

DESCRIPTION AND OPERATION

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

Resistance spot welding is particularly suitable for welding zinc-coated panels, because no widespread warming occurs.

- With electrolytically zinc-plated panels there is no need for any special preparation because the zinc coating does not need to be removed.

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Tools and Equipment for Body Repairs

Alignment systems

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

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

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

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

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

- Universally applicable to all types of passenger car. Can also be used on light commercial and off-road vehicles.
- Accepts the forces involved during straightening.
- High stability and mobility.
- Can accept all or part of the weight of the vehicle.
- Quick to set up.

- Simple to use.
 - Stationary design with drive-on ramp.
 - Height-adjustable aligning platform.
 - Universal gauge extensions with fast anchoring ability around the whole circumference of the aligning platform.
- Facility to test individual body measurement points, with or without aggregates being removed.

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

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

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

Pay attention to the following points:

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

Measuring systems

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

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

Basically, the measuring systems must meet the following requirements:

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

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

Beam compass

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

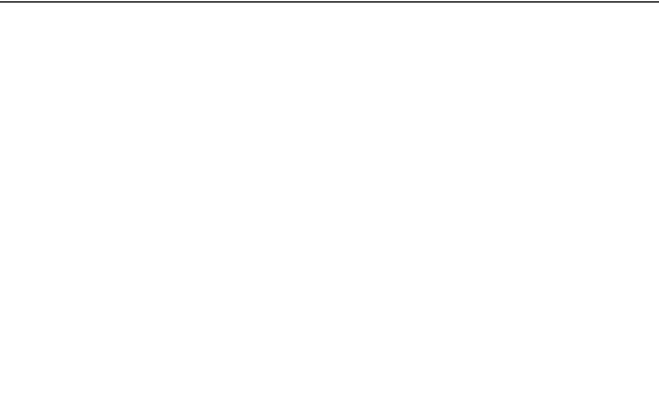
As a basic principal, body reference points should be chosen which are shown in the body frame measurement data sheet.

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

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

Laser measuring systems

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



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

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

Mechanical measuring system

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

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

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

Further advantages:

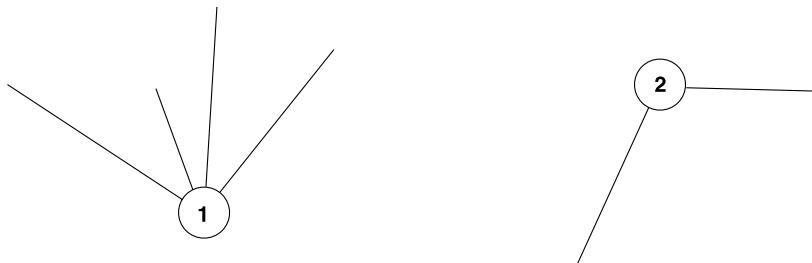
- Fast deployment.
- Simple to use.
- Can be extended using adapters, measuring probes and measuring tubes.

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

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

Ultrasonic and mechanical-electronic measuring systems

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



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

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

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

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

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Welding gear

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

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

Description
1 MIG welding machine
2 Resistance spot welding machine

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

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

and therefore cannot reliably join panel thicknesses greater than 3 mm.

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

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

Further advantages of the new inverter welding equipment are:

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

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

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

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

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

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Establish Repair Method

General

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

Planning

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

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

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

Chronological sequence of repair

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

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

Job steps for the coachbuilder:

- Straightening
- Establish separating cuts and mark them.
 - Take into account the requirements given in the repair instructions.
 - Place the new part ready for use and include it in the repair plan.

- Separate and remove the old part.
 - Take into account the special features particular to the vehicle.
- Prepare the joint locations.
 - Sand and align the weld flanges.
 - Apply corrosion protection measures.
 - Offer up the new part.
- Attach the new component.
- Rework the welded joints (grind welded seams).

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Alignment Check

General

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

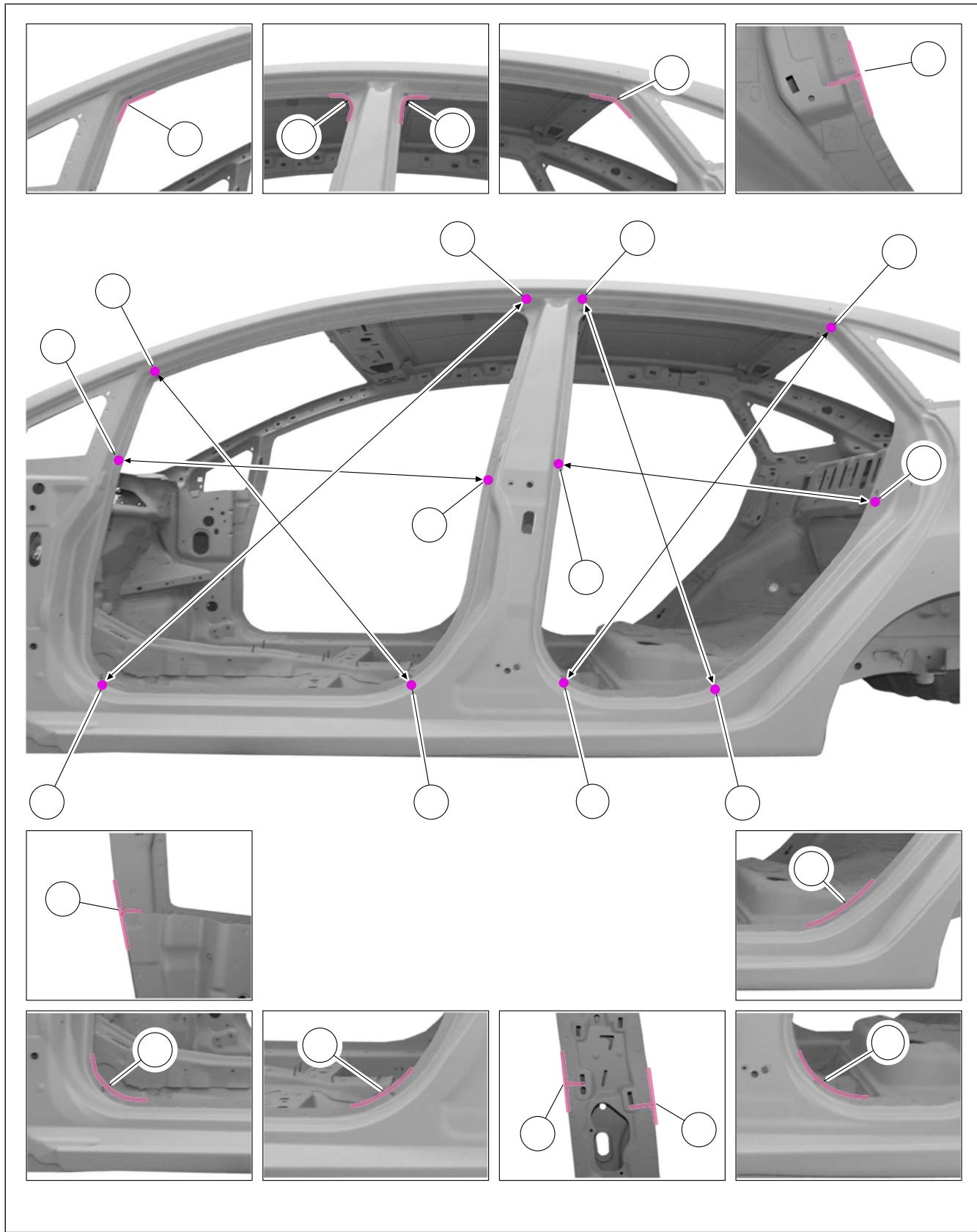
With simple measuring systems, it is possible in most cases to draw a conclusion about the extent of the damage through a quick measurement without time-consuming assembly work (straightening jig).

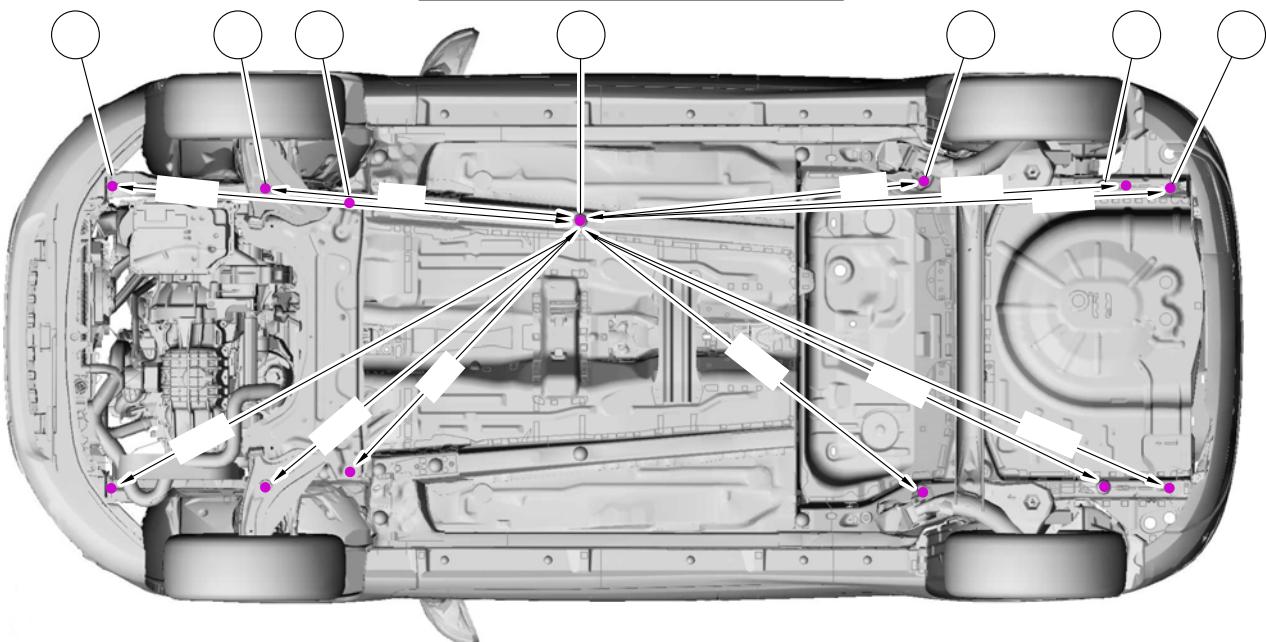
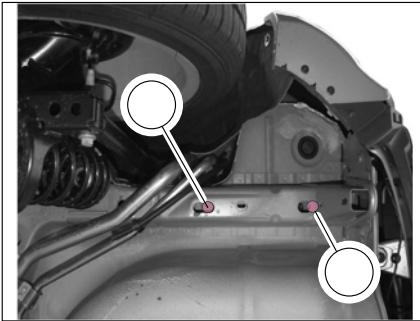
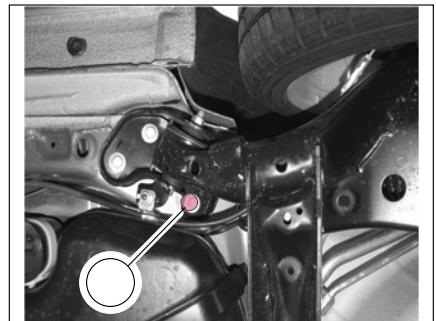
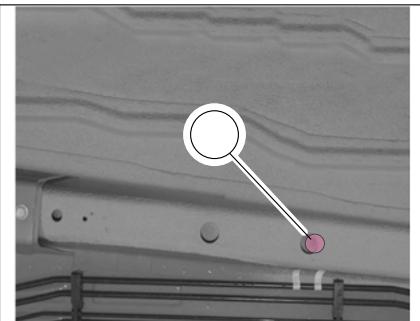
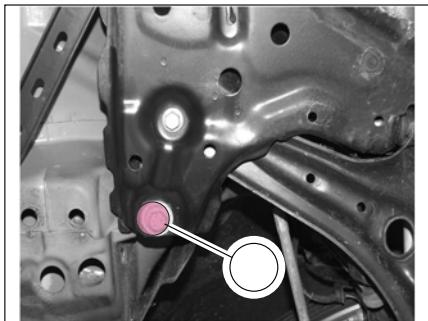
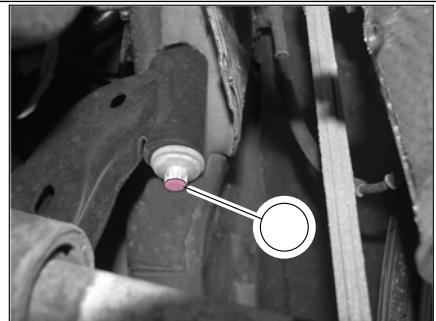
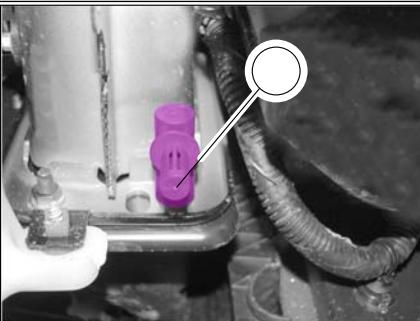
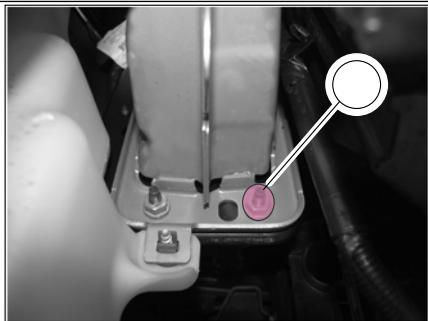
NOTE: For the floor pan and the exterior of the vehicle, measuring data is contained in the vehicle-specific repair instructions for each vehicle. Manufacturers of measuring and straightening jigs create data sheets for this purpose for each vehicle.

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

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

Example of measuring the vehicle superstructure

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Straightening

General

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

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

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

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

Note the following points during the process of body straightening:

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

Special features of non-monocoque bodywork

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

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

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

Straightening of chassis frames

NOTE: High-strength steels must not be heated.

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

The following conditions must be met:

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

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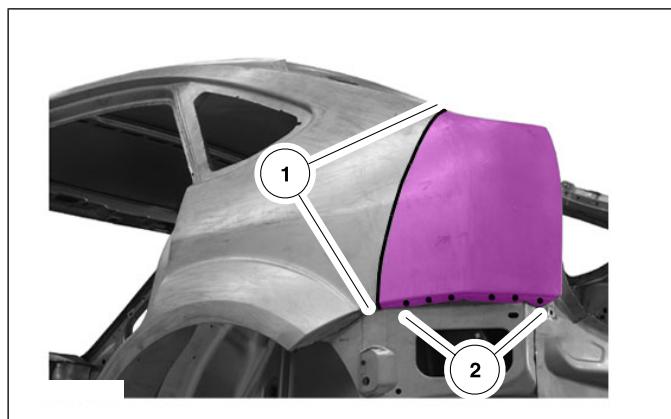
Complete Panel Replacement/Partial Replacement

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

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

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

Partial Replacement



Item	Description
1	Join area
2	Original welding

Decision criteria

The following are always crucial for the decision:

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

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

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

the model-specific body literature. These requirements must be complied with.

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

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

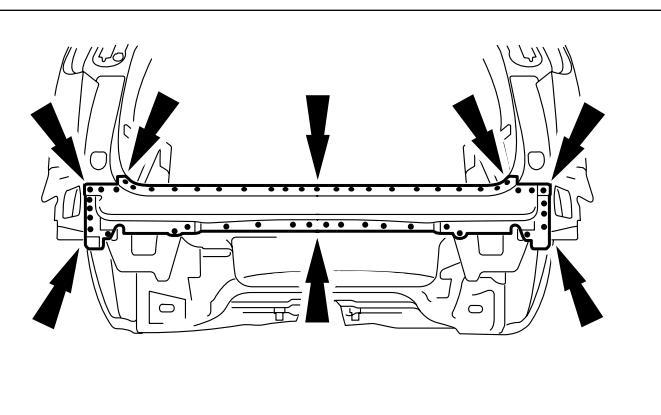
Advantages of a partial replacement

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

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

Complete replacement

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



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

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

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Corrosion Prevention

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

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

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

Panel coatings and corrosion protection

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

A variety of coating processes are used:

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

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

The following points must be noted when welding:

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

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

Corrosion protection measures during repair work

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

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

Before welding

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

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

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

Procedure:

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

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

After welding

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

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Reworking of the affected areas is therefore vital:

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

NOTE: Only apply a small amount of panel cleaner to the cleaning cloth when cleaning the repair area. Make sure that no cleaner reaches the connecting flange, so that the welding primer is not washed away again.

Priming after welding

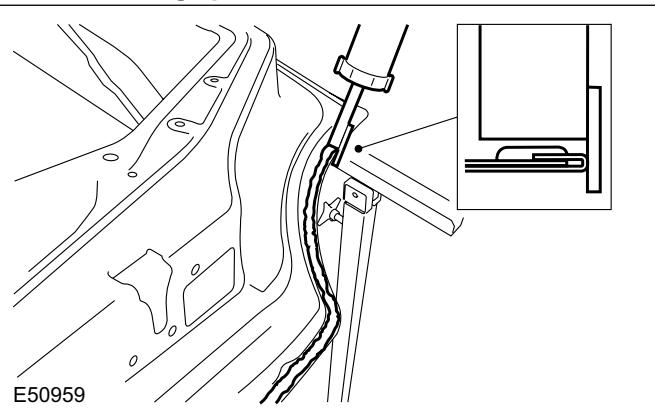
Primer is applied to the welded flanges after cleaning. A check must also be made that the production corrosion protection is present in the area of the flanges. Any damage must also be re-primed.

Sealing work

- If MIG welding is carried out during a sectional repair on a connecting flange with sealant or adhesive material, the material must be applied at a distance of approx. 10 mm from the weld spot.
- These areas must be sealed very carefully after the work has been completed.

Depending on the type of repair, the clinched flanges on the hood, doors, tailgate and trunk lid must be sealed with clinched flange sealer.

Clinched flange protection with flat nozzle



Clean the clinched flange area of the new component with silicone remover and dry with a lint-free cloth.

The sealant must be applied to the dry primed surface (i.e. dip priming as for delivery).

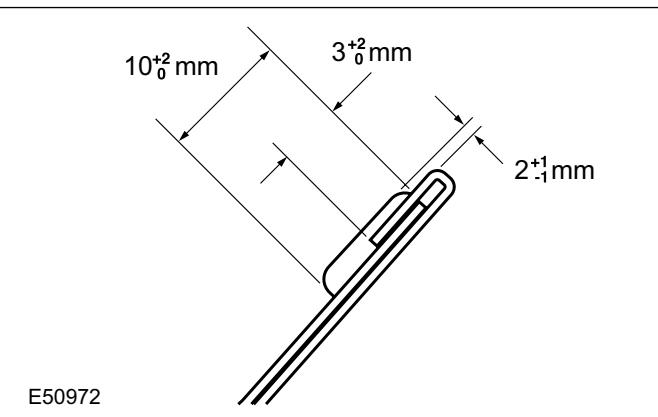
Apply clinched flange protection to the clinched flange using one of the flat nozzles supplied. The nozzle must be cut to the necessary width beforehand and the guide stop cut as required.

During application the clinched edge must be covered with an overlap of at least 3 mm. The beginnings, ends and edges or interruptions in the sealer bead need to be reworked by forming with a brush or a spatula, to ensure a 100% tight sealing of the flange.

The speed and angle of application are decisive for a good appearance and a bubble-free bead. Always apply the sealer with as few as possible interruptions to avoid sealer rework. Never use solvents or thinners as this will considerably slow down the hardening process of the sealer.

For an application thickness of 3 mm of the clinched flange sealer it is recommended to allow to dry over night at room temperature. A minimum hardening time of 5 hours is required anyhow before a 2-component primer can be applied.

Clinched flange protection applied to the correct width and thickness.



Underbody protection/stone chip protection

The underbody protection is used as corrosion protection and must also be applied such that it matches the original condition, from a visual perspective.

Two main application methods are used in production:

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- The underbody protection is applied as a sprayable sealing compound.
- In the area around the structural members, the underbody protection is sprayed on and spread across a wide area.

Because of the coarse surface structure of the stone chip protection material, it is recommended to only perform a repair over the whole surface, if there is damage over visible areas. Otherwise there is the danger of serious irregularities on the surface.

The thickness and appearance of the underbody protection and stone chip protection must be matched to the original. Special spray guns are used to work the materials for this reason. A test spray must always be performed beforehand however, to determine the correct appearance and layer thickness.

Cavity protection

After painting work has been completed, a general check is made of the work that has been done. Before final reassembly of the vehicle, the cavity wax protection in the area of the repair must be renewed. Cavity wax protection must be performed carefully so that the quality of the repair conforms with Ford standards:

- Guide the cavity wax probe carefully in the area of the repair so that targeted corrosion protection is achieved.
- Pay special attention to edges and swage line on stepped joints, the wax must cover the inner edge areas.
- The cavity wax must flow along the stepped sheets so that the wax is drawn between them by capillary action.

A hole may be drilled in a suitable place for areas which are not accessible for the application of cavity wax. The diameter depends on the size of plugs available. When this is done it is vital to make sure that no drilling swarf remains in the cavity (rust will form if any remains). The edge of the hole must be treated with cavity wax. Finally close with a plug and seal with underseal.

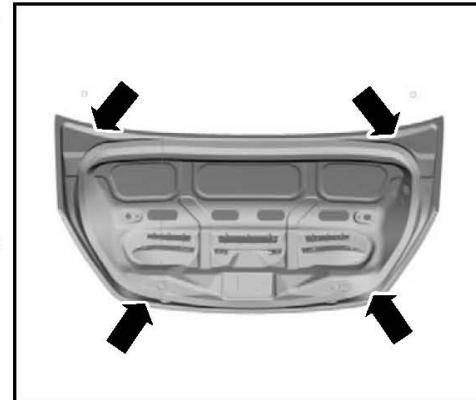
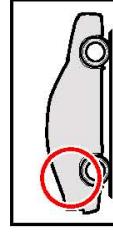
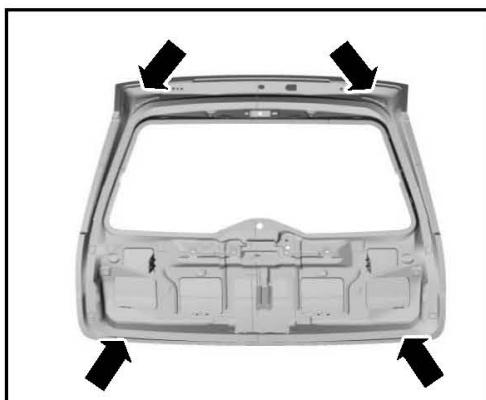
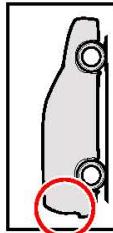
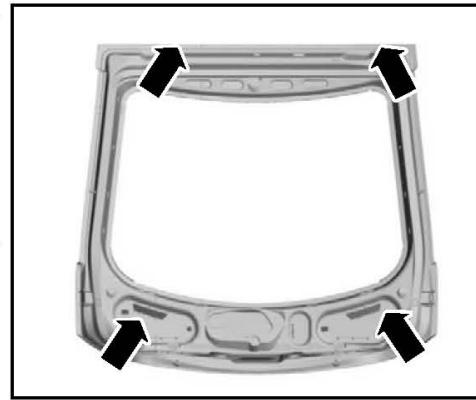
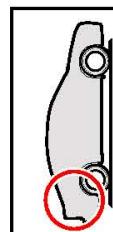
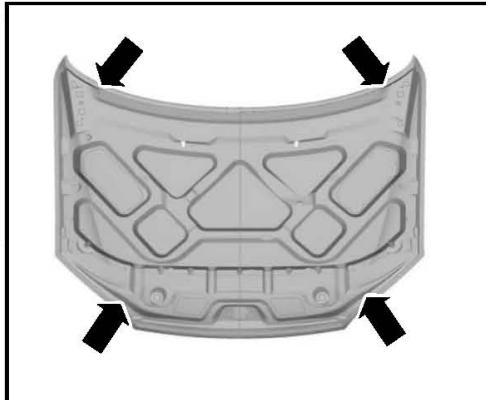
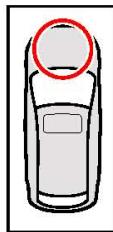
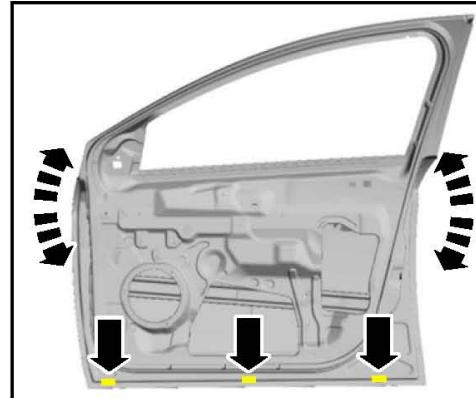
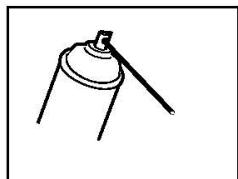
Only on components with clinched flange edges:

After painting, the inner clinched flange edge must be sealed as far as is possible with cavity wax. For this, the repaired component should be positioned upright and corrosion protection wax sprayed into the water drainage holes and/or the thread holes for the hinges in both directions (50 ml corresponds to about 20 seconds spraying time).

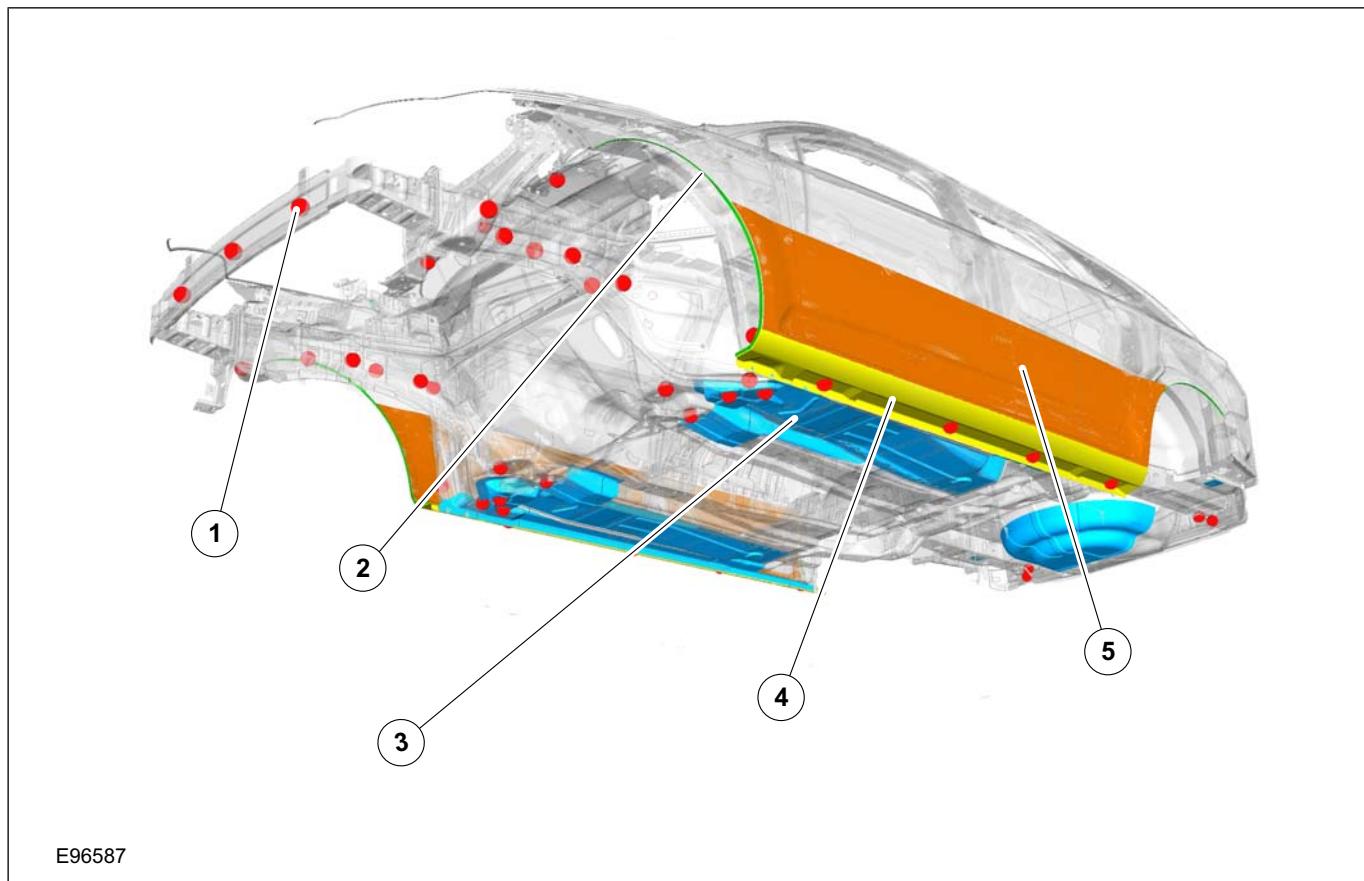
For doors, tilt and turn the component to spread the corrosion protection wax over the whole edge of the flange.

Wax application

DESCRIPTION AND OPERATION



E114334

DESCRIPTION AND OPERATION**Corrosion protection for the floor pan (example)**

Item	Description
1	Injection points for cavity wax protection
2	PVC stone chip protection at the wheel arches
3	PVC underbody protection
4	PVC stone chip protection
5	PU primer

DESCRIPTION AND OPERATION

Corrosion Damage/Corrosion Repair

Modern vehicle bodies are protected from corrosion by elaborate measures. Multilayer coatings on the panel surface prevent direct contact between the metal and oxygen, and so protect it from corrosion.

In the long-term however, corrosion on a vehicle cannot be completely prevented.

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

What is corrosion?

Corrosion is destruction of a subsurface caused by chemical or electrochemical effects which operate from the outer surface.

If the protective layers become damaged, electrochemical conversion processes are initiated, which allow the metal to oxidize. This leads to the formation of corrosion.

The following factors lead to corrosion:

- Mechanical damage such as stone chips and scratches which penetrate through to the steel panel.
- Damp interiors.
- Unfavorable weather or environmental conditions, as may occur in areas with high humidity, high salt content in the air or serious air pollution due to aggressive gases and dusts.
- Insufficient corrosion protection after repairs.
- Lack of care by the vehicle owner of the painted and corrosion proofed surfaces or areas on the vehicle.

In order to maintain long-term corrosion protection, the vehicle must be checked at regular intervals.

In doing so, the follow areas must be inspected and any damage rectified:

- Damage to the paint surface cause by scratches or stone impact must be suitably rectified according to the specifications.
- Damage to the PVC underbody protection or the PU stone chip protection must be refinished.
- Damage to the PVC underbody protection or the PU stone chip protection must be refinished.
- Incomplete or damaged sealing at clinched flanges must be renewed.
- Check the cavity protection and renew it if incomplete.

- Poorly installed or damaged covers and stone chip protection fixtures must always be renewed.
- Check seals and seal carriers for wear and correct mounting. Any damaged seals must be renewed.
- All rubber grommets and blanking plugs must be present and correctly installed.
- A damp or wet floor inside the vehicle indicates that there are leaks in the bodywork. The interior must be dried out and the leaks must be completely rectified.

The corrosion formation can vary in extent.

With rust film or edge rust formation, the surface of the paint has small traces of corrosion present. The traces of corrosion can possibly be removed in such cases by polishing the paint surfaces. If this is not possible however, the traces of corrosion must be rectified by using a touch-up technique.

If the corrosion is just starting, with up to 1 mm rusting below (in the form of a dot or a line) the damage is rectified as follows:

- Clean the defective location.
- Mechanically remove the rusting which is starting below the surface.
- If the area is small, apply primer and allow it to dry, then use the paint pencil to touch up the area - if not, respray the damaged area.

If rust is already under the paint finish to the steel panel, then the whole paint finish in the affected area must be sanded away.

Furthermore, the existing traces of corrosion in the body panel must be carefully and completely removed.

Finally a new paint finish must be applied in this area. In the case of rusting through, the affected body panel is already completely destroyed. Such damage requires complete or at least partial replacement.

NOTE: : In the general section there are several chapters which present the techniques necessary for a professional corrosion repair.

The outcome of this is the following repair sequence:

- Remove the rusted-through part.
- Remove the remaining traces of corrosion.
- Offer up the new part.
- Prepare the joint areas.

DESCRIPTION AND OPERATION

- Weld the new part into place.
- Produce the corrosion protection.

For a professional repair it is essential to reproduce the corrosion protection during and after the repair.

DESCRIPTION AND OPERATION

Sealer, Underbody Protection Material and Adhesives

Sealants, adhesives, cavity wax and underbody protection materials are used during the various body repairs. In this area Ford offers a range of products which have been tested and matched to each other.

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

Clinched flange protection

One-component adhesive/sealer which can be applied by brush or spraying, based on MS polymer, with a flat nozzle for application and with the following properties:

- Can be sanded
- Permanently elastic
- Non-corrosive
- Very good adhesion
- Rapid hardening and resistant to ageing
- Can be over-painted with almost all proprietary paints

Seam sealant T Anthracite

One-component sealer based on MS polymer, for sealing joints and seams, with the following properties:

- Silicon-free
- Solvent-free and low-odor
- suitable for gluing HVH elements into position in their respective body areas

Body sealant T beige

Sealer with the following properties:

- Stable
- Contains solvent
- Especially suitable for visible seams
- After hardening can be overpainted with two-pack paint

Underbody Coating

Underbody protection is necessary for permanently elastic corrosion protection of vehicle underbodies.

It is very durable and has good resistance to abrasion,

Cavity wax

This touch-proof, transparent corrosion protection wax is used for the preservation of cavities and flange joints.

Anti-corrosion wax

Anti-corrosion wax is a coating material which can be applied in fine spray, forming a very thin and grease-like protective film, therefore offering very good corrosion protection.

2-component metal adhesive

For joining metal to metal and plastic to metal. The adhesive reduces droning noises and improves corrosion protection.

Windshield sealant

Solvent-containing, stable sealing material. The sealer is permanently elastic and does not form a skin on the surface.

1-component window glass adhesive kit

For direct glazing. The vehicle is ready to drive after 6 hours (passenger airbag). Prevents contact corrosion.

2-component window glass adhesive kit

For direct glazing. The vehicle is ready to drive after 1 hour (passenger airbag). The adhesive is not an electrical conductor and permits interference-free radio reception. Prevents contact corrosion. Using a 150ml additional cartridge, the adhesive can also be used for large windows or to produce a double seam of adhesive.

PU glass adhesive

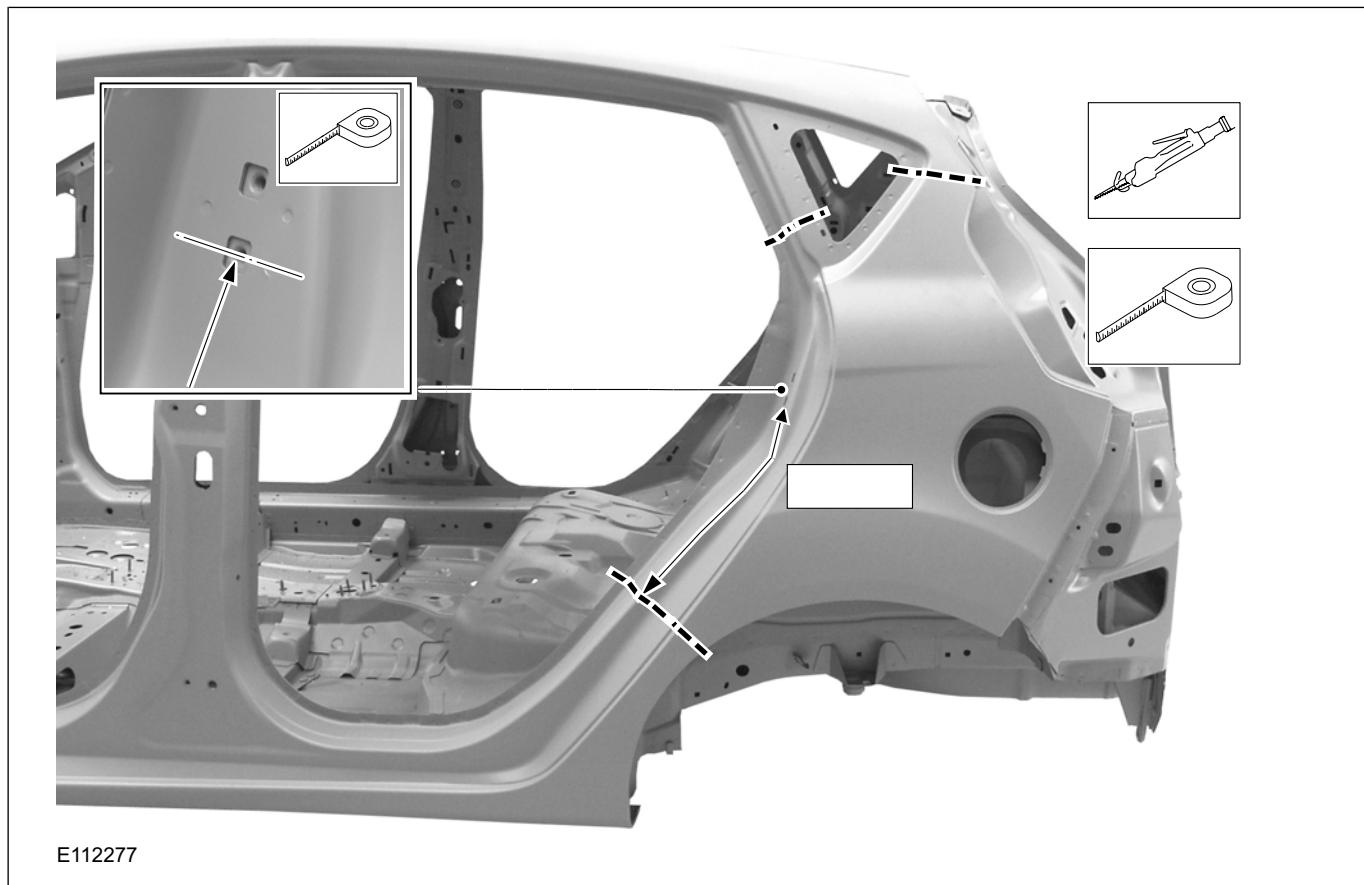
150ml additional/replacement cartridge for direct glazing using 2-component window adhesive kit. Suitable for double beads or larger windows. Also suitable for sealing NVH elements.

DESCRIPTION AND OPERATION

Cutting Technique

NOTE: Without exception, before starting work you must read the safety and warning instructions in the chapter "Safety Instructions". In addition, pay attention to the warning instructions of the particular equipment manufacturer.

Possible cut lines (example)



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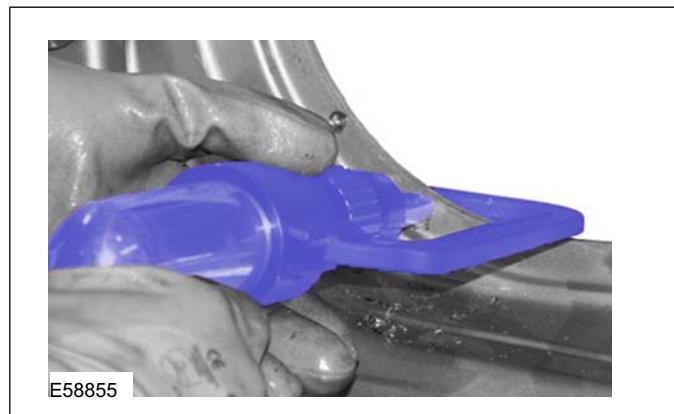
Depending on the separating tools used, there are some fundamental points to bear in mind:

- Only start the cutting work once the new part is to hand.
- Compare the new part with the old part for shape and size.
- The straightening work must be completed before any body components to be replaced are cut out.
- Before separation work is started, all welded connections which cannot be seen must be freed of underbody protection, sealant etc.

Spot weld milling tool

Resistance spot welds are separated using a spot weld drilling machine or a spot weld milling tool.

NOTE: After all separation work, make certain that the metal swarf is completely removed from the vehicle body.



NOTE: Steplessly variable machines increase the working life of the cutting tool. Use of a suitable lubricant can increase this even further.

A spot weld milling tool usually has an adjustable depth stop and a safety fixing system. These prevent the machine from drilling too deep and the cutter from slipping while working.

DESCRIPTION AND OPERATION

Rod sander

Another option for separating resistance spot welds is to use the rod sander.

If spot welds and MIG welds are difficult to reach, a rod sander may offer an alternative.

The cutting depth of the orbital saw can be set. This allows separating cuts to be made, despite panels or other components lying in danger behind. Straight cut lines can be more easily made using the orbital saw.

Short stroke saw

The short stroke saw is suitable for separating vehicle body components and for making a separating cut for partial repairs.

NOTE: In order not to damage panels, wiring harnesses, hoses or similar components which lie behind, remove them beforehand as necessary.

The narrow design of the saw blade permits cutting in tight curves. Straight cuts require a relatively great deal of practice.

Orbital saw

Where use of the short stroke saw is difficult because of the body construction, the orbital saw can be used.

DESCRIPTION AND OPERATION

Panel Beating Technique and Smart Repairs

General

Smaller scale body repairs, where damaged panels do not need to be replaced, can often be carried out by realignment work. Whether the repair is economical however, often depends on the accessibility of the affected body area.

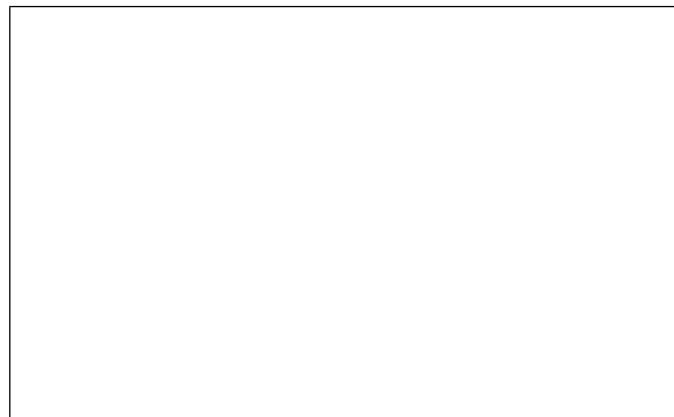
NOTE: Basic and in-depth training courses are offered on the topics which follow. An overview of the complete range of training offered is provided by the Ford Service Organization Training brochure.

During damage assessment, the following technical points must be taken into account:

- Small mild dents (without damage to the paint), which are in areas that make access from the inside possible, can be rectified using undamaged paint panel beating.
- If the inner side of the damaged area (with paint damage) can be accessed, then conventional panel beating techniques can be used.
- If the damaged area has no access from inside, then it can only be rectified using outside panel beating techniques.

Dent removal using special panel beating levers

NOTE: In the Undamaged Paint Dent Removal section, you will find more information on pressure techniques.



Des crip tion	Description
1	Deflection by a hook arrangement
2	Pressure tool

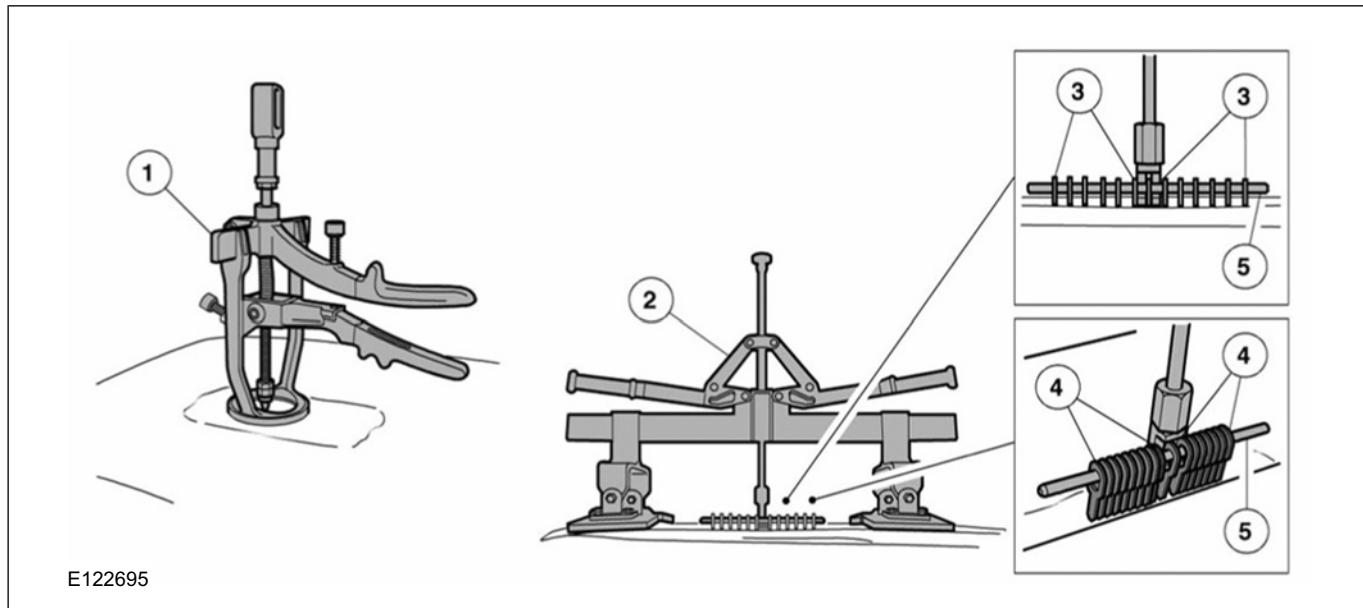
This panel beating technique with pressure is mainly used to rectify smaller dents as a result of hail impact, transportation or parking, without the paint being damaged.

Small dents are removed from the inside of the body panel by pushing them outwards in a mechanical process using panel beating levers.

Because of the great variety of shapes of these levers, it is possible to use this panel beating technique on almost all areas of the vehicle body.

DESCRIPTION AND OPERATION

Dynamic puller with counter bearing



Description	
1	Puller device for minor damage, with integral copper electrode
2	Puller device for more extensive damage
3	U-washers spot-welded in place
4	Puller bits spot-welded in place
5	Attachment for U-washers or puller bits

This method can be used to reshape dents or more extensive damage from the outside.

For minor damage, the copper electrode in the tool is secured onto the panel surface by spot-welding and the puller device is used to pull out the damage without jolting.

For more extensive damage, puller bits or U-washers (depending on the application area) are spot-welded to the panel surface and the area pulled out using the puller device.

Because of the versatile puller and the variable counter bearing, a wide variety of damage can be worked and rectified using this repair method.

Because of the mechanical lever operation, the variable counter bearing and the optimum controlled application of power, this external dent removal system allows dents in almost all vehicle body areas to be pulled out.

Hollow leveling (removing dent without a dolly)

Hollow leveling can only be used on areas which are accessible from the rear.

DESCRIPTION AND OPERATION

Description
1 Center of dent
2 Spoon

During hollow leveling, the dent is removed from the inside using suitable panel beating tool and applying knocking or pressing movements. High spots around the edge of the dent area are flattened with blows from the aluminum or wooden headed hammer.

The usual tools are for instance hammers of various designs, dollies, levering irons and various spoon irons. The correct choice of tool is made depending on the shape of the dent and the access which is possible.

Dent removal using hammer and dolly

Panel beating can only be performed using a hammer and dolly if access can be gained from the rear side.

Description
1 Aluminum hammer
2 Box file

The purpose of the dolly in this case is to transfer the force of the impacts from the hammer to the steel panel which is in between. As this is done, the deformed body panel is smoothed (dressed) and the tension fields in the body panel are removed.

The favored tool for this repair process is the aluminum hammer and as opposite support the universal hand dolly. To rectify minor panel

damage, the box file should be used as opposite support. Because of its serrated surface, the box file prevents normal stretching of the body panel which would otherwise occur.

Heat-induced material shrinking

Material shrinking, also called settling in, can be performed in a variety of ways depending on the extent of the damage and the access to the repair area.

These repair processes differ depending on the type of heating and subsequent working of the heated surface. They sub-divide into two basic processes:

- Heating using a carbon electrode.
- Heating using the oxy-acetylene torch.

In the carbon electrode process the working is done exclusively by warming. In this case the access to the repair position is only from the outside.

Description
1 Carbon electrode

DESCRIPTION AND OPERATION

Description		
Descript ion		
2	Spiral shaped heating pattern	

If the damage is concentrated in a spot and is in the form of a more rigid raised area, then the carbon electrode must be replaced by a copper electrode. As heat is applied, slightly more pressure is applied to the raised area.

In the method using heating by the oxy-acetylene torch, material shrinking is achieved by a combination of heat and mechanical working of the damaged area.

The combination of heating and mechanical working is very effective.

As soon as the warm point is established, hammering is immediately started using the aluminum hammer together with a suitable dolly on the inside of the repair surface, working in spiral movements towards the warm point. This causes material to build up in the center of the warmed area.

Lead loading

Despite good external panel beating techniques, it is not always possible to rectify every surface unevenness. For this reason, application of lead loading is an important part of panel beating.

 **CAUTION: Poisonous gases and dust can be produced when working solder. Use an extraction unit and, if required, a protective mask.**

NOTE: Since 07/2003, lead compounds have been ruled out for production. Appropriate lead-free tin solders and pastes must also be used in the workshop.

Typical application areas:

- Body components with limited or no access from the rear.
- Body components with very narrow cross-section.
- Body components which are particularly exposed or which can move.
- Weld seams of partial repairs.
- Rocker panel areas, wheel arch edges, side panel areas.
- Doors, hood, luggage compartment lid.
- Swage lines and joint areas.

Tin has the following advantages:

- Excellent bonding on bare metal surfaces.
- Good moulding properties.
- Good properties for the production of shapes and contours.
- Permanent shape.
- Heat expansion is the same as steel.

To create a basis for the actual lead loading process, a lead loading paste is first applied to the panel. The paste is then heated and wiped away with a cloth. Now the tin can be applied and moulded with a brazing block.

Description		
Descript ion		
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.

DESCRIPTION AND OPERATION

After the repair site has cooled down, it is worked using for example the body plane until the surface is smooth and has no transitions.

DESCRIPTION AND OPERATION**Paintless Dent Removal**

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

General

Application is restricted to body surfaces which are accessible from both sides. This repair technique is seldom feasible on double-skinned body components or closed body profiles. The same applies to edge areas, swage lines and seams on body components, which are very dimensionally stable.

The following characteristics must be present for a dent to be removed:

- The diameter must be no more than 50 mm.
- No material stretching in the centre of the dent.
- Repair area must be accessible

Furthermore, sufficient experience in the use of special tools and knowledge of materials are also requirements for a successful repair.



Satisfactory repair results are only possible on mild dents with little depth and small deformation radii. Therefore this repair method is particularly suitable for hail, parking and transportation damage.

Dent with material stretching

Item	Description
1	Deflection by a hook arrangement
2	Pressure tool

Mild dent

DESCRIPTION AND OPERATION

If strong and direct force during the damage process causes the material to stretch in the middle of a dent, then the result is a small and sharp edged dent. Such damage cannot be rectified without visible deformation.

Advantages of a planishing technique:

- Economical in time and materials
- The original paint is retained
- Environmentally friendly (no sanding or painting work)

While carrying out the repair, the following itemized repair route and process flow must be complied with:

1. Damage diagnosis
2. Repair preparations
3. Perform repair
4. Paint finishing, corrosion protection and quality control

In order to ensure corrosion protection, all inner areas of the repair must be treated afterwards. Where it is possible, the paint is repaired. In every case the inner area of the repair must be treated with cavity wax.

DESCRIPTION AND OPERATION

Plastic Repairs

General

The proportion of plastics used in vehicle construction continues to rise. Up to now damaged plastic components often had to be replaced. These days, plastic repairs are becoming more and more widely accepted because of the increasing cost of spare parts.

NOTE: Plastic adhesives are chemical products and are subject to the safety instructions of the manufacturer.

In repair work, the material properties of plastics are highly significant. There are two main groups:

- Thermoplastics.
- Thermosets.

NOTE: Elastomers make up a third group of plastics. These are not mentioned below because they have no plastics repair applications.

Thermoplastics

Heat causes thermoplastics (also called TP polymers) to transform from the solid state into the thermoelastic state and then into the thermoplastic state. When thermoplastics are cooled, they return to solid state.

Brief description	Plastic
ABS	Acrylonitrile butadiene styrene copolymer
PA	Polyamide
PC	Polycarbonate
PP	Polypropylene
PP/EPDM	Polypropylene/ethylene propylene diene copolymer
PC/PBT	Polycarbonate/polybutylene terephthalate
Hard PVC / soft PVC	Polyvinylchloride

Thermosets

Thermosets (also called TS polymers) are much harder and more brittle than thermoplastics. Their strength remains largely unchanged when they are heated. Thermosets are destroyed when heated

above the critical temperature. Also, the original state will no longer be restored on cooling.

Brief description	Plastic
GRP	Glass reinforced plastic
PUR	Close-meshed cross-linked polyurethane
PUR	Wide-meshed cross-linked polyurethane

Plastic identification

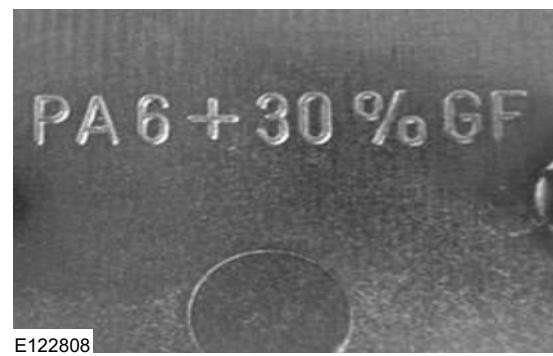
Normally the appropriate identifier is marked on the plastic components used in vehicle construction.

The capital letter sequences used for this are standardized in DIN EN ISO 1043-1 and DIN ISO 1629 (for rubber) and can be looked up in the tables which they contain. In addition the string of characters provides information about the exact mixture ratio and the proportion of certain fillers.

Examples of the identification of plastics



DESCRIPTION AND OPERATION



NOTE: The identification of the type of plastic is necessary for the plastic welding process in order to determine the correct welding rod (welding material) to use.

If an identifier is missing or cannot be made out, the following easy to perform tests will help:

Visual Inspection

Visual inspections mainly serve to identify PUR and GRP materials. Thermoplastic components are often painted and are therefore difficult to identify.

Identification characteristics:

- When PUR cracks or similar damage occurs, pores of foam can be seen.
- GRP can be recognized by the glass fiber structure on the inside.

Mechanical test:

The plastic group can be determined by a sound test:

- Degree of hardness - the higher-pitched the sound, the harder the plastic.
- Elasticity - the more muffled the sound, the higher the elasticity of the plastic.

Sanding test

In this a place is chosen which will not be visible later, and the finger belt sander is used to sand the plastic.

The plastic group can be determined using the pattern of the dust:

- Thermosets produce a white dust.
- Thermoplastics smear and do not produce dust.

Float test in water:

Take a small piece of plastic from the component to be repaired and test whether it floats on water (PP-EPDM, HD-PE, PP) or sinks (PVC/U, PVC/P, ABC, PC).

Nature of the surface

The surface of plastics can be categorized as rigid (PVC-U, PVC-P) and waxy (PP/EPDM, HD/PE, PP).

Adherence test using welding rod

Heat a welding rod that is identified with the type of material and the plastic component using the hot air gun. Press the welding rod onto the plastic component to be welded. When the welding rod cools down, if it remains stuck to the component or can only be removed with great difficulty, then it can be assumed that the two are made of the same plastic. When pulling away from PP/EPDM, HD/PE and PP, this can lead to strings.

⚠ CAUTION: Danger of poisoning! When burned, most plastics release vapors harmful to health. Ventilate the room well and use respiratory protection. Where possible work using an extraction system.

Burning test

Every plastic has a characteristic behavior and smell when burned. Using a knife, cut off a small piece from the component to be repaired, remove any dirt and paint residues and set light to the small chip. Now observe the burning behavior. Compare the color, type and smell of the smoke with the results from the following table.

Short description	Plastic recognition using a burning test
ABS	Blackish smoke, the material drips like a candle when burning and smells like wax.
PA	No smoke, draws filaments, smells like burnt horn.

DESCRIPTION AND OPERATION

Short description	Plastic recognition using a burning test
PC	Yellowish, sooty smoke. Smells sweetish.
PP	No smoke, the material drips like a candle when burning and smells like burnt oil.
PP/EDM	No smoke, the material drips like a candle when burning and smells like burnt oil.
PC/PBT	Hard and shiny, burns yellow, fluffy soot.
Hard PVC / soft PVC	Blackish smoke and acrid smell.

Safety instructions

In addition to the general safety instructions, the relevant regulations and accident prevention legislation must be observed.

NOTE: Without exception, before starting work you must read the safety and warning instructions in the chapter "Safety Instructions". In addition, pay attention to the warning instructions of the particular equipment manufacturer.

Information sheets, safety notices and guidelines for the processing of adhesives containing isocyanate, polyester resin, adhesives, solvent and thinners provide more details on their use.

The following instructions must always be followed:

- Polyester resin, adhesive, solvents and thinners are inflammable and must not be used near naked fire or flames.
- Sawing and grinding operations must only be carried out in rooms equipped with extraction systems.
- If no rooms with extraction systems are available, only use tools with extraction equipment.
- Protective equipment such as gloves, protective goggles, aprons and breathing masks are essential.

Because of the various compositions of plastics, repair work to plastic parts involves a variety of repair methods.

The following methods are used:

- Thermoplastic straightening.
- Plastic welding.
- Plastic adhesive bonding.
- Plastic lamination techniques.

Thermoplastic straightening

Damage to thermoplastics can be rectified by heating using the hot air gun (temperature about 100°C) while the deformation is pressed out until the shape is regained.

Plastic welding

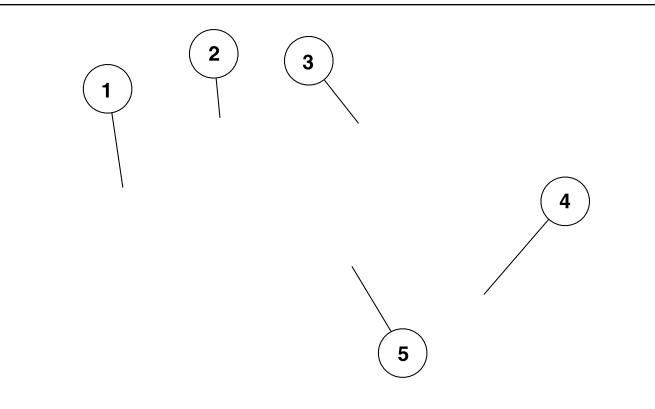
Splits formed in plastic bumpers are typical possible plastic repairs.

NOTE: Do not carry out plastic welding in the area of fixed foam backing. The foam backing will usually be destroyed and the function of the component is then no longer guaranteed.

If repair using adhesive methods is not possible because of unfavorable conditions at the rear of the repair location, plastic welding is a possible repair process.

There are two methods of welding: hot air draw welding and hot air fanning welding.

Plastic welding set



Item	Description
1	Various welding rods
2	Scraper (heart-shaped)
3	Hot air blower (approx. 1500 W)
4	Clamps
5	Welding nozzles

In addition to the components listed, plastic welding requires tools already found in the workshop such as scrapers, sanders, face cutters etc.

DESCRIPTION AND OPERATION

As with all other welding processes, only certain material combinations can be joined together using plastic welding.

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

NOTE: The manufacturer's data must be taken into account when choosing welding materials and the correct temperature setting of the hot air gun.

Repair sequence during plastic welding:

- To prepare the location for welding, remove paint residues and sand the weld area.
- If parts of the material have been pushed in by an impact, the damaged area can be brought back to shape by heating.
- Drill out the ends of the split to stop it spreading further. Machine the location of the weld into a 90° V-shaped groove, to accept the welding rod.
- Lay the welding rod in the groove.
- Perform the welding. Hot air draw welding or hot air fanning welding.
- Rework the weld seam. After cooling, sand the raised weld seam.
- Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface and paint it.

Despite good preparation and the correct choice of welding materials, weld faults may occur.

The following points must be noted when welding plastic:

- Weld together like with like:
 - With very few exceptions, only the same materials can be welded together, e.g. PP with PP.
- Correct temperature:
 - The correct choice of temperature is important for the success of the repair. The plastic must be warmed until it plasticizes (dough-like, soft).

Guideline values for welding temperature:

Brief description	Plastic	Temperature
ABS	Acrylonitrile butadiene styrene copolymer	360°
PA	Polyamide	400°

Brief description	Plastic	Temperature
PC	Polycarbonate	370°
PP	Polypropylene	280°
PP/EPDM	Polypropylene/ethylene propylene diene copolymer	280°
PUR	Polyurethane	300°
Hard PVC	Polyvinylchloride	340°
Soft PVC	Polyvinylchloride	370°

- Even pressure:
 - When rod welding, the pressure is applied by pressing on the welding rod.
- Steady speed:
 - To achieve a good weld, care must be taken that the working speed is steady.

Possible causes of weld faults:

- Deformation caused by overheating of the repair area or tensions in the material while welding the component.
- Plastic material too thin.
- Poor weld joint because the weld temperature was too low or the welding speed was too fast.
- Welding different materials together.
- Weld seam dropped because the split gap was too wide or the welding temperature was too high.

A good weld is recognized by a slightly raised, smooth and even weld bead on the surface of the component.

The weld bead must only be worked once it has fully cooled down.

Plastic adhesive bonding

Adhesive bonding of plastics has some advantages over welding methods:

- Within the group of thermoelastic plastics, all semi-rigid ancillary components (such as bumpers, front grilles, etc.) can be repaired without identification.
- A two-component polyurethane based adhesive is used for all thermoplastic parts.
- Reinforcement strips can be attached behind splits (split length up to max. 100mm) and

DESCRIPTION AND OPERATION

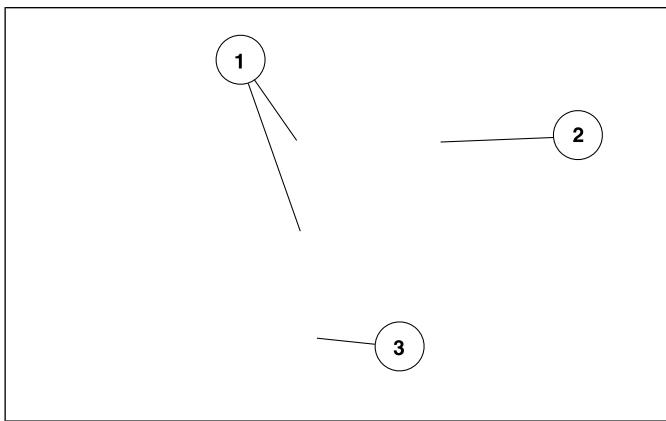
openings to ensure the original strength properties.

Tools and equipment also familiar from paint repairs can be used in making adhesive repairs to thermoplastic components.

Angle grinders and belt sanders can be used to grind out scratches and splits. Orbital sanders with extractors are used for fine sanding.

The infrared heater is used to provide fast and certain drying throughout.

Plastic adhesive set



Item	Description
1	2-component adhesive
2	Cartridge gun
3	Mixing tube

Apart from the components shown, other materials may be needed to bond plastics, depending on the repair position.

For large scale repairs, it may be necessary to insert reinforcement panel strips and reinforcement matting as fixing aids.

Repair sequence during plastic adhesive bonding:

NOTE: Follow the manufacturer's guidelines when using adhesives.

- Prepare the location of the bond. Remove paint residues and sand the area to be bonded. Drill out the ends of the split to stop it spreading further. Prepare the bond location into a V-shape and clean it with plastic cleaner.
- Apply the adhesive. The two-component adhesive is applied to the cleaned and primed repair location using a hand gun. Spread and smooth the adhesive using a flexible plastic spatula.
- Rework the bond location. After cooling, sand the raised adhesive. Clean the sanded repair

surface using plastic cleaner. Apply plastic primer thinly to the repair surface. Apply paint.

GRP repairs

GRP material is hard and brittle in its strength properties. Because of these material properties, splits and openings often result in cases of serious damage.

The stability of GRP parts is impaired if the glass fiber reinforcement is cracked. The component must be replaced in cases of serious damage that affect the structure.

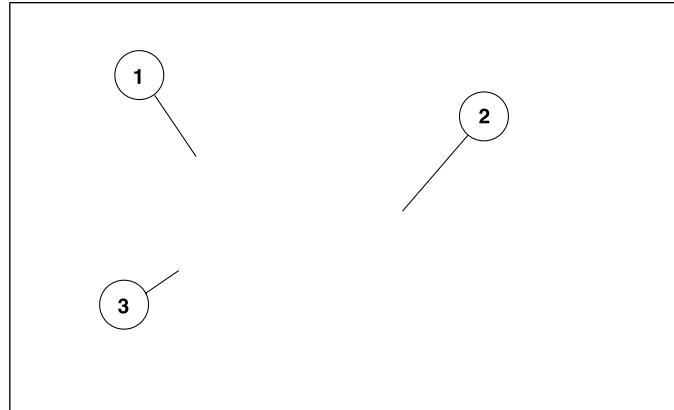
Minor damage (such as abrasion, splits up to 80mm, holes up to approx. 60mm diameter, etc.) can be repaired to a technically and visually perfect standard, provided that the damage does not occur in heavily used or hard-to-reach areas.

To ensure perfect repair results, observe the following points:

- The room temperature should be at least 15°C and the air should be as dry as possible.
- The repair location must be thoroughly dry and clean.
- Before the repair, the GRP part being repaired must be dried using an infrared heater or in a drying oven.
- In cases of large splits and fractures, the strength of the outer skin can be re-established by backing with a reinforcement material.

Tools and equipment from the paint shop can be used to carry out repairs to GRP parts. Angle grinders and belt sanders can be used to grind out scratches and splits. Orbital sanders with extractors are used for fine sanding.

GRP repair set



DESCRIPTION AND OPERATION

Item	Description
1	Polyester resin
2	Glass fiber mats
3	Hardener

Scissors, paintbrush and cleaning materials are other materials which will be needed to perform a GRP repair.

NOTE: Follow the manufacturer's instructions when using the repair materials.

The repair process for a GRP repair is as follows:

- Prepare the repair location. Remove paint residues and sand the repair area.
- Drill out the ends of the split to stop it spreading further.
- The repair location must be sanded by hand. If machine working is attempted, the resin will be heated so much that the surface structure will be changed. The result is inadequate adhesion.
- Perform the GRP repair. Apply polyester resin thinly to the repair location. Lay the glass fiber mat in place and apply polyester resin over it again.
- Rework the location of the repair. Sand away any polyester resin which stands proud after it has hardened.
- Clean the sanded repair surface using plastic cleaner. Apply plastic primer thinly to the repair surface and after it has dried apply the paint finish.

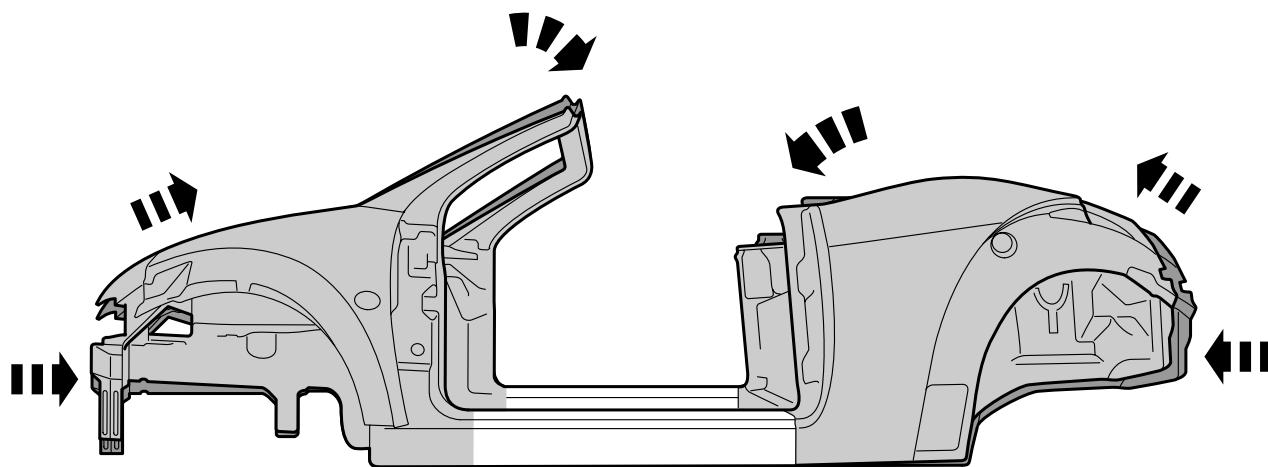
DESCRIPTION AND OPERATION

Special Repair Techniques

Cabriolet vehicles

The body of a cabriolet vehicle is different to the self-supporting body of a saloon car because of

the special roof construction (folding top). The stability requirements must therefore be ensured by construction changes within the body structure.



These are for instance:

- Longitudinal and torsional reinforcing components which compensate for the lack of the roof.
- Reinforcements to the floor assembly, particularly in the rocker panel area.
- Reinforcements in the pillar areas.
- High-strength and ultra-high-strength steel panels with single panel thicknesses of up to 2.5 mm, which in combination can become up to 6mm thick (e.g. reinforcements in the floor area, rocker panels).

If deformation to load carrying components occurs, the stability of the whole body shell can be adversely affected.

On a cabriolet, accident damage repair to the components mentioned above is considerably different in certain aspects compared with the usual repairs (closed body construction):

- A model specific alignment angle system must always be used during straightening and repair work, securing using clamps at the rocker panel area is not always adequate for the cabriolet.
- To avoid damage to the doors, they must always be open during straightening work. In the case of more severe damage, additional tension and compression spindles must be used to stabilize the door cut-outs (between the A- and B-pillars).
- In load bearing areas such as the rocker panels, side members and floor pan, increased straightening forces are necessary due to the additional reinforcements.

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- NOTE:** Additional information on welding can be found in the section Welding Equipment and Joining Techniques.
- High-power welding equipment for panel thicknesses in overall combination of up to 6 mm total material thickness.
- The fitting accuracy and longitudinal rigidity of the affected component is especially important to ensure that the doors, door windows and the roof fit and close correctly.

Liquefied gas vehicles

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

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

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

⚠ CAUTION: Danger of fire and explosion.
The safety instructions must always be followed when performing service work on fuel/gas systems. Failure to follow these instructions may result in personal injury.

NOTE: You will find further information about working on liquefied gas vehicles in the section Health and Safety Information.

Refrigerated conversion vehicles

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

⚠ CAUTION: Danger of injury. Work on the 230^{SP}volt system of the refrigeration equipment must only be carried out by trained specialist personnel.

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

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

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

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

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

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

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

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

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

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

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

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

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

If access to the back of a body panel section is needed because of body straightening work, in

DESCRIPTION AND OPERATION

some circumstances it is cheaper to perform a cut-out repair instead of removing an element.

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

NOTE: You will find further information about working on vehicles with a refrigerated compartment in the section Health and Safety Information.

DESCRIPTION AND OPERATION

Joining Techniques

Welding

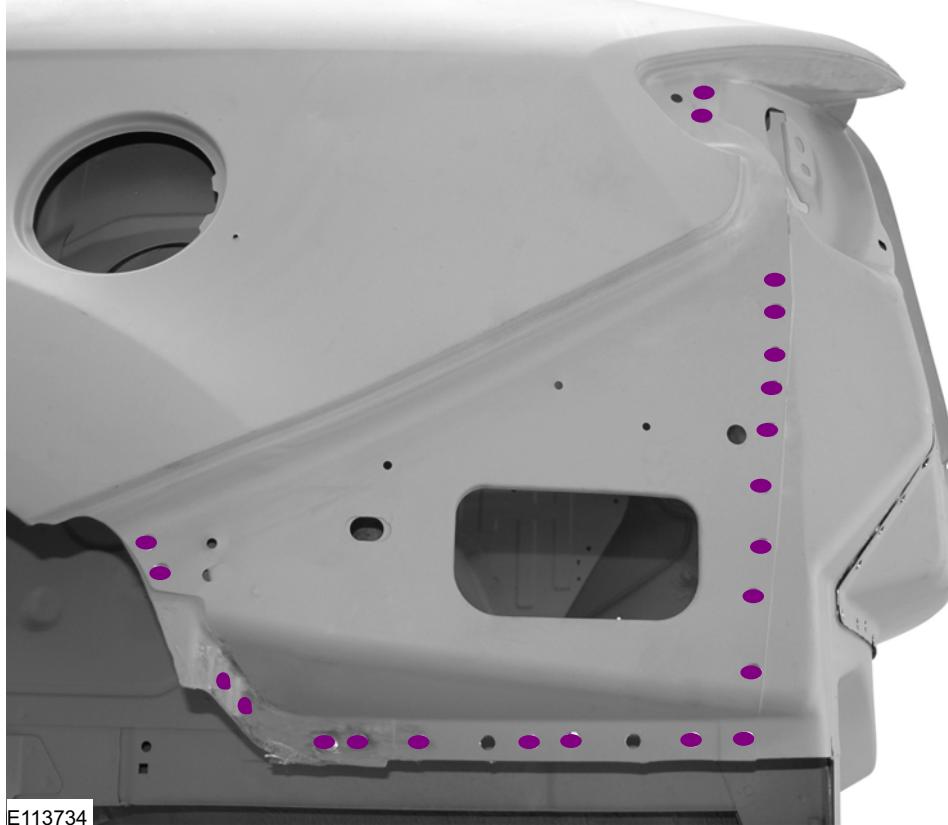
Before welding work is performed on a vehicle body, all safety measures for the protection of people, modules and electrical components must be observed.

NOTE: Before beginning the work, please refer to the safety instructions and warnings in the chapter Safety Instructions. Please also note the warnings of the respective equipment manufacturer.

Resistance spot welding and MIG welding are the most common techniques used in body construction. During repair work, the welded connection must be restored to be equivalent to the original.

Resistance spot welding.

NOTE: Before starting the work, please refer to the chapter on safety instructions.



In doing so, the repair welds must match the standard of those produced in production in number and diameter.

Preconditions for resistance spot welding:

- The panels to be welded overlap.
- The weld spot is accessible on both sides for the electrodes.
- The shape and alignment of the weld electrodes is correct.
- The resistance welding equipment is powerful enough to be able to reproduce the production spot weld diameter.

NOTE: The welding equipment settings and the adjustment of the individual parameters are to be made in accordance with the device manufacturer's specifications.

Well-prepared welding flanges are a prerequisite for a problem-free welded joint. This means:

- The welding flanges must lie perfectly flat to one another.
- The welding flanges must be clean and free of oil or grease on both sides.
- Welding primer (zinc-coated and conductive) must be applied as corrosion prevention.

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Only in limited cases can welding errors in resistance spot weld joints be detected from the outside. Therefore, a test weld should be carried out before each repair weld. The peel test carried out after the welding gives information on the quality of the welding. The spot weld itself must never separate, it must tear away leaving a hole.

MIG welding

Basically, three methods of MIG welding are used:

- Puddle weld.
- Continuous bead welding
- Intermittent bead welding

Fields of application

- Any joins that are MIG welded in production must also be replaced by MIG welds.
- Puddle welding may be used in certain cases, if there is insufficient access.
- If the overall panel thickness is greater than 3 mm, without correspondingly powerful spot welding equipment, puddle welding should be used.
- When dealing with any MIG brazed joints which are present, follow the vehicle-specific repair instructions.

NOTE: The increased application of heat during MIG welding destroys the corrosion protection layers over a much larger area than during resistance spot welding. For this reason, greater care must be taken when applying the corrosion protection afterwards.

Welding repairs can only be carried out properly if the equipment is set up correctly and all welding-related preparations are complied with accurately.

- Please note the instructions of the respective welding equipment manufacturer.
- The hose assembly must be untwisted.
- The core must be free from particles of wire debris.
- The gas and current nozzles must be free of slag and scale residue.
- Pay attention to the quality of the welding wire and the gas flow rate.
- Ensure that the joint surface is perfect.
- Prepare a bare metal joint surface.
- Maintain the correct gaps (root formation).
- Produce a test weld.

Plug Weld



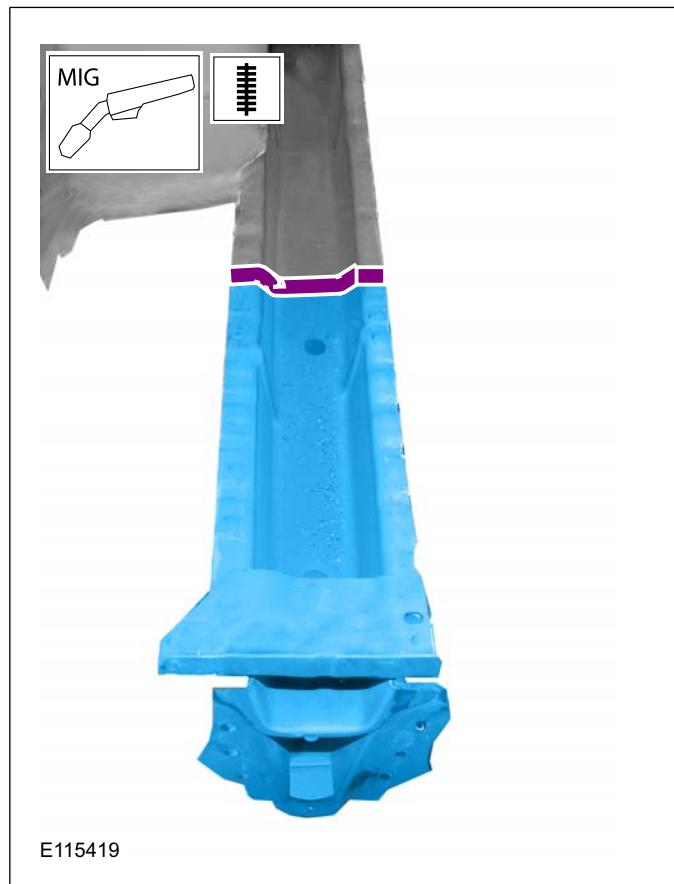
DESCRIPTION AND OPERATION

Special features to note when puddle welding:

- The panels to be joined must lie perfectly flat to one another.
- The panel flanges must be treated with corrosion protection. The position of the weld must be bare.
- Prepare the holes depending on the thickness and number of the panels. The hole size should be 6-10 mm, or match the original weld spot.
- Start the welding procedure on the panel at the bottom so that the hole is filled completely.

Continuous bead welding

A welded joint with a full seam is suitable for joining highly profiled body parts. Pillar and sill areas are typical application areas.



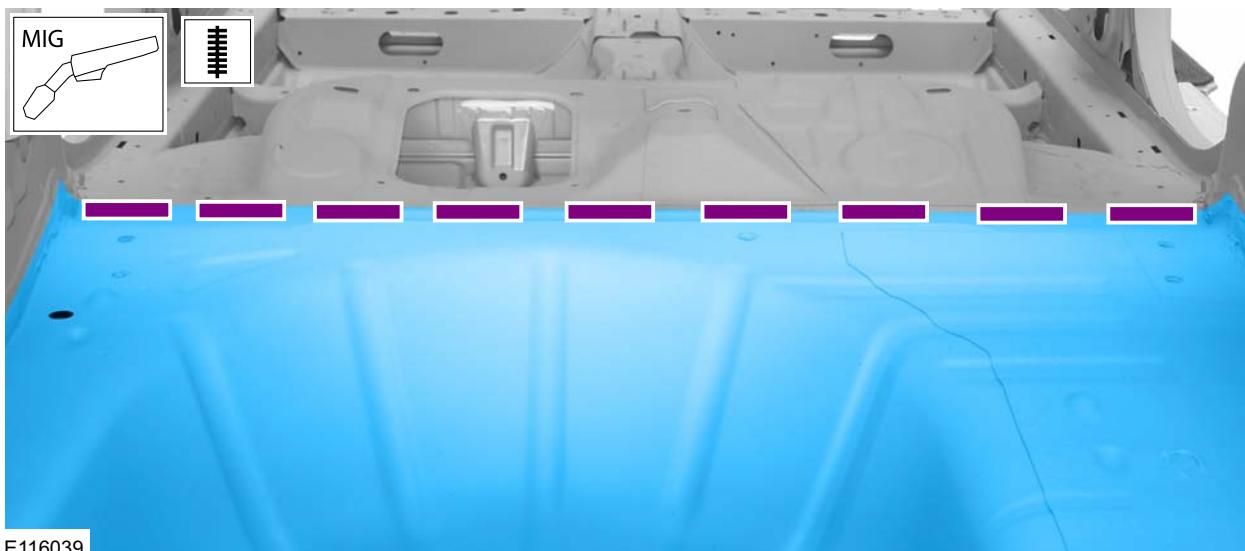
Special features to note during bead welding:

- Both parts of the panel must be bare on both sides over a width of 5 mm.
- Align the parts precisely with clamps.
- To prevent the panel from warping, tack longer joints before welding them.

Intermittent bead welding

Intermittent bead welding is used when the connecting flanges are stepped. This form of seam is mainly used on the external panel area for sectional repairs.

DESCRIPTION AND OPERATION

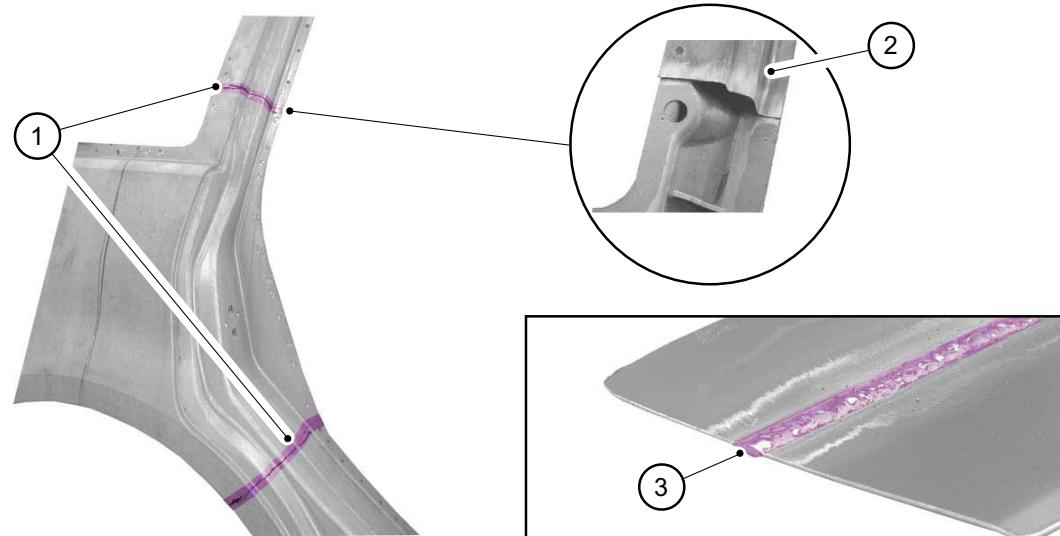


Special features to note when intermittent bead welding:

- Weld gap.
- Spot weld interval.
- Apply alternate tack welding across the entire length of the seam. This keeps warping to a minimum.

Joining techniques

Butt joints



Description	
1	Join areas
2	Profile
3	Full seam

The butt joint is a joining technique frequently used in body repairs. The butt joint is typically used for repairs in the pillar and rocker panel area.

Areas that are suitable for the use of the butt joint:

- short seam lengths.
- highly profiled structures.

The edges of the panels to be joined are placed against each other and are joined with a full seam

DESCRIPTION AND OPERATION

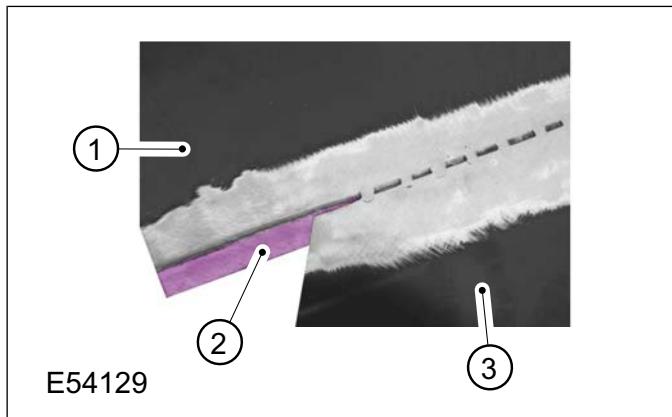
in whilst maintaining a required welding gap (welding gap same as panel thickness).

NOTE: The butt joint requires a high degree of accuracy and care when trimming and cutting. For correct execution of the welding, an exact, even welding gap must be maintained.

Preparation of the joint areas includes:

- Sanding the connection areas bare on both sides.
- Removal of the zinc layer in the welding area.
- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Tack welding in the join area: From the edges to the centre, then check the shape.
- Joining new and old parts with a full seam weld.

Joggled joint



Descript ion	Description
1	Body part
2	Joggled area
3	New panel

The joggled joint variant is restricted to body areas with a good surface condition without beads/swage lines or profiles. A sectional replacement with a joggled joint is welded using a continuous seam. This procedure is used, for example, at the transition from the side panel to the rocker panel (3-door vehicles).

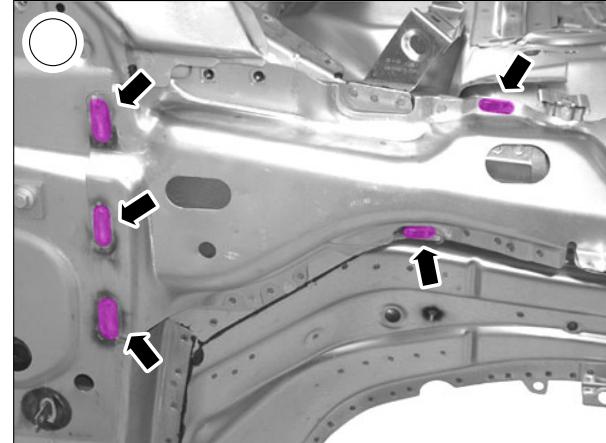
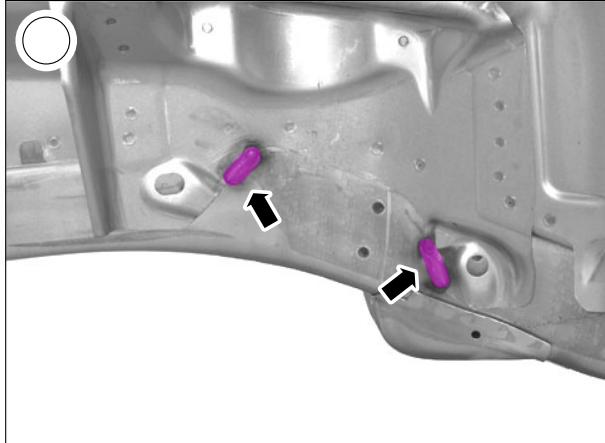
When cutting the new part, slight measuring tolerances are permitted, as these are covered by the joggled area.

Preparation of the joint areas includes:

- Sanding the connection areas bare on both sides.
- Removal of the zinc layer in the welding area.
- Preparation of a joggled strip.
- Carrying out welding tests on an equivalent sample panel before the actual welding, if necessary.
- Joining the new and old panel with continuous seam welding.
- Lead loading the weld seam.

DESCRIPTION AND OPERATION

MIG brazes



Description	
1	Rear side member / wheelhouse reinforcement
2	Apron panel reinforcement / A-pillar

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

In areas where resistance spot welding is not possible due to limited space or higher strength requirements, MIG welding was previously used.

Increasingly, these MIG welded seams are being replaced by MIG brazes. The temperature range used during MIG brazing is significantly lower. This keeps the damage to the anti-corrosion zinc layer on zinc-coated panels to a minimum.

This results in the following advantages of the MIG brazed seam:

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- No corrosion of the brazed seam.
- Low erosion of the zinc coating in the joining area.
- Low level of heating and thus little warping.
- Easy finishing of the brazed seam.
- Good for bridging gaps.

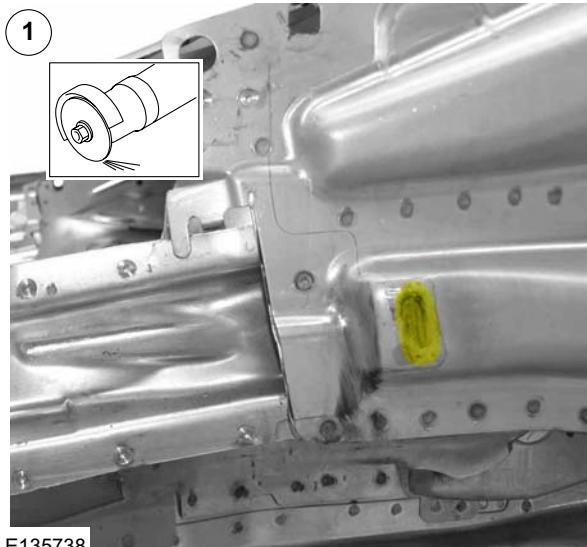
Technicians performing MIG brazing must use a **Ford-certified MIG brazing device** and must have been given appropriate training on the brazing techniques which are used.

Only use the Ford-approved brazing solder SG-CuSi3 (SG-CuSi3Mn1).

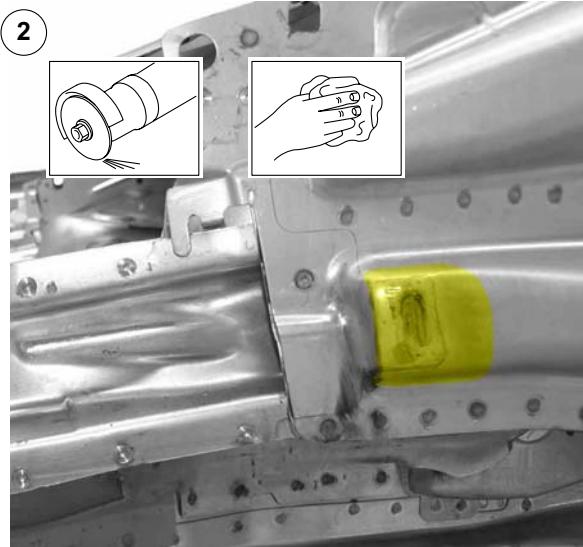
Unless specified otherwise, a minimum gap of 30 mm must be maintained between the MIG brazed seam and any adhesive bonds.

CAUTION: MIG welds must not be carried out on or near existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam.

If MIG brazing cannot be used then the factory-installed MIG brazed joints should be replaced with MIG welds in a different place during service repairs. These MIG welds must not be carried out on or in the immediate vicinity of existing MIG brazed seams as even the smallest amount of brazing solder can result in a reduction in the strength of the weld seam. Consequently, the corresponding graphics offer two alternative repair techniques (1: MIG brazing; 2: MIG welding).



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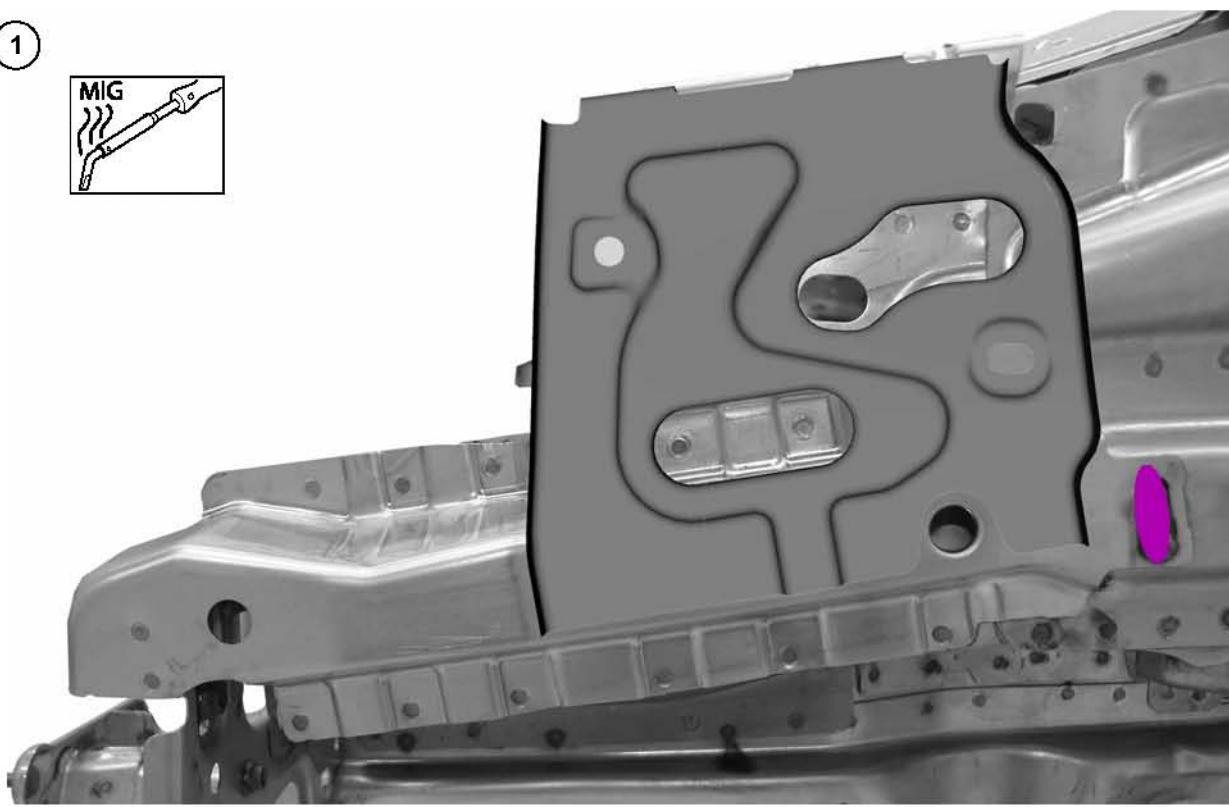
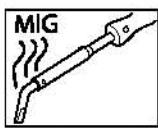


Description	
1	Preparation of the MIG brazing: Flatten the old brazed seam with a grinder.

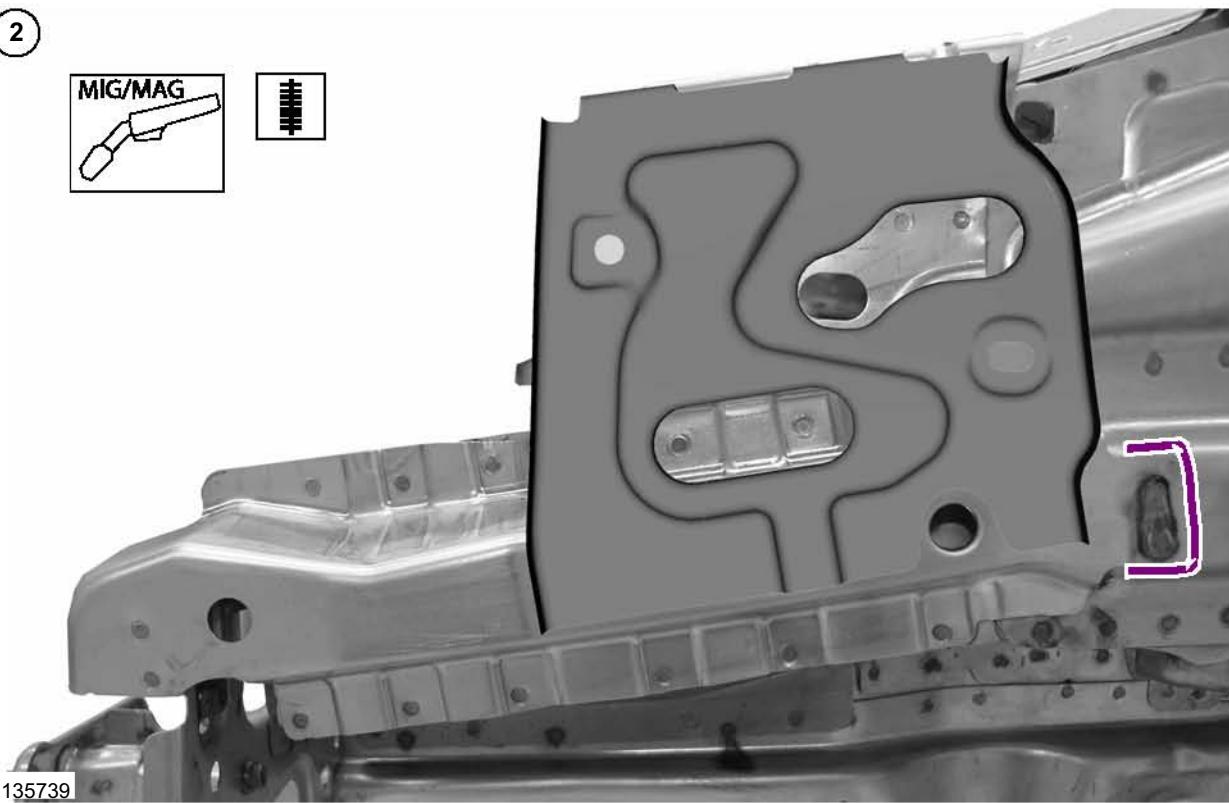
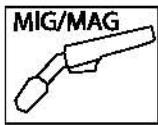
Description	
2	Preparation of the MIG welding: Grind the old brazed seam and the surrounding area until they are clean, and remove any residue of the brazed seam.

DESCRIPTION AND OPERATION

1



2



E135739

DESCRIPTION AND OPERATION

Description	Description
1	MIG brazing: Braze a new seam in the same place as the factory location for the seam.
2	MIG welding: Weld the seam away from the location of the factory-installed MIG brazed seam.

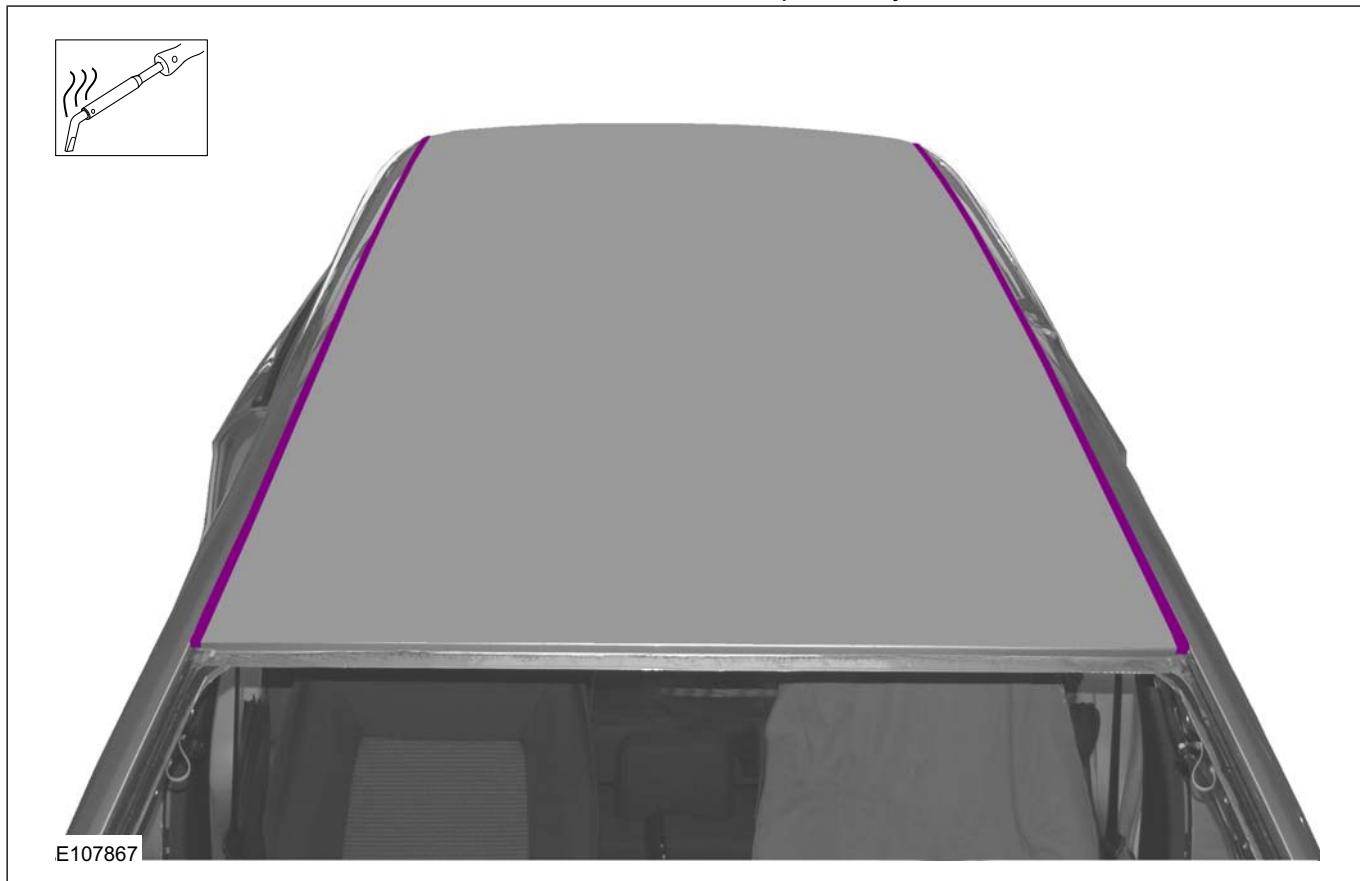
Apart from in the locations used in production, MIG brazing can also be performed on non load-bearing outer body skin panels and floor panels.

CAUTION: Without prior approval from Ford, MIG brazing must not be performed on structural parts of the chassis or body.

Soft soldering

WARNING: The roof repair may only be carried out in Ford-approved special workshops and only by specially trained personnel.

NOTE: The roof is secured to the side walls with laser soldered seams in production. When repairs are carried out, these laser-soldered seams must be replaced by soft-soldered seams.



E107867

WARNING: Poisonous gases and dust can be produced when working solder. Use an extraction unit and, if required, a protective mask.

NOTE: Ford offers basic and in-depth training on the following topics.

NOTE: Areas for soft soldered joints require careful preparation. It is extremely important that the joint surfaces are exactly aligned and that a bare metal joint surface is prepared.

This means:

- Thorough cleaning of the surfaces to be brazed.
- Close contact of the panels at the brazing position.
- Use the soldering iron to warm the location of the seam to be joined.
- The liquid brazing material is drawn between the panels through capillary action.

Rivets

With riveting, two or more panels are joined together using a joining element (rivet). In body

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construction, pop rivets and punched rivets are used.

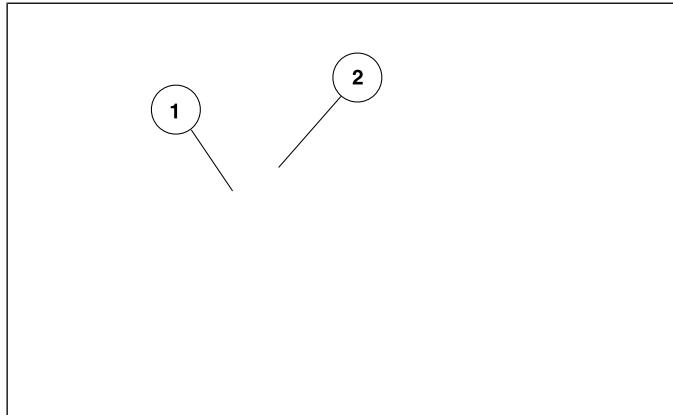
Advantages of riveted connections:

- Metallic and non-metallic materials can be joined together.
- Different thicknesses of materials can be used.
- The material does not have to be heated, and therefore does not warp.
- Low level of preparation required.

NOTE: For detailed instructions on the procedure, please refer to the equipment manufacturer's operating manual.

Disadvantage:

- During dismantling procedures, swarf/rivet remains can fall into inaccessible cavities, which can lead to rattling and rusting.

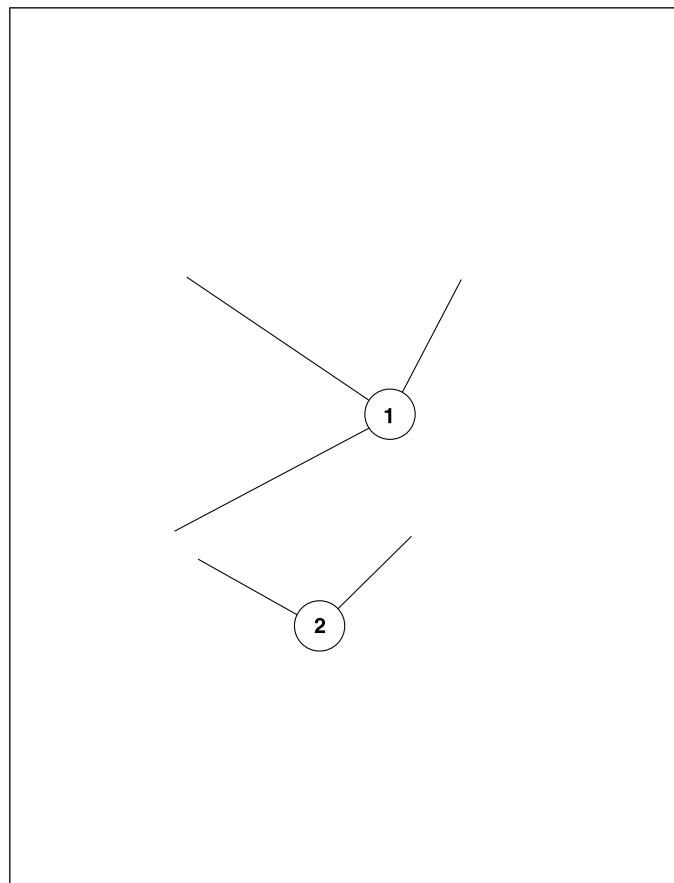


Description	Description
1	Panels
2	Pop rivet

Pop rivets are used if only one side of the panel is accessible. In this process, overlapping panels are drilled and connected with a pop rivet.

Pop rivets can be inserted pneumatically, hydraulically or manually with rivet guns.

Bonding



Description	Description
1	Butt joints
2	Bonded connection

Bonded connections are used more and more in modern body designs. Here, a distinction is made between bonds for stabilization purposes and bonds for adhesive strength. Bonds for stabilization purposes are found on clinched flanges and on cross beams in doors or on the roof.

 **WARNING: Risk of poisoning! Adhesive can be harmful to health. Ventilate rooms well and use breathing protection. Where possible, work with an extraction unit.**

NOTE: Adhesives are chemical products and are subject to the safety regulations of the manufacturer.

Please refer to the specifications in the general part of the particular manual for information on the repair adhesive which is to be used.

Advantages of glued joints:

DESCRIPTION AND OPERATION

- They are air and watertight.
- High corrosion protection
- Different materials can be connected.
- Bonding can be combined with resistance spot welding.

NOTE: The quality of the bonded connection is largely dependent on the care taken during preparatory work. When gluing bodywork parts, follow the work instructions from the adhesive manufacturer.

Bonding and welding

On some vehicle models, (such as the Ford Ka), bonding is combined with resistance spot welding. This connection technique has the following advantages:

- Tight, anti-corrosion connection seam.
- High strength due to additional resistance weld spots.

Please note the following points during the repair work:

- Only use adhesive suitable for welding (conductive).
- Carry out resistance spot welding on the connection flanges before the adhesive hardening process.
- Carry out test welding with the adhesive applied.
- If MIG welding is carried out during a sectional repair on a connecting flange with sealant or adhesive material, the material must be applied at a distance of approx. 10 mm from the weld spot.
- These areas must be sealed very carefully after the work has been completed.

Bonding and riveting

As with welding, bonding can also be combined with riveting. This connection technique has additional advantages. These are:

- Metallic and non-metallic materials can be joined together.
- Different thicknesses of materials can be used.
- The material does not have to be heated, and therefore does not warp.
- The rivet connection stabilizes the connected components during the adhesive hardening phase.

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Impact of Insufficient Repair Quality

Body repairs usually require a significant level of intervention in the existing body shell structure. The corrosion protection, seals and NVH components are destroyed and must be replaced.

To prevent the vehicle quality from being reduced due to a poor quality repair, all repairs carried out in all repair sections must be inspected during and after the accident repair.

Simply checking the vehicle at the time of delivery is not sufficient to guarantee the repair quality. Rather, continuous checking of the work carried out is recommended.

NOTE: Logs of the acceptance of individual operations are a useful tool for quality assurance. A comprehensive final inspection can be carried out based on a final acceptance log.

In the process, the entire repair sequence must be split into meaningful sections, with the creation of check points to which particular attention must be paid.

The following are some possible sections:

- During and after body work.
- Final assembly, ancillary components, functional tests.
- Vehicle delivery.

NOTE: The following points offer an indication of possible test logs. They can be combined and supplemented differently, depending on the individual operating procedures.

During and after body work the following areas should be checked:

After completion of the body repairs, the following areas should be checked:

- Manufacturing inspection for functionality and originality in the accident area.
- Check snug fitting of metal panel parts (welding and screw connections).
- Check snug fitting of ancillary components (doors, hoods, glazing).
- Check surface condition of the welded seams.
- Check seals, blanking plugs, NVH components.
- Check corrosion prevention measures
- Check that the repair work is in the correct condition for painting.

Final assembly, ancillary components, functional tests

After final assembly, not only a visual inspection is required, but also the functionality of many components must be checked:

- Check repair area for originality.
- Check ancillary components for correct installation.
- Check precision fitting of all parts.
- Check that the doors and flaps are working correctly.
- Check that all mechanical parts, such as the window winder are working correctly.
- Check for leaks in the repair area.

Vehicle delivery

Vehicle delivery again offers the opportunity of checking the repair quality. In the process, the following points are to be checked again:

- Corrosion protection, sound damping matting and rubber seals.
- Check for traces of leftover paint.
- Check the cleanliness of the vehicle.
- Functional check of the mechanical and electrical components.
- Road test the vehicle.
- Check for noise, vibration and harshness (NVH).
- Check for wind noises.

After repair work on the body and vehicle, not only the visual restoration of the damaged vehicle, but also the functional restoration must be guaranteed.

Customers are making increasingly high demands of vehicles, particularly in terms of driving comfort. Customers find noise, vibrations and harshness (NVH) as well as squeaking and rattling annoying, particularly after repair work. It is therefore important that the condition of the vehicle at the time of production be restored after an accident repair.

After body repairs, the entire repair area must be checked for any water leaks. It is crucial that a leak test be carried out as part of the final inspection so that water leaks can be detected and eliminated even before delivery of the vehicle to the customer.

The requirements of the vehicle manufacturer are to be taken into consideration during all inspections. Only in this way can it be guaranteed

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that the vehicle quality is not reduced through insufficient repair quality.

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Water Leaks

Water leaks can occur after body repair work, but can also occur on new vehicles. The test methods described below allow the various causes to be identified. In all cases, a systematic and logical procedure is required to locate water leaks.

General

When searching for faults, it must be taken into account that water can enter the vehicle passenger compartment in various ways and circumstances. Therefore, it is sometimes not sufficient to perform a water test on a stationary vehicle.

Before beginning extensive checks, a thorough visual inspection must be carried out. The following points are to be taken into account in the process:

- Check the clearance and accurate fit of ancillary components such as the trunk lid and doors.
- Check for correct installation and possible damage to sealing elements such as blanking plugs, seals and rubber door seals.
- Check that the water runoff openings and pipes are free of obstructions

Test method

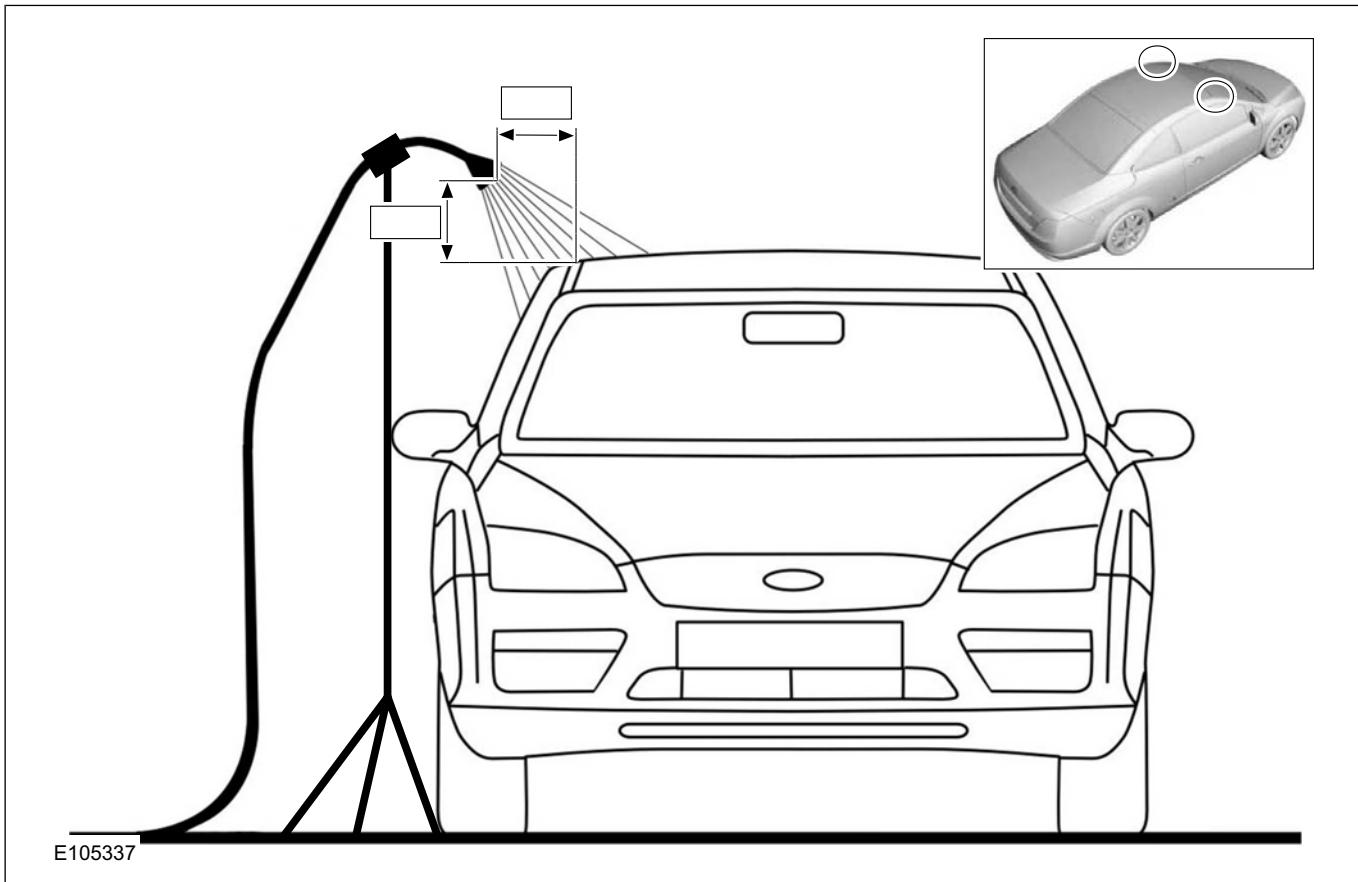
Water test

NOTE: Do not use a power washer. Use a normal garden hose with a spray nozzle or sprinkler head. Make certain that all windows and doors are completely closed.

Water leaks into the vehicle passenger compartment cannot usually be located immediately, as the water often spreads across a large area. For this reason, the passenger compartment must be dried before the leak tests. Any ancillary components that block the view must be removed. During the water test, the vehicle is sprayed or sprinkled with water at the suspected location of the leak. At the same time, a second person checks the passenger compartment for places where water enters the vehicle. Depending on the test and the vehicle, it may take some time before there is any sign of water entering the vehicle. We recommend laying blotting paper under the location being tested so that the water entry can be localized.

Example: Water test with sprinkler head (rain test)

DESCRIPTION AND OPERATION



Car wash test

Certain leak problems only appear in a car wash or can only be simulated there. The concerned area of the passenger compartment should be inspected with a torch during the wash procedure.

Road Test

Some leaks only appear when the vehicle is moving. If no leaks are detected during the above-mentioned tests, road tests should be carried out on wet roads:

- At various speeds.
- On various road surfaces (asphalt to cobbles).
- With loaded or unloaded vehicle.
- Driving through puddles (splash water).

Test with UV lamp

A leak test can also be performed using a UV lamp and a special contrasting agent. The advantages of using contrast agent are:

- No need to dry out wet areas beforehand.
- The water entry and its subsequent path can be seen more clearly.
- No need to remove most ancillary components from the vehicle.

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

Procedure for using a UV lamp.

- Wet the test area with clear water from the outside.
- Prepare test liquid and apply it from the outside using a suitable water sprayer.
- Illuminate the relevant area from the inside using the UV lamp. The test liquid which enters will make the leak visible.

Chalk/powder test

This test checks the contact surfaces of seals on doors, hatches and lids.

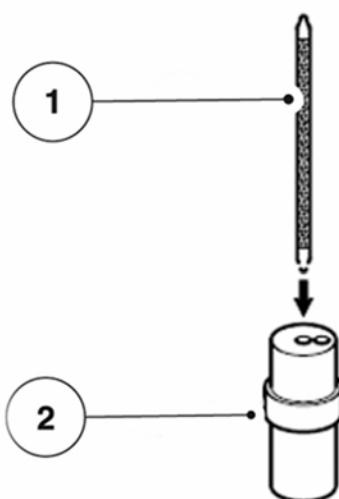
Process using a door seal as an example:

To do this, the door seal is coated with powder or brushed with chalk. A thin layer of grease is applied to the contact area of the seal. The door must then be slowly closed and reopened. The width and continuity of the imprint can now be checked on the seal.

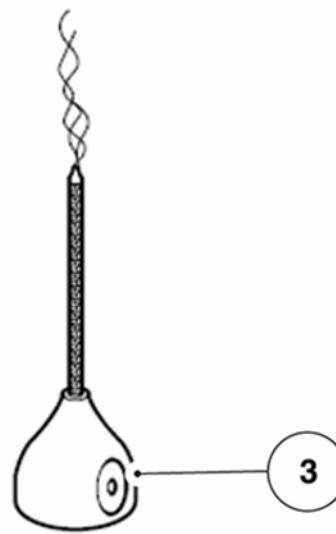
DESCRIPTION AND OPERATION

Smoke test

Flow checking device



E122761



Description	Description
1	Test pipe
2	Test pipe opener
3	Puffer ball

Operating principle

The flow checking device is a set made up of a flow-testing pipe, a test pipe opener, puffer ball and closing-off caps for the pipe.

The test pipe contains a filling layer which is impregnated with fuming sulfuric acid. When air is blown through the pipe by the puffer ball, sulfuric acid is emitted as an aerosol in the form of a white smoke.

NOTE: Pay attention to the instructions for use and the safety directions issued by the manufacturer. The smoke test can only be performed in a draft-free environment.

This test can be used to detect leaks visually. Procedure:

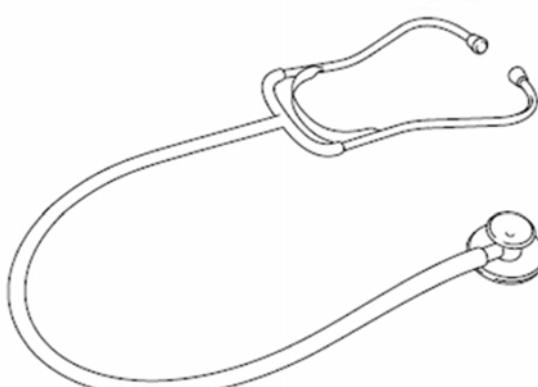
- Break off both tips of the pipe in the pipe opener, in exceptional cases in the top of the packaging.
- Insert the pipe into the puffer ball so there are no leaks.
- Close the hole in the puffer ball with your thumb and press the air contained in the ball through the pipe.
- Set the ventilation blower in the passenger compartment to the highest setting.

- Close all doors so that a slight overpressure can build up in the passenger compartment.
- Move the smoke pipe along the outside of the body to the areas to be checked.
- Leaks can be detected through the irregular movement of the smoke.

Stethoscope test

This procedure is very similar to the smoke test. Instead of the smoke pipe, move a stethoscope past the areas of the body that are at risk. Leaks can now be detected acoustically.

Stethoscope



E122763

DESCRIPTION AND OPERATION

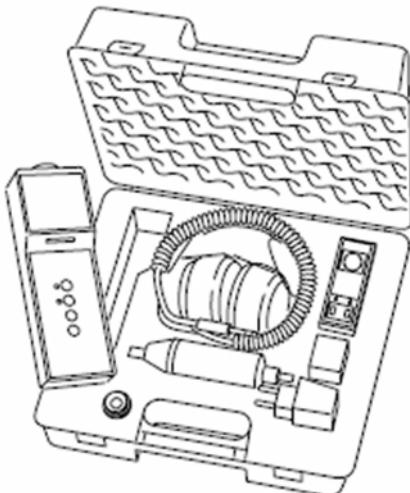
Ultrasonic detection

This test uses ultrasonic waves to locate the positions of leaks. When an ultrasonic transmitter is placed inside the vehicle, it sends out ultrasonic waves. A leak is located by running a detector along the suspected area. The position with the loudest reception of the escaping ultrasonic waves is the location of the leak.

Procedure:

- Place the ultrasonic transmitter in the vehicle.
- Completely close the vehicle.
- Search the exterior of the vehicle using the detector.
- The detector provides a simple indication of a leak.

Ultrasonic test device



E122762

Workflow for tracing water entry

Stage	Testing	Result	Action
1st	Ask customer for a detailed list of possible reasons for the water entry. Does this information allow the cause of the leak to be identified?	Yes	Dry out the vehicle and repair the damage. Perform a water test as a check (see test method).

Stage	Testing	Result	Action
		No	Step 2.
2nd	Perform an initial visual inspection on the vehicle. Look for signs of water entry. Can the cause of the leak be identified immediately?	Yes	Dry out vehicle. Repair damage. Perform a water test as a check (see test method).
		No	Step 3.
3rd	Is it possible that water is getting into the vehicle through a seal (door seal, trunk lid seal)?		Check the seal for damage. Check the creation of the seal using the chalk test (see test methods). Step 4.
		No	Step 5.
4th	Is the contact area for the seal adequate?	Yes	Step 5.
		No	Perform work as described under Areas with possible water leaks - Door seals. Dry out vehicle. Repair damage. Perform a water test as a check (see test method).
5th	Before starting any further work, use the VIN to look for model-specific information in eTIS. Perform Oasis query and check TSIs. Does this information allow the cause of the leak to be identified?	Yes	Dry out vehicle. Repair the damage using the information found. Perform a water test as a check (see test method).
		No	Step 6.

DESCRIPTION AND OPERATION

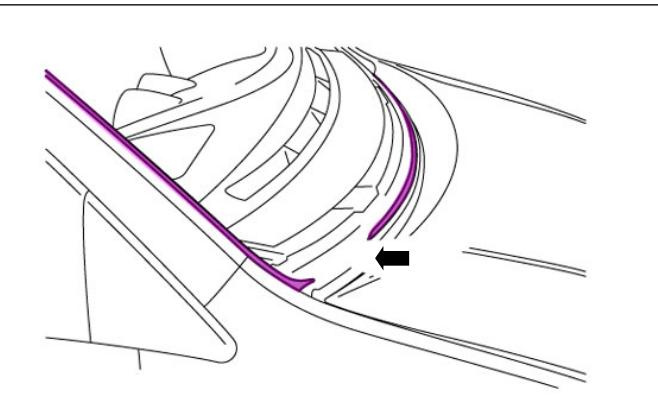
Stage	Testing	Result	Action
6th	Establish the extent of the damage. To do this, expose wet areas. Remove parts. Investigate the suspected area for signs of water. Does an investigation of the suspected area allow the cause of the leak to be identified?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	Step 7.
7th	Check exterior areas (seals, seal welds). Check interior areas: Signs of water, plugs, seal welds. Can the cause of the leak be identified?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	Step 8.
8th	Perform water test or ultra-sound test. Can the cause of the leak be found?	Yes	Dry out vehicle. Repair leak. Perform a water test as a check (see test method).
		No	The water entry may only occur under dynamic driving conditions. This requires intensive tests to be repeated with the corresponding climatic influences (rain).

vibrations, roughness chapters may be useful in identifying the fault.

An outline of the possible complaints due to water leaks is provided below. The causes of water leaks and the possible remedies are presented using selected examples. They are intended to provide troubleshooting tips and suggestions for the user but do not represent an exhaustive faults list.

Glued windows

A broken pasted seam can cause water to enter around the window. A broken pasted seam can be located using a water test or by carefully blowing compressed air onto the inside of the window seal.



Corrective action

Broken adhesive seams **-Arrow-** can be sealed from inside using PU glass adhesive.

If this seal does not resolve the problem or the broken pasted seam is too extensive, it is necessary to remove the window and glue it back into place.

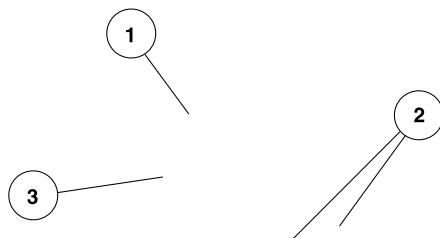
Door seals

If water appears at the bottom of the door, it is possible that the door seal behind the door trim is damaged. If the door is intact, water can enter through the window weatherstrip and flow out through gaps on the underside of the door. If the door seal adhesion is faulty or the door seal is damaged, water can get into the interior.

Possible complaints and corrective actions

NOTE: Water leaks and changed vehicle acoustics can have similar causes. For this reason, information from the Wind noise or Noise,

DESCRIPTION AND OPERATION



Fastening bolts could be loose or clips incorrectly positioned on door modules.

Corrective action

Depending on the door seals used, different sealing methods can be used.

NOTE: The drainage holes on the underside of the door may not be blocked - if they are, clean them. Defective films and foam seals must be replaced.

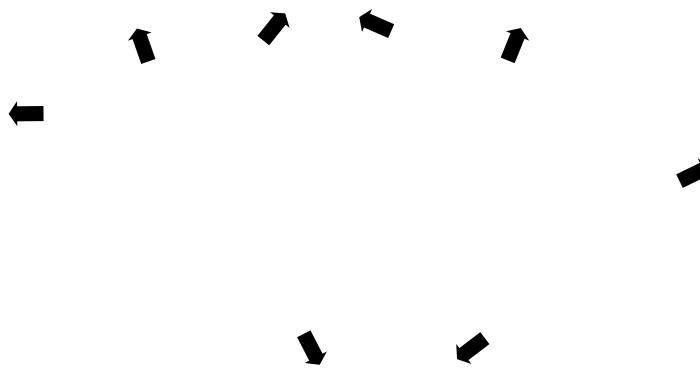
Once the adhesive surfaces have been cleaned, plastic films must be stuck with double-sided adhesive tape or replaced.

Leaky foam seals are sealed with Butyl tape or replaced.

Plastic door modules are fitted with a weatherstrip, which cannot be replaced. Seal the leaky point with Butyl tape or replace the part.

Description	Description
1	Seal/adhesion
2	Clips
3	Door speaker

Door weatherstrip



Leaks can be caused by badly fitted seals. In particular, areas with radii -Arrow- must be thoroughly checked.

Door seals can develop leaks due to:

- Damaged or expanded seals.
- Ageing.
- Insufficient contact pressure.
- Inadequate contact area for seal on body part.

- Uneven welded flange thickness because of several layers of body panels or production tolerances.
- Kinks.

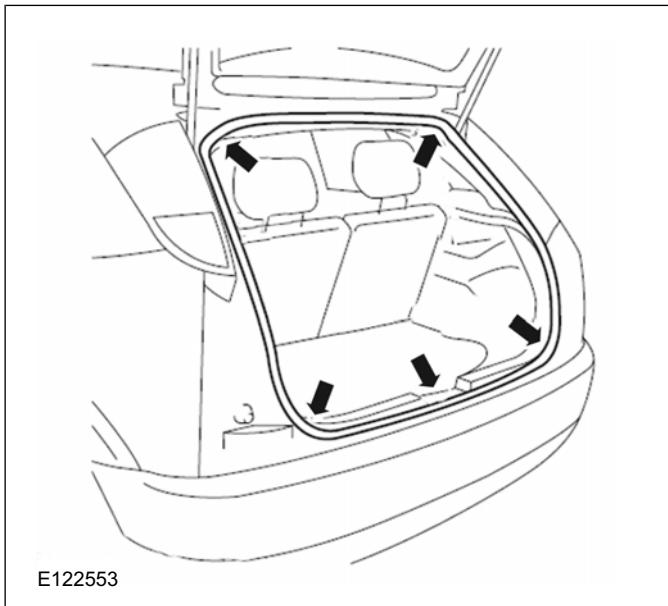
The contact pressure of a seal can be determined using a strip of paper. If a strip of paper trapped in the closed door can be pulled out easily, the contact pressure is too low.

To resolve

DESCRIPTION AND OPERATION

- Replace damaged or aged seals. Prevent kinks.
- The contact pressure can be changed by adjusting the catch bolt or correcting the panel flange.
- Even out the uneven welded flange thicknesses. Properly repair any paint damage that occurs. If the bodywork flanges are very uneven, appropriate alignment work must be performed. Pay particular attention here to the new corrosion protection which needs to be applied afterwards.
- If water entry is caused by a spot weld (burr on the surface), this must be rectified and appropriate corrosion protection applied.

Tailgate sealing rubber

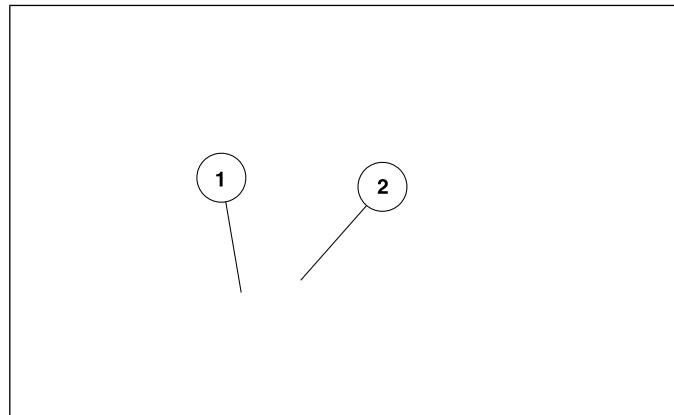


Leaks at the tailgate rubber seal have the same causes and remedial measures as for door rubber seals. Especially vulnerable areas -arrows- must be thoroughly checked.

Rubber grommets / plugs

Rubber grommets or plugs are fitted at numerous points on the body. They are frequently used as seals for cables, hoses or actuating links. Rubber plugs are frequently used for gaps caused during production.

Example: Possible problem locations in the tailgate area



Description	Descript ion
1 Hinge seal	1
2 Cable duct	2

Leaks can be caused by badly fitted or damaged rubber grommets and plugs.

Damaged cable insulation can also cause leaks.

Where components are bolted on, water can enter if there are inadequate seals at the connection point.

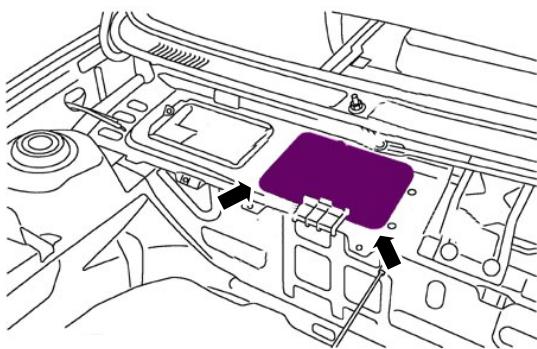
To resolve

- Correctly fit rubber grommets / plugs. During fitting, ensure that the sealing lips are not trapped and are applied properly.
- The contact area of the rubber grommets / plugs can also be sealed with PU sealing compound.
- Replace the damaged rubber grommets and repair the damaged cable insulation.
- Smooth the panel deformations in the contact area of the plugs.

Heater housing/ventilation

Loose butyl sealing strips, damaged sealing surfaces or a trapped carpet can cause leaks around the heater housing / ventilation **Arrow**. Badly positioned or badly fitted hoses can also be responsible for water entry. Water drains must not be blocked

DESCRIPTION AND OPERATION



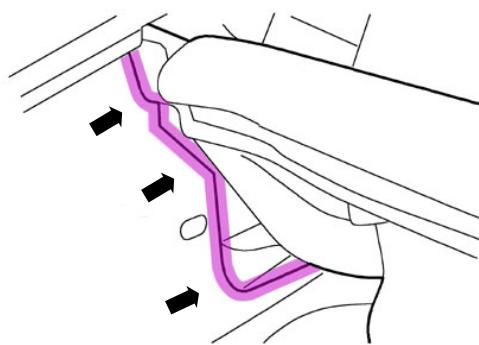
NOTE: A large quantity of water flows through the water tank. If there are leaks in this area, it is essential to ensure that the water drainage mechanisms function correctly. Drainage openings may not be blocked or stuck. Leaves and other dirt must be removed before troubleshooting.

Corrective action

Before the actual repair, make sure that the water drains are not blocked or stuck.

Remove the heater housing / ventilation and fit a new Butyl sealing strip. Damaged sealing surfaces must first be adjusted. A trapped carpet must be removed.

Seal welds



PU sealing beads are applied to welded or riveted connections **Arrows** to seal the interior of the vehicle. Incorrectly applied or damaged seal welds can allow moisture to penetrate into the interior of the vehicle. It is also possible that sealing beads whose shape and size appear to be intact actually have poor adhesion.

Corrective action

Incomplete seal welds must be supplemented with PU sealing compound. Damaged seal welds must

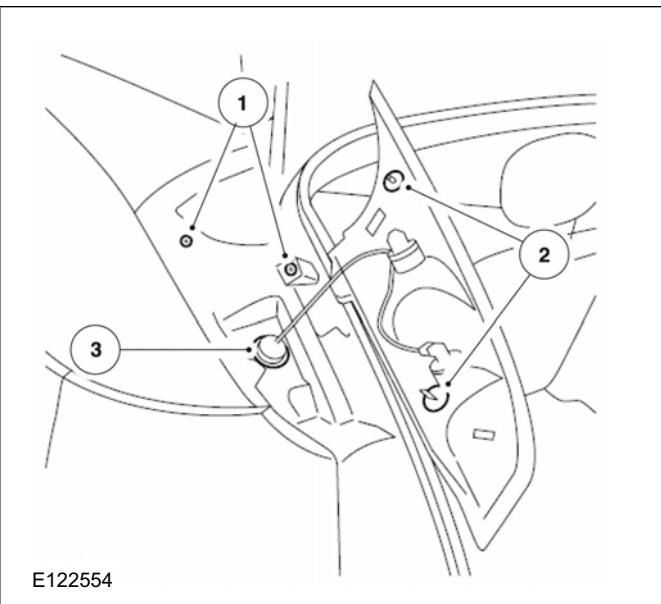
be removed and re-applied properly. Make sure that any residual moisture is effectively removed before a new seal is applied.

Attached parts

The add-on parts include:

- Exterior mirrors, handles, controls.
- Mouldings, roof mouldings, lettering.
- Roof aerial, roof rack or connections for roof rack systems.
- Bumper mountings.
- Injection nozzles, door contact switches, bump stop rubber.
- Control unit seals.
- Tail lamps.
- All kind of screwed connections (pedal block, door and tailgate hinges)

Example: Possible water entry points at the rear lamp



Description	
1	Clips
2	Gaskets.
3	Rubber grommet

Add-on body parts must be fitted with seals, grommets or sealing compound to prevent water entry. However, even when a sealing system is fitted, the screw thread may still cause leaks.

DESCRIPTION AND OPERATION

Corrective action

Seals must be tested and, if necessary, replaced. Check contact surface and adjust if necessary. Points sealed with sealing compound must be thoroughly cleaned and the seal replaced. Check grommets and replace if necessary. At all screwed connections, seal the thread with an appropriate sealing material.

DESCRIPTION AND OPERATION

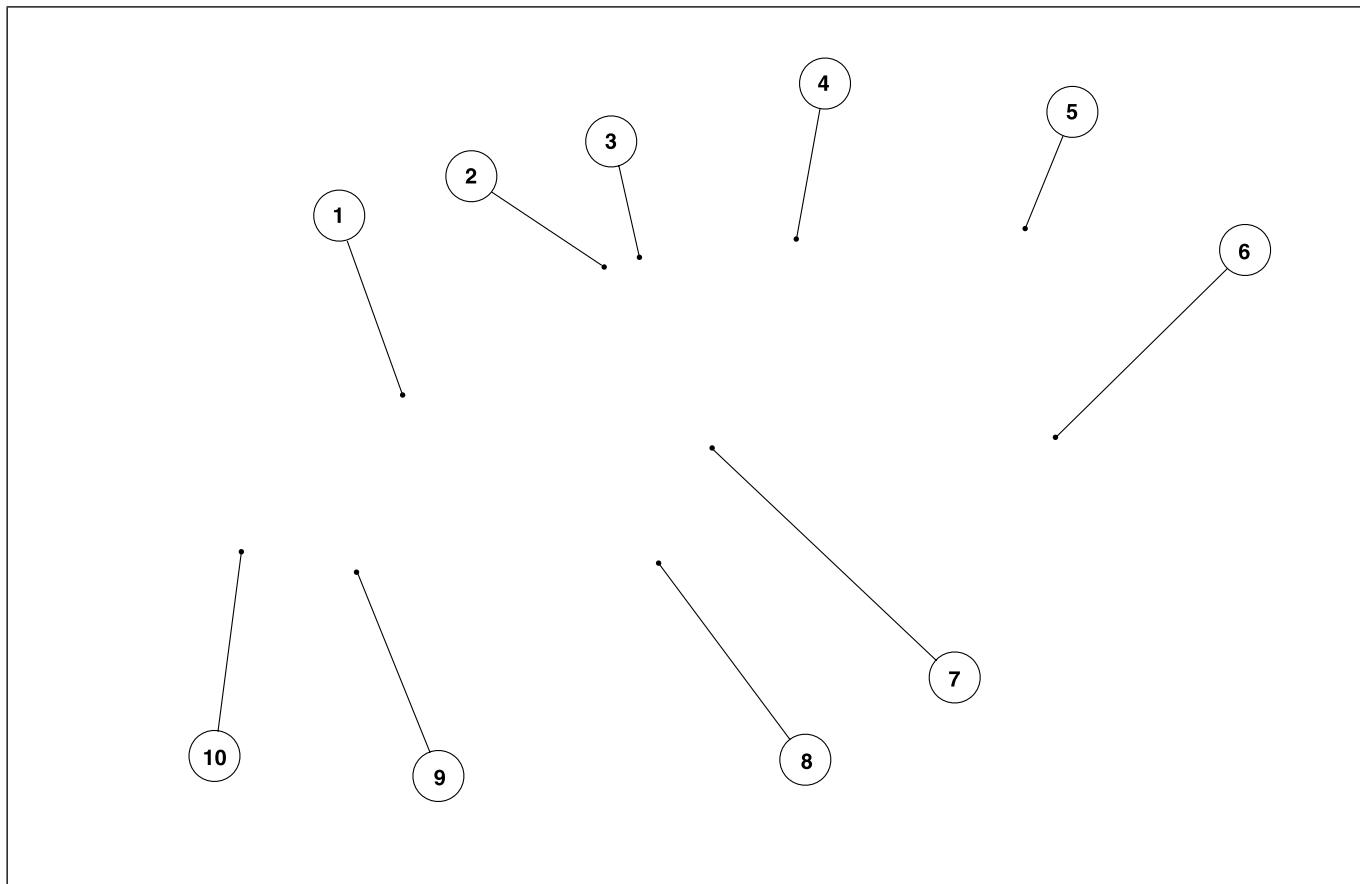
Wind Noise

Wind noises as well as other general noises are dealt with under Noise, Vibration and Harshness (NVH).

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

Due to the continuous reduction in drivetrain noises, wind noises have come to the fore in the vehicle and are perceived to a greater extent by the customer.

Potential areas of wind noises



Item	Description
1	Wiper arms
2	Windscreen seal
3	Antenna/antenna base
4	Sun roof/roof rail
5	Tailgate
6	Door handles
7	Exterior Rear View Mirror

There are various causes of wind noises. They can be due to the design of the vehicle, or they can occur after a repair. They are mostly caused by poorly mounted components, which must be located and installed in the correct position.

General information

In order to carry out targeted diagnosis, it is important to know the basics of noise formation and sound transmission.

Item	Description
8	Door seals
9	Headlamps
10	Radiator grille.

Noises are categorized according to their type and formation as follows:

"Normal" air flow noises:

Normal air flow noises are caused by air blowing against even, flat vehicle surfaces, such as the

DESCRIPTION AND OPERATION

roof, doors and side windows. When the vehicle is moving fast, air layers (turbulence) form, which cause variations in air pressure. These variations in air pressure spread in the form of sound waves and are transferred to the vehicle interior via the side windows and seals.

Noises caused by deviations in air flow and circulation around separate components:

If air flows over an edge on a vehicle, the air flow cannot follow the shape of the surface, but separates at the edge. Eddies are formed, which collapse again after a certain time or distance. The associated fluctuations in air pressure create a corresponding sound wave which is noticeable by for instance a rushing noise at the A-pillar or the outside mirror.

Turbulence and the associated radiation of noise can also occur at the vehicle underbody. Air circulation around small components and also flow through small gaps (e.g. the radiator grille) cause the rushing noise to change to a whistling, which rises and becomes louder as the vehicle speed increases.

Noises caused by vibrating seals:

Seals which do not make firm contact at the door or window area can be made to vibrate by pressure variations outside the vehicle, which in turn mean noise radiating into the interior of the vehicle.

Noises caused by air flowing out:

Noises caused by air flowing out are created by leaks at the vehicle interior sealing system, when stationary air mixes with flowing air. As a result, the noise increases as the speed of the air flowing out increases. Example: Letting air out of a tire.

Cavity noises:

Cavity noises are those created when the air volumes found in bodywork cavities are caused to vibrate by an opening located in the airflow. The frequency of the tone does not vary with the vehicle speed but depends on the volume of the cavity and the size of the opening. Example: Blowing across the top of a bottle.

Wind noises overview:

Workshop diagnosis

Assessment	Type of wind noises	Place of origin
Normal	"Normal" wind noises	Roof, side windows
Normal	Noises caused partly by changes in the direction of air flow and by air flow around separate components	A-pillars, outside mirrors, antennas
Serious	Noises caused by vibrating seals	Door gaps too large, door/window seals not making firm contact
Serious	Air escape and air passage noises	Leaks in the bodywork/sealing system
Serious	Cavity noises	Unsealed body-work cavities

Those noises listed under "Serious" indicate a possible source of the fault.

Workshop diagnosis

There are two ways that the level of noise in the vehicle interior can be reduced and the character of the noise can be improved through assessment and diagnosis in the service department:

- Reducing the intensity of the noise sources.
- Reducing the noise transfer routes.

Before carrying out repair work, a visual inspection of the vehicle must be carried out. The gaps in the doors, the sunroof and at all other body parts must be checked in particular.

When the doors are adjusted to fit exactly, development of wind noises at high speeds can often be eliminated (lifting of doors off the seals). Furthermore, the following points should be noted:

- The windows and doors must be fully closed.
- The air guides and air grilles must be correctly seated.
- All of the trim strips and plastic components must be firmly fixed down without gaps.
- All blanking plugs present.

DESCRIPTION AND OPERATION

Test method

The test procedures given in the chapter Noise, Vibration and Harshness can also be used to diagnose wind noises.

Road tests

Wind noises can usually only be localized by road tests

NOTE: There should always be two people present during road tests to find noises. A driver who reconstructs the situation causing the noise, and a person to carry out the checks.

The following points should be taken into account for such road tests:

- Check that the tire pressure is correct.
- Remove non-standard ancillary components from the vehicle.
- Choose a dry, flat road with as little traffic as possible.

- Carry out the road test in all speed ranges. Use a high gear so that the engine noise is low.
- Do not perform a road test near any sound reflecting objects.

If it is difficult to detect the noise sources, the search can be made easier by masking potential areas.

Chalk/powder test

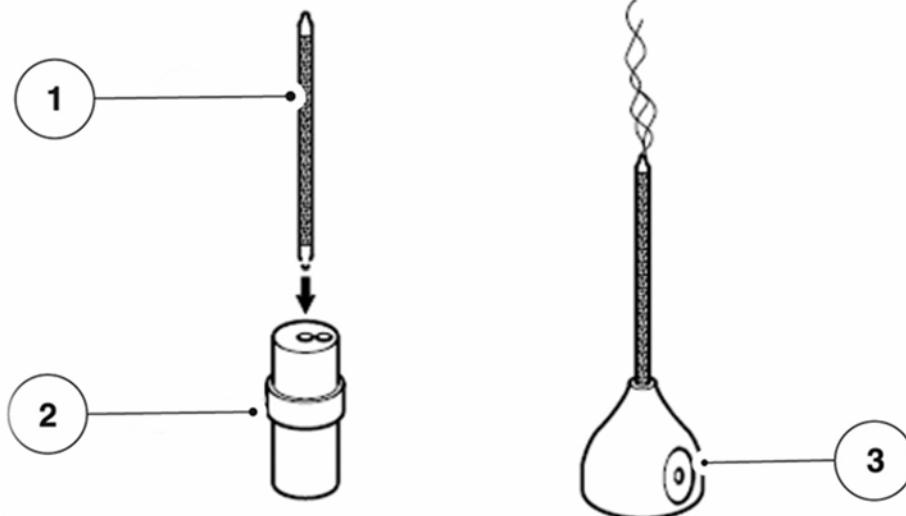
This test checks the contact surfaces of seals on doors, hatches and lids.

Process using a door seal as an example:

To do this, the door seal is coated with powder or brushed with chalk. A thin layer of grease is applied to the surface against which the seal makes contact. The door must then be slowly closed and reopened. The width and continuity of the imprint can now be checked on the seal.

Smoke test

Flow checking device



E122761

Item	Description
1	Test pipe
2	Test pipe opener
3	Puffer ball

Mode of operation:

The flow checking device is a set made up of a flow-testing pipe, a test pipe opener, puffer ball and closing-off caps for the pipe.

The test pipe contains a filling layer which is impregnated with fuming sulfuric acid. When air is blown through the pipe by the puffer ball, sulfuric

acid aerosol is emitted in the form of a white smoke.

NOTE: Pay attention to the instructions for use and the safety directions issued by the manufacturer. The smoke test can only be performed in a draft-free environment.

This test can be used to detect leaks visually.

Procedure:

- Break off both tips of the pipe in the pipe opener, in exceptional cases in the top of the packaging.
- Insert the pipe into the puffer ball so there are no leaks.

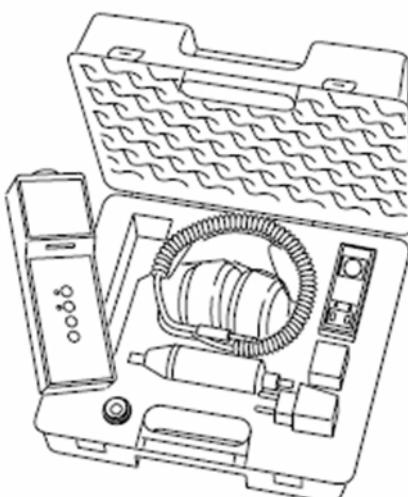
DESCRIPTION AND OPERATION

- Close the hole in the puffer ball with your thumb and press the air contained in the ball through the pipe.
- Set the ventilation blower in the passenger compartment to the highest setting.
- Close all doors so that a slight overpressure can build up in the passenger compartment.
- Move the smoke pipe along the outside of the body to the areas to be checked. Leaks can be detected through the irregular movement of the smoke.

Ultrasonic test

This test searches for leaks in the system of seals or rather acoustic bridges. When an ultrasonic transmitter is placed inside the vehicle, it sends out ultrasonic waves. A leak is located by running a detector along the suspected area. The position with the loudest reception of the escaping ultrasonic waves indicates places where noises occur.

Ultrasonic test device



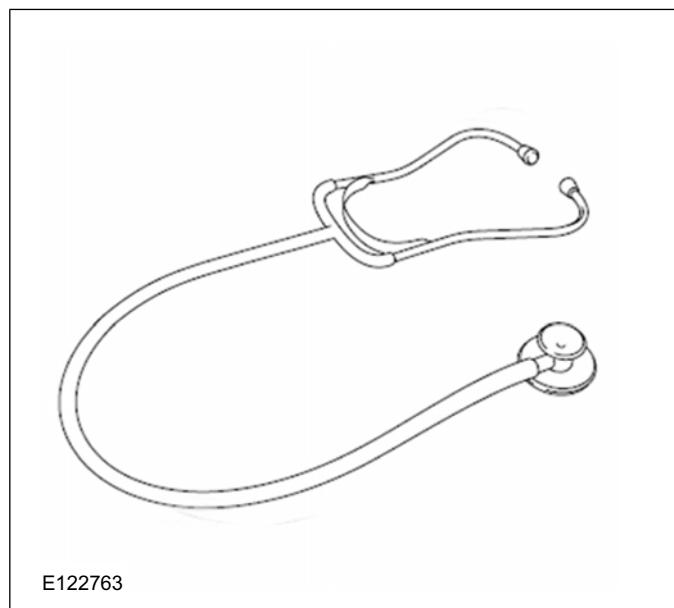
E122762

Procedure:

- Place the ultrasonic transmitter in the vehicle.
- Completely close the vehicle.
- Search the exterior of the vehicle using the detector.
- The detector provides a simple indication of a leak.

Stethoscope test

Stethoscope



E122763

Diagnosis

Wind noises often have similar causes as the general NVH noises. For instance, a windshield which is incorrectly bonded in position can cause normal driving noises to become more noticeable.

Asking the customer detailed questions and a road test together with the customer are the requirements for a targeted diagnosis.

NOTE: Take the customer concern seriously. But do not confirm that a noise is a problem until you are sure that it is something which is not normal for the vehicle series.

Possible questions:

- How long has the noise been there?
- Has any work been done on the vehicle?
- Where does the noise come from?
- In which driving situation does the noise appear?
- Is there any special situation in which the noise appears?

Remember that a noise is often more or less noticeable depending on where you are sitting in the vehicle.

DESCRIPTION AND OPERATION

Stage	to test	Result	Reference or Action
1st	Road test the vehicle with the customer. First let the customer drive to demonstrate the noise, before you drive the vehicle yourself. Check that the concern is justified. Is this a noise which gives cause for concern?	Yes	Step 2.
		No	Explain the noise and tell the customer what is causing it. Possibly offer a comparable vehicle for a road test.
2nd	Visually inspect the vehicle. Look for loose, damaged or missing components. Check that the vehicle is to standard production series specification. In particular, check for any after-market components which may have been installed. Depending on the type of noise, check the suspected area. Could a cause of the noise be found?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 3.

Stage	to test	Result	Reference or Action
3rd	Before starting any further work, use the VIN to look for model-specific information in eTIS. Perform Oasis query and check TSBs. Can a cause for the noise be determined based on the information available?	Yes	Take the action specified in the Oasis or TSB information. Check whether the measures have been successful.
		No	Step 4.
4th	Localize the noise. In doing so, check whether it is an unusual noise or if it is a usual driving noise that is more noticeable because of inadequate sealing. Is it an unusual noise?	Yes	Step 5.
		No	Step 7.
5th	Determine the source of the noise. Can the cause be determined?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 6.
6th	Determine the path of the noise using the stethoscope. By way of a trial, mask the suspected area or components or remove them. Can the cause be determined?	Yes	Eliminate the noise or carry out a repair as the case may be. Check whether the measures have been successful.
		No	Step 7.

DESCRIPTION AND OPERATION

Stage	to test	Result	Reference or Action
7th	Check the vehicle for inadequate or damaged seals. The sealing of a vehicle can be checked using the stethoscope, the powder test, the smoke test and the ultrasonic detector. (See under test method.) Could a leak be detected?	Yes	Renew the seal or perform the appropriate repair as necessary. Check whether the measures have been successful.
		No	Step 8.
8th	Under certain circumstances there may be a constructional problem which is not yet known about. Record the problem in an Express Service Report and send it on by the usual method.		

Possible concerns with corrective measures

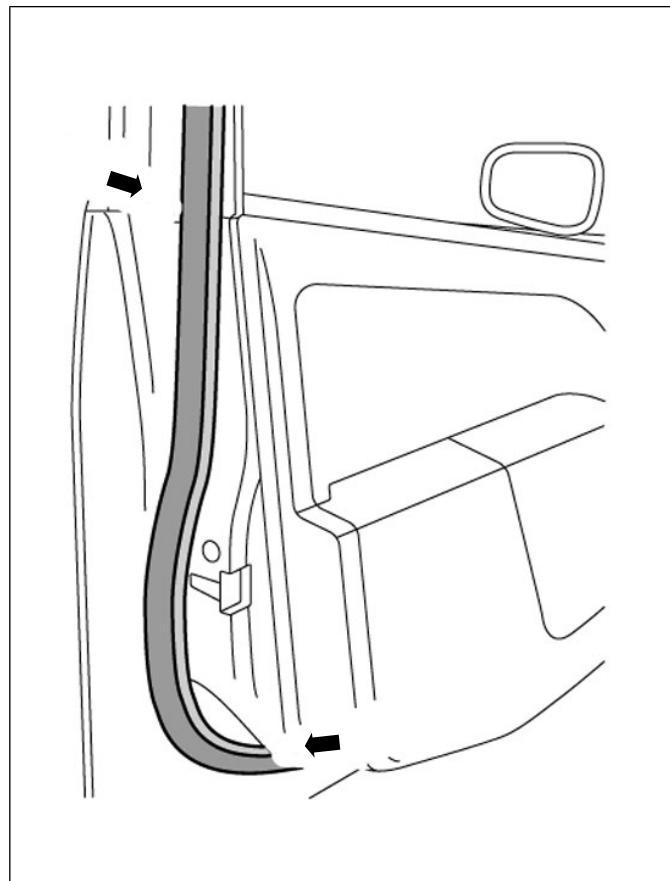
NOTE: Instructions on general noise are summarized separately in the Noise, Vibration and Harshness section. These can be useful when searching for the causes of wind noises.

There follows an outline of the possible concerns relating to wind noises. Selected examples are given showing the causes of wind noises and the ways in which they can be eliminated. They are intended to provide troubleshooting tips and suggestions for the user but do not represent an exhaustive faults list. The topics are subdivided by the different groups of components.

The test procedures described in the Noise, Vibration and Harshness section can be used when troubleshooting.

Seals

In general, seals are very important when eliminating wind noises. Special attention should always be paid here to the possible causes of wind noises.



Take the following points into account:

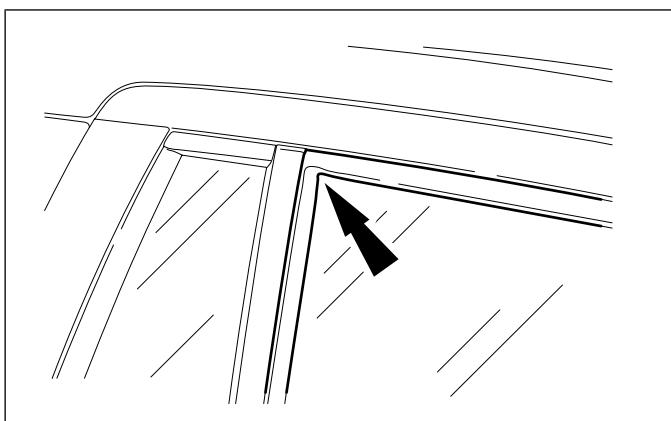
- Seals age, i.e. they become porous and with time they lose their original elasticity. If the vehicle is relatively old and there are already visible signs of distortion or damage to a seal, then it should be replaced.
- At high speeds the doors or hatches may lift slightly from the seal surfaces because of variations in air pressure. Wind noises are caused when the preload on the sealing surface is not sufficient. The preload depends on the installation position of the components, the elasticity of the seal and the location of the sealing flange.
- The contact surface of the seal must be sufficient. This can be checked using the chalk test. If the specified width of the contact surface is not known, you must determine it on another component of identical construction.
- A bulging seal carrier indicates that the sheet metal of the retaining flange is uneven.

DESCRIPTION AND OPERATION

- Seals must be correctly installed. Special attention must be paid at corners **-arrow-** that the installation follows the contours.
- The seal must not show any kinks or folds or any other damage.
- Seals must seal all around their circumference. Gaps in seals result in openings which lead to an increased incidence of noise. In this respect, it is especially important to pay attention to the seals in the area of the windows.

Remedial Action

Renew older seals which no longer have adequate preload. Deformed or widened retaining flanges must be reworked and provided with a new seal.

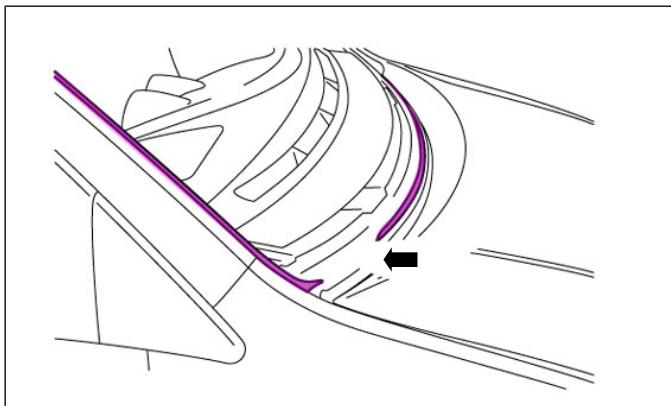


The corner areas **-arrow-** of a seal must be properly seated. In some circumstances, a butyl sealing strip must be affixed to support the sealing at a corner.

Bonded joints

Glass is usually installed today using a bonded joint. Gaps in the bonded joint can lead to noises in the vehicle interior. If there are noises which are believed to be associated with window glass, the following points should be checked:

Gap in window bonding



- The window must be bonded without any gaps **-arrow-**. Leaks can be found using the ultrasonic tester or compressed air carefully blown from inside onto the window glass bonding.
- The installed position of the window glass must be correct. It must not have been bonded into a position which is too low or offset to one side.
- The sealing or trim strips must fit tightly and the glass must be mounted so that it is fully enclosed. If a sealing or trim strip has not been applied with enough pressure, high air speeds can cause it to lift up. This can lead to wind noises at higher speeds. Apply masking tape to these areas for test purposes.

Corrective measures

Leaking areas of the window glass bonding material can be sealed using PU sealing compound. Pay special attention at the front windshield, that any breaks in the bonding are not too large. Otherwise the glass must be removed and bonded in place again.

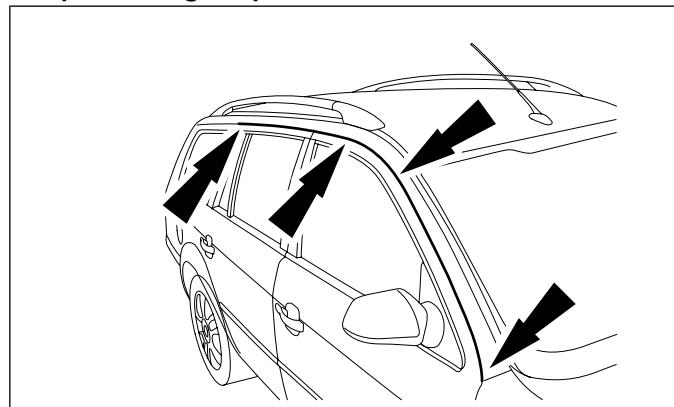
The installed location of a window glass cannot be corrected. It must be removed and bonded into place again.

Replace the trim strips or secure the lip seal using PU adhesive.

Gaps, edges

Door gaps and edges are places where air turbulence can form. This causes noises which can be perceived as troublesome.

Gaps and edges - problem areas



Doors, hood and tailgate can cause wind noises because of gaps **-arrow-** which are too large. If the components are not installed flush to the bodywork or the neighboring component, air break edges can arise, which in turn can create a wind noise.

DESCRIPTION AND OPERATION

The sun roof may be the cause of whistling noises in the roof area. The sun roof may be incorrectly adjusted or the seal on the sun roof may be damaged.

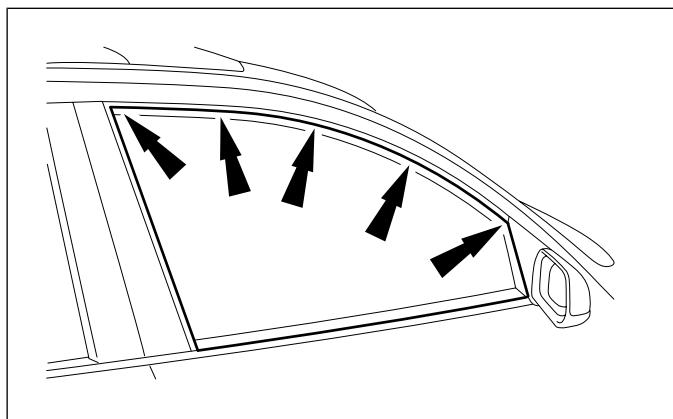
Noises from the door area could come from a window which does not fully close. Side guides (seals) can also be the cause of wind noises.

The covers of window frames can be incorrectly mounted or aligned. The quarter-lights in doors must also be checked for correct installation.

Corrective measures

Check the gaps and adjust them according to the specifications. If there are problems at the sun roof, correct the adjustment and if necessary replace the seals.

Problem area at side windows



Side windows which do not fully shut **-arrows-** must be adjusted. If the vehicle is equipped with electric window regulators, the remedy may be to perform the window regulator learning process again. In all cases, make certain that the glass enters far enough into the seal.

Ancillary Components

Components installed on the bodywork may cause noises when they are not correctly mounted.

When troubleshooting it may be helpful to remove the suspected component or, when this is not possible, to mask it off with suitable covering tape.

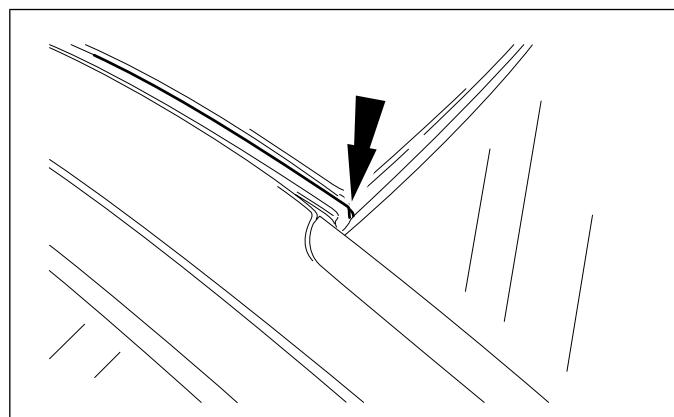
Roof moldings, roof rail, roof antennas

Moldings and roof moldings must touch the bodywork along their whole length without any gap. Check the end sections in particular. These must neither have any splits nor stand away from the bodywork.

Noises may come from the roof rail if the seal between it and the roof is not correctly installed or is cracked. Gaps at the mounting grooves of the carrier can also create wind noises.

The roof antenna and antenna foot seal must be correctly secured. The seal must lie completely on the roof and must not be damaged.

Roof moldings mounting



If the original mounting points of the roof moldings are in good condition, the fixing can be improved using silicone sealant **-arrow-** if necessary. Align or renew the seals of the roof rail. Reduce the clearances of the mounting grooves.

Corrective measures

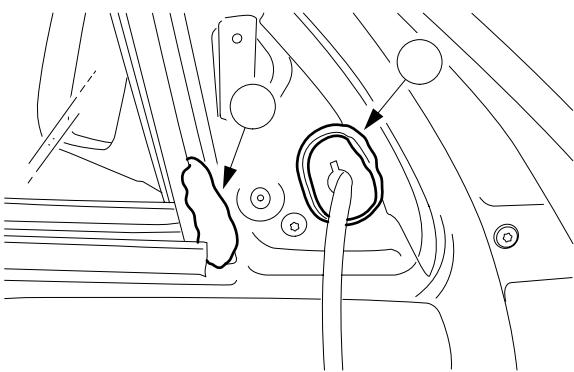
If the original mounting points of the roof moldings are in good condition, the fixing can be improved if necessary using silicone sealant **-arrow-**.

Exterior mirrors

Exterior mirrors or covers of exterior mirrors which are not correctly mounted cause noises. The cover must lie evenly on the component and must not lift during driving. There are ducts present on the doors for the electrical or mechanical adjusters for the exterior mirrors. If there are leaks, wind noises will be caused. Holes can also be present at the transition to other components.

Exterior mirror seals

DESCRIPTION AND OPERATION



There are ducts present on the doors for the electrical or mechanical adjusters for the exterior mirrors. If there are leaks, wind noises will be caused. Holes can also be present at the transition to other components.

Remedial Action

If there is inadequate sealing of the foam seals -2- they must be replaced or supplemented with suitable material. Transitions to other components can be sealed with butyl sealing compound -1-.

Moldings, covers, door handles, windshield wiper arms

Moldings and covers especially tend to cause wind noises because of their location. These components interrupt smooth bodywork surfaces and air turbulence therefore arises at the edges. If there are noise concerns in the area of the doors, check especially for gaps and projections. Moldings must not stand away from the bodywork or the door. There must not be any gaps or discontinuities at the location of joints.

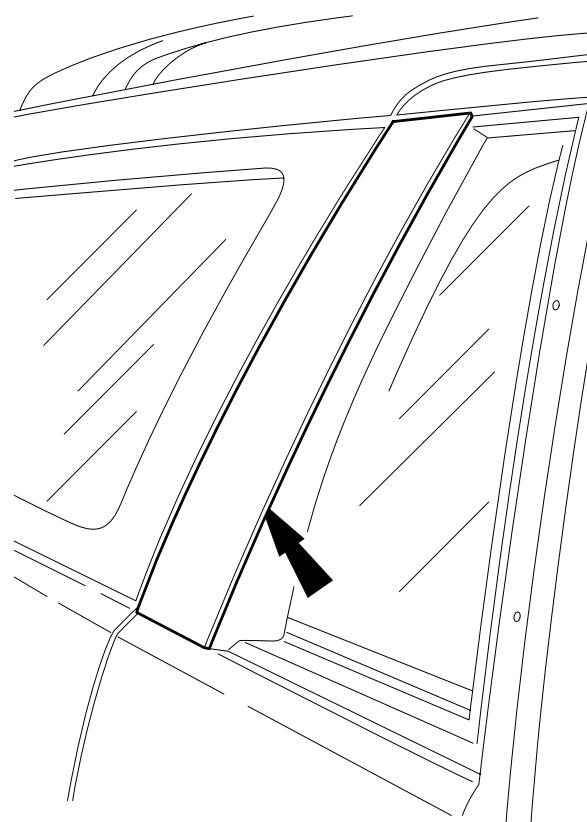
Incorrectly adjusted windshield wiper arms can cause wind noises. Especially if they are too far over the glass surface when in the rest position.

Wind noises in the transition area between the air cowl cover and the wing or the windshield can be caused by an incorrectly installed air cowl cover. At high air speeds the air cowl cover may lift and noises will then occur.

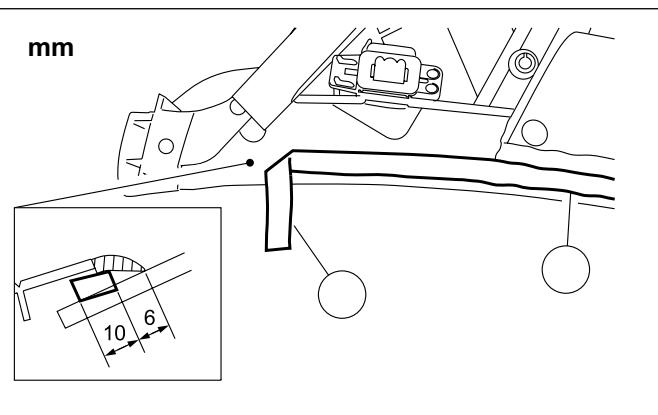
Because of their necessary mechanical features, door handles have a range of openings and edges which allow noise to be generated. The door handle can be masked off for testing purposes. If a reduction in wind noises is noticed, inadequate sealing may be the reason for the noises.

Remedial Action

Openings which are used to secure trim panels must be checked for leaks. Any leaks found can be rectified using butyl strips.



Loose or damaged outer trim on the pillars -arrow- must be secured or replaced.



A butyl sealing strip -1- can be laid underneath the cover in the transition area between the air cowl cover and the wing or windshield.

The sealing of the door handles must be renewed when required. In addition, noise absorbing material can be applied to the back of the door handles.

DESCRIPTION AND OPERATION

Noise, Vibration and Harshness

Noise, coming from the vehicle and which can be heard inside and outside the vehicle.

Vibrations, oscillations that are felt and noticeable inside the vehicle.

Harshness, noises which come from the vehicle and which can be heard, felt and noticed inside and outside the vehicle.

These terms are grouped together under the title Noise, Vibration, Harshness, or NVH for short.

The task of vehicle development and production is to ensure that noises caused by the vehicle do not disturb the driver and passengers. Moreover, the external noises emitted by the vehicle must not exceed the thresholds set by law.

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

Noise types and causes

Noises in and around the vehicle are assigned specific descriptions:

- Humming and droning are perceived as low tones.
- Buzzing and whirring are middle tones.
- Howling, whistling, squeaking are assigned to the high tones.

Low to middle tones are considered to be unpleasant. They are palpable and noticeable as oscillations and vibrations throughout the body. Loud howling and whistling is painful to the ears.

A noise usually consists of a superimposition of different tones which spread as oscillations.

Each of these oscillations has a specific oscillating time and can be measured in frequencies. The frequency describes the number of oscillations per second. The frequency unit is specified in Hertz (Hz).

The human ear can perceive frequencies between 20 and 20000 Hz.

Where the different notes come from in a vehicle:

- Low notes are mostly produced by the engine.
- Low tones can also be produced by the roadbed, particularly on rough surfaces. This is a form of droning which can be felt by the vehicle occupants as vibration or roughness.

- High tones however, which are experienced as howling or whistling noises, are often air currents (wind noises) or come from ancillary components such as the generator, power steering pump or drivebelt.
- There are also clattering noises which can occur when driving over an uneven road. These jerking noises are produced by, for example, the shock absorbers, chassis components or loose articles inside the vehicle.

Noises can already be contained where they occur or, if this is not possible, can be confined with suitable measures.

The basic procedures here are the damping of oscillating parts, the insulation of components or the absorption of the noises through appropriate materials.

Damping

If a damper is installed next to an oscillating mass, the characteristic of the damper will reduce the movement of this mass accordingly (e.g. bumper on chassis).

Damping affects the resonance of an object or system.

Isolation

In oscillation technology, the term isolation means decoupling (separation) of components and systems. An engine is mounted in sprung elements, so that as little oscillation as possible is passed to the vehicle.

In automotive technology, the isolation technique used is nearly always rubber mounting. Rubber has a large internal damping capacity. The elasticity of the rubber acts like a spring.

Absorption

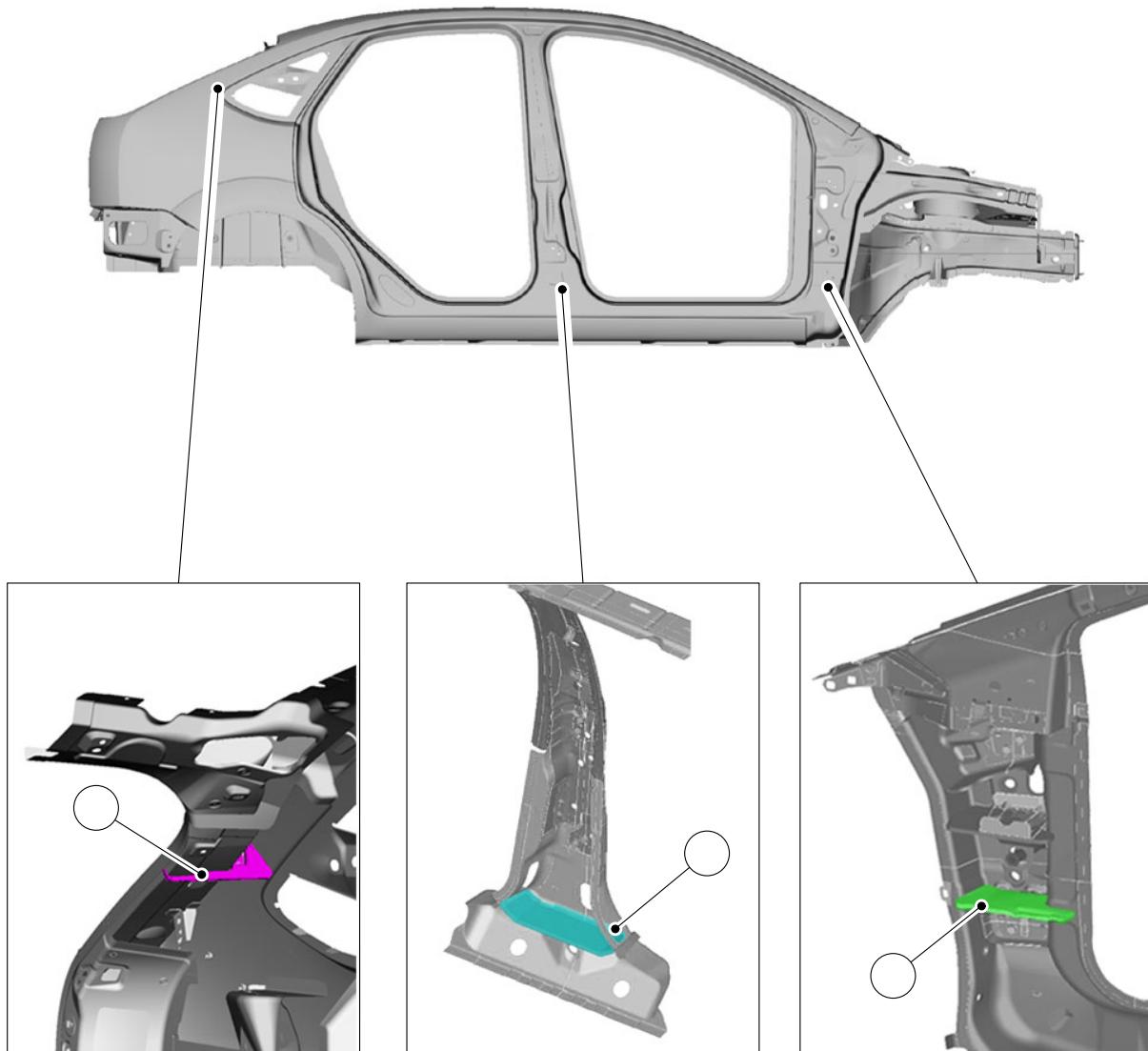
Sound waves are reflected from hard surfaces. Through the use of absorption material, sound waves hit soft surfaces and are absorbed by them.

The composition and thickness of the material used plays an important role here. A soft surface, depending on its composition, absorbs the sound waves and reduces their energy.

NVH elements

NVH elements are installed to prevent airborne sound transfers to the passenger compartment in different body cavities.

DESCRIPTION AND OPERATION



Item	Description
1	C-pillar area
2	B-pillar area
3	A-pillar area

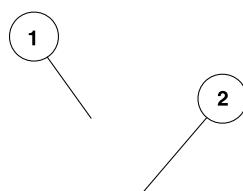
On the Focus 2004.75 (07/2004-) these elements are located in the cavities of the A, B and C pillars. On the estate version, they are also located in the D pillars.

The NVH material consists of a carrier plate which has compressed isolation material at the edges. In the drying system of the painting equipment used

in production, the body is heated to approx. 170° C. At this temperature the isolation material expands to seal the gap between the carrier plate and the bodywork.

NOTE: NVH elements must not be damaged during work on the vehicle body. NVH elements deformed through impact must always be replaced. PU adhesive must always be applied to the edges of new and reused NVH elements during repair work.

DESCRIPTION AND OPERATION



Item	Description
1	NVH element
2	PU adhesive

For the exact installation position of an NVH element, please refer to the vehicle-specific repair instructions.

If an NVH element is to be reused, the bonding on the body panel must be detached. To do this, the body panel must be heated in the area around the NVH element. The bonding can be detached at approx. 170° C. The damaged panel part can now be carefully dismantled.

Before installing the new panel part, a PU adhesive must be applied to the contact areas between the panel and the NVH element.

Test techniques, measuring devices

The shortest route to an accurate diagnosis results from:

- general information on the problem vehicle and a comparison test with a vehicle of the same construction, without NVH problems.
- vehicle history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- application of diagnosis procedures in which the vehicle is split into corresponding areas.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- general information on the problem vehicle and a comparison test with a vehicle of the same construction, without NVH problems.
- vehicle history, including repair history and usage patterns.

- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- application of diagnosis procedures in which the vehicle is split into corresponding areas.

NOTE: The diagnosis of droning problems is one of the most difficult tasks in the NVH area. With the exception of installed components under stress, a certain diagnosis of droning problems (or boom) on customer vehicles makes great demands on the automotive technician. The performance of measuring equipment and their practice-orientated application can only be obtained through suitable instruction (NVH training). The successful use of these devices requires a great deal of experience on the part of the user.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- a road or system test to determine the exact nature of the concern.

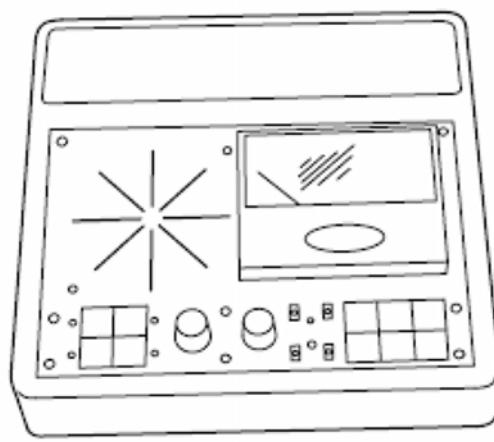
Analysis of possible causes:

- checking of the cause and elimination of the faults found.
- a road test or system test to make sure the concern has been corrected or brought back to within an acceptable range.
- It is often very difficult to locate noises that are audible in the passenger compartment based on the problem description provided by the customer and the road tests performed. The direction of the noise can be detected subjectively, but the source of the noise cannot be found.

NOTE: For a selection of simple test tools, see the wind noises section.

Electronic NVH tester

DESCRIPTION AND OPERATION



E122758

NOTE: Before using the NVH tester in the service, the service technician should take part in an NVH training course to ensure effective use of this device during the road test. A description of the function and application of the NVH tester is enclosed with the device.

The measuring device described below is used for diagnosis of the solid-borne sound and solid-borne sound transmission paths. The device is particularly suitable for medium and high frequency noise analyses. It principally enables noise diagnosis in the area of solid-borne sound and helps to identify solid-borne sound transmission routes.

In order to obtain a positive diagnosis of droning problems (low frequency noises) and their sources, you must have sufficient experience of how to use this measuring device.

The device works according to the following operating principle: Accelerometers (transmitters) are fitted on various vehicle components or body areas. The signals recorded here can be listened to one after the other on headphones or speakers via the different channels. Simultaneous illustration of several or all measuring channels (for comparison) is only possible visually on the display of the measuring device.

Layout and operation:

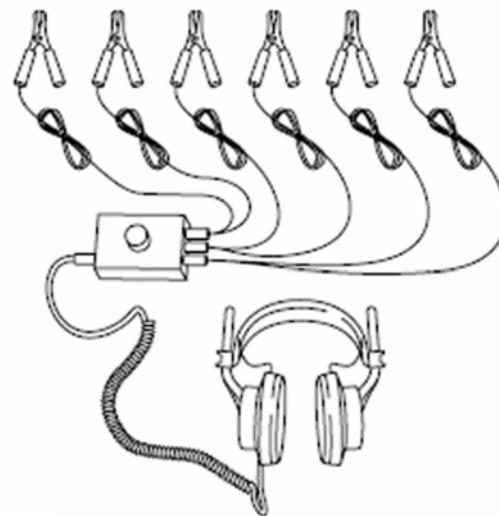
- The test device has six different channels for noise diagnosis.
- Each channel is marked in color on the terminal, cable and test device.
- The solid-borne sound recorded is transmitted to the test device or the headphones by the magnetic accelerometers (transmitters).

- There is an amplifier on the test device with which the signal strength and the corresponding channel can be set.
- Only the noises from a transmitter are transferred to the headphones.
- All connected cables can be visually illustrated individually or simultaneously on the display.
- The test device saves the recorded data.
- The recorded data can be imported to a PC and evaluated.

The NVH tester is equipped in addition with mobile magnetic sensors which are particularly suitable for the following noise tests:

- Internal noises at the dashboard
- Engine noise
- Electrical noises (sparking/voltage transmissions)
- Wind noises
- Vacuum - leaks

Chassis noise tester (chassis ear)



E122759

Used to diagnose solid-borne sound and its transmission routes. The device is particularly suitable for medium and high frequency noise analysis and principally enables noise diagnosis in the area of solid-borne sound and helps to identify solid-borne sound transmission routes.

In order to obtain a positive diagnosis of droning problems (low frequency noises) and their sources, you must have sufficient experience of how to use this measuring device.

Layout and operation:

DESCRIPTION AND OPERATION

The test device has six different channels for noise diagnosis. This means that six microphones equipped with clamps can be attached to different components on the vehicle. The emitted or transmitted solid-borne sound will be transferred from microphone to the headphones. There is an amplifier between the microphone and the headphones at which the signal strengths and the corresponding channel can be set.

Only the noises from one microphone are transferred to the headphones. Each channel is color-coded on the clamp, cable and amplifier.

NOTE: In order to be able to relate the positions of the different microphones during the test process, they are entered in a special test sheet according to their colors. Microphones, clamps and cables must be carefully routed and attached.

Test process (example for transmission noise):

- Attach microphones to various positions on the transmission or mountings. This first allows the source of the noise to be determined, and then the possible transfer routes.
- A road test can be performed after all the clamps have been attached to the vehicle and all the cables connected to the amplifier.
- Firstly, all the channels are switched through one after the other in neutral, to check the operation of the different channels as well as the noise level in neutral.
- During the road test, all channels are listened to in the different gears, engine speeds, vehicle speeds and loads. This procedural method permits unambiguous diagnosis of the cause of the noise and the route of the noise until it enters the bodywork structure.
- The characteristics of the noise which is the cause of the concern should match those of the noise which is heard. This means compare the sound.
- Depending on the input signal level, there may be a great deal of difference in the noise level in the individual channels.
- Always set the amplifier volume to zero before switching to another channel.
- In order to be able to make any comparisons, the volume settings of the different channels must be recorded on the test sheet.

SECTION 501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks

VEHICLE APPLICATION: 2011.50 Ranger

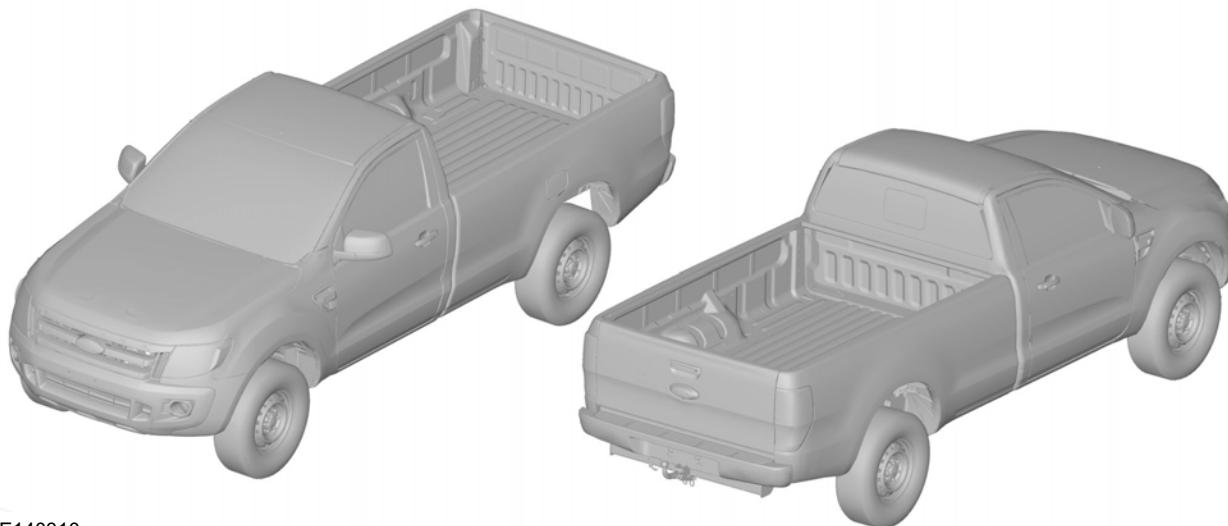
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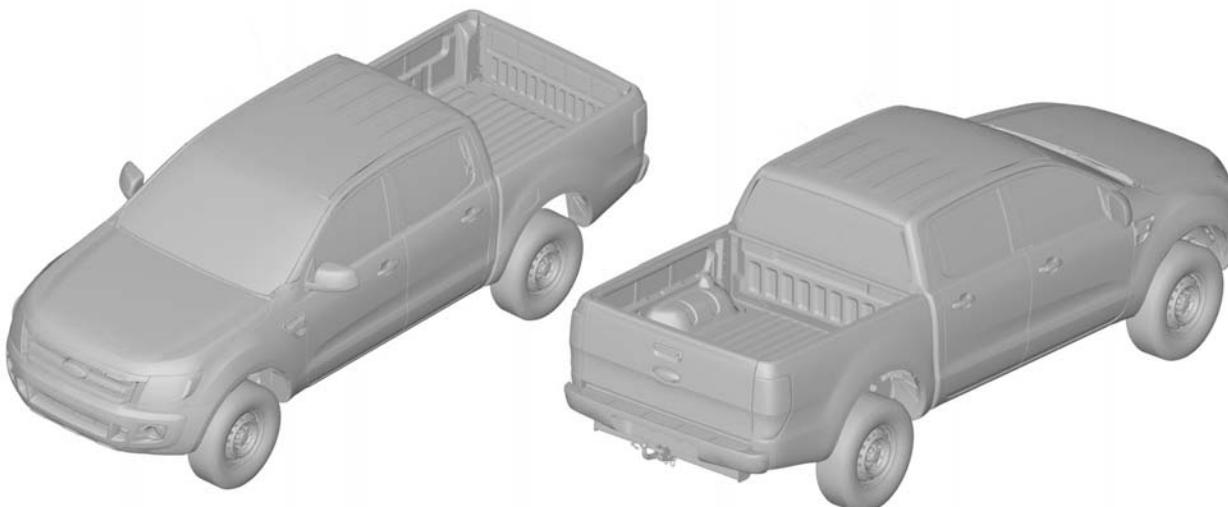
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GENERAL PROCEDURES

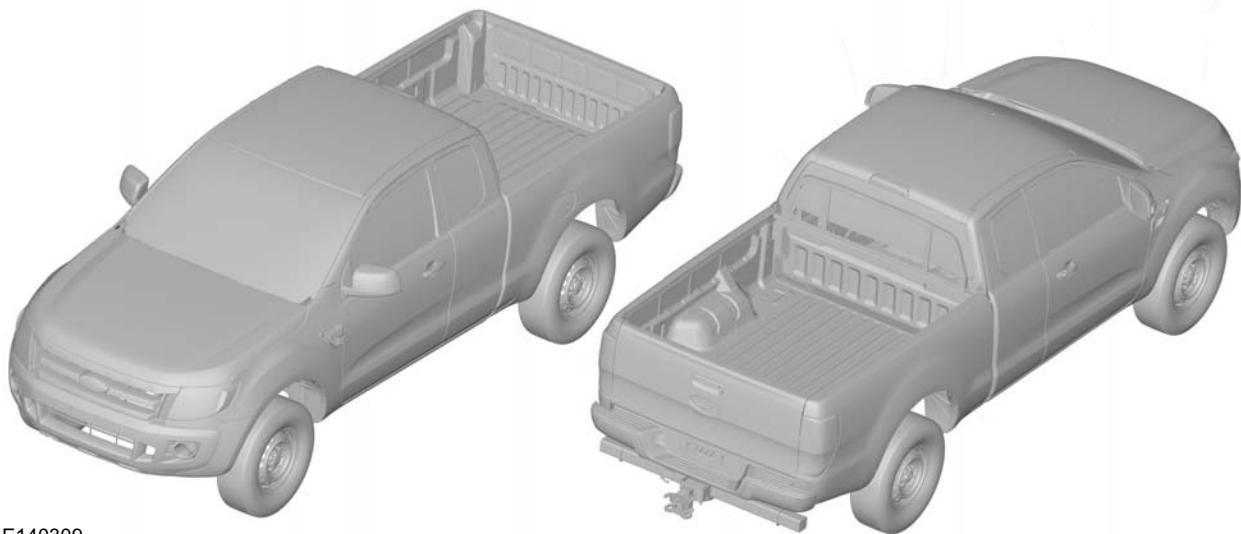
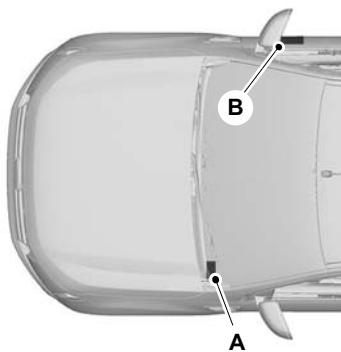
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DESCRIPTION AND OPERATION**Body and Frame – Component Location****Body, single cab**

E140310

Body, double cab

E140311

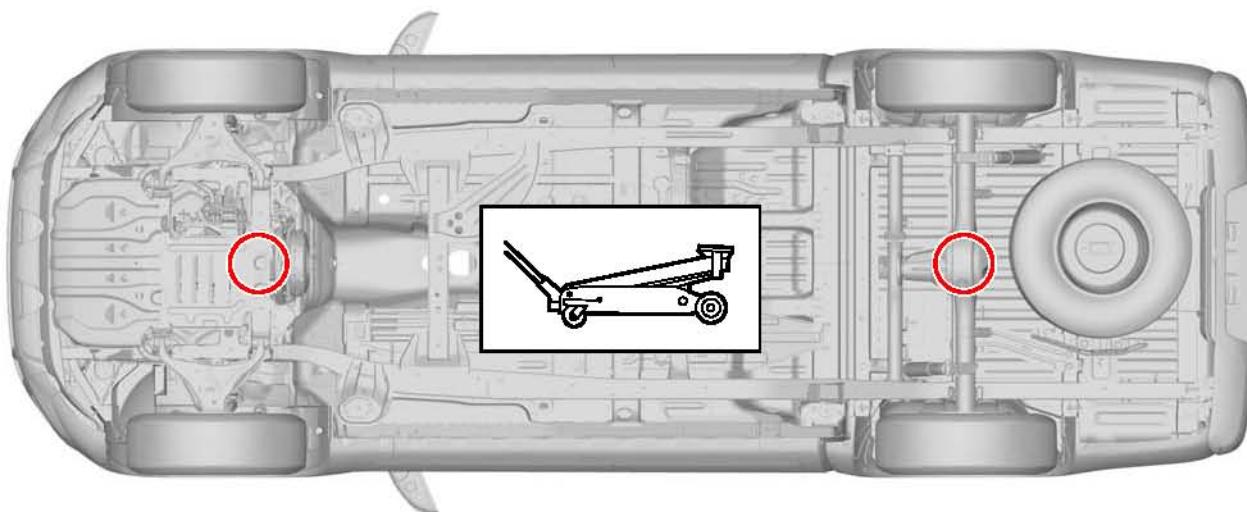
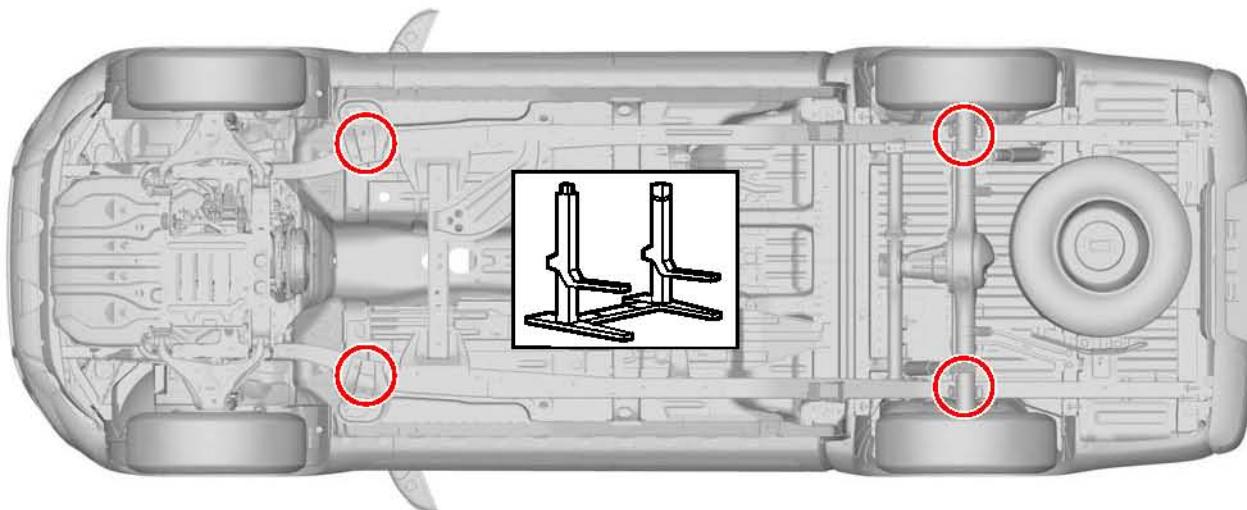
DESCRIPTION AND OPERATION**Body, stretch cab****Location of the VIN plate**

E133363

Item	Description
A	Left-hand side of the instrument panel.
B	Right-hand side beneath the front door on the chassis.

DESCRIPTION AND OPERATION

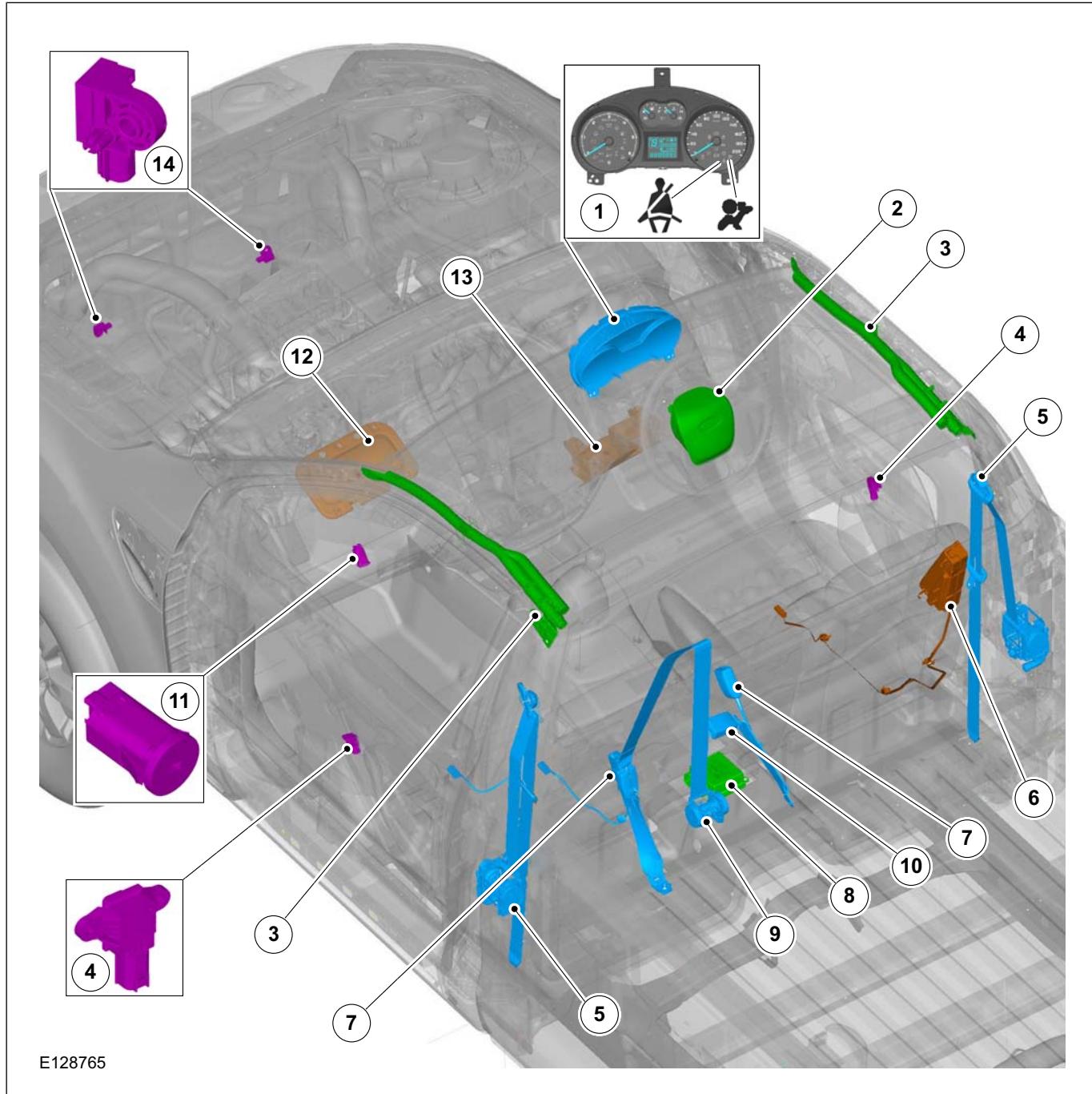
Lifting points



E140312

DESCRIPTION AND OPERATION

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



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

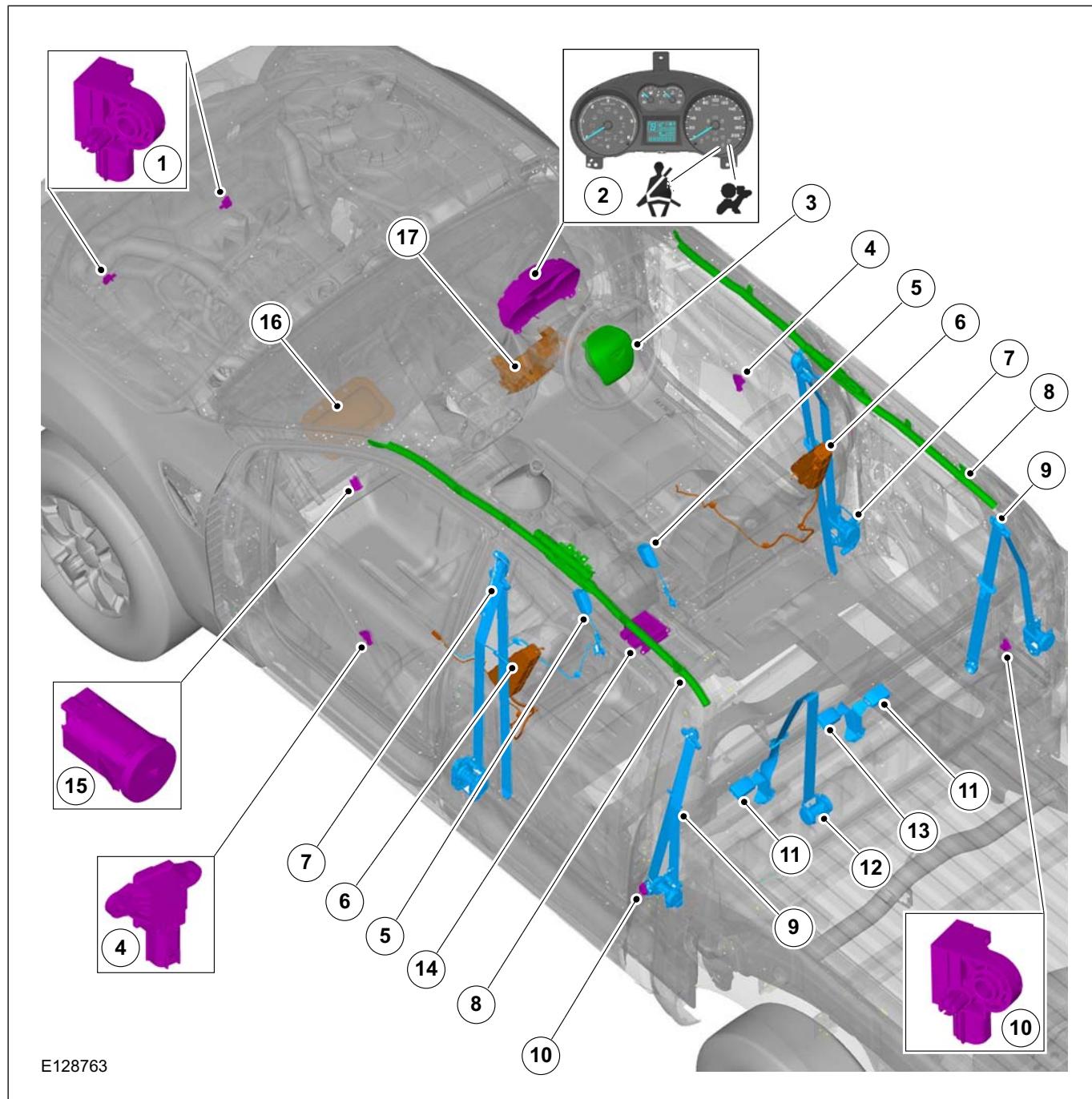
Item	Description
7	Front safety belt buckle
8	Restraints control module
9	Front center safety belt retractor
10	Front center safety belt buckle
11	Passenger airbag deactivation switch
12	Passenger air bag

DESCRIPTION AND OPERATION

Item	Description
13	Driver lower air bag

Item	Description
14	Front impact severity sensor

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



Item	Description
1	Front impact severity sensor
2	Instrument cluster with air bag indicator light and safety belt warning light
3	Driver air bag

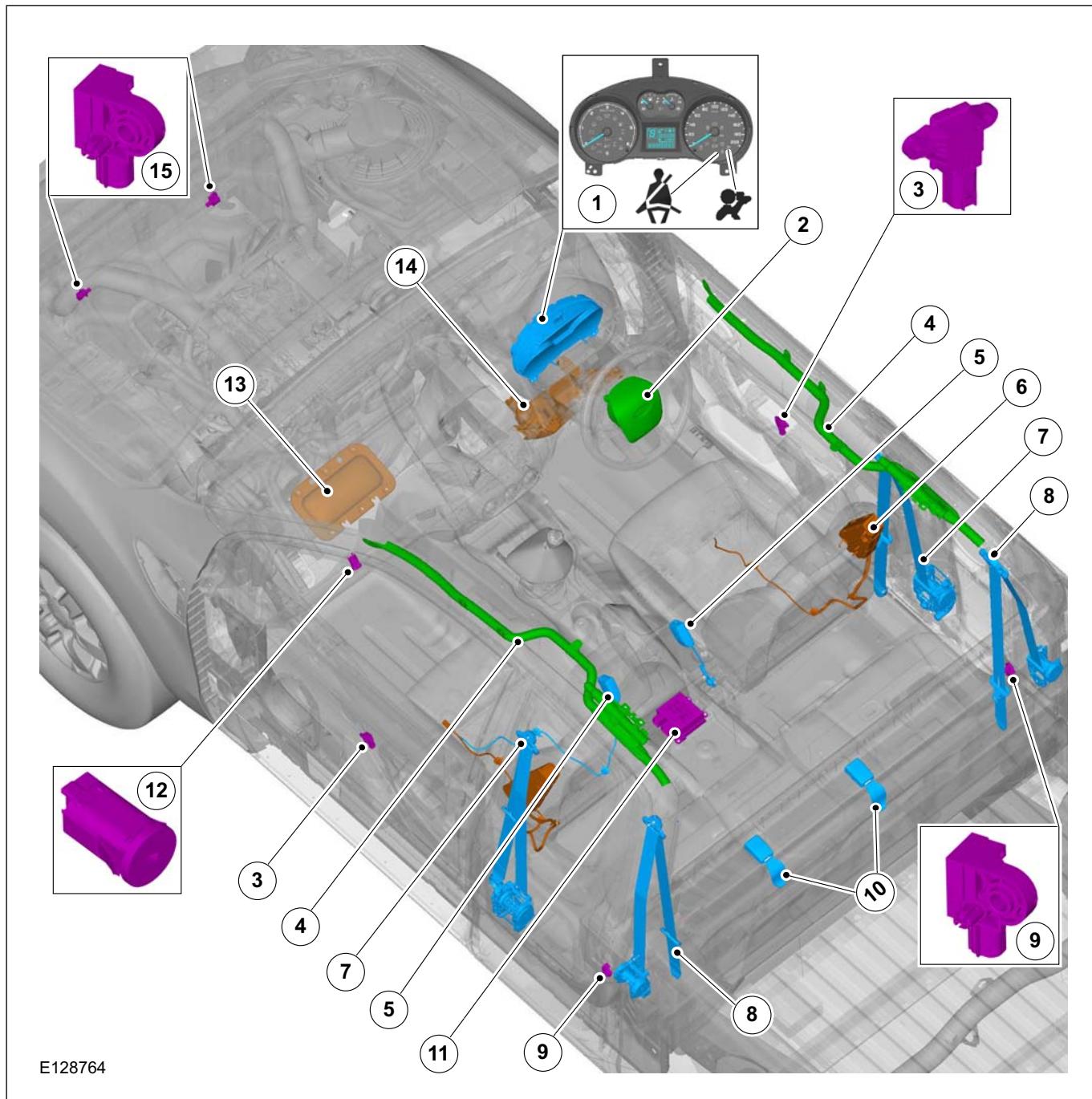
Item	Description
4	Side impact sensor (Driver and passenger side)
5	Front safety belt buckle
6	Curtain air bag (Driver and passenger side)

DESCRIPTION AND OPERATION

Item	Description
7	Front safety belt retractor
8	Side air curtain
9	Rear safety belt retractor
10	Side impact sensor (Rear side)
11	Rear safety belt buckle
12	Rear center safety belt retractor

Item	Description
13	Rear center safety belt buckle
14	Restraints control module
15	Passenger airbag deactivation switch
16	Passenger air bag
17	Driver lower air bag

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

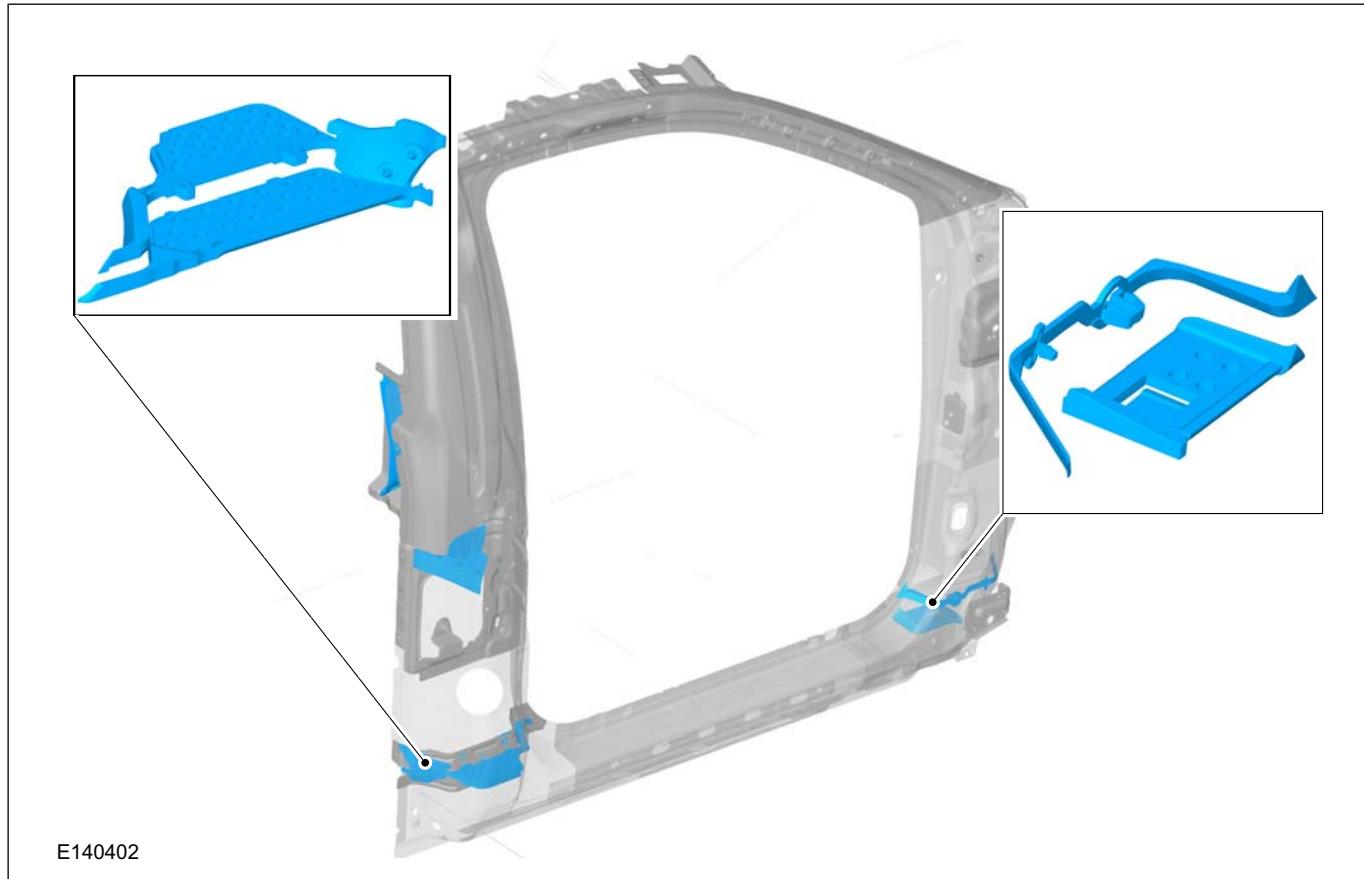


DESCRIPTION AND OPERATION

Item	Description
1	Instrument cluster with air bag indicator light and safety belt warning light
2	Driver air bag
3	Side impact sensor (Driver and passenger side)
4	Curtain air bag
5	Front safety belt buckle
6	Side air bag (Driver and passenger side)
7	Front safety belt retractor

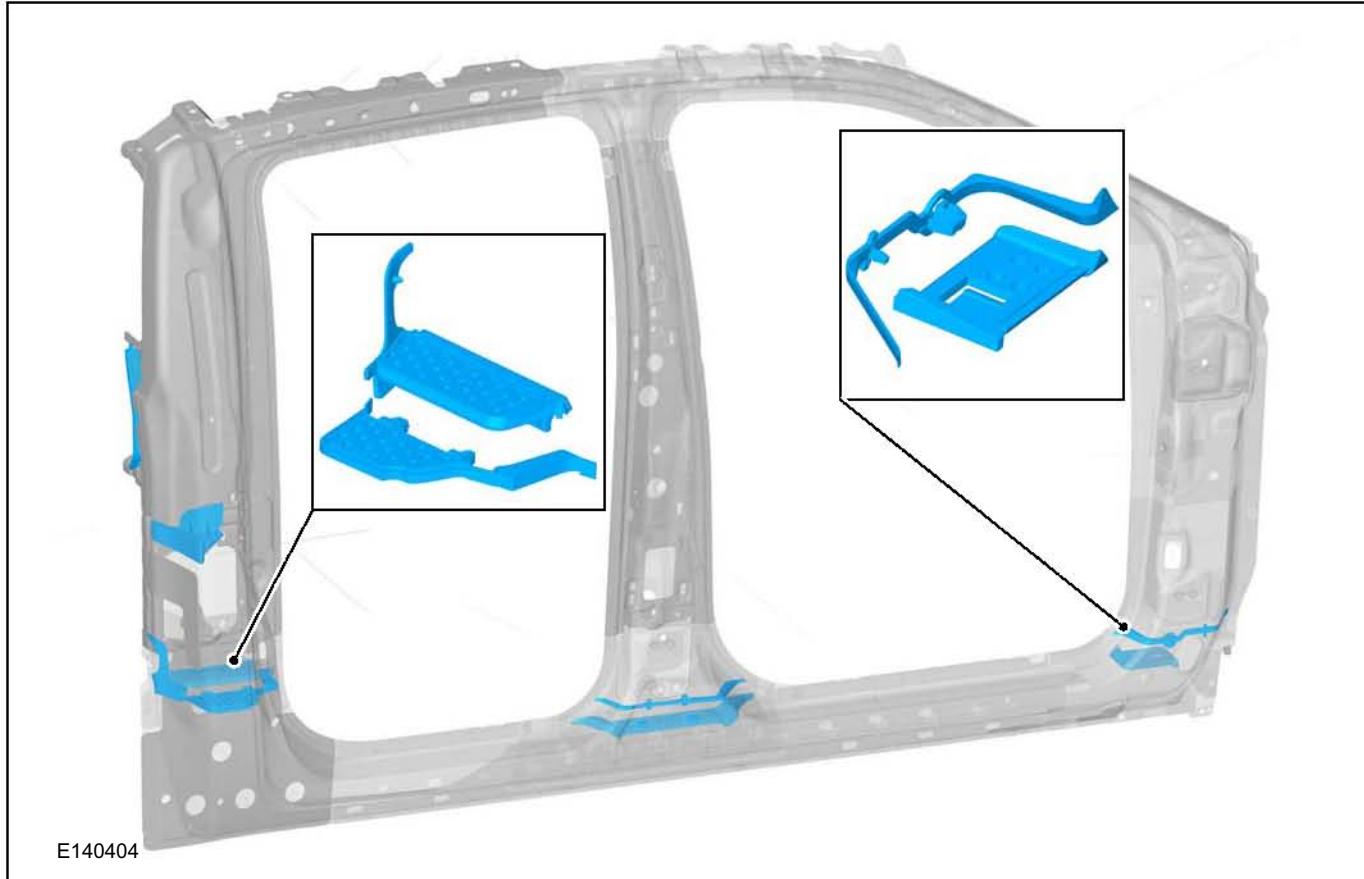
Item	Description
8	Rear safety belt retractor
9	Side impact sensor (Rear side)
10	Rear safety belt buckle
11	Restraints control module
12	Passenger airbag deactivation switch
13	Passenger air bag
14	Driver lower air bag
15	Front impact severity sensor

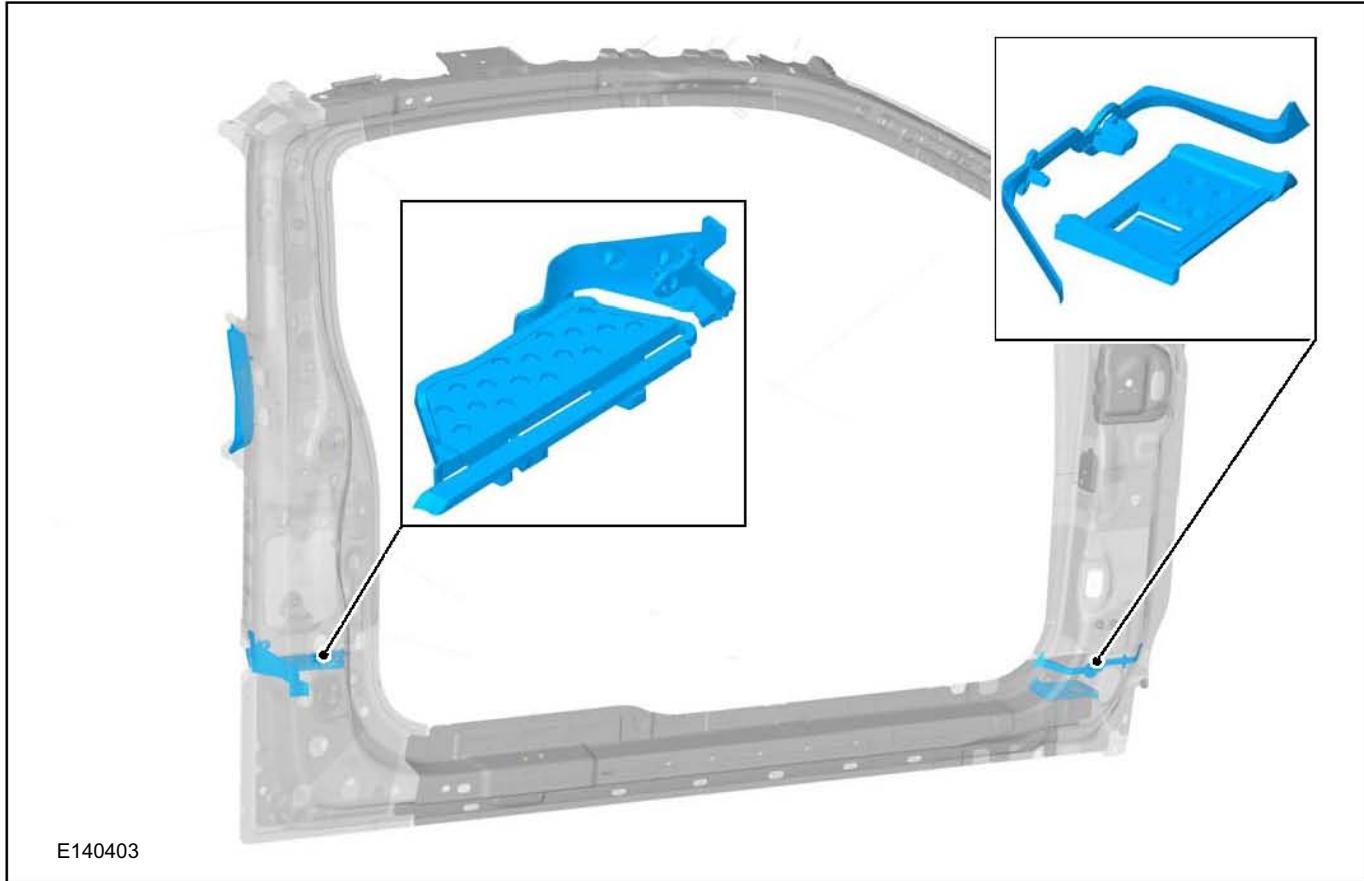
NVH elements, single cab



DESCRIPTION AND OPERATION

NVH elements, double cab



DESCRIPTION AND OPERATION**NVH elements, stretch cab**

DESCRIPTION AND OPERATION

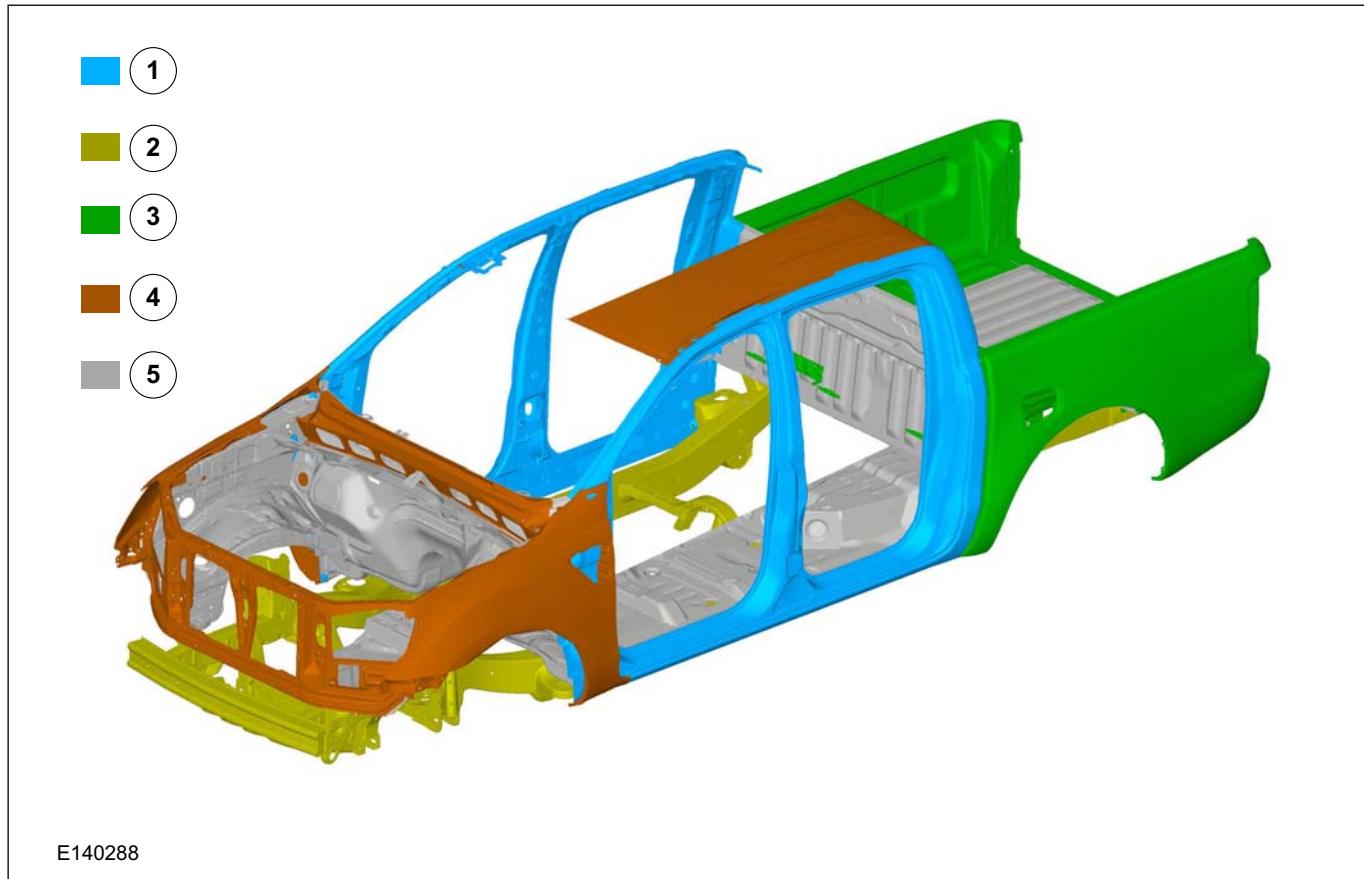
Body and Frame – Overview

Introduction

With the 2011.25 model year, the Ford Ranger is superseded by a completely new vehicle. The T6 is based on the U1 platform which has been developed in co-operation with Mazda. 2-door and 4-door body versions are offered. Within the company the model designation is P375. Overall the vehicle weighs less than its predecessor.

However, it offers increased occupant safety through the use of high-strength and super-high-strength steels. The high-strength and super-high-strength steels used make extra demands on the tools to be employed for some body repairs.

High-strength and super-high-strength steels



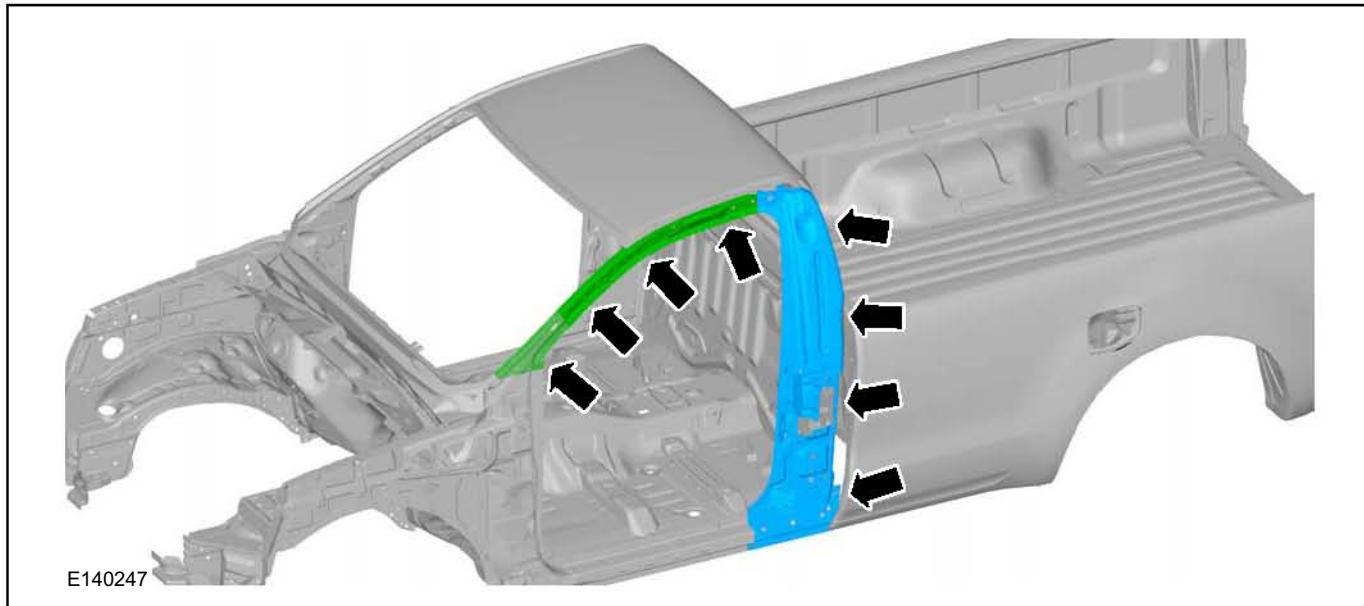
Item	Description
1 UHSS (> 800 MPa)	
2 EHSS (380 - 800 MPa)	
3 VHSS (280 - 380 MPa)	
4 HSS (180 - 280 MPa)	

Item	Description
5 MS (< 180 MPa)	

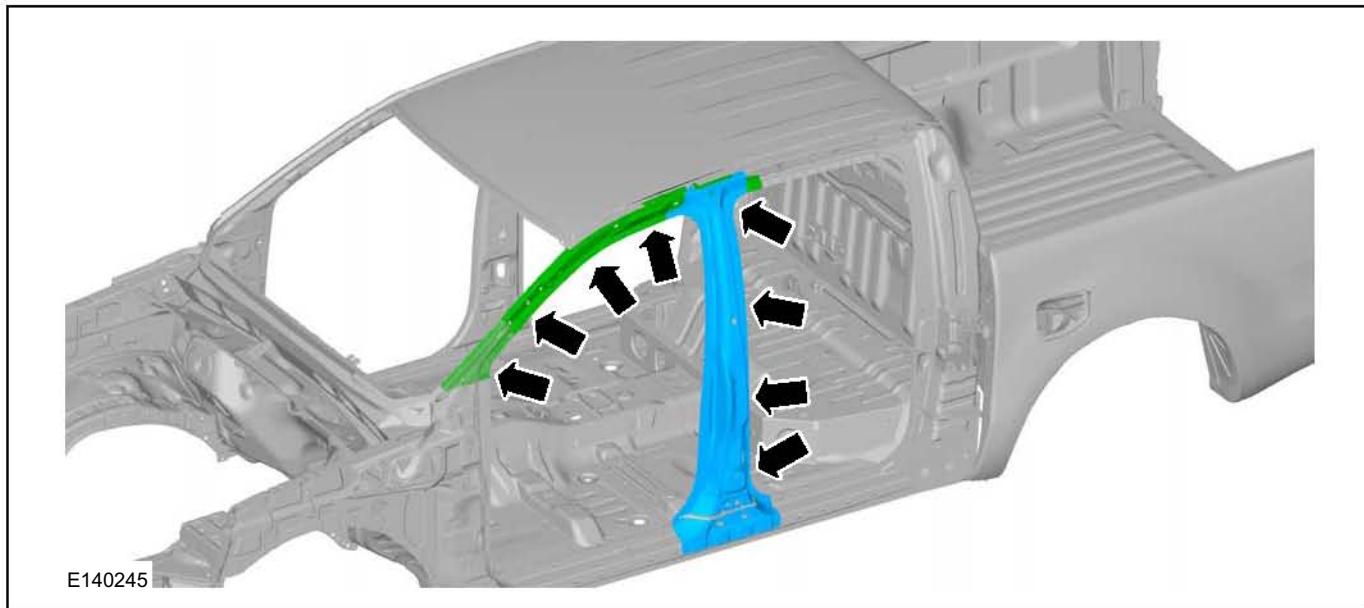
Usibor steel

Single cab

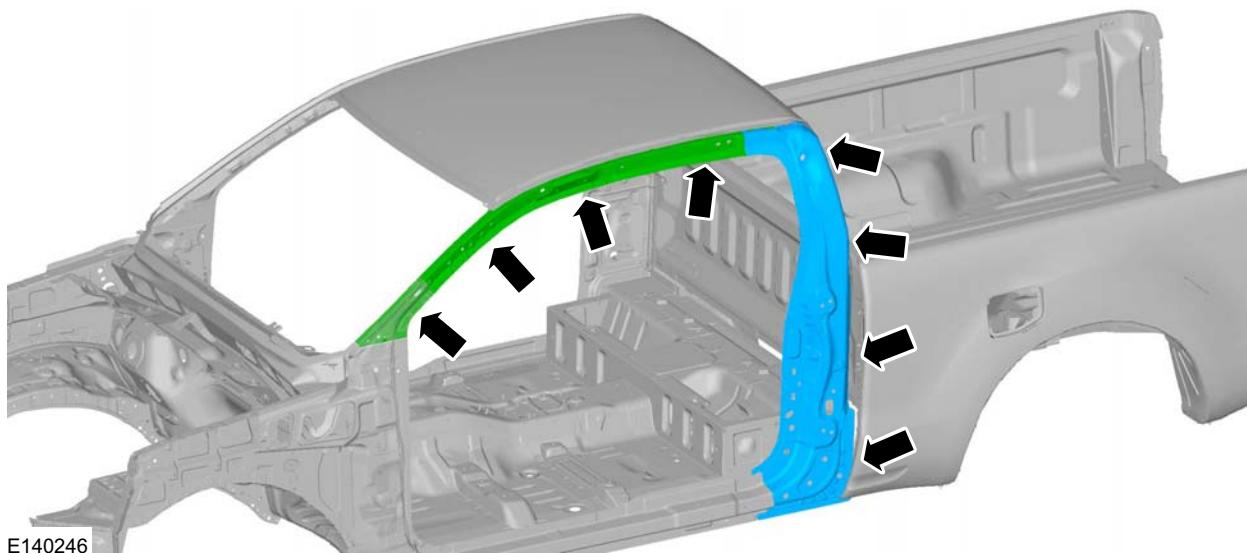
DESCRIPTION AND OPERATION



Double cab



Super cab

DESCRIPTION AND OPERATION

The reinforcements at the A- and B-pillars are made of Usibor steel. This material has a yield strength of 1300 MPa.

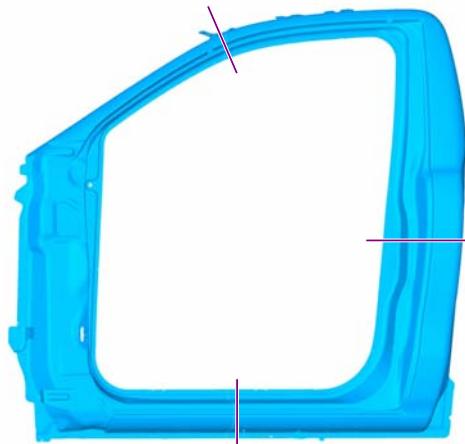
Sectional repairs must NOT be performed on components made of Usibor !

The required continuous MIG weld seam in the cut area would cause structural changes in the steel and lead to a significant loss in strength.

In the event of damage, the complete component must therefore always be renewed.

Also, because of the strength of these components, it is not always possible to work them with conventional body repair tools.

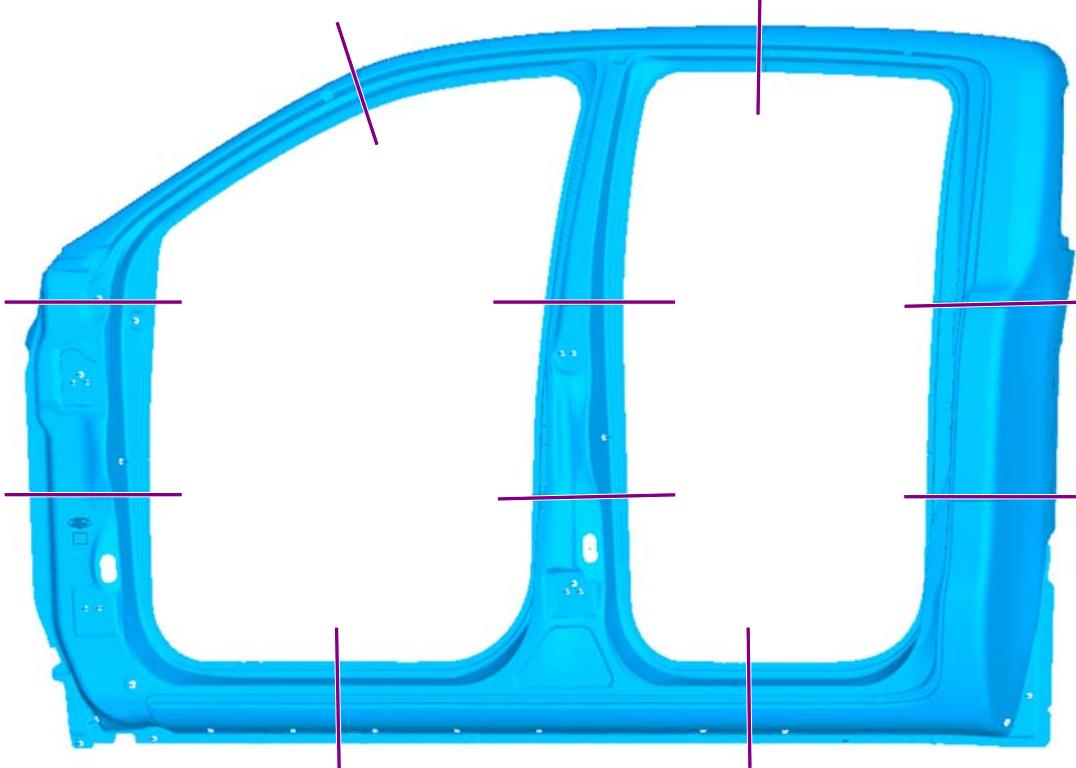
or welding work (resistance spot welding and inert gas puddle welding), additional preparation work and/or special welding equipment are required.

Sheet metal parts for quarter panel partial replacement**Single cab**

E140304

Double cab

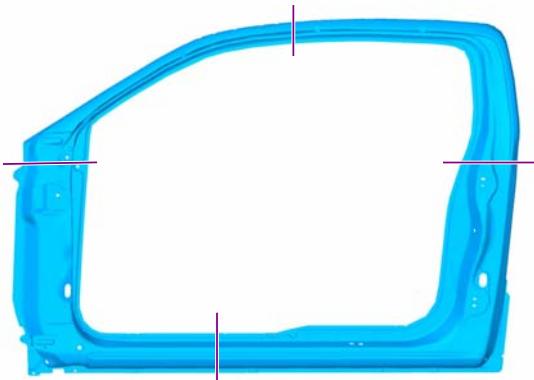
DESCRIPTION AND OPERATION



E140289

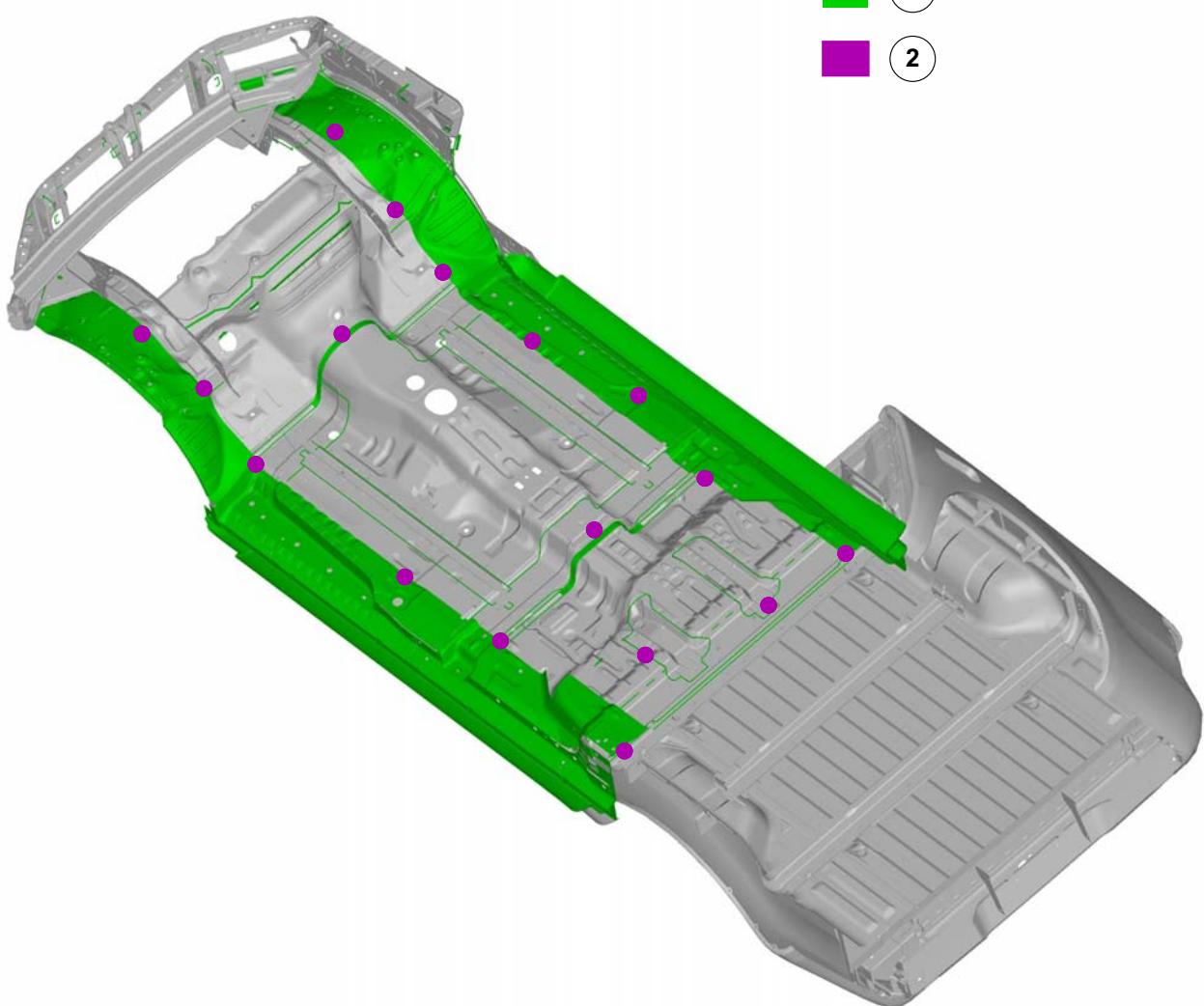
Super cab

Anti corrosion protection



E140305

DESCRIPTION AND OPERATION



E140306

Item	Description
1	Underbody PVC stone chip protection
2	Injection points for cavity wax protection

GENERAL PROCEDURES**Underbody Tolerance Check****1. Body dimensions, all versions (quick measurements using the Allvis system)**

- All dimensions are measured from the middle of the hole or bolt head or from the edge of

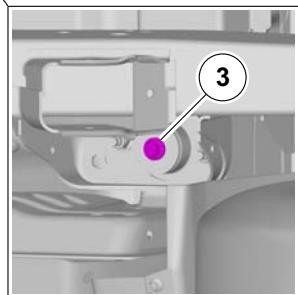
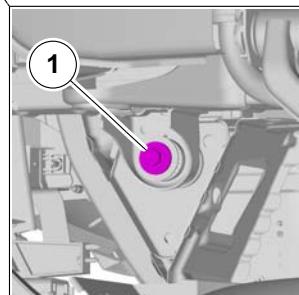
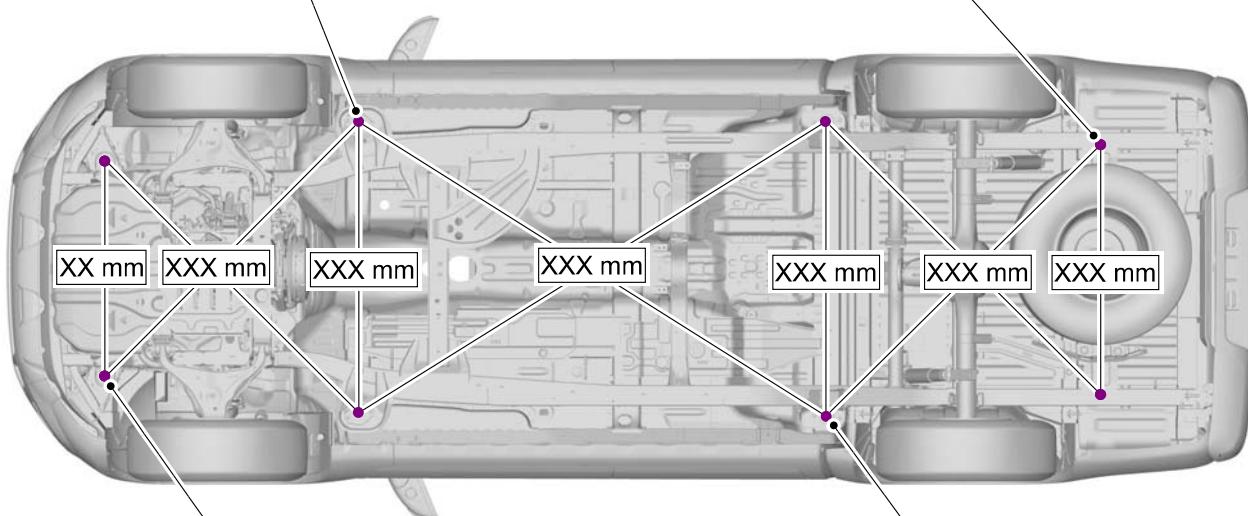
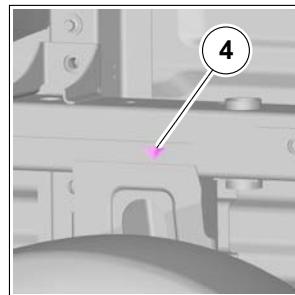
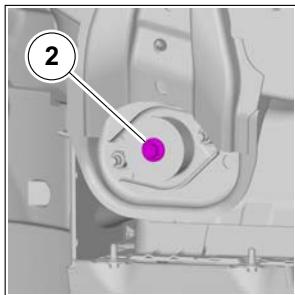
the panel, using the Allvis system, with component assemblies installed.

- A tolerance of ± 3 mm applies to all measurements given. All detailed illustrations correspond to the left-hand side of the vehicle.

Allvis specifications

Point of measurement	Adapter	Height setting of the test probes
1	xx mm (Socket)	xxx mm
2	xx mm (Socket)	xxx mm
3	xx mm (Socket)	xxx mm
4	xx mm (Probe)	xxx mm

GENERAL PROCEDURES



E140308

GENERAL PROCEDURES**Frame Tolerance Check****1. Front end body dimensions, all vehicles**

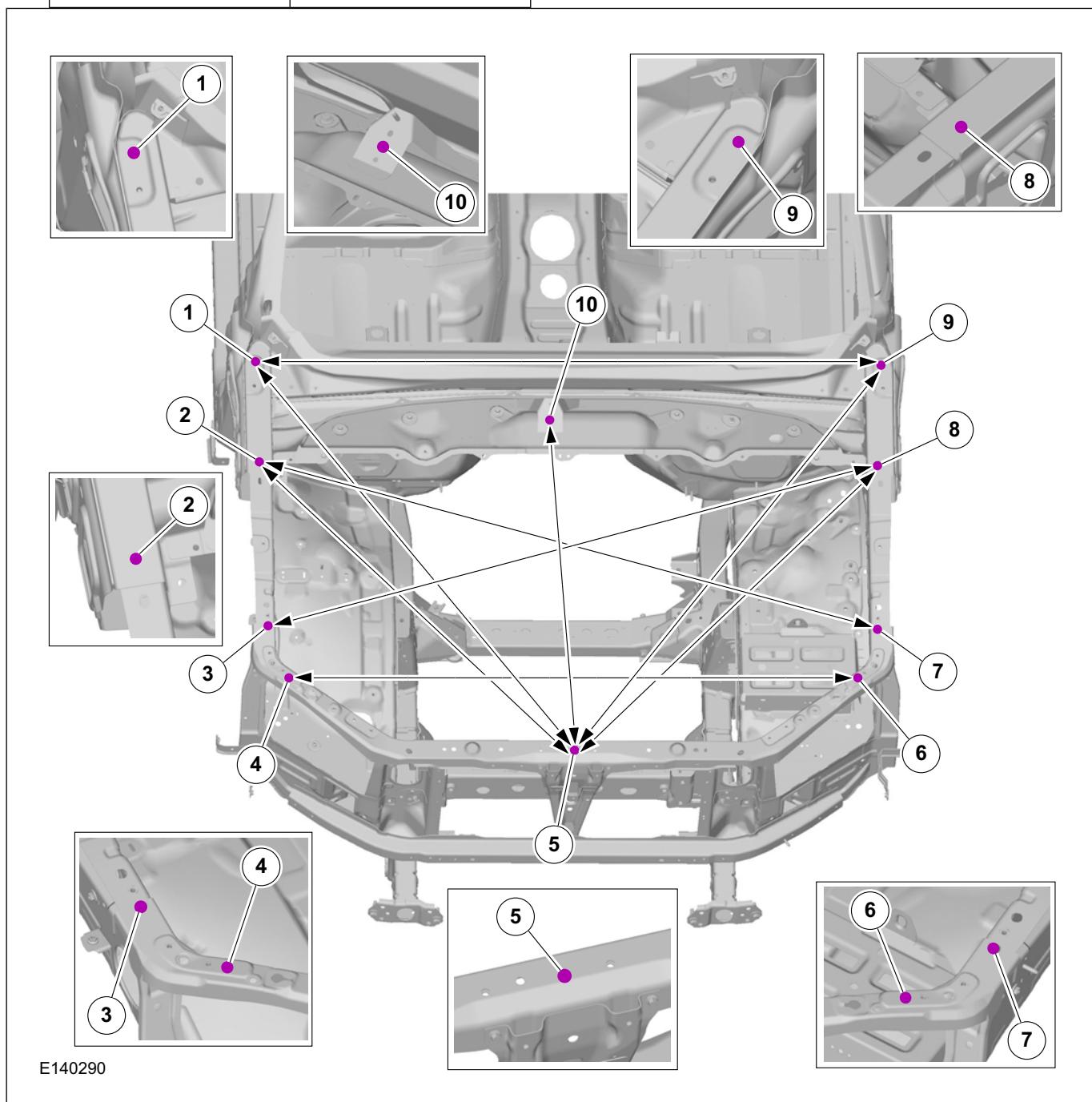
- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the centre of each hole or panel edge using a symmetrically adjusted measuring gauge.

1 - 9 = XX mm	5 - 8 = XX mm
2 - 5 = XX mm	5 - 9 = XX mm
2 - 7 = XX mm	5 - 10 = XX mm
3 - 8 = XX mm	

Measuring points and dimensions

1 - 5 = XX mm

4 - 6 = XX mm

**2. Body dimensions, side view double cab**

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from

GENERAL PROCEDURES

- the edge of the steel panel using a symmetrically adjusted measuring gauge.
- Measuring points 1, 2, 3, 4, 6, 7, 10 and 11 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 8, 9 and 12 are shown looking from the vehicle interior outwards.

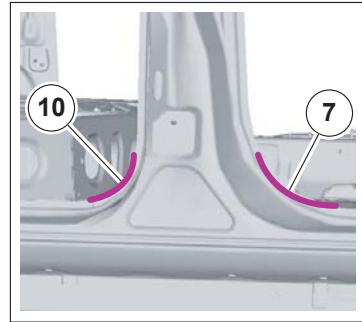
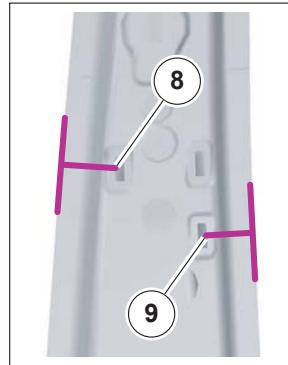
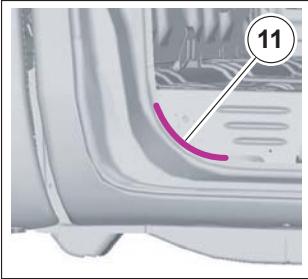
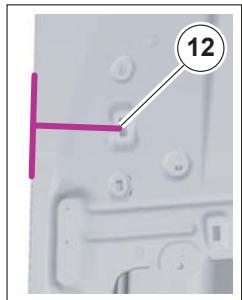
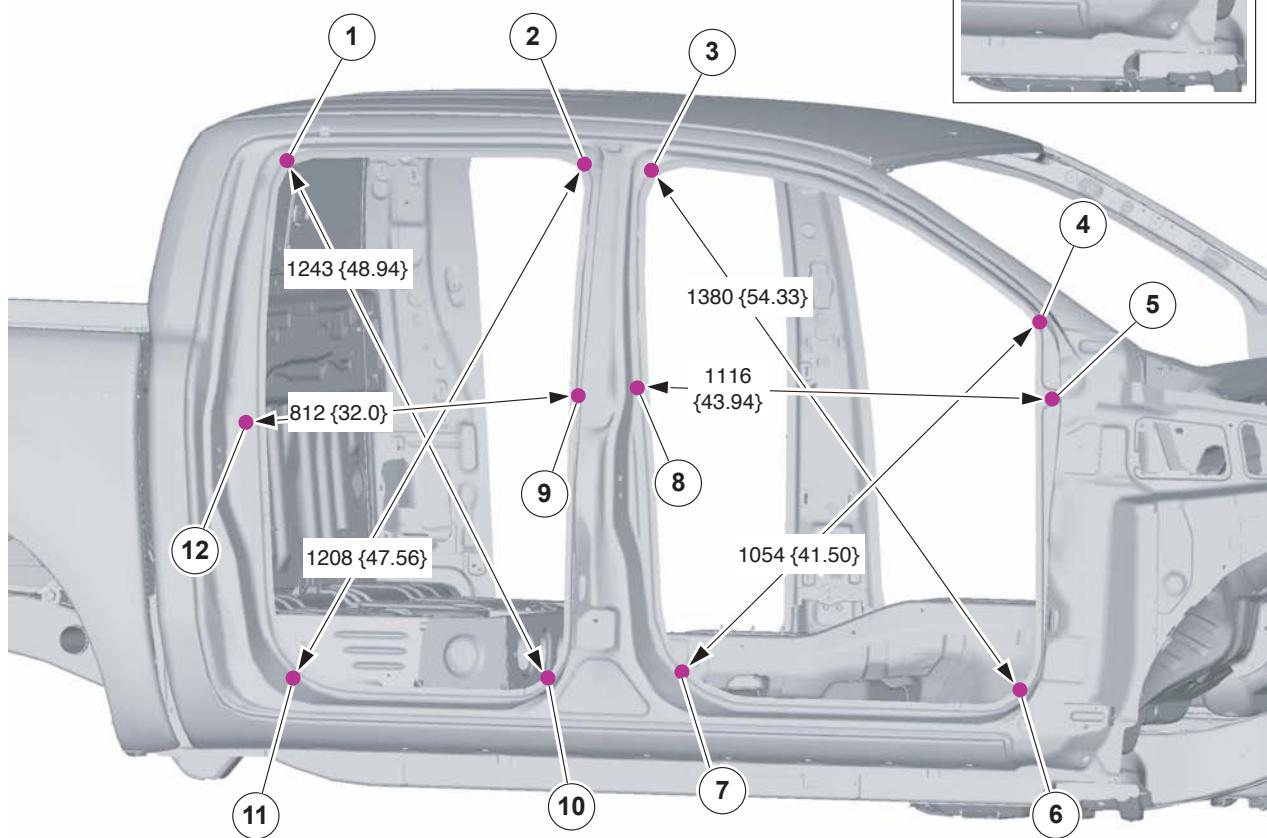
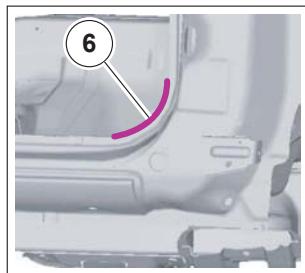
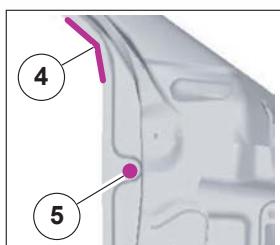
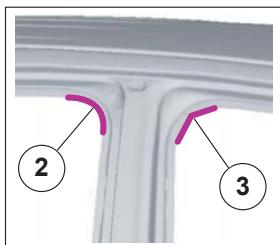
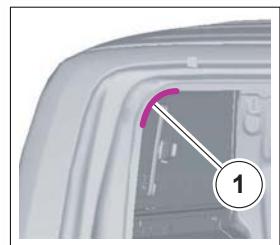
- The detailed view of measuring point 5 is measured in the hole and represent the greatest distance to the measuring point opposite.

Measuring points and dimensions

1 - 10 = XX mm	4 - 7 = XX mm
2 - 11 = XX mm	5 - 8 = XX mm
3 - 6 = XX mm	9 - 12 = XX mm

CABIN SIDE FRAME STRAIGHT-LINE DIMENSIONS (DOUBLE CAB) [DIMENSIONS]

id098010628800



mm {in}

abs0zb00000014

3. Body dimensions, side view double cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from

the edge of the steel panel using a symmetrically adjusted measuring gauge.

CABIN SIDE FRAME STRAIGHT-LINE DIMENSIONS (REGULAR CAB) [DIMENSIONS]

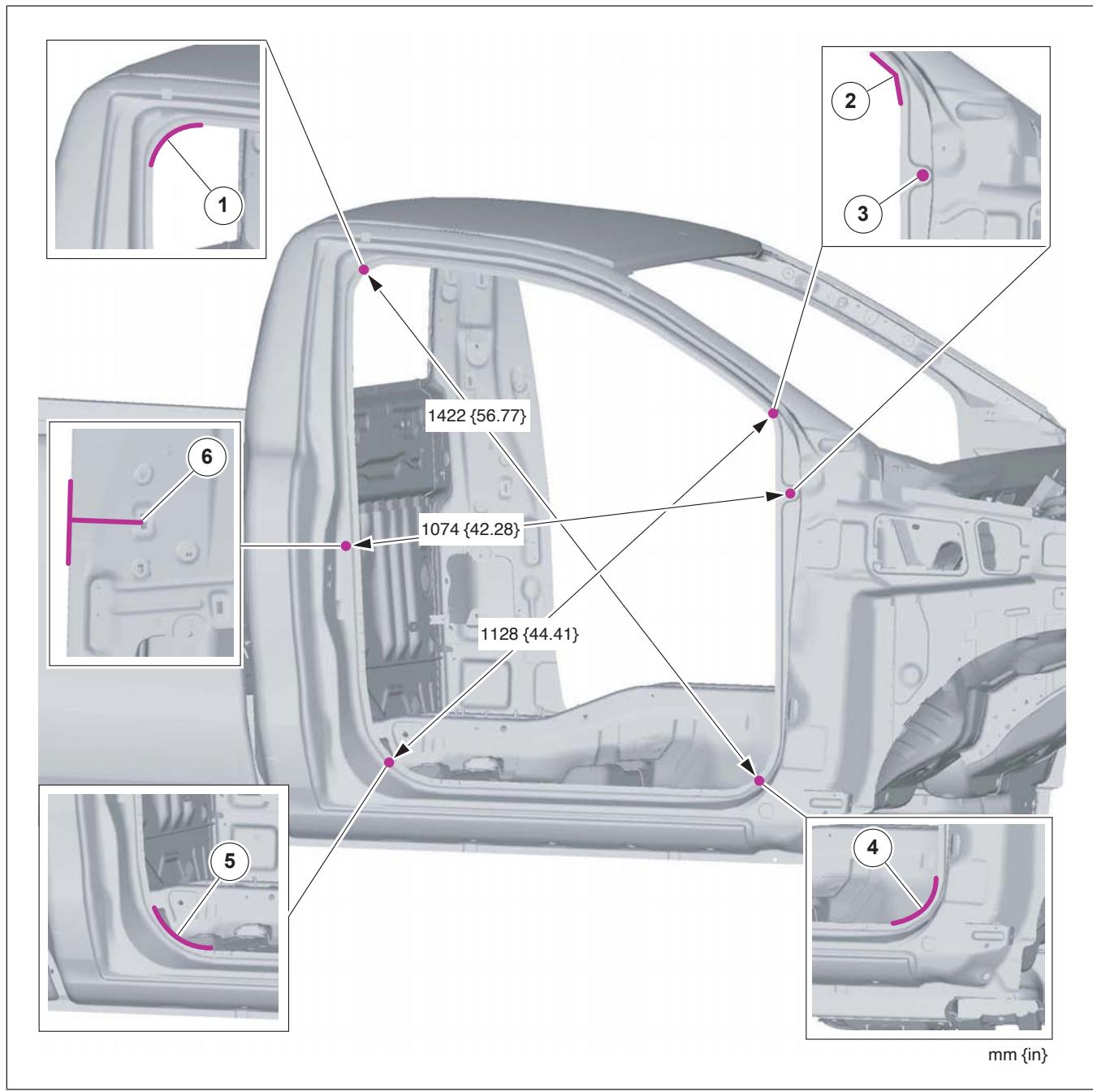
id098010608300

- Measuring points 1, 2, 4 and 5 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed view of measuring point 3 is measured in the hole and represent the greatest distance to the measuring point opposite.

- The detailed view of measuring point 6 is shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 4 = XX mm	3 - 6 = XX mm
2 - 5 = XX mm	



4. Body dimensions, side view Regular cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the edge of the steel panel using a symmetrically adjusted measuring gauge.

- Measuring points 1, 2, 4 and 5 are measured in the curve and represent the greatest distance to the measuring point opposite.
- The detailed view of measuring point 3 is measured in the hole and represent the greatest distance to the measuring point opposite.

CABIN SIDE FRAME STRAIGHT-LINE DIMENSIONS (FREESTYLE CAB) [DIMENSIONS]

id098010628700

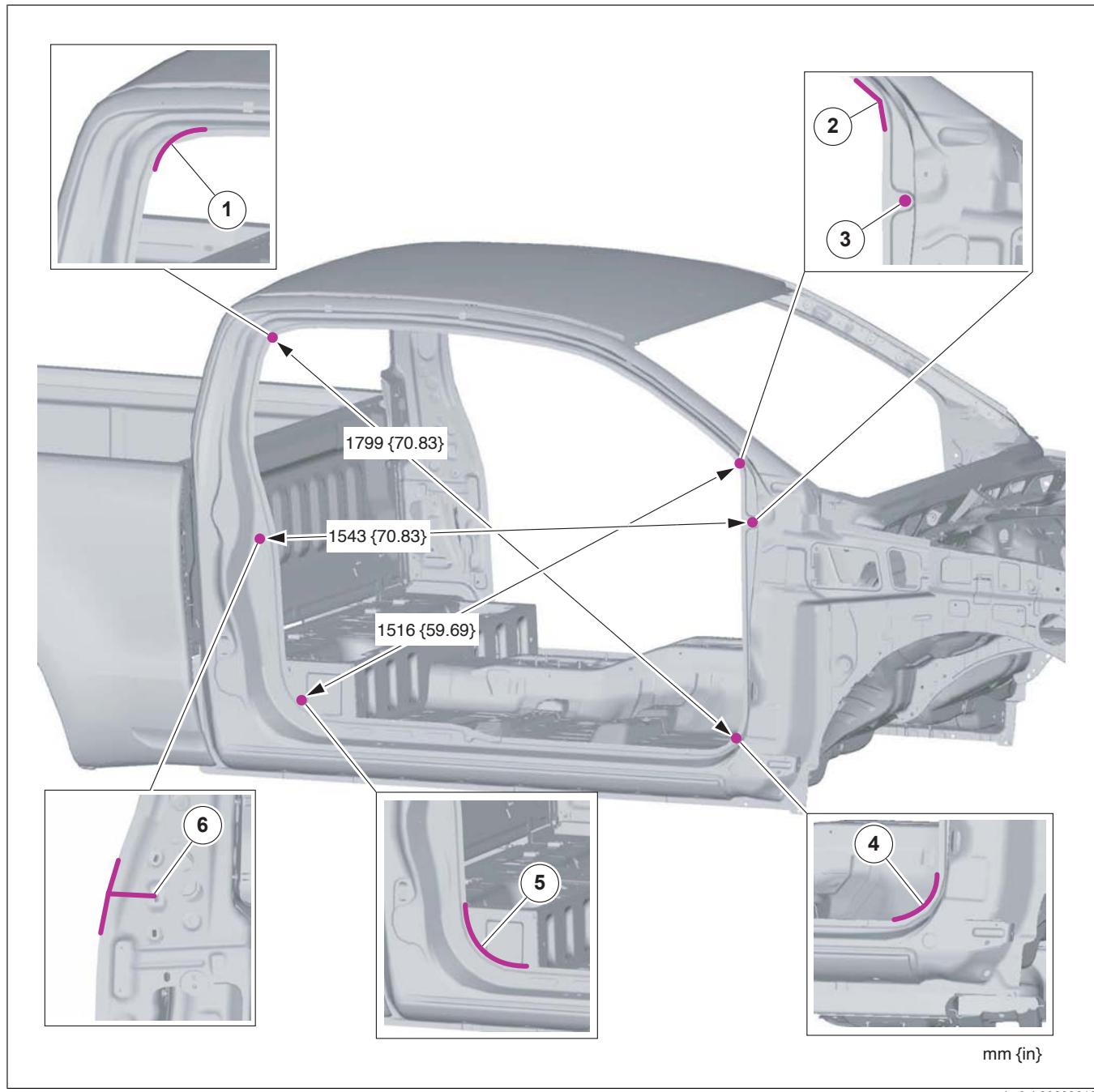
greatest distance to the measuring point opposite.

- The detailed view of measuring point 6 is shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 4 = XX mm 3 - 6 = XX mm

2 - 5 = XX mm



abs0zb000000013

5. Body dimensions, interior double cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.

- Measuring points 3 and 4 are measured in the hole and represent the greatest distance to the measuring point opposite.
- The detailed views of measuring points 1, 2, 5 and 6 are shown looking from the vehicle interior outwards.
-

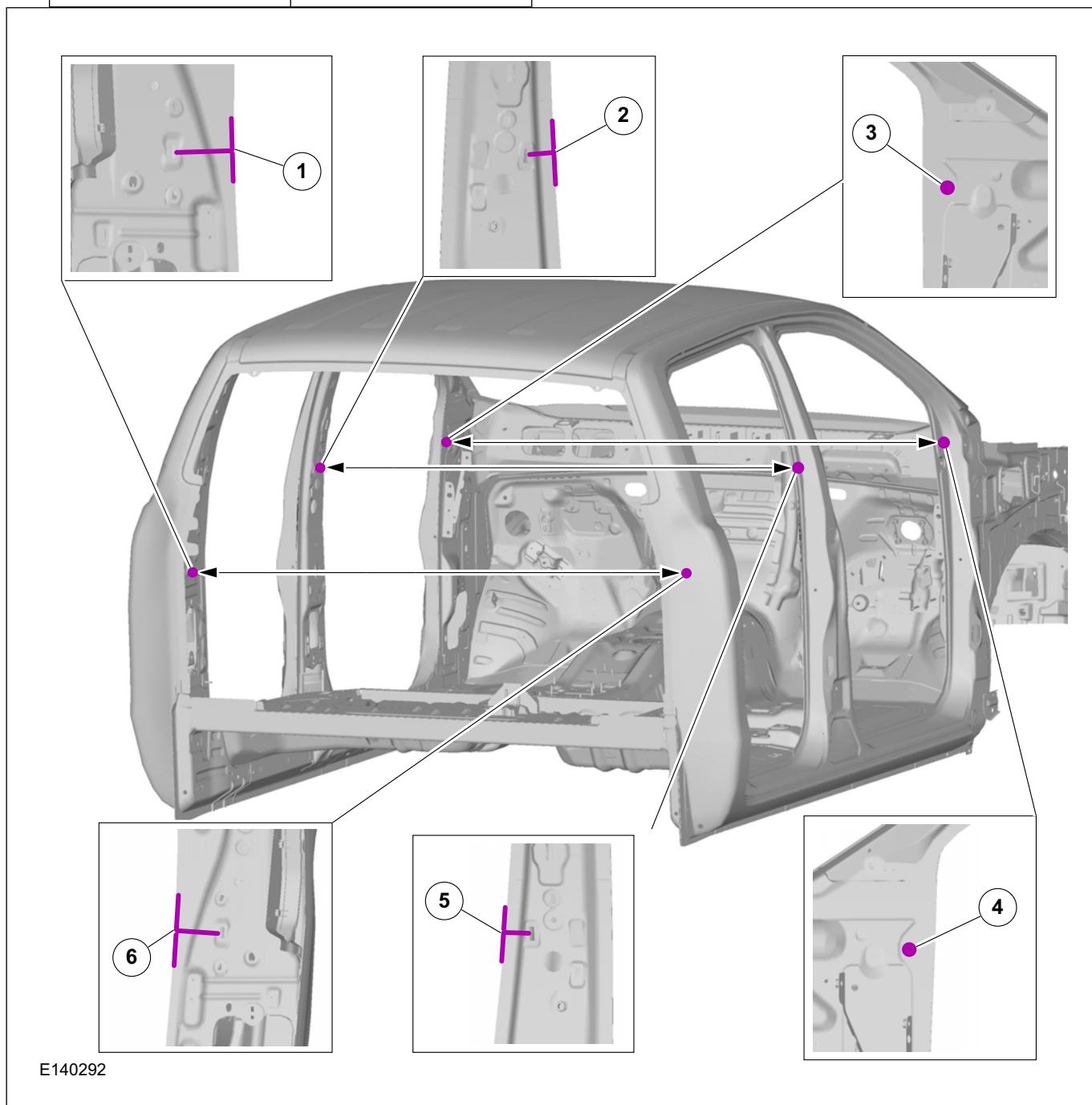
GENERAL PROCEDURES

Measuring points and dimensions

1 - 6 = XX mm

3 - 4 = XX mm

2 - 5 = XX mm



6. Body dimensions, interior single cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 1 and 2 are measured in the hole and represent the greatest distance to the measuring point opposite.

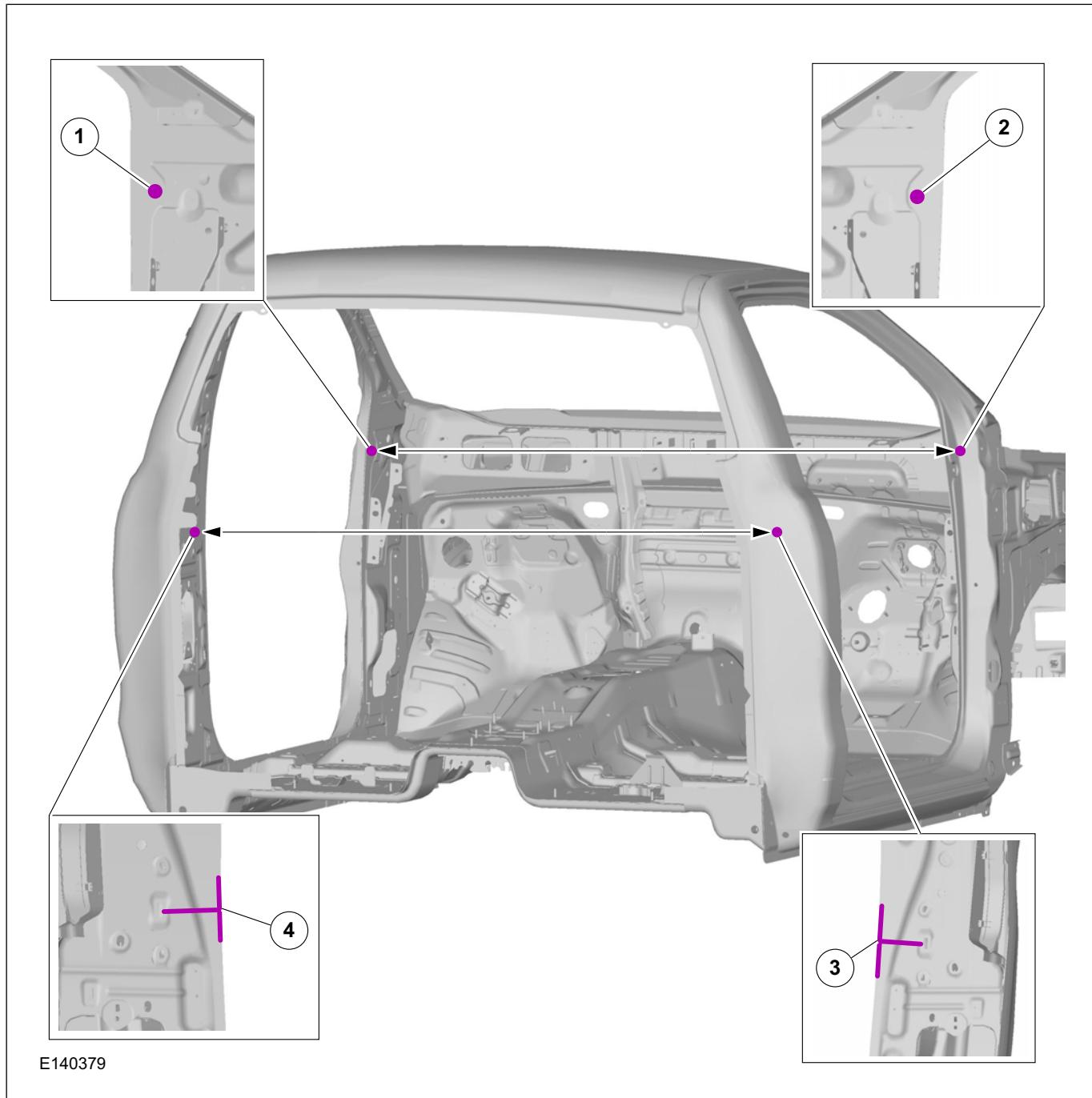
- The detailed views of measuring points 3 and 4 are shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 2 = XX mm

3-4 = XX mm

GENERAL PROCEDURES



E140379

7. Body dimensions, interior stretch cab

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 1 and 2 are measured in the hole and represent the greatest distance to the measuring point opposite.

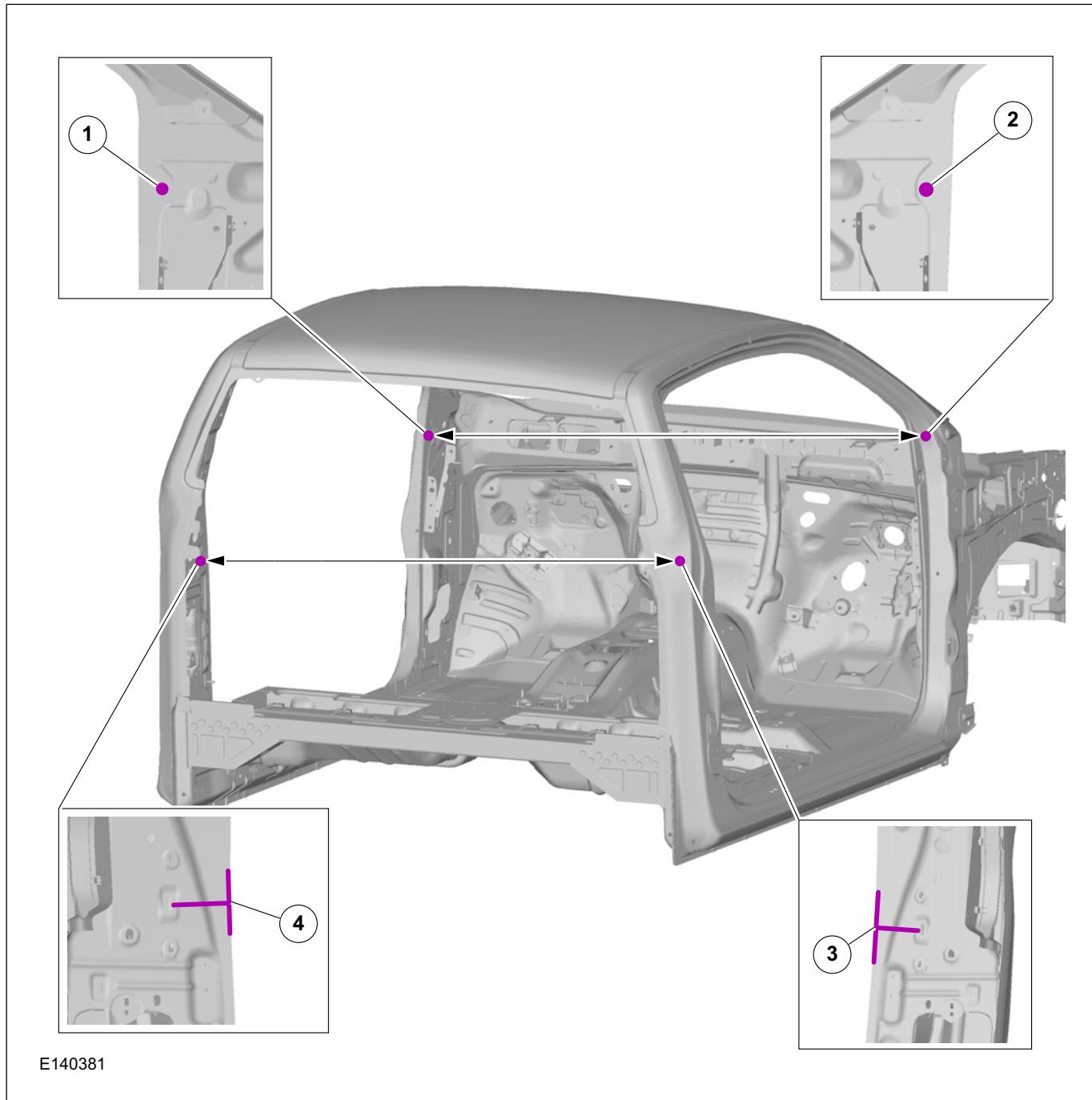
- The detailed views of measuring points 3 and 4 are shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 2 = XX mm

3 - 4 = XX mm

GENERAL PROCEDURES



E140381

8. Body dimensions, rear all vehicles

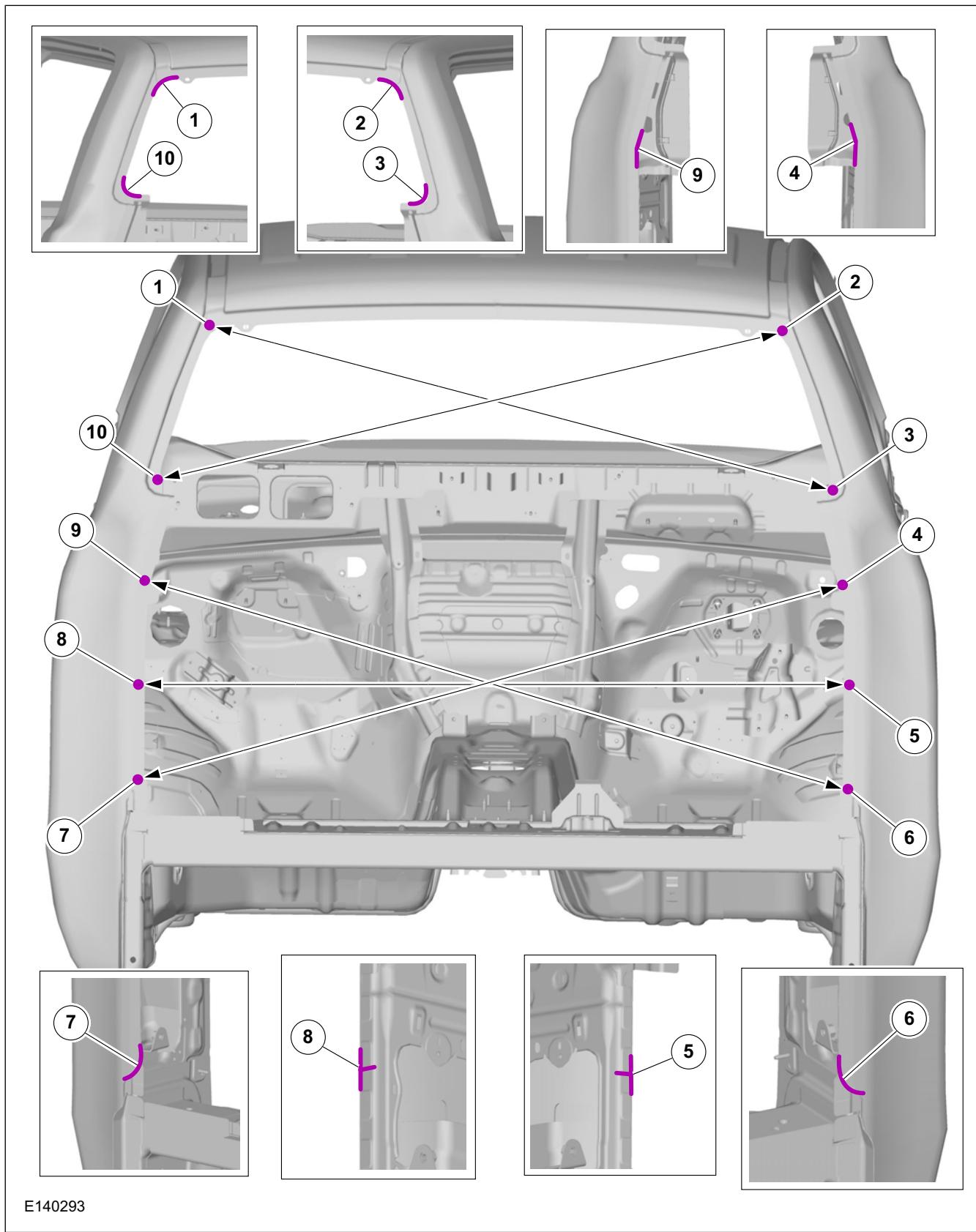
- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from the center of the welded flange using a symmetrically adjusted measuring gauge.
- Measuring points 1, 2, 3, 4, 6, 9, and 10 are measured in the curve and represent the greatest distance to the measuring point opposite.

- The detailed views of measuring points 5 and 8 are shown looking from the vehicle interior outwards.

Measuring points and dimensions

1 - 3 = XX mm	4 - 7 = XX mm
2 - 10 = XX mm	5 - 8 = XX mm
6 - 9 = XX mm	5 - 9 = XX mm

GENERAL PROCEDURES



E140293

9. Tailgate opening dimensions, all vehicles

- All dimensions with tolerance ± 3 mm. All dimensions were determined starting from

the center of the welded flange using a symmetrically adjusted measuring gauge.

GENERAL PROCEDURES**Measuring points and dimensions**

1 - 3 = XX mm

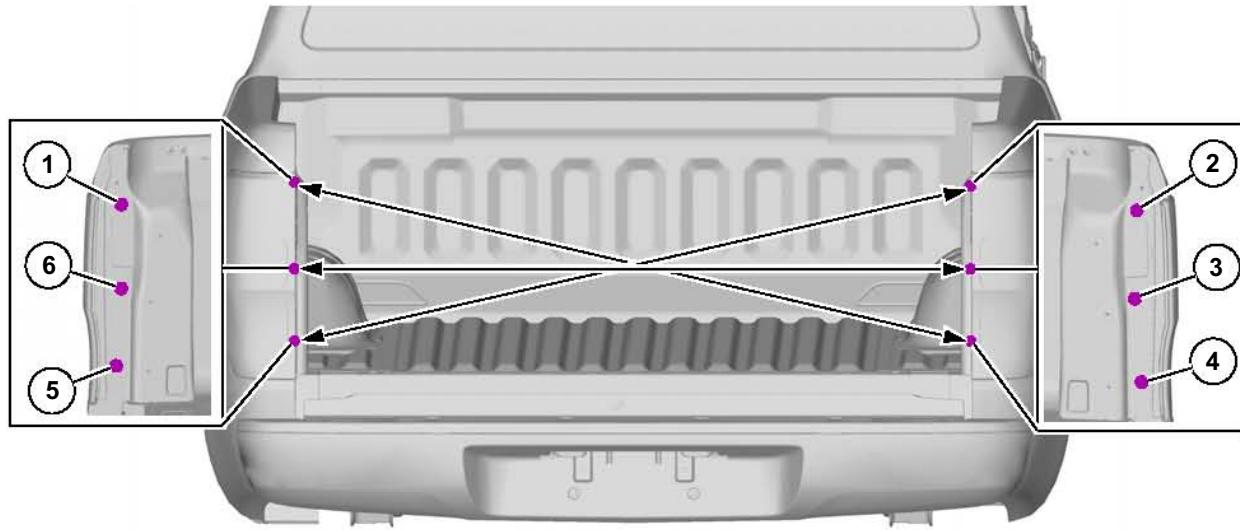
4 - 7 = XX mm

2 - 10 = XX mm

5 - 8 = XX mm

6 - 9 = XX mm

5 - 9 = XX mm

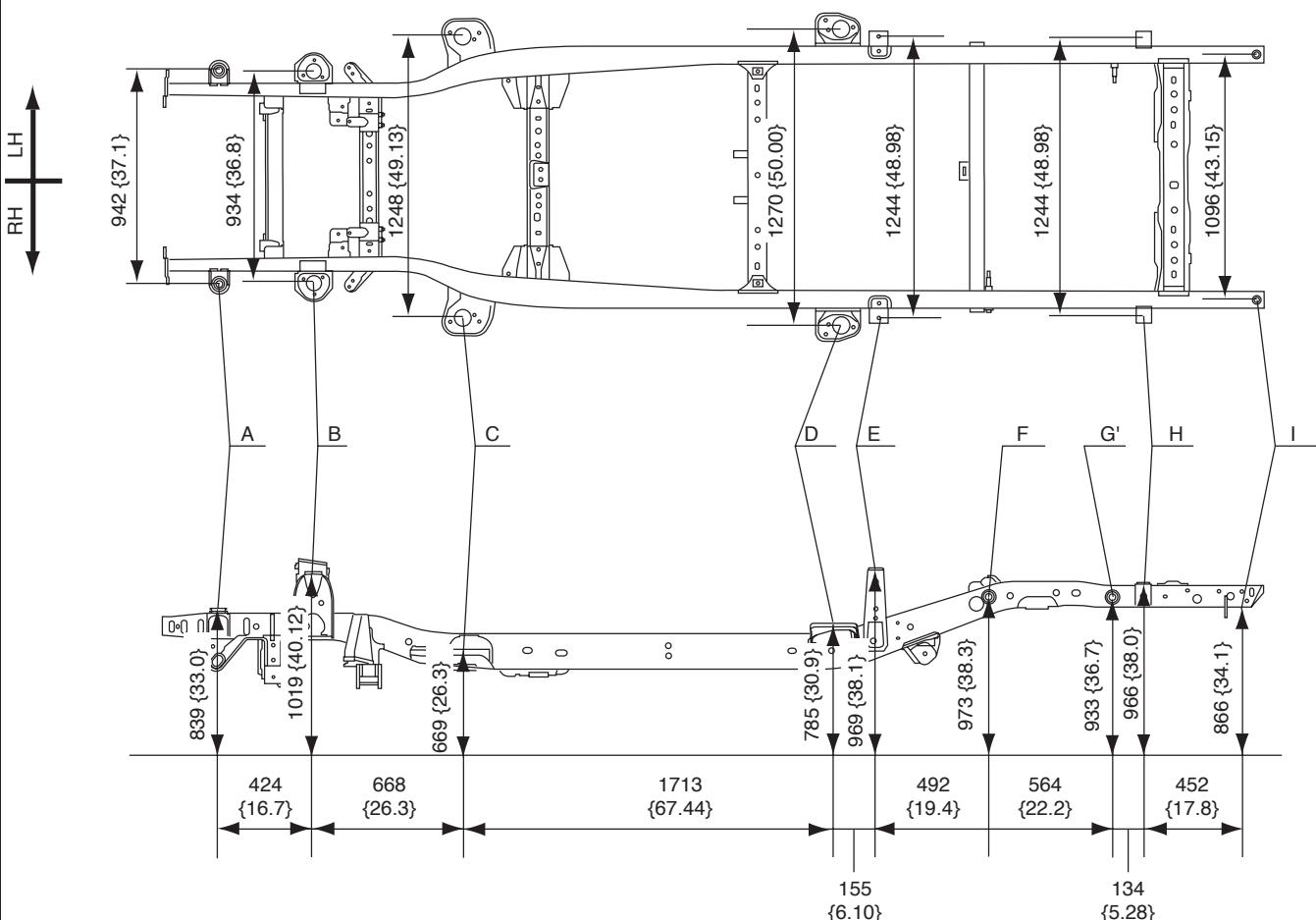


E140294

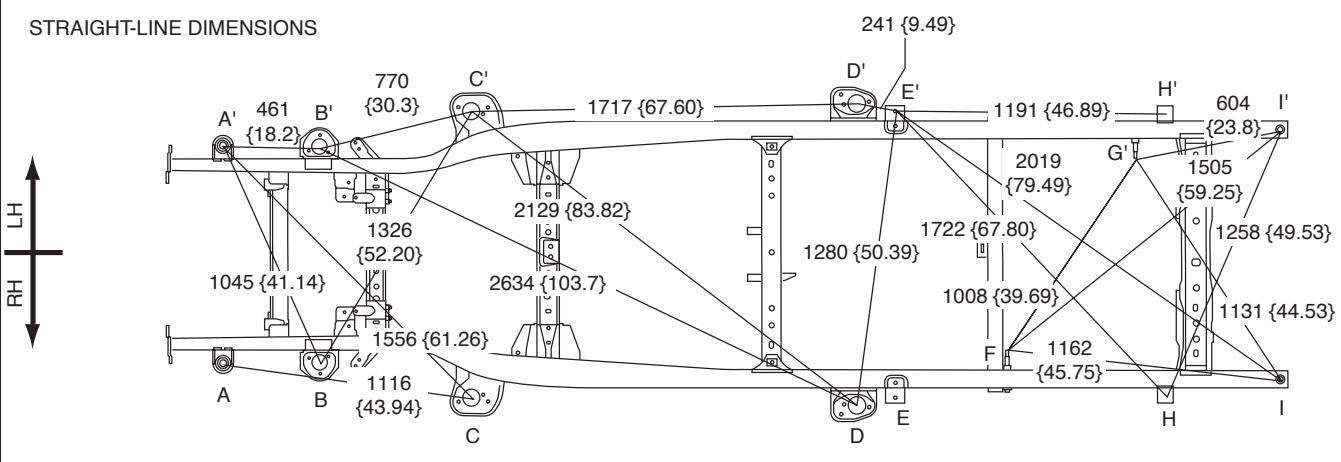
FRAME DIMENSIONS (UNDERBODY FREESTYLE CAB 2WD HIGH CLEARANCE MODEL) [DIMENSIONS]
id098010618100

FLAT-PLANE DIMENSIONS

mm {in}



STRAIGHT-LINE DIMENSIONS



abs0zb00000000

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	ø15.25 {0.6004}
B	Upper arm bracket datum hole	ø28.9 {1.14}
C	Cabin mounting bracket No.2 datum hole	ø38.65 {1.522}

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
D	Cabin mounting bracket No.3 datum hole	ø38.65 {1.522}
E	Box mounting bracket No.1 datum hole	ø10 {0.39}
F	Damper bracket	-
G'	Damper bracket	-

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}

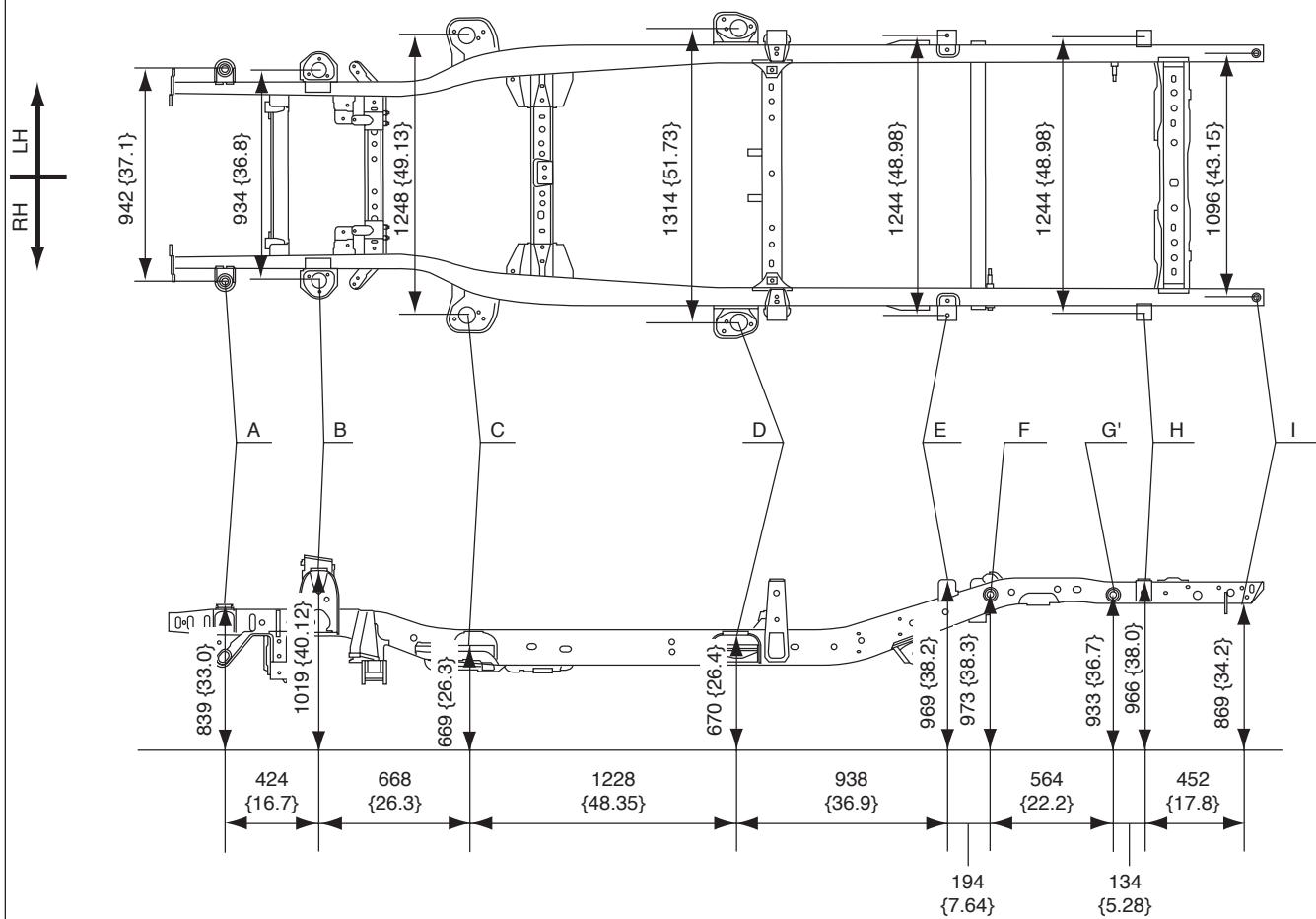
Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
I	Side member datum hole	ø6.5 {0.26}

id098010618300

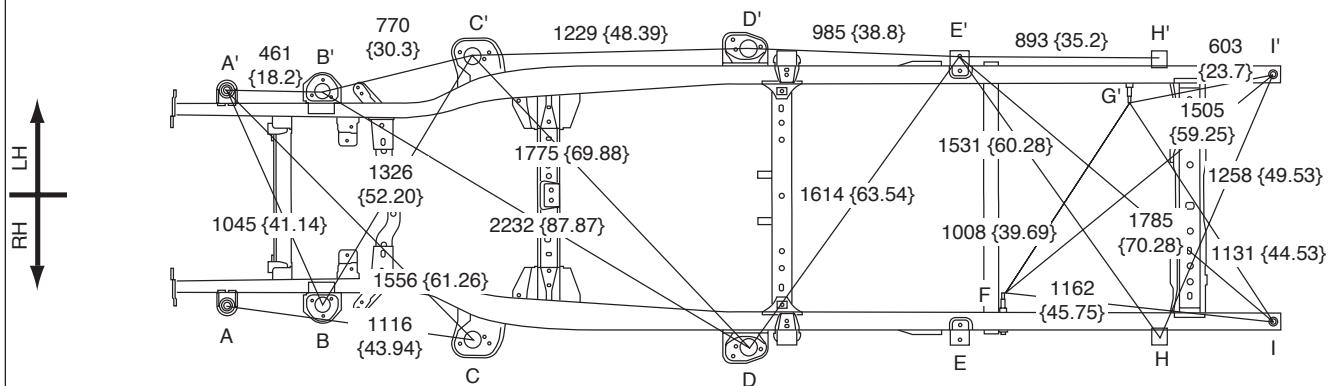
FRAME DIMENSIONS (UNDERBODY REGULAR CAB 4WD) [DIMENSIONS]

FLAT-PLANE DIMENSIONS

mm {in}



STRAIGHT-LINE DIMENSIONS



Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	ø15.25 {0.6004}
B	Upper arm bracket datum hole	ø28.9 {1.14}
C	Cabin mounting bracket No.2 datum hole	ø38.65 {1.522}

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
D	Cabin mounting bracket No.3 datum hole	ø38.65 {1.522}
E	Box mounting bracket No.2 datum hole	ø10 {0.39}
F	Damper bracket	-
G'	Damper bracket	-

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}

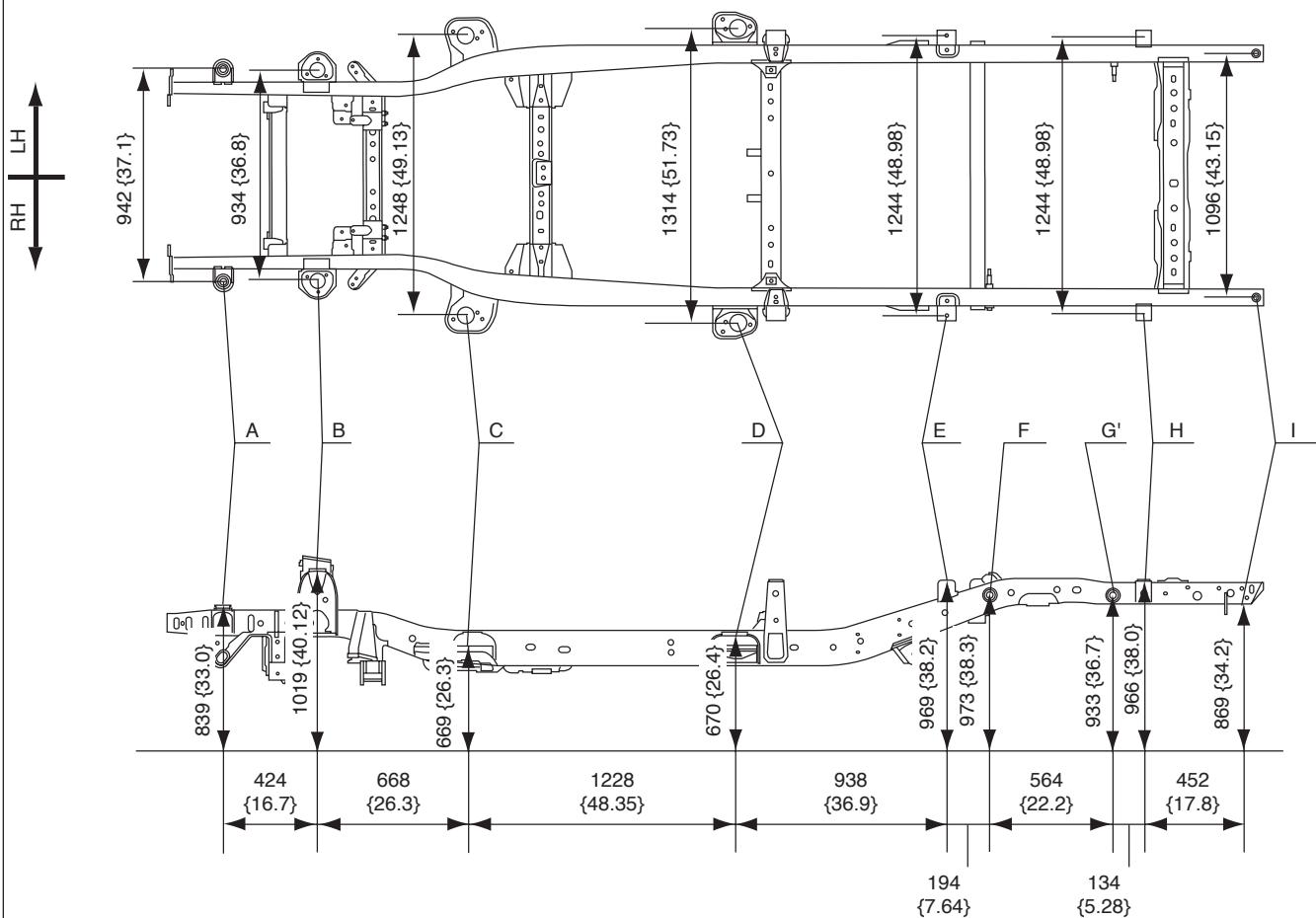
Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
I	Side member datum hole	ø6.5 {0.26}

FRAME DIMENSIONS (UNDERBODY REGULAR CAB 2WD HIGH CLEARANCE MODEL) [DIMENSIONS]

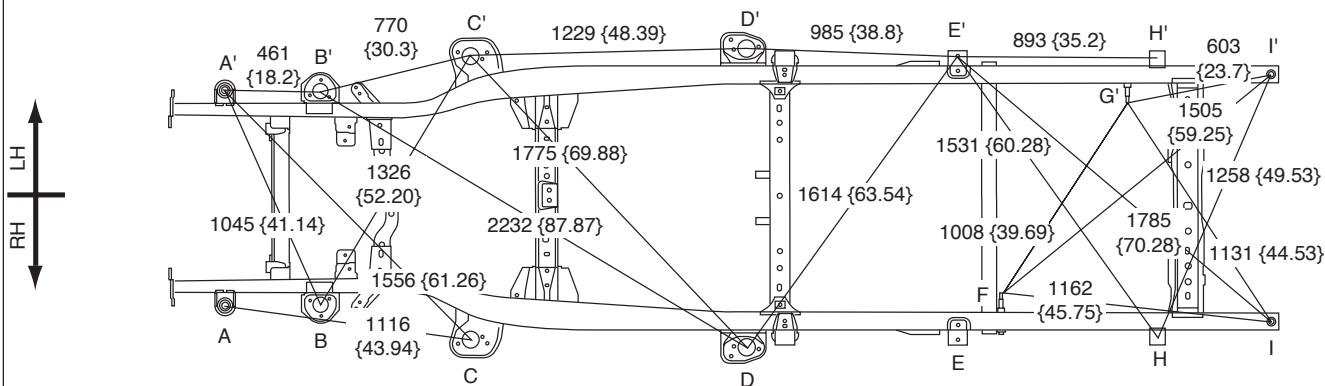
id098010618400

FLAT-PLANE DIMENSIONS

mm {in}



STRAIGHT-LINE DIMENSIONS



Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	ø15.25 {0.6004}
B	Upper arm bracket datum hole	ø28.9 {1.14}
C	Cabin mounting bracket No.2 datum hole	ø38.65 {1.522}

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
D	Cabin mounting bracket No.3 datum hole	ø38.65 {1.522}
E	Box mounting bracket No.2 datum hole	ø10 {0.39}
F	Damper bracket	-
G'	Damper bracket	-

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}

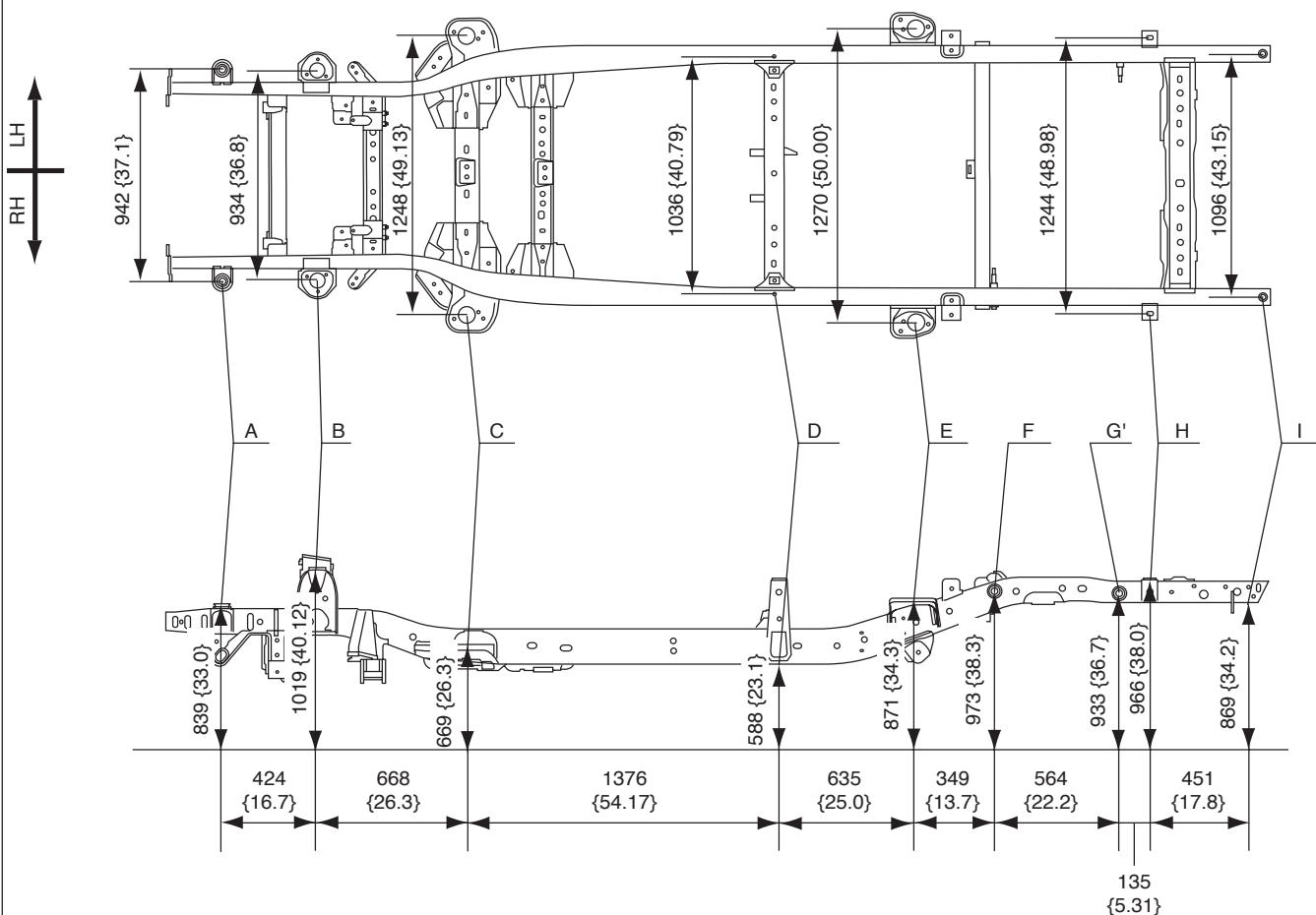
Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
I	Side member datum hole	ø6.5 {0.26}

FRAME DIMENSIONS (UNDERBODY DOUBLE CAB 2WD HIGH CLEARANCE MODEL) [DIMENSIONS]

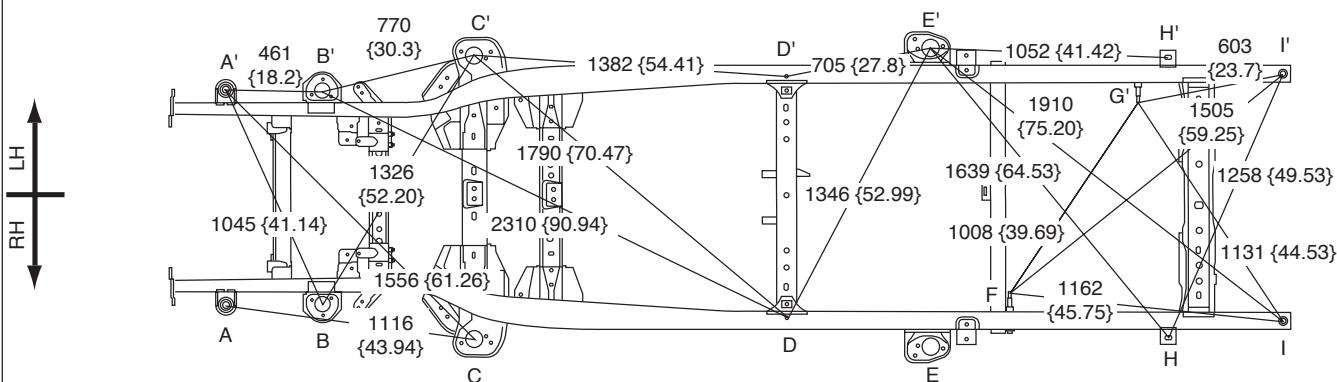
id098010619000

FLAT-PLANE DIMENSIONS

mm {in}



STRAIGHT-LINE DIMENSIONS



abs0zb000000007

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	$\varnothing 15.25$ {0.6004}
B	Upper arm bracket datum hole	$\varnothing 28.9$ {1.14}
C	Cabin mounting bracket No.2 datum hole	$\varnothing 38.65$ {1.522}
D	Side member datum hole	$\varnothing 6$ {0.2}

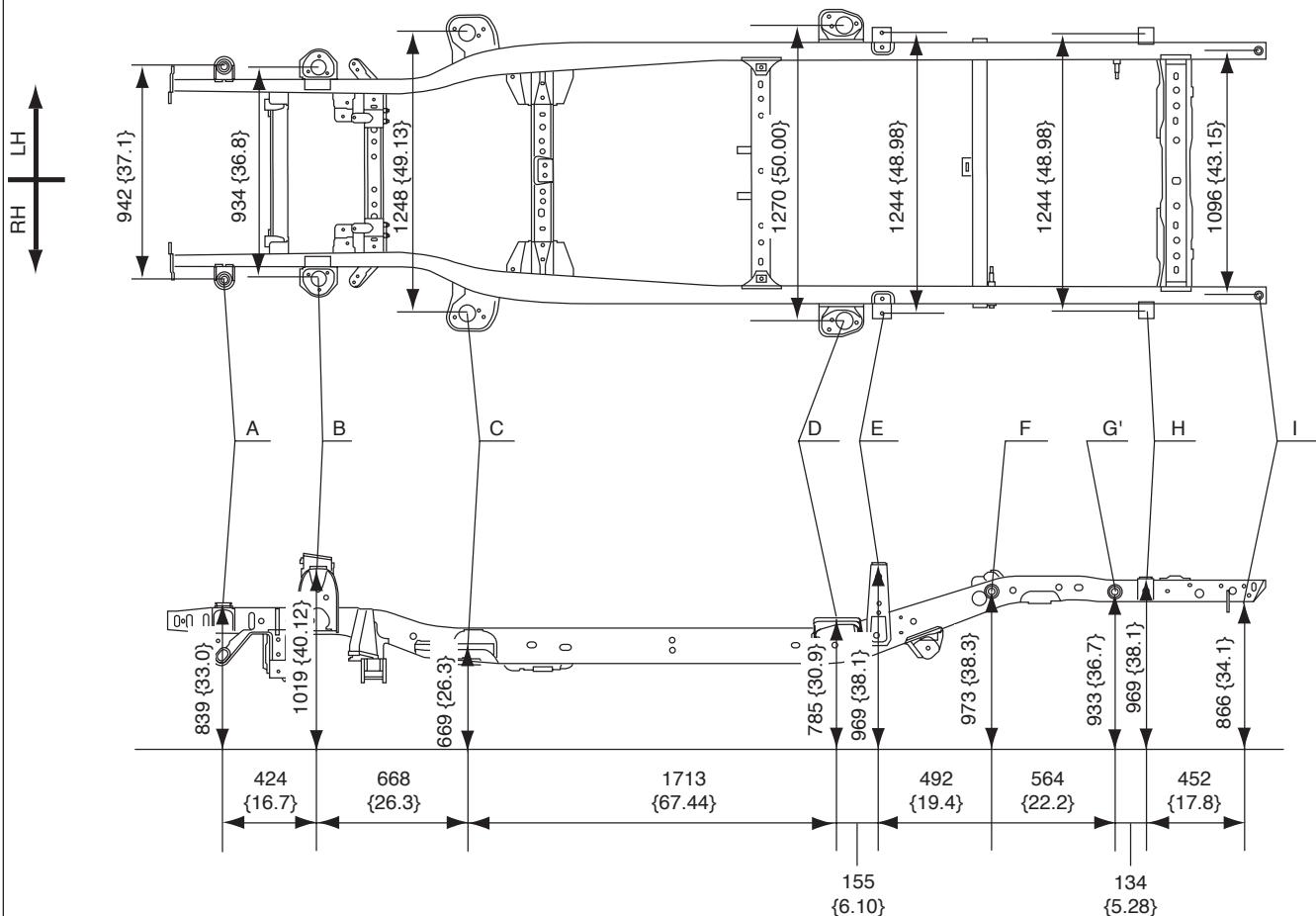
Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
E	Cabin mounting bracket No.3 datum hole	ø38.65 {1.522}
F	Damper bracket	-
G'	Damper bracket	-
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}
I	Side member datum hole	ø6.5 {0.26}

id098010608000

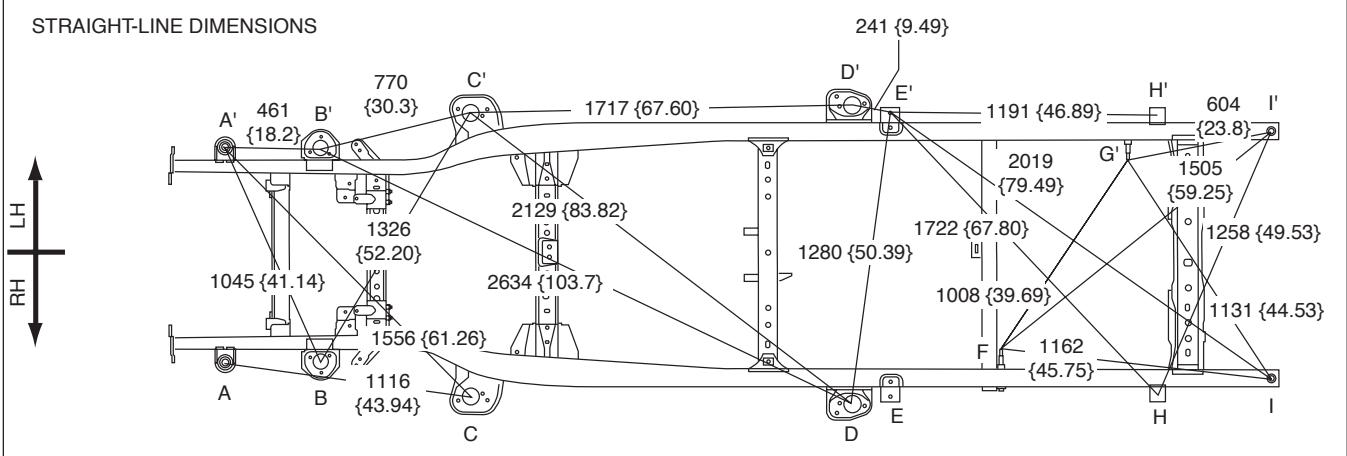
FRAME DIMENSIONS (UNDERBODY FREESTYLE CAB 4WD) [DIMENSIONS]

FLAT-PLANE DIMENSIONS

mm {in}



STRAIGHT-LINE DIMENSIONS



abs0zb0000000005

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	$\varnothing 15.25$ {0.6004}
B	Upper arm bracket datum hole	$\varnothing 28.9$ {1.14}
C	Cabin mounting bracket No.2 datum hole	$\varnothing 38.65$ {1.522}

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
D	Cabin mounting bracket No.3 datum hole	$\varnothing 38.65$ {1.522}
E	Box mounting bracket No.1 datum hole	$\varnothing 10$ {0.39}
F	Damper bracket	-
G'	Damper bracket	-

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}

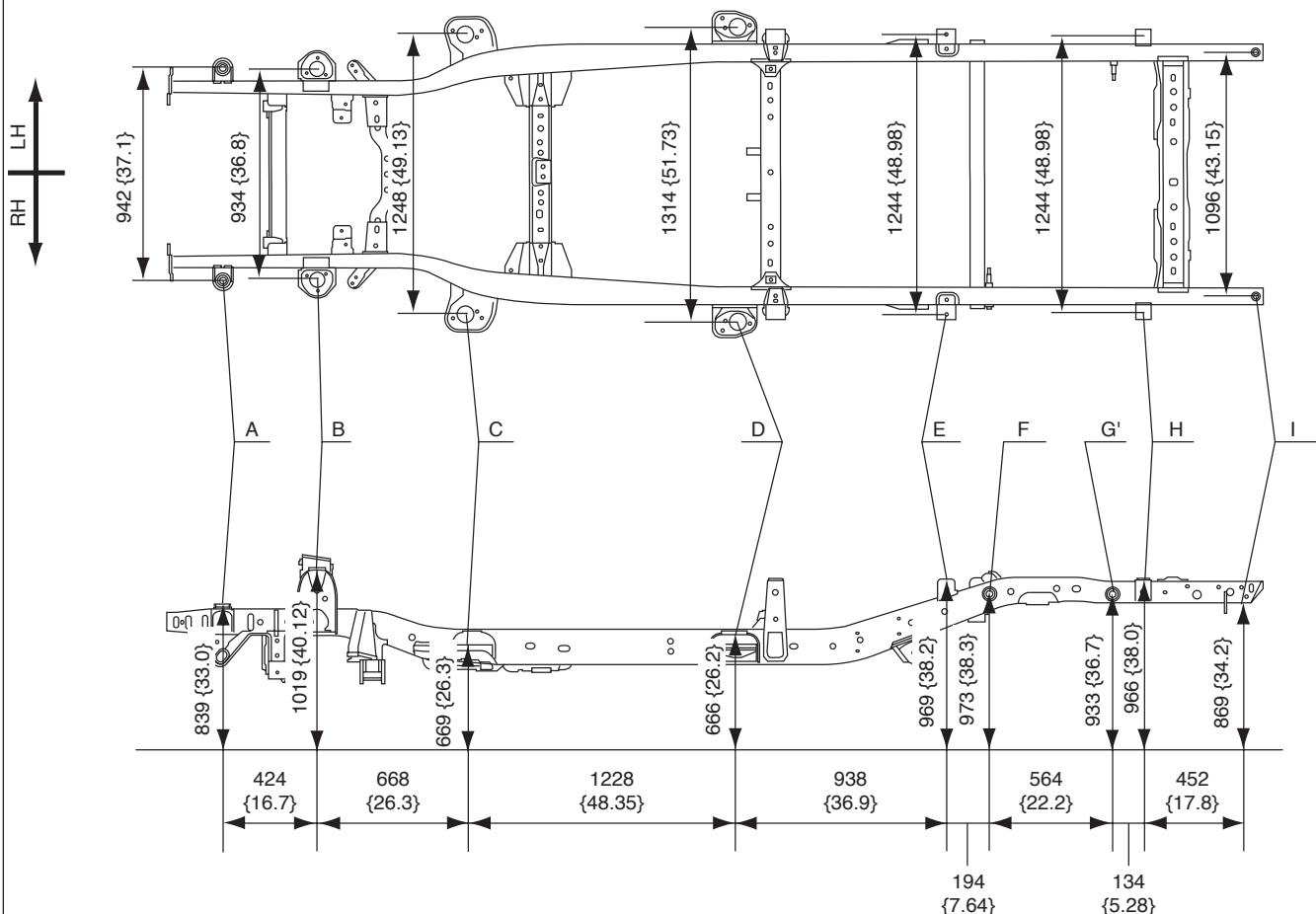
Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
I	Side member datum hole	ø6.5 {0.26}

id098010604900

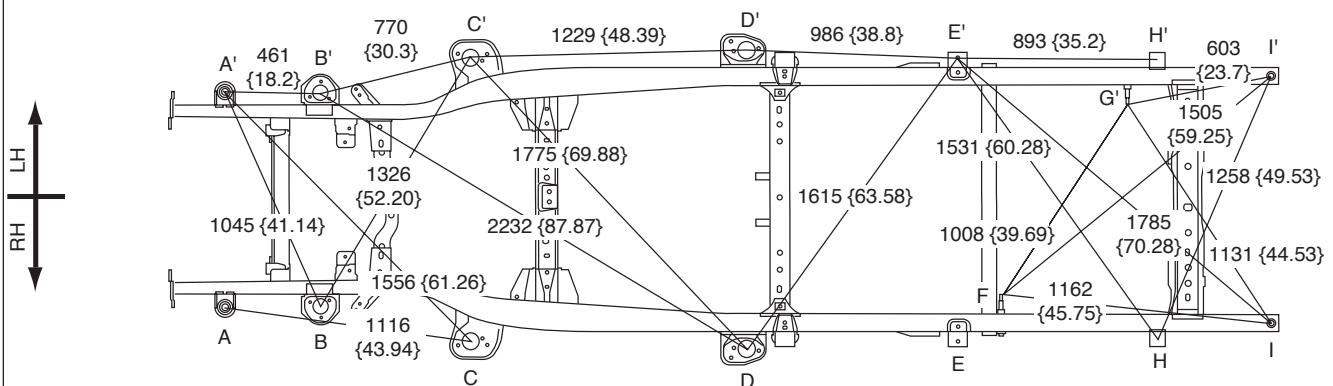
FRAME DIMENSIONS (UNDERBODY REGULAR CAB 2WD) [DIMENSIONS]

FLAT-PLANE DIMENSIONS

mm {in}



STRAIGHT-LINE DIMENSIONS



abs0zb00000000

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	ø15.25 {0.6004}
B	Upper arm bracket datum hole	ø28.9 {1.14}
C	Cabin mounting bracket No.2 datum hole	ø38.65 {1.522}

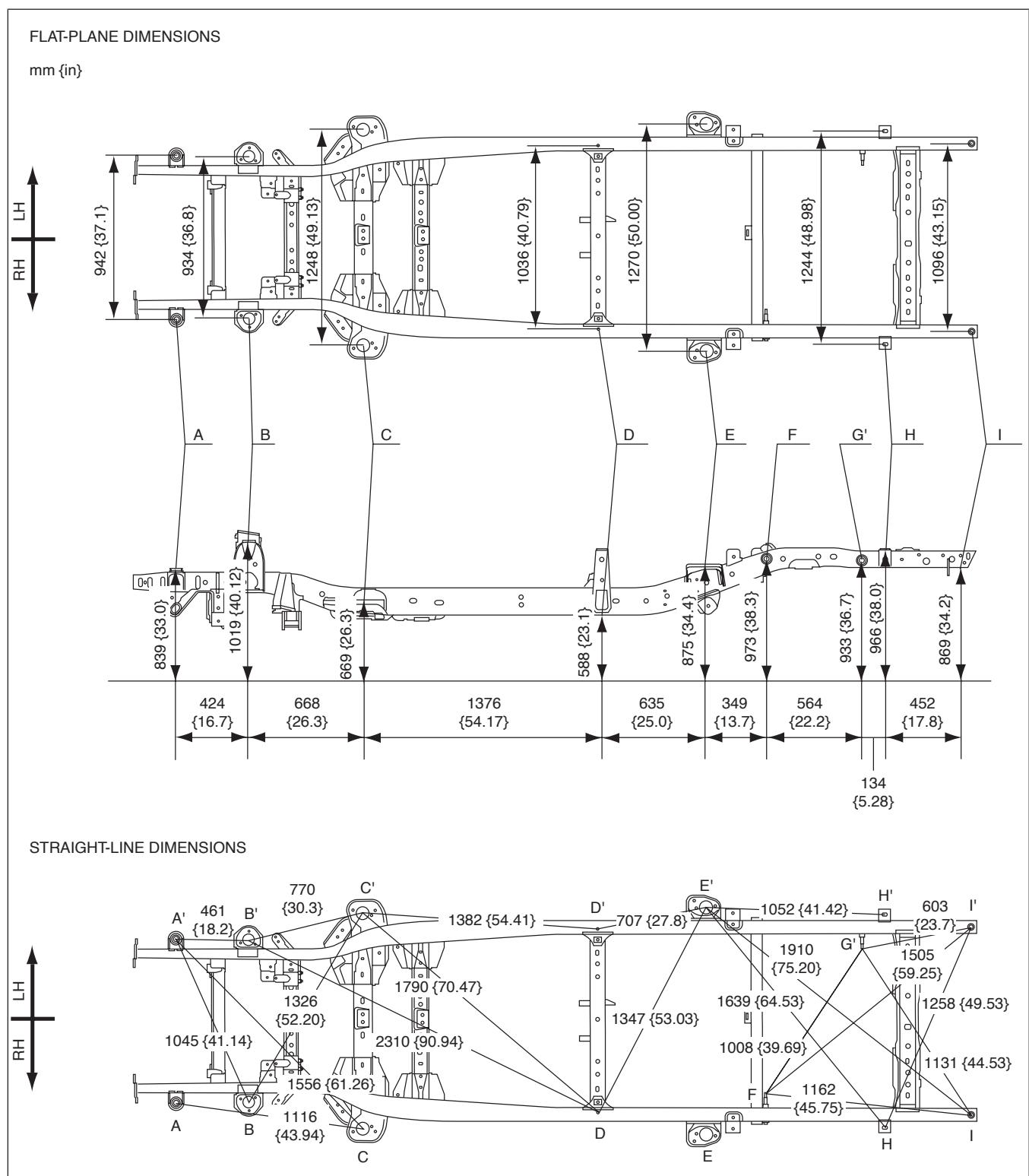
Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
D	Cabin mounting bracket No.3 datum hole	ø38.65 {1.522}
E	Box mounting bracket No.2 datum hole	ø10 {0.39}
F	Damper bracket	-
G'	Damper bracket	-

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
I	Side member datum hole	ø6.5 {0.26}

id098010607900

FRAME DIMENSIONS (UNDERBODY DOUBLE CAB 4WD) [DIMENSIONS]



abs0zb000000004

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
A	Cabin mounting bracket No.1 datum hole	$\varnothing 15.25$ {0.6004}
B	Upper arm bracket datum hole	$\varnothing 28.9$ {1.14}
C	Cabin mounting bracket No.2 datum hole	$\varnothing 38.65$ {1.522}
D	Side member datum hole	$\varnothing 6$ {0.2}

Point symbol	Designation	Hole diameter or bolt or nut size mm {in}
E	Cabin mounting bracket No.3 datum hole	ø38.65 {1.522}
F	Damper bracket	-
G'	Damper bracket	-
H	Box mounting bracket No.3 datum hole	20 × 26 {0.79 × 1.0}
I	Side member datum hole	ø6.5 {0.26}

SECTION 501-27 Front End Sheet Metal Repairs

VEHICLE APPLICATION:BT50 & Ranger

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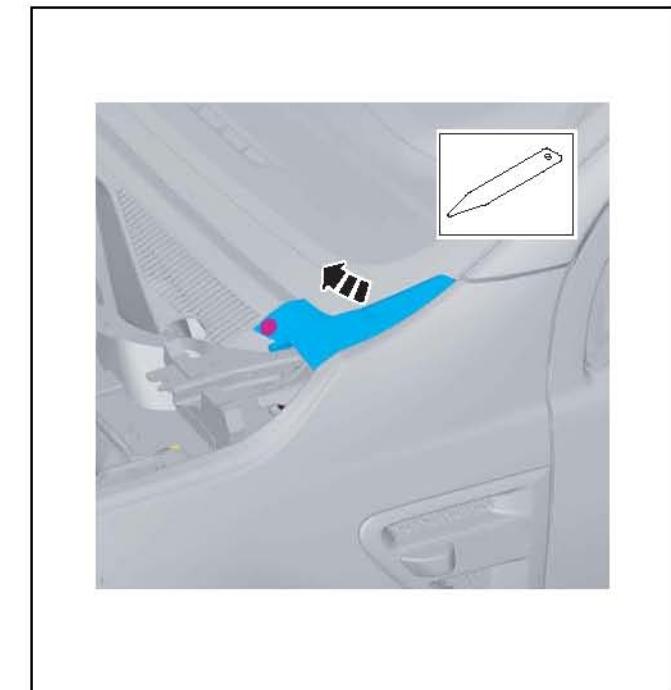
REMOVAL AND INSTALLATION

Front Fender.....	501-27-2
Fender Apron Panel Reinforcement.....	501-27-4

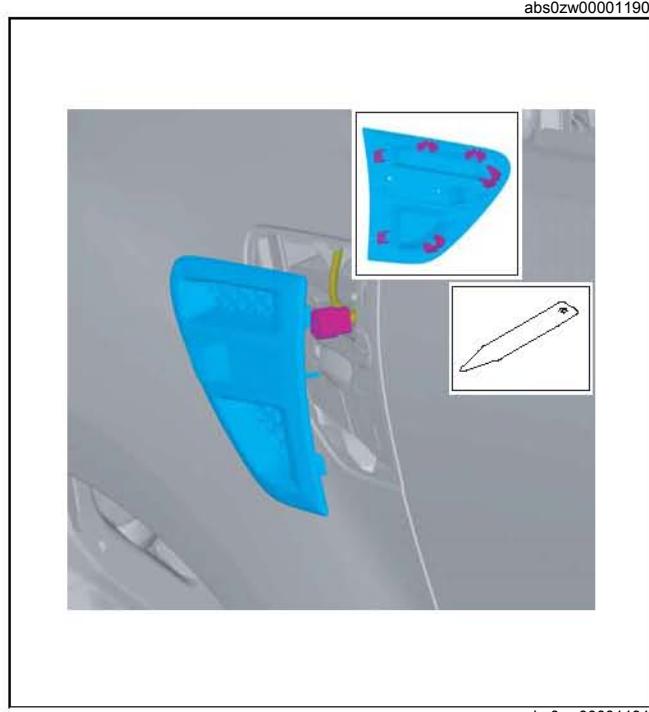
id091000801000

FRONT FENDER PANEL REMOVAL/INSTALLATION**Removal**

1. Refer to: [Battery Disconnect and Connect](#).
2. Refer to: [Front Bumper Cover](#).
3. Refer to: [Headlamp Assembly](#).
- 4.

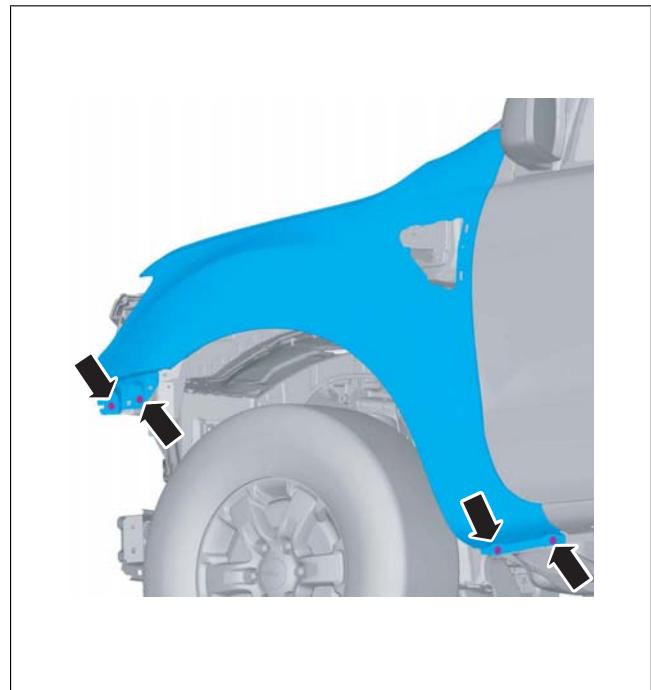


5.



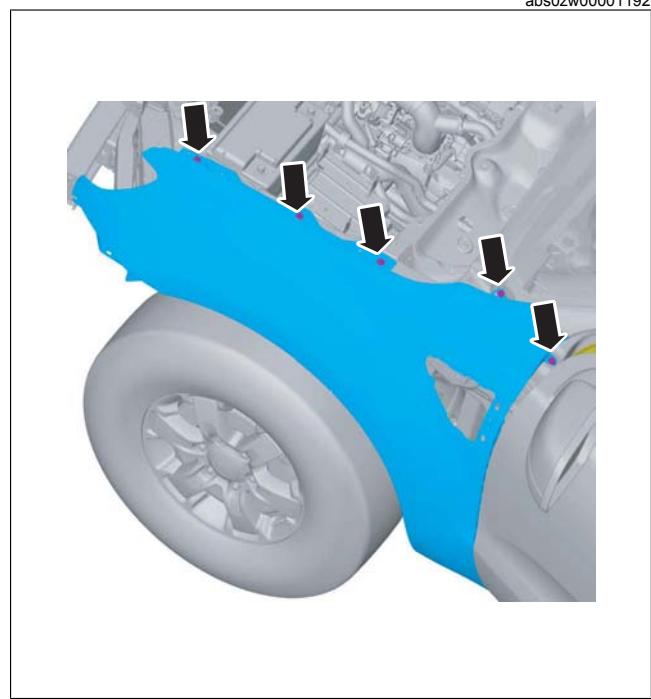
abs0zw00001191

6. Torque: 15 Nm.



abs0zw00001192

7. Torque: 15 Nm.



abs0zw00001193

Installation

1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION

Fender Apron Panel Reinforcement

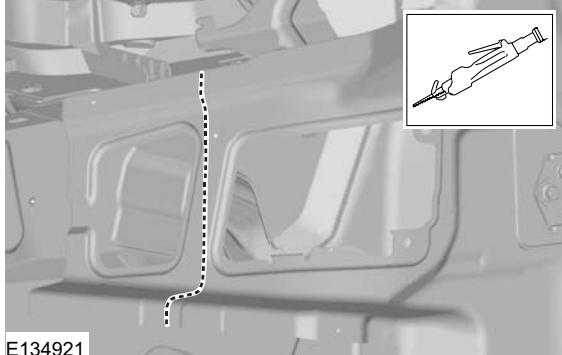
General Equipment

Air Body Saw

Removal

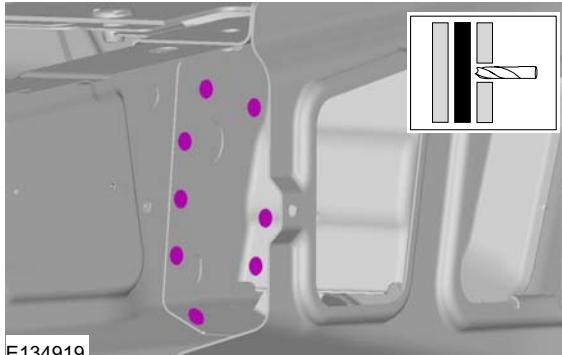
1. Refer to: **Battery Disconnect and Connect** (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: **Front Fender** (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. • **Partial Replacement**
 - Possible cut line.

General Equipment: Air Body Saw



4. • Mill out the spot welds.

General Equipment: Spot weld drill Bit

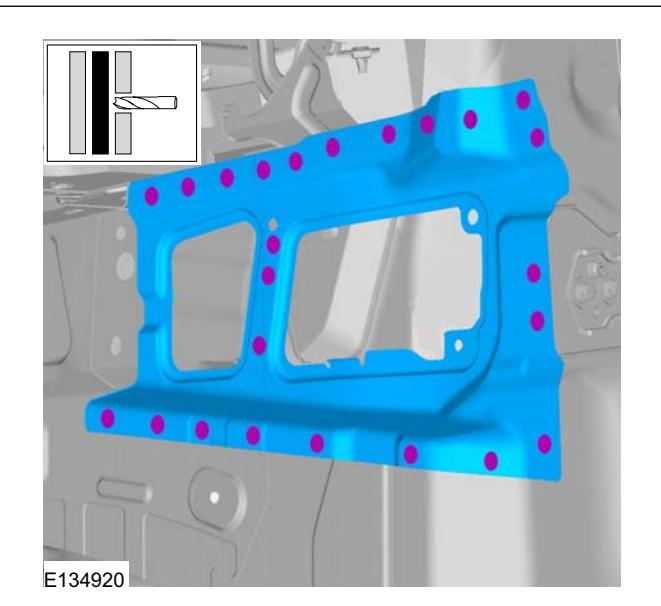


General Equipment

Spot weld drill Bit

5. • Mill out the spot welds.

General Equipment: Spot weld drill Bit



Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

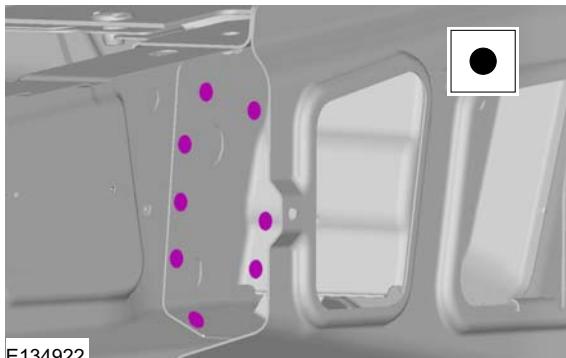
Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

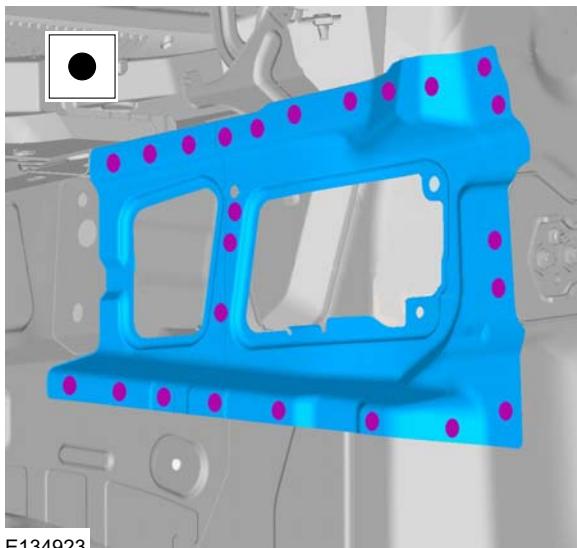
Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

REMOVAL AND INSTALLATION

3. • Resistance spot weld - Panel thickness 3 mm and greater.



4. • Resistance spot weld - Panel thickness 3 mm and greater.



SECTION 501-28 Roof Sheet Metal Repairs

VEHICLE APPLICATION:BT50 & Ranger

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REMOVAL AND INSTALLATION

Roof Panel — Single Cab.....	501-28-2
Roof Panel — Double Cab.....	501-28-7
Roof Panel — Stretch Cab.....	501-28-8

REMOVAL AND INSTALLATION**Roof Panel — Single Cab****General Equipment**

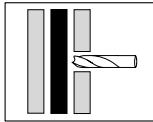
Hot Air Gun
Spot weld drill Bit

Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

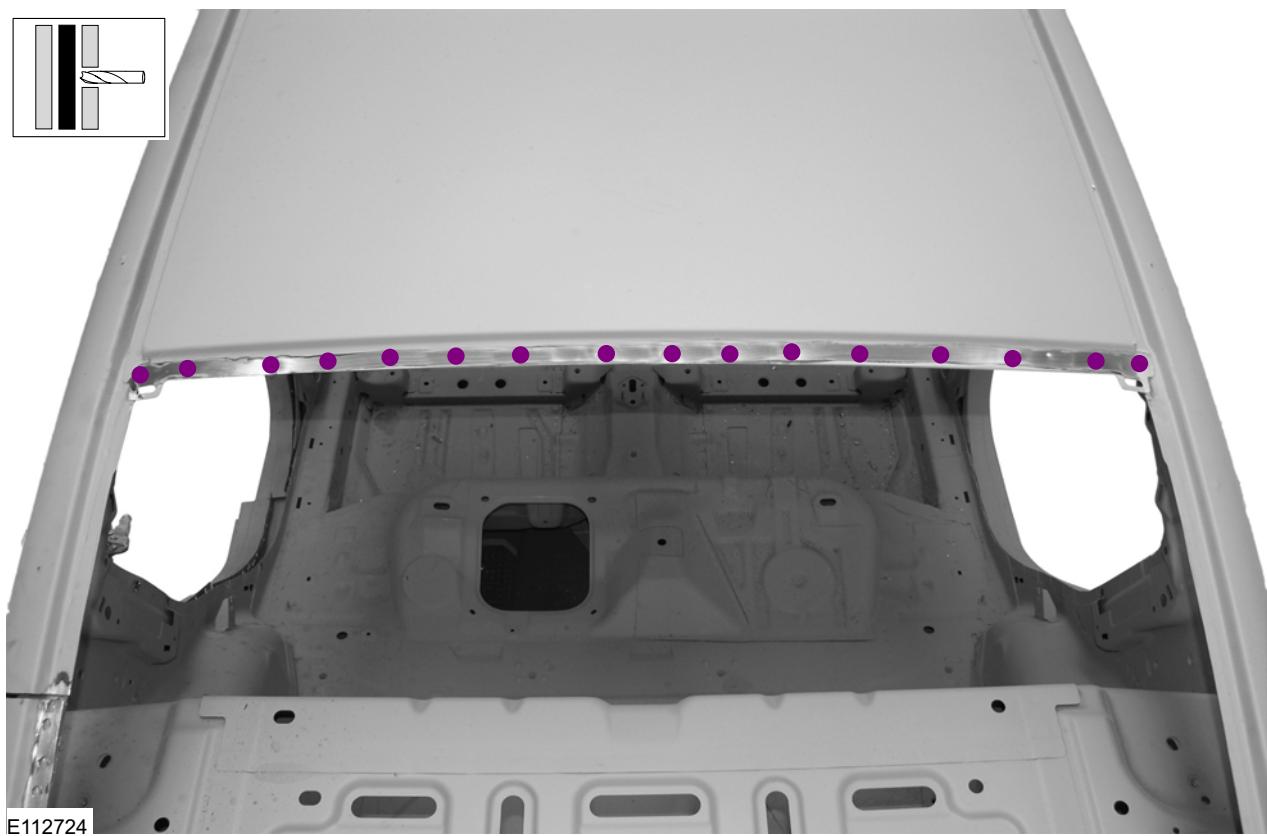
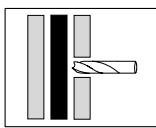
1. • Front and Rear Door
 - Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
 - Refer to: **Headliner - 4-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - A- B- and C-Pillar Trim
 - Refer to: **A-Pillar Trim Panel** (501-05, Removal and Installation).
 - Refer to: **B-Pillar Trim Panel** (501-05, Removal and Installation).
 - Refer to: **C-Pillar Trim Panel - 4-Door** (501-05, Removal and Installation).
 - Refer to: **Rear Window Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
2. • General Equipment: Spot weld drill Bit



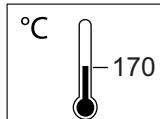
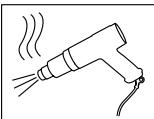
E112723

REMOVAL AND INSTALLATION

3. • General Equipment: Spot weld drill Bit



4. • General Equipment: Hot Air Gun



REMOVAL AND INSTALLATION

Installation

1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

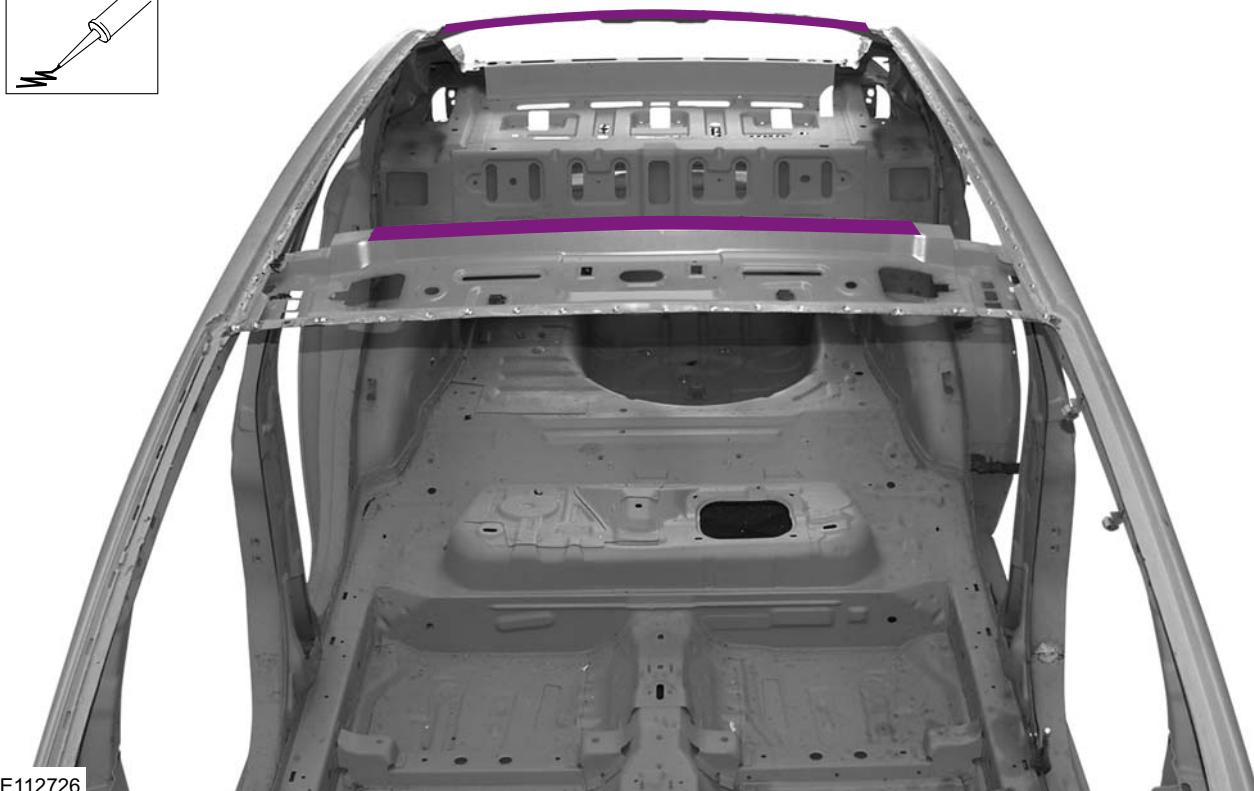
Authoring Template

Refer to: **Tools and Equipment for Body Repairs**
(501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must be applied with a minimum height of 20 mm.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

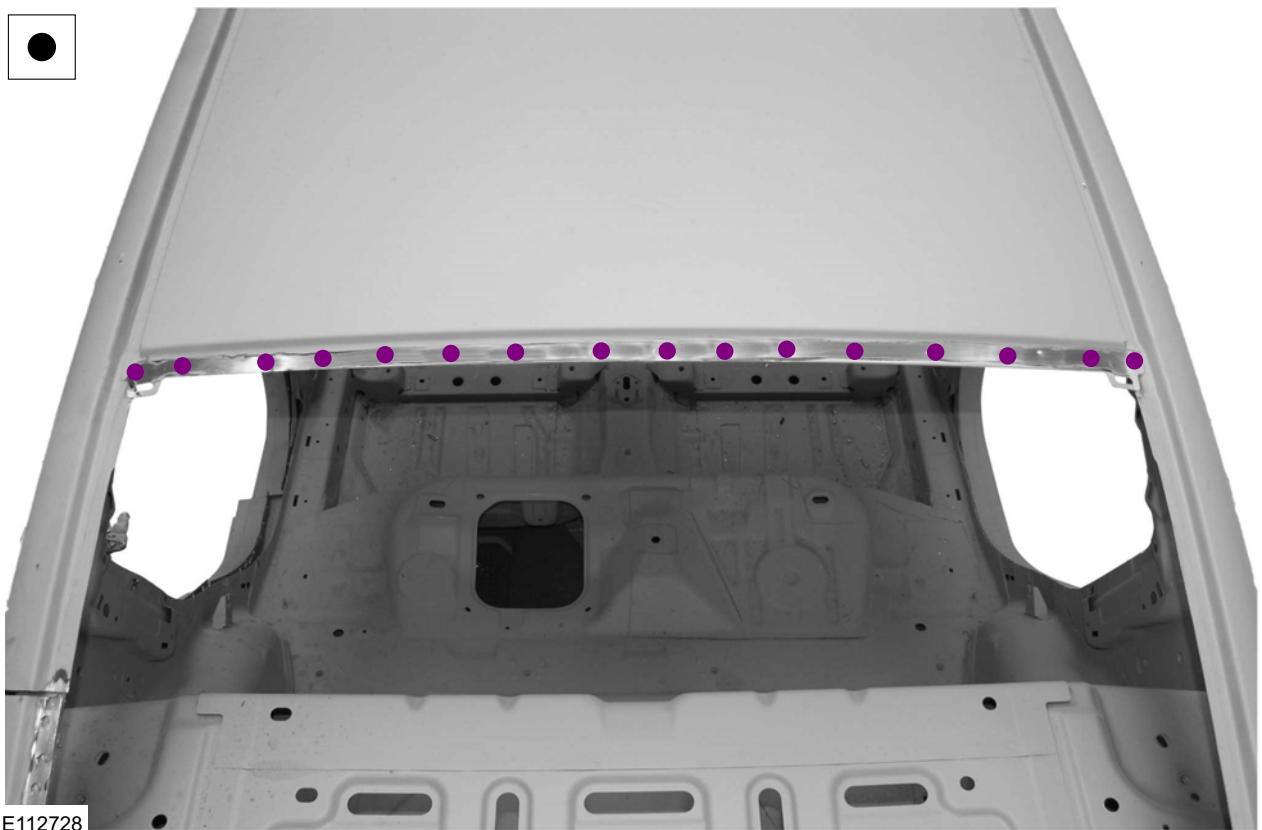


4. • Resistance spot weld - Panel thickness 3 mm and greater!

REMOVAL AND INSTALLATION

E112727

5. • Resistance spot weld - Panel thickness 3 mm and greater!



E112728

REMOVAL AND INSTALLATION

6. • Front and Rear Door
 - Refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
 - Refer to: [Headliner - 4-Door](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - A- B- and C-Pillar Trim
 - Refer to: [A-Pillar Trim Panel](#) (501-05, Removal and Installation).
 - Refer to: [B-Pillar Trim Panel](#) (501-05, Removal and Installation).
 - Refer to: [C-Pillar Trim Panel - 4-Door](#) (501-05, Removal and Installation).
 - Refer to: [Rear Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

REMOVAL AND INSTALLATION**Roof Panel — Double Cab**

- 1. Information not available at this time.**

REMOVAL AND INSTALLATION**Roof Panel — Stretch Cab**

2. Information not available at this time.

SECTION 501-29 Side Panel Sheet Metal Repairs

VEHICLE APPLICATION:BT50 & Ranger

CONTENTS	PAGE
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REMOVAL AND INSTALLATION

A-Pillar Outer Panel.....	501-29-2
A-Pillar Assembly.....	501-29-11
Rocker Panel — Double Cab.....	501-29-15
Rocker Panel — Single Cab.....	501-29-20
Rocker Panel — Super Cab.....	501-29-26
Rocker Panel Inner Reinforcement — Double Cab.....	501-29-32
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Rocker Panel Inner Reinforcement — Super Cab.....	501-29-40
B-Pillar and Reinforcement — Double Cab.....	501-29-44
B-Pillar Outer Panel — Double Cab.....	501-29-56

REMOVAL AND INSTALLATION**A-Pillar Outer Panel****General Equipment**

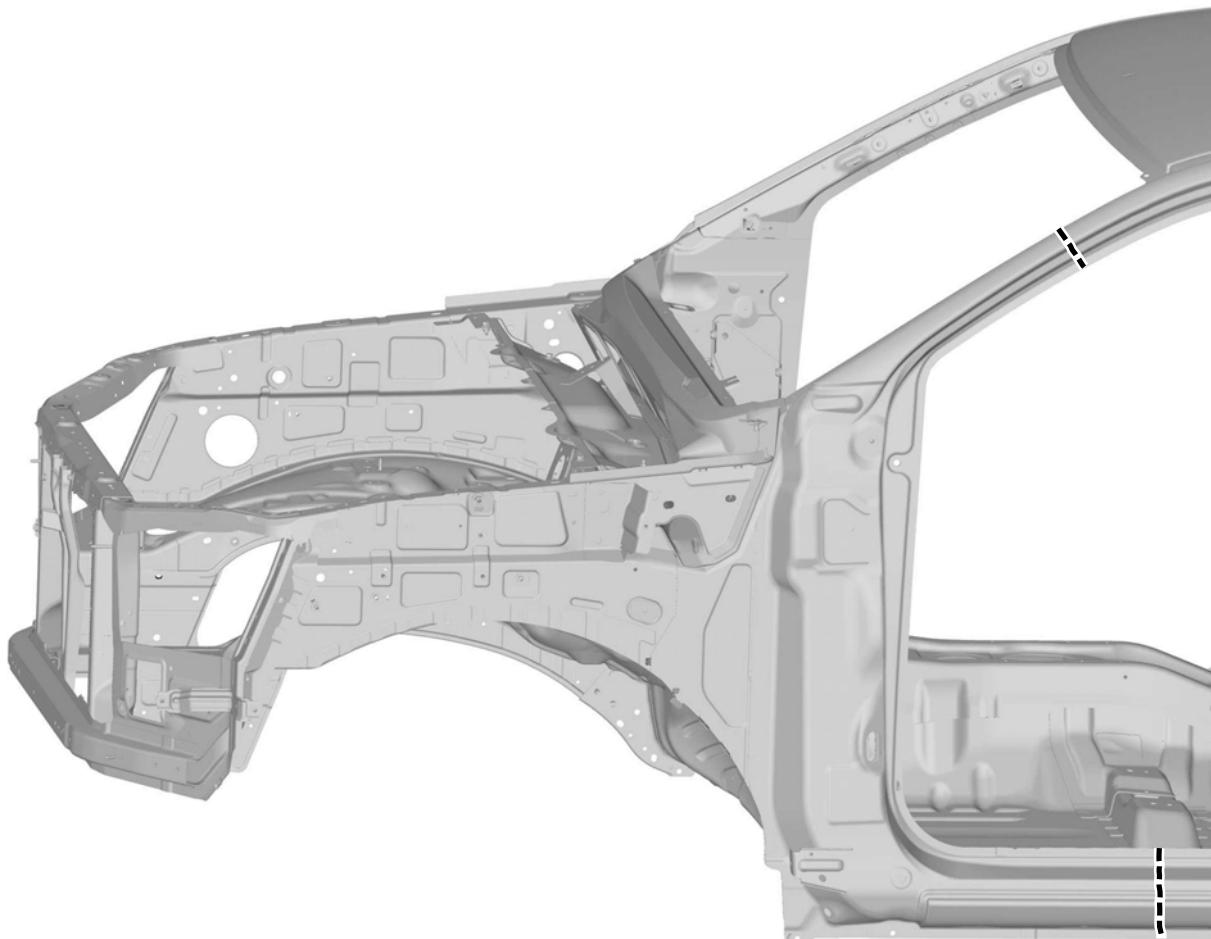
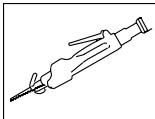
6 mm Drill Bit
Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit	
Materials	
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

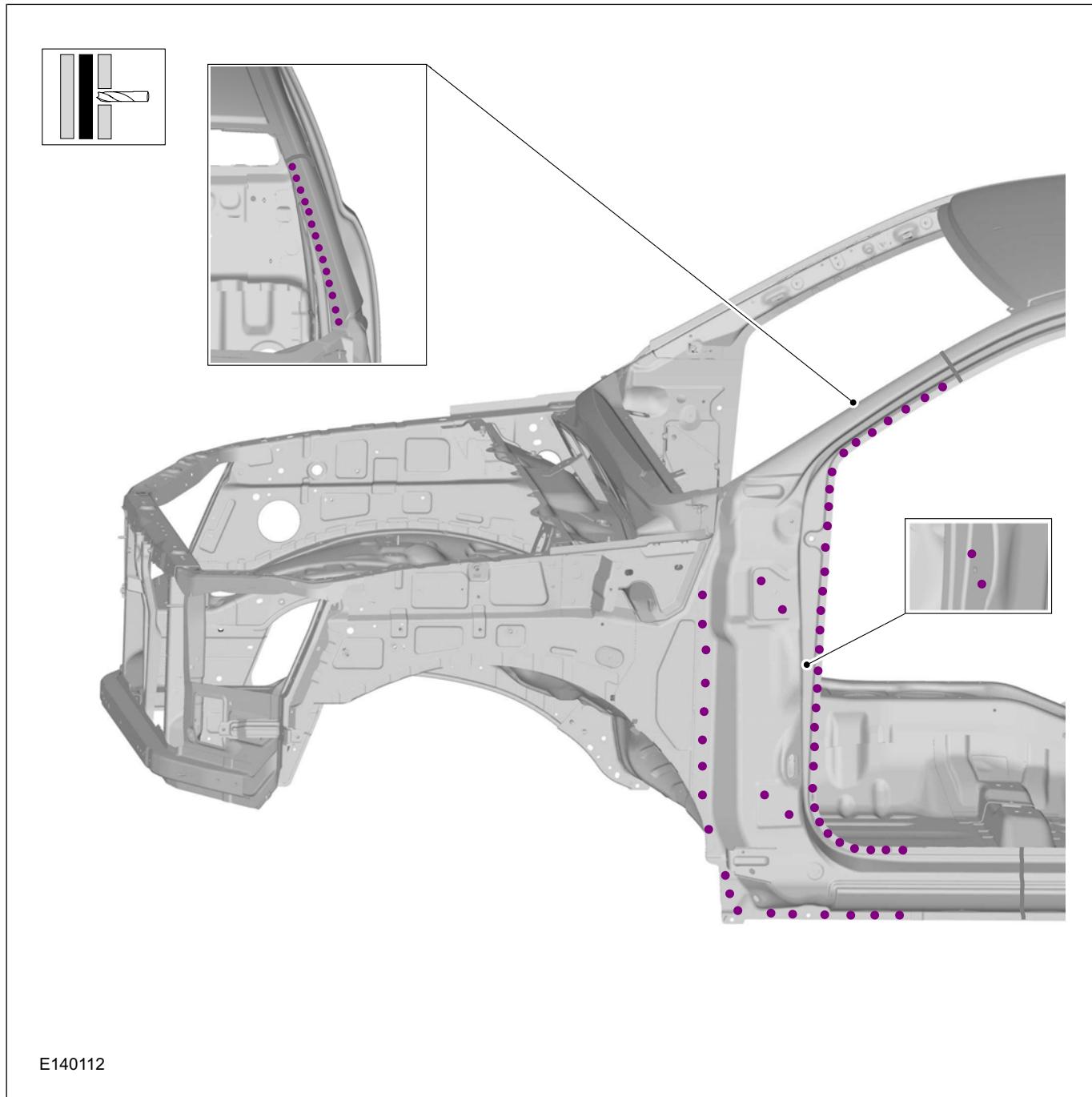
Removal

1. Refer to: [Tools and Equipment for Body Repairs](#) (501-25 Body Repairs - General Information, Description and Operation).
2. • Windshield
 - Refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
 - Front Door
 - Refer to: [Front Door](#) (501-03 Body Closures, Removal and Installation).
 - Door Hinges
 - Weatherstrip
 - A-pillar Trim
 - Refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - Rocker Panel Trim
 - Driver or passenger seat
 - Refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
 - Refer to: [Fender Apron Panel Reinforcement](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 - Reposition the carpeting and the wiring harness away from the working area.
 - 3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

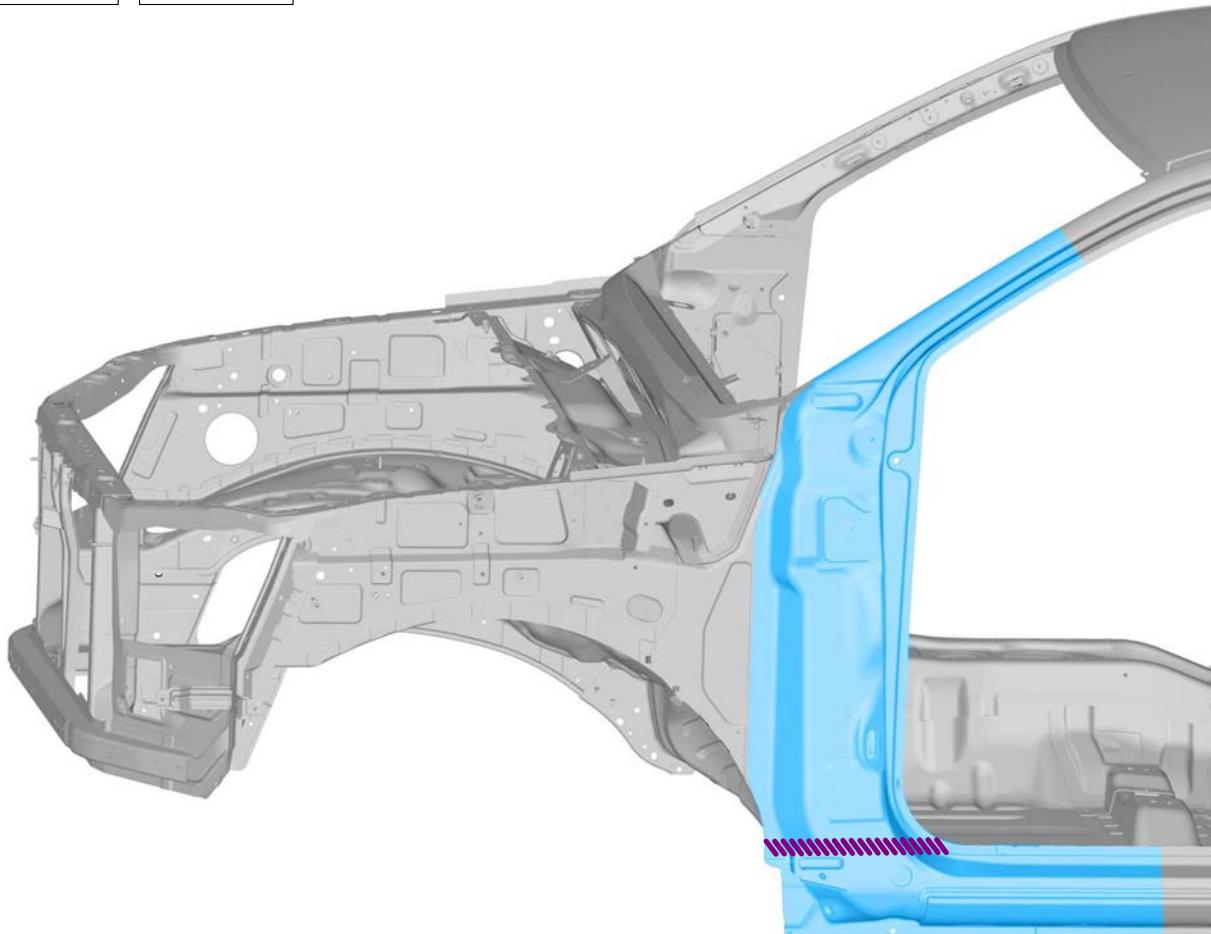
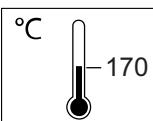
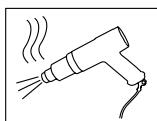
E140111

4. • General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

E140112

5. • General Equipment: Hot Air Gun

REMOVAL AND INSTALLATION

E140113

Installation

- NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

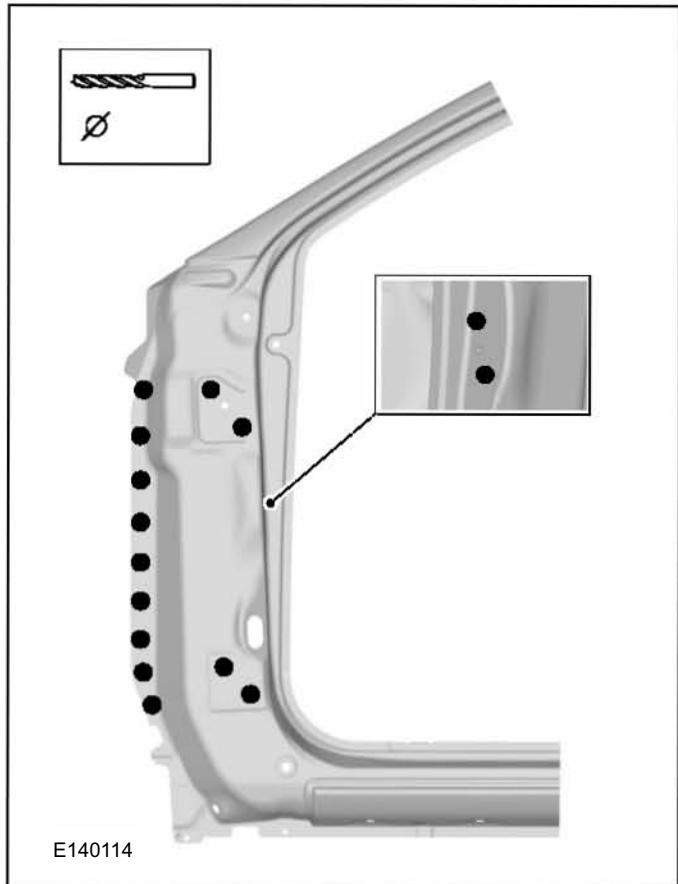
- NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or

sealed needs to be thoroughly sealed afterwards.

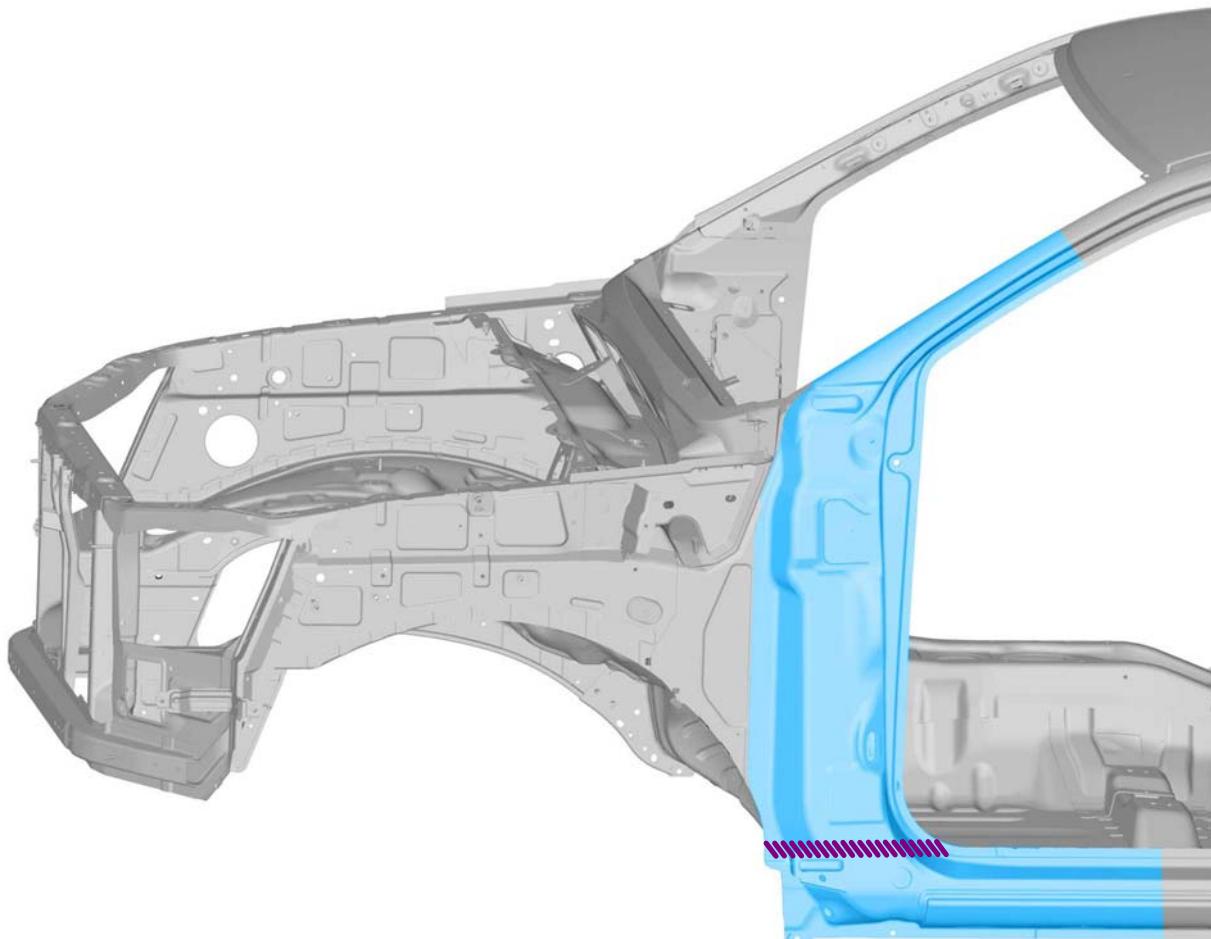
Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

REMOVAL AND INSTALLATION

3. • General Equipment: 6 mm Drill Bit

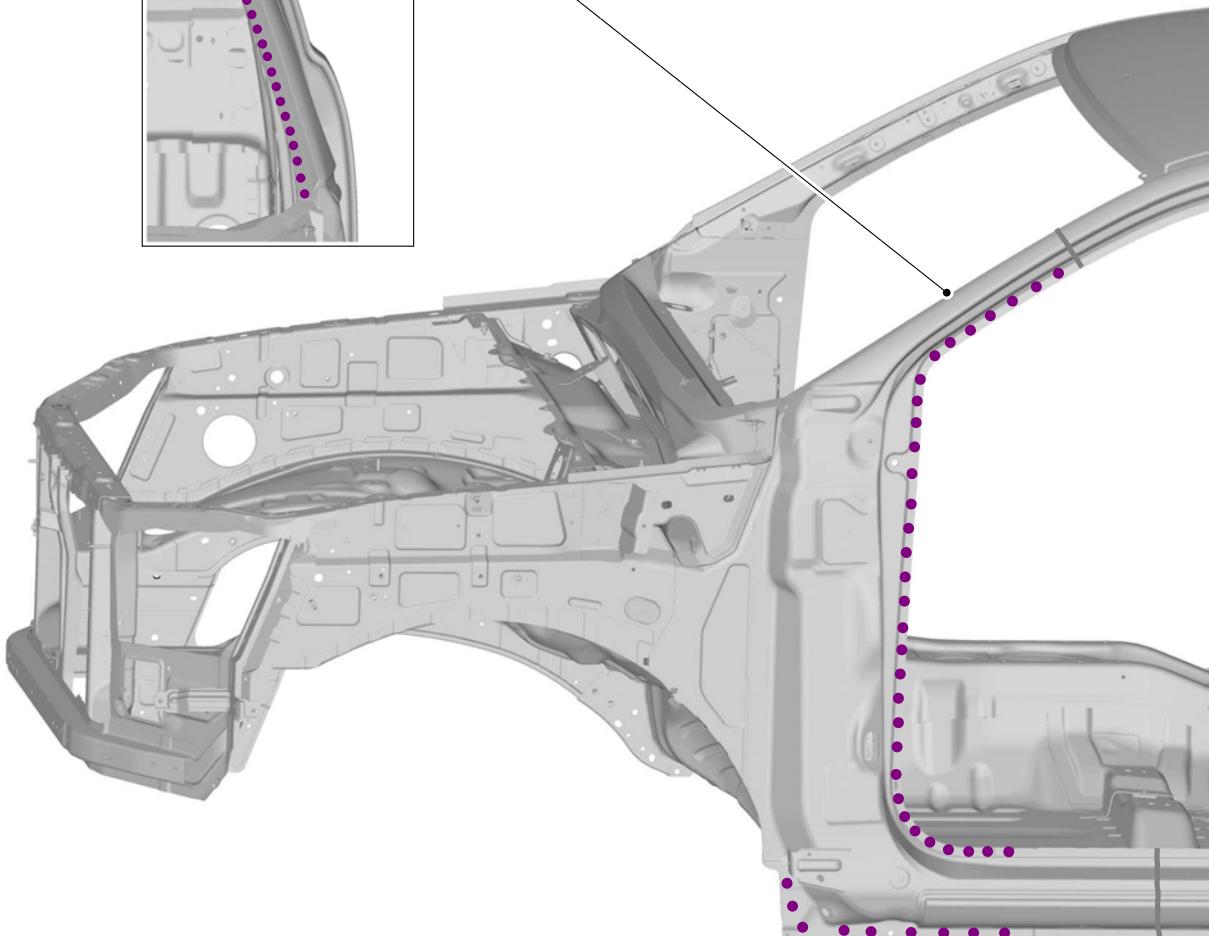
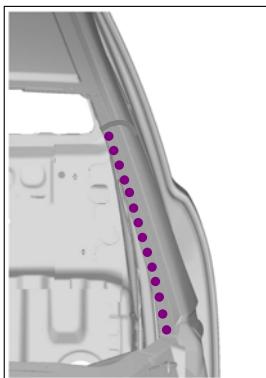


4. • Material: Windshield Adhesive Kit
(WSS-M11P57-A5) adhesive

REMOVAL AND INSTALLATION

E140115

5. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION

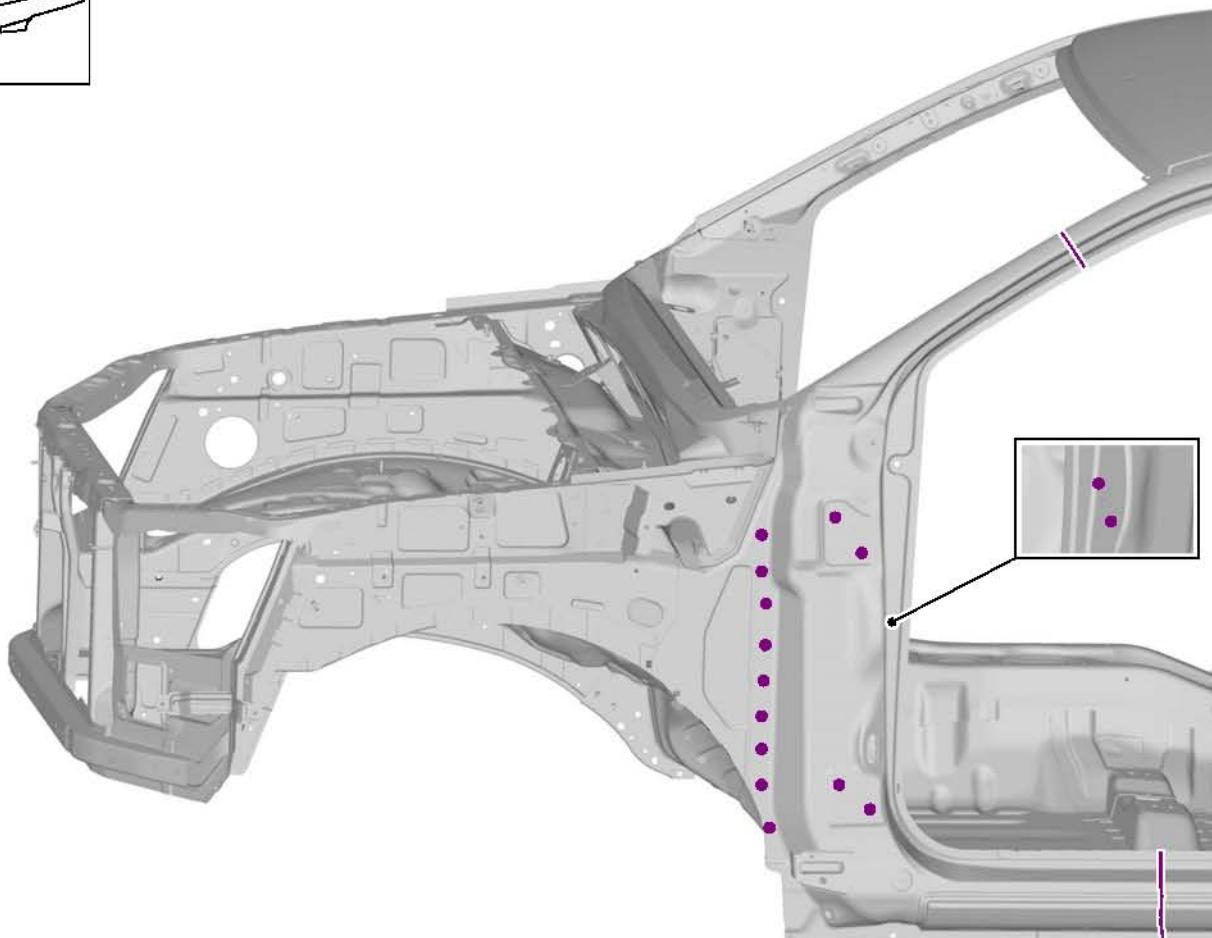
E140116

6. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION



MIG



E140117

REMOVAL AND INSTALLATION

7. • Windshield

Refer to: [Windshield Glass \(501-11 Glass, Frames and Mechanisms, Removal and Installation\)](#).

• Front Door

Refer to: [Front Door \(501-03 Body Closures, Removal and Installation\)](#).

• Door Hinges

• Weatherstrip

• A-pillar Trim

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

• Rocker Panel Trim

• Driver or passenger seat

Refer to: [Front Seat \(501-10 Seating, Removal and Installation\)](#).

• Refer to: [Fender Apron Panel Reinforcement \(501-27 Front End Sheet Metal Repairs, Removal and Installation\)](#).

REMOVAL AND INSTALLATION**A-Pillar Assembly****General Equipment**

6 mm Drill Bit
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit

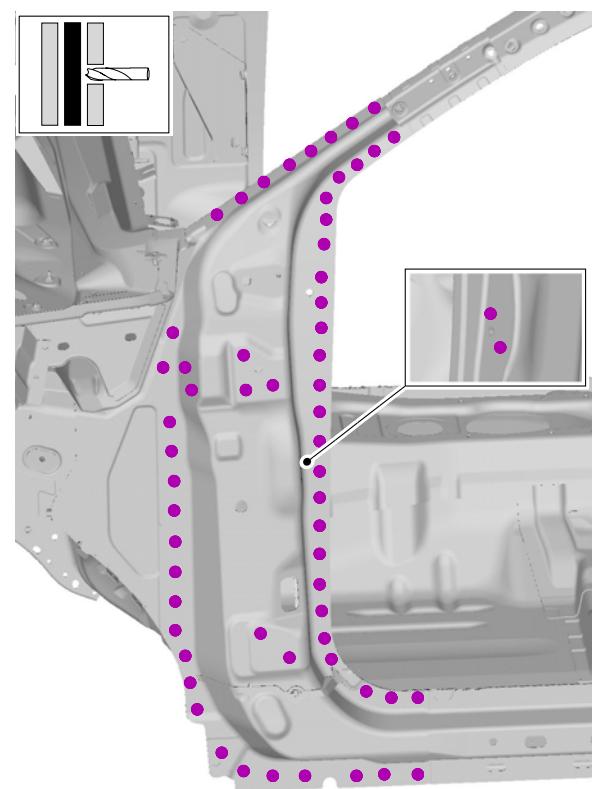
Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

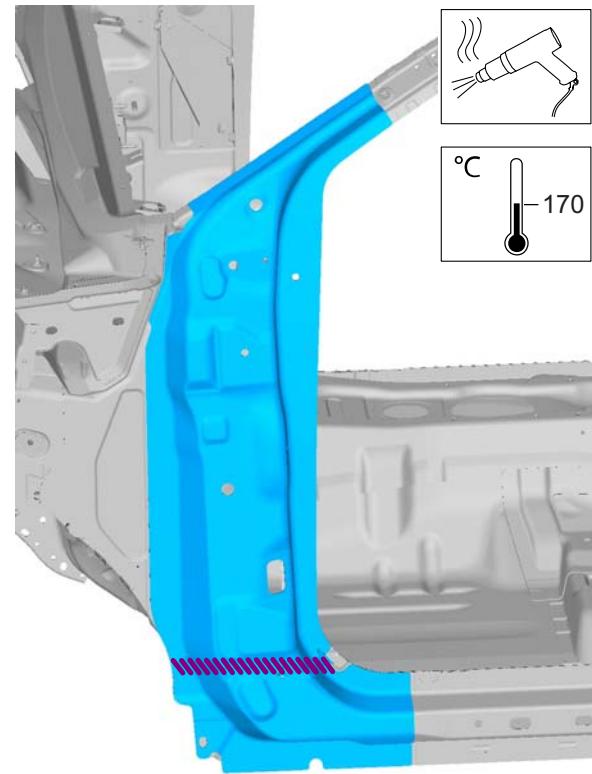
Removal

REMOVAL AND INSTALLATION

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Windshield
Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).
 - Front Door
Refer to: **Front Door** (501-03 Body Closures, Removal and Installation).
 - Door Hinges
 - Weatherstrip
 - A-pillar Trim
Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - Rocker Panel Trim
 - Driver or passenger seat
Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
 - Refer to: **Fender Apron Panel Reinforcement** (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 - Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Spot weld drill Bit



4. • General Equipment: Hot Air Gun



REMOVAL AND INSTALLATION

Installation

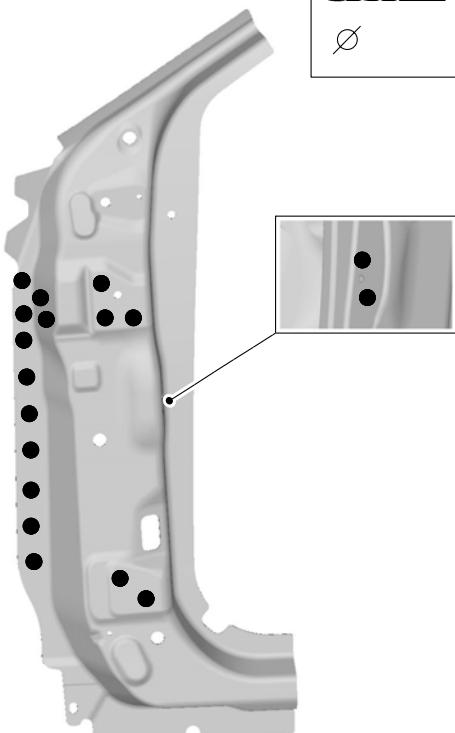
- 1. NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

- 2. NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

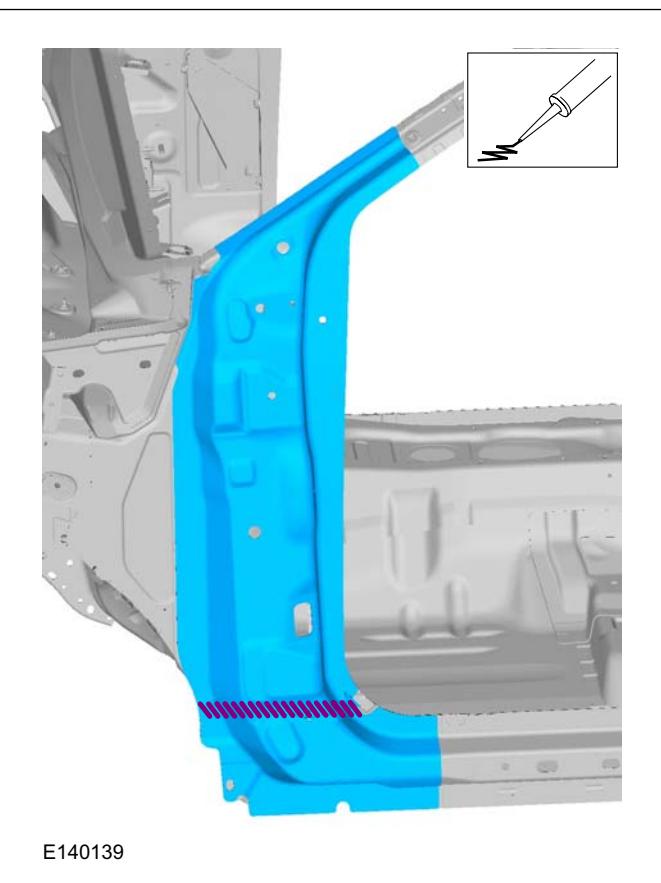
Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

- 3. • General Equipment:** 6 mm Drill Bit



E140138

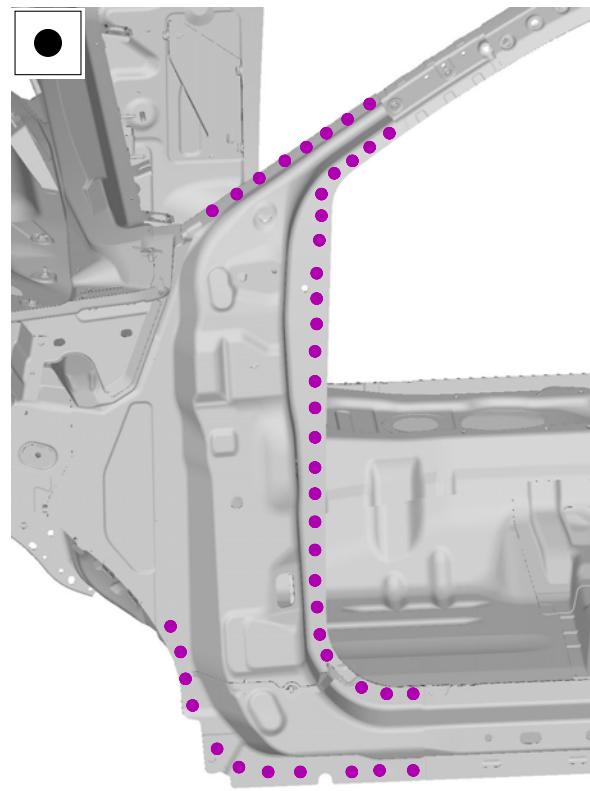
- 4. • Material:** Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



E140139

REMOVAL AND INSTALLATION

5. • General Equipment: Resistance Spotwelding Equipment



E140140

6. • General Equipment: MIG/MAG Welding Equipment



E140141

7. • Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).

- Windshield

Refer to: **Windshield Glass** (501-11 Glass, Frames and Mechanisms, Removal and Installation).

- Front Door

Refer to: **Front Door** (501-03 Body Closures, Removal and Installation).

- Door Hinges
- Weatherstrip
- A-pillar Trim

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

- Rocker Panel Trim
- Driver or passenger seat

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

- Refer to: **Fender Apron Panel Reinforcement** (501-27 Front End Sheet Metal Repairs, Removal and Installation).

REMOVAL AND INSTALLATION**Rocker Panel — Double Cab****General Equipment**

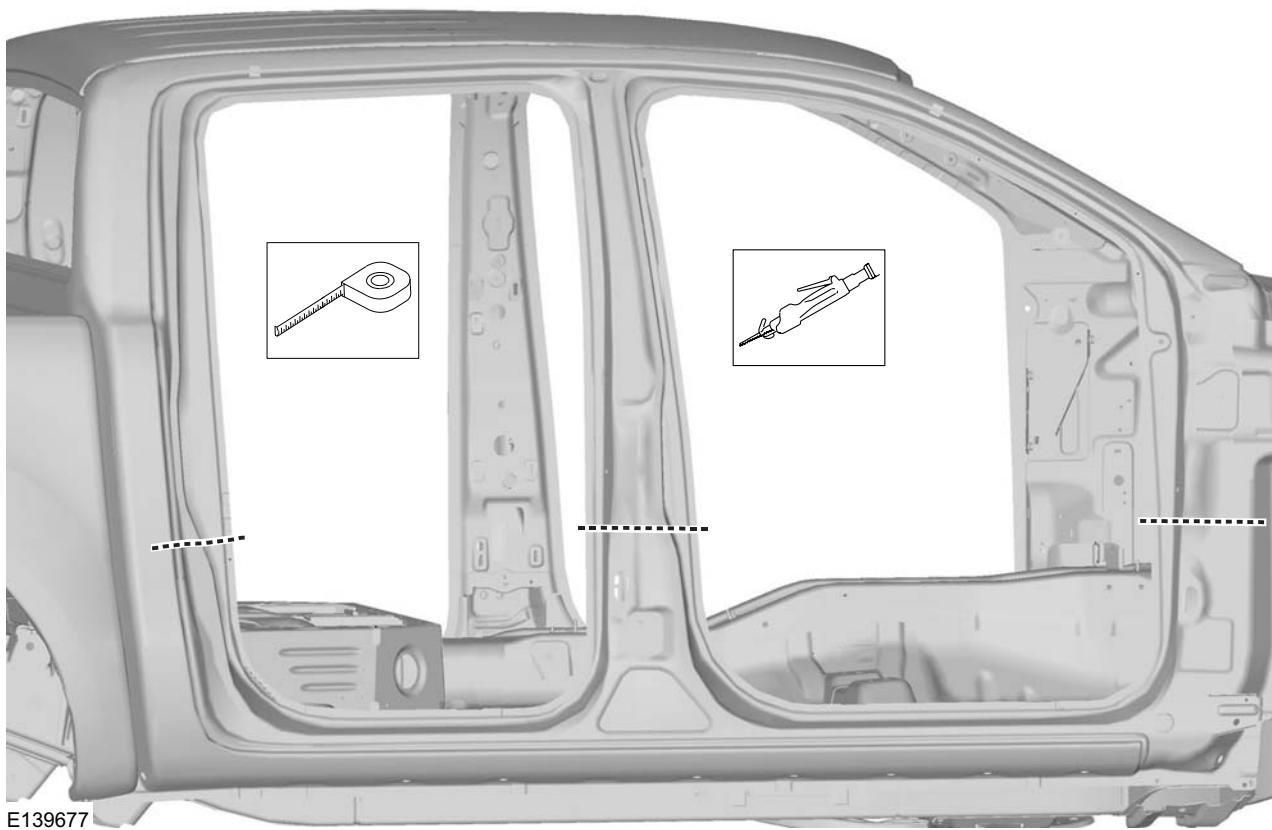
Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

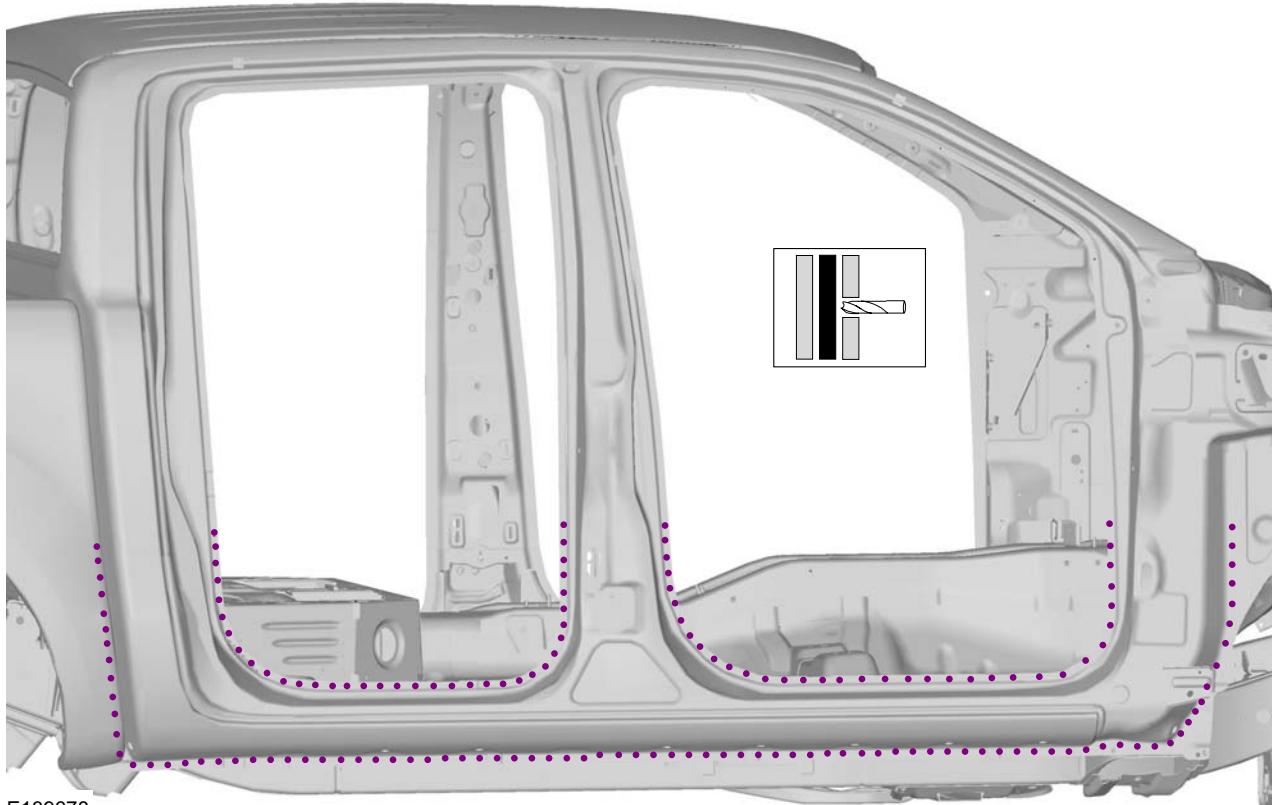
Spot weld drill Bit	
Materials	
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

1. • Refer to: **Front Door** (501-03 Body Closures, Removal and Installation).
Refer to: **Rear Door - Double Cab** (501-03 Body Closures, Removal and Installation).
Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **B-Pillar Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **B-Pillar Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **C-Pillar Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **C-Pillar Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Rear Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
Refer to: **Rear Seat** (501-10 Seating, Removal and Installation).
 - Remove the load body from the vehicle.
 - Reposition the carpeting and the wiring harness away from the working area.
2. • General Equipment: Air Body Saw

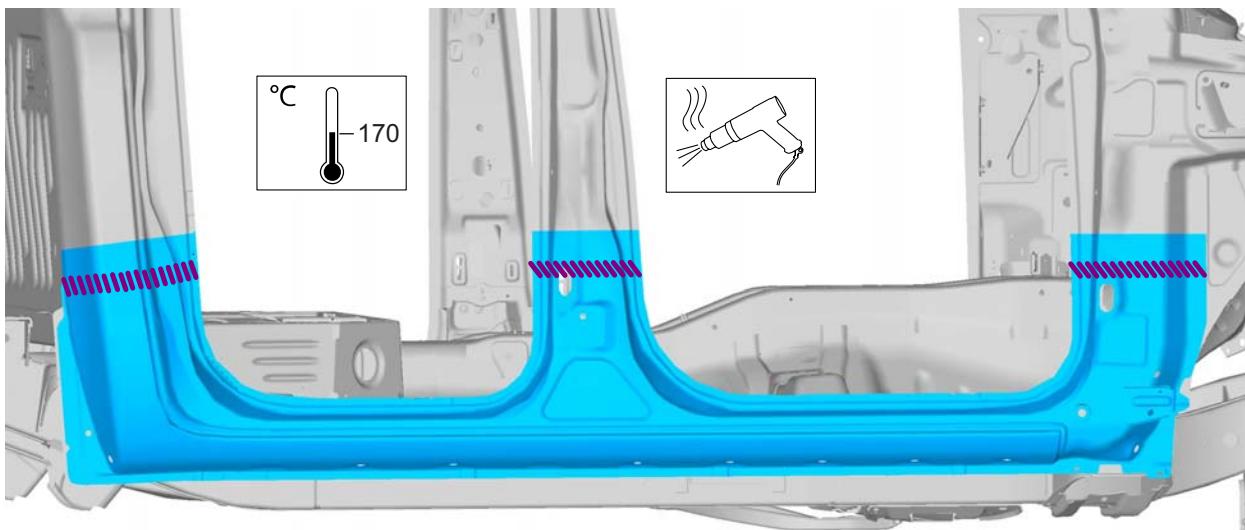
REMOVAL AND INSTALLATION

3. • General Equipment: Spot weld drill Bit



REMOVAL AND INSTALLATION

4. • General Equipment: Hot Air Gun



E139679

Installation

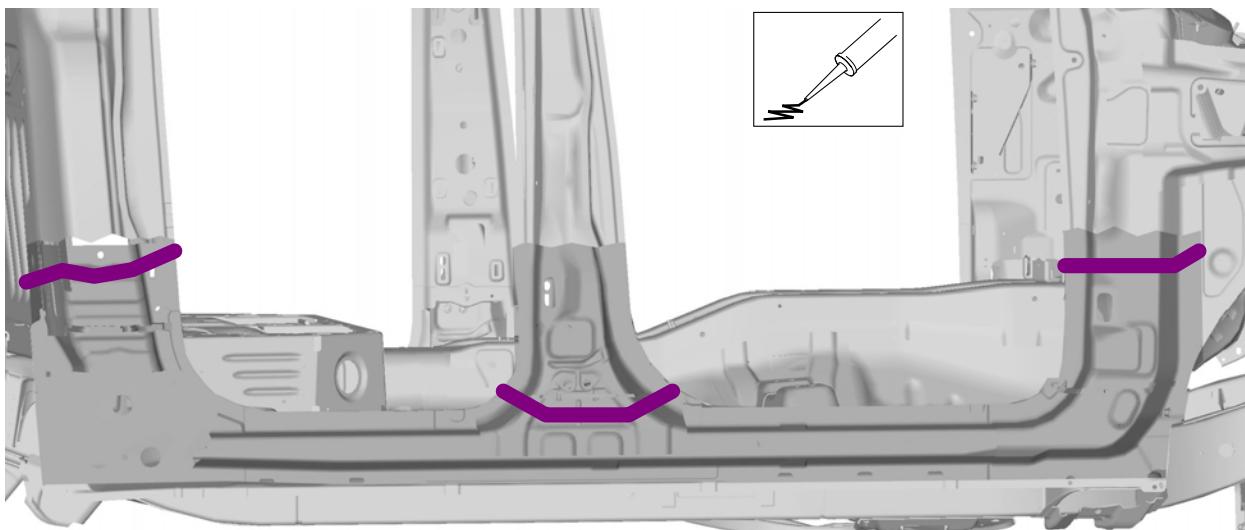
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: [Tools and Equipment for Body Repairs](#) (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

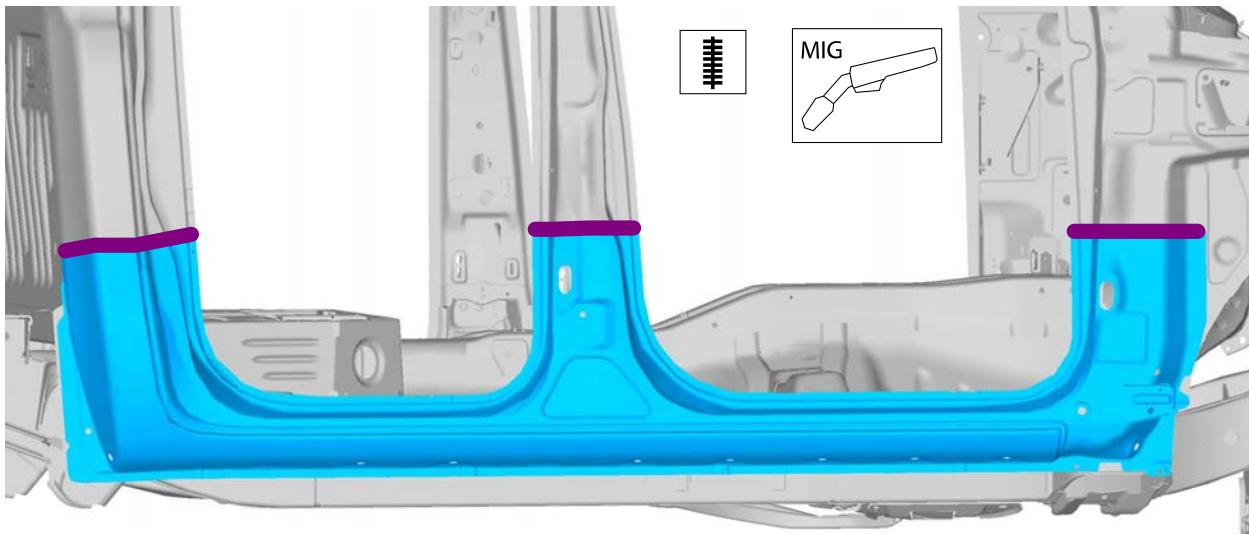
Refer to: [Sealer, Underbody Protection Material and Adhesives](#) (501-25 Body Repairs - General Information, Description and Operation).

3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



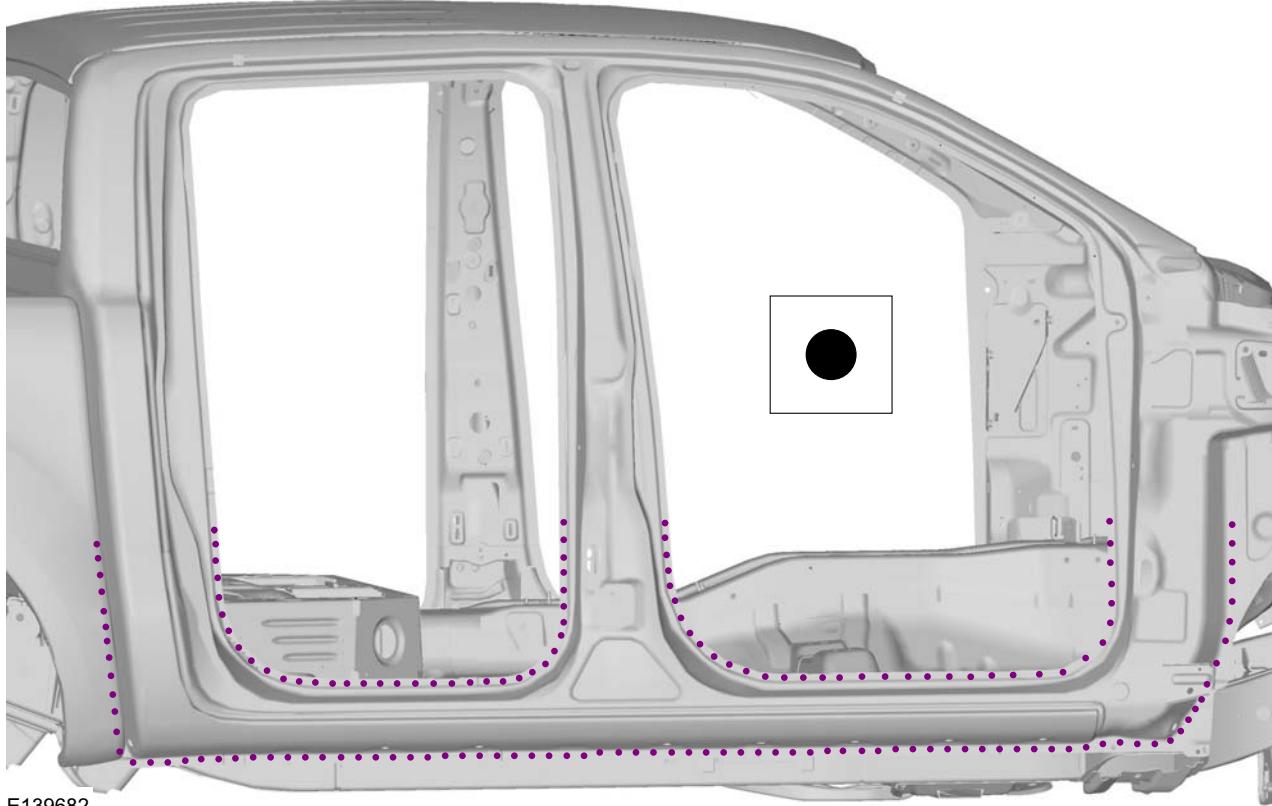
E139680

4. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION

E139681

5. • General Equipment: Resistance Spotwelding Equipment



E139682

REMOVAL AND INSTALLATION

6. • Refer to: **Front Door** (501-03 Body Closures, Removal and Installation).
Refer to: **Rear Door - Double Cab** (501-03 Body Closures, Removal and Installation).
Refer to: **A-Pillar Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **B-Pillar Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **B-Pillar Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **C-Pillar Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Cowl Side Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **C-Pillar Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Front Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Rear Scuff Plate Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **Front Seat** (501-10 Seating, Removal and Installation).
Refer to: **Rear Seat** (501-10 Seating, Removal and Installation).
• Install the load body into the vehicle.

REMOVAL AND INSTALLATION**Rocker Panel — Single Cab****General Equipment**

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit	
Materials	
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

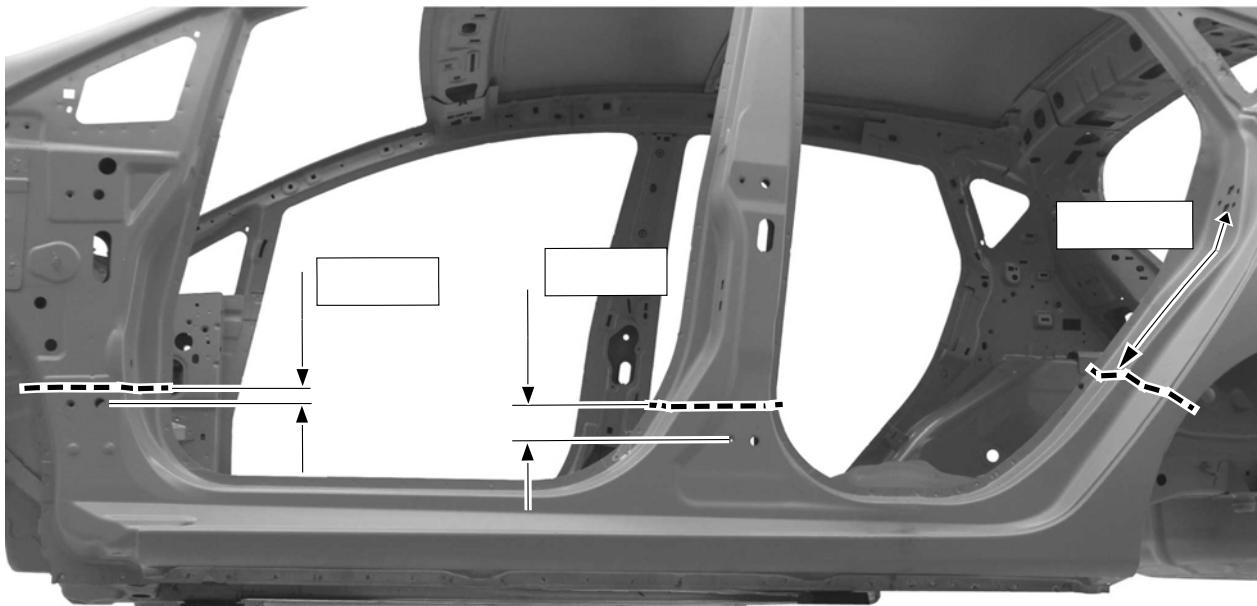
1. • Door Hinges
 - Front and Rear Door
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - A- B- and C-Pillar Trim

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

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

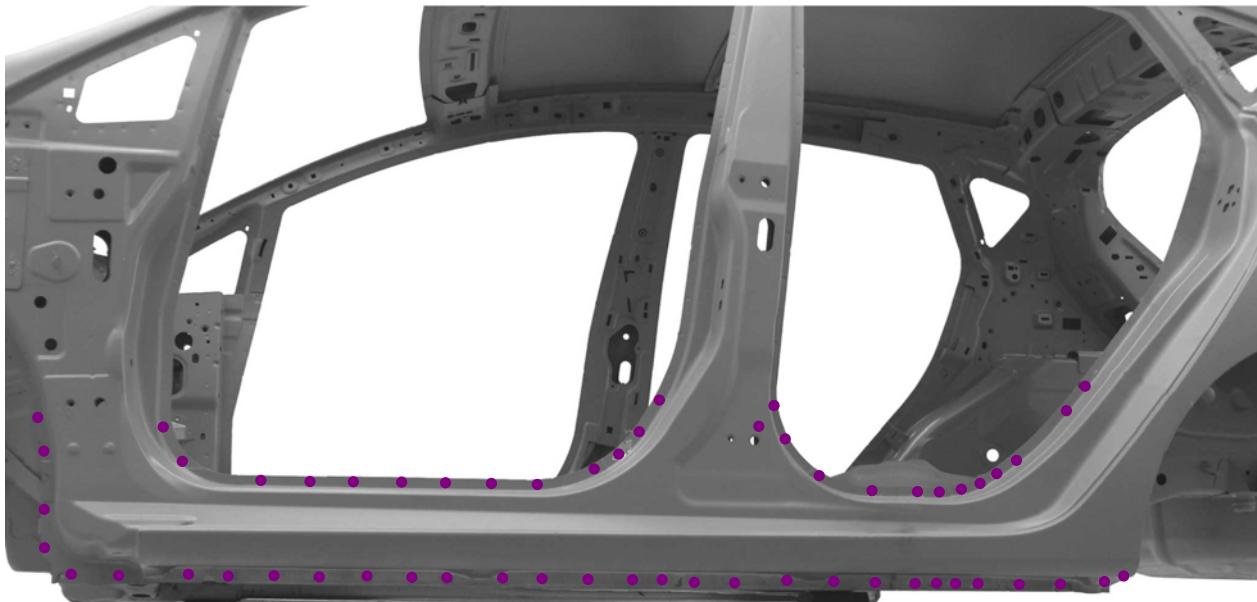
Refer to: [C-Pillar Trim Panel - 4-Door](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

 - Rocker Panel Trim
 - Refer to: [Front Seat](#) (501-10, Removal and Installation).
 - Refer to: [Rear Seat Cushion](#) (501-10, Removal and Installation).
 - Refer to: [Rear Seat Backrest](#) (501-10, Removal and Installation).
 - Reposition the carpeting and the wiring harness away from the working area.
2. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

E112744

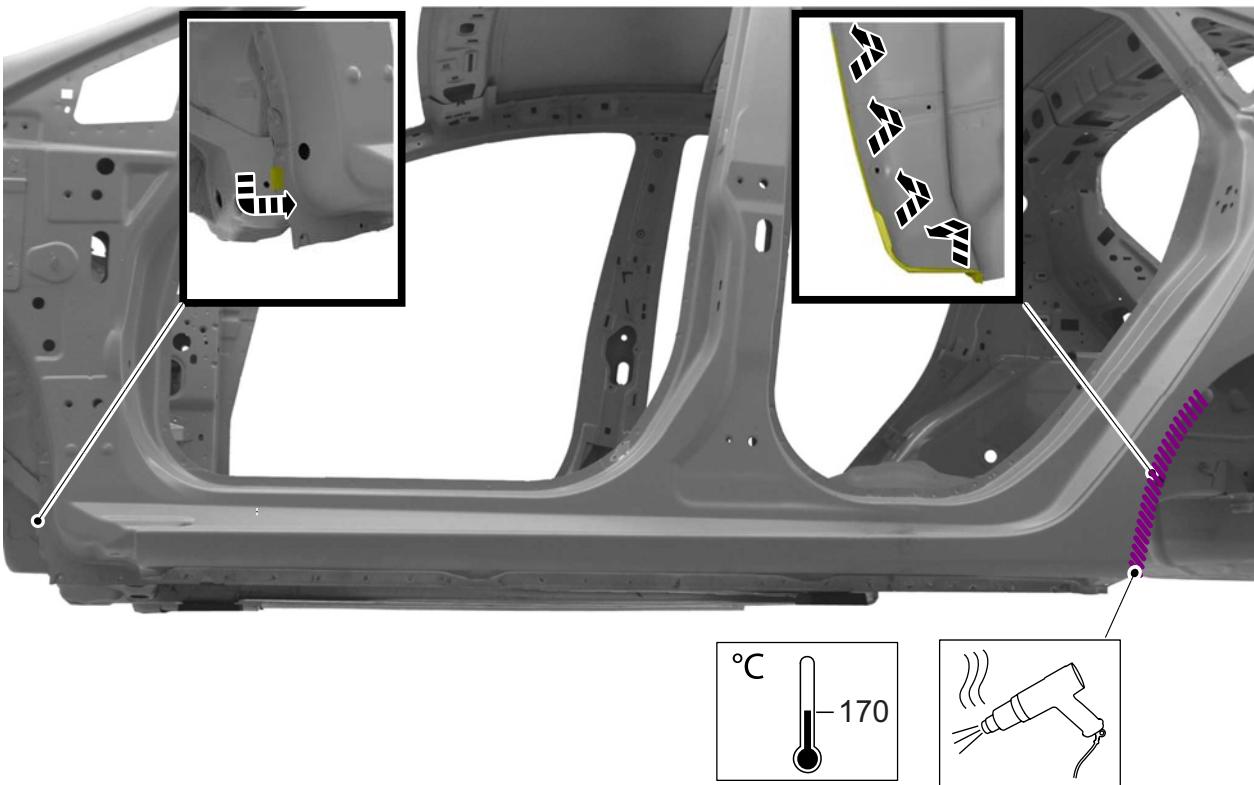
3. • General Equipment: Spot weld drill Bit



E112745

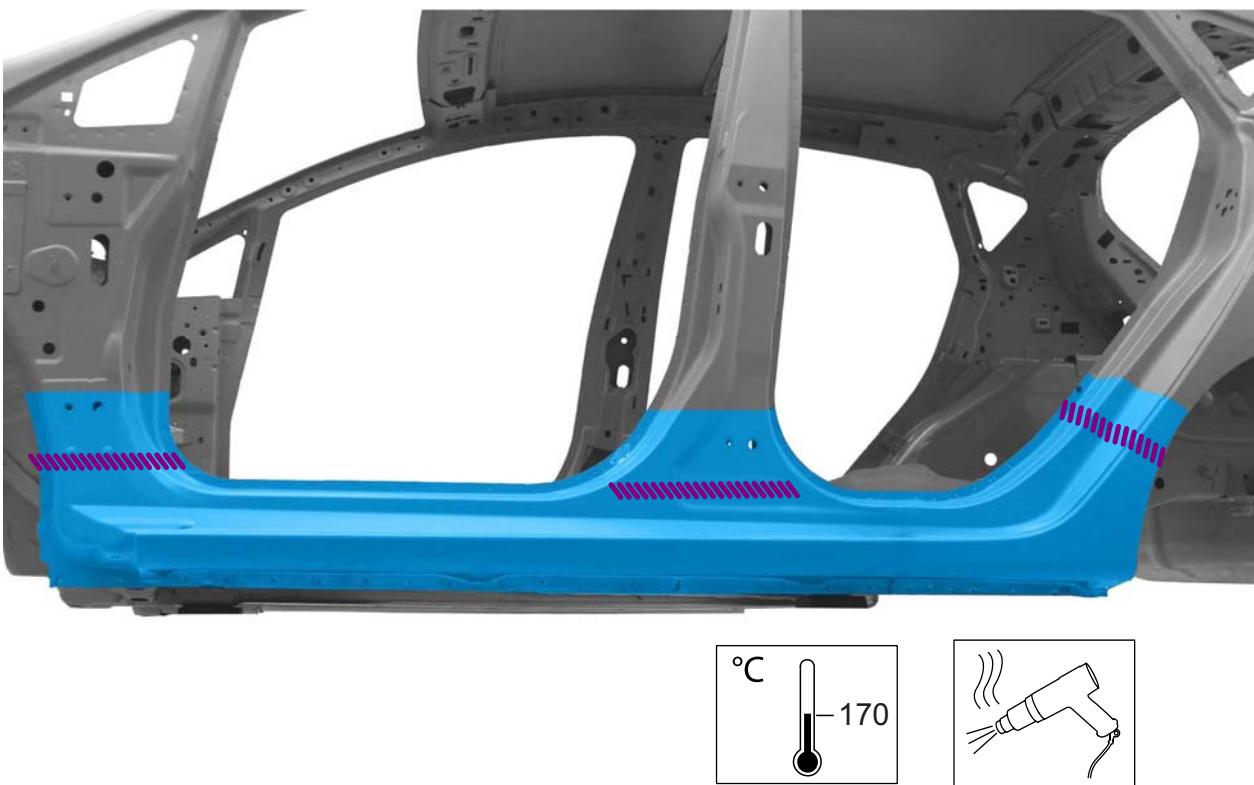
REMOVAL AND INSTALLATION

4. • General Equipment: Hot Air Gun



E112746

5. • General Equipment: Hot Air Gun



E112747

REMOVAL AND INSTALLATION

Installation

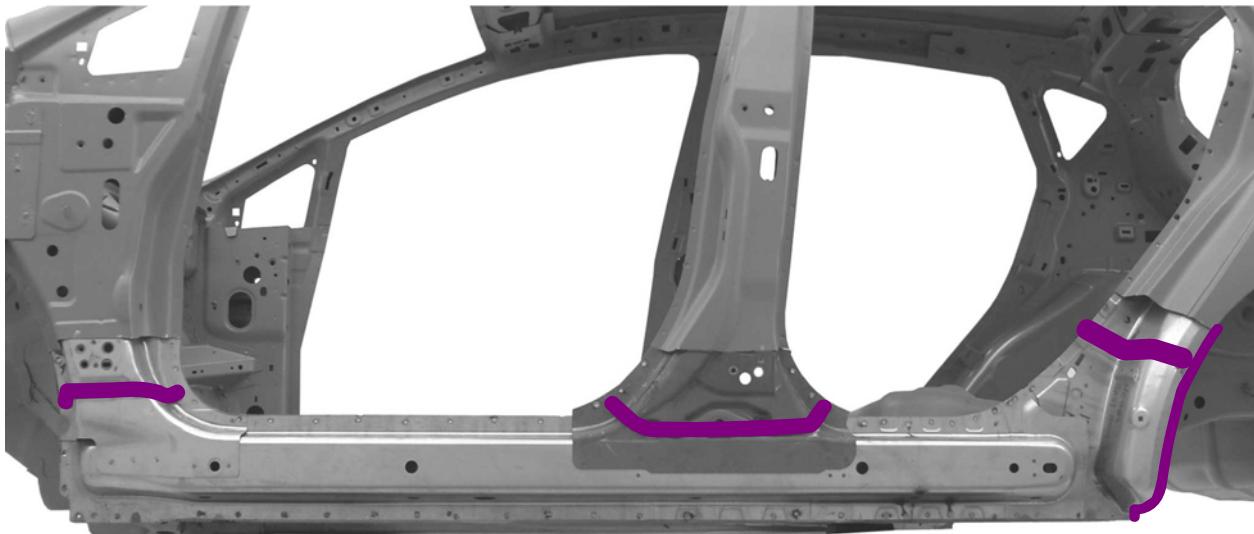
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs**
(501-25 Body Repairs - General Information, Description and Operation).

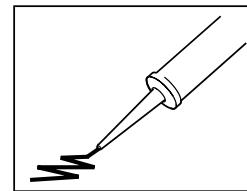
2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

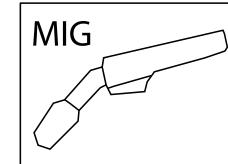
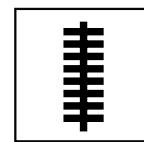
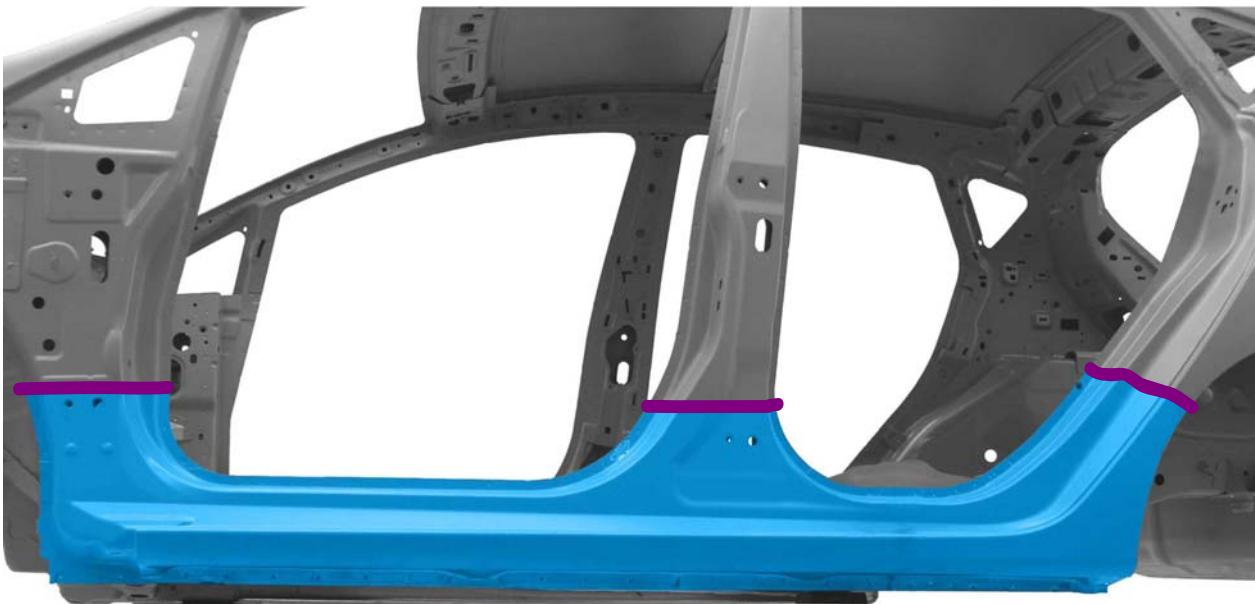
3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



E112748

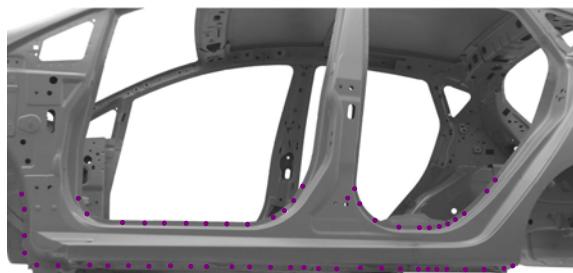


4. • General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION

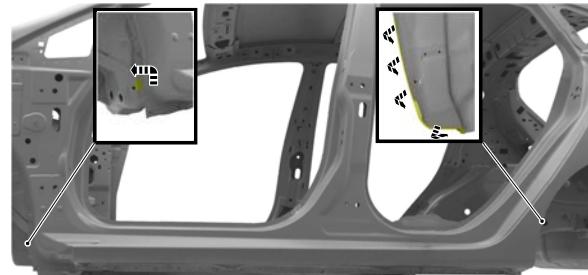
E112749

5. • General Equipment: Resistance Spotwelding Equipment



E112788

- 6.



E112789

REMOVAL AND INSTALLATION

7. • Door Hinges
 - Front and Rear Door
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - A- B- and C-Pillar Trim
- Refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Refer to: [B-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Refer to: [C-Pillar Trim Panel - 4-Door](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Rocker Panel Trim
 - Refer to: [Front Seat](#) (501-10, Removal and Installation).
 - Refer to: [Rear Seat Cushion](#) (501-10, Removal and Installation).
 - Refer to: [Rear Seat Backrest](#) (501-10, Removal and Installation).

REMOVAL AND INSTALLATION**Rocker Panel — Super Cab****General Equipment**

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

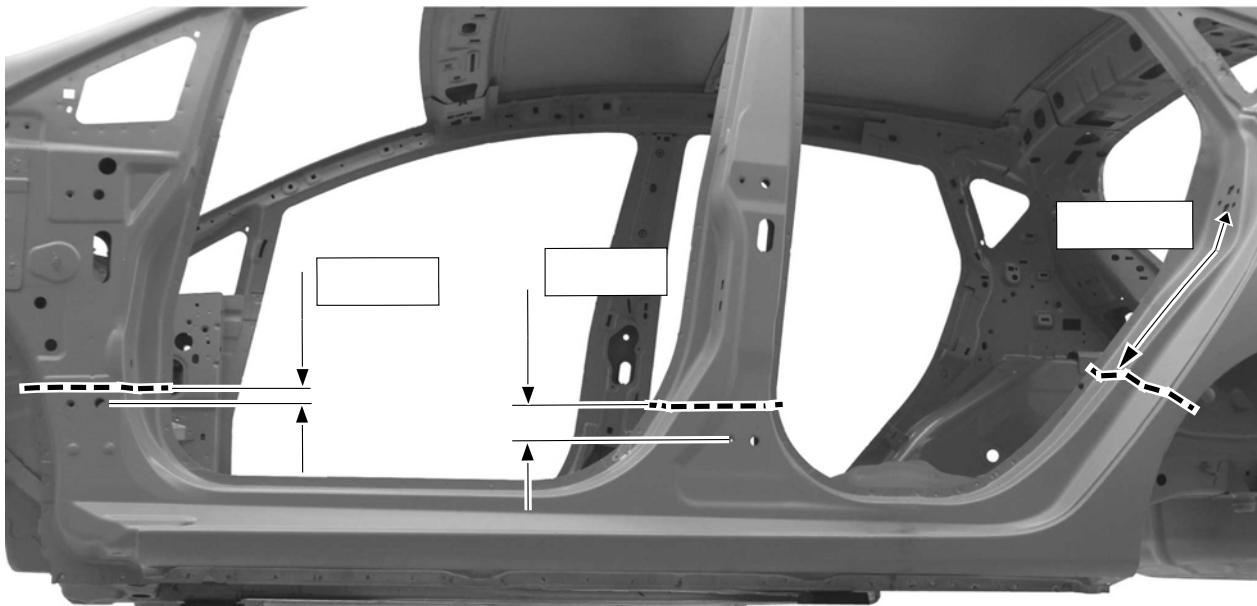
Spot weld drill Bit

Materials

Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

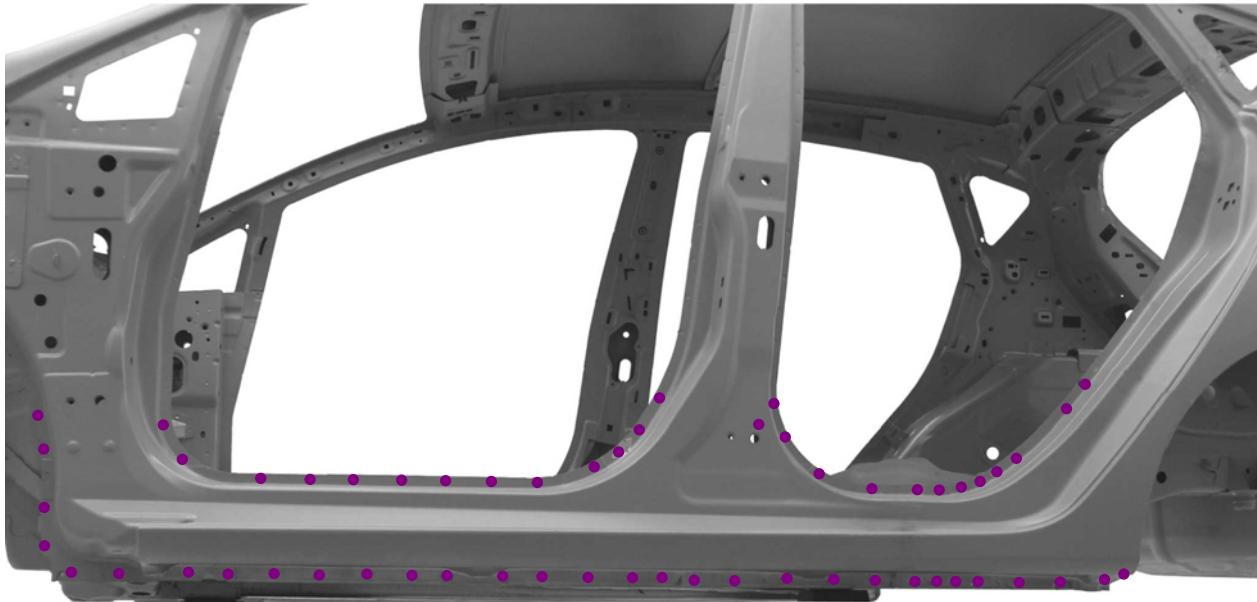
Removal

1. • Front and Rear Door
 - Door Hinges
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - Refer to: **A-Pillar Trim Panel** (501-05, Removal and Installation).
Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - Rocker Panel Trim
 - Refer to: **Front Seat** (501-10, Removal and Installation).
Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).
Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).
 - Reposition the carpeting and the wiring harness away from the working area.
2. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

E108797

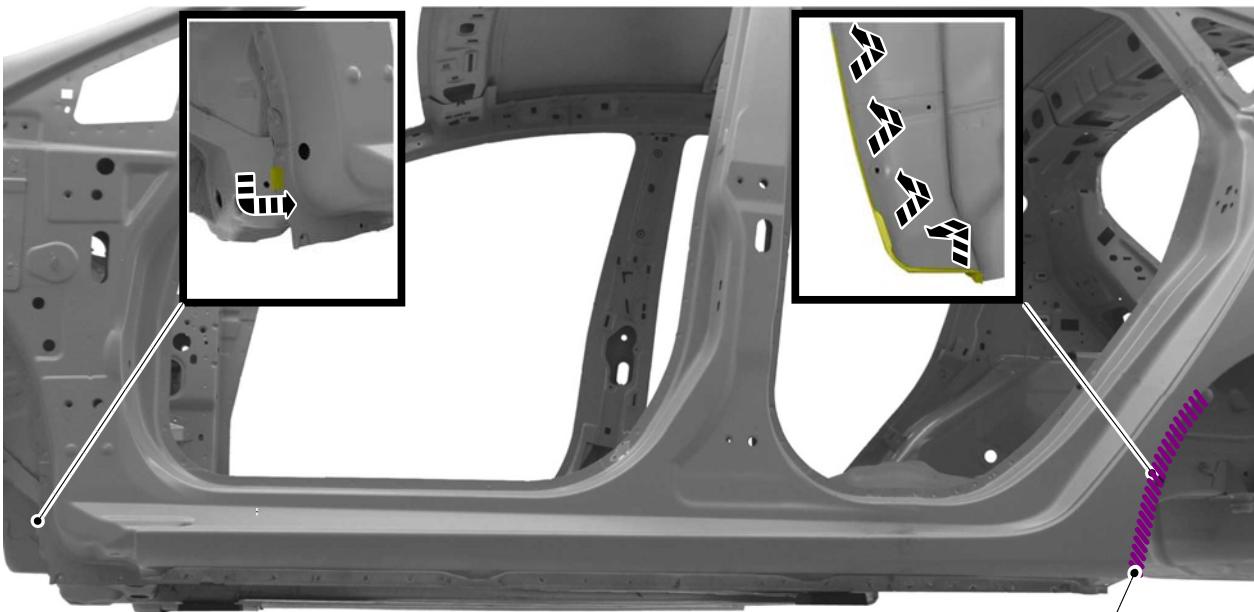
3. • General Equipment: Spot weld drill Bit



E108798

REMOVAL AND INSTALLATION

4. • General Equipment: Hot Air Gun



E108799

5. • General Equipment: Hot Air Gun



E108800

REMOVAL AND INSTALLATION

Installation

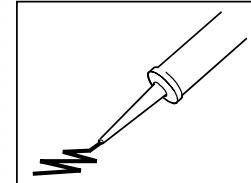
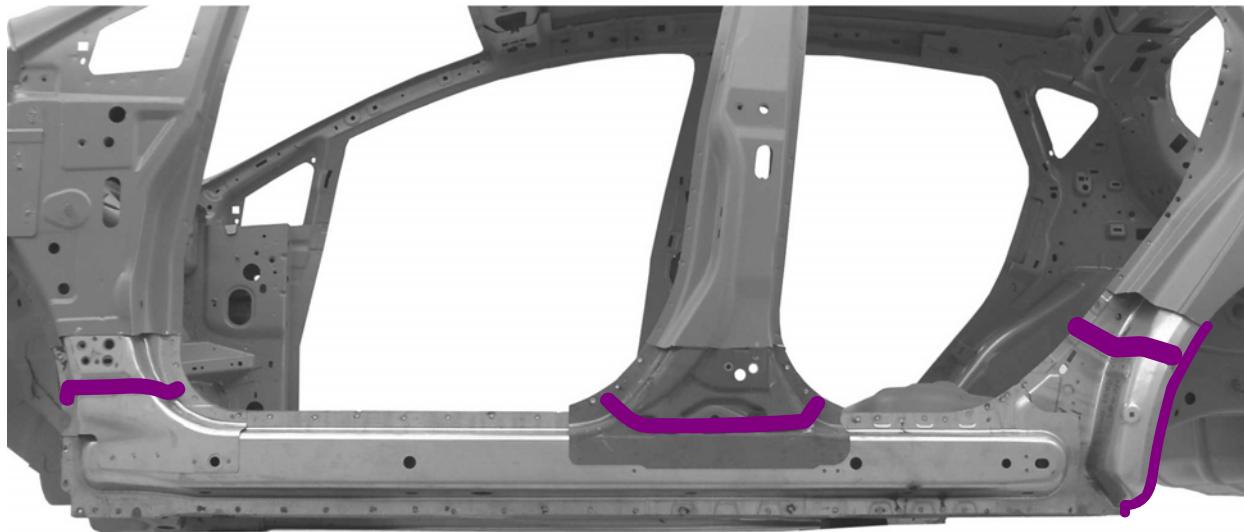
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs**
(501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

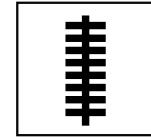
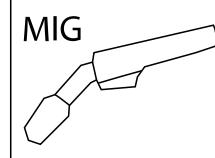
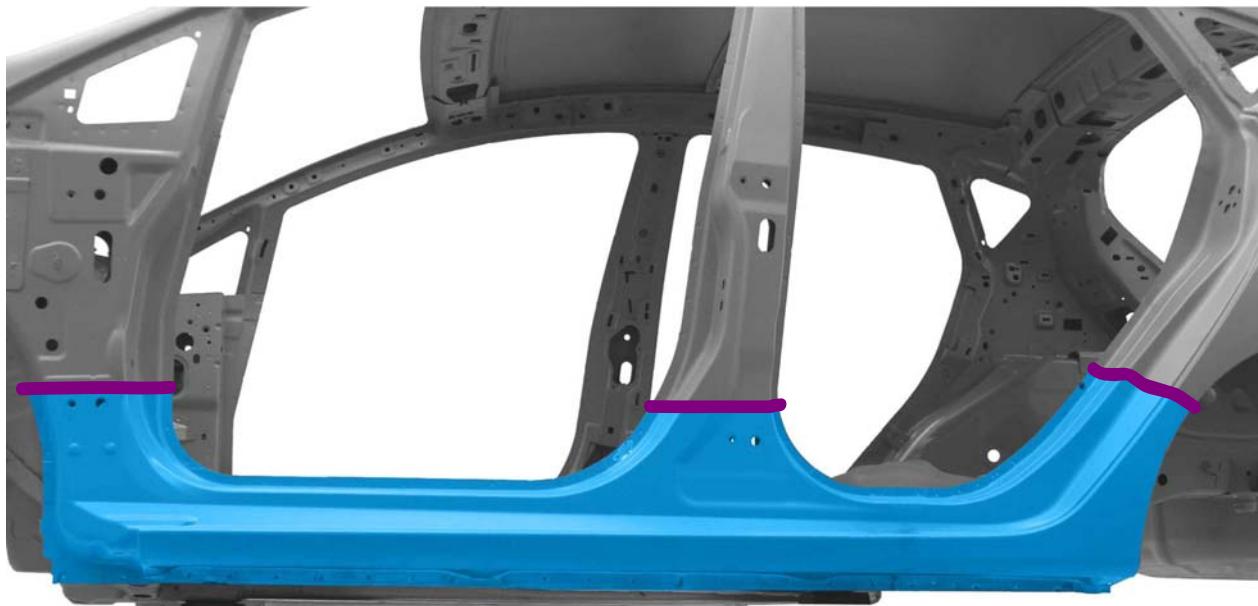
Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



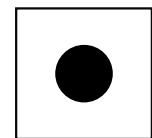
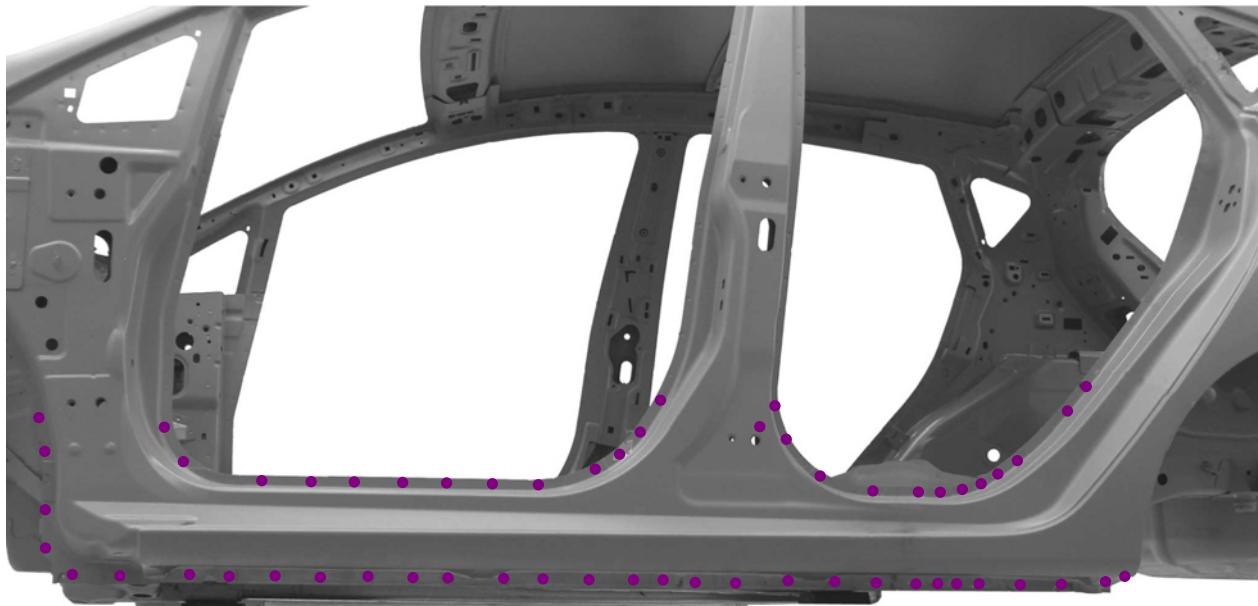
E108801

4. • General Equipment: MIG/MAG Welding Equipment

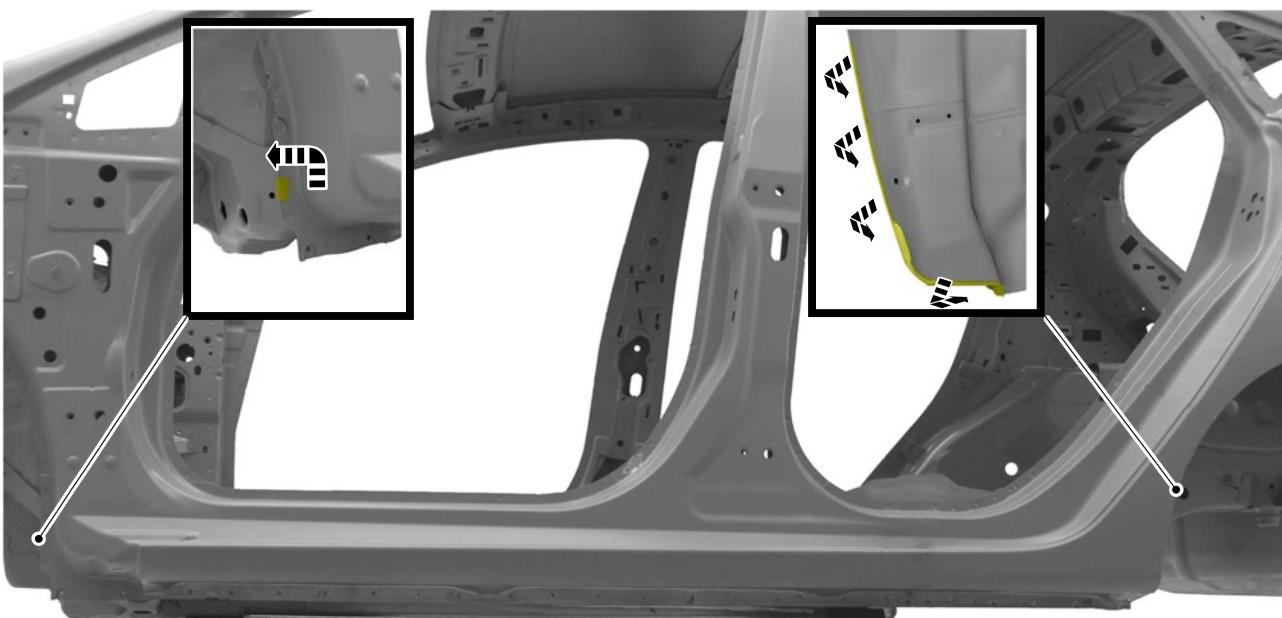
REMOVAL AND INSTALLATION

E108802

5. • General Equipment: Resistance Spotwelding Equipment



E108803

REMOVAL AND INSTALLATION**6.**

E108804

7. • Front and Rear Door
 - Door Hinges
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - Refer to: **A-Pillar Trim Panel** (501-05, Removal and Installation).
Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).
Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - Rocker Panel Trim
 - Refer to: **Front Seat** (501-10, Removal and Installation).
Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).
Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

REMOVAL AND INSTALLATION**Rocker Panel Inner Reinforcement — Double Cab****General Equipment**

Air Body Saw
MIG/MAG Welding Equipment

General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

Removal

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: **A-Pillar Assembly** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Rocker Panel
 - Door Hinges
 - Front and Rear Door
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - A- B- and C-Pillar Trim

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

Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

 - Rocker Panel Trim
 - Refer to: **Front Seat** (501-10, Removal and Installation).

Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).

Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

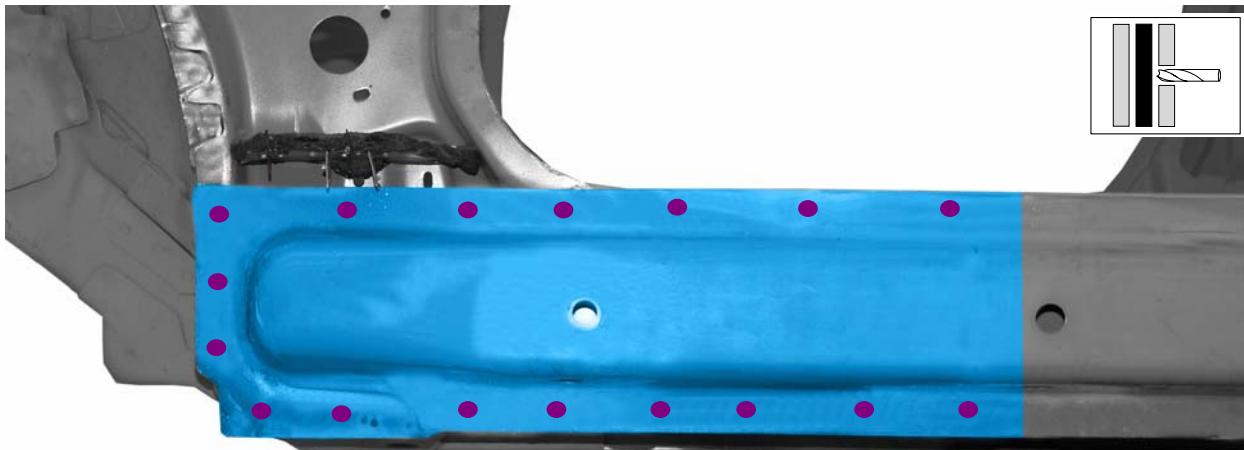
 - Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION



E115412

4. • General Equipment: Spot weld Drill Bit



E115413

Installation

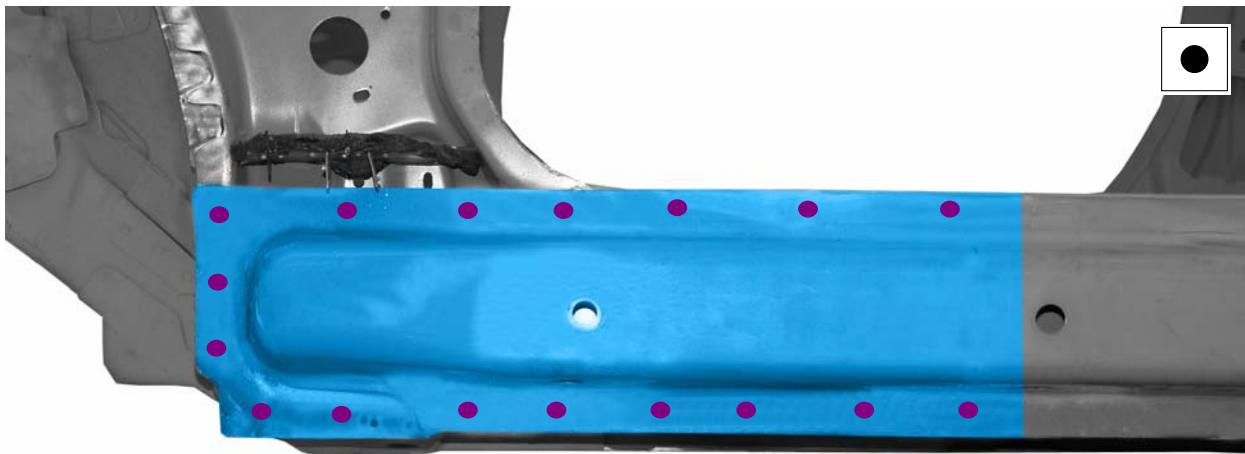
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION

E115414

4. • General Equipment: MIG/MAG Welding Equipment



E115415

REMOVAL AND INSTALLATION

5. • Refer to: **A-Pillar Assembly** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Rocker Panel
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

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

Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Rocker Panel Trim
- Refer to: **Front Seat** (501-10, Removal and Installation).

Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).

Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

REMOVAL AND INSTALLATION**Rocker Panel Inner Reinforcement — Single Cab****General Equipment**

Air Body Saw
MIG/MAG Welding Equipment

General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

Removal

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: **A-Pillar Assembly** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Rocker Panel
 - Door Hinges
 - Front and Rear Door
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - A- B- and C-Pillar Trim

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

Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

 - Rocker Panel Trim
 - Refer to: **Front Seat** (501-10, Removal and Installation).

Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).

Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

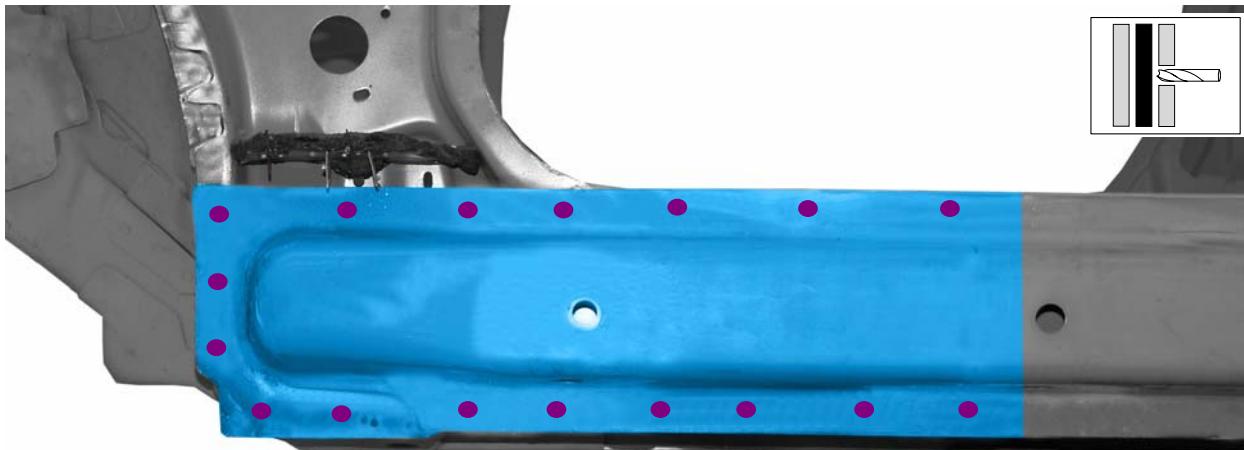
 - Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION



E115412

4. • General Equipment: Spot weld Drill Bit



E115413

Installation

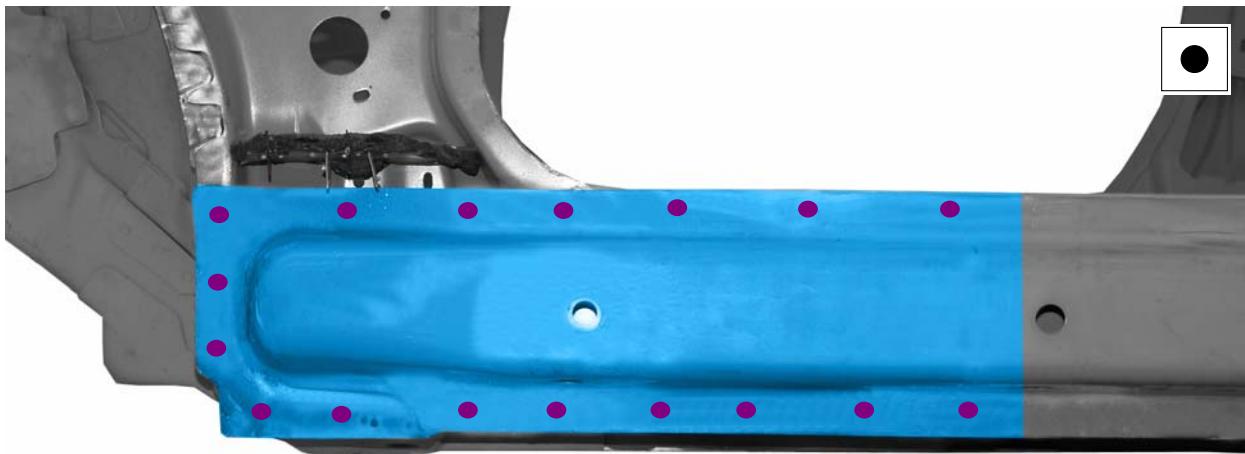
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION

E115414

4. • General Equipment: MIG/MAG Welding Equipment



E115415

REMOVAL AND INSTALLATION

5. • Refer to: **A-Pillar Assembly** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Rocker Panel
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

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

Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Rocker Panel Trim
- Refer to: **Front Seat** (501-10, Removal and Installation).

Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).

Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

REMOVAL AND INSTALLATION**Rocker Panel Inner Reinforcement — Super Cab****General Equipment**

Air Body Saw
MIG/MAG Welding Equipment

General Equipment

Resistance Spotwelding Equipment
Spot weld drill Bit

Removal

1. Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).
2. • Refer to: **A-Pillar Assembly** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
 - Rocker Panel
 - Door Hinges
 - Front and Rear Door
 - Front Wheel Arch Trim
 - Rear Wheel Arch Trim
 - A- B- and C-Pillar Trim

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

Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

 - Rocker Panel Trim
 - Refer to: **Front Seat** (501-10, Removal and Installation).

Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).

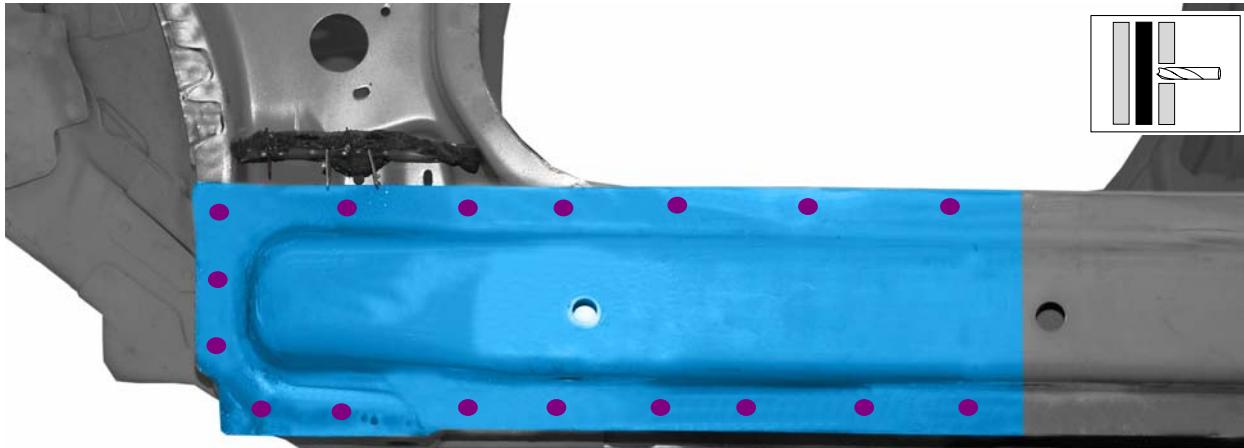
Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

 - Reposition the carpeting and the wiring harness away from the working area.
3. • General Equipment: Air Body Saw

REMOVAL AND INSTALLATION

E115412

4. • General Equipment: Spot weld Drill Bit



E115413

Installation

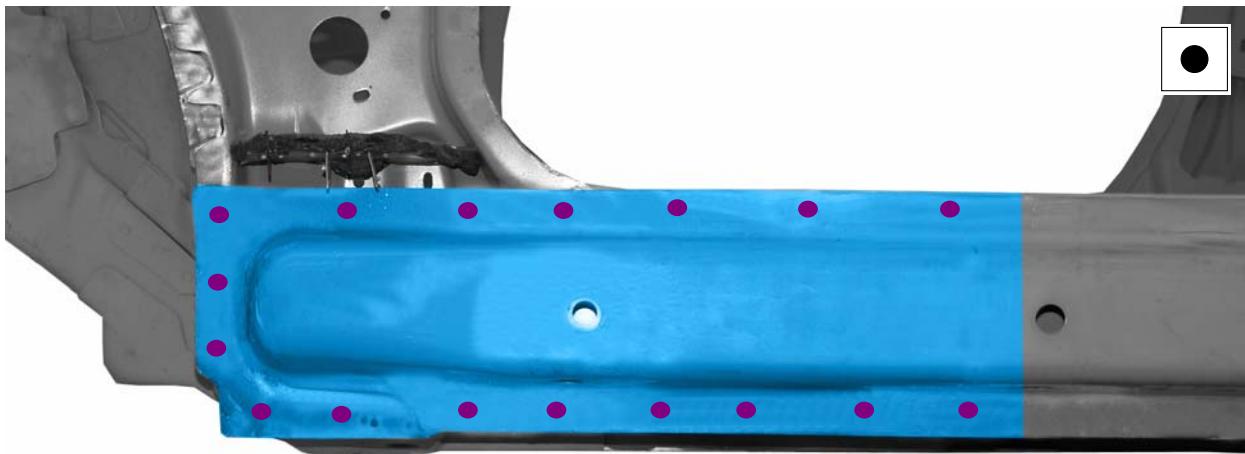
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION

E115414

4. • General Equipment: MIG/MAG Welding Equipment



E115415

REMOVAL AND INSTALLATION

5. • Refer to: **A-Pillar Assembly** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Refer to: **A-Pillar Outer Panel** (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
- Rocker Panel
- Door Hinges
- Front and Rear Door
- Front Wheel Arch Trim
- Rear Wheel Arch Trim
- A- B- and C-Pillar Trim

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

Refer to: **B-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **C-Pillar Trim Panel - 5-Door** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Rocker Panel Trim
- Refer to: **Front Seat** (501-10, Removal and Installation).

Refer to: **Rear Seat Cushion** (501-10, Removal and Installation).

Refer to: **Rear Seat Backrest** (501-10, Removal and Installation).

REMOVAL AND INSTALLATION**B-Pillar and Reinforcement — Double Cab****General Equipment**

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit	
Materials	
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

Removal

NOTE: Equipment:

Measurement and alignment angle system

1.  **WARNING: High-strength steel (Usibor 1500)**

- A suitably powerful resistance spot welding device with **inverter technology** must be used for this repair. Observe the manufacturer's welding equipment instructions and sub-section 501-25.
- The B-pillar reinforcement is made of high-strength steel plate (Usibor 1500).
- A partial replacement of the B-pillar reinforcement is not permissible. The required continuous MIG weld seam in the area of the cut causes structural changes which result in significant loss of strength in the B-pillar reinforcement.
- Due to its strength, the B-pillar reinforcement can not always be worked on with conventional body tools.
- Additional preparations are required for MIG puddle welding.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. • **Rocker Panel Trim**

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

Refer to: **Rear Seat Cushion** (501-10 Seating, Disassembly and Assembly).

Refer to: **Rear Seat Backrest** (501-10 Seating, Disassembly and Assembly).

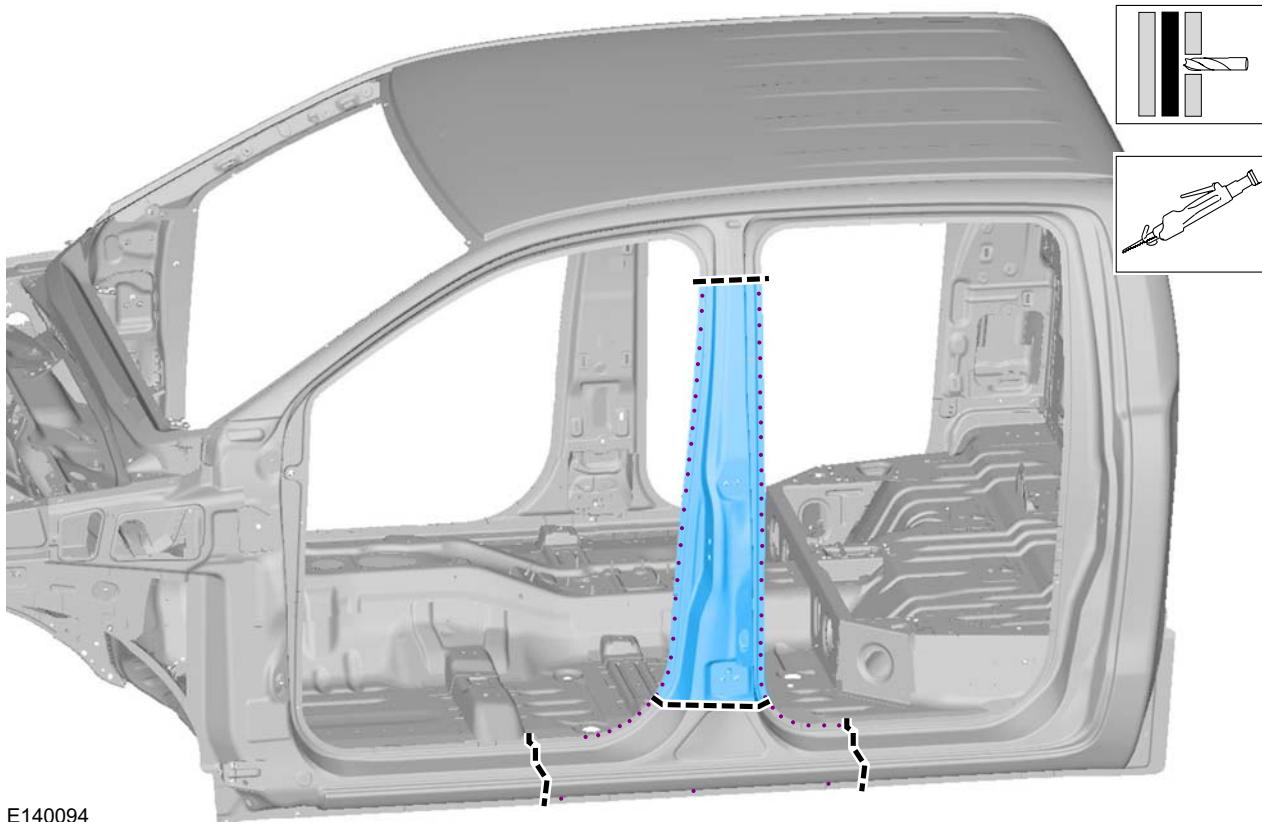
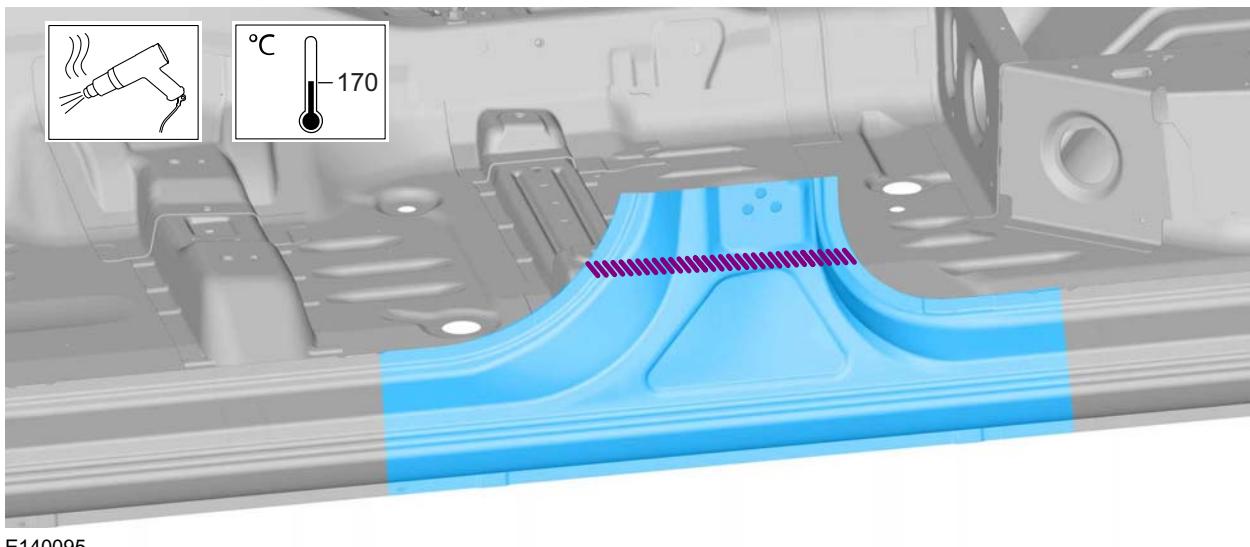
Refer to: **B-Pillar Upper Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

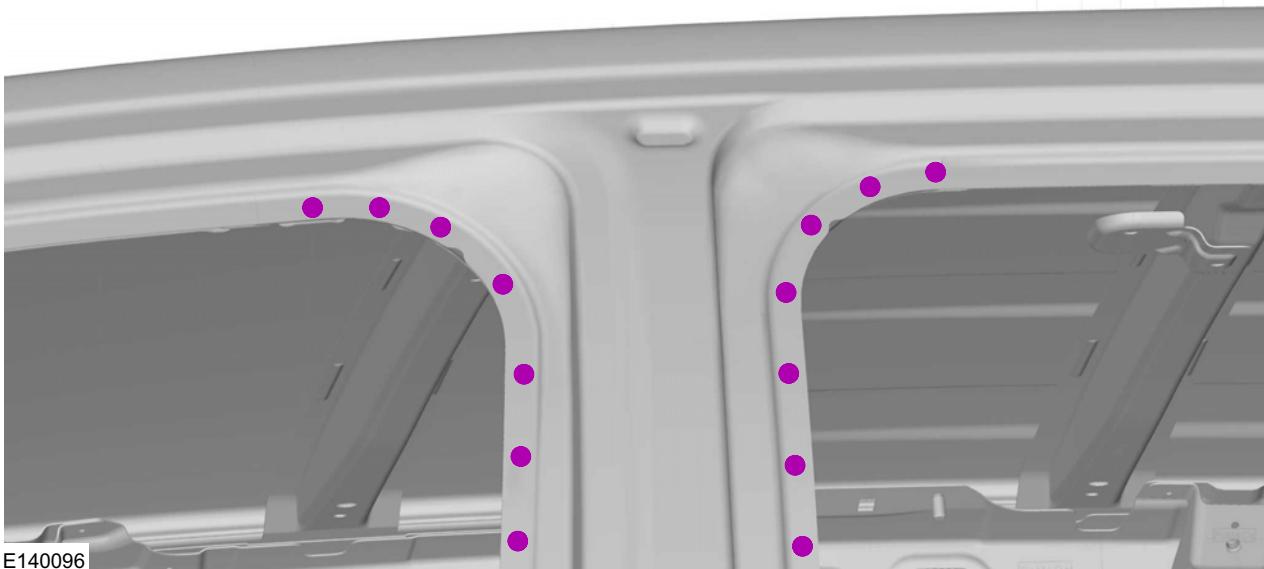
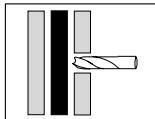
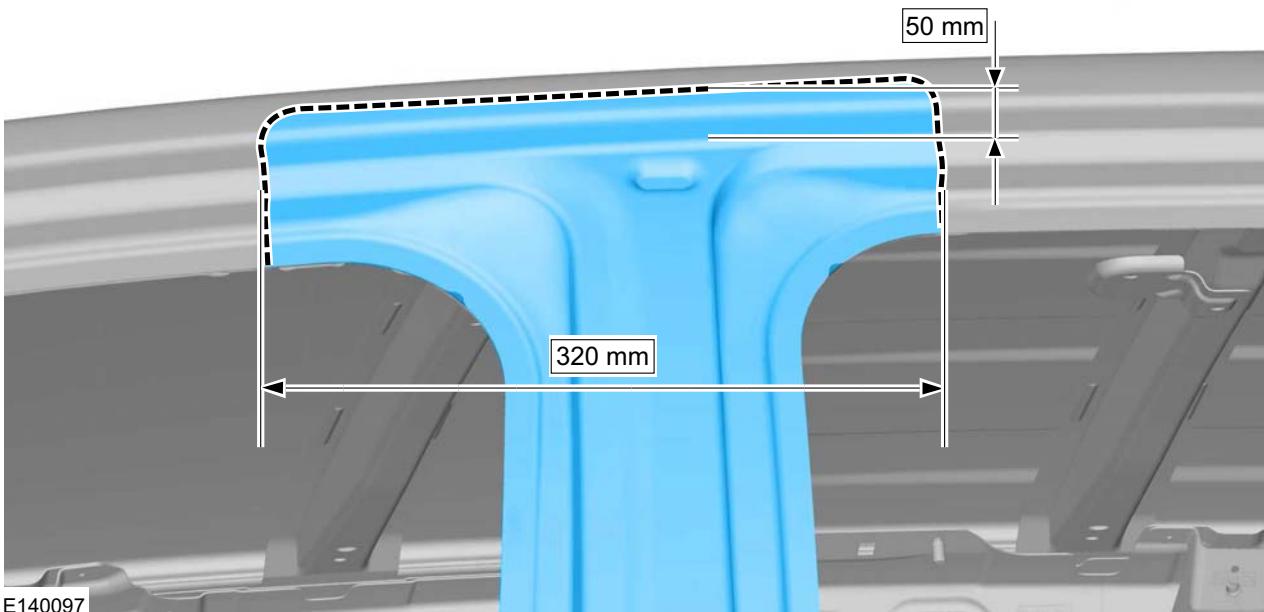
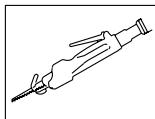
Refer to: **B-Pillar Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

Refer to: **Headliner** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Front and Rear Door
- Reposition the carpeting and the wiring harness away from the working area.

3. • **General Equipment: Air Body Saw**
General Equipment: Spot weld drill Bit

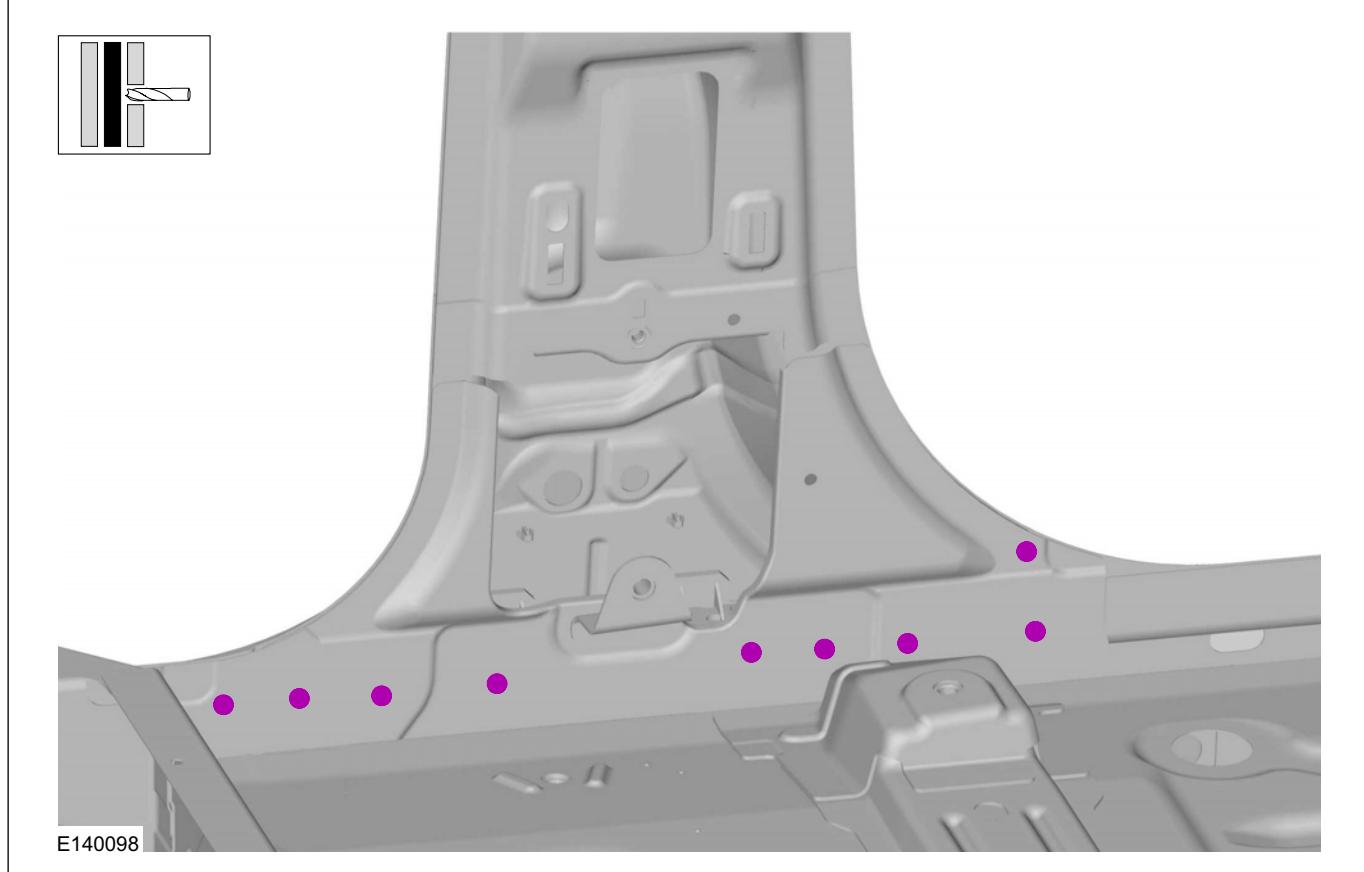
REMOVAL AND INSTALLATION**4. • General Equipment: Hot Air Gun****5. • General Equipment: Spot weld drill Bit**

REMOVAL AND INSTALLATION**6. • General Equipment: Air Body Saw**

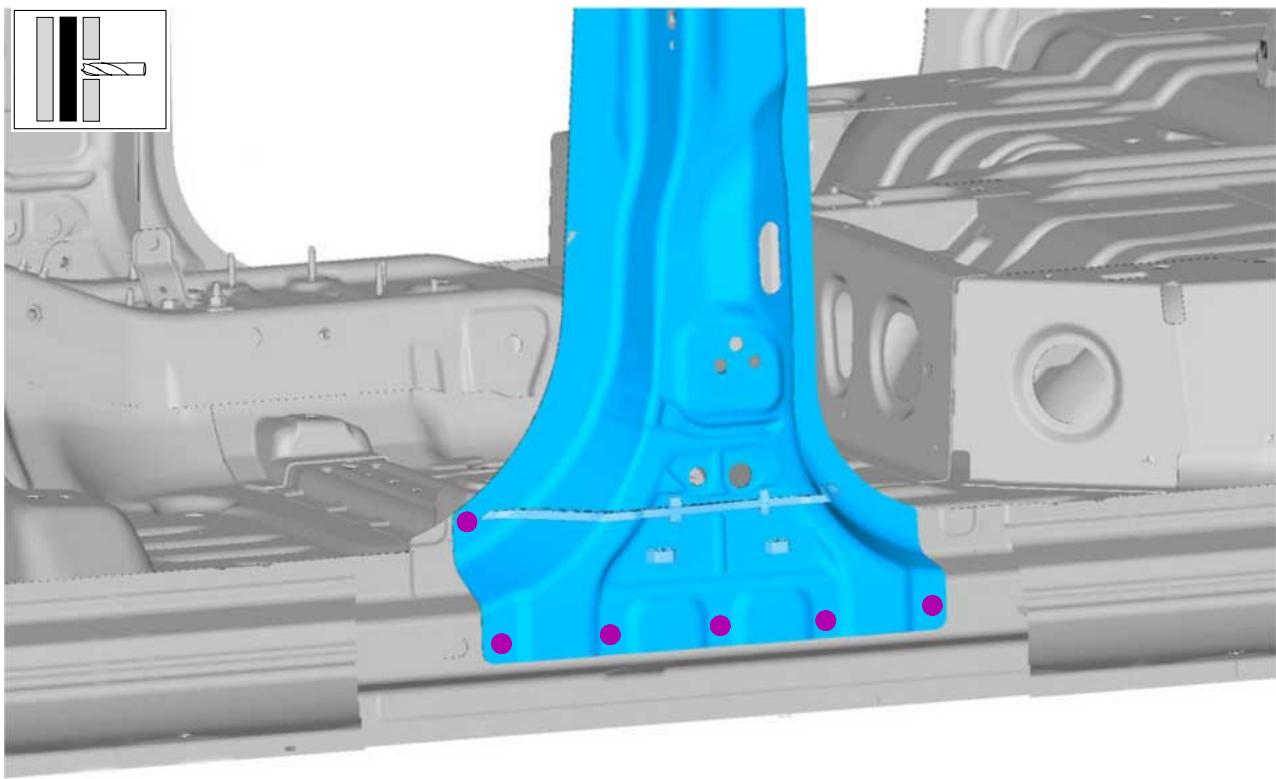
REMOVAL AND INSTALLATION

7. • General Equipment: Air Body Saw

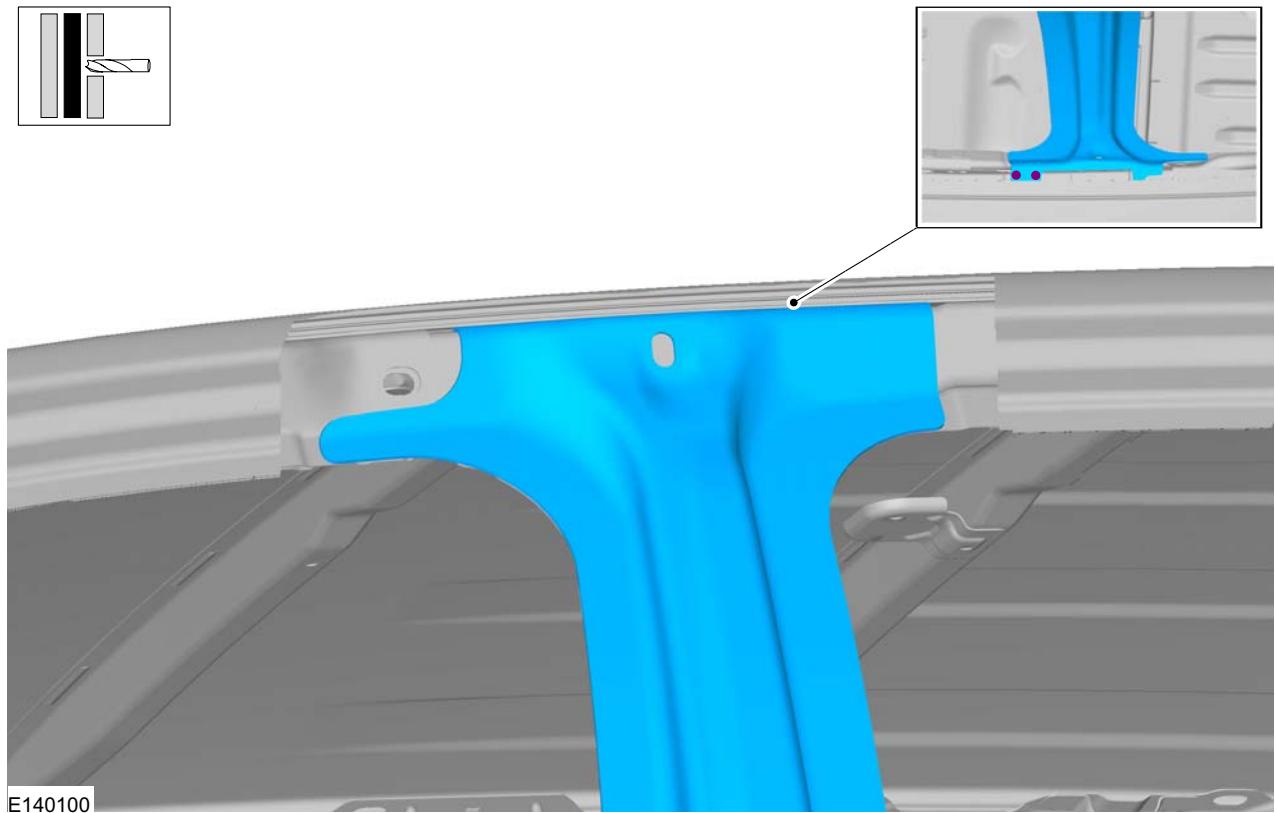
General Equipment: Spot weld drill Bit



8. • General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

E140099

9. • General Equipment: Spot weld drill Bit

E140100

REMOVAL AND INSTALLATION

Installation

- 1. NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs**
(501-25 Body Repairs - General Information, Description and Operation).

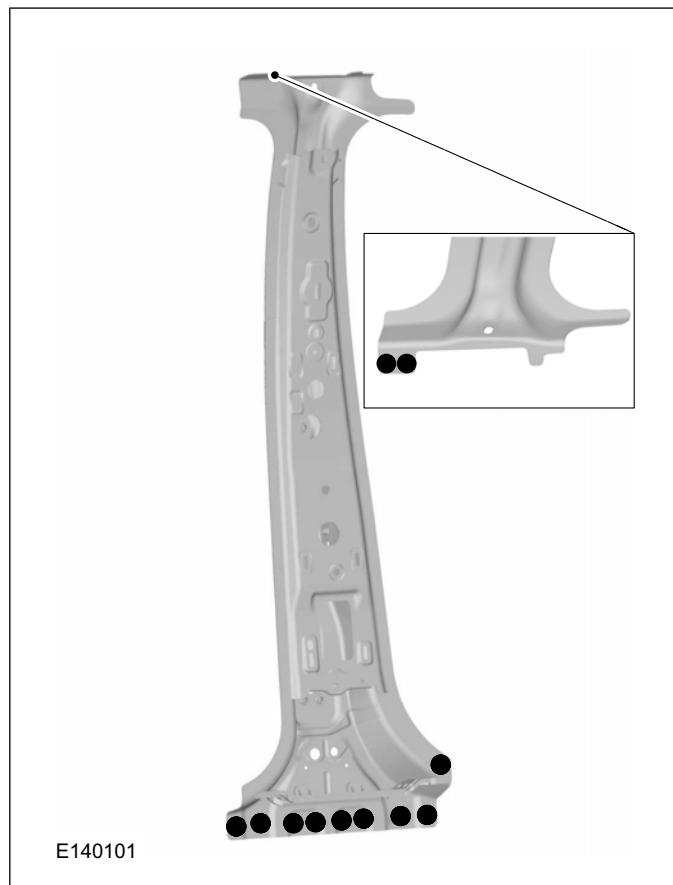
- 2. NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

- 3. • •** The holes need to be pre-milled with a spherical cutter with a small diameter. Afterwards these holes are then milled out to the required diameter with a spindle milling cutter. This method is essential in order to ensure that the material in the edge area of the milled holes is not weakened.

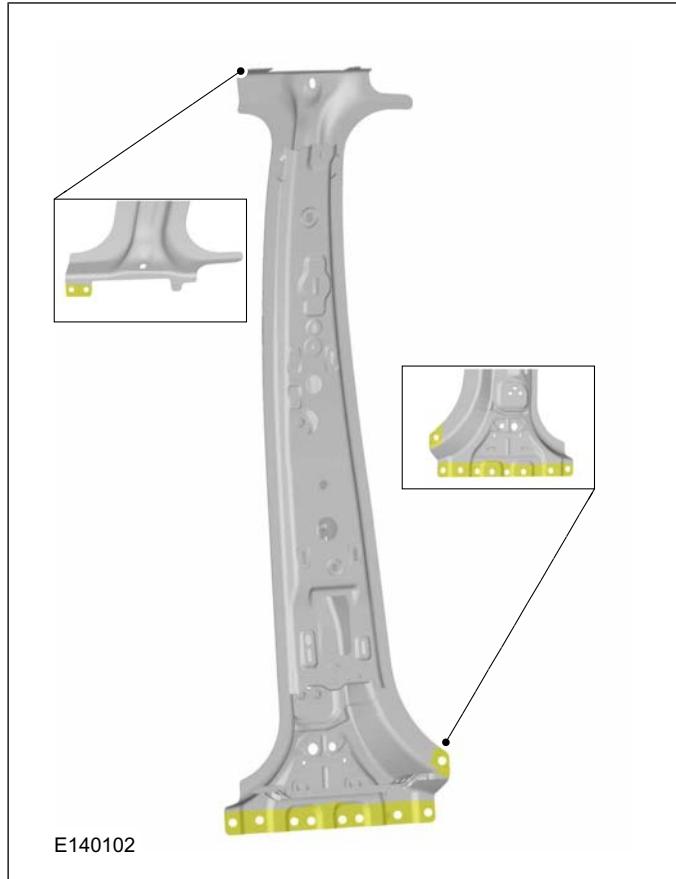
Equipment: Spherical cutter

- Equipment: spindle milling cutter

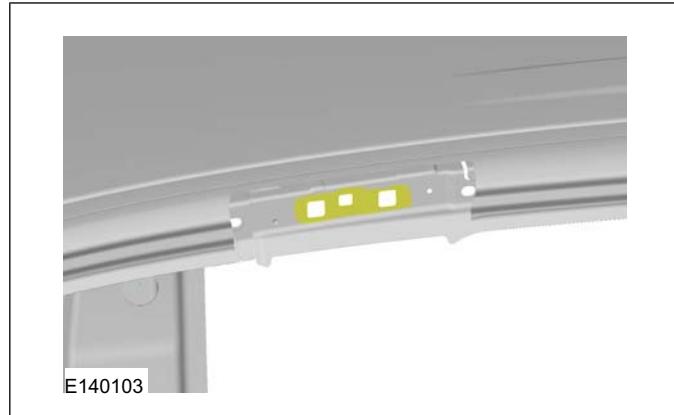


REMOVAL AND INSTALLATION

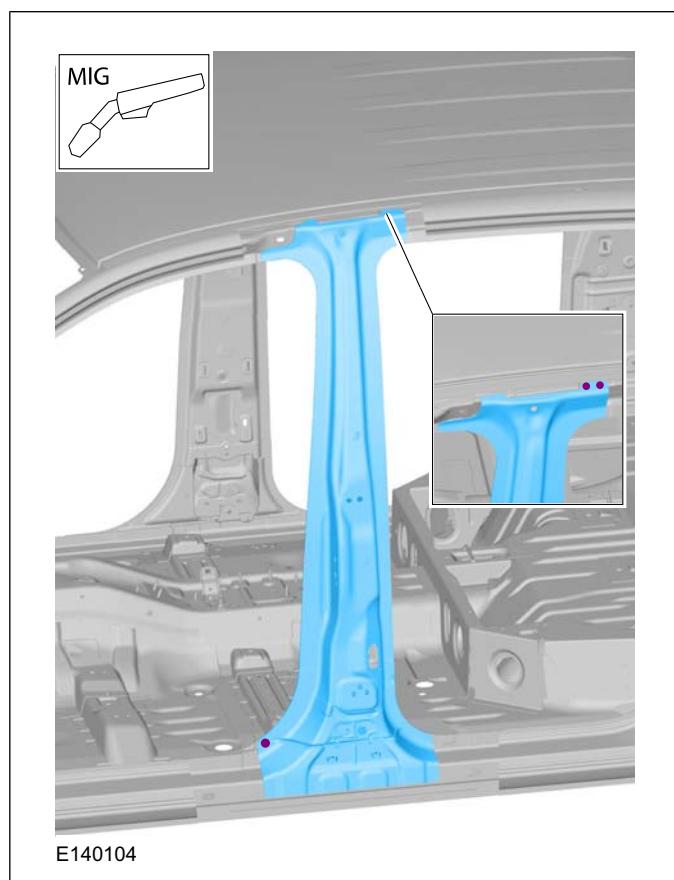
4. • **WARNING:** The B-pillar reinforcement is covered with a hot-dip aluminized coating on its entire surface. This coating needs to be fully ground off on the welding flanges on the front and rear using a fibre grinding disc. Any contamination due to parts of the coating in the welding bath will weaken the welded joint.



5. • **WARNING:** The A-pillar reinforcement is covered with a hot-dip aluminized coating on its entire surface. This coating needs to be fully ground off on the welding flanges on the front using a fibre grinding disc. Any contamination due to parts of the coating in the welding bath will weaken the welded joint.

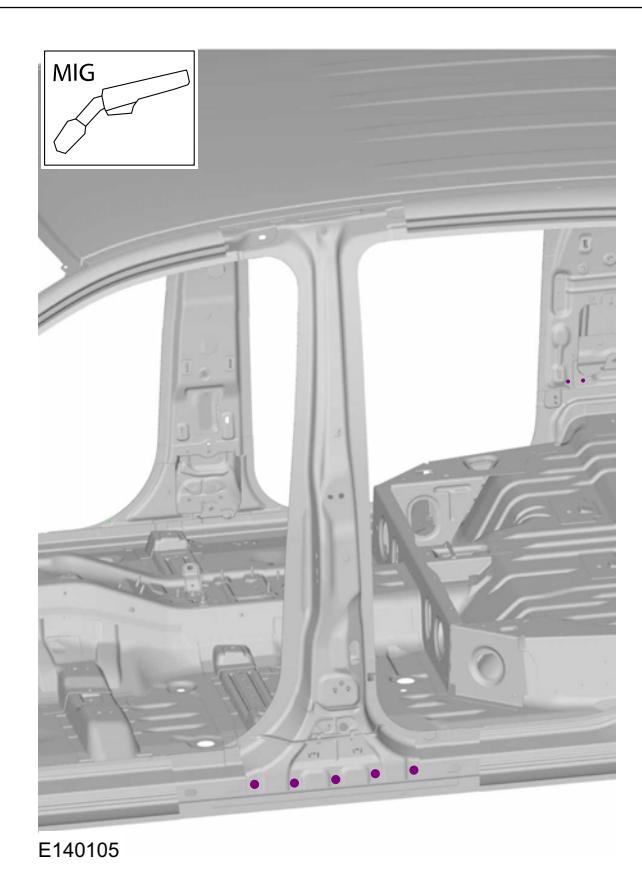


6. • Resistance spot weld - Panel thickness 3 mm and greater!
- General Equipment: Resistance Spotwelding Equipment

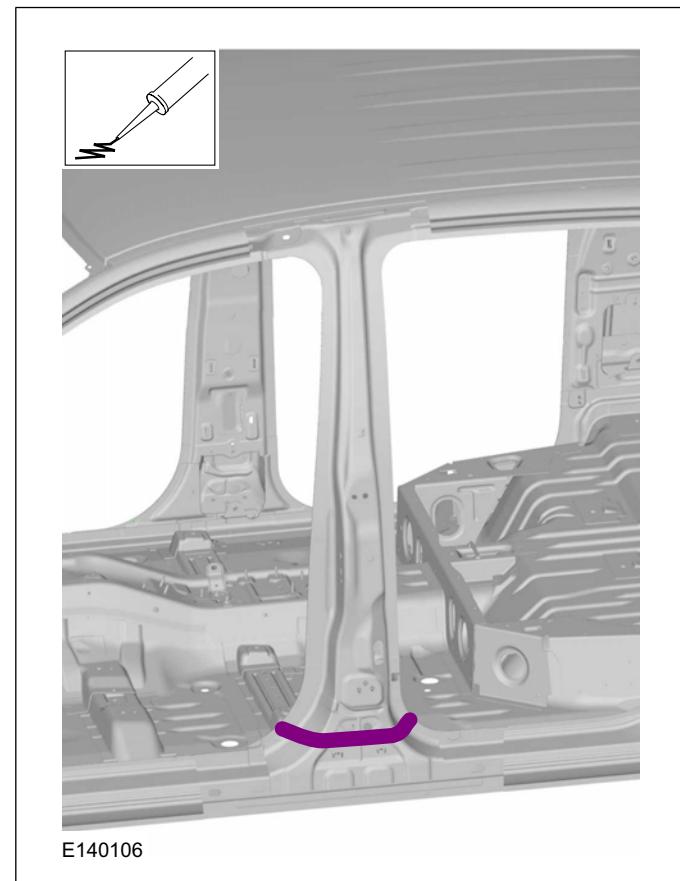


REMOVAL AND INSTALLATION

7. • General Equipment: MIG/MAG Welding Equipment

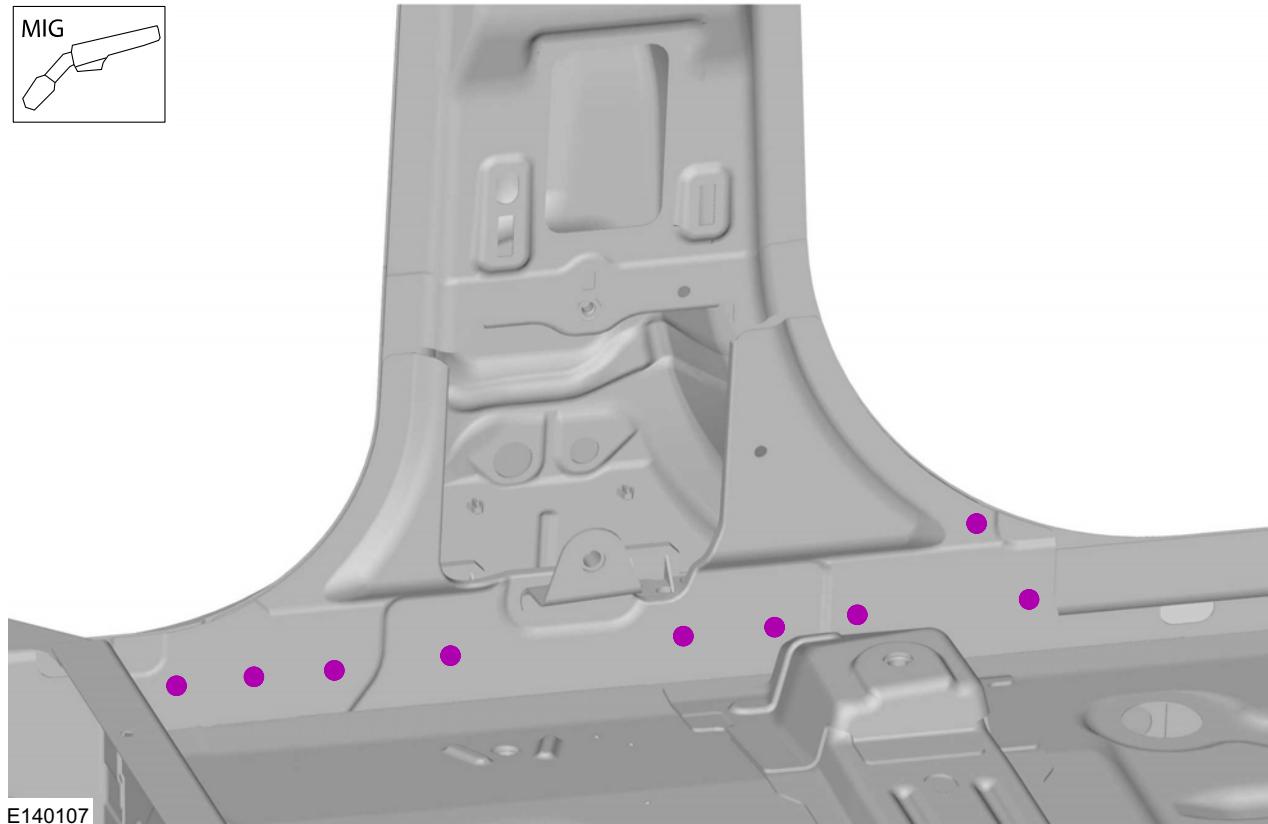
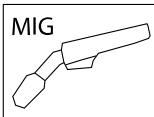


8. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive



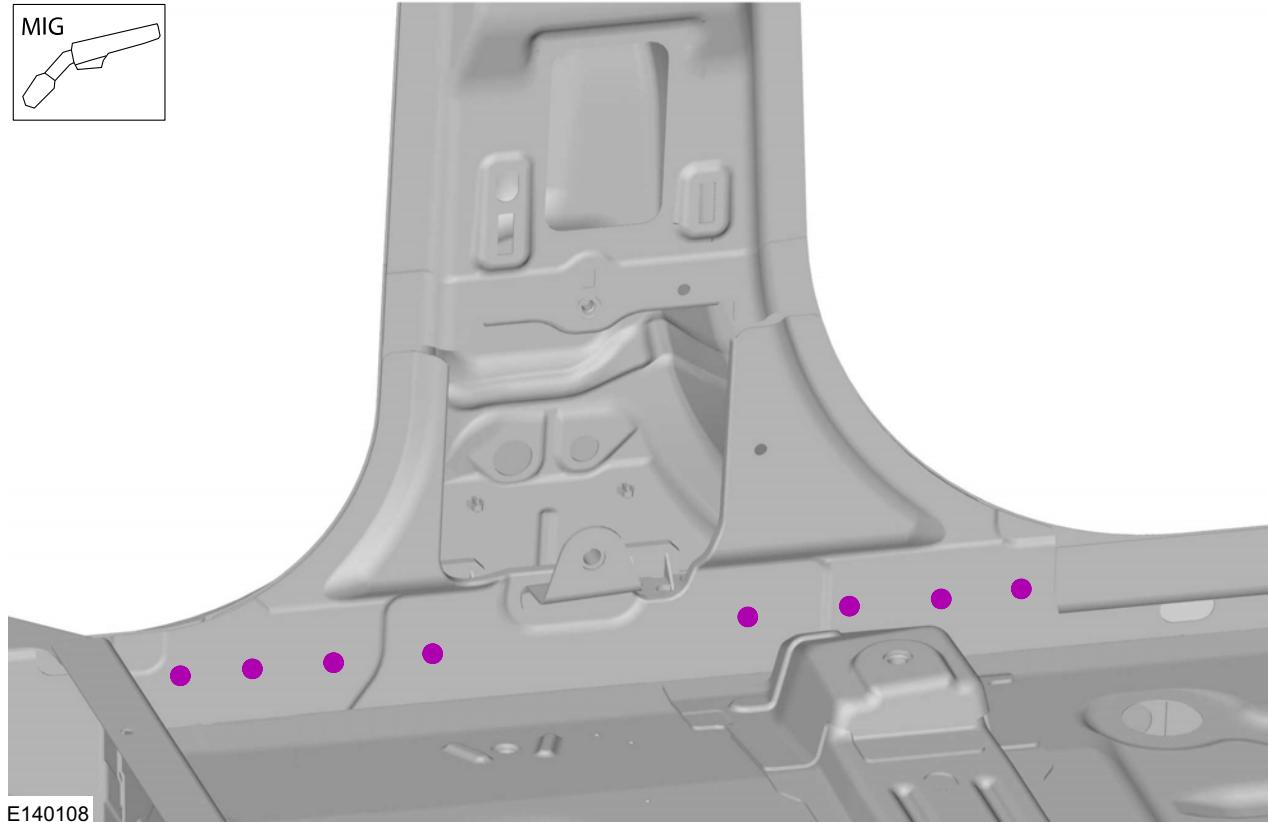
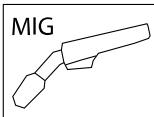
9. • Puddle weld **2** panel layer.
General Equipment: MIG/MAG Welding Equipment

REMOVAL AND INSTALLATION



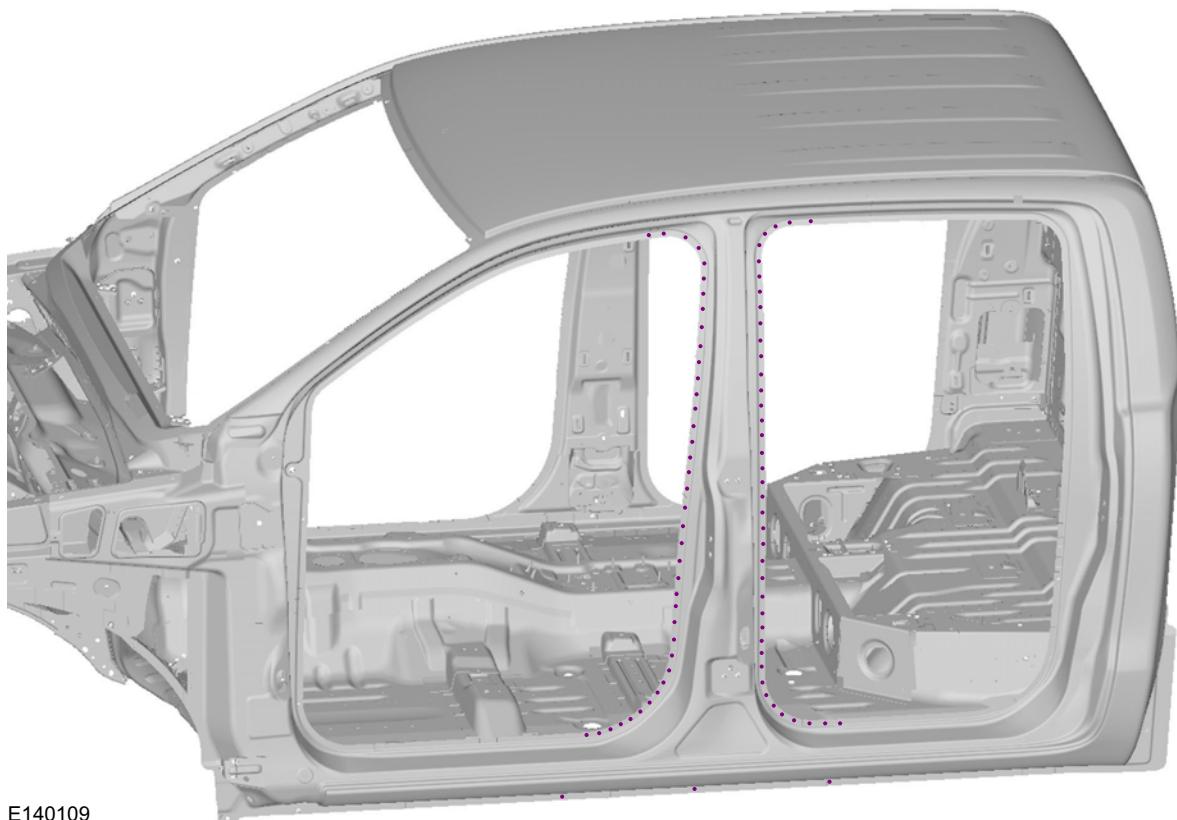
10. • Puddle weld 3 panel layer.

General Equipment: MIG/MAG Welding
Equipment

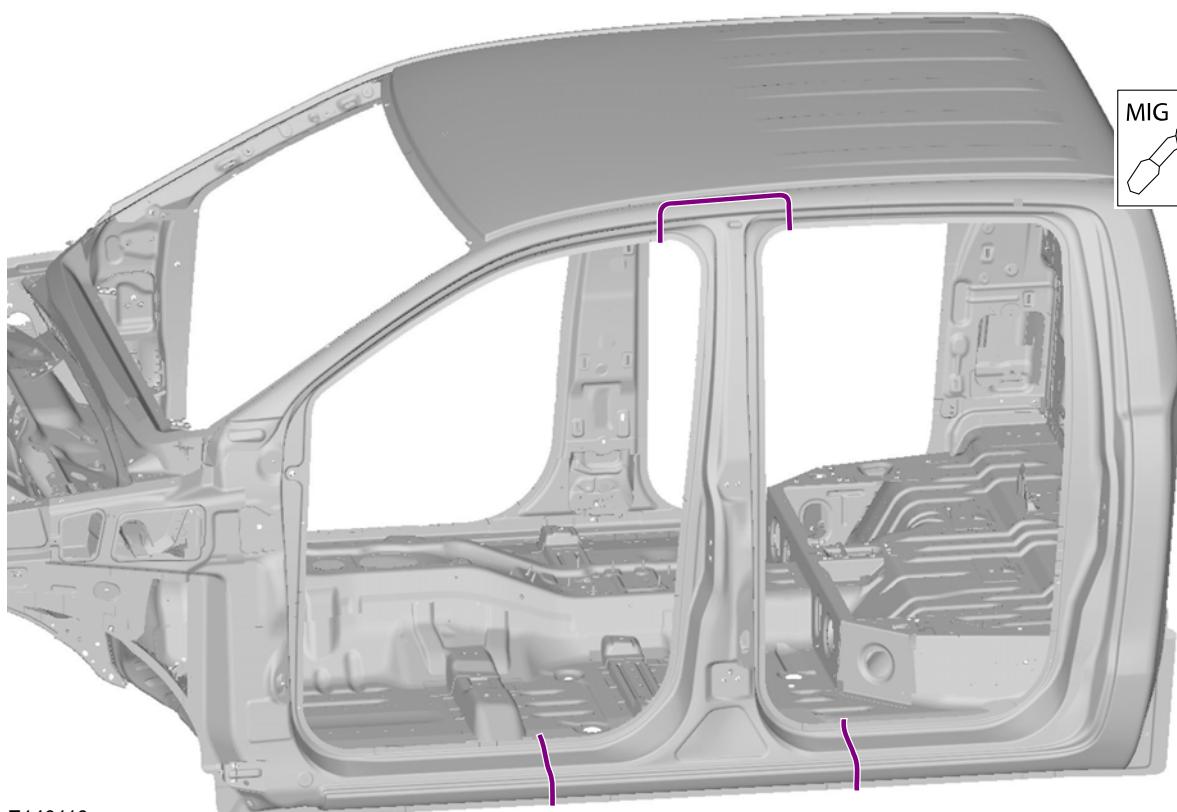
REMOVAL AND INSTALLATION

- 11.** • Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION

- 12 • General Equipment: MIG/MAG Welding Equipment



REMOVAL AND INSTALLATION

13. • Rocker Panel Trim

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

Refer to: **Rear Seat Cushion** (501-10 Seating, Disassembly and Assembly).

Refer to: **Rear Seat Backrest** (501-10 Seating, Disassembly and Assembly).

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

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

Refer to: **Headliner** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Front and Rear Door

REMOVAL AND INSTALLATION**B-Pillar Outer Panel — Double Cab****General Equipment**

Air Body Saw
Hot Air Gun
MIG/MAG Welding Equipment
Resistance Spotwelding Equipment

General Equipment

Spot weld drill Bit	
Materials	
Name	Specification
Windshield Adhesive Kit	WSS-M11P57-A5

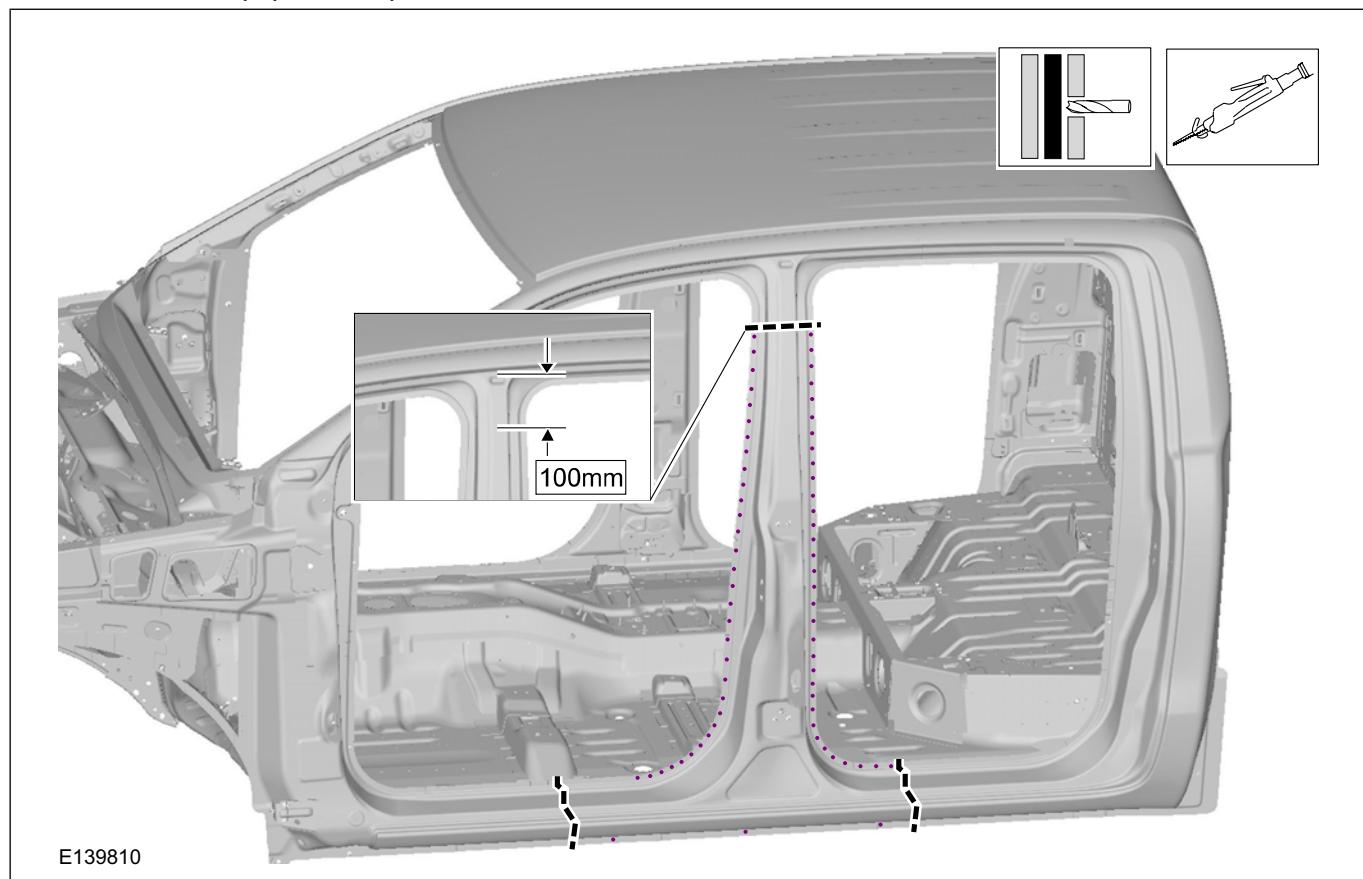
Removal**1.** • Rocker Panel Trim

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

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

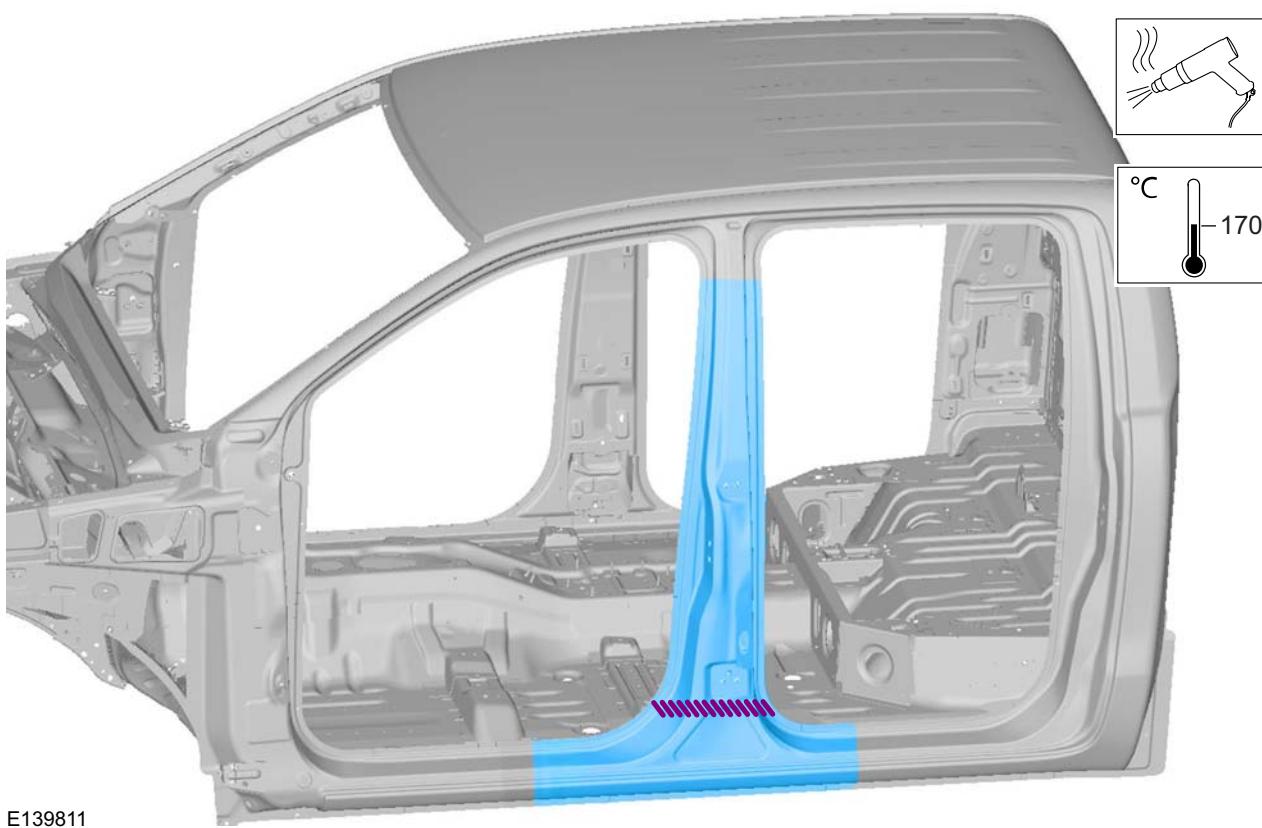
Refer to: **B-Pillar Lower Trim Panel** (501-05 Interior Trim and Ornamentation, Removal and Installation).

- Front and Rear Door
- Reposition the carpeting and the wiring harness away from the working area.

2. • General Equipment: Air Body Saw
General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

3. • General Equipment: Hot Air Gun



Installation

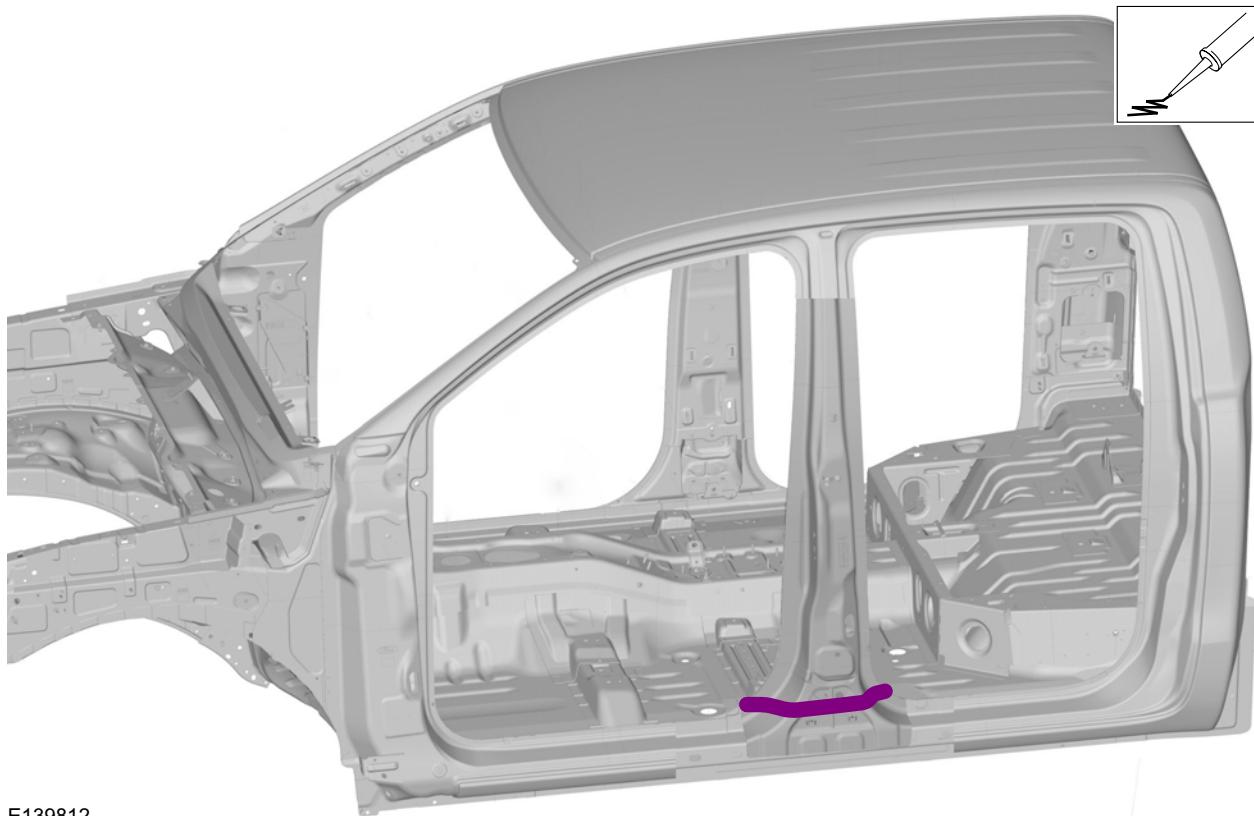
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

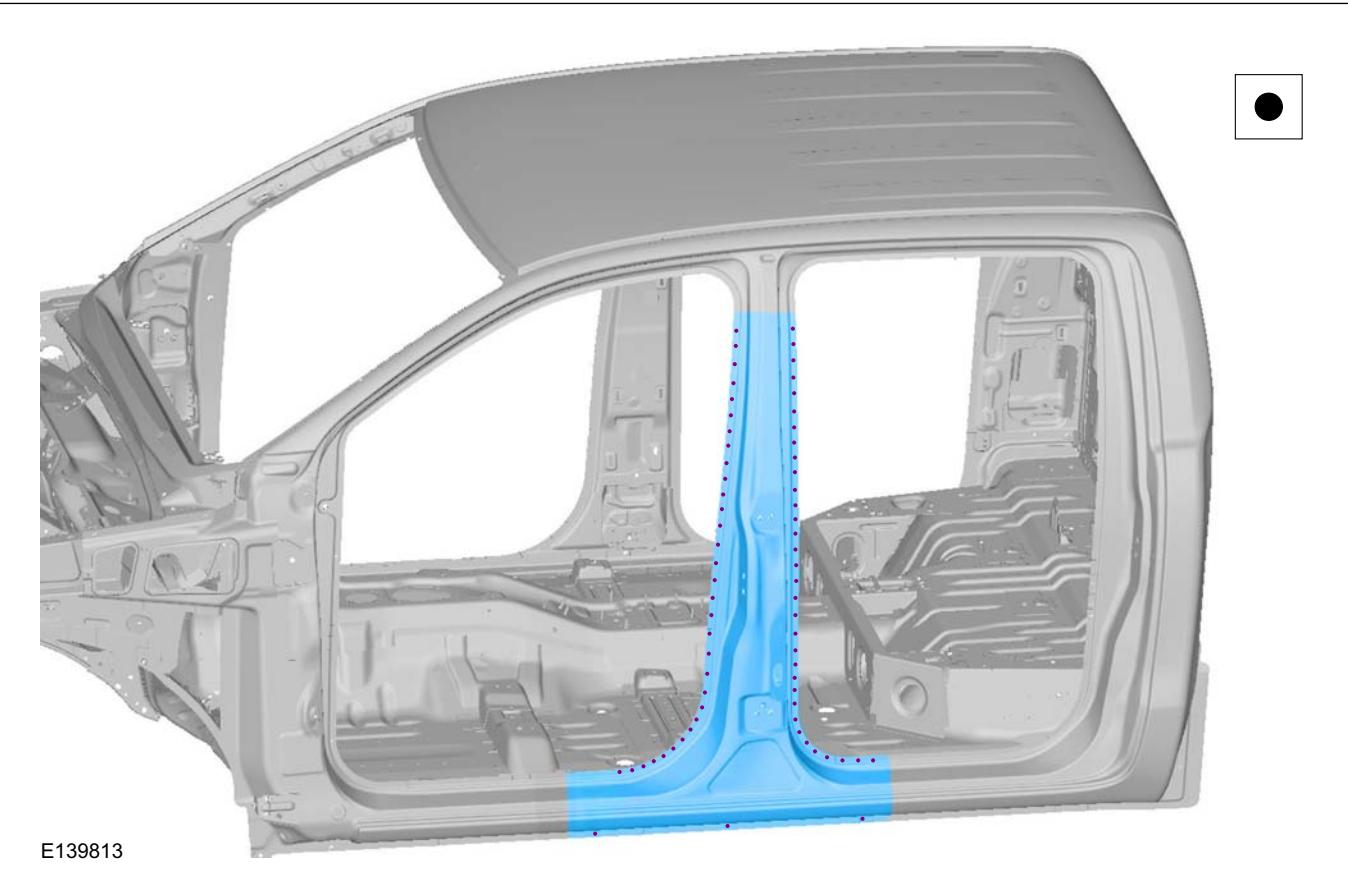
3. • Material: Windshield Adhesive Kit (WSS-M11P57-A5) adhesive

REMOVAL AND INSTALLATION

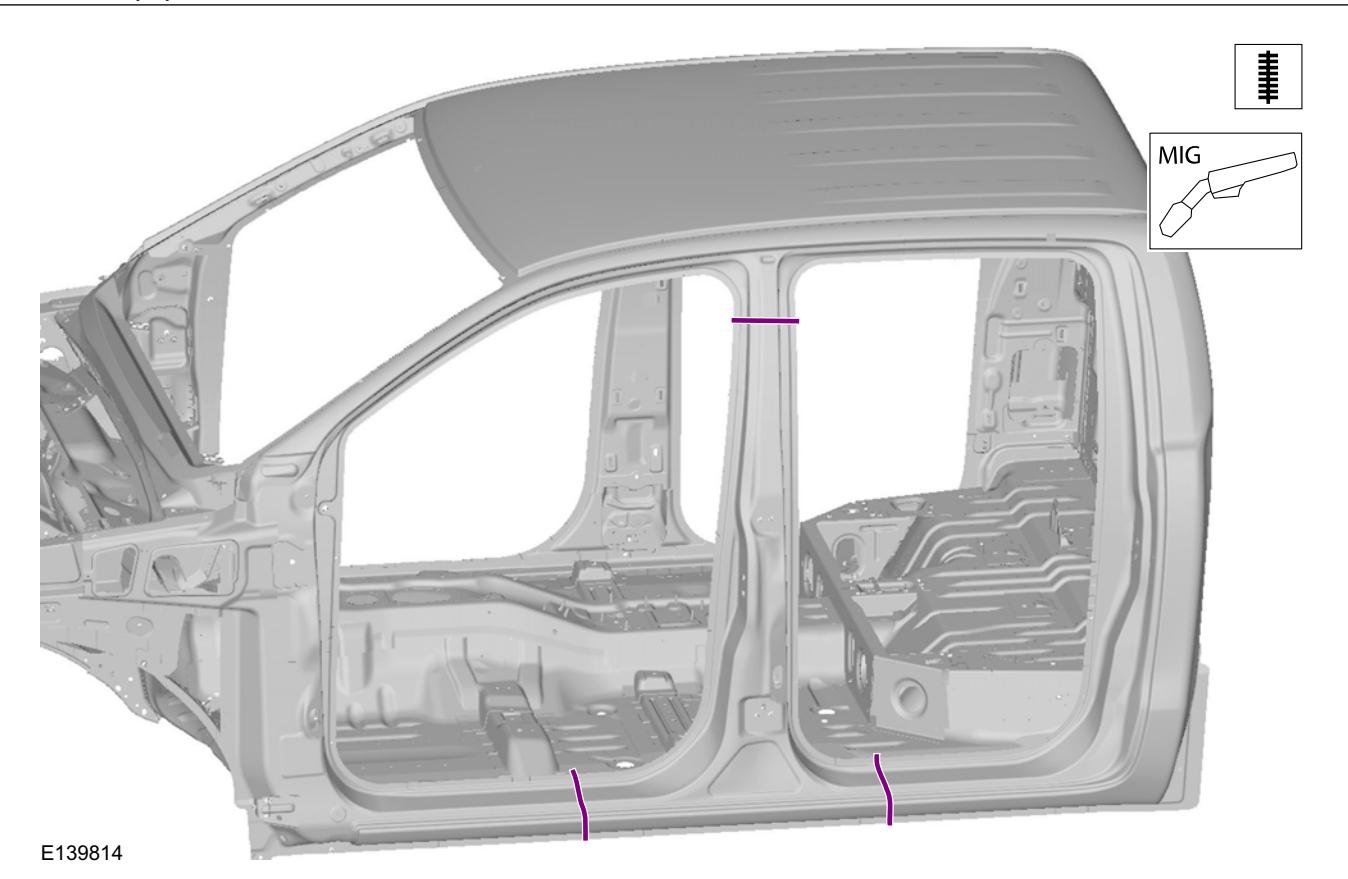
E139812

4. • Resistance spot weld - Panel thickness 3 mm and greater!

General Equipment: Resistance Spotwelding Equipment

REMOVAL AND INSTALLATION

5. • General Equipment: MIG/MAG Welding Equipment



REMOVAL AND INSTALLATION

6. • Rocker Panel Trim

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

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

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

• Front and Rear Door

SECTION 501-30 Rear End Sheet Metal Repairs

VEHICLE APPLICATION:BT50 & Ranger

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REMOVAL AND INSTALLATION

Back Panel — Single Cab.....	501-30-2
Back Panel — Double Cab.....	501-30-5
Back Panel — Super Cab.....	501-30-8

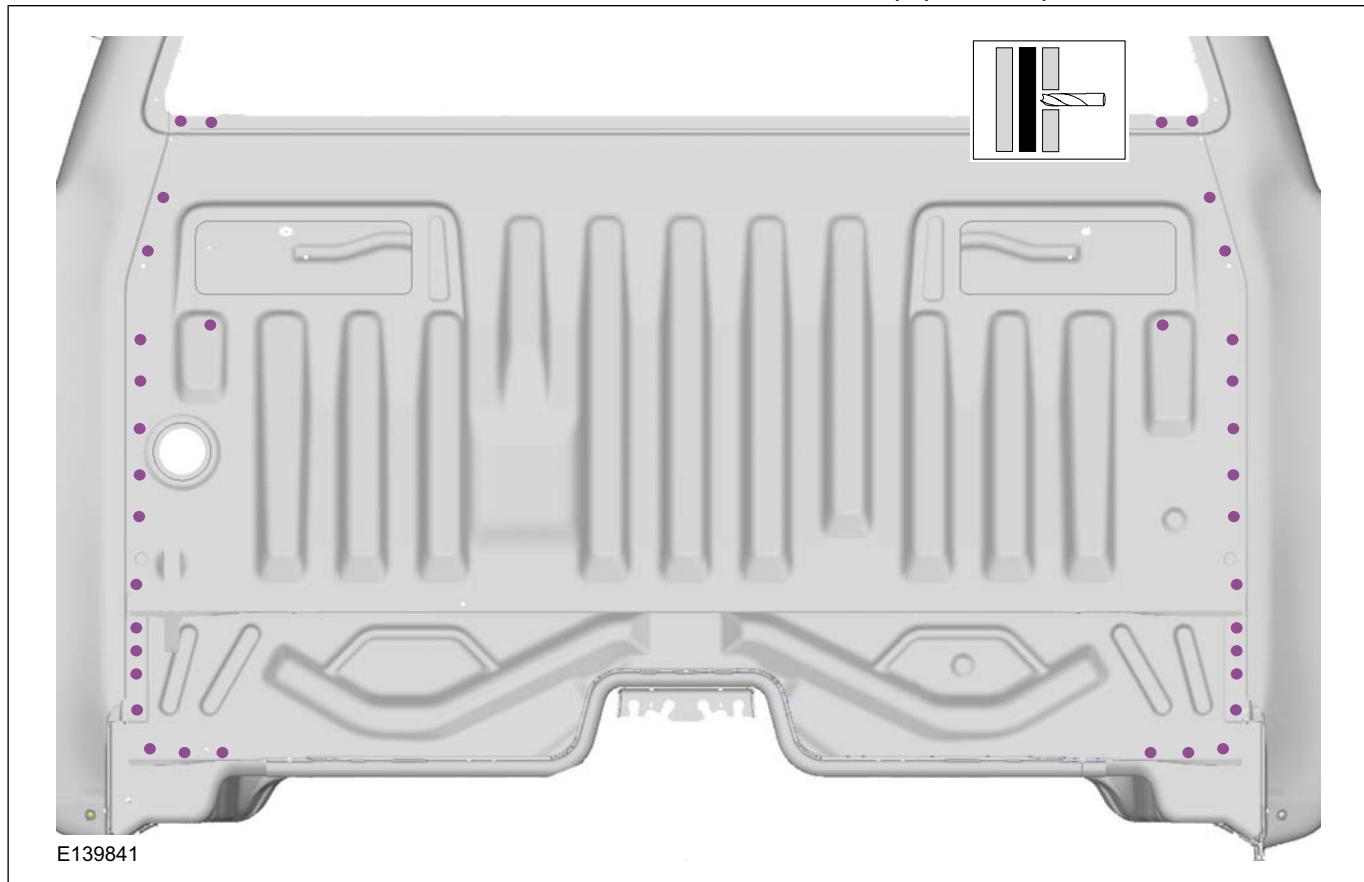
REMOVAL AND INSTALLATION**Back Panel — Single Cab****General Equipment**

Spot weld drill Bit

Removal

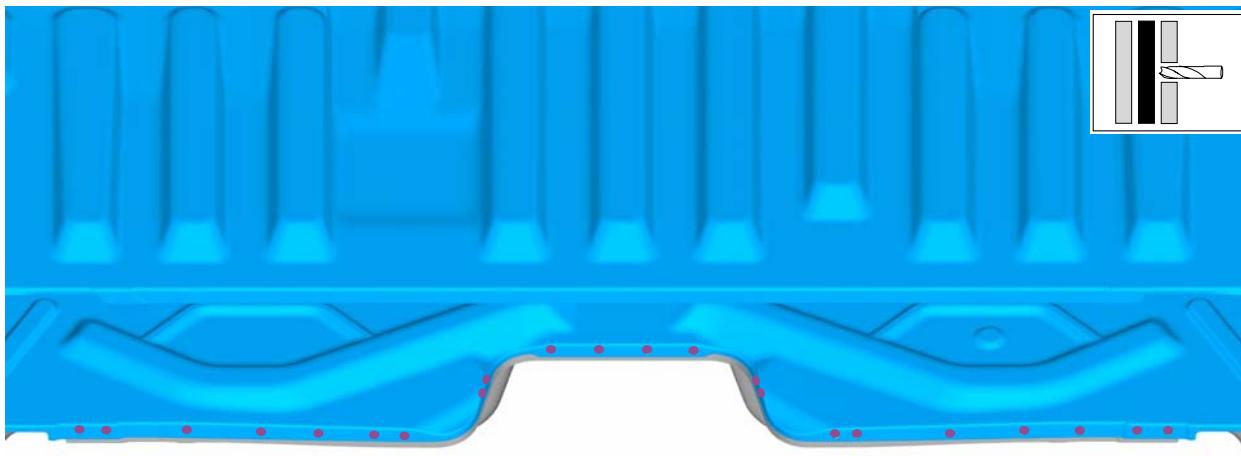
1. Remove the load body.
2. Mill out the spot welds.

General Equipment: Spot weld drill Bit



3. Mill out the spot welds.

General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

E139842

Installation

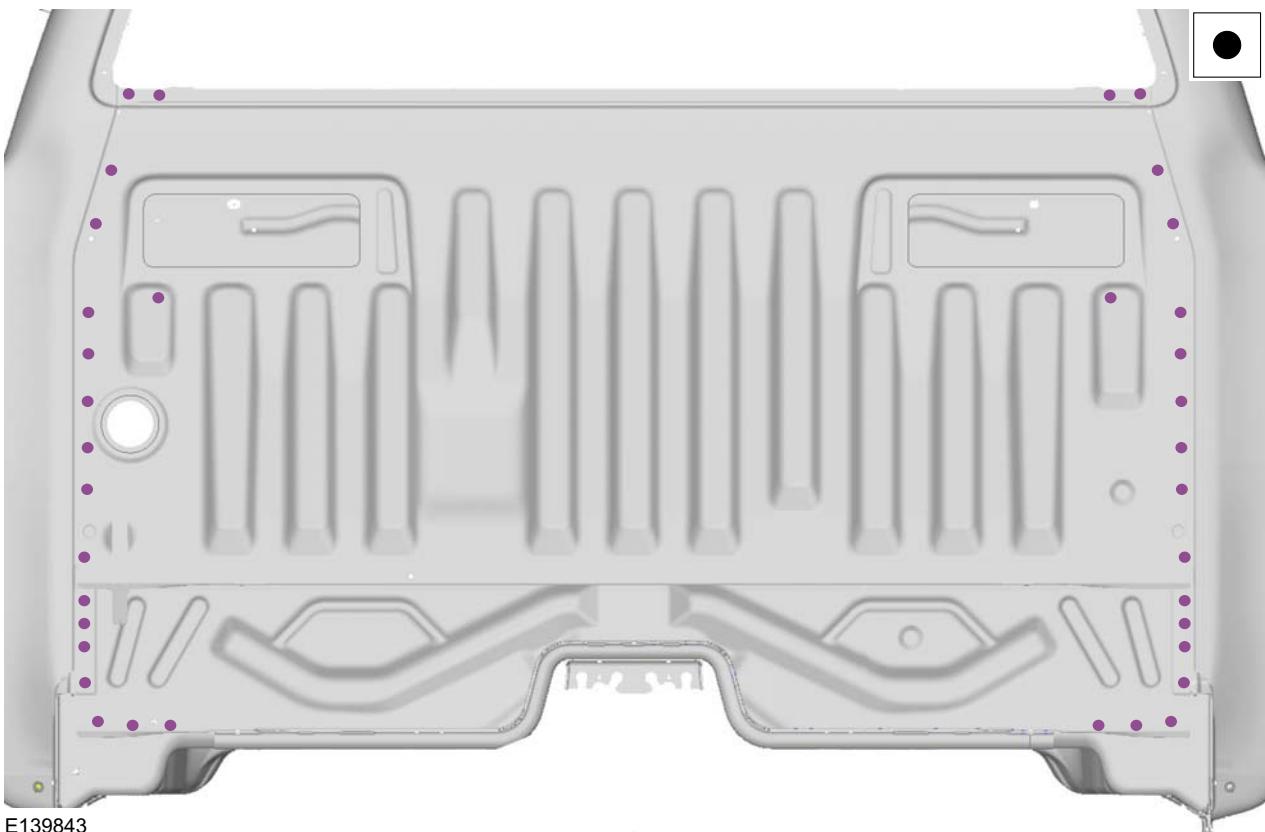
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs**
(501-25 Body Repairs - General Information,
Description and Operation).

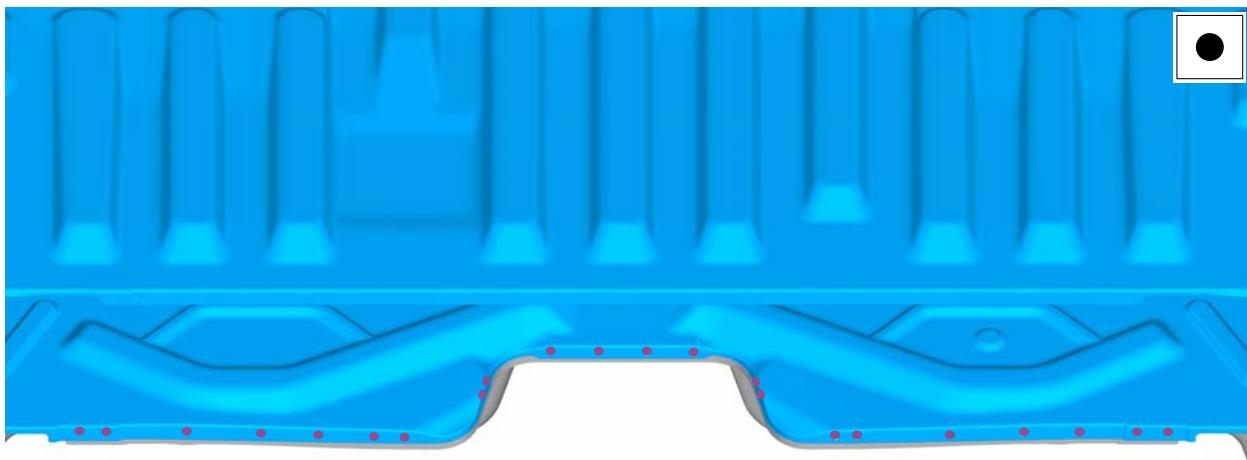
2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • Resistance spot weld - Panel thickness 3 mm and greater.

REMOVAL AND INSTALLATION

4. • Resistance spot weld - Panel thickness 3 mm and greater.



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5. Install the load body.

REMOVAL AND INSTALLATION**Back Panel — Double Cab****General Equipment**

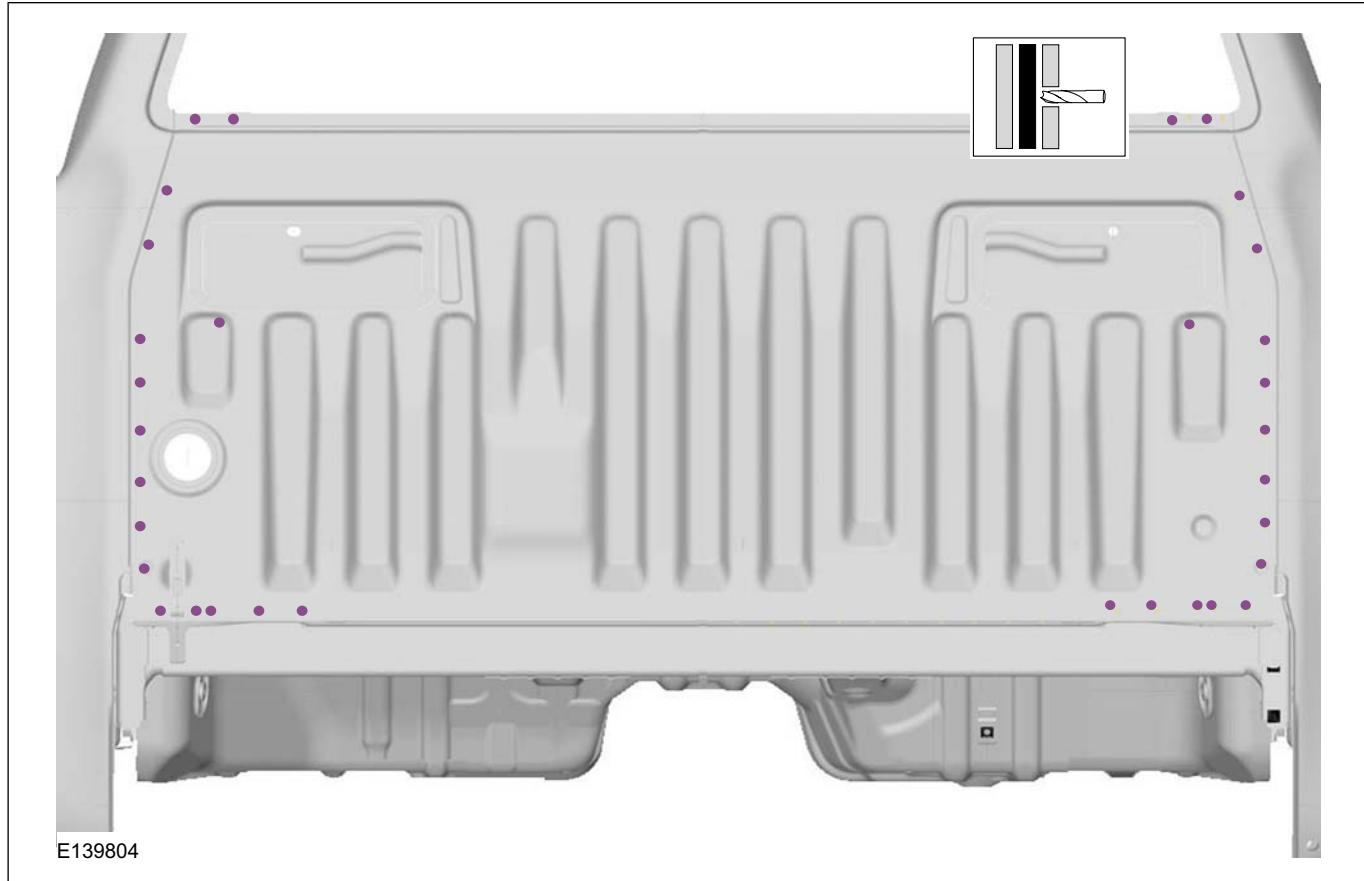
Spot weld drill Bit

Removal

1. Remove the load body.

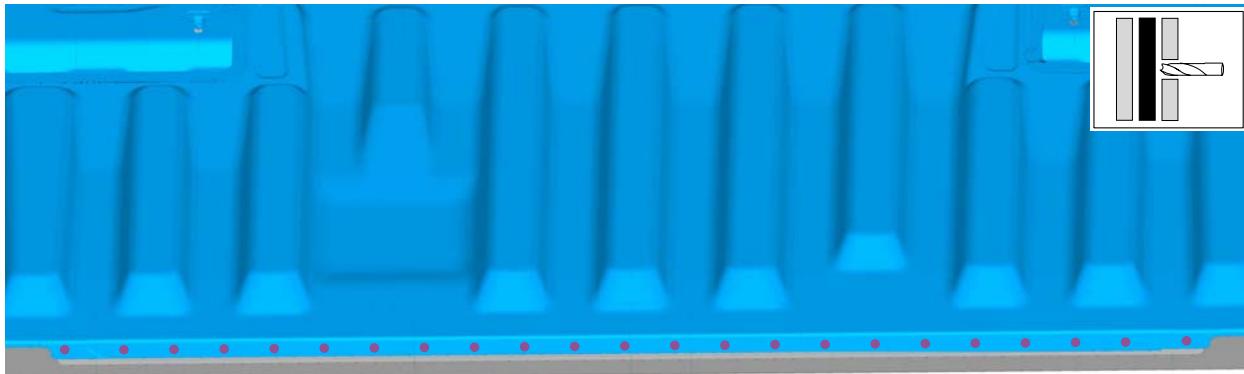
2. Mill out the spot welds.

General Equipment: Spot weld drill Bit



3. Mill out the spot welds.

General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

E139805

Installation

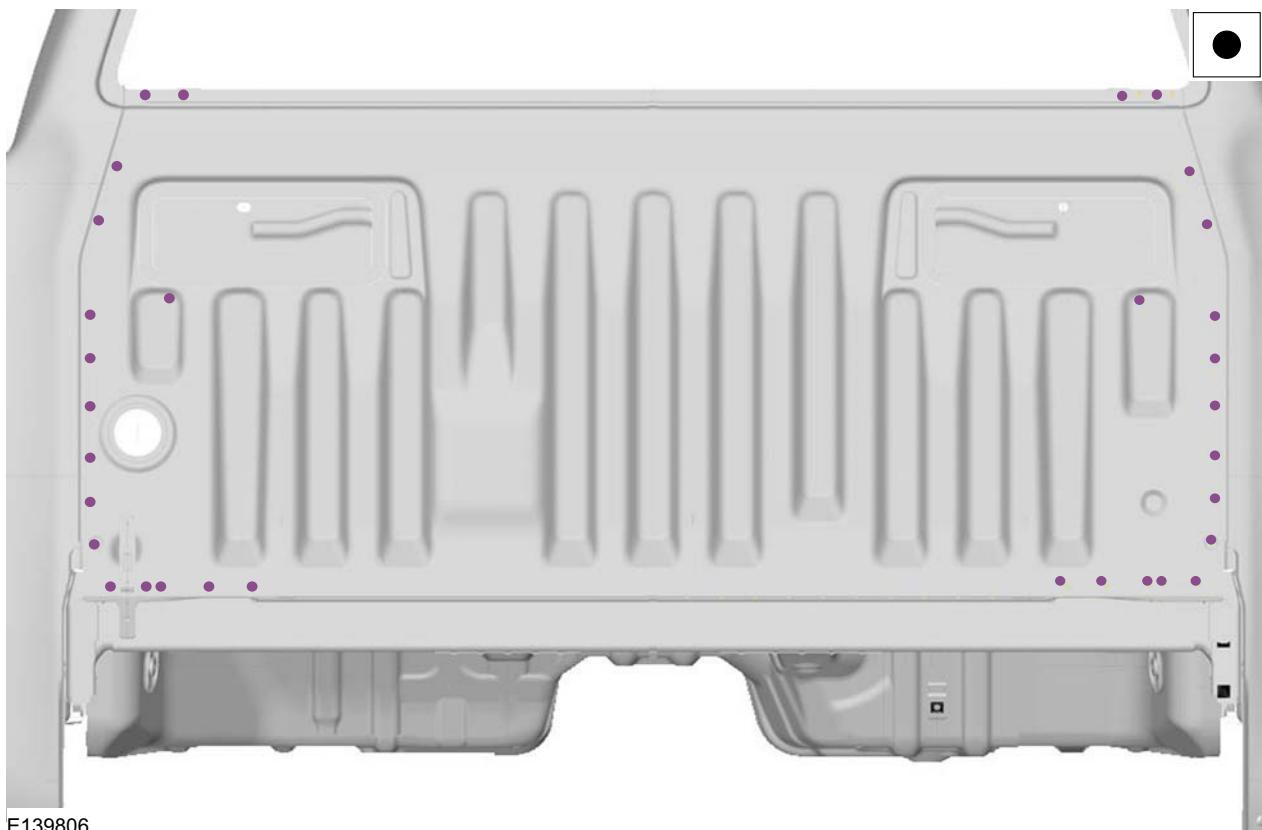
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

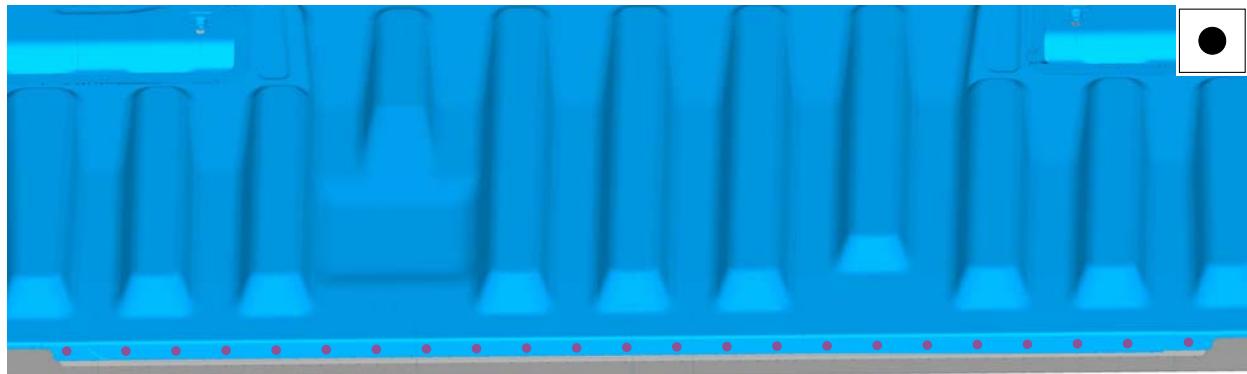
2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • Resistance spot weld - Panel thickness 3 mm and greater.

REMOVAL AND INSTALLATION

4. • Resistance spot weld - Panel thickness 3 mm and greater.



5. Install the load body.

REMOVAL AND INSTALLATION**Back Panel — Super Cab****General Equipment**

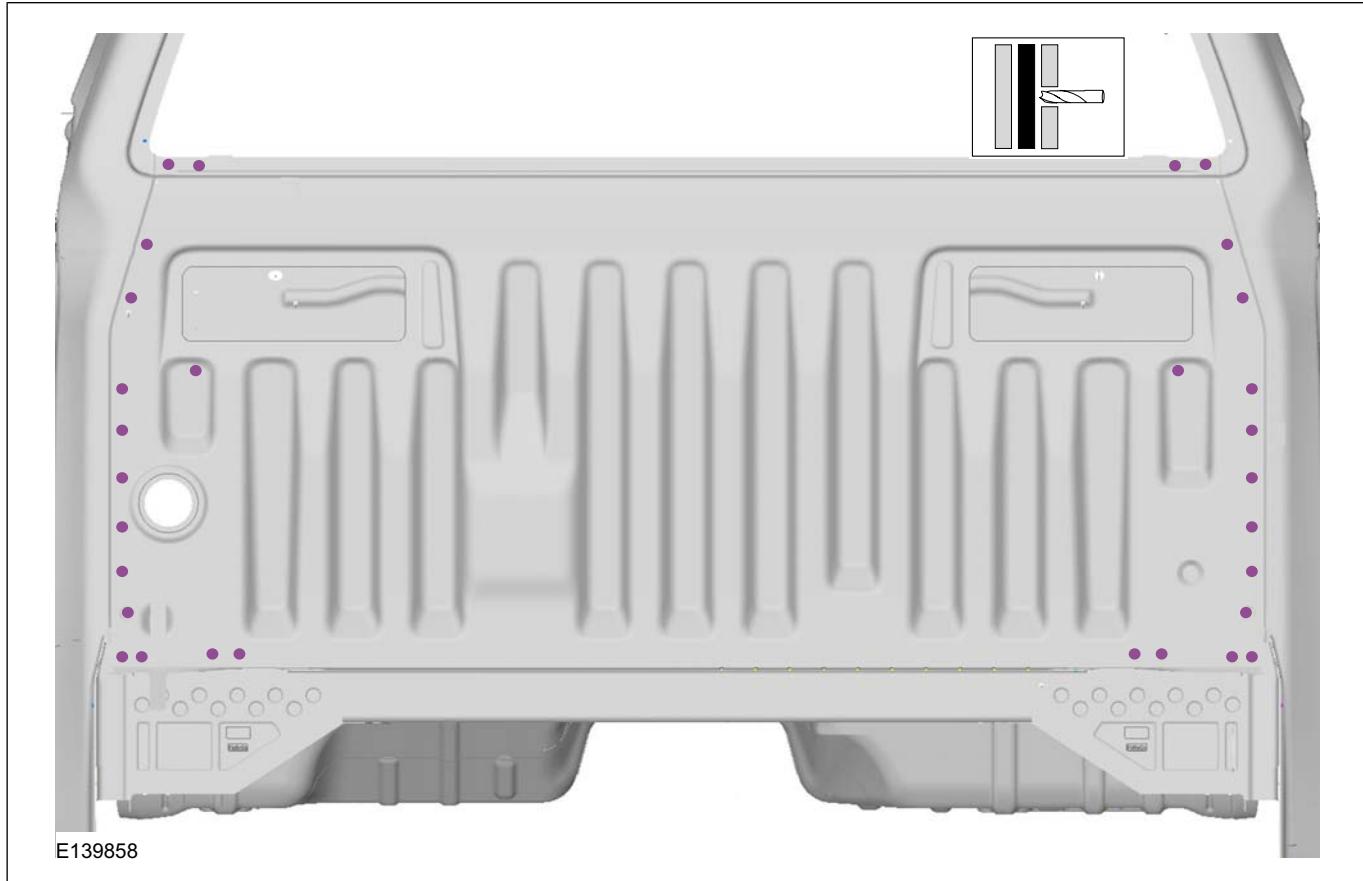
Spot weld drill Bit

Removal

1. Remove the load body.

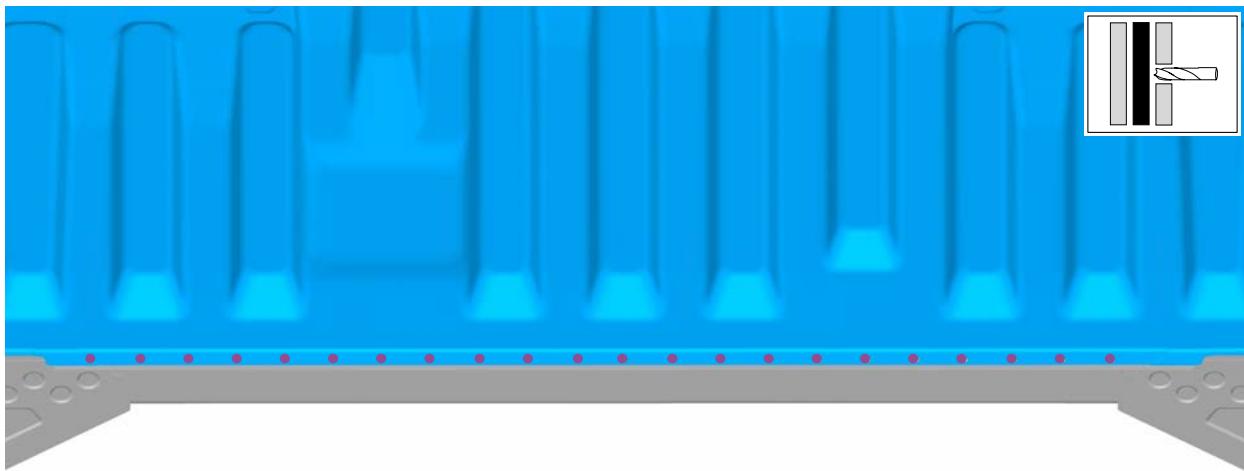
2. Mill out the spot welds.

General Equipment: Spot weld drill Bit



3. Mill out the spot welds.

General Equipment: Spot weld drill Bit

REMOVAL AND INSTALLATION

E139859

Installation

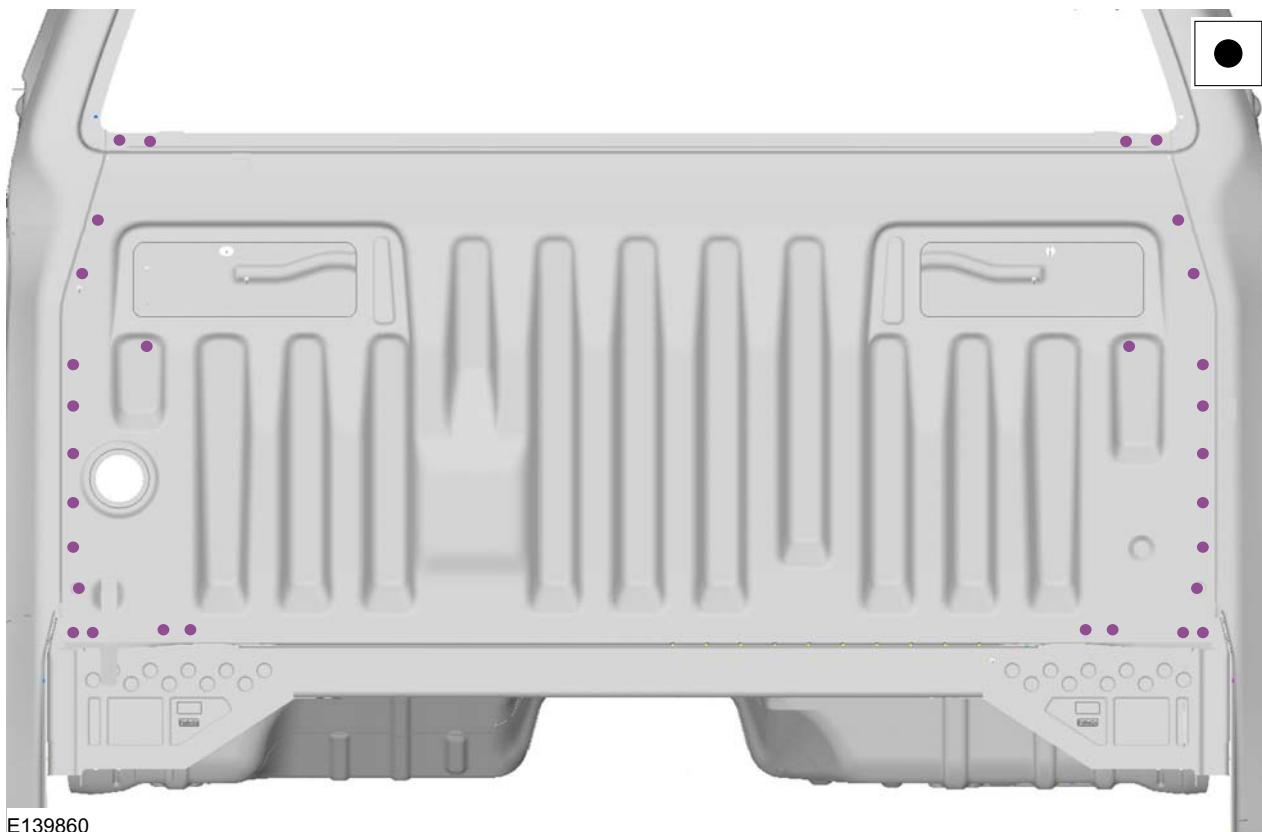
1. **NOTE:** Before resistance spot welding of body panels with a total panel thickness of 3 mm and greater, the manufacturer's welding equipment instructions and sub-section 501-25 must be followed.

Refer to: **Tools and Equipment for Body Repairs** (501-25 Body Repairs - General Information, Description and Operation).

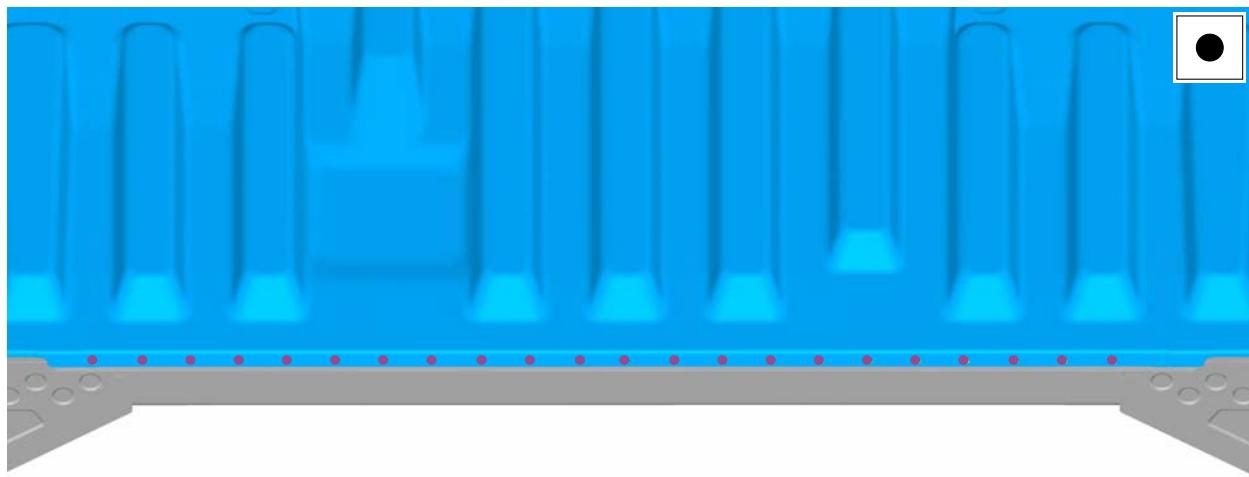
2. **NOTE:** Sealer or adhesive must not be applied in welding zones. Areas which were bonded or sealed needs to be thoroughly sealed afterwards.

Refer to: **Sealer, Underbody Protection Material and Adhesives** (501-25 Body Repairs - General Information, Description and Operation).

3. • Resistance spot weld - Panel thickness 3 mm and greater.

REMOVAL AND INSTALLATION

4. • Resistance spot weld - Panel thickness 3 mm and greater.



5. Install the load body.