FOREWORD

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GROUP

5

FORD RANGER 2011.50MY
BODY REPAIR MANUAL

Body and Paint

SECTION TITLE PAGE

Body and Paint

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SECTION 501-00 Body System - General Information

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

Body – Overview

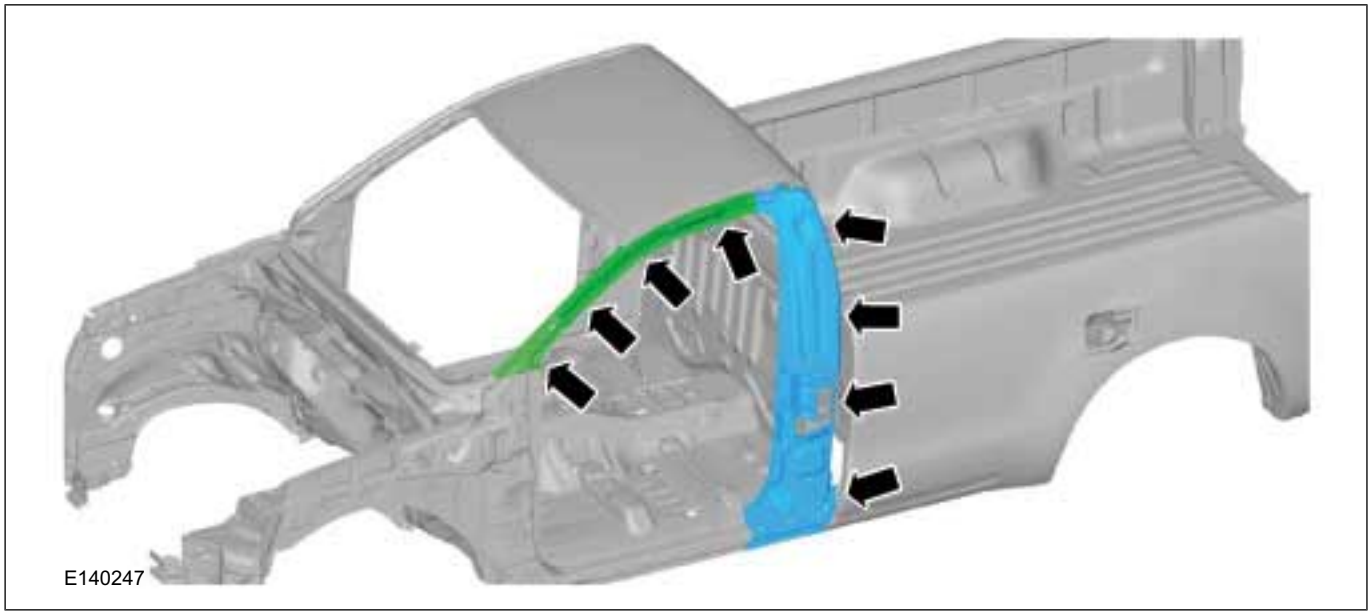
General

At introduction the following vehicle variants are available:

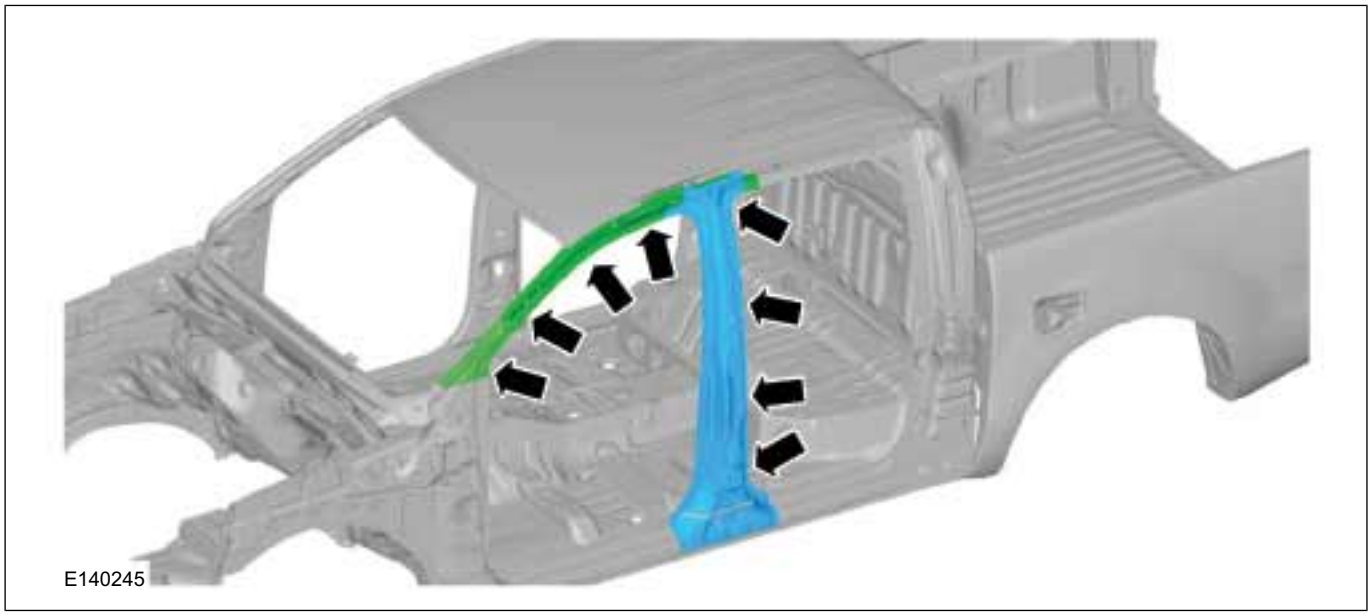
- 2.5L petrol 4x2 low rider, 4x2 high rider, 4x4 with manual transmission
- 2.2L diesel 88kW & 92kW 4x2 low rider, 4x2 high rider, 4x4 with manual transmission
- 2.2L diesel 110kW 4x2 low rider, 4x2 high rider drive ratio 3.31, 4x2 high rider drive ratio 3.55 with manual transmission
- 2.2L diesel 110kW 4x2 high rider with auto transmission
- 2.2L diesel 110kW 4x4 manual and auto transmission
- 3.2L diesel 4x2 high rider and 4x4 drive ratio 3.31, 4x2 high rider and 4x4 drive ratio 3.55 with manual transmission

A- and B-pillar reinforcement

Single cab

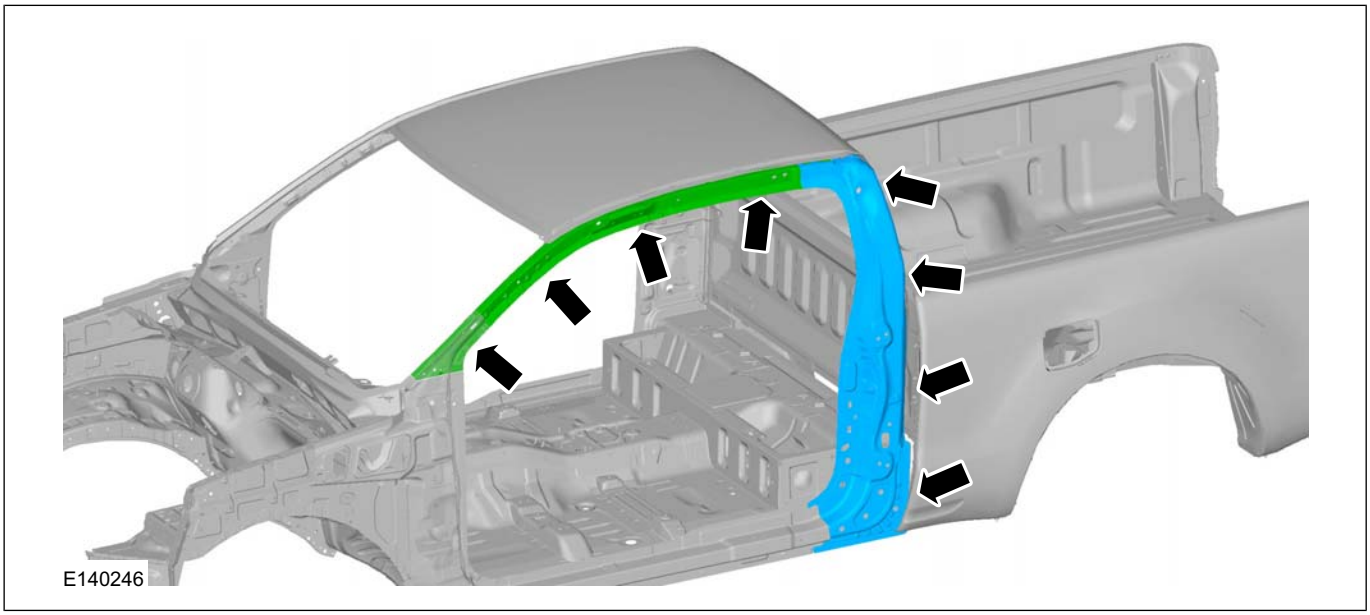


Double cab



DESCRIPTION AND OPERATION

Super cab

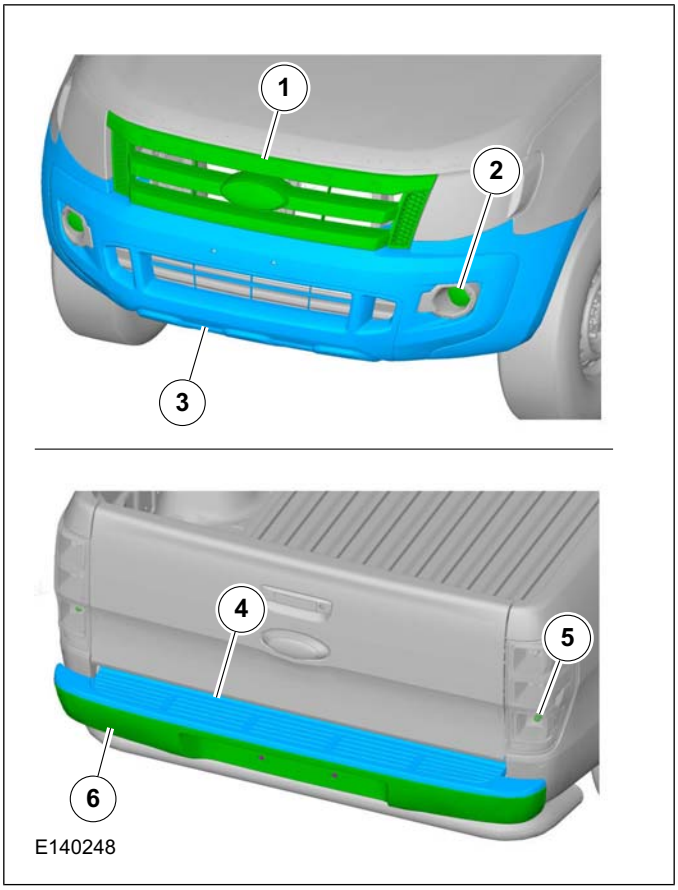


The A- and B-pillar reinforcement is made of the highest strength boron steel.

These sheet metal parts can only be replaced as a complete unit during repairs and that section repairs are not possible.

Special installation and removal requirements must be observed during repairs. Special tools are also required. Relevant instructions are available in the current service literature.

Bumpers and radiator grille



Item	Description
1	Radiator grille
2	Front fog lights
3	Front bumper and cover

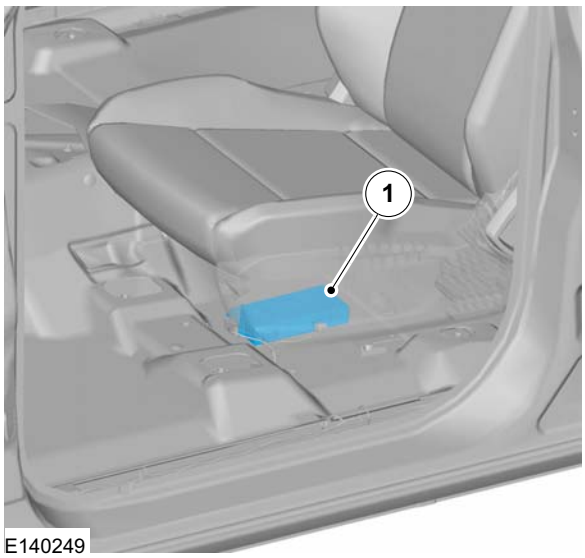
DESCRIPTION AND OPERATION

Item	Description
4	Rear bumper
5	Rear fog lamp
6	Rear bumper cover

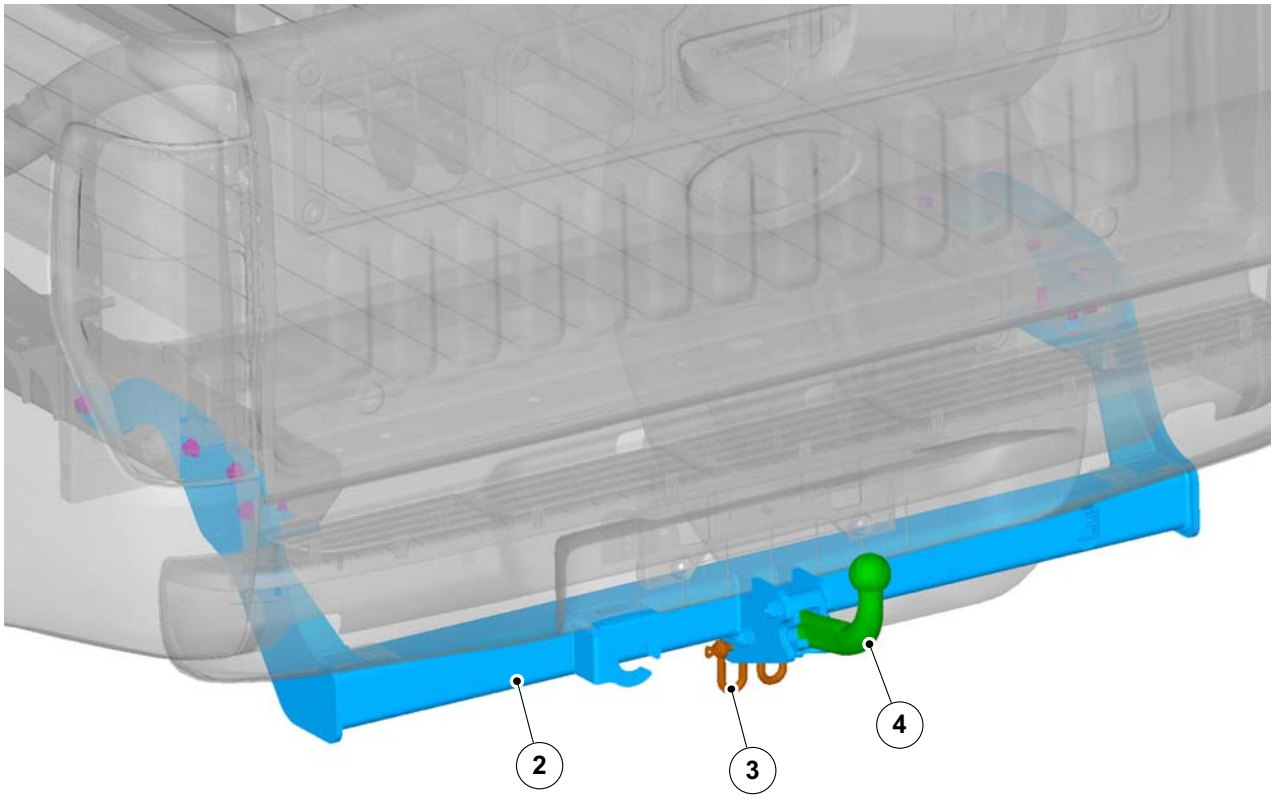
The bumpers are painted in the body color as standard for all vehicle variants.

The bumper cover is only available in grey.

Trailer towbar



E140249



E140266

Item	Description
1	Module, trailer towbar
2	Trailer towbar

Item	Description
3	Shackles
4	Tow ball arm

At introduction, a removable towbar is made available for the vehicle.

If the vehicle is delivered from the factory with a towbar, then this is equipped with a 13-pin socket.

DESCRIPTION AND OPERATION

For aftermarket installation, both a variant with a 13-pin socket and also a variant with a 7 pin socket are available in service.

The fundamental difference between the two variants:

- The 7-pin version does not support deactivation of the parking aid (if it is installed in the vehicle).

The trailer towbar module is connected to constant positive at the passenger compartment fuse box (terminal 30, fuse 23).

For the 13-pin version, the trailer towbar module is connected with the parking aid module. As soon as a connector is inserted into the socket, the rear parking aid is deactivated.

SECTION 501-02 Front End Body Panels

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

Cowl Panel Grille..... 501-02-2

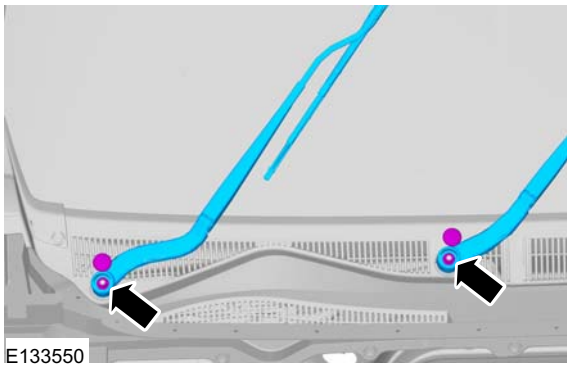
REMOVAL AND INSTALLATION

Cowl Panel Grille

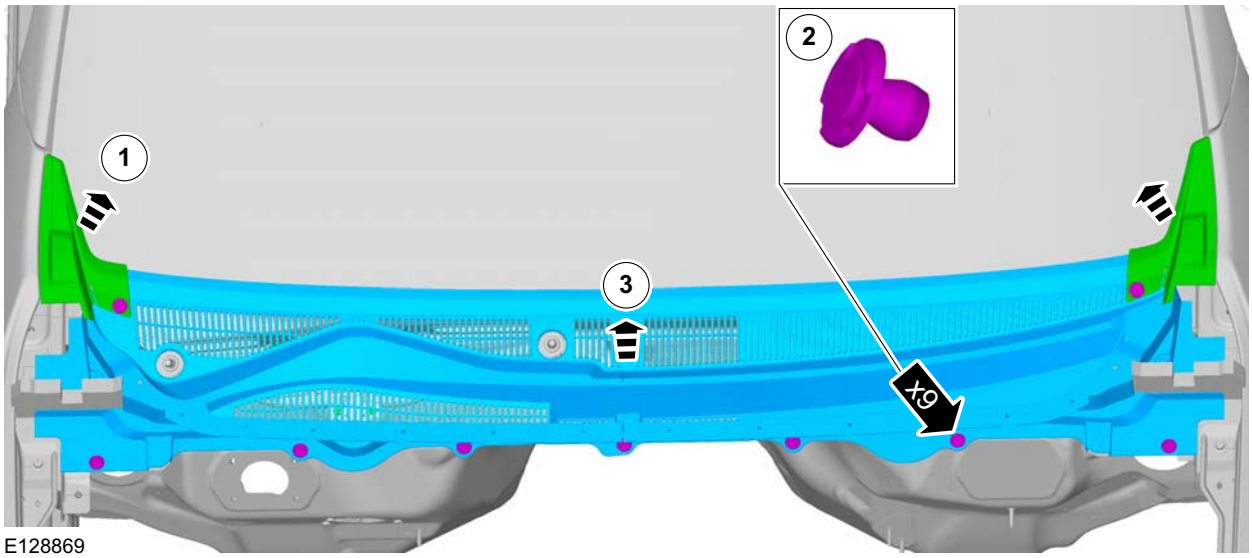
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Torque: 35 Nm



2.



Installation

1. **CAUTION: Make sure that the motor is in the park position.**

To install, reverse the removal procedure.

2. Check the angle of the wiper arms to the windscreen.

Refer to: Windshield Wiper Blade and Pivot Arm Adjustment (501-16 Wipers and Washers, General Procedures).

SECTION 501-03 Body Closures

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

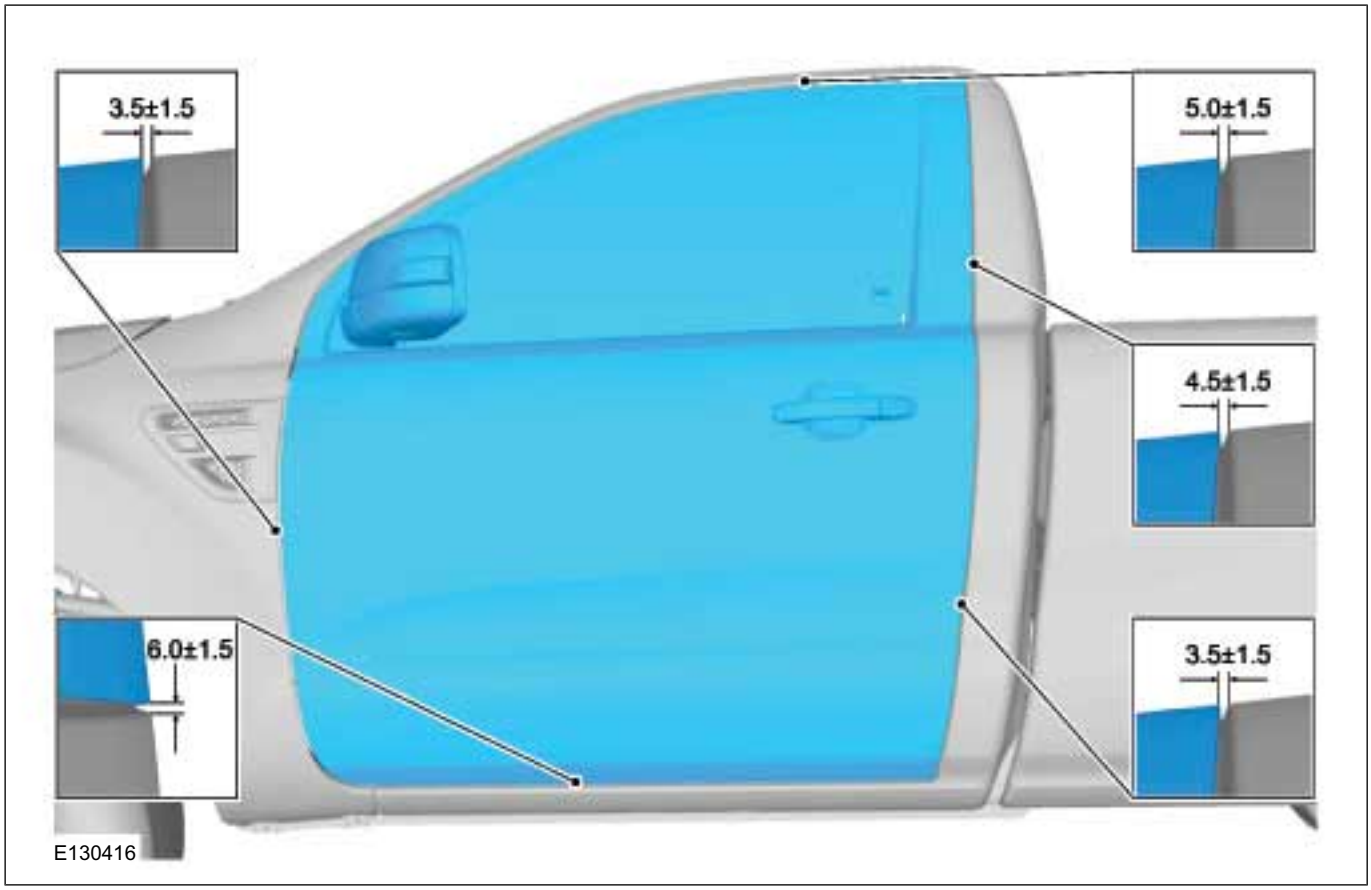
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GENERAL PROCEDURES

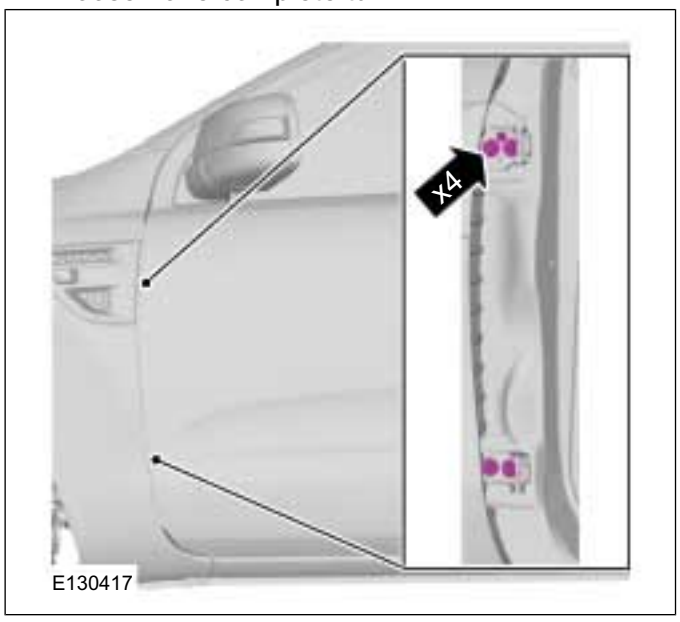
Door Alignment — Single Cab

Activation

1. **NOTE:** All the values are in mm.



2. Loosen one complete turn.

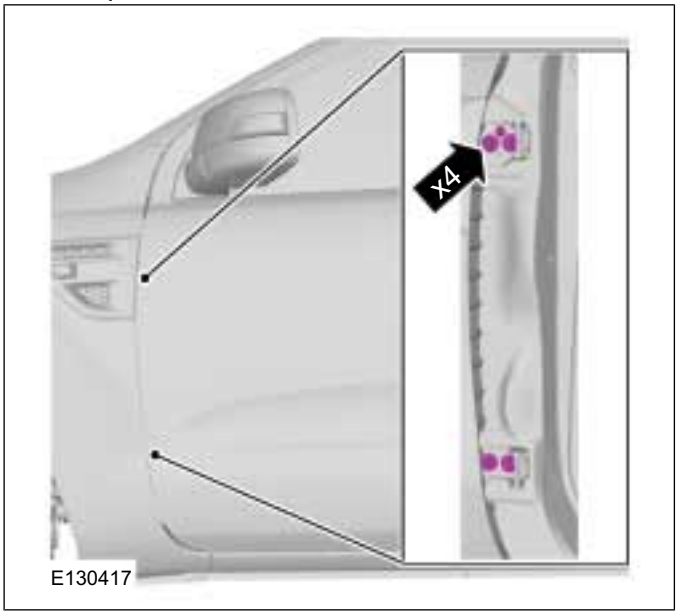


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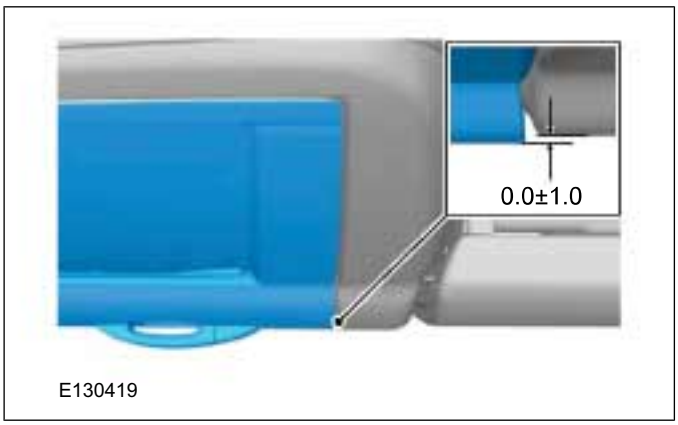


GENERAL PROCEDURES

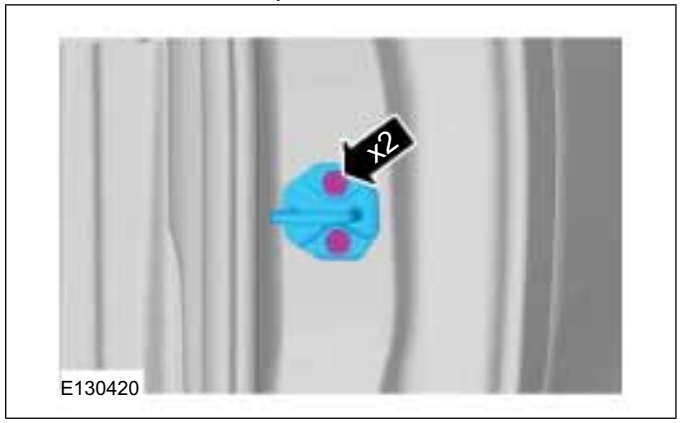
4. Torque: 25 Nm



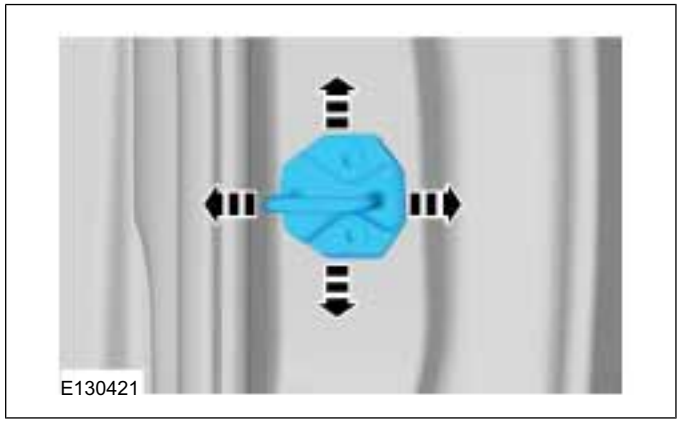
5. **NOTE:** All the values are in mm.



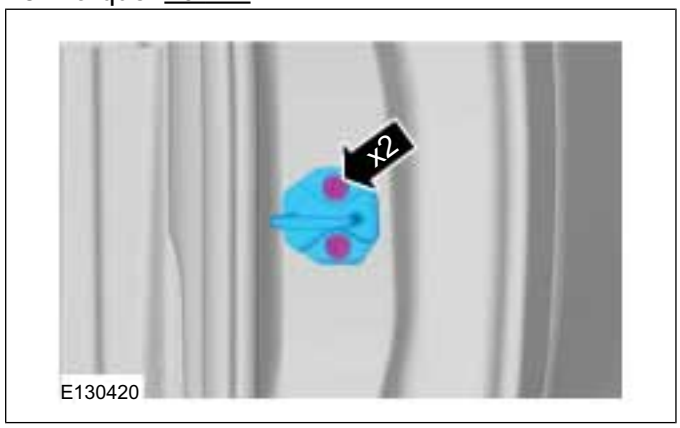
6. Loosen one complete turn.



7.

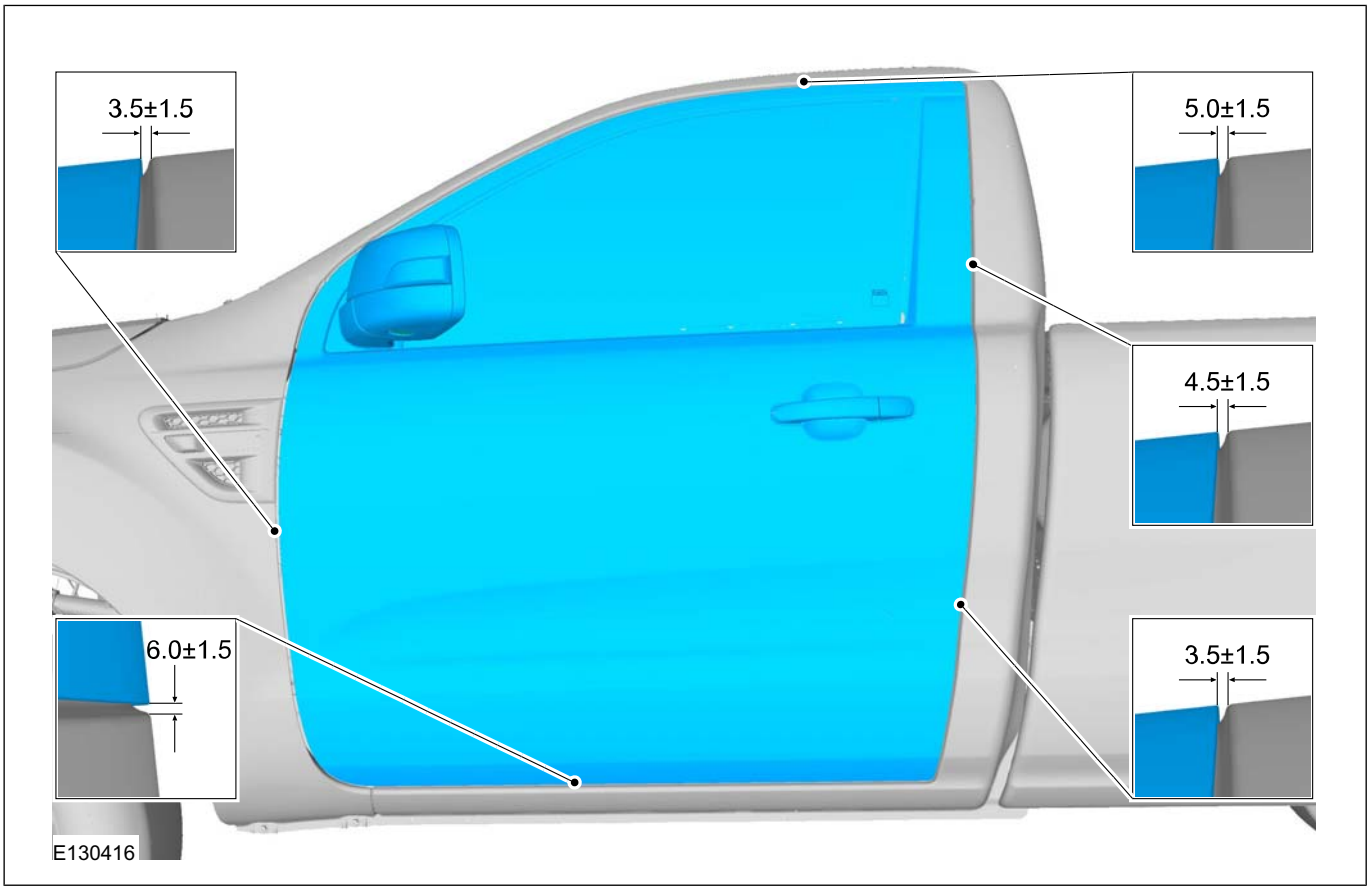


8. Torque: 20 Nm



9. **NOTE:** All the values are in mm.

GENERAL PROCEDURES

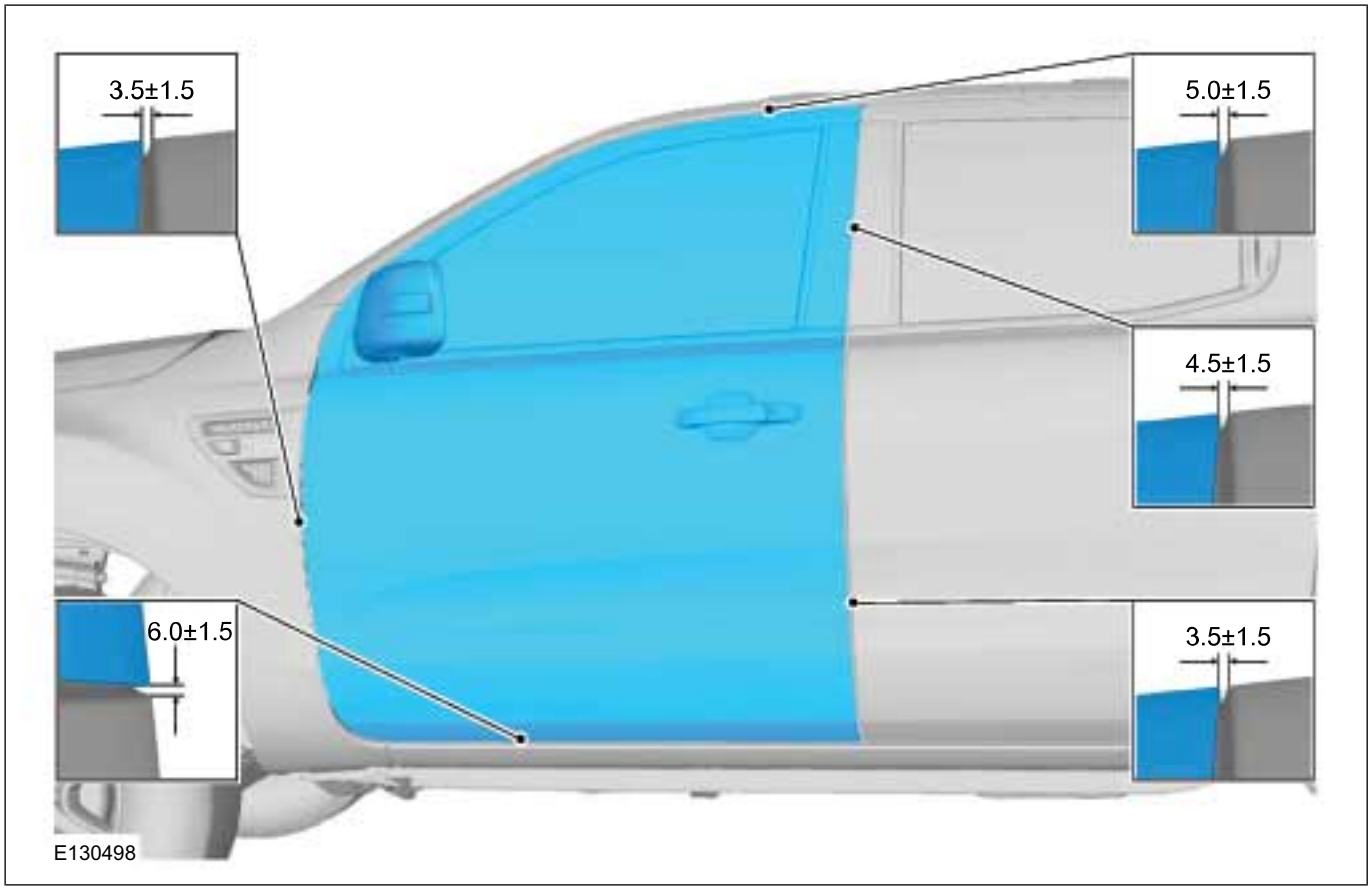


GENERAL PROCEDURES

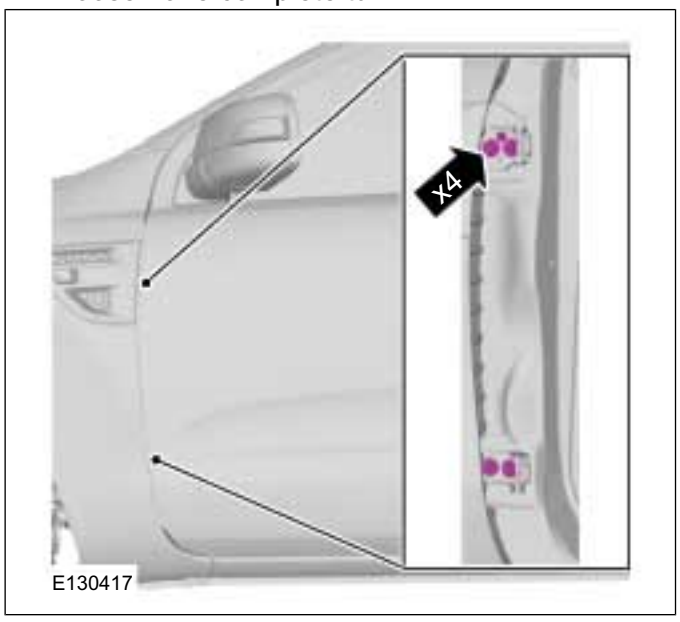
Front Door Alignment — Double Cab

Activation

10. **NOTE:** All the values are in mm.



11. Loosen one complete turn.

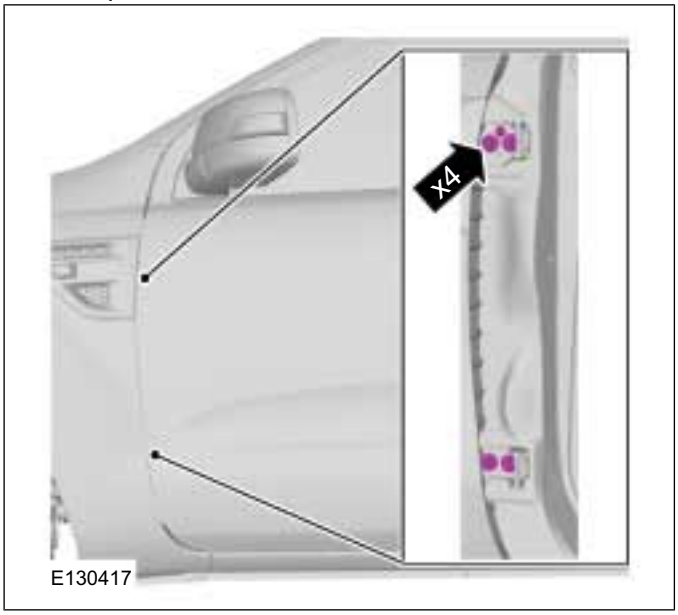


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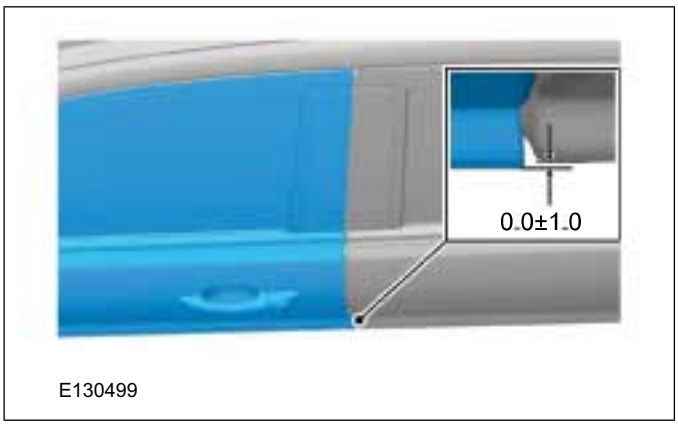


GENERAL PROCEDURES

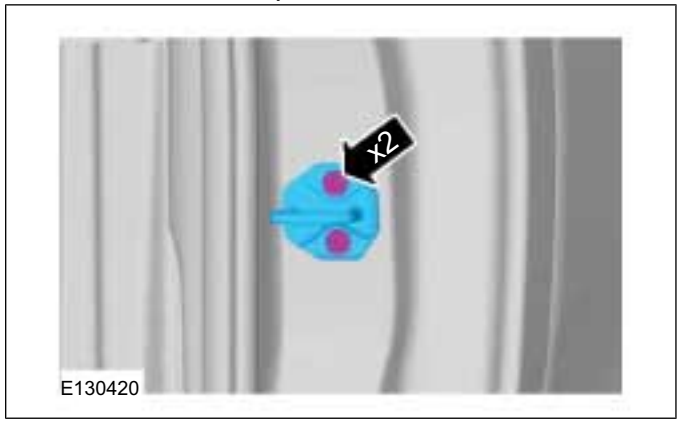
13. Torque: 25 Nm



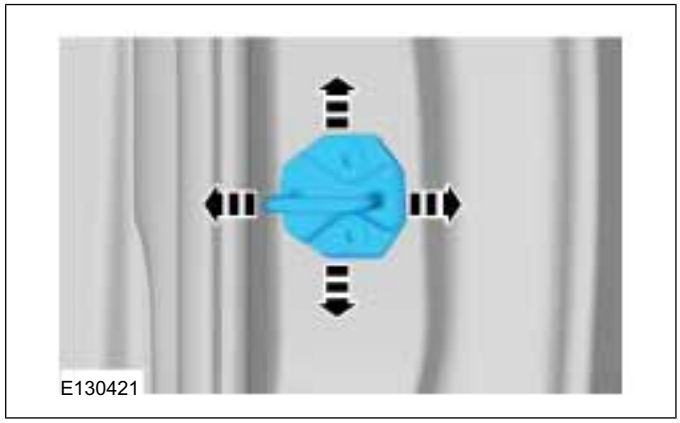
14. NOTE: All the values are in mm.



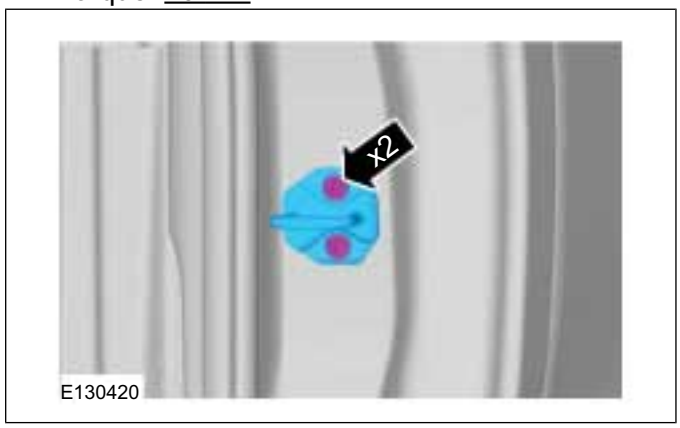
15. Loosen one complete turn.



16.

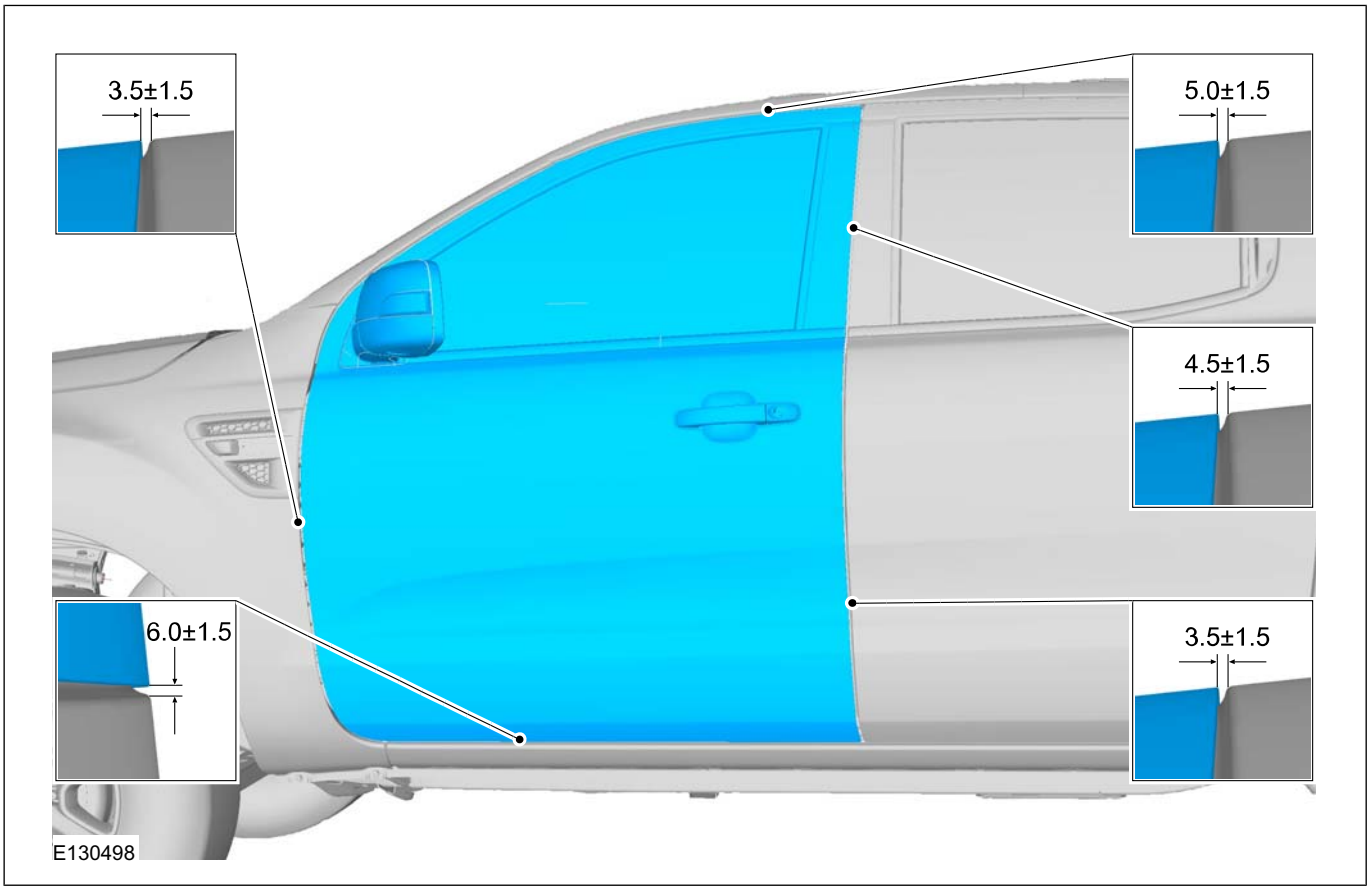


17. Torque: 20 Nm



18. NOTE: All the values are in mm.

GENERAL PROCEDURES

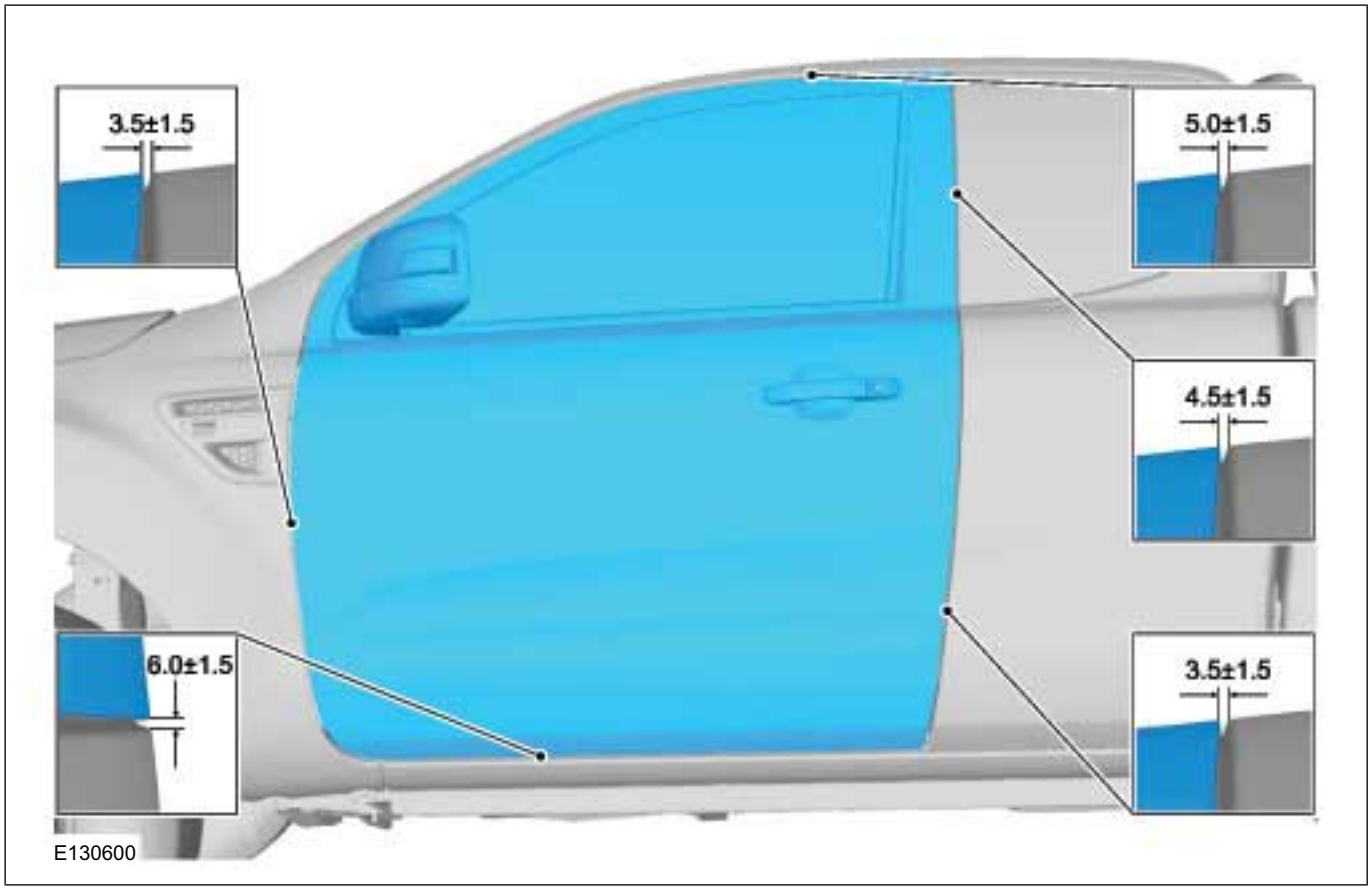


GENERAL PROCEDURES

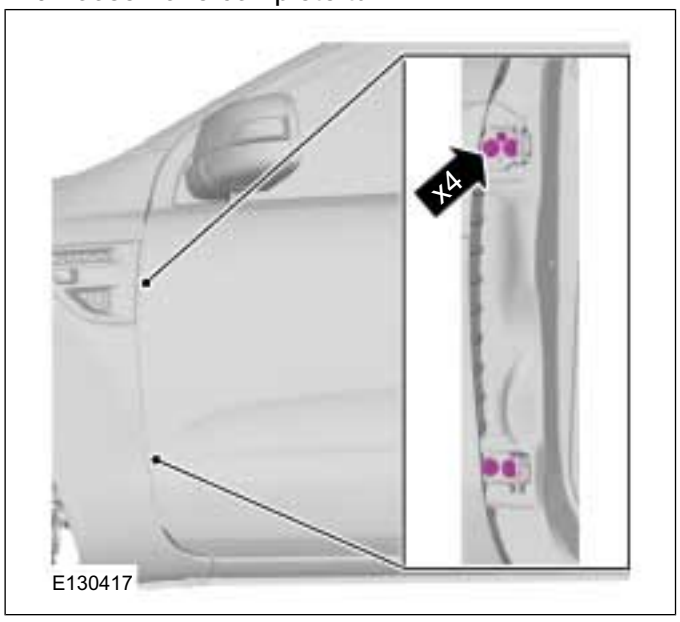
Front Door Alignment — Super Cab

Activation

19. **NOTE:** All the values are in mm.



20. Loosen one complete turn.

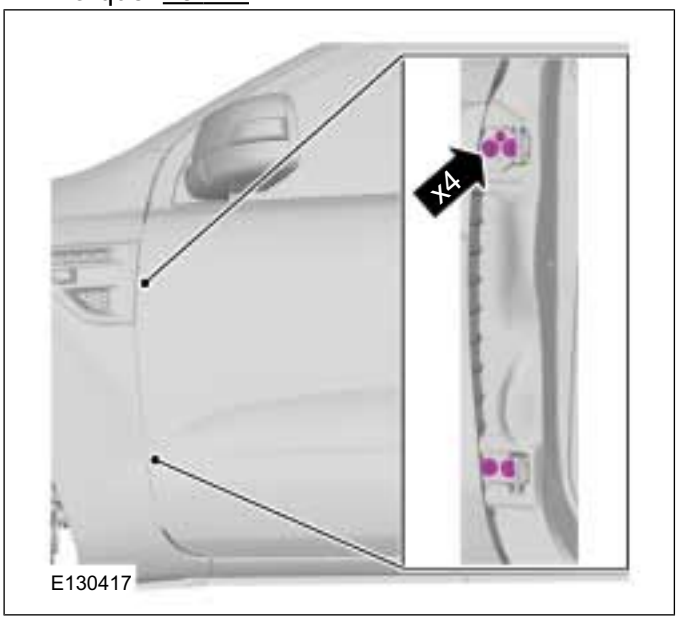


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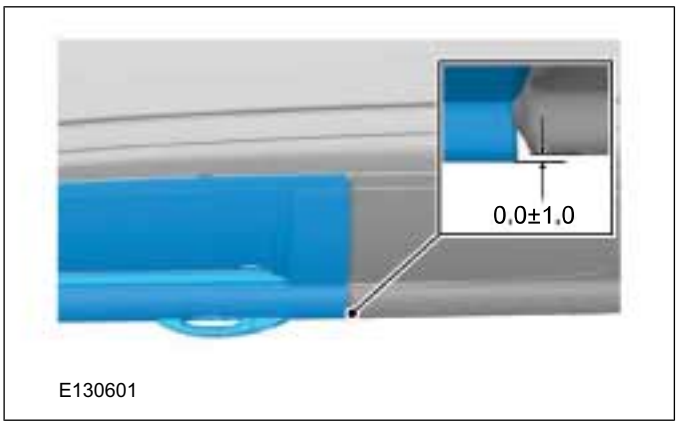


GENERAL PROCEDURES

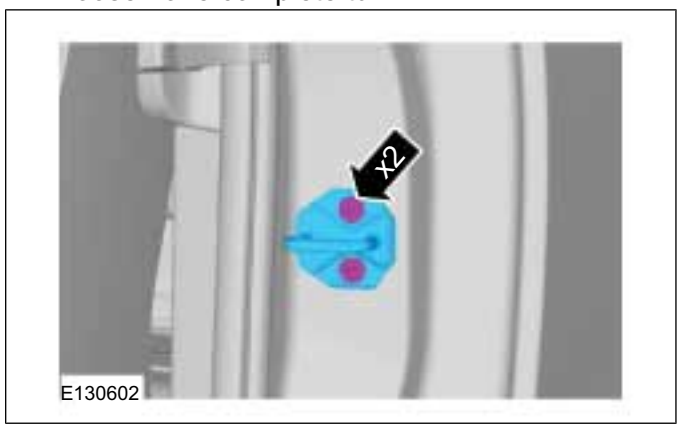
22. Torque: 25 Nm



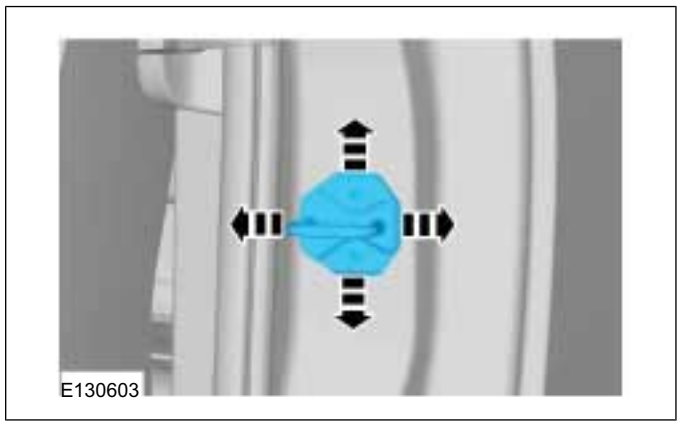
23. NOTE: All the values are in mm.



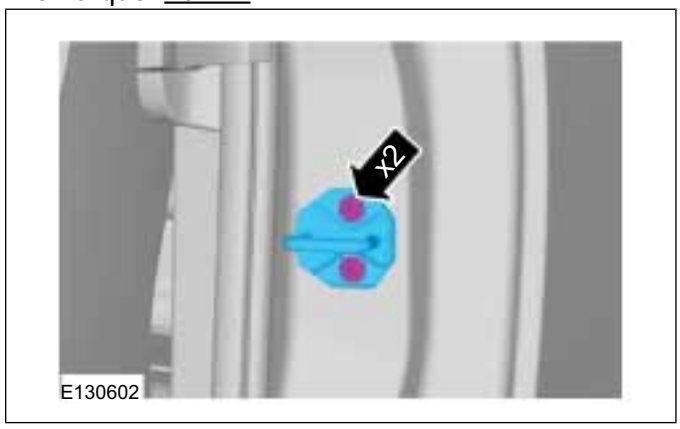
24. Loosen one complete turn.



25.

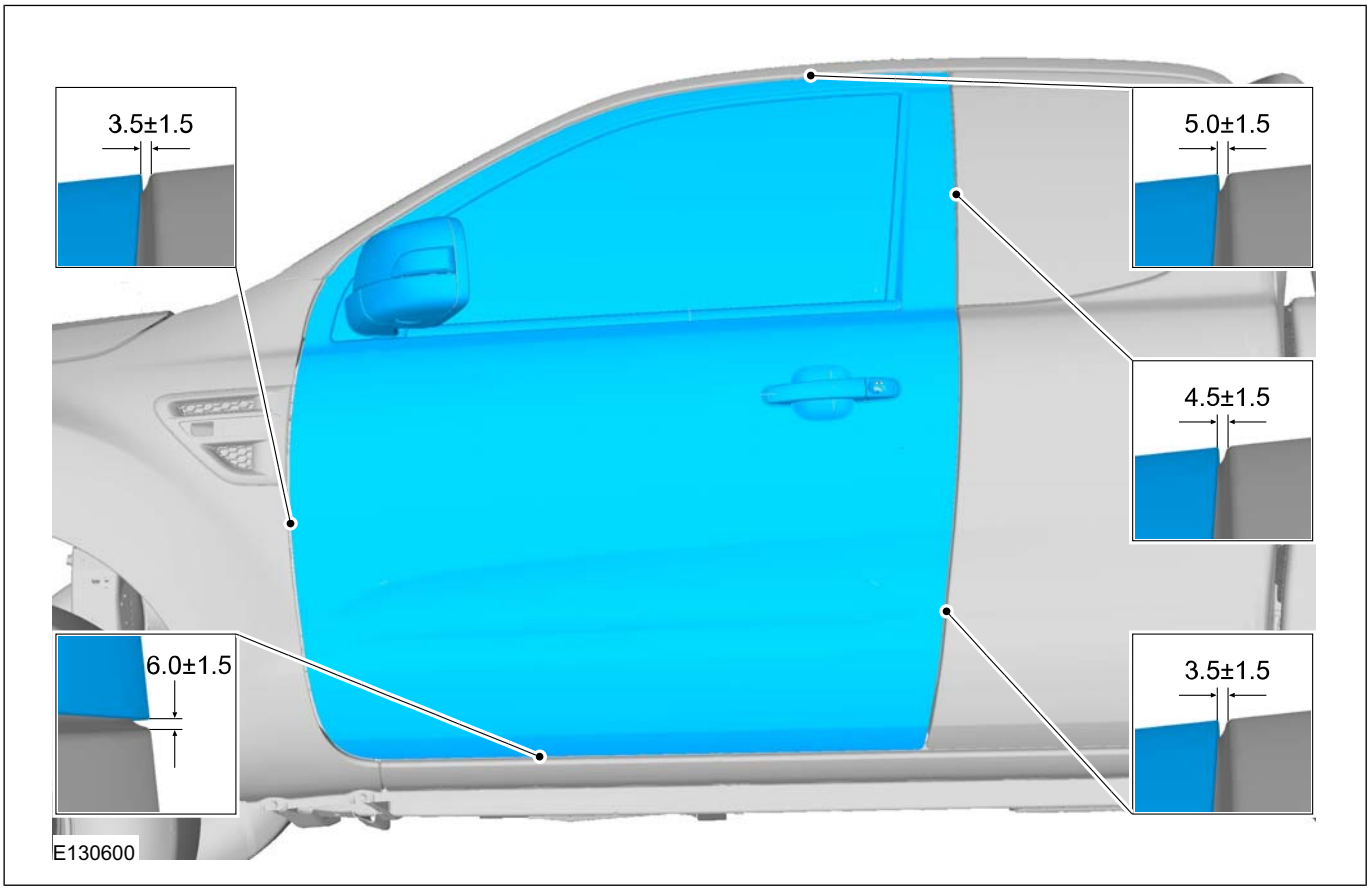


26. Torque: 20 Nm



27. NOTE: All the values are in mm.

GENERAL PROCEDURES

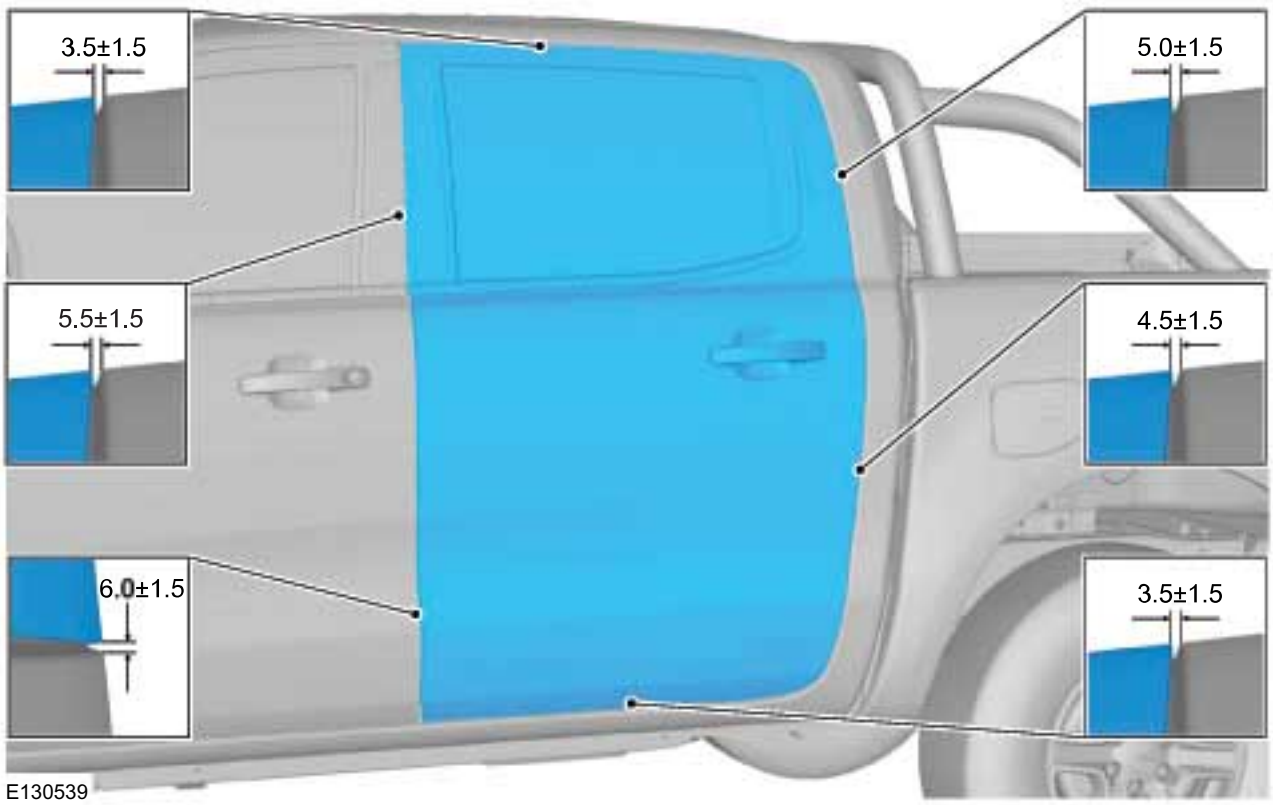


GENERAL PROCEDURES

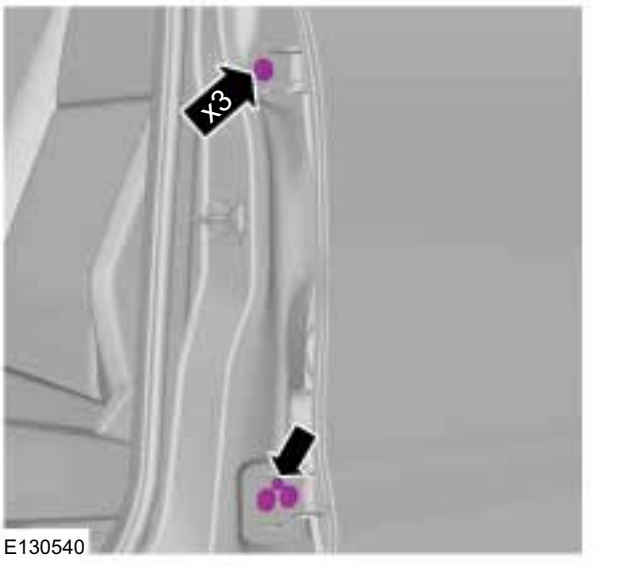
Rear Door Alignment — Double Cab

Activation

28. NOTE: All the values are in mm.



29. Loosen one complete turn.



30. Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

31. Loosen one complete turn.

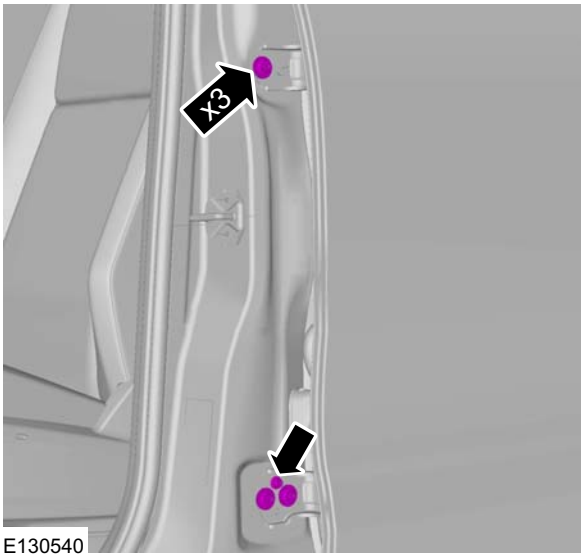


GENERAL PROCEDURES

32.


E130541

33. Torque: 35 Nm

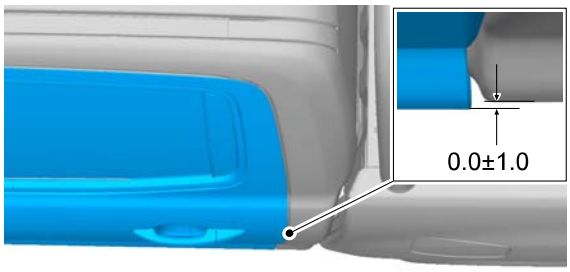


E130540

34. Torque: 35 Nm

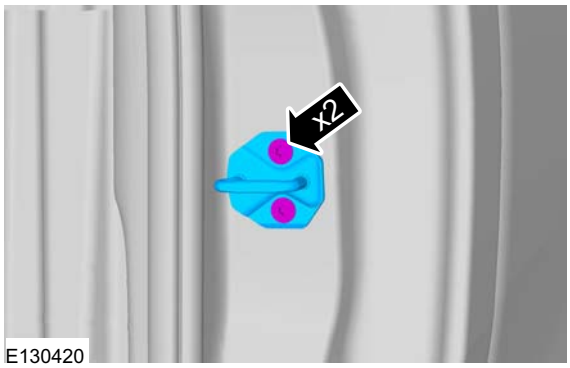

E130553

35. **NOTE:** All the values are in mm.



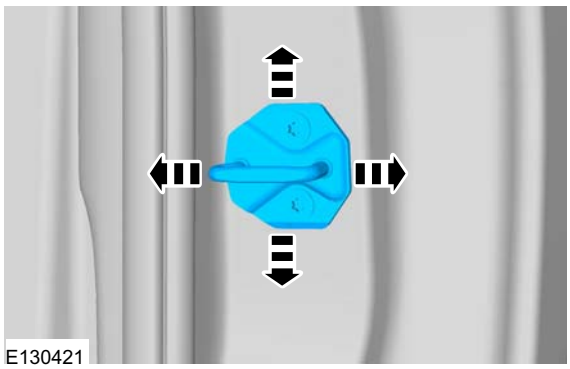
E130542

36. Loosen one complete turn.



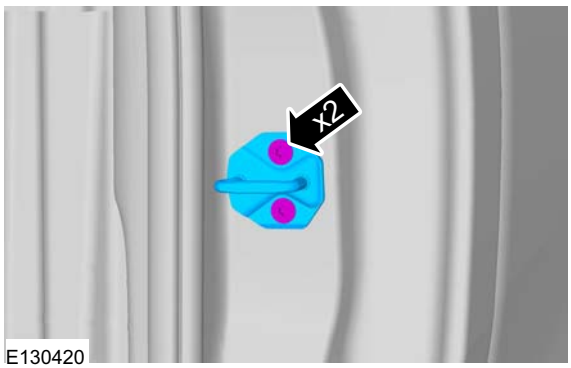
E130420

37.

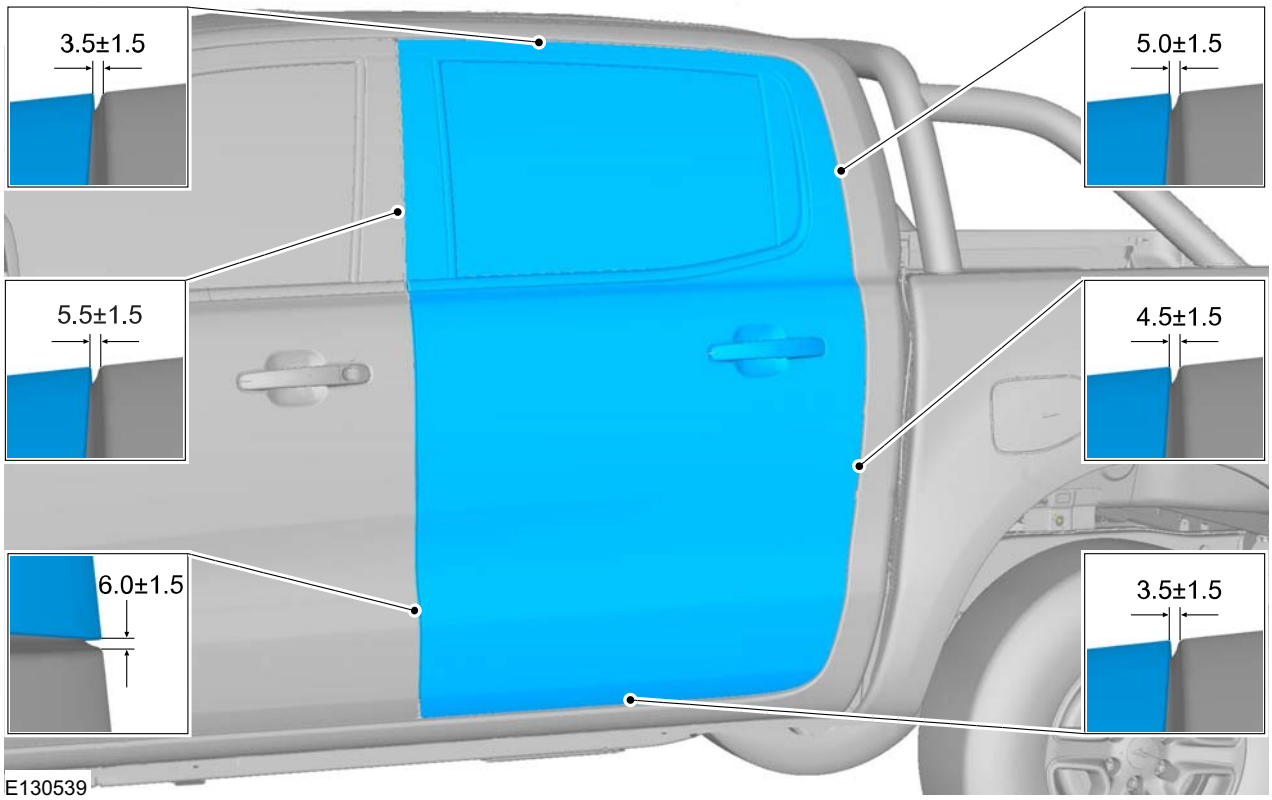

E130421

GENERAL PROCEDURES

38. Torque: 20 Nm



39. **NOTE:** All the values are in mm.

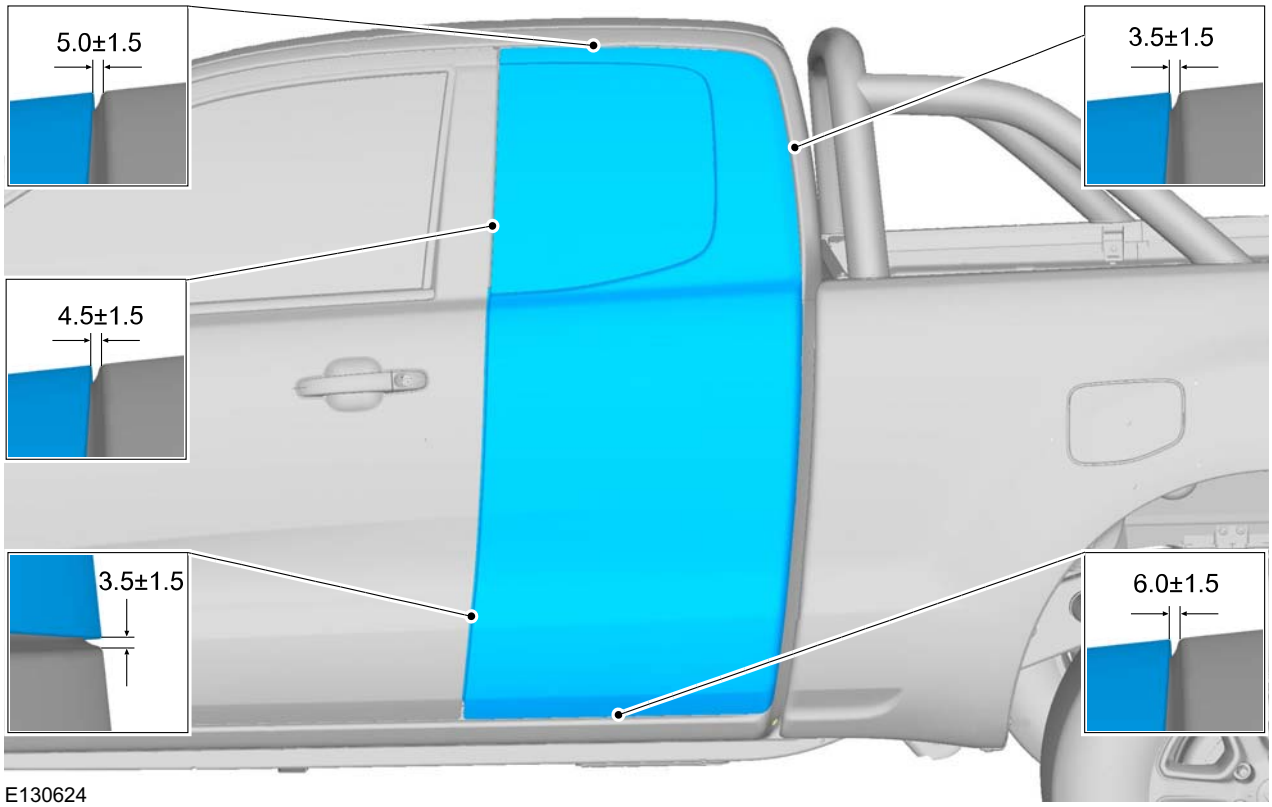


GENERAL PROCEDURES

Rear Door Alignment — Super Cab

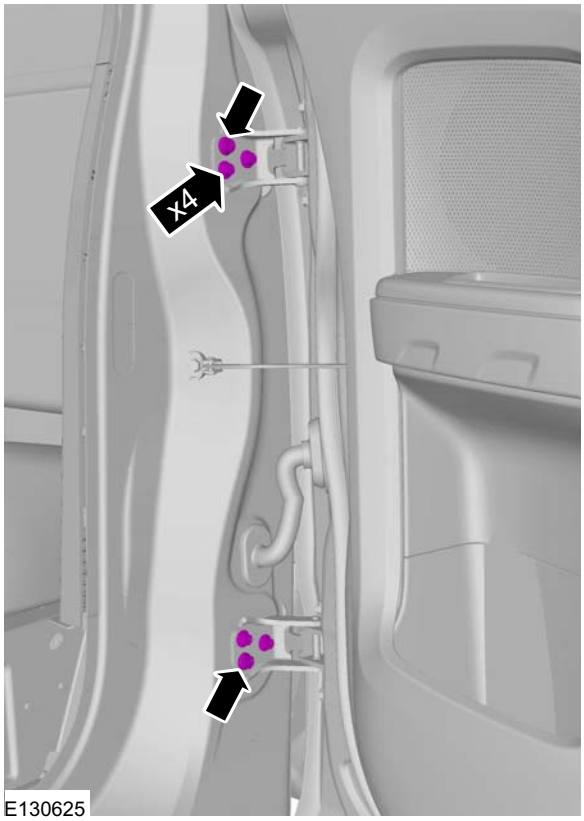
Activation

40. **NOTE:** All the values are in mm.



GENERAL PROCEDURES

41. Loosen one complete turn.

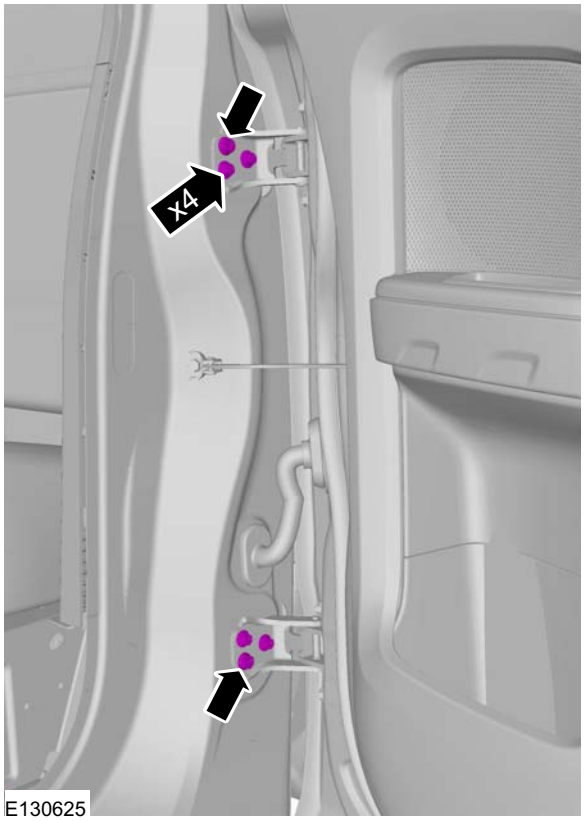


E130625

42.

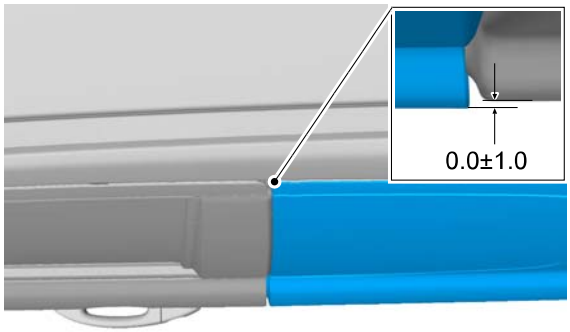

E130626

43. Torque: 35 Nm



E130625

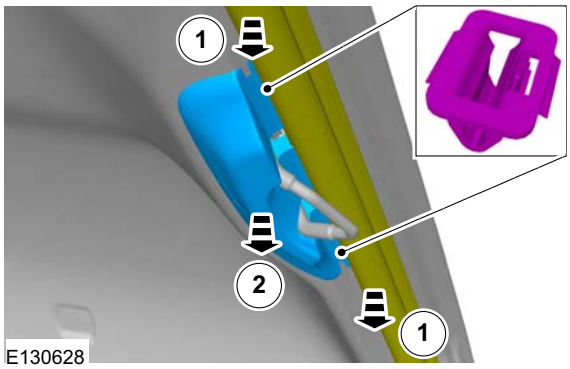
44. NOTE: All the values are in mm.



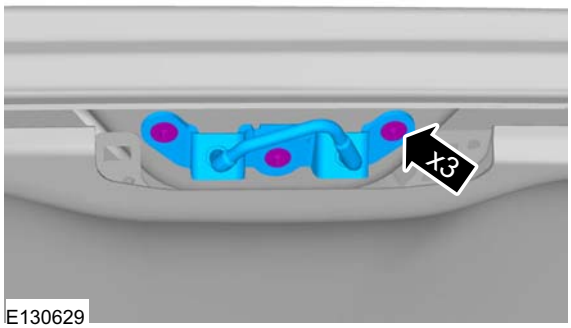
E130627

GENERAL PROCEDURES

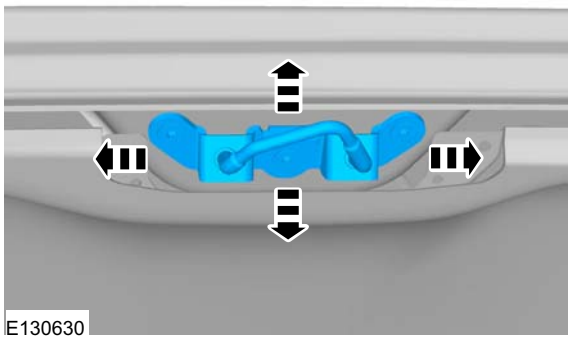
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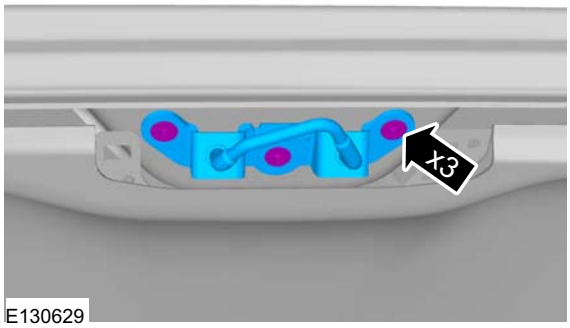
46. Loosen one complete turn.



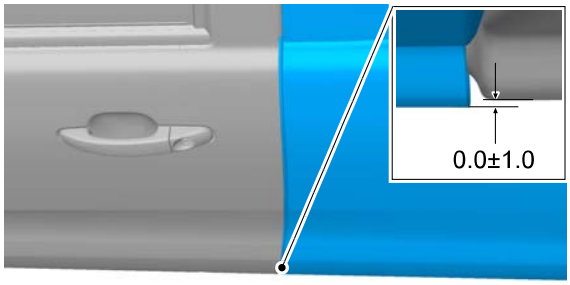
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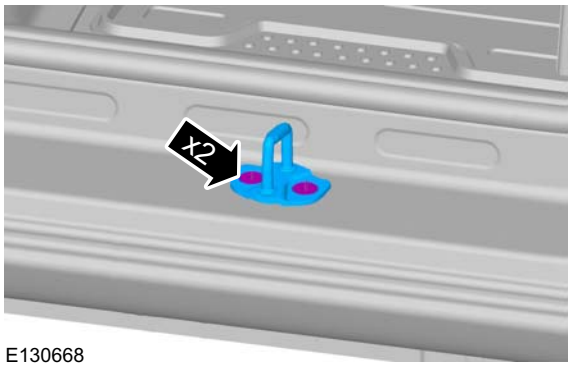
48. Torque: 10 Nm



49.

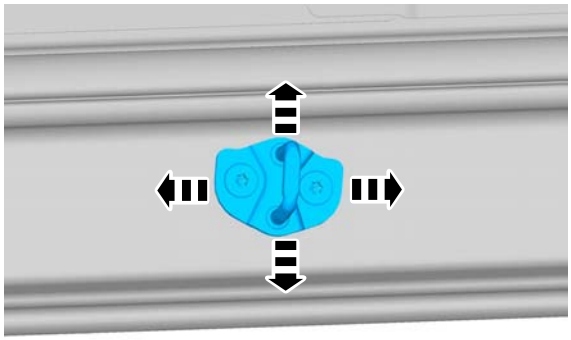


50. Loosen one complete turn.



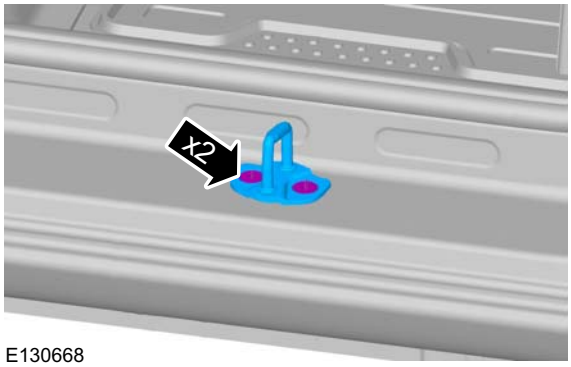
GENERAL PROCEDURES

51. Torque: 20 Nm



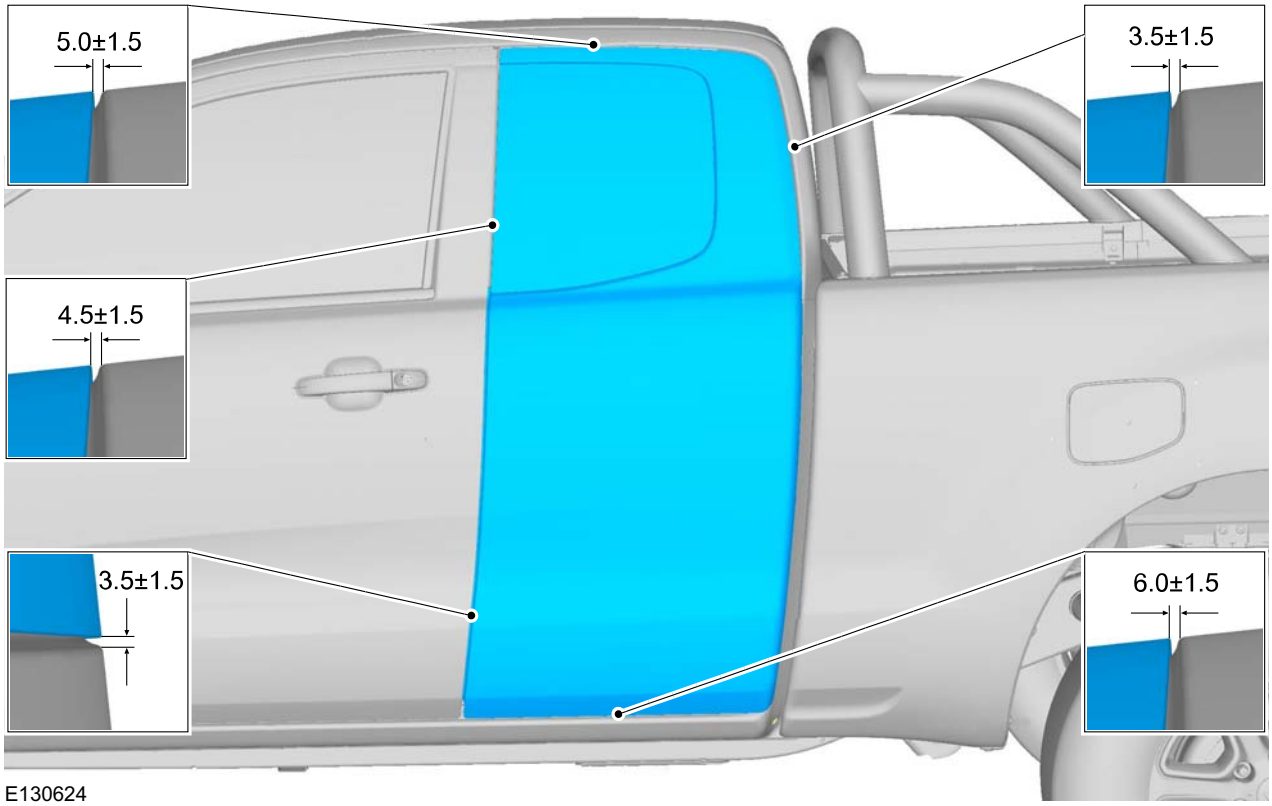
E130669

52. Torque: 10 Nm



E130668

53. NOTE: All the values are in mm.



E130624

GENERAL PROCEDURES

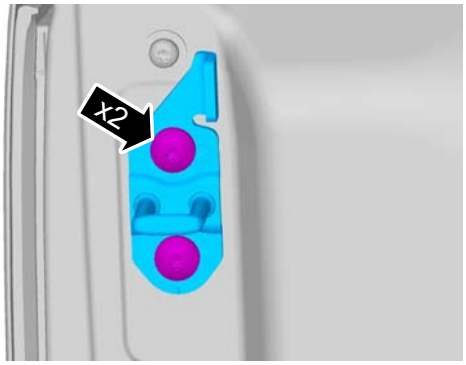
Liftgate Alignment

Activation

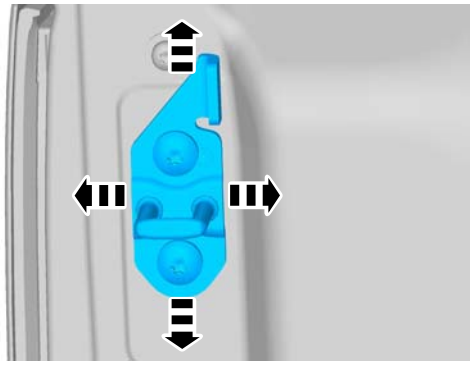
54.



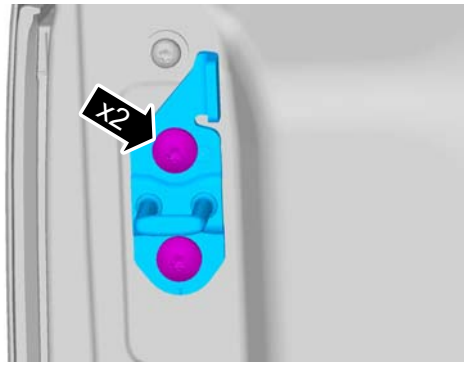
55. Loosen one complete turn.



56.



57. Torque: 10 Nm

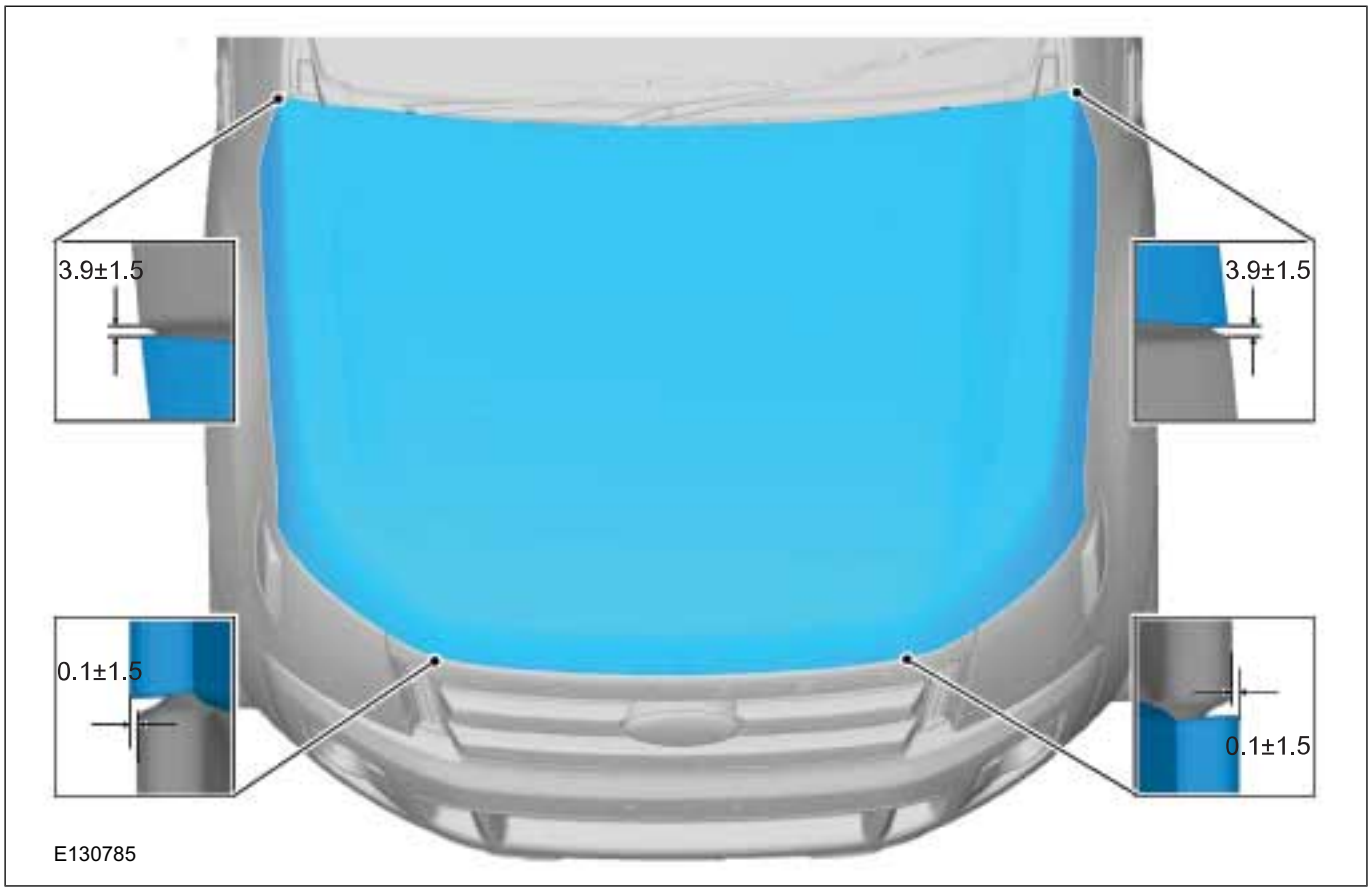


GENERAL PROCEDURES

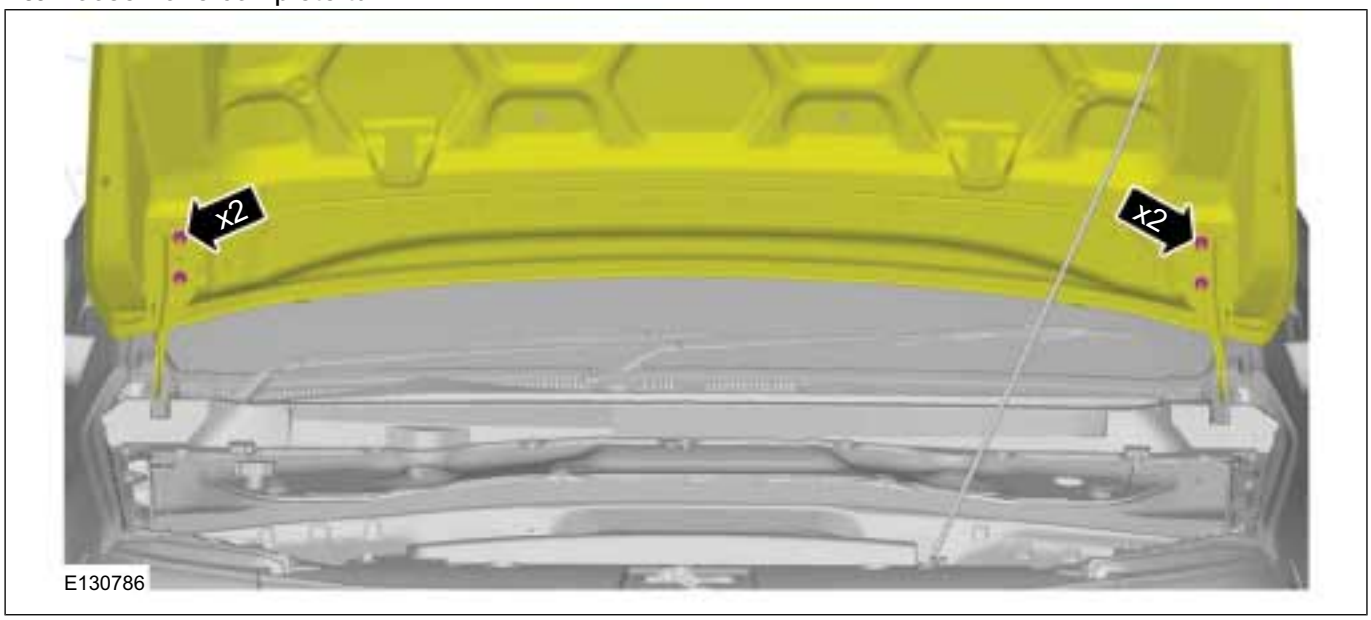
Hood Alignment

Activation

58. **NOTE:** All the values are in mm.

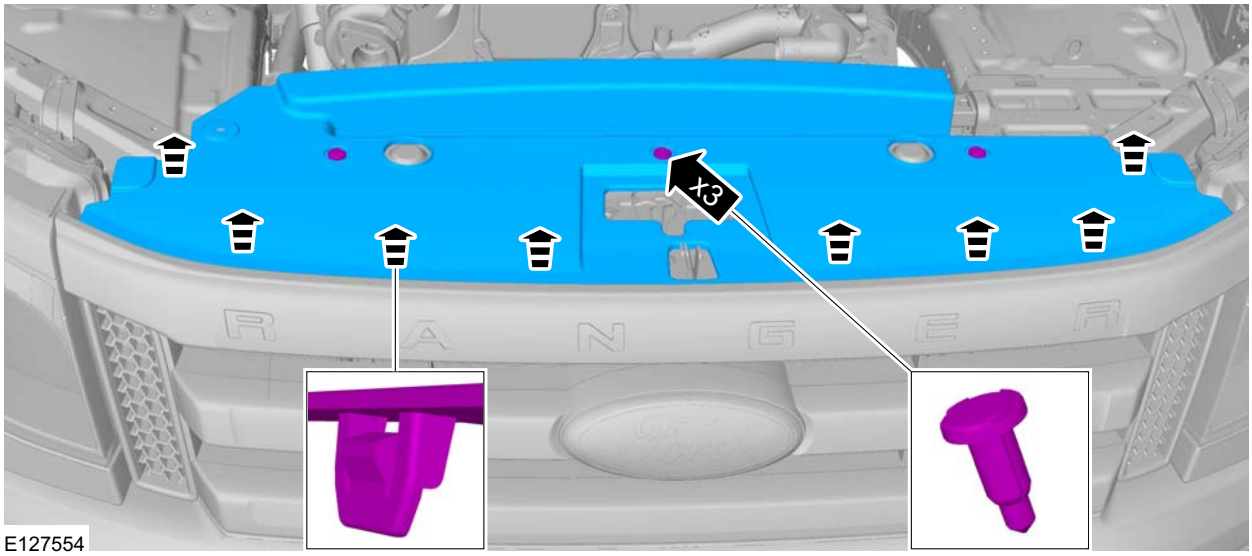


59. Loosen one complete turn.



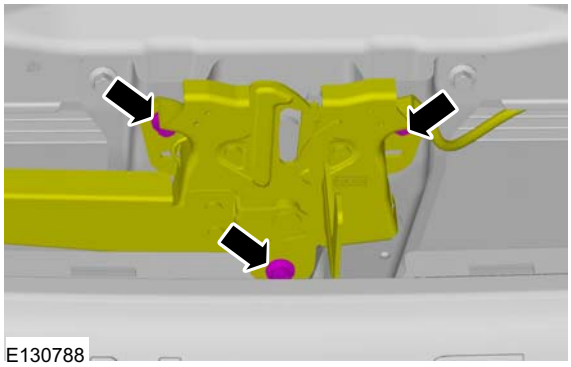
GENERAL PROCEDURES

60.

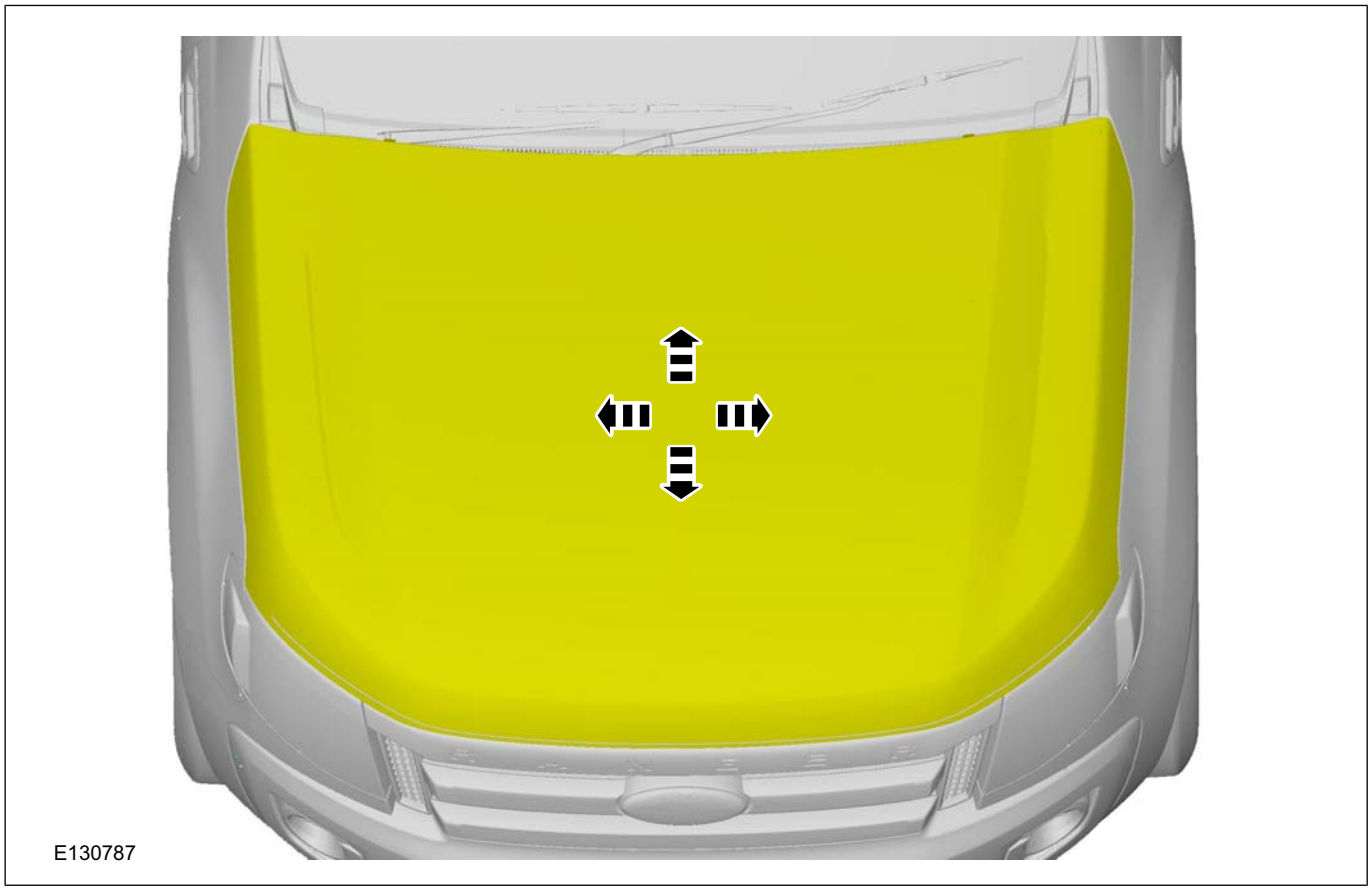


62.

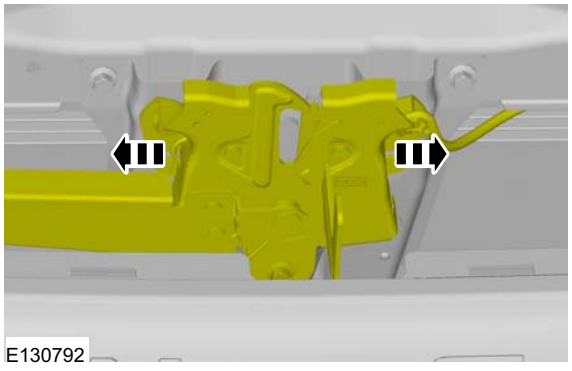
61. Loosen one complete turn.



GENERAL PROCEDURES

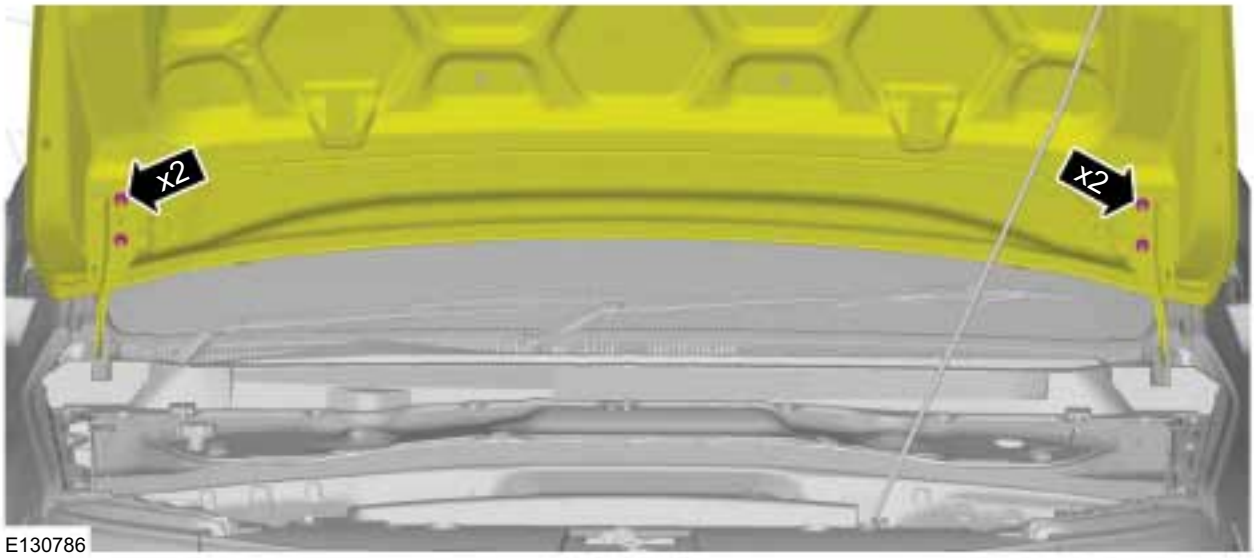


63.



64. Check the area for paintwork damage and repair if necessary.
Torque: 25 Nm

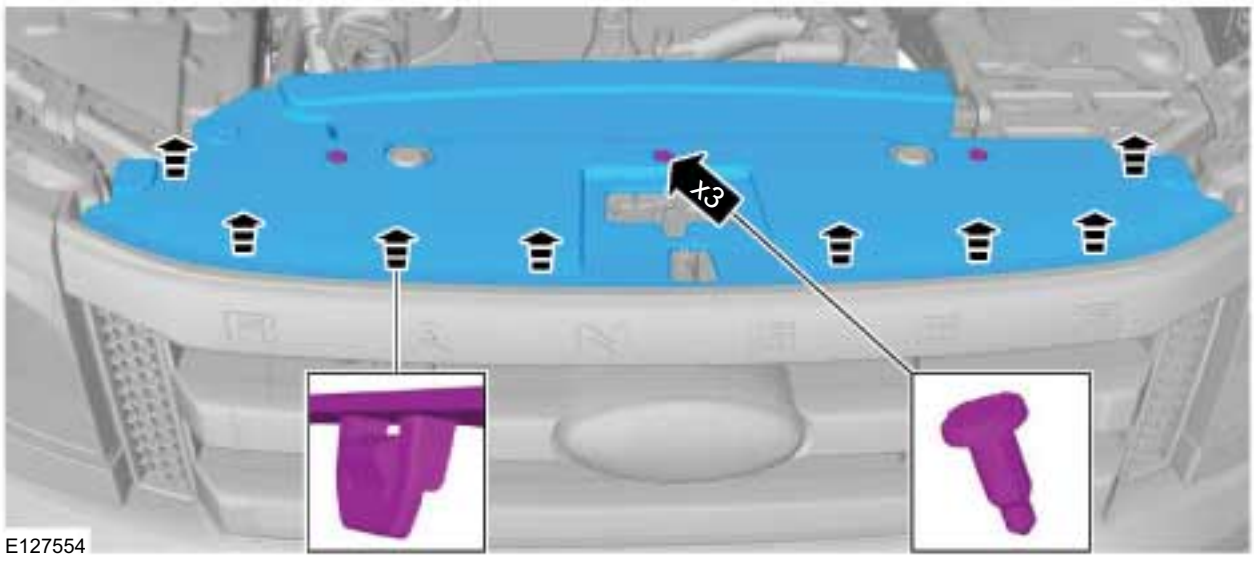
GENERAL PROCEDURES



65. Torque: 10 Nm

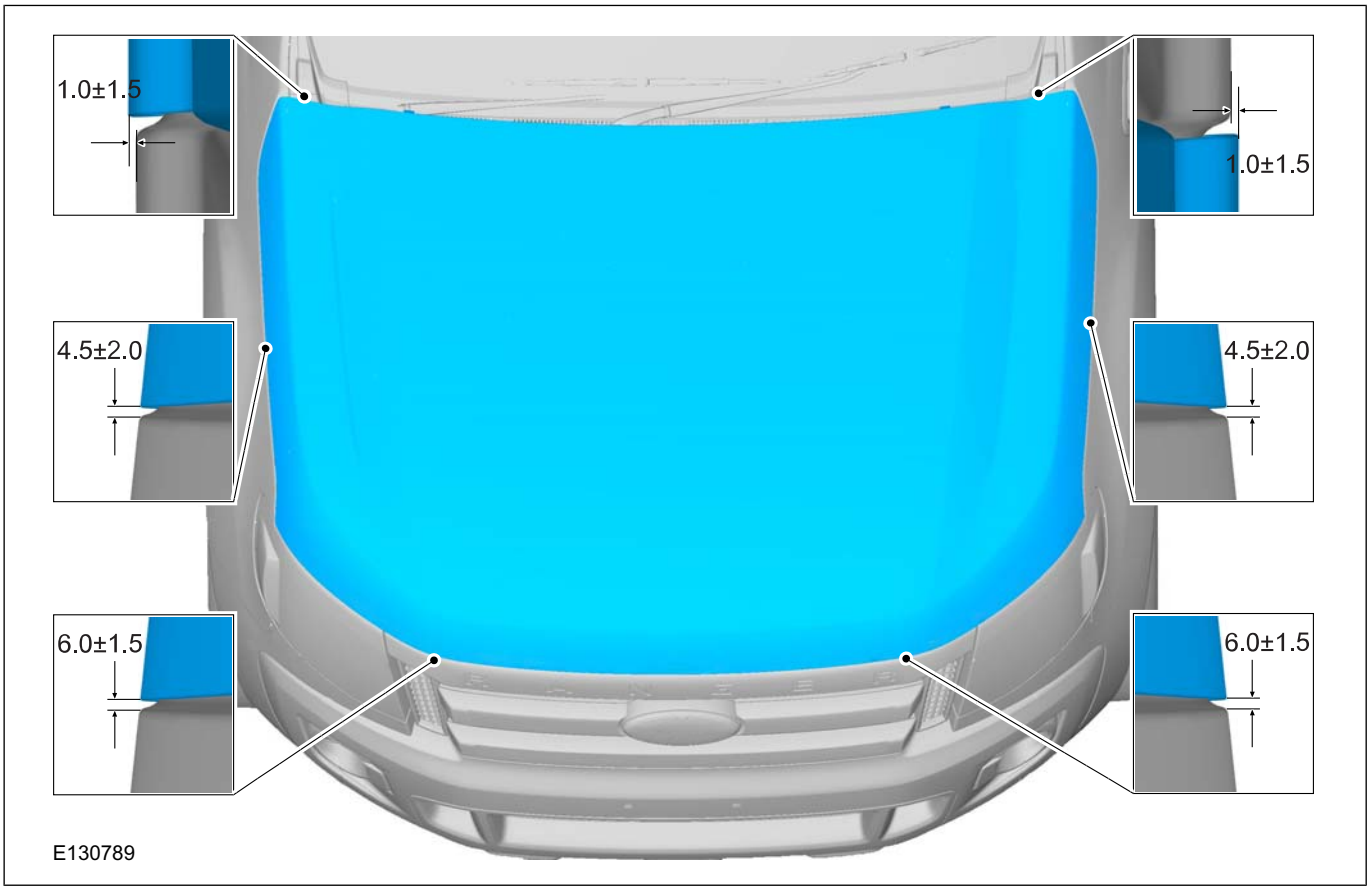
66.





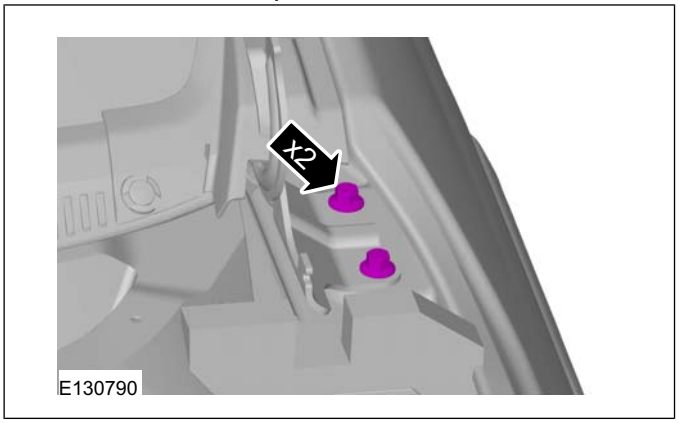
67. **NOTE:** All the values are in mm.

GENERAL PROCEDURES

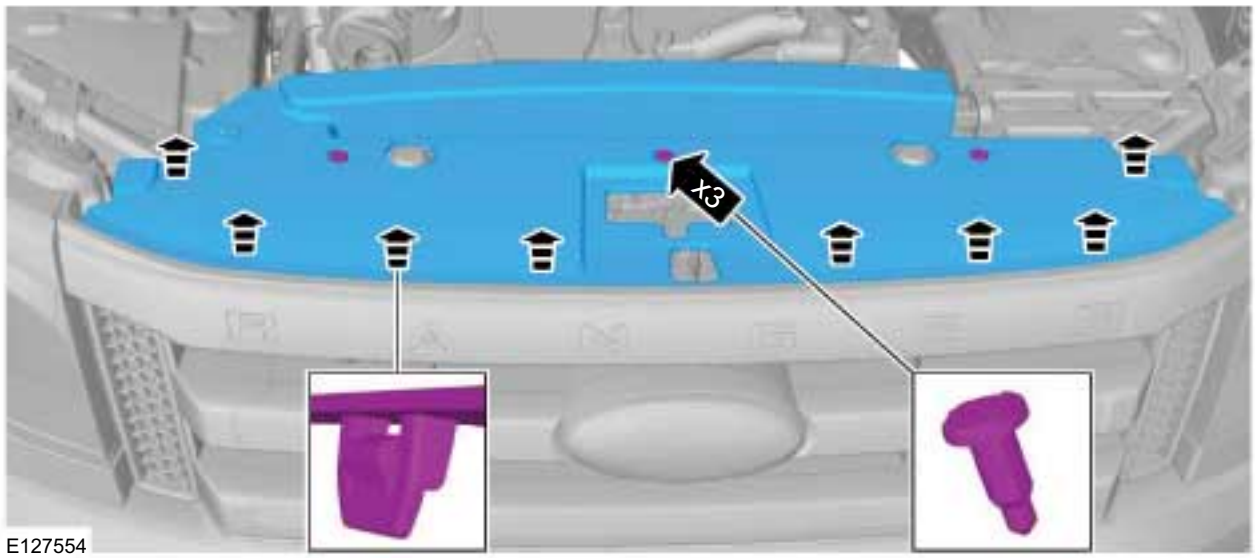


68. Loosen one complete turn.

69.



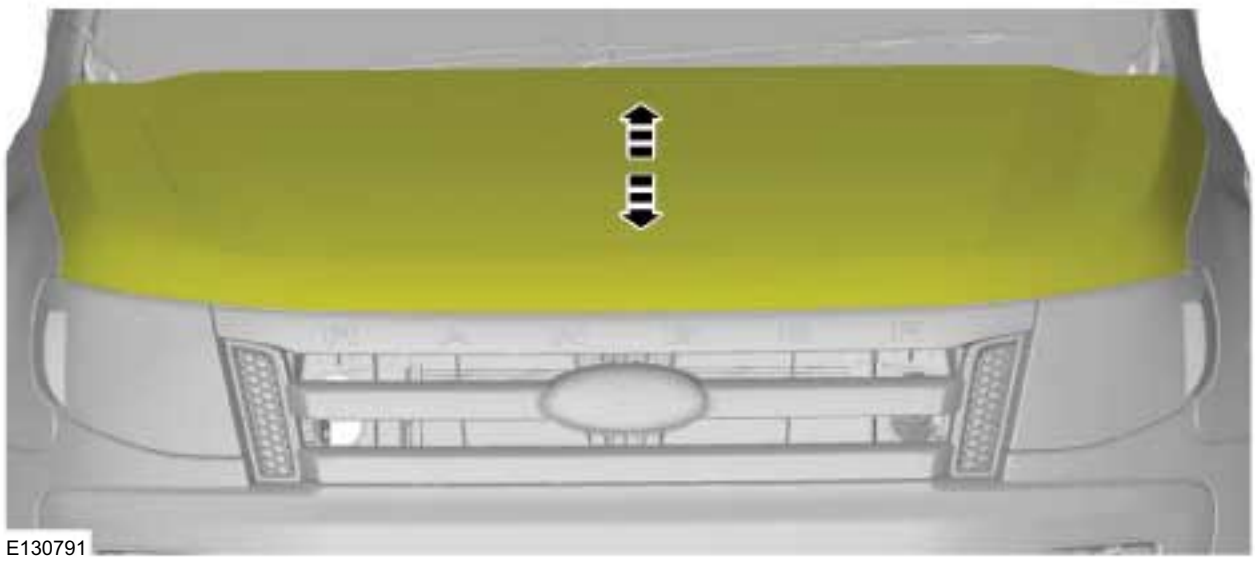
GENERAL PROCEDURES



70. Loosen one complete turn.

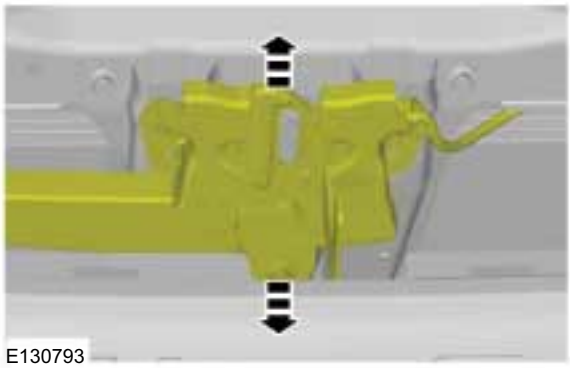


71.

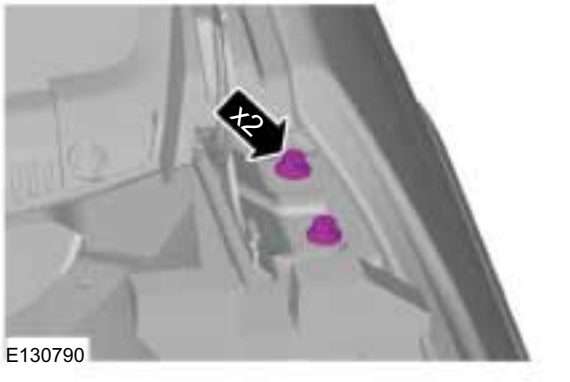


GENERAL PROCEDURES

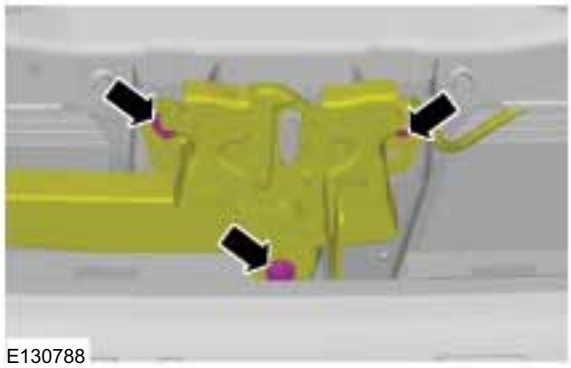
72.



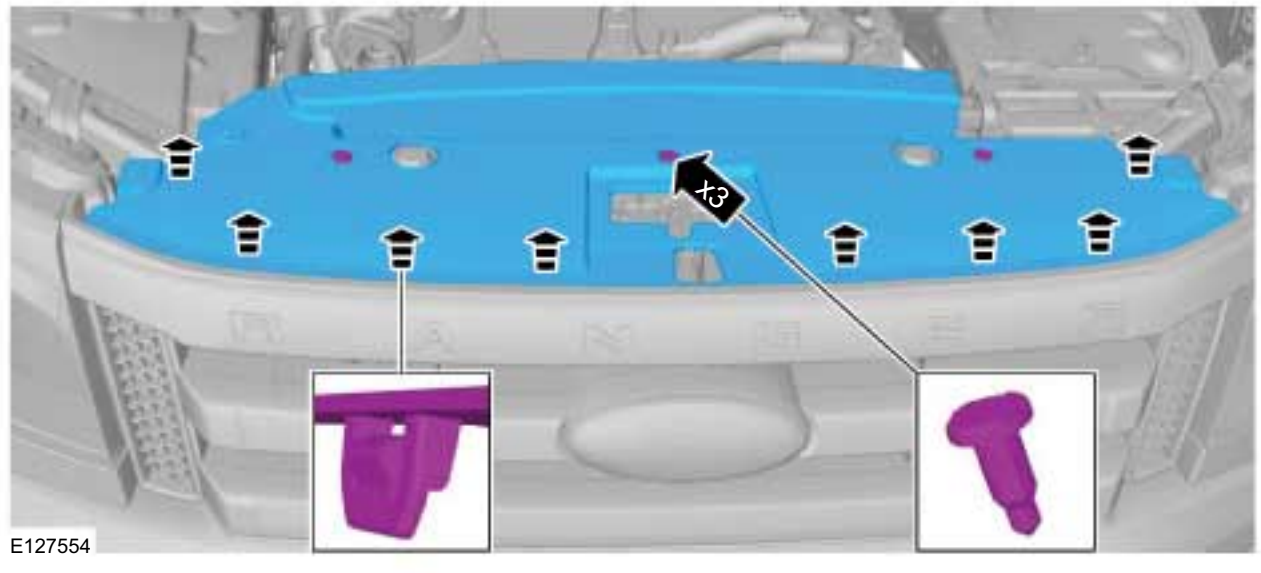
73. Check the area for paintwork damage and repair if necessary.
Torque: 25 Nm



74. Torque: 10 Nm



75.



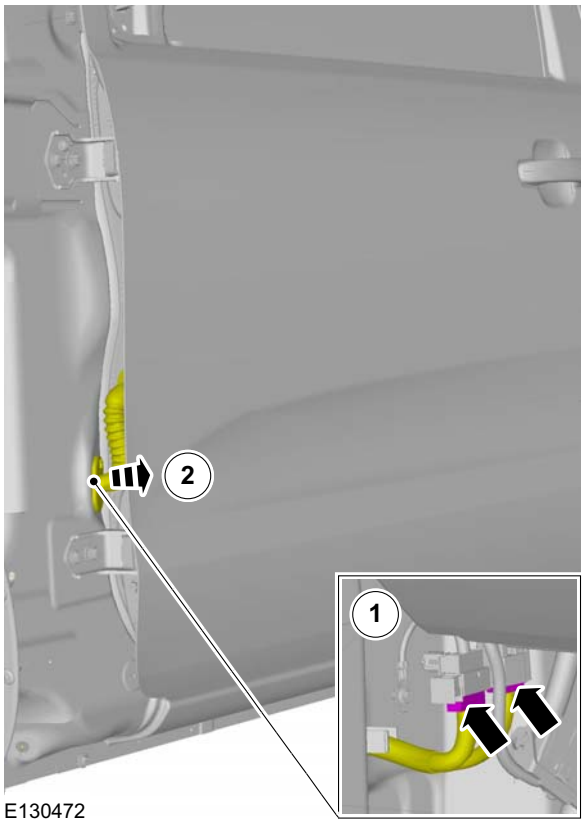
REMOVAL AND INSTALLATION

Door — Single Cab

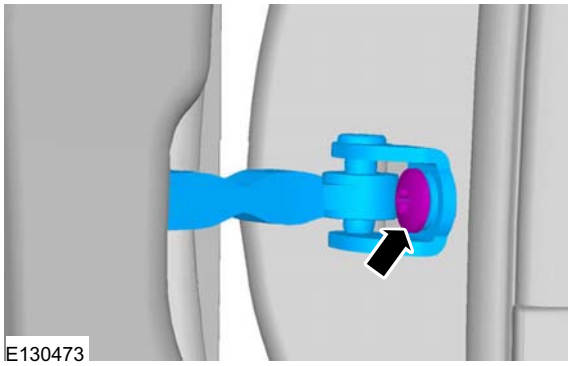
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Refer to: Front Fender (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4.



5. Torque: 25 Nm



6. Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Door Alignment - Single Cab (501-03 Body Closures, General Procedures).

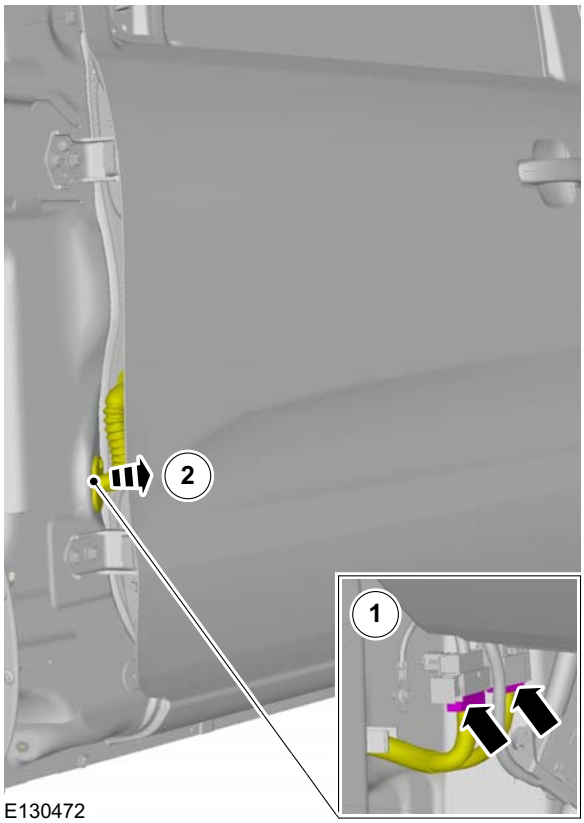
REMOVAL AND INSTALLATION

Front Door

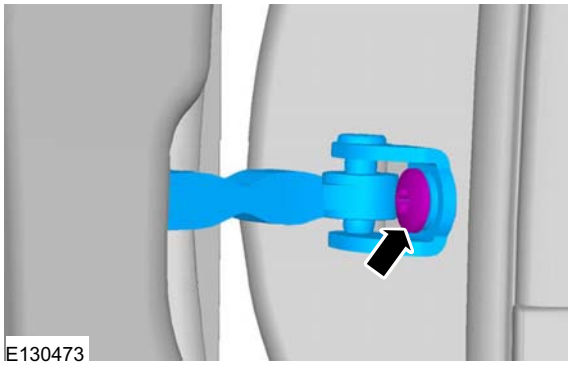
Removal

NOTE: Removal steps in this procedure may contain installation details.

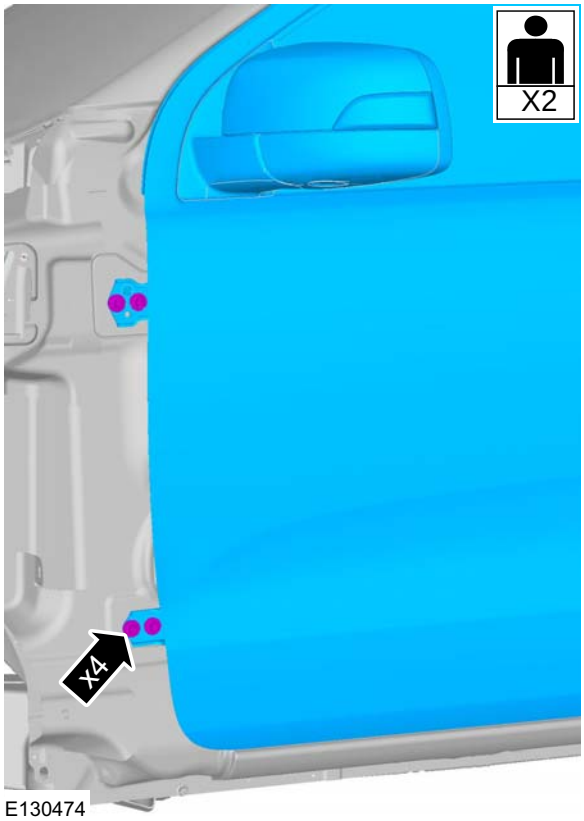
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Refer to: Front Fender (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4.



5. Torque: 25 Nm



6. Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

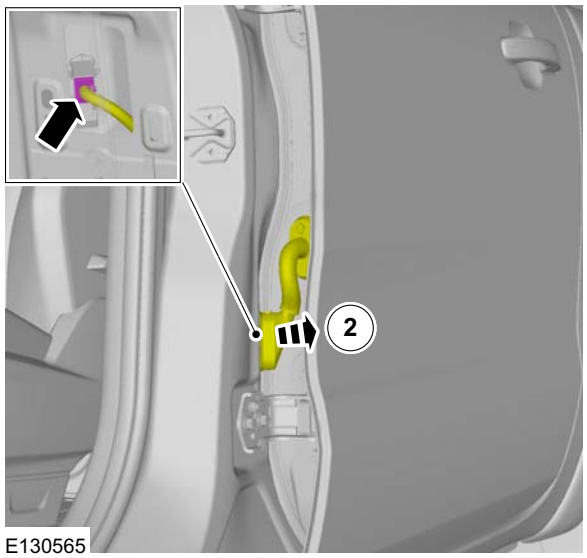
2. Refer to: Front Door Alignment - Double Cab (501-03 Body Closures, General Procedures).
   Refer to: Front Door Alignment - Super Cab (501-03 Body Closures, General Procedures).

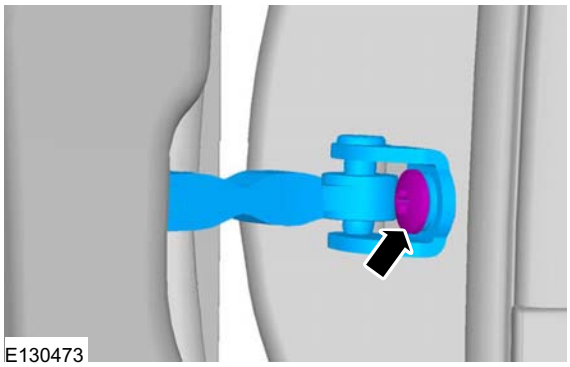
REMOVAL AND INSTALLATION

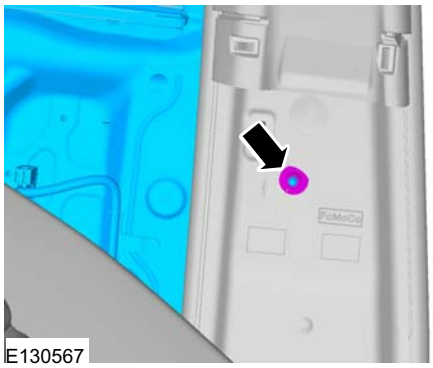
Rear Door — Double Cab

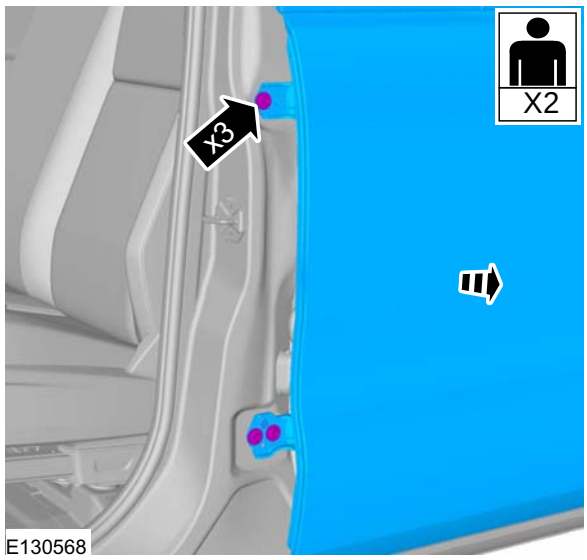
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. 

4. Torque: 25 Nm


5. Torque: 25 Nm


6. Torque: 25 Nm


Installation

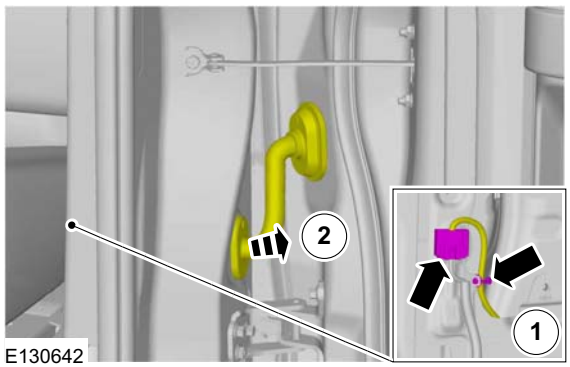
1. To install, reverse the removal procedure.
2. Refer to: Rear Door Alignment - Double Cab (501-03 Body Closures, General Procedures).

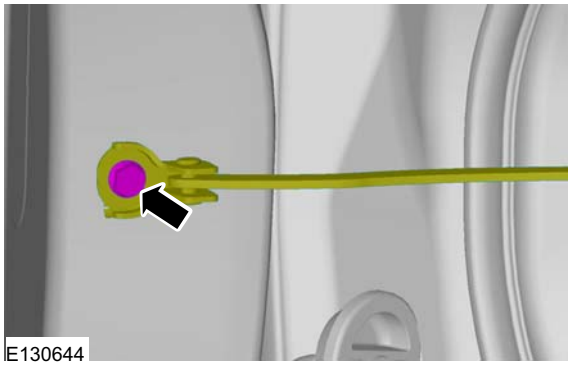
REMOVAL AND INSTALLATION

Rear Door — Super Cab

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. 

4. Torque: 10 Nm


5. Torque: 25 Nm


Installation

1. To install, reverse the removal procedure.
2. Refer to: Rear Door Alignment - Super Cab (501-03 Body Closures, General Procedures).

SECTION 501-05 Interior Trim and Ornamentation

VEHICLE APPLICATION: 2011.50 Ranger

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B-Pillar Upper Trim Panel..... 501-05-3
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C-Pillar Upper Trim Panel..... 501-05-5
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Rear Door Trim Panel — Double Cab..... 501-05-12
Rear Door Trim Panel — Super Cab..... 501-05-14
Front Scuff Plate Trim Panel..... 501-05-15
Rear Scuff Plate Trim Panel..... 501-05-16
Headliner..... 501-05-17

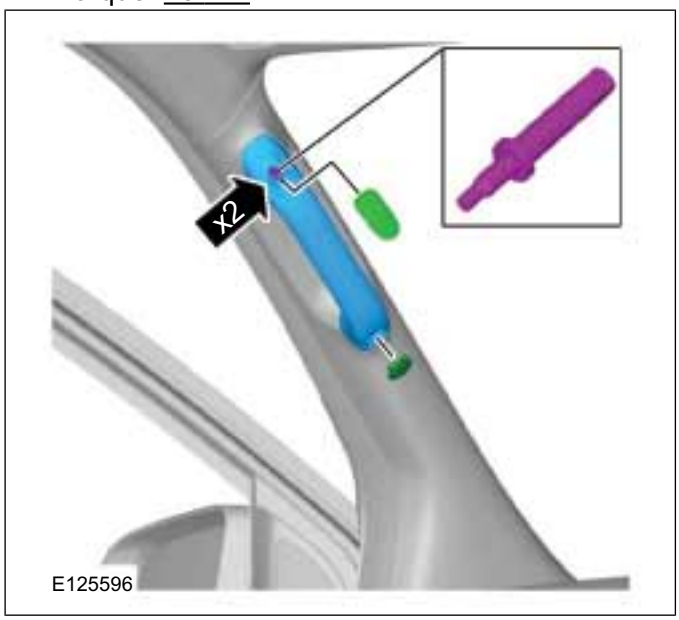
REMOVAL AND INSTALLATION

A-Pillar Trim Panel

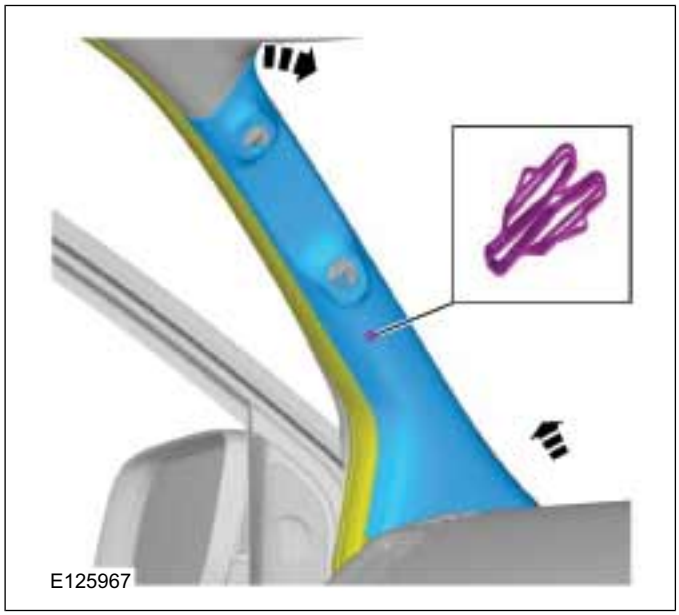
Removal

NOTE: Removal steps in this procedure may contain installation details.

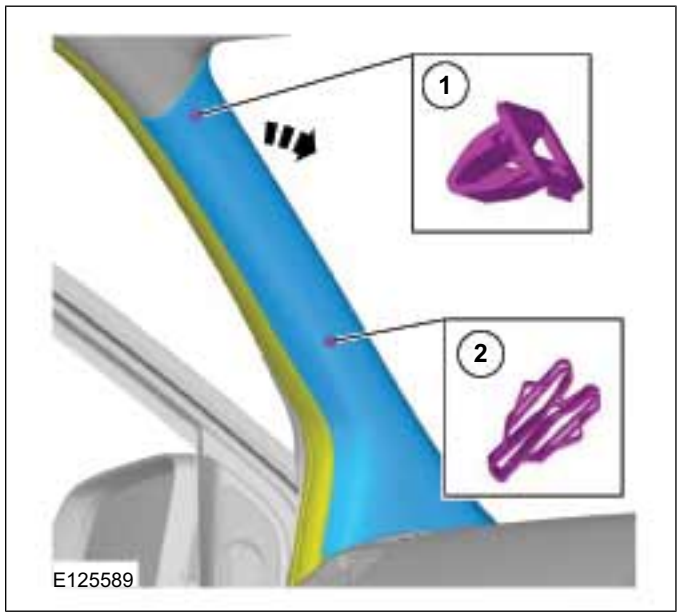
1. Torque: 10 Nm



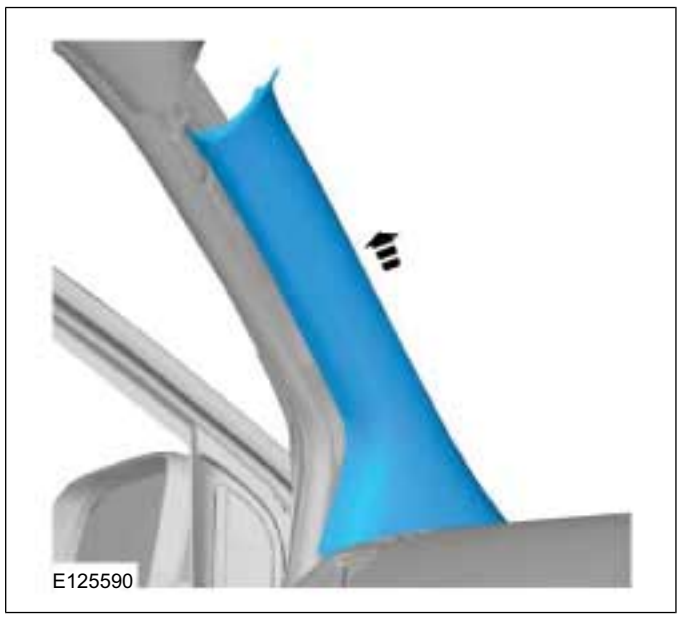
2.



3.



4.



Installation

1. To install, reverse the removal procedure.

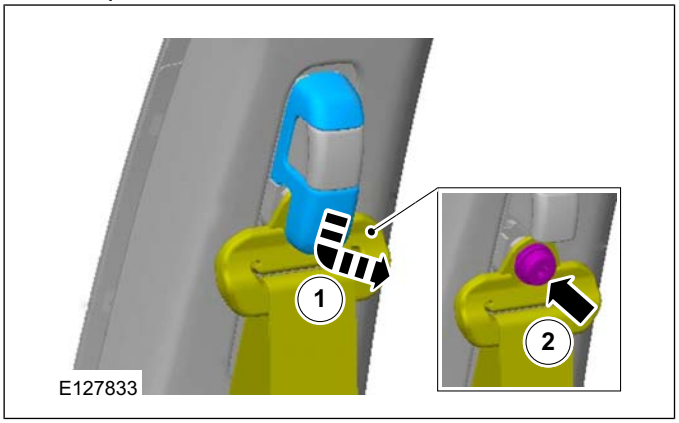
REMOVAL AND INSTALLATION

B-Pillar Upper Trim Panel

Removal

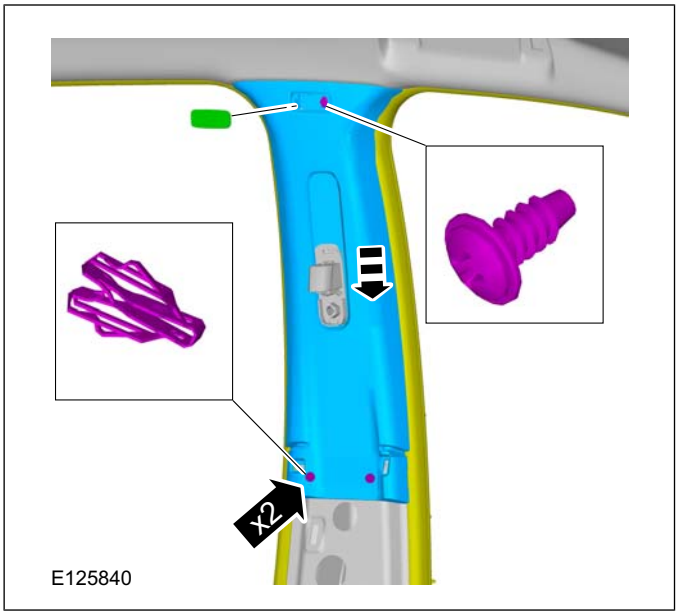
NOTE: Removal steps in this procedure may contain installation details.

1. Torque: 47 Nm



2. Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.



Installation

1. To install, reverse the removal procedure.

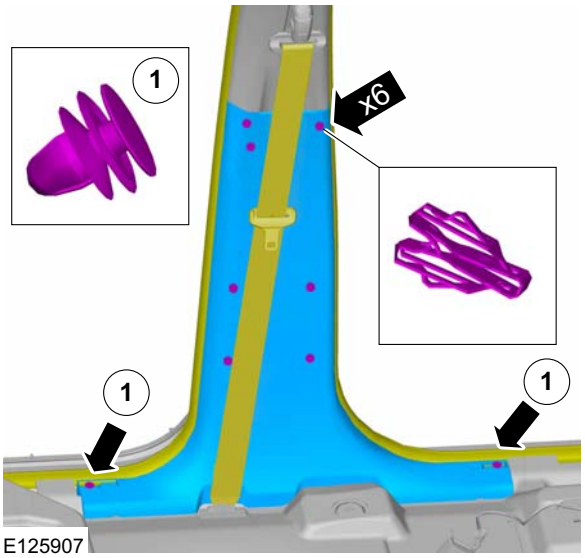
REMOVAL AND INSTALLATION

B-Pillar Lower Trim Panel

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Refer to: Rear Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

C-Pillar Upper Trim Panel

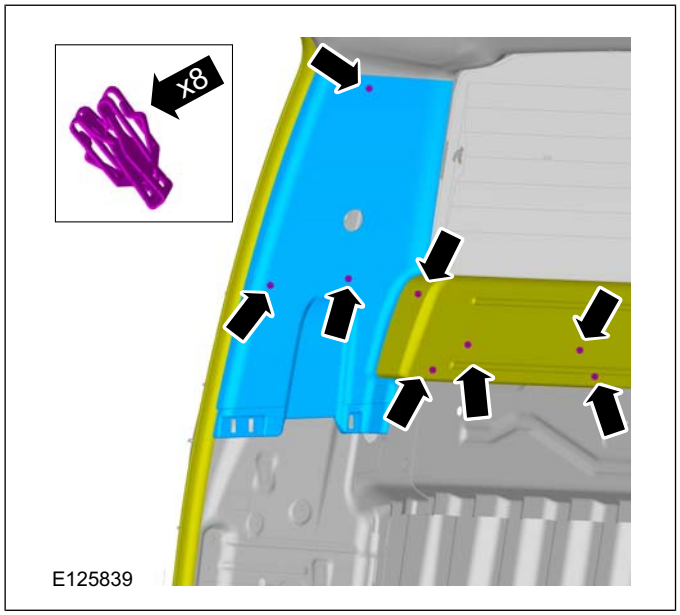
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Rear Safety Belt Retractor (501-20 Safety Belt System, Removal and Installation).
2. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

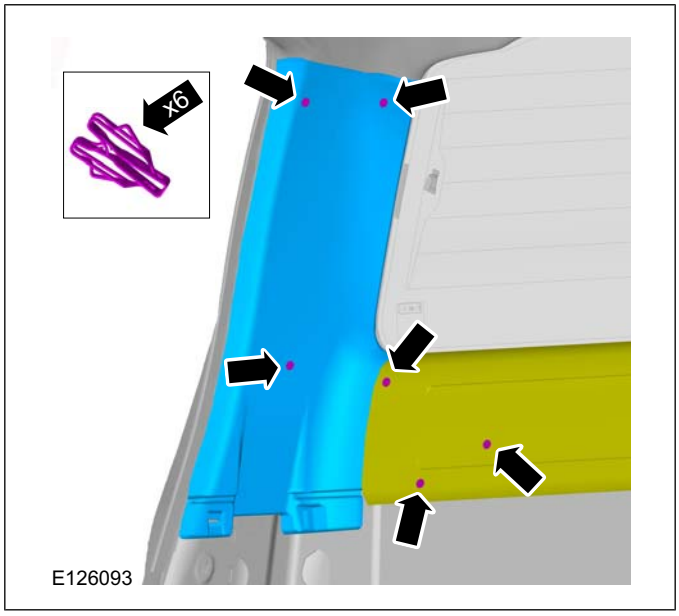
Single cab

3.

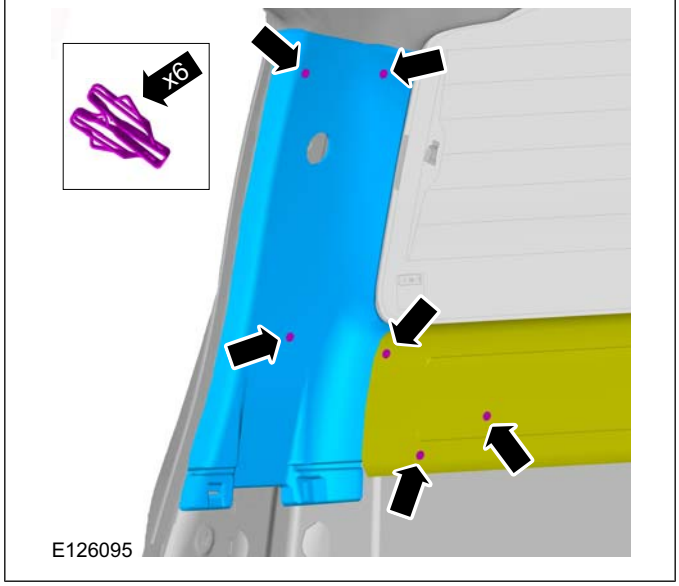


Stretch cab

4.



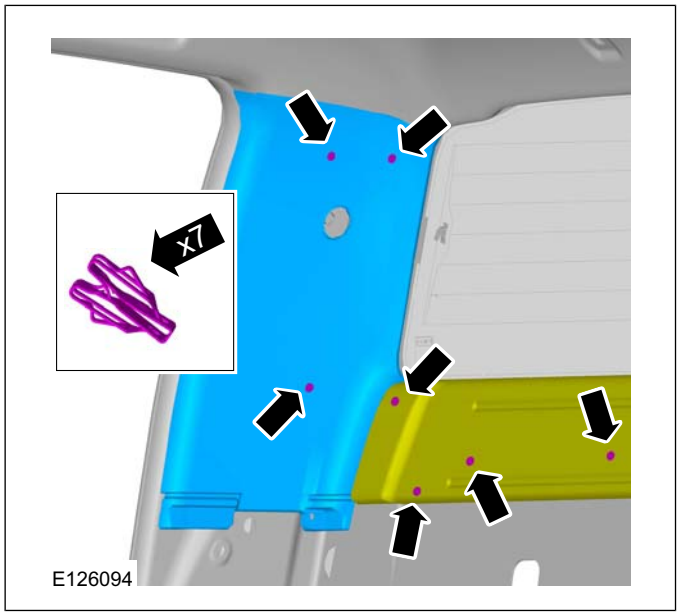
5.



REMOVAL AND INSTALLATION

Double cab

6.



Installation

1. To install, reverse the removal procedure

REMOVAL AND INSTALLATION

C-Pillar Lower Trim Panel

Removal

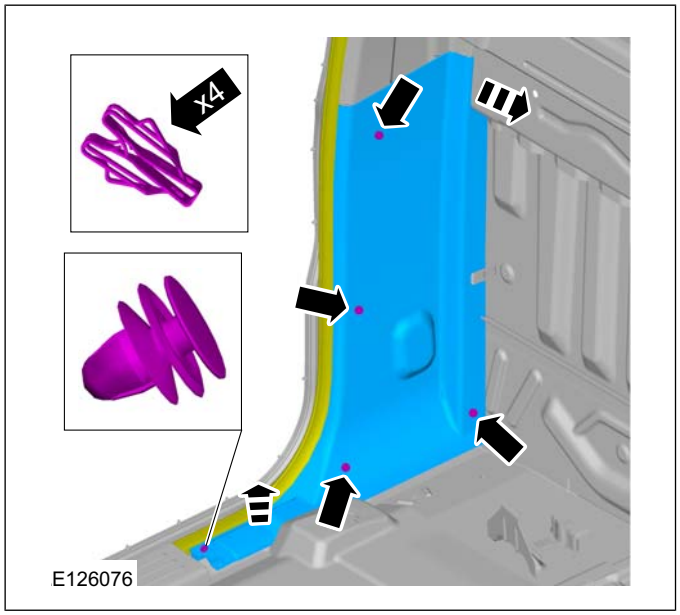
NOTE: Removal steps in this procedure may contain installation details.

Single cab

1. Remove scuff plate

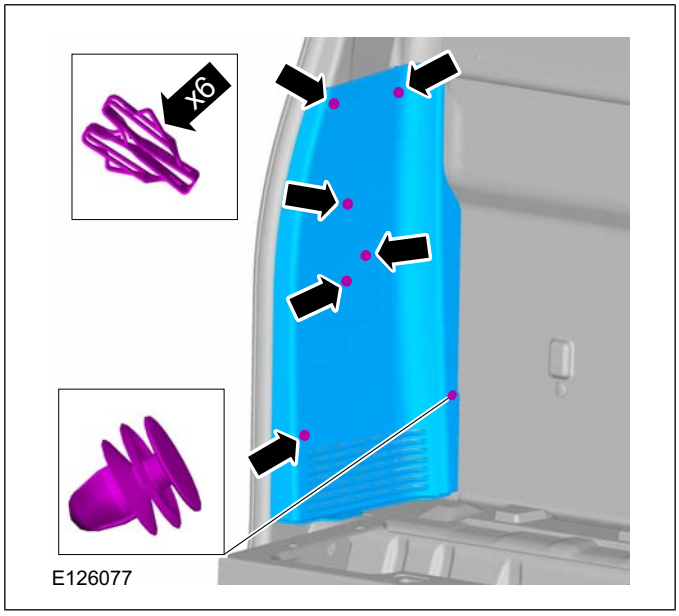
   Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



Stretch cab

3.

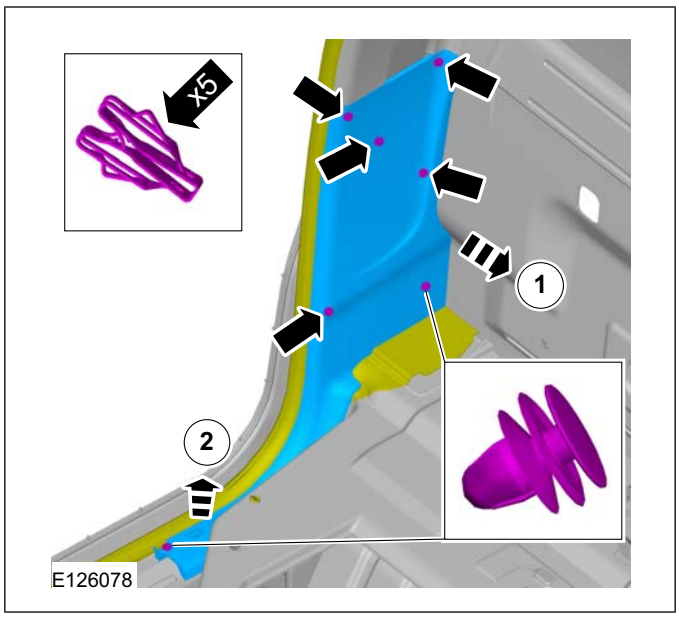


Double cab

4. Remove rear scuff plate

   Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

5.



REMOVAL AND INSTALLATION

Installation

1. To install reverse the removal procedure

REMOVAL AND INSTALLATION

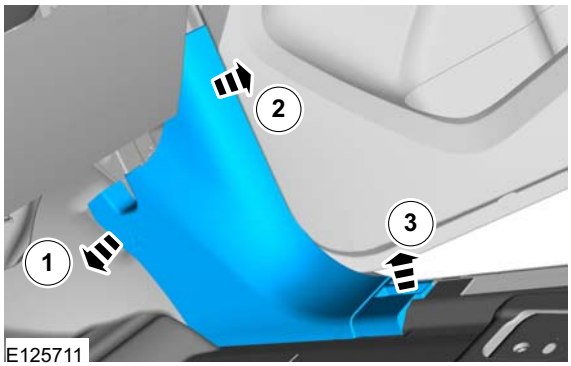
Cowl Side Trim Panel

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



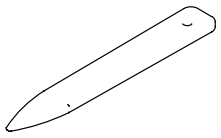
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Door Trim Panel

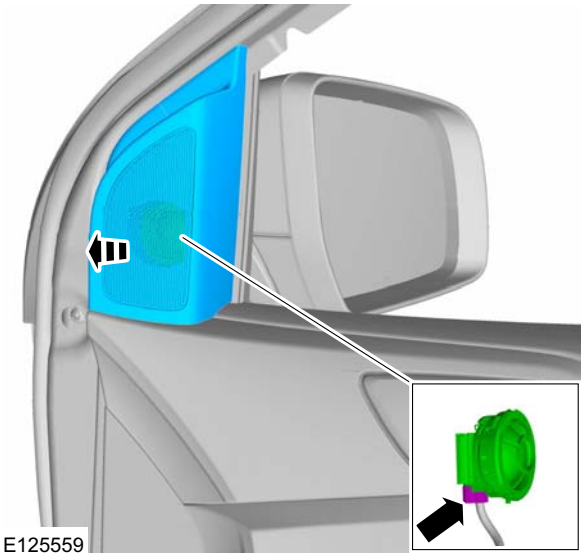
Special Tool(s)

 E84511	501-125 Remover, Grab Handle Cover

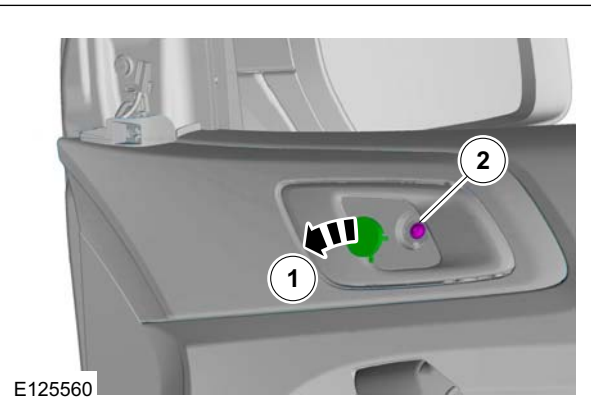
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.

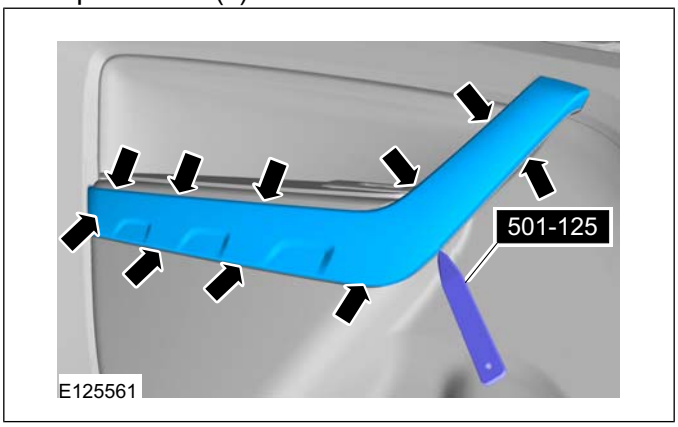


2.

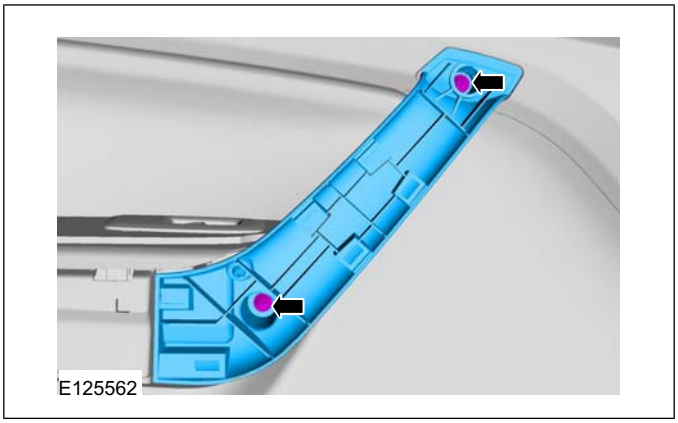


3. **CAUTION: Take extra care not to damage the edges of the component.**

Special Tool(s): 501-125



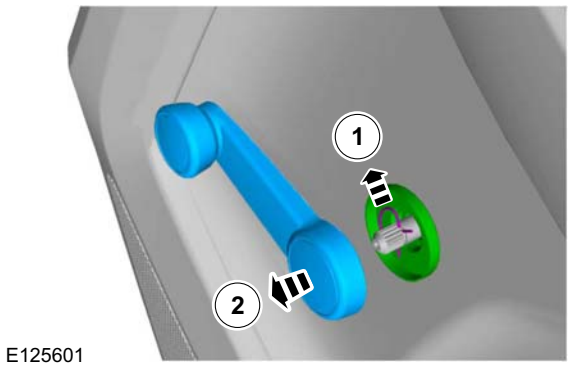
4.



REMOVAL AND INSTALLATION

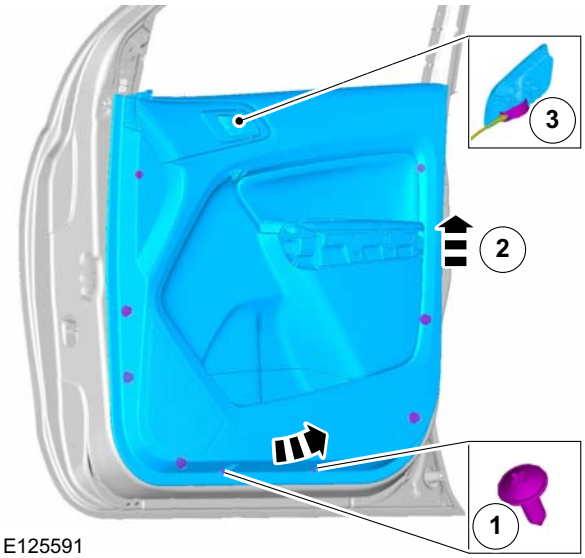
Vehicles with manual windows

5.



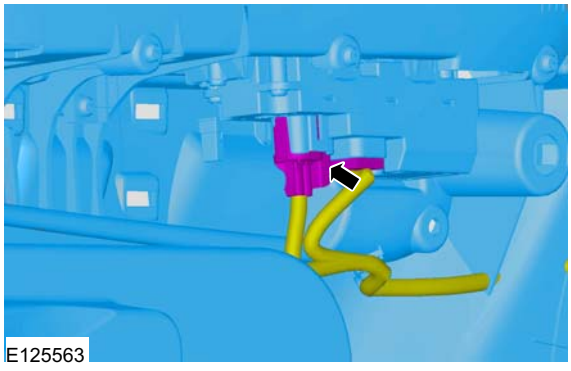
All vehicles

6.



Vehicles with power windows

7.



Installation

1. To install, reverse the removal procedure.

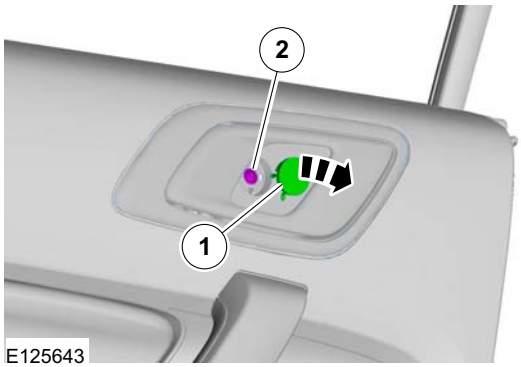
REMOVAL AND INSTALLATION

Rear Door Trim Panel — Double Cab

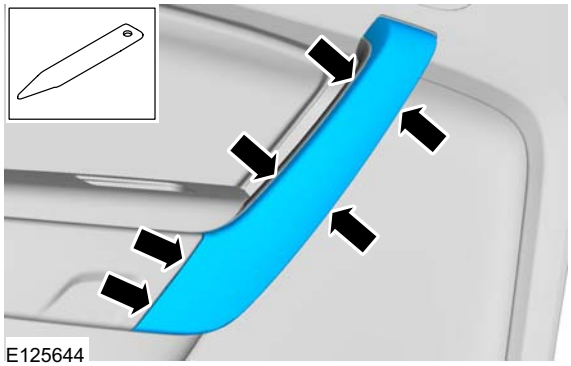
Removal

NOTE: Removal steps in this procedure may contain installation details.

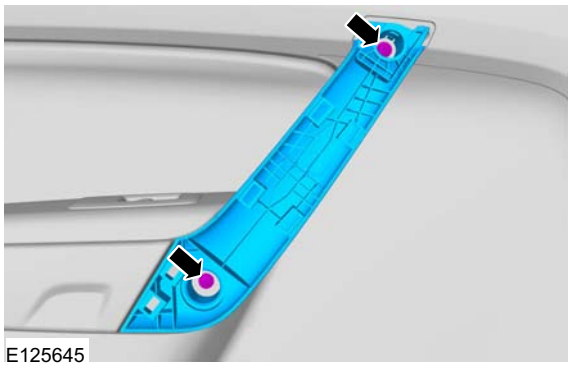
1.



2. ⚠ **CAUTION: Take extra care not to damage the edges of the component.**

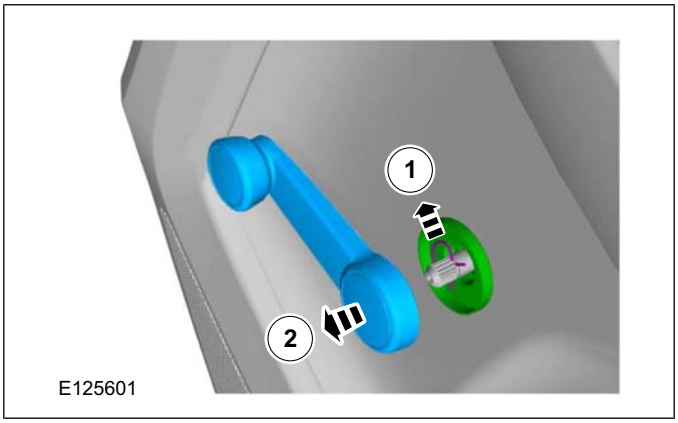


3.



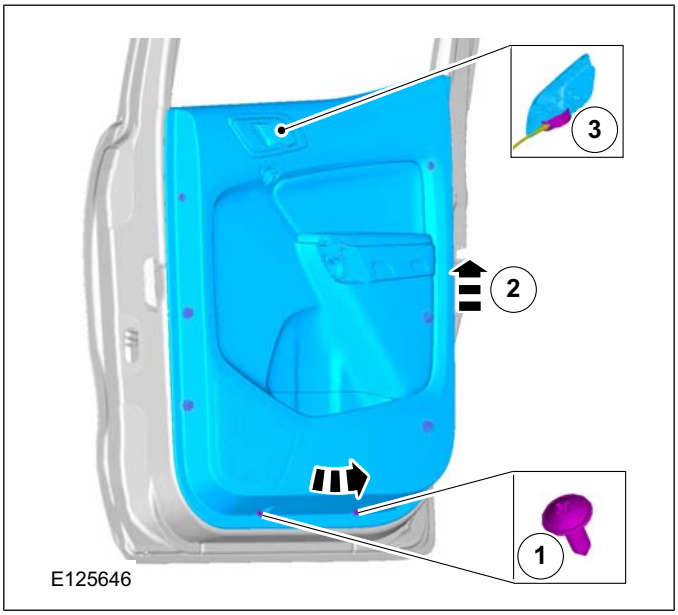
Vehicles with manual windows

4.



All vehicles

5.



REMOVAL AND INSTALLATION

Vehicles with power windows

6.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

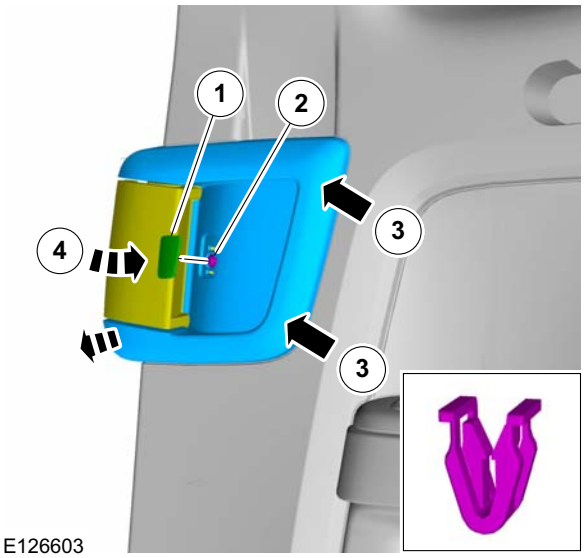
Rear Door Trim Panel — Super Cab

Removal

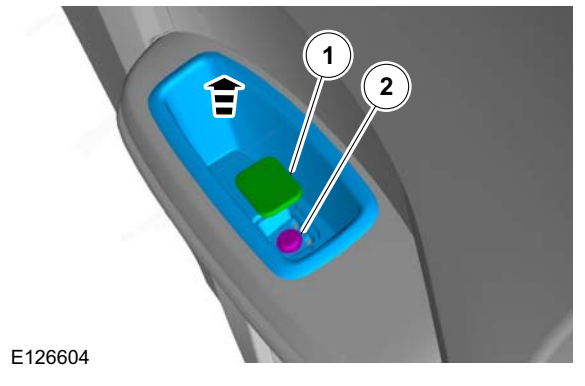
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Safety Belt Retractor - Super Cab (501-20 Safety Belt System, Removal and Installation).

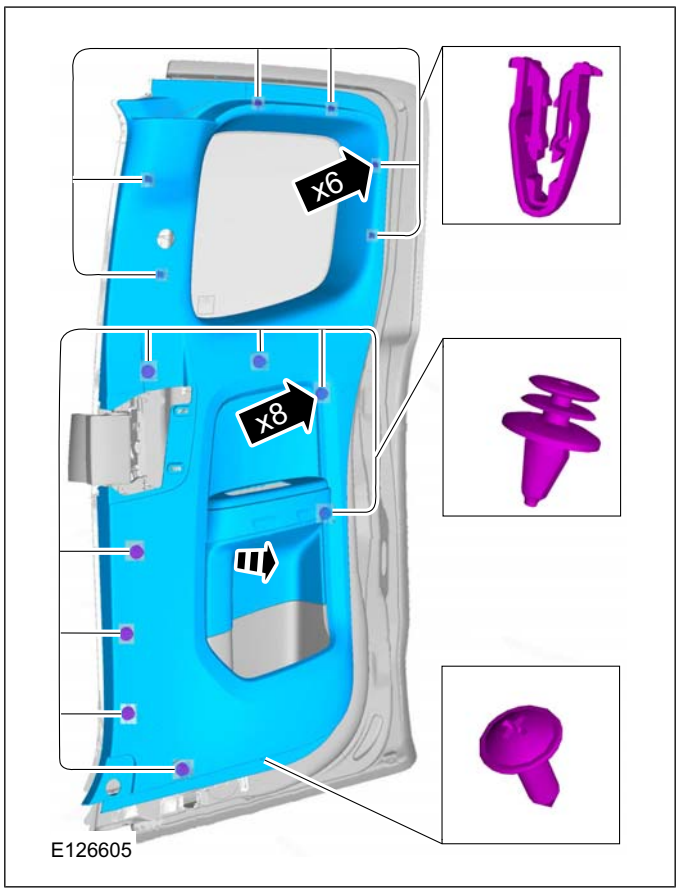
2.



3.



4.



Installation

1. To install, reverse the removal procedure.

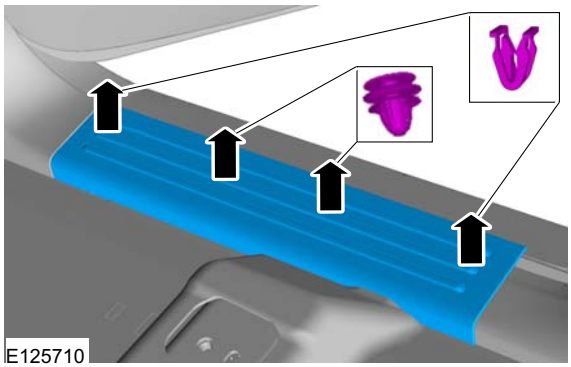
REMOVAL AND INSTALLATION

Front Scuff Plate Trim Panel

Removal

NOTE: Removal steps in this procedure may contain installation details.

1.



Installation

1. To install, reverse the removal procedure.

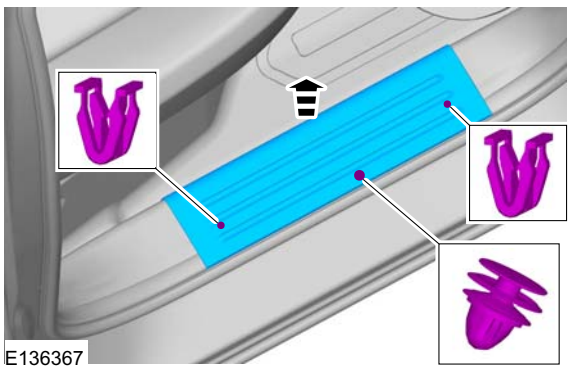
REMOVAL AND INSTALLATION

Rear Scuff Plate Trim Panel

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. **NOTE:** Note the position of each fastener.



Installation

1. **NOTE:** Make sure that the fasteners are installed to the position noted before removal.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Headliner

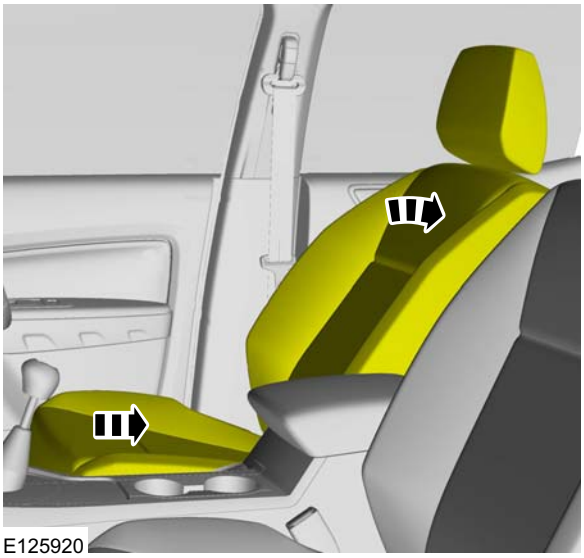
Removal

NOTE: Removal steps in this procedure may contain installation details.

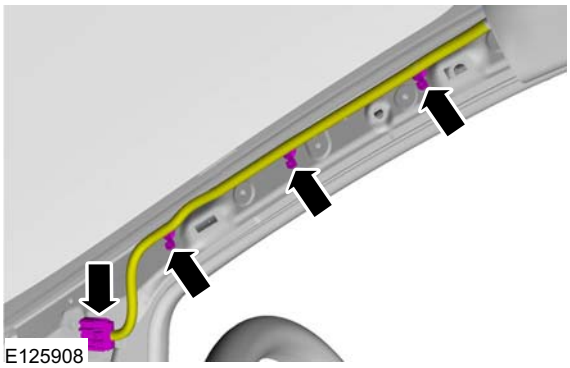
1. On both the sides.

   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. On both the sides.



3.



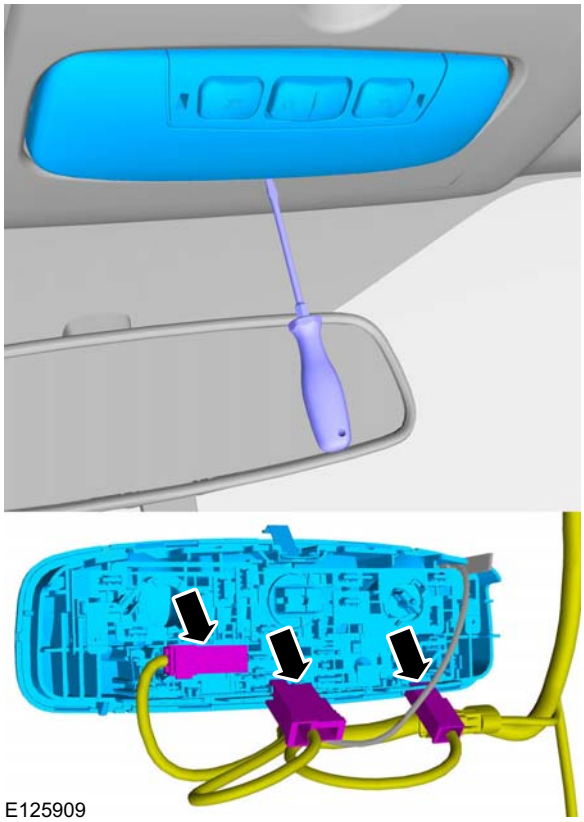
4. On both the sides.

   Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

5. On both the sides.

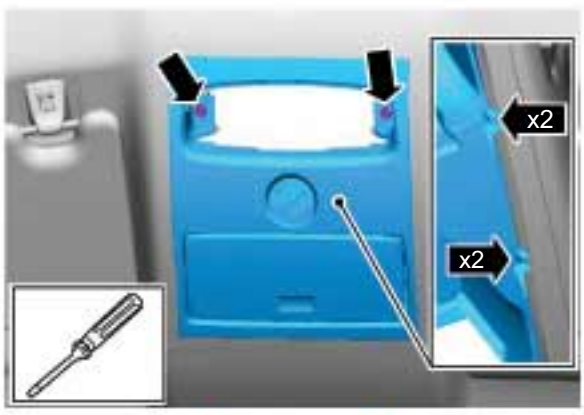
   Refer to: C-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

6.



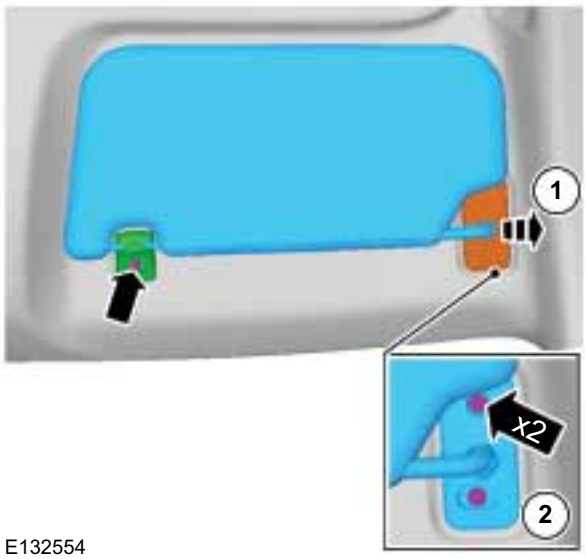
REMOVAL AND INSTALLATION

7. **NOTE:** This step is not necessary when installing a new component.

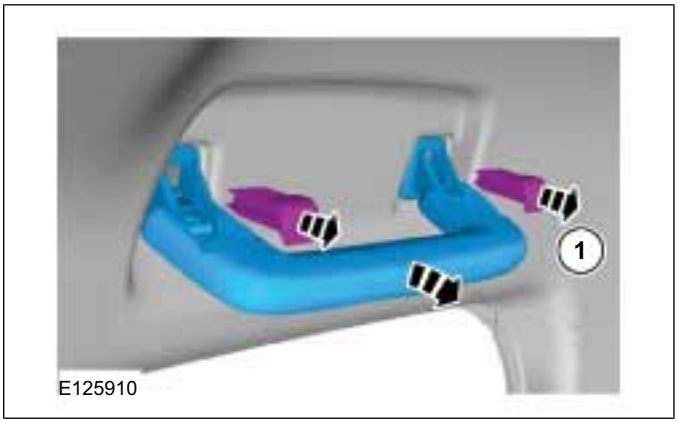




8. On both the sides.

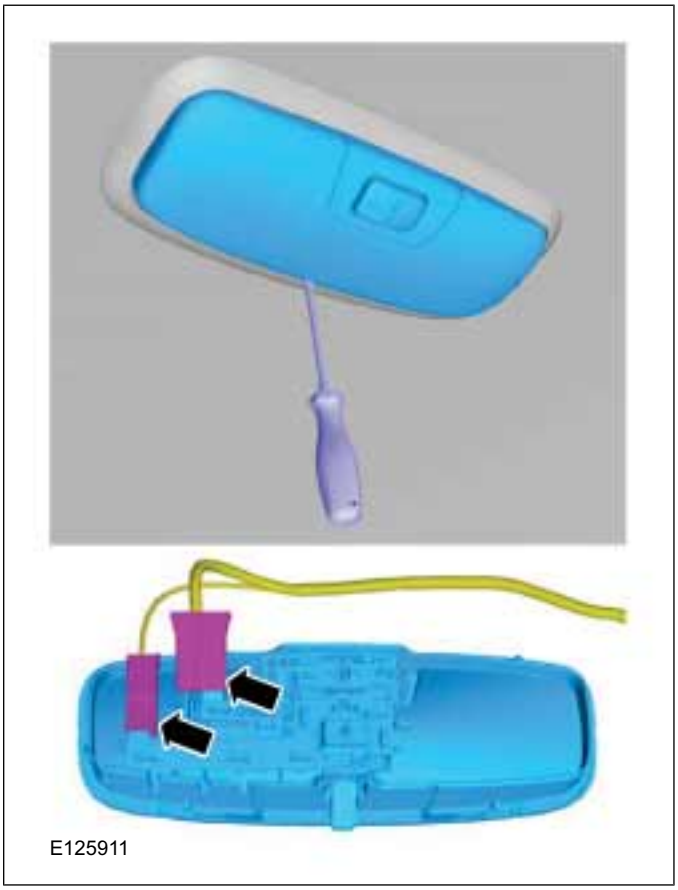


9.



Stretch cab oder Double cab

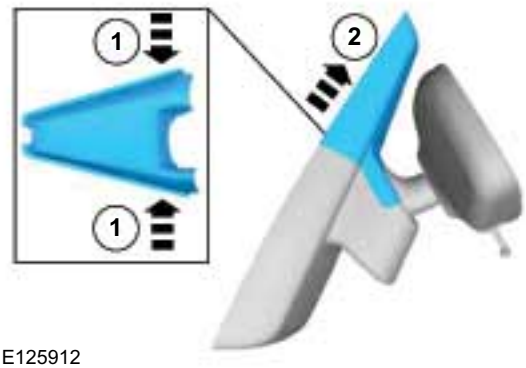
10.



REMOVAL AND INSTALLATION

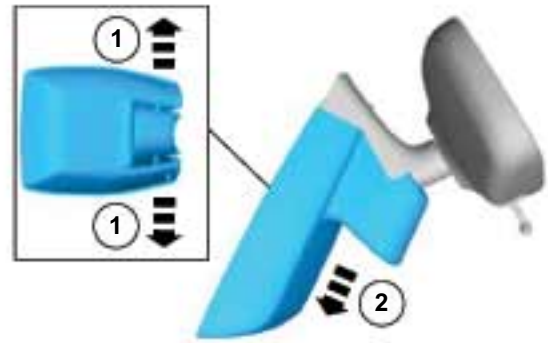
Vehicles with autolamps and rain sensor

11.



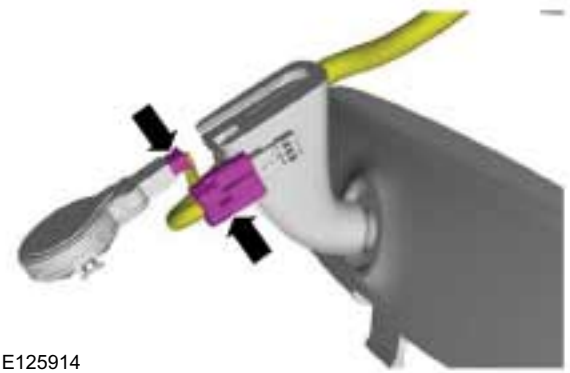
E125912

12.



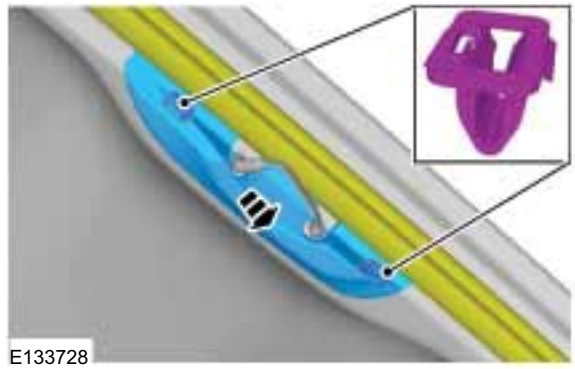
E125913

13.


E125914

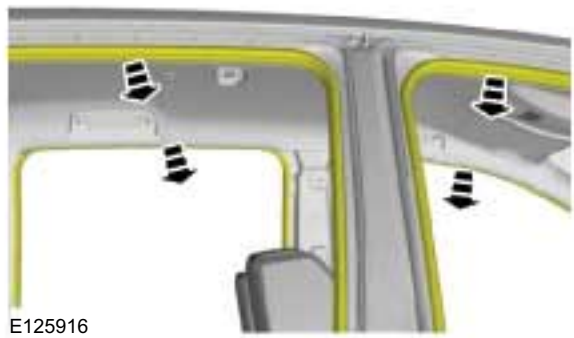
Stretch cab

14.


E133728

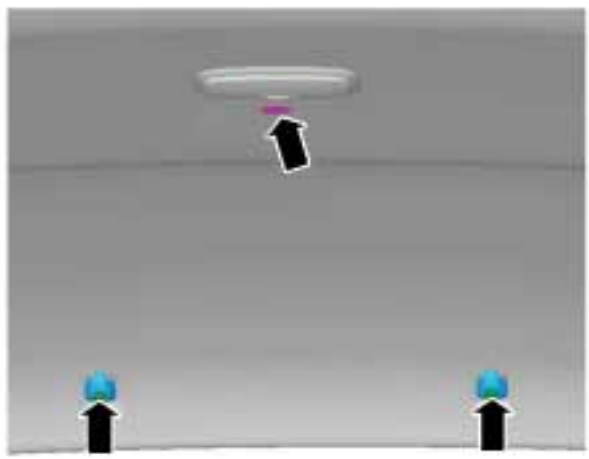
Double cab

15. Support the headliner.


E125916

Stretch cab oder Double cab

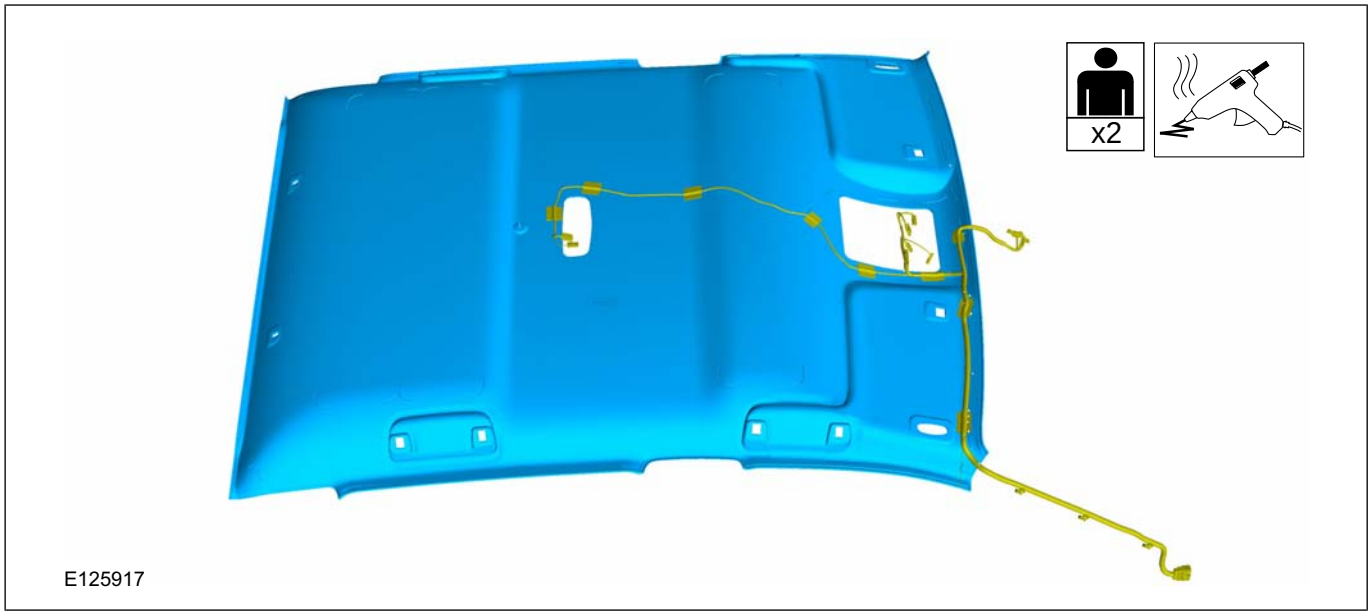
16.


E125915

17. NOTE: Right-hand drive vehicles.

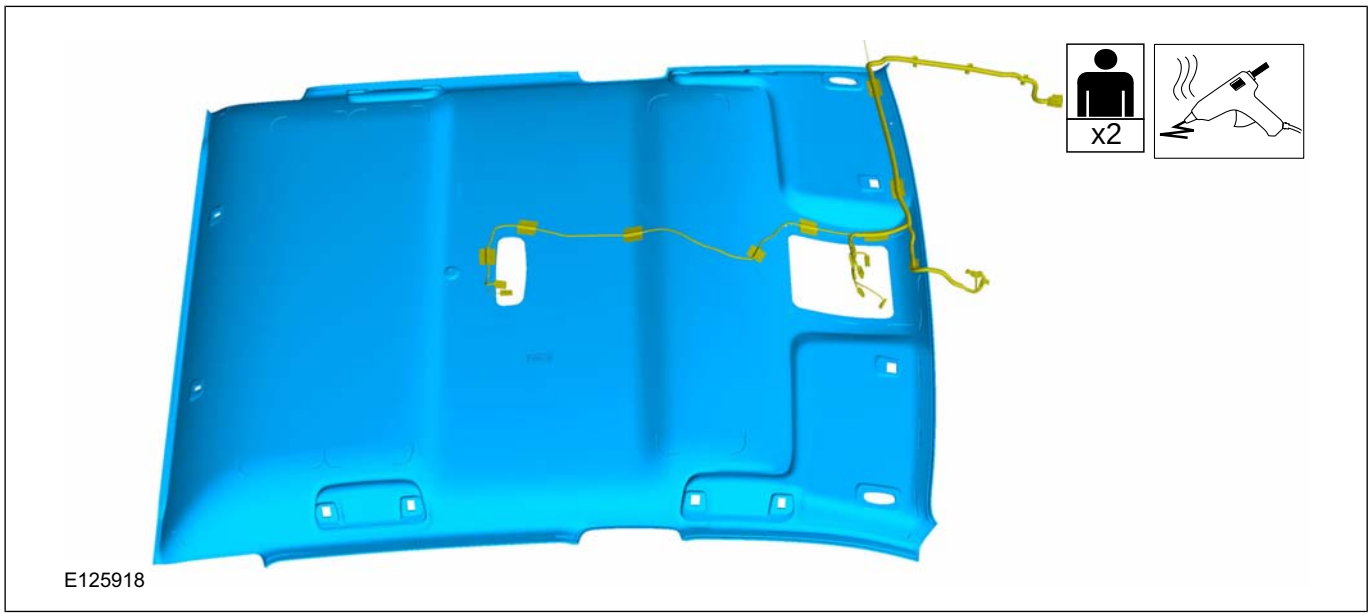
REMOVAL AND INSTALLATION

NOTE: Note the position of each component before removal.



18. **NOTE:** Left-hand drive vehicles.

NOTE: Note the position of each component before removal.



REMOVAL AND INSTALLATION

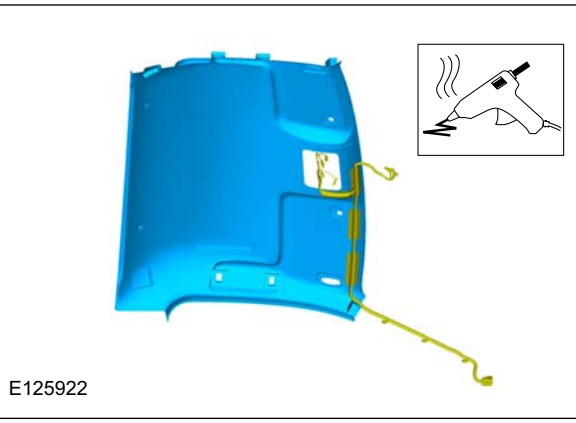
Single cab

19.



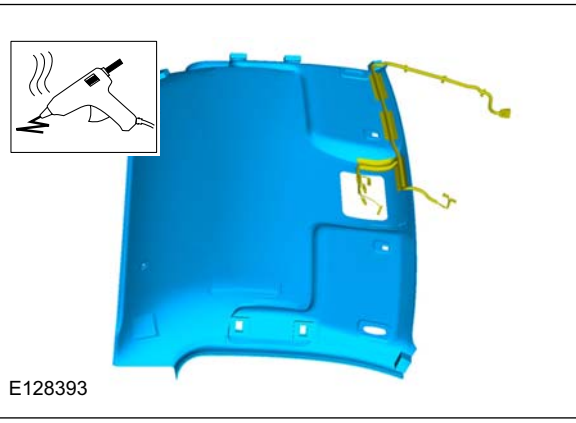
20. **NOTE:** Right-hand drive vehicles.

    NOTE: Note the position of each component before removal.



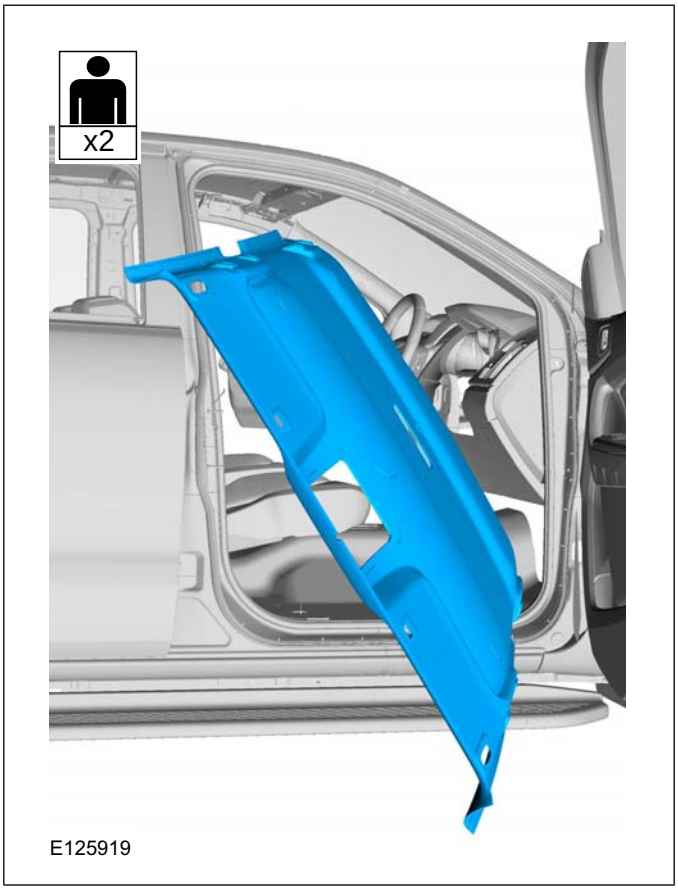
21. **NOTE:** Left-hand drive vehicles.

    NOTE: Note the position of each component before removal.



All vehicles

22. **CAUTION: Take extra care not to crease the headliner.**



Installation

1. **NOTE:** Make sure that this component is installed to the noted removal position.

   Using a suitable adhesive, bond the roof wiring harness to the headliner.

2. To install, reverse the removal procedure.

SECTION 501-08 Exterior Trim and Ornamentation

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

Radiator Grille..... 501-08-2

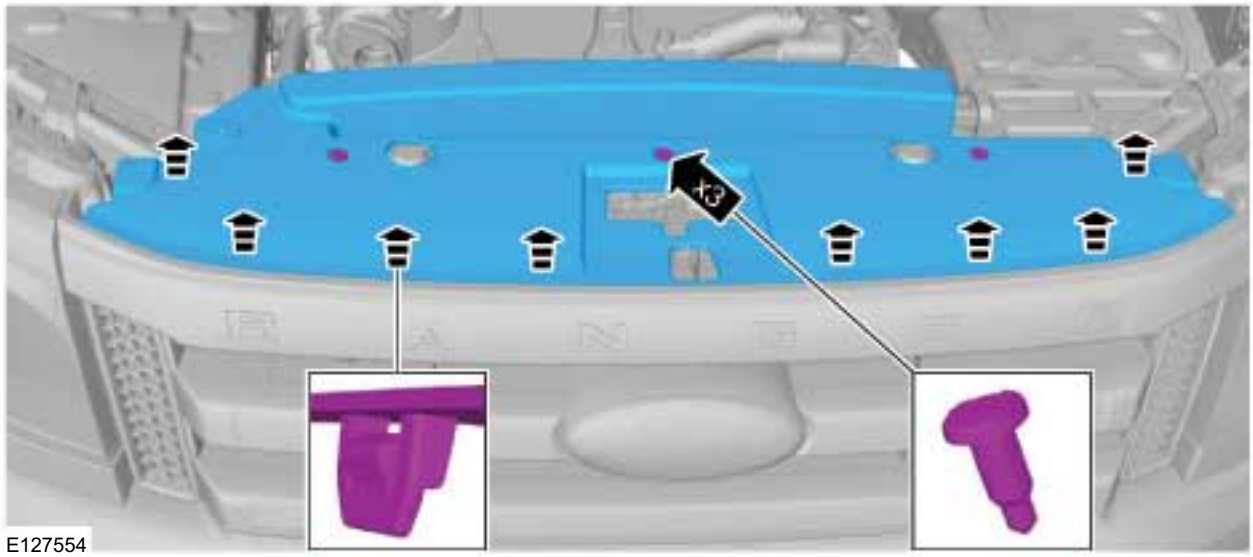
REMOVAL AND INSTALLATION

Radiator Grille

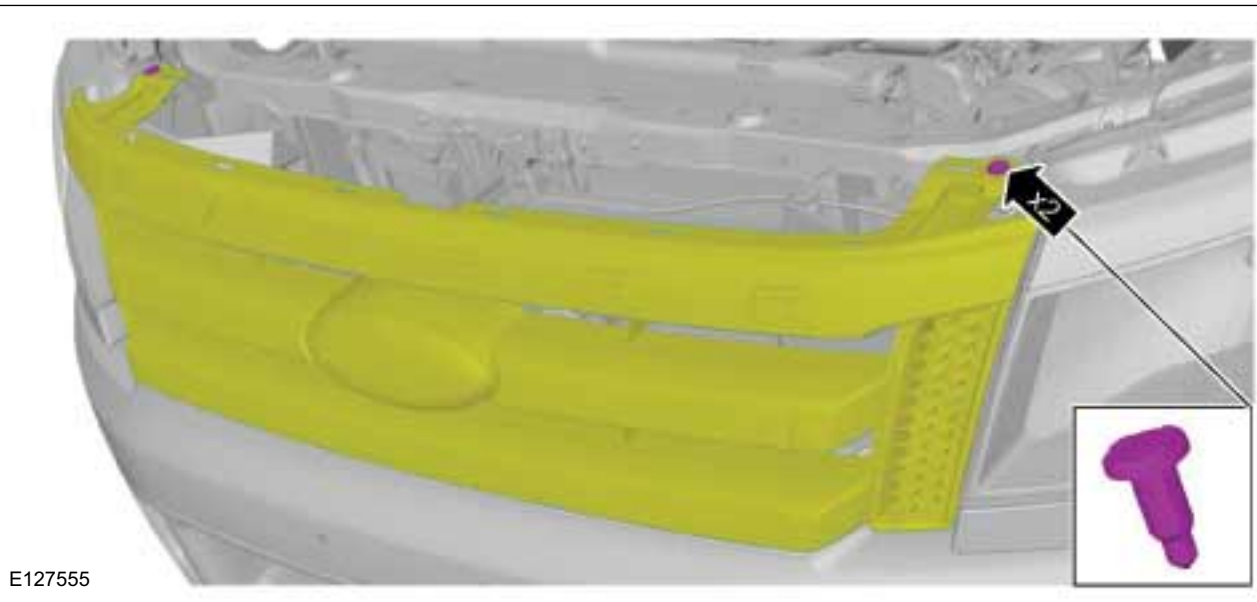
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.

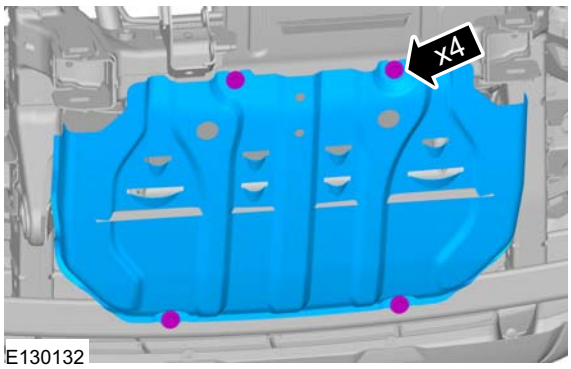


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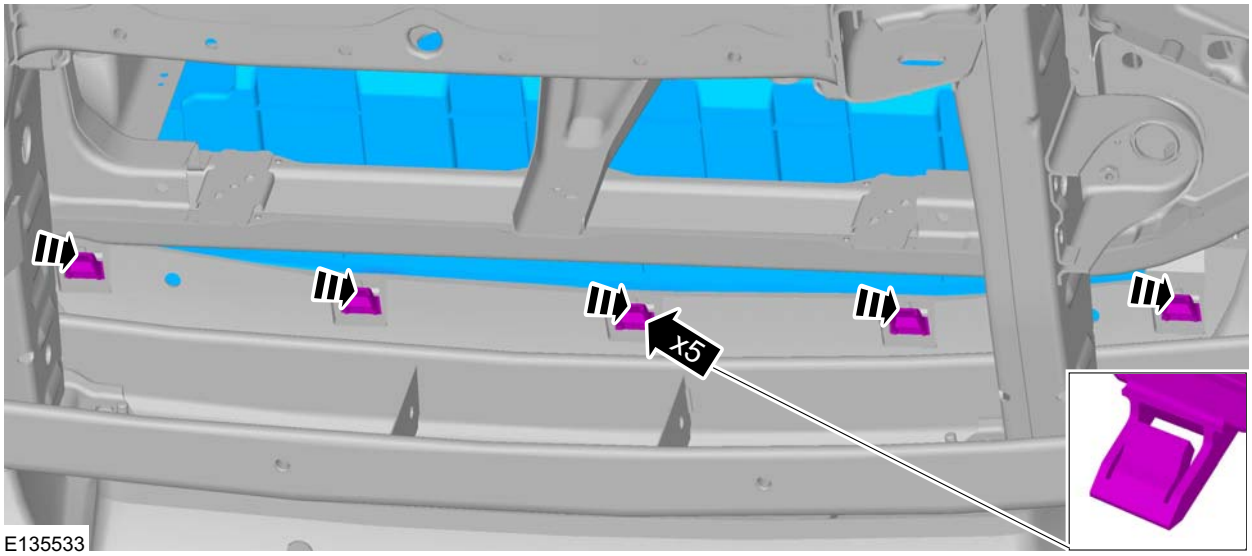


REMOVAL AND INSTALLATION

3. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
4. Torque: 30 Nm



5.



Installation

1. To install, reverse the removal procedure.

SECTION 501-09 Rear View Mirrors

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

Exterior Mirror..... 501-09-2
Exterior Mirror Glass..... 501-09-3
Exterior Mirror Motor..... 501-09-4
Interior Rear View Mirror..... 501-09-5

REMOVAL AND INSTALLATION

Exterior Mirror

Removal

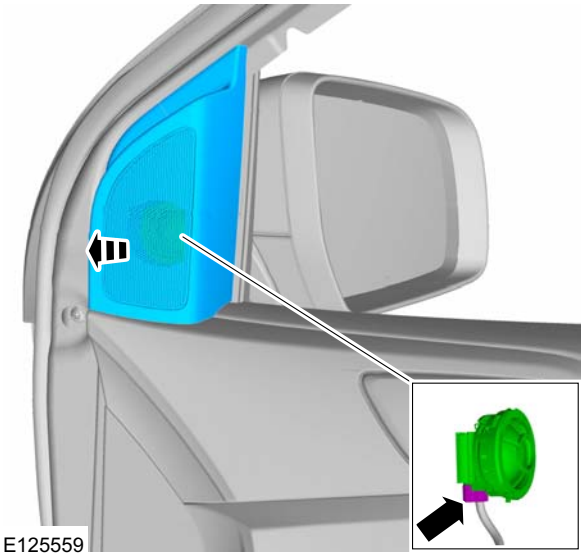
NOTE: Removal steps in this procedure may contain installation details.

Vehicles with power mirrors

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

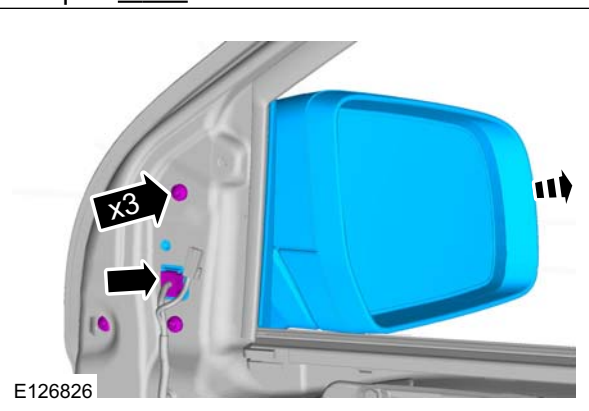
All vehicles

2.



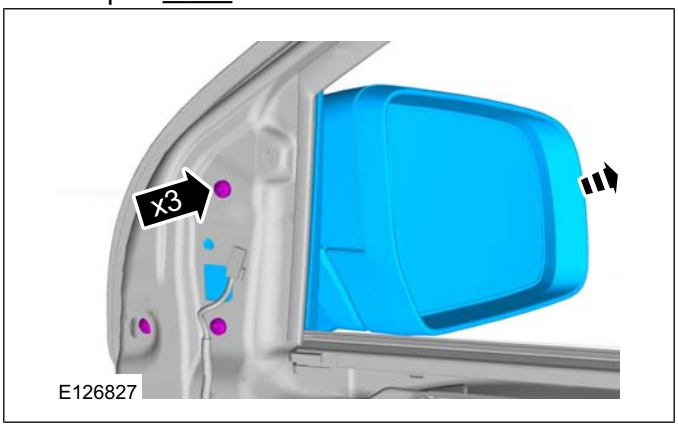
Vehicles with power mirrors

3. Torque: 8 Nm



Vehicles with manual mirrors

4. Torque: 8 Nm



Installation

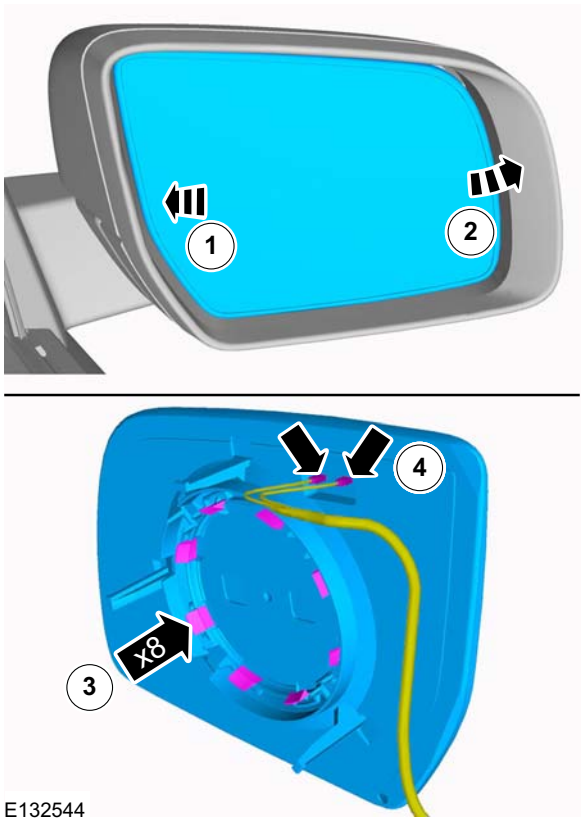
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

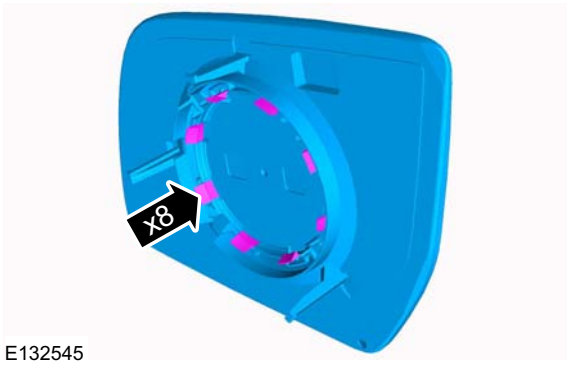
Exterior Mirror Glass

Removal

1.



2. NOTE: Vehicles without heated mirror.



Installation

1. To install, reverse the removal procedure.

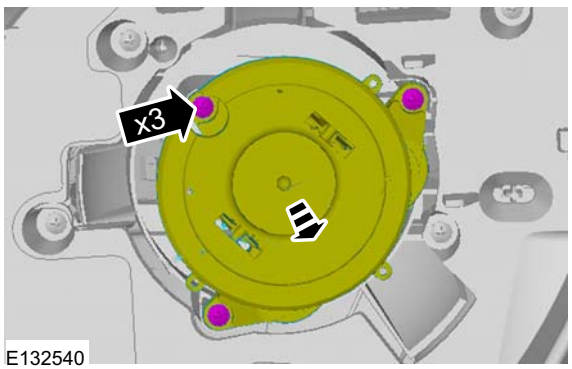
REMOVAL AND INSTALLATION

Exterior Mirror Motor

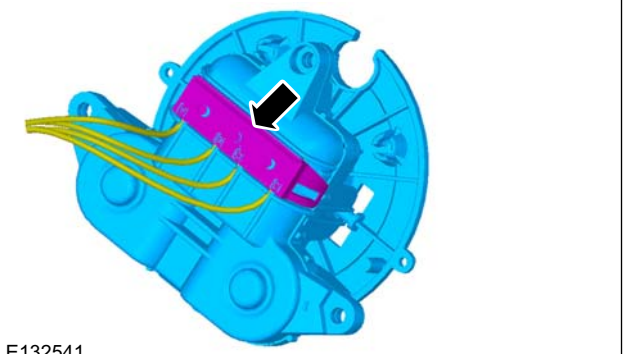
Removal

1. Refer to: Exterior Mirror Glass (501-09 Rear View Mirrors, Removal and Installation).

2.



3.



Installation

1. To install, reverse the removal procedure.

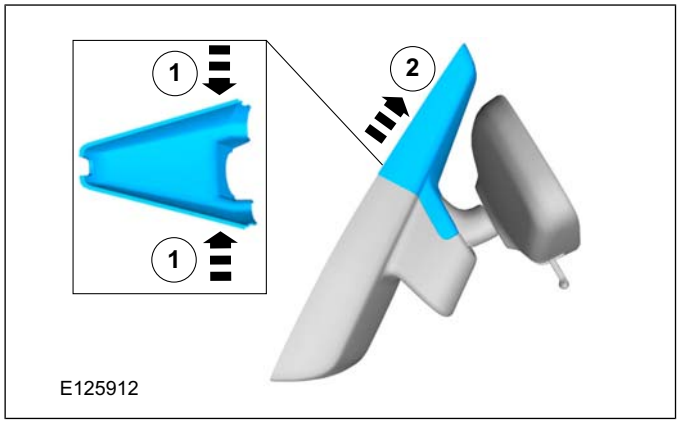
REMOVAL AND INSTALLATION

Interior Rear View Mirror

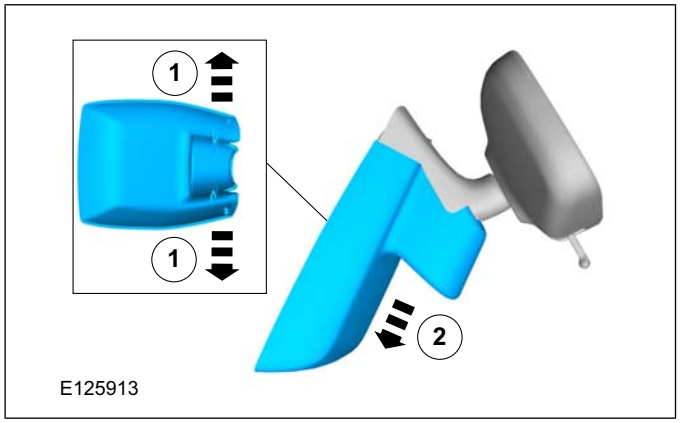
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.

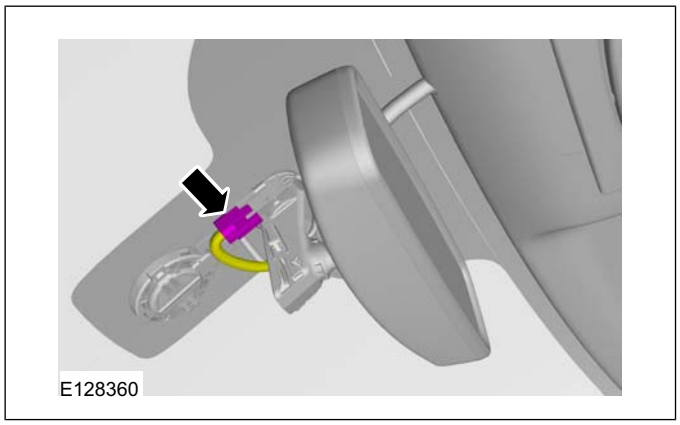


2.



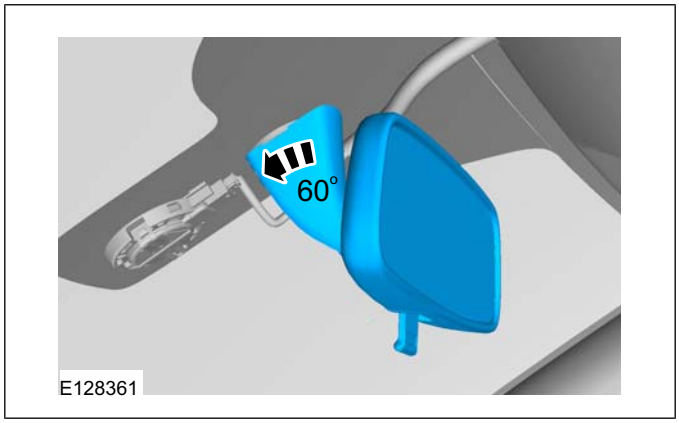
Vehicles with auto-dimming interior mirror

3.



All vehicles

4.



Installation

1. To install, reverse the removal procedure.

SECTION 501-10 Seating

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

Seats 501-10-2

REMOVAL AND INSTALLATION

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Front Seat Backrest 501-10-12
Rear Seat 501-10-14
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DISASSEMBLY AND ASSEMBLY

Front Bench Seat Backrest 501-10-17
Front Bench Seat Cushion 501-10-19
Front Seat Cushion 501-10-21
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DESCRIPTION AND OPERATION

Seats

General

Side airbags and height adjustable head restraints are installed as standard equipment. Depending on the vehicle specification, either 2-way, 4-way or 8-way adjustable head restraints are installed as an option.

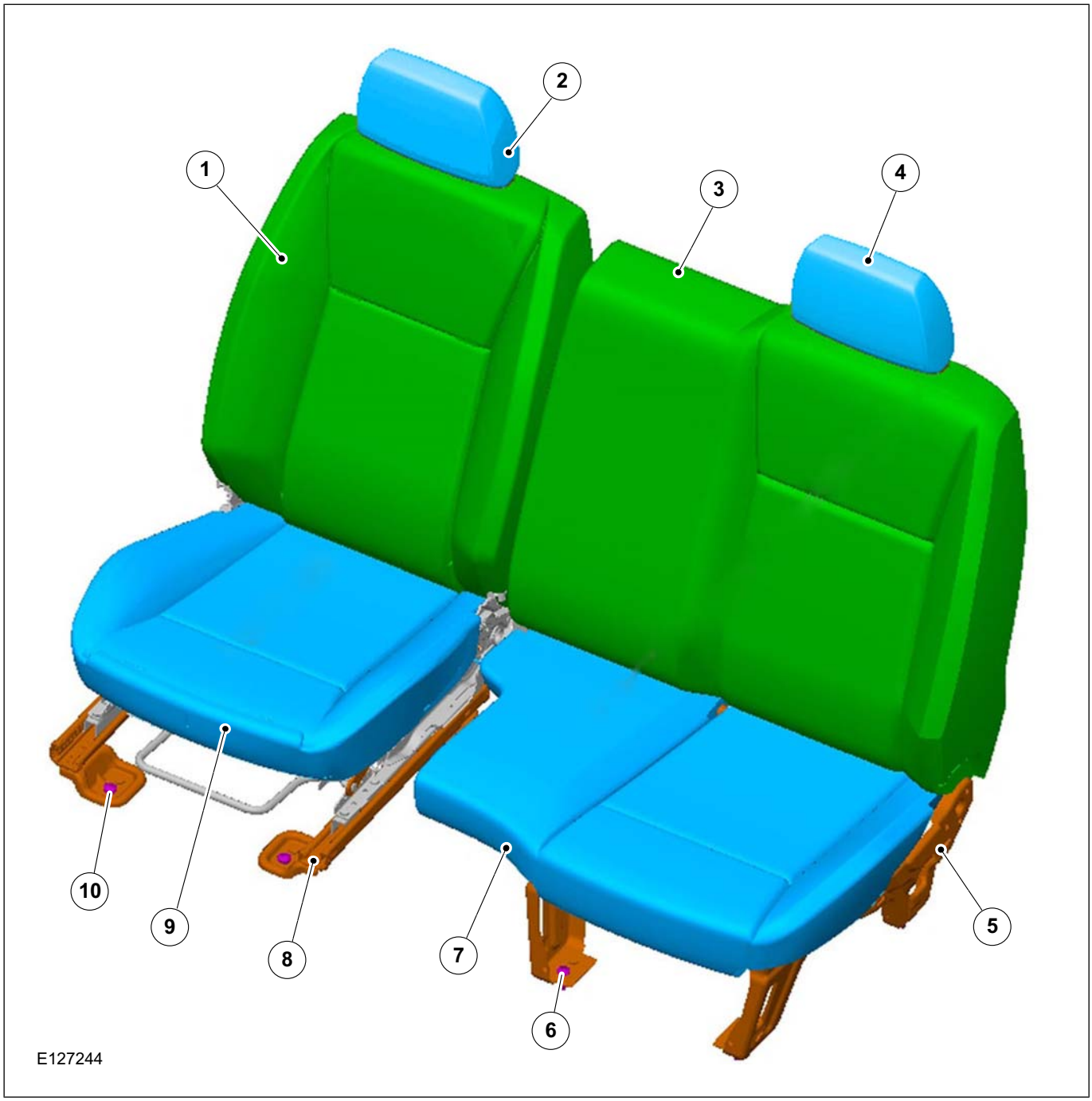
Depending on the vehicle specification, the front seats may be equipped with any one or combination of the following:

- Manual or power seat height adjustment
- Seat rails, forward and rearward motion
- Backrest recline
- Manually adjustable lumbar mat
- Heated cushion and backrest

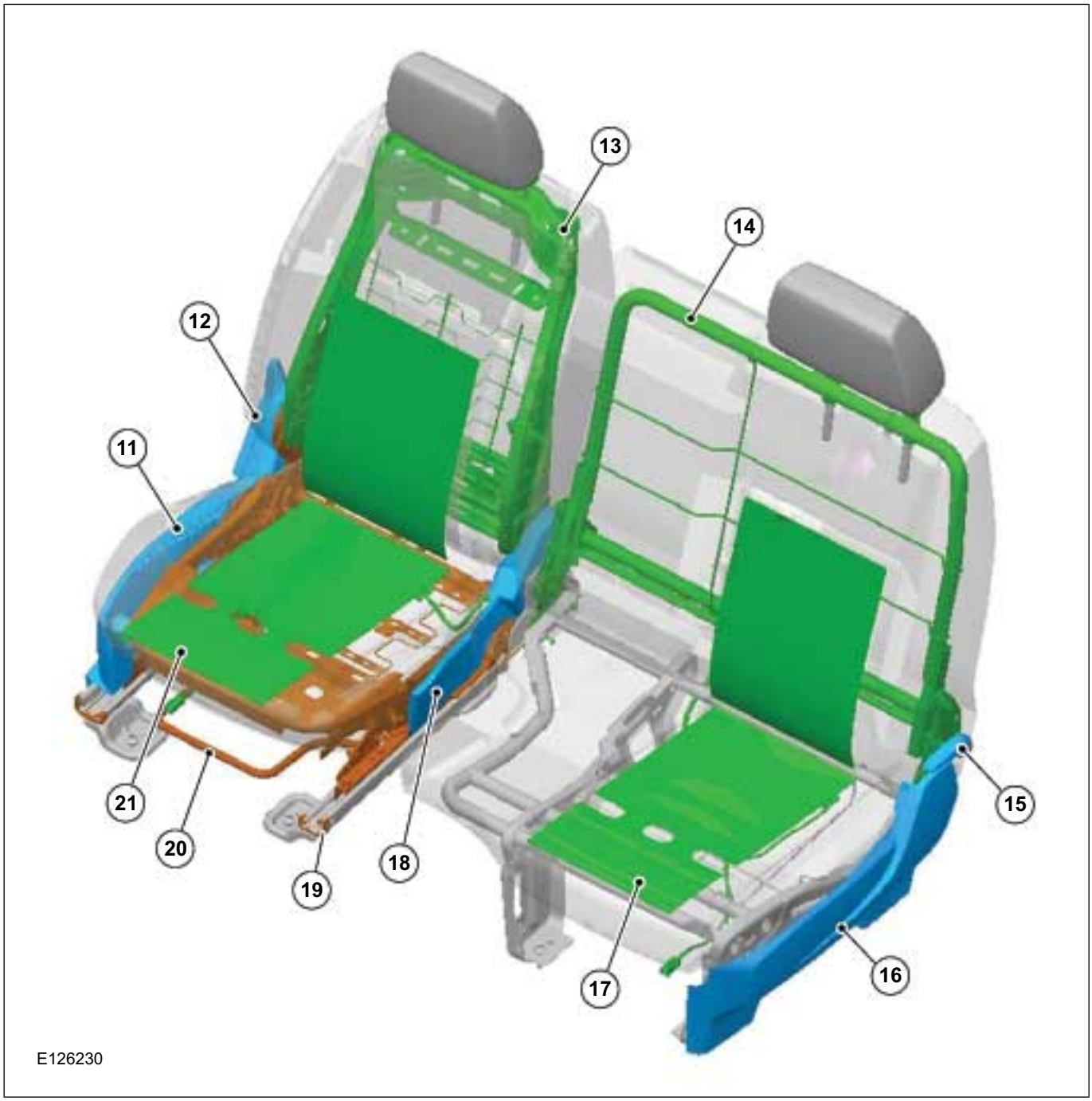
Always move the head restraints to the raised position if the rear seat is occupied by a passenger or is used for a child restraint system. The rear head restraints must be lowered to allow the seat to be folded down.

Single cab front seat

DESCRIPTION AND OPERATION

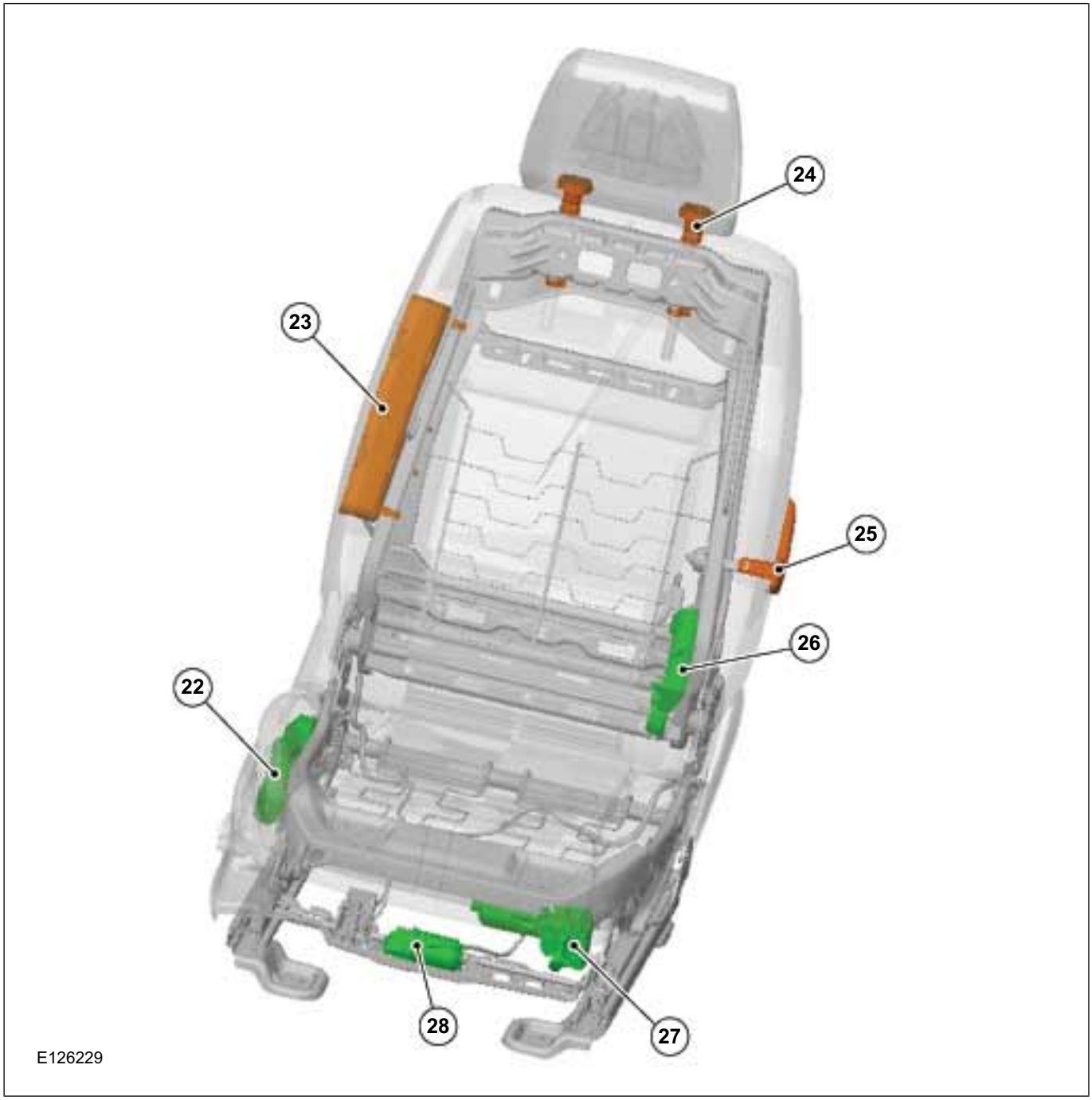


DESCRIPTION AND OPERATION



Double cab front power seat

DESCRIPTION AND OPERATION



Item	Description
1	Backrest trim cover
2	Head restraint adjustment
3	Front seat bench backrest trim cover
4	Head restraint adjustment
5	Front seat bench cushion frame
6	Front seat retaining bolts
7	Front seat bench cushion
8	Seat frame upper track

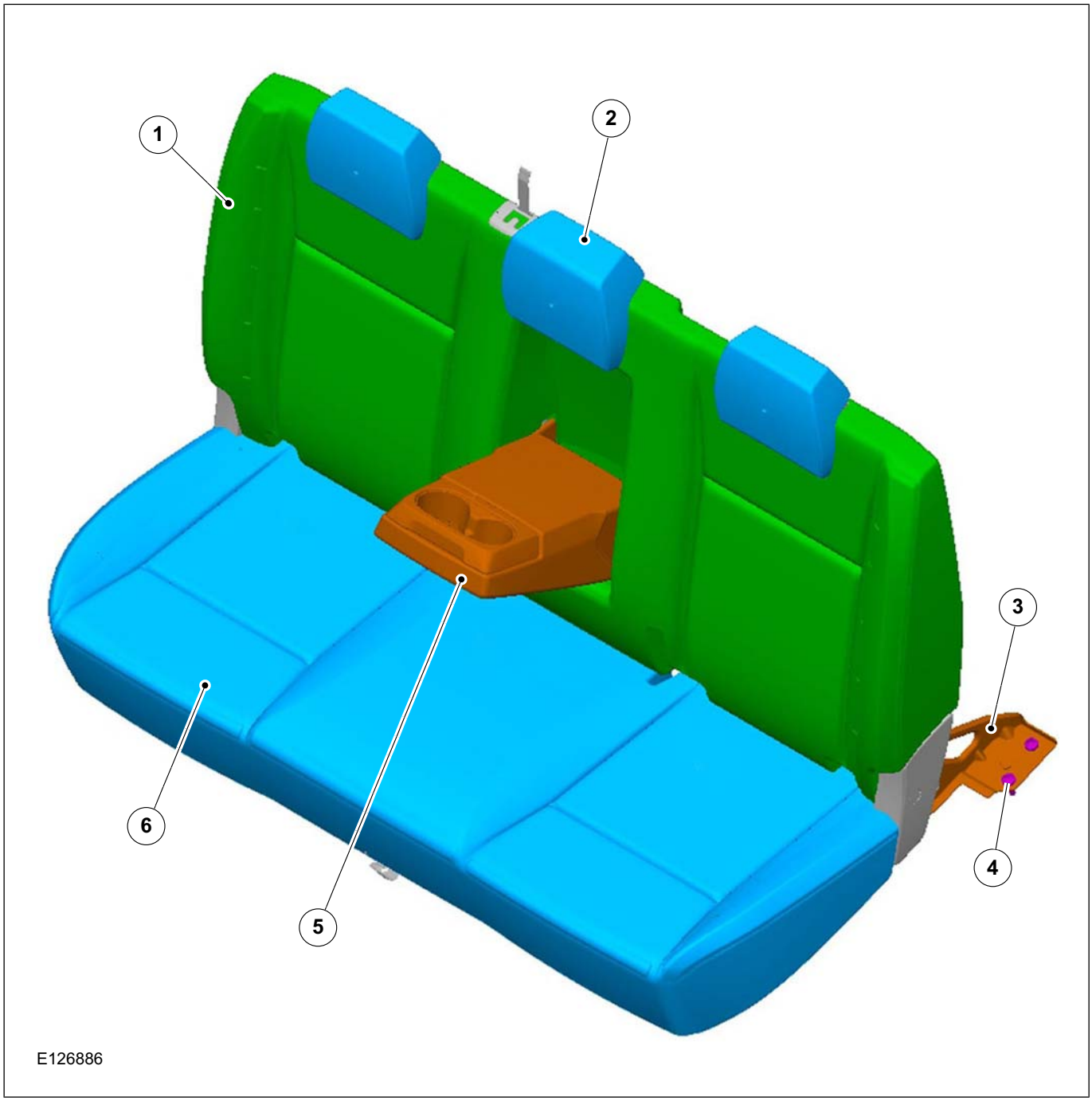
Item	Description
9	Front seat cushion cover
10	Front seat cushion base retaining bolts
11	Cushion side shield
12	Seat adjustment lever
13	Front seat backrest frame and lumbar support
14	Backrest front seat bench frame
15	Latch lever

DESCRIPTION AND OPERATION

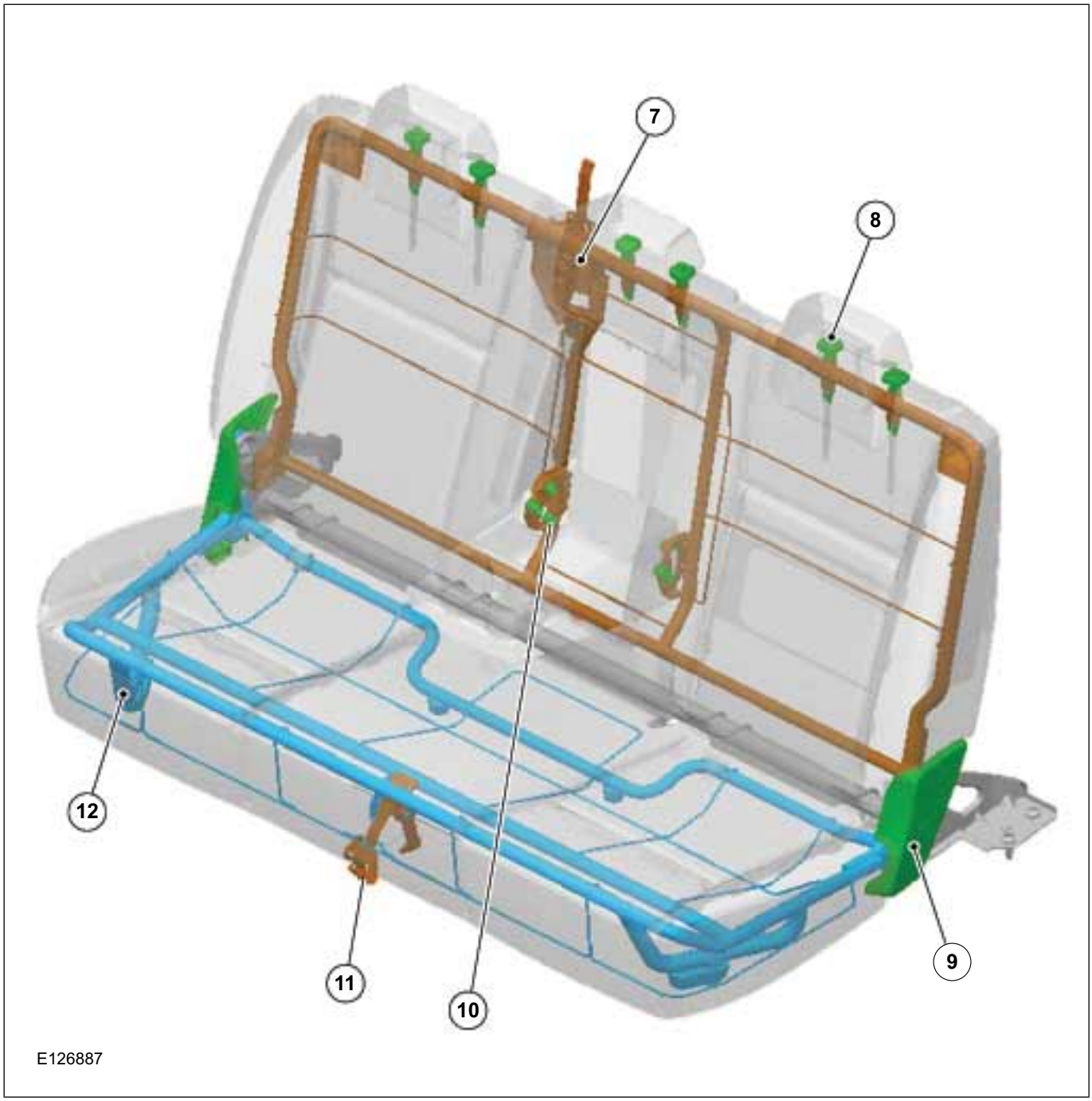
Item	Description
16	Front bench cushion side shield
17	Front seat cushion heating mat
18	Cushion side shield
19	Lower track end cap
20	Manual seat lower track
21	Front seat cushion and backrest heating mat
22	Switch group for electrically adjustable driver's seat

Item	Description
23	Side airbag
24	Head restraint guide
25	Manually adjustable lumbar lever
26	Servo motor, electrically adjustable backrest
27	Servo motors, seat height and seat angle electric adjustment
28	Servo motor, forward and rearward motion

Double cab rear seat



DESCRIPTION AND OPERATION

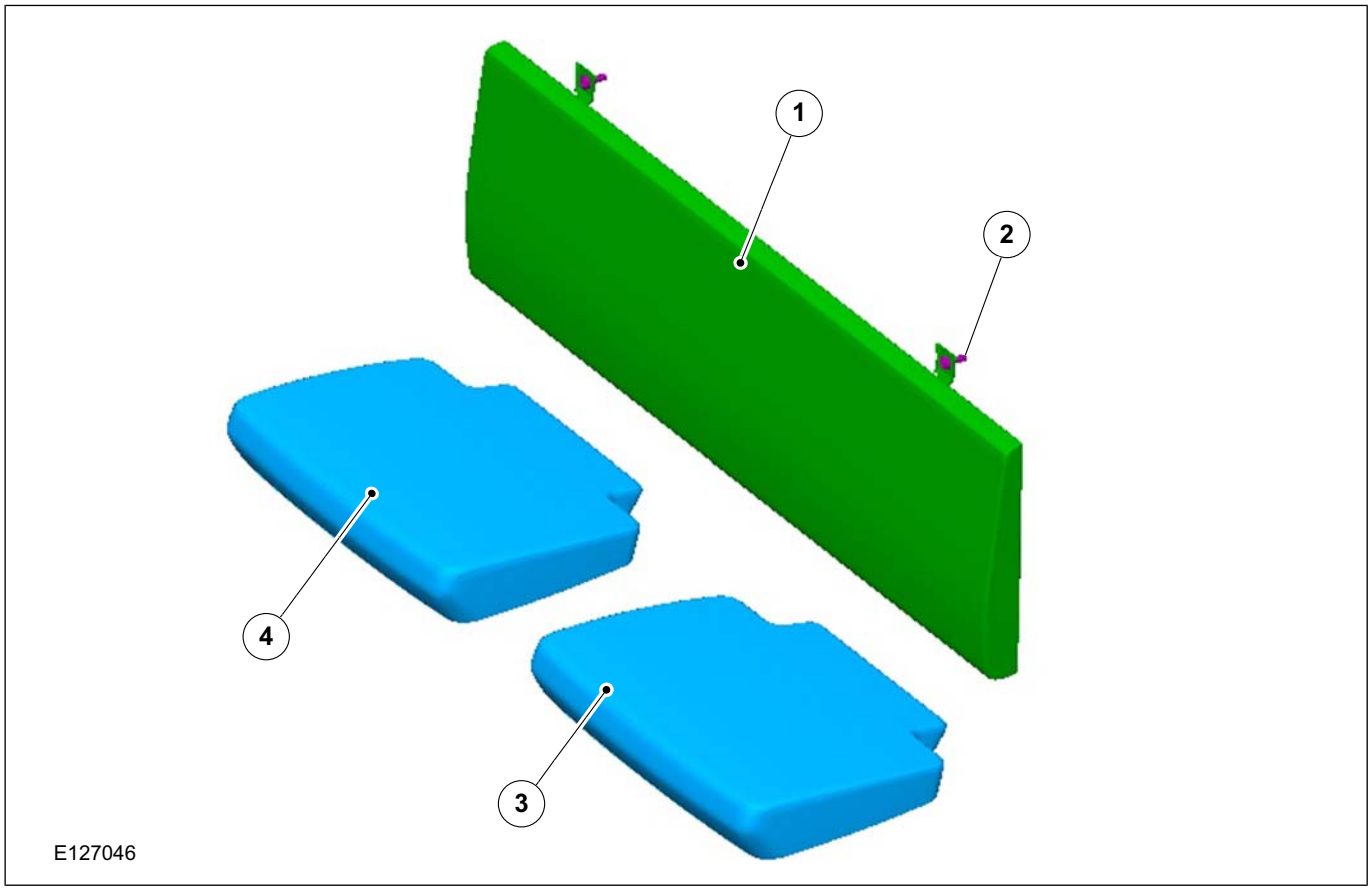


Item	Description
1	Rear seat backrest trim cover
2	Head restraint adjustment
3	Rear seat frame mounting bracket
4	Rear seat cushion retaining bolts
5	Armrest trim
6	Rear seat cushion trim cover
7	Rear seat backrest frame

Item	Description
8	Head restraint guide
9	Cushion cover
10	Bush
11	Rear seat cushion frame floor hook
12	Rear seat cushion frame

Rap cab rear seat

DESCRIPTION AND OPERATION



Item	Description
1	Rear seat backrest
2	Back rest upper bolts
3	Rear seat cushion trim
4	Rear seat cushion trim

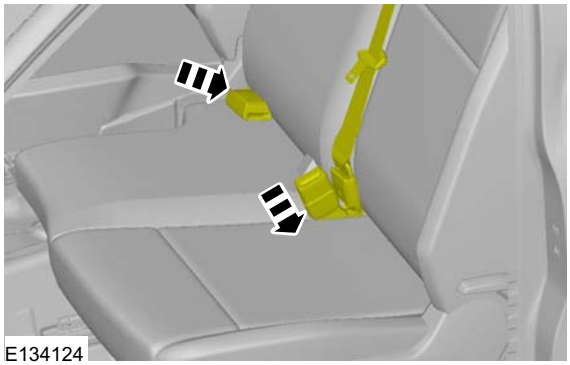
REMOVAL AND INSTALLATION

Front Bench Seat

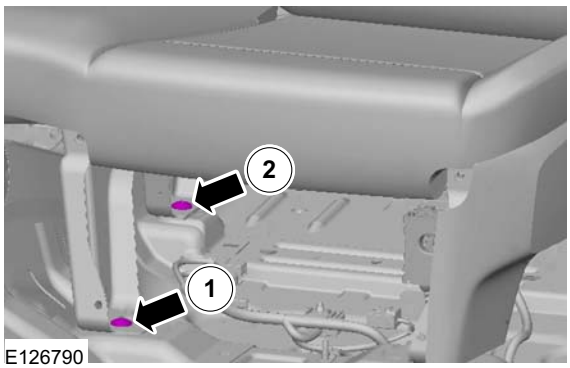
Removal

NOTE: Removal steps in this procedure may contain installation details.

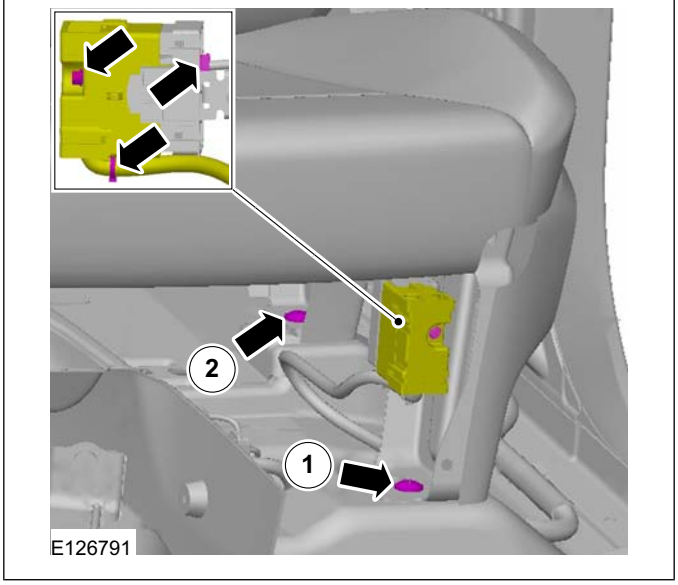
1.



2. 1. Torque: 48 Nm
2. Torque: 30 Nm



3. 1. Torque: 48 Nm
2. Torque: 30 Nm



4.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Seat(40 100 0; 40 100 4; 40 101 0)

Removal

NOTE: Removal steps in this procedure may contain installation details.

All vehicles

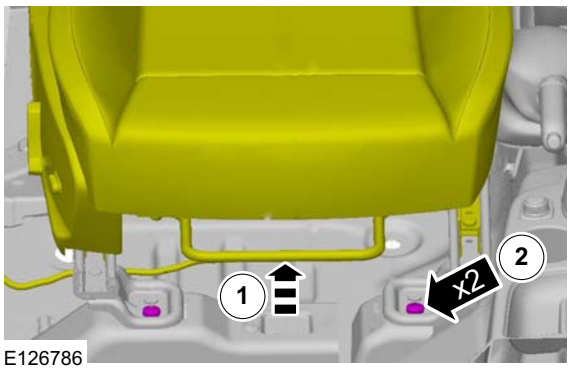
1. **WARNINGS:**

   The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

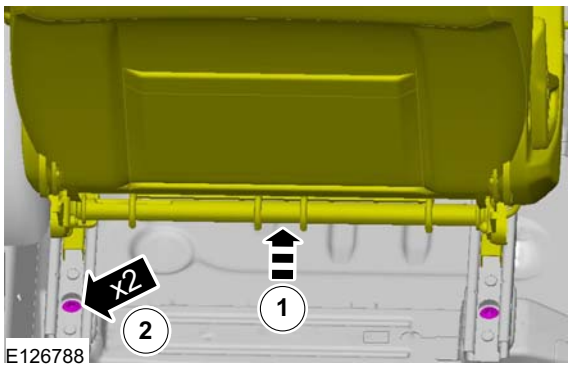
   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. 2. Torque: 48 Nm

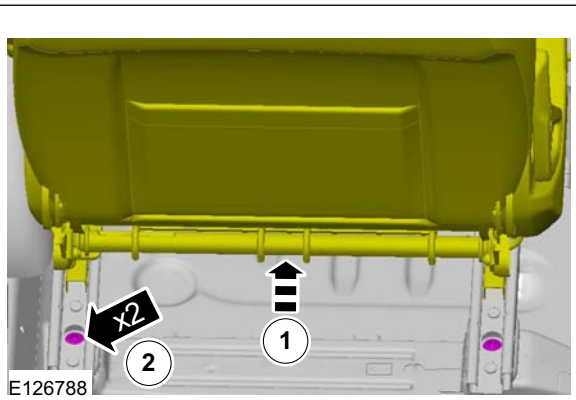


4. 2. Torque: 48 Nm



Single cab

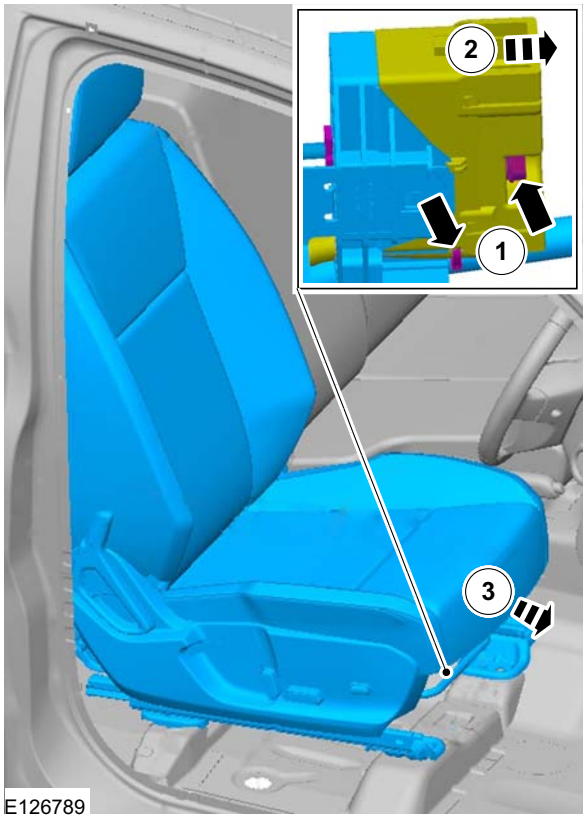
5. 2. Torque: 30 Nm



REMOVAL AND INSTALLATION

All vehicles

6. Disconnect the heated seat and side air bag module electrical connectors (if equipped).



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

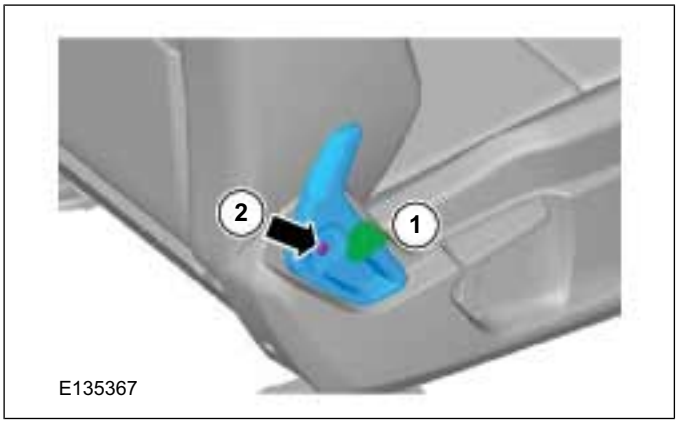
Front Seat Backrest

Removal

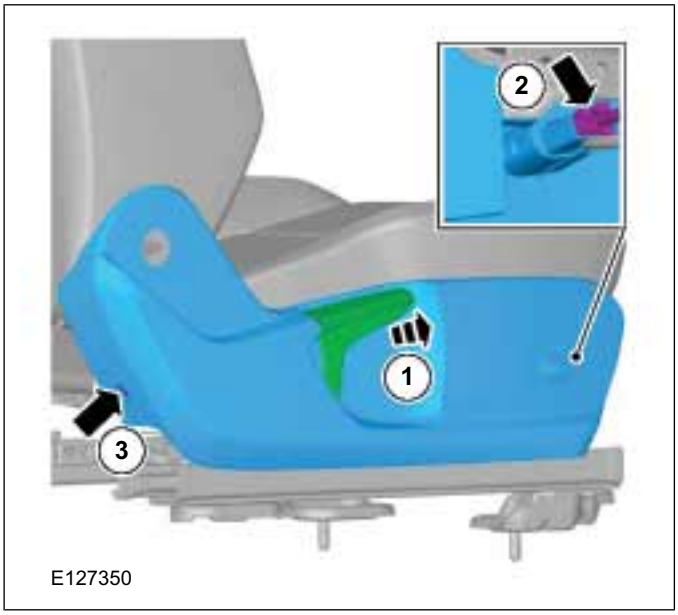
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Seat (501-10 Seating, Removal and Installation).

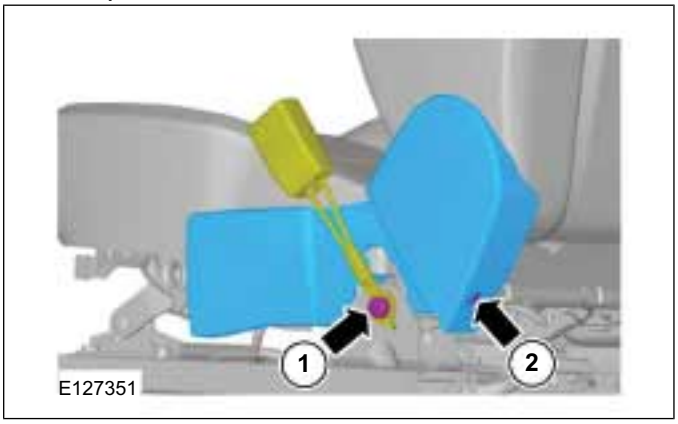
2.



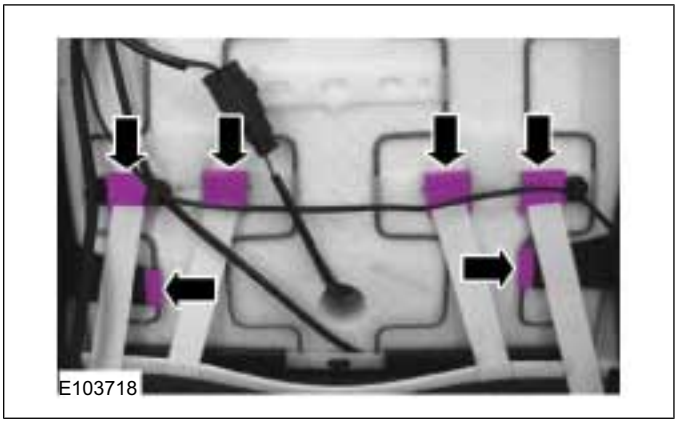
3.



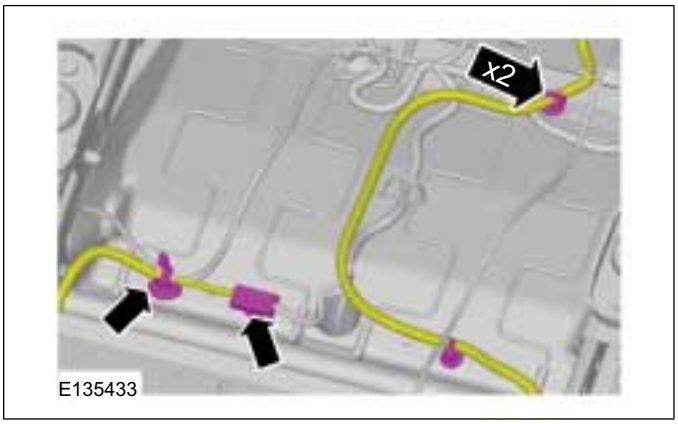
4. Torque: 38 Nm



5.

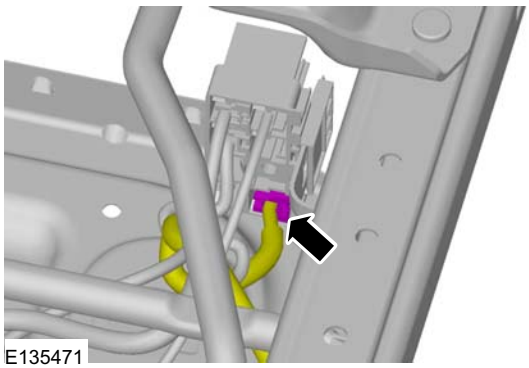


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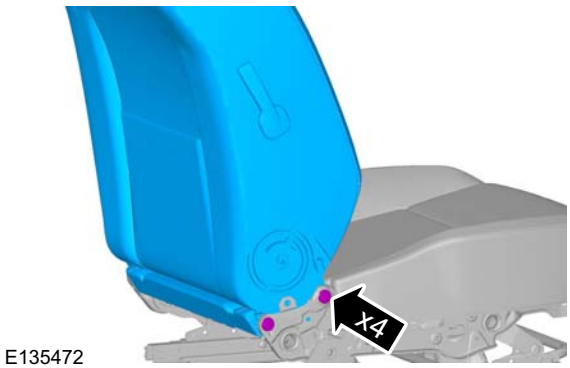


REMOVAL AND INSTALLATION

7.



8. Torque: 45 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Seat

Removal

NOTE: Removal steps in this procedure may contain installation details.

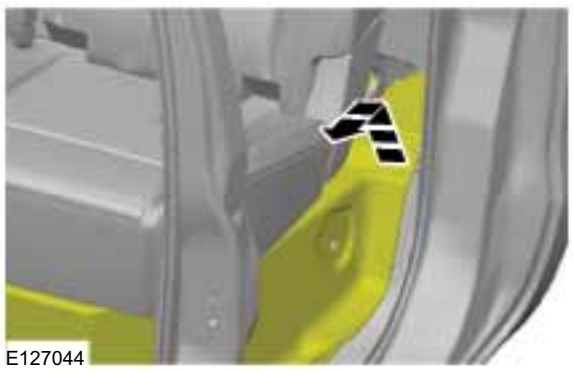
Double cab

WARNINGS:

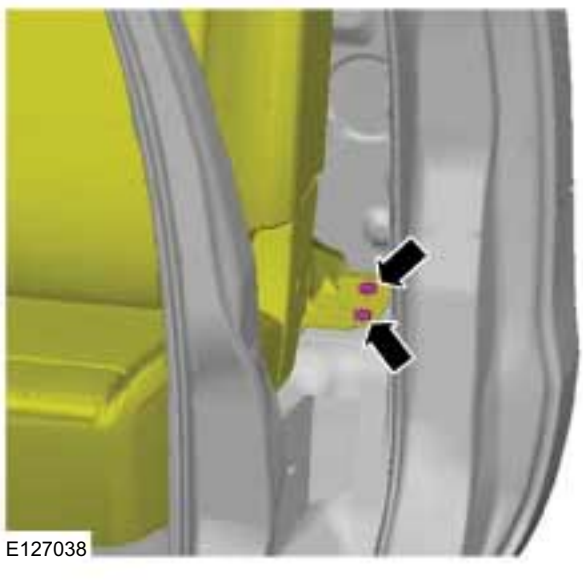
The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

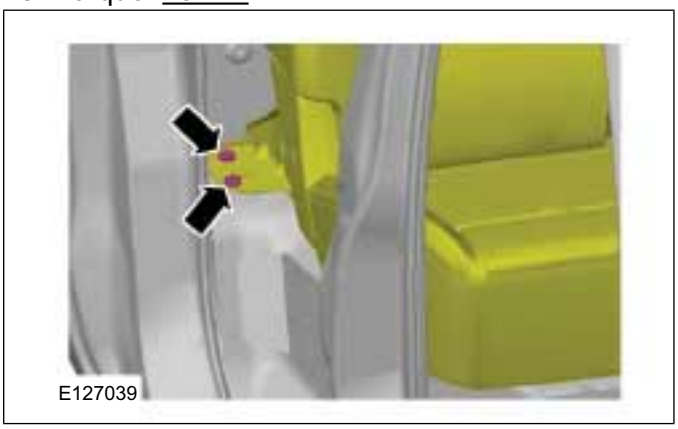
1.



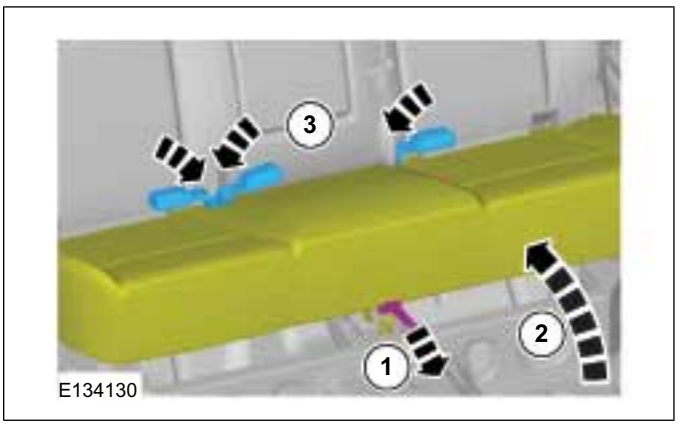
2. Torque: 48 Nm



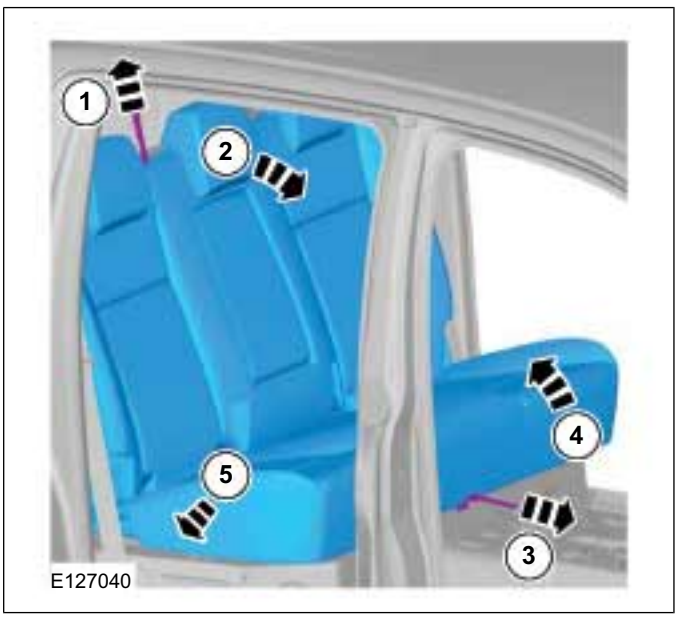
3. Torque: 48 Nm



4.



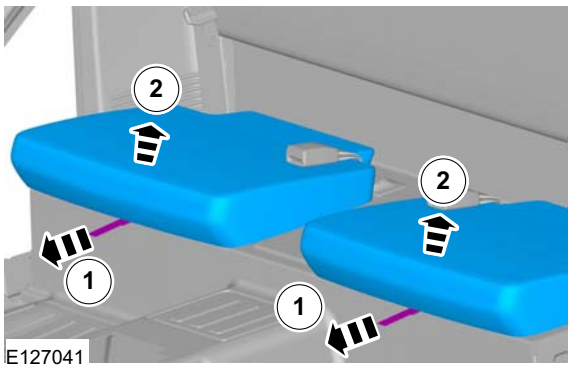
5.



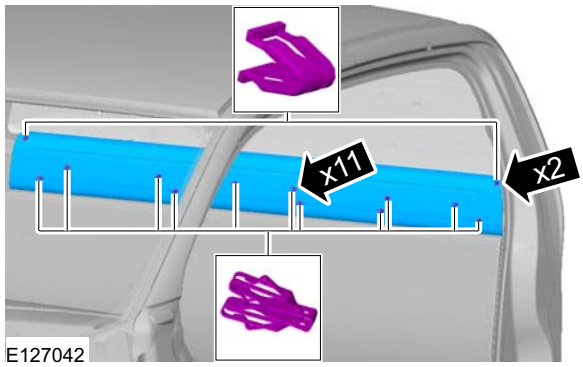
REMOVAL AND INSTALLATION

Stretch cab

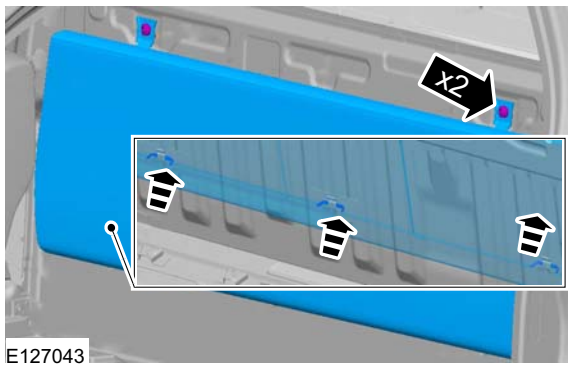
6.



7.



8. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

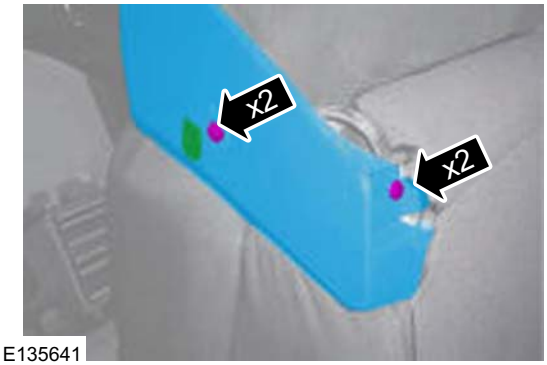
Rear Seat Backrest

Removal

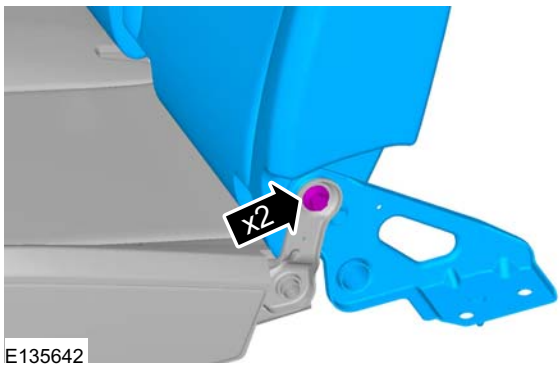
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Rear Seat (501-10 Seating, Removal and Installation).

2. On both sides.



3. On both sides.
   Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.

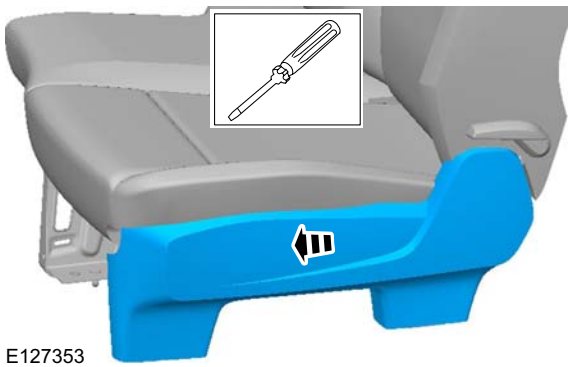
DISASSEMBLY AND ASSEMBLY

Front Bench Seat Backrest

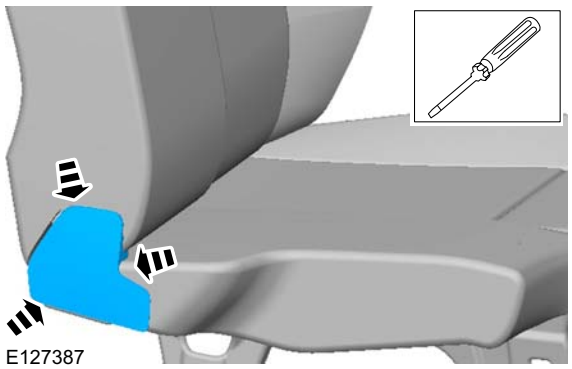
Disassembly

NOTE: Disassembly steps in this procedure may contain assembly details.

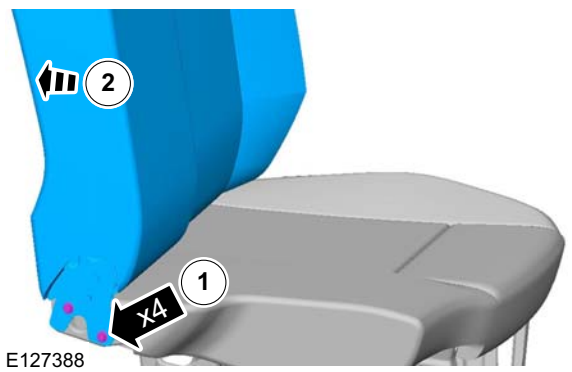
1.



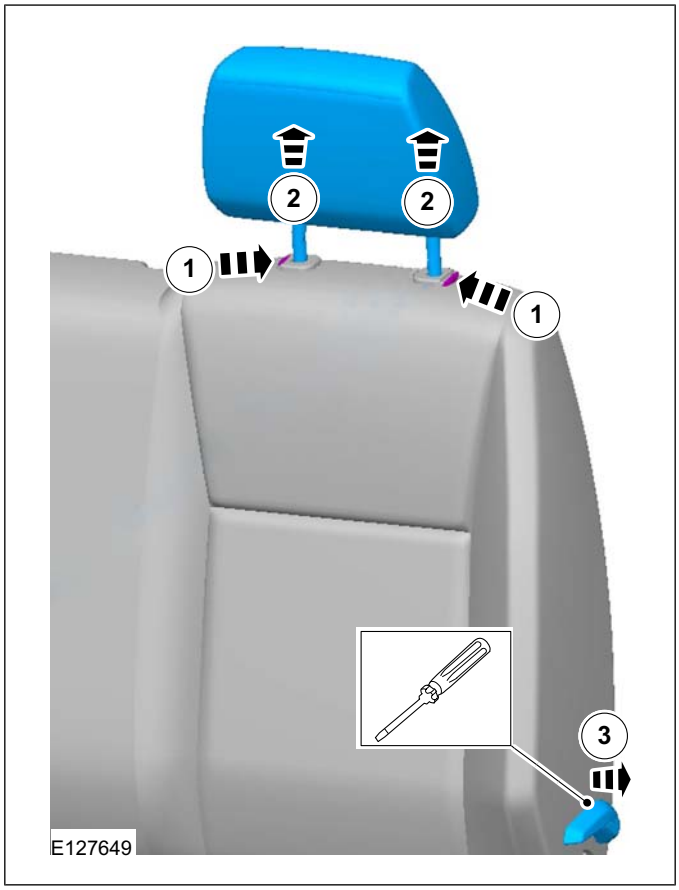
2.



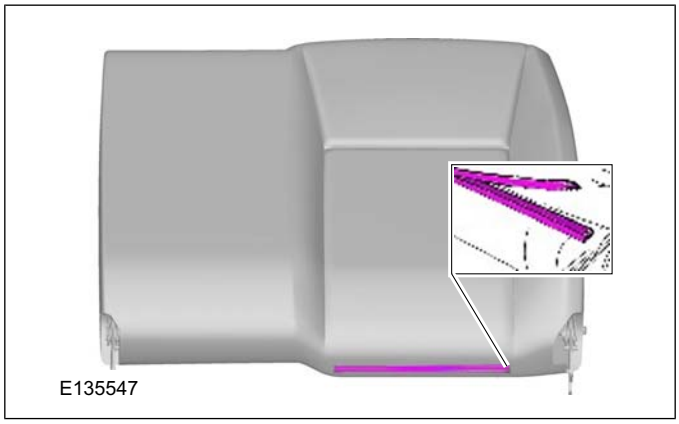
3. Torque: 35 Nm



4.

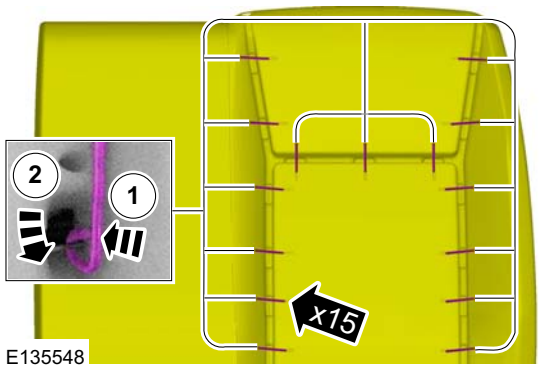


5.



DISASSEMBLY AND ASSEMBLY

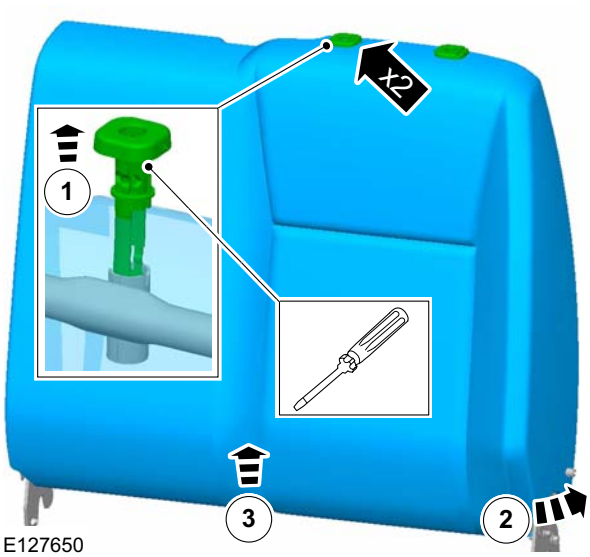
6.



9.



7.



8.



Assembly

10. To assemble, reverse the disassembly procedure.

DISASSEMBLY AND ASSEMBLY

Front Bench Seat Cushion

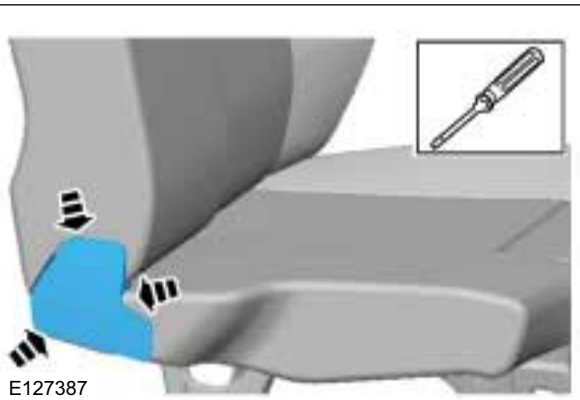
Disassembly

NOTE: Disassembly steps in this procedure may contain assembly details.

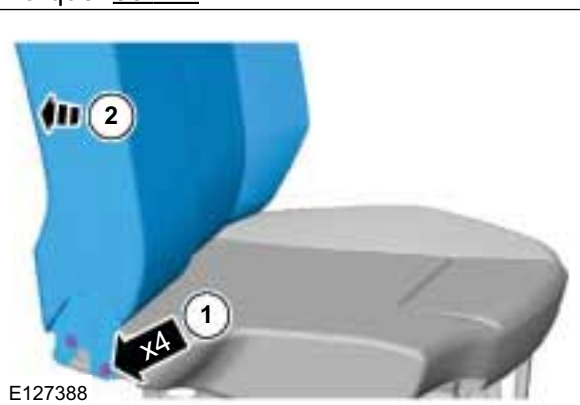
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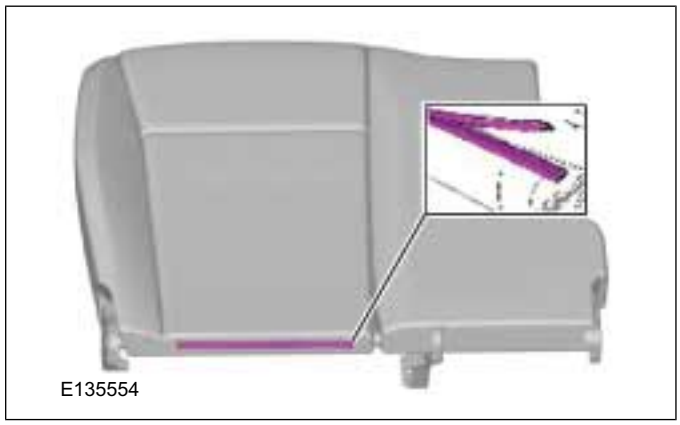
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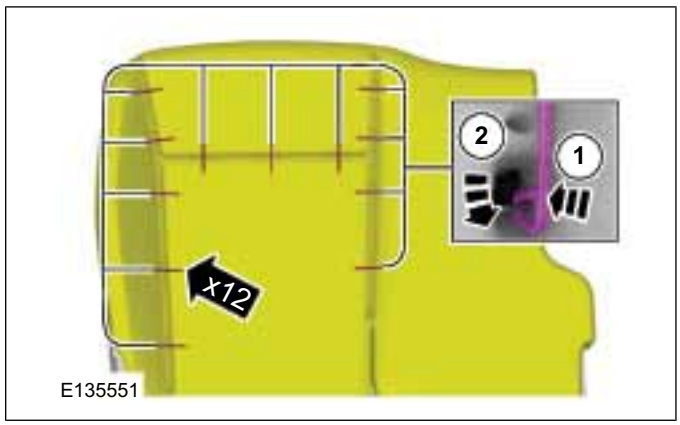
3. Torque: 35 Nm



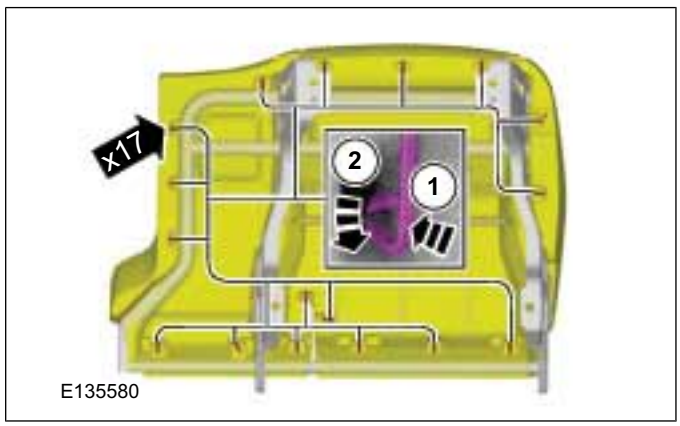
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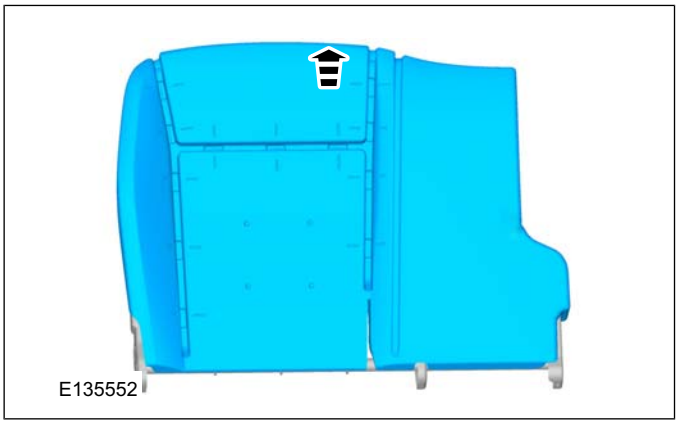


DISASSEMBLY AND ASSEMBLY

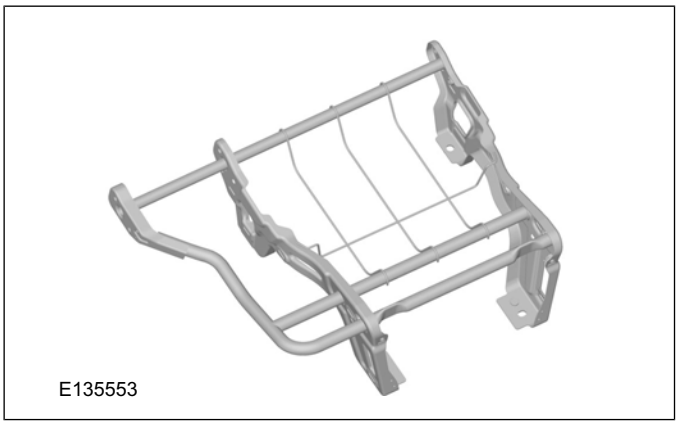
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8.



9.



Assembly

10. To assemble, reverse the disassembly procedure.

DISASSEMBLY AND ASSEMBLY

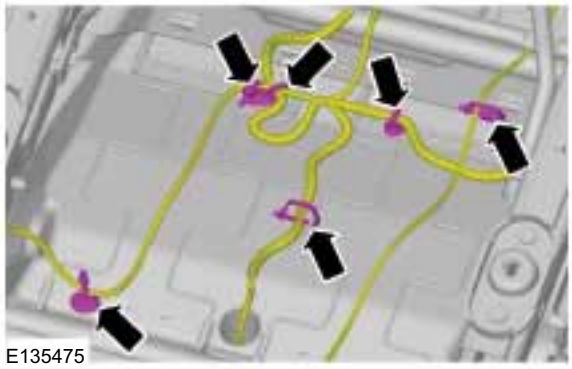
Front Seat Cushion

Disassembly

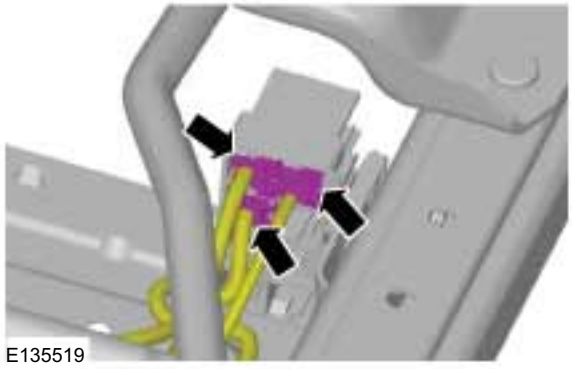
NOTE: Disassembly steps in this procedure may contain assembly details.

1. Refer to: Front Seat Backrest (501-10 Seating, Removal and Installation).

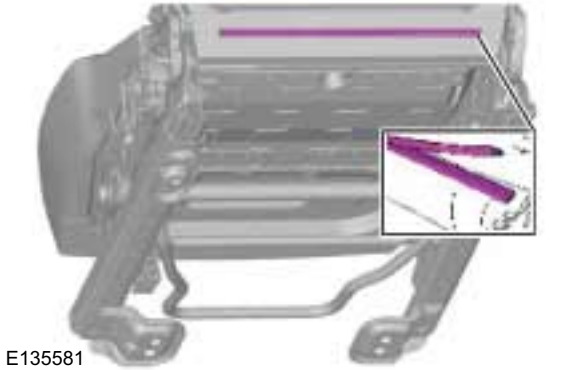
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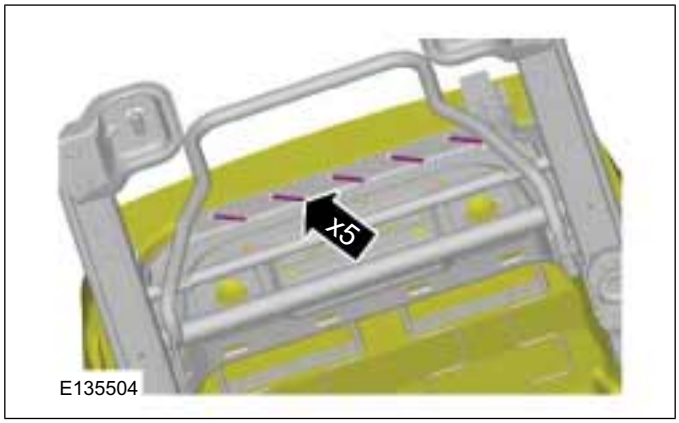
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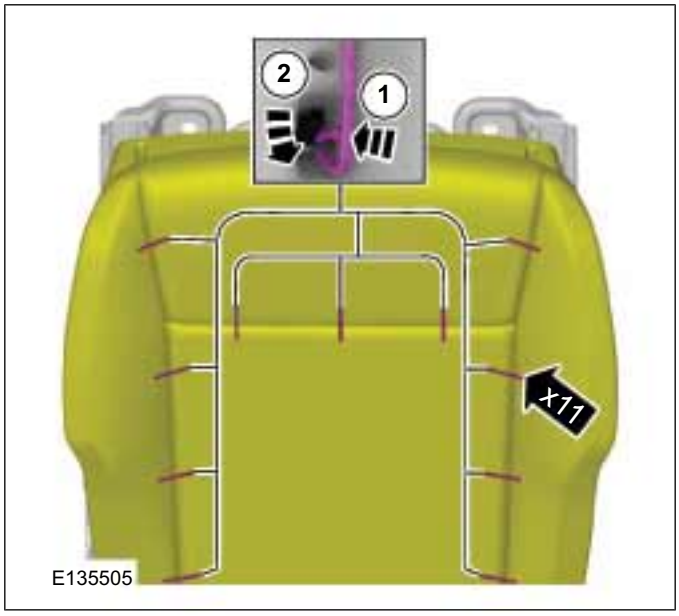
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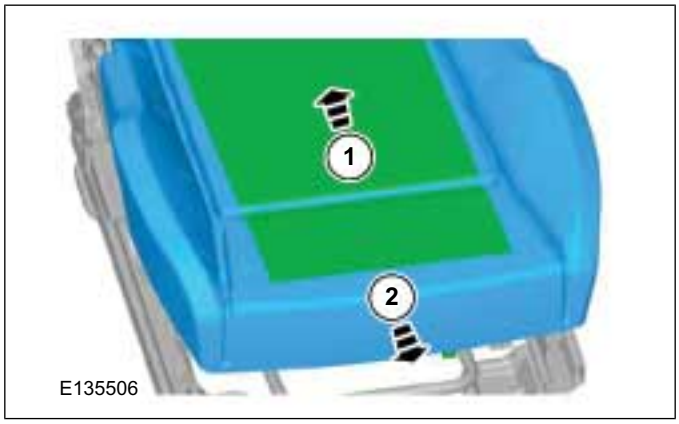
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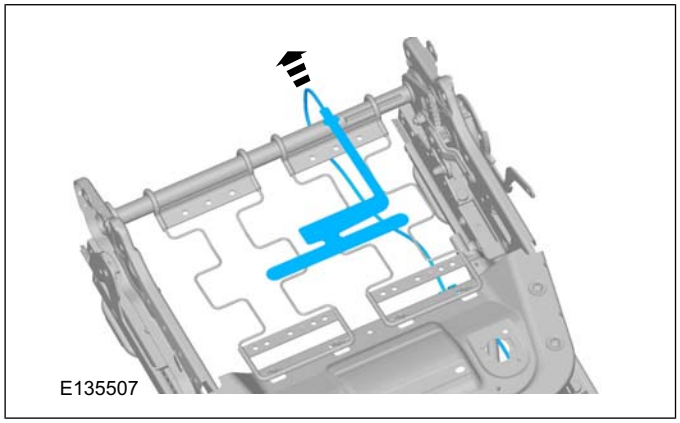


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DISASSEMBLY AND ASSEMBLY

8.



Assembly

9. To assemble, reverse the disassembly procedure.

DISASSEMBLY AND ASSEMBLY

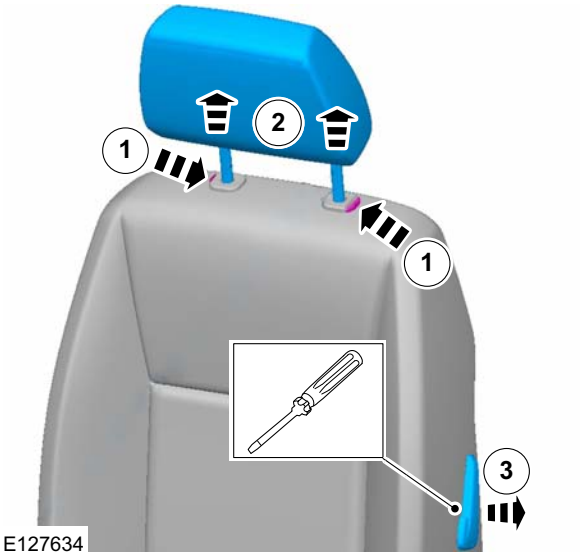
Front Seat Backrest

Disassembly

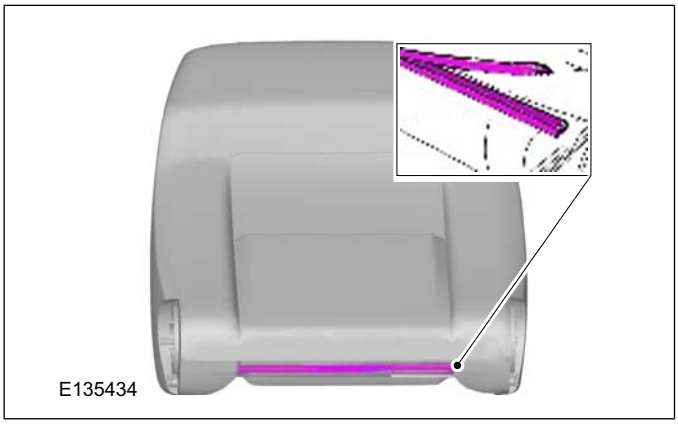
NOTE: Disassembly steps in this procedure may contain assembly details.

1. Refer to: Front Seat Backrest (501-10 Seating, Removal and Installation).

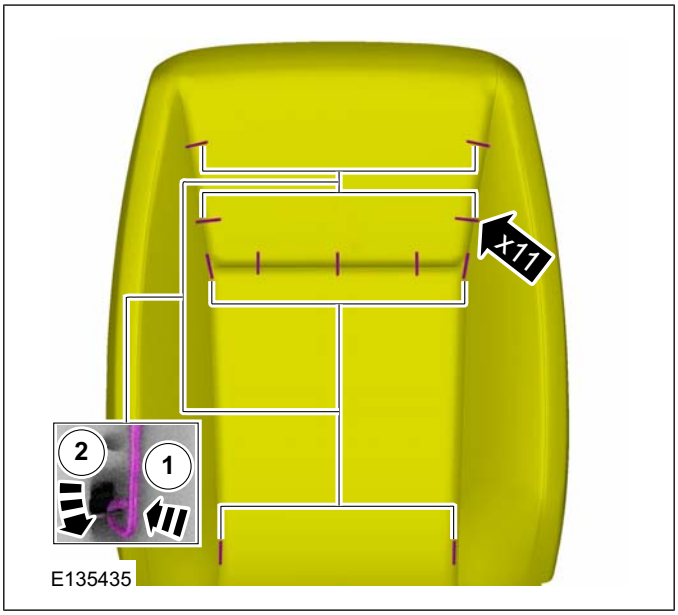
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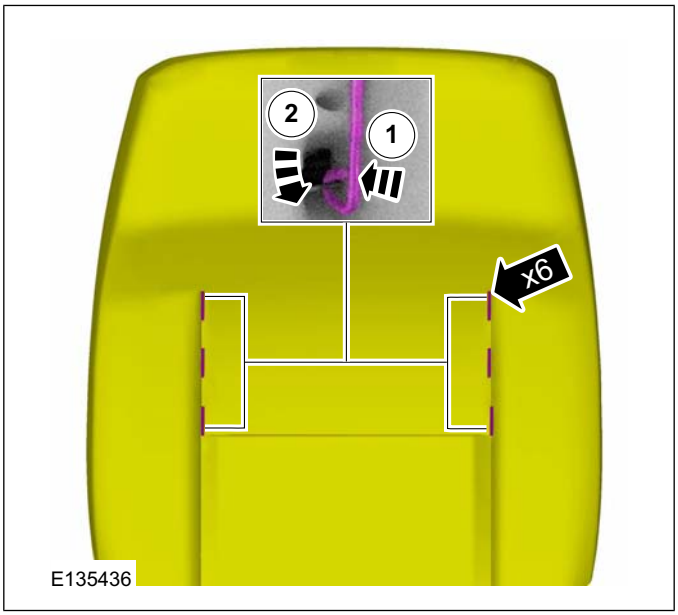
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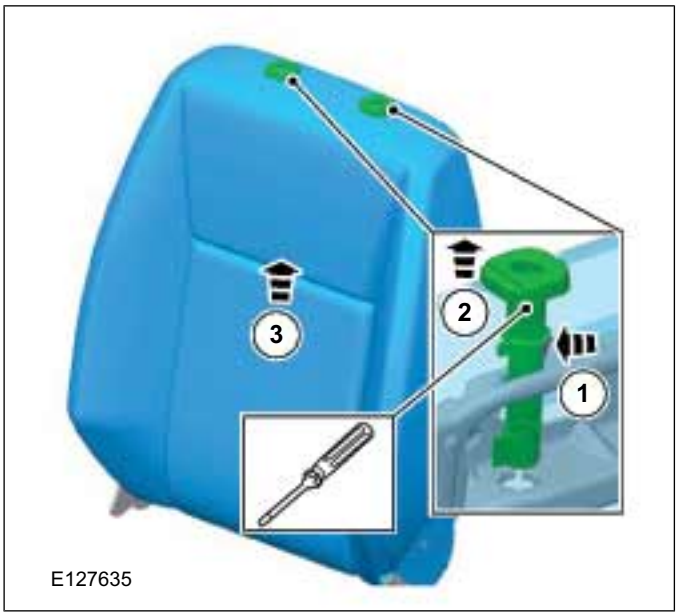


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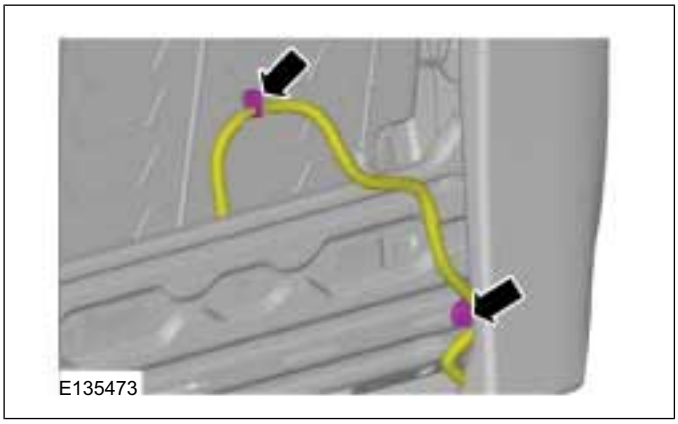


DISASSEMBLY AND ASSEMBLY

6.



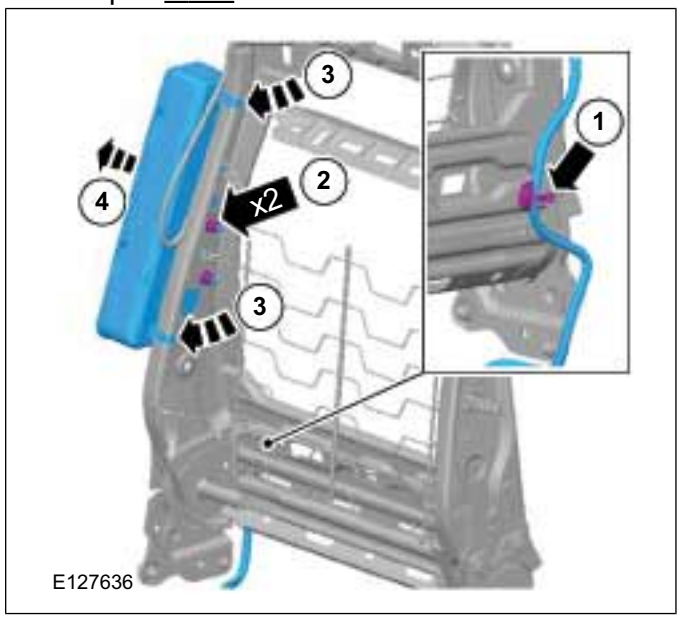
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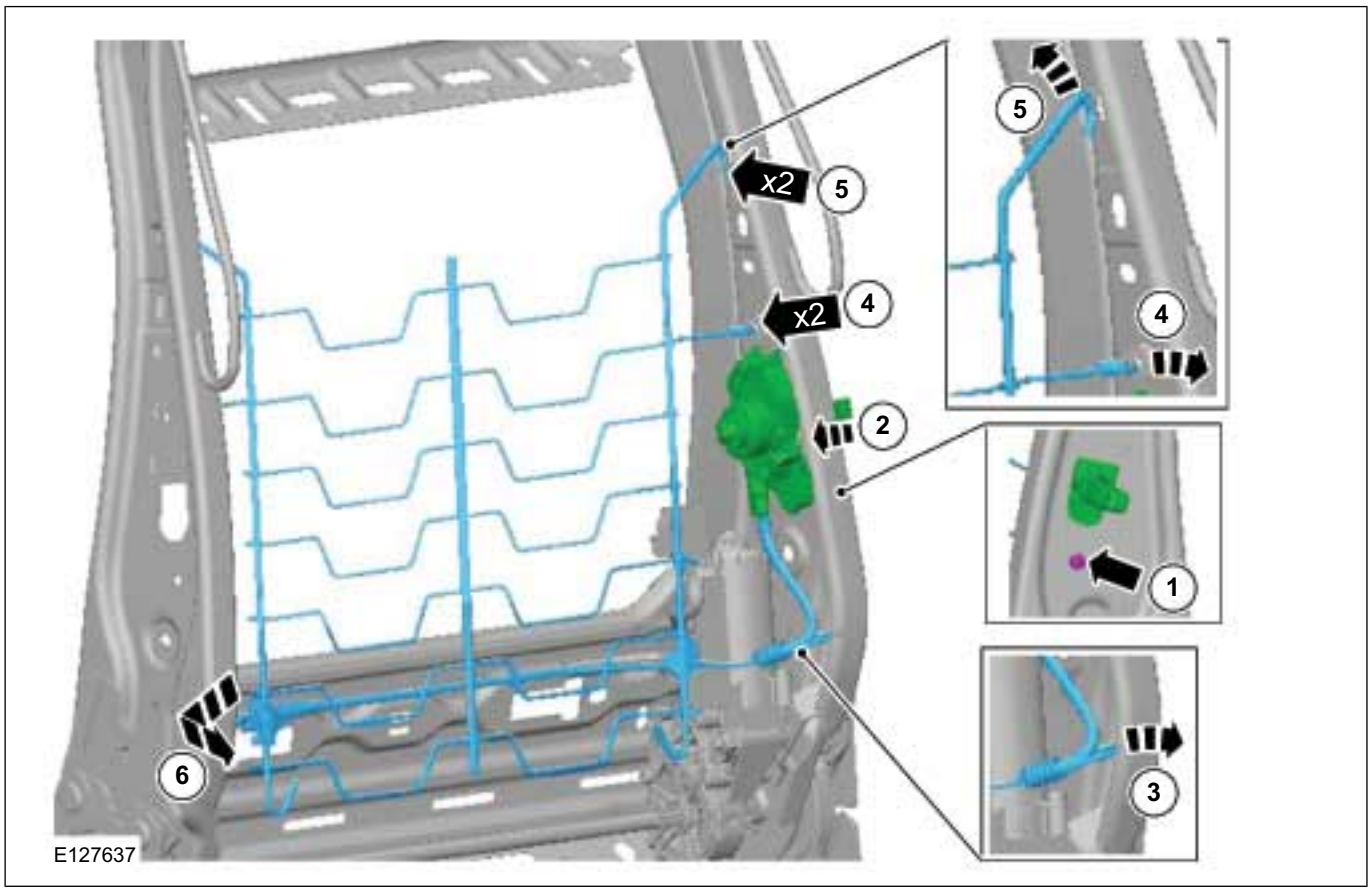


9. Torque: 5 Nm



10. Torque: 3 Nm

DISASSEMBLY AND ASSEMBLY



Assembly

11. To assemble, reverse the disassembly procedure.

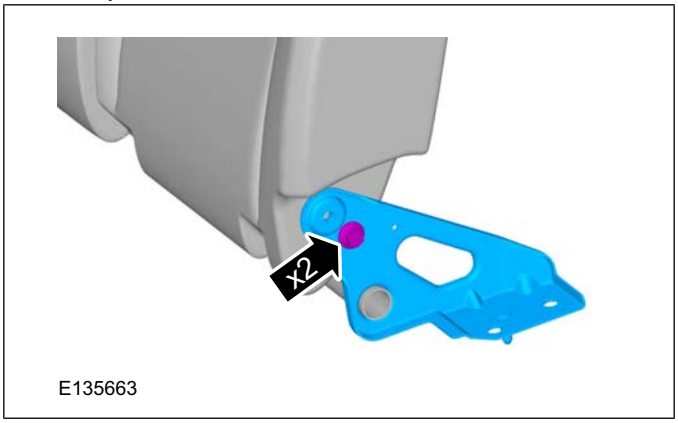
DISASSEMBLY AND ASSEMBLY

Rear Seat Backrest

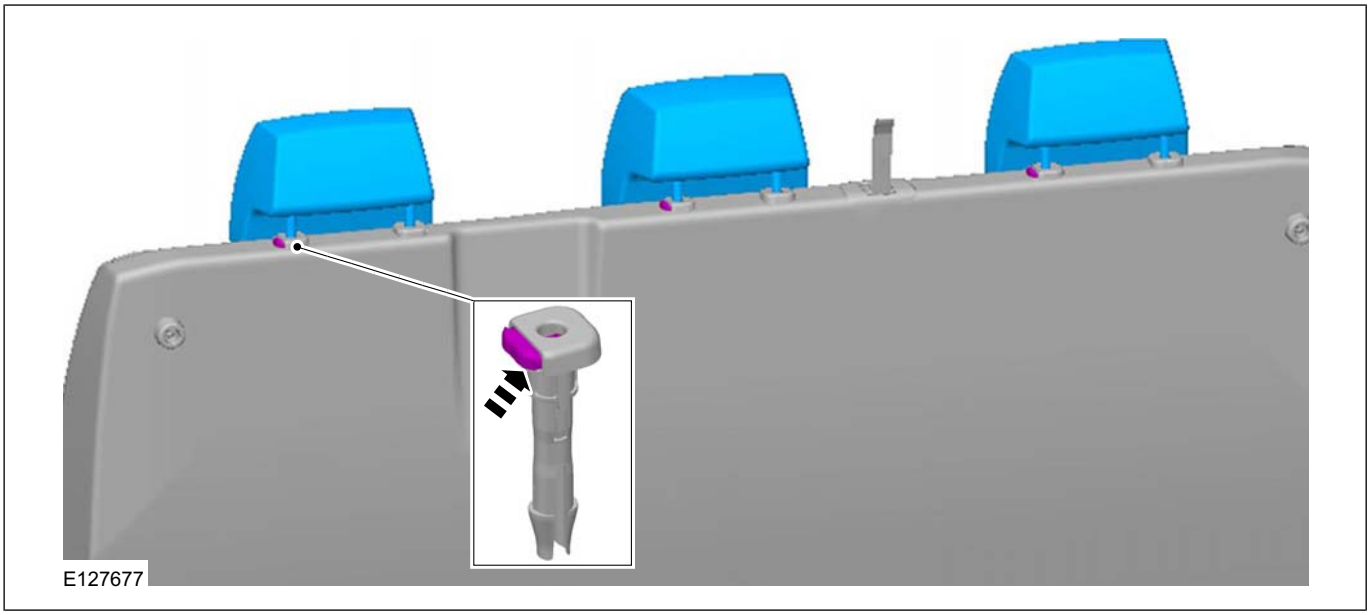
Disassembly

NOTE: Disassembly steps in this procedure may contain assembly details.

1. Refer to: Rear Seat Backrest (501-10 Seating, Removal and Installation).
2. Torque: 25 Nm

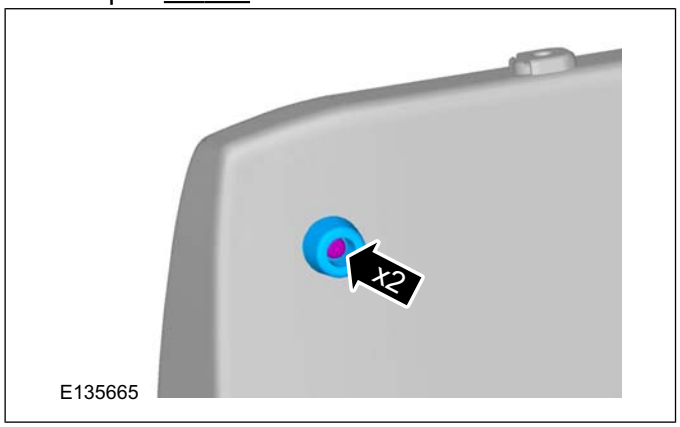


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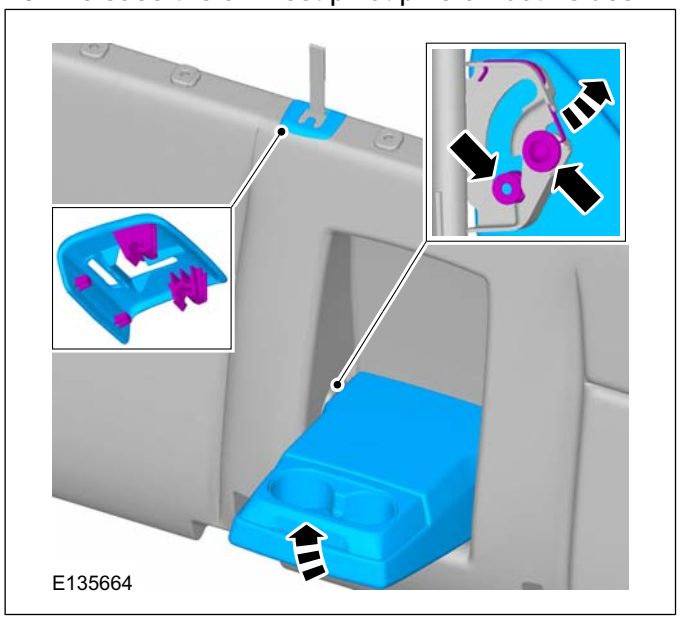


DISASSEMBLY AND ASSEMBLY

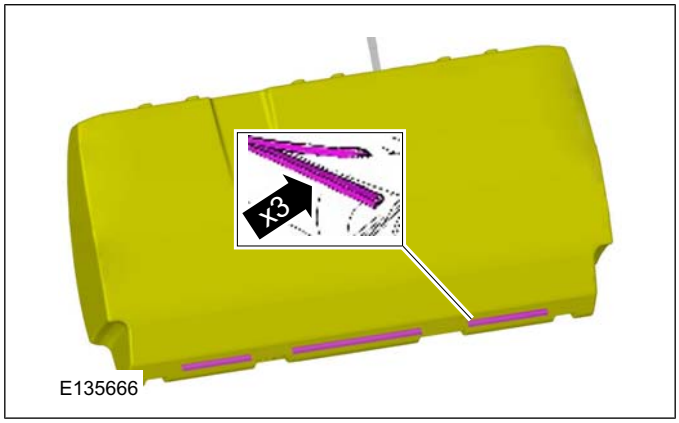
4. Torque: 10 Nm



5. Release the armrest pivot pins on both sides.

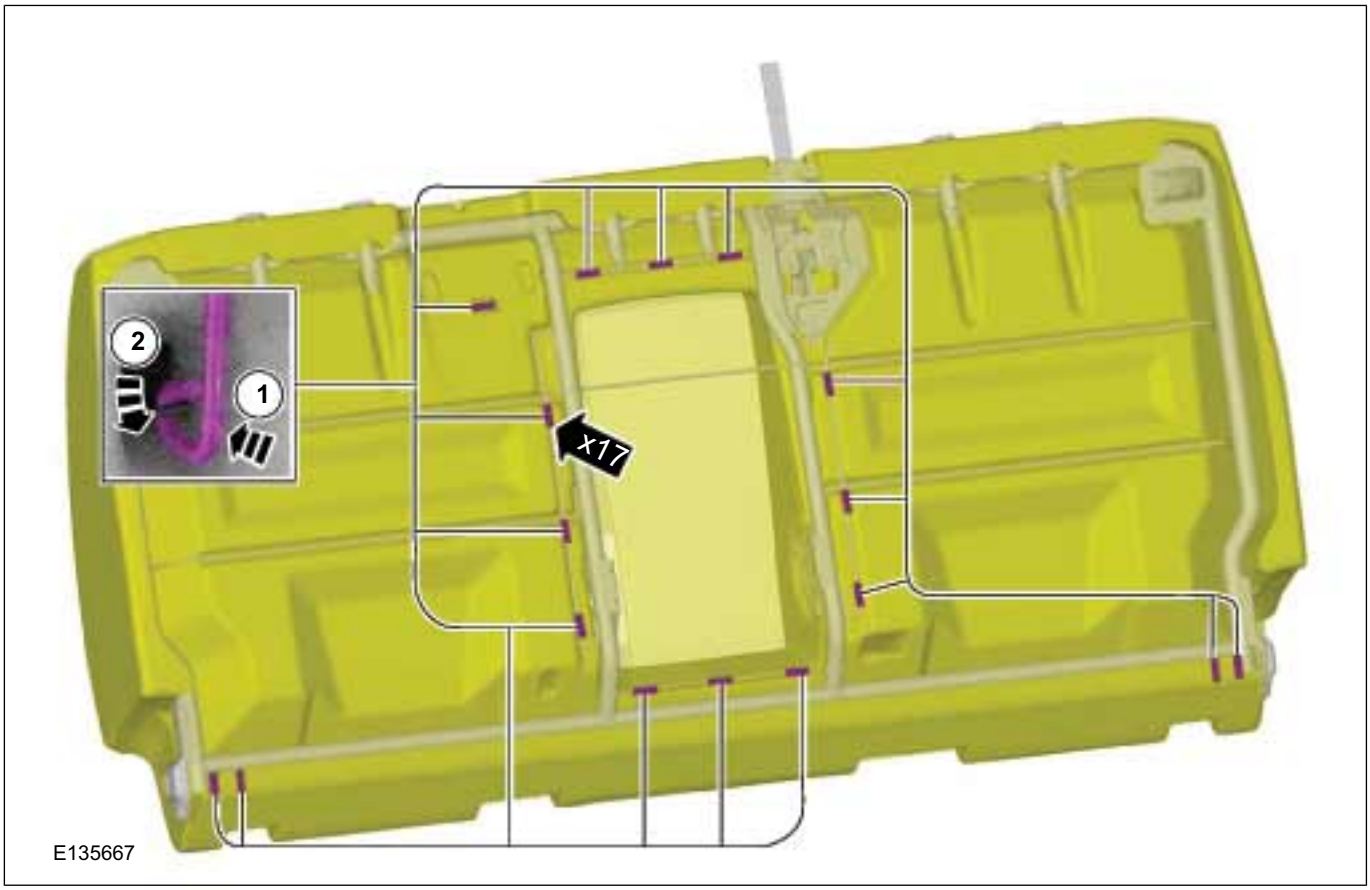


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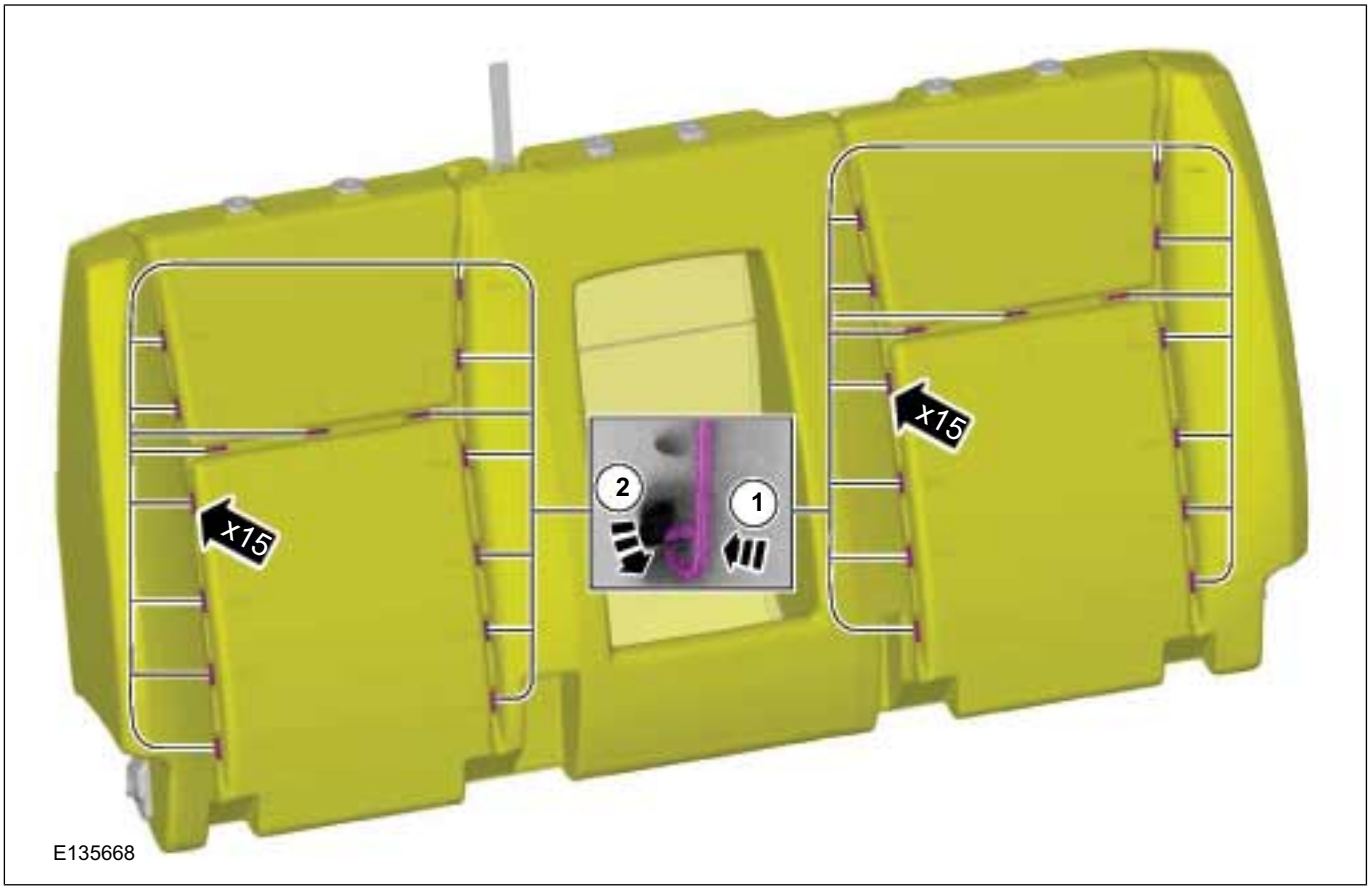


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DISASSEMBLY AND ASSEMBLY

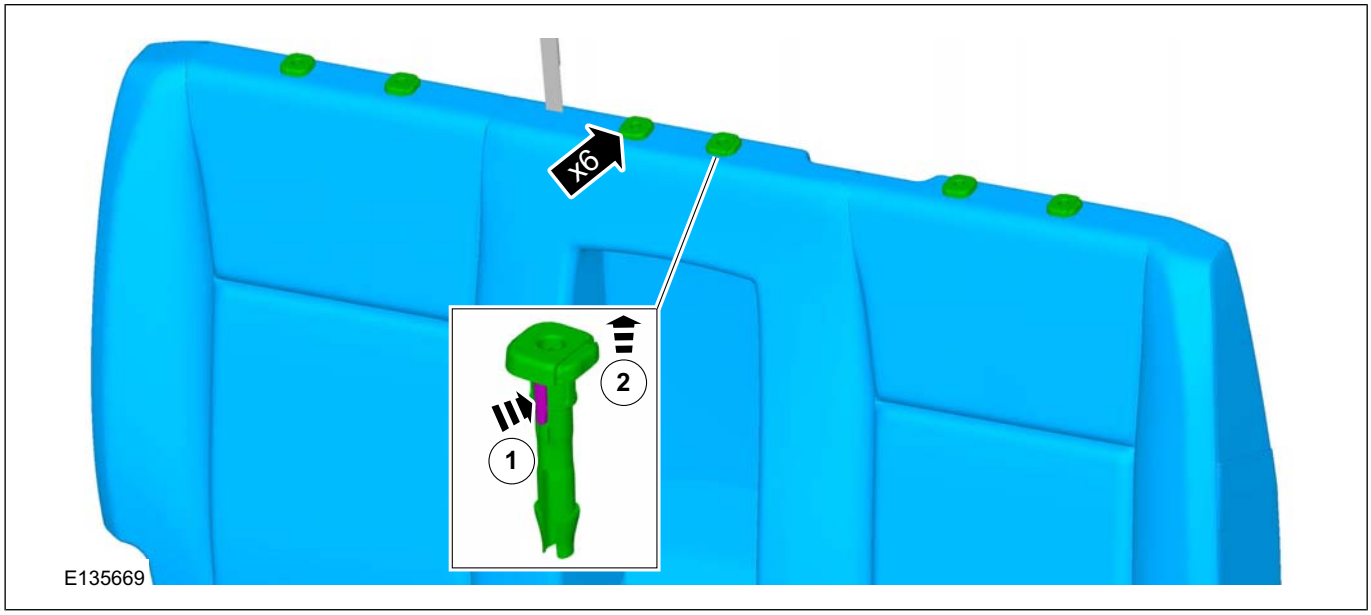


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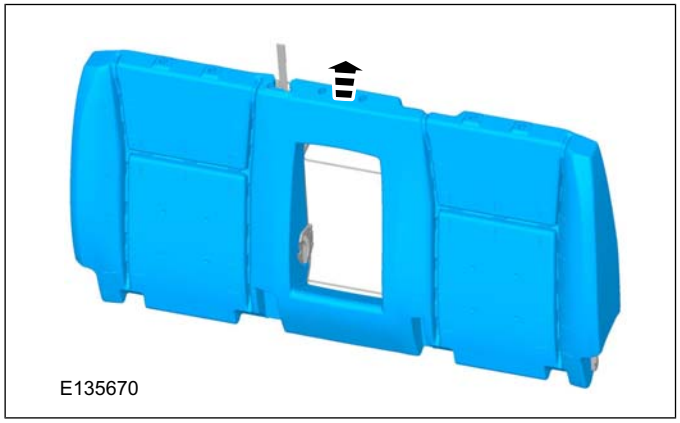


DISASSEMBLY AND ASSEMBLY

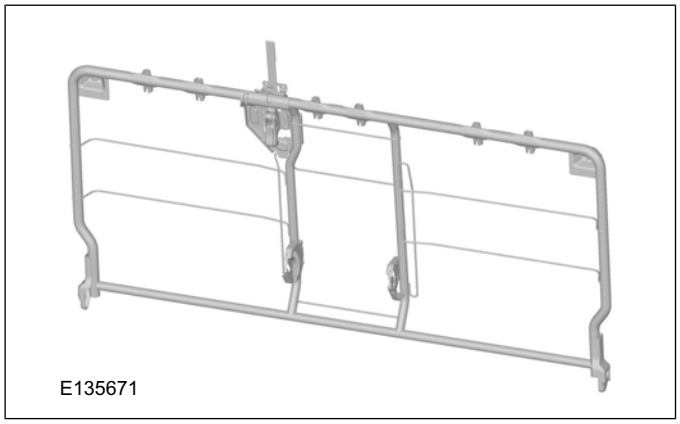
9.



10.



11.



Assembly

12. To assemble, reverse the disassembly procedure.

DISASSEMBLY AND ASSEMBLY

Rear Seat Cushion

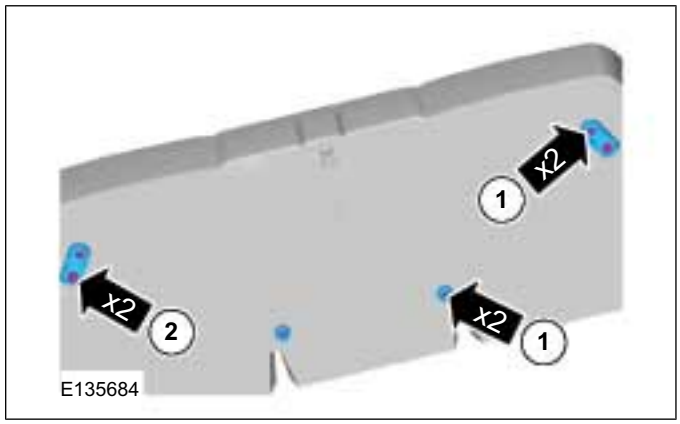
Disassembly

NOTE: Disassembly steps in this procedure may contain assembly details.

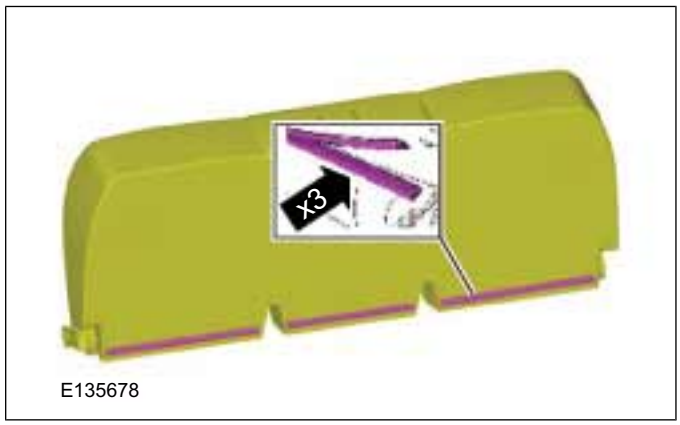
1. Torque: 25 Nm



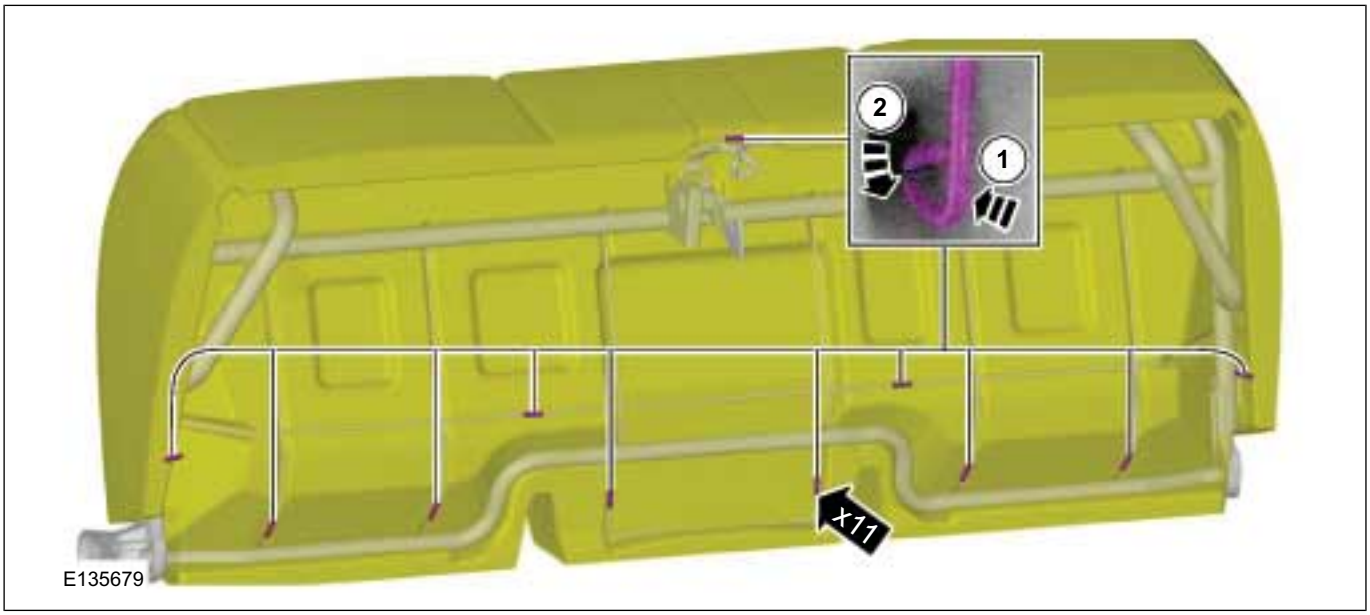
2. 1. Torque: 10 Nm
2. Torque: 8 Nm



3.

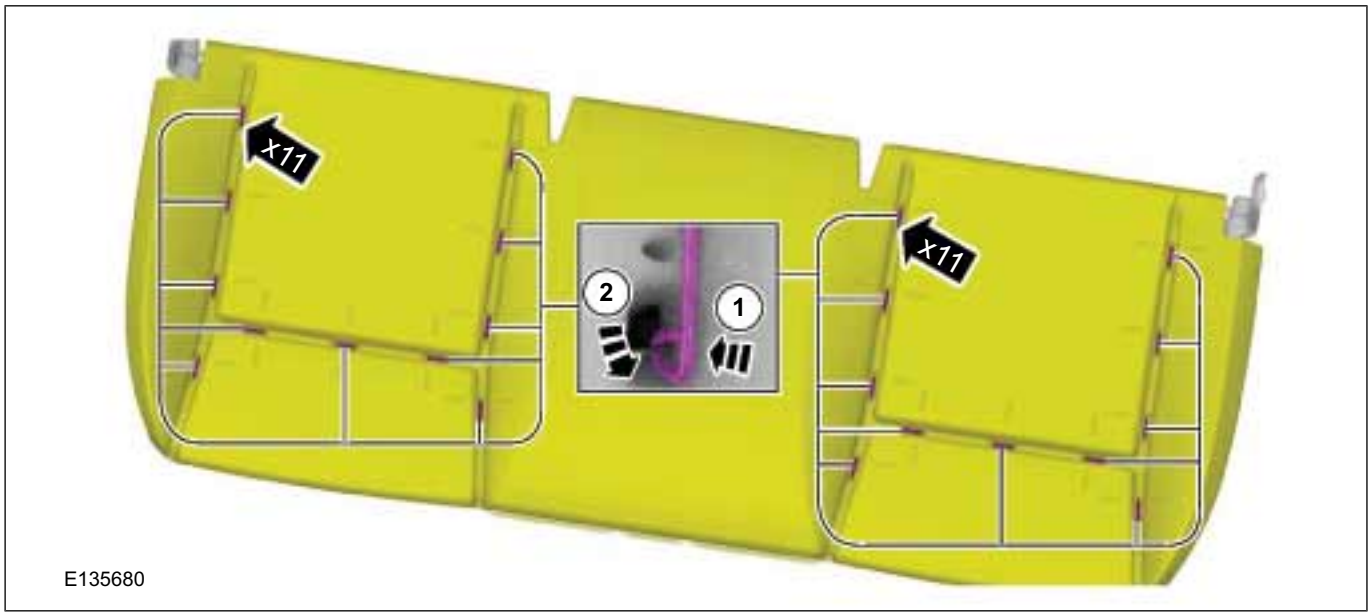


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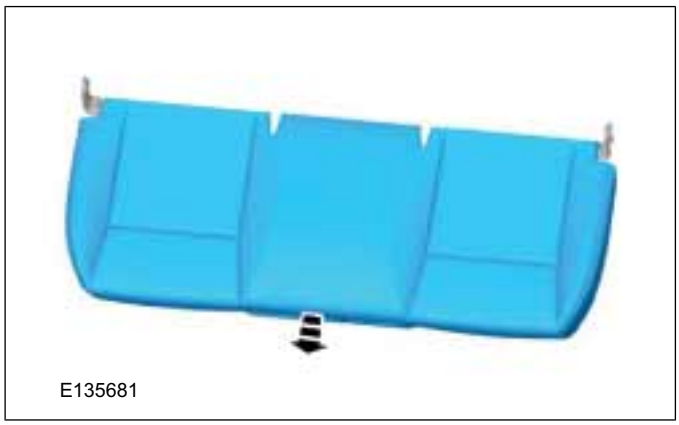
DISASSEMBLY AND ASSEMBLY

5.

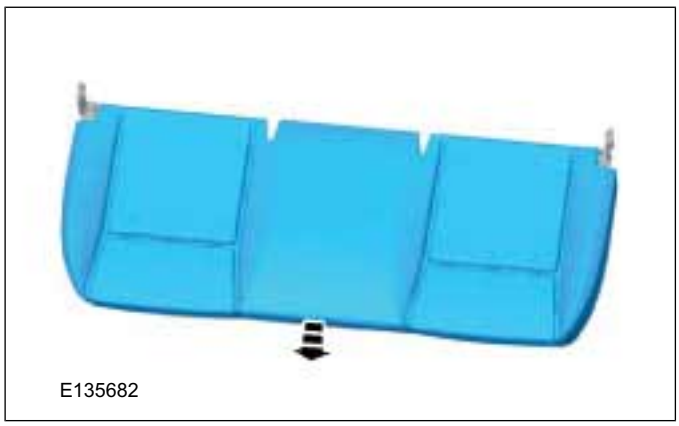


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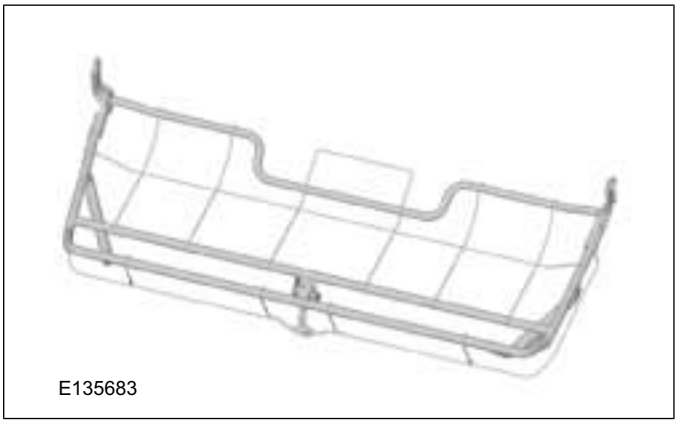
6.


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7.


E135682

8.


E135683

Assembly

9. To assemble, reverse the disassembly procedure.

SECTION 501-11 Glass, Frames and Mechanisms

VEHICLE APPLICATION: 2011.50 Ranger

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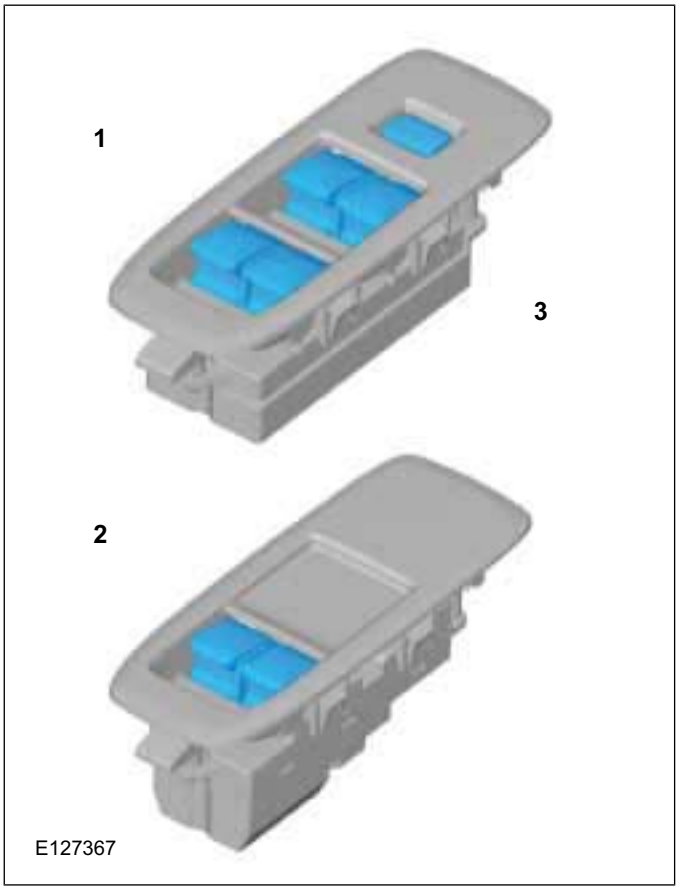
DESCRIPTION AND OPERATION

Glass, Frames and Mechanisms

The switch for the driver's door window on the driver's door switch unit is designed as a two-stage switch.

In addition, the window regulator motor on the driver's door is provided with two Hall sensors. The hall sensors detect the speed of the window regulator motor and therefore recognize any obstruction as the window rises.

Driver's door switch unit



Item	Description
1	4-way switch unit
2	2-way switch unit
3	Rear window disable switch

Switches - passenger door and rear doors

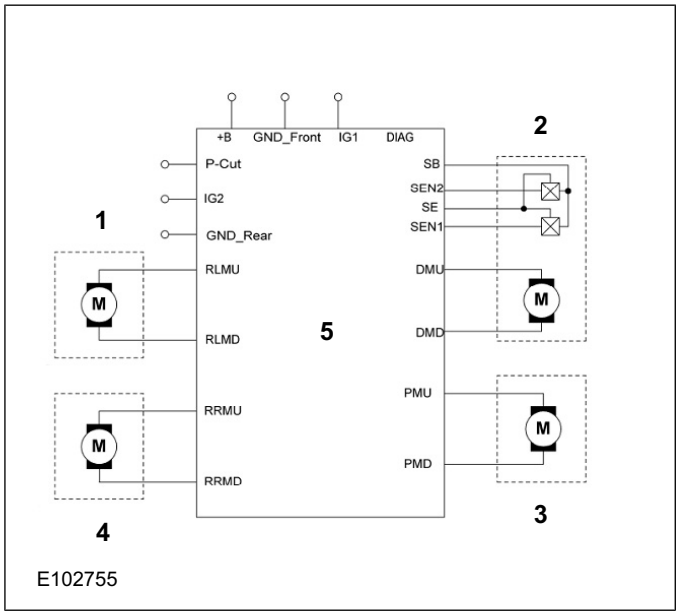


These doors are equipped with a simple switch for the window regulator motors.

This switch only has a simple up and down function (no anti-trap protection).

NOTE: The window regulator motors in the rear doors can be deactivated using the disable switch in the driver's door switch unit.

Window regulator motors



Item	Description
1	Rear left-hand door window regulator motor
2	Window regulator motor, driver's side
3	Window regulator motor, passenger's side

DESCRIPTION AND OPERATION

Item	Description
4	Rear right-hand door window regulator motor
5	Driver's door switch unit

NOTE: If a window regulator is operated at the same time from the driver's door switch unit and from the respective simple switch, the relevant window stops immediately.

Each window regulator motor can be controlled from the driver's door switch unit.

In addition, the motors for the passenger's door and the rear doors (when equipped) can be controlled using the corresponding simple switches on the doors.

Service Instructions

After the battery has been disconnected or the driver's door switch unit has been changed, the window regulator motor in the driver's door must be reprogrammed (see current service literature).

Diagnostic Information

The switch unit and the window regulator motors are not connected to the communication network. The system cannot therefore be diagnosed using the DLC (data link connector).

Instructions if there is a operating concern with the driver's door window regulator motor:

- After the window regulator motors have been deactivated, they continue to turn for a short time. During "Ignition ON" the switch unit detects the run-on phase via the Hall sensors.
- If however the ignition is switched off while the driver's door window regulator motor is operating, the power supply of the Hall sensors is immediately interrupted. The run-on phase of the window regulator motor then can no longer be detected.
- In order to maintain the power supply for this situation, the driver's door switch unit is protected by an additional fuse F26 (in the engine compartment fuse box).
- If the fuse fails the driver's door window regulator motor will no longer operate.

Instruction if there is a malfunction of both front window regulator motors:

- Both window regulator motors are protected in common by fuse F20 (passenger compartment fuse box).

Instruction if there is a malfunction of both rear window regulator motors:

- Both window regulator motors are protected in common by fuse F51 (passenger compartment fuse box).

GENERAL PROCEDURES

Door Window Motor Initialization

WARNING: The window anti-trap function will not operate during the window motor initialization procedure.

NOTE: Make sure that the window runs are correctly installed and free of foreign material.

NOTE: If the power to a window regulator motor has been disconnected, that window regulator motor must be initialized.

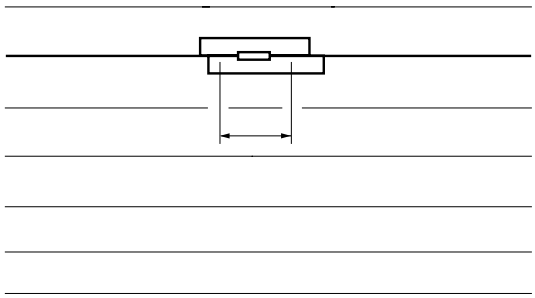
NOTE: Wait for a minimum of 1 minute before connecting the battery, fuse or electrical connector.

1. **Start the engine.**
2. **Press and hold the power window control switch close button until the door window is fully closed.**
3. **Release the power window control switch close button.**
4. **Press the power window control switch close button three times for one second.**
5. **Briefly press the power window control switch open button to the 2nd detent and release the button. The door window should open automatically.**
6. **Briefly press the power window control switch close button to the 2nd detent and release the button. If the door window does not close automatically, repeat the complete procedure.**
7. **Repeat the door window motor initialization for each door window motor.**
8. **Switch off the engine.**

GENERAL PROCEDURES

Heated Window Grid Wire Repair

1. **Clean the filament using isopropyl alcohol.**
2. **Attach tape to both sides of the filament.**



A6E7736W003

3. **Using a small brush or marking pen, apply silver paint.**
4. **CAUTION: Do not operate the rear window defroster until the paint is completely dry. It may cause other malfunctions if it is used before the paint is dry.**

   After 2—3 min, carefully remove the tape without damaging the applied area.
5. **Dry the repaired part according to the following procedure.**
   - When the room temperature is 25 °C {77 °F}, leave to dry for 24 h.
   - When a hot air blower is used, dry with air at a temperature of 150 °C {302 °F} or 30 min.

REMOVAL AND INSTALLATION

Windshield Glass

General Equipment

Adhesive Tape
Direct Glazing Removal/Replacement Equipment
Knife

Materials	
Name	**Specification**
Windscreen Adhesive Kit - 1 Component	WSK-M11P57-A3 / 7U7J-T03863-AA
Windshield Adhesive Kit	WSS-M11P57-A5

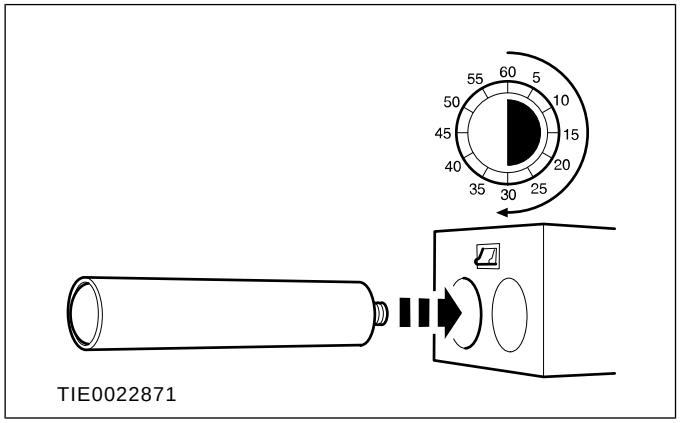
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive
   • Remove the polyurethane (PU) adhesive cap and heat the 2K-PU adhesive for a minimum of 30 minutes.

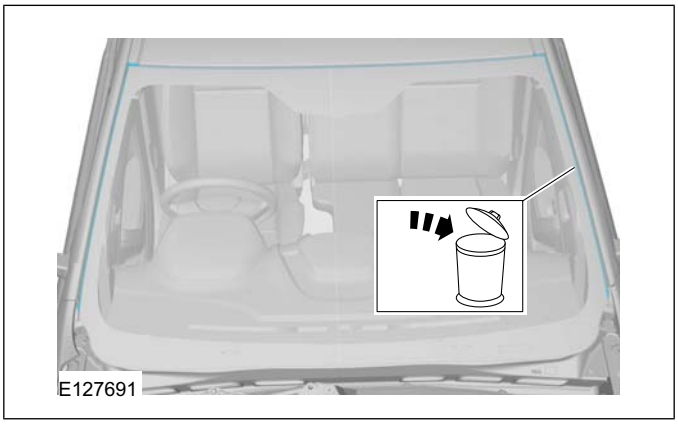
   General Equipment: Direct Glazing Removal/Replacement Equipment
   • Repairs under warranty:

   Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive



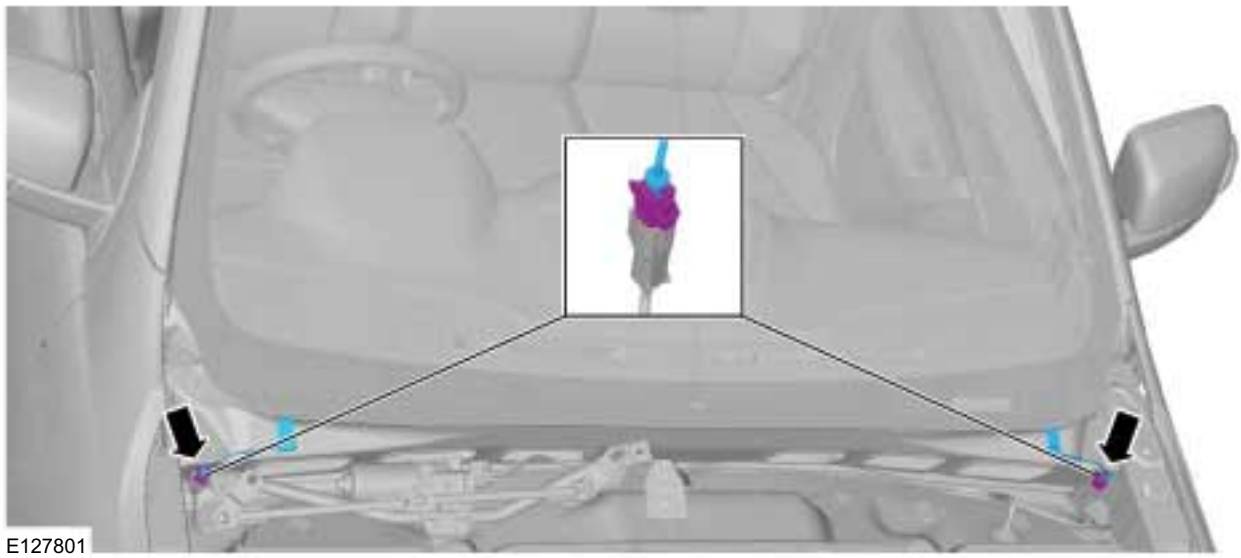
3. **CAUTION: Make sure that the motor is in the park position.**

   Refer to: Wiper Linkage Assembly (501-16 Wipers and Washers, Removal and Installation).
4. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
5.

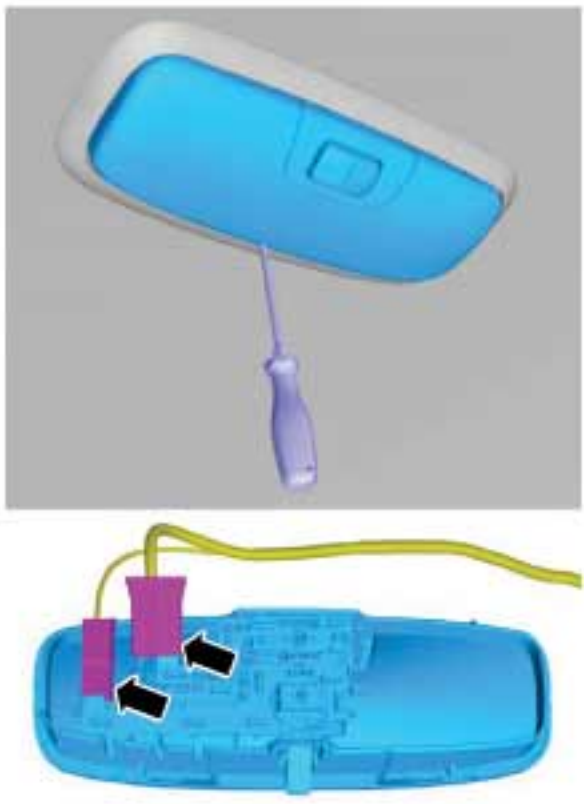


6. **NOTE:** Vehicles with heated windsheild only.

REMOVAL AND INSTALLATION

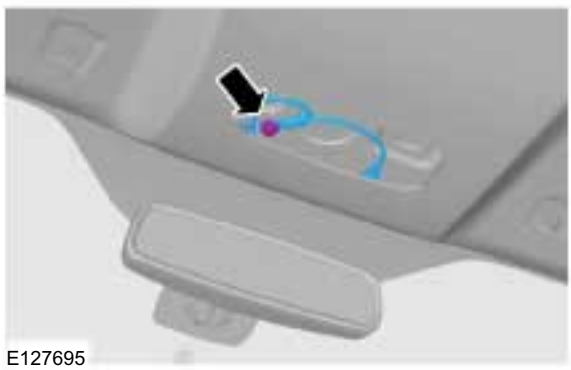

E127801

7. **NOTE:** Vehicles with heated windsheild only.

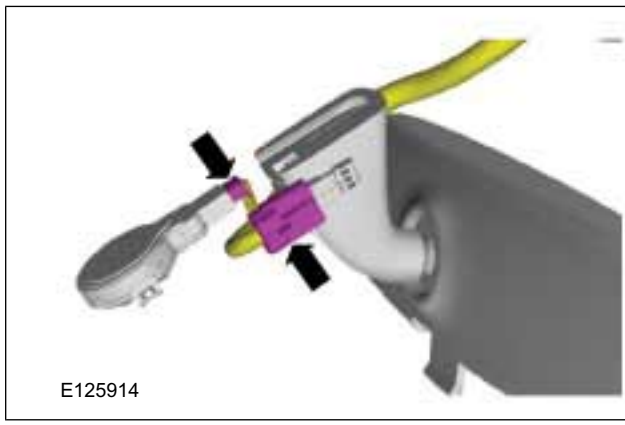

E125911

8. **NOTE:** Vehicles with heated windsheild only.

Torque: 10 Nm


E127695

9. **NOTE:** Vehicles with auto-dimming interior mirror and rain sensor only.


E125914

10. Refer to interior rear view mirror removal

11. 

REMOVAL AND INSTALLATION

Use a suitable awl to thread the cutting wire.

General Equipment: Direct Glazing Removal/Replacement Equipment

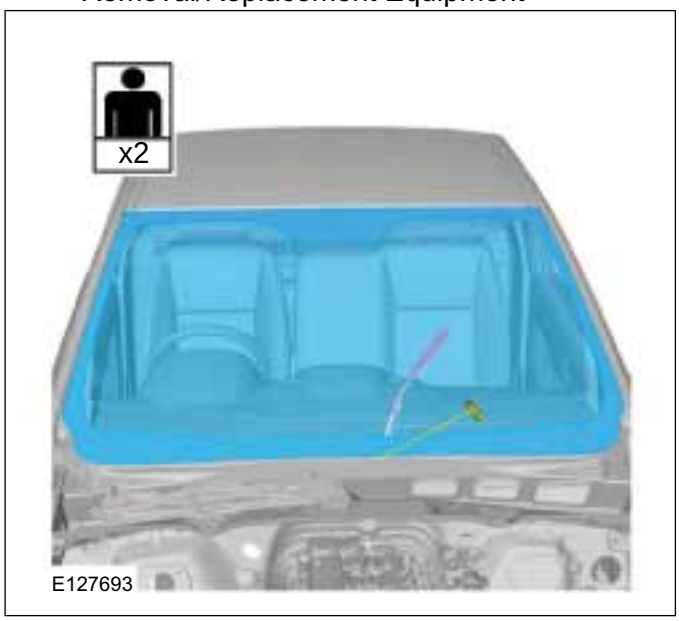


12.

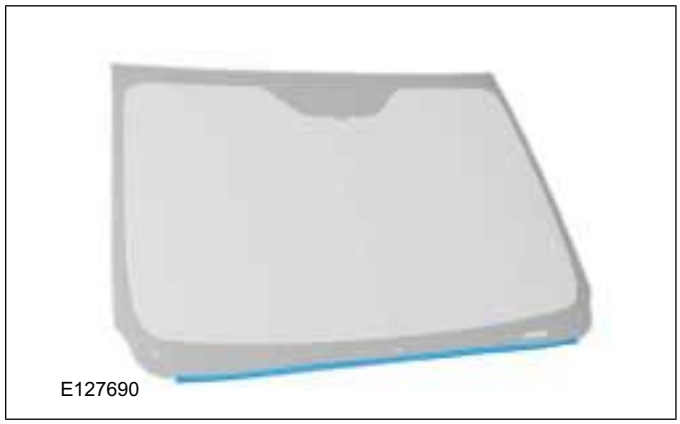
CAUTION: If the original window glass is to be installed, take care not to damage the electrical connectors and the weatherstrip (if equipped).

Use a suitable brace to prevent trim damages.

General Equipment: Direct Glazing Removal/Replacement Equipment

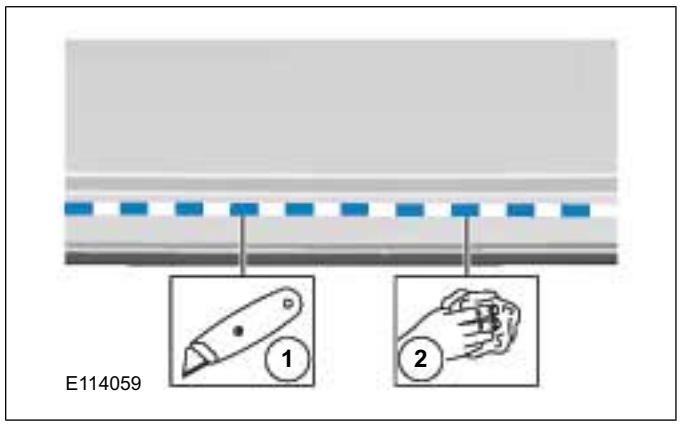


13.



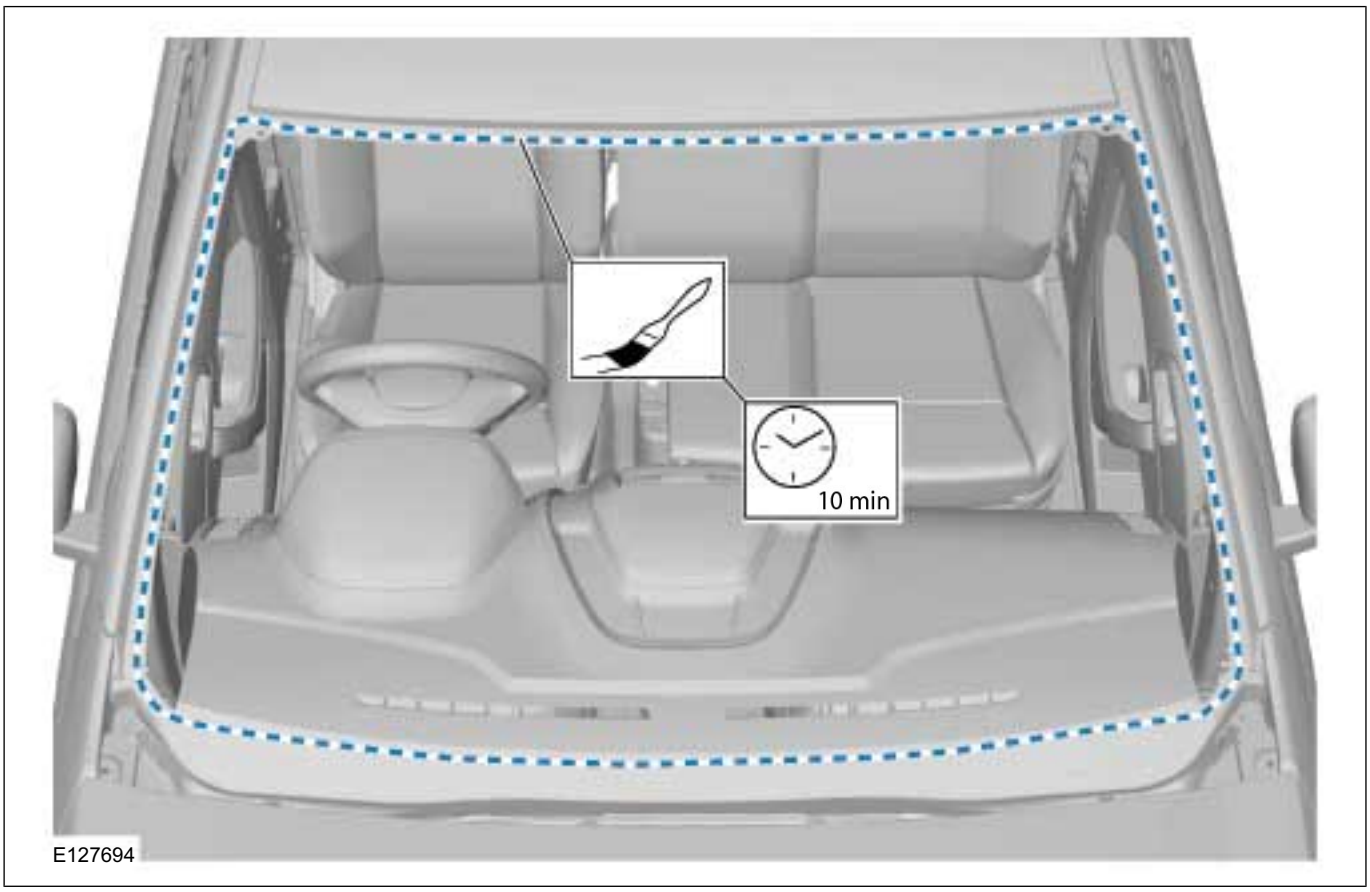
Installation

1. **NOTE:** Minimum 1 mm bead thickness.
   - General Equipment: Knife
   - **NOTE:** Make sure that the mating faces are clean and free of foreign material.
   - **NOTE:** Touching the adhesive surface will impair rebonding.
   - Prepare the windshield glass, windshield glass flange and trimmed PU adhesive in accordance with the instructions supplied with the glass adhesive kit.



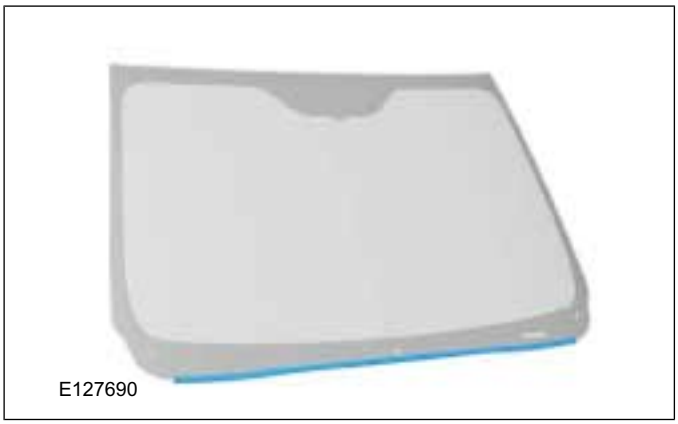
2. Apply the activator/primer in accordance with the instructions supplied with the glass adhesive kit.

REMOVAL AND INSTALLATION

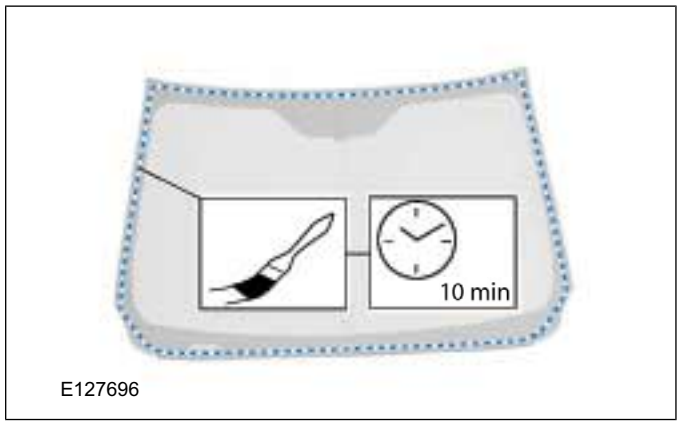


3. **NOTE:** Touching the adhesive surface will impair rebonding.

   NOTE: Make sure that the mating faces are clean and free of foreign material.



4. Apply the activator/primer in accordance with the instructions supplied with the glass adhesive kit.

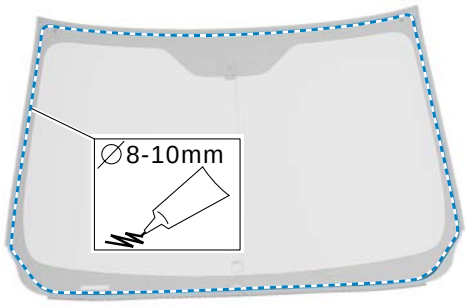


5. **NOTE:** Discard the first 100 mm of adhesive as this may have a reduced working time.

REMOVAL AND INSTALLATION

NOTE: Make sure that any breakage in the continuous bead of adhesive is overlapped by 20 mm.

General Equipment: Direct Glazing Removal/Replacement Equipment
Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive
Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive



E127697

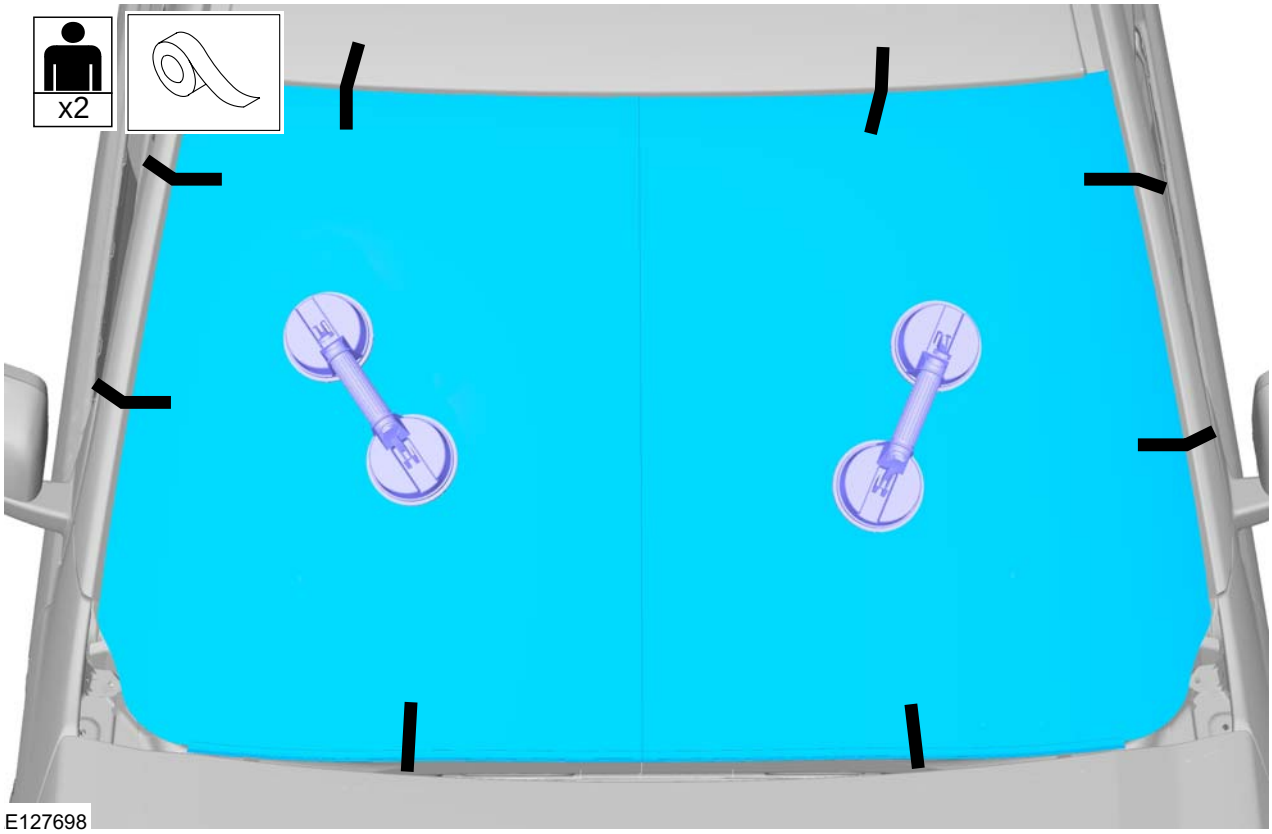
6. **CAUTIONS:**

Make sure that equal pressure is applied to the full length of the component.

During the curing time of the polyurethane (PU) adhesive, the door windows must be left open.

Using tape, secure the Windshield glass in the correct position until the PU adhesive has cured.

General Equipment: Adhesive Tape



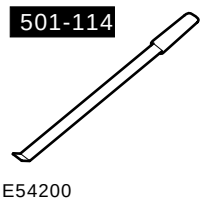
E127698

7. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Door Window Glass

Special Tool(s)

 E54200	501-114 Release Lever, Door Glass

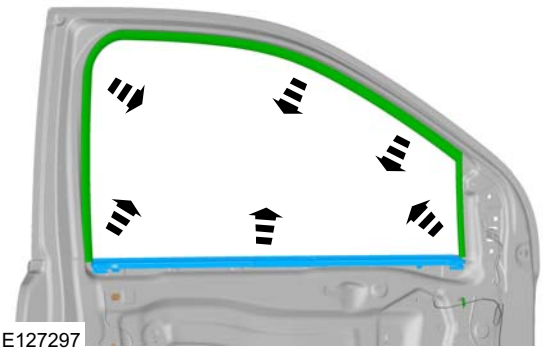
Removal

NOTE: Removal steps in this procedure may contain installation details.

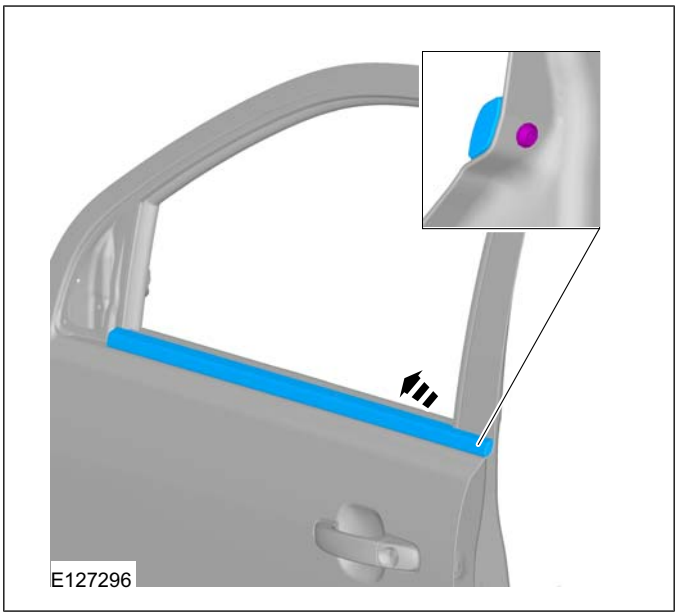
1. **NOTE:** Ensure that the front door window glass is in the lowered position.

   Refer to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

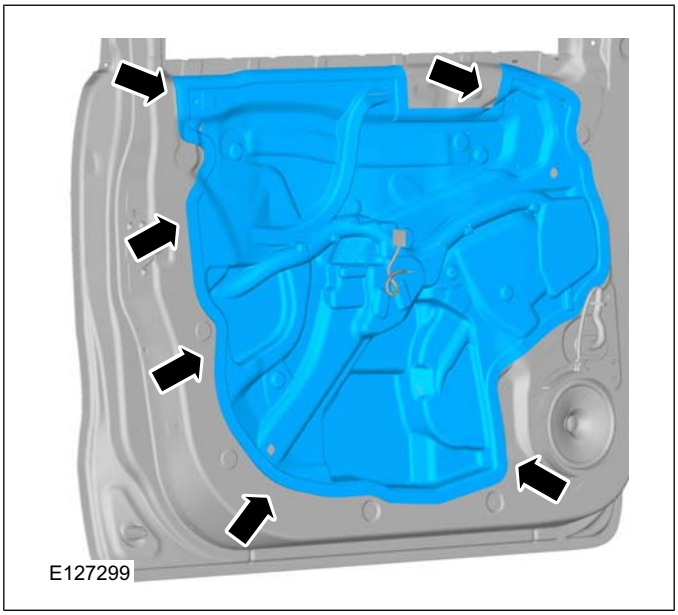
2.



3.

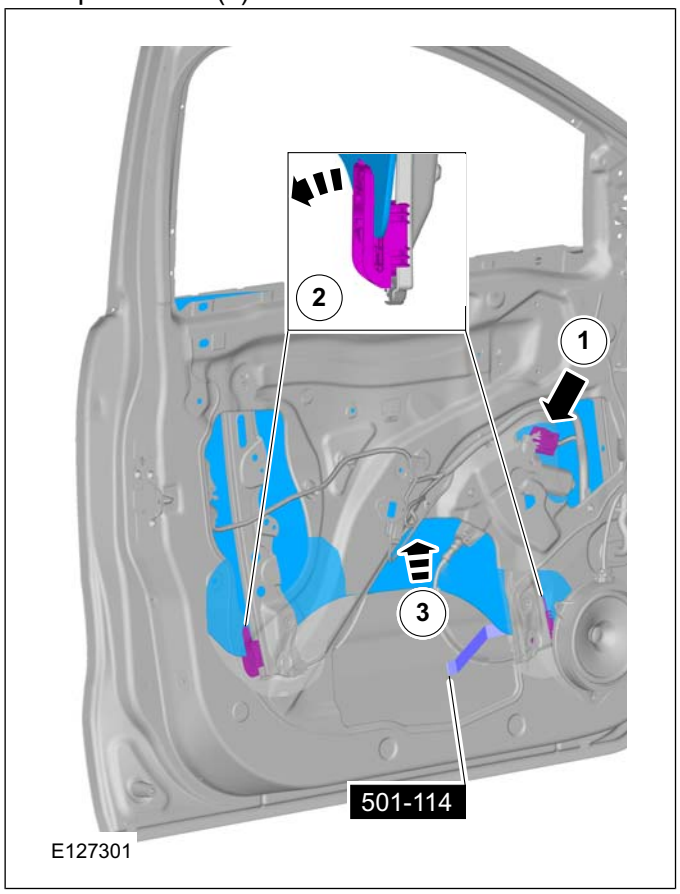


4. **CAUTION: Do not touch the adhesive surface as re-bonding will be impaired.**

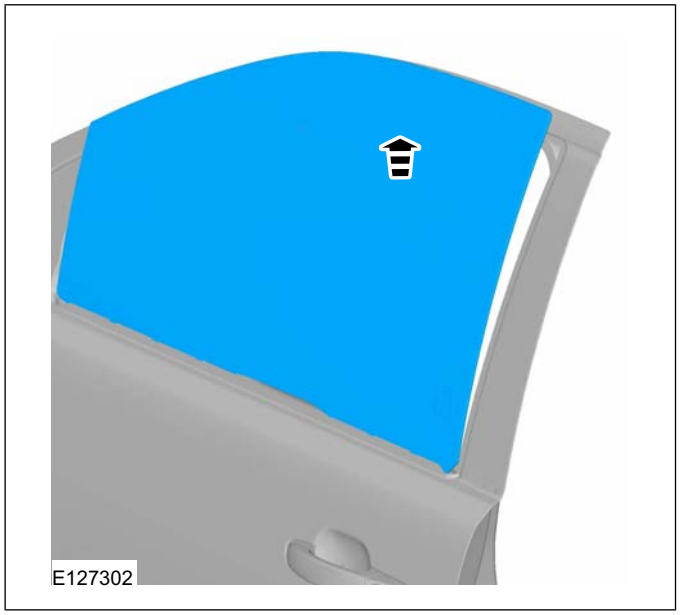


REMOVAL AND INSTALLATION

5. Special Tool(s): 501-114



6.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Door Window Regulator

General Equipment

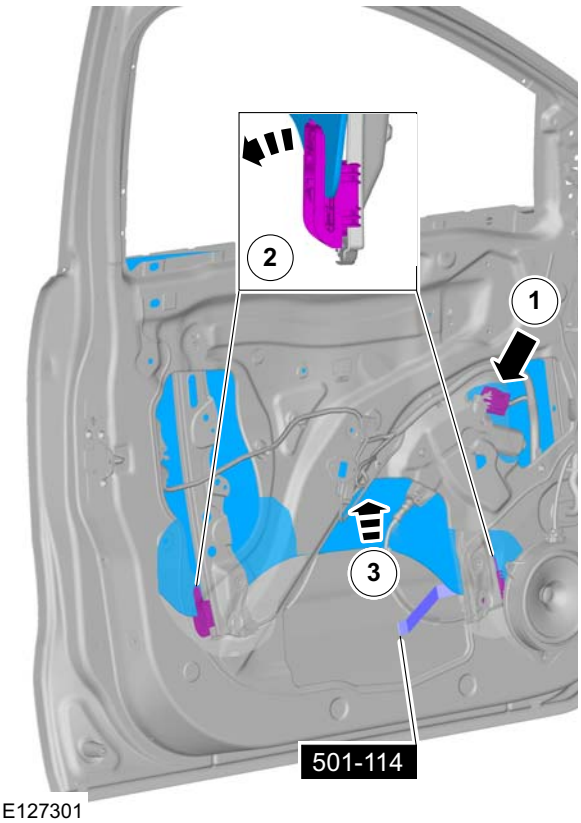
Adhesive Tape

Removal

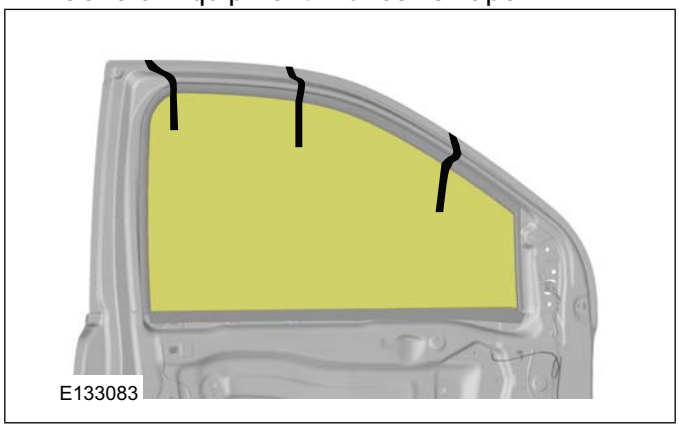
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.

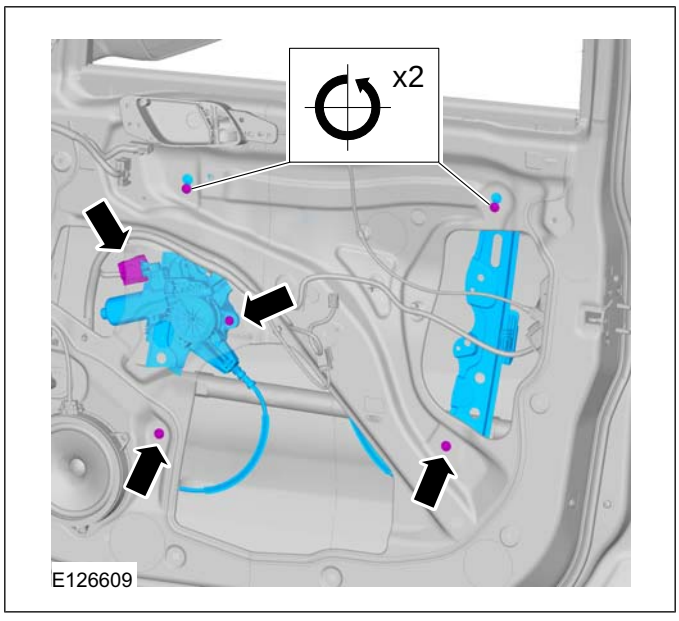


3. Using tape, secure the window glass.
   General Equipment: Adhesive Tape



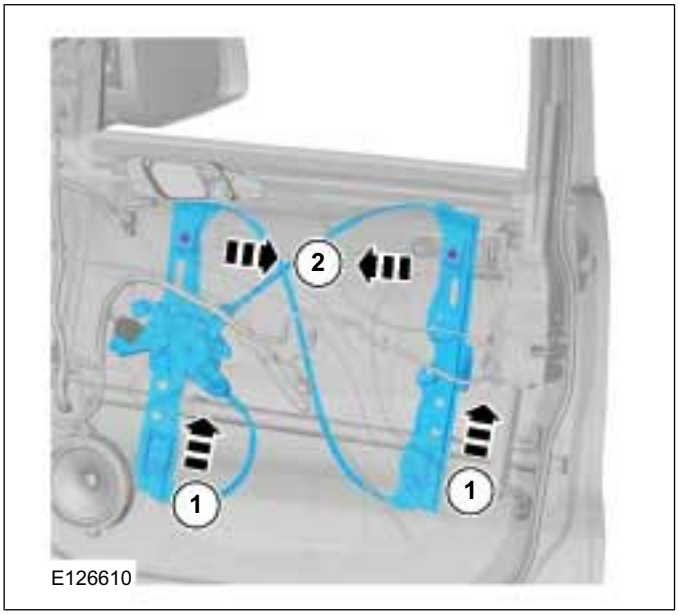
Vehicles with power windows

4.

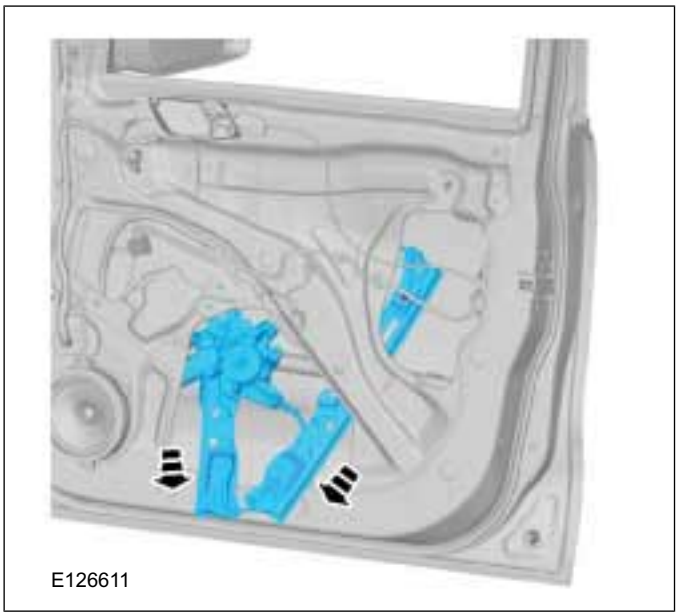


REMOVAL AND INSTALLATION

5.

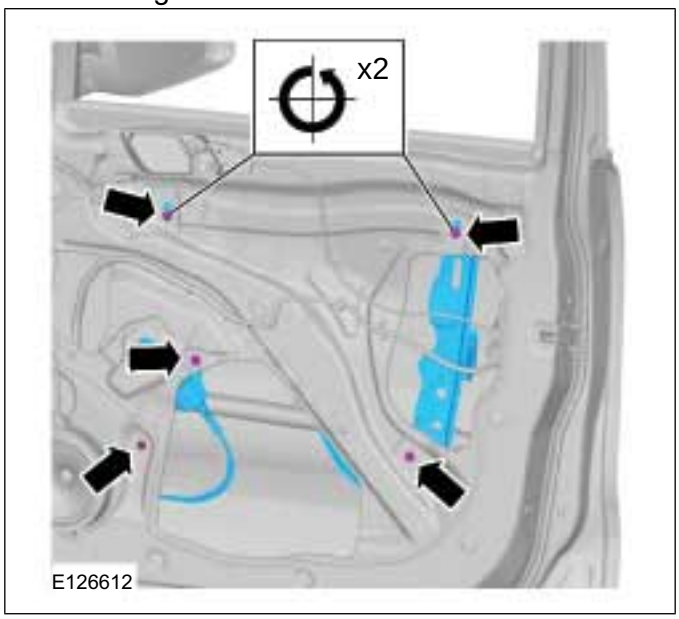


6.

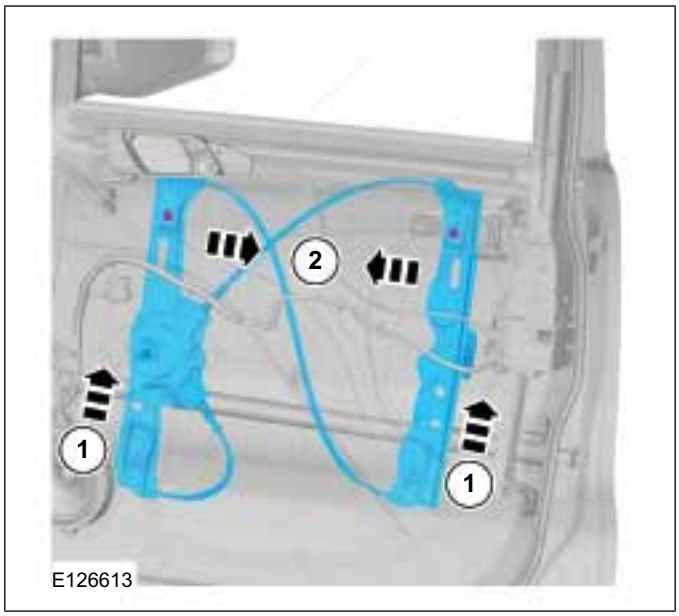


Vehicles with manual windows

7. Remove the 3 front door window regulator retaining bolts.

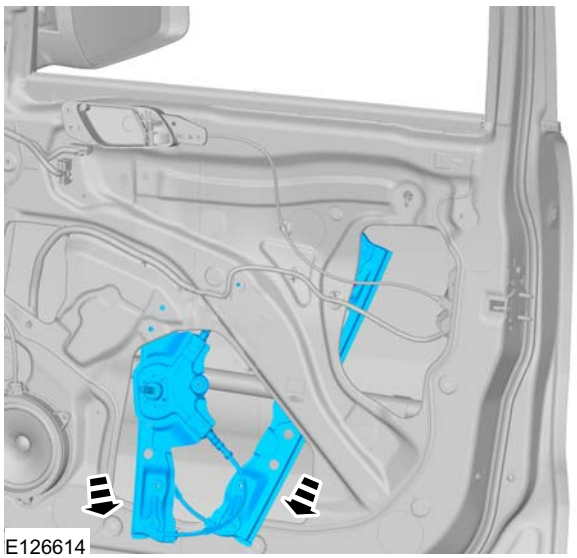


8.



REMOVAL AND INSTALLATION

9.



Installation

1. To install, reverse the removal procedure.

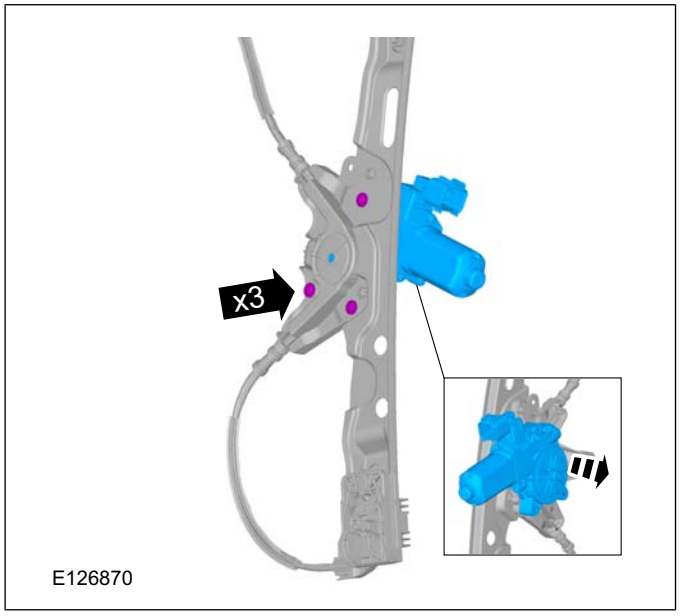
REMOVAL AND INSTALLATION

Front Door Window Regulator Motor

Removal

1. Refer to: Front Door Window Regulator (501-11 Glass, Frames and Mechanisms, Removal and Installation).

2.



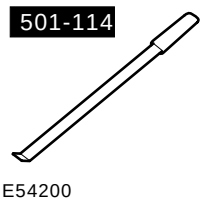
Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Door Window Glass

Special Tool(s)

 E54200	501-114 Release Lever, Door Glass

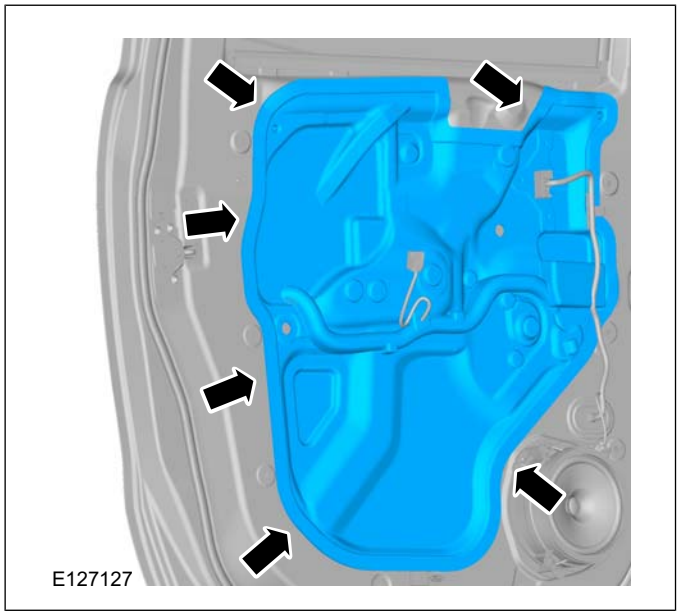
Removal

NOTE: Removal steps in this procedure may contain installation details.

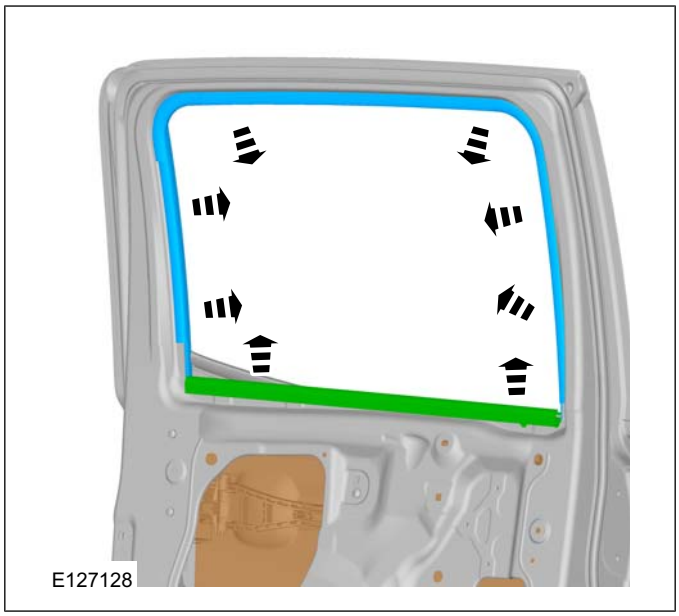
1. **NOTE:** Ensure that the rear door window glass is in the lowered position.

   Refer to: Rear Door Trim Panel - Double Cab (501-05 Interior Trim and Ornamentation, Removal and Installation).

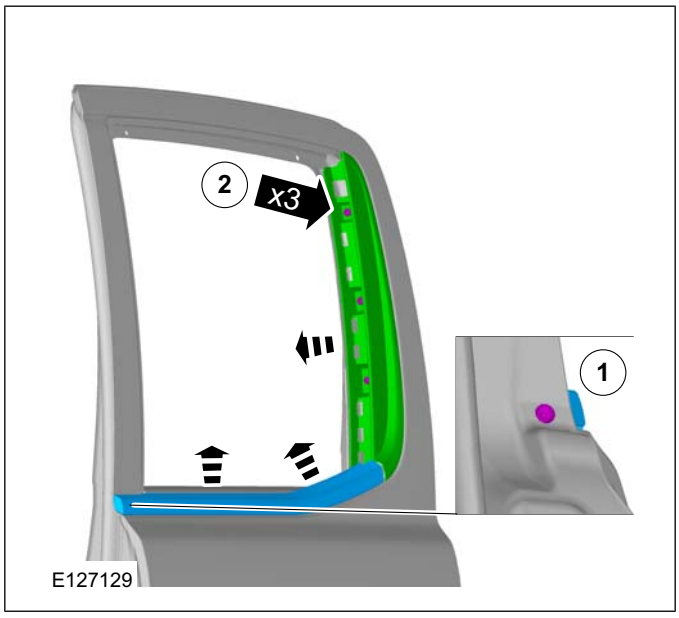
2. **CAUTION: Do not touch the adhesive surface as re-bonding will be impaired.**



3.

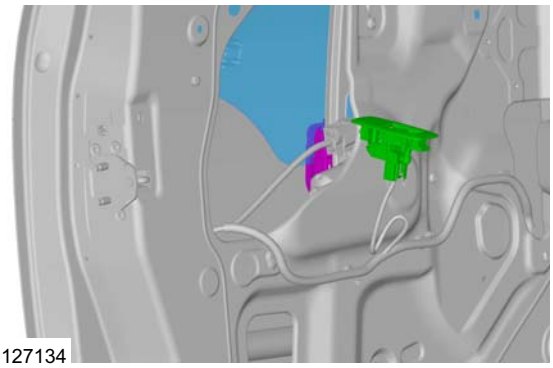


4.

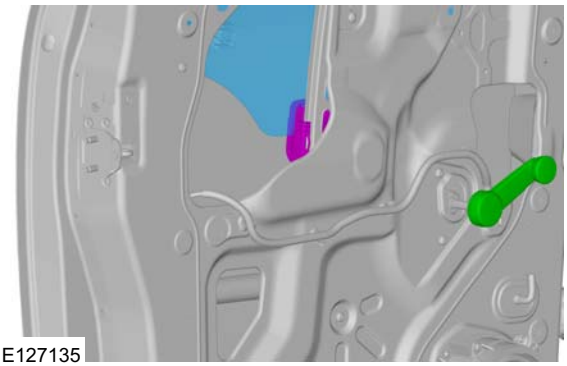


REMOVAL AND INSTALLATION

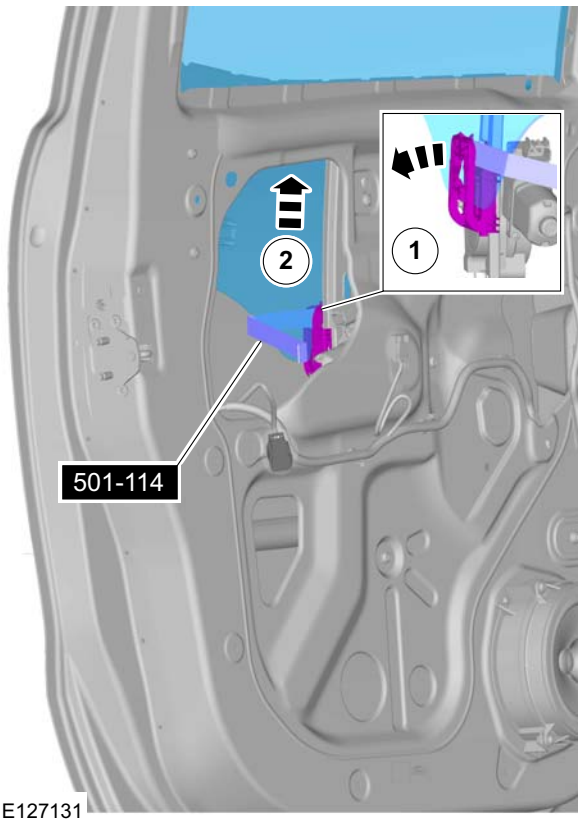
5. **NOTE:** Vehicle with power windows only
   - Connect the rear door window regulator motor switch.
   - Raise the rear door window glass upto the access hole
   - Disconnect the rear door window regulator motor switch.


E127134

6. **NOTE:** Vehicle with manual windows only
   - Install the rear door window regulator crank handle.
   - Raise the rear door window glass upto the access hole
   - Remove the rear door window regulator crank handle.

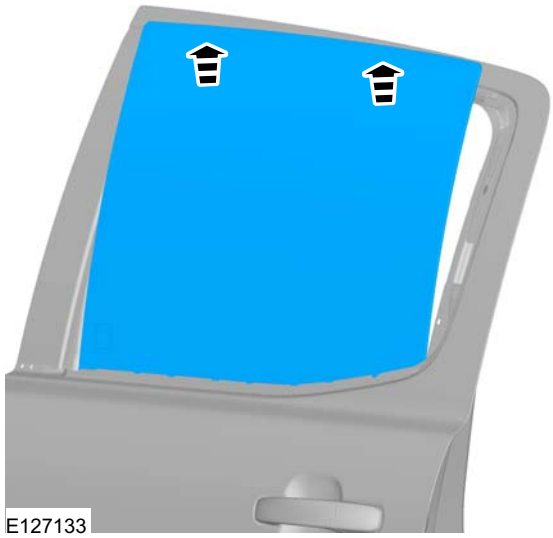

E127135

7. Special Tool(s): 501-114



E127131

8.


E127133

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Door Window Regulator

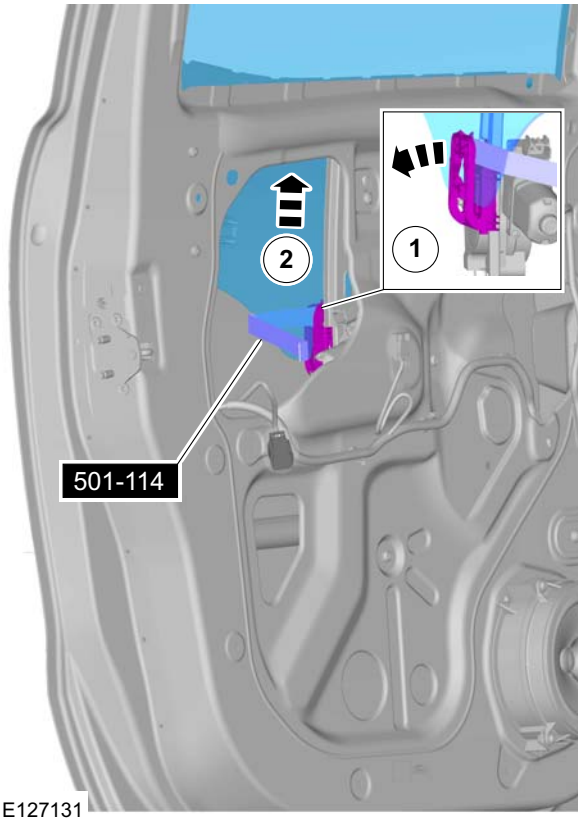
General Equipment

Adhesive Tape

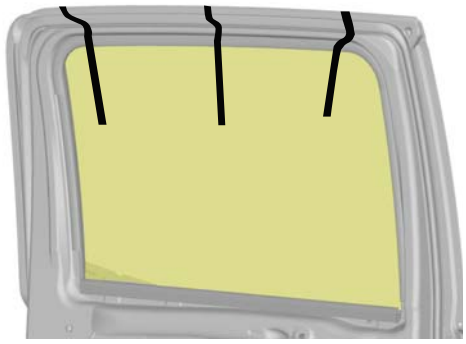
Removal

1. Refer to: Rear Door Trim Panel - Double Cab (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.

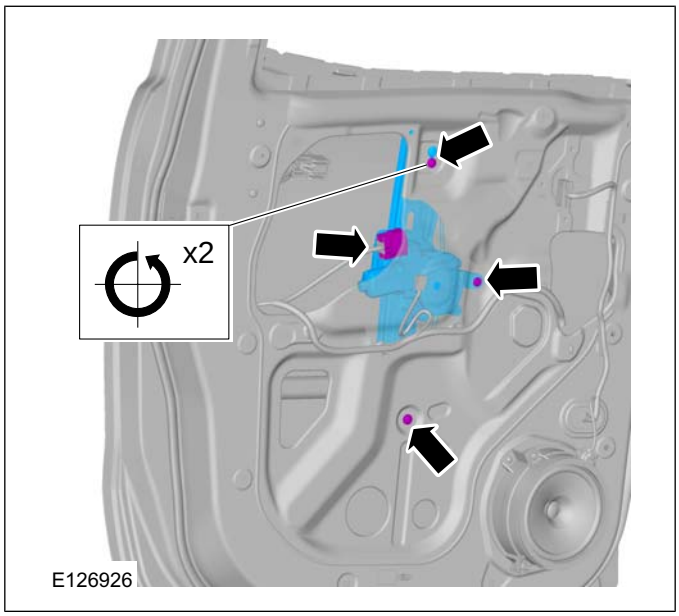


3. Using tape, secure the window glass.
   General Equipment: Adhesive Tape



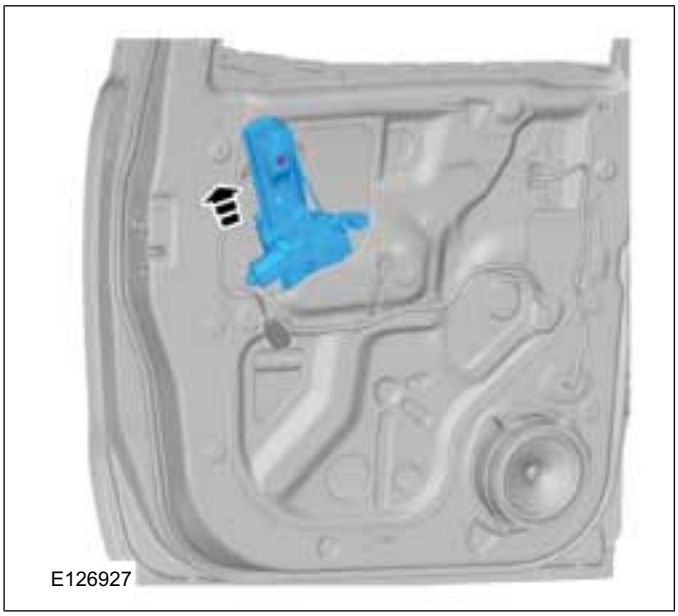
Vehicles with power windows

4. • Disconnect the front door window regulator motor electrical connector.
   • Remove the 2 rear door window regulator retaining bolts.



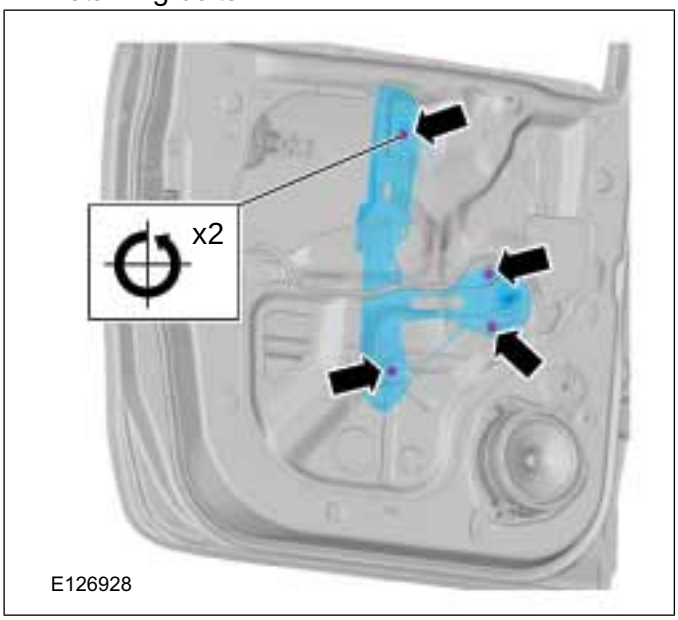
REMOVAL AND INSTALLATION

5.

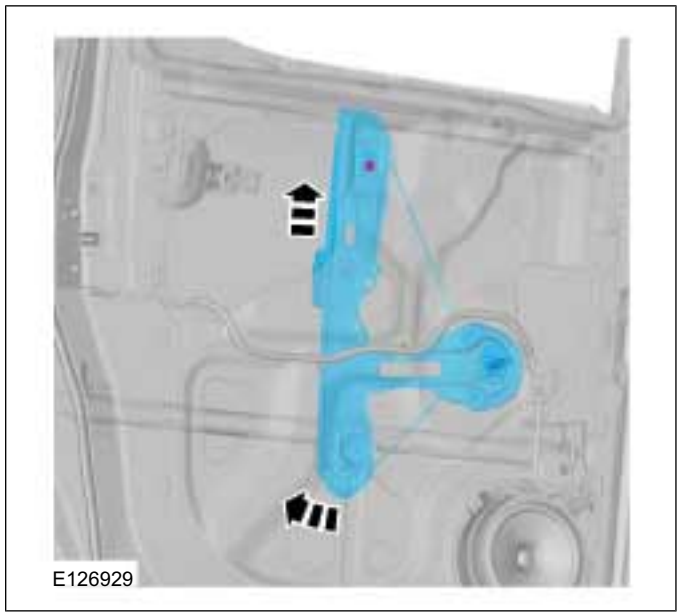


Vehicles with manual windows

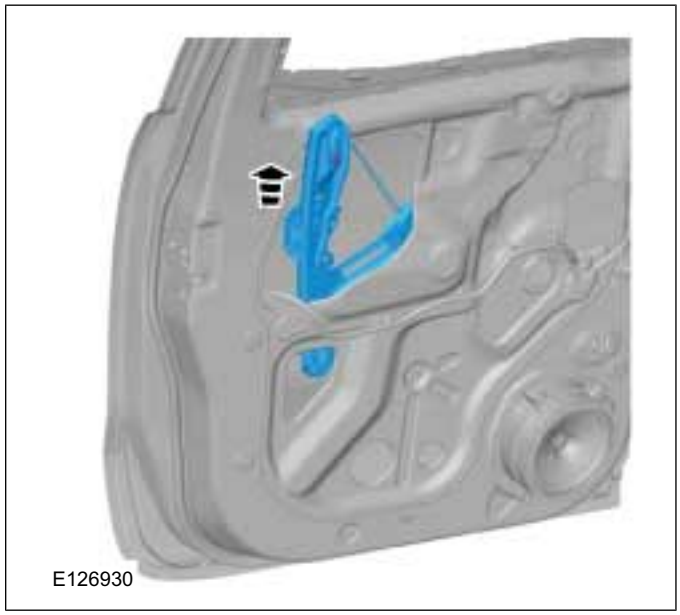
6. Remove the 3 rear door window regulator retaining bolts.



7.



8.



Installation

1. To install, reverse the removal procedure.

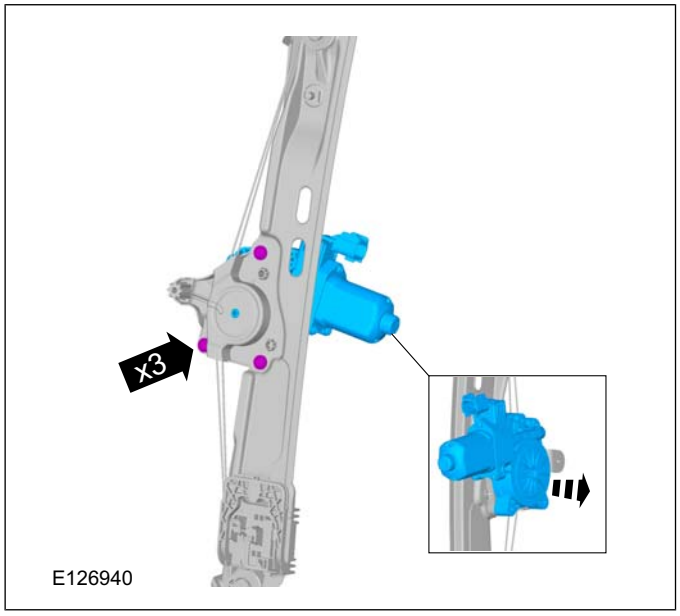
REMOVAL AND INSTALLATION

Rear Door Window Regulator Motor

Removal

1. Refer to: Rear Door Window Regulator (501-11 Glass, Frames and Mechanisms, Removal and Installation).

2.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Window Glass

General Equipment

Adhesive Tape
Direct Glazing Removal/Replacement Equipment
Knife

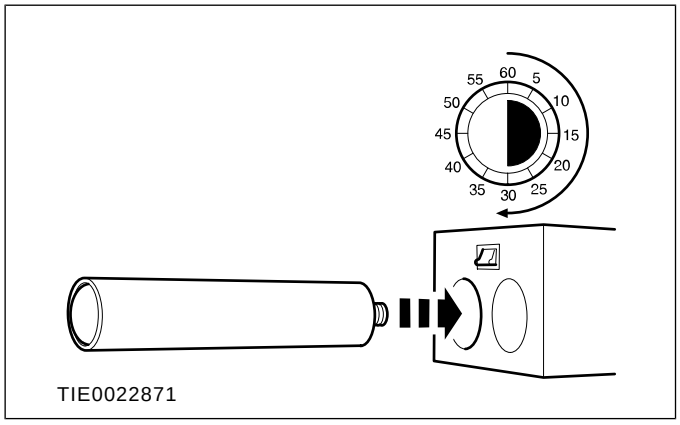
Materials	
Name	**Specification**
Windscreen Adhesive Kit - 1 Component	WSK-M11P57-A3 / 7U7J-T03863-AA
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

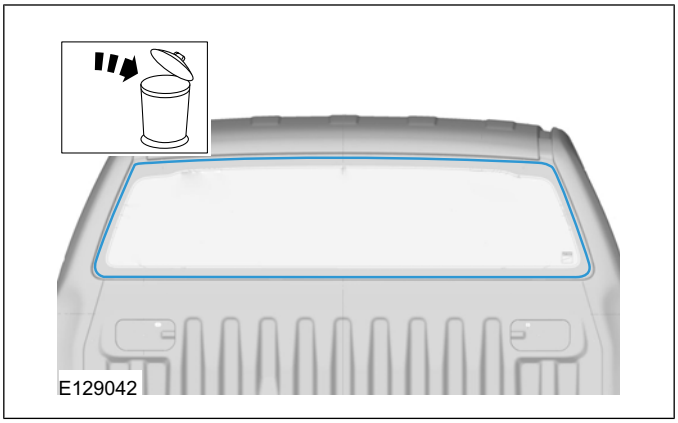
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: C-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Refer to: Headliner (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Refer to: Rear Seat (501-10 Seating, Removal and Installation).
5. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive
   • Remove the polyurethane (PU) adhesive cap and heat the 2K-PU adhesive for a minimum of 30 minutes.

   General Equipment: Direct Glazing Removal/Replacement Equipment
   • Repairs under warranty:

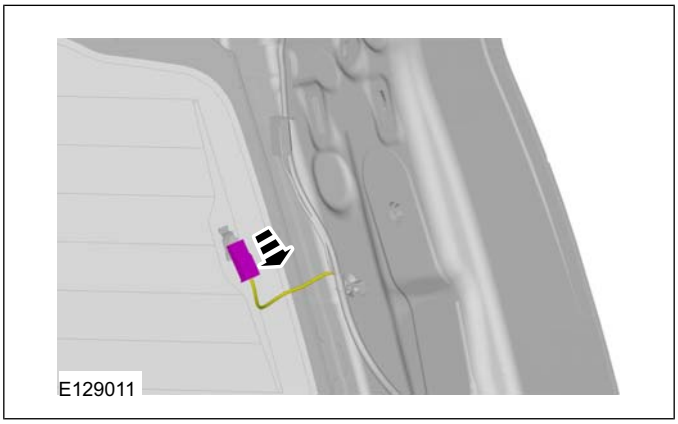
   Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive



6.



7. **NOTE:** Vehicles with heated windsheild only.

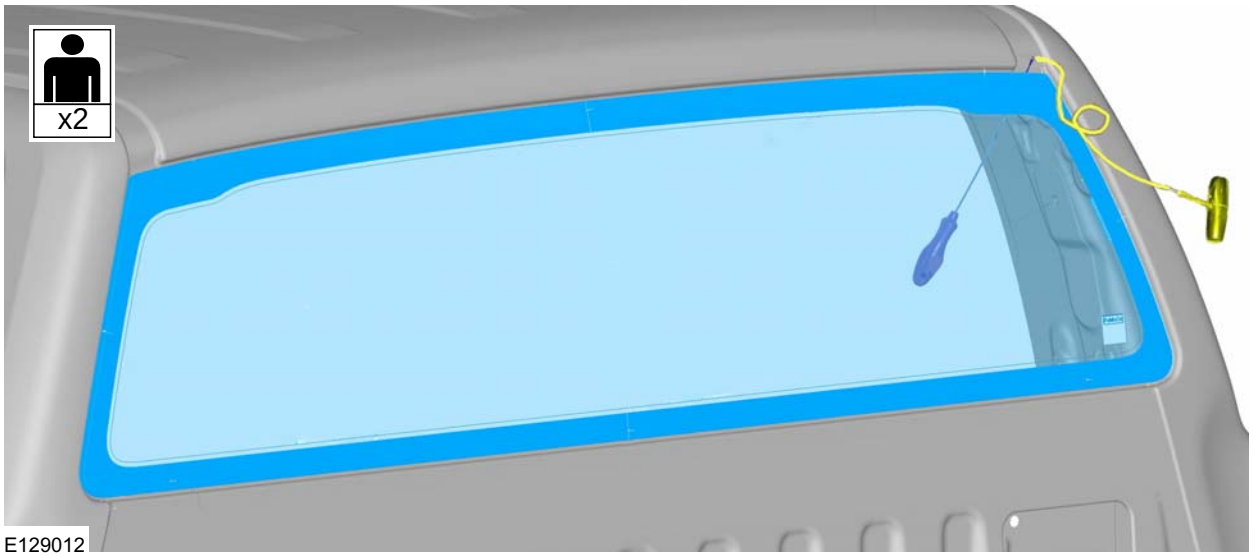


8. 

Use a suitable awl to thread the cutting wire.

General Equipment: Direct Glazing Removal/Replacement Equipment

REMOVAL AND INSTALLATION



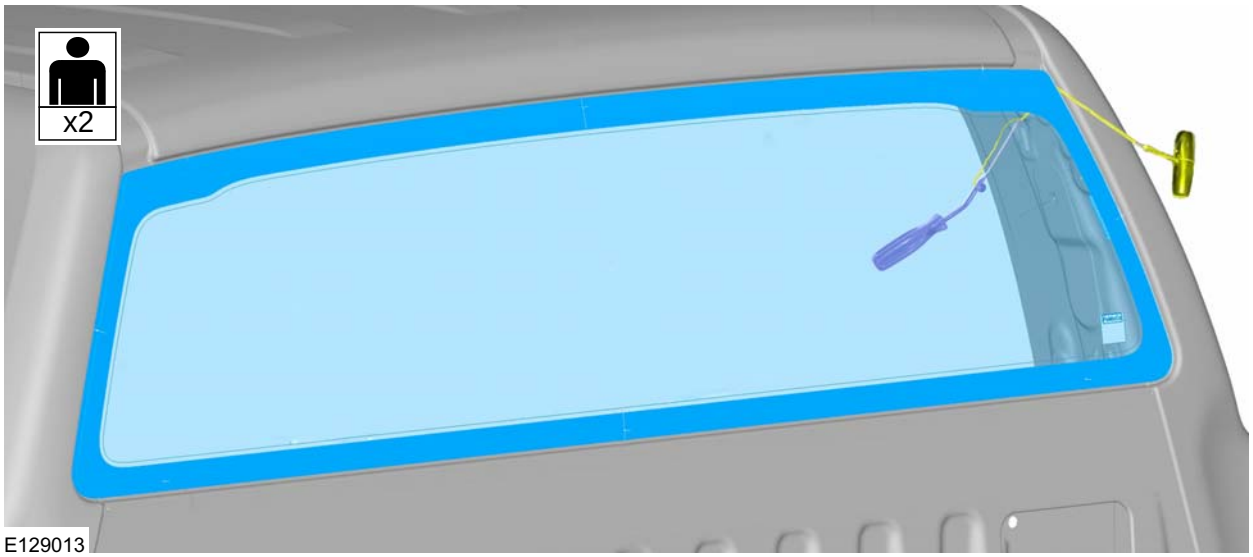
E129012

9.

CAUTION: If the original window glass is to be installed, take care not to damage the electrical connectors and the weatherstrip (if equipped).

Use a suitable brace to prevent trim damages.

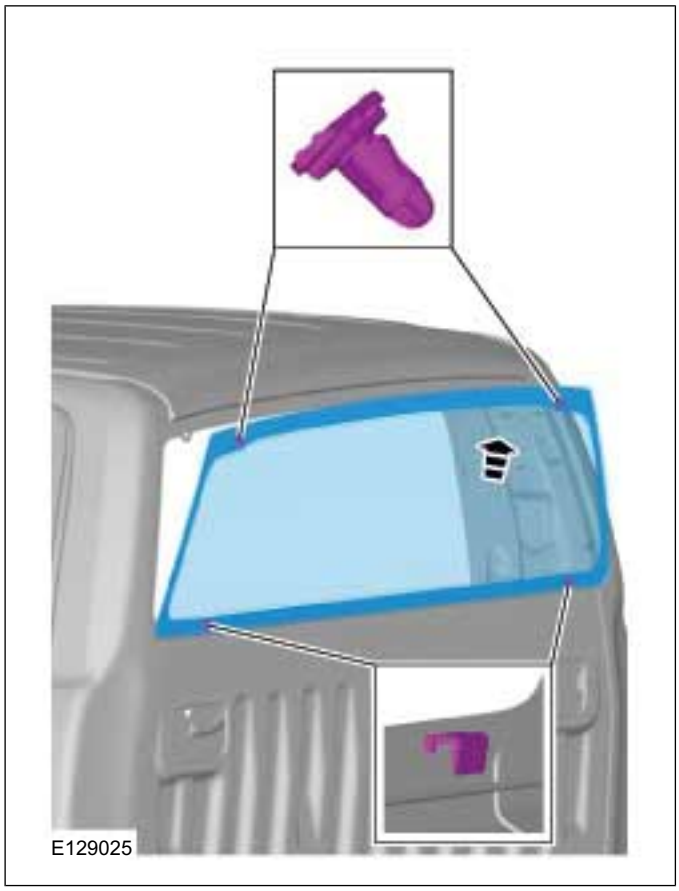
General Equipment: Direct Glazing Removal/Replacement Equipment



E129013

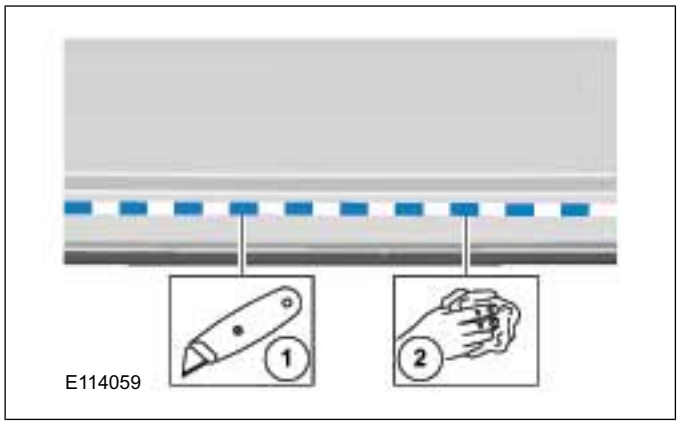
REMOVAL AND INSTALLATION

10.

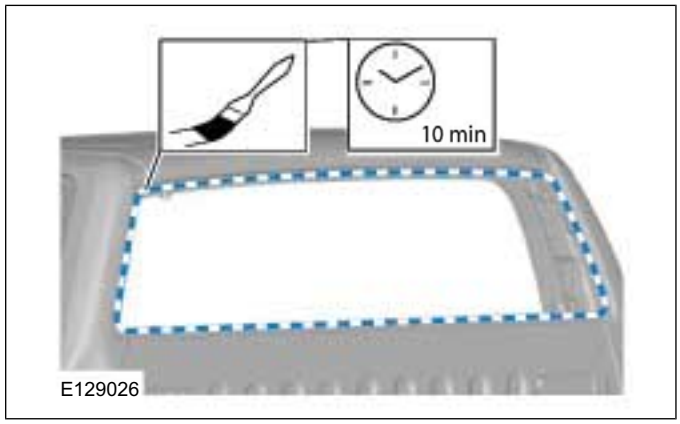


Installation

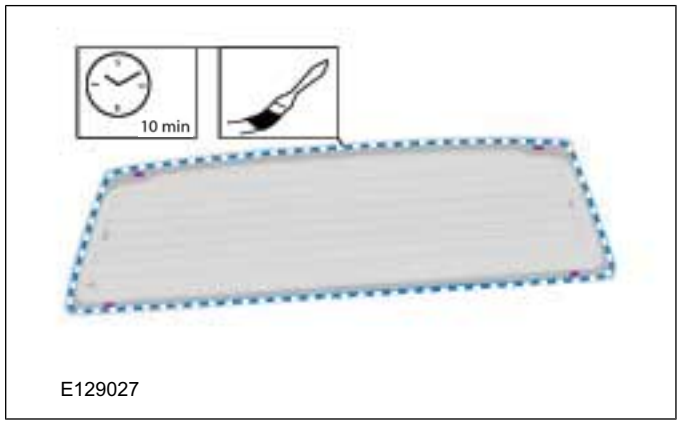
1. **NOTE:** Minimum 1 mm bead thickness.
   - General Equipment: Knife
   - **NOTE:** Make sure that the mating faces are clean and free of foreign material.
   - **NOTE:** Touching the adhesive surface will impair rebonding.
   - Prepare the windshield glass, windshield glass flange and trimmed PU adhesive in accordance with the instructions supplied with the glass adhesive kit.



2. Apply the activator/primer in accordance with the instructions supplied with the glass adhesive kit.



3. Apply the activator/primer in accordance with the instructions supplied with the glass adhesive kit.

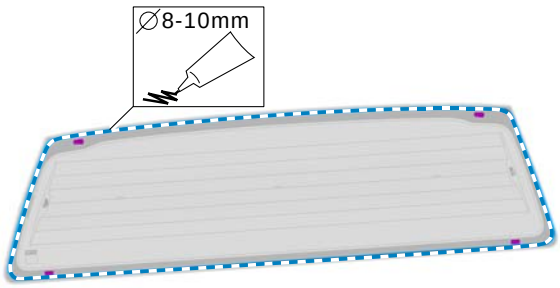


4. **NOTE:** Discard the first 100 mm of adhesive as this may have a reduced working time.

REMOVAL AND INSTALLATION

NOTE: Make sure that any breakage in the continuous bead of adhesive is overlapped by 20 mm.

General Equipment: Direct Glazing Removal/Replacement Equipment
Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive
Material: Windscreen Adhesive Kit - 1 Component (WSK-M11P57-A3 / 7U7J-T03863-AA) adhesive



E129037

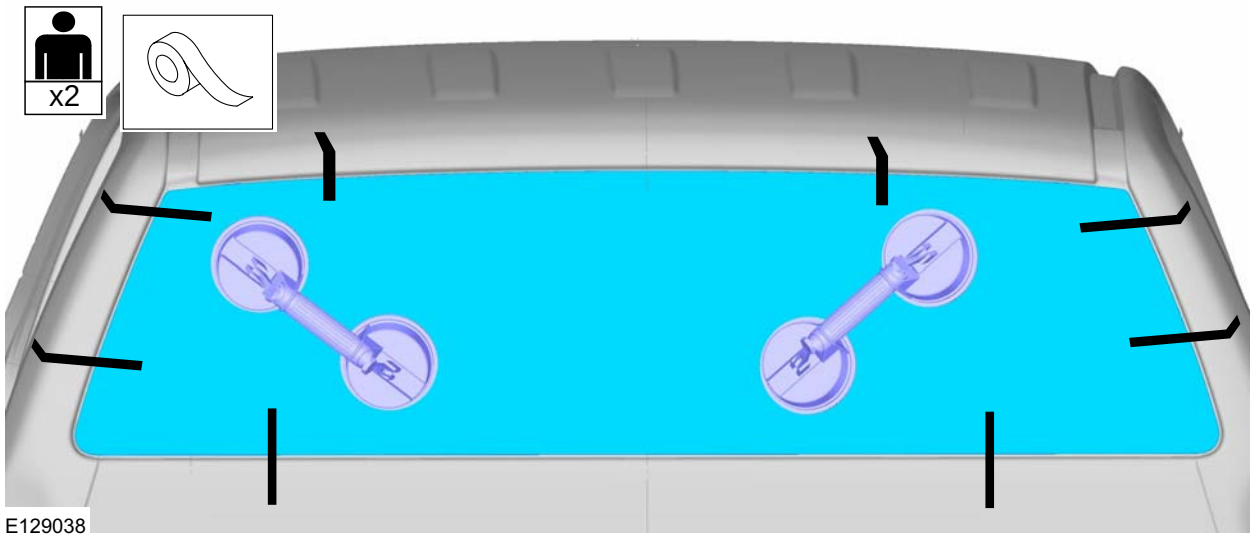
5. **CAUTIONS:**

Make sure that equal pressure is applied to the full length of the component.

During the curing time of the polyurethane (PU) adhesive, the door windows must be left open.

Using tape, secure the windshield glass in the correct position until the PU adhesive has cured.Adhesive tape

General Equipment: Adhesive Tape



E129038

6. To install reverse the removal procedure.

SECTION 501-12 Instrument Panel and Console

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

Instrument Panel..... 501-12-2

REMOVAL AND INSTALLATION

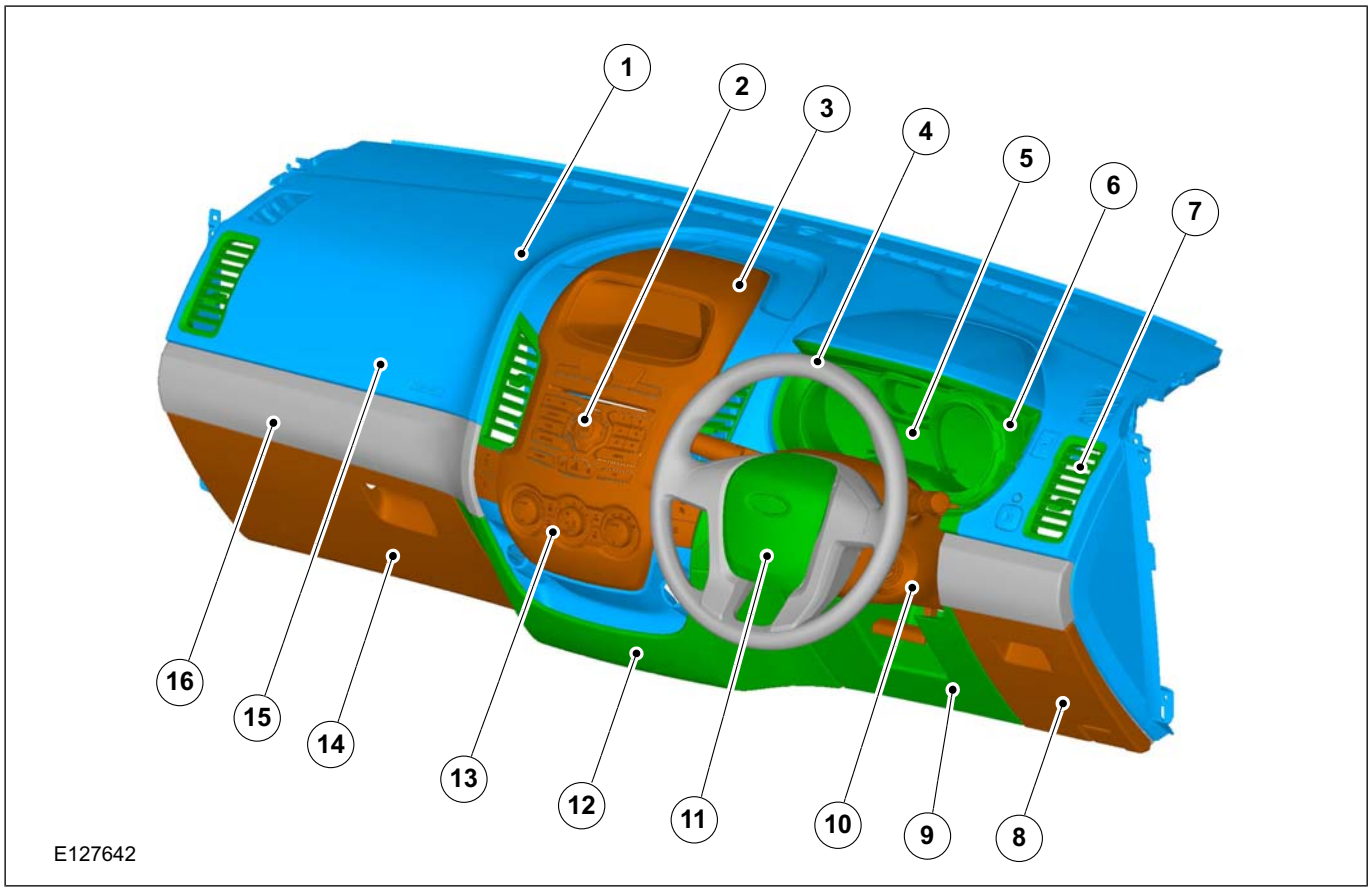
Instrument Panel — LHD 4WD/LHD RWD..... 501-12-3
Instrument Panel — RHD 4WD/RHD RWD..... 501-12-11
Floor Console — Single Cab..... 501-12-19
Floor Console — Double Cab..... 501-12-21
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Overhead Console..... 501-12-26

DISASSEMBLY AND ASSEMBLY

Instrument Panel..... 501-12-28

DESCRIPTION AND OPERATION

Instrument Panel



Item	Description
1	Instrument panel
2	Audio control
3	Center finishing panel
4	Steering wheel
5	Instrument cluster
6	Instrument cluster bezel
7	Ventilator grille
8	Driver glove compartment
9	Driver lower airbag module
10	Steering column cover
11	Driver air bag module
12	Lower finishing panel
13	Heater / AC control
14	Passenger glove compartment
15	Passenger air bag module
16	Side finishing panel

REMOVAL AND INSTALLATION

Instrument Panel — LHD 4WD/LHD RWD

General Equipment

Ford Diagnostic Equipment

Removal

WARNINGS:

The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Single cab

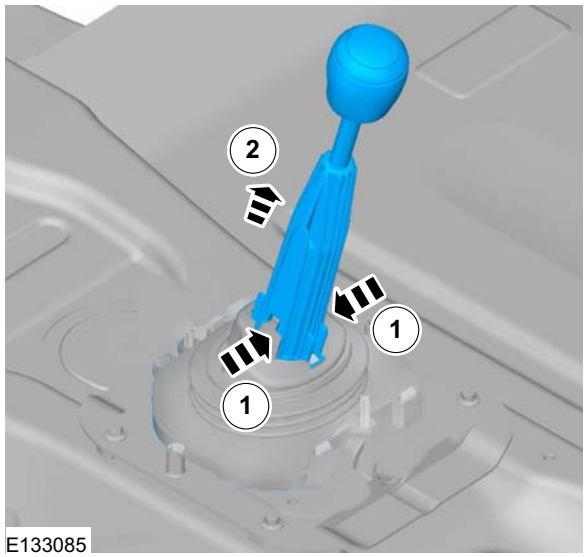
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).

Double cab

3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Vehicles with manual transmission

4.



REMOVAL AND INSTALLATION

Vehicles with driver lower air bag

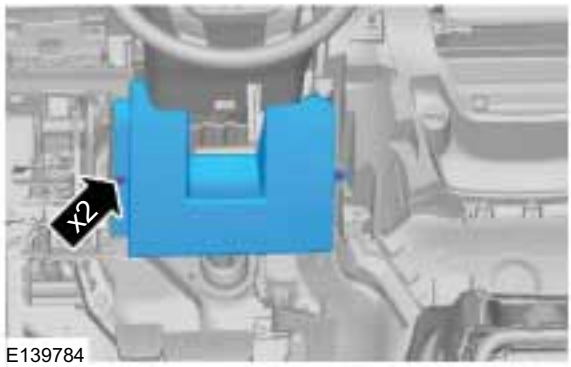
5. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

6.



7.

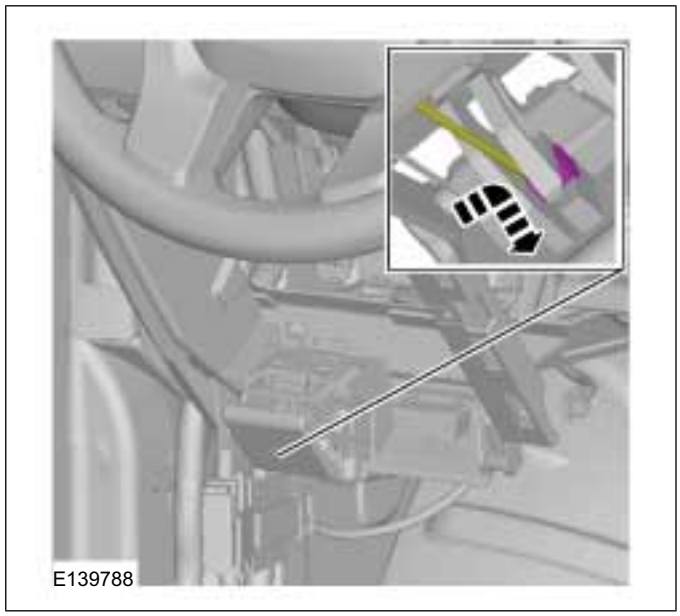


All vehicles

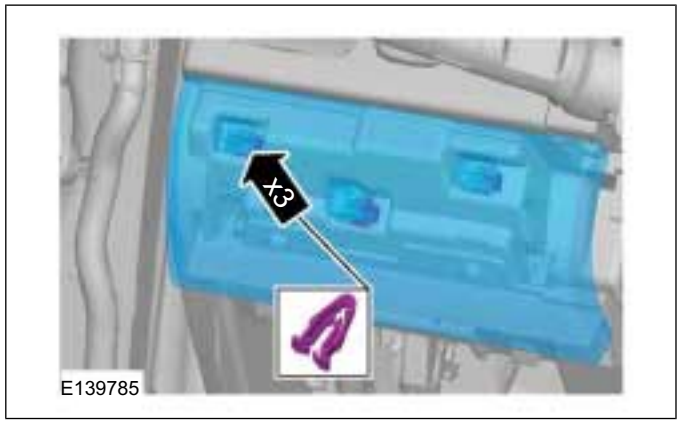
8. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).

9. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

10.

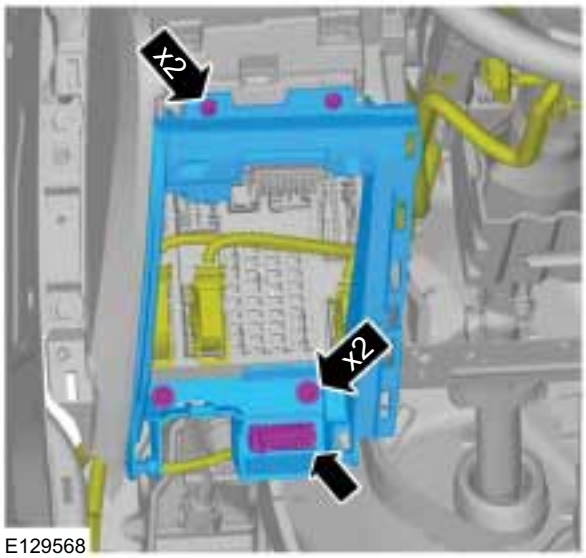


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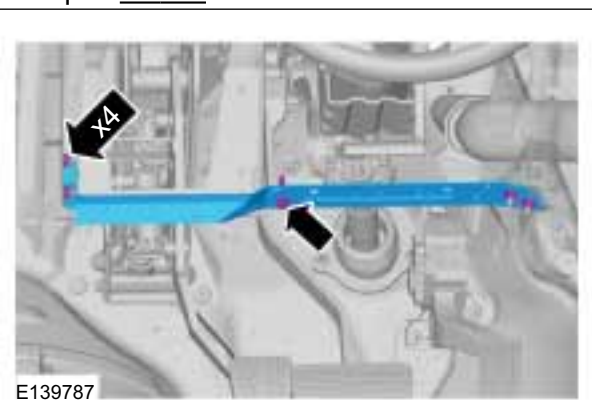


REMOVAL AND INSTALLATION

12.



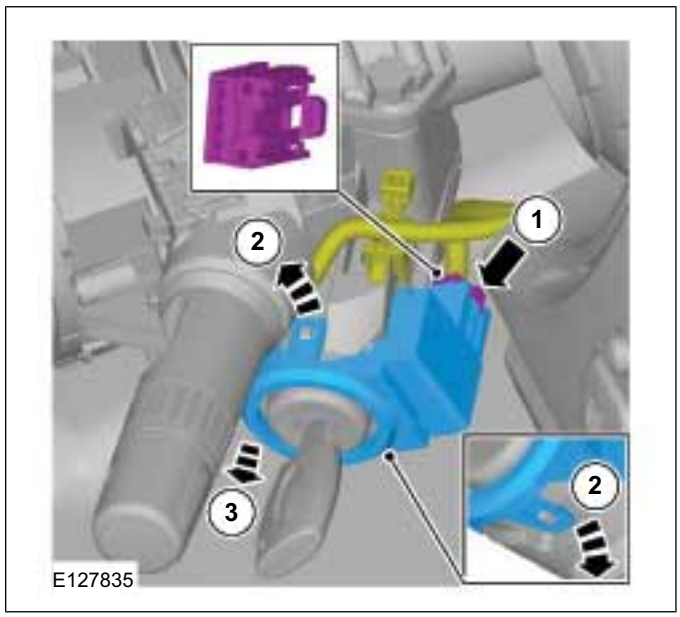
13. Torque: 10 Nm



14. Refer to: Ignition Switch (211-05 Steering Column Switches, Removal and Installation).

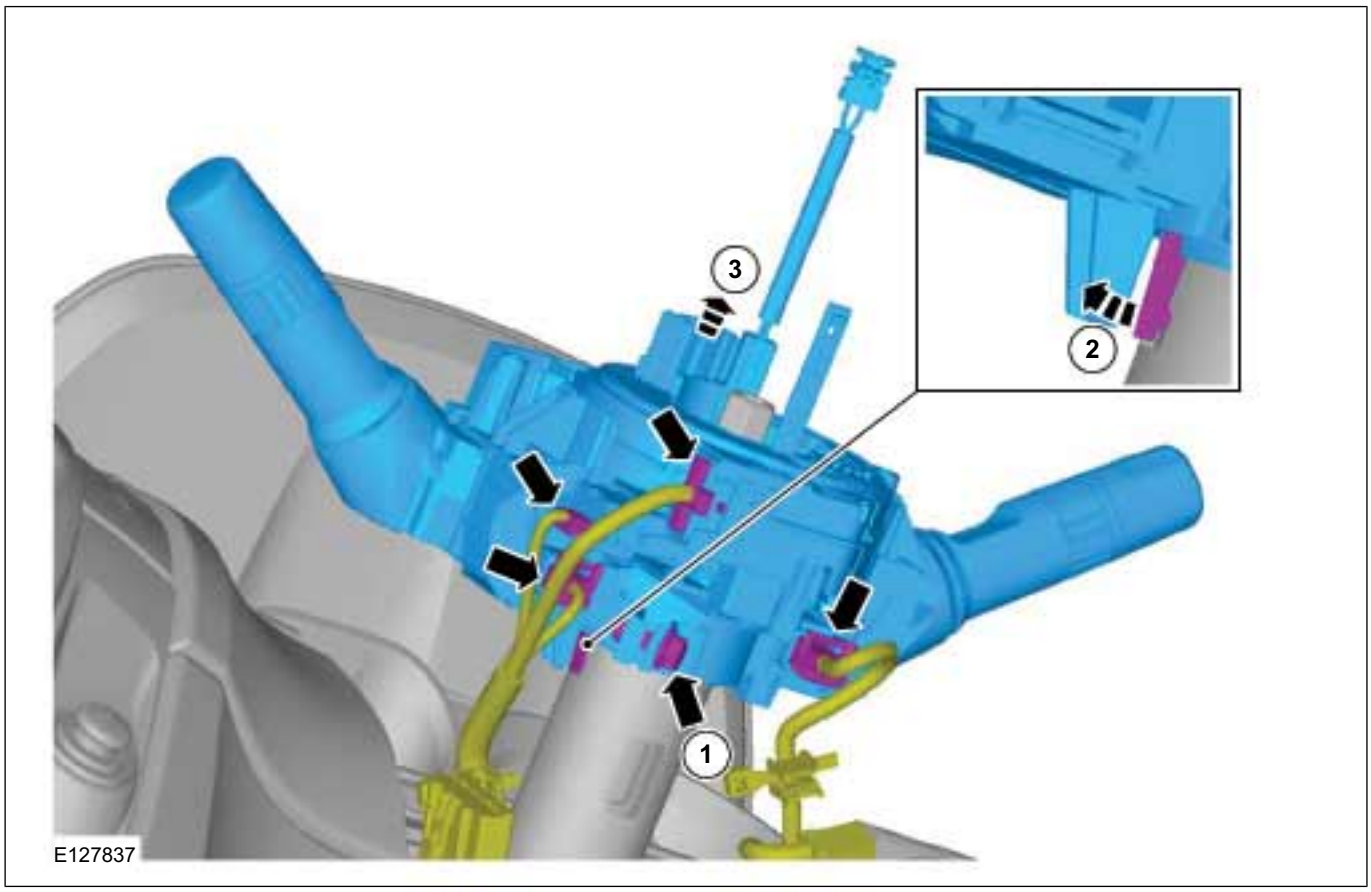
15. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).

16.

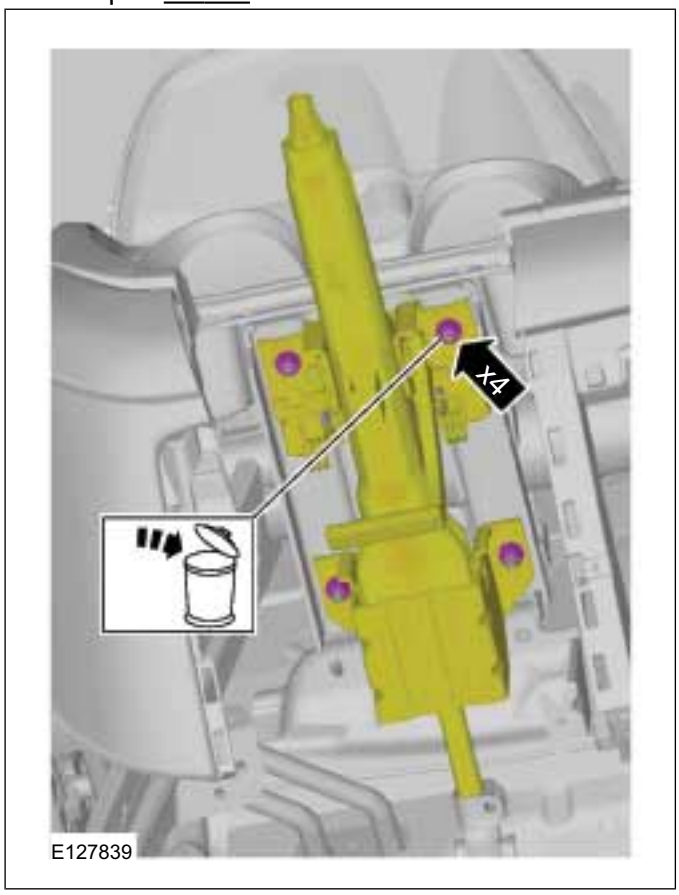


17. 1. Torque: 7 Nm

REMOVAL AND INSTALLATION

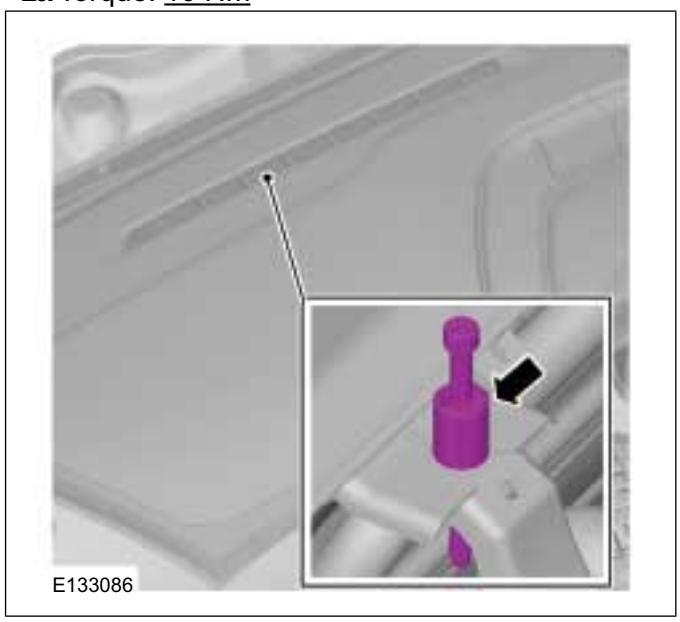


18. Torque: 15 Nm



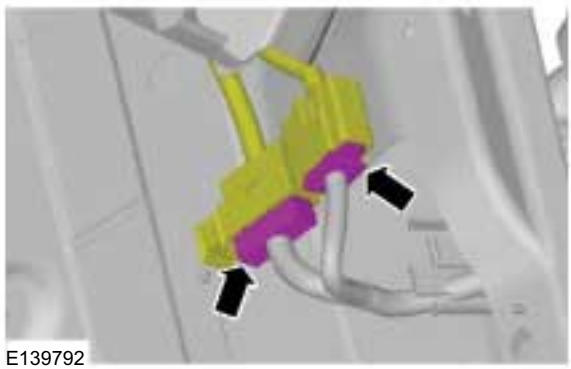
19. Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

20. Torque: 10 Nm

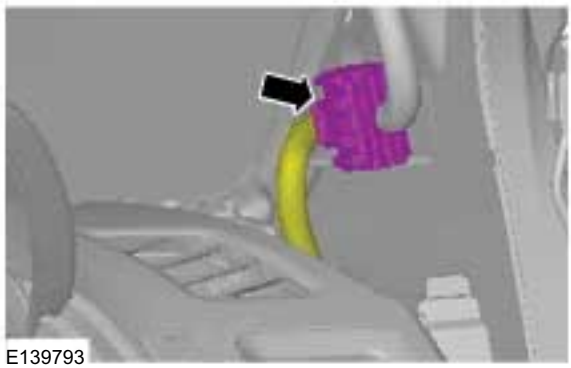


REMOVAL AND INSTALLATION

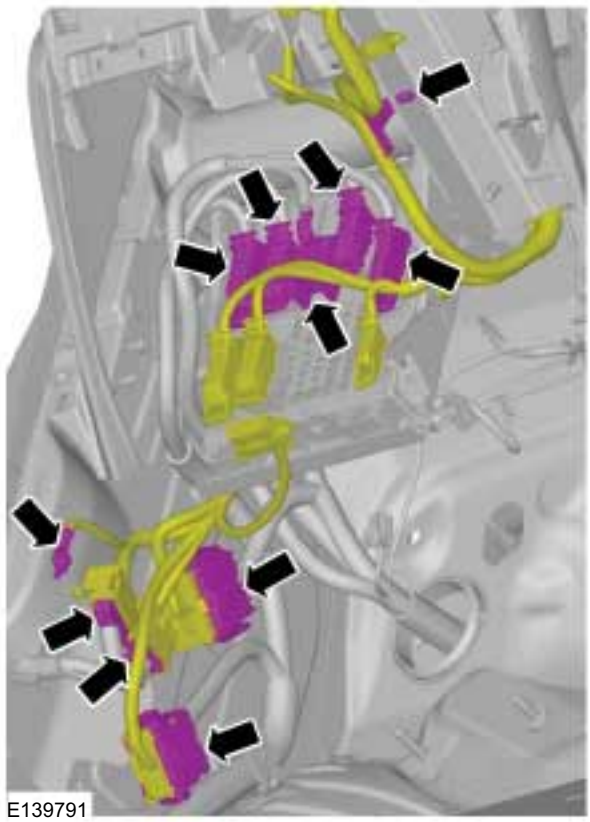
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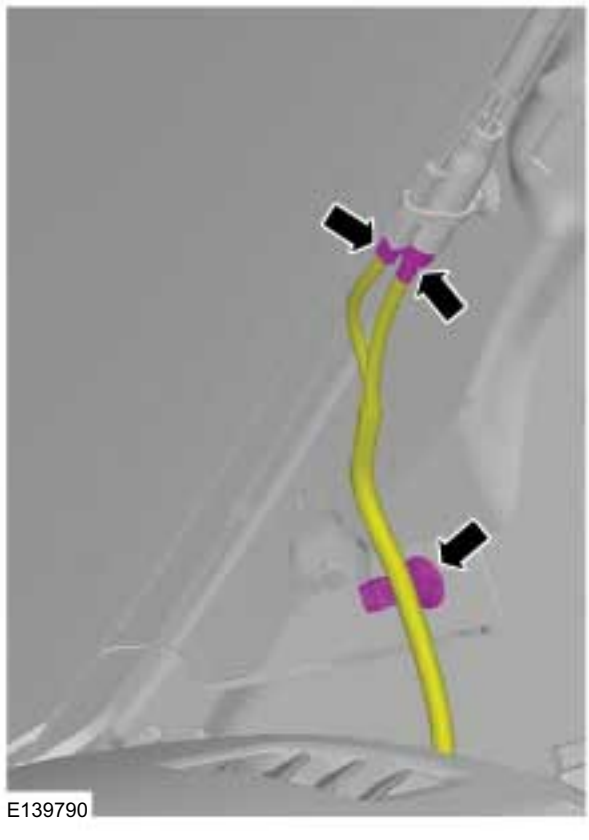
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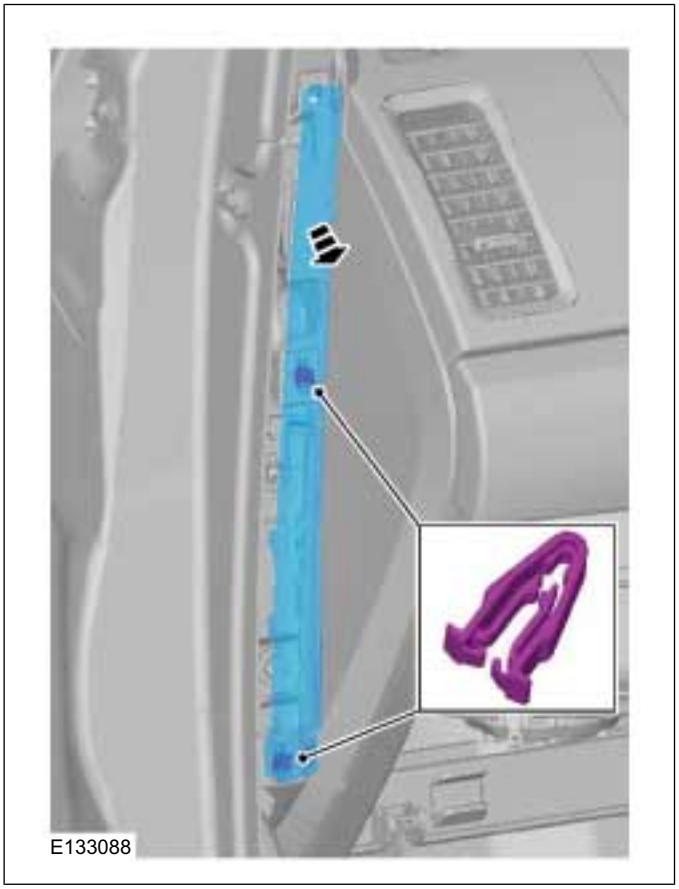


24.



REMOVAL AND INSTALLATION

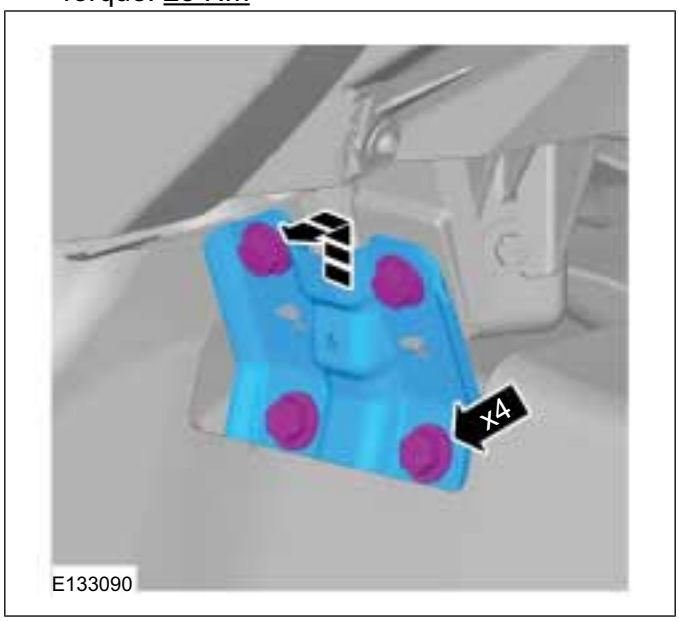
25. On both sides.



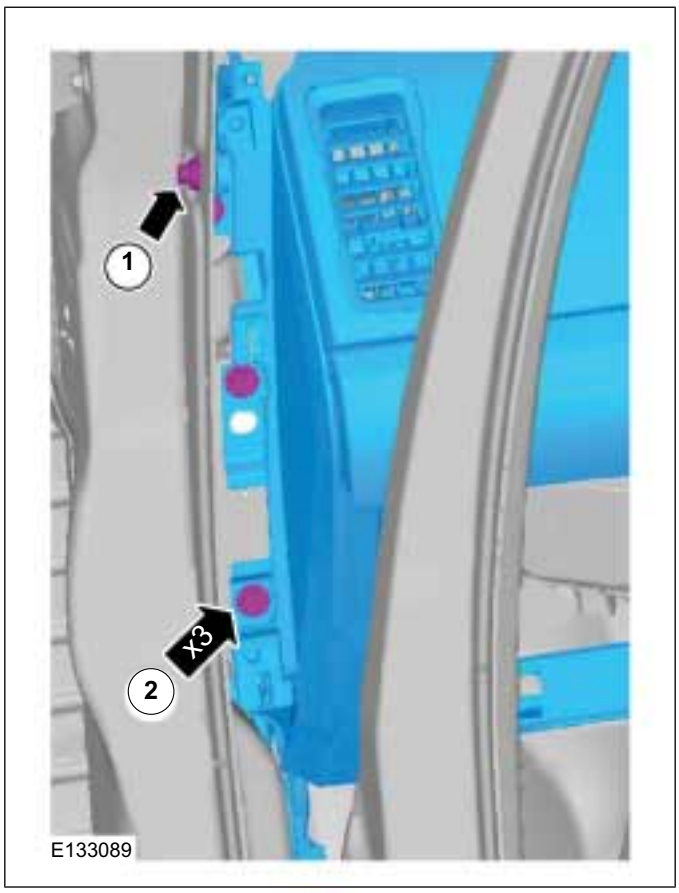
26. Torque: 25 Nm



27. On both sides.
Torque: 25 Nm

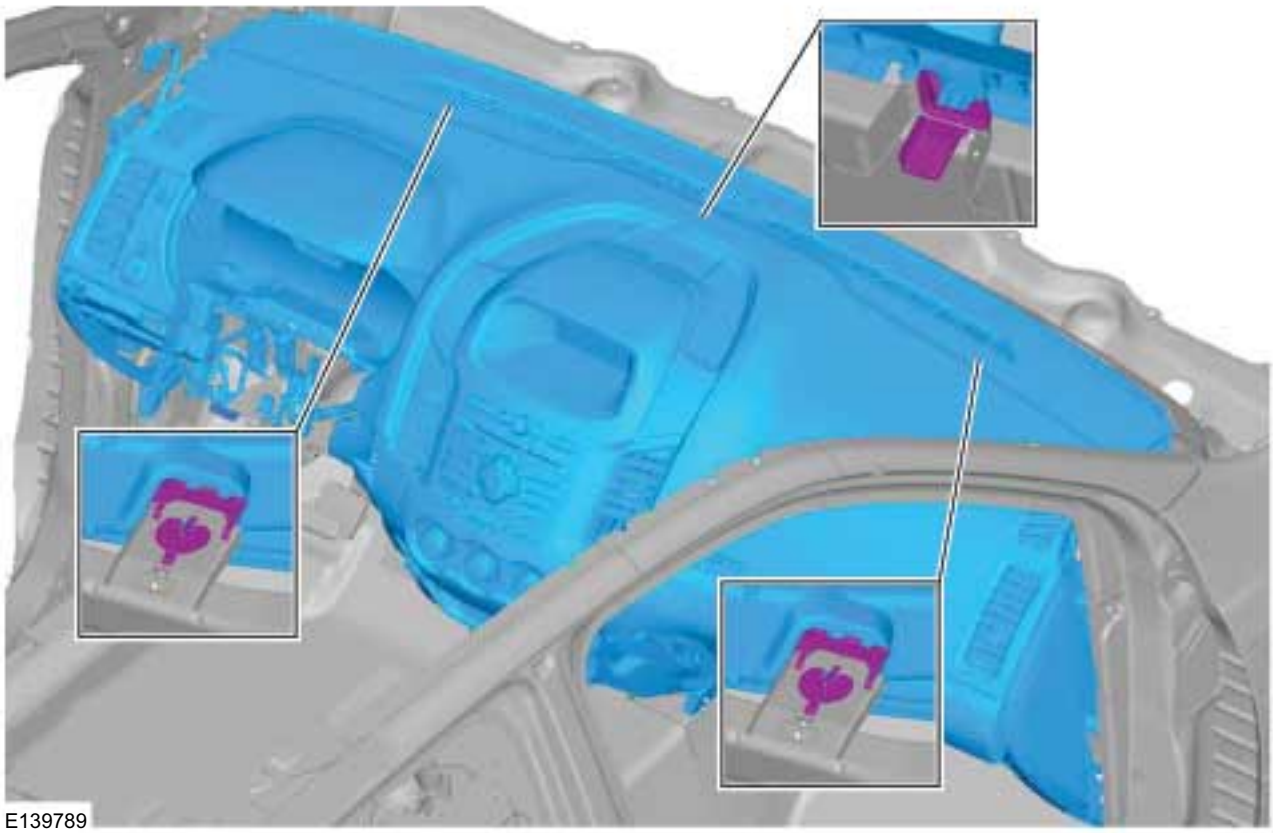


28. 1. On both sides.
Torque: 25 Nm
2. On both sides.
Torque: 25 Nm



29. **NOTE:** Note the position of the component before removal.

REMOVAL AND INSTALLATION

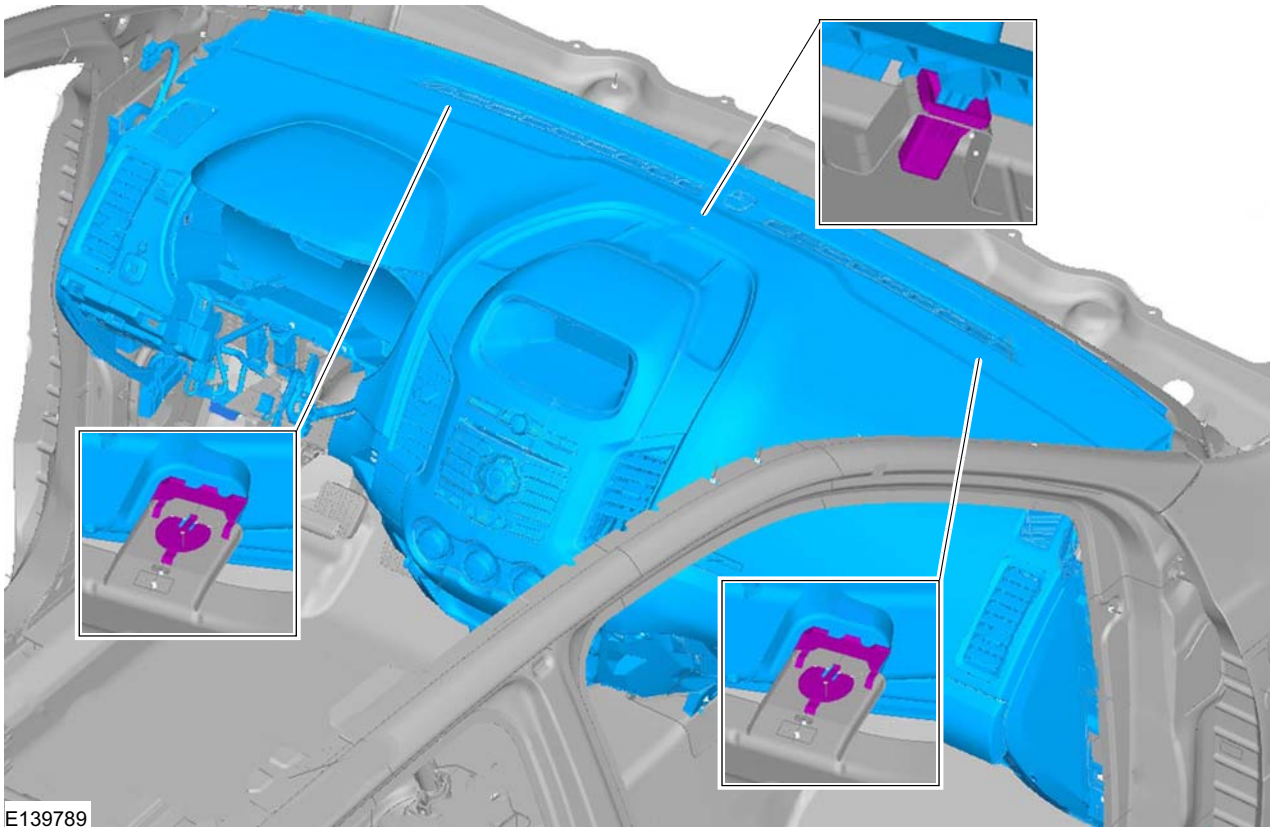


Installation

1. ⚠ **CAUTION: Make sure that the three locking positions are locked correctely.**

NOTE: Make sure that the adjuster is correctely alighned.

REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.
3. Configure the steering column module.
   General Equipment: Ford Diagnostic Equipment

REMOVAL AND INSTALLATION

Instrument Panel — RHD 4WD/RHD RWD

General Equipment

Ford Diagnostic Equipment

Removal

WARNINGS:

The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Single cab

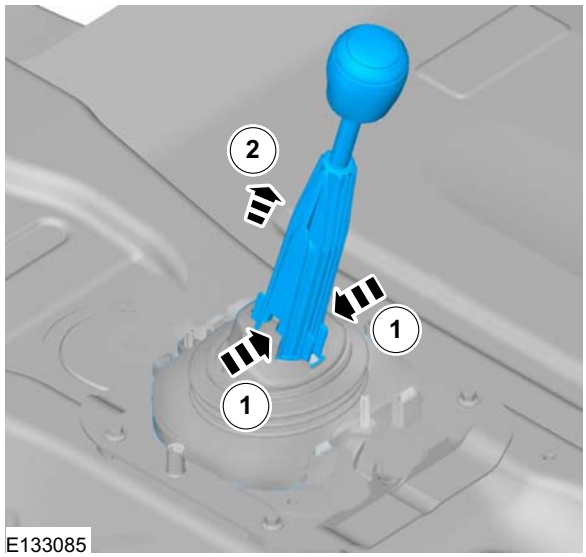
2. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).

Double cab

3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Vehicles with manual transmission

4.



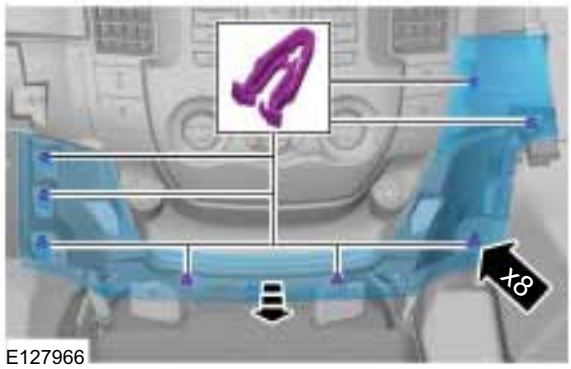
REMOVAL AND INSTALLATION

Vehicles with driver lower air bag

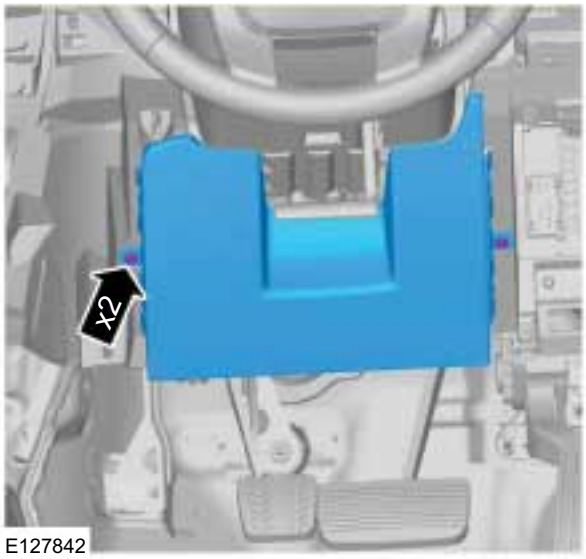
5. Refer to: Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

Vehicles without driver lower air bag

6.



7. Torque: 2 Nm

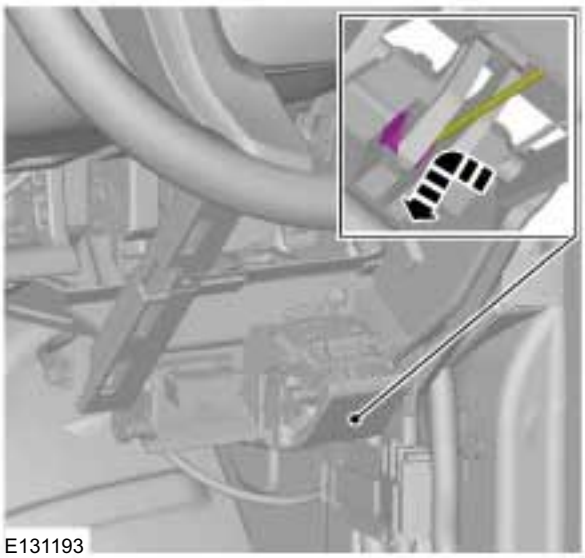


All vehicles

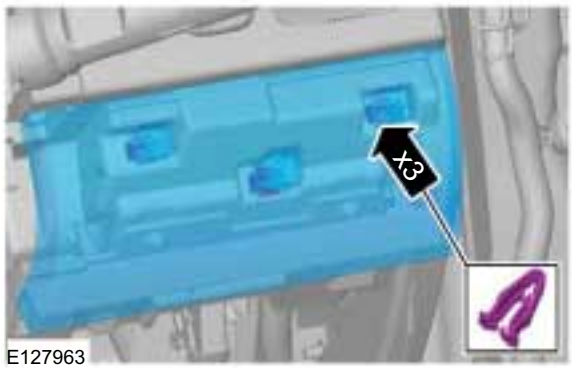
8. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).

9. Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

10.

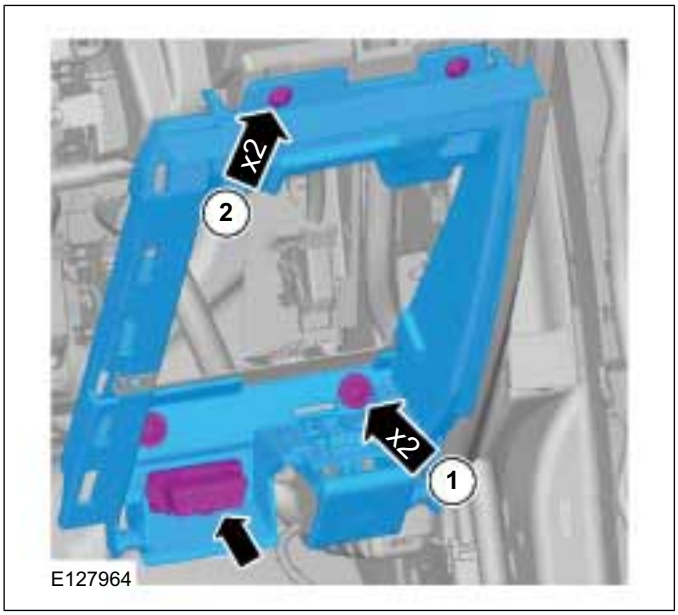


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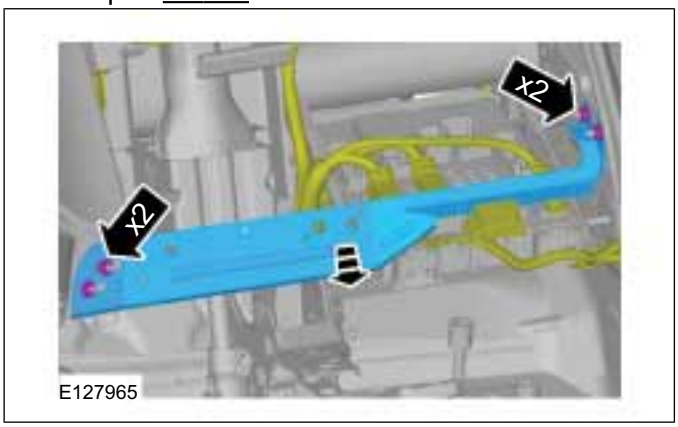


REMOVAL AND INSTALLATION

12. 1. Torque: 3 Nm
2. Torque: 2 Nm



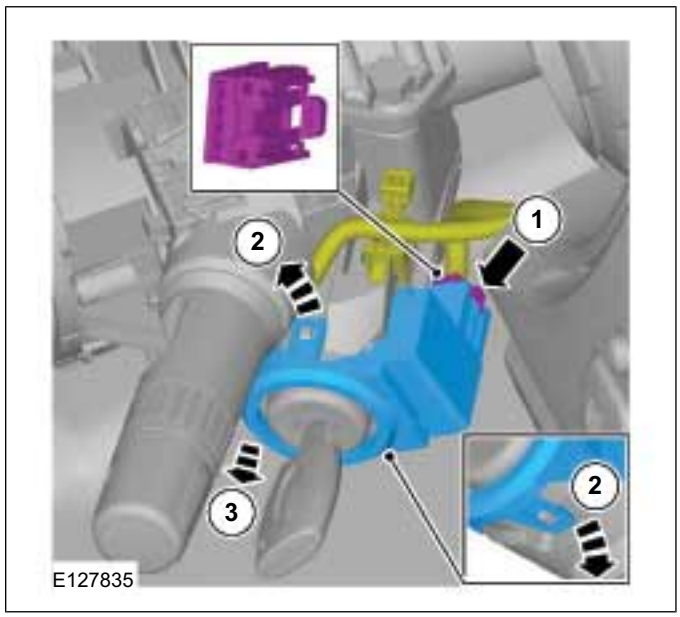
13. Torque: 10 Nm



14. Refer to: Ignition Switch (211-05 Steering Column Switches, Removal and Installation).

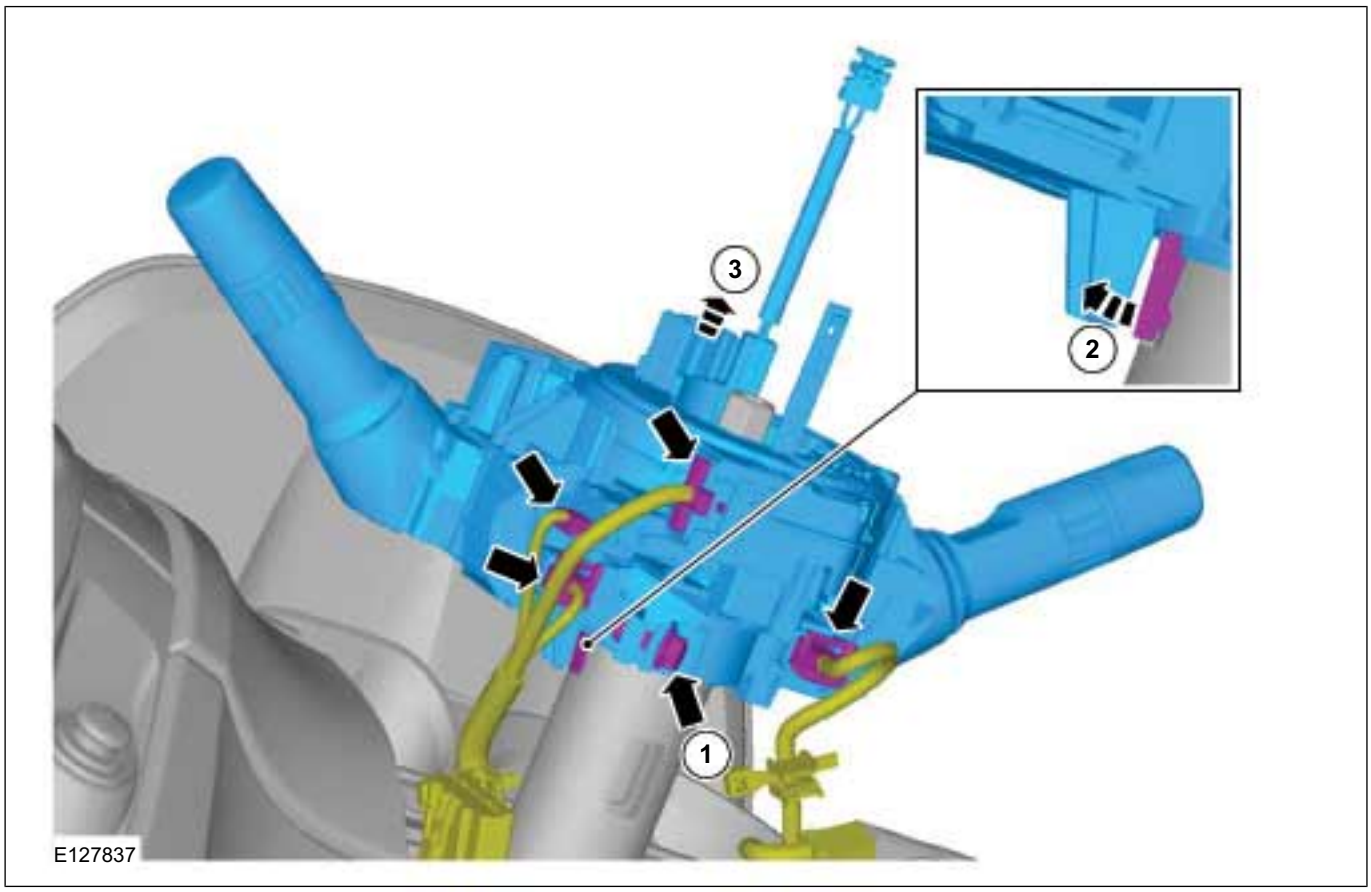
15. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).

16.

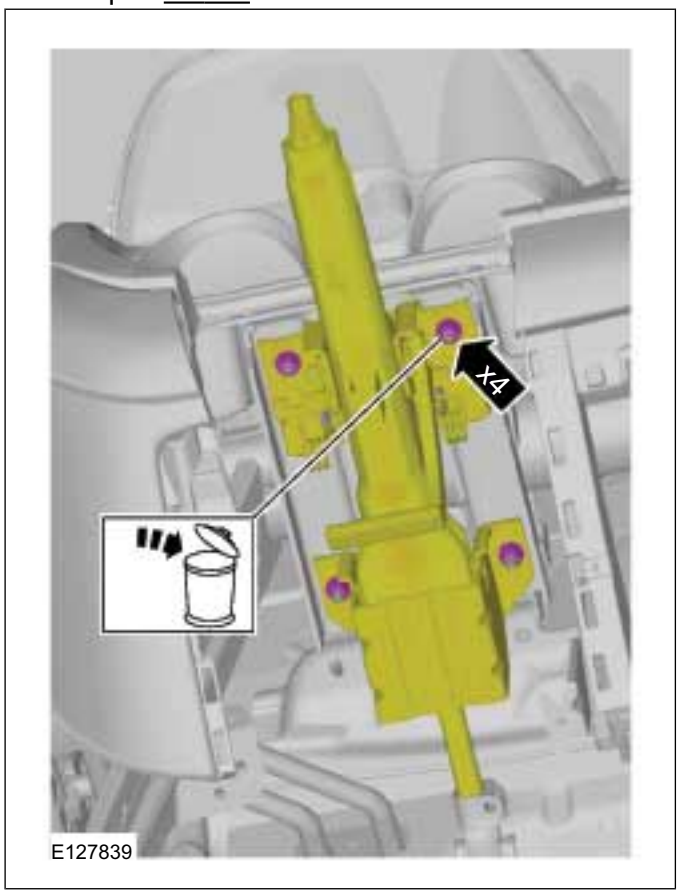


17. Torque: 7 Nm

REMOVAL AND INSTALLATION

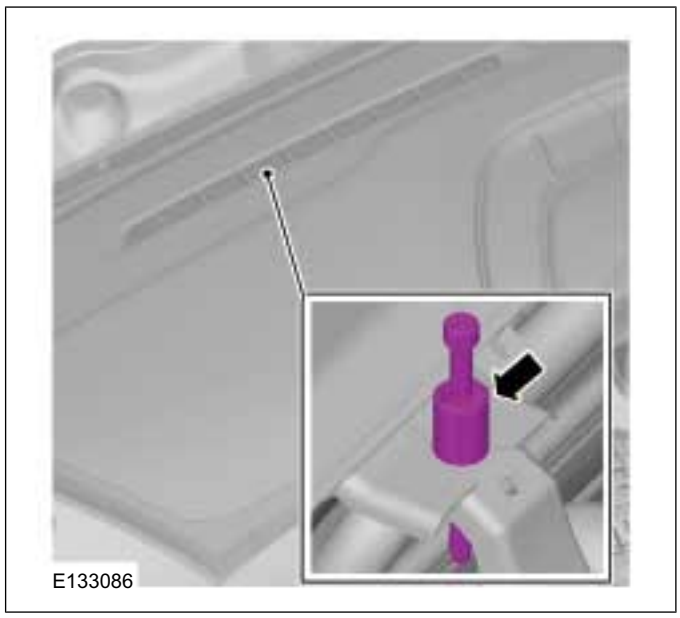


18. Torque: 15 Nm



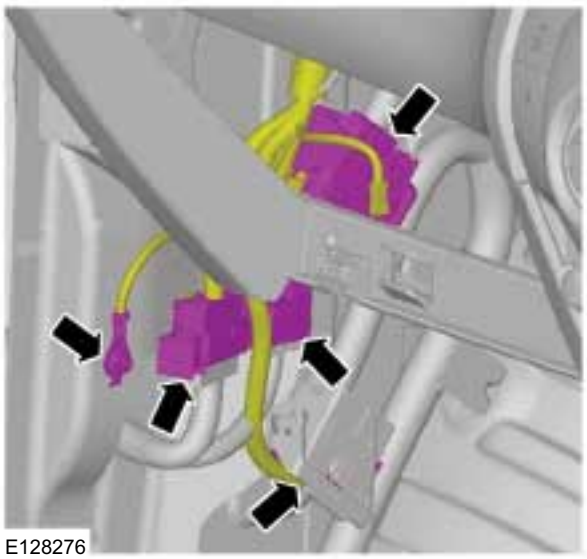
19. Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

20.

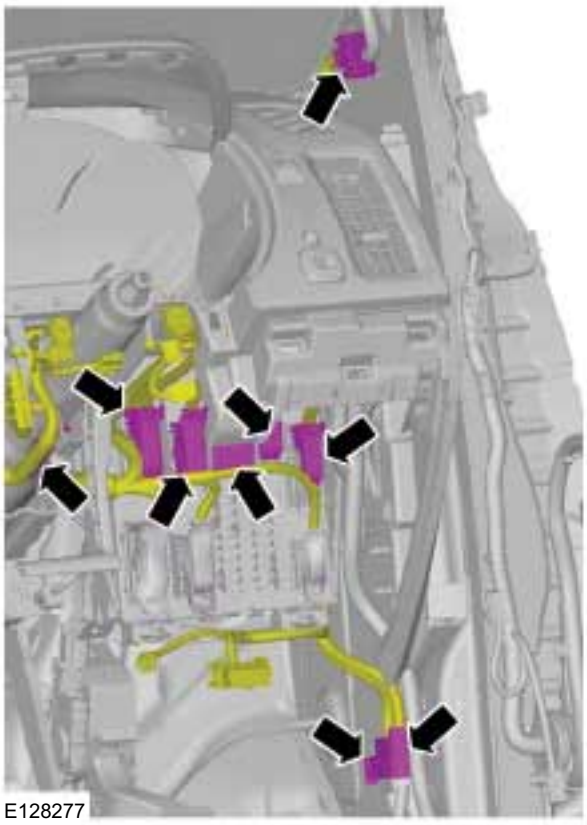


REMOVAL AND INSTALLATION

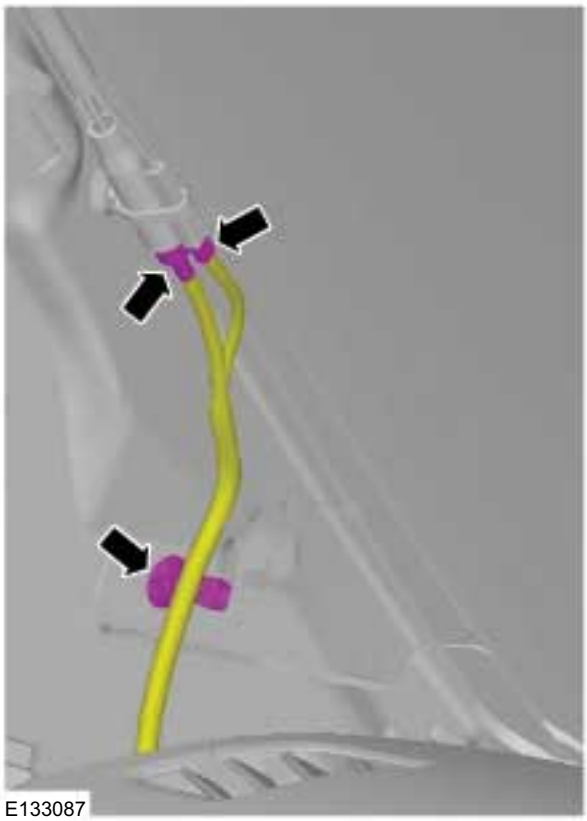
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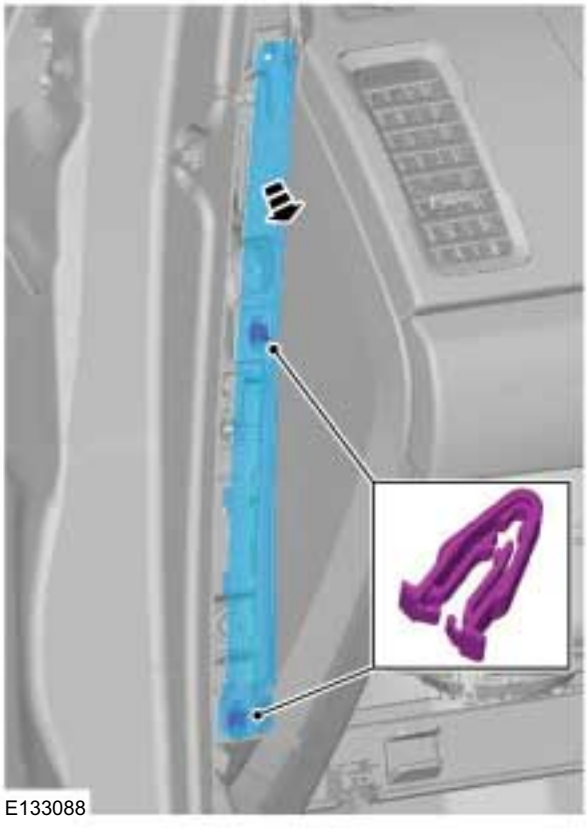
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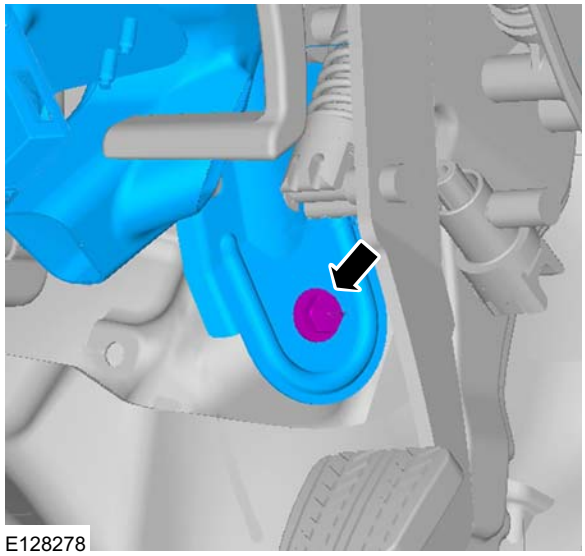


24. On both sides.

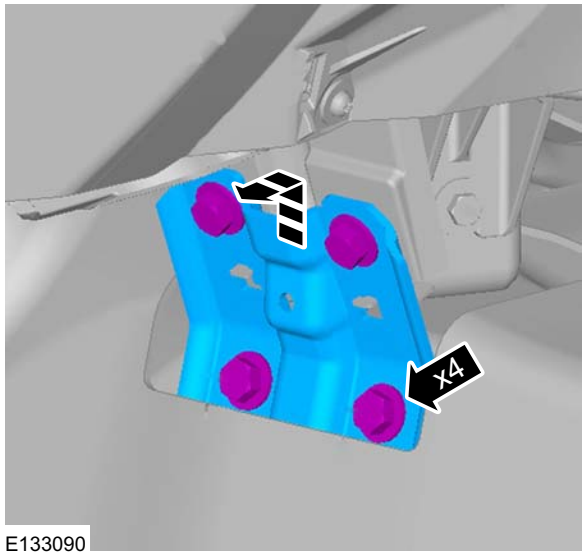


REMOVAL AND INSTALLATION

25. Torque: 25 Nm

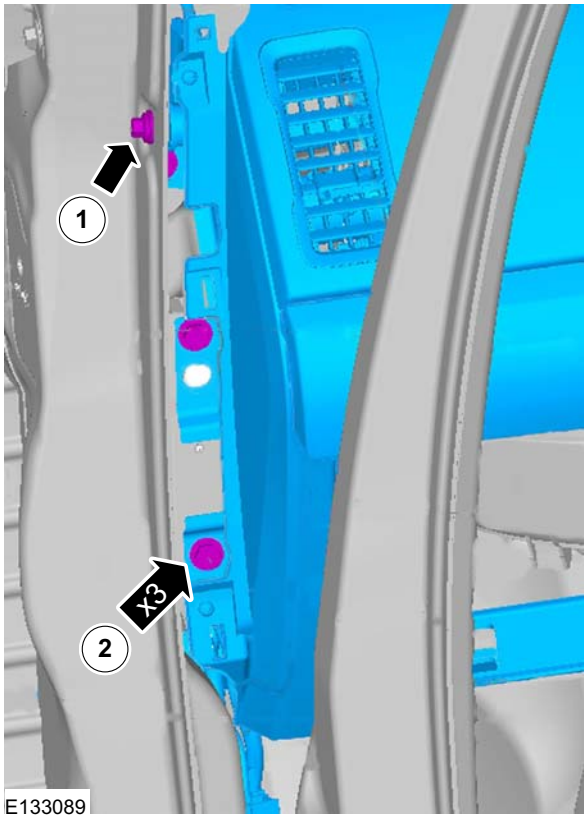

E128278

26. On both sides.
Torque: 25 Nm



E133090

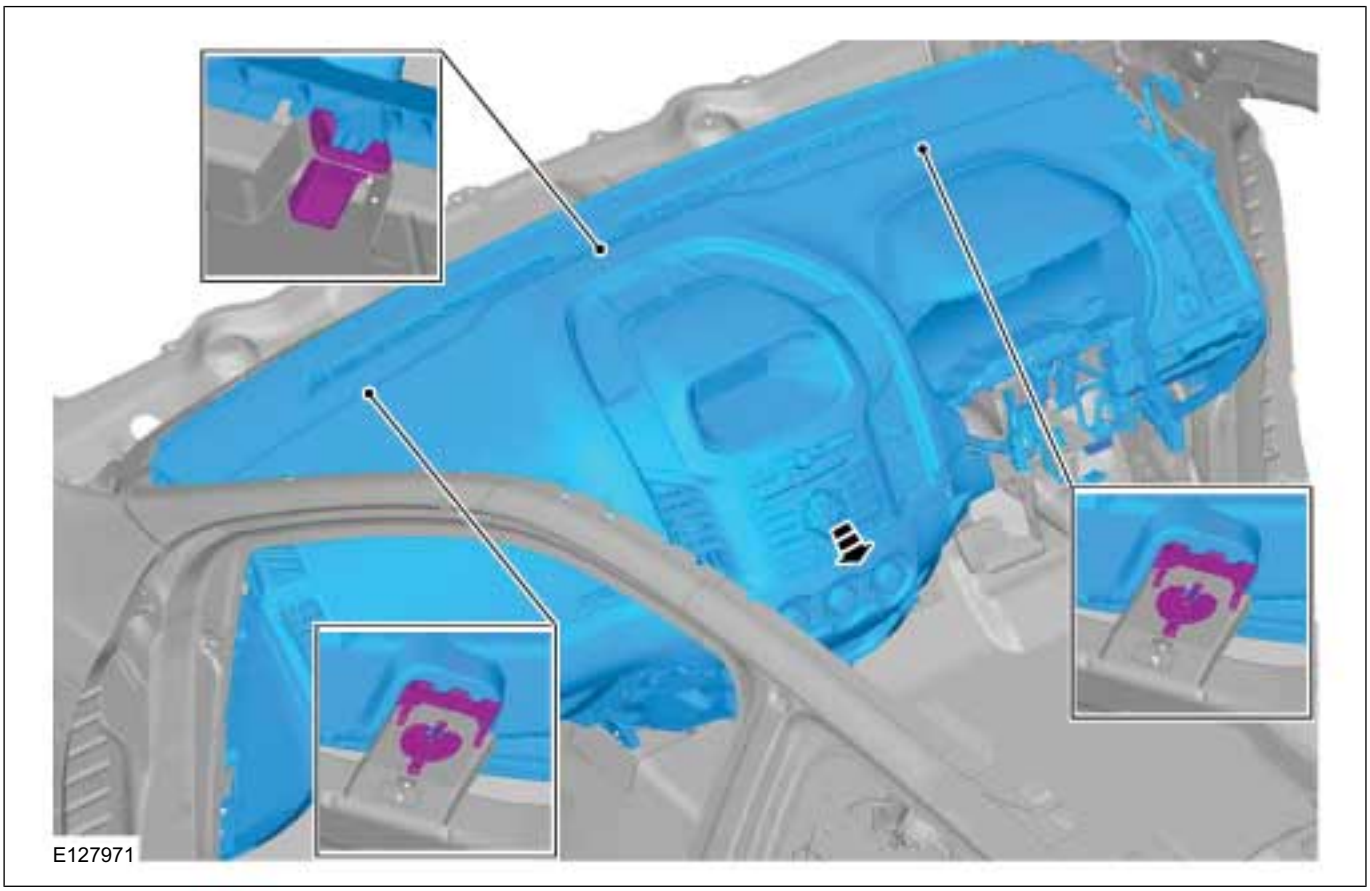
27. 1. On both sides.
Torque: 25 Nm
2. On both sides.
Torque: 25 Nm



E133089

28. **NOTE:** Note the position of the component before removal.

REMOVAL AND INSTALLATION

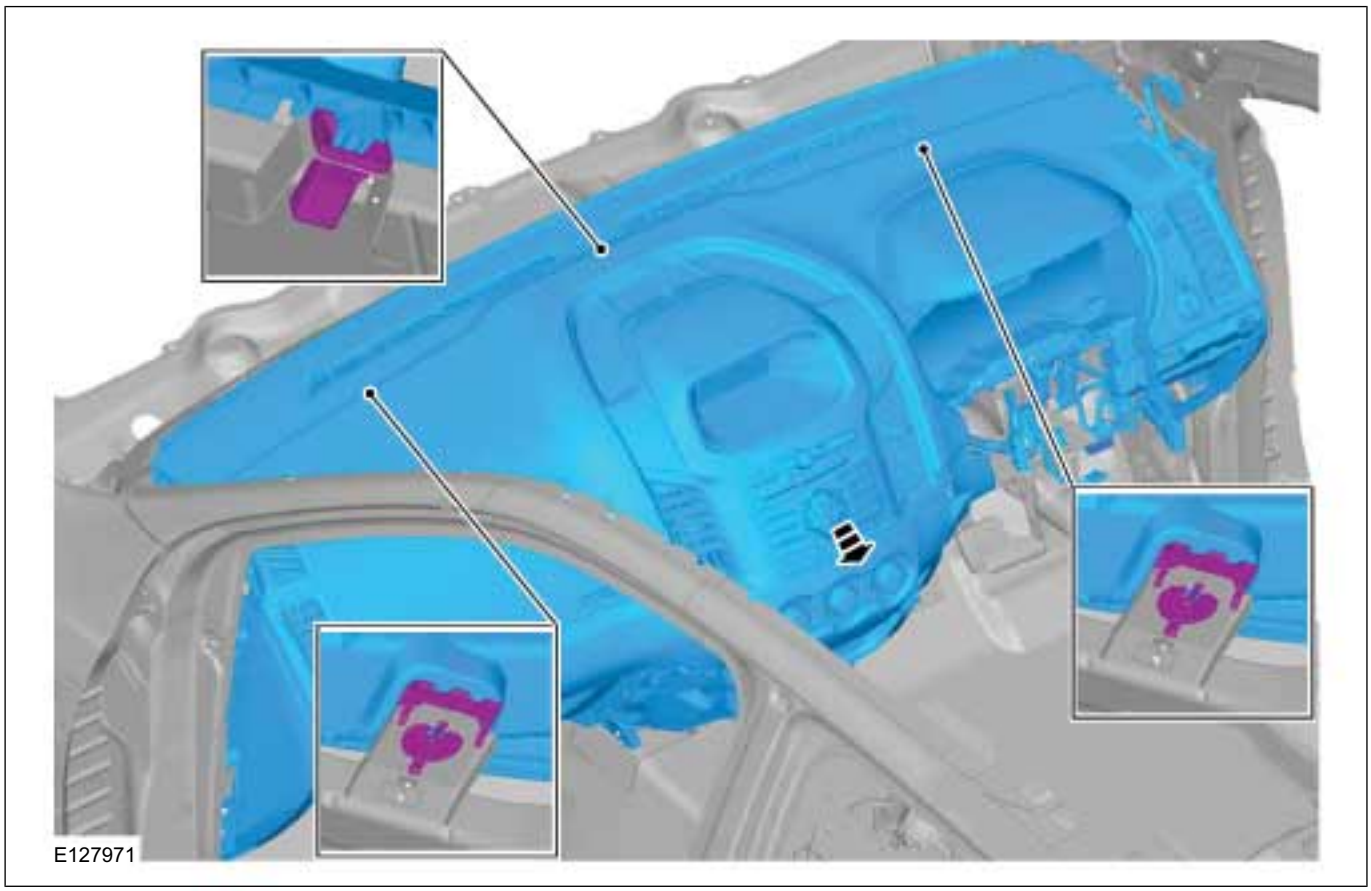


Installation

1. ⚠ **CAUTION: Make sure that the three locking positions are locked correctely.**

NOTE: Make sure that the adjuster is correctely alighned.

REMOVAL AND INSTALLATION



2. To install, reverse the removal procedure.
3. Configure the steering column module.
   General Equipment: Ford Diagnostic Equipment

REMOVAL AND INSTALLATION

Floor Console — Single Cab

Removal

NOTE: Removal steps in this procedure may contain installtion details.

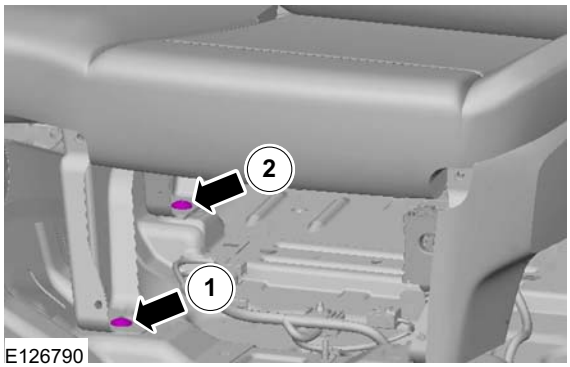
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Driver and passenger seat

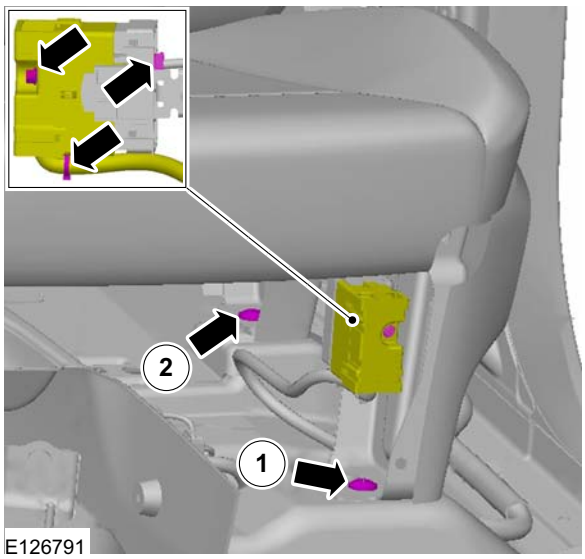
3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Vehicles with front bench seat

4. Torque: 50 Nm



5. Torque: 50 Nm

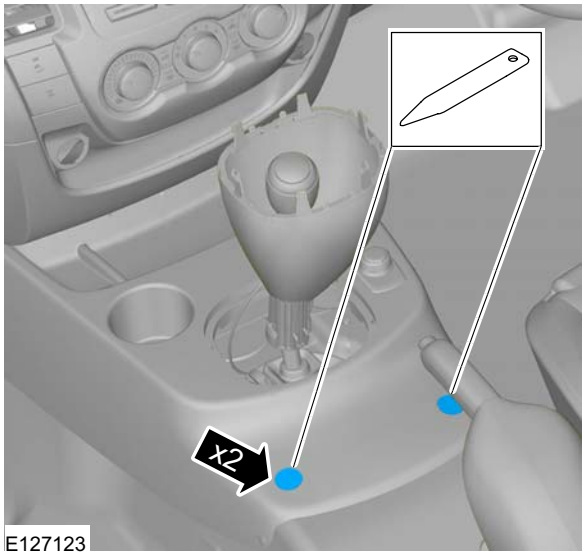


6.

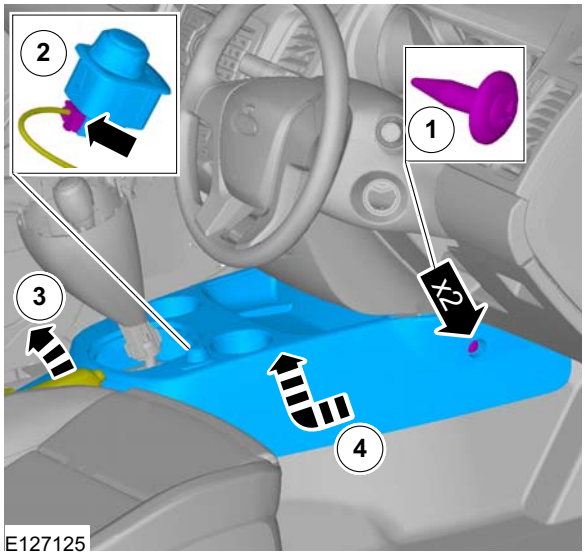


REMOVAL AND INSTALLATION

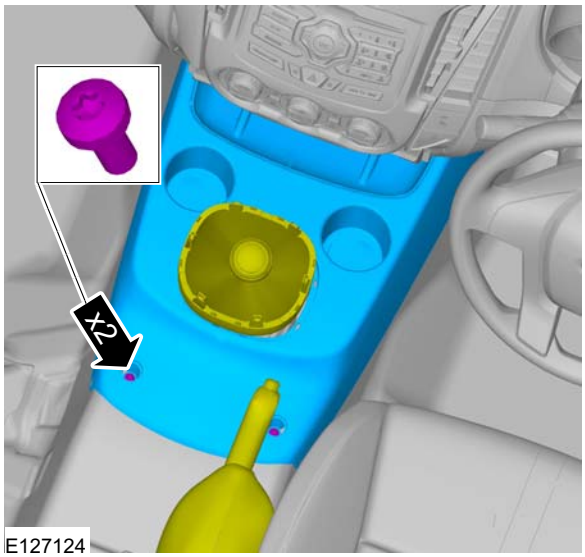
7.



9.



8. Torque: 6 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Floor Console — Double Cab

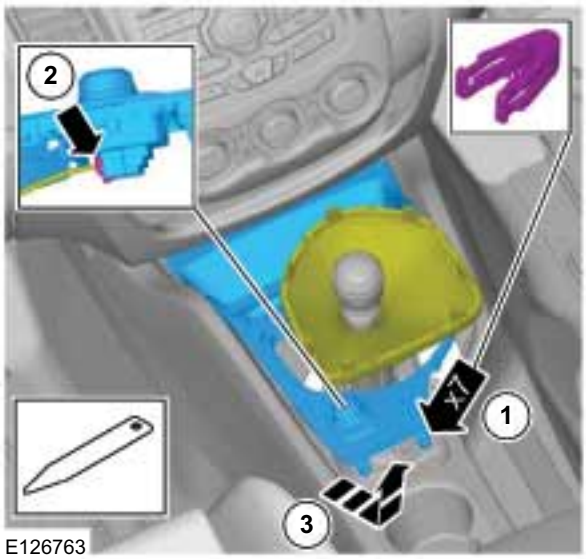
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

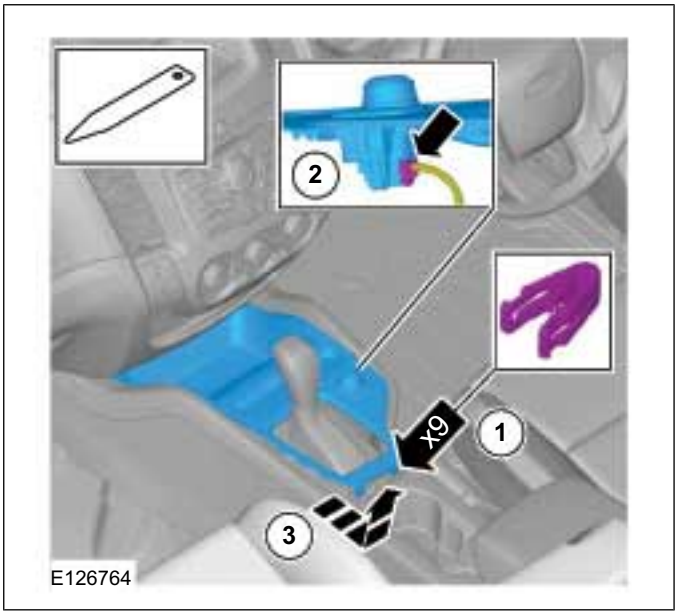
Vehicles with manual transmission

3.

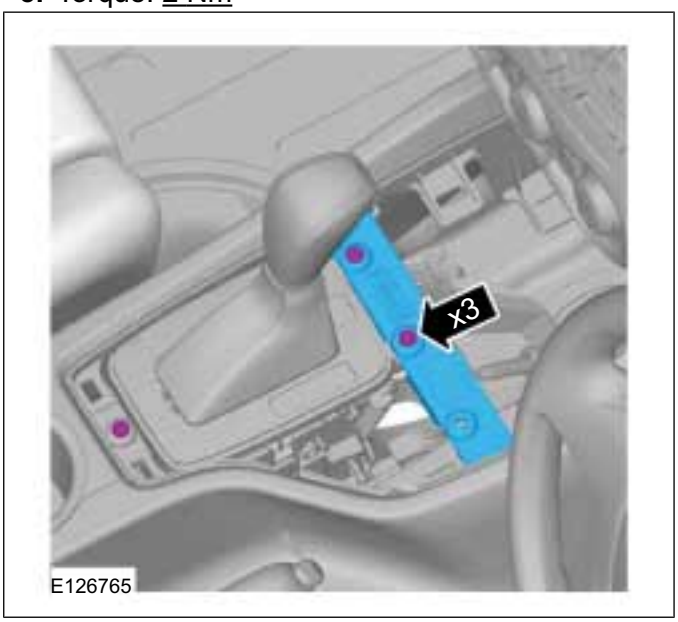


Vehicles with automatic transmission

4.



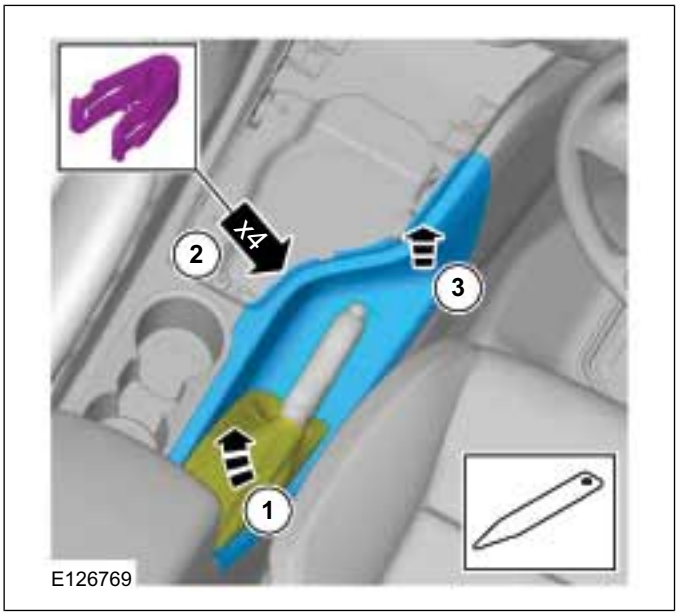
5. Torque: 2 Nm



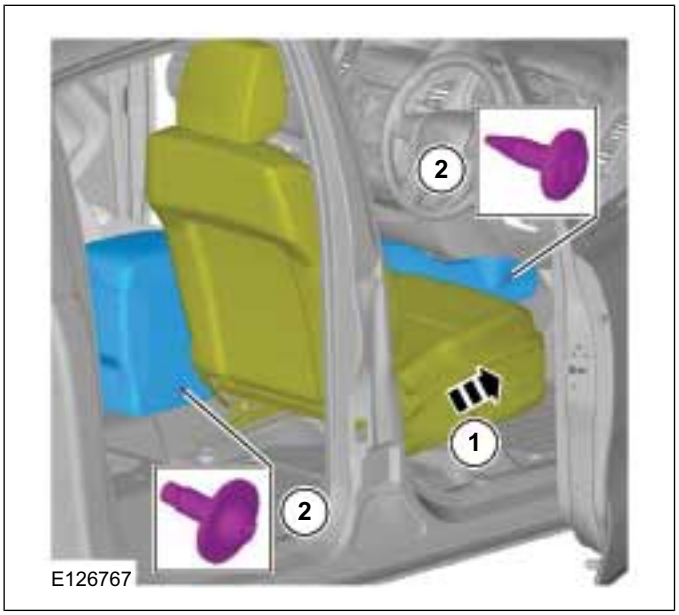
REMOVAL AND INSTALLATION

All vehicles

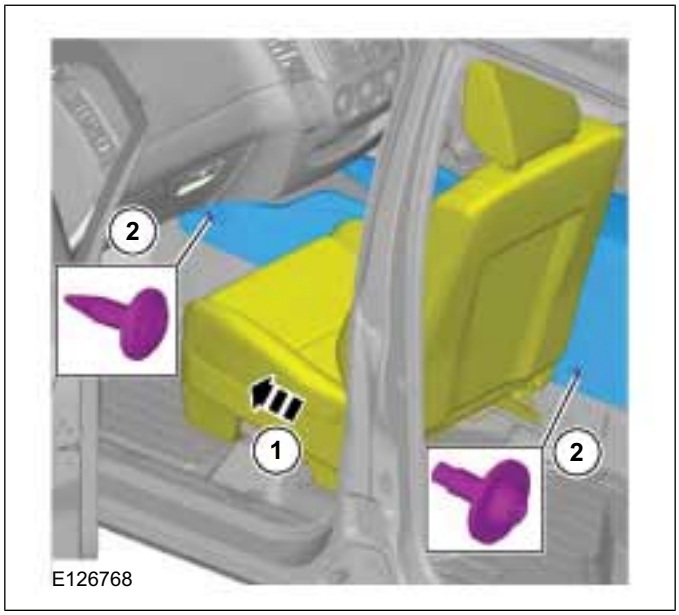
6.



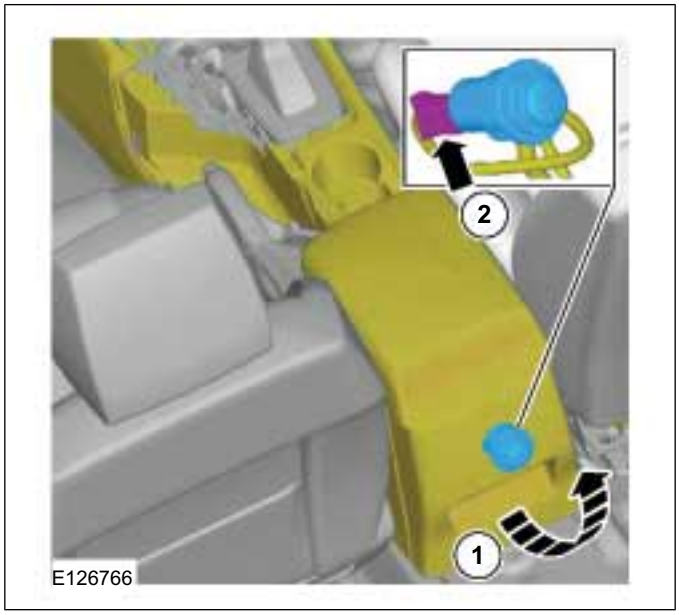
7. 2. Torque: 6 Nm



8. 2. Torque: 6 Nm

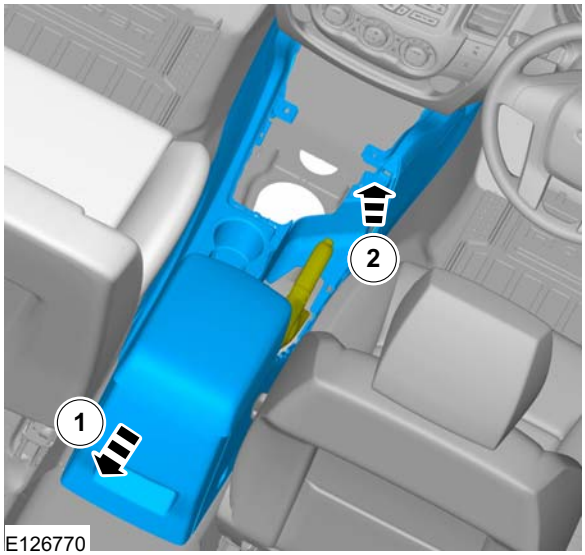


9.



REMOVAL AND INSTALLATION

10.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

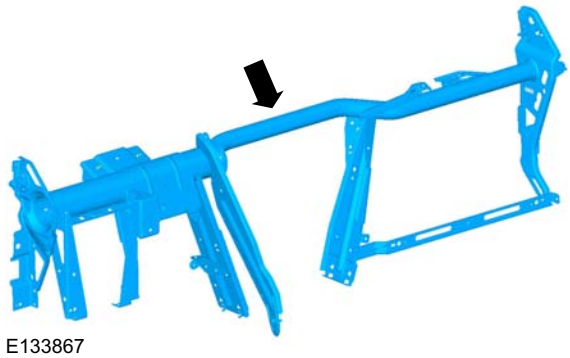
In-Vehicle Crossbeam

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Instrument Panel Wiring Harness (418-02 Wiring Harnesses, Removal and Installation).

2.



E133867

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

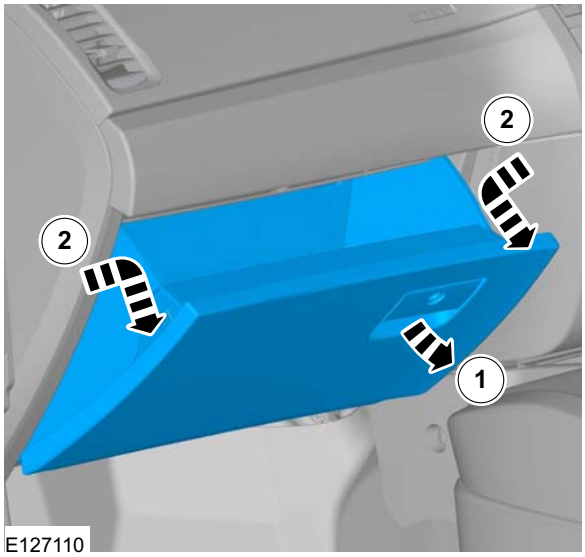
Glove Compartment

Removal

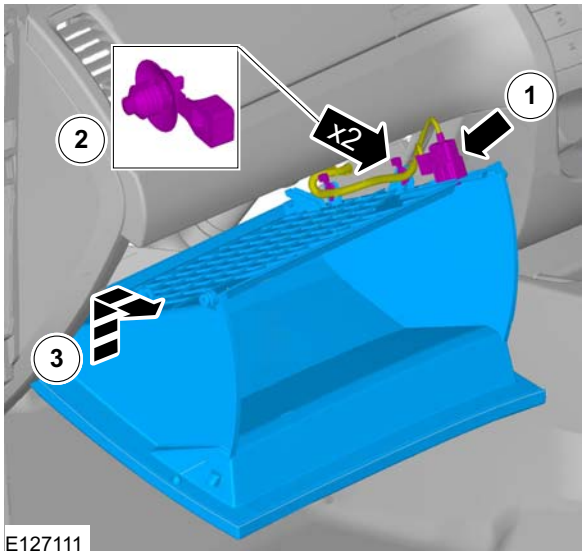
NOTE: Removal steps in this procedure may contain installtion details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

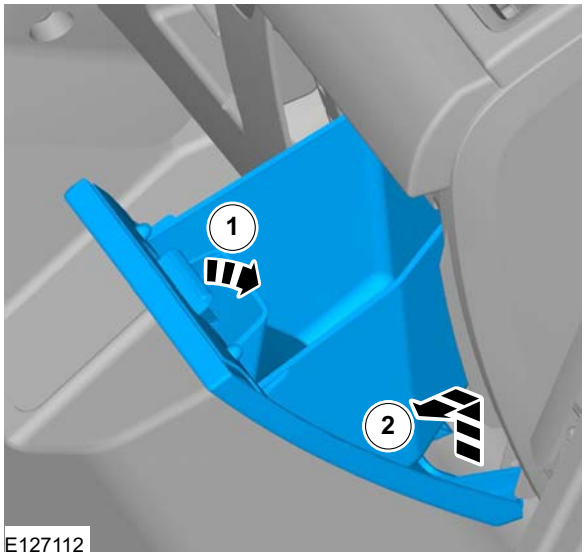
2.



3.



4.



Installation

NOTE: Make sure that the passenger glove box lamp is correctly located.

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Overhead Console

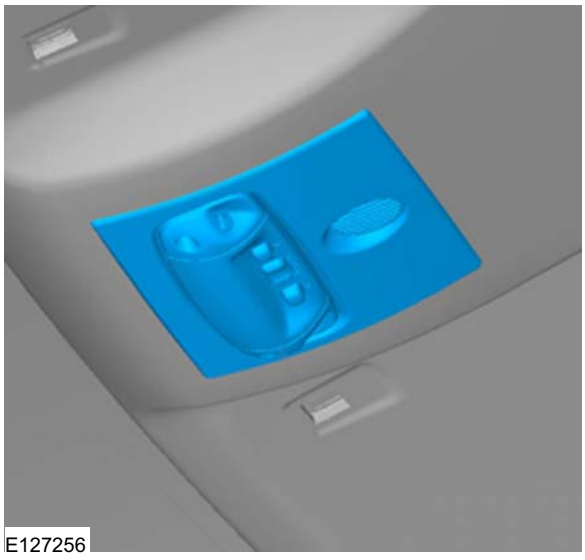
Removal

NOTE: Removal steps in this procedure may contain installation details.

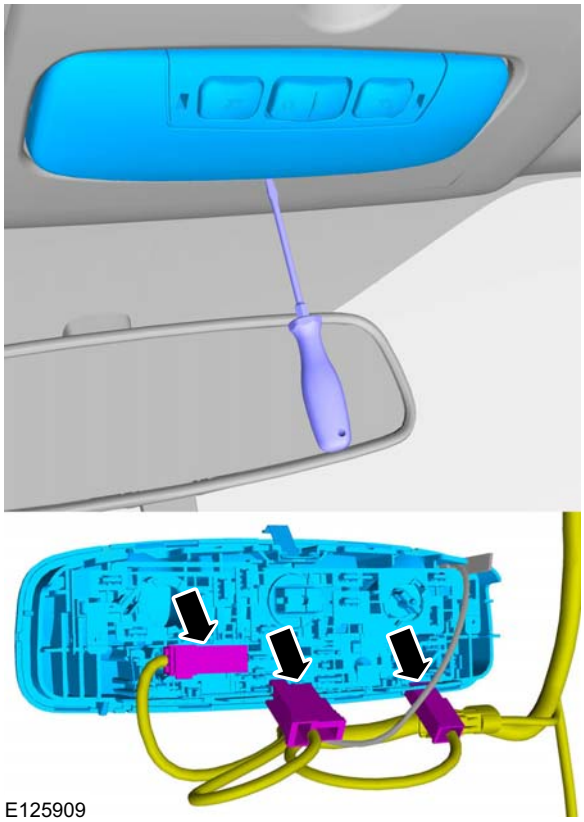
1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Long over head console.


E127255

4. Short over head console.

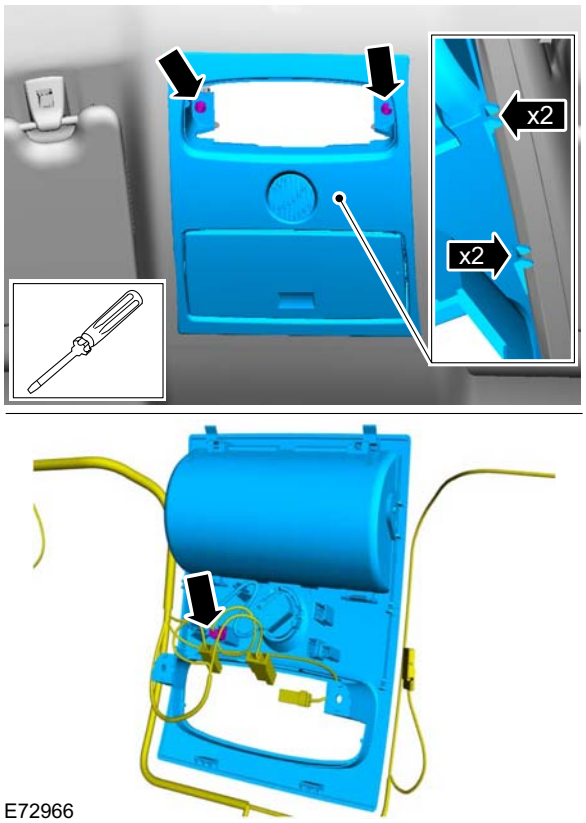

E127256

5.


E125909

REMOVAL AND INSTALLATION

6. Torque: 4 Nm



Installation

1. To install, reverse the removal procedure.

DISASSEMBLY AND ASSEMBLY

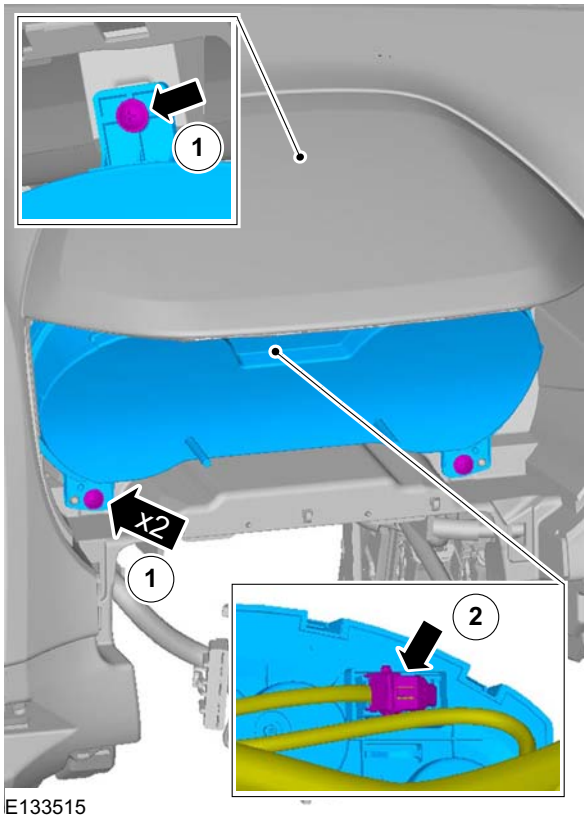
Instrument Panel

Disassembly

1. Refer to: Instrument Panel - RHD 4WD/RHD RWD (501-12 Instrument Panel and Console, Removal and Installation).
2. Refer to: Audio Unit (415-01 Information and Entertainment System, Removal and Installation).
3. If fitted.

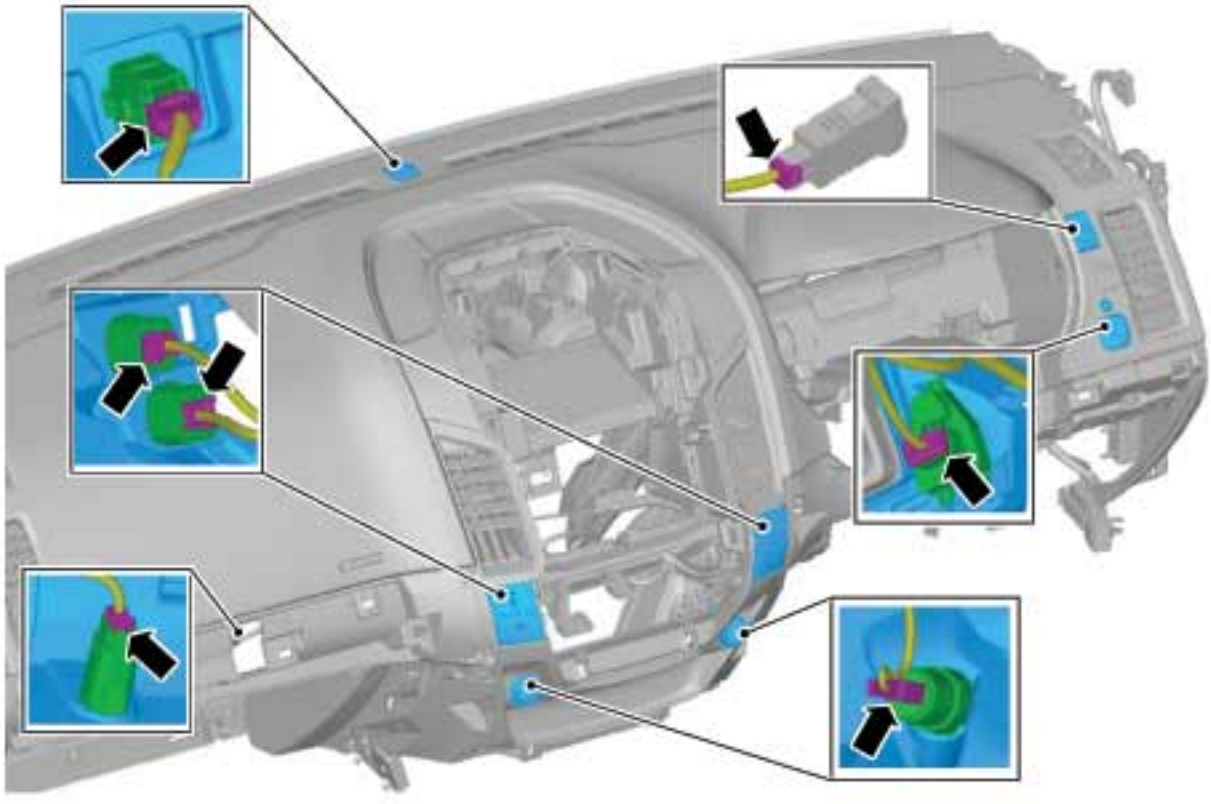
   Refer to: Information and Entertainment Display Unit (415-01 Information and Entertainment System, Removal and Installation).
4. If fitted.

   Refer to: Bluetooth Module (415-01 Information and Entertainment System, Removal and Installation).
5. Refer to: Passenger Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).
6. Torque: 2 Nm

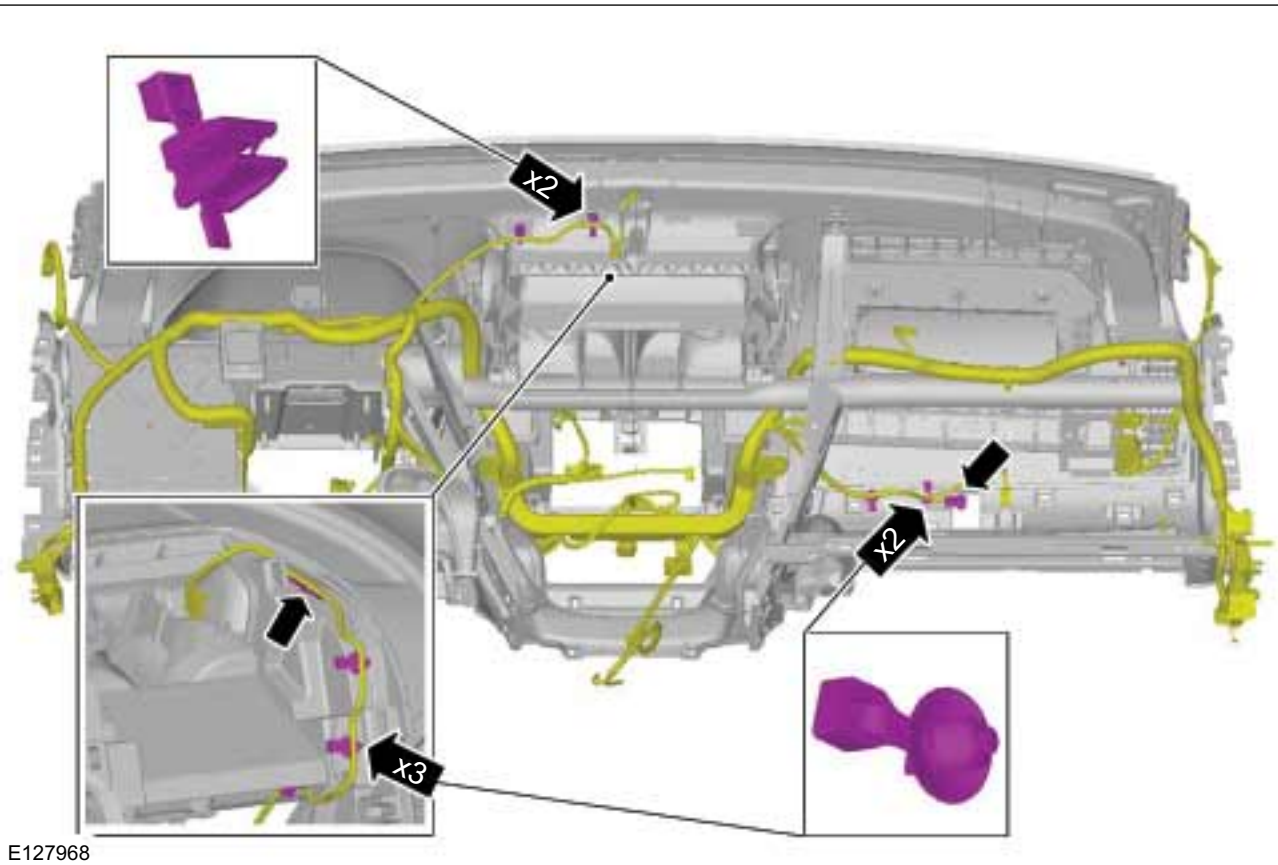


7. Note the position of the component before removal.

DISASSEMBLY AND ASSEMBLY

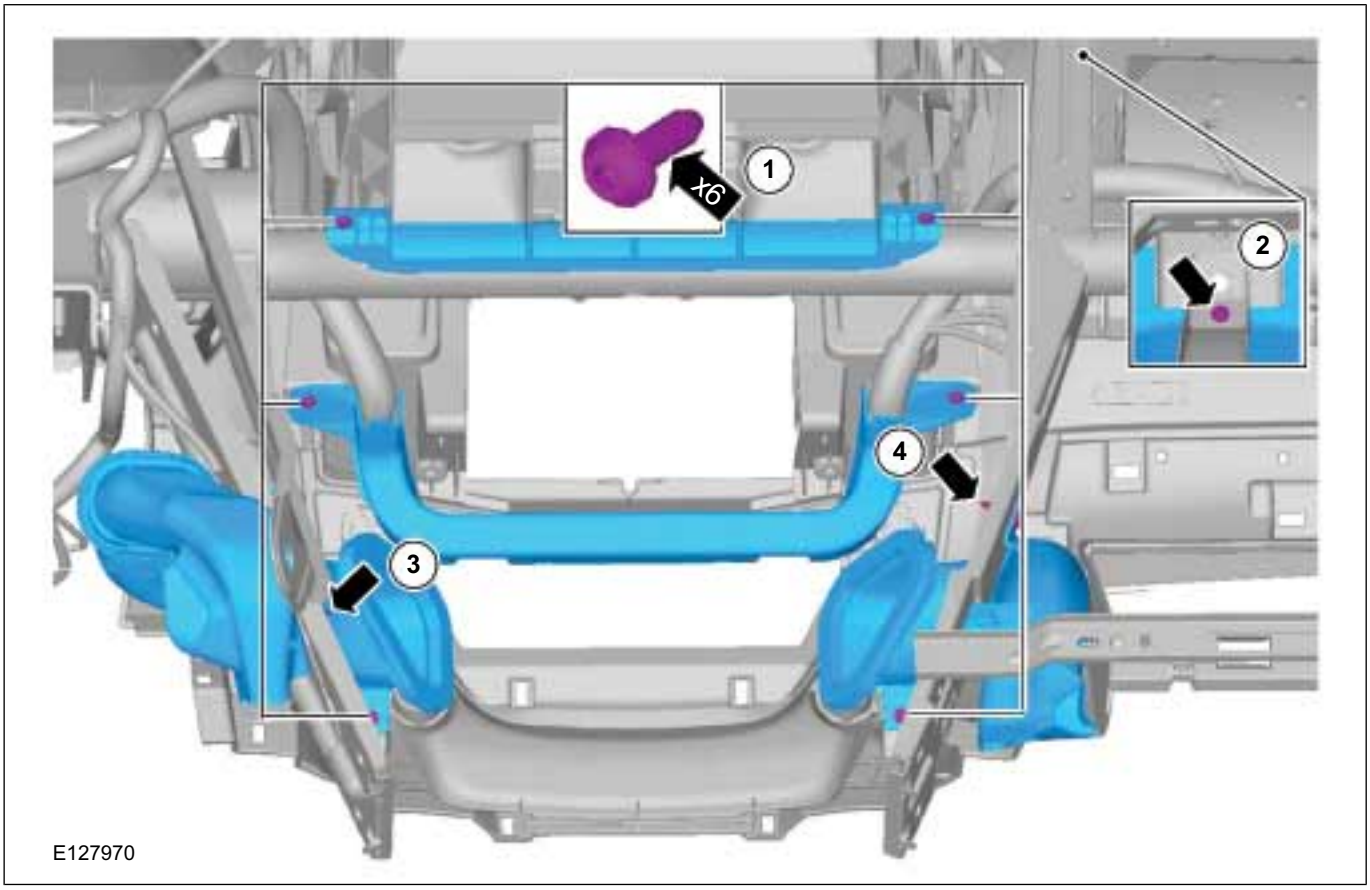


8.

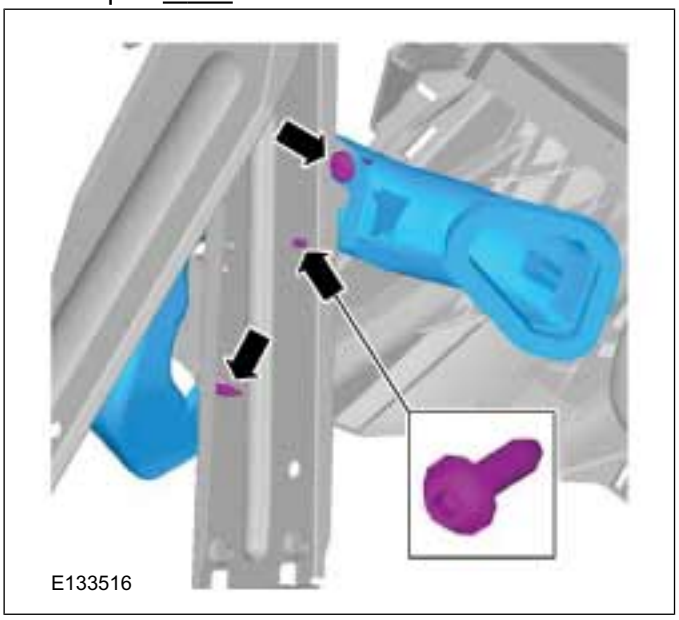


DISASSEMBLY AND ASSEMBLY

9.

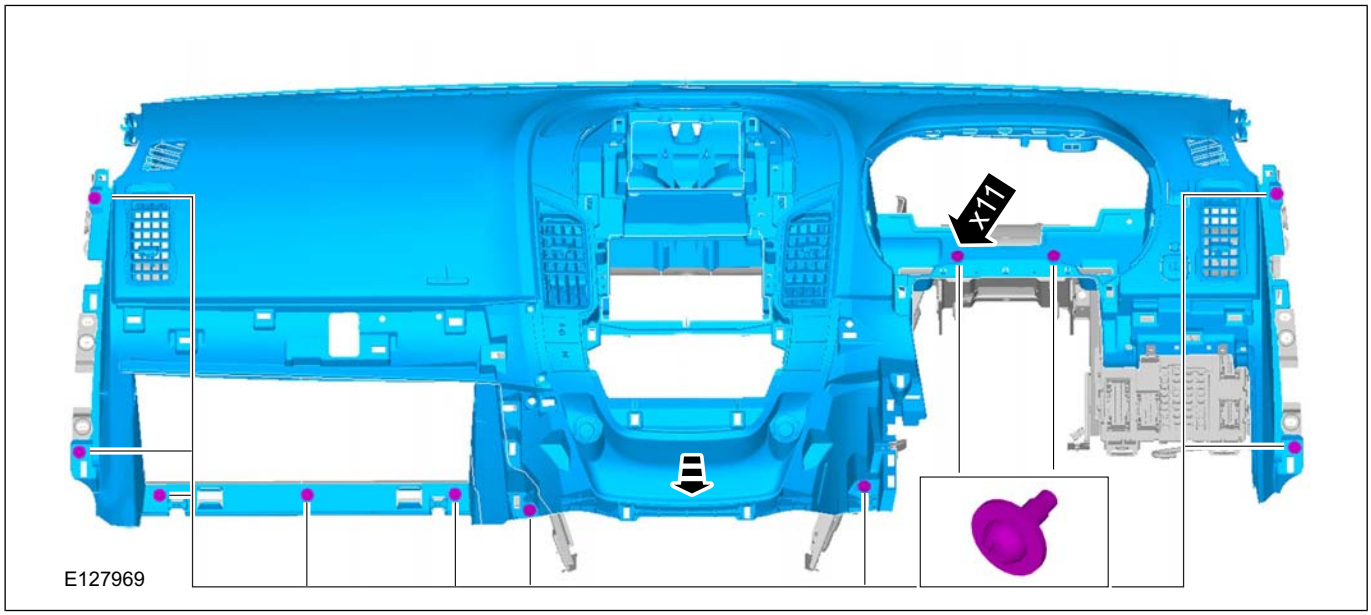


10. Torque: 3 Nm



11. Torque: 3 Nm

DISASSEMBLY AND ASSEMBLY



Assembly

12. To assemble, reverse the disassembly procedure.

SECTION 501-14 Handles, Locks, Latches and Entry Systems

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

Handles, Locks, Latches and Entry Systems..... 501-14-2

GENERAL PROCEDURES

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REMOVAL AND INSTALLATION

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Hood Latch..... 501-14-17
Tailgate Release Handle..... 501-14-19
Tailgate Latch..... 501-14-20

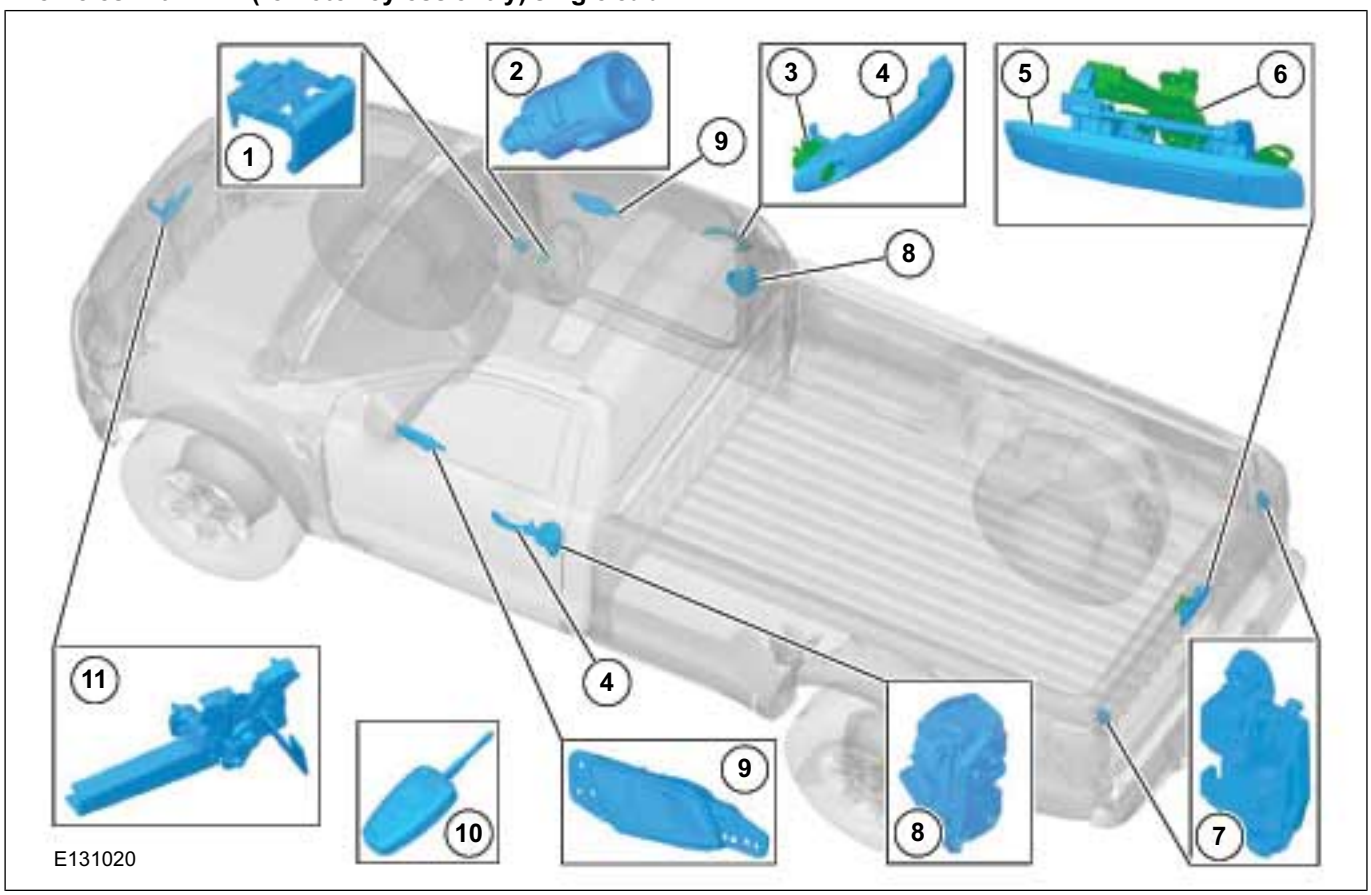
DISASSEMBLY AND ASSEMBLY

Door Lock Cylinder..... 501-14-21

DESCRIPTION AND OPERATION

Handles, Locks, Latches and Entry Systems

Vehicles with RKE (remote keyless entry) single cab

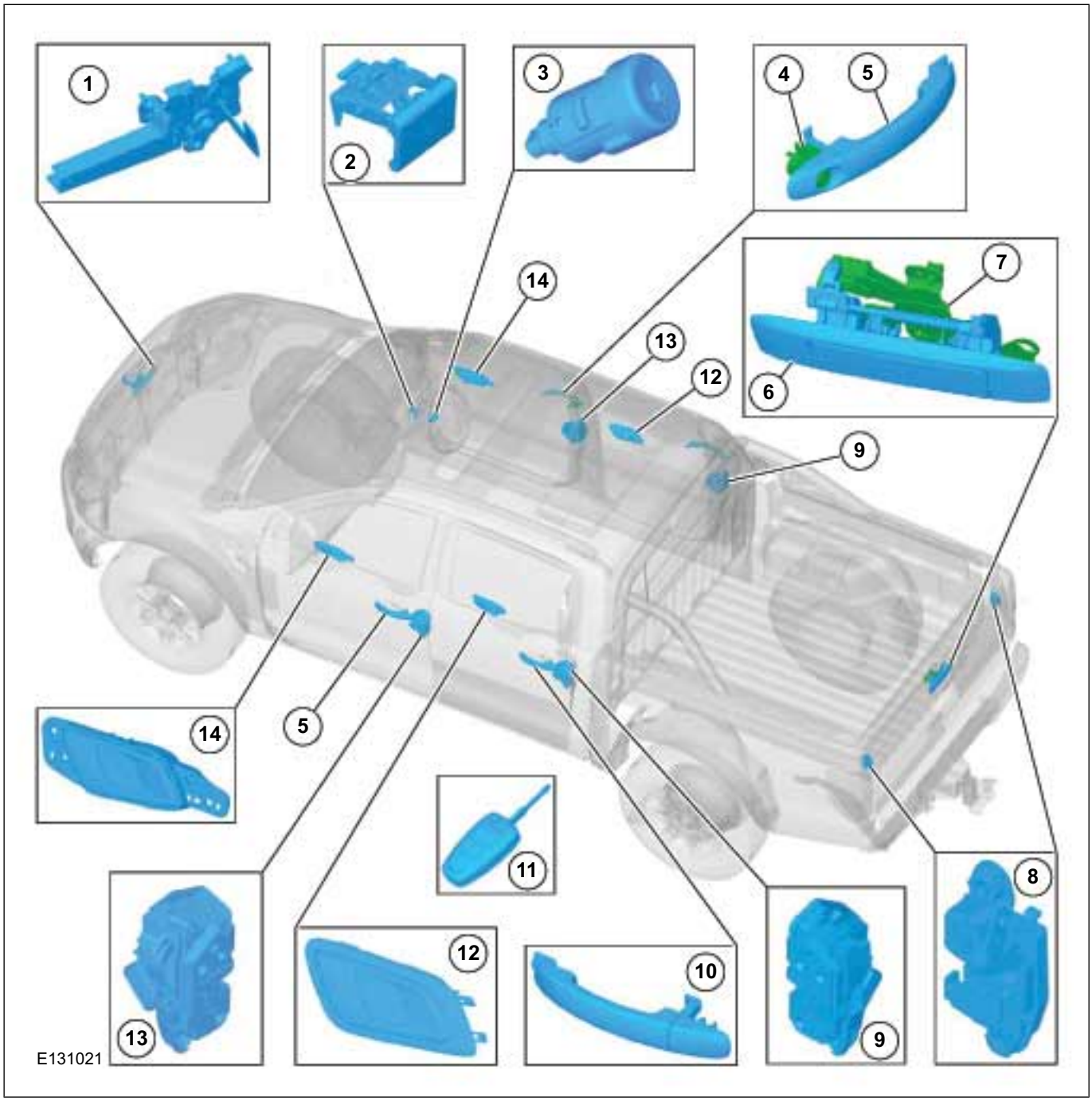


Item	Description
1	Hood latch release handle
2	Steering column ignition cylinder
3	Door lock cylinder
4	Exterior door handle
5	Tailgate handle
6	Tailgate release handle
7	Tailgate latch

Item	Description
8	Door latch
9	Interior door handle
10	Mechanical key with transmitter (radio frequency remote control)
11	Hood latch

Vehicles with RKE (remote keyless entry) double cab

DESCRIPTION AND OPERATION

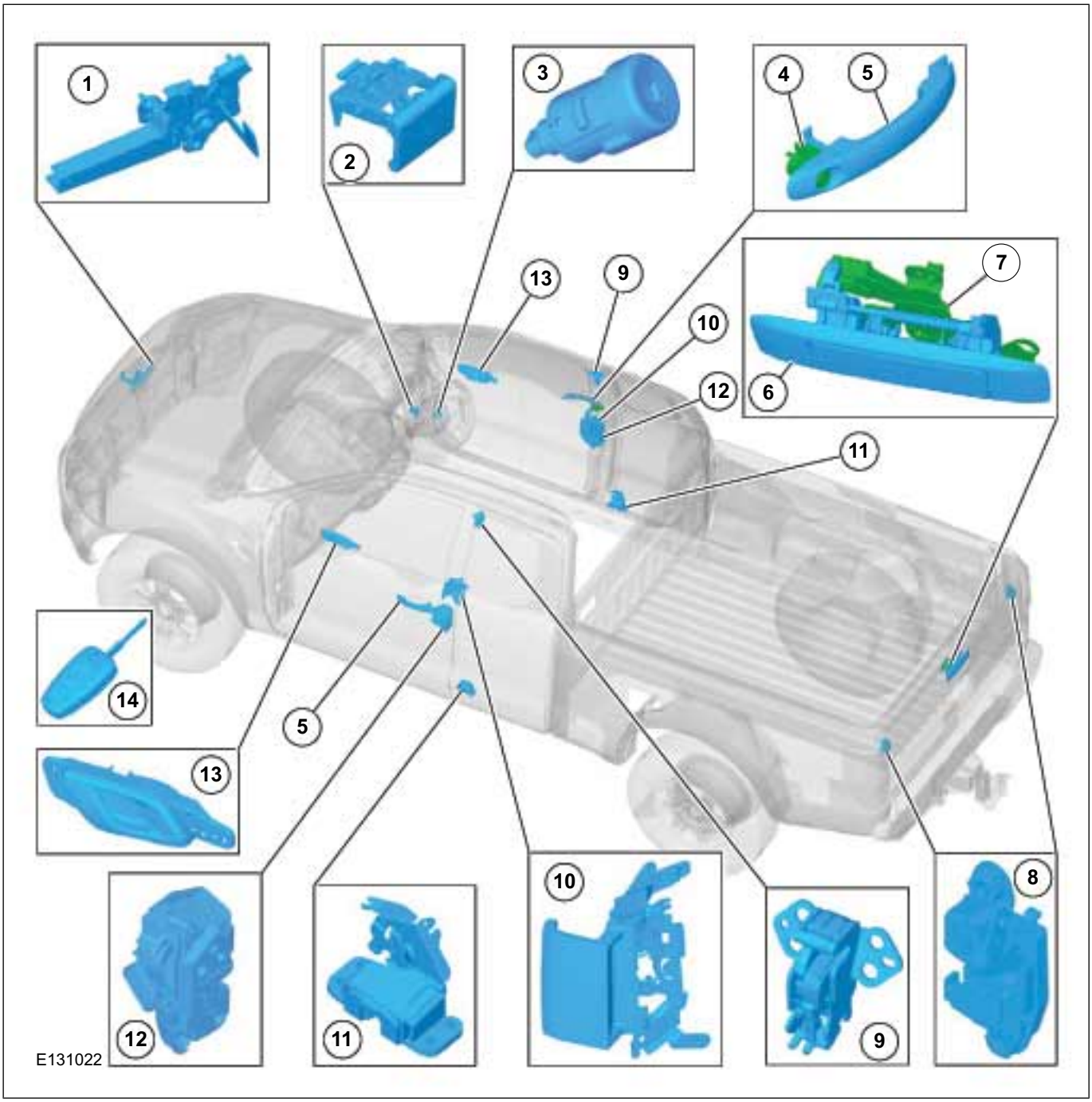


Item	Description
1	Hood latch
2	Hood latch release handle
3	Steering column ignition cylinder
4	Door lock cylinder
5	Front exterior door handle
6	Tailgate handle
7	Tailgate release handle
8	Tailgate latch

Item	Description
9	Rear door latch
10	Rear exterior door handle
11	Mechanical key with transmitter (radio frequency remote control)
12	Rear interior door handle
13	Front door latch
14	Front interior door handle

Vehicles with RKE (remote keyless entry) super cab

DESCRIPTION AND OPERATION



Item	Description
1	Hood latch
2	Hood latch release handle
3	Steering column ignition cylinder
4	Door lock cylinder
5	Front exterior door handle
6	Tailgate handle
7	Tailgate release handle
8	Tailgate latch

Item	Description
9	Rear door upper latch
10	Rear door interior handle
11	Rear door lower latch
12	Rear interior door handle
13	Front interior door latch
14	Mechanical key with transmitter (radio frequency remote control)

DESCRIPTION AND OPERATION

General

When one of the buttons on the remote control is pressed, a coded HF radio signal is sent from the transmitter in the mechanical key. This signal is received by the RF receiver located in the BCM (body control module), which decodes the signal. If the coded signal is valid, the BCM will operate the latches.

Unlocking is confirmed by one long flash of the turn signal lamps, when the unlocking is completed.

There are various circumstances in which remote unlocking is not possible:

- The radio transmitter or receiver is overloaded because of radio interference.
- The key (electronics) is damaged.
- The battery in the key is discharged.
- The overload protection of the door latches is active (after too many operations).

As well as remote keyless entry, the vehicle can be locked and unlocked using the lock cylinder in the driver's door. If RKE is not fitted, the vehicle can also been unlocked using the lock cylinder in the passenger's door. The lock cylinder is mechanically connected to a switch, which is linked to the BCM.

Double Locking

The double locking system has the same functionality of central locking but also prevents the doors from being opened from inside using the interior door handles.

The double locking function is actuated if one of the following conditions is satisfied:

- A key is inserted into a door cylinder lock and turned to the "locking" position twice within 3 seconds.
- The locking button on the remote transmitter is pressed twice within 3 seconds.

Confirmation that the vehicle is double locked is also given by two short flashes of the turn signal lamps, when the double locking process is completed. The ordinary central locking in this case will be signaled by a single short flash of the turn signal lamps.

Door latch for single cab

The front door entry system contains a latch that is fastened to the inside of the door frame and is controlled by the exterior and interior door handles. The latch contains the door ajar switch and door lock actuator. The front doors are locked/unlocked by the Remote Keyless Entry (RKE) transmitter, lock/unlock button inside the vehicle or the driver door lock cylinder.

The door latches have electric motors to operate the locking and double locking function. The electric motors are actuated directly by the BCM.

When the door latch is locked, the exterior door handle is disengaged from the door latch.

A control switch is incorporated in the door latch in the driver's door. This control switch monitors the position of the door latch and reports the information to the BCM. This information is sent to the BCM for use in warning systems, locking functions and anti-theft alarm systems.

Door latch for double cab

The front door entry system contains a latch that is fastened to the inside of the door frame and is controlled by the exterior and interior door handles. The latch contains the door ajar switch and door lock actuator. The front doors are locked/unlocked by the Remote Keyless Entry (RKE) transmitter, lock/unlock button inside the vehicle or the driver door lock cylinder.

The rear door entry system contains a latch that is fastened to the inside of the door frame and is controlled by the exterior and interior door handles. The latch contains the door ajar switch and door lock actuator. The rear doors can be locked/unlocked by the RKE transmitter, lock/unlock button inside the vehicle. The rear doors have a child safety lock feature, which is a manual lock on the inside of the rear door frame. When the child safety feature is on, the rear doors cannot be opened from the interior door handle.

The door latches have electric motors to operate the locking and double locking function. The electric motors are actuated directly by the BCM.

When the door latch is locked, the exterior door handle is disengaged from the door latch.

A control switch is incorporated in the driver's door latch. This control switch monitors the position of the door latch and reports the information to the BCM. This information is sent to the BCM for use in warning systems, locking functions and anti-theft alarm systems.

Door latch for super cab

The front door entry system contains a latch that is fastened to the inside of the door frame and is controlled by the exterior and interior door handles.

DESCRIPTION AND OPERATION

The latch contains the door ajar switch and door lock actuator. The front doors are locked/unlocked by the Remote Keyless Entry (RKE) transmitter, lock/unlock button inside the vehicle or the driver door lock cylinder.

The front door latches have electric motors to operate the locking and double locking function. The electric motors are actuated directly by the BCM.

When the front door latch is locked, the exterior door handle is disengaged from the door latch.

A control switch is incorporated in the driver's door latch. This control switch monitors the position of the door latch and reports the information to the BCM. This information is sent to the BCM for use in warning systems, locking functions and anti-theft alarm systems.

The rear door entry system contains a latch that is fastened to the inside of the door frame and is controlled by the exterior and interior door handles. The latch contains the door ajar switch . No lock actuators or mechanisms are fitted to the rear doors, as the front door must be open in order to access the rear door latch.

Tailgate latch

The lock cylinder is optional. If equipped, the tailgate release handle is integrated with a lock cylinder. The tailgate is not linked to the central locking system.

Hood Latch

The hood latch system contains a latch fastened to the body and a hood latch striker attached to the hood. The latch is controlled by the hood latch release handle and cable.

GENERAL PROCEDURES

Remote Keyless Entry (RKE) Transmitter Programming

Programming

1. To programme new remote controls turn the ignition key to position II four times within six seconds.
2. Turn the ignition to position 0. A tone sounds to indicate that it is now possible to programme the remote controls for ten seconds.
3. Press any button on a new remote control. A tone will sound as confirmation.
4. Repeat this last step for all your remote controls, including your original. Do not remove the key from the ignition when pressing the button on this remote control.
5. Switch the ignition back on (position II) or wait for ten seconds without programming another remote control to end the key programming. Only the remote controls which you have just programmed are now able to lock and unlock the vehicle.

REMOVAL AND INSTALLATION

Ignition Lock Cylinder

General Equipment

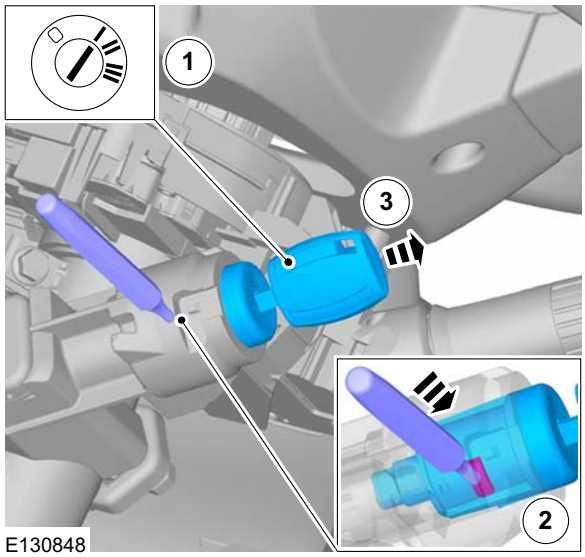
Punch

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Passive Anti-Theft System (PATS) Transceiver (419-01 Anti-Theft - Passive, Removal and Installation).
2. 1. Turn the ignition key to position I.
   2. Using a suitable punch, release the locking tang.

      General Equipment: Punch



Installation

1. **CAUTION: Make sure that the ignition switch and the ignition lock cylinder are aligned before installation.**

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

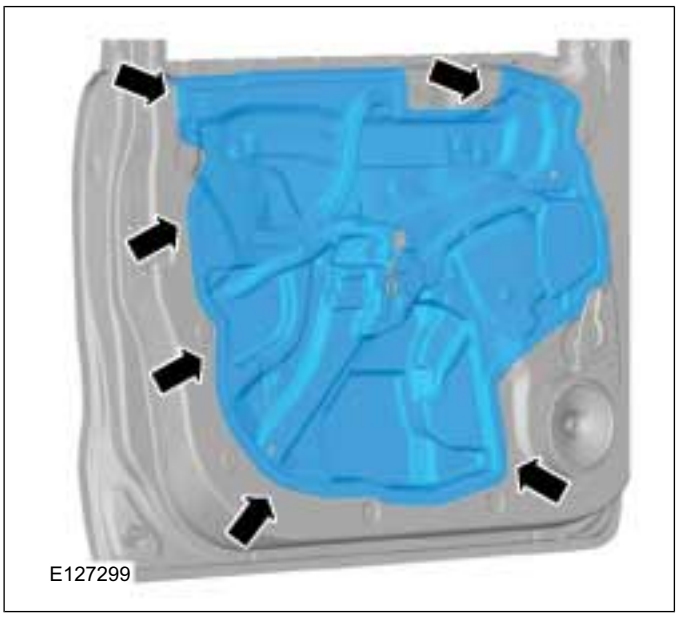
Front Door Latch

Removal

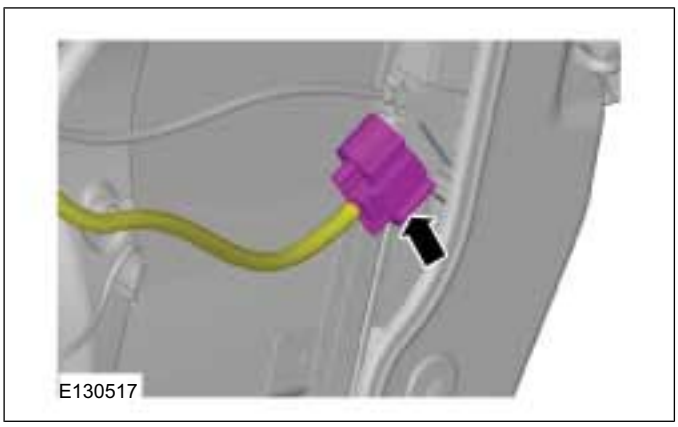
NOTE: Removal steps in this procedure may contain installation details.

NOTE: Make sure that door window glass remains in the close position.

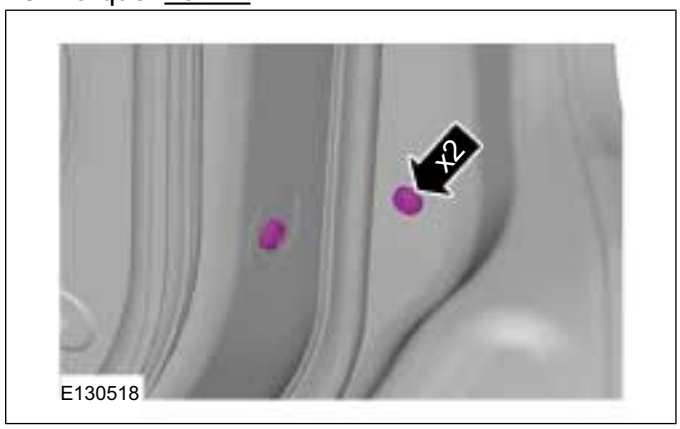
1. Refer to: Exterior Front Door Handle (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).
2. Refer to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. **CAUTION: Do not touch the adhesive surface as re-bonding will be impaired.**



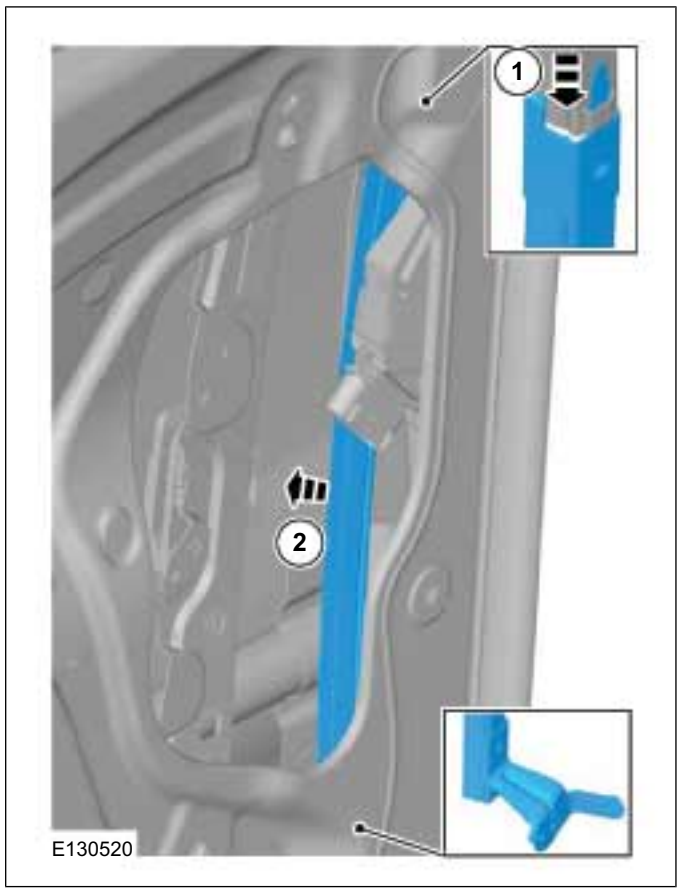
4.



5. Torque: 10 Nm

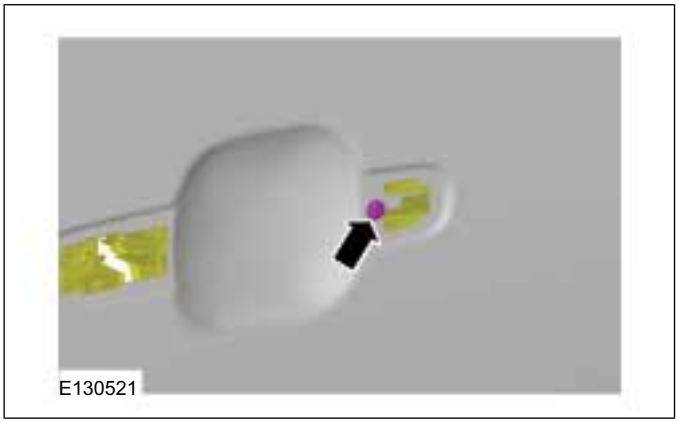


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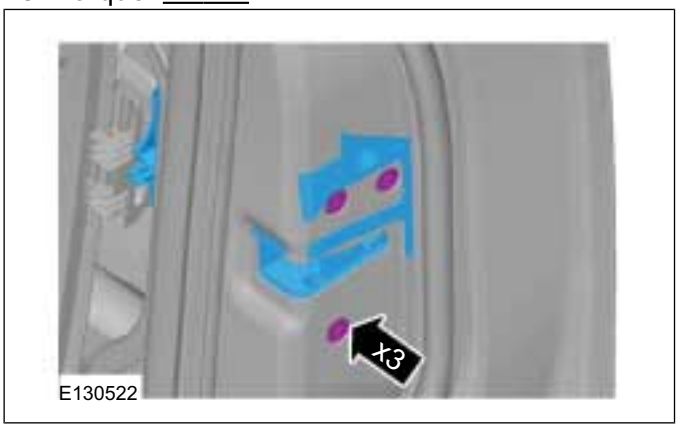


REMOVAL AND INSTALLATION

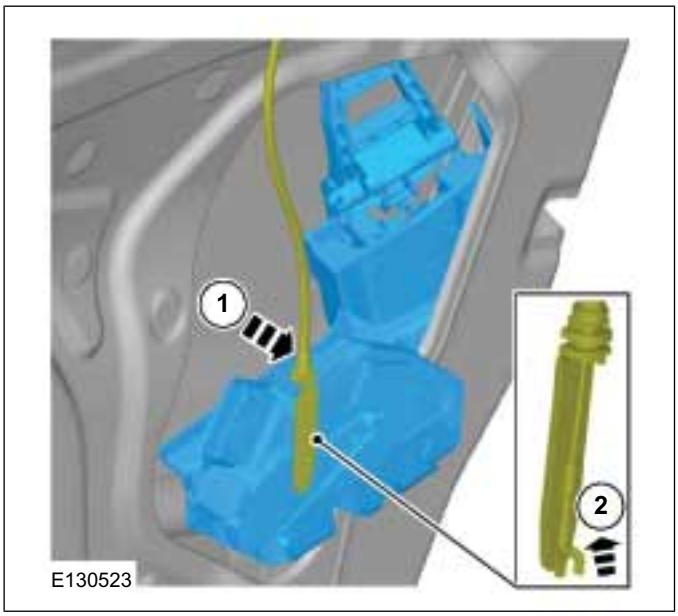
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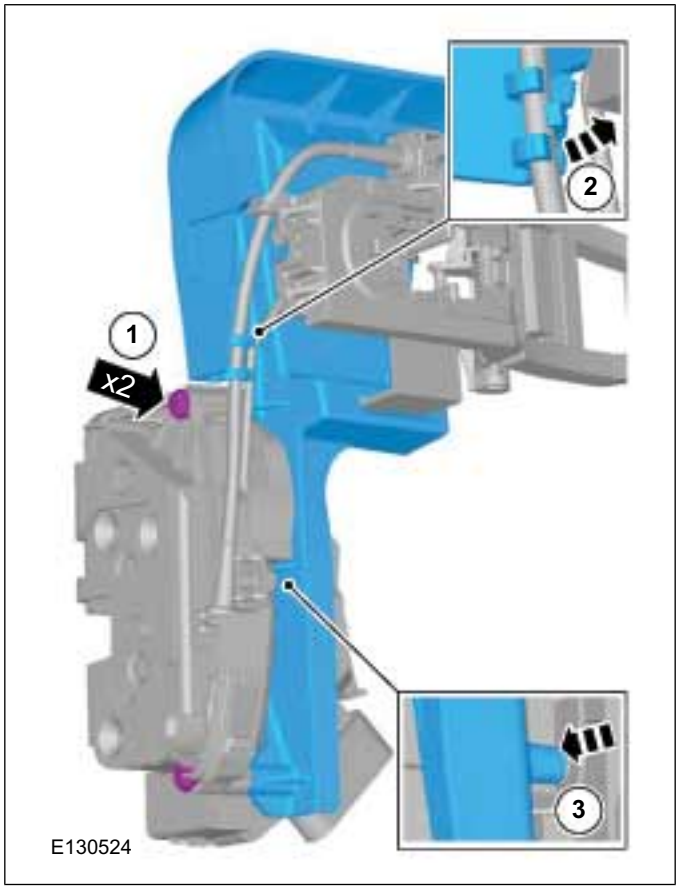
8. Torque: 12 Nm



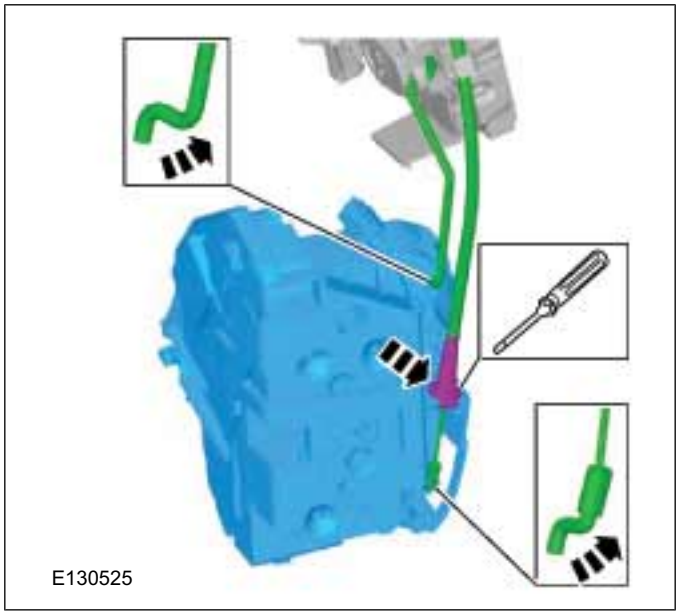
9.



10.



11.



Installation

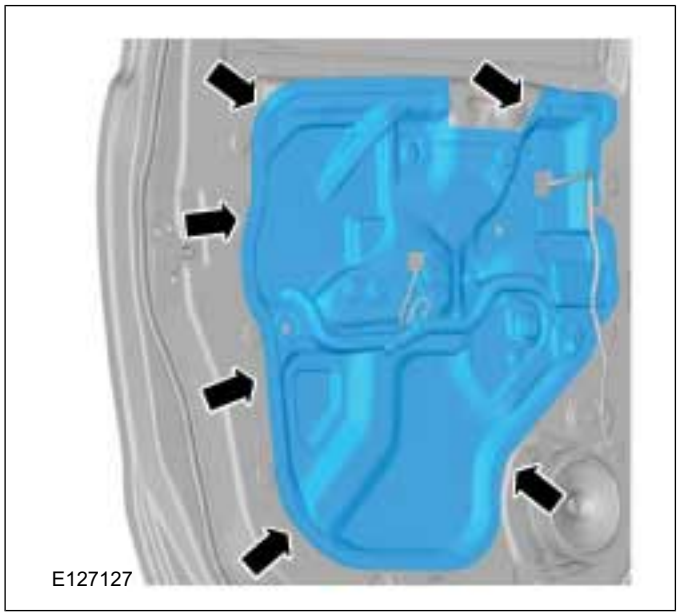
1. To install, reverse the removal procedure.

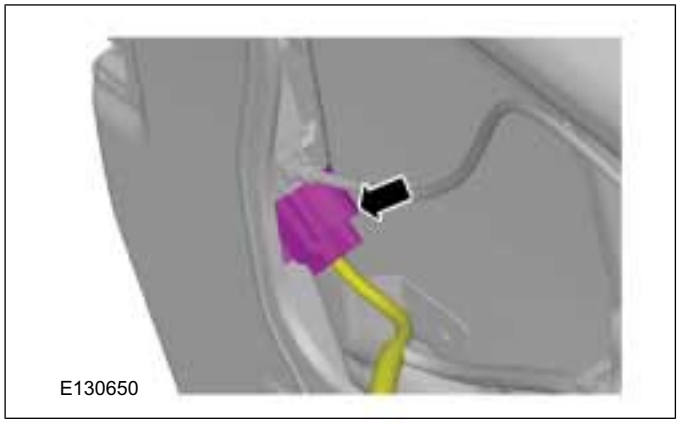
REMOVAL AND INSTALLATION

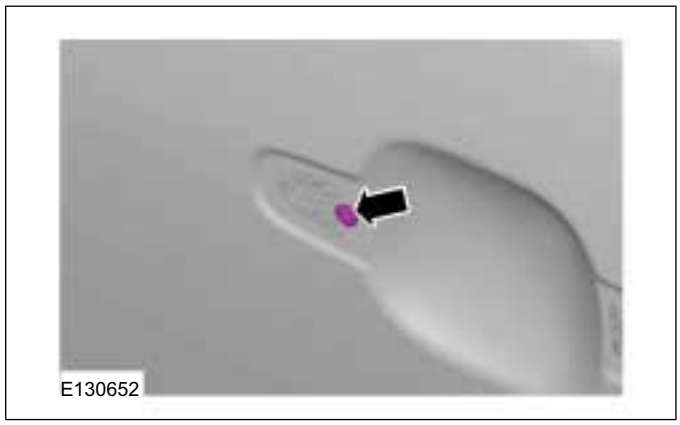
Rear Door Latch — Double Cab

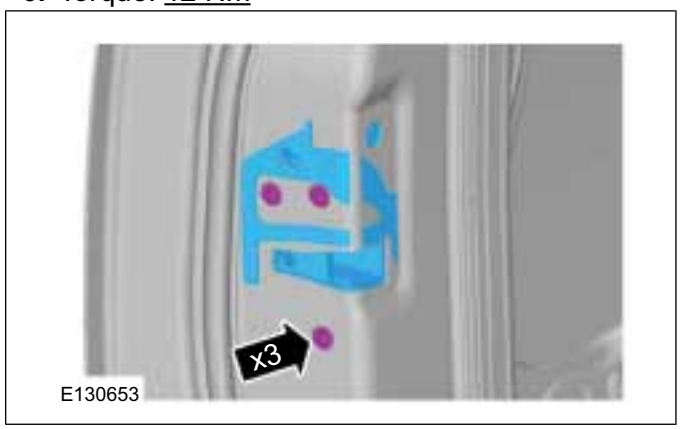
Removal

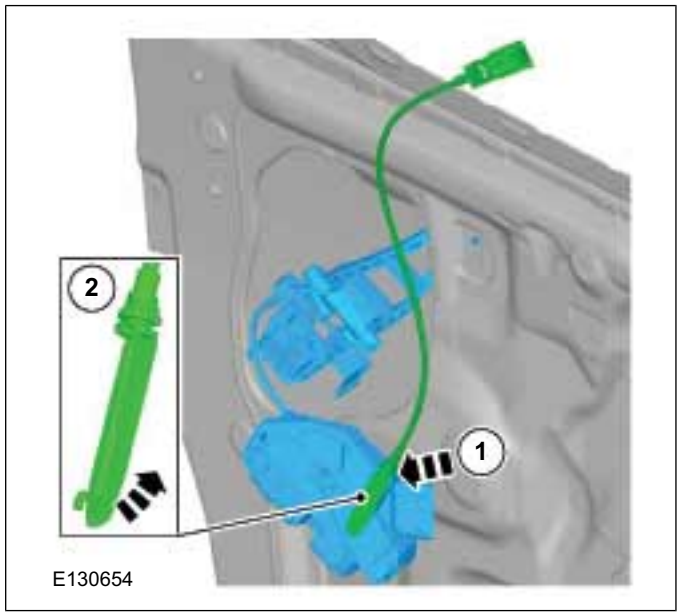
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Exterior Rear Door Handle (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).
2. Refer to: Rear Door Trim Panel - Double Cab (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. 

4. 

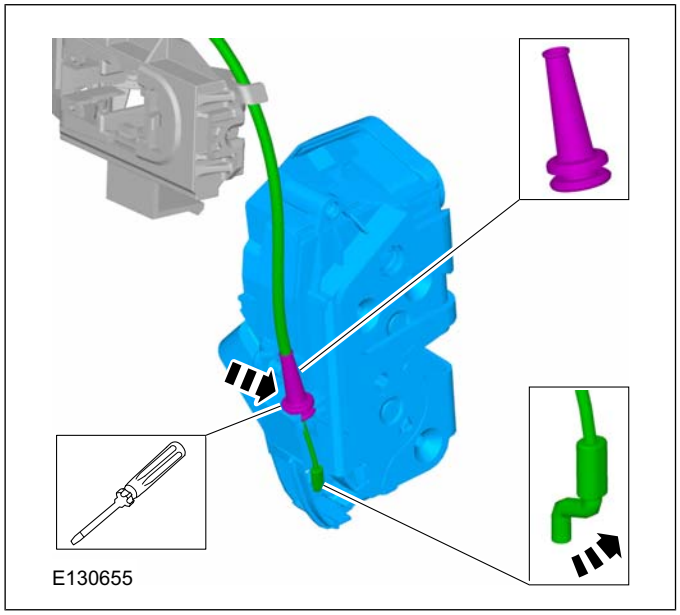
5. 

6. Torque: 12 Nm


7. 

REMOVAL AND INSTALLATION

8.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

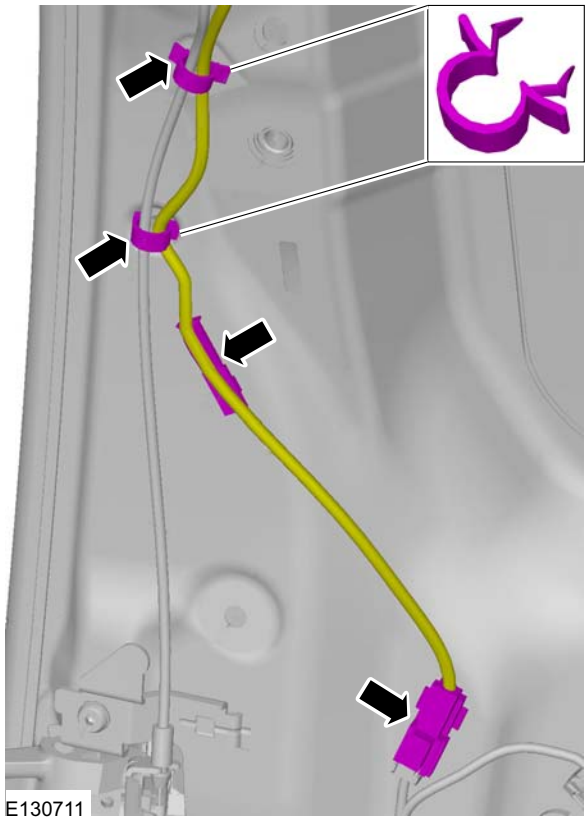
Rear Door Latch — Super Cab

Removal

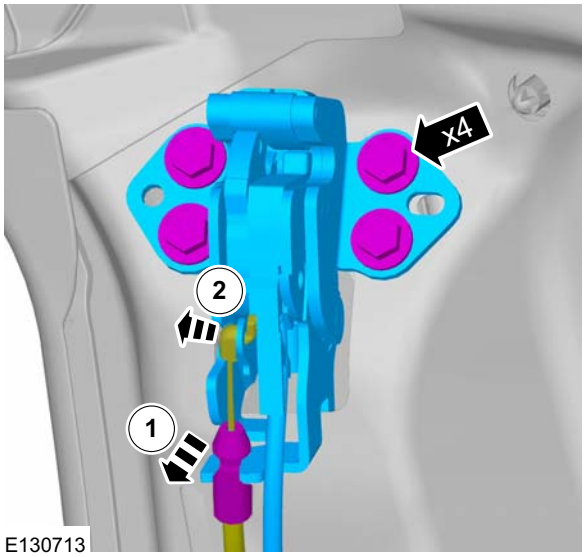
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Rear Door Trim Panel - Super Cab (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



3. Torque: 10 Nm

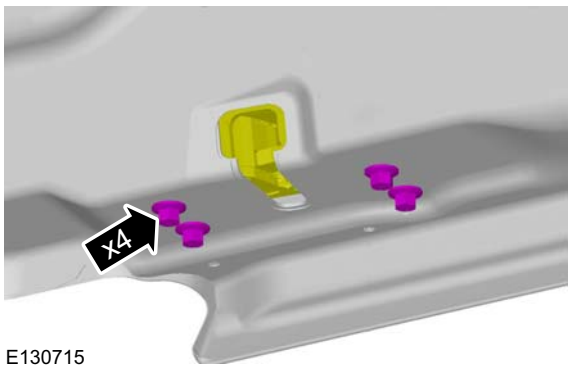


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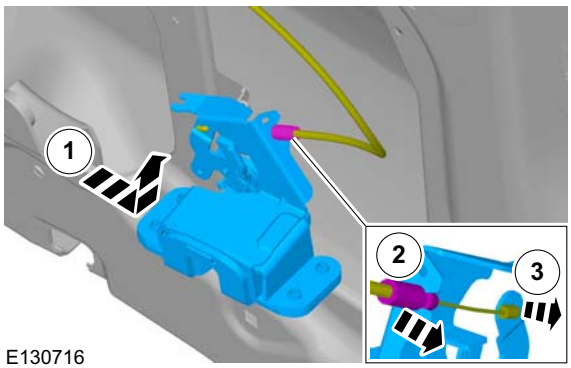


REMOVAL AND INSTALLATION

5. Torque: 12 Nm



6.



Installation

1. To install, reverse the removal procedure.

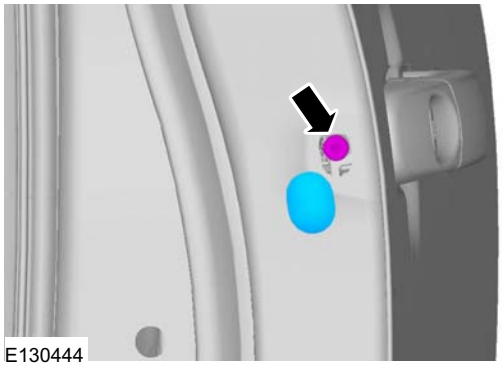
REMOVAL AND INSTALLATION

Exterior Front Door Handle

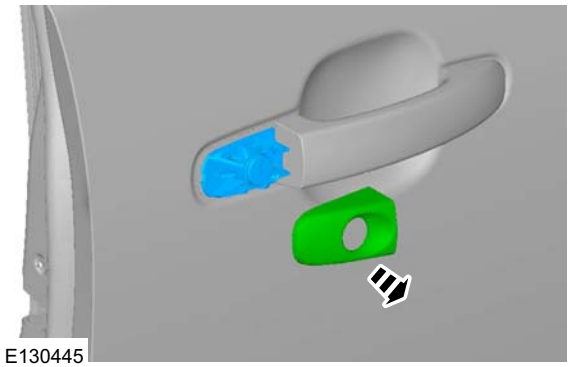
Removal

NOTE: Removal steps in this procedure may contain installation details.

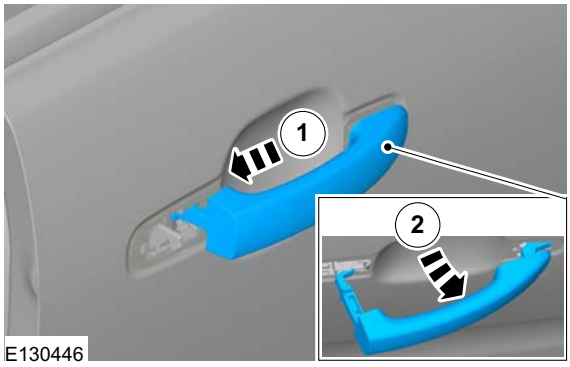
1. **NOTE:** Use suitable tool to remove the cover.



2.



3.



Installation

1. To install, reverse the removal procedure.

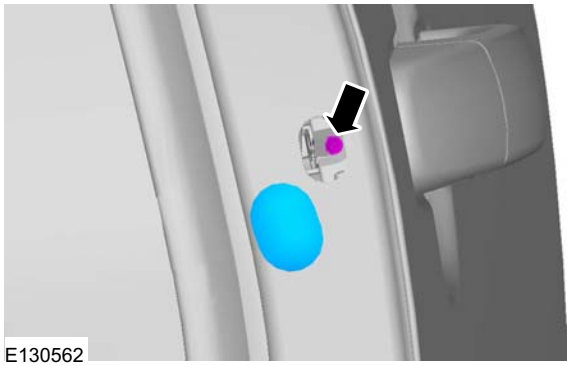
REMOVAL AND INSTALLATION

Exterior Rear Door Handle

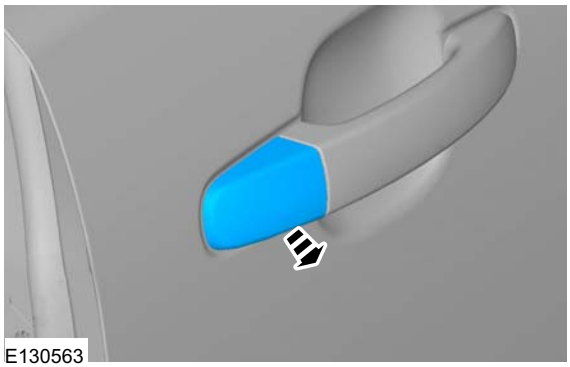
Removal

NOTE: Removal steps in this procedure may contain installation details.

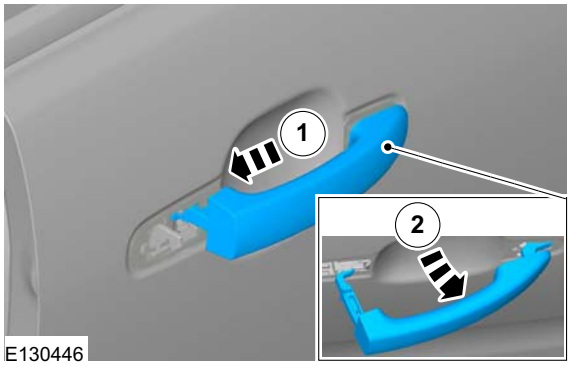
1. **NOTE:** Use suitable tool to remove the cover.



2.



3.



Installation

1. To install, reverse the removal procedure.

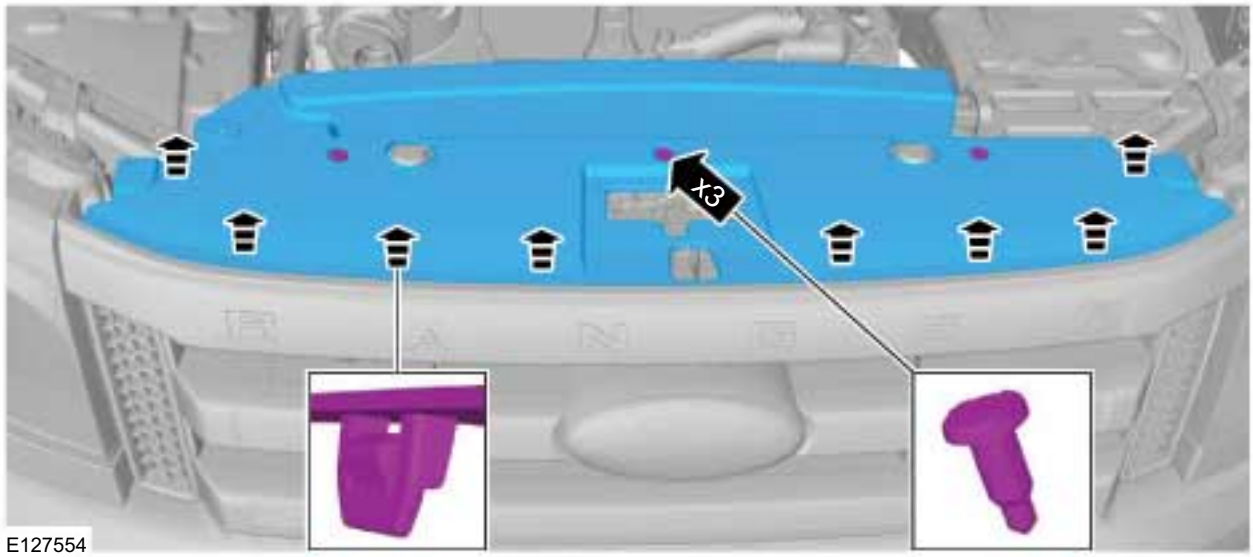
REMOVAL AND INSTALLATION

Hood Latch

Removal

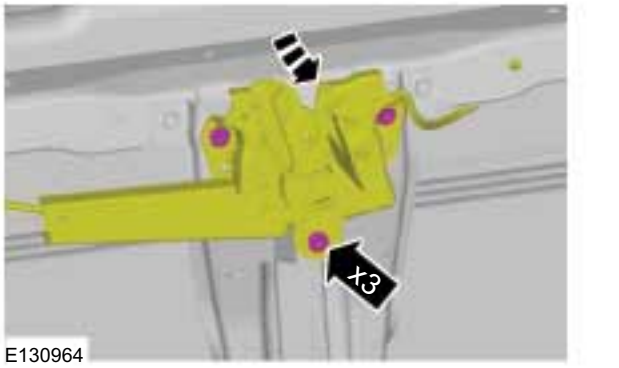
NOTE: Removal steps in this procedure may contain installation details.

1.

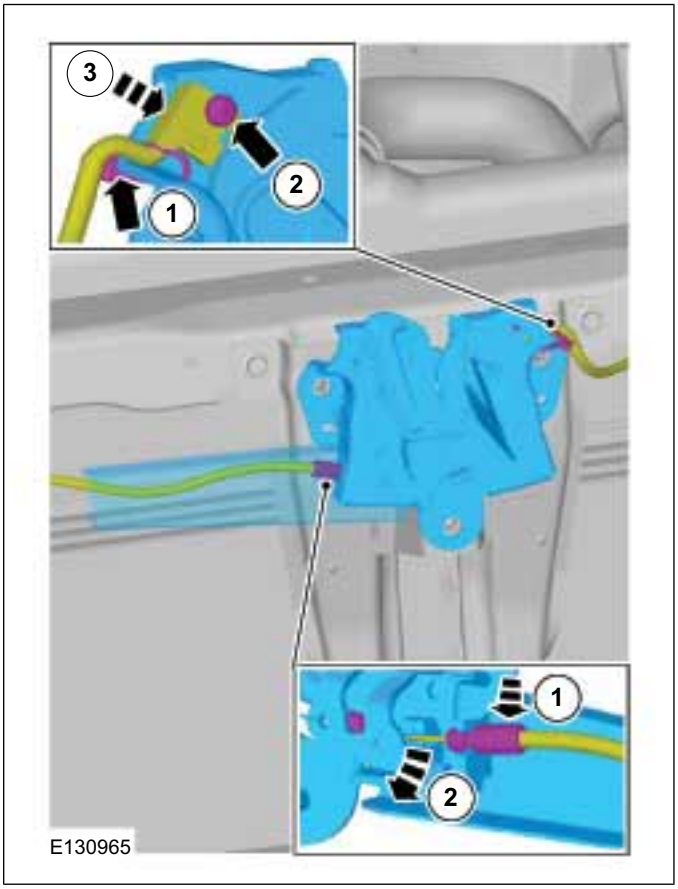


2. **NOTE:** Mark the position of the hood latch prior to removing the hood latch bolts to aid positioning during installation.

Torque: 11 Nm



3. 3. If equipped.



REMOVAL AND INSTALLATION

Installation

1. **CAUTION: Make sure that the clearance on either side of the hood is equal and no strain is placed on the hood latch.**

   NOTE: Check the latch adjustment to make sure the latch was installed and aligned correctly.

   To install, reverse the removal procedure.

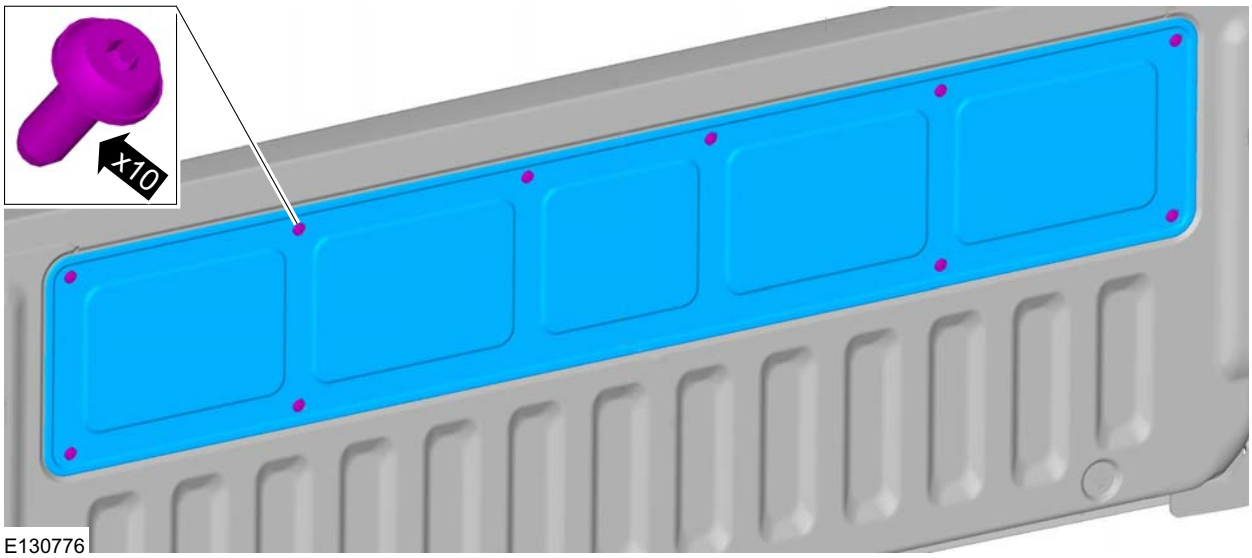
REMOVAL AND INSTALLATION

Tailgate Release Handle

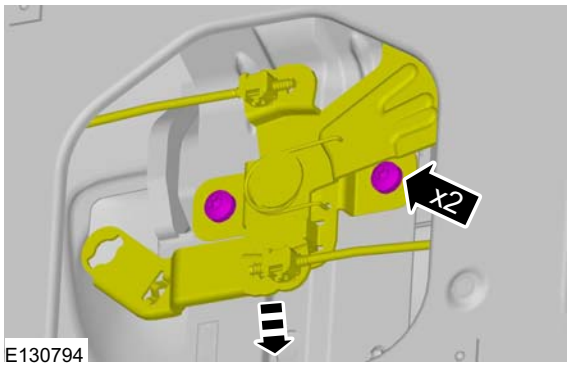
Removal

NOTE: Removal steps in this procedure may contain installation details.

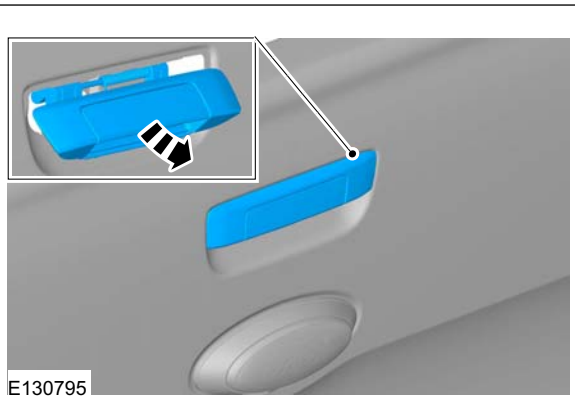
1.



2. Torque: 8 Nm



3.



Installation

1. To install, reverse the removal procedure.

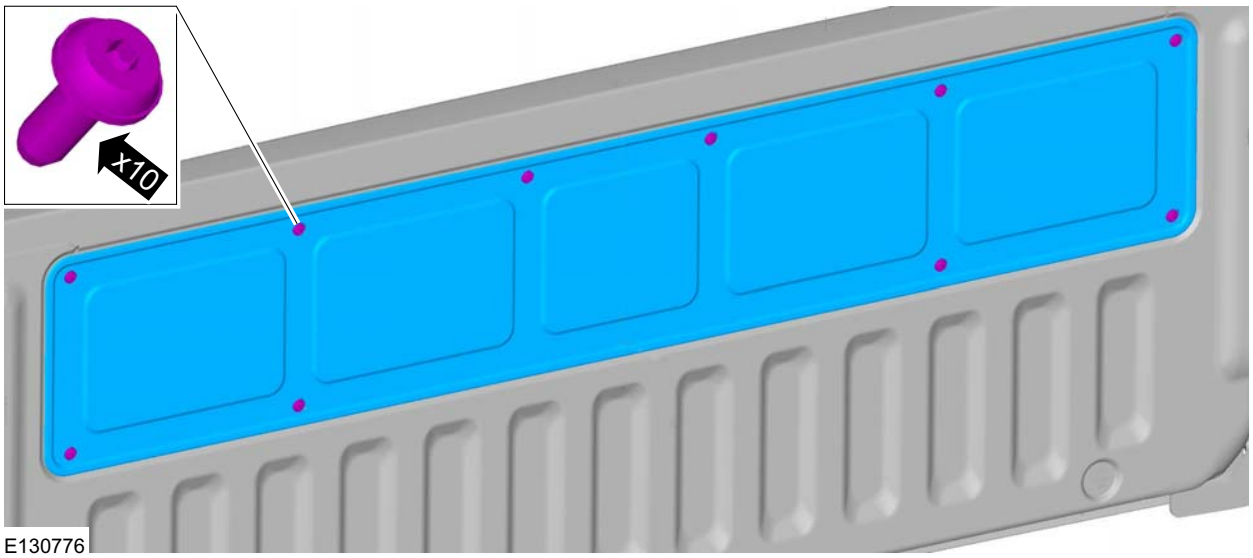
REMOVAL AND INSTALLATION

Tailgate Latch

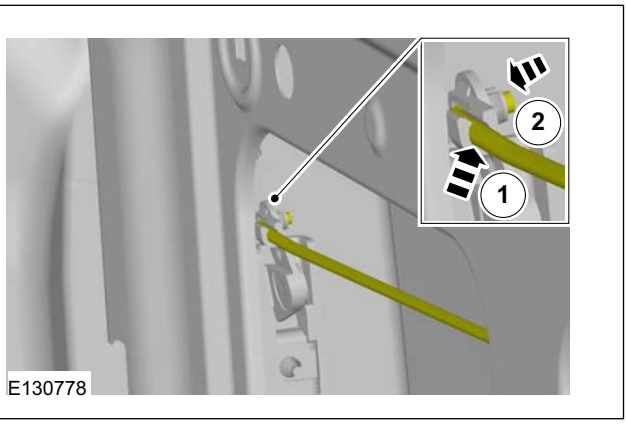
Removal

NOTE: Removal steps in this procedure may contain installation details.

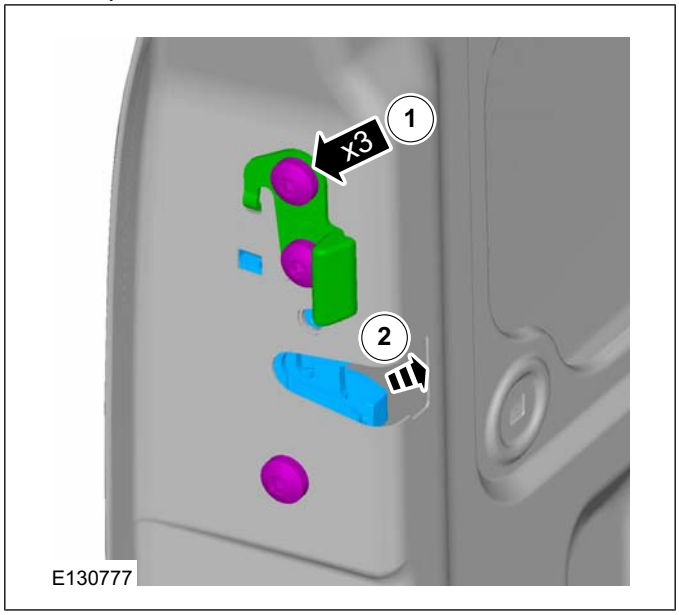
1.



2.



3. Torque: 25 Nm



Installation

1. To install, reverse the removal procedure.

DISASSEMBLY AND ASSEMBLY

Door Lock Cylinder

General Equipment

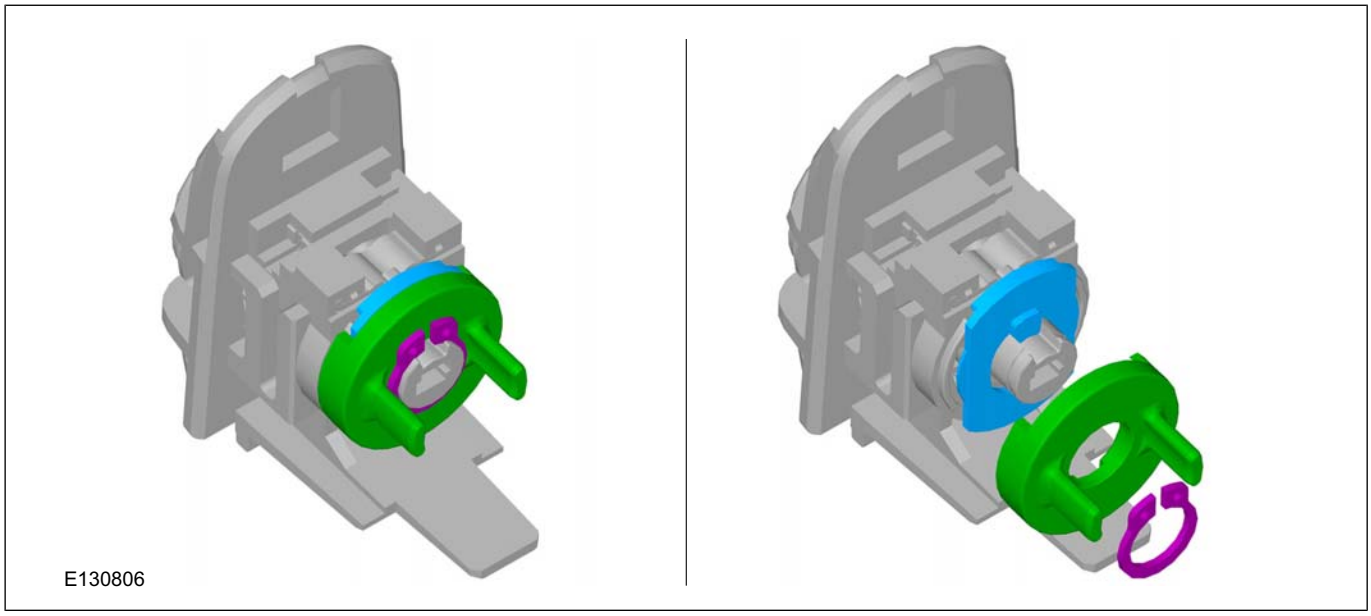
2 mm Punch

Disassembly

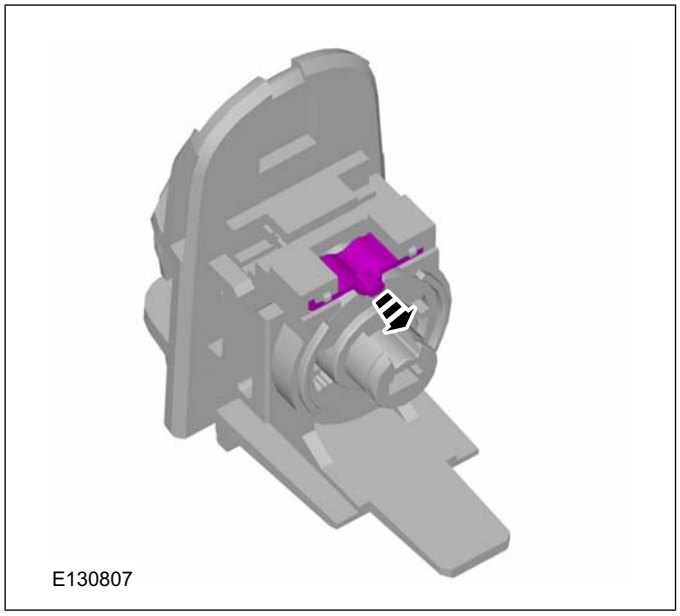
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Exterior Front Door Handle (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

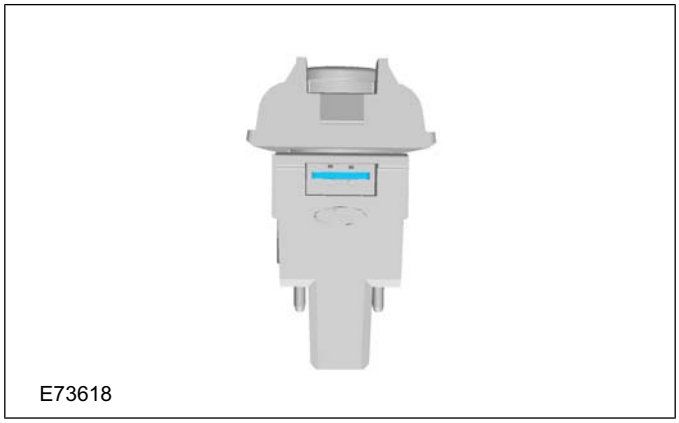
2.



3.



4.



DISASSEMBLY AND ASSEMBLY

5. General Equipment: 2 mm Punch


E130809

6.


E130810

7.


E130811

8. ⚠ **CAUTION: Note the position of the components before removal.**

Make sure to read the key code from the key entry to the end of the lock barrel in sequence.



E130812

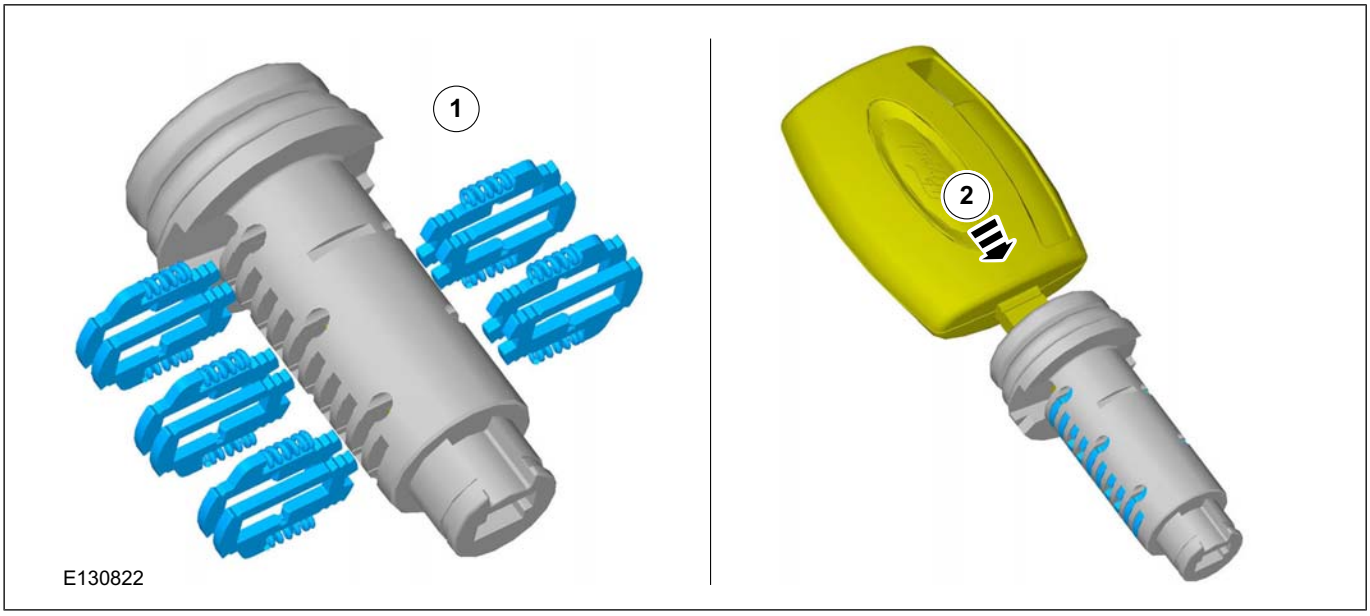


DISASSEMBLY AND ASSEMBLY

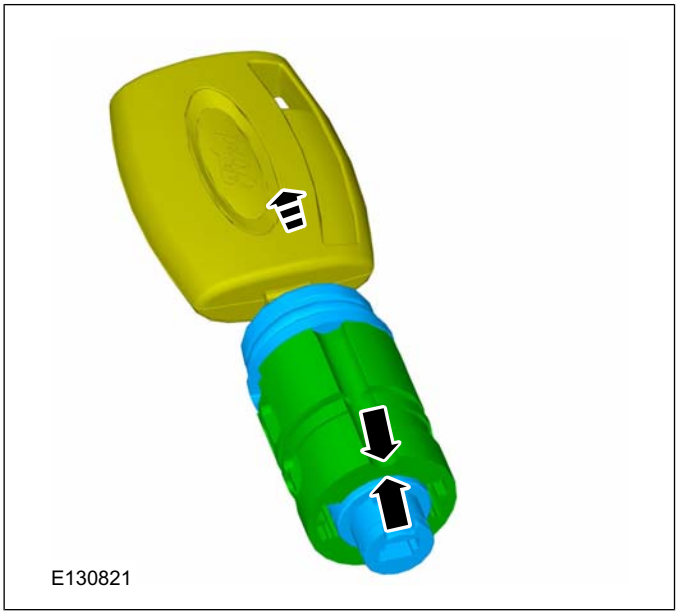
Assembly

NOTE: Make sure that new components are installed.

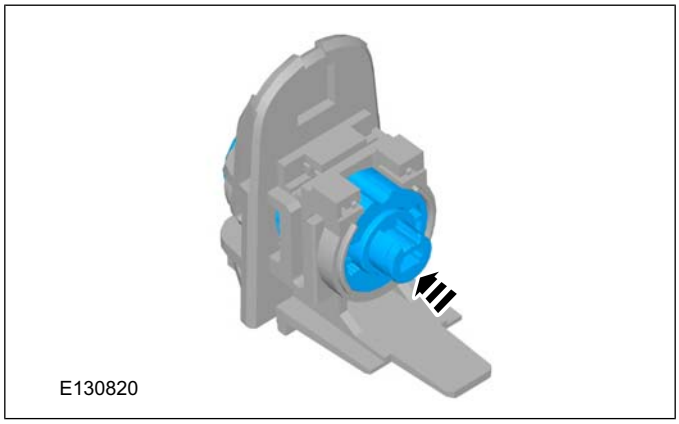
9. **CAUTION: Make sure that the components are installed to the position noted before removal.**



10.

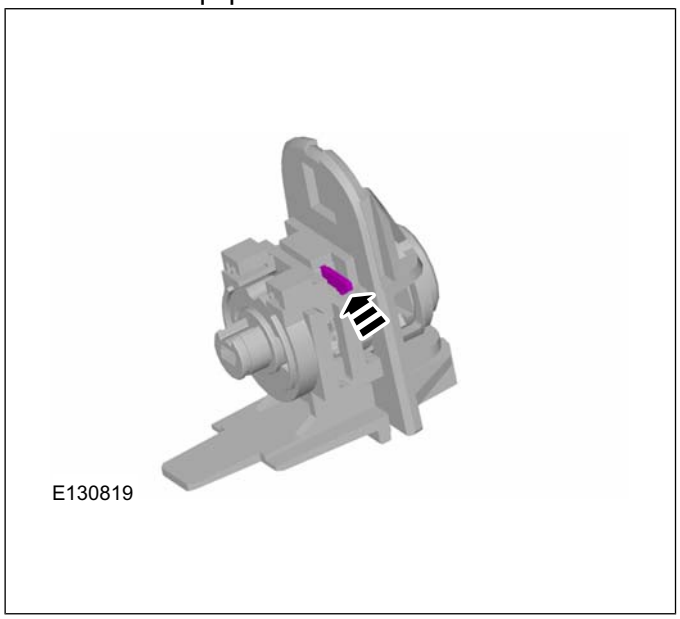


11.

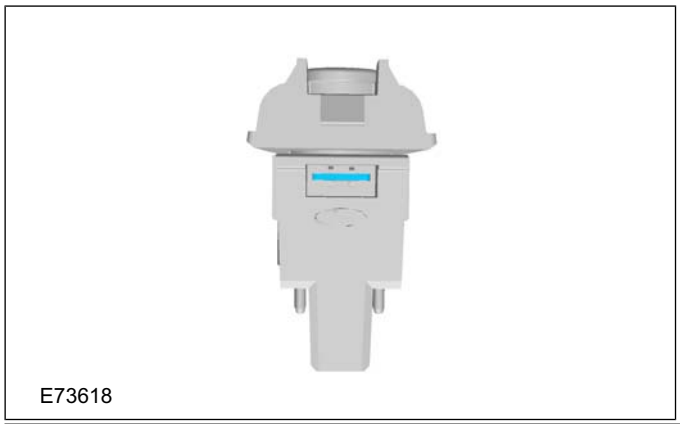


DISASSEMBLY AND ASSEMBLY

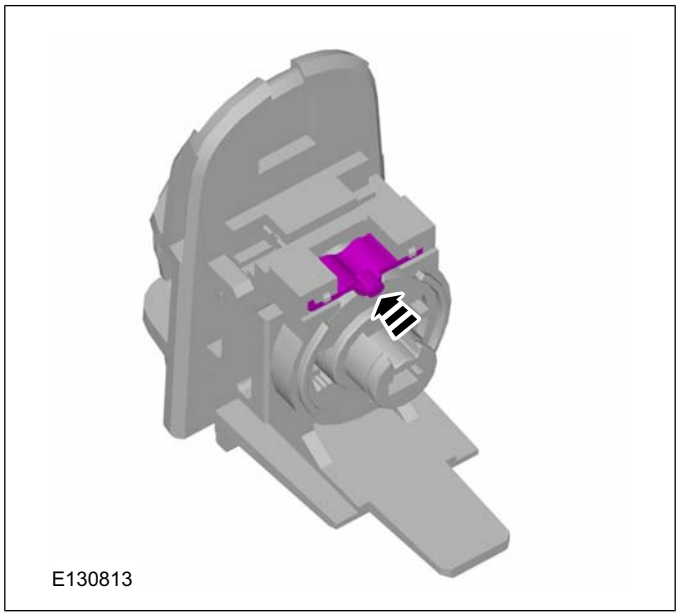
12. General Equipment: 2 mm Punch



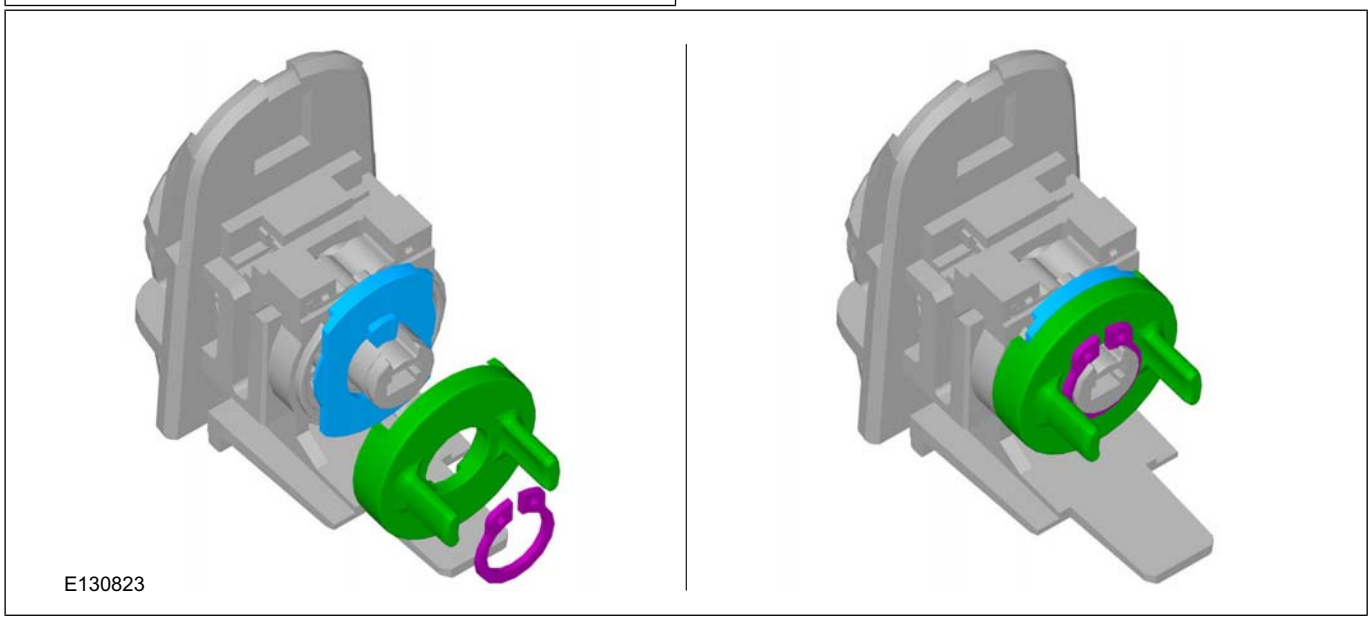
13.



14. NOTE: The component can only be installed in 1 position.



15.



16. To assemble, reverse the disassembly procedure.

SECTION 501-16 Wipers and Washers

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

Wipers and Washers..... 501-16-2

GENERAL PROCEDURES

Windshield Wiper Blade and Pivot Arm Adjustment..... 501-16-4

REMOVAL AND INSTALLATION

Windshield Wiper Motor..... 501-16-5
Wiper Linkage Assembly..... 501-16-6
Windshield Washer Reservoir..... 501-16-7

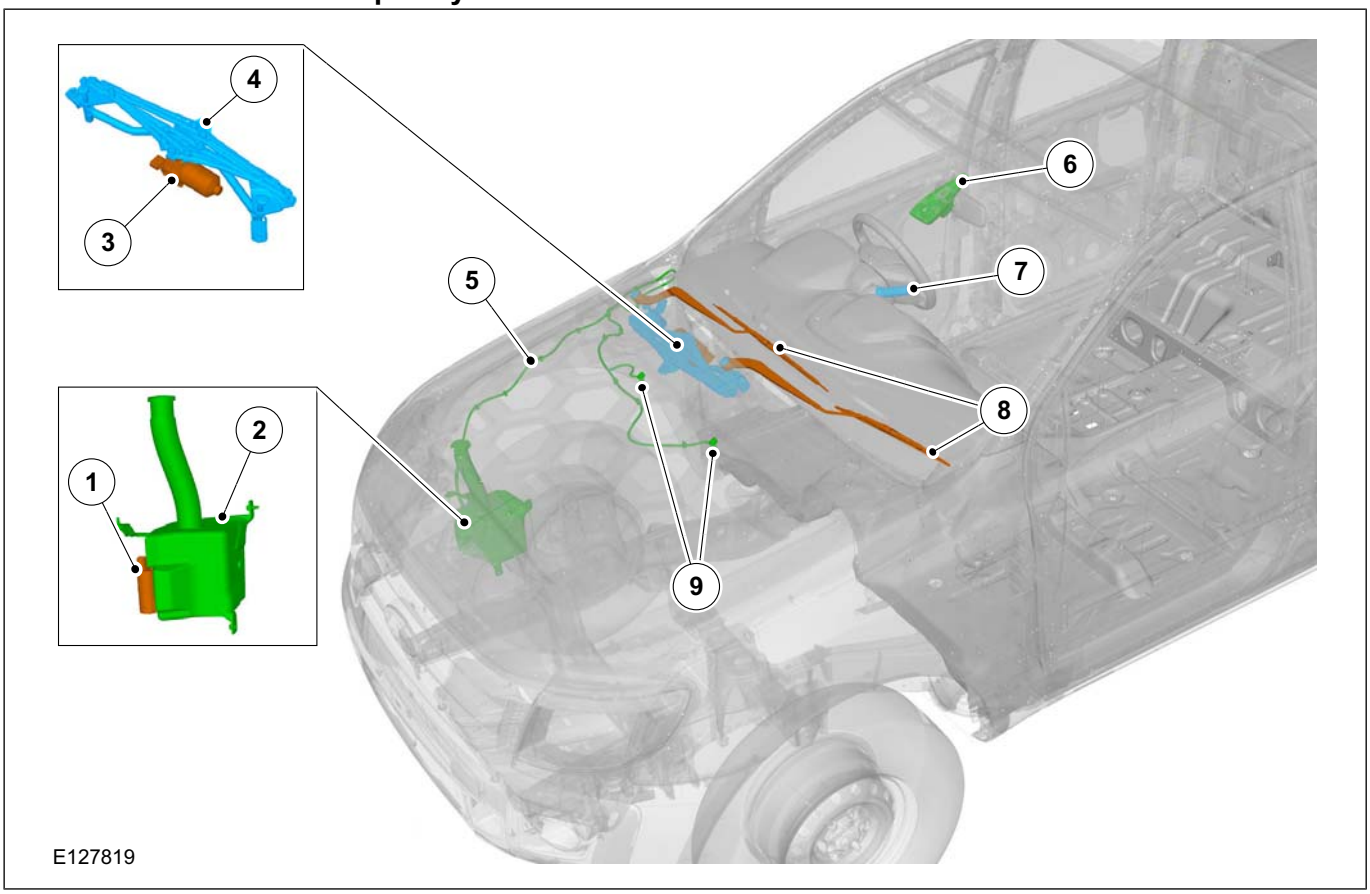
DESCRIPTION AND OPERATION

Wipers and Washers

CAUTION: The automatic windshield wipers must be switched off before the vehicle is driven into a car wash.

If the windshield is iced up, the wipers may only be activated by the rain sensor after the windshield has been completely defrosted.

NOTE: The rain sensor is an optical measuring instrument. Contamination such as oil, grease or dust impair its correct operation. Before switching on the automatic windshield wipers, the windshield must be clean in the area of the rain sensor.



Item	Description
1	Windshield washer motor
2	Windshield washer tank
3	Windshield wiper motor
4	Windshield wiper linkage assembly
5	Windshield washer hose
6	Rain sensor
7	Windshield wiper and washer switch
8	Windshield wiper arm and blade
9	Windshield washer nozzle

The rain sensor (6) is integrated together with the light sensor in a housing which is mounted behind the rear view mirror on the windshield.

The rain sensor comprises an opto-electronic measuring and evaluation circuit. The sensor can calculate the amount of precipitation falling on the windshield and request that the windshield wipers are switched on.

On the basis of the information provided by the rain sensor, the windshield wipers are then set to the required wipe speed.

The windshield wash/wipe system will only operate if the ignition switch is in the position "I" or "II".

Five wash functions are available: "Off", "Flick-wipe", "Speed 1", "Speed 2" and "Intermittent" or "Automatic wipe" (depending on the vehicle specification).

In "Speed 1" or "Speed 2" mode, the wipers are operating continuously at either normal speed or fast speed.

DESCRIPTION AND OPERATION

When the intermittent wipe mode is switched on the windshield wipers operate at normal speed with the following wiper delays:

- Wiper delay 1: 1 second
- Wiper delay 2: 3.5 seconds
- Wiper delay 3: 6 seconds
- Wiper delay 4: 9,5 seconds
- Wiper delay 5: 15.5 seconds
- Wiper delay 6: 22 seconds

NOTE: In the event of a failure, or if the control resistor is not connected the default time for the wiper delay is 8 seconds.

When the windshield washer switch is operated washer fluid is sprayed onto the windshield. After a short delay designed to protect the wiper blades the wipers perform 2 or 3 wipes at low speed.

If when the windshield washer switch is activated the windshield wipers are switched off, then a single wipe is performed 4 seconds after the wipers have returned to the home position after performing the 2 or 3 wipes.

If when the windshield washer switch is activated the wipers are in intermittent mode, and if the selected wiper delay time is longer than 6 seconds, then a single wipe is performed 6 seconds after the wipers have returned to the home position after performing the 2 or 3 wipes. If the selected delay time is less than 6 seconds then no post wipe is required.

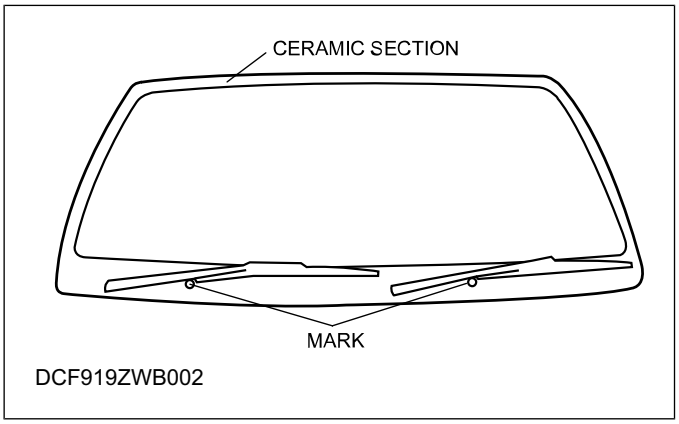
The post wipe function on the windshield ensures that any water remaining on the windshield after washing is wiped away. It is only required if the wipers are switched off or they are set to intermittent mode.

GENERAL PROCEDURES

Windshield Wiper Blade and Pivot Arm Adjustment

1. **Operate the windshield wipers, and then turn off the windshield wiper motor to set the wipers in the park position.**
2. **NOTE: If the hollowed mark in the ceramic coating cannot be located, measure the distance from the cowl grille end line, and adjust the windshield wiper arm and blade.**

   Slide the serrated connecting part and adjust the windshield wiper arm and blade so that its end is aligned with the hollowed mark in the ceramic coating.



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REMOVAL AND INSTALLATION

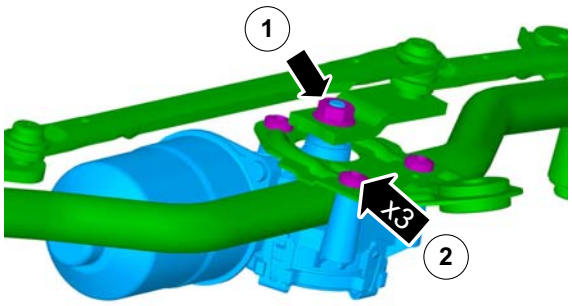
Windshield Wiper Motor

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Wiper Linkage Assembly (501-16 Wipers and Washers, Removal and Installation).

2. Torque:
   - 1 21 Nm



E134161

Installation

1. To install, reverse the removal procedure.

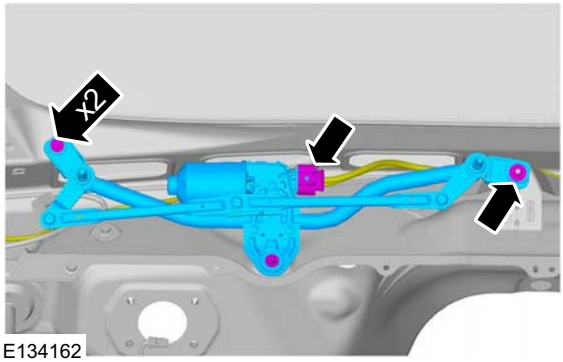
REMOVAL AND INSTALLATION

Wiper Linkage Assembly

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
3. Torque: 10 Nm



E134162

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Windshield Washer Reservoir

Removal

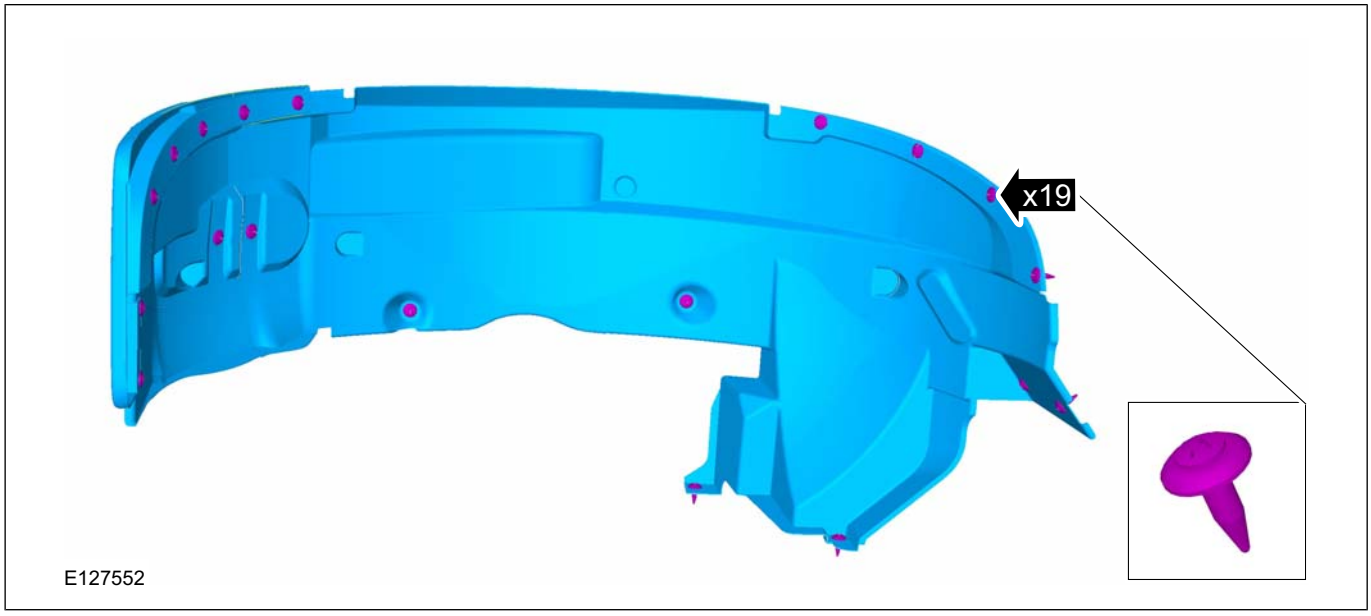
CAUTIONS:

⚠ **When servicing the windshield washer pump, be careful not to damage the windshield washer pump seal.**

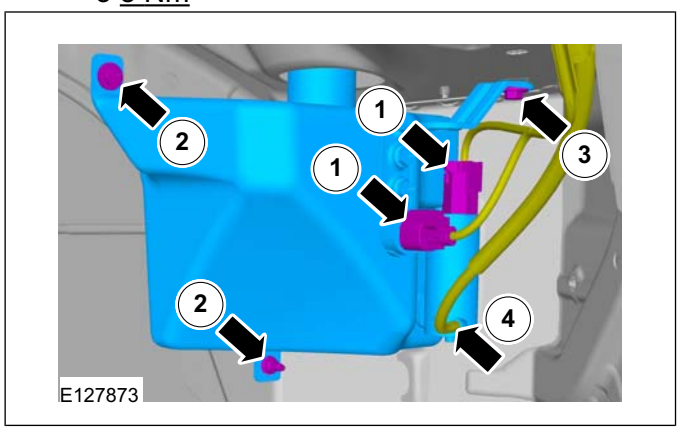
⚠ **Do not operate the windshield washer pump before filling the windshield washer reservoir. Failure to do so could result in premature pump failure.**

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
4.



5. Torque:
   - 2 4 Nm
   - 3 8 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 501-19 Bumpers

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

Front Bumper..... 501-19-2
Front Bumper Cover..... 501-19-4
Rear Bumper..... 501-19-9

REMOVAL AND INSTALLATION

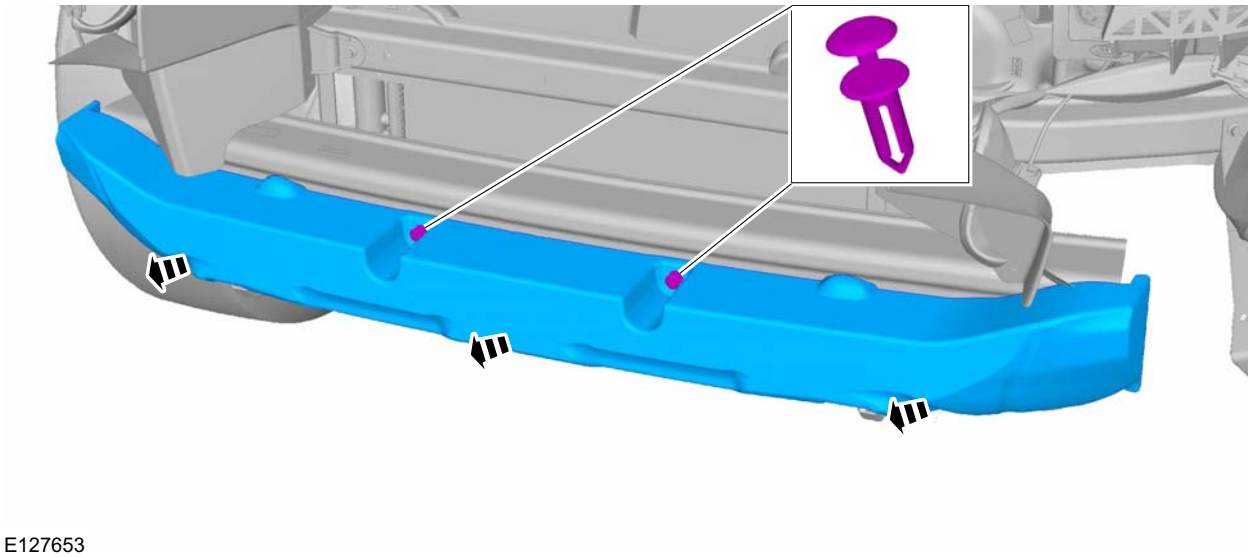
Front Bumper

Removal

NOTE: Removal steps in this procedure may contain installation details.

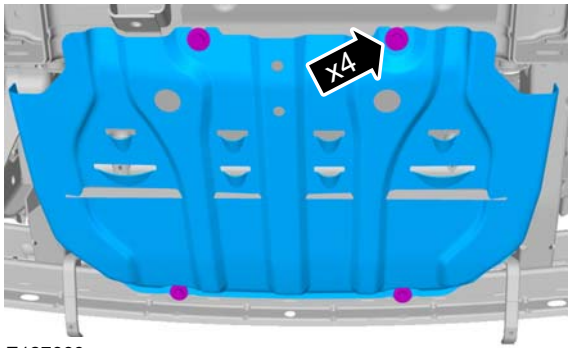
1. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).

2.



E127653

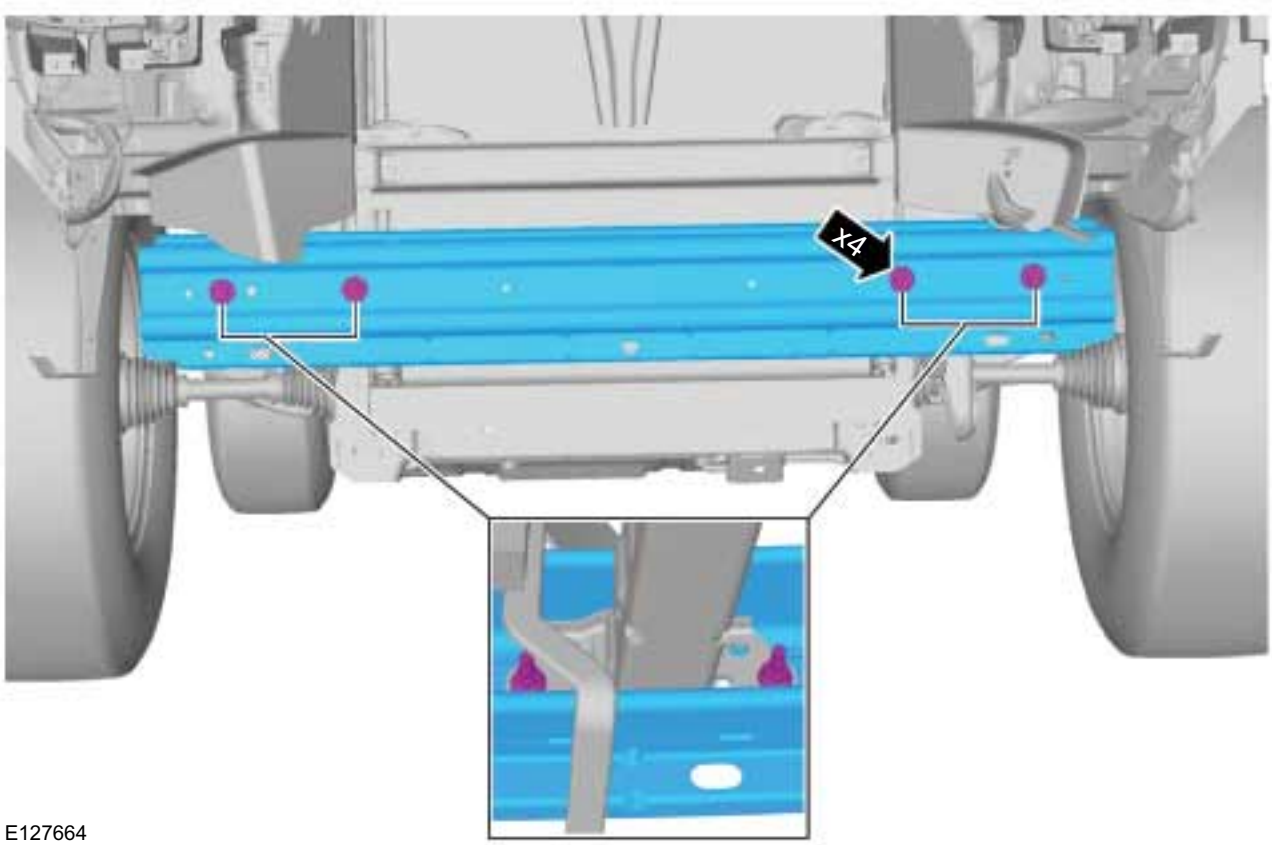
3. Torque: 30 Nm



E127663

4. Torque: 47 Nm

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

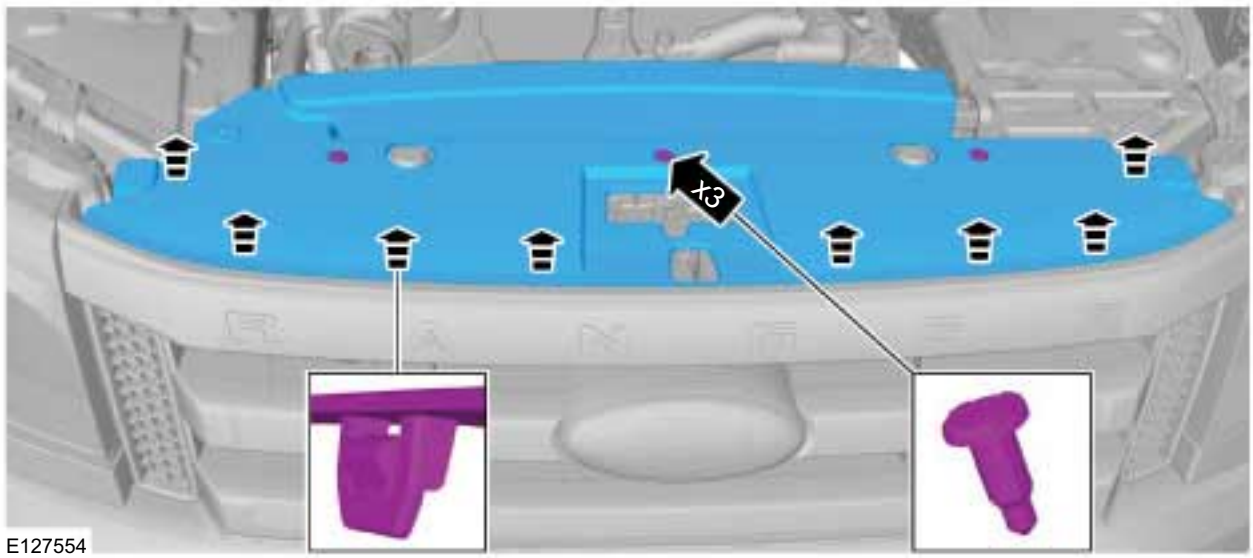
Front Bumper Cover

Removal

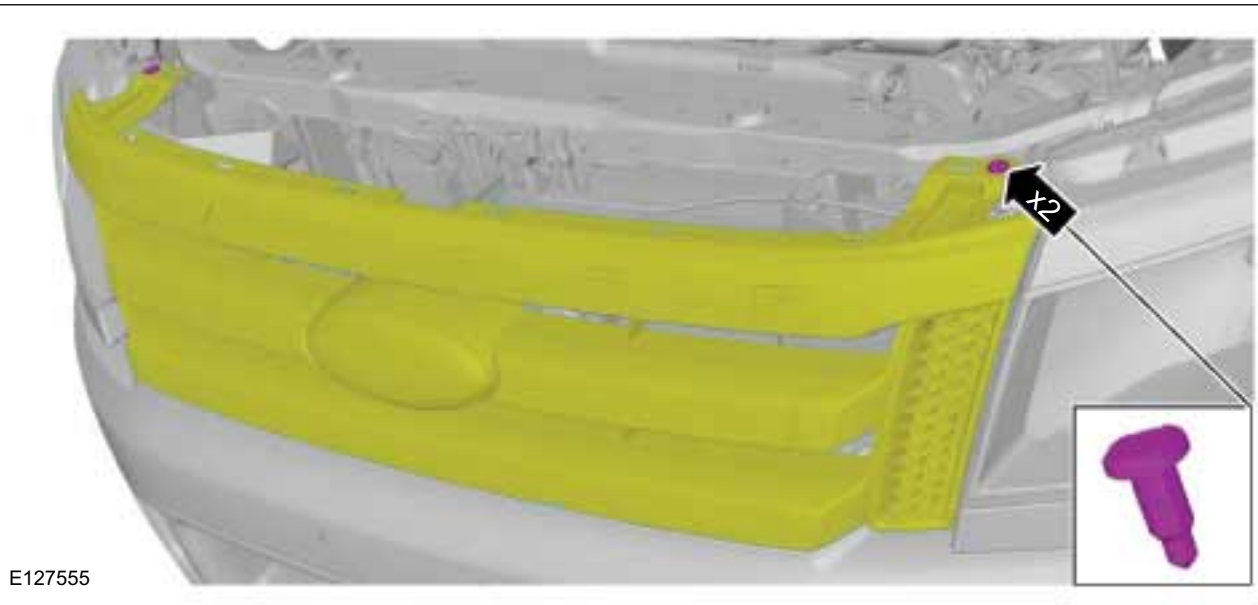
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2.



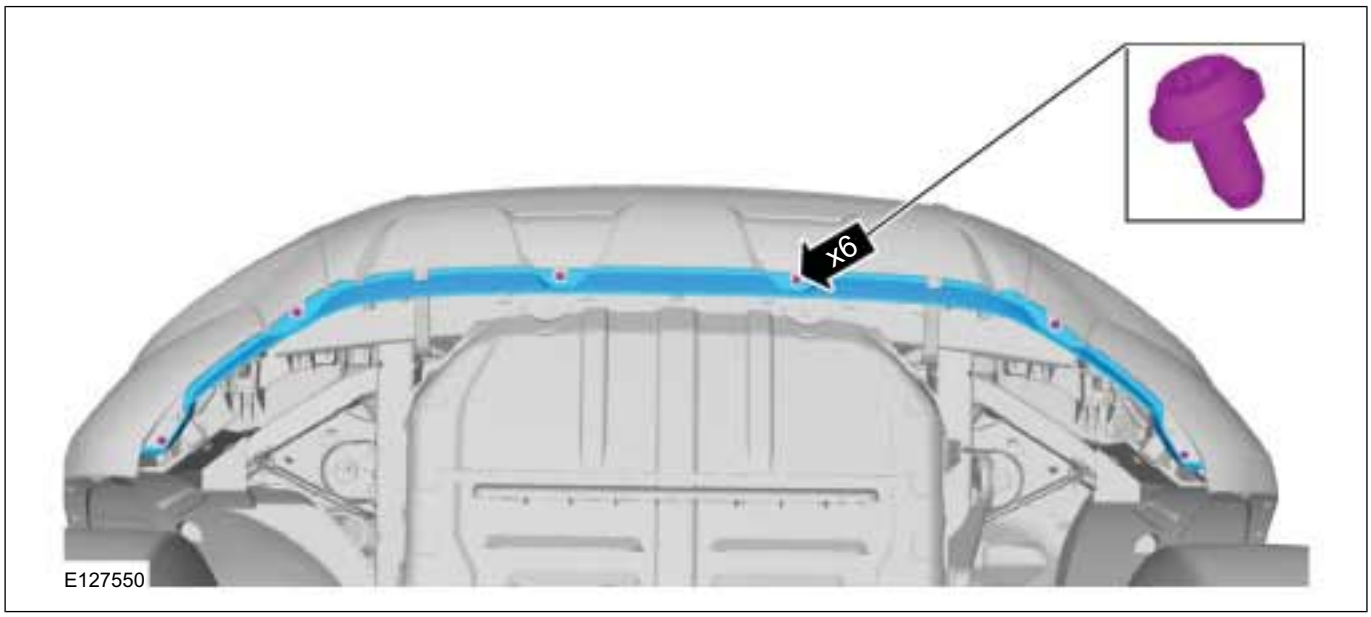
3.



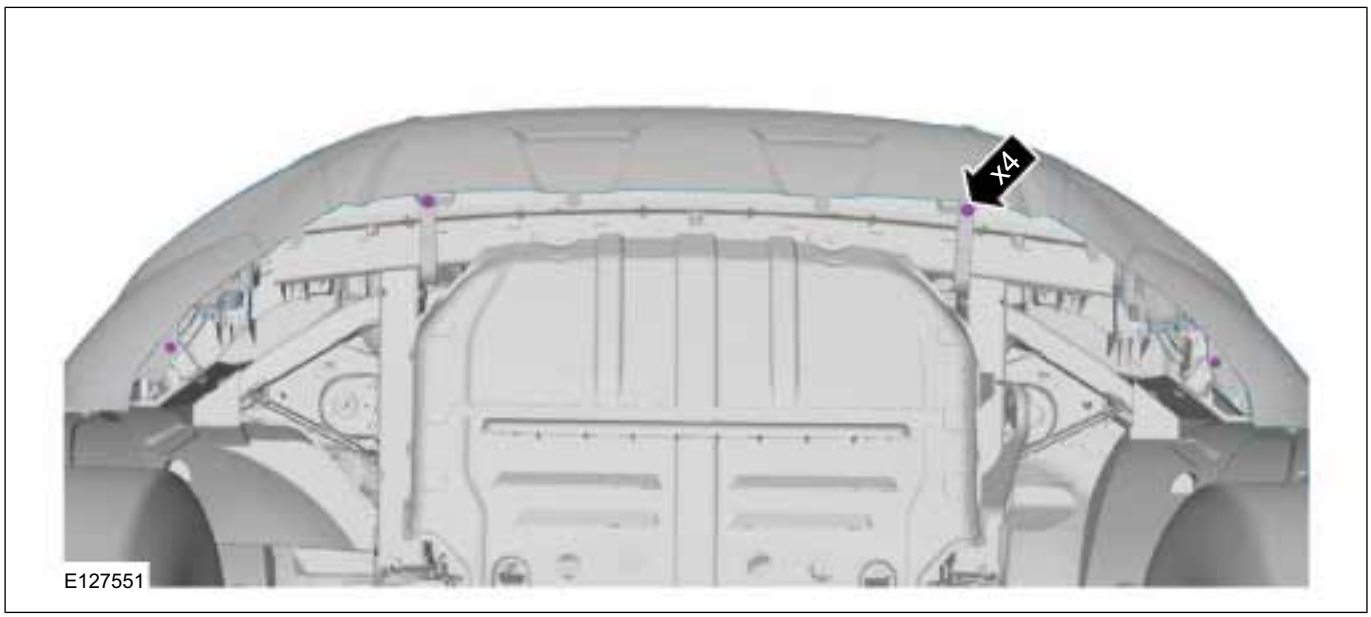
4. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).

5.

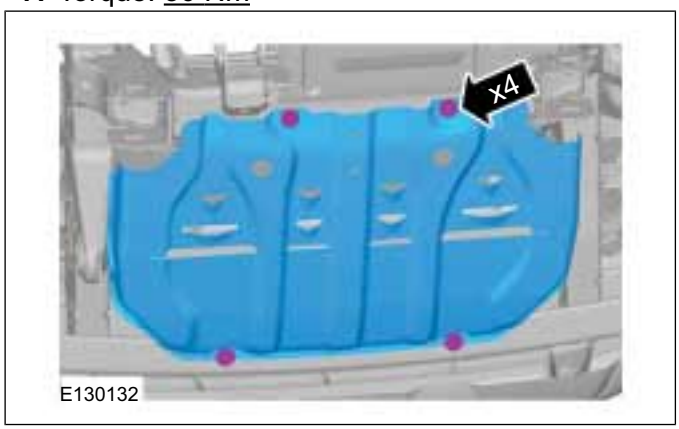
REMOVAL AND INSTALLATION



6.

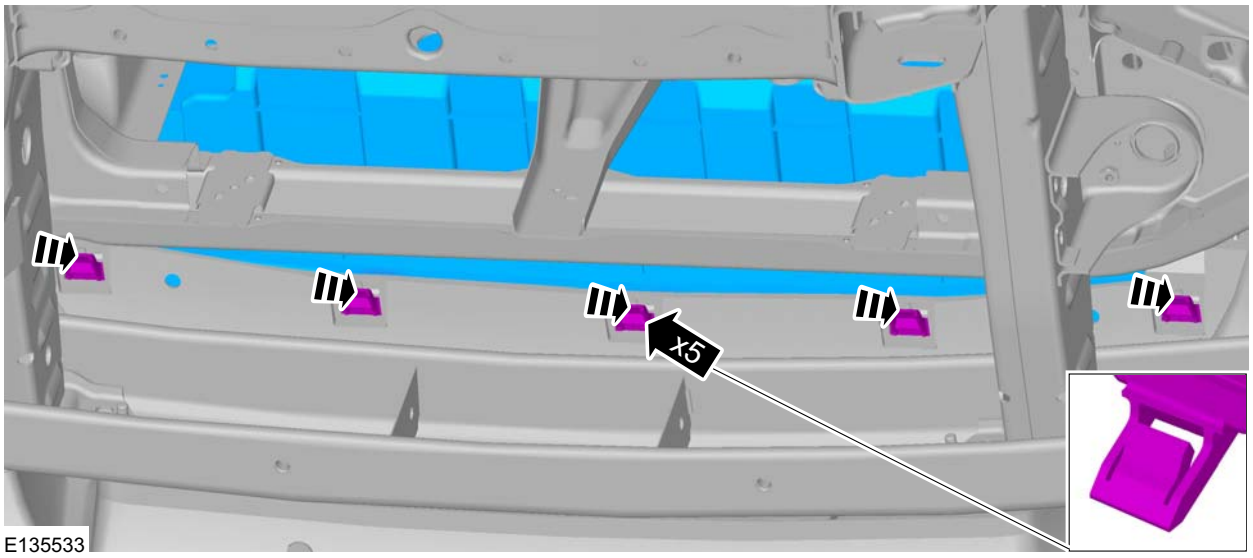


7. Torque: 30 Nm

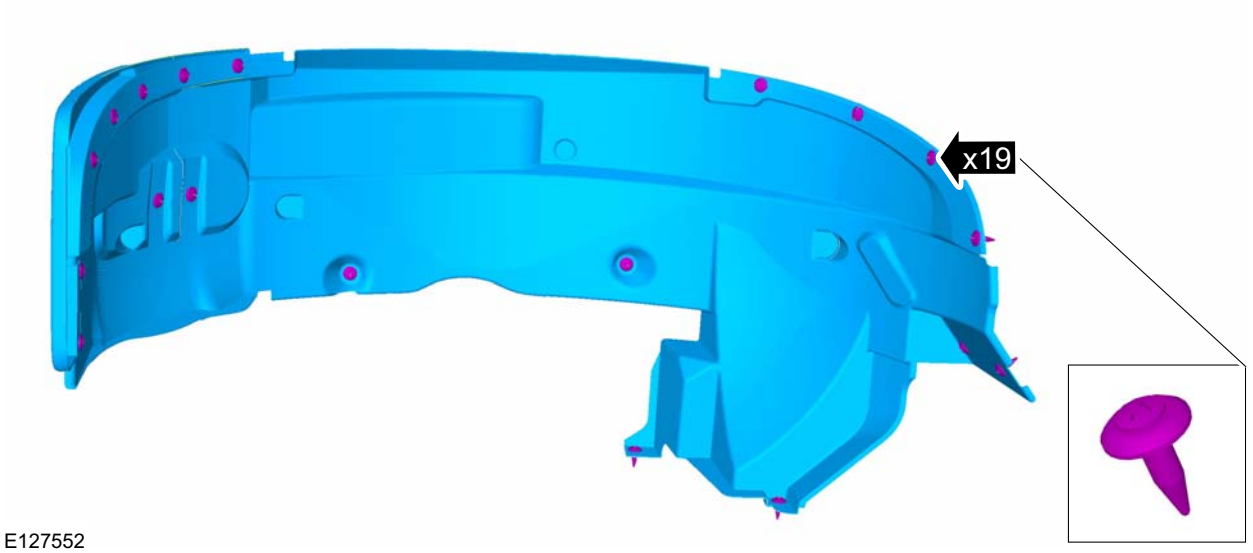


8.

REMOVAL AND INSTALLATION

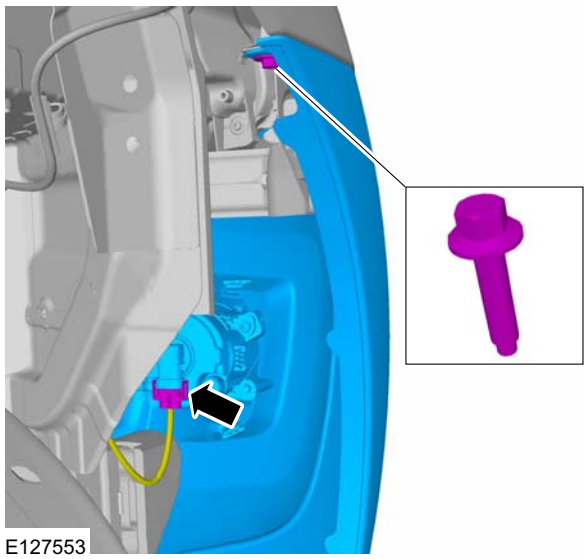


9. On both the sides.

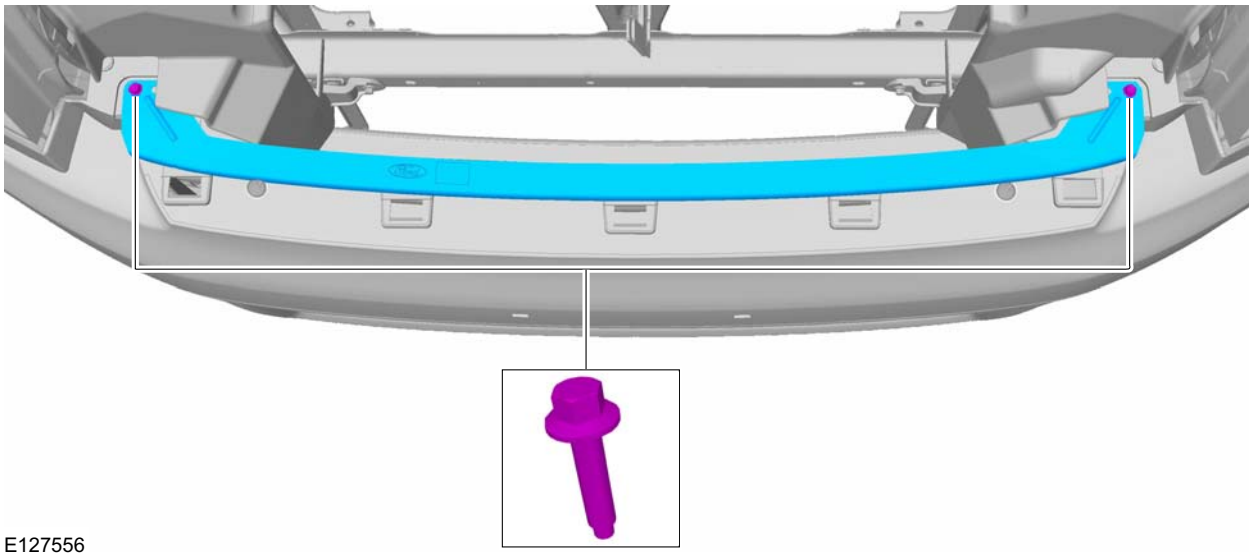


REMOVAL AND INSTALLATION

10. On both the sides.

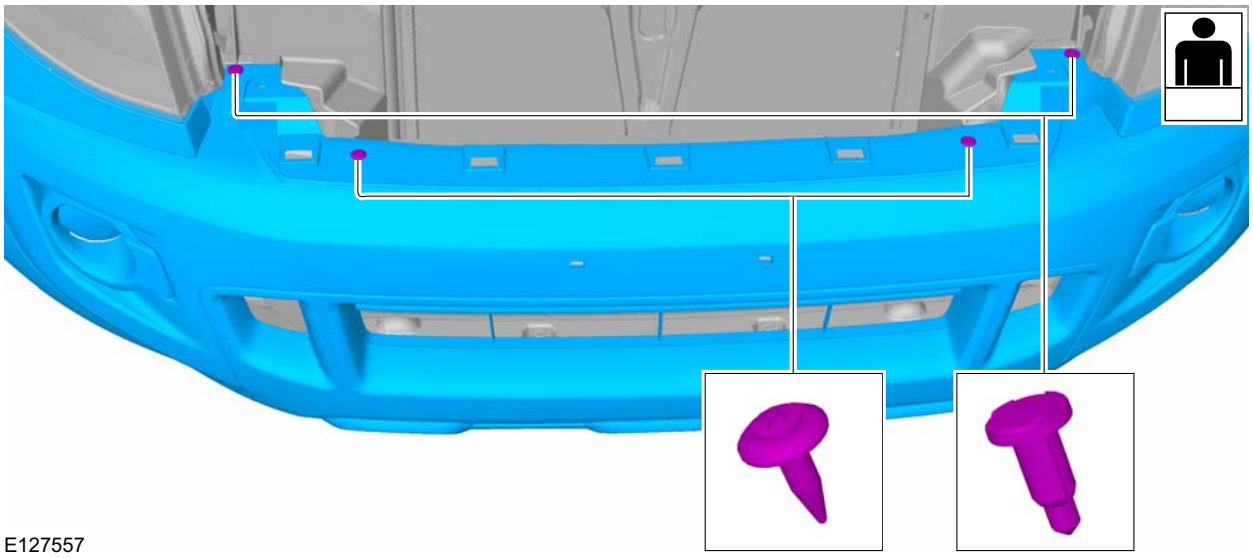

E127553

11. Torque: 10 Nm


E127556

12.

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

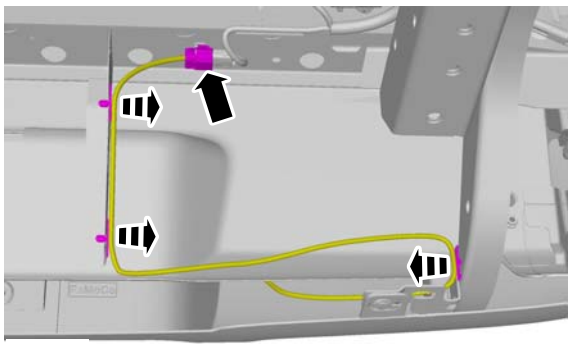
REMOVAL AND INSTALLATION

Rear Bumper

Removal

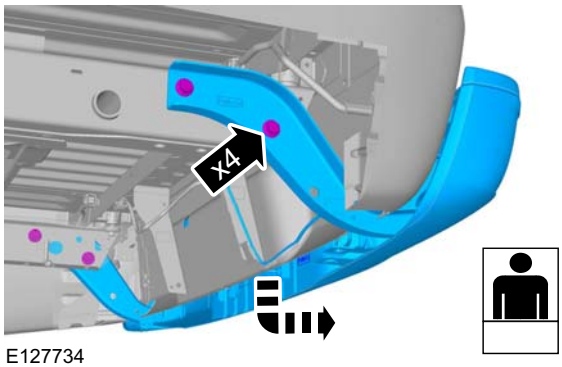
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3.



E127733

4. Torque: 105 Nm



E127734

Installation

1. To install, reverse the removal procedure.

SECTION 501-20A Safety Belt System

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

Safety Belt System..... 501-20A-2

REMOVAL AND INSTALLATION

Front Safety Belt Retractor — Single Cab..... 501-20A-8
Front Safety Belt Retractor — Single Cab, Vehicles With: Double Passenger Seat..... 501-20A-10
Front Safety Belt Retractor — Double Cab..... 501-20A-11
Front Safety Belt Retractor — Super Cab..... 501-20A-13
Front Safety Belt Buckle..... 501-20A-15
Safety Belt Shoulder Height Adjuster..... 501-20A-17
Rear Safety Belt Retractor..... 501-20A-18
Rear Center Safety Belt Retractor..... 501-20A-20
Rear Safety Belt Buckle..... 501-20A-21

DESCRIPTION AND OPERATION

Safety Belt System

System Overview

WARNINGS:

All safety belt assemblies (including retractors, buckles, shoulder belt height adjusters [if equipped], child safety seat tether attachments and attaching hardware) should be inspected after any collision. All new belt assemblies should be installed unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and new assemblies installed if either damage or incorrect operation is noted. Failure to install a new belt and retractor assembly could increase the risk of injury in collisions.

The safety belt retractor pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

CAUTION: Do not attempt to repair or lubricate the retractor / buckle mechanisms or modify the belts.

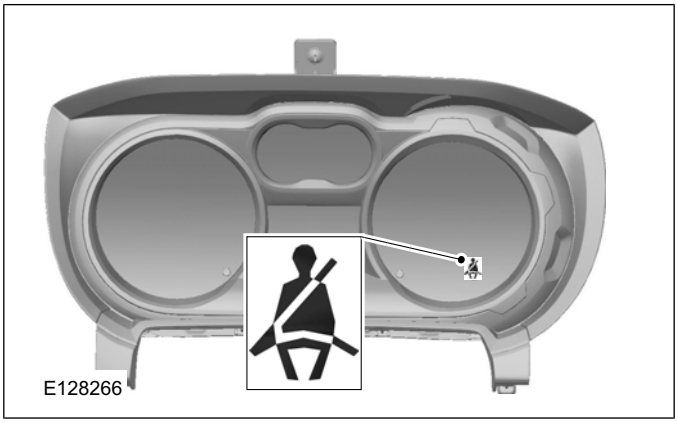
The safety belt system utilizes three-point lap and diagonal safety belts in all outboard seat positions and two point lap or three-point safety belts in the centre positions.

The front safety belt retractors incorporate a load limiting device, which allows progressive payout of additional safety belt webbing when the force exerted exceeds a predetermined limit.

The front safety belt upper anchors are connected to safety belt shoulder height adjusters mounted in the B-pillar.

A beltminder function is fitted to some vehicles. If the driver's seatbelt is not fastened, the belt warning lamp will illuminate at key on for 6 seconds, or until the seatbelt is fastened, whichever is the first. The beltminder warning is triggered when the vehicle speed is at 25 km/h (15 mph), or greater, and the driver and/or passenger safety belt(s) are not fastened. The warning will continue for 5 minutes or until the safety belt(s) are fastened, whichever is the first.

The safety belt minder feature can be disabled.

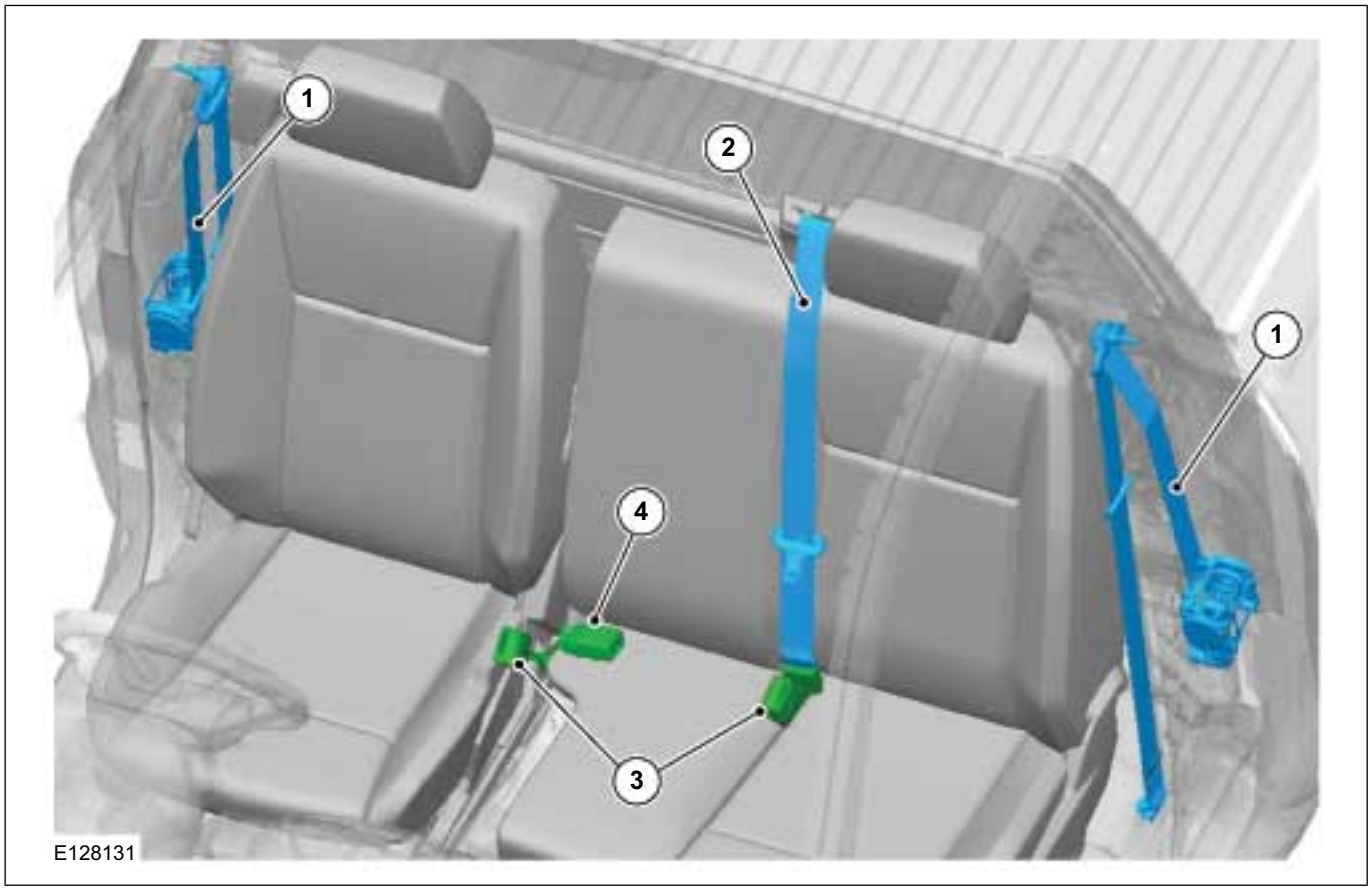


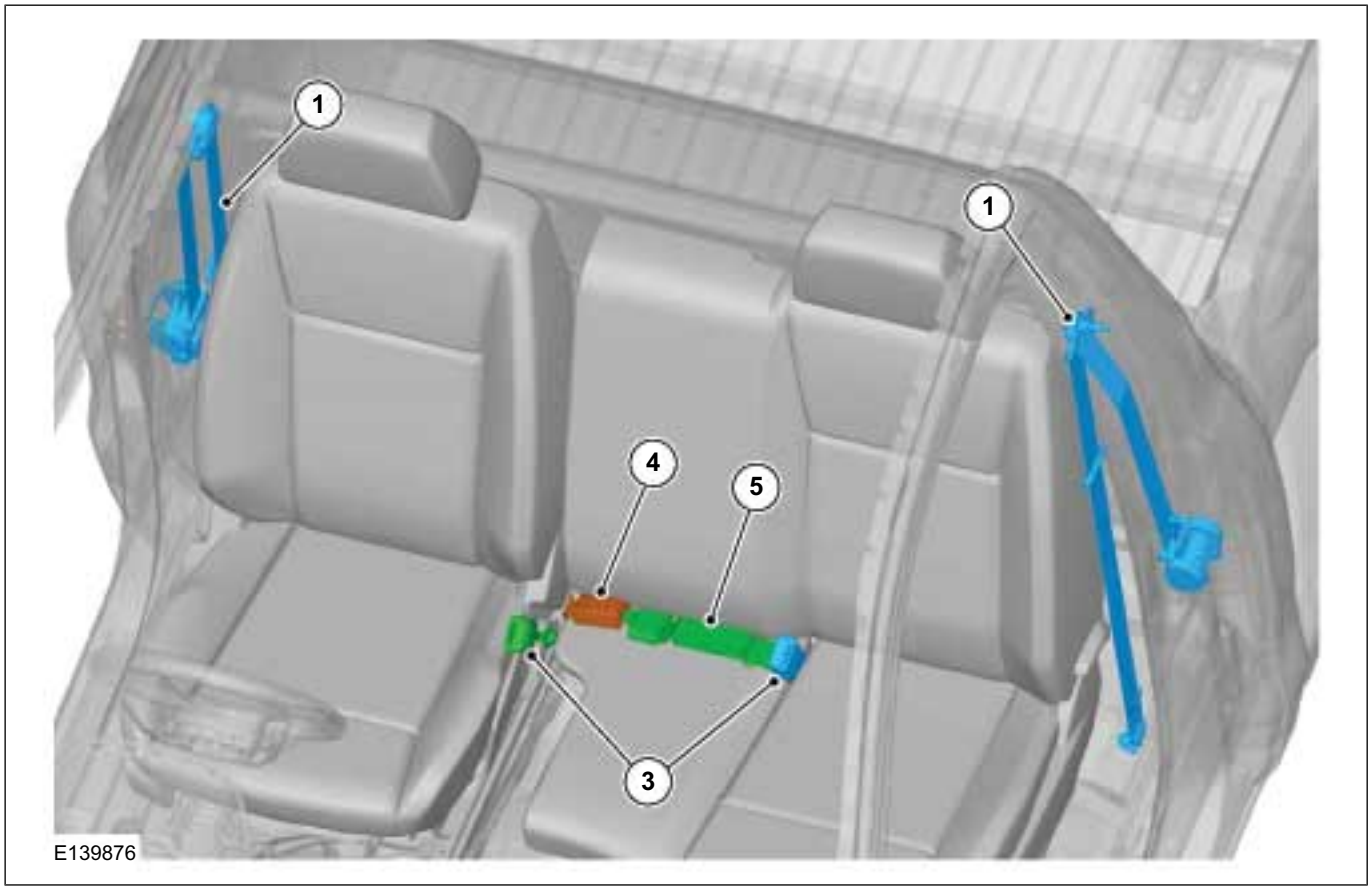
The safety belt retractor pretensioners have a lower deployment threshold than that required by the air bags. Hence it is possible that during a minor collision, which exceeds the deployment threshold, only the safety belt retractor pretensioners will deploy. The safety belt retractor pretensioners will also deploy when the side airbags are deployed but not deploy in a rear collision.

Rear seat safety belt retractors and buckles are of the conventional type.

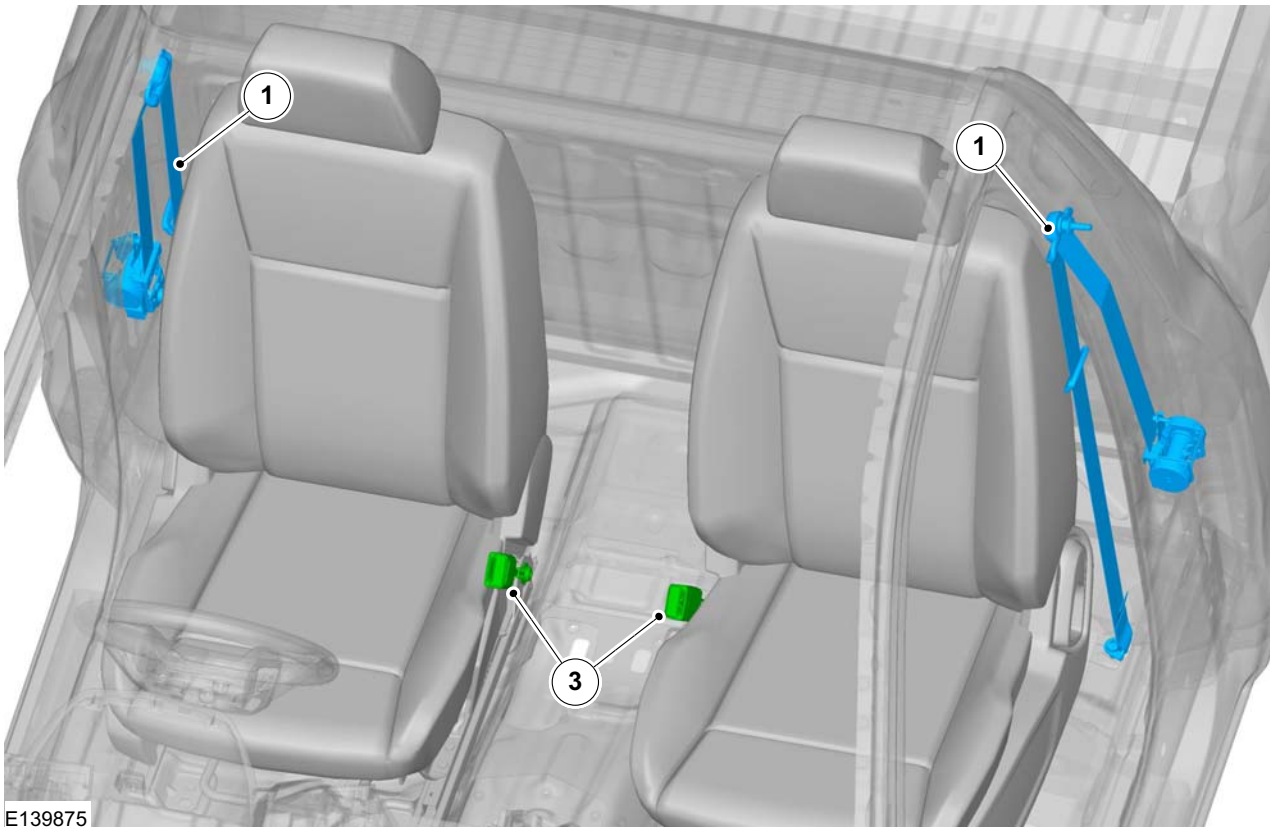
Single cab

DESCRIPTION AND OPERATION





DESCRIPTION AND OPERATION

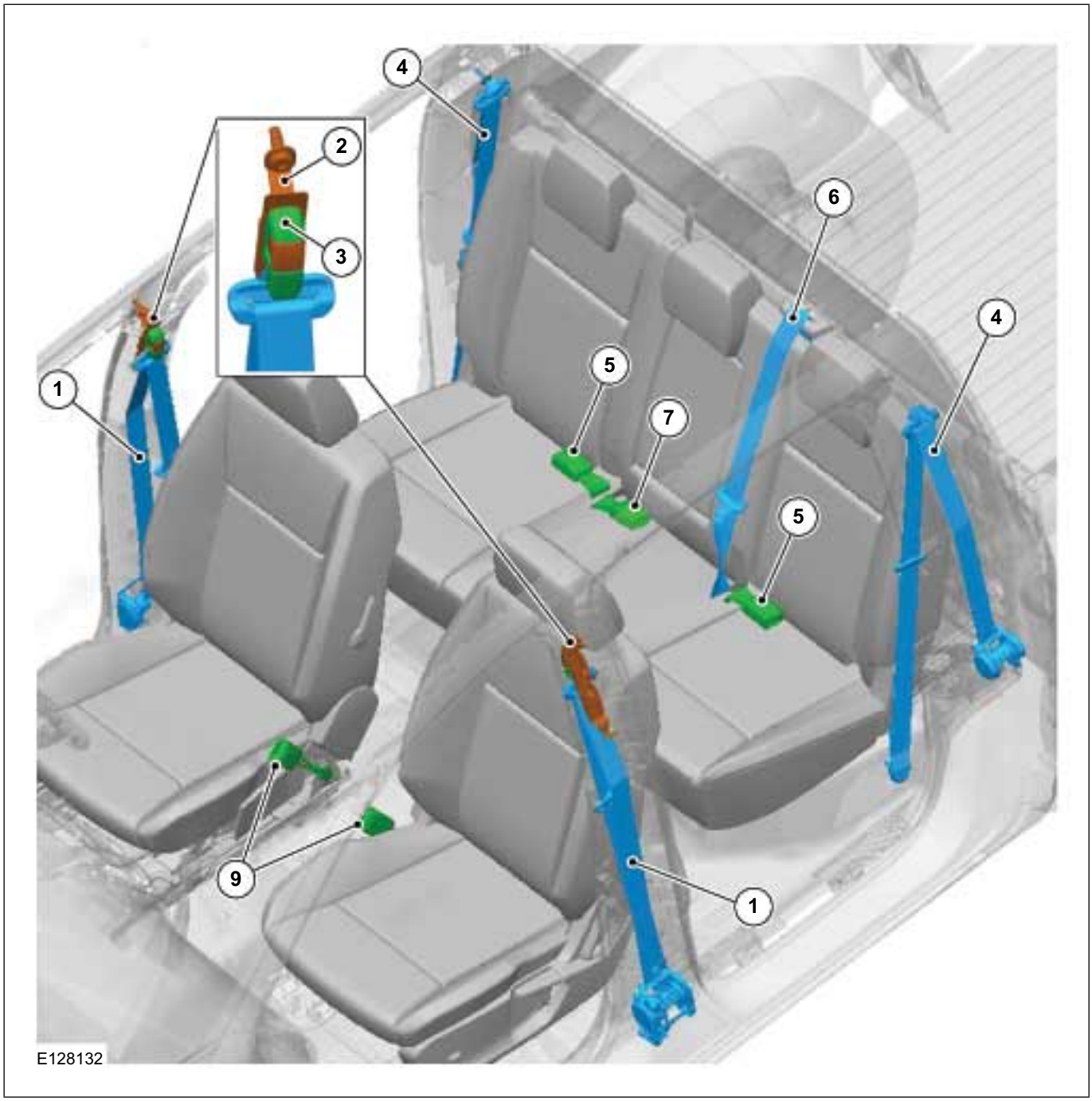


Item	Description
1	Front safety belt retractor
2	Front three point center safety belt retractor
3	Front safety belt buckle

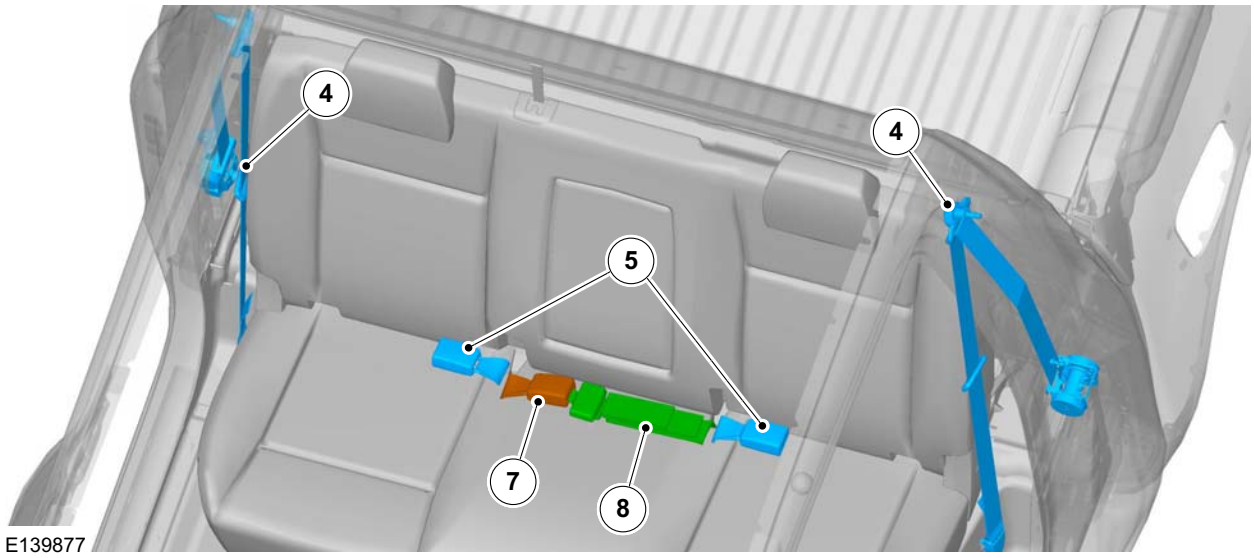
Item	Description
4	Front center safety belt buckle
5	Front two point center safety belt

Double cab

DESCRIPTION AND OPERATION



DESCRIPTION AND OPERATION

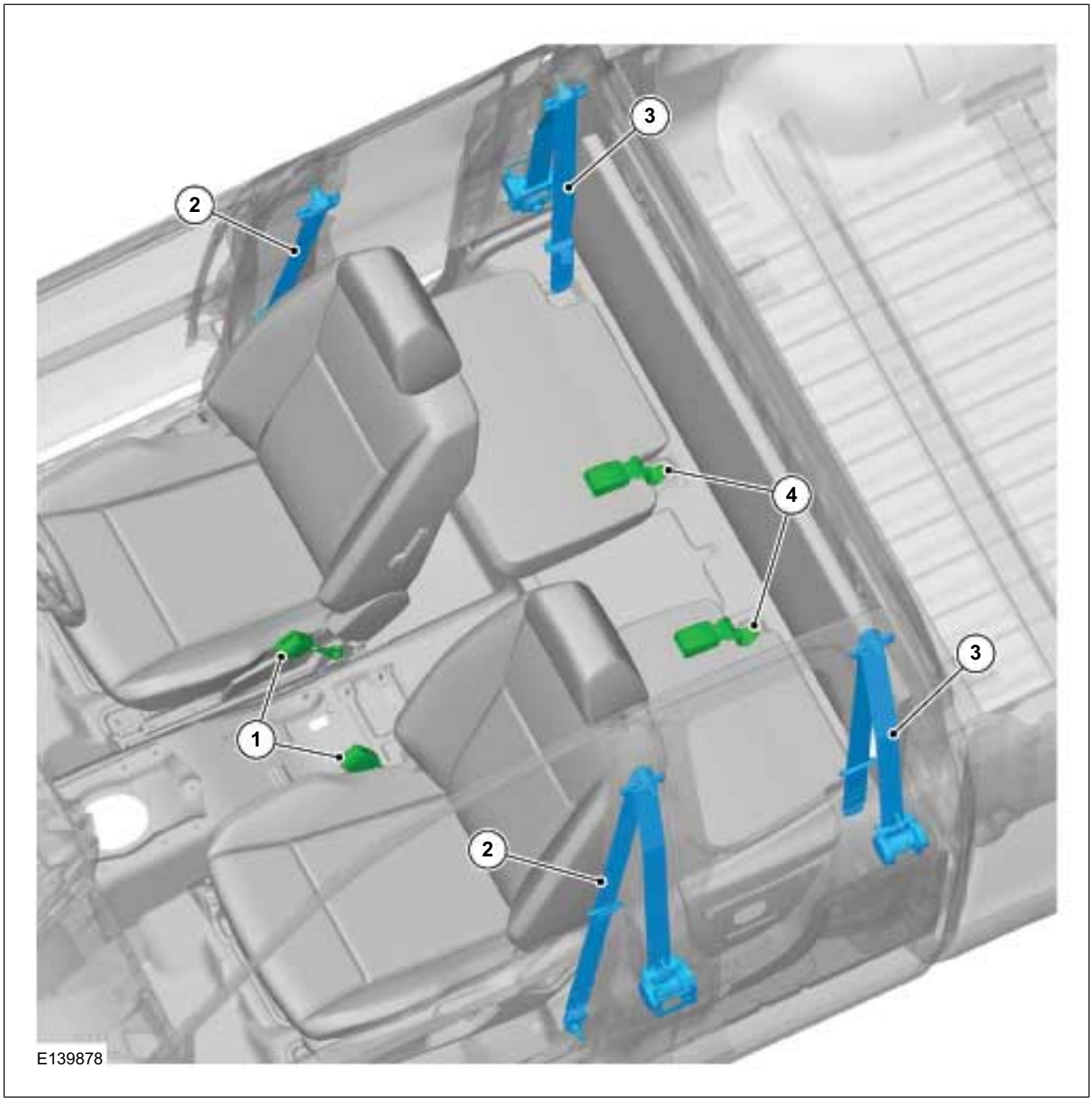


Item	Description
1	Front safety belt retractor
2	Safety belt shoulder height adjuster
3	Safety belt shoulder height adjusting cover
4	Rear safety belt retractor
5	Rear safety belt buckle

Item	Description
6	Rear three point center safety belt retractor
7	Rear center safety belt buckle
8	Rear two point center safety belt
9	Front safety belt buckle

Super cab

DESCRIPTION AND OPERATION



Item	Description
1	Front safety belt buckle
2	Front safety belt retractor
3	Rear safety belt retractor
4	Rear safety belt buckle

REMOVAL AND INSTALLATION

Front Safety Belt Retractor — Single Cab

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. **WARNINGS:**

   The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

   Handling the seat belt (pre-tensioner seat belt) improperly can accidentally deploy the pre-tensioner seat belt, which may seriously injure you. Read the service warnings and cautions before handling the seat belt (pre-tensioner seat belt).

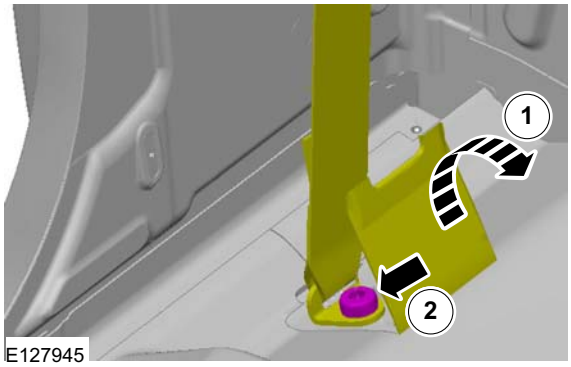
   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

   CAUTION: The ELR (emergency locking retractor) has a spring that will unwind if the retractor cover is removed. The spring cannot be rewound by hand. If this occurs, the ELR will not work properly. Therefore, do not disassemble the retractor.

   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

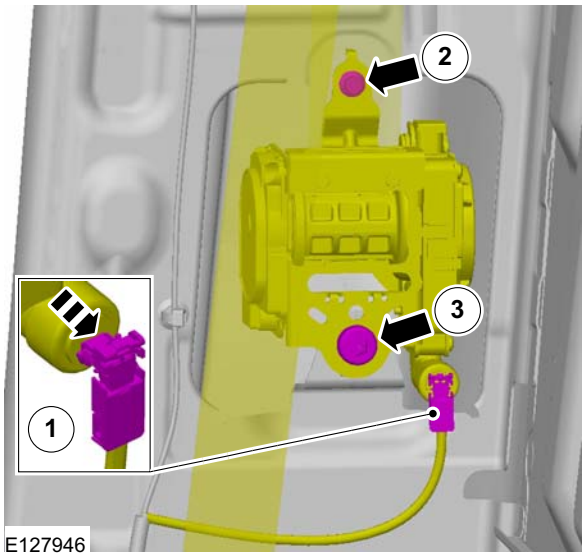
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3. Torque: 48 Nm



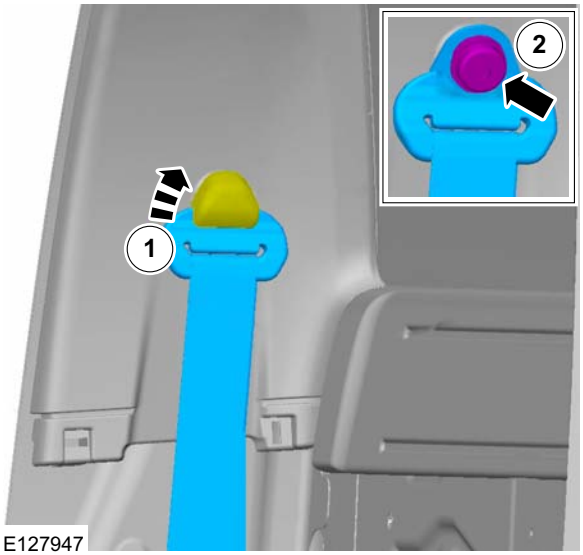
4. Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

5. 2. Torque: 11 Nm
   3. Torque: 48 Nm



REMOVAL AND INSTALLATION

6. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Safety Belt Retractor — Single Cab, Vehicles With: Double Passenger Seat

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. **WARNINGS:**

   The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

   Handling the seat belt (pre-tensioner seat belt) improperly can accidentally deploy the pre-tensioner seat belt, which may seriously injure you. Read the service warnings and cautions before handling the seat belt (pre-tensioner seat belt).

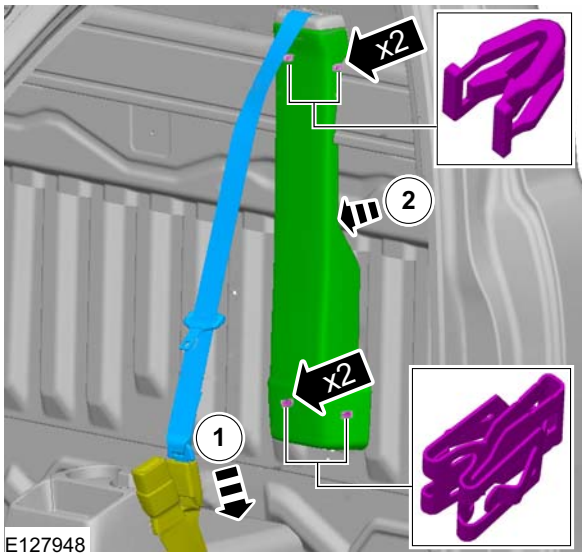
   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

   CAUTION: The ELR (emergency locking retractor) has a spring that will unwind if the retractor cover is removed. The spring cannot be rewound by hand. If this occurs, the ELR will not work properly. Therefore, do not disassemble the retractor.

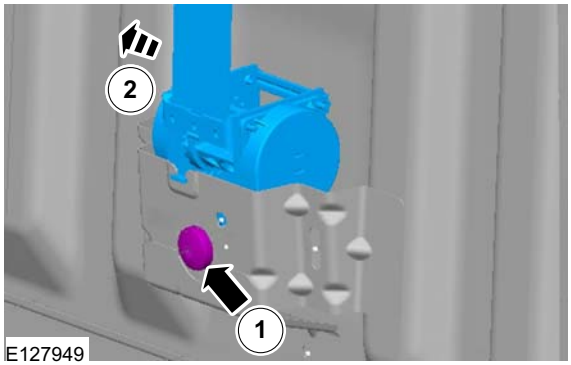
   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3. **NOTE:** Note the position of the component before removal.



4. Torque: 48 Nm



Installation

1. **NOTE:** Make sure that this component is installed to the noted removal position.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Safety Belt Retractor — Double Cab

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. **WARNINGS:**

   The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

   Handling the seat belt (pre-tensioner seat belt) improperly can accidentally deploy the pre-tensioner seat belt, which may seriously injure you. Read the service warnings and cautions before handling the seat belt (pre-tensioner seat belt).

   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

   CAUTION: The ELR (emergency locking retractor) has a spring that will unwind if the retractor cover is removed. The spring cannot be rewound by hand. If this occurs, the ELR will not work properly. Therefore, do not disassemble the retractor.

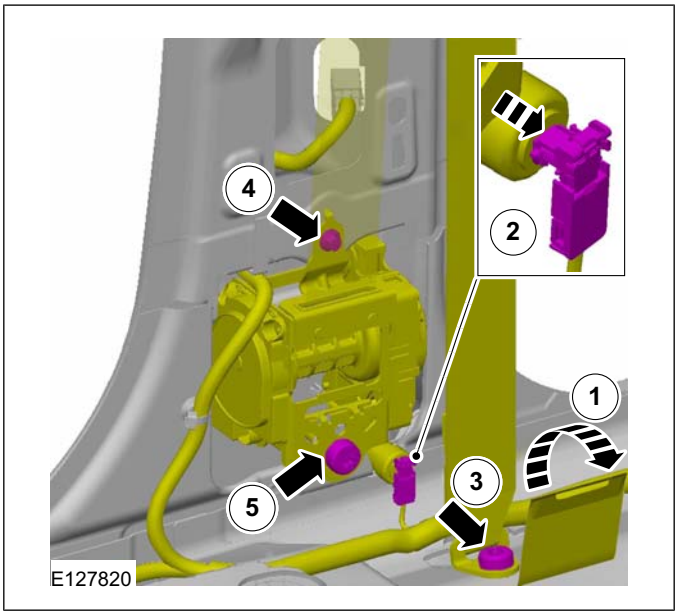
   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3. Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

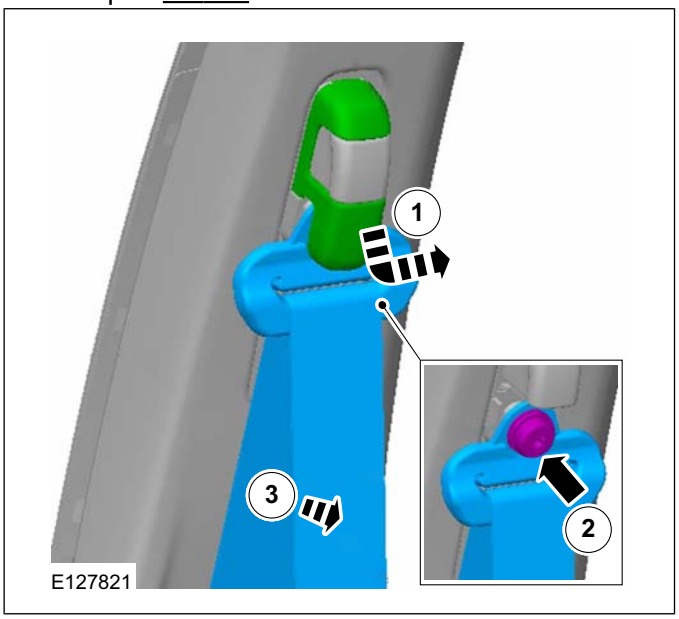
4. **NOTE:** Note the position of the component before removal.

   3. Torque: 48 Nm
   4. Torque: 11 Nm
   5. Torque: 48 Nm



REMOVAL AND INSTALLATION

5. Torque: 48 Nm



Installation

1. **NOTE:** Make sure that this component is installed to the noted removal position.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Front Safety Belt Retractor — Super Cab

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. **WARNINGS:**

   The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

   Handling the seat belt (pre-tensioner seat belt) improperly can accidentally deploy the pre-tensioner seat belt, which may seriously injure you. Read the service warnings and cautions before handling the seat belt (pre-tensioner seat belt).

   Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

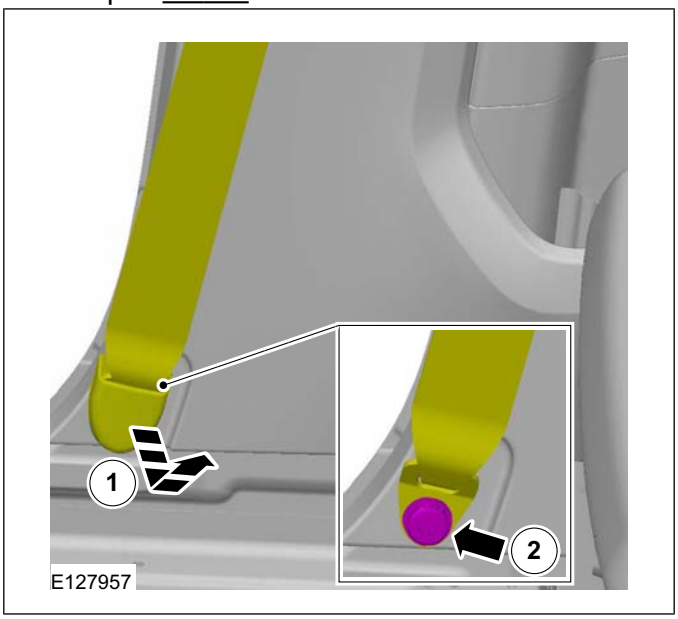
   CAUTION: The ELR (emergency locking retractor) has a spring that will unwind if the retractor cover is removed. The spring cannot be rewound by hand. If this occurs, the ELR will not work properly. Therefore, do not disassemble the retractor.

   Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

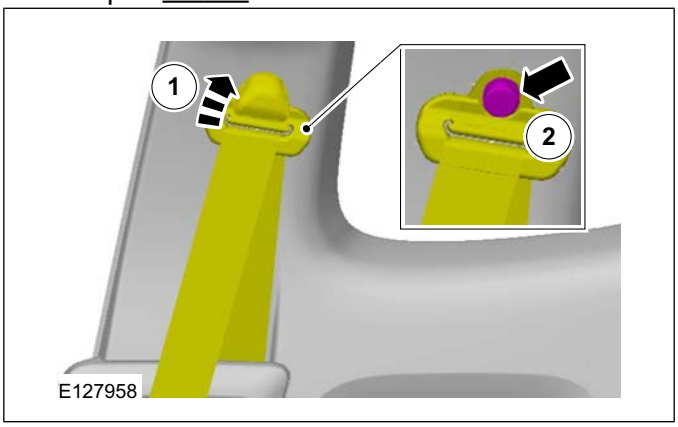
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3. **NOTE:** Note the position of the component before removal.

   Torque: 48 Nm



4. Torque: 48 Nm



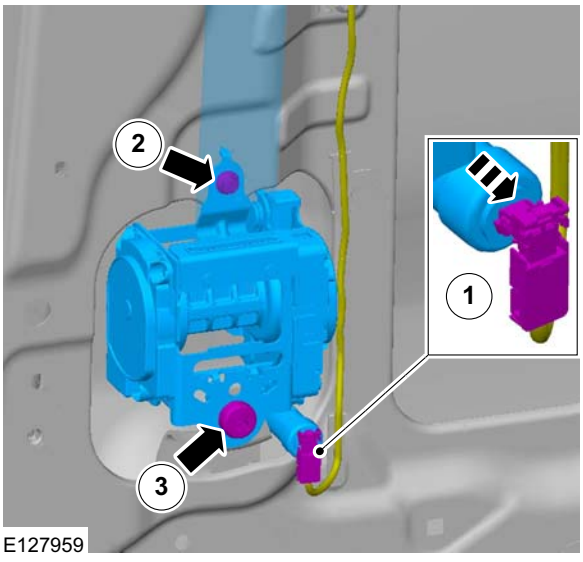
REMOVAL AND INSTALLATION

5. Refer to: Rear Door Trim Panel - Super Cab (501-05 Interior Trim and Ornamentation, Removal and Installation).

6.



7. 2. Torque: 11 Nm
   3. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

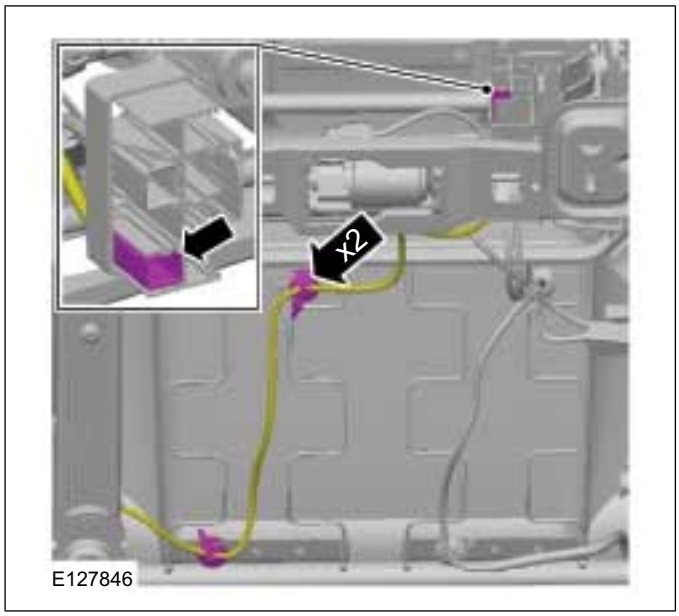
Front Safety Belt Buckle

Removal

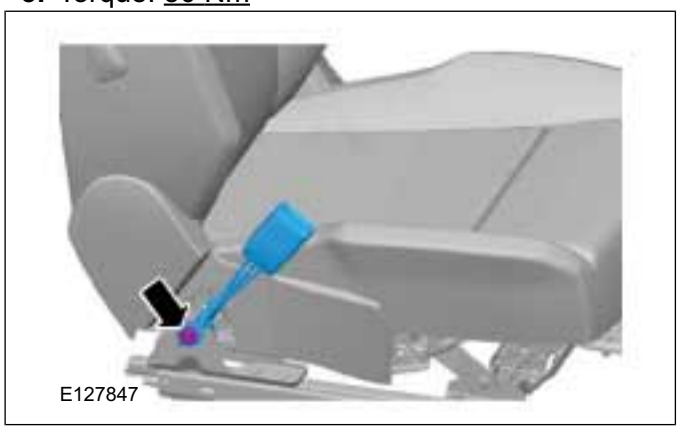
NOTE: Removal steps in this procedure may contain installation details.

Double cab

1. Refer to: Front Seat (501-10 Seating, Removal and Installation).
2. **CAUTION: Note the position of the component before removal.**

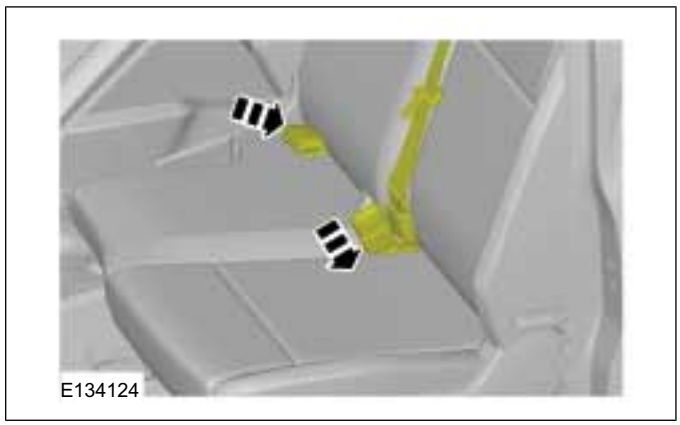


3. Torque: 50 Nm

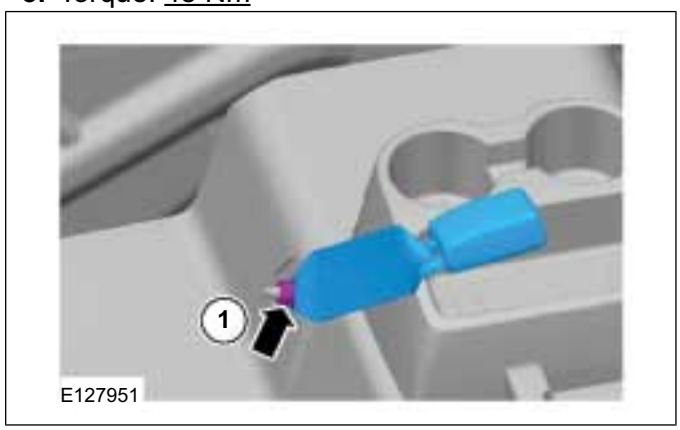


Single cab

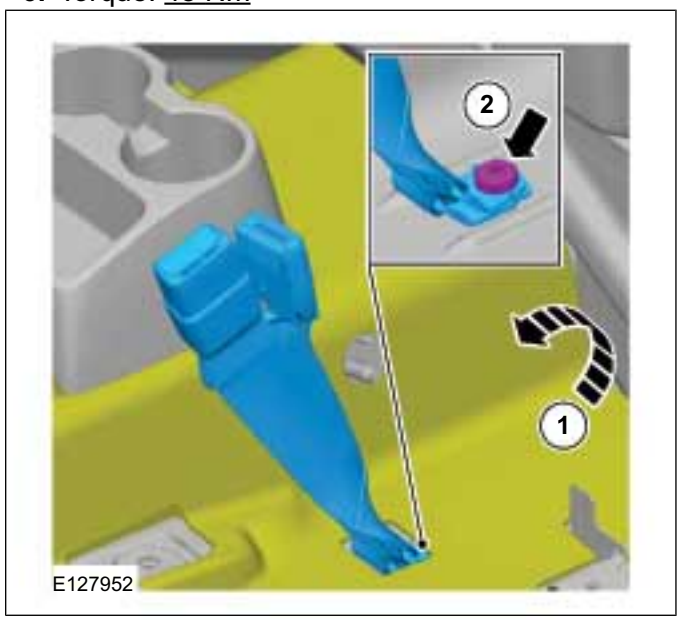
4.



5. Torque: 48 Nm



6. Torque: 48 Nm



REMOVAL AND INSTALLATION

Installation

1. **NOTE:** Make sure the safety belt webbing is not twisted prior to repositioning the seat.

   NOTE: Make sure that the safety belt buckles are accessible after repositioning the seat.

   To install, reverse the removal procedure.

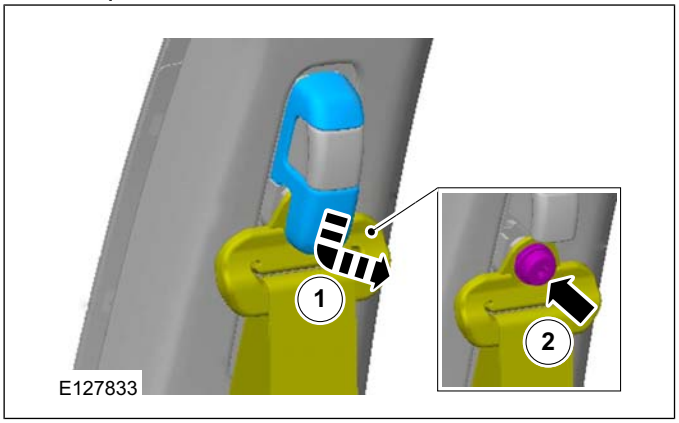
REMOVAL AND INSTALLATION

Safety Belt Shoulder Height Adjuster

Removal

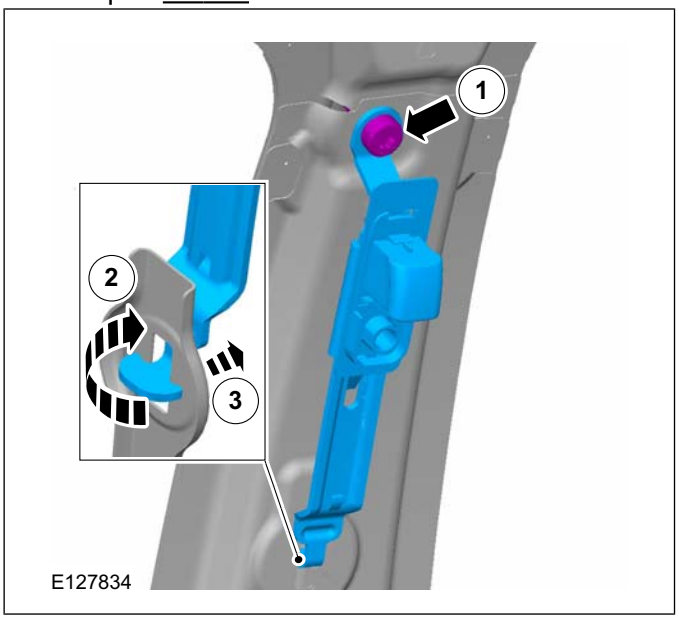
NOTE: Removal steps in this procedure may contain installation details.

1. Torque: 48 Nm



2. Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Rear Safety Belt Retractor

Removal

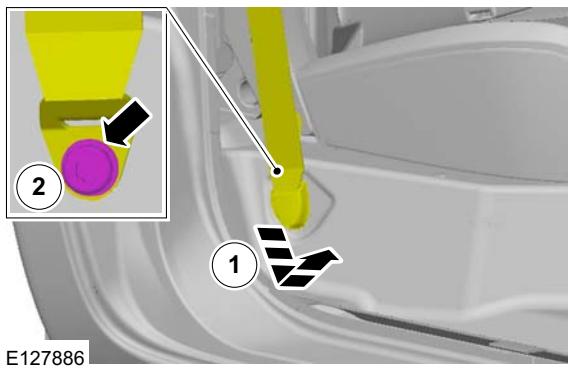
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

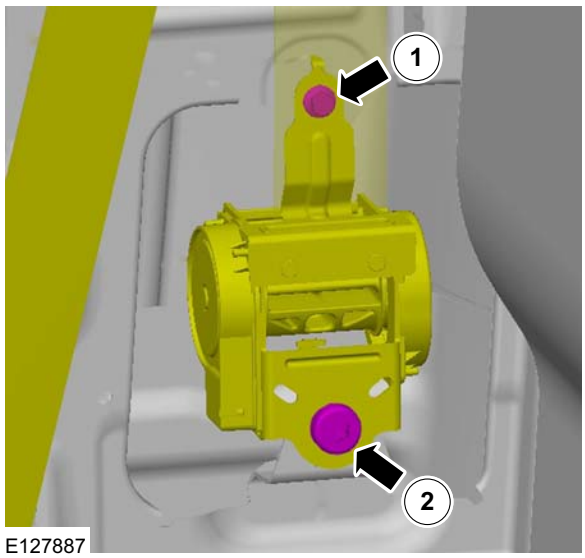
Double cab

2. **NOTE:** Note the position of the component before removal.

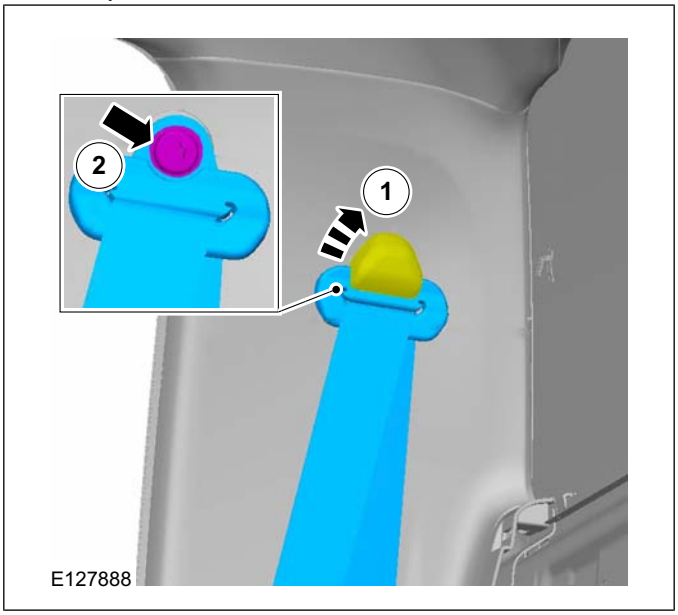
   Torque: 48 Nm



3. 1. Torque: 11 Nm
   2. Torque: 48 Nm

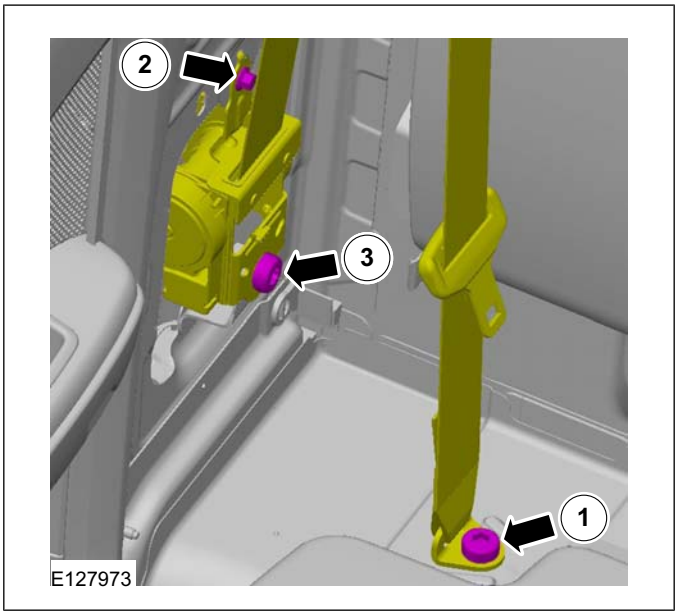


4. Torque: 48 Nm



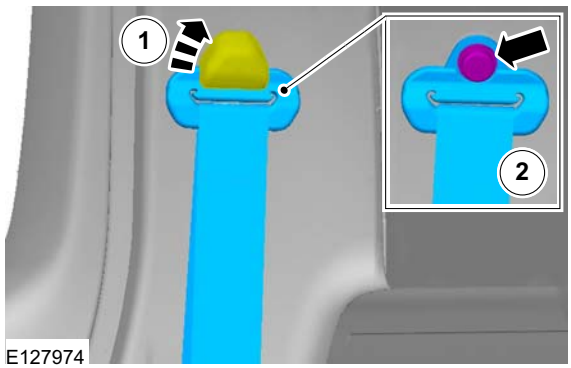
Stretch cab

5. 1. Torque: 48 Nm
   2. Torque: 11 Nm
   3. Torque: 48 Nm



REMOVAL AND INSTALLATION

6. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

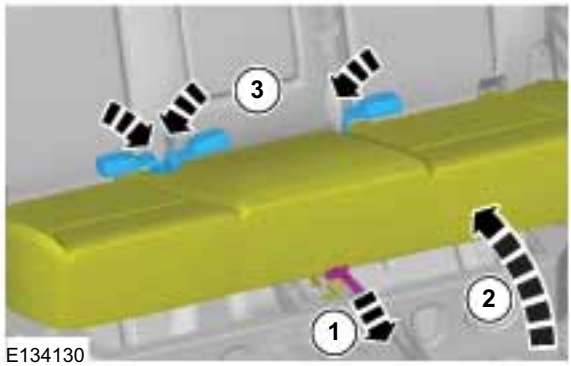
REMOVAL AND INSTALLATION

Rear Center Safety Belt Retractor

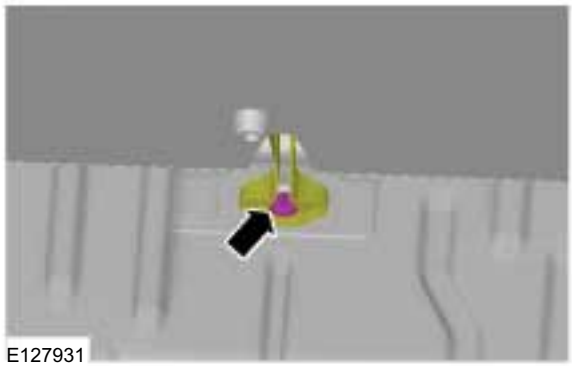
Removal

NOTE: Removal steps in this procedure may contain installation details.

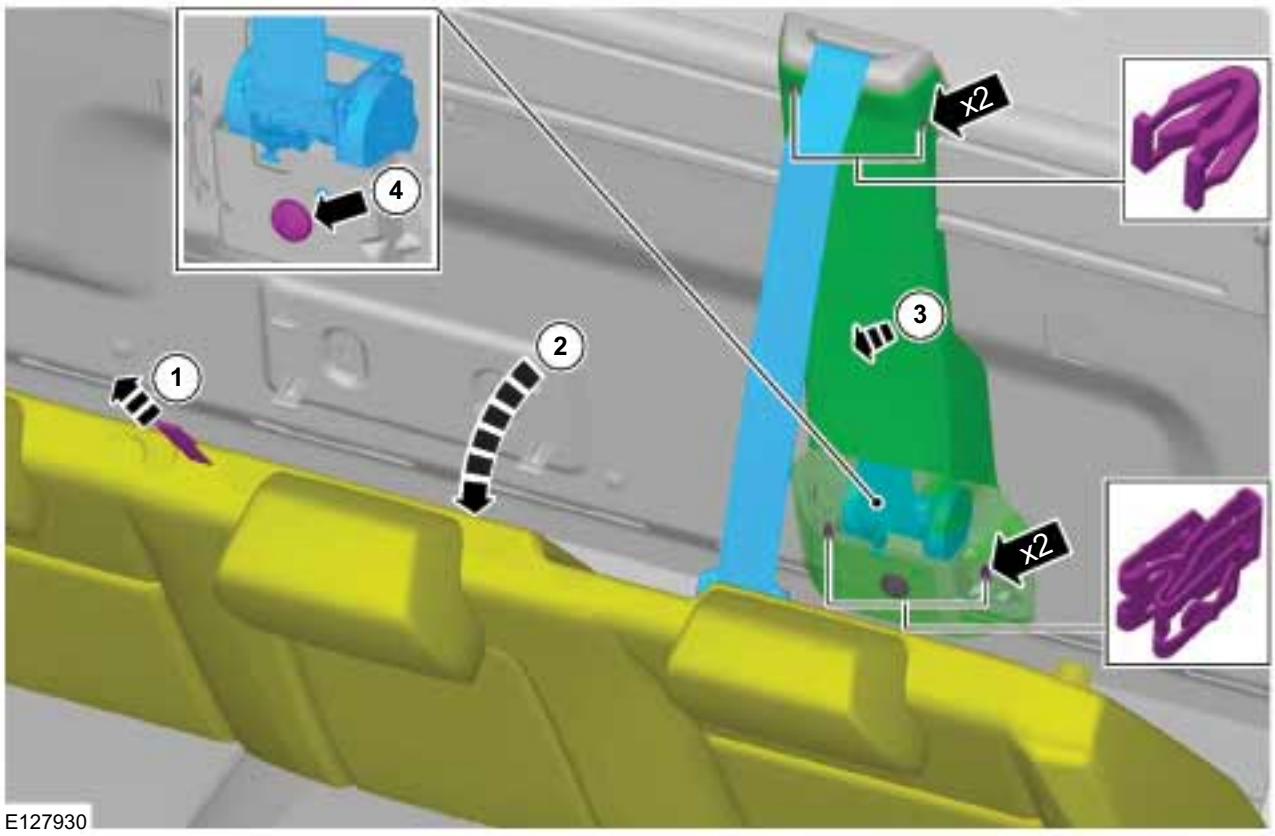
1.



2. Torque: 48 Nm



3. 4. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

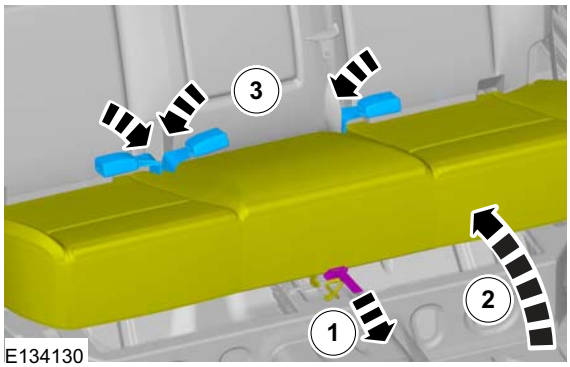
Rear Safety Belt Buckle

Removal

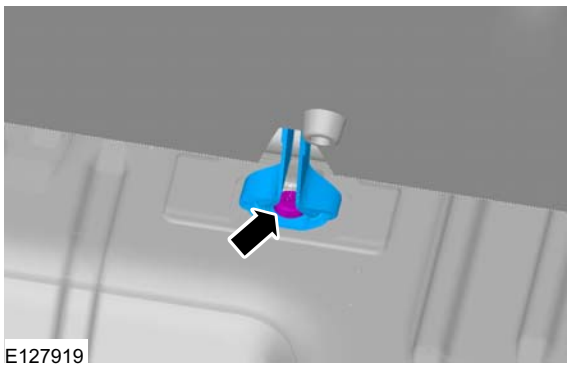
Double cab

NOTE: Removal steps in this procedure may contain installation details.

1.

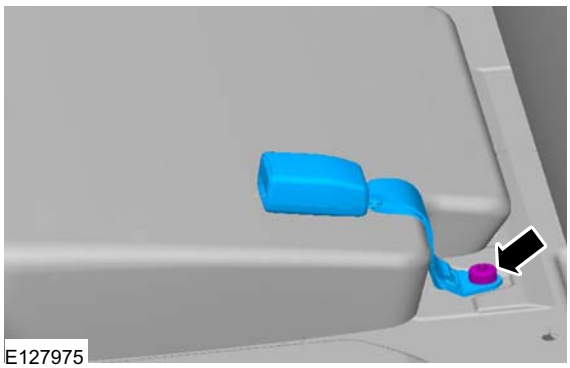


2. Torque: 48 Nm



Stretch cab

3. Torque: 48 Nm



Installation

1. **NOTE:** Make sure the safety belt webbing is not twisted prior to repositioning the seat.

   NOTE: Make sure that the safety belt buckles are accessible after repositioning the seat.

   NOTE: Make sure to tighten the bolt to specification.

   To install, reverse the removal procedure.

SECTION 501-20B Supplemental Restraint System

VEHICLE APPLICATION: 2011.50 Ranger

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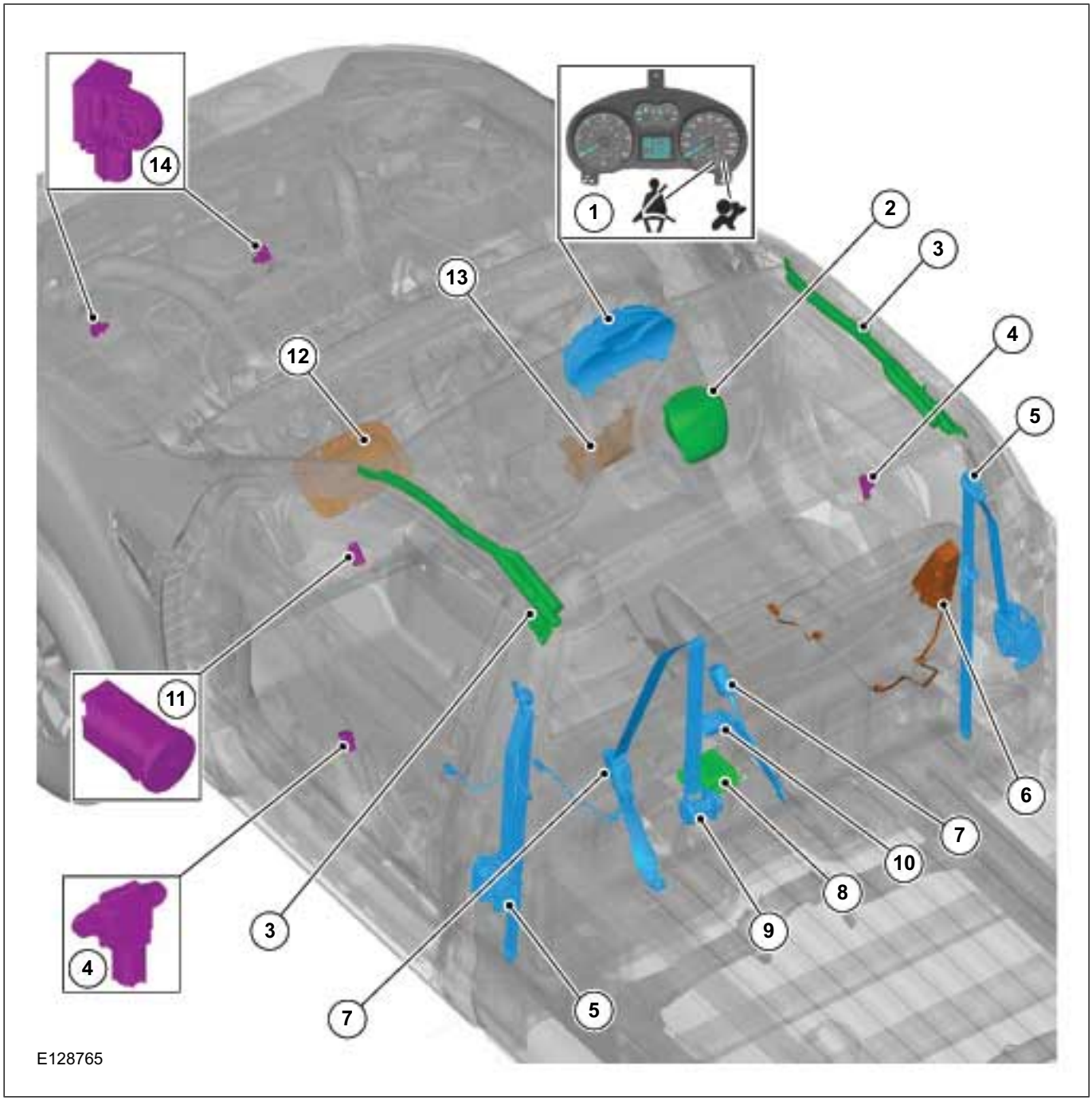
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DESCRIPTION AND OPERATION

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) – Component Location

Single cab



Item	Description
1	Instrument cluster with air bag indicator light and safety belt warning light
2	Driver air bag module
3	Side air curtain module
4	Side impact sensor

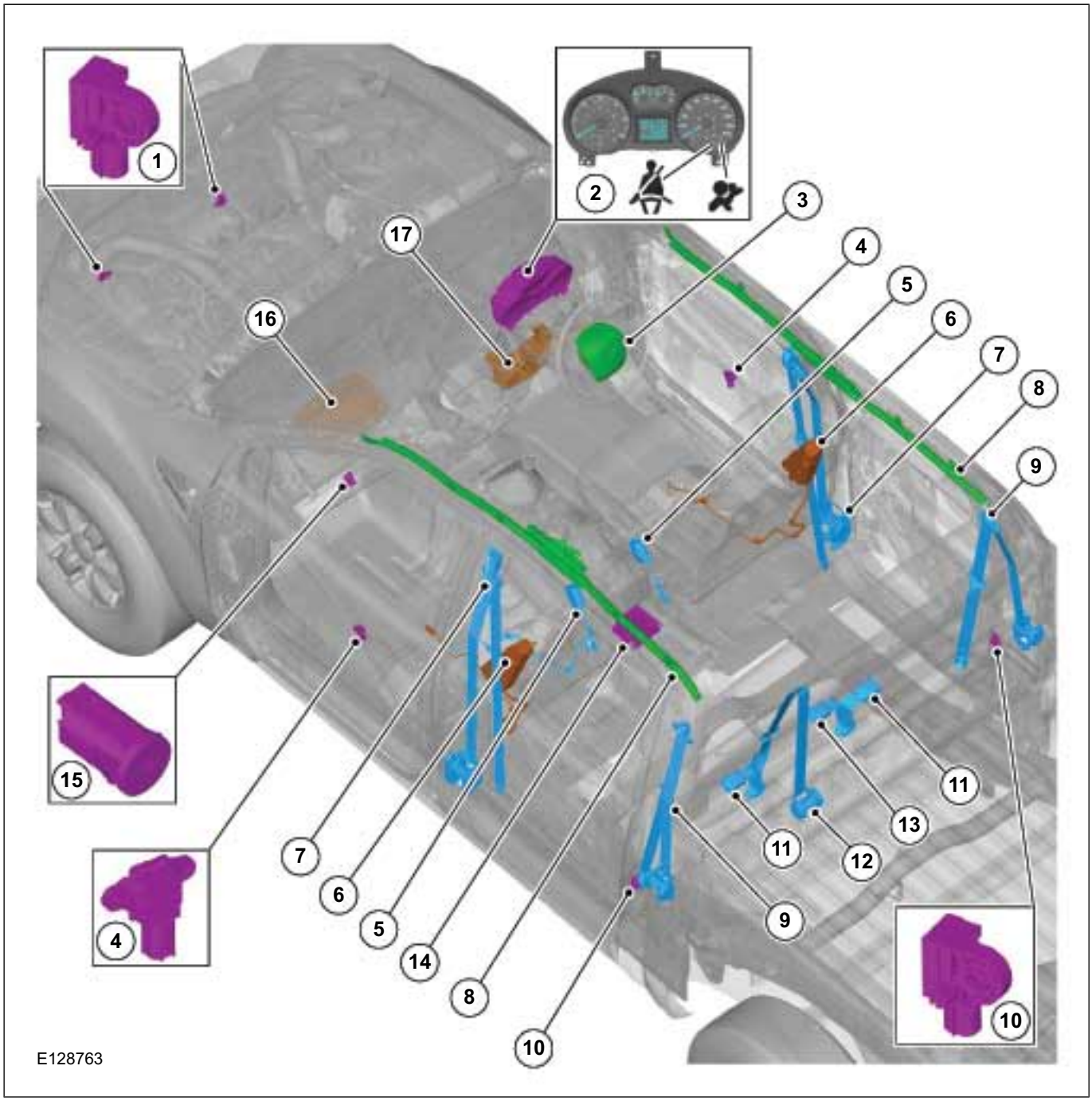
Item	Description
5	Front safety belt retractor
6	Side air bag module
7	Front safety belt buckle
8	Restraints control module (RCM)

DESCRIPTION AND OPERATION

Item	Description
9	Front center safety belt retractor
10	Front center safety belt buckle
11	Passenger airbag deactivation (PAD) switch

Item	Description
12	Passenger air bag module
13	Driver lower air bag module
14	Front impact severity sensor

Double cab



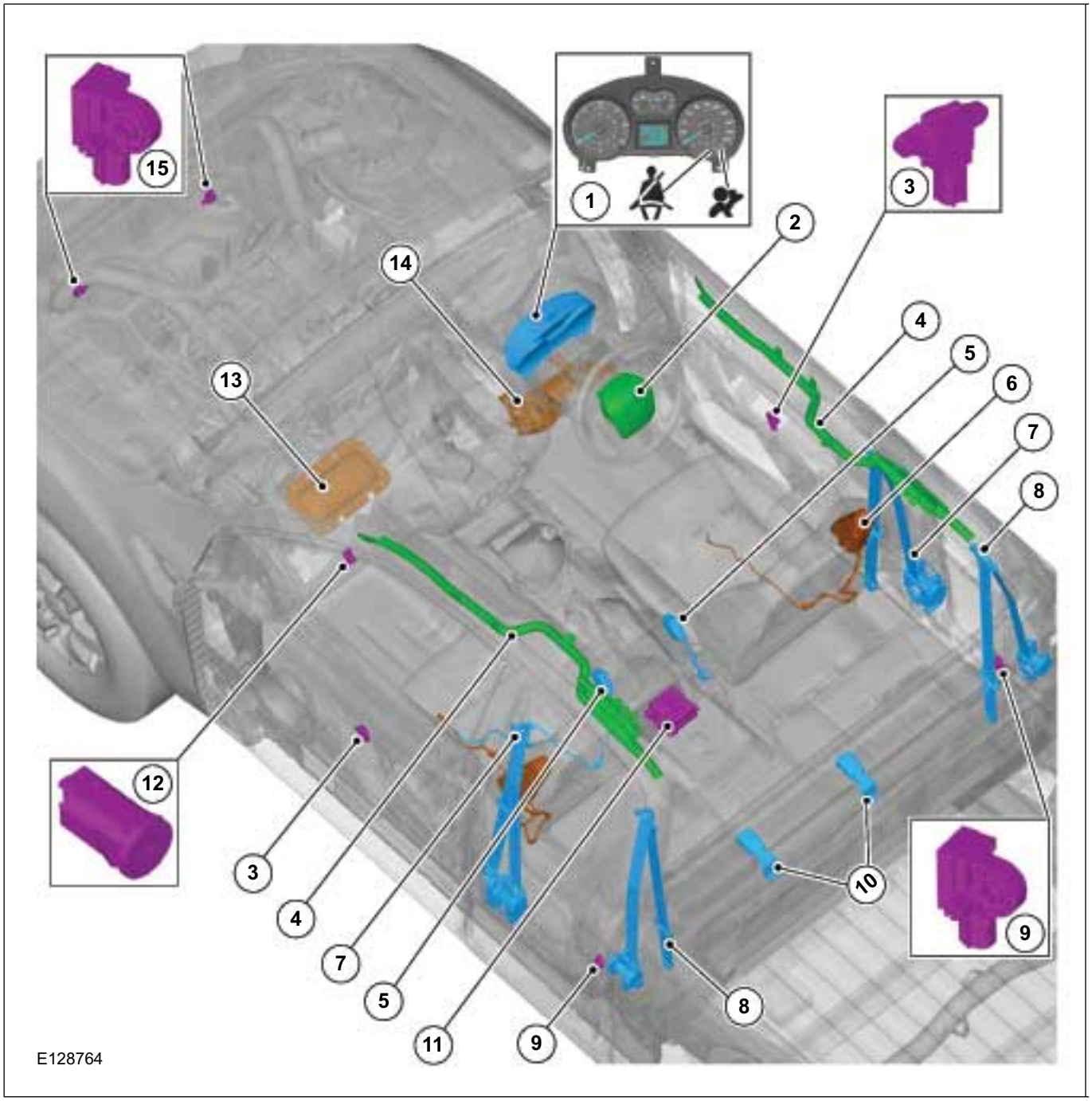
DESCRIPTION AND OPERATION

Item	Description
1	Front impact severity sensor
2	Instrument cluster with air bag indicator light and safety belt warning light
3	Driver air bag module
4	Side impact sensor
5	Front safety belt buckle
6	Side air bag module
7	Front safety belt retractor
8	Side air curtain module
9	Rear safety belt retractor

Item	Description
10	Side impact sensor (rear)
11	Rear safety belt buckle
12	Rear center safety belt retractor
13	Rear center safety belt buckle
14	Restraints control module (RCM)
15	Passenger airbag deactivation (PAD) switch
16	Passenger air bag module
17	Driver lower air bag module

DESCRIPTION AND OPERATION

Stretch cab



Item	Description
1	Instrument cluster with air bag indicator light and safety belt warning light
2	Driver air bag module
3	Side impact sensor
4	Side air curtain module
5	Front safety belt buckle
6	Side air bag module

Item	Description
7	Front safety belt retractor
8	Rear safety belt retractor
9	Side impact sensor (rear)
10	Rear safety belt buckle
11	Restraints control module (RCM)
12	Passenger airbag deactivation (PAD) switch

DESCRIPTION AND OPERATION

Item	Description
13	Passenger air bag module

Item	Description
14	Driver lower airbag module
15	Front impact severity sensor

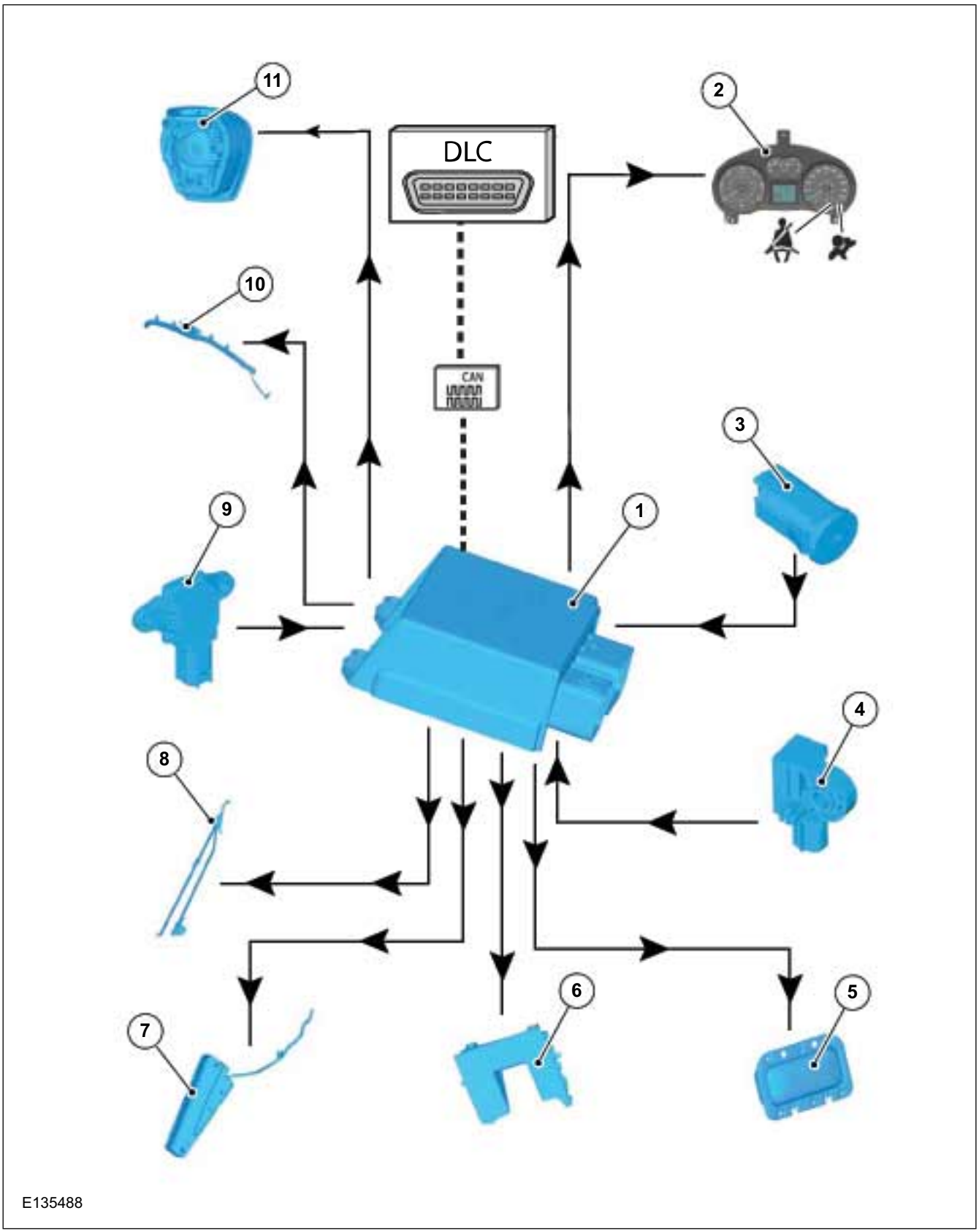
DESCRIPTION AND OPERATION

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

System overview

Click here to view diagrams

DESCRIPTION AND OPERATION



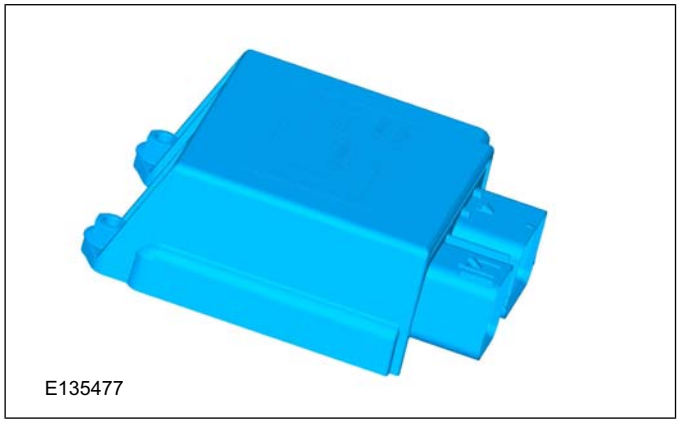
Item	Description
1	RCM (Restraint Control Module)
2	Air bag warning indicator

Item	Description
3	Passenger airbag deactivation (PAD) switch

DESCRIPTION AND OPERATION

Item	Description
4	Front impact severity sensor
5	Passenger air bag module
6	Driver lower airbag module
7	Side airbag module
8	Safety belt retractor and pretensioner
9	Side impact sensor
10	Side air curtain module
11	Driver airbag module

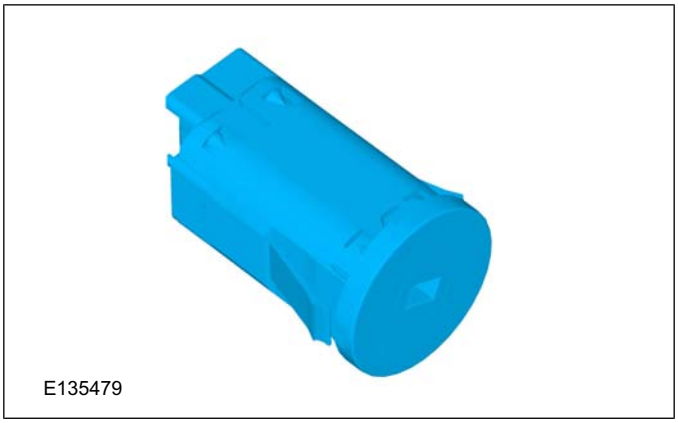
RCM (Restraint Control Module)


E135477

Electronic sensors are incorporated into the RCM; these measure the vehicle acceleration / deceleration in the event of a collision. The calculated value is evaluated by the RCM to determine the severity of the impact.

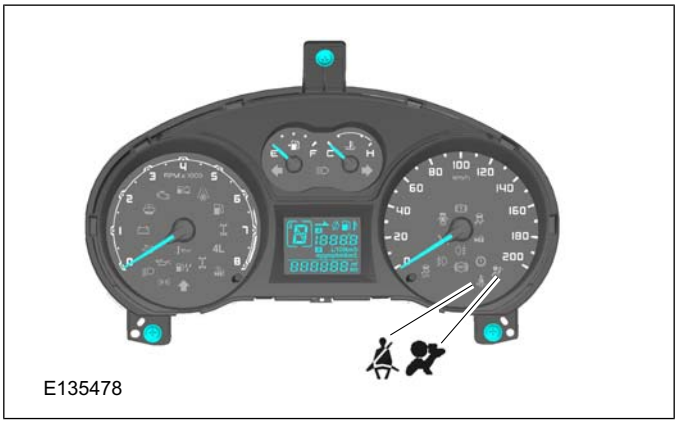
The RCM compares the values it receives from the crash sensor, side impact sensors and the internal electronic sensors. If the deceleration, due to a frontal or side impact, exceeds the stored value the RCM will trigger the air bag modules and the safety belt pretensioners as required. The RCM can be used again after a collision, provided the RCM is not physically damaged and it passes a self-test.

Passenger air bag deactivation switch


E135479

When the ignition is switched on, a warning lamp in the instrument panel indicates that the passenger air bag module has been deactivated.

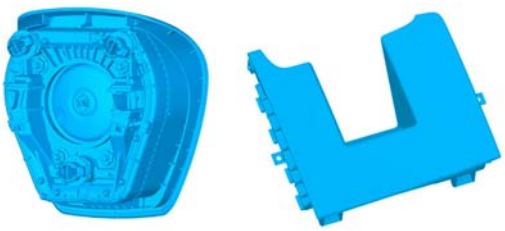
Air bag warning indicator


E135478

The airbag warning indicator is active when an airbag system Fault has occurred or the airbag module is disconnected. The indicator will have a predetermined bulb prove- out following ignition being turned to 'Run' configurable with restraints system.

DESCRIPTION AND OPERATION

Driver air bag and driver lower air bag



E135480

This vehicle line is available with a steering wheel mounted driver air bag and a driver lower air bag (knee air bag).

Side impact sensors

1. Side impact sensor (Front doors)



E135481

There are two side impact sensors located in the front driver and passenger doors. The sensors transmit digitally encoded pressure information to the RCM, where it is evaluated to assess the severity of a side impact. Power is supplied to the sensor by the RCM. If the sensor fails, the RCM stores a diagnostic trouble code (DTC).

2. Side impact sensor (Rear side)



E135483

There are two side impact sensors located at the bottom of the C-pillars in stretch cab and double cab variants. The sensors transmit digitally encoded acceleration information to the RCM, where it is evaluated to assess the severity of a side impact. Power is supplied to the side impact sensor by the RCM. If the senor fails, the RCM stores a diagnostic trouble code (DTC).

Side air curtain

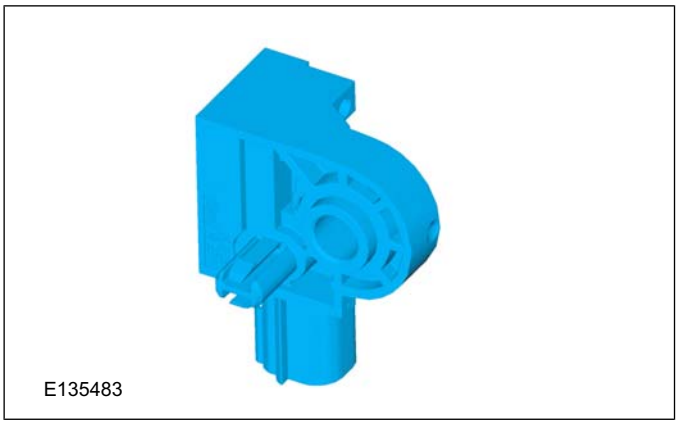


E135482

In the event of a side impact, the side air curtains (curtain air bags) deploy from the headliner, protecting the first and second row outboard occupants during a side impact.

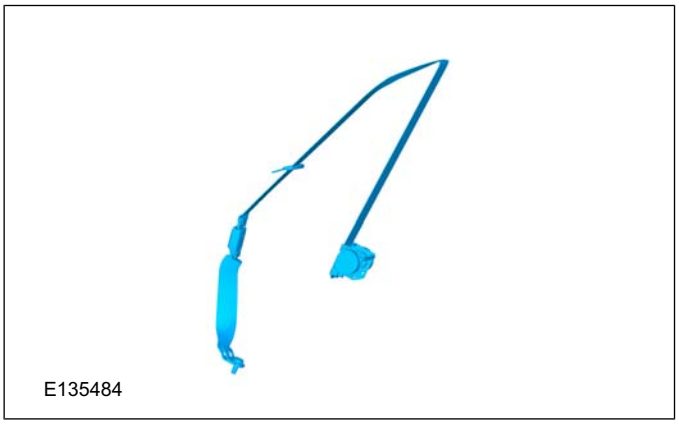
DESCRIPTION AND OPERATION

Front impact severity sensor



There are two front impact severity sensors located at the front of the vehicle, behind the radiator grille. The sensors transmit digitally encoded acceleration information to the RCM, where it is evaluated to assess the severity of a front impact. Power is supplied to the sensor by the RCM. If the sensor fails, the RCM stores a diagnostic trouble code (DTC).

Safety belt retractor and pretensioners

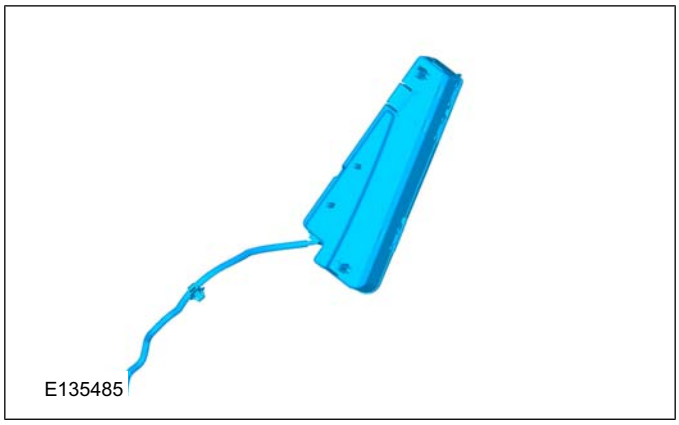


The front outboard seat belts are available equipped with a retractor pretensioner and load limiter. In the event of a collision, the safety belt pretensioner deploy in one of two ways:

- On their own.
- Simultaneously with the front air bag module(s).

Safety belt use is necessary to obtain the best occupant protection and to receive the full advantage of the SRS.

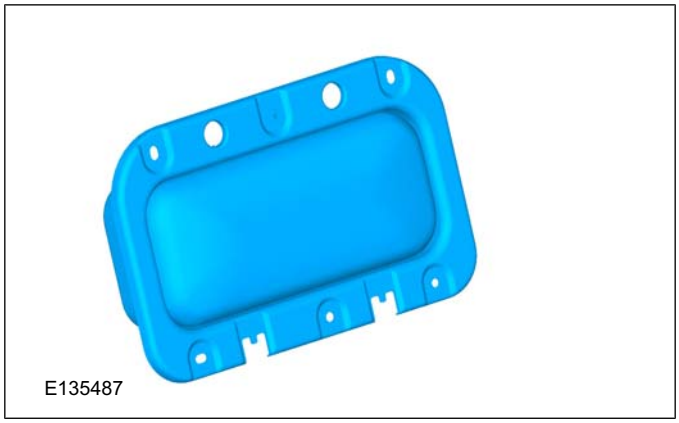
Side air bag



The side air bags are incorporated in the front seat backrests and side air bag modules deploy from the outboard of front seat backrest upon a side impact.

When a side air bag is deployed, the seam of the seat cover tears open enabling the side air bag to inflate unhindered from the front seat backrest.

Passenger air bag



The passenger air bag is designed to provide increased collision protection for front seat passengers.

GENERAL PROCEDURES

Clockspring Adjustment

General Equipment

Adhesive Tape

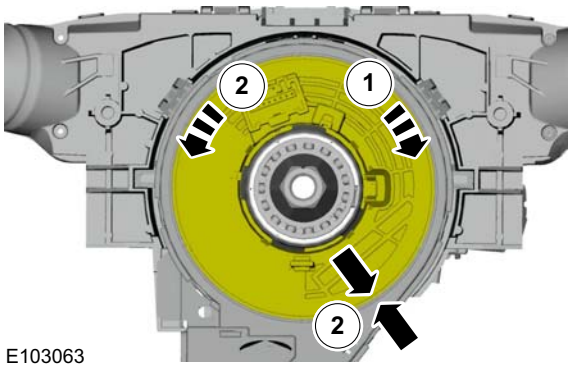
WARNINGS:

If there is a break between installing the clockspring and steering wheel rotation sensor assembly and installing the steering wheel, the centralizing of the clockspring must be repeated.

If the centralization of the clockspring is in doubt, the centralizing of the clockspring must be repeated.

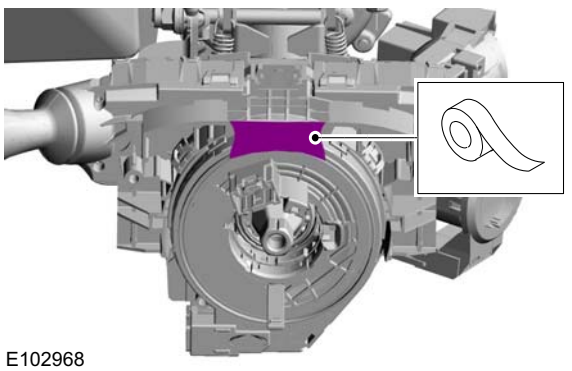
NOTE: Make sure that the road wheels are in the straight ahead position.

1. 1. Turn the clockspring in a clockwise direction until a resistance is felt.
2. Turn the clockspring in a counterclockwise direction 2.5 revolutions, until the arrow marked on the rotor of the clockspring aligns with the raised 'V' section on the outer cover of the clockspring.



2. **CAUTION: Make sure that the clockspring rotor does not rotate.**

General Equipment: Adhesive Tape



GENERAL PROCEDURES

Deployed Air Bag Disposal

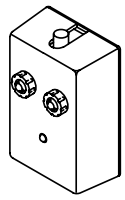
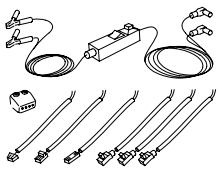
WARNING: After deployment, the air bag module surface may contain deposits of sodium hydroxide, a product of the gas generate combustion, that is irritating to the skin. Use protective gloves when handling any deployed air bag module. Failure to follow this instruction may result in personal injury.

1. **Remove the deployed air bag module(s). For additional information, refer to the relevant procedure in this section.**
2. **Seal the deployed air bag module(s) in the packaging from the new air bag module(s) or a suitable polythene bag, and then dispose of in accordance with local contaminated waste regulations.**

GENERAL PROCEDURES

Scrapped Vehicle Air Bag and Safety Belt Pretensioner Disposal - In-Vehicle Disposal

Special Tool(s)

	418-143 Adapter Box (AC)
	418-S055C Test and Deployment Lead, Air Bag/Pyrotechnic Safety Belt

Disposal

WARNINGS:

To avoid accidental deployment, the restraints control module (RCM) backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.

To minimize the possibility of premature deployment, do not use radio key code savers when working on the SRS. Failure to follow this instruction may result in personal injury.

Before deploying the air bag module or safety belt pretensioner pyrotechnic make sure that all personnel in the vicinity are aware that a loud noise (bang) is about to occur. Do not let anybody approach closer than 6 meters. Failure to follow this instruction may result in personal injury.

The air bag module or the safety belt pretensioner should not be handled immediately following deployment as the air bag module will be very hot. Failure to follow this instruction may result in personal injury.

After deployment, the inflator(s) becomes inert, direct contact to the skin or eyes of any free pyrotechnic residues should be avoided. Failure to follow this instruction may result in personal injury.

Always wear gloves and safety glasses when handling deployed air bag modules and safety belt pretensioners, Failure to follow this instruction may result in personal injury.

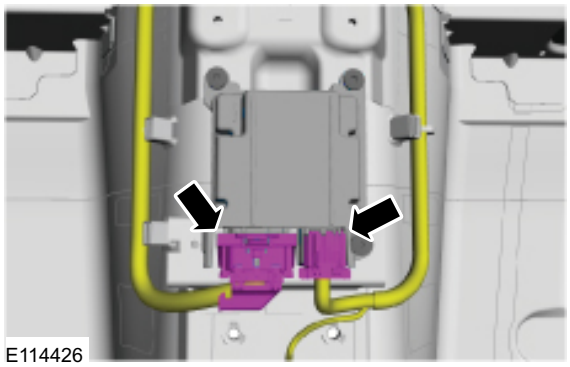
If the air bag module or safety belt pretensioner pyrotechnic residue should contact the eyes, wash the eyes with clean water and seek medical assistance. Failure to follow this instruction may result in personal injury.

If a large amount of air bag or safety belt pretensioner pyrotechnic residue is inhaled, seek medical assistance. Failure to follow this instruction may result in personal injury.

3. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

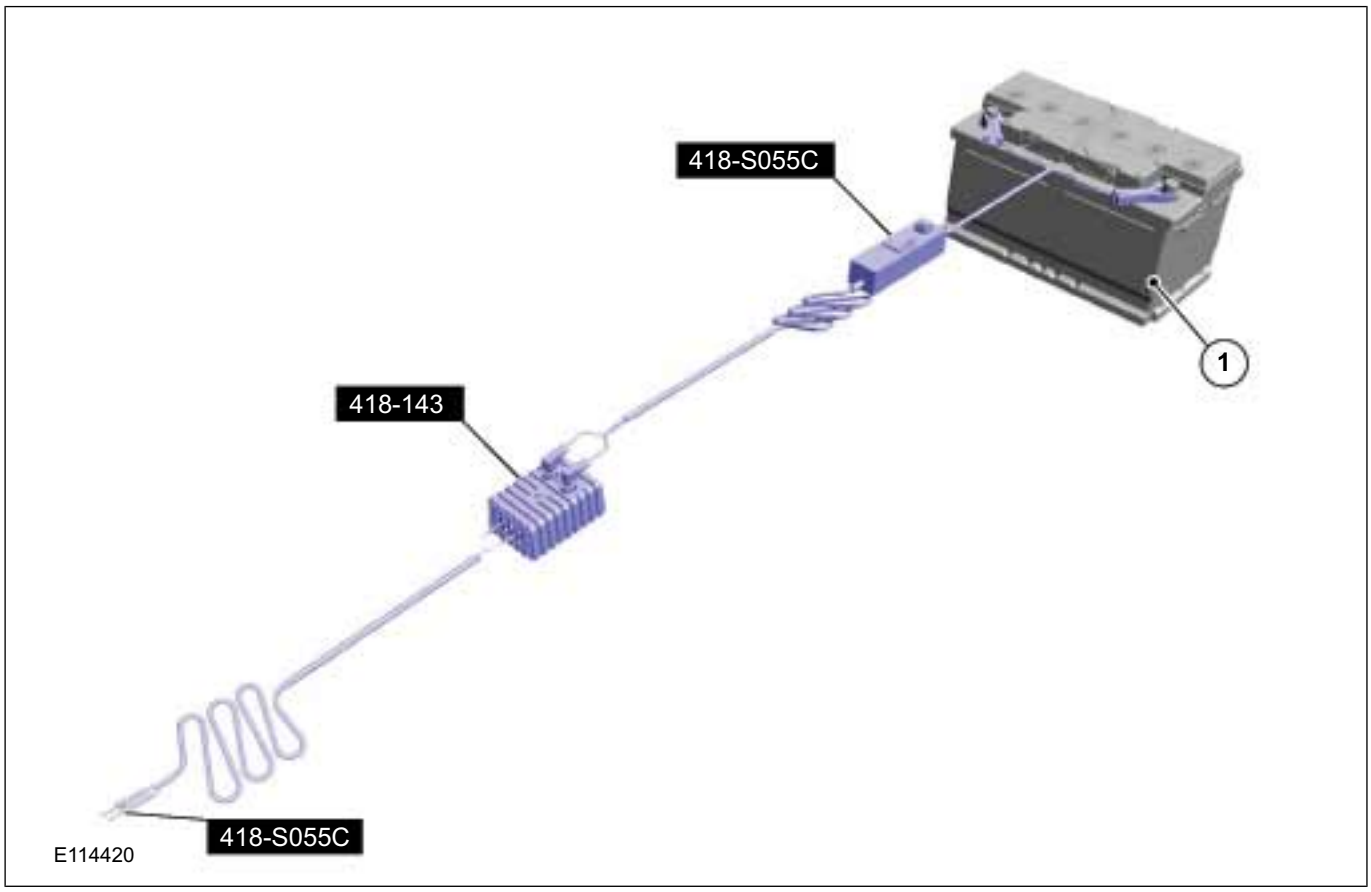
4. Refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).
   Refer to: Floor Console Extension - Vehicles With: Center Armrest (501-12, Removal and Installation).

5.

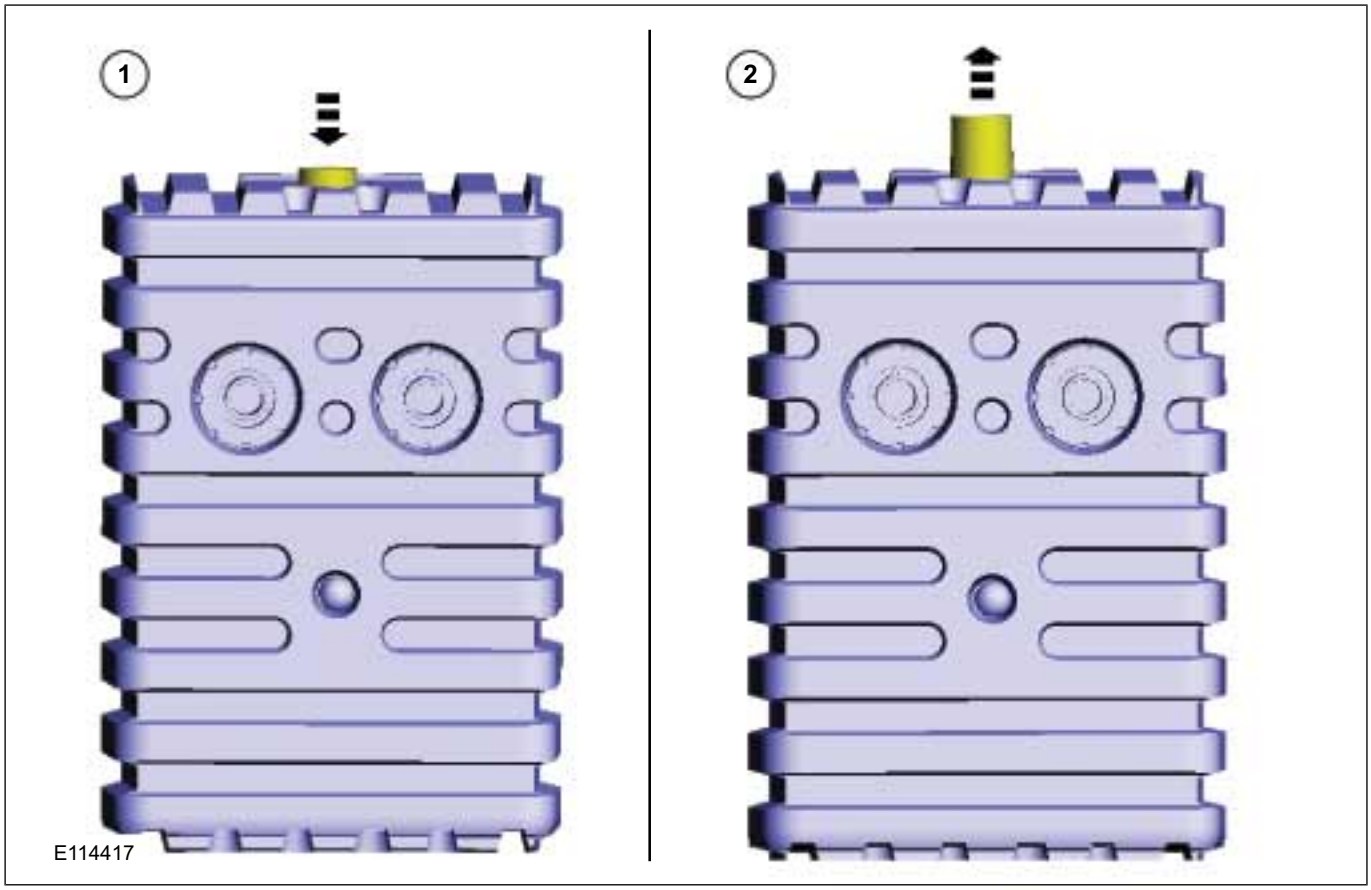


6. 1. 12 volt battery.
   Special Tool(s): 418-143, 418-S055C

GENERAL PROCEDURES

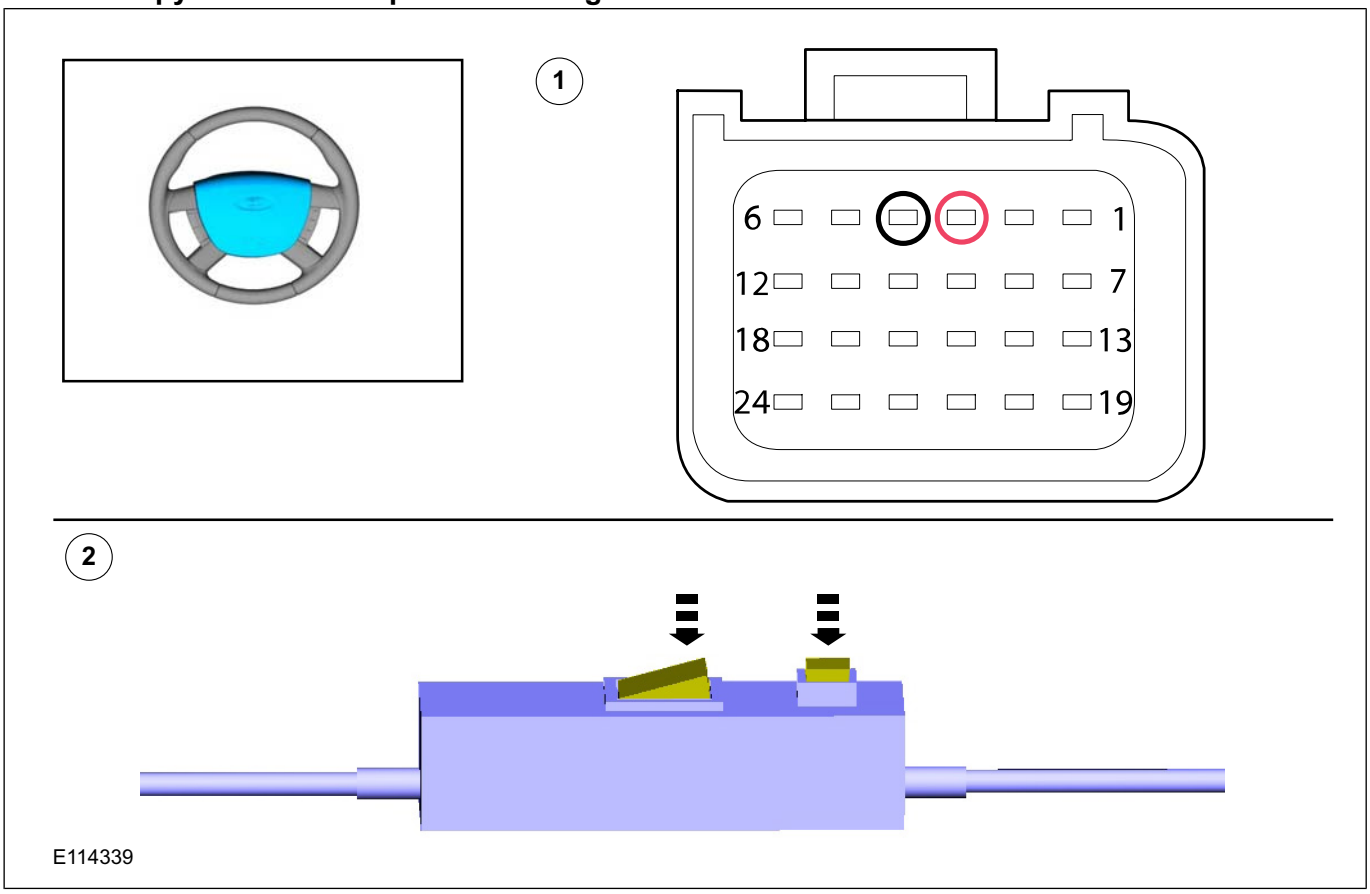


7.



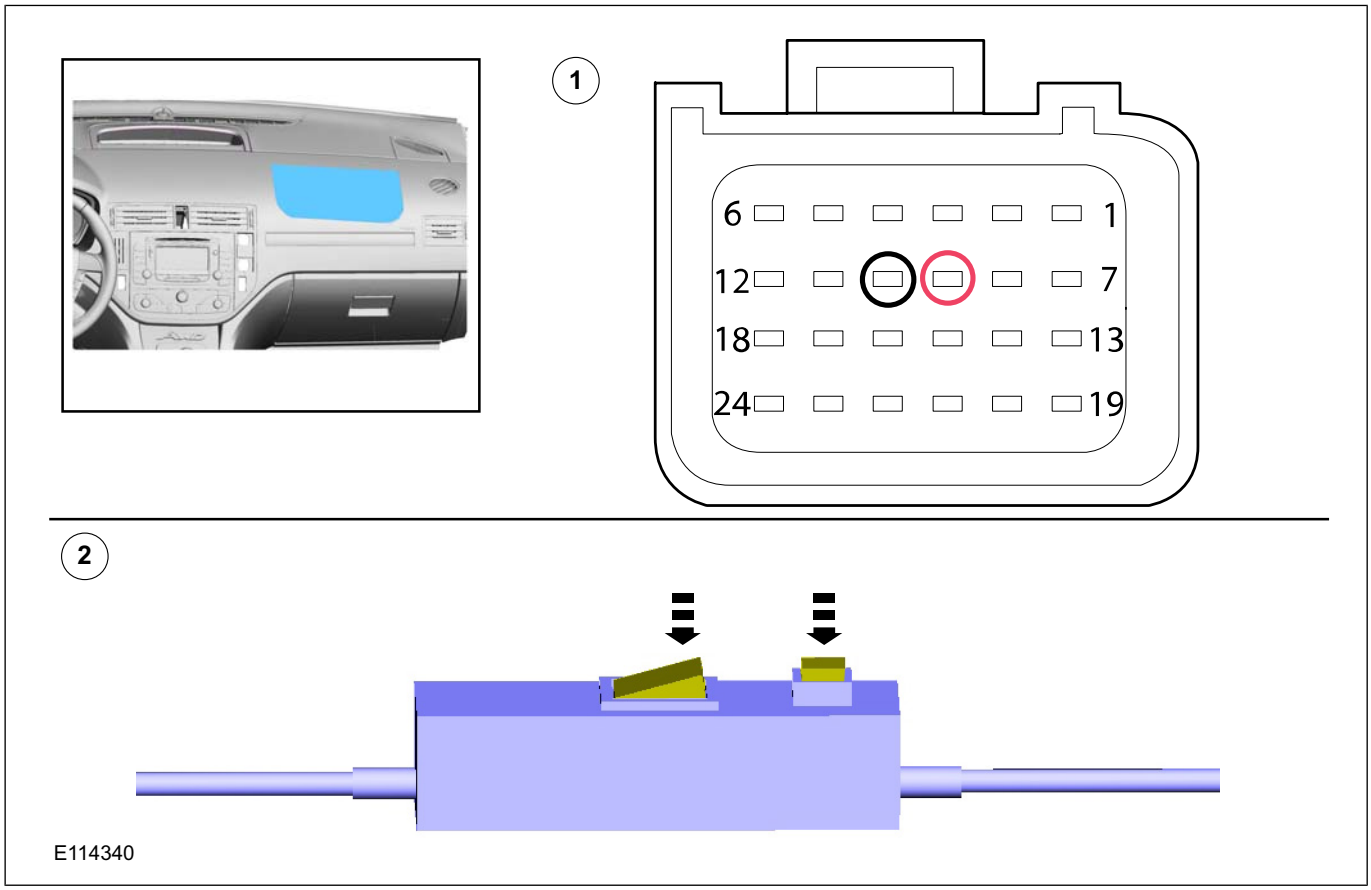
GENERAL PROCEDURES

8. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**



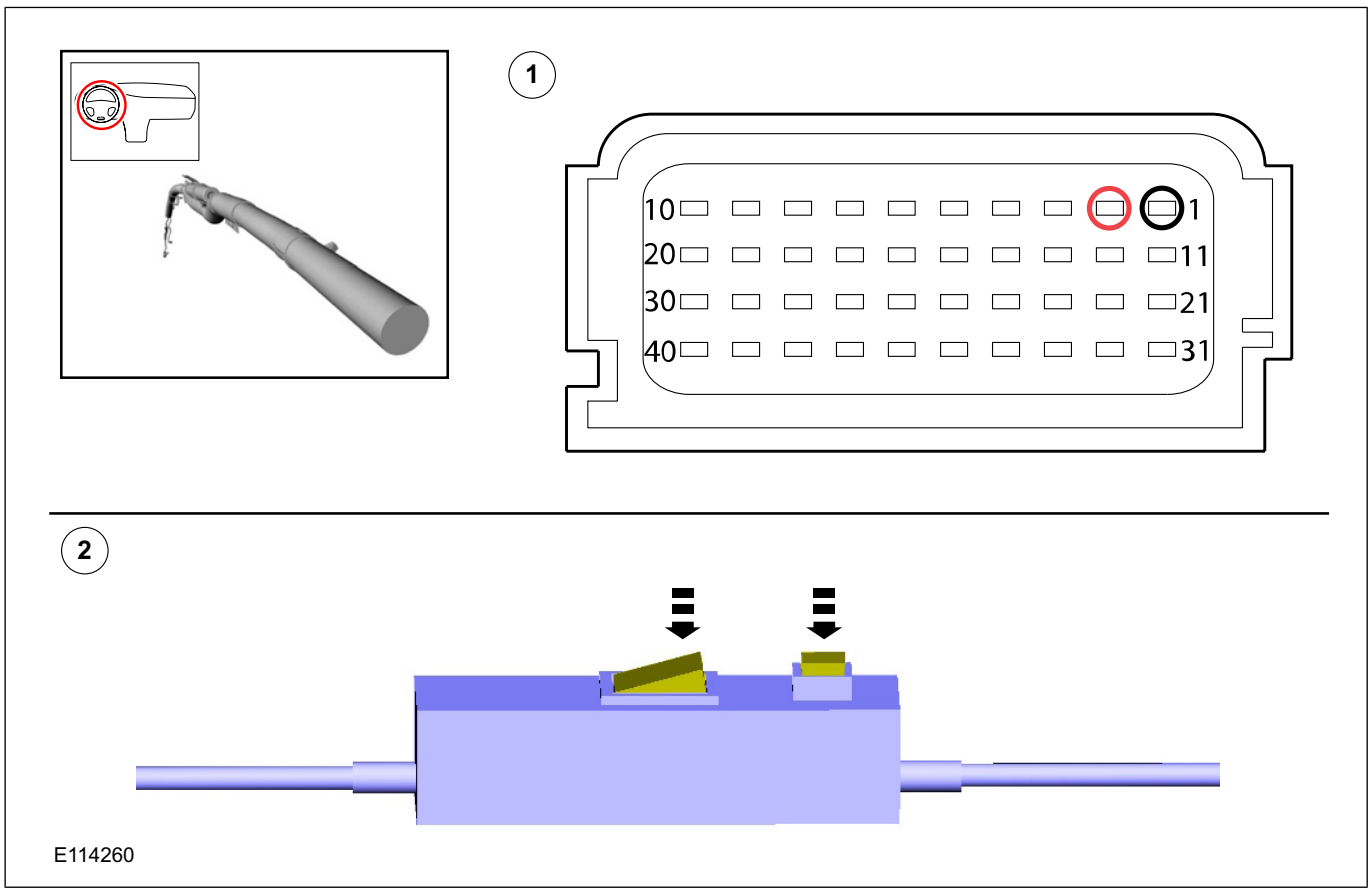
9. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



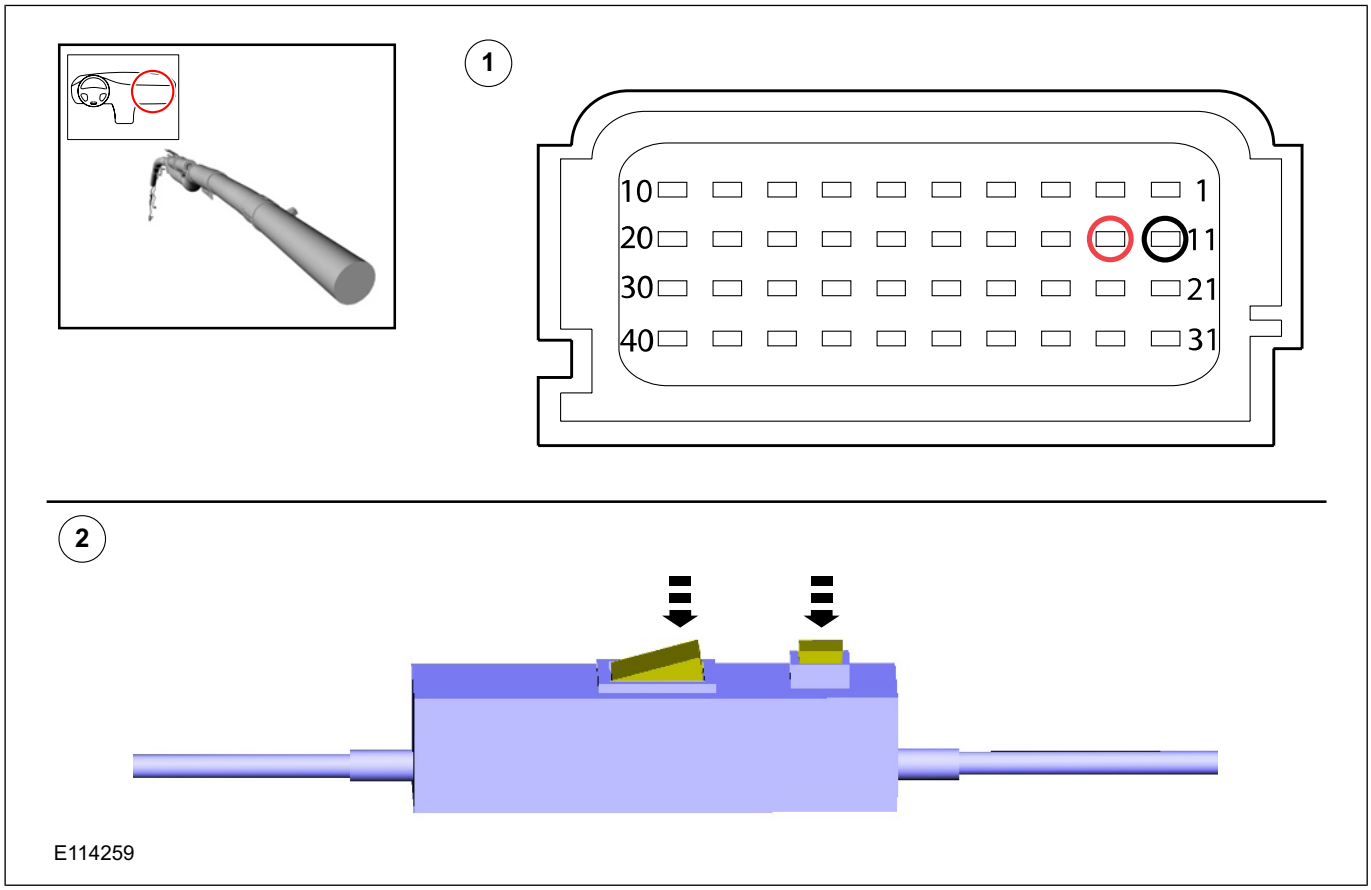
10. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



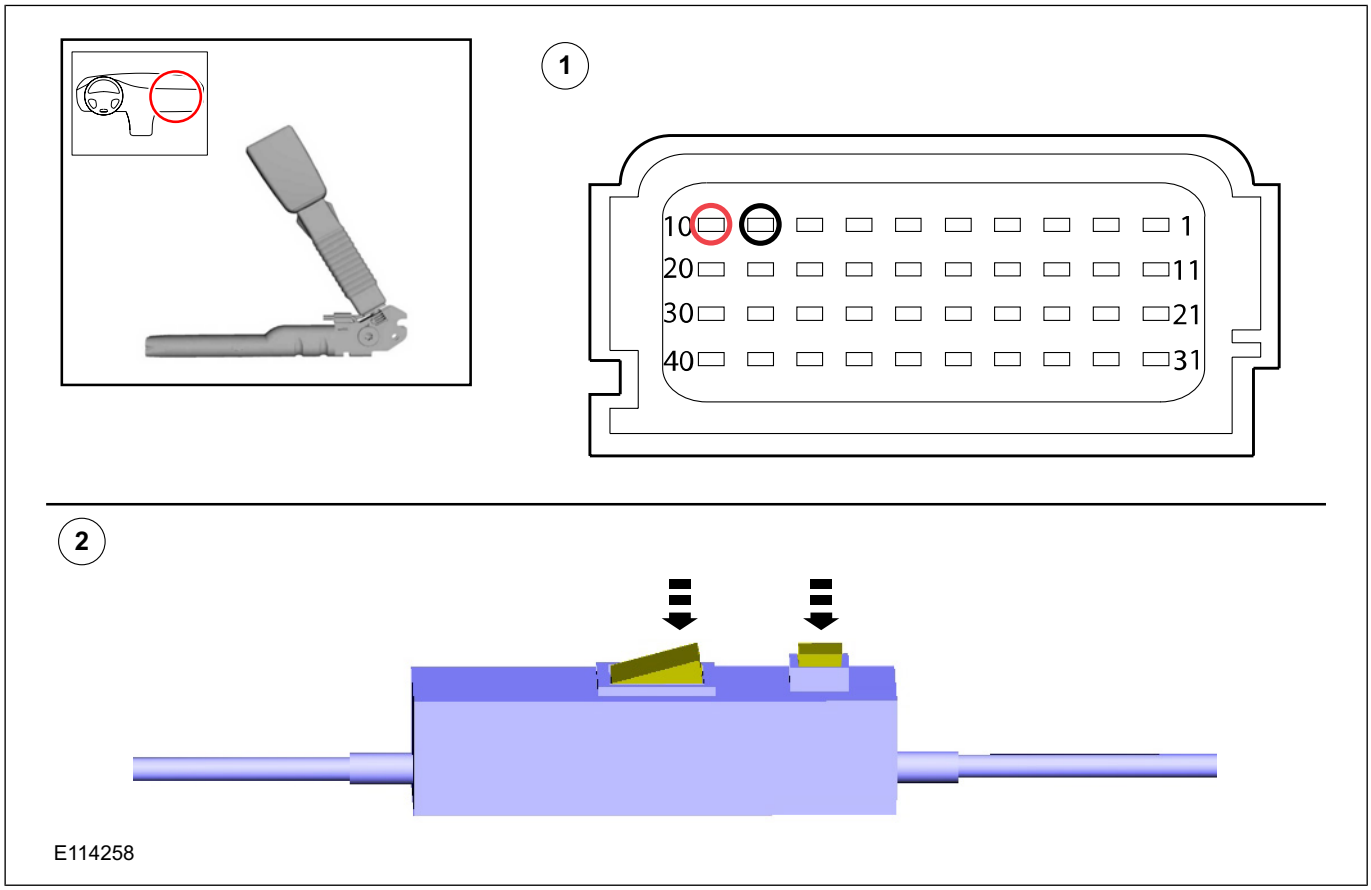
11. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



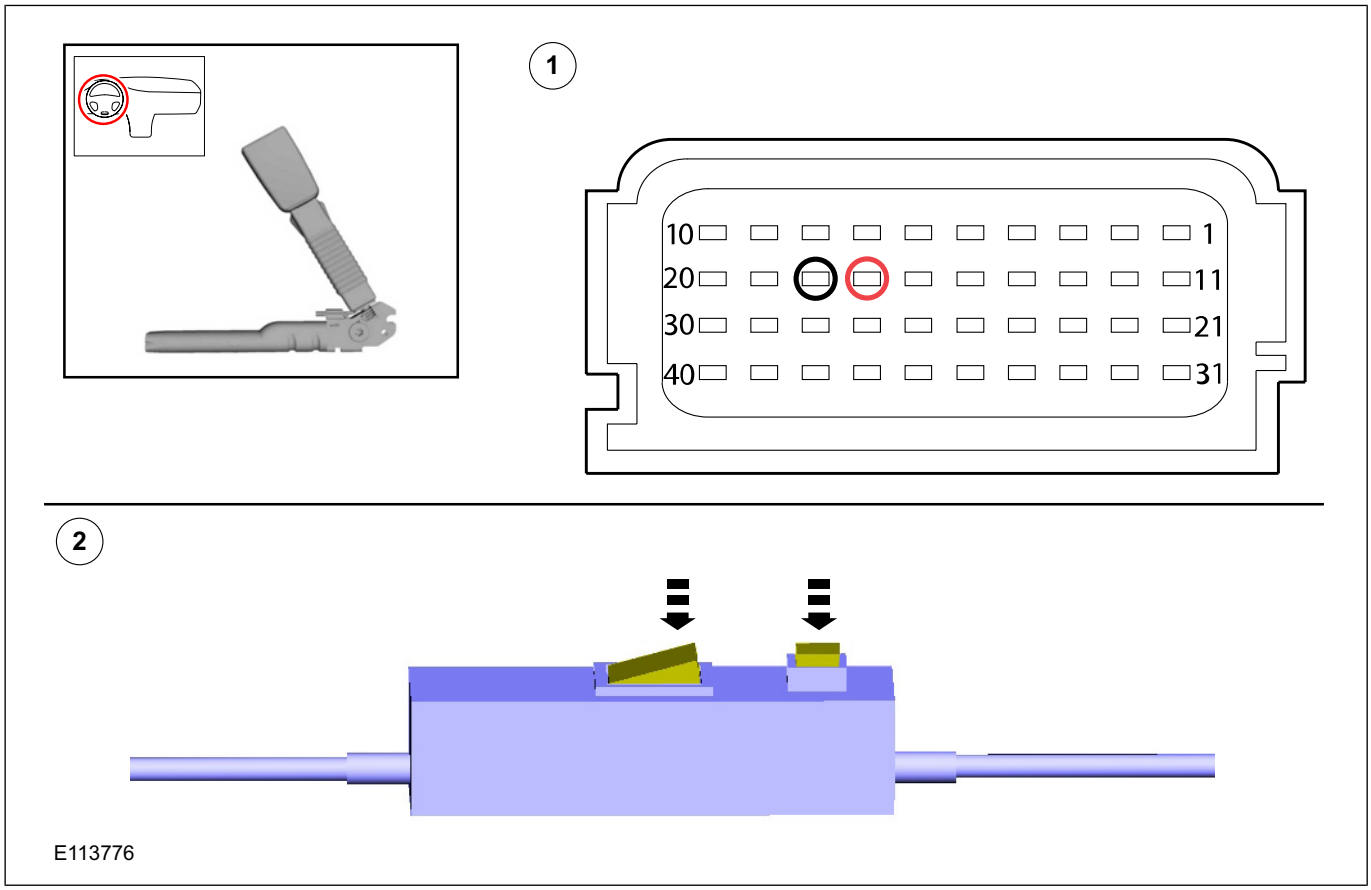
12 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



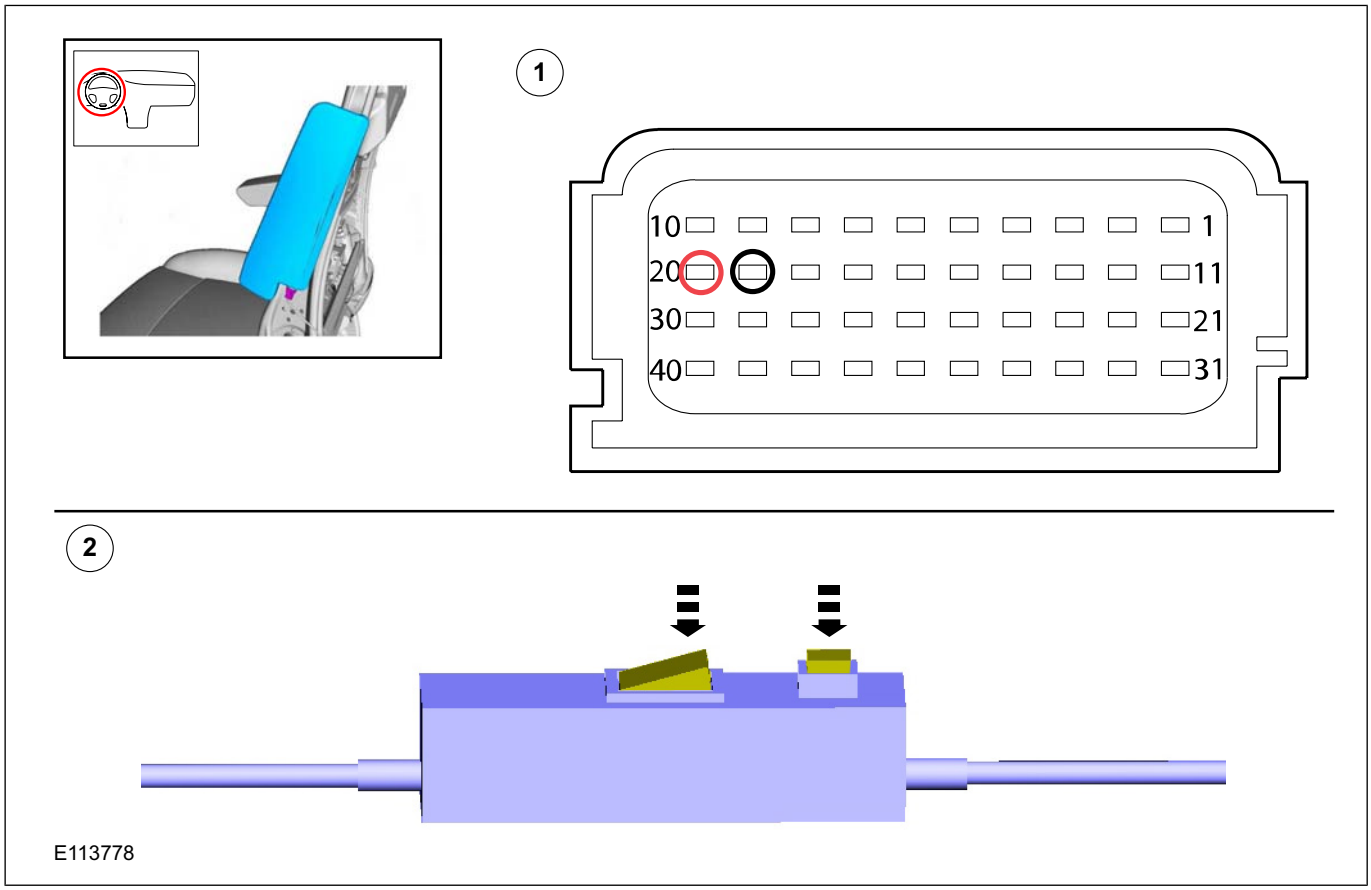
13. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



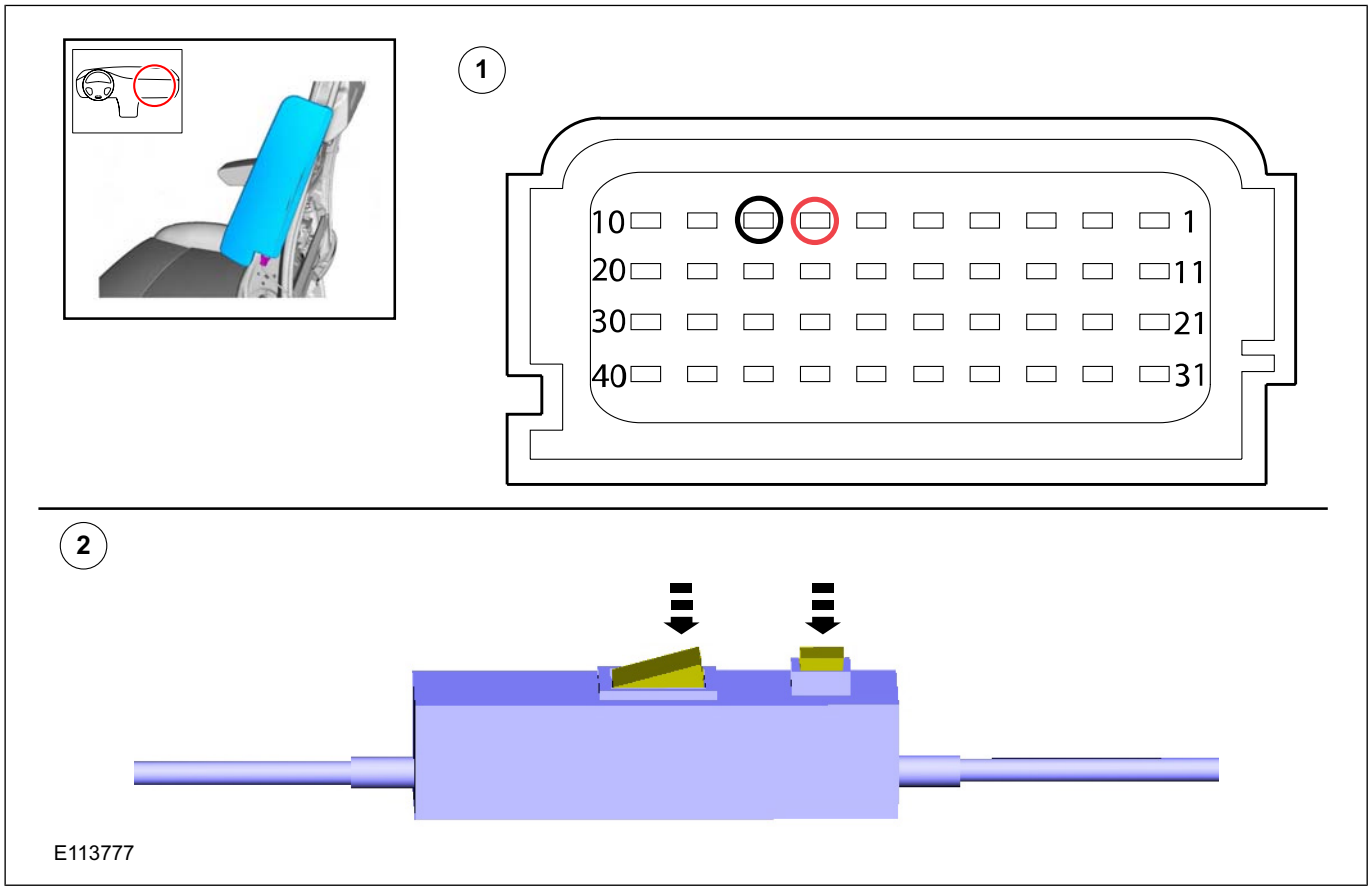
14. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



15. 2. **WARNING: Make sure to be a minimum distance of 6 meters from pyrotechnic components during deployment. If possible stand behind a wall.**

GENERAL PROCEDURES



16. Deployed air bag module(s) and safety belt pretensioners should be sealed in suitable bags and then disposed of in accordance with local contaminated waste regulations.

17. **NOTE:** All unserviceable air bag modules have been placed on the Mandatory Return List. All discolored or damaged air bag modules should be treated the same as any unserviceable live air bag module being returned.

    Refer to: Front Safety Belt Retractor (501-20A, Removal and Installation).
    Refer to: Driver Air Bag Module (501-20B, Removal and Installation).
    Refer to: Passenger Air Bag Module (501-20B, Removal and Installation).
    Refer to: Side Air Bag Module (501-20B, Removal and Installation).
    Refer to: Side Air Curtain Module (501-20B, Removal and Installation).

18. **WARNING: Under no circumstances is an unserviceable air bag module or safety belt pretensioner to be returned through the local mailing system. Failure to follow this instruction may result in personal injury.**

    If an air bag module or safety belt pretensioner fails to deploy, seal the unserviceable air bag module or safety belt pretensioner in suitable packaging and return to the Exchange Plan Center, as appointed through the local National Sales Company

GENERAL PROCEDURES

Unserviceable Air Bag Disposal

1. **WARNINGS:**

   To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.

   To prevent premature deployment, live air bag modules must only be placed on work benches which have been ground bonded. Failure to follow this instruction may result in personal injury.

   NOTE: All unserviceable air bag modules have been placed on the Mandatory Return List. All discolored or damaged air bag modules should be treated the same as any unserviceable live air bag module being returned.

   Remove the unserviceable air bag module. For additional information, refer to the relevant procedure in this section.

2. **WARNING: Under no circumstances is an unserviceable air bag module(s) to be returned through the local mailing system. Failure to follow this instruction may result in personal injury.**

   Seal the unserviceable air bag module(s) in the packaging from the new air bag module(s) and address to the appropriate manufacturer. The package should then be forwarded to the Exchange Plan Center (as appointed through the national sales company) who will arrange forwarding to the manufacturer.

3. **NOTE: Autoliv air bag modules and seat belt pretensioners.**

   Autoliv Gmbh, Theodor Heuss Strasse 2, 85221, Dachau, Germany.

4. **NOTE: TRW air bag modules.**

   TRW Occupant Restraint Systems, FAO Rene Getto, Industriestr 20, 73551, Aldorf, Germany.

5. **NOTE: TRW seat belt pretensioners.**

   TRW Occupant Restraint Systems, FAO Helmut Goss, Industriestr 20, 73551, Aldorf, Germany.

6. **NOTE: Takata Petri air bag modules.**

   Takata Petri AG, Grossostheimer Strasse 223, D-63741 Aschaffenburg, (Supplier Code P790M) Germany.

GENERAL PROCEDURES

Unserviceable Air Bag Disposal

1. Information not available at this time.

REMOVAL AND INSTALLATION

Driver Air Bag Module

General Equipment

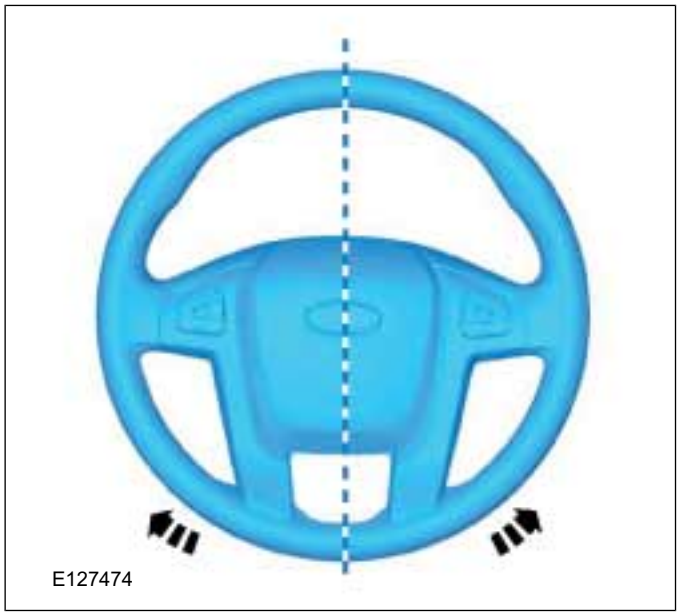
Flat Headed Screw Driver

Removal

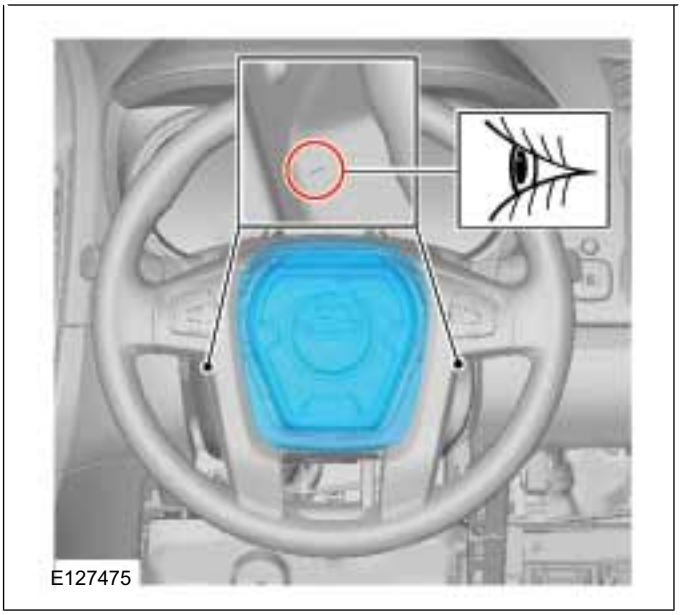
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

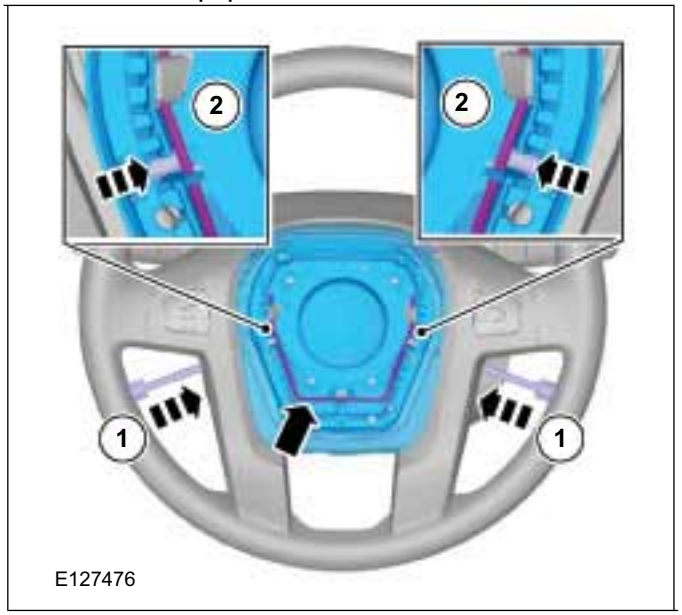
1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. **NOTE:** Make sure that the road wheels are in straight ahead position.


E127474

4. Depending on the vehicle variant, steering wheels with a different design for cut marks can be fitted.


E127475

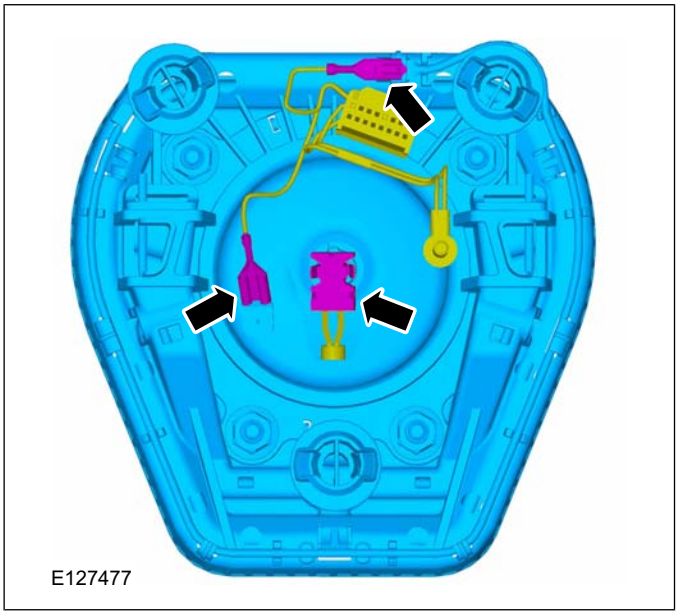
5. General Equipment: Flat Headed Screw Driver



E127476

REMOVAL AND INSTALLATION

6.



Installation

1. To install, reverse the removal procedure.

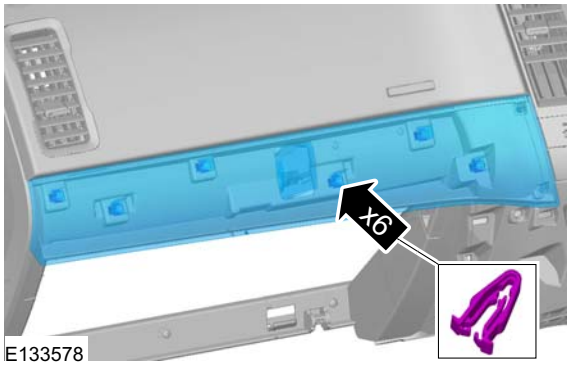
REMOVAL AND INSTALLATION

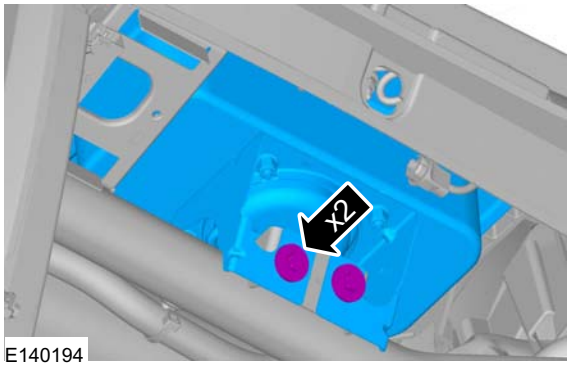
Passenger Air Bag Module

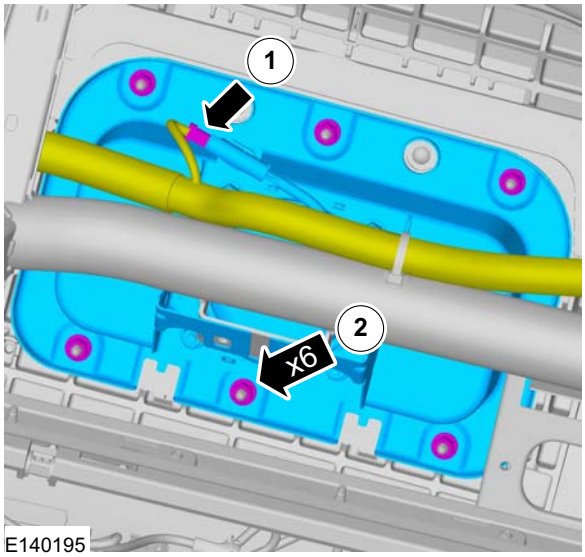
Removal

WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Glove Compartment - Removal (501-12 Instrument Panel and Console, Removal and Installation).
3. 

4. Torque: 7 Nm


5. **NOTE:** Take extra care when handling the component.
   Torque: 6 Nm


Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Driver Lower Air Bag Module

Removal

WARNINGS:

The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

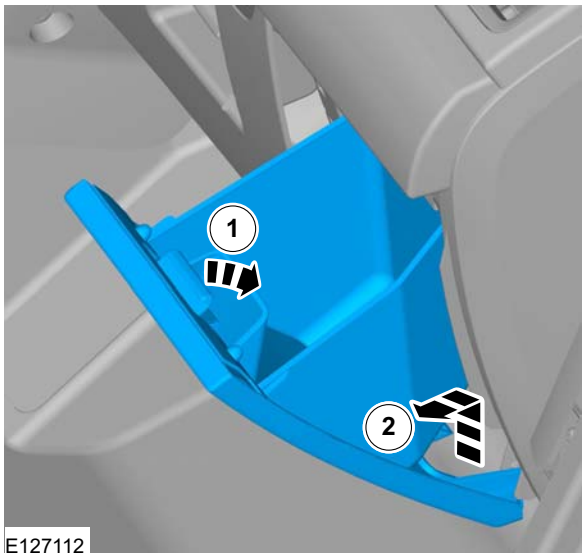
Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

NOTE: Removal steps in this procedure may contain installation details.

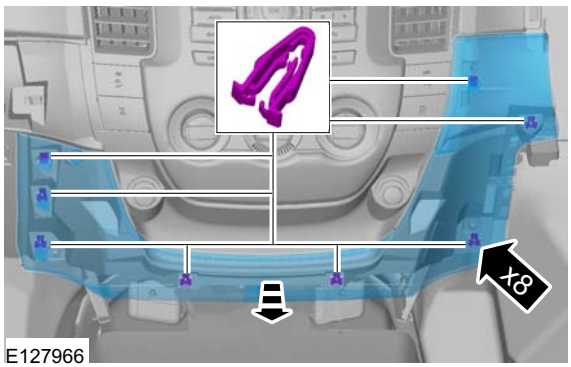
1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

3.

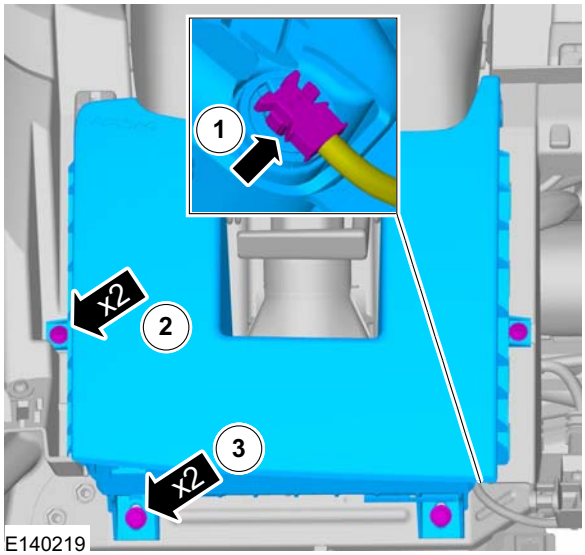


4.



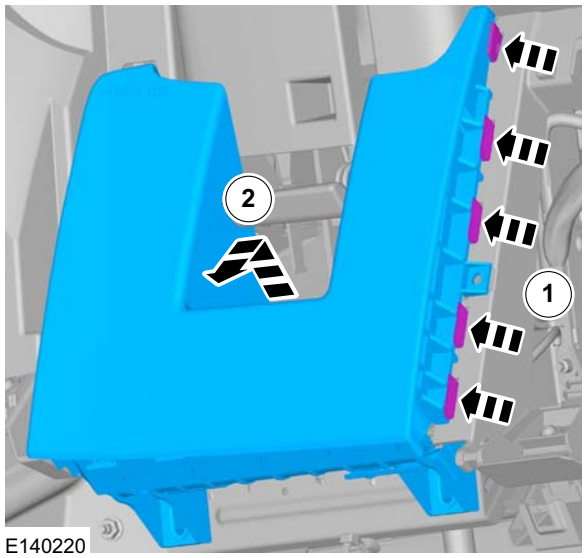
5. **NOTE:** Make sure that the steering column adjustment arm is in normal position.

   3. Torque: 9 Nm



REMOVAL AND INSTALLATION

6. 1. On both sides.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

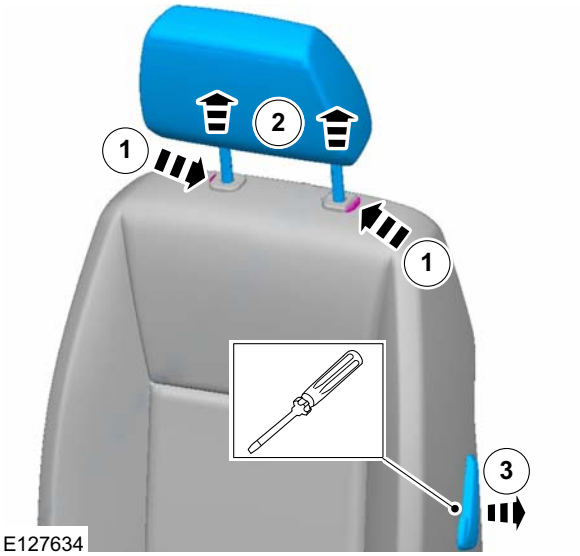
Side Air Bag Module

Removal

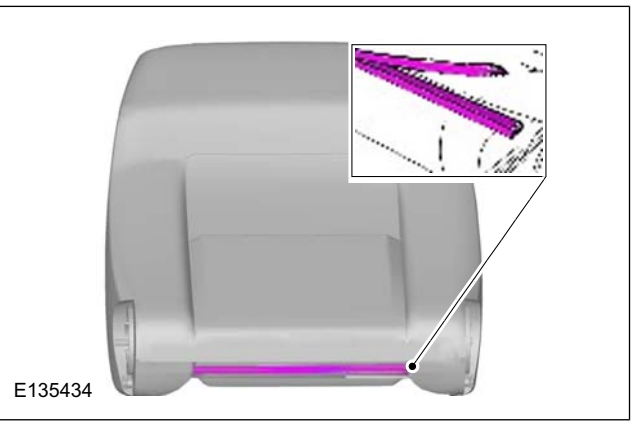
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Front Seat Backrest (501-10 Seating, Removal and Installation).

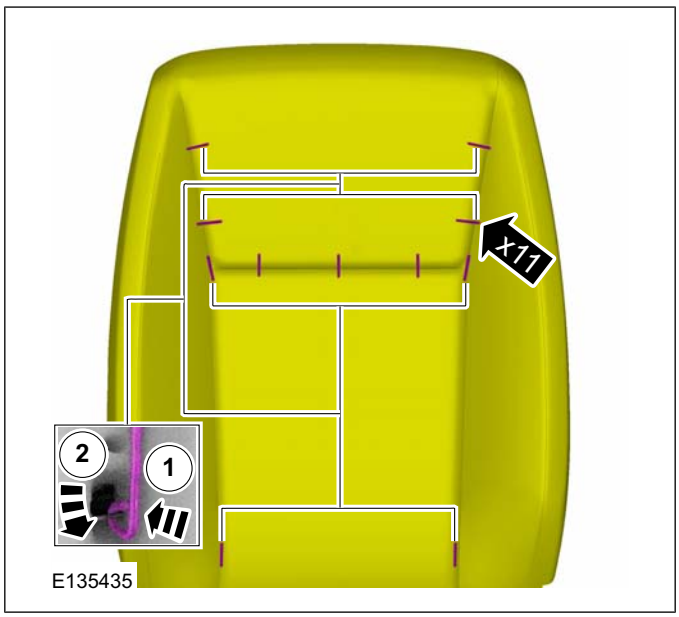
2.



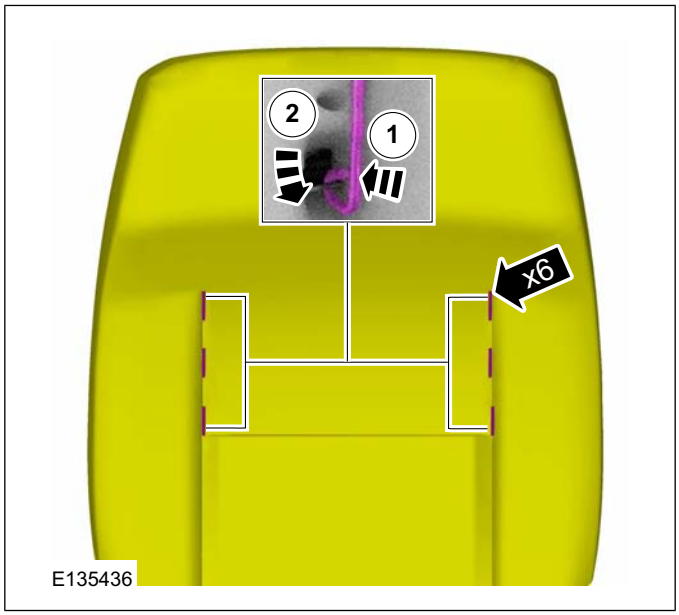
3.



4.

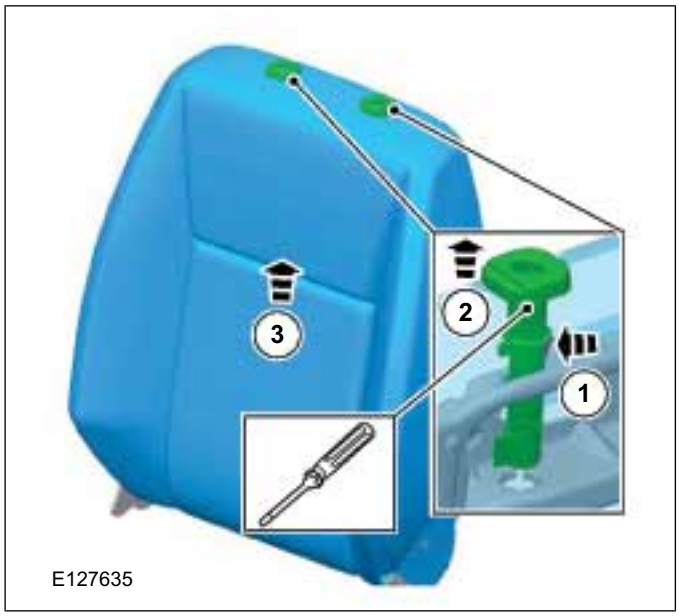


5.

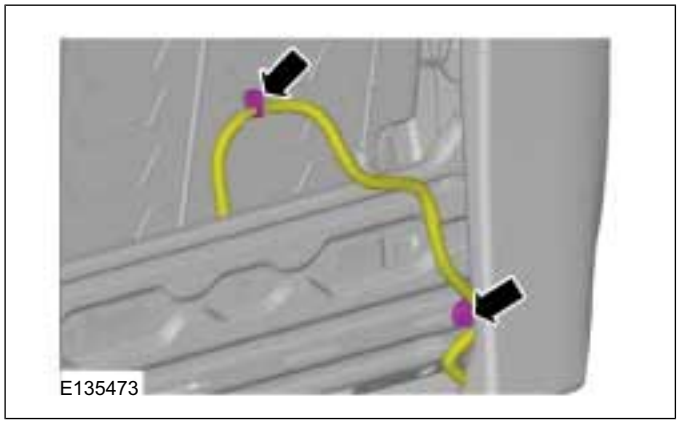


REMOVAL AND INSTALLATION

6.



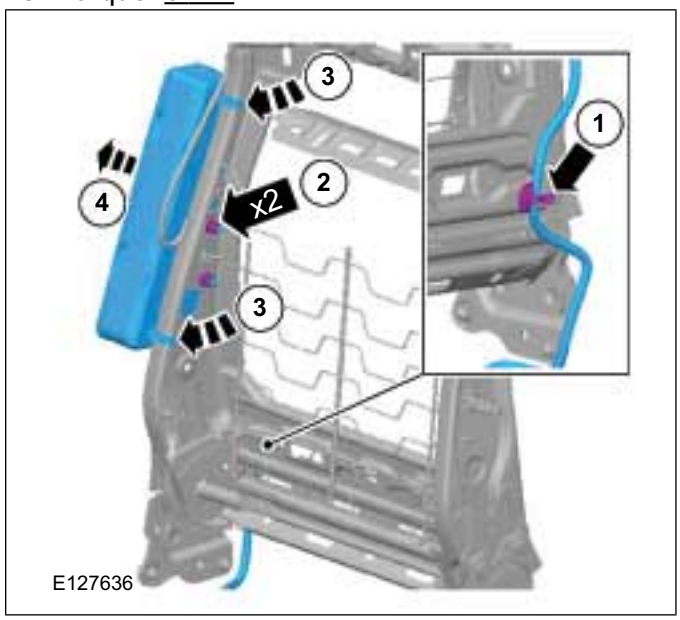
7.



8.



9. Torque: 6 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Side Air Curtain Module

General Equipment

Long Nose Pliers

Removal

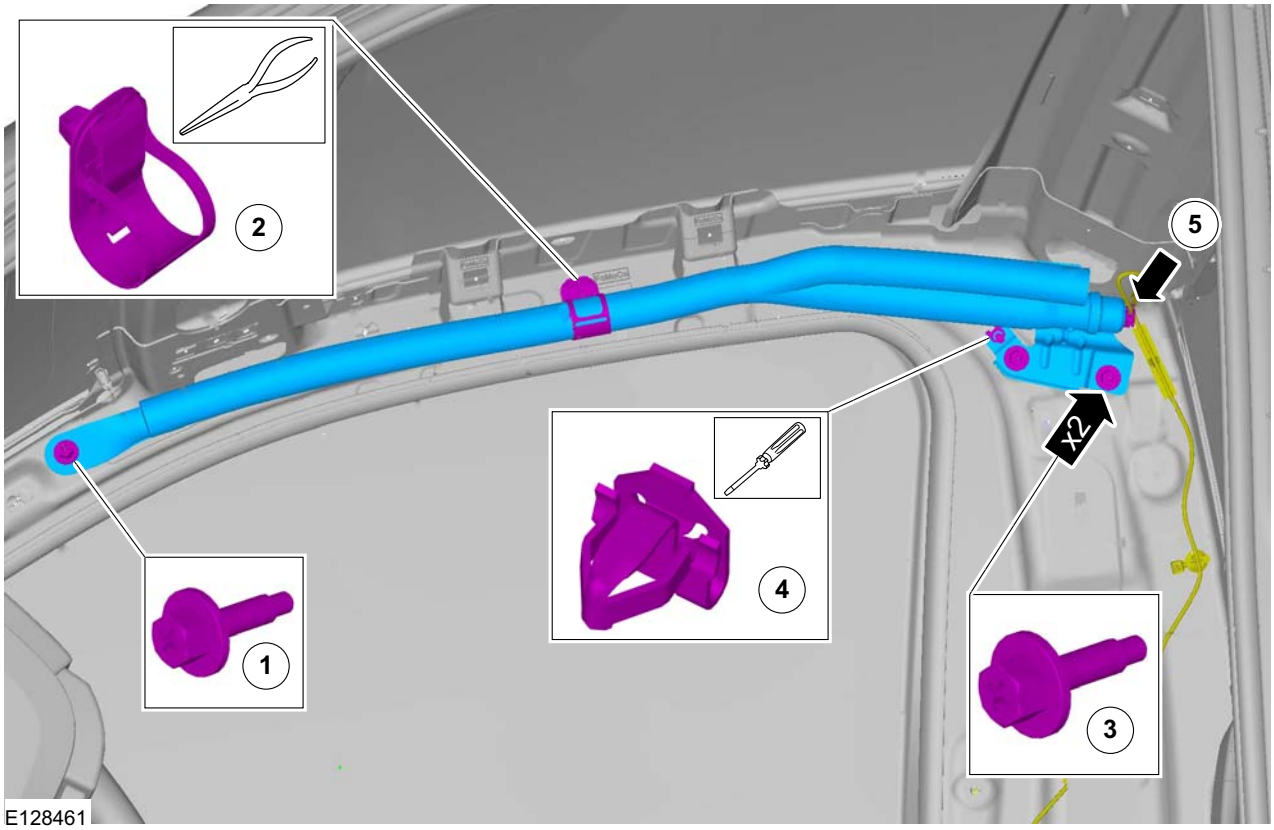
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Refer to: Headliner (501-05 Interior Trim and Ornamentation, Removal and Installation).

Single cab

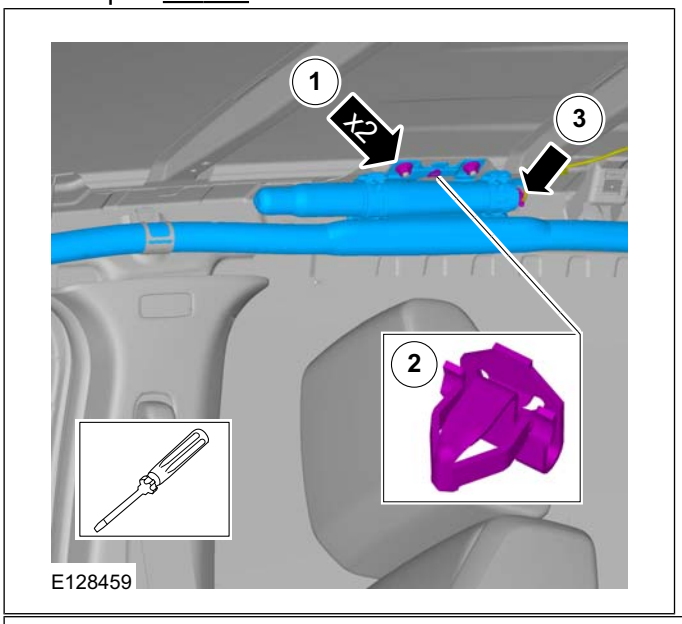
4. 1. Torque: 10 Nm
   2. General Equipment: Long Nose Pliers
   3. Torque: 10 Nm



REMOVAL AND INSTALLATION

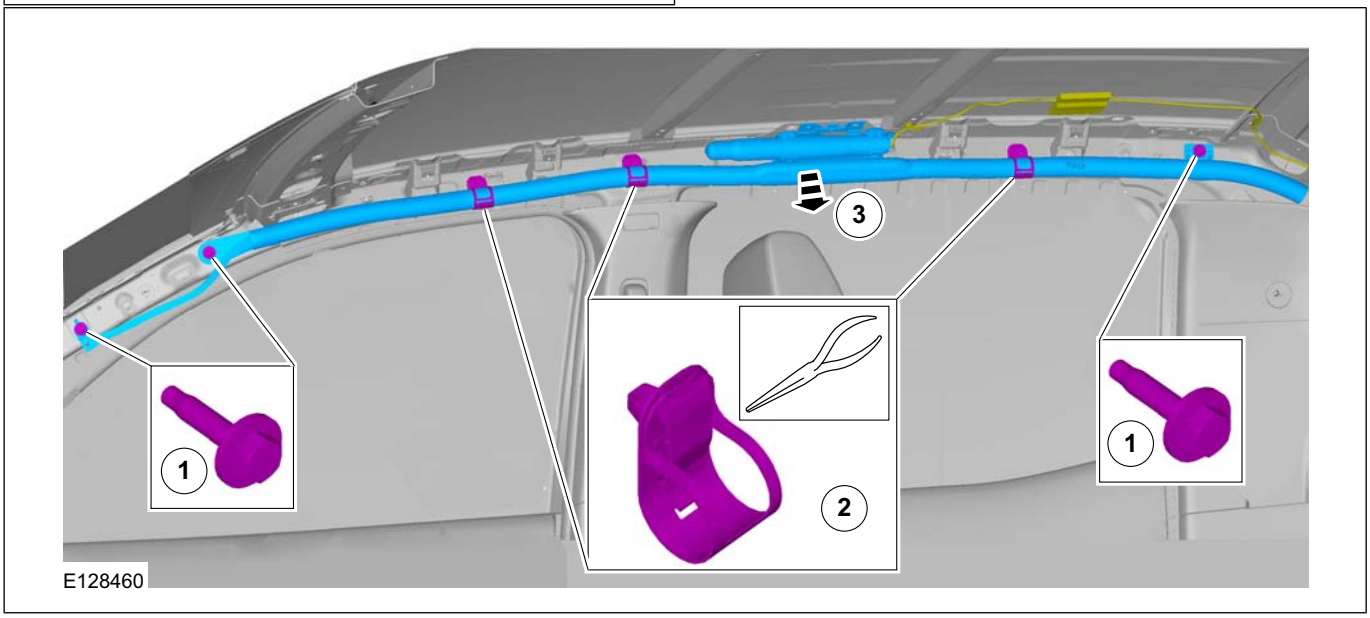
Double cab

5. On both sides.
Torque: 10 Nm



6. 1. On both sides.

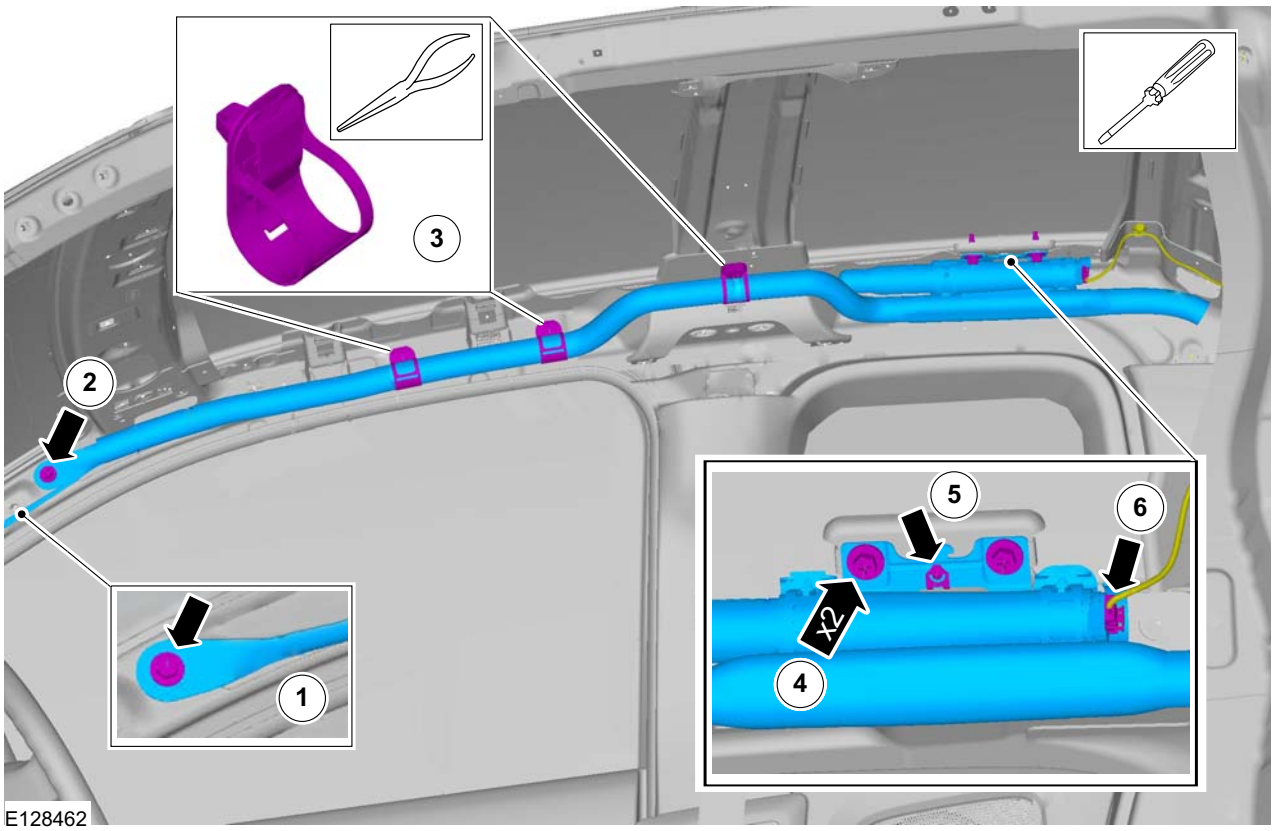
General Equipment: Long Nose Pliers
Torque: 10 Nm



Stretch cab

7. 1. Torque: 10 Nm
2. Torque: 10 Nm
3. General Equipment: Long Nose Pliers
4. Torque: 10 Nm

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

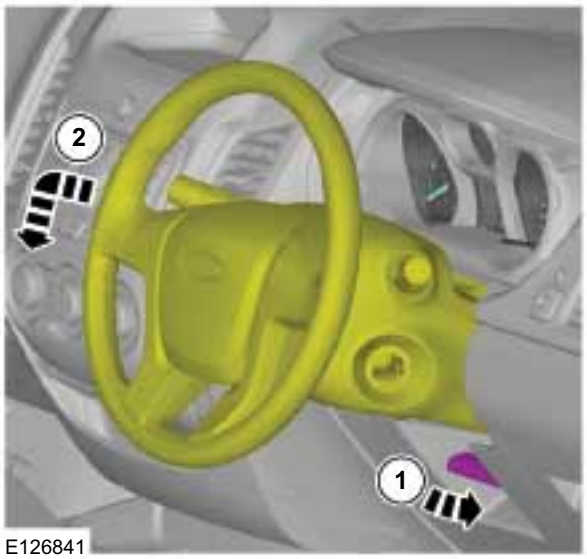
REMOVAL AND INSTALLATION

Clockspring

Removal

NOTE: Removal steps in this procedure may contain installation details.

1.



2.



3.



4.

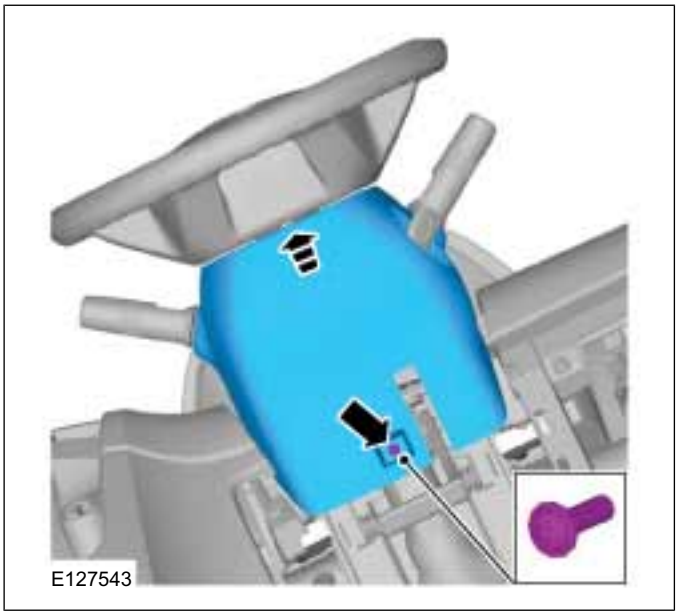


REMOVAL AND INSTALLATION

5.

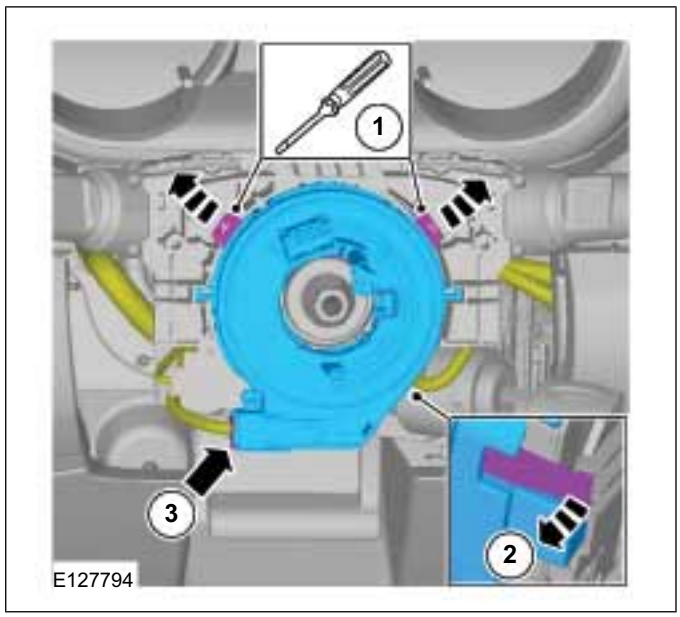


6.



7. Refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).

8.



Installation

1. To install, reverse the removal procedure.

2. Refer to: Clockspring Adjustment (501-20 Supplemental Restraint System, General Procedures).

REMOVAL AND INSTALLATION

Restraints Control Module (RCM)

Removal

WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

Double cab

2. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Stretch cab

3. Refer to: Floor Console - Double Cab (501-12 Instrument Panel and Console, Removal and Installation).

Single cab

4. Refer to: Floor Console - Single Cab (501-12 Instrument Panel and Console, Removal and Installation).

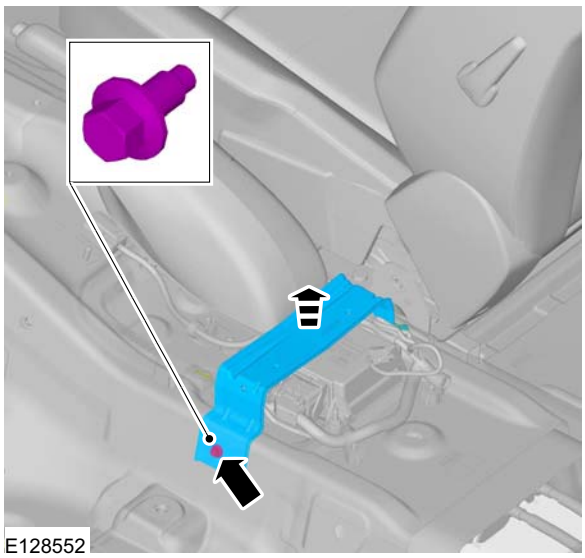
Vehicles with front bench seat

5. **NOTE:** Remove front bench seat only.
   Refer to: Front Seat (501-10 Seating, Removal and Installation).

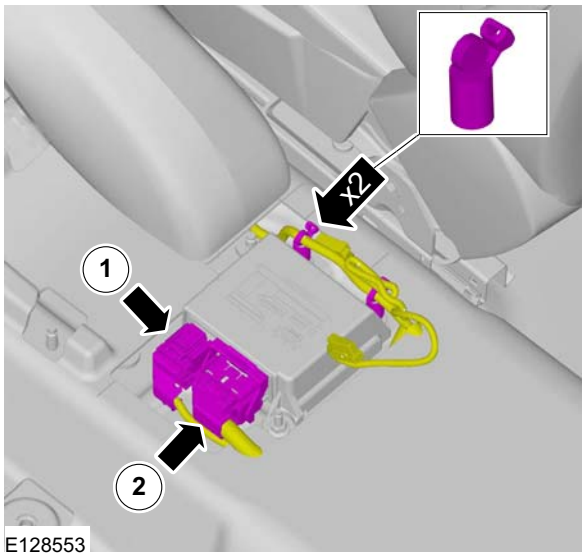
All vehicles

6. **NOTE:** Both seats must be move forward before removing the RCM module.

On both sides.
Torque: 11 Nm

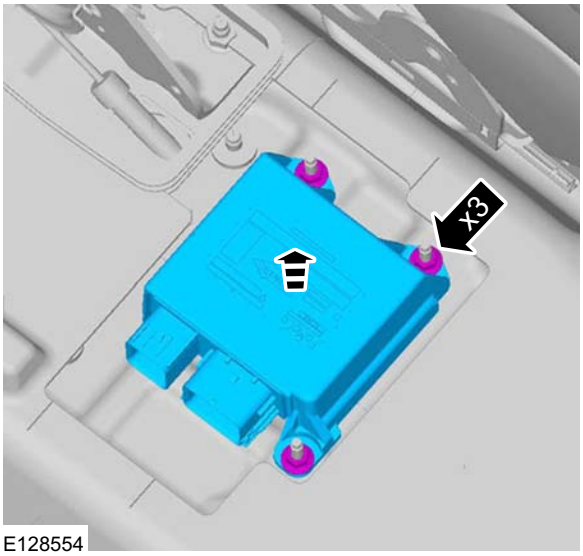


7.



REMOVAL AND INSTALLATION

8. Torque: 11 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

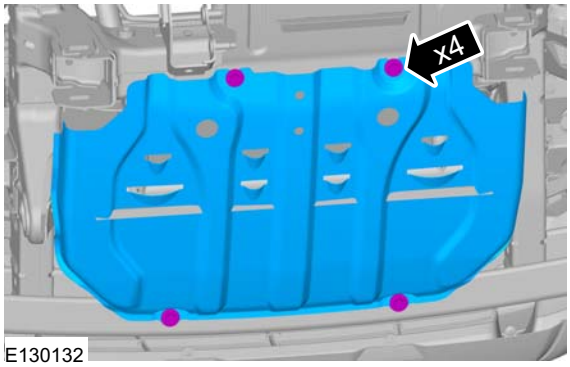
Front Impact Severity Sensor

Removal

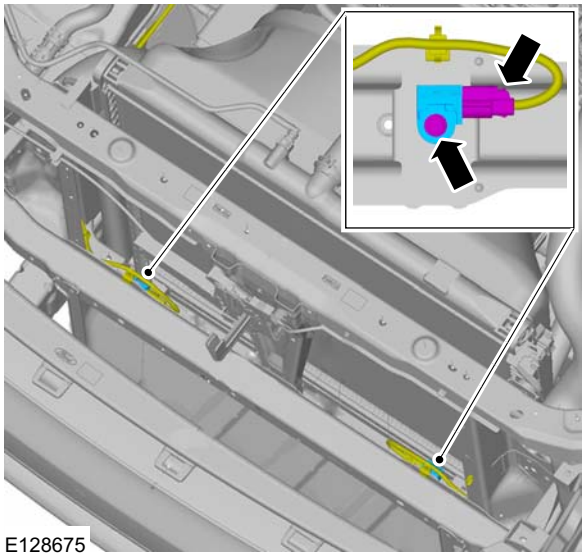
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Lifting (100-02 Jacking and Lifting, Description and Operation).
3. Torque: 30 Nm



4. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Side Impact Sensor

Removal

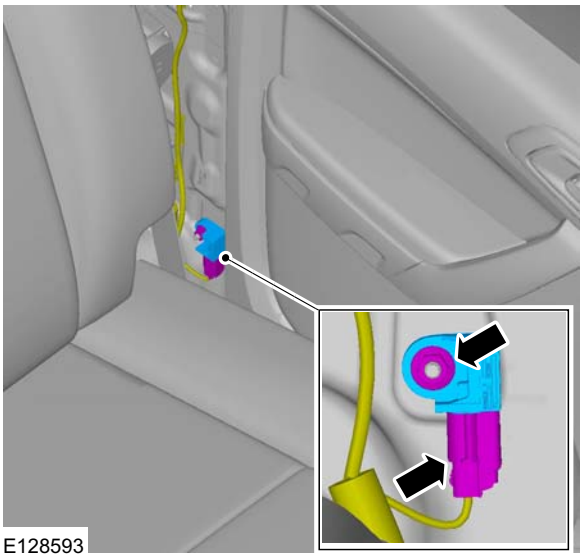
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

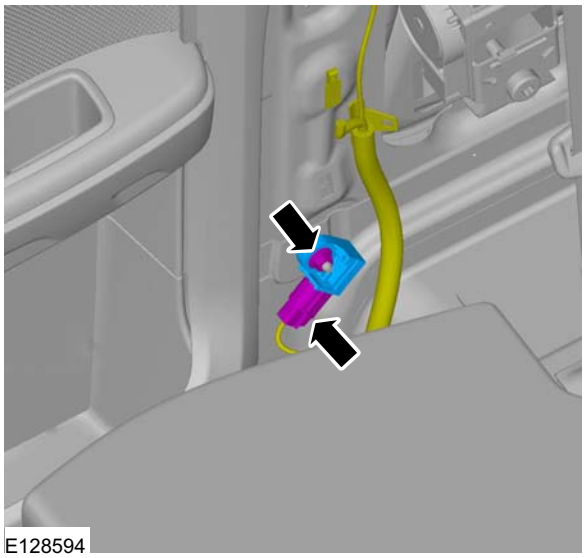
Double cab

2. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. On both sides.
   Torque: 10 Nm


E128593

Stretch cab

4. Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. On both sides.
   Torque: 10 Nm

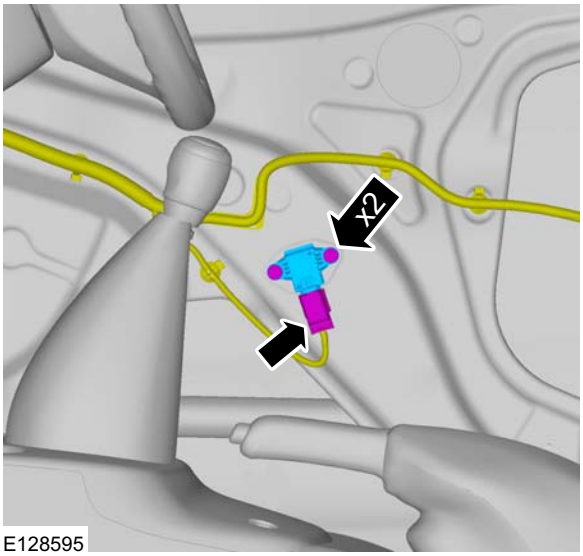

E128594

REMOVAL AND INSTALLATION

All vehicles

6. Refer to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. On both sides.
Torque: 2 Nm



Installation

1. To install, reverse the removal procedure.

SECTION 501-25 Body Repairs - General Information

VEHICLE APPLICATION: 2011.50 Ranger

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SPECIFICATIONS

Description	Finis Code	Specification
Underbody protection	5 030 492	-
Anti-corrosion wax	1 219 834	WSK-M7C89-A
Cavity wax	5 030 081	-
Profiled butyl seal	1 128 983	S-M3G4620-A
Clinched flange protection	1 136 479	WSK-M4G245-B
Seam sealing compound	1 205 817	WSS-M4G364-A
Body sealing compound	1 143 255	-
Metal adhesive kit	1 203 241	-
Windshield sealant	1 613 838	WSK-M4G329-A
Adhesive spoiler set	1 219 837	-

DESCRIPTION AND OPERATION

Description and Usage of Body Repair Literature

The purpose of this document is to give the vehicle body specialist a general overview of possible repair techniques for body repair on Ford vehicles. Likewise, information about materials and tools to be used is given.

No model-specific information is given. Such information is saved in the respective Ford Etis workshop manual. Supplementary or updated information can be found in the Technical Service Information.

Information on repair techniques, materials or tools, which are not necessary for body repair on Ford vehicles or which are not considered as conventionally in use, are not listed in this document.

Layout:

The general section is divided into the following subject areas:

- How to use the document, with information on the symbols used
- Health and safety information on using materials and tools
- Information on bodywork construction and materials used
- Workshop equipment and use of tools
- Damage Assessment and determining the extent of the repair area
- Explanation of possible repair techniques for body repair
- Possibilities of the repair or remedying leaks, noises

Training:

The Ford Service Organization offers basic and more in-depth training on much of the content of this document. You can obtain an overview of the entire training offering from the Ford Service Organisation or on the Internet at www.ford-training.de.

DESCRIPTION AND OPERATION

Symbols

Warnings and hazard notices

Warnings and hazard notices are shown in this literature by WARNING, CAUTION and NOTE indicators. These notices are always shown before a job step which can be associated with an immediate personal or material danger.

WARNING: This notice is used when failure to exactly follow the instructions given in this literature or failure to follow them at all may result in a hazard to persons and/or in persons being injured.

CAUTION: This notice is used when failure to exactly follow the instructions or test procedures given in this literature or failure to follow them at all may result in damage to the vehicle or to components.

NOTE: This notice is used when the operator should be made aware of special or extra information.

Symbols used

Symbols are used to graphically represent additional information about the operation, tool or materials. This information will not be shown separately again as text.

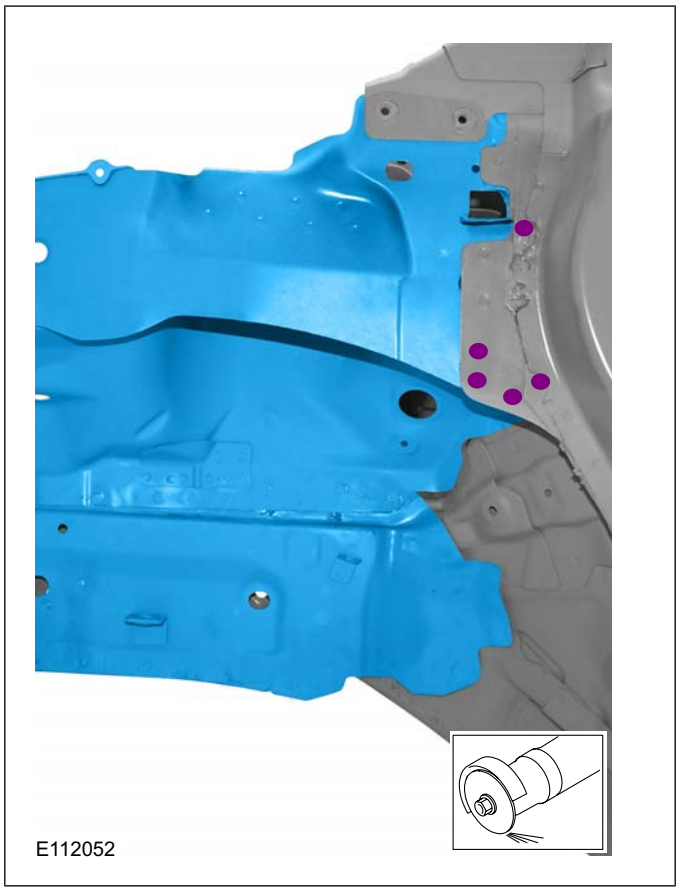
The symbols used in this and other body repair manuals may be used alone as well as in combination in a diagram.

All the symbols used in these documents can be found in the General Information section.

For additional information, refer to: Symbols Glossary (100-00 General Information, Description and Operation).

Color coding

Different colors or shading can be used to depict special areas and components.


E112052

- Blue: Main component which will be removed or installed. Only actual movements will be shown in blue in the diagram.
- Magenta: Materials or fixings, e.g. bolts, clips, spot welds or adhesives.
- Yellow: Component which is being cleaned or loosened, moved or fastened, but remains in the vehicle.
- Light blue: Color for special tools and color for equipment.

In an assembly operation, the colors show the sequence of removal steps.

- Blue: Main component which is being installed, removed, taken away or added.
- Green: Component which, in addition to the main component (blue) is being installed, removed, taken away or added.
- Brown: Component which, in addition to the main component (blue) and the additional component (green) is being installed, removed, taken away or added.

DESCRIPTION AND OPERATION

Movement arrows

Necessary work such as clinching flanges or moving lugs etc. will be represented by broken arrows.



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Magnified and detailed views

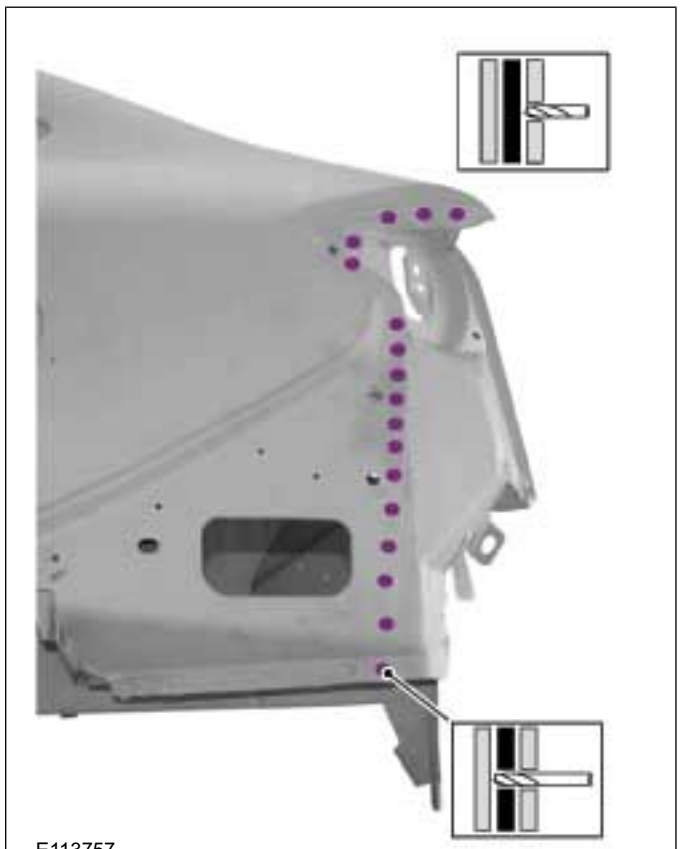
If a detail cannot be clearly seen in the illustration because of its size or location, it is shown enlarged in a separate window.



E113412

Position lines within a diagram

A position line is used to indicate a special position or a component. A spot weld which must be drilled out through two panel thicknesses is indicated here, different to all the others.



E113757

DESCRIPTION AND OPERATION

Health and Safety Precautions

General

Appropriate repair methods and their correct implementation are very important for both vehicle operating safety and personal safety.

WARNING: There is danger of injury through:

- High voltage when electrical welding.
  - Do not perform welding work in a damp environment or on a wet substrate. Use suitable insulation underneath.
- Flammable substances in the welding area.
  - Remove flammable substances from the danger area. Remove the fuel tank and, where required, those components which supply fuel.
  - Completely remove the battery before carrying out any welding in that area.
- Welding fumes, which are harmful to health.
  - Always ventilate the workplace well and use an extraction system.
- Welding spatter and UV radiation.
  - Wear protective clothing, gloves and welding mask or welding goggles.
- Pyrotechnic components.
  - Disconnect the battery negative clamp and cover the battery terminal. Remove any airbag components.

All the regulations governing Health and Safety at Work must be complied with during body repairs.

Personal protection

Welding gases and grinding dusts can be harmful to the health. For this reason, make sure that rooms are well ventilated and work using the welding fumes extraction system. Sealants, underbody protection and paint residues must not be burnt down with an unshielded flame, as this will produce gases which are damaging to health. A dedicated extraction system must always be used when welding or brazing.

When working with substances containing solvents, good ventilation must be provided, respiratory protection must be worn and an extraction system must be used.

Do not weld in damp areas, if necessary use an insulation mat. Welding and grinding work near the battery presents the danger of explosion. For this reason, it must be removed before the work is started.

Cutting, grinding and alignment work on metal panels can cause a noise level of 85 to 90 dB (A) or even more. For this reason, you must always wear ear defenders.

The various body areas are subject to very high forces during realignment work. Should any component suddenly become detached during this process, there is a very great danger of injury. For this reason, pulling chains and pulling shackles must be secured with arrester cables.

NOTE: Work on airbag systems may only be performed by persons who have a relevant certificate of competence.

Some special instructions must be followed when working on airbag systems:

- Always stand to the side of it when removing or installing an airbag.
- Always store an airbag or an airbag/steering wheel with the airbag side pointing upwards and in a safe place.
- Only install the airbag again when the vehicle is fully repaired and the complete electrical systems has been tested.
- Take into account the location of air curtains and shoulder airbags.

Protection of the vehicle

Protect affected areas from weld spatter and dust during all welding and grinding work on the vehicle. If metallic dust stays on the vehicle for some time, there is the likelihood of film rust formation. Grinding or sanding work produce tiny spots of damage to the paint surface, which may cause corrosion.

For this reason, make sure to:

- Use carbon fibre blankets to protect the vehicle body.
- Use covering film to protect the vehicle body from sanding dust and metal dust.
- Take appropriate measures to protect the interior equipment of the vehicle during any repair work.

DESCRIPTION AND OPERATION

In addition, take into account:

- Remove fuel supply components as necessary.
- Protect working areas which are in danger of catching fire with a fireproof blanket.
- The welding must not cause components of the air conditioning system to become heated.
- Removal of any attached components in the space adjoining the repair area.
- Use covering paper to protect the interior from grinding dust.
- Create a definite barrier between the work area and the interior by using a carbon fibre blanket.

Protective equipment

The following protective equipment must always be used:

- Protective helmet or welding mask.
- Ear defenders and breathing protection.
- Protective gloves and safety boots.
- Welding fume extraction.

Electronic components

Increased use of comfort and safety electronics in modern motor vehicles also requires the greatest attention to be paid during body work. Overvoltages produced during welding and in alignment work during bodyshell rectification may cause electronic systems to be damaged. In particular, the safety instructions for performing welding work on vehicles with airbag systems must be adhered to.

NOTE: After disconnecting the power supply and before performing further work, a wait time of up to 15 minutes must be maintained, depending on the vehicle. Work on airbag systems may only be performed by persons who have a relevant certificate of competence.

Pay attention to the following points:

- Disconnect the battery negative clamp and cover the battery terminal.
- Disconnect the electrical connector at the airbag control module.
- If welding is to be performed directly near a control module, it must be removed beforehand.
- Never connect the negative cable of the welder near an airbag or a control module.
- Connect the negative cable of the welder close to the location of the weld.

For additional information, refer to:

Side Air Curtain Module (501-20 Supplemental Restraint System, Removal and Installation),
Side Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation),
Driver Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation),
Driver Lower Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation),
Passenger Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation),

Liquefied gas vehicles

Alternative fuel vehicles often require special handling in the workshop area. Above all, assembly operations to some extent require particular knowledge when dealing with the special technology and the safety regulations.

NOTE: Only fully trained personnel are permitted to work on alternative fuel vehicles.

These special requirements must be understood and taken into account in the body shop as well.

CAUTION: Danger of fire and explosion. The safety instructions must always be followed when performing service work on fuel/gas systems. Failure to observe this instruction can lead to injury.

If the smell of liquefied petroleum gas (LPG) or compressed natural gas (CNG) is noticed in the workshop, instruct everyone present as follows:

- No smoking and extinguish all naked flames.
- Shut off all electrical and air powered equipment.
- Evacuate the area.
- Ventilate the area.
- Contact the fire control authorities.
- Move the vehicle to a dedicated, well ventilated area.

Alternative fuels require special handling:

- Handle them in a specially dedicated, well ventilated area, which is only accessible to authorized persons.
- Identify the designated area with new warning notices.
- If possible close the main shut-off valve and run the vehicle on alternative fuel until it switches automatically to petrol operation. Only then is it

allowed to drive the vehicle into the workshop or service area.
- If possible do not allow any liquefied gas (LPG) to escape.
- The ambient temperatures must not exceed 40°C. For this reason the LPG and CNG fuel tanks must be removed on vehicles with LPG or CNG operation before using a drying oven to dry the paint where the temperature exceeds 40°C.

Avoid situations in which fuel from an LPG or CNG fuel tank can escape. These situations include:

- Extremely hot ambient temperatures.
- Parking near a heating device.
- Raising the vehicle near a ceiling heater.

Refrigerated conversion vehicles

Apart from the special materials used in building the structure of the refrigerated compartment, such vehicles have special energy and refrigeration systems which require special handling during repair.

CAUTIONS:

⚠ **Danger of injury. Work on the 230<SP>volt system of the refrigeration equipment must only be carried out by trained specialist personnel.**

⚠ **The refrigeration system is filled with refrigerant R134a. This can cause frostbite if it contacts the skin. Pay attention to the corresponding warning notices and instructions in the chapter Air Conditioning Systems.**

NOTE: Work on the refrigerant circuit may only be performed by persons who have a relevant certificate of competence.

Vehicles with a refrigerated compartment are often used to transport foodstuffs. For this reason, additional hygiene regulations must be complied with during repair work.

Aluminum and plastic are used to construct the two different types of compartment found on refrigerated vehicles.

The aluminum conversion is a very stable and technically perfect variant. However, against this the relatively high production costs and a lower payload must be taken into account, because of the weight of the aluminum conversion itself.

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

The plastic conversion has developed into a light, clean and economical alternative because of constant further development of materials and working techniques.

NOTE: The material combinations, the workmanship and the working methods must comply with the current food hygiene regulations. For this reason, service and repair work on the refrigerated conversion may only be performed by authorized and specially trained technicians.

Refrigerated compartment constructions are often made using both materials. The floor pan is made of structured, slip-proof aluminum panels and the wall and ceiling cladding is made of smooth surfaced plastic elements.

⚠ **CAUTION: PUR hard foam is flammable. If PUR hard foam is overheated, it will burn on its own with a brilliant yellowish flame. It produces unpleasant choking and toxic fumes. Special measures must be taken when welding the vehicle body.**

Polyurethane wall and ceiling elements are manufactured using a sandwich principle. An insulating polyurethane core is coated with food grade ABS plastic on one side.

PUR hard foam does not decompose, is rot resistant and is odorless. These properties make it suitable for use as insulation.

Because of its closed cell structure, water uptake by PUR hard foam is for the most part only a problem at edges. Cut edges or other mechanically worked surfaces must however be sealed with the greatest care.

The conversion to a refrigerated vehicle is performed as made-to-order production. The large surfaces of the wall and ceiling cladding can be changed and are particularly easy to repair.

If access to the back of a body panel section is needed because of body straightening work, in some circumstances it is cheaper to perform a cut-out repair instead of removing an element.

The repair process is fully described in the Student Information booklet Refrigeration System Technology, Transit 2000.5 Freshline.

DESCRIPTION AND OPERATION

Environmental Regulations

Orderly and responsible waste management is not only very important for the protection of health and the environment, but it also has great importance where saving natural resources is concerned.

In body repair shops, since the introduction of the EU directives on the avoidance of vehicle waste and the promotion of return, re-use and recycling of vehicles and their components (2000/53/EU), more rigorous attention than before is also paid to avoidance and recycling of waste materials.

NOTE: The organization of disposal in the operation must comply with the country specific waste regulations:

In this respect, body repair shops must take into account and comply with the following requirements:

- Separate waste according to its recycling and disposal methods.
- Produce evidence for the correct transport and disposal of waste.

NOTE: The organization of disposal in the plant must comply with the requirements of the Waste Avoidance and Management Act.

The avoidance and recycling of waste must always take priority. However, despite all measures which may be taken, waste cannot be completely avoided.

NOTE: Useable waste which is not allowed in household rubbish, must be disposed of as special waste

All remaining waste must be treated as commercial waste and disposed of according to the local requirements.

Only applies to the EU:

The vehicle manufacturer is also under a legal obligation since the older vehicle legislation came into force throughout Europe in 2002.

This law covers the surrender, withdrawal and environmentally friendly disposal of older vehicles through the manufacturer.

The older vehicle legislation contains all the necessary information for the environmentally compatible disposal of older vehicles, starting with preliminary handling involving the removal of all operating fluids, deactivation of pyrotechnic components, elimination of pollutants and then further handling by dismantling components for re-use and recycling.

DESCRIPTION AND OPERATION

Body Construction

General

Under bodywork construction, a general distinction is made between monocoque and non-monocoque bodywork. The safety of the occupants is the main consideration for all types of bodywork construction. The front and rear sections are designed so that they absorb the energy of the impact via crumple zones. The use of modern design and manufacturing methods and the use of newly developed body panels (relating to their deformation and strength properties) mean that, despite the continuous weight-savings, all safety-related requirements made of the construction can be met.

Integral body-frame

In this method of construction, coverings, reinforcements, retaining panels and profiles are permanently joined together using a variety of joining techniques (gluing, spot welding, laser welding, soft soldering or brazing). The load-bearing function of the structure must always be achieved in each case.

There is no distinction made between components which are purely subject to bending/torsion or thrust loads and parts which perform sealing/covering functions (as in non-monocoque bodywork for example). In modern passenger vehicles, monocoque bodywork is very widespread and offers the advantages of a lightweight and low-cost construction.

TO BE UPDATED LATER

The rigidity of the bodywork is achieved by a panel skin and panel cross-section with the largest possible profile and therefore the largest resisting torque (such as for instance the rocker panel). Swage lines in the outer area of the bodywork increase the stiffness and the natural vibration frequency, to prevent possible drumming noises.

The mounting points for ancillary components such as doors and wings are permanently built into the monocoque bodywork.

High rigidity of the bodywork is vitally important to keep the elastic deformations low at the joins to the ancillary components and to prevent noise when driving. Small gap dimensions are therefore

DESCRIPTION AND OPERATION

only possible on vehicles with very stiff bodywork. With high bodywork stiffness, the construction can exert an influence on the handling of the vehicle (e.g. on poor road surfaces).

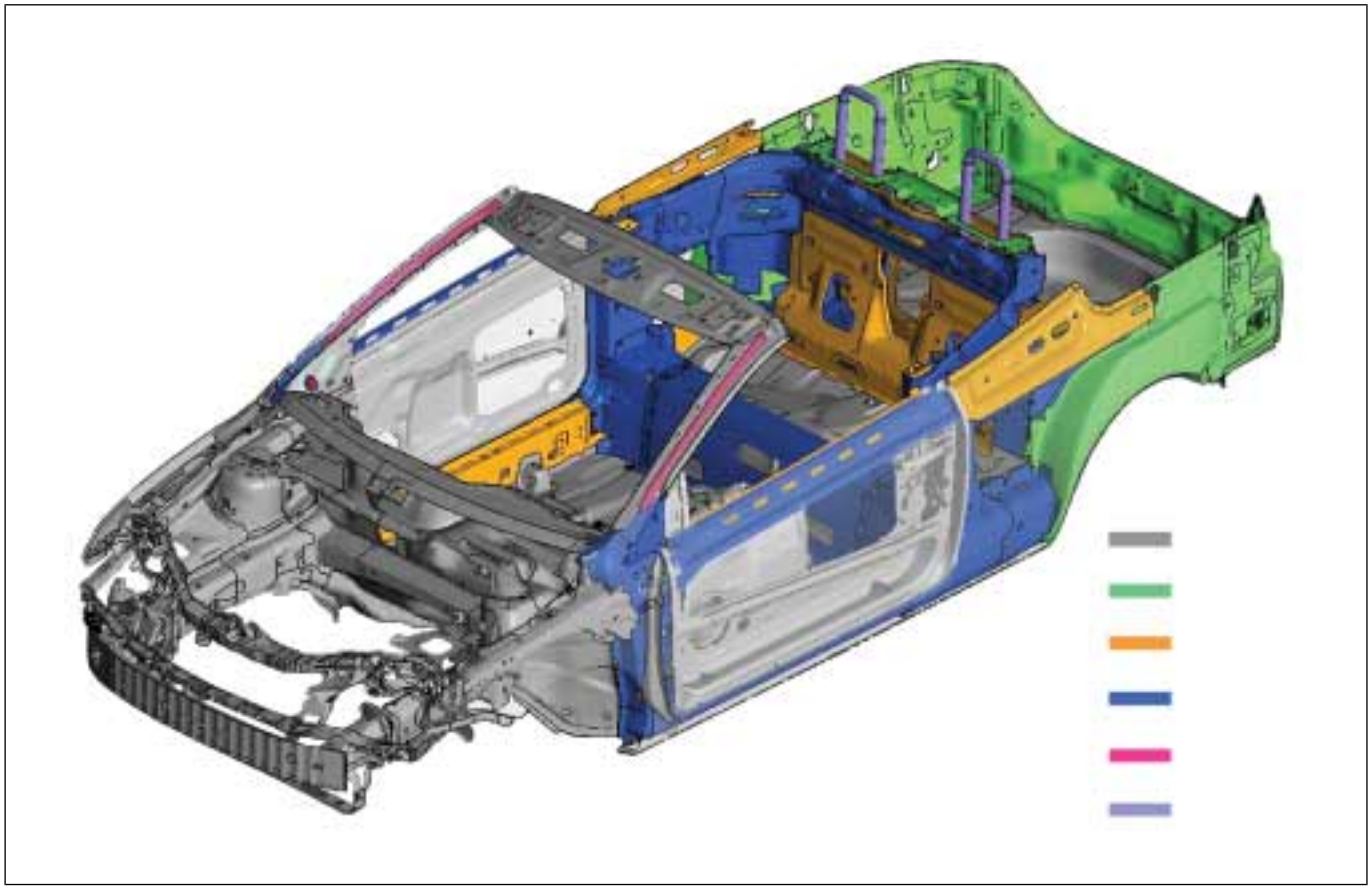
Advantages of monocoque bodywork:

- Weight reduction.
- Economical manufacturing technology.
- High torsional rigidity and high flexural strength.
- Defined deformation behavior at the front and rear.
- Maximum passive safety due to the strong passenger compartment

The protected passenger compartment with strong pillars, rocker panels and doors with integral side impact protection increase occupant protection. Opening of the doors is ensured, even if there is extreme deformation.

NOTE: Repair work must always be performed according to the established workshop literature. All the safety requirements must be guaranteed after any repair work has been performed !

Convertible



Description	Description
1	Body components adopted from the Focus 2004.75 (07/2004-)
2	Conventional bodywork construction steel
3	High-strength sheet steel
4	Super-high strength sheet steel

Description	Description
5	Maximum-strength sheet steel
6	Aluminium, can be subjected to high stresses

The body of a convertible differs from the principle of the integral body-frame of a saloon due to the lack of a roof construction. The body has a high

DESCRIPTION AND OPERATION

degree of torsional stiffness. This is achieved by using high, super-high and maximum-strength sheet steel and body reinforcements in specifically-targeted areas.

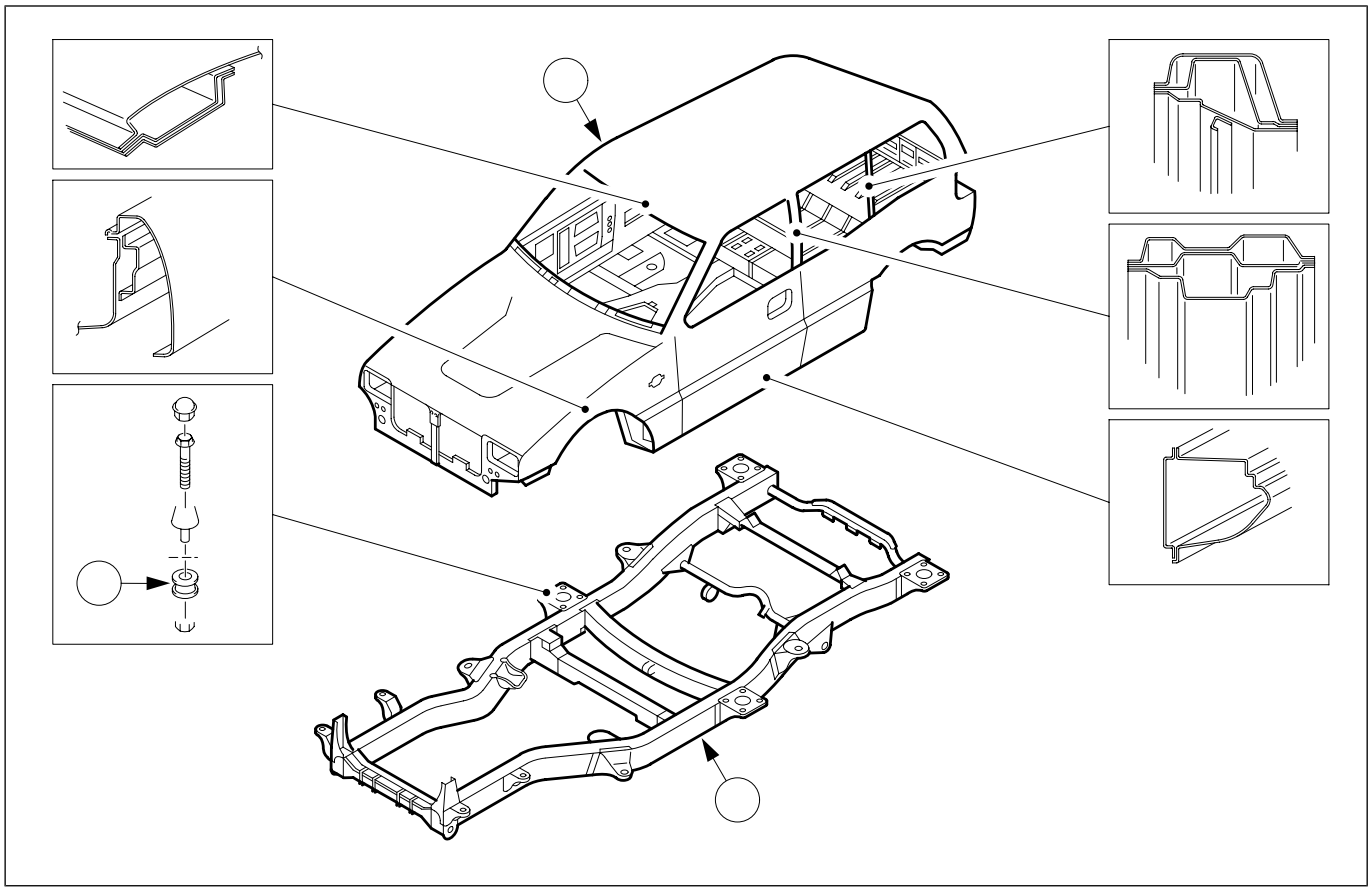
These reinforcements can be installed in the area of the doors (diagonal braces etc.) or on the underfloor. In contrast to the saloon (or other non-convertibles) with square-section side members (closed profile), these reinforcements have a profile which is open on the underside (U-section).

Special constructional changes within the bodywork structure:

- Reinforcing or increase in the thickness of the sheet steel in the pillar area.
- Reinforcing or increase in the thickness of the sheet steel in the floor pan structure (rocker panel area).
- Use of heavily structured reinforcing panels in the rocker panel and pillar area.
- In the area of the windshield frame and A-pillars, thick-walled reinforcing tubes are used (roll-over protection).
- Because there is no roof, the bridge construction principle cannot be used as it is on the saloon for example. Flexural and torsional rigidity must be ensured by other components.

Non-monocoque bodywork

Non-monocoque bodywork is built onto a frame or a chassis. Frames used for this have various construction forms, e.g. the ladder frame or tube frame. Non-monocoque bodywork is the original way of constructing vehicles.



Description	Description
1	Vehicle body.
2	Frame Assembly
3	Bolted connection

The ladder frame is still commonly used today for truck and off-road vehicles. The bodywork is placed on the frame or chassis. The total load which occurs while driving is transferred to the chassis.

More sporting vehicles can be built with non-monocoque bodywork, mostly using a lattice tube frame. Limitations in the design are accepted for the benefit of low weight. The outer skin here

DESCRIPTION AND OPERATION

is usually made of plastic or alloy. This type of construction is also common in touring car racing for instance.

Special features of non-monocoque bodywork construction:

- Partly large surface panels and high volume shaped parts.
- Thicker materials and greater reinforcements in the frame area.
- Floor pan as frame structure with high torsional rigidity and flexural strength.
- Side panels only make a small contribution to the overall stability of the body.

Instructions for repair:

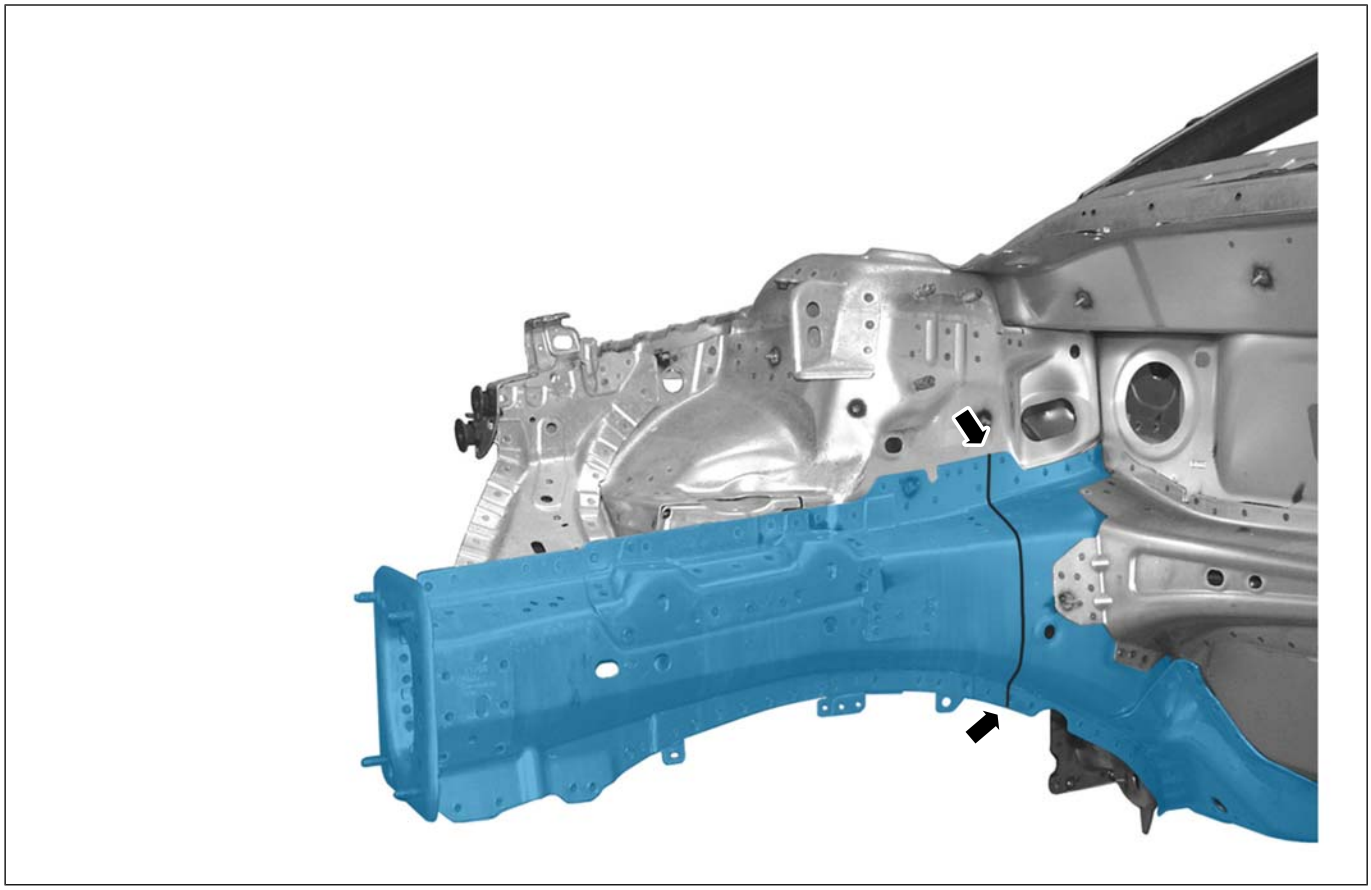
A different repair technique is necessary during repairs. A deformed frame structure requires high suction power during straightening repairs. Frequently, the body also has to be detached from the frame structure in order to carry out separate repair.

Due to the very stable frame structure, please note that the straightening behavior is completely different to that of a passenger vehicle. The frame and the attached body must be repaired independently of each other.

Further information can be found in the respective body repair manual.

Special points:

Tailored blanks



Blue: Tailored blank

Arrows: Laser weld seam

The term "tailored blanks" describes the connection of two different panel thicknesses and/or strengths in the bodywork carcass. This connection is done using laser weld seams. Cut locations exactly on the laser weld seams are not permitted, as at present no joining techniques are approved for use in repair procedures that would re-create joins of the same quality.

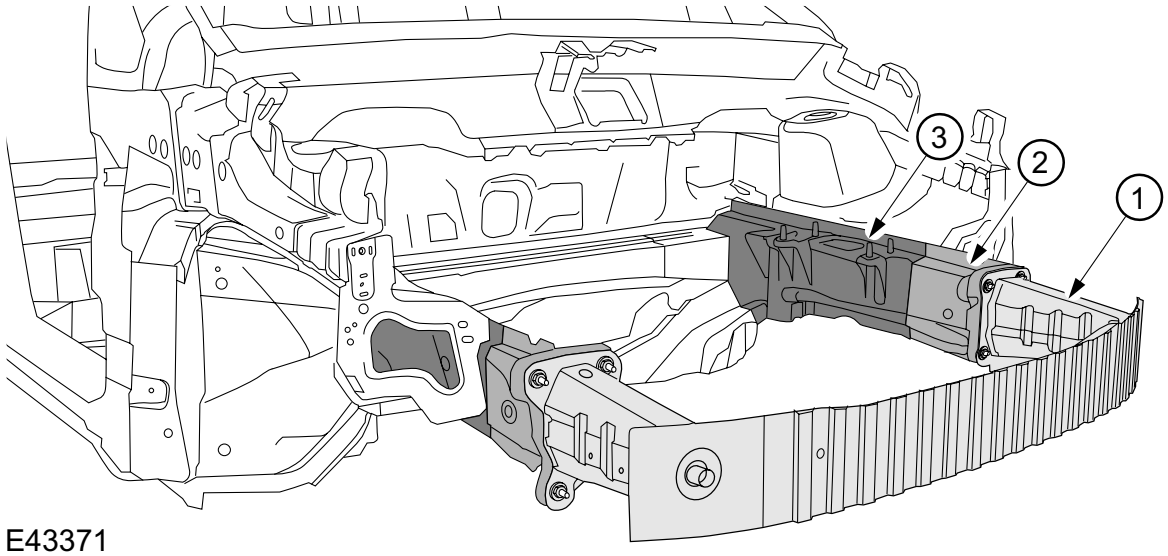
NOTE: No cutting, no welding and therefore no sectional repairs are permitted in the immediate area of the laser weld seams. The model specific requirements are documented in the respective Body Repair Manuals.

Typical application areas are:

DESCRIPTION AND OPERATION

- Side member
- Door inner reinforcement/door frames
- Wheelhouses
- Rocker panel inner reinforcement
- Roof rail inner reinforcement

Deformation behavior



E43371

Description	Description
1	Bolted crash element
2	Front side member
3	Rear side member

Different materials and design features lead to staged deformation of the front and rear of the vehicle in an accident.

The rear of the vehicle, like the front of the vehicle, has structures which protect the passenger cell through staged deformation in the event of an accident. The design layouts, however, are adapted to the requirements of the rear area.

Crash element:

At the front of the vehicle there is a crash element which is connected to the side member by threaded connections. This crash element can absorb light impacts of up to about 15 km/hr. Because of the threaded connections, the crash element can be changed very quickly.

NOTE: Deformed crash elements must not be straightened or repaired.

Heavier impacts which can no longer be absorbed by the crash element must be absorbed by the side members or the floor pan structure. Depending on the extent of the damage, a part or complete replacement can be performed on the side member.

DESCRIPTION AND OPERATION

Diagnosis and Damage Evaluation

Assessment of the extent of the damage includes visual inspection and dimensional inspection of the vehicle. In order to correctly determine the extent of the damage caused by an accident, in-depth technical knowledge, practical experience with the technical equipment and the testing and measuring devices is required.

Noticeable damage to the bodywork structure

Positive accidental damage assessment can only be achieved if the service technician is able to reconstruct the effect of an impact on the body structure.

For example:

If the impact occurs on the front left-hand side member, the right-hand side member will usually also have been damaged. Often the length of this side member will not have changed, but because of the rigid body design, it may have become deformed. This damage can be detected through the size of the gap between the door and fender or by measuring the vehicle.

In the case of more severe impacts, in which the front part of the vehicle cannot absorb all of the impact energy, the passenger cell is also used to absorb the energy. Here, the energy is transferred via the A pillar and distributed there. This results in deformations in the roof and the door sill.

NOTE: Because of existing damage to the bodywork structure, damage diagnosis on a vehicle lift may give extra incorrect diagnosis results.

NOTE: Training courses are offered on this subject. For an overview, please refer to the Ford Service Organisation's training course brochure.

If for instance the Ford Focus Coupé/Cabriolet is raised on a vehicle lift, the dead weight of the vehicle will cause the front end to drop by approx. 2 to 3 mm.

The altered door position is clearly recognizable by stiffness of the lock; the door moves upwards. This causes the lock pin to contact the guide element of the door lock.

It is possible to draw conclusions about the extent of the damage through a visual inspection of the external damage. In general, the following areas are to be checked during the visual inspection:

- Outer panel including seam seals for cracks or flakes in the paint caused by the accident.
- Size of the gap on doors and hoods for evenness.
- Freedom of movement of door and hood/tailgate locks.
- The vehicle roof for folds (gap measurement on vehicles with sunroof)
- Dotted flange in door section for deformation and cracked weld spots.
- The side members and crash components for crumpling and folding.
- Trunk floor and floor pan from above and below for crumpling.

No noticeable damage to the bodywork structure

In addition to external indicators such as flaking paintwork or cracks in the underbody protection, it is vital to check for damage to the body structure that is not visible from the outside (hidden body damage) during a damage assessment. Unless ancillary components are removed, it is often impossible to achieve accurate diagnosis of the underlying body parts.

NOTE: In order to determine the damage as accurately as possible, it may be necessary to remove ancillary components in the area of the damage.

Particular attention must be paid to the following components:

- The A, B and C pillars in the roof area.
- Floor pan.
- Rear ancillary components, such as bumper, lights, etc.
- Trunk floor, spare wheel cavity.
- Rear coverings, such as interior trim, carpet, etc.
- Lower rubber seals, e.g. in door area (welded flange).
- Area under the rear seat.
- Attachment points of transmission system, steering, engine, drive shafts, front and rear axles.
- Electrical components, e.g. the radio (damage through shaking or through voltage peaks).

DESCRIPTION AND OPERATION

Non-monocoque bodywork

The chassis and bodywork must always be checked during damage diagnosis on vehicles with non-monocoque bodywork.

It is also important here to inspect closely for damage the impact area and the areas absorbing forces.

With these vehicles, simple inspections can already give an indication of possible deformations.

In addition, you must check for the following for vehicles with frame structures:

- Cracks in the paint on the frame welds.
- Traces of deformation on frame components.
- Check attachment points (silent blocks) for position changes and damage.
- Changed position of rubber seals.
- Fit and function of the ancillary components.

DESCRIPTION AND OPERATION

Body Sheet Metal

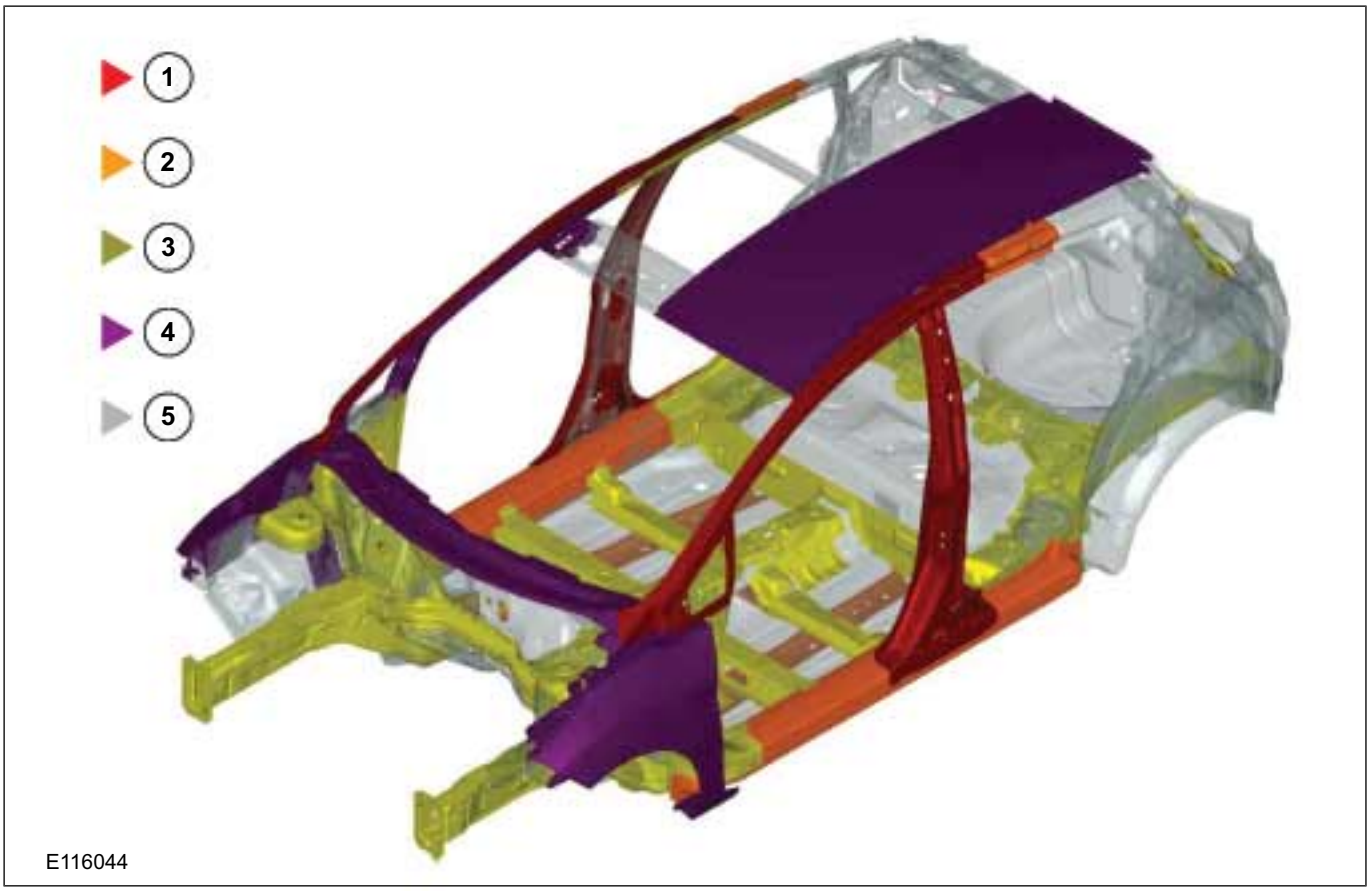
Types of steel

Steel body panels are still the most important materials used in the fabrication of stressed skin vehicle bodies. In addition to the familiar types of steel, reinforced high-strength and also ultra-high-strength special steels are used in vehicle body construction.

Types of steels are classified by their properties of strength and elasticity.

- Normal strength steel has a minimum yield strength of up to about 210 N/mm².
- High strength steels have a minimum yield strength of about 150 to 600 N/mm².
- Ultra-high-strength steels have a minimum yield strength of about 400 to 1200 N/mm².

High-strength and ultra-high-strength steels are mostly installed in safety relevant locations (structural components). Among others, these are side members, pillars, roof frames.



Pos.	Used type of steel	Application range (Examples)
1	Ultra High Strengh Steel (UHSS)	Impact Carriers, Bumper Carriers, A-B-Pillar Reinforce-ments
2	Extra High Strengh Steel (EHSS)	Frame Side Member; Rocker Reinforcements
3	Very High Strengh Steel (VHSS)	Wheel House; Structural Members
4	High Strengh Steel (HSS)	Roof Sticks, Fenders
5	Normal strength steels	Outer Panel

Normal strength steels

Normal strength steels are most often used in body construction. They are relatively soft and are therefore particularly suitable for the deep drawing

DESCRIPTION AND OPERATION

processes used in body manufacturing. As well as very good reshaping properties, the panels also have a relatively high rigidity.

High strength steels

The strength of the material and the nature of the surface can be changed as required by different engineering processes. In order to achieve suitable configuration and a good match between construction specifications and what is possible in production, a large range of high strength panels is available.

The range of the minimum yield strength is from 180 N/mm² to 460 N/mm². High strength thin steel panels usually have a surface finish. Electrolytic surface sealing is preferred. Within the group of high strength steels, various types of steel are used in body construction:

- **Micro-alloyed high strength steels** for very difficult drawn components such as fenders, the internal components of doors, hoods and luggage compartment lids or load bearing components such as sidemembers, crossmembers etc.
- **Bake-hardening steels** and **phosphorus alloyed steels** for external panel components with higher draw depth and subject to higher operational demands.
- **Isotropic materials** for flat shaped outer steel panels on doors, hoods, luggage compartment lids, roofs.

Ultra-high-strength steels

These steels are predominately used for body structural components which are relevant to safety. Despite the reduced thicknesses of the panels used, weight reduction is often achieved together with greater strength. As with high-strength steels, special types of steel are used in the ultra-high-strength steels group:

- **Complex phase steels** are used for door side impact carriers, bumper carriers and body components relevant to crashes. Besides high strength, they have good cold reshaping properties and are easily welded.
- **Dual phase steels** have the same properties as complex phase steels. Because of their high strengthening properties they are suitable for body reinforcements.
- **Residual austenite steels** and **martensite phase steels** have very high strength levels of up to 1200 N/mm² and are mostly used in body structures relevant to crashes.
- **Manganese-boron steels** have ultra high strength levels of up to 1600 N/mm² and are mostly used in body structures relevant to crashes.

Due to the use of Ultra-high-strength steels, some special points must be taken into account during body repair:

- Increased force required during straightening.
- Strong springback tendency during alignment work.
- Cutting tools have a shorter useful life.

⚠ **CAUTION: High-strength and ultra-high-strength steel panels must not be heated during straightening work.**

Work without applying heat when carrying out straightening work. Losses of strength will occur at temperatures as low as 250 °C. The basic working methods and the tools to be used are the same however.

Coated steel panels

In a similar way to high-strength steel panels, coated steel panels are finding more applications because of the better corrosion protection which they offer. There are basically two different process which are used to apply a zinc layer:

- Hot dip zinc coating.
- Electrolytic zinc plating.

The following points must be noted when welding:

NOTE: Welding fumes are harmful to health. Make certain that the workspace is well ventilated and use welding fume extraction.

- Zinc starts to melt at about 420 °C.
- The zinc vaporizes at a temperature of about 900 °C.
- The amount of heating determines the damage to the zinc coating, and therefore to the corrosion protection.

DESCRIPTION AND OPERATION

- **NOTE:** Coated panels have a higher electrical resistance, but this can be compensated for by increasing the welding current by 10 - 20% .

  Resistance spot welding is particularly suitable for welding zinc-coated panels, because no widespread warming occurs.
- With electrolytically zinc-plated panels there is no need for any special preparation because the zinc coating does not need to be removed.

DESCRIPTION AND OPERATION

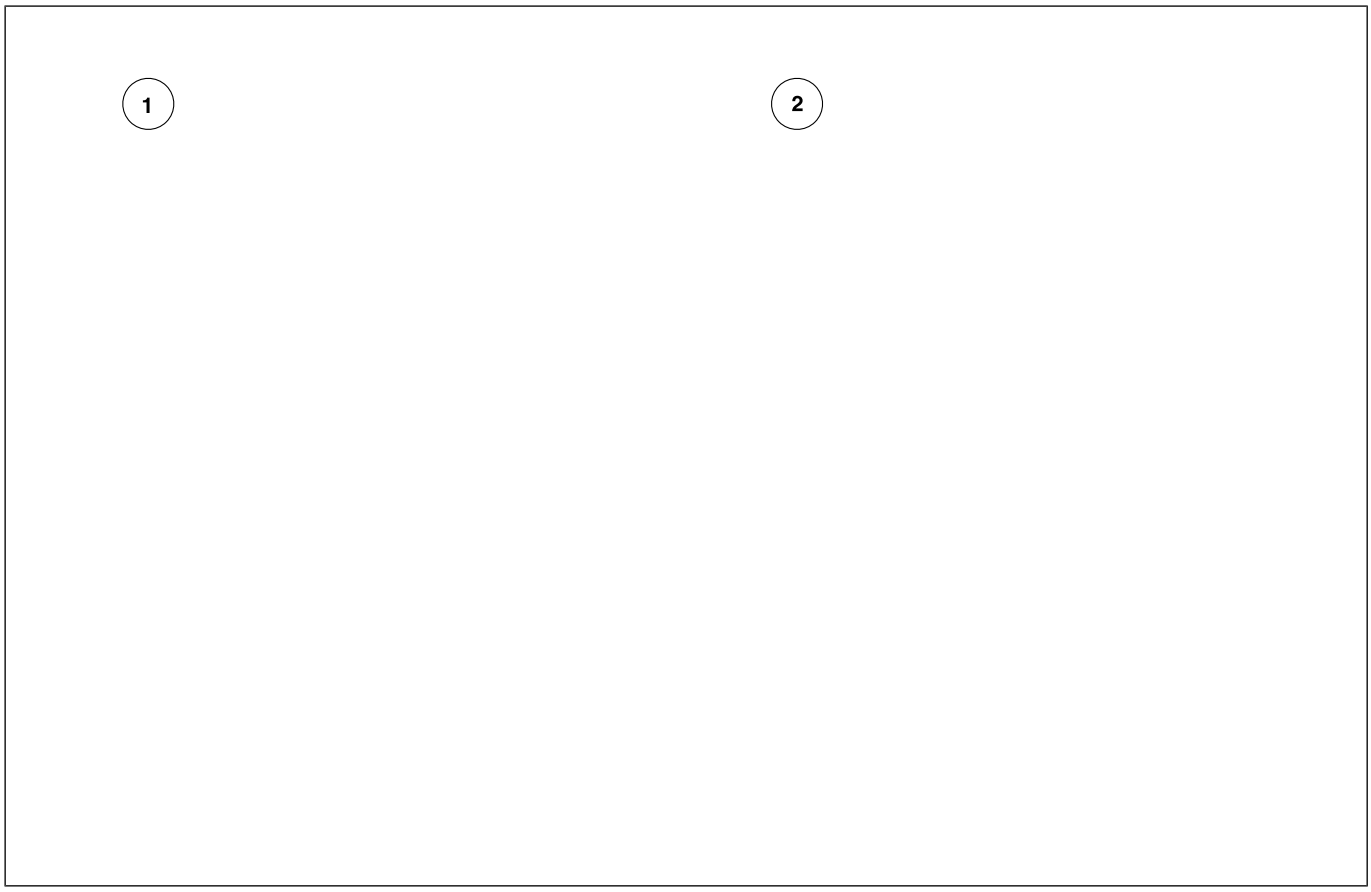
Tools and Equipment for Body Repairs

Alignment systems

NOTE: All the equipment for body work and painting work can be ordered online via the Wielander & Schill service portal http://fo.oem.wielanderschill.com.

Straightening and alignment repairs are often required to restore a vehicle body to its original shape after accident damage.

Universal aligning and measuring systems and universal alignment angle systems are suitable for this work.



Description	Description
1	Universal aligning and measuring system
2	Universal alignment angle system

Basically, the aligning and measuring system must satisfy the following requirements:

- Universally applicable to all types of passenger car. Can also be used on light commercial and off-road vehicles.
- Accepts the forces involved during straightening.
- High stability and mobility.
- Can accept all or part of the weight of the vehicle.
- Quick to set up.
- Simple to use.
  - Stationary design with drive-on ramp.
  - Height-adjustable aligning platform.
  - Universal gauge extensions with fast anchoring ability around the whole circumference of the aligning platform.
- Facility to test individual body measurement points, with or without aggregates being removed.

Alignment angle devices survey the vehicle at several points on the body. These are usually points which are also used in production. In addition, a recording over the rocker panels is possible. A measuring system is not needed, because the necessary body points are specified with gauges. For this purpose, vehicle specific or universal gauges are available.

DESCRIPTION AND OPERATION

Universal alignment systems consist of a vehicle mounting (universal clamps at the rocker panels) and a pulling device. In addition, a measuring system is required.

NOTE: Because universal clamps are used, the rocker panel area must be reworked for optical and corrosion protection reasons after the repair is completed.

Pay attention to the following points:

- Clean the attachment areas.
- Anchor the vehicle free of stress on the relevant system.
- Support the aggregates to take strain off the body.

Measuring systems

In order to exactly diagnose a damaged vehicle body, measuring systems are required. Depending on the measuring method, the systems vary in having mechanical, optical, acoustic and electronic measuring devices. In some cases, hybrid versions of particular systems are found.

NOTE: When working with each measuring system, the manufacturer's instructions provided in the description of the measuring equipment must be followed.

Basically, the measuring systems must meet the following requirements:

- Universally applicable to all types of passenger car. Also can be used on light commercial and off-road vehicles.
- Suitable for all accident damage.
- Fast capture of body measurement points in the underfloor and external areas.
- Data catalog to record all measurement points (length, width and height) both with and without the aggregates being installed.

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range of training offered in the Ford Service Organization training brochure.

Beam compass

The beam compass is a very practical and straightforward aid for measuring bodywork and especially floor assemblies. The beam compass can be used to detect dimensional variations across the length and the width by means of comparison measurements and diagonal measurements.

As a basic principal, body reference points should be chosen which are shown in the body frame measurement data sheet.

NOTE: To be able to determine difference in measurements, the same reference points must always be chosen on both sides. For this purpose the beam compass must be positioned symmetrically.

Comparison measurements can also be made on the outside of the body. Depending on the damage, left/right measurements (symmetry measurements) and diagonal measurements can be made using the beam compass, telescopic rod or a measuring tape.

Laser measuring systems

These systems use laser beams which are projected in one or more planes.

TO BE UPDATED LATER

By the use of two parallel laser heads which can be turned, symmetrical points of a vehicle body can be tested and compared. Using the linear scales which are attached to the measuring points, the measurement data is read off with the aid of the projected laser beams.

The integral inclination gauge also allows differences in height to be quickly checked.

Mechanical measuring system

The use of mechanical measuring equipment is an easy and effective way to check a vehicle frame and chassis assembly quickly, exactly and reliably.

In many cases an assessment of the damage can be made with the help of this system, without the need for elaborate setting up.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Because of its self-centering mount, measurement can be carried out by one person.

Further advantages:

- Fast deployment.
- Simple to use.
- Can be extended using adapters, measuring probes and measuring tubes.

Measuring systems which are firmly mounted on an aligning platform require more work in setting them up. They are used to constantly check measurements during alignment work.

This type of mechanical measuring system has measuring scales and measuring slides in three measuring axes. So that the body can be measured, the vehicle is secured on the aligning platform base frame using four universal chassis clamps. The exact fixing points are given in each respective data sheet.

Ultrasonic and mechanical-electronic measuring systems

These measuring systems can be combined with all current aligning platforms. In addition these measuring systems can be used independently of an aligning platform by using a vehicle lift or suitable support stands.

TO BE UPDATED LATER

Description	Description
1	Ultrasound measuring instrument
2	Mechanical-electronic measuring system

Acoustic or ultrasonic measuring systems use ultrasonic emitters and sensors to survey a body.

To do this, ultrasonic emitters are mounted on the vehicle using special attachments. During the measuring process the ultrasonic emitters constantly send out signals which are received by sensors (microphones) and then passed to a

DESCRIPTION AND OPERATION

computer. The measurements are displayed on the computer screen and are compared with the required values supplied by the vehicle manufacturer.

The ways in which mechanical-electronic measuring systems can be used are similar to those of the acoustic measuring systems. They can also be set up on a suitable understructure, without an alignment jig. After this system has been arranged under the vehicle floor and adjusted to three undamaged vehicle measuring points, the measuring arm is brought up to the required measuring points and the readings compared with the reference values. The data is transmitted to a computer where it is evaluated and the results displayed on a screen.

Welding gear

As in the past, the dominant process in body construction is **resistance welding**, in particular spot welding. Depending on body type, up to 5000 spot welds are applied, either by welding robots or in the multi-point welding machine.

Resistance spot welding permits very high energy to be concentrated on a relatively small area of the workpiece in the shortest possible time and when high pressure is applied, a permanent joint is formed. During repairs the resistance spot welds used in production must be re-created accordingly.

TO BE UPDATED LATER

Description	Description
1	MIG welding machine
2	Resistance spot welding machine

NOTE: If a suitably powerful welding machine is not available and multi-layer panel joints with a total thickness of over 3 mm need to be made, puddle welding must be used.

Although in principle, high and ultra-high-strength panels are adequately or well suited to resistance spot welding, considerable problems may arise because of low welding power, especially where thicker panels or triple or multi-layer panels have to be welded together in the workshop. In particular, older welding equipment does not have the latest welding technology nor welding power and therefore cannot reliably join panel thicknesses greater than 3 mm.

NOTE: When installing body components made of ultra-high strength steel (e.g. boron), only **inverter welding equipment** certified by Ford may be used.

Equipment with inverter technology allows better spot weld quality because of a constant high welding current. In addition the high welding current makes shorter welding times possible and the electrodes therefore have a longer working life. Inverter welding is a further development of electrode welding. In addition, a much higher electrode force (contact pressure of welding tongs) can be achieved with modern equipment.

Further advantages of the new inverter welding equipment are:

DESCRIPTION AND OPERATION

- good welding performance with constant quality, even with high switch-on times
- recognition of and compensation for disruptive factors: e.g. primer, adhesive, rust-prevention paint
- own and pre-set welding programs which can be saved and called up
- quality confirmation through logging of all important welding data
- fast changing of spot welding clamps or spot welding guns as required

The following functions can be controlled and monitored by programming the welding equipment:

- Control of the start conditions by resistance measurement (dirt, paint, bodywork adhesive, shunt circuit through the next spot weld).
- Ensuring the optimum welded connection.
- Checking the energy balance, resistance and quality.

In the case of resistance spot welded connections, faults in the weld are difficult to see from the outside. It is therefore absolutely vital to know the particular properties of the welding machine being used. A test weld with subsequent peeling test will provide information on the quality of the weld. The spot weld itself must not separate, it must tear away leaving a hole.

In the production of vehicle bodies, **MIG welding** plays a minor role as a joining technique. It is used for components subject to high demands, such as threaded plates for axle mountings, or at locations which cannot be spot welded for access reasons.

DESCRIPTION AND OPERATION

Establish Repair Method

General

Before starting accident repair work, make sure that the necessary spare parts and repair material are available.

Planning

NOTE: The body interconnection is to be maintained if possible. Repair is preferred to renewal of body components. Furthermore, check if it is possible to perform a partial repair.

During planning the following job steps must be observed and adhered to:

- Determine the repair method taking into account the information made available in ETIS.
- Work out which repair components will be needed and obtain them.
- Establish what disassembly work is needed.
- Check for specific features such as airbags, route of water drain hoses, electric cables and the location of NVH elements.
- Cut out the old parts (only when the new parts are waiting ready).
- Prepare the joint locations.
- Attach the new parts.
- Prepare the area of the repair for painting (grinding welded beads).
- Perform any solder work which is required at the repair location.

Chronological sequence of repair

NOTE: Refer to each vehicle specific chapter in the workshop literature for details on the individual points.

The actual sequence of repair can be divided into the following steps:

Job steps for the coachbuilder:

- Straightening
- Establish separating cuts and mark them.
  - Take into account the requirements given in the repair instructions.
  - Place the new part ready for use and include it in the repair plan.
- Separate and remove the old part.
  - Take into account the special features particular to the vehicle.
- Prepare the joint locations.
  - - Sand and align the weld flanges.
  - Apply corrosion protection measures.
  - Offer up the new part.
- Attach the new component.
- Rework the welded joints (grind welded seams).

DESCRIPTION AND OPERATION

Alignment Check

General

If there is concern that the body has been deformed, the body must be measured. Several measuring procedures and tools can be used for this purpose.

With simple measuring systems, it is possible in most cases to draw a conclusion about the extent of the damage through a quick measurement without time-consuming assembly work (straightening jig).

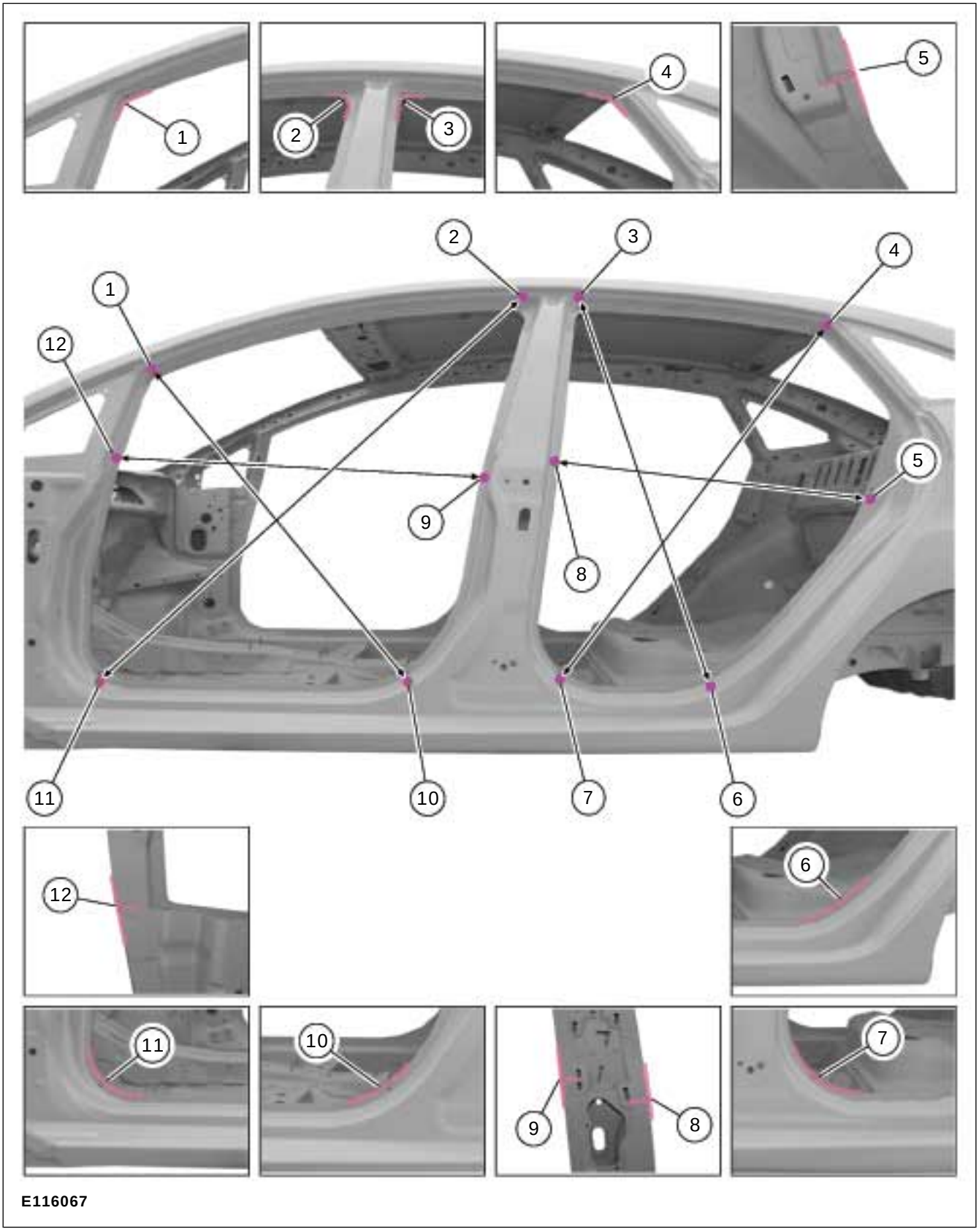
NOTE: For the floor pan and the exterior of the vehicle, measuring data is contained in the vehicle-specific repair instructions for each vehicle. Manufacturers of measuring and straightening jigs create data sheets for this purpose for each vehicle.

Data sheets with the body frame dimensions for body measurement are specified in the model-specific repair instructions in each case. Pay attention to the position of the measuring probes for each of the measurements given. A tolerance of ± 3 mm applies to all specified dimensions.

Measuring points that are specified in a curve are to be measured so that the greatest distance from the opposite measuring point is reflected. For exact determination of the measuring points, enlarged sections are shown.

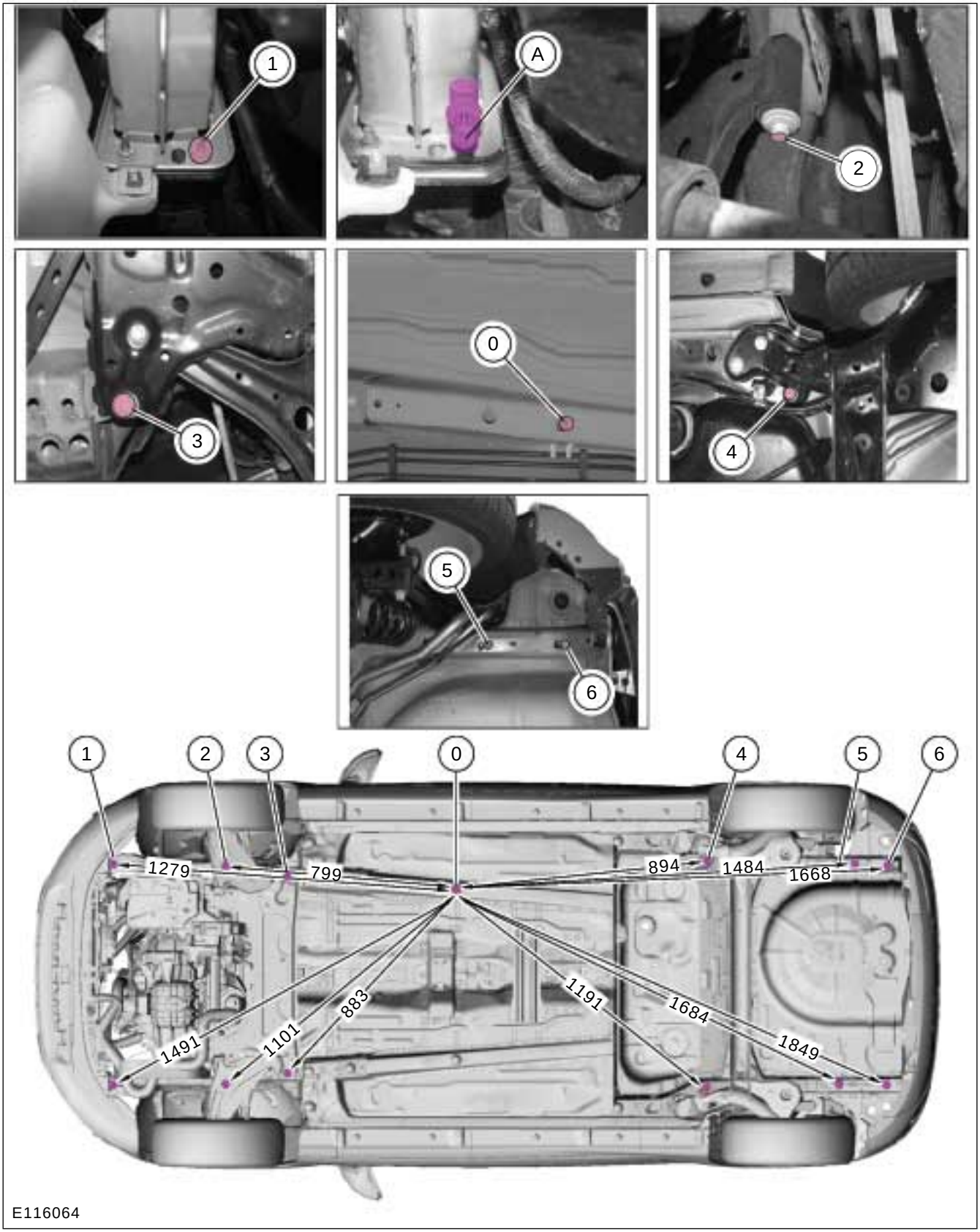
Example of measuring the vehicle superstructure

DESCRIPTION AND OPERATION



Example of measuring the floor pan

DESCRIPTION AND OPERATION



DESCRIPTION AND OPERATION

Straightening

General

Straightening repairs are often required to restore the original body shape. To do this, the vehicle must be placed on a straightening jig so that a pulling device can be used.

NOTE: Basic and advanced training courses are offered for the following contents. For an overview of all training courses offered, please refer to the Ford Service Organisation training course brochure.

Straightening is considered as the process of pulling out the deformed body parts, up to cutting out the parts that need replacing. If distorted components remain on the vehicle, then the term alignment work is used.

Body straightening requires practice and experience. Before starting body straightening, the exact direction of impact must be determined. The straightening force must be applied in the opposite direction to that of the impact. Only in this way can it be guaranteed that the original shape will be achieved again.

Note the following points during the process of body straightening:

- Secure the pulling unit with a safety cable.
- Do not remove bonded glass prior to straightening.
- Never apply heat during straightening.
- If necessary, open doors or hoods/lids/liftgates during straightening.
- Check dimensions and gaps continuously during straightening.
- High-strength steel panels have a stronger tendency to retain their deformed shape.
- During the straightening repairs, monitor the attachment of the pulling unit to the vehicle.
- Carry out the straightening work in several stages, never in one pulling process. This prevents the risk of overstretching and of joints tearing out.
- During individual straightening steps (under a pulling load), relieve tension by striking the deformed areas with an aluminum hammer while they are still under tension.

Special features of non-monocoque bodywork

Straightening is different to monocoque body construction because of separate straightening for bodywork and chassis.

If only the body is damaged in an accident, light straightening repairs can be carried out while still mounted on the chassis.

NOTE: With strong straightening forces, these bolted connections may be damaged (bodywork to chassis frame). Monitor the bolted connections continuously during the straightening work. Holding clamps or alignment angles must be attached directly to the chassis frame.

Straightening of chassis frames

NOTE: High-strength steels must not be heated.

If the body and chassis frame have to be straightened, they must first be separated from each other.

The following conditions must be met:

- The repair must be economically justified.
- The production quality and stability of a frame must be achieved again after carrying out the repair.
- In principle, the driving and operating safety of the vehicle is paramount.
- Cold straightening of deformed areas with sharp edged folds cannot be carried out.
- Straightening with the application of heat (welding torch) requires much experience and accurate knowledge of the behavior of steel panels when heated.
- The temperature and duration of application of the heat are to be considered in particular.
- Individual components of the frame, such as cross members, brackets, etc. can be replaced.

DESCRIPTION AND OPERATION

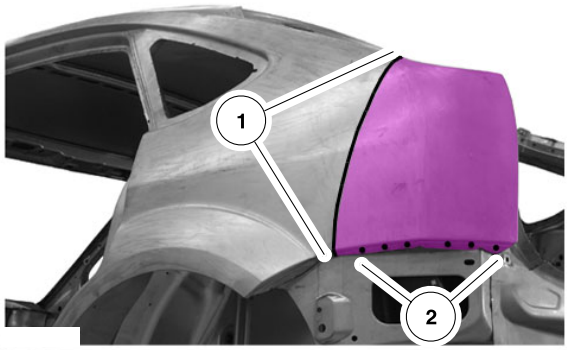
Complete Panel Replacement/Partial Replacement

NOTE: Basic and advanced training is offered for the following contents. For an overview of all training courses offered, please refer to the Ford Service Organisation's training course brochure.

Repairs always mean intervention in the body shell structure and thus also intervention in the vehicle's passive security system.

NOTE: From an economic perspective, the possibility of a partial replacement (sectional repair) must be considered when assessing an accident-damaged vehicle.

Partial Replacement



Item	Description
1	Join area
2	Original welding

Decision criteria

The following are always crucial for the decision:

- How economical the repair is.
- Retention of the original join.

In addition, Ford must have given its approval for a sectional replacement solution in the damaged area. For those partial replacements approved by the factory and described in the model-specific body workshop literature/technician's information, some spare parts (service parts) specially prepared for partial replacements are offered through the spare parts sales department.

Sectional replacement (sectional repair) means the replacement of a section of the body shell structure. Sectional repairs fulfill their purpose above all if the replacement of a complete part is too time-consuming and thus not economical. Approved sectional repairs are clearly defined in the model-specific body literature. These requirements must be complied with.

Depending on the damaged areas, further facts are to be taken into account when deciding for or against partial replacement:

- Severance cuts should be as short as possible.
- The effort for follow-on work on the connections must not be too great.
- It must be possible to reproduce the optical path of visible edges on door openings.
- Inner reinforcement panels must not limit the straightening work.
- Inner reinforcement profiles in the pillar areas must allow for separation.
- The Ford regulations for partial replacements on structural frame sections must be taken into account.
- The large surface welding seams at the connections must be restored.

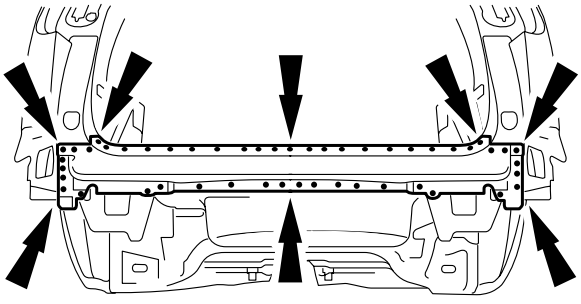
Advantages of a partial replacement

A partial replacement repair offers many advantages for a professional repair of accident damage:

- Repairs can be made both in the outer panel area (e.g. side frame) and in the inner areas (e.g. structural member, trunk floor).
- The repair can be limited to the actual damaged area.
- Reduction of repair costs, as aggregates and other components can usually remain in the vehicle.

Complete replacement

In a complete replacement, the original connections are largely reused.



DESCRIPTION AND OPERATION

A complete replacement is advantageous if the damaged body part can be detached from its original connections and a completely new part can be fitted without creating additional joints (e.g. liftgate).

A complete replacement is necessary if there is no sectional replacement solution.

DESCRIPTION AND OPERATION

Corrosion Prevention

The corrosion protection provided in production must be carefully maintained and reproduced during body repair work, in order to ensure the long-term warranty for Ford vehicles.

NOTE: Please take the notes in the model-specific repair descriptions into account. Please also note the manufacturer's instructions when handling the different anti-corrosion agents.

Only Ford original bodywork components and Ford approved repair materials are to be used for body repairs. The Ford logo is stamped onto every Ford original spare part.

Panel coatings and corrosion protection

Body steel panels are provided with a coating for corrosion protection purposes. The coating material is predominantly zinc in a variety of composition forms. Aluminum is also used to some extent. Basically, all types of steel sheet can be coated.

A variety of coating processes are used:

- Hot dip zinc coating.
- Electrolytic zinc plating.
- Organic coating.
- Hot dip aluminum coating.

NOTE: Welding fumes are harmful to health. Make certain that the workspace is well ventilated and use welding fume extraction.

The following points must be noted when welding:

- Zinc starts to melt at about 420°C.
- The zinc vaporizes at a temperature of about 900°C.
- The amount of heating determines the damage to the zinc coating, and therefore to the corrosion protection.
- Resistance spot welding is particularly suitable for welding zinc-coated panels, because no widespread warming occurs.
- With electrolytically zinc-plated panels there is no need for any special preparation because the zinc coating does not need to be removed.

NOTE: Coated panels have a higher electrical resistance, but this can be compensated for by increasing the welding current by 10 - 20% .

Corrosion protection measures during repair work

CAUTION: Always be extremely careful when handling solvents, sealants and adhesives. Some products contain substances harmful to health or give off harmful or poisonous vapors. Always follow the manufacturer's instructions. If there is any doubt as to whether a particular solvent is suitable, it must NOT be used.

All Ford bodywork components have a cathodic primer. Moreover, most parts are zinc-plated on one or both sides. If possible, these protective layers must not be damaged.

Before welding

Interior surfaces of new bodywork components which will no longer be accessible after installation must be painted beforehand. The welding flanges are treated with a special welding primer. The joint areas are not always accessible from inside later. Therefore, prepare these areas so that no soot is produced by burning paint during welding.

NOTE: In order to ensure that the corrosion protection produced in production is not destroyed, the working area must be kept as small as possible.

NOTE: Do not touch cleaned bare metal any more with the bare hands. The dampness of your hands will corrode the metal.

Procedure:

- Remove the primer or paint/zinc layer in the welding area using a tress wire brush to prevent the formation of soot from the paint.
- Thoroughly clean the welding area with a metal cleaning agent and rub dry.
- Coat the welding flange with welding primer on all sides and allow to dry.

NOTE: The welding primer must only be applied thinly to the spot welding area, to minimize spattering when welding.

After welding

During repair work, body panels are often heated at very high temperatures, which results in the destruction of the corrosion protection.

DESCRIPTION AND OPERATION

Reworking of the affected areas is therefore vital:

- Grind the welded seams flat and clean thoroughly with silicone remover. Dry with a lint-free cloth.
- If the join area is accessible from the inside, the transition area to the paint must be abraded for all types of join so that good adhesion of the primer is achieved later.
- If the join area is not accessible from the inside, the cleaning and sanding work is not done. For this reason, ensure that there is as little contamination as possible in the area of the repair. This allows the cavity wax applied later to penetrate the join area without hindrance.

NOTE: Only apply a small amount of panel cleaner to the cleaning cloth when cleaning the repair area. Make sure that no cleaner reaches the connecting flange, so that the welding primer is not washed away again.

Priming after welding

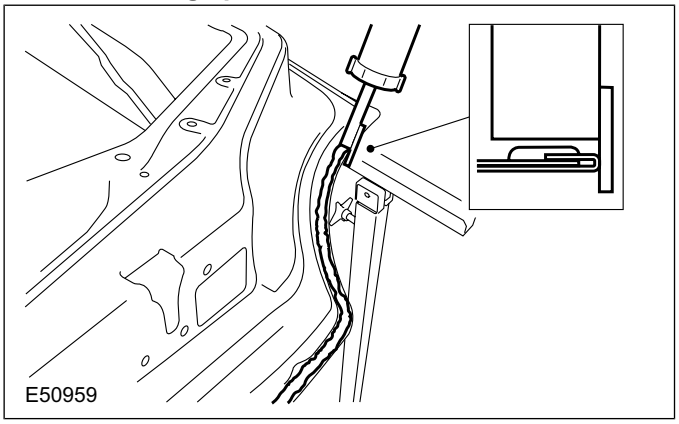
Primer is applied to the welded flanges after cleaning. A check must also be made that the production corrosion protection is present in the area of the flanges. Any damage must also be re-primed.

Sealing work

- If MIG welding is carried out during a sectional repair on a connecting flange with sealant or adhesive material, the material must be applied at a distance of approx. 10 mm from the weld spot.
- These areas must be sealed very carefully after the work has been completed.

Depending on the type of repair, the clinched flanges on the hood, doors, tailgate and trunk lid must be sealed with clinched flange sealer.

Clinched flange protection with flat nozzle



Clean the clinched flange area of the new component with silicone remover and dry with a lint-free cloth.

The sealant must be applied to the dry primed surface (i.e. dip priming as for delivery).

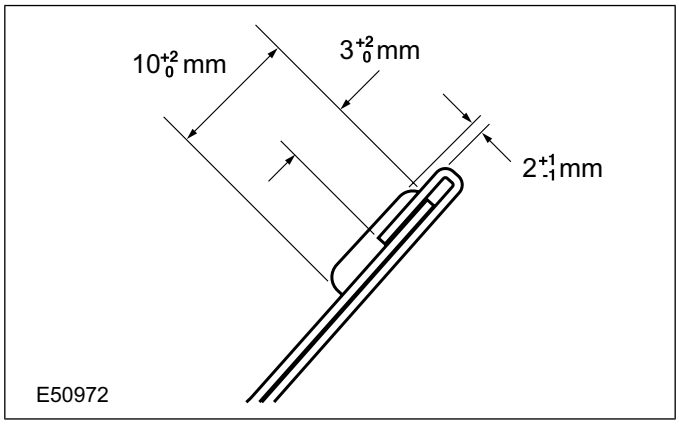
Apply clinched flange protection to the clinched flange using one of the flat nozzles supplied. The nozzle must be cut to the necessary width beforehand and the guide stop cut as required.

During application the clinched edge must be covered with an overlap of at least 3 mm. The beginnings, ends and edges or interruptions in the sealer bead need to be reworked by forming with a brush or a spatula, to ensure a 100% tight sealing of the flange.

The speed and angle of application are decisive for a good appearance and a bubble-free bead. Always apply the sealer with as few as possible interruptions to avoid sealer rework. Never use solvents or thinners as this will considerably slow down the hardening process of the sealer.

For an application thickness of 3 mm of the clinched flange sealer it is recommended to allow to dry over night at room temperature. A minimum hardening time of 5 hours is required anyhow before a 2-component primer can be applied.

Clinched flange protection applied to the correct width and thickness.



Underbody protection/stone chip protection

The underbody protection is used as corrosion protection and must also be applied such that it matches the original condition, from a visual perspective.

Two main application methods are used in production:

DESCRIPTION AND OPERATION

- The underbody protection is applied as a sprayable sealing compound.
- In the area around the structural members, the underbody protection is sprayed on and spread across a wide area.

Because of the coarse surface structure of the stone chip protection material, it is recommended to only perform a repair over the whole surface, if there is damage over visible areas. Otherwise there is the danger of serious irregularities on the surface.

The thickness and appearance of the underbody protection and stone chip protection must be matched to the original. Special spray guns are used to work the materials for this reason. A test spray must always be performed beforehand however, to determine the correct appearance and layer thickness.

Cavity protection

After painting work has been completed, a general check is made of the work that has been done. Before final reassembly of the vehicle, the cavity wax protection in the area of the repair must be renewed. Cavity wax protection must be performed carefully so that the quality of the repair conforms with Ford standards:

- Guide the cavity wax probe carefully in the area of the repair so that targeted corrosion protection is achieved.
- Pay special attention to edges and swage line on stepped joints, the wax must cover the inner edge areas.
- The cavity wax must flow along the stepped sheets so that the wax is drawn between them by capillary action.

A hole may be drilled in a suitable place for areas which are not accessible for the application of cavity wax. The diameter depends on the size of plugs available. When this is done it is vital to make sure that no drilling swarf remains in the cavity (rust will form if any remains). The edge of the hole must be treated with cavity wax. Finally close with a plug and seal with underseal.

Only on components with clinched flange edges:

After painting, the inner clinched flange edge must be sealed as far as is possible with cavity wax. For this, the repaired component should be positioned upright and corrosion protection wax sprayed into the water drainage holes and/or the thread holes for the hinges in both directions (50 ml corresponds to about 20 seconds spraying time).

For doors, tilt and turn the component to spread the corrosion protection wax over the whole edge of the flange.

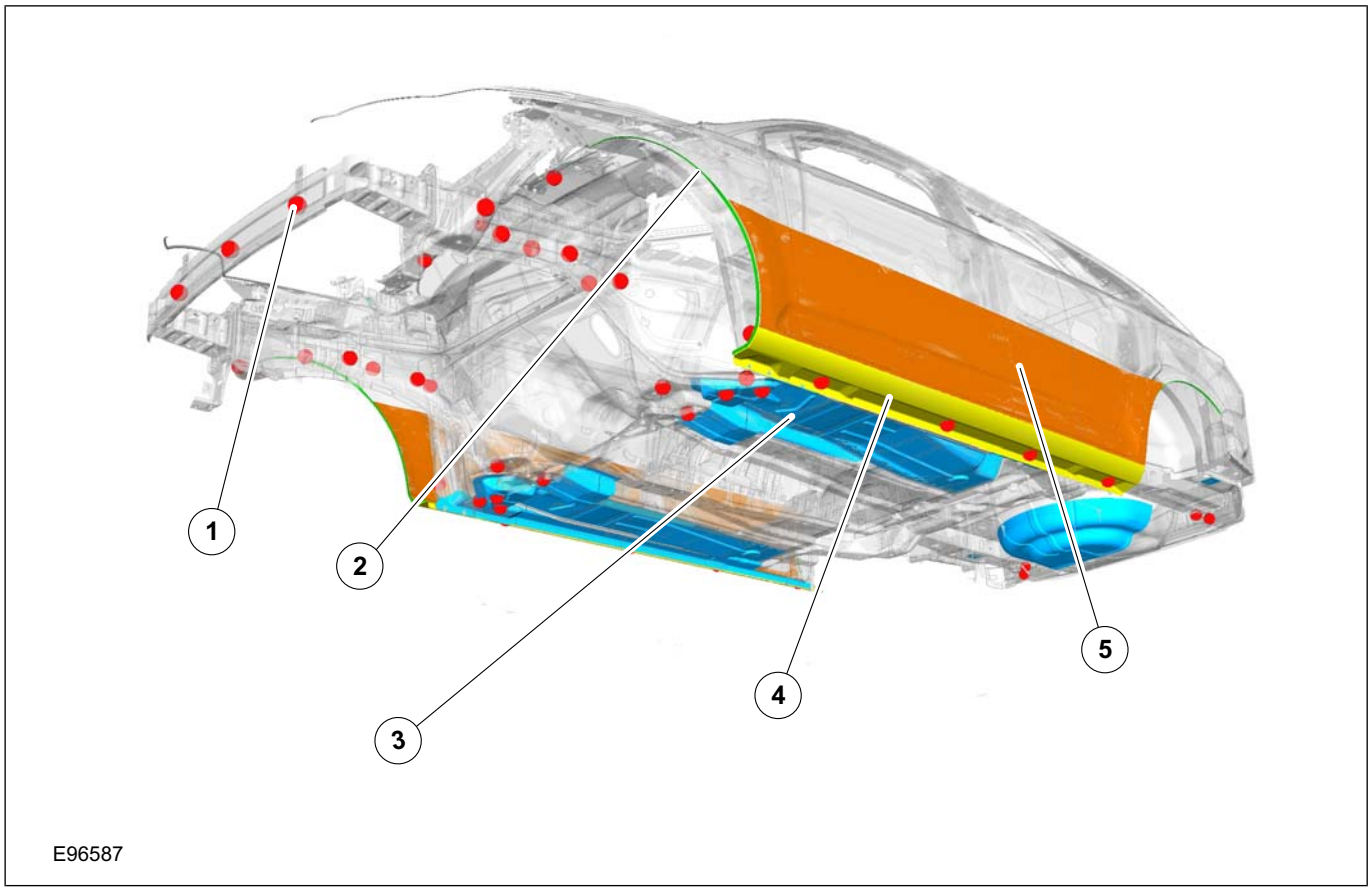
Wax application

DESCRIPTION AND OPERATION



DESCRIPTION AND OPERATION

Corrosion protection for the floor pan (example)



Item	Description
1	Injection points for cavity wax protection
2	PVC stone chip protection at the wheel arches
3	PVC underbody protection
4	PVC stone chip protection
5	PU primer

DESCRIPTION AND OPERATION

Corrosion Damage/Corrosion Repair

Modern vehicle bodies are protected from corrosion by elaborate measures. Multilayer coatings on the panel surface prevent direct contact between the metal and oxygen, and so protect it from corrosion.

In the long-term however, corrosion on a vehicle cannot be completely prevented.

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range of training in the Training Brochure issued by the Ford Service Organization.

What is corrosion?

Corrosion is destruction of a subsurface caused by chemical or electrochemical effects which operate from the outer surface.

If the protective layers become damaged, electrochemical conversion processes are initiated, which allow the metal to oxidize. This leads to the formation of corrosion.

The following factors lead to corrosion:

- Mechanical damage such as stone chips and scratches which penetrate through to the steel panel.
- Damp interiors.
- Unfavorable weather or environmental conditions, as may occur in areas with high humidity, high salt content in the air or serious air pollution due to aggressive gases and dusts.
- Insufficient corrosion protection after repairs.
- Lack of care by the vehicle owner of the painted and corrosion proofed surfaces or areas on the vehicle.

In order to maintain long-term corrosion protection, the vehicle must be checked at regular intervals.

In doing so, the follow areas must be inspected and any damage rectified:

- Damage to the paint surface cause by scratches or stone impact must be suitably rectified according to the specifications.
- Damage to the PVC underbody protection or the PU stone chip protection must be refinished.
- Damage to the PVC underbody protection or the PU stone chip protection must be refinished.
- Incomplete or damaged sealing at clinched flanges must be renewed.
- Check the cavity protection and renew it if incomplete.
- Poorly installed or damaged covers and stone chip protection fixtures must always be renewed.
- Check seals and seal carriers for wear and correct mounting. Any damaged seals must be renewed.
- All rubber grommets and blanking plugs must be present and correctly installed.
- A damp or wet floor inside the vehicle indicates that there are leaks in the bodywork. The interior must be dried out and the leaks must be completely rectified.

The corrosion formation can vary in extent.

With rust film or edge rust formation, the surface of the paint has small traces of corrosion present. The traces of corrosion can possibly be removed in such cases by polishing the paint surfaces. If this is not possible however, the traces of corrosion must be rectified by using a touch-up technique.

If the corrosion is just starting, with up to 1 mm rusting below (in the form of a dot or a line) the damage is rectified as follows:

- Clean the defective location.
- Mechanically remove the rusting which is starting below the surface.
- If the area is small, apply primer and allow it to dry, then use the paint pencil to touch up the area - if not, respray the damaged area.

If rust is already under the paint finish to the steel panel, then the whole paint finish in the affected area must be sanded away.

Furthermore, the existing traces of corrosion in the body panel must be carefully and completely removed.

Finally a new paint finish must be applied in this area. In the case of rusting through, the affected body panel is already completely destroyed. Such damage requires complete or at least partial replacement.

NOTE: : In the general section there are several chapters which present the techniques necessary for a professional corrosion repair.

The outcome of this is the following repair sequence:

- Remove the rusted-through part.
- Remove the remaining traces of corrosion.
- Offer up the new part.
- Prepare the joint areas.

DESCRIPTION AND OPERATION

- Weld the new part into place.
- Produce the corrosion protection.

For a professional repair it is essential to reproduce the corrosion protection during and after the repair.

DESCRIPTION AND OPERATION

Sealer, Underbody Protection Material and Adhesives

Sealants, adhesives, cavity wax and underbody protection materials are used during the various body repairs. In this area Ford offers a range of products which have been tested and matched to each other.

CAUTION: Always be extremely careful when handling solvents, sealants and adhesives. Some products contain substances harmful to health or give off harmful or poisonous vapors. Always follow the manufacturer's instructions. If there is any doubt as to whether a particular solvent is suitable, it must NOT be used.

Clinched flange protection

One-component adhesive/sealer which can be applied by brush or spraying, based on MS polymer, with a flat nozzle for application and with the following properties:

- Can be sanded
- Permanently elastic
- Non-corrosive
- Very good adhesion
- Rapid hardening and resistant to ageing
- Can be over-painted with almost all proprietary paints

Seam sealant T Anthracite

One-component sealer based on MS polymer, for sealing joints and seams, with the following properties:

- Silicon-free
- Solvent-free and low-odor
- suitable for gluing HVH elements into position in their respective body areas

Body sealant T beige

Sealer with the following properties:

- Stable
- Contains solvent
- Especially suitable for visible seams
- After hardening can be overpainted with two-pack paint

Underbody Coating

Underbody protection is necessary for permanently elastic corrosion protection of vehicle underbodies. It is very durable and has good resistance to abrasion,

Cavity wax

This touch-proof, transparent corrosion protection wax is used for the preservation of cavities and flange joints.

Anti-corrosion wax

Anti-corrosion wax is a coating material which can be applied in fine spray, forming a very thin and grease-like protective film, therefore offering very good corrosion protection.

2-component metal adhesive

For joining metal to metal and plastic to metal. The adhesive reduces droning noises and improves corrosion protection.

Windshield sealant

Solvent-containing, stable sealing material. The sealer is permanently elastic and does not form a skin on the surface.

1-component window glass adhesive kit

For direct glazing. The vehicle is ready to drive after 6 hours (passenger airbag). Prevents contact corrosion.

2-component window glass adhesive kit

For direct glazing. The vehicle is ready to drive after 1 hour (passenger airbag). The adhesive is not an electrical conductor and permits interference-free radio reception. Prevents contact corrosion. Using a 150ml additional cartridge, the adhesive can also be used for large windows or to produce a double seam of adhesive.

PU glass adhesive

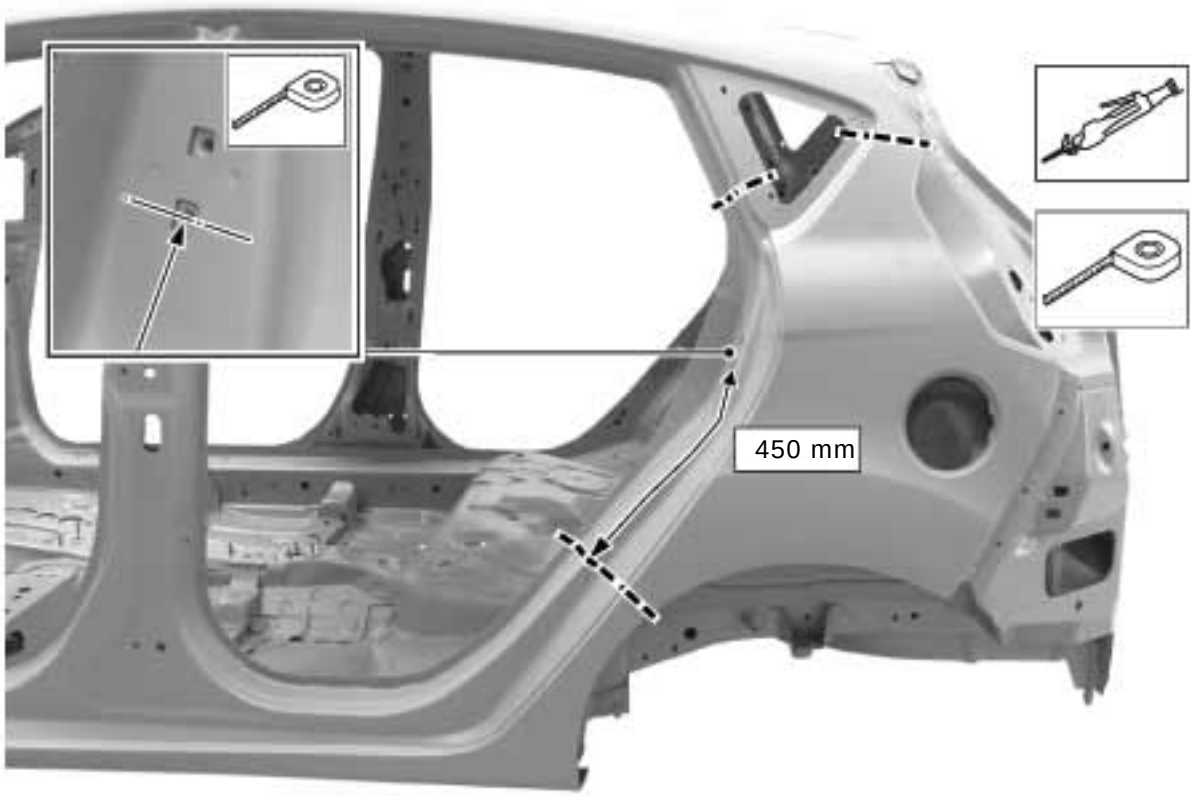
150ml additional/replacement cartridge for direct glazing using 2-component window adhesive kit. Suitable for double beads or larger windows. Also suitable for sealing NVH elements.

DESCRIPTION AND OPERATION

Cutting Technique

NOTE: Without exception, before starting work you must read the safety and warning instructions in the chapter "Safety Instructions". In addition, pay attention to the warning instructions of the particular equipment manufacturer.

Possible cut lines (example)



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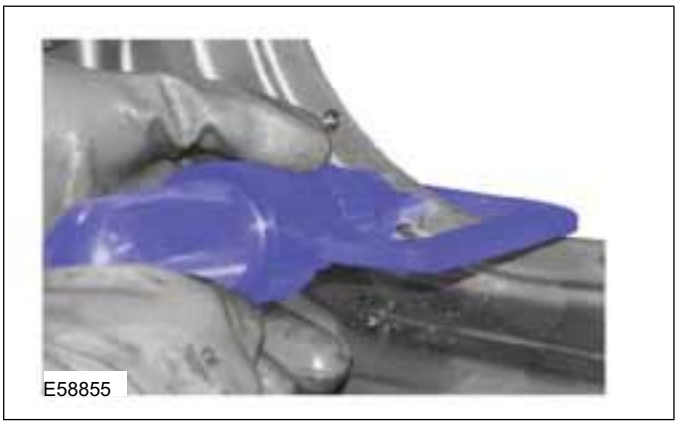
NOTE: After all separation work, make certain that the metal swarf is completely removed from the vehicle body.

Depending on the separating tools used, there are some fundamental points to bear in mind:

- Only start the cutting work once the new part is to hand.
- Compare the new part with the old part for shape and size.
- The straightening work must be completed before any body components to be replaced are cut out.
- Before separation work is started, all welded connections which cannot be seen must be freed of underbody protection, sealant etc.

Spot weld milling tool

Resistance spot welds are separated using a spot weld drilling machine or a spot weld milling tool.



E58855

NOTE: Steplessly variable machines increase the working life of the cutting tool. Use of a suitable lubricant can increase this even further.

A spot weld milling tool usually has an adjustable depth stop and a safety fixing system. These prevent the machine from drilling too deep and the cutter from slipping while working.

DESCRIPTION AND OPERATION

Rod sander

Another option for separating resistance spot welds is to use the rod sander.

TO BE UPDATED LATER

If spot welds and MIG welds are difficult to reach, a rod sander may offer an alternative.

Short stroke saw

The short stroke saw is suitable for separating vehicle body components and for making a separating cut for partial repairs.

TO BE UPDATED LATER

NOTE: In order not to damage panels, wiring harnesses, hoses or similar components which lie behind, remove them beforehand as necessary.

The narrow design of the saw blade permits cutting in tight curves. Straight cuts require a relatively great deal of practice.

Orbital saw

Where use of the short stroke saw is difficult because of the body construction, the orbital saw can be used.

TO BE UPDATED LATER

The cutting depth of the orbital saw can be set. This allows separating cuts to be made, despite panels or other components lying in danger behind. Straight cut lines can be more easily made using the orbital saw.

DESCRIPTION AND OPERATION

Panel Beating Technique and Smart Repairs

General

Smaller scale body repairs, where damaged panels do not need to be replaced, can often be carried out by realignment work. Whether the repair is economical however, often depends on the accessibility of the affected body area.

NOTE: Basic and in-depth training courses are offered on the topics which follow. An overview of the complete range of training offered is provided by the Ford Service Organization Training brochure.

During damage assessment, the following technical points must be taken into account:

- Small mild dents (without damage to the paint), which are in areas that make access from the inside possible, can be rectified using undamaged paint panel beating.
- If the inner side of the damaged area (with paint damage) can be accessed, then conventional panel beating techniques can be used.
- If the damaged area has no access from inside, then it can only be rectified using outside panel beating techniques.

Dent removal using special panel beating levers

NOTE: In the Undamaged Paint Dent Removal section, you will find more information on pressure techniques.

TO BE UPDATED LATER

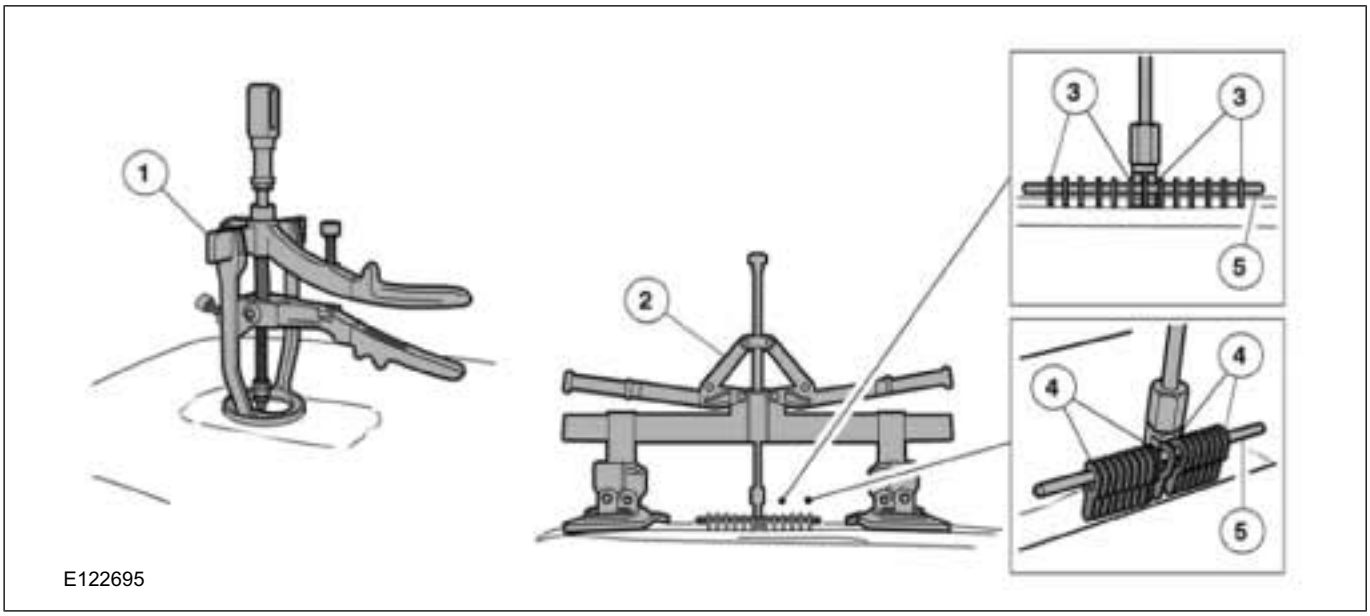
Description	Description
1	Deflection by a hook arrangement
2	Pressure tool

This panel beating technique with pressure is mainly used to rectify smaller dents as a result of hail impact, transportation or parking, without the paint being damaged.

Small dents are removed from the inside of the body panel by pushing them outwards in a mechanical process using panel beating levers.

Because of the great variety of shapes of these levers, it is possible to use this panel beating technique on almost all areas of the vehicle body.

DESCRIPTION AND OPERATION



E122695

Description	Description
1	Puller device for minor damage, with integral copper electrode
2	Puller device for more extensive damage
3	U-washers spot-welded in place
4	Puller bits spot-welded in place
5	Attachment for U-washers or puller bits

This method can be used to reshape dents or more extensive damage from the outside.

For minor damage, the copper electrode in the tool is secured onto the panel surface by spot-welding and the puller device is used to pull out the damage without jolting.

For more extensive damage, puller bits or U-washers (depending on the application area) are spot-welded to the panel surface and the area pulled out using the puller device.

Because of the versatile puller and the variable counter bearing, a wide variety of damage can be worked and rectified using this repair method.

Because of the mechanical lever operation, the variable counter bearing and the optimum controlled application of power, this external dent removal system allows dents in almost all vehicle body areas to be pulled out.

Hollow leveling (removing dent without a dolly)

Hollow leveling can only be used on areas which are accessible from the rear.

TO BE UPDATED LATER

DESCRIPTION AND OPERATION

Description	Description
1	Center of dent
2	Spoon

During hollow leveling, the dent is removed from the inside a using suitable panel beating tool and applying knocking or pressing movements. High spots around the edge of the dent area are flattened with blows from the aluminum or wooden headed hammer.

The usual tools are for instance hammers of various designs, dollies, levering irons and various spoon irons. The correct choice of tool is made depending on the shape of the dent and the access which is possible.

Dent removal using hammer and dolly

Panel beating can only be performed using a hammer and dolly if access can be gained from the rear side.

TO BE UPDATED LATER

Description	Description
1	Aluminum hammer
2	Box file

The purpose of the dolly in this case is to transfer the force of the impacts from the hammer to the steel panel which is in between. As this is done, the deformed body panel is smoothed (dressed) and the tension fields in the body panel are removed.

The favored tool for this repair process is the aluminum hammer and as opposite support the universal hand dolly. To rectify minor panel damage, the box file should be used as opposite support. Because of its serrated surface, the box file prevents normal stretching of the body panel which would otherwise occur.

Heat-induced material shrinking

Material shrinking, also called settling in, can be performed in a variety of ways depending on the extent of the damage and the access to the repair area.

These repair processes differ depending on the type of heating and subsequent working of the heated surface. They sub-divide into two basic processes:

- Heating using a carbon electrode.
- Heating using the oxy-acetylene torch.

In the carbon electrode process the working is done exclusively by warming. In this case the access to the repair position is only from the outside.

TO BE UPDATED LATER

Description	Description
1	Carbon electrode

DESCRIPTION AND OPERATION

Description	Description
2	Spiral shaped heating pattern

If the damage is concentrated in a spot and is in the form of a more rigid raised area, then the carbon electrode must be replaced by a copper electrode. As heat is applied, slightly more pressure is applied to the raised area.

In the method using heating by the oxy-acetylene torch, material shrinking is achieved by a combination of heat and mechanical working of the damaged area.

TO BE UPDATED LATER

Description	Description
1	Overstretched area
2	Point heating using the oxy-acetylene torch
3	Spiral shaped knocking back with dolly

The repair area must always be accessible from both sides, so that the heated area can be properly worked mechanically.

The combination of heating and mechanical working is very effective.

As soon as the warm point is established, hammering is immediately started using the aluminum hammer together with a suitable dolly on the inside of the repair surface, working in spiral movements towards the warm point. This causes material to build up in the center of the warmed area.

Lead loading

Despite good external panel beating techniques, it is not always possible to rectify every surface unevenness. For this reason, application of lead loading is an important part of panel beating.

CAUTION: Poisonous gases and dust can be produced when working solder. Use an extraction unit and, if required, a protective mask.

NOTE: Since 07/2003, lead compounds have been ruled out for production. Appropriate lead-free tin solders and pastes must also be used in the workshop.

Typical application areas:

- Body components with limited or no access from the rear.
- Body components with very narrow cross-section.
- Body components which are particularly exposed or which can move.
- Weld seams of partial repairs.
- Rocker panel areas, wheel arch edges, side panel areas.
- Doors, hood, luggage compartment lid.
- Swage lines and joint areas.

Tin has the following advantages:

- Excellent bonding on bare metal surfaces.
- Good moulding properties.
- Good properties for the production of shapes and contours.
- Permanent shape.
- Heat expansion is the same as steel.

To create a basis for the actual lead loading process, a lead loading paste is first applied to the panel. The paste is then heated and wiped away with a cloth. Now the tin can be applied and moulded with a brazing block.

DESCRIPTION AND OPERATION

After the repair site has cooled down, it is worked using for example the body plane until the surface is smooth and has no transitions.

DESCRIPTION AND OPERATION

Paintless Dent Removal

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

General

Application is restricted to body surfaces which are accessible from both sides. This repair technique is seldom feasible on double-skinned body components or closed body profiles. The same applies to edge areas, swage lines and seams on body components, which are very dimensionally stable.

The following characteristics must be present for a dent to be removed:

- The diameter must be no more than 50 mm.
- No material stretching in the centre of the dent.
- Repair area must be accessible

Furthermore, sufficient experience in the use of special tools and knowledge of materials are also requirements for a successful repair.

TO BE UPDATED LATER

Item	Description
1	Deflection by a hook arrangement
2	Pressure tool

Mild dent

TO BE UPDATED LATER

Satisfactory repair results are only possible on mild dents with little depth and small deformation radii. Therefore this repair method is particularly suitable for hail, parking and transportation damage.

Dent with material stretching

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

If strong and direct force during the damage process causes the material to stretch in the middle of a dent, then the result is a small and sharp edged dent. Such damage cannot be rectified without visible deformation.

Advantages of a planishing technique:

- Economical in time and materials
- The original paint is retained
- Environmentally friendly (no sanding or painting work)

While carrying out the repair, the following itemized repair route and process flow must be complied with:

1. Damage diagnosis
2. Repair preparations
3. Perform repair
4. Paint finishing, corrosion protection and quality control

In order to ensure corrosion protection, all inner areas of the repair must be treated afterwards. Where it is possible, the paint is repaired. In every case the inner area of the repair must be treated with cavity wax.

DESCRIPTION AND OPERATION

Plastic Repairs

General

The proportion of plastics used in vehicle construction continues to rise. Up to now damaged plastic components often had to be replaced. These days, plastic repairs are becoming more and more widely accepted because of the increasing cost of spare parts.

NOTE: Plastic adhesives are chemical products and are subject to the safety instructions of the manufacturer.

In repair work, the material properties of plastics are highly significant. There are two main groups:

- Thermoplastics.
- Thermosets.

NOTE: Elastomers make up a third group of plastics. These are not mentioned below because they have no plastics repair applications.

Thermoplastics

Heat causes thermoplastics (also called TP polymers) to transform from the solid state into the thermoelastic state and then into the thermoplastic state. When thermoplastics are cooled, they return to solid state.

Brief description	Plastic
ABS	Acrylonitrile butadiene styrene copolymer
PA	Polyamide
PC	Polycarbonate
PP	Polypropylene
PP/EPDM	Polypropylene/ethylene propylene diene copolymer
PC/PBT	Polycarbonate/polybutylene terephthalate
Hard PVC / soft PVC	Polyvinylchloride

Thermosets

Thermosets (also called TS polymers) are much harder and more brittle than thermoplastics. Their strength remains largely unchanged when they are heated. Thermosets are destroyed when heated above the critical temperature. Also, the original state will no longer be restored on cooling.

Brief description	Plastic
GRP	Glass reinforced plastic
PUR	Close-meshed cross-linked polyurethane
PUR	Wide-meshed cross-linked polyurethane

Plastic identification

Normally the appropriate identifier is marked on the plastic components used in vehicle construction.

The capital letter sequences used for this are standardized in DIN EN ISO 1043-1 and DIN ISO 1629 (for rubber) and can be looked up in the tables which they contain. In addition the string of characters provides information about the exact mixture ratio and the proportion of certain fillers.

Examples of the identification of plastics

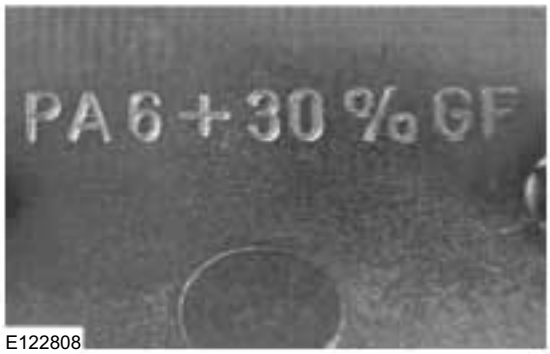


E122806

DESCRIPTION AND OPERATION



E122807



E122808

NOTE: The identification of the type of plastic is necessary for the plastic welding process in order to determine the correct welding rod (welding material) to use.

If an identifier is missing or cannot be made out, the following easy to perform tests will help:

Visual Inspection

Visual inspections mainly serve to identify PUR and GRP materials. Thermoplastic components are often painted and are therefore difficult to identify.

Identification characteristics:

- When PUR cracks or similar damage occurs, pores of foam can be seen.
- GRP can be recognized by the glass fiber structure on the inside.

Mechanical test:

The plastic group can be determined by a sound test:

- Degree of hardness - the higher-pitched the sound, the harder the plastic.
- Elasticity - the more muffled the sound, the higher the elasticity of the plastic.

Sanding test

In this a place is chosen which will not be visible later, and the finger belt sander is used to sand the plastic.

The plastic group can be determined using the pattern of the dust:

- Thermosets produce a white dust.
- Thermoplastics smear and do not produce dust.

Float test in water:

Take a small piece of plastic from the component to be repaired and test whether it floats on water (PP-EPDM, HD-PE, PP) or sinks (PVC/U, PVC/P, ABC, PC).

Nature of the surface

The surface of plastics can be categorized as rigid (PVC-U, PVC-P) and waxy (PP/EPDM, HD/PE, PP).

Adherence test using welding rod

Heat a welding rod that is identified with the type of material and the plastic component using the hot air gun. Press the welding rod onto the plastic component to be welded. When the welding rod cools down, if it remains stuck to the component or can only be removed with great difficulty, then it can be assumed that the two are made of the same plastic. When pulling away from PP/EPDM, HD/PE and PP, this can lead to strings.

CAUTION: Danger of poisoning! When burned, most plastics release vapors harmful to health. Ventilate the room well and use respiratory protection. Where possible work using an extraction system.

Burning test

Every plastic has a characteristic behavior and smell when burned. Using a knife, cut off a small piece from the component to be repaired, remove any dirt and paint residues and set light to the small chip. Now observe the burning behavior. Compare the color, type and smell of the smoke with the results from the following table.

Short description	Plastic recognition using a burning test
ABS	Blackish smoke, the material drips like a candle when burning and smells like wax.
PA	No smoke, draws filaments, smells like burnt horn.

DESCRIPTION AND OPERATION

Short description	Plastic recognition using a burning test
PC	Yellowish, sooty smoke. Smells sweetish.
PP	No smoke, the material drips like a candle when burning and smells like burnt oil.
PP/EDM	No smoke, the material drips like a candle when burning and smells like burnt oil.
PC/PBT	Hard and shiny, burns yellow, fluffy soot.
Hard PVC / soft PVC	Blackish smoke and acrid smell.

Safety instructions

In addition to the general safety instructions, the relevant regulations and accident prevention legislation must be observed.

NOTE: Without exception, before starting work you must read the safety and warning instructions in the chapter "Safety Instructions". In addition, pay attention to the warning instructions of the particular equipment manufacturer.

Information sheets, safety notices and guidelines for the processing of adhesives containing isocyanate, polyester resin, adhesives, solvent and thinners provide more details on their use.

The following instructions must always be followed:

- Polyester resin, adhesive, solvents and thinners are inflammable and must not be used near naked fire or flames.
- Sawing and grinding operations must only be carried out in rooms equipped with extraction systems.
- If no rooms with extraction systems are available, only use tools with extraction equipment.
- Protective equipment such as gloves, protective goggles, aprons and breathing masks are essential.

Because of the various compositions of plastics, repair work to plastic parts involves a variety of repair methods.

The following methods are used:

- Thermoplastic straightening.
- Plastic welding.
- Plastic adhesive bonding.
- Plastic lamination techniques.

Thermoplastic straightening

Damage to thermoplastics can be rectified by heating using the hot air gun (temperature about 100°C) while the deformation is pressed out until the shape is regained.

Plastic welding

Splits formed in plastic bumpers are typical possible plastic repairs.

NOTE: Do not carry out plastic welding in the area of fixed foam backing. The foam backing will usually be destroyed and the function of the component is then no longer guaranteed.

If repair using adhesive methods is not possible because of unfavorable conditions at the rear of the repair location, plastic welding is a possible repair process.

There are two methods of welding: hot air draw welding and hot air fanning welding.

Plastic welding set

TO BE UPDATED LATER

Item	Description
1	Various welding rods
2	Scraper (heart-shaped)
3	Hot air blower (approx. 1500 W)
4	Clamps
5	Welding nozzles

In addition to the components listed, plastic welding requires tools already found in the workshop such as scrapers, sanders, face cutters etc.

DESCRIPTION AND OPERATION

As with all other welding processes, only certain material combinations can be joined together using plastic welding.

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

NOTE: The manufacturer's data must be taken into account when choosing welding materials and the correct temperature setting of the hot air gun.

Repair sequence during plastic welding:

- To prepare the location for welding, remove paint residues and sand the weld area.
- If parts of the material have been pushed in by an impact, the damaged area can be brought back to shape by heating.
- Drill out the ends of the split to stop it spreading further. Machine the location of the weld into a 90° V-shaped groove, to accept the welding rod.
- Lay the welding rod in the groove.
- Perform the welding. Hot air draw welding or hot air fanning welding.
- Rework the weld seam. After cooling, sand the raised weld seam.
- Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface and paint it.

Despite good preparation and the correct choice of welding materials, weld faults may occur.

The following points must be noted when welding plastic:

- Weld together like with like:
  - With very few exceptions, only the same materials can be welded together, e.g. PP with PP.
- Correct temperature:
  - The correct choice of temperature is important for the success of the repair. The plastic must be warmed until it plasticizes (dough-like, soft).

Guideline values for welding temperature:

Brief description	Plastic	Temperature
ABS	Acrylonitrile butadiene styrene copolymer	360°
PA	Polyamide	400°
PC	Polycarbonate	370°
PP	Polypropylene	280°
PP/EPDM	Polypropylene/ethylene propylene diene copolymer	280°
PUR	Polyurethane	300°
Hard PVC	Polyvinylchloride	340°
Soft PVC	Polyvinylchloride	370°

- Even pressure:
  - When rod welding, the pressure is applied by pressing on the welding rod.
- Steady speed:
  - To achieve a good weld, care must be taken that the working speed is steady.

Possible causes of weld faults:

- Deformation caused by overheating of the repair area or tensions in the material while welding the component.
- Plastic material too thin.
- Poor weld joint because the weld temperature was too low or the welding speed was too fast.
- Welding different materials together.
- Weld seam dropped because the split gap was too wide or the welding temperature was too high.

A good weld is recognized by a slightly raised, smooth and even weld bead on the surface of the component.

The weld bead must only be worked once it has fully cooled down.

Plastic adhesive bonding

Adhesive bonding of plastics has some advantages over welding methods:

- Within the group of thermoelastic plastics, all semi-rigid ancillary components (such as bumpers, front grilles, etc.) can be repaired without identification.
- A two-component polyurethane based adhesive is used for all thermoplastic parts.
- Reinforcement strips can be attached behind splits (split length up to max. 100mm) and

openings to ensure the original strength properties.

Tools and equipment also familiar from paint repairs can be used in making adhesive repairs to thermoplastic components.

Angle grinders and belt sanders can be used to grind out scratches and splits. Orbital sanders with extractors are used for fine sanding.

The infrared heater is used to provide fast and certain drying throughout.

Plastic adhesive set

TO BE UPDATED LATER

Item	Description
1	2-component adhesive
2	Cartridge gun
3	Mixing tube

Apart from the components shown, other materials may be needed to bond plastics, depending on the repair position.

For large scale repairs, it may be necessary to insert reinforcement panel strips and reinforcement matting as fixing aids.

Repair sequence during plastic adhesive bonding:

NOTE: Follow the manufacturer's guidelines when using adhesives.

- Prepare the location of the bond. Remove paint residues and sand the area to be bonded. Drill out the ends of the split to stop it spreading further. Prepare the bond location into a V-shape and clean it with plastic cleaner.
- Apply the adhesive. The two-component adhesive is applied to the cleaned and primed repair location using a hand gun. Spread and smooth the adhesive using a flexible plastic spatula.
- Rework the bond location. After cooling, sand the raised adhesive. Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface. Apply paint.

GRP repairs

GRP material is hard and brittle in its strength properties. Because of these material properties, splits and openings often result in cases of serious damage.

The stability of GRP parts is impaired if the glass fiber reinforcement is cracked. The component must be replaced in cases of serious damage that affect the structure.

Minor damage (such as abrasion, splits up to 80mm, holes up to approx. 60mm diameter, etc.) can be repaired to a technically and visually perfect standard, provided that the damage does not occur in heavily used or hard-to-reach areas.

To ensure perfect repair results, observe the following points:

- The room temperature should be at least 15°C and the air should be as dry as possible.
- The repair location must be thoroughly dry and clean.
- Before the repair, the GRP part being repaired must be dried using an infrared heater or in a drying oven.
- In cases of large splits and fractures, the strength of the outer skin can be re-established by backing with a reinforcement material.

Tools and equipment from the paint shop can be used to carry out repairs to GRP parts. Angle grinders and belt sanders can be used to grind out scratches and splits. Orbital sanders with extractors are used for fine sanding.

GRP repair set

TO BE UPDATED LATER

DESCRIPTION AND OPERATION

Item	Description
1	Polyester resin
2	Glass fiber mats
3	Hardener

Scissors, paintbrush and cleaning materials are other materials which will be needed to perform a GRP repair.

NOTE: Follow the manufacturer's instructions when using the repair materials.

The repair process for a GRP repair is as follows:

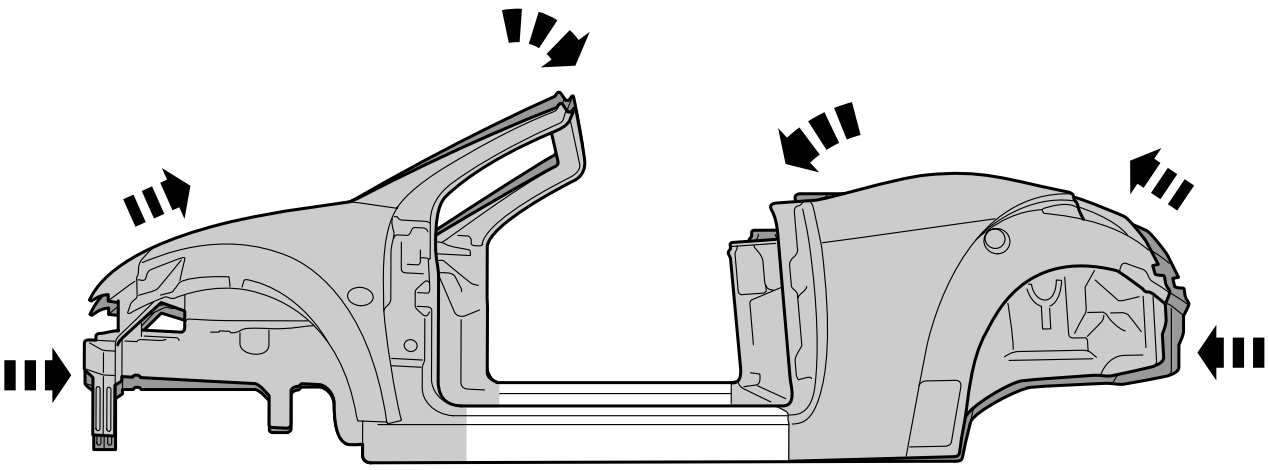
- Prepare the repair location. Remove paint residues and sand the repair area.
- Drill out the ends of the split to stop it spreading further.
- The repair location must be sanded by hand. If machine working is attempted, the resin will be heated so much that the surface structure will be changed. The result is inadequate adhesion.
- Perform the GRP repair. Apply polyester resin thinly to the repair location. Lay the glass fiber mat in place and apply polyester resin over it again.
- Rework the location of the repair. Sand away any polyester resin which stands proud after it has hardened.
- Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface and after it has dried apply the paint finish.

DESCRIPTION AND OPERATION

Special Repair Techniques

Cabriolet vehicles

The body of a cabriolet vehicle is different to the self-supporting body of a saloon car because of the special roof construction (folding top). The stability requirements must therefore be ensured by construction changes within the body structure.



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These are for instance:

- Longitudinal and torsional reinforcing components which compensate for the lack of the roof.
- Reinforcements to the floor assembly, particularly in the rocker panel area.
- Reinforcements in the pillar areas.
- High-strength and ultra-high-strength steel panels with single panel thicknesses of up to 2.5 mm, which in combination can become up to 6mm thick (e.g. reinforcements in the floor area, rocker panels).

If deformation to load carrying components occurs, the stability of the whole body shell can be adversely affected.

On a cabriolet, accident damage repair to the components mentioned above is considerably different in certain aspects compared with the usual repairs (closed body construction):

- A model specific alignment angle system must always be used during straightening and repair work, securing using clamps at the rocker panel area is not always adequate for the cabriolet.
- To avoid damage to the doors, they must always be open during straightening work. In the case of more severe damage, additional tension and compression spindles must be used to stabilize the door cut-outs (between the A- and B-pillars).
- In load bearing areas such as the rocker panels, side members and floor pan, increased straightening forces are necessary due to the additional reinforcements.

DESCRIPTION AND OPERATION

- **NOTE:** Additional information on welding can be found in the section Welding Equipment and Joining Techniques.

  High-power welding equipment for panel thicknesses in overall combination of up to 6 mm total material thickness.
- The fitting accuracy and longitudinal rigidity of the affected component is especially important to ensure that the doors, door windows and the roof fit and close correctly.

Liquefied gas vehicles

Alternative fuel vehicles often require special handling in the workshop area. Above all, assembly operations to some extent require particular knowledge when dealing with the special technology and the safety regulations.

NOTE: Only fully trained personnel are permitted to work on alternative fuel vehicles.

These special requirements must be understood and taken into account in the body shop as well.

CAUTION: Danger of fire and explosion. The safety instructions must always be followed when performing service work on fuel/gas systems. Failure to follow these instructions may result in personal injury.

NOTE: You will find further information about working on liquefied gas vehicles in the section Health and Safety Information.

Refrigerated conversion vehicles

Apart from the special materials used in building the structure of the refrigerated compartment, such vehicles have special energy and refrigeration systems which require special handling during repair.

CAUTION: Danger of injury. Work on the 230<SP>volt system of the refrigeration equipment must only be carried out by trained specialist personnel.

NOTE: Work on the refrigerant circuit may only be performed by persons who have a relevant certificate of competence.

Vehicles with a refrigerated compartment are often used to transport foodstuffs. For this reason, additional hygiene regulations must be complied with during repair work.

Aluminum and plastic are used to construct the two different types of compartment found on refrigerated vehicles.

The aluminum conversion is a very stable and technically perfect variant. However, against this the relatively high production costs and a lower payload must be taken into account, because of the weight of the aluminum conversion itself.

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range listed in the Training brochure published by the Ford Service Organization.

The plastic conversion has developed into a light, clean and economical alternative because of constant further development of materials and working techniques.

NOTE: The material combinations, the workmanship and the working methods must comply with the current food hygiene regulations. For this reason, service and repair work on the refrigerated conversion may only be performed by authorized and specially trained technicians.

Refrigerated compartment constructions are often made using both materials. The floor pan is made of structured, slip-proof aluminum panels and the wall and ceiling cladding is made of smooth surfaced plastic elements.

CAUTION: PUR hard foam is flammable. If PUR hard foam is overheated, it will burn on its own with a brilliant yellowish flame. It produces unpleasant choking and toxic fumes. Special measures must be taken when welding the vehicle body.

Polyurethane wall and ceiling elements are manufactured using a sandwich principle. An insulating polyurethane core is coated with food grade ABS plastic on one side.

PUR hard foam does not decompose, is rot resistant and is odorless. These properties make it suitable for use as insulation.

Because of its closed cell structure, water uptake by PUR hard foam is for the most part only a problem at edges. Cut edges or other mechanically worked surfaces must however be sealed with the greatest care.

The conversion to a refrigerated vehicle is performed as made-to-order production. The large surfaces of the wall and ceiling cladding can be changed and are particularly easy to repair.

If access to the back of a body panel section is needed because of body straightening work, in

DESCRIPTION AND OPERATION

some circumstances it is cheaper to perform a cut-out repair instead of removing an element.

The repair process is fully described in the Student Information booklet Refrigeration System Technology, Transit 2000.5 Freshline.

NOTE: You will find further information about working on vehicles with a refrigerated compartment in the section Health and Safety Information.

DESCRIPTION AND OPERATION

Joining Techniques

Welding

Before welding work is performed on a vehicle body, all safety measures for the protection of people, modules and electrical components must be observed.

NOTE: Before beginning the work, please refer to the safety instructions and warnings in the chapter Safety Instructions. Please also note the warnings of the respective equipment manufacturer.

Resistance spot welding and MIG welding are the most common techniques used in body construction. During repair work, the welded connection must be restored to be equivalent to the original.

Resistance spot welding.

NOTE: Before starting the work, please refer to the chapter on safety instructions.


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In doing so, the repair welds must match the standard of those produced in production in number and diameter.

Preconditions for resistance spot welding:

- The panels to be welded overlap.
- The weld spot is accessible on both sides for the electrodes.
- The shape and alignment of the weld electrodes is correct.
- The resistance welding equipment is powerful enough to be able to reproduce the production spot weld diameter.

NOTE: The welding equipment settings and the adjustment of the individual parameters are to be made in accordance with the device manufacturer's specifications.

Well-prepared welding flanges are a prerequisite for a problem-free welded joint. This means:

- The welding flanges must lie perfectly flat to one another.
- The welding flanges must be clean and free of oil or grease on both sides.
- Welding primer (zinc-coated and conductive) must be applied as corrosion prevention.

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Only in limited cases can welding errors in resistance spot weld joints be detected from the outside . Therefore, a test weld should be carried out before each repair weld. The peel test carried out after the welding gives information on the quality of the welding. The spot weld itself must never separate, it must tear away leaving a hole.

MIG welding

Basically, three methods of MIG welding are used:

- Puddle weld.
- Continuous bead welding
- Intermittent bead welding

Fields of application

- Any joins that are MIG welded in production must also be replaced by MIG welds.
- Puddle welding may be used in certain cases, if there is insufficient access.
- If the overall panel thickness is greater than 3 mm, without correspondingly powerful spot welding equipment, puddle welding should be used.
- When dealing with any MIG brazed joints which are present, follow the vehicle-specific repair instructions.

NOTE: The increased application of heat during MIG welding destroys the corrosion protection layers over a much larger area than during resistance spot welding. For this reason, greater care must be taken when applying the corrosion protection afterwards.

Welding repairs can only be carried out properly if the equipment is set up correctly and all welding-related preparations are complied with accurately.

- Please note the instructions of the respective welding equipment manufacturer.
- The hose assembly must be untwisted.
- The core must be free from particles of wire debris.
- The gas and current nozzles must be free of slag and scale residue.
- Pay attention to the quality of the welding wire and the gas flow rate.
- Ensure that the joint surface is perfect.
- Prepare a bare metal joint surface.
- Maintain the correct gaps (root formation).
- Produce a test weld.

Plug Weld



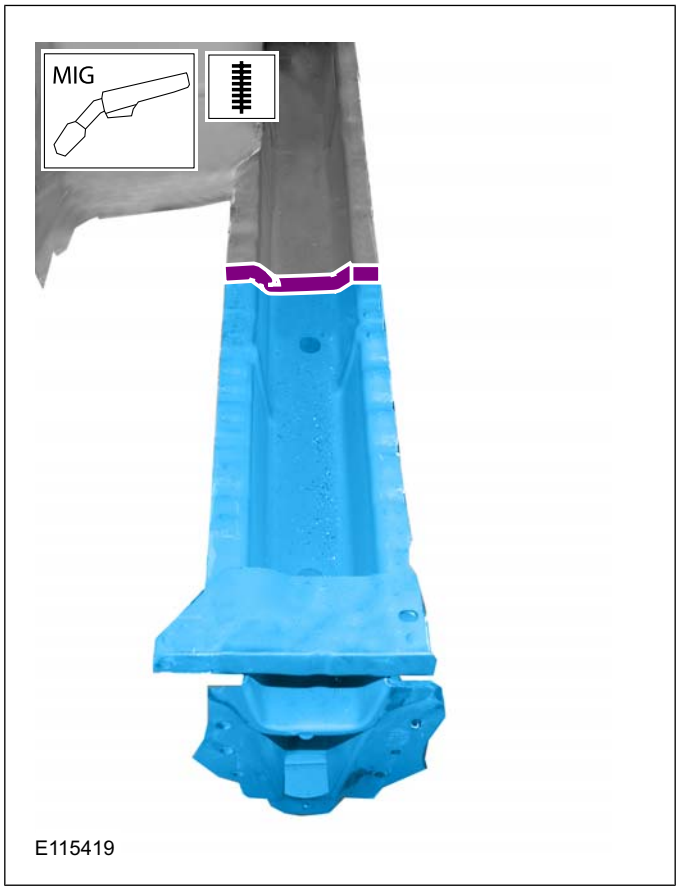
DESCRIPTION AND OPERATION

Special features to note when puddle welding:

- The panels to be joined must lie perfectly flat to one another.
- The panel flanges must be treated with corrosion protection. The position of the weld must be bare.
- Prepare the holes depending on the thickness and number of the panels. The hole size should be 6-10 mm, or match the original weld spot.
- Start the welding procedure on the panel at the bottom so that the hole is filled completely.

Continuous bead welding

A welded joint with a full seam is suitable for joining highly profiled body parts. Pillar and sill areas are typical application areas.



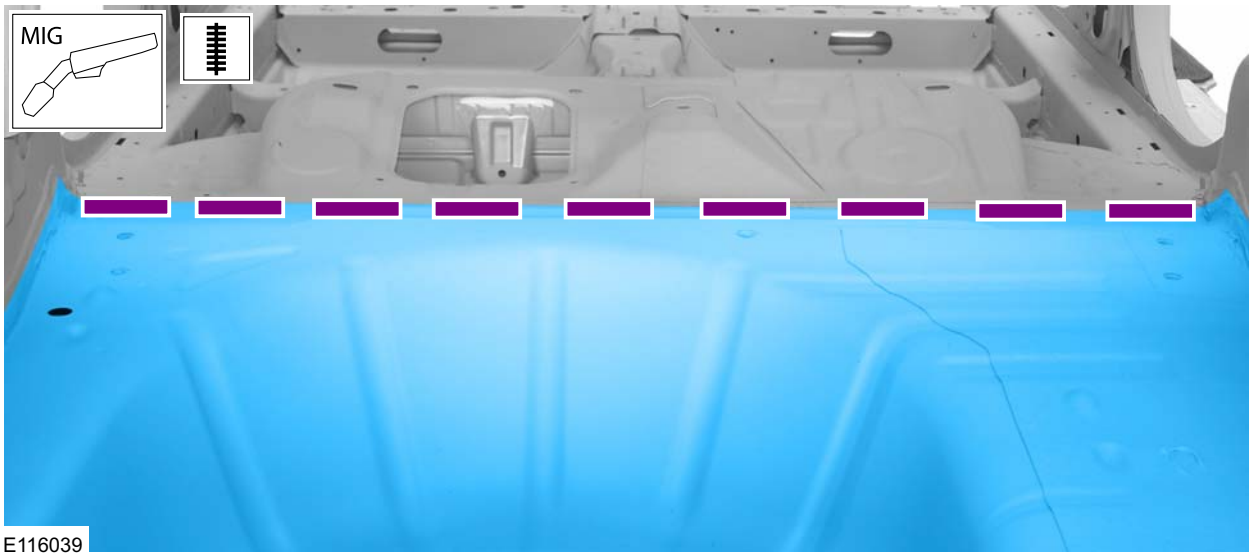
Special features to note during bead welding:

- Both parts of the panel must be bare on both sides over a width of 5 mm.
- Align the parts precisely with clamps.
- To prevent the panel from warping, tack longer joints before welding them.

Intermittent bead welding

Intermittent bead welding is used when the connecting flanges are stepped. This form of seam is mainly used on the external panel area for sectional repairs.

DESCRIPTION AND OPERATION

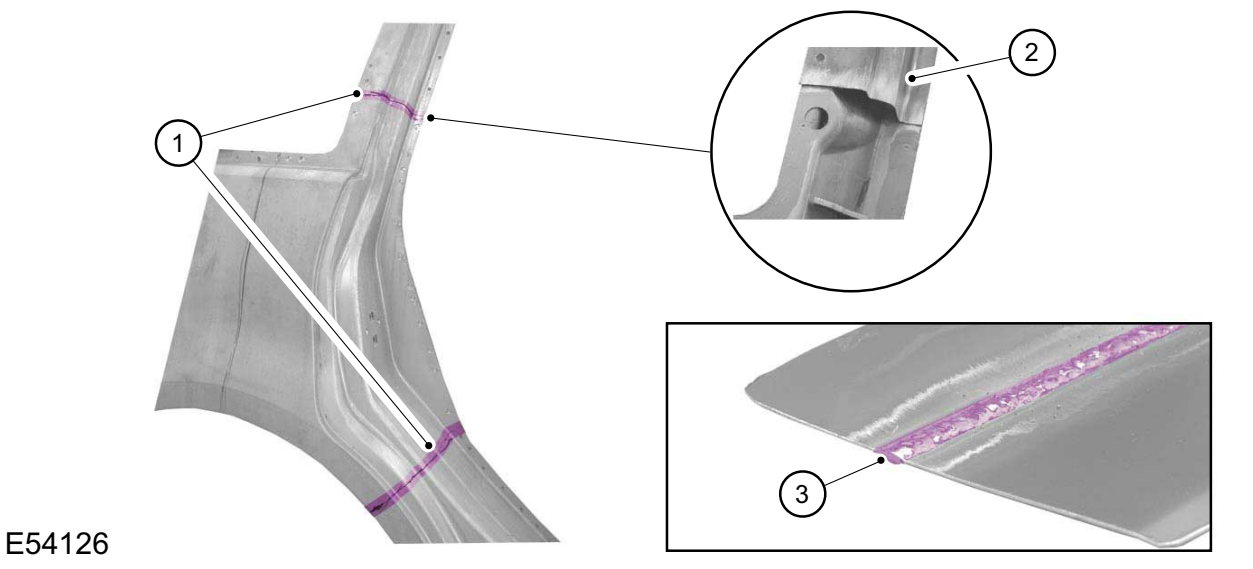


Special features to note when intermittent bead welding:

- Weld gap.
- Spot weld interval.
- Apply alternate tack welding across the entire length of the seam. This keeps warping to a minimum.

Joining techniques

Butt joints



Description	Description
1	Join areas
2	Profile
3	Full seam

The butt joint is a joining technique frequently used in body repairs. The butt joint is typically used for repairs in the pillar and rocker panel area.

Areas that are suitable for the use of the butt joint:

- short seam lengths.
- highly profiled structures.

The edges of the panels to be joined are placed against each other and are joined with a full seam

DESCRIPTION AND OPERATION

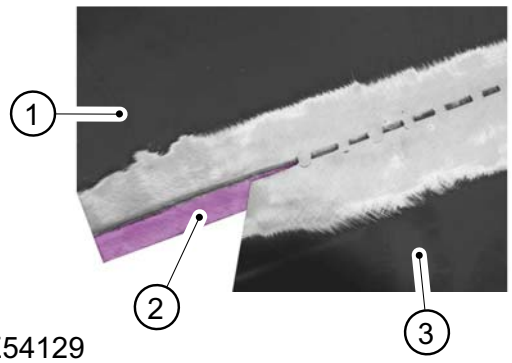
in whilst maintaining a required welding gap (welding gap same as panel thickness).

NOTE: The butt joint requires a high degree of accuracy and care when trimming and cutting. For correct execution of the welding, an exact, even welding gap must be maintained.

Preparation of the joint areas includes:

- Sanding the connection areas bare on both sides.
- Removal of the zinc layer in the welding area.
- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Tack welding in the join area: From the edges to the centre, then check the shape.
- Joining new and old parts with a full seam weld.

Joggled joint



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Description	Description
1	Body part
2	Joggled area
3	New panel

The joggled joint variant is restricted to body areas with a good surface condition without beads/swage lines or profiles. A sectional replacement with a joggled joint is welded using a continuous seam. This procedure is used, for example, at the transition from the side panel to the rocker panel (3-door vehicles).

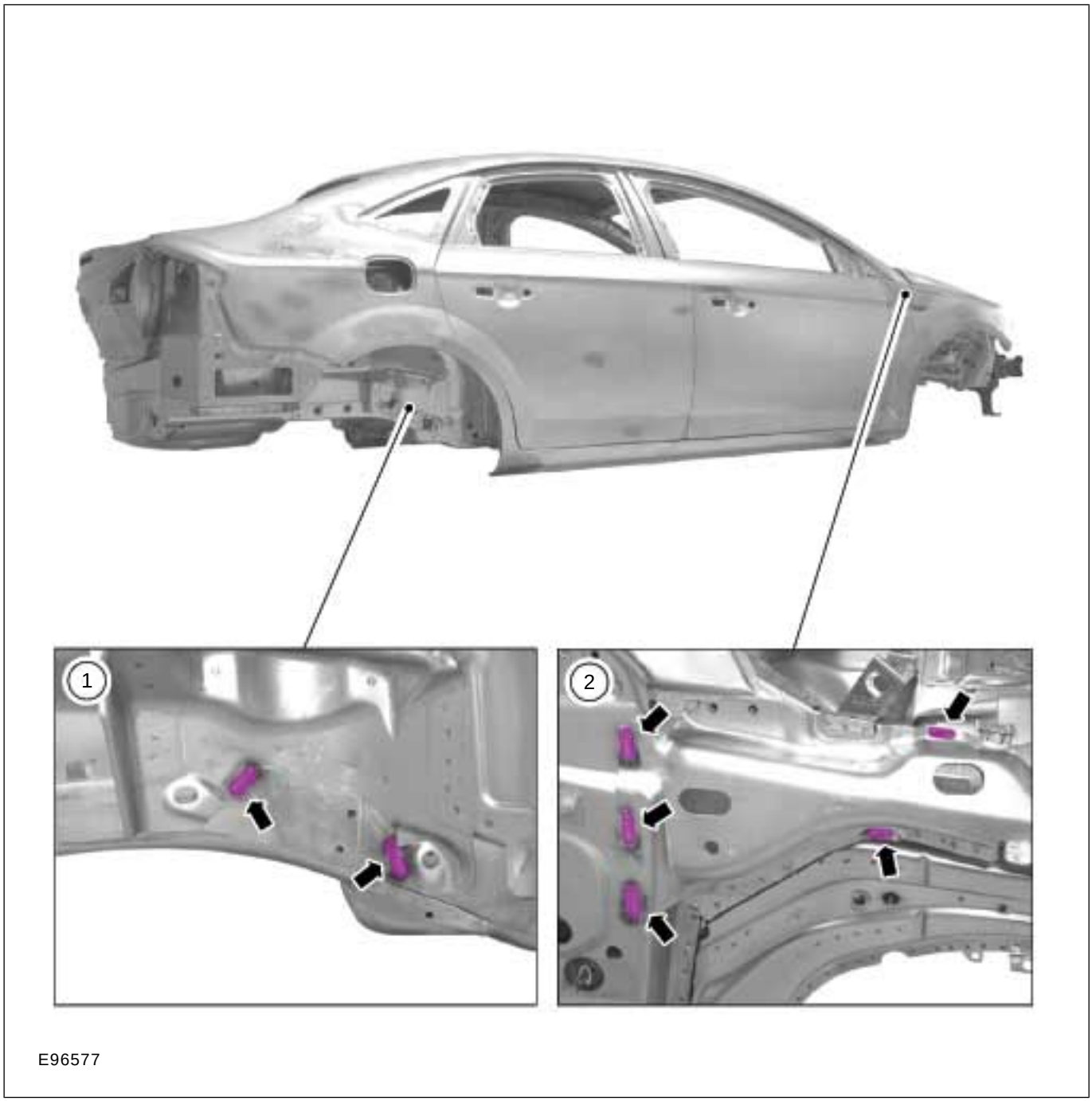
When cutting the new part, slight measuring tolerances are permitted, as these are covered by the joggled area.

Preparation of the joint areas includes:

- Sanding the connection areas bare on both sides.
- Removal of the zinc layer in the welding area.
- Preparation of a joggled strip.
- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Joining the new and old panel with continuous seam welding.
- Lead loading the weld seam.

DESCRIPTION AND OPERATION

MIG brazes



Description	Description
1	Rear side member / wheelhouse reinforcement
2	Apron panel reinforcement / A-pillar

Metal Inert Gas (MIG) brazing is increasingly used in production for certain body areas.

In areas where resistance spot welding is not possible due to limited space or higher strength requirements, MIG welding was previously used.

Increasingly, these MIG welded seams are being replaced by MIG brazes. The temperature range used during MIG brazing is significantly lower. This keeps the damage to the anti-corrosion zinc layer on zinc-coated panels to a minimum.

This results in the following advantages of the MIG brazed seam:

DESCRIPTION AND OPERATION

- No corrosion of the brazed seam.
- Low erosion of the zinc coating in the joining area.
- Low level of heating and thus little warping.
- Easy finishing of the brazed seam.
- Good for bridging gaps.

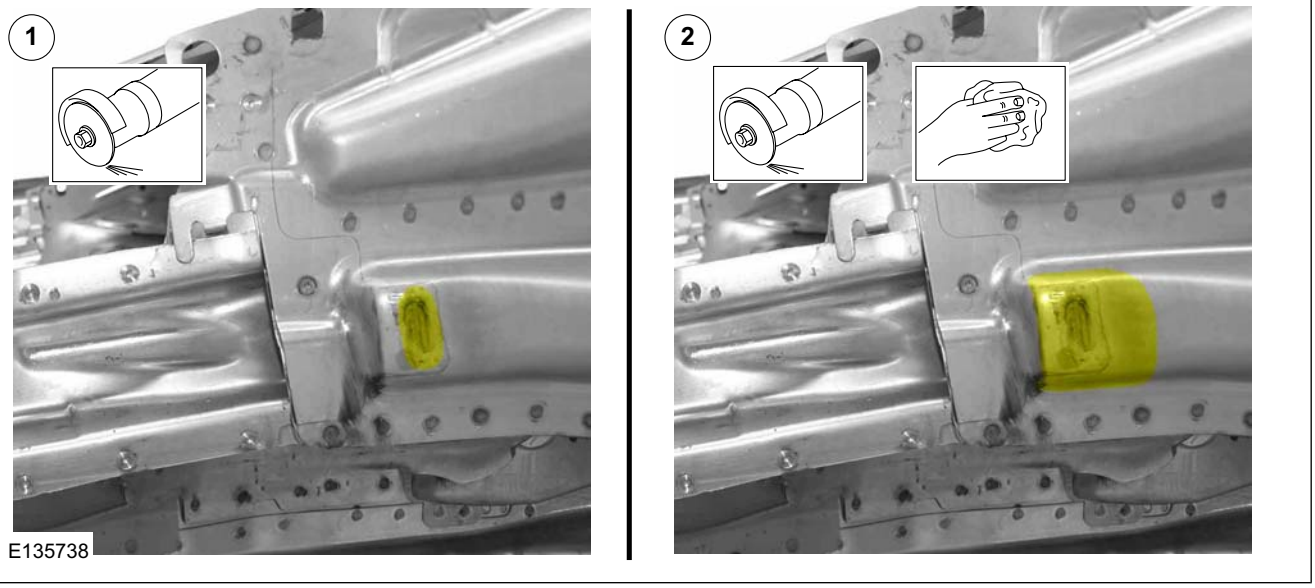
Technicians performing MIG brazing must use a **Ford-certified MIG brazing device** and must have been given appropriate**training** on the brazing techniques which are used.

Only use the Ford-approved brazing solder SG-CuSi3 (SG-CuSi3Mn1).

Unless specified otherwise, a minimum gap of 30 mm must be maintained between the MIG brazed seam and any adhesive bonds.

CAUTION: MIG welds must not be carried out on or near existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam.

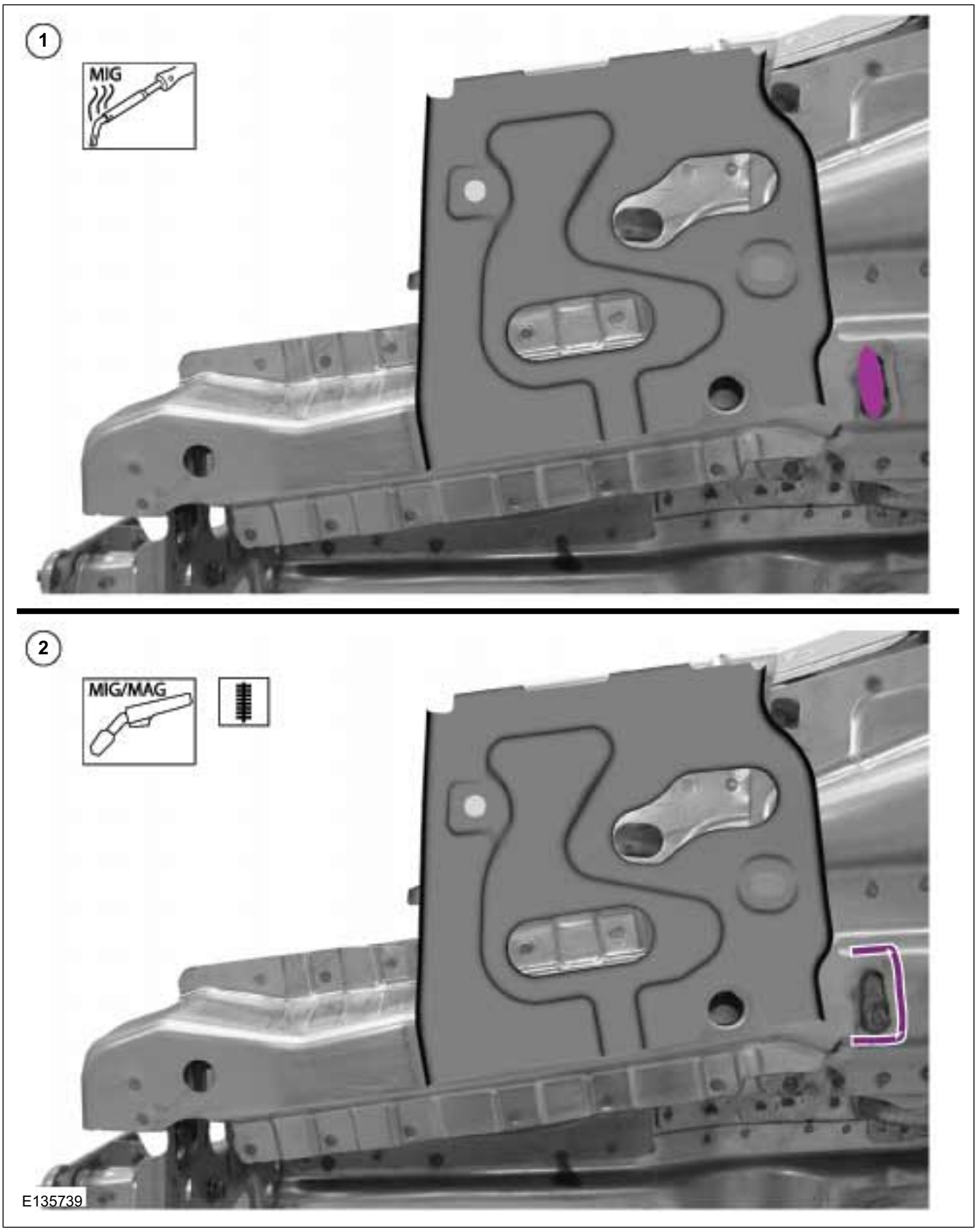
If MIG brazing cannot be used then the factory-installed MIG brazed joints should be replaced with MIG welds in a different place during service repairs. These MIG welds must not be carried out on or in the immediate vicinity of existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam. Consequently, the corresponding graphics offer two alternative repair techniques (1: MIG brazing; 2: MIG welding).



Description	Description
1	Preparation of the MIG brazing: Flatten the old brazed seam with a grinder.

Description	Description
2	Preparation of the MIG welding: Grind the old brazed sean and the surrounding area until they are clean, and remove any residue of the brazed seam.

DESCRIPTION AND OPERATION



DESCRIPTION AND OPERATION

Description	Description
1	MIG brazing: Braze a new seam in the same place as the factory location for the seam.
2	MIG welding: Weld the seam **away** from the location of the factory-installed MIG brazed seam.

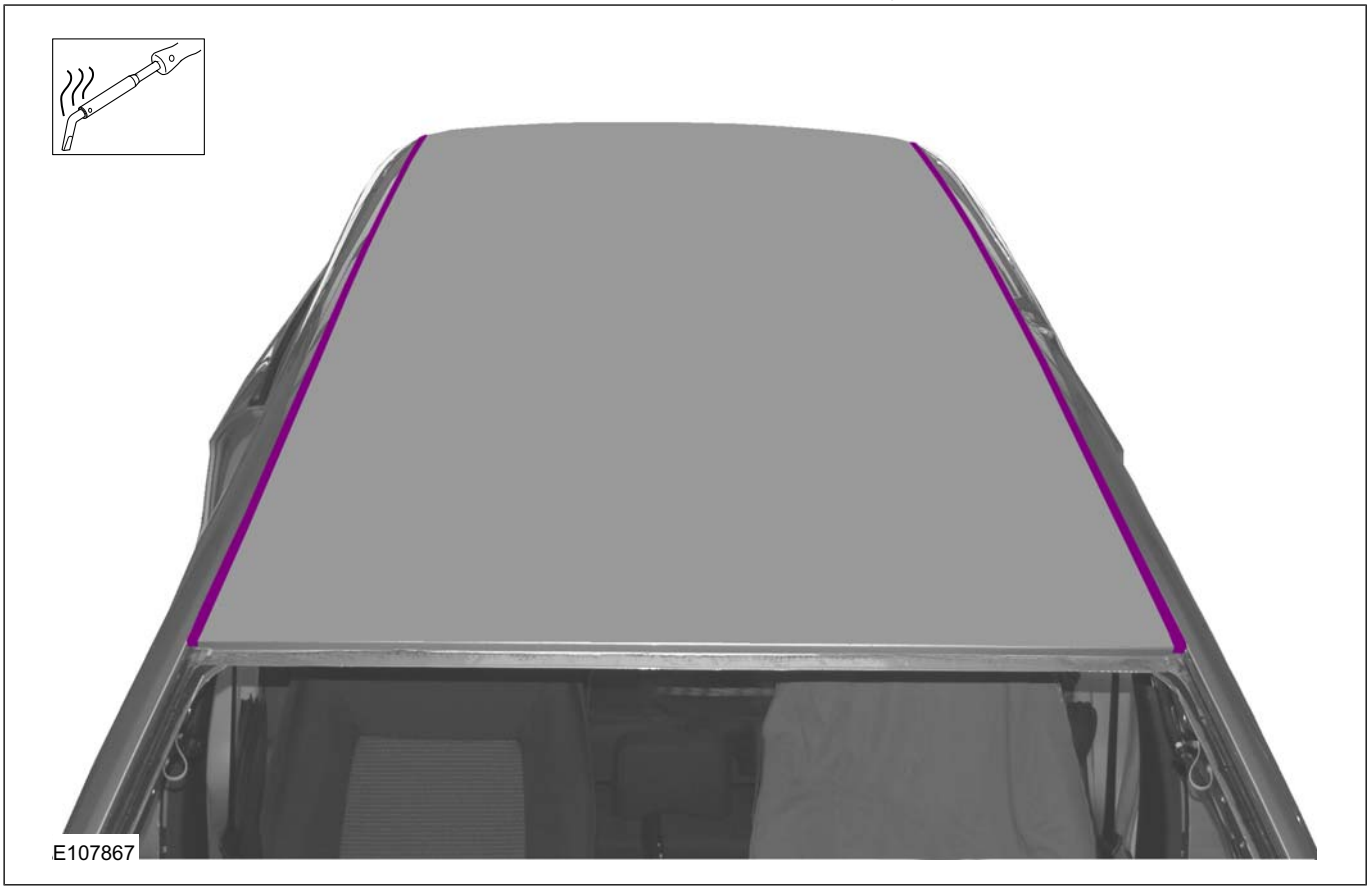
Apart from in the locations used in production, MIG brazing can also be performed on non load-bearing outer body skin panels and floor panels.

CAUTION: Without prior approval from Ford, MIG brazing must not be performed on structural parts of the chassis or body.

Soft soldering

WARNING: The roof repair may only be carried out in Ford-approved special workshops and only by specially trained personnel.

NOTE: The roof is secured to the side walls with laser soldered seams in production. When repairs are carried out, these laser-soldered seams must be replaced by soft-soldered seams.



WARNING: Poisonous gases and dust can be produced when working solder. Use an extraction unit and, if required, a protective mask.

NOTE: Ford offers basic and in-depth training on the following topics.

NOTE: Areas for soft soldered joints require careful preparation. It is extremely important that the joint surfaces are exactly aligned and that a bare metal joint surface is prepared.

This means:

- Thorough cleaning of the surfaces to be brazed.
- Close contact of the panels at the brazing position.
- Use the soldering iron to warm the location of the seam to be joined.
- The liquid brazing material is drawn between the panels through capillary action.

Rivets

With riveting, two or more panels are joined together using a joining element (rivet). In body

DESCRIPTION AND OPERATION

construction, pop rivets and punched rivets are used.

Advantages of riveted connections:

- Metallic and non-metallic materials can be joined together.
- Different thicknesses of materials can be used.
- The material does not have to be heated, and therefore does not warp.
- Low level of preparation required.

NOTE: For detailed instructions on the procedure, please refer to the equipment manufacturer's operating manual.

Disadvantage:

- During dismantling procedures, swarf/rivet remains can fall into inaccessible cavities, which can lead to rattling and rusting.

TO BE UPDATED LATER

Description	Description
1	Panels
2	Pop rivet

Pop rivets are used if only one side of the panel is accessible. In this process, overlapping panels are drilled and connected with a pop rivet.

Pop rivets can be inserted pneumatically, hydraulically or manually with rivet guns.

Bonding

TO BE UPDATED LATER

Description	Description
1	Butt joints
2	Bonded connection

Bonded connections are used more and more in modern body designs. Here, a distinction is made between bonds for stabilization purposes and bonds for adhesive strength. Bonds for stabilization purposes are found on clinched flanges and on cross beams in doors or on the roof.

WARNING: Risk of poisoning! Adhesive can be harmful to health. Ventilate rooms well and use breathing protection. Where possible, work with an extraction unit.

NOTE: Adhesives are chemical products and are subject to the safety regulations of the manufacturer.

Please refer to the specifications in the general part of the particular manual for information on the repair adhesive which is to be used.

Advantages of glued joints:

DESCRIPTION AND OPERATION

- They are air and watertight.
- High corrosion protection
- Different materials can be connected.
- Bonding can be combined with resistance spot welding.

NOTE: The quality of the bonded connection is largely dependent on the care taken during preparatory work. When gluing bodywork parts, follow the work instructions from the adhesive manufacturer.

Bonding and welding

On some vehicle models, (such as the Ford Ka), bonding is combined with resistance spot welding. This connection technique has the following advantages:

- Tight, anti-corrosion connection seam.
- High strength due to additional resistance weld spots.

Please note the following points during the repair work:

- Only use adhesive suitable for welding (conductive).
- Carry out resistance spot welding on the connection flanges before the adhesive hardening process.
- Carry out test welding with the adhesive applied.
- If MIG welding is carried out during a sectional repair on a connecting flange with sealant or adhesive material, the material must be applied at a distance of approx. 10 mm from the weld spot.
- These areas must be sealed very carefully after the work has been completed.

Bonding and riveting

As with welding, bonding can also be combined with riveting. This connection technique has additional advantages. These are:

- Metallic and non-metallic materials can be joined together.
- Different thicknesses of materials can be used.
- The material does not have to be heated, and therefore does not warp.
- The rivet connection stabilizes the connected components during the adhesive hardening phase.

DESCRIPTION AND OPERATION

Impact of Insufficient Repair Quality

Body repairs usually require a significant level of intervention in the existing body shell structure. The corrosion protection, seals and NVH components are destroyed and must be replaced.

To prevent the vehicle quality from being reduced due to a poor quality repair, all repairs carried out in all repair sections must be inspected during and after the accident repair.

Simply checking the vehicle at the time of delivery is not sufficient to guarantee the repair quality. Rather, continuous checking of the work carried out is recommended.

NOTE: Logs of the acceptance of individual operations are a useful tool for quality assurance. A comprehensive final inspection can be carried out based on a final acceptance log.

In the process, the entire repair sequence must be split into meaningful sections, with the creation of check points to which particular attention must be paid.

The following are some possible sections:

- During and after body work.
- Final assembly, ancillary components, functional tests.
- Vehicle delivery.

NOTE: The following points offer an indication of possible test logs. They can be combined and supplemented differently, depending on the individual operating procedures.

During and after body work the following areas should be checked:

After completion of the body repairs, the following areas should be checked:

- Manufacturing inspection for functionality and originality in the accident area.
- Check snug fitting of metal panel parts (welding and screw connections).
- Check snug fitting of ancillary components (doors, hoods, glazing).
- Check surface condition of the welded seams.
- Check seals, blanking plugs, NVH components.
- Check corrosion prevention measures
- Check that the repair work is in the correct condition for painting.

Final assembly, ancillary components, functional tests

After final assembly, not only a visual inspection is required, but also the functionality of many components must be checked:

- Check repair area for originality.
- Check ancillary components for correct installation.
- Check precision fitting of all parts.
- Check that the doors and flaps are working correctly.
- Check that all mechanical parts, such as the window winder are working correctly.
- Check for leaks in the repair area.

Vehicle delivery

Vehicle delivery again offers the opportunity of checking the repair quality. In the process, the following points are to be checked again:

- Corrosion protection, sound damping matting and rubber seals.
- Check for traces of leftover paint.
- Check the cleanliness of the vehicle.
- Functional check of the mechanical and electrical components.
- Road test the vehicle.
- Check for noise, vibration and harshness (NVH).
- Check for wind noises.

After repair work on the body and vehicle, not only the visual restoration of the damaged vehicle, but also the functional restoration must be guaranteed.

Customers are making increasingly high demands of vehicles, particularly in terms of driving comfort. Customers find noise, vibrations and harshness (NVH) as well as squeaking and rattling annoying, particularly after repair work. It is therefore important that the condition of the vehicle at the time of production be restored after an accident repair.

After body repairs, the entire repair area must be checked for any water leaks. It is crucial that a leak test be carried out as part of the final inspection so that water leaks can be detected and eliminated even before delivery of the vehicle to the customer.

The requirements of the vehicle manufacturer are to be taken into consideration during all inspections. Only in this way can it be guaranteed

DESCRIPTION AND OPERATION

that the vehicle quality is not reduced through insufficient repair quality.

DESCRIPTION AND OPERATION

Water Leaks

Water leaks can occur after body repair work, but can also occur on new vehicles. The test methods described below allow the various causes to be identified. In all cases, a systematic and logical procedure is required to locate water leaks.

General

When searching for faults, it must be taken into account that water can enter the vehicle passenger compartment in various ways and circumstances. Therefore, it is sometimes not sufficient to perform a water test on a stationary vehicle.

Before beginning extensive checks, a thorough visual inspection must be carried out. The following points are to be taken into account in the process:

- Check the clearance and accurate fit of ancillary components such as the trunk lid and doors.
- Check for correct installation and possible damage to sealing elements such as blanking plugs, seals and rubber door seals.
- Check that the water runoff openings and pipes are free of obstructions

Test method

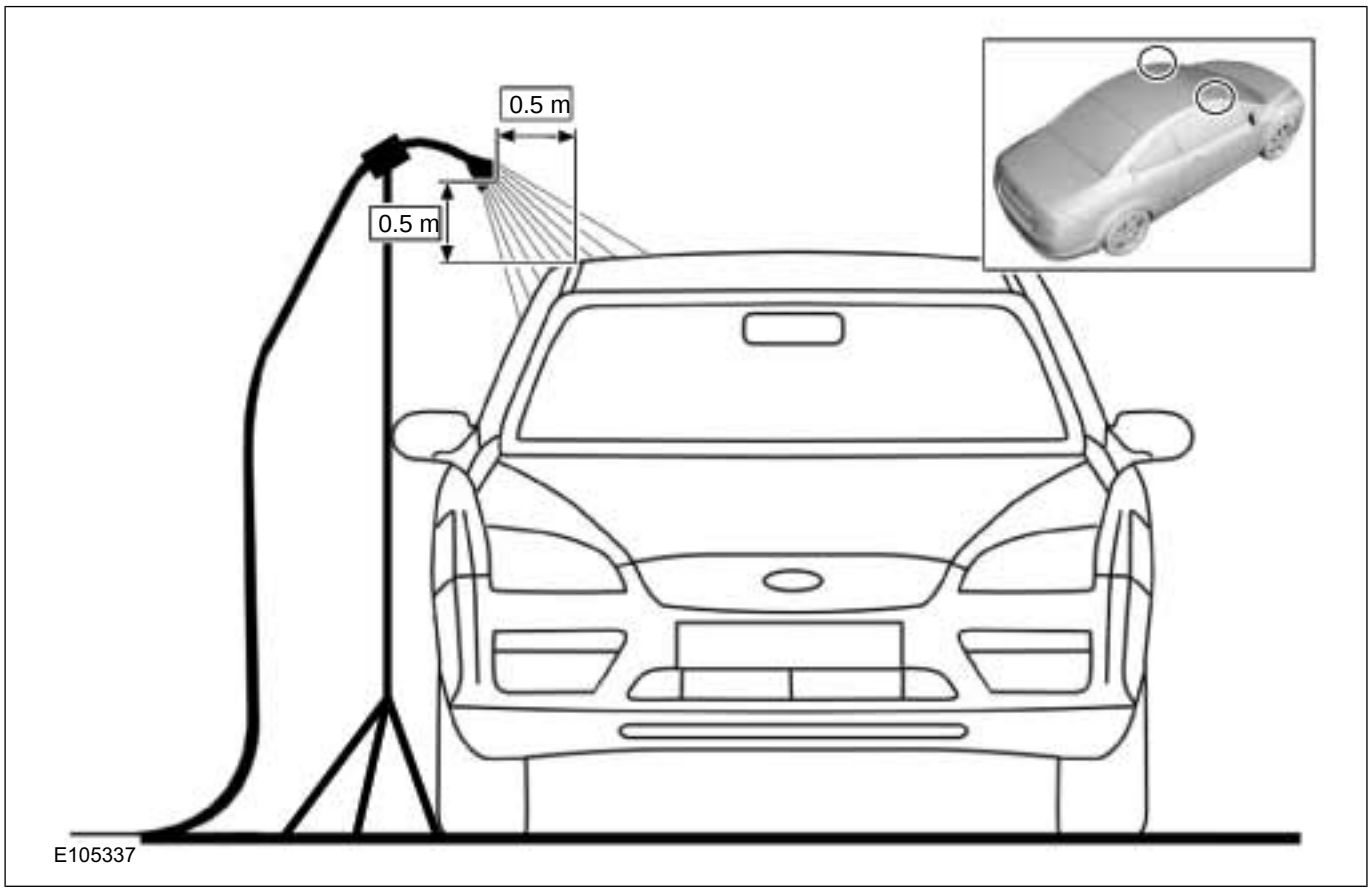
Water test

NOTE: Do not use a power washer. Use a normal garden hose with a spray nozzle or sprinkler head. Make certain that all windows and doors are completely closed.

Water leaks into the vehicle passenger compartment cannot usually be located immediately, as the water often spreads across a large area. For this reason, the passenger compartment must be dried before the leak tests. Any ancillary components that block the view must be removed. During the water test, the vehicle is sprayed or sprinkled with water at the suspected location of the leak. At the same time, a second person checks the passenger compartment for places where water enters the vehicle. Depending on the test and the vehicle, it may take some time before there is any sign of water entering the vehicle. We recommend laying blotting paper under the location being tested so that the water entry can be localized.

Example: Water test with sprinkler head (rain test)

DESCRIPTION AND OPERATION



Car wash test

Certain leak problems only appear in a car wash or can only be simulated there. The concerned area of the passenger compartment should be inspected with a torch during the wash procedure.

Road Test

Some leaks only appear when the vehicle is moving. If no leaks are detected during the above-mentioned tests, road tests should be carried out on wet roads:

- At various speeds.
- On various road surfaces (asphalt to cobbles).
- With loaded or unloaded vehicle.
- Driving through puddles (splash water).

Test with UV lamp

A leak test can also be performed using a UV lamp and a special contrasting agent. The advantages of using contrast agent are:

- No need to dry out wet areas beforehand.
- The water entry and its subsequent path can be seen more clearly.
- No need to remove most ancillary components from the vehicle.

NOTE: The equipment manufacturer's instructions must be followed when using a UV lamp and contrast agent.

Procedure for using a UV lamp.

- Wet the test area with clear water from the outside.
- Prepare test liquid and apply it from the outside using a suitable water sprayer.
- Illuminate the relevant area from the inside using the UV lamp. The test liquid which enters will make the leak visible.

Chalk/powder test

This test checks the contact surfaces of seals on doors, hatches and lids.

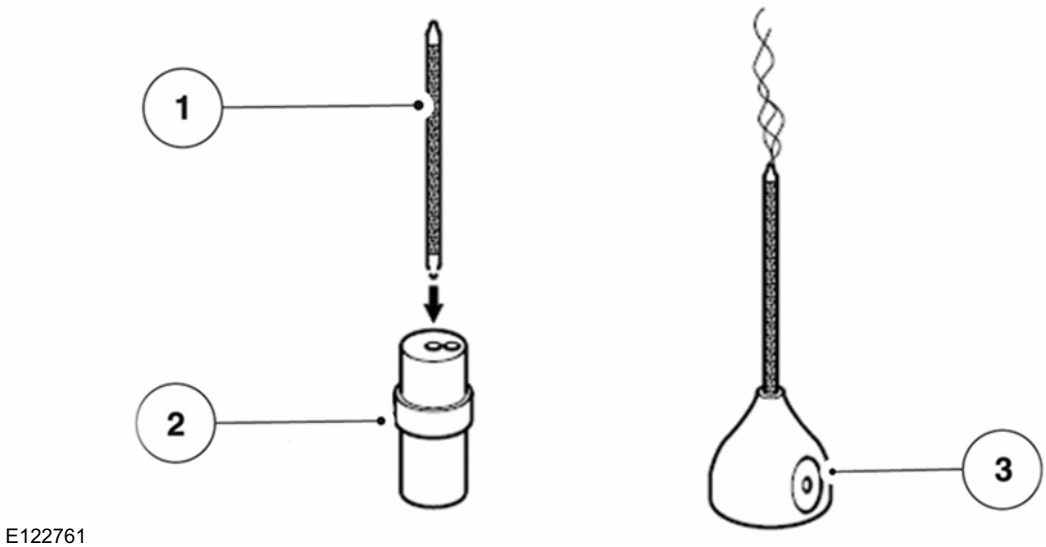
Process using a door seal as an example:

To do this, the door seal is coated with powder or brushed with chalk. A thin layer of grease is applied to the contact area of the seal. The door must then be slowly closed and reopened. The width and continuity of the imprint can now be checked on the seal.

DESCRIPTION AND OPERATION

Smoke test

Flow checking device



Description	Description
1	Test pipe
2	Test pipe opener
3	Puffer ball

Operating principle

The flow checking device is a set made up of a flow-testing pipe, a test pipe opener, puffer ball and closing-off caps for the pipe.

The test pipe contains a filling layer which is impregnated with fuming sulfuric acid. When air is blown through the pipe by the puffer ball, sulfuric acid is emitted as an aerosol in the form of a white smoke.

NOTE: Pay attention to the instructions for use and the safety directions issued by the manufacturer. The smoke test can only be performed in a draft-free environment.

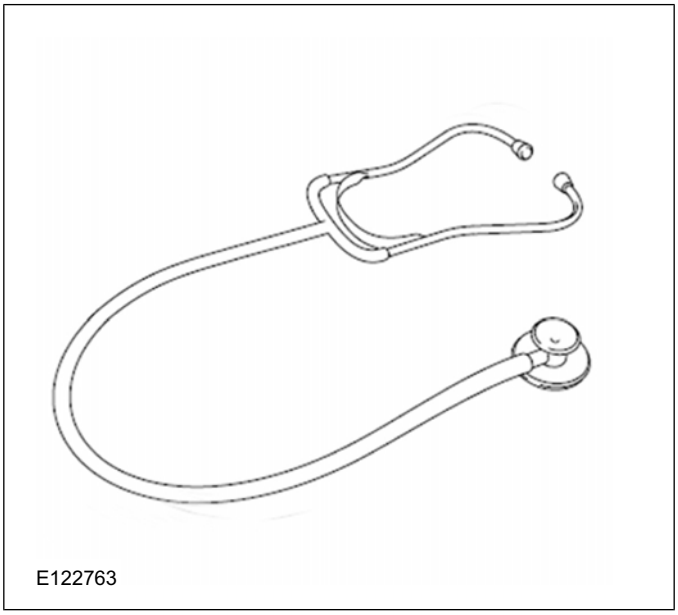
This test can be used to detect leaks visually. Procedure:

- Break off both tips of the pipe in the pipe opener, in exceptional cases in the top of the packaging.
- Insert the pipe into the puffer ball so there are no leaks.
- Close the hole in the puffer ball with your thumb and press the air contained in the ball through the pipe.
- Set the ventilation blower in the passenger compartment to the highest setting.
- Close all doors so that a slight overpressure can build up in the passenger compartment.
- Move the smoke pipe along the outside of the body to the areas to be checked.
- Leaks can be detected through the irregular movement of the smoke.

Stethoscope test

This procedure is very similar to the smoke test. Instead of the smoke pipe, move a stethoscope past the areas of the body that are at risk. Leaks can now be detected acoustically.

Stethoscope



DESCRIPTION AND OPERATION

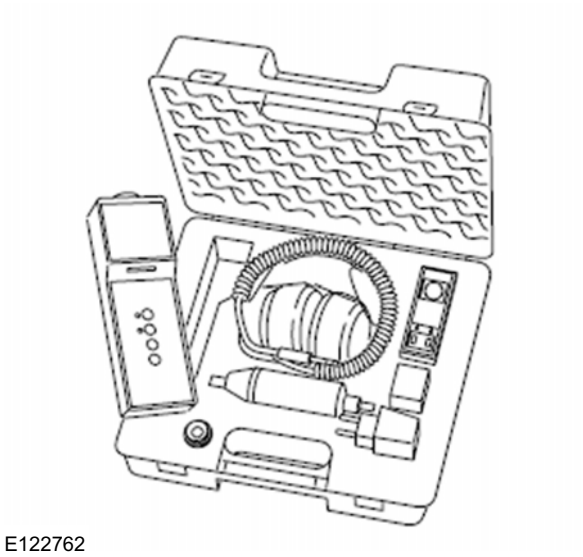
Ultrasonic detection

This test uses ultrasonic waves to locate the positions of leaks. When an ultrasonic transmitter is placed inside the vehicle, it sends out ultrasonic waves. A leak is located by running a detector along the suspected area. The position with the loudest reception of the escaping ultrasonic waves is the location of the leak.

Procedure:

- Place the ultrasonic transmitter in the vehicle.
- Completely close the vehicle.
- Search the exterior of the vehicle using the detector.
- The detector provides a simple indication of a leak.

Ultrasonic test device



E122762

Workflow for tracing water entry

Stage	Testing	Result	Action
1st	Ask customer for a detailed list of possible reasons for the water entry. Does this information allow the cause of the leak to be identified?	Yes	Dry out the vehicle and repair the damage. Perform a water test as a check (see test method).
		No	Step 2.
2nd	Perform an initial visual inspection on the vehicle. Look for signs of water entry. Can the cause of the leak be identified immediately?	Yes	Dry out vehicle. Repair damage. Perform a water test as a check (see test method).
		No	Step 3.
3rd	Is it possible that water is getting into the vehicle through a seal (door seal, trunk lid seal)?		Check the seal for damage. Check the creation of the seal using the chalk test (see test methods). Step 4.
		No	Step 5.
4th	Is the contact area for the seal adequate?	Yes	Step 5.
		No	Perform work as described under Areas with possible water leaks - Door seals. Dry out vehicle. Repair damage. Perform a water test as a check (see test method).
5th	Before starting any further work, use the VIN to look for model-specific information in eTIS. Perform Oasis query and check TSIs. Does this information allow the cause of the leak to be identified?	Yes	Dry out vehicle. Repair the damage using the information found. Perform a water test as a check (see test method).
		No	Step 6.

DESCRIPTION AND OPERATION

Stage	Testing	Result	Action
6th	Establish the extent of the damage. To do this, expose wet areas. Remove parts. Investigate the suspected area for signs of water. Does an investigation of the suspected area allow the cause of the leak to be identified?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	Step 7.
7th	Check exterior areas (seals, seal welds). Check interior areas: Signs of water, plugs, seal welds. Can the cause of the leak be identi-fied?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	Step 8.
8th	Perform water test or ultra-sound test. Can the cause of the leak be found?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	The water entry may only occur under dynamic driving condi-tions. This requires intensive tests to be repeated with the corres-ponding climatic influences (rain).

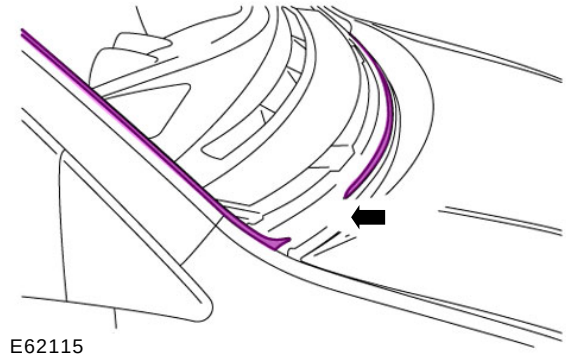
Possible complaints and corrective actions

NOTE: Water leaks and changed vehicle acoustics can have similar causes. For this reason, information from the Wind noise or Noise, vibrations, roughness chapters may be useful in identifying the fault.

An outline of the possible complaints due to water leaks is provided below. The causes of water leaks and the possible remedies are presented using selected examples. They are intended to provide troubleshooting tips and suggestions for the user but do not represent an exhaustive faults list.

Glued windows

A broken pasted seam can cause water to enter around the window. A broken pasted seam can be located using a water test or by carefully blowing compressed air onto the inside of the window seal.



Corrective action

Broken adhesive seams **-Arrow-** can be sealed from inside using PU glass adhesive.

If this seal does not resolve the problem or the broken pasted seam is too extensive, it is necessary to remove the window and glue it back into place.

Door seals

If water appears at the bottom of the door, it is possible that the door seal behind the door trim is damaged. If the door is intact, water can enter through the window weatherstrip and flow out through gaps on the underside of the door. If the door seal adhesion is faulty or the door seal is damaged, water can get into the interior.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Description	Description
1	Seal/adhesion
2	Clips
3	Door speaker

Fastening bolts could be loose or clips incorrectly positioned on door modules.

Corrective action

Depending on the door seals used, different sealing methods can be used.

NOTE: The drainage holes on the underside of the door may not be blocked - if they are, clean them. Defective films and foam seals must be replaced.

Once the adhesive surfaces have been cleaned, plastic films must be stuck with double-sided adhesive tape or replaced.

Leaky foam seals are sealed with Butyl tape or replaced.

Plastic door modules are fitted with a weatherstrip, which cannot be replaced. Seal the leaky point with Butyl tape or replace the part.

Door weatherstrip

TO BE UPDATED LATER

Leaks can be caused by badly fitted seals. In particular, areas with radii **-Arrow-** must be thoroughly checked.

Door seals can develop leaks due to:

- Damaged or expanded seals.
- Ageing.
- Insufficient contact pressure.
- Inadequate contact area for seal on body part.
- Uneven welded flange thickness because of several layers of body panels or production tolerances.
- Kinks.

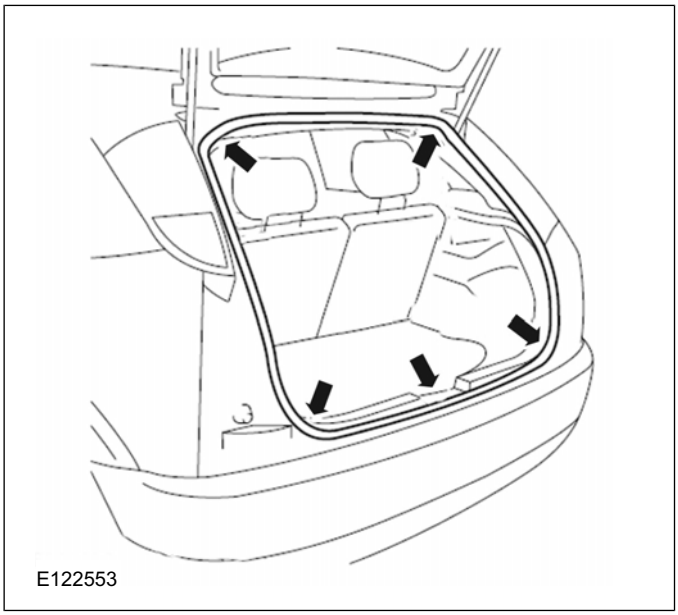
The contact pressure of a seal can be determined using a strip of paper. If a strip of paper trapped in the closed door can be pulled out easily, the contact pressure is too low.

To resolve

DESCRIPTION AND OPERATION

- Replace damaged or aged seals. Prevent kinks.
- The contact pressure can be changed by adjusting the catch bolt or correcting the panel flange.
- Even out the uneven welded flange thicknesses. Properly repair any paint damage that occurs. If the bodywork flanges are very uneven, appropriate alignment work must be performed. Pay particular attention here to the new corrosion protection which needs to be applied afterwards.
- If water entry is caused by a spot weld (burr on the surface), this must be rectified and appropriate corrosion protection applied.

Tailgate sealing rubber


E122553

Leaks at the tailgate rubber seal have the same causes and remedial measures as for door rubber seals. Especially vulnerable areas -arrows- must be thoroughly checked.

Rubber grommets / plugs

Rubber grommets or plugs are fitted at numerous points on the body. They are frequently used as seals for cables, hoses or actuating links. Rubber plugs are frequently used for gaps caused during production.

Example: Possible problem locations in the tailgate area

TO BE UPDATED LATER

Description	Description
1	Hinge seal
2	Cable duct

Leaks can be caused by badly fitted or damaged rubber grommets and plugs.

Damaged cable insulation can also cause leaks.

Where components are bolted on, water can enter if there are inadequate seals at the connection point.

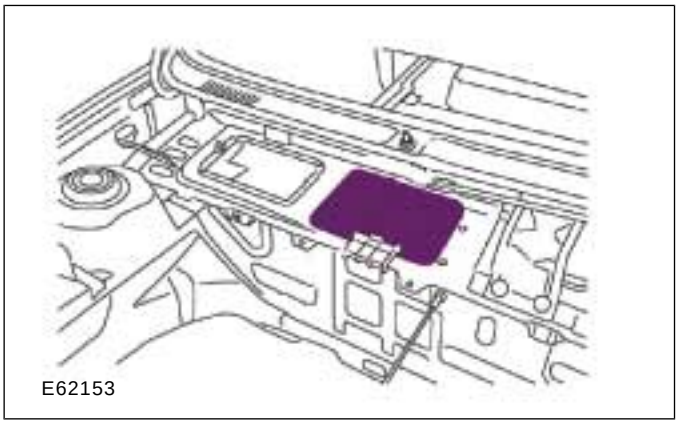
To resolve

- Correctly fit rubber grommets / plugs. During fitting, ensure that the sealing lips are not trapped and are applied properly.
- The contact area of the rubber grommets / plugs can also be sealed with PU sealing compound.
- Replace the damaged rubber grommets and repair the damaged cable insulation.
- Smooth the panel deformations in the contact area of the plugs.

Heater housing/ventilation

Loose butyl sealing strips, damaged sealing surfaces or a trapped carpet can cause leaks around the heater housing / ventilation **Arrow**. Badly positioned or badly fitted hoses can also be responsible for water entry. Water drains must not be blocked

DESCRIPTION AND OPERATION


E62153

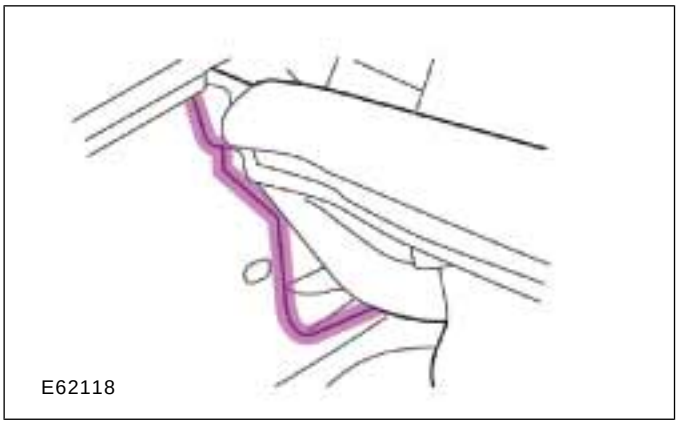
NOTE: A large quantity of water flows through the water tank. If there are leaks in this area, it is essential to ensure that the water drainage mechanisms function correctly. Drainage openings may not be blocked or stuck. Leaves and other dirt must be removed before troubleshooting.

Corrective action

Before the actual repair, make sure that the water drains are not blocked or stuck.

Remove the heater housing / ventilation and fit a new Butyl sealing strip. Damaged sealing surfaces must first be adjusted. A trapped carpet must be removed.

Seal welds


E62118

PU sealing beads are applied to welded or riveted connections **Arrows** to seal the interior of the vehicle. Incorrectly applied or damaged seal welds can allow moisture to penetrate into the interior of the vehicle. It is also possible that sealing beads whose shape and size appear to be intact actually have poor adhesion.

Corrective action

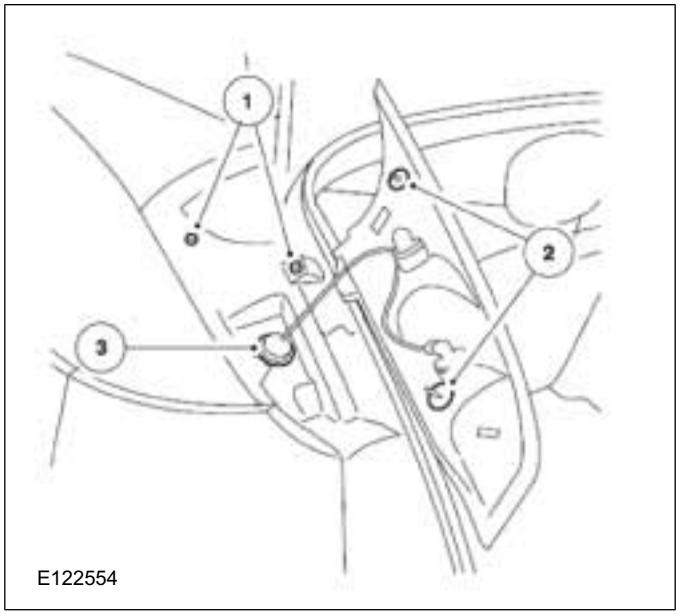
Incomplete seal welds must be supplemented with PU sealing compound. Damaged seal welds must be removed and re-applied properly. Make sure that any residual moisture is effectively removed before a new seal is applied.

Attached parts

The add-on parts include:

- Exterior mirros, handles, controls.
- Mouldings, roof mouldings, lettering.
- Roof aerial, roof rack or connections for roof rack systems.
- Bumper mountings.
- Injection nozzles, door contact switches, bump stop rubber.
- Control unit seals.
- Tail lamps.
- All kind of screwed connections (pedal block, door and tailgate hinges)

Example: Possible water entry points at the rear lamp



E122554

Description	Description
1	Clips
2	Gaskets.
3	Rubber grommet

Add-on body parts must be fitted with seals, grommets or sealing compound to prevent water entry. However, even when a sealing system is fitted, the screw thread may still cause leaks.

DESCRIPTION AND OPERATION

Corrective action

Seals must be tested and, if necessary, replaced. Check contact surface and adjust if necessary. Points sealed with sealing compound must be thoroughly cleaned and the seal replaced. Check grommets and replace if necessary. At all screwed connections, seal the thread with an appropriate sealing material.

DESCRIPTION AND OPERATION

Wind Noise

Wind noises as well as other general noises are dealt with under Noise, Vibration and Harshness (NVH).

NOTE: Basic and in-depth training is offered on the following topics. You will find an overview of the complete range of courses in the Training Brochure issued by the Ford Service Organization.

Due to the continuous reduction in drivetrain noises, wind noises have come to the fore in the vehicle and are perceived to a greater extent by the customer.

There are various causes of wind noises. They can be due to the design of the vehicle, or they can occur after a repair. They are mostly caused by poorly mounted components, which must be located and installed in the correct position.

General information

In order to carry out targeted diagnosis, it is important to know the basics of noise formation and sound transmission.

Potential areas of wind noises

TO BE UPDATED LATER

Item	Description
1	Wiper arms
2	Windscreen seal
3	Antenna/antenna base
4	Sun roof/roof rail
5	Tailgate
6	Door handles
7	Exterior Rear View Mirror

Item	Description
8	Door seals
9	Headlamps
10	Radiator grille.

Noises are categorized according to their type and formation as follows:

"Normal" air flow noises:

Normal air flow noises are caused by air blowing against even, flat vehicle surfaces, such as the

DESCRIPTION AND OPERATION

roof, doors and side windows. When the vehicle is moving fast, air layers (turbulence) form, which cause variations in air pressure. These variations in air pressure spread in the form of sound waves and are transferred to the vehicle interior via the side windows and seals.

Noises caused by deviations in air flow and circulation around separate components:

If air flows over an edge on a vehicle, the air flow cannot follow the shape of the surface, but separates at the edge. Eddies are formed, which collapse again after a certain time or distance. The associated fluctuations in air pressure create a corresponding sound wave which is noticeable by for instance a rushing noise at the A-pillar or the outside mirror.

Turbulence and the associated radiation of noise can also occur at the vehicle underbody. Air circulation around small components and also flow through small gaps (e.g. the radiator grille) cause the rushing noise to change to a whistling, which rises and becomes louder as the vehicle speed increases.

Noises caused by vibrating seals:

Seals which do not make firm contact at the door or window area can be made to vibrate by pressure variations outside the vehicle, which in turn mean noise radiating into the interior of the vehicle.

Noises caused by air flowing out:

Noises caused by air flowing out are created by leaks at the vehicle interior sealing system, when stationary air mixes with flowing air. As a result, the noise increases as the speed of the air flowing out increases. Example: Letting air out of a tire.

Cavity noises:

Cavity noises are those created when the air volumes found in bodywork cavities are caused to vibrate by an opening located in the airflow. The frequency of the tone does not vary with the vehicle speed but depends on the volume of the cavity and the size of the opening. Example: Blowing across the top of a bottle.

Wind noises overview:

Workshop diagnosis

Assessment	Type of wind noises	Place of origin
Normal	"Normal" wind noises	Roof, side windows
Normal	Noises caused partly by changes in the direction of air flow and by air flow around separate components	A-pillars, outside mirrors, antennas
Serious	Noises caused by vibrating seals	Door gaps too large, door/ window seals not making firm contact
Serious	Air escape and air passage noises	Leaks in the bodywork/ sealing system
Serious	Cavity noises	Unsealed body-work cavities

Those noises listed under "Serious" indicate a possible source of the fault.

Workshop diagnosis

There are two ways that the level of noise in the vehicle interior can be reduced and the character of the noise can be improved through assessment and diagnosis in the service department:

- Reducing the intensity of the noise sources.
- Reducing the noise transfer routes.

Before carrying out repair work, a visual inspection of the vehicle must be carried out. The gaps in the doors, the sunroof and at all other body parts must be checked in particular.

When the doors are adjusted to fit exactly, development of wind noises at high speeds can often be eliminated (lifting of doors off the seals). Furthermore, the following points should be noted:

- The windows and doors must be fully closed.
- The air guides and air grilles must be correctly seated.
- All of the trim strips and plastic components must be firmly fixed down without gaps.
- All blanking plugs present.

DESCRIPTION AND OPERATION

Test method

The test procedures given in the chapter Noise, Vibration and Harshness can also be used to diagnose wind noises.

Road tests

Wind noises can usually only be localized by road tests

NOTE: There should always be two people present during road tests to find noises. A driver who reconstructs the situation causing the noise, and a person to carry out the checks.

The following points should be taken into account for such road tests:

- Check that the tire pressure is correct.
- Remove non-standard ancillary components from the vehicle.
- Choose a dry, flat road with as little traffic as possible.
- Carry out the road test in all speed ranges. Use a high gear so that the engine noise is low.
- Do not perform a road test near any sound reflecting objects.

If it is difficult to detect the noise sources, the search can be made easier by masking potential areas.

Chalk/powder test

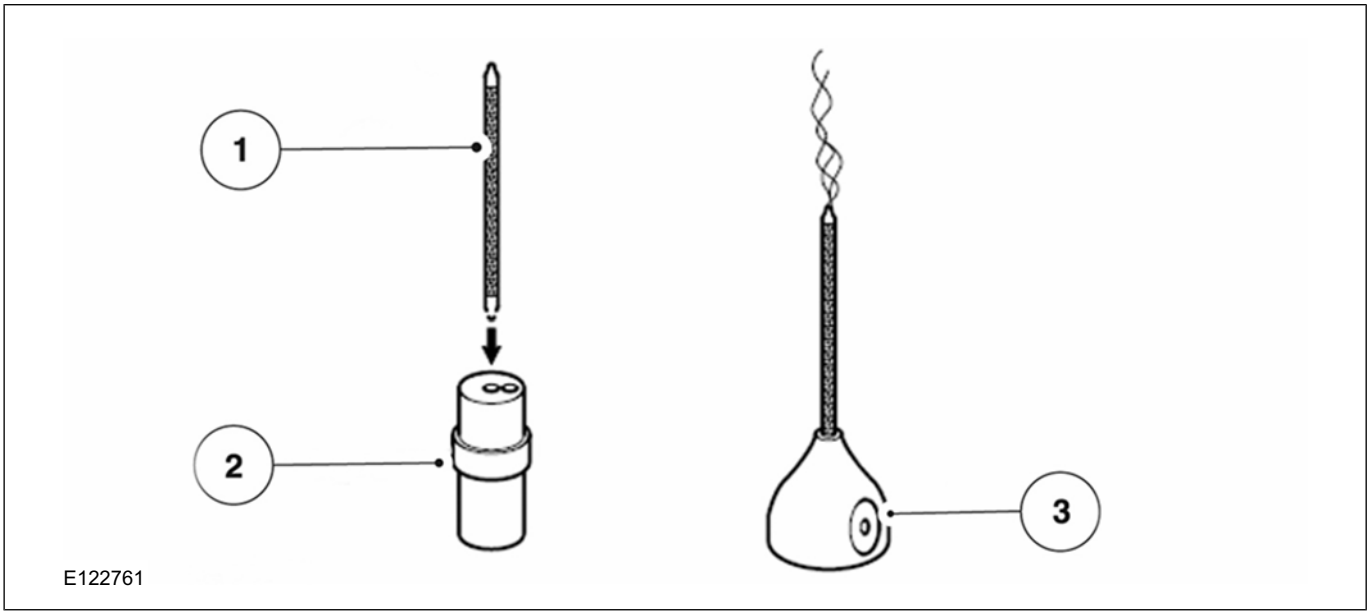
This test checks the contact surfaces of seals on doors, hatches and lids.

Process using a door seal as an example:

To do this, the door seal is coated with powder or brushed with chalk. A thin layer of grease is applied to the surface against which the seal makes contact. The door must then be slowly closed and reopened. The width and continuity of the imprint can now be checked on the seal.

Smoke test

Flow checking device



Item	Description
1	Test pipe
2	Test pipe opener
3	Puffer ball

Mode of operation:

The flow checking device is a set made up of a flow-testing pipe, a test pipe opener, puffer ball and closing-off caps for the pipe.

The test pipe contains a filling layer which is impregnated with fuming sulfuric acid. When air is blown through the pipe by the puffer ball, sulfuric acid aerosol is emitted in the form of a white smoke.

NOTE: Pay attention to the instructions for use and the safety directions issued by the manufacturer. The smoke test can only be performed in a draft-free environment.

This test can be used to detect leaks visually.

Procedure:

- Break off both tips of the pipe in the pipe opener, in exceptional cases in the top of the packaging.
- Insert the pipe into the puffer ball so there are no leaks.

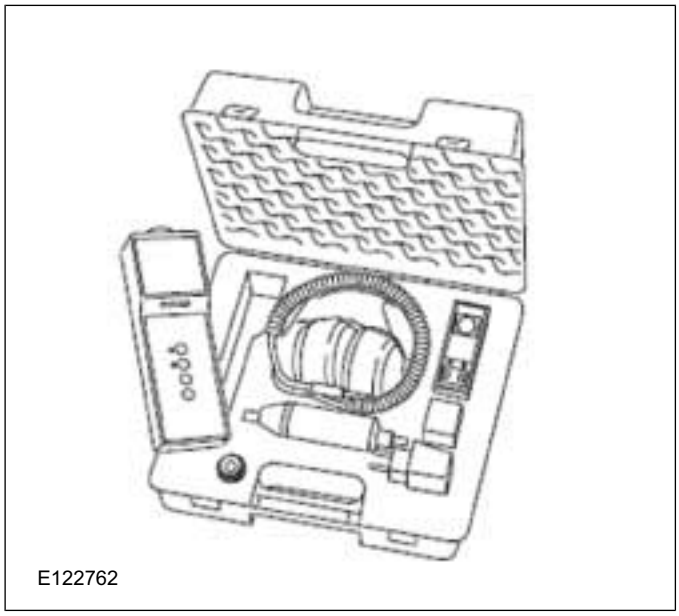
DESCRIPTION AND OPERATION

- Close the hole in the puffer ball with your thumb and press the air contained in the ball through the pipe.
- Set the ventilation blower in the passenger compartment to the highest setting.
- Close all doors so that a slight overpressure can build up in the passenger compartment.
- Move the smoke pipe along the outside of the body to the areas to be checked. Leaks can be detected through the irregular movement of the smoke.

Ultrasonic test

This test searches for leaks in the system of seals or rather acoustic bridges. When an ultrasonic transmitter is placed inside the vehicle, it sends out ultrasonic waves. A leak is located by running a detector along the suspected area. The position with the loudest reception of the escaping ultrasonic waves indicates places where noises occur.

Ultrasonic test device



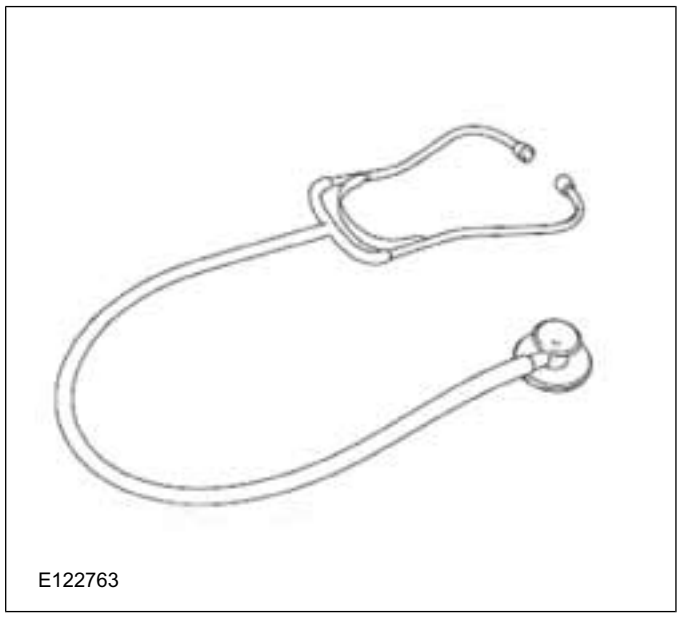
E122762

Procedure:

- Place the ultrasonic transmitter in the vehicle.
- Completely close the vehicle.
- Search the exterior of the vehicle using the detector.
- The detector provides a simple indication of a leak.

Stethoscope test

Stethoscope



E122763

Diagnosis

Wind noises often have similar causes as the general NVH noises. For instance, a windshield which is incorrectly bonded in position can cause normal driving noises to become more noticeable.

Asking the customer detailed questions and a road test together with the customer are the requirements for a targeted diagnosis.

NOTE: Take the customer concern seriously. But do not confirm that a noise is a problem until you are sure that it is something which is not normal for the vehicle series.

Possible questions:

- How long has the noise been there?
- Has any work been done on the vehicle?
- Where does the noise come from?
- In which driving situation does the noise appear?
- Is there any special situation in which the noise appears?

Remember that a noise is often more or less noticeable depending on where you are sitting in the vehicle.

DESCRIPTION AND OPERATION

Stage	to test	Result	Reference or Action
1st	Road test the vehicle with the customer. First let the customer drive to demonstrate the noise, before you drive the vehicle yourself. Check that the concern is justified. Is this a noise which gives cause for concern?	Yes	Step 2.
		No	Explain the noise and tell the customer what is causing it. Possibly offer a comparable vehicle for a road test.
2nd	Visually inspect the vehicle. Look for loose, damaged or missing components. Check that the vehicle is to standard production series specification. In particular, check for any aftermarket components which may have been installed. Depending on the type of noise, check the suspected area. Could a cause of the noise be found?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 3.
3rd	Before starting any further work, use the VIN to look for model-specific information in eTIS. Perform Oasis query and check TSBs. Can a cause for the noise be determined based on the information available?	Yes	Take the action specified in the Oasis or TSB information. Check whether the measures have been successful.
		No	Step 4.
4th	Localize the noise. In doing so, check whether it is an unusual noise or if it is a usual driving noise that is more noticeable because of inadequate sealing. Is it an unusual noise?	Yes	Step 5.
		No	Step 7.
5th	Determine the source of the noise. Can the cause be determined?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 6.
6th	Determine the path of the noise using the stethoscope. By way of a trial, mask the suspected area or components or remove them. Can the cause be determined?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 7.

DESCRIPTION AND OPERATION

Stage	to test	Result	Reference or Action
7th	Check the vehicle for inadequate or damaged seals. The sealing of a vehicle can be checked using the stethoscope, the powder test, the smoke test and the ultrasonic detector. (See under test method.) Could a leak be detected?	Yes	Renew the seal or perform the appropriate repair as necessary. Check whether the measures have been successful.
		No	Step 8.
8th	Under certain circumstances there may be a constructional problem which is not yet known about. Record the problem in an Express Service Report and send it on by the usual method.		

Possible concerns with corrective measures

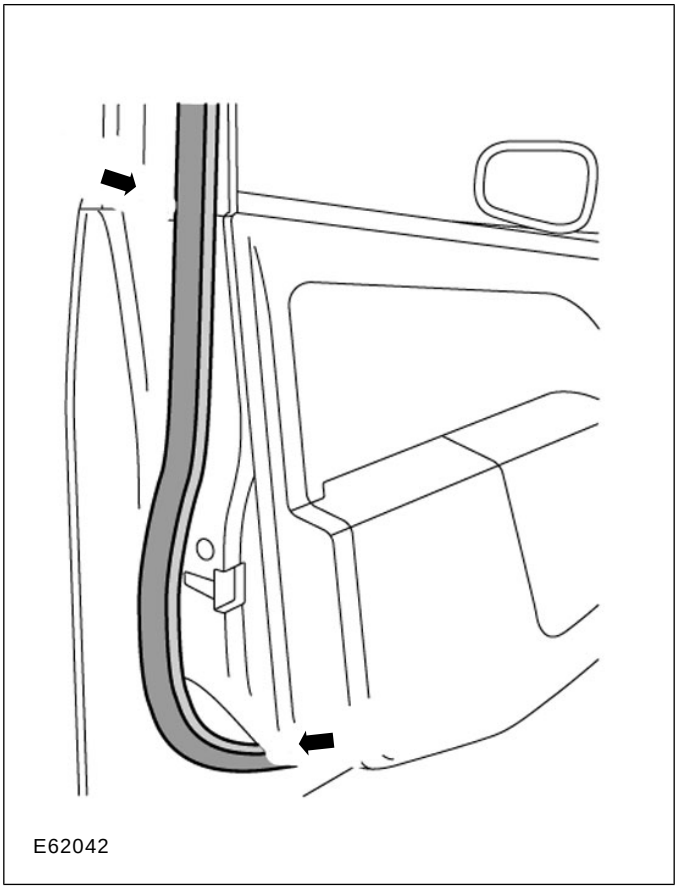
NOTE: Instructions on general noise are summarized separately in the Noise, Vibration and Harshness section. These can be useful when searching for the causes of wind noises.

There follows an outline of the possible concerns relating to wind noises. Selected examples are given showing the causes of wind noises and the ways in which they can be eliminated. They are intended to provide troubleshooting tips and suggestions for the user but do not represent an exhaustive faults list. The topics are subdivided by the different groups of components.

The test procedures described in the Noise, Vibration and Harshness section can be used when troubleshooting.

Seals

In general, seals are very important when eliminating wind noises. Special attention should always be paid here to the possible causes of wind noises.


E62042

Take the following points into account:

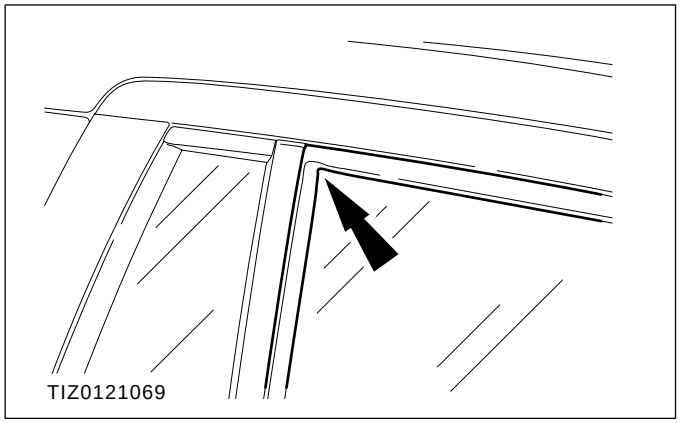
- Seals age, i.e. they become porous and with time they lose their original elasticity. If the vehicle is relatively old and there are already visible signs of distortion or damage to a seal, then it should be replaced.
- At high speeds the doors or hatches may lift slightly from the seal surfaces because of variations in air pressure. Wind noises are caused when the preload on the sealing surface is not sufficient. The preload depends on the installation position of the components, the elasticity of the seal and the location of the sealing flange.
- The contact surface of the seal must be sufficient. This can be checked using the chalk test. If the specifed width of the contact surface is not known, you must determine it on another component of identical construction.
- A bulging seal carrier indicates that the sheet metal of the retaining flange is uneven.

DESCRIPTION AND OPERATION

- Seals must be correctly installed. Special attention must be paid at corners **-arrow-** that the installation follows the contours.
- The seal must not show any kinks or folds or any other damage.
- Seals must seal all around their circumference. Gaps in seals result in openings which lead to an increased incidence of noise. In this respect, it is especially important to pay attention to the seals in the area of the windows.

Remedial Action

Renew older seals which no longer have adequate preload. Deformed or widened retaining flanges must be reworked and provided with a new seal.

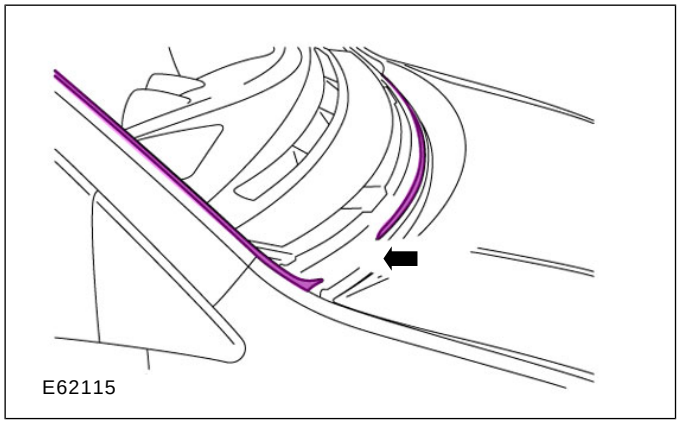

TIZ0121069

The corner areas **-arrow-** of a seal must be properly seated. In some circumstances, a butyl sealing strip must be affixed to support the sealing at a corner.

Bonded joints

Glass is usually installed today using a bonded joint. Gaps in the bonded joint can lead to noises in the vehicle interior. If there are noises which are believed to be associated with window glass, the following points should be checked:

Gap in window bonding


E62115

- The window must be bonded without any gaps **-arrow-**. Leaks can be found using the ultrasonic tester or compressed air carefully blown from inside onto the window glass bonding.
- The installed position of the window glass must be correct. It must not have been bonded into a position which is too low or offset to one side.
- The sealing or trim strips must fit tightly and the glass must be mounted so that it is fully enclosed. If a sealing or trim strip has not been applied with enough pressure, high air speeds can cause it to lift up. This can lead to wind noises at higher speeds. Apply masking tape to these areas for test purposes.

Corrective measures

Leaking areas of the window glass bonding material can be sealed using PU sealing compound. Pay special attention at the front windshield, that any breaks in the bonding are not too large. Otherwise the glass must be removed and bonded in place again.

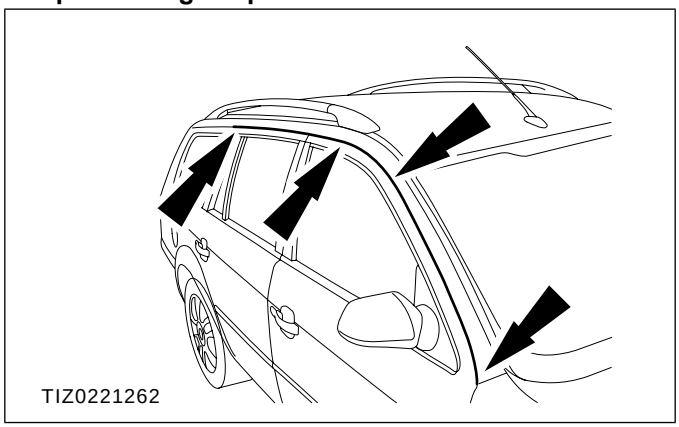
The installed location of a window glass cannot be corrected. It must be removed and bonded into place again.

Replace the trim strips or secure the lip seal using PU adhesive.

Gaps, edges

Door gaps and edges are places where air turbulence can form. This causes noises which can be perceived as troublesome.

Gaps and edges - problem areas


TIZ0221262

Doors, hood and tailgate can cause wind noises because of gaps **-arrow-** which are too large. If the components are not installed flush to the bodywork or the neighboring component, air break edges can arise, which in turn can create a wind noise.

DESCRIPTION AND OPERATION

The sun roof may be the cause of whistling noises in the roof area. The sun roof may be incorrectly adjusted or the seal on the sun roof may be damaged.

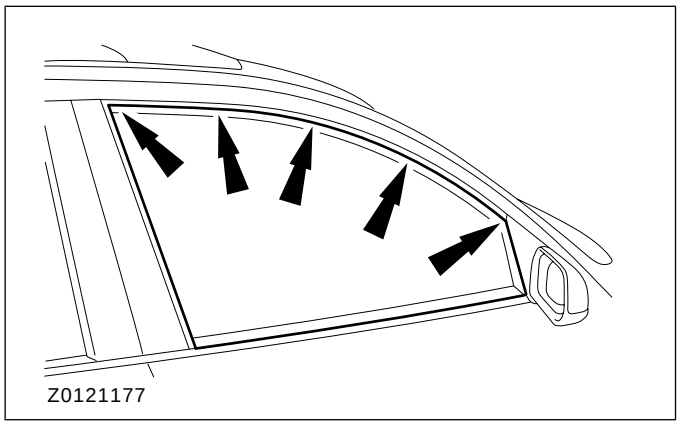
Noises from the door area could come from a window which does not fully close. Side guides (seals) can also be the cause of wind noises.

The covers of window frames can be incorrectly mounted or aligned. The quarter-lights in doors must also be checked for correct installation.

Corrective measures

Check the gaps and adjust them according to the specifications. If there are problems at the sun roof, correct the adjustment and if necessary replace the seals.

Problem area at side windows



Side windows which do not fully shut **-arrows-** must be adjusted. If the vehicle is equipped with electric window regulators, the remedy may be to perform the window regulator learning process again. In all cases, make certain that the glass enters far enough into the seal.

Ancillary Components

Components installed on the bodywork may cause noises when they are not correctly mounted.

When troubleshooting it may be helpful to remove the suspected component or, when this is not possible, to mask it off with suitable covering tape.

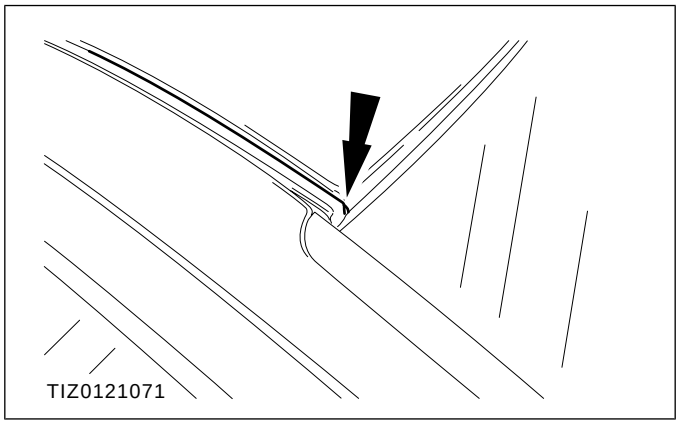
Roof moldings, roof rail, roof antennas

Moldings and roof moldings must touch the bodywork along their whole length without any gap. Check the end sections in particular. These must neither have any splits nor stand away from the bodywork.

Noises may come from the roof rail if the seal between it and the roof is not correctly installed or is cracked. Gaps at the mounting grooves of the carrier can also create wind noises.

The roof antenna and antenna foot seal must be correctly secured. The seal must lie completely on the roof and must not be damaged.

Roof moldings mounting



If the original mounting points of the roof moldings are in good condition, the fixing can be improved using silicone sealant -arrow- if necessary. Align or renew the seals of the roof rail. Reduce the clearances of the mounting grooves.

Corrective measures

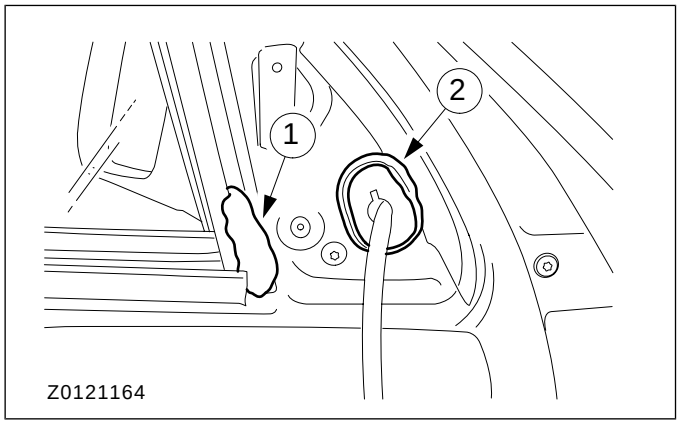
If the original mounting points of the roof moldings are in good condition, the fixing can be improved if necessary using silicone sealant **-arrow-**.

Exterior mirrors

Exterior mirrors or covers of exterior mirrors which are not correctly mounted cause noises. The cover must lie evenly on the component and must not lift during driving. There are ducts present on the doors for the electrical or mechanical adjusters for the exterior mirrors. If there are leaks, wind noises will be caused. Holes can also be present at the transition to other components.

Exterior mirror seals

DESCRIPTION AND OPERATION



There are ducts present on the doors for the electrical or mechanical adjusters for the exterior mirrors. If there are leaks, wind noises will be caused. Holes can also be present at the transition to other components.

Remedial Action

If there is inadequate sealing of the foam seals **-2-** they must be replaced or supplemented with suitable material. Transitions to other components can be sealed with butyl sealing compound **-1-**.

Moldings, covers, door handles, windshield wiper arms

Moldings and covers especially tend to cause wind noises because of their location. These components interrupt smooth bodywork surfaces and air turbulence therefore arises at the edges. If there are noise concerns in the area of the doors, check especially for gaps and projections. Moldings must not stand away from the bodywork or the door. There must not be any gaps or discontinuities at the location of joints.

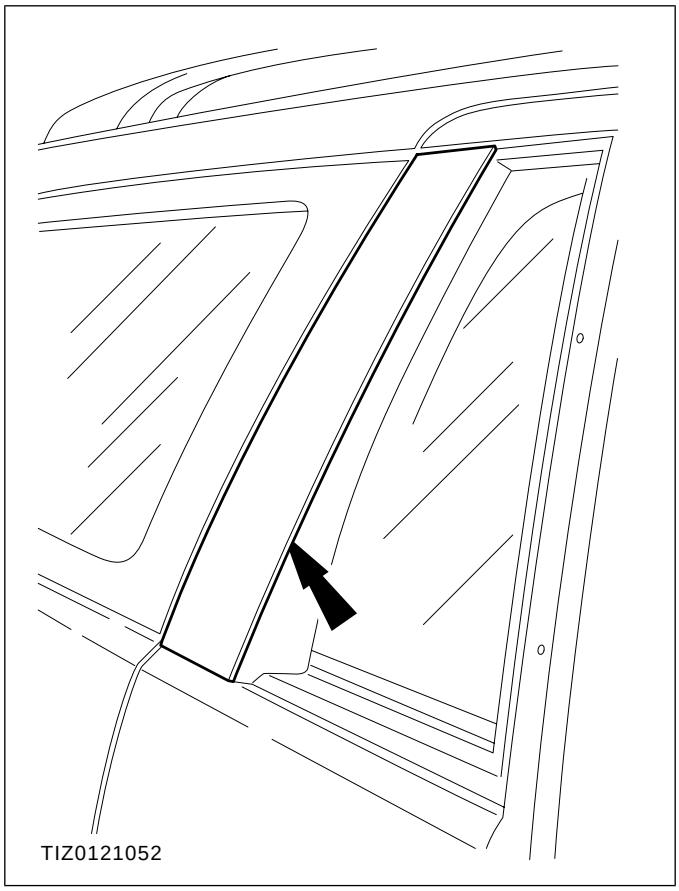
Incorrectly adjusted windshield wiper arms can cause wind noises. Especially if they are too far over the glass surface when in the rest position.

Wind noises in the transition area between the air cowl cover and the wing or the windshield can be caused by an incorrectly installed air cowl cover. At high air speeds the air cowl cover may lift and noises will then occur.

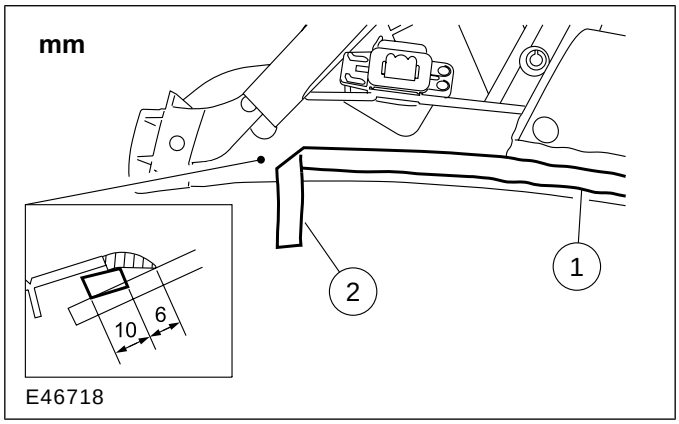
Because of their necessary mechanical features, door handles have a range of openings and edges which allow noise to be generated. The door handle can be masked off for testing purposes. If a reduction in wind noises is noticed, inadequate sealing may be the reason for the noises.

Remedial Action

Openings which are used to secure trim panels must be checked for leaks. Any leaks found can be rectified using butyl strips.



Loose or damaged outer trim on the pillars **-arrow-** must be secured or replaced.



A butyl sealing strip **-1-** can be laid underneath the cover in the transition area between the air cowl cover and the wing or windshield.

The sealing of the door handles must be renewed when required. In addition, noise absorbing material can be applied to the back of the door handles.

DESCRIPTION AND OPERATION

Noise, Vibration and Harshness

Noise, coming from the vehicle and which can be heard inside and outside the vehicle.

Vibrations, oscillations that are felt and noticeable inside the vehicle.

Harshness, noises which come from the vehicle and which can be heard, felt and noticed inside and outside the vehicle.

These terms are grouped together under the title Noise, Vibration, Harshness, or NVH for short.

The task of vehicle development and production is to ensure that noises caused by the vehicle do not disturb the driver and passengers. Moreover, the the external noises emitted by the vehicle must not exceed the thresholds set by law.

NOTE: Basic and advanced training courses are offered for the following contents. For an overview of all courses offered, please refer to the Ford Service Organisation's training course brochure.

Noise types and causes

Noises in and around the vehicle are assigned specific descriptions:

- Humming and droning are perceived as low tones.
- Buzzing and whirring are middle tones.
- Howling, whistling, squeaking are assigned to the high tones.

Low to middle tones are considered to be unpleasant. They are palpable and noticeable as oscillations and vibrations throughout the body. Loud howling and whistling is painful to the ears.

A noise usually consists of a superimposition of different tones which spread as oscillations.

Each of these oscillations has a specific oscillating time and can be measured in frequencies. The frequency describes the number of oscillations per second. The frequency unit is specified in Hertz (Hz).

The human ear can perceive frequencies between 20 and 20000 Hz.

Where the different notes come from in a vehicle:

- Low notes are mostly produced by the engine.
- Low tones can also be produced by the roadbed, particularly on rough surfaces. This is a form of droning which can be felt by the vehicle occupants as vibration or roughness.
- High tones however, which are experienced as howling or whistling noises, are often air currents (wind noises) or come from ancillary components such as the generator, power steering pump or drivebelt.
- There are also clattering noises which can occur when driving over an uneven road. These jerking noises are produced by, for example, the shock absorbers, chassis components or loose articles inside the vehicle.

Noises can already be contained where they occur or, if this is not possible, can be confined with suitable measures.

The basic procedures here are the damping of oscillating parts, the insulation of components or the absorption of the noises through appropriate materials.

Damping

If a damper is installed next to an oscillating mass, the characteristic of the damper will reduce the movement of this mass accordingly (e.g. bumper on chassis).

Damping affects the resonance of an object or system.

Isolation

In oscillation technology, the term isolation means decoupling (separation) of components and systems. An engine is mounted in sprung elements, so that as little oscillation as possible is passed to the vehicle.

In automotive technology, the isolation technique used is nearly always rubber mounting. Rubber has a large internal damping capacity. The elasticity of the rubber acts like a spring.

Absorption

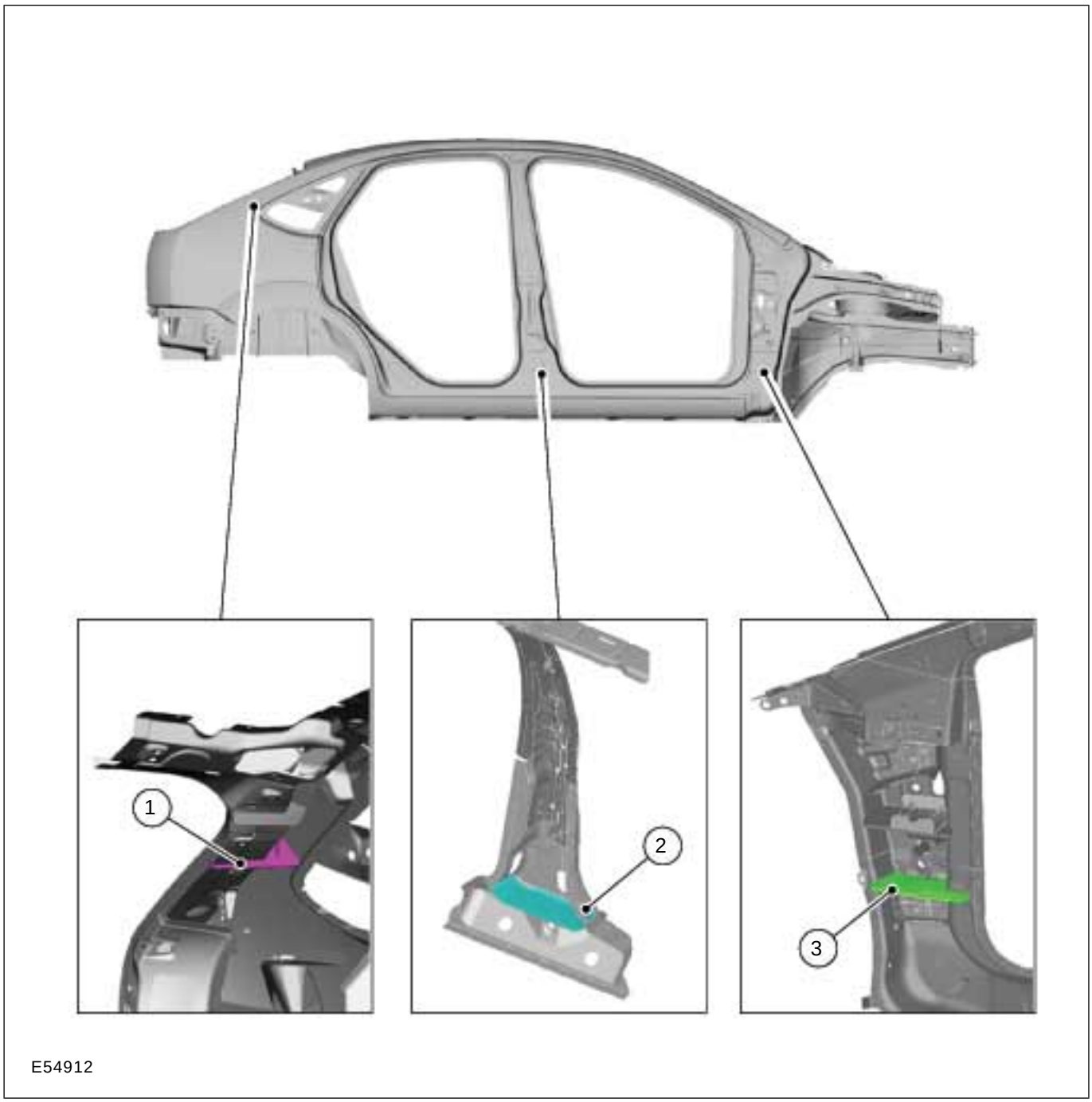
Sound waves are reflected from hard surfaces Through the use of absorption material, sound waves hit soft surfaces and are absorbed by them.

The composition and thickness of the material used plays an important role here. A soft surface, depending on its composition, absorbs the sound waves and reduces their energy.

NVH elements

NVH elements are installed to prevent airborne sound transfers to the passenger compartment in different body cavities.

DESCRIPTION AND OPERATION



Item	Description
1	C-pillar area
2	B-pillar area
3	A-pillar area

On the Focus 2004.75 (07/2004-) these elements are located in the cavities of the A, B and C pillars. On the estate version, they are also located in the D pillars.

The NVH material consists of a carrier plate which has compressed isolation material at the edges. In the drying system of the painting equipment used in production, the body is heated to approx. 170° C. At this temperature the isolation material expands to seal the gap between the carrier plate and the bodywork.

NOTE: NVH elements must not be damaged during work on the vehicle body. NVH elements deformed through impact must always be replaced. PU adhesive must always be applied to the edges of new and reused NVH elements during repair work.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Item	Description
1	NVH element
2	PU adhesive

For the exact installation position of an NVH element, please refer to the vehicle-specific repair instructions.

If an NVH element is to be reused, the bonding on the body panel must be detached. To do this, the body panel must be heated in the area around the NVH element. The bonding can be detached at approx. 170° C. The damaged panel part can now be carefully dismantled.

Before installing the new panel part, a PU adhesive must be applied to the contact areas between the panel and the NVH element.

Test techniques, measuring devices

The shortest route to an accurate diagnosis results from:

- general information on the problem vehicle and a comparison test with a vehicle of the same construction, without NVH problems.
- vehicle history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- application of diagnosis procedures in which the vehicle is split into corresponding areas.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- general information on the problem vehicle and a comparison test with a vehicle of the same construction, without NVH problems.
- vehicle history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- application of diagnosis procedures in which the vehicle is split into corresponding areas.

NOTE: The diagnosis of droning problems is one of the most difficult tasks in the NVH area. With the exception of installed components under stress, a certain diagnosis of droning problems (or boom) on customer vehicles makes great demands on the automotive technician. The performance of measuring equipment and their practice-orientated application can only be obtained through suitable instruction (NVH training). The successful use of these devices requires a great deal of experience on the part of the user.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- a road or system test to determine the exact nature of the concern.

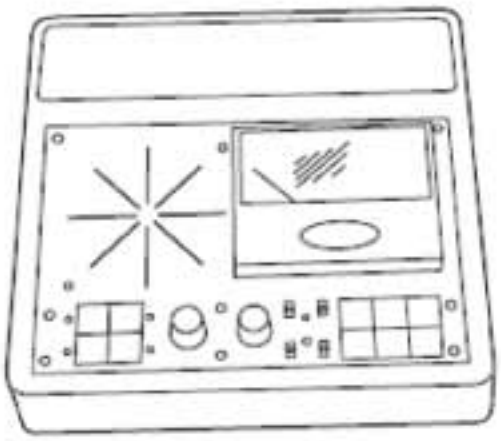
Analysis of possible causes:

- checking of the cause and elimination of the faults found.
- a road test or system test to make sure the concern has been corrected or brought back to within an acceptable range.
- It is often very difficult to locate noises that are audible in the passenger compartment based on the problem description provided by the customer and the road tests performed. The direction of the noise can be detected subjectively, but the source of the noise cannot be found.

NOTE: For a selection of simple test tools, see the wind noises section.

Electronic NVH tester

DESCRIPTION AND OPERATION



E122758

NOTE: Before using the NVH tester in the service, the service technician should take part in an NVH training course to ensure effective use of this device during the road test. A description of the function and application of the NVH tester is enclosed with the device.

The measuring device described below is used for diagnosis of the solid-borne sound and solid-borne sound transmission paths. The device is particularly suitable for medium and high frequency noise analyses. It principally enables noise diagnosis in the area of solid-borne sound and helps to identify solid-borne sound transmission routes.

In order to obtain a positive diagnosis of droning problems (low frequency noises) and their sources, you must have sufficient experience of how to use this measuring device.

The device works according to the following operating principle: Accelerometers (transmitters) are fitted on various vehicle components or body areas. The signals recorded here can be listened to one after the other on headphones or speakers via the different channels. Simultaneous illustration of several or all measuring channels (for comparison) is only possible visually on the display of the measuring device.

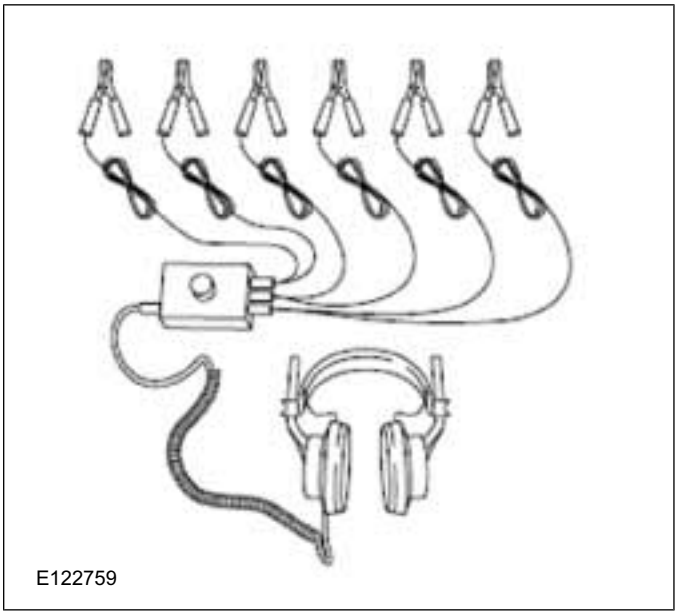
Layout and operation:

- The test device has six different channels for noise diagnosis.
- Each channel is marked in color on the terminal, cable and test device.
- The solid-borne sound recorded is transmitted to the test device or the headphones by the magnetic accelerometers (transmitters).
- There is an amplifier on the test device with which the signal strength and the corresponding channel can be set.
- Only the noises from a transmitter are transferred to the headphones.
- All connected cables can be visually illustrated individually or simultaneously on the display.
- The test device saves the recorded data.
- The recorded data can be imported to a PC and evaluated.

The NVH tester is equipped in addition with mobile magnetic sensors which are particularly suitable for the following noise tests:

- Internal noises at the dashboard
- Engine noise
- Electrical noises (sparking/voltage transmissions)
- Wind noises
- Vacuum - leaks

Chassis noise tester (chassis ear)



E122759

Used to diagnose solid-borne sound and its transmission routes. The device is particularly suitable for medium and high frequency noise analysis and principally enables noise diagnosis in the area of solid-borne sound and helps to identify solid-borne sound transmission routes.

In order to obtain a positive diagnosis of droning problems (low frequency noises) and their sources, you must have sufficient experience of how to use this measuring device.

Layout and operation:

DESCRIPTION AND OPERATION

The test device has six different channels for noise diagnosis. This means that six microphones equipped with clamps can be attached to different components on the vehicle. The emitted or transmitted solid-borne sound will be transferred from microphone to the headphones. There is an amplifier between the microphone and the headphones at which the signal strengths and the corresponding channel can be set.

Only the noises from one microphone are transferred to the headphones. Each channel is color-coded on the clamp, cable and amplifier.

NOTE: In order to be able to relate the positions of the different microphones during the test process, they are entered in a special test sheet according to their colors. Microphones, clamps and cables must be carefully routed and attached.

Test process (example for transmission noise):

- Attach microphones to various positions on the transmission or mountings. This first allows the source of the noise to be determined, and then the possible transfer routes.
- A road test can be performed after all the clamps have been attached to the vehicle and all the cables connected to the amplifier.
- Firstly, all the channels are switched through one after the other in neutral, to check the operation of the different channels as well as the noise level in neutral.
- During the road test, all channels are listened to in the different gears, engine speeds, vehicle speeds and loads. This procedural method permits unambiguous diagnosis of the cause of the noise and the route of the noise until it enters the bodywork structure.
- The characteristics of the noise which is the cause of the concern should match those of the noise which is heard. This means compare the sound.
- Depending on the input signal level, there may be a great deal of difference in the noise level in the individual channels.
- Always set the amplifier volume to zero before switching to another channel.
- In order to be able to make any comparisons, the volume settings of the different channels must be recorded on the test sheet.

SECTION 501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

DESCRIPTION AND OPERATION

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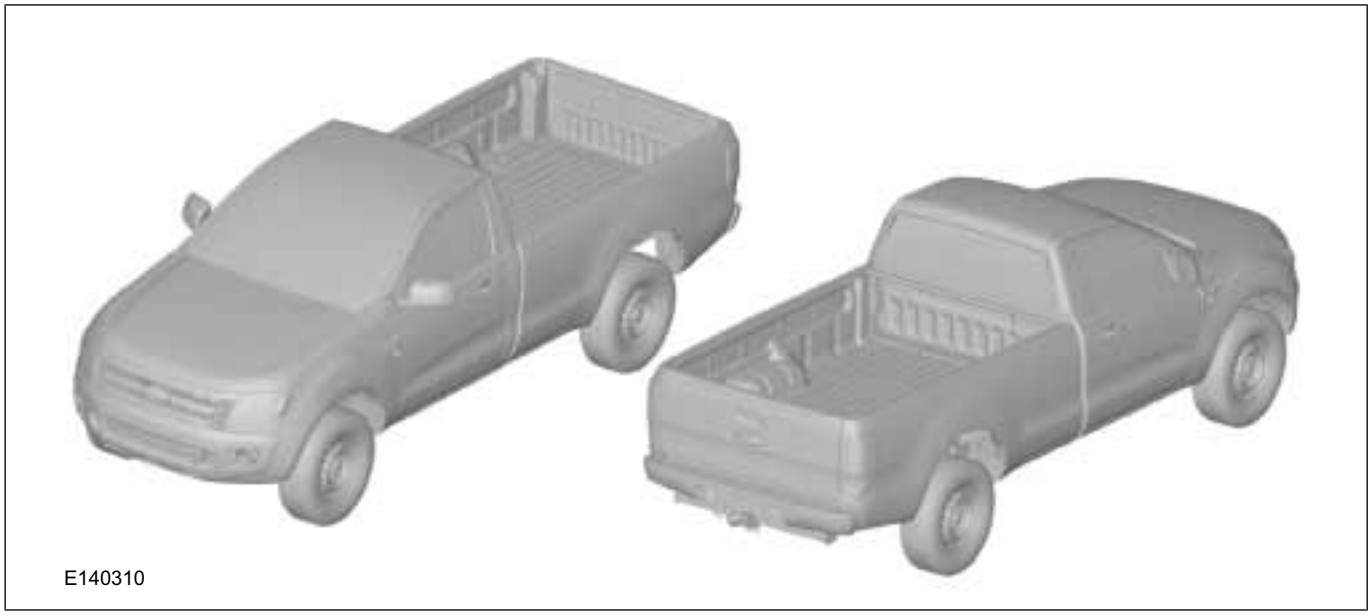
GENERAL PROCEDURES

Underbody Tolerance Check..... 501-26-16
Frame Tolerance Check..... 501-26-18

DESCRIPTION AND OPERATION

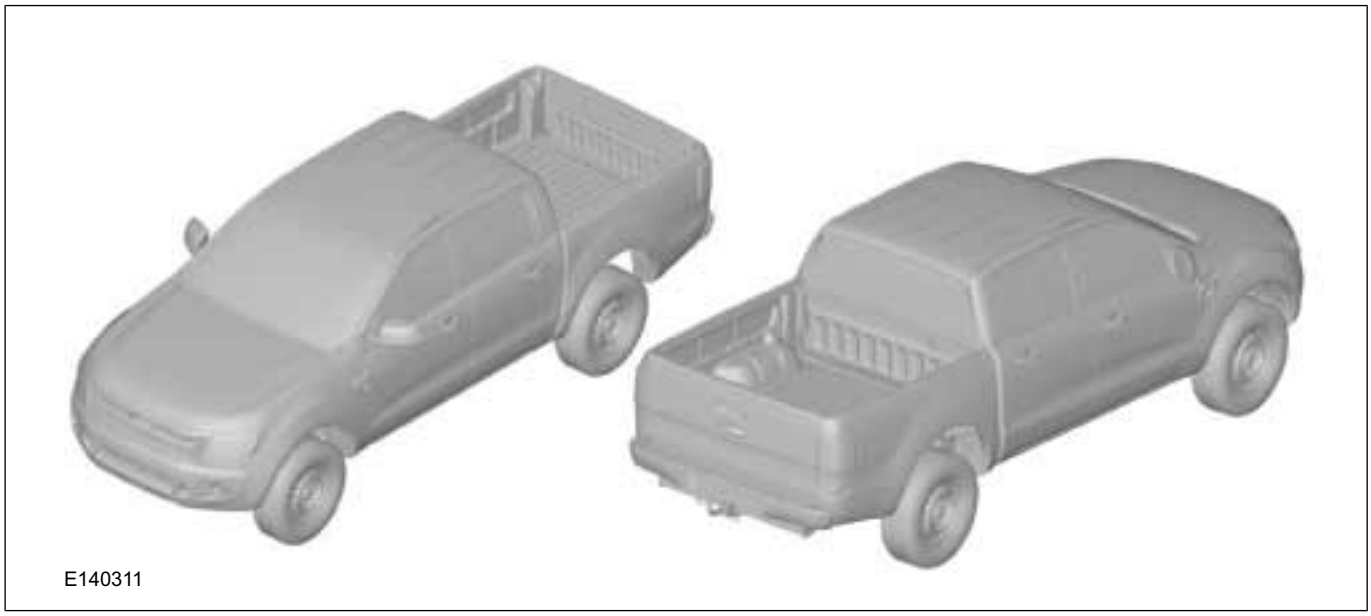
Body and Frame – Component Location

Body, single cab



E140310

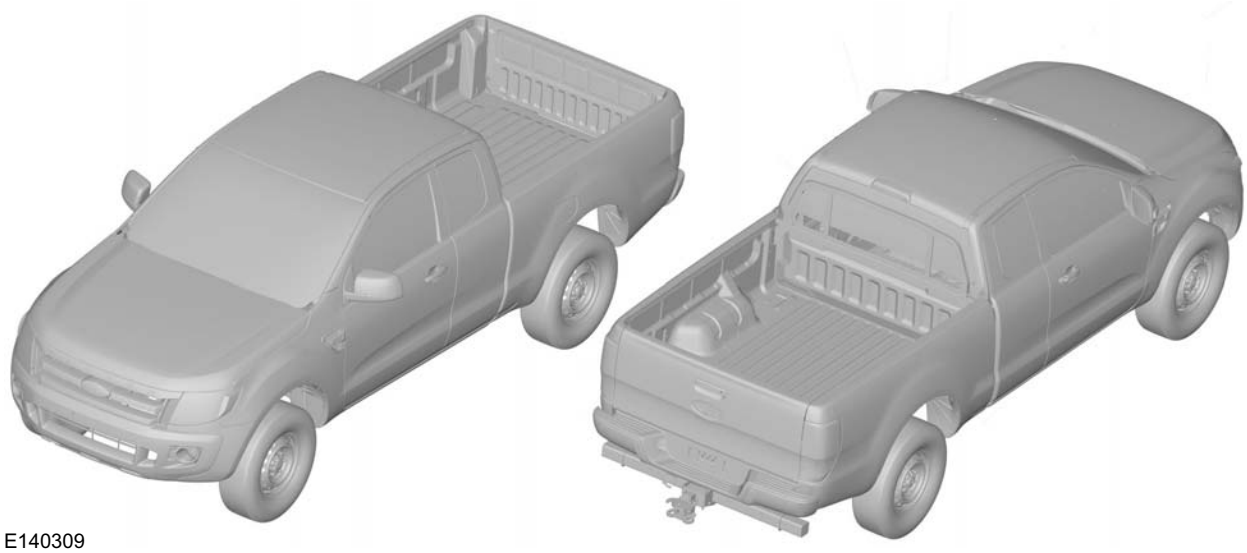
Body, double cab



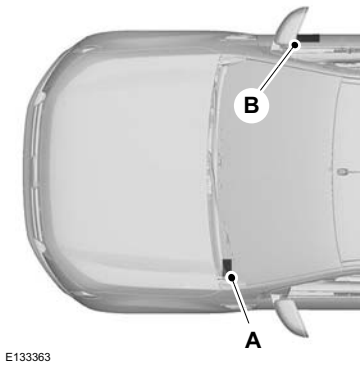
E140311

DESCRIPTION AND OPERATION

Body, stretch cab


E140309

Location of the VIN plate

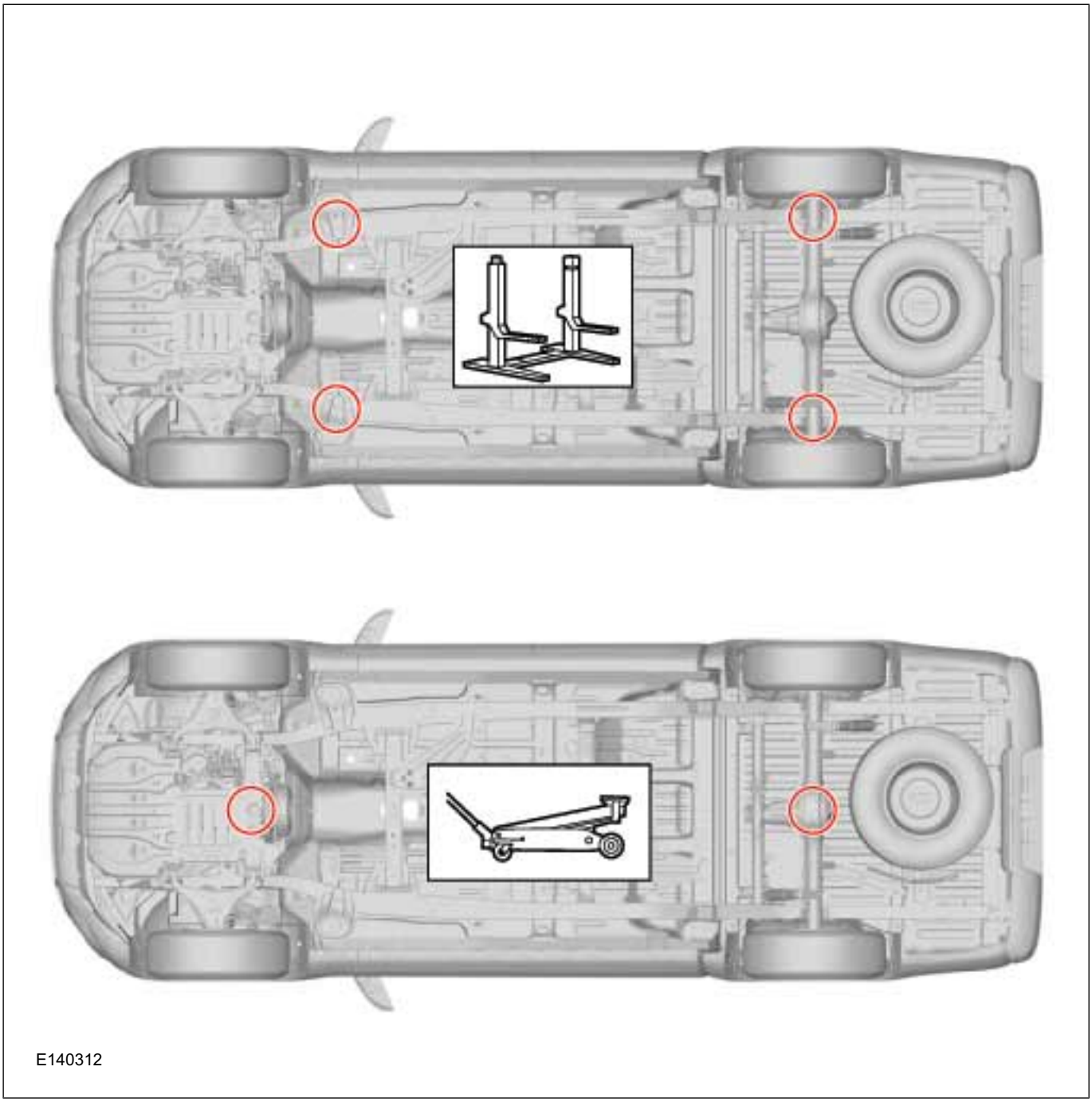


E133363

Item	Description
A	Left-hand side of the instrument panel.
B	Right-hand side beneath the front door on the chassis.

DESCRIPTION AND OPERATION

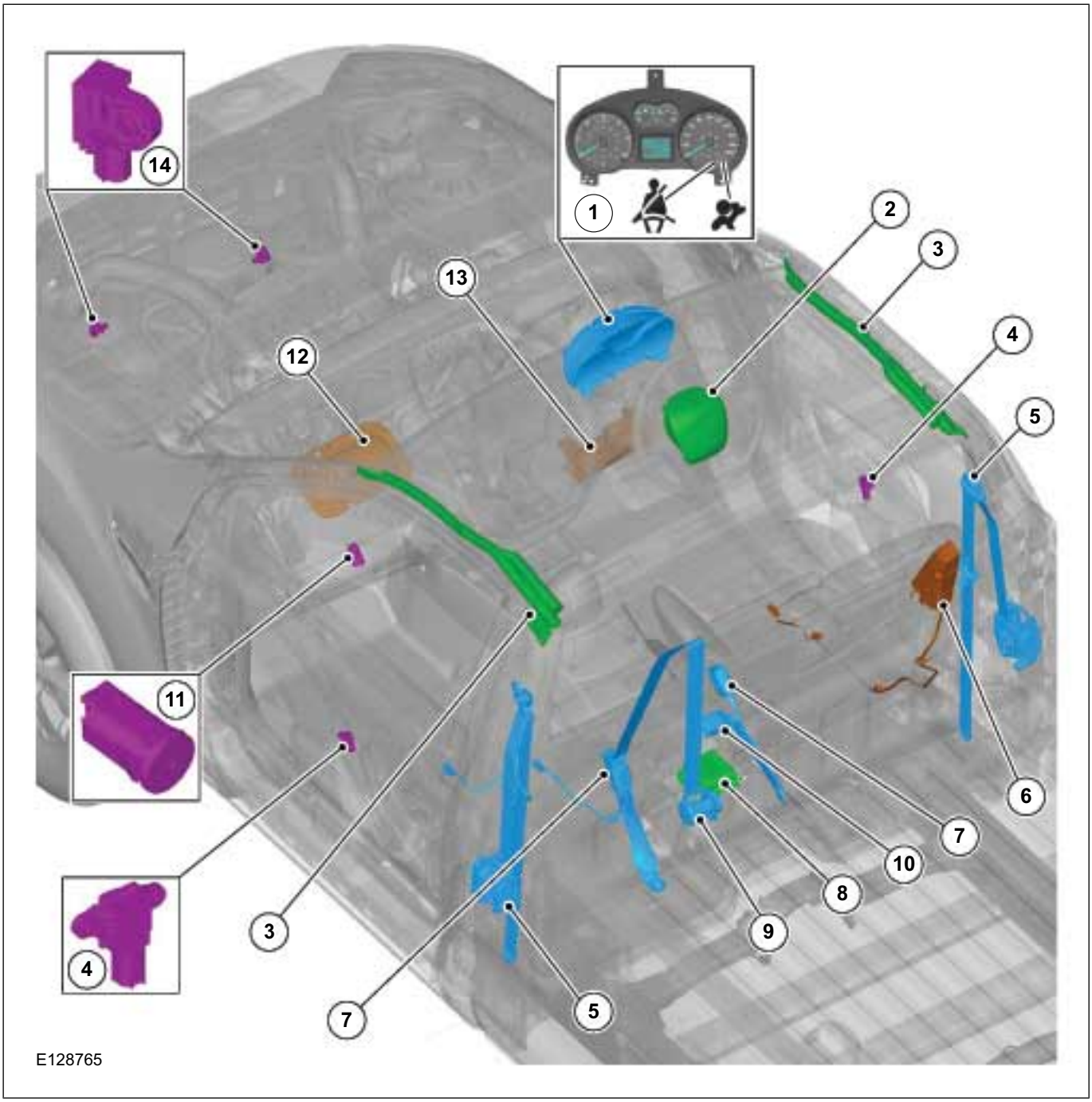
Lifting points



E140312

DESCRIPTION AND OPERATION

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) for single cab



Item	Description
1	Instrument cluster with air bag indicator light and safety belt warning light.
2	Driver air bag
3	Curtain air bag
4	Side impact sensor
5	Front safety belt retractor
6	Side air bag

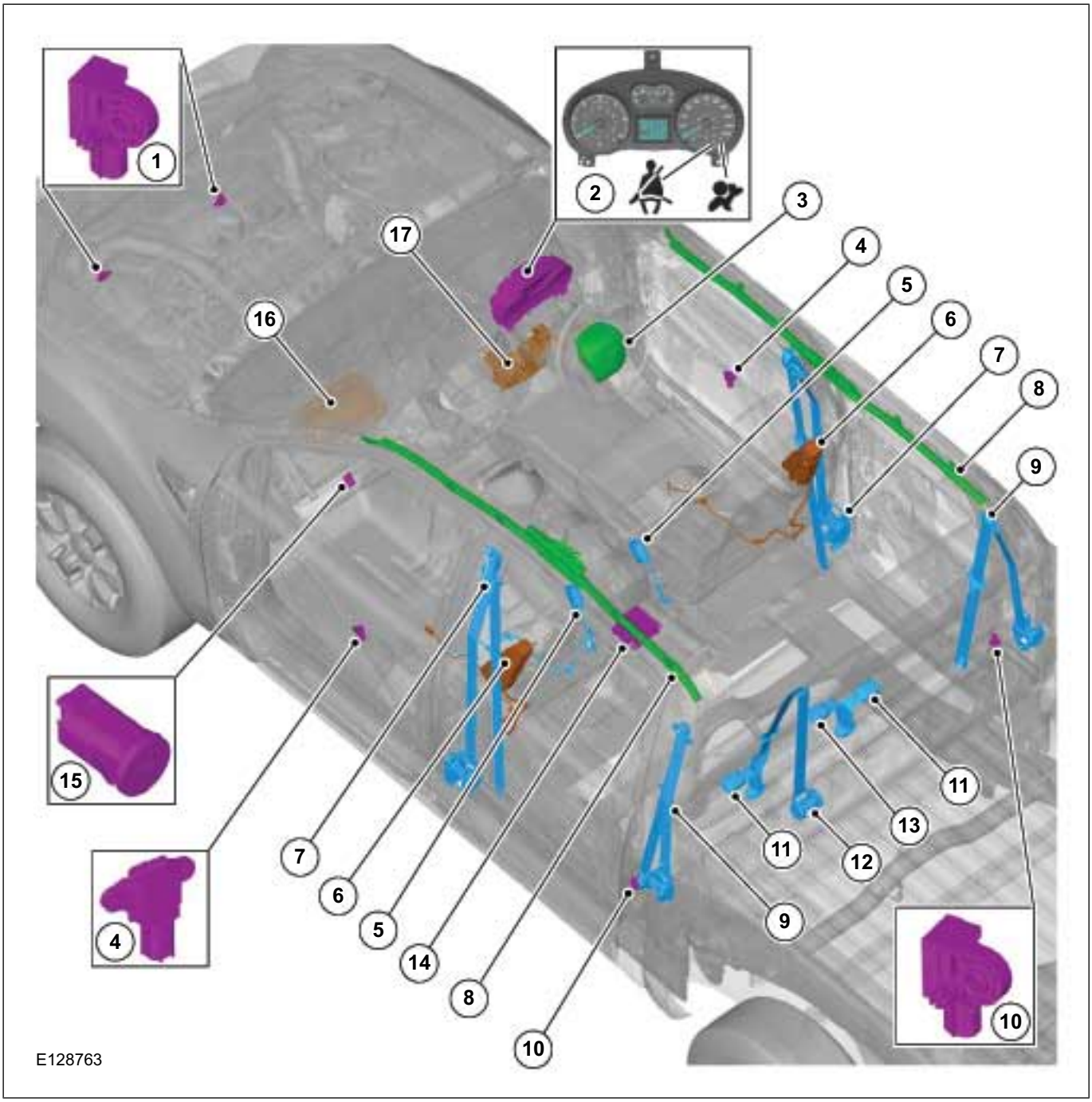
Item	Description
7	Front safety belt buckle
8	Restraints control module
9	Front center safety belt retractor
10	Front center safety belt buckle
11	Passenger airbag deactivation switch
12	Passenger air bag

DESCRIPTION AND OPERATION

Item	Description
13	Driver lower air bag

Item	Description
14	Front impact severity sensor

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) for double cab



Item	Description
1	Front impact severity sensor
2	Instrument cluster with air bag indicator light and safety belt warning light
3	Driver air bag

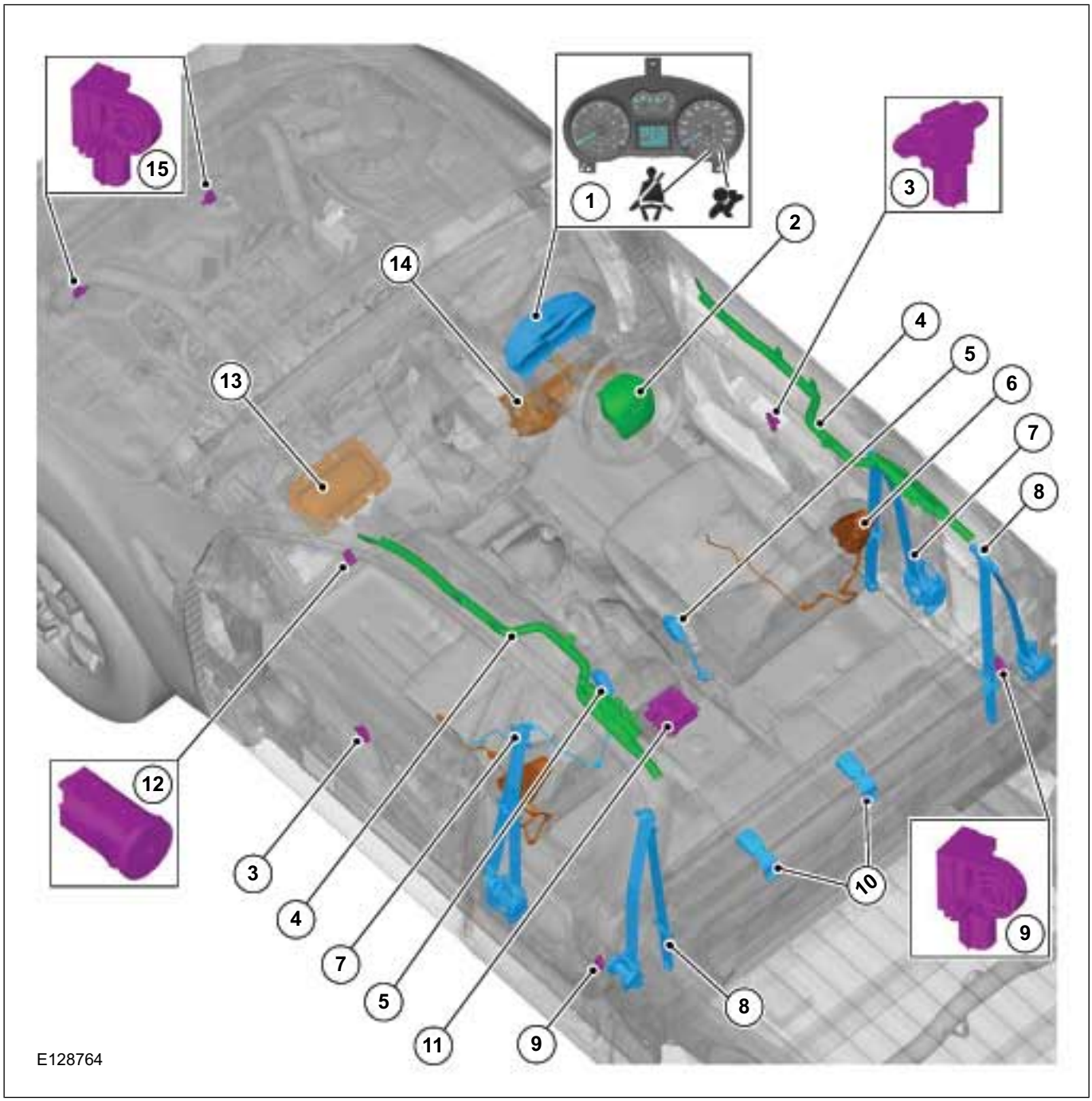
Item	Description
4	Side impact sensor (Driver and passenger side)
5	Front safety belt buckle
6	Curtain air bag (Driver and passenger side)

DESCRIPTION AND OPERATION

Item	Description
7	Front safety belt retractor
8	Side air curtain
9	Rear safety belt retractor
10	Side impact sensor (Rear side)
11	Rear safety belt buckle
12	Rear center safety belt retractor

Item	Description
13	Rear center safety belt buckle
14	Restraints control module
15	Passenger airbag deactivation switch
16	Passenger air bag
17	Driver lower air bag

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) for stretch cab

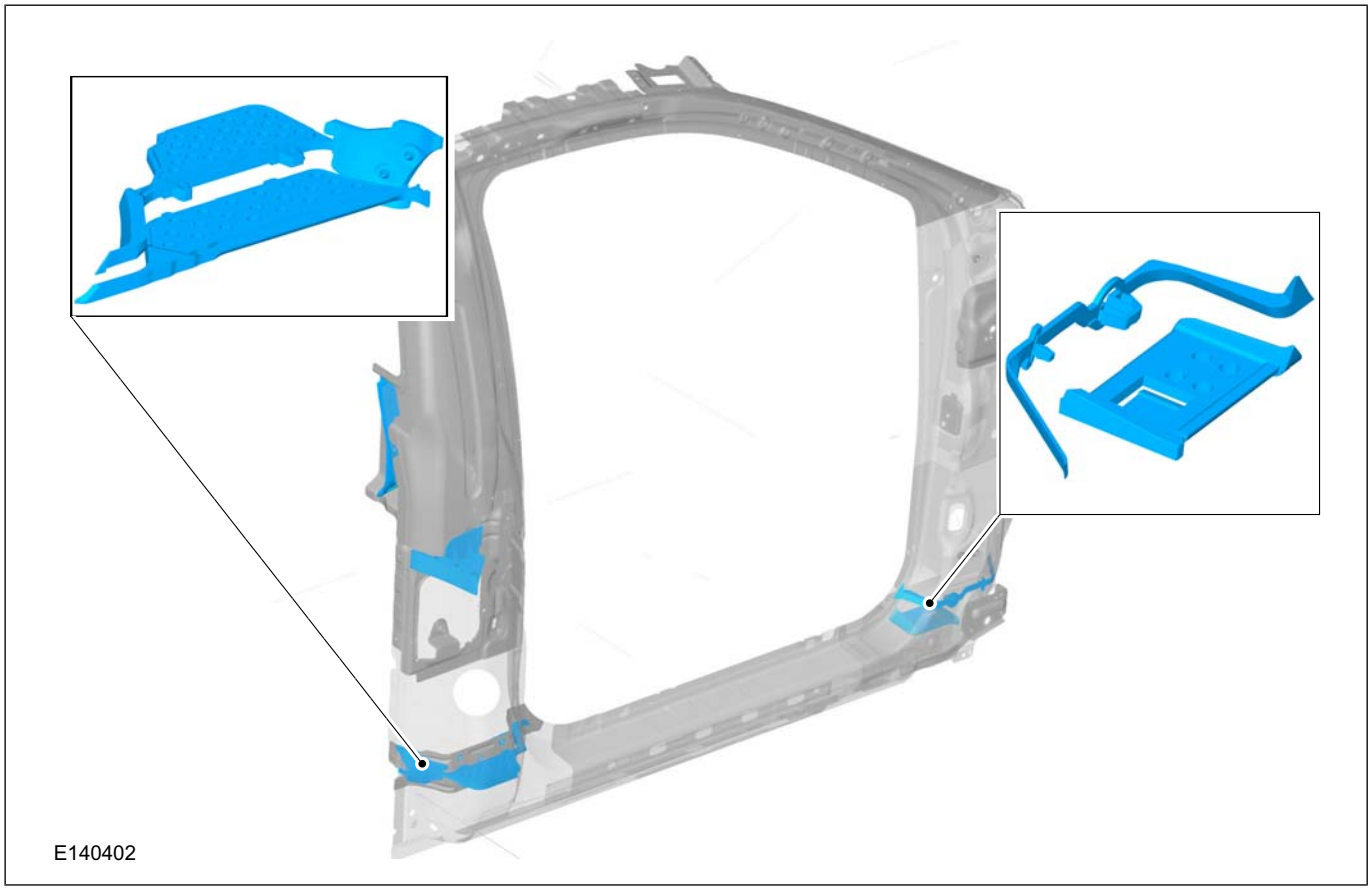


DESCRIPTION AND OPERATION

Item	Description
1	Instrument cluster with air bag indicator light and safety belt warning light
2	Driver air bag
3	Side impact sensor (Driver and passenger side)
4	Curtain air bag
5	Front safety belt buckle
6	Side air bag (Driver and passenger side)
7	Front safety belt retractor

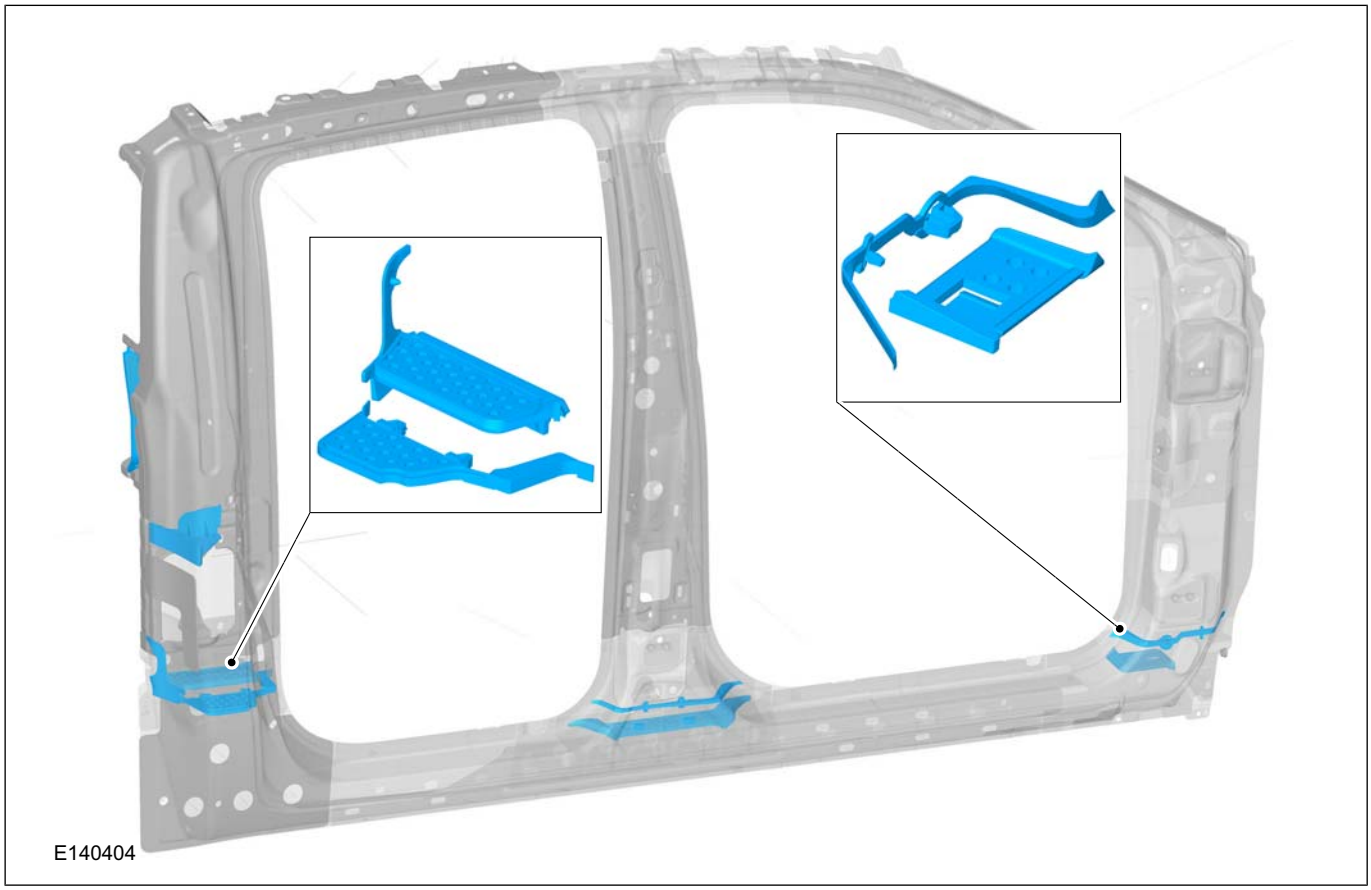
Item	Description
8	Rear safety belt retractor
9	Side impact sensor (Rear side)
10	Rear safety belt buckle
11	Restraints control module
12	Passenger airbag deactivation switch
13	Passenger air bag
14	Driver lower air bag
15	Front impact severity sensor

NVH elements, single cab



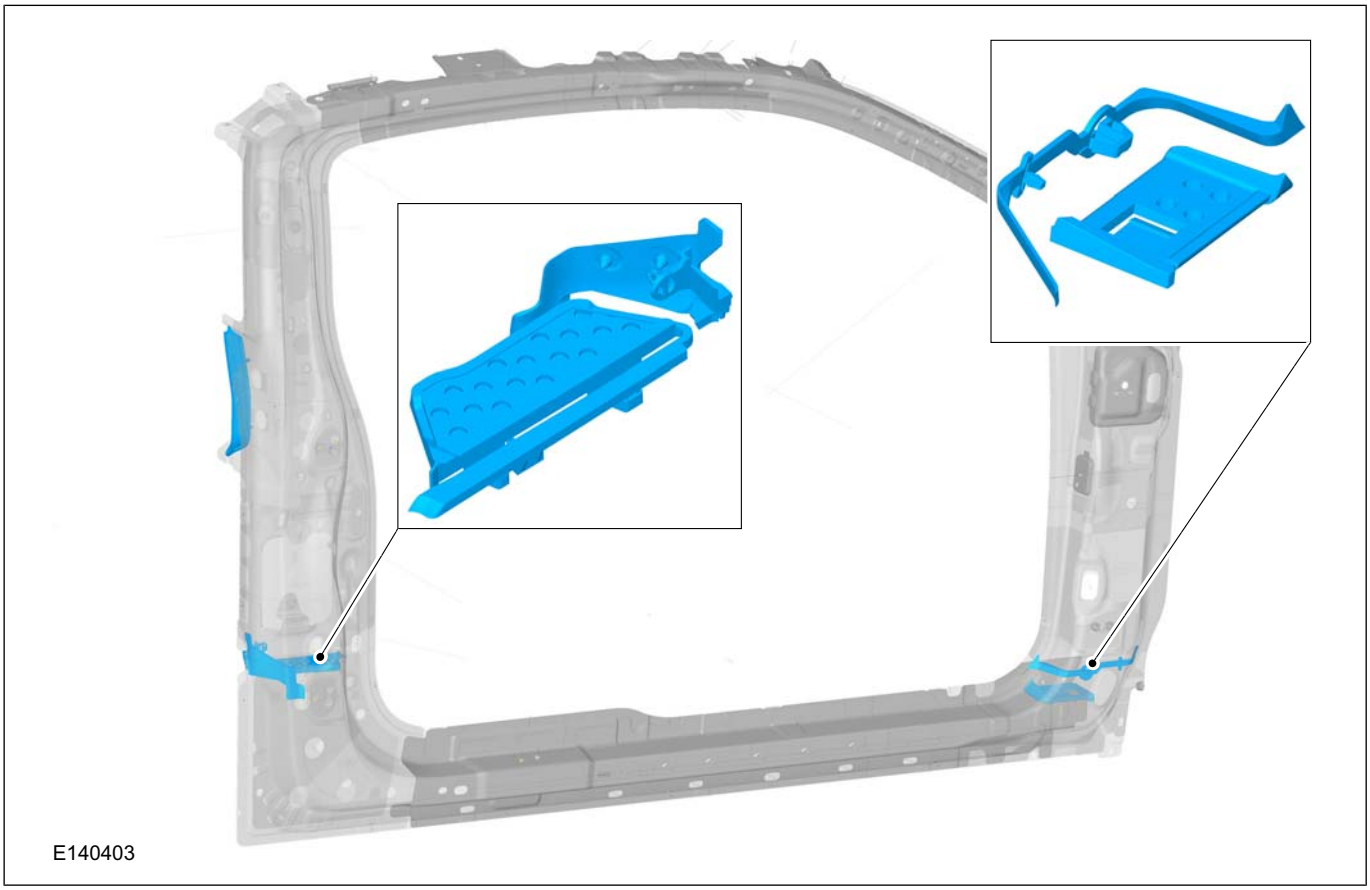
DESCRIPTION AND OPERATION

NVH elements, double cab



DESCRIPTION AND OPERATION

NVH elements, stretch cab



DESCRIPTION AND OPERATION

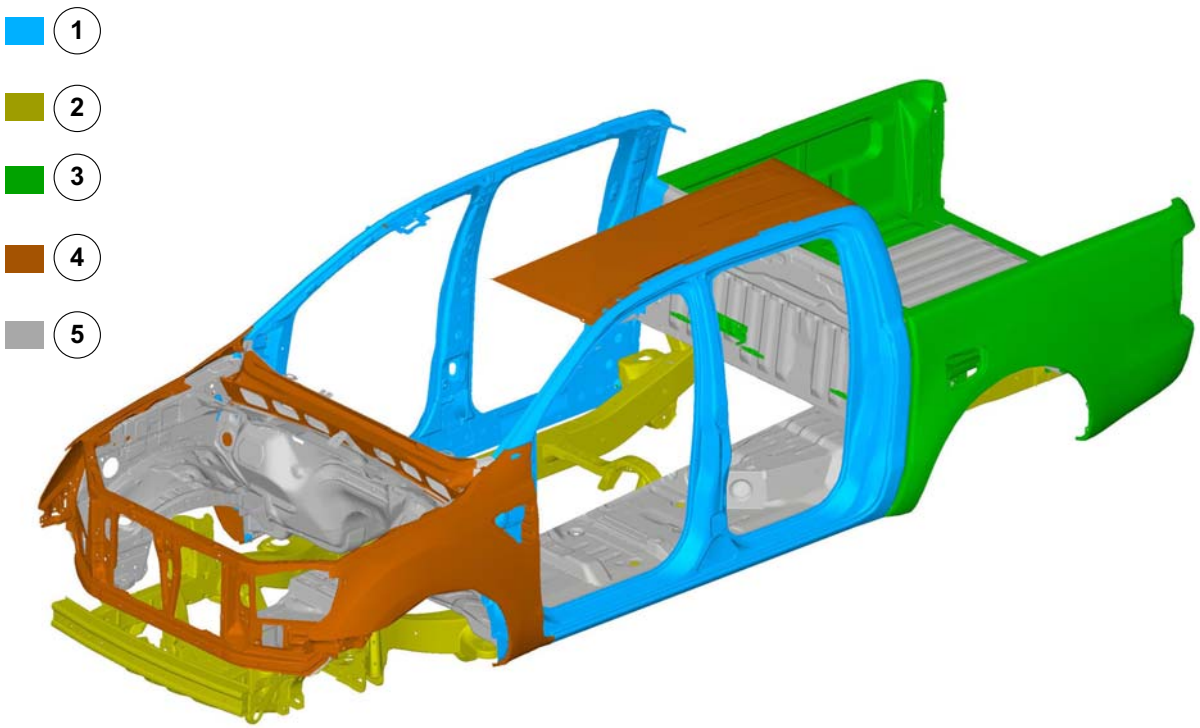
Body and Frame – Overview

Introduction

With the 2011.25 model year, the Ford Ranger is superseded by a completely new vehicle. The T6 is based on the U1 platform which has been developed in co-operation with Mazda. 2-door and 4-door body versions are offered. Within the company the model designation is P375. Overall the vehicle weighs less than its predecessor.

However, it offers increased occupant safety through the use of high-strength and super-high-strength steels. The high-strength and super-high-strength steels used make extra demands on the tools to be employed for some body repairs.

High-strength and super-high-strength steels



E140288

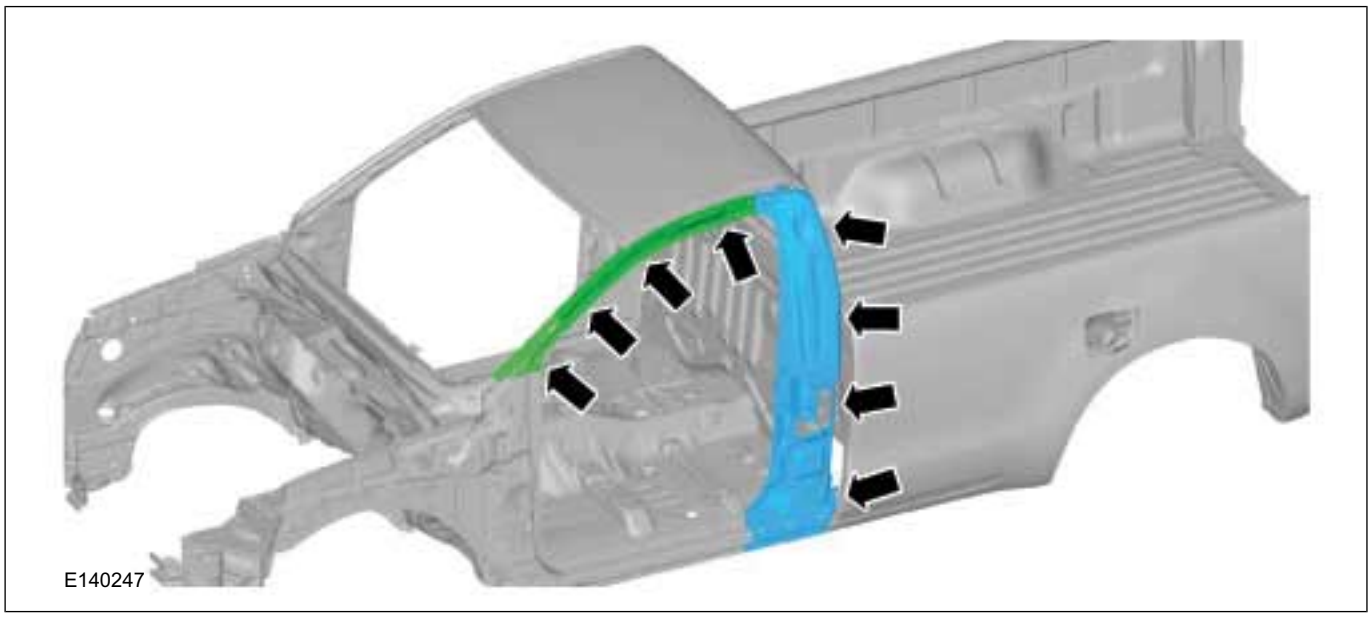
Item	Description
1	UHSS (> 800 MPa)
2	EHSS (380 - 800 MPa)
3	VHSS (280 - 380 MPa)
4	HSS (180 - 280 MPa)

Item	Description
5	MS (< 180 MPa)

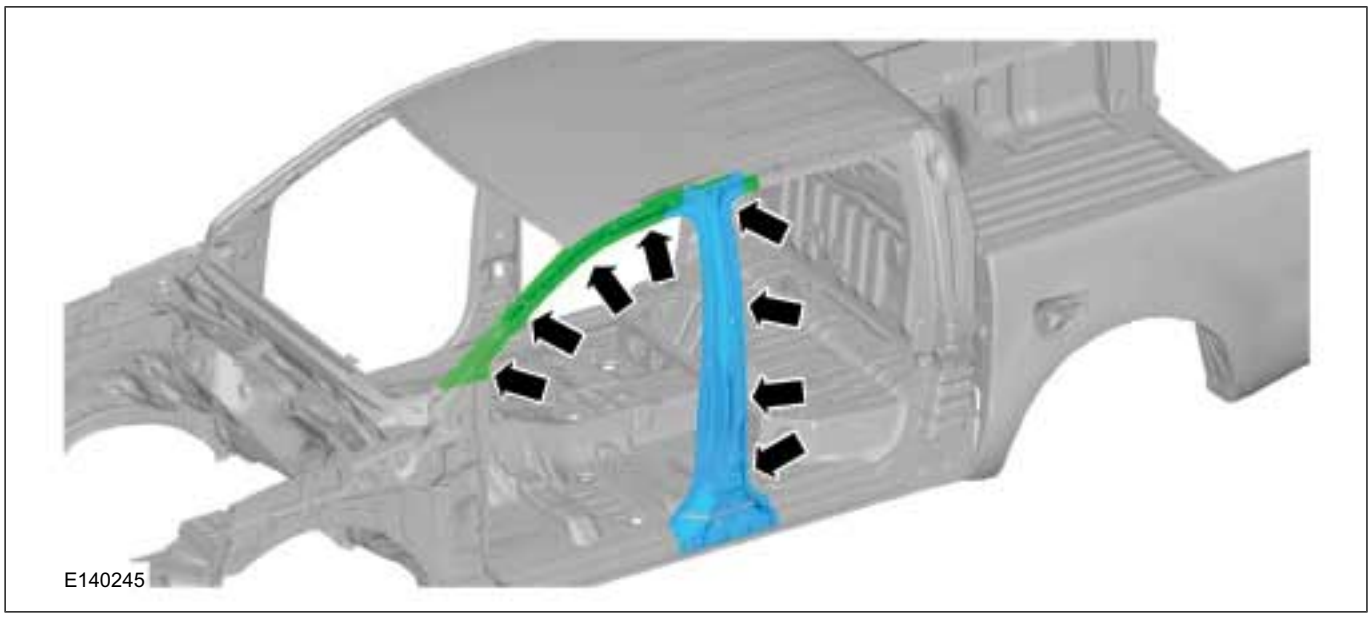
Usibor steel

Single cab

DESCRIPTION AND OPERATION

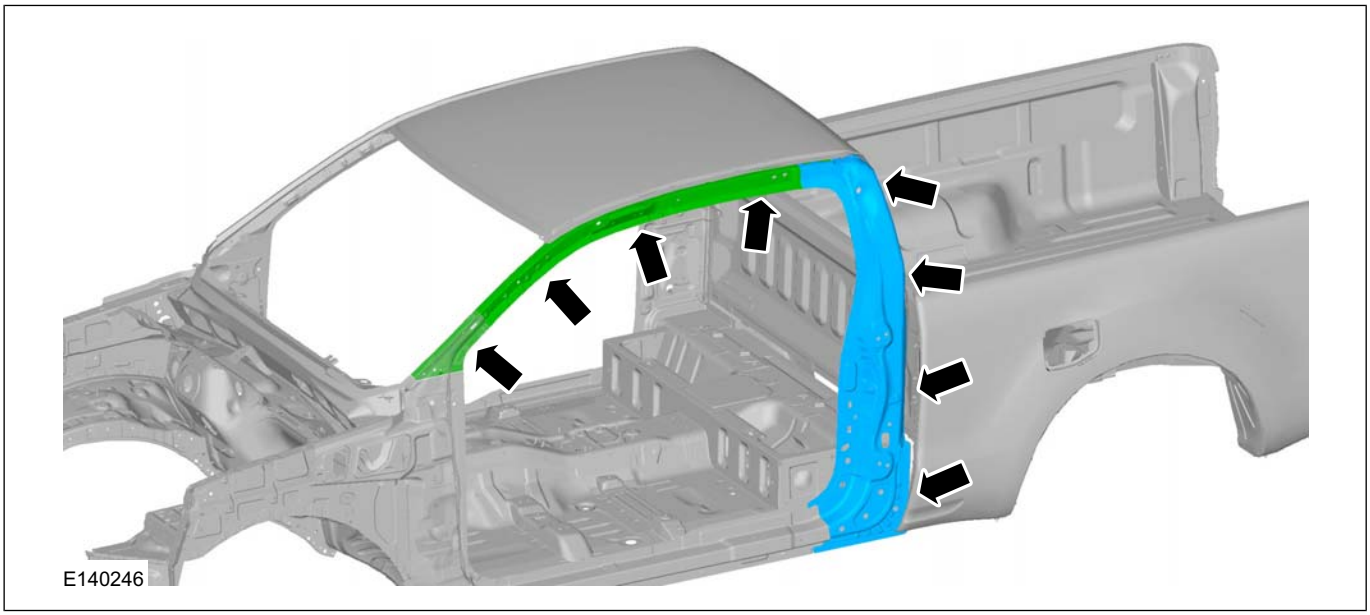


Double cab



Super cab

DESCRIPTION AND OPERATION



The reinforcements at the A- and B-pillars are made of Usibor steel. This material has a yield strength of 1300 MPa.

Sectional repairs must NOT be performed on components made of Usibor !

The required continuous MIG weld seam in the cut area would cause structural changes in the steel and lead to a significant loss in strength.

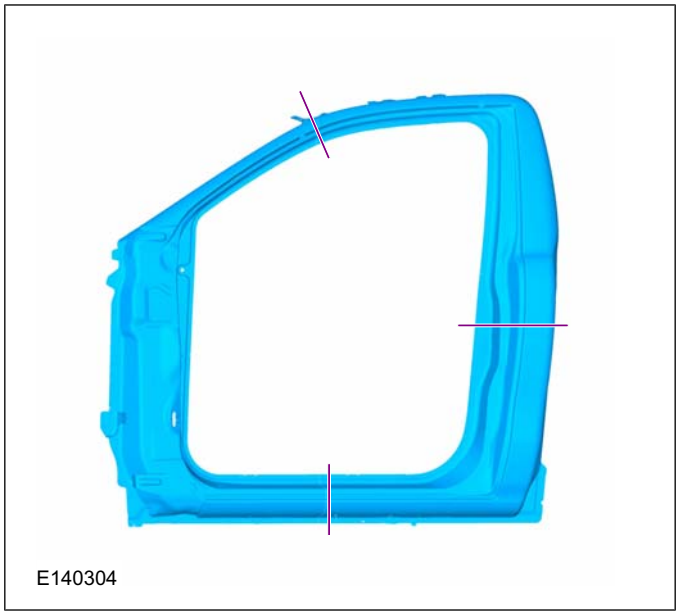
In the event of damage, the complete component must therefore always be renewed.

Also, because of the strength of these components, it is not always possible to work them with conventional body repair tools.

or welding work (resistance spot welding and inert gas puddle welding), additional preparation work and/or special welding equipment are required.

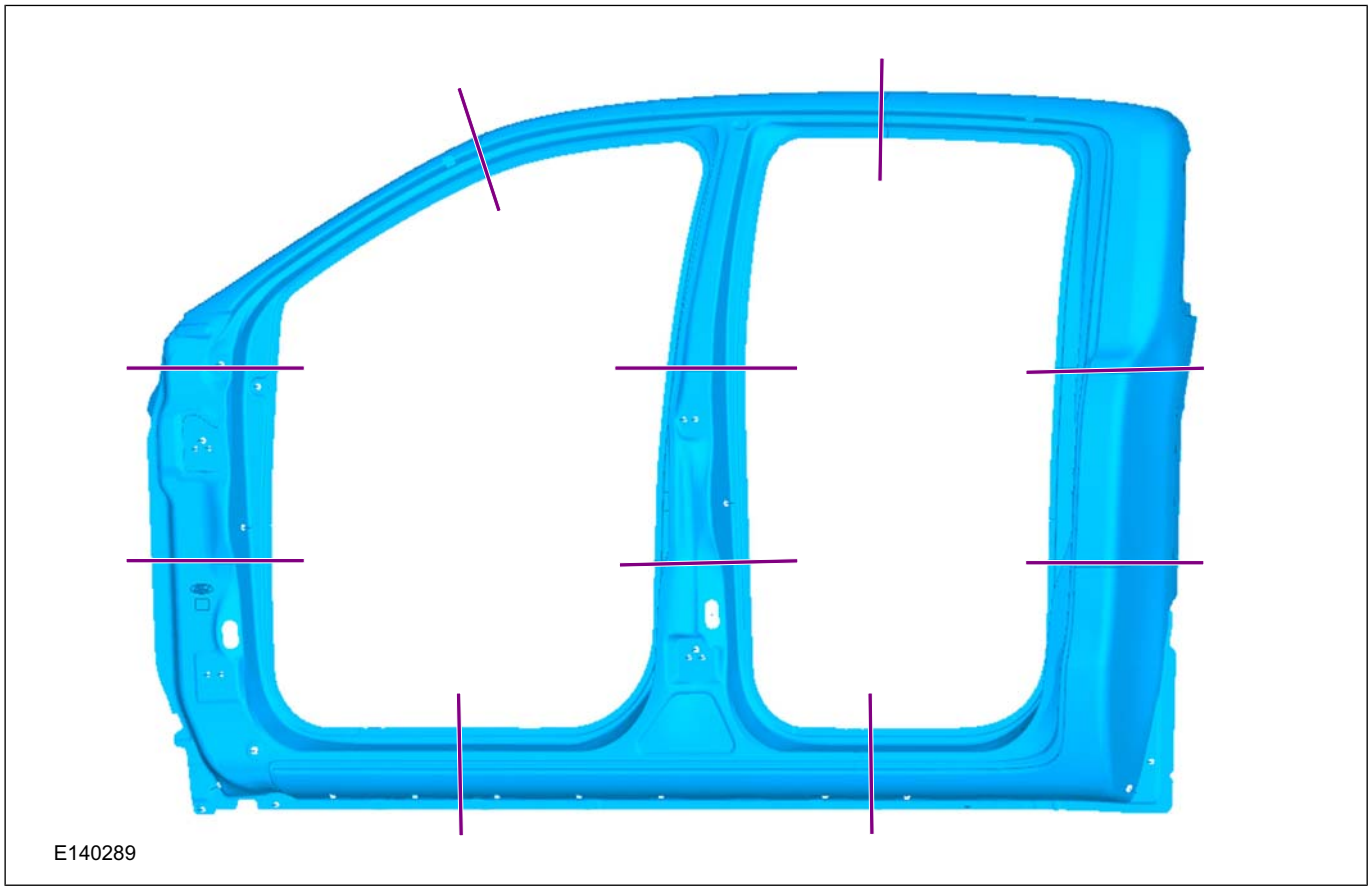
Sheet metal parts for quarter panel partial replacement

Single cab

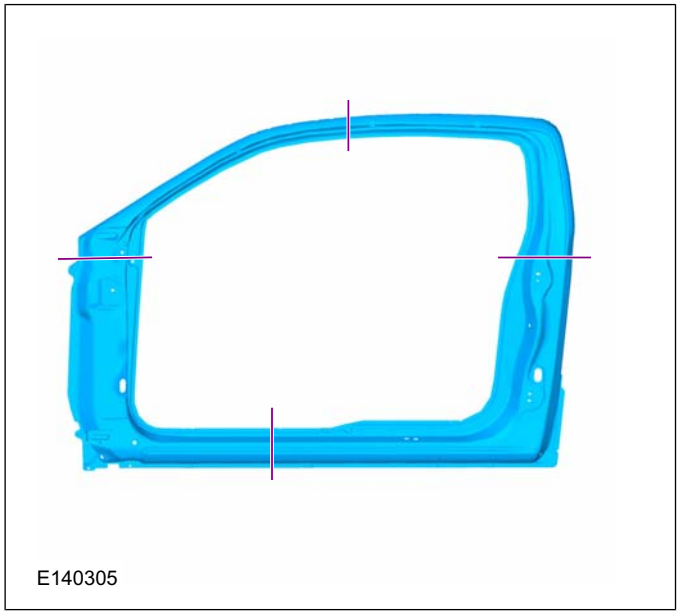


Double cab

DESCRIPTION AND OPERATION

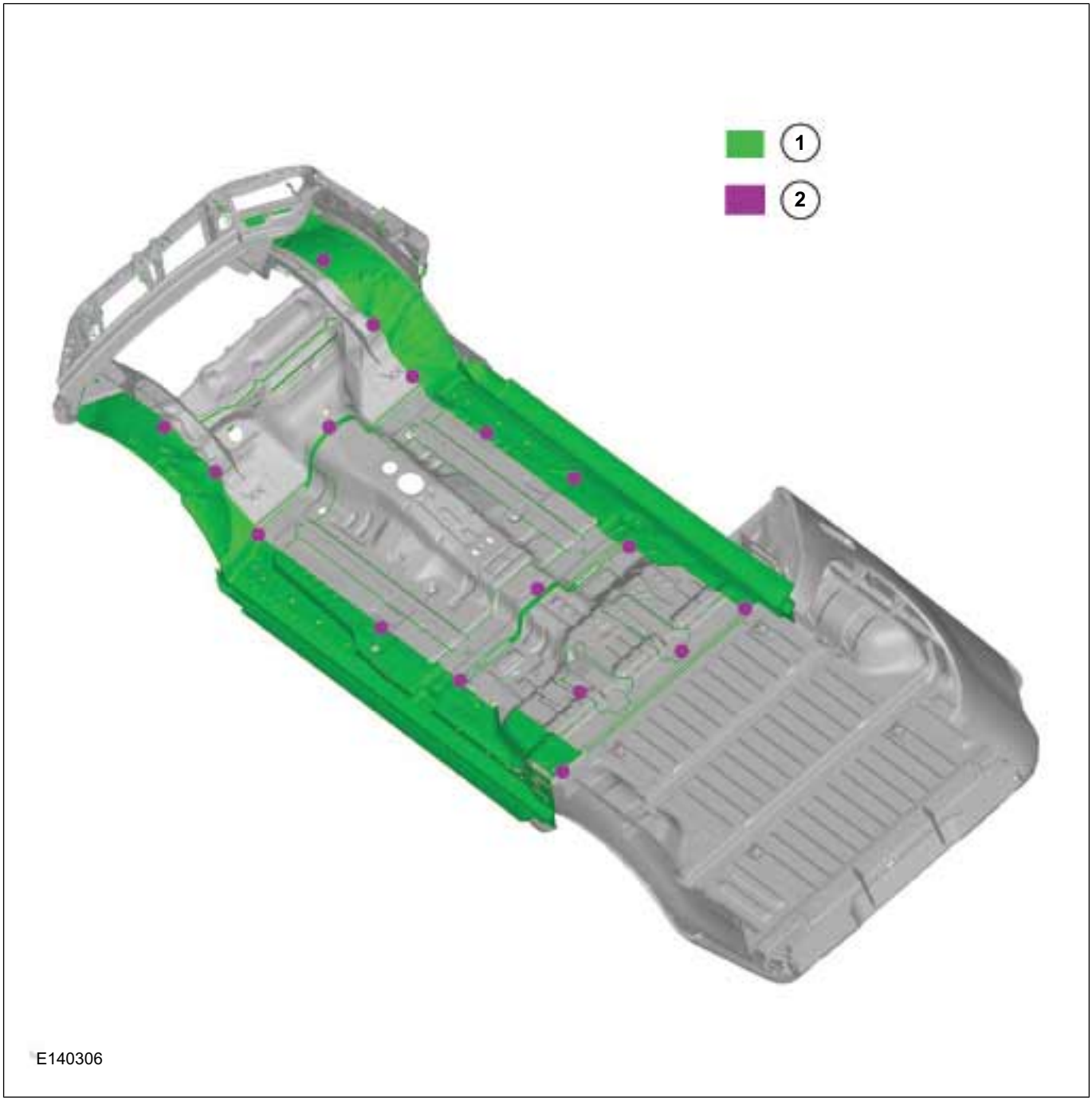

E140289

Super cab


E140305

Anti corrosion protection

DESCRIPTION AND OPERATION



Item	Description
1	Underbody PVC stone chip protection
2	Injection points for cavity wax protection

GENERAL PROCEDURES

Underbody Tolerance Check

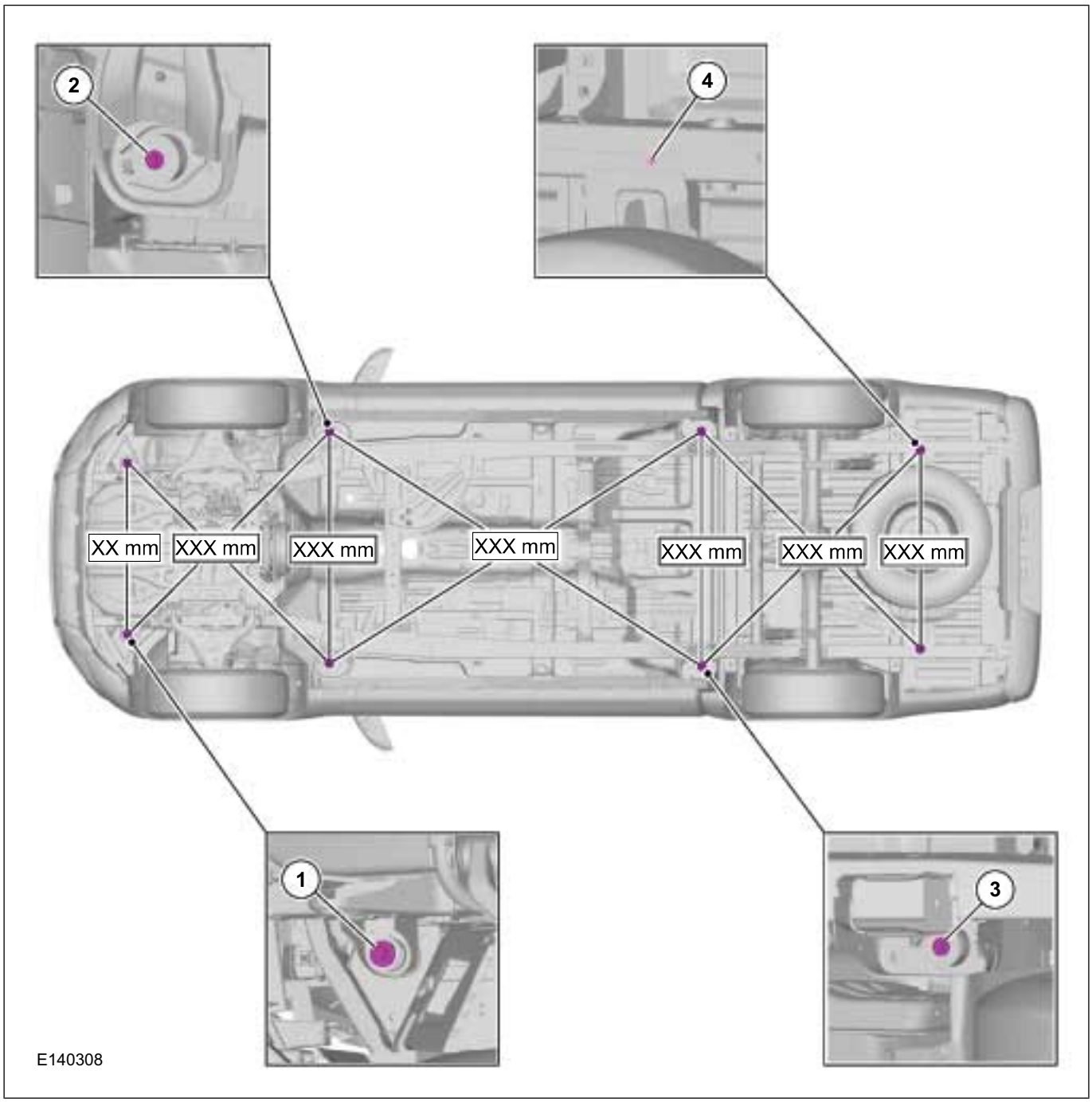
1. Body dimensions, all versions (quick measurements using the Allvis system)

- All dimensions are measured from the middle of the hole or bolt head or from the edge of the panel, using the Allvis system, with component assemblies installed.
- A tolerance of ± 3 mm applies to all measurements given. All detailed illustrations correspond to the left-hand side of the vehicle.

Allvis specifications

Point of measurement	Adapter	Height setting of the test probes
1	xx mm (Socket)	xxx mm
2	xx mm (Socket)	xxx mm
3	xx mm (Socket)	xxx mm
4	xx mm (Probe)	xxx mm

GENERAL PROCEDURES



GENERAL PROCEDURES

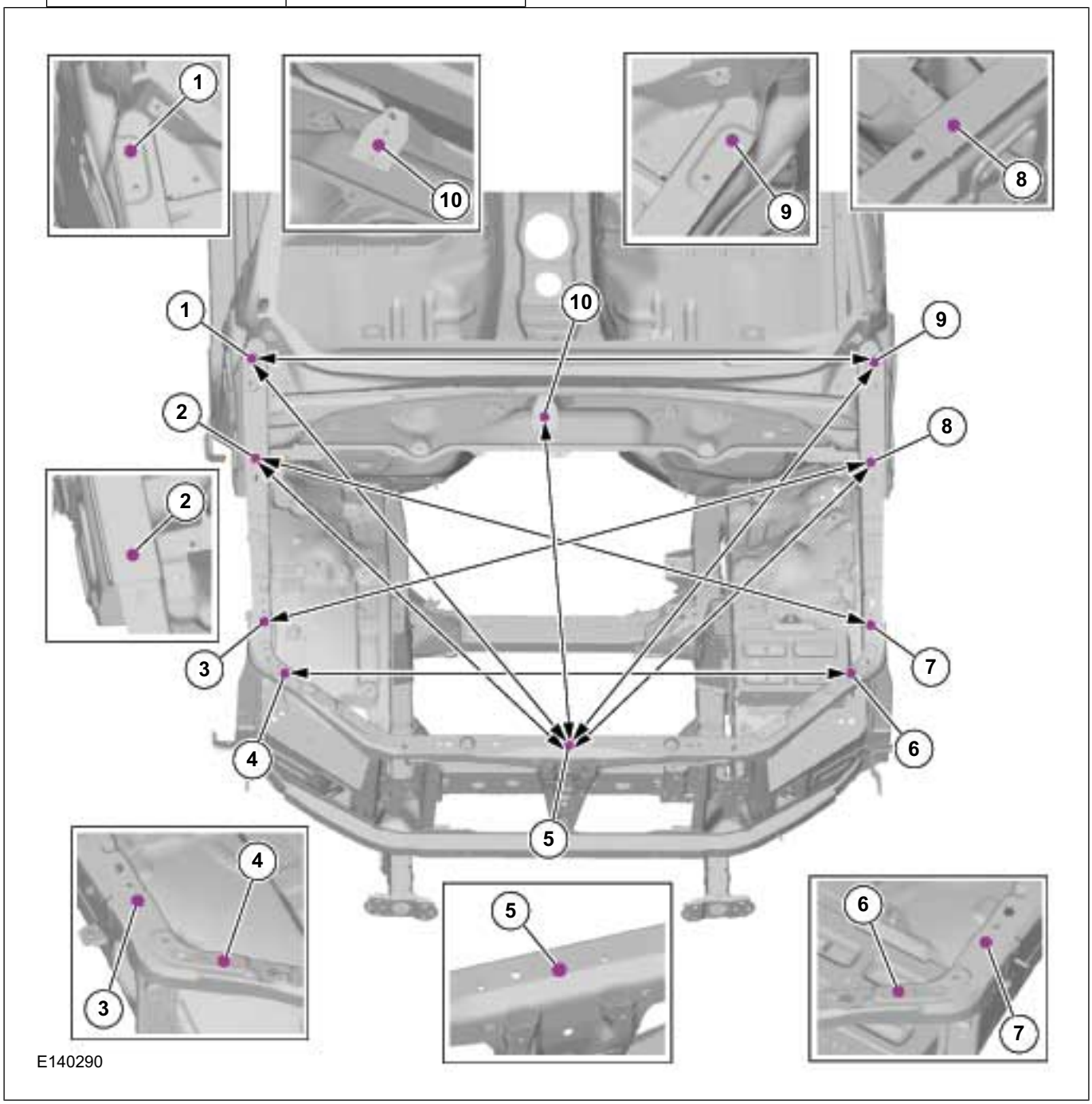
Frame Tolerance Check

1. Front end body dimensions, all vehicles

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the centre of each hole or panel edge using a symmetrically adjusted measuring gauge.

Measuring points and dimensions

1 - 5 = XX mm	4 - 6 = XX mm
1 - 9 = XX mm	5 - 8 = XX mm
2 - 5 = XX mm	5 - 9 = XX mm
2 - 7= XX mm	5 - 10 = XXmm
3 - 8 = XX mm	



2. Body dimensions, side view double cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from

GENERAL PROCEDURES

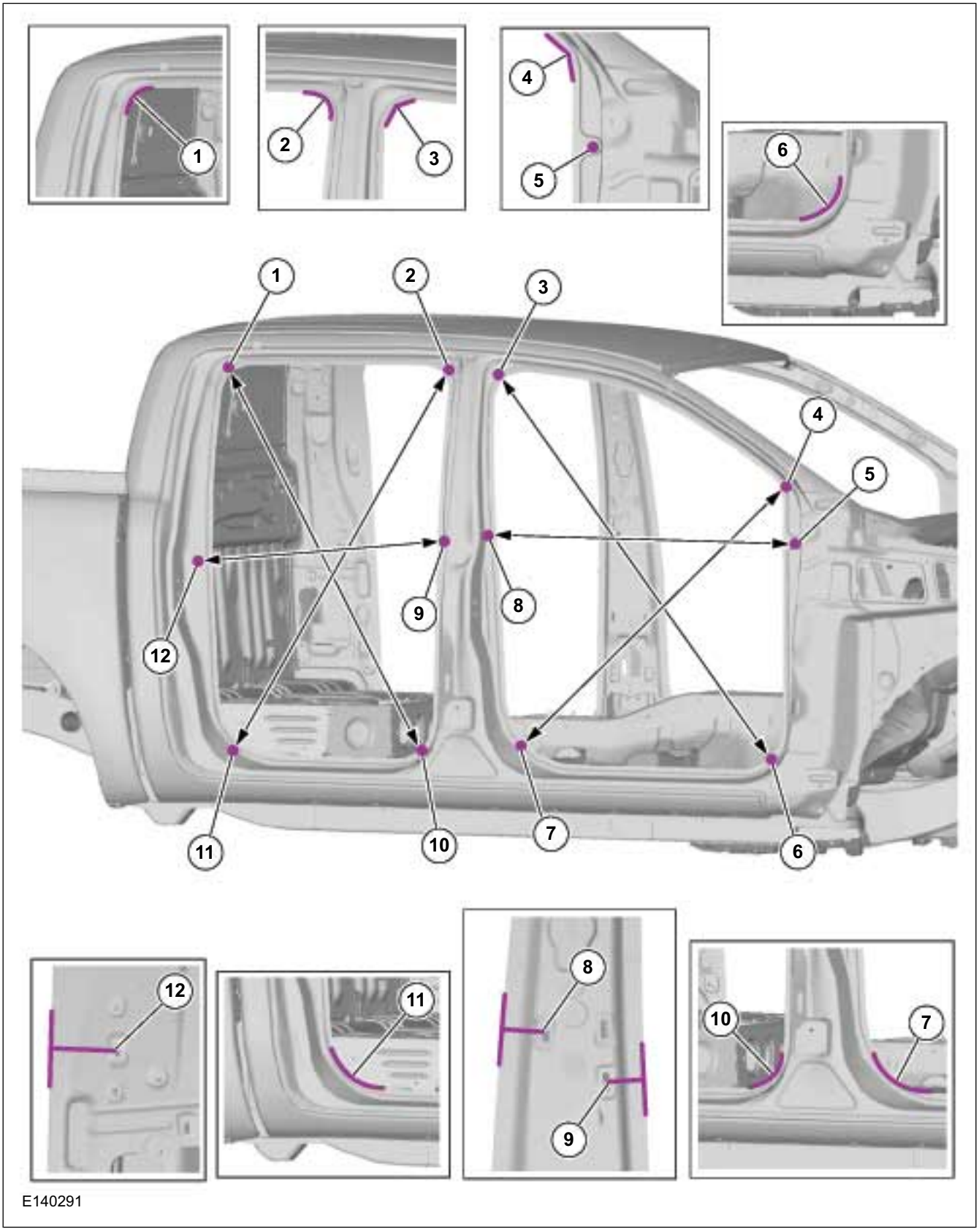
the edge of the steel panel using a symmetrically adjusted measuring gauge.

- Measuring points 1, 2, 3, 4, 6, 7, 10 and 11 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 8, 9 and 12 are shown looking from the vehicle interior outwards.
- The detailed view of measuring point 5 is measured in the hole and represent the greatest distance to the measuring point opposite.

Measuring points and dimensions

1 - 10 = XX mm	4 - 7 = XX mm
2 - 11 = XX mm	5 - 8 = XX mm
3 - 6 = XX mm	9 - 12 = XX mm

GENERAL PROCEDURES



3. Body dimensions, side view single cab

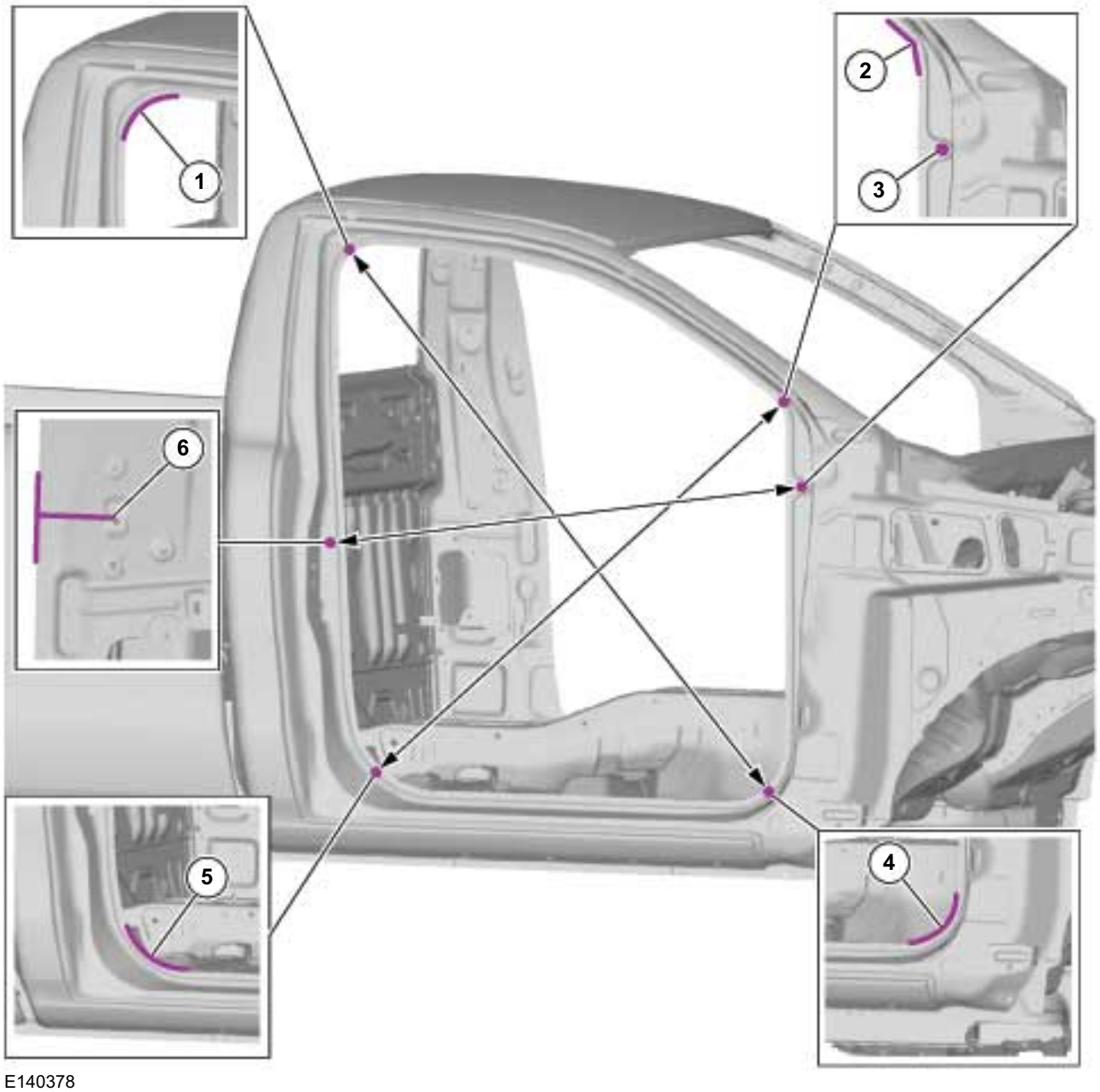
- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the edge of the steel panel using a symmetrically adjusted measuring gauge.

GENERAL PROCEDURES

- Measuring points 1, 2, 4 and 5 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed view of measuring point 3 is measured in the hole and represent the greatest distance to the measuring point opposite.
- The detailed view of measuring point 6 is shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 4 = XX mm	3 - 6 = XX mm
2 - 5 = XX mm	



E140378

4. Body dimensions, side view stretch cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the edge of the steel panel using a symmetrically adjusted measuring gauge.
- Measuring points 1, 2, 4 and 5 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed view of measuring point 3 is measured in the hole and represent the

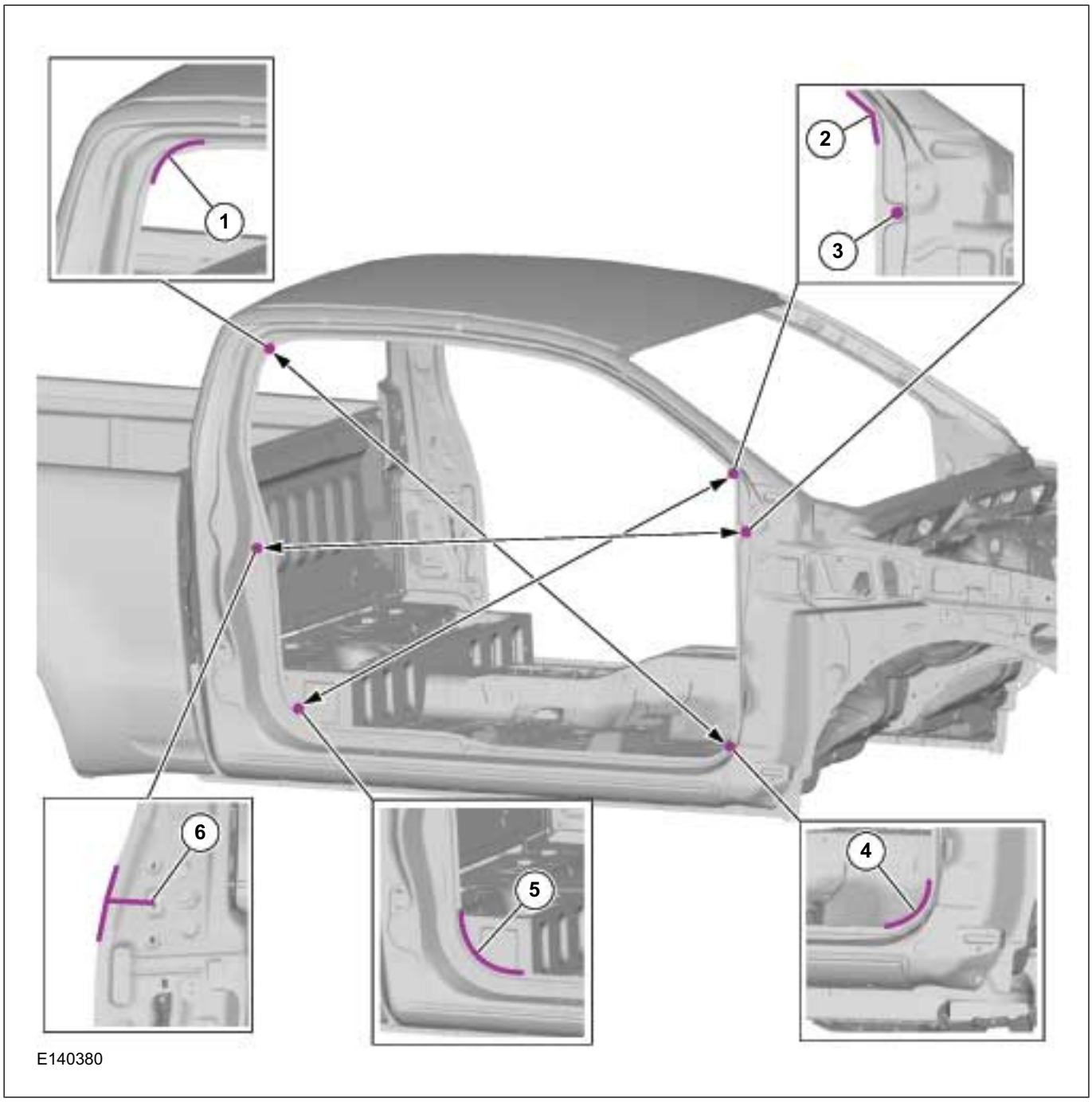
GENERAL PROCEDURES

greatest distance to the measuring point opposite.

- The detailed view of measuring point 6 is shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 4 = XX mm	3 - 6 = XX mm
2 - 5 = XX mm	



E140380

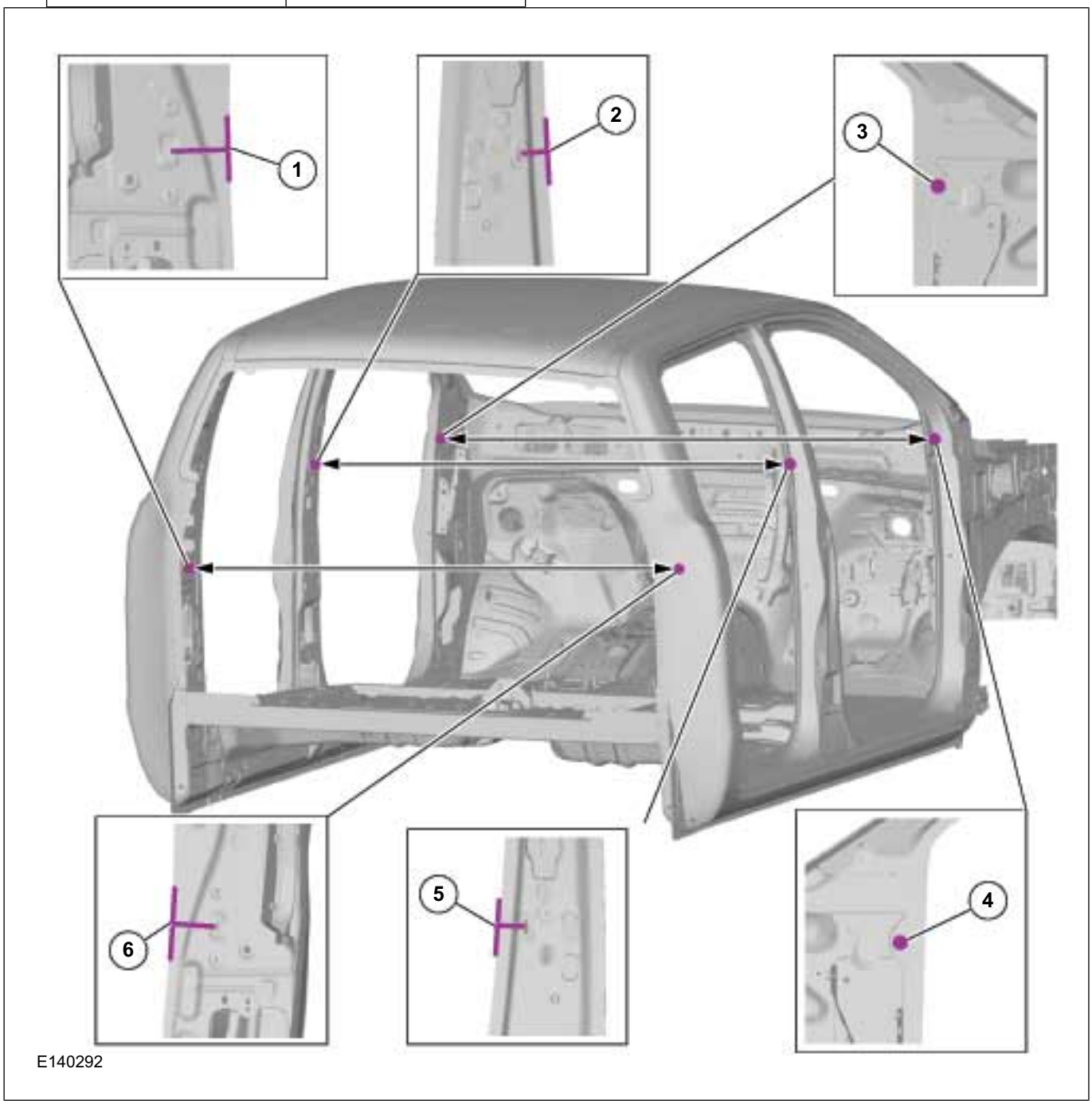
5. Body dimensions, interior double cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 3 and 4are measured in the hole and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 1, 2, 5 and 6 are shown looking from the vehicle interior outwards.
-

GENERAL PROCEDURES

Measuring points and dimensions

1 - 6 = XX mm	3 - 4 = XX mm
2 - 5 = XX mm	



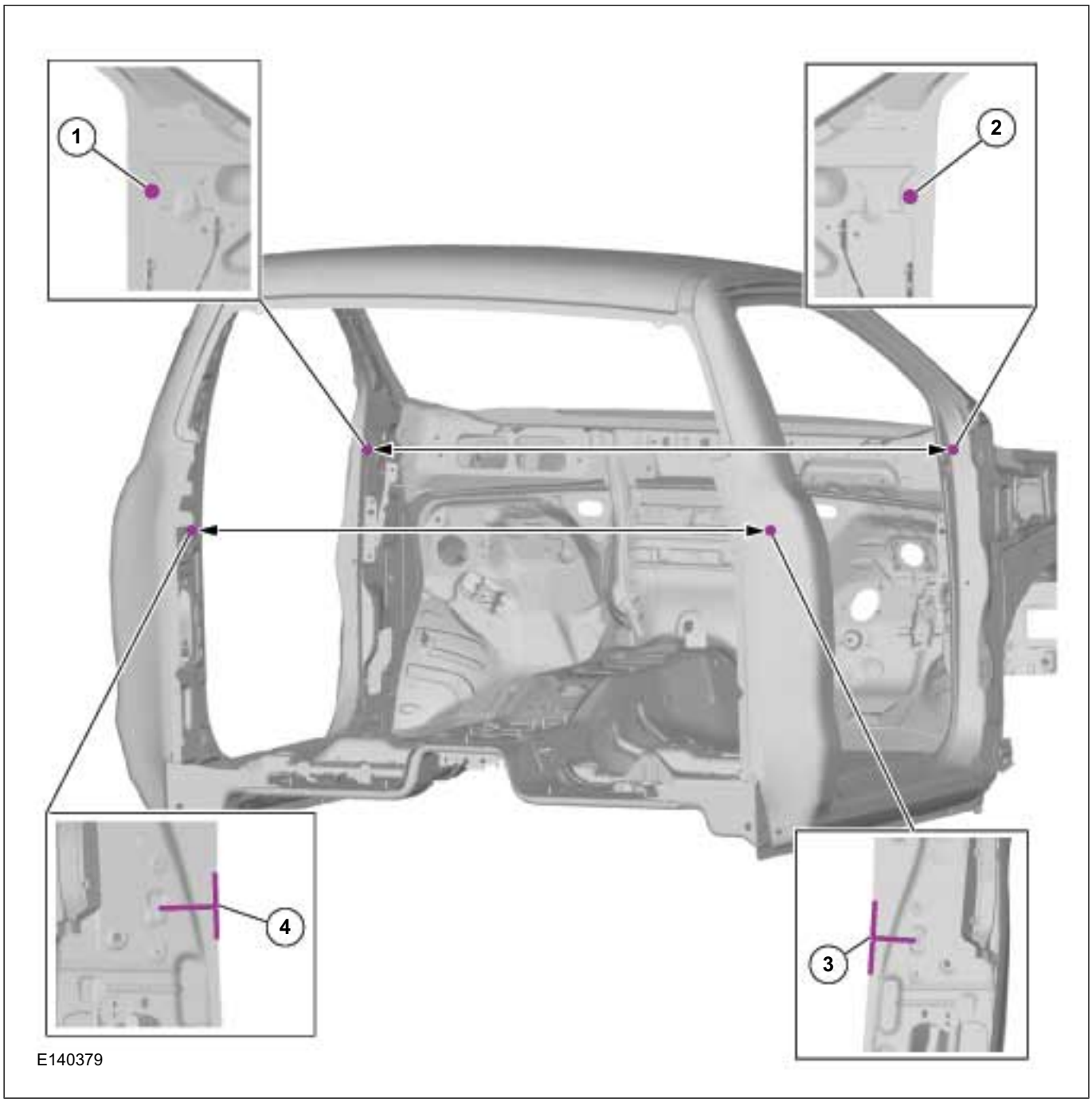
6. Body dimensions, interior single cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 1 and 2 are measured in the hole and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 3 and 4 are shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 2 = XX mm	3-4 = XX mm

GENERAL PROCEDURES



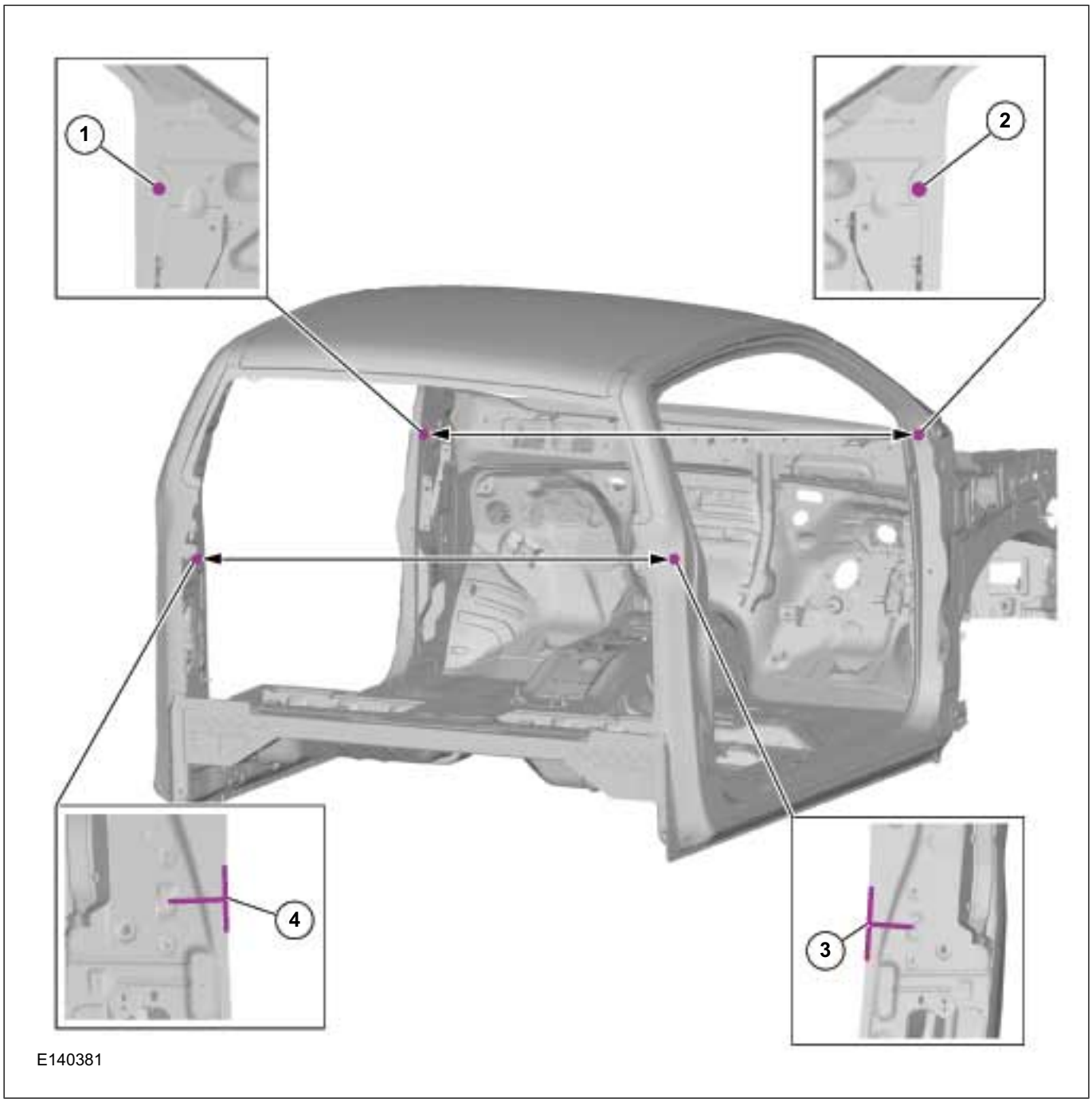
7. Body dimensions, interior strecth cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 1 and 2 are measured in the hole and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 3 and 4 are shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 2 = XX mm	3 - 4 = XX mm

GENERAL PROCEDURES



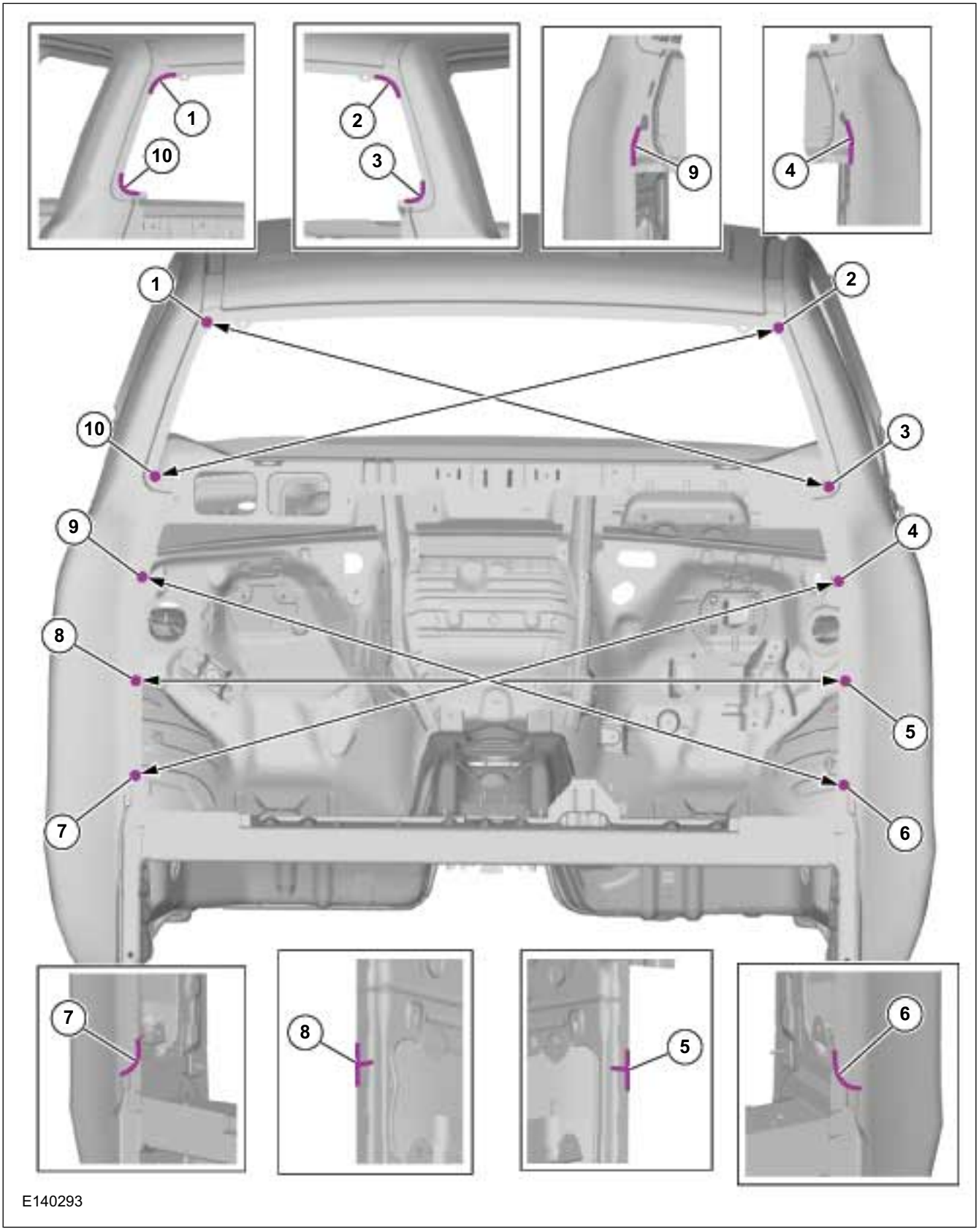
8. Body dimensions, rear all vechicles

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 1, 2, 3, 4, 6, 9, and 10 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 5 and 8 are shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 3 = XX mm	4 - 7 = XX mm
2 - 10 = XX mm	5 - 8 = XX mm
6 - 9 = XX mm	5 - 9 = XX mm

GENERAL PROCEDURES



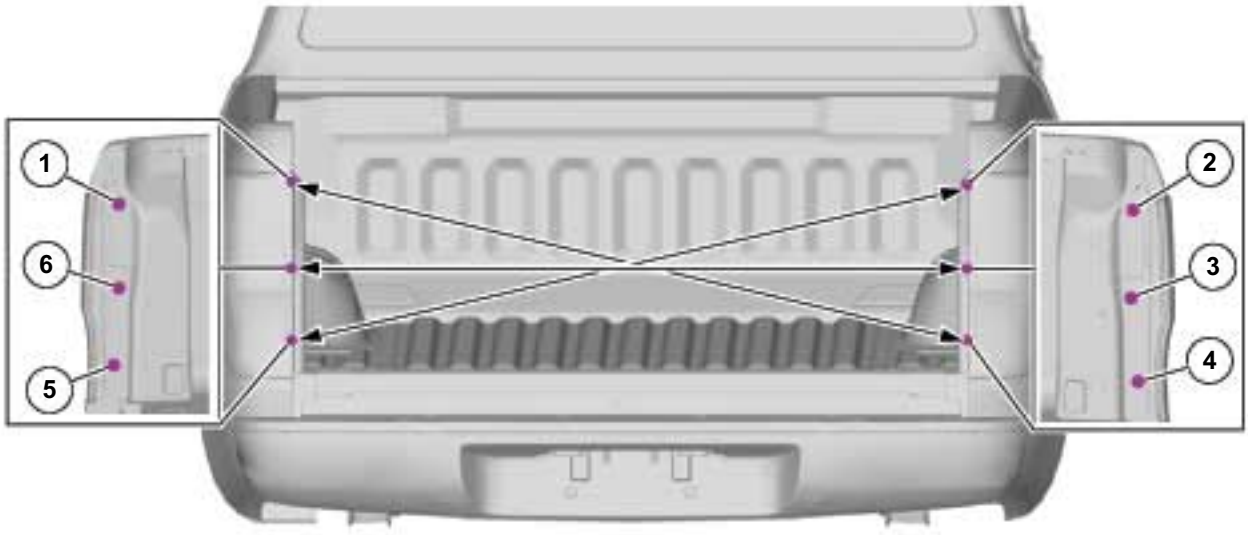
9. Tailgate opening dimensions, all vechicles

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.

GENERAL PROCEDURES

Measuring points and dimensions

1 - 3 = XX mm	4 - 7 = XX mm
2 - 10 = XX mm	5 - 8 = XX mm
6 - 9 = XX mm	5 - 9 = XX mm



E140294

SECTION 501-27 Front End Sheet Metal Repairs

VEHICLE APPLICATION: 2011.50 Ranger

CONTENTS PAGE

REMOVAL AND INSTALLATION

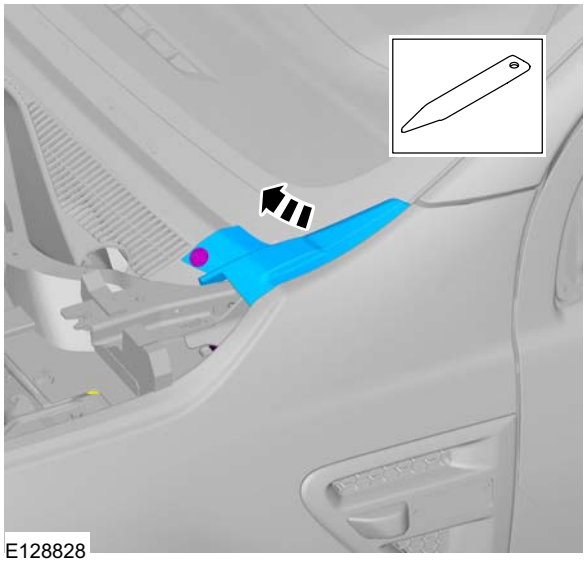
Front Fender..... 501-27-2
Fender Apron Panel Reinforcement..... 501-27-4

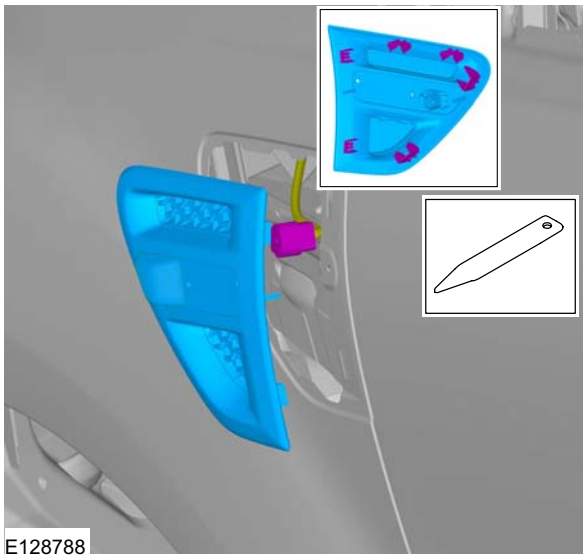
REMOVAL AND INSTALLATION

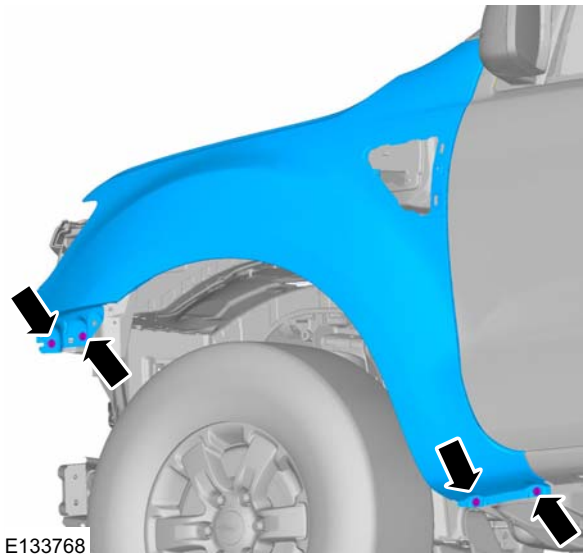
Front Fender

Removal

NOTE: Removal steps in this procedure may contain installation details.

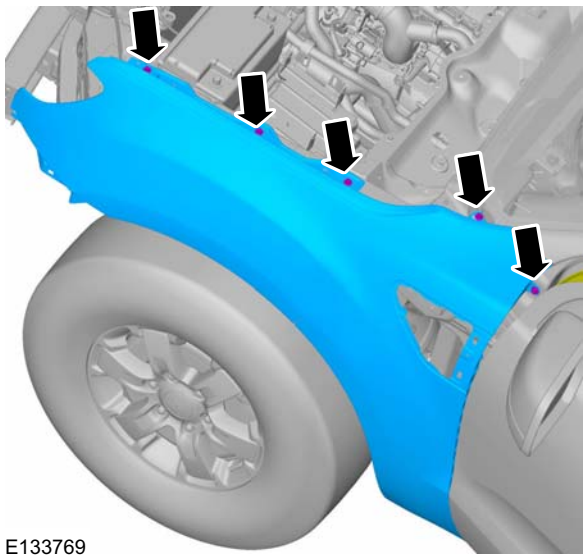
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).
3. Refer to: Headlamp Assembly (417-01 Exterior Lighting, Removal and Installation).
4. 

5. 

6. Torque: 9 Nm


REMOVAL AND INSTALLATION

7. Torque: 9 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Fender Apron Panel Reinforcement

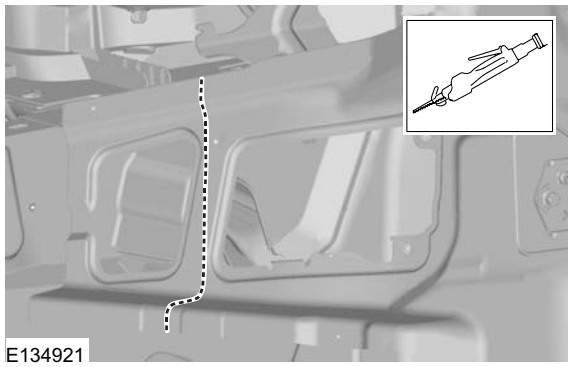
General Equipment

Air Body Saw

Removal

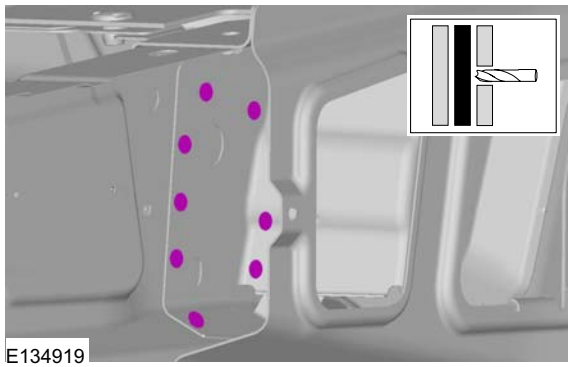
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Front Fender (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. • **Partial Replacement**
   • Possible cut line.

   General Equipment: Air Body Saw


E134921

4. • Mill out the spot welds.

   General Equipment: Spot weld drill Bit

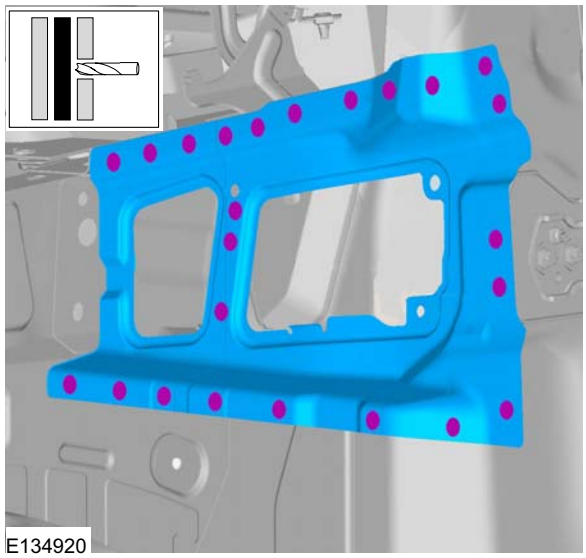

E134919

General Equipment

Spot weld drill Bit

5. • Mill out the spot welds.

   General Equipment: Spot weld drill Bit


E134920

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

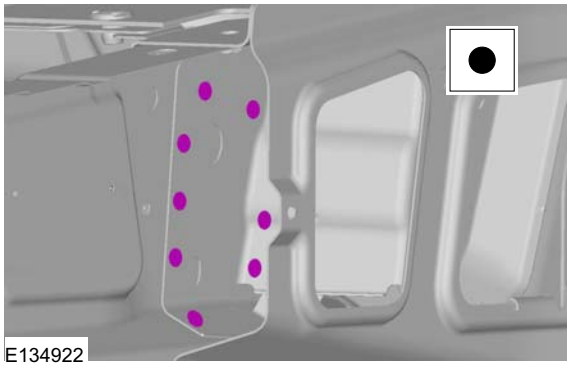
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

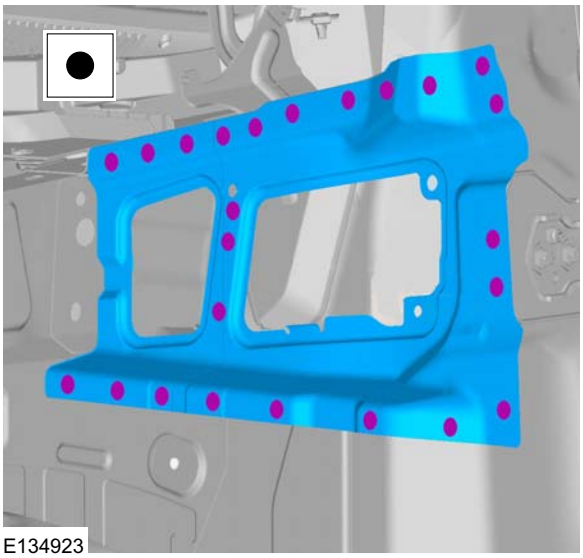
   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

REMOVAL AND INSTALLATION

3. • Resistance spot weld - Panel thickness 3 mm and greater.


E134922

4. • Resistance spot weld - Panel thickness 3 mm and greater.


E134923

SECTION 501-28 Roof Sheet Metal Repairs

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

Roof Panel — Single Cab..... 501-28-2
Roof Panel — Double Cab..... 501-28-7
Roof Panel — Stretch Cab..... 501-28-8

REMOVAL AND INSTALLATION

Roof Panel — Single Cab

General Equipment
Hot Air Gun
Spot weld drill Bit

Materials	
Name	**Specification**
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

1.
- Front and Rear Door
- Refer to: Windshield Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
- Refer to: Headliner - 4-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- A- B- and C-Pillar Trim

  Refer to: A-Pillar Trim Panel (501-05, Removal and Installation).
  Refer to: B-Pillar Trim Panel (501-05, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 4-Door (501-05, Removal and Installation).
- Refer to: Rear Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).

2.
- General Equipment: Spot weld drill Bit

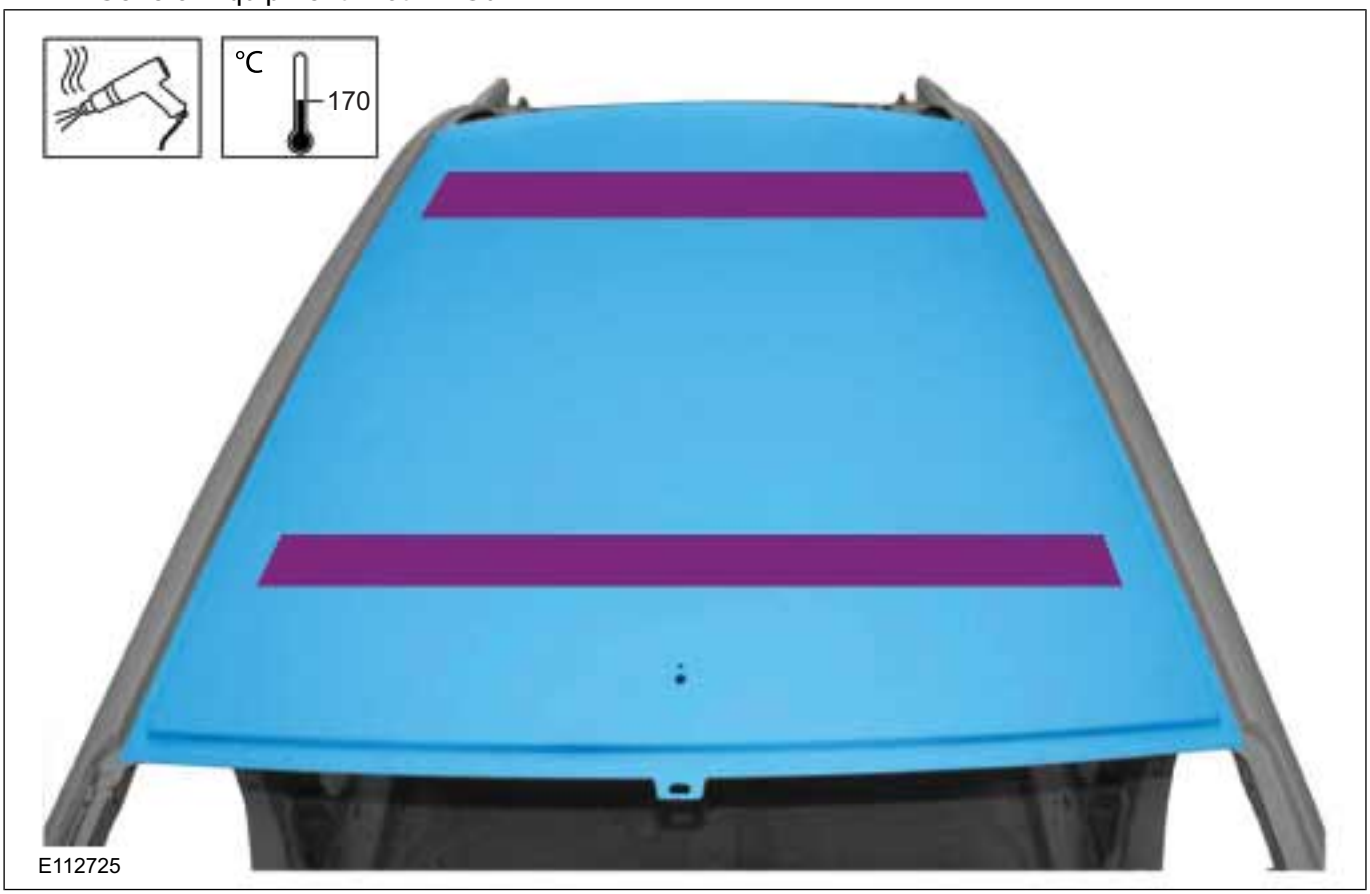

E112723

REMOVAL AND INSTALLATION

3. • General Equipment: Spot weld drill Bit



4. • General Equipment: Hot Air Gun



REMOVAL AND INSTALLATION

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

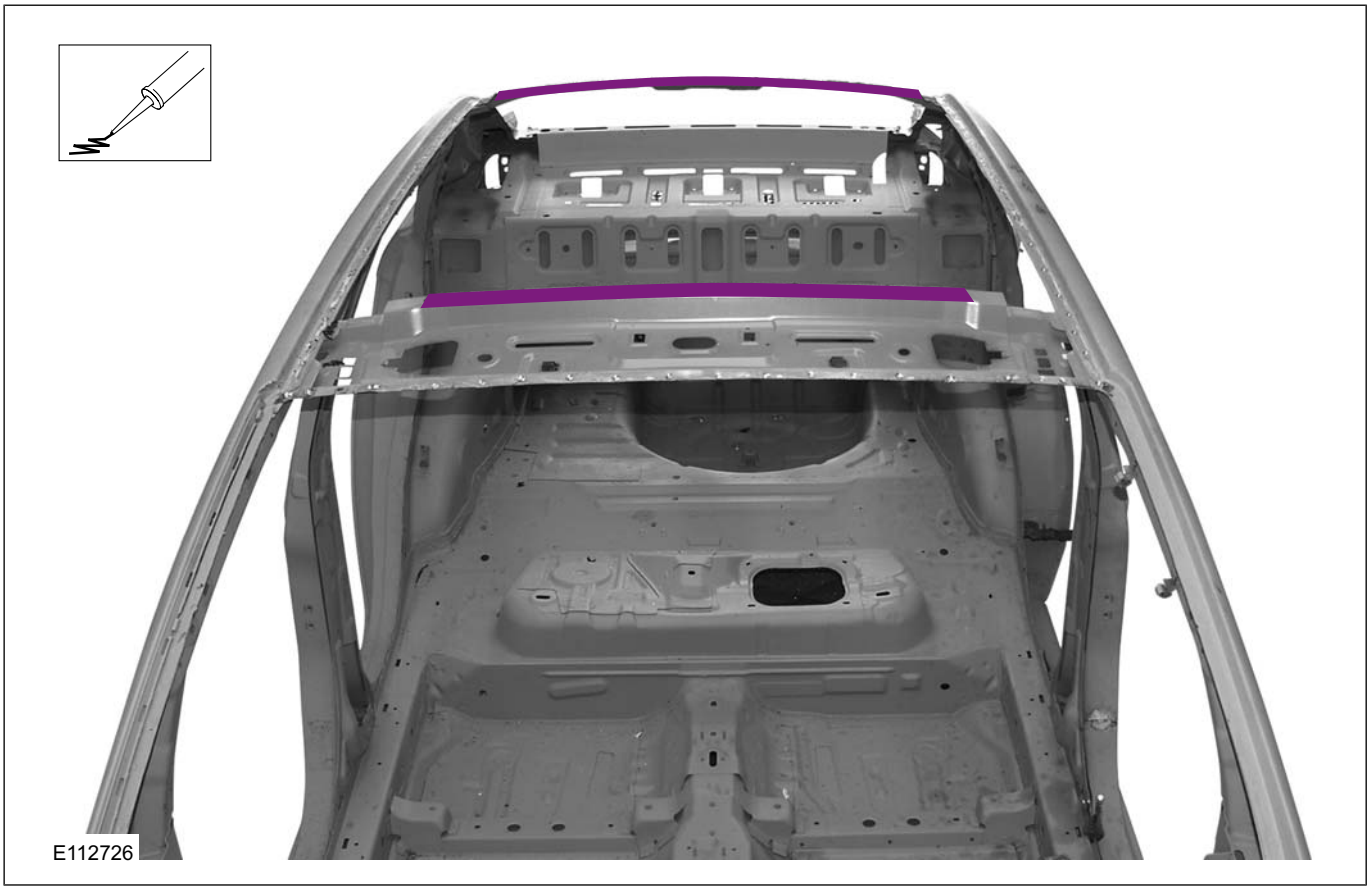
   Authoring Template

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must be applied with a minimum height of 20 mm.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

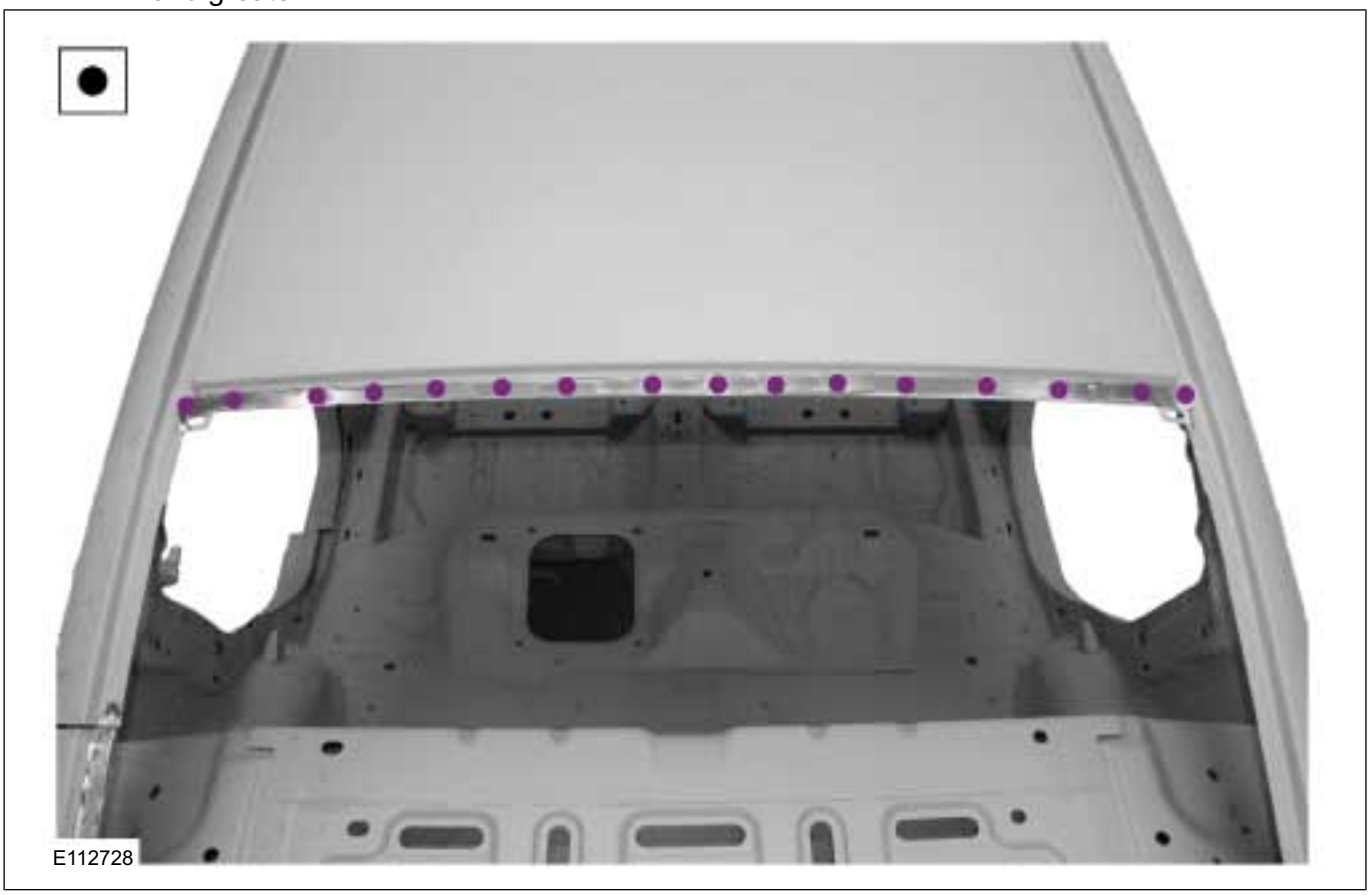


4. • Resistance spot weld - Panel thickness 3 mm and greater!

REMOVAL AND INSTALLATION


E112727

5. • Resistance spot weld - Panel thickness 3 mm and greater!


E112728

REMOVAL AND INSTALLATION

6.
- Front and Rear Door
- Refer to: Windshield Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
- Refer to: Headliner - 4-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- A- B- and C-Pillar Trim

  Refer to: A-Pillar Trim Panel (501-05, Removal and Installation).
  Refer to: B-Pillar Trim Panel (501-05, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 4-Door (501-05, Removal and Installation).
- Refer to: Rear Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).

REMOVAL AND INSTALLATION

Roof Panel — Double Cab

1. Information not available at this time.

REMOVAL AND INSTALLATION

Roof Panel — Stretch Cab

2. Information not available at this time.

SECTION 501-29 Side Panel Sheet Metal Repairs

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

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Rocker Panel — Single Cab..... 501-29-20
Rocker Panel — Super Cab..... 501-29-26
Rocker Panel Inner Reinforcement — Double Cab..... 501-29-32
Rocker Panel Inner Reinforcement — Single Cab..... 501-29-36
Rocker Panel Inner Reinforcement — Super Cab..... 501-29-40
B-Pillar and Reinforcement — Double Cab..... 501-29-44
B-Pillar Outer Panel — Double Cab..... 501-29-56

REMOVAL AND INSTALLATION

A-Pillar Outer Panel

General Equipment

6 mm Drill Bit
Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

1. Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).
2. • Windshield

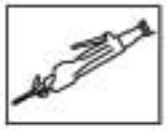
   Refer to: Windshield Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
   - Front Door

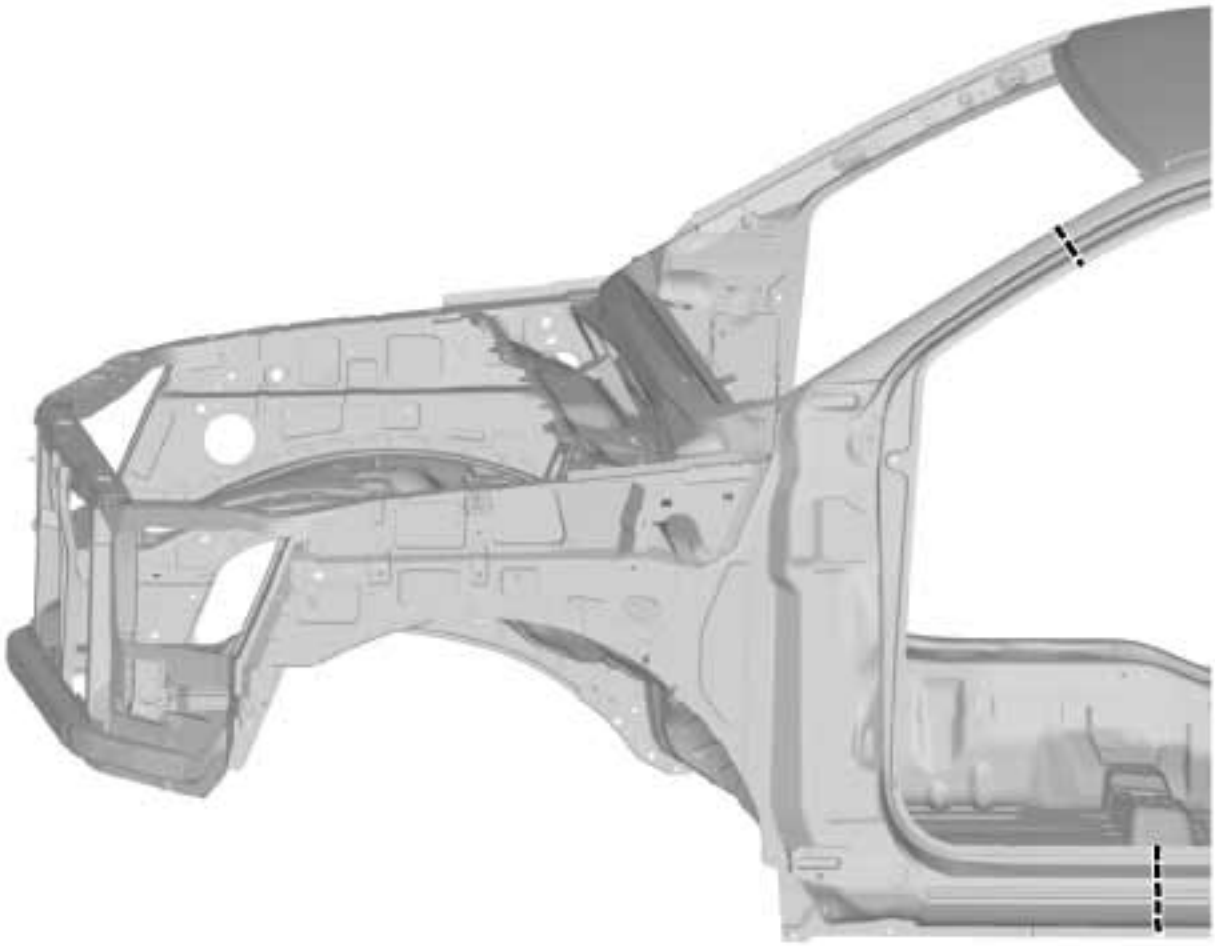
     Refer to: Front Door (501-03 Body Closures, Removal and Installation).
   - Door Hinges
   - Weatherstrip
   - A-pillar Trim

     Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   - Rocker Panel Trim
   - Driver or passenger seat

     Refer to: Front Seat (501-10 Seating, Removal and Installation).
   - Refer to: Fender Apron Panel Reinforcement (501-27 Front End Sheet Metal Repairs, Removal and Installation).
   - Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

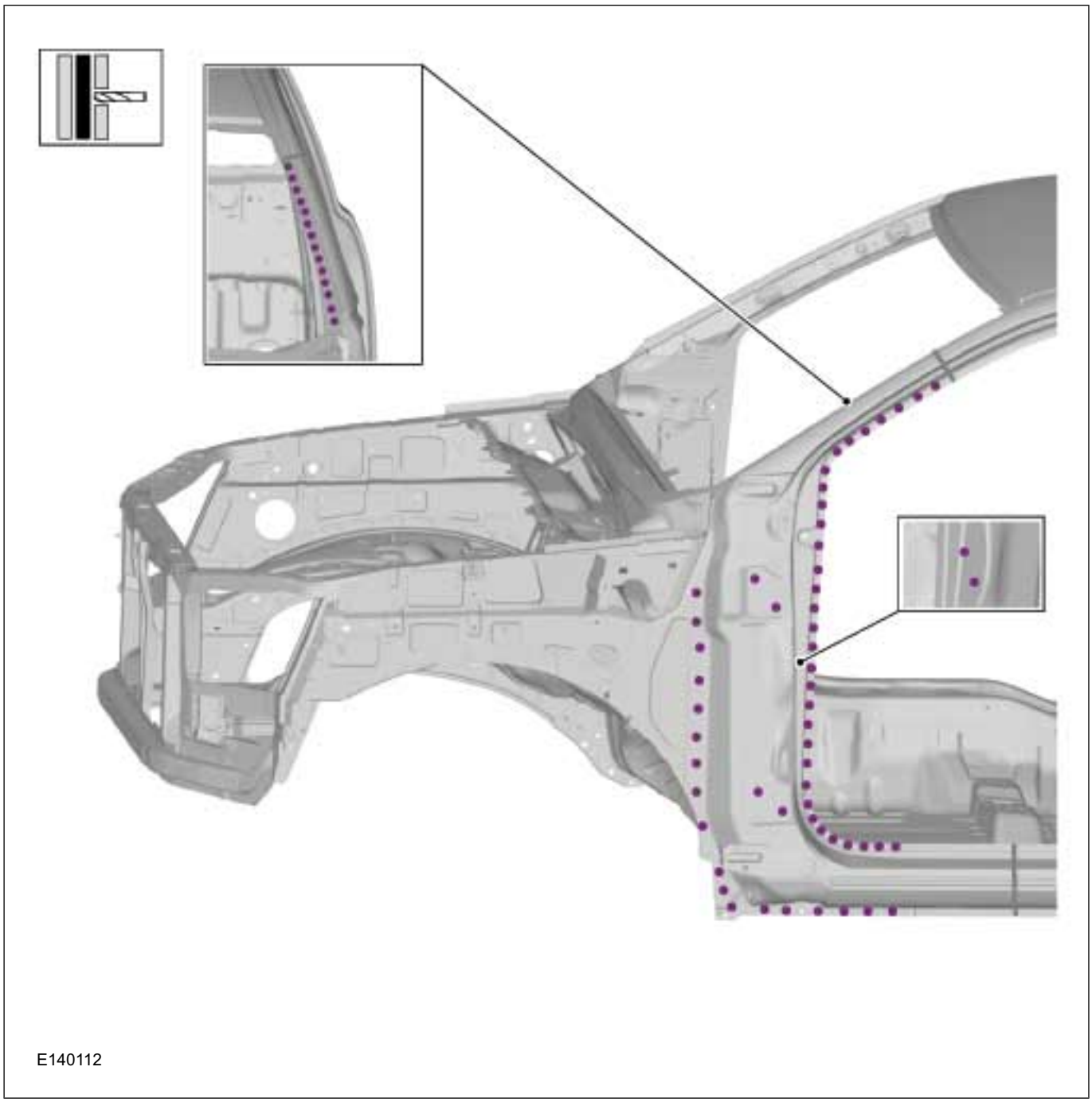




E140111

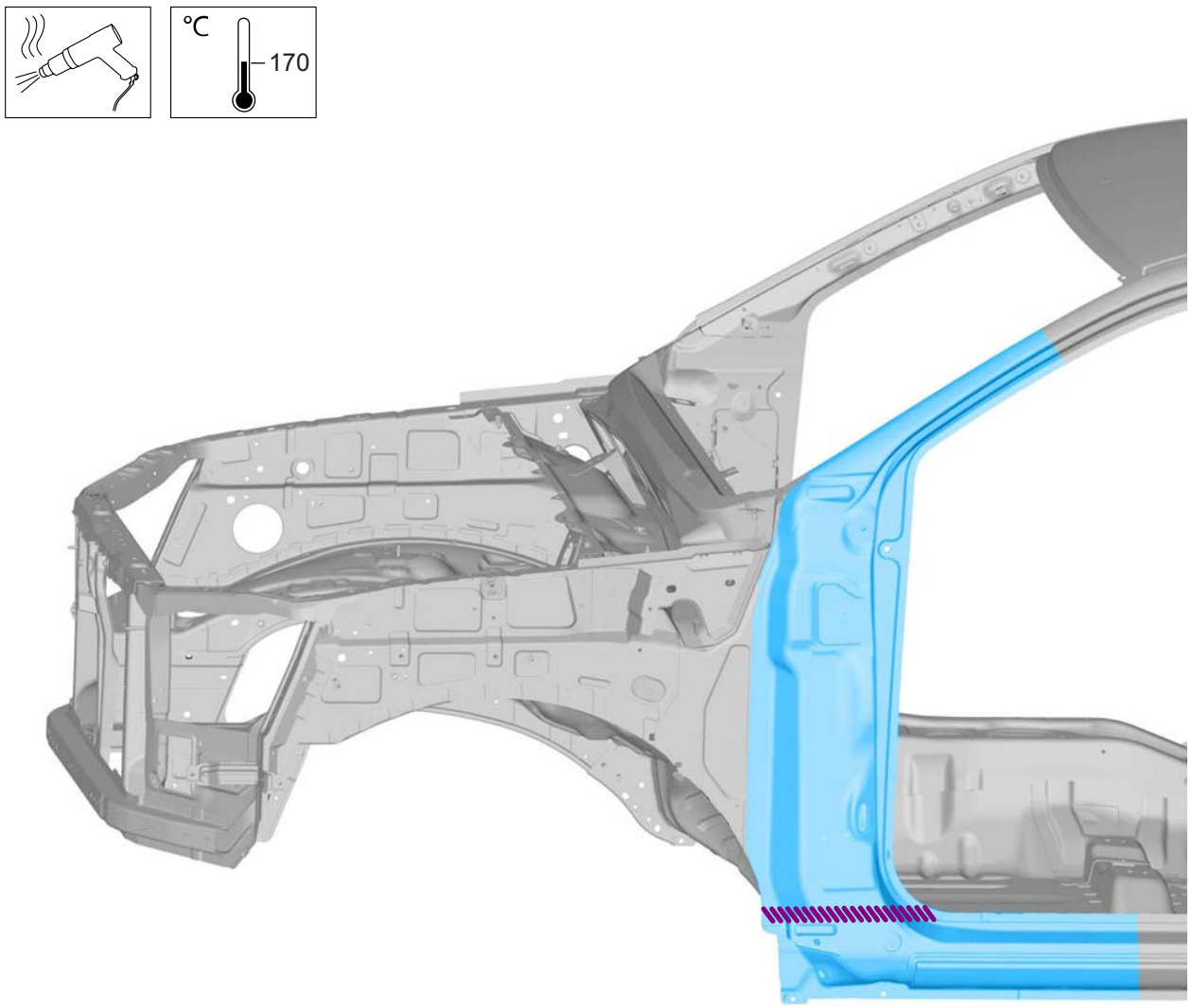
4. • General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION



5. • General Equipment: Hot Air Gun

REMOVAL AND INSTALLATION



E140113

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

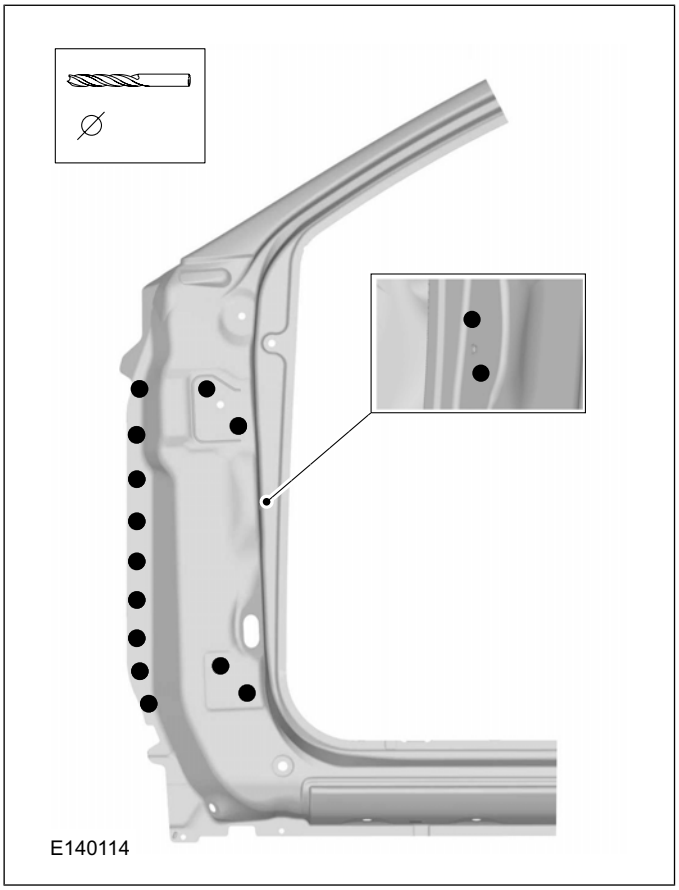
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

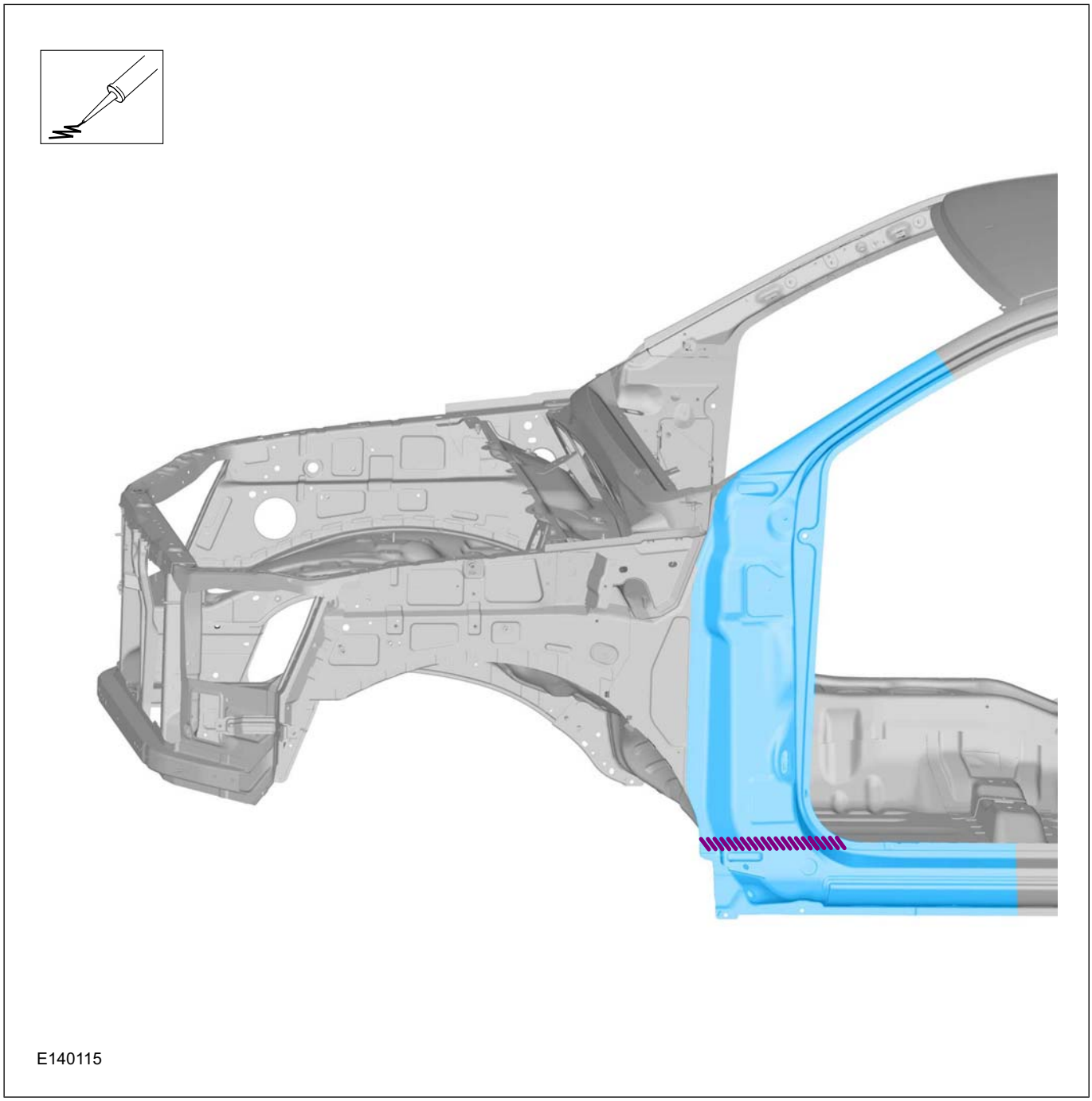
REMOVAL AND INSTALLATION

3. • General Equipment: 6 mm Drill Bit



4. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

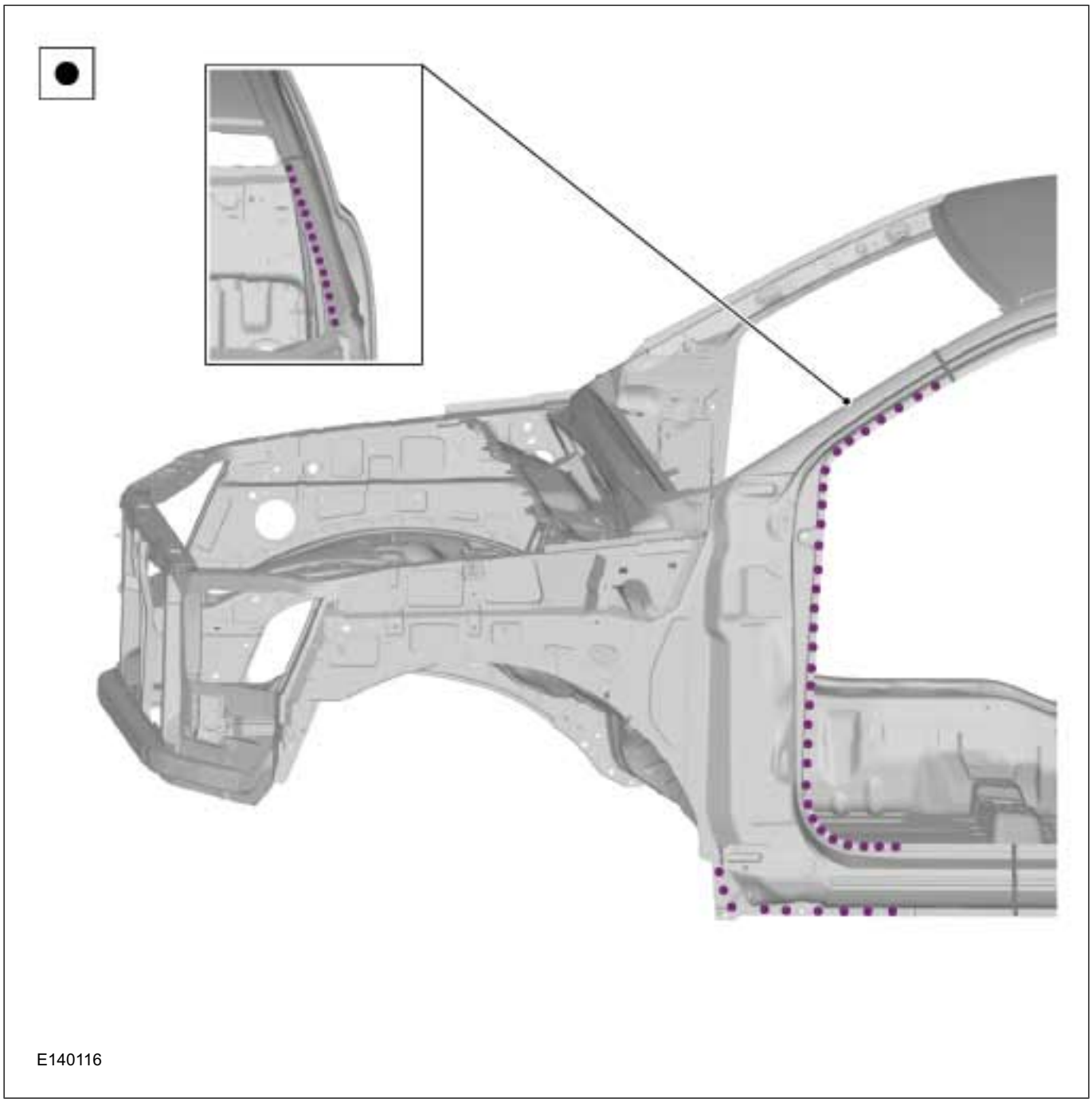
REMOVAL AND INSTALLATION



E140115

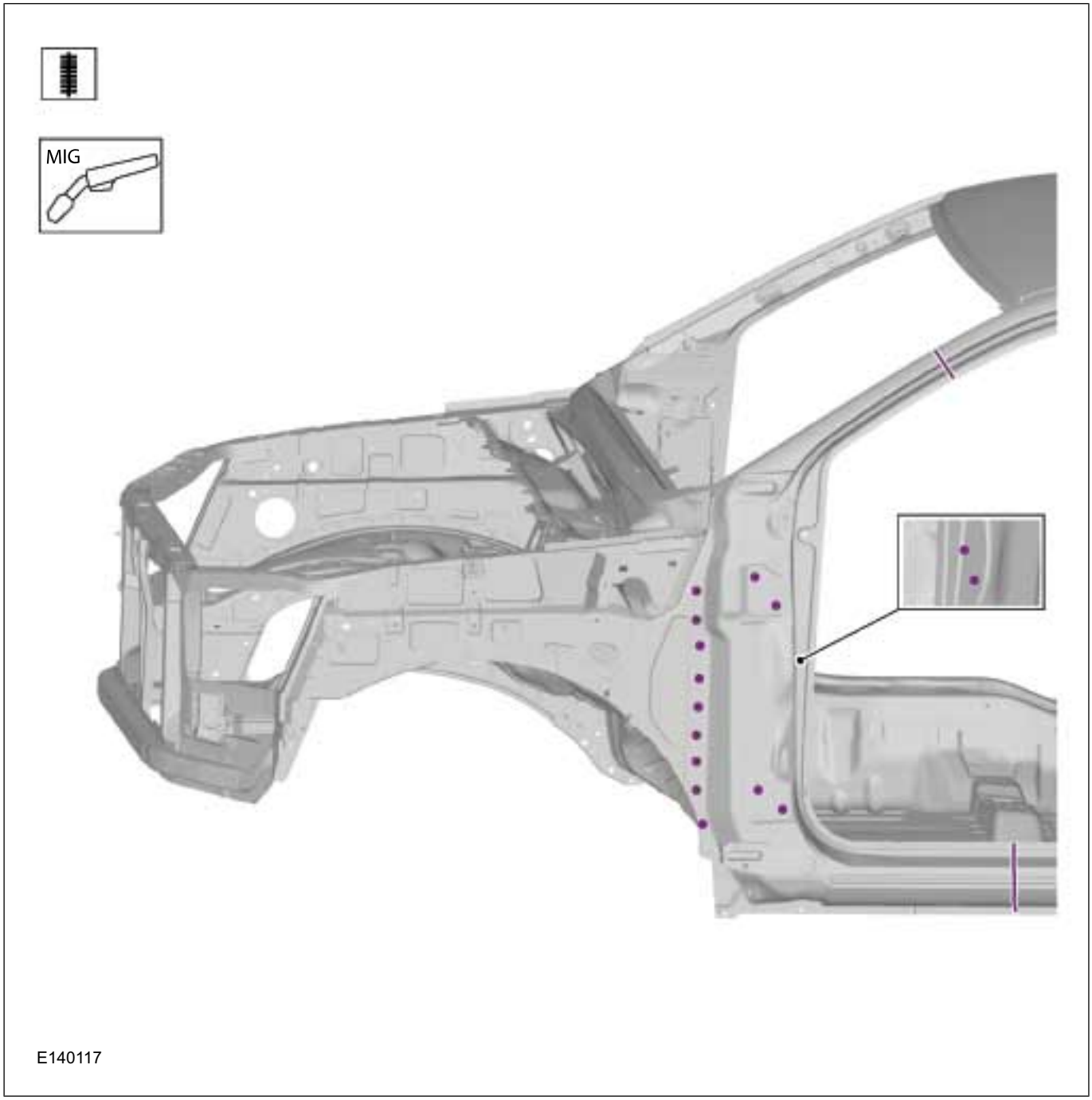
5. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION



6. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION



REMOVAL AND INSTALLATION

7. • Windshield

   Refer to: Windshield Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).

   • Front Door

   Refer to: Front Door (501-03 Body Closures, Removal and Installation).

   • Door Hinges
   • Weatherstrip
   • A-pillar Trim

   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

   • Rocker Panel Trim
   • Driver or passenger seat

   Refer to: Front Seat (501-10 Seating, Removal and Installation).

   • Refer to: Fender Apron Panel Reinforcement (501-27 Front End Sheet Metal Repairs, Removal and Installation).

REMOVAL AND INSTALLATION

A-Pillar Assembly

General Equipment

6 mm Drill Bit
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

REMOVAL AND INSTALLATION

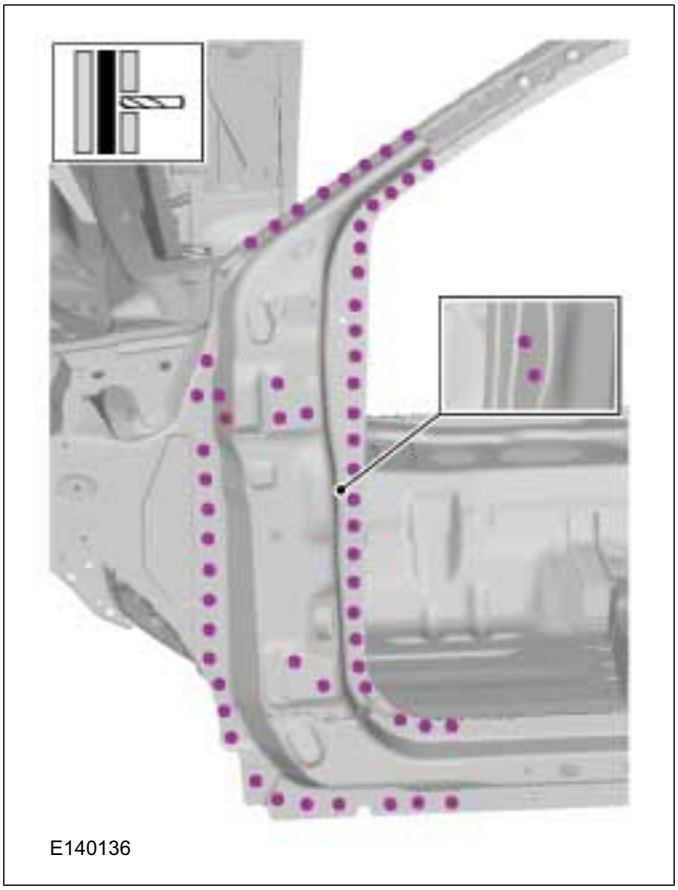
1. Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   - Windshield

     Refer to: Windshield Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
   - Front Door

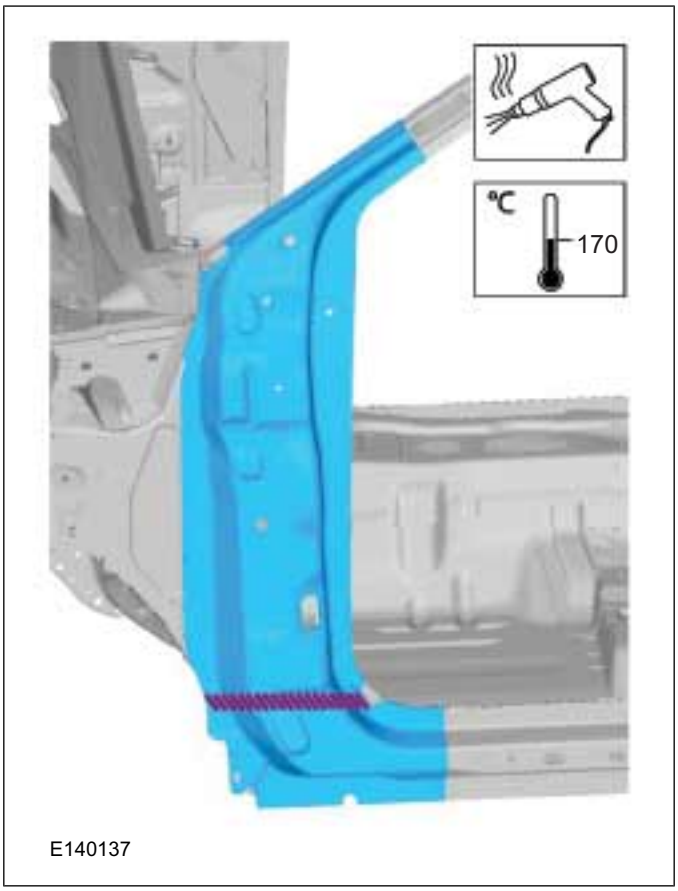
     Refer to: Front Door (501-03 Body Closures, Removal and Installation).
   - Door Hinges
   - Weatherstrip
   - A-pillar Trim

     Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   - Rocker Panel Trim
   - Driver or passenger seat

     Refer to: Front Seat (501-10 Seating, Removal and Installation).
   - Refer to: Fender Apron Panel Reinforcement (501-27 Front End Sheet Metal Repairs, Removal and Installation).
   - Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Spot weld drill Bit


E140136

4. • General Equipment: Hot Air Gun



E140137

REMOVAL AND INSTALLATION

Installation

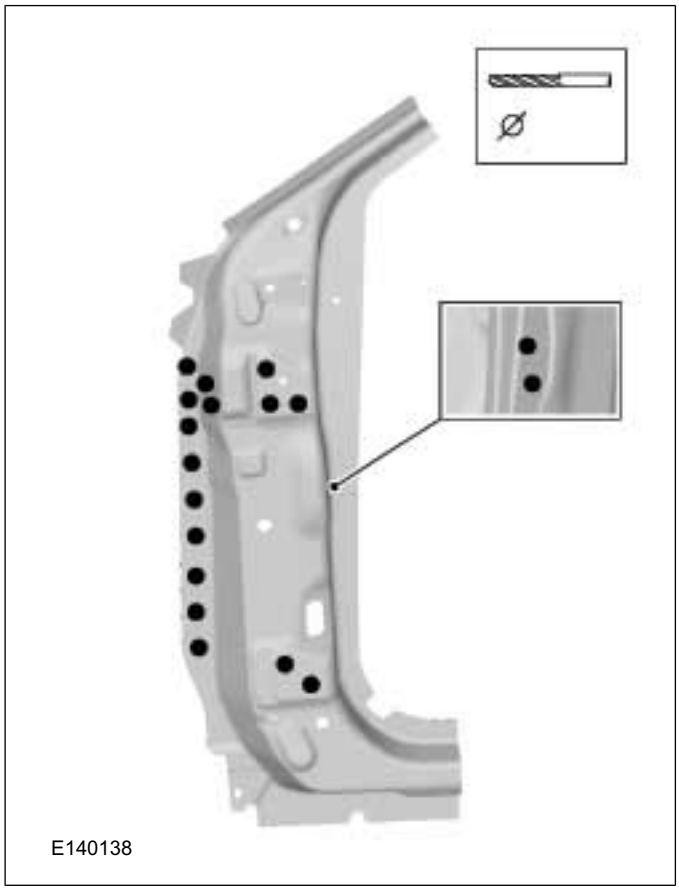
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

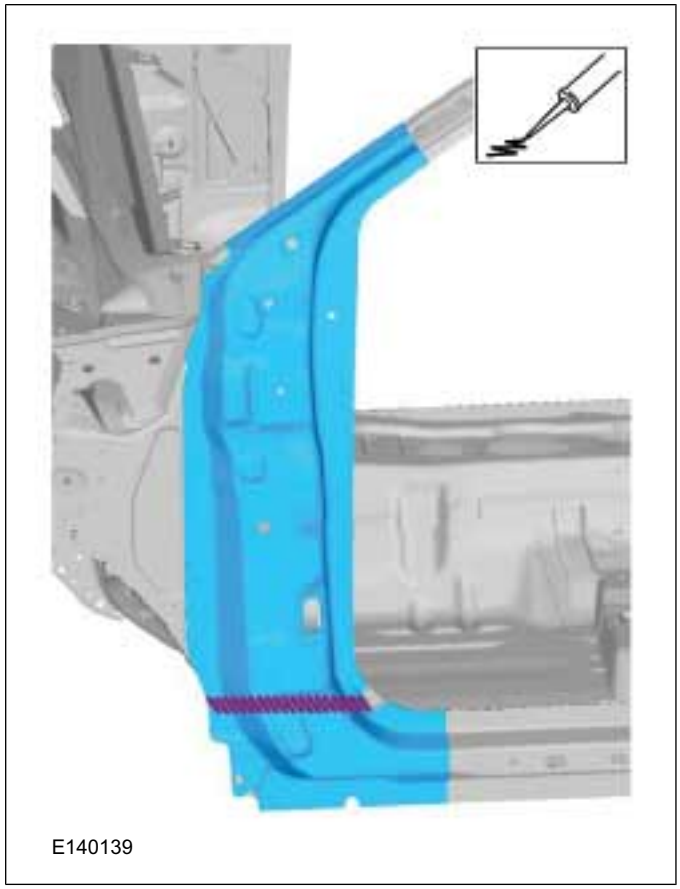
   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: 6 mm Drill Bit



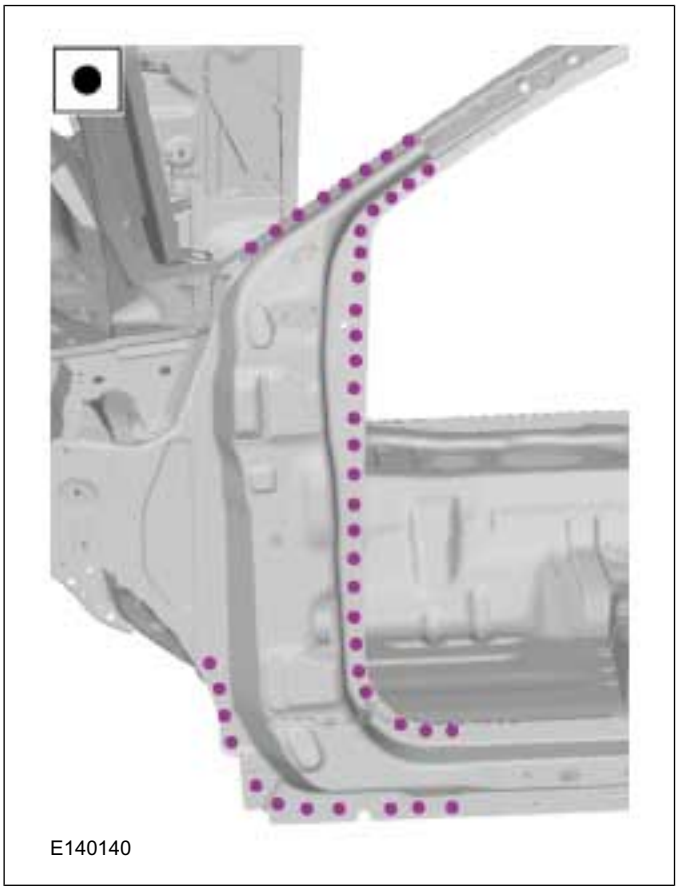
E140138

4. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

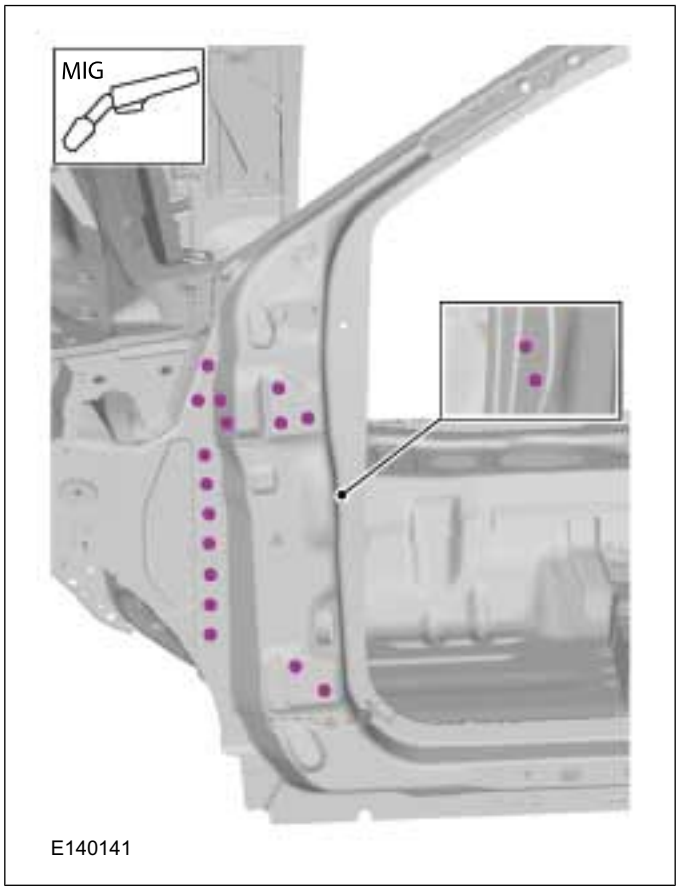

E140139

REMOVAL AND INSTALLATION

5. • General Equipment: Resistance Spotwelding Equipment


E140140

6. • General Equipment: MIG/MAG Welding Equipment



E140141

7. • Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   - Windshield

     Refer to: Windshield Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
   - Front Door

     Refer to: Front Door (501-03 Body Closures, Removal and Installation).
   - Door Hinges
   - Weatherstrip
   - A-pillar Trim

     Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   - Rocker Panel Trim
   - Driver or passenger seat

     Refer to: Front Seat (501-10 Seating, Removal and Installation).
   - Refer to: Fender Apron Panel Reinforcement (501-27 Front End Sheet Metal Repairs, Removal and Installation).

REMOVAL AND INSTALLATION

Rocker Panel — Double Cab

General Equipment

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

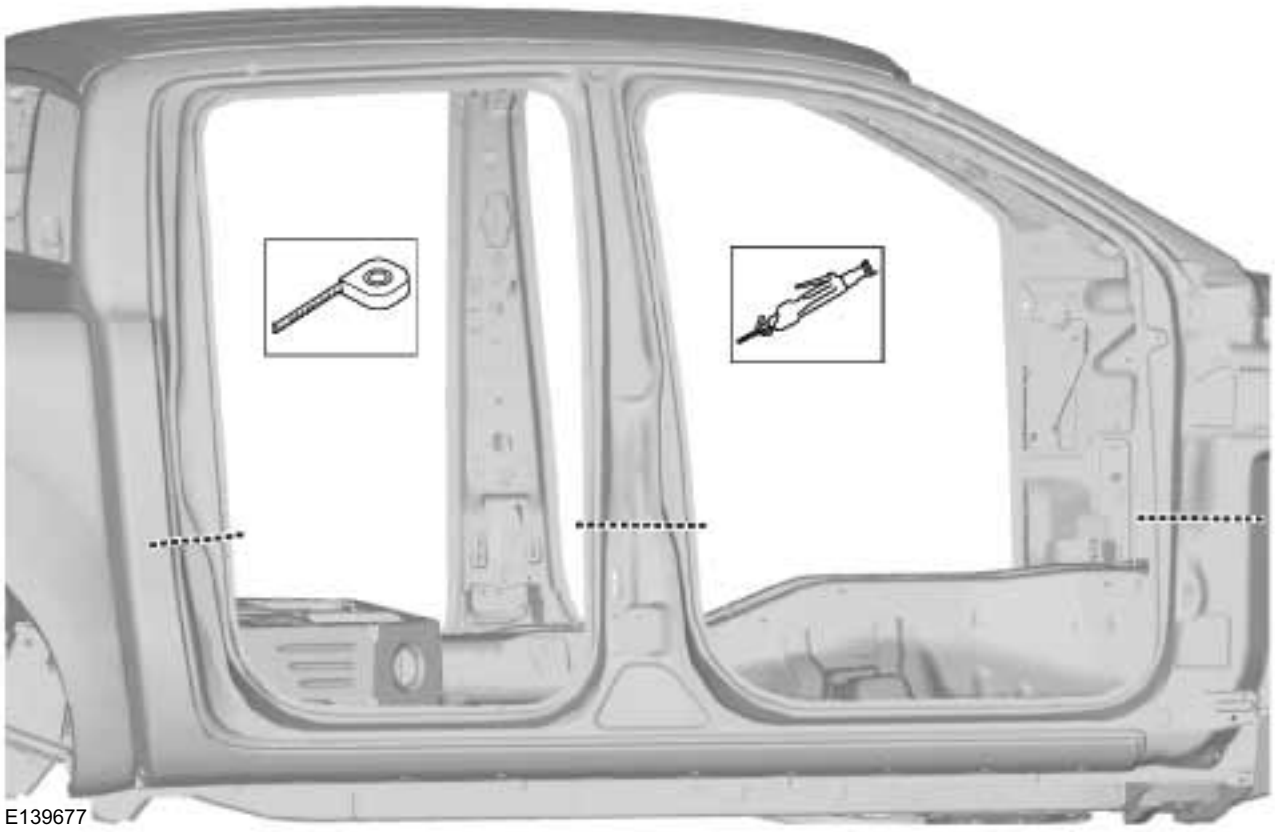
Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

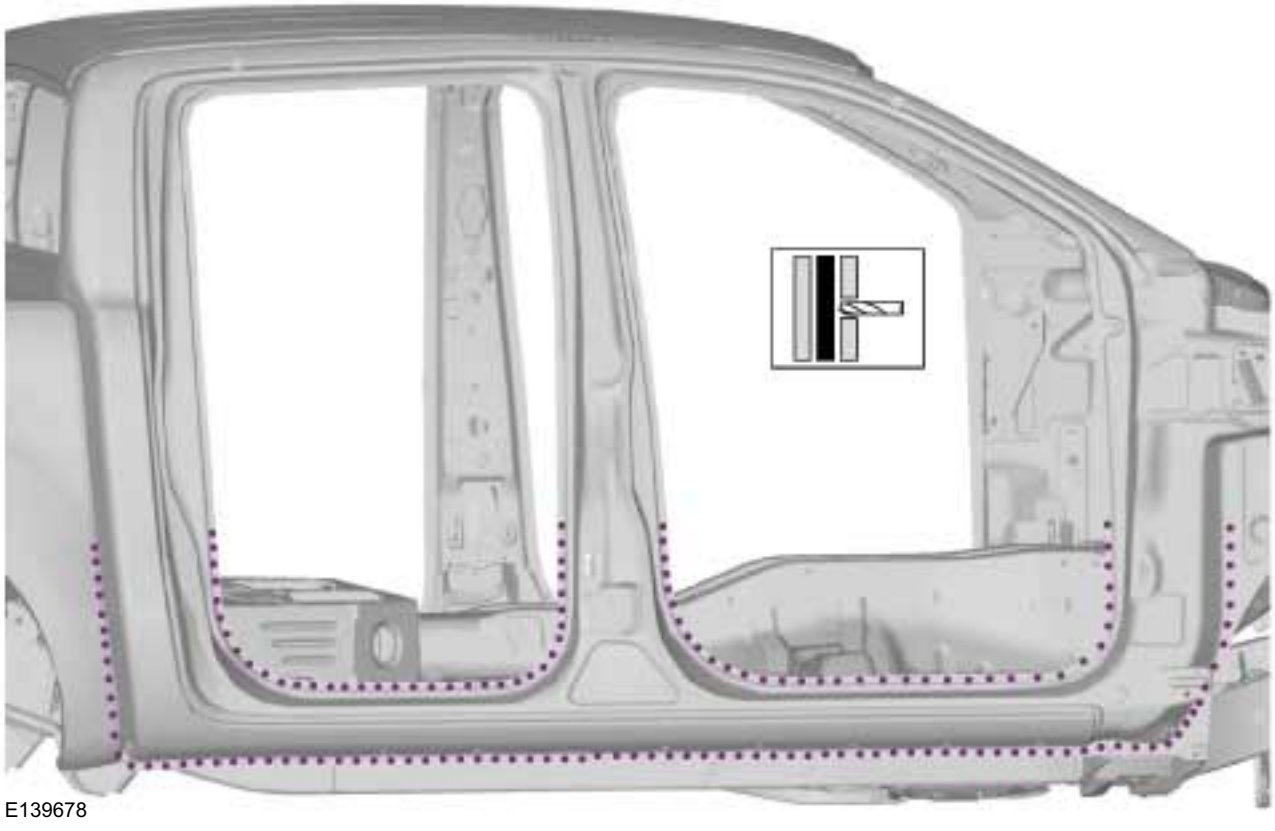
Removal

1. • Refer to: Front Door (501-03 Body Closures, Removal and Installation).
   Refer to: Rear Door - Double Cab (501-03 Body Closures, Removal and Installation).
   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Rear Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Front Seat (501-10 Seating, Removal and Installation).
   Refer to: Rear Seat (501-10 Seating, Removal and Installation).
   • Remove the load body from the vechicle.
   • Reposition the carpeting and the wiring harness away from the working area.
2. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

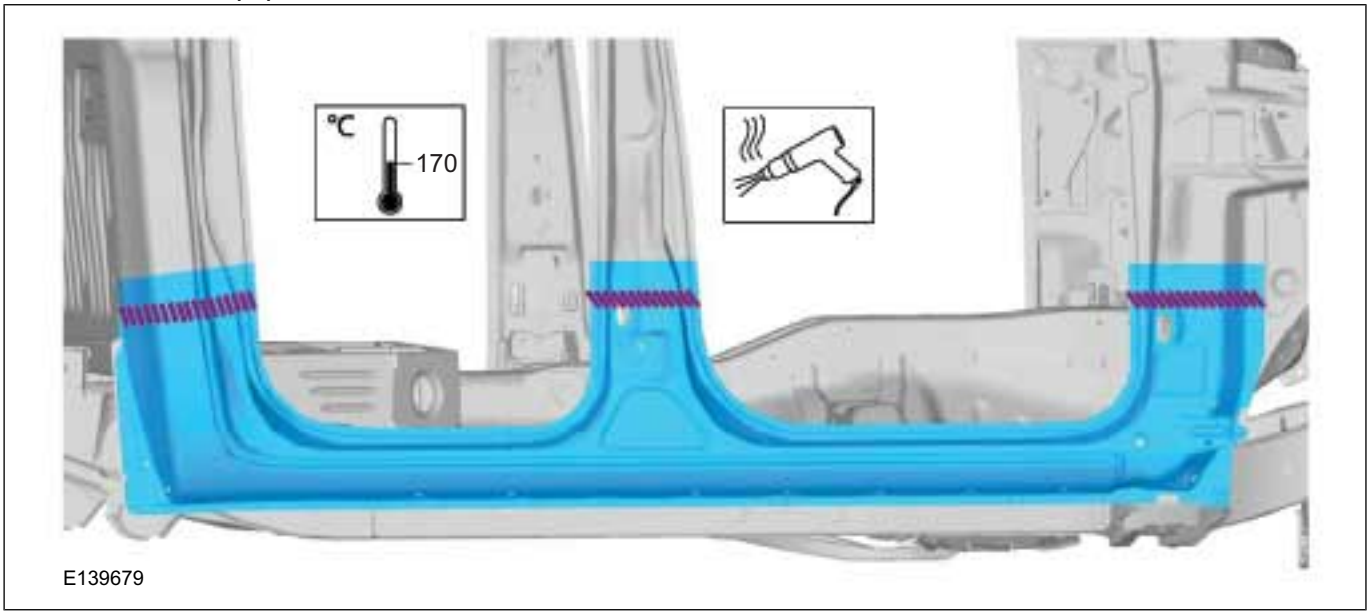

E139677

3. • General Equipment: Spot weld drill Bit


E139678

REMOVAL AND INSTALLATION

4. • General Equipment: Hot Air Gun



E139679

Installation

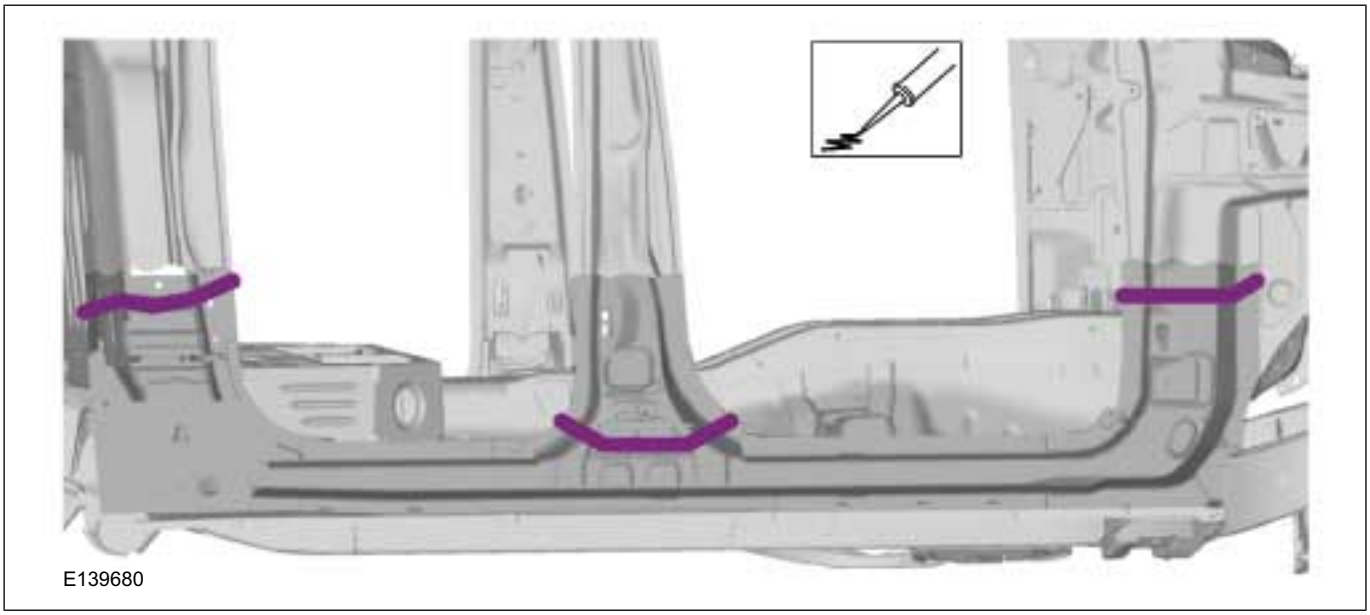
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

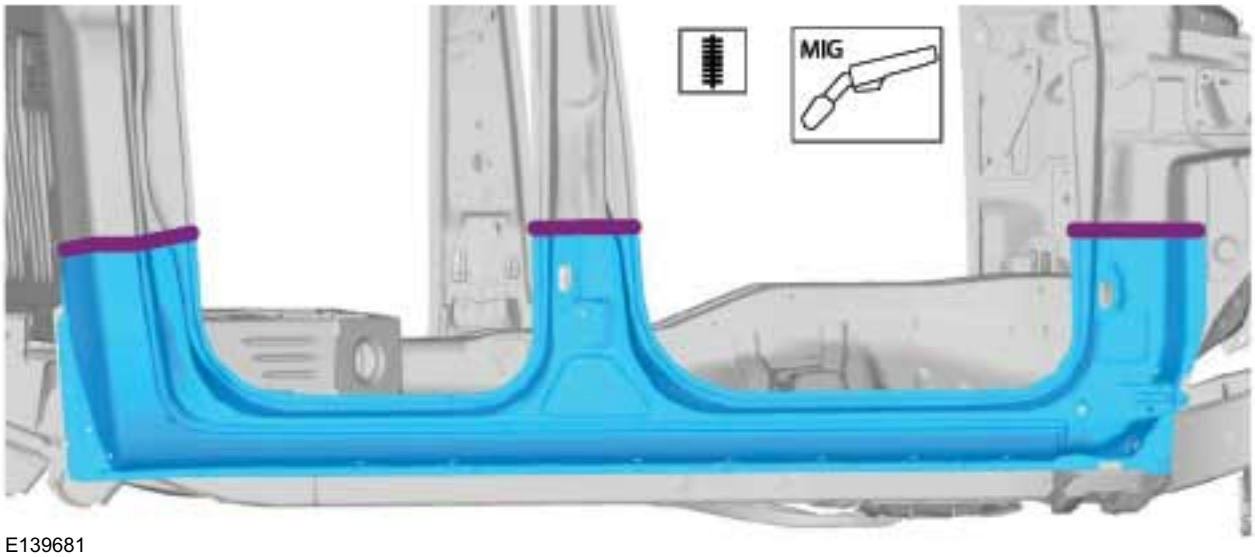
   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive


E139680

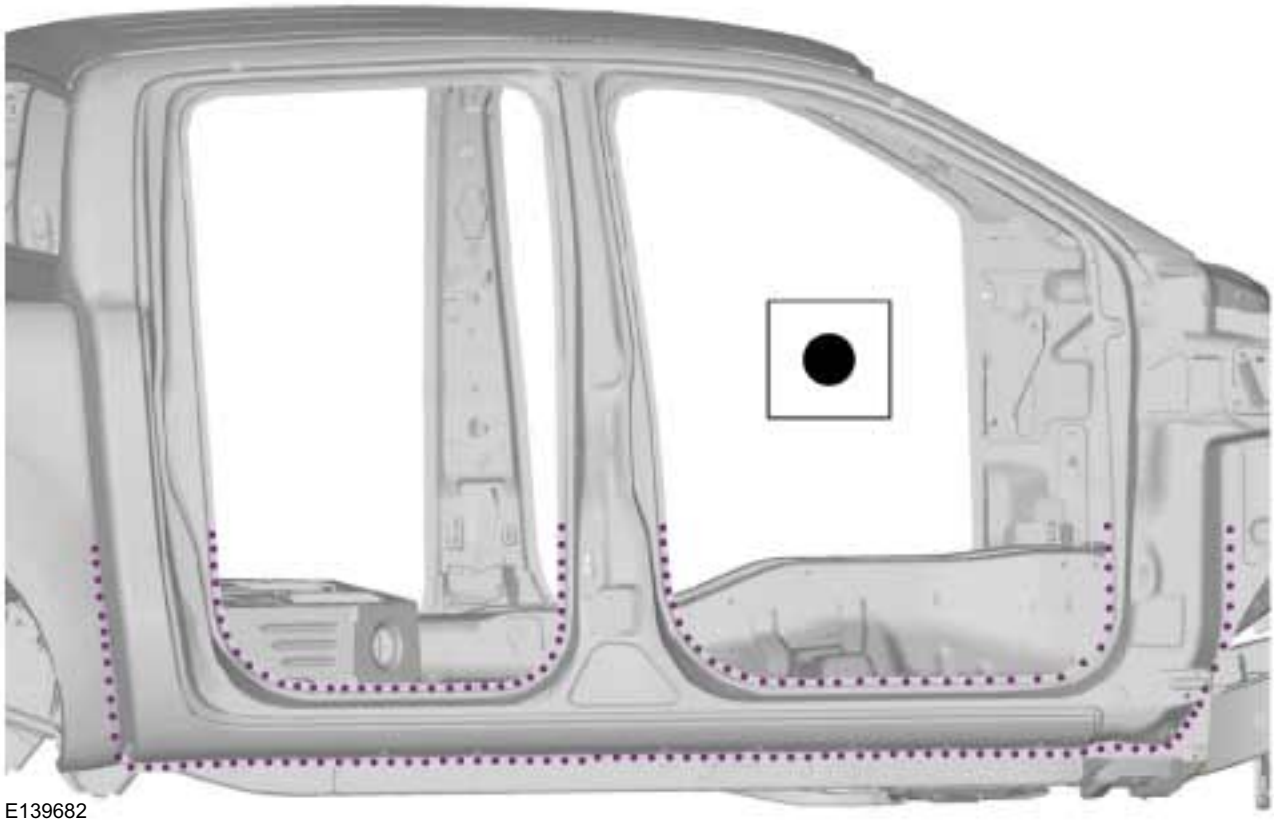
4. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION



E139681

5. • General Equipment: Resistance Spotwelding Equipment


E139682

REMOVAL AND INSTALLATION

6. • Refer to: Front Door (501-03 Body Closures, Removal and Installation).
   Refer to: Rear Door - Double Cab (501-03 Body Closures, Removal and Installation).
   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Rear Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Front Seat (501-10 Seating, Removal and Installation).
   Refer to: Rear Seat (501-10 Seating, Removal and Installation).
   • Install the load body into the vechicle.

REMOVAL AND INSTALLATION

Rocker Panel — Single Cab

General Equipment

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

Materials

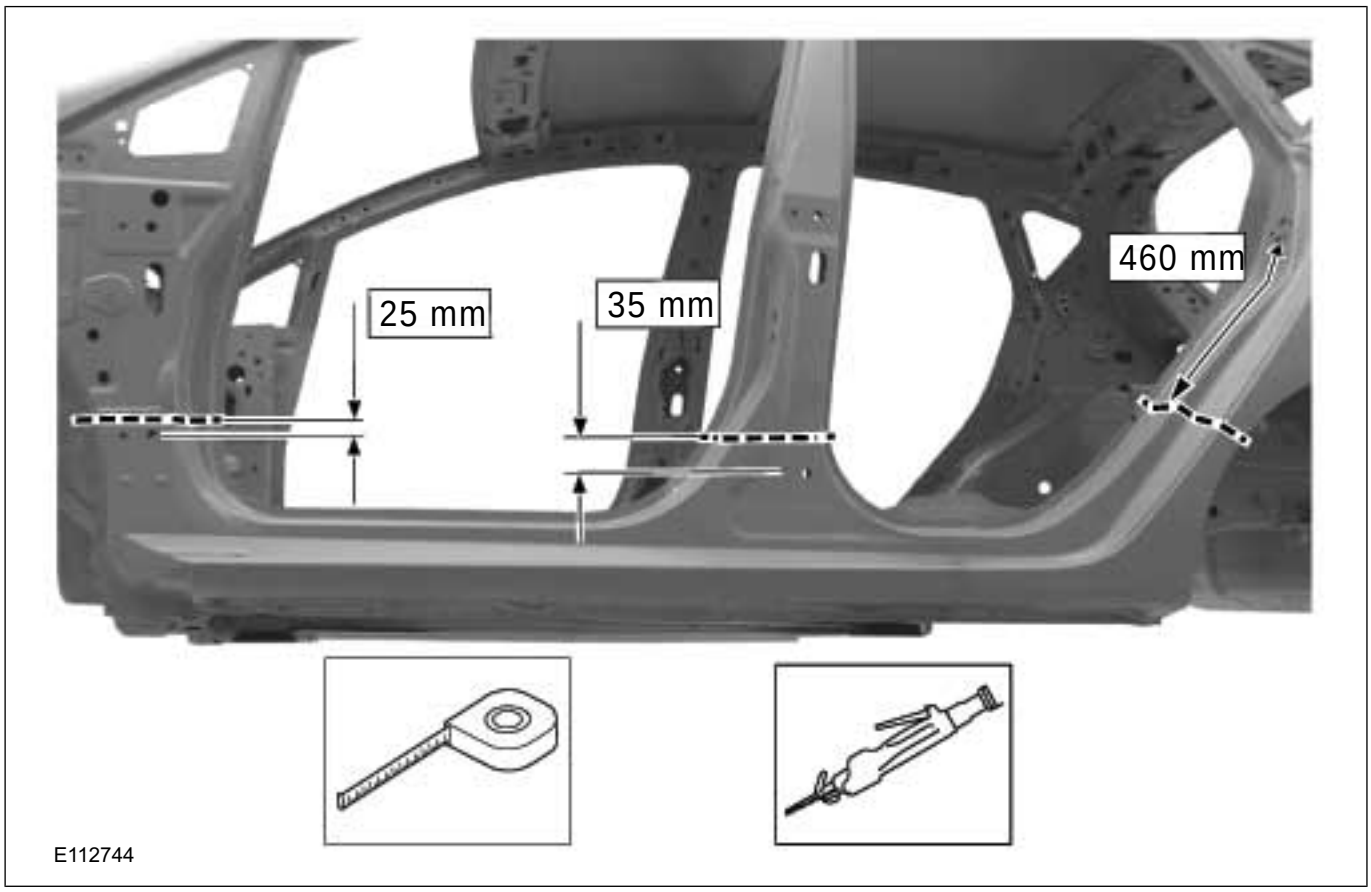
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

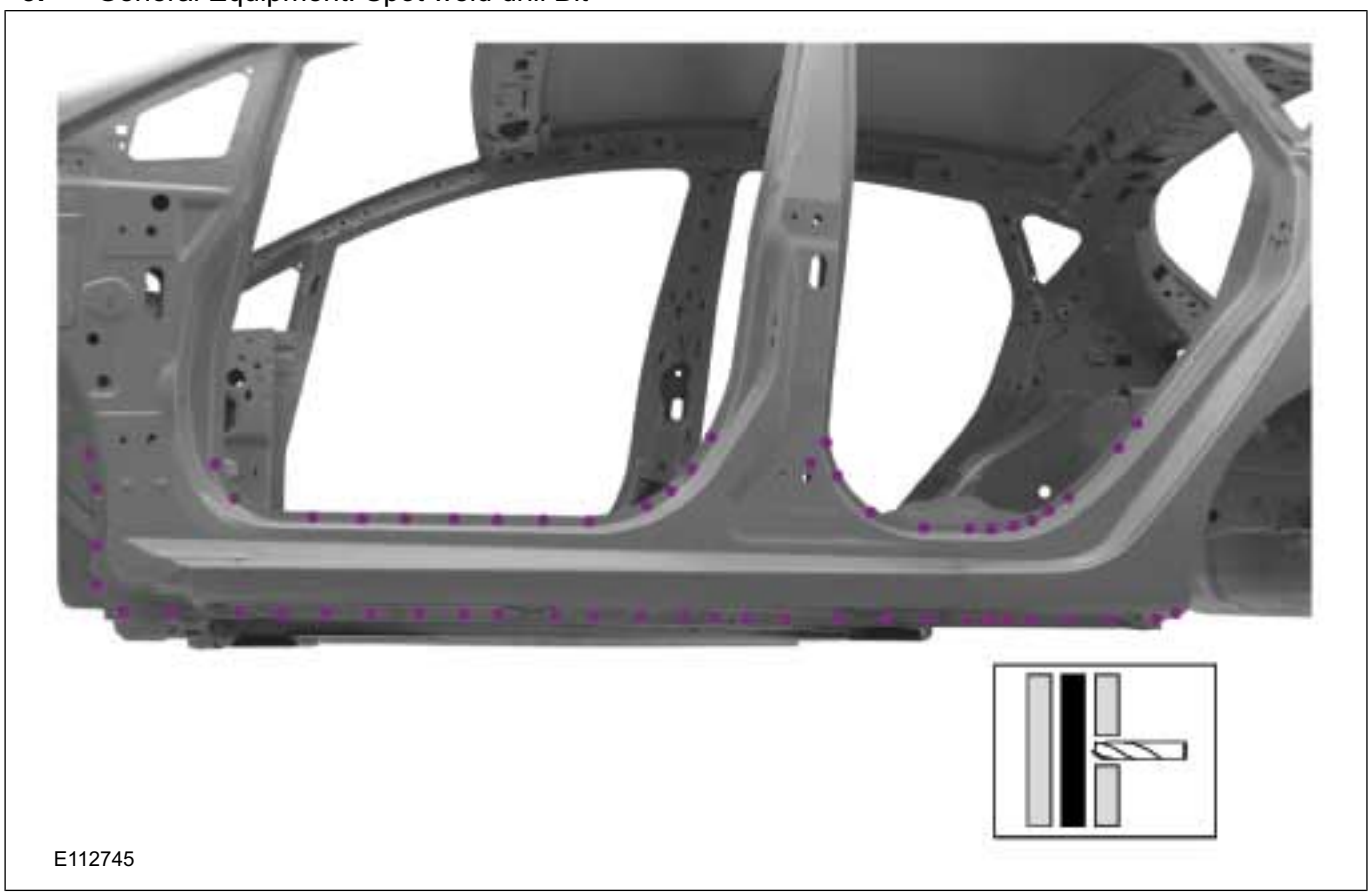
1. • Door Hinges
   • Front and Rear Door
   • Front Wheel Arch Trim
   • Rear Wheel Arch Trim
   • A- B- and C-Pillar Trim

   Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: B-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Trim Panel - 4-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
   • Rocker Panel Trim
   • Refer to: Front Seat (501-10, Removal and Installation).
   Refer to: Rear Seat Cushion (501-10, Removal and Installation).
   Refer to: Rear Seat Backrest (501-10, Removal and Installation).
   • Reposition the carpeting and the wiring harness away from the working area.
2. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

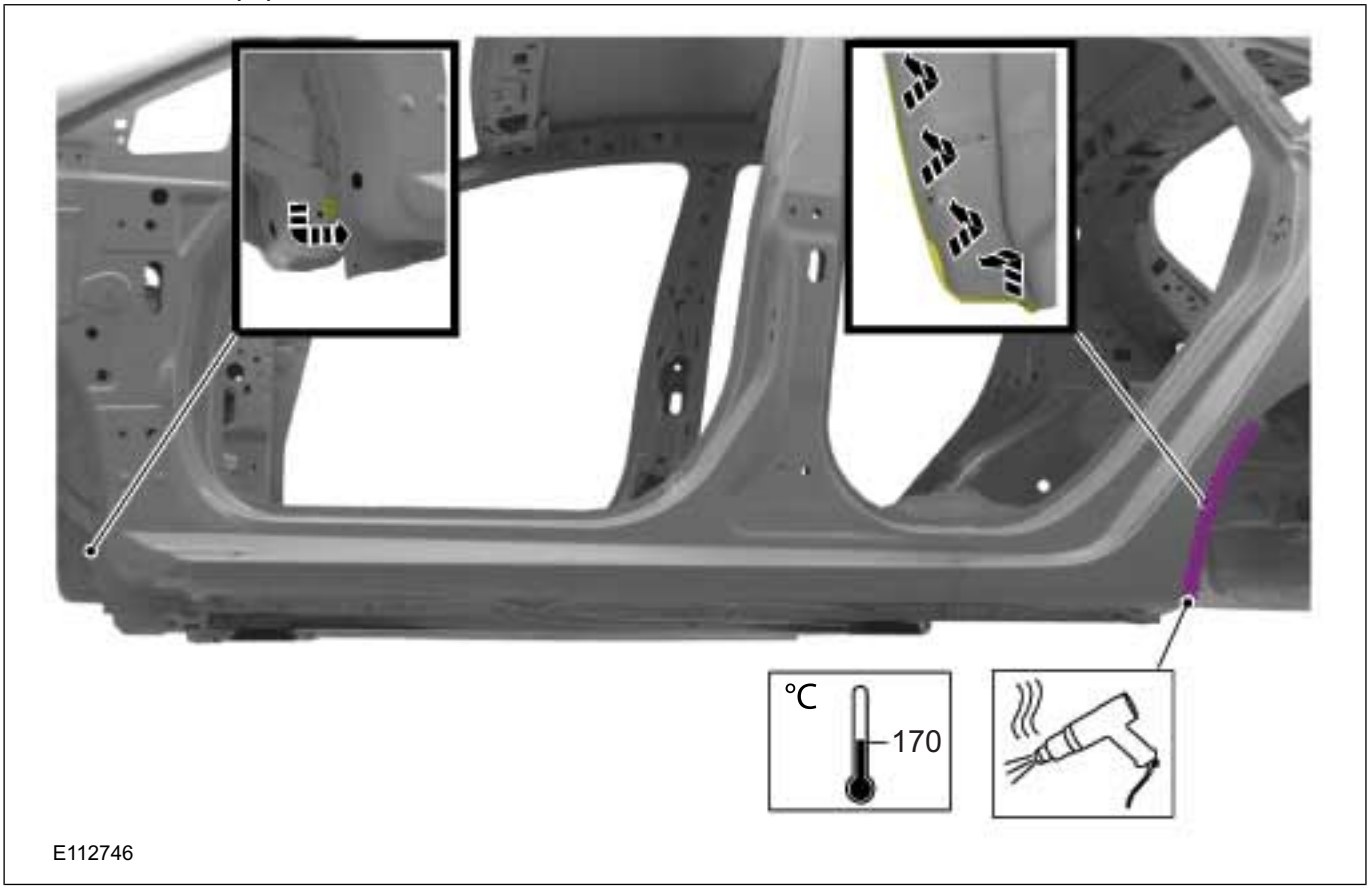


3. • General Equipment: Spot weld drill Bit



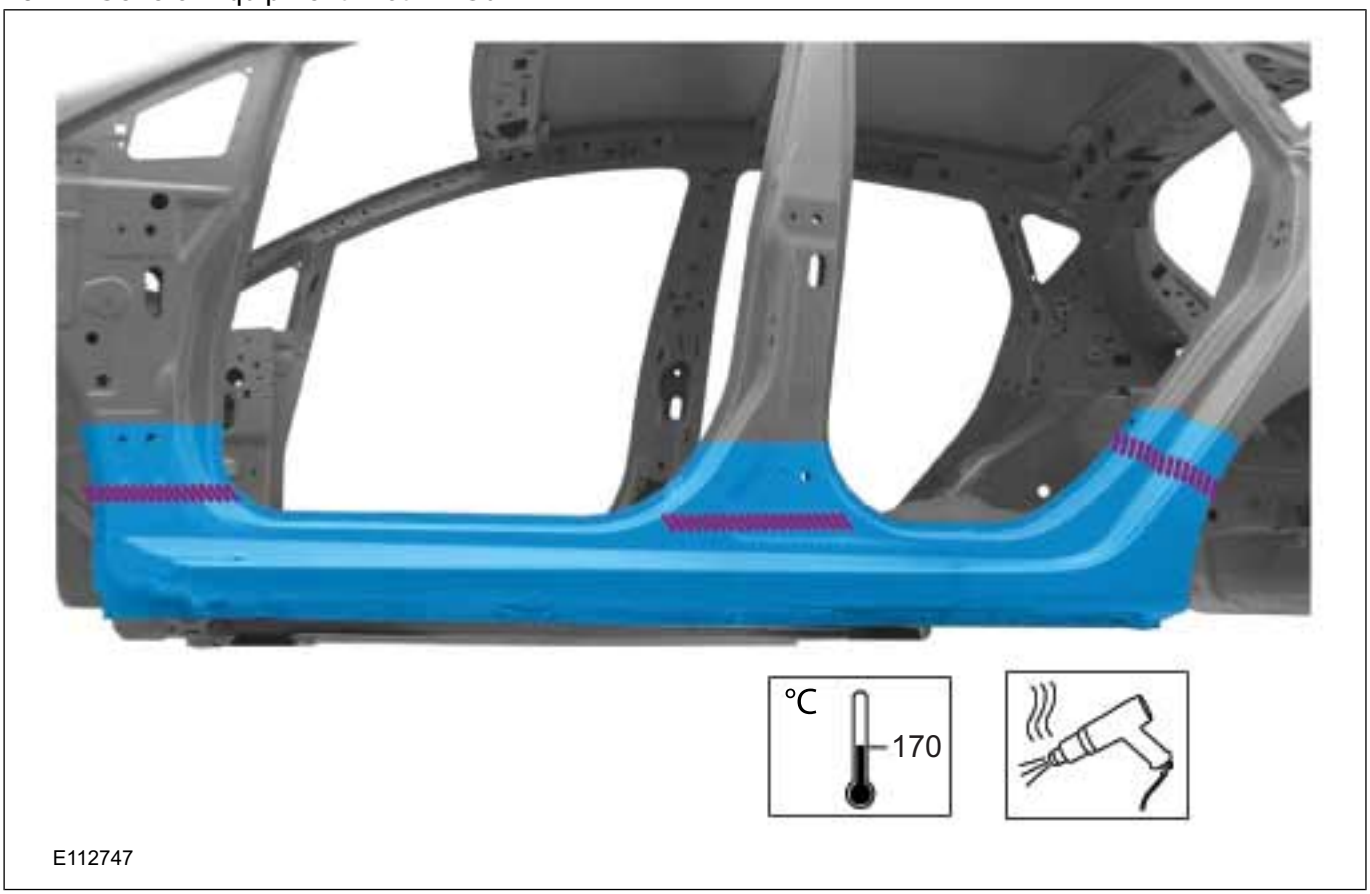
REMOVAL AND INSTALLATION

4. • General Equipment: Hot Air Gun



E112746

5. • General Equipment: Hot Air Gun



E112747

REMOVAL AND INSTALLATION

Installation

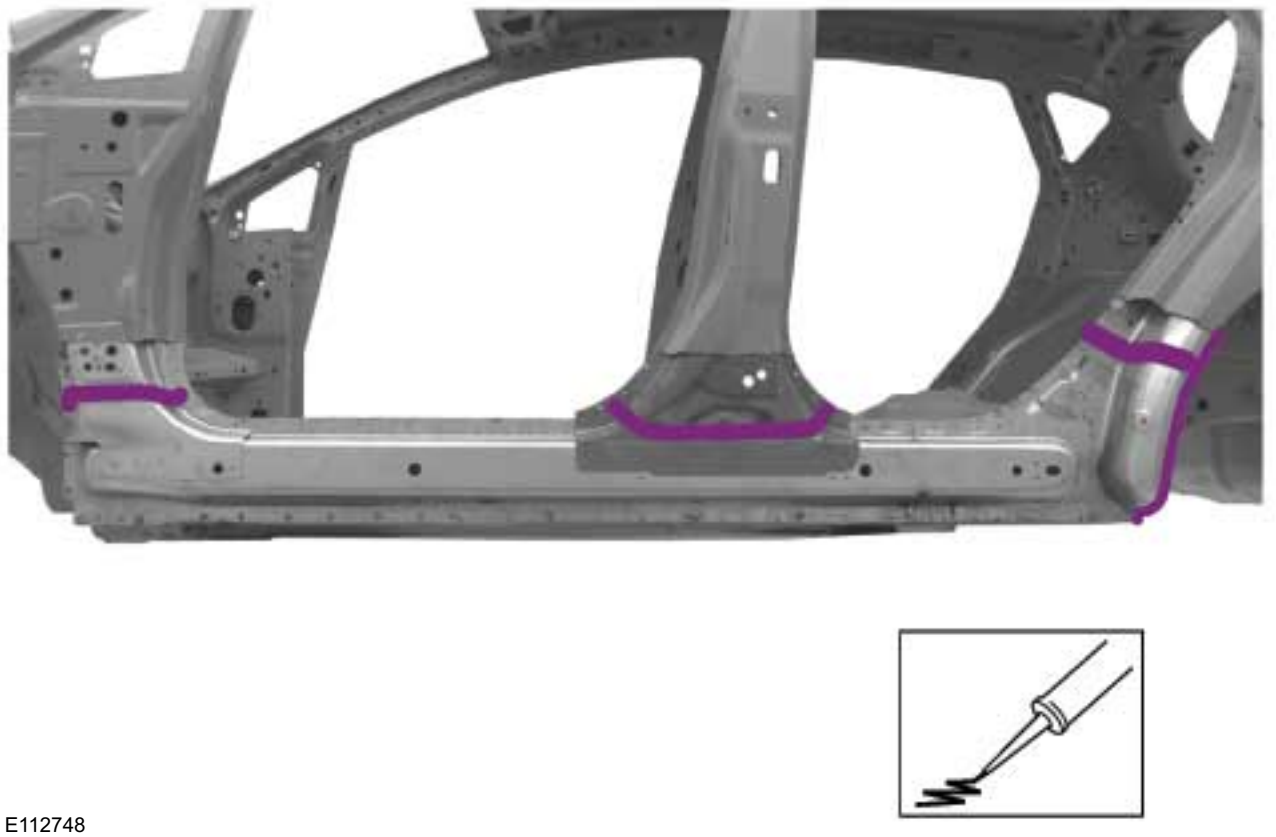
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

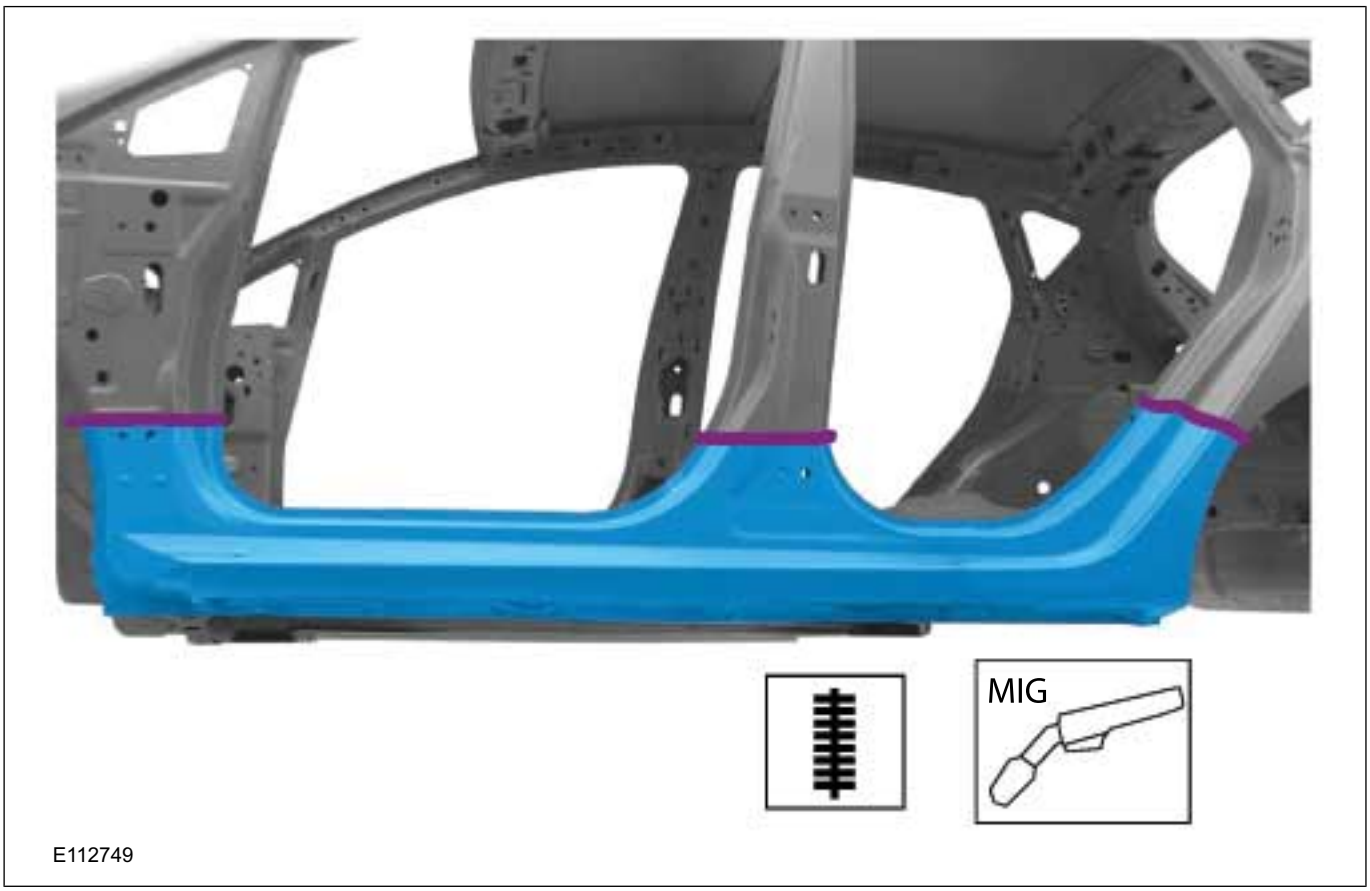
3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



E112748

4. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION



5. • General Equipment: Resistance Spotwelding Equipment



6.



REMOVAL AND INSTALLATION

7.
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

  Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: B-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 4-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Rocker Panel Trim
- Refer to: Front Seat (501-10, Removal and Installation).
  Refer to: Rear Seat Cushion (501-10, Removal and Installation).
  Refer to: Rear Seat Backrest (501-10, Removal and Installation).

REMOVAL AND INSTALLATION

Rocker Panel — Super Cab

General Equipment

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

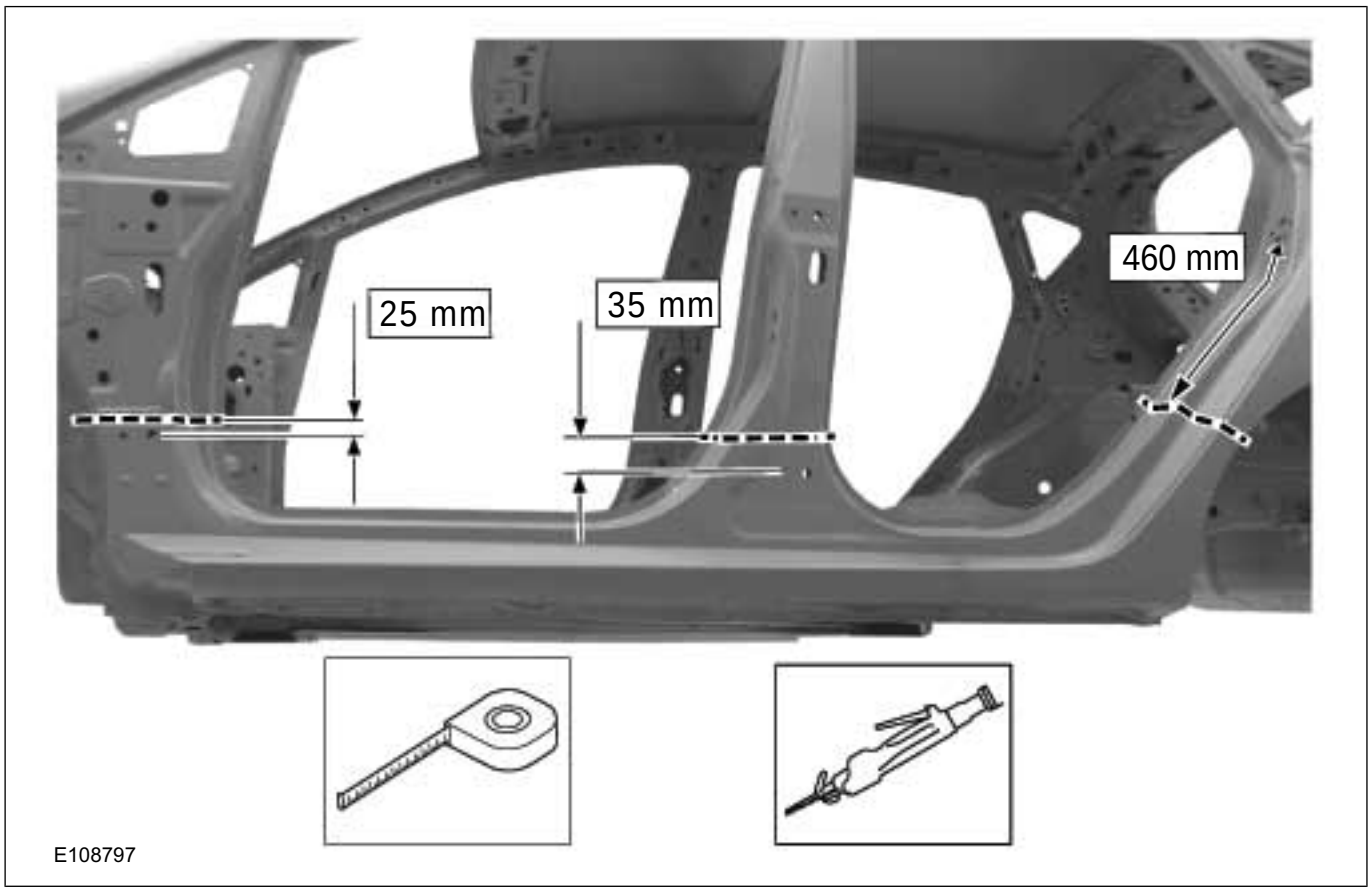
Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

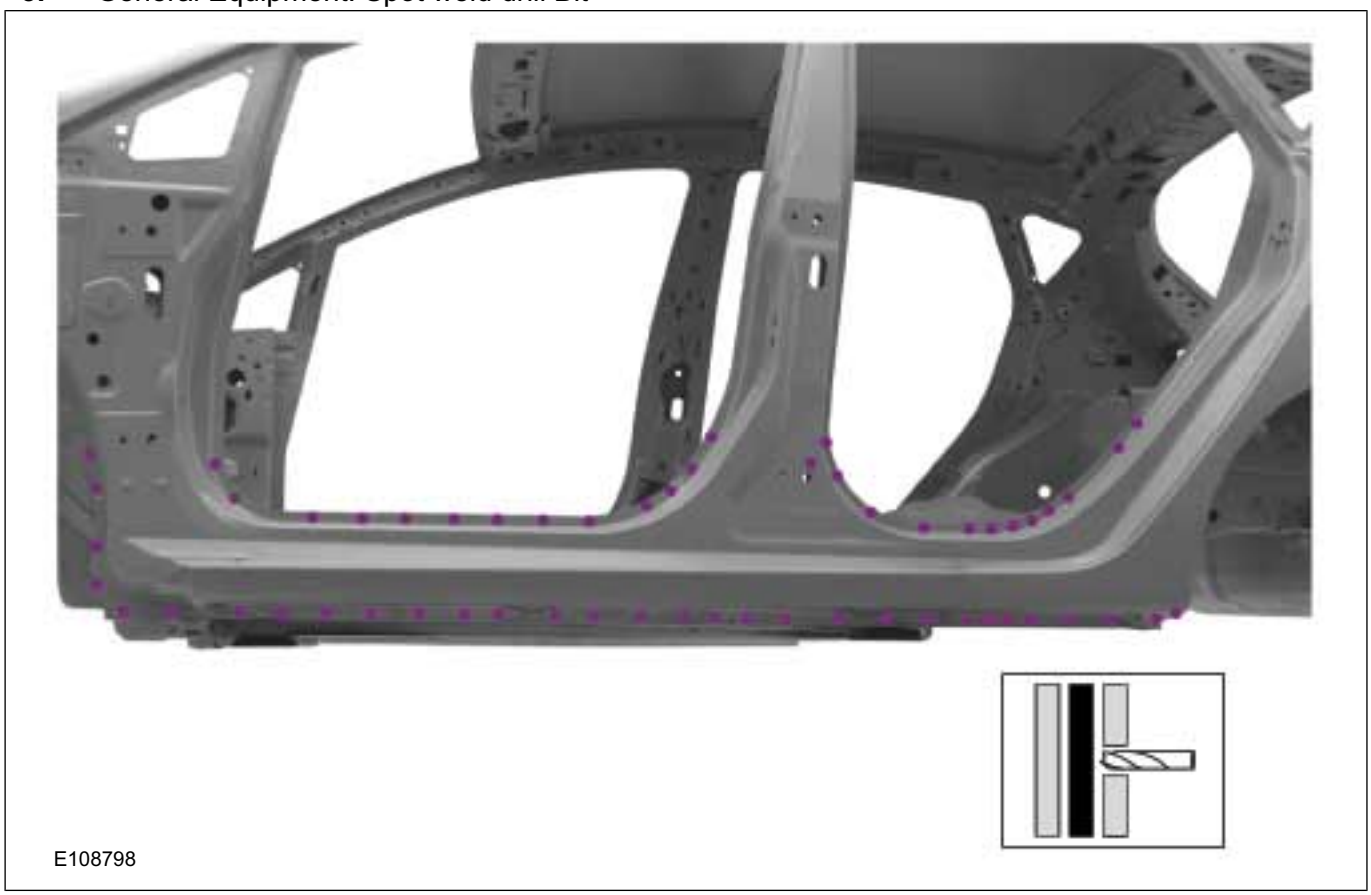
Removal

1. • Front and Rear Door
   • Door Hinges
   • Front Wheel Arch Trim
   • Rear Wheel Arch Trim
   • Refer to: A-Pillar Trim Panel (501-05, Removal and Installation).
   Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
   • Rocker Panel Trim
   • Refer to: Front Seat (501-10, Removal and Installation).
   Refer to: Rear Seat Cushion (501-10, Removal and Installation).
   Refer to: Rear Seat Backrest (501-10, Removal and Installation).
   • Reposition the carpeting and the wiring harness away from the working area.
2. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

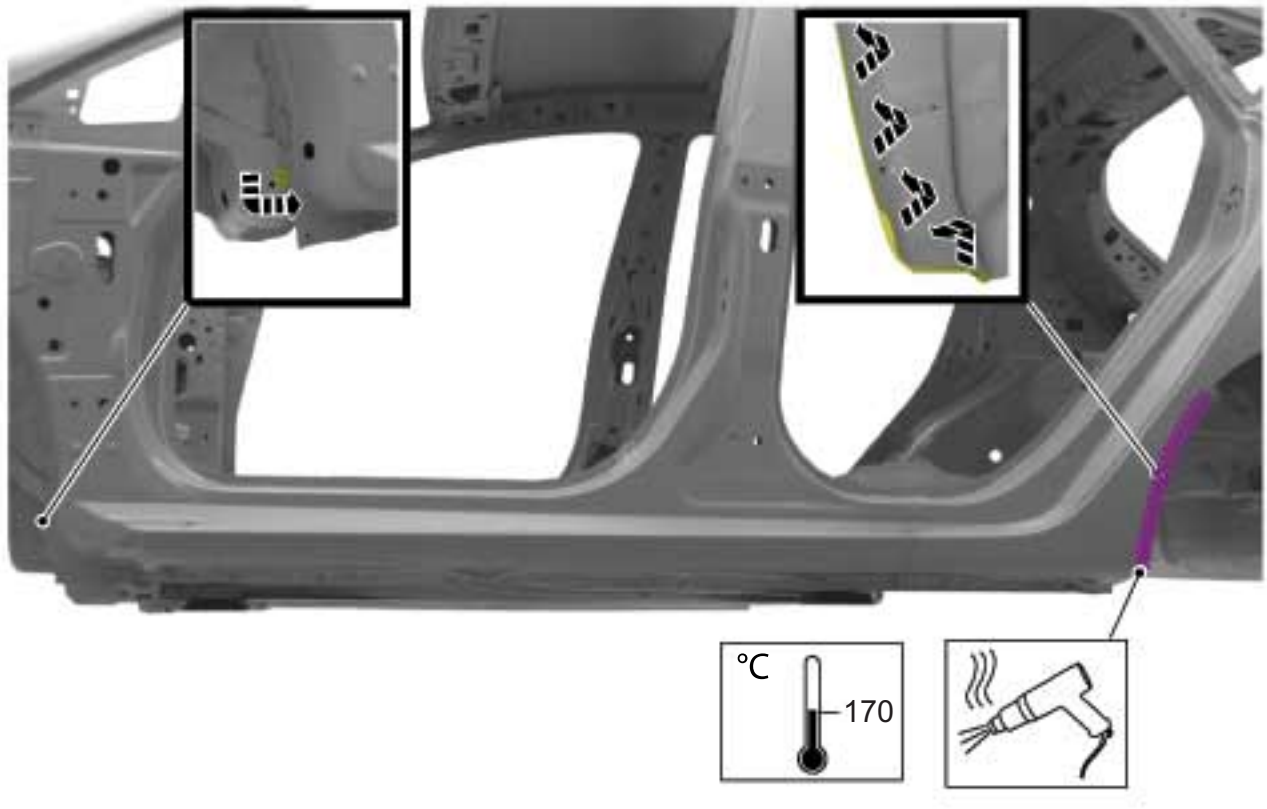


3. • General Equipment: Spot weld drill Bit



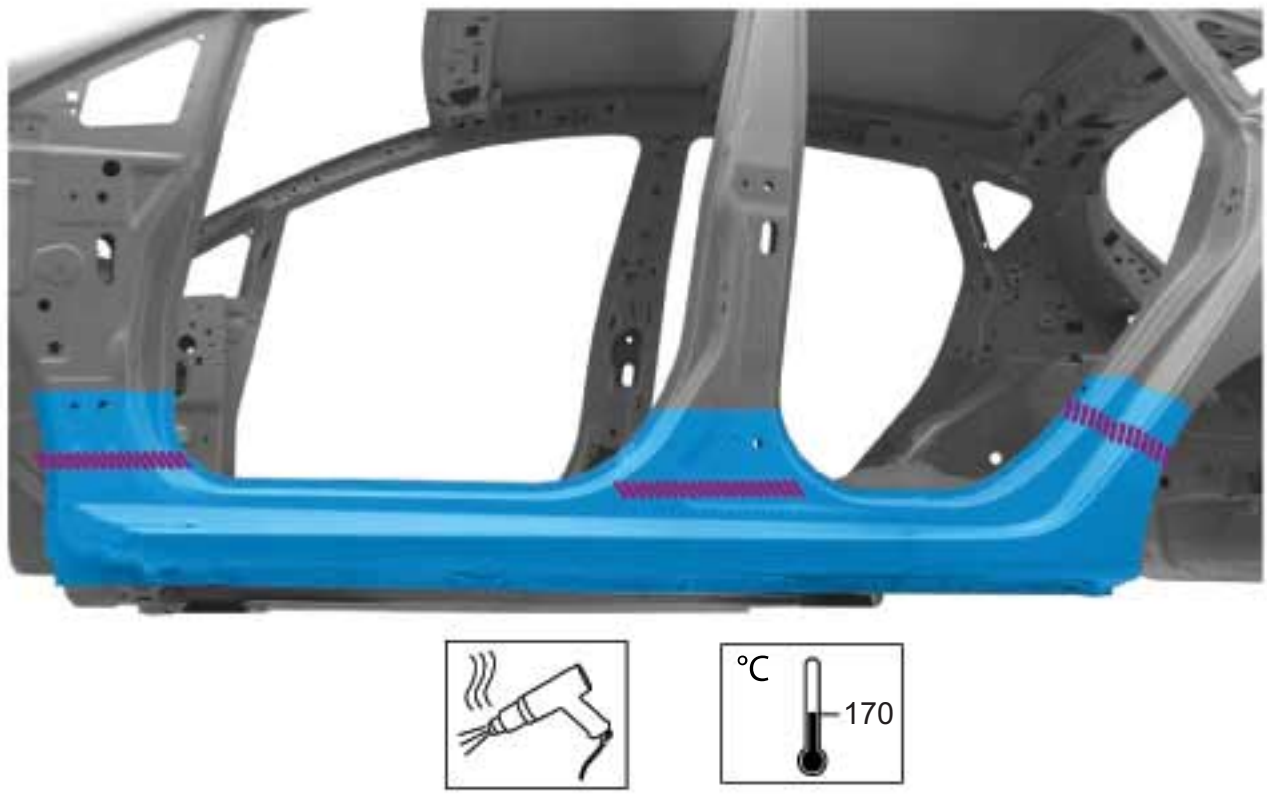
REMOVAL AND INSTALLATION

4. • General Equipment: Hot Air Gun



E108799

5. • General Equipment: Hot Air Gun



E108800

REMOVAL AND INSTALLATION

Installation

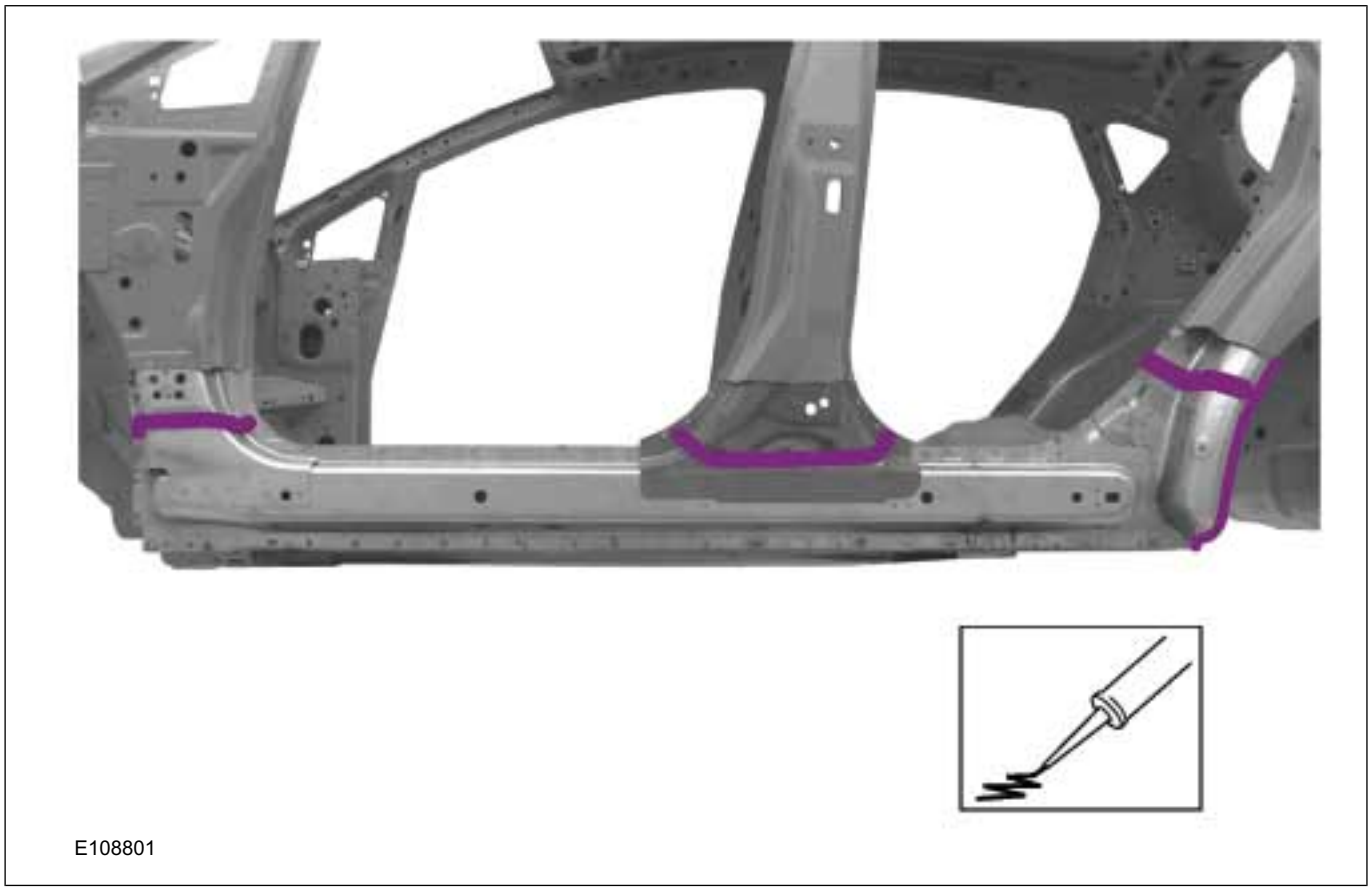
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

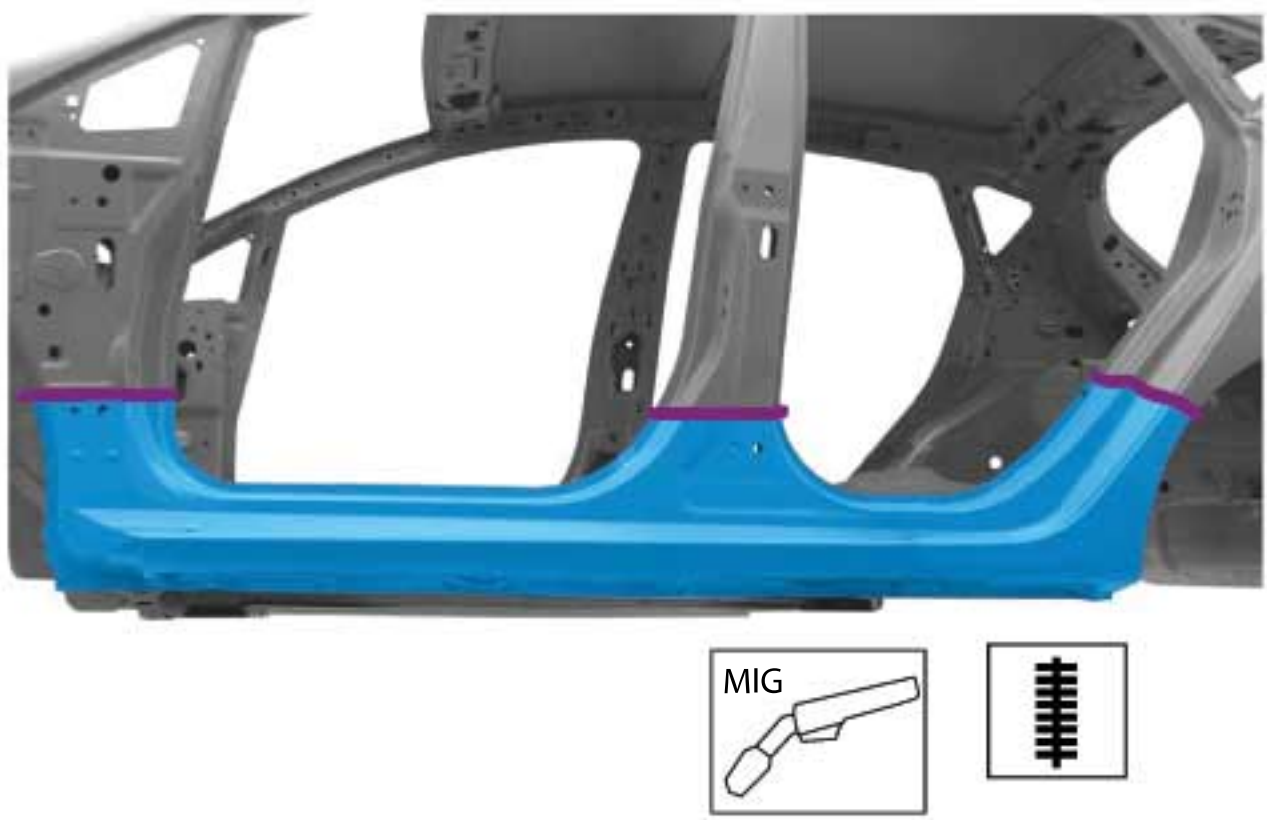
3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



E108801

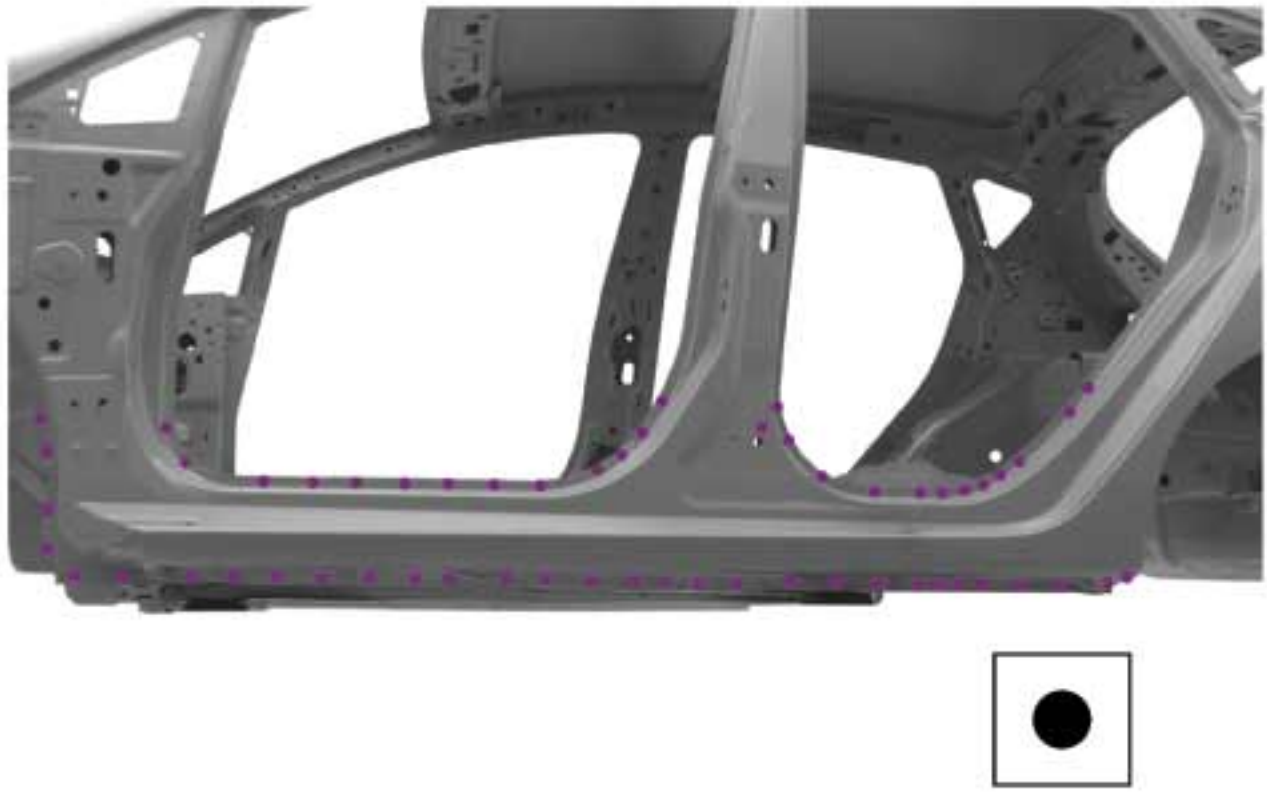
4. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION



E108802

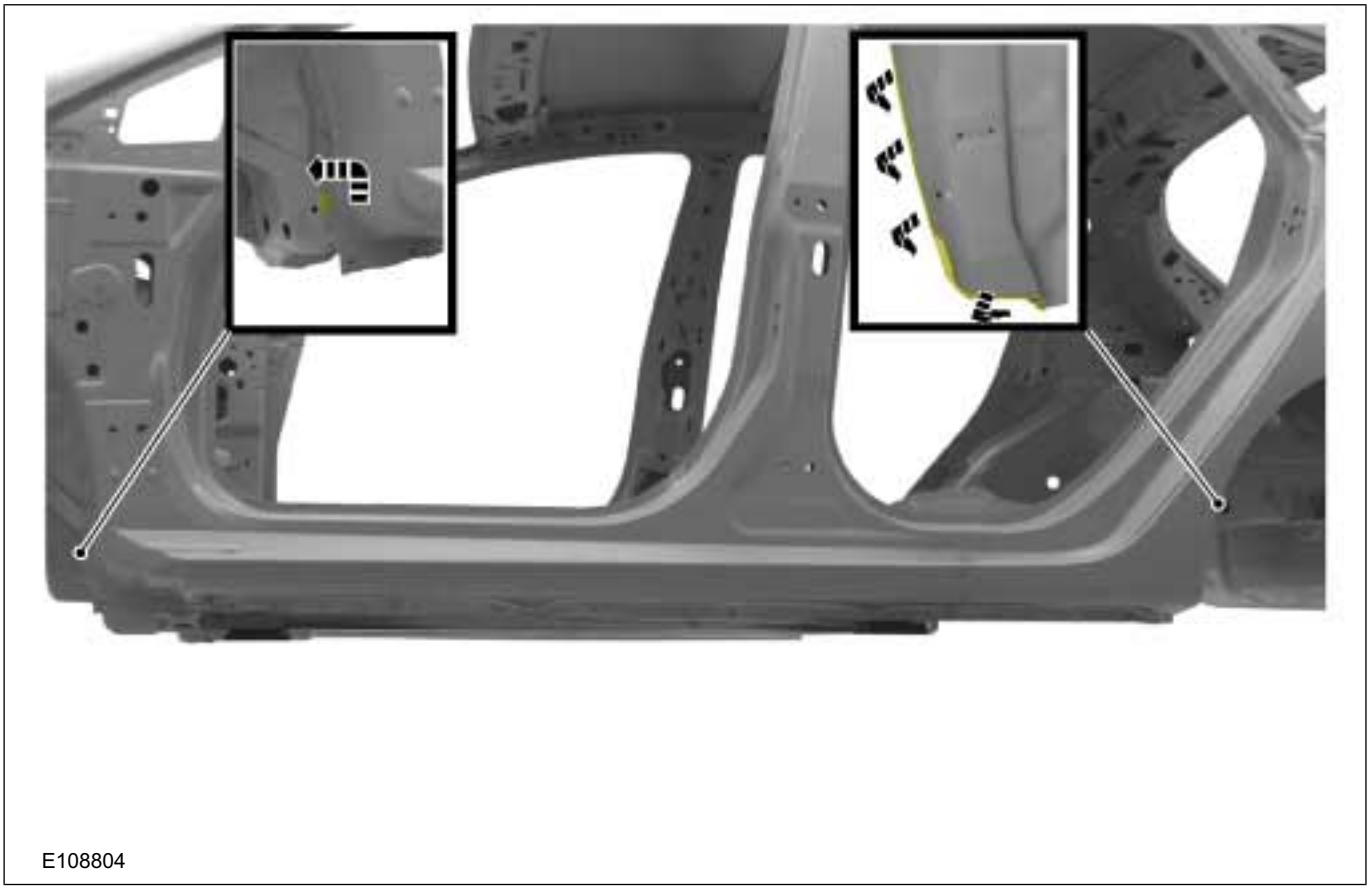
5. • General Equipment: Resistance Spotwelding Equipment



E108803

REMOVAL AND INSTALLATION

6.



E108804

7.
- Front and Rear Door
- Door Hinges
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- Refer to: A-Pillar Trim Panel (501-05, Removal and Installation).
  Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Rocker Panel Trim
- Refer to: Front Seat (501-10, Removal and Installation).
  Refer to: Rear Seat Cushion (501-10, Removal and Installation).
  Refer to: Rear Seat Backrest (501-10, Removal and Installation).

REMOVAL AND INSTALLATION

Rocker Panel Inner Reinforcement — Double Cab

General Equipment

Air Body Saw
MIG/MAG Welding Equipment

General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

Removal

1. Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: A-Pillar Assembly (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   • Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   • Rocker Panel
   • Door Hinges
   • Front and Rear Door
   • Front Wheel Arch Trim
   • Rear Wheel Arch Trim
   • A- B- and C-Pillar Trim

     Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
     Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
     Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
   • Rocker Panel Trim
   • Refer to: Front Seat (501-10, Removal and Installation).
     Refer to: Rear Seat Cushion (501-10, Removal and Installation).
     Refer to: Rear Seat Backrest (501-10, Removal and Installation).
   • Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION



E115412

4. • General Equipment: Spot weld drill Bit



E115413

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION



E115414

4. • General Equipment: MIG/MAG Welding Equipment



E115415

REMOVAL AND INSTALLATION

5.
- Refer to: A-Pillar Assembly (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Rocker Panel
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

  Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Rocker Panel Trim
- Refer to: Front Seat (501-10, Removal and Installation).
  Refer to: Rear Seat Cushion (501-10, Removal and Installation).
  Refer to: Rear Seat Backrest (501-10, Removal and Installation).

REMOVAL AND INSTALLATION

Rocker Panel Inner Reinforcement — Single Cab

General Equipment

Air Body Saw
MIG/MAG Welding Equipment

General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

Removal

1. Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: A-Pillar Assembly (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   • Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   • Rocker Panel
   • Door Hinges
   • Front and Rear Door
   • Front Wheel Arch Trim
   • Rear Wheel Arch Trim
   • A- B- and C-Pillar Trim

     Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
     Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
     Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
   • Rocker Panel Trim
   • Refer to: Front Seat (501-10, Removal and Installation).
     Refer to: Rear Seat Cushion (501-10, Removal and Installation).
     Refer to: Rear Seat Backrest (501-10, Removal and Installation).
   • Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION



E115412

4. • General Equipment: Spot weld drill Bit



E115413

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION



E115414

4. • General Equipment: MIG/MAG Welding Equipment



E115415

REMOVAL AND INSTALLATION

5.
- Refer to: A-Pillar Assembly (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Rocker Panel
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

  Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Rocker Panel Trim
- Refer to: Front Seat (501-10, Removal and Installation).
  Refer to: Rear Seat Cushion (501-10, Removal and Installation).
  Refer to: Rear Seat Backrest (501-10, Removal and Installation).

REMOVAL AND INSTALLATION

Rocker Panel Inner Reinforcement — Super Cab

General Equipment

Air Body Saw
MIG/MAG Welding Equipment

General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

Removal

1. Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: A-Pillar Assembly (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   • Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
   • Rocker Panel
   • Door Hinges
   • Front and Rear Door
   • Front Wheel Arch Trim
   • Rear Wheel Arch Trim
   • A- B- and C-Pillar Trim

     Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
     Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
     Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
   • Rocker Panel Trim
   • Refer to: Front Seat (501-10, Removal and Installation).
     Refer to: Rear Seat Cushion (501-10, Removal and Installation).
     Refer to: Rear Seat Backrest (501-10, Removal and Installation).
   • Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION



E115412

4. • General Equipment: Spot weld drill Bit



E115413

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION



E115414

4. • General Equipment: MIG/MAG Welding Equipment



E115415

REMOVAL AND INSTALLATION

5.
- Refer to: A-Pillar Assembly (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Refer to: A-Pillar Outer Panel (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Rocker Panel
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

  Refer to: A-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: B-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
  Refer to: C-Pillar Trim Panel - 5-Door (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Rocker Panel Trim
- Refer to: Front Seat (501-10, Removal and Installation).
  Refer to: Rear Seat Cushion (501-10, Removal and Installation).
  Refer to: Rear Seat Backrest (501-10, Removal and Installation).

REMOVAL AND INSTALLATION

B-Pillar and Reinforcement — Double Cab

General Equipment

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

NOTE: Equipment:

Measurement and alignment angle system

1. **WARNING: High-strength steel (Usibor 1500)**
   - A suitably powerful resistance spot welding device with **inverter technology** must be used for this repair. Observe the manufacturer's welding equipment instructions and sub-section 501-25.
   - The B-pillar reinforcement is made of high-strength steel plate (Usibor 1500).
   - A partial replacement of the B-pillar reinforcement is not permissible. The required continuous MIG weld seam in the area of the cut causes structural changes which result in significant loss of strength in the B-pillar reinforcement.
   - Due to its strength, the B-pillar reinforcement can not always be worked on with conventional body tools.
   - Additional preparations are required for MIG puddle welding.

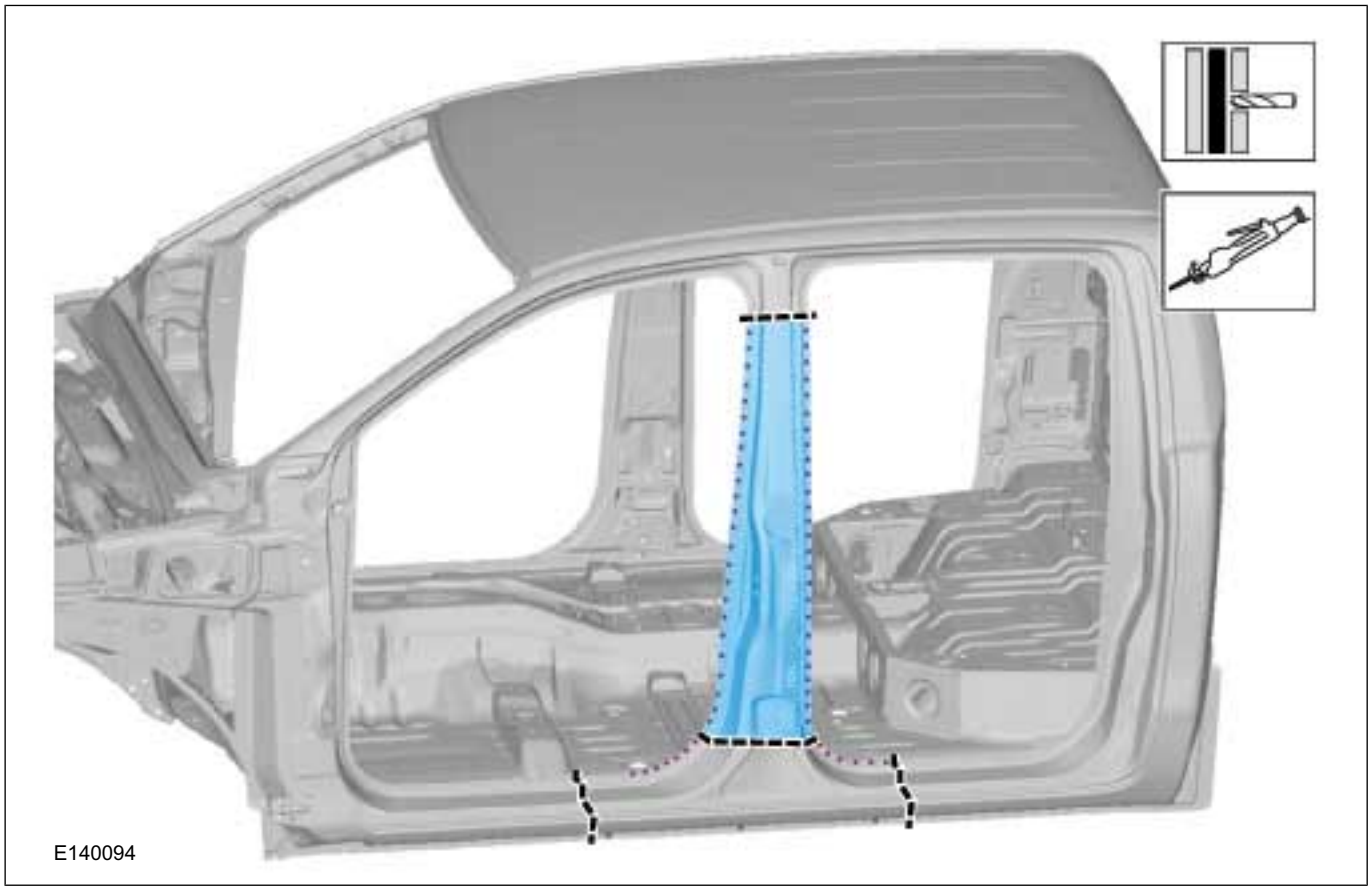
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. • Rocker Panel Trim

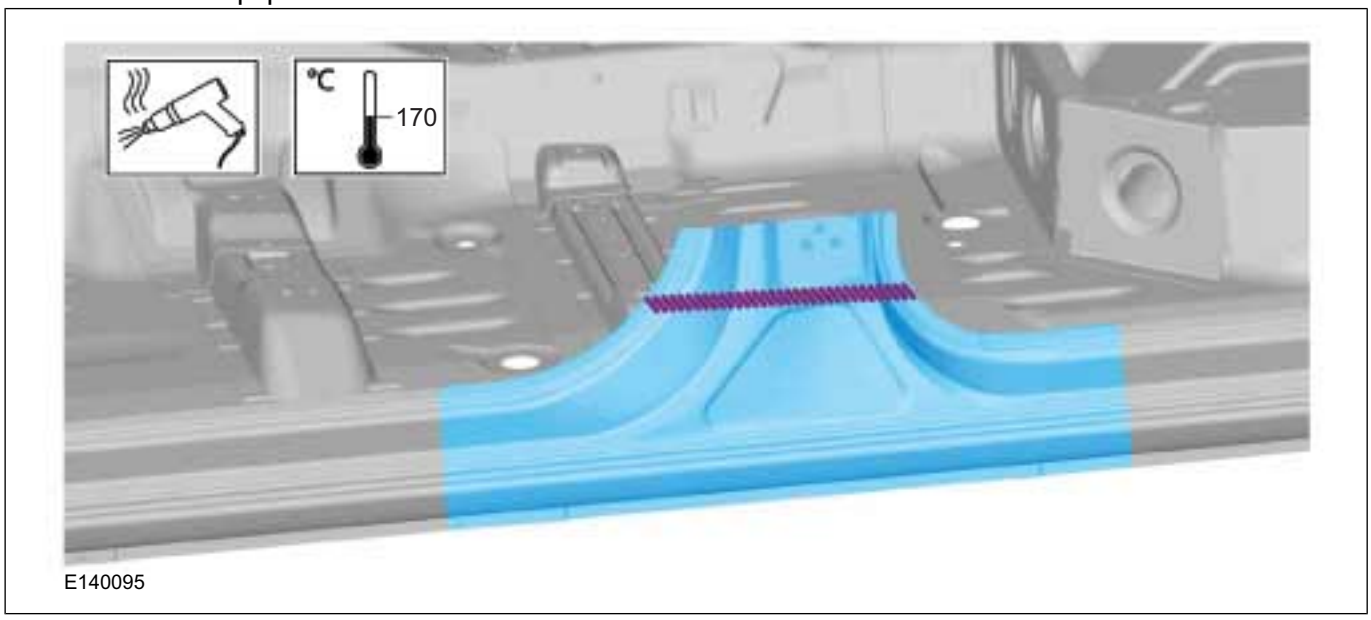
   Refer to: Front Seat (501-10 Seating, Removal and Installation).
   Refer to: Rear Seat Cushion (501-10 Seating, Disassembly and Assembly).
   Refer to: Rear Seat Backrest (501-10 Seating, Disassembly and Assembly).
   Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
   Refer to: Headliner (501-05 Interior Trim and Ornamentation, Removal and Installation).
   - Front and Rear Door
   - Reposition the carpeting and the wiring harness away from the working area.

3. • General Equipment: Air Body Saw
   General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

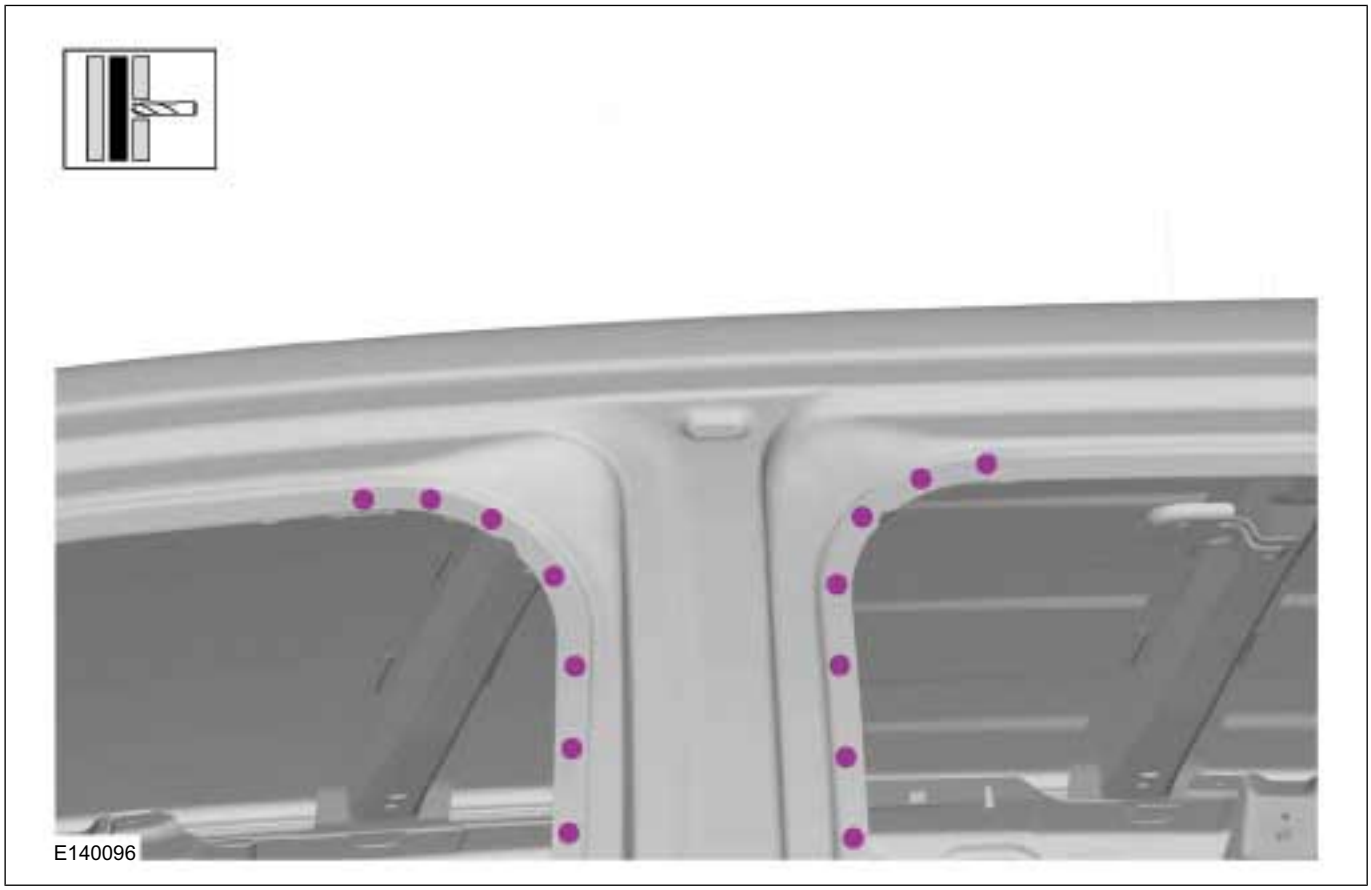


4. • General Equipment: Hot Air Gun

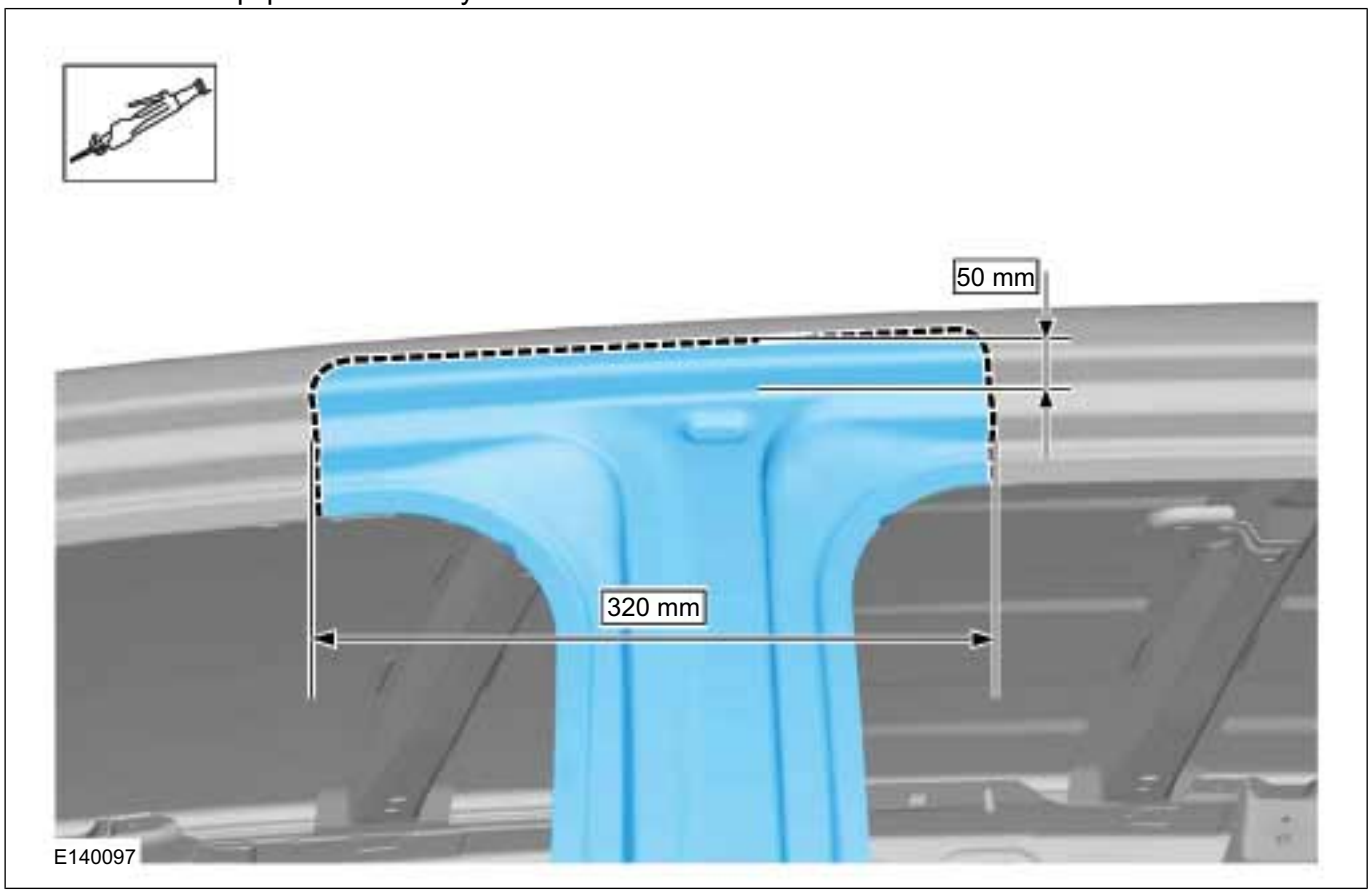


5. • General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

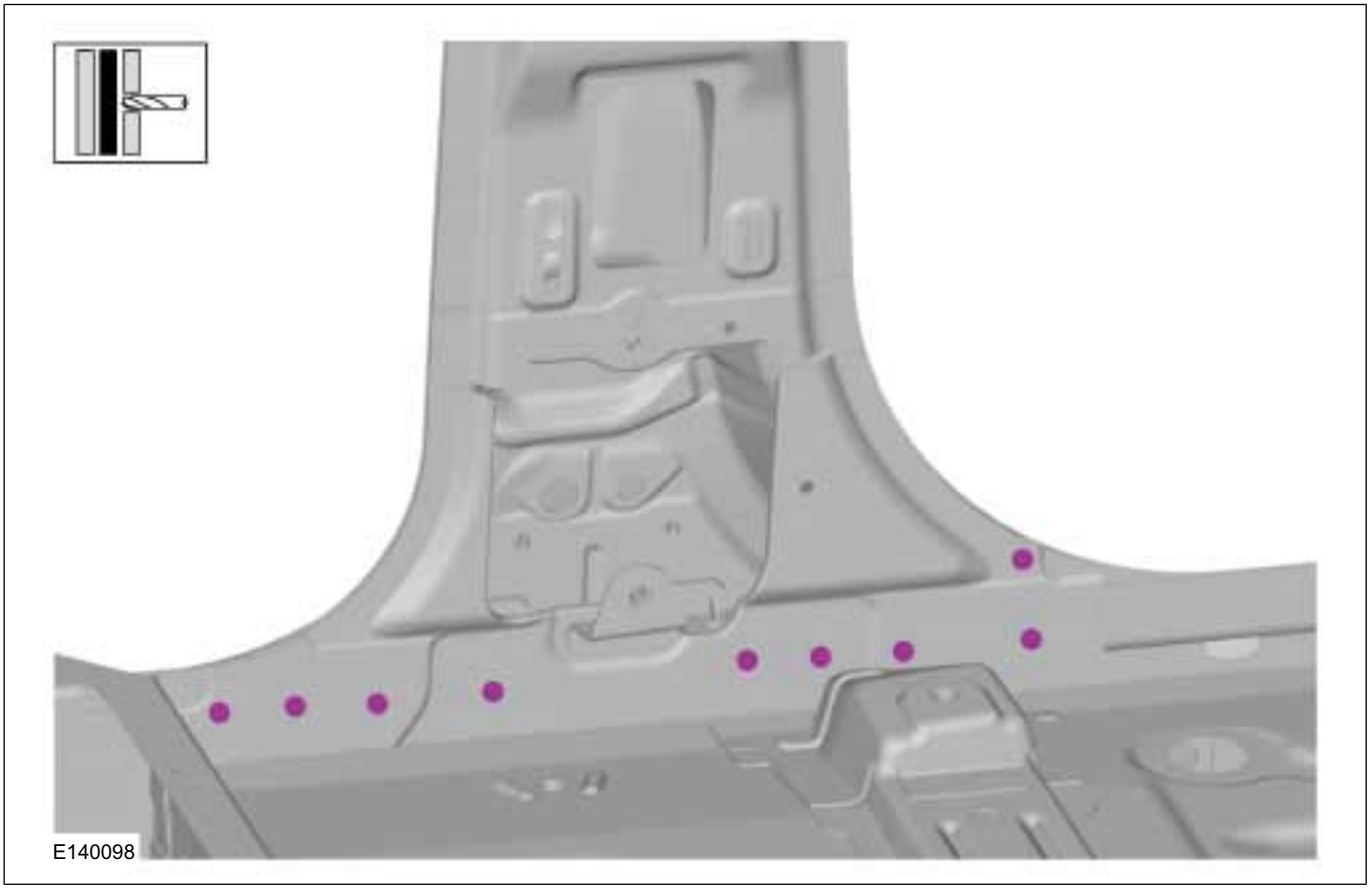


6. • General Equipment: Air Body Saw



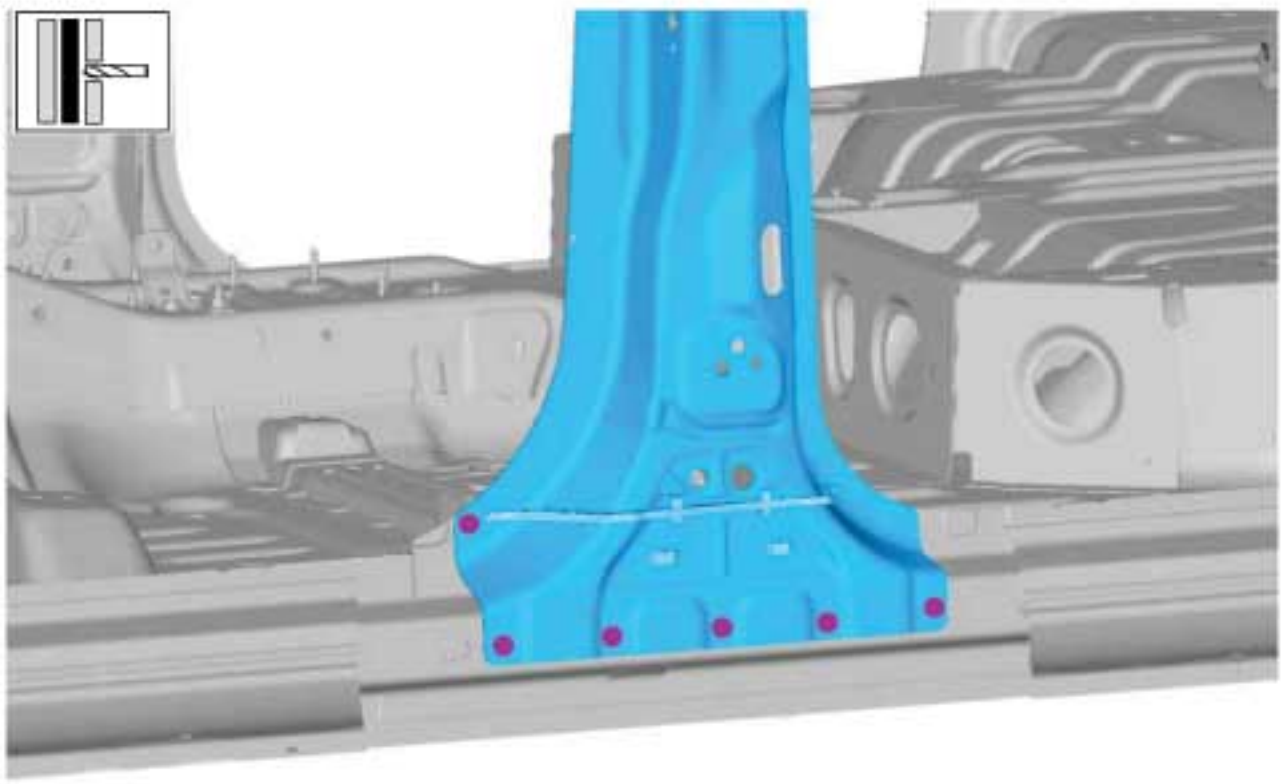
REMOVAL AND INSTALLATION

7. • General Equipment: Air Body Saw General Equipment: Spot weld drill Bit



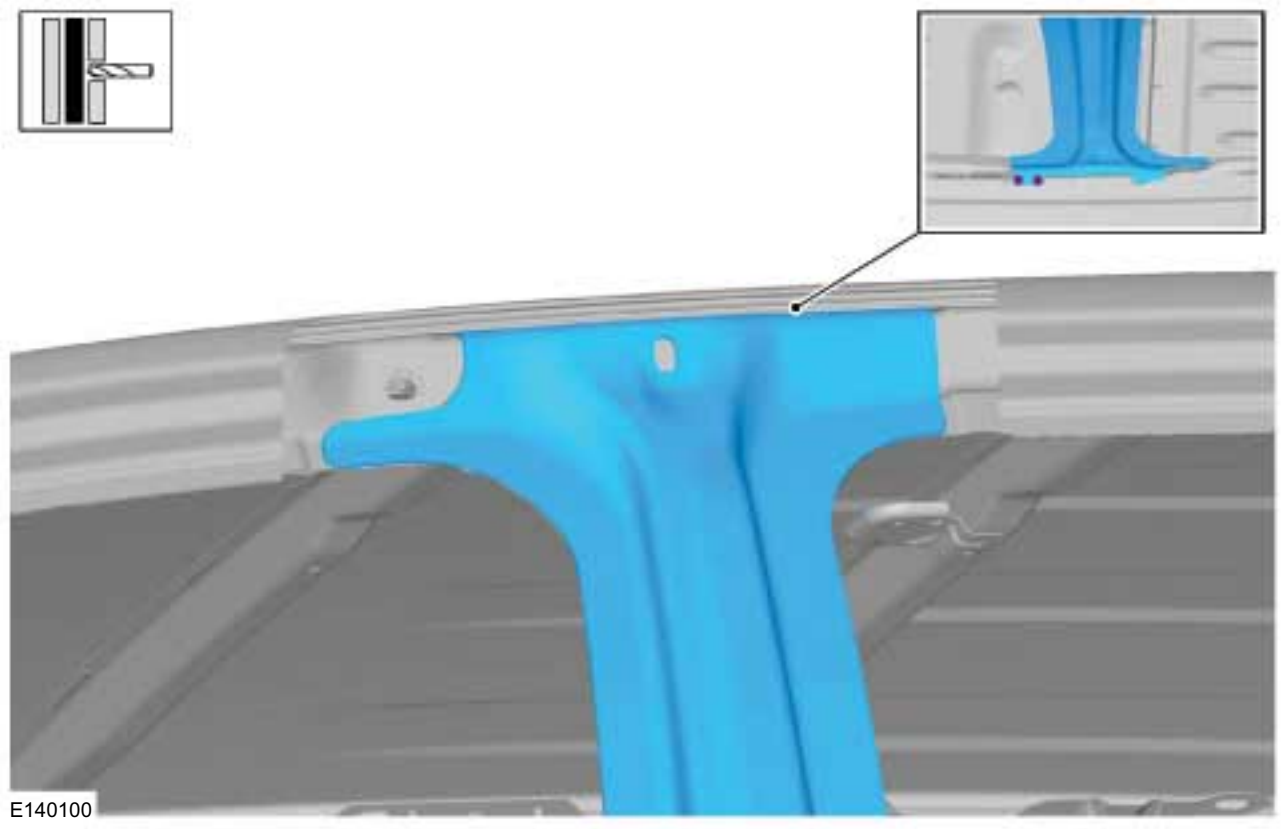
8. • General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION



E140099

9. • General Equipment: Spot weld drill Bit



E140100

REMOVAL AND INSTALLATION

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

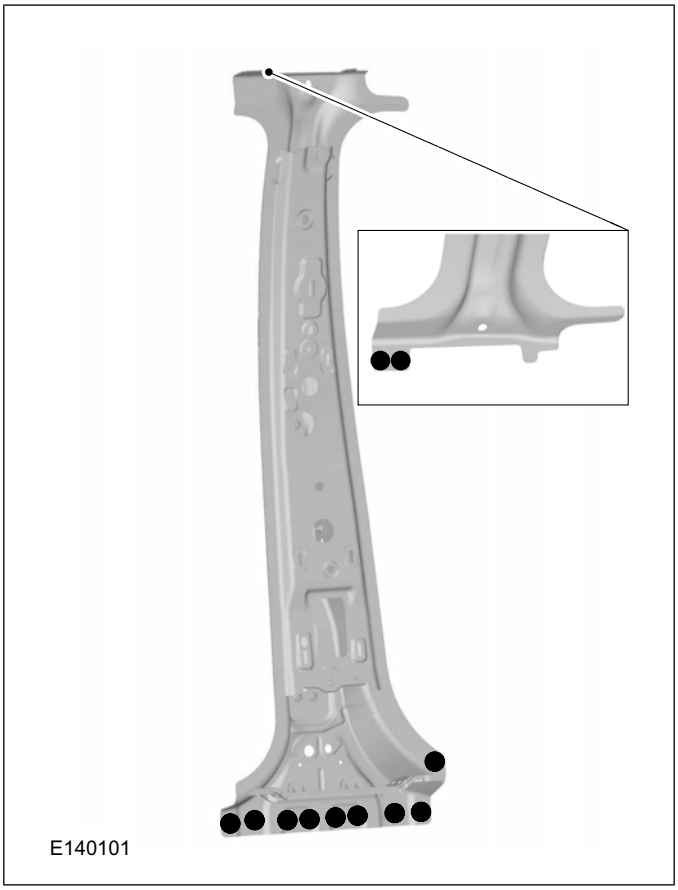
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

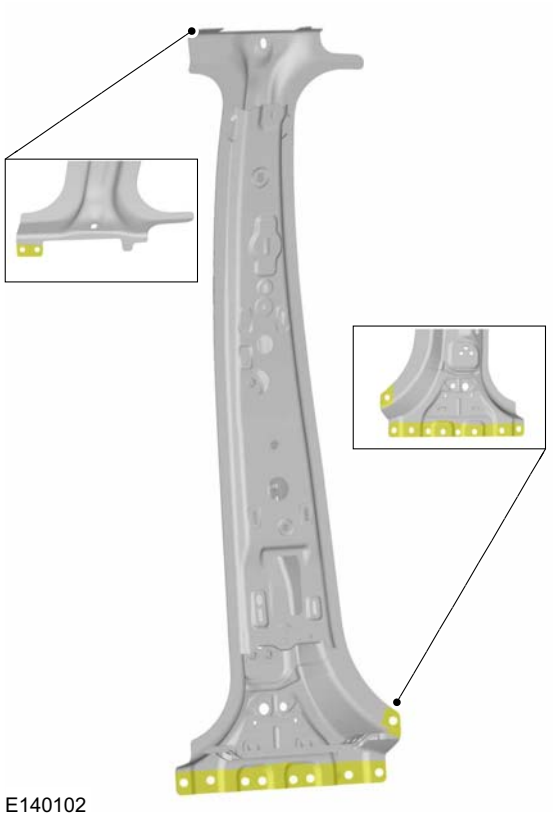
3. • • The holes need to be pre-milled with a spherical cutter with a small diameter. Afterwards these holes are then milled out to the required diameter with a spindle milling cutter. This method is essential in order to ensure that the material in the edge area of the milled holes is not weakened.

   Equipment: Spherical cutter
   • Equipment: spindle milling cutter



REMOVAL AND INSTALLATION

4. • **WARNING: The B-pillar reinforcement is covered with a hot-dip aluminized coating on its entire surface. This coating needs to be fully ground off on the welding flanges on the front and rear using a fibre grinding disc. Any contamination due to parts of the coating in the welding bath will weaken the welded joint.**



E140102

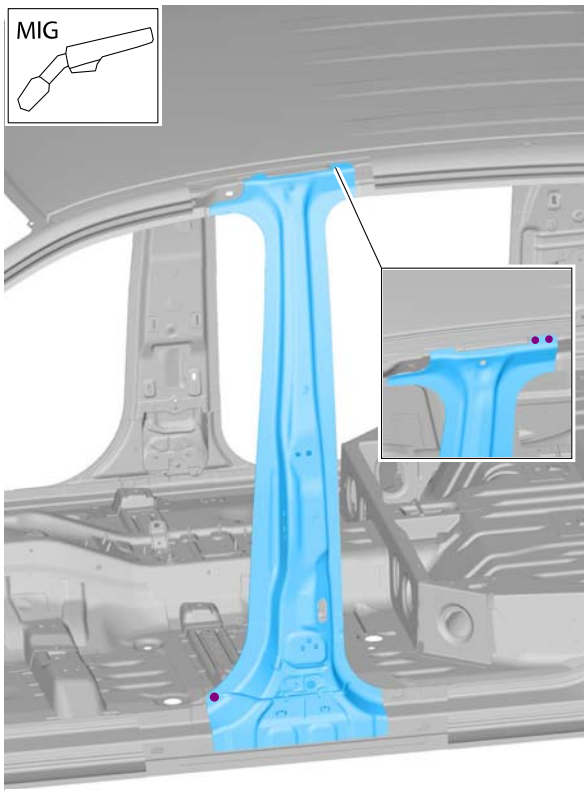
5. • **WARNING: The A-pillar reinforcement is covered with a hot-dip aluminized coating on its entire surface. This coating needs to be fully ground off on the welding flanges on the front using a fibre grinding disc. Any contamination due to parts of the coating in the welding bath will weaken the welded joint.**



E140103

6. • Resistance spot weld - Panel thickness 3 mm and greater!

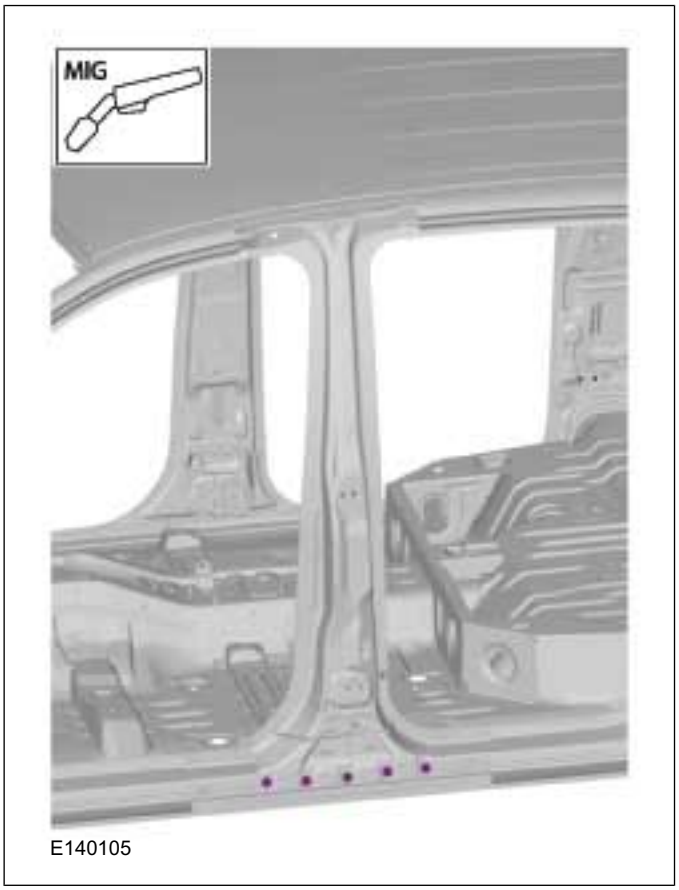
   General Equipment: Resistance Spotwelding Equipment



E140104

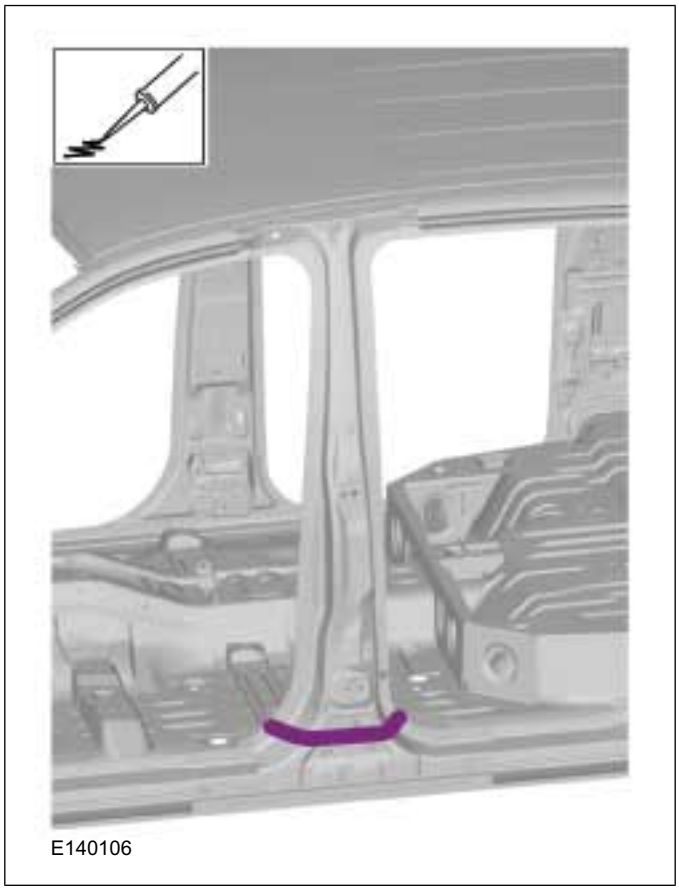
REMOVAL AND INSTALLATION

7. • General Equipment: MIG/MAG Welding Equipment



E140105

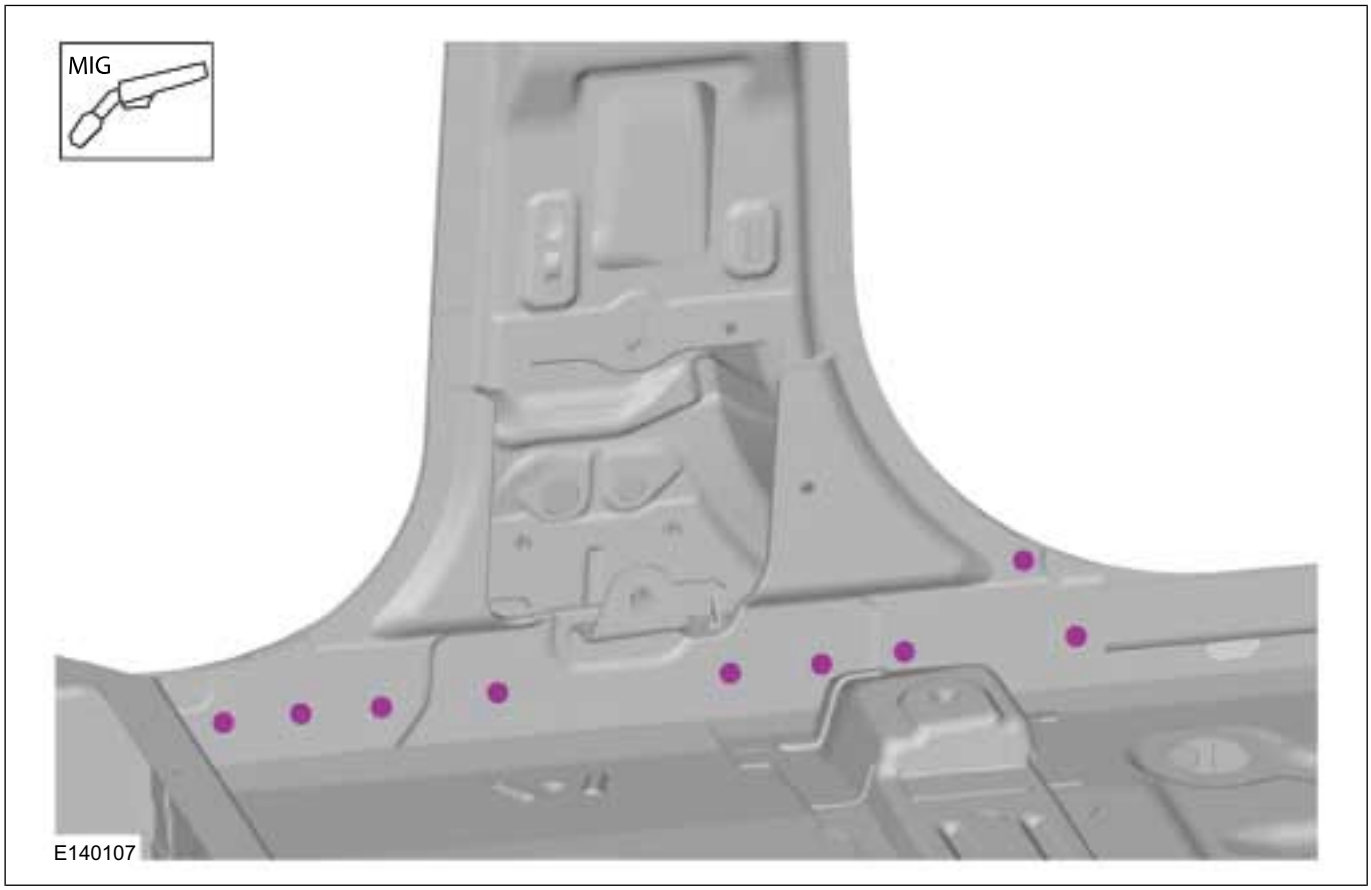
8. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive


E140106

9. • Puddle weld **2** panel layer.

General Equipment: MIG/MAG Welding Equipment

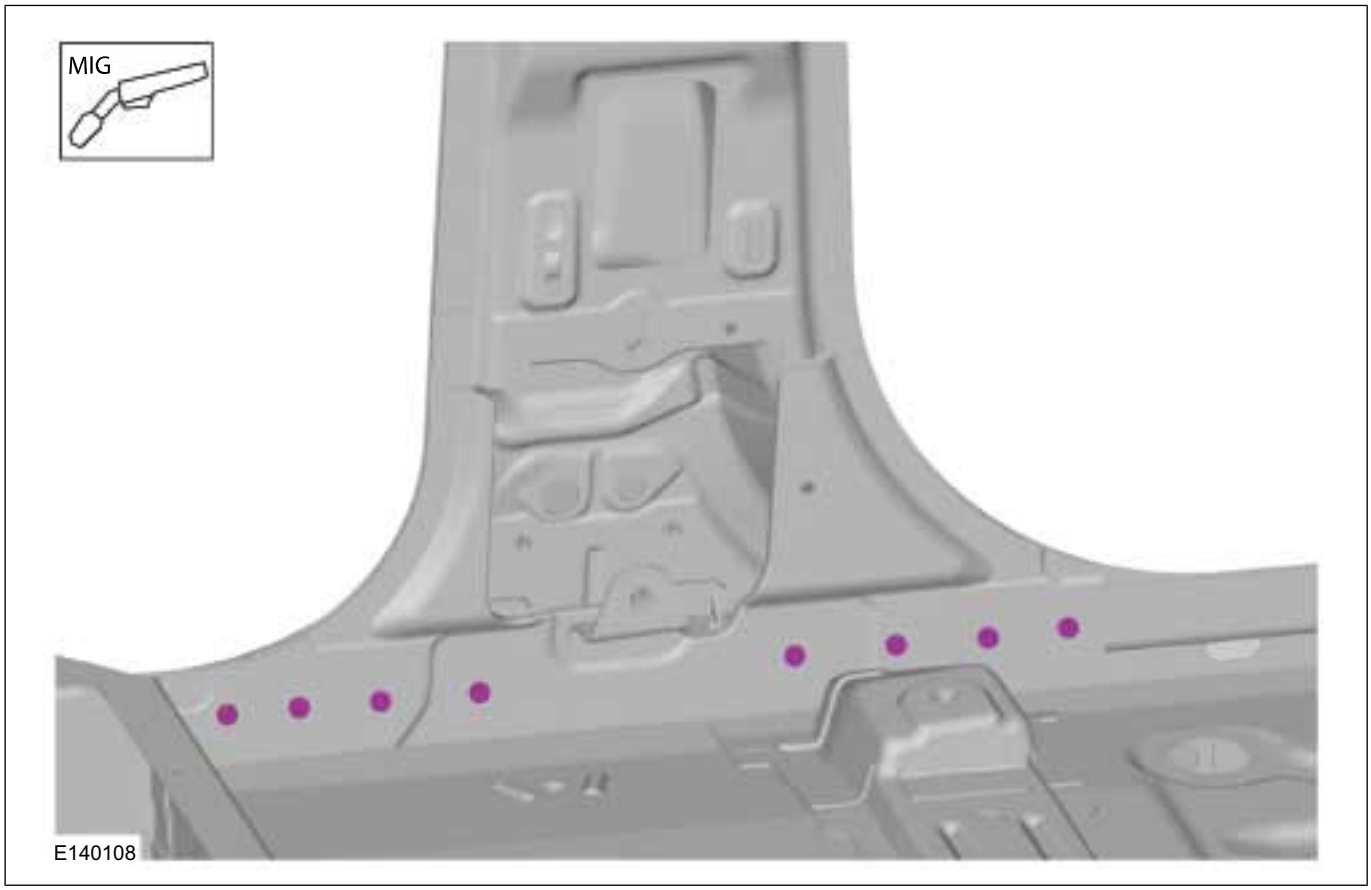
REMOVAL AND INSTALLATION



10. • Puddle weld **3** panel layer.

General Equipment: MIG/MAG Welding Equipment

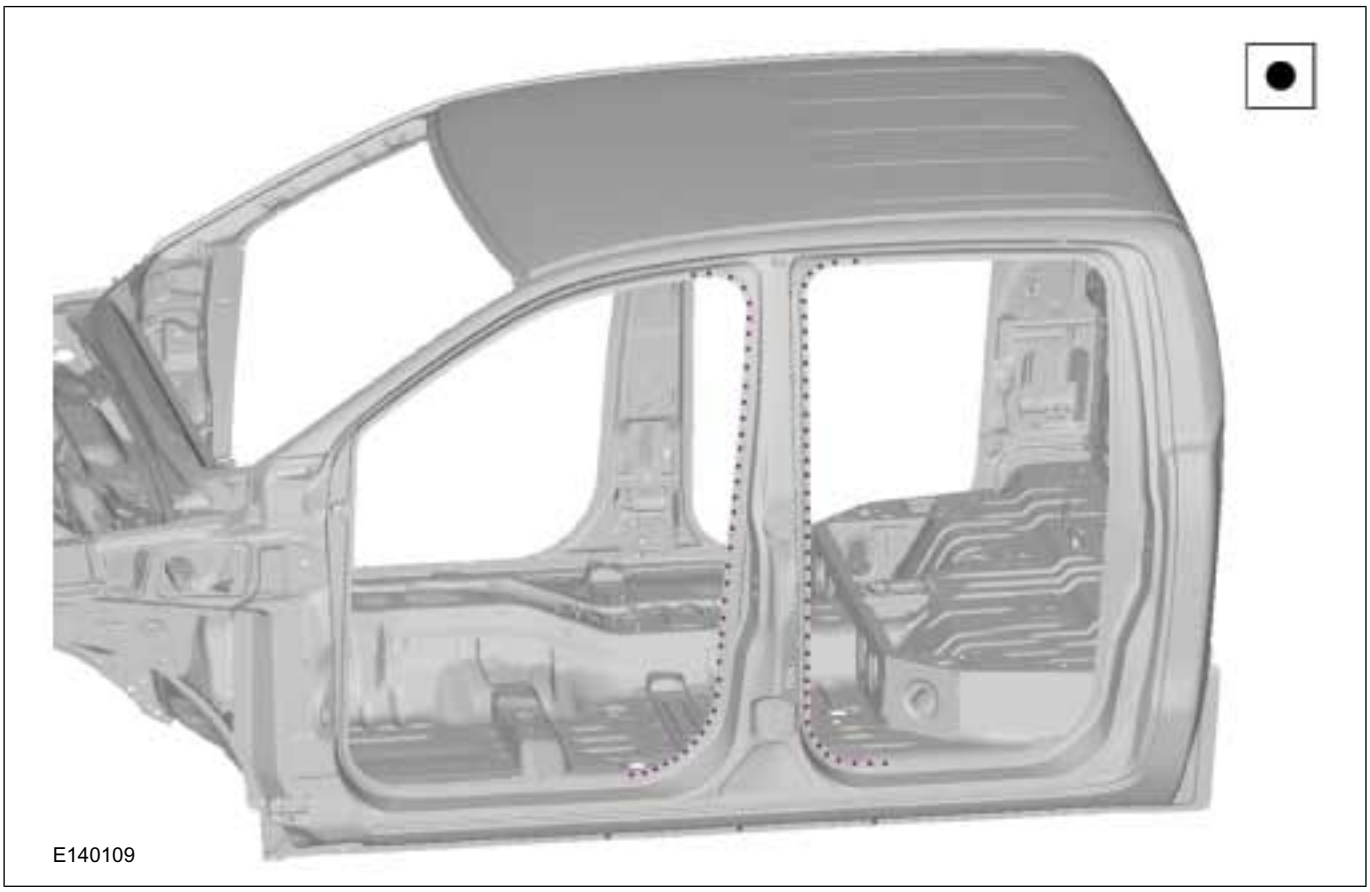
REMOVAL AND INSTALLATION



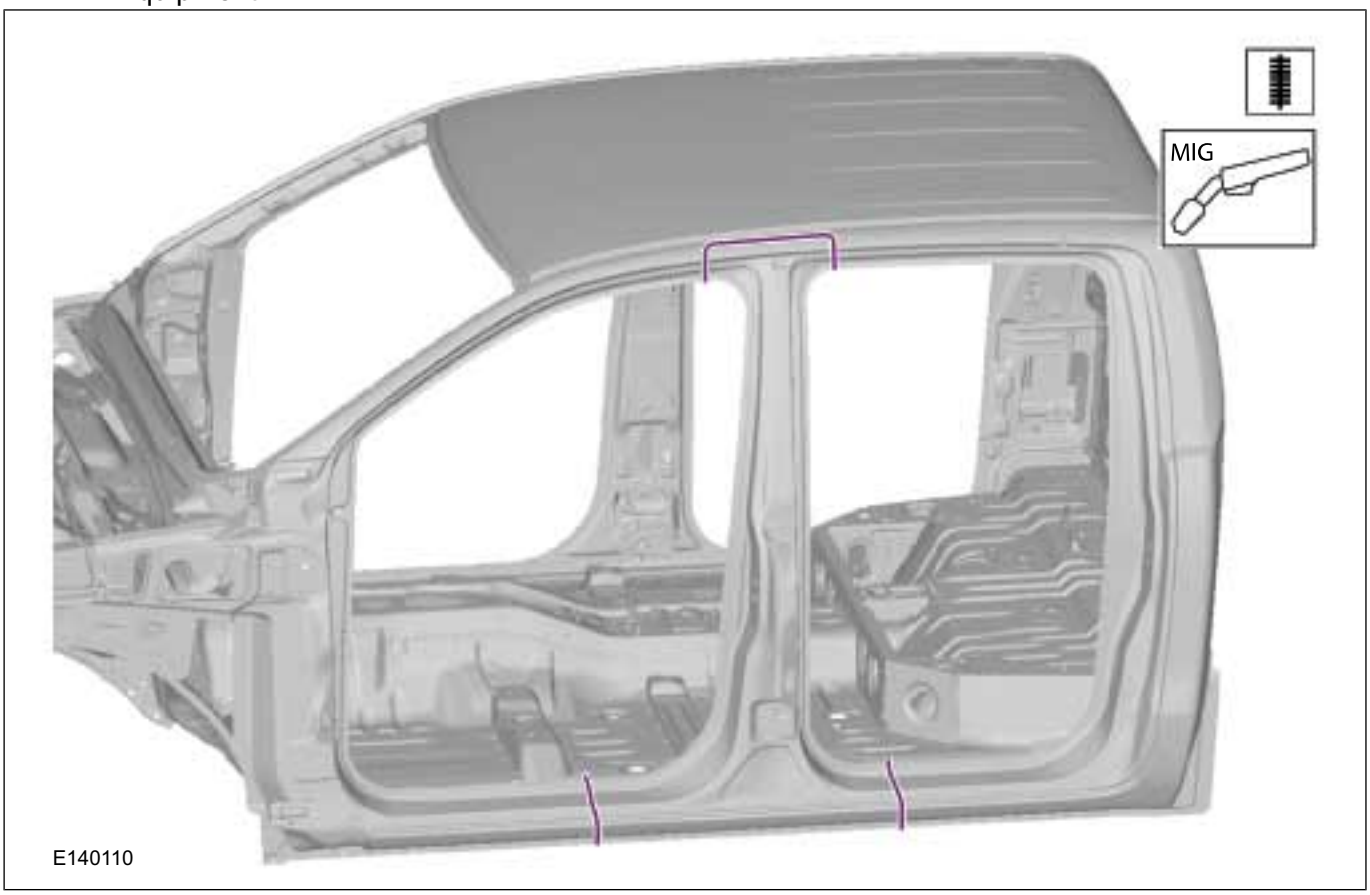
11. • Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION



12 • General Equipment: MIG/MAG Welding Equipment



REMOVAL AND INSTALLATION

13. • Rocker Panel Trim

    Refer to: Front Seat (501-10 Seating, Removal and Installation).
    Refer to: Rear Seat Cushion (501-10 Seating, Disassembly and Assembly).
    Refer to: Rear Seat Backrest (501-10 Seating, Disassembly and Assembly).
    Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
    Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
    Refer to: Headliner (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Front and Rear Door

REMOVAL AND INSTALLATION

B-Pillar Outer Panel — Double Cab

General Equipment
Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment
Spot weld drill Bit

Materials	
Name	**Specification**
Windshield Adhesive Kit	WSS-M11P57-A5

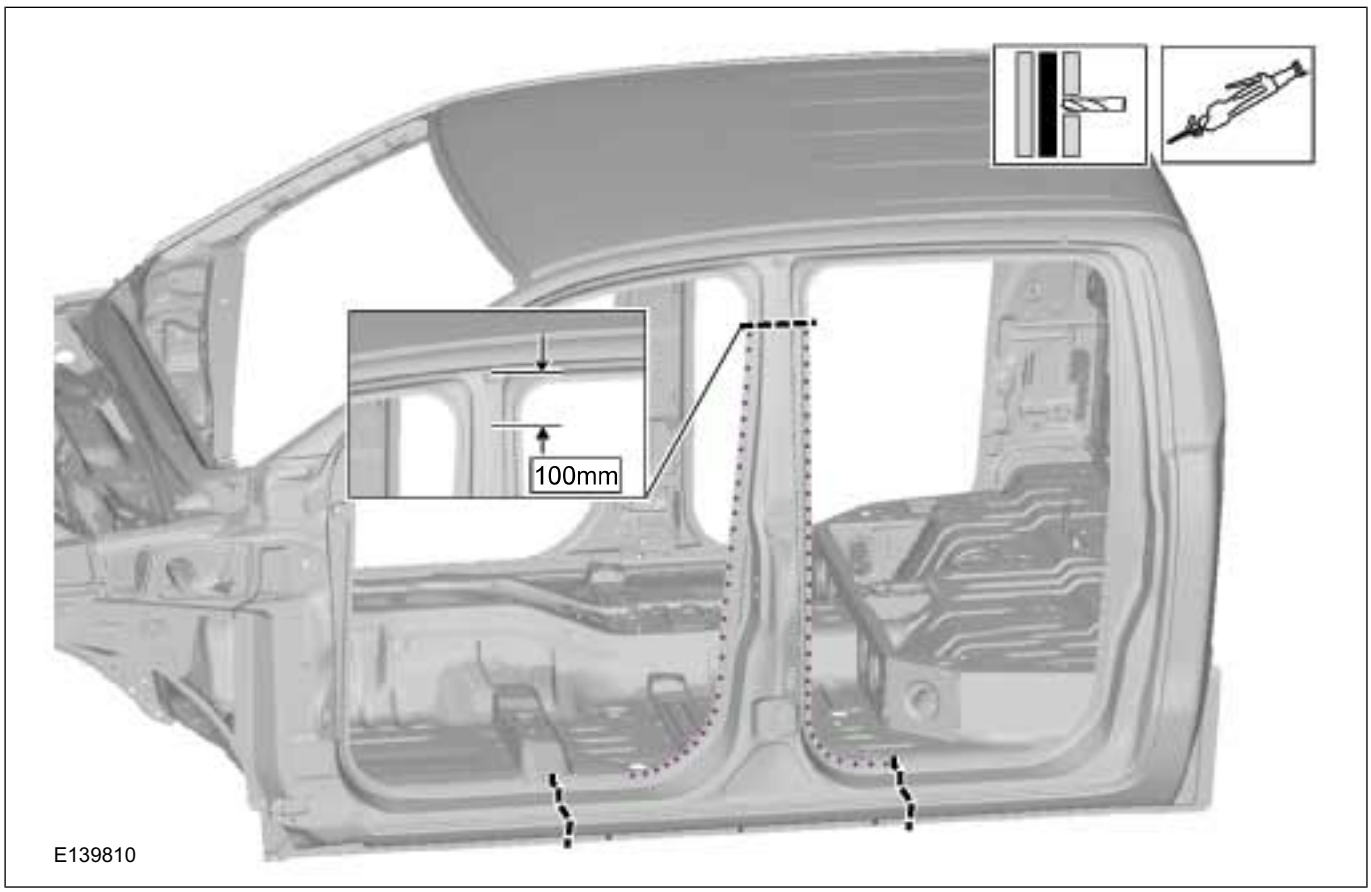
Removal

1. • Rocker Panel Trim

Refer to: Front Seat (501-10 Seating, Removal and Installation).
Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

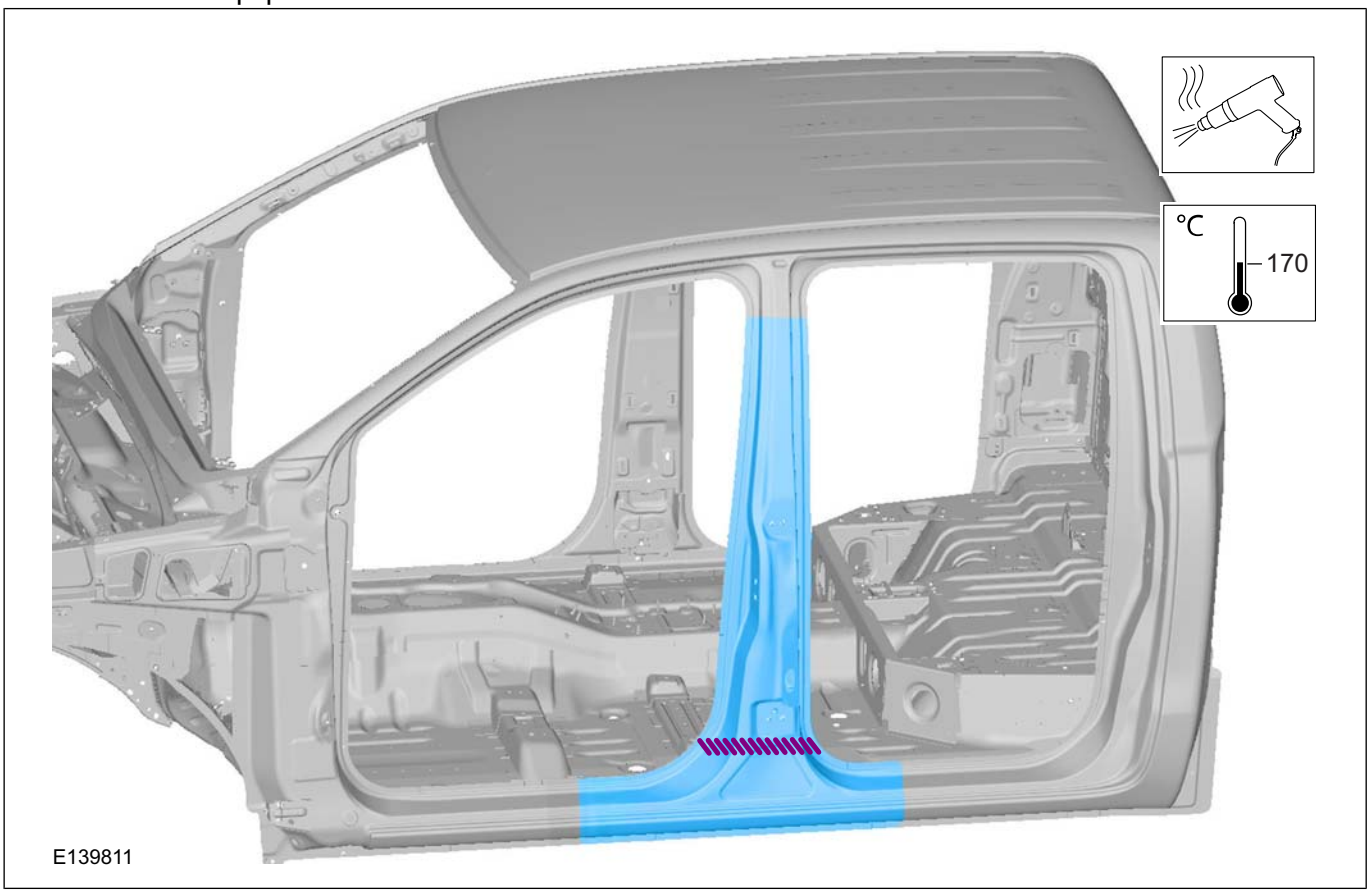
- Front and Rear Door
- Reposition the carpeting and the wiring harness away from the working area.

2. • General Equipment: Air Body Saw
General Equipment: Spot weld drill Bit



REMOVAL AND INSTALLATION

3. • General Equipment: Hot Air Gun



Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

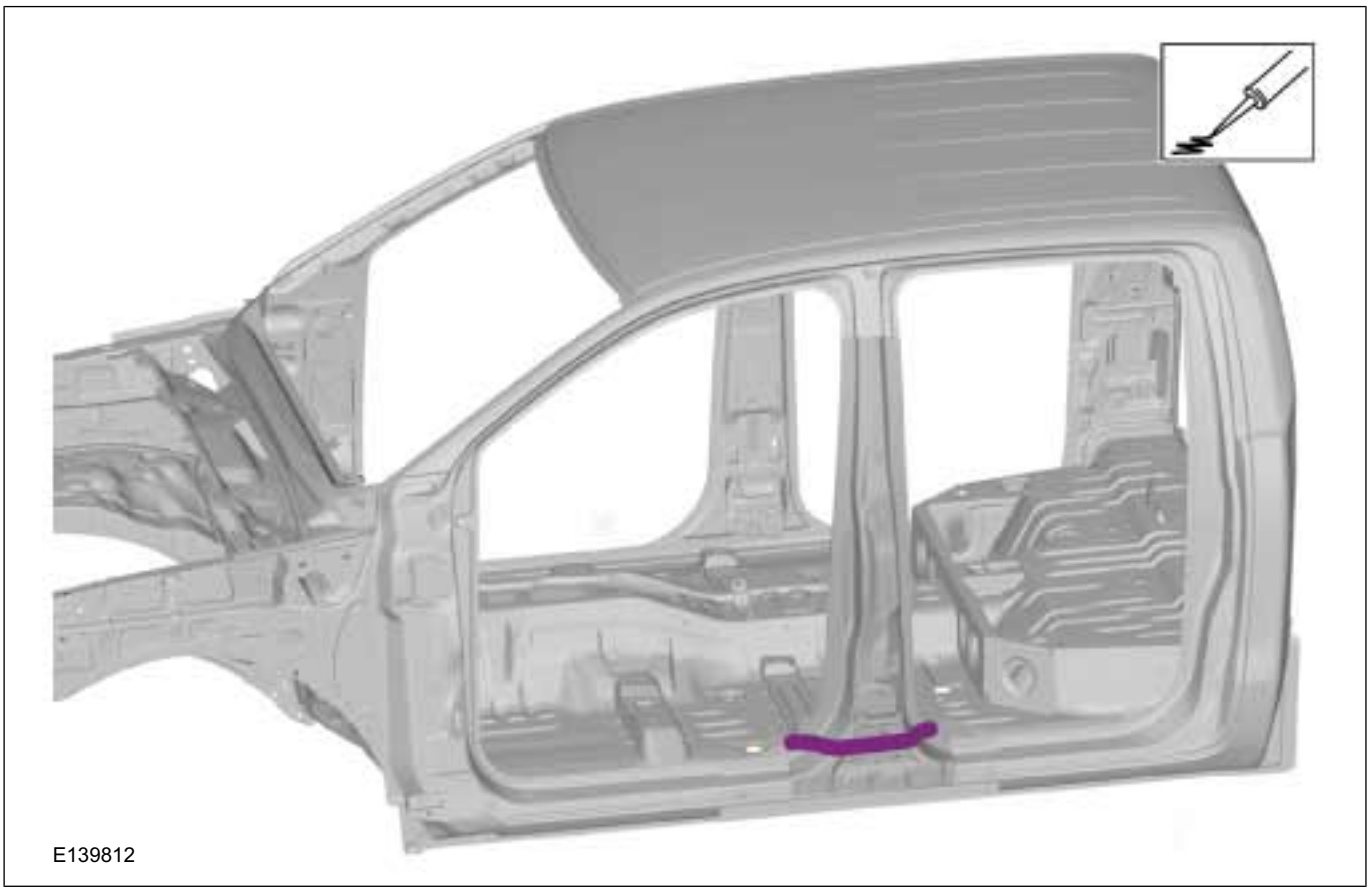
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

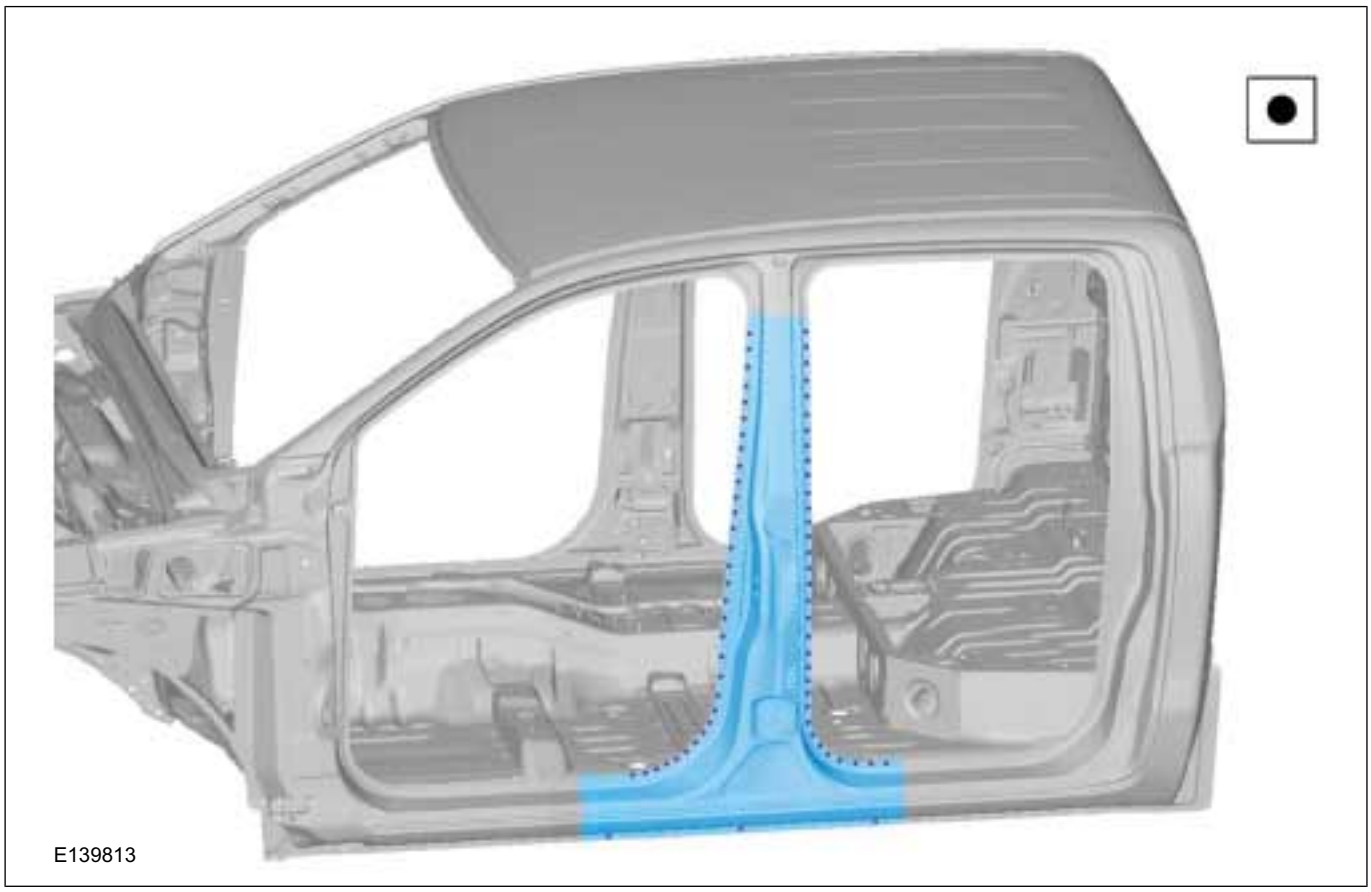
REMOVAL AND INSTALLATION



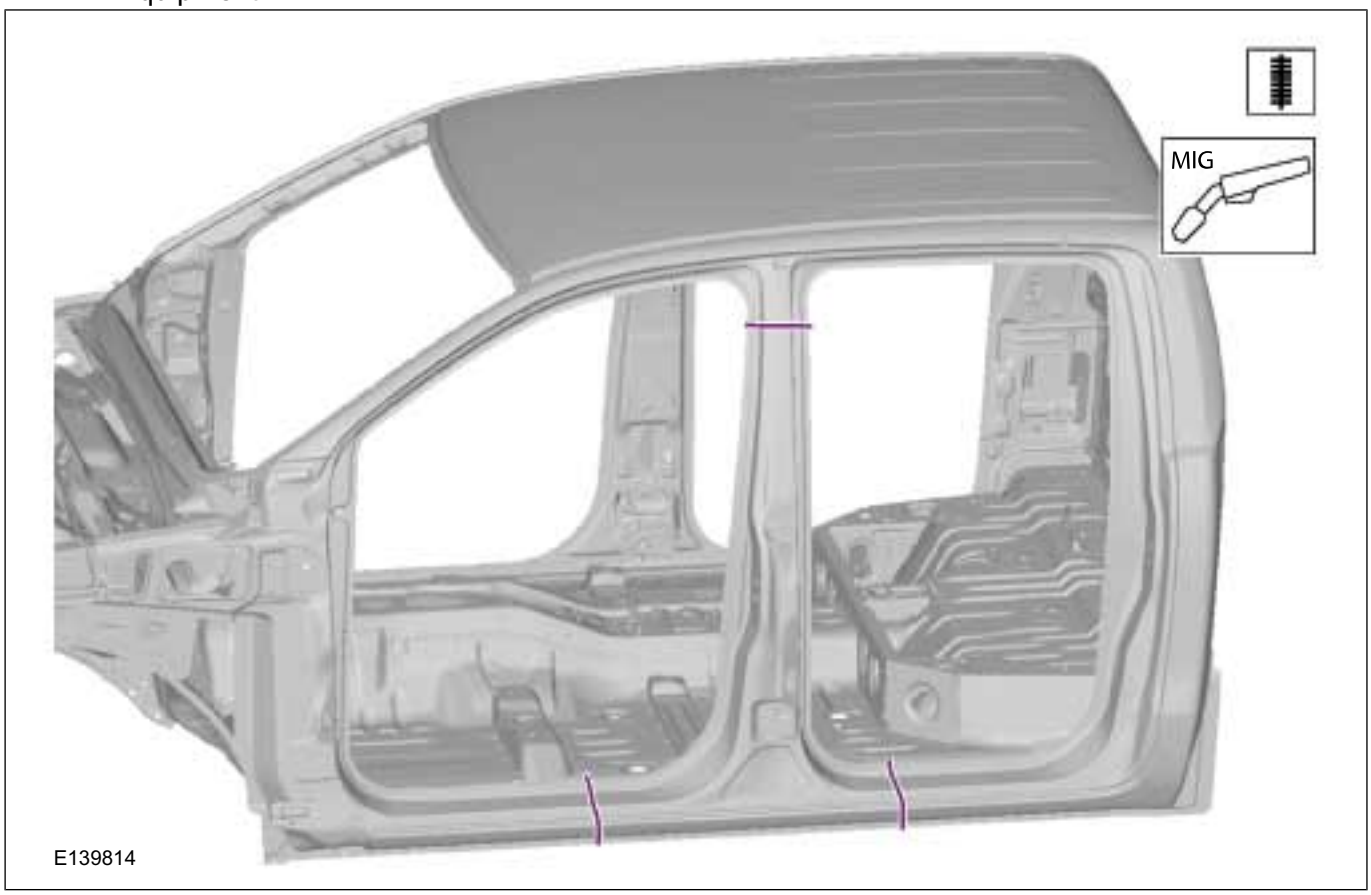
4. • Resistance spot weld - Panel thickness 3 mm and greater!

   General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION



5. • General Equipment: MIG/MAG Welding Equipment



REMOVAL AND INSTALLATION

6. • Rocker Panel Trim

Refer to: Front Seat (501-10 Seating, Removal and Installation).
Refer to: B-Pillar Upper Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: B-Pillar Lower Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Front and Rear Door

SECTION 501-30 Rear End Sheet Metal Repairs

VEHICLE APPLICATION: 2011.50 Ranger

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REMOVAL AND INSTALLATION

Back Panel — Single Cab

General Equipment

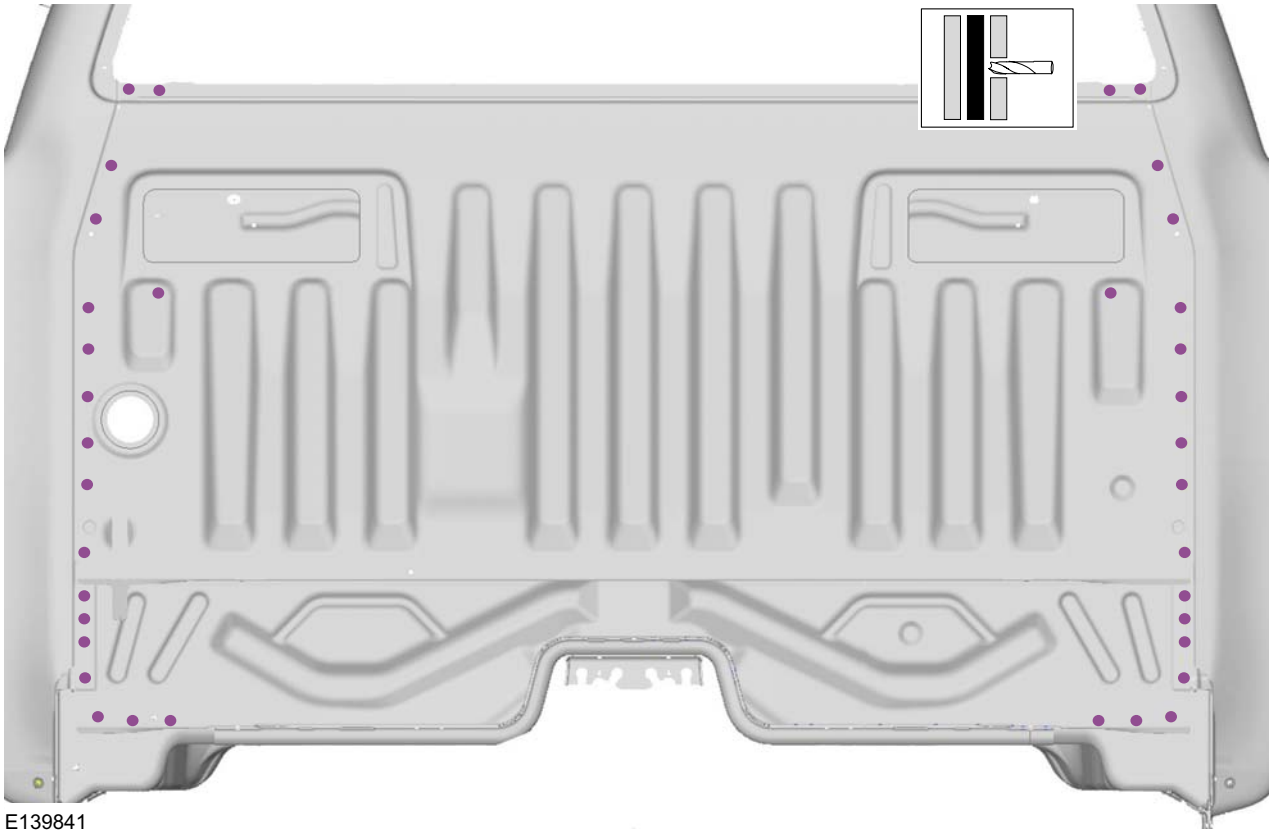
Spot weld drill Bit

Removal

1. Remove the load body.

2. Mill out the spot welds.

General Equipment: Spot weld drill Bit

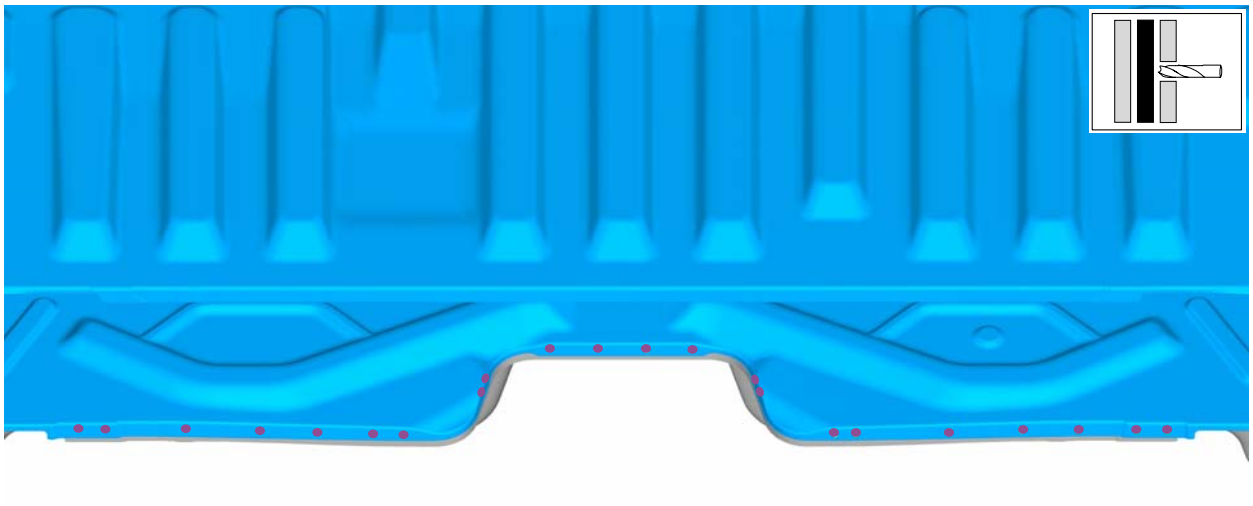


E139841

3. Mill out the spot welds.

General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION



E139842

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

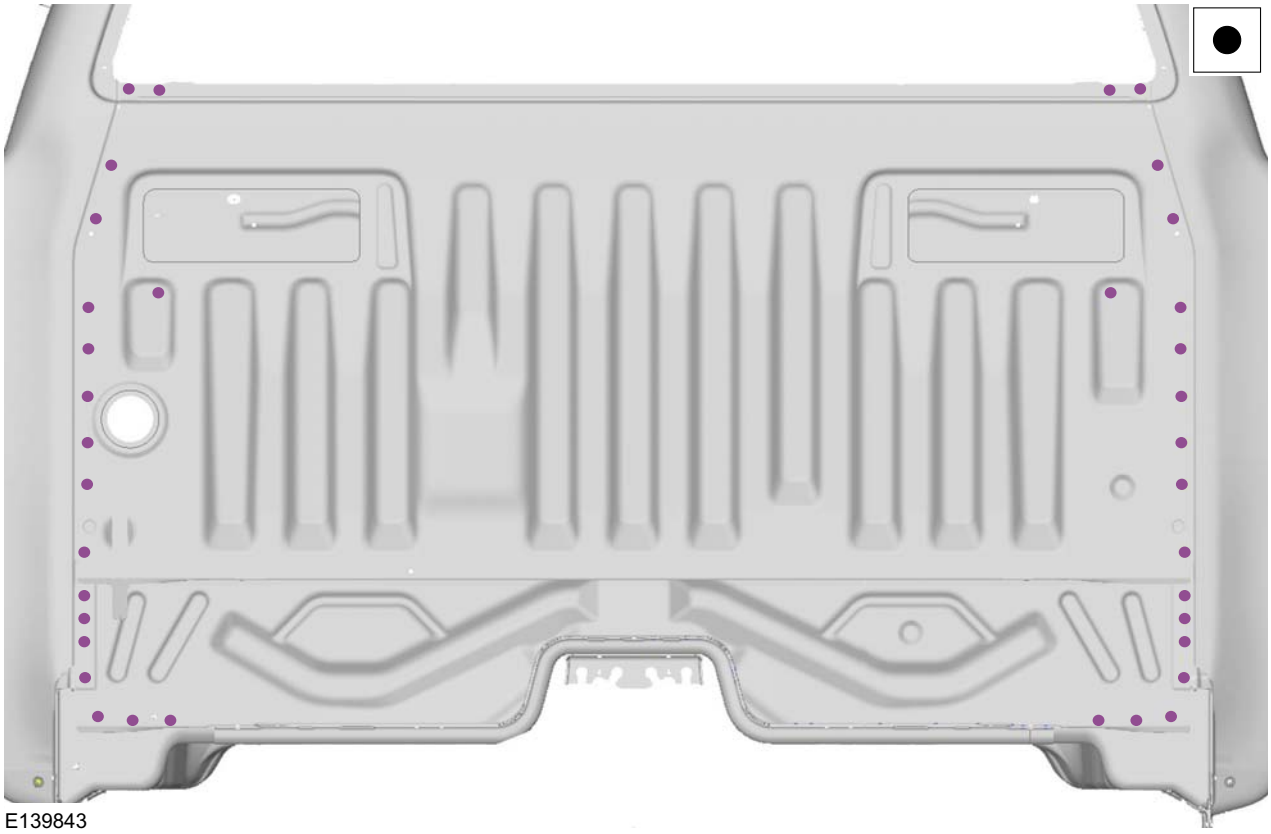
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

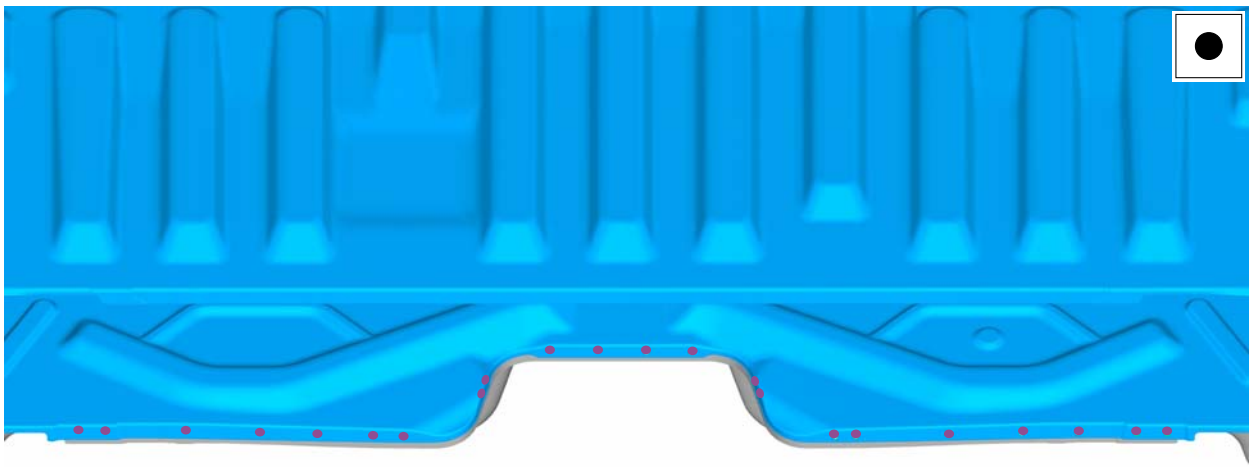
   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • Resistance spot weld - Panel thickness 3 mm and greater.

REMOVAL AND INSTALLATION


E139843

4. • Resistance spot weld - Panel thickness 3 mm and greater.


E139840

5. Install the load body.

REMOVAL AND INSTALLATION

Back Panel — Double Cab

General Equipment

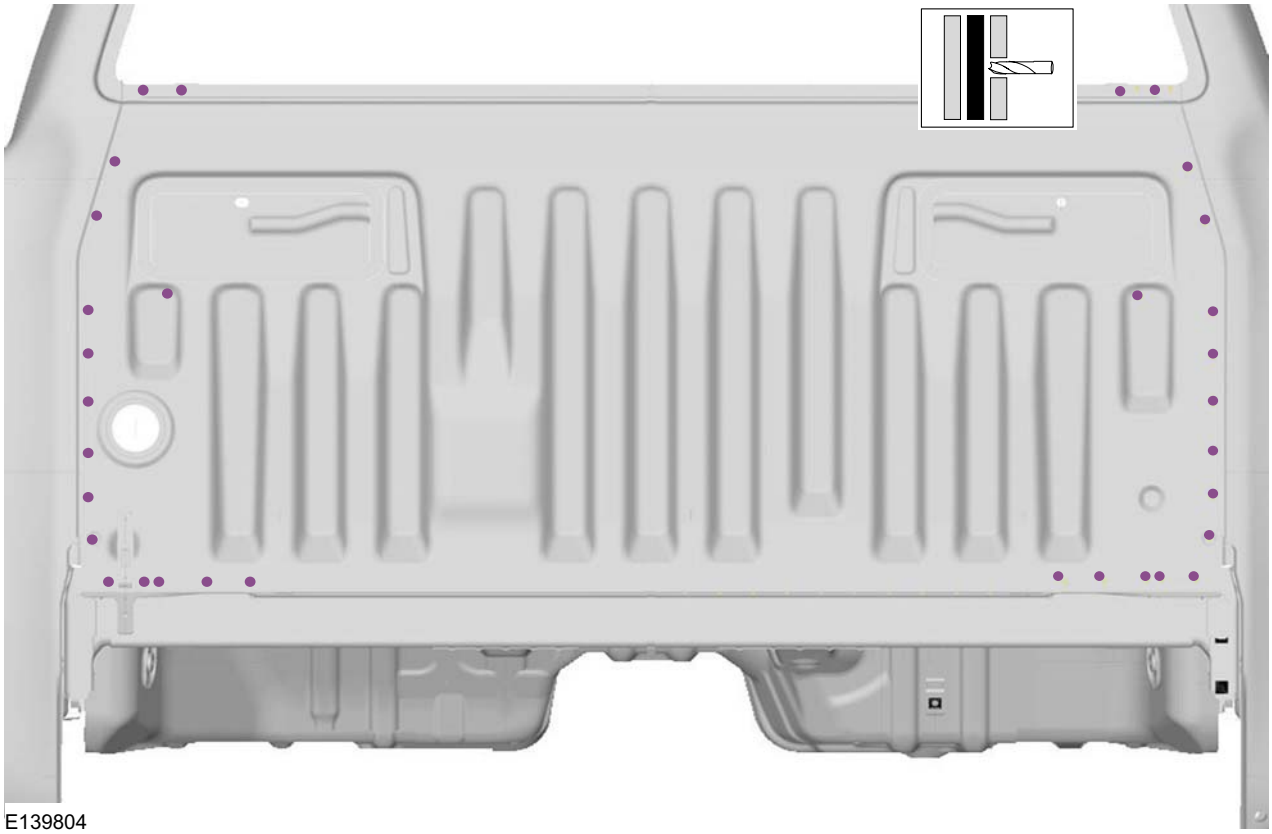
Spot weld drill Bit

Removal

1. Remove the load body.

2. Mill out the spot welds.

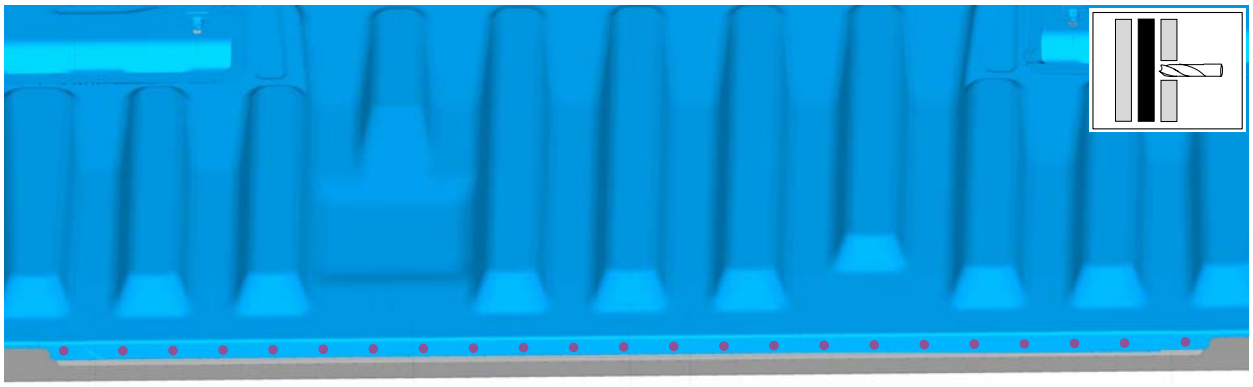
General Equipment: Spot weld drill Bit



3. Mill out the spot welds.

General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION



E139805

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

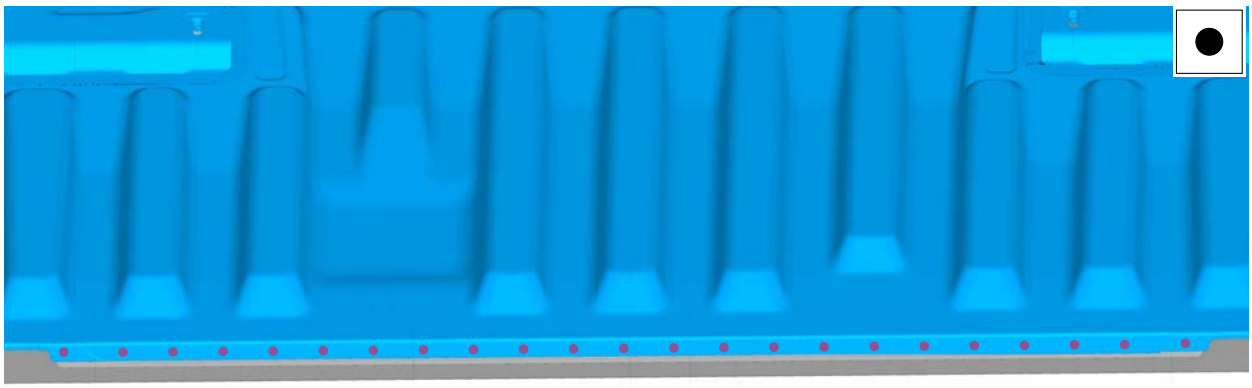
   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • Resistance spot weld - Panel thickness 3 mm and greater.

REMOVAL AND INSTALLATION


E139806

4. • Resistance spot weld - Panel thickness 3 mm and greater.


E139807

5. Install the load body.

REMOVAL AND INSTALLATION

Back Panel — Super Cab

General Equipment

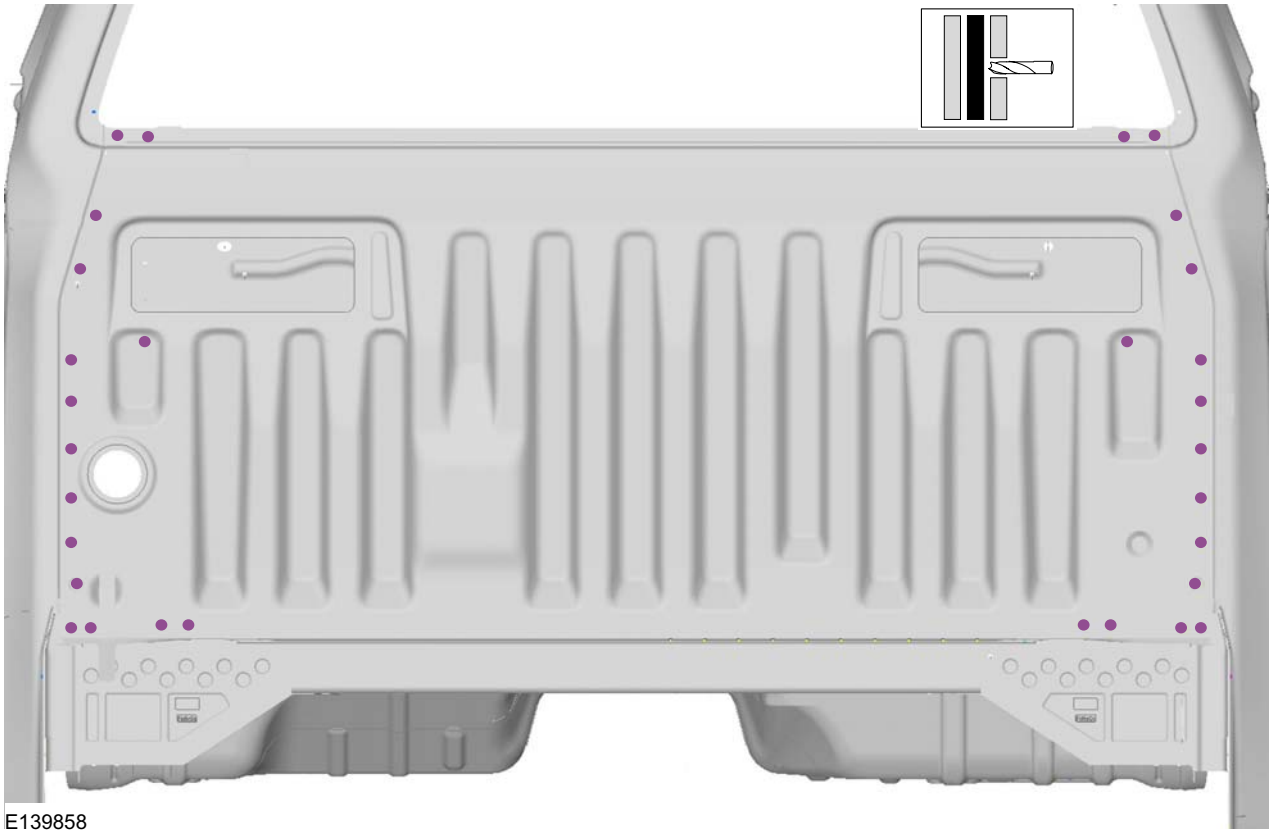
Spot weld drill Bit

Removal

1. Remove the load body.

2. Mill out the spot welds.

General Equipment: Spot weld drill Bit



3. Mill out the spot welds.

General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION



E139859

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

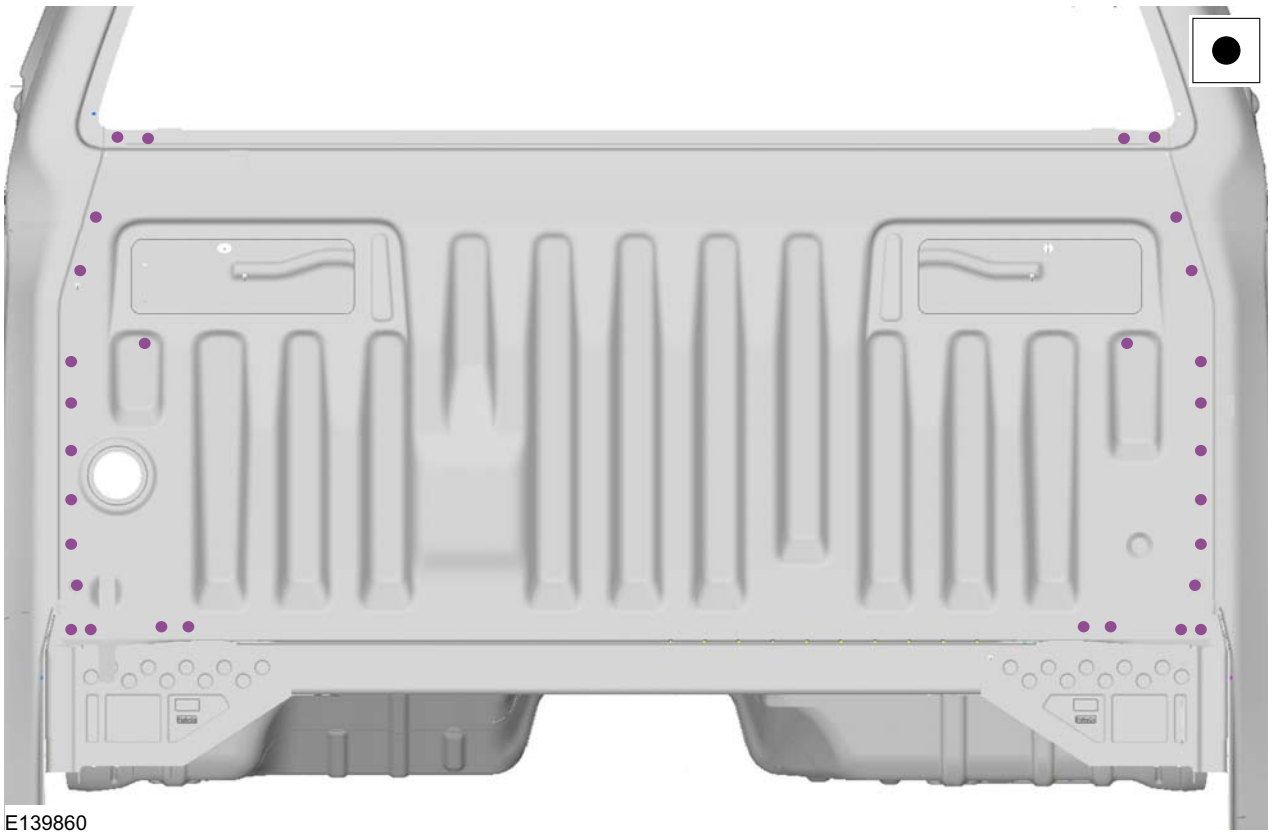
   Refer to: Tools and Equipment for Body Repairs (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

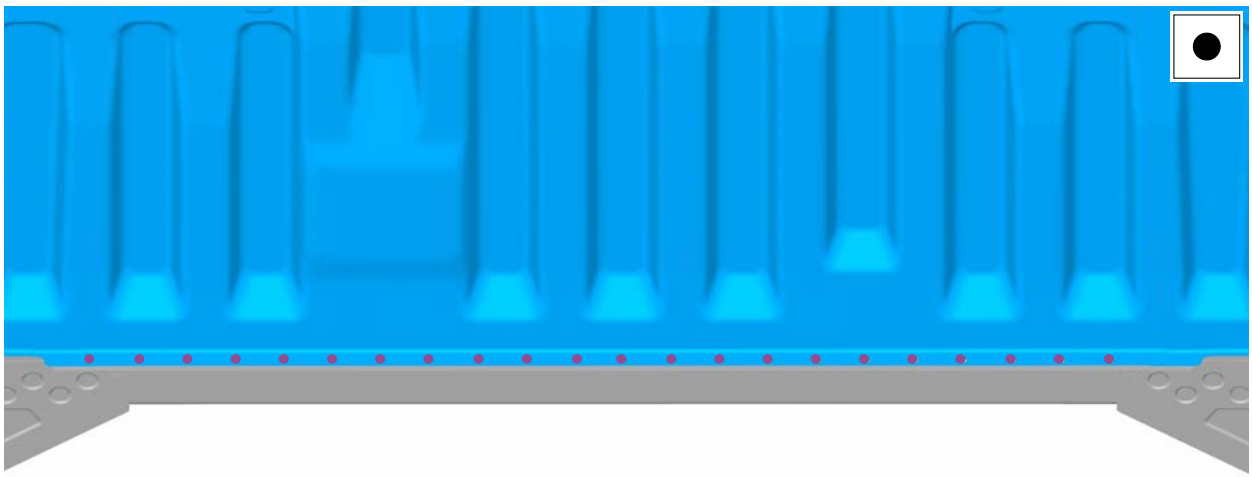
   Refer to: Sealer, Underbody Protection Material and Adhesives (501-25 Body Repairs - General Information, Description and Operation).

3. • Resistance spot weld - Panel thickness 3 mm and greater.

REMOVAL AND INSTALLATION


E139860

4. • Resistance spot weld - Panel thickness 3 mm and greater.


E139861

5. Install the load body.

SECTION 501-36 Paint - General Information

VEHICLE APPLICATION: 2011.50 Ranger

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DESCRIPTION AND OPERATION

Description and Usage of Paint Literature

Vehicle paints are subject to severe demands caused by external influences. Moisture, air-borne deposits in the form of various chemicals and UV light constantly affect a paint surface. Furthermore, mechanical damage occurs through grit, stones and sand. Bird droppings, insect residues, pollen and tree sap also attack the paint surface.

The present literature not only informs the specialist about current repair painting techniques, but also provides tips and instructions on modern and economical repair processes.

High quality bodywork paints require the use of the most modern technologies and regular updating of the technician's knowledge of painting techniques, because of the constantly new developments in paint technology.

Information about different materials is listed under Specification.

Furthermore, information on the fundamental principles of repair painting and paint materials is provided in several chapters. The safety instructions indicate the possible health hazards and other sources of danger. There are also notes about tools and materials as well as on basic painting methods.

In the model specific repair instructions, only the most important repair steps or special features are referred to. Detailed information on the generally applicable painting procedures is given in this paint manual.

Direct supply of repair paints by Ford has been discontinued. There is however an agreement with many paint manufacturers, which ensures fast and problem-free supply to the dealer undertakings.

Paint suppliers:

- DuPont
- Glasurit
- PPG
- Sikkens
- Spies Hecker
- Standox

When using painting materials, it should be taken into account that the manufacturers have exactly matched their products between each other. In order to avoid quality defects, difficulties in working and losses in corrosion protection, these may not be substituted with other products.

NOTE: The Ford Service Organization organizes basic and more in-depth training on much of the content of this paint manual. As well as the practical part of the training, a further component is the Student Information document, which offers supplementary information in the form of a brochure.

During all work it must always be ensured that personal safety and the operational capability of the vehicle are not threatened by the choice of methods, tools and components.

The information given in the diagrams in the chapter "Paint Damage" is provided by the repair paint manufacturer.

DESCRIPTION AND OPERATION

Symbols

General

Various symbols, signs, instructions and illustrations are used in this literature. Warnings and cautions have different meanings and require different ways of proceeding. Diagrammatic representations are provided with instructional signs for improved clarity. These are briefly explained below:

WARNING: This caption is used when failure to follow instructions exactly or failure to follow them at all may result in a hazard to persons or in persons being injured.

CAUTION: This caption is used when incorrectly following the test procedures or instructions or failure to follow them at all could lead to damage to the vehicle or components.

NOTE: This caption is used when attention needs to be drawn to special or extra information.

When reading this handbook, you will come across the points WARNING, CAUTION AND NOTE. These instructions are always given immediately before the corresponding job steps.

Hazardous materials designations

Many accidents occur because of ignorance. In the area of personal health protection, it is particularly important to clearly emphasize sources of danger and their effects on human organs.

Only with knowledge of hazardous material designations can it be certain that the necessary precautions are taken when handling substances which are harmful to health.

NOTE: Pay attention to the manufacturer's data on the containers and given in the Safety Data Sheet.

DESCRIPTION AND OPERATION

Hazardous material symbols

TO BE UPDATED LATER

Item	Description
1	Very poisonous, T+ (extremely toxic), small quantities can be fatal.
2	Poisonous, T (toxic), causes serious damage to health
3	Corrosive, C (corrosive), destroys living tissue.
4	Harmful to health, Xn (noxious).

Item	Description
5	Irritant, Xi (irritant), can cause inflammation.
6	Explosive
7	Highly flammable, F+ (extremely flammable), already flammable at temperatures below 0° C.

DESCRIPTION AND OPERATION

Item	Description
8	Flammable, F (flammable), forms a flammable mixture with air.
9	Oxidizing, O (oxidizing), reacts with combustible substances.

As well as the danger symbols, there is more comprehensive manufacturer's information to be found on the containers and in the Safety Data Sheets, and you must pay attention to this information.

Instructions on measures to be taken for personal protection.

As well as the information about sources of danger, there are mandatory instructions which draw your attention to the personal protection measures to be taken.

Mandatory symbol

TO BE UPDATED LATER

Item	Description
1	Breathing protection must be worn
2	Eye protection must be worn
3	Ear protection must be worn
4	Protective gloves must be worn
5	Protective footwear must be worn

Icons

So that the necessary information for optimal handling is clear, unambiguous and can be quickly understood, the leading paint manufacturers have agreed a standard symbolic language. Language independent representations in the form of icons provide handling instructions which are supplemented with quantity or time information.

Pretreatment

TO BE UPDATED LATER

Item	Description
1	Clean
2	Sand

DESCRIPTION AND OPERATION

Mix

TO BE UPDATED LATER

Item	Description
1	2 component mixture
2	3 component mixture
3	Use a measuring rod
4	Addition of hardener
5	Addition of additives

Process

TO BE UPDATED LATER

Item	Description
1	Flow-beaker spray gun
2	Suction-beaker spray gun
3	Spray passes
4	Filler
5	Coat
6	Underbody protection spray gun

DESCRIPTION AND OPERATION

Dry

TO BE UPDATED LATER

Item	Description
1	Ventilate
2	Drying time
3	Drying time with infra-red dryer

Further processing

TO BE UPDATED LATER

Item	Description
1	Hand abrade (wet)
2	Hand abrade (dry)
3	Eccentric sander (wet)
4	Eccentric sander (dry)
5	Oscillating sander (wet)
6	Oscillating sander (dry)

Store

TO BE UPDATED LATER

Item	Description
1	Protect from moisture
2	Store in a frost-free environment
3	Store in a cool place
4	Close the container

Other

TO BE UPDATED LATER

Item	Description
1	Stir by hand
2	Stir using a mixing machine
3	Polish
4	Roll

DESCRIPTION AND OPERATION

Health and Safety Precautions

General instructions for the paint shop and handling paint materials

Hazardous areas in repair paint shops:

- Danger from fires, explosions and hot surfaces.
- Dangers to health and safety from the effects of harmful substances because of their absorption through the skin and/or inhalation.
- Dangers caused by electricity, compressed air, power tools and noise.

WARNING: During painting work there is an increased danger of fire or explosion. Prevent any sparks being created. Fire, naked lights and smoking are forbidden.

Measures:

- Wear protective footwear made from anti-static material.
- Only use tools made of wood, brass or copper to clean stands and extraction ducts. Do not use tools made of steel.

Only fill or decant paint materials in a specially marked area.

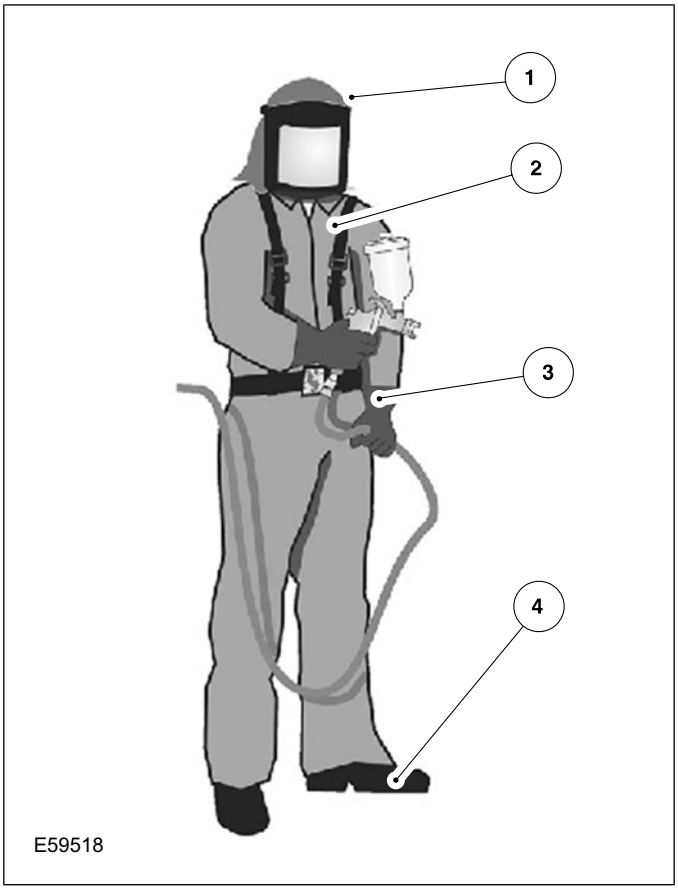
As well as these general instructions on the dangers in repair paint shops, all national and international regulations must be observed:

- Health and Safety at Work Act
- Ordinance on Hazardous Substances
- Technical Rules for Hazardous Substances
- Regulations for the Prevention of Industrial Accidents
- EU Directive on Hazardous Substances, 98/24/EU
- EU Directive on Noise, 2003/10/EU
- EU Directive on Volatile Organic Compounds (VOC), 1999/13/EU, 2001/81/EU, 2004/42/EU
- Safety instructions of equipment and tool manufacturers

Personal protection

Besides the body and limbs, several organs vital to life are in very particular danger. Because damage is mostly irreparable, special attention and comprehensive protection are necessary.

WARNING: Solvents cause damage to the health through inhalation. Splashes in the eyes or on the skin can cause bodily harm. When working with solvents, always use suitable means of protection.



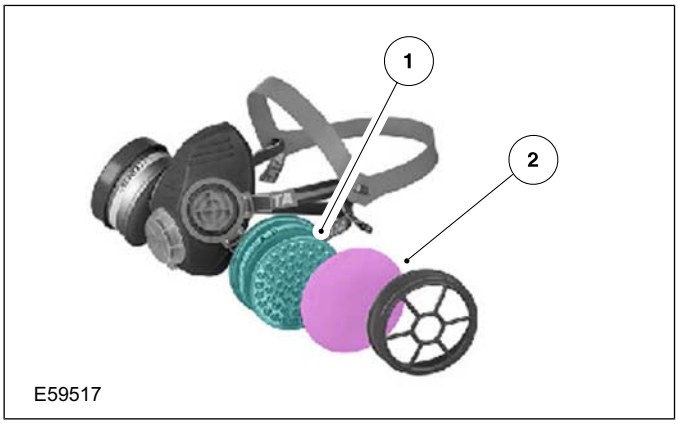
Item	Description
1	Protective hood with fresh air supply
2	Protective clothing
3	Protective gloves
4	Protective footwear

Breathing protection

During painting work and in the preparations for painting, gases, vapors, mists or dusts can appear in dangerous concentrations in the areas where fellow employees breath.

For short periods of work or minimal concentrations of hazardous substances, breathing protection devices with a combination filter are suitable as breathing protection equipment.

DESCRIPTION AND OPERATION



E59517

Item	Description
1	Activated charcoal filter
2	Coarse filter

For higher concentrations of harmful substances, breathing protection devices which are independent of the local atmosphere are suitable.

In these types of isolation systems, a compressed air hose carries natural air from the compressor line into the protective mask. During supply, the air undergoes pressure reduction, water removal, fine filtration and usually warming to natural breath temperature.

WARNING: Vapor or spray mist containing isocyanate as a paint base or hardener can cause toxic respiratory disease (conditions similar to asthma) leading to permanent damage, even when inhaled in the lowest concentrations.

Filter masks with wadding, sponge or colloid filters and also paper masks are all unsuitable for working with coating materials because they do not stop solvent vapors.

The instructions for use provided by the manufacturer must be observed when working with breathing protection equipment.

Skin protection

Spray painters who are subject to considerable exposure to coating materials must wear suitable protective work clothing (flame-proof and anti-static).

NOTE: Also, when working with water based materials, comprehensive skin protection must be worn, because these materials are very easily absorbed through the skin.

The protective clothing must be changed at the proper intervals. Items of clothing which are contaminated with coating materials can easily catch fire.

When selecting protective clothing, it must be taken into account that cloth containing a high proportion of easily melted plastic thread considerably increases the degree of burns injury (melted plastic on the skin!). This must also be taken into account in the choice of underwear.

For areas of skin which are not covered by protective clothing, suitable skin protection, skin cleaning and skin care agents must be used.

Eye protection

Working with portable hand sanding machines on which the tools move unguarded, at speed and with power is fundamentally dangerous.

Goggles must be worn not only when sanding, but also when working with paints and their additives. These contain substances which are harmful to the eyes. Damage ranging from irritation of the cornea to incurable illnesses are possible.

The protective goggles must be inert toward splashes of solvent, and fully enclose the areas at the side of the eyes on both sides. The best protection during spray painting is offered by full mask respirators or helmet respirators with a built-in visor.

Ear protection

Noise disturbance in repair paint shops caused by various sources is particularly high. Sanding and compressed air machines, paint cabin extractor fans (compressors) and extractor ducts in the work rooms are the causes of the high levels of noise.

WARNING: Avoid damage to your hearing! Wear ear protection.

Suitable ear protection is offered by ear plugs or ear defenders.

DESCRIPTION AND OPERATION

Environmental Regulations

Waste disposal in the repair paint shop

More than ever before, since the introduction of EU directives, rigorous attention is paid to the avoidance of waste materials and to recycling in repair paint shops. In this respect, repair paint shops must take into account and comply with the following requirements:

- Separate waste according to its recycling and disposal methods.
- Produce evidence for the correct transport and disposal of waste.

NOTE: The organization of disposal in the plant must comply with the requirements of the Waste Avoidance and Management Act: The avoidance and recycling of waste must always take priority.

However, despite all measures which may be taken, waste cannot be completely avoided.

NOTE: Waste which is not allowed in household rubbish, and which can no longer be utilized, must be disposed of as special waste.

Paint residues containing solvent, application residues, sanding dust, waste containing peroxides, solvents, soiled cleaning cloths and paint slurry all count as special waste. Each of these must be collected in a separate, sealed and suitably labeled metal container and properly disposed of using a specialist company.

Careful separation allows some waste to be usefully re-used.

- Empty metal containers can be sent for scrap instead of being disposed of as waste.
- Contaminated cleaning thinners can be separated by distillation.
- Packing material and masking paper can be added to the recycled paper collection.

Residues which cannot be used must be correctly disposed of.

All remaining waste must be treated as commercial waste and disposed of according to the local regulations.

The new VOC (Volatile Organic Compounds) solvent regulation

Keeping the air clean protects the environment and the population from the heath-damaging effects of air pollutants.

In certain atmospheric conditions, volatile organic compounds contribute to summer smog.

NOTE: For comprehensive information, please refer to the European VOC Directive, 1999/13/EU. Furthermore, the effective national regulations must be complied with.

The European VOC (Volatile Organic Compounds) Directive has controlled the limits for such compounds since August 2001. It applies to production coating companies and those which undertake repair painting of private and commercial vehicles.

Not least because of the VOC legislation, modern, low solvent and solvent-free lacquers and paints are finding greatly increased distribution across industry and the trade. Up to the year 2007, emissions from painting work will drop by at least 40%.

At the same time, the paint manufacturers guarantee for example that they will produce a ready-to-spray product consisting of base paint + hardener + thinners, with a permitted VOC level.

A company in business today can conform with the stipulated requirements by introducing water-based paints and using the other necessary products from the relevant paint manufacturers.

For more detailed information, please refer to the EU VOC Directive.

DESCRIPTION AND OPERATION

Factory Paint Application

General fundamentals of paint technology

Paint is a pigment-containing liquid which undergoes chemical and/or physical processes after it has been applied to a surface, so changing into a solid film covering.

Repair paint consists of binder, pigments, filler and solvent.

NOTE: Organic solvent is being replaced by solvent based on water.

Constituents of paint

- Binder
  - Mostly semi-fluid resins which bind together the other components of the paint when it dries.
  - Makes the paint durable.
  - Ensures good surface coverage.
- Pigments
  - Fine, colored powders, which give color to the paint.
  - Cover the components below (covering power).
- Additives
  - Additives give the paint special properties.
  - e.g. flow improver, softener, drying accelerator, thickener.
- Solvent
  - Thins the paint and allows it to flow more freely.
  - Evaporates during drying.

Painting process and corrosion protection.

In production, painting consists of individual steps which are optimally matched to each other.

Bodywork consists almost entirely of steel panels which have been pre-coated with zinc. The zinc layer is between 5-10 µm thick and acts as the first corrosion protection layer of the steel panel.

Production sequence:

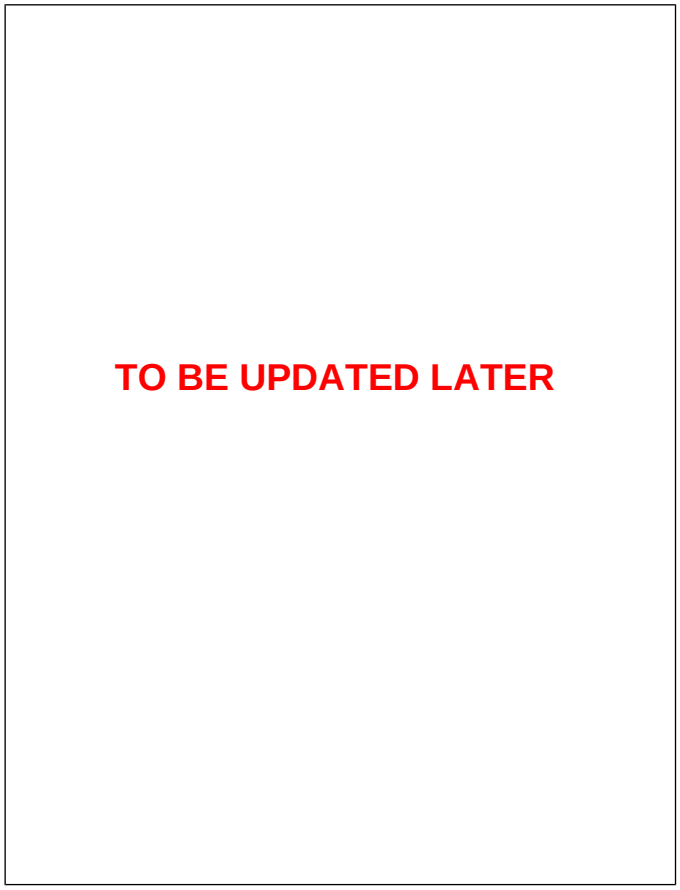
- Clean and de-grease
  - In the first step, the bare bodywork is initially dipped in a cleaning bath and cleaned with a degreasing solution.
- Phosphatising
  - The cleaned bodywork is dipped in a bath containing various phosphate salt solutions. This creates a crystalline metal-phosphate layer which offers the optimal prepared surface and also corrosion protection.
- CDP base
  - The cataphoretic dip paint (CDP) base acts as a further corrosion protection layer.
  - In this process the bodywork is completely immersed in a bath consisting of a paint and electrolyte solution.
  - By application of an electric voltage, an electric field is created.
  - Positively charged paint particles settle on the negatively charged bodywork and form a protective layer up to 20 µm thick.
  - Next the bodywork is placed in a dryer, where the CDP base is hardened at 180°C.
- Sealing, stone-chip protection
  - Edges, seams and but joints are sealer with a sealing compound.
  - Vulnerable areas are coated with stone-chip protection.
- Filler
  - Filler protects the body panels from stone impacts. Furthermore, any unevenness of the metal surface is flattened out, in order to create the most homogenous and fault-free undersurface possible.
  - Once the filler is dry, it serves as the base on which paint is applied.
- Top coat
  - The top coat is applied as a single layer or two layers of paint.
  - When working with two layer paint, in the first job step the initial colored base paint is applied. In the second job step, a clear lacquer is applied, giving the base paint shine and hardness.

DESCRIPTION AND OPERATION

The structure of an original paint finish

During construction of the original paint, a total surface thickness of between 120 and 130 µm is achieved. The thicknesses of the layers may vary however, because they are greater for horizontal surfaces than vertical ones.

Paint layers



Item	Description
1	Steel panel
2	Phosphate layer 2.9 g/m², corresponding to 2 µm.
3	Cathodic dip paint 30-35 µm
4	Filler 30-35 µm
5	Base paint 15-20 µm
6	Clear varnish 55 µm

Colored fillers applied in production

Filler which gives color is used in production. Its use makes the base paint and clear varnish unnecessary on certain vehicle interior surfaces (engine, doors).

Not every exterior paint has its own matching filler. It is more that the tones of the filler are color compatible, i.e. they have similar intensity to the top coat.

During repair painting the filler color tones must be used according to the manufacturer's instructions.

DESCRIPTION AND OPERATION

Paintwork Defects and Damage

Diagnosis and Damage Assessment

Paint concerns, regardless of their causes, are part of the everyday work in the paint shop. Correct damage assessment and determination of the cause are preconditions for a professional resolution of a paint concern.

Paint concerns can still occur through a variety of causes, despite improved paint materials and new spray methods.

NOTE: A first appraisal of the paint damage should be done before cleaning. External factors such as rust, droppings, incorrect or insufficient paint care can then be more easily detected.

Diagnosis is best done in daylight but not in direct sunlight. Exact evaluation can also be done under artificial light from special luminescent lamps.

Paint damage guide

The most important paint damage concerns which make a paint repair necessary are:

- Damage from biological paint contamination such as bird or insect droppings, tree resin and aphids.
- Chemical paint damage caused by industrial contaminants such as smoke, fuel, acids, oils.
- Mechanical damage caused by stone impact during operation, scratches in the car wash and parking.
- Damage caused by faults in treatment. Application defects such as paint runs or orange peel.
- Dirt inclusions in the paint layer, e.g. caused by dust in top coat or textile lint.
- Damage due to corrosion.

Before repair of such paint concerns, exact diagnosis must be performed to determine the cause exactly. On the spot diagnoses using simple aids and processes are often enough.

Diagnosis without disturbing the paint is done by:

- Optical inspection without visual aids, under suitable light conditions from a suitable angle and correct distance.
- Optical inspection with the help of a magnifying glass.
- pH paper.
- Measurement of the thickness using FE / NFE coating thickness meters for ferrous (FE) and non-ferrous metals and non-magnetic steel (NFE) - magnetic process on steel panels, eddy current process on non-metals.

A test method where the traces of testing can be easily removed again is the finger nail test. With suitable experience the existing hardness of the paint can be determined.

Test methods where the paint is partially destroyed are:

- Pencil hardness test.
- Adhesion test using adhesive tape.
- Lattice cut test process to check the strength of adhesion.

Under certain circumstances these test methods are not enough for a certain diagnosis. In this case, paint diagnosis under laboratory conditions must be performed.

Measuring and testing equipment for painted surfaces

Coating thickness measuring devices

Magnifying glass

pH paper (together with water)

Suitable photographic equipment with macro lens

Shine measuring equipment

Paint damage caused by environmental factors

- Bee droppings
- Bird droppings
- Insects
- Tree resin and sap
- Aphid secretions
- Tar spots
- Cement, plaster and slaked lime
- Rust film/deposits from industrial fallout
- Battery acid
- Brake fluid

DESCRIPTION AND OPERATION

In all the cases of paint damage described below, if the damage is irreversible a new paint finish must be applied.

Paint damage cause by bee droppings

Bee droppings can be recognized on a paint surface through its yellow or brown color and sausage or drop-like shape with a diameter of 3-4 mm.

Cause/damage pattern:

- In combination with heat and high air humidity, bee droppings leave discolorations and cause paint decomposition.
- The paint can be destroyed down to the filler.

TO BE UPDATED LATER

Repair of damage:

- If the damage is light, perform a polishing repair.

Paint damage caused by bird droppings

Bird dropping damage appears most often as matt, etched topcoat areas of various sizes. If left on the vehicle for a long time, crack formation and etching down to the filler will occur.

Cause/damage pattern:

- Bird droppings are particularly harmful in combination with heat and moisture. The urea (white part) has a very high salt content and is very aggressive.
- The intensity of the damage varies depending on the type, quantity, contact time and extent.
- Cracks, etching, marks up to dissolution of the top coat are the results.

TO BE UPDATED LATER

Repair of damage:

- If the damage is light, perform a polishing repair.

Paint damage caused by insects

At insect impact locations on the hood, roof and bumper, small etched or etched through paint marks with partially visible spots of filler.

Cause/damage pattern:

- The top coat layer is destroyed in a short time by surface swelling and etching.
- Colliding insects stick to the paint surface. In combination with moisture and heat, because of the resulting acids the insect bodies sink into the paint top coat.
- The corrosion is G, C, U or O shaped and is only a few millimeters thick.

TO BE UPDATED LATER

Repair of damage:

- Wash the vehicle, treat the affected area with insect remover. Clean the paint surface several times.
- Protect with hard wax.

DESCRIPTION AND OPERATION

Paint damage caused by tree resin or sap

Small yellow-brown marks or drops on the horizontal parts of the vehicle. The drops melt in sunlight. Resin damage only occurs in the warm summer months.

Cause/damage pattern:

- Because of their chemical composition, tree resins combine with or adhere very well to paint top coats and cause them to swell. The higher the temperature, the more intensive is the chemical bonding between the resin and the paint topcoat surface.

TO BE UPDATED LATER

Repair of damage:

- Soak several times using a cloth saturated with a petrol & paraffin mixture.

NOTE: After successful cleaning the top coat must be preserved.

- Swellings can be removed by warming.

Paint damage from aphid secretions

Small, round, matt marks about 1 mm diameter and etching with small islands down to the filler. Fresh aphid excrement looks like small drops of honey.

Cause/damage pattern:

- Aphids produce a mixture of starch, leaf acid and sugar from sap in leaves. Under the effects of warming and moisture this can turn into alcohol.
- The round shape of the damage and the island of intact paint are typical.

TO BE UPDATED LATER

Repair of damage:

- Remove the excrement as soon as possible.
- Small single matt locations without etching can be repaired using a polishing repair.

Paint damage caused by tar spots

Yellow or dark marks.

Cause/damage pattern:

- Firmly stuck spots of tar which lead to discoloration of the surface. In some cases penetration through the clear lacquer into the top coat.

TO BE UPDATED LATER

Repair of damage:

- Clean the paint surface with tar remover and polish.

Paint damage caused by cement, plaster and slaked lime

Damage appears as whitish matt marks on the top coat.

Cause/damage pattern:

- Corrosive alkaline compounds interacting with moisture.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Repair of damage:

- Wash immediately if the contamination is fresh.
- If the contamination has dried on, dissolve and neutralise it with vinegar, then thoroughly wash off with water and rinse.
- Rectify mild damage using a polishing repair.

Rust film/deposits from industrial fallout

Small round marks, about 1 mm in size, in all shades from black, grey, blue to reddish, on the horizontal surfaces of the vehicle.

Cause/damage pattern:

- Deposits from oil fired systems and industrial plant, especially at high humidities and inversion weather conditions, cause damage to the paint top coat.
- As the activity time increases so called rust halos form. They spread as long as the deposits corrode.
- Industrial fallout containing iron will no longer be removable after a few days!

TO BE UPDATED LATER

Repair of damage:

- Remove the dust using an industrial fallout remover and thoroughly wash.
- Polish the paint surface.

NOTE: Never try to remove the particles of industrial fallout by polishing or rubbing!

- Use cleaning dough.

Damage caused by battery acid.

Splashes of battery acid caused by carelessly topping up the battery.

WARNING: Batteries contain sulphuric acid. When working near the battery, or where there is battery acid on the vehicle body, protect the skin and eyes from contact with the acid. If battery acid contacts the skin or enters the eyes, flush the affected area immediately with water (flush for at least 15 minutes) and call a doctor without delay. If acid is swallowed, call a doctor immediately. Failure to follow these instructions may result in personal injury.

NOTE: High temperatures accelerate the attack on the top coat. At 50°C the top coat layer breaks down after about 15 minutes!

Cause/damage pattern:

- Etching of the paint layer to decomposition of the paint finish.

TO BE UPDATED LATER

Repair of damage:

- Flush the acid splashes with plenty of water and neutralize with car washing liquid.
- If the contact time of the acid was short, perform a polishing repair.

Paint damage caused by brake fluid.

Careless handling of brake fluid. The glycols contained in the fluid cause swellings.

DESCRIPTION AND OPERATION

Cause/damage pattern:

- The temperature and contact time are critical. Splashes lead to loss of shine and lightening of color.

TO BE UPDATED LATER

Repair of damage:

- Flush immediately with plenty of water.
- The swellings can often be made to recede completely by treatment with the radiant heater or in the paint drying oven at max. 60°C for about 1 hour.

Mechanical damage

Stone impact damage or mechanical damage

Mechanical damage caused by impact of stones or other hard objects and extending down to the metal panel lead very quickly to corrosion and rusting under the paint on the adjoining surface.

Cause/damage pattern:

- Paint damage caused from the outside, down to filler, primer or metal panel.

TO BE UPDATED LATER

Repair of damage:

- Sand or blast out.
- Use anti-corrosion primer.
- Apply top coat.

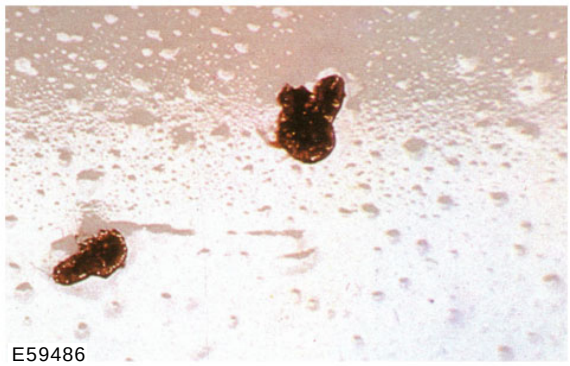
Damage due to corrosion

Blistering/rusting below

Air or water filled blister-shaped raised areas in the paint film.

Cause/damage pattern:

- Overpainting corroded steel panel.
- Condensation in the spray air.
- Sanding water not dried out or salt crystal residues.
- Road chippings and road winter grit containing salt.


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Repair of damage:

- Sand the affected area of damage or the body component and re-create the paint finish.
- More severe and larger areas of rusting below must be repaired using the corresponding repair painting, Repair Level III or IV.

Damage caused by faults in treatment

- Craters
- Paint boils
- Adhesion defects
- Adhesion defects - clear lacquer
- Sanding scores
- Formation of stripes
- Peeling/blistering on plastic parts
- Blistering on polyester material
- Peroxide marks in metallic paints

DESCRIPTION AND OPERATION

- Crack formation
- Shrinking back/zone edge marks
- Blistering
- Etching
- Paint wrinkles/puckering
- Cloud formation
- Spots/metallics
- Metamerism/color deviations
- Washing out
- Loss of gloss
- Covering ability/areas of thin paint
- Flow problems/orange peel
- Dirt embedded in metallic base paint
- Dirt embedded in top coat
- Water marks
- Paint runs
- Swirl marks

Craters

Crater-like single or extensively occurring depressions with raised edges, in top coat or the intermediate layers.

Cause/damage pattern:

- Substrate not adequately cleaned with silicone remover.
- Spray air contaminated by oil residues and water accumulations.
- Filter ceiling not adequate for requirements.
- Use of polishes, cleaning agents or sprays (e.g. interior sprays) containing silicone.
- Oil, wax, grease, silicone containing residues.
- Working clothes contaminated by materials containing silicone.

TO BE UPDATED LATER

Repair of damage:

- Sand paint surface, clean with silicone remover and apply one thin spray pass. Let it begin to dry well, then apply several thin and dry sprayed passes.

Paint boils

Small, hard, closed or burst blisters in the paint top coat. They appear locally in groups or spread individually across the whole surface. Sanding opens up a larger cavity, under which the primer can often be seen.

Cause/damage pattern:

- Paint applied in layers which were too thick.
- Specified flash-off and drying times between coats were not adhered to.
- Specified working viscosity and spray pressure were not adhered to.
- Use of unsuitable hardener and thinner materials. (Solvent combinations in paint system not optimally matched).
- Poor booth conditions.

TO BE UPDATED LATER

Repair of damage:

- Single boil blisters can be removed using polishing.
- After thorough drying, sand the top coat at the affected areas, clean with silicone remover and re-paint. Fill any fine pores still present with 2-component acrylic filler.
- On larger areas of damaged topcoat, sand completely away and apply new paint finish.

Adhesion defects

Whole coating detached from substrate or individual layers one from another. Sometimes

DESCRIPTION AND OPERATION

adhesion defects can only be noticed after an external influence such as stone impact.

Cause/damage pattern:

- Substrate not adequately prepared (rust, grease, moisture, sanding, cleaning).
- Unsuitable material used.
- Drying times, flash-off times too short.
- Base paint not sprayed wet-in-wet, instead the intermediate drying times were too long.
- Failure to intermediate sand.
- Condensation formed because of temperature fluctuations.
- Unprofessional preparation (especially on plastics).
- Overheated CDP/intermediate filler.

TO BE UPDATED LATER

Repair of damage:

- Sand out the damage and recreate the paint finish. Create the paint finish strictly in accordance with the general technical information.

Adhesion defects in clear lacquer.

Clear lacquer detched from base paint.

Cause/damage pattern:

- Base paint layer too thick.
- Intermediate and final flash-off times of base paint too long.
- Incorrect mixture ratio clear lacquer/hardner.

TO BE UPDATED LATER

Repair of damage:

- Refinish sanding and recreate the paint finish.

Sanding scores

Single or wide area clusters of scoring or sanding marks, often with raised edges. Noticeable on metallic paints as light-dark stripes.

Cause/damage pattern:

- Stopper sanded too coarsely.
- Filler sanded too coarsely.
- Filler not thoroughly dried bfore sanding.
- Old paint sanded too coarsely.
- Soft elastic substrates, e.g. TPA base, treated with thinners which was too aggressive and therefore etched.
- Top coat applied too thinly.

TO BE UPDATED LATER

Repair of damage:

- If the damage pattern is minimal, after the top coat has dried fine sand the paint surface and refurbish by polishing.
- If the damage is great or on metallic paints, sand the paint surface or substrates and if necessary remove them, then cover the bare metal and re-paint.

DESCRIPTION AND OPERATION

Formation of stripes

Differing, stripe shaped color/effect formations in dark/light areas of a metallic paint finish.

Cause/damage pattern:

- Spray gun (nozzle) not perfect.
- Incorrect spray pressure.
- Thinners not suitable.
- Incorrect spray viscosity.
- Flash-off time too short.
- Unsuitable working temperature.

TO BE UPDATED LATER

Repair of damage:

- Apply base paint evenly.
- Repair spray gun.
- After clear lacquer has thoroughly dried, sand surface and paint again.

Peeling/blistering on plastic parts

Paint adhesion insufficient between top coat and filler and/or primer layer. It often happens that the whole of the paint finish detaches from the plastic.

Cause/damage pattern:

- Plastic item not cleaned sufficiently, not or inadequately tempered.
- Unsuitable cleaning agent used.
- Unsuitable materials used.
- Moisture.
- Paint finish underbaked or overbaked.
- Poor or lack of intermediate sanding.

TO BE UPDATED LATER

Repair of damage:

- Sand away faulty paint coats and re-apply paint finish.
- In extreme cases use a new part.

Blistering on polyester material

Color shade differences or marks in paintwork subsequently applied to previously unpainted plastic material.

Cause/damage pattern:

- Plastic material is not suitable for painting.
- Incorrect bonding agent.
- Paint used not solvent resistant.

Repair of damage:

- Repaint using suitable materials.
- Install unpainted new part (after consulting customer).

Peroxide marks in metallic paints

After longer period of drying, abnormal marks where the color shade varies.

Cause/damage pattern:

- Too much hardener added to polyester stopper (over 3% can cause this damage pattern).
- Polyester stopper not well enough mixed.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Repair of damage:

- Sand, fill with polyester or epoxide filler and re-paint.

Crack formation

Cracks of different lengths and depths running in all directions.

Cause/damage pattern:

- Layers too thick.
- Painted several times.
- Temperature fluctuations.
- Mechanical effects e.g. distortions.
- Substrate not thoroughly hardened.
- Old paint not completely dried out.
- No or insufficient hardener added.
- 2-component materials used on nitro or TPA.

TO BE UPDATED LATER

Repair of damage:

- Sand away layers until sound substrate is reached and create new paint finish (prime, fill, apply topcoat).

Shrinking back/zone edge marks

Lifting or dropping in of edge zones (edges which accentuate themselves in the top coat), flow problems and loss of shine in top coat.

Cause/damage pattern:

- Old paintwork not rubbed down to a seamless transition.
- Stopper and filler on a viscoplastic base primer.
- Filler sanded and overpainted when not thoroughly hard.
- Previous materials overworked too early, substrate not sufficiently hardened.
- Primer applied in layers which were too thick, and not dried for long enough.
- Sanding paper too coarse.
- Top coat thinned too much.

TO BE UPDATED LATER

Repair of damage:

- After hardening off the top coat, fine sand the surface and polish up, apply filler if necessary and paint once more.

Blistering

Small, spot-like, air-filled or water-filled blister shaped high-spots in the paint construction. Their dimensions can range from pin-head to pin-point size in a closed paint film. Arrangement and accumulation very variable. In the advanced stages, circular flaking of the paint from the substrate. These are neither boils nor corrosion.

Cause/damage pattern:

- Moisture absorption by substrate.
- Insufficient drying of the substrate after wet sanding (especially on polyester material).
- Humidity too high before painting; condensation formation because of temperature fluctuations.
- Pores/sink holes in substrate not sanded out.

DESCRIPTION AND OPERATION

- Polyester material not covered.
- Sweat from hands.
- Salts and minerals in sanding water.
- Spray air contaminated.

TO BE UPDATED LATER

Repair of damage:

- Sand away damage, matt sand remainder of surface, clean with silicone remover, fill and re-paint.

Etching

The base paint is etched by the clear lacquer. This causes the aluminum pigments to change their alignments. The color of the etched base paint seems more grey than that of normal base paint. Result is that the surface structure of the clear lacquer becomes increasingly more matt.

Cause/damage pattern:

- Base painted too wet.
- No intermediate flash-off time.
- Layers too thick.

TO BE UPDATED LATER

Repair of damage:

- Sand and re-paint.

Paint wrinkles/puckering

Lifting/puckering of the paint surface.

Cause/damage pattern:

- First paint not hardened through or can be etched.
- Areas of clear lacquer which were sanded through to base paint have not been not isolated with filler, or with unsuitable filler.
- Unsuitable substrate (e.g. spray can painting with TPA or nitro).
- Use of unsuitable primer, paint and thinner materials.
- Paint systems not matched to each other.
- In wet-in-wet process, specified flash-off times not adhered to.
- Synthetic resin top coat (alkyd resin) worked over too soon.

TO BE UPDATED LATER

Repair of damage:

- After thorough drying, completely remove the top coat together with the attacked substrate at the affected areas and re-create a new paint finish.
- Before applying top coat, rub down the complete surface.

Cloud formation

Differing, blotchy color/effect formations in dark/light areas of a metallic paint finish.

Cause/damage pattern:

- Spray gun, spray nozzle, spray pressure not perfect.
- Varying spray viscosity, spraying method, flash-off times, spray booth temperature.
- Thinners not suitable.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Repair of damage:

- Droplet method before clear lacquer application.
- After clear lacquer has thoroughly dried, sand surface and re-paint.

Spots

Points rising up from the paint film.

Cause/damage pattern:

- Metallic base paint sprayed too dry, so that the metal particles could not incorporate into the paint. The clear lacquer could not cover these vertical standing particles because the spray air was too hot or the booth temperature was too high.

TO BE UPDATED LATER

Repair of damage:

- After the paint surface has dried, lightly sand it with grade P800 sanding paper, clean with silicone remover and re-apply clear lacquer.

Metamerism/color deviations

Noticeable when identical color shades undergo a change of hue as the light source changes (daylight/artificial light). Different pigment composition between original and repair paint.

Cause/damage pattern:

- Use of paints with pigmentation which was not compatible with the standard, e.g. a green can be formulated from yellow and blue, or directly from green.
- Use of an unsuitable mixed or ready made paint to re-tone.

TO BE UPDATED LATER

Repair of damage:

- Repaint using the correct paint.

Washing out

On paint which has been newly applied but not yet dried, the interaction of surface tension and very different specific gravities of the different pigments can lead to swirl-like turbulence which results in separation of the pigments.

Cause/damage pattern:

- Layer too thick, paint not stirred enough.

TO BE UPDATED LATER

Repair of damage:

- Sand and re-paint.

Loss of gloss

Milky, dreary tarnishing of the paint with more or less even loss of gloss.

DESCRIPTION AND OPERATION

Cause/damage pattern:

- Cold with low air humidity.
- Heat with high air humidity.
- Substrate can be etched.
- Hardener fault or wrong hardener used.
- Paint thinned too much.
- Proportion of pigment too high because of poor stirring.
- Not optimum drying.

TO BE UPDATED LATER

Repair of damage:

- After drying, remove the matt effect by polishing. If unsuccessful, rub down complete area and paint again.

Covering ability/areas of thin paint

Different color shades in the surface. The minimum layer thickness is not achieved here. The effects range from local minor shade variations through mottled spray zones to completely missing top coat.

Cause/damage pattern:

- No correct, uniform substrate (effect paint).
- On three-layer systems, wrong filler.
- Insufficient top coat application.

TO BE UPDATED LATER

Repair of damage:

- Sand surface and recreate the paint finish.

Flow problems/orange peel

Surface structure bumpy, grained. The surface is similar to the peel of an orange.

Cause/damage pattern:

- Paint viscosity too high.
- Use of fast evaporating, highly volatile thinners.
- Booth temperature too high.
- Spray gun distance too great, too little material applied.
- Nozzle too large.
- Incorrect spray pressure.

TO BE UPDATED LATER

Repair of damage:

- Small surfaces: fine sand and polish.
- Sand out the surface and recreate the paint finish.

Dirt embedded in metallic base paint.

Inclusions of contamination in metallic base paint, of different sizes and shapes (grains or lint).

Cause/damage pattern:

- Dust was not properly removed from the surface to be painted.
- Paint material not sieved.
- Function of the painting facilities not optimum.
- Filter contaminated.
- Wearing unsuitable clothing.

Repair of damage:

- Sand and repaint.

DESCRIPTION AND OPERATION

Dirt embedded in top coat

Inclusions of contamination in top coat or under paint layers, of different sizes and shapes (grains or lint). Optical adverse effect.

Cause/damage pattern:

- Dust was not properly removed from the surface to be painted.
- Paint material not sieved.
- Function of the painting facilities not optimum.
- Filter contaminated.
- Wearing unsuitable clothing.

TO BE UPDATED LATER

Repair of damage:

- Single inclusions: after thorough hardening, sand out using 1200 - 1500 grade paper and repolish using a suitable silicone-free sanding or painting paste.
- Large area contamination: sand and repaint.

Water marks

Ring shaped marks appearing on the paint surface.

Cause/damage pattern:

- Evaporation of water droplets on freshly painted and not yet fully hardened paint finishes (mostly only found on horizontal surfaces).
- Layer too thick.
- Drying time too short.
- Hardening faults or hardener no longer useable.
- Use of unsuitable thinners.

TO BE UPDATED LATER

Repair of damage:

- Rub down only slight marks with sanding paper grade P1000 - P1200 and then polish.
- For heavy marking, sand the surface matt, clean with silicone remover and repaint.

Paint runs

Wave-like paint run tracks in top coat or in an intermediate layer on vertical surfaces. Mostly in the area of swage lines, seams or openings (there they are paint runs, otherwise curtains).

Cause/damage pattern:

- Uneven paint application.
- The specified viscosity was not complied with.
- Use of unsuitable thinner materials.
- Air, material or room temperature too low.
- Layers too thick.
- Spray gun (nozzle) not perfect.

TO BE UPDATED LATER

Repair of damage:

- After thorough drying, sand unevenness flat, if necessary leave to dry afterwards.
- Small areas of damage can be equalised using the paint plane, then sand, polish or repaint.

DESCRIPTION AND OPERATION

Swirl marks

Three dimensional appearance in the paint surface in the form of smears or blotches. This effect is intensified in direct sunlight.

Cause/damage pattern:

- Polishing using polishing machine on paint which has not yet hardened throughout.
- Polishing intervals too long or none at all.
- Pressure too high while polishing.
- Incorrect polishing material or polishing tool.

TO BE UPDATED LATER

Repair of damage:

- Allow the paint to harden completely and then polish.
- If the damage is irreversible, rub down and apply new clear lacquer.

DESCRIPTION AND OPERATION

Tools and Equipment for Paint Repairs

General work equipment

In the repair paint shop there is a range of painting tools which make the work of the painter easier and improve the quality of the repair paintwork.

Among these are small tools which are used for the following work:

- **Measuring beakers** to measure and mix various paint materials.
- **Measuring rods** with which the required combination amounts of paint and primer filler are gauged and mixed.
- **Viscosity measuring beaker** with a calibrated opening of 4mm, used to set the correct paint viscosity.
- **Paint filter/paint sieve** for filtering foreign bodies out of mixed paint or primer. Care must be taken that the correct filter is used for each paint.
- **Color sample plates** onto which the mixed paint is applied, and the shade is then compared to that of the vehicle. Other aids which should help the painter to find the correct shade are **color sample cards** and **color panels**, which are offered by many paint manufacturers.
- **Dust bonding cloths** which are impregnated with a tacky resin and which pick up dust particles particularly well. A surface to be painted must be cleaned with a dust binding cloth immediately before paint is applied.
- **Compressed air guns** are used to remove sanding residues and to dry sanded surfaces.

Filler and spray guns

NOTE: Regular maintenance, cleaning after use and careful handling of all individual parts of the spray gun are essential for a high-quality paint finish.

The spray gun is the most important implement in the paint shop. Application of paint using the spray gun can produce a layer with absolutely constant thickness and a smooth paint surface.

Principle of operation

TO BE UPDATED LATER

Item	Description
1	Air supply
2	Paint supply
3	Nozzle needle

Because of the construction design and with the aid of compressed air, a spray-ready paint mixture is dragged out of the container to the nozzle by the venturi effect, and is applied to the surface being worked.

When the trigger of the spray gun is pressed to the first pressure point, only the compressed air passage opens. If the trigger is pressed further, the nozzle needle displaces and the air stream drags paint with it at high speed. This produces a spray mist consisting of micro-droplets of paint.

DESCRIPTION AND OPERATION

Types of spray gun

TO BE UPDATED LATER

Item	Description
1	Suction-beaker spray gun
2	Flow-beaker spray gun

In the flow-beaker spray gun, the paint container is mounted above the spray gun. On the suction-beaker spray gun, it is below.

Furthermore, spray guns are categorized by their air pressure requirement into high and low pressure guns.

High pressure guns have the disadvantage that they exhibit high consumption of energy and materials. The spray pressure they require is between 1 - 6 bar.

Because of the high air pressure and the large amount of air needed, the result is a powerful paint mist formation (paint transfer rate approx. 35%).

Current practice is mainly to work with reduced mist spray systems (RP and HVLP systems).

Reduced pressure (RP) guns are optimized high pressure guns which have an input pressure at the gun of approx. 2.5 bar and an atomization pressure at the air cap of 1 - 2 bar. In practice this spray technology is preferred for spraying clear lacquer because of the finer atomization.

Low pressure guns have the advantage that they exhibit minimal paint mist formation and because of this the paint transfer rate rises to approx. 65%. The spray pressure required in this case is between 1 - 5 bar. Nozzle sizes from 1 - 2.2 mm can be used.

HVLP spray guns

TO BE UPDATED LATER

Item	Description
1	Quantity control
2	Working pressure control
3	Spray pattern control

The high volume low pressure (HVLP) spray gun is a high performance spray gun which forms a soft, fine and homogenous spray pattern. The atomization pressure at the air cap is 0.7 bar when the input pressure at the gun is 2.0 bar.

The low atomization pressure of 0.7 bar together with greatly reduced spray mist provide high material ejection. The low nozzle internal pressure minimizes rebound of the paint droplets from the object and thus the proportion of overspray.

This spray technology has a very high application efficiency. By matching the size of the nozzle, the HVLP spray gun can be used for all repair painting materials.

HVLP spray guns are often used in practice for the application of water based paints.

Mini spray guns are often used for small, localized touching-up work. Use of HVLP spray technology and nozzle sizes of 0.3 - 1.2 mm permits very fine

DESCRIPTION AND OPERATION

work, so that the area of the repair can be kept as small as possible.

In order to ensure that a spray gun operates efficiently for a long time, careful cleaning is absolutely vital after use.

NOTE: During cleaning you must distinguish between water based and solvent based materials.

Cleaning by hand:

- Empty the paint beaker immediately after use.
- Flush the gun with cleaner.
- Clean it inside and outside with a brush.
- Dismantle the gun to clean it thoroughly.
- Clean the air cap using a suitable brush.
- Use nozzle cleaning needles to clean bores and nozzles.

A spray gun washing machine is recommended if the painting work is highly intensive.

New types of paint processing systems are replacing the conventional mixing beaker, filter and spray gun flow beaker. This reduces the amount of solvent required for cleaning and the amount of routine waste which remains.

Paint preparation system (PPS)

TO BE UPDATED LATER

Item	Description
1	Beaker
2	Color bag

With this system, which is suitable for both suction and flow beaker spray guns, only one beaker is required for mixing and painting.

A bag is inserted in the beaker, in which paint can be mixed, processed and stored after use or completely disposed of.

The small quantity of paint remaining in the gun is removed using a minimum quantity of solvent from the pipette bottle.

The amount of cleaner used is reduced because only the spray gun needs to be cleaned.

Hand and machine sanding tools

Sanding is used to prepare a surface for application of a paint layer, enabling it to adhere well. Sanding materials have a great influence on the quality of a repair paint finish. The correct sanding medium must therefore be chosen for every material.

DESCRIPTION AND OPERATION

During sanding, material is mechanically removed from a surface.

In the paint shop, carborundum or silicon carbide abrasive on a substrate of paper or cloth are the most common sanding materials used.

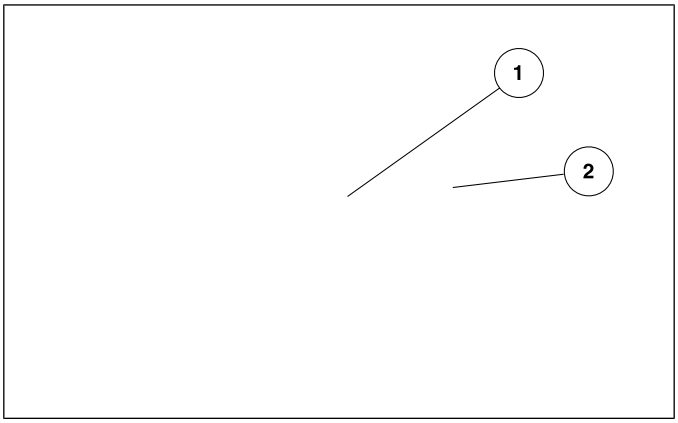
Carborundum is a very hard mineral consisting mostly of aluminum oxide. During use carborundum becomes blunt and wears away.

Silicon carbide has a very high degree of hardness, but is more brittle than carborundum. When silicon carbide is used, the mineral grains break. New long and pointed profiles are formed.

Use of the correct sanding paper depends on the application, the substrates and the tools used. The following table can be used as a guideline, but the recommendations of the supplier of the auxiliary materials and additive materials must be followed.

Application	Working area	Grade	Sanding system
Body work, corrosion damage	Equalizing paint system transition	to P150	Orbital sander, dry
			Hand sanding, dry
Stopper	Rough sand	P80 - P150	Orbital sander, dry
	Fine sand	P240 - P320	Orbital sander, dry
			Hand sanding, dry
Spray stopper	Rough sand	P120 - P180	Orbital sander, dry
	Fine sand	P240 - P320	Orbital sander, dry
			Hand sanding, dry
Filler sanding work	Filler fine sand	P400 - P500	Orbital sander, dry
		P800 - P1200	Hand sand, wet
Top coat	Old paint	P400 - P500	Orbital sand, dry
		P800 - P1200	Hand sand, wet
	Touch-up paint surfaces	P1000 - P2000	Hand sand, wet
Paint damage	Sanding out faults	P2000 - P3000	Hand sand, wet

Soft Pads are recommended for manual refinishing of contours, curves and difficult to reach areas. On a Soft Pad the abrasive is found on a coarse structured fleece. Because of this, it is very flexible, does not kink and does not slip in the hand. This enables a fine and even finish to be achieved.



Item	Description
1	Extraction bores
2	Connection for extraction equipment

Notes on working with sanding tools:

DESCRIPTION AND OPERATION

- Tools with a rigid backing pad do not adjust to fit the surface. They are used for flat surfaces.
- Tools with a flexible backing pad are used for fine sanding of a surface because they adjust to the shape of the surface.
- Build up an even working pressure over the sanding surface.
- Keep the sanding paper tight on the tool (use self-gripping systems).
- Align the extraction holes in the sanding paper with the holes in the tool.
- Guide the tool flat over the surface to be worked. Do not tilt it.

Hand sanding can be carried out dry but also wet. Wet and dry paper with particle size P 80 to P 1200 is used for this in the paint field.

Ways of sanding

Sanding tools are driven either by electricity or compressed air.

TO BE UPDATED LATER

Item	Description
1	Sanding machine
2	Polishing machine
3	Orbital sander

The disadvantage of electrically driven machines is that their own weight is high compared with pneumatic systems. They also become warm during work. They do not however need any special operating equipment for their energy supply.

Sanding machines are categorized by their type of sanding movement.

Rotational sanders

On these machines the sanding paper turns.

- Advantage:
  - Ideal for heavy sanding work.
  - Fast and aggressive sanding possible.
- Disadvantage:
  - Large amount of heat developed.
  - Difficulty sanding flat surfaces.
- Application:
  - Removal of old paint layers.
  - Preparation of panel for stopper.
  - Removal of rust.

Oscillating sander

On these machines the sanding paper oscillates. The backing pad is rectangular.

- Advantage:
  - Large sanding surface.
  - Ideal for large and flat surfaces.
- Disadvantage:
  - Hardly useable on rounded surfaces.
  - Flexible backing pad not possible.
  - Vibrations because of the poor support of the backing pad.
- Application:
  - Sanding of polyester stopper.
  - Sanding processes on flat surfaces.

Orbital sander

On these machines the sanding paper turns and oscillates.

- Advantage:
  - Easy to handle and good sanding power.
  - Minimal heat development.
- Disadvantage:
  - Not suitable for sanding stopper on flat surfaces.
  - Smooth guidance important, otherwise sanding marks will occur.
- Application:
  - Sanding of paint layers.
  - Well suited for final preparation of a primer.

NOTE: Comply with the manufacturer's recommendations when setting the orbital sander.

DESCRIPTION AND OPERATION

On the orbital sander, stroke settings of approx. 3 mm for fine sanding work and approx. 5 - 7 mm for coarse sanding work have been established.

Polishing and finishing tools

The term polishing in the context of paint repairs means the elimination of paint flaws and high shine polishing of neighboring parts.

During polishing the fine sanded surface is returned to a high shine using a special abrasive polish.

Before the actual polishing, all flaws in the paint surface must be removed and the following working procedures must be adhered to:

- Thoroughly clean the vehicle.
- Remove spray mist from all surfaces.
- Sand out and polish particle inclusions.
- Sand down paint runs and polish them out.
- Examine the exactness of the color match in daylight.
- Remove masking edges.
- Remove sanding water, sanding dust and polish residues.

After the polishing process the results must be tested using a special test spray.

Infrared drying technology

The drying process in a painting/drying cabin occurs through heat conductance (convection). When an infrared dryer is used, the drying process is through heat radiation.

TO BE UPDATED LATER

The infrared rays penetrate the air and the paint layer without warming them. Because the infrared rays are reflected from the steel panel, the paint coat is warmed from the inside outwards.

Advantages of infrared drying:

- The drying process occurs from the inside to the outside.
- The drying time is shorter than for warm air systems.
- Because the infrared dryer consists of several cassettes which can be switched on independently, the drying area can be optimally controlled.

Independent of the manufacturer's instructions, pay attention to the following:

- Flash-off time of the paint before switching on the infrared dryer.
- Distance between the infrared dryer and the surface.
- Duration of the irradiation.

The most common use of the infrared dryer is to dry stopper and primers. The wait time between the job steps is shortened without having to use the painting/drying cabin.

The painting/drying cabin can then be used exclusively for application and drying of topcoat.

There are two types of infrared dryer:

- Infrared dryer with short wavelength radiation.
- Infrared dryer with medium wavelength radiation.

As an indication, the following drying times are listed for some materials (at 80 cm distance):

NOTE: Observe the material manufacturer's and supplier's specifications.

- Polyester stopper 2 minutes.
- Spray stopper 2 to 7 minutes.
- Water based primer-filler 7 to 9 minutes.
- Primer 3 to 8 minutes.
- Top coat 7 to 10 minutes.

Air dryers

The air dryer is suitable in places where drying needs to be done, but without great outlay (painting/drying cabin or infrared dryer).

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

NOTE: Air from the compressor is often too cold for effective drying.

Air dryers use the venturi effect to blow the warm ambient air over the paint surface in a gentle air flow.

Paint mixing system

Because of the many different color variants, it is now seldom possible to store all color shades as ready-made mixtures.

For this reason, vehicle manufacturers make the mixture proportions of their paints available as color codes. The required color shade can be obtained from the paint mixing system using this color code.

All the color components are combined according to their proportions by weight using a precise computer scales to produce a finished color shade.

Painting cabin

The air requirement in a painting cabin is large. The outside air which is drawn in must be passed through filtering and warming equipment. This particularly applies during colder times of the year and especially for combined types of building where the painting cabin is also used as a drying cabin.

It is primarily used to keep the air free of dust. At the same time, explosive solvent-air mixture concentrations are prevented

NOTE: Vacuum will lead to contamination of the newly applied paint. The outside air flows through door gaps, wall joints and other openings and as it does so, brings dust deposits with it.

The air supply quantity depends on the size of the painting space and the quantity of extracted air. Enough air must be supplied to cause positive pressure in the painting space. An air extraction : air supply ratio of about 1 : 1.05 is sufficient.

The filters should have a dust-removal grade of not less than 99.8% and must always be kept clean.

It is especially important that the air supply does not cause strong air currents in the painting cabin. If not, the following problems could occur:

- Paint contamination cause by paint mist, which persists in air eddies and gradually falls on the fresh paintwork.
- Flow problems in the paint because of the high speed of the air, causing the paint to thicken very quickly on the surface.
- Loss of gloss and wrinkle formation because the surface dries too fast.
- Painter disturbance while working.

In modern paint cabins the air supply is provided from the complete surface of the ceiling. The air speed should be 0.3 m/sec (measured in the unrestricted cross-section of the spray cabin). At the same time, the air in the cabin should change about 350 times per hour.

Air extraction is best achieved through extraction channels in the floor of the painting cabin.

NOTE: Refer to the manufacturer's specifications for the operating instructions, safety instructions and notes on the maintenance of a paint cabin.

Smooth walls in the paint cabin should prevent dust deposits. Regular cleaning is necessary however.

Special easily washed adhesive-bonding paint can be applied to the walls to protect the cabin from paint mist.

DESCRIPTION AND OPERATION

Refinishing Materials

The manufacturer's instructions must always be followed when dealing with all materials! The information given in the following text is data which is independent of the manufacturer, and it should only be used as an indication.

Stopper materials

- 1-component nitro-combination stopper
- 2-component polyester stopper
- 2-component plastic stopper

Use suitable primer to protect from corrosion areas which have been sanded bare before applying stopper.

1-component nitro-combination stopper

Nitro-combination stopper has mostly been superseded by 2-component polyester stopper.

Fast drying fine stopper for the smoothing of irregularities.

The working properties of 1-component nitro-combination stopper can be improved by the addition of nitro thinners.

Drying time increases with thickness of the layer.

Application	1-component nitro-combination stopper
Layer thickness	Max. 80 µm
Drying time	up to 2 hours at 20°C
Sand	P240 - P400

2-component polyester general stopper

CAUTIONS:

⚠ **Do not exceed the quantity of hardener specified by the manufacturer, excess peroxide can cause staining of the paint top coat.**

⚠ **Mix the stopper base and the hardener well to avoid a marble-like effect.**

Check that the manufacturer permits use on the substrate to which it will be applied.

2-component polyester stopper is available in coarse and fine grades. The coarse stopper can be used for very uneven areas and surfaces and fine stopper or spray stopper should be applied afterwards.

Application	2-component polyester coarse stopper
Use	Rough equalization of unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 4 - 6 minutes
Drying	20°C approx. 12 minutes
	Short wavelength infrared approx. 4 minutes
	Medium wavelength infrared approx. 5 - 10 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150

Application	2-component polyester fine stopper
Use	Equalization of unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 4 - 6 minutes
Drying	20°C approx. 12 minutes
	Short wavelength infrared approx. 4 minutes
	Medium wavelength infrared approx. 5 - 10 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P240

Application	2-component polyester glass fiber stopper
Use	Equalization of unevenness; blending in of vehicle extensions; repair of GRP components
Hardener quantity	approx. 3 - 5%

DESCRIPTION AND OPERATION

Application	2-component polyester glass fiber stopper
Working time	approx. 4 - 6 minutes
Drying	20°C approx. 12 minutes
	Short wavelength infrared approx. 4 minutes
	Medium wavelength infrared approx. 5 - 10 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150

2-component polyester fine stopper should always be applied after 2-component polyester glass fiber stopper.

Application	2-component polyester spray stopper
Use	Equalization of unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 25 - 30 minutes
Layer thickness	200 µm or 4 - 8 spray passes
Drying	20°C approx. 3 hours
	Short wavelength infrared approx. 10 minutes
	Medium wavelength infrared approx. 15 - 20 minutes
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150; fine sand - P280

Application	2-component plastic stopper for flexible thermoplastic
Use	Equalization of scratches or unevenness
Hardener quantity	approx. 3 - 5%
Working time	approx. 25 - 30 minutes
Drying	20°C approx. 15 - 30 minutes

Application	2-component plastic stopper for flexible thermoplastic
	60°C approx. 15 min
	(Short wavelength infrared approx. 8 minutes)*
	(Medium wavelength infrared approx. 8-10 minutes)*
Sanding tool	Eccentric, sanding disk by hand
Grade	P80 - P150; fine sand - P280

***Infrared drying may adversely affect adhesion, therefore check the manufacturer's instructions.**

Plastic stopper has a very great tendency to shrink back, so that the edge of the stopper repair becomes visible.

Plastic stoppers are flexible and universally applicable on all types of plastic (except for pure PE and PP, these are plastics which cannot be painted). The manufacturer's instructions must be very exactly followed in order that no adhesion problems occur. A special plastic etch primer is specified for some materials.

Primers

Application	1-component primer
Use	Isolation of bare sanded areas.
Spray gun	HVLP 1.3 mm
Spray pressure	2.0 bar
Drying	20°C approx. 15 - 20 minutes
	60°C approx. 10 min
Coat application	Wet on wet, no intermediate sanding

Application	2-component primer
Use	Corrosion protection and bonding agent (steel sheet, zinc coated steel sheet, aluminum)

DESCRIPTION AND OPERATION

Application	2-component primer
Spray gun	HVLP 1.3 mm
Spray pressure	2.0 bar
Drying	20°C approx. 15 - 20 minutes
	60°C approx. 10 min
Coat application	Wet on wet, no intermediate sanding

HS primer filler and HS tinted filler

Note:

- Primer filler is available as 1-component and 2-component water based and solvent based forms.
- 1-component products are only suitable for isolation of sanded through bare areas and new painting.
- Water based products are also used for the skinning of thermoplastics and substrates which are sensitive to solvents.
- Tinted fillers can be individually matched to the top coat color and therefore find uses in effect paints and paints with poor covering power.
- Use dry sand or wet sand filler according to application in order to avoid unnecessary sanding work.
- On critical substrates the use of epoxy resin base filler is recommended in order to avoid adhesion problems.

Application	HS primer filler and HS tinted filler
Use	Equalization of unevenness, edge zones, sanding scores
Spray gun	HVLP 1.6 - 1.9 mm
Spray pressure	2.0 bar
Layer thickness	50 - 70 µm to 150 µm possible
Drying	20°C approx. 2.5 hours
	(60°C approx. 25 min)*
	(Short wavelength infrared approx. 8 minutes)*

Application	HS primer filler and HS tinted filler
	(Medium wavelength infrared approx. 10-15 minutes)*
Coat application	Wet on wet, no intermediate sanding

***In order to avoid boiling out, drying should be performed slowly.**

Paint

The base and the clear lacquer must be matched to one another.

Application	Water based paint
Use	Two layer metallic effect paint and Uni-paint finishes
Spray viscosity	At 20°C 18 - 20 s
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar
Layer thickness	15 - 20 µm
Drying	20°C approx. 2.5 hours
	60°C approx. 25 min
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes
Coat application	Wet on wet
Ventilation time	approx. 5 minutes

The base paint must be dried matt before the clear lacquer is applied.

Application	2-component HS clear lacquer
Use	Gloss providing protective coat for base coat substrate
Spray viscosity	At 20°C 18 - 20 s
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar
Layer thickness	50 - 70 µm

DESCRIPTION AND OPERATION

Application	2-component HS clear lacquer
Drying	20°C approx. 10 hours
	60°C approx. 30 min
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	2K HS Uni top coat
Use	Color and gloss providing paint layer
Spray viscosity	At 20°C 20 - 22 s
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar - 3.0 bar
Layer thickness	50 - 70 µm
Drying	20°C approx. 8 hours
	60°C approx. 30 min
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 -15 minutes

DESCRIPTION AND OPERATION

Additional Materials

The manufacturer's instructions must always be followed when dealing with any materials! The information given in the following text is data which is independent of the manufacturer, and it should only used as an indication.

Adhesive sealants

Adhesive sealants are permanently elastic, long-lived, can be painted and accept filler.

Application: Sealing of visible and normal seams.

Can be over-painted with 2-component paint, primer and fillers after having dried throughout.

Contamination can be removed using cleaner and thinner.

1-component PUR adhesive sealant

Note:

- Hardens using oxygen from the air. For that reason, it must only be stripped after it has completely dried through.

2-component MS polymer adhesive sealant

2-component MS polymer adhesive sealant is free of isocyanate, solvent and silicones and can be spot-welded.

MS polymer adhesive sealant

Can be over painted with water-based paints.

Suitable for spraying and brushing to obtain a composition true to the original.

MS polymer adhesive sealant is free of isocyanate, solvent and silicones and can be spot-welded.

Underbody protection

Underbody protection products are immune to abrasion, permanently elastic, adhere well and are suitable for a true to original texture.

Underbody protection based on solvent

Application:

- Underbody protection for visible areas.

Properties:

- Can be over-painted, also with 2-component paint.
- Can be colored with a proportion of up to 40% paint.

Note:

- Contamination can be removed using cleaner and thinner.

Water based underbody protection

Can be over-painted with water based paint.

Can be colored with water based paint.

Contamination can be removed using water.

Application	Water based underbody protection
Use	**Underbody protection** for visible areas
Spray viscosity	ready to use
Spray gun	Suction beaker HVLP gun 3 - 4 mm
Spray pressure	4 - 6 bar
Layer thickness	500 - 1000 µm
Drying	approx. 6 hours at 20°C
	approx. 45 - 60 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Water based underbody protection
Use	**Isolation primer** for peroxide marks, bloomed old paintwork and thermo-plastics.

DESCRIPTION AND OPERATION

Application	Water based underbody protection
Spray viscosity	Thin as necessary with distilled water
Spray gun	HVLP gun 1.9 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	40 - 50 µm
Drying	approx. 2 hours at 20°C
	approx. 30 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Paint additives

Application	Sanding test color
Use	To test sanding results
Spray gun	HVLP 1.7 - 1.9 mm
Spray pressure	2.0 bar
Layer thickness	Spray drifted

Application	Fixer additive
Use	Converts solid top coat into two layer solid; multi-color painting
Spray viscosity	18 - 20 secs at 20°C
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	max. 30 µm
Coat application	Wet on wet
Ventilation time	approx. 15 - 30 minutes

Maintain maximum layer thickness without fail.

Must always next be overpainted with clear lacquer.

Application	Drying accelerator
Use	Accelerates drying with only minimal reduction in working life
Working life	approx. 5 hours at 20°C

Application	Drying accelerator
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 6 hours at 20°C
	approx. 25 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Cannot be used in all paints, read the manufacturer's instructions.

Particularly suitable for partial painting.

Application	Elastifier additive in primer material
Use	Elastifies the complete paint structure on plastics.
Addition	Up to 25%
Spray gun	HVLP 1.7 - 1.9 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 µm
Drying	approx. 4 hours at 20°C
	approx. 40 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Elastifier additive in top coat
Use	Elastifies the complete paint structure on plastics.
Addition	Up to 25%
Spray gun	HVLP 1.7 - 1.9 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 60 µm

DESCRIPTION AND OPERATION

Application	Elastifier additive in top coat
Drying	approx. 16 hours at 20°C
	approx. 45 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Application	Matting additive in solid paint
Use	Elastifies the complete paint structure on plastics.
Semi-gloss addition	Up to 25% in the paint without hardener and thinner
Silk gloss addition	Up to 35% in the paint without hardener and thinner
Silk matt addition	Up to 45% in the paint without hardener and thinner
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 8 hours at 20°C
	approx. 30 minutes at 60°C
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

CAUTION: Do not dry using infrared.

Application	Matting additive in clear lacquer
Use	Elastifies the complete paint structure on plastics.
Semi-gloss addition	Up to 25% in the paint without hardener and thinner
Silk gloss addition	Up to 35% in the paint without hardener and thinner
Silk matt addition	Up to 45% in the paint without hardener and thinner
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 8 hours at 20°C
	approx. 30 minutes at 60°C

Note:

- When mixing, first put in the matting additive, then the hardener and thinners.
- Stir immediately after adding the matting additive.
- Do not store after addition of the matting additive, storage will change the degree of gloss.
- Also suitable for use on plastics without addition of elastifier additive.

Application	Matting paste
Use	Matts, elasticizes and gives structure to solid paint and clear lacquer during painting of bumpers or hard plastic.
Addition	1:1 or 2:1 depending on manufacturer in solid paint without hardener or thinners.
Spray gun	HVLP 1.2 - 1.3 mm
Spray pressure	2.0 - 3.0 bar
Layer thickness	50 - 70 µm
Drying	approx. 6 - 10 hours at 20°C
	approx. 30 minutes at 60°C

DESCRIPTION AND OPERATION

Application	Matting paste
	Short wavelength infrared approx. 8 minutes
	Medium wavelength infrared approx. 10 - 15 minutes

Note:

- **The paint must not be filtered.**

Application	Anti-silicone additive
Use	Prevents silicone craters
Addition	2% to maximum 5%

Note:

- Only add away from the paint cabin and immediately remove contaminated cloths.
- If anti-silicone additive is used in the first coat, then it must be used in the following coats, and in at least the same proportions.

Additive materials

Variety of adhesive tapes

For profile, fine and large area masking work.

Properties:

- Withstands heat.
- Withstands water-based paint.
- Accepts paint.
- Easily removed without leaving adhesive residues.

Masking film.

For masking of large areas on vehicles.

Properties:

- Accepts 2-component and water-based paints.
- Withstands heat.
- Withstands water spray and condensation.
- Withstands solvent.
- Easily cut.
- Environmentally friendly and can be recycled.

Polishing materials.

Polishing means microfine sanding. For this reason, polishes must only contain abrasives, and no silicones.

During polishing repair, a good shine is achieved through the step-by-step use of polishes, starting with a highly abrasive polish and ending with a polish having very slight abrasive action.

Polishes are available in graduations from coarse to fine.

Abrasives

Please refer to the "Tools" chapter for information on abrasives.

DESCRIPTION AND OPERATION

Paint Repairs

General information

There is a great difference between painting in production and repair painting.

In production, only the bodyshell is painted, it has no trim, upholstery or assemblies. Because of this, other paints, tools and processing techniques can be used.

In contrast to that used in production, paint used in the workshop must dry at low temperatures. Plastics and the vehicle electronics must not be subjected to temperatures greater than 70°C.

The painting process in the case of repair work consists of two phases:

- Pre-treatment of the surface for corrosion protection and the smoothing of irregularities.
- Top coat application.

The precondition for a professional paint finish on a vehicle is the permanently maintained cleanliness of work spaces, tools and equipment,

Original materials must be worked according to the manufacturer's instructions, so that no problems arise in the processing nor during drying.

The room temperature must be 20 - 25°C and the humidity must be low. Temperatures which are too low or too high can lead to porosity, poor flow and boiling. High humidity leads to paint damage such as tarnishing of the paint film (matt film), adhesion problems and craters.

Pre-treatment of the surface

Perfect preparation of the subsurface is the precondition for a brilliant paintwork result. Faults in the preliminary stages delay completion and cause unnecessary extra work. The working steps described here demonstrate how important it is to follow these instructions step by step.

NOTE: Thorough cleaning of the vehicle and especially of the area being repaired is particularly important because of the danger of contamination of the paint.

Clean the area of the damage

TO BE UPDATED LATER

Clean the damaged surface thoroughly, to allow the extent of the damage to be seen. Use silicone remover to produce a grease-free surface.

NOTE: The treated surface must be rubbed with a clean dry cloth before the solvent evaporates, otherwise there will be no cleaning effect.

Effective de-greasing is important not only before the application of paint, but also before all sanding stages, for two reasons:

- During sanding of grease contaminated surfaces, globules may form with the sanding dust. Sanding marks will occur and the sanding medium quickly becomes unuseable.
- Oil and grease are embedded by the action of the abrasive particles, and are then very difficult to remove.

Establish the area of damage and the repair stages. In doing so, establish how much disassembly work must be undertaken. Perform a color test at this stage.

Mask off the area of the repair ready for preparatory work.

Sand out the damage location

TO BE UPDATED LATER

DESCRIPTION AND OPERATION

When sanding, produce smooth transitions from the painted area to the bare metal.

Use an eccentric sander and P80 or P120 abrasive sheets. Finish off sanding with P150 or P180. The remaining adhering sanding dust must be completely removed.

Cleaning, de-greasing

TO BE UPDATED LATER

Use silicone remover to thoroughly clean the surface in order to remove grease residues, sweat from the hands and other contamination.

NOTE: Use a solvent test to establish whether the old paint can be etched. Apply 2-component thinners to the damaged area using a clean cloth and rub lightly for about 1 minute. If the subsurfaces can be etched away, special pre-treatment is necessary. See "Tips and Tricks"

Apply primer filler

TO BE UPDATED LATER

Before applying stopper, apply primer to the sanded and bare surface.

Allow the primer to dry and then lightly sand by hand using P220 - P400 dry.

NOTE: Most stopper can be applied directly to bare metal. But application of a primer filler provides better corrosion protection.

NOTE: Avoid sanding through to the bare metal. Points which are sanded through must be retreated with primer filler.

Stopper application

TO BE UPDATED LATER

Pre-sand the hardened stopper using an eccentric sander and P80 dry, then final-sand using P120 - P140 dry. Clean the sanded surface using silicone remover.

Apply 2-component stopper to the filled surface. The stopper compound must only be applied thinly.

NOTE: Use of a testing powder is recommended so that the sanding process can be more easily checked.

Apply filler

TO BE UPDATED LATER

Filler can now be applied to the dried repair area. Choose the correctly toned filler according to the manufacturer's instructions.

NOTE: Alternatively, filler with the correct tone can be mixed with the aid of colour matching cards.

DESCRIPTION AND OPERATION

Sand the filler.

TO BE UPDATED LATER

The working area is expanded by applying new masking. This makes it possible to even out the transition from the damage area to the vehicle paintwork.

NOTE: The primer filler must be carefully sanded. Faults in the primer filler layer will be visible in the top coat.

The sanding process consists of two stages. Coarse sanding levels out the surface of the filler primer. Fine sanding ensures the necessary surface structure which allows the top coat to adhere well and cover sanding marks.

Sand the filler using the eccentric sander and P400 - P500 used dry. Clean the sanded filler finished surface using silicone remover.

The painted area is matted using a fine matting sponge, and then thoroughly cleaned.

Surface ready for paint

TO BE UPDATED LATER

The surface which has been repaired and then prepared according to the manufacturer's instructions is now ready for basic paint application.

Top coat application

It is important for a good paint result that the recommended process data is adhered to, i.e. mixture proportions, layer thickness, viscosity, drying time etc.

First of all the work area is carefully masked ready for paint application. The correct adhesive materials and techniques must be used so that no hard transitions and edges are created during painting.

NOTE: The chapter "Tips and Tricks" gives in-depth information on masking work.

Thoroughly check the surface once more and rub-off with a dust-bonding cloth.

NOTE: Once more check the paint material and that the spray gun is correctly adjusted before applying the paint.

Paint application

TO BE UPDATED LATER

The base paint is applied in two or three steps. First of all only the repair area is painted with the first paint application.

Flash off

TO BE UPDATED LATER

Allow the paint application to flash off until the surface has a matt appearance. So that the transition to the original paint is optimally created, the next paint application is applied to a wider area.

After the base paint has dried for the specified time, the clear lacquer is applied. Next the transitions to the original paintwork are treated with fade-out

DESCRIPTION AND OPERATION

remover. This removes the spray mist and forms an ideal paint surface.

Repair stages for repair painting

The required time and material data is divided into four painting levels for calculations concerning repair painting. Proceed according to these divisions for every calculation.

Level 1 - Painting of new components

On new components, all inner surfaces, seams and edges which will no longer be seen after assembly must be primed and pre-painted.

NOTE: The cathodic dip primer must not be sanded away. Cleaning with silicone remover or light sanding of the primer is all that is required.

Job steps:

- Wash off, prime and pre-paint inner surfaces, seams and edges which cannot be reached at all or only partly after the component is installed.
- Sand new component with P280 - P320 or a fine sanding pad.
- Clean subsurface with silicone remover.
- Carry out masking work (when painting an installed component).
- Apply one spray run of filler, dry.
- Sand the filler. P1200 wet or P500 dry.
- Clean filler application with silicone remover.

Then the prepared surface can be painted with solid or 2-component paint.

If the new part has mild transport damage, this must be rectified beforehand.

To do so, add the following steps:

- Grind out the scratch.
- Finely sand the surrounding surfaces.
- Use a steel cleaning agent to thoroughly clean and then rub dry.
- Apply corrosion protection primer to the bare areas.

Level II - Top surface painting (color tone matching)

Complete bodywork surfaces which are to be painted without the need to apply stopper belong to this group. In addition, surfaces with faults in the top coat surface which cannot be removed by polishing.

The following faults are included:

- Loss of gloss.
- Sanding scores.
- Heavy paint runs.
- Large dust and dirt inclusions.

The scope of the work is as follows:

- Sand the surface.
- Sand out paint damage and faults.
- Treatment of small areas which have been sanded through.
- Masking work (when painting an installed component).
- Apply top coat according to the painting process (one or several coat process).
- Dry the top coat and perform finishing work.

Level III - Repair painting with stopper applied to up to 50% of the surface.

If in addition to painting, work with stopper application must be performed, then the repair levels III or IV must be used.

In repair level III, apart from painting the complete bodywork surface, partial stopper work is carried out on up to 50% of the surface to be painted. The necessary primer and filler work are also included.

The following damage must be rectified in this level:

- Slight panel unevenness.
- Damage due to corrosion.
- Dented body surfaces.
- Weld locations.
- Deep scores or scratches.

The scope of the work is as follows:

- Fine sand pre-treated bodywork surfaces (e.g. lead-loaded areas).
- Sand out existing damage.
- Perform all necessary masking operations on the vehicle.
- Apply primer.
- Partial stopper application on up to 50% of the surface to be painted (two to a maximum of three stopper applications).
- Fill the repair area.
- Apply stone chip protection (when present in production).
- Apply top coat according to the painting process (one or several coat process).
- Dry the top coat and perform finishing work.

DESCRIPTION AND OPERATION

Level IV - Repair painting with stopper applied to more than 50% of the surface.

In repair level IV, apart from painting the complete bodywork surface, partial stopper work is carried out on more than 50% of the surface to be painted. The necessary primer and filler work are also included.

The following damage must be rectified in this level:

- Damage due to hail.
- More extensive stone chip damage.
- Extensively dented body panels.
- Sectional repairs with large weld seams.
- Surfaces with severe corrosion damage.

The scope of the work is different to level III because of the partial application of stopper to more than 50% of the area to be painted. In addition, more extensive sanding work is usually required.

Polish

In order to achieve faultless quality, it is sometimes necessary afterwards to polish a newly painted surface.

Even after the most careful painting, it sometimes happens that dirt inclusions and paint runs occur in work with top coat or clear lacquer. Before polishing, such paint faults must be removed with the sanding cylinder ("Finiball") and hand sanding or eccentric sander in a wet sanding process.

Sanding cylinder

TO BE UPDATED LATER

The special sanding compound **-1-** (sanding bloom) for the sanding cylinder is self-adhering and available in grades from P1000 to P2500.

- P1000 - P1500 for pre-sanding of runs and large imperfections in the paint.
- P1500 - P3000 for subsequent sanding of runs and sanding out of dust inclusions.

A small eccentric sander can be used for more extensive working areas. When doing so, first of all put the eccentric sander in place and then switch it on, so that the danger of sanding through on edge is reduced.

Finally polish the sanded area to a high gloss with suitable polish. To this end the various manufacturers recommend materials and process techniques which are specially suited to their products.

NOTE: The polishing is to be done in the same way as that used to remove swirl marks.

Polish

TO BE UPDATED LATER

NOTE: Before using the nap sponge for the first time and after any long pauses in working, dampen the nap sponge with polish.

Job steps:

- Clean and degrease the area to be polished using silicone remover.
- Apply the polish to the polishing disc and spread it.
- Place the polishing machine down flat on the area to be polished and before switching it on, gently distribute the polish over the underlying surface.
- Polish out the location for 10 - 15 seconds with the edge, working with a criss-cross motion.
- Subsequently polish the location for about 10 seconds with the machine laid down flat.
- Wash off and clean the polished location using the professional polishing cloth and then clean the polished surface.
- It is absolutely vital to carry out a visual check after finishing the polishing procedure. If any swirl marks are not completely removed by the first polishing procedure, then process must be repeated.

DESCRIPTION AND OPERATION

Aids

Cleaning putty

Cleaning putty allows deposits on the paint surface to be removed easily and gently. The following paint faults can be removed using cleaning putty:

- Metal deposits and iron dust.
- Paint or color mist.
- Tree resin and tar.
- Insect residues.

The surface to be worked must be thoroughly cleaned before the cleaning putty can be applied. Then the surface is sprayed with soapy water. Now the cleaning putty can be slid over the surface until all unevenness is removed.

DESCRIPTION AND OPERATION

Painting Plastic Parts

General

Although these days plastics can be produced in all colors and with a matt or gloss surface, painting is often necessary.

NOTE: Manufacturer's limitations concerning the feasibility of painting certain components must always be observed.

Reasons in favor of applying paint to plastic are:

- Individual coloring, matching the body paint.
- More gloss and color brilliance through painting.
- Removal of production imperfections.
- Protection from atmospheric exposure.

Nowadays painting plastic presents no problems because the materials are known and matched to the paint. In order that the painter can use the correct painting materials, the type of plastic must first be correctly determined.

To allow this, plastics are marked on the rear in accordance with the recommendations of the Association of Vehicle Manufacturers.

Once the type of plastic is determined it is an easy matter to assign special paint recommendations, matched to that particular plastic. Unmarked plastics require knowledge of materials so that a correct choice of paint materials can be made and the component can be reliably painted.

Plastic groups

Thermoplastics

When warmed these undergo a reversible transformation into a plastic deformable state and once cooled they maintain their shape. They consist of string-like (linear) or only slightly branched molecular chains.

Thermosets

Thermosets are hard and have the form of a close-meshed network in all directions. They do not undergo plastic deformation, are especially resistant to chemicals, are difficult to swell and are insoluble. At normal temperatures they are hard to brittle. At first the material does not undergo any change when heated, but when it reaches a critical point, the thermoset is totally destroyed.

Elastomers

Elastomers are characterized by high elasticity over a wide temperature range. They have properties like rubber or a sponge and after compression or distension they return to their original state.

Types of plastic

The plastics used in the automotive area:

- ABS - Acrylonitrile butadiene styrene (polymer)
- PA - Polyamide
- PC - Polycarbonate
- PE - Polyethylene
- PP - Polypropylene
- PP/EPDM - Polypropylene/ethylene propylene diene copolymer
- PC/PBT - Polycarbonate/Polybutylene terephthalate
- PBT/PC - Polybutylene terephthalate/Polycarbonate
- PUR - Polyurethane
- GRP - Glass reinforced plastic

NOTE: PE and PP are plastics which cannot be painted, or can only be painted using special techniques.

As well as the pure plastics, so-called 'blends' are also used. This means combinations of different plastics. If we were dealing with metals they would be called alloys.

Plastic identification

Normally the identifier is marked on the plastic components used in vehicle construction.

One method to determine the plastic group is the sanding test. In this a place is chosen which will not be visible later, and the finger belt sander is used to sand the plastic.

The plastic group can be determined using the pattern left by the sanding and the dust:

- Thermosets produce a white dust.
- Thermoplastics smear and do not produce dust.

The plastic group can be determined by a sound test:

DESCRIPTION AND OPERATION

- Degree of hardness - the higher-pitched the sound, the harder the plastic.
- Elasticity - the more muffled the sound, the higher the elasticity of the plastic.

Cleaning plastic

Plastic components are manufactured using complicated moulds and presses or other highly engineered tools, mostly using an injection moulding process or reactive injection moulding process.

In order to be able to remove the component from a particular tool, a separating agent is used, which in some cases adheres very strongly to the plastic.

This separating agent on the plastic components must be completely removed before any surface coating is applied.

Warm storage (tempering) before actual cleaning brings the following advantages:

- The separating agent sweats out of the plastic.
- Tensions in the plastic are released.
- Air inclusions can be recognized and removed.

Intensively clean the item several times using a pad and fresh cleaning agent.

NOTE: A single wipe, even with cleaning agent, is not usually sufficient in most cases. Clean textured components with the aid of a soft brush.

After cleaning, it is absolutely vital that cleaning agent absorbed by the plastic should be expelled by tempering again. If the ventilation is good and the room temperature is about 20°C the solvent can be evaporated away by overnight storage.

Painting new components

It is absolutely vital that the substrate of an unpainted new component is free of separating agent. Paint can only be applied directly to very few plastics. The plastic must first be identified exactly and then worked with a repair system which is matched to the type of plastic. In most cases a plastic etch primer must be applied as adhesion base to all plastics which can be painted.

NOTE: Plastics have a tendency to become electrostatically charged. This can easily cause contamination during painting. Special antistatic cleaning cloths prevent electrostatic charging.

Work process for thermoplastics:

- Thoroughly clean the surface.
- Temper the plastic.
- Afterwards clean with antistatic cleaner or antistatic cloths.
- Apply the bonding agent.
- Apply elastic filler. After it has dried, sand and clean.
- Apply one coat Uni-paint with elasticizer additive. For two layer painting the elasticizer additive is in the clear lacquer.

NOTE: Follow the paint manufacturer's guidelines during all work.

Work process for thermosets:

- As a rule, thermosets can be handled in the same way as normal body components.

Work process for PUR soft foam:

- The work process is the same as for thermoplastic.
- Instead of using bonding agent, a filler wash is applied to close the pores of the PUR soft foam.

The primer which has been applied to a primed new component can vary greatly. If no manufacturer's data is available, the composition and suitability for further working must be tested.

Painted components with an already ascertained and intact paint coat present no problems for possible repainting. After sanding and careful cleaning with plastic cleaner or thinners, painting can be done directly.

Unknown primer

When dealing with unknown substrates it is important to carry out an adhesion test on the existing paint before any repainting is attempted. First of all a mechanical test must be carried out, for instance using a lattice cut and tear-off band. If the adhesion of the old paint is not acceptable, it must be mechanically removed and new paint finish applied.

If the adhesion is acceptable, then an etch test is performed using 2-component thinners. If no etching can be detected in this test, application of the the paint finish can be started directly. Otherwise the old paint must be removed and a new paint finish created.

With the help of universal or special plastic primers and with only a few materials complementary to those previously present anyway, the painter can now apply a long-lasting paint finish to all popular vehicle attachments made of plastic.

DESCRIPTION AND OPERATION

Paint faults on plastic substrates

NOTE: Paint faults are fully described in the chapter Paint Defects and Damage.

The most common paint faults which can occur when painting plastic components and the methods of repair are briefly described.

Discoloration

Cause/damage pattern:
- Plastic material is not suitable for painting.
- Incorrect bonding agent.
- Paint used not solvent resistant.

Repair of damage:
- Repaint using suitable materials.
- Install a new unpainted component.

Softening

Cause/damage pattern:
- Substrate not carefully cleaned.
- Air humidity too high or working temperature too low.
- Drying time incorrect (too short).
- Materials for substrate not correctly matched to each other or not mixed correctly.

Repair of damage:
- Dry out, sand, re-isolate and paint.
- Sand away faulty paint coats and re-apply paint finish.

Paint damage caused by detachment, poor adhesion

Cause/damage pattern:
- Insufficient paint adhesion between top coat and filler. The whole of the paint finish detaches from the plastic.
- Plastic not cleaned sufficiently, not or inadequately tempered.
- Unsuitable cleaning agent or materials used.
- Poor or lack of intermediate sanding.
- Paint finish underbaked or overbaked.

Repair of damage:
- Sand away faulty paint coats and re-apply paint finish.

Paint damage caused by blisters, craters, sink holes

Cause/damage pattern:
- Painting on PUR plastic which was not painted in production.
- Surface of the plastic material too porous.
- Flash-off time not adhered to.
- Drying temperature too high.
- Moisture in plastic material.
- Layers too thick.

Repair of damage:
- Clean the damaged area, sand, re-isolate and paint.
- Remove the paint layers and re-paint.

Crack formation

Cause/damage pattern:
- Overexpansion of painted PUR plastic components.
- Use of unsuitable paint materials.
- Paint materials not suited to each other or incorrect mixture ratio.

Repair of damage:
- It is not possible to repair overexpanded PUR plastic components.
- On other plastics, sand away damaged layers, isolate and repaint.

DESCRIPTION AND OPERATION

Spot Repairs

General

In general, partial surface painting at a point is called a spot repair. Using this technique, minor paint damage can be resolved economically and to time.

Advantage of this method

Because this application remains confined to the area of the damage, it is often unnecessary to remove components or color match against neighboring components. The material used is very much reduced because only a part of the repair area is coated.

Practical application areas

Only occasionally can satisfactory results be achieved in the centre of larger surfaces and/or on difficult colors. In addition, unprofessional application may cause tear-off edges to appear in clear lacquer. Only certain application areas are recommended.

NOTE: The final decision on whether to spot repair or paint the component must be made by an expert.

Application areas:

- 2-layer paint.
- Depending on the damage zone, paint damage up to a diameter of 3.5 cm or a length of 10 cm.
- Scratches.
- Clear lacquer application up to an area of DIN A4 max.
- Smaller areas which are optically broken up by other components such as trim strip, tail lights, swage lines and edges.
- Boundary zones and edge areas of larger components.

The best application areas have proven to be optical break lines such as corners, narrow surfaces, fenders and wheel arches.



Because of their locations, the violet colored areas are the most suitable for spot repair painting. The turquoise areas are only marginally suitable and the rest of the areas are not suitable for spot repairs.

DESCRIPTION AND OPERATION

Repair process

Perfect preparation of the subsurface is the precondition for a brilliant paintwork result. Faults in the preliminary stages delay completion and cause unnecessary extra work. The working steps described here demonstrate how important it is to follow these instructions step by step.

Illustration of damage

TO BE UPDATED LATER

A typical case for spot repair is a small stone chip on the fender.

Cleaning

TO BE UPDATED LATER

First of all the component is thoroughly cleaned using silicone remover and refurbished using abrading and polishing paste. This re-creates the original degree of shine and ensures exact color matching on the touch-up surface.

Sand out

TO BE UPDATED LATER

Sand out the damaged location using P180 - P320. Only small sanding blocks and small sanding machines must be used, so that the area of the repair remains as small as possible.

Sanding is completed by rubbing down the surrounding surface with a fine sanding pad or P1000 paper. Remove sanding residues and clean the repair area with silicone remover. The peripheral zone must then be masked for application of the filler.

NOTE: The size of the repair area must be kept as small as possible (maximum size DIN A4).

Filling

TO BE UPDATED LATER

The filler layer is applied in stages. First of all, filler is only applied to the location which has been sanded away. After a wait time for flashing off, the second coat is applied so that it spreads over onto the existing paintwork.

The filler must be dried according to the instructions of the material supplier.

DESCRIPTION AND OPERATION

Rubbing down

TO BE UPDATED LATER

The repair location is now rubbed down with P400 - P500 and the bordering surface with P2000 - P4000. Remove sanding residues and clean the repair area with silicone remover.

Paint

TO BE UPDATED LATER

Before painting, clean the area for the final time using a dust-bonding cloth. Then apply the basic paint in thin layers using a spray gun until enough coverage is achieved.

After drying, apply clear lacquer in 1 or 2 coats (depending on product). In doing so, spray so that only the newly applied basic paint is completely covered. Finally a touch-up thinners is sprayed over the edge of the clear lacquer to dissolve the clear lacquer spray mist.

Dry

TO BE UPDATED LATER

Now dry the clear lacquer according to the manufacturer's instructions using an infrared gun.

Polish

TO BE UPDATED LATER

Polish the component using a polisher and polish and check the polished area for any swirl marks which may be present. Polish away any swirl marks which are present.

Dirt inclusions

Sand out

TO BE UPDATED LATER

Minor damage can be removed with a small sanding machine or preferably with an eccentric sander with P1500 - P2000. Very fine spray mist

DESCRIPTION AND OPERATION

can be removed using P2000 - P4000 paper and a larger eccentric sander.

DESCRIPTION AND OPERATION

Corrosion Prevention

General

Although corrosion protection measures and painting processes in production have reached a very high technical standard and will be continuously developed further, in the long term corrosion on a vehicle cannot be totally avoided. Further demands are therefore made of the paint specialist besides his knowledge of normal repainting of vehicles which have been repaired after an accident, in addition specialist knowledge is required for assessing and rectifying damage due to corrosion.

During repair painting, take care over the maintenance and re-creation of the corrosion protection applied in production, in view of the long-term warranty on Ford vehicles. Only those repair materials which are approved by Ford may be used for body repair work and repair painting.

For detailed information on corrosion protection measures during body repairs, please refer to chapter 501-25.

Furthermore, information on corrosion protection measures is repeated in individual chapters of the paint manual.

In particular, pay attention that the layer thicknesses specified in production are maintained. The complete system of solid one-layer on galvanized steel panels must equal at least 90 µm and the total system of two-layer on galvanized steel panels must equal at least 105 µm.

It is important that sealing operations, as far as they are necessary, should be undertaken after the application of the paint to specification, in order to ensure the best corrosion protection. All components which form hollow cavities such as pillars, rails, side components etc. must be provided with a coating of cavity protection wax.

Causes of corrosion

Corrosion of steel is an electrochemical process during which the steel combines with oxygen. The following factors lead to corrosion:

- Acidic compounds contained in the air, such as carbonic acid and sulphur dioxide, combined with oxygen from the air and/or water. Salts such as sodium chloride used as road salt accelerate the corrosion process.
- Mechanical damage such as stone chips and scratches which penetrate through to the steel panel.
- Lack of care by the vehicle owner of the painted and corrosion proofed surfaces or areas on the vehicle.
- Unfavorable weather or environmental conditions, as may occur in areas with high humidity, high salt content in the air or serious air pollution due to aggressive gases and dusts.

In the case of mechanical damage, formation of rust can often be seen, beginning to spread into the painted surface from a point (stone chip) or from a line (scratch). If these faults are not professionally rectified in good time, the result is rusting through from the outside to the inside. Rusting penetration from the inside to the outside occurs when for instance the cavity protection was inadequate.

Operations after painting

NOTE: The manufacturer's instructions must be followed when working with the various corrosion protection materials.

- After painting, treat all cavities in the repair area with cavity protection wax. In doing so, pay particular attention to the weld seams. In dead-end applications with a panel insert, the cavity protection wax must be applied so that it also reaches the area of the panel insert.
- Seals which were applied in production and not over painted must be reapplied. Seals protect vulnerable parts of the bodywork, keep moisture away, reduce wind and road noise and dampen vibrations.
- Apply transparent wax.

Definition of the degree of rust

In workshop practice, in order to be able to carry out a consistent and objective evaluation of the scope of the damage, a degree of rust on the scale of 1 to 5 is determined by the DIN 53 210 standard. The main criterion here is the extent to which rust exists under the paint structure. It is determined in millimeters (mm).

DESCRIPTION AND OPERATION

Underlying rust grade: R1 < 1 mm

Corrosion starting with up to 1 mm of rust underlying (in the form of a spot or a line).

The damage can be rectified by cleaning the defective location and mechanically removing the underlying rust. For a small extent, apply a primer using a brush and allow it to dry. Touch-up the location with a paint pen or provide a new paint coating.

Underlying rust grade R2 < 1 - 2 mm

Advanced corrosion with up to 2 mm underlying rust.

Rectifying the damage:

- Clean the defective location.
- Remove the underlying rust mechanically down to the paintwork carrier.
- Apply 1-component filler and then 2-component "Vario" filler.
- Provide the damage location with new paint coat on visible outer surfaces. Only locally touch-up areas which are not optically conspicuous.

Underlying rust grade R3 < 2 - 4 mm

More advanced corrosion with up to 4 mm underlying rust. The damage must be rectified in the same way as for R2. A permanent cure of this type of damage pattern is still just possible

Underlying rust grade R4 < 4 - 5 mm

Notably advanced corrosion with up to 5 mm underlying rust. The damage must be rectified in the same way as for R2. If it is found that for whole areas this is only possible with a great deal of work, or is not possible at all, then a new component must be used.

Underlying rust grade R5 > 5 mm

Extreme corrosion, with more than 5mm underlying rust (panels, flanges or load-bearing components partially rusted or rusted through).

Such damage can no longer be repaired because in many cases the constructional strength of the component can no longer be produced. The risk in making a repair is too great. Install a new component and paint it.

DESCRIPTION AND OPERATION

Color Identification and Chromatics

Basic color theory

In order to achieve optically perfect painting results it is vital to understand the physical principles of the origin of color impression.

Color

Color itself is a sensory perception.

This perception arises through the combined effect of the following components:

- Light (sunlight or artificial light irradiates the object).
- Surface of the object (reflection from the object of certain constituent parts of the light).
- Eye (perception of the reflections from the object).

TO BE UPDATED LATER

Because the sensory impression of color is produced by all three of these components, it is dependent on the type, quality and function of the individual components. Practical examples make this clear:

- If a particular article is subjected to artificial light, then it gives a different impression of color to that which it gives in sunlight.
- An object with uniform color but different surface textures appears to have different colors (grained or ungrained dashboard).
- A person with perception disorder (colorblindness) cannot recognize certain colors or distinguish between them e.g. red-green weakness).

In turn the type of color is determined by the light absorption ability of an object. Light shines with all color components (spectral colors) onto an object, certain components of the light are absorbed (taken in) and other components are reflected (sent on). The components which are reflected produce the specific color impression.

TO BE UPDATED LATER

The colors as we see them are the result of a combination of reflected colors from the spectrum. Physically speaking, these are electromagnetic waves with different wavelengths (and frequencies). The healthy human eye can recognize wavelengths between 0.36 µm (violet) and 0.78 µm (red).

If all the perceptible wavelengths of the spectrum impinge on the human eye at the same time, the impression of white light is produced.

Additive and subtractive color mixing

TO BE UPDATED LATER

Additive color mixing is the combination of light from different sources to give white. Different intensities of the additive primary colors red, green and blue allow millions of different colors to be represented (RGB colors).

Additive color mixing is always therefore used when light should enter the eye directly (without reflection off an object). Such as in the case of computer monitors or overhead beamers.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Subtractive color mixing means mixing the primary colors cyan, magenta and yellow to form a desired color (CMY colors).

Subtractive color mixing is used when light should enter the eye of an observer after reflection from an object. Such as happens with painting or in printing.

Oswald color circle

TO BE UPDATED LATER

The Oswald color circle is based on subtractive color mixing, and enables the behavior of paints when they are mixed together to be represented.

Colors lying opposite each other are complementary colors and should not be mixed together as this will produce a dull (i.e. grey) shade. If green is added to red, the red becomes greyer, not greener.

Color shades which are side by side are partner colors and produce a mixed color shade. For instance, mixing red and blue produces a pure violet.

In addition, black and/or white may be necessary to produce a particular color shade.

- White makes the color shade lighter.
- Black makes the color shade darker.
- With black and white the color shade becomes more dreary or greyer.

Metamerism

Metamerism is the name of the effect which occurs when two colors appear identical in a particular light (e.g. artificial light), but the colors appear different under another light source (e.g. daylight).

The cause is the fact that the human brain, aided by the eyes, does not evaluate the wavelength, instead it evaluates the spectral intensity of the reflected light.

It is for this reason that color matching in practice must only ever be performed in daylight, or under special artificial light which is based on daylight.

Metallic and pearl pigments

Colored paints achieve their color effect by the addition of pigments. Pigments are colored, solid, very fine organic and inorganic particles which are insoluble in the binding material.

Metallic pigments

Aluminum platelets are added as pigment to form metallic paint.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

Depending on the size and shape of the aluminum platelets, different metallic effects can be achieved:

- Cornflake aluminum (1) causes very strong dispersion because of rough edges, low brilliance, very low flop and produces grey-silver shades.
- Dollar aluminum (2) causes hardly any dispersion because of the smooth surface, high brilliance, produces very light, almost white silver shades.

With metallic paints however, only a light-dark light reflection effect occurs.

Colored metallic paints are produced by the extra addition of color pigments to the metallic paint.

Pearl pigments

TO BE UPDATED LATER

The basis of pearl pigments is formed by mica, which is metallized with a silver or gold layer.

Depending on the angles of light and observation, the mica platelets reflect different proportions of light. Because of this, the color of the paint appears to the observer to change.

Pearl pigments produce a colored and light-dark reflected light effect.

Color codes and their determination on Ford vehicles

It is necessary to determine the correct color shade of the original paintwork in order to perform a professional and perfect paint repair.

The original paint color shade can be found by:

- Inspection of the vehicle type plate with the color code stamped on it.
  - Later design
  - Earlier design
- Color shade catalog or color shade system of the manufacturer.
- The bare bodyshell plate with color designation.

Type plate

Type plate - location on Ford vehicles:

- Right-hand B-pillar - door rebate
- Left-hand B-pillar - door rebate
- Hood lock panel
- Left-hand vertical edge of inner front wing
- Right-hand vertical edge of inner front wing
- Right-hand engine compartment side member
- Left-hand bulkhead
- Right-hand bulkhead

DESCRIPTION AND OPERATION

- Luggage compartment interior
- Inner rear panel - luggage compartment

TO BE UPDATED LATER

The type plate gives the color code in the last row.

TO BE UPDATED LATER

On the newer type plates, the color code is given in the left-hand column, at the penultimate position.

TO BE UPDATED LATER

Color shade catalog or color shade system of the repair paint manufacturer.

The repair paint manufacturers offer a variety of possible systems for the determining the production color shade of motor vehicles. There are electronic systems, color card systems and manuals for the determination of color shades.

DESCRIPTION AND OPERATION

Most repair paint manufacturers use the following systems:

- A tabular system based on the following parameters:
  - Color code
  - Make
  - Model
  - Build year
  - Color or color name
  - Ancillary codes
- A system with color cards based on the following parameters:
  - Make
  - Color shade
  - Build year

TO BE UPDATED LATER

Because of the many parameters used, in a tabular system the color shade can also be determined by the lack of a parameter.

When using the color cards, emphasis is placed on matching of the original color shade with the color shade samples. For this reason this method is very helpful when the other parameters are not available.

Comparison of the results of both methods increases the certainty of using the correct original color shade and its formulation.

Additional certainty can be achieved during color shade determination by making a color sample plate. Here it is however important to apply the complete paint structure with base paint and clear lacquer onto a sample plate (1) in order to carry out a color shade and color coverage test.

TO BE UPDATED LATER

The color shade comparison is done by comparing the vehicle paintwork with the sample plate (1). The color coverage test is possible by using the black test stripe (2): If the test stripe (2) is still visible after test painting of the sample plate (1), the coverage is not good enough.

By using this determination of the original color shade, the formulation and information on any very slight fine adjustments which may be necessary can be established.

Bare bodyshell plate

The bare bodyshell plate is located:

- On the hood lock panel.
- Near the type plate.

The color name is stamped on in the last row.

TO BE UPDATED LATER

DESCRIPTION AND OPERATION

Matching tinted filler to the color code

NOTE: Color samples must always be made from the same materials as the subsequent repair painting. Perform color shade matching in the fully hardened state, in natural light or under suitable artificial light.

Various tinted fillers are used during factory painting. In order to achieve the exact color shade of the factory applied paint, attention should be paid that the correctly matched fillers are used.

TO BE UPDATED LATER

The repair paint manufacturers offer suitable precolored primers. The use of filler color cards allows the matching color shade to be determined.

DESCRIPTION AND OPERATION

Tips and Tricks

Comparing paint structures

It may happen that an area remains visible, especially when the area of the repair is small. The reason for this is the structural variation in the paint surface at the repair location compared with the original paint finish. The original paint finish has a slight orange peel effect while the repair areas is extremely smooth.

This effect can be reduced by fine sanding using P3000 of the area around the repair location and then polishing.

Etching substrate

If the substrate can be etched during the solvent test, suitable preparation must be done.

Job steps:

NOTE: Follow the manufacturer specific instructions.

- Sand the damaged area extensively using an eccentric sander and P80 or P120 abrasive sheets. Finish off sanding with P150 or P180.
- Remove the sanding dust and clean the area of the damage using silicone remover.
- Apply polyester stopper to the bare panel and to the damaged area.
- Sand the dried polyester stopper to an even surface using P80 - P150. Finish sanding using P180 - P240. If required apply more stopper, again only on the bare panel.
- Wet sand the residual old paint finish using P600 - P800. Transitions with P400 - P600. Clean with silicone remover.
- Prime bare metal areas with acid primer.
- After the acid primer has been left exposed to the air for the correct evaporation time, apply 2-component primer filler in thin layers over the complete repair area, leaving enough air exposure time in between coats.
- After the filler has dried, sand wet with P800 or sand dry with P400. Sanded through areas must be covered again with 2-component Nonstop filler primer.

Another possible method of preventing etching of the substrate is to use waterbased primer and filler materials.

Masking the vehicle

Masking and covering work are among the most important preparations required to achieve a high quality paint finish. Paint application onto neighboring components, paint mist and sharp paint transitions are quality faults. For this reason it is extremely important to take special care and to use suitable masking materials.

NOTE: When water based paints are used, all materials must be stable towards water.

Plan the masking work:

- Determine the sequence of masking work. Sometimes after masking film has been applied, it is difficult or impossible to reach certain areas.
- Prepare the masking material.
- Start with small difficult areas.

Pay special attention to the areas of profiled seals, edges, openings and paint transitions.

Masking tape

Masking tape is available in various widths for special application areas. In practice however, a wide tape has proved best for almost all areas, also taking into account the time required for masking work.

NOTE: Use of differing masking materials is often much more time-consuming.

Advantages

- Good coverage. Narrower tapes must often be applied in several layers.
- More resistant to tearing.
- Wide tapes can be applied deep into joints and therefore protect from paint mist and contamination.
- Removal is often easier.

Masking film

Transparent plastic film has become accepted as a practical method to mask large areas of a whole vehicle. It can quickly and easily be applied to the vehicle from the roll.

DESCRIPTION AND OPERATION

NOTE: Only mask the vehicle when it is dry. Moisture under the film can lead to matt paint in the drying process.

Using masking film

- Clean the vehicle before masking it.
- Pull the film over the vehicle. Because of the static charge, the film lies on the vehicle like a second skin.
- Cut out the repair area using the film knife and then mask it.

Other ways of masking a vehicle are:

- Masking using masking paper.
- Painting cloth (mostly used during filling work).

Profiled seals

If it is not possible to remove a profiled seal, then it must be masked in such a way that no edges can form due to paint accumulation.

To do this, the seal is lifted slightly and masked. The following techniques are possible:

TO BE UPDATED LATER

Item	Description
1	Masking tape with plastic strips
2	Sealing lip
3	Sandpaper with masking tape

- Laying a string or cord under the seal. Suitable for soft and elastic seal lips.
- Special masking tape with plastic strips for hard seal lips.
- Instead of using plastic strips, fine sandpaper cut into strips can be inserted and secured using normal masking tape.
- If the seal can be easily displaced, normal masking tape can also be used.

Edges/openings

Smooth paint transitions can be produced by positioning adhesive tapes.

NOTE: Pull the adhesive tapes away immediately after the paint has been applied and check the paint transitions.

TO BE UPDATED LATER

Item	Description
1	Vehicle edge
2	Adhesive surface
3	Masking paper

Possible variations

- At edges apply one strip of masking tape half on the area not to be painted and mask using a second strip.
- On surfaces, two masking strips can be attached, each affixed by half their adhesive surface. The adhesive strip which arises is then applied with one half on the edge of the area to be painted. The other half is aligned and fixed in addition in the curves.
- Affix masking paper on one side over the area to be painted. Double back the masking paper and secure it.
- Affix round profiled foam at the edge of the area to be painted using masking tape.

Foam strips are suitable for affixing to openings such as door gaps.

DESCRIPTION AND OPERATION

TO BE UPDATED LATER

NOTE: Choose a suitable profile diameter. A profile which is too thick will protrude from the opening, one which is too thin will leave a gap.

Clean the door opening well and affix the matching shape.

Color shade problems

If a vehicle color shade is taken from a vehicle on a hot summer day and the mixed color applied, this may cause color shade problems. Some colors change so much at higher temperatures that it can lead to an incorrect result. Red color shades are particularly prone to this shade behavior.

This means that color determination should always be done on the bodywork when it is at about the same temperature as the later working temperature will be. The best temperature of the item is between 15° and 25° C.

Isopropanol and water

Painted surfaces are very easily cleaned using a mixture of 70% water and 30% isopropanol (can be obtained through a laboratory supplies specialist or a pharmacist).

Temperature reduction spray

If finishing work must be performed on touched-up surfaces and newly painted plastic parts, problems may arise. The paint and the transitions are not yet fully hardened.

NOTE: When working with the polishing machine, make certain that each operating run lasts no longer than about 5 - 10 seconds, in order to prevent the paint becoming warm.

Even so, in order to be able to polish over transitions, temperature reduction spray must be applied to the surface. The transition area is then alternately sprayed and polished until a perfect transition surface is achieved.

Paint faults on soft plastic components where elasticizer additive has been used in painting must be wet sanded using grade P2000 - P2500 paper.

In doing this the sanding location and the surroundings are sprayed with temperature reduction spray and the paint faults sanded out by hand. Afterwards the location is polished as described above.

Paint plane

Dirt inclusions and paint runs can be removed with the sanding cylinder ("Finiball") and hand sanding or eccentric sander in a wet sanding process.

Another practical tool for removal of paint faults which lie proud of the surface is the paint plane.

NOTE: Guide the tool carefully with the minimum of force. It must not tilt, otherwise more serious damage may easily be caused.

TO BE UPDATED LATER

This tool allows paint faults to be carefully removed in shavings. Afterwards the surface must be polished using suitable materials.

Shading

Even when all the rules, steps and corresponding instructions have been followed concerning possible shades, it may happen that the mixed color shade does not exactly match the vehicle color.

In these cases, shading must be done. Because there is no fixed formula for this, experience and a trained eye are important. Some rules must be followed for shading.

NOTE: Self-made color sample plates of the current colors are very helpful for determining the

color shade. Refer to the chapter Color Determination and Color Theory.

- When shading, if possible only use the paint mixture that is also allotted in the color shade formula.
- Observe the rules concerning contrary colors (complementary colors) and partner colors according to the Oswald color circle.
- Complementary colors are not recommended during shading because they mutually inhibit and lead to muddy mixtures.

Sanding marks

In certain circumstances, the recommended sanding methods up to now are no longer suitable for light metallic color shades. Wet sanding with grade P1200 paper or a grey sanding pad can cause sanding scratches which can become very visible under certain lights.

In order to achieve an excellent paint result on difficult color shades, follow these working rules:

- Sand filler as before, rub down area to be painted with 3M ultra fine matting sponge and 3M matting gel.
- Sand filler as before, rub down area to be painted with soaked 3M wet sand paper P1500 - P2000.
- Sand filler as before, rub down area to be painted with 3M 260 L P1000 eccentric (Interface Pad).

Improving touch-up work

During application of special effect base paints, the effect particles align themselves exactly parallel to the surface in the paint layer while it is still liquid. This means a particular thickness of the paint layer is required.

Because during painting the layer thickness in the transition zones reduces from normal to zero, the effect particles can no longer align themselves. This leads to lighter, darker or cloudy zones.

If 1-component clear lacquer is sprayed before the base coat, this effect is prevented. An optically perfect transition will result.

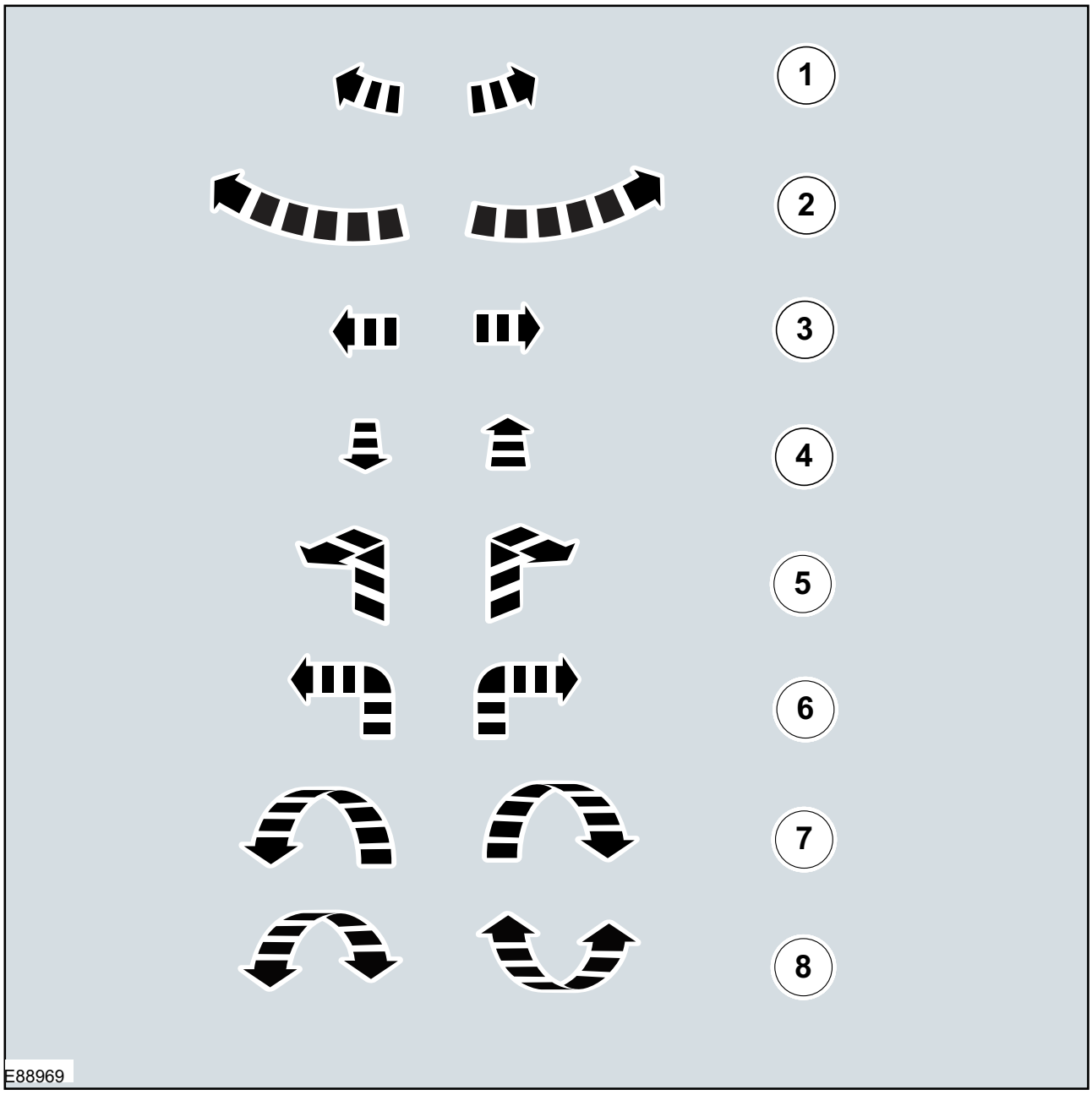
DESCRIPTION AND OPERATION

Symbols Glossary

Symbols are used inside the graphics and in the text area to enhance the information display.

Movement Symbols

Movement symbols provide detailed information to a required component movement. These component movements can be rotational or 1-3 dimensional movements.



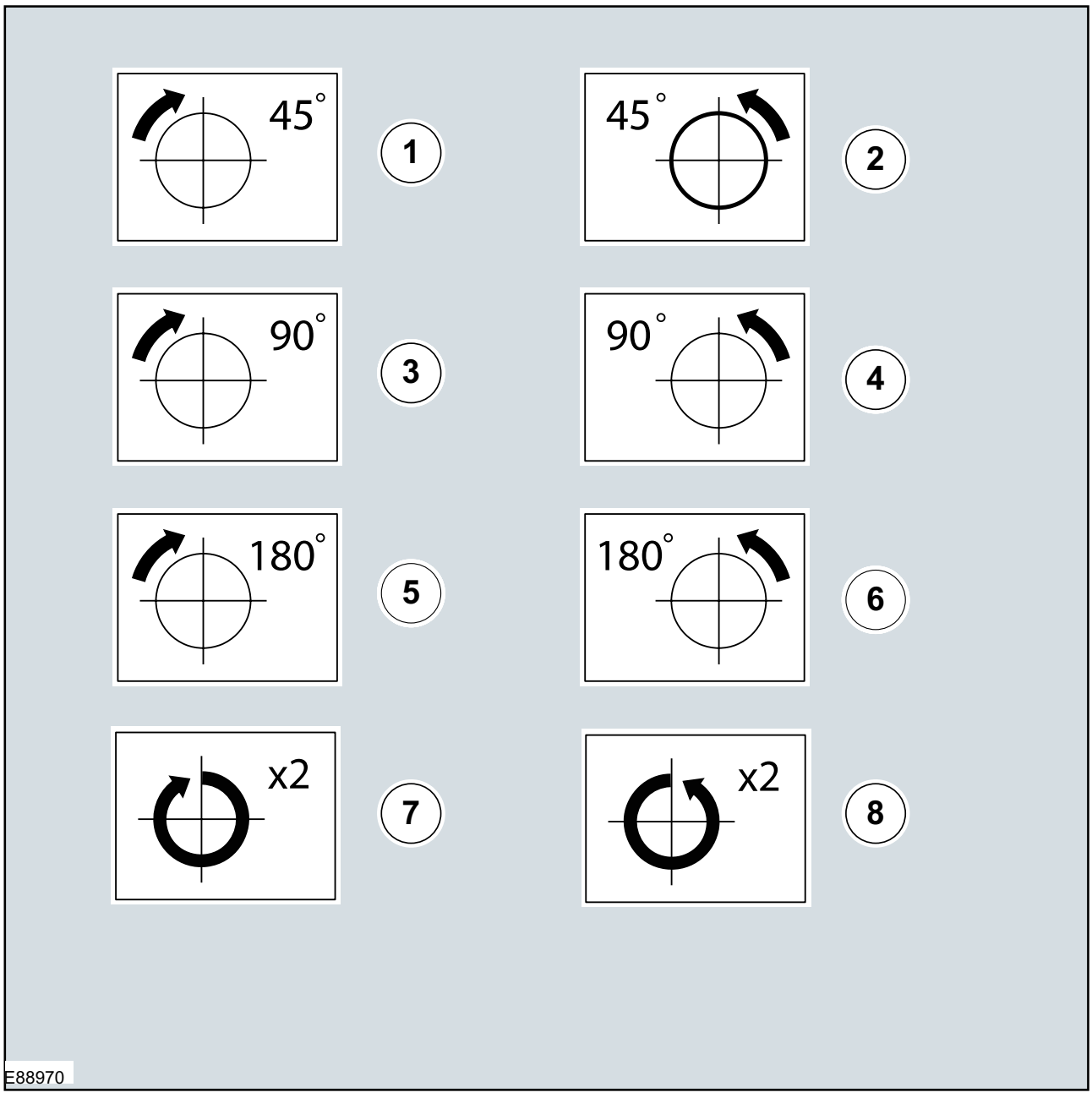
DESCRIPTION AND OPERATION

Item	Description
1	Minor component movement clockwise/counterclockwise
2	Major component movement clockwise/counterclockwise
3	Component movement to the left/right/up/down
4	Component movement towards/away
5	3 dimensional component movement

Item	Description
6	2 dimensional component movement
7	3 dimensional component rotation
8	3 dimensional component cycling

Turn Symbols

Turn symbols are used to provide further information on the direction or angle of component turns.



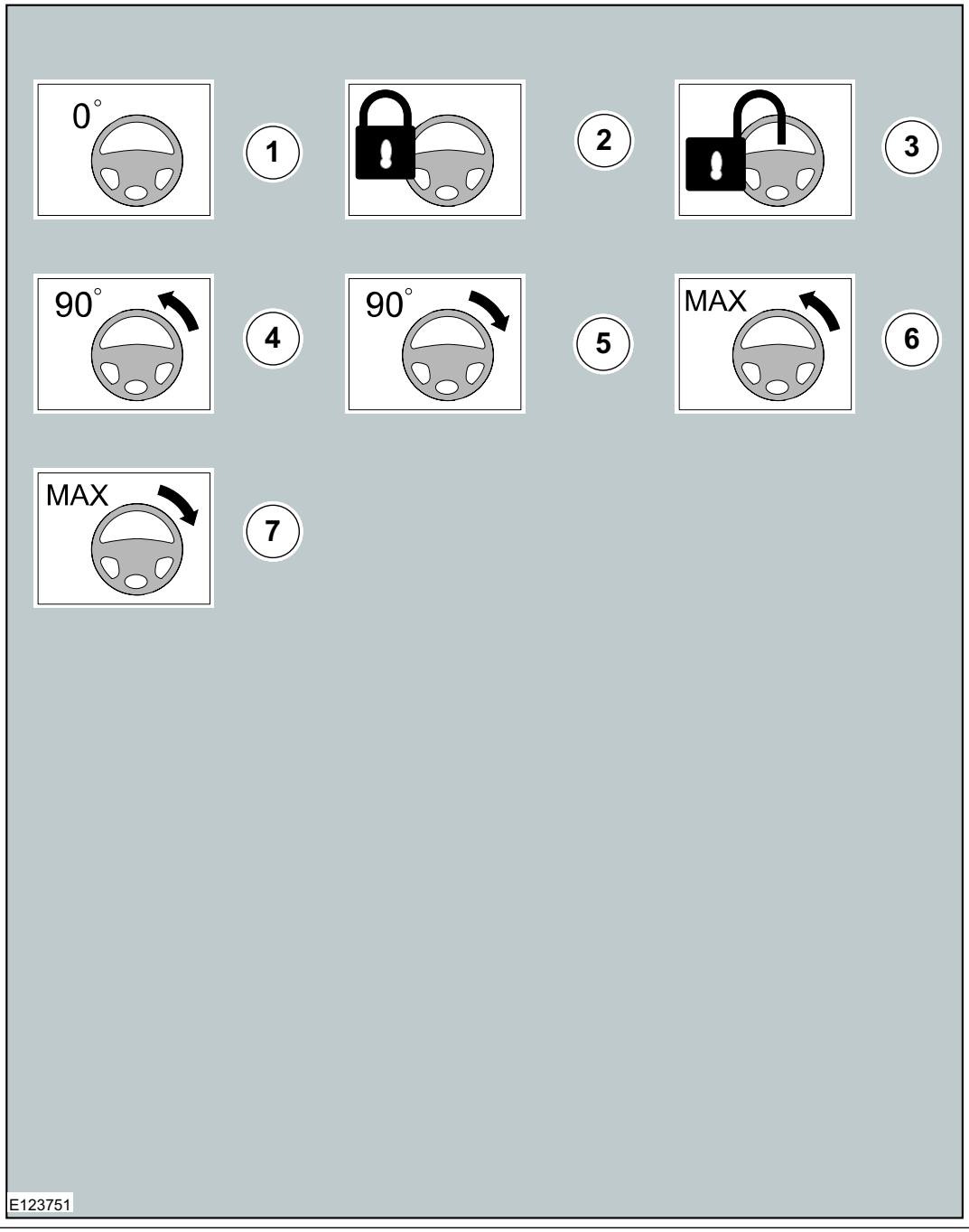
DESCRIPTION AND OPERATION

Item	Description
1	Turn the component clockwise through 45°
2	Turn the component counterclockwise through 45°
3	Turn the component clockwise through 90°
4	Turn the component counterclockwise through 90°
5	Turn the component clockwise through 180°

Item	Description
6	Turn the component counterclockwise through 180°
7	Turn the component clockwise through 2 complete turns
8	Turn the component counterclockwise through 2 complete turns

Steering Wheel Symbols

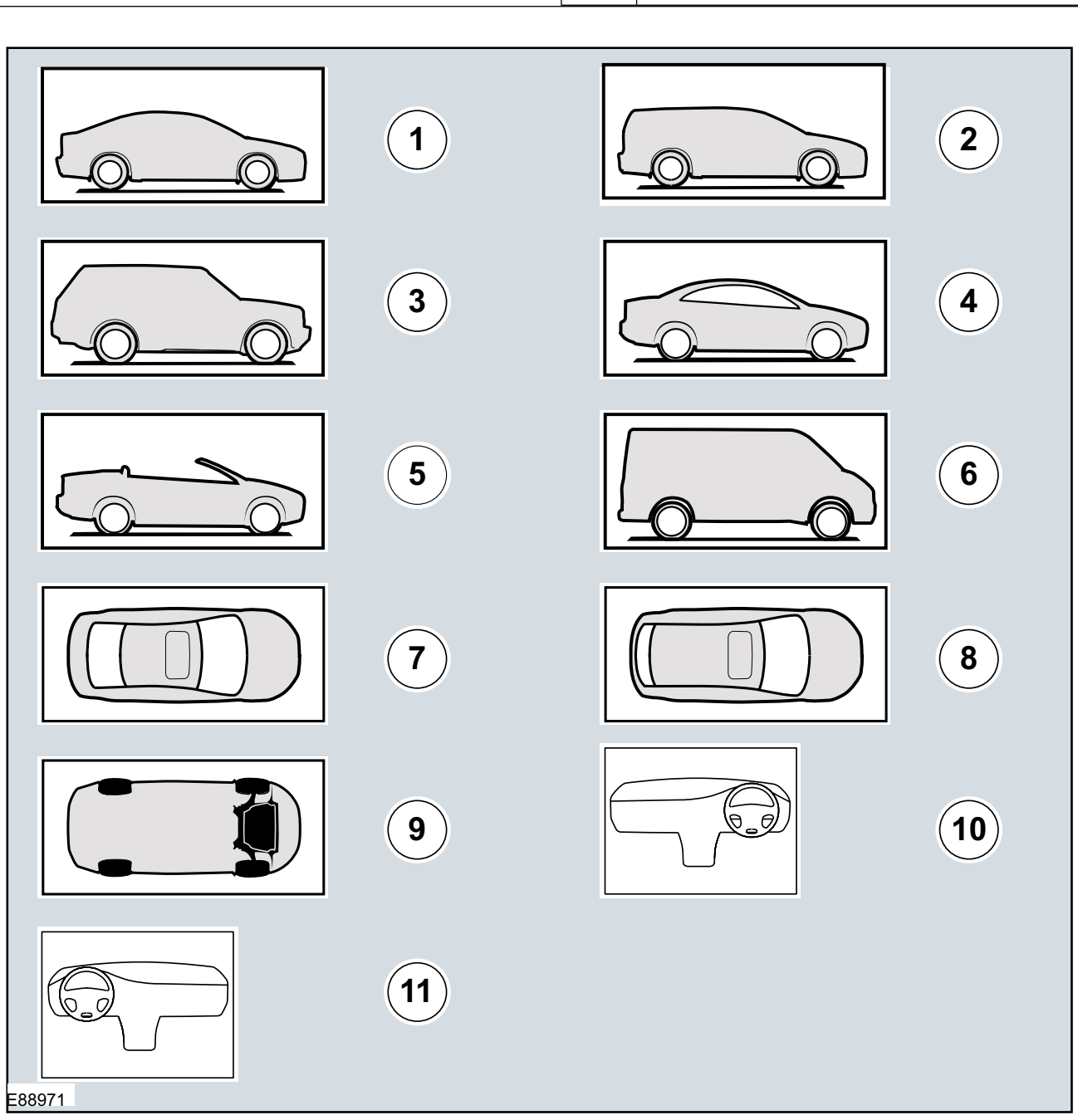
Steering wheel symbols are used to provide further information to a required steering wheel position or steering column lock status.



DESCRIPTION AND OPERATION

Item	Description
1	Steering wheel in straight ahead position
2	Steering column lock locked
3	Steering column lock unlocked
4	Turn the steering wheel to the 90° left position

Item	Description
5	Turn the steering wheel to the 90° right position
6	Turn the steering wheel to the left-hand end position
7	Turn the steering wheel to the right-hand end position



Item	Description
1	3, 4, 5-door body style
2	Wagon body style

Item	Description
3	Sports utility vehicle body style
4	Coupe body style

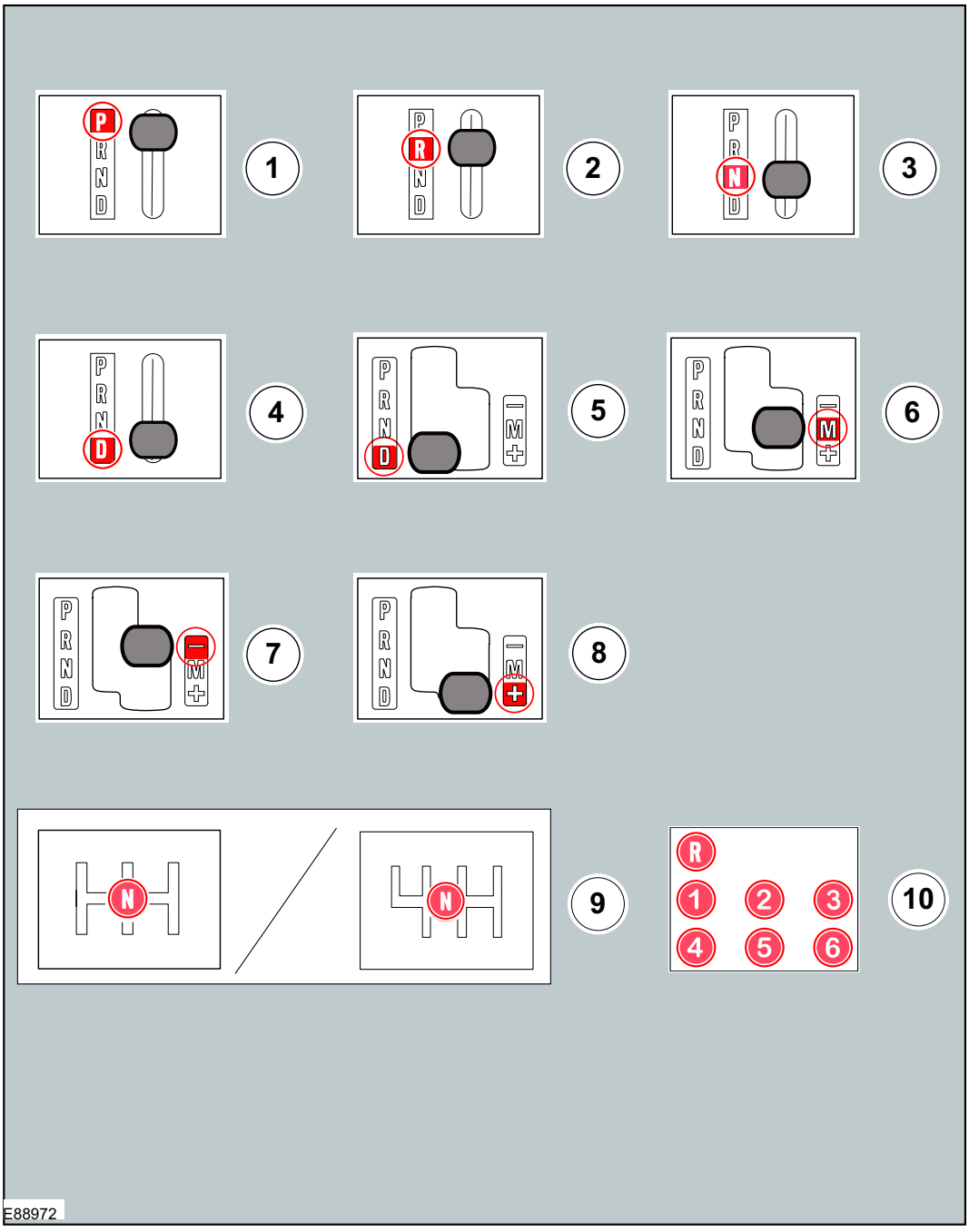
DESCRIPTION AND OPERATION

Item	Description
5	Convertible body style
6	Van body style
7	3, 4, 5-door body style - Top View
8	Wagon body style - Top View
9	Underview

Item	Description
10	Right-hand drive (RHD) vehicle
11	Left-hand drive (LHD) vehicle

Gearshift lever and selector lever position symbols

Gearshift lever and selector lever position symbols are used to show the lever position that is required to be selected to carry out a procedure step.



DESCRIPTION AND OPERATION

Item	Description
1	Set the selector lever to the park (P) position
2	Set the selector lever to the reverse (R) position
3	Set the selector lever to the neutral (N) position
4	Set the selector lever to the drive (D) position
5	Set the selector lever with manual shift pattern to the park (D) position
6	Set the selector lever with manual shift pattern to the manual (M) position

Item	Description
7	Set the selector lever with manual shift pattern to the shift down (-) position
8	Set the selector lever with manual shift pattern to the shift up (+) position
9	Set the gearshift lever to the neutral (N) position
10	Further gearshift lever positions that may appear in illustrations

Screwdriver symbols

The screwdriver symbols are used to show which screwdriver bit is recommended to carry out a procedure step.

DESCRIPTION AND OPERATION

Health and Safety Precautions

Introduction

Many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health. This subsection lists, alphabetically, some of these hazardous operations and the materials and equipment associated with them. Precautions necessary to avoid these hazards are identified.

The list is not exhaustive and all operations and procedures, and the handling of materials, should be carried out with health and safety in mind.

Before using any product the Materials Safety Data Sheet supplied by the manufacturer or supplier should be consulted.

Acids and Alkalis

See also Battery Acids.

For example caustic soda, sulphuric acid.

Used in batteries and cleaning materials.

Irritant and corrosive to the skin, eyes, nose and throat. Cause burns. Can destroy ordinary protective clothing.

Avoid splashes to the skin, eyes and clothing. Wear suitable protective impervious apron, gloves and goggles. Do not breath mists.

Make sure access to eye wash bottles, shower and soap are readily available for splashing accidents.

Display Eye Hazard sign.

Air Bags

See also Fire, Chemical Materials.

Highly flammable, explosive – observe No Smoking policy.

Used as a safety restraint system mounted in the steering wheel and passenger side of the instrument panel.

The inflator contains a high-energetic propellant which, when ignited, produces a VERY HOT GAS (2500°C).

The gas generant used in air bags is Sodium Azide. This material is hermetically sealed in the module and is completely consumed during deployment. No attempt should be made to open an air bag inflator as this will lead to the risk of exposure to Sodium Azide. If a gas generator is ruptured, full protective clothing should be worn when dealing with the spillage.

After normal deployment, gloves and safety goggles must be worn during the handling process.

Deployed air bags should be disposed of in a plastic bag in accordance with local regulations at an approved chemical waste site.

Following any direct contact with gas generant.

- wash affected areas thoroughly with water.
- seek medical assistance if necessary.

Air Bags - Do's

- Do store modules in an upright position.
- Do keep modules dry.
- Do carry modules with the cover side pointing away from the body.
- Do place modules with their cover side upwards.
- Do carefully inspect modules for damage.
- Do stand to one side when connecting modules.
- Do make sure all test equipment is properly calibrated and maintained.
- Do wash hands after handling deployed air bags.

Air Bags - Do Nots

- Do not store highly flammable material together with modules or gas generators.
- Do not store gas generators at temperatures exceeding 80°C.
- Do not store modules upside down.
- Do not attempt to open a gas generator housing.
- Do not expose gas generators to open flame or sources of heat.
- Do not place anything on top of a module cover.
- Do not use damaged modules.
- Do not touch a fired module or gas generator for at least 10 minutes.
- Do not use any electrical probes on the wiring circuit.

Air Conditioning Refrigerant

See also Chlorofluorocarbon, Chemical Materials

Highly flammable, combustible – observe No Smoking policy.

DESCRIPTION AND OPERATION

Skin contact may result in frostbite.

Instructions given by the manufacturer must be followed. Avoid naked lights, wear suitable protective gloves and goggles.

If refrigerant comes into contact with the skin or eyes, immediately rinse the affected areas with water. Eyes should also be rinsed with an appropriate irrigation solution and should not be rubbed. SEEK MEDICAL ASSISTANCE IF NECESSARY.

Air Conditioning Refrigerant - Do Nots

- Do not expose refrigerant bottles to sunlight or heat.
- Do not stand refrigerant bottles upright; when filling, hold them with the valve downwards.
- Do not expose refrigerant bottles to frost.
- Do not drop refrigerant bottles.
- Do not vent refrigerant to atmosphere under any circumstance.
- Do not mix refrigerants, for example R12 (Freon) and R134a.

Adhesives and Sealers

See also Fire, Chemical Materials.

Highly flammable, flammable, combustible – observe No Smoking policy.

Generally should be stored in No Smoking areas. Cleanliness and tidiness in use should be observed, for example disposable paper covering benches; should be dispensed from applicators where possible; containers, including secondary containers, should be labeled appropriately.

Solvent-based Adhesives/Sealers - See Solvents

Follow manufacturers instructions.

Water-based Adhesives/Sealers

Those based on polymer emulsions and rubber latexes may contain small amounts of volatile toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.

Hot Melt Adhesives

In the solid state, they are safe. In the molten state they may cause burns and health hazards may arise from the inhalation of toxic fumes.

Use appropriate protective clothing and a thermostatically controlled heater with a thermal cut-out and adequate extraction.

Resin-based Adhesives/Sealers, for example Epoxide and Formaldehyde Resin-based

Mixing should be carried out in well ventilated areas, as harmful or toxic volatile chemicals may be released.

Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic or harmful chemicals through the skin. Splashes can damage the eyes.

Provide adequate ventilation and avoid skin and eye contact.

Anaerobic, Cyanoacrylate (super-glues) and other Acrylic Adhesives

Many are irritant, sensitizing or harmful to the skin and respiratory tract. Some are eye irritants.

Skin and eye contact should be avoided and the manufacturers instructions followed.

Cyanoacrylate adhesives (super-glues) MUST NOT contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and SEEK IMMEDIATE MEDICAL ATTENTION. Do not attempt to pull tissue apart. Use in well ventilated areas as vapors can cause irritation to the nose and eyes.

For two-pack systems see Resin-based and Isocyanate Adhesives/Sealers.

Isocyanate (Polyurethane) Adhesives/Sealers

See also Resin-based Adhesives.

Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.

Over exposure is irritating to the eyes and respiratory system. Excessive concentrations may produce effects on the nervous system including

drowsiness. In extreme cases, loss of consciousness may result. Long term exposure to vapor concentrations may result in adverse health effects.

Prolonged contact with the skin may have a defatting effect which may lead to skin irritation and in some cases, dermatitis.

Splashes entering the eye will cause discomfort and possible damage.

Any spraying should preferably be carried out in exhaust ventilated booths, removing vapors and spray droplets from the breathing zone.

Wear appropriate gloves, eye and respiratory protection.

Antifreeze

See also Fire, Solvents.

For example isopropanol, ethylene glycol, methanol.

Highly flammable, flammable, combustible.

Used in vehicle coolant systems, brake air pressure systems, screenwash solutions.

Vapors may be given off from coolant antifreeze (glycol) when heated. Avoid breathing these vapors.

Antifreeze may be absorbed through the skin in toxic or harmful quantities. Antifreeze, if swallowed, can be fatal and MEDICAL ATTENTION SHOULD BE SOUGHT IMMEDIATELY.

These products must not be used in any cooling or industrial water system that is connected or linked to general, food preparation or drinking water supplies.

Asbestos

See also Warning Symbols on Vehicles at the end of this subsection.

Breathing asbestos dust may cause lung damage or, in some cases, cancer.

Used in brake and clutch linings, transmission brake bands and gaskets.

The use of drum cleaning units, vacuum cleaning or damp wiping is preferred.

Asbestos dust waste should be dampened, placed in a sealed container and marked for safe disposal. If any cutting or drilling is attempted on materials containing asbestos the item should be dampened and only hand tools or low speed power tools used.

Battery Acids

See also Acids and Alkalis.

Gases released during charging are explosive. Never use naked flames or allow sparks near charging or recently charged batteries.

Make sure there is adequate ventilation.

Brake and Clutch Linings and Pads

See Asbestos.

Brake Fluids (Polyalkylene Glycols)

See also Fire.

Splashes to the skin and eyes are slightly irritating. Avoid skin and eye contact as far as possible. Inhalation vapor hazards do not arise at ambient temperatures because of the very low vapor pressure.

Brazing

See Welding.

Chemical Materials

See also Legal Aspects.

Chemical materials such as solvents, sealers, adhesives, paints, resin foams, battery acids, antifreeze, brake fluids, fuels, oils and grease should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive, irritant or highly flammable and give rise to hazardous fumes and dusts.

The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening; or may reduce life expectancy.

Chemical Materials - Do's

– Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, posters or other instructions. Material

health and safety data sheets can be obtained from manufacturers.

- Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
- Do organize work practices and protective clothing to avoid soiling of the skin and eyes; breathing vapors, aerosols, dusts or fumes; inadequate container labeling; fire and explosion hazards.
- Do wash before job breaks, before eating, smoking, drinking or using toilet facilities when handling chemical materials.
- Do keep work areas clean, uncluttered and free of spills.
- Do store chemical materials according to national and local regulations.
- Do keep chemical materials out of the reach of children.

Chemical Materials - Do Nots

- Do not mix chemical materials except under the manufacturers instructions; some chemicals can form other toxic or harmful chemicals, give off toxic or harmful fumes or become explosive when mixed together.
- Do not spray chemical materials, particularly those based on solvents, in confined spaces, for example when people are inside a vehicle.
- Do not apply heat or flame to chemical materials except under the manufacturers instructions. Some are highly flammable and some may release toxic or harmful fumes.
- Do not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas such as pits.
- Do not transfer chemical materials to unlabelled containers.
- Do not clean hands or clothing with chemicals. Chemicals, particularly solvents and fuels, will dry the skin and may cause irritation leading to dermatitis or be absorbed through the skin in toxic or harmful quantities.
- Do not use emptied containers for other materials except when they have been cleaned under supervised conditions.
- Do not sniff or smell chemical materials. Brief exposure to high concentrations of fumes can be toxic or harmful.

Chlorofluorocarbons (CFC)

There is concern in the scientific community that CFCs and Halons are depleting the upper ozone layer which filters out harmful ultraviolet radiation. Decreased filtration of ultraviolet radiation may result in increases in skin cancer, cataracts and immune system suppression in humans, as well as decreased productivity of crops and aquatic systems.

CFCs are used primarily as refrigerants in vehicle air conditioning systems and as aerosol propellants. Halons are used as fire extinguishants.

Clutch Fluids

See Brake fluids.

Clutch Linings and Pads

See Asbestos.

Corrosion Protection Materials

See also Solvents, Fire.

Highly flammable, flammable – observe No Smoking policy.

These materials are varied and the manufacturers instructions must be followed. They may contain solvents, resins or petroleum products. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Cutting

See Welding.

Dewaxing

See Solvents and Fuels (Kerosene).

DESCRIPTION AND OPERATION

Dusts

Powder, dusts or clouds may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

Fine dusts of combustible material can present an explosion hazard. Avoid explosive limits and sources of ignition.

Electric Shock

Electric shock can result from the use of faulty electrical equipment or from the misuse of equipment in good condition.

Make sure that electrical equipment is maintained in good condition and frequently tested. Faulty equipment should be labeled and preferably removed from the workstation.

Make sure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged.

Make sure that electrical equipment and flexes do not come into contact with water.

Make sure that electrical equipment is protected by the correct rated fuse.

Never misuse electrical equipment and never use equipment that is in any way faulty. The results could be fatal.

Make sure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.

Make sure that the designated electrical workers are trained in basic First Aid.

In cases of electrocution:

- switch off the power supply before approaching the victim.
- if this is not possible push or drag the victim from the source of electricity using dry non-conductive material.
- commence resuscitation if trained to do so.
- SUMMON MEDICAL ASSISTANCE.

Engine Oils

See Lubricants and Grease.

Exhaust Fumes

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should be run only under conditions of adequate exhaust extraction or general ventilation and not in confined spaces.

Gasoline (petrol) engine

There may not be adequate warning of odor or of irritation before toxic or harmful effects arise. These may be immediate or delayed.

Diesel engine

Soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.

Fibre Insulation

See also Dusts.

Used in noise and sound insulation.

The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect.

Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

Fire

See also Welding, Foams, Legal Aspects.

Many of the materials found on or associated with the repair of vehicles are highly flammable. Some give off toxic or harmful fumes if burnt.

Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Make sure, before using electrical or welding equipment, that there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

DESCRIPTION AND OPERATION

First Aid

Apart from meeting any legal requirements it is desirable for someone in the workshop to be trained in First Aid procedures.

Splashes in the eye should be flushed carefully with clean water for at least ten minutes.

Soiled skin should be washed with soap and water.

In case of cold burns, from alternative fuels, place affected area in cool to cold water.

Individuals affected by inhalation of gases and fumes should be removed to fresh air immediately. If effects persist, consult a doctor.

If liquids are swallowed inadvertently, consult a doctor giving him the information on the container or label. Do not induce vomiting unless this action is indicated on the label.

Fluoroelastomer

See Viton.

Foams - Polyurethane

See also Fire.

Used in sound and noise insulation. Cured foams used in seat and trim cushioning.

Follow manufacturers instructions.

Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work in or near uncured materials.

The components, vapors or spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be inhaled. These materials must be applied with adequate ventilation and respiratory protection. Do not remove the respirator immediately after spraying; wait until the vapors/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes. Smoking, naked flames or the use of electrical equipment during foaming operations and until vapors/mists have cleared should not be allowed. Any heat cutting of cured foams or partially cured foams should be conducted with extraction ventilation. See also the vehicle Body Repair Manual.

Freon

See Air Conditioning Refrigerant.

Fuels

See also, Fire, Legal Aspects, Chemicals and Solvents.

Avoid skin contact with fuel where possible. Should contact occur, wash the affected skin with soap and water.

Gasoline (Petrol)

Highly flammable - observe No Smoking policy.

Swallowing can result in mouth and throat irritation and absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Aspiration of liquid into the lungs, through vomiting, is a very serious hazard.

Gasoline dries the skin and can cause irritation and dermatitis on prolonged or repeated contact. Liquid in the eye causes severe smarting.

Motor gasoline may contain appreciable quantities of benzene, which is toxic upon inhalation, and the concentration of gasoline vapors must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.

Make sure there is adequate ventilation when handling and using gasoline. Great care must be taken to avoid the serious consequences of inhalation in the event of vapor build up arising from spillages in confined spaces.

Special precautions apply to cleaning and maintenance operations on gasoline storage tanks.

Gasoline should not be used as a cleaning agent. It must not be siphoned by mouth. See First Aid.

Gas-oil (Diesel Fuel)

Combustible.

DESCRIPTION AND OPERATION

Gross or prolonged skin contact with high boiling point gas oils may also cause serious skin disorders including skin cancer.

Kerosene (Paraffin)

Used also as heating fuel, solvent and cleaning agent.

Flammable - observe No Smoking policy.

Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs.

Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating.

In normal circumstances the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperature should be avoided (mists may arise in dewaxing). Avoid skin and eye contact and make sure there is adequate ventilation.

Alternative Fuel

Highly flammable. Observe ``NO SMOKING" signs.

Make sure there is adequate ventilation when working on alternative fuelled vehicles. Great care must be taken to avoid the serious consequences of inhalation in the event of vapor build up in confined spaces.

Inhalation in high concentrations may cause dizziness, headache, nausea and loss of co-ordination. Very high concentrations may result in loss of consciousness.

Contact with liquefied petroleum gas (LPG) or compressed natural gas (CNG) to the skin may cause cold burns and frost bite.

Long sleeved cotton overalls, steel toe capped safety boots and rubber neoprene gloves should be worn during removal and installation of LPG/CNG fuel system components.

LPG/CNG fuel leaks could cause a fire and be a hazard to health that can lead to personal injury, illness or even death.

If a leak is detected, under no circumstances attempt to seal the leak by tightening the union/connection until the fuel in the system or component is depressurized. Once tightened the system should be checked for integrity following the specified procedures.

If the fuel tank is to be removed for service or repair the fuel must be evacuated using dedicated equipment and following the specified procedures.

Gas Cylinders

See also Fire.

Gases such as oxygen, acetylene, argon and propane are normally stored in cylinders at pressures of up to 138 bar (2000 psi) and great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.

Cylinders should be stored in well-ventilated enclosures, and protected from ice and snow, or direct sunlight. Fuel gases, for example acetylene and propane, should not be stored in close proximity to oxygen cylinders.

Care should be exercised to prevent leaks from gas cylinders and lines, and to avoid sources of ignition.

Only trained personnel should undertake work involving gas cylinders.

Gases

See Gas Cylinders.

Gaskets (Fluoroelastomer)

See Viton.

General Workshop Tools and Equipment

It is essential that all tools and equipment are maintained in good condition and that the correct safety equipment is used where required.

Never use tools or equipment for any purpose other than that for which they were designed. Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time that the equipment is used.

Do not use damaged or defective tools or equipment, particularly high-speed equipment such as grinding wheels. A damaged grinding wheel can

disintegrate without warning and cause serious injury.

Wear suitable eye protection when using grinding, chiseling or sand blasting equipment.

Wear a suitable breathing mask when using abrasive blasting equipment, working with asbestos-based materials or using spraying equipment.

Make sure there is adequate ventilation to control dusts, mists and fumes.

High Pressure Air, Lubrication and Oil Test Equipment

See also Lubricants and Greases.

Always keep high-pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Never direct a high-pressure nozzle, for example diesel injector, at the skin as the fluid may penetrate to the underlying tissue, and cause serious injury.

Halon

See CFCs.

Legal Aspects

There are many laws and regulations relating to health and safety in the use and disposal of materials and equipment in a workshop.

For a safe working environment and to avoid environmental pollution, workshops should be familiar, in detail, with the many health and safety laws and regulations within their country, published by both national and local authorities.

Lubricants and Greases

Avoid all prolonged and repeated contact with mineral oils. All lubricants and greases may be irritating to the eyes and skin.

Transmission Fluids

Safety instructions

Certain Transmission and Power Steering fluids supplied to Ford may contain additives which have the potential to cause skin disease (dermatitis) to exposed persons. The dermatitis may be irritant or allergic in nature. Risks are higher where prolonged or repeated skin contact with a fluid may occur. These fluids are used for vehicle initial fill and service purposes. This sub-section is to:

- Inform Service personnel who may come into contact with these vehicle fluids (hazard communication).
- Summarise appropriate workplace control measures and personal protective equipment requirements.
- Draw attention to the existence of Material Safety Datasheets (MSDS's) for the fluids (available from Ford Customer Service Division). These MSDS's contain detailed information on hazards and appropriate controls.

Control measures

Workplace risk assessments made under national chemical control regulations should identify operations involving the fluids as potentially hazardous and specify workplace control and worker awareness measures. In such circumstances, the relevant Material Safety Datasheet (see the details specified below) which specifies hazards and control measures in detail should be made available for guidance.

Avoid unprotected skin contact with the fluids, and in particular, avoid prolonged or repeated skin contact. Work practices should be organised so as to minimise the potential for skin contact. This may include the use of drip trays, absorbents, correct fluid handling equipment (funnels etc), and workplace housekeeping measures such as the cleaning of contaminated surfaces.

Personnel engaged in operations where skin contact could occur (such as fluid draining or filling) should wear impervious gloves made from nitrile rubber, certified to a chemical protection standard, e.g. Europe Standard EN374. This glove type is widely available from reputable suppliers of gloves for chemical protection [including the manufacturers Ansell-Admont (Solvex Range), North Safety products (North Nitrile Latex Gloves range), and

DESCRIPTION AND OPERATION

Supplemental Restraint System (SRS) Health and Safety Precautions

WARNINGS:

- **Only qualified technicians are allowed to work on pyrotechnic components.**
- **INHALED: Exposure to pyrotechnic residue may cause low blood pressure, severe headache, irritation of mucous membranes, fainting, shortness of breath or rapid pulse. Move a victim to fresh air. Seek immediate medical attention.**
- **EYE CONTACT: Exposure to unburned pyrotechnic residue may cause irritation, burning and etching of the eyes. Flush immediately with plenty of cold running water for at least 15 minutes. Seek immediate medical attention.**
- **EYE CONTACT: Exposure to burned pyrotechnic residue may cause irritation, burning and etching of the eyes. Flush immediately with diluted boric acid solution. Seek immediate medical attention.**
- **SKIN CONTACT: Unburned pyrotechnic residue may be rapidly absorbed through the skin in toxic quantities. Wash immediately with plenty of soap and water. Seek medical attention.**
- **SKIN CONTACT: Burned pyrotechnic residue may be rapidly absorbed through the skin in toxic quantities. Wash with plenty of water. Do not use soap. Seek medical attention.**
- **SWALLOWED: Unburned pyrotechnic residue is extremely toxic. If conscious drink plenty of water then induce vomiting. Seek immediate medical attention. If unconscious, or in convulsions do not attempt to induce vomiting or give anything by mouth. Seek immediate medical attention.**
- **SWALLOWED: Burned pyrotechnic residue is extremely toxic. Drink plenty of water and seek immediate medical attention.**
- **The deployment key must only be accessible to authorized personnel.**
- **Make sure that the deployment key remains removed from the deployment equipment except during deployment.**
- **If permenantly disabling or enabling the passenger air bag a new seat belt for vehicles without or with a passenger air bag must be installed.**
- **Undeployed pyrotechnic components must not be deployed in the vehicle.**
- **Pyrotechnic components must be deployed following local regulations.**
- **Check thoroughly that no loose objects can be spread during the deployment of pyrotechnic components.**
- **Pyrotechnic components must be transported following local regulations.**
- **Never carry out any electrical measurement on disconnected, undeployed pyrotechnic components.**
- **Pyrotechnic components must not be disassembled.**
- **Pyrotechnic components are not interchangeable between vehicles.**
- **Always carry a live air bag module away from the body with the air bag or trim cover pointing upwards.**
- **Live air bag modules must be placed in a suitable cage when removed from the vehicle. The air bag or trim cover must be facing upwards.**
- **Do not install a rearward facing child safety seat to the passenger seat with an activated passenger air bag.**

CAUTIONS:

- **Pyrotechnic components must not be subjected to temperatures higher than 110°C.**
- **Never install aftermarket accessories to the vehicle on or adjacent to the supplemental restraint system module.**

DESCRIPTION AND OPERATION

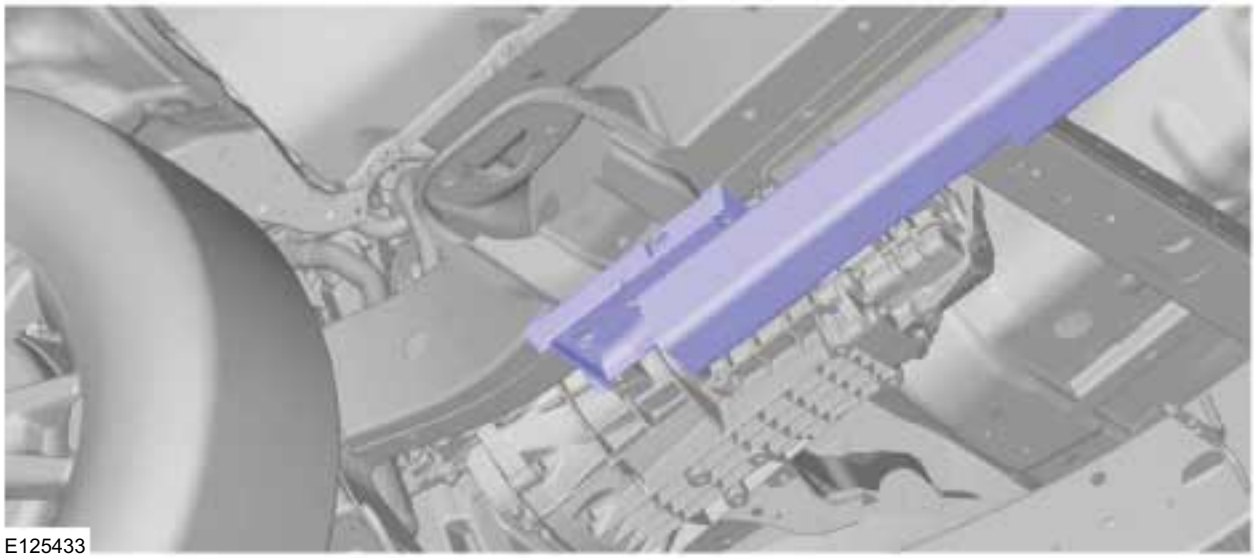
Lifting

Vehicle Lift Positions

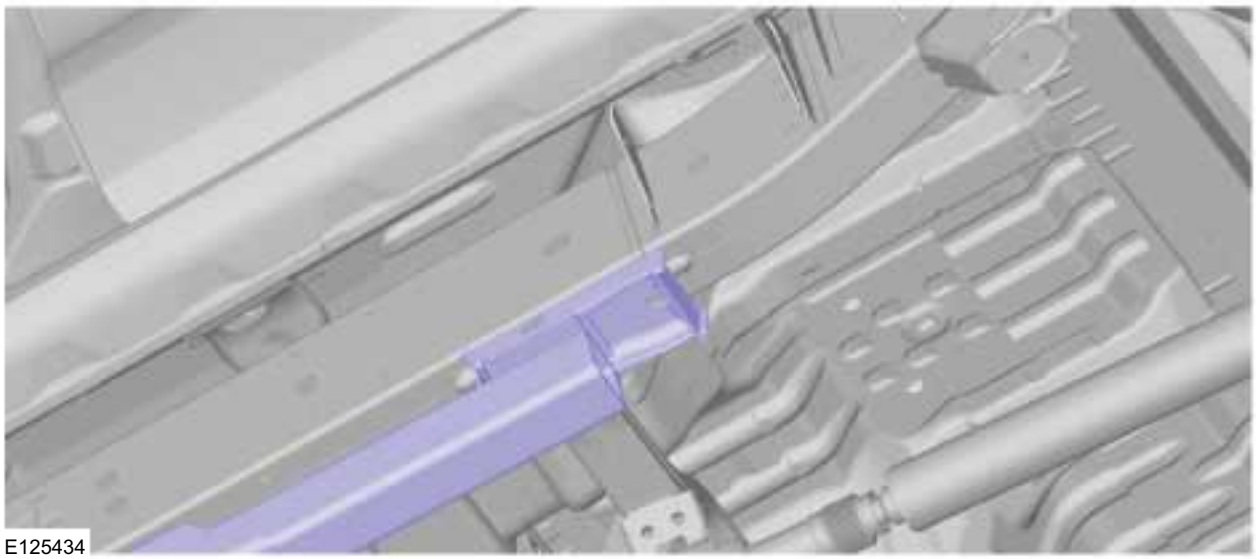
WARNING: Lifting a vehicle that is not stabilized is dangerous. The vehicle can slip off the lift and cause serious injury and/or vehicle damage. Make sure that the vehicle is on the lift horizontally by adjusting the height of the support at the end of the arm of the lift.

Use safety stands to support the vehicle after it has been lifted.

Front


E125433

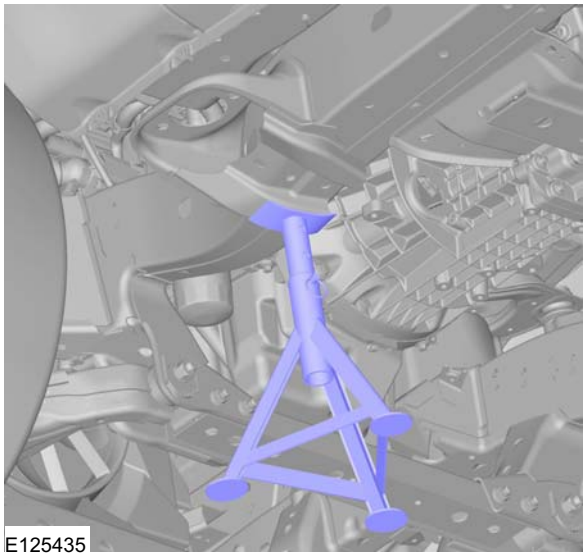
Rear


E125434

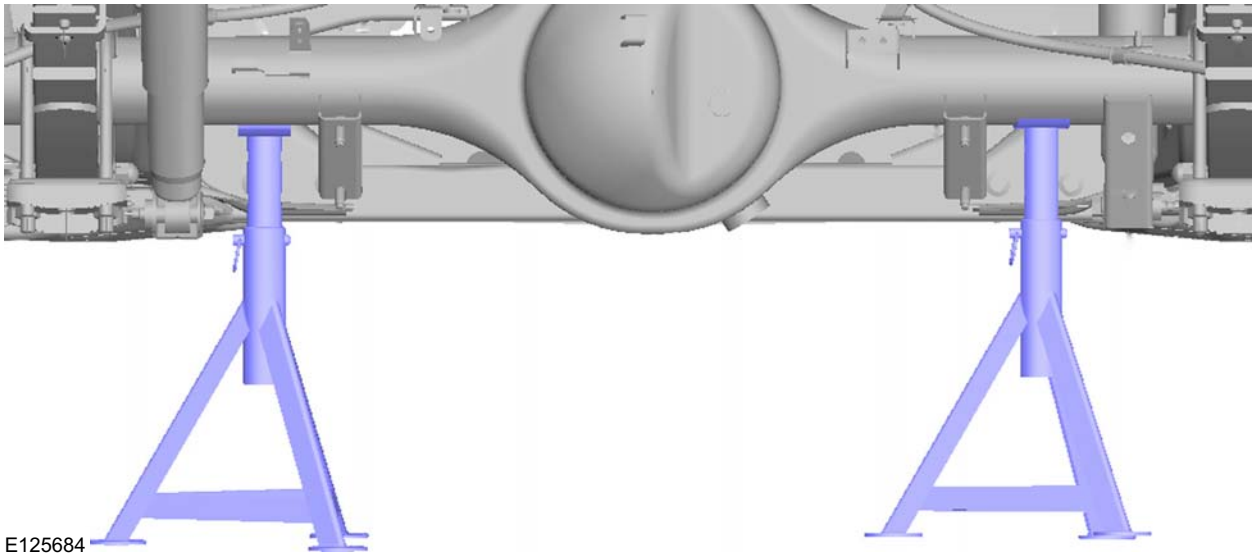
DESCRIPTION AND OPERATION

Safety Stand Positions

Front


E125435

Rear


E125684

REMOVAL AND INSTALLATION

Wheel and Tire

Removal

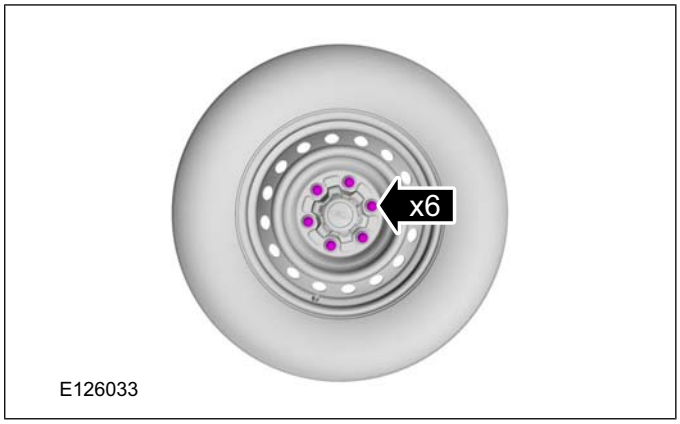
CAUTIONS:

Do not use heat to loosen a seized wheel nut.

Do not use power tools on locking wheel nuts.

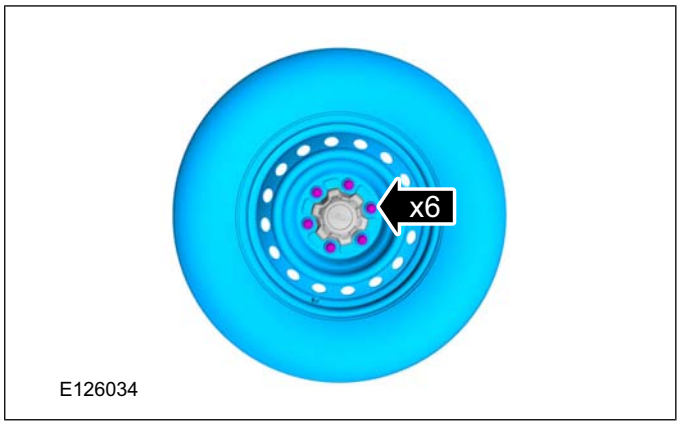
1. Loosen

1.



2. For additional information, refer to: Jacking (100-02 Jacking and Lifting, Description and Operation) / Lifting (100-02 Jacking and Lifting, Description and Operation).

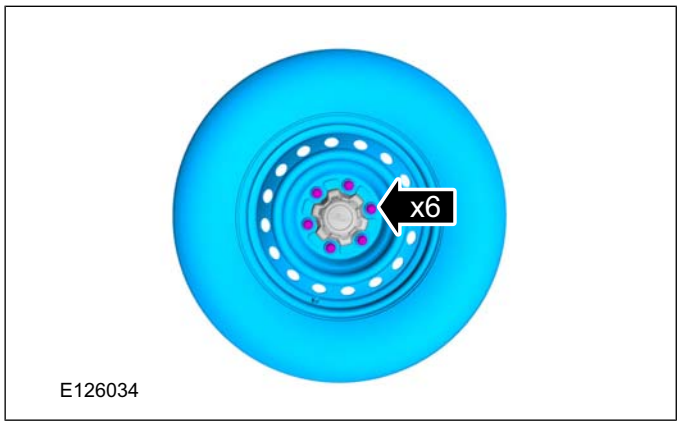
3.



Installation

1. WARNING: Make sure that the mating faces are clean and free of corrosion and foreign material

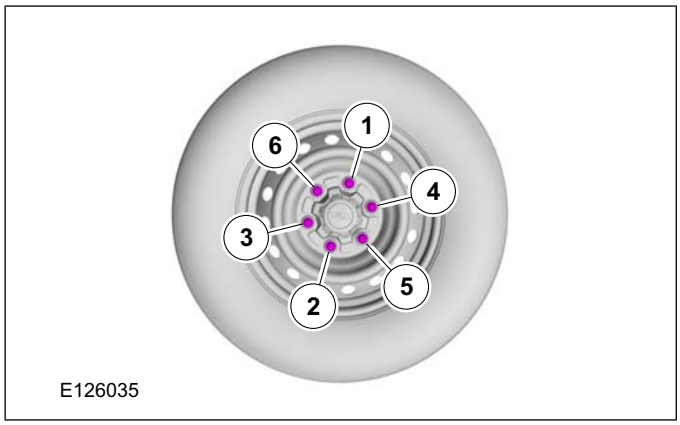
NOTE: Only tighten the nuts finger tight at this stage.



2. Lower the vehicle.

3. When installing the wheels and tires, tighten the wheel nuts in a criss-cross pattern to the following tightening torque.

- Tightening torque 88.2—117.6 Nm {9.00—11.99 Kgf·m, 65.06—86.73 ft·lbf}.



REMOVAL AND INSTALLATION

Steering Wheel(13 524 0)

General Equipment

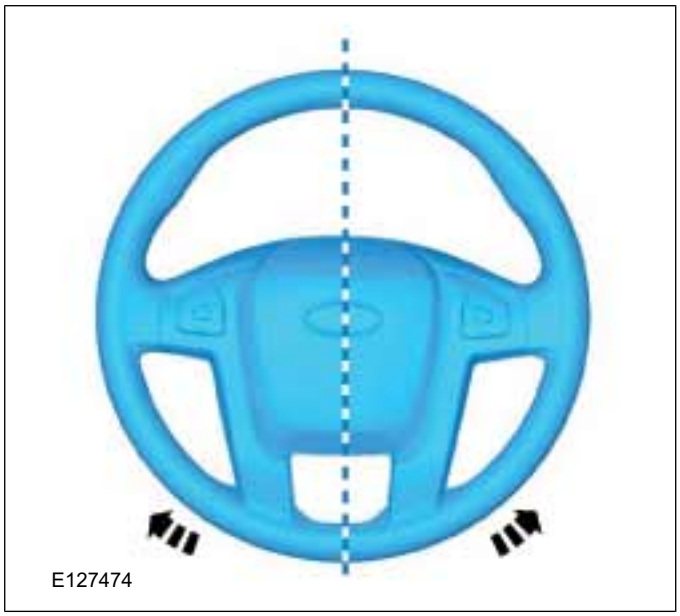
Adhesive Tape

Removal

CAUTION: Make sure that the steering wheel lock is engaged.

NOTE: Removal steps in this procedure may contain installation details.

1.


E127474

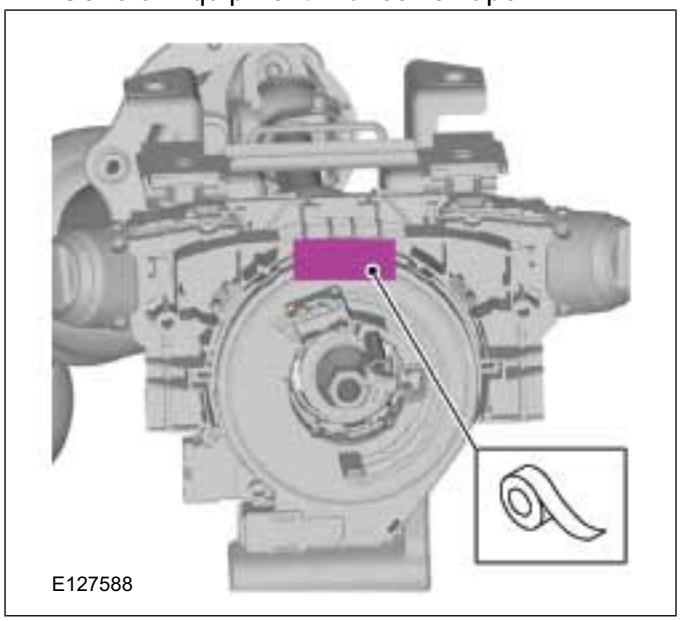
2. Refer to: Driver Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation).

3. Torque: 40 Nm


E127587

CAUTION: Make sure that the clockspring rotor does not rotate.

4. General Equipment: Adhesive Tape


E127588

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

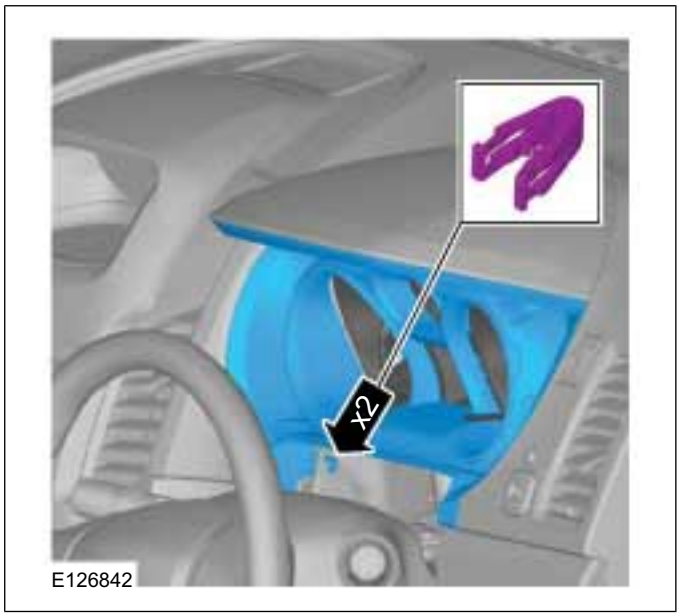
Ignition Switch(33 616 0)

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2.



3.



4.



5.



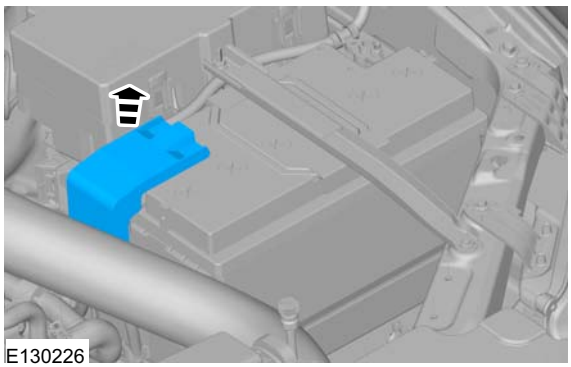
GENERAL PROCEDURES

Battery Disconnect and Connect

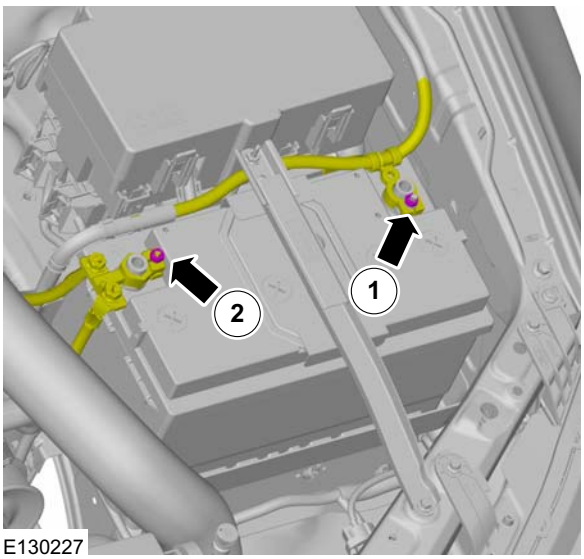
Activation

1. Obtain and record the audio unit keycode and preset radio frequencies.

2.


E130226

3. Torque: 27 Nm



E130227

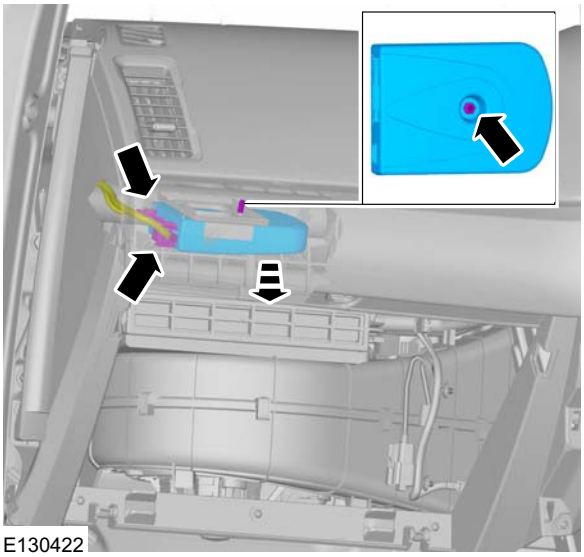
REMOVAL AND INSTALLATION

Bluetooth Module(33 635 0)

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Glove Compartment (501-12 Instrument Panel and Console, Removal and Installation).
2. Torque: 2 Nm



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

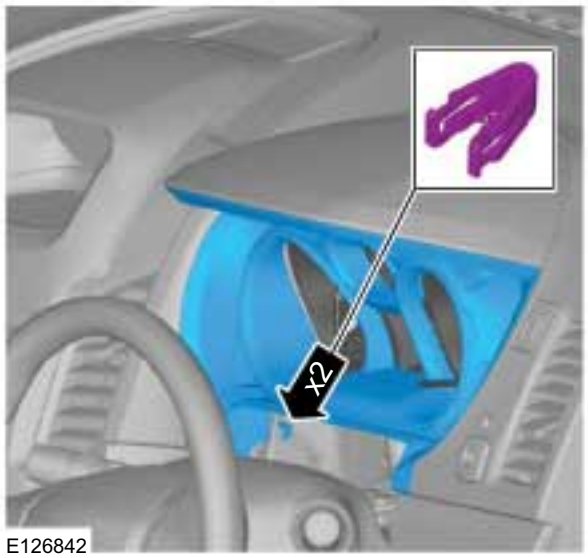
Passive Anti-Theft System (PATS) Transceiver

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2.



3.



4.

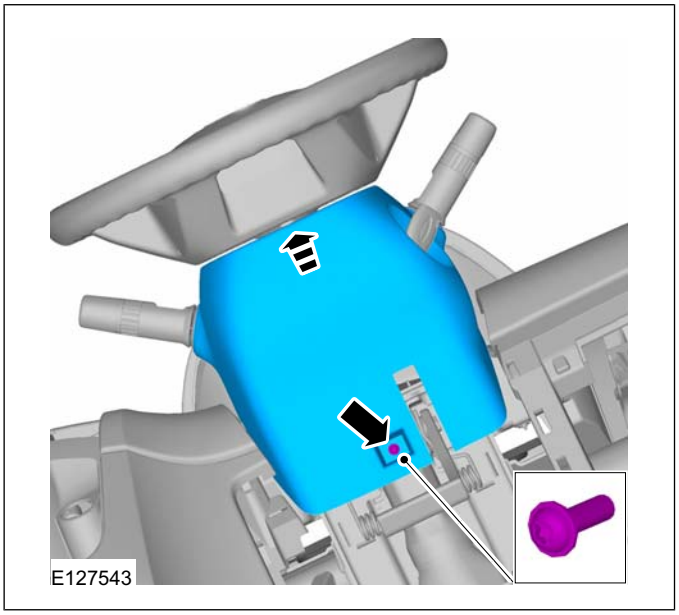


5.

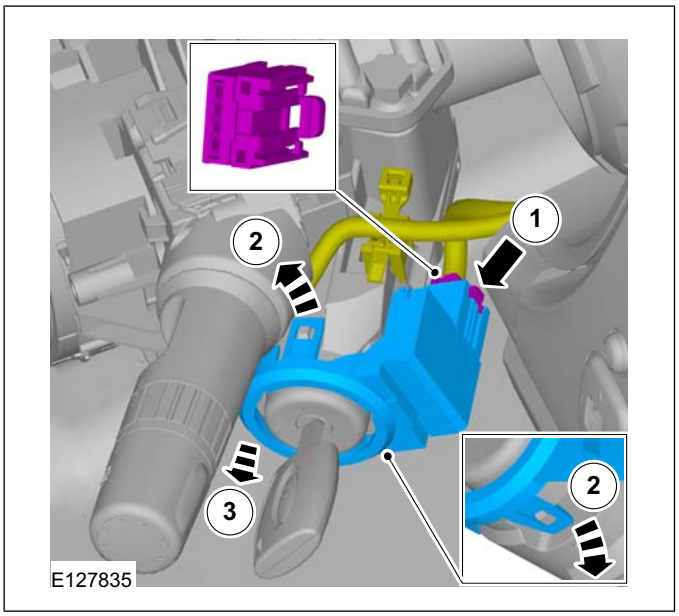


REMOVAL AND INSTALLATION

6.



7.



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Audio Unit

Removal

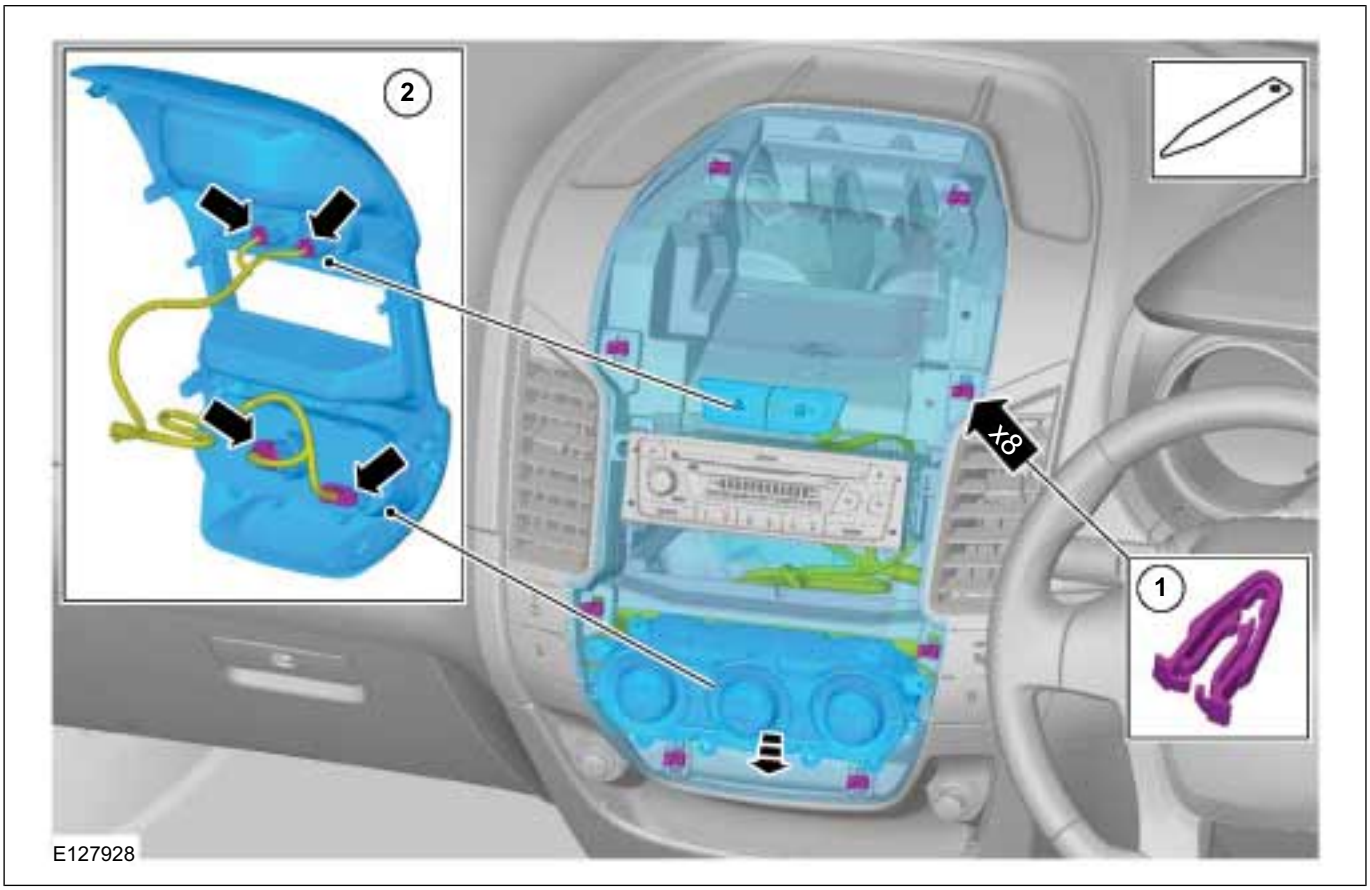
WARNING: The supplemental restraint system (SRS) is active for a certain length of time after the power supply has been disconnected. Wait for a minimum of 3 minutes before disconnecting or removing any SRS components.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

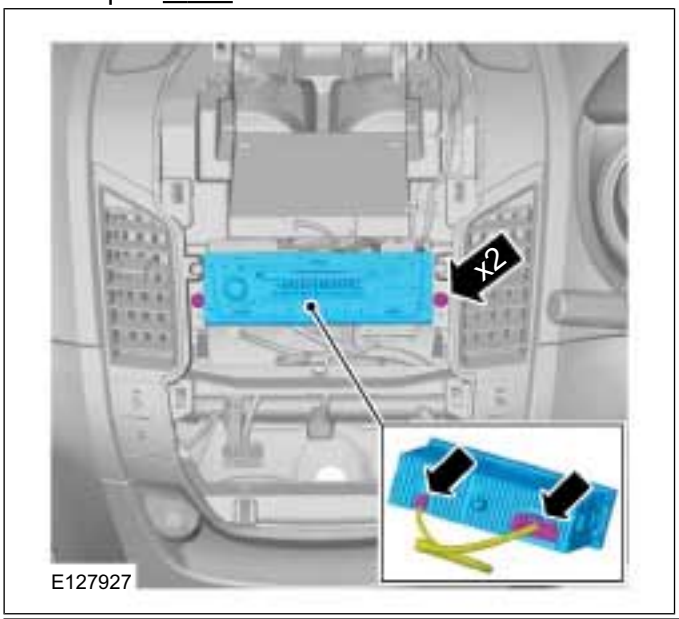
Vehicles with single DIN Standard audio unit

2.



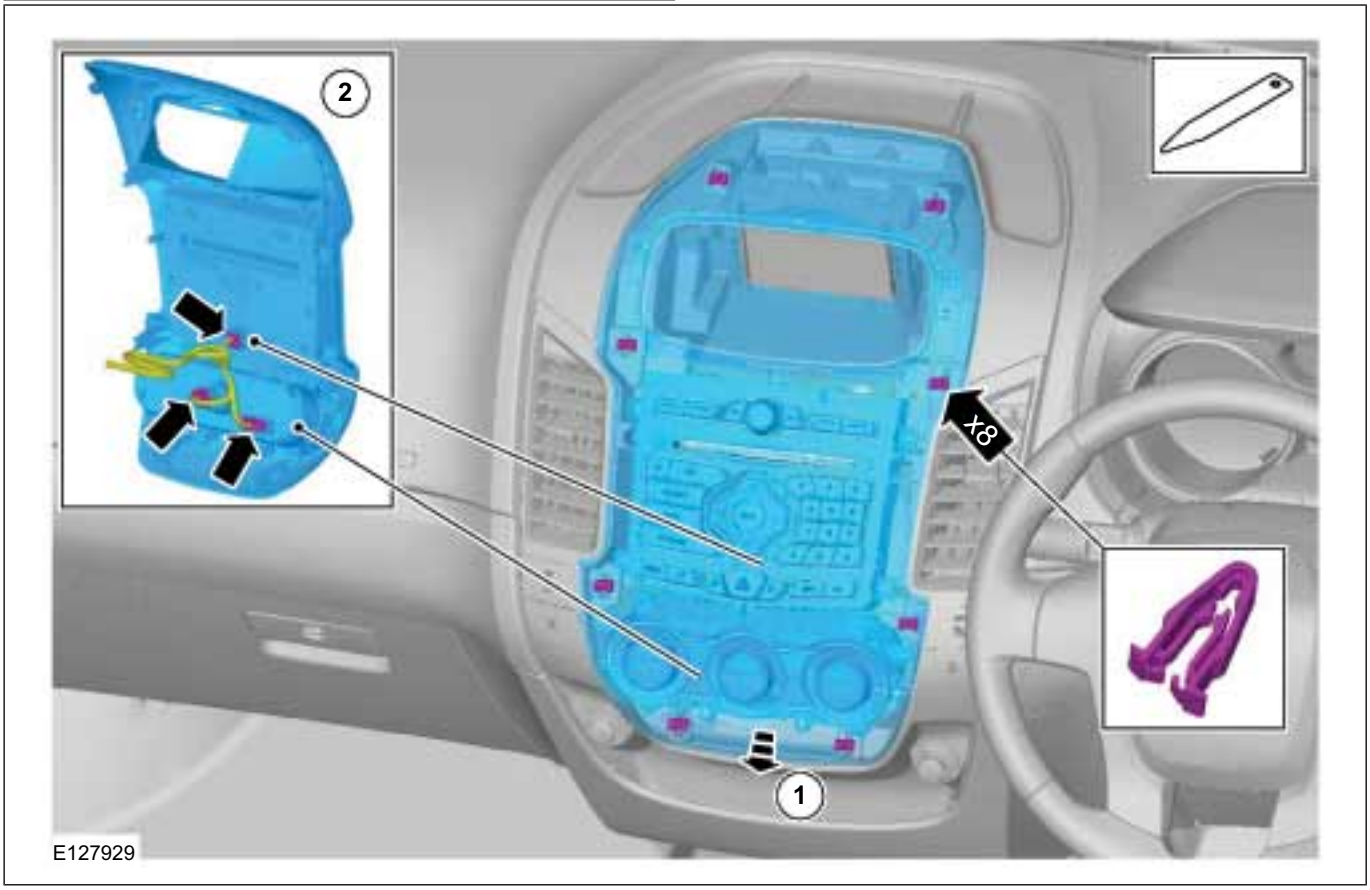
REMOVAL AND INSTALLATION

3. Torque: 3 Nm



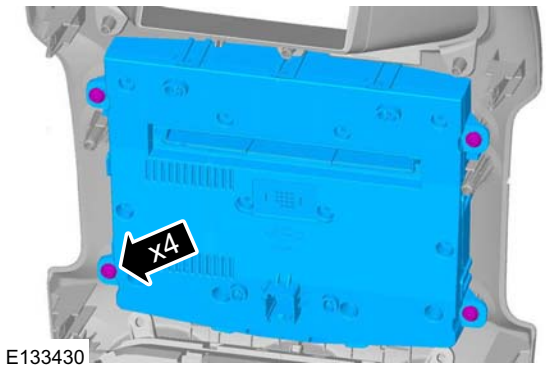
Vehicles with double DIN Standard audio unit

4.

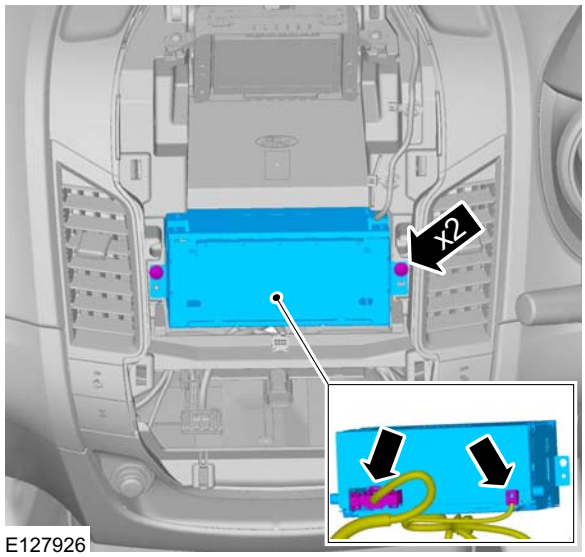


REMOVAL AND INSTALLATION

5. Torque: 2 Nm



6. Torque: 3 Nm



Installation

1. To install, reverse the removal procedure.

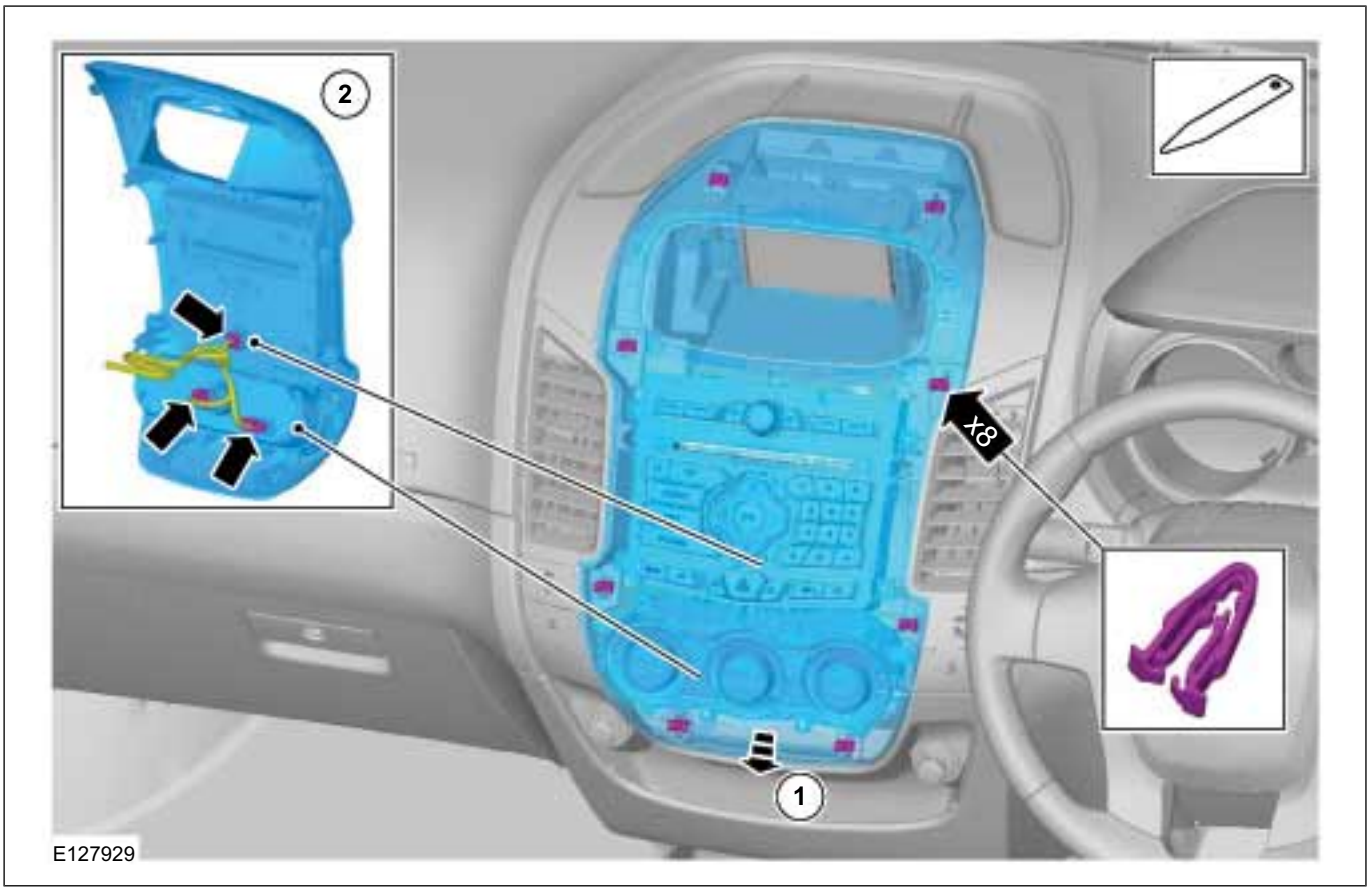
REMOVAL AND INSTALLATION

Information and Entertainment Display Unit

Removal

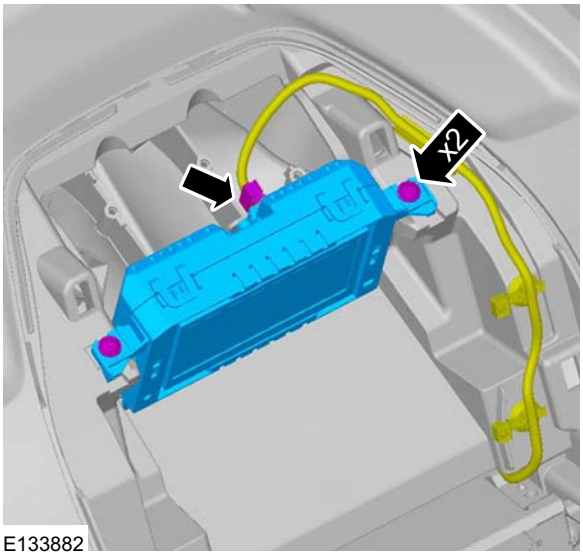
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3.



REMOVAL AND INSTALLATION

4.



Installation

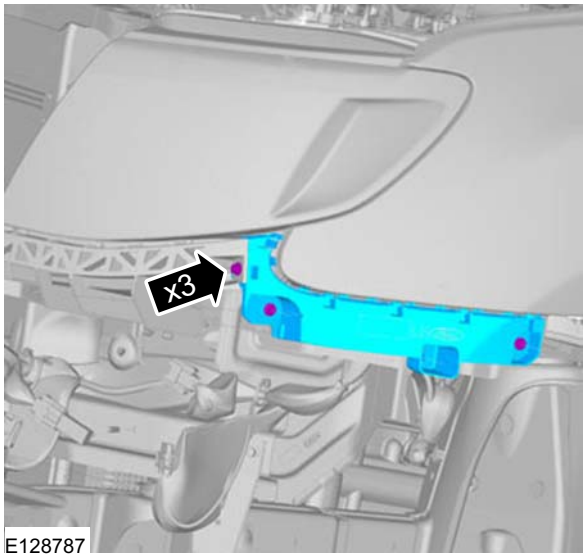
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Headlamp Assembly

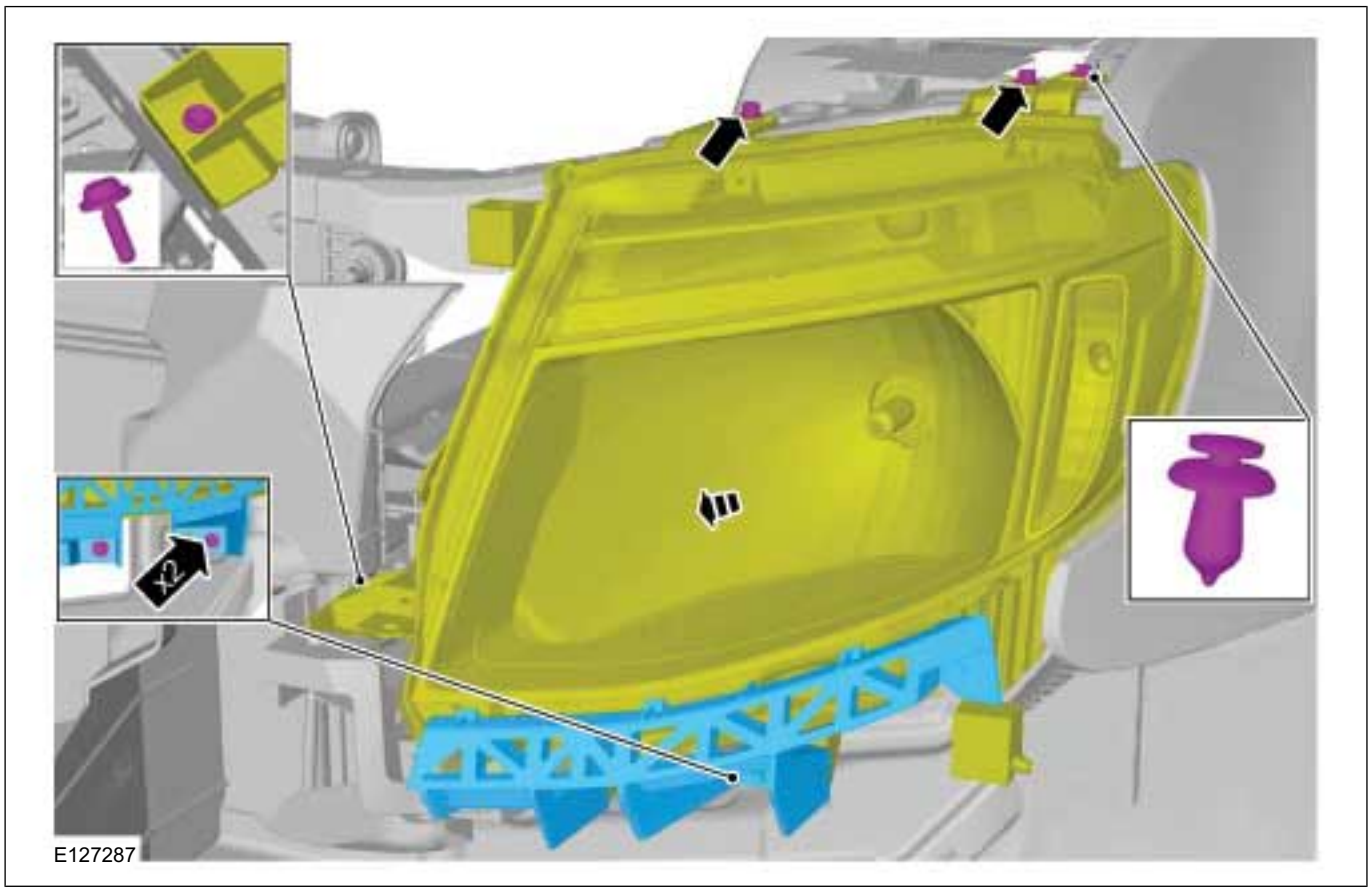
Removal

NOTE: Removal steps in this procedure may contain installation details.

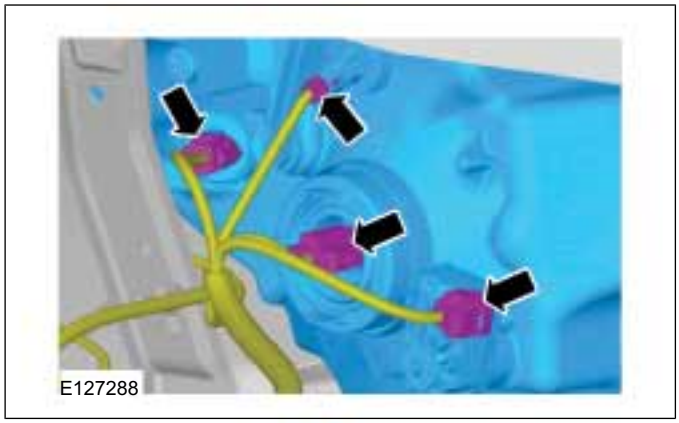
1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).
3. 

4.

REMOVAL AND INSTALLATION



5.



Installation

1. To install, reverse the removal procedure.
2. Refer to: Headlamp Adjustment (417-01 Exterior Lighting, General Procedures).

GENERAL PROCEDURES

Headlamp Adjustment

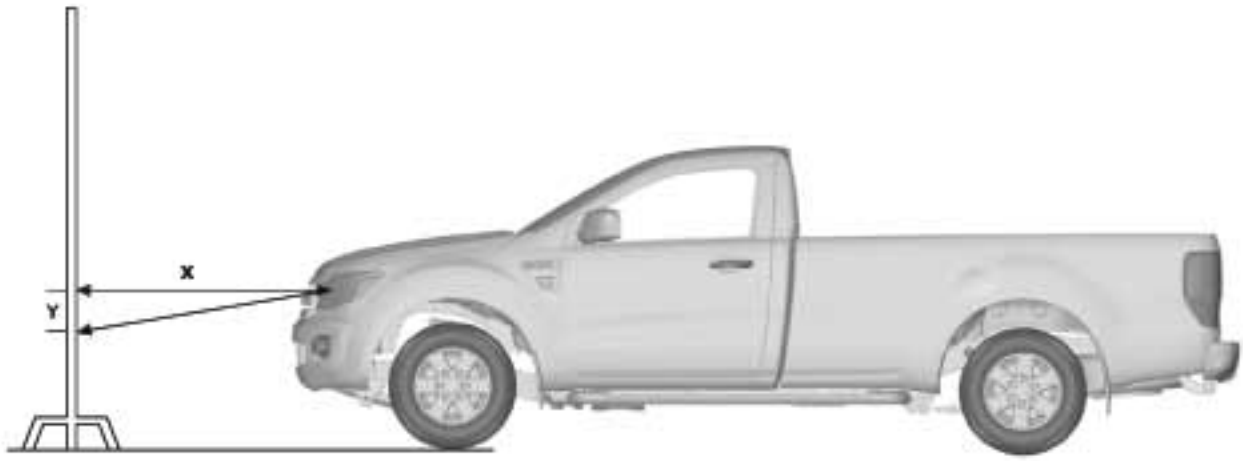
General Equipment

Headlamp Beam Setter

Activation

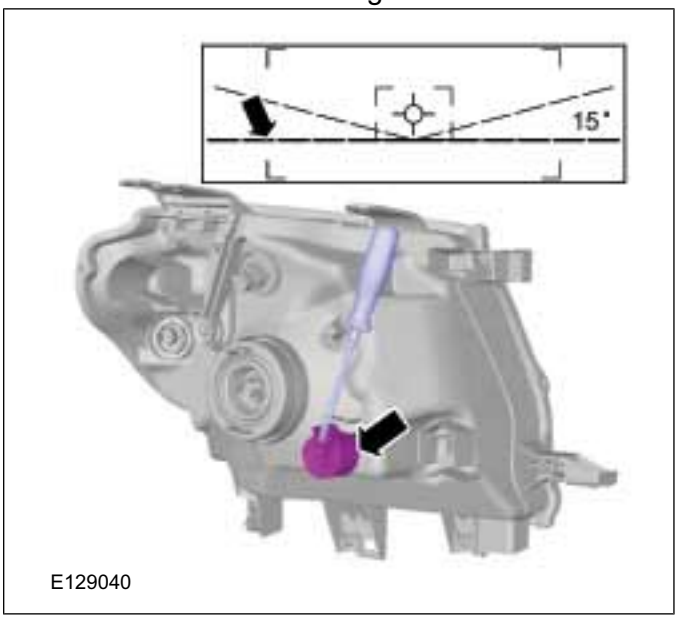
1. Adjust the tire pressure to the specification.
2. Position the unloaded vehicle on a flat, level surface.
3. Seat one person in the driver's seat.
4. Position the vehicle straight ahead and perpendicular to the white screen.
5. Repeatedly operate the headlamp leveling switch and then set it to "0".
6. Set the measuring screen of the beam setting equipment to the correct headlamp adjustment setting.

   General Equipment: Headlamp Beam Setter
7. **X:** 3 m [9.8 ft], **Y:** 1.2°, **Z:** 36 mm [1.4 inch].



E136737

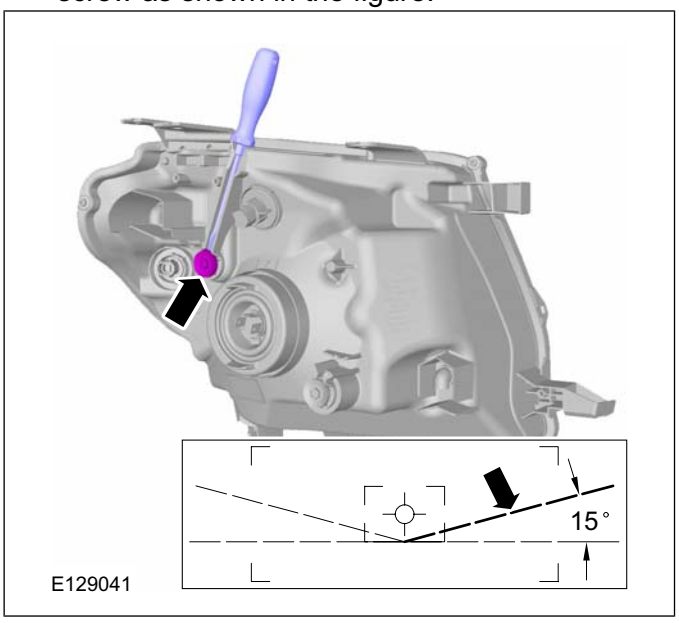
8. Place an object in front of the headlight not being adjusted to block its light beam.
9. Start the engine so that the battery remains charged.
10. Turn on the headlamp.
11. Adjust the headlight by loosening the adjusting screw as shown in the figure.



E129040

GENERAL PROCEDURES

12. Adjust the headlight by loosening the adjusting screw as shown in the figure.



REMOVAL AND INSTALLATION

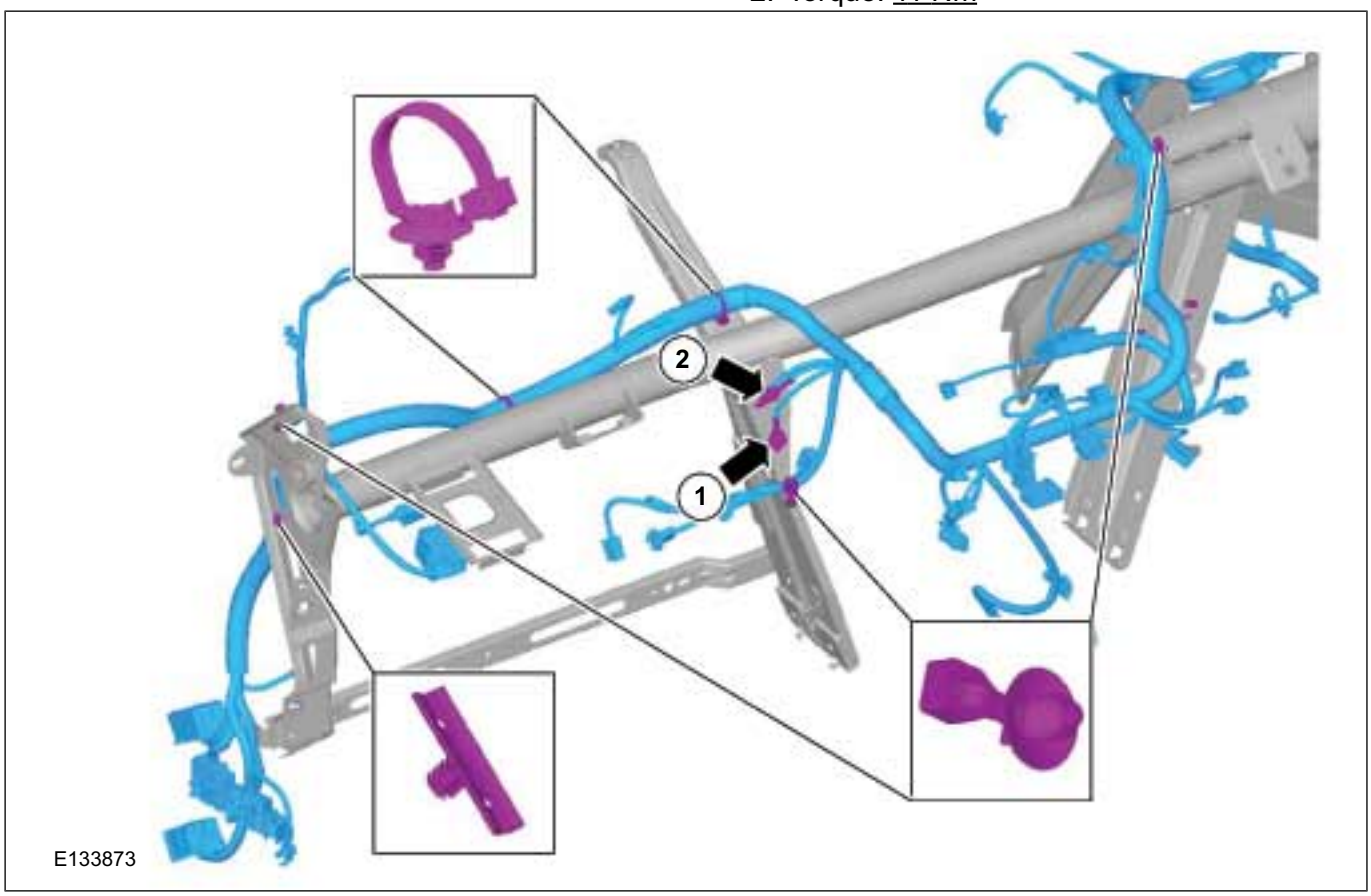
Instrument Panel Wiring Harness

Removal

WARNING: Make sure that the vehicle electrical system is fully depowered and no other power source is connected.

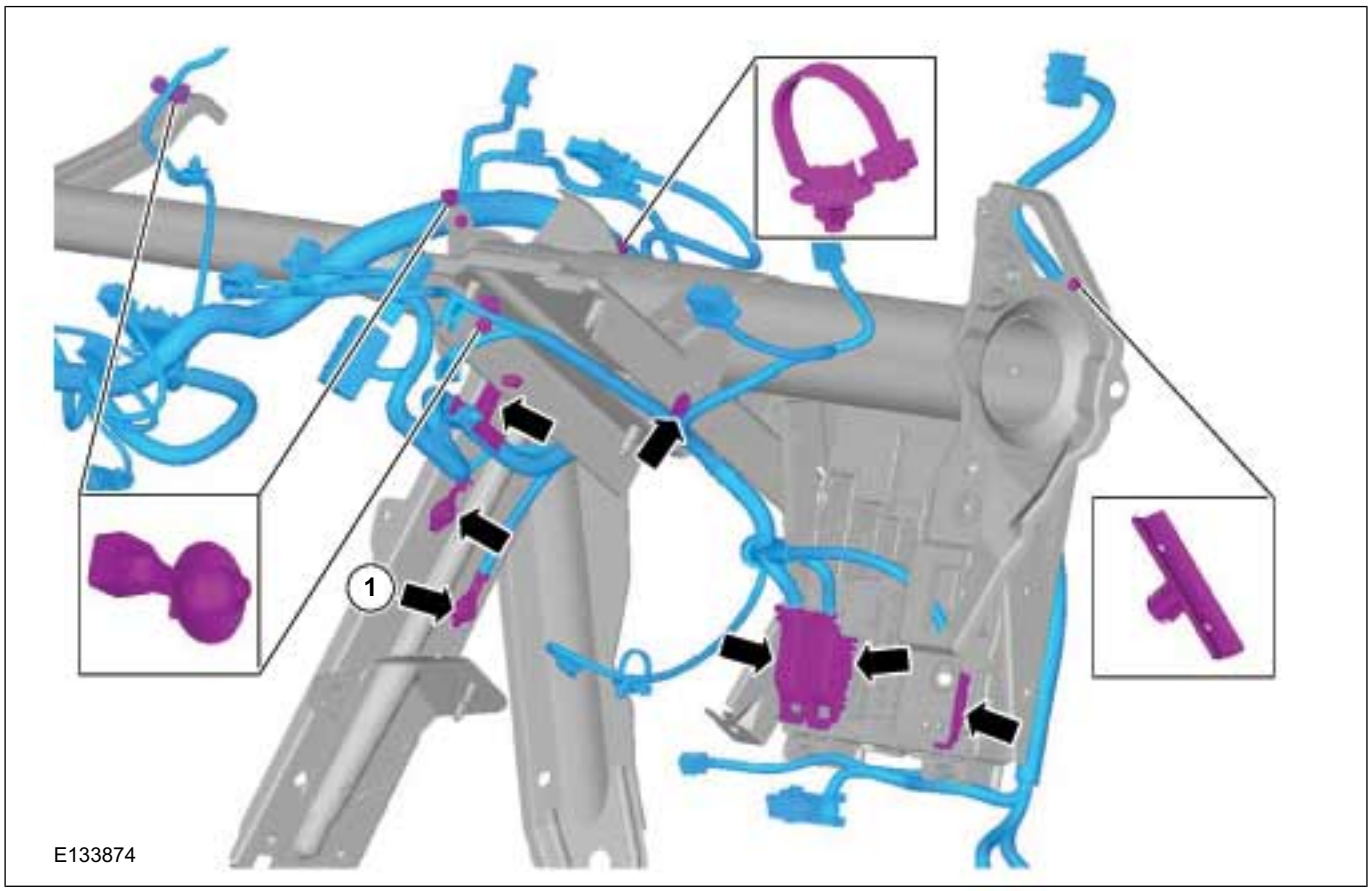
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supplemental Restraint System (SRS) Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Instrument Panel - RHD 4WD/RHD RWD (501-12 Instrument Panel and Console, Removal and Installation).
3. Refer to: Instrument Panel (501-12 Instrument Panel and Console, Disassembly and Assembly).
4. 1. Torque: 11 Nm
   2. Torque: 11 Nm



5. 1. Torque: 11 Nm

REMOVAL AND INSTALLATION



Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

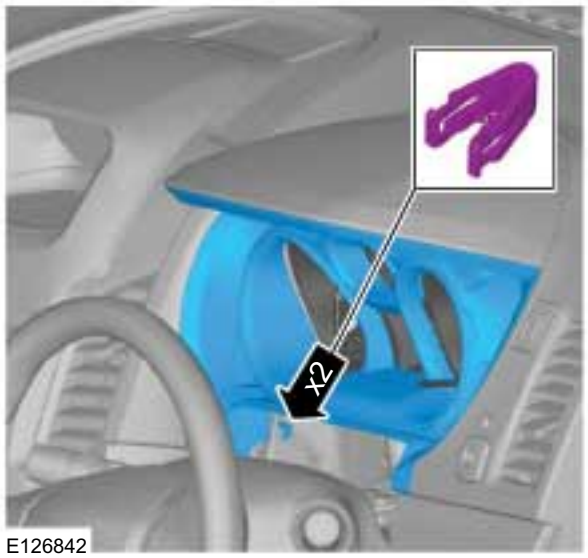
Passive Anti-Theft System (PATS) Transceiver

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2.



3.



4.

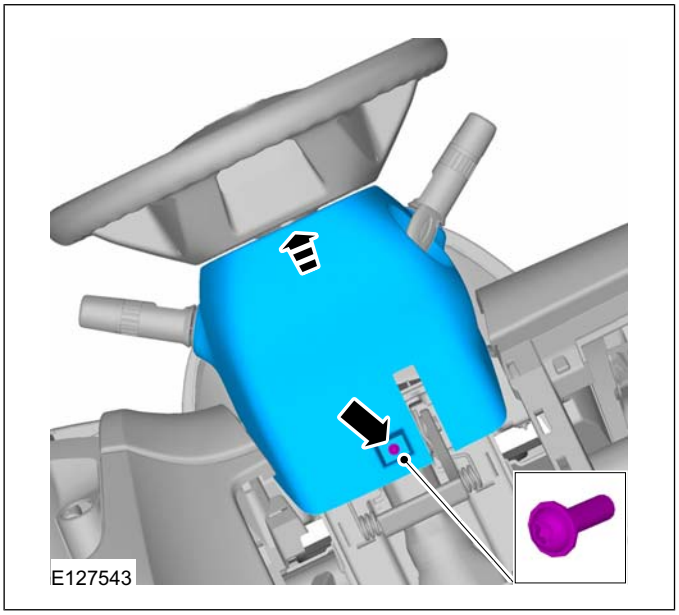


5.

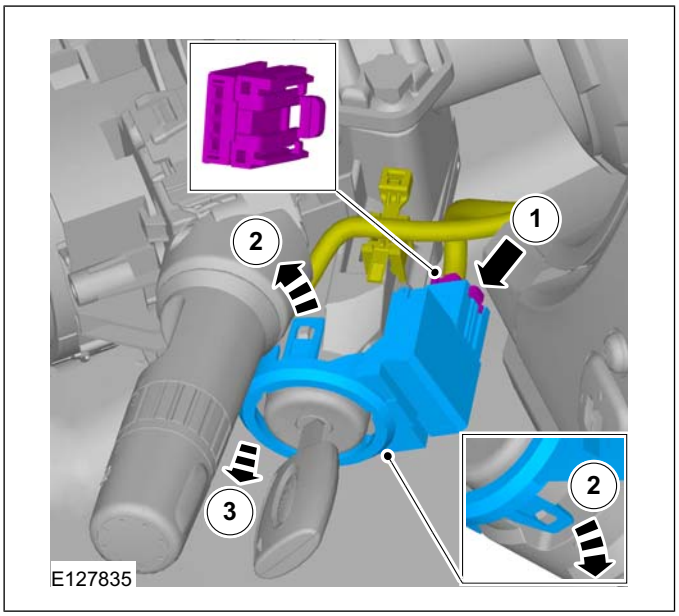


REMOVAL AND INSTALLATION

6.



7.



Installation

1. To install, reverse the removal procedure.