FORD FIGO B517

GROUP

5

Body and Paint

SECTION TITLE PAGE

SPECIFICATIONS

Torque Specifications

Item	Nm	lb-ft	lb-in
Hood hinge to hood retaining nuts	23	17	-
Hood hinge retaining bolts	23	17	-
Windshield wiper arm retaining nuts	20	15	-
Fender splash shield retaining screws	5	-	44
Fender retaining bolts	7	-	62
Washer reservoir to radiator grille opening panel retaining bolt	3	-	27
Front bumper retaining bolts	25	18	-
Radiator grille opening panel retaining bolts	25	18	-
Hood release cable fitment to body	9	-	-

SPECIFICATIONS

Torque Specifications

Description	Nm	lb-ft	lb-in
Safety belt lower anchor retaining bolts	40	30	-
Safety belt upper anchor retaining bolts	40	30	-

REMOVAL AND INSTALLATION

Headliner(43 612 0)

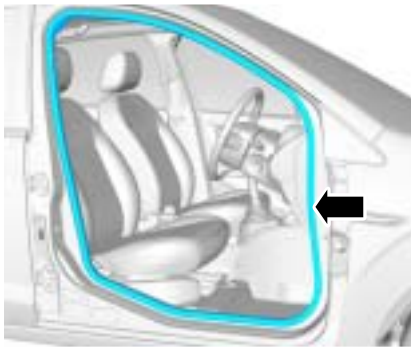
General Equipment

6 mm flat-bladed screwdriver

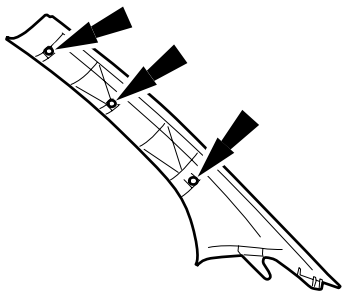
Removal

All vehicles

1. **Detach the front door opening weatherstrips.**

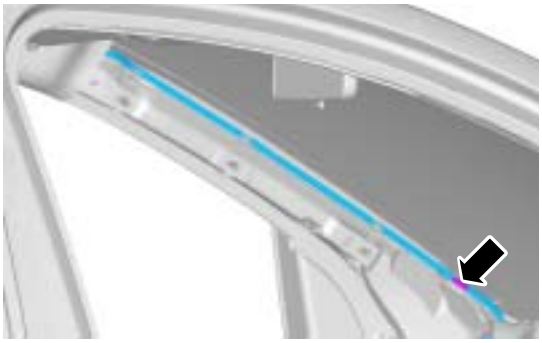

E119720

2. **Remove the A-pillar trim panels.**


VUE0027052

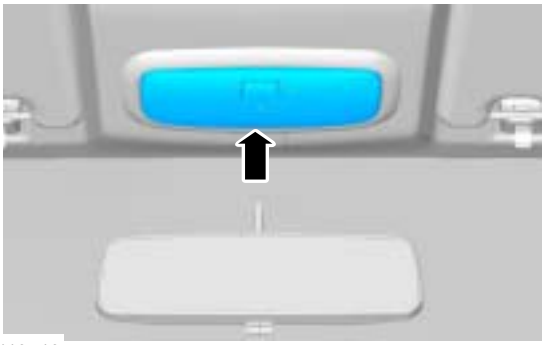
3. **NOTE: When disconnecting the rear washer tube, allow the washer fluid to drain into a suitable container.**

Detach the rear washer tube from the A-pillar.

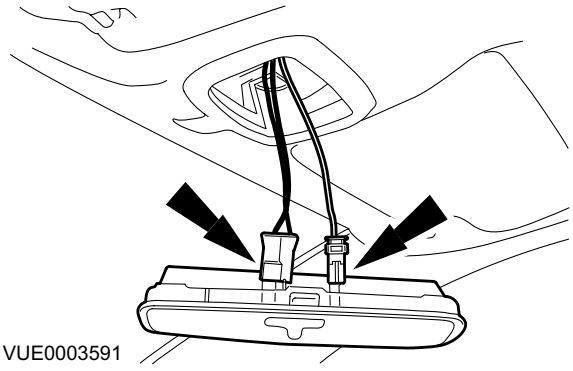

E119721

All vehicles

4. **Detach the interior lamp.**


E119719

5. **Disconnect the electrical connectors and remove the interior lamp.**


VUE0003591

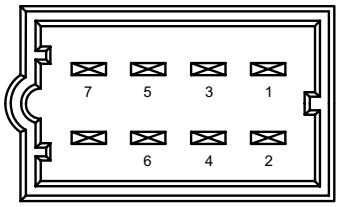
SPECIFICATIONS

Torque Specifications

Item	Nm	lb-ft	lb-in
External mirror retaining bolt	11	8	-

DIAGNOSIS AND TESTING

Circuit to test	Connect self–powered test light or ohmmeter to terminals	Move switch to these positions	A good switch will indicate
Power mirror, right side	6 and 5	Right	Closed circuit
Left/right	6 and 3	Rest	Open circuit
Left/right	6 and 3	Left	Closed circuit
Left/right	6 and 3	Right	Open circuit
Up/down	4 and 3	Rest	Open circuit
Up/down	4 and 3	Up	Closed circuit
Up/down	4 and 3	Down	Open circuit
Left/right	4 and 3	Rest	Open circuit
Left/right	4 and 3	Left	Open circuit
Left/right	4 and 3	Right	Closed circuit



E124614

REMOVAL AND INSTALLATION

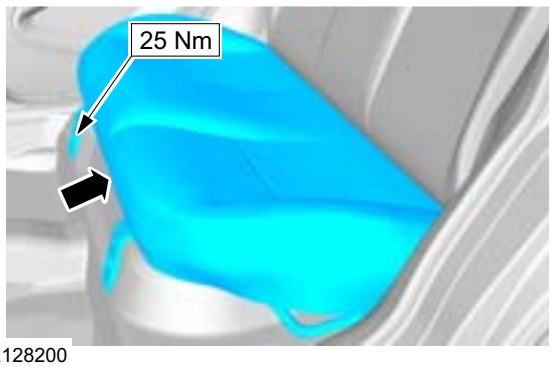
Rear Seat Backrest Cover

General Equipment

Hog ring pliers

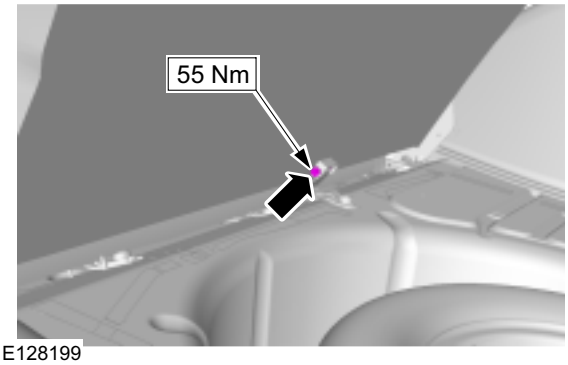
Removal

1. **Remove the rear seat cushion assembly.**



E128200

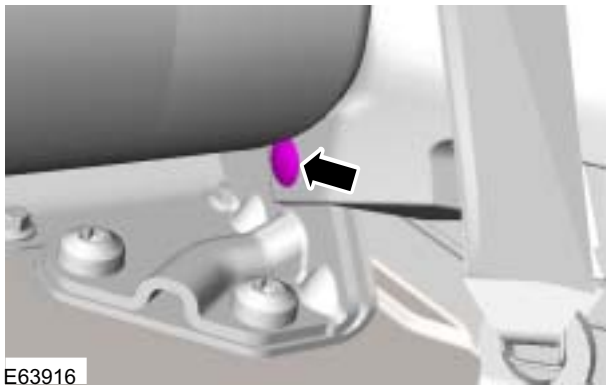
2. **Remove the safety belt bolt.**



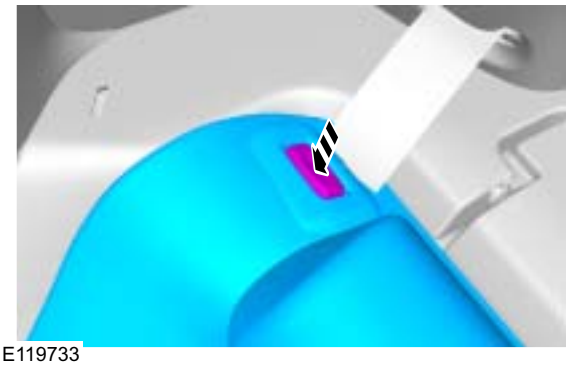
E128199

3. **Detach the retaining clip and remove the rear scuff plate trim panel.**

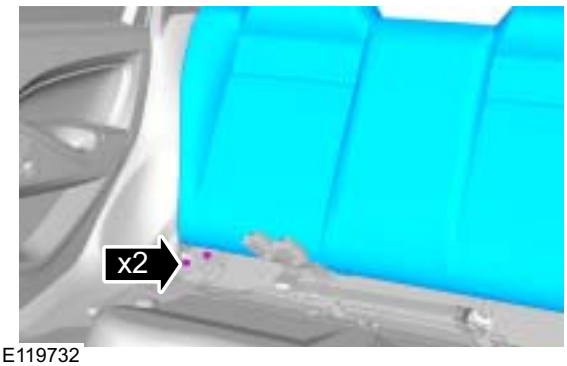
   For additional information, refer to: Rear Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).


E63916

4. **Fold the rear seat back by pressing the push button on both the sides.**

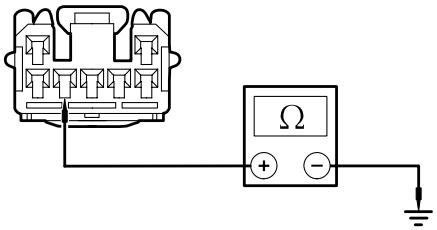
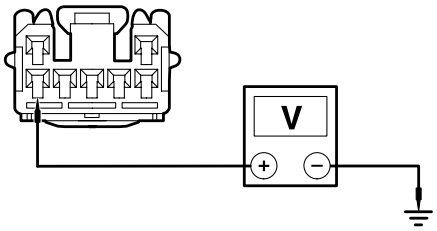

E119733

5. **Remove the rear seat backrest frame bolts (both sides).**



E119732

DIAGNOSIS AND TESTING

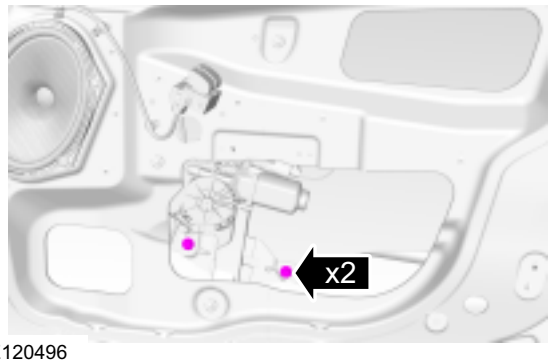
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 E122952	3 Measure the resistance between the driver power window control switch CAPW10 pin 4, circuit GD356 (BK/VT), harness side and ground. • Is the resistance less than 2 ohms? → **Yes** GO to B5. → **No** REPAIR circuit GD356 (BK/VT), splice SAD356 and ground G10. TEST the system for normal operation.
B5: CHECK FOR VOLTAGE TO THE DRIVER POWER WINDOW CONTROL SWITCH	
	1 Ignition switch in position II.
 E122954	2 Measure the voltage between the driver power window control switch CAPW10 pin 3, circuit CBP57 (BN/GN), harness side and ground. • Is the voltage greater than 10 volts? → **Yes** INSTALL a new driver side power window switch. CHECK the operation of the system. → **No** LOCATE and RECTIFY the break in the circuit CBP57 (BN/GN) between the driver side power window switch and soldered connection splice SABP57 using the Wiring Diagram. CHECK the operation of the system.

PINPOINT TEST C : A SINGLE POWER WINDOW IS INOPERATIVE - PASSENGER SIDE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Use a digital multimeter for all electrical measurements.	
C1: DOES THE PASSENGER WINDOW OPERATE FROM THE DRIVER SIDE POWER WINDOW CONTROL SWITCH	
	1 Ignition switch in position II.
	2 Operate the passenger power window from the driver power window control switch. • Does the passenger power window operate? → **Yes** REPAIR circuit CBP57 (BN/GN). TEST the system for normal operation. → **No** GO to B4.

GENERAL PROCEDURES

8. Tighten the window glass clamp retaining bolts.



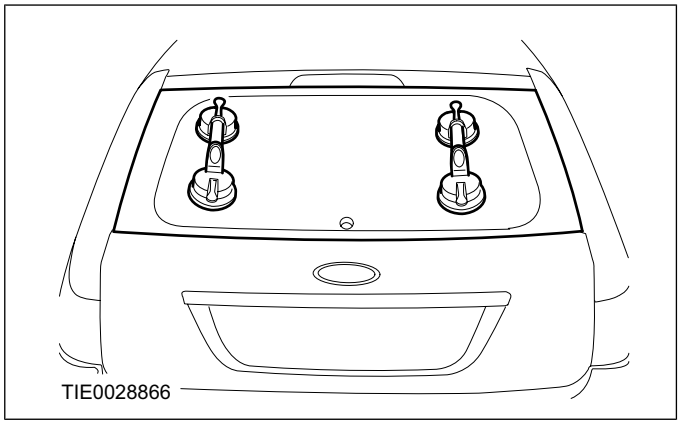
E120496

9. Attach the door panel watershield.
10. Install the door trim panel.

    For additional information, refer to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

REMOVAL AND INSTALLATION

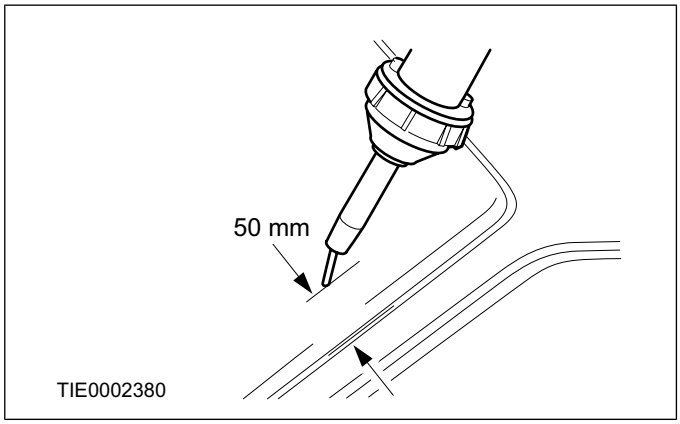
7. **With the aid of another technician, use glazing suction cups to install the liftgate window glass.**
   - Press firmly and evenly into position.



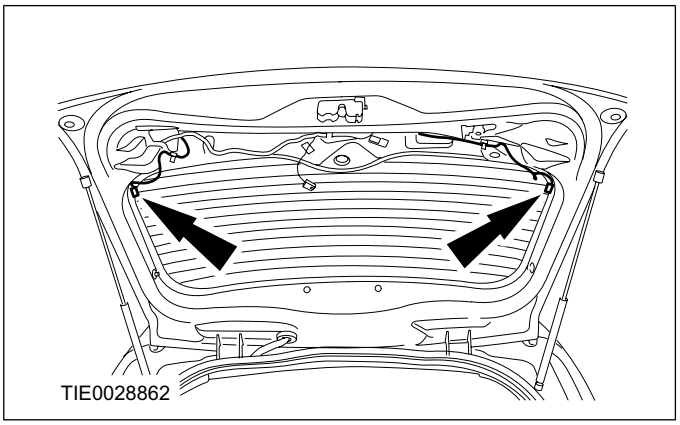
8. **CAUTION: During the curing period of the PU adhesive, the door windows must be left open to avoid a build up of pressure when the doors are opened and closed.**

   Using suitable tape, secure the liftgate window glass in the correct position until the PU adhesive has cured.

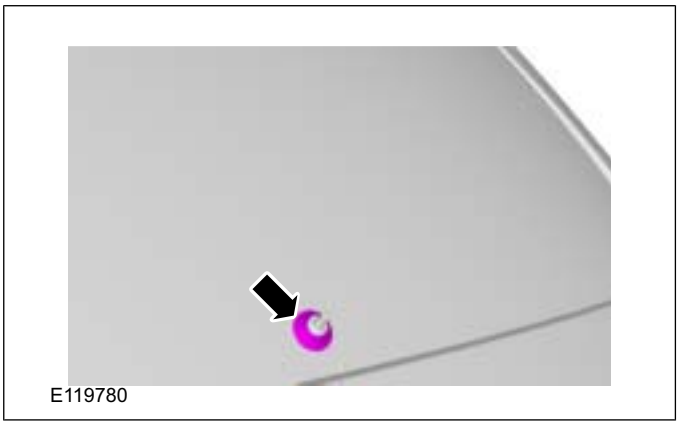
9. **If the ambient temperature falls below 10°C, use a hot air gun and apply warm air (25°C) continuously for 15 minutes (inside or outside the vehicle).**



10. **Connect the heated liftgate window glass electrical connectors.**



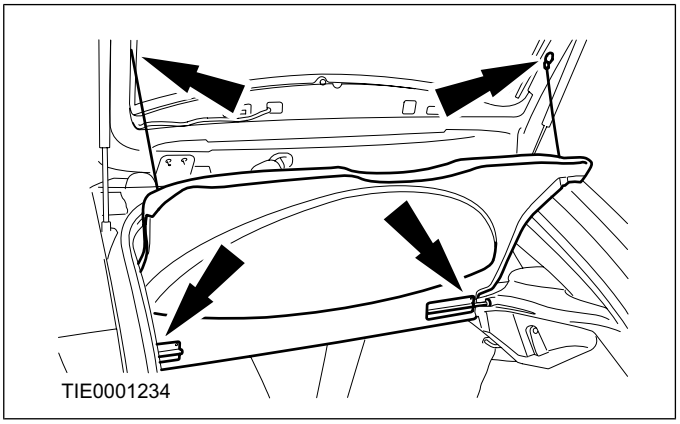
11. **Install the liftgate window wiper motor spindle grommet.**



12. **Install the liftgate window wiper motor.**

    For additional information, refer to: Rear Window Wiper Motor (501-16 Wipers and Washers, Removal and Installation).

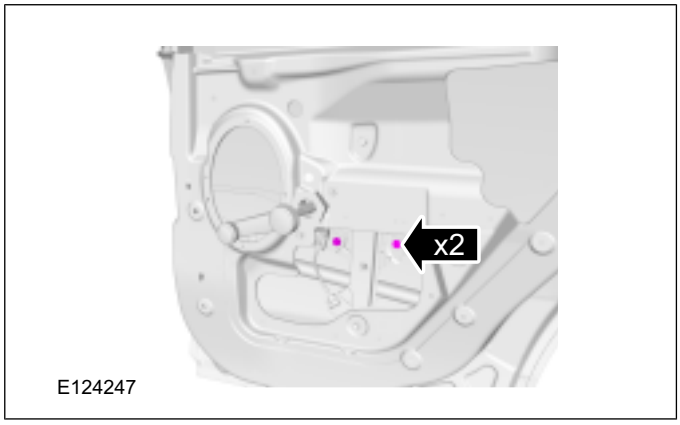
13. **Install the parcel shelf (If equipped).**



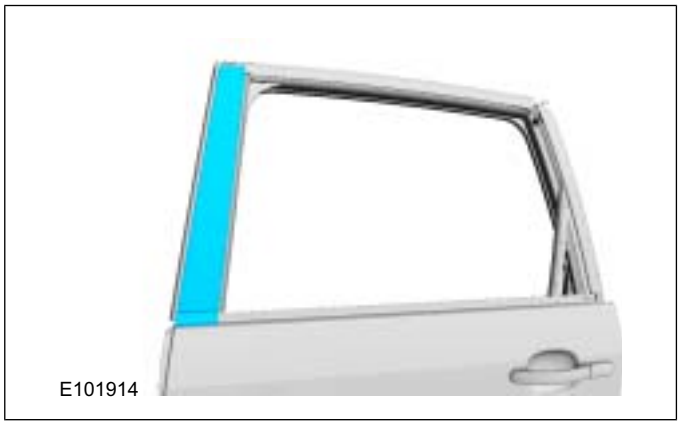
REMOVAL AND INSTALLATION

All vehicles

7. Remove the rear window glass bolts.



8. Remove the rear door trim panel.

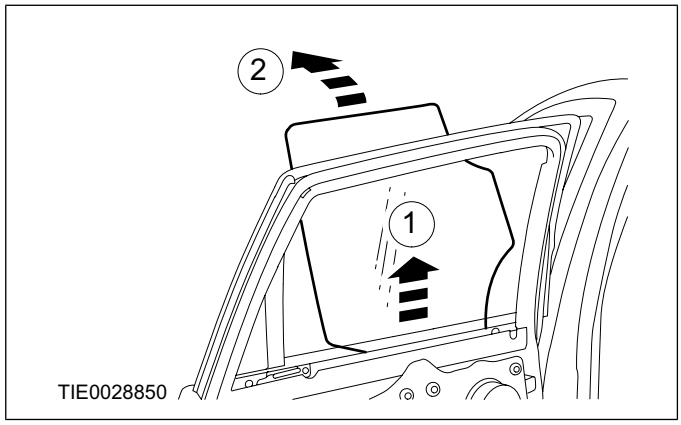


9. Detach the rear door window glass weatherstrip.

10. NOTE: The rear door window glass must be removed towards the outside of the window opening.

Remove the rear door window glass.

1. Lift the window glass.
2. Tip the window glass forwards and remove the window glass from the rear door.



Installation

1. NOTE: The rear door window glass must be installed from the outside of the window opening.

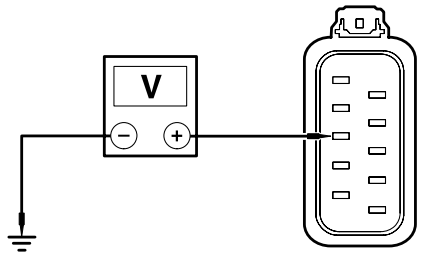
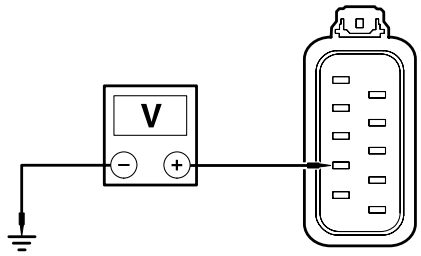
To install, reverse the removal procedure.

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

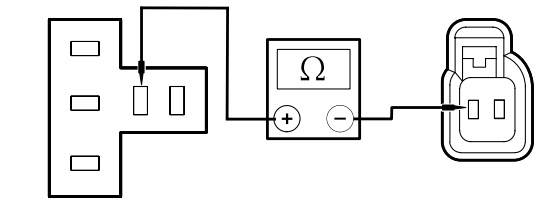
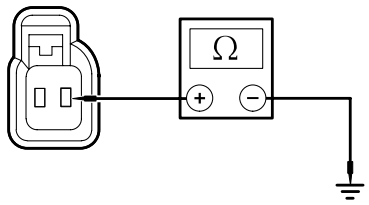
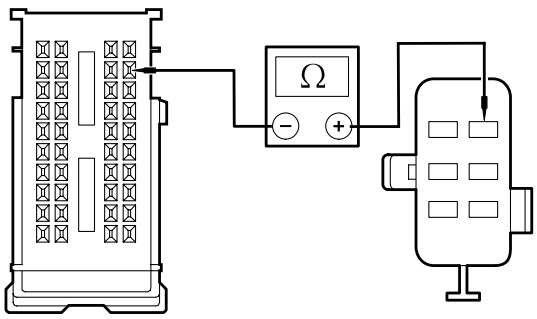
VEHICLE APPLICATION: 2010.25 Figo

CONTENTS PAGE

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 E124655	3 After pressing remote lock position, measure the voltage between the driver door latch unit connector CAPL63, pin 5, circuit CPL11 (GY/BN) wiring harness side and ground. • Is the voltage greater than 5 volts? → **Yes** RENEW the driver door latch unit. CHECK the system for operation. → **No** Repair the circuit CPL11 (GY/BN) and splice S2PL11 using the wiring diagram. Test the system for normal operation.
B5: CHECK THE OPERATION OF DRIVER DOOR LATCH UNIT (UNLOCK POSITION).	
	1 Disconnect the driver door latch unit connector CAPL63.
	2 Connect the 20A fused jumper wire between the driver door latch unit connector, pin 4, circuit CPL26 (GN/VT) harness side and ground.
 E124656	3 After pressing remote unlock position, measure the voltage between the driver door latch unit connector CAPL63 pin 7, circuit CPL51 (BU/GN) harness side and ground. • Is the voltage greater than 5 volts? → **Yes** RENEW the driver door latch unit. CHECK the system for operation. → **No** GO to B6.
B6: CHECK THE CIRCUIT CPL51 (BU/GN) BETWEEN THE BFC AND DRIVER DOOR LATCH UNIT FOR OPEN CIRCUIT.	
	1 Ignition switch in position 0.
	2 Disconnect the BFC C2AM02-B.

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 E124288	2 Measure the resistance between tail gate release relay connector C2BP02-R10 pin 5, CPL84 (GN/BN) and tail gate decklid motor connector C4PR57 pin 1, CPL84 (GN/BN) harness side. • Is the resistance less than 2 ohms? → **Yes** GO to F9. → **No** Repair the circuit CPL84 (BN) using the wiring diagram. Test the system for normal operation.
F9: CHECK THE GROUND CONNECTION OF THE TAIL GATE DECKLID MOTOR FOR OPEN	
 E124669	1 Measure the resistance between tail gate decklid motor connector C4PR57 pin 2 circuit GD326 (BK/WH) harness side and ground. • Is the resistance less than 2 ohms? → **Yes** GO to F10. → **No** Locate and rectify in the circuit GD326 (BK) and soldered connection splice S4D326 and Using the wiring diagram. Check the operation of the system.
F10: CHECK THE CONTINUITY BETWEEN BFC AND TAIL GATE DECKLID RELEASE SWITCH	
	1 Connect the tail gate decklid motor connector C4PR57.
	2 Disconnect the BFC connector C2AM02-A.
	3 Disconnect the tail gate decklid release switch connector C2PL45.
 E124670	4 Measure the resistance between BFC connector C2AM02-A pin 2 circuit CPL45 (BN) and tail gate decklid release switch connector C2PL45 pin 6 harness side. • Is the resistance less than 2 ohms? → **Yes** GO to F11. → **No** Repair the circuit CPL45 (BN) between BFC and tailgate decklid release switch. Test the operation of the system.

REMOVAL AND INSTALLATION

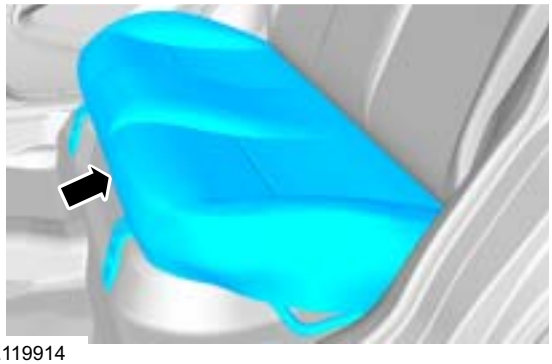
Fuel Filler Door Release Handle and Cable

Removal

1. Remove both side front seats.

   For additional information, refer to: Front Seat (501-10 Seating, Removal and Installation).

2. Remove the rear seat cusion.



E119914

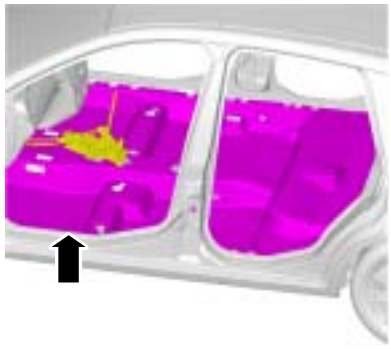
3. Remove the rear seat back rest cover.

   For additional information, refer to: Rear Seat Backrest Cover (501-10 Seating, Removal and Installation).

4. Remove the center console, front door, rear door scuff plates, B pillar trims and all required parts. For additional information, refer to:

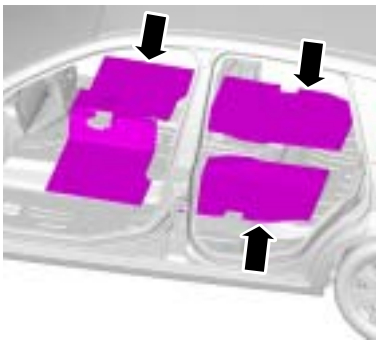
   Floor Console (501-12 Instrument Panel and Console, Removal and Installation),
   B-Pillar Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation),
   Front Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation),
   Rear Scuff Plate Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

5. Remove the floor carpet.



E122465

6. Remove the secondary carpets.



E122466

7. For removal of the cable, reverse the installation procedure.

Installation

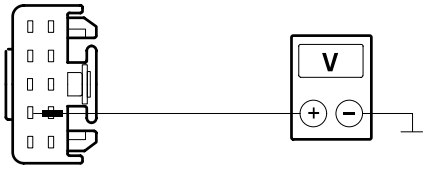
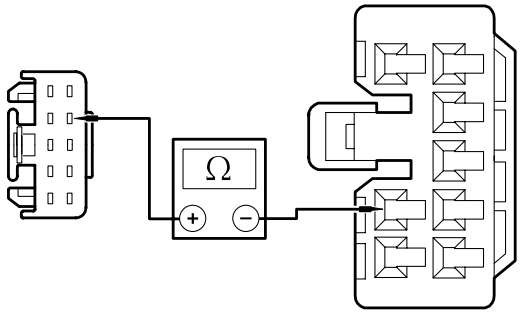
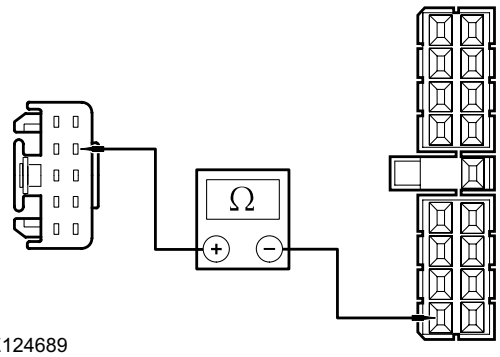
1. The general routing of the cable routing, tape fitment locations are shown.

SECTION 501-16 Wipers and Washers

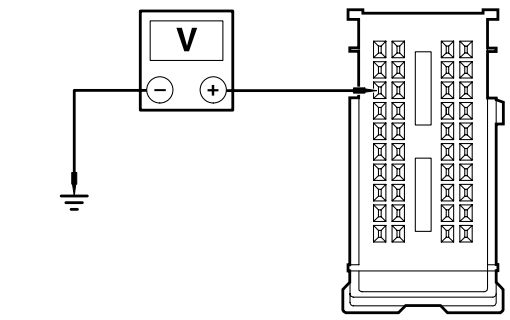
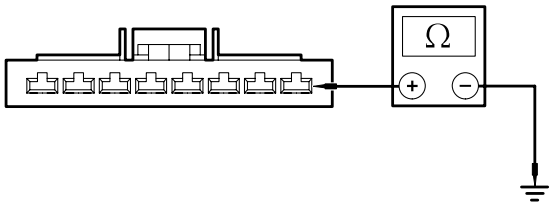
VEHICLE APPLICATION: 2010.25 Figo

CONTENTS PAGE

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 VFE0022280	4 Measure the voltage between the wash/wipe system switch, connector C2RW08, pin 7, circuit CRW01 (WH), wiring harness side and ground. • Does the meter display battery voltage? → **Yes** Vehicles with BFC GO to B6. Vehicles without BFC GO to B5. → **No** GO to B4.
B4: CHECK FOR CONTINUITY BETWEEN THE BFC/FRONT WIPER MODULE AND WASH/WIPE SYSTEM SWITCH	
	1 Ignition switch in position 0.
	2 Disconnect wash/wipe system switch and BFC/Front Wiper Module.
 E124690	
 E124689	3 Measure the resistance between the wash/wipe system switch connector C2RW08, pin 7 circuit CRW01 (WH) and – C2AM02-B, pin 8, circuit CRW01 (WH) for vehicles with BFC harness side. – C2RW03, pin 2, circuit CRW01 (WH) for vehicles with Front Wiper Module (FWM) harness side. • Is the resistance less than 2 ohms registered? → **Yes** RENEW wash/wipe system switch. CHECK the operation of the system. → **No** LOCATE and RECTIFY the break in the circuit between the wash/wipe system switch and BFC using the wiring diagrams. CHECK the operation of the system.

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 E122953	4 Measure the voltage between the BFC: – connector C2AM02-A, pin 33, circuit CBP38 (GY/BU), wiring harness side and ground. • Is battery voltage measured? → **Yes** GO to D8. → **No** LOCATE and RECTIFY the break in the circuit CBP38 (GY/BU) between the wash/wipe system switch and the BFC using the Wiring Diagrams. CHECK the operation of the system.
D8: CHECK GROUND CONNECTION OF BFC FOR OPEN CIRCUIT	
	1 Disconnect BFC connector C2AM02-C.
 E122943	2 Measure the resistance between the BFC, – Connector C2AM02-C, pin 8, circuit GD357 (BK), wiring harness side and ground. • Is a resistance of less than 2 ohms registered? → **Yes** RENEW the BFC. CHECK the operation of the system. → **No** LOCATE and RECTIFY the break in the circuit GD357 (BK), ground G13 between the BFC using the Wiring Diagrams. CHECK the operation of the system.

PINPOINT TEST E : WASH/WIPE FUNCTION INOPERATIVE

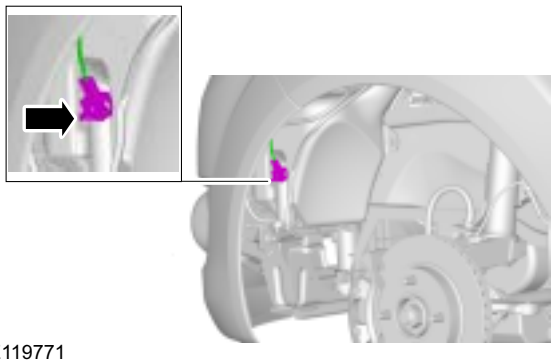
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: DETERMINE THE FAULT CONDITION	
	1 Ignition switch in position II.
	2 SWITCH ON the front and rear wash/wipe functions in turn.

DIAGNOSIS AND TESTING

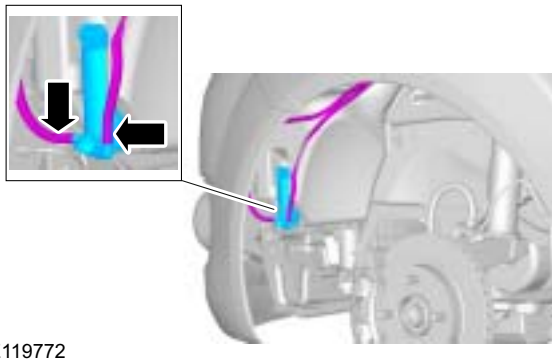
Circuit to test	Connect a digital multimeter with the following connections	Set the switch to the following position	Switch is OK when the following test readings are seen
		2	4 -14 kOhm
		3	14 -24 kOhm
		4	24 -34 kOhm
		5	34 -43 kOhm
		6	43 -57 kOhm
Flick wipe, front wiper	6 and 9	Flick wipe	Circuit closed
		Off	Circuit open
		Intermittent	Circuit open
		Slow	Circuit closed
		Fast	Circuit open
Intermittent, front wiper	6 and 10	Flick wipe	Circuit open
		Off	Circuit open
		Intermittent	Circuit closed
		Slow	Circuit open
		Fast	Circuit open
	7 and 9	Flick wipe	Circuit open
		Off	Circuit closed
		Intermittent	Circuit closed
		Slow	Circuit open
		Fast	Circuit open
Slow wipe, front wiper	6 and 9	Flick wipe	Circuit closed
		Off	Circuit open
		Intermittent	Circuit open
		Slow	Circuit closed
		Fast	Circuit open
Fast wipe, front wiper	6 and 8	Flick wipe	Circuit open
		Off	Circuit open
		Intermittent	Circuit open
		Slow	Circuit open
		Fast	Circuit closed
Front washer system	6 and 2	Off	Circuit closed
		Front washer system on	Circuit open
	2 and 3	Off	Circuit open
		Front washer system on	Circuit closed

REMOVAL AND INSTALLATION

6. **Disconnect the windshield washer pump connector.**

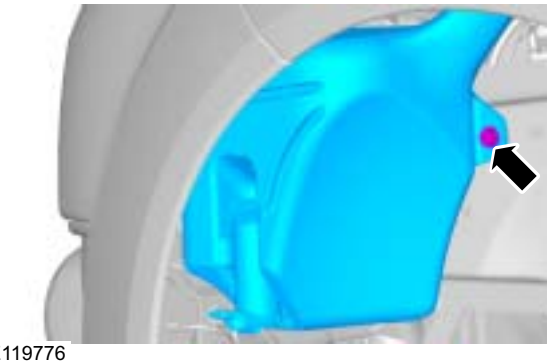

E119771

7. **Disconnect the hoses from the windshield washer fluid reservoir.**


E119772

8. **Remove the washer reservoir.**

   Remove the windshield washer fluid washer bolt.


E119776

Installation

1. **Install the components in reverse order.**

SECTION 501-20A Safety Belt System

VEHICLE APPLICATION: 2010.25 Figo

CONTENTS PAGE

DESCRIPTION AND OPERATION

System structure

The following components form part of the supplemental restraint system (SRS):

- Air bag control module
- Driver and passenger air bag modules
- Clockspring
- Air bag warning indicator

Air Bag Control Module


E124162

The air bag control module is located under the floor console, near to the gearshift lever. The installation marks on the air bag control module are to make sure it is aligned correctly.

A micro mechanical sensor is incorporated into the air bag control module; this measures the acceleration/deceleration in the event of a collision. The calculated value is evaluated by the air bag control module to determine the severity of the impact.

The air bag control module compares the values it receives from the micro mechanical sensor. If the deceleration due to a frontal impact exceeds a stored value then the air bag control module triggers the air bags.

If the vehicle battery is destroyed in the collision, a voltage hold circuit in the air bag control module will still enable the air bags to be triggered up to 150 ms after the start of the impact.

If a system fault is detected by the air bag control module, the air bag warning indicator is illuminated. The fault can be located by carrying out a diagnostic check using the Ford approved diagnostic tool.

The air bag control module can be used again after a collision for up to 5 times, provided that the air bag control module is not physically damaged and that it passes a self-test.

Driver and Passenger Air Bag Modules


E55577

The driver air bag module is fitted to the steering wheel, the cover forming the outer surface of the steering wheel boss. The cover has invisible 'split lines' moulded in its surface allowing the air bag to easily exit through the cover when the system deploys. A new driver air bag module and driver air bag module wiring harness must be installed following deployment.

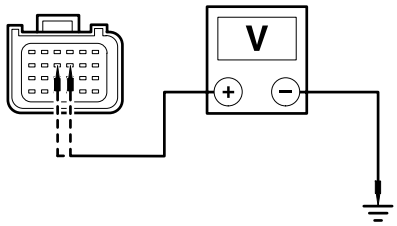

E55578

The passenger air bag module is located above the glove compartment and is secured to the in-vehicle crossbeam and the instrument panel. The cover is integrated into the instrument panel to provide an unobtrusive appearance. The cover has invisible 'split lines' moulded in its surface allowing the air bag to easily exit through the cover when the system deploys.

The passenger air bag is deployed simultaneously with the driver air bag.

A new passenger air bag module must be installed following deployment.

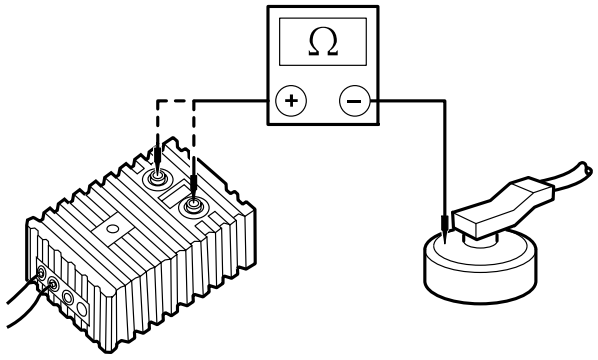
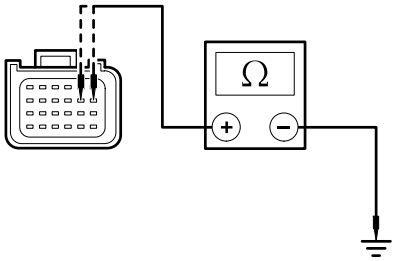
DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
 TIE0030191	4 Measure the voltage between the: • Air bag control module C3R114-A pin 9, circuit RR101 (YE/GN), harness side and ground. • Air bag control module C3R114-A pin 10, circuit CR101 (VT/BN), harness side and ground. • Is any voltage present? → **Yes** REPAIR circuit CR101 (VT/BN) and circuit RR101 (YE/GN). REPEAT the self-test, CLEAR the DTCs. REACTIVATE the system. → **No** INSTALL a new clockspring. REFER to: Clockspring (501-20 Supplemental Restraint System, Removal and Installation). . REPEAT the self-test, CLEAR the DTCs. REACTIVATE the system.

PINPOINT TEST D : DTC B1925: PASSENGER AIR BAG SHORT TO BATTERY

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
WARNING: To avoid accidental deployment, the air bag control module 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 SRS, or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.	
NOTE: Use a digital multimeter for all electrical measurements.	
D1: CHECK THE PASSENGER AIR BAG WIRING HARNESS FOR A SHORT TO BATTERY OR IGNITION	
	1 Deactivate the SRS.
	2 Disconnect Passenger Air Bag Module Simulator.
	3 Disconnect Air Bag Control Module C3R114-A.
	4 Ignition switch in position II.

DIAGNOSIS AND TESTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
	2 Select DMM specific on Ford approved diagnostic tool.
	3 Connect the Test and Deployment Lead to Ford approved diagnostic tool.
 E39389	4 Measure the resistance between each of the terminals and the passenger air bag module casing. • Are the resistances greater than 10,000 ohms? → **Yes** REPEAT the self-test, CLEAR the DTCs. REACTIVATE the system. → **No** INSTALL a new passenger air bag module. REFER to: Passenger Air Bag Module (501-20 Supplemental Restraint System, Removal and Installation). . REPEAT the self-test, CLEAR the DTCs. REACTIVATE the system.
J3: CHECK THE PASSENGER AIR BAG WIRING HARNESS FOR A SHORT TO GROUND	
	1 Ignition switch in position 0.
	2 Disconnect Air Bag Control Module C3R114-A.
	3 Disconnect Passenger Air Bag Module Simulator.
 TIE0030198	4 Measure the resistance between the: • Air bag control module C3R114-A pin 7, circuit CR103 (GN/WH), harness side and ground. • Air bag control module C3R114-A pin 8, circuit RR103 (BK/WH), harness side and ground. • Are the resistances greater than 10,000 ohms? → **Yes** REPEAT the self-test, CLEAR the DTCs. REACTIVATE the system. → **No** REPAIR circuit CR103 (GN/WH) or circuit RR103 (BK/WH). REPEAT the self-test, CLEAR the DTCs. REACTIVATE the system.

PINPOINT TEST K : DTC B2792: CROSS LINK BETWEEN FIRING CIRCUITS

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
WARNING: To avoid accidental deployment, the air bag control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s)	

REMOVAL AND INSTALLATION

Air Bag Control Module(33 650 0)

General Equipment

Ford Approved Diagnostic Tool

Removal

WARNINGS:

To avoid accidental deployment, the air bag control module 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.

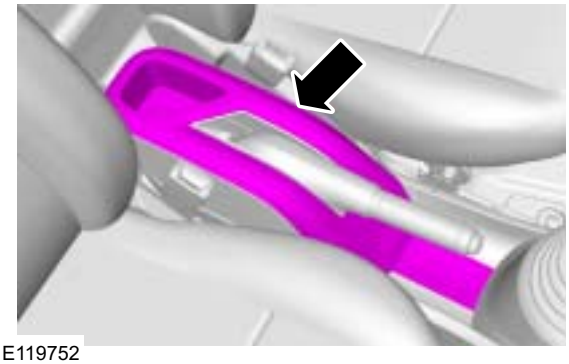
To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.

Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.

1. **Disconnect the battery ground cable.**

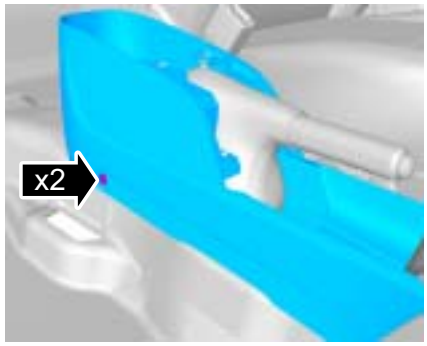
   For additional information, refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2. **Raise the parking brake control lever.**
3. **Remove the parking brake control lever trim panel.**



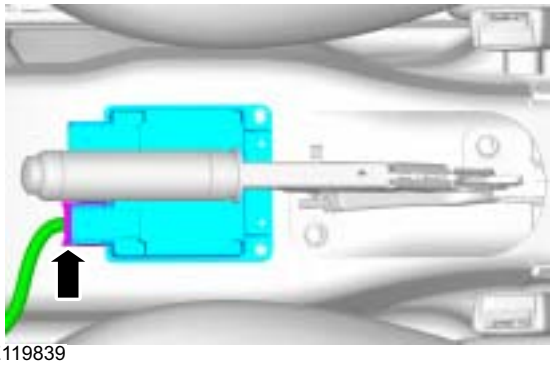
E119752

4. **Detach the console panel by removing the screws on both sides.**



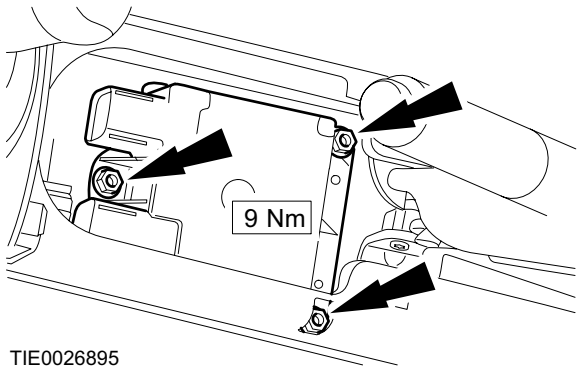
E119753

5. **Disconnect the air bag control module electrical connectors.**



E119839

6. **Remove the air bag control module.**



TIE0026895

Installation

WARNING: Never probe the electrical connectors of air bag modules or any other supplemental restraint system component.

REMOVAL AND INSTALLATION

Passenger Air Bag Module(40 701 0)

Removal

All vehicles

WARNINGS:

To avoid accidental deployment, the air bag control module 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.

Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.

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

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 minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.

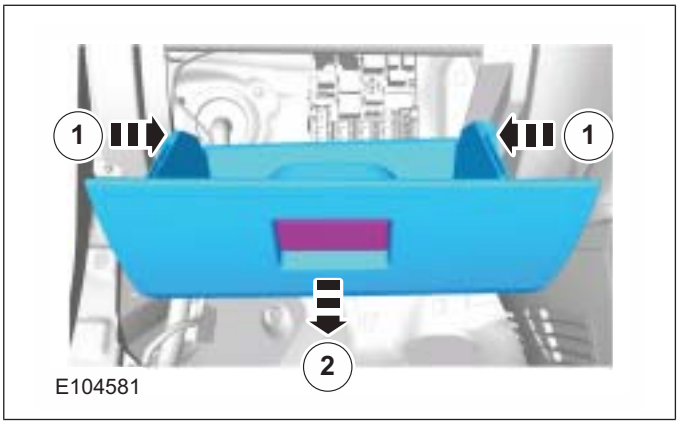
Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.

Painting over the air bag module trim covers or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.

1. **Disconnect the battery ground cable.**

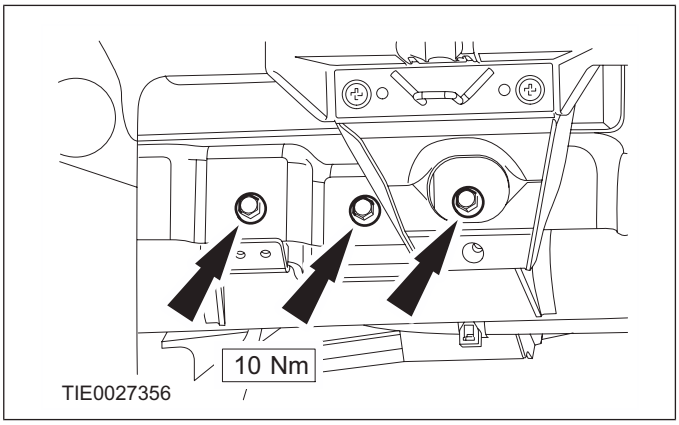
   For additional information, refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).

2. **Remove the glove box.**
   1. Push glove box sides inwards.
   2. Tilt the glove box forward.
   3. Pull the glove box away from the instrument panel.



E104581

3. **Detach the passenger air bag module bracket from the in-vehicle crossbeam.**



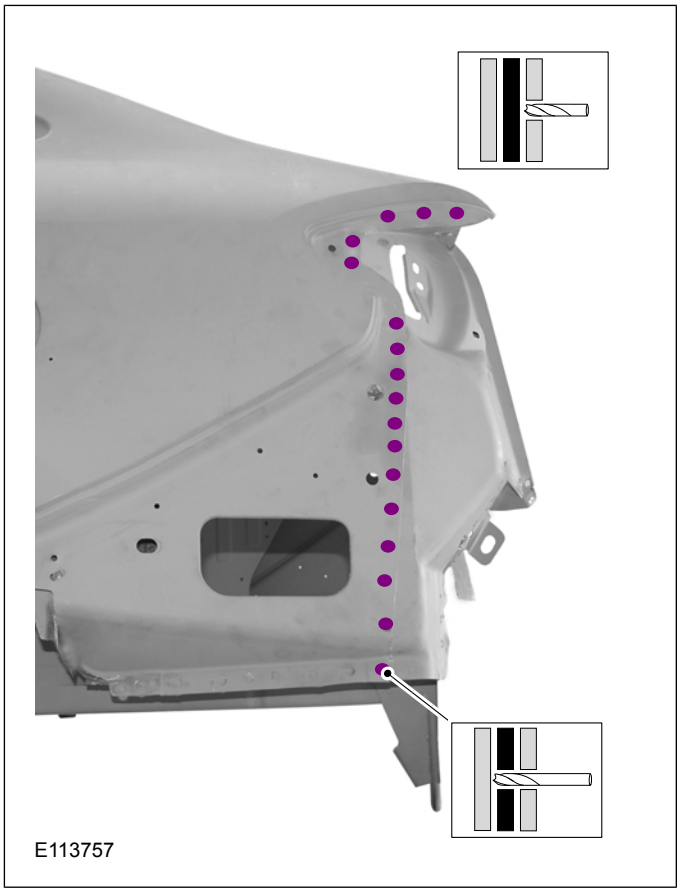
TIE0027356

4. **NOTE: If necessary, use a trim pad removal tool to aid the release of the passenger air bag module cover retaining clips from the instrument panel.**

   Detach the passenger air bag module from the instrument panel.

DESCRIPTION AND OPERATION

out through two panel thicknesses is indicated here, different to all the others.



DESCRIPTION AND OPERATION

- 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.

5S Implementation,Periodical Audit and Sustenance

Understanding the 5S Principles and Philosophy

The **5S's** are 5 Japanese PRINCIPLES beginning with the letter **S**:

SEIRI - **SEITON** - **SEISO** - **SEIKETSU** - **SHITSUKE**

Like most of the Japanese words, the literal translation of each into English has very little significance in identifying their true meaning. To truly understand each of them the **5S's** need to be explained in detail.

SEIRI : **CLEARING UP**

SEITON : **ORGANISING**

SEISO : **CLEANING**

SEIKETSU : **STANDARDIZING**

SHITSUKE : **TRAINING** & **DISCIPLINE**

SEIRI : CLEARING UP

It is the first step of the 5S. Initially, the significance is not just "clearing up" objects or things in a working area, but it concentrates more on identifying the objects. In this particular case, the objective is to differentiate the useful from the useless. You have to throw away the unnecessary items, and keep only what you really need, what is necessary for the work in the bodyshop. What is useless takes extra space and can be the source for error.

During this first step, which consists in throwing away the useless, there might be tools or equipment items which cannot be 'classified' immediately. In other words, nobody can say immediately they are useful or not. What is useful for someone may not be for someone else. Therefore a list of "questionable objects" should be made and be observed for a time, in order to be able to classify them correctly. During this observation period, the objects will have to prove their usefulness, otherwise they will have to be thrown away.

SEITON: ORGANISING

This is the second step of the 5S. You have quantified and identified all the useless objects and made a list of all the objects which are 'in doubt'. All you have left are the necessary objects, which everyone agrees with. But even then the remaining objects seem to be in a mess and it is as difficult as before to find what is needed. Here again, the most important action is not tidying up but the way you do it. You have to define a methodical approach to storage. This method must be established by the frequency of use of the useful objects. The useful objects must be stored in a practical way.

The objective is to have a spot for each thing in order to systematically put them back in place. You have to eliminate the needs for searching an object for more than 30 seconds: tools, equipment's, documents, parts. Store useful things = Define a proper way of storage

SEISO: CLEANING

This is the third step of the 5S. You have defined and build up a working area where useful objects are stored and tagged and also where it is quick and easy to find them. But even then, the working area is not clean; dust, dirt, leaks are causing inefficiencies & health & safety hazards. Avoid making dirt in order not to have to clean up. Inspect and detect failures or a drop in standards.

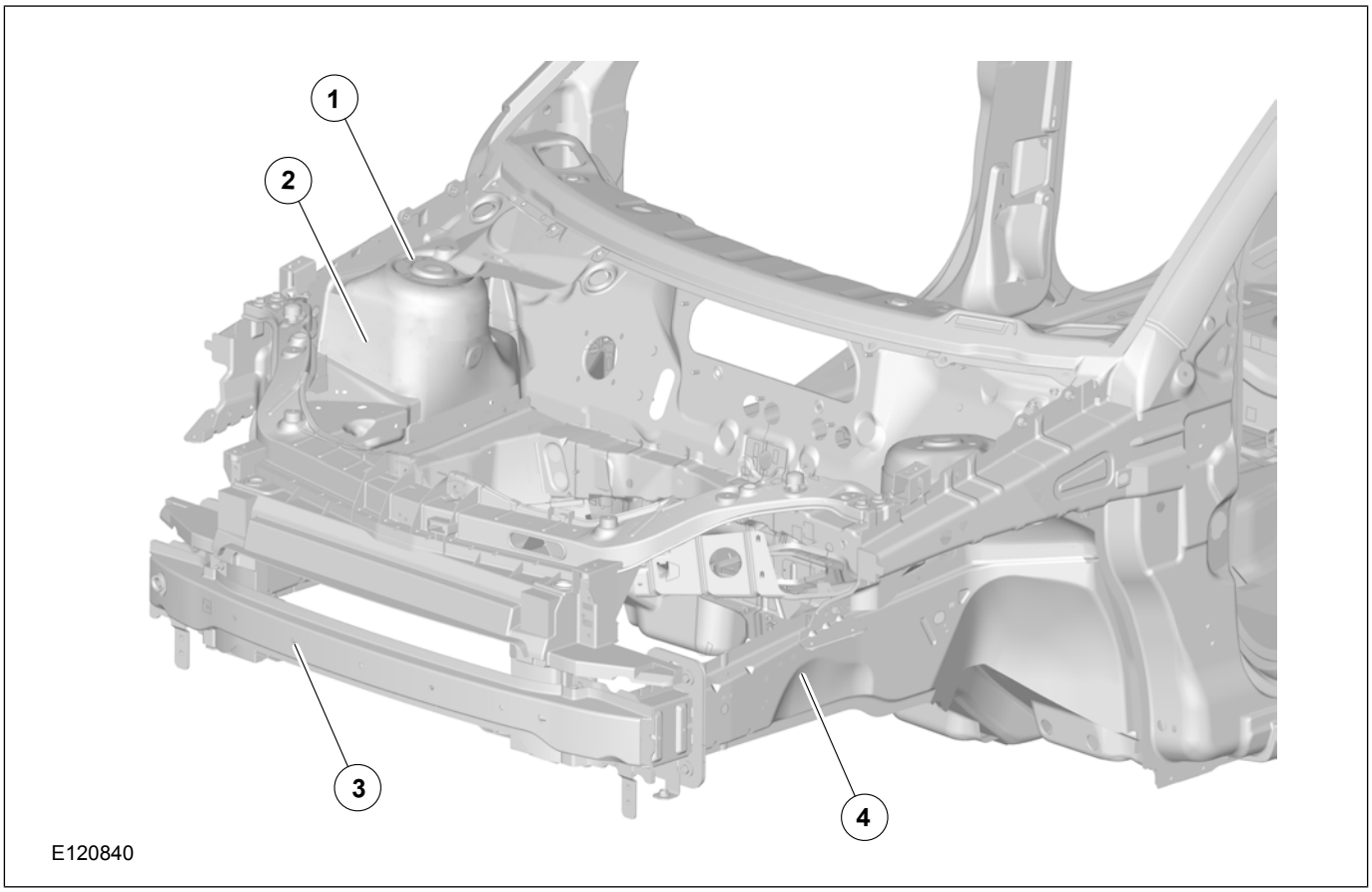
The objective is not just to clean up to have a better working environment, but to use the clean area to identify the problems and the sources of dirt & eliminate them. Keep these objectives in mind: Inspect in order to repair, eliminate the sources of dirt, and look to prevent damage by taking good care of the material and search for the most practical way to spend less time cleaning up.

SEIKETSU: STANDARDIZING

This is the fourth step of the 5S. The objects are all useful, stored, and easy to use, the cleaning time is reduced and there is an improved working area that is clean. Despite all of that, the dirt & rubbish reappear, the way people approach their job is not the same for everyone; we do things we are asked, but often with a degree of resentment. The objective of SEIKETSU is to establish visual operational rules to prevent returning to the 'bad old ways'.

SEIKETSU is achieved by consensus; it is a critical phase where everyone agrees to put into practice the same agreed operational rules. This is where people have to learn how to work together. To

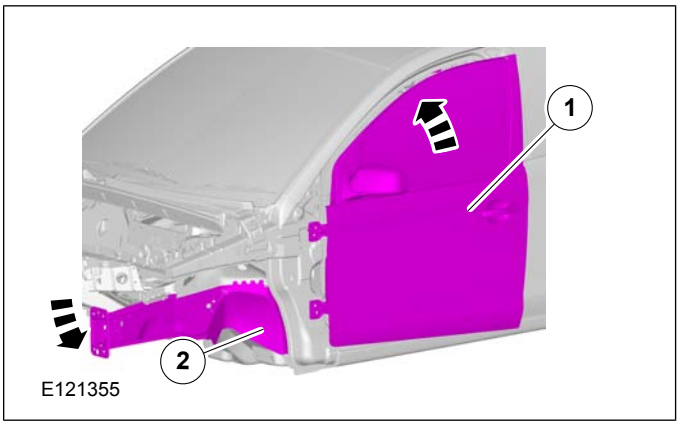
DESCRIPTION AND OPERATION



Item	Description
1	Damper Housing
2	Front Wheel Housing
3	Front Bumper Reinforcement
4	Front Side Frame

4. In a head on collision the front side frame may be pushed down or pushed up. In both the cases, with the root of the side frame as the center of rotation, bending moment is generated, causing the deformation of the front side frame and the dashboard lower panel.

- If the front side frame is pushed down, the root of the front door hinge is deformed and consequently the door is raised.
- Inversely if the front side frame is pushed up, the root of the hinge installed area is also deformed causing the door to move down.



Item	Description
1	Front Door
2	Front Side Frame

Pushed down

DESCRIPTION AND OPERATION

working or a material that became hard after hardening, they are gradually cooled down after heating in the furnace. Depending upon the kinds of materials and desired requirements, heating temperature, time duration of holding temperature, cooling temperature, its speed has to be adjusted.

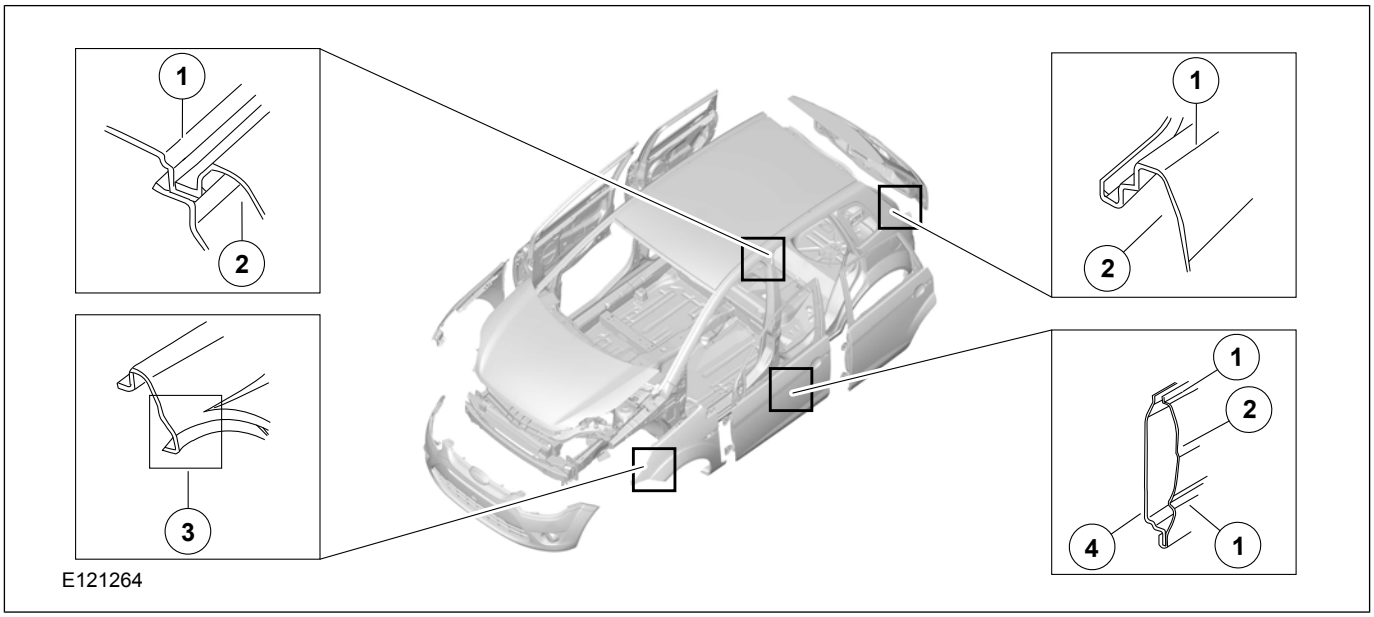
Bending and Strength

In considerations of external appearance and strength, automotive body panels are press-formed in various shapes and configurations. By giving a steel panel its own designed shape and configuration, it heighten its strength and, likewise, obtain its needed strength from other parts with which it is assembled into a unit.

Steel Sheet Bending

While considering its design (external appearance), automotive body panels are press formed with sharp bent areas where it is necessary for higher strength. Those sharply bent areas are called Crown and has the following categories.

- **Low crown:** Its curved surface or edge is very gently sloping.
- **High crown:** Its curved surface or edge is very sharp.
- **Combination crown:** A low crown and high crown are combined on panel.
- **Reverse crown:** An edge curved inward toward the panel.



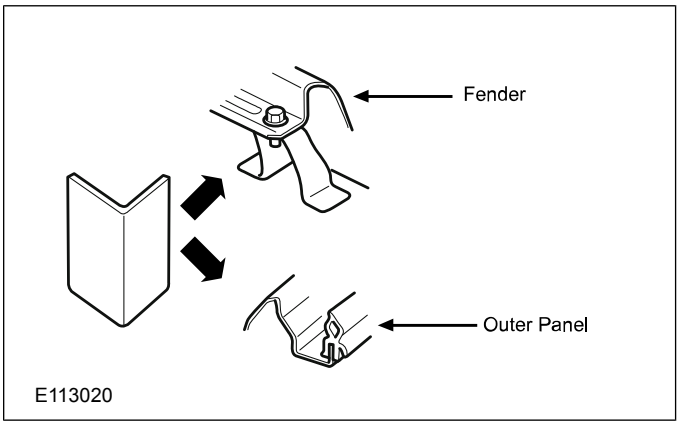
E121264

Item	Description
1	High Crown
2	Low Crown
3	Combination Crown
4	Reverse Crown

In repairing a damaged body or panel, a smaller load is required for a low crowned panel because it has a small curvature, while a high crowned panel (deep-drawn panel with a high curvature) has some restoring force against the deformation of the damaged area. On the other hand, a reverse crown is incorporated in a panel that has a sharp inward curvature. Because of this, the strength is so concentrated that the repairing work becomes difficult.

Angle Bending

When a panel is bent at a right angle, this bending is called an angle bending. The angle bending is mainly used for door panels and fenders.



E113020

DESCRIPTION AND OPERATION

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.

E59088

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

Further advantages:

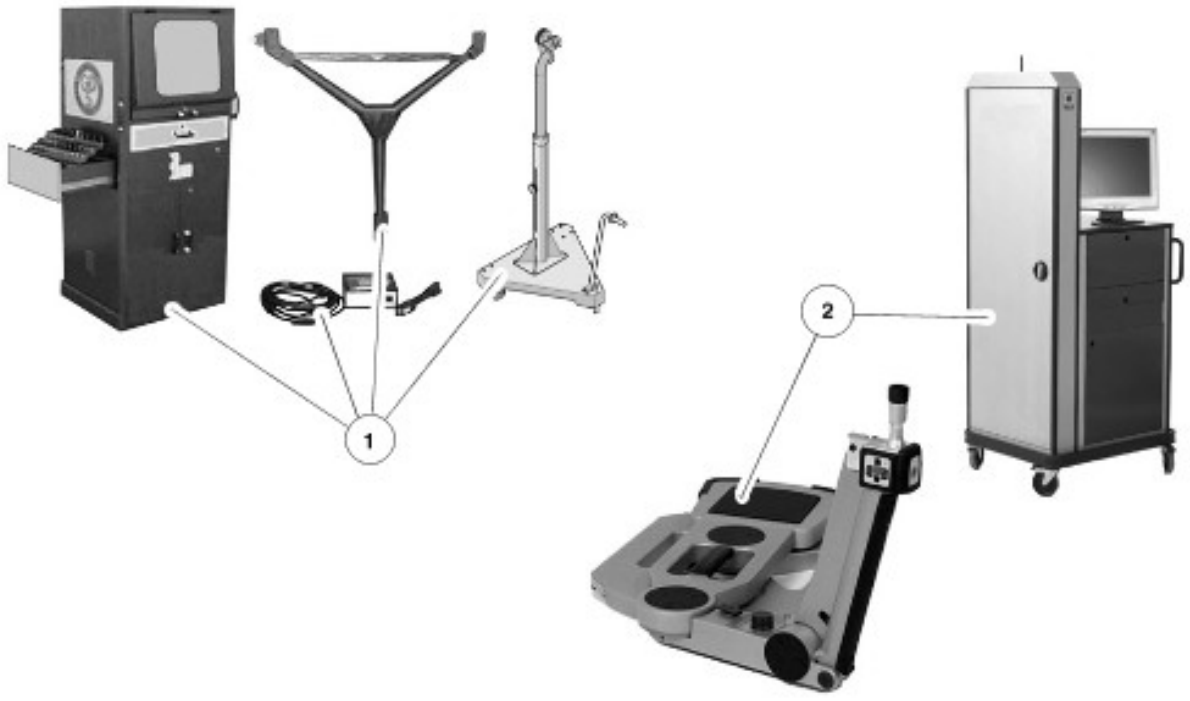
- Fast deployment.
- Simple to use.
- Can be extended using adapters, measuring probes and measuring tubes.

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.

Acoustic-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.



E59221

DESCRIPTION AND OPERATION

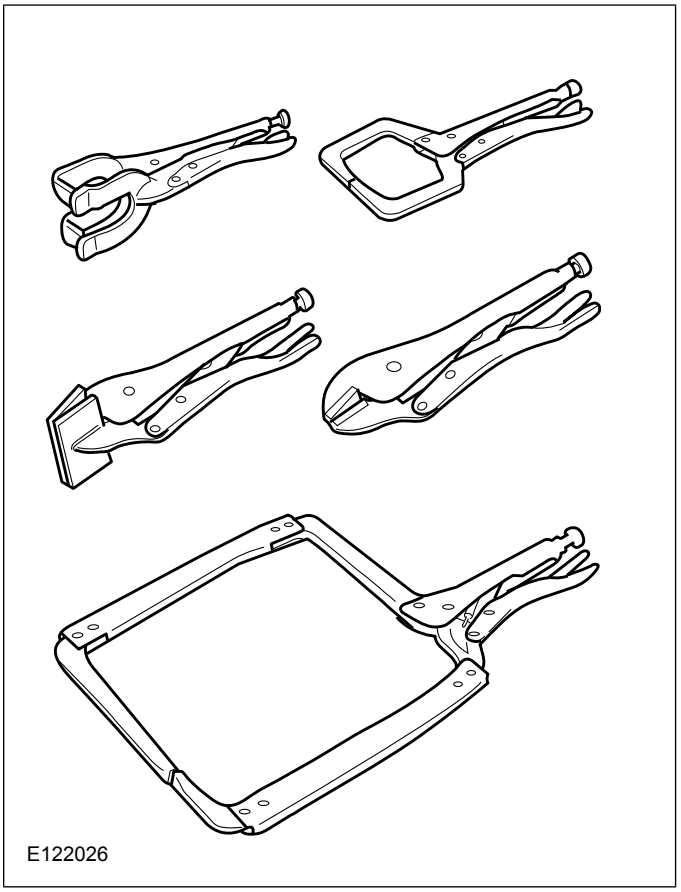
Installation Tools

Vise Grip Wrench

Used to install panels and tightening welded areas.

Adjustments of openings' dimensions and tightening forces can be easily made.

Panels not scratched easily.



C-Clamps

Some other type of C-Clamps are shown below

DESCRIPTION AND OPERATION

Straightening

Repairing Major Damage/Collision

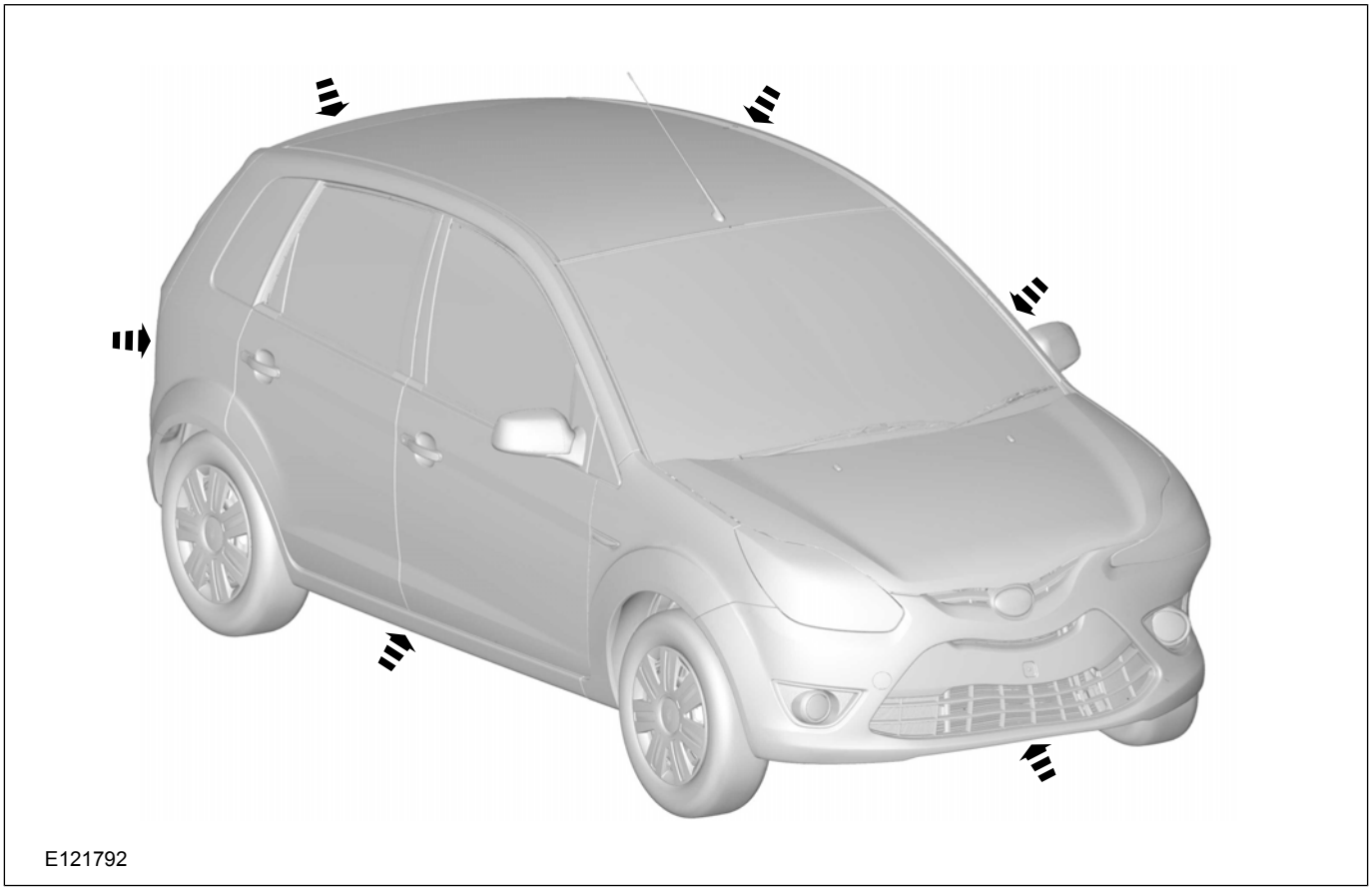
Basic Repair Work Processes

It is possible that the crash impact reaches the body's skeletal member parts and the damaged range is so extensive that the core body parts may be under bending, twisting and stress. Therefore, it may become necessary to use a large frame reforming machine. Depending upon the level of the crush, it may be also necessary to replace a large size part like an outer panel. At any rate, in repairing a major damage on a vehicle, it is vitally important to correctly diagnose the dispersions of the damages over the whole vehicle. The man/hours and repair estimation is heavily depended upon whether the preliminary diagnose is correct or not.

Diagnose Damaged Areas

Check the damaged portion of the traffic accident vehicle by eye and touch to estimate the extent of the crash damage.

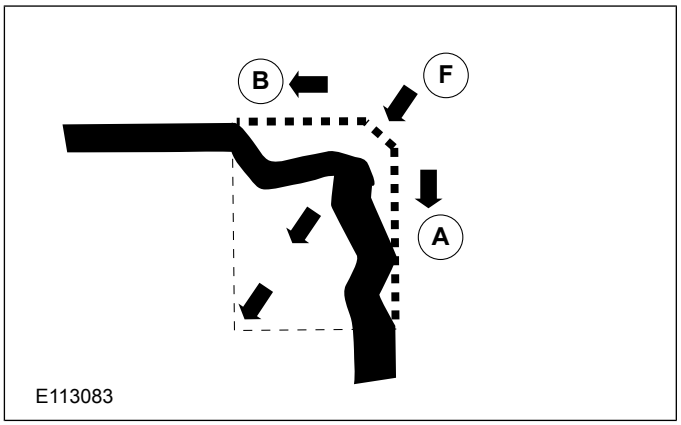
1. Know the damaged areas. Observe the entire vehicle and count the number of impacts, evaluate their magnitude and work out the damage sequence.



E121792

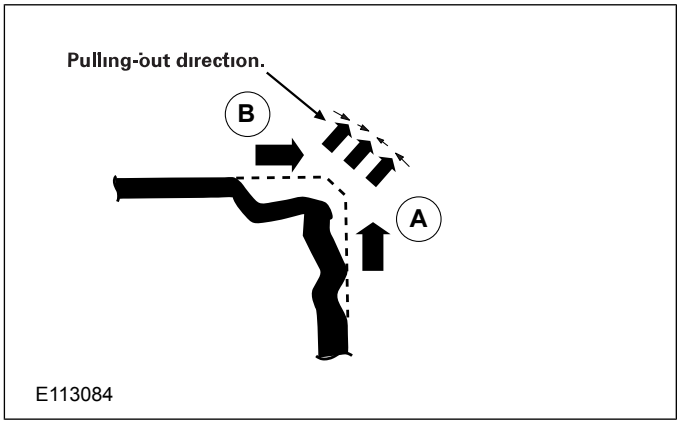
2. Check external flaws and deformations. Observe the vehicle from the front, rear, and sides and check lateral and vertical bends, twists, out-of-true lines, on the side view, swellings and depressions of the body. At the same time, check for deformation of the outer panel or any other connected areas away from the crashed area.

DESCRIPTION AND OPERATION



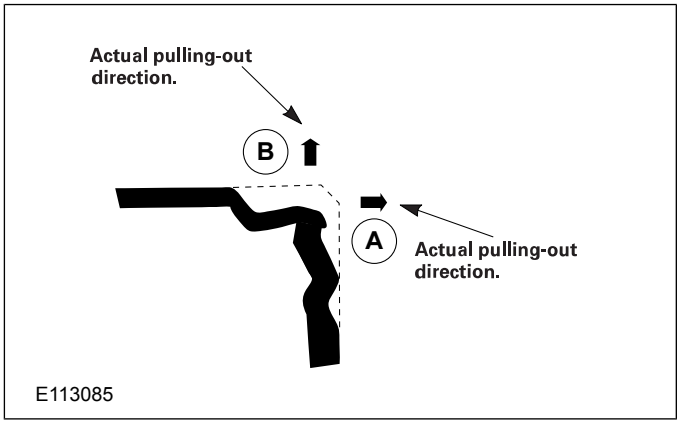
Diagonal Pulling-out

Change the pulling-out angle to adjust magnitude (A) and/or (B).

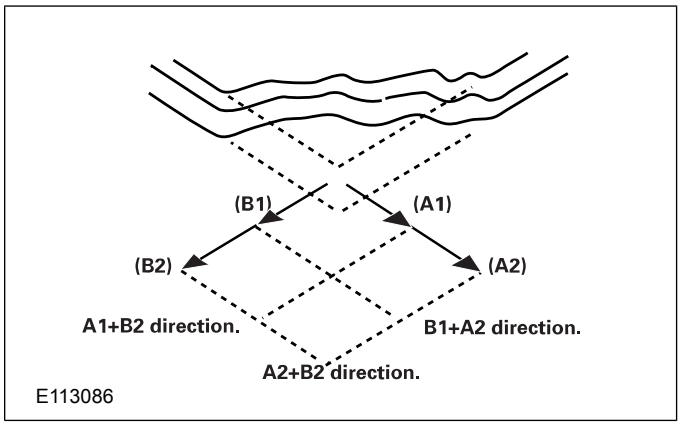


Perpendicular Pulling-out

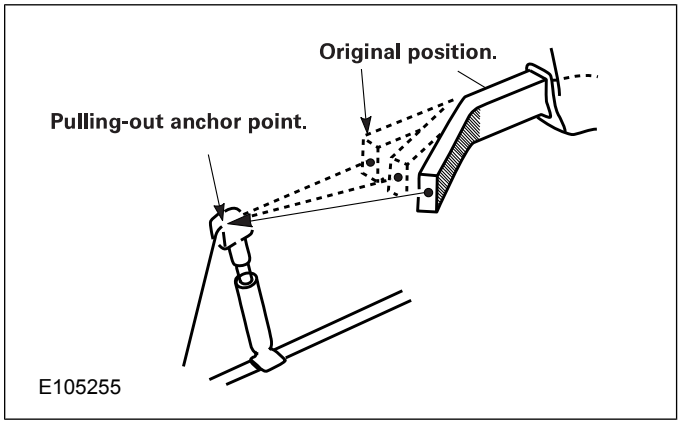
Add the pulling-out forces (A) and (B) perpendicularly while adjusting their magnitude.



By pulling-out the body from two perpendicular directions, it is easy to control the change of direction of the composite force. This allows easier, step by step restoration of the body.



On estimating the restored shape of the body, set the pulling-out anchor point on an extended line in the required direction. By gradually pulling-out that part of the body, the damaged section is finally restored to the proper shape.



Rough Panel Reforming on Front Damage

The following case as an example is that, together with the side bulkhead, the front side frame and the front wheelhouse are crushed on one side. If the impact is great, the damper housing, dashboard side member, the front pillar, and even the front side frame on the opposite side are damaged and the impact force disperses as far as the roof panel causing distortions on it.

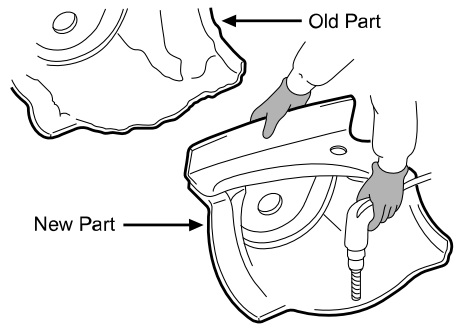
CAUTION: Always attach a safety cable when using a hydraulic ram or a frame straightening tale; do not stand in direct line of the chains used on such equipment.

Reforming Procedures

1. Decision on how to proceed with the repair work. By pulling out the damaged area, restore the opposite side to the original position to repair. Remove the damaged part (one side) and install a new part. Repair and reform the part to which the replaced part is installed.

DESCRIPTION AND OPERATION

Body Repair Manual, for welding diagram, if available, or the old part itself.

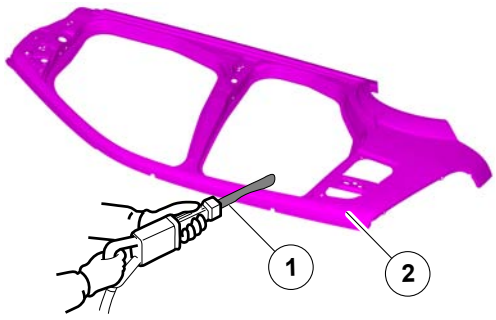


E113113

4. Rough cutting of the new part (cut and joint replacement). As for a new part to be cut and jointed such as an outer panel, cut the old and new parts, using an air saw or air chuck grinder, so that the joint area can be overlapped about 20 to 30 mm (0.8 to 1.2 in.).

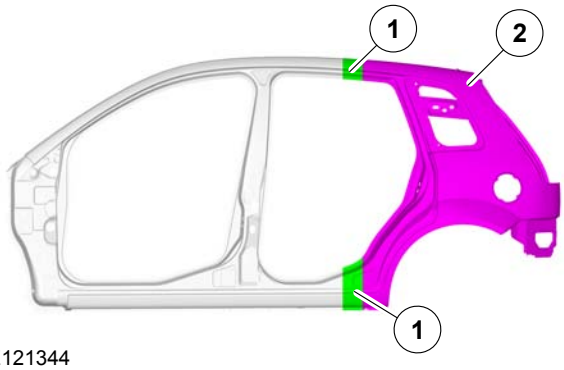
WARNING: To prevent eye injury, wear goggles or safety glasses whenever sanding.

If the overlapping margin to the body side is too much, it may become hard to put the mating parts, like a door, in position.



E121570

Item	Description
1	Air Saw
2	Outer Panel New Part



E121344

Item	Description
1	Overlapping
2	Outer Panel

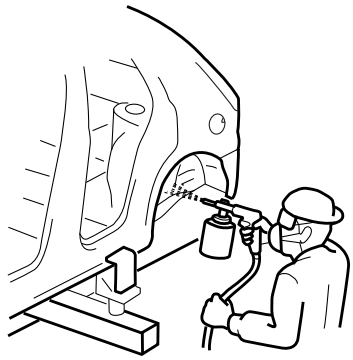
5. Positioning the new part. Align the new part to the reference hole or old part position and fix it to the body with the use of a vise, grip wrench, or screw clamp. In case fixing tools cannot be used due to lack of space, fix the new part with bolts or tapping screws. It is extremely important to fix the frame and damper housing to the correct positions because they influence the wheel alignment. The well-fitting of the outer panel and the rear panel to the externally attached parts is also very important, influencing the external appearance, too.


E113078

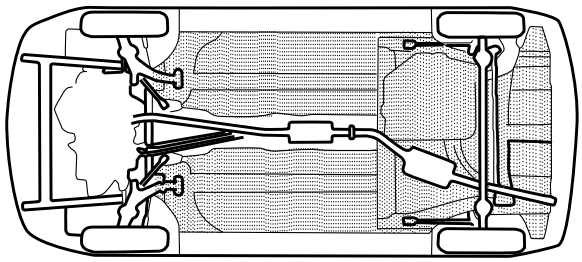
Complete Part Installation

1. Fix the new part.

DESCRIPTION AND OPERATION



E121913



E105336

General Straightening sequence

Body straightening requires practice and experience. Before starting, the exact direction of impact must be determined.

The straightening force must have the exact opposite direction of the impact force. Only in this way can it be guaranteed that the original shape will be achieved again.

The pulling forces only work with their full impact if the pulling direction is direct. Using the wrong pulling direction could lead to additional deformation, which is difficult to correct afterwards.

Please note the following points:

- 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.

Off-road vehicles

Straightening repairs on off-road vehicles are different to repairs on normal bodies due to the two-part construction of the vehicle.

This means there are two areas that must be taken into consideration separately:

- Straightening the body.
- Straightening the body with chassis frame.

Straightening the body

If only the body is damaged in an accident, light straightening repairs can be carried out.

NOTE: With strong straightening forces, these bolted connections may be damaged. Monitor the bolted connections continuously during the straightening work.

If a straightening jig is used for straightening work, the holding clamps or alignment angles must be attached directly to the chassis frame. During the straightening work, the pulling forces must not become too high. The bolted connections are to be monitored continuously.

Straightening the body and chassis frame

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 quality and stability of a frame after production must be restored after carrying out the repair.
- In principle, the driving and operating safety of the vehicle is paramount.

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

Item	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.

NOTE: You will find additional important advice on the topic of lead loading in the joining techniques section.

For corrosion protection and adhesion reasons, on body components subject to more demands, such as doors or hoods, it is preferable to apply lead loading rather than stopper.

In addition, lead loading application is suitable for creation of surface contours when the options for panel beating are limited.

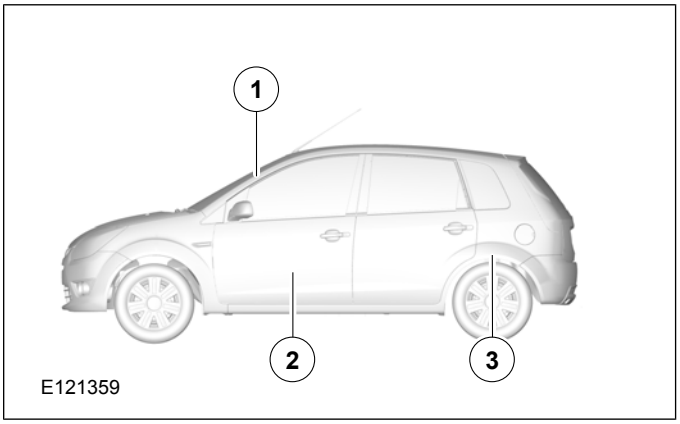
Typical application areas:

- 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.

Minor panel repair by washer welding process

This method of repairing is used to repair recessed areas where hands cannot reach such as a door panel, pillar, side sill, and rear wheel arch.

Because the heat generated while welding washers impair the paint layer inside the panel, it is necessary to treat the area with anti-rust process after the repair.



Item	Description
1	Front Pillar
2	Front Door
3	Rear Wheel Arch

WARNING: To prevent injury to your hands, wear gloves whenever hammering work.

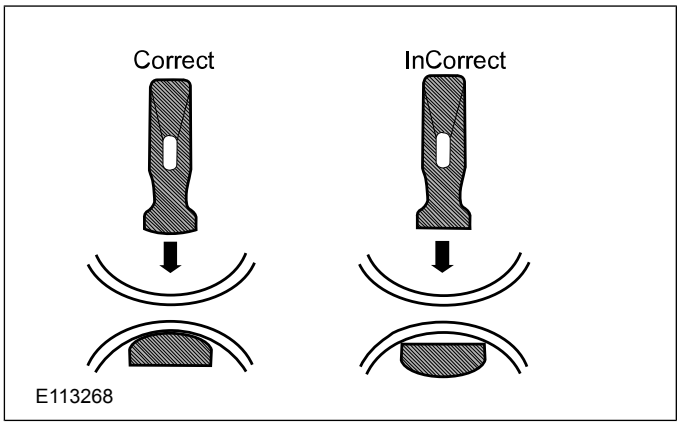
CAUTION: Always attach a safety cable when using a hydraulic ram or a frame straightening tale; do not stand in direct line of the chains used on such equipment.

In repairing by washer welding, there are two ways. One way is to pull-out with a sliding hammer and another way is, a shaft going though washers and using a frame corrector, pull-out the recessed area. Depending upon the damaged condition, one of the two methods is employed.

Pulling out with a sliding hammer

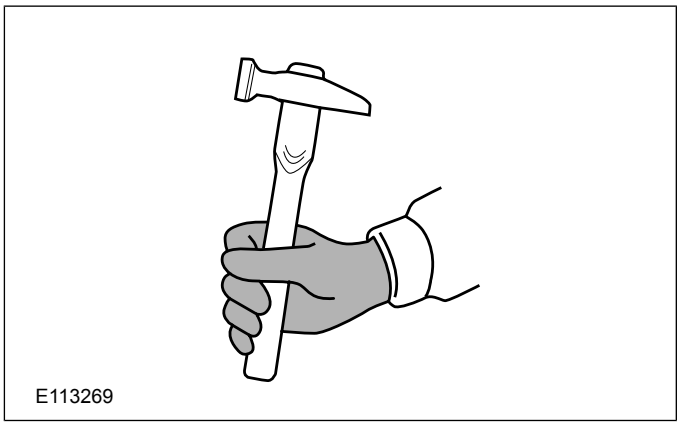
The repair according to the method is rather easy because the area where washers are welded can be regionally pulled out, but, if the area that requires repair is extended widely, this method does not fit for this type of work, in addition, it is impossible to do hammering work while being pulled out.

DESCRIPTION AND OPERATION

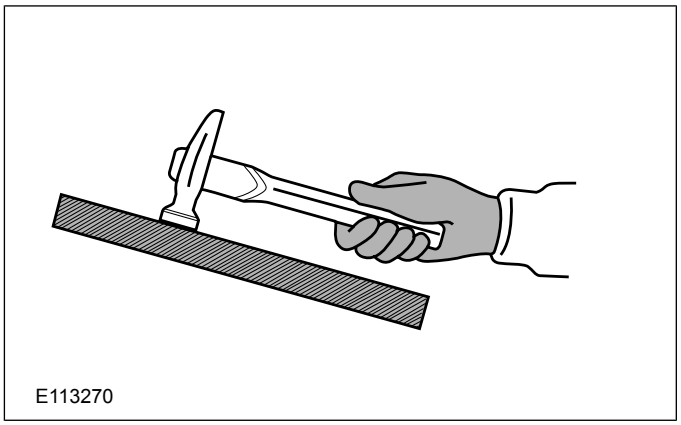


5. Hand repairing of unevenness using a hammer
Key points in hammering work:

Hold the hammer at around the end of the grip lightly and swing it using your wrist.

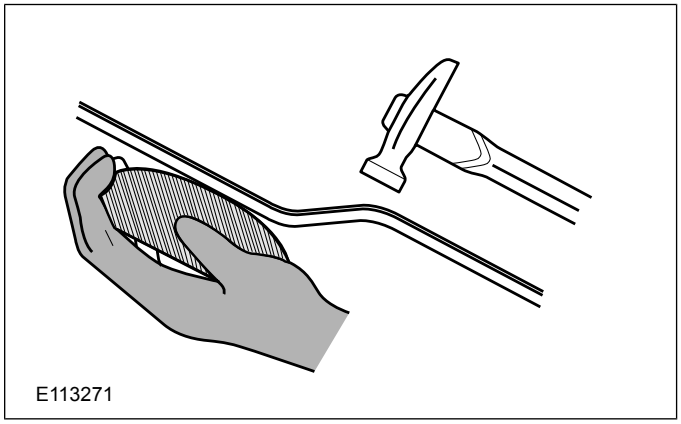


When striking with a hammer, the hammer face must always make contact with the panel surface evenly. NOTE: If the edge of the face contacts the surface, a crescent recess will be left on the panel that is very difficult to take off. Do not use too much force. Strike it as if bouncing it. If the panel is struck with too much force, it will be elongated later and need shrinking work.



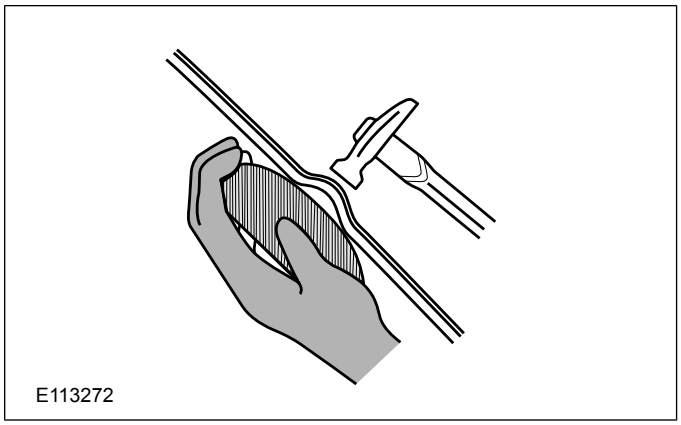
Hammering off dolly

Hammering off dolly is used for a comparatively large unevenness. The recess is stricken out with a dolly. Place the dolly right beneath the lowered area and strike the raised areas around. Then the raised areas will be lowered due to the hammer impact and, on the other hand, the lowered area will be raised due to the reaction of the hammer impact. It is very important to maintain a good balance between the hammer impact and the force to keep the dolly in position.



Hammering on dolly

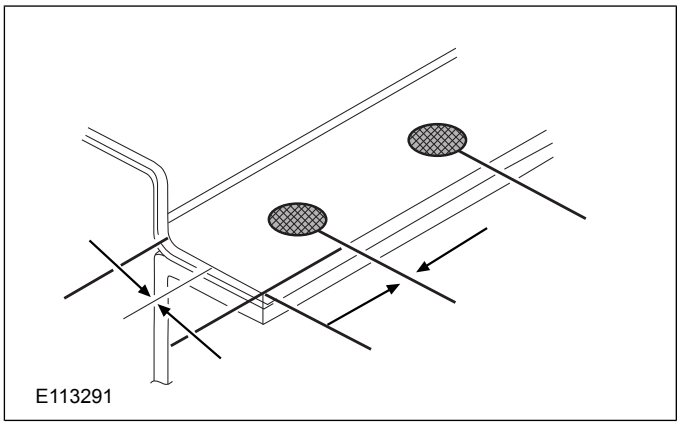
Hammer on dolly is used to get rid of tiny unevenness still remaining on the repair surface. Place the dolly straight under the raised area and strike the area from above with a hammer. While the hammer impact is flattening the raised area, the dolly slightly bounces back due to the hammer impact. To make it flat, repeat this work along the repaired surface on the panel while moving the hammer and dolly.



Spoon

For example, start to push inside of the panel with the spoon, and strike with a hammer from the outside of the panel.

DESCRIPTION AND OPERATION



6. When performing spot welding, make sure that you conform to the following condition: use the correct current, conductivity time, welding pressure, holding time, and shutdown time recommended for the spot welder. Follow the spot welder manufacturer's instructions.

Welding Parameters (Given as reference only)

GMT (mm)	Welding Force (kN)	Welding Time (ms)	Welding Current (kA)	Cap Diameter (mm)	Contact Diameter (mm)
0.63	1.85	140	8.5	16	6
0.75	1.95	160	9.0	16	6
0.80	2.10	160	9.5	16	6
0.85	2.30	180	10.0	16	6
0.90	2.45	200	10.5	16	6
1.00	2.65	220	11.0	16	6
1.13	2.90	220	11.5	16	6
1.25	3.10	240	12.0	16	6
1.38	3.40	260	12.5	16	6
1.50	3.65	280	13.0	16	6
1.75	4.10	320	13.5	16	6
2.00	4.50	360	14.0	20	8
2.25	4.90	440	15.0	20	8
2.50	5.20	520	16.0	20	8
2.75	5.55	560	16.5	20	8
3.00	5.90	640	17.0	20	8

Inspection of Welded Area

Destructive Inspection (Using Test Piece)

1. Prepare test pieces made of the same material and thickness as the welded work piece and weld together as illustrated.

2. Apply force in the directions shown by the arrows to separate the spot weld, and check the conditions of the broken pieces. If a through hole appears in a panel, the welding shall be judged correct.

WARNING: To prevent injury to your hands, wear gloves whenever checking work.

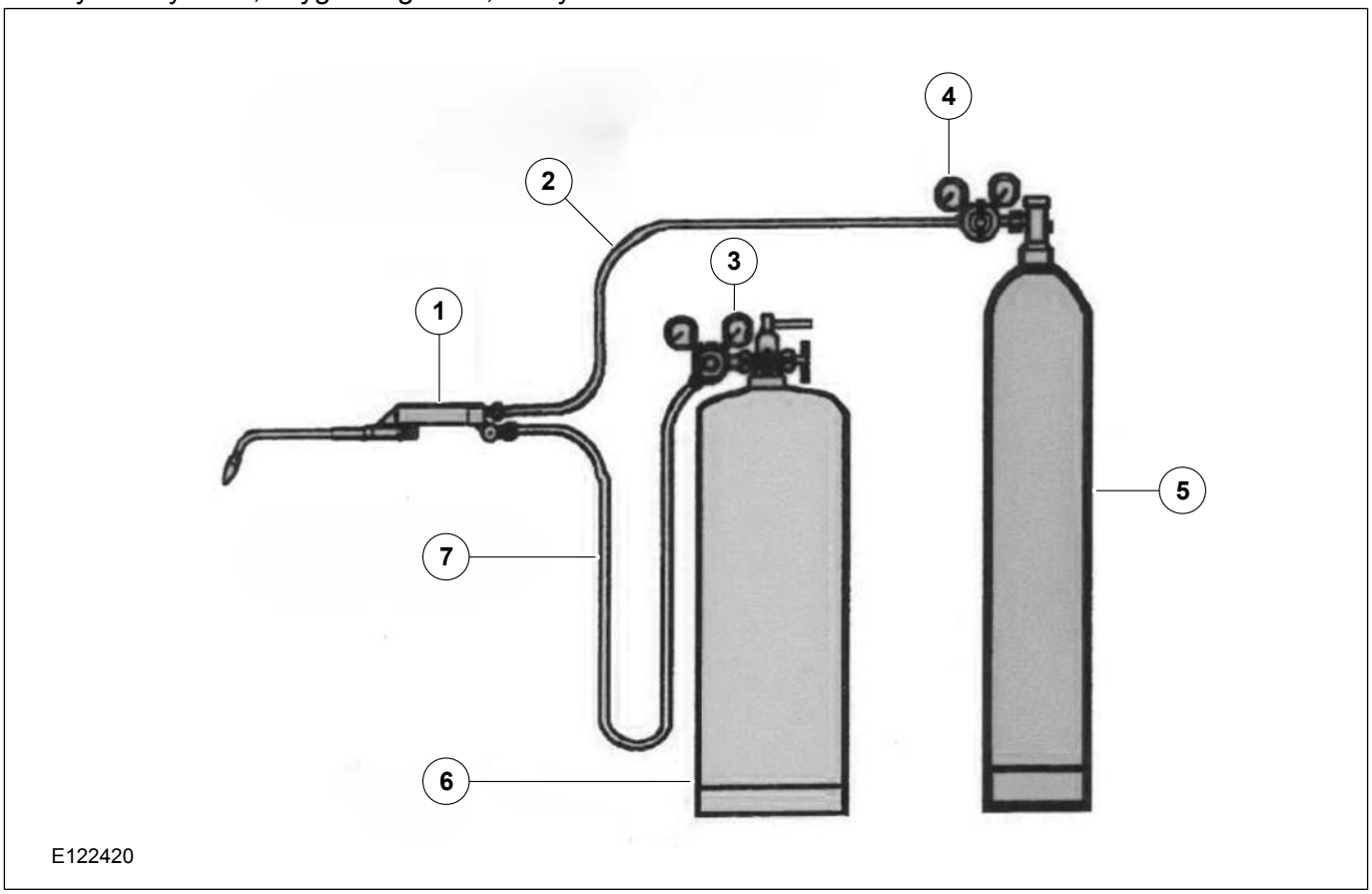
DESCRIPTION AND OPERATION

The torch nozzle and the contact tip wear more rapidly than when welding steel panels.

Oxyacetylene Gas Welding

Welding Equipment

A gas welding outfit consists of the oxygen cylinder, acetylene cylinder, oxygen regulator, acetylene regulator and torch with its hoses. For safety, anti-flashback (check) valves should be fitted between the hose ends and torch. Should a backfire occur in the torch, such check valves prevent an internal fire from going through the hose to the regulators and bottles where it could cause an explosion.



E122420

Item	Description
1	Torch
2	Oxygen Hose
3	Acetylene Gas Regulator
4	Oxygen Regulator
5	Oxygen Cylinder
6	Dissolved Acetylene Cylinder
7	Acetylene Gas Hose

Oxygen and Oxygen Cylinder

Oxygen (O2) is a colorless, odorless gas that is 1.1 times heavier than air. Oxygen is chemically active and combines with most matter except inert gases, gold, platinum, etc. and produces oxides. This rapid oxidation produces light and heat, which is called combustion. Although oxygen itself does not burn, it assists burning of other material and often called the “supporter of combustion”. While there are several ways of producing oxygen, industrial welding oxygen is produced by fractionating the liquefied air made by compressing air at low temperatures.

The oxygen cylinder is a thick steel reservoir tested to a pressure as high as 19600 kPa (200 kgf/cm2). A safety device “works at 19600 kPa (200 kgf/cm2)” in the valve neck of the cylinder and helps prevent rupture if the internal pressure becomes excessive. The oxygen is compressed to 14700 kPa (150 kgf/cm2) 95°F (35°C) and charged into the cylinder. An oxygen cylinder is painted black to indicate that the content is oxygen along with stamped O2 mark on the shoulder of the cylinder. (Note: The color

DESCRIPTION AND OPERATION

- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Joining the new and old panel with intermittent seam welding.
- Lead loading the weld seam.

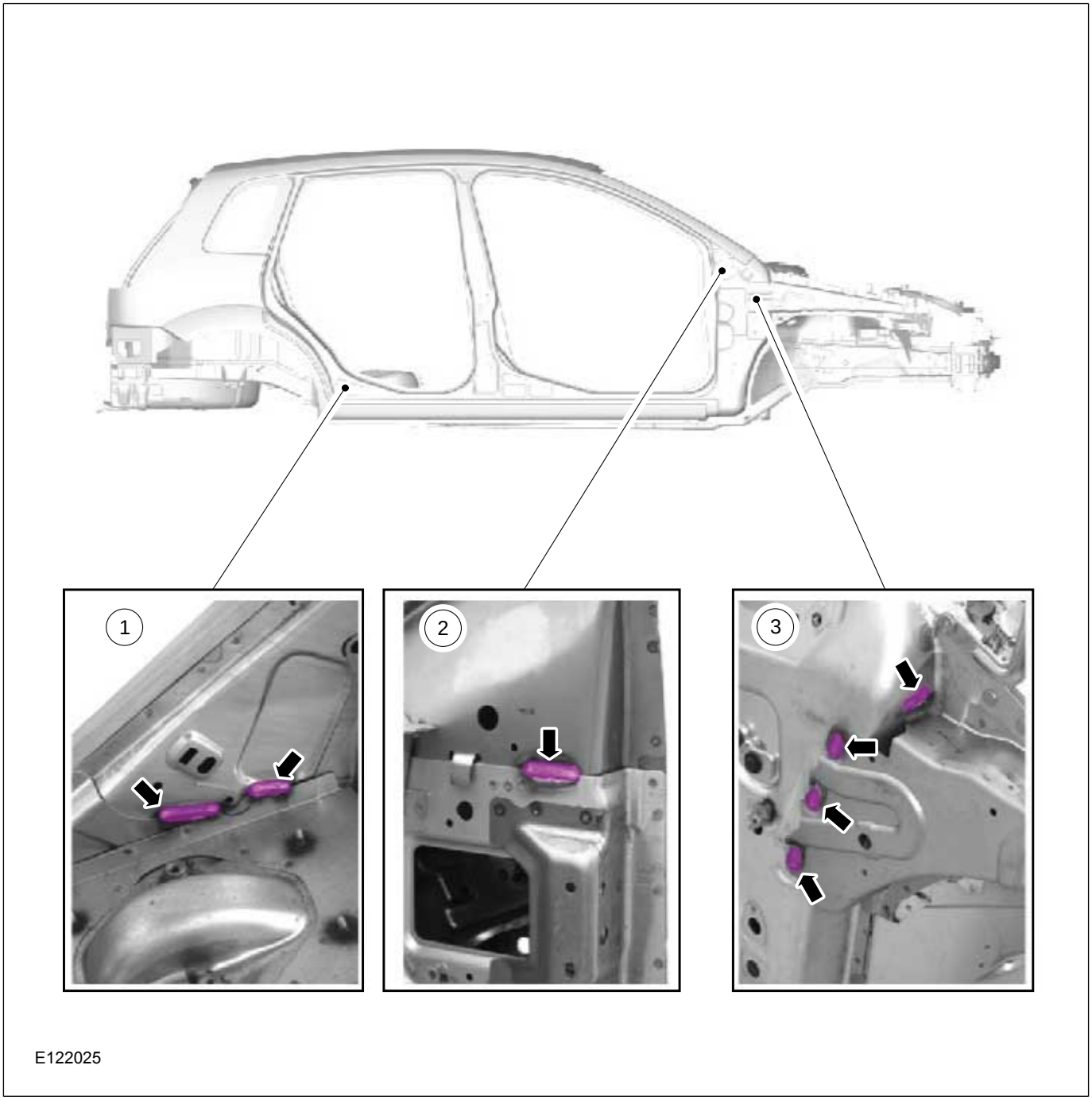
MIG brazes

Metal Inert Gas (MIG) brazing is increasingly used in production for certain body areas.

In areas in which 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.

NOTE: At the time of printing, MIG brazing has still not been approved for repair in the workshop. Please find out the current status.



E122025

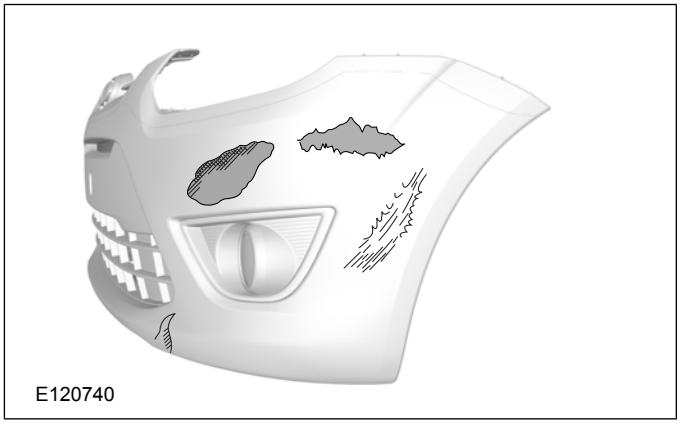
DESCRIPTION AND OPERATION

- 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.

Paint Repair Process

- The plastic parts to be repaired according to the following repairing process are mostly large ones in size and PP, ABS, PC or PA materials.
- It is extremely important to confirm the plastic material of the part and select the appropriate repair materials. In repairing, pay particular attention not to cause deformation or other damages to the part due to drying heat and other conditions.
- Basically, the repair process for resin parts can be divided into two. One is for PP and “ ABS+PA” resin parts and another is for the other types of plastic materials.

NOTE: The states of damage and their way of repair are described below. Since the repair methods are different according to the repair materials, always check the paint manufacturer’s instructions.



E120740

Steps of Repair Painting

The following are the steps taken for paint repair after the undercoat process has been completed.

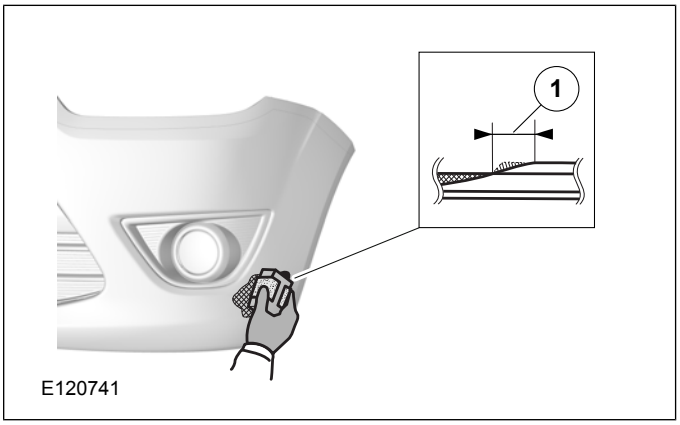
For filling and reforming, refer to the Body Repair Manual Body Basic.

Example of repair materials.

- **Primer surfacer:** Two-liquid mixing type (Bumper primer surfacer gray).
- **Top coat paint:** Two-liquid polyester urethane (2K type).

NOTE: Follow the paint manufacturer's recommendation.

1. Grinding for better adherence (for primer surfacer painting). Grind the old paint surface around the area to be repaired with P200 to P400 sandpaper to form featheredge.

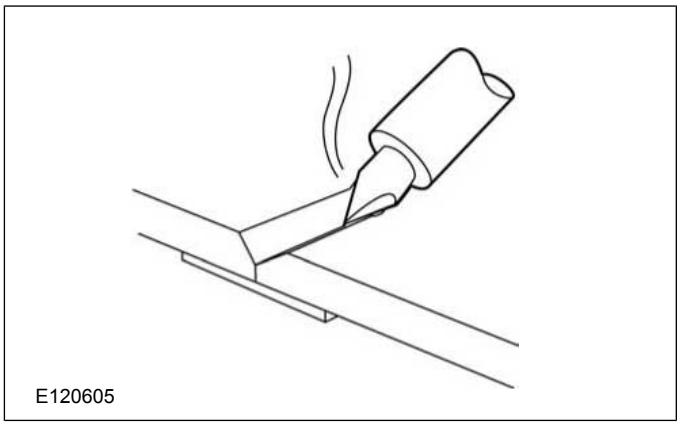


E120741

Item	Description
1	Feather edge

2. Paint PP primer (Raw surface exposed area). As the PP bumper cannot be painted directly on the raw surface, be sure to paint the PP primer on the raw surface first to secure tight adherence to the top coat.

DESCRIPTION AND OPERATION

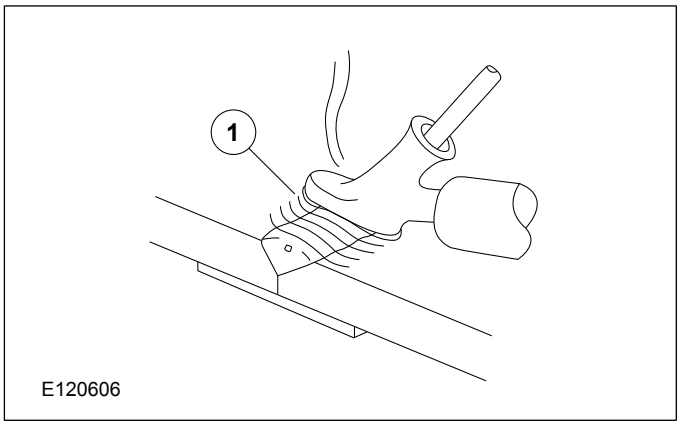

E120605

V-groove halfway through the backside of the part with either the 6121-T Teardrop Cutter Bit or the 6200VG V-Groovin'' Tool.

Remove the paint in the area surrounding the v-groove and radius into the vgroove with coarse sandpaper.

Melt the Rod Together with the Base Material

Set the temperature setting of your airless plastic welder to the setting that's appropriate for the welding rod you selected in the identification process. In most cases, the welding rod should melt cleanly and not be discolored (the only exception would be nylon, where the rod should turn a light brown).



E120606

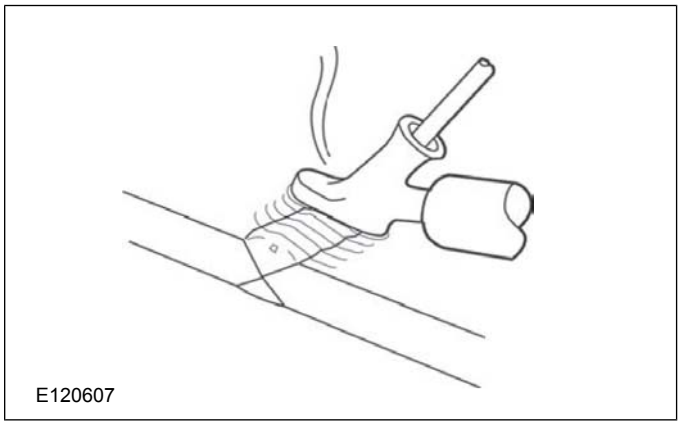
Item	Description
1	Melt rod and base material together

Lay the welder tip on the surface of the plastic and slowly melt the rod into the v-groove. Pull the welder toward you so you can see the welding rod fill the vgroove as you make your pass.

Lay down no more than 2 inches of welding rod into the v-groove at a time. Remove the rod from the welder tip, and before the melted rod has time to cool down, go back over it with the hot welder tip and thoroughly melt the rod together with the base material. It helps to press into the plastic with the edge of the welder tip to mix the materials, then go back and smooth it out. Keep the heat on it until you have a good mix between the rod and base.

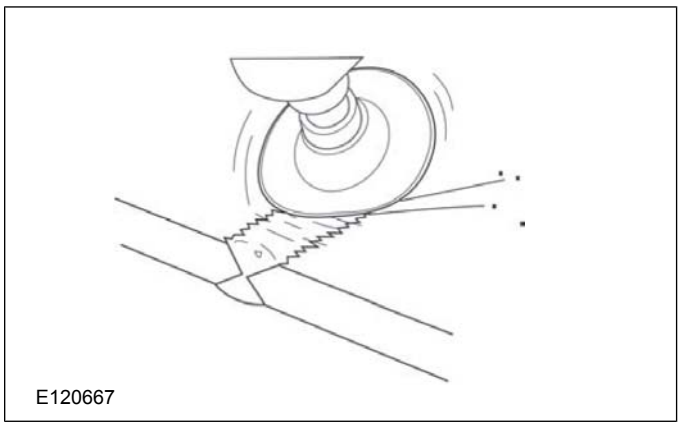
V-Groove and Weld Opposite Side

After the weld on the backside cools, repeat the v-grooving and welding process on the opposite side.


E120607

Grind Weld to a Smooth Contour

If you need to refinish the plastic, grind weld to a smooth contour with coarse sandpaper. Grind the weld slightly flush so that filler can cover the welded area completely.


E120667

Repair Method C: FiberFlex

Repairing with Uni-Weld FiberFlex Universal Rod

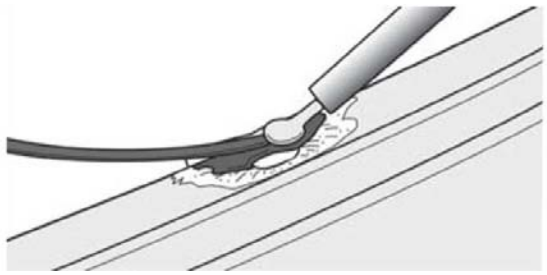
Uni-Weld FiberFlex is a unique repair material in that it sticks to any plastic substrate. It is not a true welding rod, but rather a thermoplastic or hot-melt adhesive. When you do a repair with the FiberFlex, you will actually be using the heat of the welder to apply an adhesive. FiberFlex has a very strong bond and is reinforced with carbon and glass fibers for outstanding strength.

FiberFlex is the best way to repair TPOs (aka TEO, PP/EPDM, TSOP), the most common automotive

DESCRIPTION AND OPERATION

Apply 6481 Aluminum Tape across the gap to support the melted rod while it's hot.

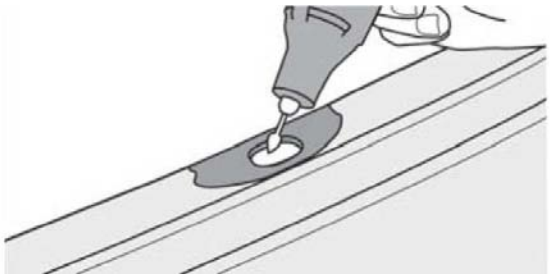
Melt 2045W Stainless Steel Reinforcing Mesh into the plastic across the gap if desired for extra strength. This step is often not necessary because FiberFlex is blended with glass fibers for strength.



E120708

Apply FiberFlex to area using the instructions on Page 7. After cooling, remove aluminum tape and repeat on opposite side.

Allow FiberFlex to cool completely. Open the hole with a die grinder or drill bit, then sand with 80 grit in a DA at low speed to finish the repair.



E120709

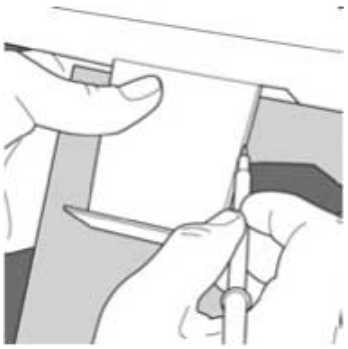
Applying epoxy filler

Grind area to be filled with coarse sandpaper. Slightly v-groove away from the damaged area. All gloss on the surface should be removed to maximize filler adhesion.

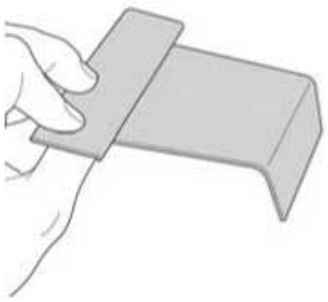
If the material is a polyolefin (PP, PE, TEO, or TPO), apply 1060FP Filler Prep Adhesion Promoter.

Choose a two-part epoxy filler to match the hardness of the substrate. If flexible, use 2000 Flex Filler 2. If rigid, use 2020 SMC Hardset Filler.

Mix epoxy adhesive in equal parts and apply. Build up slightly higher than the surface to allow for sanding. Allow at least 20 minutes to cure before sanding. Contour and smooth the surface with 80 and 180 grit paper.



E120711



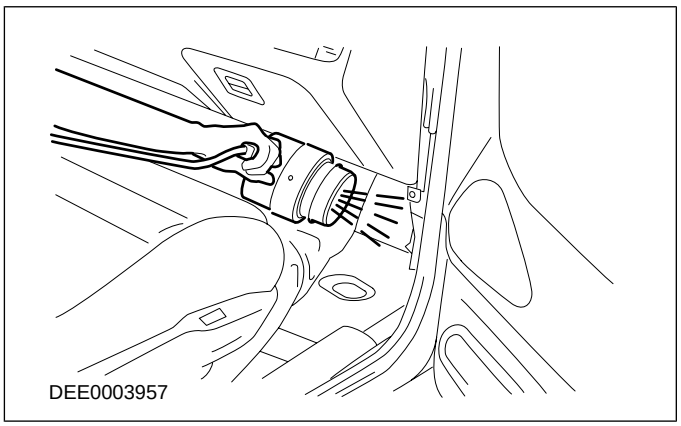
E120712

E120713

E120714

DESCRIPTION AND OPERATION

NOTE: The equipment manufacturer's instructions must be followed when using a UV lamp and contrast agent.


DEE0003957

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 will make the leak visible.

Chalk/powder test

In this test, the contact area of the seal is checked.

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 door seal.

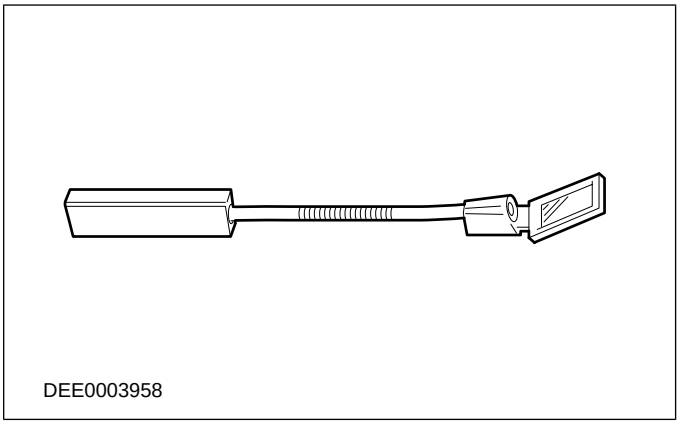
Smoke test

This test can be used to detect leaks visually. The process is as follows:

- 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.

Special Mirror Test

The special mirror can be used to see into hard-to-reach areas.


DEE0003958

Benefits

A switchable light is built into the mirror area.

The angle of inclination of the mirror can be set manually using the handle.

The connector between the handle and the mirror is flexible.

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.

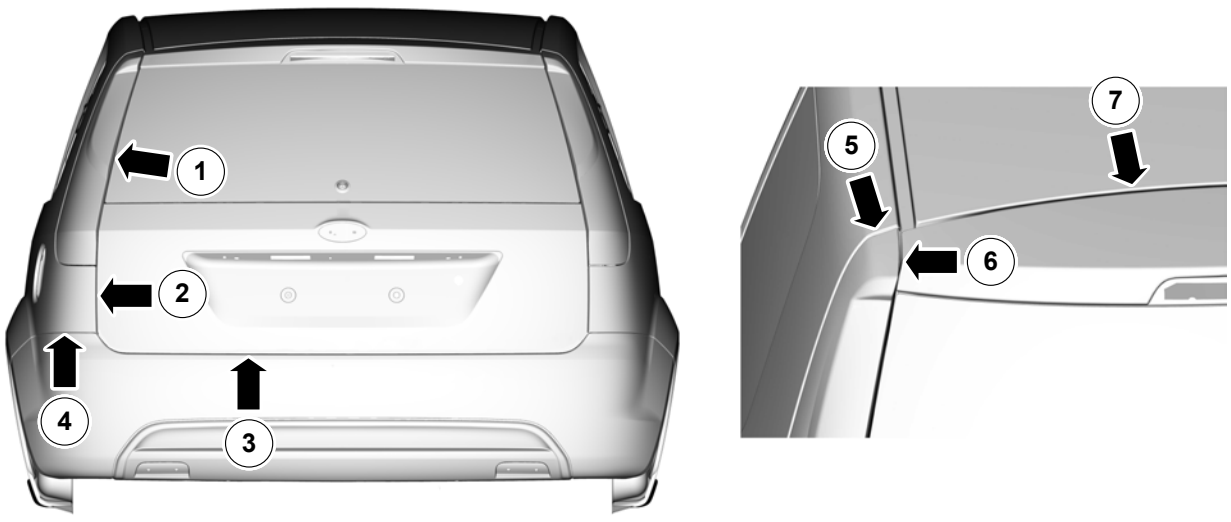
Ultrasonic detection

With this test, a leak can be found electronically. The procedure is as follows:

- 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.

DESCRIPTION AND OPERATION

Point No	Parameters	Gap	Flushness	Parallism		Symmetry	
				Gap	Flush	Gap	Flush
1	Hood to bumper	6.0±2.0	Bumper U/F 2.0±2.0	0.5	1.0	1.0	2.0
2	Hood to head-lamp	4.0±1.5	Hood U/F 1.5±1.0	0.5	1.0	1.0	1.0
3	Hood to fender	4.0±1.0	Hood U/F 1.0±1.0	0.5	1.0	1.0	1.0
4	Fender to head-lamp top corner	2.0±1.5	Fender U/F 0.5±1.0	0.5	1.0	1.0	1.0
5	Fender to head-lamp	2.0±1.5	0.0±1.0	0.5	1.0	1.0	1.0
6	Headlamp to bumper bottom	3.0±1.0	Bumper U/F 1.0±1.0	0.5	1.0	1.0	1.0
7	Fender to bumper	0.0±0.5	Bumper U/F 1.0±1.0	0.5	1.0	0.5	1.0
8	Bumper to bumper lower grill at top	1.2±1.0	Lower Grille U/F 2.0±1.0	1.0	1.0	N/A	N/A
9	Bumper to bumper lower grill at bottom	1.2±1.0	Lower Grille U/F 2.0±1.0	1.0	1.0	N/A	N/A
10	Bumper to bumper lower grill at side	1.2±1.0	Lower Grille U/F 2.0±1.0	1.0	1.0	N/A	N/A
11	Foglamp bezel to foglamp gap	1.0±1.0	Fog lamp bezel U/F 3.0±1.0	1.0	1.0	1.0	1.0
12	Foglamp bezel to bumper gap	2.0±1.5	N/A	1.0	N/A	1.0	N/A



E124958

DESCRIPTION AND OPERATION

Noise, Vibration and Harshness

Introduction

This chapter gives an overview of how noise, vibration and harshness (NVH) can be produced in a vehicle, and which corrective measures are possible.

What is understood by NVH in vehicle technology

N = Noise - Sound, can be heard

V = Vibration - Oscillation, can be felt

H = Harshness - Roughness, can be heard and felt

Types of noise in NVH technology

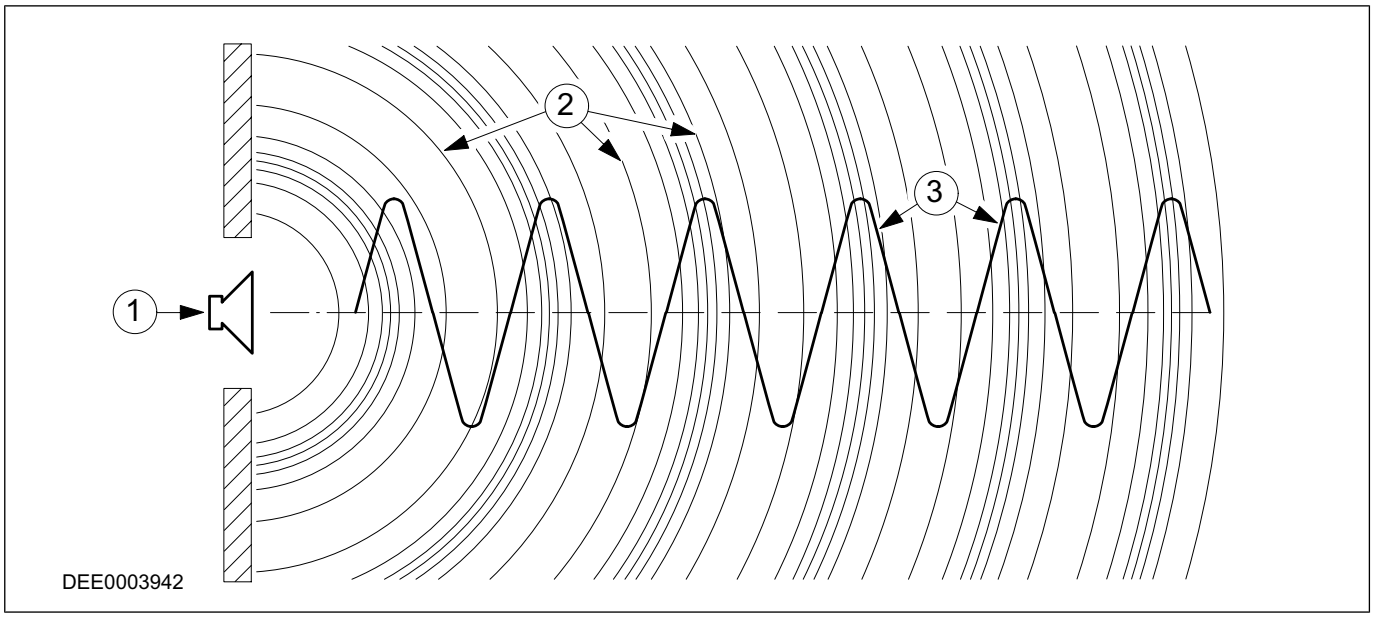
- Noises in a vehicle are classified by their notes:
  - Low notes - growling, droning
  - Mid-pitch notes - buzzing, whirring
  - High notes - howling, whistling, squeaking
- Loud howling and whistling is painful to the ears.

Where the different notes come from in a vehicle:

- Low notes are mostly produced by the engine.
- Low notes are also caused by the road surface, especially if the surface is rough. This is a form of droning which can be felt by the vehicle occupants as vibration or roughness.
- High notes however, which are experienced as howling or whistling noises are often air currents (wind noise) or come from attached 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.

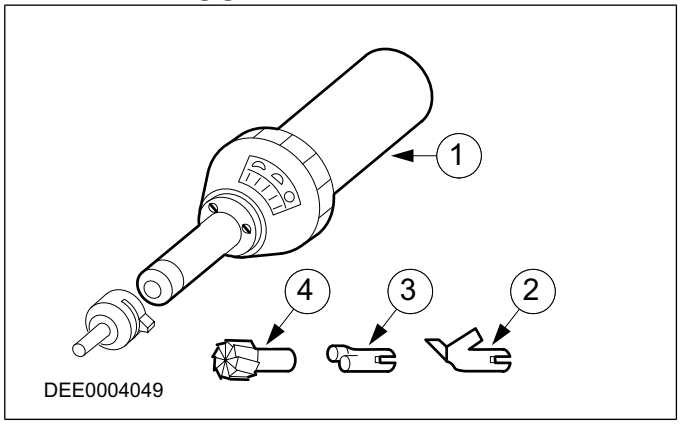
Noise transmission through air

Spreading of sound waves in the air



DESCRIPTION AND OPERATION

Plastic welding gun

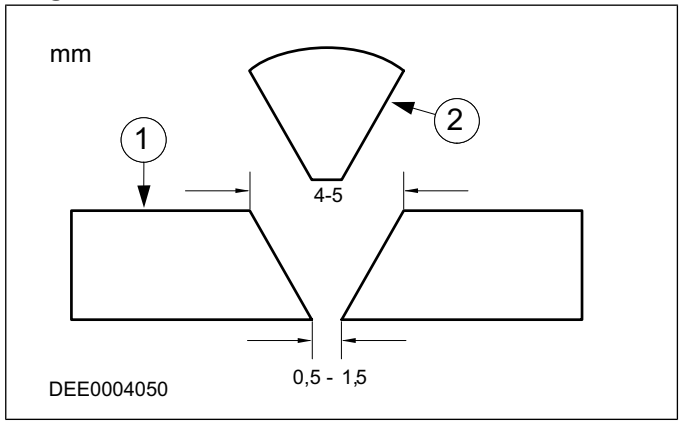


Item	Description
1	Plastic welding gun
2	Rapid welding nozzle
3	Wedge nozzle (fixed nozzle)
4	Face cutter

Preparing the repair location (crack)

Prepare cracking for the welding process in V-formation.

V-groove weld seam



Item	Description
1	Part to be repaired
2	Weld additive (shaped)

Preparing the V-groove weld seam:

- Form the welding groove using the scraper (face cutter).
- Keep the angle of the joint at 60° - 70°.
- **NOTE:** Boring out the end of the cracked (3mm drill bit) prevents further cracking. Where the edge alignment is uneven, fix the start of the crack using clamp pliers before starting welding.

  Finally, bore out the end of crack.

Preparing the hot air blower and welding rod

Convert the hot air blower into a plastic welding gun (extension nozzle and rapid welding nozzle).

- Set the weld temperature (200°C -700°C) according to the prescribed values.

Weld temperature

Two factors determine the weld temperature:

- Plastic material
- Thickness of the welding rod

Values for the most important materials and conventional welding rod thickness (5.7 mm x 3.7 mm)

Thermoplastic	Weld temperature in °C (guide value)	Potentiometer control setting for plastic welding gun	
		Wedge nozzle	Rapid welding nozzle 5.7mm
ABS	350	4,5	5,3

DESCRIPTION AND OPERATION

Item	Description
1	Centre of the dent
2	Edge of the dent

Pre-requirement for the repair

The material at the centre of the dent must not have stretched.

Repair procedure

– Diagnose the damaged area.
– Mark the dent.
– Prepare the area to be repaired.
– Put the adjustable lamp in position.
– Reshape the dent.
– Renew the corrosion protection.
– Carry out quality control.

Repair tools/aids

– Special dent removal levering tools
– Adjustable lamp

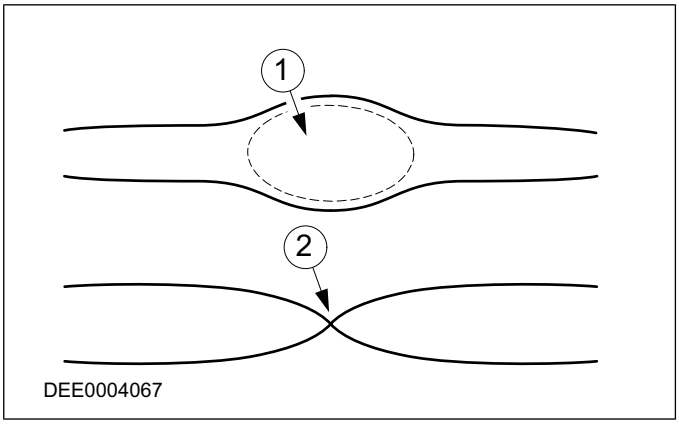
Repair Procedure

1. Decide on the repair method.
2. Mark the dent

   NOTE: Do not use a pen containing solvent (paint damage).

   - The dent is marked in the repair area to help recognition.
3. Prepare the repair area
   - It must be certain that the inside of the dent is accessible. Repair openings must not be made.
   - Clean the bodywork in the damaged area. Good visual checking is vital to success.
   - Polish the repair surface if it is matt. The repair procedure can only be checked exactly if there is enough reflection of light.
4. Place the adjustable lamp in position.
   - The adjustable lamp should be positioned and adjusted so that the dent can be clearly seen in the reflection on the paintwork (oval shape).
   - When pressure on the dent is increased the oval shape changes into lines which cross over each other. The point where the lines cross is the pressure point for the pressure tool.

Light reflection when pressing



Item	Description
1	No pressure on the dent
2	Pressure applied to the dent

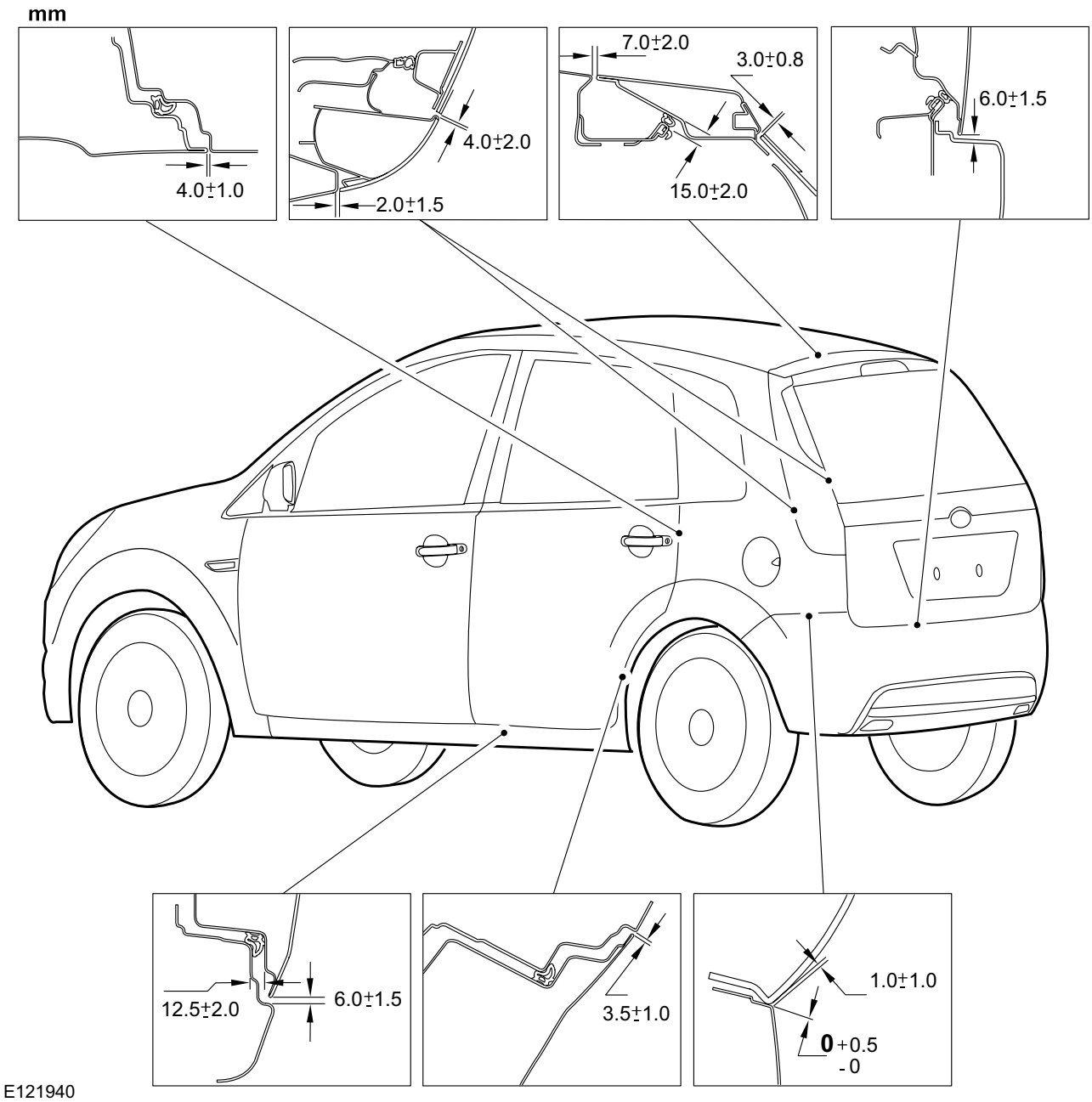
5. Position the pressure tool
   - Position the tip of the pressure tool on the edge of the dent.
   - By moving back and forth with light pressure applied on the dent with the tip of the tool, the reflected light shows the position of the pressure tool.
6. Working principle while applying pressure
   - The operation concentrates on forming a half circle, working chronologically.
   - To restore the surface, all that is needed is to work on one half of the dent.
   - The unworked half of the dent restores on its own, through tension produced by the pressure.

DESCRIPTION AND OPERATION

Overview of parts, front end

Item	Description
1	Galvanised steel panels
2	High strength and galvanised steel panels
3	High-strength low alloy steel

GENERAL PROCEDURES



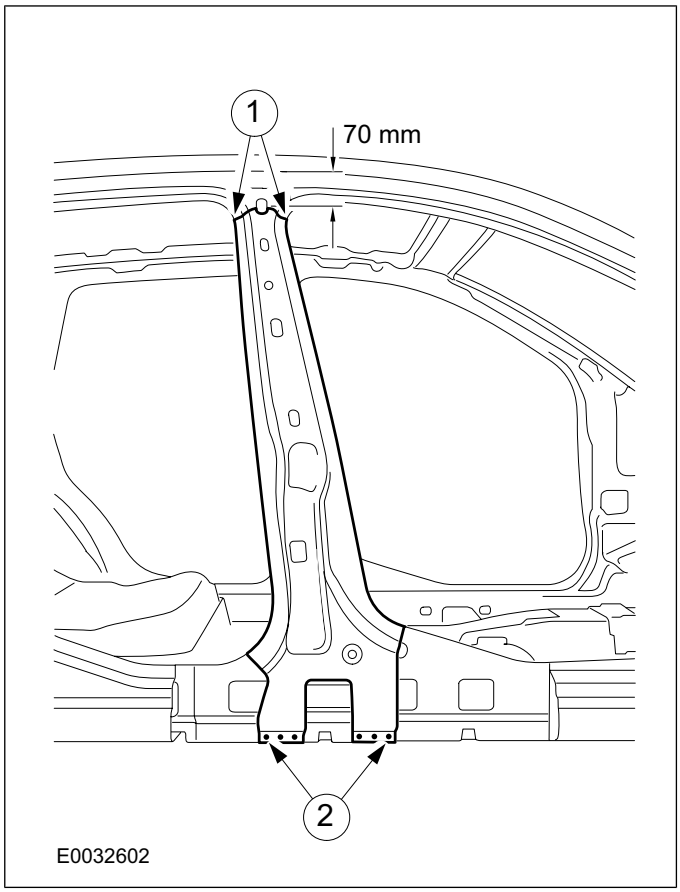
SPECIFICATIONS

Lubricants, sealants and adhesives

	Part number	Specification
PU glass adhesive (150 ml)	1 102 109	WSK-M11 P57-A1

REMOVAL AND INSTALLATION

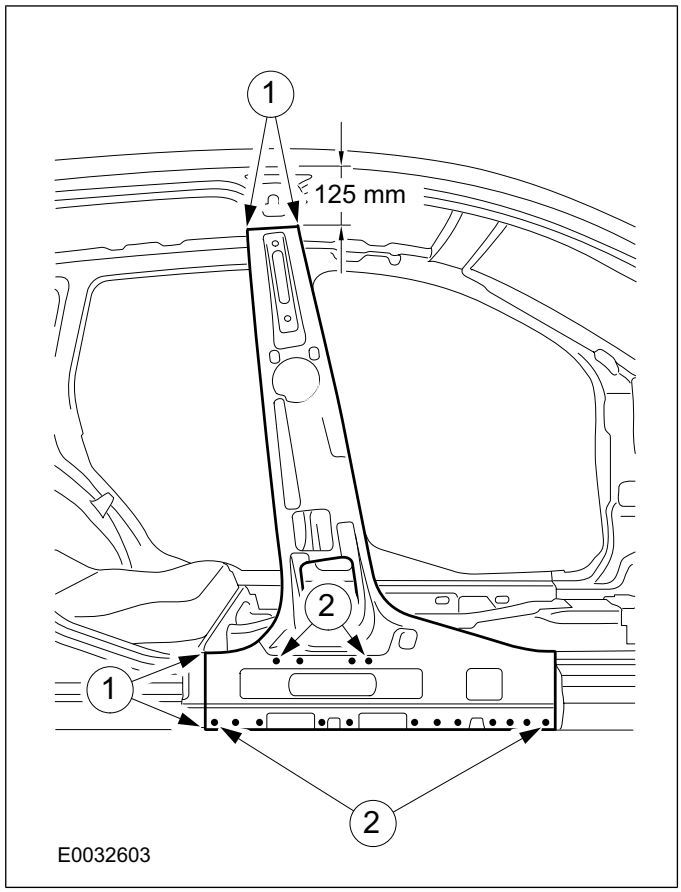
2. Mill out the spot welds.



4. B-pillar inner panel

1. Separating cut.

2. Mill out the spot welds.



Installation

NOTE: The instructions concerning welding equipment given in Section 501-25A must be observed before resistance spot welding body panels with a total thickness of 3 mm and greater.

1. B-pillar inner panel

1. Continuous MIG weld seam.

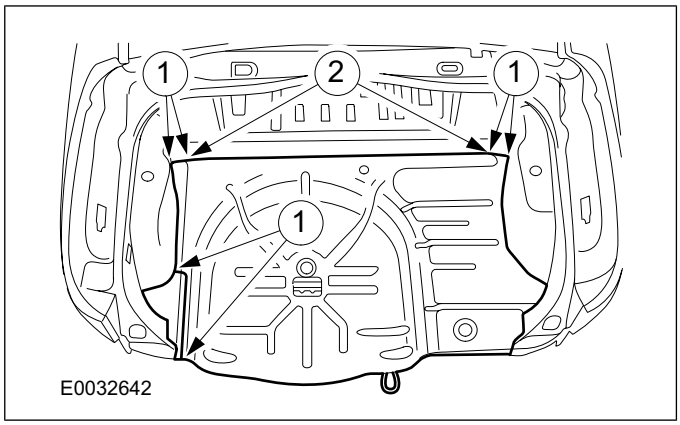
SPECIFICATIONS

Lubricants, sealants and adhesives

	Part number	Specification
PU glass adhesive (150 ml)	1 102 109	WSK-M11 P57-A1
Metal adhesive kit, 2-component	1 203 241	WSK-M4 G200 A/B

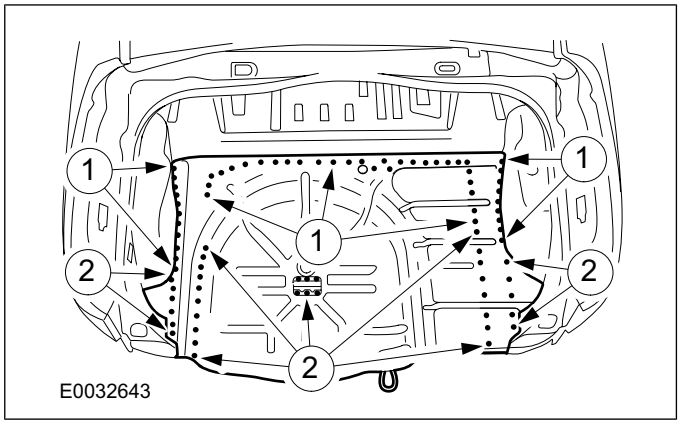
REMOVAL AND INSTALLATION

2. Intermittent MIG weld seam.



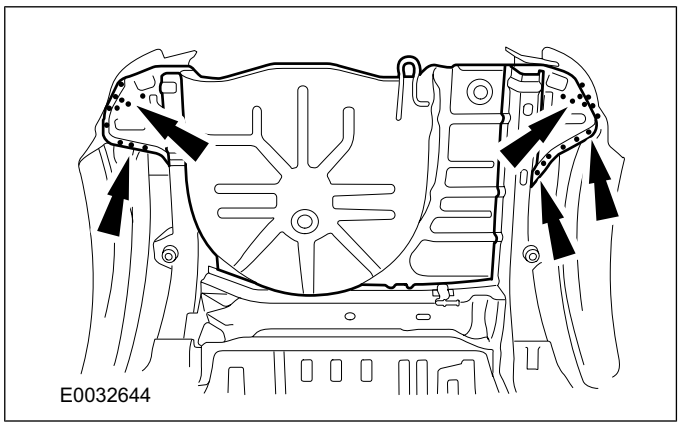
3. Luggage compartment floor panel

1. Puddle weld.
2. Resistance spot welding.



4. Luggage compartment floor panel

- Resistance spot welding.



SPECIFICATIONS

Description	Finis Code	Specification
Underbody protection	5 030 492	-
Anti-corrosion wax	1 219 834	WSK-M7C89-A
Profiled butyl seal	1 128 983	S-M3G4620-A
Weld primer	1 205 996	-
Clinched flange protection	1 136 479	WSK-M4G245-B
Cavity wax	5 030 081	-
Seam sealing compound	1 205 817	WSS-M4G364-A
Body sealing compound	1 143 255	-
Because the supply of paint materials to the dealer workshops has been handed over to paint suppliers, the specifications for these materials are not given in the table.		

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.

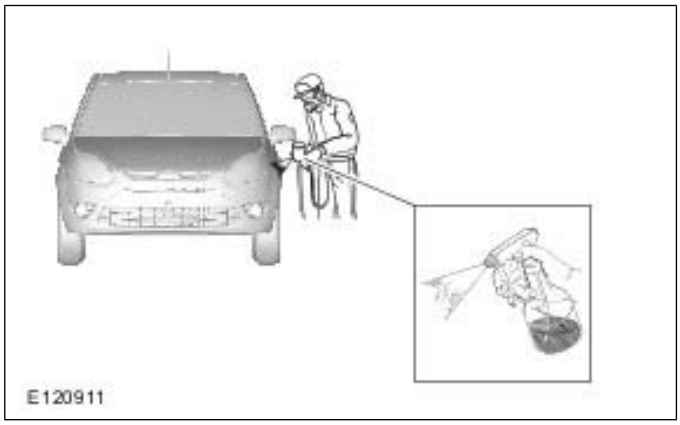
A company in business today can conform with the stipulated requirements by introducing water-based paints and using the other necessary products from the relevant paint manufacturers.

For more detailed information, please refer to the EU VOC Directive.

DESCRIPTION AND OPERATION

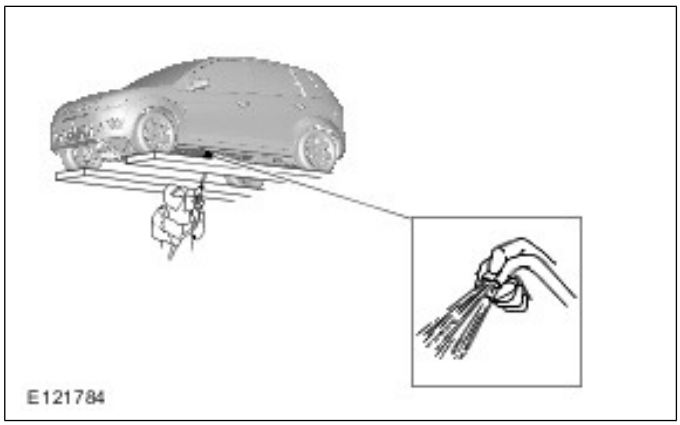
Air Spraying Method

Making use of the principle of an atomizer and by the force of compressed air, paint is sprayed over an object to be painted to form a paint layer. In spite of some paint to be wasted, it is widely used for minor painting jobs, as it is easy to do paint jobs without any particular facility. As even a complicated surface of the panels can be painted beautifully, it is the most ideal way for panel paint repair.



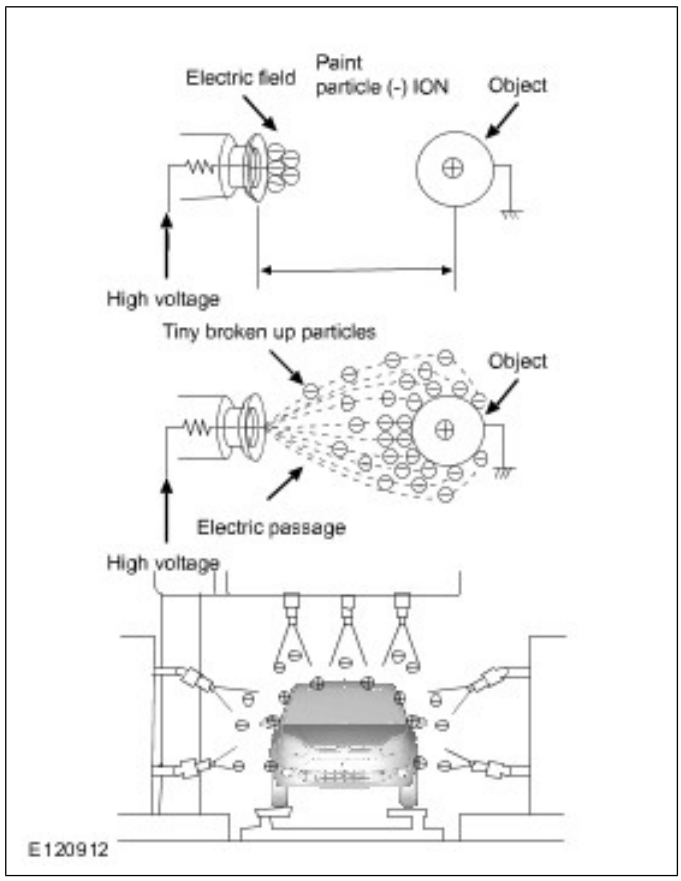
Airless Spraying Method

High pressure is added to the paint to let it spray out from a small nozzle over an object and make the paint layer on the object. Because less air is mixed with the paint, the wasted splash of paint is minimized and at the same time, the paint of a high viscosity can be sprayed. As compared to the air spraying, the sprayed surface is not as smooth so that this method is mostly used for under body coating.



Electrostatic Painting

By connecting the grounded object to be painted to the plus terminal (+) and the paint spraying device to the minus terminal (–), and turning on electricity of –60 kV to –120 kV, make an electro statistic field between the two terminals. The paint particles coming out of the paint spraying device are broken up and made tiny while they repel each other and are attracted to the plus (+) terminal and attached to the object to be painted. Because the paint is electrically attracted to the object, the loss of paint is minimal. Because the paint particles are broken up due to electrical repulsion, the surface of the paint layer is superb and, therefore, this method is used for intermediate and top coating on mass-production line through the use of automatic electro statistic painting machines.



Permeating Painting

The object to be painted is dipped in the paint in a tank. There are two types of this painting method. One is the dipping painting and another is the electro deposition painting.

Dipping Painting Method

As, by dipping an object to be painted into the tank, the whole surface is painted at one time, this method is ideal for a massproduction process. Though the loss of paint is minimal, due to the movement of lifting the product from the tank, the difference of paint layer thickness is significant depending upon places of the object. Depending upon the sectional shape of the object, it may happen that part of it is not painted as desired.

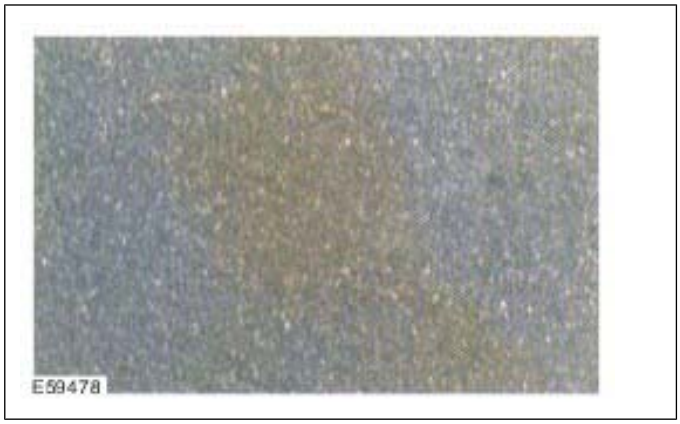
DESCRIPTION AND OPERATION

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.



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.

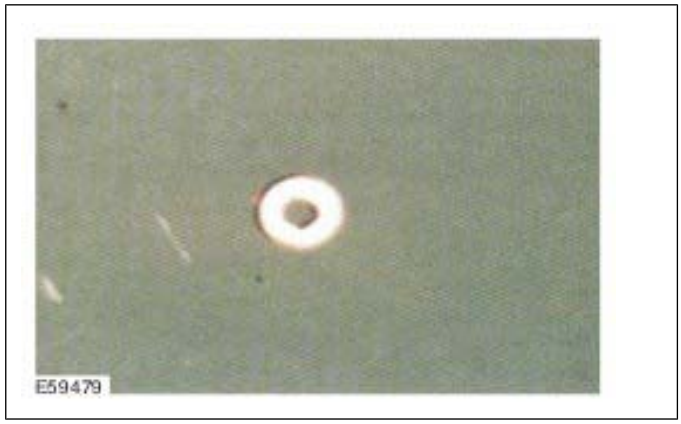
- Swellings can be removed by warming.

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.



Repair of damage:

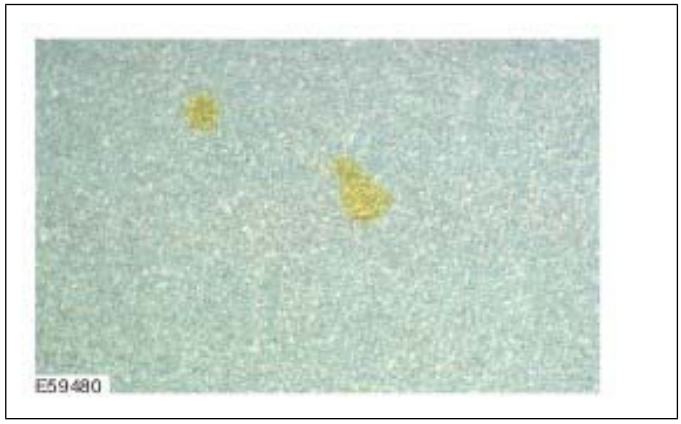
- Remove the excrement as soon as possible.
- Small single matt locations without etching can be repaired using a polishing repair.

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.



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

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.

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.

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:

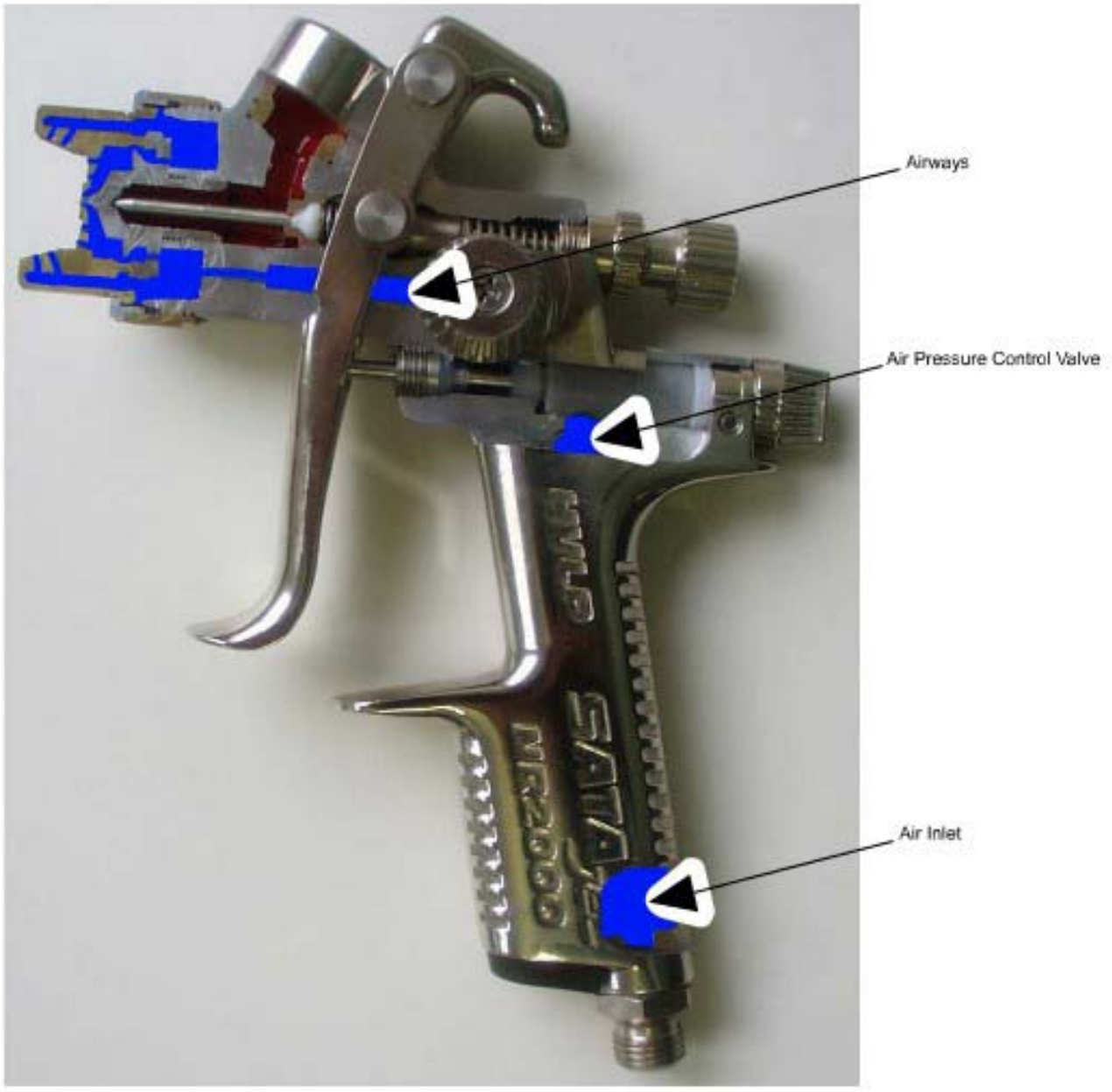
- Uneven paint application.
- The specified viscosity was not complied with.
- Use of unsuitable thinner materials.
- Air, material or room temperature too low.
- Layers too thick.
- Spray gun (nozzle) not perfect.

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

Air pressure can be adjusted by the air pressure control valve.



Spray Gun - Fluid Control

The fluid control screw effectively restricts the amount of needle travel, which in turn reduces or increases the flow of fluid for atomization.

Trigger now squeezed, allowing fluid needle to retract from tip and let material through fluid tip.

DESCRIPTION AND OPERATION

- 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).

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.

Other Equipments and tools

Surform

This is designed to use for shaving off the putty surface and making a rough cut of the piled putty.

DESCRIPTION AND OPERATION

Application	Matting paste
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
	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

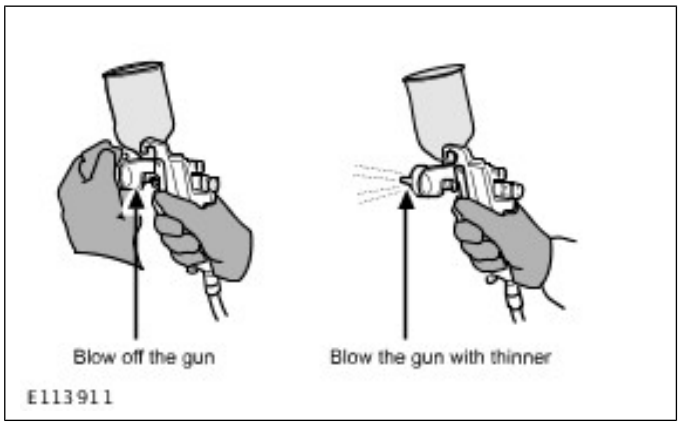
Please refer to the "Tools" chapter for information on abrasives.

DESCRIPTION AND OPERATION

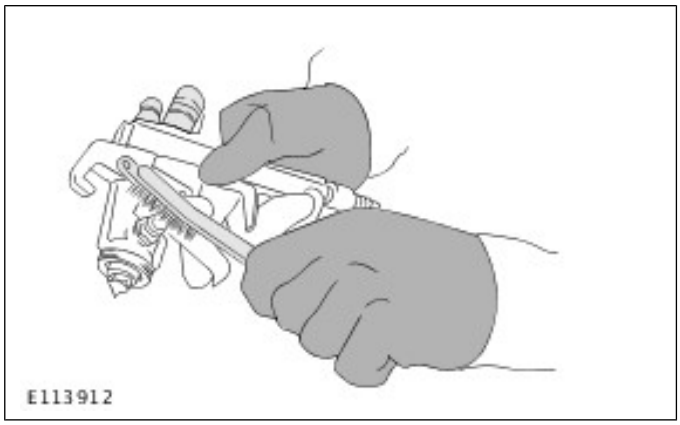
Washing Procedures

1. Cover the air cap with a cloth and pull the trigger. Then, the air that is blown out of the paint nozzle tip enters the paint passage thus cleaning the inside of the gun.

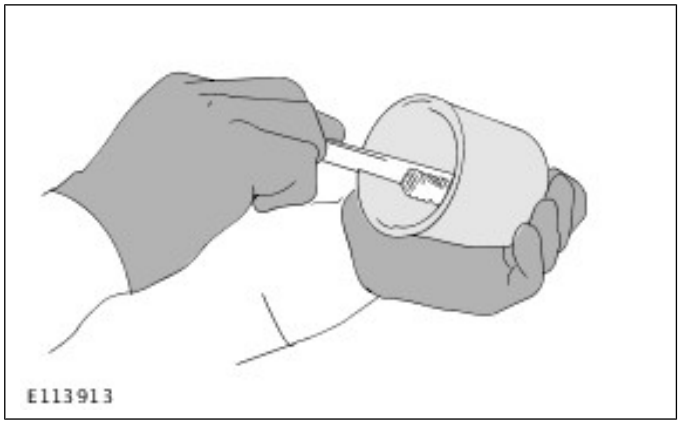
2. Discard the paint remaining in the cup and put some thinner in for washing and blow the gun out.



3. Clean the inside and outside of the spray gun with an attached hairbrush and clean it.



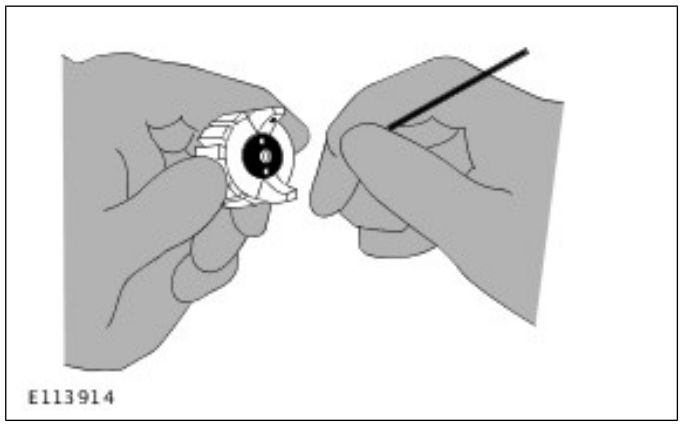
4. Clean the inside of the paint cup.



5. Remove the air cap and clean the inside and outside with an attached hairbrush soaked in thinner.

NOTE: When washing, be careful not to damage the air hole of the air cap because it affects the spraying pattern greatly. Never use a steel wire or wire brush for cleaning. When the air hole is clogged, clean it using a wood toothpick or something like that.

NOTE: When it is hard to get rid of the stuck paint, wash it after it has been submerged in lacquer thinner.



How to judge if incorrect pattern of spraying comes from air cap or spraying nozzle:

First, mark the pattern on a surface as shown in the figure below, turn the air cap 180° and mark the pattern once again. If the deformity of the pattern is the same, the cause of it is in the paint nozzle. If the deformity is in the reverse direction, the air cap is clogged with paint or dust or damaged. Remove the paint residue or dust completely from the air cap. If the damage is too much, replace the part with a new air cap.

DESCRIPTION AND OPERATION

Color Clear Painting

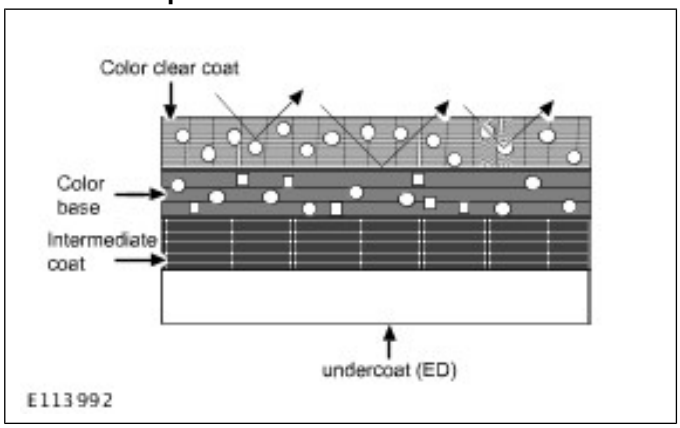
Color clear paint is a mixture of clear coat used for top coat for metallic painting and transparent pigment and dyes. The use of this paint provides vivid, deep and transparent colors.

Its paint layer is made up from top half-transparent color clear layer and lower color based layer.

NOTE: As color clear paint is half-transparent, its color looks different according to the thickness of the layer. It is, therefore, necessary to prepare several color test pieces that have a different paint layer thickness for comparing the color the same way as for the three-coat pearl

NOTE: If the paint used as color base is inferior in hiding the undercoat color, paint the color that is good in hiding the lower coat first before painting color base.

Color clear paint:



Minor Paint Repair Working Exercise

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

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

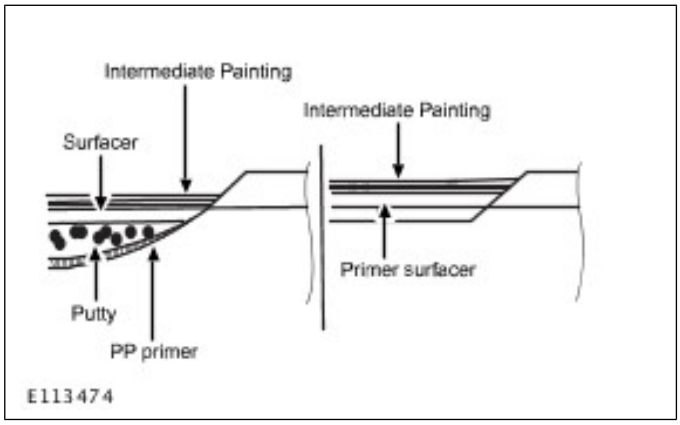
When sanding, produce smooth transitions from the painted area to the bare metal.

DESCRIPTION AND OPERATION

- On PP plastic parts (bumper, side sill, garnish etc.), paint the intermediated paint to match the color.
- For the paint, use the top coat enamel paint.

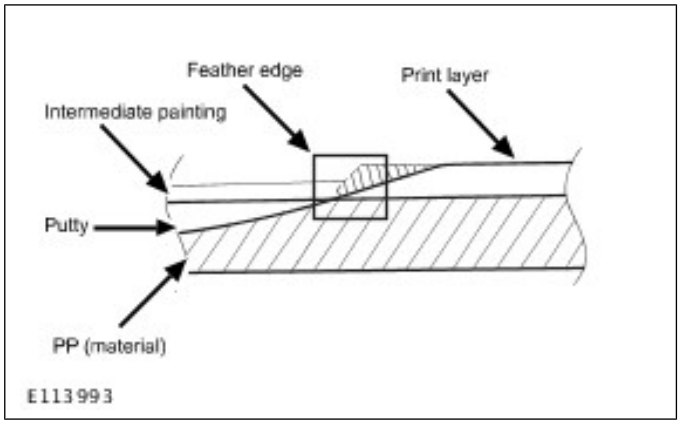
NOTE: Mix it with thinner and softener or hardener according to the paint manufacturer's instructions on mixing ratio and dry it according to the instructions.

- Before painting, clean the entire surface to be painted with a tack cloth.
- The paint thickness is aimed to be 20 to 30 m at 2 to 3 double coating sprayings to hide the primer surfacer paint color.



9. Sanding for better adherence (for top coating).

- After drying the painted surface, polish the surface with P600, P800, or P1000 sandpaper with or without water.
- Take care not to expose the intermediate or primary surfacer layer.
- To paint in gradation, form a featheredge around the area to be top coated with P1500 sandpaper.

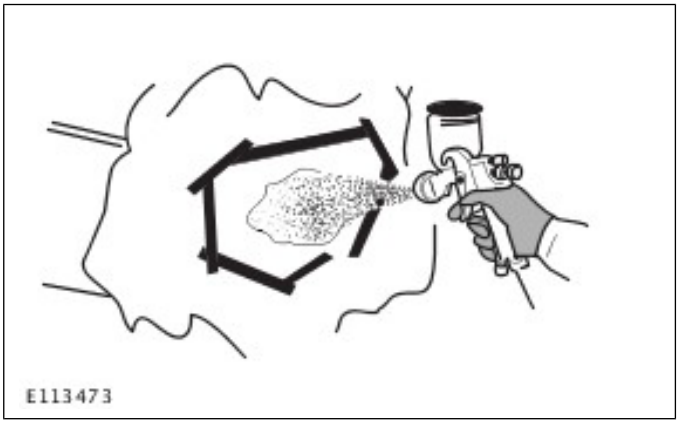


10. Clean the surface by air blow and wipe off all oil, fat, and grease with grease remover.

11. Masking (for top coating).

12. Top coating

- Follow the paint manufacturer's instructions about the mixing of softener, hardener and thinner.
- Immediately before painting, clean the entire surface with a tack cloth.
- Without trying to paint at one time, take flash time and spray several times, hide the intermediate and primer surfacer paint color.
- After spraying the top coat enamel paint, leave it for 5 to 10 minutes and spray clear coat on it.

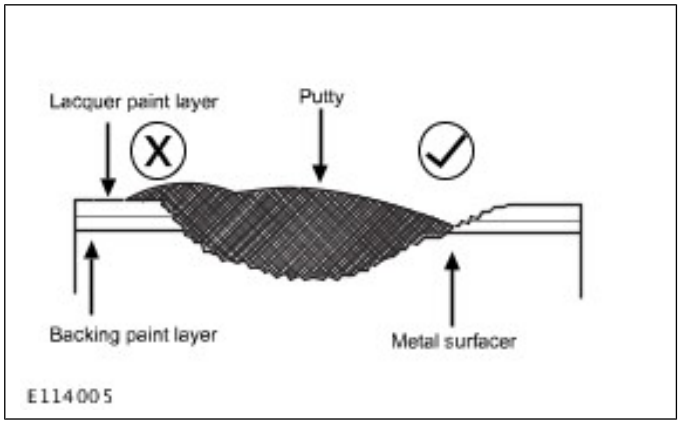


After painting the clear coat, take about 5 to 10 minutes setting time, while taking care of the deformation of the part, force dry it.

13. Final polishing.

- Confirm that the top coat layer has been completely dried.
- Polish with a waterproof P2000 sand paper with soap water.
- Wipe off water and clean the surface by air blow.
- Put some fine or ultra fine compound on the painting surface and wool buff. Press the wool buff lightly against the surface and take off sandpaper hair scratches.
- Make sure viewing from a low angle that there are no sandpaper hair scratches.
- Polish the surface very lightly with an electric polisher with a sponge buff with ultra fine compound.
- Finish the paint surface by polishing with wax.

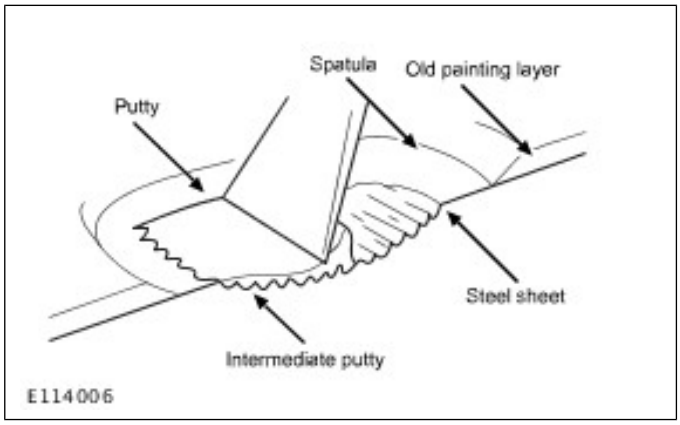
DESCRIPTION AND OPERATION



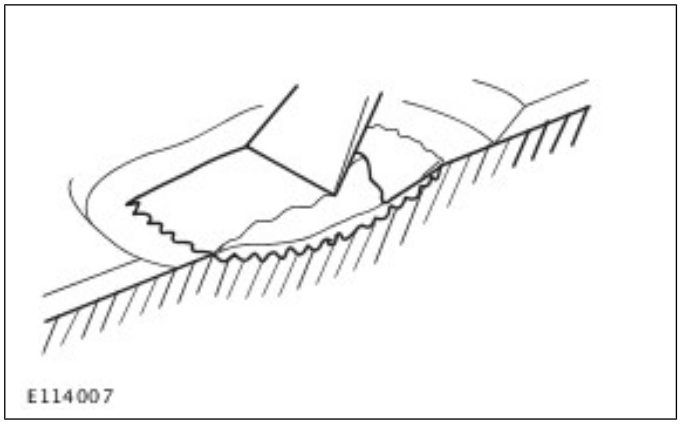
Basic technique in putty application:

In applying putty, do not try to heap up all at a time but do it in several layers.

6. At the first application of the putty, stand the spatula nearly on end to apply the putty very thinly so that the putty penetrates into hair scratches caused by sand-paper polishing.

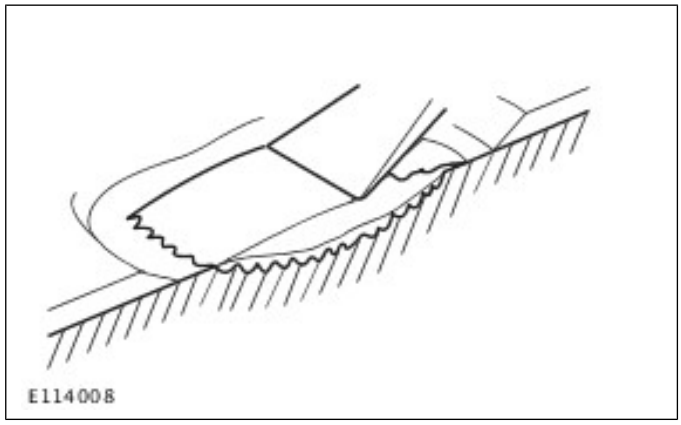


7. Heap up the putty thickly with a spatula holding it a little sideways.



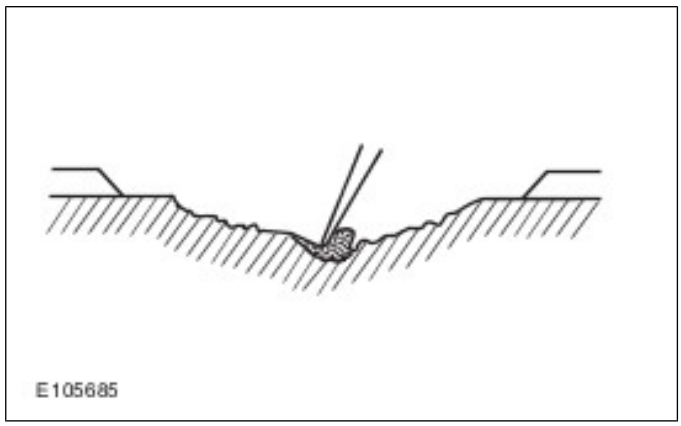
8. Make the putty surface flat. If the spatula's unevenness remains on the putty, take it out using the spatula in a flat way. Complete this process of making the putty surface flat before the putty starts to dry.

NOTE: If a large amount of putty is applied at a time, air may be entrapped in the putty.

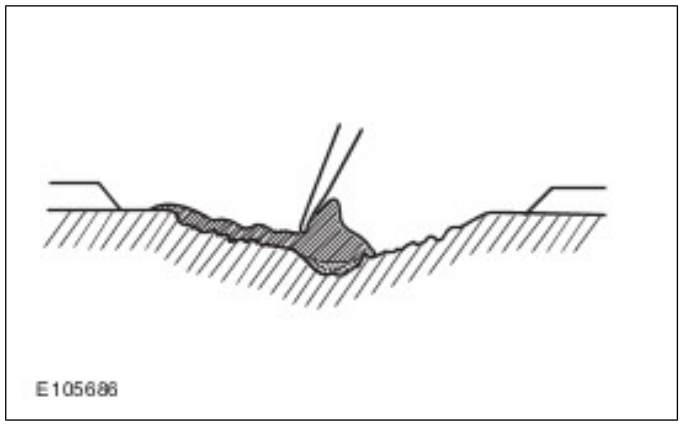


Apply putty on the uneven panel:

Apply putty into a partially deep dented area of the damage.

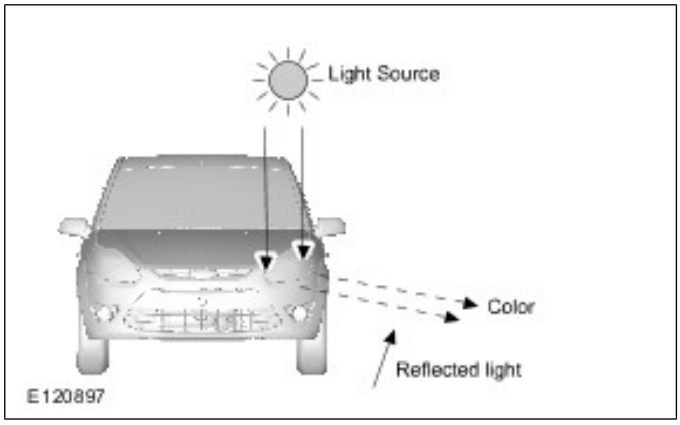


Apply over the whole area of the damage.



Take a slightly larger amount of putty on the spatula, heap up it over the whole area of the damage holding the spatula in an inclined way.

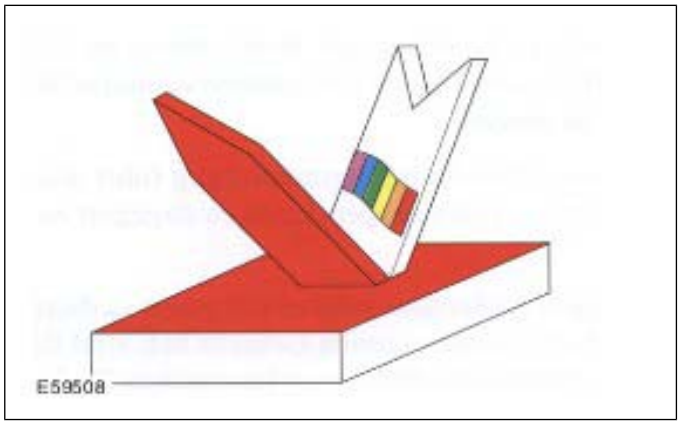
DESCRIPTION AND OPERATION



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 (color blindness) 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.



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.

Three Factors of Colors

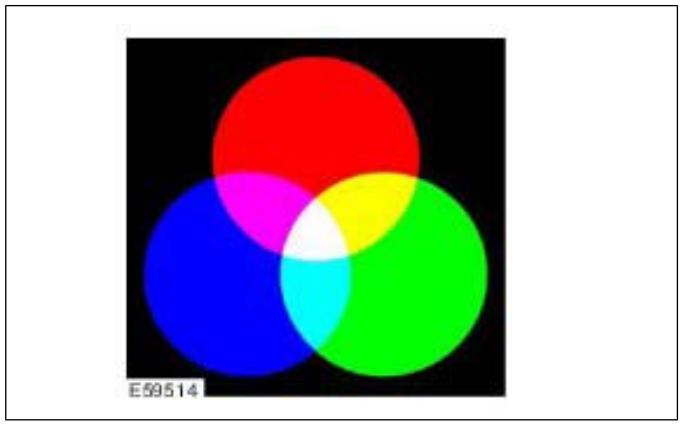
A chromatic color is comprised of three factors that are Hue, Value, and Chroma, while non-chromatic colors have only value.

Hue: The feature that characterizes each color like red, blue, yellow, and green.

Value: The degree of brightness.

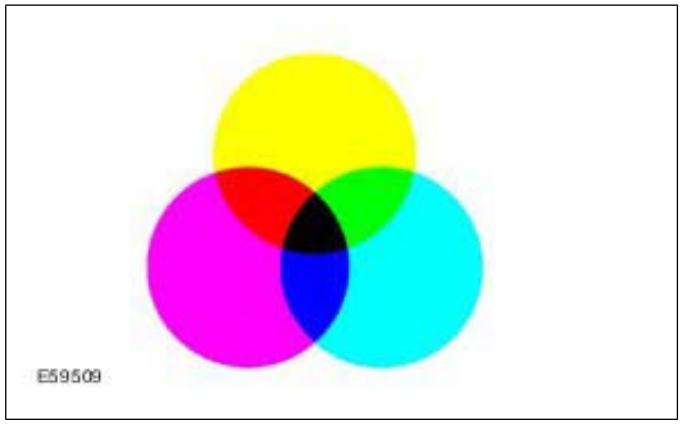
Chroma: The degree of freshness, apart from the degrees of hue and value.

Additive and subtractive color mixing



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

Step of Mixing Colors

Mixing color specification is available

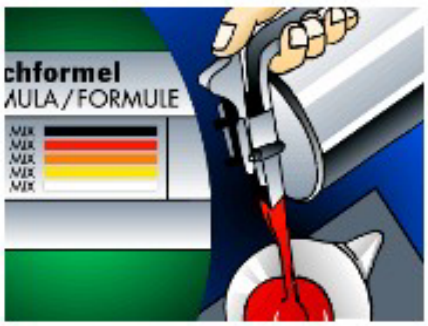
1. Confirm the color difference between the color card attached to the color sample book and the color surrounding the damaged area on the actual car.

- In a case that the color sample is not available but the mixing color spec. is available, use a small amount of paints, make a preliminary color mixing. After making a test spraying, make a test sample for the color and compare the colors.
- In a case that the difference between the color sample and the actual color on the car is too great. Confirm whether there is a different color mixing specs on the actual car color system or not.

E113696

2. Measure necessary amounts of colors.

- Compare the color with that of the actual car. If no substantial difference is found in hue, direction, and shade of color, mix the color according to the mixing color spec.
- If the difference is too great, instead of following the color spec., before mixing the colors, make an adjustment in accordance to the color difference in the amounts of primary colors beforehand.



E113622

3. Painting with a spatula and color comparison. Test-paint the mixed color on a test plate and confirm whether or not it is the correct color after it dries.

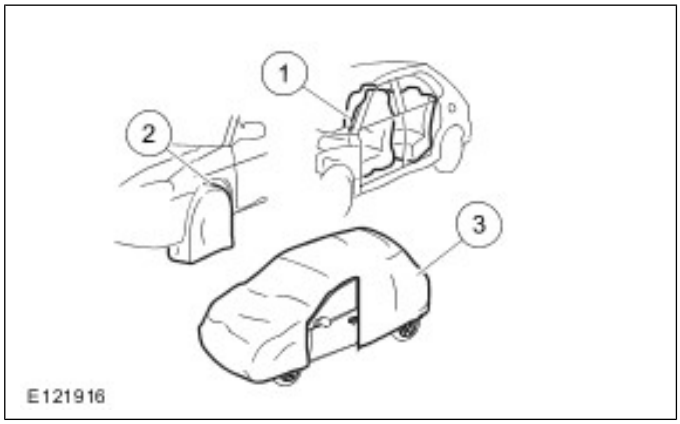
E113623

4. test painting and color comparison. Under the same condition as for the actual color repair, conduct a test painting. Take note that, in particular, pearl colors and metallic colors change greatly if painted under different painting conditions. Compare the direction, conditionally identical colors, the size of paint particles, brightness etc. of the color on the dried painted test plate with those of the actual car from every angle and under different light sources.

DESCRIPTION AND OPERATION

Special Covers

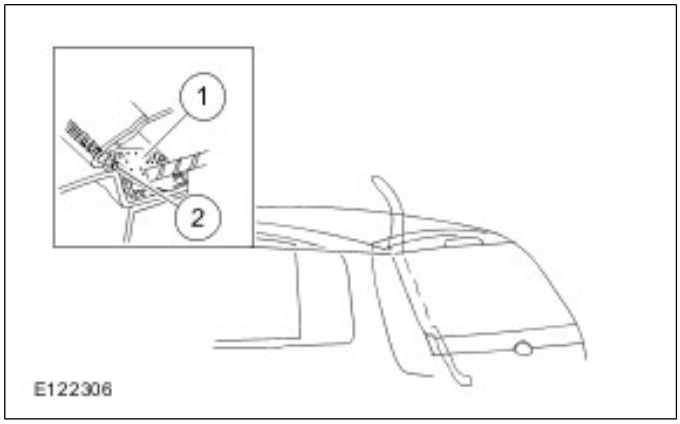
There are body covers of a variety of uses. One cover covers a whole body, another covers just a half part of a vehicle body. In addition, there are wheel covers, or sheet covers that protect the cabin from being unnecessarily paint-stained.



Item	Description
1	Seat cover
2	Wheel cover
3	Body cover

Trim Cord

This cord is used to prevent the rubber strips around glass from being paint-stained. By inserting it between the rubber stripe and body, the stripe can be separated from the body.

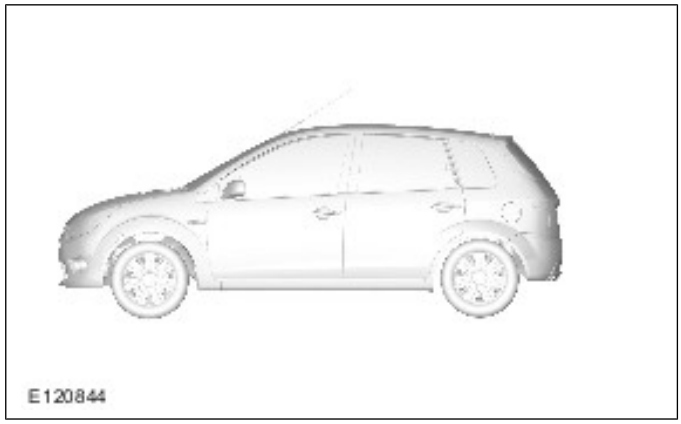


Item	Description
1	Weatherstrip
2	Cord

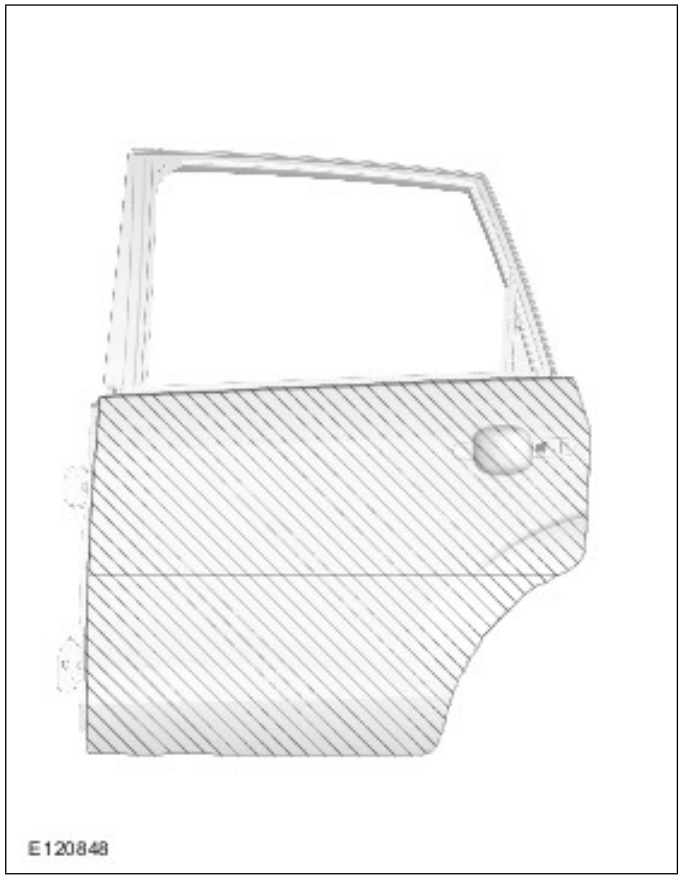
Methods of Masking

Masking work can be divided into four groups.

1. To paint a whole vehicle.



2. To paint an individual panel.



3. To paint an individual panel (block painting) and to paint the adjoining panel in gradation.