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## Body Repairs

### General Information

#### Introduction

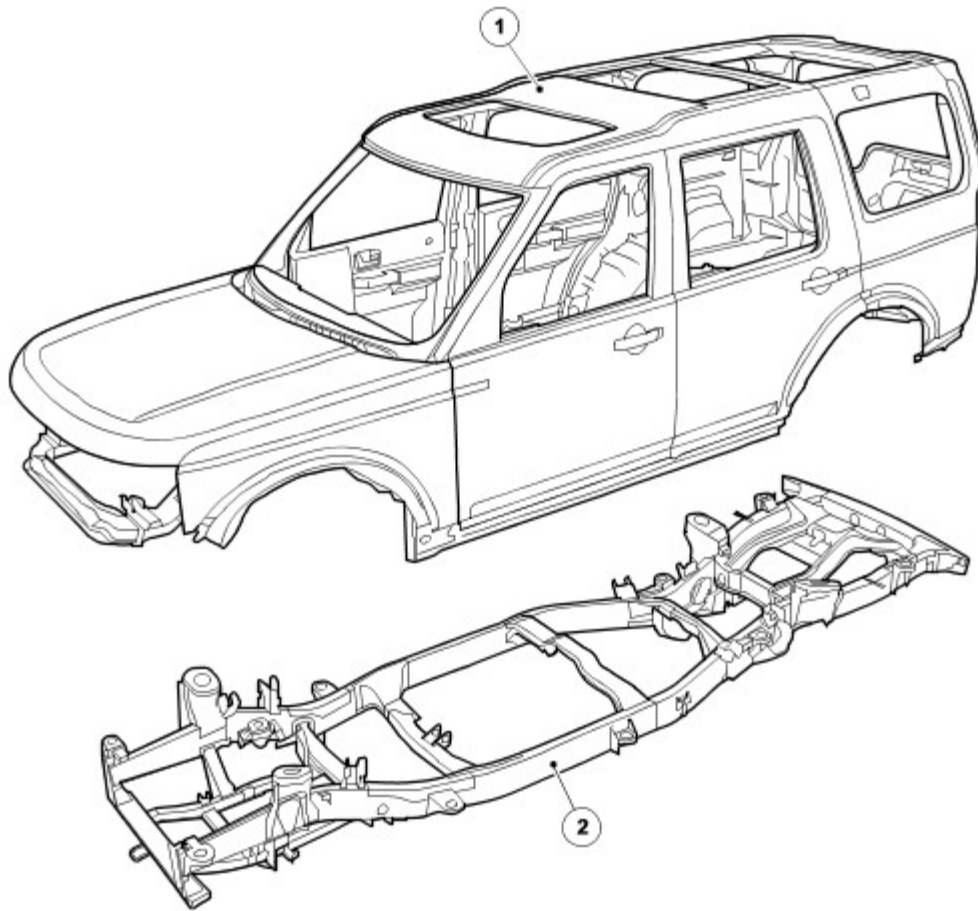
The body plays a significant role in the increasing trend of ever more rapidly changing model variants. The different customer groups are strongly influenced by the design and shape of the body. At the same time the stability of the body plays the most important part in ensuring passenger and driver safety. Lightweight construction, alternative materials, composite materials, plastics and appropriate joining processes are all design features that characterise modern Land Rover vehicle bodies.

In terms of manufacturing technology, modern safety cell bodies can be produced almost without any problems. Land Rover guarantee high quality standards by ensuring that mechanical strength properties are tried and tested in numerous computer simulations, crash tests, by testing materials and by employing sophisticated manufacturing technologies. In the event of repairs it is vital that the production quality standards are upheld. This requires a well-equipped workshop, and places particular emphasis on the qualifications of the workshop technicians. Up-to-date knowledge of current manufacturing technologies and continuous training on new repair methods and techniques are vital for high-quality body repairs. The model-specific repair manuals and the general repair techniques provide valuable support when undertaking body repairs.

Always follow the repair instructions published in this manual. Failure to observe this instruction can result in serious impairment of vehicle safety. All specified safety requirements must be met after the work has been carried out.

### Vehicle design

### Vehicle design



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Item	Part Number	Description
1		Body
2		Integral body Frame

## High Strength Steels

Land Rover vehicles are constructed from a number of different steels, partly to obtain an optimised body (collision, safety, rigidity, fuel economy, etc).

Steels are divided into several groups according to their tensile and yield strength, that is to say the force necessary to bring about plastic deformation of the material.

### Yield Summary

Yield is the strength at which the metal changes from elastic to plastic in behaviour, the point of no return.

### Tensile Summary

Tensile strength is the breaking strength of a material when subjected to a tensile (stretching) force, the point of no return.

Abbreviation	Steel type	Yield Point
SS	Soft Steel	Maximum Yield point of 220 MPa

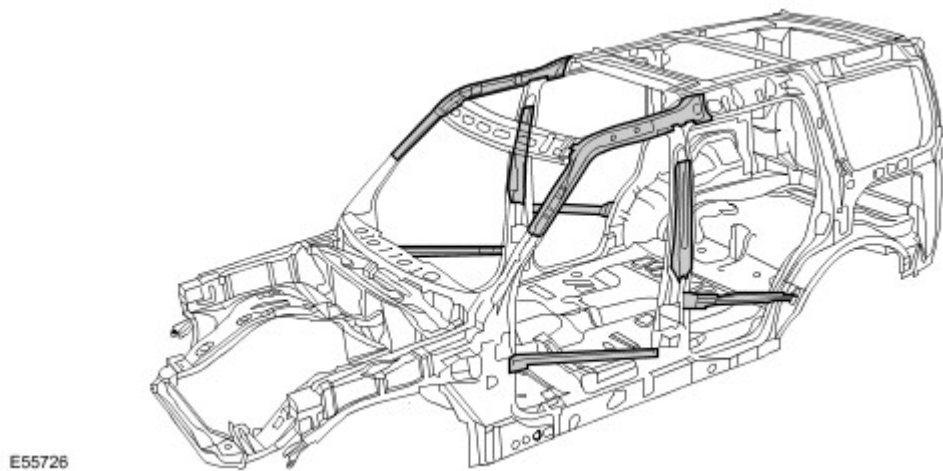
DP	Dual Phase Steel	Steel With a Yield Point up tp 400 MPa
HS	High Strength Steel	Steel With a Yield Point 220 - 450 MPa
EHS	Extra High Strength Steel	Steel With a Yield Point 450 - 800 MPa
UHS	Ultra High Strength Steel	Steel With a Yield Point up to 1400 MPa

### Ultra High Strength

The addition of ultra high strength steel in the A Pillar, B-Pillar and cantrail gives the body greater strength in a front or side impact.

No attempt should be made to straighten ultra high strength steel, due to its brittleness.

### Ultra High Strength steel in body structure

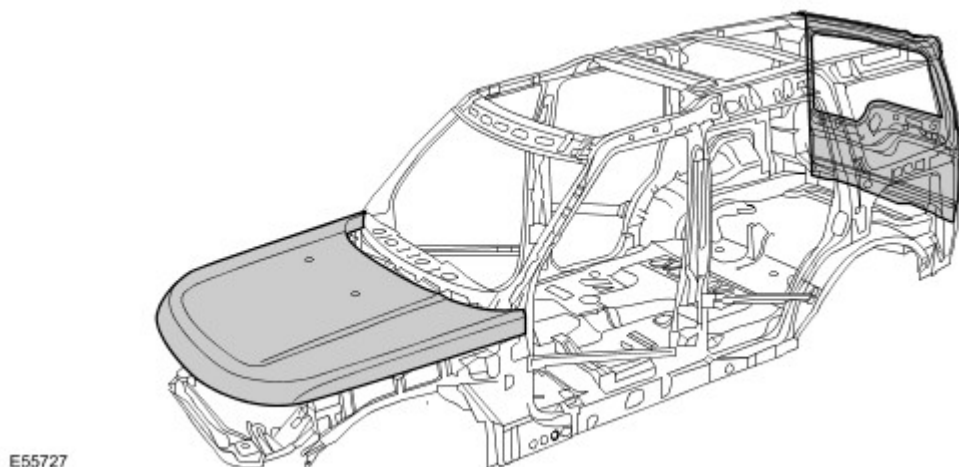


### Aluminium

Aluminium 6000 series is used in the hood, tailgate and liftgate. It is made from magnesium/copper aluminium alloy and is heat treated during manufacturing/paint bake process resulting in a panel with increased strength and dent resistance.

When repairing aluminium you must use tools that have only been used on aluminium and never on steel panels, this is to prevent cross-contamination

### Aluminium in body structure

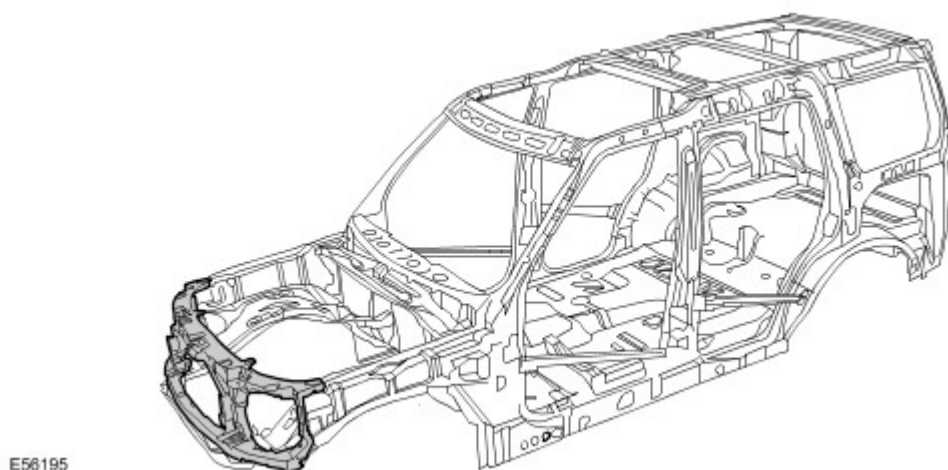


## Magnesium

Magnesium AM60B is used to make the hood latch panel. It has good ductility and energy absorbing properties. It is also used on the instrument panel mounting beam.

No attempt should be made to weld or straighten the hood latch panel and it should be replaced in the event of an accident. If the corrosive coating is damaged it must be repaired using 'Land Rover Low Temperature Anti-Corrosion Coating', service part no VEP 501 840 PMA

## Magnesium in body structure



## Accident damage and diagnosis

### General notes

- Exact diagnosis of the extent of damage enables proper repair planning.
- All body repairs must be carried out in accordance with the guidelines in this Body Repair Manual.
- The stability and strength properties of the body must be taken into account during body repairs. The body has exactly defined deformation patterns that must not be affected by any repair work.
- For instance, the crumple zones absorb the bulk of the impact energy. If any unprofessional repair techniques or methods are used in these areas then this can pose a fundamental threat to vehicle safety.

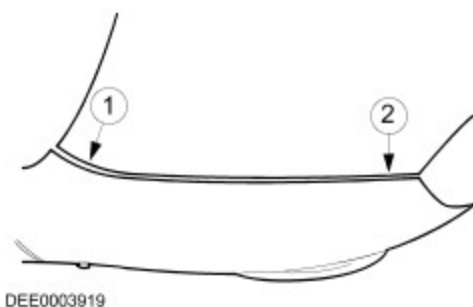
### Hidden damage

- As well as looking at external indicators like flaked off paint, it is vital to check for hidden body damage or deformation that is not visible from the outside. Large attached parts like bumpers and inner fenders often need to be removed to allow accurate assessment of damage to underlying body parts.

Gap dimensions For additional information, refer to [Body and Frame](#) (501-26 )

Gap dimensions offer another alternative for diagnosis by visual inspection. If any changes or misaligned edges are apparent, then this usually indicates that the dimensions of the affected part are incorrect.

## Changes in gap dimension



Item	Part Number	Description
1		Gap too wide
2		Gap too small

## Planning a repair

The following decisions have to be made before the repairs are started:

- Does the vehicle need to be put on a straightening jig, or can it be straightened by other means?
- Does the body need to be measured?
- Do aggregates like engine or axles need to be removed?
- **NOTE :**  
It is preferable to repair body parts rather than to renew them, as this keeps the complete body-shell intact.
- Which body parts need to be renewed?
- Which body parts can be repaired?

## Obtaining spare parts

The availability of spare parts often determines how easily the body repairs can be carried out. The following procedure is recommended:

- Obtain all the data for the vehicle, including type, vehicle identification number, trim code, engine identification letters, initial registration etc.
- Establish all of the metal parts that need to be renewed.
- Establish all of the attached parts that need to be renewed, including small parts like rivets, clips etc.

## Straightening repairs

Straightening repairs are often required to restore the body to its original shape after an accident. This can be done with:

- Alignment jigs
- Universal straightening and measuring jigs

The following points must be followed to ensure that the repairs are carried out professionally and that all the dimensions are correct after the repairs have been carried out.

- **Structure:** The repair sequence depends on the individual repair plan (taking any necessary disassembly work into account). Clean the attachment areas. Anchor the vehicle free of stress on the relevant system. Support the aggregates to take strain off the body. Decide on at least three measuring/mounting points that are undamaged and as far apart as possible (for basic adjustment). Check the dimensions of the measuring/mounting points.
  - The repair sequence depends on the individual repair plan (taking any necessary disassembly work into account).
  - Clean the attachment areas.
  - Anchor the vehicle free of stress on the relevant system.
  - Support the aggregates to take strain off the body.
  - Decide on at least three measuring/mounting points that are undamaged and as far apart as possible (for

- basic adjustment).
- Check the dimensions of the measuring/mounting points.
- Straightening: **NOTE :**  
Check dimensions and gaps continuously during straightening.

A body is always straightened in the opposite direction to that of the impact. Always carry out straightening repairs with the complete body shell assembled (do not cut out any parts beforehand). Carry out the straightening work in several stages. This prevents the risk of over stretching or of welded joints tearing out. During the individual straightening steps, relieve tension by striking with an aluminium hammer while the part is subjected to a tensile load (in the area of pre-determined folding points, dents, welded joints etc.).

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**CAUTION : Ultra High Strength steel in the A-Pillar, B-Pillar and cantrail cannot be straightened.**

## Panel Beating

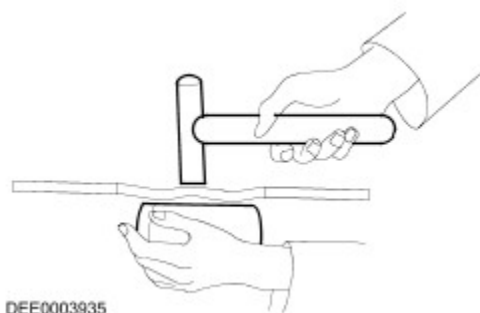
### Fundamentals of panel beating

- Before carrying out any sectional replacements or complete replacements of body panels, always check carefully whether the damaged panel(s) can be rectified by panel beating.
- Panel beating is usually the easiest and most economical method of repairing a damaged panel.

Examples of applications of different panel beating techniques:

- Aluminium hammer and mallet Advantage: Low risk of overstretching the panel. Used for repairs of small dents on panels that are accessible from both sides. These two panel beating tools are usually used for "finishing repairs".
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## Fine straightening with an aluminium hammer and a universal dolly



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- Sliding hammer If the damaged panel is only accessible from the outside, use a sliding hammer to pull it back into shape. The discs or studs needed to mount the sliding hammer are welded onto the bare surface. Dents in the panel can be flattened out using controlled application of the sliding hammer.
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panel can be flattened out using controlled application of the sliding hammer.

## Cutting out body parts

Depending on how the parts are joined/connected, different tools are suitable for cutting/separating body parts.

- **NOTE :**

All other parts like interior equipment, window glass etc. must be protected against flying sparks.

- **NOTE :**

Ensure that the milling depth is set correctly to prevent the remaining flange from being weakened.

Spot-weld mill

## Spot-weld mill



- **Rod sander NOTE :**

Wear protective clothing. Protect any vulnerable body or glass areas against flying sparks. Remove explosive materials from the vicinity.

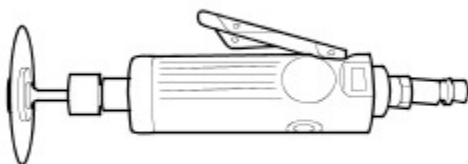
Any spot welds that are inaccessible for the spot-weld mill (diameter > 8 mm) should be ground out using a rod sander. The same applies to MIG spot welds or seams.

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## Rod sander



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- **NOTE :**

Underlying metal parts, wiring harnesses, hoses etc. must not be damaged - remove them beforehand if necessary.

Body saws are particularly versatile and are therefore very suitable for making severance cuts on body parts.

## Short stroke saw



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- Reciprocating saw In addition to the short stroke saw, the reciprocating saw can be used. With this, it is possible to make narrow and straight cuts to an exact depth.
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## Reciprocating saw



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## Carrying out the repairs

- Complete replacement In a complete replacement the entire damaged old part is removed at its original joins/connections, and a complete new part is then installed. The following illustration shows a replacement new back panel.
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## Replacement of a new back panel

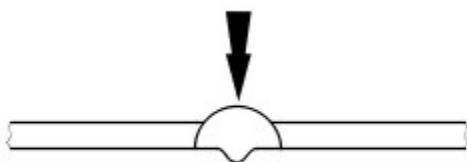


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- Sectional replacement In many cases it makes technical and economical sense to carry out a sectional replacement. The two main considerations are firstly, maintaining the original overall body shell structure and secondly, keeping the repair costs to a minimum.
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- The main method for sectional replacement: Butt joints New part and old part are joined with a continuous MIG weld seam. Butt joints are most commonly used for sectional replacements on members and pillars, or on short severance cuts.
  - Butt joints
  - New part and old part are joined with a continuous MIG weld seam.
  - Butt joints are most commonly used for sectional replacements on members and pillars, or on short severance cuts.

## Butt joint



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### NOTE :

The severance cut should always be kept as short as possible on sectional replacement. Only cut at the severance lines shown in the repair chapters. Do not make any cuts near reinforcements or pre-determined folding lines.

- Prepare parts remaining on the vehicle / new parts. Reshape the adjoining surface of any dented body parts that are to remain on the vehicle using a hammer and a counterhold (ensure that the old part matches the shape of the new part). Grind off left over spot welds or seams with a suitable tool. Cut the new parts to shape. If necessary punch or drill holes for mig plug welding. **NOTE :**

Do not use a welding torch to remove paint residue (the heat could cause the metal to deform).

Prepare all joining flanges to a bright metal finish on both sides. Do not use an angle grinder for this purpose (this could weaken the metal and damage the zinc layer). Suitable tools: rotating wire brush, belt sander or plastic disc. Apply welding primer liberally to all weld flanges. The primer must be well stirred or shaken before use.

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- If necessary punch or drill holes for mig plug welding.
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### NOTE :

When using aerosols, take care not to contaminate adjacent parts with spray mist.

fitting the new part.

- It must be ensured that the new part fits exactly to the specified dimensions, to help this it is recommended to use such equipment as: Alignment jig Universal measuring system Jig system Ruler or tape measure

- Alignment jig
- Universal measuring system
- Jig system
- Ruler or tape measure
- Any attached body parts that require accurate alignment and fitting must be incorporated in this step; for instance bumpers, seals, headlamps, rear lamps and lock assembly components. If this is not done carefully it may result in water leaks, wind noises and substantial follow-on work.
- Ensure that edges line up with adjacent parts and check that gaps are consistent (compare left and right-hand sides). Make sure that the shape of the vehicle is retained.

Secure the new part

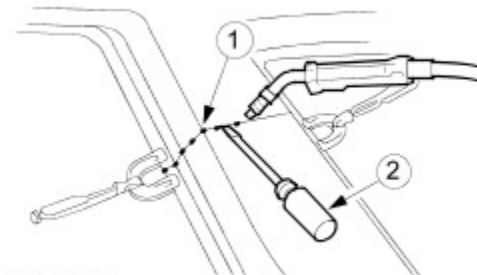
● **NOTE :**

The need for subsequent follow-on work can be significantly reduced if aligning and tack-welding are carried out with due care.

Depending on accessibility the following methods for securing are available: Grip pliers (set of) Screw clamp (set of) Self-tapping screws Tack welds

- Grip pliers (set of)
- Screw clamp (set of)
- Self-tapping screws
- Tack welds
- Using a suitable tool ensure that the edges of sectional replacements of profiled parts line up. The edge is then tack welded to ensure that it lines up.

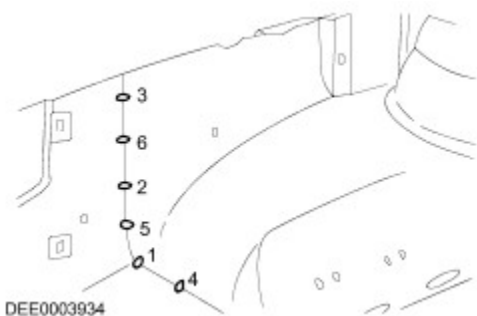
## Aligning and tack weld



Item	Part Number	Description
1		Tack welds
2		Using a suitable tool to align

- Longer joints are usually tack welded to prevent the panel from warping. It is important to carry out the tack welds in the correct sequence (see diagram).
- Weld in the new part following the instructions in the repair manual.

## Correct tack welding sequence



## Safety measures

- The electronic control modules (ECM) fitted to vehicles make it advisable to follow suitable precautions prior to carrying out welding repair operations. Harsh conditions of heat and vibration may be generated during these operations which could cause damage to the modules. In particular, it is essential to follow the appropriate precautions when disconnecting or removing the airbag RCM. For additional information, refer to [Specifications](#) (501-20B )
- Do not allow electronic modules or lines to come into contact with the ground connection or the welding electrode.
- Connect the ground connection of the electrical welder directly to the part that is to be welded. Ensure that there are no electrically insulating parts between the ground connection and the welding point.

## Resistance spot welding

Where resistance spot welds have been used in production, they must be reproduced with new spot welds in replacement where possible. All such reproduction spot welds should be spaced 25 to 30mm apart.

Setting up the equipment and co-ordinating the welding parameters

- **Equipment:** Follow the equipment manufacturer's instructions for the equipment settings. Select the correct electrode arms (as short as possible). Align the electrode arms and tips exactly. Electrode tips should be convex (rough shaping with a file, fine shaping with a sanding block).
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  - Align the electrode arms and tips exactly.
  - Electrode tips should be convex (rough shaping with a file, fine shaping with a sanding block).
- **Body:** Ensure that the flanges to be joined lie perfectly flat to one another. Prepare a bare metal joint surface (inside and outside).
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  - Prepare a bare metal joint surface (inside and outside).
- **Notes on technique/method:** Carry out a test weld on a sample piece of the material coated in welding paste. If any metal parts are located between the electrode arms then there will be a loss of induction and therefore power (adjust current setting). The power needs to be adjusted for high and ultra high-strength steel. Repeated welding on old welding points often leads to poor quality welds. Keep the electrode tips as near as possible to an angle of 90° to the contact surface. The electrodes work best if their shape is convex. Clean the contact surface of the electrodes regularly.
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### Resistance spot welding panels where the total thickness is 3 mm or more

For all repairs to modern Land Rover vehicles, spot-welding equipment should be suitable for reliable welding of zinc-plated, high-strength and high-tensile steels in three or more layers, up to 5 mm total thickness. If these requirements are not fulfilled, plug welding must be used for safety reasons. The electrical specifications (current, resistance, heat) of the spot-welding equipment have different validity, depending upon the type of equipment. Therefore, it is essential that the equipment manufacturer's instructions are observed with regard to the actual welding performance.

## MIG / MAG welding

Setting up the equipment and co-ordinating the welding parameters

- Any joins that are MIG/MAG welded in production must also be MIG/MAG welded during repairs. Also during repairs, some resistance spot welds need to be replaced by plug welds.
- If access is difficult, or if a suitably powerful spot welder (see above) for total panel thicknesses of 3 mm or more is not available, resistance spot welding must be partially replaced by plug welding during repairs. In this case, the increased time needed and the correspondingly more demanding corrosion protection requirements, must be taken into account.
- Welding repairs can only be carried out properly if the equipment is set up correctly and all the welding parameters

are co-ordinated.

- **Equipment:** Set up the equipment as directed by the manufacturer. The hoses must be untwisted. The core must be free of abraded rod particles. The gas and current nozzles must be free of slag and scale residue. Pay attention to the quality of the welding wire and the throughput of gas.
  - Set up the equipment as directed by the manufacturer.
  - The hoses must be untwisted.
  - The core must be free of abraded rod particles.
  - The gas and current nozzles must be free of slag and scale residue.
  - Pay attention to the quality of the welding wire and the throughput of gas.
- **Body:** Ensure that the joint surface is correct. Prepare a bare metal joint surface. Maintain the correct gaps (formation of roots).
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  - Prepare a bare metal joint surface.
  - Maintain the correct gaps (formation of roots).
- **Notes on technique/method: NOTE :**

The increased application of heat during MIG welding destroys the welding primer/zinc layer over a much larger area than during resistance spot welding, as a result of which much more care needs to be taken when applying anti-corrosion protection afterwards.

**NOTE :**

A test weld should always be carried out to ensure that the welded joint is not just a surface connection.

Attach the ground cable right next to the welding point (ensure that good contact is made). During plug welding start welding on the lower panel to ensure adequate penetration.

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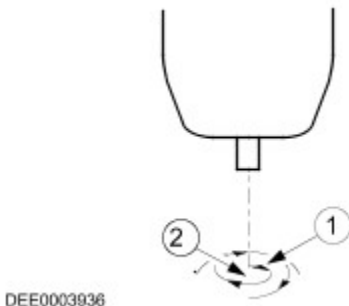
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Attach the ground cable right next to the welding point (ensure that good contact is made).

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## Plug welding

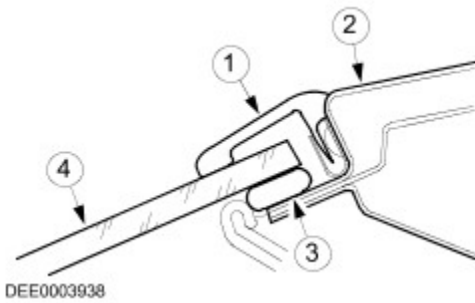


Item	Part Number	Description
1		Welding direction: circular pattern working from the inside outwards
2		Welding starting point: centre of hole on lower panel

## Bonded glazing

- The windscreen, side and rear windows are bonded directly onto the window frames on the body and liftgate.
- The windows are bonded primarily for reasons of adhesive strength. Bonded glazing provides additional torsional stiffness to the body.

## Adhesive bonding of bonded windows



Item	Part Number	Description
1		Rubber strip
2		Window frame
3		Adhesive
4		Window glass

## Removing and installing bonded windows

### Safety measures

- The following safety measures must always be followed to prevent personal injury: Wear protective gloves. Wear protective goggles.
  - Wear protective gloves.
  - Wear protective goggles.

### Preparations

- Before cutting out a bonded window, undo and remove any attached parts in the cutting area that are at risk, e.g. trim panels and decorative strips, as well as all electrical connections.
- Mask any painted areas that are adjacent to the window.
- Cut off any surplus adhesive, as this makes it easier to cut out the window.
- Secure vertical windows against dropping out.

### Cutting out the window

- Cut into the adhesive bead at easily accessible points using the cutting tool.
- Carefully guide the cutting tool around the window, cutting through the adhesive bead.
- Avoid touching the window frame and the body flange.
- Use cup suction tools to lift the cut-out window out of the window aperture.

### General preparations for bonding

- Follow the manufacturer's instructions.
- Cut back the remaining adhesive bead on the metal flange to a residual height of about 1mm. Do not touch or clean the cut surface afterwards.
- Carefully rectify any paint damage (apply primer and top coat).
- Renew the window stops as necessary.

### Bonding the window glass

- Apply an even bead of adhesive to the window or to the body flange.
- Insert the window glass into the window aperture and centre it (2 technicians required).
- Check the gaps.
- **NOTE :**

Open the windows and doors while the window is left to dry and do not move the vehicle (slamming doors creates excess pressure which could cause the window to become loose).

Use adhesive tape to prevent the window from falling out or slipping.

#### Finishing operations

- Reconnect all electrical connections and check that the components operate correctly.
- Install the attached parts and check that the fit is accurate and secure. Carry out a visual inspection to ensure that the gaps and joints are even.
  - Carry out a visual inspection to ensure that the gaps and joints are even.
- Thoroughly clean the window glass.

### Protective equipment and safety at work

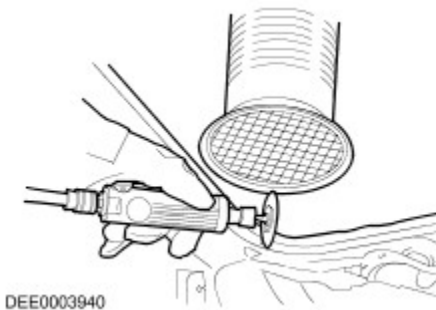
- Various safety measures and legal requirements must be met when carrying out repairs. All regulations relating to health and safety at work must be followed.

#### Welding safety precautions

- The following safety precautions must be observed to prevent the risk of personal injury: Safety hood (face protection) Welding shield Safety gloves Safety shoes Extraction unit for welding smoke
  - Safety hood (face protection)
  - Welding shield
  - Safety gloves
  - Safety shoes
  - Extraction unit for welding smoke
- Welding should always be carried out in well ventilated areas. A fire extinguisher must also always be within reach.

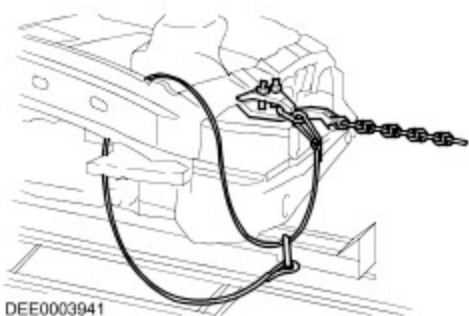
#### General body repair safety measures

### Extraction unit



- Sealing compound, underbody protection etc. must **not** be burned off with a naked flame. This would produce toxic gases. If for instance PVC is burned, then gases containing hydrochloric acid are produced. For this reason a suitable extraction unit should always be used when performing grinding, welding or soldering work.
- Always ensure good ventilation when working with materials that contain solvents, wear breathing equipment and use an extraction unit.
- Ear defenders should always be worn when cutting, grinding or straightening metal, as the noise levels can reach or even exceed 85 - 90 dB(A).
- When removing components from a vehicle mounted on a lifting ramp, watch out for a shift in its centre-of-gravity. When first placing the vehicle on the ramp, take into account that it may need to be secured against tipping over.
- Chains and chain clamps must be secured with safety ropes during straightening work.

### Safety rope



## Paint Preparation

### Paint repairs

Before carrying out paintwork repairs, clean the vehicle thoroughly using either a steam cleaner or high pressure washer.

Wash locally repaired areas using a mild water-mixable detergent and wipe them clean with solvent, immediately before paint application.

Ensure damaged paintwork which has led to exposed metal is abraded until the metal is clean, extending beyond the area of the original damage. Treat the bare metal with an etch phosphate to remove all traces of rust and to provide a key for new paint coats. Re-treat the affected area using either a separate acid-etch primer and two pack surfacer or an integrated etch primer/filler, and follow with a two pack paint system. Treat those surfaces not receiving paint using an approved cavity wax, following paint operations



**CAUTION :** When preparing bumpers for painting, ensure the PDC sensors are not damaged. Only remove the clear coat if possible. When painting the PDC sensors, do not apply excessive layers of paint as this can hinder the performance of the sensors.



**CAUTION :** When heat curing paint repairs, the temperature must not exceed 65°C (149°F). Temperature above this figure will cause the reflective elements within the headlamps and tail lamps to distort and may damage other components.