

FOREWORD

This Shop Manual is published for the information and guidance of personnel responsible for maintenance of HYUNDAI D4A, D4D series diesel engine, and includes procedures for adjustment and maintenance services.

We earnestly look forward to seeing that this manual is made full use of in order to perform correct service with no wastage.

For more details, please consult your nearest authorized HYUNDAI dealer or distributor.

Kindly note that the specifications and maintenance service figures are subject to change without prior notice in line with improvement which will be effected from time to time in the future.

January, 2005

1. How This Manual Is Compiled

- This manual is compiled by classifying various systems into certain groups.
- Each group contains specifications;troubleshooting; maintenance service standards; tightening torque; lubricant fluid and sealant; special tools; and service procedure.
- Page enumeration is independent by every group where first page is always 1.

Group No.	Group denomination	Contents
1	General	General specifications, engine No. and name plate, precautions for maintenance operations, table of standard tightening torques
2	Engine proper	Engine body
3	Lubrication	Lubrications system
4	Cooling	Cooling system
5	Engine electrical	Starter, alternator, preheating, engine start system
6	Intake and exhaust	Intake and exhaust system, air cleaner, turbocharger
7	Fuel system	Fuel system

2. Terms and Units

The terms and units in this manual are defined as follows.

- **Front and rear**

The terms "front" is the fan side and "rear" the flywheels side of the engine.

- **Left and right**

The terms "right" and "left" shall be used to indicate the side as viewed from the flywheel side of the engine.

- **Terms of service standards**

- (1) Standard value

Standard value dimensions in designs indicating : the design dimensions of individual parts, the standard clearance between two parts when assembled, and the standard value for an assembly part, as the case may be.

- (2) Limit

When the value of a part exceeds this, it is no longer serviceable in respect of performance and strength and must be replaced or repaired.

- **Tightening torque**

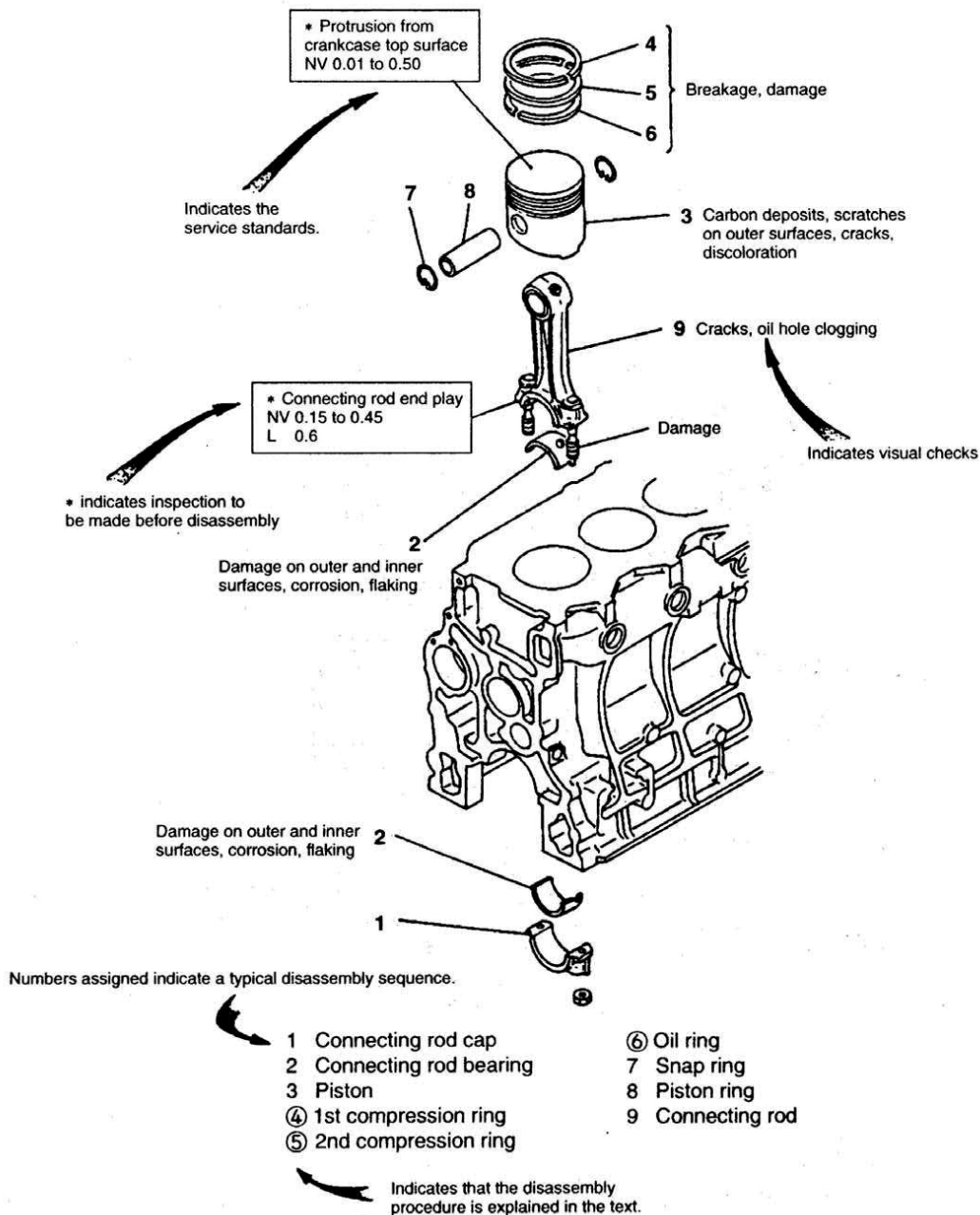
Appropriate tightening torque has particular importance in respect of performance. Accordingly, tightening torque is specified in locations that are to be tightened.

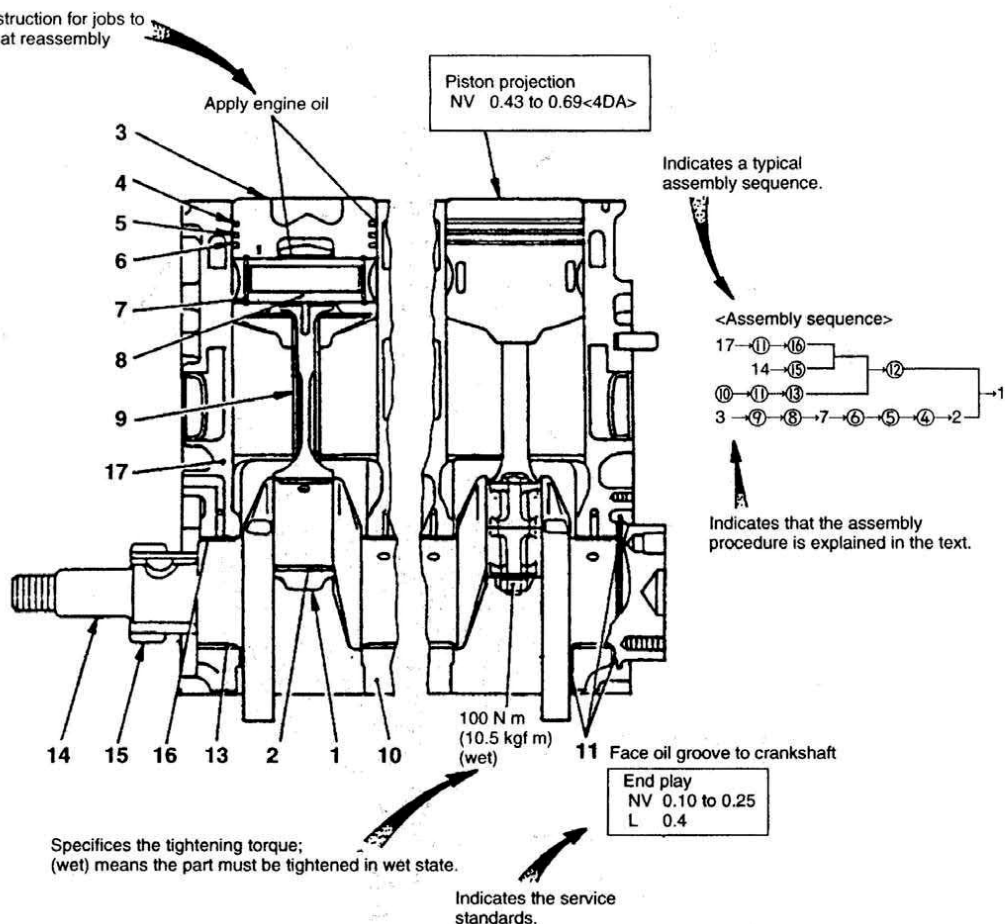
Where there is no specified figure for tightening torque, follow the table covering standard tightening torques.

When the item is to be tightened in a "wet" state, wet is indicated. Where there is no indication, read it as dry, and tighten at specified torque.

3. READING THE ILLUSTRATION

(Ex. 1 : Disassembly and Inspection)





Illustrations(exploded views and assembly drawings) show a typical service procedures if it is identical among various types of available systems and units.

1. GENERAL SPECIFICATIONS

• Units

Tightening torques and other parameters are given in SI * units with metric units added in brackets { }.

* SI : Le Systeme International d'Unites

Example : 390 N.m {40 kgf.m}

SI unit Metric unit

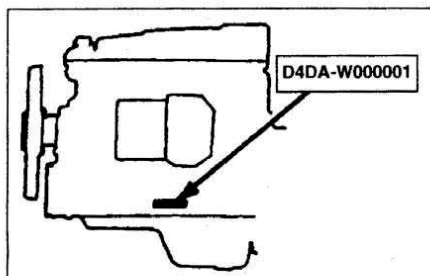
Unit	SI unit {metric unit}	Conversion factor
Force	N {kgf}	9.80665 N {1 kgf}
Moment of force	N · m {kgf · m}	9.80665 N · m {1 kgf · m}
Pressure	Positive pressure	kPa {kgf/cm ² }
	Vacuum pressure	kPa {mmHg}
		Pa {mmHg}
Volume	dm ³ {L}	1 dm ³ {1 L}
Power	kW {PS}	0.7355 kW {1 PS}
Heat quantity	J {kcal}	4186.8 J {1 kcal}
Heat flow	W {kcal/h}	1.16279 W {1 kcal/h}
Angle	°	—
Temperature	°C	—
Electric current	A	—
Voltage	V	—
Resistance	Ω	—
Electric power	W	—

Unit	SI unit	Foot-pound unit	Conversion factor
Force	N(Newton)	lbf	1 N = 0.2248 lbf
Moment of force	N · m	lbf.ft	1 N · m = 0.7375 lbf.ft
Pressure	kPa(kilopascal)	lbf/in. ²	1 kPa = 0.145 lbf/in. ² 1 kPa = 0.2953 in. Hg
Volume	L	gal.	1 L = 0.2642 gal. (U.S.) 1 L = 0.220 gal. (Imp.)
	cm ³	oz	1 cm ³ = 0.033814 oz (U.S.) 1 cm ³ = 0.035195 oz (Imp.)
	cm ³	cu.in.	1 cm ³ = 0.061023 cu.in.
Power	kW(kilowatt)	HP	1 kW = 1.34 HP
Temperature	°C	°F	t°C = (1.8t°F + 32)°F
Mass quantity of matter	kg	lb	1 kg = 2.2046 lb
	g	oz	1 g = 0.035274 oz
Dimension	m	ft.	1 m = 3.2808 ft.
	mm	in.	1 mm = 0.03937 in.
Stress	N/cm ²	lbf/in. ²	1 N/cm ² = 1.45 lbf/in. ²

The serial number for engine is assigned to the respective engine in manufacturing sequence : every engine has its own number. This number is required for incidental inspection of the engine. Please do not fail to mention this number to the dealers when ordering spare parts.

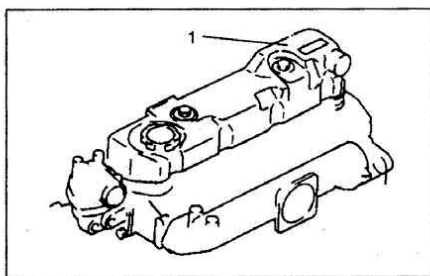
2. Engine Number

The engine number is punch-marked on the shown location.



3. Name Plate and Caution Plate

1 : Name plate or caution plate



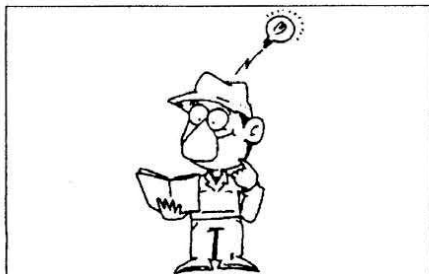
- 1. ENGINE MODEL
- 2. TOTAL displacement
- 3. Rated output
- 4. Engine speed

D4DA-C			
 HYUNDAI			
TOTAL	CYLINDER	VOLUME	3907(cc)
ENGINE	OUTPUT		100/2400 (ps/rpm)
VALVE	CLEARANCE		(GOLD)
INLET	0.4 mm	EXHAUST	0.4 mm
FIRING	ORDER		1 - 3 - 4 - 2
FUEL	INJECTION	TIMING	7° BTDC

4. PRECAUTIONS FOR MAINTENANCE OPERATION

In order to determine the condition of the engine adequately, attend the engine beforehand to find and keep record of the accumulated mileage, operating condition, what the customer's demand is, and other information that may be necessary. Prepare the steps to be taken and perform efficient and wasteless maintenance procedure.

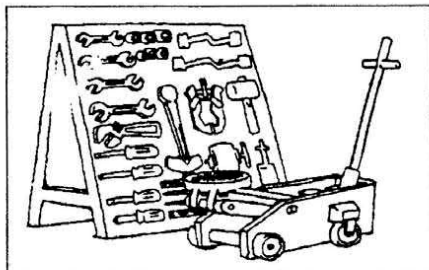
- Determine where the fault exists and check for the cause to see whether removal or disassembly of the part is necessary. Then follow the procedure specified by this manual.
- Perform maintenance work at a level area.



- Prepare general and special tools necessary for the maintenance work.

NOTE:

Do not attempt to use tools other than special tools where use of special tools is specified in this manual. This will avoid injury or damage.



- When removing or installing the engine, attach the lifting wire rope hooks to the engine's lifting eyes and hoist the engine slowly such that it does not touch other components.

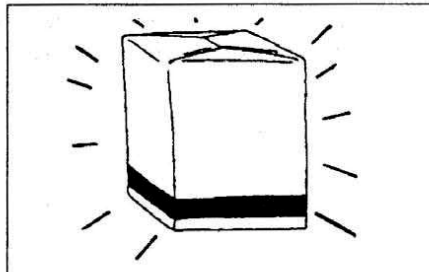
NOTE:

Check that the wire rope and crane are sufficiently strong.

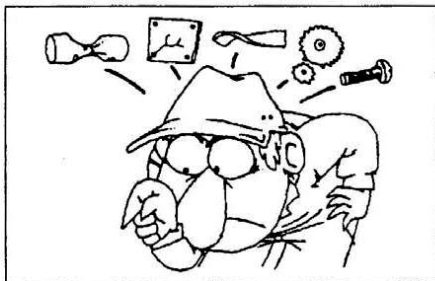
- Be particularly careful not to work in shoes that have oily soles and are slippery. When working as a team of two or more, arrange signals in advance and keep confirming safety. Be careful not to accidentally bump switches or levers.
- Check for oil leakage before cleaning the area having the fault other-wise you might miss detecting the leakage.
- Prepare replacement part(s) beforehand.



- Replace oil seals, packing, O-rings and other rubber parts ; gaskets and split pins with new parts whenever any of them has been removed. Use only genuine HYUNDAI replacement parts.



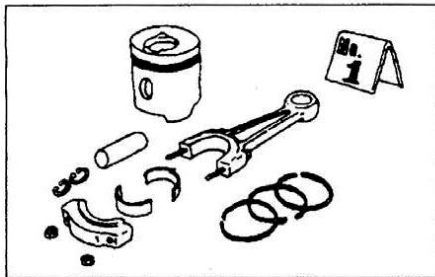
- On disassembly, visually inspect all parts for wear and tear, cracks, damage, deformation, degradation, rust, corrosion, smoothness in rotation, fatigue, clogging and any other possible defect.



- Put alignment marks on part combinations before disassembly and arrange the disassembled parts neatly. This will help avoid mismatching of the parts later. Put the alignment marks, punch marks, etc. Where performance and appearance will not be affected. Cover the area left open after removal of parts to keep it free from dust.

NOTE:

- 1) Take care to avoid mixing up numerous parts, similar parts, left and right, etc.
- 2) Keep new parts for replacement and original (removed) parts separate.

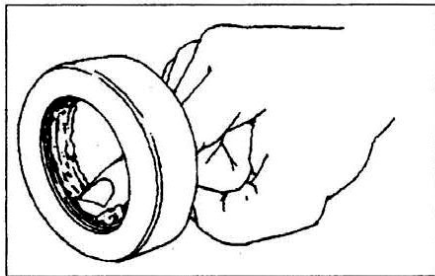


- Apply the specified oil or grease to U-packings, oil seals, dust seals and bearings during assembly.

NOTE:

Use only the specified oil, grease, ect. for lubricant.

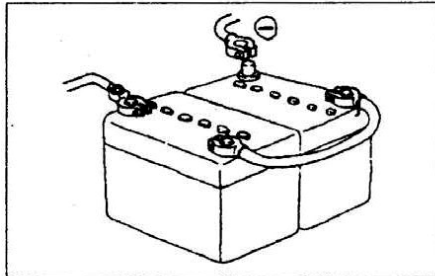
Remove the excess immediately after application with a piece of rag.



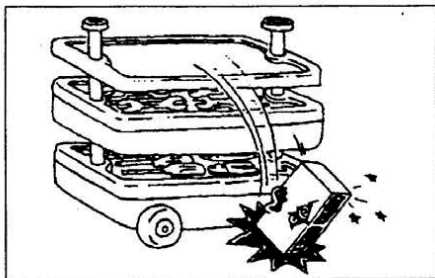
- Wear goggles when using a grinder or welder. Pay full attention to safety by wearing gloves when necessary. Watch out for sharp edges, ect. that might injure your hands or fingers.



- Before carrying out maintenance work on the electric system, disconnect the negative terminals of the batteries.

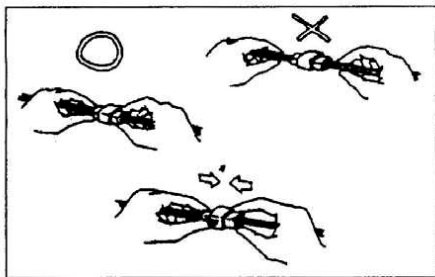


- Take care when handling sensors, relays, etc. which are vulnerable to shock and heat.



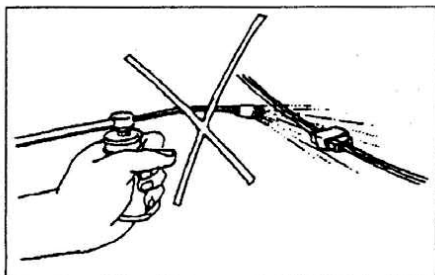
- Pull the connector, and not the harness lead, to separate connectors.

To separate a lock-type connector, first push toward arrow mark. To re-connect a lock-type connector, press the separated parts until they click together.



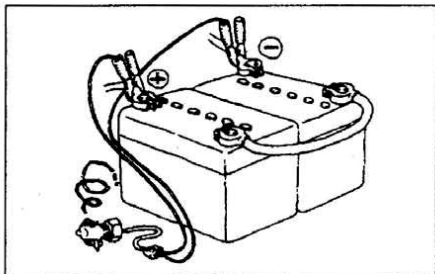
- When washing the Engine, cover the electric system parts and instruments with waterproof material beforehand (Cover with vinyl sheet or the like). Keep water away from harness wire connectors and sensors.

If any of them should get wet, wipe them off immediately.

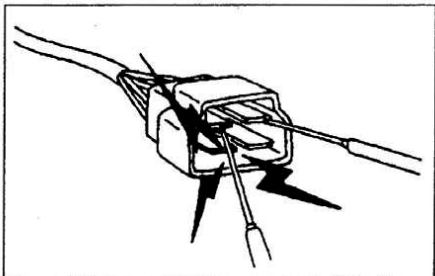


- To apply voltage for testing, check that the positive and negative cables are connected properly, then increase voltage gradually from 0 volt. Do not apply voltage higher than the specified value.

In particular, pay close attention to the electronic control unit and sensors, since they are not always supplied with 24V.



- When using testers or the like for continuity tests, be careful not to allow test probes to touch the wrong terminals.



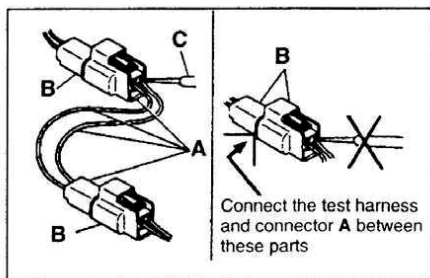
● Measurement Procedures Using Connectors

Test with connectors engaged (continuity through circuit obtained)

<Waterproof connector>

Prepare a test harness and connectors **A**, then connect it between the two parts of harness **B** that is to be tested. Check the circuit by touching test probe **C** to the test connector.

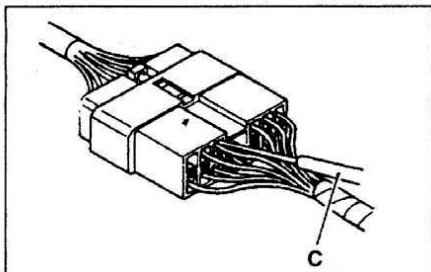
Never insert the test probe from the harness side of the waterproof connection, or waterproof performance might be diminished causing corrosion of the connector.



<Non-waterproof connector>

Insert test probe **C** from the harness side of the connector.

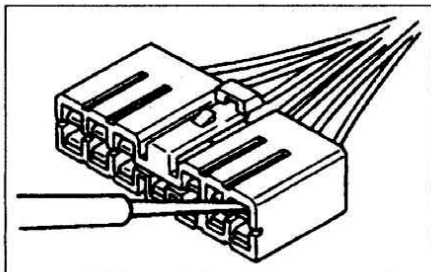
Where control units, etc. have connectors that are too small to accept the test probe, do not force the test probe into them.



Test with connectors disengaged

Using female pins

Insert a test probe into a terminal. However, do not force the probe into the terminal, or it will cause a poor contact.

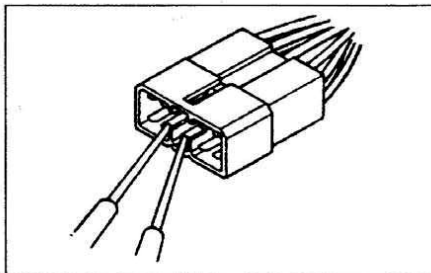


Using male pins

Touch the pins directly using test probes.

NOTE:

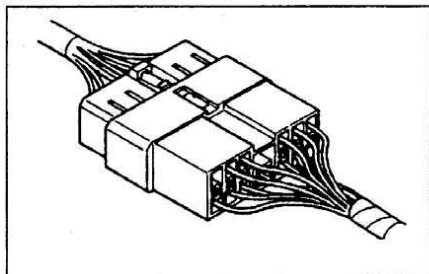
Be sure that you do not short circuit the connector pins when you use the test probe because this could damage the internal circuit of the electronic control unit.



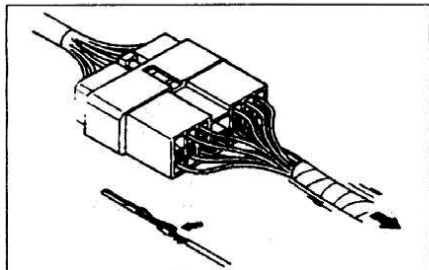
● Connector Inspection Procedures

Visual inspection

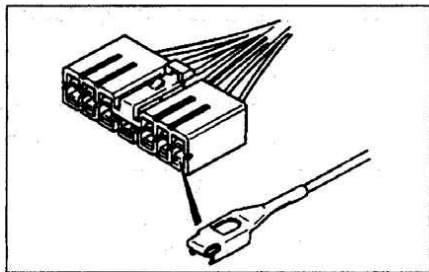
Check for loose connection and poor engagement.



Check if harnesses are broken by pulling gently around the terminals.



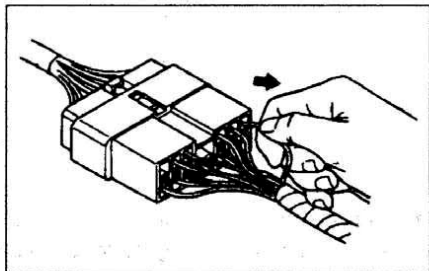
Check for a decrease in contact pressure between the male and female terminals.



Check for poor contact caused by connector pins having fallen out, rusted terminals or foreign particles.

Connector pin fall out inspection

Damaged connector pin stoppers can cause poor engagement of the terminals (male and female pins) even if the connector body is secured, and might cause some pins to fall out. Check if the pins have fallen out from the connector by pulling each harness gently.



● Inspection Procedures for Blown Fuses

Remove fuse **B** and measure resistance between the loaded side of the fuse and ground.

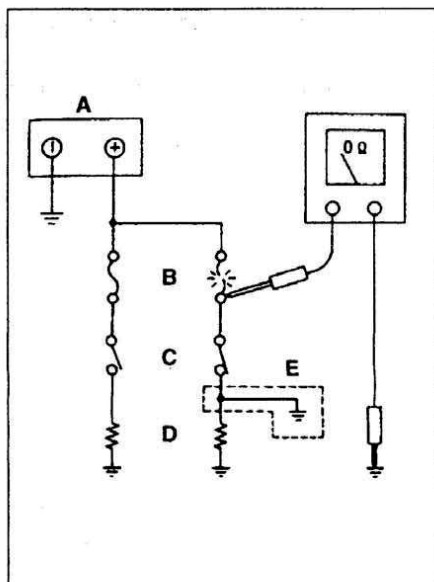
Turn on all circuit switches (connected to the fuse).

If the resistance value reading is approximately 0, a short has occurred between the switch and the loaded point. A value of other than zero may indicate that the fuse was blown by a temporary short but the short is no longer present.

The major causes of a short circuit are as follows :

- Harness stuck onto the vehicle body.
- Harness sheath damaged by friction or heat.
- Water in connectors or circuits.
- Mistakes (accidental short circuits)

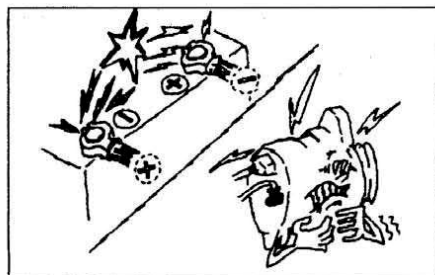
A : Battery **D** : Load
B : Fuse **E** : Short circuit
C : Loaded switch



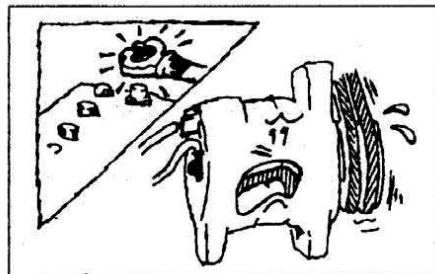
● Precautions for Handling Alternator

When servicing the alternator, pay attention to the following :

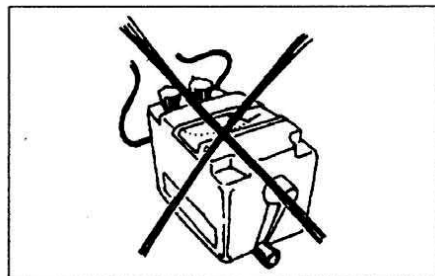
- Do not connect the alternator with battery polarities reversed.
- If the alternator is connected with reversed polarities, a large current flow from the battery to the alternator occurs, and the diode or regulator might be damaged.



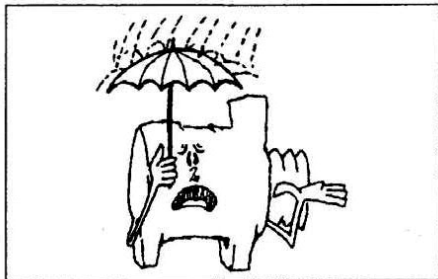
- While the engine is running, do not remove the battery terminals, if the battery terminals are removed at that time, a surge voltage is generated and the diode or regulator might be weakened.



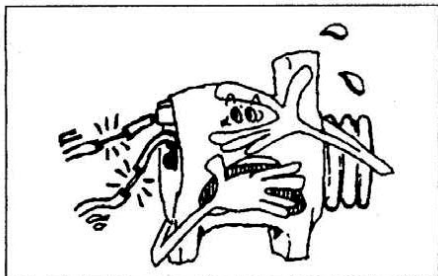
- Do not use a high-voltage tester such as a megger for inspection. If a high-voltage tester is used, the diode or regulator might be destroyed.



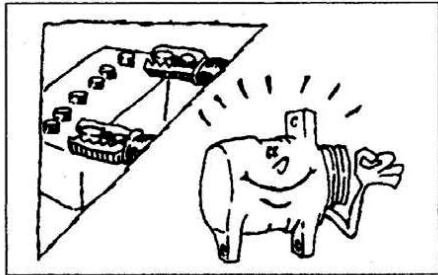
- Do not splash water over the alternator.
If water is directly splashed over the alternator, individual components will be short-circuited and might be destroyed.



- Do not short-circuit terminal B and terminal L while running the alternator.
If the terminals are short-circuited while the alternator is running, the diode trio might be destroyed.



- Disconnect the battery terminals before quick-charging the battery.
Quick-charging without disconnecting the battery terminals might damage the diode or regulator.



5. TABLE OF STANDARD TIGHTENING TORQUES

- Use specified bolts and nuts and tighten them at specified torques according to the following table, unless otherwise specified.
- Threads and contact seats shall be dry.
- Where there is a difference in strength classification between the nut and bolt (or stud bolt), the torque specified for the bolt shall apply.

Hex-head Bolt and Stud Bolt

Unit: N · m {kgf · m}

Strength classification	4 T		7 T		8 T	
Representation						
Diameter symbol						
M5	2 to 3 {0.2 to 0.3}	—	4 to 6 {0.4 to 0.6}	—	5 to 7 {0.5 to 0.7}	—
M6	4 to 6 {0.4 to 0.6}	—	7 to 11 {0.7 to 1.1}	—	8 to 12 {0.8 to 1.2}	—
M8	9 to 14 {0.9 to 1.4}	—	17 to 26 {1.7 to 2.6}	—	20 to 29 {2.0 to 3.0}	—
M10	19 to 28 {1.9 to 2.8}	18 to 26 {1.8 to 2.7}	36 to 52 {3.5 to 5.5}	33 to 49 {3.3 to 5.0}	45 to 60 {4.5 to 6.0}	41 to 59 {4.3 to 6.0}
M12	35 to 50 {3.4 to 5.0}	31 to 46 {3.1 to 4.7}	70 to 95 {7.0 to 9.5}	65 to 85 {6.5 to 8.5}	85 to 110 {8.5 to 11}	75 to 100 {7.5 to 10}
M14	60 to 85 {6.0 to 8.5}	55 to 75 {5.5 to 7.5}	120 to 160 {12 to 16}	110 to 140 {11 to 14}	130 to 180 {13 to 18}	120 to 160 {12 to 17}
M16	90 to 130 {9.5 to 13}	90 to 120 {9.0 to 12}	180 to 240 {18 to 24}	160 to 220 {16 to 22}	200 to 270 {20 to 27}	190 to 260 {19 to 26}
M18	140 to 190 {14 to 19}	120 to 160 {12 to 16}	260 to 340 {26 to 35}	220 to 290 {22 to 30}	290 to 390 {30 to 40}	260 to 340 {26 to 35}
M20	190 to 260 {19 to 26}	170 to 230 {17 to 23}	350 to 470 {36 to 48}	320 to 420 {32 to 43}	410 to 550 {41 to 56}	370 to 490 {37 to 50}
M22	260 to 340 {26 to 35}	230 to 300 {23 to 31}	470 to 640 {48 to 65}	430 to 570 {43 to 58}	550 to 740 {56 to 75}	490 to 670 {50 to 68}
M24	340 to 450 {34 to 46}	290 to 390 {29 to 40}	630 to 840 {63 to 86}	540 to 730 {55 to 74}	730 to 980 {74 to 100}	630 to 840 {64 to 86}

Hex-head Flange Bolt

Unit: N · m {kgf · m}

Strength classification	4 T		7 T		8 T	
Representation						
Diameter symbol						
M6	4 to 6 {0.4 to 0.6}	—	8 to 12 {0.8 to 1.2}	—	9 to 14 {0.9 to 1.4}	—
M8	10 to 15 {1.0 to 1.5}	—	19 to 28 {1.9 to 2.8}	—	22 to 32 {2.2 to 3.3}	—
M10	21 to 30 {2.1 to 3.1}	20 to 28 {1.9 to 2.9}	39 to 58 {3.9 to 6.0}	37 to 53 {3.6 to 5.4}	50 to 65 {5.0 to 6.5}	45 to 65 {4.5 to 6.5}
M12	38 to 54 {3.8 to 5.5}	35 to 51 {3.4 to 5.2}	80 to 110 {8.0 to 11}	70 to 95 {7.0 to 9.5}	90 to 120 {9.0 to 12}	85 to 110 {8.5 to 11}

Hex-head Nut

Unit: N · m {kgf · m}

Strength classification	4 T		6 T			
Representation						
Diameter symbol	Standard screw	Coarse screw	Standard screw		Coarse screw	
M5	2 to 3 {0.2 to 0.3}	—	4 to 6 {0.4 to 0.6}		—	
M6	4 to 6 {0.4 to 0.6}	—	7 to 11 {0.7 to 1.1}		—	
M8	9 to 14 {0.9 to 1.4}	—	17 to 26 {1.7 to 2.6}		—	
M10	19 to 28 {1.9 to 2.8}	18 to 26 {1.8 to 2.7}	36 to 52 {3.5 to 5.5}		33 to 49 {3.3 to 5.0}	
M12	35 to 50 {3.4 to 5.0}	31 to 46 {3.1 to 4.7}	70 to 95 {7.0 to 9.5}		65 to 85 {6.5 to 8.5}	
M14	60 to 85 {6.0 to 8.5}	55 to 75 {5.5 to 7.5}	120 to 160 {12 to 16}		110 to 140 {11 to 14}	
M16	90 to 130 {9.5 to 13}	90 to 120 {9.0 to 12}	180 to 240 {18 to 24}		160 to 220 {16 to 22}	
M18	140 to 190 {14 to 19}	120 to 160 {12 to 16}	260 to 340 {26 to 35}		220 to 290 {22 to 30}	
M20	190 to 260 {19 to 26}	170 to 230 {17 to 23}	350 to 470 {36 to 48}		320 to 420 {32 to 43}	
M22	260 to 340 {26 to 35}	230 to 300 {23 to 31}	470 to 640 {48 to 65}		430 to 570 {43 to 58}	
M24	340 to 450 {34 to 46}	290 to 390 {29 to 40}	630 to 840 {63 to 86}		540 to 730 {55 to 74}	

Hex-head Flange Nut

Unit: N · m {kgf · m}

Strength classification	4 T	
Representation		
Diameter symbol	Standard screw	Coarse screw
M6	4 to 6 {0.4 to 0.6}	—
M8	10 to 15 {1.0 to 1.5}	—
M10	21 to 30 {2.1 to 3.1}	20 to 28 {1.9 to 2.9}
M12	38 to 54 {3.8 to 5.5}	35 to 51 {3.4 to 5.2}

Tightening torque for flare nut for general purpose

Unit: N · m {kgf · m}

Pipe diameter	φ 4.76mm	φ 6.35mm	φ 8mm	φ 10mm	φ 12mm	φ 15mm
Tightening torque	17 {1.7}	25 {2.6}	39 {4.0}	59 {6.0}	88 {9.0}	98 {10.0}

Tightening torque for air piping nylon tube for general purpose {DIN type}

Unit: N · m {kgf · m}

Standard diameter	6 × 1 mm	10 × 1.25 mm	12 × 1.5 mm	15 × 1.5 mm
Tightening torque	$20^{+6}_{-0} \left\{ \begin{matrix} 2.0^{+0.6} \\ 0 \end{matrix} \right\}$	$34^{+10}_{-0} \left\{ \begin{matrix} 3.0^{+1.0} \\ 0 \end{matrix} \right\}$	$49^{+10}_{-0} \left\{ \begin{matrix} 5.0^{+1.0} \\ 0 \end{matrix} \right\}$	$54^{+5}_{-0} \left\{ \begin{matrix} 5.5^{+0.5} \\ 0 \end{matrix} \right\}$