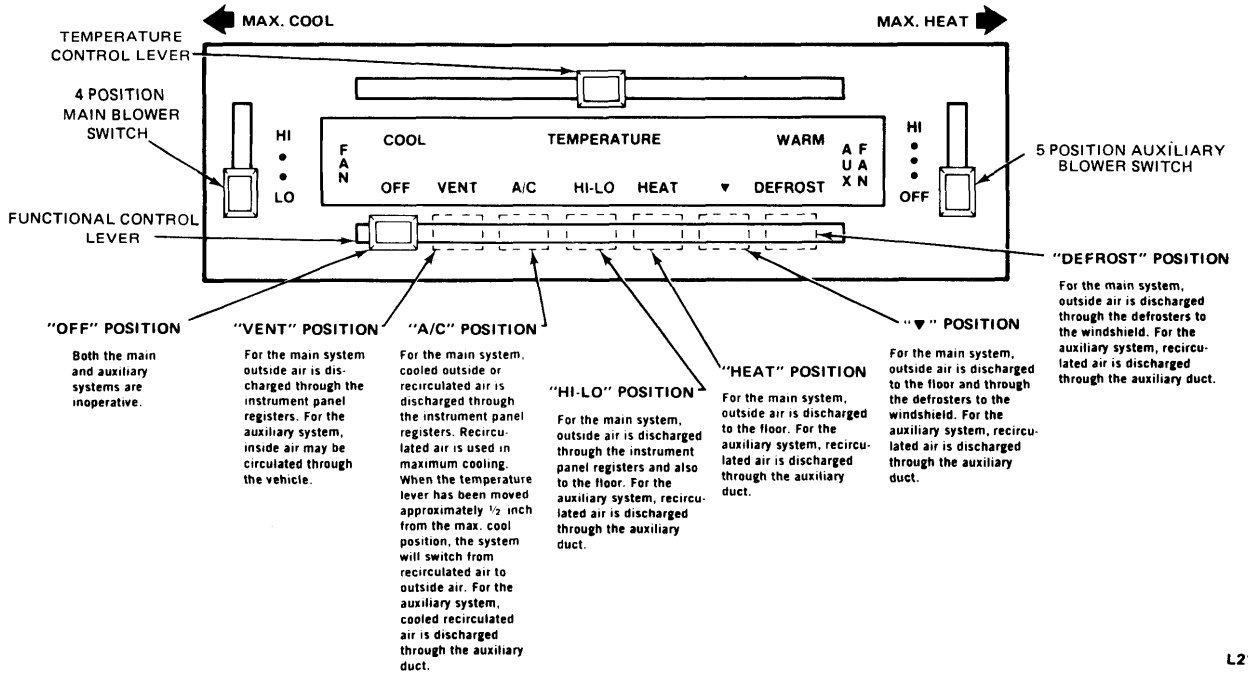


FIG. 1 Dual Air Conditioner—Heater Control Operation

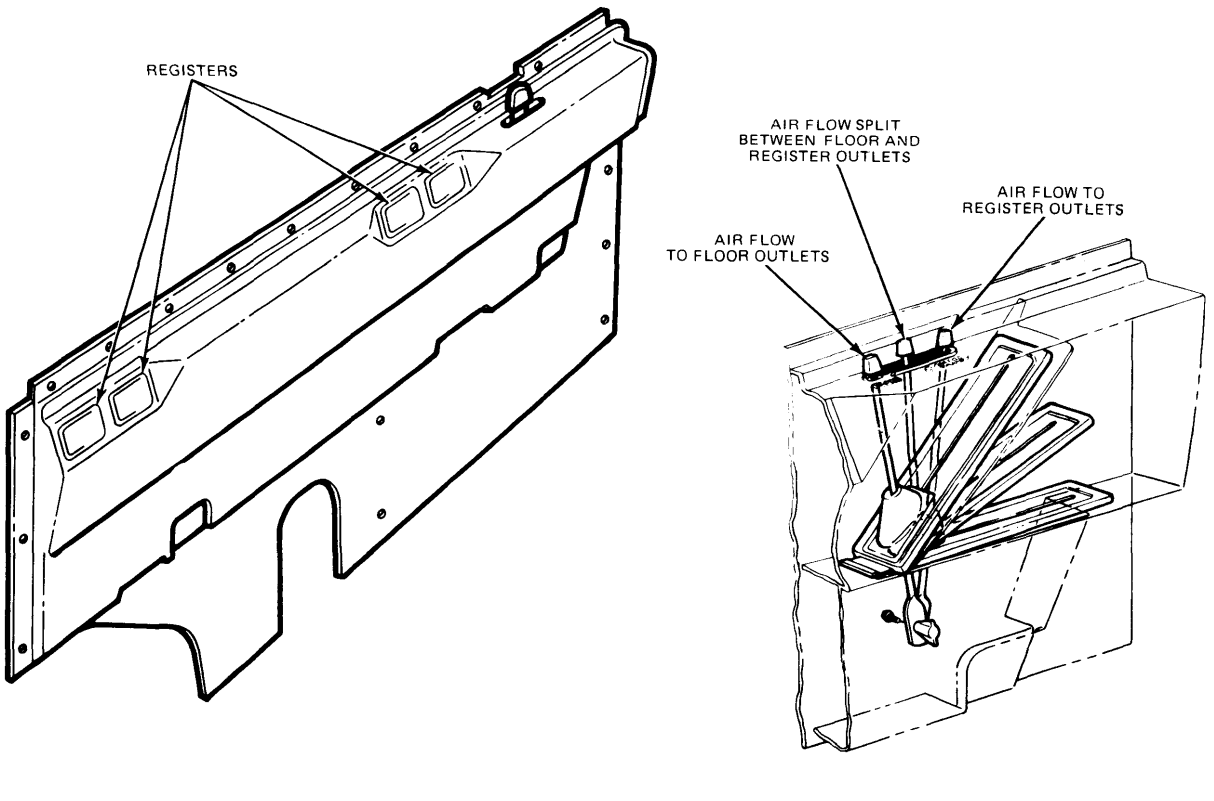


FIG. 2 Auxiliary Heater-A/C System Functional Control Lever Operation, (Bus Model Only)

Air conditioning can be obtained from the auxiliary air conditioner by moving the mode selector lever on the main control assembly to the A/C position, the function control lever on the auxiliary duct to REGISTERS, and the auxiliary fan switch to HI or any other blower speed.

With the combination auxiliary heater-air conditioner system, in the A/C position, a vacuum

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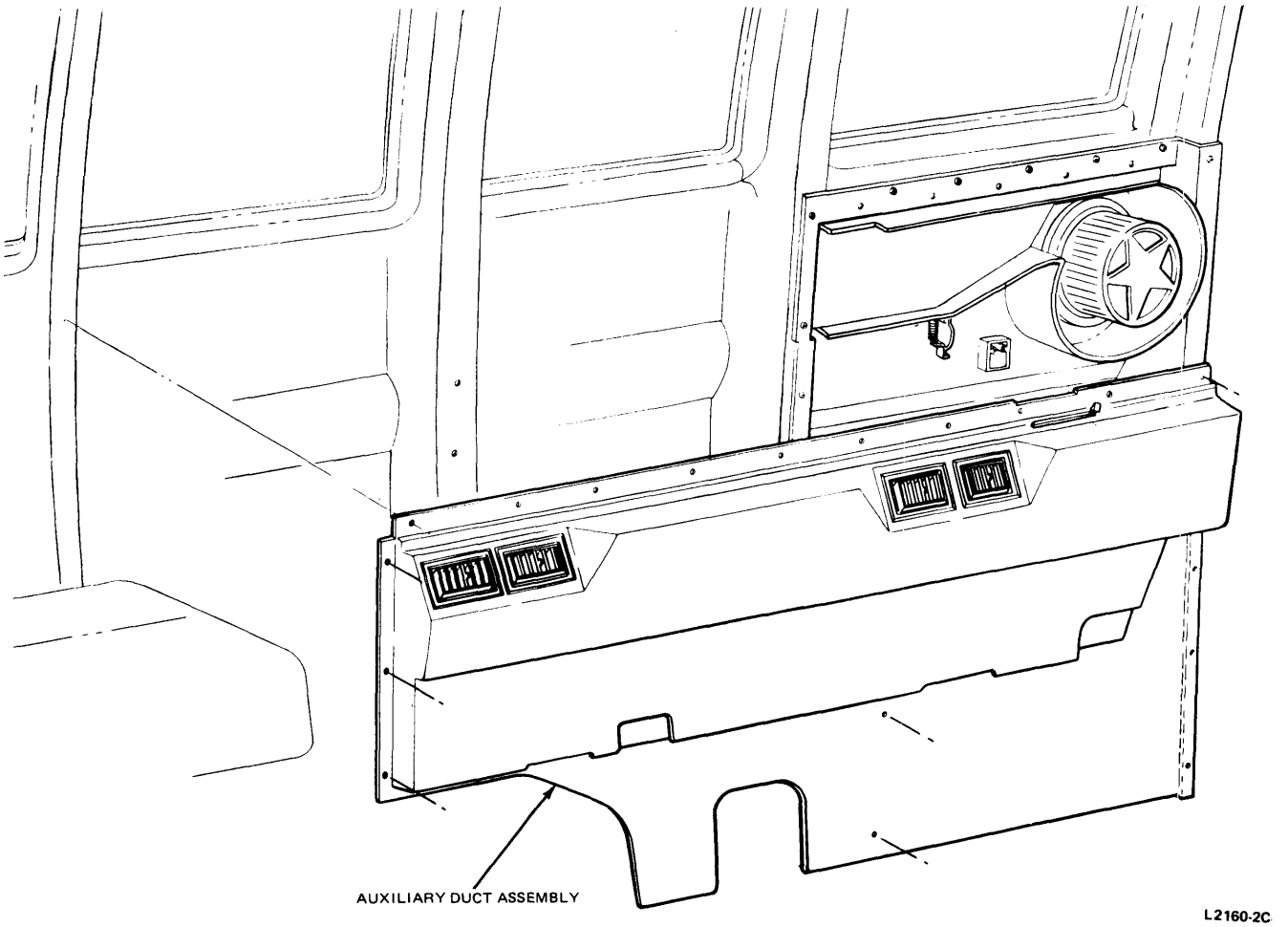


FIG. 3 Auxiliary Duct Assembly Removal Club Wagon Only

operated water valve shuts off water to the auxiliary heater core, assembly for air to bypass the heater core. This water shut-off and air bypass for the re-circulating air system enables maximum cooling in the A/C position (Figs. 14, 15, 16, 18 and 19)

SYSTEM COMPONENTS

CONTROLS

Function Control Lever

The function control lever controls the air distribution on the auxiliary systems and is located on top of the auxiliary duct and directs the air to the floor, up through the registers, or split between the two positions (Fig. 2).

Auxiliary Blower Switch

The auxiliary blower switch controls the speed and off-on operation of the auxiliary blower motor and wheel assembly (Fig. 1). The switch is located on the right side of the main control assembly. With the main heater system, the blower for the auxiliary heater operates completely independent of the main blower. With the main heater-air conditioner, the auxiliary blower will operate only when the main system is operating (Figs. 22 thru 28).

AUXILIARY HEATER AND/OR AIR CONDITIONER ASSEMBLY

The auxiliary heater and/or air conditioner assembly is mounted to the left body side behind the driver. All components (which include the blower motor and wheel, resistor, wiring grommet and seal, A/C core and seal, heater core and seal, and right angle expansion valve) are serviceable from inside the vehicle (Figs. 27 thru 30).

To remove any of the above components it is necessary to remove the auxiliary heater-A/C cover assembly on standard models (Fig. 4), the auxiliary duct assembly and the first bench seat on bus vehicles (Figs. 2 and 3) and the auxiliary duct assembly on Super Wagon vehicles (Fig. 5). To service the heater and/or air conditioner unit as an assembly it is necessary to remove the auxiliary heater-A/C cover assembly, left body side window garnish moulding, and the first bench seat on bus vehicles. The forward portion of the auxiliary duct assembly must also be loosened before removal of the auxiliary heater-air conditioner assembly. The assembly is mounted to the body side with five screws on van models and ten screws on bus models.

EXPANSION VALVE

The function of the expansion valve is to automatically regulate the flow of refrigerant into the evaporator, and is the dividing point in the system between high and low pressure refrigerant.

The temperature sensing bulb, clamped to the suction (outlet) tube on the evaporator, measures the temperature of the refrigerant in the suction tube and

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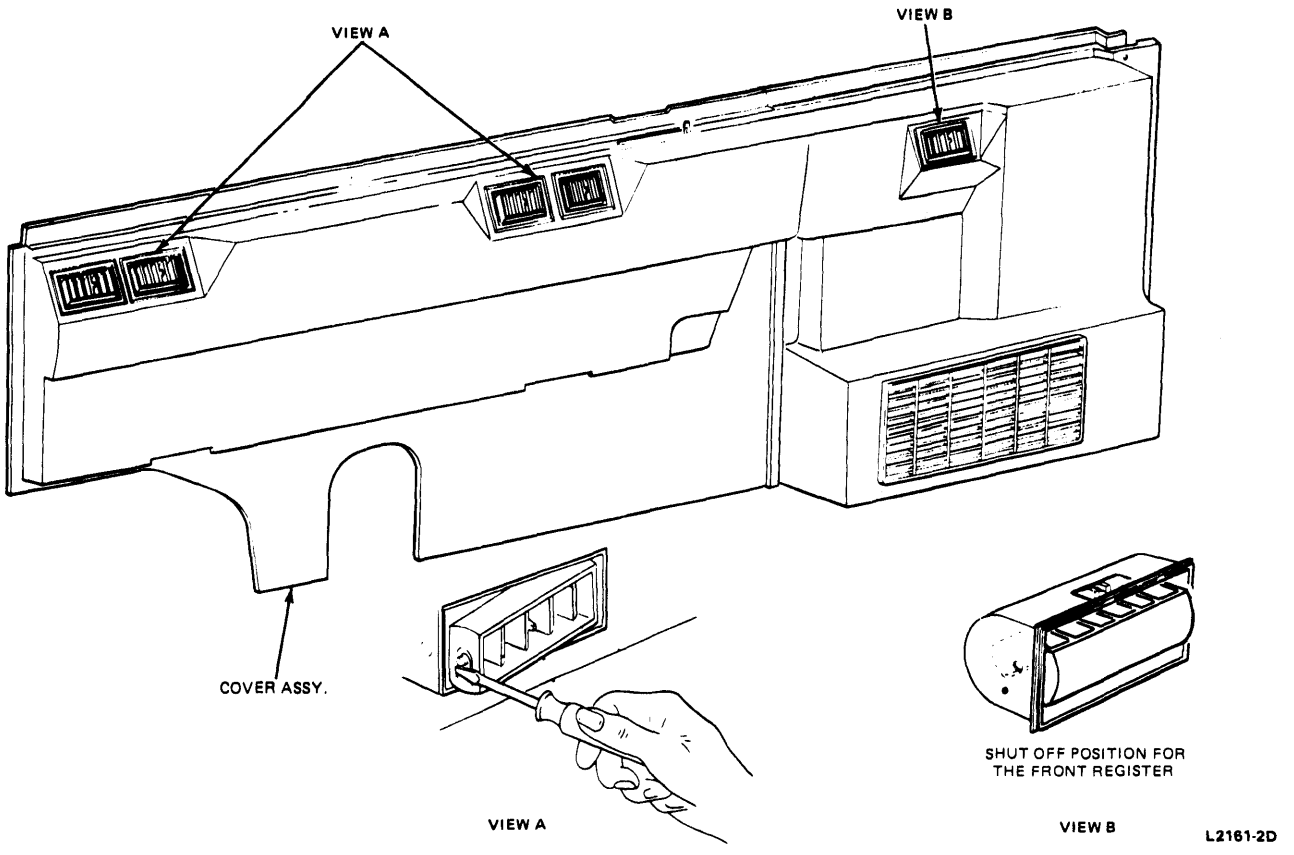


FIG. 4 Auxiliary Duct-Register Operation

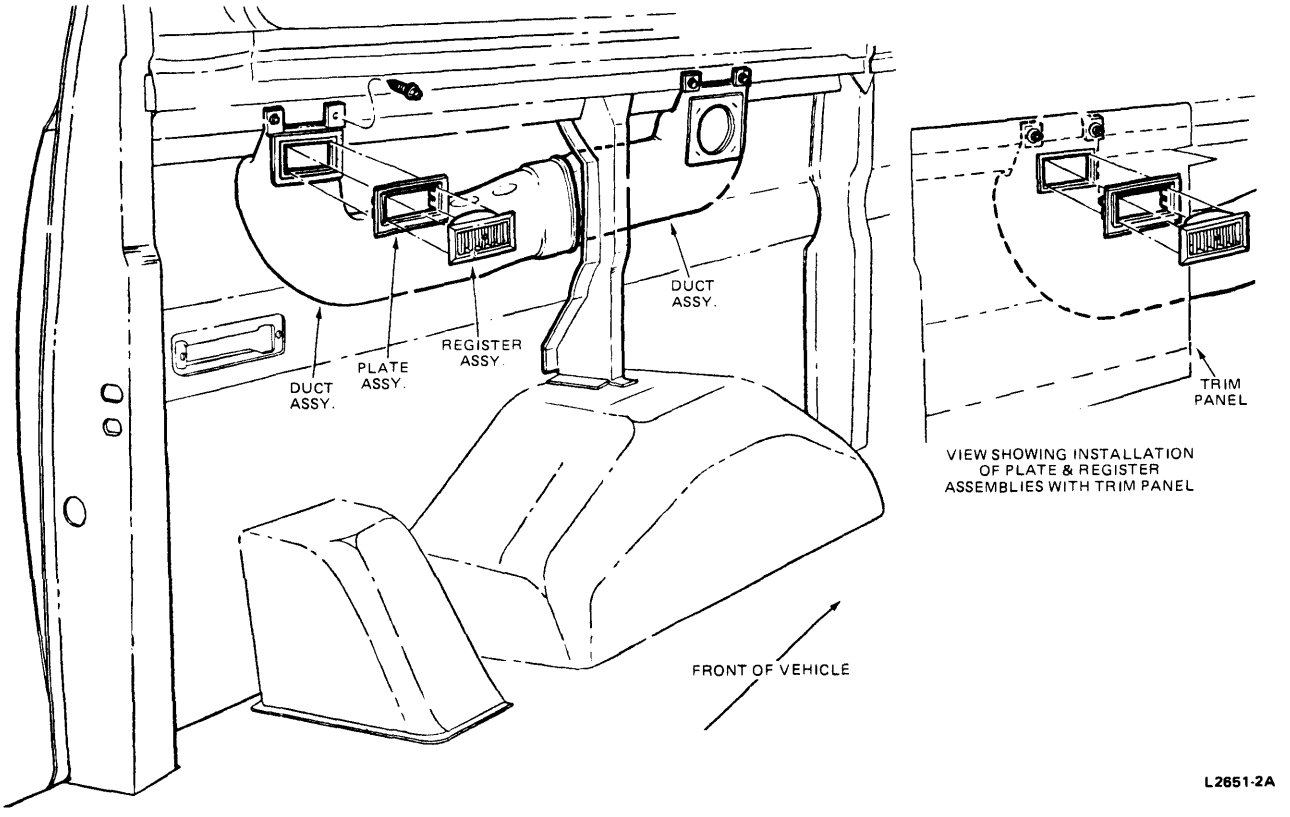


FIG. 5 Super Wagon Auxiliary Duct Assembly—Removal and Installation

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transmits the temperature variation to the expansion valve. This temperature variation regulates the refrigerant (R-12) flow to the core. When the bulb senses a high temperature the valve opens and floods refrigerant through the evaporator core. When the bulb senses a low temperature, the valve starts closing to shut off the refrigerant to the evaporator core.

AUXILIARY HEATER-AIR CONDITIONER COVER ASSEMBLY

The cover assembly is mounted to the body with fifteen screws on both van and bus vehicles (Fig. 4). On bus vehicles, the first bench seat must be removed to service the cover assembly. The auxiliary duct assembly and the auxiliary heater and/or air conditioner assembly must be installed prior to installing the cover assembly.

AUXILIARY HEATER-AIR CONDITIONER DUCT ASSEMBLY (FIGS. 2, 3 AND 5)

To remove the auxiliary heater-air conditioner duct it is necessary to remove the auxiliary heater-air conditoner cover assembly, left body side window garnish moulding, and the first two bench seats on bus vehicles. The duct assembly is mounted to the body by fifteen screws on bus vehicles, seven screws on van vehicles and four screws on Super Wagon vehicles.

To service the function control lever and door it is necessary to remove the auxiliary duct assembly from the vehicle and remove the duct outer panel from the duct inner panel to obtain access to the function control lever and door.

REGISTERS

The five register assemblies can be adjusted to direct air as desired. The register louvers can be closed to block most of the air flow. The front register can be rotated 90 degrees to block all of the air flow out the front register. Pry on the end pivot with thin blade to separate the pivot from the pivot hole and pull the barrel assembly from the register housing (Figs. 4 and 5). The pivot ends of the barrels have different sizes to control register position when installed.

HOSE ROUTINGS

Auxiliary heater and/or A/C hose routings are illustrated in (Figs. 6 through 17).

VACUUM SYSTEMS

Refer to Figs. 18 and 19 for system air flow and vacuum control charts, and vacuum schematic and selector test. Refer to Figs. 20 and 21 for vacuum hose routings.

DIAGNOSIS AND TESTING

Refer to Parts 36-10 and 36-30 for heater and air conditioning diagnosis and testing procedures.

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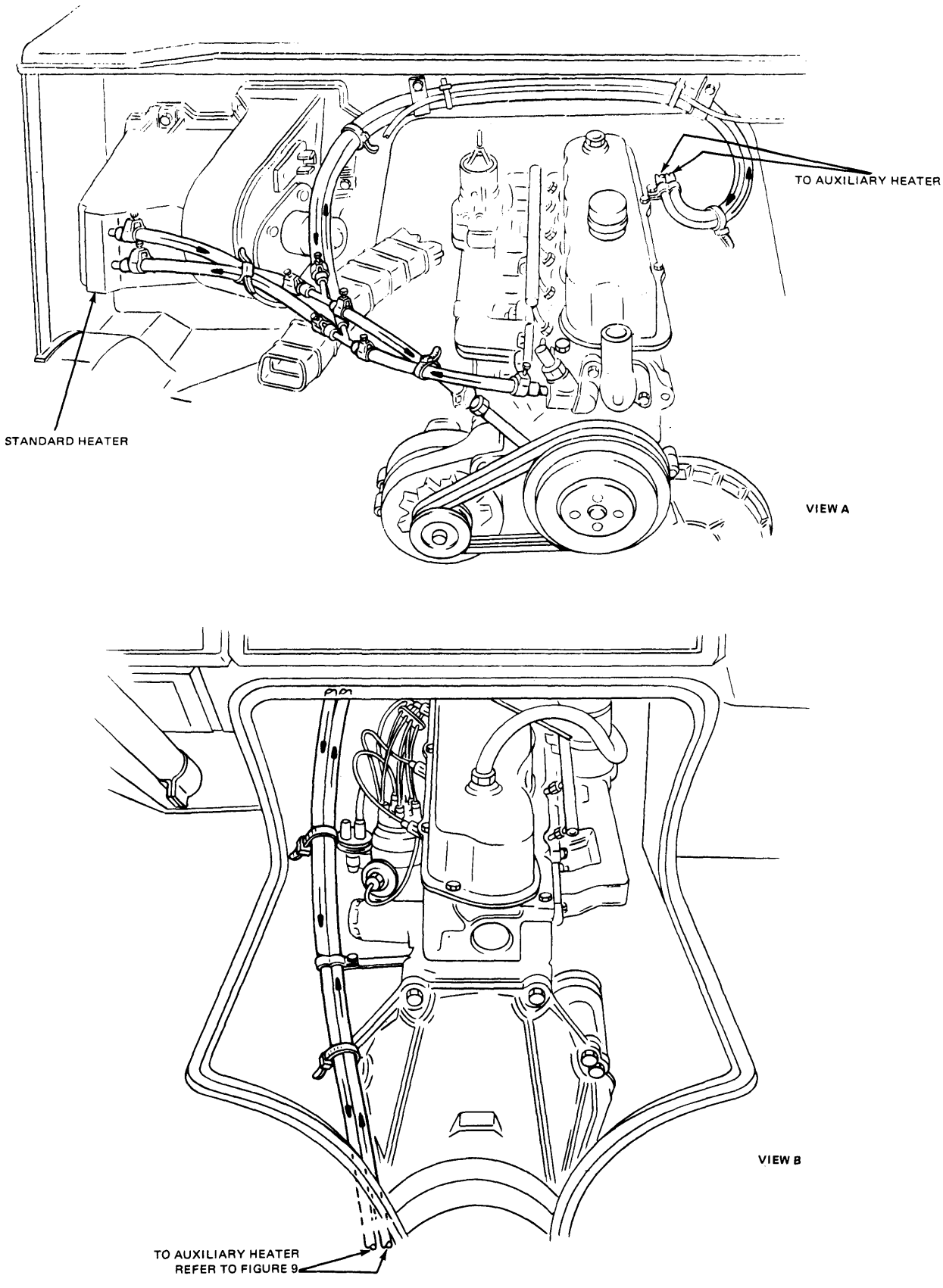


FIG. 6 Auxiliary Heater Hose Routing—4.9L (300 CID) I-6 Engine

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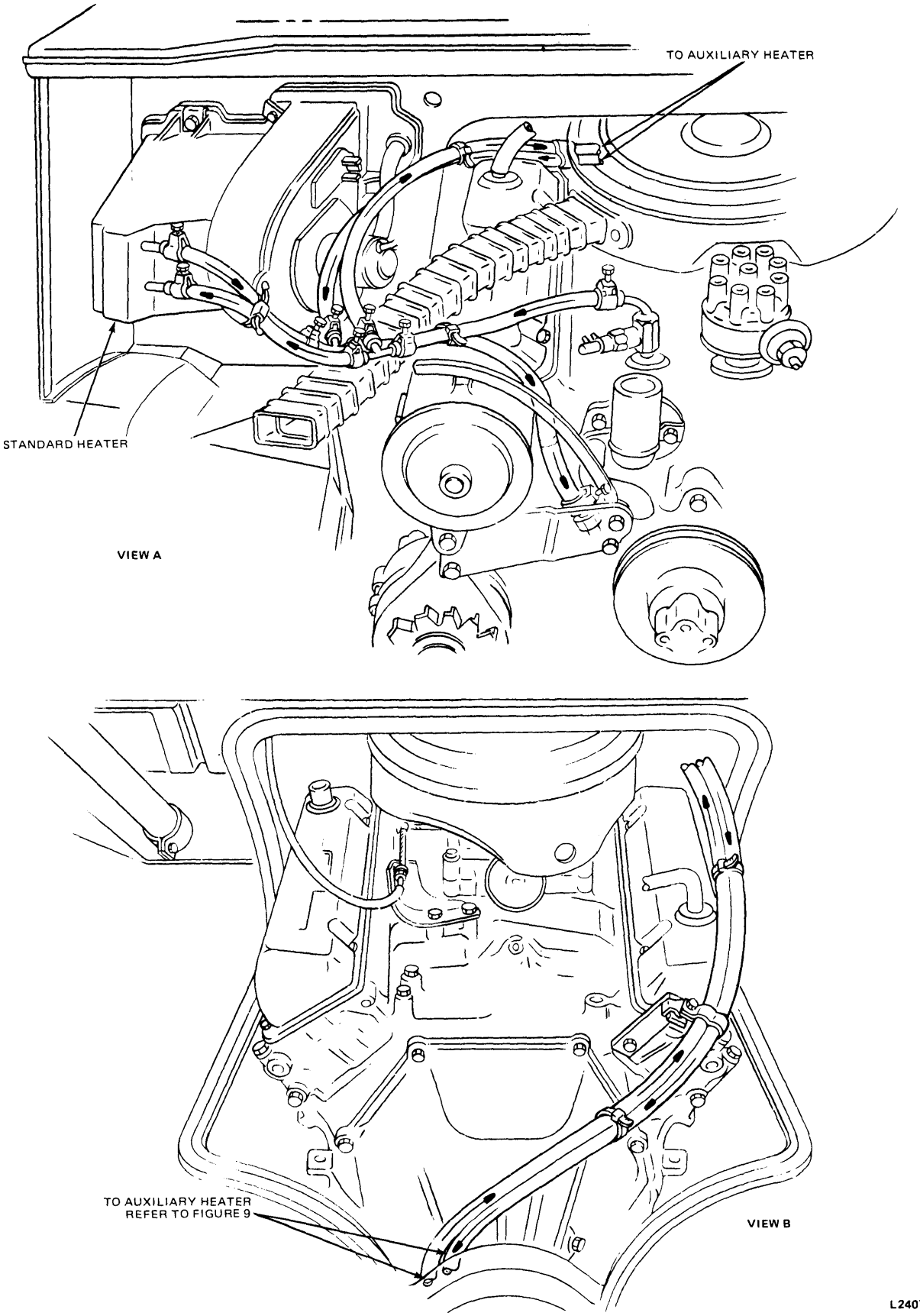


FIG. 7 Auxiliary Heater Hose Routing—5.8L (351 CID) V-8 Engine

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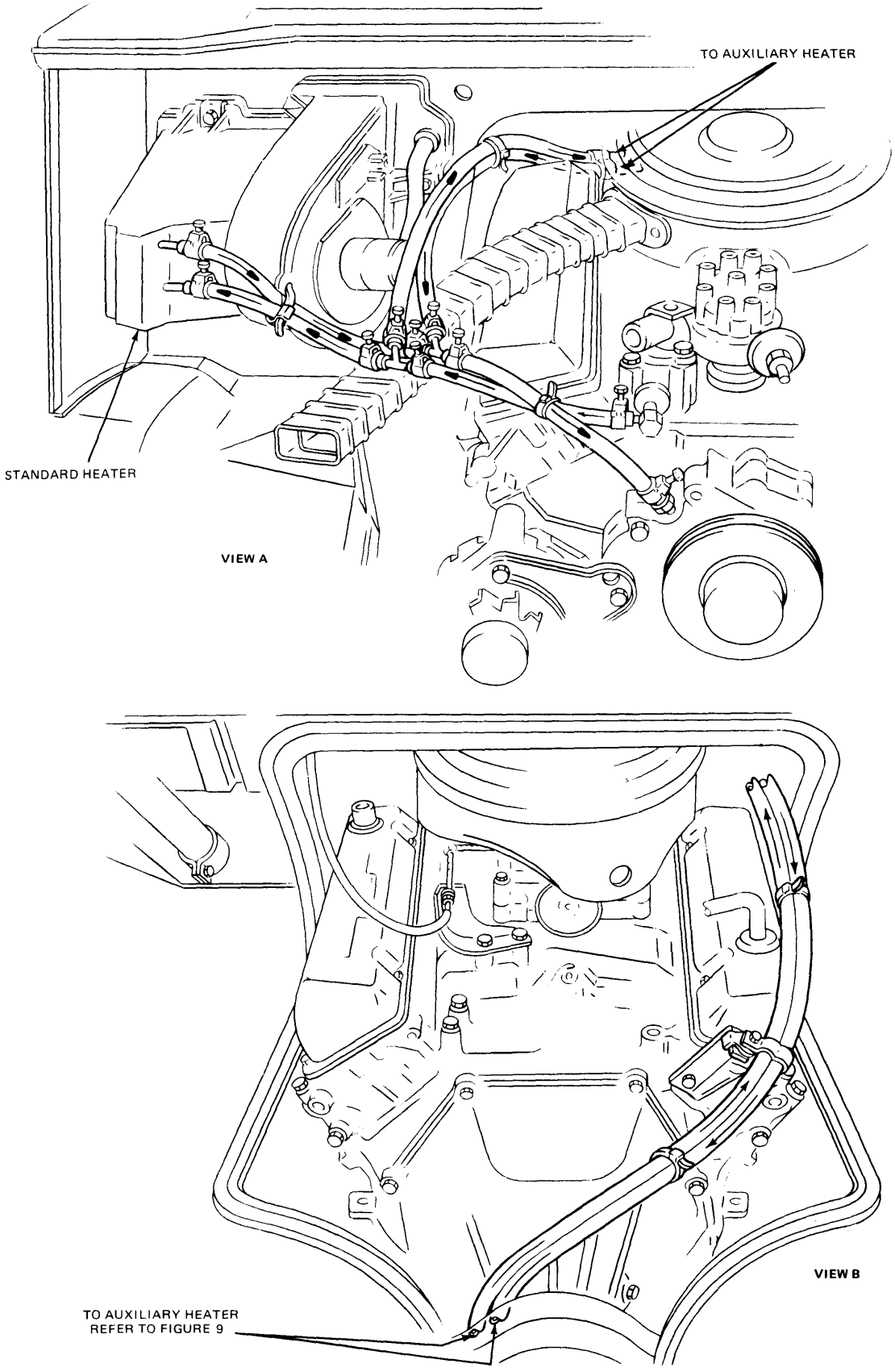


FIG. 8 Auxiliary Heater Hose Routing—7.5L (460 CID) V-8 Engine

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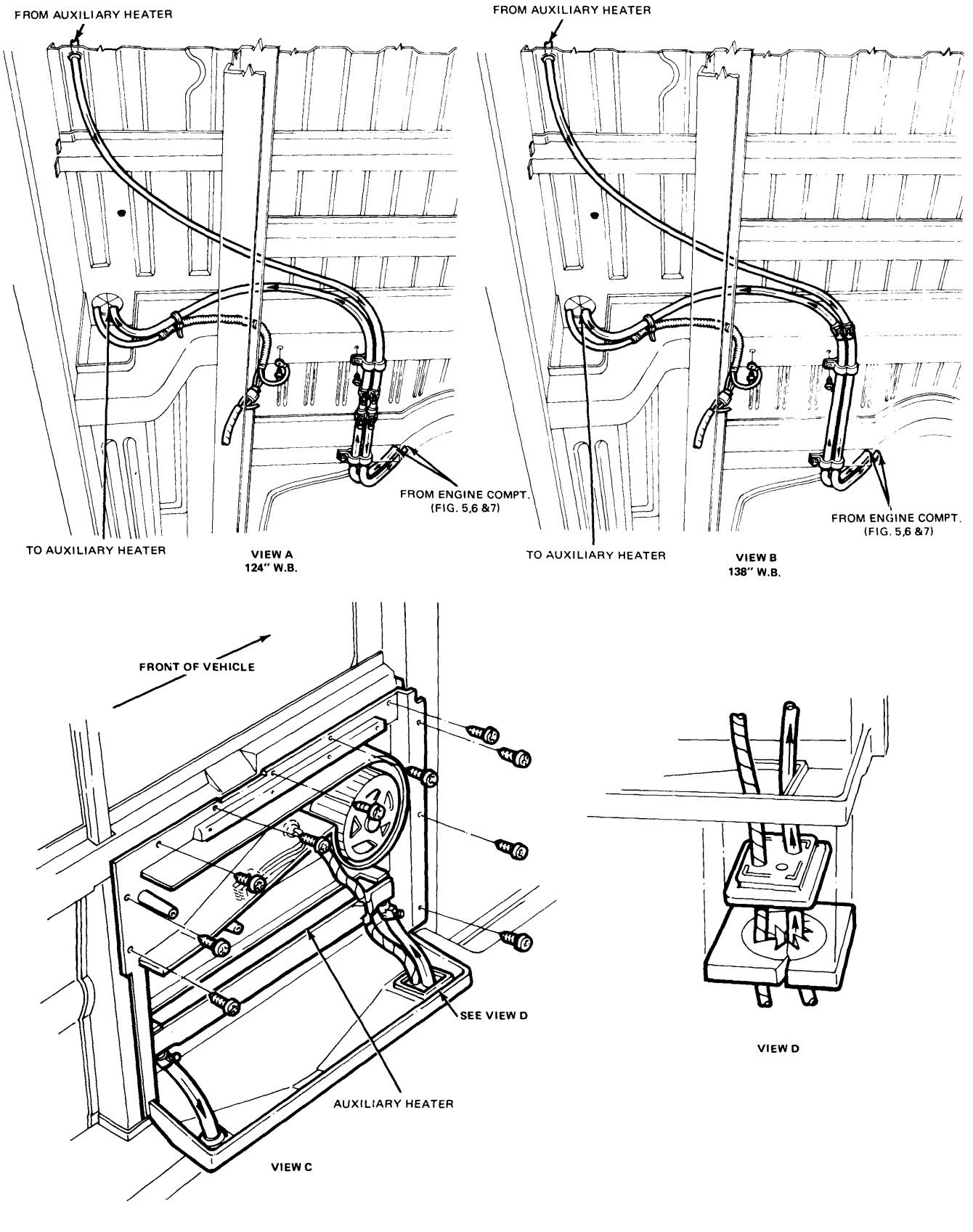


FIG. 9 Auxiliary Heater Hose Routing—Under Vehicle—124" and 138" W/B

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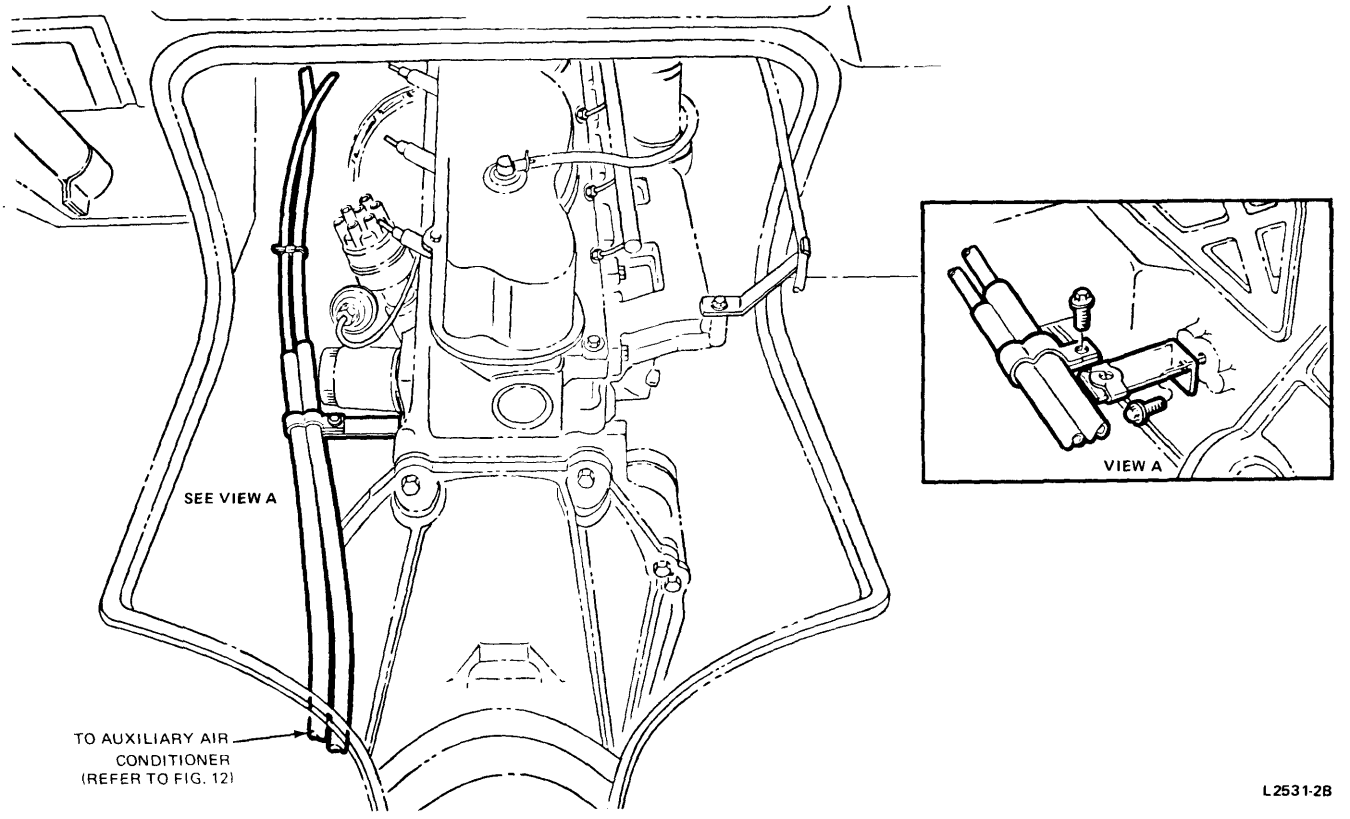


FIG. 10 Auxiliary Air Conditioner Hose Routing—4.9L (300 CID) I-6 Engine

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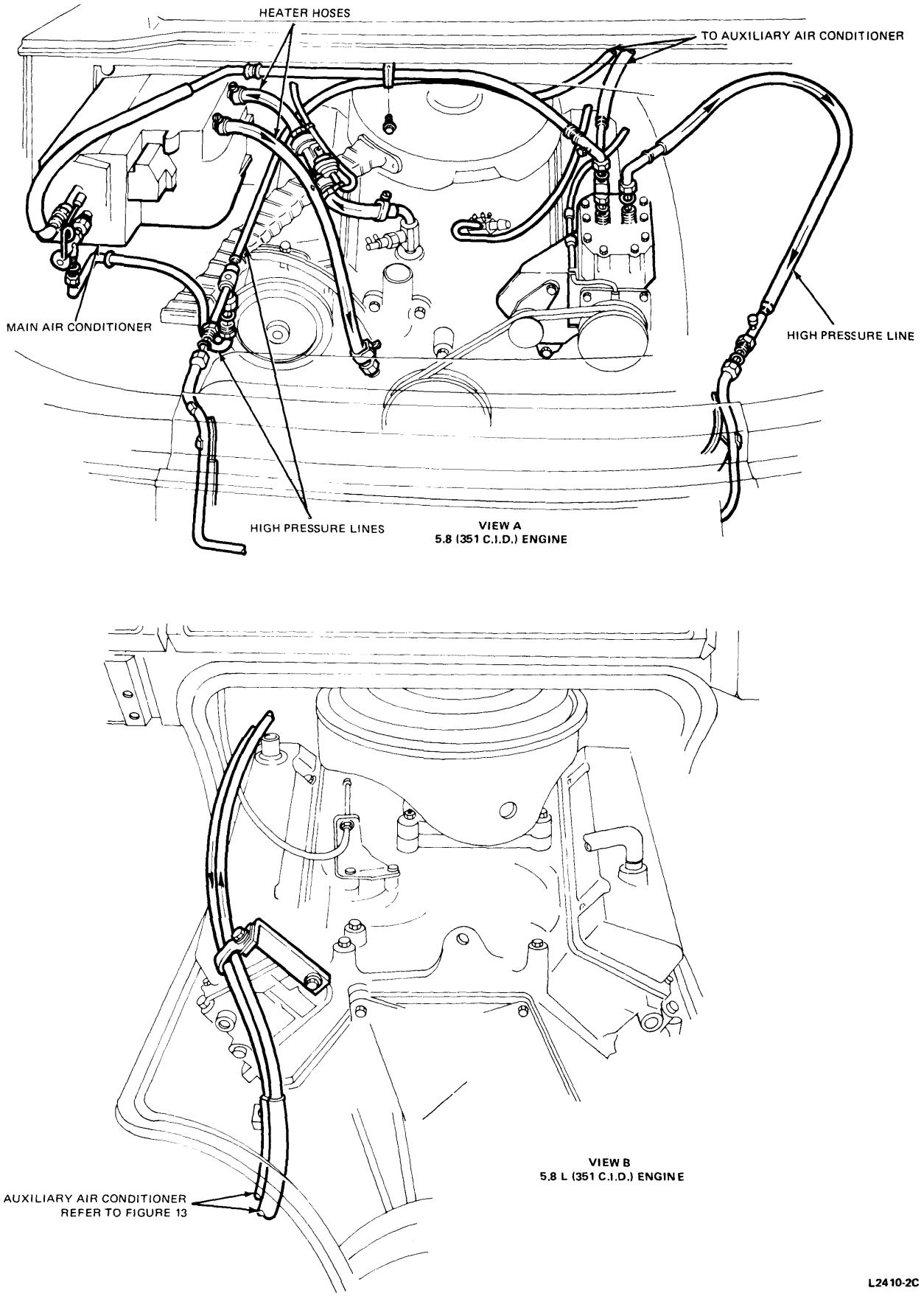


FIG. 11 Auxiliary Air Conditioner Hose Routing—5.8L (351 CID) V-8 Engine

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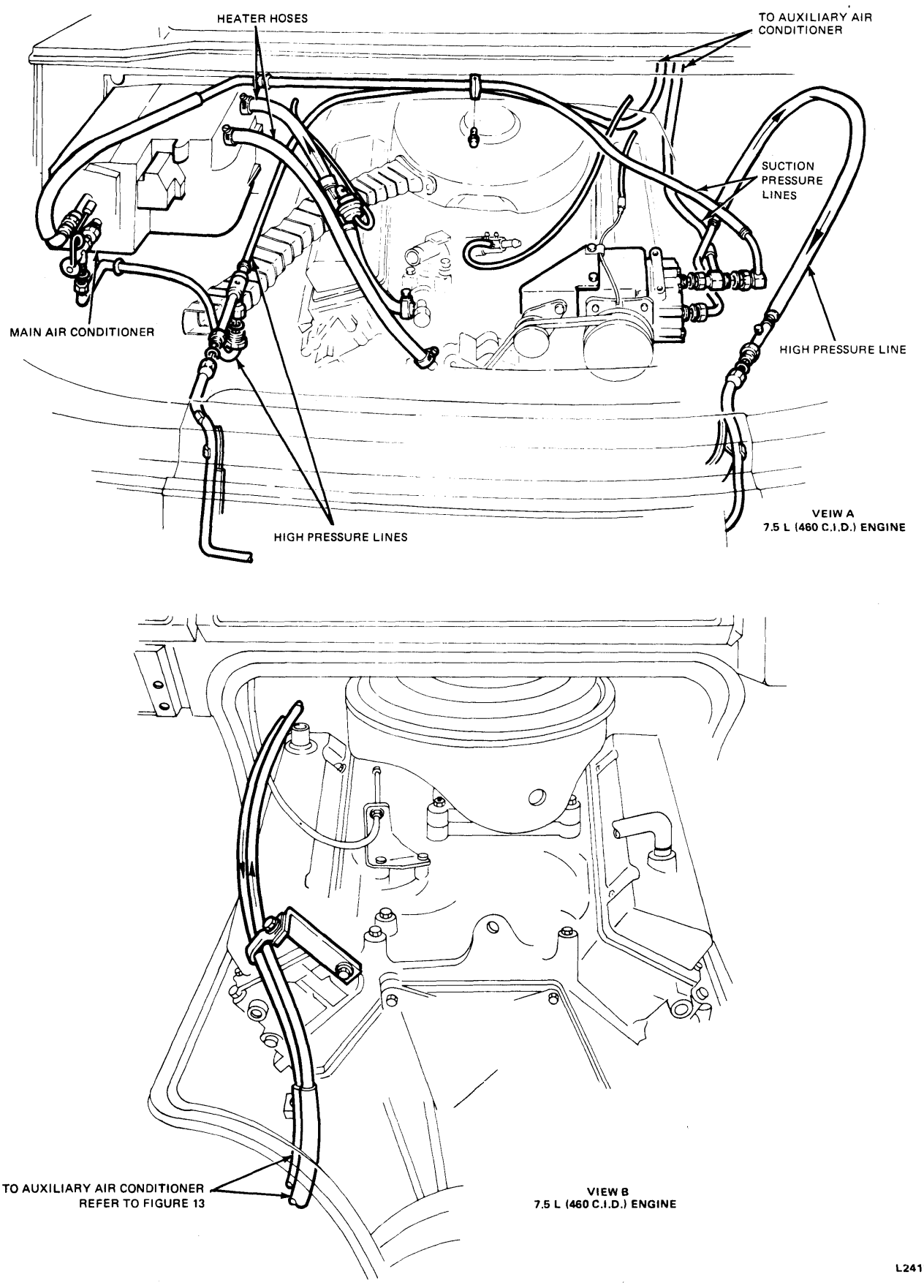


FIG. 12 Auxiliary Air Conditioner Hose Routing—7.5L (460 CID) V-8 Engine

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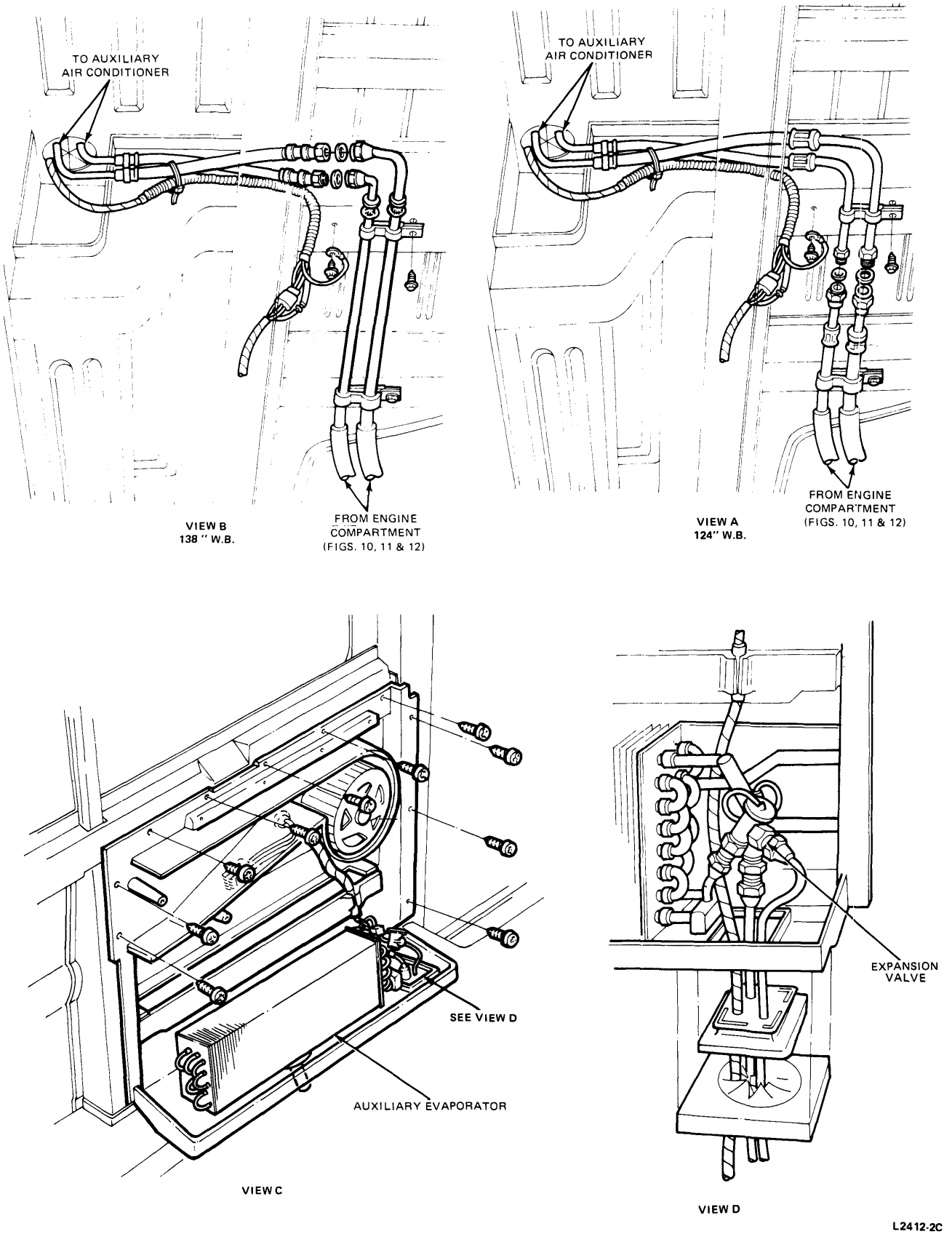


FIG. 13 Auxiliary Air Conditioner Hose Routings—Under Vehicle—124" and 138" W/B

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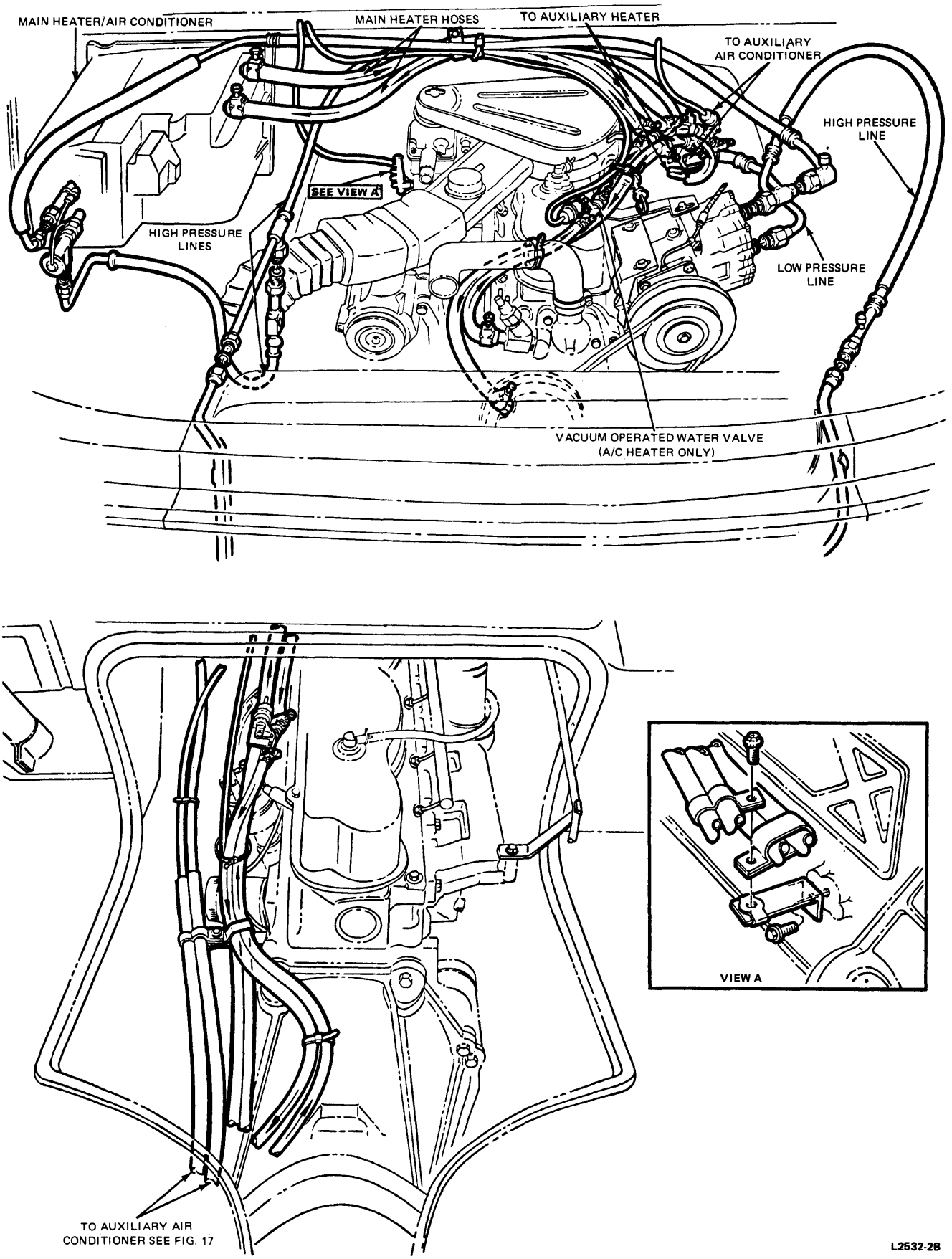


FIG. 14 Auxiliary A/C and Auxiliary Heater Hose Routing—4.9L (300 CID) V-8 Engine

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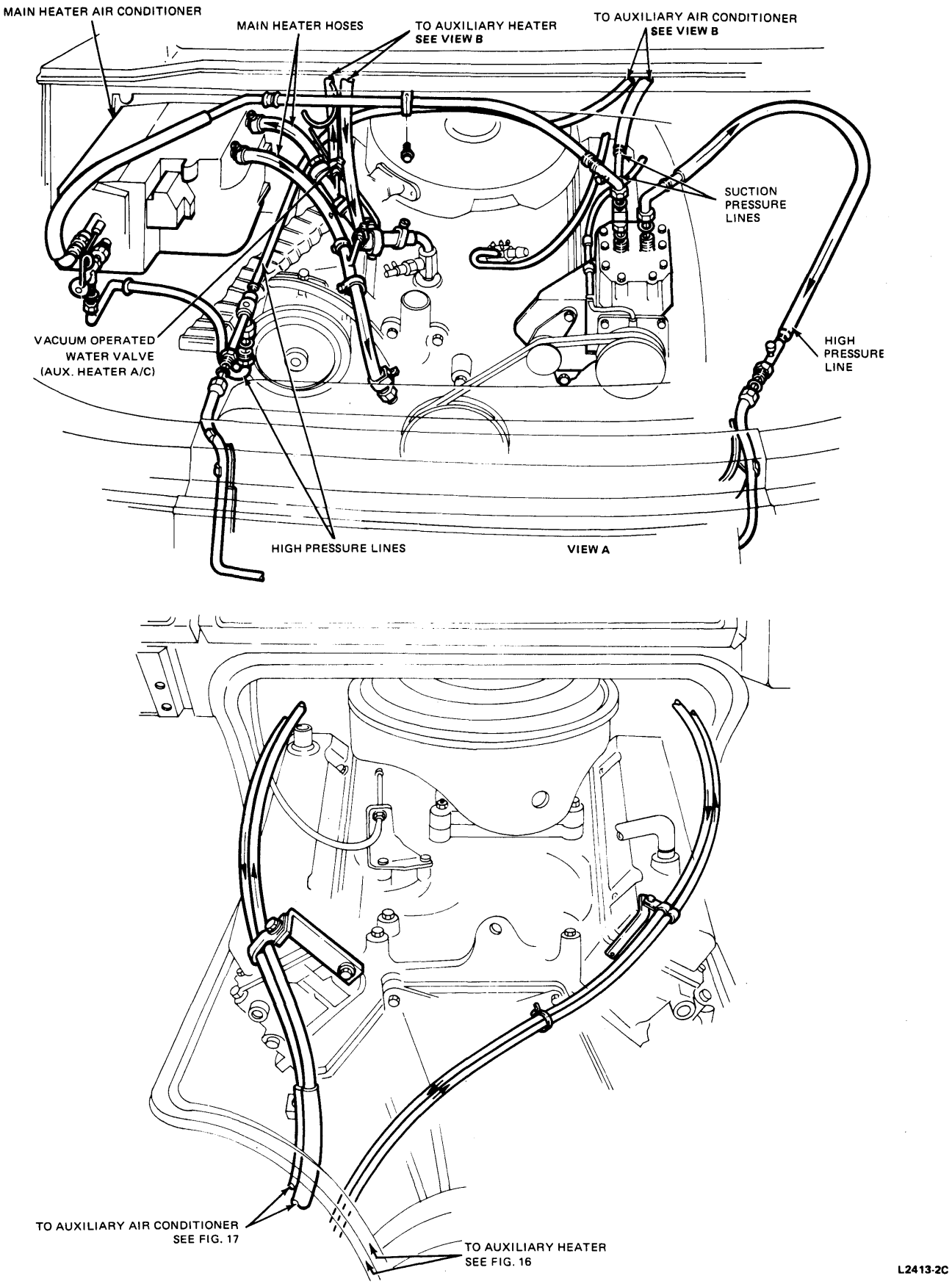


FIG. 15 Auxiliary A/C and Auxiliary Heater Hose Routing—5.8L (351 CID) V-8 Engine

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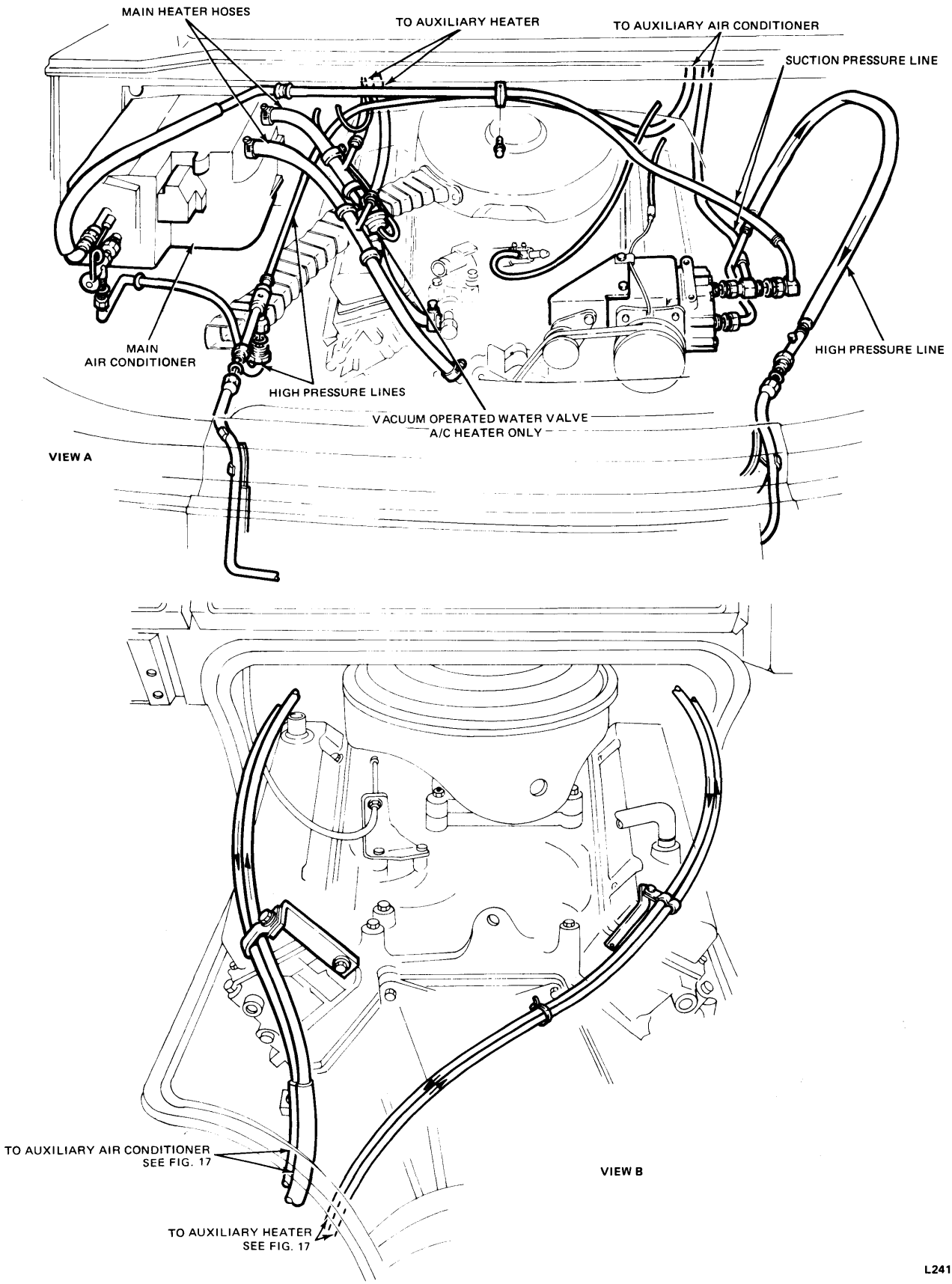


FIG. 16 Auxiliary A/C and Auxiliary Heater Hose Routing—7.5L (460 CID) V-8 Engine

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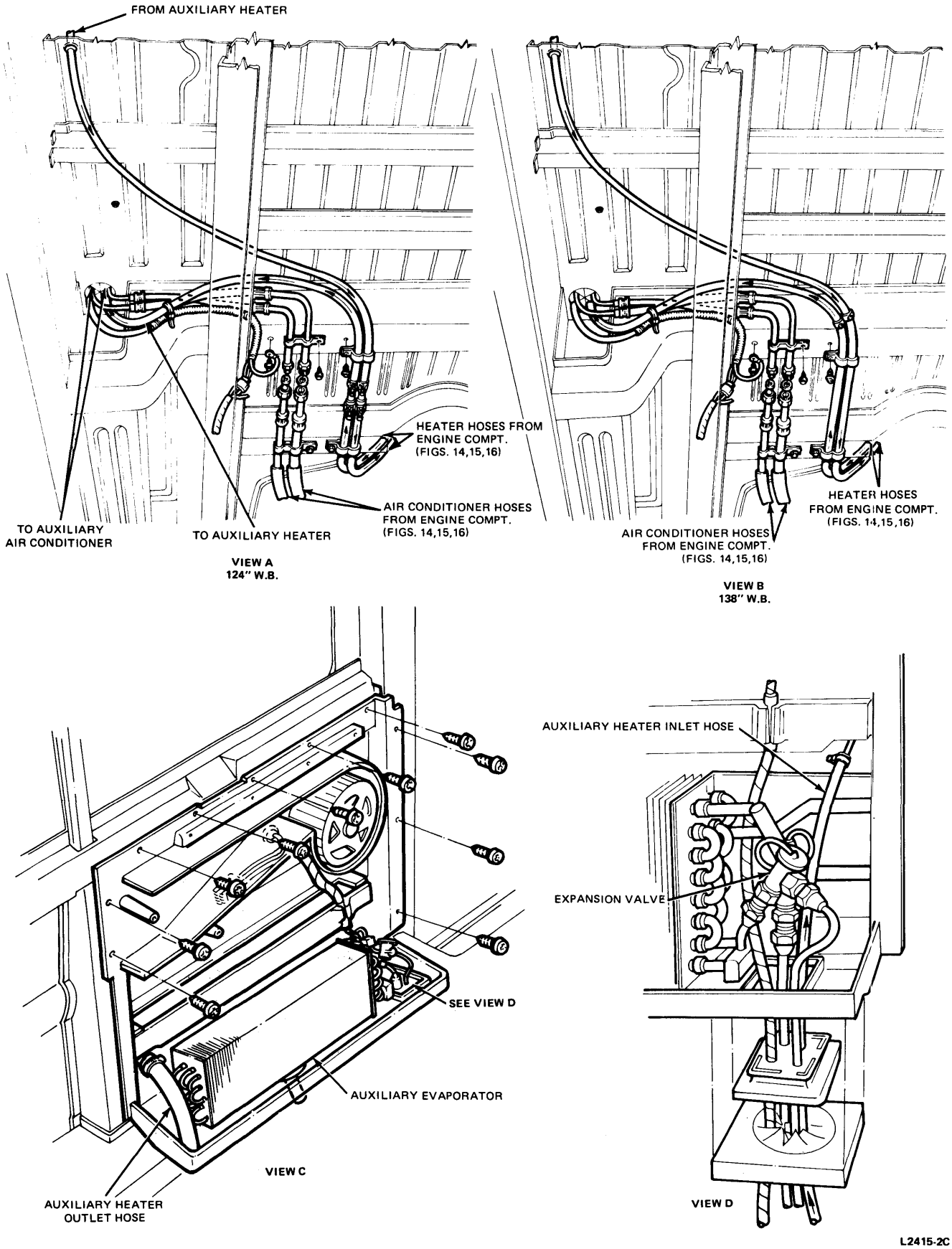
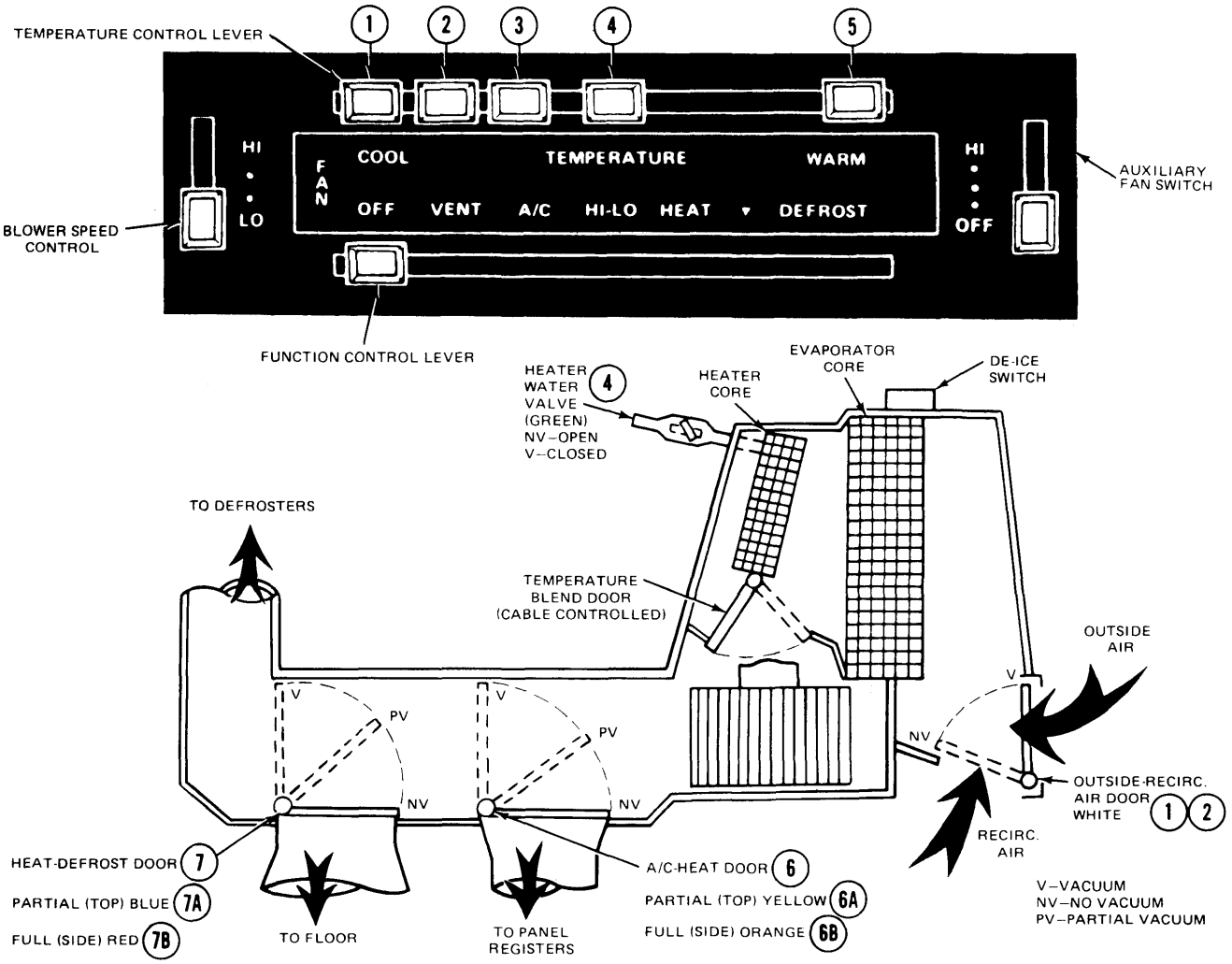


FIG. 17 Auxiliary A/C and Auxiliary Heater Hose Routing—Under Vehicle—124" and 138" W/B

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E-100–E-350
MANUAL A/C-HEATER SYSTEM VACUUM MOTOR TEST CHART

FUNCTION CONTROL LEVER POSITION	TEMPERATURE CONTROL LEVER POSITION	VACUUM MOTORS APPLIED WITH VACUUM						
		AUXILIARY A/C HEATER WATER VALVE ‡	OUTSIDE –RECIRC	WATER VALVE	A/C-HEAT PARTIAL	A/C-HEAT FULL	HEAT-DEFROST PARTIAL	HEAT-DEFROST FULL
OFF	Any Position	–	1 2	4	–	–	–	–
VENT	Any Position	A4		4	6a	6b	7a	7b
A/C *	Cool - 1	A4	1–2	4	6a	6b	7a	7b
	Cool - 2	A4	–	4	6a	6b	7a	7b
	Cool - 3 Blend - 4 Warm - 5	A4			6a	6b	7a	7b
HI - LO	Cool - 1	–	–	4	6a	–	7a	7b
	Cool - 2	–	–	4	6a	–	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	–	6a	–	7a	7b
HEAT	Cool - 1	–	–	4	–	–	7a	7b
	Cool - 2	–	–	4	–	–	7a	7b
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	7a	7b
▽ (DEFOG)	Cool - 1	–	–	4	–	–	7a	–
	Cool - 2	–	–	4	–	–	7a	–
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	7a	–
DEFROST	Cool - 1	–	–	4	–	–	–	–
	Cool - 2	–	–	4	–	–	–	–
	Cool - 3 Blend - 4 Warm - 5	–	–	–	–	–	–	–
VACUUM LINE COLOR CODE		ORANGE	WHITE	GREEN	YELLOW (TOP)	ORANGE (SIDE)	BLUE (TOP)	RED (SIDE)

* COMPRESSOR CLUTCH ENGAGED WHEN ICING SWITCH IS CLOSED
NO VACUUM

‡ NOT USED WITH AUX. HEATER ONLY

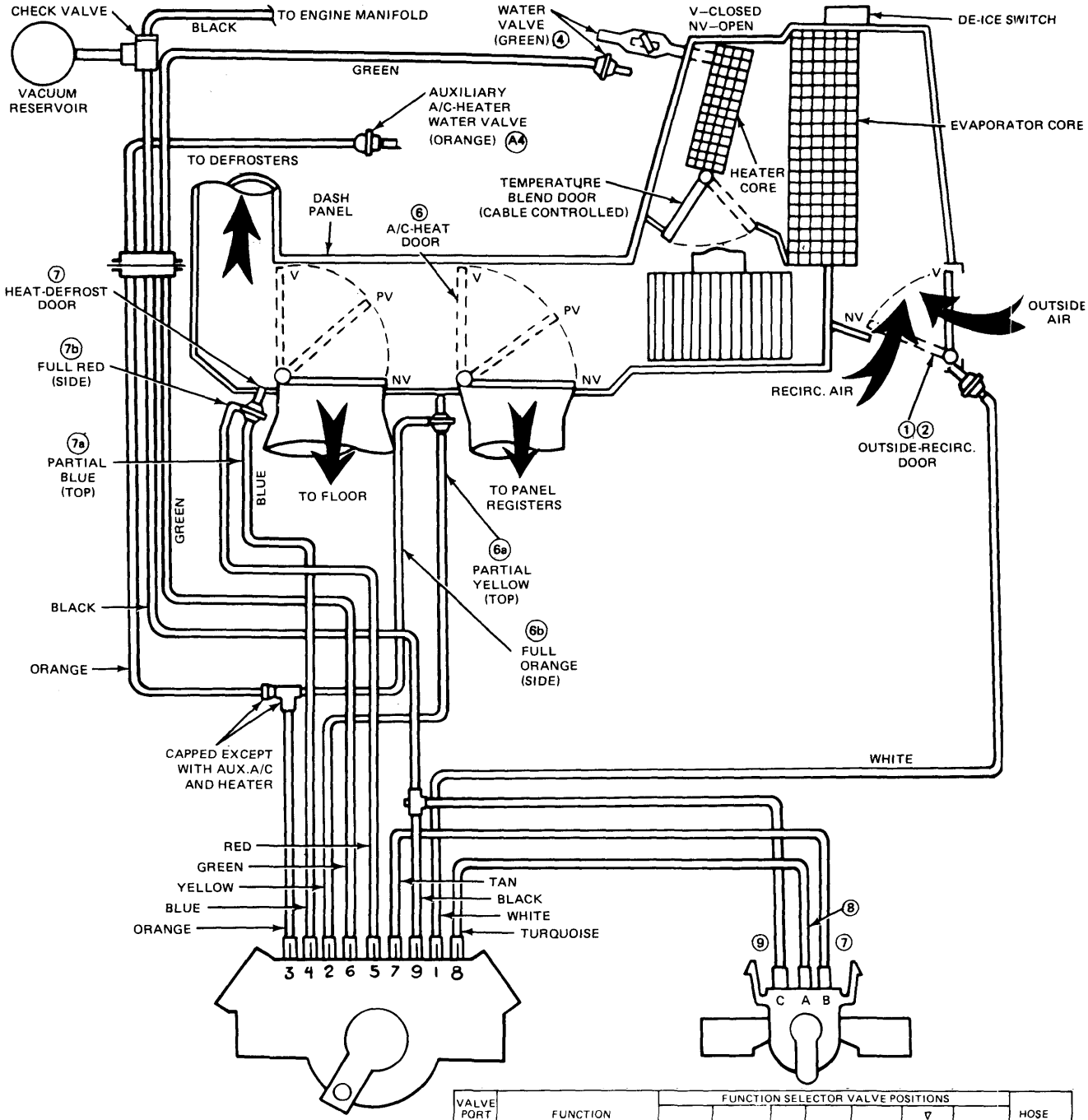
DE-ICING SWITCH SETTING – CUT-IN 42° F – CUT-OUT 28° F

L2560-2B

FIG. 18 Manual A/C-Heater System Air Flow Schematic and Vacuum Control Chart—E-100—E-350

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VALVE PORT	FUNCTION	FUNCTION SELECTOR VALVE POSITIONS							HOSE COLOR
		OFF	VENT	A/C	HI-LO	HEAT	▽ (DEFOG)	DEFROST	
1	Outside-Recirc.	V		To 8					White 1-2
2	Partial A/C-Heat		V	V	V				Yellow 6A
3	Full A/C-Heat		V	V					Orange 6B
3	Aux. A/C-Heater Water Valve		V	V					Orange
4	Partial Heat–Defrost		V	V	V	V	V		Blue 7A
5	Full Heat		V	V	V	V			Red 7b
6	To Engine Water Valve	V	V	To 7	To 7	To 7	To 7	To 7	Green 4
7	From Temp Valve Port B	Seal	Seal	To 6	To 6	To 6	To 6	To 6	Tan
8	From Temp Valve Port A	Seal	Seal	To 1	Seal	Seal	Seal	Seal	Turquoise
9	Source Vacuum	V	V	V	V	V	V	V	Black

PORT	FUNCTION	TEMPERATURE SELECTOR VALVE LEVER POSITIONS				HOSE COLOR
		COOL		TEMPERATURE	WARM	
C	Source Vacuum	V	V	V	V	Black
A	Outside-Recirc.	V				Turquoise
B	Water Valve	V	V			Tan

L2561-2B

FIG. 19 Manual A/C-Heater System Vacuum Schematic and Selector Test—E-100—E-350

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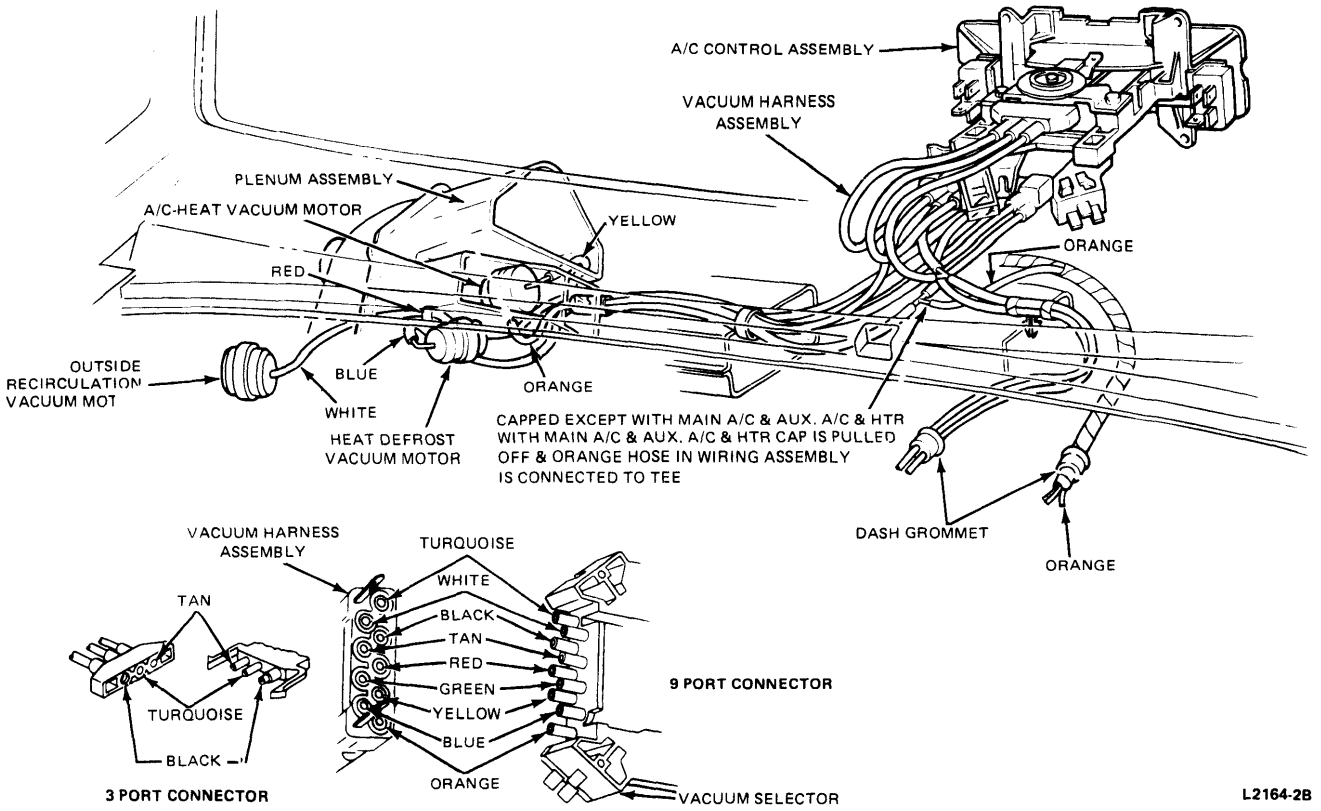


FIG. 20 Vacuum System Color Codes and Routing

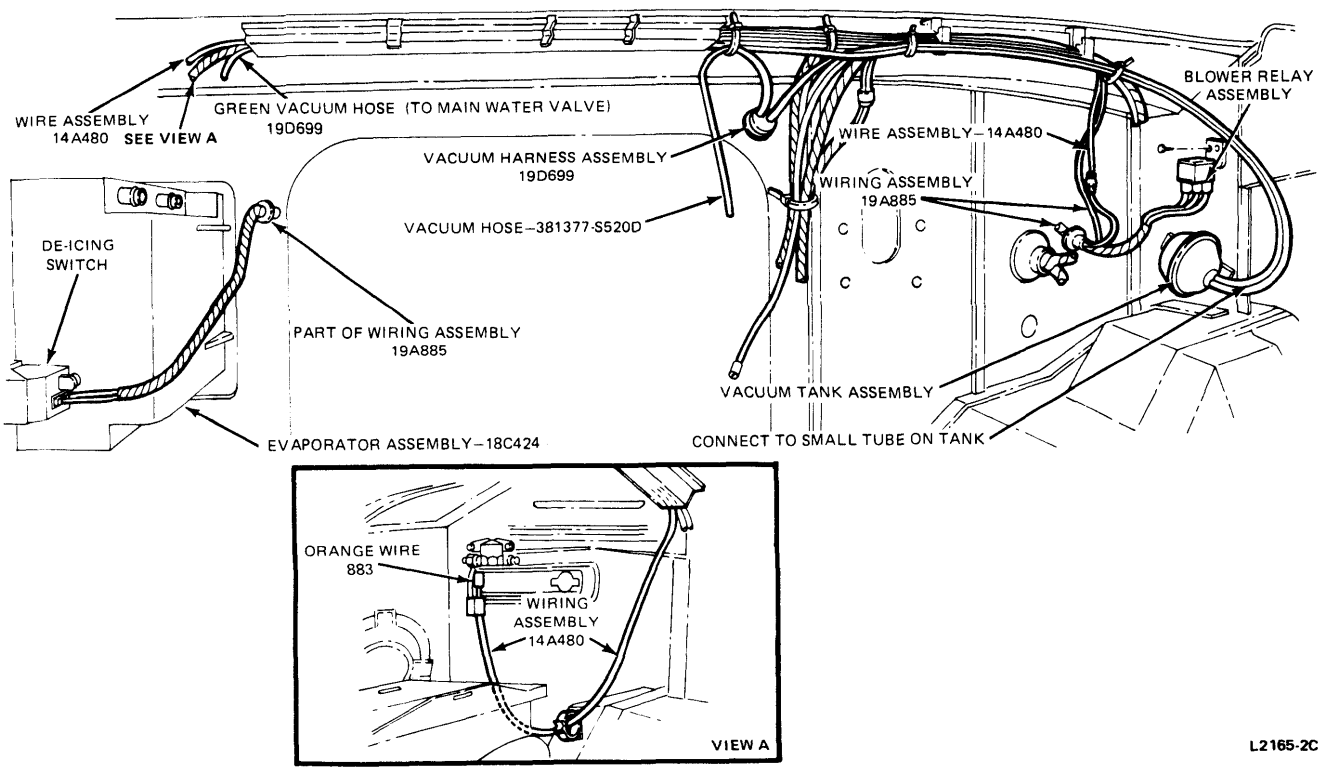


FIG. 21 Engine Compartment—Vacuum Hose Routing

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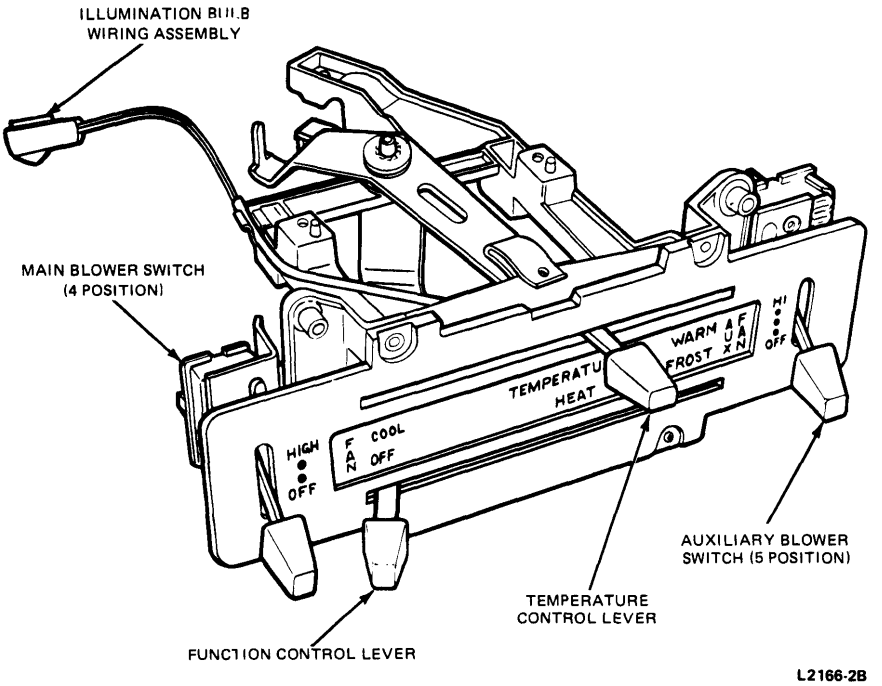


FIG. 22 Dual Heater System—Heater Control Assembly—Front View

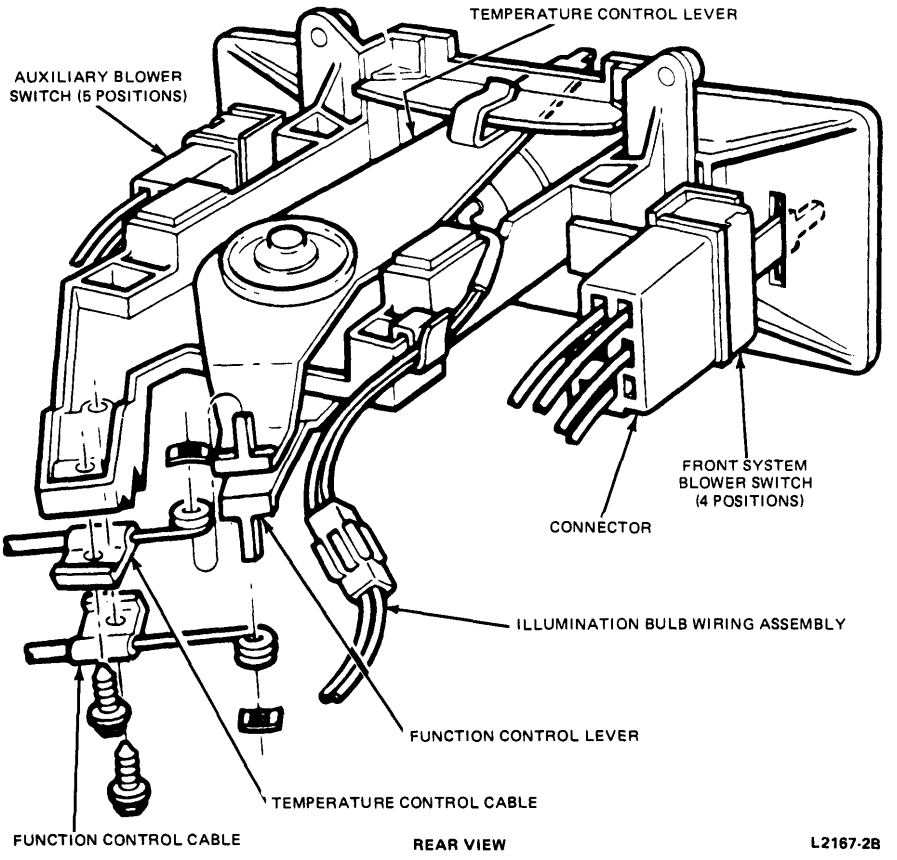


FIG. 23 Dual Heater System—Heater Control with Control Cables—Rear View

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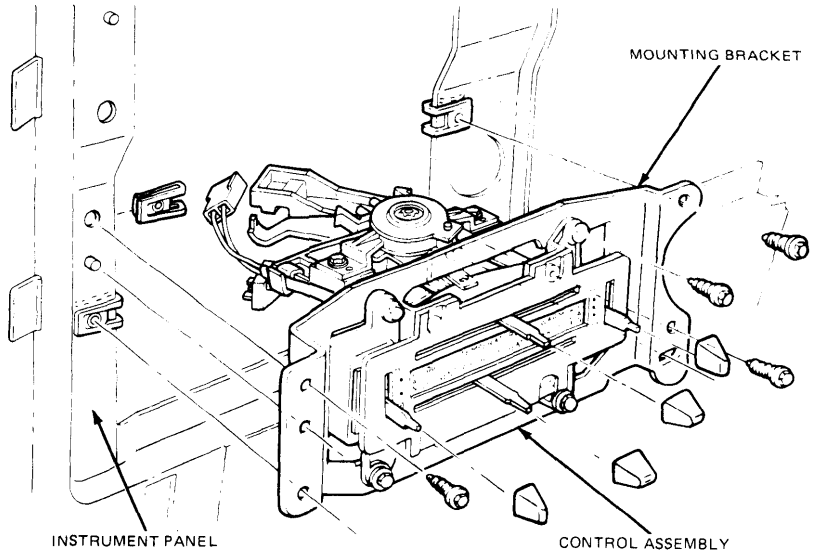


FIG. 24 Dual A/C Heater Systems—Control Assembly and Mounting Bracket—Front View

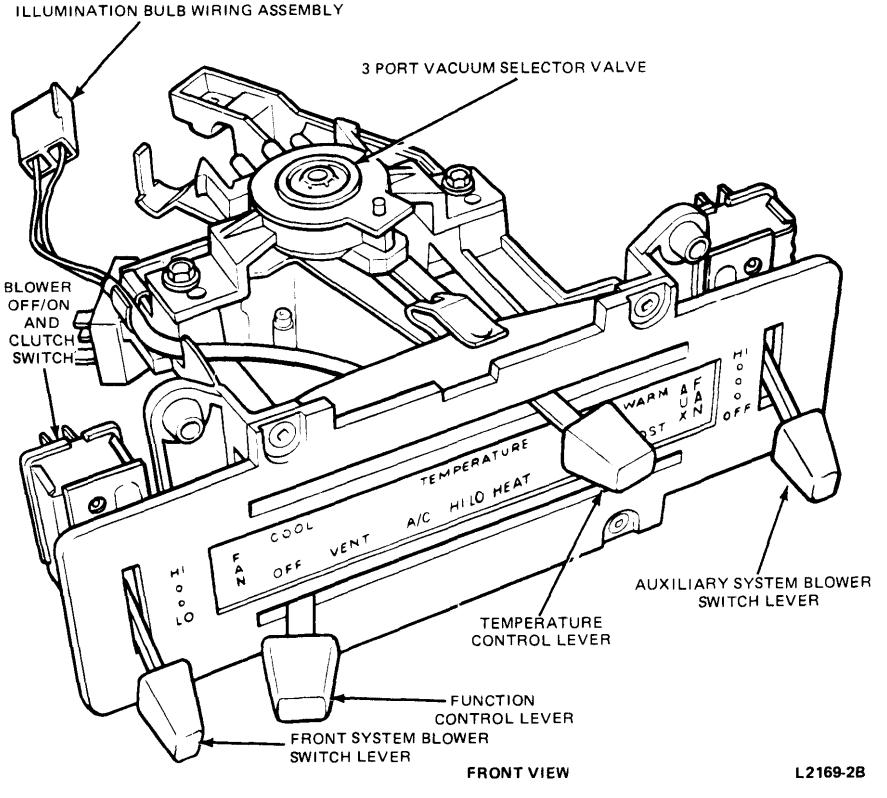


FIG. 25 Dual A/C—Heater Control Assembly—Front View

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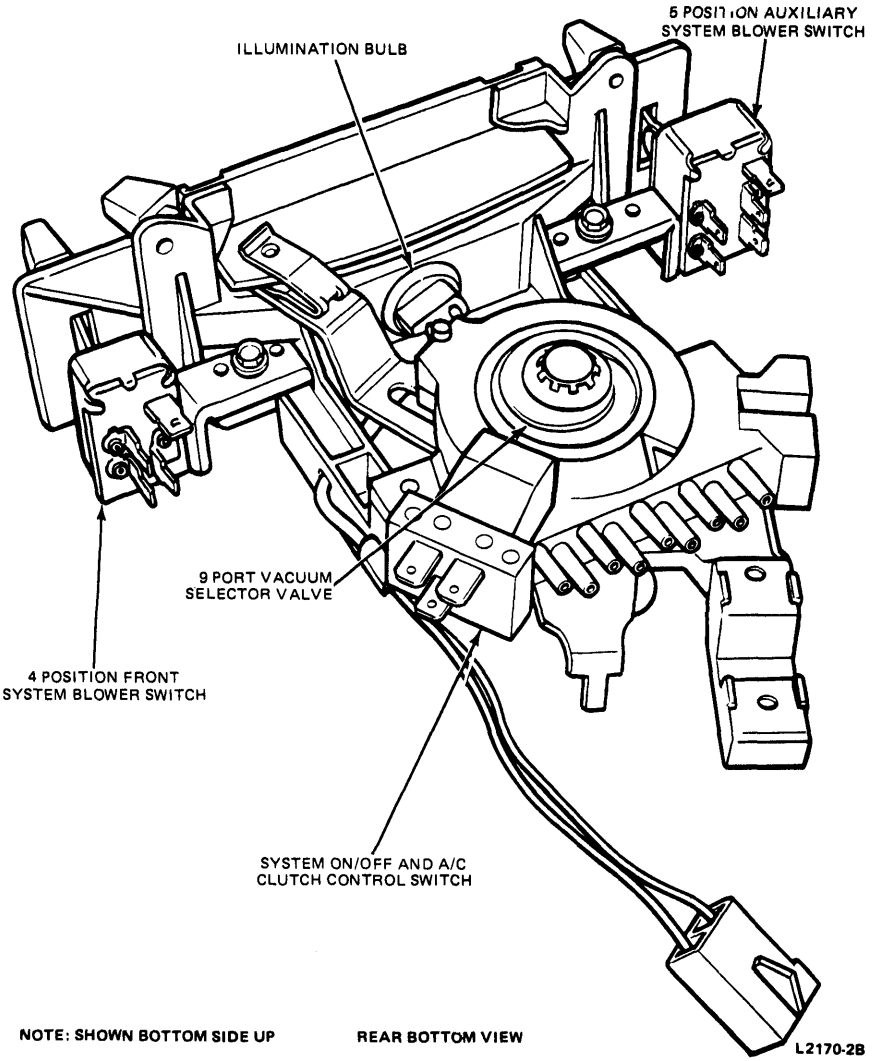
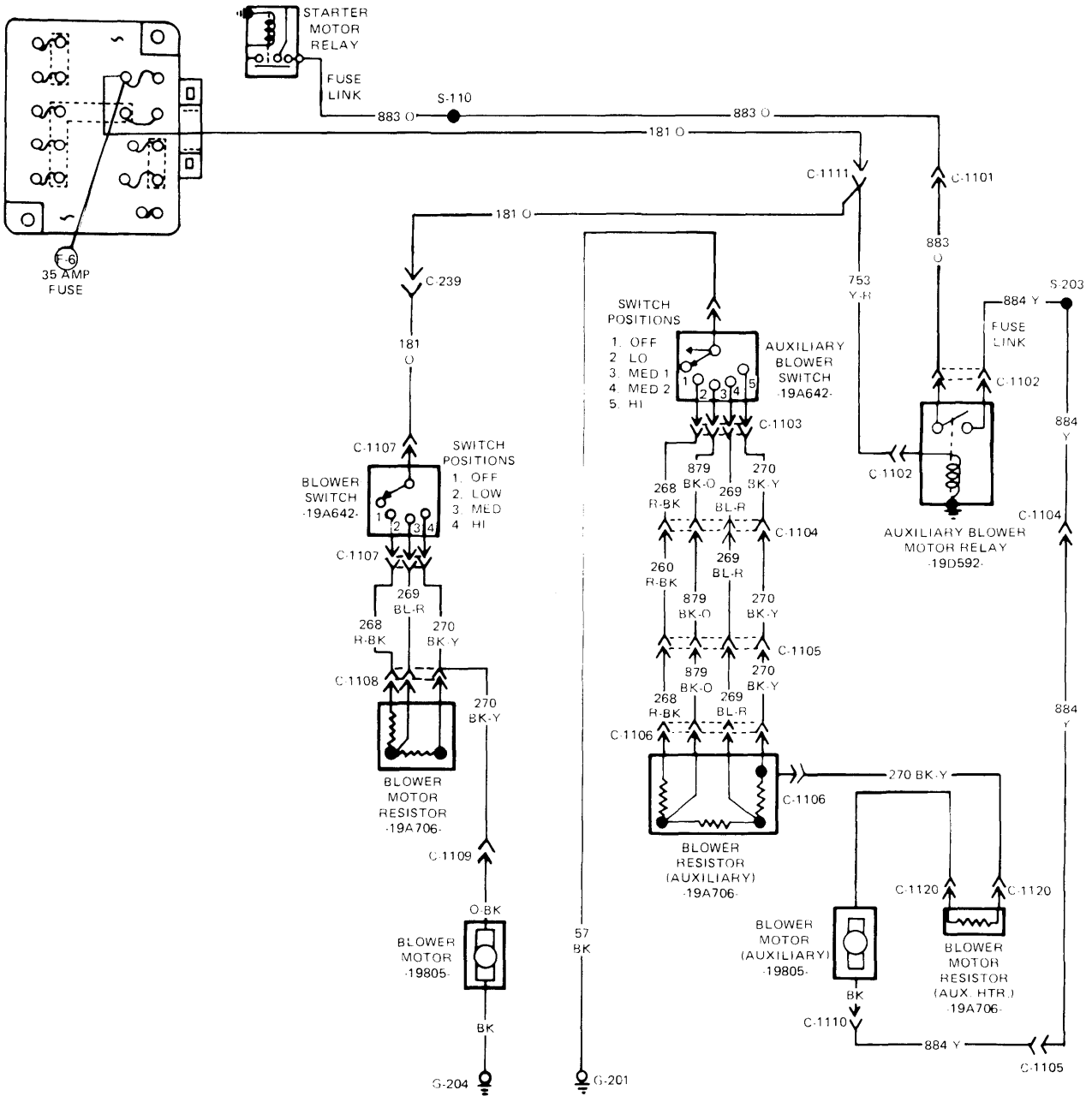


FIG. 26 Dual A/C—Heater System Control Assembly—Rear View

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BLOWER SWITCH -19A642-			
BLOWER SPEED	TERMINAL CONTINUITY CONNECTIONS	APPROXIMATE CURRENT IN VEHICLE (AMPS)	APPROX. BLOWER VOLTAGE
Off	–	5	5
Low	B-M1(2) (5)	7	6
Med.	B-M1-M2(2) (4) (5)	11	8
High	B-H-M2(2) (1) (4)	15	11

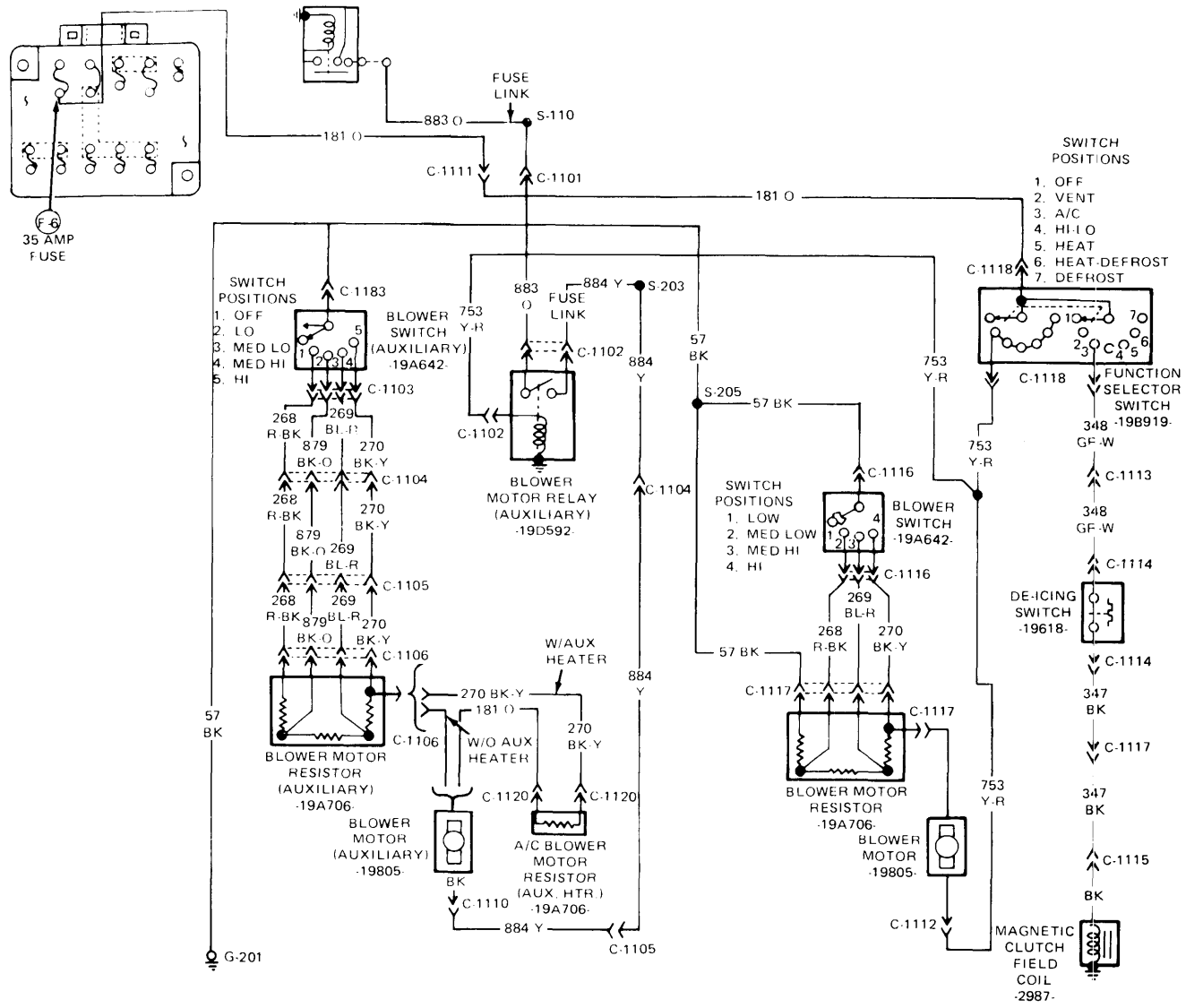
AUXILIARY BLOWER SWITCH -19A642-			
BLOWER SPEED	TERMINAL CONTINUITY CONNECTIONS	APPROXIMATE CURRENT IN VEHICLE (AMPS)	APPROX. BLOWER VOLTAGE
Off	–	00	0
Low	B-L	4	4
Med. Low	B-M1-L	6	5
Med. High	B-M2-M1	8	7
High	B-H-M2	12	8

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FIG. 27 Dual Heater System — Electrical Wiring Diagram

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FUNCTION SELECTOR SWITCH -19B919-							
SWITCH SCHEMATIC	TERMINAL CONNECTIONS (CONTINUITY)						
	OFF	VENT	A/C	HI-LO	HEAT	▽ (DEFOG)	DEFROST
X W Z Y	NONE	W-X	W-X Y-Z	W-X	W-X	W-X Y-Z	W-X Y-Z

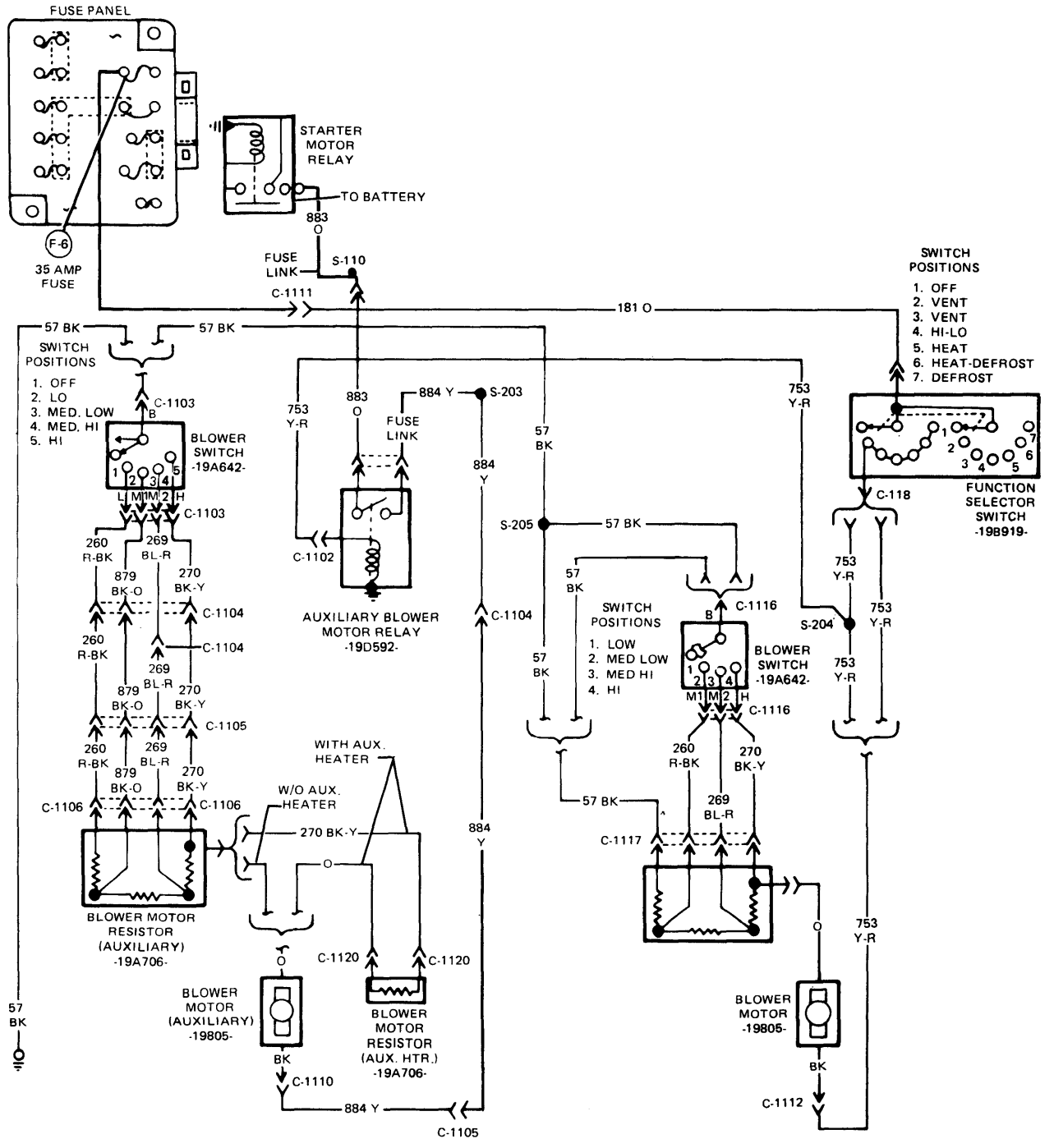
BLOWER SWITCH -19A642-			
BLOWER SPEED	TERMINAL CONNECTIONS	APPROXIMATE CURRENT DRAW IN VEHICLE (AMPS)	APPROX. BLOWER VOLTAGE
LOW	B(2)	5	5
MED LOW	B-M1(2) (5)	7	6
MED HI	B-M1-M2(2) (4) (5)	11	8
HI	B-H-M2(2) (1) (4)	15	11
AUXILIARY HEATER BLOWER SWITCH -19A642-			
OFF	–	0	0
LOW	B(2)	4	4
MED LOW	B-M1(2) (5)	6	5
MED HI	B-M1-M2(2) (1) (5)	8	7
HI	B-H-M2(2) (3) (4)	12	8
AUXILIARY A/C BLOWER SWITCH -19A642-			
OFF	–	0	0
LOW	B-L	5	5
MED LOW	B-M1-L	7	6
MED HI	B-M2-M1	11	6
HI	B-H-M2	16	10

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FIG. 28 Dual Heater A/C System — Electrical Wiring Diagram

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BLOWER SWITCH -19A642-			
BLOWER SPEED	TERMINAL CONNECTIONS	APPROXIMATE CURRENT DRAW IN VEHICLE (AMPS)	APPROXIMATE BLOWER VOLTAGE
Low	B-2	5	5
Med. Low	B-M1(2) (5)	7	6
Med. High	B-M1-M2(2(4)(5)	11	8
High	B-H-M2(2)(1)(4)	15	11

AUXILIARY BLOWER SWITCH -19A642-			
BLOWER SPEED	TERMINAL CONNECTIONS	APPROXIMATE CURRENT DRAW IN VEHICLE (AMPS)	APPROXIMATE BLOWER VOLTAGE
Off	–	0	0
Low	B-L	5	5
Med. Low	B-M1-L	7	6
Med. High	B-M2-M1	11	6
High	B-H-M2	16	10

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FIG. 29 Dual Deluxe Heater System — Electrical Wiring Diagram

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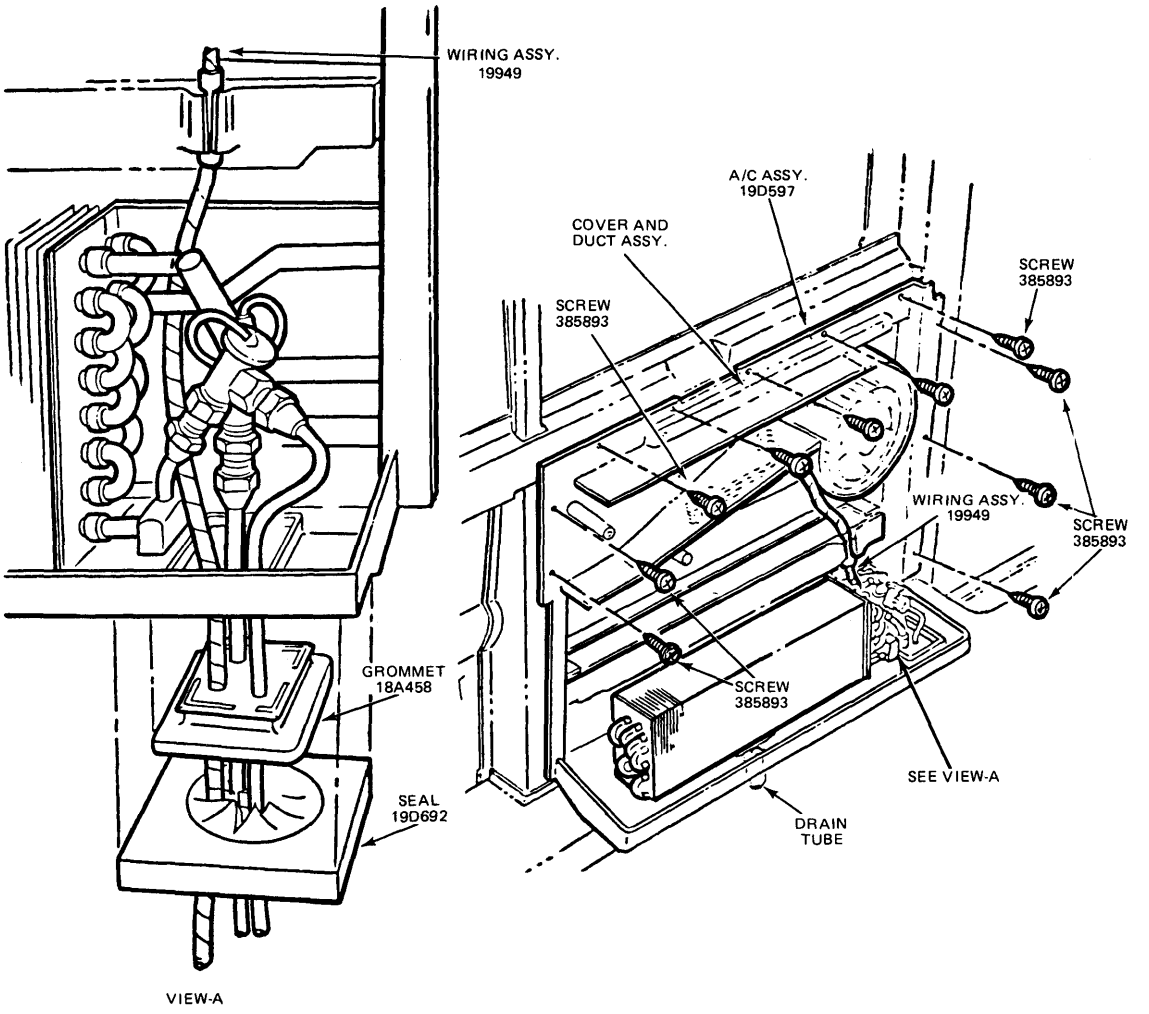


FIG. 30 Blower Motor and Wheel—Installation

REMOVAL AND INSTALLATION

AUXILIARY HEATER AND/OR AIR CONDITIONER COVER ASSEMBLY

Removal and Installation (Figs. 2, 3 and 5)

1. Remove the first bench seat (if so equipped). Refer to group 41-14.
2. Remove the auxiliary heater and/or air conditioning cover assembly attaching screws and remove the cover.
3. Position the cover assembly to the body side panel and install the attaching screws.
4. Install the bench seat (if removed) and tighten the retaining bolts 25-45 ft-lb.

AUXILIARY EVAPORATOR CORE ASSEMBLY

Removal

1. Remove the first bench seat (if so equipped). Refer to Group 41-14..
2. Remove the auxiliary heater and/or air conditioning cover assembly attaching screws (15) and remove the cover (Fig. 32).
3. Discharge the refrigerant system observing all safety precautions. Refer to Group 36-30.
4. Disconnect the suction line and liquid line from the evaporator core and expansion valve (Fig. 17).
5. Remove the evaporator core and seal assembly with the expansion valve attached (4 screws).

Installation

1. Carefully position the evaporator core and seal assembly in position and install the four attaching screws. Do not bend or damage the core fins.
2. Connect the lines to the evaporator core and expansion valve. Be sure the "O" rings are positioned properly.
3. Leak test, evacuate and charge the refrigerant system (Group 36-30) with the specified amount of refrigerant.
4. Position the cover assembly to the body side panel and install the attaching screws (15).
5. Install the bench seat (if removed) and tighten the retaining bolts to 25-45 ft-lb.

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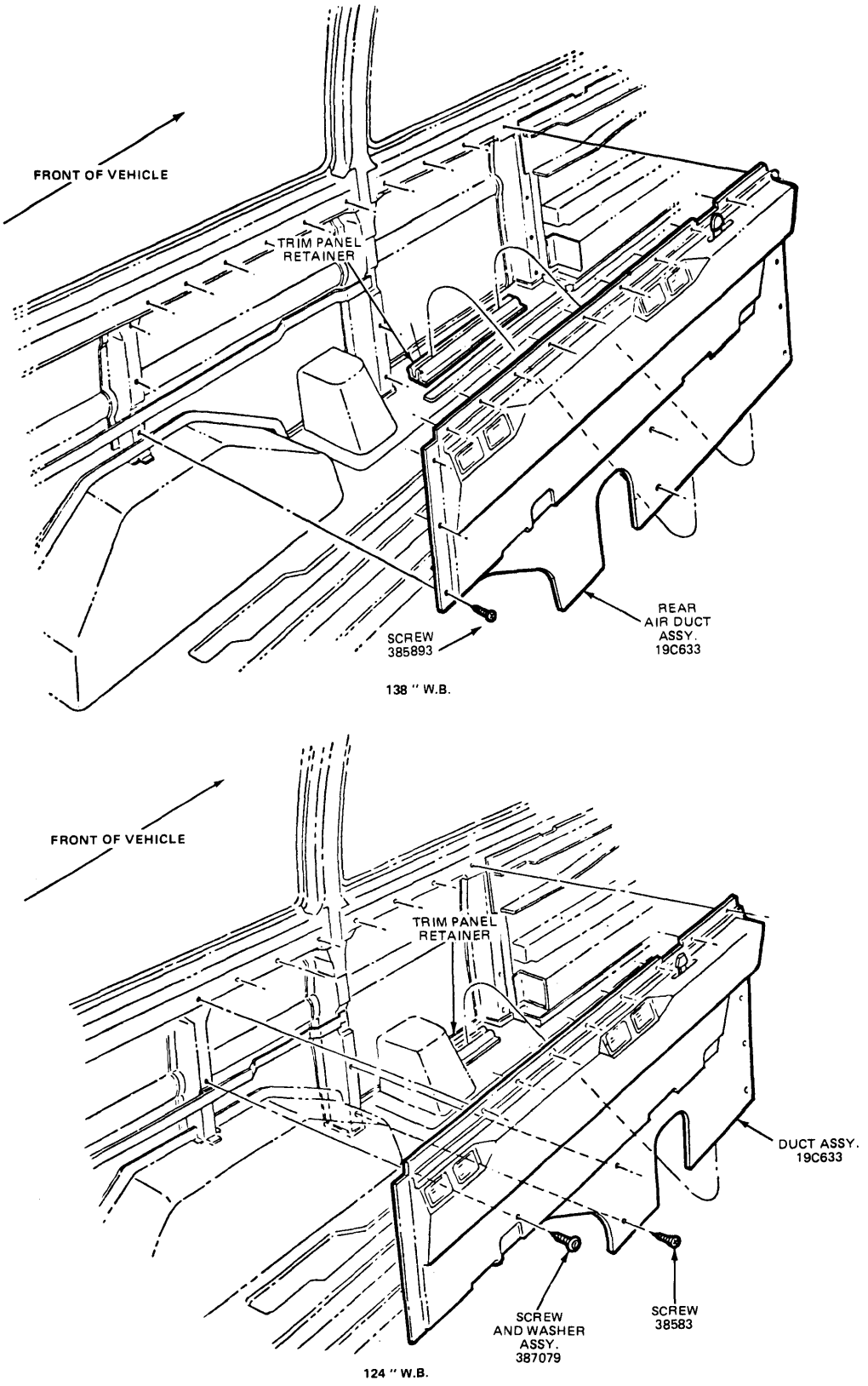


FIG. 31 Duct Assembly—124" W. Band 138" W.B.

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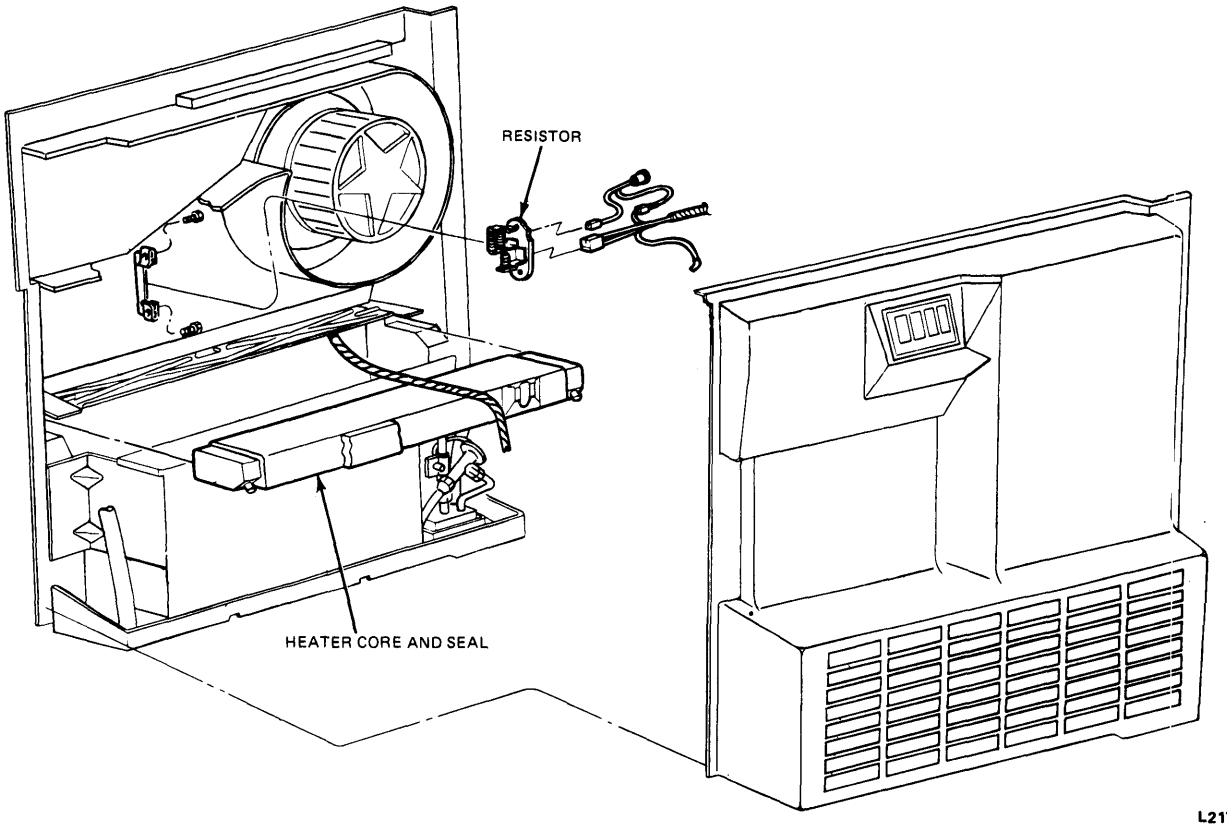


FIG. 32 Heater Core and Resistor—Installation

EXPANSION VALVE

Removal

1. Remove the first bench seat (if so equipped). Refer to Group 41-14.
2. Remove auxiliary heater and/or air conditioning cover attaching screws (15) and remove the cover (Fig. 32).
3. Discharge the refrigerant system. Refer to Group 36-30. Observe all safety precautions.
4. Disconnect the inlet line from the expansion valve (Fig. 17).
5. Remove the bulb insulation from the suction (outlet) line.
6. Remove the capillary tube clamp from the suction (outlet) line (1 screw).
7. Remove the expansion valve from the evaporator liquid (inlet) line.

Installation

When installing a new expansion valve, make sure all the "O" ring seals are lubricated with clean refrigerant oil and are positioned properly in their respective locations.

1. Connect the liquid inlet line to the expansion valve.
2. When assembling the expansion valve to the core, do not damage the valve bulb. The suction tube the bulb attaches to, must be clean. The bulb must also be adequately wrapped with insulation tape.
3. Install the capillary tube bulb clamp to the suction (outlet) line (1 screw).
4. Wrap the bulb and the suction line with insulation tape.
5. Connect the inlet line to the expansion valve.
6. Leak test, evacuate and charge the refrigerant system (Group 36-30). Observe all safety precautions.
7. Position the cover assembly to the body side panel and install the attaching screws (15).
8. Install the bench seat (if removed) and tighten the retaining bolts (25-45 ft-lb).

AUXILIARY HEATER CORE AND SEAL ASSEMBLY

Removal

1. Remove the first bench seat (if so equipped). Refer to Group 41-14.
2. Remove auxiliary heater and/or air conditioning cover attaching screws (15) and remove the cover (Fig. 31).
3. Partially drain the engine coolant from the cooling system.
4. Remove the heater hoses from the auxiliary heater core assembly (2 clamps) (Figs. 9 and 17).
5. Pull the wiring assembly away from the heater core seal.
6. Slide the heater core and seal assembly out of the housing slot.

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Installation

1. Slide the heater core and seal assembly into the housing slot (position the wiring to one side).
2. Install the heater hoses to the heater core assembly (2 clamps).
3. Fill the cooling system to specification.
4. Position the cover assembly to the body side panel and install the attaching screws (15).
5. Install the bench seat (if removed) and tighten the retaining bolts 25-45 ft-lb.

RESISTOR ASSEMBLY

To install a new resistor assembly, remove the first bench seat (if so equipped). Remove the auxiliary heater and/or air conditioning cover assembly (15 screws). Then, disconnect the wiring connectors from the resistor assembly and remove the resistor (2 screws) (Fig. 32).

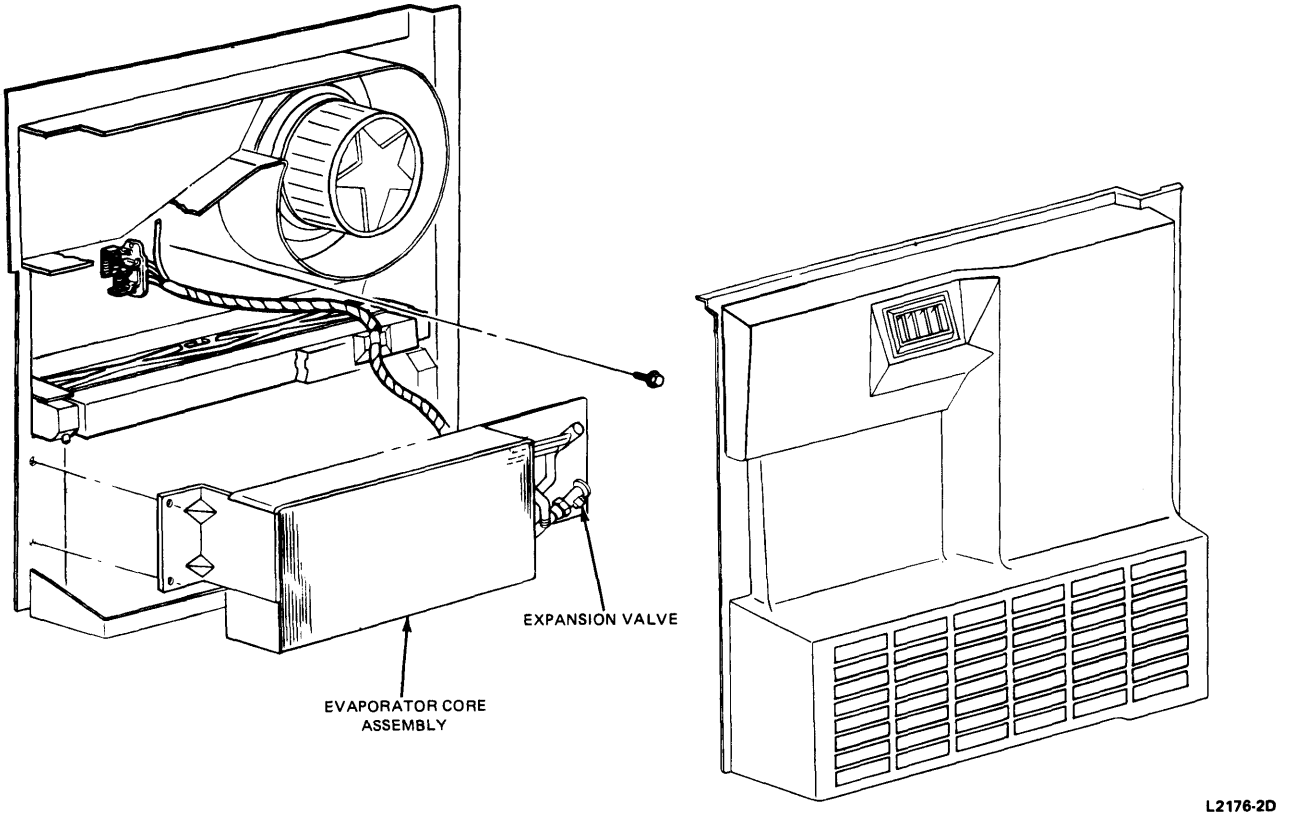


FIG. 33 Evaporator Core and Vacuum Motor—Installation

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SPECIFICATIONS

AUXILIARY HEATER (WITH MAIN HEATER)

Protective Device	One 30 amp. fuse, a 16 gauge fuse link in a 12 gauge wiring assembly, and a blower motor relay	
Control Illumination	One 1CP 161 bulb	
Blower Motor Current Draw @ 12.8 Volts	**Voltage (Approx.)**	**Current (Approx.)**
Off	0	0
Low	5.0	5.0 Amps
Medium Low	6.0	7.0 Amps
Medium High	6.0	11.0 Amps
High	10.0	16.0 Amps

NOTE: The amps listed above represent the blower amps under normal operating conditions which includes a resistor in the circuit wiring.

AUXILIARY A/C OR A/C-HEATER WITH MAIN HEATER-AIR CONDITIONER

Protective Device	One 30 amp. fuse, a 16 gauge fuse link in a 12 gauge wiring assembly, and a blower motor relay	
Control Illumination	One 1CP 161 bulb	
Blower Motor Current Draw @ 12.8 Volts	**Voltage (Approx.)**	**Current (Approx.)**
Off	0	0
Low	5.0	5.0 Amps
Medium	6.0	6.0 Amps
High	9.0	11.0 Amps
Refrigerant Charge of R-12	3.50 + 1/4 lbs. without Auxiliary A/C Unit 4.25 + 1/4 lbs. with Auxiliary A/C Unit	
Compressor		
Displacement	10.3 cu. in.	
Oil Capacity	Tecumseh 11 oz.	
Drive Ratio		
E-100-150	1.32:1	
E-250-350	1.25:1	

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SPEED CONTROL

GROUP 37 (19000)

PART TITLE	PART NO.
Speed Control System	37-01

Speed Control System

PART 37-01

APPLIES TO E-100 THROUGH E-350 AND F-100 THROUGH F-350, AND BRONCO

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Speed Sensor	01-17
Vacuum Reservoir	01-18

DESCRIPTION AND OPERATION

SPEED CONTROL E-100—E-350, F-100-350 AND BRONCO

The speed control system is composed of the OFF-ON switch and the SET-ACCEL and COAST switches, a servo (throttle actuator) assembly, a speed sensor, an amplifier assembly and the necessary wires, linkage, check valve assembly, vacuum reserve tank and vacuum hose to connect the components. The switches are located in the steering wheel spokes (Figs. 1 and 2). The amplifier assembly is located under the instrument panel (Fig. 3). The servo assembly (throttle actuator) is attached to the engine intake manifold (Figs. 8 and 9). The speed control sensor (E-100—E-350) is located on the left side of the dash panel and on the left fender apron (F-100-350 and Bronco) (Fig. 10). The vacuum reservoir is located under the left fender apron on F-100—F-350 and Bronco, and in the engine compartment for E-100—E-350. To operate the speed control system the engine must be running and the vehicle speed over 30 mph. Manifold vacuum is constantly supplied when the engine is running. When the on/off switch in the steering wheel is actuated to the **ON position the system is made ready to accept a set speed signal.** When the vehicle has been accelerated and stabilized at a speed over 30 mph and the **ON switch engaged, the operator may quickly depress and release the set/accelerate button. This speed will be maintained until a new speed is set by the operator, the brake pedal is depressed, or the system is turned OFF.**

DECREASING SET SPEED

The rate of set speed may be reduced by applying the brake and then re-setting the speed using the preceding method or by depressing the coast switch. When the vehicle has slowed to the desired speed the coast switch is released and the new speed is set

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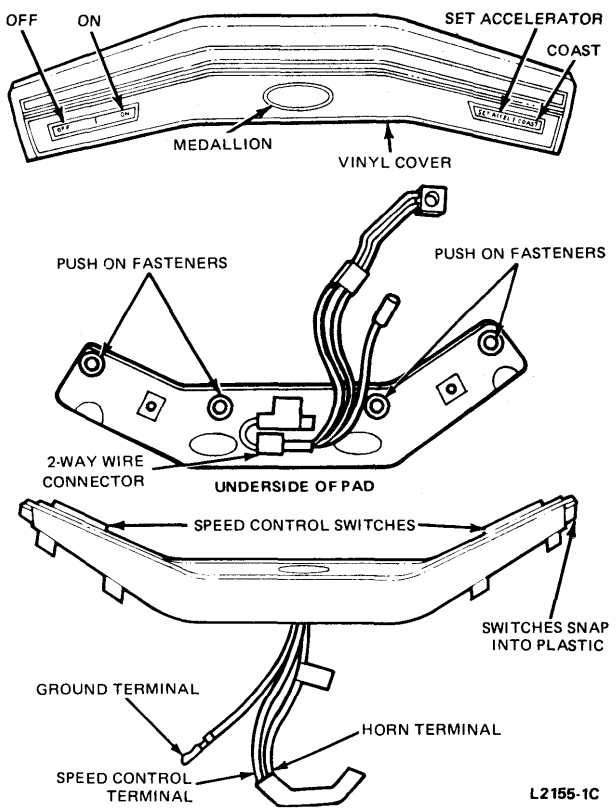


FIG. 1 Control Switch Installation

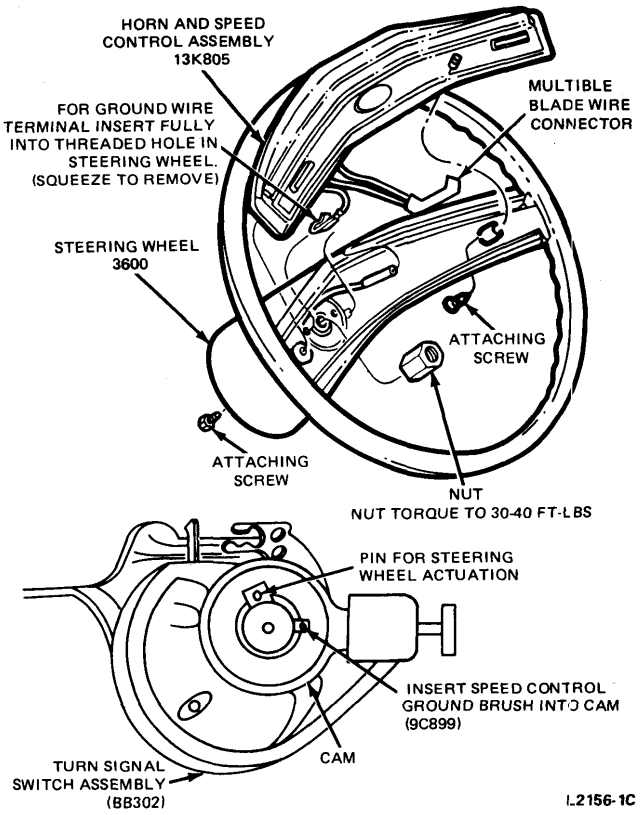


FIG. 2 Horn and Speed Control Switch and Wiring Installation

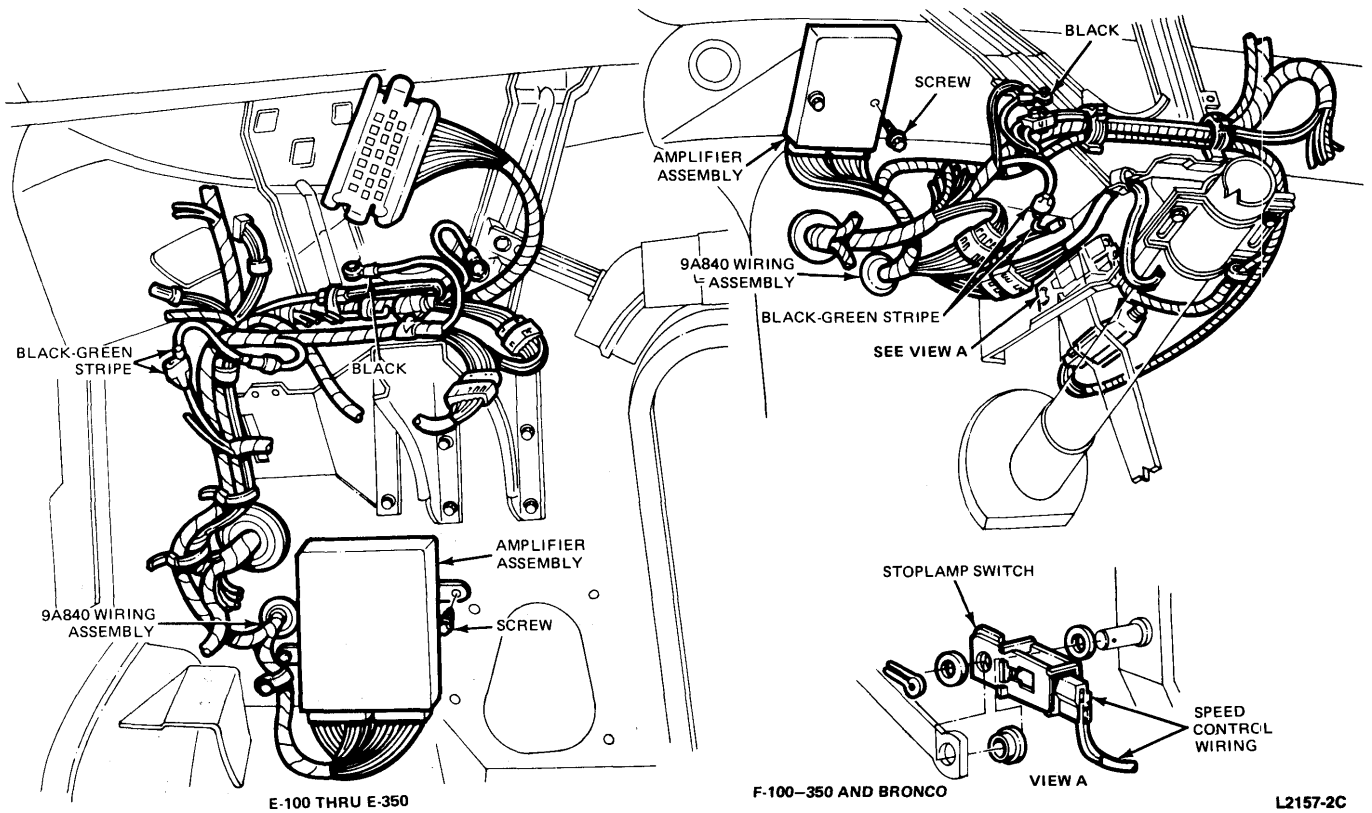


FIG. 3 Speed Control Amplifier and Wiring Installation

automatically. If the vehicle speed is reduced below 30 mph, the operator must manually increase the speed up to 30 mph. and re-set the system.

INCREASING SET SPEED

The vehicle set speed may be increased at any time by depressing the accelerator until the higher rate is

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reached and stabilized, then depressing and releasing the set speed button.

Speed may also be increased by depressing the set/accelerate switch button, (at speeds over 30 mph), and holding it in that position. When the desired rate of speed is attained and the button is released, that new set speed will be maintained.

GROUND BRUSH

Removal

1. Remove the steering wheel for access.
2. Snap the brush assembly out of the turn signal switch.

Installation

1. Install the ground brush in the turn signal switch. (If the turn signal switch was lifted off the column when removing the ground brush, install the turn signal switch.)
2. Install the steering wheel trim pads and the steering wheel (Fig. 4).

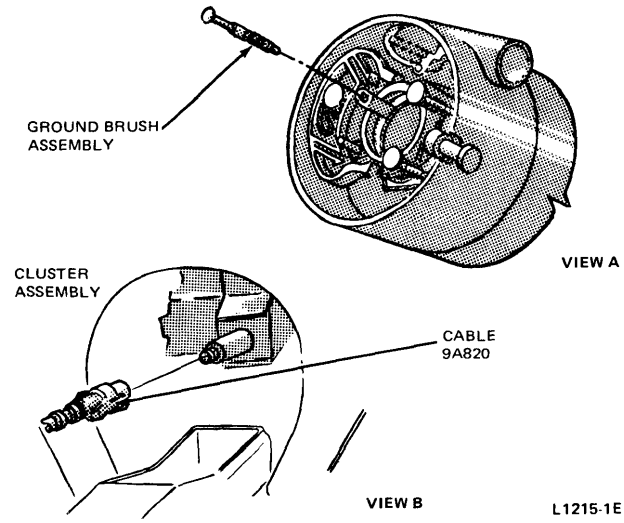


FIG. 4 Ground Brush Installation

DIAGNOSIS AND TESTING

Speed control system tests should be performed using the Tester ARE-22015 or equivalent. If the ARE-22015 Tester is not available, use the following procedures.

NOTE: Diagnosis guides are provided at the end of this section to assist in locating speed control system problems.

VISUAL INSPECTION

A visual inspection is an important part of the system test. When performing a visual inspection, check all items for abnormal conditions such as frayed wires and damaged vacuum reserve tanks and hoses. For the speed control system to function properly, it is necessary that the speedometer cables be properly routed and securely attached to the components. All vacuum hoses must be securely attached and routed with no sharp bends or kinks. The servo (throttle actuator) and throttle linkage should operate freely and smoothly. **The bead chain should have no more than 1/4 inch free play. Electrical connections must be complete and tight. The wiring harness must be properly routed. Look for frayed wiring insulation or evidence of shorts.** Any problems revealed by the visual inspection should be corrected before further tests of the speed control system are made.

CONTROL SWITCHES TEST

Disconnect the 6-way connector (C-1006 on E-100—E-350 and C-717 on F-100—F-350 and Bronco) at the amplifier from the steering column control switches (Fig. 3). Then, check the lead (Light Blue-Black Hash -151) from the control switches as follows:

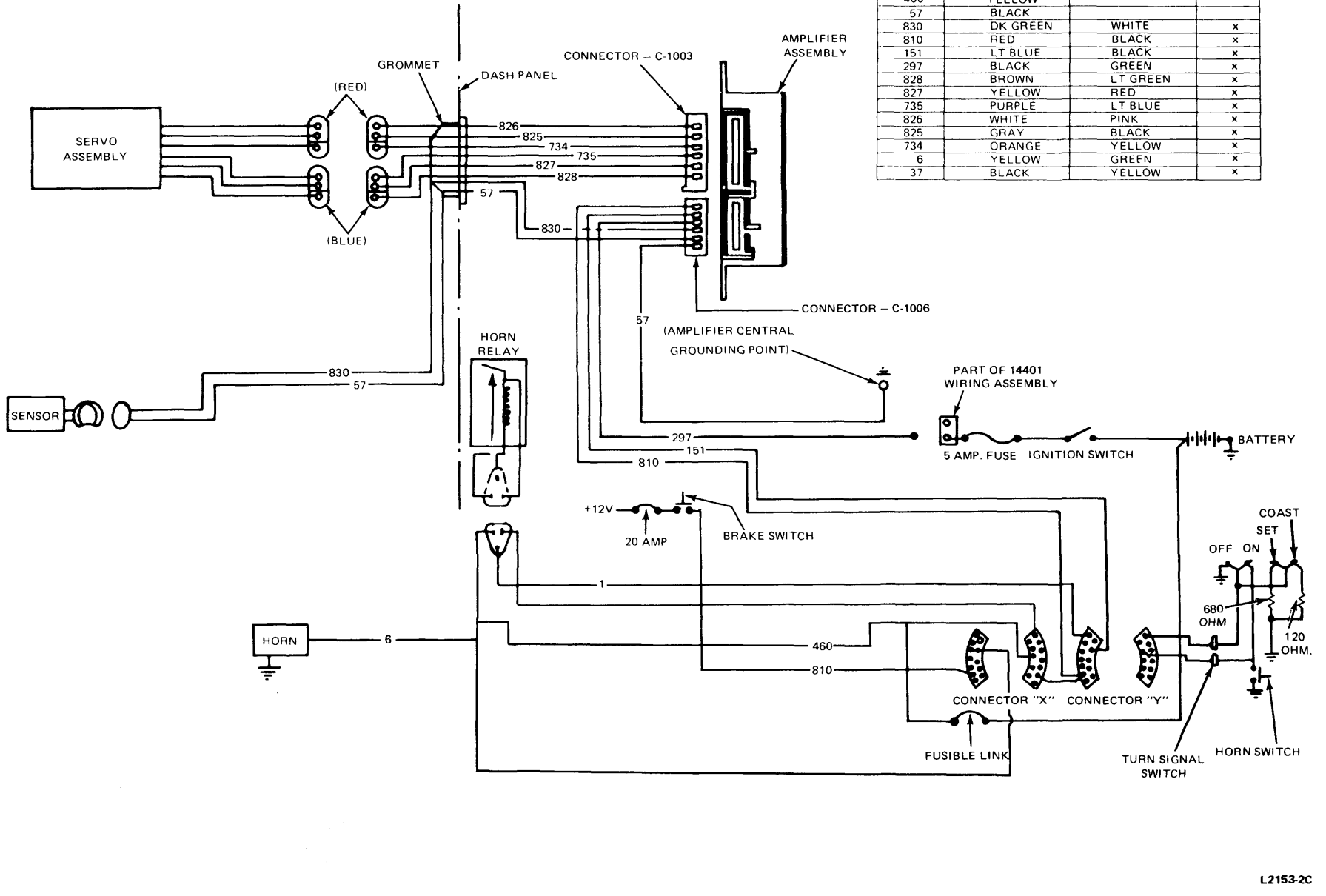
1. Check for battery voltage at the lead (Light Blue-Black Hash) when the "ON" switch is depressed. Battery voltage should be available at the lead (Light Blue-Black Hash) coming from the control switches. (Refer to the wiring diagram). (See Figs. 5-8).
2. Connect an ohmmeter between the Light Blue-Black Hash wire (151) and ground. Check the wire for continuity to ground (0-1 ohm) when the "OFF" switch is depressed. If a resistance higher than 1 ohm is found, the wiring, slip rings, or the switch is at fault, or the steering column is not properly grounded. To check for proper ground, connect an ohmmeter between any good electrical ground point on the body sheet metal and the steering column upper flange. Scrape away paint in a non-visible spot if necessary for good contact. The resistance should be less than 1/2 ohm. Rotate the steering wheel back and forth and check flexible coupling for resistance of less than 1 ohm. If resistance higher than 3 ohms is noted, clean the horn brush contacts and the ground brush. A resistance of less than 1 ohm must be obtained before performing the remaining tests.
3. With an ohmmeter connected between the Light Blue-Black Hash wire (151) and ground, depress the set-speed switch. A reading of approximately 680 ohms should be indicated on the ohmmeter.
4. With an ohmmeter connected between the Light Blue-Black Hash wire (151) and ground, depress the coast switch. A reading of approximately 120 ohms should be indicated on the ohmmeter.

SPEED SENSOR TEST

Disconnect the 6-way connector (C-1006 on E-100—E-350 and C-717 on F-100—F-350, Bronco) at the amplifier assembly, (Figs. 5-7), and connect an ohmmeter between the wire connector terminals (Dark Green-White Stripe -830 and Black -57 on E-100—E-350 and Green -614 and Black -57 on F-100 through F-350 and Bronco) at the speed sensor end. A reading

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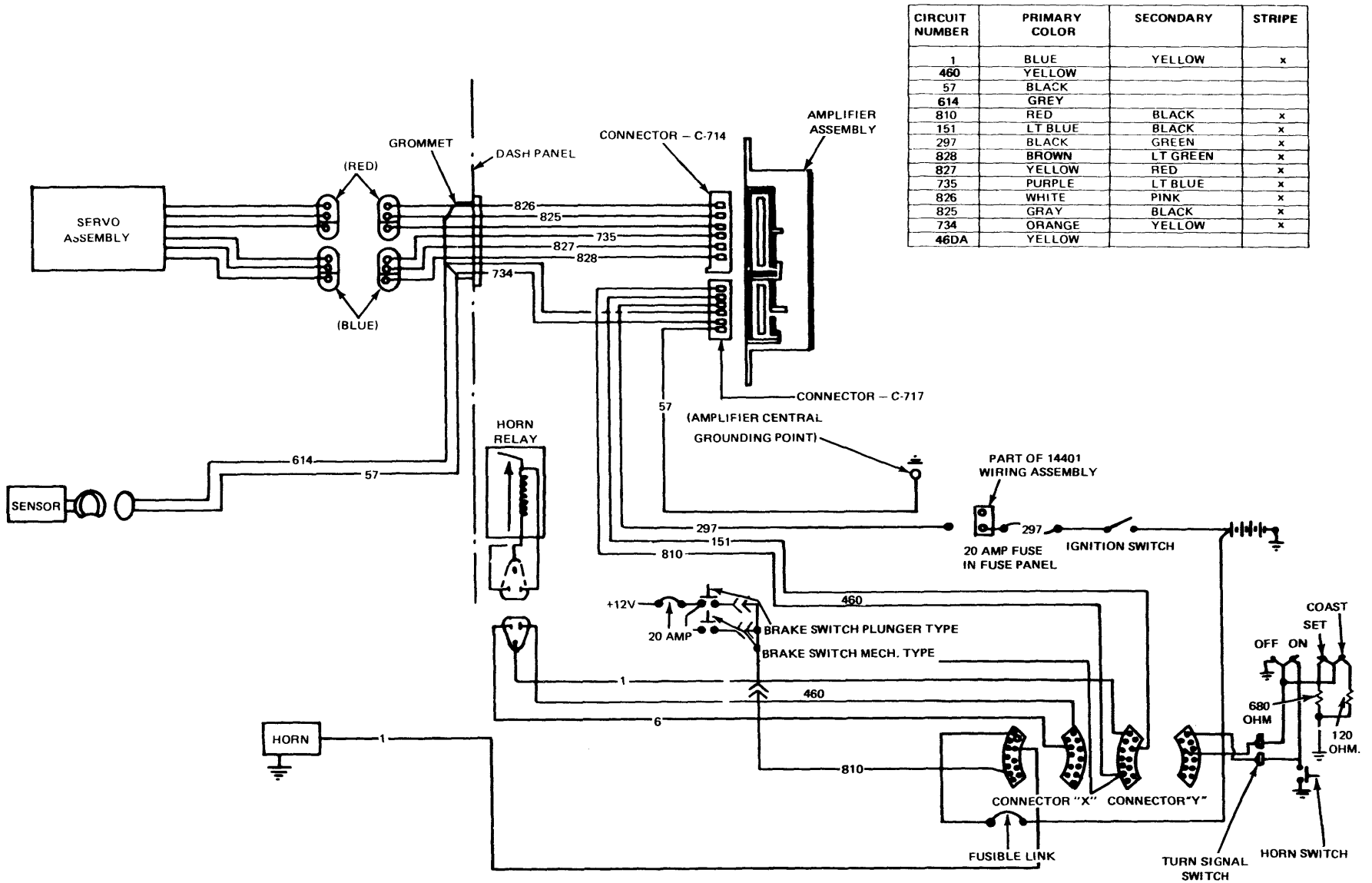


CIRCUIT NUMBER	PRIMARY COLOR	SECONDARY	STRIPE
1	BLUE	YELLOW	x
460	YELLOW		
57	BLACK		
830	DK GREEN	WHITE	x
810	RED	BLACK	x
151	LT BLUE	BLACK	x
297	BLACK	GREEN	x
828	BROWN	LT GREEN	x
827	YELLOW	RED	x
735	PURPLE	LT BLUE	x
826	WHITE	PINK	x
825	GRAY	BLACK	x
734	ORANGE	YELLOW	x
6	YELLOW	GREEN	x
37	BLACK	YELLOW	x

FIG. 5 Wiring Diagram—E-100—E-350

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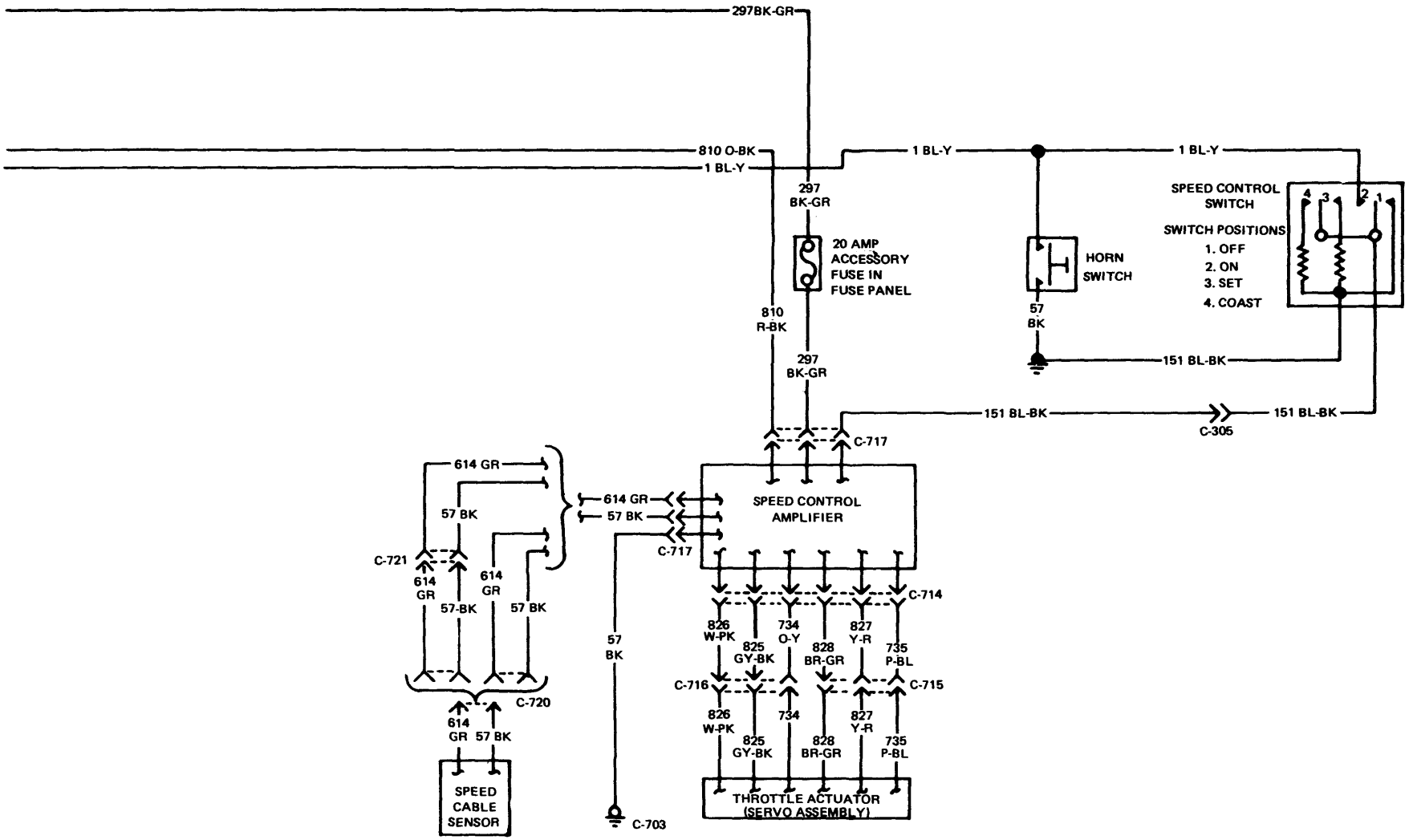
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CIRCUIT NUMBER	PRIMARY COLOR	SECONDARY	STRIPE
1	BLUE	YELLOW	x
460	YELLOW		
57	BLACK		
614	GREY		
810	RED	BLACK	x
151	LT BLUE	BLACK	x
297	BLACK	GREEN	x
828	BROWN	LT GREEN	x
827	YELLOW	RED	x
735	PURPLE	LT BLUE	x
826	WHITE	PINK	x
825	GRAY	BLACK	x
734	ORANGE	YELLOW	x
46DA	YELLOW		

FIG. 6 Wiring Diagram—F-100—F-350 and Bronco

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L2182-2E

FIG. 7 Main Wiring Diagram—F-100—F-350 and Bronco

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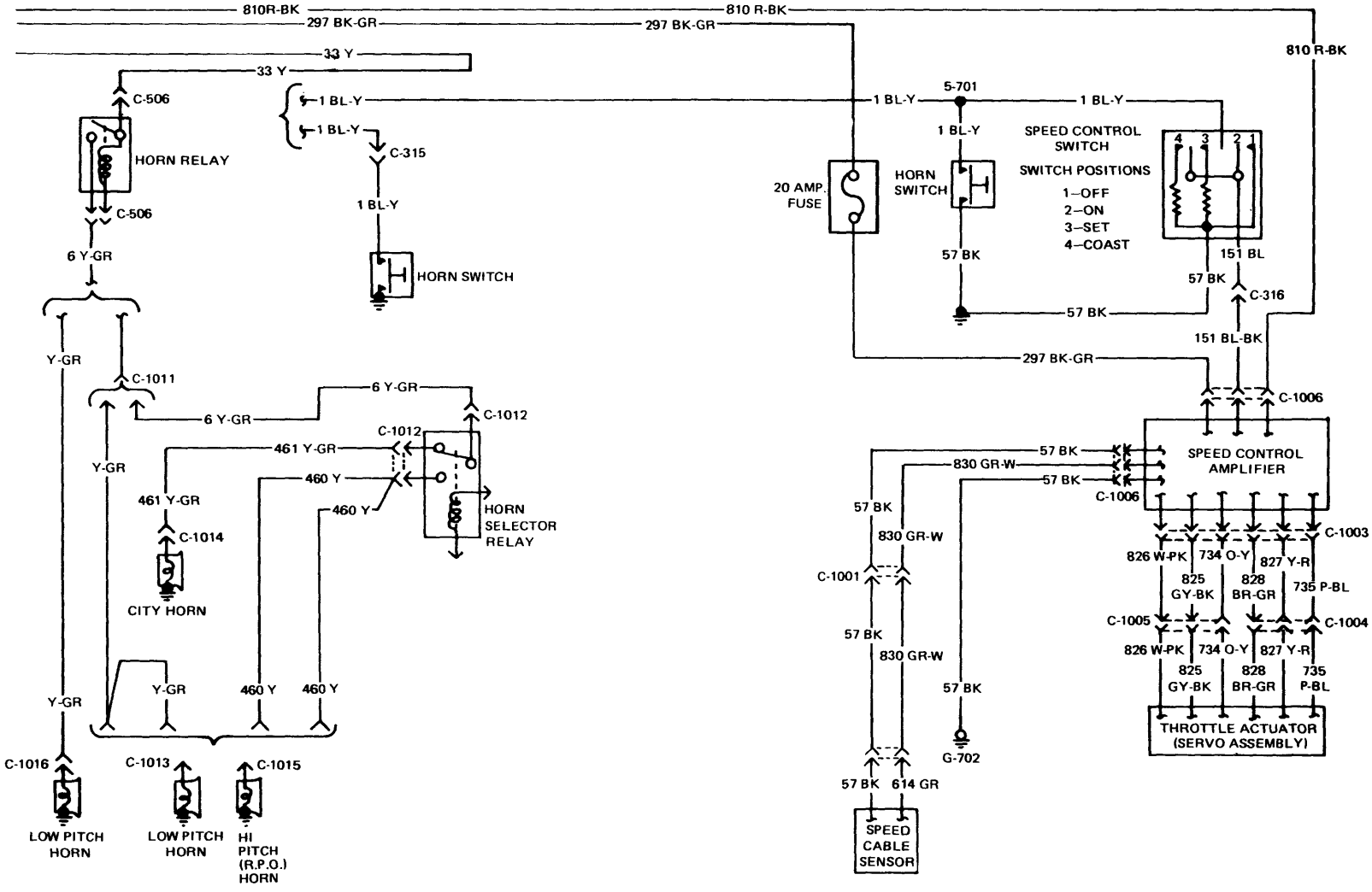


FIG. 8 Main Wiring Diagram—E-100—E-350

L2183-2C

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of approximately 40 ohms should be obtained. A reading of Zero ohms indicates a shorted coil and a maximum reading indicates an open coil. Replace the sensor in either case.

If the ohmmeter records 40 ohms and the speedometer operates properly within needle waver, the speed sensor is probably good. A speed sensor of known good quality can also be substituted in place of the existing sensor to check for proper operation.

SERVO ASSEMBLY TEST

Disconnect the ball chain from the carburetor (Figs. 9 and 10). Separate connector C-714 (F-100—F-350, Bronco or C-1003) (E-100—E-350) at the amplifier (Figs. 3-7). Connect an ohmmeter between the Orange-Yellow Hash wire 734 and Gray-Black Hash wire 825 at the 8-way connector. A resistance of approximately 85 ohms should be obtained. Connect the ohmmeter between the Orange-Yellow Hash 734 and White-Pink Hash wire 826. A resistance of approximately 85 ohms should be obtained. Reconnect the ball chain to the carburetor.

Start the engine, and with the servo disconnected from the amplifier, connect the Orange-Yellow Hash lead (wire 734) of the servo to the battery positive terminal. Connect the White-Pink Hash lead (wire 826) of the servo to ground, and momentarily touch the Gray-Black Hash lead (wire 825) of the servo to ground. The servo throttle actuator should tighten the bead chain and open the throttle. The throttle should hold in that position or slowly release the tension on the chain. When the White-Pink Hash wire is removed from ground, the servo should release the bead chain tension immediately. Replace the servo if it fails any part of the preceding test. If the Orange-Yellow Hash lead is shorted to either the White Pink Hash or Gray-Black Hash leads, it may be necessary to replace the amplifier.

AMPLIFIER TEST

Do not use a test lamp to perform the following tests as excessive current draw will damage electronic components inside the amplifier. **Use only a voltmeter of 5,000 ohm/volt rating or higher.**

ON CIRCUIT TEST

Turn on the ignition switch and connect a voltmeter between ground and the wire lead (151) (Light Blue-Black Hash) at the amplifier connector (C-717 on F-100—F-350, Bronco and C-1006 on E-100—E-350). The voltmeter should read 12 volts when the "ON" switch on the steering wheel is depressed and held. If voltage is not available check the horn relay circuit and control switch test. Release the "ON" button; 12 volts should remain at the blue wire indicating the "ON" circuit is engaged. If the voltage does not remain, check for ground on the amplifier, fuse and/or circuit breaker and/or hang in a known good amplifier and re-check for a good "ON" circuit.

OFF CIRCUIT TEST

With the ignition on and the voltmeter connected between ground and the Light Blue-Black Hash wire (151), depress the OFF switch on the steering wheel. Voltage on the blue wire should drop to zero indicating the "ON" circuit is de-energized. If the voltage does not drop to zero, perform the control switch test. If the switches check OK, hang in a known good amplifier and recheck the "OFF" circuit as above.

SET-ACCELERATE CIRCUIT TEST

With the ignition on and the voltmeter connected between ground and the Light Blue-Black Hash wire (151), depress the "ON" switch, then hold Set-Accel button on steering wheel. Voltmeter should indicate approximately 10 volts. Rotate the steering wheel back and forth and watch the voltmeter for fluctuations. If the voltage varies more than 0.5 volt, perform the control switch test.

COAST CIRCUIT TEST

With the ignition on and the voltmeter connected between ground and the Light Blue-Black Hash wire (151), depress the "ON" switch, then hold the coast down button on steering wheel. Voltmeter should indicate approximately 6 volts. If all the functions check "OK", perform the servo check and sensor test and hang in a known good amplifier.

Do not substitute a new amplifier for the old amplifier until the actuator coils have been tested. Refer to the Servo Assembly (Throttle Actuator Test).

ROAD TEST

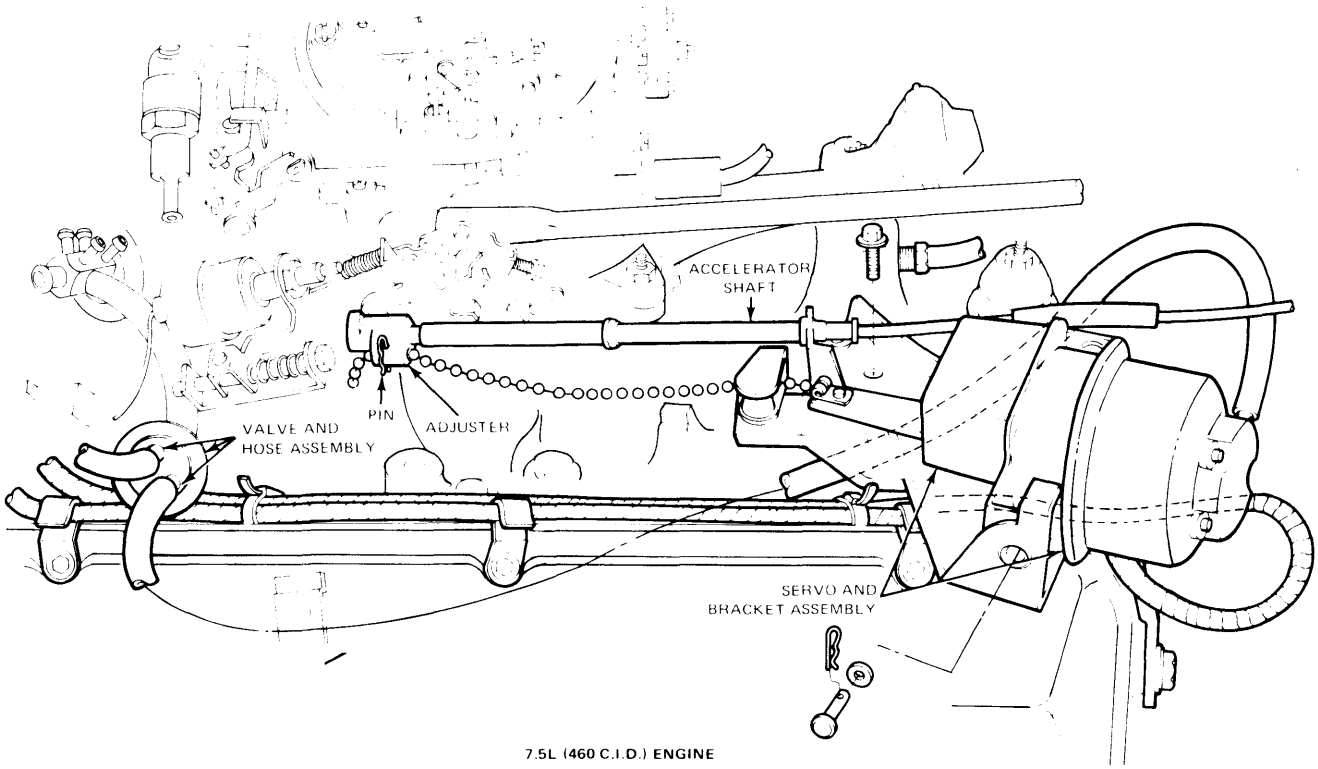
1. Start the engine.
2. Shift the transmission to drive.
3. Turn on the speed control.

   NOTE: IF ANY TIME DURING THE FOLLOWING STEPS THE SYSTEM SHOULD APPEAR TO GO OUT OF CONTROL AND OVERSPEED, BE PREPARED TO SHIFT THE TRANSMISSION INTO NEUTRAL AND TURN THE SYSTEM OFF AT ONCE WITH THE "OFF" SWITCH OR THE IGNITION SWITCH.
4. Accelerate and hold at 35 mph.
5. Press and release the set-speed button. Hold foot pressure very lightly on accelerator pedal. Normally the speed will continue at 35 mph.
6. Press the "OFF" button (Figs. 1 and 2). The engine should decelerate.
7. Press "ON" button, accelerate and hold the speed at 35 mph.
8. Press the hold and set-speed button. Slowly remove the foot from the accelerator. The engine speed should gradually increase.
9. When the speed reaches 50 mph, release the set-speed button.
10. Press the "COAST" button and hold. The engine should decelerate and slow to 35 mph.
11. Release the "COAST" button. Speed should set in.
12. Press the brake pedal. The system should shut off causing the engine to idle.

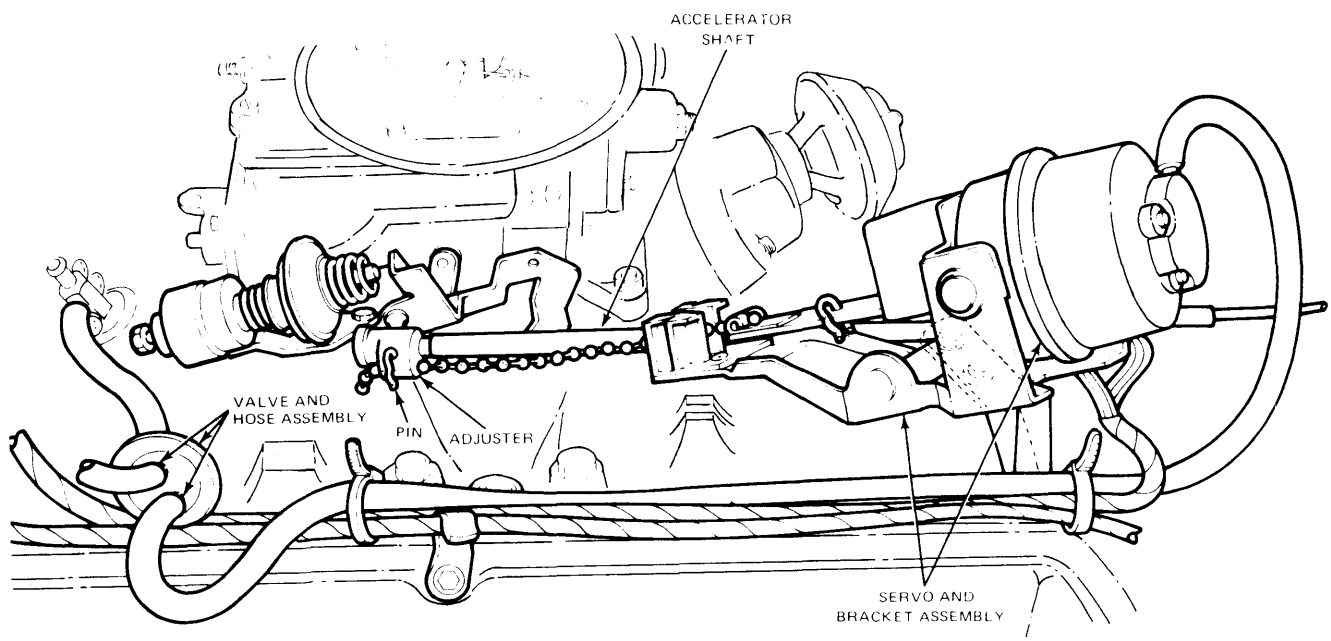
When performing these tests, keep the vehicle speeds within reasonably low limits. If the system does

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7.5L (460 C.I.D.) ENGINE



5.8L AND 6.6L (351 and 400 C.I.D.) ENGINE

L2180-2C

FIG. 9 Servo and Bracket Installation—E-100—E-350

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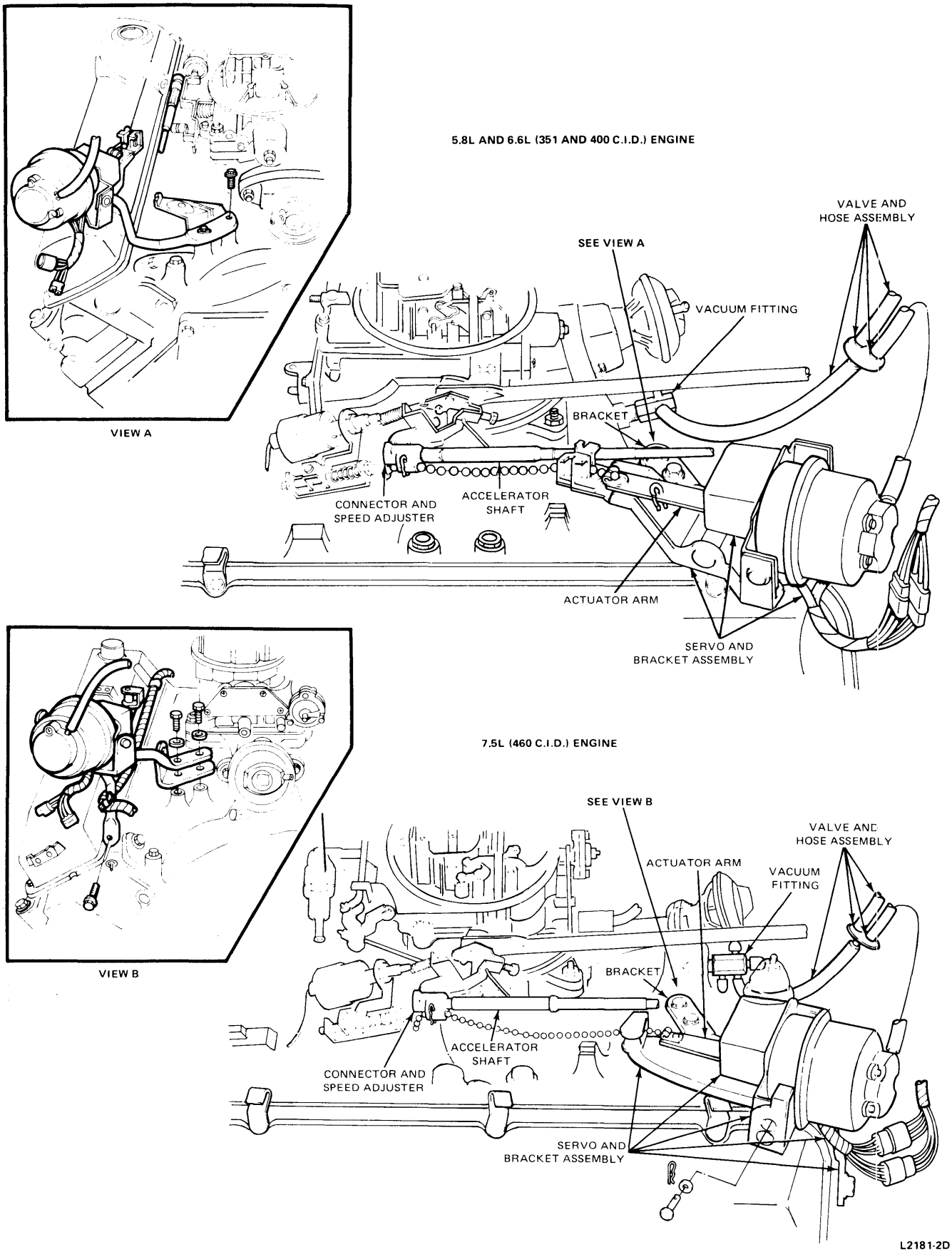


FIG. 10 Servo and Bracket Installation—F-100—F-350 and Bronco

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not perform as normally expected, make note of the malfunction.

SUPPLY CIRCUIT

Blow the horn. This test will determine that there is power in the horn circuit to the steering wheel.

BRAKE STOPLIGHT SWITCH AND CIRCUIT TEST

To be performed when brake application will not disconnect the speed control.

1. Check for stop lamp operation with a maximum brake pedal effort of 6 lbs. If more than 6 lbs. effort is required, check the brake pedal actuation and stop lamp switch. Repair or replace as required.
2. If stop lamps work properly, check the battery voltage on the Black-Green stripe Hash lead 297 at the amplifier connector C-1006 (E-100—E-350) or C-717 (F-100—F-350 and Bronco) (Figs. 4-7). Depress the brake pedal until the stop-lamps are lit. Check voltage on the Red-Black stripe Hash lead 810 at the same connector. The difference between the two voltage readings must not exceed 1.5 volts. The high resistance must be found and corrected in the stop lamp circuit.
3. If the stop lamps do not work, the stop lamp switch, supply circuit, or bulbs must be checked.

HORN RELAY CIRCUIT TEST—E-100—E-350 AND F-100-350

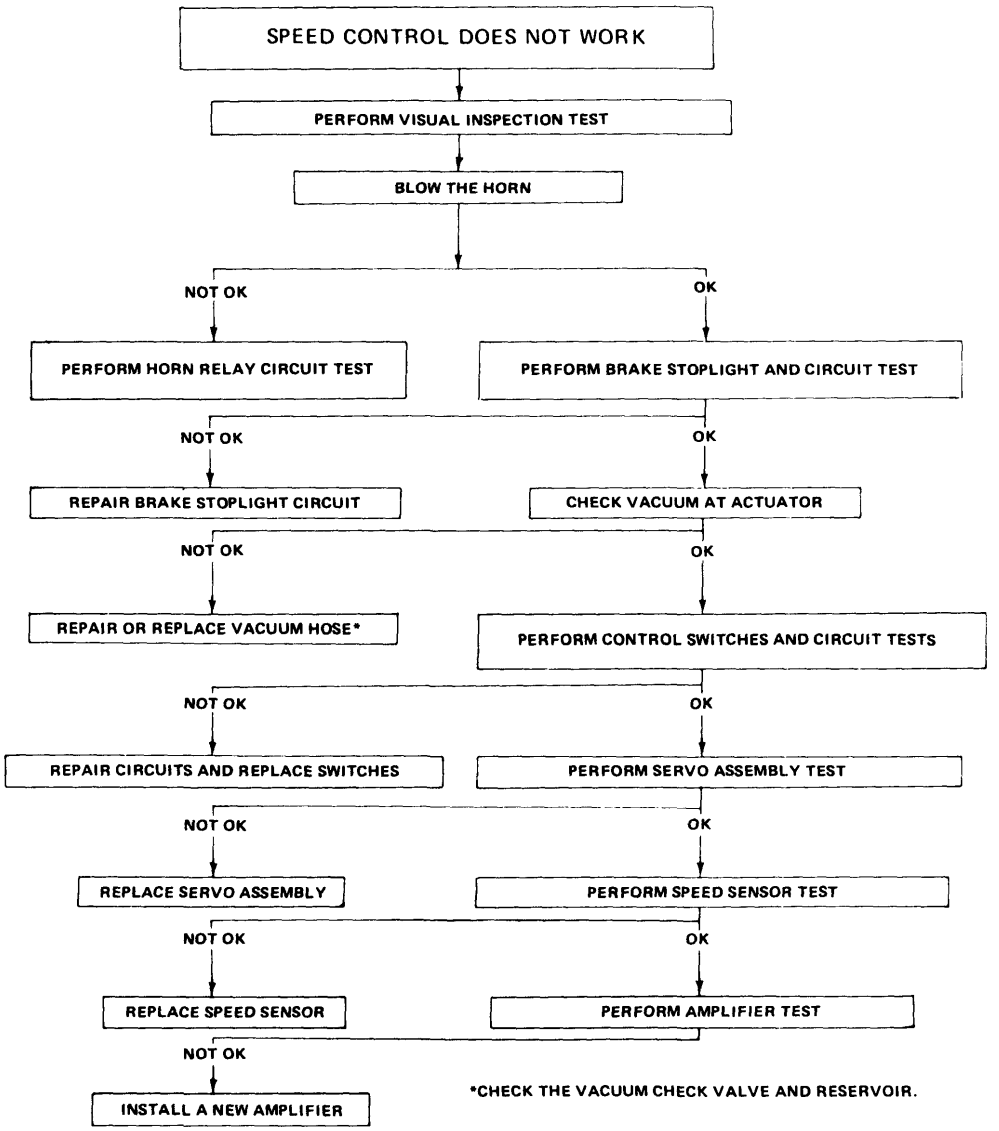
1. Locate horn relay wire connector marked "X" and "Y" on the wiring diagram (Figs. 5 and 6).
2. Using the connector "X" locate the Blue-Yellow stripe wire 6. With a voltmeter, measure for battery voltage (approximately plus 12 volts) on the male side of the connector.
3. Using the connector "Y", locate the Blue-Yellow stripe wire. Connect a voltmeter to the female side of the connector and check for approximately plus 12 volts.
4. With the voltmeter still connected to the female lead in Step 3, depress the horn switch. The voltmeter should read zero.
5. If the above checks prove satisfactory, connect the voltmeter to the male side of the Yellow-Green stripe wire in the connector "X". Depress the horn switch and read the meter. The reading should be 12 volts and the horn should operate.
6. If the horn does not operate, the horn failure is in the circuitry between the connector and the horn and should be repaired. If intermittent horn blow is encountered when a door is closed or when going over road bumps, tap the side of the horn relay. If the horn blows when the relay is tapped, the horn relay should be replaced.

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DIAGNOSIS GUIDES

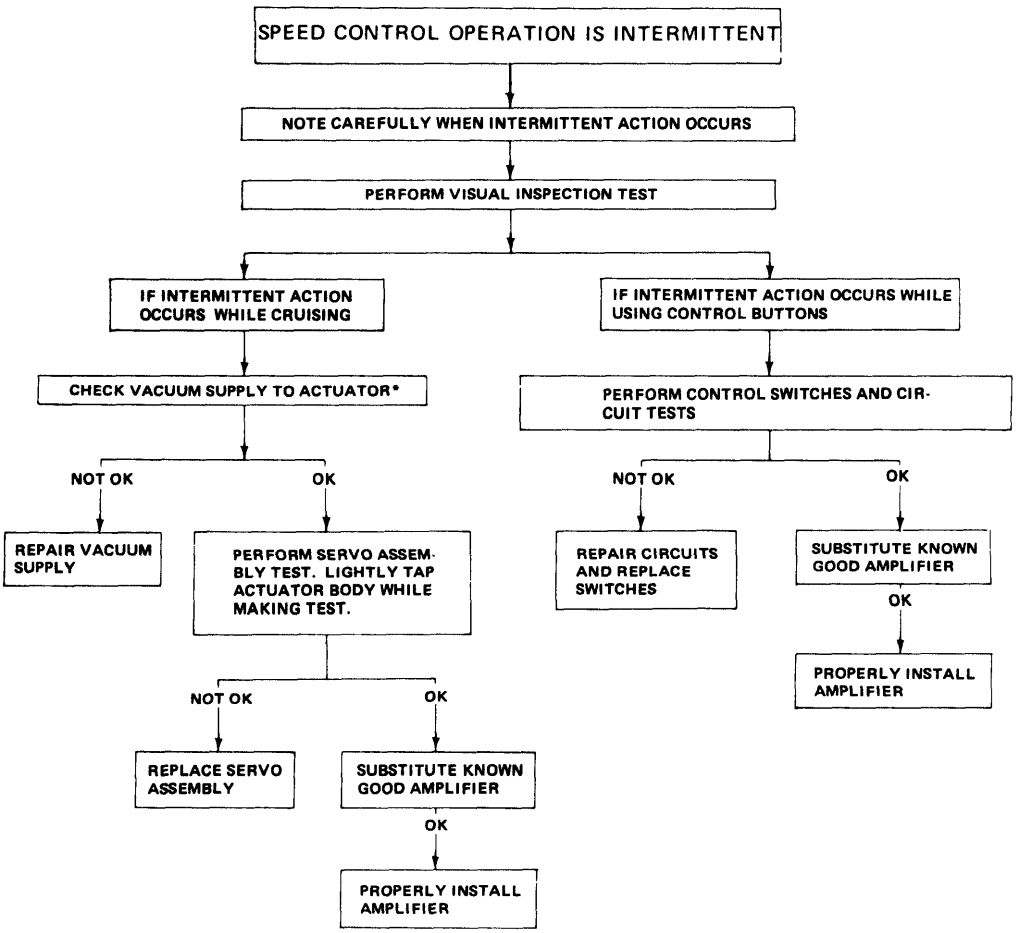
The following speed control system diagnosis guides can be used to determine and isolate speed control problems.



CL2204-2A

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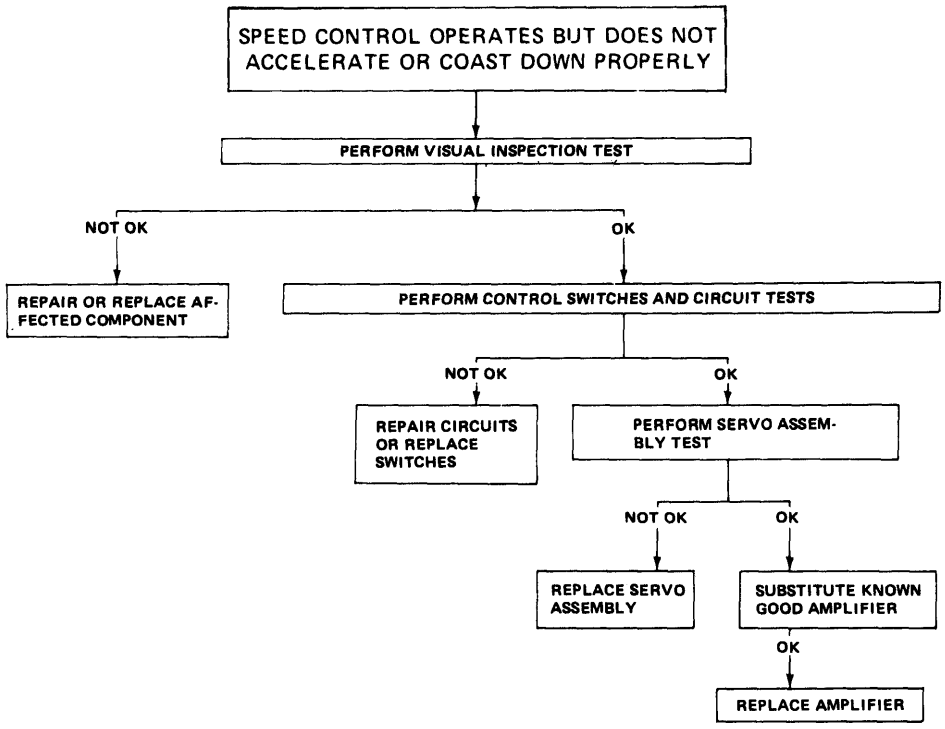


*CHECK THE VACUUM CHECK VALVE AND RESERVE TANK.

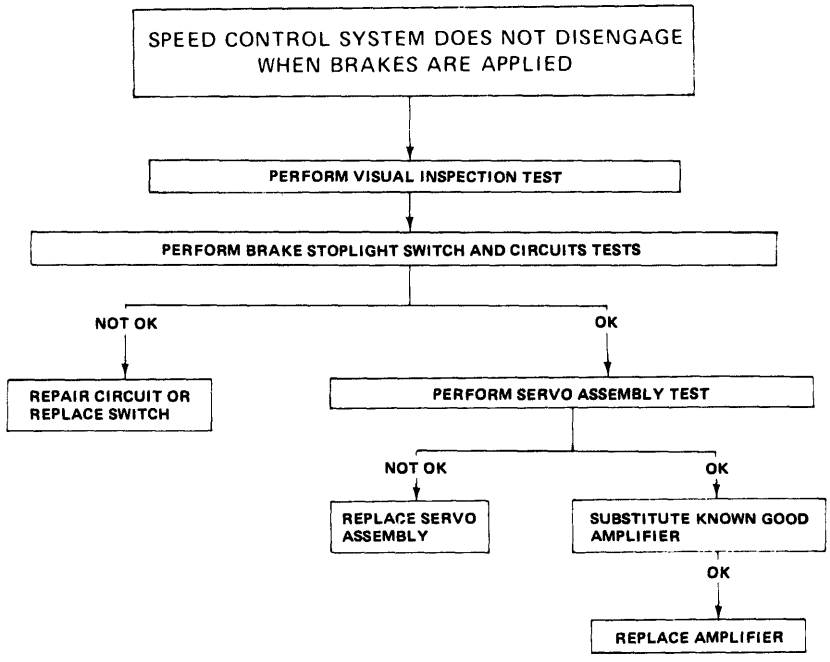
CL2204-2A1

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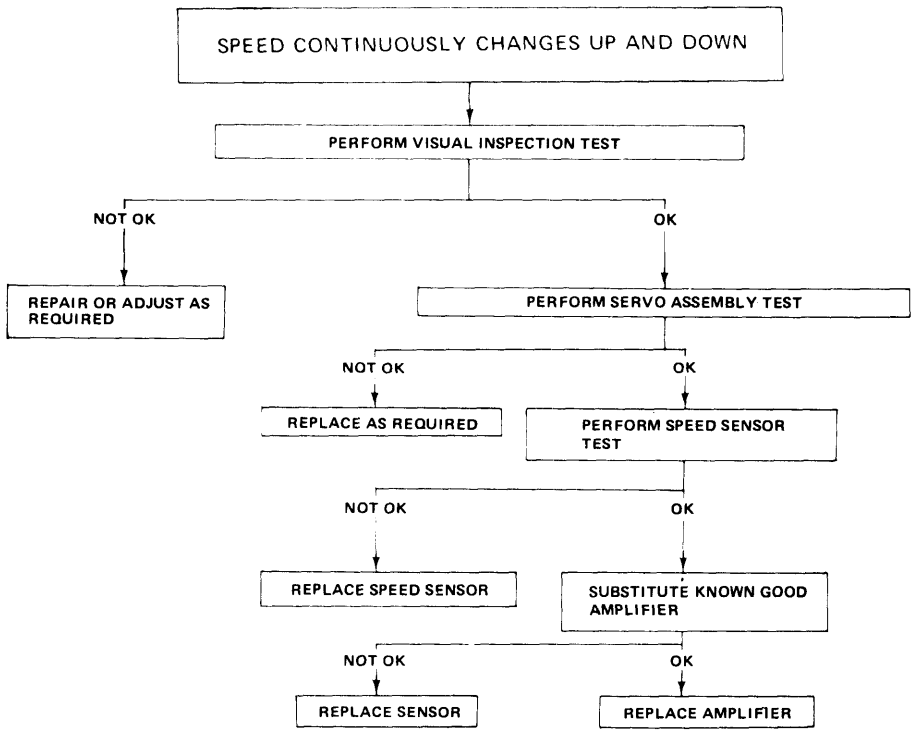
CL2204-2A2



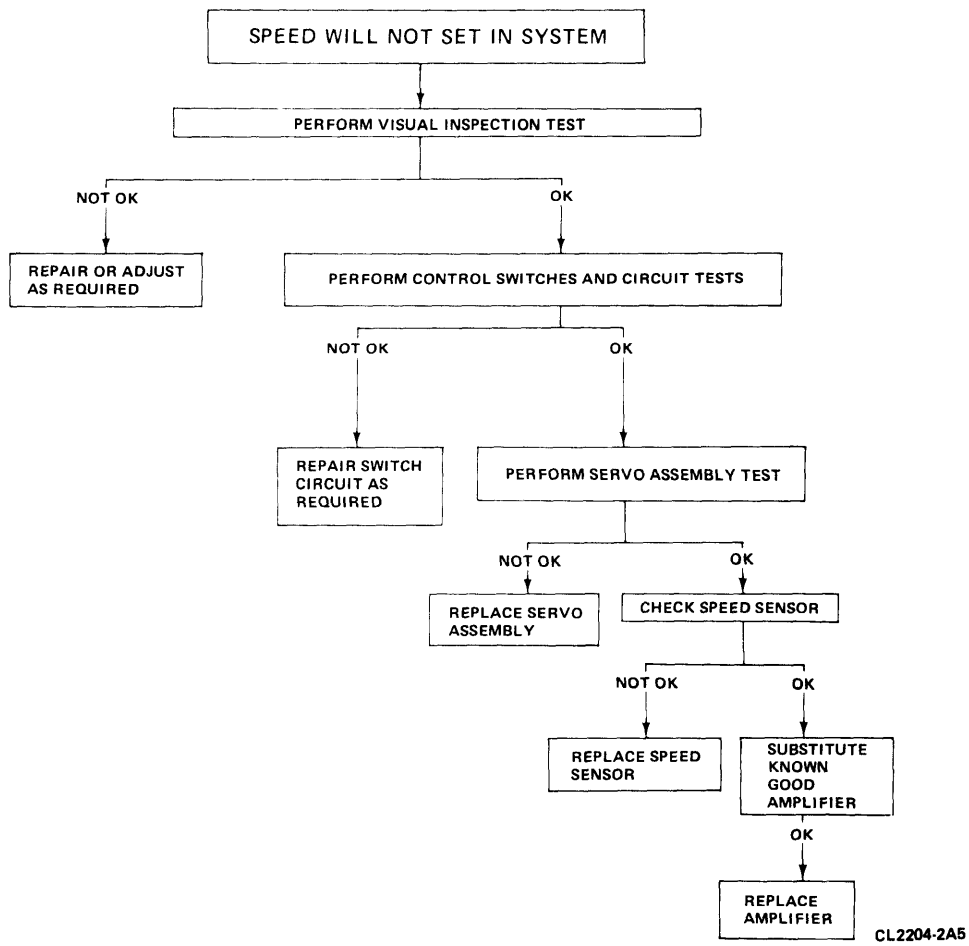
CL2204-2A3

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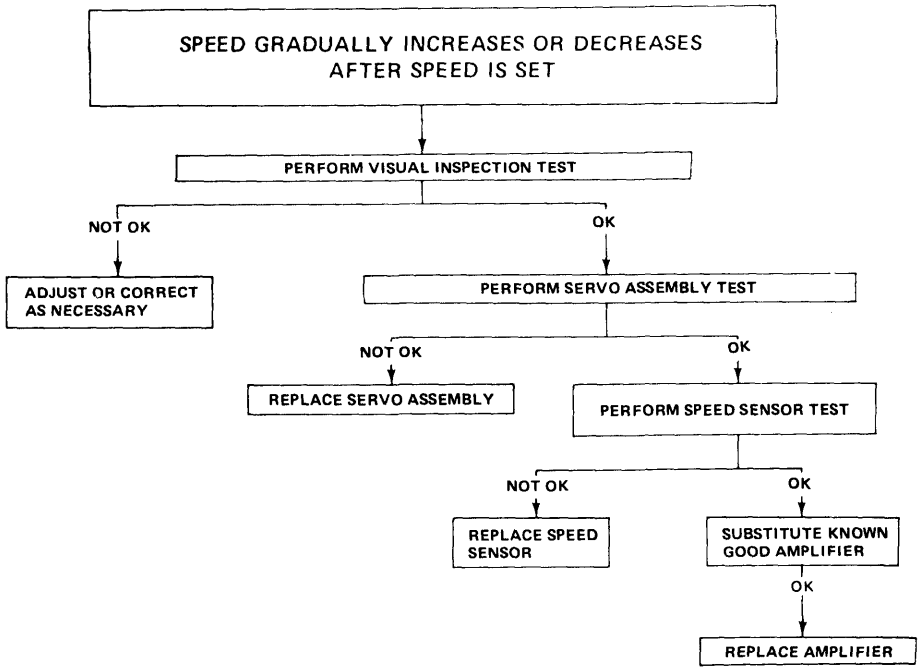
CL2204-2A4



CL2204-2A5

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CL2204-2A6

ADJUSTMENTS

LINKAGE ADJUSTMENT E-100—E-350, F-100-350 AND BRONCO

Adjust the bead chain to obtain 0.06-0.25 inch actuator arm free travel when the engine is at hot idle (Figs. 9 and 10). The adjustment should be made to take as much slack out of the bead chain as possible **without restricting the carburetor lever from returning to idle.** The tighter the bead chain the better performance on the speed control system. Cut off chain in excess of (4) beads. On vehicles equipped with a solenoid anti-diesel valve, perform this adjustment with the ignition switch in the OFF position.

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REMOVAL AND INSTALLATION

CONTROL SWITCHES

Removal

1. Remove the two retaining screws holding the horn foam pad assembly to the steering wheel (Fig. 1).
2. Lift up the pad assembly to expose the horn and speed control wire terminals. Disconnect and remove the pad assembly.
3. The speed control switches may be removed by disengaging the 2-way wire connector at the base. Remove (4) push-on fasteners and unsnap the switches out of the plastic retainer.

Installation

1. Snap the switch into the plastic bezel (Fig. 1) and switch assembly retainer portion of the trim pad running the wires to the center hole as removed.
2. Secure (4) push-on fasteners to the switch retainer, install the 2-way wire connectors and snap into base.
3. Attach the wires to the steering wheel hub and the horn foam pad to the steering wheel with the two retaining screws (Fig. 2).

SPEED SENSOR

Removal

1. Separate the electrical connector leading to the amplifier assembly.
2. Disconnect the upper and lower speedometer cables at the speed sensor (Fig. 11).
3. Remove the speed sensor.

Installation

1. Install the speed sensor.
2. Install O-ring seals on sensor.
3. Connect the upper and lower speedometer cables.
4. Connect the electrical connector leading to the amplifier assembly.

AMPLIFIER ASSEMBLY

Removal

1. Disconnect the connectors at the amplifier (Fig. 3).
2. Remove the attaching screws or nuts that fasten the amplifier bracket to the vehicle.
3. Remove the amplifier assembly and mounting bracket from the vehicle.
4. Remove the amplifier assembly from the mounting bracket.

Installation

1. Install the amplifier on the mounting bracket.
2. Connect the connectors to the amplifier (Fig. 3).
3. Attach the amplifier assembly and mounting bracket to the vehicle with the attaching screws or nuts.
4. Test the system for proper operation.

SERVO ASSEMBLY (THROTTLE ACTUATOR)

Removal

1. Disconnect the wiring harness connectors under the hood at the servo assembly (Figs. 9 and 10).

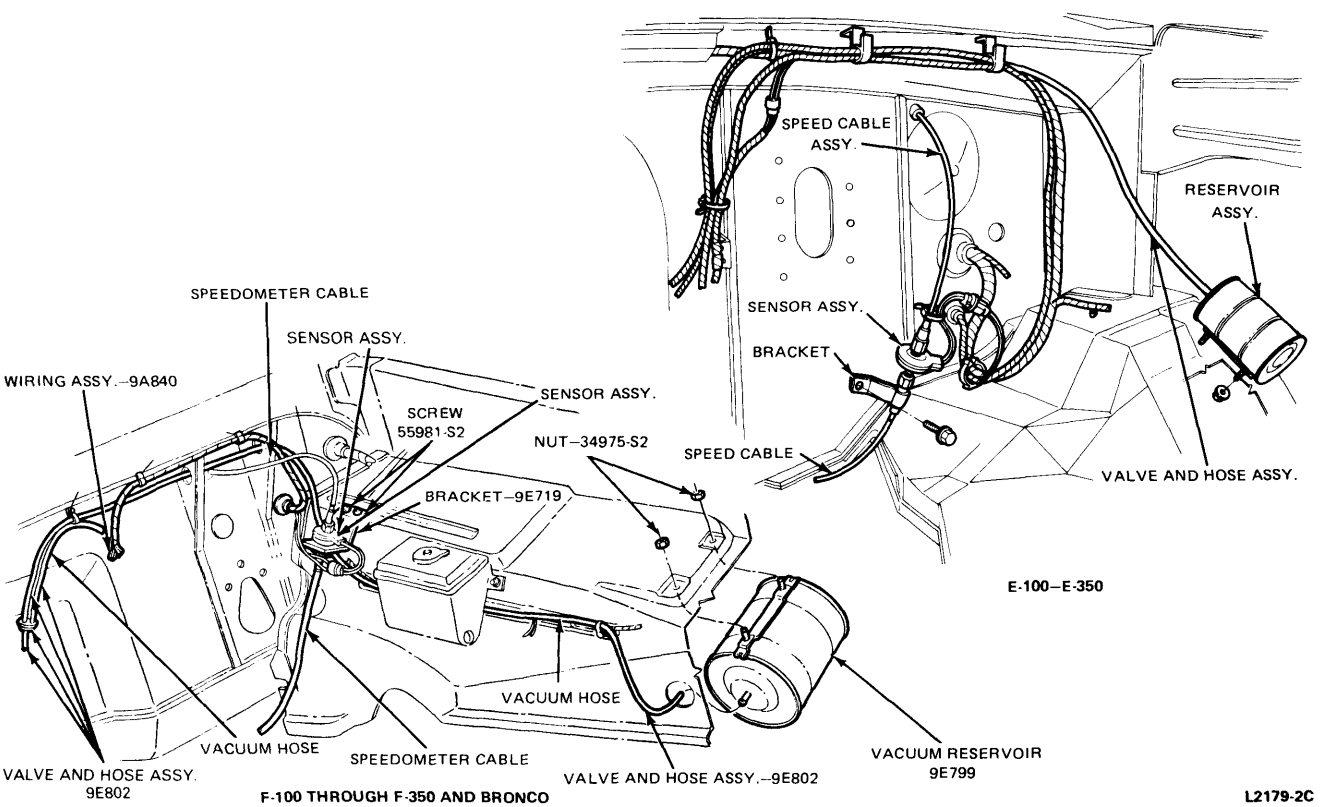


FIG. 11 Speed Sensor and Vacuum Reservoir Installation—Engine Compartment

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2. Disconnect the ball chain and disconnect the vacuum hose at the servo assembly.
3. Remove the pins retaining the servo assembly to the mounting bracket and remove the servo assembly.

Installation

1. Position the servo assembly to the bracket and install the retaining pins. Connect the vacuum hose.
2. Connect the ball chain at the connector (refer to Adjustments).
3. Connect the wiring harness connectors under the hood at the servo assembly.

VACUUM RESERVOIR

Removal

1. Under the hood, locate the vacuum line to the vacuum reservoir and disconnect the line at the vacuum reservoir (Fig. 11).
2. Remove the two nuts holding the vacuum reservoir to the fender apron then, remove the reservoir. Care should be taken not to damage the vacuum line during reservoir removal.

Installation

1. Install the reservoir to the fender apron and attach the two retaining nuts securely.
2. Install the vacuum hose to the reservoir.

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SEATS

GROUP 41 (70000)

PART TITLE	PART NO.	PART TITLE	PART NO.
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Folding Rear Seats	41-20	Seat Tracks — Manual	41-01
Seat and Shoulder Belts	41-50	Seat Trim	41-60

Seat Tracks — Manual

PART 41-01

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Seat Back — Angle		Driver's Seat	
Captains Chairs	01-1	Bronco	01-4
Tie Rod		Fold-Down Front Passenger Seat	
F-100 — F-350 and Bronco	01-1	E-100 — E-350	01-5
REMOVAL AND INSTALLATION		Passenger's Seat	
Bench Type		Bronco	01-4
F-100 — F-350 and Bronco	01-4	Seat Support — Captains Chair	
Bucket Type		E-100 — E-350 and Club Wagon	01-4
E-100 — E-350	01-4	SPECIFICATIONS	01-6

ADJUSTMENTS

TIE ROD

F-100—F-350 AND BRONCO

Tie rod adjustment will affect only the right hand side of the seat (Figs. 1 and 2). In case the latch retaining the track fails to release, turn the adjusting turnbuckle, clockwise enough to shorten the tie rod travel and release the track latch. If the latch fails to secure the seat travel, turn the adjusting turnbuckle counterclockwise enough to allow the latch to snap into locking position. The turn buckle should be adjusted to its maximum counterclockwise position and still enable the latch to release.

SEAT BACK—ANGLE

CAPTAINS CHAIR

The captains chair can be faced either forward or rearward as the occupant desires. However, **the chair is intended to be locked in the forward facing direction when the vehicle is in motion.**

To rotate the seat, lift the lock handle on the right side of the seat pedestal (Fig. 3). The passenger seat

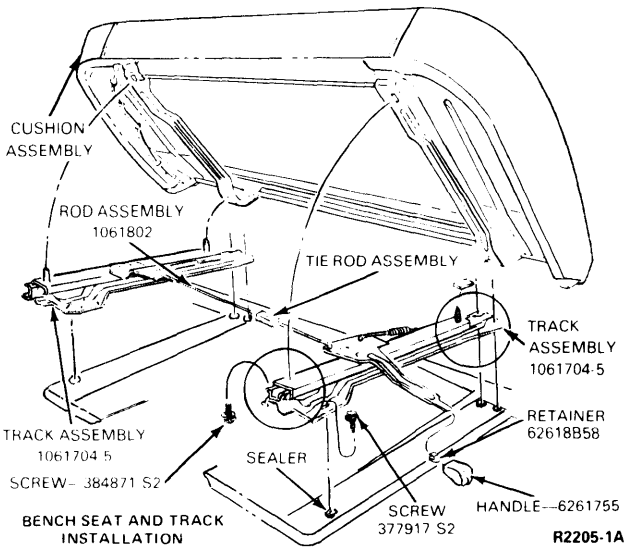


FIG. 1 Bench Seat and Track Installation—F-Series

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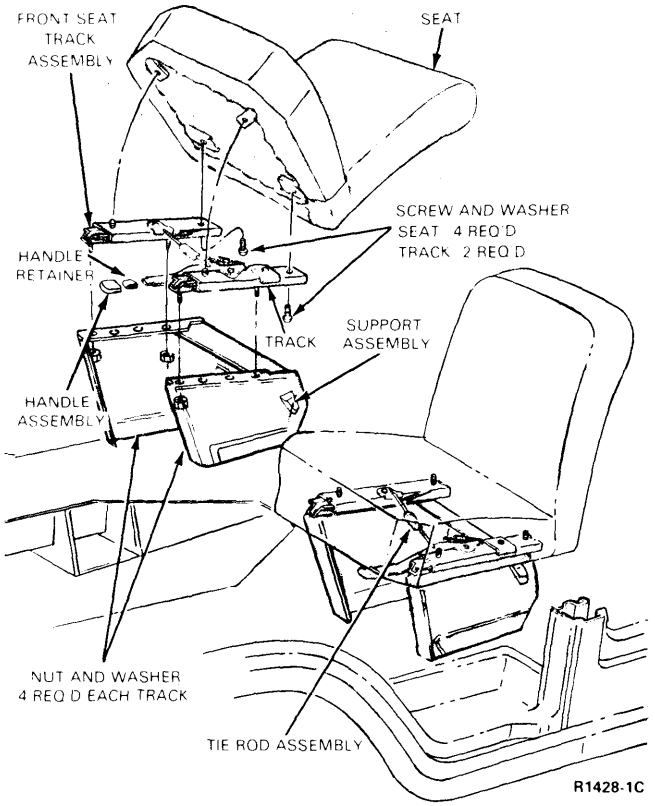


FIG. 2 Bucket Seat and Track Installation—E-100—E-350

automatically latches in either the forward or rearward facing positions. The drivers seat can be latched in the forward position only. The seat may be more firmly locked in the latched position, against slight movements, by rotating the lock handle downward. An alternate seat support for captains chairs is shown in Fig. 4. To rotate, actuate handle rearward to unlatch the seat and rotate. Actuate handle forward to latch mechanism.

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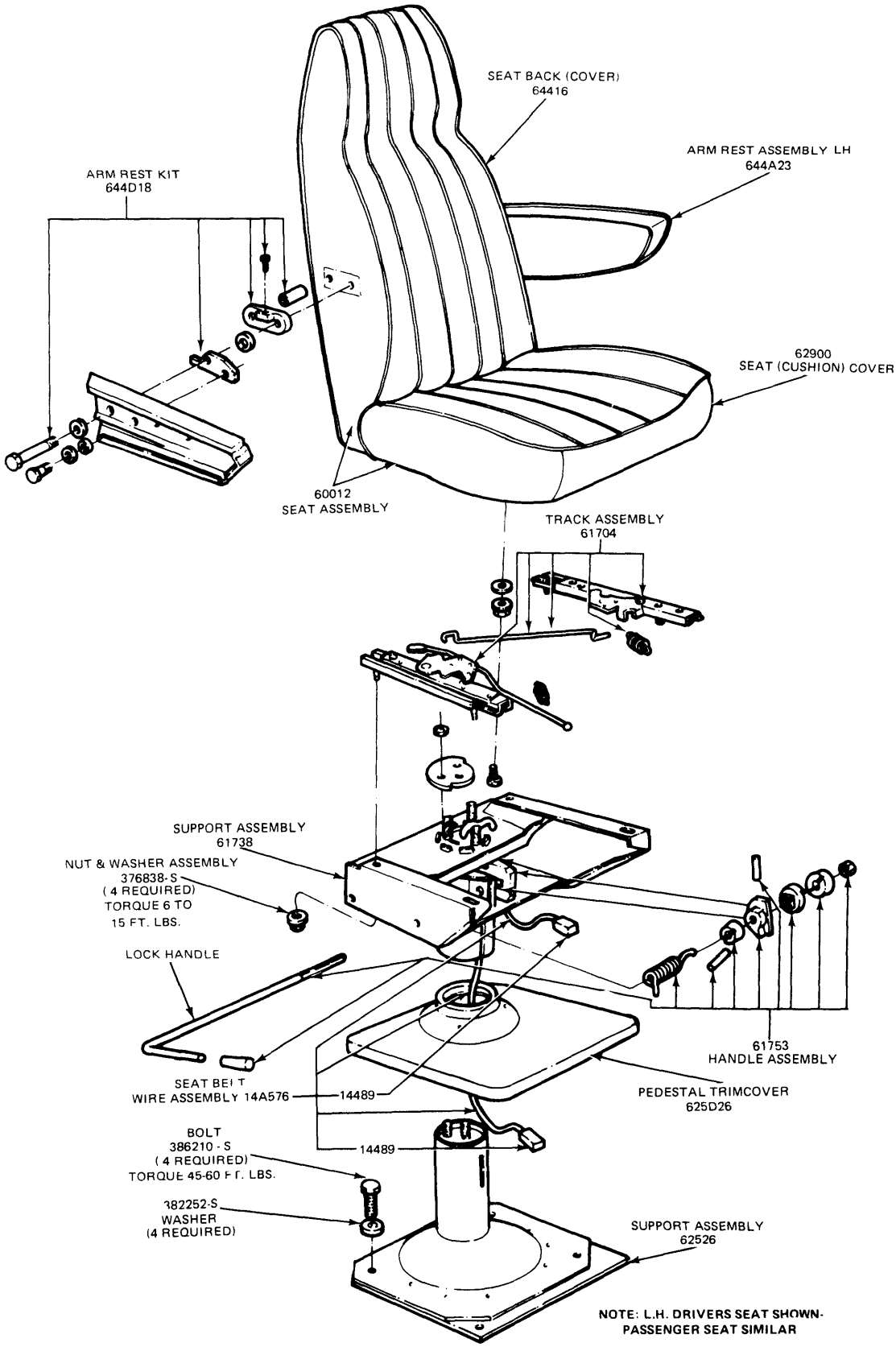


FIG. 3 Seat Support Installation Captains Chair—E-100—E-350 and Club Wagon

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REMOVAL AND INSTALLATION

SEAT TRACK—MANUAL BENCH TYPE

F-100-350 AND BRONCO

Removal

1. Remove the seat track-to-floor pan retaining screw and washer assemblies (three on each side) and lift the seat and track assembly out of the vehicle (Fig. 1).
2. Disconnect the seat track latch tie rod from the latches on the seat tracks.
3. Remove the seat track-to-seat cushion (screw and washers) and remove the tracks from the cushion.

Installation

1. Lubricate the seat track assemblies. Assemble the seat tracks to the cushion assembly with the anti-squeak pads, (and spacers, if so equipped), fitting over the studs between the track and cushion (Fig. 1). Install the track-to-cushion screw and washers and tighten to specifications in this Part.
2. Connect the tie rod to the latch on each seat track.
3. Lift the seat and track assembly into the cab and secure it to the floor pan with the retaining screw and washer assemblies. Tighten the screws to specifications in this Part.

SEAT TRACK—BUCKET TYPE

E-100—E-350

Removal

This procedure applies to both right and left front seats.

1. Remove the seat track-to-support nuts and lift the seat and track assembly from its support (Fig. 2).
2. If either seat or track is being replaced, remove the track-to-seat screws and separate the seat from the track.
3. If only the seat is being replaced, proceed to step 1, under Installation. If only the track is being replaced, loosen the turnbuckle and detach the tie rod from the bracket on the right track and the release lever on the left track. Remove the handle assembly and retainer from the lever. Remove the small spring from each track. Transfer all these parts to the replacement track.

Installation

1. Position the track assembly to the seat and secure it with the attaching screws. Tighten to specifications in this Part.
2. Position the seat and track assembly on the support assembly and secure it with the attaching nuts and washers. Tighten to specifications.

DRIVER'S SEAT

BRONCO

Removal

Refer to Fig. 4.

1. Remove seat track-to-floor screws and lift the seat and track assembly from vehicle.
2. If either seat or track is being replaced, remove track-to-seat screws and separate seat from track.
3. If only seat is being replaced, proceed to step 1 under installation. If only track is being replaced, loosen turnbuckle and detach left track.
4. Remove handle assembly and retainer from assembly and retainer from lever. Remove spring from each track. Transfer all these parts to replacement track.

Installation

1. Position the track assembly to the seat and secure with attaching screws. Tighten to specification in this part.
2. Position seat and track assembly on the floor and secure with screws and washers, putting sealer under track assembly (Fig. 1).

PASSENGER'S SEAT

BRONCO

Removal

Refer to Fig. 1.

1. Release latch and move seat forward.
2. Remove screws and washers from support assembly. Remove support assembly and seat from vehicle.
3. Remove seat from support assembly.
4. Replace seat or support assembly.

Installation

1. Position seat on support assembly and secure with attaching screws. Tighten to specification.
2. Position seat and track assembly on the floor and secure with screws and washers, putting sealer under track assembly (Fig. 1). Tighten to specifications.
3. Adjust striker assembly by loosening two bolts and sliding striker assembly to hold latch securely.
4. Tighten striker assembly bolts to sepcifications.

SEAT SUPPORT—CAPTAINS CHAIR

E-100—E-350 AND CLUB WAGON

Removal

1. Slide the seat assembly rearward and remove two bolts and spacers attaching the rear of the seat to the seat track, (Figs. 3 and 5).
2. Slide the seat forward and remove two bolts and spacers attaching the front of the seat to the track. Then, lift the seat assembly from the track.
3. Remove three screws attaching the support base trim cover and raise the cover.
4. Remove four bolts and washers attaching the support to the floor pan, and remove the support.

Installation

1. Position the seat support to the floor pan and install the attaching bolts and washers. Tighten the bolts to 45-60 ft-lb torque.
2. Slide the base trim cover down over the base and install the attaching screws.

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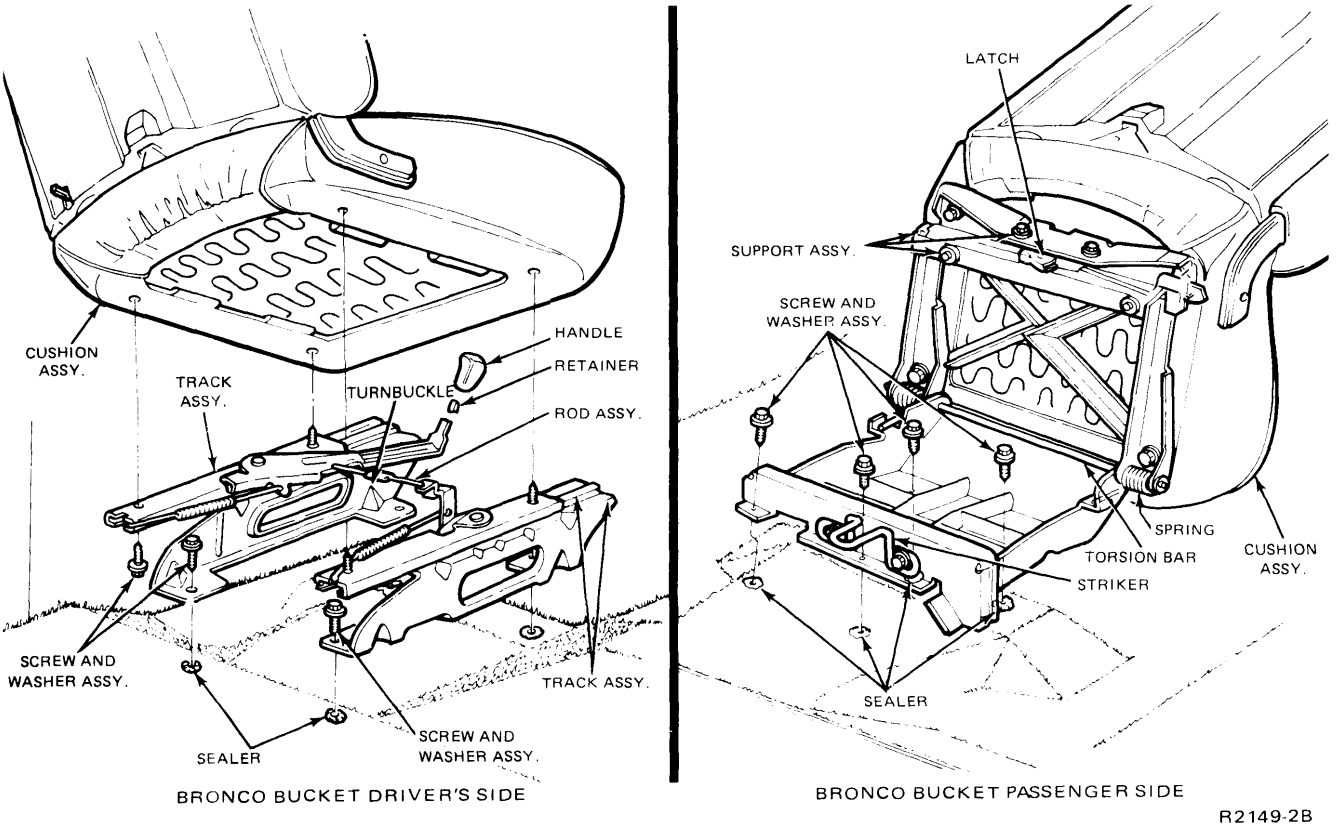


FIG. 4 Bronco Passenger Side and Driver's Side Seat Installation

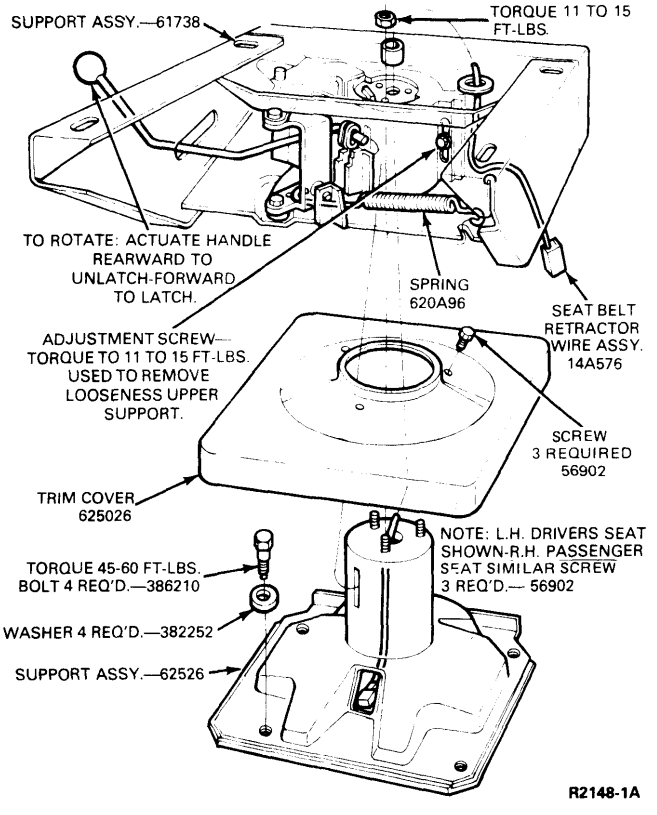


FIG. 5 Alternate Seat Support-Captains Chair—E-100—E-350 and Club Wagon

3. Position the seat assembly on the seat track and install the spacers and retaining bolts. Tighten the bolts to 6-15 ft-lb.

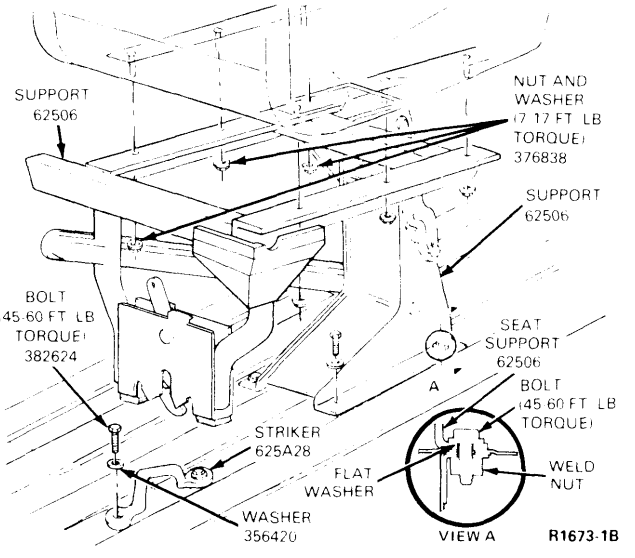


FIG. 6 Fold-Down Front Passenger Seat—E-100—E-350

FOLD-DOWN FRONT PASSENGER SEAT

E-100—E-350

The fold-down seat is attached to the support assembly with six nuts, tighten to 7-17 ft-lb, (Figs. 4, 5 and 6). The support assembly is attached to the floor pan with three screws and washers. The rear latch striker is attached to the floor pan with two screws and washers. Tighten all bolts to 45-60 ft-lb.

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SPECIFICATIONS

SEAT TRACK — MANUAL — TORQUE FT-LBS

	Seat Track-to-Cushion				Seat Track-to-Floor Plan		
Vehicle	Bench	Bucket	Folding	Captains	Bench	Bucket	Folding and Captains
Econoline	—	7-17	6-11	6-15	—	7-17	45-60
F-Series & Bronco	12-20	—	—	—	18-32	—	—

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Conventional Rear Seats

PART 41-14

APPLIES TO E-100 — E-350 AND F-SERIES CREW CAB

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REMOVAL AND INSTALLATION	
Seat Cushion and Back Assembly	
E-100 — E-350	14-1
REMOVAL AND INSTALLATION (Cont'd)	
F-Series Crew Cab	14-1

REMOVAL AND INSTALLATION

SEAT CUSHION AND BACK ASSEMBLY

E-100—E-350

The rear seat and cushion assemblies are attached to the floor pan as shown in Fig. 1. When installing the seat assembly to the floor, tighten the attaching bolts to 45-60 ft-lb torque.

Also optional with E-100—E-350 is rear seat quick floor disconnects (Fig. 2). Remove and install as shown in Fig. 2. Keep striker area free of foreign objects and never attempt to adjust the seat latch while the vehicle is moving. After adjusting, make certain latch rods and handles are latched securely to the strikers.

F-SERIES CREW CAB

The rear seat and track assembly is attached to the floor pan with four bolts on each side (Fig. 3). When installing the seat and track assembly, apply sealer around the bolt holes between the track support and the floor pan. Tighten the eight attaching bolts to 18-32 ft-lb torque.

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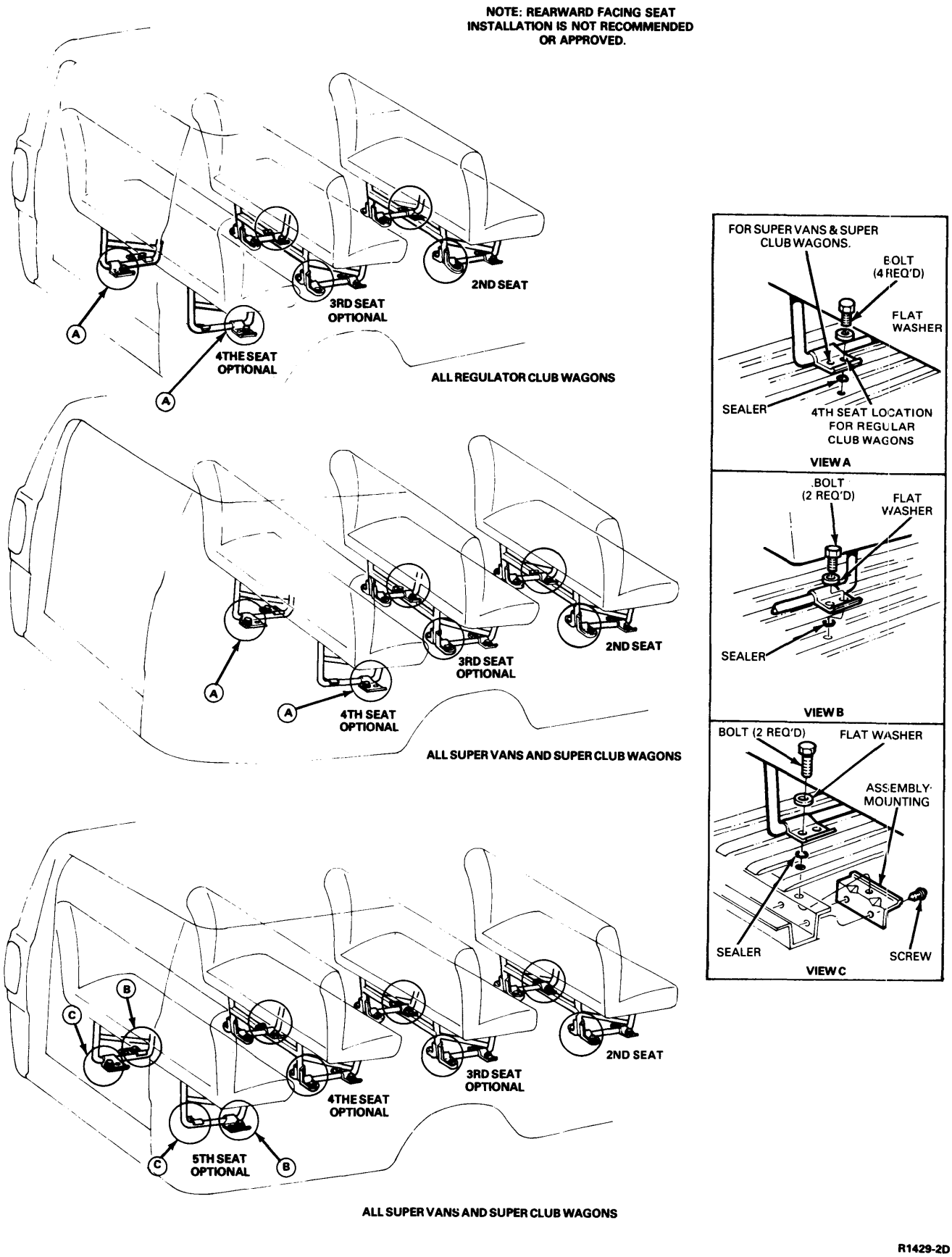


FIG. 1 Rear Seat Cushion and Back Assemblies—E-100—E-350

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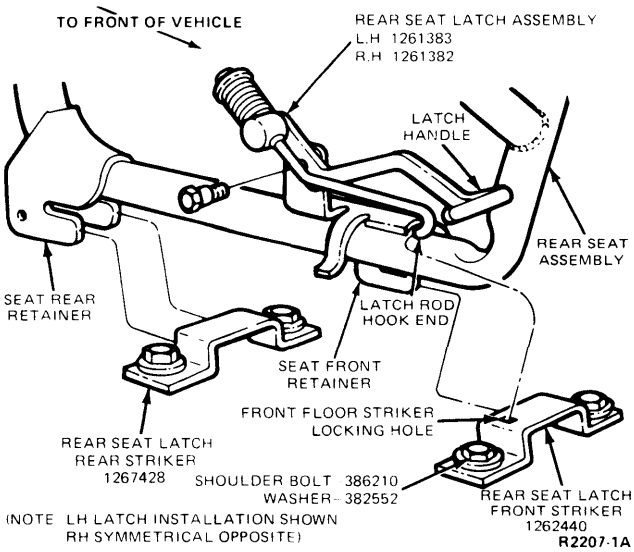


FIG. 2 Optional Quick Disconnect for Rear Seat E-100—E-350

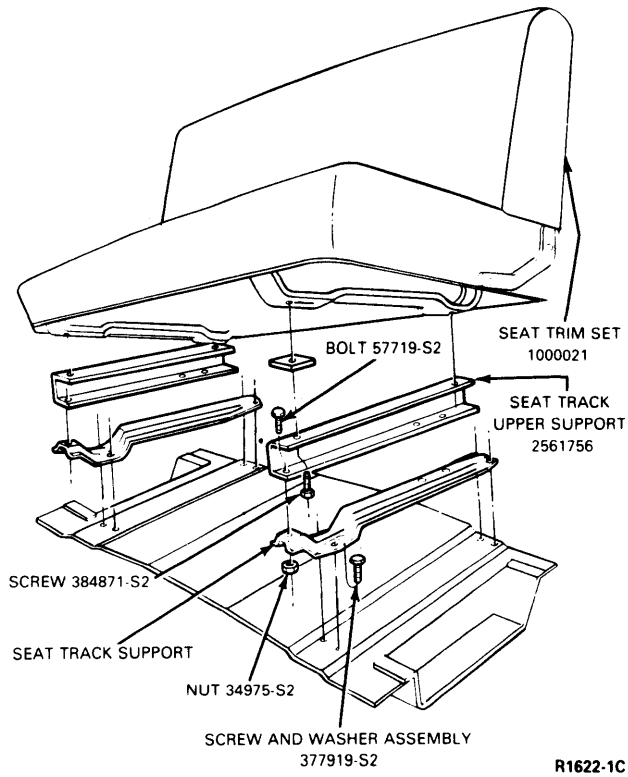


FIG. 3 Rear Seat Installation—F-Series Crew Cab

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Folding Rear Seats

PART 41-20

APPLIES TO F-SERIES WITH SUPER CAB AND BRONCO

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION	20-1	REMOVAL AND INSTALLATION	20-2

GENERAL INFORMATION

F-series Super Cab models have optional folding side-mounted rear seats which are designed to fold upward against the side of the cab for storage (Fig. 1).

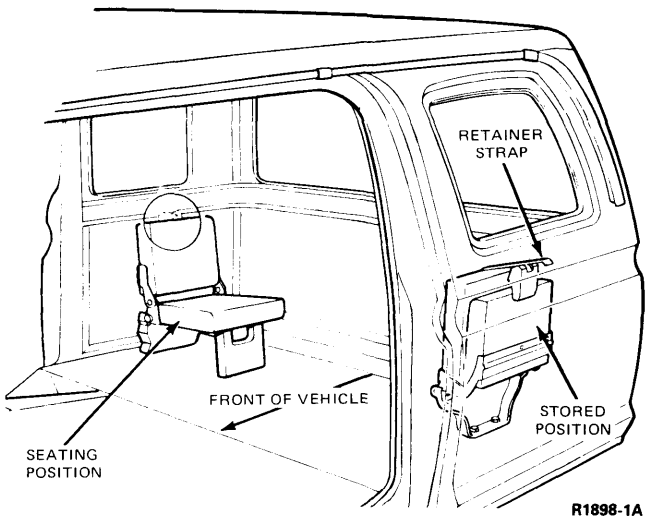


FIG. 1 Side-Mounted Folding Rear Seats—F-Series Light Truck Super Cab Models

Also optional with F-150 and 250 (4x4) Super Cab models is forward-facing folding rear seat which converts to a load floor (Fig. 2). The back of the seat is held in an upright position by a latch mounted on the inside rear of the cab (Fig. 3). The bottom of the seat pivots to lie flat against supporting bumpers.

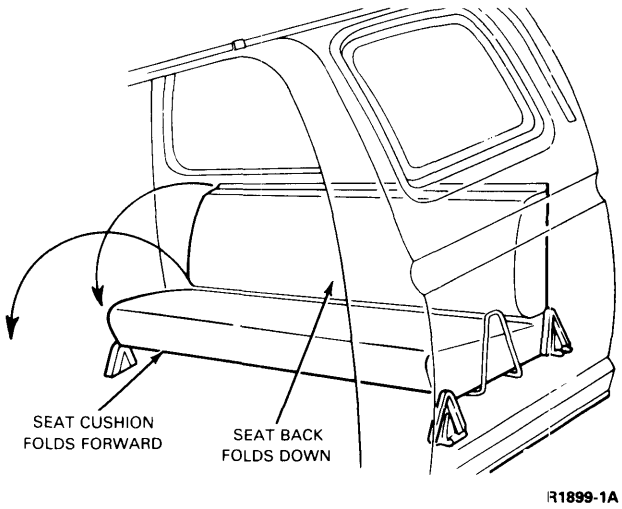


FIG. 2 Forward-Facing Folding Rear Seat—F-Series Light Truck Super Cab Models

The Bronco has an optional fold-down rear seat (Fig. 6). A seat back latch on the lower right-hand side of the rear seat is lifted to unlock the seat back. The seat back is folded to the cushion and locked with an auxiliary seat back latch. A cushion latch located at the center rear of the cushion is lifted to unlock the cushion from the floor-mounted striker. The cushion folds forward to provide a flat storage area.

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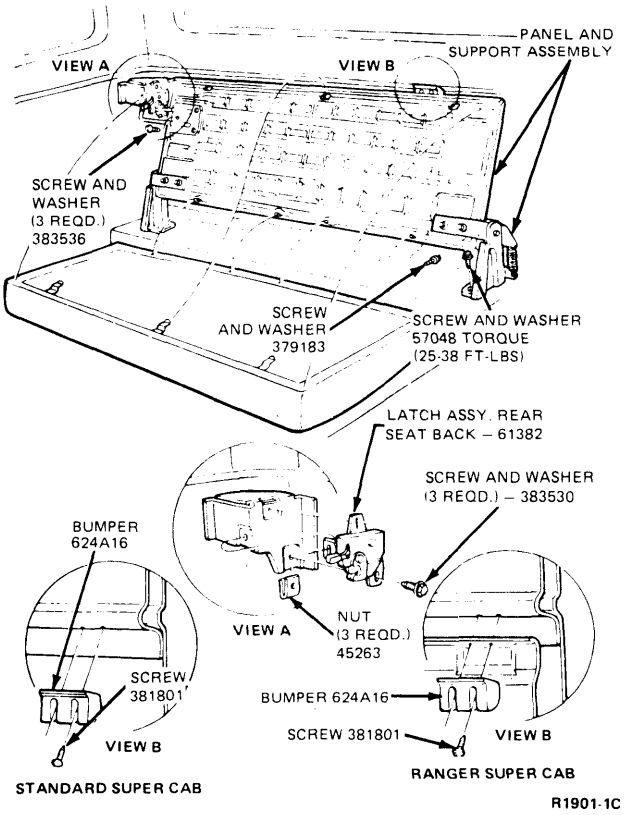


FIG. 3 Forward-Facing Rear Seat Back Installation—F-Series Light Truck Super Cab Models

REMOVAL AND INSTALLATION

Removal and installation points are shown in Figs. 3, 4, 5 and 6.

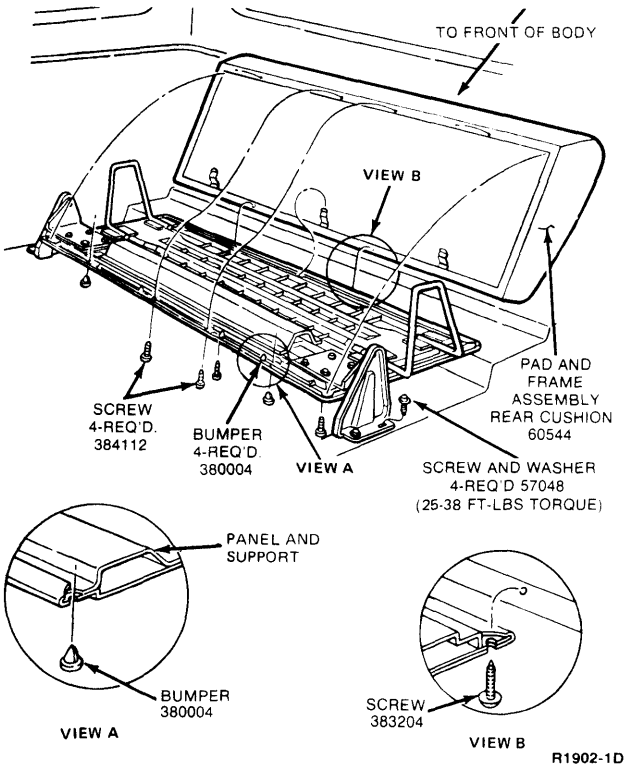


FIG. 4 Forward-Facing Rear Seat Cushion Installation—F-Series Super Cab Models

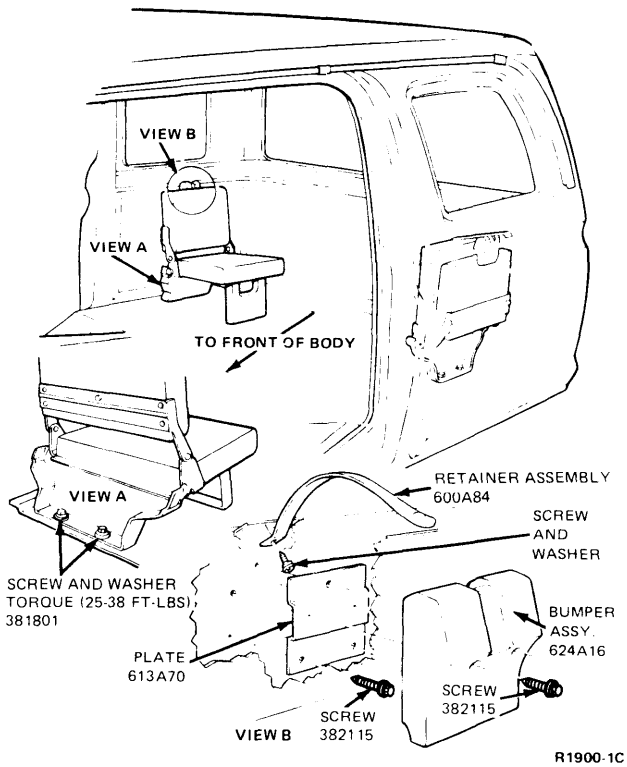


FIG. 5 Side-Mounted Rear Seat Installation—Super Cab Models

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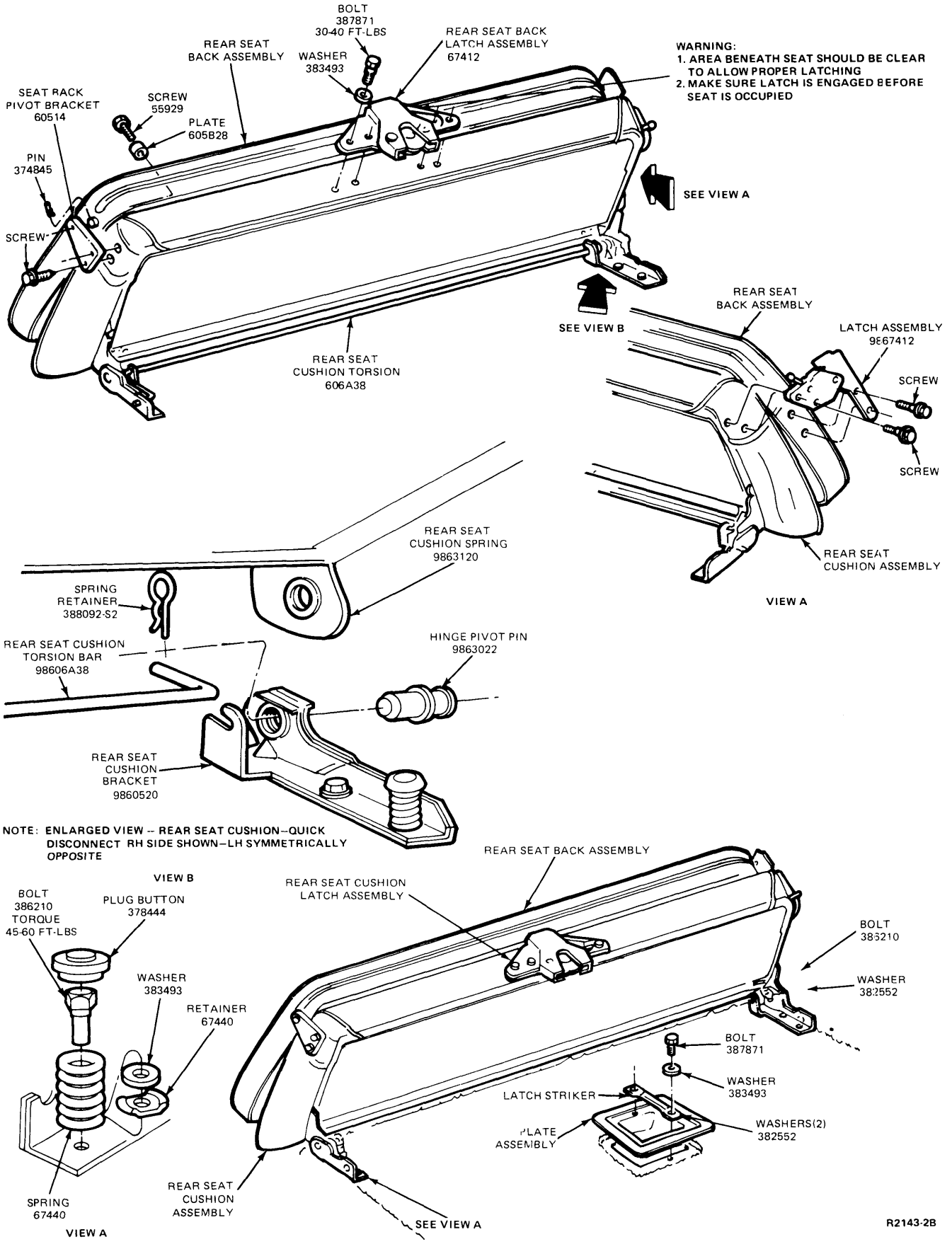


FIG. 6 Rear Fold Down Seat—Bronco

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Seat Back Latch

PART 41-25

BRONCO AND F-100 THROUGH F-350

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION	25-1		

GENERAL INFORMATION

All folding front seats have a latch designed to hold the seat back in the normal position. For rear seat passenger entry and exit and to gain access to the storage compartment (F-Series and Bronco with full bench seat), a handle on the side of the seat back releases the seat back latch.

If the seat back will not latch in position or the latch mechanism will not unlock, it may be necessary to remove the side shield and/or remove the seat back trim cover far enough to inspect the latch mechanism. Then replace any parts to put the latch system in proper working order (Figs. 1, 2, and 3).

For information on the seat back latch used with forward-facing rear seat option (Super Cab only), See Part 41-20.

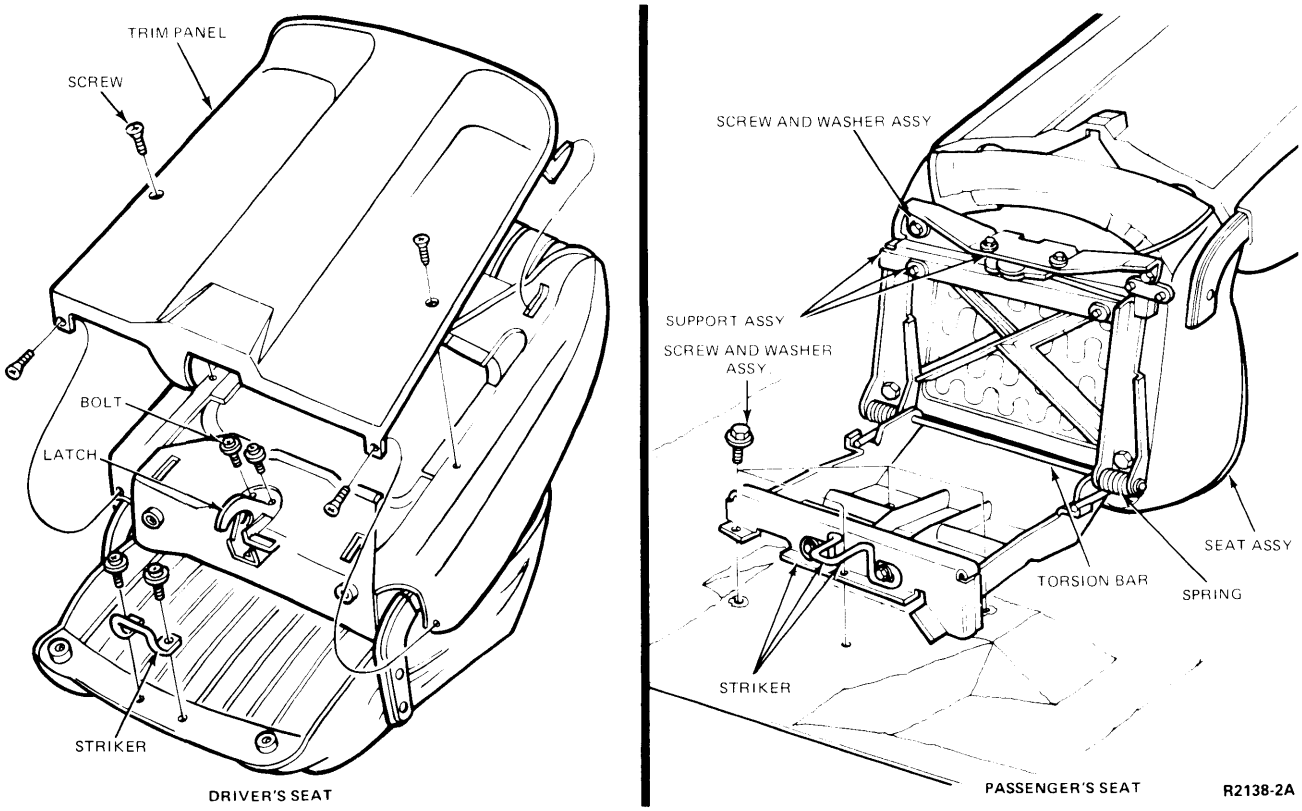


FIG. 1 Bucket Seat Back Latch Installation—Bronco

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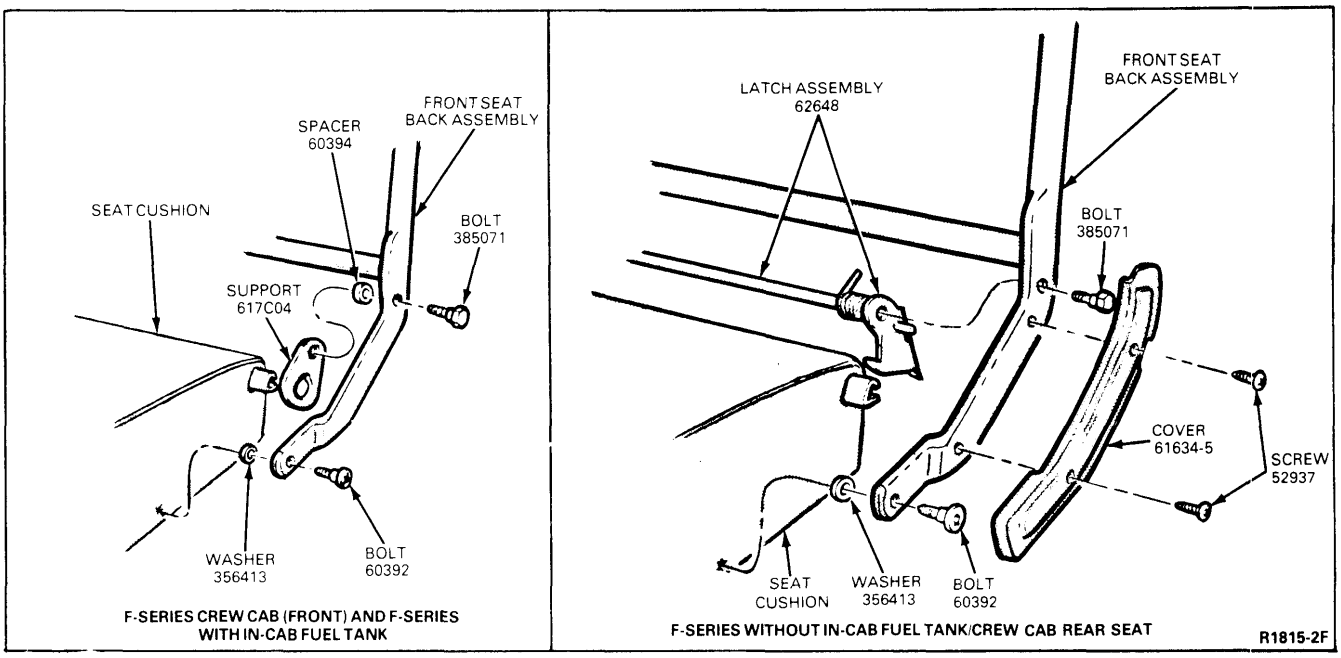


FIG. 2 Seat Back Latch Installation—F-Series Conventional Cab

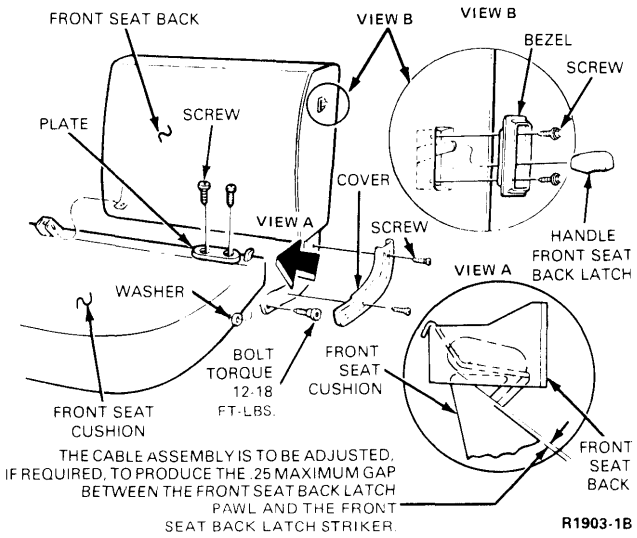


FIG. 3. Front Seat Back Latch Installation—Bronco and F-Series Super Cab Models

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Seat and Shoulder Belts

PART 41-50

APPLIES TO ALL MODELS

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GENERAL INFORMATION

The seat belts (Bronco and Light truck) and shoulder belts (light trucks so equipped) are factory installed in their proper locations. If the seat belts or shoulder belts are removed for any reason, they should be installed as shown in Figs. 1 through 8. Sealer should be placed around all seat belt anchor bolt holes in the floor pan. Tighten the anchor bolts to specification shown at the end of this Part.

Belt assemblies must be installed in matched sets as received and **must not be interchanged between vehicle models.**

If a component portion (buckle portion, retractor portion, etc.) **of a seat belt or shoulder belt assembly is nonfunctional or damaged, the entire assembly (buckle, tongue and shoulder harness portions) must be replaced.** The replacement

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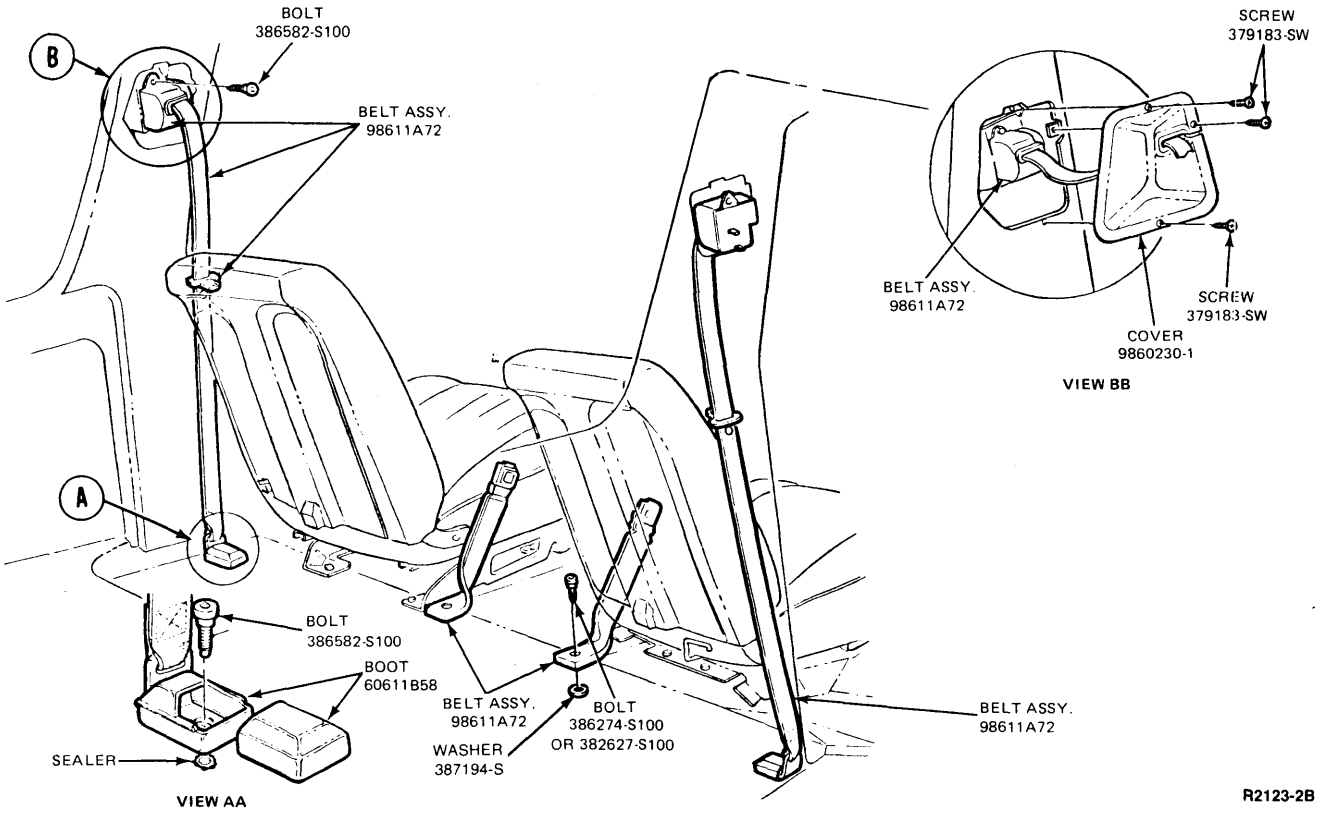


FIG. 1 Seat Belt Installation—Bronco Front Bucket Seat

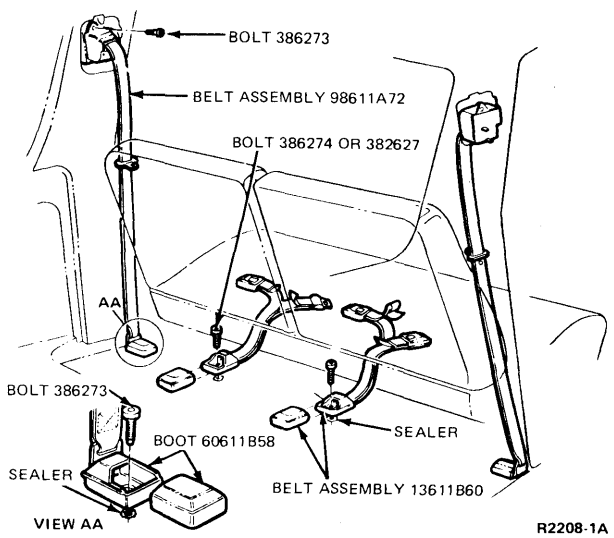


FIG. 2 Seat Belt Installation—Bronco Front Bench Seat

assembly must be installed as a matched set and the identification labels on all portions must bear exactly the same code, date of manufacture and manufacturer's name. Under no circumstances are seat belt or shoulder belt components to be replaced as individual components.

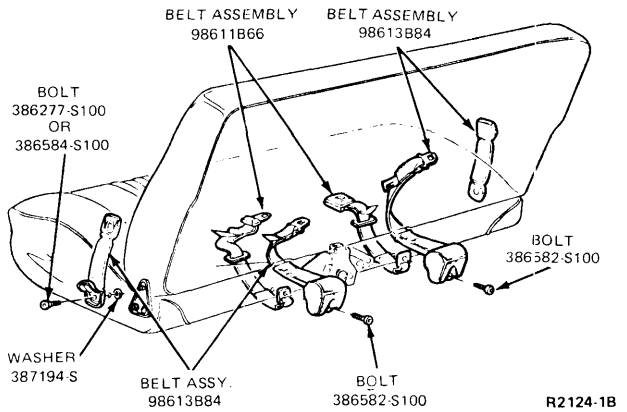


FIG. 3 Seat Belt Installation—Bronco Rear Seat

SEAT BELT EXTENSION ASSEMBLY

A seat belt assembly that is too short when fully extended over the lap of a stocky vehicle occupant, can be lengthened approximately 8 inches with a seat belt extension assembly which can be procured through local Ford Dealers. The seat belt extension assembly is only available with black webbing and standard buckle.

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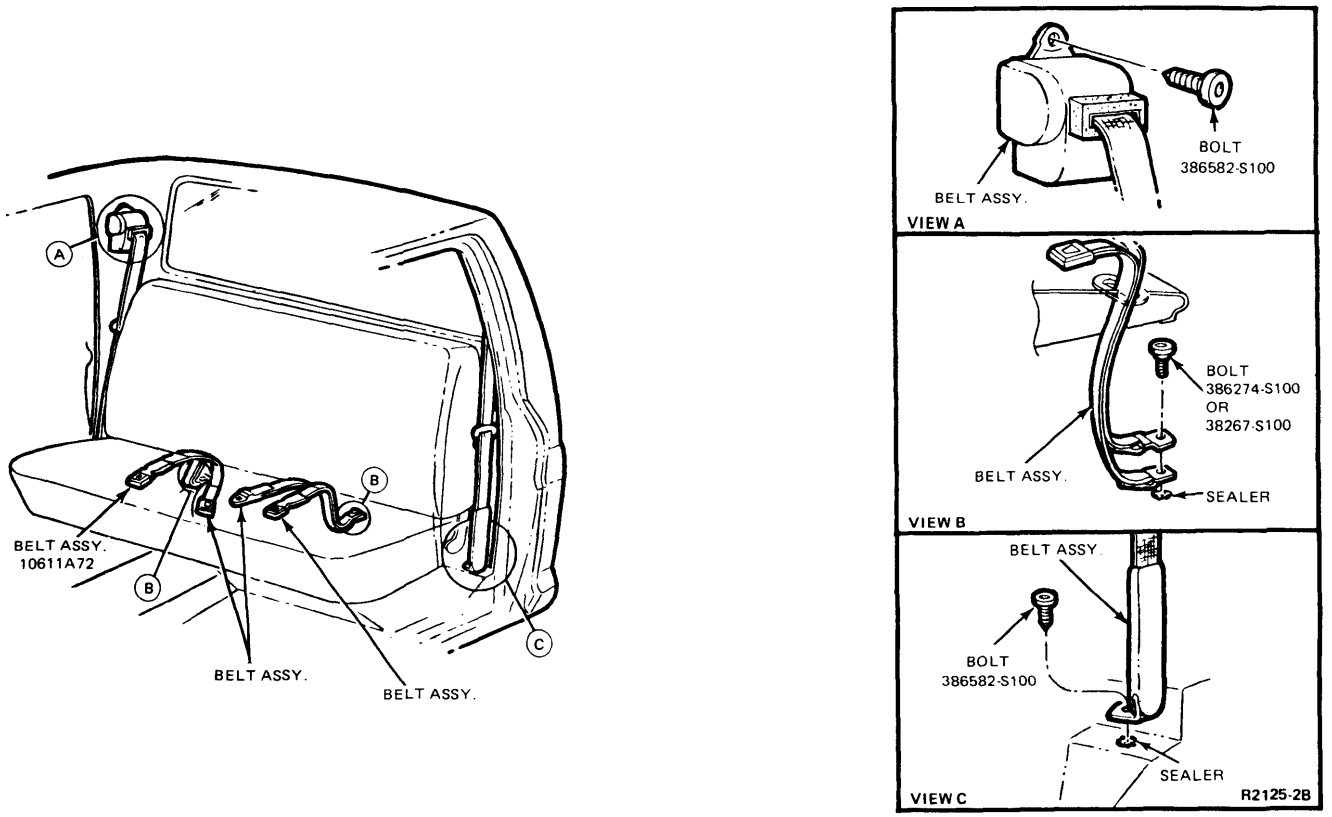


FIG. 4 Front Seat Belt Installation—F-100—F-350

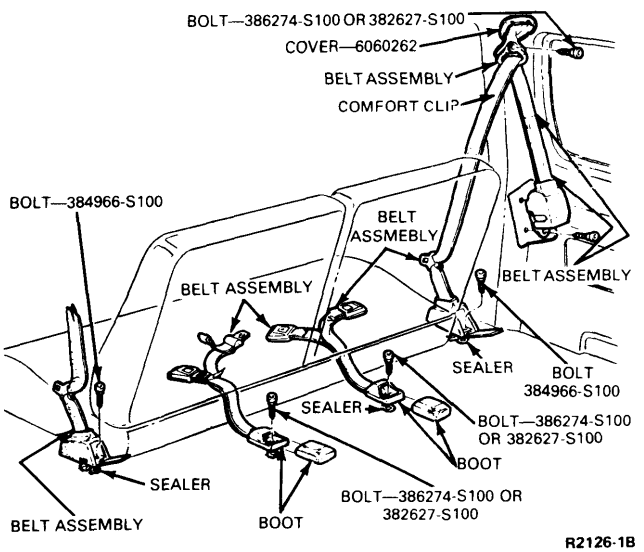


FIG. 5 Front Seat Belt Installation—Super Cab

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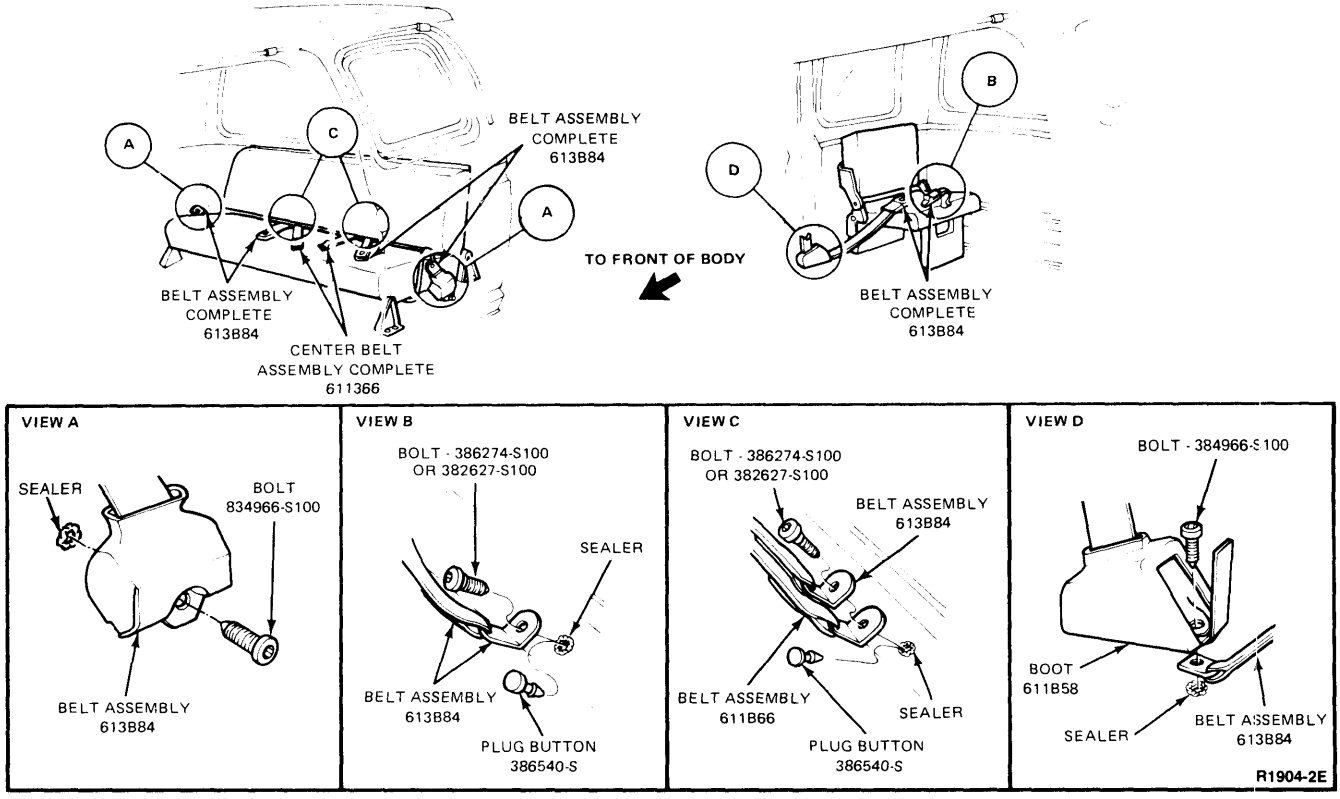


FIG. 6 Rear Seat Belt Installation—Super Cab

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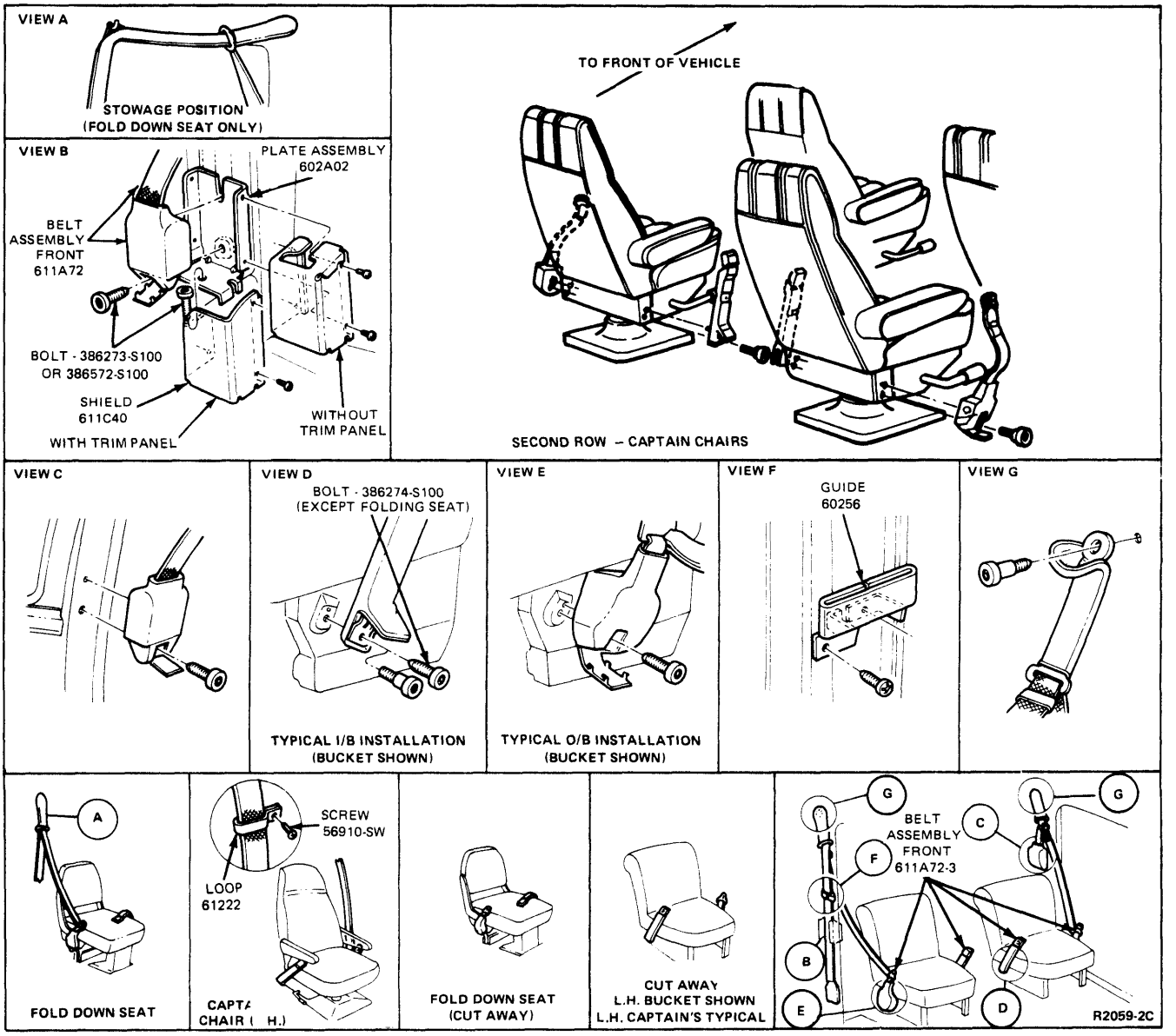


FIG. 7 Front Seat Belt Installation—E-100—E-350

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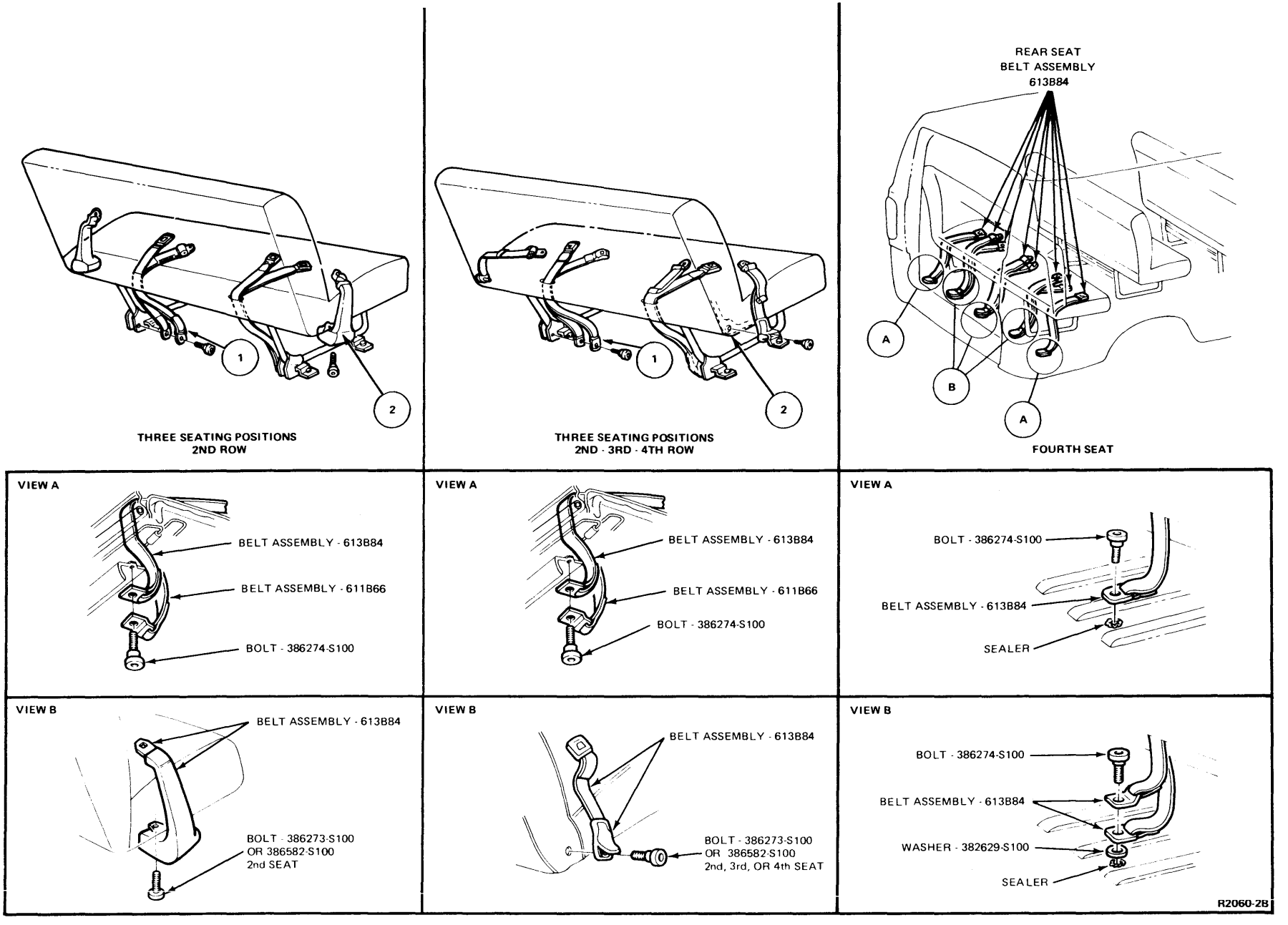


FIG. 8 Second, Third, Fourth and Fifth Row Seat Belt Installation—E-100—E-350

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DESCRIPTION AND OPERATION

OCCUPANT RESTRAINT SYSTEM DESCRIPTION

Three distinct front outboard seat belt systems are installed in the 1979 vehicle:

- A two point (with or without retractors).
- A three point (with two retractors).
- A continuous loop seat belt system (with one retractor).

The two-point system consists of a lap belt only or a lap with retractor. The three point system can be identified by the fixed tongue on the front outboard lap/shoulder belt and two retractors. (One retractor for the lap belt and the second retractor for the shoulder belt).

The continuous loop system can be identified by the movable tongue on the front outboard lap/shoulder belt and only one retractor. (This is a combination lap/shoulder belt retractor).

SEAT BELT WARNING SYSTEM

The two-point system does not have a warning system. The three-point and the continuous loop system incorporate a buzzer and light warning system. On both systems the seat belt warning light will illuminate for approximately eight seconds after the ignition switch is turned "on", regardless of seat belt usage. The seat belt warning buzzer is grounded by a switch in the left lap retractor, on the three point system and by a switch in the left inboard buckle, on the continuous loop system. The seat belt warning buzzer will sound for approximately eight seconds unless the drivers belt is used.

THREE-POINT SYSTEM F-100-F-350 SUPER CAB AND E-100—E-350

The occupant restraint system for front outboard passengers is a 3-point system. The outboard lap belt and shoulder harness are sewn together at the tongue. To secure the belts, the tongue is inserted into the buckle.

The webbing for the lap belt extends from a belt retractor that automatically locks when the belt is being worn. This lock prevents the belt from being pulled out further, but allows the belt to retract, and thus maintains a snug fit around the user for optimum safety. This lap belt retractor is located NEAR the rocker panel.

CONTINUOUS LOOP SYSTEM F-100—F-350 AND BRONCO

The occupant restraint system for front outboard passengers is a continuous loop system. The outboard combination lap and shoulder belt use a common sliding tongue. To secure the belts, the tongue is inserted into the inboard buckle.

The webbing for the lap belt is anchored NEAR the inboard side of the sill **without a retractor.**

The shoulder harness retractor is designed to let the webbing freely move in or out at all times, except during vehicle maximum deceleration, when it is automatically locked by a mechanically actuated inertia sensor.

The inboard belt with the buckle passes through the seat on bench seat installations before being anchored to the floor and directly to a fixed anchorage on the floor on bucket seat installations. Attaching the tongue and buckle secures the occupant with both lower and upper restraints. This attachment of the tongue and buckle can be accomplished by a single continuous movement.

THREE-POINT LAP-SHOULDER BELT—OPERATION

1. Pull the lap-shoulder belt from the retractor in one continuous motion, so shoulder portion of belt crosses your shoulder and chest and insert the belt tongue into the proper buckle. If the pulling motion is interrupted while extending the belt, it may be necessary to return the belt to the stowed, or fully retracted position, in order to release the stop mechanism in the lap portion of the belt.
2. Adjust lap portion of seat belt snugly **around the hips** —not the waist, by allowing any excess belt to return into the retractor.
3. The shoulder restraint portion of the belt adjusts automatically to a snug position. The inertia reel attached to the shoulder belt allows freedom of movement, locking tight only on hard braking or impacts of approximately five mph or more. The reel cannot be made to "lock up" by jerking on the webbing.

TWO-POINT LAP BELT OPERATION—NON-RETRACTOR

To lengthen the belt, tip the tongue at a right angle to the belt, and pull the tongue until the ends can be joined over the lap.

To fasten the belt, insert the tongue into the open end of the buckle until you hear a snap. Shorten the belt, if necessary, by pulling on the loose end of the webbing. The belt should be snug across **the hips; never across the waist.**

TWO POINT LAP OPERATION—RETRACTOR

The webbing for the lap belt extends from a retractor that automatically locks when the belt is worn. This lock prevents the belt from being pulled out further but allows the belt to retract and thus maintains a snug fit around the user for optimum safety. The lap belt retractor is located on the sill.

CENTER LAP BELTS

The center seat belts do not have retractors. To lengthen the belt, tip the tongue at a right angle to the belt, and pull the tongue until the ends can be joined over the lap.

To fasten the belt, insert the tongue into the open end of the buckle until you hear a snap. Shorten the belt, if necessary, by pulling on the loose end of the

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webbing. The belt should be snug across the hips; never across the waist.

UNFASTENING SEAT BELTS

Push the release button in the buckle and allow the front and rear outboard belts to retract to the fully stowed position.

ADJUSTMENTS

ADJUSTING SHOULDER BELT (SUPER CAB)

To relieve belt pressure on your shoulder after the shoulder belt is fastened, slide the shoulder harness "comfort clip" to a position that provides a comfortable shoulder harness length.

CAUTION: Never allow more slack than is required to insert a fist between the shoulder belt and the chest; never wear the shoulder belt under the arm. This practice may reduce the restraint system effectiveness.

CENTER LAP BELT AND LAP BELTS FOR SIDE FACING SEATS (SUPER CAB)

The center lap belts don't have retractors. To lengthen the belt, tip the tongue at a right angle to the belt, and pull the tongue until the ends can be joined over the lap.

To fasten the belt, insert the tongue into the open end of the buckle until you hear a snap and feel the latch engage. Shorten the belt, if necessary, by pulling on the loose end of the webbing. The belt should be snug across the hips, NEVER ACROSS THE WAIST.

REAR OUTBOARD BELTS (CREW CAB AND SUPER CAB WITH FORWARD FACING SEAT)

To fasten the rear outboard belt, pull the belt out of the retractor with a steady motion and insert it into the buckle until you hear a snap, and feel the latch engage. Adjust the lap belt snugly around the hips, never around the waist, by allowing the slack to return to the retractor.

SEAT BELT MAINTENANCE

Seat belt assemblies are maintenance-free; however, they should be periodically inspected to assure that they have not become damaged and that they remain in proper operating condition.

JAMMED LAP BELT RETRACTOR

If the lap belt retractor is jammed by allowing the belt to retract while twisted, webbing can be freed with this proceudre:

1. Use both hands to tighten the webbing on the spool by pulling on the belt.
2. Push the webbing into the retractor until the belt is completely retracted. Repeat step 1 if necessary.
3. Pull the belt out of the retractor as far as it will go and inspect the webbing for foreign material or twisting.
4. Remove the foreign matter or untwist the belt and let the webbing retract.
5. Then, sit in the seat, pull out the lap belt, and buckle up. Do this about five times to make sure the belt retractor operates properly.

TESTING

WEBBING CANNOT BE PULLED FROM LAP BELT RETRACTOR

1. Pull webbing from the shoulder harness retractor, allowing the lap belt to retract fully into the retractor. Pull webbing from the lap belt retractor.
2. If OK, withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times to insure proper operation. If not OK, replace the seat belt assembly.
3. If the webbing does not come loose from lap belt retractor, unsnap retractor cover door and disengage locking bar from the ratchet gear. (Use a small common screwdriver which has no burrs or sharp edges.) Hold the locking bar down and pull the webbing from the retractor. Inspect the webbing for foreign material and/or twist and remove. Allow webbing to retract back into the retractor. Withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times to insure proper operation. If not OK, replace the seat belt assembly.

LAP BELT RETRACTOR DOES NOT LOCK

1. Withdraw a minimum of 18 inches of webbing from lap belt retractor and check for lock-up. (Retractor must lock-up after 18 inches of webbing withdrawal.) Return two inches into retractor and pull out.
2. Unsnap retractor cover door and check locking bar spring. Pull webbing from the lap belt retractor and check for broken spring on locking bar by moving locking bar away from ratchet gear. (Use a small common screwdriver which has no burrs or sharp edges.) Spring should force locking bar back into engagement with ratchet gear.

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3. If not OK, replace the seat belt assembly. If OK, check locking bar for foreign material. Remove foreign material. Withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times, to insure proper operation. If not OK, replace the seat belt assembly.

REMOVAL AND INSTALLATION

SEAT BELTS

Use service Tool No. T70P-2100B or equivalent to remove or install all seat belt assembly anchorage bolts. Upon installation, tighten the anchorage bolts to 20-30 ft-lbs.

BRONCO—FRONT BUCKET SEATS

Remove the shoulder belt retractor cover and lift the cover from the floor anchorage. Remove the shoulder belt retractor anchorage bolt and the floor anchorage bolt. Remove affected seat belt assembly from the vehicle (Fig. 1).

The buckle end of the front seat belt and center seating position belts can be removed by removing the seat belt anchorage bolt from the floor. Driver's buckle contains an electrical switch. Disconnect before removing the anchorage bolt.

On rear seat positions, remove any affected seat belt assemblies by removing the seat belt anchorage bolts from the seat frame (Fig. 3).

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle. Check for sealer around each removed floor anchorage bolt holes and add sealer if necessary.

BRONCO-FRONT BENCH SEAT (FIG. 2)

Remove the buckle end of the front bench seat belt by removing the belt assembly cover and anchor bolt at the floor. The driver's side buckle contains an electrical connector which must be disconnected before removing the anchor bolt.

Install by connecting the electrical connector (driver's side only) and securing with the anchor bolt. Install cover.

F-100—F-350

On front seat outboard positions only: Remove the shoulder belt retractor cover. Remove the shoulder belt retractor anchorage bolt and the lap belt bolt. Remove affected seat belt assembly from the vehicle.

The buckle end of the front seat belt and the center seating position belts can be removed by removing the seat belt anchorage bolt from the floor. Driver's buckle contains an electrical switch. Disconnect before removing the anchorage bolt.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle. Check for sealer around each removed floor anchorage bolt holes and add sealer if necessary, (Fig. 4).

F-100—F-350 SUPER CAB (REFER TO FIGS. 4, 5 AND 6)

On front seat outboard positions only: Lift the cover from the "D" ring attachment and the lap belt retractor. Remove the shoulder belt retractor anchorage bolt, the "D" ring attaching bolt and the lap belt retractor bolt. Remove affected seat belt assembly from the vehicle.

The buckle end of the front seat belt can be removed by lifting the cover and removing the seat belt anchorage bolt. Driver's buckle contains an electrical switch. Disconnect before removing the anchorage bolt.

Rear seat and front center seating positions: Remove any affected seat belt assemblies by removing the seat belt anchorage bolts from the rear floor.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle. Check for sealer around each removed floor anchorage bolt holes and add sealer if necessary.

E-100—E-350—(FIGS. 7 AND 8)

On front seats only—Remove the "B" pillar trim to expose the shoulder belt retractor. Lift the covers from the "D" ring attachment and the lap belt retractor. Remove the shoulder belt retractor anchorage bolt, the "D" ring attaching strap bolt and the lap belt retractor bolt. Remove affected seat belt assembly from the vehicle. Driver's lap belt retractor contains an electrical switch. Disconnect before removing the anchorage bolt.

The buckle end of the front seat belt can be removed by lifting the cover and removing the seat belt anchorage bolt.

Second Seat—Remove any affected seat belt assemblies by removing the seat belt anchorage bolts from under the seat.

Third Seat—Remove any affected seat belt assemblies by removing the seat belt anchorage bolts from under or on the outboard side of the seat. **(Note: Remove the seat assembly for access to the left hand seat belt outboard attaching bolt.)**

Fourth Seat—Remove any affected seat belt assemblies by removing the seat belt attaching bolts from the rear floor.

Note location of steel and rubber washers so they can be correctly replaced.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle. Check for sealer around each removed floor anchorage bolt holes and add sealer if necessary.

MAJOR REPAIR OPERATIONS

SEAT AND SHOULDER BELTS

The seat belts and shoulder belts are factory installed in their proper locations. If the belts are removed for any reason, they should be installed as shown in Figs. 1 through 8. Sealer should be placed around all seat belt anchor bolt holes in the floor pan. Tighten the anchor bolts to specification, shown at the end of this Part.

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SEAT BELT WITH NO ANCHOR PLATE THREAD DAMAGE

1. Remove the damaged bolt for the anchor reinforcement and discard.
2. Install a new bolt with the same part number as indicated at the end of this Part and tighten to specification.

SEAT AND SHOULDER HARNESS BELT WITH DAMAGED ANCHOR PLATE THREADS

1. Remove the broken or stripped bolt and discard.
2. Drill out the internal threads in the seat belt anchor plate with a 27/64 inch drill. (Shoulder belt 13/32 inch drill.)
3. Re-thread the anchor plate with a 1/2-13 tap (seat belt).
4. Blow out the chips.
5. Install the attachment parts in the sequence shown in Figs. 1 through 7, whichever is applicable. Tighten the replacement bolt to specification, as shown at the end of this Part. Original parts are to be replaced with the repair parts indicated in the seat belt parts replacement guides at the end of this Part. Unless specified in the guides, use original parts.
6. When repairing a multiple belt and attachment, install nut (382599-S100 or equivalent) to the bolt in the tunnel area from the underside of the floor pan. Tighten to specification, shown at the end of this Part.

CLEANING

The following procedure is recommended for the removal of spots and stains from seat and shoulder belts. It is important that proper cleaning techniques and cleaning agents be used to prevent setting the stain or affecting the color and/or flame resistance of the belts.

MATERIALS

Procure the following materials before attempting cleaning procedures on belts.

1. Clean, undyed cotton fabric.
2. Medium hard bristle brush.
3. Kar-Kleen (Part B5A-19525-A or an equivalent cleaner). Available from Ezy Products Inc., 12801 Newburgh Road, Livonia, Michigan 48150. Phone: (313) 464-1408.
4. Spot Lifter—Automotive Fabric (Part C9AZ-19526-A or an equivalent spot lifter), 8 oz. Aerosol spray can.
5. Solvents: Part M14 J209A (F) or an equivalent. Available from Western Eaton Solvents Chemical Co., 1339 Huron River Drive, Romulus, Michigan 48174. Phone: (313) 941-4800. Product-Sol Inc., available from Product-Sol Inc., 2010 Cole, Birmingham, Michigan 48008. Phone: (313) 566-0744.

CLEANING PROCEDURE

1. Remove excess staining material from fabric by scraping or wiping with a clean cloth.
2. Identify the staining material if possible.
3. Proceed to clean the fabric as necessary by following either the spot cleaning or general cleaning procedures that follow.

SPOT CLEANING

For stains from grease, oil, tar, water spotting, crayon and lipstick.

1. Spray stain with spot lifter (C9AZ-19526-A or equivalent) from a distance of 8-10 inches as directed by instructions on can.
2. Allow the spot lifter to dry completely until forming a white powder on the fabric.
3. Brush and vacuum the white powder from the fabric.
4. If the spot is not removed, repeat Steps 1, 2 and 3 as necessary.

CAUTION: Care should be used in application of the spot lifter to prevent it from contacting vinyl trim.

5. After the stain has been removed, proceed to Step 10.
6. If the stain is still visible after several applications of the spot lifter, blot the area with a cloth saturated with one of the recommended solvents.
7. Rub in a circular motion while continuously exposing a clean part of the cloth.
8. Gradually widen the area of application to the edges of the belts.
9. Repeat Steps 6 to 8 as necessary.
10. Wipe cleaned area with damp cloth to remove any residual cleaner.

GENERAL CLEANING

For stain from dirt, dry soil, food, pop, and coffee.

1. Apply Kar-Kleen, or equivalent with cloth or brush as directed by instructions on can.
2. Rub in a circular manner until stain is removed.
3. Gradually widen the area of application to edges of belts.
4. Repeat Steps 1, 2 and 3 as necessary.
5. Rub cleaned area with a damp cloth to absorb residual Kar-Kleen or equivalent solvents.
6. Allow belts to dry at room temperature.

NOTE: Spot cleaning will be sufficient when the soiled area is not excessive. In the event of severe soiling or staining, clean the entire belt to avoid a "ring" condition.

SEAT BELT PROCEDURE AFTER AN ACCIDENT—

All seat belt assemblies must be replaced after a collision provided either:

1. The seat belt was in use at the time of the accident or,
2. The seat belt was damaged by the accident (bent retractor, torn webbing, etc.) or,
3. The seat belt attaching area(s) was damaged by the accident.

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Before installing the new seat belt assembly, the seat belt attaching areas must be inspected for damage and distortion and if the attaching points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

Install the new seat belt(s) using the appropriate instructions in the shop manual; then functionally test.

FUNCTIONAL TEST PROCEDURE

Determine the type(s) of seat belt assembly(s) that have been replaced. Then functionally test the new seat belt assembly using the appropriate procedure listed.

LAP BELT RETRACTOR TEST—(2 Point System)

Grasp the new seat belt tongue and pull the webbing out of the retractor until the manufacturer's label is exposed. Return approximately five inches of webbing into the retractor and pull. If the retractor locks, the belt assembly is functioning properly. If the retractor does not lock or the webbing cannot be pulled from the retractor far enough to expose the manufacturer's identification label, rework the sheet metal surface in the seat belt retractor attaching area until the retractor will function properly.

NOTE: If the retractor of a new seat belt assembly has been bolted into a damaged or distorted mounting area, the new retractor could be warped and may not function. If this is the case, reshape the sheet metal and install another new complete seat belt assembly.

CONTINUOUS LOOP SHOULDER/LAP BELT TEST—(System with Movable Tongue and One Retractor).

1. Driver will buckle up and proceed to a safe test area. If the R.H. passenger seat belt must be tested, a passenger should be buckled into the R.H. seat. (The passenger belt may be tested utilizing a driver only, providing the driver has the ability to grasp the R.H. shoulder belt and extend it approximately 26 inches with no compromise to safe driving.) This method applies to the 5 MPH test only.

   NOTE: The R.H. shoulder belt is not extended fully to preclude the possibility of a false feeling (full extension vs. lock-up).
2. After reaching a safe area to perform sudden stops, the driver will attain a speed of approximately 5 MPH. The driver should inform the passenger (if applicable) that he is preparing to make a severe brake application. At this time, both driver annd rider should grasp their respective shoulder harness and prepare to lean slightly forward at the moment the brake application is made.
3. The driver will make a maximum brake application (approximately 32 ft/Sec/Sec) without tire skid. (The maximum brake application should be on dry concrete or equivalent hard road surface. Never on a wet or gravel road). The driver and passenger should lean forward slightly into the shoulder harness. At this instant, the belts should "lock-up" without webbing payout.
4. If there is a "lock-up" of both shoulder straps, the seat belt assemblies are functioning properly. Should either or both retractors fail to "lock-up" at the 5 MPH speed, the test should be repeated at a constant 15 MPH. (This test must be performed with a R.H. passenger if the R.H. belt is to be tested.)
5. If either or both shoulder belts do not "lock-up" at the 15 MPH test, the vehicle is to be returned for repair of the malfunctioning seat belts. Remove the retractor and rework the sheet metal in the retractor's mounting surface. Re-install the retractor assembly and re-test the seat belt assembly(s) as previously stated.

   NOTE: If the retractor of a new seat belt assembly has been bolted into a damaged or distorted mounting area, the new retractor could be warped and may not function. If this is the case, reshape the sheet metal and install another new complete seat belt assembly.

THREE POINT SHOULDER/LAP BELT TEST: (3 Point System with Stationary Tongue and Two Retractors)

The three point system uses two retractors; the lap belt retractor operates the same as the two point lap belt retractor system and may be tested using the same procedure as the **Lap Belt Procedure Test.** The shoulder belt retractor operates the same as the continuous loop shoulder retractor and may be tested using the same procedure as the **Continuous Loop Shoulder/Lap Belt Test** with one exception; pull the shoulder belt 8-10 inches instead of the 26 inches recommended for the continuous loop system.

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SPECIFICATIONS

PARTS REPLACEMENT CHART — SEAT AND SHOULDER BELT WITH DAMAGED WELD NUT ANCHOR PLATE THREADS

ORIGINAL PARTS — SEAT BELT			REPLACEMENT PARTS — SEAT BELT		
Part No.	① Code Letter	Part Name	Part No.	① Code Letter	Part Name
386273	IA	Bolt — 7/16-20 x 1.38 Pan Head Tapping	383531-S36	X	Bolt — 1/2-13 x 1.38 Pan Locking
386274	IB	Bolt — 7/16-20 x 1.75 Pan Head Tapping (.50 Shoulder)	383753-S36	Y	Bolt — 1/2-13 x 1.75 Pan Locking (.50 Shoulder)
382629-S100	—	Washer — .463/.443 I.D. Plate (1.80 Dia. .190 Thick)	382522-S100	—	Washer — 1/2 Flat (1.30 Dia. .190 Thick)
382583-S100	—	Washer — 1/2 Serrated (.18 Thick)	382533-S100	—	Washer — 1/2 Flat (.25 Thick)
386272	IF	Bolt — 7/16-20 x .88 Pan Head Tapping	383437-S36	W	Bolt — 1/2 x 13 Pan Locking
386276-S100	IL	Bolt — 7/16-20 x 1.75 Pan Shoulder Tapping (.75 Shoulder)	383754-S36	Z	Bolt — 1/2-13 x 2.25 Pan Locking (.88 Shoulder)
386277-S100	IK	Bolt — 7/16-20 x 1.38 Pan Shoulder Tapping (.50 Shoulder)	385709-S	T	Bolt — 1/2-13 x 1.38 Pan Head Shoulder Locking
ORIGINAL PARTS — SHOULDER BELT			**REPLACEMENT PARTS — SHOULDER BELT**		
Part No.	① Code Letter	Part Name	Part No.	① Code Letter	Part Name
386392-S100	D IG	Bolt — 3/8-16 x 1.50 Pan Head Tapping 7/16-20 x 2.15	382627-S100 383754	Z	Bolt — 1/2-15 x 2.25 Pan Head Tapping

① Identification letter on top of bolt head or face of spacer.
Note: Bolt torque must be maintained at 20-30 ft-lbs.

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Seat Trim

PART 41-60

APPLIES TO ALL LIGHT TRUCK LINES

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REMOVAL AND INSTALLATION	
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Seat Cushion and Back Cover — Bucket Seat	
Bronco, F-Series and E-100 — E-350	60-8
Seat Cushion Cover — Bench Seat	
Bronco and F-Series	60-8

GENERAL INFORMATION

SEAT TRIM

The following seat trim removal and installation procedures generally apply to all truck lines. If some of the steps do not apply to the particular vehicle being serviced, proceed to the next step and review the appropriate illustration shown.

Unless otherwise noted, the illustrations shown in this section are **typical of all bucket and bench seat assemblies.** See Figs. 1 through 12.

WARNING: All rotating chairs should be latched in the forward facing position while the vehicle is in motion.

Seat trim replacement requires removal and installation of seat components such as seat assemblies, track assemblies and seat belts. Refer to the applicable part in Group 41 for these procedures.

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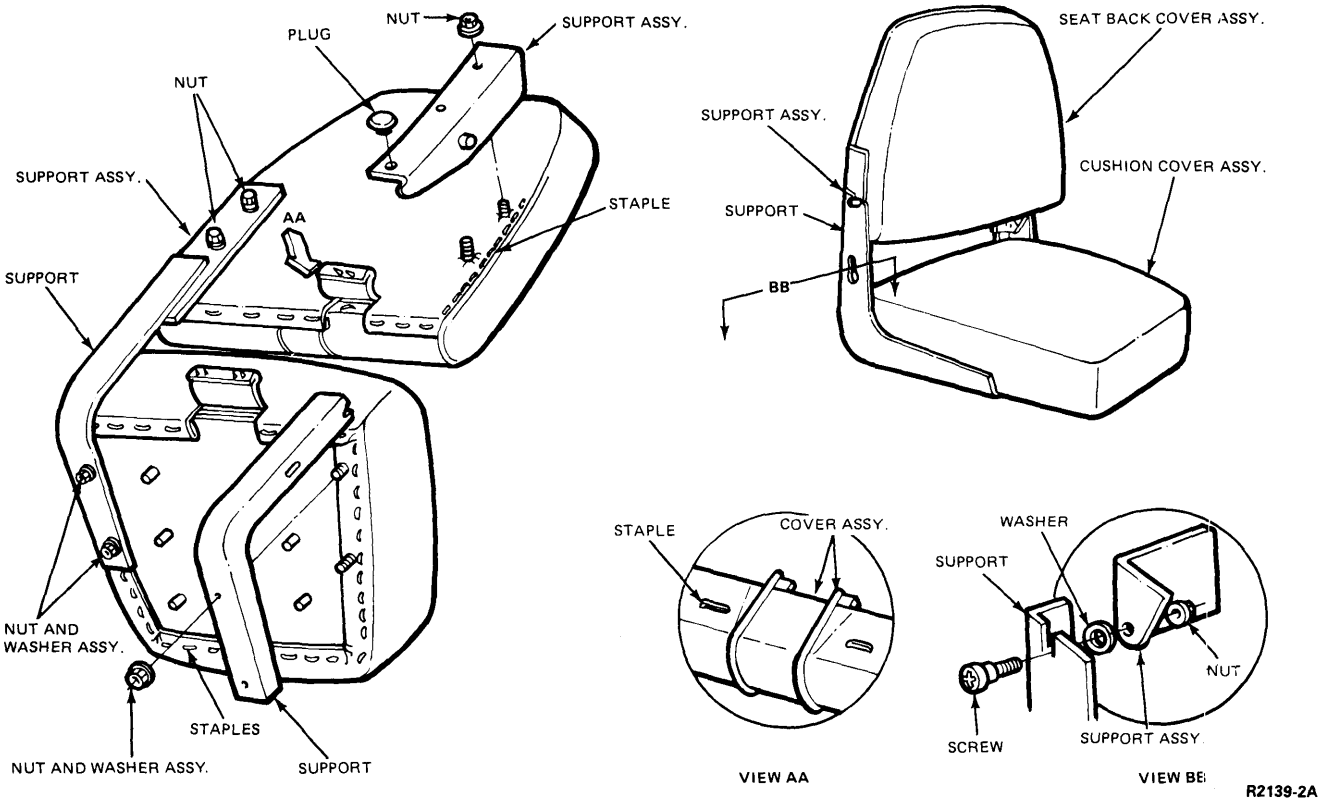


FIG. 1 Passenger Fold Down Seat—E-100—E-350

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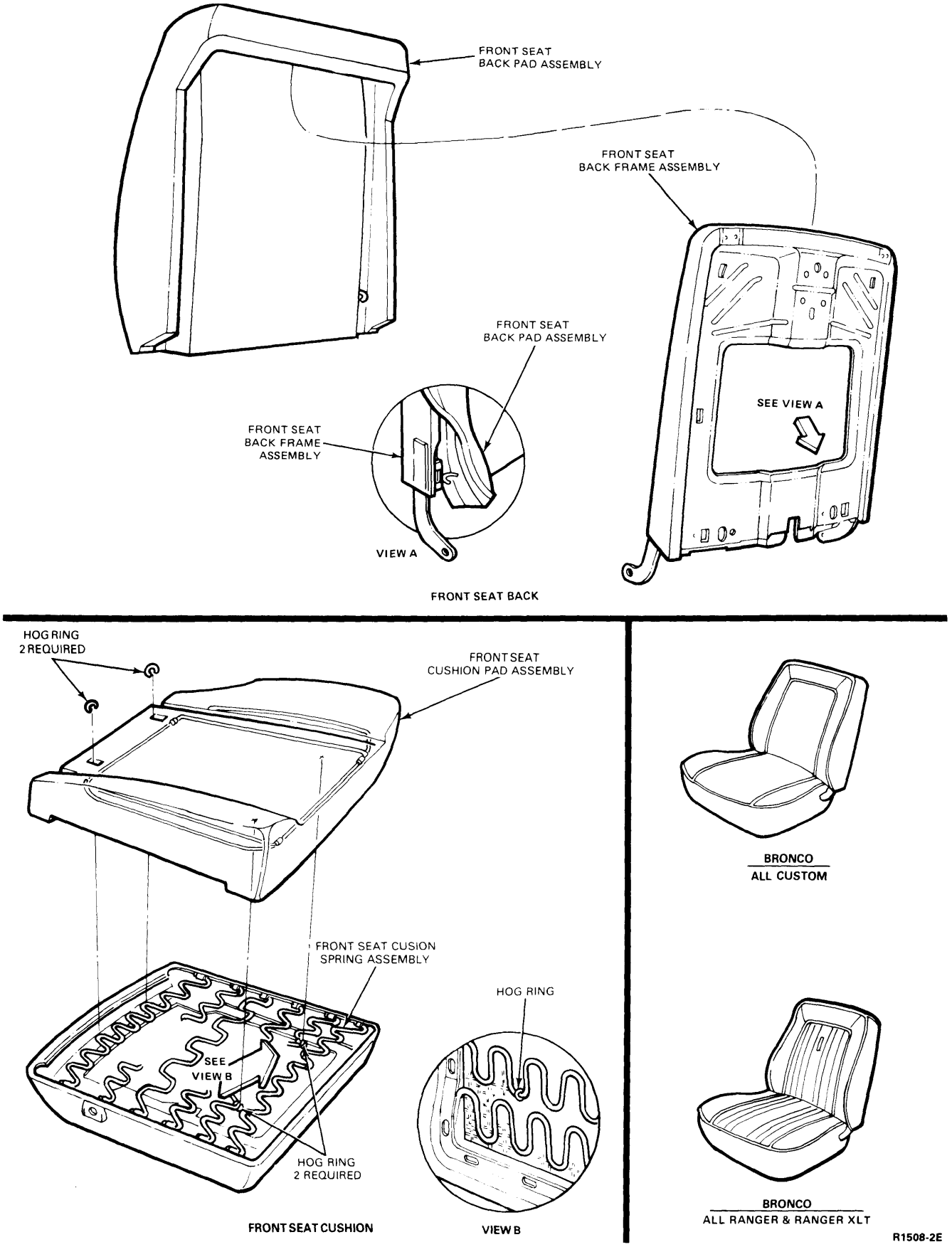


FIG. 2 Front Seat Cushion and Back Cover Installation Bronco—Bucket Seat

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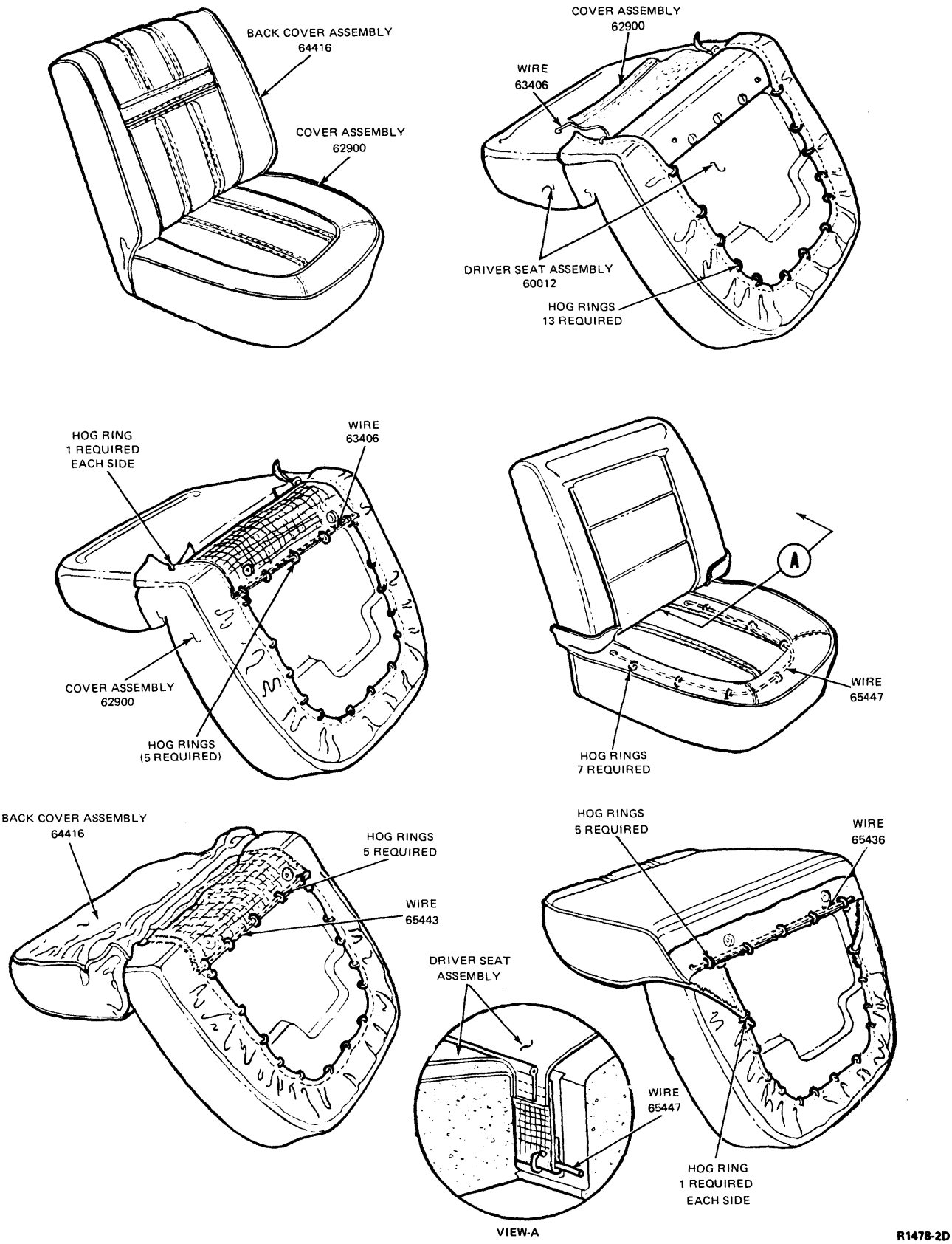


FIG. 3 Front Seat Assemblies—E-100—E-350

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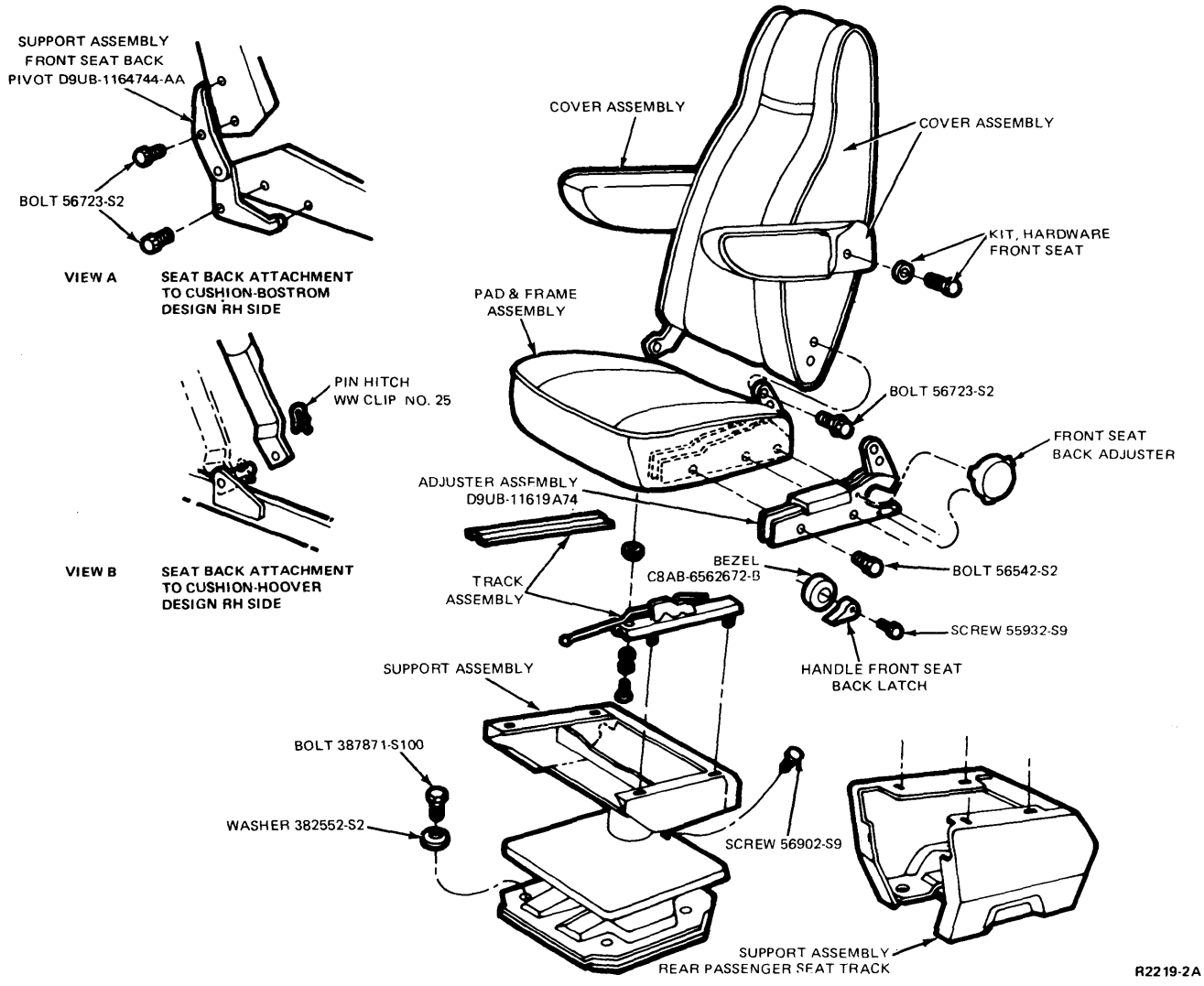


FIG. 4 Captains Chair-Reclining Seat Back/Stationary Supports—E-100—E-350

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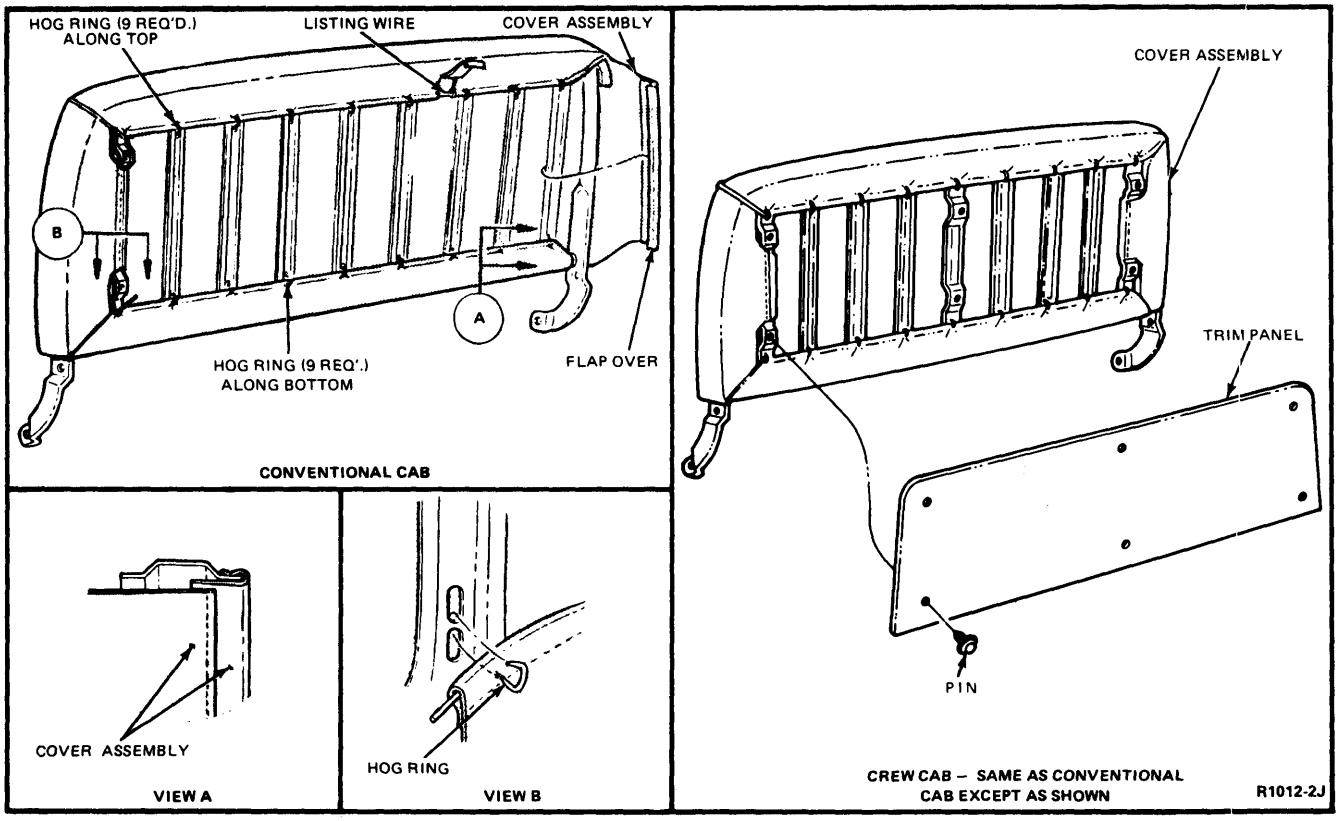


FIG. 5 Seat Back Cover Installation—F-Series

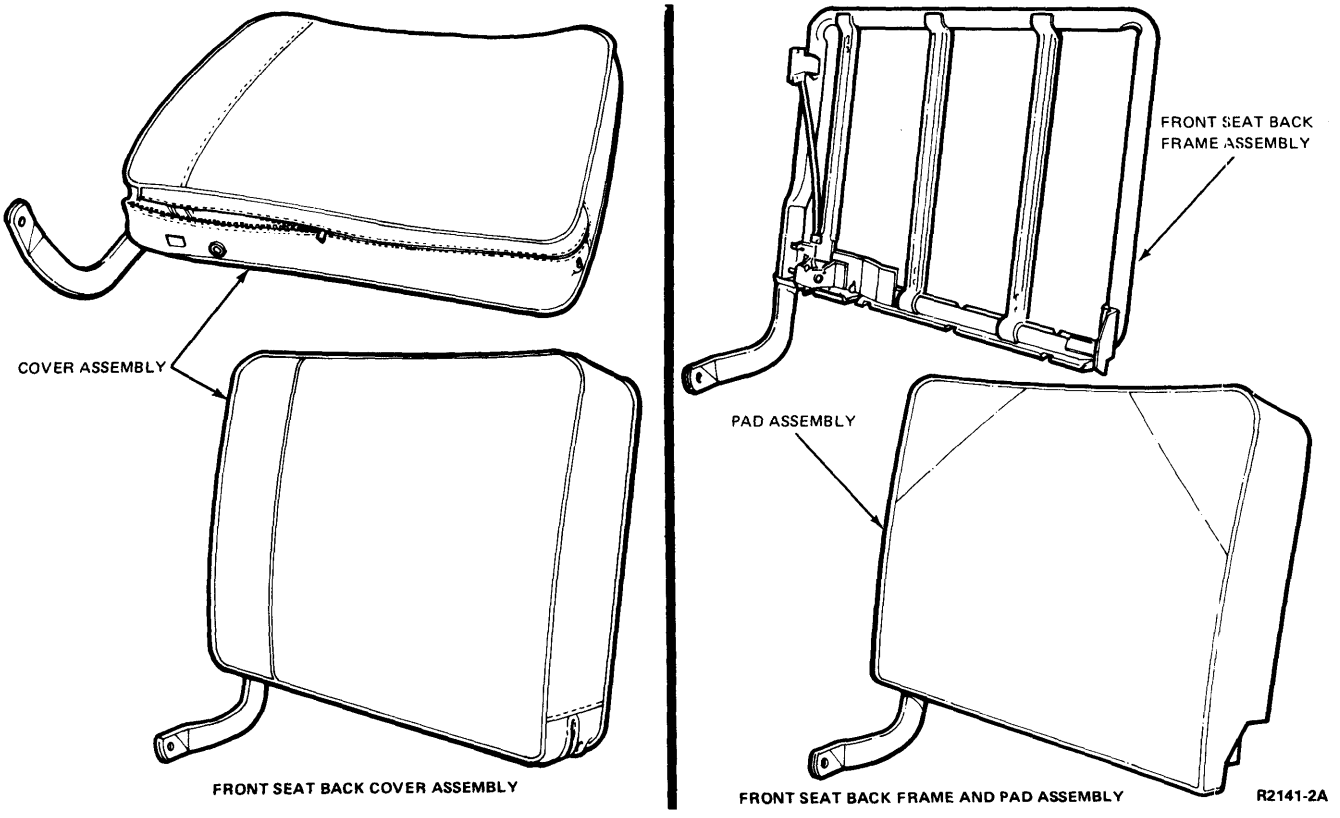


FIG. 6 Front Seat Back Frame, Pad and Cover—F-Series, Super Cab and Bronco

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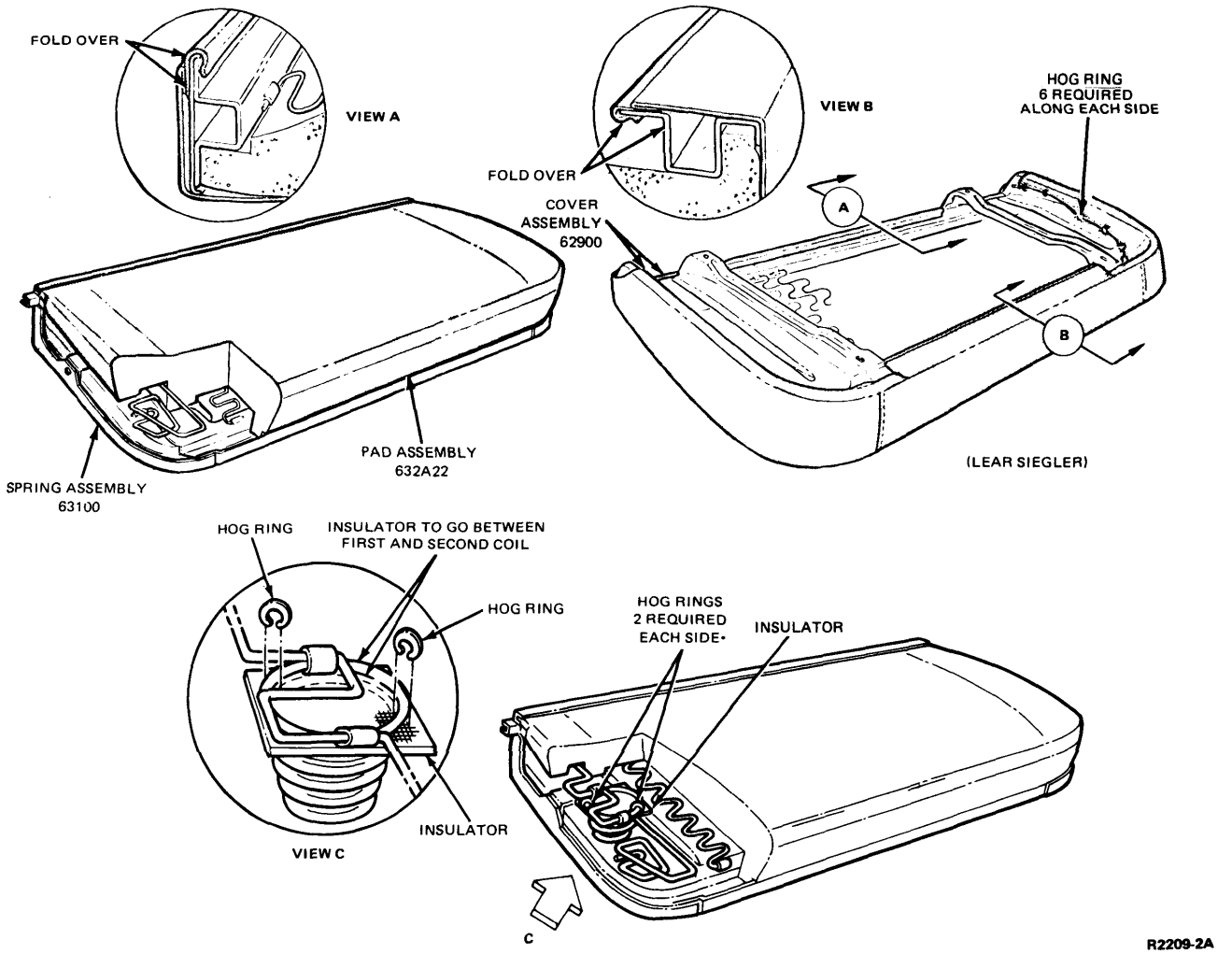


FIG. 7 Front Seat Cushion Cover Installation—F-Series, Conventional Cab

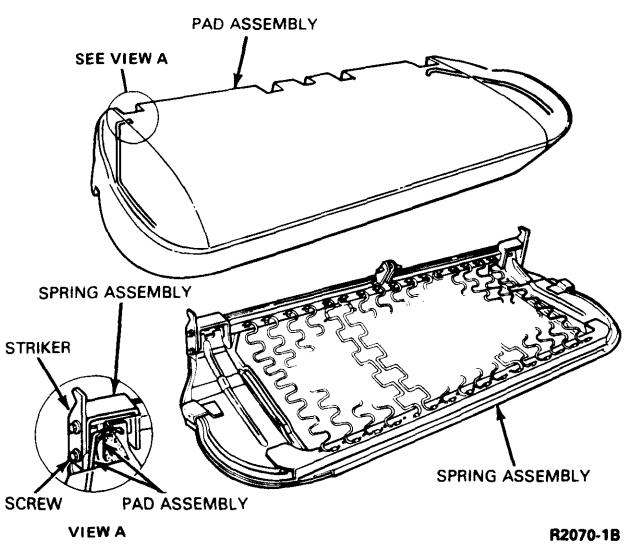


FIG. 8 Front Seat Cushion Cover Installation—F-Series Super Cab

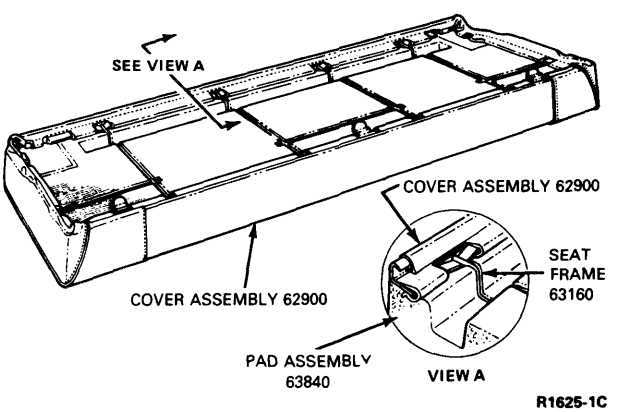


FIG. 9 Rear Seat Installation—F-Series Super Cab

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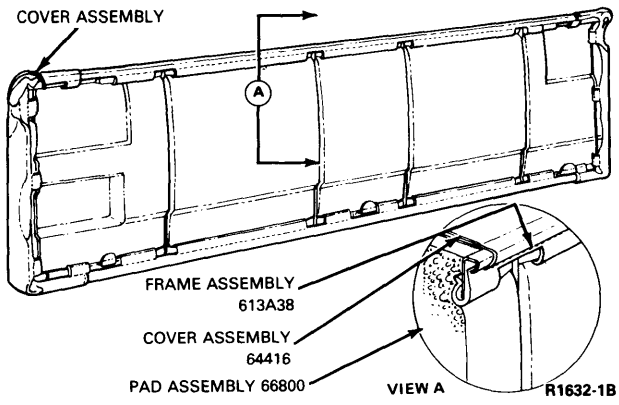


FIG. 10 Rear Seat Back Cover Installation—F-Series Super Cab

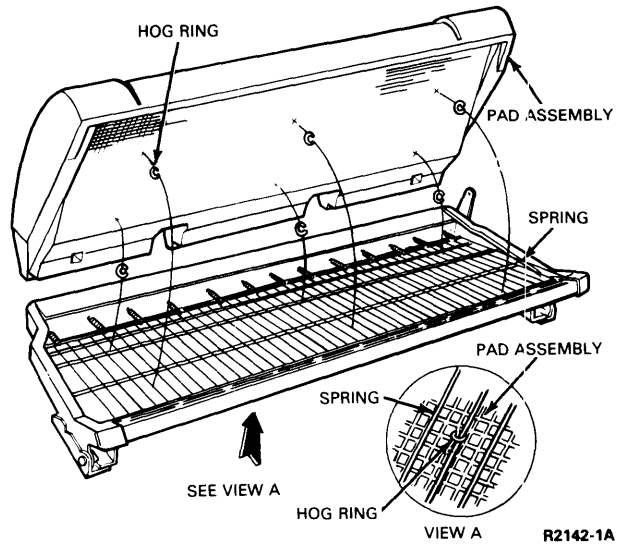


FIG. 11 Rear Folding Seat—Bronco

REMOVAL AND INSTALLATION

SEAT CUSHION AND BACK COVER—BUCKET SEAT

BRONCO, F-SERIES AND E-100—E-350 (FIGS. 1, 2 AND 3)

Repairs to seat cushions or seat backs are performed out of the vehicle and are usually limited to replacement of torn or burned seat covers. In a few instances, the pads may be damaged and require replacement.

When installing a new seat or back cover assembly, refer to Figs. 1, 2 and 3. for the location of listing wires, hog rings, anti-squeak pads, and seat pad stack-up.

1. Remove the seat belt retainer loop (if so equipped), one screw. Remove the seat and track assembly if the cushion cover is to be replaced (Group 41).
2. Remove the seat tracks from the seat.
3. Remove the seat back assembly (Figs. 1, 2 and 3) and the seat cushion stops.
4. Remove the hog rings retaining the seat cushion cover to the frame and remove the cover.
5. Remove the back cushion stops and the seat back release handle.
6. Remove the seat back panel assembly (retained with clips).
7. Remove the hog rings retaining the seat back cover to the frame and remove the cover.
8. Transfer the bolster wires to the cover listings.
9. Position the seat cushion cover to the seat and install the hog rings as shown in Figs. 1, 2 and 3. Install the seat cushion stops.
10. Position the seat back assembly and install the hog rings, (Figs. 1, 2 and 3).
11. Install the seat back stops, release handle and rear seat back panel assembly. Then, install the seat back to the seat cushion assembly.
12. Install the seat tracks to the seat cushion and tighten to specifications, (Group 41).
13. Install the seat assembly into the vehicle. Tighten to specifications, Group 41. Install the seat belt retainer loop (if so equipped), one screw.

SEAT CUSHION COVER—BENCH SEAT

BRONCO AND F-SERIES

1. Remove the seat and track assembly from the vehicle (Group 41).
2. Remove the seat back assembly (Figs. 4 and 5) from the seat cushion.
3. Cut the hog rings retaining the cushion cover to the frame assembly and remove the cover.
4. Transfer the listing wires from the old cover to the listings in the new cover.
5. Position the cover over the spring assembly and fasten the cover with hog rings.
6. Install the seat back to the seat cushion.
7. Install the seat and track assembly into the vehicle and tighten the attaching screws and washers to specifications shown in Group 41.

SEAT BACK COVER—BENCH SEAT

BRONCO, F-SERIES

1. Remove the seat back-to-cushion mounting bolts and washers. Separate the back from the cushion and lift the seat back out of the vehicle.
2. Cut the hog rings attaching the cover to the seat back or cushion spring assembly (Figs. 3 and 4) and remove the seat back cover.
3. Remove plastic retainers and front seat back trim panel.
4. If the padding is being replaced, cut the hog rings that attach the padding to the spring assembly and remove the padding.
5. Position the new pad to the seat back assembly and fasten it in place with hog rings.

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6. Transfer the listing wires from the old cover to the listings in the new cover.
7. Position the new cover over the padding, pull the cover tight, and fasten the cover to the spring assembly with hog rings.
8. Install front seat back trim panel.
9. Install the seat back to the seat cushion assembly.

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WINDOW GLASS AND MECHANISMS

GROUP 42 (70000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Front Door Window Glass and Mechanisms	42-04	Tailgate Window Mechanisms	42-35
Pivot Type Rear Door and Side Window	42-25	Vent Window Mechanisms	42-15
Rear Door Window Glass and Mechanisms	42-30	Window Glass and Mechanisms General Service	42-01

Window Glass and Mechanisms General Service

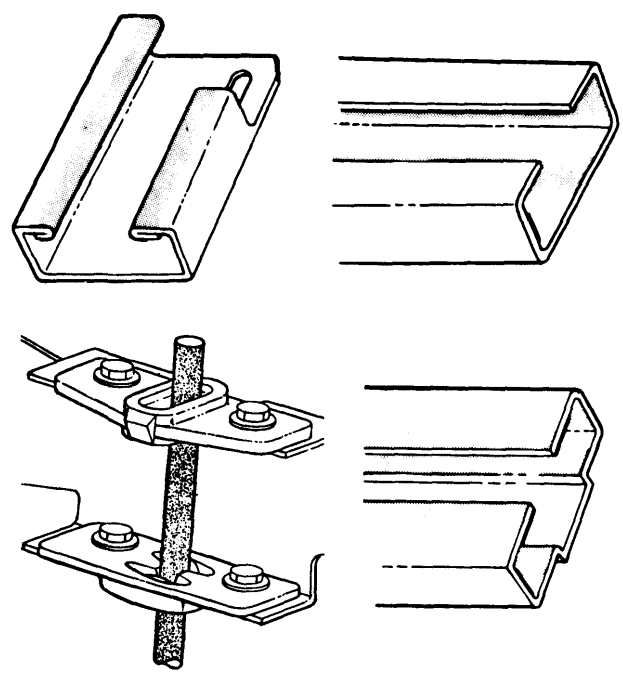
PART 42-01

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GENERAL INFORMATION	01-1		

GENERAL INFORMATION

WINDOW MECHANISM LUBRICATION

The door window mechanism should be properly lubricated to provide ease of operation. The window glass mechanism should be lubricated whenever the glass channel or window regulator is removed or excessive effort is required to operate the windows. To lubricate a door window mechanism, apply an even coating of Polyethylene grease (C4AZ-19584-A or equivalent) to the window regulator rollers, shafts and the entire length of the roller guides as illustrated by the shaded areas in Fig. 1.



APPLY AN EVEN COATING OF POLYETHELENE GREASE C4AZ-19584-A, OR EQUIVALENT TO ALL WINDOW REGULATOR ROLLERS, SHAFTS AND THE ENTIRE LENGTH OF ROLLER GUIDES AS ILLUSTRATED BY THE SHADED AREAS.

N1607-1G

FIG. 1 Window Mechanism Lubrication

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Front Door Window Glass and Mechanisms

PART 42-04

APPLIES TO ALL MODELS

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Door Window	
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E-100 — E-350, F-100 — F-350 and Bronco	04-4

ADJUSTMENTS

WINDOW MECHANISM

E-100—E-350

1. Remove the trim panel from the door, if so equipped.
2. Remove the access cover from the door.
3. Loosen the front run retainer and division bar lower attaching screw and the rear run retainer lower attaching screw(Fig. 1).
4. Lower the window glass until the top edge of the glass is approximately four inches above the belt line (Fig. 1).
5. Tighten the screws, (Fig. 1) and check the operation of the window mechanism.
6. Install the access cover and, if so equipped, the trim panel on the door.

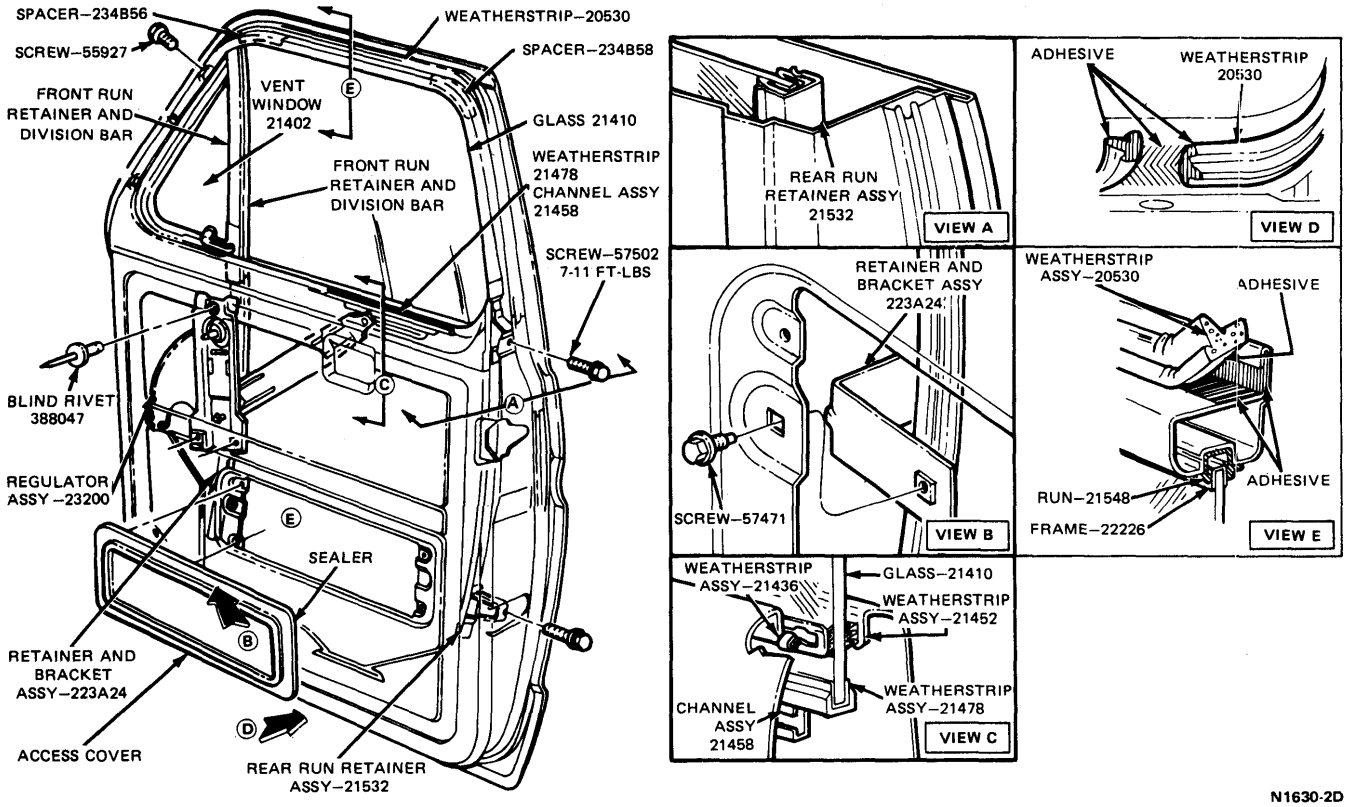


FIG. 1 Front Door Window Glass Adjustment—E-100—E-350

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DOOR WINDOW

F-SERIES AND BRONCO

Eliminate the looseness by performing the following adjustment procedures (Fig. 2).

1. Lower glass to full down position.
2. Using a blunt tool, remove door glass run at rear of door frame from top of door to belt.
3. Install piece of two-sided vinyl foam tape (ESBM3G-111-A or equivalent 1/2" wide x 1/8" thick x 14" long as shim into the run retainer.
4. Install run and cycle glass to assure smooth operation.

If after performing the above adjustment procedure the glass tilts and/or comes out of glass run approximately 2/3 of way up, perform the following:

1. Remove door trim panel and watershield.
2. Lower glass to full down position.
3. Loosen tapping screws retaining vent window to door frame. Also, loosen retainer screw for vent window division bar.
4. Raise vent window as high into door frame as it will go and tighten tapping screws. Then, tighten cover retainer screw.
5. Cycle glass to assure smooth operation.

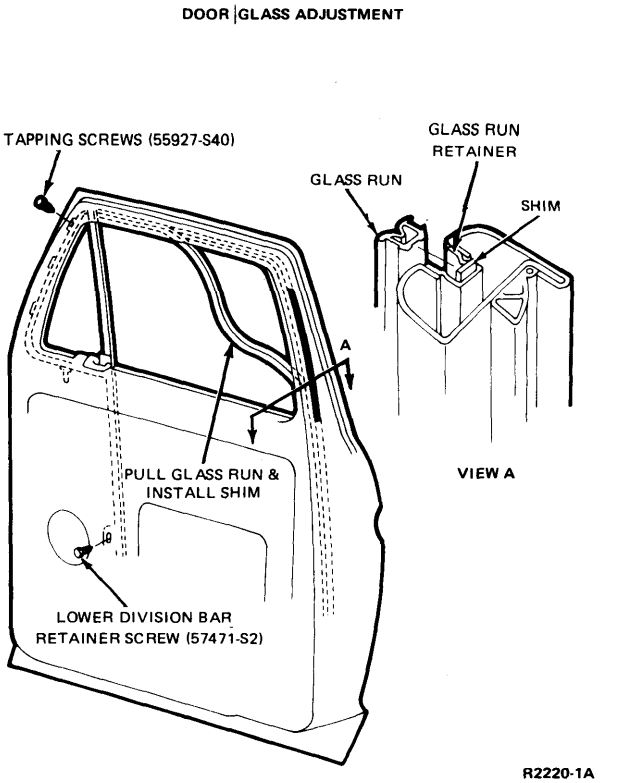


Fig. 2 Door Glass Adjustment—F-100—F-350 and Bronco

REMOVAL AND INSTALLATION

FRONT DOOR GLASS

E-100—E-350

Removal

1. Remove the door trim panel.
2. Remove three screws attaching the vent window assembly to the upper leading edge of the door (Fig. 1).
3. Remove one screw attaching the front run retainer and division bar bracket to the door (View B).
4. Slide the front run from the front run retainer and division bar.
5. Unsnap and remove the belt line weatherstrip from the door (View C).
6. Lower the glass. Remove two screws attaching the rear run retainer to the door edge, and lower the rear run retainers to the bottom of the door.
7. Tilt the vent window and division bar assembly rearward and separate the vent window from the front run retainer and division bar. Then, remove the vent window and the front run retainer and division bar from the door.
8. Rotate the front edge of the glass downward, and lift the glass and channel assembly from the door, sliding the glass channel off the regulator arm roller.
9. Remove the glass channel from the glass with the tool shown in Fig. 3.

GLASS AND CHANNEL REMOVAL TOOL (NO. 2900) AVAILABLE FROM SOMMER AND MALA GLASS MACHINE COMPANY, 5501 W. OGDEN AVENUE, CHICAGO 50, ILLINOIS

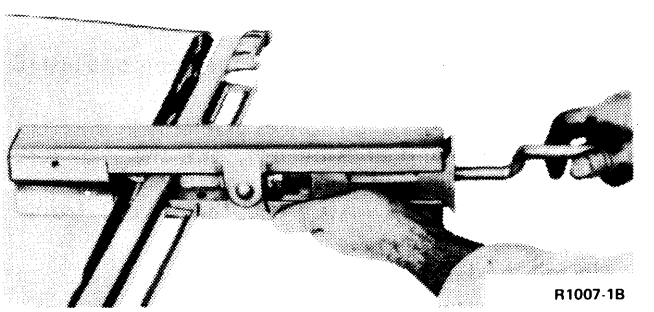


FIG. 3 Glass Channel Replacement

Installation

1. Install the glass channel on the glass with the tool shown in Fig. 4.
2. Lubricate the window mechanism as shown in Part 42-01.
3. Position the glass and channel assembly in the door, inserting the regulator arm roller in the glass channel.

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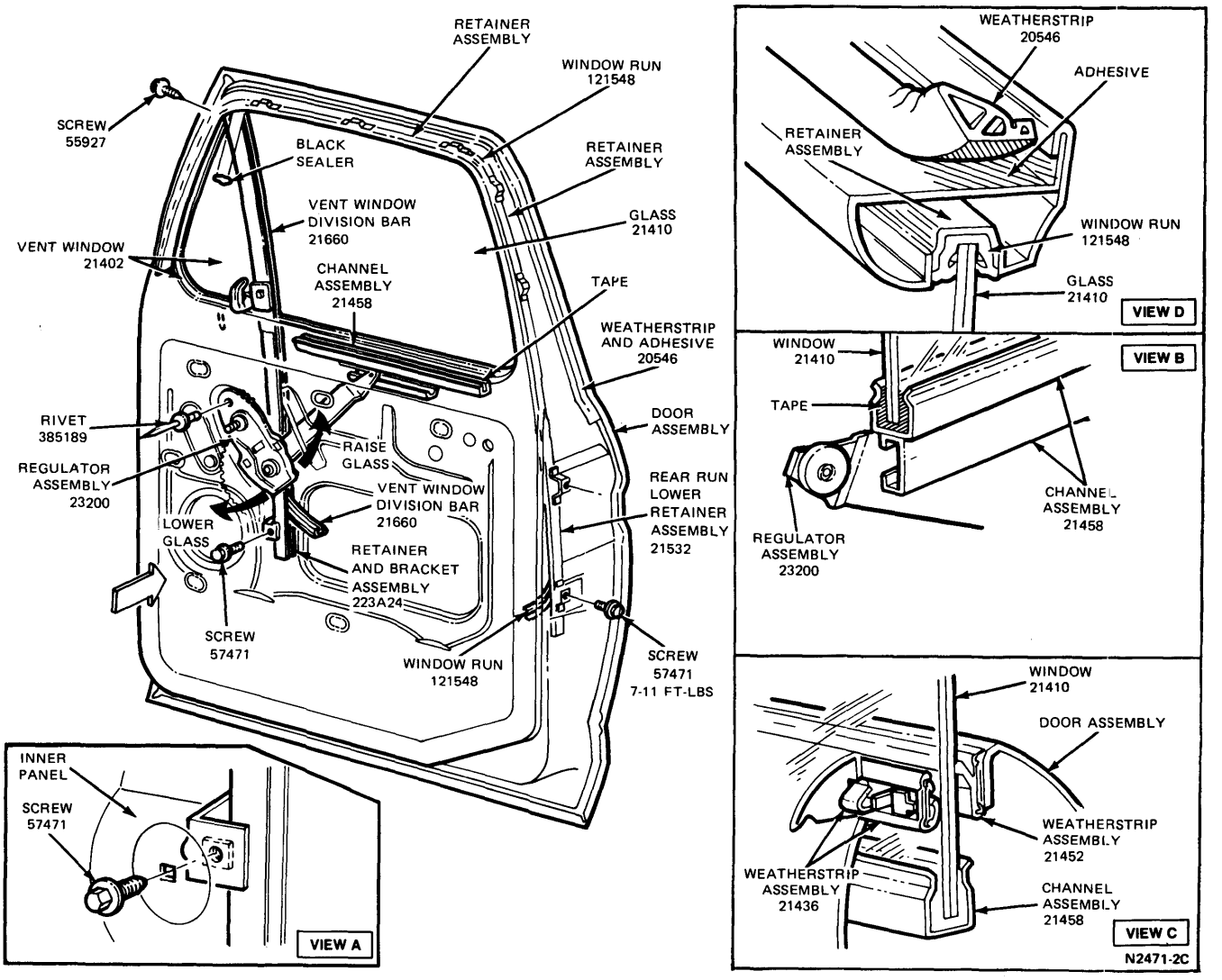


FIG. 4 Window Mechanism Adjustment—Bronco and F-Series Truck

4. Position the vent window and the front run retainer and division bar in the door. Then, insert the front run retainer and division bar in the rear edge of the vent window frame.
5. Position the rear run retainer to the door, and install the two attaching screws.
6. Position the glass and channel assembly in the front run retainer and division bar, and the rear run. Then, place the vent window assembly into position in the door, and install the three vent frame attaching screws.
7. Install the belt weatherstrips.
8. Insert the front run in the front run retainer and division bar.
9. Install the screw attaching the front run retainer and division bar bracket to the door.
10. Adjust the window glass as outlined in Adjustments.
11. Install the door trim panel, if so equipped.

BRONCO AND F-100 THRU F-350

Removal

1. Remove the door trim panel.
2. Remove the screw from the front run retainer (Fig. 2, View A).
3. Remove three vent window assembly attaching screws from the front edge of the door.
4. Lower the door glass and pull the glass run out of the upper run retainer near the vent window division bar only enough to allow removal of the vent window assembly (View D).
5. Tilt the vent window and division bar assembly toward the rear of the door and remove the vent window from the door.
6. Rotate the front edge of the glass downward and lift the glass from the door (View B).
7. Remove the glass from the glass channel with the tool shown in Fig. 4.

Installation

1. Install the glass in the glass channel with the tool shown in Fig. 4.
2. Position the glass and channel assembly into the door, inserting the regulator arm roller into the slot of the glass channel (View B, Fig. 2).

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3. Position the vent window and division bar into the door and insert the front edge of the glass into the division bar (front) run.
4. Install the three vent window attaching screws at the forward edge of the door.
5. Insert the glass run into the upper run retainer near the division bar.
6. Install the screw at the front run retainer (View A, Fig. 2) and adjust as outlined in Adjustments.
7. Check the operation of the window and install the door trim panel.

DOOR GLASS BELT WEATHERSTRIP

E-100—E-350

Removal

1. Remove the trim panel from the door inner panel.
2. Disconnect the regulator arm roller from the regulator arm by removing the roller retainer clip (Fig. 1) and pulling the arm from the roller. Allow the glass to rest at the bottom of the runs.
3. Unsnap and remove the belt line weatherstrip(s) from the door.

Installation

1. Position the weatherstrip to the door and snap into place.
2. Insert the retaining clip on the regulator arm roller and insert the roller in the glass channel.
3. Insert the window regulator arm pin in the roller and press firmly to lock the roller on the regulator arm.
4. Install the trim panel on the door inner panel.

WINDOW REGULATOR

E-100—E-350, F-100—F-350 AND BRONCO

Removal (Refer to Fig. 5)

1. Remove door trim panel and access cover, if so equipped.
2. Support glass in the full up position.
3. Remove center pin from regulator attaching rivets with drift punch. Then, drill head from each rivet using a 1/4" drill and remove rivet. Be careful not to route out sheet metal holes during drilling.
4. Disengage regulator arm from glass bracket and remove regulator.

Installation (Fig. 5)

1. Position regulator in door and insert arm into glass bracket channel.
2. Position regulator to inner panel and install rivets to attach regulator to inner panel. A 1/4"-20 x 1/2" screw and washer assembly and a 1/4"-20 nut and washer assembly may be used in place of the rivets if rivets not available.
3. Check operation of window mechanism and install door trim panel.

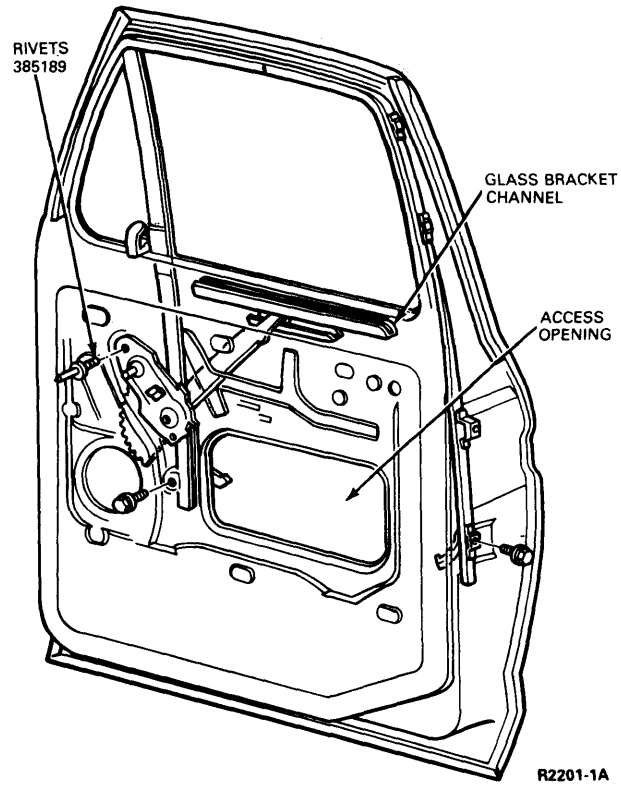


FIG. 5 Window Regulator—Removal and Replacement

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Vent Window Mechanism

PART 42-15

APPLIES TO ALL MODELS

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Vent Window Glass	
All Models	15-1

REMOVAL AND INSTALLATION

VENT WINDOW GLASS

ALL MODELS

Removal

1. Open the vent window.
2. Push the glass from the glass frame with the tool shown in Fig. 1

GLASS AND CHANNEL REMOVAL TOOL (NO. 2900) AVAILABLE FROM SOMMER AND MALA GLASS MACHINE COMPANY, 5501 W. OGDEN AVENUE, CHICAGO 50, ILLINOIS

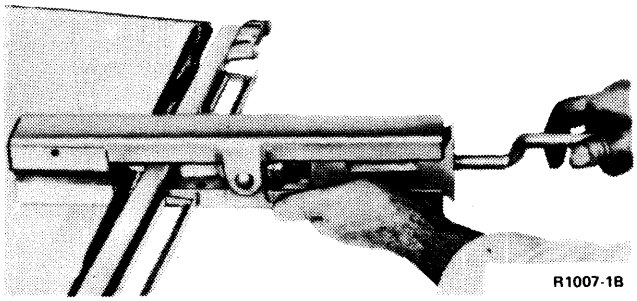


FIG. 1 Vent Glass Replacement

3. Clean the glass frame of tape and sealer.

Installation

1. Apply sealer to the glass frame.
2. Install the glass and new tape in the glass frame with the tool shown in Fig. 1.
3. Trim the excess edges of the tape around the glass frame and clean the glass and surrounding area.

VENT WINDOW ASSEMBLY

E-100—E-350

Removal

Refer to Fig. 1, Part 42-04.

1. Remove the access cover from the door inner panel.
2. Remove three screws attaching the vent window assembly to the upper leading edge of the door.
3. Remove one screw attaching the front run retainer and division bar bracket to the door (View B).
4. Slide glass and channel assembly off regulator arm with roller in down position.
5. Slide the front run out of the front run retainer and division bar.
6. Disconnect the regulator arm roller from the "C" channel bracket by pulling the arm from the channel.
7. Pull the rear run down and out of the run slot along the top of the glass opening.
8. Tilt the vent window and division bar assembly rearward and separate the vent window from the front run retainer and division bar. Then, remove the vent window and the front run retainer and division bar from the door.
9. Remove two screws attaching the vent window upper pivot to the vent window frame.
10. Remove the nut, spring, spacer and bushing from the vent window lower pivot. Then, separate the vent window glass and frame from the vent window frame.
11. To remove the weatherstrip, remove two screws from the top of the vent window frame. Then, straighten the weatherstrip retaining tabs and remove the weatherstrip.

Installation

1. Position the weatherstrip to the vent frame and bend the retaining tabs down to retain the weatherstrip. Install the two screws at the top of the vent frame.
2. Position the glass frame to the vent frame and install spacer, bushing, spring and nut on the vent window lower pivot. Adjust the spring tension to hold the vent window in any position at highway speeds.
3. Position the vent window upper pivot to the glass frame pivot and vent frame and install the two attaching screws.
4. Position the vent window and the front run retainer and division bar in the door. Then, insert the front run retainer and division bar in the rear edge of the vent window.

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5. Position the glass and channel assembly in the front run retainer and division bar. Then, place the vent window assembly into position in the door, and install three screws attaching the vent frame to the upper leading edge of the door.
6. Insert the rear run into the slot along the top edge of the window opening.
7. Insert the front run in the front run retainer and division bar.
8. Install the glass and channel assembly to regulator arm roller.
9. Install the screw attaching the front run retainer and division bar bracket to the door.
10. Adjust the window glass runs.
11. Install the access cover on the door inner panel.

BRONCO AND F-100—F-350

Removal

Refer to Fig. 3, Part 42-04.

1. Remove the door trim panel retaining screws and remove the door trim panel.
2. Remove the screw that retains the division bar to the door inner panel (View A).
3. Remove the three screws that attach the vent assembly to the leading edge of the door.
4. Lower the door glass.
5. Pull the top weatherstrip part way out of the door window frame in the division bar area (View D).
6. Tilt and remove the vent window and division bar assembly from the door.
7. Separate the run and retainer from the vent window division bar.
8. Remove two vent upper pivot-to-vent frame screws.
9. Remove the retaining nut and tension spring from the vent window lower pivot.
10. Separate the vent glass retainer and the pivot stops from the vent frame and weatherstrip assembly.

Installation

1. Position the vent glass retainer assembly with the pivot stops into the vent window frame and weatherstrip assembly.
2. Install the two upper pivot-to-frame retaining screws.
3. Install the pivot tension spring and retaining nut. Adjust spring tension so that the vent will stay open at highway speeds.
4. Position the run and retainer assembly in the vent window assembly.
5. Position the vent window and division bar assembly into the door and to the glass edge.
6. Install the three vent window frame-to-leading edge of door window frame retaining screws.
7. Position the weatherstrip back into the door window frame (division bar area).
8. Install the division bar lower run-to-door inner panel screw (adjust the run for proper door window operation).
9. Install the door trim panel.

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Pivot Type Rear Door and Side Window

PART 42-25

APPLIES TO E-100 THROUGH E-350 AND F SUPER CAB

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Movable Glass Weatherstrip	
E-100 — E-350 and Club Wagon	25-1
Light Truck with Super Cab	25-1

REMOVAL AND INSTALLATION

MOVABLE GLASS—DOOR AND BODY SIDE

E-100—E-350 AND CLUB WAGON

Removal

1. Remove the trim panel from the door, (if so equipped). It is not necessary to remove the body side trim panel unless the hinge on the body is to be removed.
2. Remove screws attaching the latch assembly and the latch anchor to the door or side inner panel. It is necessary to catch the loose tapping plate when removing the handle screws on the door flip windows (Figs. 1 and 2).
3. Remove glass and latch assembly by rotating it out to disengage the hinge.
4. To remove the hinge from the door or body remove the four screws.

Installation

1. Position the hinge to the body and tighten the four screws (8-20 in-lbs).
2. Engage the glass and latch assembly into the hinge. Rotate the hinge to a closed position.
3. Position the latch plate to the door or side inner panel. Position the latch anchor inside the door and install the attaching screws. The latch anchor is attached to the body side inner panel when equipped with garnish mouldings (Figs. 1 and 2). Tighten the screws to 2-6 ft-lbs torque.
4. Install the door trim panel, if so equipped.

MOVABLE GLASS WEATHERSTRIP

E-100—E-350 AND CLUB WAGON

1. Open the window and pull the weatherstrip from the window opening.
2. Apply weatherstrip adhesive to both sides of the window opening flange around the entire perimeter of the opening.
3. Install the weatherstrip on the window opening flange as shown in Figs. 1 and 2.
4. Apply lubricant ESB-M99B67-A ESB-M99B77-A, or equivalent to outside surface of weatherstrip along entire top and 4 inches on each side at top.

LIGHT TRUCK WITH SUPER CAB

Removal

1. Mark the position of the latch on the body. Remove the latch bracket cover for access to the attaching bolts and remove the bolts (Fig. 3).
2. With an assistant, depress each side of the hinge and pull the hinge from the body. Repeat this procedure for the other hinge.
3. Push the hinge pin from each hinge with a small diameter rod inserted through the hole in the bottom of the hinge. Then, remove the hinges from the glass frame.
4. Remove the latch from the glass.

Installation

1. Install the latch on the glass.
2. Position the hinges to the glass and install the hinge pins.

   NOTE: The large hole in the hinge must be on the top when installed.
3. Position the hinges to the body and press them firmly into place.
4. Position the latch to the body in the same location it was in before being removed. **Failure to properly position the latch could result in glass failure.**
5. Install the two latch attaching bolts and tighten securely.
6. Install the latch bracket cover.

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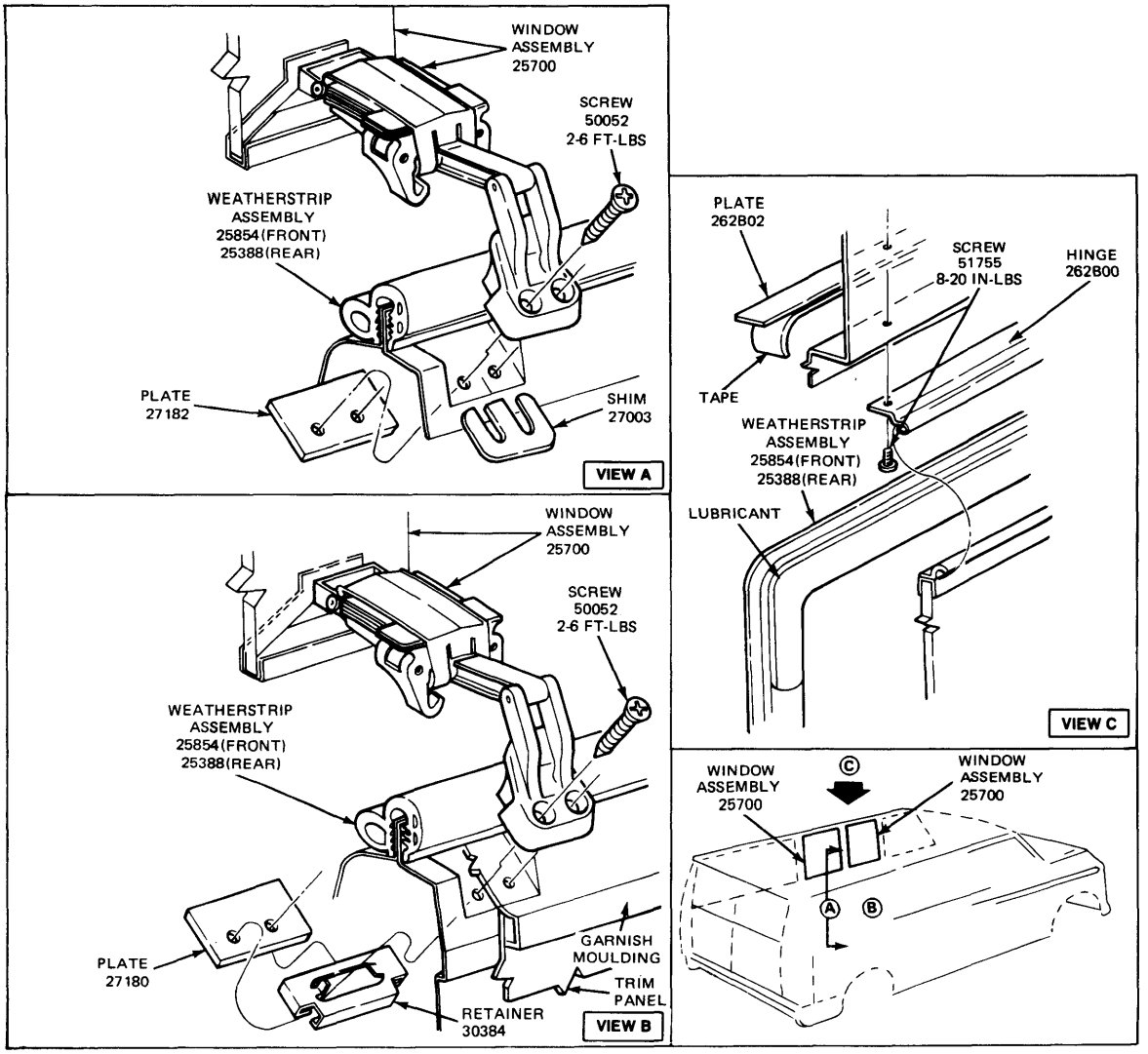


FIG. 1 Body Side Pivot Windows—E-100—E-350—Club Wagon

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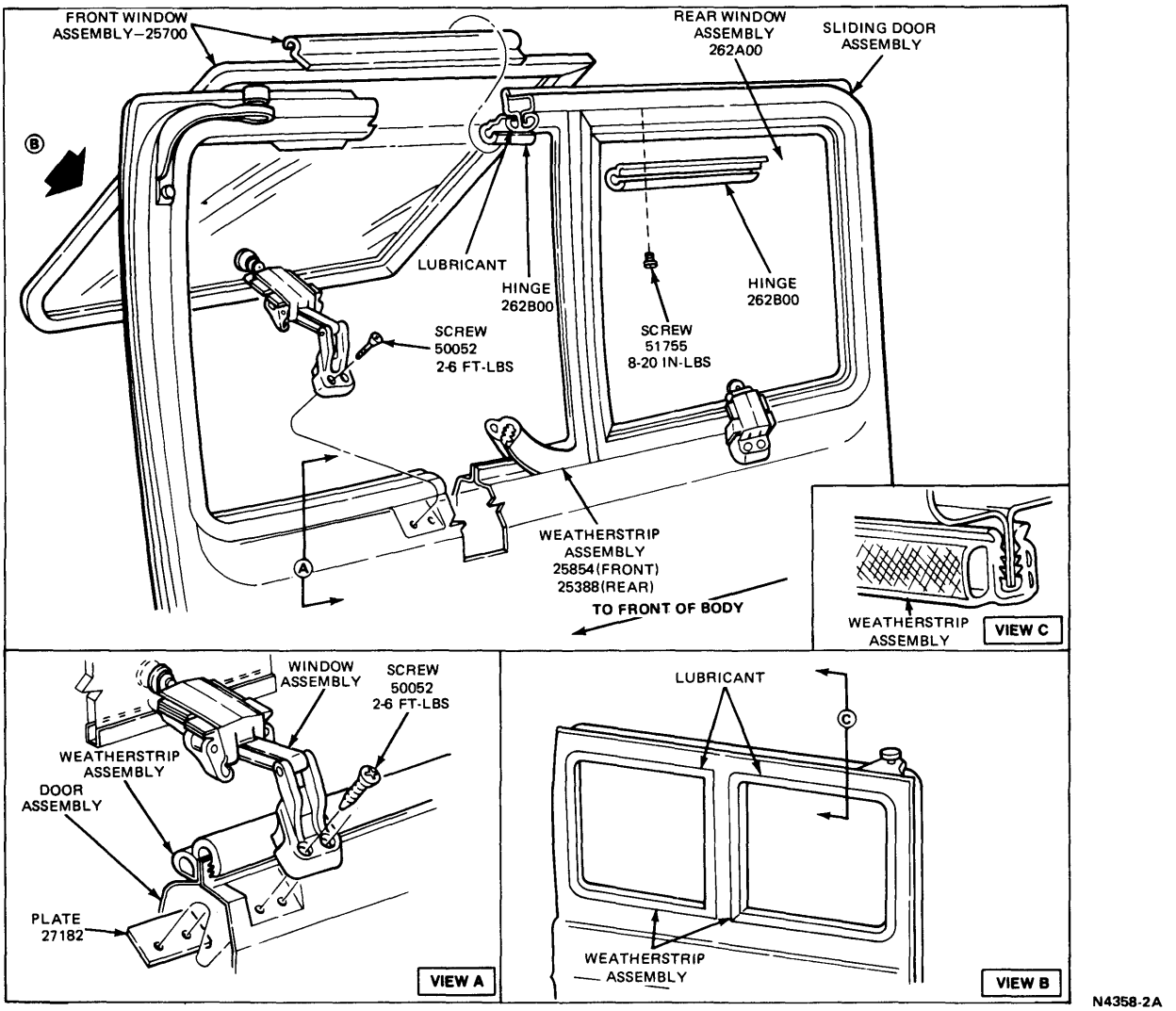


FIG. 2 Sliding Door Pivot Windows—E-100—E-350—Club Wagon

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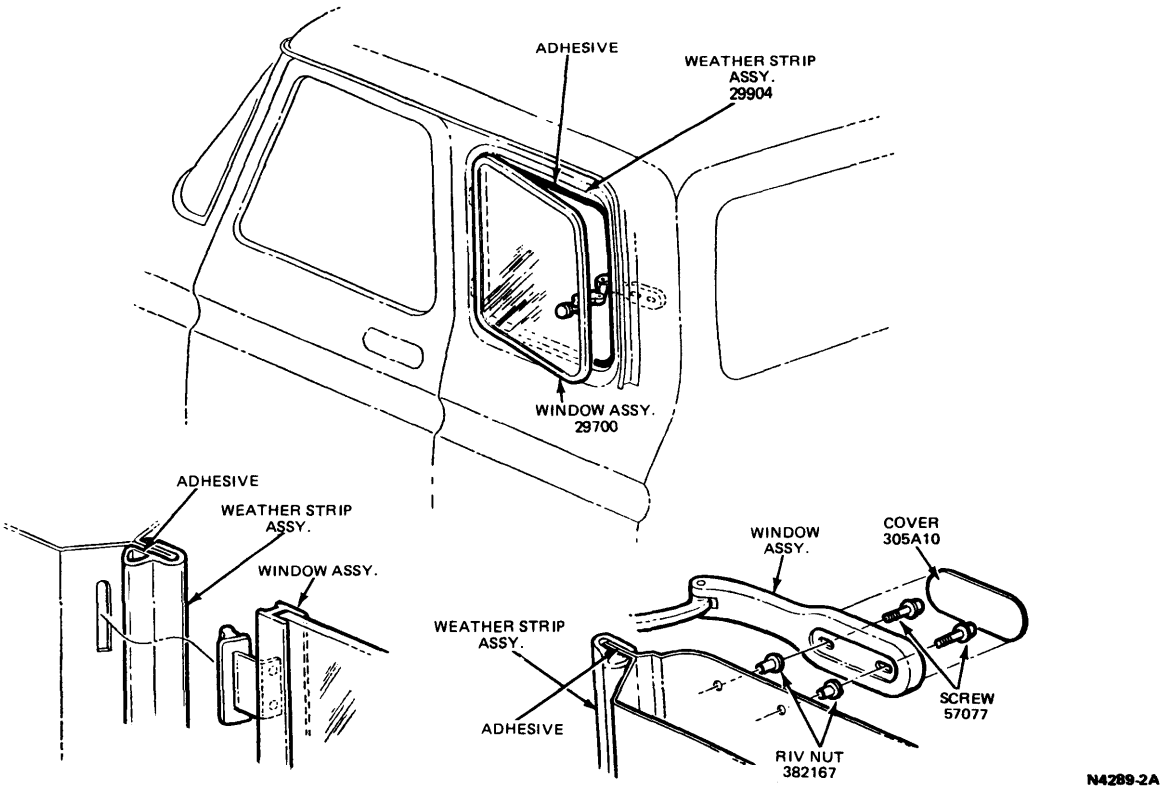


FIG. 3 Pivot-Type Window Installation—Light Truck Super Cab

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Rear Door Window Glass and Mechanisms

PART 42-30

APPLIES TO CREW CAB ONLY

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	30-1	REMOVAL AND INSTALLATION	30-2

ADJUSTMENTS

DOOR WINDOW ADJUSTMENT

CREW CAB

1. Remove the door trim panel and watershield.
2. Loosen the screw and washer at the lower end of the front run retainer (Fig. 1, View A).
3. Loosen the rear run lower attaching screw (Fig. 3).
4. Lower the glass 1/3 of the way down. Adjust the screw at the lower end of the front run retainer until the washer on the stud just comes against the door inner panel. Then, tighten the front run retainer, screw and washer assembly, and the rear run lower attaching screw.
5. Lower the glass and check the height of the top edge of the glass. It should be approximately flush with the top edge of the belt line. If adjustment is necessary, loosen the regulator attaching screws and rotate the regulator down and forward to lower the glass, or up and rearward to raise the glass. Tighten the regulator attaching screws when the correct height is obtained.
6. Install the watershield and trim panel on the door.

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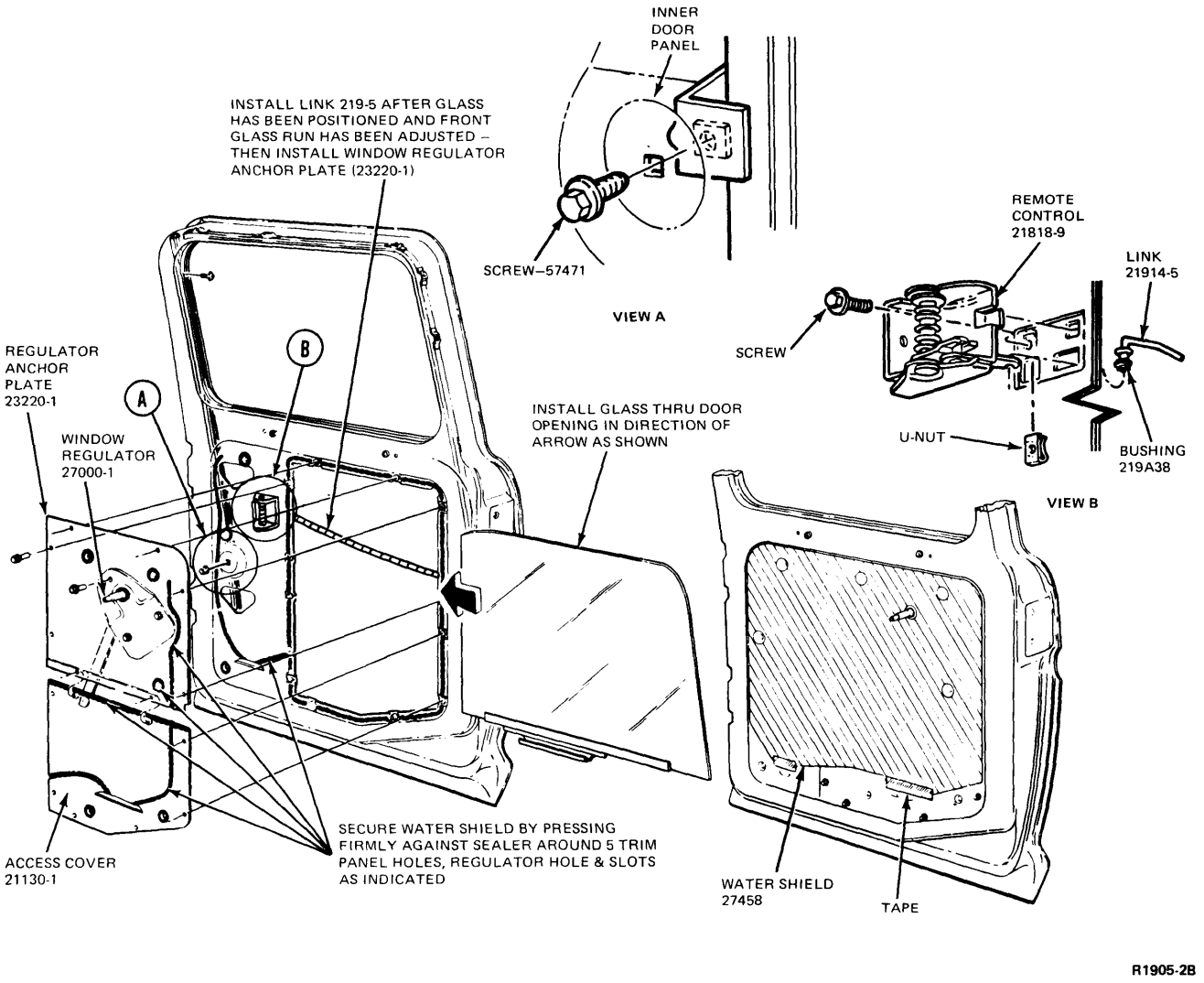


FIG. 1 Door Window Glass and Mechanism—Crew Cab Rear Door

REMOVAL AND INSTALLATION

Removal

1. Remove the door handle and window regulator handle and remove the door trim panel, (see Part 45-03).
2. Remove the window regulator (Part 42-04).
3. Remove the lower access panel or cover.
4. Disconnect the remote control link and remove the remote control attaching screws. Remove the remote control.
5. Remove the screw from the front run retainer stud.
6. Lower the door glass and pull the glass run out of the upper run retainer.
7. Swing the front run forward to clear the glass. Work the glass rearward out of the access hole in the door. Remove the glass from the glass channel with the tool shown in Fig. 2.

Installation

1. Install the glass into the glass channel with the tool shown in Fig. 2. Lubricate the window mechanisms as shown in Part 42-01.
2. Position the glass and channel assembly into the door as shown in Fig. 1. Position the glass into the front and rear runs and install the front run retainer screw.
3. Raise the glass.
4. Install the remote control and connect the remote control link.
5. Install the lower door access panel. Position the regulator arm roller into the slot in the glass retainer.
6. Install the perimeter retaining screws and tighten securely.
7. Check the operation of the window regulator and install the door trim panel watershield, trim panel, door handle and window regulator crank.

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GLASS AND CHANNEL REMOVAL TOOL (NO. 2900) AVAILABLE FROM
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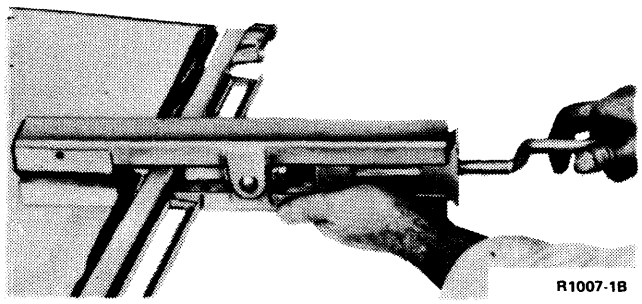


FIG. 2 Glass Channel Replacement

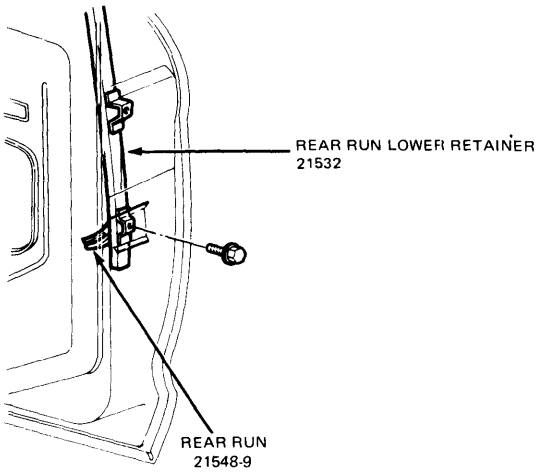


FIG. 3 Window Glass Run Retainers

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Tailgate Window Mechanisms

PART 42-35

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION	35-1
Tailgate Glass	35-1		

ADJUSTMENTS

TAILGATE GLASS

1. Fore and aft adjustments can be made after opening the tailgate by loosening the back window-side glass run attaching screws (2 per side). Adjust the glass as required and tighten the attaching screws (6-11 ft-lbs) (Fig. 1).
2. To adjust the glass side to side remove the tailgate inside cover panel and loosen the window glass to window bracket screws and nuts (4 screws and nuts). Tighten the screws and nuts after positioning the glass (6-11 ft-lbs.)

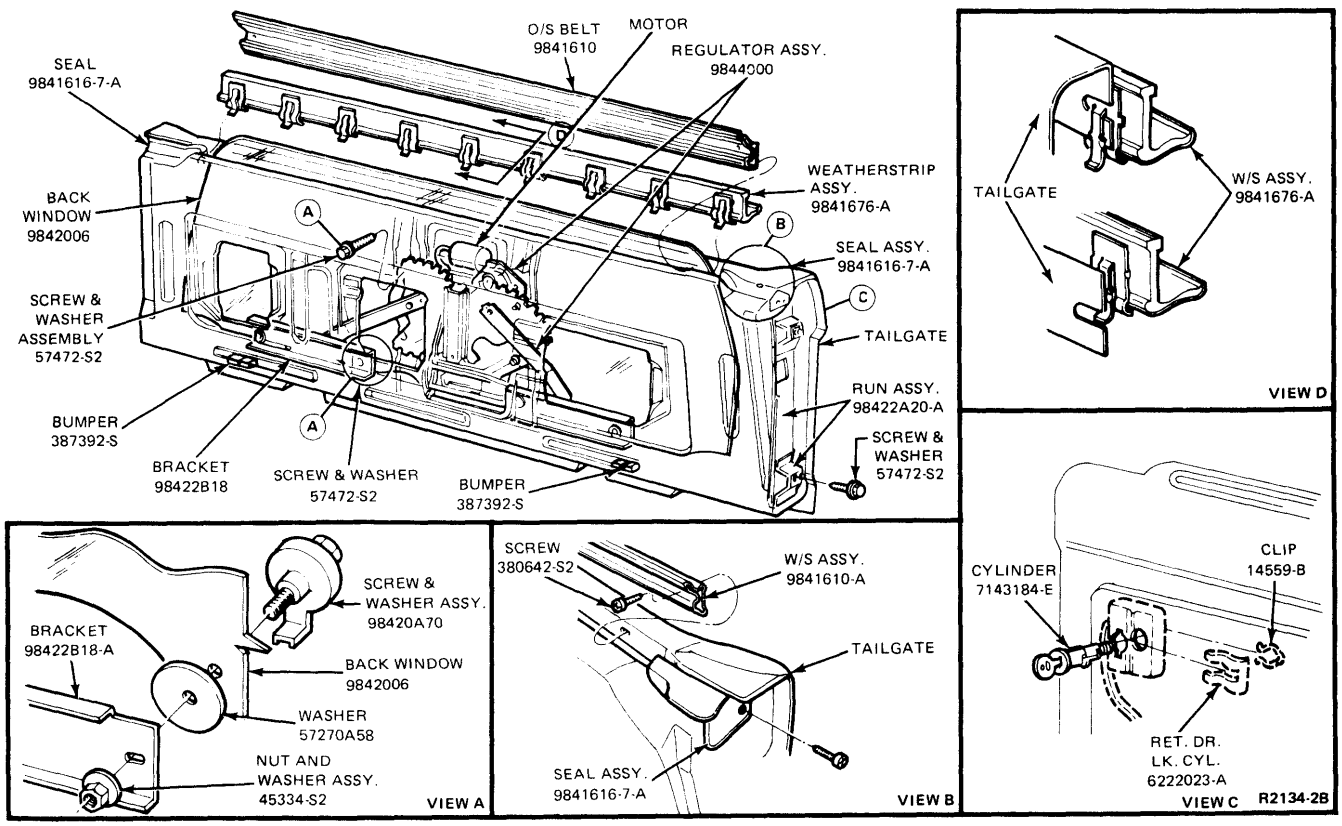


FIG. 1 Tailgate Window Mechanism and Belt Weatherstrips—Bronco

REMOVAL AND INSTALLATION

Removal

1. Open the tailgate.
2. Remove the inside cover panel and remove four screw assemblies, washers and nuts attaching the glass to the glass brackets (Fig. 1, View A).
3. Slide the glass from the tailgate assembly.

Installation

1. Position the glass in the open tailgate and install four screw assemblies, washers and nuts to the window glass brackets.
2. Check window operation and adjust if necessary.
3. Install the inside cover plate.

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STATIONARY WINDOW GLASS

GROUP 43 (70000)

PART TITLE	PART NO.
Stationary Glass — Butyl Type Seal	43-11
Stationary Glass — Weatherstrip Type Seal	43-01

Stationary Glass — Weatherstrip Type Seal

PART 43-01

APPLIES TO E-100 — E-350, F-100 — F-350 AND BRONCO

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REMOVAL AND INSTALLATION (Cont'd.)	
Rear Side Window Glass	
Bronco and F-Series Super Cab	01-2
Windshield	
Bronco, and F-Series	01-1

REMOVAL AND INSTALLATION

WINDSHIELD

BRONCO AND F-SERIES

Removal

1. Remove the windshield wiper arms and blades.
2. Remove the inside rear view mirror and bracket.
3. Remove interior retaining brackets.
4. Loosen the weatherstrip around the windshield opening.
5. Push the windshield glass, and mouldings, (if so equipped), out of the windshield opening from inside the vehicle.
6. Remove the mouldings, (if so equipped), from the weatherstrip (Fig. 1).
7. Remove the weatherstrip from the glass.
8. Clean the glass and/or weatherstrip of all old sealer if either is to be re-used.

Installation

1. Clean the windshield opening flange to remove all old sealer or other foreign material.
2. Apply sealer (19563 or equivalent), to the windshield opening flange.
3. Position the weatherstrip on the windshield glass.
4. Reinstall the mouldings.
5. Insert a draw cord in the pinch weld opening of the weatherstrip all around the weatherstrip. Overlap the cord about 18 inches at the lower center of the glass. Tape the ends of the cord to the inside of the glass as shown in Fig. 2.
6. Coat the weatherstrip mounting surfaces with a solution of mild soap and water. **DO NOT USE SILICONE LUBRICANT.** Position the mouldings on the weatherstrip, (Fig. 1).
7. Position the windshield and weatherstrip to the windshield opening.
8. With an assistant applying hand pressure to the outside of the windshield, pull the draw cord from the inside to pull the lip of the weatherstrip over the windshield opening flange. Draw the weatherstrip lip over the lower flange, each side of the flange, and then over the upper flange.
9. Apply sealer (19563 or equivalent) around opening.
10. Install the rear view mirror and bracket.
11. Clean the glass and surrounding area.
12. Install the windshield wiper arms and blades.
13. Reinstall the interior retainers.

BACK WINDOW

F-SERIES AND BRONCO

Removal

1. Remove the outside mouldings from the weatherstrip, if so equipped (Fig. 3). **Note:** Some

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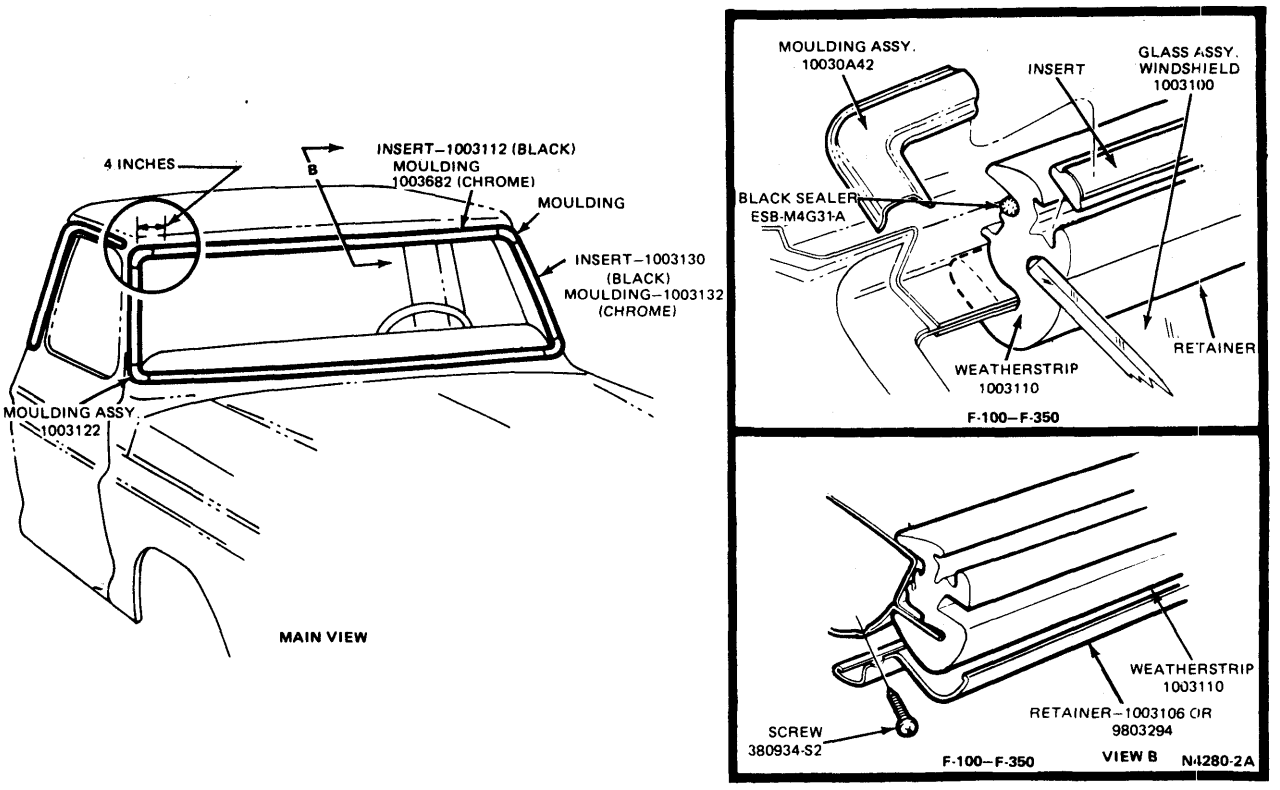


FIG. 1 Windshield Installation—F-Series Shown—Bronco Typical

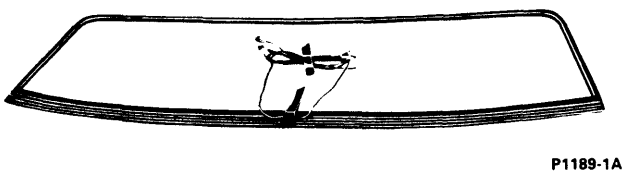


FIG. 2 Draw Cord Installed—Typical

F-Series have vinyl mouldings. It is not necessary to remove the mouldings for glass removal.

2. Push the back window glass and weatherstrip out of the window opening from inside the cab.
3. Remove the weatherstrip from the glass and clean all sealer from the weatherstrip and/or glass, if either is to be re-used.
4. Clean all sealer from the back window opening.

Installation

1. Position the weatherstrip to the back window glass.
2. Install a draw cord all around the weatherstrip in the flange crevice, allowing the cord to overlap at the bottom center of the glass. Coat the weatherstrip mounting surface with rubber lube (19583 or equivalent).
3. Apply (19554 or equivalent) sealer to the back window opening as shown in Fig. 3.
4. Position the glass and weatherstrip to the window opening. With a helper applying hand pressure from outside the cab, pull (from inside) the weatherstrip lip over the window opening flange with the draw cord. Pull the weatherstrip over the lower flange pulling one end of the cord at a time. Then, pull the weatherstrip over the side flanges and upper flange. Install the outside mouldings, (if so equipped).
5. Clean the glass and the area around the window to remove all excess sealer.
6. Test for water leaks.

REAR SIDE WINDOW GLASS

BRONCO AND F-SERIES SUPER CAB

When removing or replacing the glass, a helper must be employed to work outside the vehicle.

Removal

1. Working from inside, start at one corner and work across the top of the glass, pulling the weatherstrip down and pushing the glass and weatherstrip outward until the helper can grasp the glass and lift it from the glass opening.
2. Remove the weatherstrip from the glass (Fig. 4).

Installation

1. Clean the weatherstrip with cleaning solvent to remove all old sealer and cement.
2. Clean the glass opening flange. Check the flange for wavy areas, and repair as necessary.

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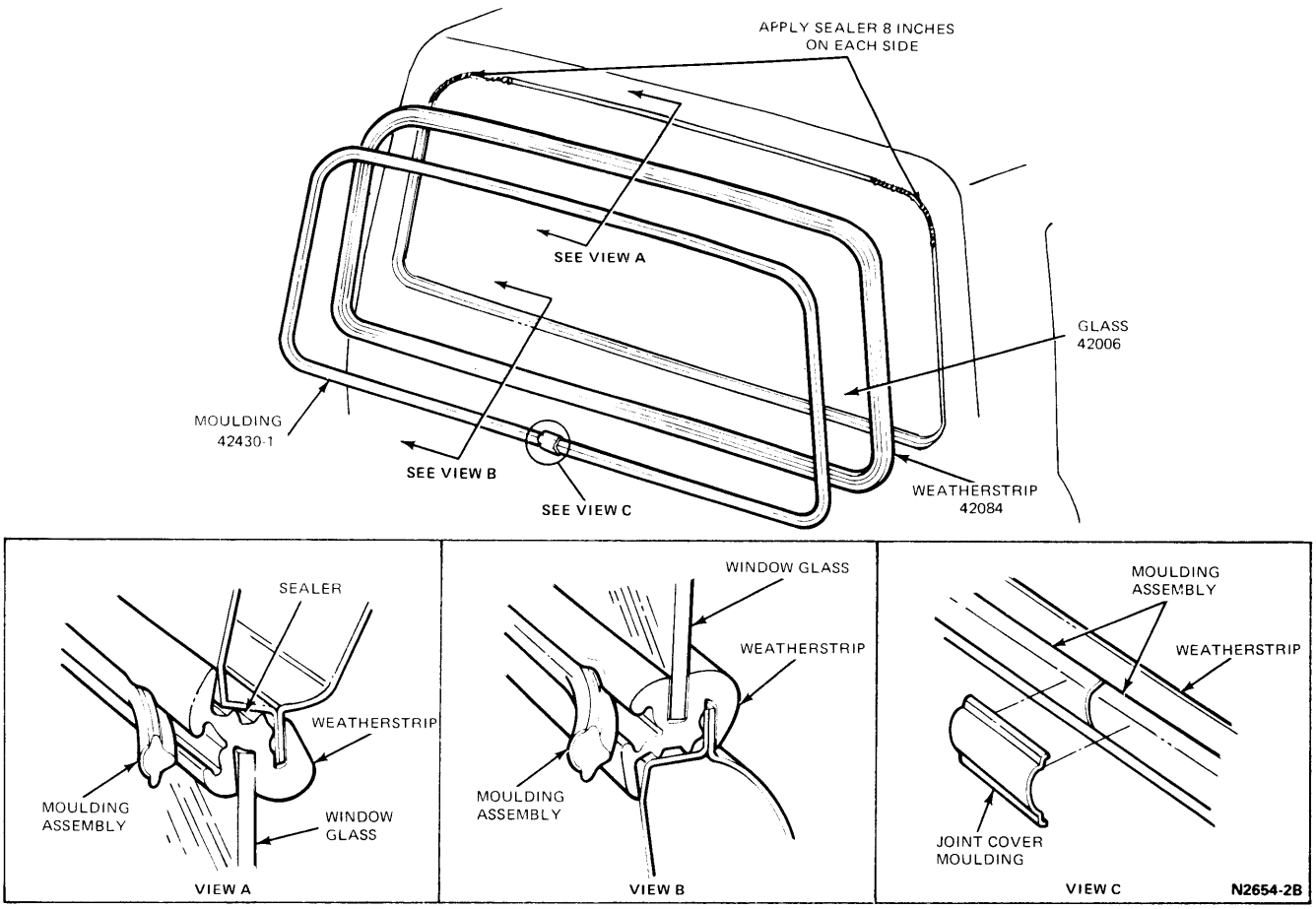


FIG. 3 Stationary Back Window Installation—F-Series and Bronco

3. Apply sealer, (19554 or equivalent), in the glass crevice of the weatherstrip and install it on the glass.
4. Run a bead of sealer around the opening flange and in the inner flange crevice of the weatherstrip. See Figs. 4 and 5.
5. Install a draw cord all around the weatherstrip in the flange crevice. Let the draw cord overlap at the bottom center. Apply rubber lube to the weatherstrip lip.
6. Have a helper position the window assembly in the window opening and apply hand pressure on the glass from the outside. From the inside, draw the lip of the weatherstrip over the window opening lower flange with a draw cord. Alternate from side to side, moving about 12 inches at a time, until the window is in place.
7. Water test the installation for leaks, and seal with additional sealer if necessary.

BODY SIDE AND REAR WINDOW GLASS

E-100—E-350

Removal and Installation

NOTE: Mouldings can be installed on the bench prior to window installation.

1. Loosen the weatherstrip around the inside and outside of the window opening.
2. From the inside of the vehicle, push the glass and weatherstrip from the window opening.
3. Remove the weatherstrip from the glass.
4. Clean the weatherstrip and body opening to remove all old sealer.
5. Apply sealer, (C5AZ-19554-A or equivalent), in the glass groove of the weatherstrip (Fig. 6).
6. Apply sealer, (C5AZ-19554-A or equivalent), around the entire perimeter of the window opening.
7. Position the weatherstrip to the window glass. Install a draw cord in the pinch weld opening of the weatherstrip. Overlap the cord about 18 inches at the lower center of the glass and tape the ends of the cord to the inside of the glass.
8. Position the window glass and weatherstrip to the body opening.
9. With an assistant applying hand pressure from the outside, pull the draw cord to pull the lip of the weatherstrip over the window opening flange. Draw the weatherstrip over the lower flange, each side flange, and then over the upper flange.
10. Clean the glass, weatherstrip, and surrounding area to remove all excess sealer.
11. Test for water leaks.

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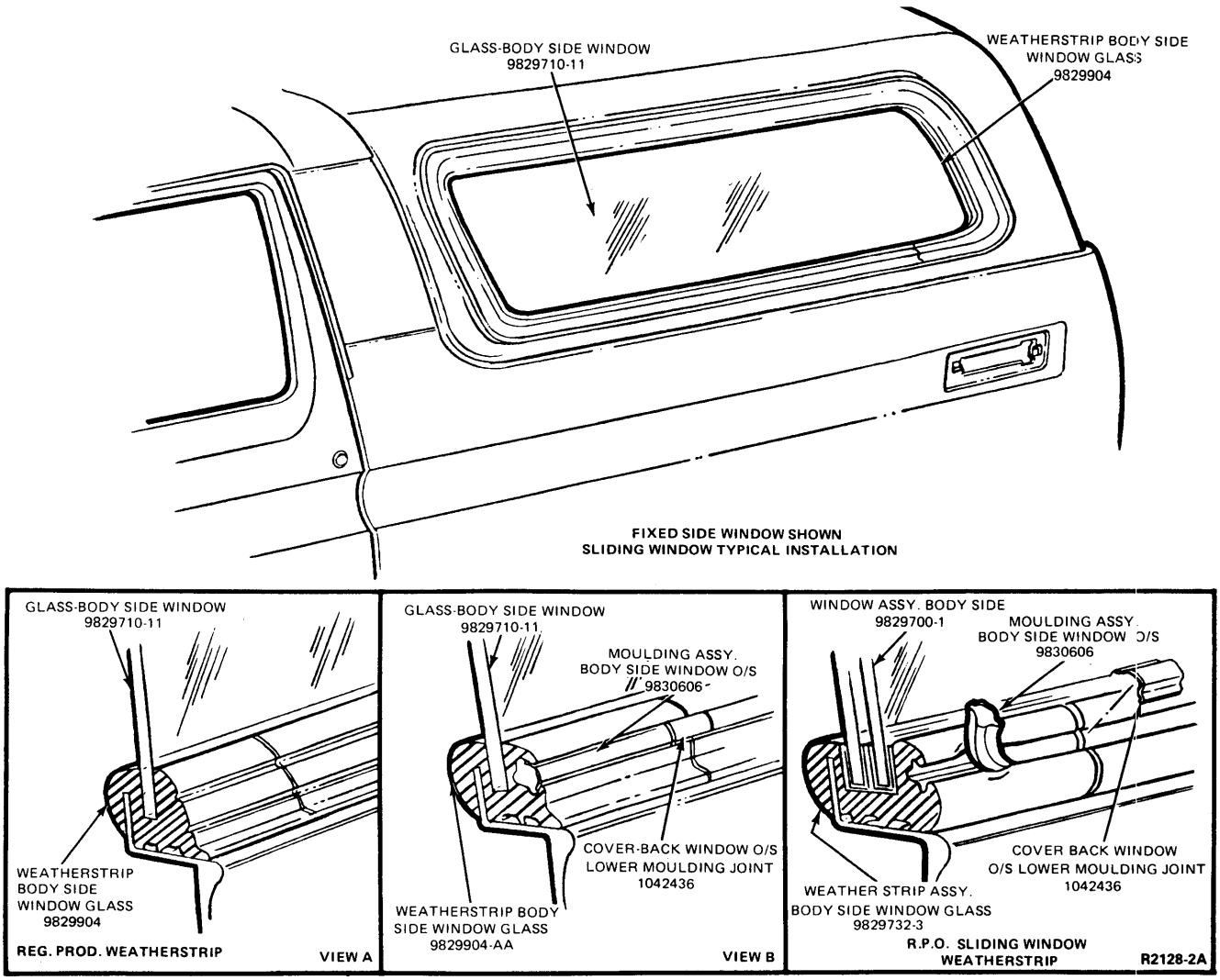


FIG. 4 Rear Side Window Installation—Bronco

MOVABLE BACK WINDOW
F-SERIES AND BRONCO

Removal

1. Push the back window frame and weatherstrip out of the window opening from inside the cab (Fig. 7).
2. Remove the weatherstrip from the window frame and place the movable windows in the open position.
3. From the bottom of the window frame, remove the screw retaining each division bar. Also, remove the two screws retaining the anchor plate in the window track and remove the plate.
4. Spread the window frame and work the movable glass out of its track, and remove it from the frame.
5. If the stationary glass is to be replaced, remove the division bar top retaining screw and remove the division bar.
6. Spread the window frame just enough to permit the stationary glass to be worked out of the frame.

Installation

1. If the stationary glass is to be replaced, apply Lubricant, (19558 or equivalent), to the window weatherstrip and track. Spread the frame slightly and slide the glass into place, in the frame. Do not allow the weatherstrip to bunch.
2. Position the division bar in the frame and install the top retaining screw.
3. Spread the frame slightly and install the movable glass in its track.
4. Position the anchor plate in the window track and install the two retaining screws.
5. Install the division bar lower retaining screws.
6. Position the weatherstrip to the window frame.
7. Install a draw cord all around the weatherstrip in the flange crevice, allowing the cord to overlap at the bottom center of the glass.
8. Apply sealer, (19554 or equivalent), to the back window opening as shown in Fig. 7.
9. Position the glass and weatherstrip to the window opening. With an assistant applying hand pressure from outside the cab, pull the weatherstrip lip over the window opening flange with a draw cord. Pull the weatherstrip over the lower flange, pulling one end of the cord at a time. Then, pull the seal over the side flanges and upper flange.

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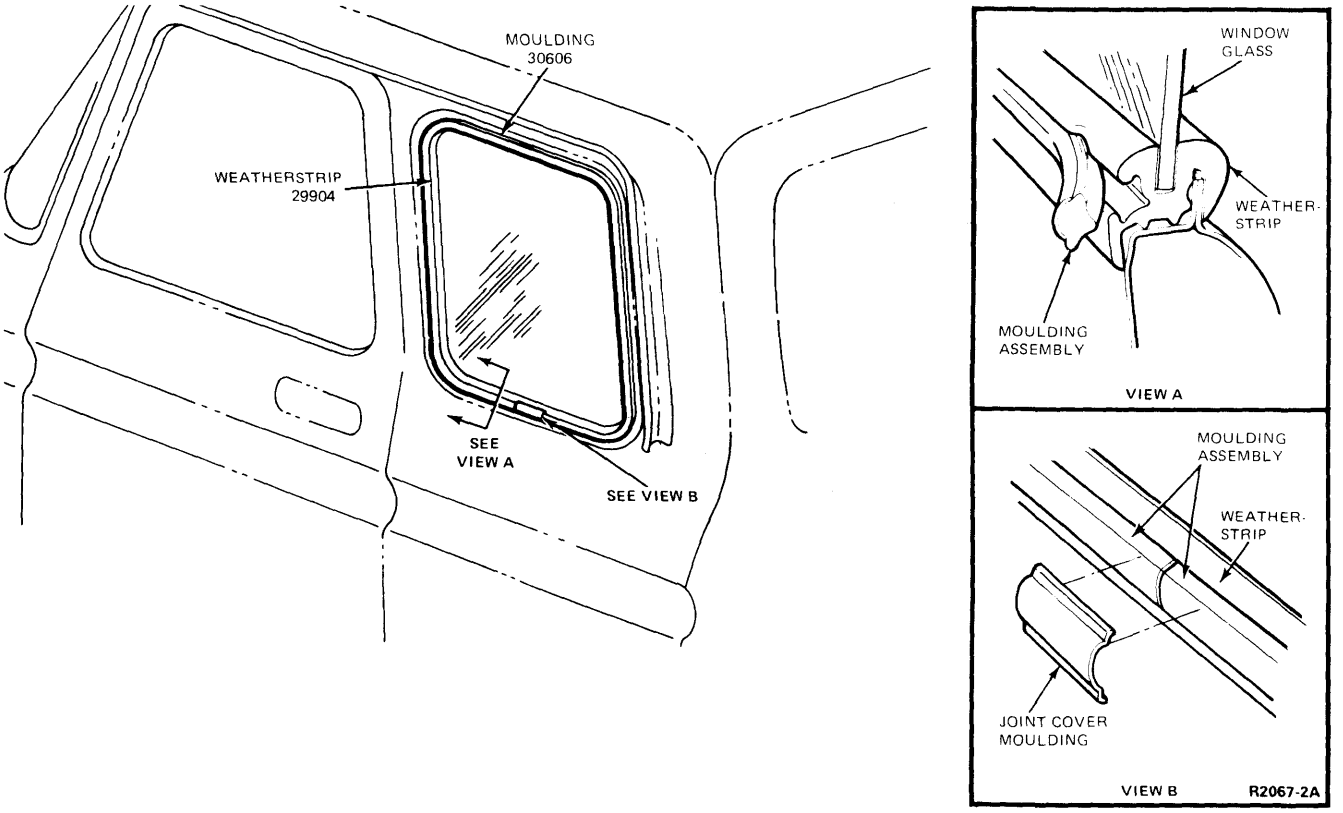


FIG. 5 Quarter Window Installation—F-Series Super Cab

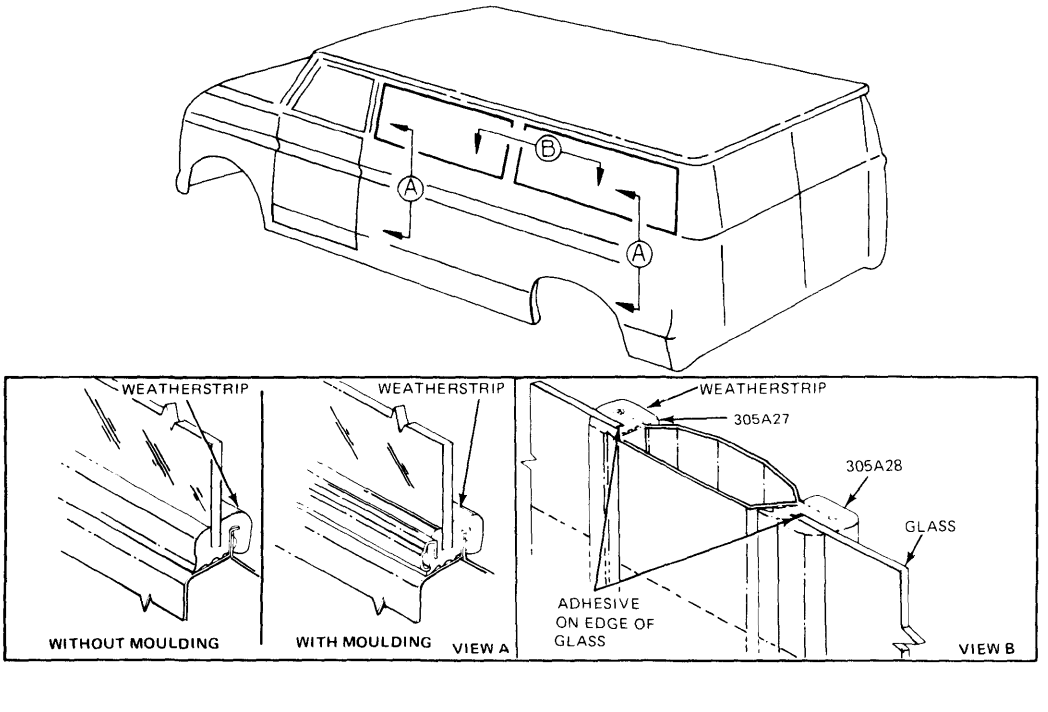


FIG. 6 Body Side and Rear Stationary Window Installation—E-100—E-350

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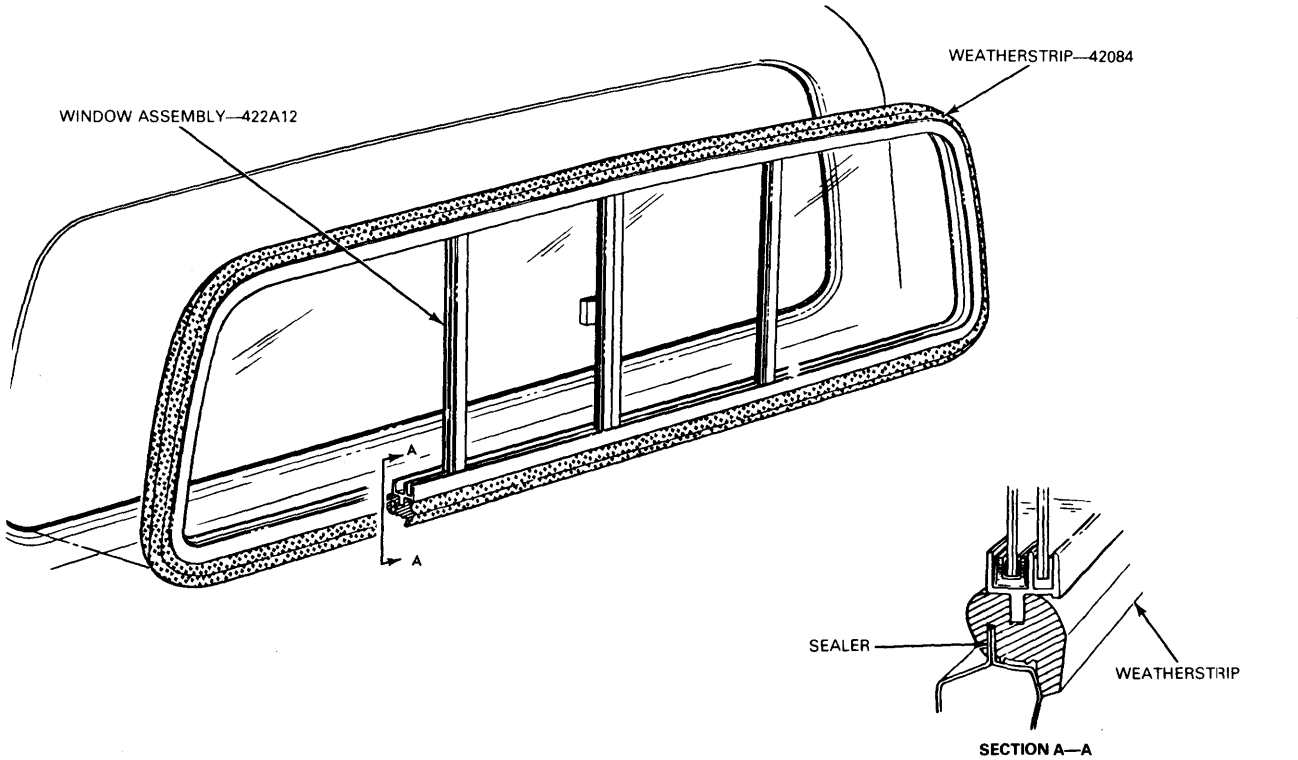


FIG. 7 Movable Back Window—F-100—F-350

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Stationary Glass — Butyl Type Seal

PART 43-11

APPLIES TO E-100 — E-350 AND CLUBWAGON ONLY

SUBJECT	PAGE
DESCRIPTION	11-1
REMOVAL AND INSTALLATION	
Procedure No. 1	11-1
Procedure No. 2	11-2

DESCRIPTION

There are two procedures applicable to the installation of glass with butyl type seal.

Procedure No. 1 should be used with butyl kit (03863 or equivalent) packaged with 5/16 inch diameter butyl (round type) DO NOT use this kit if adhesion of existing butyl-to-pinch weld flange is unreliable, as indicated by a surface which is not smooth and free of excessive skips, bumps and contamination.

Procedure No. 2 should be used with butyl kit (03863 or equivalent) packaged with "I" beam type butyl, where complete replacement of existing butyl is necessary.

REMOVAL AND INSTALLATION

(PROCEDURE NO. 1)

Removal

1. Remove the windshield wiper arms and blades.
2. Remove the windshield exterior mouldings (Figs. 1 and 2). On vehicles with heated rear windows, disconnect heating wires before proceeding with glass removal.
3. With an electric knife (special tool T70B-42006-A, or equivalent) insert the blade under the edge of the glass. Cut the butyl seal as close to the inside surface of the glass as possible. To cut the butyl at the lower corners of the windshield, move the handle of the tool as close to the corner as possible. Then, rotate the blade downward to cut the corner butyl seal and remove glass from the vehicle using the glass holding tool (Figs. 3, 4, and 5).
4. Temporarily position the replacement glass in the windshield opening using spacers to prevent glass-to-metal contact. Adjust glass side to side to the best glass-to-"A" pillar weld flange overlap position and adjust lower spacers, if necessary, for proper positioning at the top. A minimum of 3/16 inch butyl tape-to-glass contact is required around the perimeter to assure proper retention and a waterproof seal. Mark this location with a crayon on the outside surface of the glass and a corresponding point of the glass opening. Remove the glass and clean the inside surface and edge thoroughly.

Installation

1. Start at the side of the glass opposite the original butyl splice and place the 5/16 inch diameter butyl furnished in the kit on top of and in a position that assures the 3/16 inch minimum contact with the glass on the existing butyl remaining on the pinch weld flange (Fig. 6).

   NOTE: Do not allow the new butyl to overhang the edge of the existing butyl and do not stretch the butyl or bridge the corners of the windshield opening.

2. Carefully splice the two loose ends of the new butyl. The cut line of the splice must taper downward toward the outboard side of the vehicle.

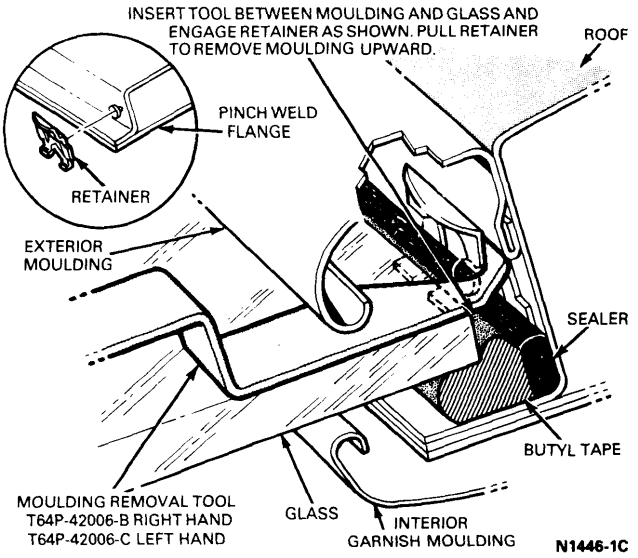


FIG. 1 Windshield Moulding Removal Tool—Typical

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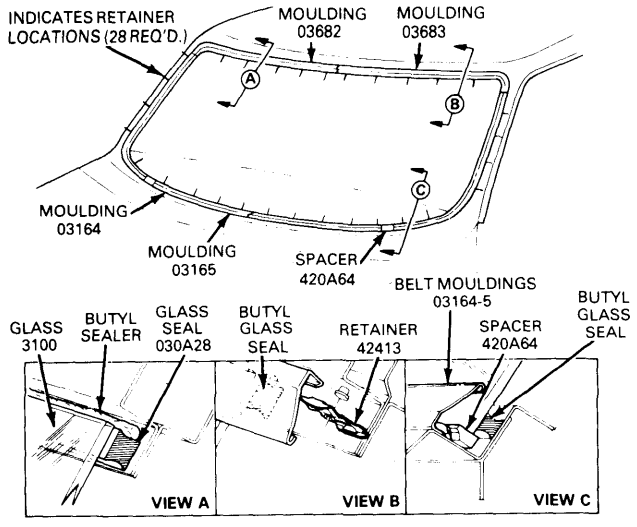


FIG. 2 Windshield and Exterior Moulding Installation—E-100—E-350 and Club Wagon

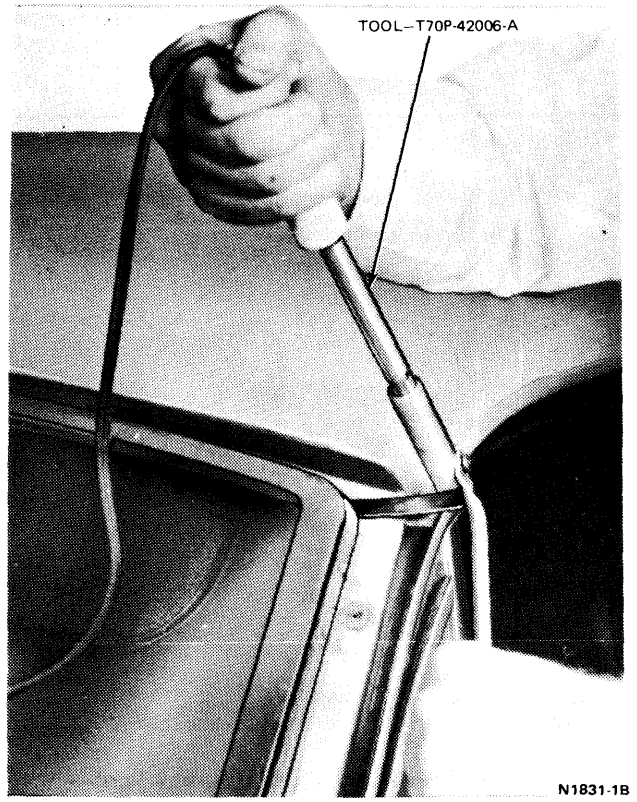


FIG. 3 Removing Butyl Type Seal—Typical

3. Apply the primer (furnished in the kit) around the perimeter of the cleaned inside surface and the edge of the glass in the area that will contact the butyl seal. Allow the primer to dry one minute before installing the glass.
4. Place the glass in the opening, aligning the crayon marks.
5. Firmly press the glass against the butyl with hand pressure or weights (approximately 200 lbs of pressure). Recheck to assure that the 3/16 inch contact between glass and butyl is achieved. A dull spot indicates an area where the butyl is not contacting the glass surface. Additional pressure should seal such areas.
6. From outside the vehicle, apply C9AZ-19554-B Auto Glass Liquid Sealer or equivalent around the entire edge of the glass.
7. Remove any excess primer from the inside surface of the glass with a razor blade and wipe the glass with a clean cloth dampened in naphtha.

   NOTE: Do not use razor blade to clean primer from heated rear windows. Use of razor blades, steel wool, or abrasive powders will damage the grid wires.
8. When the liquid sealer has "skinned-over" (approximately ten minutes), water test the installation. If necessary, repair any leaks with additional liquid sealer.
9. On heated rear windows, apply a piece of tape to the pinch weld flange under the wires. Then connect the wires and install mouldings.
10. Install the mouldings and wiper arms and blades.
11. Clean the glass and surrounding areas.

(PROCEDURE NO. 2)

Removal

Use this procedure if adhesion of existing butyl is unreliable.

1. Remove the windshield wiper arms and blades.
2. Remove the windshield exterior mouldings (Figs. 1 and 2). On vehicles with heated rear windows, disconnect heating wires before proceeding with glass removal.
3. With an electric knife (special tool T70B-42006-A, or equivalent) insert the blade under the edge of the glass. Cut the butyl seal as close to the inside surface of the glass as possible. To cut the butyl at the lower corners of the windshield, move the handle of the tool as close to the corner as possible. Then, rotate the blade downward to cut the corner butyl seal and remove glass from the vehicle using the glass holding tool (Figs. 3, 4 and 6).
4. Clean all remaining butyl from the pinch weld flange and wipe the sheet metal with naphtha or equivalent solvent to provide a clean surface for the replacement butyl.
5. Inspect flange carefully for sheel metal deficiencies, and the sealing surface of the pinch weld flange for chipped or missing paint and repair as necessary.

Installation

1. Starting at the midpoint on "A" pillar, apply the butyl tape around the opening as shown in Fig. 7, View B.
2. Cut the butyl at the required length on a 45 degree angle and carefully splice the two loose ends. The splice cut line must taper down and toward the outboard side of the vehicle (Fig. 7, View A).
3. Apply the primer (furnished in the kit) around the perimeter of the cleaned inside surface and the edge of the glass in the area that will contact the butyl seal (Fig. 5).

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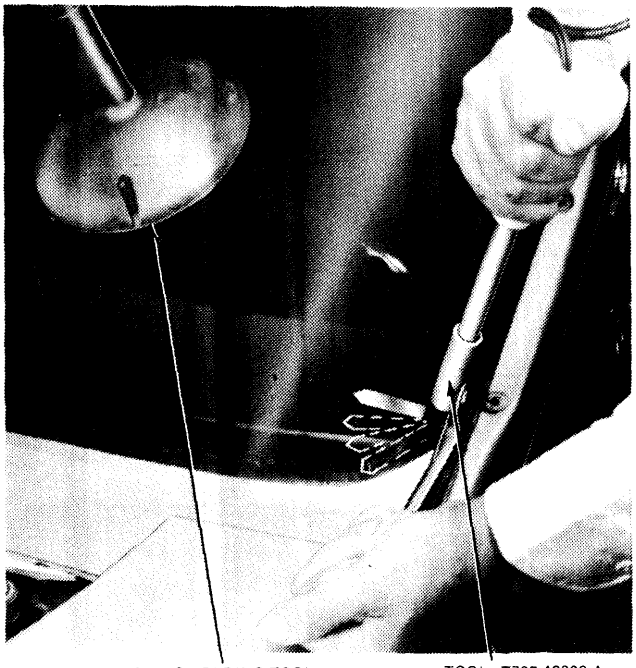


FIG. 4 Cutting Corner Seal—Typical

4. Allow the primer to dry one minute before installing the glass.
5. Place the glass in the opening, aligning the crayon marks.
6. Firmly press the glass against the butyl with hand pressure or weights (approximately 200 lbs). Re-check to assure that 3/16 inch contact between glass and butyl is achieved. A dull spot indicates an area where the butyl is not contacting the glass surface. Additional pressure should seal such areas.

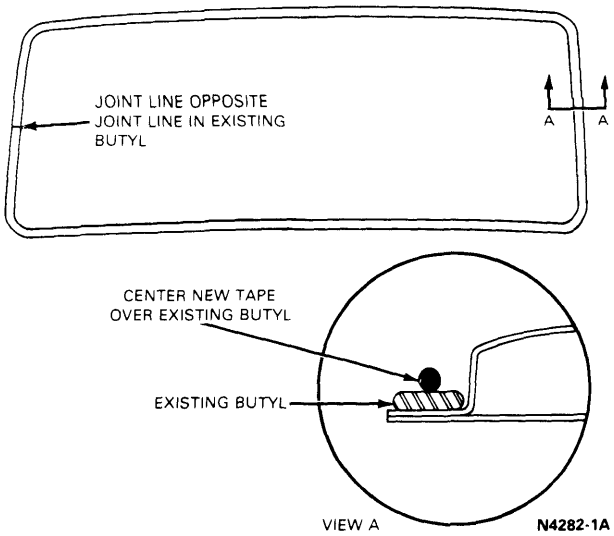


FIG. 5 Procedure No. 1—Butyl Tape Installation

7. From outside the vehicle, apply C9AZ-19554-B Auto Glass Liquid Sealer or equivalent around the entire edge of the glass.
8. Remove any excess primer from the inside surface of the glass with a razor blade and wipe the glass with a clean cloth dampened in naphtha.

   NOTE: Do not use a razor blade to clean primer from heated rear window. Use of razor blades, steel wool, or abrasive powder will damage the grid wires.
9. When the liquid butyl has "skinned-over" (approximately ten minutes), water test the installation. If necessary, repair any leaks with additional liquid sealer.
10. On heated rear windows, apply a piece of tape to the pinch weld under the wires. Then connect wires and install mouldings.
11. Install the exterior mouldings and wiper arms and blades.
12. Clean the glass and surrounding area.

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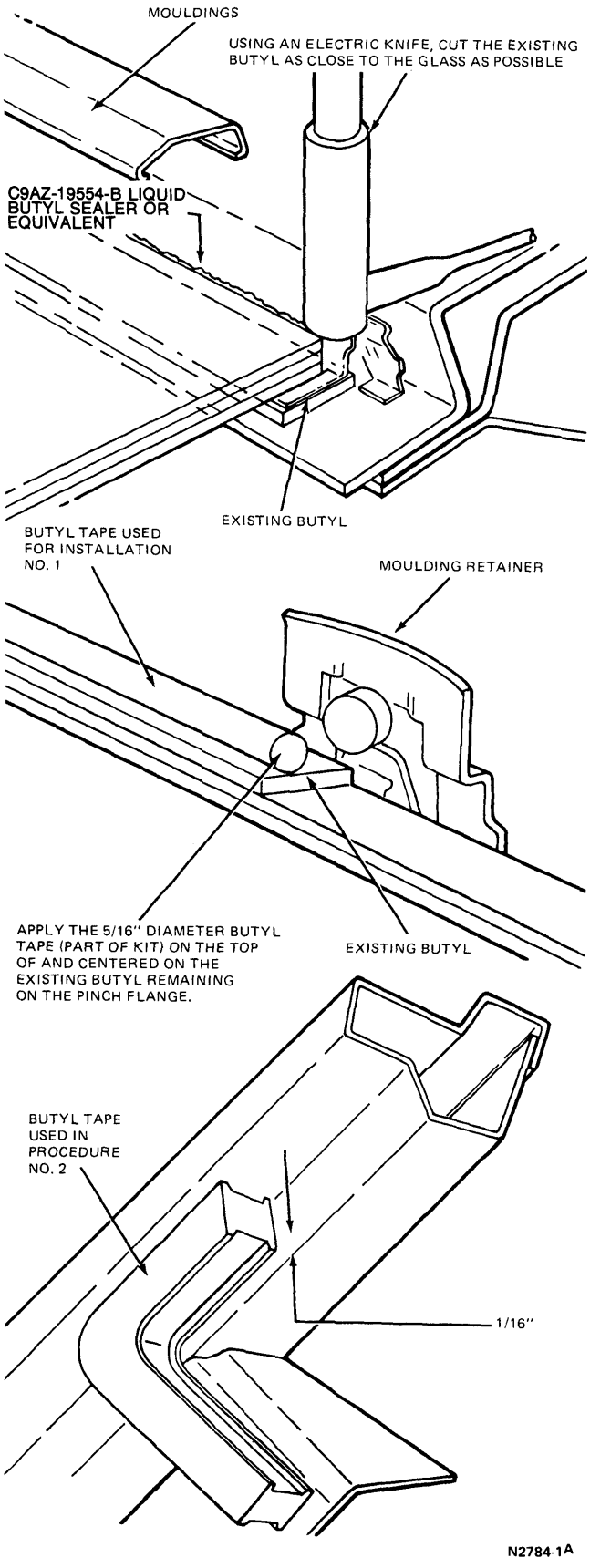


FIG. 6 Tape Installation

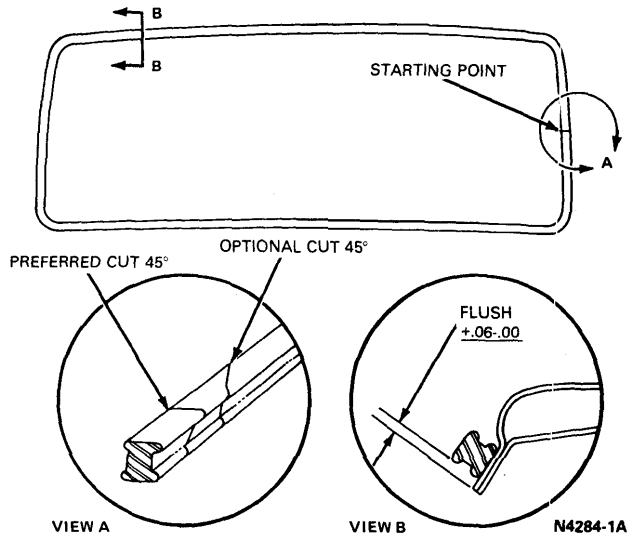


FIG. 7 Procedure No. 2—Single Row Butyl Tape Replacement

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DOORS, HOOD AND TAILGATE

GROUP 44 (16000 & 70000)

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Doors, Hinges, Checks and Weatherstrips	44-06	Tailgate — Bronco and F-Series	44-86
		Tailgate Weatherstrip	44-92

Doors, Hood and Tailgate — General Service

PART 44-01

APPLIES TO ALL MODELS

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		Lock Cylinder Lubricant	01-1

GENERAL INFORMATION

DOOR AND WINDOW WEATHERSTRIP LUBRICANT

SILICON LUBRICANT C0AZ-19553-A (JELLY) AND C0AZ-19533-C (SPRAY), OR EQUIVALENT

This lubricant is to be used on the door and window weatherstrips. It is recommended that silicon lubricant be applied to the weatherstrips as required. Its use makes the doors easier to close, avoids weatherstrip squeaks, retards excess weatherstrip wear from chafing between the door glass upper frame and the weatherstrip. Also, it helps to retain door window alignment by reducing friction between the glass and the rubber weatherstrip.

DOOR, HOOD AND TAILGATE HINGES— LUBRICANT

POLYETHYLENE GREASE C4AZ-19584-E OR EQUIVALENT

This lubricant is used to lubricate door hinges. Apply an even coat to all movable hinge surfaces as outlined in the maintenance schedules or when a binding or squeaking condition occurs (Fig. 1).

LOCK CYLINDER LUBRICANT

LOCK LUBRICANT D2AZ-19587-A OR EQUIVALENT

This lubricant is used to help prevent sticking or binding of all key lock cylinders.

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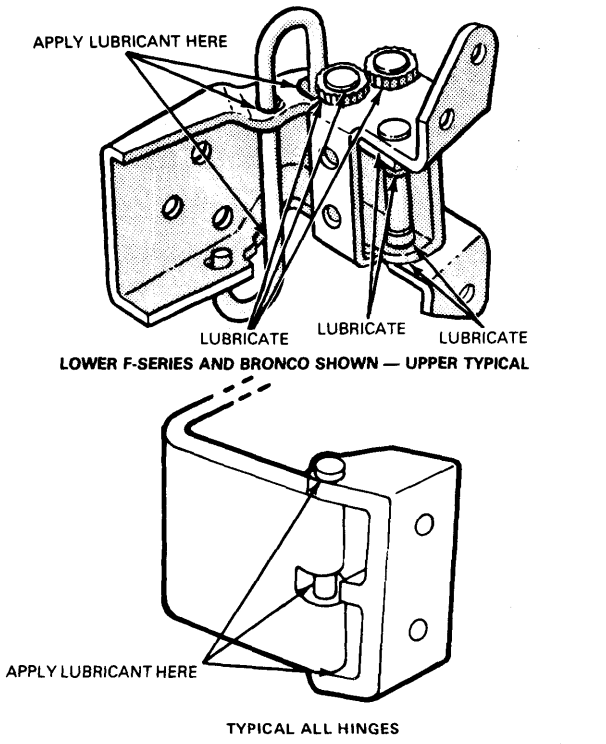


FIG. 1 Door Hinge Lubrication—Typical

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Doors, Hinges, Checks and Weatherstrips

PART 44-06

APPLIES TO ALL MODELS

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Hinged — Cargo Door Alignment		Door Weatherstrips	06-3
E-100 — E-350 and Club Wagon	06-2		

ADJUSTMENTS

DOOR ALIGNMENT

E-100—E-350 AND CLUB WAGON

The door hinges provide sufficient adjustment to correct most door misalignment conditions. The holes of the hinge and/or hinge attaching points are enlarged or elongated to provide for hinge and door alignment (Fig. 1). Do not cover up a poor door alignment with a latch striker adjustment.

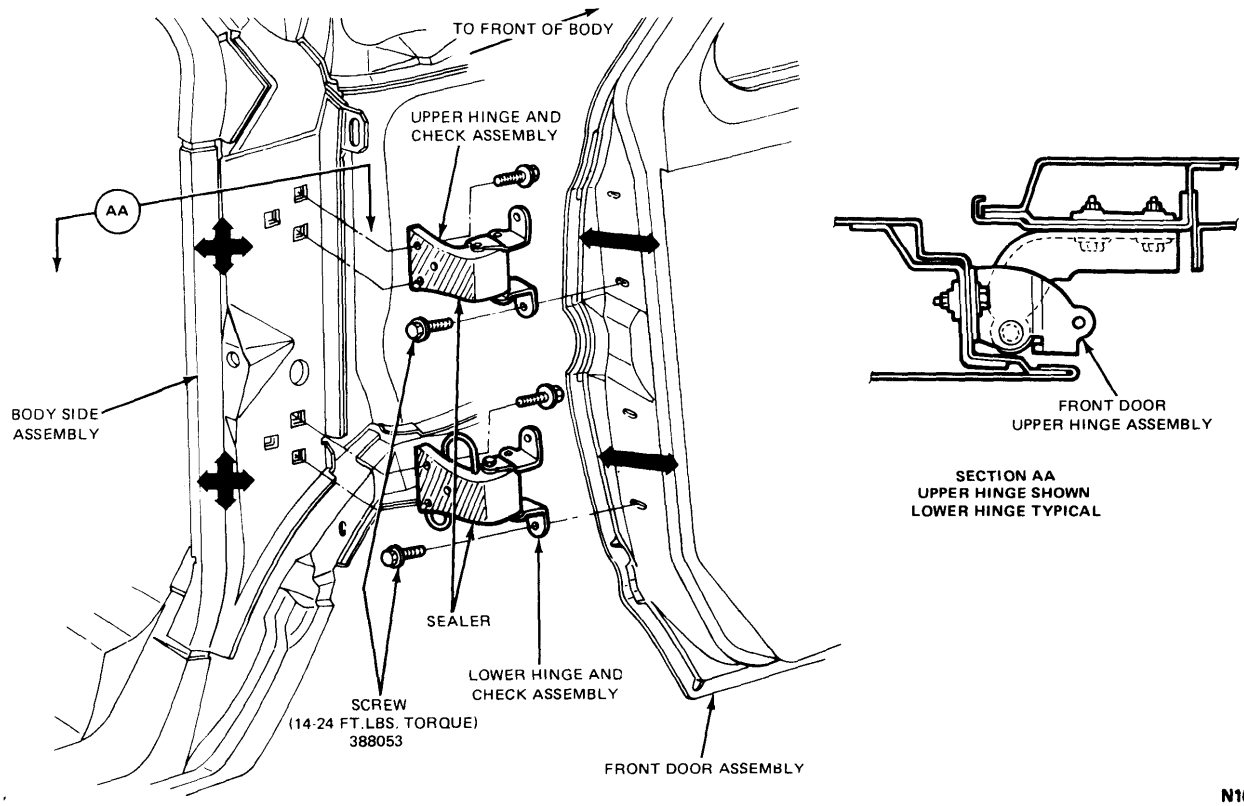


FIG. 1 Front Door Hinge Adjustment—E-100—E-350 and Club Wagon

Front Door

1. Determine which hinge bolts must be loosened to move the door in the desired direction (Fig. 1).
2. Loosen the hinge bolts just enough to permit movement of the door with a padded pry bar.
3. Move the door the distance estimated to be necessary. Tighten the hinge bolts and check the door fit to be sure there is no bind or interference with the adjacent panel.
4. Repeat the operation until the desired fit is obtained. Then, check the striker plate alignment for proper door closing.

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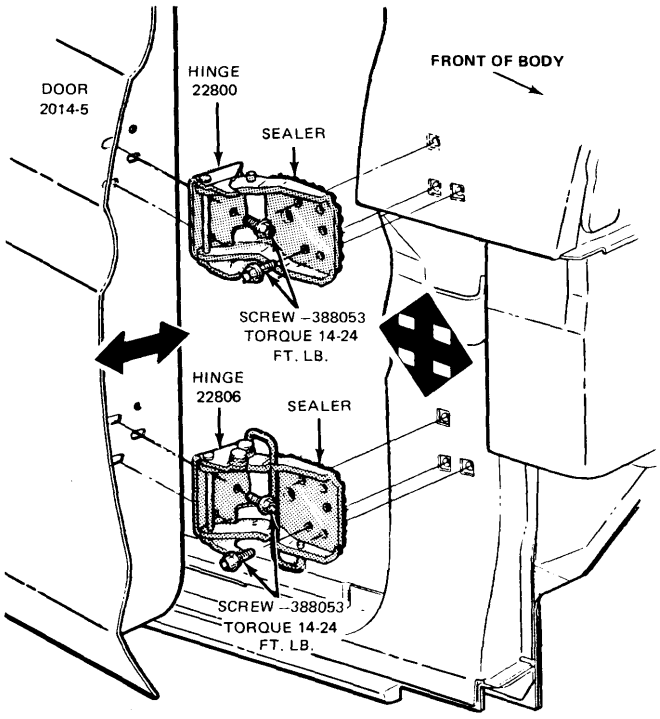


FIG. 2 Door Hinge Adjustment—Bronco and F-Series

BRONCO AND F-SERIES

Do not cover up a poor door alignment with a latch striker adjustment.

1. See Fig. 2, to determine which hinge bolts must be loosened to move the door in the desired direction.
2. Loosen the hinge bolts just enough to permit movement of the door with a padded pry bar.
3. Move the door the distance estimated to be necessary. Tighten the hinge bolts and check the door fit, to be sure there is no bind or interference with the adjacent panel.
4. Repeat the operation until the desired fit is obtained, and check the striker plate alignment for proper door closing.

HINGED—CARGO DOOR ALIGNMENT

E-100—E-350 AND CLUB WAGON

The door hinge attachment to the door and body provide a means for adjusting the doors in the body opening. Up or down and in or out adjustment is accomplished by enlarged holes at the hinge-to-door attachment (Fig. 3). Side to side movement of the doors is provided by horizontally enlongated holes at the hinge-to-body attachment (Fig. 3).

The cargo doors should be adjusted to obtain a proper fit. After the doors have been adjusted, tighten the hinge attaching bolts securely, and adjust the latch mechanisms if required.

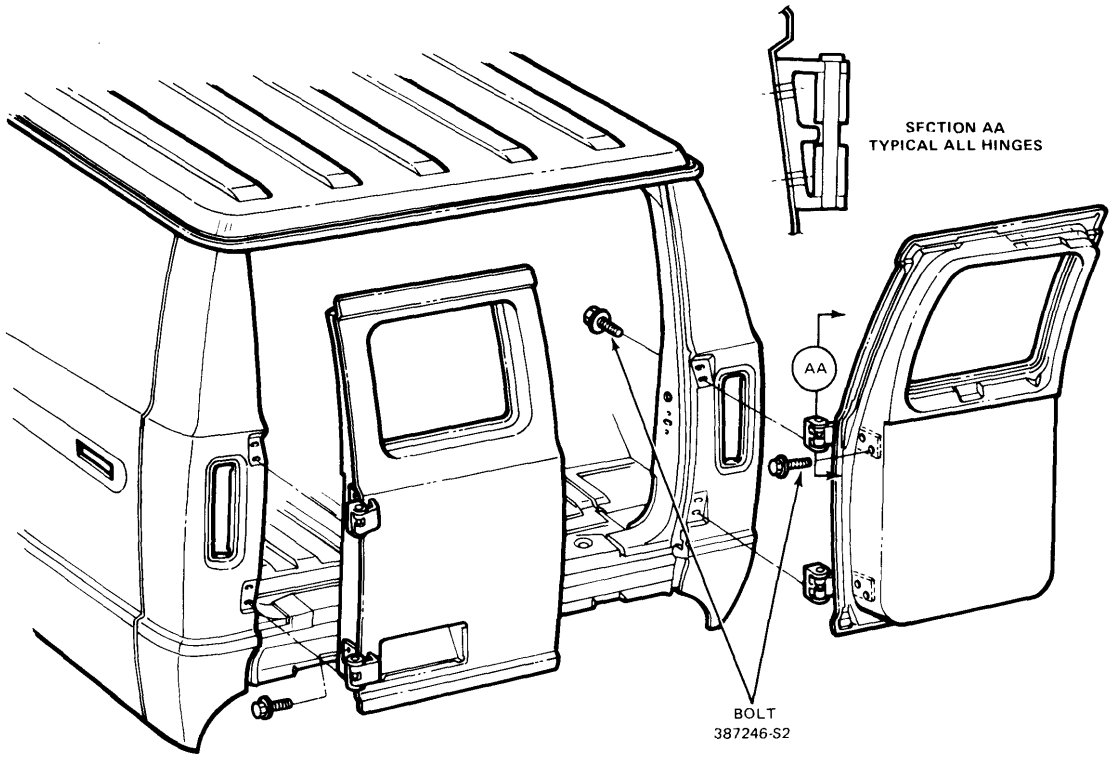


FIG. 3 Cargo and Back Door Alignment—E-100—E-350 and Club Wagon

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REMOVAL AND INSTALLATION

DOORS

1. Remove all usable hardware, trim, and glass parts.
2. Remove the upper and lower hinge access hole cover plates (if so equipped) mark the location of the hinge on the door and body.
3. Remove the door to lower hinge retaining bolts.
4. Support the door, and remove the door to upper hinge retaining bolts. Slide the door off the hinges.
5. If a hinge is to be replaced, remove the hinge to pillar bolts, and remove the hinge.
6. Cement the door weatherstrip in proper position on the door. Include the belt seals.
7. If a hinge has been removed, install the hinge in the pillar in approximately the same position as the removed hinge.
8. Position the door on the hinges, and install the retaining bolts snug.
9. Install the lock mechanism. Install the glass mechanism, glass, and vent window assembly. Make all necessary adjustments as these assemblies are installed.
10. Adjust the door, and tighten all hinge bolts securely. To provide a good weatherstrip seal, the upper front edge of the door must be 3/16 inch inboard of the upper part of the pillar from the belt line to a point near the top of the door. This adjustment is made by adjusting the upper striker of the right hand door inboard 3/16".
11. If the truck is so equipped, install the water shield. The top edge should be cemented to the inside surface of the inner panel.
12. Install the hinge access hole cover plates and the door access hole cover plate.

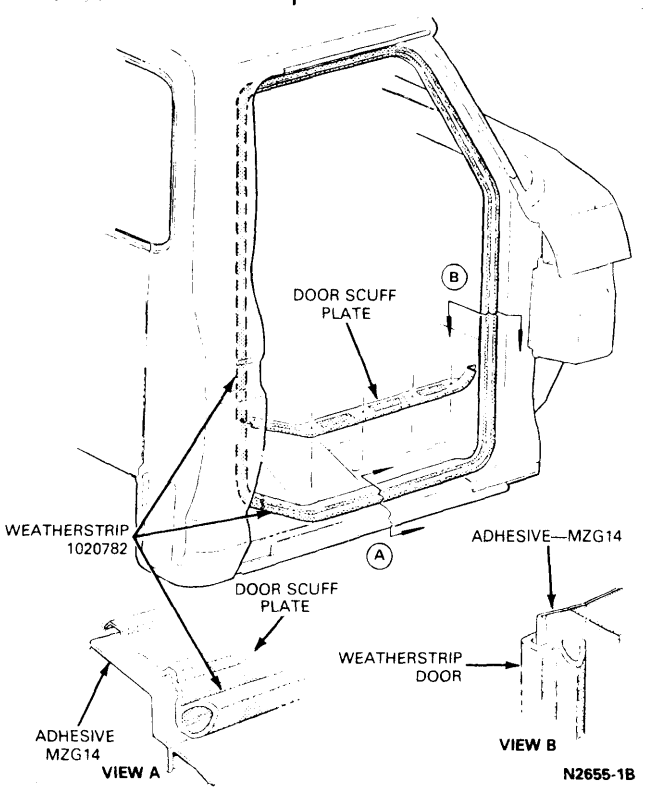


FIG. 4 Typical Door Opening Weatherstrip Installation (Except E-100—E-350)

DOOR HINGE

BRONCO F-SERIES AND E-100—E-350

1. Support the door.
2. Mark the location of the hinge on the door and body.
3. Remove the hinge-to-body attaching bolts.
4. Remove the hinge-to-door attaching bolts and remove the hinge.
5. Position the new hinge to the door and body, and install the attaching bolts.
6. Adjust the door and hinges and remove the support.

DOOR WEATHERSTRIPS

A typical door weatherstrip installation is shown in Figs. 4 and 5. Remove the weatherstrip, clean all old weatherstrip adhesive and apply new adhesive (Part Number MZG14) or equivalent to the retaining flanges. Then, install the weatherstrip. Cut the weatherstrip 1/8 inch long, cover the ends with adhesive and butt them together.

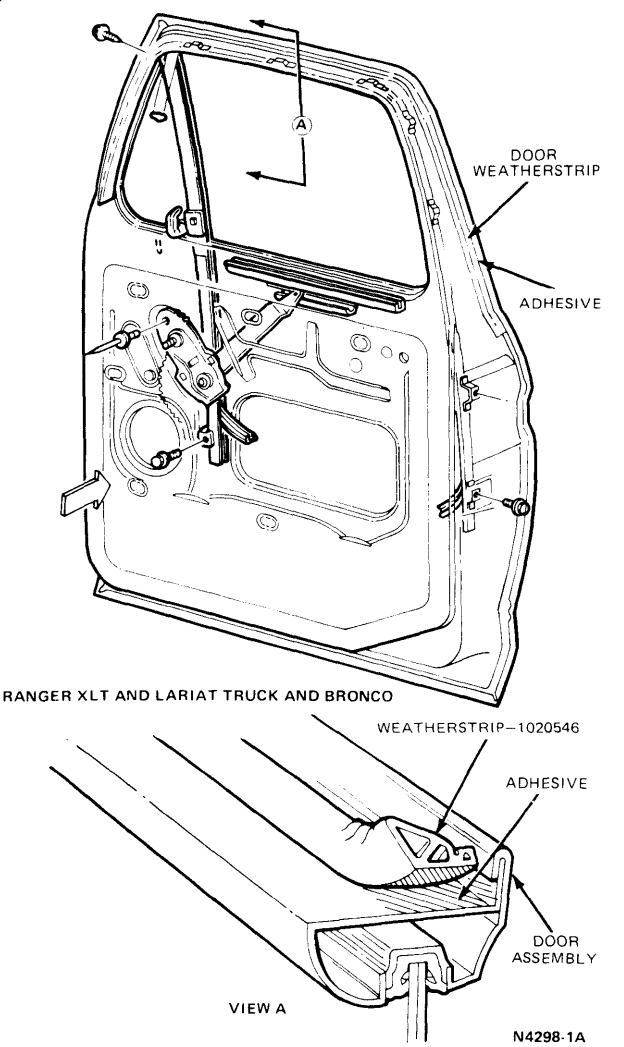


FIG. 5 Typical Door Secondary Weatherstrip Installation

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Sliding Door

PART 44-08

APPLIES TO E-100 THROUGH E-350

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ADJUSTMENTS	
Fore and Aft	08-3
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Up or Down	08-1
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Door Latch	
Front	08-6
Rear	08-6
Lower Guide Assembly	08-3
Striker — Front Latch	08-7
Upper Bracket and Roller Assembly	08-3
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DESCRIPTION AND OPERATION

The door is operated by rotating the inside or outside handle (inside-rearward or outside-downward) to release the latch and sliding the door rearward to the full open position. When the door has been pushed fully rearward, the hold-open check will activate and thereby prevent the door from inadvertently closing. There are no intermediate hold-open positions. To close the door, the inside or outside handle must be activated (inside-forward or outside-upward) to release the door from the check position.

If the door is slammed with sufficient force, the latch will engage the striker in the primary position and the door panel will flush with the body panel. A door slammed with less force may allow the rear latch to engage the rear striker in the secondary position. In this event, the door may be placed in the primary or fully-latched position by rotating the inside or outside handle (inside - forward, outside - upward) until a click is heard.

From the inside of the vehicle, the door can be locked by pushing down on the lock knob and cannot be opened unless the lock knob is in the up position. Locking or unlocking the door from the outside can be accomplished with the key only. The floor pan sheet metal design incorporates an integral side step in vehicles equipped with the sliding door.

ADJUSTMENTS

SLIDING DOOR—IN OR OUT

UPPER ROLLER ASSEMBLY

To adjust the upper edge of the door, loosen the upper roller retaining nut and move the roller in or out, to obtain a flush fit with the body sheet metal at the top edge of the door (View D, Fig. 1).

LOWER-GUIDE ASSEMBLY

Support the door assembly so that **no up or down** movement can be made to the door when performing the in or out adjustment.

To adjust the lower front edge of the door, loosen the retaining screws on the guide assembly and move the guide assembly **forward,** to obtain a snug fit to the body and **rearward** to move it away from the body, at the B pillar post (View E, Fig. 1).

SLIDING DOOR—UP OR DOWN

Upper Roller and Lower Guide Assembly

To move the front edge of the door up or down, loosen the three lower guide attaching screws (View E, Fig. 1), then rotate the guide at the lower attaching screw to obtain the desired door **up or down** position.

Loosen the upper roller bracket assembly attaching screws and adjust the bracket so that the bottom edge of the roller assembly is approximately 1/16 inch from the bottom flange of the upper track (View B, Fig. 2).

HINGE ASSEMBLY

To move the rear edge of the door **up or down,** remove the door trim panel and/or plug buttons, (if so equipped), (Fig. 6). With the door in the open position, loosen the hinge assembly attaching screws (View C, Fig. 1) and move the hinge assembly **up or down** to obtain the desired door position.

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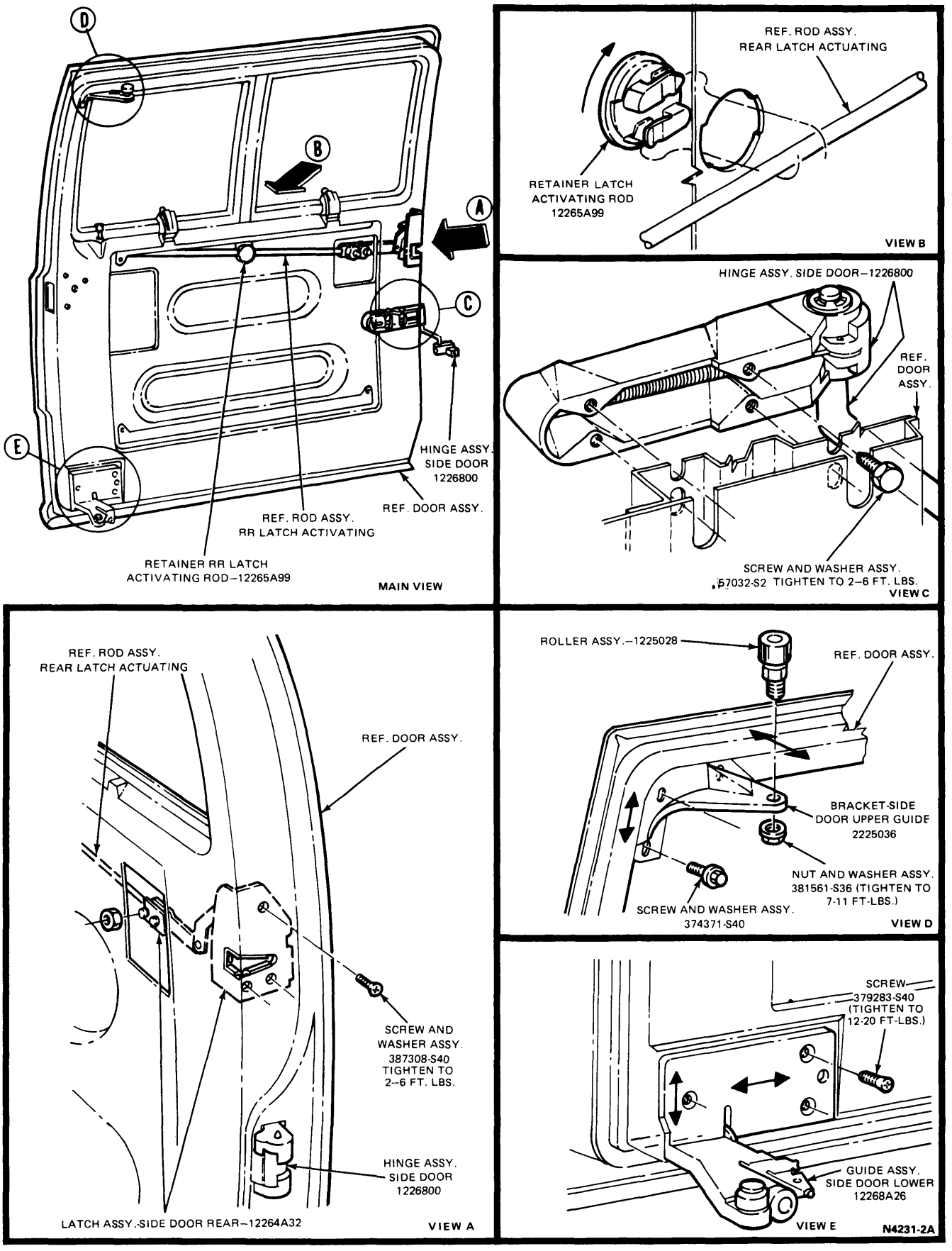


FIG. 1 Sliding Door Adjustments—In or Out or Up or Down

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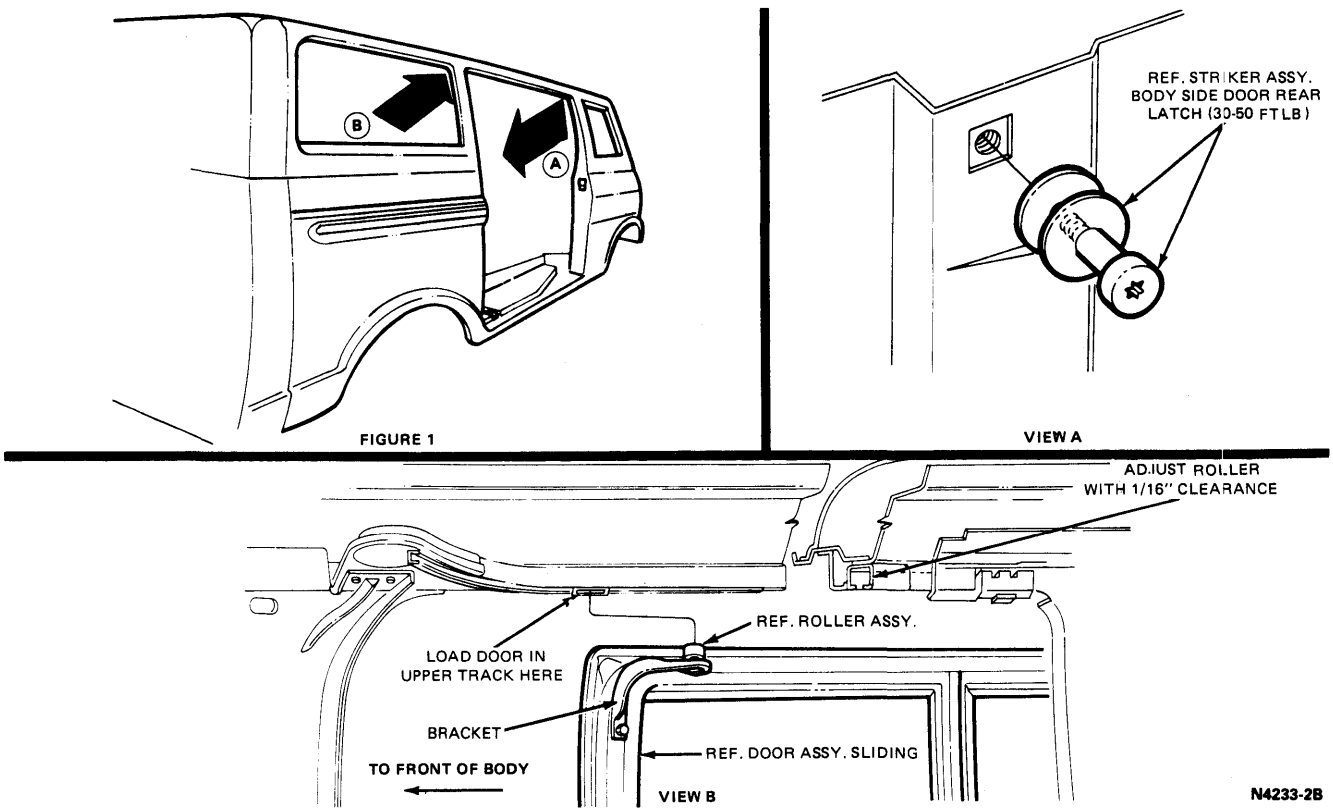


FIG. 2 Sliding Door—Guides and Rollers

STRIKER—REAR LATCH

The rear latch striker assembly can be adjusted **in or out.** Loosen and adjust the striker, to obtain proper adjustment with the rear latch assembly (View B, Fig. 3).

SLIDING DOOR—FORE AND AFT

CENTER HINGE CHECK AND FRONT STRIKER

To gain access to the hinge check, remove the 2 screws retaining the center track shield. The rear side marker lamp must be removed (see Part 32-21) to gain access to the rear center track rear attaching screws. Remove center track shield by pushing it forward, clearing it from the slot position. It can now be removed from the body.

Loosen the three bolts at the hinge check, (View A, Fig. 3). These bolts must be kept loose when making the fore and aft adjustment. Then remove the B pillar post trim panel (nine screws). Loosen the (two) striker bolts and remove the striker (View A, Fig. 3). Then reinstall the front striker and shim as necessary to obtain the proper fit and operation of the front latch assembly. Adjust the door check so it is fully engaged with the hinge lever and the check bumper is firmly depressed with the hinge casting (make sure check latching face is vertical).

LOWER CHECK

The lower check holds the sliding door assembly in the full open position (View D, Fig. 3).

No adjustment is required for this component.

REMOVAL AND INSTALLATION

UPPER BRACKET AND ROLLER ASSEMBLY

1. Remove the upper garnish moulding, open and support the door.
2. Mark the location of the upper bracket assembly to the door (Fig. 2).
3. Remove the screws retaining the bracket and roller assembly and remove the assembly from the door, through the opening at the back of the upper track.
4. If a new bracket is being installed, transfer the roller assembly to the new bracket.
5. Position the bracket and roller assembly to the door and install the three retaining screws (Figs. 1 and 2).
6. See Adjustment procedures outlined in this Part.

LOWER GUIDE ASSEMBLY

1. Open and support the door.
2. Remove the lower guide check screws and remove the check.
3. Slide the door forward on the support, to gain access to the lower guide attaching screws.
4. Mark the location of the lower guide bracket to the door (View E, Fig. 1), and remove the guide attaching screws. **To gain access to the stop actuating rod retainer assembly, (View A, Fig. 4), rotate the guide assembly 90 degrees.**

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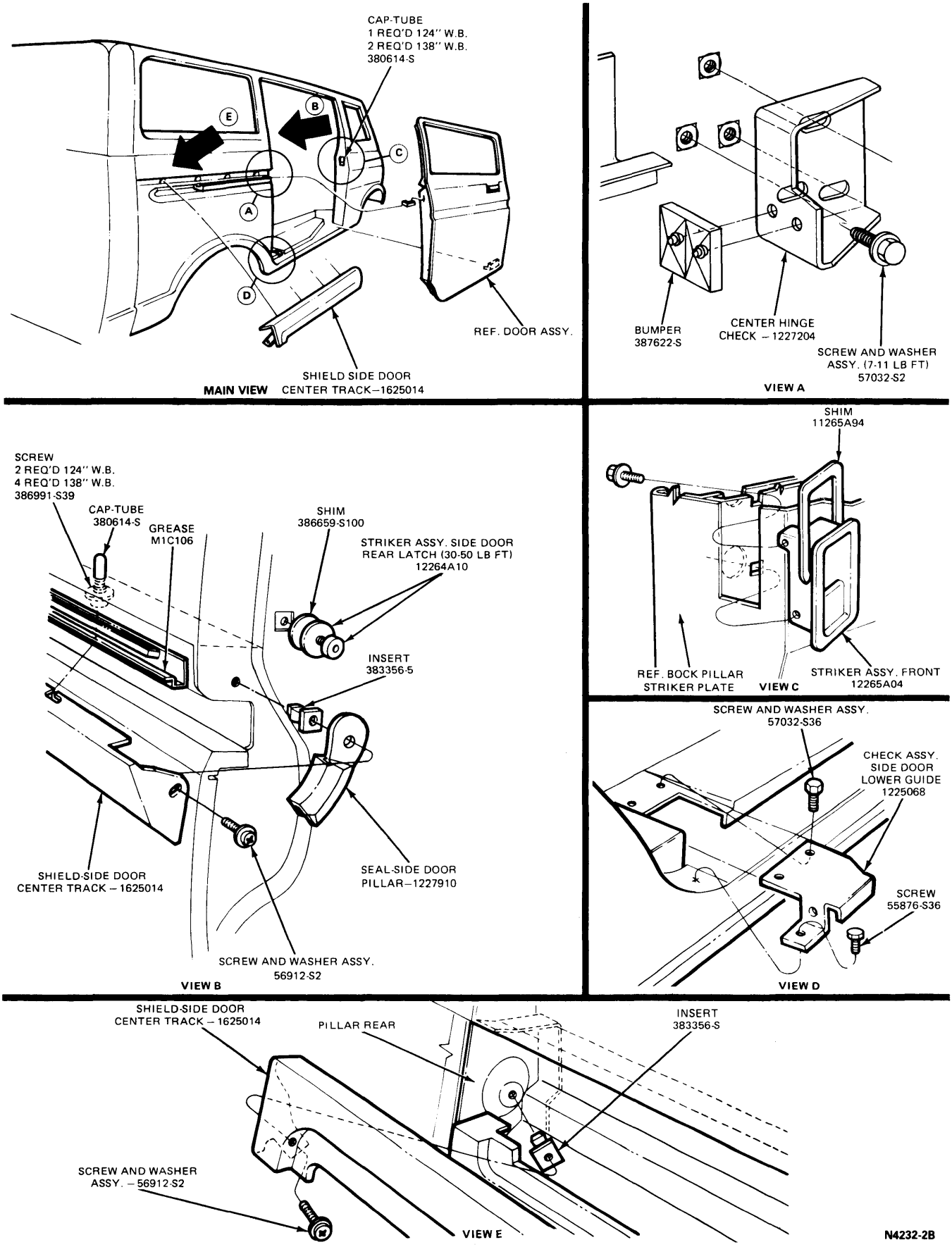


FIG. 3 Sliding Door Adjustments—Fore and Aft

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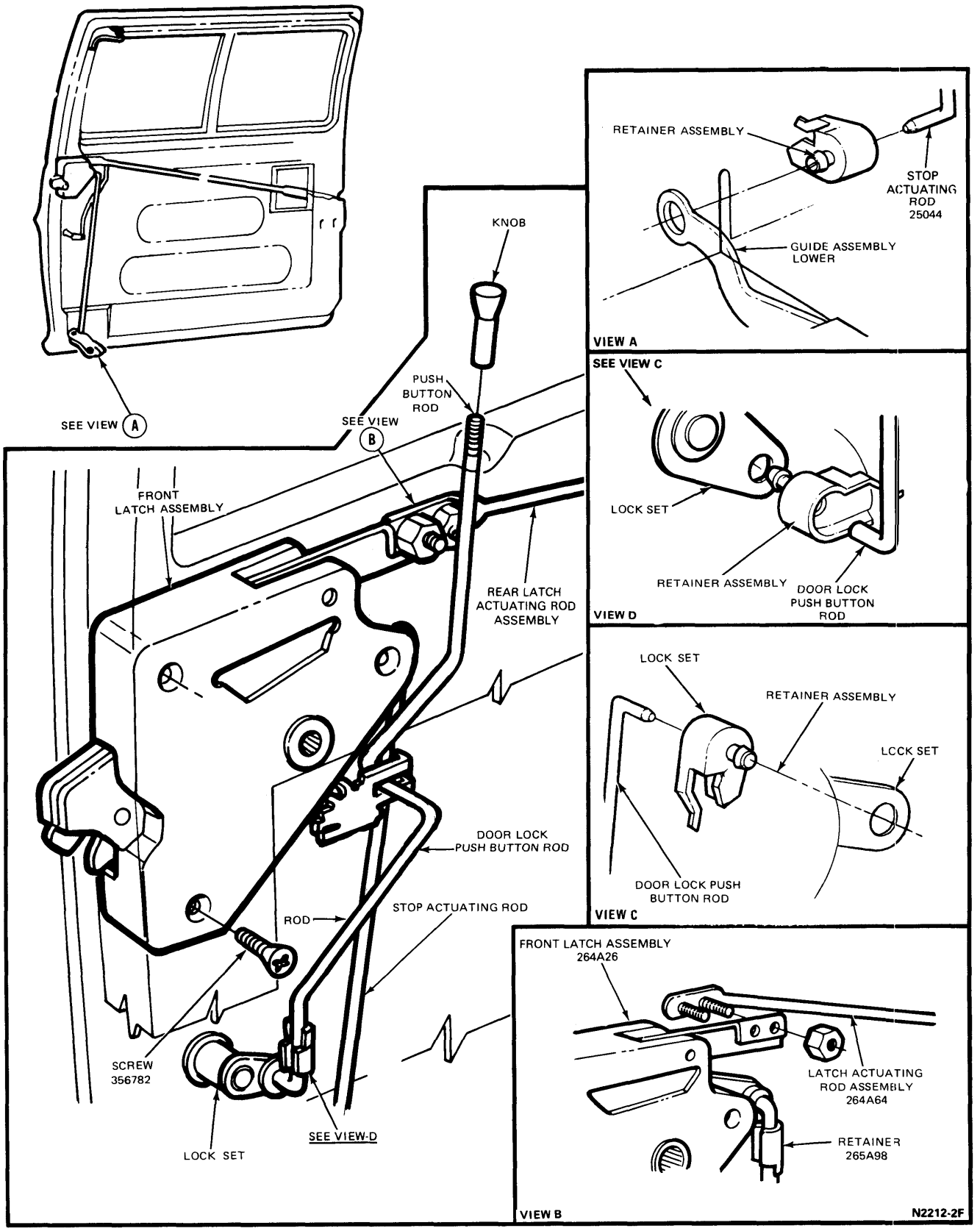


FIG. 4 Sliding Door—Latch and Rods—E-100—E-350

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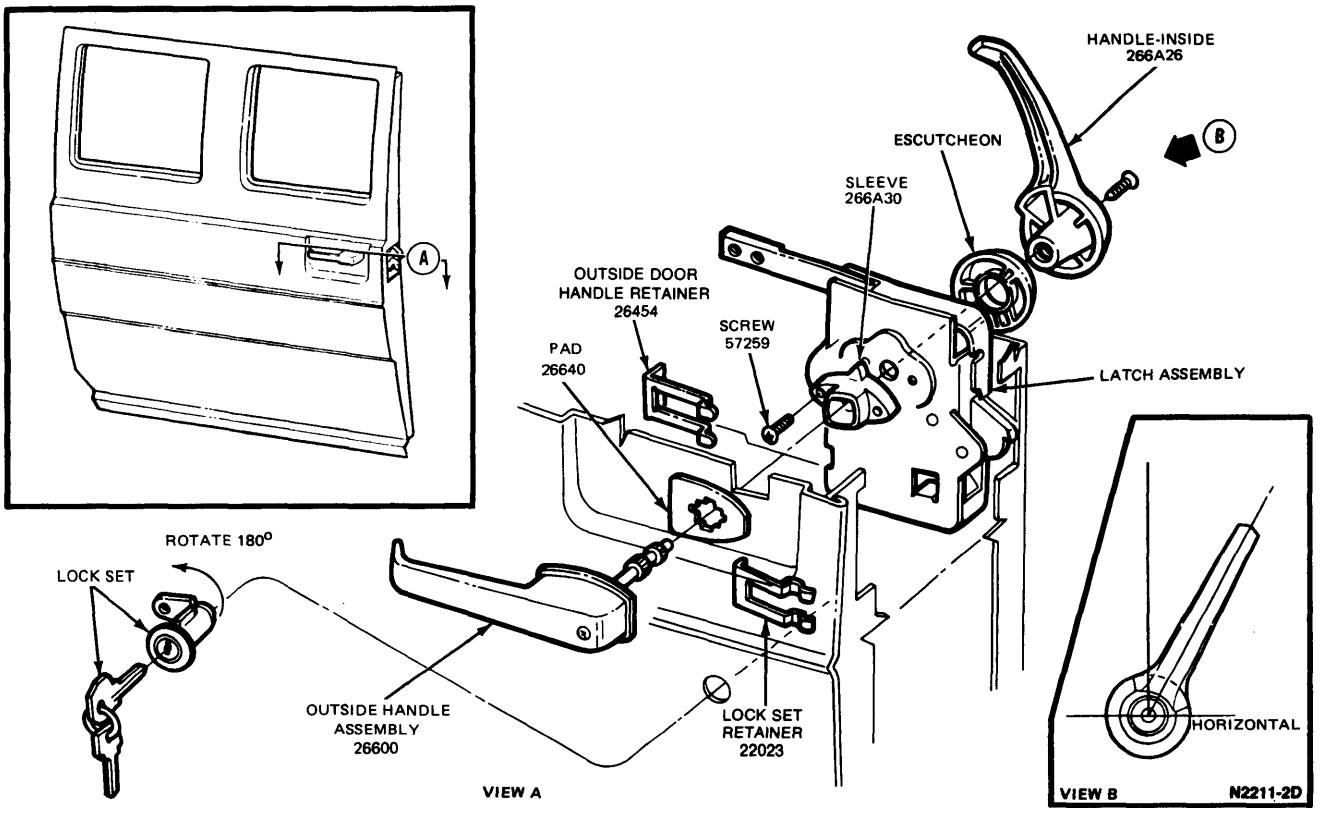


FIG. 5 Sliding Door—Lock and Latch—E-100—E-350

Then, disconnect the stop actuating rod from the stop and remove the guide assembly.

5. Connect the rod to the new lower guide stop arm and secure the retainer.
6. Position the guide assembly to the door and install the retaining screws.
7. Rotate the inside door handle forward to insure proper releasing action of the stop.

DOOR LATCH—FRONT

1. **Do not remove the outside door handle screw.** Remove the outside door handle retainer and remove the handle and serrated shaft as an assembly, (Fig. 5), from the door.
2. Remove the sleeve attaching screws and remove the sleeve, (Fig. 5), from the latch.
3. Remove the rear latch actuating rod assembly from the rear latch, (Main View, Fig. 4).
4. Remove the door lock push button rod from the lock cylinder and disengage it from the latch lever arm (Views C and D, and Main View Fig. 4).
5. Remove the stop actuating rod from the front latch (Main View, Fig. 4).
6. Remove the three front latch retaining screws and disconnect the rear latch actuating rod from the latch.
7. Remove the front latch assembly through the access hole in the door.
8. Position the new latch assembly in the access hole opening and connect the rear latch actuating rod to the front latch.
9. Position the latch to the door and install the three retaining screws.
10. Connect the stop actuating rod to the front latch.
11. Position the push button lock rod through the latch lever and connect the lock rod to the lock cylinder.
12. Position the sleeve to the latch assembly and install the retaining screws, (Fig. 5).
13. Insert the outside handle assembly into the latch and install the handle retaining clip.
14. Connect the rear latch actuating rod to the rear latch assembly (Main View, Fig. 5 **The front latch must be in the full latched position and the rear latch must be in the secondary position before connecting the rear latch actuating rod to the rear latch assembly. Do not push or pull on the rod to make the hook-up. Align the attaching holes by rotating the adjustor on the rear latch actuating rod.**
15. Check for proper latching operation before installing the door trim panel, escutcheon and inside door handle.

DOOR LATCH—REAR

1. Remove the door trim panel. (See Group 45.)
2. Disconnect the actuating rod and retainer from the rear door latch arm, (View A, Fig. 1).
3. Remove the three latch retaining screws and remove the latch from the door.
4. Position the new latch assembly into the door and install the three retaining screws.
5. Connect the actuating rod and retainer to the door latch arm. **The front latch must be in the full**

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latched position and the rear latch must be in the secondary position before connecting the actuating rod and retainer to the door latch arm. Do not push or pull on the rod to make the hook-up. Align the attaching holes by rotating the adjustor on the rear latch actuating rod.

6. Check the latch operation and then, install the door trim panel. Refer to Adjustments if necessary.

DOOR HINGE ASSEMBLY

1. Open and support the door assembly.
2. Remove the center track shield as outlined in Adjustments.
3. Remove the door trim panel and/or access hole covers (if so equipped).
4. Mark the position of the hinge assembly to the door and remove the four retaining screws from the hinge.
5. Slide the hinge assembly to a position in line with the loading notches located in the center track and remove the hinge assembly. A disassembled view is shown in Fig. 7.
6. Install the new hinge assembly through the loading notches in the center track and position the hinge to the door.
7. Install the hinge retaining screws and check the operation of the door.
8. Then, install the trim panel and/or access hole covers.
9. Install the center track shield.

WEATHERSTRIPS

1. Remove the weatherstrip from the door (Fig. 6).
2. Remove all the old weatherstrip adhesive.
3. Apply adhesive Part No. 19552 or equivalent to the cleaned area.
4. Install the weatherstrip (cut 1/8 inch longer, cover ends with adhesive and butt the ends together).

STRIKER—FRONT LATCH

1. Remove the B pillar trim panel screws (nine).
2. Remove the striker bolts (two) and transfer the shim(s) to the new striker (View C, Fig. 3).
3. Position the striker and install the two attaching bolts (snug) then, adjust as necessary.
4. Install the B pillar trim panel (nine screws).

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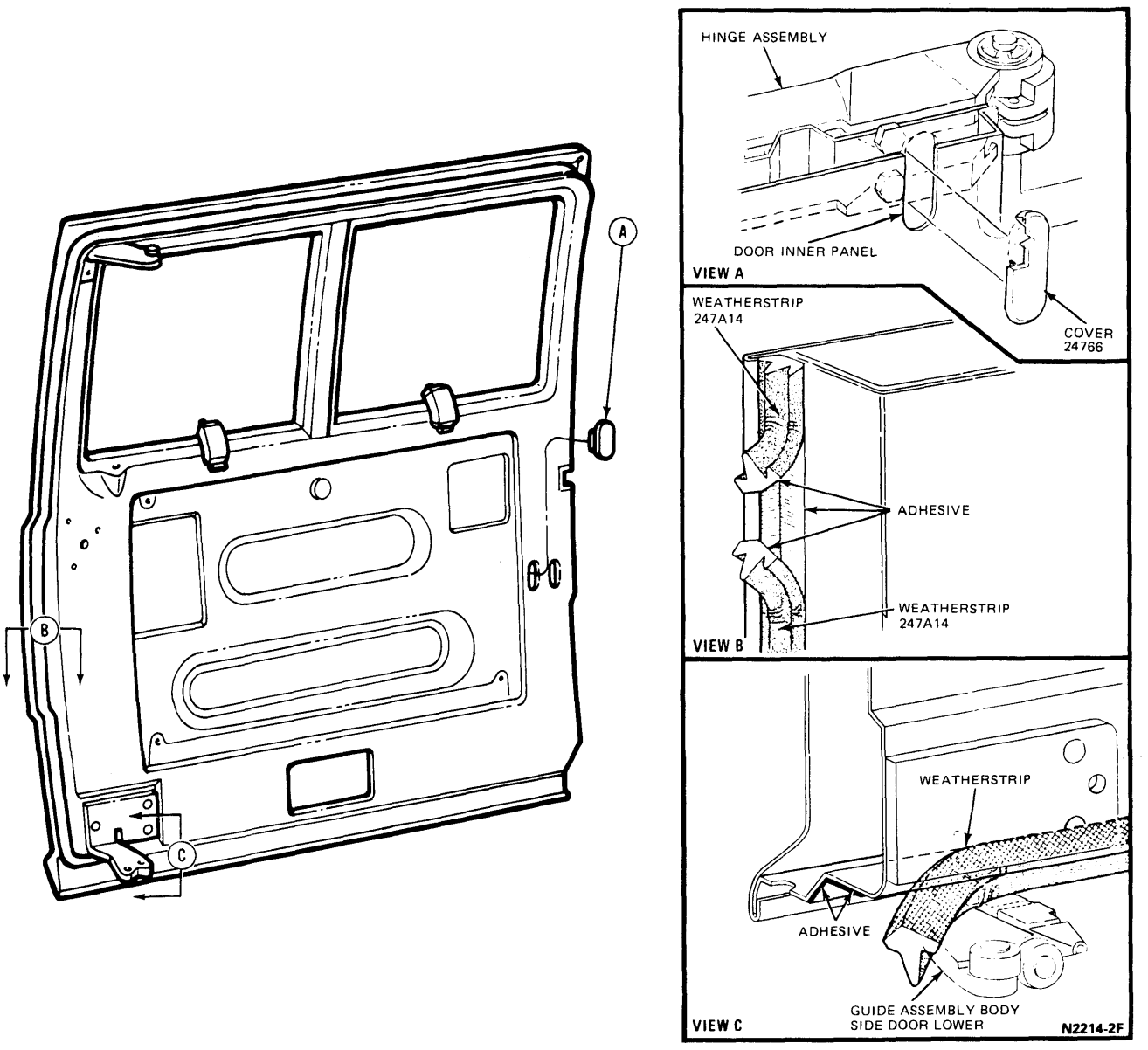


FIG. 6 Sliding Door—Weatherstrip and Access Hole Covers—E-100—E-350

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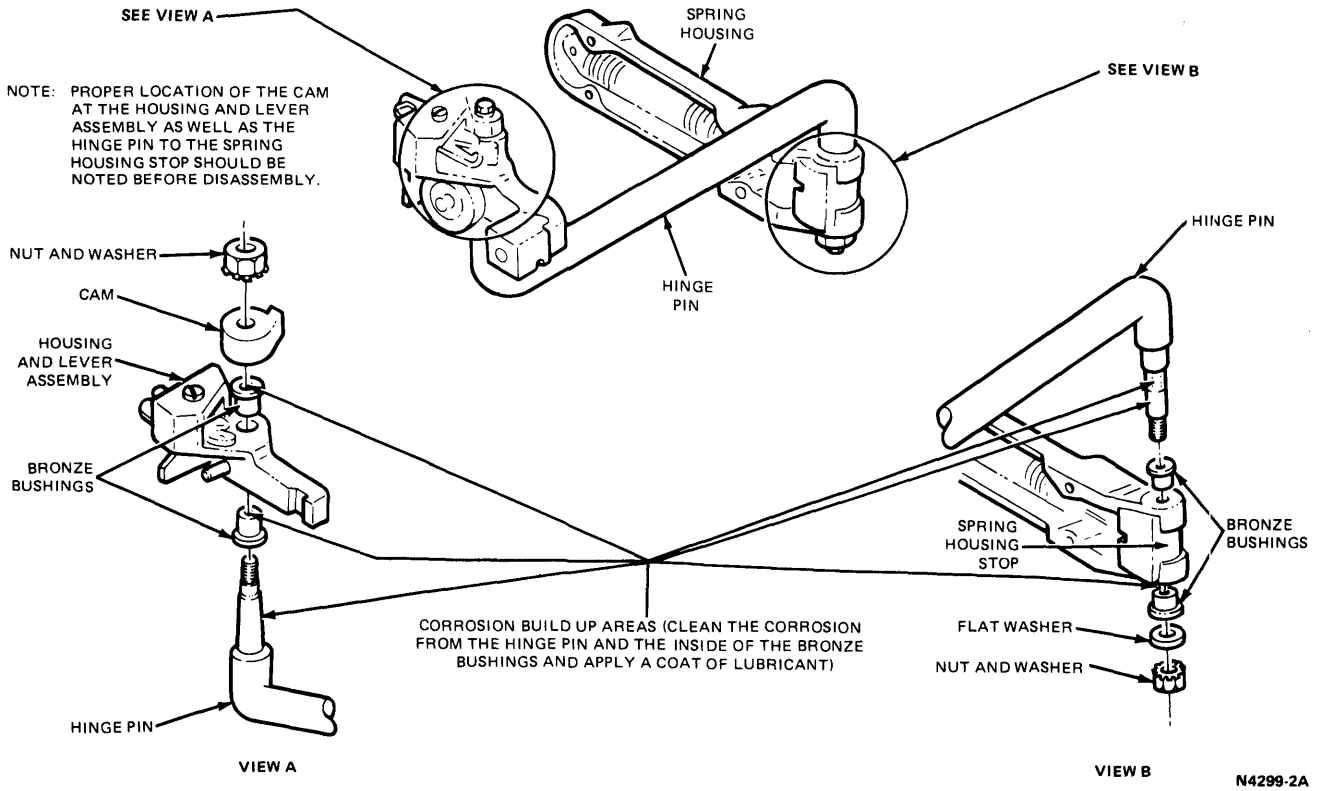


FIG. 7 Hinge Disassembled

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Door Latches and Locks

PART 44-11

APPLIES TO ALL MODELS

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ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd)	
Latch Striker Adjustment	11-1	Left Rear Door Latch	11-5
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Door Outside Handle	11-8	Remote Control Assembly —	
Front Door Latch	11-1	Front Door	11-7
Front Side and Right Rear		Remote Control Assembly —	
Cargo Doors	11-8	Right Rear Door	11-7
Front Side Cargo Door Latch	11-2	Right Rear Door Latch	11-5

ADJUSTMENTS

LATCH STRIKER ADJUSTMENT

FRONT DOORS

Use tool No. T70P-2100-A, or equivalent where required.

The striker pin can be adjusted laterally and vertically as well as fore and aft. The latch striker should not be adjusted to correct door sag. The latch striker should be shimmed to get the clearance shown in Fig. 1, between the latch striker and the latch. To check this clearance, clean the latch jaws and the striker area, and then apply a thin layer of dark grease to the latch striker. As the door is closed and opened, a measurable pattern will result. Move the striker assembly laterally to provide a flush fit at the door and the body. **Do not use more than two shims.**

REAR DOORS E-100—E-350

The back door latch strikers are adjustable inboard or outboard to obtain a flush fit of the doors with the body. To adjust the striker(s), loosen the two attaching screws and move the striker(s) as necessary to obtain the proper door fit. Tighten the two attaching screws.

REAR SIDE DOOR (E-100—E-350 WITH SIDE HINGED DOORS)

The rear side door latches (upper and lower) can be adjusted inboard or outboard to obtain a flush fit of the door with the body. To adjust the striker(s), loosen the two attaching screws and move the striker(s) as necessary. To obtain the proper door fit. Tighten the two attaching screws.

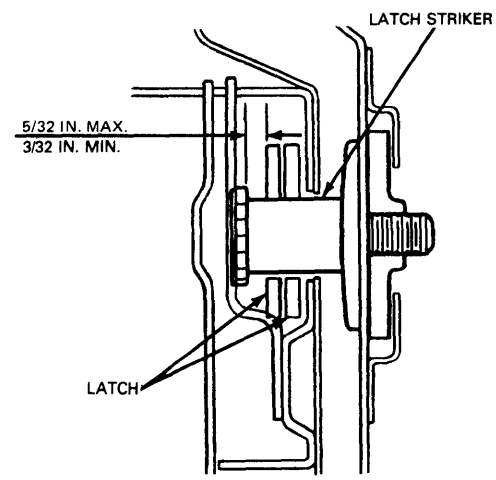


FIG. 1 Latch Striker Adjustment—Typical Bronco, F-Series and E-100—E-350

REMOVAL AND INSTALLATION

FRONT DOOR LATCH

BRONCO AND F-SERIES

Removal

1. Remove the trim panel and watershield from the door.
2. Disconnect rods from handle and lock cylinder if necessary.
3. Disconnect the rods from the latch assembly (Fig. 2).
4. Remove the latch assembly attaching screws and remove the latch from the door.

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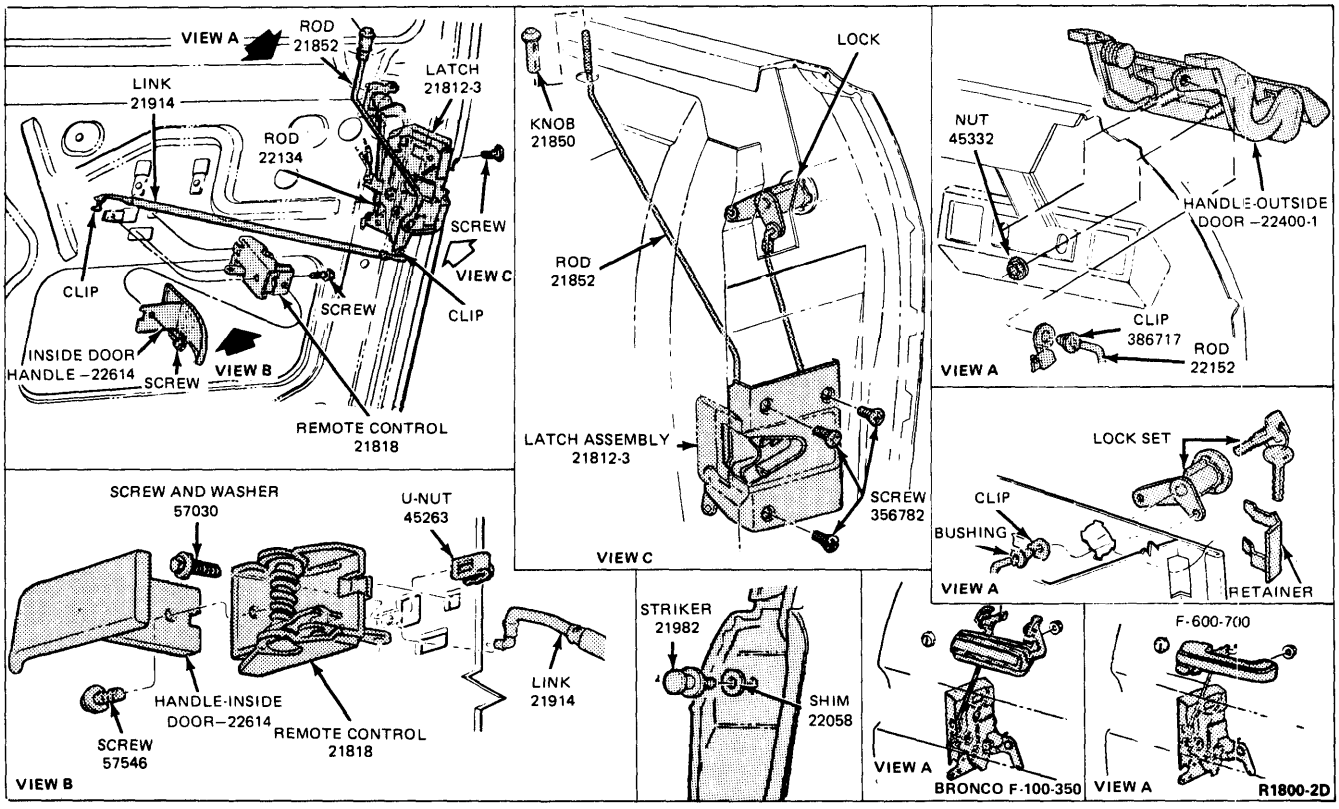


FIG. 2 Door Latch Installation—Bronco and F-Series

Installation

1. Install the rod retaining clips in the new latch assembly. Rods should be attached to Latch before latch installation.
2. Position the latch in the door and install the latch attaching screws.
3. Connect the rods to the latch assembly and check the operation of the latch.
4. Install the watershield and trim panel on the door.

E-100—E-350

Removal

1. Remove the door inside handle. If equipped with door trim panels, remove the inside handle cup and window regulator handle. If equipped with power door locks, refer to Part 44-16.
2. Remove the access cover plate or door trim panel and the watershield.
3. Remove the door glass rear run (refer to Group 42).
4. Remove the retainers that secure the control rods and link to the latch assembly (Fig. 3). Then, disconnect the rods and link from the latch assembly.
5. Remove the three screws attaching the latch to the door and remove latch assembly.

Installation

1. Position the door latch to the door and install the three attaching screws.
2. Connect the control rods and link to the door latch (Fig. 3).
3. Install the door glass rear run.
4. Install the watershield and door trim panel or access cover plate.
5. Install the door inside handle cup (if equipped with trim panel), inside handle, and window regulator handle.

FRONT SIDE CARGO DOOR LATCH

E-100—E-350 WITH HINGED SIDE DOORS

Removal

1. Remove the door access cover or trim panel and watershield (if so equipped).
2. Remove the two nuts attaching the door inside handle and remove handle (Fig. 4).
3. Remove the three remote control bracket attaching screws. Disconnect the remote control link. Remove the remote control and bracket as an assembly.
4. Unscrew and remove the door lock push button (Fig. 4).
5. Disconnect the push button rod from the door latch.
6. Disconnect the door outside handle rod from the outside handle (Fig. 4).
7. Remove the three latch attaching screws and remove latch from door.

Installation

1. Transfer the rods and bushings to the new latch assembly if the latch assembly is to be replaced.
2. Position the latch in the door and insert the push button rod through the push button hole. Install the three latch attaching screws.
3. Connect the outside handle rod to the door outside handle.

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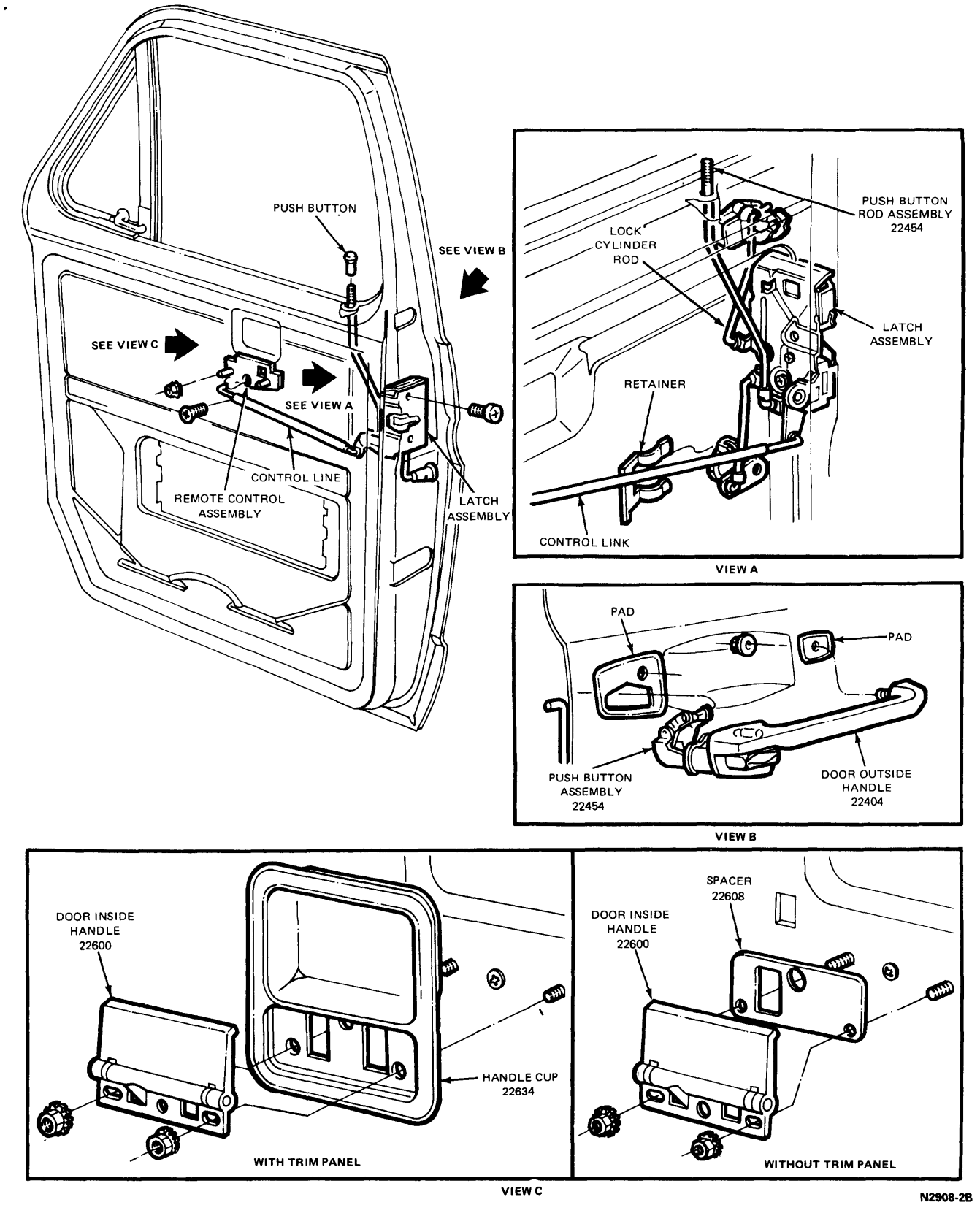
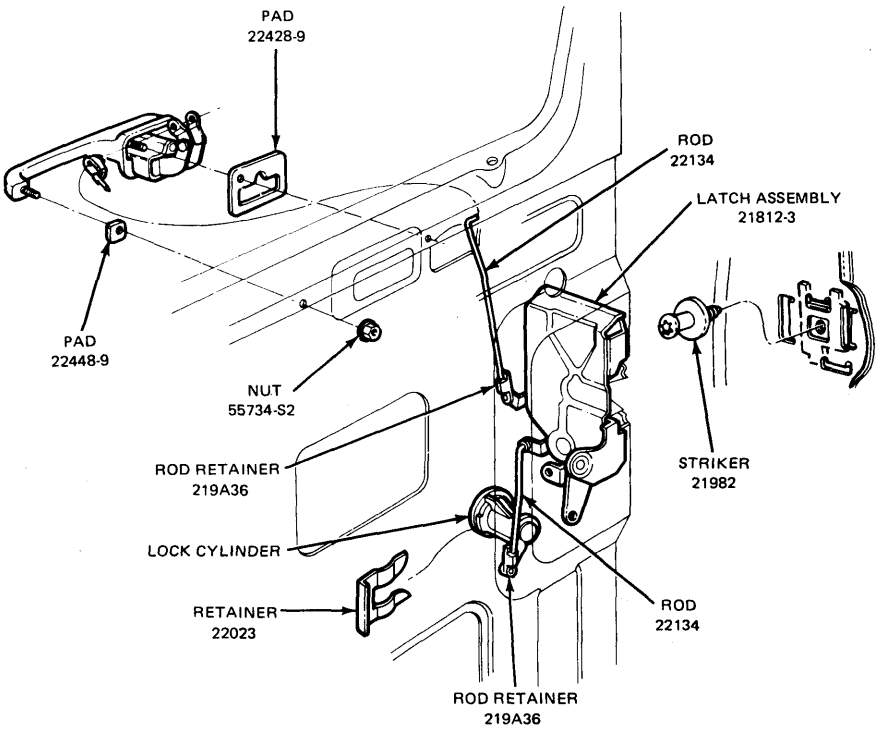


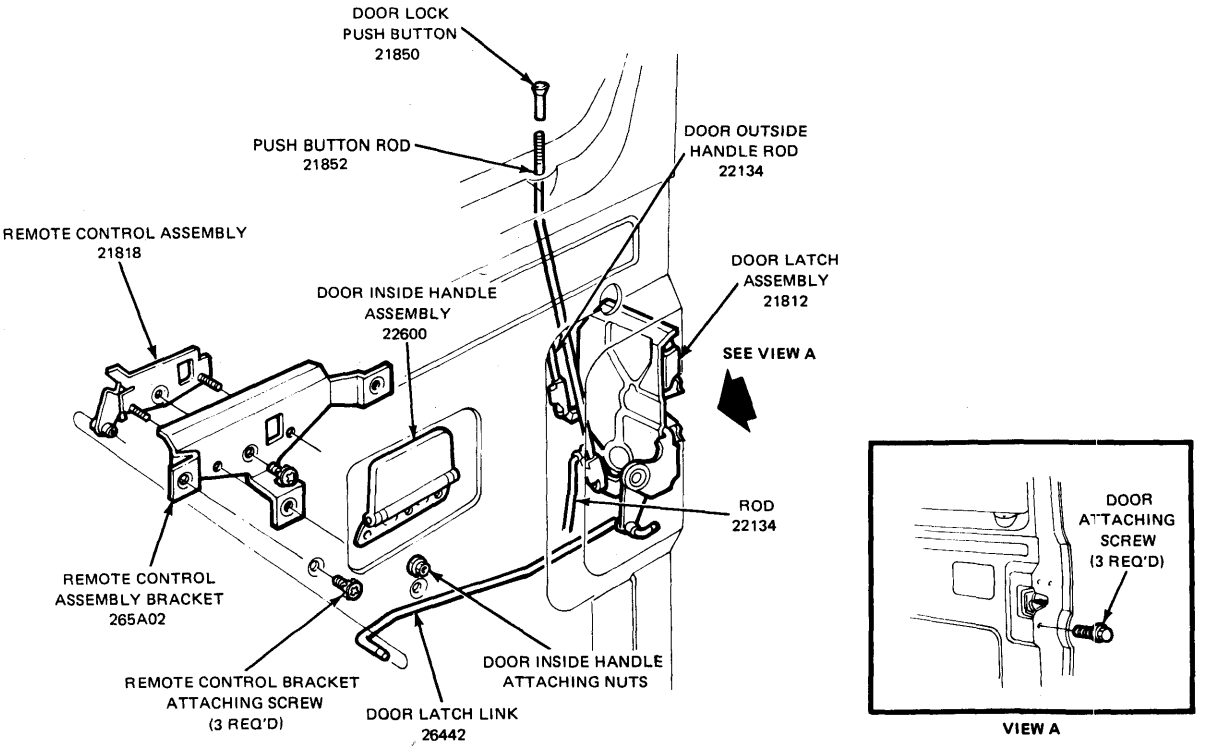
FIG. 3 Front Door Latch and Remote Control Installation—E-100—E-350 w/o Power Door Locks

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OUTSIDE HANDLE INSTALLATION



VIEW A

INSIDE HANDLE INSTALLATION

N1625-2D

FIG. 4 Front Side Cargo Door Latch Installation—E-100—E-350

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4. Connect the push button rod to the door latch.
5. Connect the link to the remote control. Position the remote control and bracket to the door inner panel and install the attaching screws.
6. Install the door inside handle and the lock push button.
7. Install the watershield and trim panel or access cover (if so equipped).

REAR SIDE CARGO DOOR LATCH

E-100—E-350 WITH HINGED SIDE DOORS

Removal

1. Remove the inside handle from the remote control shaft.
2. Disconnect the lower latch rod from the remote control (Fig. 5).

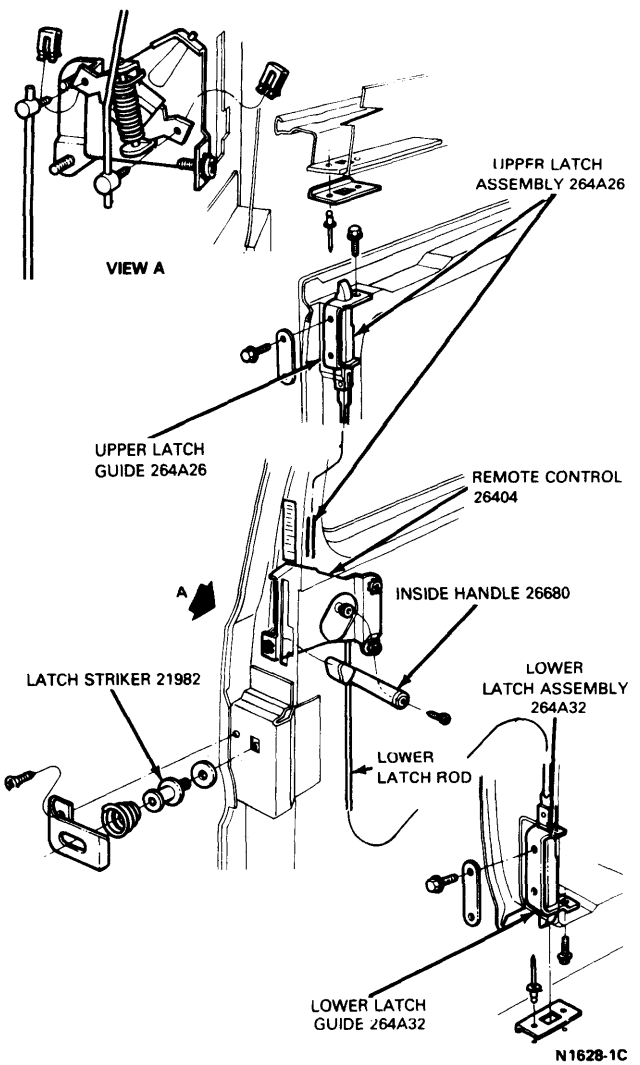


FIG. 5 Rear Side and Left Rear Door Latch Installation—E-100—E-350

3. Remove three screws attaching the lower latch guide to the bottom of the door (Fig. 5). Remove the lower latch assembly from the door.
4. Remove three screws attaching the remote control to the door.
5. Remove three screws attaching the upper latch guide to the top of the door (Fig. 5). Remove the upper latch assembly and remote control from the door.
6. Disconnect the upper latch assembly from the remote control.

Installation

1. Assemble the upper latch assembly to the remote control (Fig. 5).
2. Position the upper latch assembly and remote control to the door. Install three screws attaching the upper latch guide to the top of the door.
3. Position the lower latch assembly in the door and connect the lower latch rod to the remote control.
4. Install three screws attaching the lower latch guide to the door.
5. Install three screws attaching the remote control to the door.
6. Install the inside handle on the remote control shaft.
7. Adjust the door for a snug fit against the weatherstrip. This is done by loosening the latch guide attaching screws and moving the latch assembly inboard or outboard as required. Then, tighten the latch guide attaching screws.

RIGHT REAR DOOR LATCH

E-100—E-350

Removal

1. Remove the door trim panel and watershield (if so equipped).
2. To remove the upper latch, remove the three screws attaching the upper latch to the door (Fig. 6).
3. Disengage the lock rod clip, remove the latch rod from the upper latch, and remove the upper latch from the door.
4. To remove the lower latch, remove the four latch attaching screws and disengage the latch rod from the latch. Remove the latch from the door (Fig. 6).

Installation

1. To install the lower latch, connect the latch rod and bushing to the latch. Position the latch to the door and install the four attaching screws.
2. To install the upper latch, position the latch to the door and install the three attaching screws.
3. Connect the latch rod clip and rod to the latch (Fig. 6).
4. Check the operation of the latches and adjust the strikers, if necessary. Refer to Latch Striker Adjustments in this Part.
5. Install the watershield and door trim panel (if so equipped).

LEFT REAR DOOR LATCH

E-100—E-350

Removal and Installation

1. Remove the door trim panel and watershield (if so equipped).
2. Remove the four latch attaching screws and remove the latch from the door (Fig. 7).

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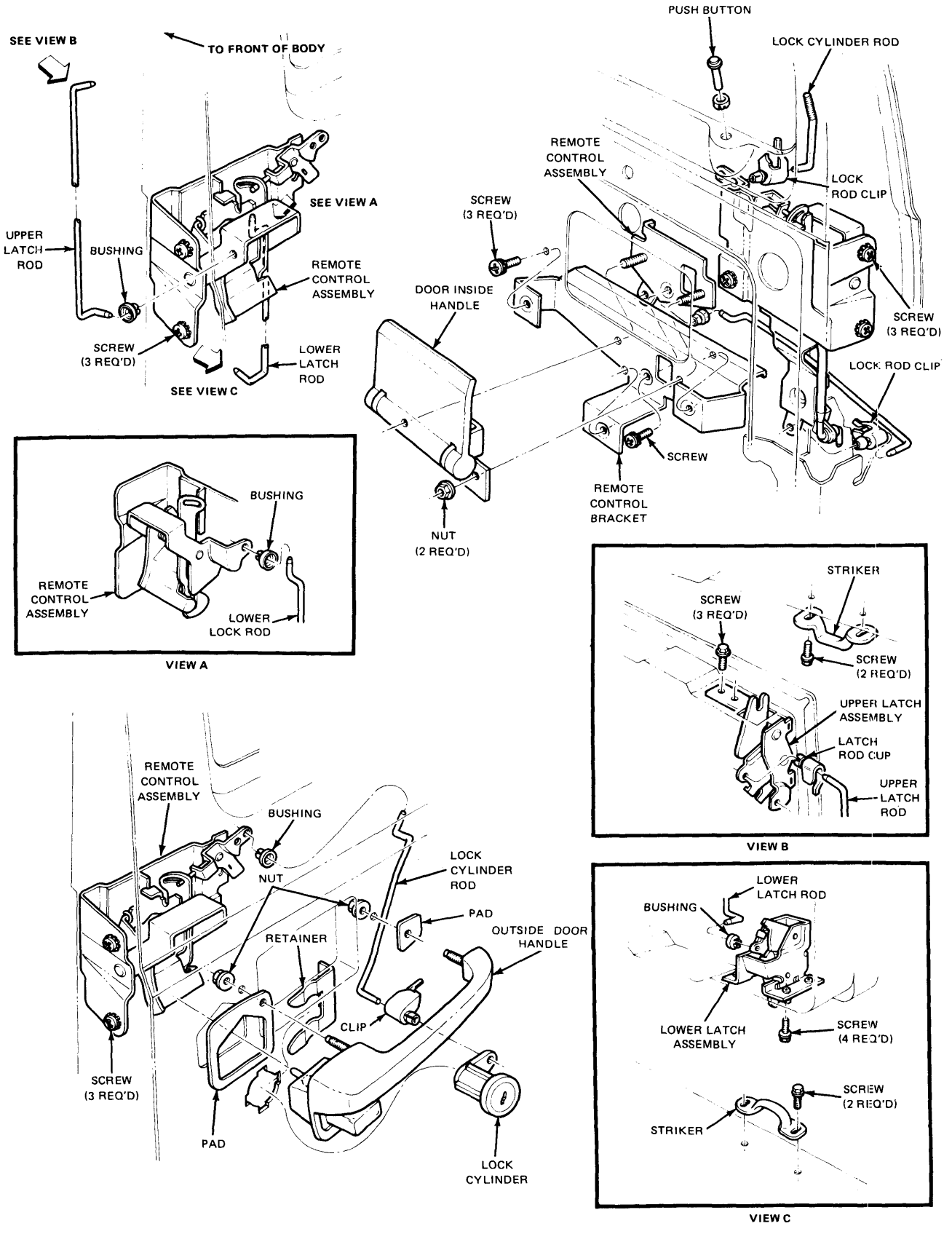


FIG. 6 Right Rear Door Latch and Remote Control Installation—E-100—E-350

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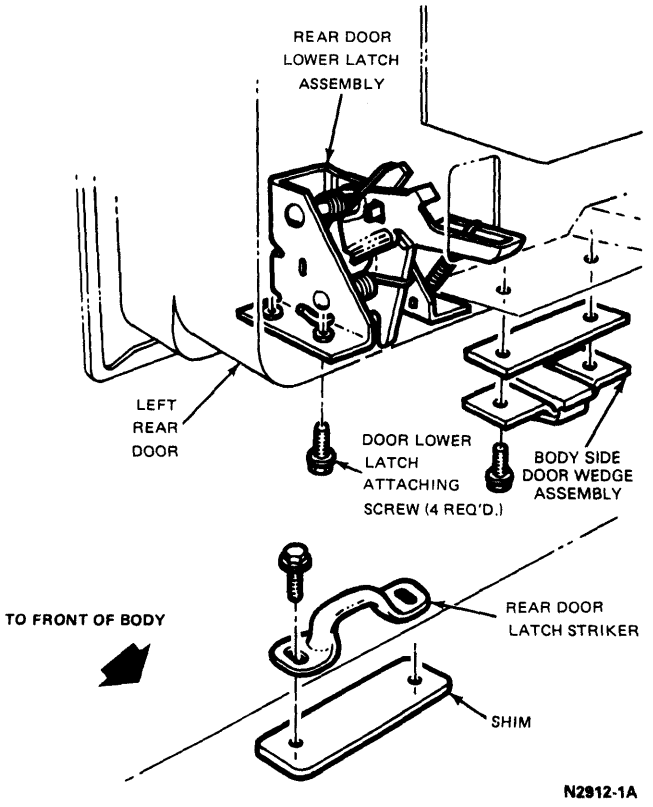


FIG. 7 Left Rear Door Latch—E-100—E-350

3. Position the latch to the door and install the four attaching screws.
4. Install the watershield and door trim panel (if so equipped).

REMOTE CONTROL ASSEMBLY—FRONT DOOR

F-SERIES AND BRONCO

1. Remove the door trim panel and watershield.
2. Disconnect the latch remote control rod from the remote control (Fig. 2).
3. Remove the screws attaching the remote control to the door inner panel, and remove the remote control.
4. Transfer the rod clip to the new remote control, if the remote control is to be replaced.
5. Position the remote control to the door inner panel and connect the rod to the remote control.
6. Install the remote control attaching screw.
7. Check the remote control and latch operation.
8. Install the watershield and door trim panel.

E-100—E-350

Removal and Installation

1. Remove the door inside handle, inside handle cup (if so equipped) and window regulator handle.
2. Remove the access cover plate and watershield from the door inner panel.
3. Remove the screw attaching the remote control to the door inner panel (Fig. 3).
4. Disengage the link from the remote control and remove the remote control from the door.
5. Transfer the bushing to the new remote control.
6. Connect the link to the remote control and install the remote control to the door inner panel with the attaching screws.
7. Install the watershield and access cover plate.
8. Install the window regulator handle, inside handle cup (if so equipped), and door inside handle.

REMOTE CONTROL ASSEMBLY—RIGHT REAR DOOR

E-100—E-350 (WITHOUT DOOR INSIDE HANDLE)

Removal

1. Remove the door trim panel and watershield (if so equipped).
2. Disconnect the lock cylinder rod from the lock cylinder (Fig. 6).
3. Remove the three screws attaching the remote control assembly to the door (Fig. 6).
4. Disconnect the upper latch rod from the upper latch (Fig. 6). Disconnect the upper latch rod from the remote control assembly.
5. Disconnect the lower latch rod from the remote control assembly, and remove the assembly from the door.

Installation

1. Transfer the lock cylinder rod and rod bushings to the new remote control assembly.
2. Position the remote control assembly into the door and connect the lower latch rod to the assembly.
3. Connect upper latch rod to remote control assembly and to the upper latch (Fig. 6).
4. Position remote control assembly to door inner panel and install three attaching screws.
5. Connect the lock cylinder rod to the lock cylinder (Fig. 6).
6. Install the watershield and door trim panel (if so equipped).

E-100—E-350 (WITH DOOR INSIDE HANDLE)

Removal

1. Remove the two nuts retaining the door inside handle to the handle remote control and remove the handle.
2. Remove the door trim panel and watershield (if so equipped).
3. Disconnect the door handle remote control link from the remote control (Fig. 6).
4. Remove the three screws attaching the door handle remote control bracket to the door inner panel. Remove the door handle remote control, bracket, and link from the door.
5. Unscrew and remove the door lock push button (Fig. 6).
6. Disconnect the lock cylinder rod from the lock cylinder.
7. Remove the three screws attaching the remote control assembly to the door (Fig. 6).

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8. Disconnect the upper latch rod from the upper latch (Fig. 6). Disconnect the upper latch rod from the remote control assembly.
9. Disconnect the lower latch rod from the remote control assembly and remove the assembly from the door.

Installation

1. Transfer the door lock push rod, lock cylinder rod, and rod bushings to the new remote control assembly.
2. Position the remote control assembly into the door, and connect the lower latch rod to the assembly.
3. Connect the upper latch rod to the remote control assembly and upper latch (Fig. 6).
4. Place the remote control assembly in position and insert the door lock push button rod through the push button hole (Fig. 6). Install the three remote control assembly attaching screws.
5. Connect the lock cylinder rod to the lock cylinder (Fig. 6).
6. Screw the door lock push button on the push button rod.
7. Position the door inside handle remote control and bracket to the door inner panel, and install the three attaching screws (Fig. 6).
8. Connect the inside handle remote control link to the remote control assembly.
9. Install the watershield and door trim panel (if so equipped).
10. Install the door inside handle.

LOCK CYLINDER

When a lock cylinder is replaced, both door lock cylinders and the ignition lock cylinder should be replaced in a set. This will avoid carrying an extra key which will fit only one lock. If a key is to be replaced, the new key code number is stamped on a metal tag attached to the key.

1. Roll the window to the up position.
2. Remove the access hole cover and/or trim panel and pull away the water shield (if so equipped).
3. Disconnect the lock actuating rod from the lock control link clip.
4. Slide the lock cylinder retainer away from the lock cylinder (Figs. 2 through 8).
5. Remove the lock cylinder.
6. Insert the lock cylinder in the door and connect the lock cylinder retainer.
7. Connect the lock actuating rod to the lock control link clip.
8. Install the water shield. Cement the top and/or side edges of the water shield to the inner surface of the inner panel.
9. Install the access hole cover and/or trim panel.

DOOR INSIDE HANDLE

F-SERIES AND BRONCO

To remove the door inside handle, remove one screw and remove the handle (Fig. 2).

E-100—E-350

Removal and Installation

The door inside handle is attached to the remote control with two nut and washer assemblies. Remove the nut and washer assemblies to remove the inside handle. An inside handle cup on E-100—E-350 models with door trim panels. The cup can be removed by pulling it off the remote control studs.

DOOR OUTSIDE HANDLE

BRONCO, F-SERIES AND E-100—E-350

Removal

1. Remove the trim panel and water shield from the door.
2. Disconnect the latch actuating rod from the handle link connector.
3. Prep the area surrounding the door handle opening with protective cover to preclude paint damage.
4. Using a 1/2" x 4" piece of wood dowel stock, or similar material, prop the door handle open to gain access to the (2) blind rivets retaining the handle.
5. Using a drift punch or similar tool, knock out the center pin or mandrel of each rivet. Then use a 1/4" drill and drill out the remainder of the rivet from the door sheet metal. (Use care in drilling so that sheet metal holes are not enlarged.)
6. Remove the prop and door handle from the door.

Installation

1. Prep area surrounding the door handle opening with protective covering to preclude paint damage.
2. Remove the door trim panel and water shield.
3. Position the door handle into the door opening and pull the handle lever open and insert a 1/2" x 4" piece of wood dowel stock or similar material between the open handle and door sheet metal. Assure that the handle base is flush to the door sheet metal and aligned to the retaining holes.
4. Install (2) 1/4" x 1/2" Blind Oval Head Rivets (388047-S100) and remove prop.
   NOTE: DO NOT SUBSTITUTE RIVETS, USE 388047-S100 RIVETS ONLY.
5. Install latch actuating rod and check for proper operation.
6. Install door watershield and trim panel.

FRONT SIDE AND RIGHT REAR CARGO DOORS

E-100—E-350

1. Remove the door trim panel and watershield (if so equipped).
2. Remove the two nut and washer assemblies attaching the outside handle to the door (Fig. 6).
3. Remove the outside handle and pads from the door.
4. Position the pads and outside handle to the door and install the two screw and washer assemblies.
5. Install the watershield and door trim panel (if so equipped).

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Power Door Locks

PART 44-16

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DESCRIPTION AND OPERATION

The power door lock control system uses electric switches controlled by the front door lock push buttons. Relays direct the current to the door lock actuator motors to lock or unlock the doors.

To lock the doors push down firmly on either front door lock push button and close the door(s). To unlock the doors from inside the vehicle, lift the push buttons on either front door upward beyond the normal travel.

The key will not lock or unlock all doors from outside the vehicle. The key inserted into the door lock can only be used to lock or unlock each individual door.

TESTING

MOTOR

Apply 12 volts directly to one terminal of the motor's (actuator) connector and ground the other terminal (Fig. 1). The motor (actuator) gear should finish its travel in less than one (1) second. Reverse the polarity for opposite travel.

Using an ammeter; the motor current draw (stall test), should not exceed 6 amps. Reverse the power and ground leads to the connector and re-test.

SWITCH

Using a self-powered test light, there should be **no continuity** between any terminals with the switch in its normal position.

Continuity should exist between terminals A and with the switch held in one position and between terminals B and C with the switch held in the other position (Fig. 1).

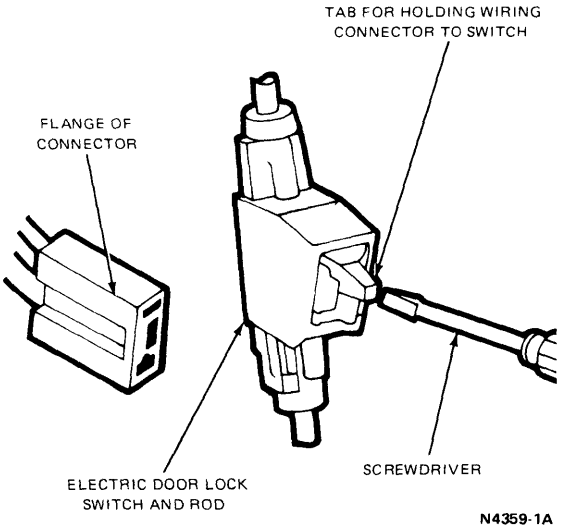


FIG. 1 Power Door Switch Pin Locations

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REMOVAL AND INSTALLATION

ELECTRIC DOOR LOCK ACTUATOR MOTOR

To remove the door lock actuator motor (Fig. 2), remove the door trim panel. Then, disconnect the actuator motor link from the door latch. Remove the screws or pop rivets attaching the actuator motor to the door and disconnect the wiring at the connector. Remove the actuator motor.

To install the door lock actuator motor, connect the wiring at the connectors and install the door lock actuator motor in the door with screws and/or pop rivets. Connect the actuator motor link to the door latch. Then, install the door trim panel.

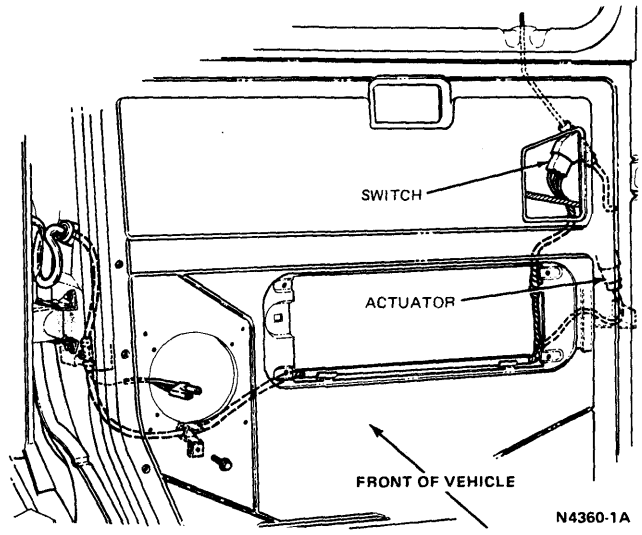


FIG. 2 Electric Door Lock Actuator Removal

DOOR LOCK CONTROL SWITCH

The power door switch is an integral part of the door lock push button rod. To replace the switch, remove the door trim panel. The switch must be detached from the door latch and/or bellcrank before disconnecting or connecting the wiring connector.

Disengage the push button rod from the latch. To disengage the wiring connector from the switch, apply pressure under the tab with a small screwdriver (Fig. 1). Then, pry the locking tab up from the flange of the connector and pull them apart.

To reassemble the wiring connector to the switch, press firmly together until the tab locks behind the flange. Install the switch to the door latch and/or bellcrank. Inspect the switch installation to ensure that no binds to sheet metal or tight wires exist.

Install the trim panel to the door.

RELAY

Remove both connectors to perform the relay tests. The relay is located on the lower left side of the instrument panel reinforcer (Fig. 3).

Verify that terminal point 1 on the relay is grounded. If terminal 1 on the relay is not grounded, check the relay case to ground screws for tightness. If the relay case to ground screws are tight, replace the relay. If not, tighten and re-test.

Apply power to terminals 2 and 4 on each relay, and connect a 12 volt test light between terminals 1 and 2, **(no longer than two minutes).** The test light should light. If the operative test light does not light, replace the relay (Fig. 4).

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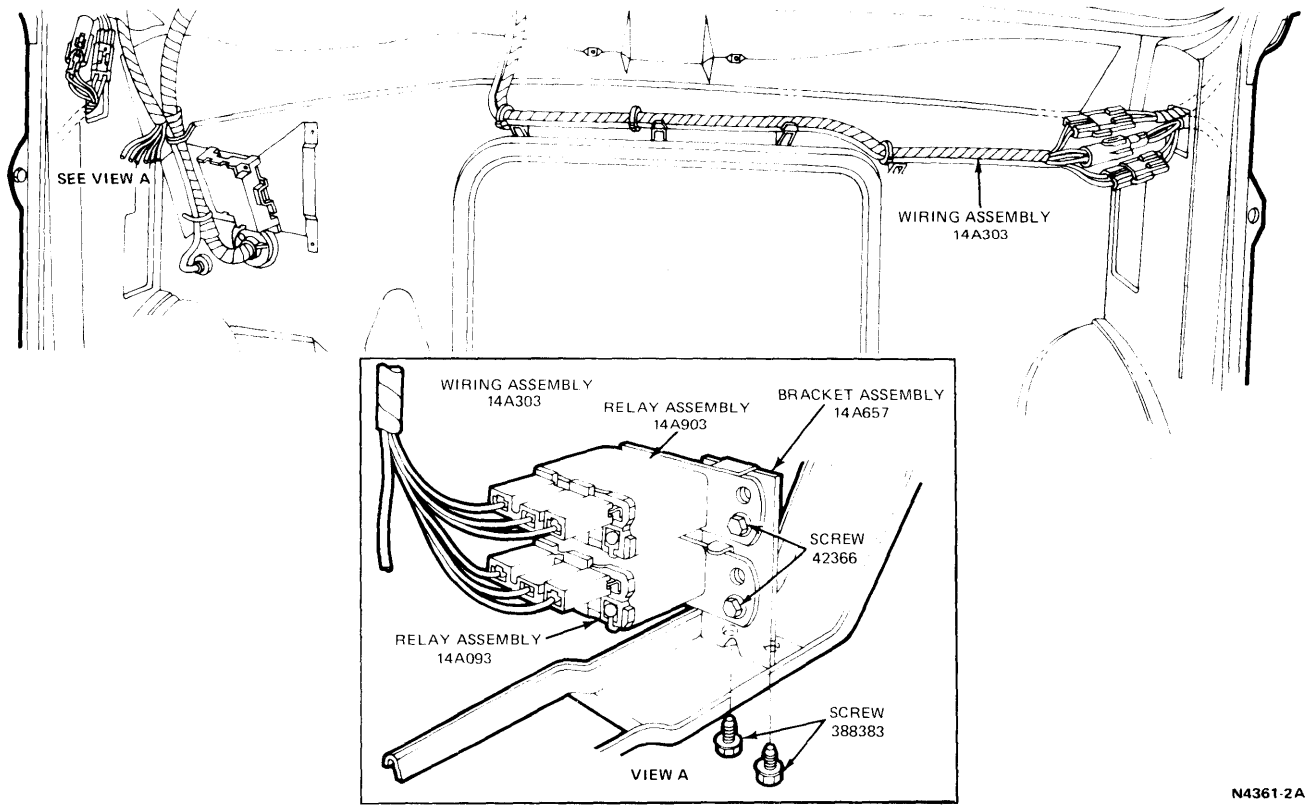


FIG. 3 Door Lock Relay Assembly Removal

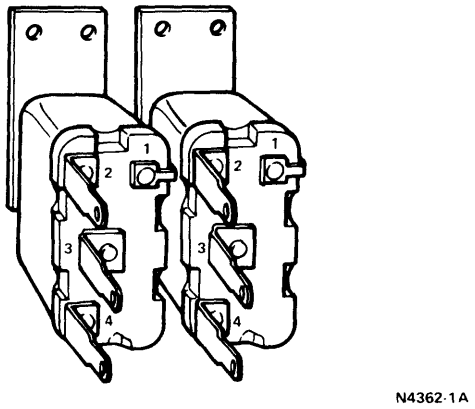


FIG. 4 Door Lock Relay Assembly Terminals

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Hood and Hinges

PART 44-21

APPLIES TO BRONCO, E-100 THROUGH E-350 AND F-100 — F-350

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ADJUSTMENTS

F-SERIES, AND BRONCO

1. Open the hood and mark the hinge and latch assembly locations.
2. Loosen the hinge to fender apron attaching screws until they are just snug (Fig. 1).
3. Adjust the hinge up or down or rotate as required to obtain a flush fit between the hood and the top of the cowl panel. Then, tighten the hinge to fender apron attaching screws.
4. Loosen the two hood latch assembly attaching screws (Part 44-31).
5. Loosen the hinge to hood attaching bolts until they are just snug. Move the hood forward or rearward and from side to side as required for a proper hood fit. Then, tighten the hinge-to-hood attaching screws. Move the latch from side to side as required to center the latch with the hood striker. Tighten the hood latch attaching screws.
6. Lubricate each hood hinge at all pivot points with Polyethylene Grease (C4AZ-19584-B) or equivalent. Recheck the functional operation of the hinges by opening and closing the hood several times to assure correct alignment and that the lubricant has effectively worked into the pivot points.

E-100—E-350 AND CLUB WAGON.

The hood can be adjusted fore-and- aft and up-and-down to obtain the proper clearance. To adjust the hood, loosen the hood-to-hinge attachments (fore-or-aft adjustment) or the hinge-to-cowl attachments (up-or-down-adjustment) until they are just snug. Then, reposition the hood as required, and tighten the attachments (Figs. 2 and 3). After the hood has been adjusted, check the hood latch adjustment. Adjust the hood latch if required (Part 44-31).

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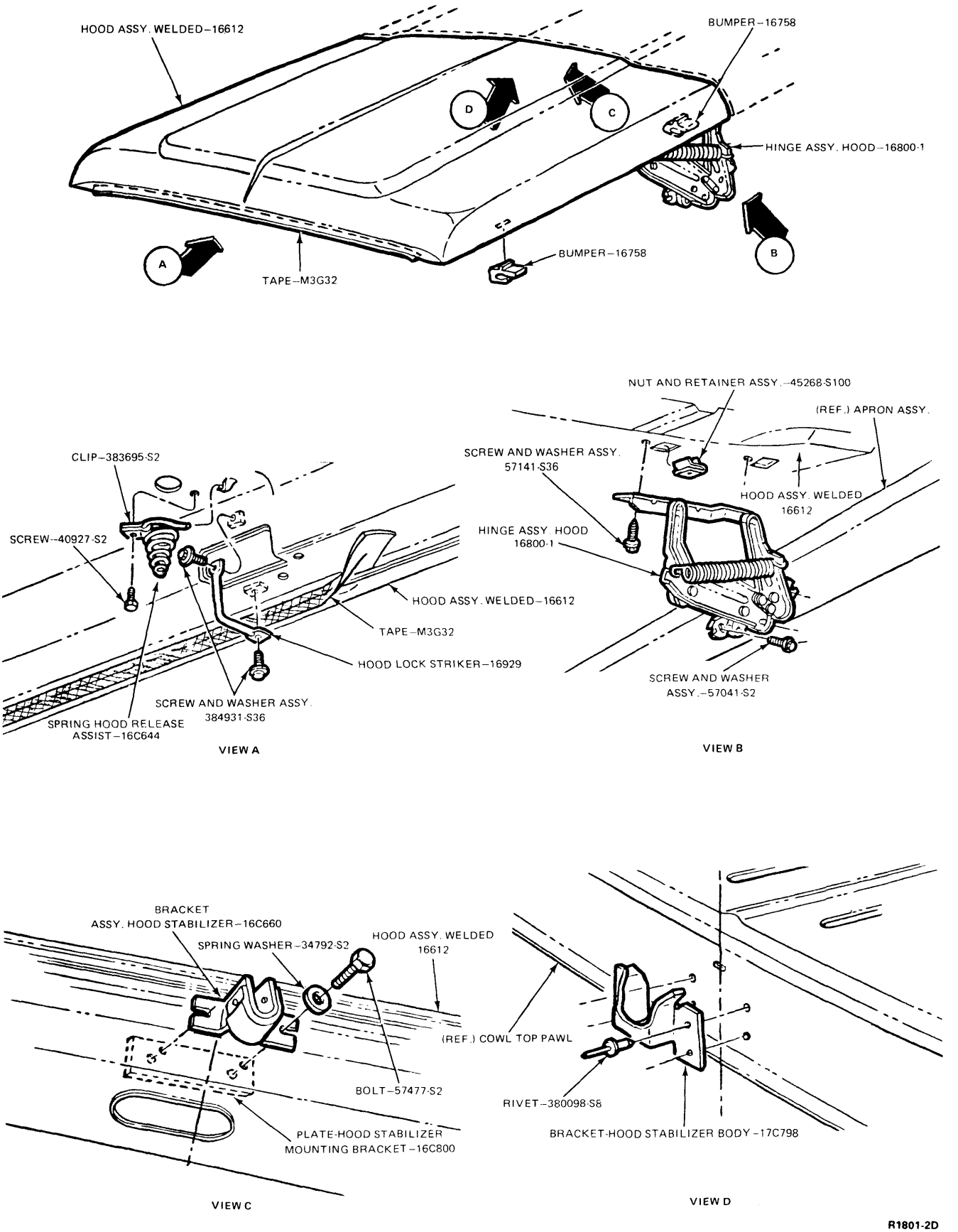


FIG. 1 Hood, Hinge and Striker Installation—Bronco and F-100 and F-350

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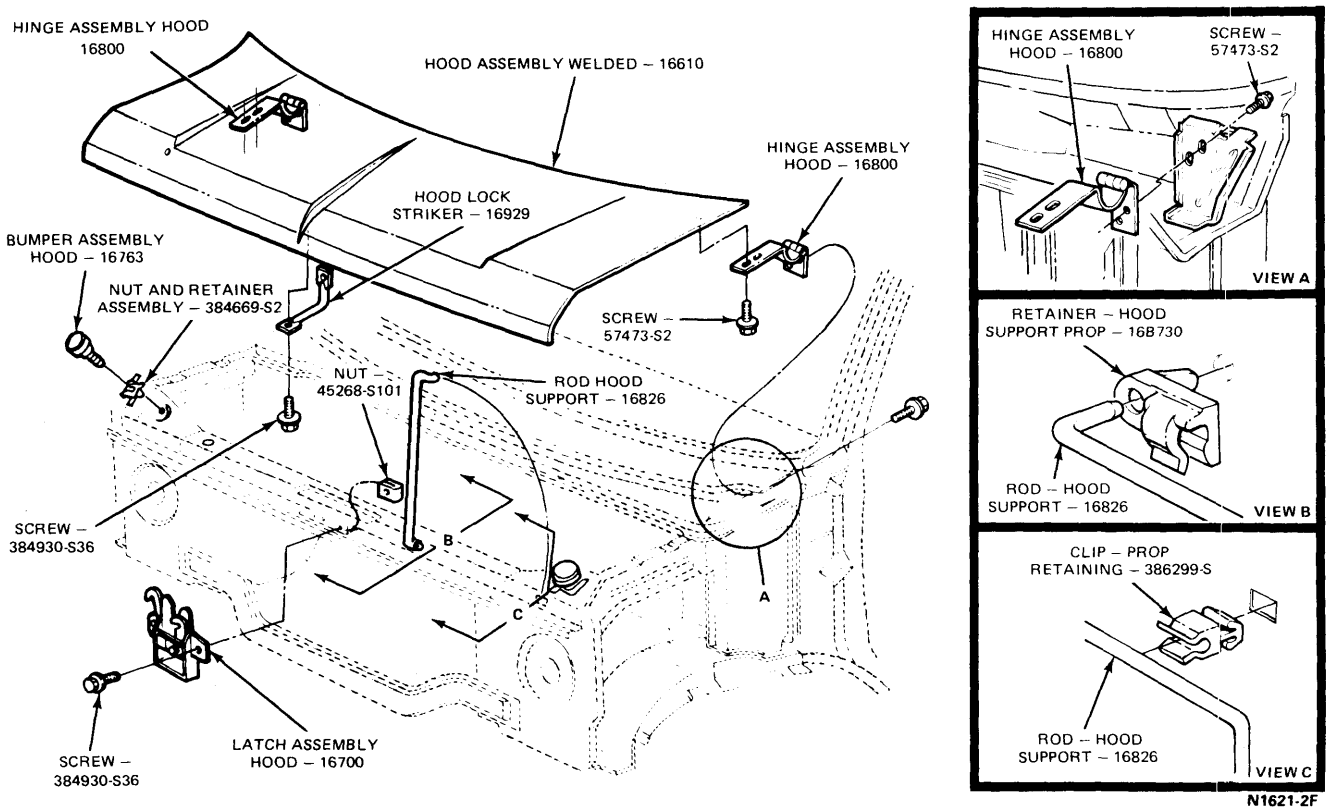


FIG. 2 E-100—E-350 Hood Installation—Steel

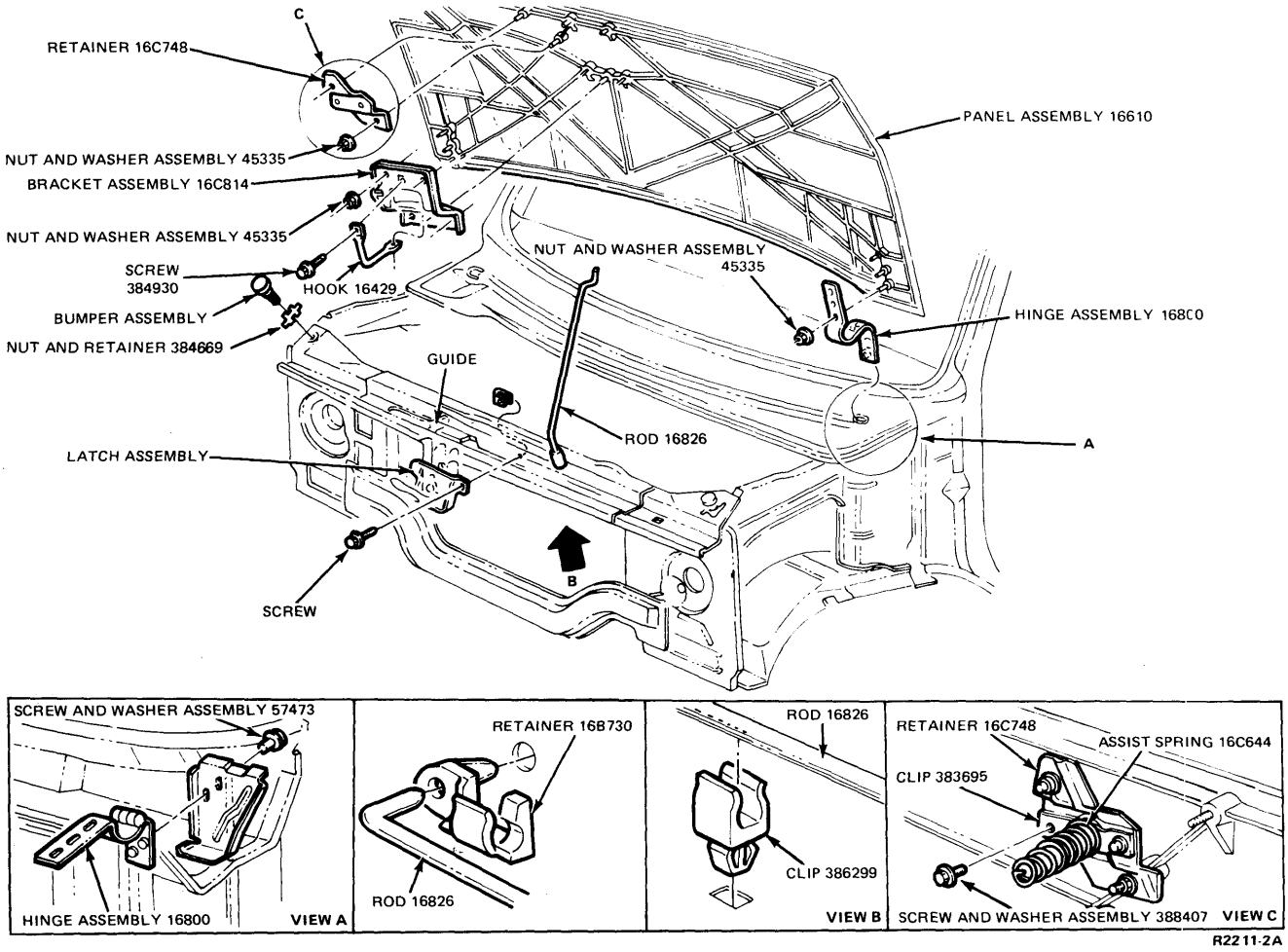


FIG. 3 E-100—E-350 Hood Installation—Fiberglass

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REMOVAL AND INSTALLATION

HOOD

F-SERIES AND BRONCO

1. Remove the hood hinge bolts and with the aid of a helper, lift the hood off the hinges.
2. If the hood is to be replaced, transfer the hood latch components and ornaments to the new hood.
3. With the aid of a helper, position the hood on the hinges and install the hinge bolts just snug.
4. Adjust the hood for a proper fit by shifting the hood on the hinges, and tighten the hinge bolts (Fig. 1).
5. Adjust the hood latch for proper alignment (44-31).

E-100—E-350

Removal

1. Open the hood and prop the hood in the open position (Figs. 2 and 3).
2. Cover the cowl area to prevent paint damage.
3. Remove screws or nuts attaching each hood hinge to the hood and remove the hood from the vehicle.
4. Remove the hood lock striker from the hood.

Installation

1. Position the hood to the hood hinges and install the attaching screws or nuts.
2. Adjust the hood (Adjustments) and tighten the hood-to-hinge attaching screws or nuts.
3. Install the hood lock striker on the hood and adjust the hood latch if required.

HOOD HINGE

F-SERIES AND BRONCO

Removal

1. Open the hood and prop it in the open position with a suitable prop.
2. Mark the locations of the hinges and remove the spring from both hinges.
3. Remove two screws attaching each hinge to the hood and remove the hood from the vehicle. Do not let the hood slide down and damage the cowl top.
4. Remove the hinge attaching bolts and remove the hinge from the vehicle.

Installation

1. Position the new hinges to the vehicle and install the attaching bolts snug.
2. Install the springs.
3. Position the hood to the hinges and install the four attaching screws snug.
4. Remove the prop supporting the hood in the open position.
5. Close the hood and adjust the hood as outlined in Adjustments.

E-100—E-350

Removal

1. Open the hood and prop it in the open position.
2. Cover the cowl area to prevent paint damage.
3. Remove hinge-to-body attachments (Figs. 2 or 3) and remove hood.
4. Remove hinge-to-hood attachments and remove the hinge.

Installation

1. Position the hinge to the hood and install the attaching screws or nuts snug.
2. Position the hinge to the body and install the attaching screws or nuts snug.
3. Adjust the hood (Adjustments) and tighten the hinge attaching screws or nuts.
4. Remove the protective cover and close the hood.

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Hood Latch

PART 44-31

APPLIES TO BRONCO, E-100 THROUGH E-350, F-100 — F-350

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ADJUSTMENTS

HOOD LATCH ADJUSTMENT

F-SERIES, E-100 — E-350, AND BRONCO

Before adjusting the hood latch, make certain that the hood is properly aligned (Part 44-21). The hood latch can be moved from side-to-side to obtain alignment with the hood lock striker. The hood latch can be adjusted up and down to obtain a snug hood fit (Figs. 1 and 2).

1. Loosen the hood latch attaching screws just enough to move the latch.
2. Move the latch from side-to-side until it is aligned with the hood lock striker. Then, tighten the latch attaching screws.
3. Loosen the hood lock striker attaching screws just enough to move the striker.
4. Raise or lower the hood lock striker as required to obtain positive hood latch-to-striker engagement with a minimum of hood free play. Tighten the hood latch attaching screws. Check the hood latch to be sure it makes full engagement with the hood lock

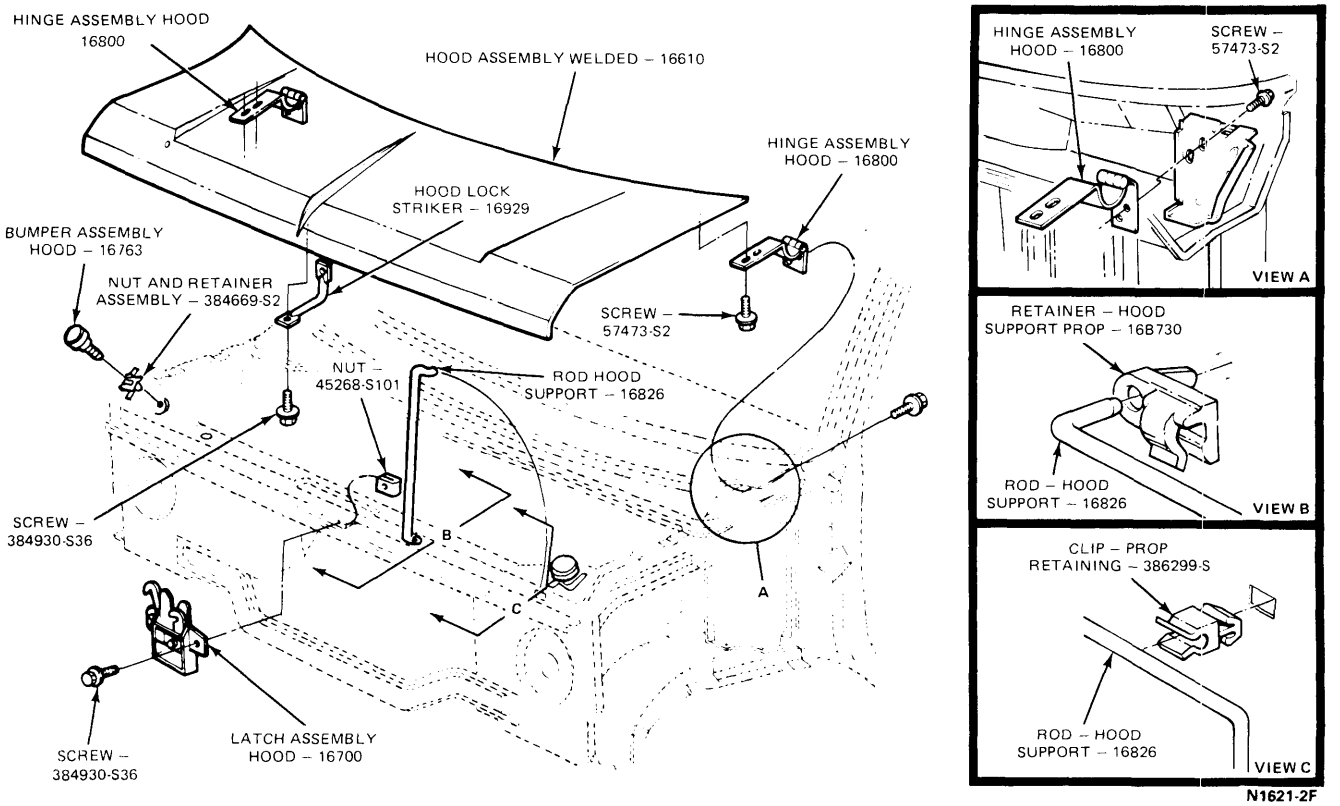


FIG. 1 Hood Latch Adjustment—E-100—E-350

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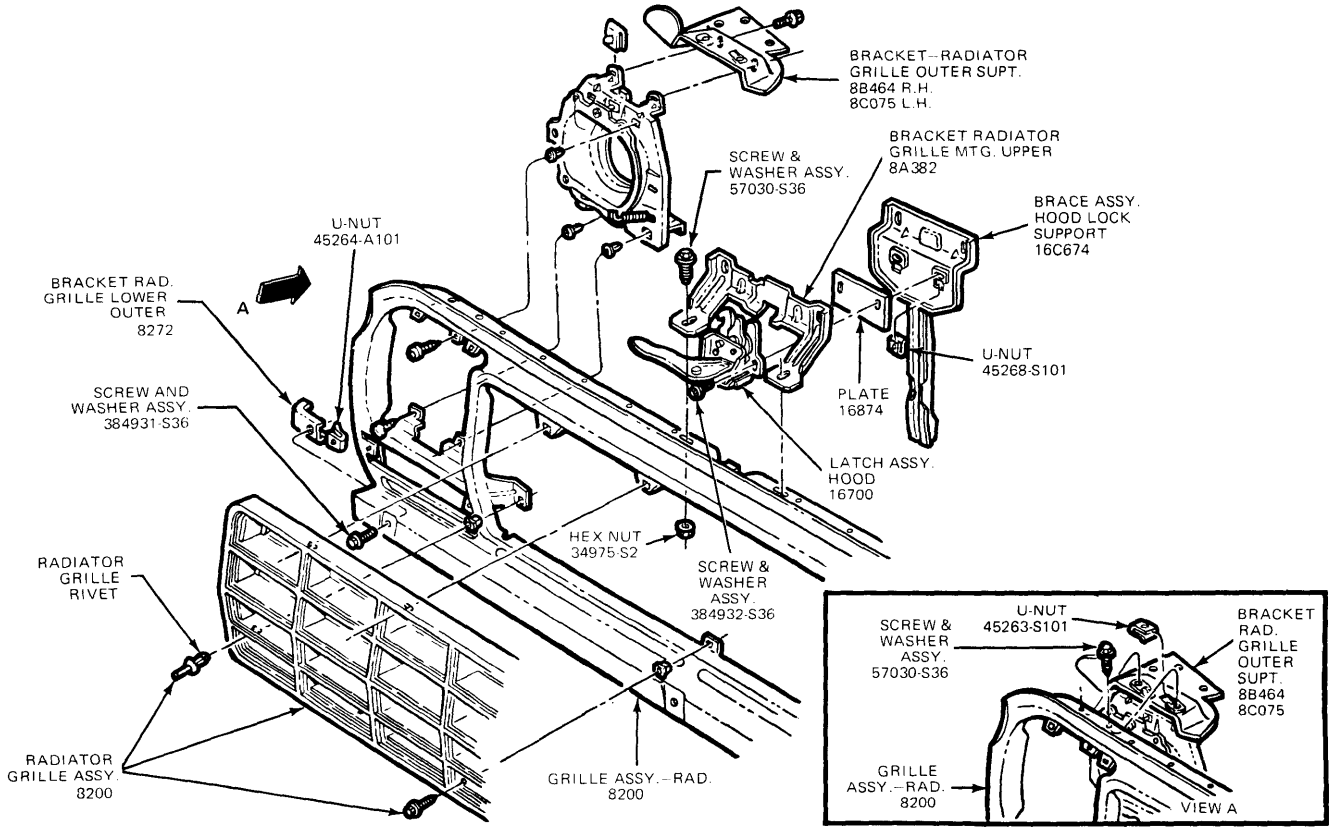


FIG. 2 Hood Latch Installation—F-100 Through F-350 and Bronco

striker. If the hood latch does not make full engagement with the hood latch striker, loosen the hood lock striker attaching screws and re-position the striker to obtain full engagement. Then, tighten the attaching screws.

5. Lubricate the latch handle pivot, catch pawls and spring with Polyethylene Grease (C4AZ-19584-B or equivalent). Recheck the functional operation of the latch mechanism by opening and closing the hood several times to assure correct alignment and that the lubricant has effectively worked into the pivot points and bearing surfaces.

HOOD LATCH REMOTE CONTROL CABLE

E-100 — E-350, F-SERIES, AND BRONCO

The remote control operated hood latch is adjusted the same as the non remote latch.

The release cable and handle are routed as shown in Figs. 3 and 4.

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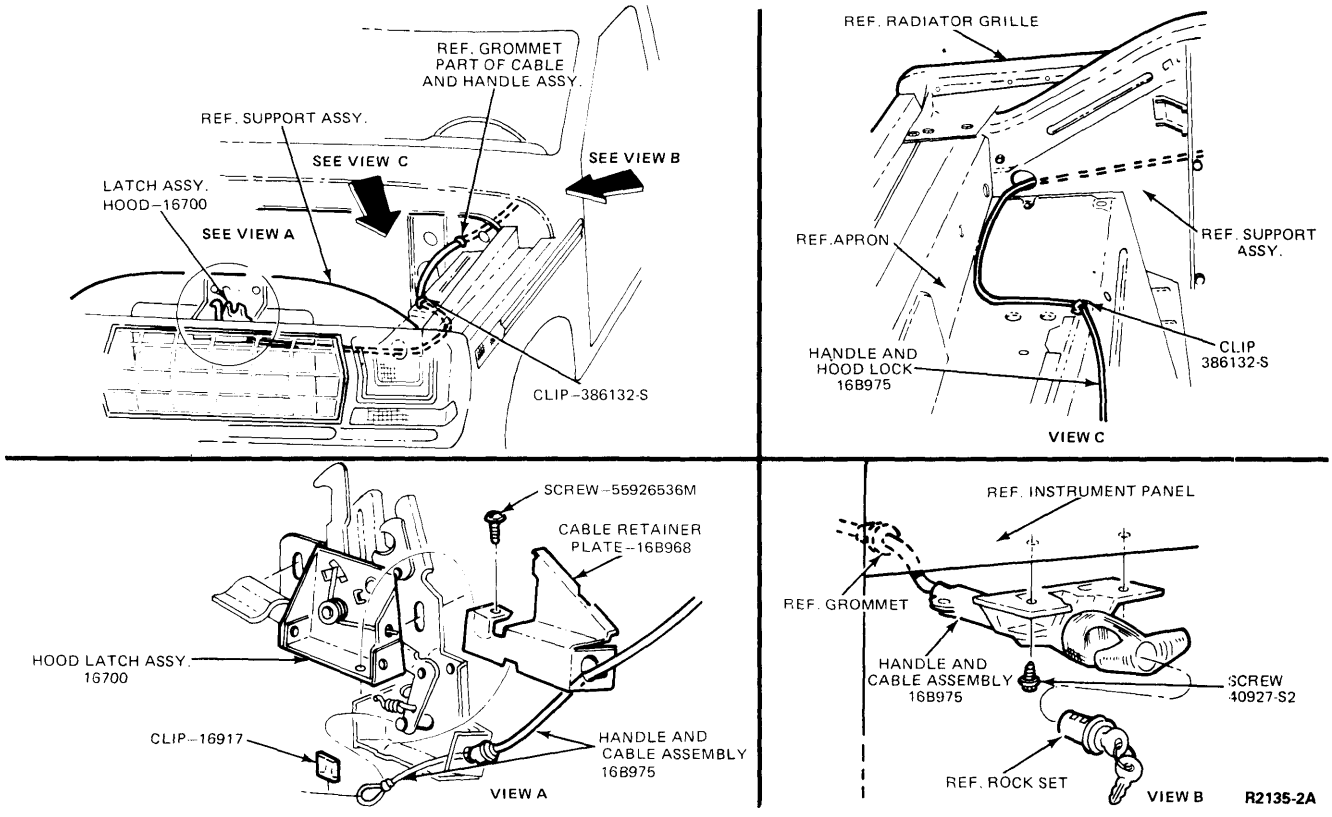


FIG. 3 Hood Latch Remote Control Cable and Lock—F-Series and Bronco

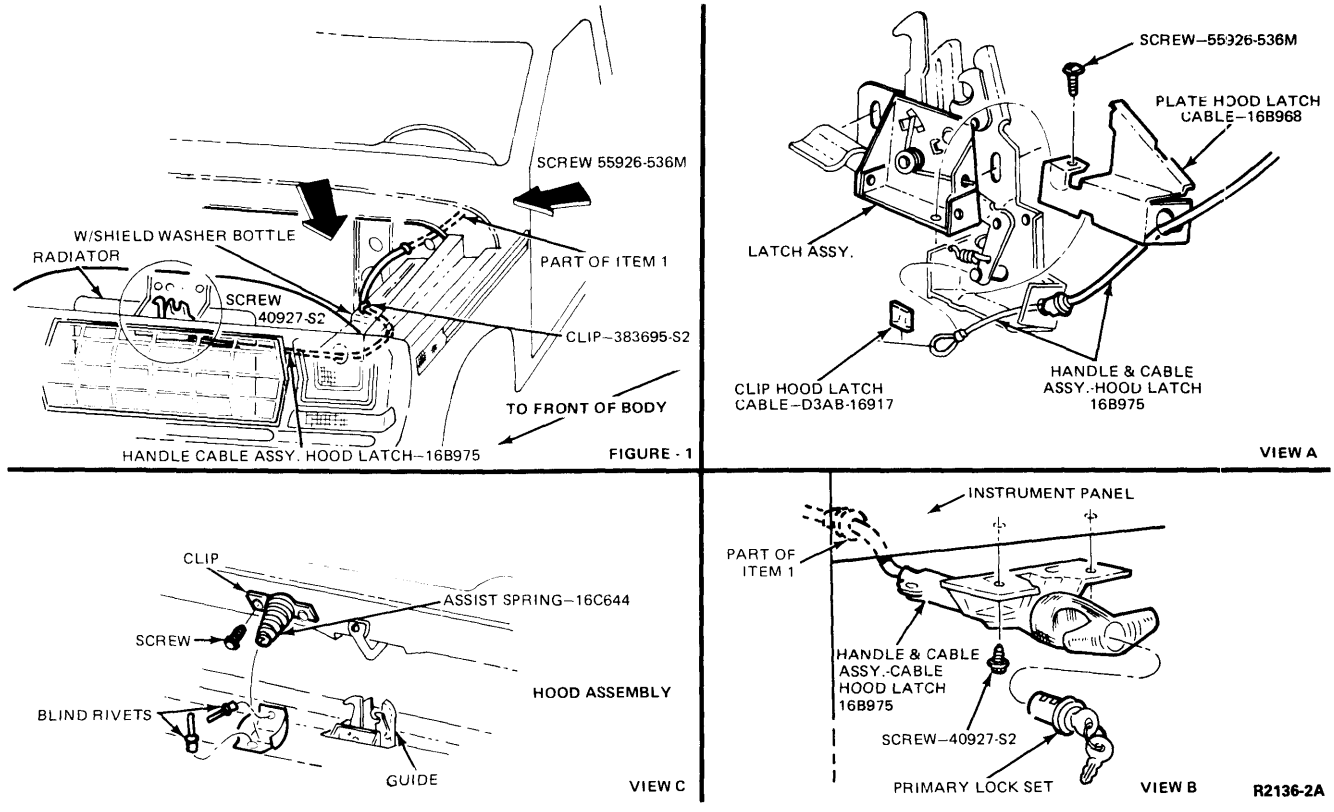


FIG. 4 Hood Latch Remote Control Cable and Lock—E-100 Through E-350

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REMOVAL AND INSTALLATION

HOOD LATCH

F- AND B-SERIES, E-100 — E-350, AND BRONCO

1. Open the hood and remove the hood latch attaching screws and remove the latch assembly from the hood latch support brace (Figs. 1 or 2).
2. Position the latch assembly to the hood latch support brace and install the attaching screws snug but do not tighten.
3. Adjust the latch assembly for positive engagement with the hood lock hook and tighten the latch attaching screws.
4. Lubricate the latch handle pivot, catch pawls and spring with Polyethylene Grease (C4AZ-19584-B or equivalent). Recheck the functional operation of the latch mechanism by opening and closing the hood several times to assure correct alignment and that the lubricant has effectively worked into the pivot points and bearing surfaces.

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Tailgate — Bronco and F-Series

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Tailgate Latch Release Hand and Lock Release Control Assemblies Bronco	86-2
REMOVAL AND INSTALLATION (Cont'd)	
Tailgate — On-Body Latch	
F-Series Styleside Pick-up	86-1
Tailgate Support, Handle and Latch Bracket	
F-Series Styleside Pick-up	86-1
Tailgate Weatherstrip	
Bronco	86-5

REMOVAL AND INSTALLATION

TAILGATE-ON-BODY LATCH

F-SERIES STYLESIDE PICK-UP

1. Open the tailgate and remove two latch attaching screws and remove the latch (Fig. 1).
2. Position the latch to the body and install the two attaching screws snug.
3. Adjust the latch and tighten screws securely.

TAILGATE SUPPORT, HANDLE AND LATCH BRACKET

F-SERIES STYLESIDE PICK-UP

Removal

1. Open the tailgate and disconnect the tailgate supports from the latch brackets as shown in Fig. 1. Remove the two upper support attaching screws.

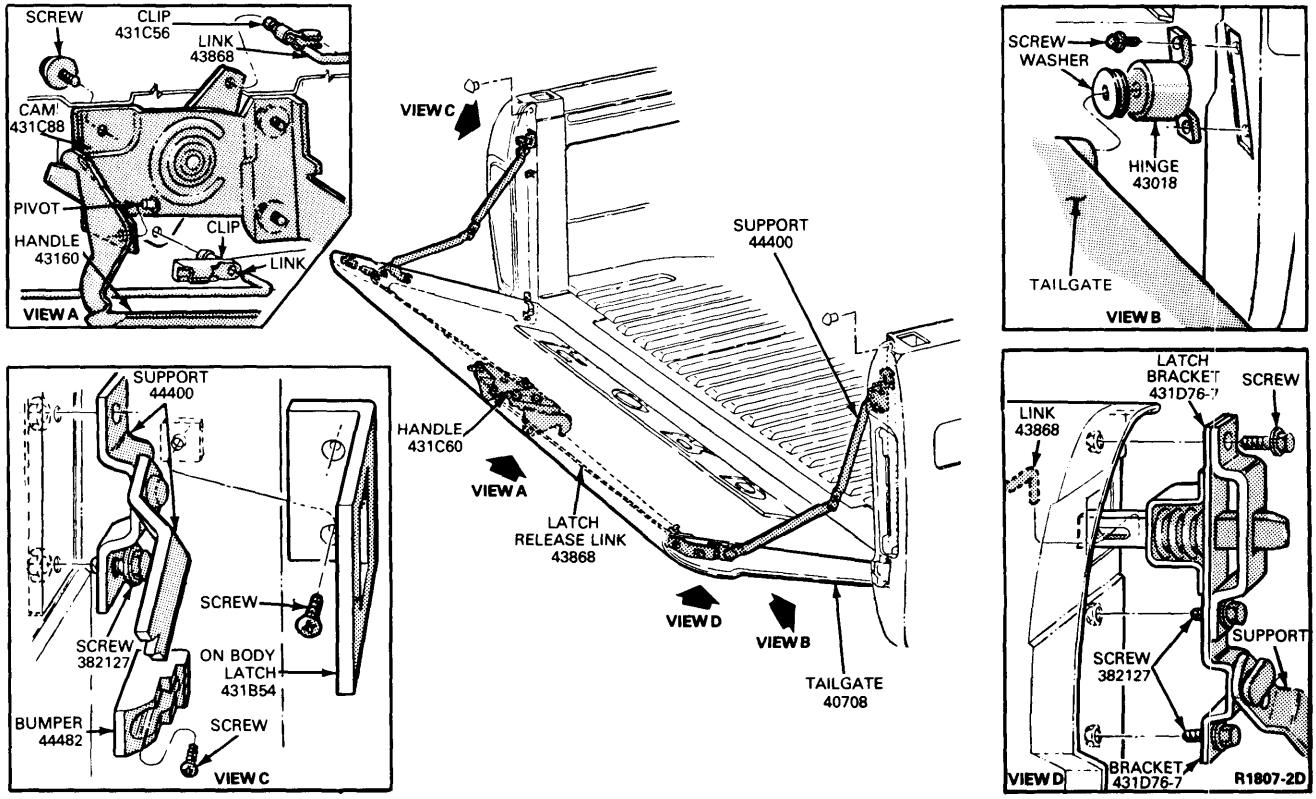


FIG. 1 Tailgate Installation—Styleside Pick-Up

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2. Remove three tailgate handle screws, disconnect the handle release links and remove the handle assembly.
3. Remove three latch bracket-to-tailgate attaching screws and remove the latch bracket assembly.

Installation

1. Position the latch bracket to the tailgate, connect the link to the latch bracket and install the attaching screws.
2. Position the tailgate handle to the tailgate. Connect the links to the center handle assembly and install the handle attaching screws.
3. Connect the tailgate supports to the latch bracket and install the upper support attaching screws.

TAILGATE

F-SERIES STYLESIDE PICK-UP

Open and support the tailgate assembly and remove the hinge attaching screws on each side of the tailgate at the latch bracket (Fig. 1). Then, carefully raise the lower portion of the tailgate upward and disengage it from the tailgate latch brackets. If a new tailgate is being installed, transfer all mouldings, latches, hinges, brackets, links, clips and washers to the new tailgate.

F-SERIES FLARESIDE PICK-UP

Unhook the tailgate chain from the tailgate. Remove the two bolts attaching the removable pivot to the body and remove pivot. Slide the tailgate off the stationary pivot (Fig. 2).

To install, position the tailgate on the stationary pivot and install the removable pivot using the two attaching bolts, hook the tailgate chain to the tailgate.

BRONCO

Removal

1. Unlatch the tailgate handle and lower the tailgate (Fig. 3). Disconnect the left and right cable assemblies at the tailgate.
2. Disconnect the tailgate window motor wire at the connector. Pull the lead wire from the tailgate body rail.
3. Support the tailgate and remove the torsion bar retainer from the body (View B, Fig. 3).
4. Remove the three screw and washer assemblies that secure the left and right hinge assemblies (Fig. 3) to the body.
5. Remove the tailgate from the vehicle.

Installation

1. Position the tailgate to the body and support.
2. Secure the hinge assemblies to the tailgate.
3. Attach the torsion bar retainer over the torsion bar.
4. Reconnect the tailgate window motor wire.
5. Secure the cable assemblies at the tailgate, remove support and check tailgate operation.

TAILGATE LATCH RELEASE HAND AND LOCK RELEASE CONTROL ASSEMBLIES

BRONCO

Removal

1. Lower the tailgate and remove the inner access cover (Fig. 3).
2. Remove two screws attaching the handle assembly to the tailgate (Fig. 4).

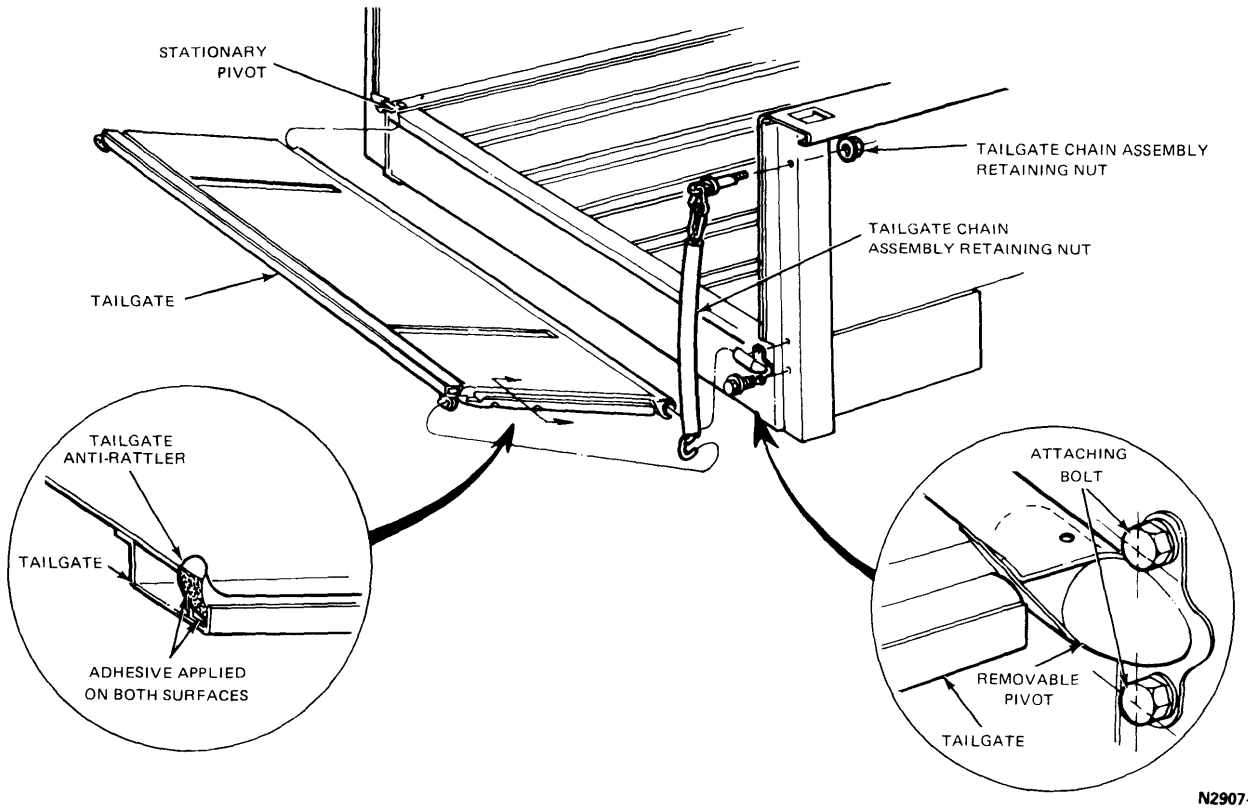
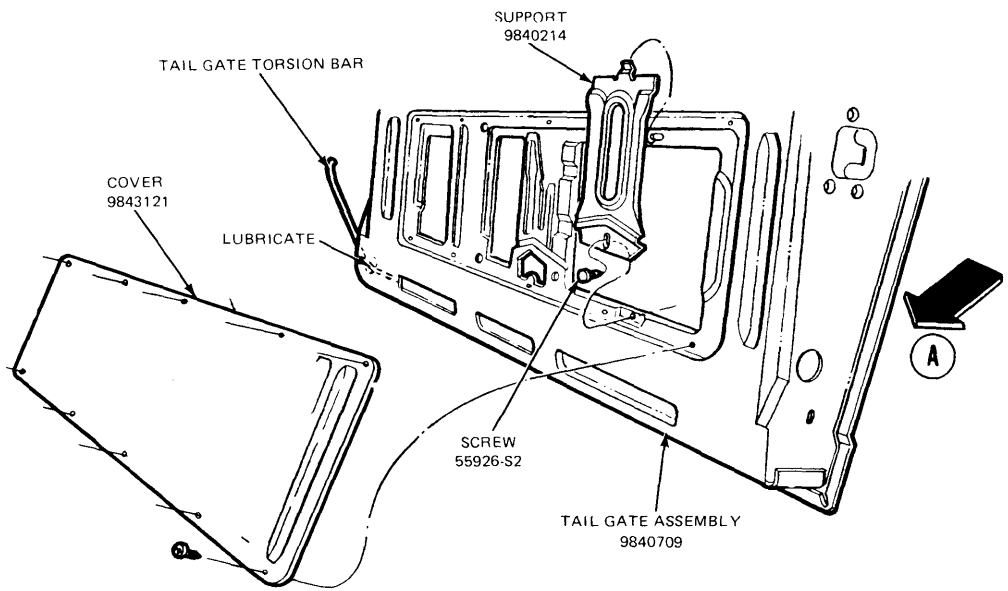
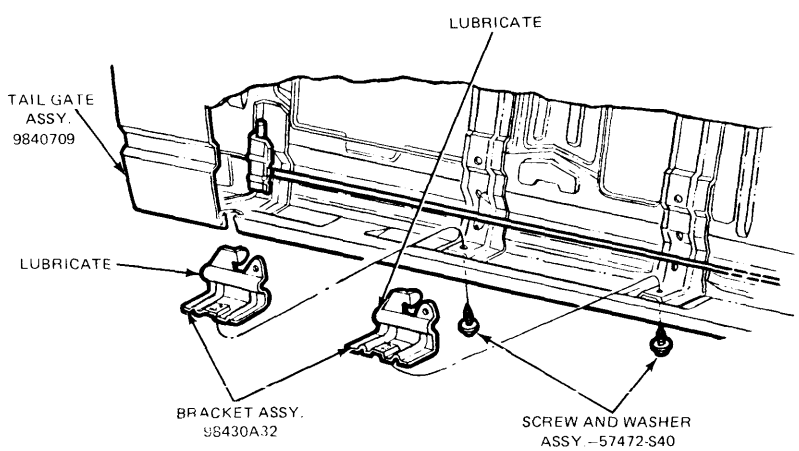


FIG. 2 Tailgate Installation—Flareside Pick-up

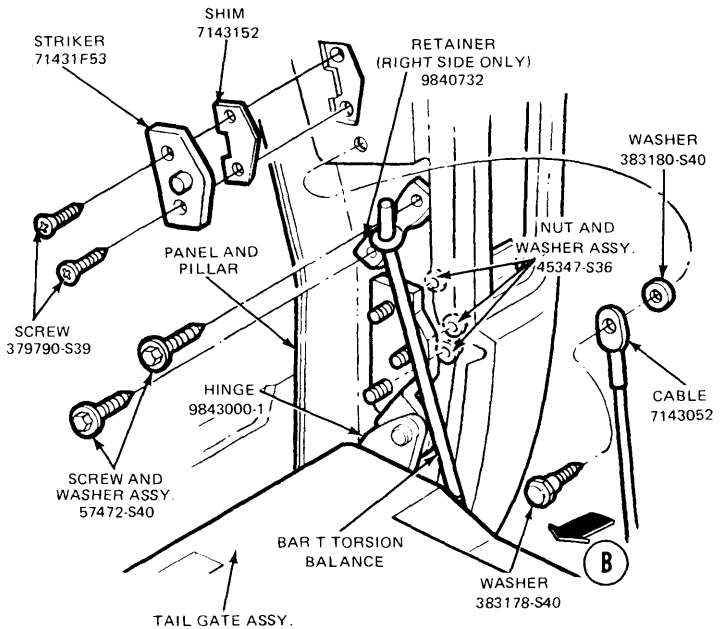
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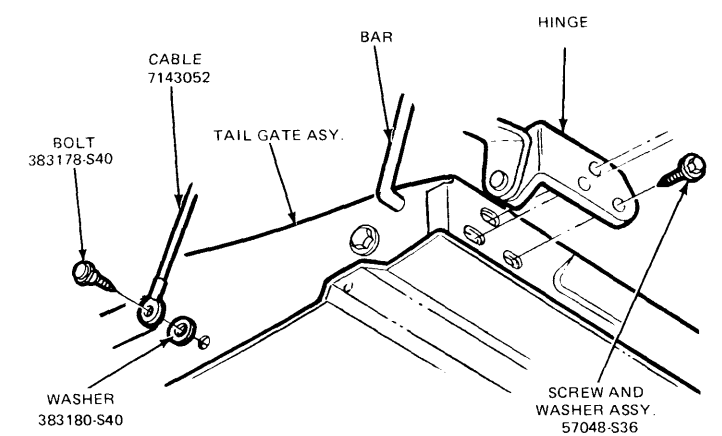




VIEW A

FIG. 3 Tailgate Installtion—Bronco



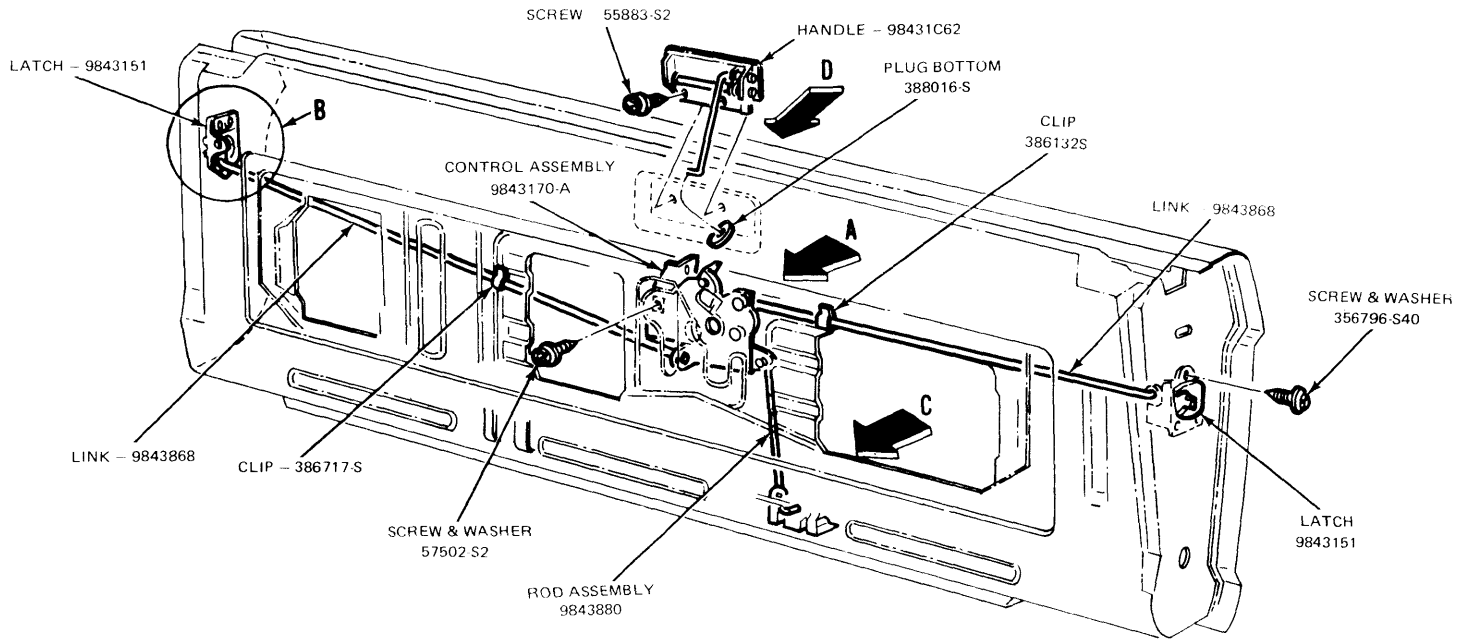


VIEW B

N4235-2A

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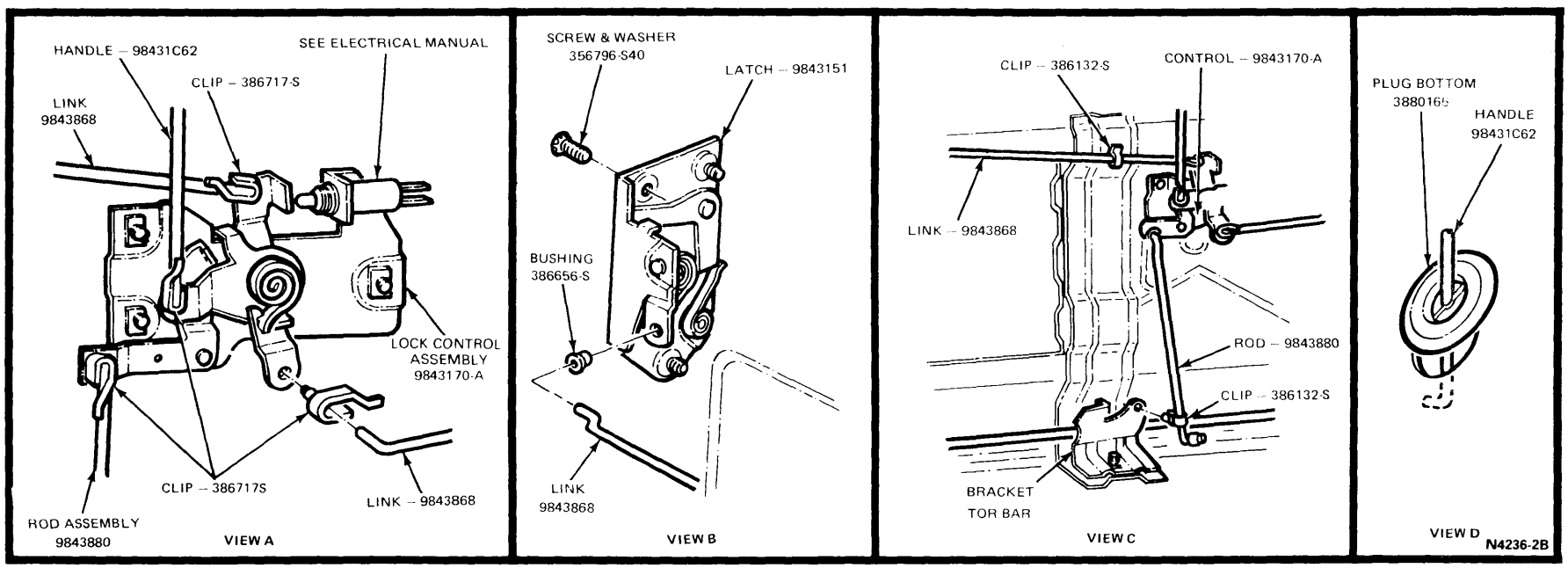


FIG. 4 Tailgate Latch Release and Lock Control—Bronco

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3. Remove the clip retaining the handle rod to the lock control.
4. Remove the handle and rod assembly.
5. Disconnect the latch release links and the latch control rod.
6. Disconnect the electrical connector from the interlock switch.
7. Remove three screw and washer assemblies that retain the lock control to the tailgate.
8. Remove the lock control from the tailgate.

Installation

1. Position the lock control into the tailgate and install three screw and washer assemblies (6-11 ft-lbs).
2. Reconnect the electrical connector.
3. Position the latch control rod and install the clip.
4. Position the latch release links and install the clips.
5. Position handle and rod assembly to the tailgate and reconnect the rod to the lock control and install clip.
6. Secure two screws retaining the handle assembly to the tailgate.
7. Reinstall the inner access cover.

TAILGATE WEATHERSTRIP

BRONCO

Refer to Part 44-92 for tailgate weatherstrip removal and installation procedures.

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Tailgate Weatherstrip

PART 44-92

APPLIES ONLY TO BRONCO

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION	92-1		

REMOVAL AND INSTALLATION

TAILGATE WEATHERSTRIP ASSEMBLY

Removal

1. Lower the tailgate.
2. Remove the screws attaching the tailgate weatherstrip and weatherstrip retainer to the body (Fig. 1).
3. Remove weatherstrip and retainer from the body.

Installation

1. Position the weatherstrip to the body and install the upper attaching screws.
2. Secure the right and left weatherstrip attaching screws to the body sill and push the weatherstrip onto the body pillar flange.
3. Position the lower weatherstrip retainer to the body and attach with eleven screws.

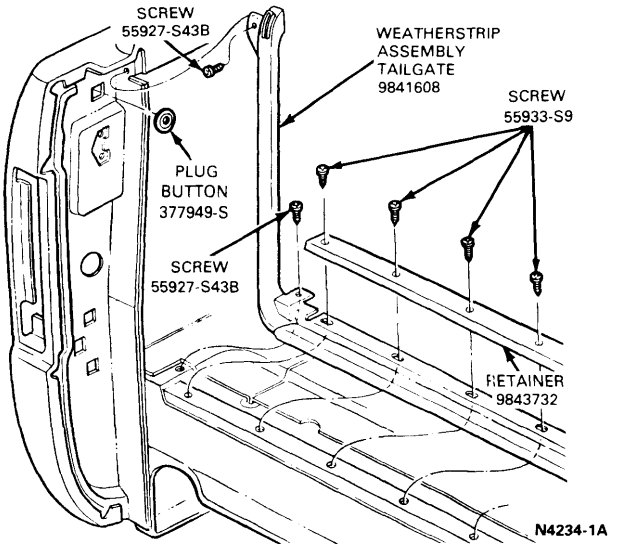


FIG. 1 Tailgate Opening Weatherstrips—Bronco

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INTERIOR TRIM

GROUP 45 (70000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Carpets and Floor Mats	45-26	Instrument Panel Pad	45-61
Console Assembly	45-31	Interior Trim — General Service	45-01
Door Trim Panels	45-03	Mouldings	45-16
Headlining	45-41	Quarter Trim Panels	45-11

Interior Trim — General Service

PART 45-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING PROCEDURE		CLEANING PROCEDURE (Cont'd)	
Fabrics	01-1	Woodgrain, Plastic, Vinyl and Leather Interior Trim	01-2
Lap Belt Webbing	01-2		

CLEANING PROCEDURE

FABRICS

The following procedure is recommended for the removal of spots and stains encountered in service. It is important that proper cleaning techniques and cleaning agents be used to prevent the stain setting or affecting the color and/or flame resistant properties of the fabric.

1. Remove excess staining material from fabric by scraping or wiping with a clean cloth.
2. Identify the staining material if possible.
3. Clean the fabric as outlined in the following Methods "A", "B", or "C".

METHOD "A" (SPOT CLEANING) Stains such as grease, oil, tar, water spots, crayon and lipstick.

NOTE—Using other than recommended cleaners or procedures may affect flammability or fabric appearance.

1. Spray stain with Spot Lifter (C9AZ-19526-A) or equivalent from a distance of 8-10" as directed on the instructions furnished with the can.
2. Allow the Spot Lifter to dry completely, forming a white powder on the surface of the fabric.
3. Brush and vacuum the white powder from the surface of the fabric.
4. If the soiled spot is not removed from the fabric, repeat Steps No. 1, 2 and 3 as necessary.

CAUTION—Care should be used in application of the Spot Lifter to prevent it from contacting vinyl trim.

METHOD "B" (GENERAL CLEANING) Stains such as grease, oil, tar, adhesive, crayon and lipstick.

1. If the stain is still visible after the spot cleaning procedure (Method "A"), blot the soiled area with a clean cotton cloth saturated with the Spot Remover (Part No. B7A-19521-A) or equivalent.
2. Rub in a circular motion while continuously exposing clean portion of cloth.
3. Gradually widen area of application onto edges of design, pleat, or biscuit.
4. Repeat Steps No. 1, 2 and 3 as necessary.
5. Wipe cleaned area with clean damp cloth to remove any residual cleaner.

METHOD "C" (GENERAL CLEANING) Stains such as dirt, dry soil, food, pop and coffee.

1. Apply the "Rosenthal" or "Bissell", or an equivalent upholstery cleaner with a clean brush or sponge as directed on the instructions furnished with the container.
2. Rub in a circular motion until stain is removed.
3. Gradually widen area of application to edges of design, pleat, or biscuit.
4. Repeat Steps No. 1, 2 and 3 as necessary.

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5. Rub cleaned area with a damp cloth to absorb residual cleaner.
6. Allow to dry at room temperature.

NOTE—Spot cleaning as described in Method "A" above will be sufficient on fabrics which are not excessively soiled. However, to maintain a uniform appearance of the seat material in the event of severe soil and stain, the entire seat or insert will have to be cleaned to prevent a "ring" condition.

CLEANING SIMULATED WOODGRAIN PLASTIC, VINYL AND LEATHER INTERIOR TRIM

Clean soiled or stained surfaces with any mild household defergent or Ford's Multi-Purpose Cleaner or an equivalent cleaner, diluted per label instructions (3 oz./ga.) and a soft cloth. Remove mild abrasions (key marks, etc.) on wood grained surfaces with Ford Custom Silicone Glass or Ford Custom Auto Wax or equivalent.

CLEANING LAP-SHOULDER BELT WEBBING

Clean the belt webbing with any mild soap solution recommended for cleaning upholstery or carpets; follow the instructions provided with the soap. Do not bleach or re-dye the webbing because this may weaken it.

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Door Trim Panels

PART 45-03

APPLIES TO ALL MODELS

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Door Trim Panel	
Bronco and F-Series	03-1
E-100 — E-350	03-1
REMOVAL AND INSTALLATION (Cont'd)	
Sliding Door Trim Panel	
E-100 — E-350 and Club Wagon	03-3
E-100 — E-350 Cargo Van	03-2

REMOVAL AND INSTALLATION

DOOR-TRIM PANEL

BRONCO AND F-SERIES TRUCK

Since all of the interior trim panels are retained to the body panels with screws, spring clips and/or metal strips, the removal and installation procedures are obvious. Access to some of these panels, however, requires prior removal of other parts. The pertinent removal procedures are outlined as follows:

To remove the door trim panels, refer to Fig. 1. The arm rest, inside door handle and window regulator handle must be removed (refer to Part 44-11). Then, remove the trim panel retaining screws, spring clips, retainers and the trim panel.

E-100—E-350

Removal

1. Remove the arm rest retaining screws and remove the arm rest from the door inner panel (Fig. 2).
2. Remove the nuts (3) from the inside door handle (refer to Part 44-11) and remove the handle and trim cup.

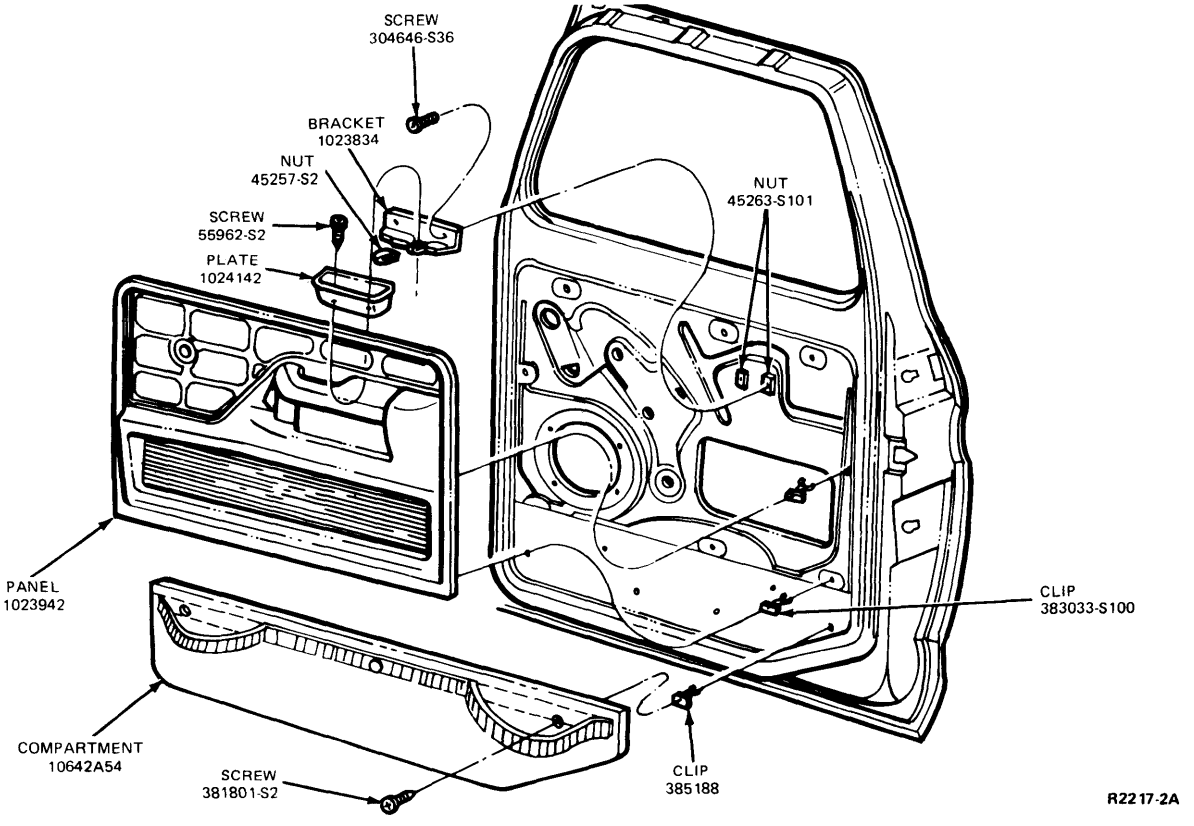


FIG. 1 Bronco and F-Series Truck Door Trim Panel Installation

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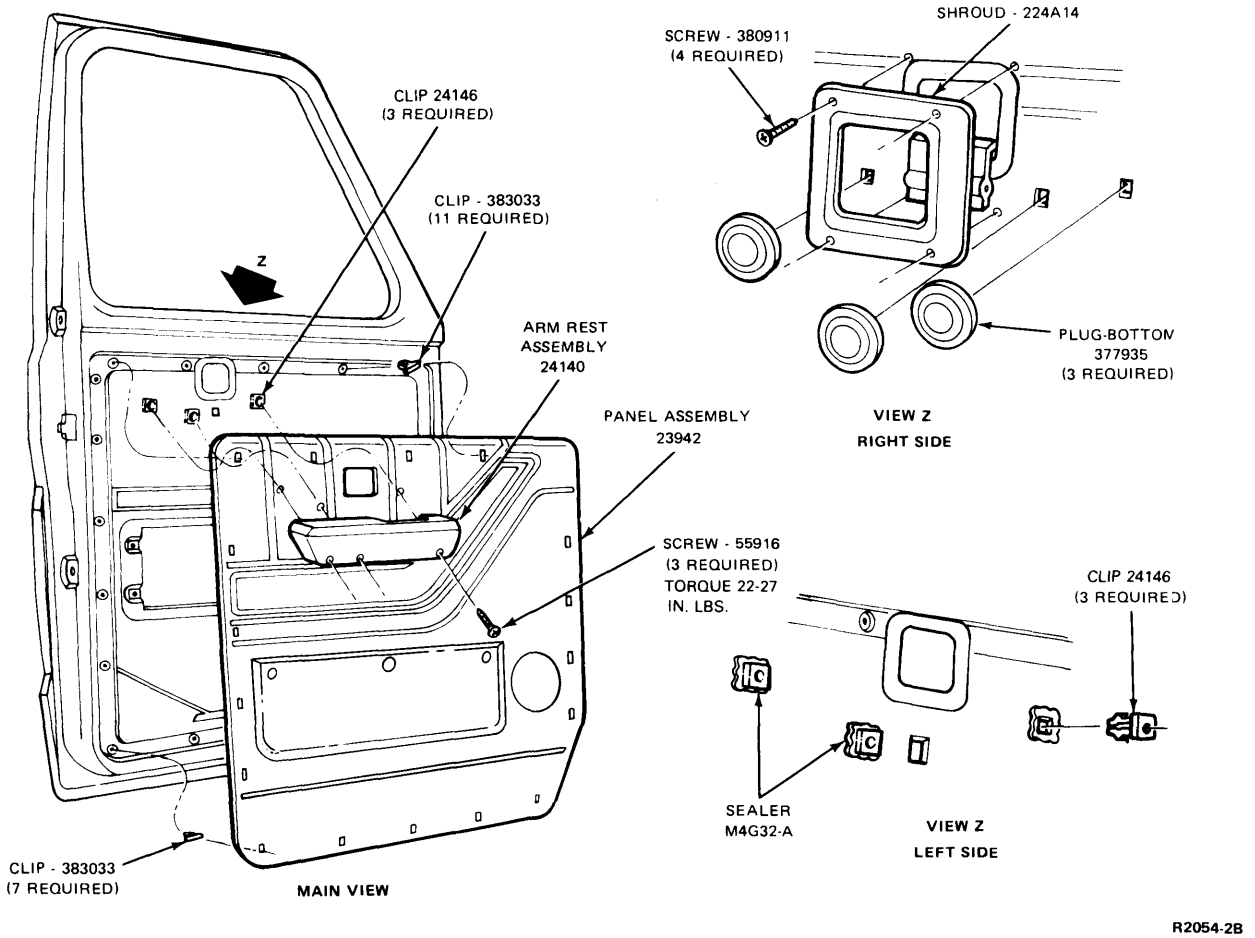


FIG. 2 E-100—E-350 Door Trim Panel Installation

3. If the vehicle is equipped with a stereo radio, remove the screws (4) retaining the speaker grille and remove the grille.
4. Remove the window regulator handle retaining screw and remove the handle, washer and spacer.
5. Remove the door trim panel clips individually from the attaching bolts in the door inner panel with a putty knife or similar flat tool.

Note: At no time should the trim panel be used to pull the clips from the inner panel holes.

Installation

1. Replace any bent or missing trim clips on the door trim panel. Position the trim panel to the door inner panel, locating the clips in the countersunk holes. Firmly push the trim panel at the clip locations to seat each clip into the holes in the door inner panel.
2. Position the inside door handle and trim cup to the door and install the retaining nuts.
3. If the vehicle is equipped with stereo radio, position the speaker grille and install the retaining screws.
4. Position the window regulator handle, washer and spacer. Install using the retainer screws.
5. Install the arm rest to the door inside panel.

SLIDING DOOR TRIM PANEL

E-100—E-350 CARGO VAN

Remove the retaining screws and remove the panel (Fig. 3).

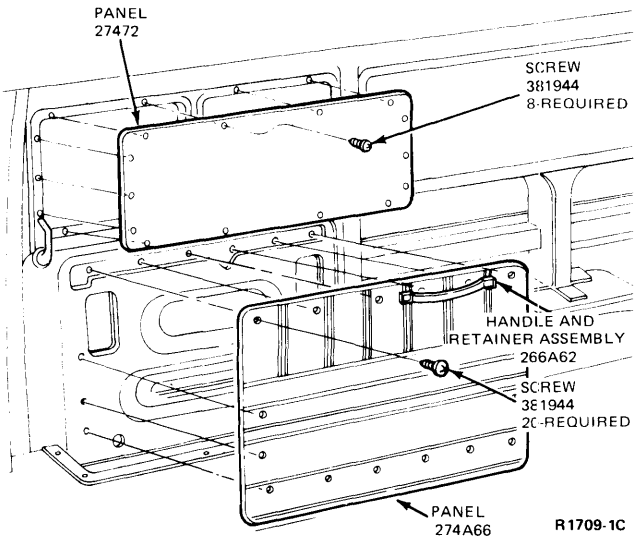


FIG. 3 Sliding Cargo Door—Trim Panel—E-100—E-350

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E-100—E-350 AND CLUB WAGON

Removal

1. Carefully pry the pull strap end caps (2) off with a small screwdriver.
2. Remove the pull strap retaining screws and pull strap. The pull strap screws remain attached to the pull strap.
3. Remove the door trim panel clips individually from the attaching bolts in the door inner panel with a putty knife or similar flat tool (Fig. 4). **Note: At no time should the trim panel be used to pull the clips from the inner panel holes.**

Installation

1. Replace any bent or missing trim clips on the trim panel.
2. Position the trim panel to the door inner panel and locate the clips in the countersunk holes. Firmly push the trim panel at the clip locations to seat each clip into the holes in the door inner panel.
3. Position the pull strap on the inner panel and tighten the retaining screws.
4. Snap the two end caps into the pull strap assembly.

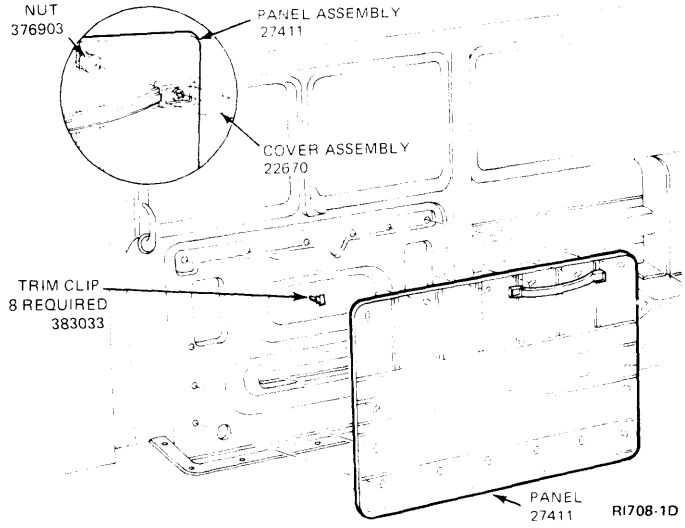


FIG. 4 Sliding Cargo Door—Trim Panel—E-100—E-350

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Quarter Trim Panels

PART 45-11

APPLIES TO E-100 — E-350, F-SERIES SUPER CAB AND BRONCO

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Back Window Trim — Upper Panel	
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Quarter Trim Panel	
E-100 — E-350	11-1
REMOVAL AND INSTALLATION (Cont'd)	
Side Trim Panels	11-1
Bronco	11-1
F-Series Super Cab	11-1

REMOVAL AND INSTALLATION

QUARTER TRIM PANEL

E-100—E-350

Since all of the interior trim panels are retained to the body panels with screws and/or metal strips, the removal and installation procedures are obvious. The trim panel, retainers and mouldings are shown in Figs. 1-6. Access to some of these panels, however, requires prior removal of other parts. The pertinent removal procedures are outlined as follows:

Before removing the left side trim panel, slide the driver's seat forward.

Before removing the right side trim panel, remove the right seat assembly from the vehicle (Group 41).

BACK WINDOW TRIM—UPPER PANEL

E-100—E-350

Remove the two retaining screws, and remove the dome light glass and lens.

SIDE TRIM PANELS

Front—trim panel, left side. Remove the first bench seat and window garnish molding.

Rear Left side—Remove the two rear bench seats and window garnish molding.

Right Rear side—Remove the two rear bench seats, the spare wheel, tire and window garnish molding.

F-SERIES SUPER CAB

The rear shoulder bolsters attach to the full width of the inner back and quarter trim panels with either rear seating option (Figs. 7 and 8). The bolsters are standard with seating options and on Ranger and Ranger XLT models. On Custom models, a three-inch-wide metal skirt will be standard, in place of the full trim panels.

BRONCO

Refer to Fig. 9 for Removal and Installation of trim panels.

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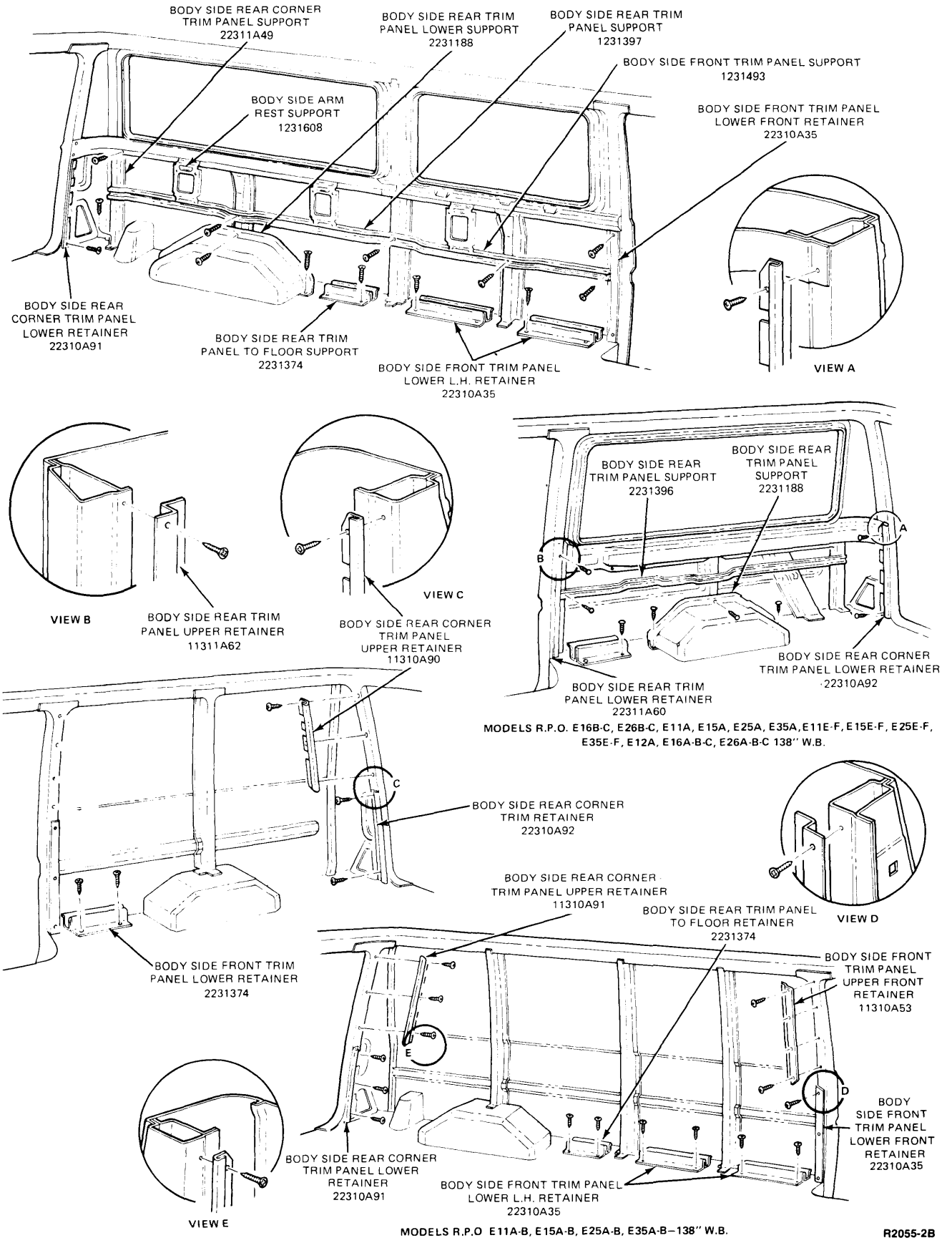


FIG. 1 Trim Panel Retainers and Supports—E-100—E-350 and Club Wagon

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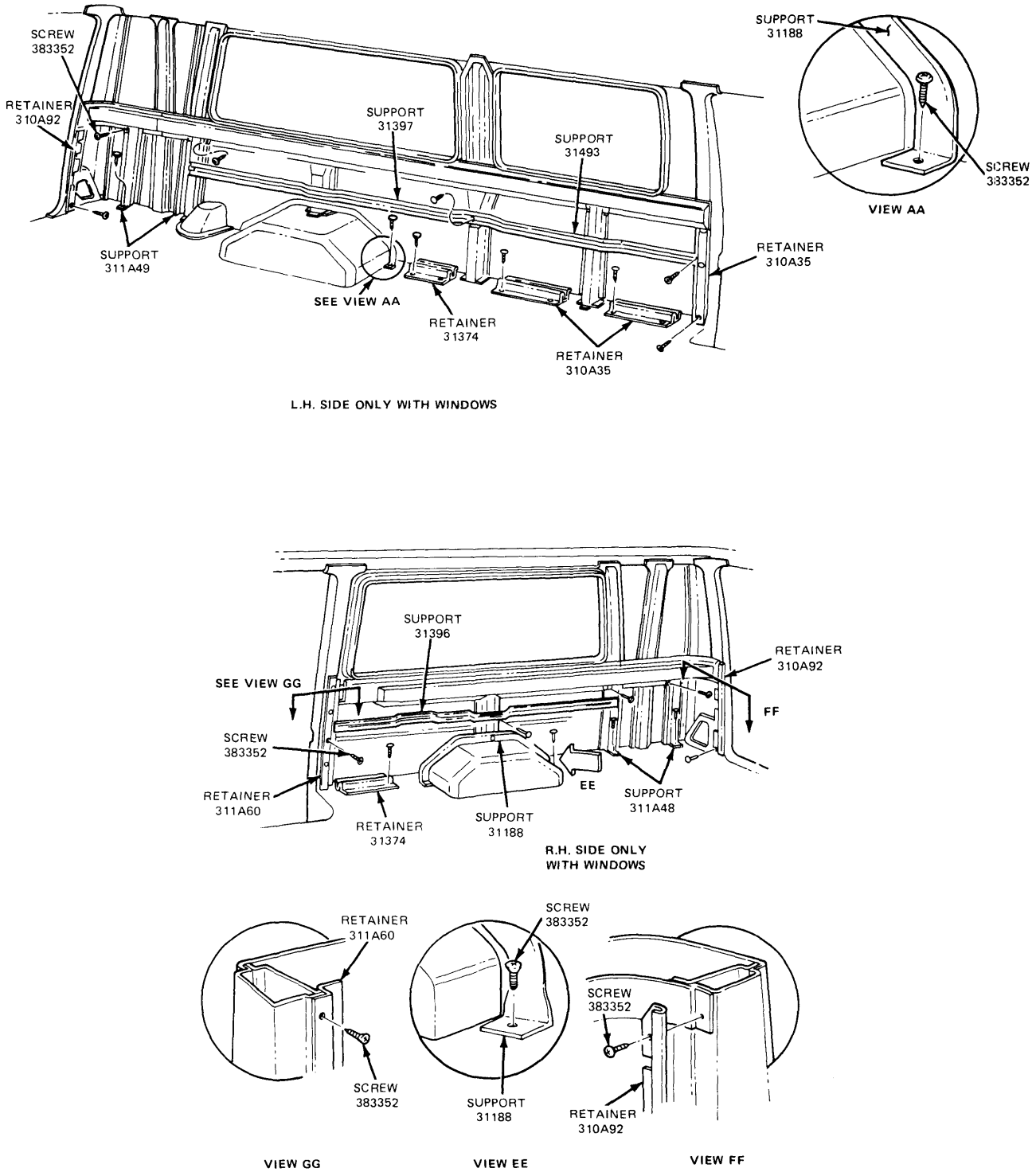


FIG. 2 Trim Panel Retainers and Supports—E-100—E-350 Super Wagon

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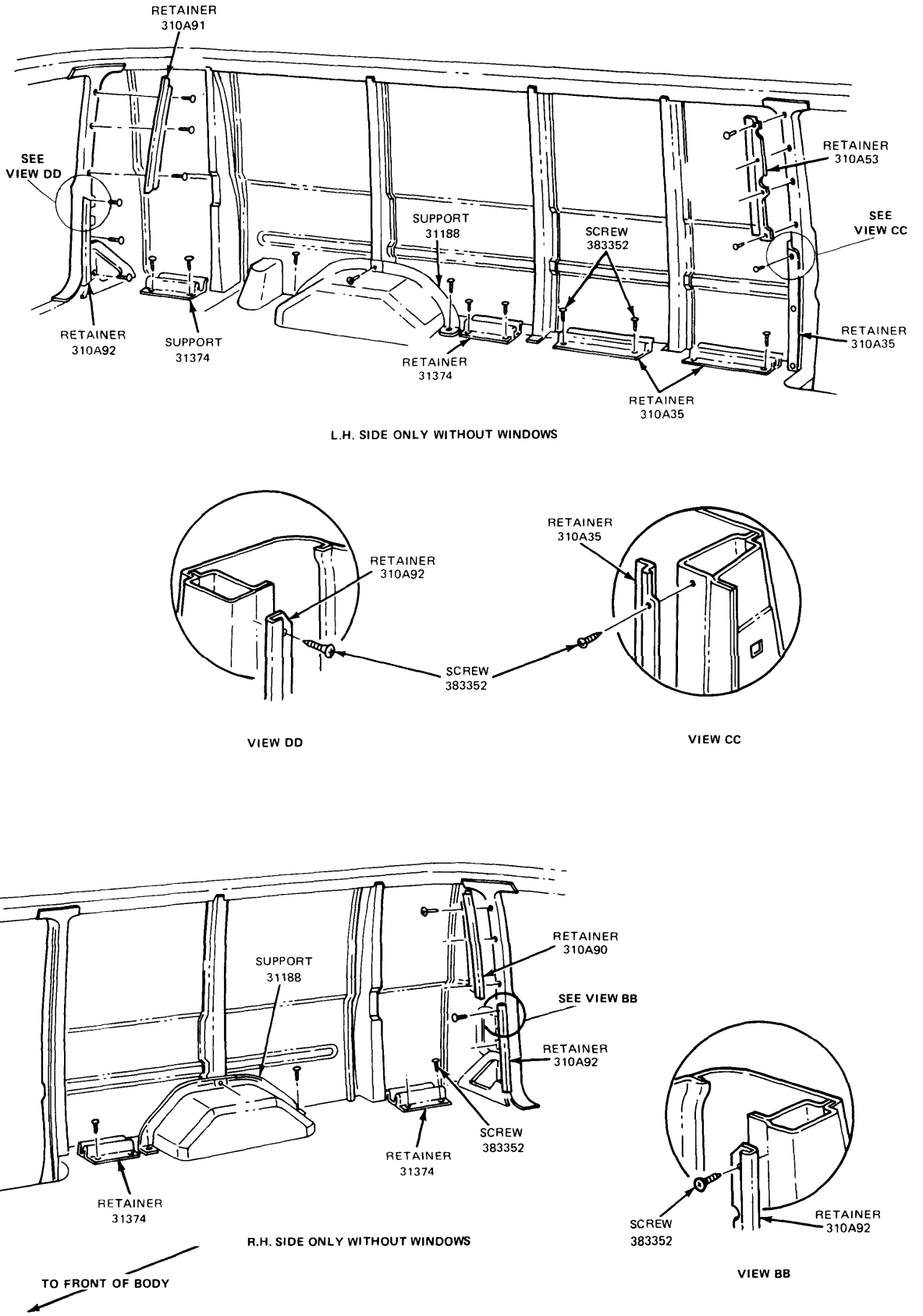


FIG. 3 Trim Panel Retainers and Supports—E-100—E-350 Super Van

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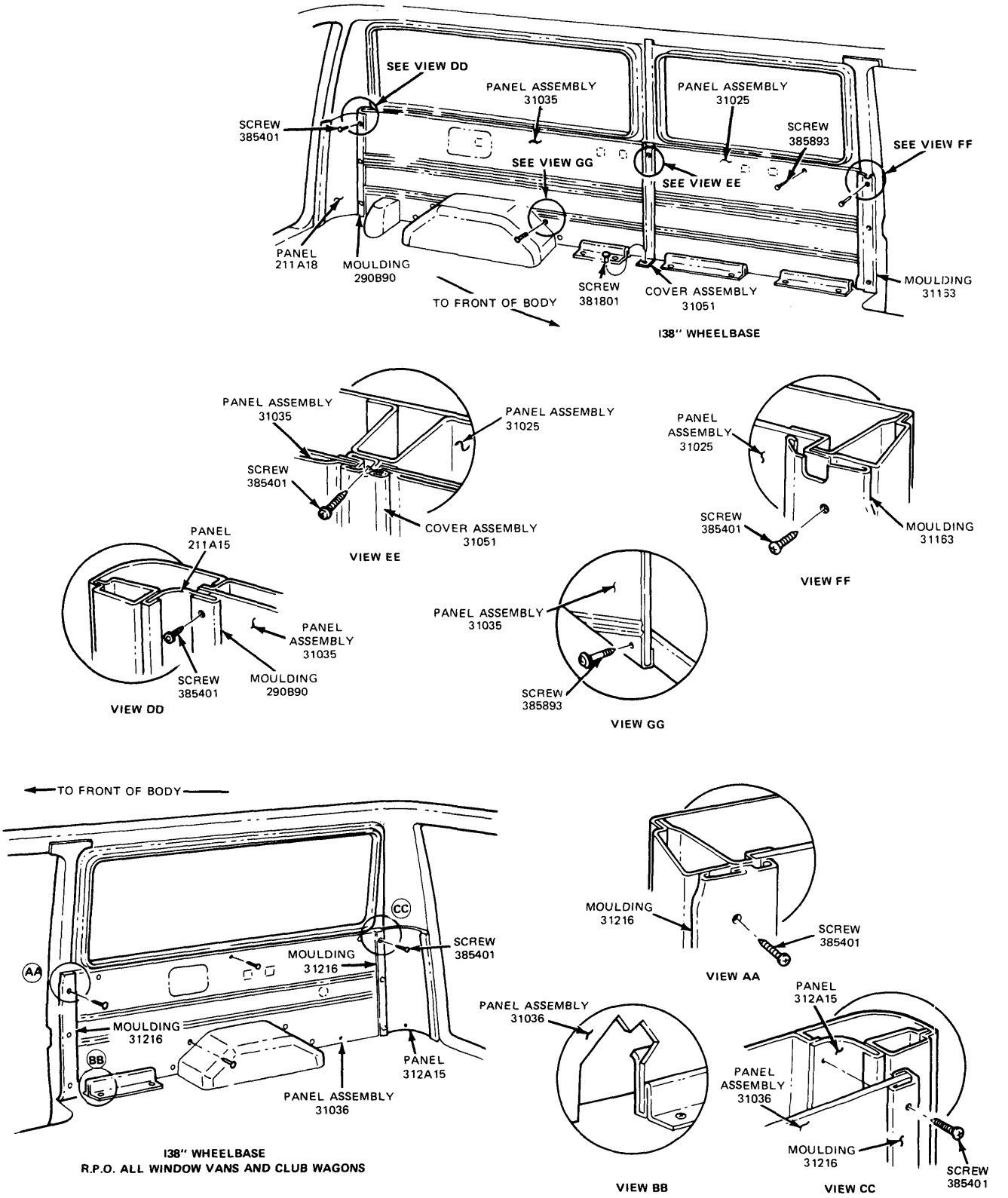


FIG. 4 Trim Panel and Mouldings—E-100—E-350

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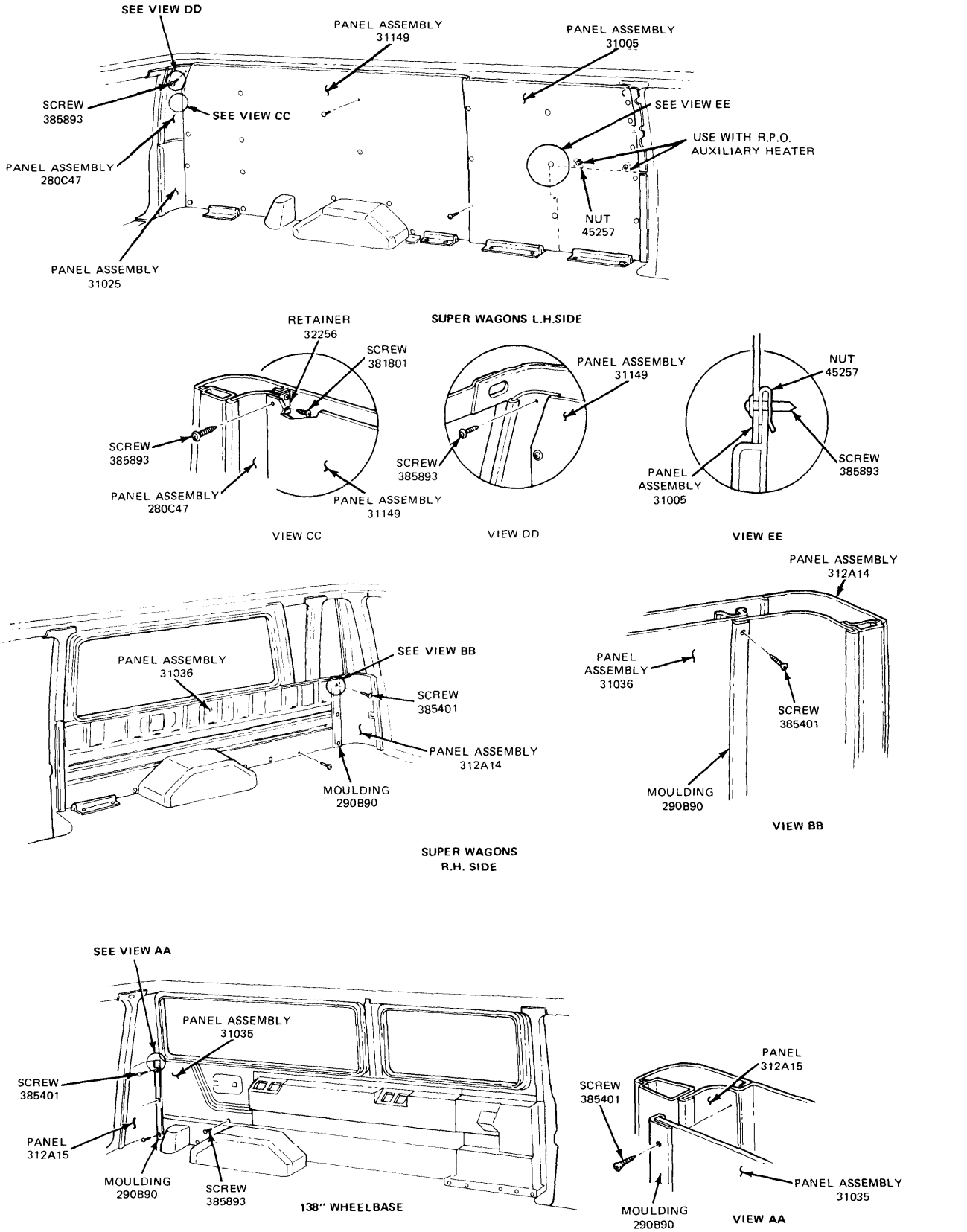


FIG. 5 Trim Panels—E-100—E-350

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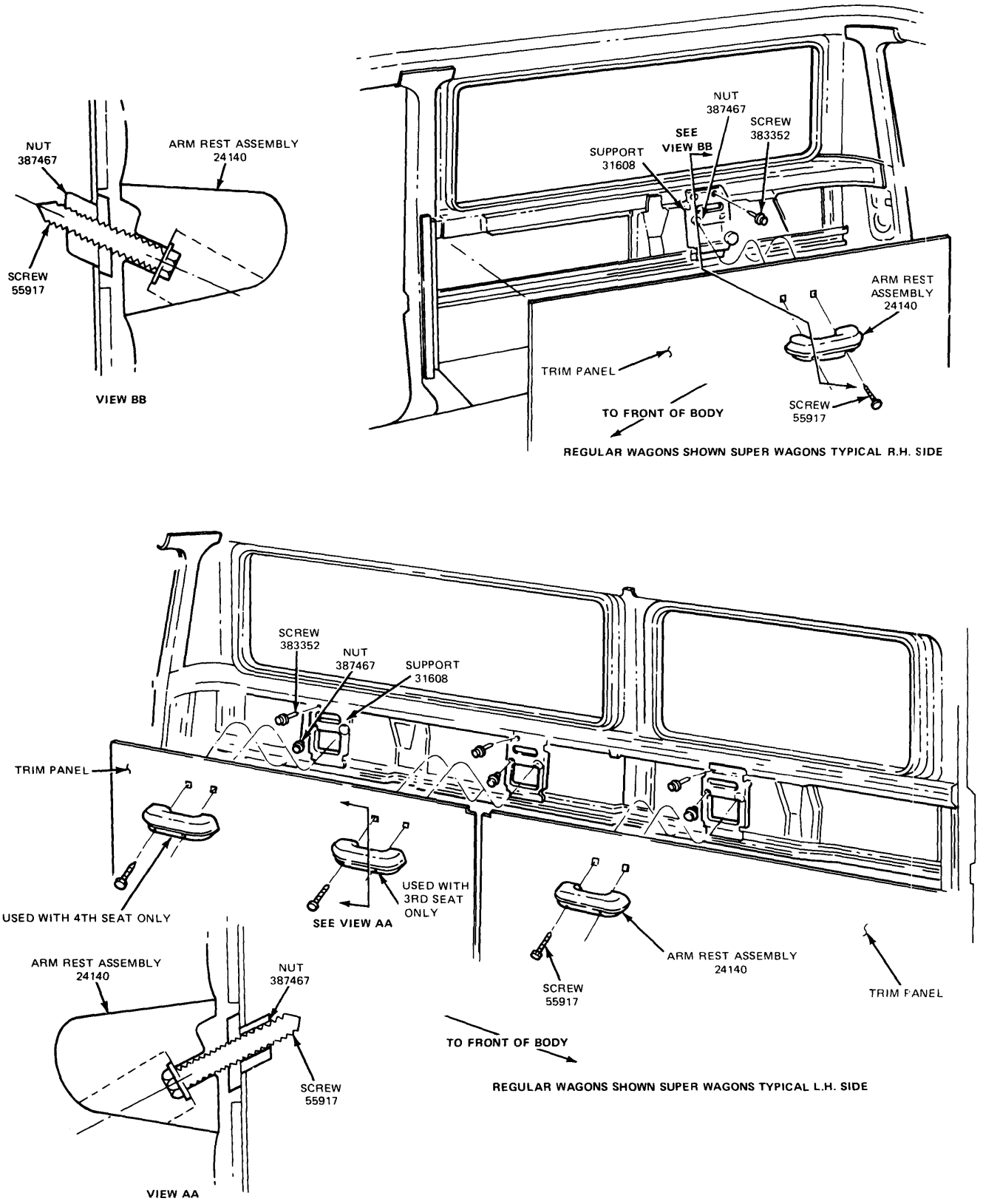


FIG. 6 Quarter Trim Armrest—E-100—E-350

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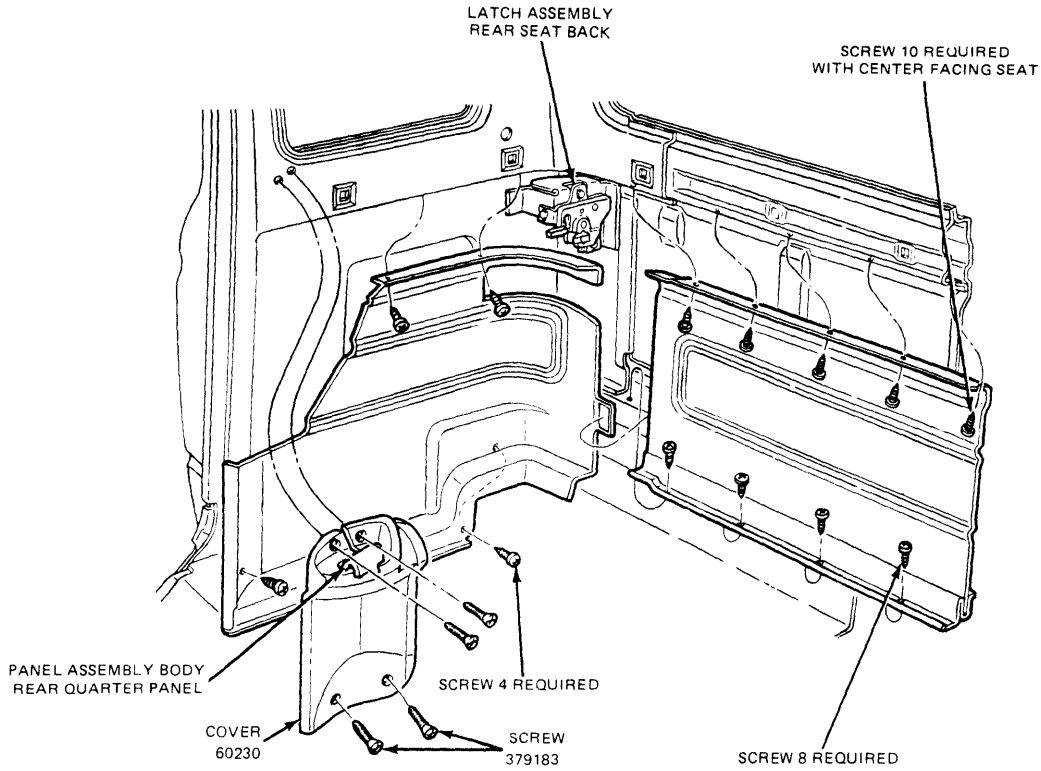


FIG. 7 F-Series Super Cab Rear Quarter and Back Trim Panels

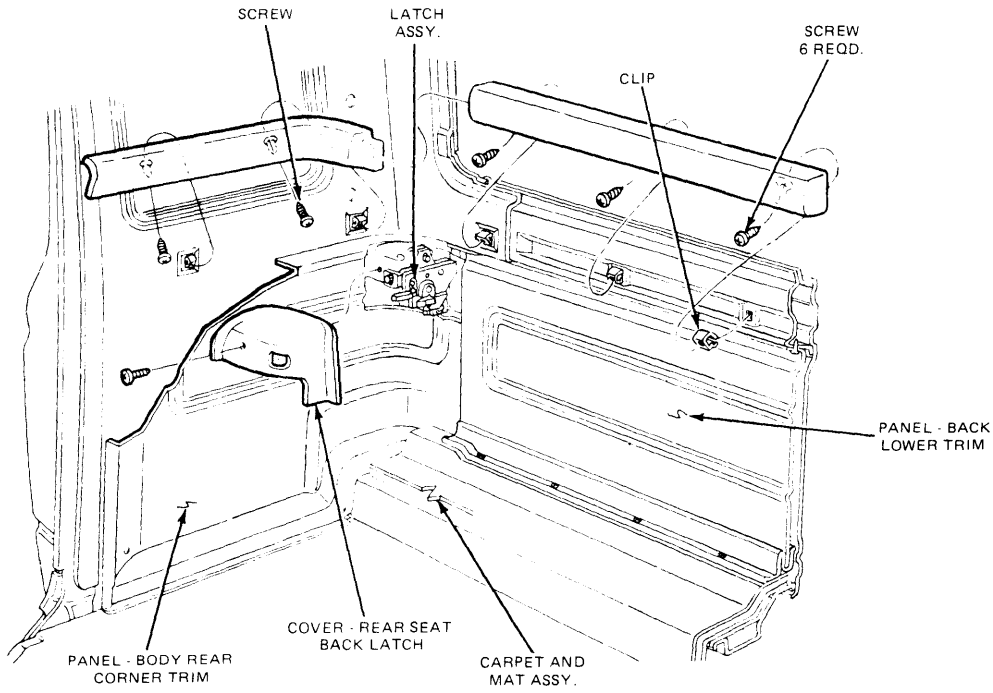


FIG. 8 F-Series Super Cab Rear Quarter Shoulder Bolsters

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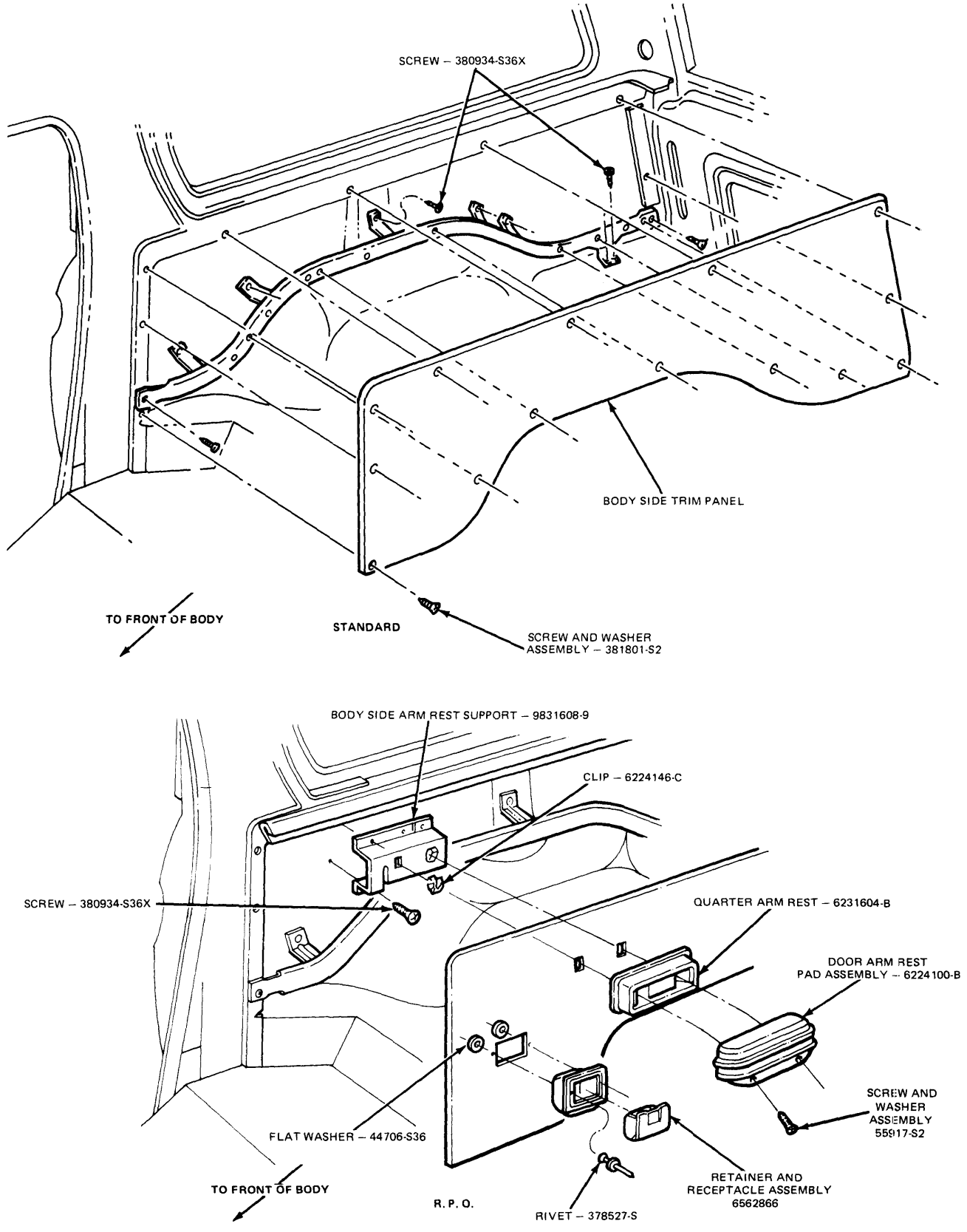


FIG. 9 Panel Assembly Body Side Trim Armrest and Ash Receptacle—Bronco

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Mouldings

PART 45-16

APPLIES TO E-100 THRU E-350 AND BRONCO

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION	16-1		

REMOVAL AND INSTALLATION

The installation of the plastic and steel interior mouldings are shown in Figs. 1 through 5. In most instances, one moulding overlaps another moulding. If this condition is found, it will be necessary to loosen or remove the overlapping moulding before removal of the desired moulding.

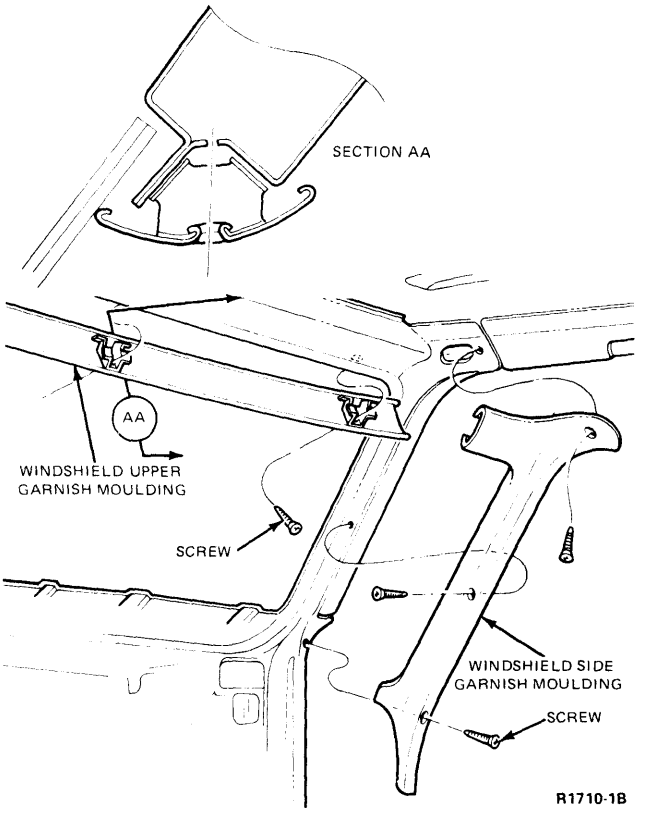


FIG. 1 Interior Plastic Mouldings—E-100 thru E-350

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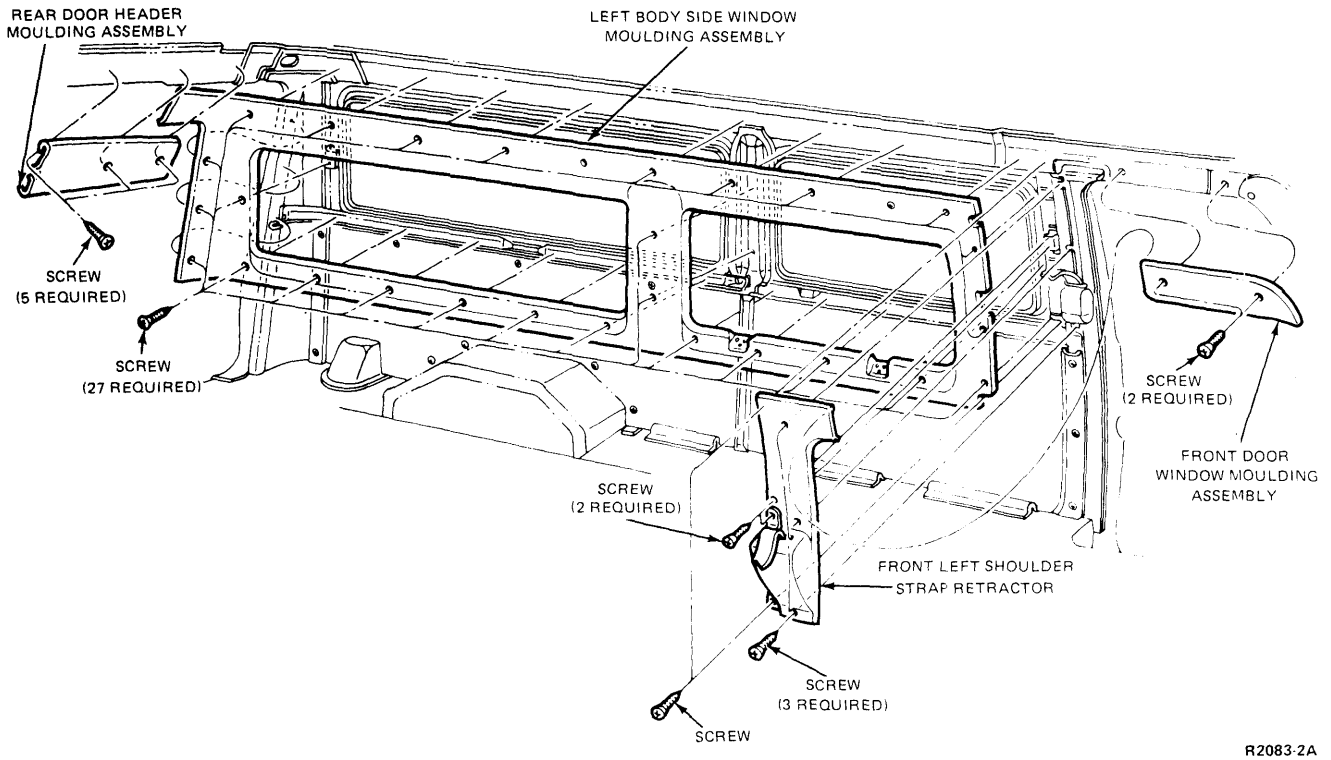


FIG. 2 Left Side Interior Mouldings—138 Inch W.B. Similar

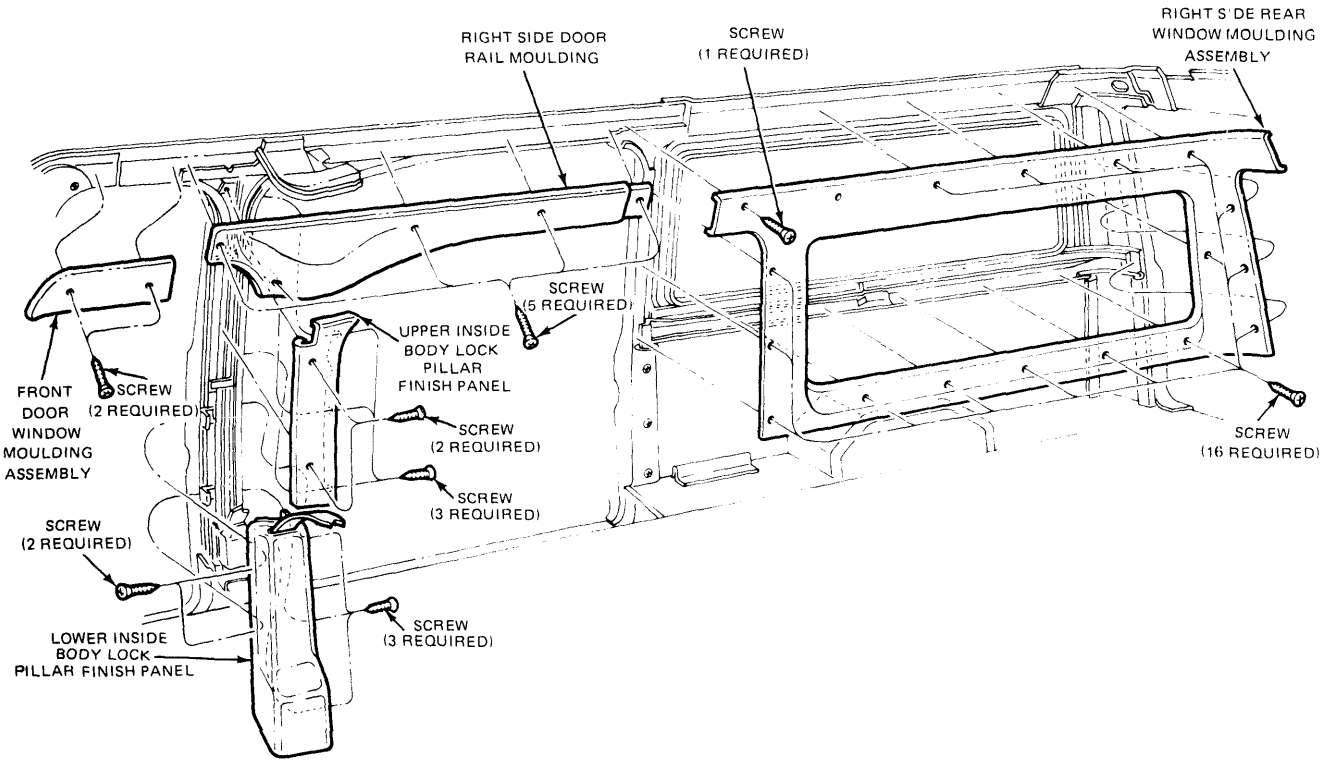


FIG. 3 Right Side Interior Mouldings—138 Inch W.B.

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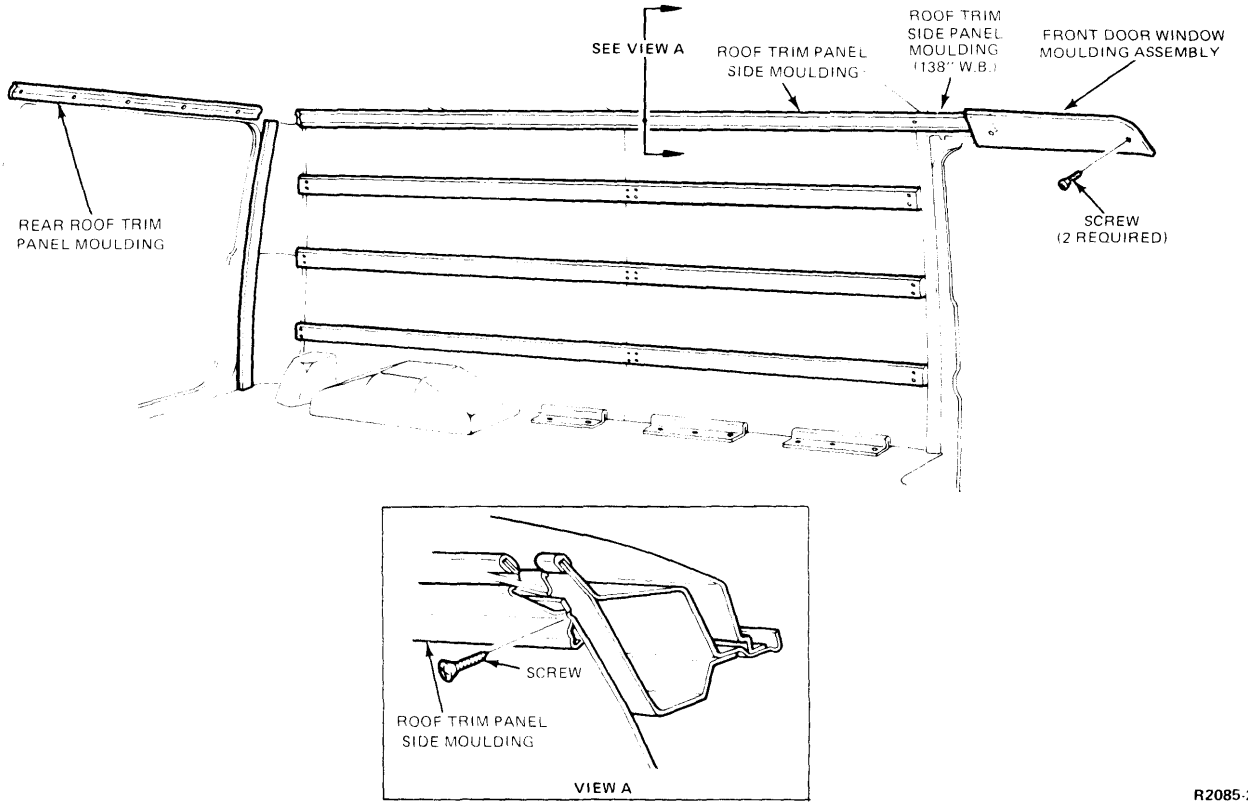


FIG. 4 Right Side Interior Mouldings—Optional 124 and 138 Inch W.B.—Left Side Similar

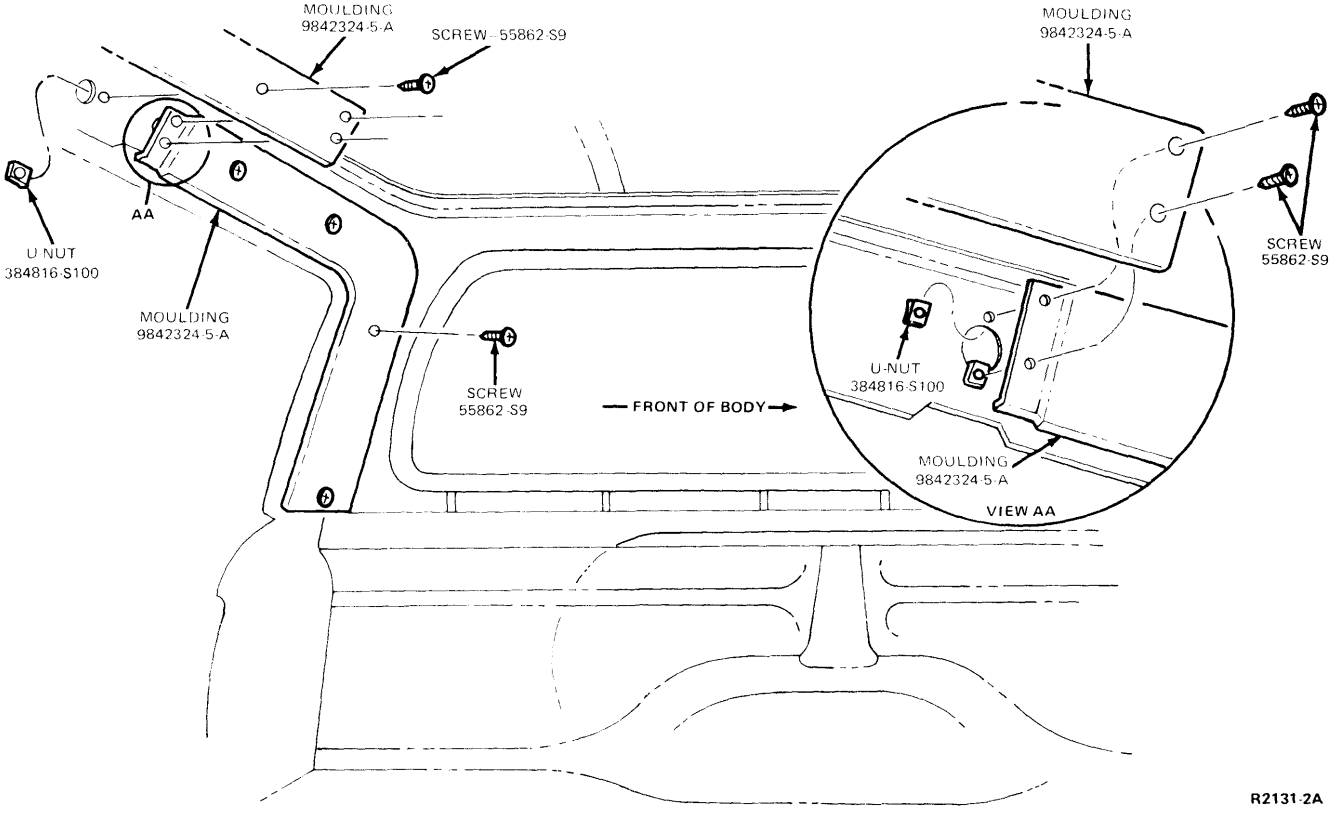


FIG. 5 Back Window Garnish Moulding—Bronco

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Carpets and Floor Mats

PART 45-26

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION	26-1		

REMOVAL AND INSTALLATION

On vehicles equipped with a floor shift, remove the gear shift lever boot and retainer assembly before removing the mat or carpet, (if so equipped).

Remove all mat or carpet retaining screws. Remove the right and left door sill scuff plates and remove the mat or carpet.

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Console Assembly

PART 45-31

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION	31-1		

Removal

1. Remove the bolts from the base of the console panel (Fig. 1).
2. Remove the console.

Installation

1. Position console to floor of vehicle (Fig. 1).
2. Secure with bolts.

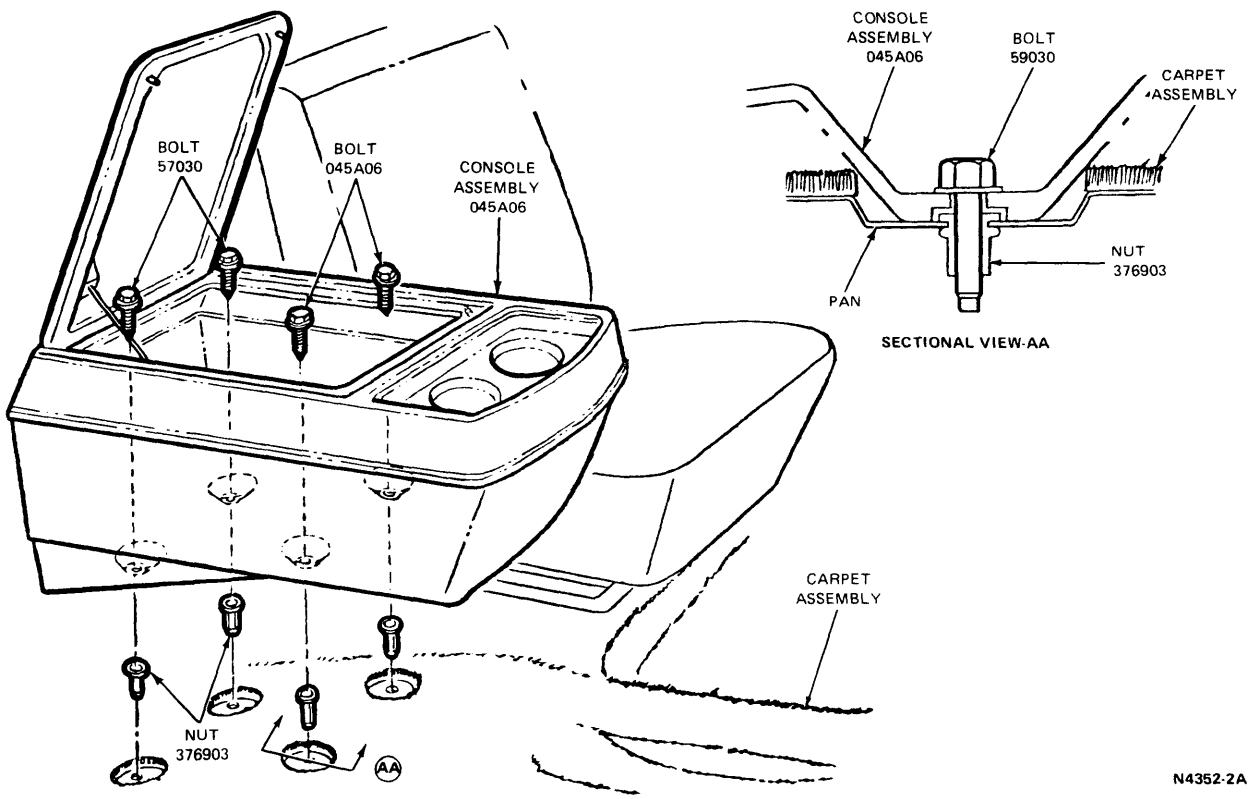


FIG. 1 Console Assembly—Removal and Installation

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Headlining

PART 45-41

APPLIES TO ALL MODELS

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Front Hard Headlining	
E-100 — E-350	41-1
Full Length Hard Headlining	
E-100 — E-350	41-1
REMOVAL AND INSTALLATION (Cont'd)	
Soft Headlining	
Bronco and F-Series	41-1
E-100 — E-350	41-1

REMOVAL AND INSTALLATION

FRONT HARD HEADLINING

E-100—E-350

Removal

1. Remove side garnish moldings, (Custom's and Chateau's only).
2. Remove front dome lamp.
3. Remove the six retaining screws from the rear of the trim panel.
4. Remove the centerline retaining screw.
5. Slide the trim panel rearward out of the windshield header retaining strip.

Installation

1. Slide the trim panel forward into the windshield header retaining strip.
2. Install the centerline retaining screw.
3. Install the six retaining screws at the rear of the trim panel.
4. Install the front dome lamp.
5. Install the side garnish moldings (Custom's and Chateau's only).

FULL LENGTH HARD HEADLINING

E-100—E-350

Removal

1. Remove all garnish moldings from the perimeter of the headliner.
2. Remove trim panel retaining screw located on the centerline of the vehicle.
3. Remove the front and rear dome lamps.
4. Remove the metal end caps from the plastic trim panel retainers. Unsnap the plastic trim panel retainers from the metal supports.
5. Bow each trim panel section downward at the center of the vehicle and remove the trim panel from the retaining clips.

SOFT HEADLINING

E-100—E-350

1. Remove the trim panel retaining screws located at the inside centerline of the vehicle.
2. Unsnap the trim panel retainers. Unscrew the screws retaining the forward trim panel section to the roof inner panel.
3. Bow each trim panel section downward at the center of the vehicle and remove the trim panel from the retaining clips.
4. Position each trim panel section in the retaining clips. Snap the trim panel retainers in place. Install the screws that retain the trim panel forward section to the roof inner panel.
5. Install the retaining screws at the centerline of the vehicle.

BRONCO AND F-SERIES

The headlining is held to the roof panel with trim mouldings as shown in Figs. 1, 2, 3, and 4. To remove headlining, remove the moulding attaching screws and remove the mouldings and headlining.

Installation

1. Position each trim panel section in the retaining clips. Push the trim into place between the metal supports.
2. Install the centerline retaining screws.
3. Snap the plastic trim panel retainers in place.
4. Install the metal end caps on the plastic trim panel retainers.
5. Install the front and rear dome lamps.
6. Install all the garnish moldings on the perimeter of the headliner.

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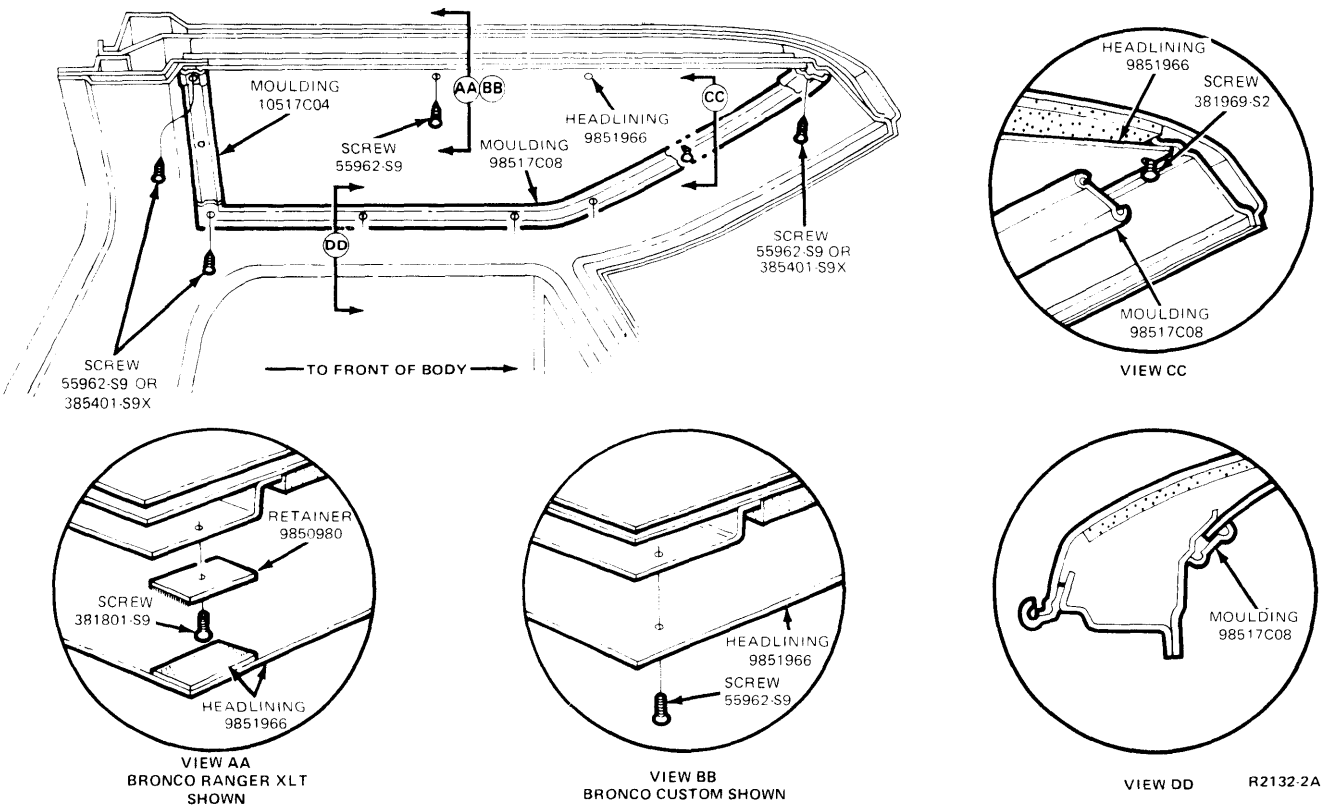


FIG. 1 Roof Trim Panel Installation Bronco

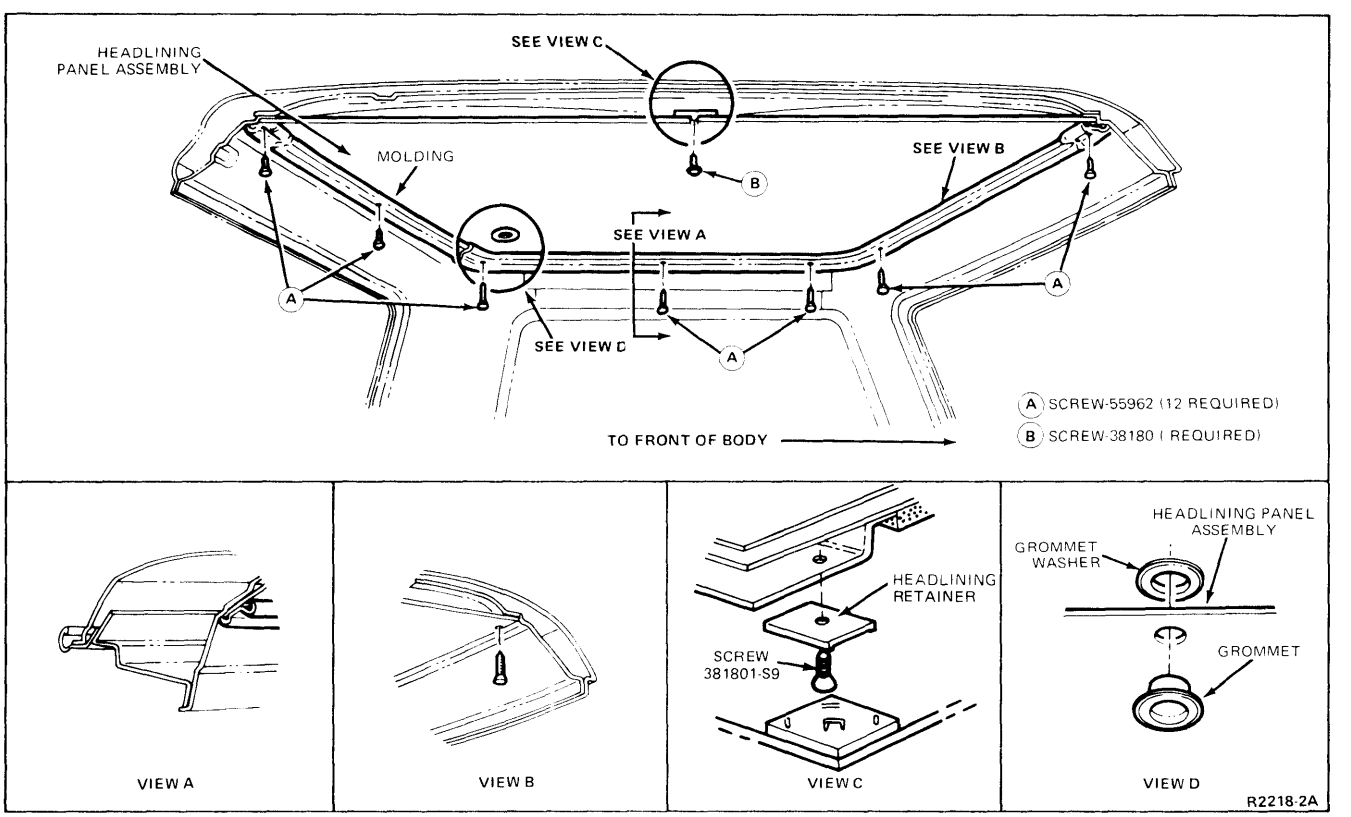


FIG. 2 Roof Trim Panel Installation—F-Series Standard Cab

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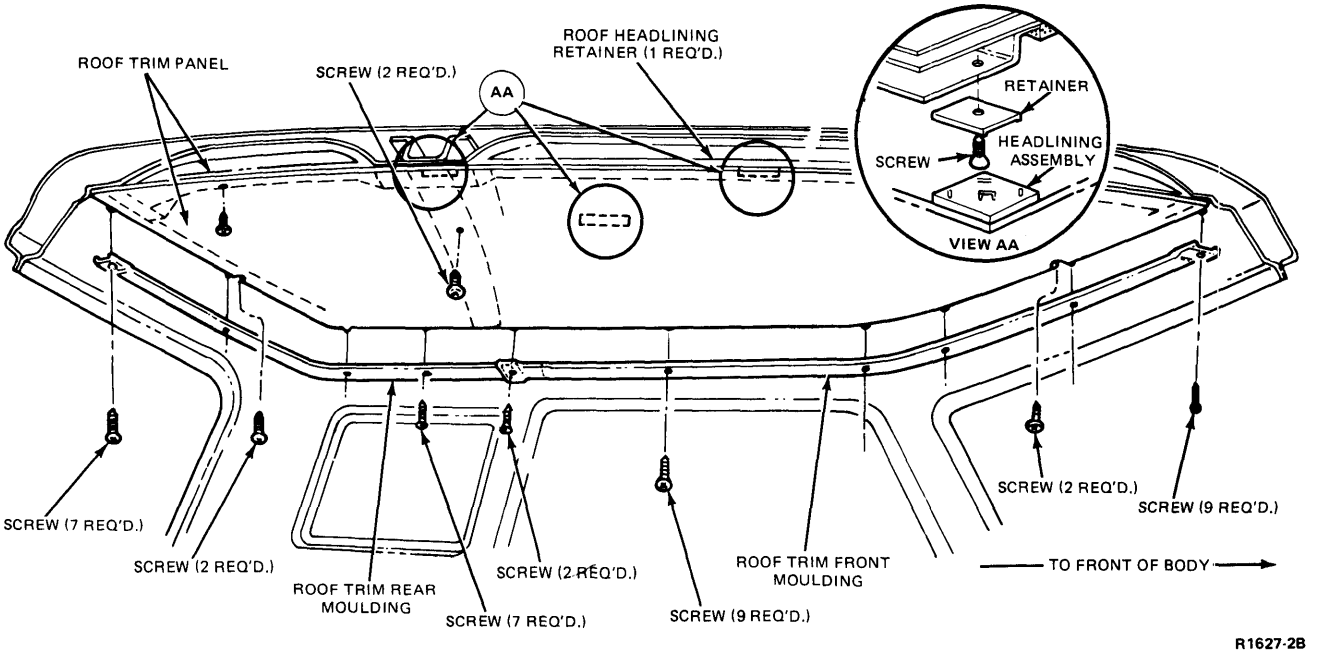


FIG. 3 Roof Trim Panel Installation—F-Series Super Cab

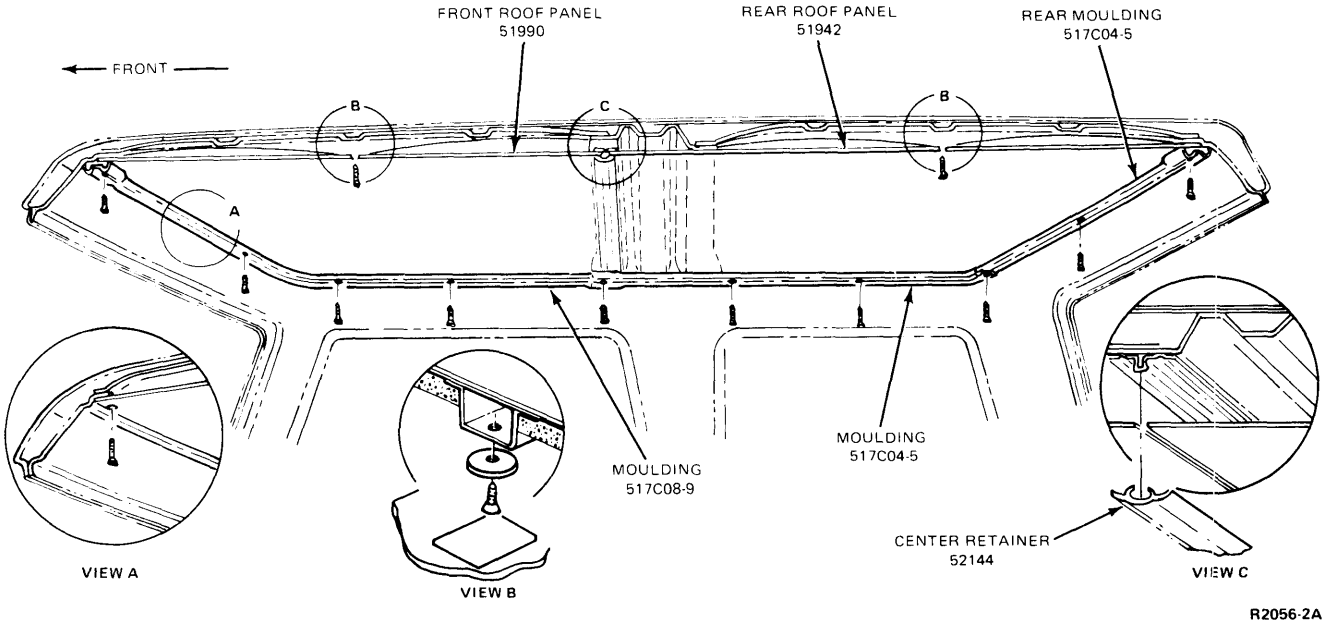


FIG. 4 Roof Trim Panel Installation—F-Series Crew Cab

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Instrument Panel Pad

PART 45-61

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION			
E-100 — E-350 and Club Wagon	61-1		
F-100 through F-350 and Bronco	61-1		

REMOVAL AND INSTALLATION

E-100—E-350 AND CLUB WAGON

The instrument panel pad is attached to the instrument panel with eleven retaining nuts (Fig. 1). To remove the pad, it is necessary to first remove the left (2 screws, 2 clips) and right (6 screws including one behind name plate, and 2 clips) finish panels; remove the cluster assembly (7 screws); and remove the radio (if so equipped—4 screws). Be sure to disconnect the battery ground cable before removing the retaining nuts under any instrument panel component.

The instrument panel assembly should be removed from the vehicle for removal of the instrument panel pad on A/C units only.

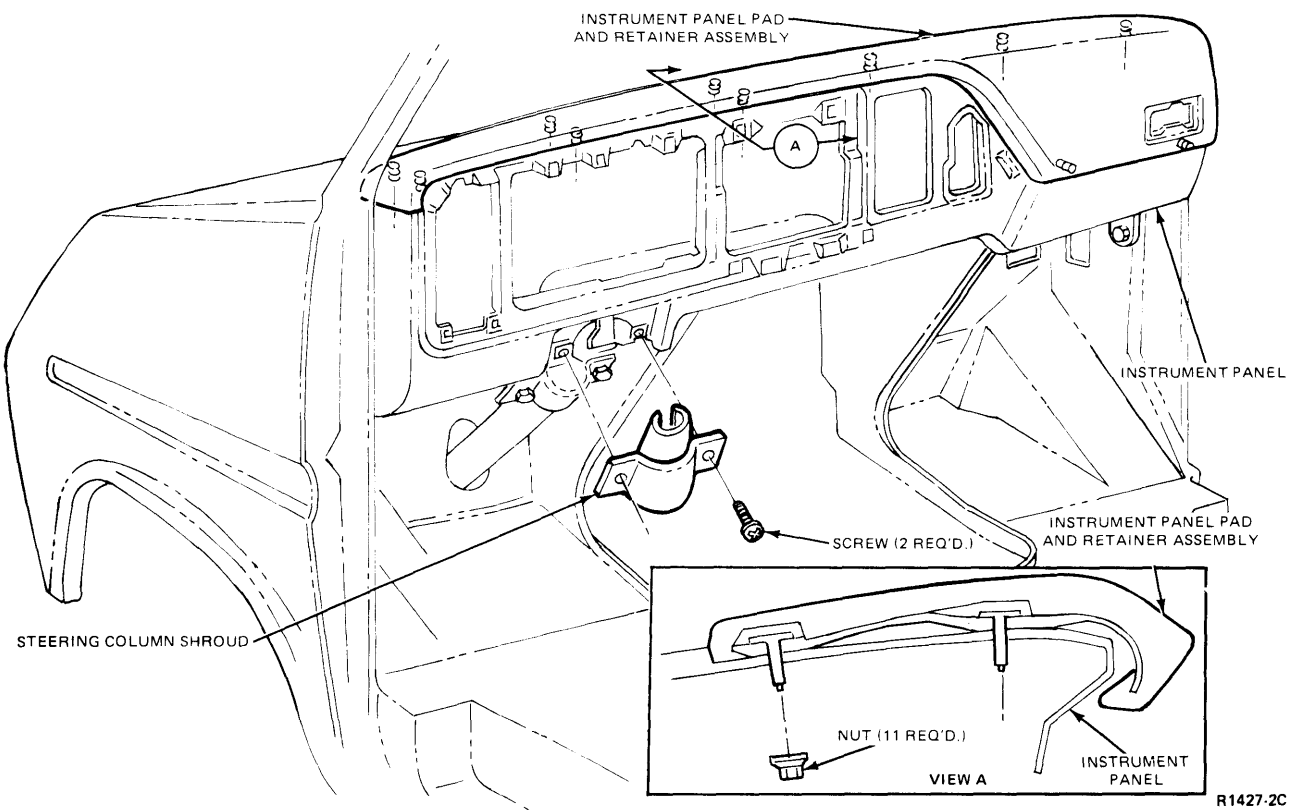


FIG. 1 Instrument Panel Pad Installation—E-100—E-350 and Club Wagon

F-100 THRU F-350 AND BRONCO

The instrument panel pad is attached to the instrument panel with ten nuts at five locations as shown in Fig. 2. Disconnect the negative (ground) cable from the battery. To remove the pad, it is necessary to remove the instrument cluster (Group 33) and trim cover, the A/C registers (if so equipped) and the glove box liner to gain access to the ten retaining nuts.

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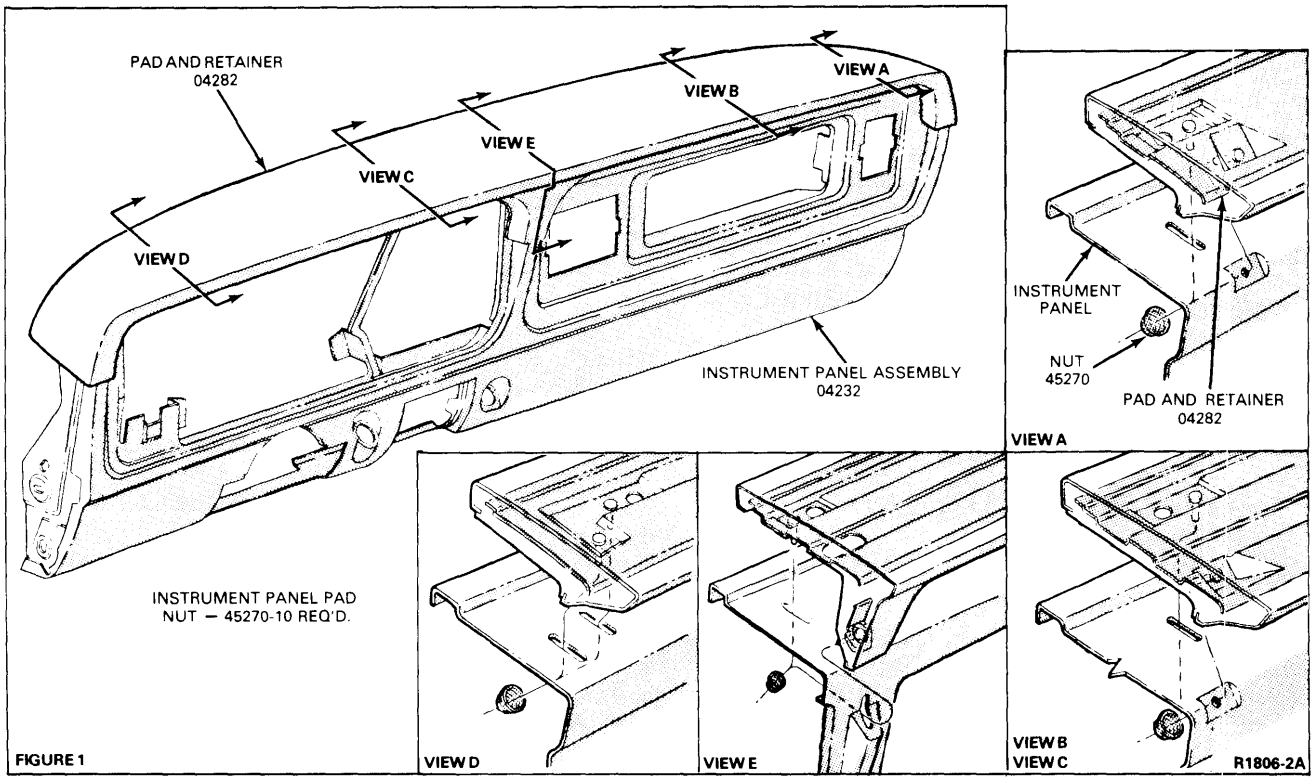


FIG. 2 Instrument Panel Pad Installation—F-100 Through F-350

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TOPS

GROUP 46 (70000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Fiberglass Rear Roof	46-51	Pick-Up Box Cover	46-50
		Tape Striping	46-30

Tape Striping

PART 46-30

APPLIES TO F-100 — F-350 AND BRONCO

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	30-1	REMOVAL AND INSTALLATION	30-2
REPAIR	30-1		

DESCRIPTION

Tape stripes are made from a tough, durable, weather-resistant, solid vinyl with a pressure-sensitive back, the pressure-sensitive back is protected by a liner paper which is easily peeled away during installation. During shipment and storage the face is protected with an easy release pre-mask paper.

REPAIR

Repair small nicks or scratches with touch-up paints mixed to blend with the affected area.

Repair blisters or air bubbles by piercing them with a sharp needle or pin at one end of the bubble. Work the trapped air out through the pin hole with the thumb moving toward the pin hole (Fig. 1) and press the tape stripe firmly against the panel. It may be necessary to preheat the panel slightly to soften the adhesive. Heat also may be used to remove small wrinkles or irregularities.

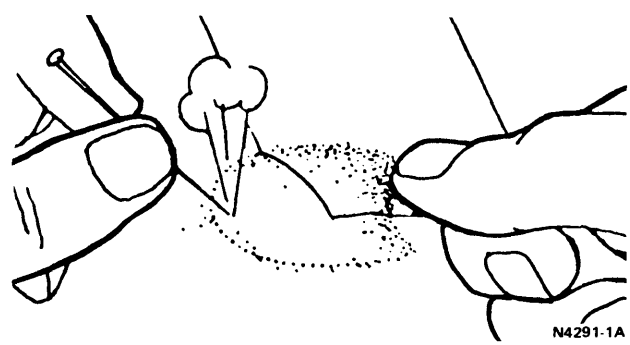


FIG. 1 Removing Entrapped Air

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REMOVAL AND INSTALLATION

Removal

1. Clean repair surfaces, adjacent panels, and openings as required.
2. Remove tape stripe overlapping parts from affected panel.
3. Remove tape stripe by starting at one edge and peeling it from painted surface. Apply heat to tape stripe to facilitate removal. NOTE: Avoid using pointed or sharp tools as they may damage the painted surface.
4. Remove adhesive from painted surfaces by wiping area with a rag saturated with 3M Adhesive Cleaner, xylol or equivalent and then scraping with a squeegee. NOTE: Exercise care when using solvents because of possible damage to painted surfaces. To determine if solvent is harmful to body paint, test it on a hidden area of the vehicle.
5. Rinse thoroughly with clean water.

Installation—Dry Method (Small or Thin Stripes)

1. Clean painted surface (including wrap-around flanges on door openings) with wax and silicone remover (3M Adhesive Cleaner, or equivalent). Wipe surface with clean cloth and allow to dry. Leading edge of doors are not stripped because cleaning or wrap-around area is impossible.

   NOTE: Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause tape strip to blister.
2. Position tape stripe to vehicle and align darts to character lines and or door openings on tape stripe to contour of the vehicle. Using masking tape, tape striping into place.
3. Remove liner paper from stripe 1/2 distance of panel, and tear off liner paper (Fig. 2).
4. Stretch striping in place but away from the sheet metal. Using squeege (plastic), start from center of panel and press striping in place, moving toward the end of the panel (Fig. 3).

   CAUTION: DO NOT USE HAND OR FINGERS TO SMOOTH ON THE STRIPING. USE OF HANDS WILL RESULT IN CREASES AND AIR BUBBLES IN STRIPING.
5. Peel off the remainder of liner paper and press into place using plastic squeege.
6. Remove pre-mask by pulling at 180 degrees angle away from stripe (Fig. 4). After removal inspect for bubbles and remove using procedure under Repair in this Part.
7. Mold recessed areas into place using 750 degrees heat gun and soft clean cloth (Fig. 5).

Installation—Wet Method (Large Areas—Decal)

1. Position tape stripe to area to be striped in the same manner as described for the dry installation method.
2. Mix a teaspoon of standard dish washing detergent (Joy, Ivory, etc.) in one gallon of water. Fill a spray bottle with the solution.
3. Remove tape stripe from vehicle and lay on flat area with line paper up.
4. Completely remove liner paper from tape stripe.
5. Wet pressure sensitive side of tape stripe and area on vehicle to be striped with detergent solution.
6. Reposition tape stripe on vehicle.
7. Using squeege and firm overlapping pressure, begin from center of tape stripe and squeege toward the sides and then toward the front. The tape stripe can be easily lifted and reapplied if air bubbles are present.
8. After the tape stripe is completely in place and squeezed, remove pre-mask. An assistant can be very helpful in removing pre-mask from large areas.
9. Use heat gun as used in dry installation to mold decal into recessed areas.

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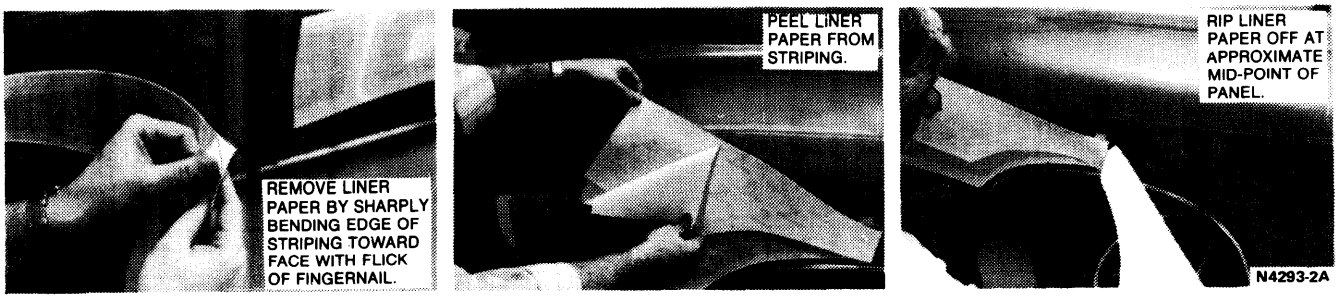


FIG. 2 Installing Tape Striping

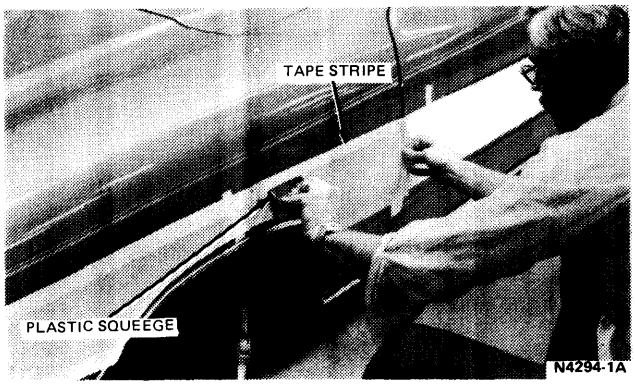


FIG. 3 Squeeging on Tape Stripe

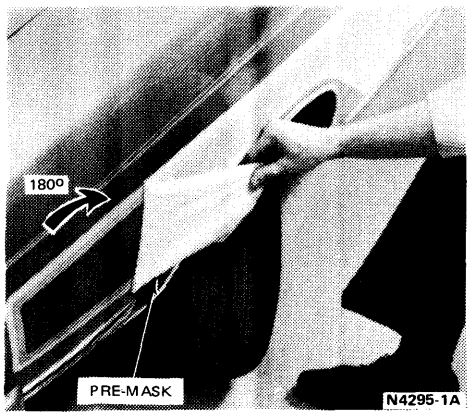


FIG. 4 Removing Pre-Mask Paper





FIG. 5 Molding Striping into Recessed Area

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Pick-Up Box Cover

PART 46-50

APPLIES TO F-100 THROUGH F-350

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	50-1	REMOVAL AND INSTALLATION	50-2
ADJUSTMENTS		Sliding Side Window Assembly	50-3
Liftgate Latch Striker	50-2	Sliding Window Screen	50-4
		Stationary Side Window Assembly	50-4

DESCRIPTION

The pickup box cover (Fig. 1) is designed for F-100 through F-350 trucks with eight foot boxes and 133 and 140 inch wheel bases. The box covers come in standard or deluxe models. Features of the standard model include fiberglass construction, tinted glass in side and rear windows, and clear glass in the front window. In addition the deluxe model features a T-handle liftgate latch addition, deluxe windows with screens, bright moldings around side and rear windows, a roof vent, a dome light and two-tone paint.

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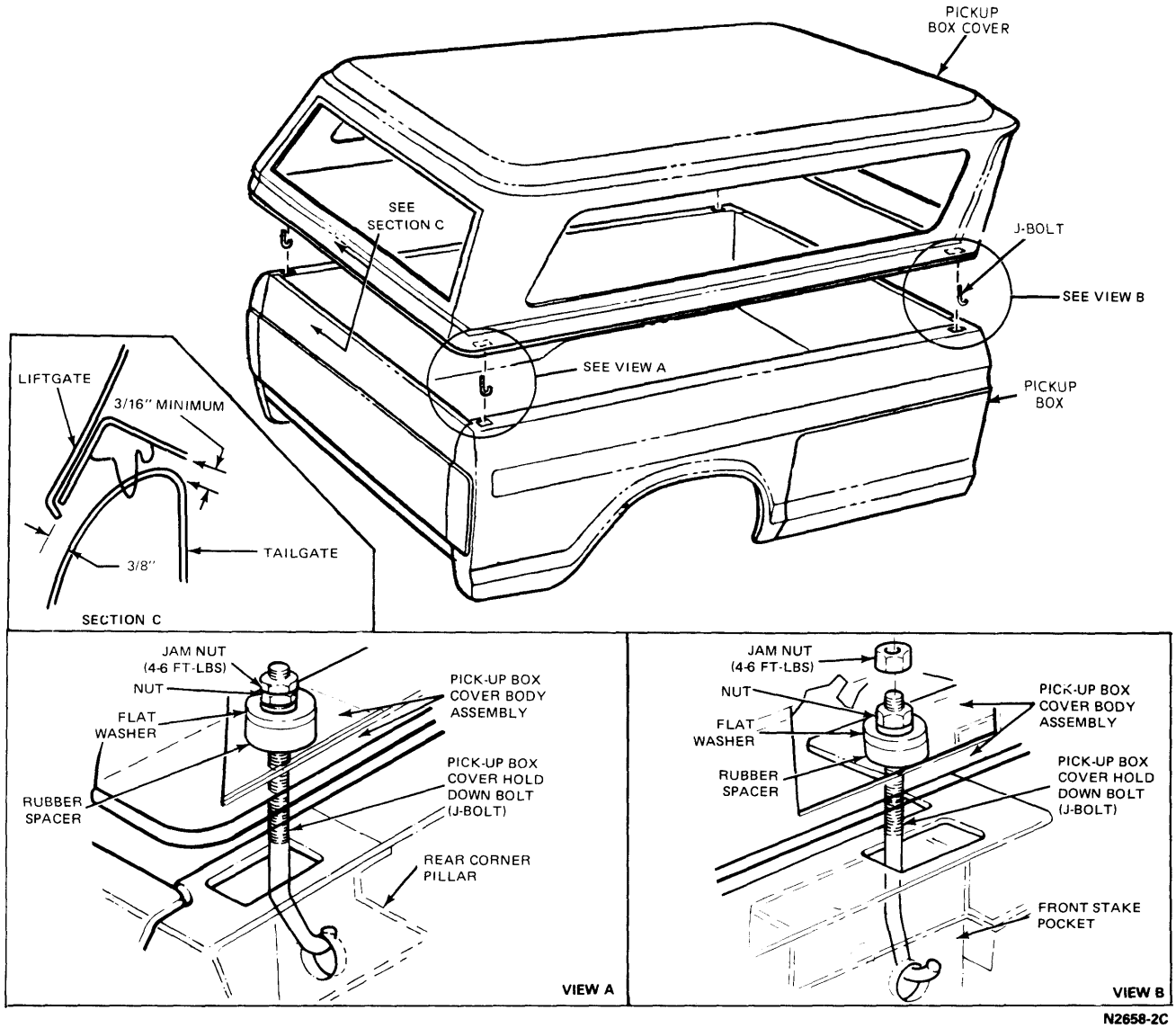


FIG. 1 Pickup Box Cover Installation

ADJUSTMENTS

LIFTGATE LATCH STRIKER

The striker-latch relationship may change after installing or removing the cover causing a poor weatherseal or latch misalignment. To adjust the strikers proceed as follows:

1. Outline the strikers on the body with a pencil to record the existing position.
2. Loosen the attaching screws and adjust the strikers forward (to correct loss of seal) or rearward (to gain latch engagement) as required.
3. When strikers are properly positioned, tighten the attaching screws (7 to 11 ft-lb).

REMOVAL AND INSTALLATION

Removal

1. Disconnect the electrical wiring (two-way connector) at the left front corner of the Pickup Box (Deluxe Model only).
2. Loosen the nuts from all four J-bolt assemblies, (Fig. 1) and unhook the J-bolts from the holes in the corner stake pockets. Do not remove the nuts from the J-bolt assemblies.
3. Remove the J-bolt assemblies from the pick-up box cover mounting holes.
4. Remove the Pickup Box Cover from the truck.

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Installation

1. Clean the top surfaces of the Pickup Box sides, front panel and tailgate to remove any abrasive materials which may have collected.
2. With the liftgate closed, position the Pickup Box Cover on the Pickup Box so the cover is centrally located side to side and the bottom edge of the liftgate is no less than 3/16 inch away from the tailgate.
3. Insert the four J-bolt assemblies down through the cover mounting holes and hook them into the holes in the walls of the corner stake pockets (Fig. 1).
4. Tighten the nuts to 4-6 ft-lbs. Then install the jam nuts, (Fig. 1) and tighten to 4-6 ft-lbs.
5. Connect the electrical wiring (two-way connector) at the left front corner of the Pickup Box (Deluxe Model only).

SLIDING SIDE WINDOW ASSEMBLY

Removal

1. The latch components can be serviced without removing window assembly. Remove screws in housing to service handle or housing (Fig. 4). To service outer latch cover, remove handle housing for access to latch cover screws. NOTE: the position of the housing and/or the cover mating flanges during removal.
2. To remove glass, remove the entire weatherstrip, window and frame assembly from the Pick-Up Box Cover (Fig. 2).
3. Place the window assembly on a work bench and remove the mylar mouldings.
4. Remove the weatherstrip. (Fig. 3).
5. To remove glass place a knife between the stationary glass and its frame and cut the double-backed adhesive tape to separate the window from the frame.
6. With the stationary glass removed, the sliding glass can be removed by flexing the frame sufficiently to remove the glass.
7. The vertical side glass weatherstrip retainer is attached to the glass with double-backed adhesive tape (Fig. 3). To remove the weatherstrip retainer, insert a knife between the retainer and the glass and cut the double-backed adhesive tape. The vertical weatherstrips are retained in grooves of the retainer and will freely slide from the ends of the grooves.

Installation

Installation of the sliding window components can generally be accomplished in the reverse order of removal, however, some special procedures will be necessary.

1. When installing the vertical side glass weatherstrip retainer, clean the glass and retainer mating surfaces with alcohol or wax and grease remover to ensure that they are free from dirt, grease, etc. Then, with the surface clean, apply double-backed adhesive tape to the back side of the retainer and install it to the glass as shown in Fig. 3. **Ensure that the tape does not extend beyond the edges of the retainer.**
2. When installing the stationary glass to the frame, clean the mating surfaces of the glass and frame

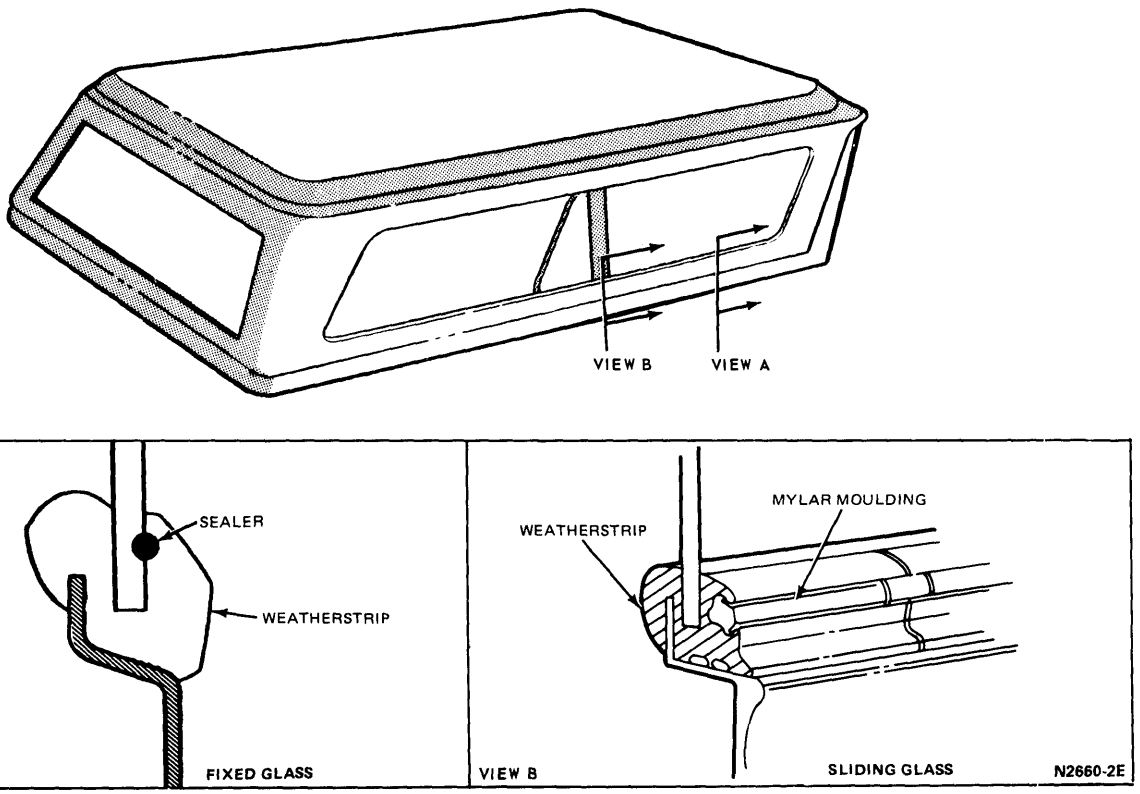


FIG. 2 Side Glass Installation—Stationary and Sliding

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with alcohol or wax and grease remover to ensure they are free of dirt, grease, etc. Then, with the surfaces clean, apply double-backed adhesive tape to the outside front half of the window frame and install the stationary glass as shown in Fig. 3. **Ensure that the tape does not extend beyond the edges of the frame and the glass is located on the frame so that the distance from the edge of the glass to the edge of frame is constant.**

3. Installation of the mylar window mouldings, use special Tool No. J26471. It spreads the channel of the weatherstrip permitting insertion of the mylar moulding (Fig. 5).

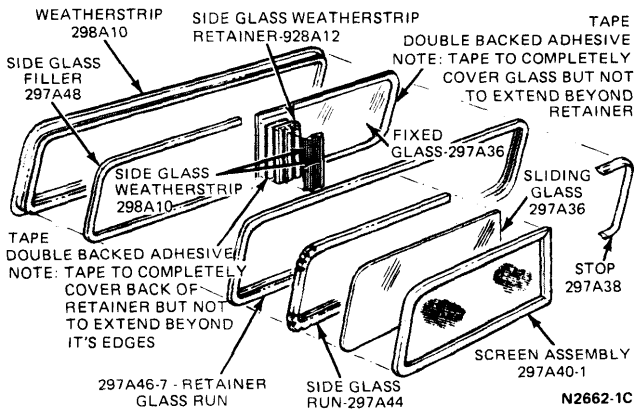


FIG. 3 Pickup Box Cover Side Glass—Disassembled

4. To install any of the window and weatherstrip assemblies into the pickup box cover, use the drawcord installation method outlined for Windshields in Group 43.

STATIONARY SIDE WINDOW ASSEMBLY

For stationary side window assembly refer to Group 43.

SLIDING WINDOW SCREEN

Removal

With the window fully open, slide the screen forward and lift out.

Installation

With the window fully open, slide the screen rearward while feeding the screen clips into the groove in the screen frame (Fig. 6).

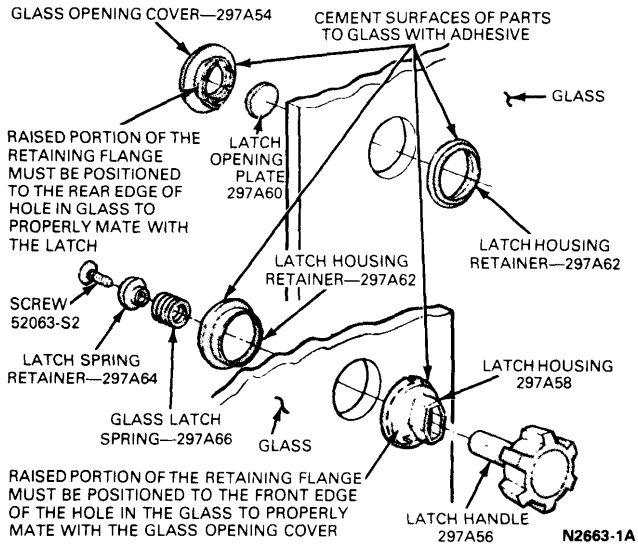


FIG. 4 Sliding Window Handle and Cover

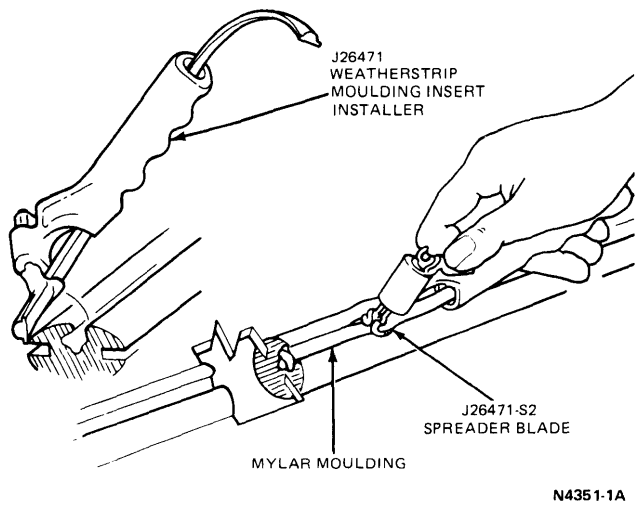


FIG. 5 J26471 Weatherstrip Moulding Insert Installer

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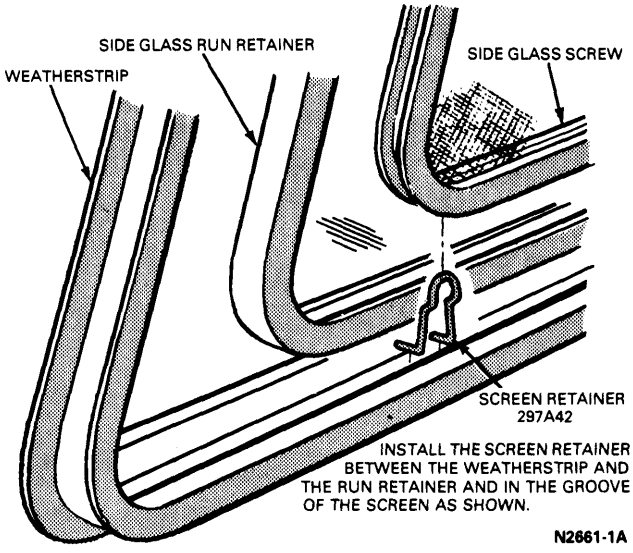


FIG. 6 Sliding Window Screen Installation

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Fiberglass Rear Roof

PART 46-51

APPLIES TO BRONCO ONLY

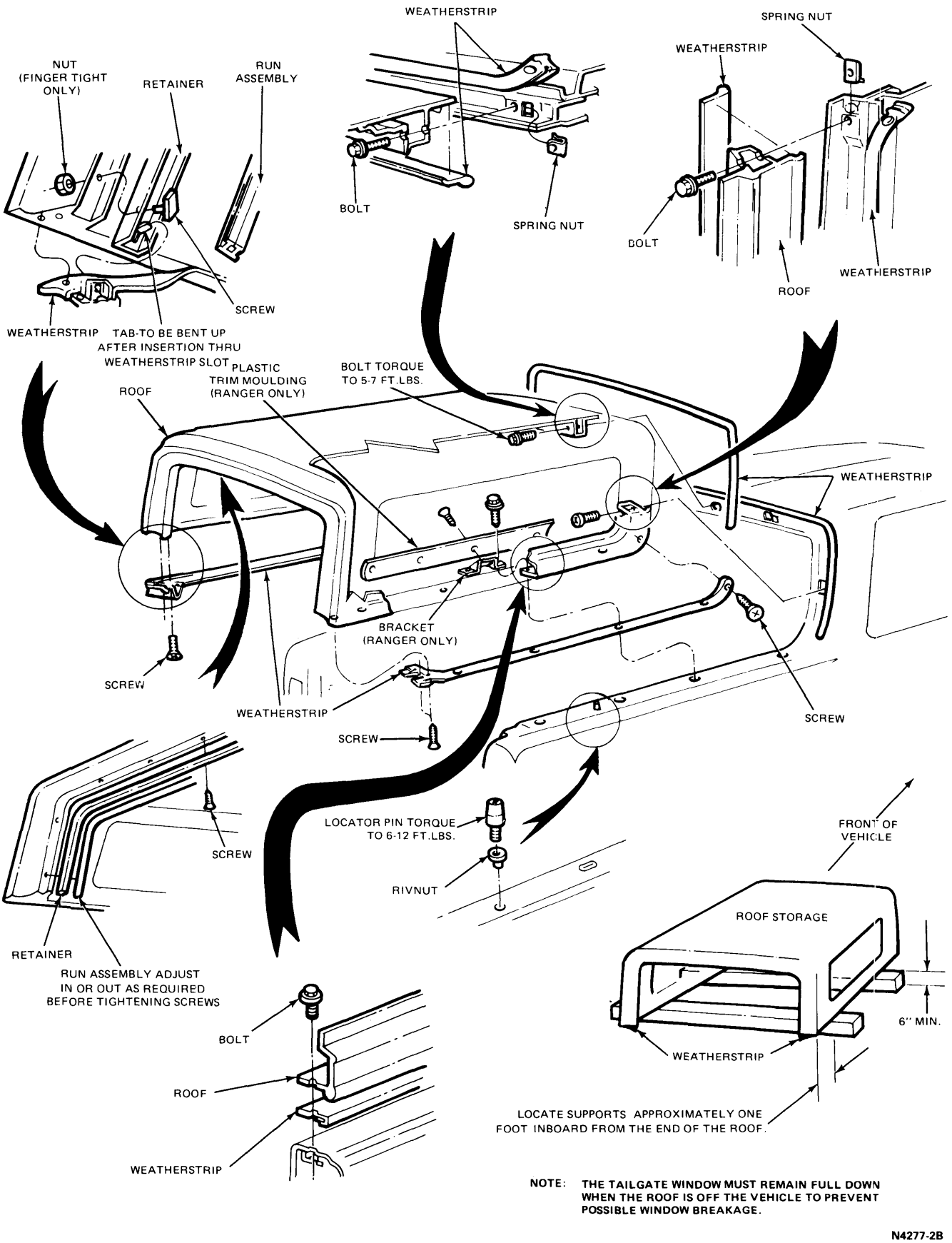
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Fiberglass Roof Repair	51-5
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Roof and Roof Weatherstrips	51-3
Standard Stationary Side Window	51-3
Tailgate Glass Care	51-6
Trim Moulding Storage (High Series Bronco Only)	51-5
Vent Window and Handle	51-5

ADJUSTMENTS

The back window glass upper run assembly can be adjusted fore and aft by loosening the nine nut and washer assemblies securing the run assembly to the roof panel, and loosening the two inboard screws (Fig. 1). Adjust the run as required and retighten the screws. (Refer to Part 42-35 for tailgate window adjustment.)

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NOTE: **THE TAILGATE WINDOW MUST REMAIN FULL DOWN WHEN THE ROOF IS OFF THE VEHICLE TO PREVENT POSSIBLE WINDOW BREAKAGE.**

N4277-2B

FIG. 1 Fiberglass Roof Removal and Installation

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REMOVAL AND INSTALLATION

ROOF AND ROOF WEATHERSTRIPS

1. Lower the tailgate window to the full down position.
   CAUTION: To prevent damage to the glass and/or window mechanism, never attempt to raise the tailgate window when the roof is off the vehicle.
2. On the Ranger model, remove the lower trim moulding attaching screws and the plastic trim mouldings. Scribe the location of the brackets on the roof's surface and number each bracket for identification for installation.

WEATHERSTRIP REPLACEMENT ON ROOF

1. To repair or replace the weatherstrips, rotate the roof to rest in an upside down position on the floor, then proceed to service the weatherstrips.
2. Remove the roof attaching bolts and moulding attaching brackets as shown in Fig. 1.
3. Carefully remove roof from vehicle to prevent tearing or separating the weatherstrip from the roof.
4. Store roof as shown. Store the plastic trim mouldings (Ranger model only) inside roof to prevent damage during storage.
5. To install, make sure tailgate window is full-down. Install the two locating pins. Carefully place roof on vehicle lining up the two locating pins.
6. Loosely install all mouldings attaching brackets and roof attaching bolts, making sure all brackets are in original position.
7. Tighten upper five attaching bolts and then, tighten remaining bolts. Bolts should be tightened enough to compress the weatherstrip without distorting the roof.
8. If used, install plastic trim mouldings.

STANDARD STATIONARY SIDE WINDOW

When removing or replacing the glass, a helper must be employed to work outside the vehicle.

Removal

1. Remove mouldings if so equipped.
2. Working from inside, start at one corner and work across the top of the glass, pulling the weatherstrip down and pushing the glass and weatherstrip outward until the helper can grasp the glass and lift it from the glass opening.
3. Remove the weatherstrip from the glass (Fig. 2).

Installation

1. Clean the weatherstrip with cleaning solvent to remove all old sealer and cement.
2. Clean the glass opening flange. Check the flange for wavy areas, and repair as necessary.
3. Apply sealer, (19554 or equivalent), in the glass crevice of the weatherstrip and install it on the glass.
4. Run a bead of sealer around the opening flange and in the inner flange crevice of the weatherstrip.
5. Install a draw cord all around the weatherstrip in the flange crevice. Let the draw cord overlap at the bottom center. Apply rubber lube to the weatherstrip lip.

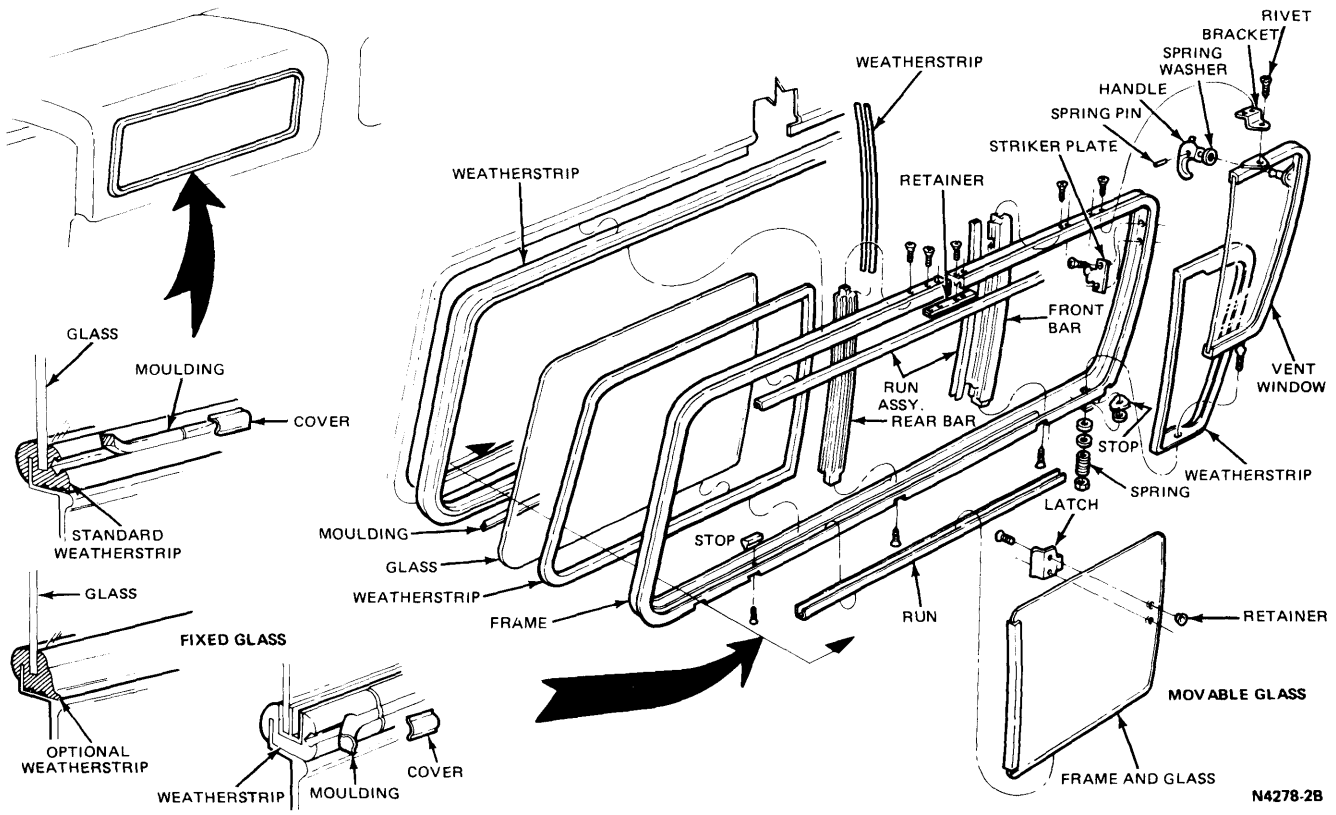


FIG. 2 Window Removal and Replacement

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6. Have a helper position the window assembly in the window opening and apply hand pressure on the glass. From the inside, draw the lip of the weatherstrip over the window opening lower flange with a draw cord. Alternate from side to side, moving about 12 inches at a time, until the window is in place.
7. Replace mouldings.

   NOTE: Mouldings may be installed on the bench before installation of assembly into opening.
8. Water test the installation for leaks, and seal with additional sealer if necessary.

OPTIONAL SLIDING GLASS—MOVABLE GLASS AND LATCH

1. Remove the moulding joint cover and moulding from the weatherstrip surrounding the window assembly (Fig. 3).
2. Remove the weatherstrip and complete window assembly from the vehicle.
3. Place the window assembly on a work bench and remove the weatherstrip.
4. Remove the four screws at the top center of the frame.
5. Remove the one screw at the top of the center division bar.
6. Remove the two screws at the top of the vent window division bar.
7. Lift the frame upward at the top center sufficiently to remove the movable glass from the frame.
8. Remove the two screws securing the latch to the glass.
9. The latch has double-backed adhesive tape between it and the glass, so use a knife and separate the tape and latch handle from the glass.
10. To install, reverse the above procedure using the draw cord method of installing the assembly into the side panel as described in the procedure for the standard stationary side window.

OPTIONAL SLIDING GLASS—FIXED GLASS PANEL

1. Remove sliding glass assembly as previously described and place on suitable work area for disassembly (Fig. 3).
2. Remove the four screws at the top center of the frame.
3. Remove the two screws securing the center division bar, one at the top and one at the bottom and remove the bar.
4. Remove the two screws at the top of the vent window division bar.
5. Lift the frame upward at the top center sufficiently to remove the sliding glass from the frame.
6. Pull the fixed glass forward in the frame approximately ten inches and then lift the frame upward at the top center sufficiently to remove the glass and weatherstrip.
7. Install by reversing the above procedures, using the draw cord method as previously described.

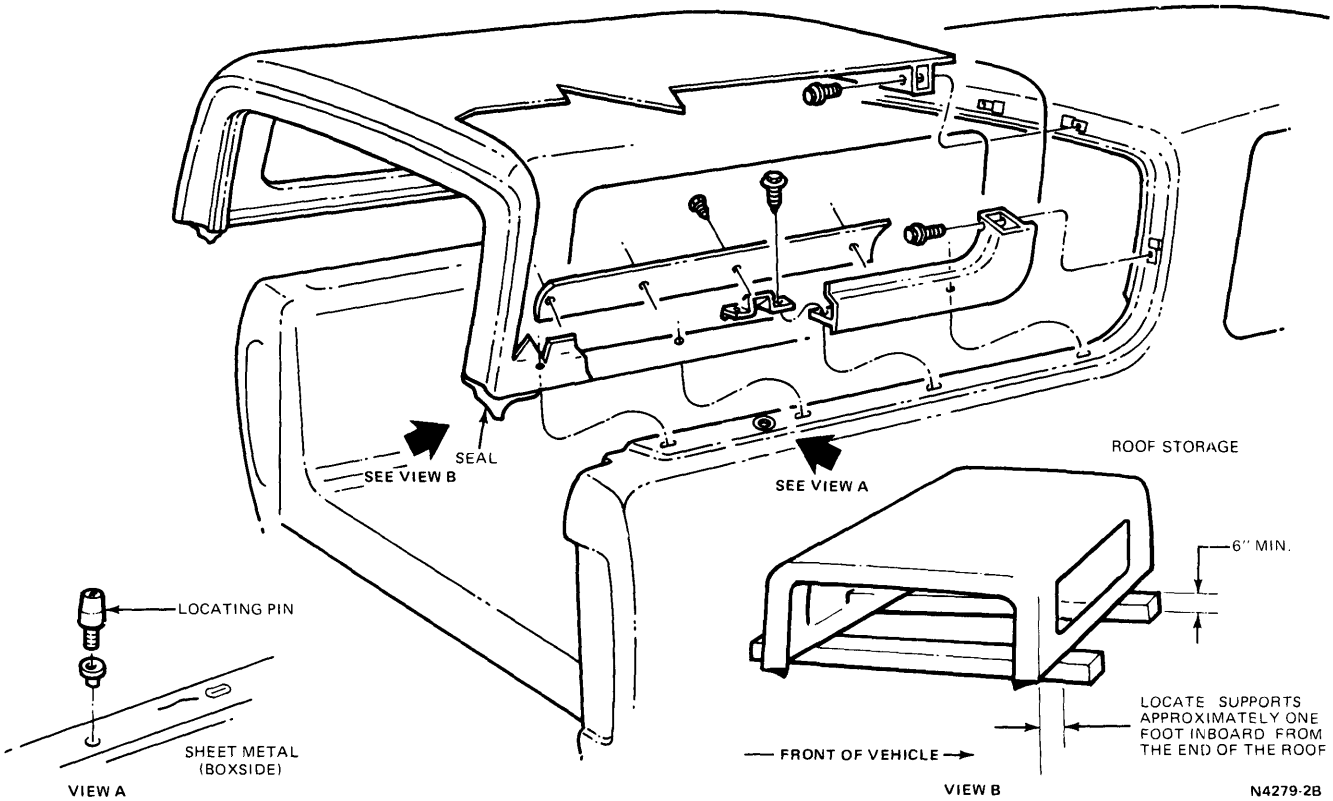


FIG. 3 Roof Removal and Installation

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VENT WINDOW AND HANDLE

1. Remove sliding glass assembly as previously described and place on suitable work area for disassembly.
2. Remove the two forward screws (where the frame is split) at the top center of the frame.
3. Remove the upper two screws securing the vent window division bar.
4. Drill out the rivet in the vent window pivot bracket.
5. Remove the nut, spring, and washers at the bottom of the vent window and then tip the vent window assembly outward and remove it from the frame.
6. Drive out the pin in the vent window handle and remove the handle.
7. Install by reversing the above procedure, using the draw cord method as previously described, to install the assembly in the side panel.

FIBERGLASS ROOF REPAIR

SURFACE PREPARATION

1. Clean the affected area with Ford Toluol or Ford Silicone and Wax Remover or equivalent; then inspect the area closely to determine the exact extent of the damage.
2. Using a burr bit on a power drill, form a V-groove the length of the scratch or gouge. The sides of the "V" should be angled no more than 45 degrees. Note: Exercise care to avoid cutting all the way through the laminate during routing operations.
3. Remove all flakey edges and feather the painted surface back approximately 1/2" beyond the damaged area by hand-sanding or power-sanding with 360 grit sandpaper.
4. Clean the repair area by blowing with dry, oil-free, high velocity compressed air.

FIBERGLASS LAMINATE REPAIR

1. Following the instructions in the Ford Fiberglass Repair or equivalent kit, mix enough filler material on a clean hard surface to re-establish the laminate surface.
2. Just prior to application of the filler material, preheat the repair area using a 375-Watt lamp placed 10" from the repair surface until it is hot to the touch.
3. Using a plastic squeegee, spatula or putty knife, apply and spread the filler material into the repair area; rolling it into the depression and over the surface to avoid excessive air entrapment. Apply sufficient filler material so that the applied repair surface is at least 1/16" above the adjacent laminate surface.
4. Let the filler set up until it is firm to the touch. Then, re-establish the original contour by filing off the excess, leaving the filler level slightly higher than that of the original surface.
5. Pre-shrink the filler, using a heat gun or heat lamp. A minimum temperature of 120°F is required for shrinkage. Note: Keep the heat source at least 12 inches away from the repair area.
6. Power-sand the filler with 360 grit sandpaper until it is smooth and even with the original surface. If the filler surface exhibits fine pinholes, apply a thin coat of Ford Glaze Wipe or equivalent. If the filler is pockmarked, do not use the Glaze Wipe. Instead, apply another layer of filler, following Steps 1-6 above.
7. Finish by sanding with a sanding block and 400 grit sandpaper.
8. Clean the repair area by blowing it with dry, oil-free, high velocity compressed air.
9. Repair the paint (Spatter Texture Coat) employing the appropriate painting procedure.

FIBERGLASS ROOF (REFER TO FIG. 3)

Removal

Lower the tailgate window to the full down position. On High Series Bronco only remove the lower trim moulding attaching screws (1) and the plastic trim mouldings (2). Scribe the location of the moulding attaching brackets (3) on the fiberglass roof's surface and number each bracket as it is removed to provide a means of identification for reinstallation. Remove all the roof attaching bolts (4) and moulding attaching brackets. Then, carefully lift the roof off the vehicle to prevent tearing or separating the weatherstrip from the fiberglass roof. Remove the two fiberglass roof locating pins (Fig. 3). Note: The tailgate window must always remain in the full down position when the roof is off the vehicle to prevent possible window breakage.

Installation

Install the two fiberglass roof locating pins and check to assure that the tailgate window is in the full down position. Carefully place the roof on the vehicle lining up the two locating pins. Then, loosely install all the moulding attaching brackets and roof attaching bolts, making sure the brackets are located in the position from which they were previously removed. Tighten the upper five attaching bolts (4). Then, tighten the remaining bolts. The bolts should be tightened enough to compress the weatherstrip without distorting the roof's attaching surface. Install the plastic trim mouldings and attaching screws. Using caution not to crack the mouldings, tighten the screws securely.

FIBERGLASS ROOF STORAGE

To prevent permanent deformation to the portion of the belt weatherstrip extending below the lower edge at the rear of the fiberglass roof (5), store the removed roof right side up on a level surface at least six inches above the ground (Fig. 3).

TRIM MOULDING STORAGE (HIGH SERIES BRONCO ONLY)

In order to protect the plastic trim mouldings from damage during storage, it is recommended they be placed inside the removed fiberglass roof.

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TAILGATE GLASS CARE

When operating the vehicle in an extremely dusty environment, the tailgate glass should be cleaned periodically to prevent build-up of surface dust. This will ensure the best possible performance and the greatest number of years of trouble-free service.

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BODY SHELL, EXTERIOR TRIM, FRAME AND UNDERBODY

GROUP 47 (70000)

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Body Shell, Exterior Trim, Frame and Underbody - General Service

PART 47-01

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GENERAL INFORMATION

TYPE OF SEALERS AND APPLICATION

Since many sealers are used in the assembly of the truck, the following all-purpose sealers have been selected for service use. The method and points of application are shown in each applicable group.

CAULKING CORD—19560, OR EQUIVALENT

This sealer has a plastic base with an asbestos filler, is heavy bodied and is commonly known as perma-gum. It is used on spotweld holes, around mounting clips, and between two surfaces not sealed by a gasket. Apply the sealer with a putty knife.

TRIM CEMENT—19C525 OR EQUIVALENT

This cement is recommended for body panel plastic water shield and on some soft trim installations. It is also useful for repair or replacement of other vinyl and rubber trim.

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RUBBER CEMENT—19552 OR EQUIVALENT

This quick-drying, strong, adhesive cement is designed to cement weather stripping to doors, bodies, cowl ventilators, and the surrounding metal. Windows and windshields that are set in rubber, can be effectively sealed against leakage by flowing cement into affected areas.

Clean all grease, dirt, and old sealer from the surfaces to be cemented. Wash the surfaces thoroughly with a rag moistened with a suitable commercial cleaner. For best results, apply a medium coat of cement to both surfaces, allow it to dry until tacky, and then press both surfaces firmly together.

BODY SEALER—19562 (WHITE AND/OR BLACK), OR EQUIVALENT

This sealer does not run, is fast drying, and remains semi-elastic. The sealer can be used for seam sealing in such areas as the floor pan, wheelhouse, dash panel, running board, door openings, and drip rails. It can also be used to seal outside moulding clip holes, and for windshield and back window installation.

DIAGNOSIS AND TESTING

DUST AND WATER LEAKS

Remember, the forward motion of the truck creates a slight vacuum within the body, particularly if a window or ventilator is partially open. Any unsealed crevice or small opening in the lower section of the body will permit air to be drawn into the body. If dust is present in the air, it will follow.

Under certain conditions, water can enter the body at any point where dirt or dust can enter. Any consideration of water leakage must take into account all points covered under dust leaks.

To determine the exact location of a dust leak, remove the following trim from the cab; the cowl trim panel, the kick pads, and the floor mats.

Removal of the trim will reveal the location of most leaks. Seal these leaks, and road test the truck on a dusty road to make sure that all leaks are sealed. The entrance of dust is usually indicated by a pointed shaft of dust or silt at the point of entrance. After the road test, check for indications of a dust pattern around the door openings, cowl panel, and cowl side panel.

Sometimes leaks can be located by putting bright lights under the truck, with the above components removed, and checking the interior of the body at joints and weld lines. The light will show through where leaks exist.

FLOOR PAN PLUGS AND GROMMETS

Many plugs and grommets are used in the floor pan and dash panel. The floor pan plugs seal the various body bolt access holes.

If any plugs are missing or damaged, a dust or water leak may result. Such leakage may also occur around grommets used on the dash panel. When dust or water leaks are evident, these plugs and grommets should be checked for proper installation.

DRAIN HOLES

Drain holes are located on the underside of each door along the weld line of the inner and outer panels. If these holes become clogged with mud or road tars, water will collect inside the panels and rust the sheet metal from the inside. A sound of sloshing water in a door is an indication of this condition.

Check the drain holes regularly. Clean the drain holes of dirt and foreign material with a punch or screwdriver.

RATTLE ELIMINATION

Most rattles are caused by a loose bolt or screw. Foreign objects such as nuts, bolts or small pieces of body deadener in the door wells, pillars, and quarter panels are often the source of rattles. Door wells can be checked by carefully striking the underside of the door with a rubber mallet. The impact made by the mallet will indicate if loose objects are in the door well.

All bolts and screws should be tightened periodically. In the event that tightening the bolts and screws located on such assemblies as the doors does not eliminate the rattles, the trouble is probably caused by **misalignment.** If this is the case, follow the adjustment and alignment procedures for these assemblies.

Rattles and squeaks are sometimes caused by weatherstripping and anti-squeak material that has slipped out of position. Apply additional cement or other adhesive, and install the material in the proper location to eliminate this difficulty.

ADJUSTMENTS

CHECKING BODY FOR MISALIGNMENT

To align or square up a body, take two opposite diagonal measurements between pillars. Use a measuring tram for these measurements. Take the measurements between reference points such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured. Since all measurements should be made from the bare metal, remove all interior trim from the checking points.

In some cases, it is difficult to obtain proper body alignment when repairing a body that is damaged on both sides. In these cases, horizontal and vertical measurements can be taken from a body of the same body style. Once these basic dimensions are taken and

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established on the damaged body, alignment can be made by diagonal measurements taken from points on the two pillars.

Do not attempt to correct any serious misalignment with one jacking operation. This is particularly true if other sections of the body also require aligning. Align each section proportionately until the proper dimensions are obtained.

Door openings are checked in the same manner as the body. Horizontal, vertical, and diagonal checking points are established on all four sides of the door opening that is being measured.

FRAME INSPECTION

Frame misalignment is the result of damaged or loose frame components, it can effect front wheel alignment and can cause improper operation and/or abnormal wear of chassis parts.

Before checking frame alignment, inspect the frame for damage and loose parts. Inspect all frame members for cracks, twists, or bends. Check all welded connections for cracks. Inspect all rivets, bolts, and body support brackets for looseness. Make all necessary repairs or replacements.

DIAGONAL OR X FRAME CHECKING METHOD

Frame alignment can be checked without removing the truck body from the frame by using the diagonal or X checking method.

This method should be used to identify misalignment prior to any attempt to straighten a frame.

1. Place the truck on a clean level floor and set the parking brake.
2. Select several points along one frame side member and very carefully transfer these points with a plumb bob to the floor. If desired, paper can be taped on the floor along both sides of the truck below the frame. Mark the points on the floor as accurately as possible.
3. Locate the corresponding points along the opposite frame side member and very carefully transfer these points to the floor in the same manner.
4. Move the truck away from the marks on the floor, and measure between diagonal points. Both corresponding measurements should be equal within 1/4 inch. Measure diagonally between all points on the floor.
5. Measure between corresponding points parallel to the frame side members. These measurements should be within 1/4 inch of each other.

The squareness of the frame side member web and the lower flanges at the spring hangers should be within 1/16 inch. The squareness of the side member web at the steering gear mounting location should be within 1/16 inch. The web and flange should be square at all other points within 1/8 inch.

Any point on one side member should be within 1/8 inch ahead, behind, above, or below the corresponding point on the opposite side member. The frame side member should not be bowed more than 1/8 inch for each 100 inches of frame length. The overall width of the frame should not vary more than 1/8 inch.

NOTE: An alternate method of checking frame alignment is to use a frame gauge such as Rotunda Models 730016 or 730017 or an equivalent.

REPAIR OPERATIONS

FRAME REPAIR

DRILLING PRECAUTIONS

Do not drill holes in the frame flanges, since this tends to reduce the frame strength.

WELDING PRECAUTIONS

Disconnect the negative battery ground cable before using electric welding equipment.

All frame welding should be done with electric welding equipment, and the heat should be kept in a small area to prevent change in hardness of the metal. **Do not apply heat to or weld 50,000, 80,000 and 110,000 psi frames. When a reinforcement is welded to a side member, run the welds lengthwise along the reinforcement.**

FRAME STRAIGHTENING

Frame misalignment can be corrected by straightening the out-of-line parts or by replacing the crossmembers, braces, or brackets if they are badly damaged.

Straightening should be attempted on frames that fail to meet specifications of the diagnal checking method or where damage is visually apparent.

To prevent internal stresses in the metal, frame straightening should be limited to parts which are not severely bent. **If heat is needed to straighten a frame member, keep the temperature below 1200 degrees F (a dull red glow). Excessive heat may weaken the metal in the frame members and cause permanent damage. Do not apply heat to 50,000, 80,000 and 110,000 psi frames.**

FRAME REINFORCING

After a bent frame member has been straightened, inspect the member closely for cracks. If any cracks show, the frame member should be reinforced or replaced. If the frame is a 50,000, 80,000 or 110,000 psi frame, **no repair method is approved.**

Reinforcements can be made from channel, angle, or flat stock. The reinforcement stock should be of the same material and the same thickness as the frame member being reinforced and should extend a minimum of six inches to either side of the crack.

To insure sound repair, the crack should be prepared before the reinforcement is welded to a cracked frame member. **Do not weld 50,000, 80,000 and 110,000 psi frames. The only frame that welding is permissible on is the 36,000 psi frame. The cracked**

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area should be wire brushed to remove paint and expose the crack. To prevent the crack from spreading, drill a 1/4 inch hole at the root of the crack. Grind out the crack to form a slot which will allow the weld to penetrate to the surface of the reinforcement.

The proper location of the reinforcement depends upon the location of the crack. If the crack is at the bottom of the channel, the reinforcement should be welded to the channel bottom. If the crack extends along the side of the channel, an additional reinforcement should be welded to the side. Drill clearance holes in the reinforcements to clear rivet and bolt heads when necessary.

FRAME MEMBER REPLACEMENT

If a damaged frame member is to be replaced, new bolts, grade 8 fasteners and rivets required for replacement of parts, should be of the same specifications as the original bolts or rivets. In cases where it is necessary to substitute a bolt for a rivet, use the next larger size bolt.

FIBERGLASS REPAIR

SAFETY PRECAUTIONS

Always use rubber gloves or the special hand cream supplied with epoxy resin repair kits. **REMOVE ANY RESIN FROM THE HANDS AS SOON AS POSSIBLE AND PARTICULARLY BEFORE THE MIXTURE STARTS TO GEL.** Any resin that adheres to the hands may be removed with lacquer thinner followed by a thorough washing with soap and water.

Use a respirator when grinding the fiberglass surface and use a vacuum attachment when operating a belt sander.

Always work in a well ventilated area in order to avoid possible toxic fumes that may result from using resin mixtures. Exercise care so as not to get any resin on clothing.

Keep all materials, utensils and the work area clean and dry as resin repairs involve chemical reactions. Any dirt, foreign material or moisture may upset the chemical reaction and result in an unsatisfactory repair.

REPAIR PROCEDURE

Grind or sand away all loose or broken material at the damaged area. Scuff sand the surface approximately one inch around the area to provide a good bonding surface. Be sure that the surface to be repaired is clean, dry, oil and paint free.

For cracks, form a shallow V along the crack with a file or grinder. Fill the area with a good quality polyester or epoxy body repair compound. Follow the manufacturer's directions with regard to mixing procedures. Allow the compound to harden and then sand smooth. If the surface is not level or smooth, use an additional filling and sand to a final smooth finish.

For larger broken areas use fiberglass cloth (five layers) impregnated with the resin, to cover the area. Overlap the damaged portion by one or two inches. When the material has hardened, file or grind and sand smooth. If low spots exist, fill them with resin mixture to which has been added short fibers cut from the fiberglass cloth. Add enough of the cloth to form a putty like resin mixture.

PAINTING

After the desired repaired surface has been obtained, prime and paint the surface in the normal manner.

CLEANING AND MAINTENANCE

CHROME AND BRIGHT METAL CARE

Many parts of the truck, such as the bumpers and body hardware, are chrome-plated or anodized aluminum. These finishes are susceptible to corrosion due to salt air near coastlines (or salt spray during winter), factory smoke and other conditions found in today's cities. When such conditions exist, frequent washing and the use of Ford Bright Metal Cleaner or equivalent is recommended.

Do not use steel wool, abrasive type cleaners or strong detergents containing highly alkaline or caustic agents on chrome plated or anodized aluminum parts. These methods or cleaners may damage the protective coating and cause discoloration and/or paint deterioration.

TRIM

The trim on the vehicle requires no special care. Periodic cleaning will preserve the beauty and life of these finishes. Wash with clear water or if the parts are very dirty, use COAA-19B521-A or an equivalent compound using a clean soft cloth or a sponge and water, rinse and wipe the parts dry. Ford Chrome Cleaner or equivalent may be used sparingly to remove rust or salt corrosion from chrome plated parts. Do not scour aluminum or chrome finished parts with steel wool or polish them with products containing abrasives. A polish will provide excellent protection for all bright metal parts.

BODY MAINTENANCE

Regular body maintenance preserves the vehicle's appearance and reduces the cost of maintenance during the life of the vehicle. The following steps are suggested as a guide for regular body maintenance.

1. Vacuum the interior thoroughly and wash the vehicle.
2. Check all openings for water leaks, and seal where necessary.
3. Cement all loose weatherstrips which are still usable.
4. Replace all door and lift gate weatherstrips which are unfit for service.
5. Apply silicone lubricant to the weatherstripping.
6. Replace all cracked, fogged, or chipped glass.
7. Align the hood and doors if necessary.

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8. Inspect the windshield wiper blades and replace them if necessary.
9. Tighten the sill plate and garnish moulding screws.
10. Clean the seats, door trim panels, and headlining.
11. Touch up or paint chipped or scratched areas.
12. Drain holes located on the underside of each rocker panel, quarter panel, and door, should be cleared periodically.

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F-100 Through F-350 and Bronco

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REMOVAL AND INSTALLATION

RADIATOR GRILLE

F-100 THROUGH F-350 AND BRONCO

The radiator grille assembly consists of the grille outer shell and grille insert. The insert is attached to the outer shell with screws, six plastic rivets and 1 screw at the lower centerline (Fig. 1). These attachments can be removed from the front of the vehicle.

The grille outer shell installation is shown in Figs. 1 and 2.

Removal

1. To remove the outer shell, remove six screws attaching each end of the grille to the fender.
2. Remove the lower retaining screws at the lower corners of the grille.
3. Remove the grille outer support bracket-to-radiator support bolts at each end of the grille.
4. Remove the upper mounting bracket-to-grille bolts.
5. Remove the retaining screw at the lower center bracket to grille screw.
6. Disconnect the parking light and headlamp wires and remove the grille.

Installation

1. Transfer all U-nuts, clips, mounting brackets, etc. to a new grille if the grille is to be replaced. Position the grille.
2. Connect the parking and headlamp wires.
3. Install the upper mounting bracket-to-grille bolts.
4. Install the grille outer support bracket-to-radiator support bolts at each end of the grille.
5. Install the lower retaining screws at the lower corners of the grille.
6. Install the screw attaching the grille to the lower center bracket.
7. Install the six screws attaching each end of the grille to the fender.

FRONT FENDER

Removal

1. Clean all dirt from the fender attaching screws, bolts and nuts.
2. Remove the grille and headlight assemblies from the vehicle.
3. Remove the screws attaching the front of the fender to the radiator support.
4. Remove one screw attaching the rear lower end of the fender to the lower corner of the cab (Figs. 2 and 3).
5. Remove one screw from inside the cab attaching the top rear corner of the fender to the cowl.
6. Remove the screws attaching the top edge of the fender to the fender apron and radiator support and remove the fender from the vehicle.
7. Remove the nuts and retainers from the fender.

Installation

1. Position the nuts and retainers on the fender.

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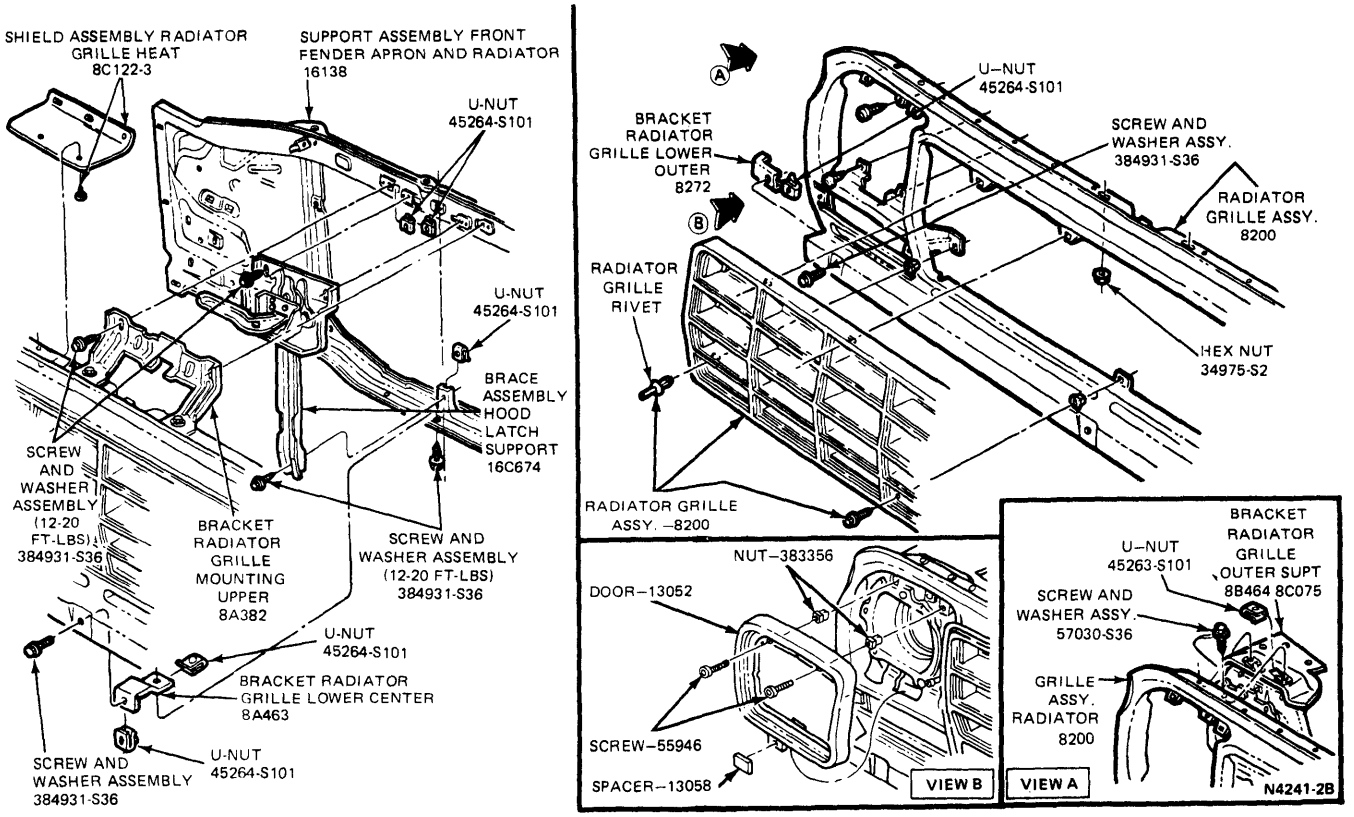


FIG. 1 Grille, Hood Latch and Related Parts—Bronco and F-100—F-350

2. Apply sealer to the upper edge of the apron.
3. Position the fender to the apron and install the screws loose.
4. Install one screw from the inside of the cab loose, attaching the top rear corner of the fender to the cowl.
5. Install a screw loose, attaching the rear lower end of the fender to the lower corner of the cab.
6. Install the screws loose, attaching the front of the fender to the radiator support.
7. Adjust the fender position and tighten all mounting screws.
8. Install the grille and headlight assemblies.

REAR FENDER—PICK-UP

1. Clean the dirt from the fender retaining bolts and nuts with a wire brush.
2. Remove the fender brace to fender nut and bolt.
3. Remove the twelve fender to body retaining nuts and washers.
4. Remove the three nuts and bolts attaching the running board to the fender and remove the fender.
5. Clean the body in the fender attaching area.
6. Position the new fender, and start all of the attaching bolts and nuts to assure bolt hole alignment.
7. Tighten all of the fender attaching nuts and bolts.

FRONT BUMPER

The front bumper installation for all light truck models is shown in Figs. 4 and 5. On models with the bumper bolted directly to the frame, remove the bumper bolts and bumper guard or push bar (if so equipped) and lift the bumper and bumper guard (if so equipped) from the frame. On models with bumper brackets (Figs. 4 and 5), remove the bumper bracket to frame attaching bolts and remove the bumper and brackets. Then, remove the brackets from the bumper.

EXTERIOR MOULDINGS

Before removing the exterior mouldings, determine by the type of retainer used if it is necessary to remove an interior trim panel (Figs. 6 through 16). Crew Cab and Super Cab models use conventional exterior mouldings except in the area of the rear door (Crew Cab) or cab extension (Super Cab). See Figs. 11 and 14 for additional mouldings needed to service these models. If a weld stud is distorted or broken off, it should be replaced with a screw (379560-S101).

BODY MOUNTS

CONVENTIONAL CAB

The body mounts for the conventional cab are shown in Fig. 17.

CREW CAB

To accommodate the additional length of the Crew Cab, the rear body mounts are located rearward 33.50 inches further than the conventional cab F-series models. These mounts incorporate unique brackets mounted outside the frame siderail with four (4) rivets. Two additional body bumpers are mounted on the frame, No. 3 crossmember (Fig. 18).

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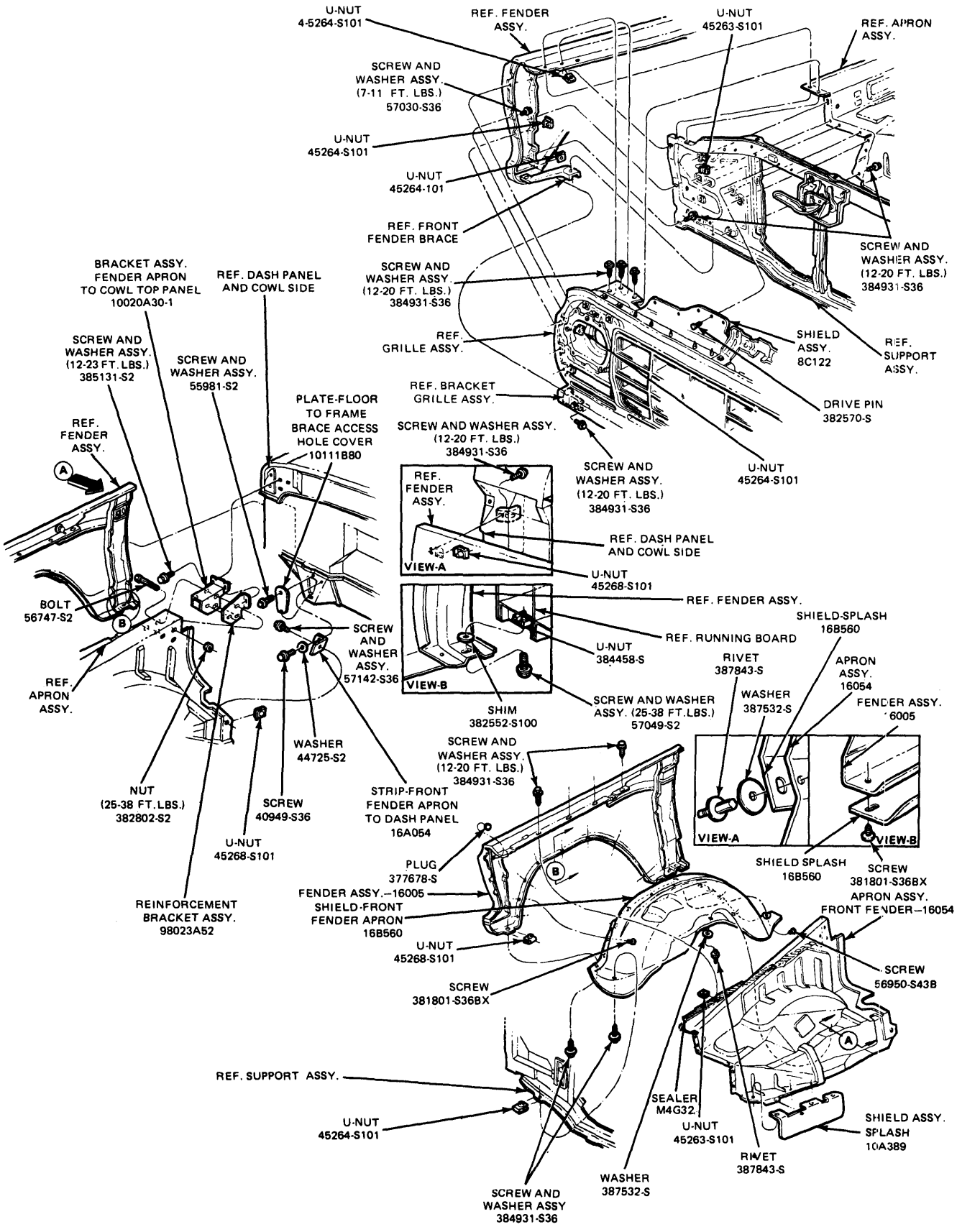


FIG. 2 Front Fender Installation Right Side—Bronco F-100—F-350

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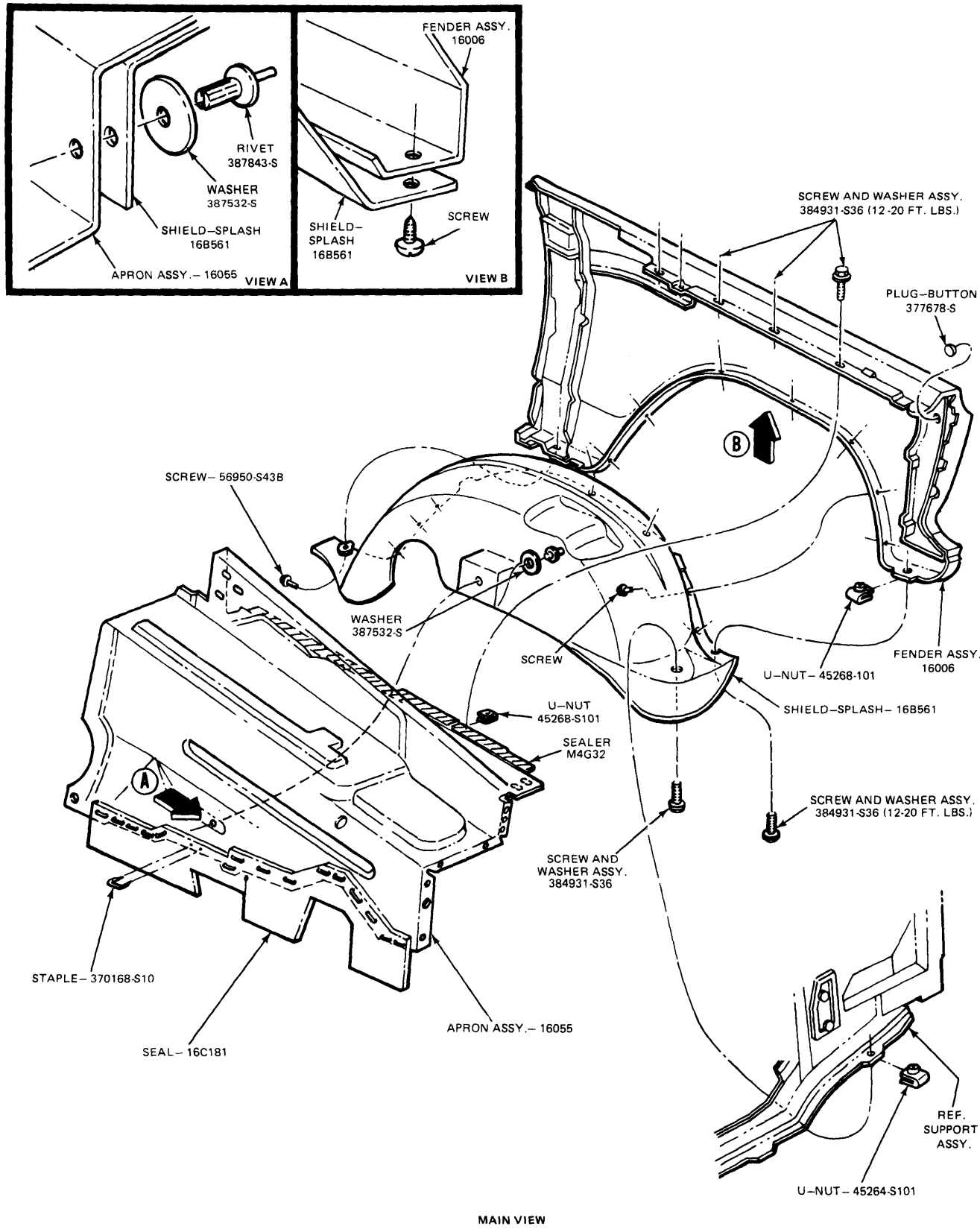


FIG. 3 Front Fender Installation Left Side—Bronco, F-100—F-350

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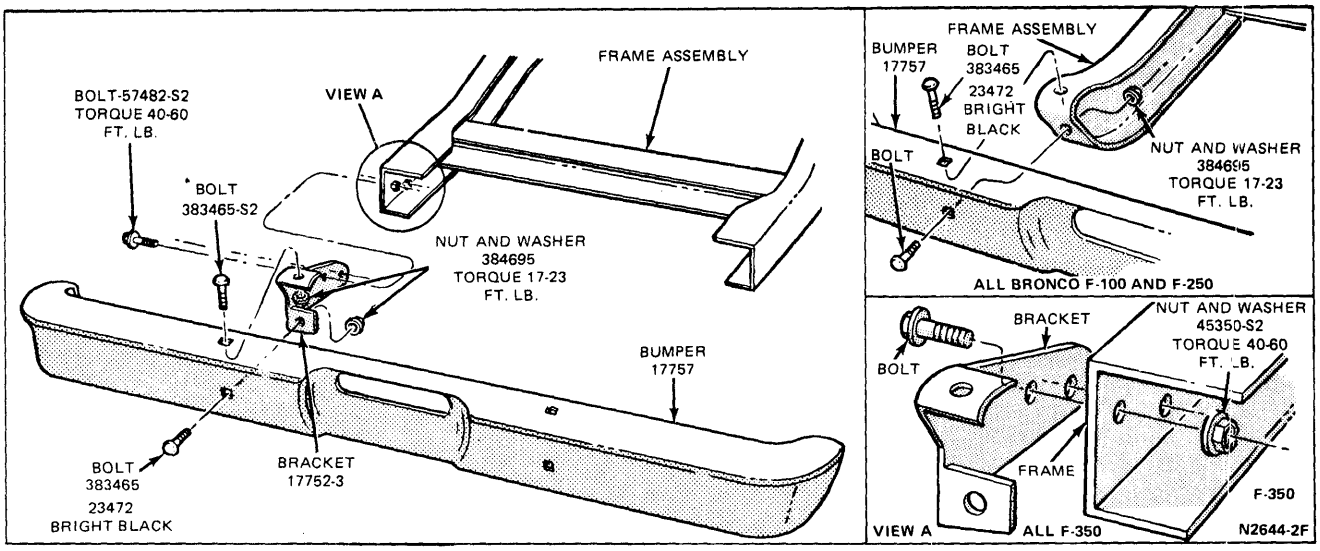


FIG. 4 Front Bumper Installation

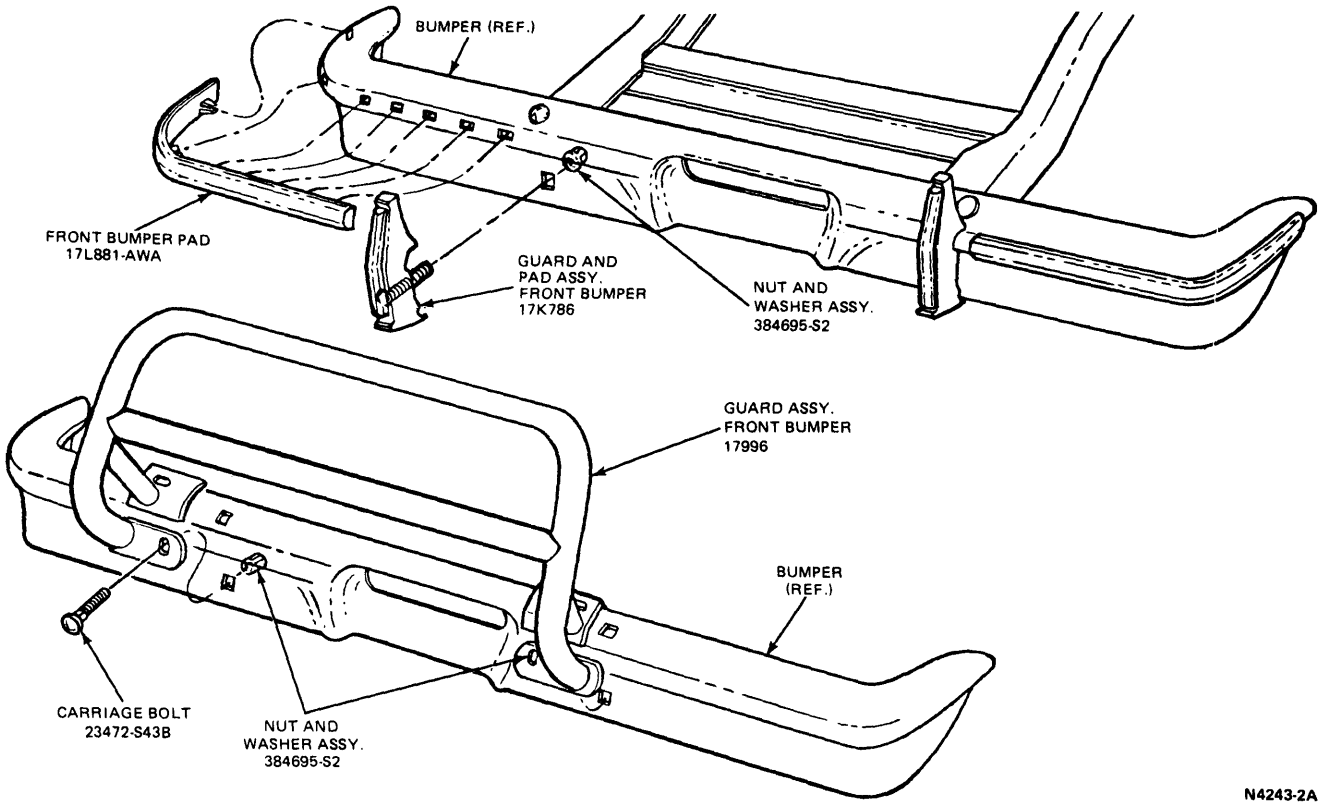


FIG. 5 Bumper Guards, Pads and Push Bar Bronco, F-100 Through F-350

SUPER CAB

To accommodate the extended cab on Super Cab models, the rear cab mounts are revised as follows:

1. New engine rear support brackets are used, riveted to the frame ahead of the No. 3 crossmember. (Fig. 19).
2. Rear cab mounting brackets are both riveted and welded to the frame.
3. The pickup box mounts to special brackets instead of to the frame as with conventional F-series pickups.

Removal

1. Loosen the attaching bolt leaving a minimum of four threads in the retainer.
2. Using a long solid bar or drift and a large hammer, strike the head of the attaching bolt sharply downward to separate the **swedged** or **flare** portion of the lower retainer from the upper retainer. Holding the lower retainer nut, remove the attaching bolt, lower retainer and absorber (Fig. 17). Note: On vehicles with a frame mounted **midship** auxiliary fuel tank it will be necessary to

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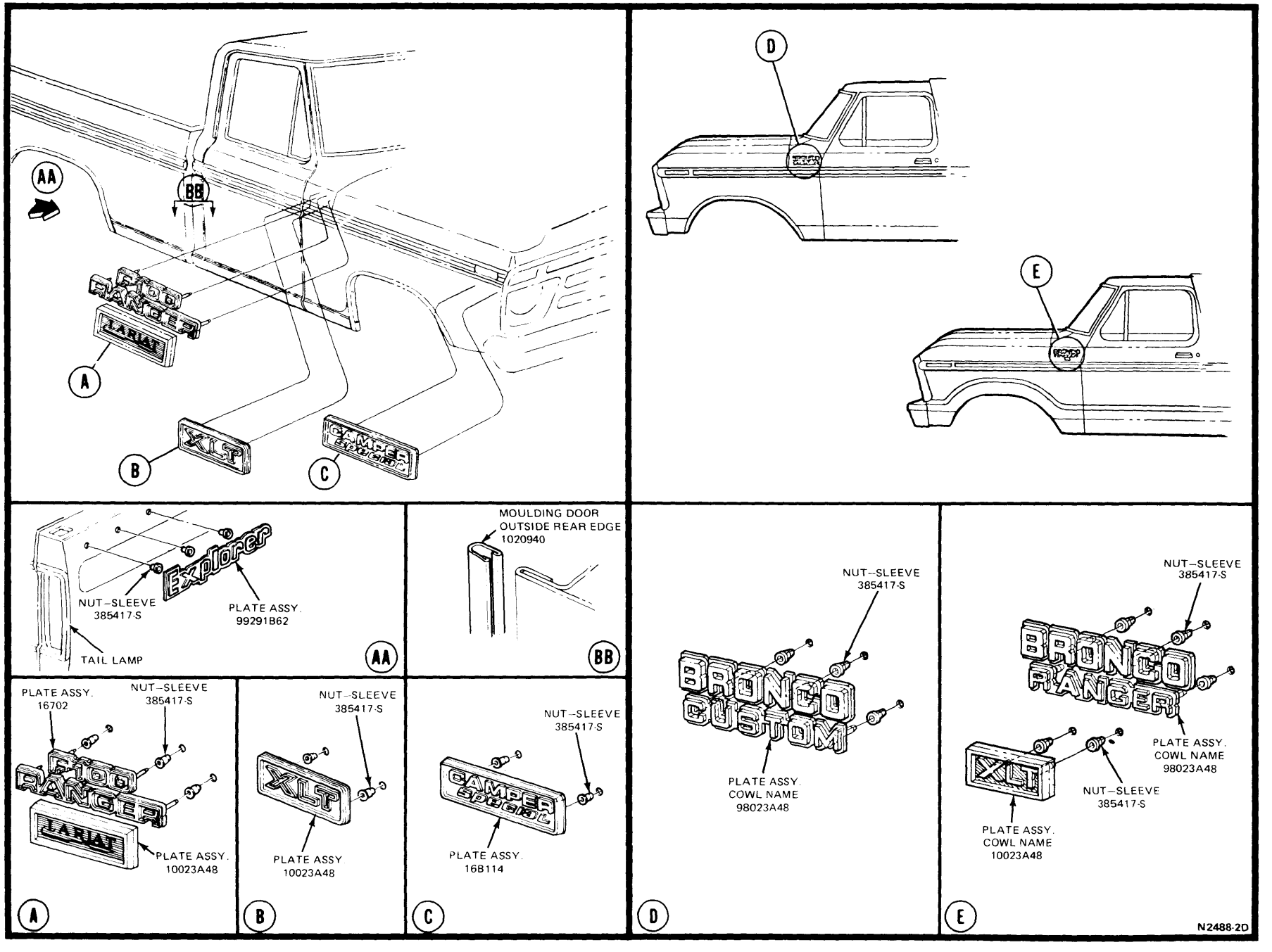


FIG. 6 Exterior Ornamentation, Model Identification and Name Plates Bronco and F-100—F-350

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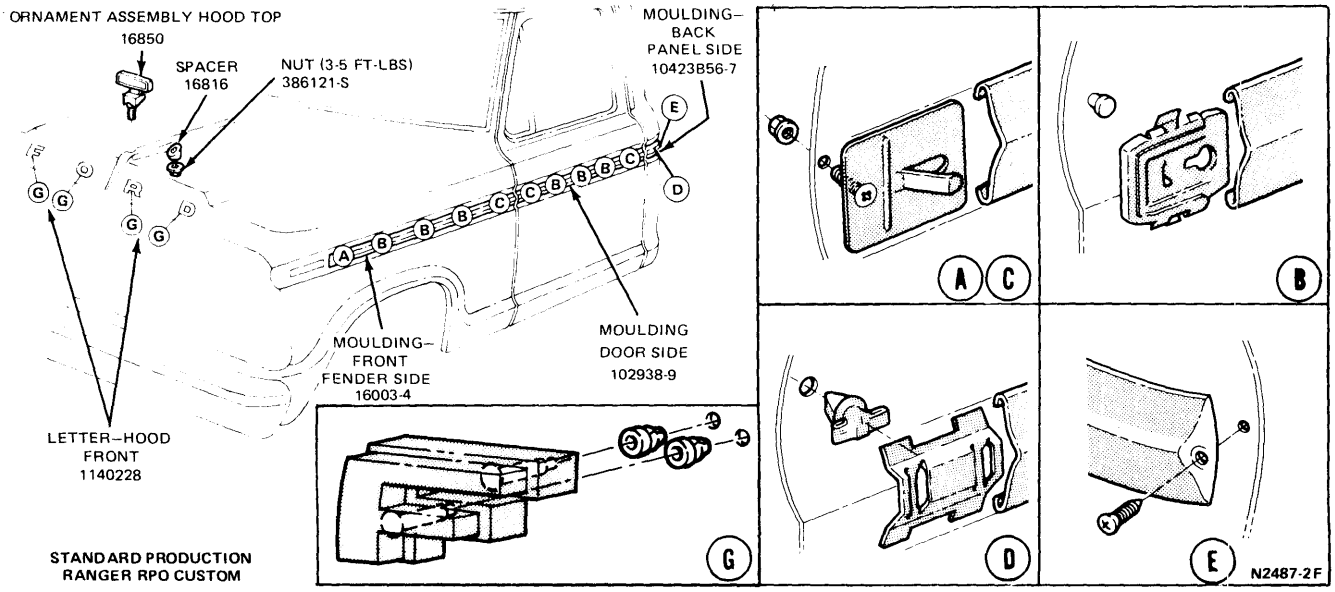


FIG. 7 Exterior Ornamentation, Front Body Side Mouldings—F-150—F-350

either loosen or remove the fuel tank to provide tool clearance when removing the rear cab mounts. Refer to Part 24-50 for removal and installation procedures.

3. Loosen all cab mount attaching bolts before raising the cab. Leave the bolts loosely in place in the mounts not being replaced.
4. Raise the body section enough to remove the upper absorber and retainer assembly.
5. Discard all parts removed.

Installation

1. Position the new upper absorber and retainer assembly. Be sure the pilot section of the rubber absorber is positioned correctly in the frame crossmember or bracket.
2. Lower the body section onto the new upper absorber and retainer. Use a drift to align the holes in the sheet metal and the mount.
3. Insert the proper attaching bolt (Fig. 17).
4. Position a new lower absorber and lower retainer assembly on the attaching bolt and tighten until snug.
5. Holding the lower retainer assembly with a suitable wrench, tighten the attaching bolt to 40 ft-lb. for the front end sheet metal mounts or 50 ft-lb. for the front and rear cab mounts.
6. Tighten all other mounts that were loosened to the appropriate torque.
7. On trucks equipped with a midship auxiliary tank it is necessary to cut the left rear cab attaching bolt 1/2 inch from the lower retainer nut to provide adequate clearance between the bolt and the fuel tank. Retighten the bolt after cutting. This operation is only necessary when the left rear cab mount is replaced.
8. If the fuel tank was loosened or removed, reinstall the fuel tank in the original position.

SLIDE-OUT SPARE TIRE CARRIER

F-100 AND F-250

Removal

1. Rotate the lock pin, aligning the tang on the pin with the slot in the channel assembly and the release handle. Remove the lock pin (Fig. 20).
2. Actuate the release handle by pulling it down and outward to unlock the carrier channel assembly from the latch bracket assembly.
3. The channel assembly and spare tire assembly is now held by the latch bracket assembly tangs.
4. Grasp the release handle and lift the carrier and spare tire upward to take the weight off the latch bracket assembly. Pull the latch bracket outward to release latch from channel assembly and carefully lower the spare tire and channel assembly to the ground.
5. Grasp the **hand-hold** area of the channel assembly and, lifting slightly, pull both the spare tire and channel assembly outward until the channel assembly contacts the built in stop of the support assembly.
6. Remove the spare tire and wheel from the channel assembly.

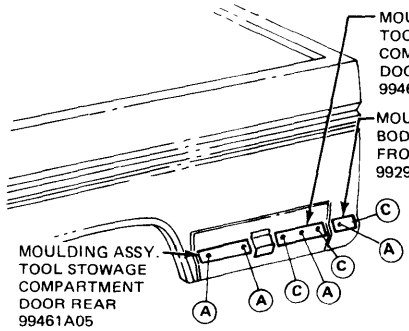
Installation

Before installing the spare tire and wheel assembly into the slide-out carrier, refer to Fig. 20 for spacer requirements and adjustment procedures.

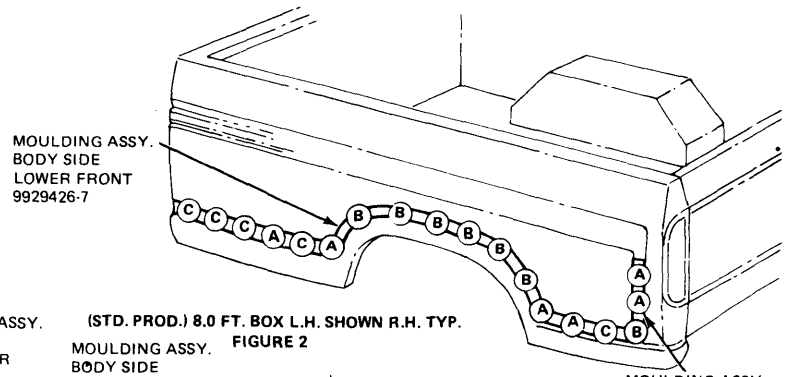
1. Place spare tire assembly in position on channel assembly.
2. Lifting the channel assembly and spare tire slightly, push both back under the vehicle until the channel assembly hits the stop and is positioned correctly on the support assembly. Note: The latch bracket assembly must be lined up with the slot in the channel assembly and the support assembly.

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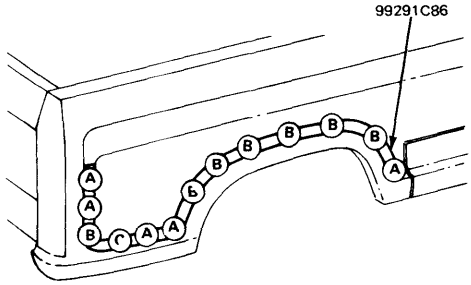
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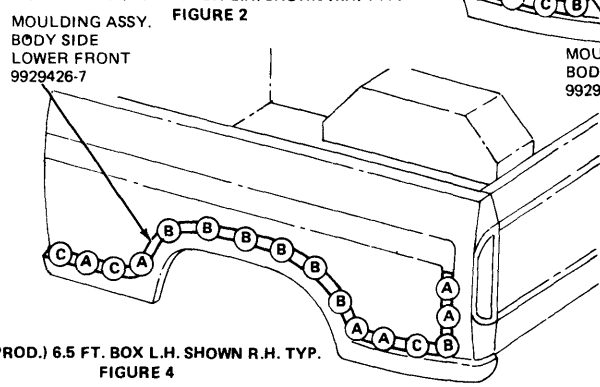
(R.P.O.) TOOL STOWAGE 8.0 FT. BOX R.H. SD.
FIGURE 1



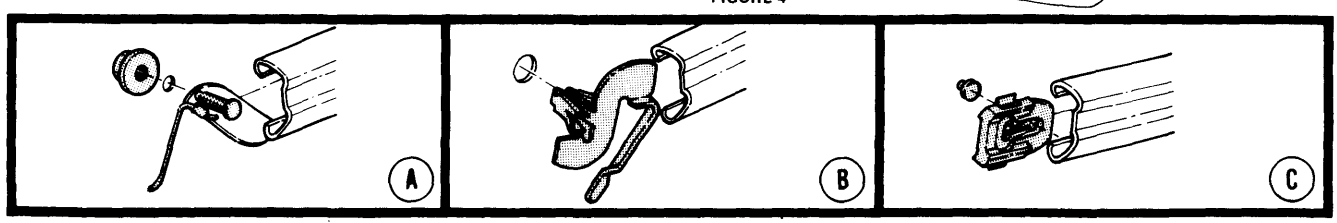
(STD. PROD.) 8.0 FT. BOX L.H. SHOWN R.H. TYP.
FIGURE 2

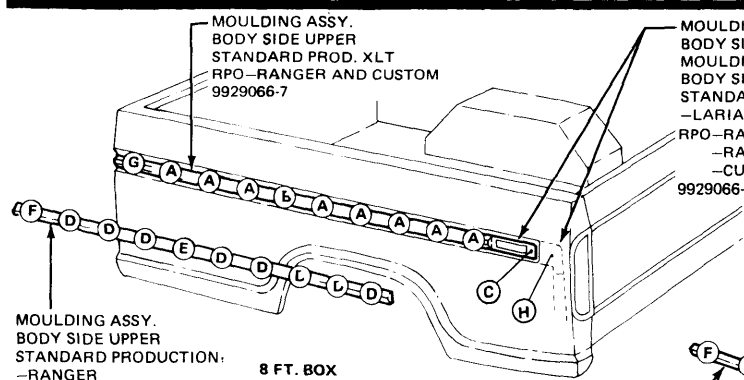


(R.P.O.) TOOL STOWAGE 8.0 FT. BOX R.H. SD.
FIGURE 3

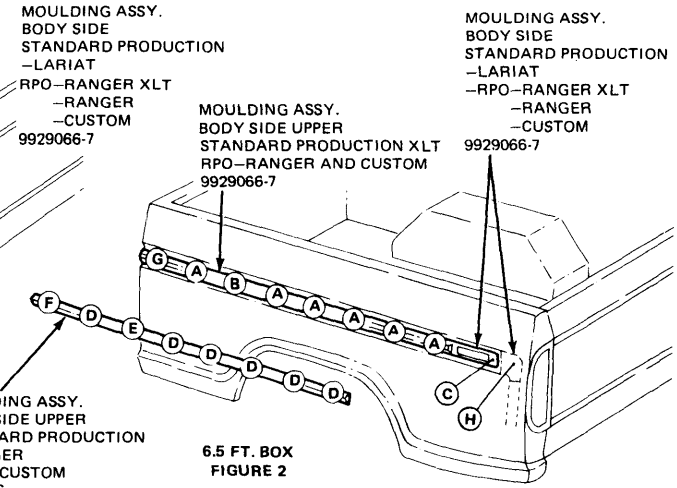


(STD. PROD.) 6.5 FT. BOX L.H. SHOWN R.H. TYP.
FIGURE 4

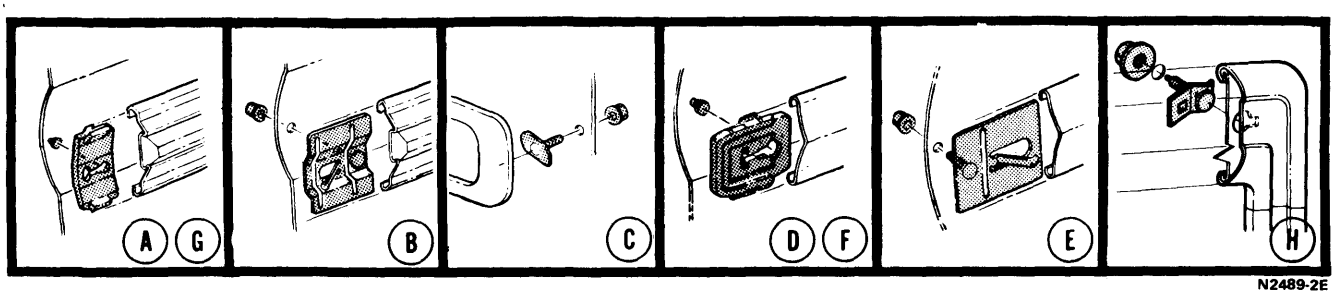




8 FT. BOX
FIGURE 1



6.5 FT. BOX
FIGURE 2



N2489-2E

FIG. 8 Exterior Ornamentation, Body Side Mouldings—F-100—F-350

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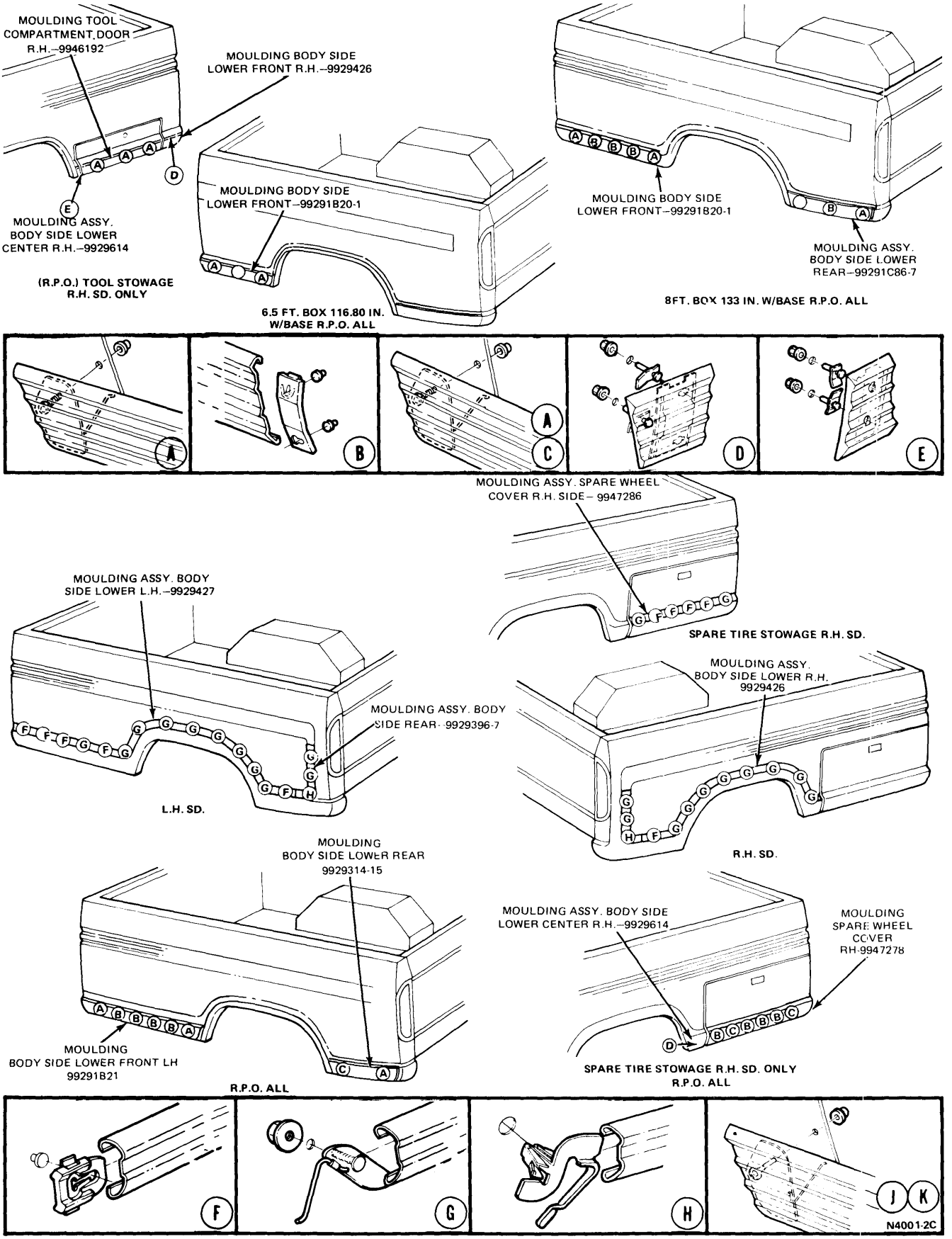


FIG. 9 Exterior Ornamentation, Body Side Lower Mouldings, Single Rear Wheels 140" Wheelbase, F-250—F-350

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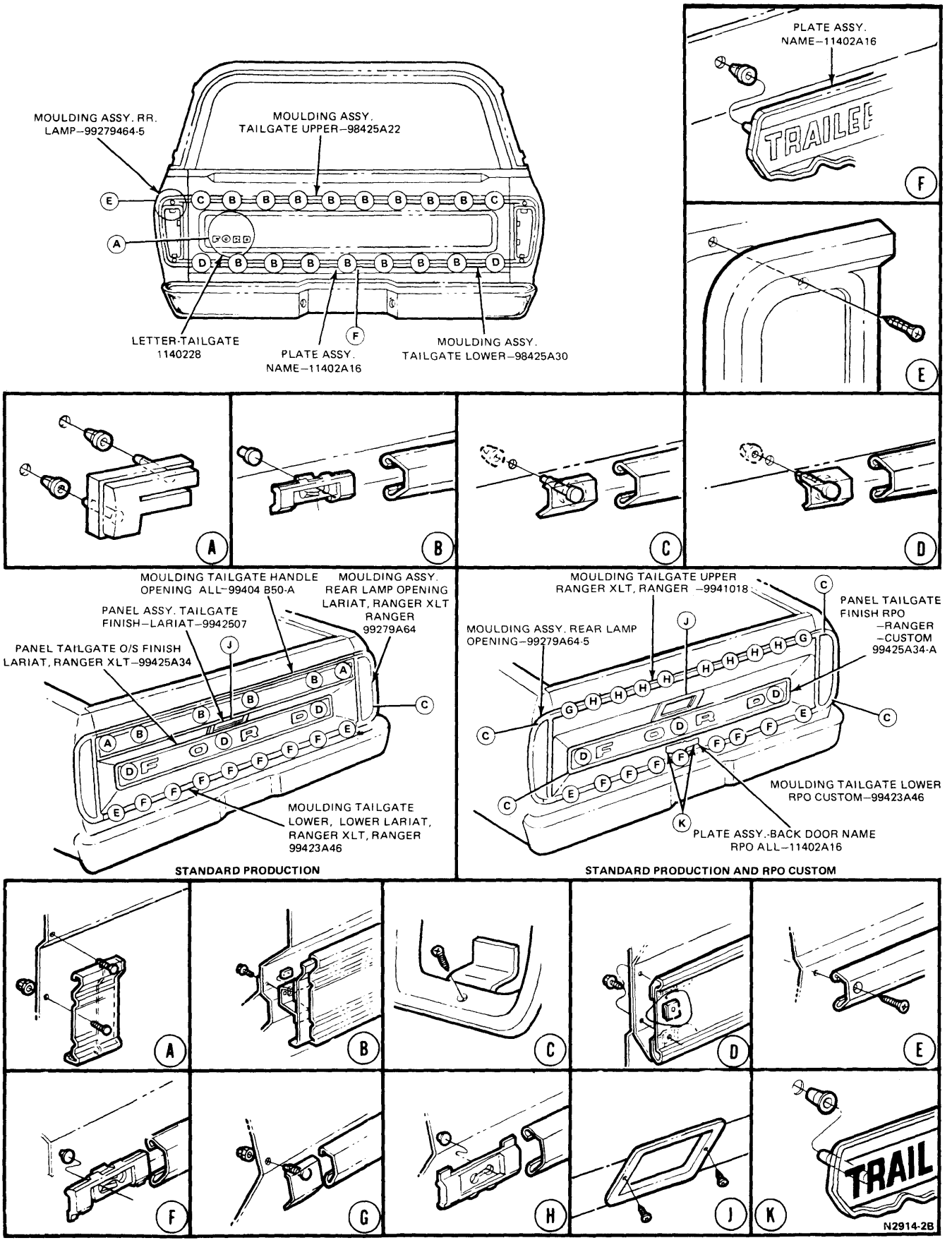


FIG. 10 Exterior Ornamentation, Rear Lamp and Tailgate Mouldings, F-100—F-350

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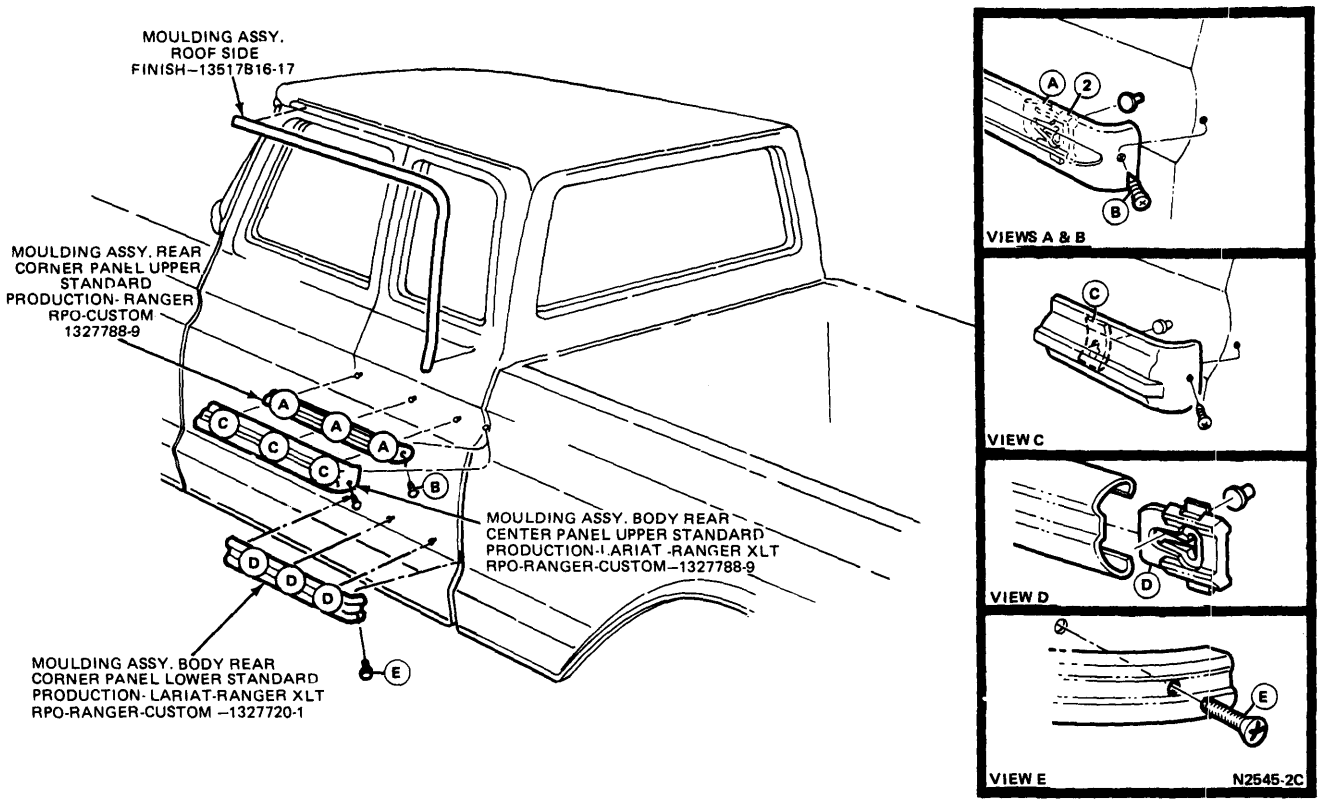


FIG. 11 Exterior Ornamentation Body Side Mouldings—Super Cab—F-100—F350

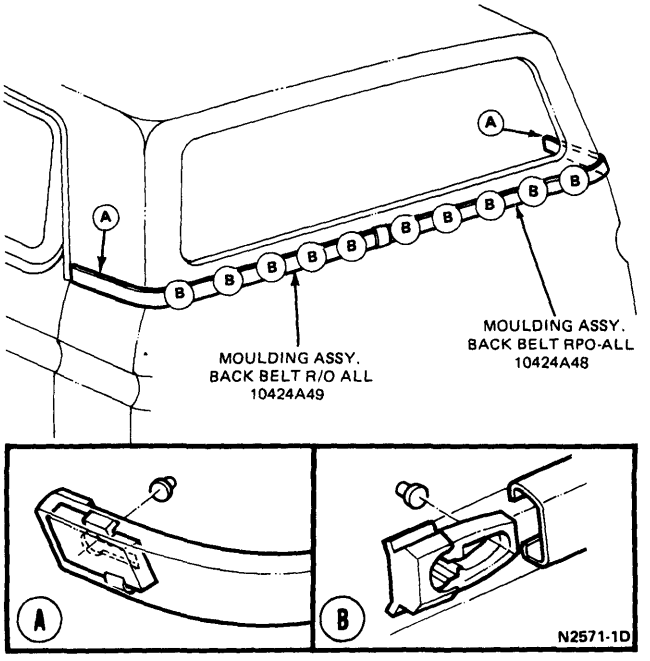


FIG. 12 Back-To-Cab Mouldings

3. Lift the spare tire assembly and channel assembly upward. The latch bracket assembly should slide freely through the slot of the channel and support assembly until the latch bracket assembly snaps into position and now supports the spare tire assembly and channel assembly.

4. Push the release handle downward (rotating inward) until it is in the **locked** position.

5. Install the lock pin in position and lock the release handle to the channel assembly (Fig. 20).

SLIDE OUT SPARE TIRE CARRIER

(STANDARD WHEELBASE—4x4 AND LONG WHEELBASE)

Refer to Figs. 21 and 22 for Removal and Installation.

SIDE-MOUNTED SPARE TIRE CARRIER

F-100 THROUGH F-350 (FIG. 23)

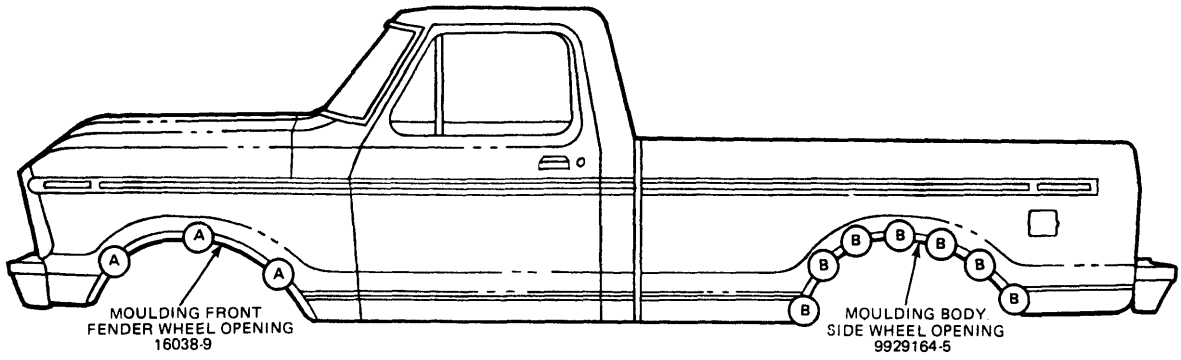
Removal

The side-mounted spare tire carrier is enclosed with a removable cover panel assembly. The cover panel assembly is held in position by two **torsion-bar** type wire latches and two **hook-type** hinges and hinge brackets.

1. Release the front and rear latches (item No. 3 Fig. 23), by lifting the latch handle out of the locked position in the lower panel inner flange. Push the latches inward and at the same time, pull downward and outward which releases the panel at the top.
2. Swing the panel assembly (item No. 1) outward and remove both front and rear hooks (hinge) from the front and rear hinge brackets (item No. 5 and No. 2) and remove the panel assembly.
3. Release the wing nut safety latch (swing the latch upward) and remove the wing nut (item No. 7).
4. Lower the retainer plate assembly (item No. 6) to the ground. Note: **The plate assembly is utilized**

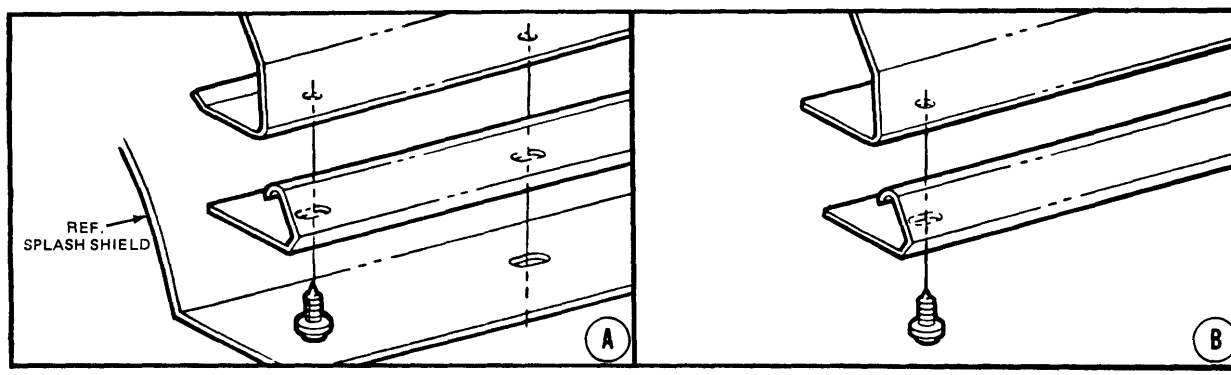
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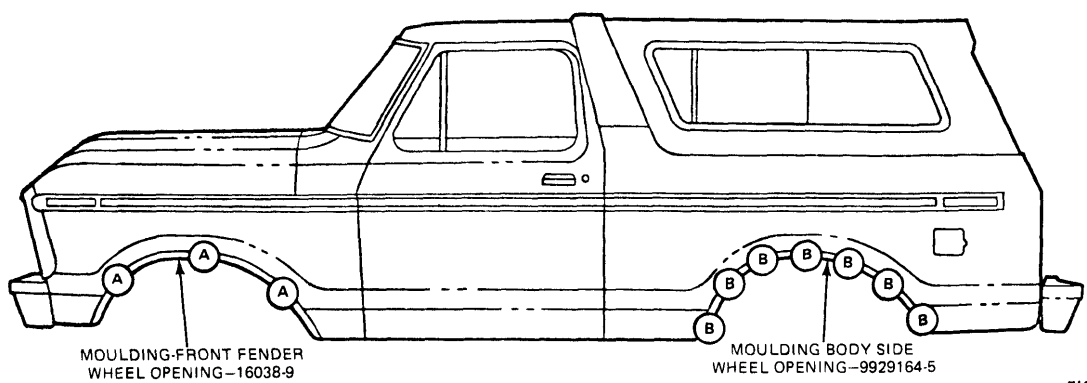
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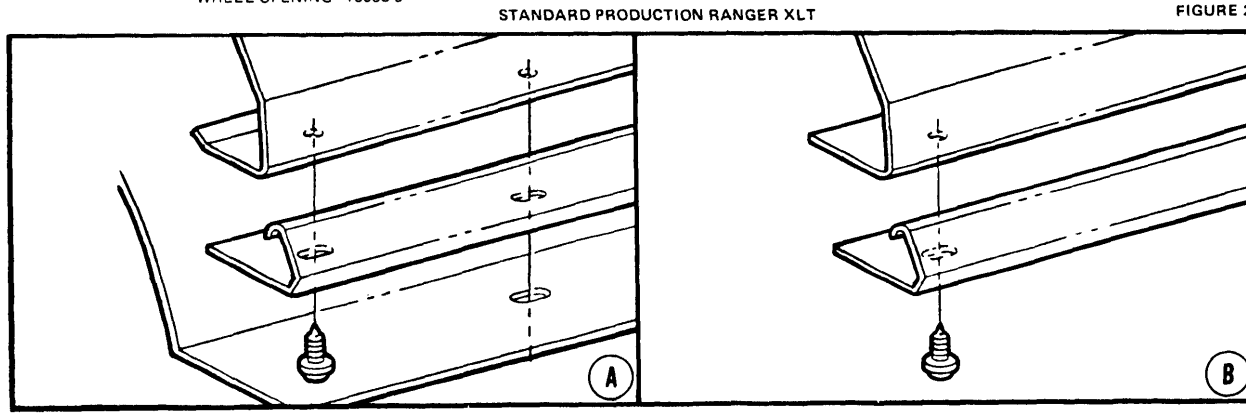
FIGURE 1





STANDARD PRODUCTION RANGER XLT

FIGURE 2



N4244-2A

FIG. 13 Exterior Ornamentation—Front and Rear Wheel Opening Mouldings Bronco, F-100—F-350

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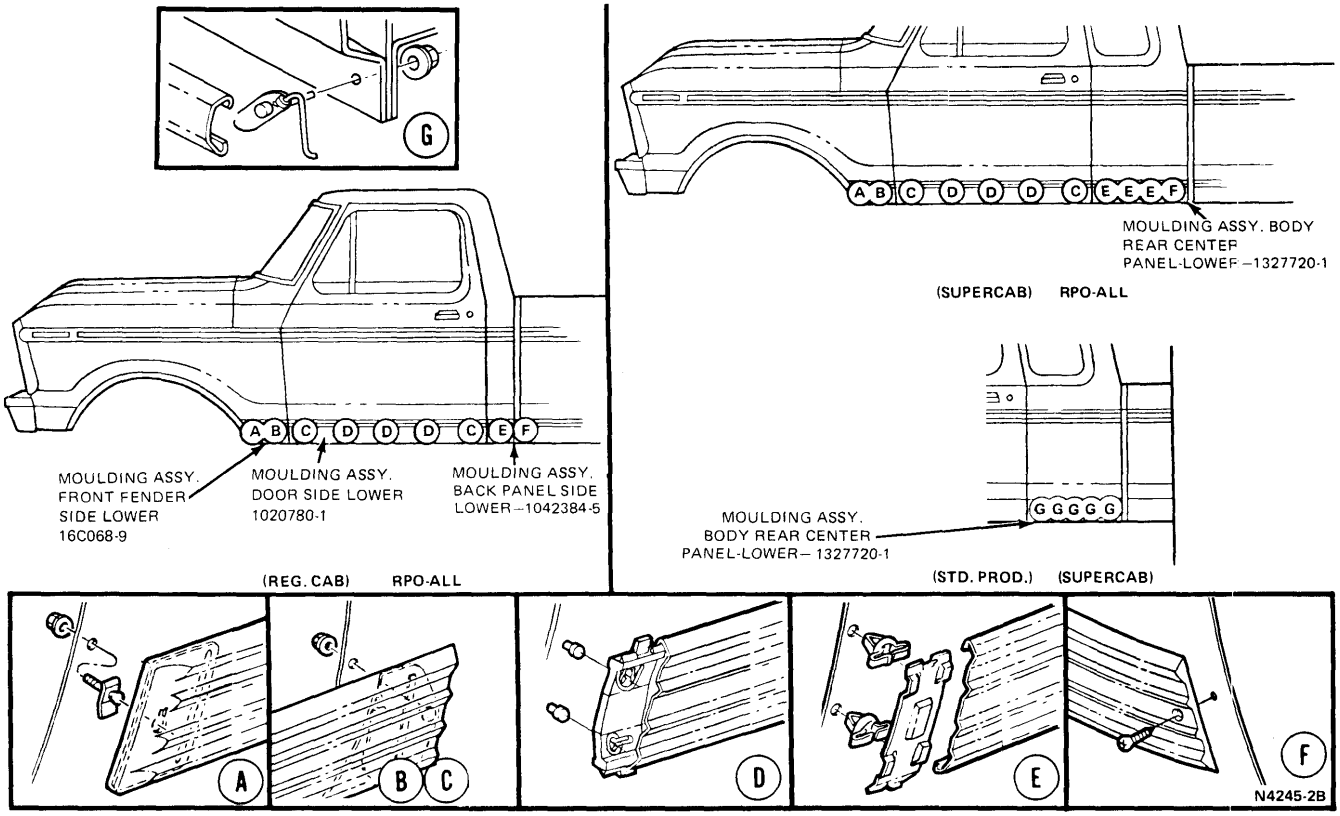
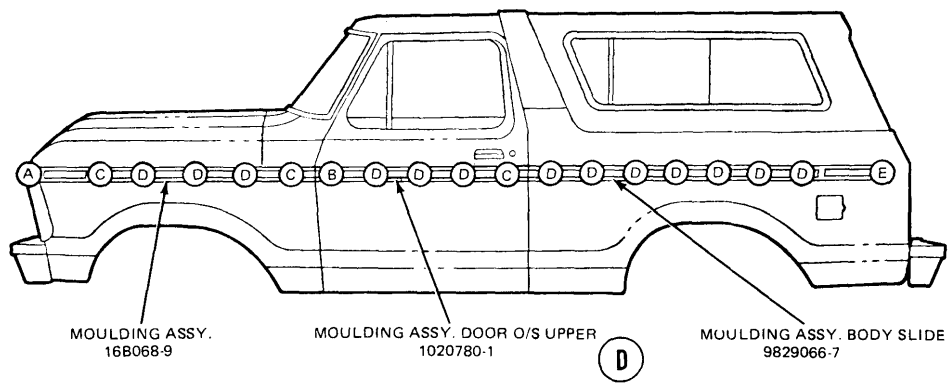


FIG. 14 Exterior Ornamentation Body Lower Mouldings F-100—F-350



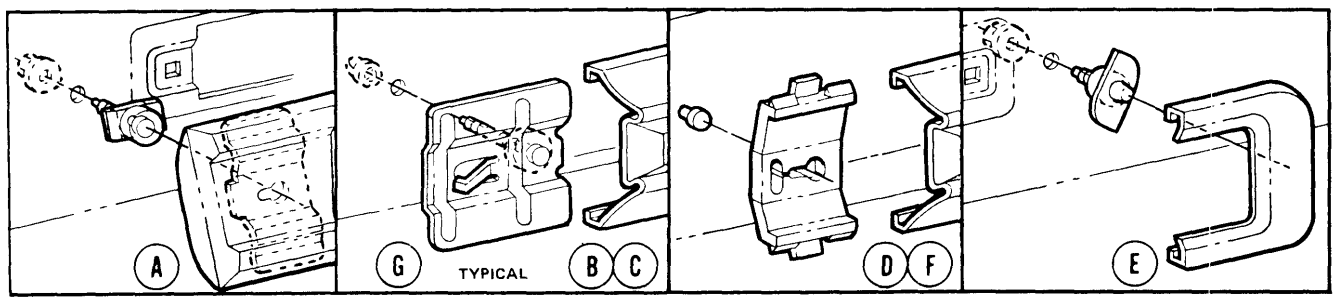


FIG. 15 Exterior Ornamentation—Body Side Mouldings Bronco

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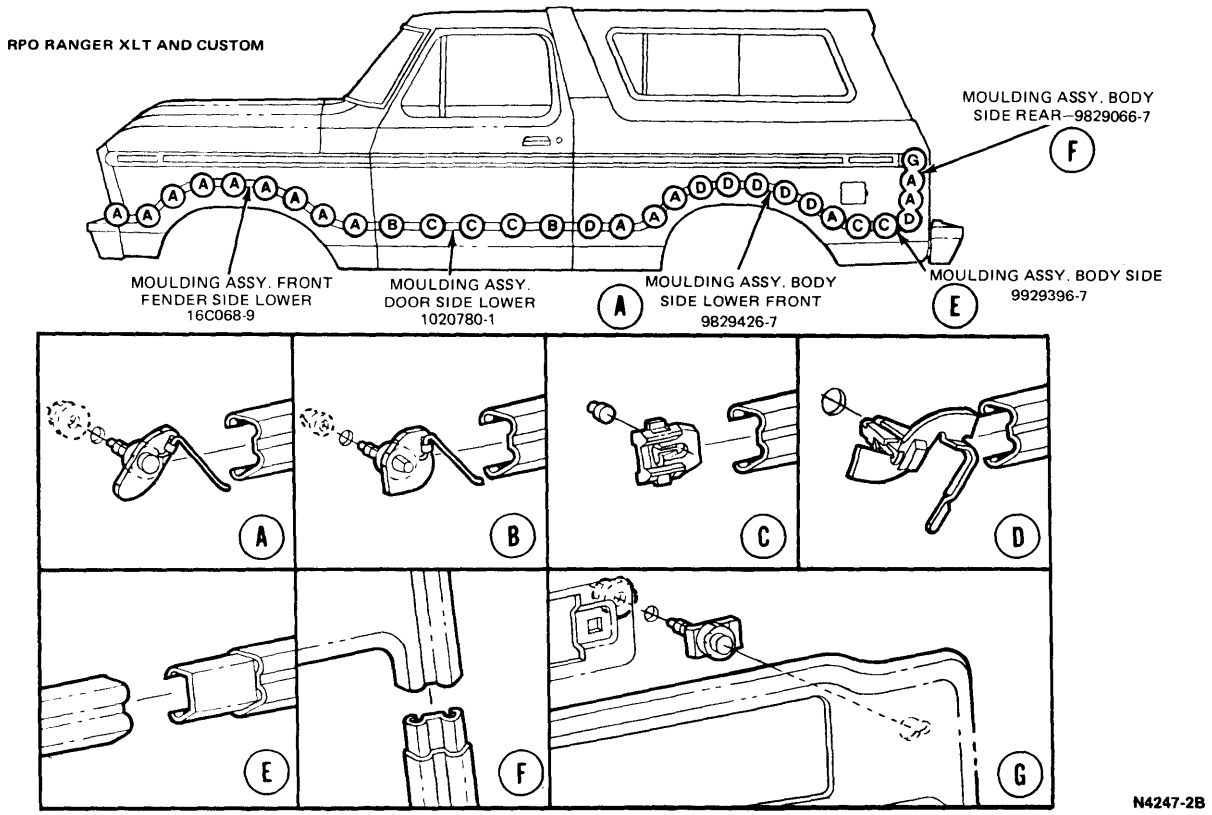


FIG. 16 Exterior Ornamentation—Body Side Lower Mouldings Bronco

as an assist ramp for removal and installation of the spare tire .

5. Remove the wing nut bolt (item No. 5) from the inner support assembly (item No. 4) and grasping the lower part of the spare tire, pull it away from the support assembly (item No. 4) allowing the spare tire assembly to slide down the retainer plate assembly as an assist ramp (item No. 6).

STYLESIDE BOX MOUNTED SPARE TIRE CARRIER

F-100—F-350

Refer to Fig. 24 for removal and installation.

SPARE TIRE CARRIER—PICKUP BOX MOUNTED (F-250 CREW CAB)

An in-pickup-box mounted spare wheel and tire carrier is available for the F-Series Crew Cab. Refer to Fig. 25 for details on installation.

The standard light truck F-250-350 style side crew cab pick-up box mounted carrier is shown in Fig. 26. Refer for details on installation.

GT—PICKUP BOX MOUNTED

The roll bar is painted gloss black and normal painting procedure can be used when a repair is required.

Removal

1. Remove nuts and bolts that secure GT bar to the front panel of the pick-up box (Fig. 27).
2. From the underside of the vehicle, remove nuts that secure GT bar and braces to the floor of the pick-up box.
3. Lift and remove complete GT bar and brace assembly from vehicle. Note: When replacing any one section of the GT bar, it is only necessary to remove the attaching nuts and bolts that secure that particular section to the vehicle.

Installation

1. Position the GT bar and brace assembly to the vehicle and secure with nuts and bolts shown in Fig. 27.
2. Tighten all attaching nuts to 12-20 ft-lbs.

SWING-AWAY SPARE WHEEL CARRIER (BRONCO)

The swing-away spare wheel carrier is shown in Fig. 28. Refer to this Figure for details on removal and installation.

REAR BUMPER

The rear bumper installation for all models is shown in Fig. 29. To remove the bumper, remove the bumper bracket to frame attaching bolts and remove the bumper and brackets, then remove the brackets from the bumper. To install the bumper install the brackets on the bumper, position the bumper to the frame and install the bumper bracket to frame bolts.

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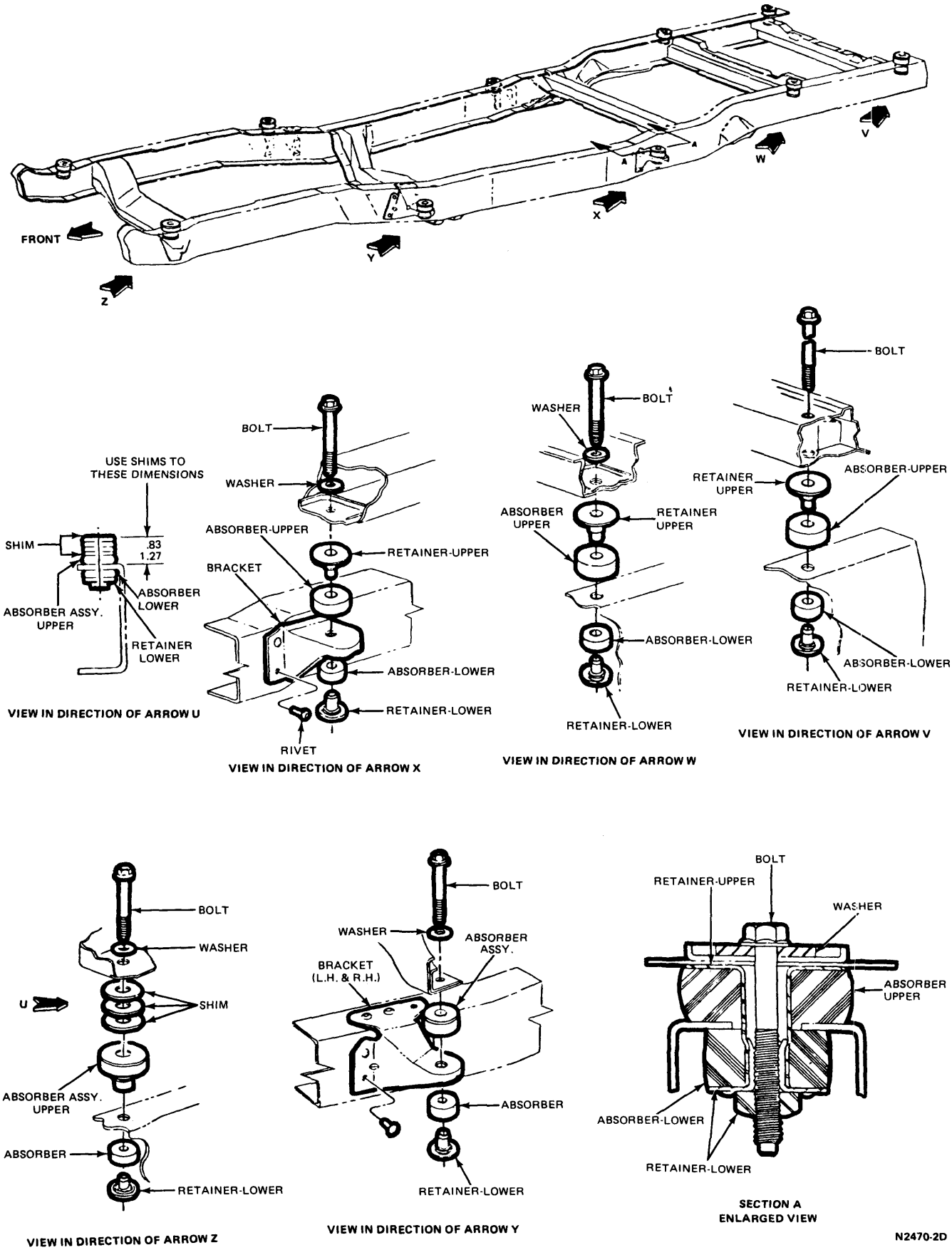
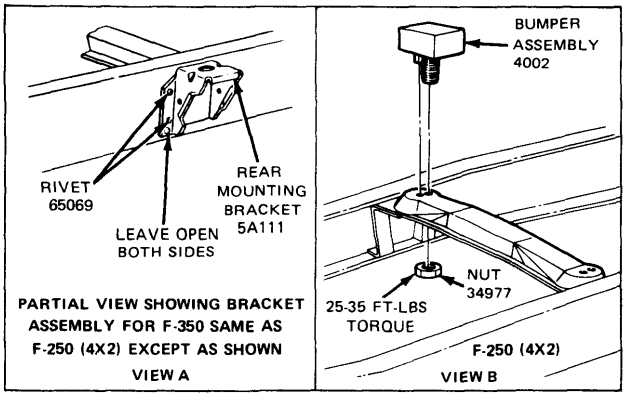
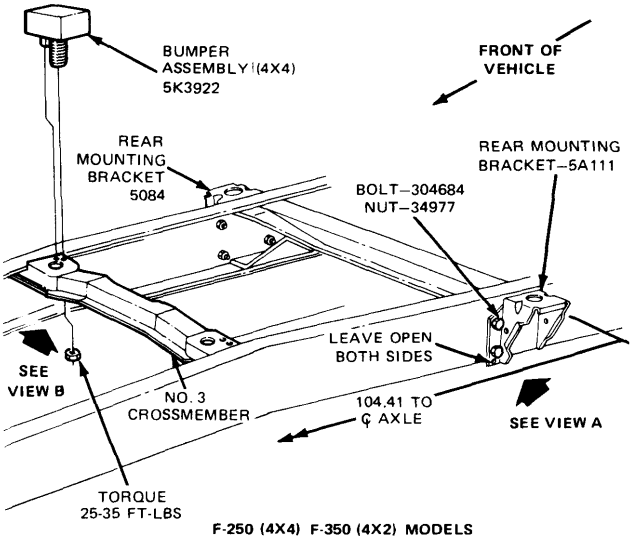


FIG. 17 Body Mounts—Conventional Cab, F-100—F350, F-150—F250 4x4 Bronco

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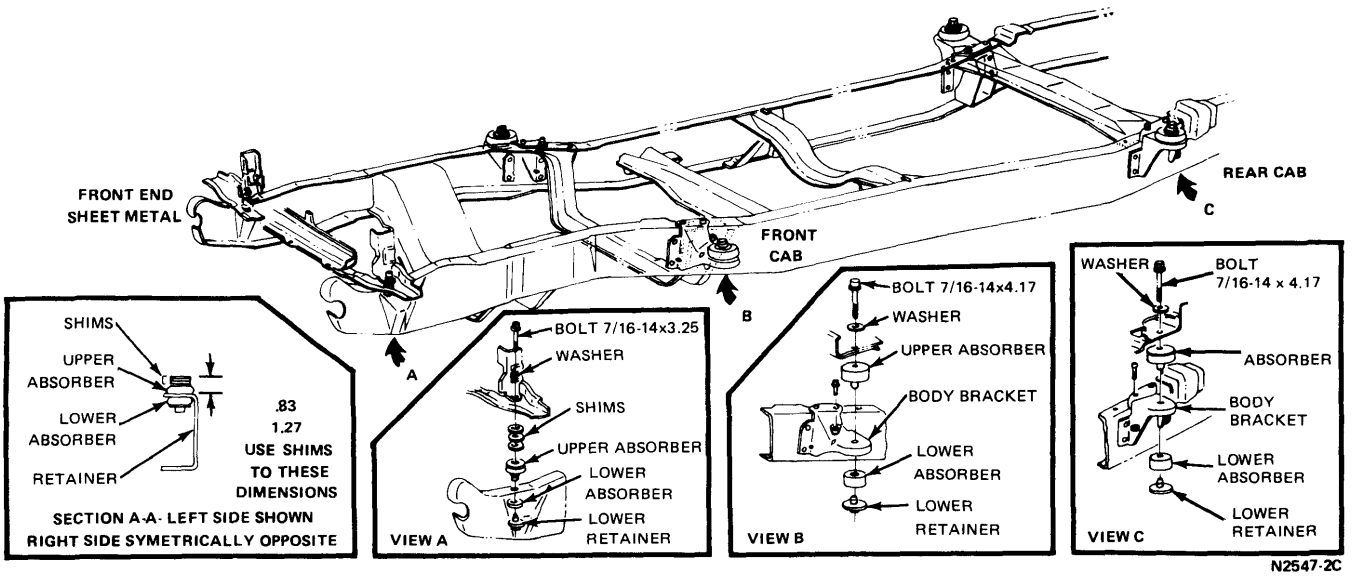




NOTE:
BODY MOUNTS FORWARD OF THIS AREA ARE THE SAME
AS COMPARABLE MODEL REGULAR CAB BODY MOUNTS

N2546-1C

FIG. 18 Body Mounts—Crew Cab



N2547-2C

FIG. 19 Body Mounts—Super Cab, F-100—F-350, F-150—F-250 4x4 Super Cab

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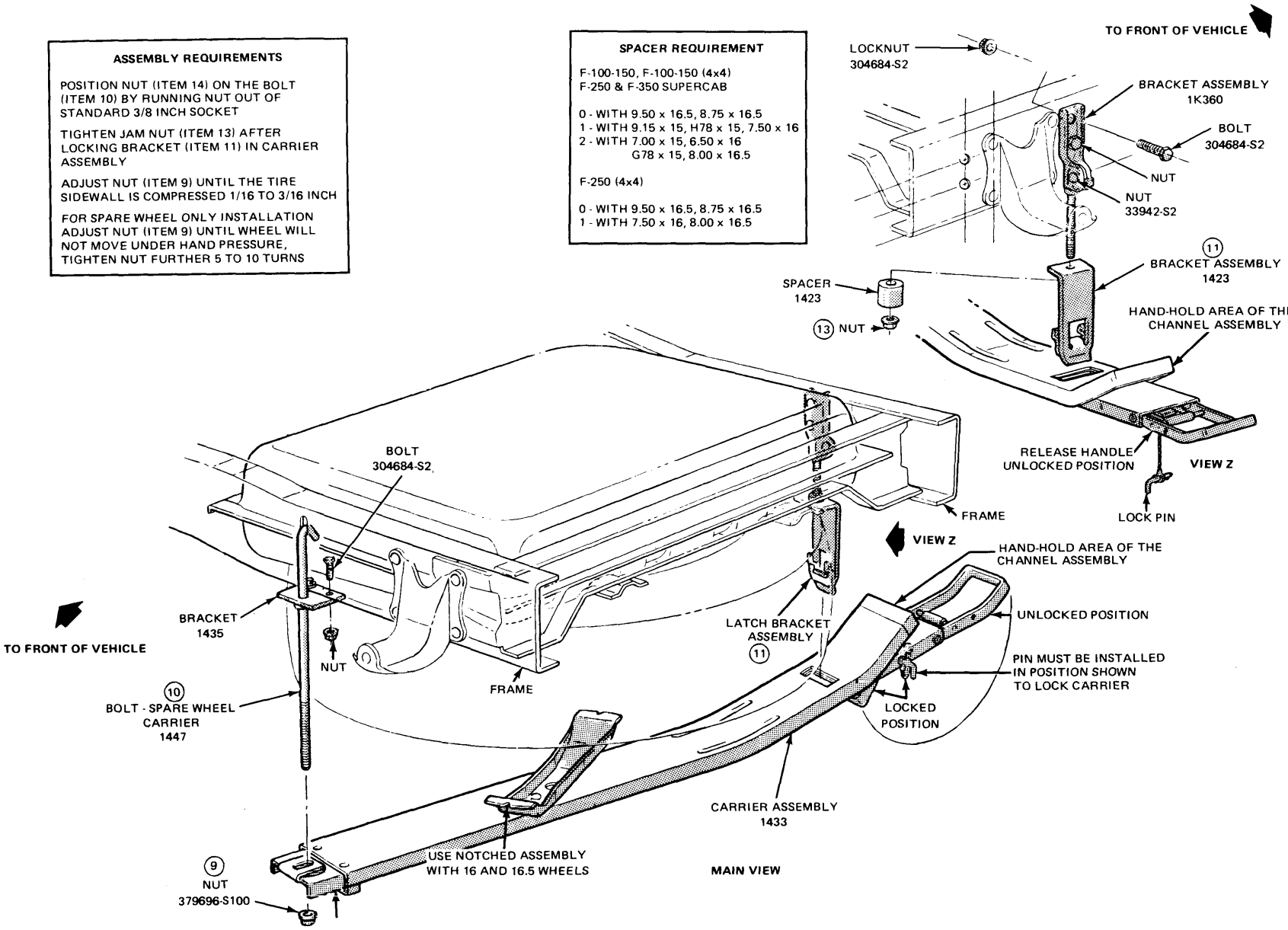


FIG. 20 Slide-out Spare Tire Carrier—Bronco, F-100 and F-250

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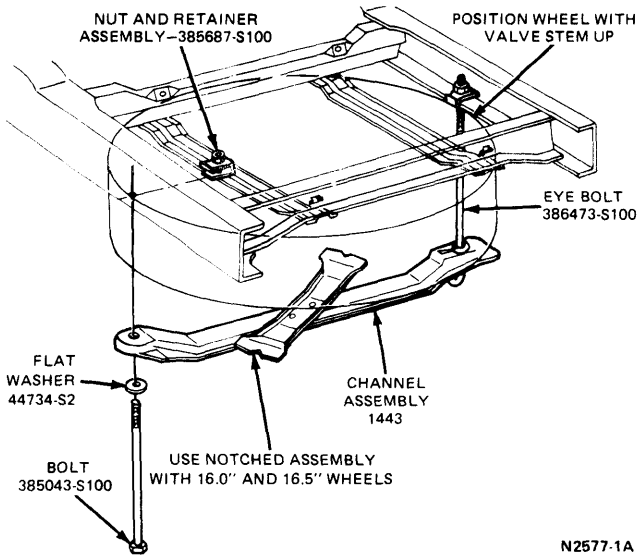


FIG. 21 Slide-Out Spare Tire Carrier—Standard Wheelbase

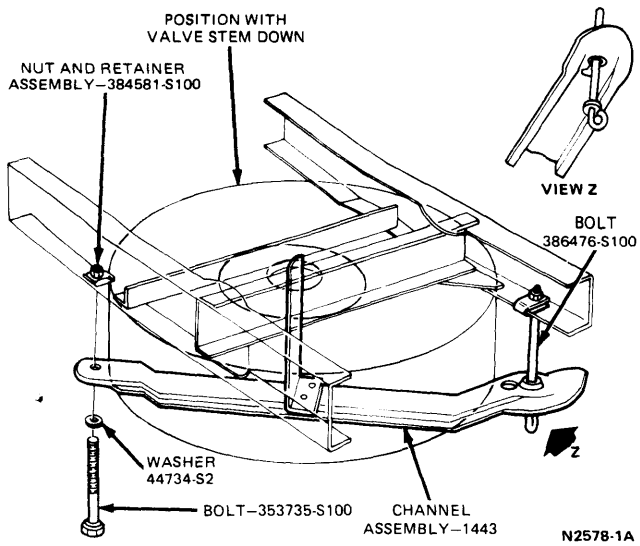
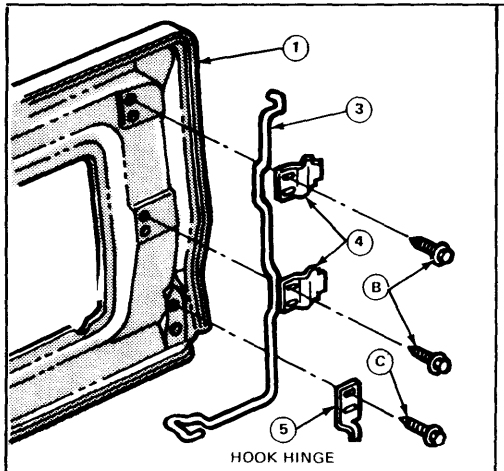


FIG. 22 Slide-Out Spare Tire Carrier—4x4 and Long Wheelbase

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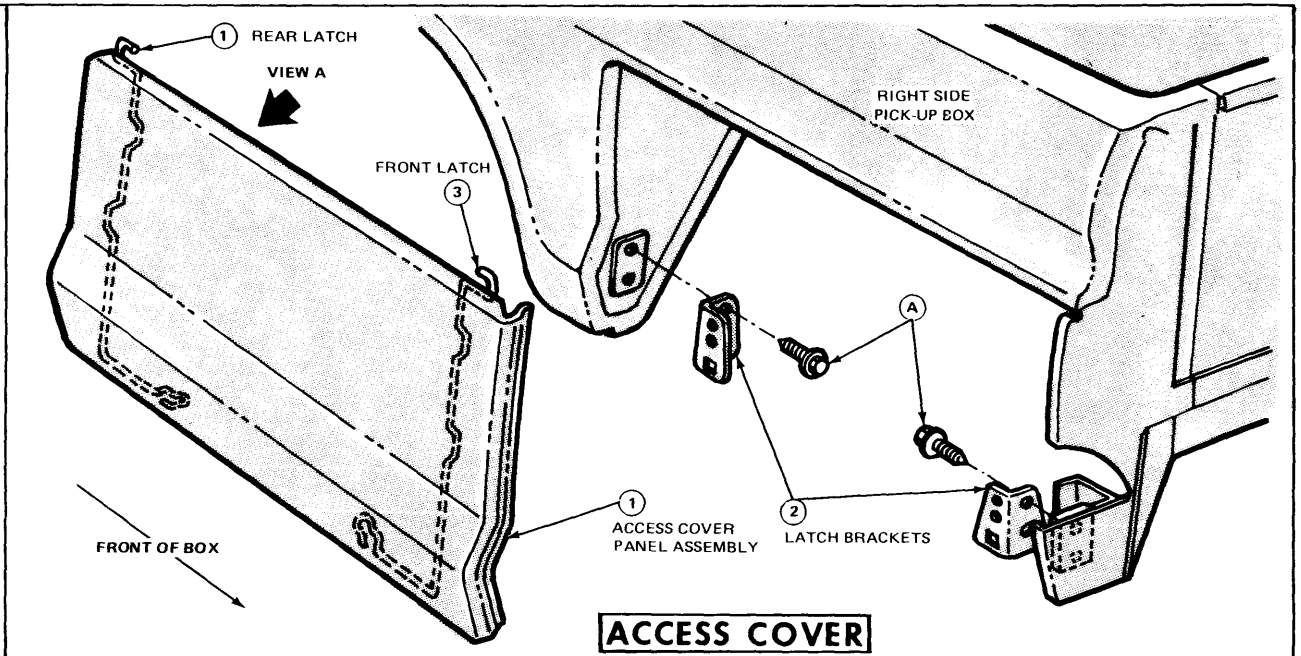
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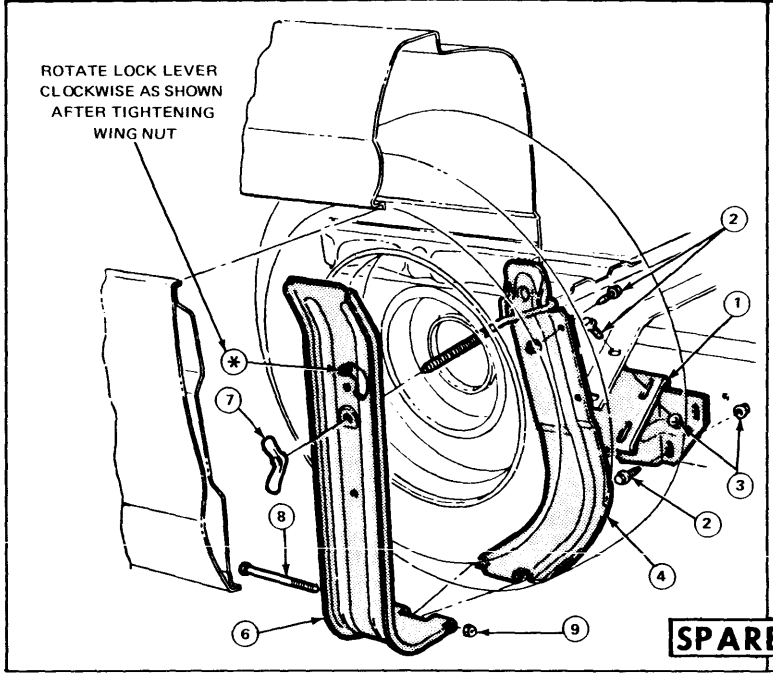


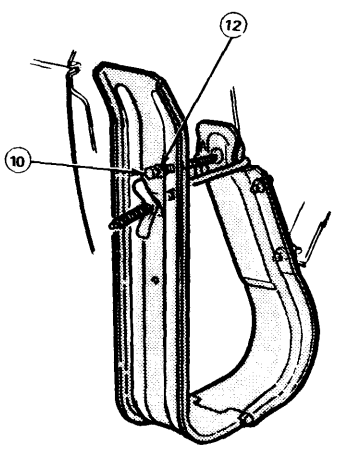
VIEW A

1. SPARE WHEEL CARRIER-ACCESS COVER PANEL ASSEMBLY.
2. ACCESS COVER PANEL ASSEMBLY-HOOK BRACKET.
3. LATCH-ACCESS COVER PANEL RETAINING.
4. LATCH BRACKETS.
5. HOOK (HINGE)-ACCESS COVER PANEL.
(A,B,C)-ATTACHING SCREWS.



ACCESS COVER





VIEW WITH SPARE TIRE CARRIER ONLY

SPARE TIRE

ITEM NO.	PART NUMBER	TORQUE FT-LBS	PART NAME
1	1A376-A		BRACKET ASSY.
2	56339		BOLT
3	382802	26-32	NUT
4	1469		SUPPORT ASSY.
5	1447		BOLT
6	1424		PLATE
7	1A384	5-10	WING NUT
8	300990		BOLT
9	385072	26-32	NUT
10	385075		BOLT
11	44729		WASHER
12	33799	26-32	NUT

* WING NUT-LATCH

N2656-2C

FIG. 23 Side-Mounted Spare Tire Carrier F-100—F-350

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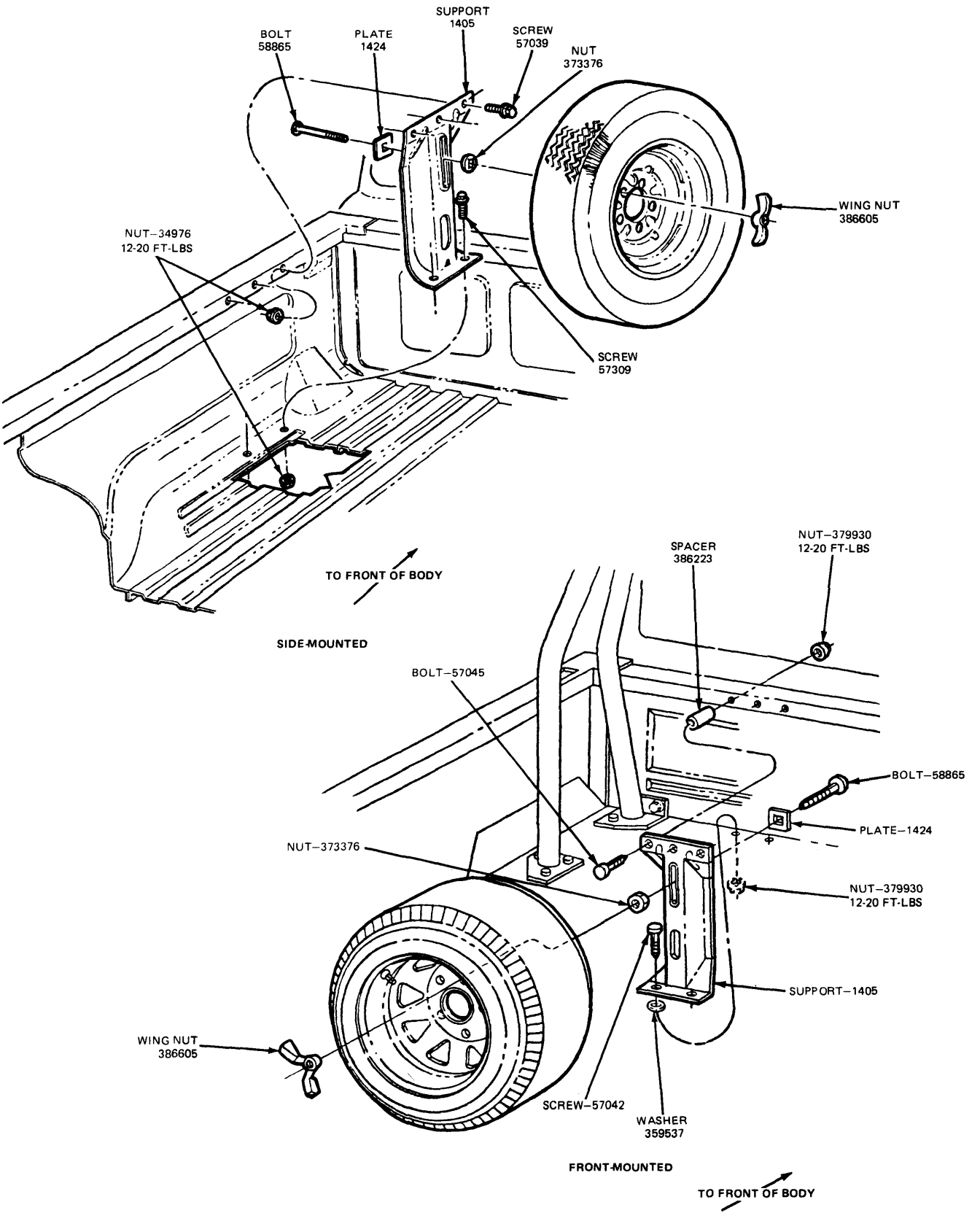


FIG. 24 Spare Tire Carrier—Pick-up Box—Mounted-Styleside F-100—F-350

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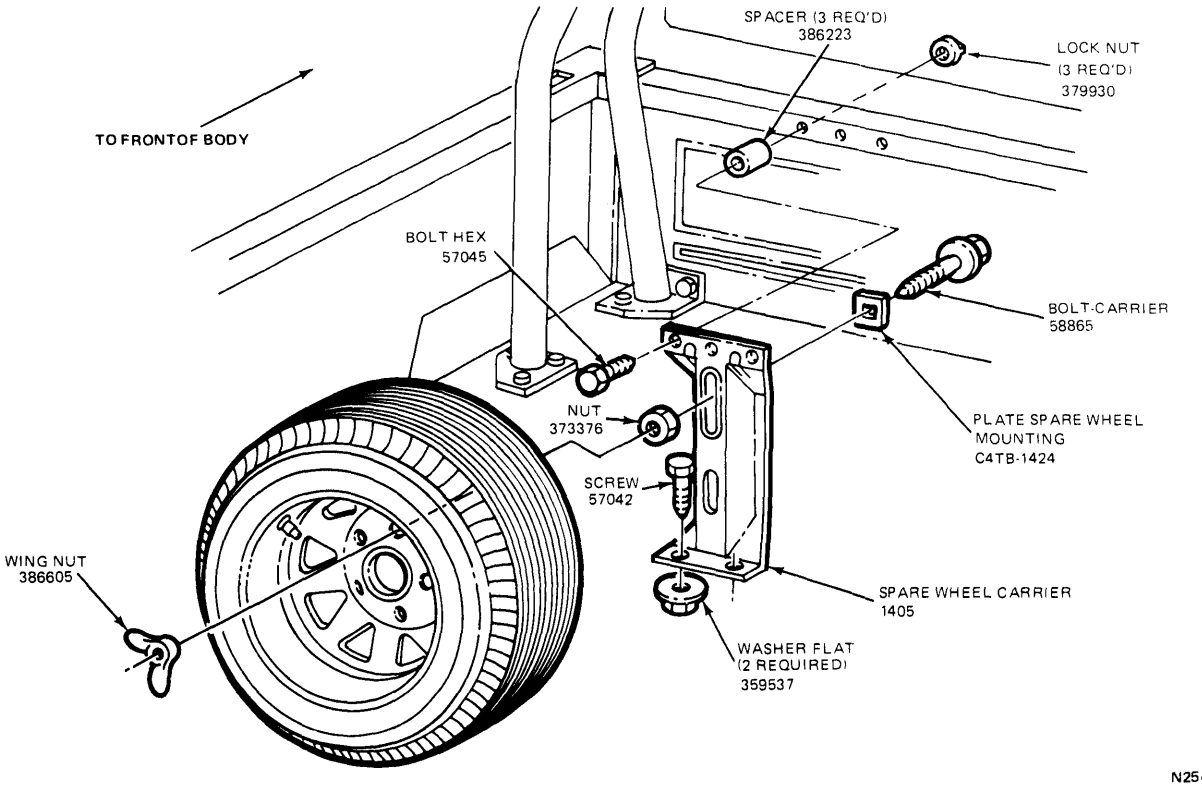


FIG. 25 Spare Tire Carrier—Pickup Box Mounted (F-250—F-350 Crew Cab)

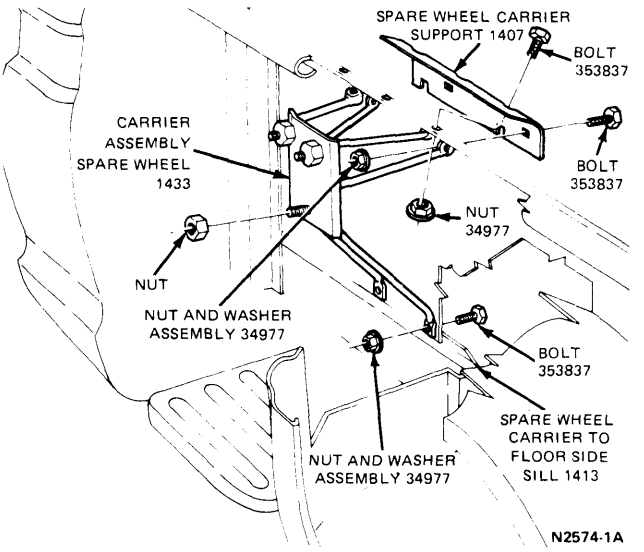


FIG. 26 Spare Tire Carrier—Pick-up Box Side Mounted

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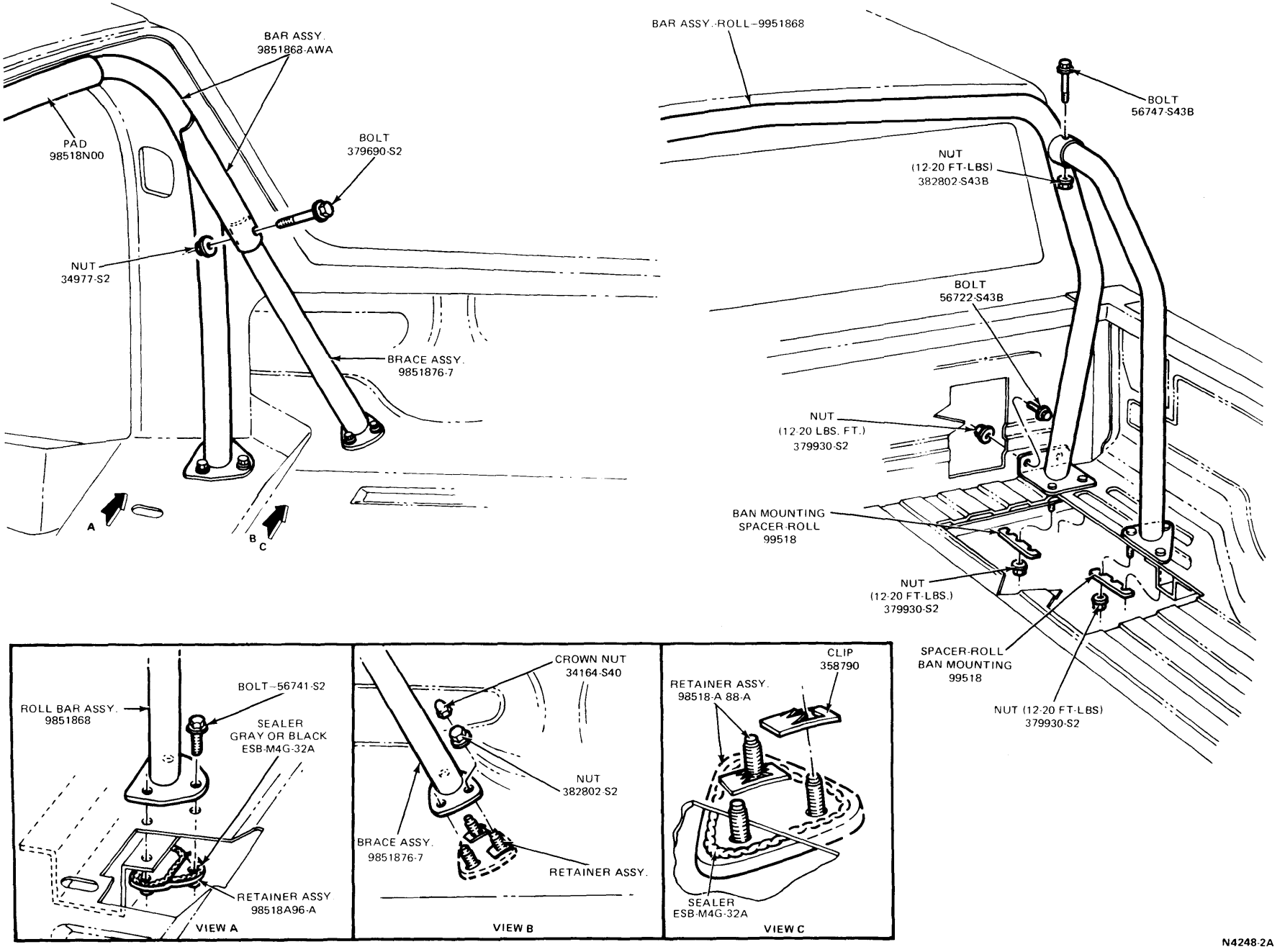


FIG. 27 GT Bar—Pickup Box Mounted Bronco and F-100—F-350

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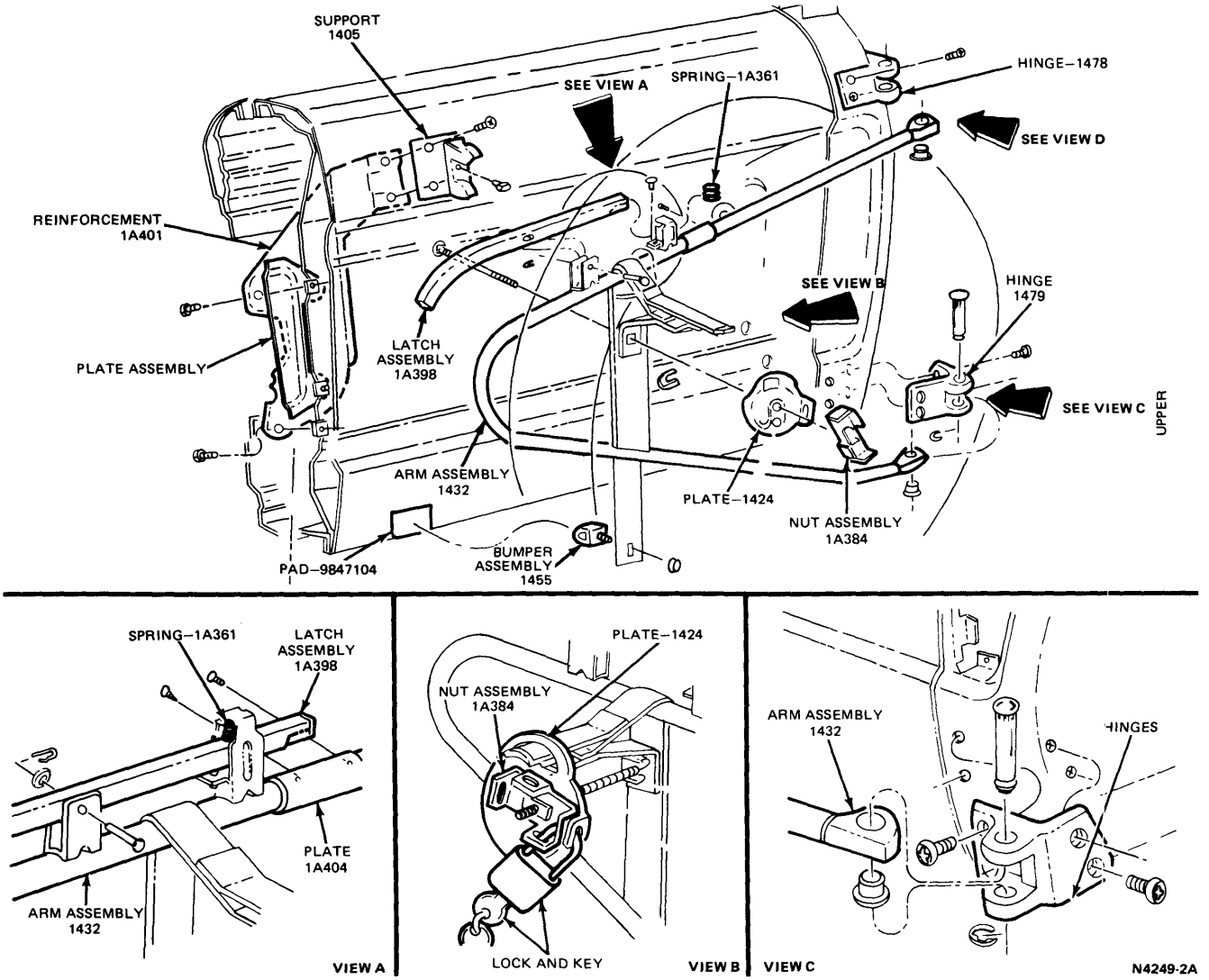


FIG. 28 Swing-Away Spare Wheel Carrier—Bronco

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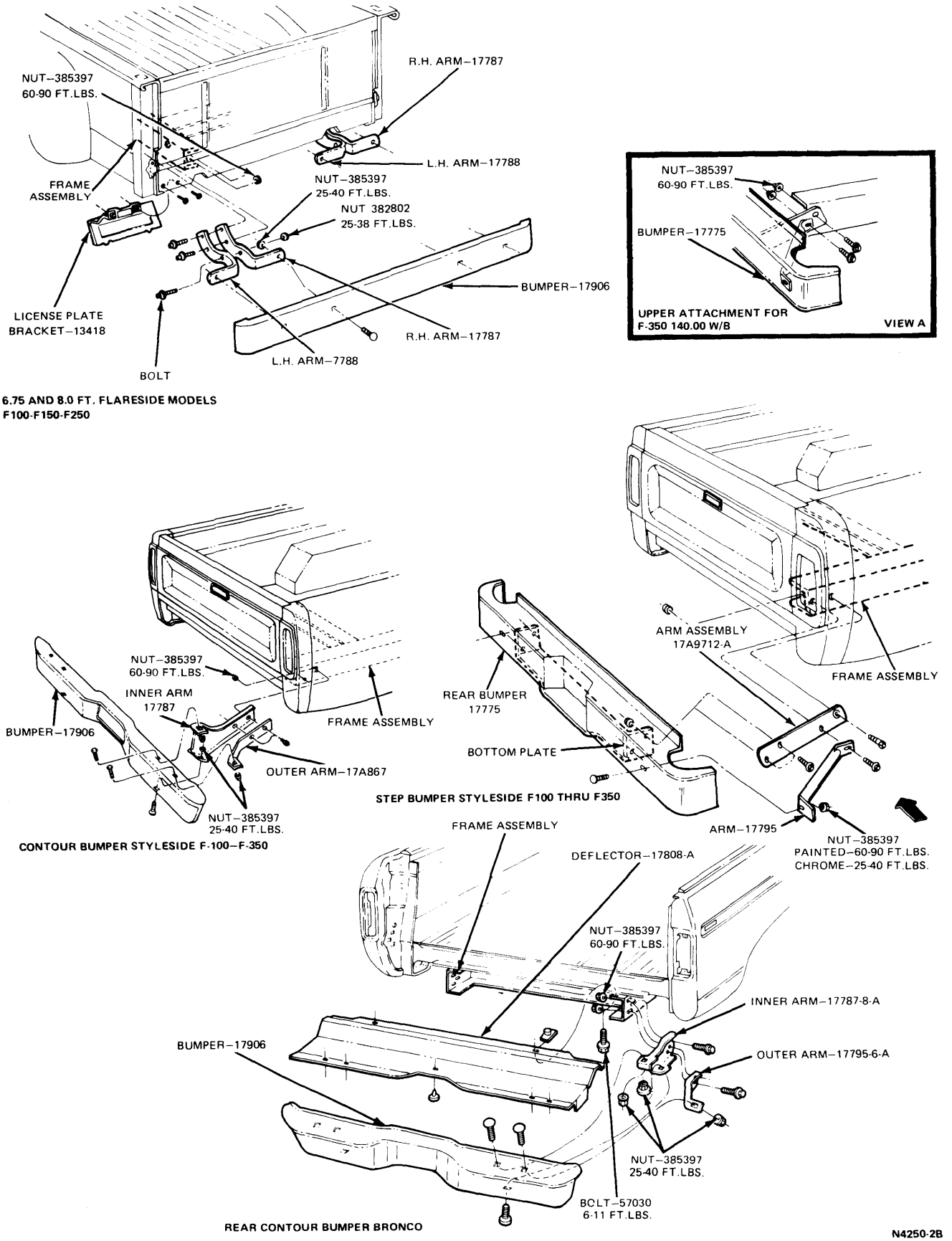


FIG. 29 Rear Bumper

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E-100 — E-350 and Club Wagon

PART 47-52

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION		REMOVAL AND INSTALLATION (Cont'd)	
Body Mounts	52-3	Front Fender	52-1
Body Sealer	52-3	Grille	52-1
Exterior Mouldings	52-3	Panel Grille Opening — Lower	52-1
Frame Dimensions	52-3	Radiator Grille	52-1
Front Bumper	52-1	Rear Bumper	52-3

REMOVAL AND INSTALLATION

GRILLE

The radiator grille is attached with different numbers of attachments depending on options.

RADIATOR GRILLE

Removal

1. Unlatch and raise the hood. Secure the hood in position with the hood support rod.
2. Remove the two screws in the center of the grille which attach to the radiator grille support.
3. Remove the four screws at the bottom of the grille.
4. Remove the nine plastic rivets located on the upper flange of the grille which attach to the radiator support and the gussets.
5. Separate the grille from the front of the vehicle.

Installation

1. Place the grille in position on the front of the vehicle.
2. Install the two center screws. Do not tighten to full torque requirement. Check the alignment on grille for uniform spacing relative to the fender screws. Tighten to full torque.
3. Install the nine plastic rivets across the top of the grille attaching the top flange to the radiator support and the side gussets.
4. Install the four screws at the bottom of the grille attaching the grille to the radiator grille opening lower panel.

PANEL GRILLE OPENING—LOWER

Removal

1. Remove the front bumper.
2. Remove the radiator grille (Fig. 1).
3. Remove the two lower center screws.
4. Remove the four side bolts which attach to the front fenders, two bolts per side (Fig. 2).

Installation

1. Install the four side bolts, two per side, attaching them to the front fenders (Fig. 2).
2. Install the two lower center screws attached to the radiator grille support (Fig. 1).
3. Install the bumper assembly (Fig. 3).
4. Install the radiator grille (Fig. 1).

FRONT FENDER

Removal

1. Remove the radiator grille as outlined in this part.
2. Remove the two screws attaching the end of the radiator grille opening lower panel to the fender (Fig. 2).
3. Remove the three screws attaching the lower edge of the fender to the wheel housing.
4. Remove the lower fender rear attaching screw (Fig. 2) and shim(s).
5. Open the door and remove the upper fender rear attaching screw and shim(s).
6. Remove the two screws attaching the front edge of the fender to the radiator support.
7. Remove the three screws and shim(s) attaching the top edge of the fender, and remove fender.

Installation

To install the front fender, follow the Removal procedure in reverse order.

Install all attaching screws loose until the fender is adjusted for proper fit and appearance. Do not exceed two shims at any location except at the lower fender rear attaching screw. When all shims are installed, tighten all attaching screws as shown, then install the radiator grille.

FRONT BUMPER

Remove the two bolts and nuts attaching each side of the bumper to the bumper bar arm, and remove

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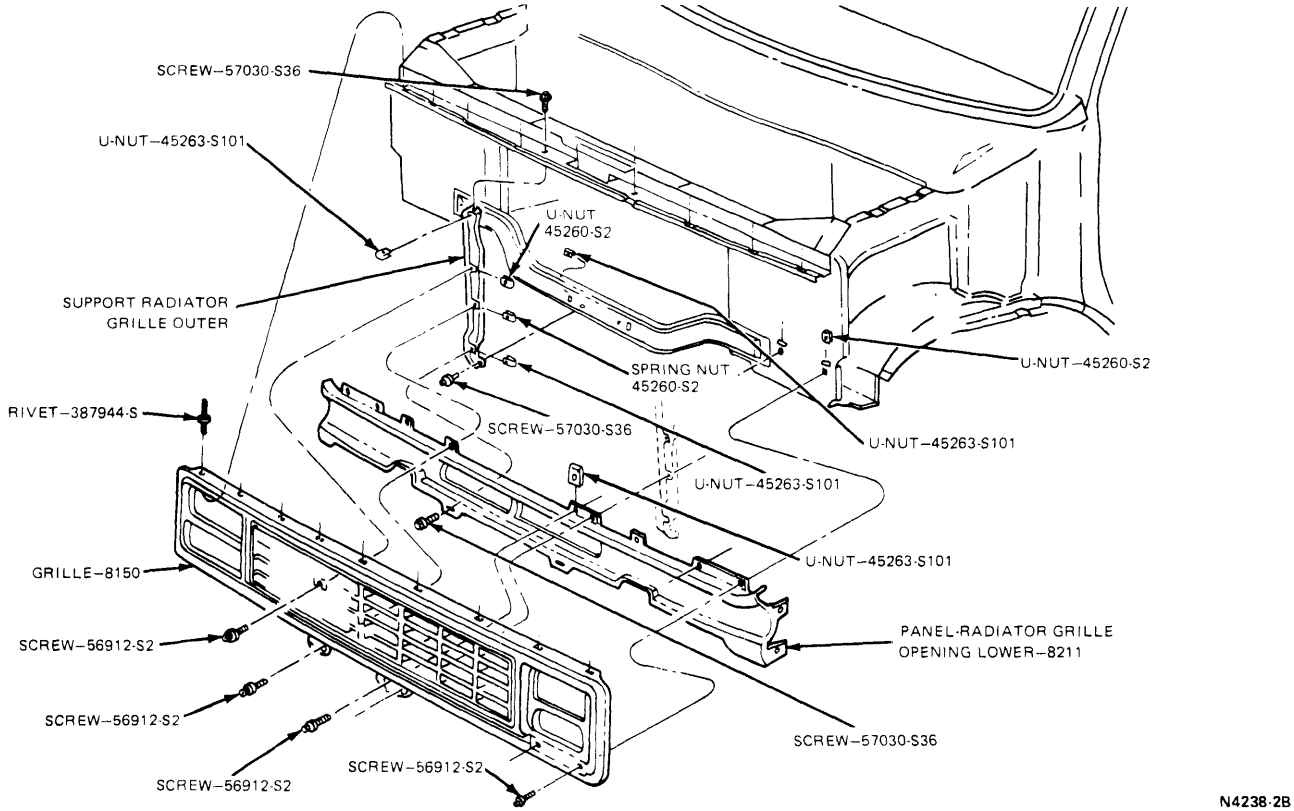


FIG. 1 E-100—E-350 Grille Installation

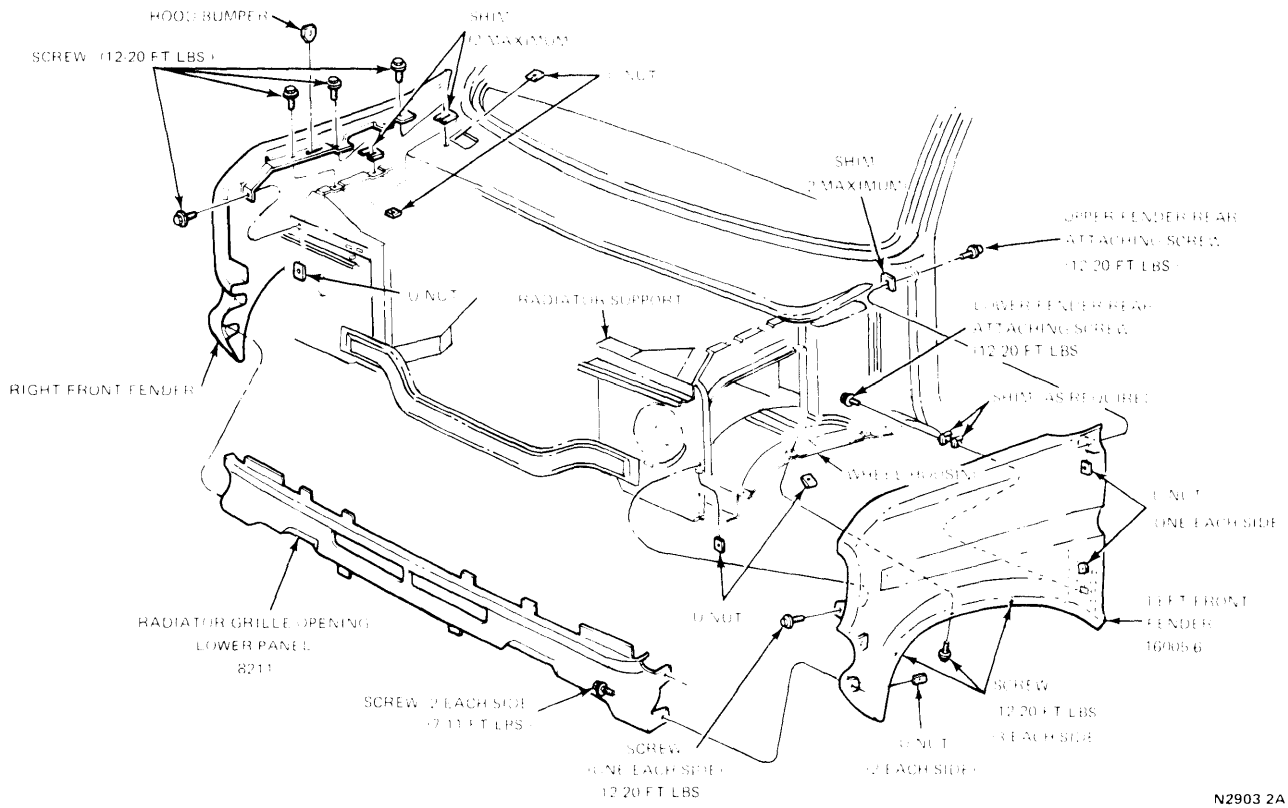


FIG. 2 Front Fender Installation

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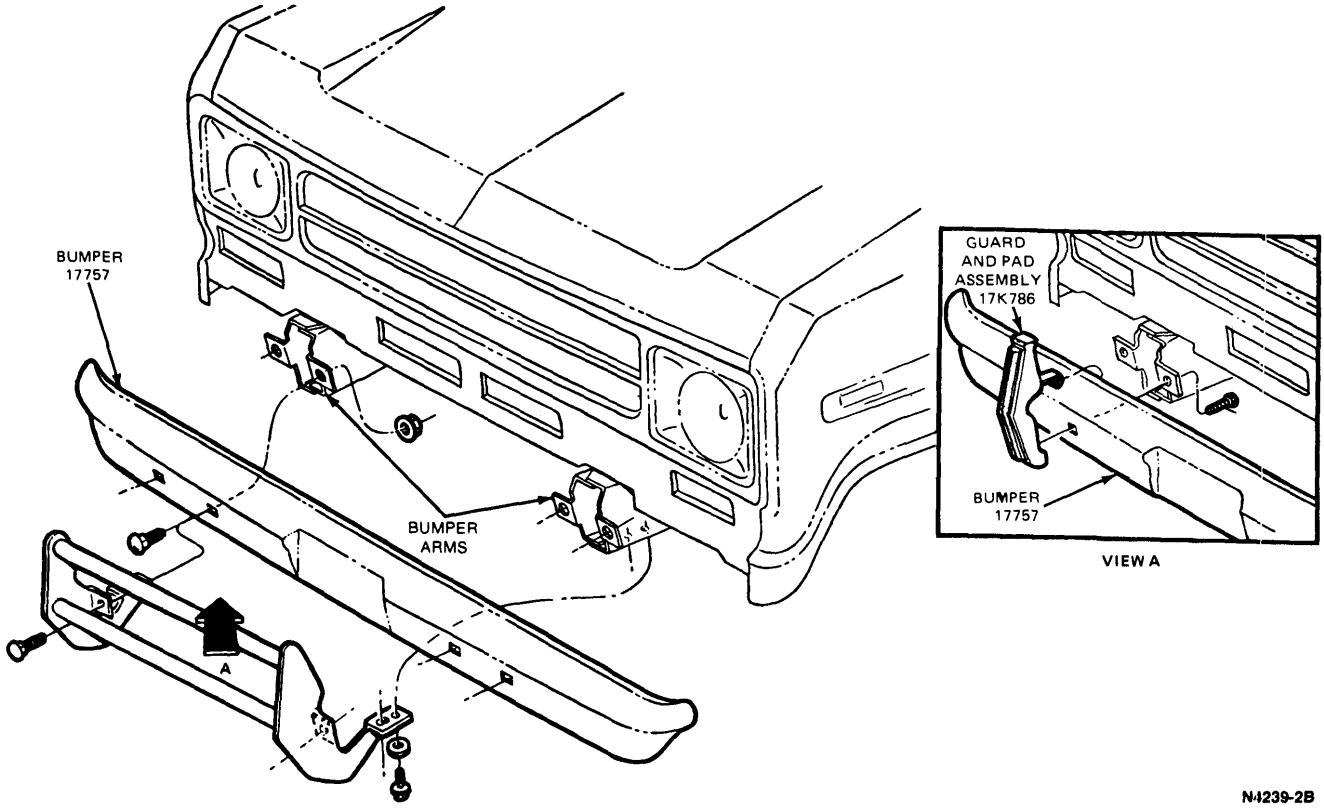


FIG. 3 Front Bumper and Bumper Guards

bumper (Fig. 3). If the vehicle is equipped with bumper guards, or push bar the inner bolt on each side of the bumper retains the guard to the bumper. If the vehicle is equipped with a push bar, remove the two bolts attaching each side of the bumper to the arms and also remove the two bolts retaining the bottom of the push bar to each side of the frame.

To install, position the bumper to the bumper bar arms and install the attaching nuts and bolts, and bumper guards or push bar (if so equipped).

REAR BUMPER

Remove the two bolts retaining each side of the bumper to the vehicle frame, (Fig. 4). To install the bumper, position the bumper to the frame and install the retaining bolts.

EXTERIOR MOULDINGS

Before removing the exterior mouldings, determine by the type of retainer used if it is necessary to remove an interior trim panel (Figs. 5 thru 9). If a weld stud is distorted or broken off, it should be replaced with screw (379560-S101).

BODY MOUNTS

The E-100—E-350 body mounts are shown in Fig. 10.

BODY SEALER

The sealer types and application procedures are given in General Information of Part 47-01. The test procedure for locating dust and water leaks is given in Diagnosis and Testing of Part 47-01.

FRAME DIMENSIONS

E-100—E-350 frame checking and repair procedures are given in part 47-01.

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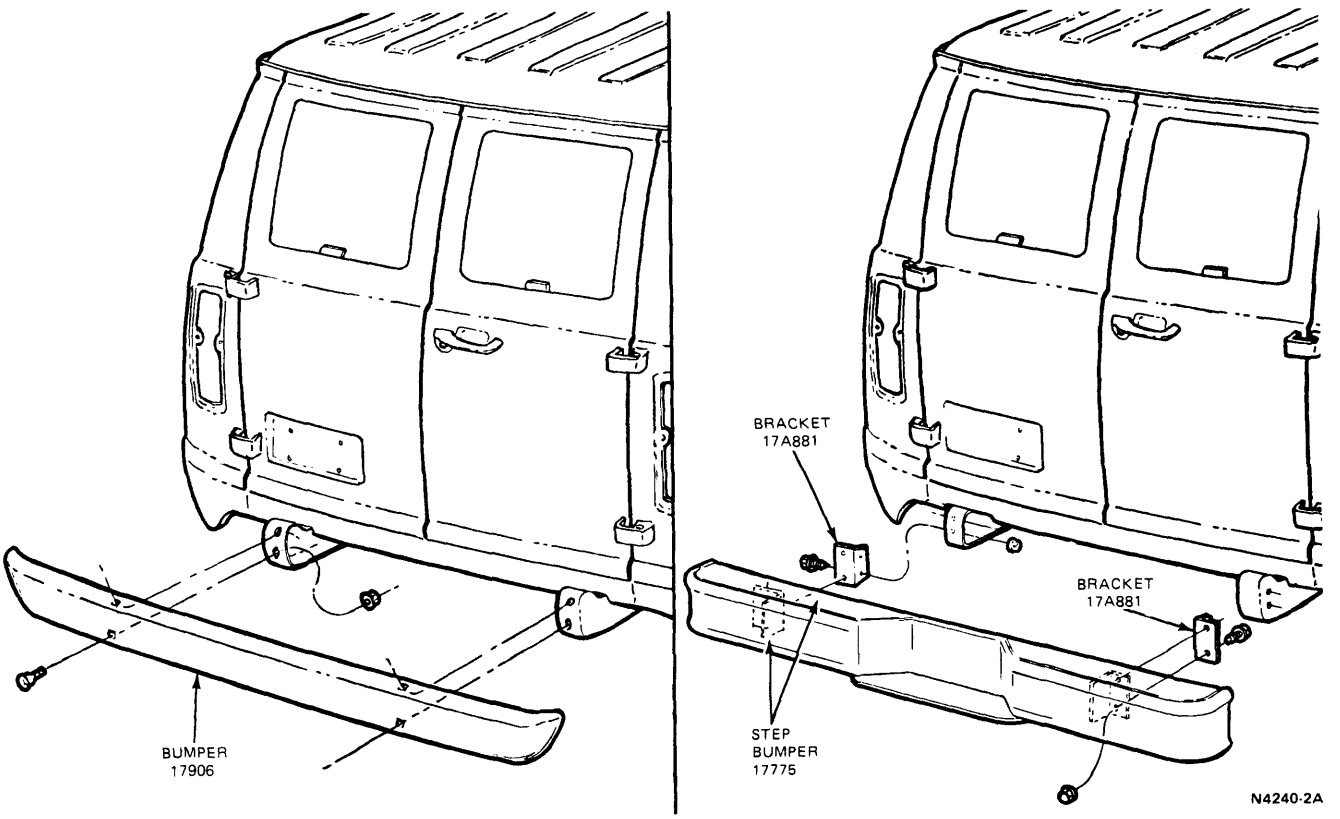


FIG. 4 Rear Bumper

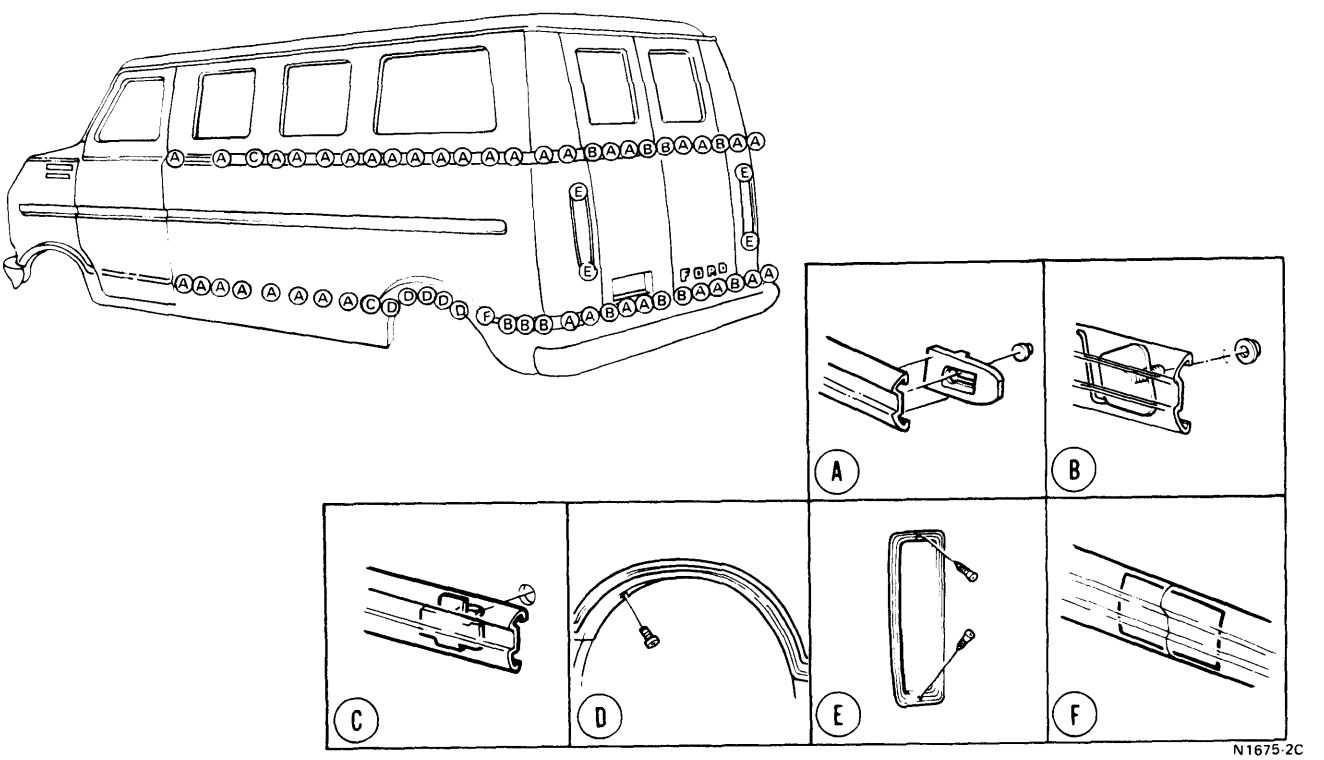
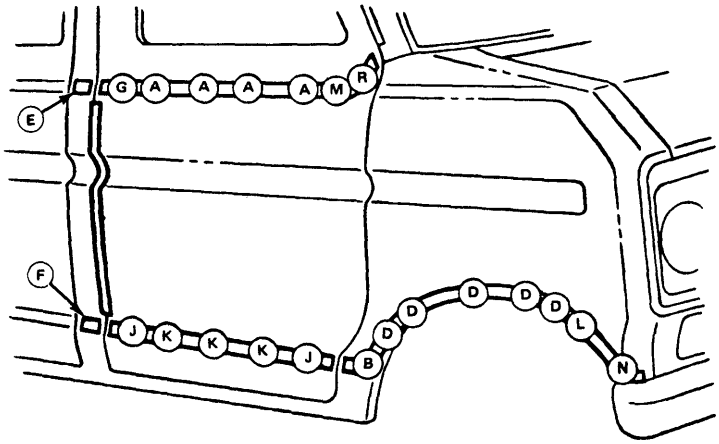


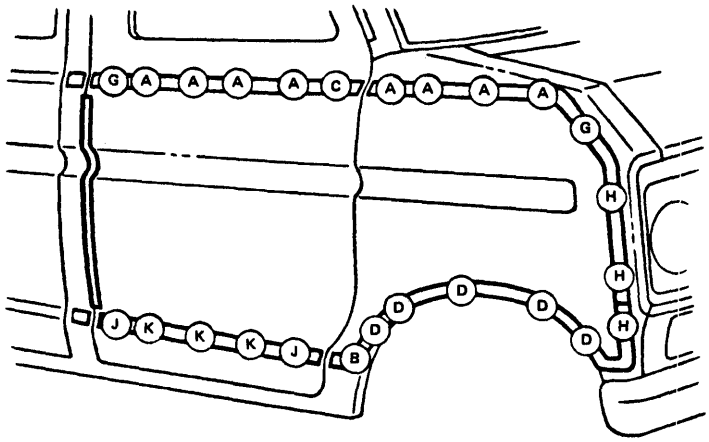
FIG. 5 E-100—E-350 Exterior Side and Rear Mouldings

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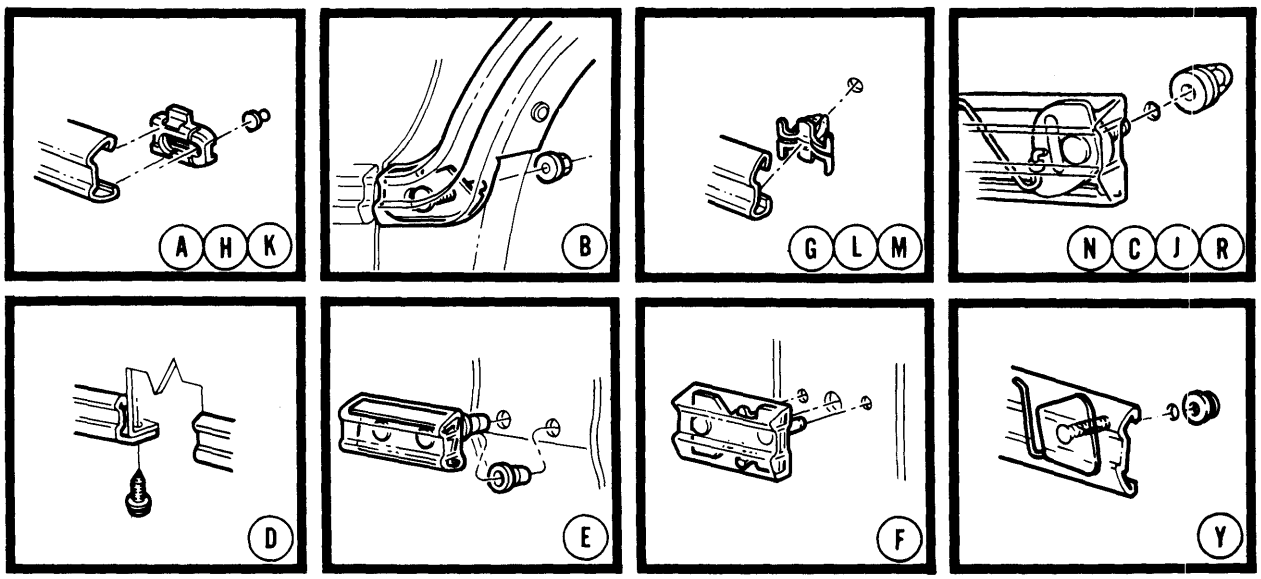
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STANDARD FRONT FENDER AND DOOR MOULDINGS



OPTIONAL FRONT FENDER AND DOOR MOULDINGS

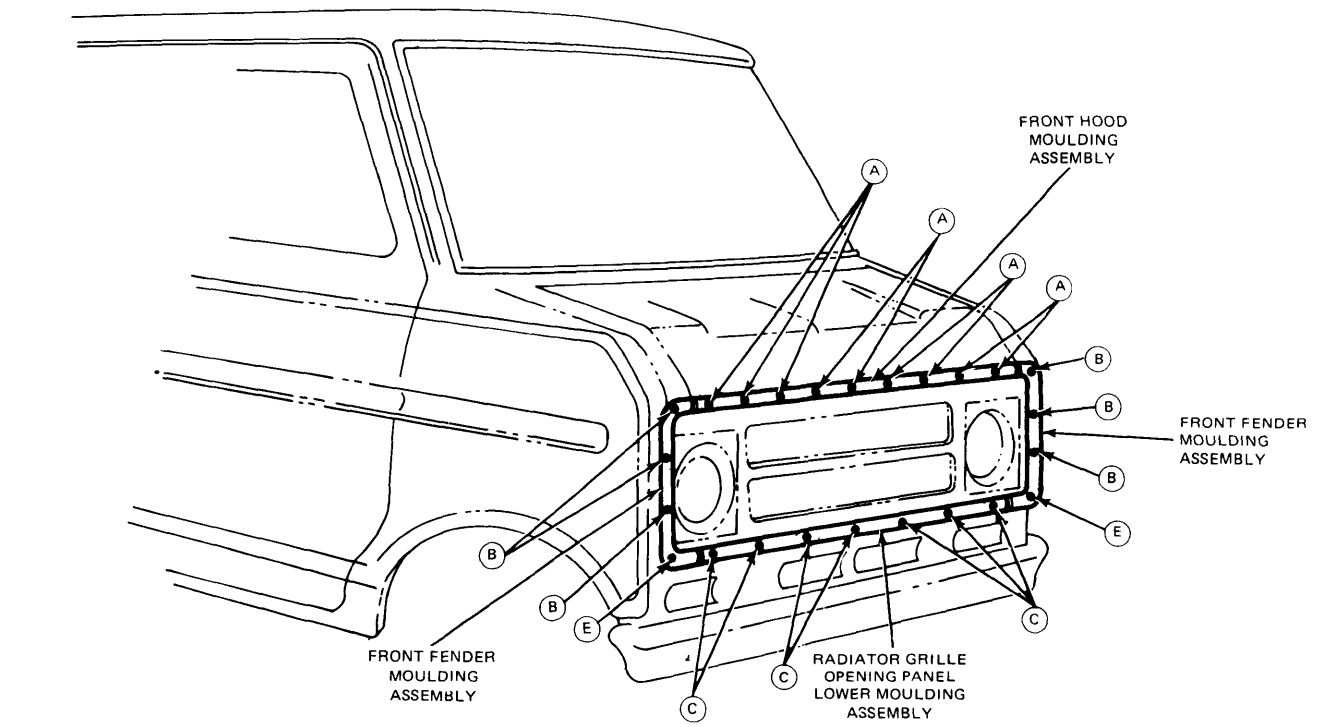


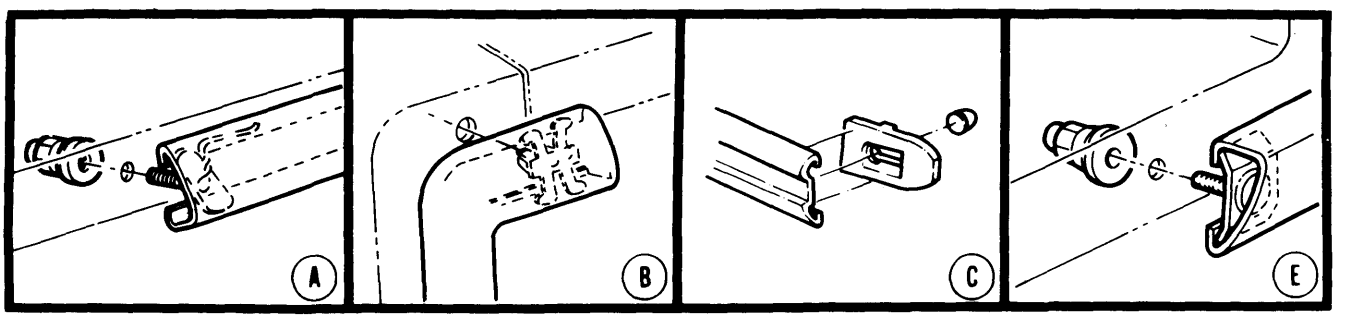
N2905-2C

FIG. 6 Exterior Front Fender and Door Mouldings

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N2906-2A

FIG. 7 Exterior Front Moulding

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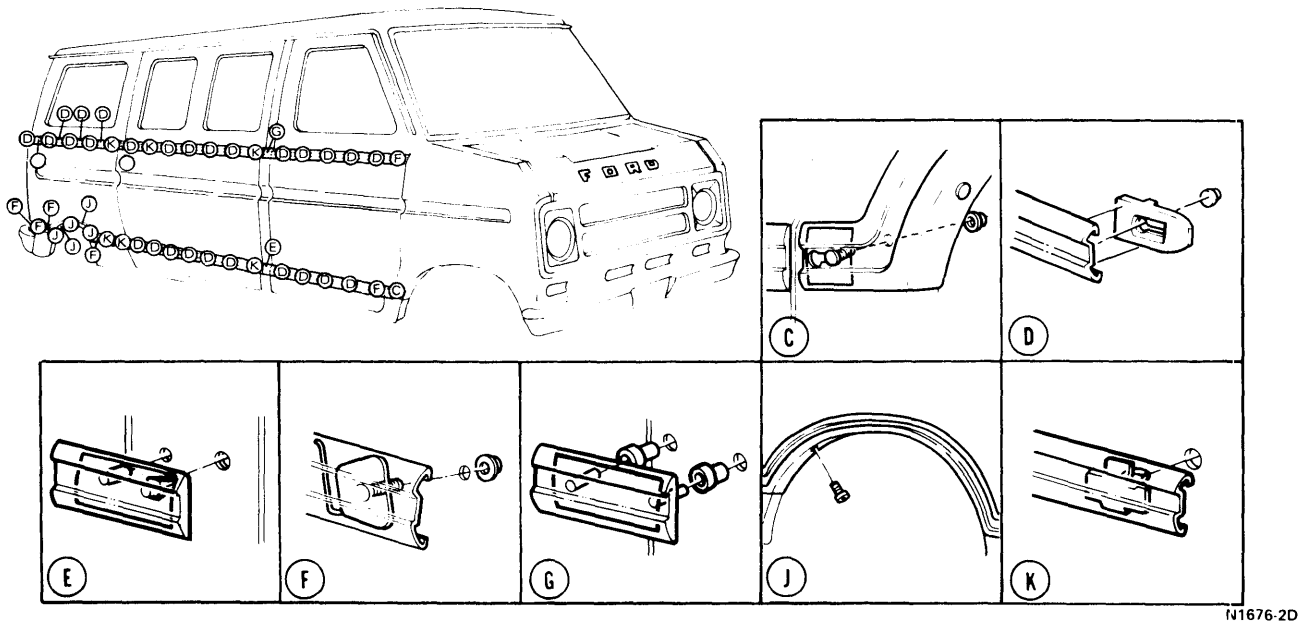


FIG. 8 Exterior Side Mouldings

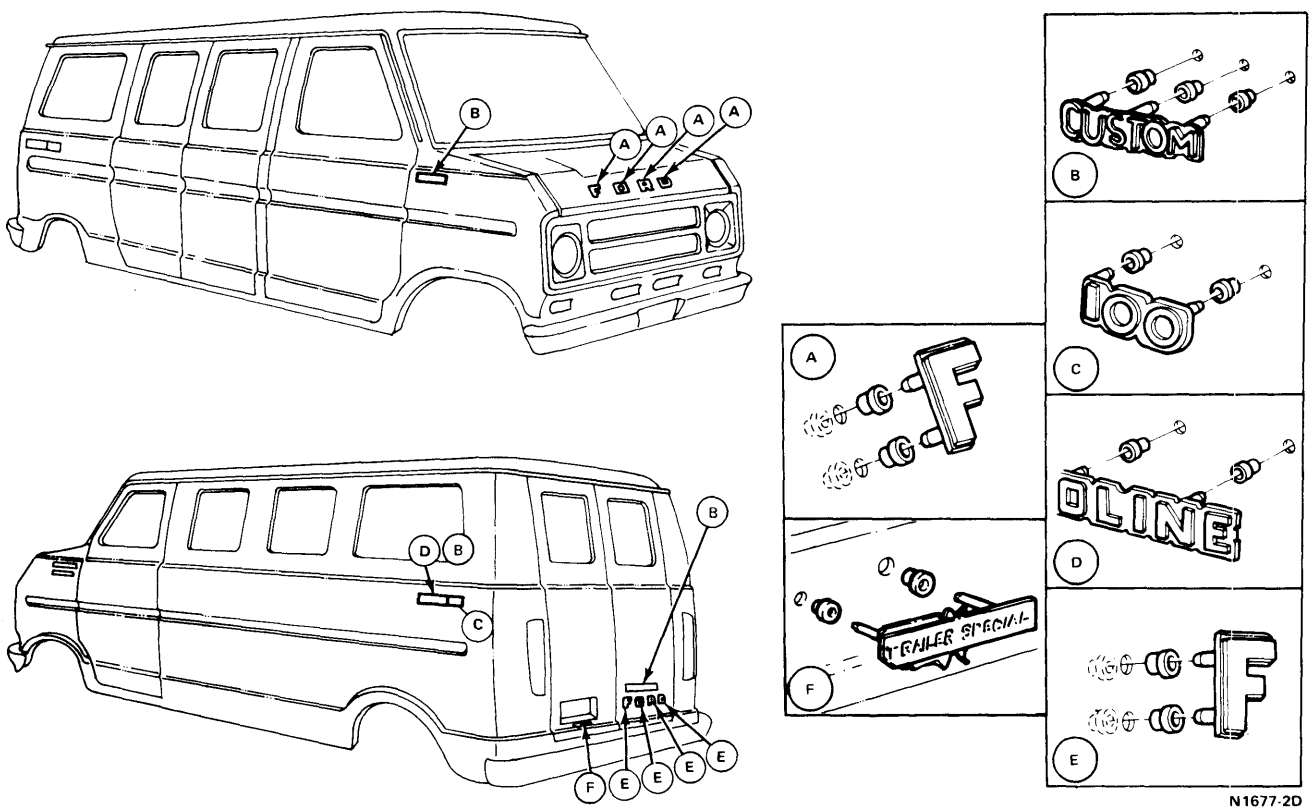


FIG. 9 E-100—E-350 Exterior Ornamentation

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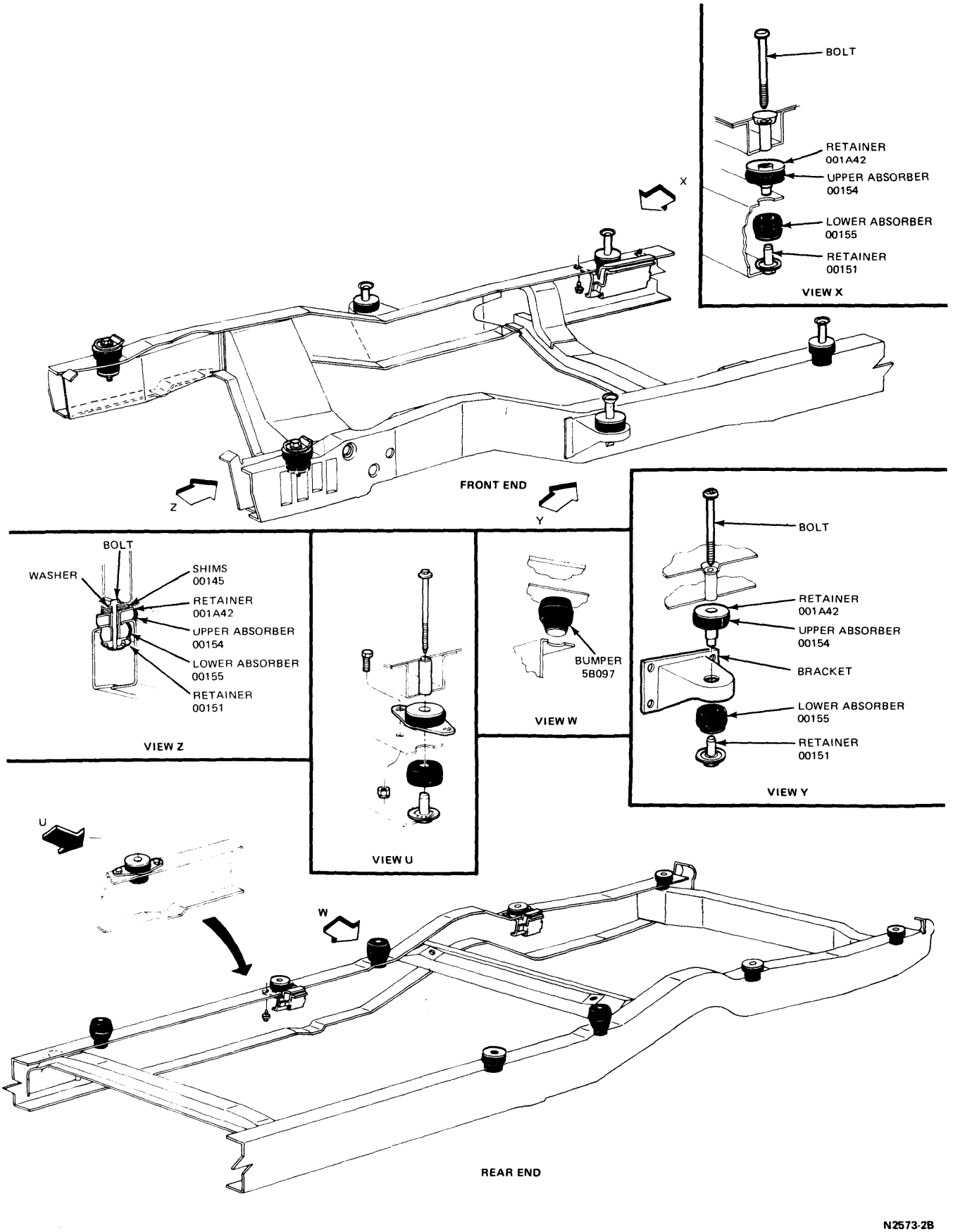


FIG. 10 E-100—E-350 Body Mounts

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DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	36/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

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METRIC–ENGLISH CONVERSION TABLE

Multiply	by	to get equivalent number of:
	LENGTH	
Inch	25.4	millimetres (mm)
Foot	0.304 8	metres (m)
Yard	0.914 4	metres
Mile	1.609	kilometres (km)
	AREA	
Inch^2	645.2	millimetres^2 (mm^2)
	6.45	centimetres^2 (cm^2)
Foot^2	0.092 9	metres^2 (m^2)
Yard^2	0.836 1	metres^2
	VOLUME	
Inch^3	16 387.	mm^3
	16.387	cm^3
	0.016 4	litres (l)
Quart	0.946 4	litres
Gallon	3.785 4	litres
Yard^3	0.764 6	metres^3 (m^3)
	MASS	
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
	TEMPERATURE	
Degree Fahrenheit	(t°F-32)÷ 1.8	degree Celsius

Multiply	by	to get equivalent number of:
	ACCELERATION	
Foot/sec^2	0.304 8	metre/sec^2 (m/s^2)
Inch/sec^2	0.025 4	metre/sec^2
	TORQUE	
Pound-inch	0.112 98	newton-metres (N-m)
Pound-foot	1.355 8	newton-metres
	POWER	
Horsepower	0.746	kilowatts (kW)
	PRESSURE OR STRESS	
Inches of water	0.249 1	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
	ENERGY OR WORK	
BTU	1 055.	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000. or 3.6 x 10^6	joules (J = one W's)
	LIGHT	
Foot candle	1.076 4	lumens/metre^2 (lm/m^2)
	FUEL PERFORMANCE	
Miles/gal	0.425 1	kilometres/litre (km/l)
Gal/mile	2.352 7	litres/kilometre (l/km)
	VELOCITY	
Miles/hour	1.609 3	kilometres/hr. (km/h)

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