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Description and Operation

Copyright Statement

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How to use This Manual

This manual covers all aspects necessary in order to service the vehicle effectively.

The manual is structured into five main sections, General Information, Chassis, Powertrain, Electrical and Body and Paint with each section dealing with a specific part of a vehicle system.

Each of the five main sections contain sub-sections dealing with items which form a part of that specific system.

Pages at the start of the manual list all sections available. Each section has a contents list detailing, where applicable, Specifications, Description and Operation, Diagnosis and Testing, General Procedures and Repair Procedures.

Where components need to be removed or disassembled in sequence, each operation in the sequence will be identified numerically and also graphically in an accompanying illustration.

NOTE: Dimensions quoted are to design engineering specifications with service limits quoted, where applicable.

Workshop Manual Organization

The five main sections, together with the areas which they cover are given below:

- **Section 1** - General Information.
- **Section 2** - Chassis.
- **Section 3** - Powertrain.
- **Section 4** - Electrical.
- **Section 5** - Body and Paint.

Sub-section numbers appear after the initial section number, for example, **Section 412-03** covers air conditioning, which is part of the electrical section.

In the number given above, the first digit of the number '**4**' indicates the section **i.e. Electrical**.

The second and third digits '**12**' of the number indicate the vehicle system **i.e. Air Conditioning**.

The last two digits of the number '**03**' indicate the part of the system covered by the sub-section **i.e. Air Conditioning Compressor**.

General Information - Important Safety Instructions

Description and Operation

Safety Notice

Appropriate service methods and correct repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as the safety of the person doing the work. This manual provides general directions for accomplishing service and repair work with tested effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the person doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in the manual must first establish that neither personal safety or vehicle integrity is compromised from choices of methods, tools or parts.

General Information - General Service Information

Description and Operation

Introduction

This manual has been written in a format that is designed to meet the needs of Land Rover technicians worldwide and to assist them in the efficient repair and maintenance of Land Rover vehicles.

This manual provides descriptions and methods for accomplishing adjustment, service and repair work using tested and effective procedures. Following these procedures will help ensure product reliability.

Special Tools

The Special Tool(s) Table provided at the beginning of each procedure lists the special tool(s) required to carry out repair operations within that specific procedure. Wherever possible, illustrations are provided which will assist technicians in identifying the special tool(s) required and also showing such tool(s) in use.

Special tools may be obtained from the manufacturer, SPX Tools, the addresses of their branches will be found in the Special Tools Glossary contained within this Section.

Important Safety Instructions

Appropriate service methods and correct repair procedures are essential for the safe and reliable operation of all motor vehicles as well as ensuring the personal safety of the individual carrying out the work.

This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Any person who departs from the instructions provided in this manual must first establish that they compromise neither their personal safety nor the vehicle integrity by their choice of methods, tools or parts.

Individuals who undertake their own repairs should have some skill or training and limit repairs to components which could not affect the safety of the vehicle or its passengers. Any repairs required to safety critical items such as steering, brakes, suspension or supplemental restraint system should be carried out by a Land Rover Dealer. Repairs to such items should NEVER be attempted by untrained individuals.

Warnings, Cautions and Notes which appear in this manual

As you read through this manual, you will come across Warnings, Cautions and Notes. A Warning, Caution or Note is placed at the beginning of a series of steps. If the warning, caution or note only applies to one step, it is placed at the beginning of the specific step after the step number.

Warnings, Cautions and Notes have the following meanings:

Warning: Procedures which must be followed to avoid the possibility of personal injury.

Caution: Calls attention to procedures which must be followed to avoid damage to components.

Note: Gives helpful information.

References

References to the Left Hand (LH) or Right Hand (RH) side given in this manual are made when viewing the vehicle or unit from the rear.

Fault Diagnostic Equipment

The vehicle is equipped with a number of electronic control systems to provide optimum performance of the vehicle's systems.

Diagnostic Equipment (T4) is available and must be used where specified. The use of this equipment will assist with the fault diagnostic abilities of the Dealer workshop. In particular, the equipment can be used to interrogate the electronic systems for diagnosis of faults which may become evident during the life of the vehicle.

This manual is produced as a reference source to supplement T4.

Features of the equipment include:

- a.** Fully upgradeable support for the technician
- b.** Structured diagnostics to accommodate all skill levels
- c.** Direct print-out of screen information and test results

Testing the vehicle

Operations covered in this manual do not include reference to testing the vehicle after repair. It is essential that work is inspected and tested after completion and if necessary, a road test of the vehicle is carried out, particularly where safety

related items are concerned.

Repairs and Replacement Parts

Land Rover parts are manufactured to the same exacting standards as the original factory fitted components. For this reason, it is essential that only genuine Land Rover parts are used during maintenance or repair.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features and corrosion prevention treatments embodied in the vehicle may be impaired if other than Land Rover recommended parts are fitted. In certain territories, legislation prohibits the fitting of parts not to manufacturer's specification. Torque wrench setting figures, where given, must be adhered to and locking devices, where specified must be used. If the efficiency of a locking device is impaired during removal it must be replaced.

Owners purchasing accessories whilst travelling abroad must ensure that the accessory and its fitted location on the vehicle conform to legal requirements.

The terms of the vehicle warranty may be invalidated by the fitting of parts other than those recommended by Land Rover.

NOTE: The fitting of non-approved Land Rover parts and accessories or the carrying out of non-approved alterations or conversions may be dangerous. Any of the foregoing could affect the safety of the vehicle and occupants; also, the terms and conditions of the vehicle warranty may also be invalidated .

All Land Rover recommended parts have the full backing of the vehicle warranty.

Land Rover Dealers are obliged to supply only Land Rover recommended parts.

Specifications

Land Rover are constantly seeking to improve the specification, design and production of their vehicles and alterations take place accordingly. Whilst every effort is made to ensure the accuracy of this Manual, it should not be regarded as an infallible guide to current specifications of any particular vehicle.

This Manual does not constitute an offer for sale of any particular vehicle. Land Rover dealers are not agents of Land Rover and have no authority to bind the manufacturer by any expressed or implied undertaking or representation.

General Information - Standard Workshop Practices

Description and Operation

Vehicle in Workshop

When working on a vehicle in the workshop always make sure that:

- Where practicable, the parking brake is applied and the wheels are securely chocked to prevent the vehicle moving forwards or backwards.
- Whenever possible, the ignition key is removed before any work is carried out on the vehicle.
- If the engine is to be run, there is adequate ventilation, or an extraction hose is used to remove exhaust fumes.
- There is adequate room to raise the vehicle and remove the wheels, if necessary.
- Fender covers are always installed if any work is to be carried out in the engine compartment.
- Where practicable, the battery is disconnected if working on the engine, underneath the vehicle, or if the vehicle is raised.



CAUTION: When electric arc welding on a vehicle, always disconnect the generator wiring to prevent the possibility of a surge of current causing damage to the internal components of the generator.

- If using welding equipment on the vehicle, a suitable fire extinguisher is readily available.

Battery - General



WARNING: It is essential that a period of 10 minutes elapses after the battery is disconnected before any work is undertaken on any part of the SRS system.

CAUTIONS:



Prior to carrying out any procedures which involve disconnecting/ or connecting the battery, refer to the Electrical Section of this manual - Battery disconnection/connection.
For additional information, refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).



A discharged battery condition may have been caused by an electrical short circuit. If this condition exists there will be an apparently live circuit on the vehicle even when all normal circuits are switched off. This can cause arcing when the jumper cables are connected.

Jump Starting a Vehicle

CAUTIONS:



While it is not recommended that a vehicle is jump started, it is recognized that this may occasionally be the only practical way to mobilize a vehicle. Reference should be made to the following.



It is advisable not to use starter/charger sets for jump starting but if this is unavoidable, make sure that the sets are not used in the 'START' mode.

- Always make sure that the jumper cables are adequate for the task.
- Always make sure that the slave battery is of the same voltage (12 volts) as the vehicle battery. The batteries must be connected in parallel.
- Make sure that the battery terminals of both batteries are fully tightened.
- Where another vehicle is used to jump start a disabled vehicle, make sure that the two vehicles are not touching.
- It is advisable that the engine of the donor vehicle is switched off during jump starting; take care to make sure that the battery of the donor vehicle does not also become discharged.
- Always make sure that switchable electric circuits are OFF before connecting jump cables. This reduces the risk of arcing occurring when the final connection is made.

Following jump starting of a disabled vehicle, the discharged battery must be checked for serviceability and recharged as soon as possible to avoid permanent damage.

Do not rely on the generator to restore a discharged battery. For a generator to recharge a battery, it would take in excess of eight hours continuous driving with no additional loads placed on the battery.

Trickle charging (defined as voltages <16 volts) may be carried out with the battery connected. Make sure that the battery terminals are fully tightened prior to trickle charging.




CAUTION: Boost charging may only be carried out with the battery disconnected from the vehicle.

Towing the Vehicle

CAUTIONS:

 The vehicle has permanent four-wheel drive. The following towing instructions must be adhered to:

 The brake servo and power assisted steering system will not be functional without the engine running. Greater pedal pressure will be required to apply the brakes and the steering system will require greater effort to turn the front road wheels. The vehicle tow connection should be used only in normal conditions, 'snatch' recovery should be avoided.

Towing the vehicle on all four wheels with driver operating steering and brakes.

Turn ignition key to position **1** to release steering lock.

Select neutral in main gearbox and transfer box.

Secure tow rope, chain or cable to front towing eyes.

Release the parking brake.

Rear suspended tow by breakdown vehicle

 **CAUTION:** The steering wheel and/or linkage must be secured in the straight ahead position. Do not use the steering lock mechanism for this purpose.

If the front axle is to be trailed turn ignition key to position **1** to release steering lock.

Select neutral in main gearbox and transfer box.

Transporting the vehicle by trailer

 **CAUTION:** Underbody components must not be used as lashing points.

Lashing/towing eyes are provided on front and rear of the chassis side members to facilitate the securing of the vehicle to a trailer or other means of transportation.

Position vehicle on trailer and apply the parking brake. Select neutral in main gearbox.

General installation Instructions

Component removal

Whenever possible, clean components and the surrounding area before removal.

- Blank off openings exposed by component removal.
- Following disconnection, seal fuel, oil or hydraulic lines immediately using suitable blanking plugs or caps.
- Seal open ends of exposed oilways using suitable tapered hardwood plugs or conspicuous plastic plugs.
- Immediately a component is removed, place it in a suitable container; use a separate container for each component and its associated parts.
- Clean bench and provide marking materials, labels and containers before disassembling components.

Disassembling

Observe scrupulous cleanliness when disassembling components, particularly when brake, fuel, air suspension or hydraulic system parts are disassembled. A particle of dirt or cloth fragment could cause a serious malfunction if trapped in these systems.

- Blow out all tapped holes, crevices, oilways and fluid passages with dry, compressed air.

 **WARNING:** Suitable eye protection must be worn.

- Use suitable marker ink to identify mating parts, do not use a scribe or centre punch as they could initiate cracks or distortion.
- Wire or tape mating parts together where necessary to prevent accidental interchange.
- Suitably identify parts which are to be renewed and to those parts requiring further inspection. Keep these parts separate.
- To make sure that the correct replacement part has been obtained, do not discard a part due for renewal until after comparing it with the new part.

Cleaning components

Always use cleaning agents which are suitable for the work being undertaken and the components being cleaned. NEVER use gasoline (petrol) as a cleaning agent (degreaser). Always make sure that the component being cleaned is compatible with the cleaning agent.

Always follow the manufacturer's instructions regarding the use of cleaning agents and make sure that the environment in which the work is being undertaken is suitable. See Health and Safety Precautions for further information regarding cleaning.

General inspection of components

All components should be inspected for wear or damage before reassembling.

- Always make sure that component to be inspected is clean and free from oil or grease.
- When a component is to be checked dimensionally against design specified values, use the appropriate measuring equipment i.e. micrometers, verniers, surface plates, dial test indicators (DTI).
- Always make sure that all measuring equipment is correctly calibrated before use.
- Reject a component which is not within specified values/limits or if it appears to be damaged.
- A component may be re-installed if dimensions obtained during checking are at the maximum tolerance limit and it is in an undamaged condition.
- Bearing journal clearances should be checked where necessary using Plastigage.
- Gaskets, seals and O-ring seals are to be re-used unless damaged.


Joints and Joint Faces

All gaskets should be installed dry unless stated otherwise. Always apply the specified lubricant to O-rings and install O-rings using the fingers only.

Use gasket removal spray and/or plastic scrapers to remove traces of old gasket.

 **CAUTION:** DO NOT use metal scrapers or emery cloth as these may damage the sealing surfaces.

Many joints use sealants instead of gaskets as the sealing medium. Where this is the case, the sealant together with its part number will be found listed in the relevant repair operation and also in the sealants table.

 **CAUTION:** Always remove all traces of the old sealant prior to reassembly. Use plastic scrapers, specified solvents where available or dry, lint free cloth. DO NOT use metal scrapers or emery cloth as these may damage the sealing surfaces. Make sure that sealing surfaces are free from oil or grease as sealants will not adhere properly to contaminated surfaces.

Do not allow sealant to enter tapped holes or oilways.

Locking Devices

Always replace locking devices with one of the same design and of the correct size.

Tab washers

Always release locking tabs before loosening fixings, do not re-use tab washers.

Locknuts

Always use a backing spanner when loosening and tightening locknuts, brake and fuel pipe unions.

Roll pins

Always install new roll pins of the correct size.

Circlips

Always install new circlips ensuring that they are of the correct size for the groove.

Woodruff keys

Woodruff keys may be re-used provided there is no indication of wear or distortion.

Remove any burrs from edges of keyways using a fine file.

Split pins

Never attempt to straighten and re-use a split pin, always make sure that replacement pins are of the correct size for the hole in which they are to be installed.

Screw Threads

- Damaged nuts, bolts and screws must always be discarded. Attempting to recut or repair damaged threads with a tap or die impairs the strength and install of the threads and is not recommended.

NOTE: During certain repair operations, it may be necessary to remove traces of thread locking agents using a tap. Where this is necessary, the instruction to do so will appear in the relevant operation and it is essential that a tap of the correct

size and thread is used.

- Some bolts are coated with a thread locking agent and unless stated otherwise, they must not be re-used. New bolts having the same part number as the original must always be installed. When nuts or bolts are to be discarded, the repair operation and relevant torque chart will include an instruction to that effect. Do not use proprietary thread locking agents as they may not meet the specification required. See also Encapsulated ('Patched') Bolts and Screws.
- Always make sure that replacement nuts and bolts are at least equal in strength to those that they are replacing. Castellated nuts must not be loosened to accept a split pin except in recommended cases when this forms part of an adjustment.
- Do not allow oil or grease to enter blind holes, the hydraulic action resulting from tightening the bolt or stud can split the housing and also give a false torque reading.
- Always tighten a nut, bolt or screw to the specified torque figure, damaged or corroded threads can give a false torque reading.
- Nut and bolt loosening and tightening sequences, where given, must ALWAYS be followed. Distortion of components or faulty sealing of joints will result if the sequences are not followed. Where an instruction is given to tighten in stages, these stages must be adhered to; do not attempt to combine stages particularly where certain stages involve tightening by degrees.
- To check or re-tighten a fixing to a specified torque, first loosen a quarter of a turn, then retighten to the specified torque figure.
- Unless instructed otherwise, do not lubricate bolt or nut threads prior to installing.

Where it is stated that bolts and screws may be re-used, the following procedures must be carried out:

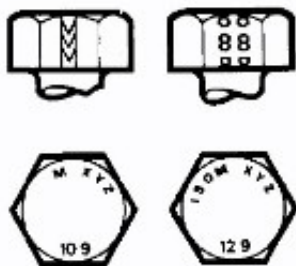
- Check that threads are undamaged.
- Remove all traces of locking agent from the threads.



CAUTION: DO NOT use a wire brush; take care that threads are not damaged.

- Make sure that threads are clean and free from oil or grease.
- Apply the specified locking agent to the bolt threads.

Bolt and Nut Identification



E48627

An ISO metric bolt or screw made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the bolt head.

In addition to marks identifying the manufacturer, the top of the bolt head is also marked with symbols indicating the strength grade e.g. 8.8, 10.9, 12.9, 14.9. Alternatively, some bolts and screws have the M and strength grade symbol stamped on the flats of the hexagon.

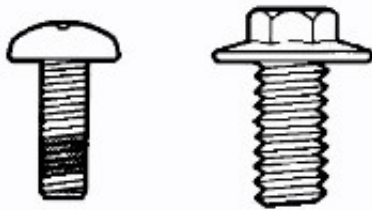
Encapsulated ('Patched') bolts and screws



E48628

Encapsulated ('patched') bolts and screws have a thread locking agent applied to the threads during manufacture. Most thread locking agents are coloured, the band of colour extending for 360° around the thread. Some locking agents however, are neutral in colour and may not be so easily identified apart from a slightly darker area of thread where the locking agent has been applied. The locking agent is released and activated by the tightening process and is then chemically cured to provide the locking action.

Self-locking bolts and screws



E48629

Unless stated in a specific repair procedure, self-locking bolts and screws i.e. nylon patched or trilobular thread can be re-used provided that resistance is felt when the locking portion enters the female thread.

Nylon patched bolts and screws have a locking agent either applied to, or inserted in the threaded portion. They are identified by the presence of a coloured section of thread extending approximately 180° around the thread or by a coloured plug inserted into the bolt.

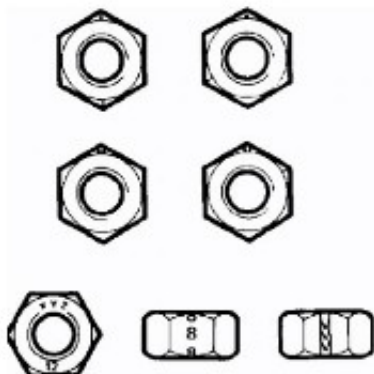
Trilobular bolts have a special thread form which creates a slight interference with the thread of the hole or nut into which it is screwed.



CAUTION: Do Not re-use self-locking fasteners in critical locations e.g. drive plates/flywheel or engine bearings. Do not install non self-locking fasteners where a self-locking fastener is specified.

Trilobular bolts should not be used as a substitute for patched bolts.

Nut identification



E48630

A nut with an ISO metric thread is marked on one face or one of the hexagonal flats with the strength grade symbol 8, 12, 14. Some nuts with the strength grade 4, 5 or 6 are also marked and some have the metric symbol M on the hexagonal flat opposite the strength grade marking.

A clock face system is sometimes used as an alternative method of indicating the strength grade. The external chamfers or a face of the nut is marked in a position relative to the appropriate hour mark on a clock face to indicate the strength grade.

A dot is used to locate the 12 o'clock position and a dash to indicate the strength grade. If the grade is above 12, two dots identify the 12 o'clock position.

When tightening a slotted or castellated nut, never loosen it to insert a split pin except where specified as part of an adjustment procedure. If difficulty is experienced in correctly positioning the slot, alternative washers or nuts should be selected.

Where a nut is tightened to adjust or maintain bearing pre-load, the tightening procedure must be adhered to.

Self-locking nuts

Unless stated otherwise, self-locking nuts once removed must be discarded and new nuts of the same type and strength grade installed.

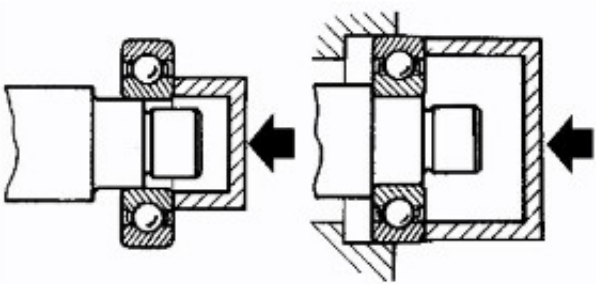
Ball and Roller Bearings

When removing and installing bearings, make sure that the following practices are observed to make sure component serviceability:



CAUTION: Service tools have been developed for removing the majority of bearings; these must always be used where specified.

- Remove all traces from bearing under inspection by cleaning with a suitable degreasant; maintain absolute cleanliness throughout operations.
- Conduct a visual inspection for markings on rolling elements, raceways, outer surfaces of outer or inner surfaces of inner rings. Reject any bearings found to be marked since marking in these areas indicates onset of wear.
- Hold inner race of bearing between finger and thumb of one hand and rotate outer race to check that it revolves absolutely smoothly. Repeat holding outer race and rotating inner race. DO NOT spin the bearing.
- Rotate outer ring gently using a reciprocating movement whilst holding inner ring; feel for any check or obstruction to rotation. Reject bearing if movement is not absolutely smooth.
- Check bearing for blueing or signs of overheating.
- Lubricate bearing with the specified lubricant.
- Inspect bearing surface of shaft and bearing housing for discolouration or other markings which indicate overheating of bearing or movement between bearing and seating.
- Before installing bearing, make sure that shaft and bearing housing are clean and free from burrs.
- If one bearing of a pair shows signs of wear, overheating etc., it is advisable to replace bearings as a pair unless it is suspected that one bearing may have been faulty when installed, was installed incorrectly or the fault arose due to oil seal failure.
- Never reinstall a bearing unless it is in a fully serviceable condition.



E48560

- When installing a bearing to a shaft, only apply force to the inner ring of the bearing. When installing a bearing into a housing, only apply force to the outer ring of the bearing.



CAUTION: Service tools have been developed for installing the majority of bearings; these must always be used where specified.

- In the case of grease lubricated bearings, fill the space between the bearing and outer seal with the recommended grade of grease before installing the seal.



CAUTION: When a waxed oil seal (installed dry) type of oil seal is to be installed, take great care that grease does not contaminate the running surface of the seal.

- Always make suitable reference marks between the components of separable bearings e.g. taper roller bearings when disassembling to make sure correct location of components when assembling. Never install new rollers in an outer ring, always install a new bearing assembly.

Brake Pads and Linings

Always install the correct grade and specification of brake pads and linings. When replacing these items, always replace as complete axle sets.

Brake Hydraulics

Always observe the following recommendations when working on the braking system:



WARNING: Do not intermix brake fluid of different specifications.

- Always use two spanners when loosening or tightening brake pipes or hose connections.
- Make sure that hoses run in a natural curve and are not kinked or twisted.
- Install brake pipes and hoses securely in their retaining clips and make sure that they cannot contact a potential chafing point.
- Containers used for brake fluid must be kept absolutely clean.
- Do not store brake fluid in unsealed containers, the fluid will absorb water which will lower the boiling point of the fluid.
- Do not allow brake fluid to be contaminated with other fluids such as mineral oil and do not put brake fluid in a container which has previously been used for storing other fluids.
- Do not re-use brake fluid which has been bled from the system.
- Always use brake fluid or a suitable brake cleaning fluid to clean hydraulic components.
- Unless stated otherwise, use only clean brake fluid to lubricate hydraulic seals and components.
- Always install blanking plugs to hoses, pipes or components immediately after disconnection.
- Check thread compatibility of original equipment with replacement components.
- Observe absolute cleanliness when working with hydraulic components.

Pipes and Hoses

When removing or installing flexible hydraulic pipes and hoses, make sure that the following procedures are observed to make sure component serviceability:

- Prior to removal, clean area around hose or pipe end which is to be disconnected.
- Obtain appropriate blanking plugs or caps before disconnecting hose or pipe end fittings in order that connections can be plugged immediately following disconnection.
- Always install blanking plugs or caps to pipes and unions immediately following disconnection.
- Clean hose or pipe and blow through with an air line.



WARNING: Suitable eye protection must be worn.

- Check hoses externally for cracks, separation of plies, security of end fittings and external damage; replace faulty hoses.
- Check pipes for signs of corrosion and chafing, replace as necessary.



CAUTION: If pipes are found to be chafed, rectify clips, mounting points etc., to prevent further problems in service.

- When installing hoses, make sure that no unnecessary bends are introduced and that hoses are not kinked, twisted or positioned close to potential chafing points.
- When installing pipes, make sure that pipes are positioned and clipped clear of potential chafing points.
- Always replace sealing washers installed to banjo bolts, sealing plugs etc.
- Always use a backing spanner when tightening unions and do not overtighten union nuts or banjo bolts.
- After engagement of 'quick-fit' connection hoses, perform a 'tug' test to make sure connection is securely installed.
- After any work on hydraulic systems, always check for fluid leaks whilst a second operator applies working pressure to the brake pedal or operates the system that has been worked on.

Fuel system hoses

Some fuel hoses are made up of two laminations, an armoured rubber outer sleeve and an inner viton core. Whenever a hose is removed, make sure that the inner bore is inspected to check that the viton lining has not become separated from the outer sleeve.



WARNING: Never attempt to repair fuel hoses or rectify leaking 'quick-fit' connectors. The fuel hose and connectors must be replaced as an assembly.

Fuel system hose clips



E48636

Certain fuel system hose clips are of the 'break-off head' type where a slot in the screw head shears off when the clip is tightened to a specific torque. These clips may be removed using a screwdriver and must be replaced with new clips on reassembly. Clips must be tightened until the portion of the slot shears off. Do not attempt to tighten clips by any other method, do not install any other type of clip.

'Quick-fit' connections are also installed to certain fuel hoses. After engagement of 'quick-fit' connections, perform a 'tug' test to make sure connection is securely installed.

Other fuel system hose clips are of the 'Jubilee' type and there may be a tamper proof cover installed over the screw head. These cover must be carefully removed before slackening the clip and should be replaced after final tightening, ensuring that the internal hexagon on the cover is correctly located on the clip screw.

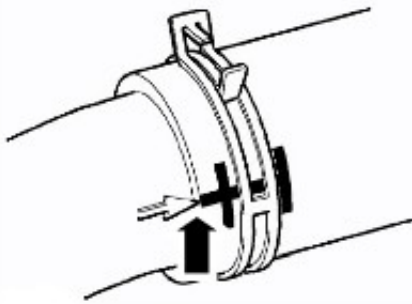
Cooling system hoses



CAUTION: The following precautions must be observed to make sure that the integrity of the cooling system hoses and their connection to the system is maintained.

Hose orientation and connection

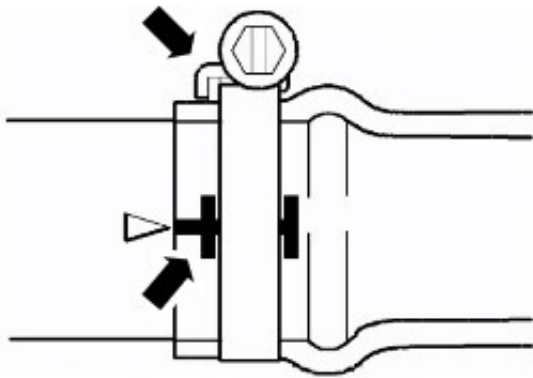
Correct orientation of cooling system hoses is important to make sure that hoses do not become fatigued or damaged through contact with adjacent components.



E48633

Where orientation marks are provided on the hose and corresponding component, the marks must be aligned when the hose is installed. Hoses must be installed fully on to their connection points, usually a moulded form on a pipe provides a positive indicator.

Hose clips



E48634

Markings are usually provided on the hose to indicate the correct clip position. If no markings are provided, position the clip directly behind the retaining lip at the end of the stub pipe. Worm drive clips should be orientated with the crimped side of the drive housing facing towards the end of the hose or the hose may become pinched between the clip and the stub pipe retaining lip. Unless otherwise stated, worm drive clips should be tightened to 3 Nm (2 lb-ft). Make sure that hose clips do not foul adjacent components.



E48635

Oetiker clips may be removed by bending the tag (arrowed) and releasing the free end of the clip. Clips must not be re-used. When installing new clips, make sure clip is positioned on hose before tightening and make sure that when clip is tightened, the tag is located in the longitudinal slot in the free end of the clip (arrowed in illustration).

'Quick-fit' connections are also installed to certain hoses/pipes. Inspect 'quick-fit' connections for damage, prior to connection. Replace if damaged. After engagement of 'quick-fit' connections, perform a 'tug' test to make sure connection is securely installed.

Heat protection

Always make sure that heat shields and protective sheathing are in good condition; replace if damage is evident. Particular care must be taken when routing hoses close to hot engine components such as the exhaust manifolds and exhaust gas recirculation (EGR) pipes. Hoses will relax and deflect slightly when hot, make sure this movement is taken into account when routing and securing hoses.

Electrical Precautions

General

The following guidelines are intended to make sure the safety of the operator whilst preventing damage to the electrical and electronic components of this vehicle.

Equipment

Prior to commencing any test procedure on the vehicle, make sure that the relevant test equipment is working correctly and that any harness or connectors are in good condition. It is particularly important to check the condition of all plugs and leads of mains operated equipment.

Polarity

Never reverse connect the vehicle battery and always make sure the correct polarity when connecting test equipment.

High voltage circuits

Whenever disconnecting live ht circuits, always use insulated pliers and never allow the open end of the ht lead to contact other components, particularly ECU's.

Connectors and harnesses

The engine compartment of a vehicle is a particularly hostile environment for electrical components and connectors. Always observe the following:

- Make sure electrically related items are dry and oil free before disconnecting/connecting test equipment.
- Make sure that disconnected multiplugs and sensors are protected from any possible oil, coolant or other liquid contamination. Any such contamination could impair performance or lead to component failure.
- Never force connectors apart or pull on the wiring harness.
- Always make sure locking tabs are disengaged before disconnecting multiplugs etc. and make sure that correct orientation is achieved before connection.
- Make sure that any protection covers, insulation etc. are replaced if disturbed.

Having confirmed that a component is faulty, carry out the following:

- Switch off the ignition and disconnect the battery.
- Remove the component and support the disconnected harness.
- When replacing electrical components, keep oily hands away from electrical connections and make sure that locking tabs on connectors are fully engaged.

Battery Disconnection/Connection

Always refer to the Electrical Section of this manual - Battery Connection/Disconnection prior to attempting to connect or disconnect the battery.

For additional information, refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Fuel Handling Precautions

The following information lists basic precautions which must be observed if fuel is to be handled safely. It also outlines other areas of risk which must not be ignored. As this information is issued for basic guidance only, consult your local Fire Department where any doubt as to personal and environmental safety exists - See also Health and Safety Precautions.

General precautions

Always have the correct type of fire extinguisher containing Foam, CO₂, Gas or powder accessible when handling or draining fuel or dismantling fuel systems. Fire extinguishers must also be located in areas where fuel is stored.

Make sure that suitable warning signs are exhibited.

Keep all sources of ignition well away from areas where fuel is being handled.

Make sure that any leadlamps are flameproof and kept clear of spillage.

WARNINGS:



Do not disassemble or reassemble fuel system components whilst vehicle is over a pit.



No one should be permitted to repair components associated with fuel without first having specialist training.

Always disconnect the vehicle battery before carrying out disassembly, reassembly or draining work on a fuel system.

Fuel tank and system draining

Draining must be carried out in accordance with the procedures given in the relevant Fuel System section of this manual.

WARNINGS:



Never drain fuel or work on a fuel system while the vehicle is over a pit. Extraction or draining of fuel must be carried out in a well ventilated area.



Never switch on or operate mobile (cellular) phones in the vicinity of vehicles when operations are being carried out on the fuel system.



Always attach fuel vapour warning labels to fuel tanks immediately after draining.



Containers used for storing fuel must be clearly marked with the contents and placed in a safe storage area which meets the requirements of the local authority.



CAUTION: Some fuel lines are now installed with 'quick release' connectors. If a connector is damaged, no attempt must be made to repair the connector, a new fuel line and connector(s) assembly must be installed.

Always release pipe clips fully before attempting to disconnect fuel pipes.

Fuel tank repairs

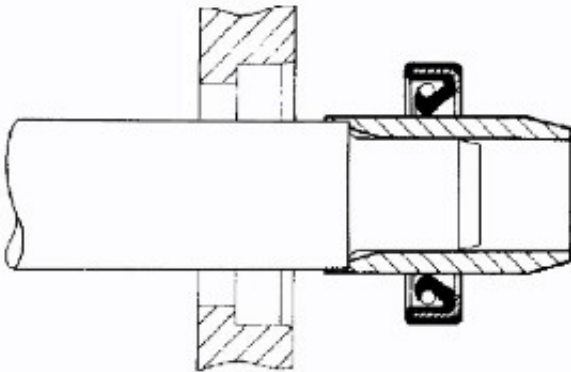


CAUTION: No attempt should be made to repair a fuel tank. If the structure of the tank is damaged, a new tank must be installed.

Oil seals

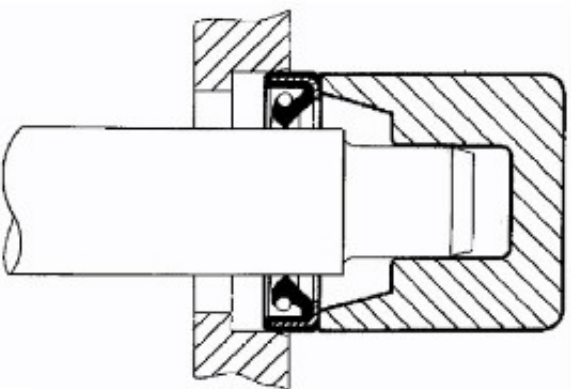
Never use a seal which has been improperly stored or handled.

- Take great care when removing old seals that the sealing surfaces and seal housing are not damaged.
- Carefully examine seal before installing to make sure that it is clean and undamaged.
- Make sure that the surface on which the seal is to run and also the seal housing is clean and free from burrs or scratches. Renew the component if the sealing surface cannot be restored.
- Special tools and protection sleeves are provided for installing the majority of seals and must be used when specified.
- Many seals are now coated with a protective wax and DO NOT need to be lubricated prior to installing. Always check the relevant repair procedure which will state if a seal must be installed dry. Never touch these seals with oily hands as the oil will contaminate the protective coating and affect the sealing properties of the seal; also, make sure that installing tools and protection sleeves are free from oil and grease. Seals which must be lubricated prior to installing should have the recommended lubricant applied to the areas specified in the repair procedure.
- Make sure that a seal is installed the correct way round. For example, the lip of the seal must face towards the lubricant which it is sealing.
- When installing an oil seal, make sure that it is positioned square to shaft and housing. Where the seal is to be installed to a housing prior to installing over a shaft, take care not to allow the weight of an unsupported shaft to rest on the seal.



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- Always use the recommended special tool and protection sleeve to install an oil seal. If no tool is specified, use a suitable mandrel approximately 0.4 mm (0.015 in) smaller than the outside diameter of the seal. Use adhesive tape on the shaft to protect the sealing lip of the seal.



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- Press or drift the seal in to the depth of its housing if the housing is shouldered or flush with the face of the housing where no shoulder is provided. Make sure that the seal is not tilted in the housing when it is installed.

(A/C) System Precautions

The A/C system contains fluids and components which could be potentially hazardous to the service engineer or the environment if not serviced and handled correctly. The following guidelines are intended to alert the service engineer to potential sources of danger and emphasise the importance of ensuring the integrity of the A/C operating conditions and components installed to the vehicle.

Where necessary, additional specific precautions are detailed in the relevant sections of this Manual and also in the Health

and Safety Section. These precautions must be referred to prior to commencing repair operations.

The refrigerant used in the A/C system is HC-134a (Hydro fluorocarbon) R134a.

WARNINGS:



Servicing must only be carried out by personnel familiar with both the vehicle system and the charging and testing equipment. All operations must be carried out in a well ventilated area away from open flame and heat sources.



R134a is a hazardous liquid and when handled incorrectly can cause serious injury. Suitable protective clothing, consisting of face protection, heat proof gloves, rubber boots and rubber apron or waterproof overalls, must be worn when carrying out operations on the A/C system.

Remedial actions



WARNING: Due to its low evaporating temperature, R134a must be handled with care. R134a splashed on any part of the body will cause immediate freezing of that area. Also, refrigerant cylinders and replenishment trolleys when discharging will freeze skin to them if contact is made.

If an accident involving R134a should occur, conduct the following remedial actions:

- If liquid R134a enters the eye, do not rub it. Gently run large quantities of eye wash over affected eye to raise the temperature. If an eye wash is not available, cool, clean water may be used to flush the eye. After rinsing, cover the eye with a clean pad and seek immediate medical attention.
- If liquid R134a is splashed onto the skin, run large quantities of water over the affected area to raise the temperature. Implement the same action if the skin comes in contact with discharging cylinders. Wrap the contaminated body parts in blankets (or similar materials) and seek immediate medical attention.
- If the debilitating effects of inhalation of R134a vapour are suspected, seek fresh air. If the affected person is unconscious, move them away from the contaminated area to fresh air and apply artificial respiration and/or oxygen and seek immediate medical attention.

Service precautions

Observe the following precautions when handling components used in the system:

- A/C units must not be lifted by their hoses, pipes or capillary lines.
- Hoses and lines must not be subjected to any twist or stress; the efficiency of the system will be impaired by kinks or restrictions. Make sure that hoses are correctly positioned before tightening couplings, and make sure that all clips and supports are utilised.
- Flexible hoses should not be positioned closer than 100 mm (4.0 in) to the exhaust manifold unless protected by heat shielding.
- Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of components and panels may transmit noise and so must be eliminated.
- The appropriate torque wrench must be used when tightening refrigerant connections to the stipulated value. An additional spanner must be used to hold the union to prevent twisting of the pipe when tightening connections.
- Before connecting any hose or pipe, make sure that refrigerant oil is applied to the seat of the new O-rings, **BUT NOT** to the threads of the connection.
- All protective plugs or caps must remain in place in the component until immediately prior to connection.
- Make sure components are at room temperature before uncapping/unplugging, to prevent condensation of moisture from the air that enters it.
- When disconnecting, immediately plug or cap all pipes to prevent ingress of dirt and moisture into the system.
- Components must not remain uncapped/unplugged, if a system has been left uncapped/unplugged for 24 hours or longer, a new receiver/drier must be installed.
- The receiver/drier contains desiccant which absorbs moisture. It must be positively sealed at all times. A receiver/drier that has been left uncapped for longer than 24 hours must not be used; install a new unit.
- The receiver/drier should be the last component connected to the system to make sure optimum dehydration and maximum moisture protection of the system.
- Whenever a component of the refrigeration system is replaced, it will also be necessary to install a new receiver/drier unit.
- Use alcohol and a clean lint-free cloth to clean dirty connections.
- Make sure that all new parts installed are marked for use with R134a.
- When a major repair has been completed, a leak test should be conducted; refer to the Repairs Section of this manual for the correct procedure.

Refrigerant oil



CAUTION: Refrigerant oil (ND-8 PAG) easily absorbs water and must not be stored for long periods. Do not pour unused refrigerant oil back into the container. Always use an approved refrigerant oil.

When replacing components in the system, drain the refrigerant oil from the component being replaced into a graduated container. On assembly, add the quantity of refrigerant oil drained to the new component - See Compressor Replacement in this Section.

A/C Compressor

A new compressor is sealed and pressurised with Nitrogen gas. When installing a new compressor, slowly release the sealing cap; gas pressure should be heard to vent as the seal is broken.



CAUTION: A new compressor should always be sealed and could be pressurised with nitrogen gas. To avoid possible oil loss, release the sealing cap(s) slowly. Do not remove the cap(s) until immediately prior to connecting the pipes to the compressor.

Rapid refrigerant discharge

If the A/C system is damaged as a result of an accident and the system is punctured, the refrigerant will discharge rapidly. The rapid discharge of refrigerant will also result in the loss of most of the oil from the system. The compressor must be removed and all the remaining oil in the compressor drained and refilled as instructed in the air conditioning section of this manual.

Precautions for refrigerant recovery, recycling and recharging

When the A/C system is recharged, any existing refrigerant is first recovered from the system and recycled. The system is then charged with the required weight of refrigerant and volume of refrigerant oil.



WARNING: Refrigerant must always be recycled before re-use to make sure that the purity of the refrigerant is high enough for safe use in the system. Recycling should always be carried out with equipment which is design certified by Underwriter Laboratory Inc. for compliance with SAE J1991. Other equipment may not recycle refrigerant to the required level of purity.

CAUTIONS:



A R134a Refrigerant Recovery Recycling Recharging Station must not be used with any other type of refrigerant. Refrigerant R134a from domestic and commercial sources must not be used in motor vehicle systems.



The system must be evacuated immediately before recharging commences. Delay between evacuation and recharging is not permitted.

A/C Compressor Replacement

A new compressor is supplied filled with a full charge ($X \text{ cm}^3$) of refrigerant oil.

A calculated quantity of oil must be drained from the new compressor before installing. To calculate the quantity of oil to be drained:

- Remove the drain plug from the old compressor.
- Invert the compressor and gravity drain the oil into a calibrated measuring cylinder. Rotate the compressor clutch to make sure the compressor is completely drained.
- Note the quantity of oil drained ($Y \text{ cm}^3$).
- Calculate the quantity of oil to be drained from the new compressor using the following formula: $X \text{ cm}^3 - (Y \text{ cm}^3 + 20 \text{ cm}^3) = Q \text{ cm}^3$
- Remove the drain plug from the new compressor and drain $Q \text{ cm}^3$ of oil. Install and tighten the compressor drain plug.

Vehicle Weights up to 07/2001

When loading a vehicle to its maximum (Gross Vehicle Weight) consideration must be taken of the unladen vehicle weight and distribution of the payload to make sure that axle loadings do not exceed the permitted maximum values.

It is the customer's responsibility to limit the vehicle's payload in an appropriate manner such that neither maximum axle loads nor Gross Vehicle Weight are exceeded.

NOTE: Axle weights are not accumulative. The individual maximum axle weights and gross vehicle weights must not be exceeded.

NOTE: EEC Kerb weight = Unladen weight + full fuel tank + 75 Kg (165lb).

90 Models

Vehicle axle weights -	Standard	Standard	High load	High load
Front axle	1200 Kg	2645 lb	1200 Kg	2645 lb
Rear axle	1380 Kg	3042 lb	1500 Kg	3307 lb
Maximum Gross Vehicle Weight (GVW) -	2400 Kg	5291 lb	2550	5622 lb
EEC Vehicle kerb weights				
Soft top	1695 Kg	3736 lb	1699 Kg	3745 lb
Pick-up	1694 Kg	3734 lb	1698 Kg	3743 lb
Hard top	1746 Kg	3849 lb	1750 Kg	3858 lb
Station wagon	1793 Kg	3952 lb	1797 Kg	3961 lb

110 Models

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Vehicle axle weights -	Levelled	Levelled	Unlevelled	Unlevelled
Front axle	1200 Kg	2645 lb	1200 Kg	2645 lb
Rear axle	1750 Kg	3858 lb	1850 Kg	4078 lb
Maximum Gross Vehicle Weight (GVW) -	2950 Kg	6503 lb	3050 Kg	6724 lb
EEC Vehicle kerb weights	Standard	Standard	High load	High load
Soft top	1872 Kg	4127 lb	1882 Kg	4149 lb
Pick-up	1880 Kg	4144 lb	1890 Kg	4166 lb
High capacity Pick-up	1917 Kg	4226 lb	1927 Kg	4248 lb
Hard top	1913 Kg	4217 lb	1923 Kg	4239 lb
Station wagon	2018 Kg	4448 lb	2018 Kg	4470 lb
County station wagon	2054 Kg	4528 lb	2054 Kg	455 lb

130 Models

Vehicle axle weights - 130 models		
Front axle	1580 kg	3483 lb
Rear axle	2200 Kg	4850 lb
Maximum Gross Vehicle Weight (GVW) -	3500 kg	7716 lb
EEC Vehicle kerb weights		
Crew cab and high capacity pick-up	2086 Kg	4598 lb

Vehicle Weights From 07/2001

90 Models

Vehicle axle weights - 90 models	Station wagon	Station wagon	Utility	Utility
Front axle	1200 Kg	2645 lb	1200 Kg	2645 lb
Rear axle	1500 Kg	3307 lb	1500 Kg	3307 lb
Maximum Gross Vehicle Weight (GVW) -	2550 Kg	5622 lb	2400	5291 lb
EEC Vehicle kerb weights				
Soft top	1770 Kg	3402 lb	1993 Kg	4393 lb
Pick -up	1770 Kg	3402 lb	1993 Kg	4393 lb
Hard top	1815 Kg	4001 lb	1987 Kg	4380 lb
Station wagon	1870- 1885 Kg	4122 - 4155 lb	1989 - 1998 Kg	4385 - 4404 lb

110 Models - Non Japanese specification

Vehicle axle weights -	Station wagon	Station wagon	Utility	Utility
Front axle	1200 Kg	2645 lb	1200 Kg	2645 lb
Rear axle	1750 Kg	3858 lb	1850 Kg	4078 lb
Maximum Gross Vehicle Weight (GVW) -	2950 Kg	6503 lb	3050 Kg	6724 lb
EEC Vehicle kerb weights	Standard	Standard	Heavy duty	Heavy duty
Soft top	1885 Kg	4155 lb	2080 Kg	4585 lb
High capacity Pick-up	1920 Kg	4232 lb	2122 Kg	4678 lb
Hard top	1920 Kg	4232 lb	2110 Kg	4651 lb
Station wagon	2055 Kg	4530 lb	2229 Kg	4914 lb

110 Models - Japanese specification

Vehicle axle weights -	Metric	Imperial
Front axle	1115 Kg	2457 lb
Rear axle	2180 Kg	4805 lb
Maximum Gross Vehicle Weight (GVW) -	3295 Kg	7262 lb

130 Models

Vehicle axle weights	Metric	Imperial
Front axle	1580 kg	3483 lb
Rear axle	2200 Kg	4850 lb
Maximum Gross Vehicle Weight (GVW) -	3500 kg	7716 lb
EEC Vehicle kerb weights	Heavy duty	Heavy duty
Crew cab and high capacity pick-up	2177 - 2286 Kg	4667 - 5039 lb

Towing weights

NOTE: * Only applies to vehicles modified to accept coupled brakes.

NOTE: All weight figures are subject to local restrictions

Towing weights	On-road	On-road	Off-road	Off-road
Unbraked trailers	750 Kg	1653 lb	500 Kg	1102 lb
Trailers with overrun brakes	3500 Kg	7716 lb	1000 Kg	2204lb
4 wheel Trailers with coupled brakes *	4000 Kg	8818 lb	1000 Kg	2204lb

Off Road Performance

90 Models

NOTE: Departure angles do not account for the addition of a tow hitch.

Item	Metric	Imperial
Max. gradient (EEC Kerb weight)	45°	
Approach angle		
Soft Top and Pick-up (EEC Kerb weight)	48°	
Hard top and Station wagon (EEC Kerb weight)	51.5°	
Departure angle		
Soft Top and Pick-up (EEC Kerb weight)	49°	
Hard top and Station wagon (EEC Kerb weight)	53°	
Wading depth	500 mm	20 in
Min. ground clearance (unladen)		
Soft Top and Pick-up (EEC Kerb weight)	191 mm	7.5 in
Hard top and Station wagon (EEC Kerb weight)	229 mm	9.0 in

110 and 130 Models

NOTE: Departure angles do not account for the addition of a tow hitch.

Item	Metric	Imperial
Max. gradient (EEC Kerb weight)	45°	
Approach angle	50°	
Departure angle		
110 Models	35°	
130 Models	34°	
Wading depth	500 mm	20 in
Min. ground clearance (unladen)	215 mm	8.5 in

Vehicle dimensions

90 Models

Item	Metric	Imperial
Overall length		
Soft top and Pick-up	3722 mm	146.5 in
Hard top and Station wagon	3883 mm	152.9 in
Overall width	1790 mm	70.5
Overall height		
Soft top and Pick-up	1965 mm	77.4 in
Pick-up and Station wagon	1963 mm	77.3 in
Hardtop	1972 mm	77.6 in
Wheelbase	2360 mm	92.9 in
Track front/rear	1486 mm	58.5 in
Width between wheel boxes	925 mm	36.4 in

110 Models

Item	Metric	Imperial
Overall length		
Soft top and Pick-up	4438 mm	175 in
Hard capacity pick-up	4631 mm	182 in
Hardtop/station and county	4599 mm	181 in
Overall width	1790 mm	70.5 in
Overall height -		
Non Japanese specification	2035 mm	80.1 in
Japanese specification	2060 mm	81.1 in
Wheelbase	2794 mm	110 in
Track front/rear	1486 mm	58.5 in
Width between wheel boxes		
High capacity pick-up	1090 mm	43 in
All other models	925 mm	36.4 in

130 Models

Item	Metric	Imperial
Overall length	5132 mm	202 in
Overall width	1790 mm	70.5 in
Overall height	2035 mm	80.1 in
Wheelbase	3266 mm	127 in
Track front/rear	1486 mm	58.5 in
Width between wheel boxes	1090 mm	43 in

V8 Models

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Item	Metric	Imperial
Overall length	4072 mm	160.5 in
Overall width	1790 mm	70.5 in
Overall height	2037 mm	80.2 in
Wheelbase	2360 mm	92.9 in
Track front/rear	1486 mm	58.5 in
Width between wheel boxes	925 mm	36.4 in
Turning circle	12.65 m	41 ft 6 in

General Information - Health and Safety Precautions

Description and Operation

Introduction

Modern vehicles contain many materials and liquids which if not handled with care can be hazardous to both personal health and the environment. Also, many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health.

This subsection lists some of these hazardous operations and the materials and equipment associated with them. Precautions necessary to avoid these hazards are identified.

The list is not exhaustive and all operations and procedures and the handling of materials, should be carried out with health and safety in mind.

Before using any product the Materials Safety Data Sheet supplied by the manufacturer or supplier should be consulted.



WARNING: Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should, as far as possible, be kept from contact with the skin. These liquids and substances include acid, anti-freeze, brake fluid, fuel, windscreen washer additives, lubricants, refrigerants and various adhesives.

Acids and Alkalis

For example - alkalis such as caustic soda used in cleaning materials; acids such as sulphuric acid used in batteries.

Both alkalis and acids are irritant and corrosive to the skin, eyes, nose and throat. They cause burns and can destroy ordinary protective clothing.

Avoid splashes to the skin, eyes and clothing. Wear suitable protective impervious apron, gloves and goggles. Do not breath mists.

Make sure access to eye wash bottles, shower and soap are readily available for splashing accidents.

Display Eye Hazard sign.

Air Bags

Highly flammable, explosive – observe No Smoking policy.

Used within the vehicle as safety restraints.

The inflator contains a high-energy propellant which, when ignited, produces a VERY HOT GAS (2500°C).

The gas inflator (generator) used in air bags is Sodium Azide. This material is hermetically sealed in each air bag module and is completely consumed during deployment. No attempt should be made to open an air bag inflator as this will lead to the risk of exposure to Sodium Azide. If a gas generator is ruptured, full protective clothing should be worn when dealing with the spillage.

After normal deployment, gloves and safety goggles should be worn during the handling process.

Deployed air bags should be disposed of in a plastic bag in accordance with local regulations at an approved chemical waste site.

Following any direct contact with Sodium Azide:

- Wash affected areas thoroughly with water.
- **SEEK IMMEDIATE MEDICAL ASSISTANCE.**

Air Bags - Do's

- Do store modules in an upright position.
- Do keep modules dry.
- Do carry modules with the cover side pointing away from the body.
- Do place modules with their cover side upwards.
- Do carefully inspect modules for damage.
- Do stand to one side when connecting modules.
- Do make sure all test equipment is properly calibrated and maintained.
- Do wash hands after handling deployed air bags.

Air Bags - Do Not

- Do Not store highly flammable material together with modules or gas generators.
- Do Not store gas generators at temperatures exceeding 80°C.
- Do Not store modules upside down.
- Do Not attempt to open a gas generator housing.

- Do Not expose gas generators to open flame or sources of heat.
- Do Not place anything on top of a module cover.
- Do Not use damaged modules.
- Do Not touch a fired module or gas generator for at least 10 minutes after firing.
- Do Not use any electrical probes on the wiring circuit.

Air Suspension

Whenever work is being undertaken on the air suspension system, suitable eye protection must be worn.

Air Conditioning Refrigerant

Highly flammable, combustible – observe No Smoking policy.

Skin contact may result in frostbite.

Instructions given by the manufacturer must be followed. Avoid naked lights, wear suitable protective gloves and goggles.

If refrigerant comes into contact with the skin or eyes, rinse the affected areas with water immediately. Eyes should also be rinsed with an appropriate irrigation solution such as a solution of 9% Sodium Chloride and Purified Water. **DO NOT RUB THE EYES AND SEEK IMMEDIATE MEDICAL ATTENTION.**

Air Conditioning Refrigerant

Do Not

- Do Not expose refrigerant bottles to sunlight or heat.
- Do Not expose refrigerant bottles to frost.
- Do Not drop refrigerant bottles.
- Do Not vent refrigerant to atmosphere under any circumstance.
- Do Not mix refrigerants.

Adhesives and Sealants

Many adhesives and sealants are highly flammable – OBSERVE NO SMOKING POLICY. These items, should be stored in flameproof cabinets in No Smoking areas. Cleanliness and tidiness in use should be observed, for example disposable paper covering benches. All adhesives and sealants should be dispensed from applicators where possible; containers, including secondary containers, should be labelled appropriately.

Anaerobic, Cyanoacrylate (super-glues) and other Acrylic Adhesives

Many are irritant, sensitizing or harmful to the skin and respiratory tract. Some are eye irritants.

Skin and eye contact should be avoided and the manufacturer's instructions followed.

Cyanoacrylate adhesives (super-glues) MUST NOT contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and **SEEK IMMEDIATE MEDICAL ATTENTION.** Do not attempt to pull skin tissue apart. Use in well ventilated areas as vapors can cause irritation to the nose and eyes.

For two-pack systems see Resin-based and Isocyanate Adhesives/Sealers.

Solvent-based Adhesives/Sealers - See Solvents

Follow manufacturers instructions.

Water-based Adhesives/Sealers

Those based on polymer emulsions and rubber/latex may contain small amounts of volatile, toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.

Hot Melt Adhesives

In the solid state, they are safe. In the molten state they may cause burns and health hazards may arise from the inhalation of toxic fumes.

Use appropriate protective clothing and a thermostatically controlled heater with a thermal cut-out and adequate extraction.

Resin-based Adhesives/Sealers, for example Epoxide and Formaldehyde Resin-based

Mixing should be carried out in well ventilated areas as harmful or toxic volatile chemicals may be released.

Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic or harmful chemicals through the skin. Splashes can damage the eyes.

Provide adequate ventilation and avoid skin and eye contact.

Isocyanate (Polyurethane) Adhesives/Sealers

See also Resin-based Adhesives

Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.

Over exposure is irritating to the eyes and respiratory system. Excessive concentrations may produce effects on the nervous system including drowsiness. In extreme cases, loss of consciousness may result. Long term exposure to vapour concentrations may result in adverse health effects.

Prolonged contact with the skin may lead to skin irritation and in some cases, dermatitis.

Splashes entering the eye will cause discomfort and possible damage.

Any spraying should preferably be carried out in ventilated booths which incorporate facilities for removing vapors and spray droplets from the breathing zone.

Wear appropriate gloves, eye and respiratory protection.

Antifreeze

May be flammable when undiluted.

Vapors may be given off from coolant antifreeze when heated. Avoid breathing these vapors.

Antifreeze may be absorbed through the skin in toxic or harmful quantities. Antifreeze, if swallowed, can be fatal; **SEEK IMMEDIATE MEDICAL ATTENTION.**

Battery Acids

See also Alkalis and Acids.

Gases released during battery charging are explosive. Always remove the battery from the vehicle prior to charging. Never use naked flames or allow sparks near charging or recently charged batteries. NEVER add acid to a battery, the chemical reaction produced will be violent and explosive. In cases of eye contact, wash affected area with copious amounts of water and **SEEK IMMEDIATE MEDICAL ATTENTION.**

Make sure there is adequate ventilation during battery charging, observe NO SMOKING POLICY.

Brake Pads and Linings

Always fit the correct grade and specification of brake pads and linings. When renewing pads and linings, always replace as complete axle sets.

Brake and Clutch Fluid

Splashes to the skin and eyes are irritating and in the long term can be damaging, avoid prolonged skin contact. In cases of eye contact, wash affected area with copious amounts of water and SEEK IMMEDIATE MEDICAL ATTENTION.

Chemical Materials

All chemical materials should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive, irritant or highly flammable and give rise to hazardous fumes and dusts.

The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening; or may reduce life expectancy.

Chemical Materials - Do's

- Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, posters or other instructions. Material health and safety data sheets can be obtained from manufacturers.
- Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
- Do organise work practices and protective clothing to avoid soiling of the skin and eyes.
- Do avoid breathing vapors, aerosols, dusts or fumes; inadequate container labelling; fire and explosion hazards.
- Do wash before job breaks, before eating, smoking, drinking or using toilet facilities when handling chemical materials.
- Do keep work areas clean, uncluttered and free of spills.
- Do store chemical materials according to national and local regulations.
- Do keep chemical materials out of the reach of children.

Chemical Materials - Do Not

- Do Not mix chemical materials except under the manufacturers instructions; some chemicals can form other toxic or harmful chemicals, give off toxic or harmful fumes or become explosive when mixed together.
- Do Not spray chemical materials, particularly those based on solvents, in confined spaces, for example when people are inside a vehicle.
- Do Not apply heat or flame to chemical materials except under the manufacturers instructions. Some are highly

flammable and some may release toxic or harmful fumes.

- Do Not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas such as pits.
- Do Not transfer chemical materials to unlabelled containers.
- Do Not clean hands or clothing with chemicals. Chemicals, particularly solvents and fuels, will dry skin and may cause irritation leading to dermatitis or be absorbed through the skin in toxic or harmful quantities.
- Do Not use emptied containers for other materials except when they have been cleaned under supervised conditions.
- Do Not sniff or smell chemical materials, even brief exposure to high concentrations of fumes can be toxic or harmful.

Corrosion Protection Materials

Some corrosion protection materials are highly flammable – observe NO SMOKING POLICY.

These materials are varied and the manufacturers instructions must always be followed. The materials may contain solvents, resins or petroleum products. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Dust

Dust or powder produced during repair operations may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

Fine dusts of combustible material can present an explosion hazard. Avoid explosive limits and sources of ignition.

Electrical Equipment

Electric shock can result from the use of faulty electrical equipment or from the misuse of equipment in good condition.

Make sure that electrical equipment is maintained in good condition and frequently tested. Faulty equipment should be labelled and preferably removed from the work station.

Make sure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged. If using cable reel extension equipment, ALWAYS ensure that the cable is fully unwound from the reel.

Make sure that electrical equipment and flexes do not come into contact with water.

Make sure that electrical equipment is protected by the correct rated fuse.

Never misuse electrical equipment and never use equipment which is in any way faulty. The results could be fatal.

Make sure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.

Make sure that the designated electrical workers are trained in basic First Aid.

In cases of electrocution:

- Switch off the power supply before approaching the victim.
- If this is not possible, **DO NOT TOUCH THE VICTIM** but push or drag the person from the source of electricity using dry, non-conductive material.
- Commence resuscitation if trained to do so.
- **SEEK IMMEDIATE MEDICAL ATTENTION.**

Exhaust Fumes

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should be run only under conditions of adequate exhaust extraction or general ventilation and not in confined spaces.

Gasoline (Petrol) engine

There may not be adequate warning of odour or of irritation before toxic or harmful effects arise. These may be immediate or delayed.

Gas Oil (Diesel engine)

Soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.

Fibre Insulation

The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect.

Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

Fire

Many of the materials found on or associated with the repair of vehicles are highly flammable. Some give off toxic or harmful fumes if burnt; others such as fluoroelastomers when burnt or damaged by excessive heat can break down and produce highly corrosive hydrofluoric acid - See Fluoroelastomers.

Should any material be in a burnt or overheated condition, handle with extreme caution and wear protective clothing when handling such items. Dispose of such material in accordance with local regulations.

Decontaminate and dispose of protective clothing immediately after use.

Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Make sure, before using electrical or welding equipment, that there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

First Aid

Apart from meeting any legal requirements it is desirable for someone in the workshop to be trained in First Aid procedures.

Splashes in the eye should be flushed carefully with clean water for at least ten minutes.

Soiled skin should be washed with soap and water.

In case of cold burns, from alternative fuels, place affected area in cool to cold water.

Individuals affected by inhalation of gases and fumes should be removed to fresh air immediately. If effects persist, consult a doctor.

If liquids are swallowed inadvertently, consult a doctor giving him the information on the container or label. Do not induce vomiting unless this action is indicated on the label.

Fluoroelastomers (Synthetic Rubber)

Many 'O' rings, seals, hoses, flexible pipes and other similar which appear to be manufactured from natural rubber are, in fact, made of synthetic materials called Fluoroelastomers.

Under normal operating conditions, these materials are safe and do not constitute a health hazard. However, if the materials are damaged by burning or exposure to excessive heat, they can break down and produce highly corrosive hydrofluoric acid.



WARNING: Contact with hydrofluoric acid can cause serious burns on contact with the skin. If skin contact does occur, carry out the following steps immediately:

Remove any contaminated clothing.

SEEK IMMEDIATE MEDICAL ATTENTION

Irrigate affected area of skin with copious amounts of cold water or limewater for 15 to 60 minutes.

Foams - Polyurethane

Used in sound and noise insulation. Cured foams used in seat and trim cushioning.

Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work in or near uncured materials.

The components, vapors or spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be inhaled. These materials must be applied with adequate ventilation and respiratory protection. Do not remove the respirator immediately after spraying, wait until the vapour/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes. Smoking, naked flames or the use of electrical equipment during foaming operations and until vapors/mists have cleared should not be allowed. Any heat cutting of cured foams or partially cured foams should be carried out in areas having suitable fume extraction equipment.

Fuels

Avoid skin contact with fuel where possible. Should contact occur, wash the affected skin with soap and water.

Gasoline (Petrol)

Highly flammable - OBSERVE NO SMOKING POLICY.

Swallowing gasoline (petrol) can result in mouth and throat irritation and absorption from the stomach can result in

drowsiness and unconsciousness. Small amounts can be fatal to children. Inhalation into the lungs, through vomiting, is a very serious hazard.

Gasoline (petrol) dries the skin and can cause irritation and prolonged or repeated contact may cause dermatitis; if it is allowed to enter the eyes, it will cause severe smarting. Wash affected area with copious amounts of water and **SEEK IMMEDIATE MEDICAL ATTENTION.**

Gasoline (petrol) may contain appreciable quantities of benzene, which is toxic upon inhalation and the concentration of vapors must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.

Make sure there is adequate ventilation when handling and using gasoline (petrol). Great care must be taken to avoid the serious consequences of inhalation in the event of vapour build up arising from spillages in confined spaces.

Special precautions apply to cleaning and maintenance operations on gasoline (petrol) storage tanks.

Gasoline (petrol) should not be used as a cleaning agent. It must not be siphoned by mouth.

Gas-oil (Diesel Fuel)

Combustible.

Prolonged skin contact with high boiling point gas oils (diesel fuel) may cause serious skin disorders including skin cancer.

Inhalation into the lungs will cause internal bleeding - **SEEK IMMEDIATE MEDICAL ATTENTION.**

If swallowed, DO NOT induce vomiting - SEEK IMMEDIATE MEDICAL ATTENTION.

Kerosene (Paraffin)

Used also as heating fuel, solvent and cleaning agent.

Flammable - OBSERVE NO SMOKING POLICY.

Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs.

Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating.

In normal circumstances the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperature should be avoided (mists may arise in dewaxing). Avoid skin and eye contact and make sure there is adequate ventilation.

If swallowed, DO NOT induce vomiting - SEEK IMMEDIATE MEDICAL ATTENTION.

Gas Cylinders

Gases such as oxygen, acetylene, argon and propane are normally stored in cylinders at pressures of up to 138 bar (13800 kPa) (2000 lbf/in²) and great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.

Cylinders should be stored in well ventilated enclosures, and protected from ice and snow or direct sunlight. Fuel gases, for example acetylene and propane should not be stored in close proximity to oxygen cylinders.

Care should be exercised to prevent leaks from gas cylinders and lines and also to avoid sources of ignition.

Only trained personnel should undertake work involving gas cylinders.

General Workshop Tools and Equipment

It is essential that all tools and equipment are maintained in good condition and the correct safety equipment is used where required.

Never use tools or equipment for any purpose other than that for which they were designed. Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time that the equipment is used.

Do not use damaged or defective tools or equipment, particularly high speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning and cause serious injury.

Wear suitable eye protection when using grinding, chiselling or sand blasting equipment.

Wear a suitable breathing mask when using abrasive blasting equipment or using spraying equipment.

Make sure there is adequate ventilation to control dusts, mists and fumes.

High Pressure Air, Lubrication and Oil Test Equipment

Always keep high pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Never direct a high pressure nozzle, for example diesel injector, at the skin as the fluid may penetrate to the underlying tissue and cause serious injury.

Jacking

Always refer to the Jacking and Lifting section of this manual prior to raising the vehicle off the ground.

When vehicle is to be raised by means of a jack, ensure that it is standing on level ground, that parking brake is applied and wheels are chocked. ALWAYS use the recommended jacking points and ensure that vehicle jack has sufficient load capacity for the weight of the vehicle.



WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Ensure that hoists have sufficient load capacity for the weight of the vehicle.

Legal Aspects

There are many laws and regulations relating to health and safety in the use and disposal of materials and equipment in a workshop.

For a safe working environment and to avoid environmental pollution, workshops should be familiar, in detail, with the many health and safety laws and regulations within their country, published by both national and local authorities.

Lubricants and Greases

Avoid all prolonged and repeated contact with mineral oils. All lubricants and greases may be irritating to the eyes and skin.

Used Engine Oil

Prolonged and repeated contact with engine oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities must be provided.

Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur.

Health Protection Precautions

- Avoid prolonged and repeated contact with oils, particularly used engine oils.
- Wear protective clothing, including impervious gloves where practicable.
- Do not put oily rags into pockets.
- Avoid contaminating clothes, particularly underpants, with oil.
- Heavily soiled clothing and oil-impregnated footwear should not be worn. Overalls must be cleaned regularly.
- First Aid treatment should be obtained immediately for open cuts and wounds.
- Use barrier creams, applying them before each work period, to help the removal of oil from the skin.
- Wash with soap and water to make sure all oil is removed (skin cleansers and nail brushes will help). Preparations containing lanoline replace the natural skin oils which have been removed.
- Do not use gasoline (petrol), kerosene (paraffin), diesel fuel (gas oil), thinners or solvents for cleaning skin.
- If skin disorders develop, obtain medical advice without delay.
- Where practicable, degrease components prior to handling.
- Where there is a risk of eye contact, eye protection should be worn, for example chemical goggles or face shields; in addition an eye wash facility should be provided.

Environmental Precautions

This section provides general information which can help to reduce the environmental impacts from the activities carried out in workshops.

Emissions to air

Many of the activities that are carried out in workshops emit gases and fumes which can contribute to global warming, depletion of the ozone layer and/or the formation of photochemical smog at ground level. By considering how the workshop activities are carried out, these gases and fumes can be minimised, thus reducing the impact on the environment.

Exhaust fumes

Running car engines is an essential part of workshop activities and exhaust fumes need to be ventilated to atmosphere. However, the amount of time engines are running and the position of the vehicle should be carefully considered at all times, to reduce the release of poisonous gases and minimise the inconvenience to people living nearby.

Solvents

Some of the cleaning agents used are solvent based and will evaporate rapidly to atmosphere if used carelessly, or if containers are left unsealed. All containers must be firmly closed when not required and solvent should be used sparingly. Wherever possible, solvents having a low toxicity and flammability should be selected. Always follow the instructions

supplied by the solvent manufacturer. Similarly, many paints are solvent based and the spray should be used in such a way as to reduce emissions to a minimum.

Refrigerant

It is illegal to release any refrigerant into the atmosphere. Discharge and replacement of these materials from air conditioning units should only be carried out using the appropriate equipment.

Discharges to water

Most workshops will have two systems for discharging waste water - storm drains and foul drains. Storm drains should only receive clean water i.e. rainwater. Foul drains will accept many of the normal waste water i.e. washing water, detergents and domestic type waste BUT NOT oil, petrol, solvent, acids, hydraulic fluid, antifreeze and similar fluids. If in doubt, always consult the local authority or water company.

Spillages

Every precaution must be taken to prevent spillage of oil, fuel, solvents etc., reaching the drains. All handling of such materials must take place well away from drains and preferably in an area with a suitable containing wall to prevent discharge into drains or watercourses. If a spillage occurs, it must be soaked up immediately using a spill kit where provided.

Checklist

Spillage prevention:

- Store liquids in a secure area.
- Make sure that taps on liquid containers are secure and cannot be accidentally turned on.
- Protect bulk storage tanks from vandalism by locking the valves.
- Transfer liquids from one container to another in an area away from open drains.
- Ensure lids are replaced securely on containers.
- Have spill kits available near to points of storage and liquid handling areas.

Spill Kits

Special materials are available to absorb a number of different substances. They can be in granular form, ready to use and are supplied in suitable containers. Disposal of used spill absorbing material is dealt with in Waste management.

Land contamination

Oils, fuels and solvents etc. can contaminate any soil with which they come into contact. Such materials MUST never be disposed of by pouring on to soil and every precaution must be taken to avoid spillage reaching soil. Waste materials stored on open ground could either leak or have contaminating substances washed off them that would contaminate the land. Always store these materials in suitable skips or similarly robust containers.

Legal compliance

Some sites may have a discharge consent for effluent discharge to the foul drain for a car wash etc. It is essential to know the types of effluent which are allowed to be discharged into the drain and to check the results of any monitoring carried out by the Water Company.

Where paint spraying operations are carried out it may be necessary to apply to the Local Authority for an air emissions licence to operate the plant. If such a licence is necessary, additional precautions will be necessary to comply with the requirements and the results of any air quality monitoring must be checked regularly.

Checklist

Always adhere to the following:

- Know what legal consents and licences apply to the operations.
- Check that the emissions and discharges comply with legal requirements.

Waste Management

Pollution can be reduced by careful handling, storage and disposal of all waste materials that occur on sites. Legislation makes it illegal to dispose of waste materials other than to licensed waste carriers and disposal sites.

This means that it is necessary to not only know what the waste materials are but also to have the necessary documentation and licences.

Handling and storage of waste

Ensure that waste materials are not poured down the drain or on to soil and are stored in such a way that they do not escape on to land or soil.

All waste must be segregated into individual types e.g. oils, metals, batteries, scrap components etc. This will prevent any reaction between different materials and assist in disposal.

Disposal of waste

Dispose of waste in accordance with the following guidelines:

- **Fuel, hydraulic fluid, anti-freeze and oil:** Keep separate and dispose of to specialist contractors.
- **Refrigerant:** Collect in specialist equipment and reuse.
- **Detergents:** Safe to pour down the foul drain if diluted.
- **Paint, thinners:** Keep separate and dispose of to specialist contractor.
- **Components:** Return to supplier for refurbishment or disassemble and reuse any suitable parts. Dispose of remainder in ordinary waste.
- **Small parts:** Reuse any suitable parts, dispose of the remainder in ordinary waste.
- **Metals:** Can be sold if separate from general waste.
- **Tyres:** Keep separate and dispose of to specialist contractor. DO NOT attempt to dispose of tyres by burning.
- **Components/materials containing asbestos:** Keep separate and dispose of to specialist contractor.
- **Oil and fuel wastes (e.g. rags, used spill kit material):** Keep separate and dispose of to specialist contractors.
- **Air filters:** Keep separate and dispose of to specialist contractors.
- **Rubber/plastics:** Dispose of in ordinary waste.
- **Hoses:** Dispose of in ordinary waste.
- **Batteries:** Keep separate and dispose of to specialist contractors.
- **Air bags - DANGER EXPLOSIVES:** Keep separate and dispose of to specialist contractors.
- **Electrical components:** Return to supplier for refurbishment or disassemble and reuse any suitable components. Dispose of remainder in ordinary waste.
- **Catalytic converters:** May be sold if kept separate from general waste.
- **Packaging:** Compact/recycle as much as possible and dispose of in ordinary waste.
- **Office/paper waste:** Recycle paper and toner and ink cartridges, dispose of remainder in ordinary waste.

Noise

Car alarm testing, panel beating, running engines, using air tools etc. are operations which invariably produce a large amount of noise. The location of such activities and also the time of day must be carefully considered having regard to the proximity of houses schools etc.

Some operations may produce high noise levels which could, in time, damage hearing. In these cases, suitable ear protection must be worn.

Solder

Solders are mixtures of metals such that the melting point of the mixture is below that of the constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes, provided a gas/air flame is used. Oxy-acetylene flames should not be used, as they are much hotter and will cause lead fumes to be produced.

Some fumes may be produced by the application of any flame to surfaces coated with grease, and inhalation of these should be avoided.

Removal of excess solder should be undertaken with care, to make sure that fine lead dust is not produced, which can give toxic effects if inhaled. Respiratory protection may be necessary.

Solder spillage and filings should be collected and removed promptly to prevent general air contamination by lead.

High standards of personal hygiene are necessary in order to avoid ingestion of lead or inhalation of solder dust from clothing.

Solvents

For example acetone, white spirit, toluene, xylene, trichloroethane.

Used in cleaning and dewaxing materials, paints, plastics, resins and thinners.

Some may be highly flammable or flammable.

Skin contact will degrease the skin and may result in irritation and dermatitis following repeated or prolonged contact. Some can be absorbed through the skin in toxic or harmful quantities.

Splashes in the eye may cause severe irritation and could lead to loss of vision.

Brief exposure of high concentrations of vapors or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness.

Repeated or prolonged exposure to excessive but lower concentrations of vapors or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects.

Aspiration into the lungs, for example through vomiting, is the most serious consequence of swallowing.

Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing if necessary.

Make sure there is good ventilation when in use, avoid breathing fumes, vapors and spray mists and keep containers tightly sealed. Do not use in confined spaces.

When spraying materials containing solvents, for example paints, adhesives, and metal coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.

Do not apply heat or flame except under specific and detailed manufacturers instructions.

Suspended Loads



CAUTION: Never improvise lifting tackle.

There is always a danger when loads are lifted or suspended. Never work under an unsupported, suspended or raised load, for example a suspended engine.

Always make sure that lifting equipment such as jacks, hoists, axle stands and slings are adequate and suitable for the job, in good condition and regularly maintained.

Viton

In common with many other manufacturers vehicles, some components installed to Land Rover vehicles have seals, 'O' rings or gaskets which contain a material known as 'Viton'.

Viton is a fluoroelastomer, that is a synthetic rubber type which contains Fluorine. Although Viton is the most well known fluoroelastomer, there are others, including Fluorel and Tecnoflon.

When used under design conditions fluoroelastomers are perfectly safe. If, however, they are exposed to temperatures in excess of 400°C, the material will not burn, but will decompose, and one of the products formed is hydrofluoric acid.

This acid is extremely corrosive and may be absorbed directly, through contact, into the general body system. **WHERE CASES OF SKIN CONTACT OCCUR, SEEK IMMEDIATE MEDICAL HELP.**

O-rings, seals or gaskets which have been exposed to very high temperatures will appear charred or as a black sticky substance.

DO NOT, under any circumstances touch them or the attached components.

Enquiries should be made to determine whether Viton or any other fluoroelastomer has been used in the affected O-ring, seal or gasket. If they are of natural rubber or nitrile there is no hazard. If in doubt, be cautious as the material may be Viton or any fluoroelastomer.

If Viton or any other fluoroelastomers have been used, the affected area should be decontaminated before the commencement of work.

Disposable heavy duty plastic gloves should be worn at all times, and the affected area washed down using wire wool and a limewater (calcium hydroxide) solution to neutralise the acid before disposing of the decomposed Viton residue and final cleaning of the area. After use, the plastic gloves should be discarded carefully and safely.

Welding

Welding processes include Resistance Welding (Spot Welding), Arc Welding and Gas Welding.

Resistance Welding

This process may cause particles of molten metal to be emitted at a high velocity, and the eyes and skin must be protected.

Arc Welding

This process emits a high level of ultra-violet radiation which may cause arc-eye and skin burns to the operator and to other persons nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens used to shield other people.

CONTACT LENS WEARERS ARE ADVISED TO REVERT TO ORDINARY SPECTACLES WHEN ARC WELDING as the arc spectrum is believed to emit microwaves which dry out the fluid between the lens and the eye. This may result in blindness when the lens is removed from the eye.

Metal spatter will also occur, and appropriate eye and skin protection is necessary.

The heat of the welding arc will produce fumes and gases from the metals being welded, the rods and from any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation of these should be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases or confined spaces where adequate ventilation cannot be provided, air-fed respirators may be necessary.



CAUTION: Some of the components installed to the vehicle e.g. the interior cross beam and underbonnet cross member are manufactured from magnesium alloy. On no account should any welding operations be attempted on these components.

Gas Welding (and Cutting)

Oxy-acetylene torches may be used for welding and cutting, and special care must be taken to prevent leakage of these gases, with consequent risk of fire and explosion.

The process will produce metal spatter and eye and skin protection is necessary.

The flame is bright, and eye protection should be used, but the ultra-violet emission is much less than that from arc welding, and lighter filters may be used.

The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts, and inhalation of the fumes should be avoided.

In brazing, toxic fumes may be produced from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. In this event particular care must be taken to avoid inhalation of fumes and expert advice may be required.

SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, FOR EXAMPLE BOILING OR STEAMING OUT OF FUEL TANKS.

Warning Symbols on Vehicles

Decals showing warning symbols will be found on various vehicle components.

These decals must not be removed. The warnings are for the attention of owners/operators and persons carrying out service or repair operations on the vehicle.

General Information - Special Tool Glossary

Description and Operation

Service Tools

Special service tools have been developed to facilitate removal, dismantling and assembly of mechanical components in a cost effective and time efficient manner. The use of such special tools also helps prevent the potential for damage to components.

Some operations described in this manual cannot be carried out properly without the aid of the relevant service tools.

All orders and enquiries from the United Kingdom and European countries except Germany, Austria, Switzerland and Spain and countries not in the following list should be sent direct to:

SPX UK Ltd.,

Genoa House,

Everdon Park,

Daventry,

Northants,

NN11 5YJ

England

Tel: 0044 (0) 1327 303467/303455

Fax: 0044 (0) 1327 706632

e-mail: spxsalesuk@servicesolutions.spx.com

Overseas orders for the following countries should be placed with the local distributor.

Germany, Austria and Switzerland

SPX Europe GMBH,

Porschestraße 4,

63512 Hainburg,

Germany

Tel: 0049 61829590

Fax: 0049 6182959299

Spain

SPX Iberica SA,

C/Francisco Arítio,

158 nave 72 (Nudo Oeste),

19004 Guadalajara,

Spain

Tel: 0034 949208381

Fax: 0034 949208327

North America

SPX Corporation

665, Eisenhower Drive,

Owatonna,

MN 55060,

USA

Tel: 0018 772979110

Fax: 0018 005787375

Australia

SPX Australia,

28, Clayton Road,

Notting Hill,

Victoria 3168,

Australia

Tel: 0061 00395446222

Fax: 0061 00395445222

e-mail: sales@spx.com.au

Japan and East Asia

Jatek Ltd.,

5 - 53, Minawacho 2-chome,

Kohoku-ku,

Yokohama,

Kanagawa 223-0051,

Japan

Tel: 0081 455627700

Fax: 0081 455627800

General Information - About This Manual

Description and Operation

Introduction

This manual has been written in a format that is designed to meet the needs of technicians worldwide. The objective is to use common formats and include similar content in each manual.

This manual provides general descriptions for accomplishing diagnosis and testing, service and repair work with tested and effective techniques. Following them will help to ensure reliability.

Important Safety Instructions

Appropriate service methods and correct repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual carrying out the work.

Anyone who departs from the instructions provided in this manual must first establish that personal safety or vehicle integrity is not compromised by the choice of method, tools or components.

Warnings, Cautions and Notes in This Manual



WARNING: Warnings are used to indicate that failure to follow a procedure correctly may result in personal injury.



CAUTION: Cautions are used to indicate that failure to follow a procedure correctly may result in damage to the vehicle or equipment being used.

NOTE: Notes are used to provide additional essential information required to carry out a complete and satisfactory repair.

Generic warnings or cautions are in their relevant description and operation procedure within section 100-00. If the generic warnings or cautions are required for a procedure, there will be a referral to the appropriate description and operation procedure.

If a warning, caution or note only applies to one step, it is placed at the beginning of the specific step.

Trustmark Authoring Standards (TAS) Removal and Installation Procedures

NOTE: TAS style procedures can be identified by steps that have no accompanying step text and the magenta color of the electrical connectors and fasteners such as nuts, bolts, clamps or clips.

A TAS removal and installation procedure uses a sequence of color illustrations to indicate the order to be followed when removing/disassembling or installing/assembling a component.

Many of the TAS procedures will have the installation information within the removal steps. These procedures will have the following note at the beginning of the procedure:

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

Items such as O-ring seals, gaskets, seals, self-locking nuts and bolts are to be discarded and new components installed unless otherwise stated within the procedure. Coated nuts or bolts are to be reused, unless damaged or otherwise stated within the procedure.

Specification procedures will contain all technical data that are not part of a repair procedure.

TAS Graphics

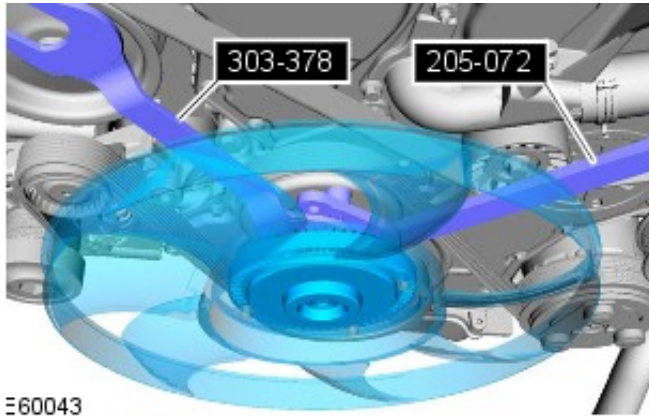
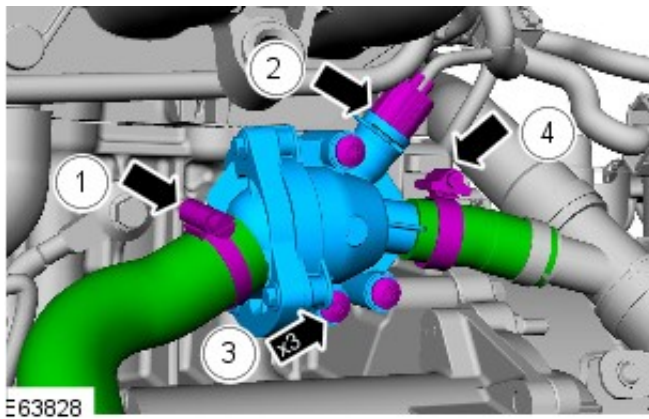
Colors used in the graphic are as follows:

- Blue - Indicates the target item, item to be removed/installed or disassembled/assembled
- Green and Brown - Indicates a secondary item that needs to be detached, removed/installed or disassembled/assembled prior to the target item
- Magenta - Indicates electrical connectors and fasteners such as nuts, bolts, clamps or clips
- Pale Blue - is for the special tool(s) and general equipment.

There may be multiple steps assigned to one illustration.

Numbered pointers are used to indicate the number of electrical connectors and fasteners such as nuts, bolts, clamps or clips.

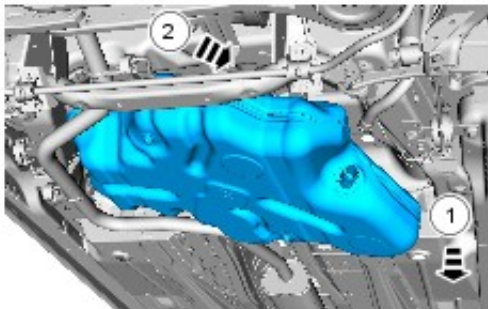
Items in the illustration can be transparent or use cutouts to show hidden detail(s).



TAS Symbols

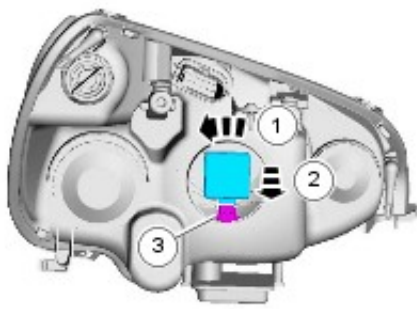
Symbols are used inside the graphics and in the text area to enhance the information display. The following paragraphs describe the various types and categories of symbols.

Prohibition symbols advise on prohibited actions to either avoid damage or health and safety related risks.



E85026

Health and Safety symbols recommend the use of particular protection equipment to avoid or at least reduce the risk or severity of possible injuries.

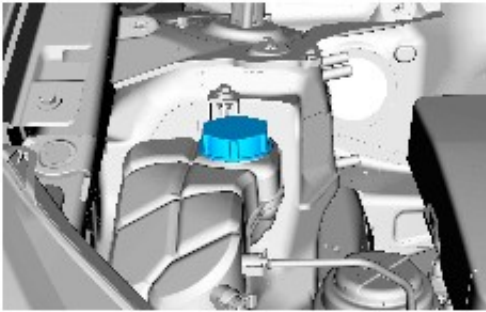


2.



E8 5027

Warning symbols are used to indicate potential risks resulting from a certain component or area.

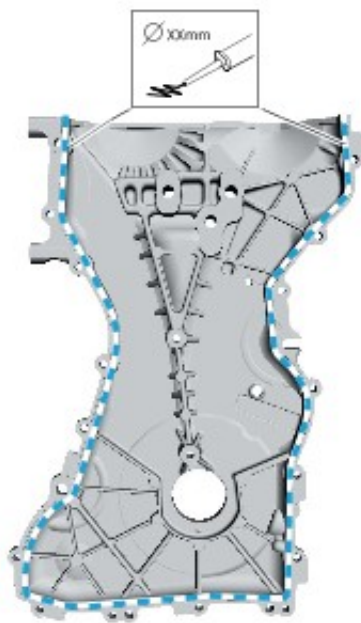


3.



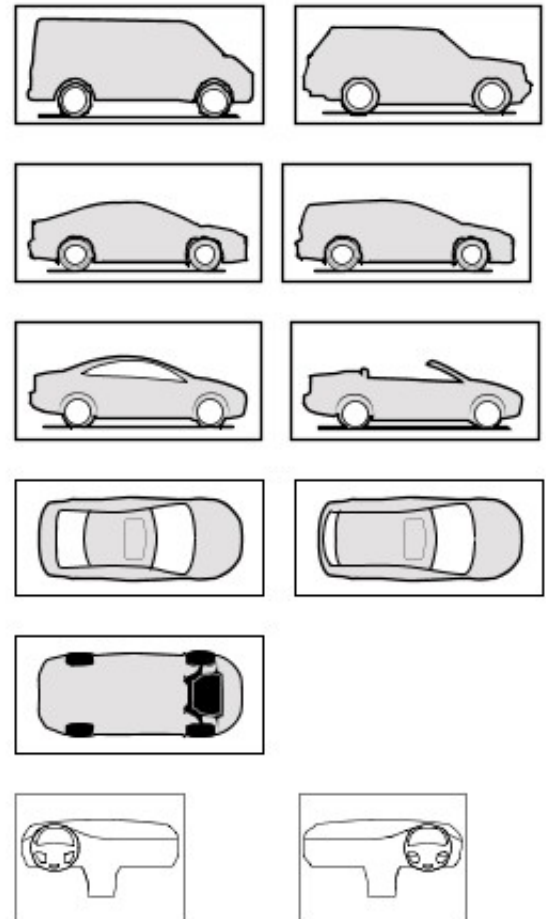
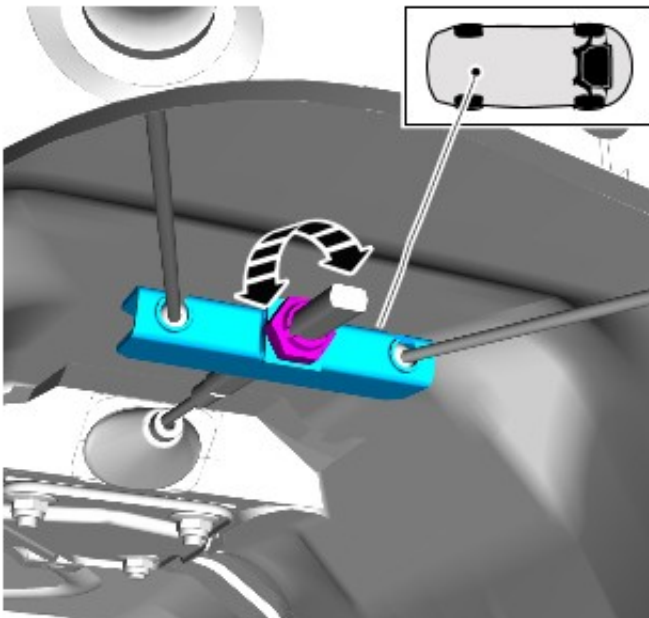
E8 5028

Instruction symbols are used to apply sealer, lubricant, weight, tape or cleaning detergent to a component.



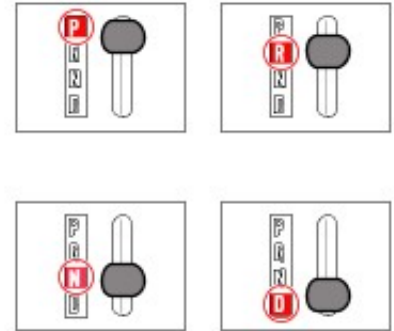
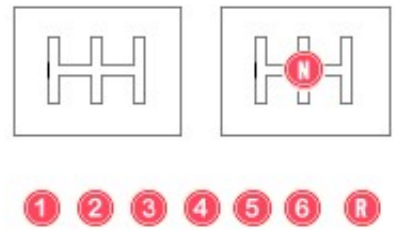
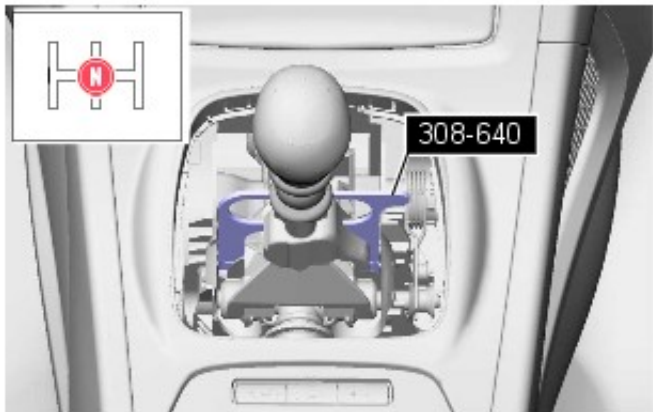
E84834

Location symbols are used to show the location of a component or system within the vehicle.



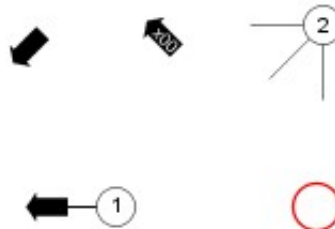
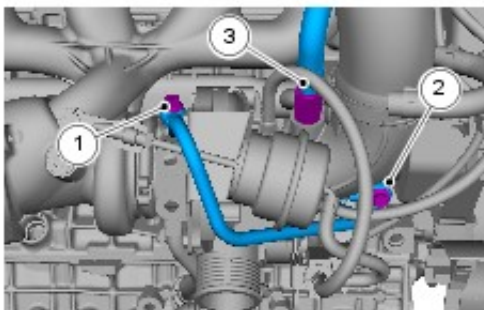
E84835

Gearshift lever or selector lever position symbols are used to show which gearshift lever or selector lever position is to be set.



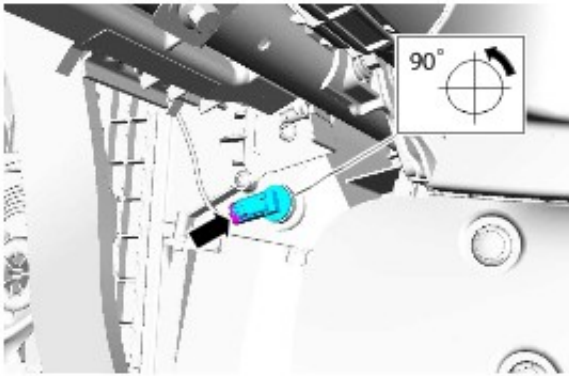
E84836

Pointer symbols are used to draw the attention to components and give special instructions such as a required sequence or number of components. The number of components is reflected by the value inside the luty arrow. A sequence number is located inside the circle. Numbers inside circles are also used to allocate special information such as tightening torques or chemicals to a particular component.



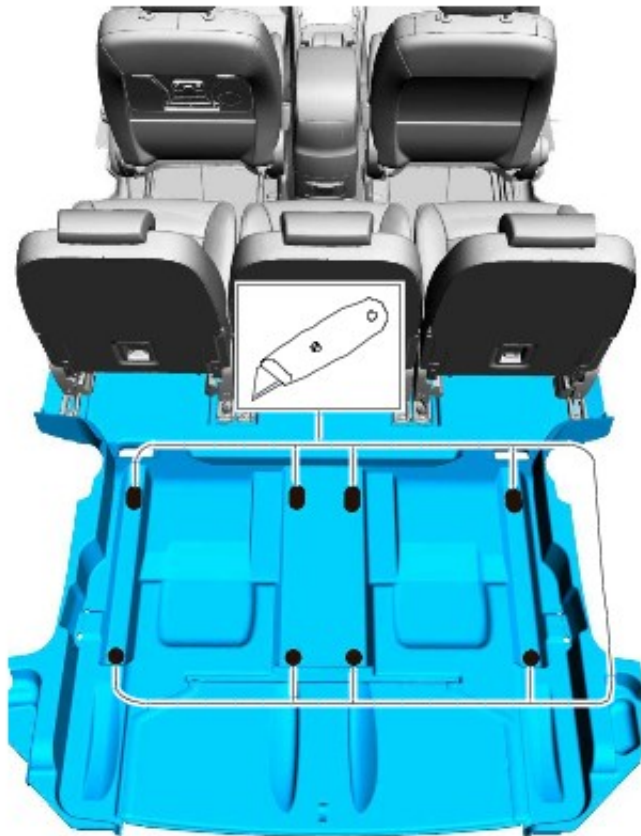
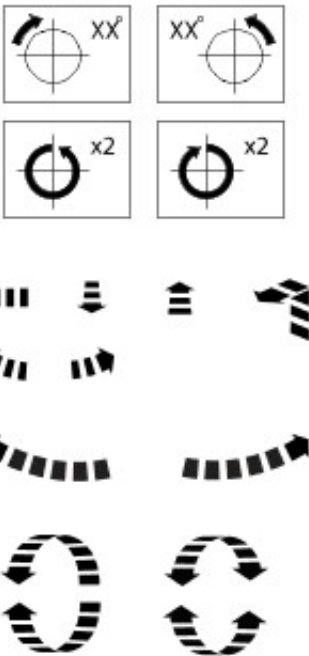
E84837

Movement arrows are used to show three dimensional or rotational movements. These movements can include specific values inside the symbol if required.



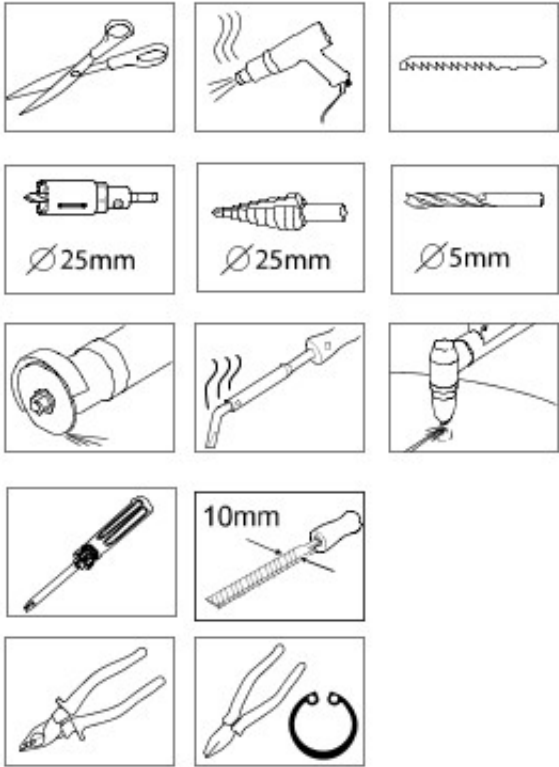
E84838

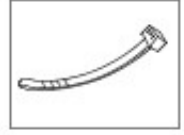
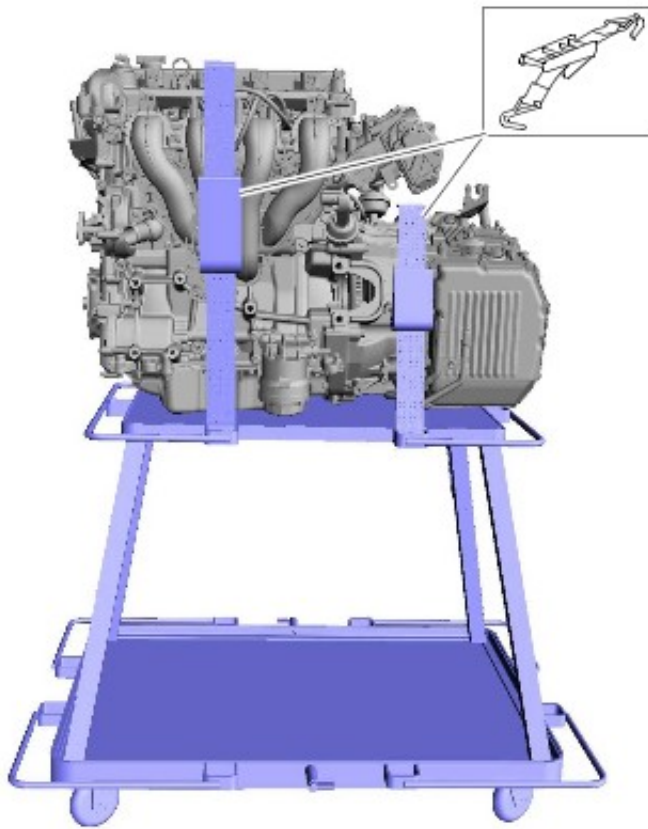
Standard tool symbols recommend the use of certain standard tools. These tools can include dimension values if required.



E84839

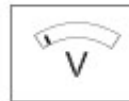
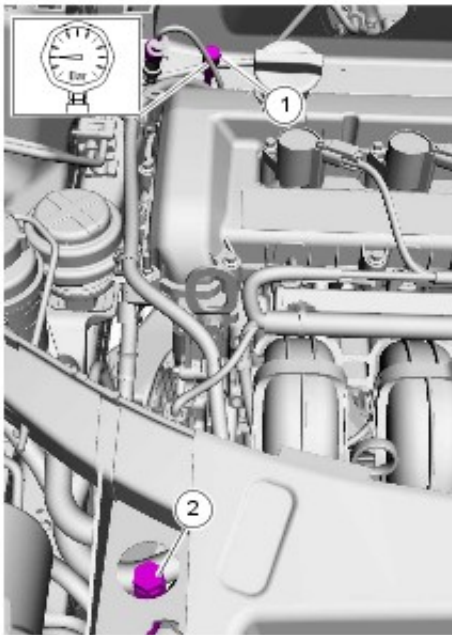
The following graphic illustrates a set of symbols that are used to provide detailed information on where to apply a material.





E84840

Measurement symbols provide detailed information on where to carry out a specific measurement. These symbols can include specific values if required.



E84841

Special Tools and Torque Figure(s)

Special tools will be shown with the tool number in the illustration. The special tool number(s), general equipment, material(s) and torque figure(s) used for the procedure step will be shown in the text column.

General Information - Diagnostic Trouble Code (DTC) Index

DTC: Engine Control Module (PCM)

Description and Operation

CAUTIONS:



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle



When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00

NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component

NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system)

NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the engine control module, for additional diagnosis and testing information refer to the relevant diagnosis and testing section. For additional information, refer to: (303-14 Electronic Engine Controls - ID4 2.2L Diesel)

[Electronic Engine Controls](#) (Description and Operation),

[Electronic Engine Controls](#) (Diagnosis and Testing).

DTC	Description	Possible causes	Action
B10A2-14	Crash Input - circuit short to ground or open	NOTE: - Circuit INSW - <ul style="list-style-type: none"> Crash input circuit, short circuit to ground, open circuit, high resistance Inertia switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the crash input circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new inertia switch as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1206-00	Crash Occurred - no sub type information	NOTE: - Circuit INSW - <ul style="list-style-type: none"> Engine control module has detected the vehicle has crashed/the inertia switch has been triggered Inertia switch circuit, short circuit to ground, short circuit to power, open circuit, high resistance Inertia switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the inertia switch circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new inertia switch as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0030-11	HO2S Heater Control Circuit (Bank 1, Sensor 1) - circuit short to ground	NOTE: - Circuit U HEATER - <ul style="list-style-type: none"> Front heated oxygen sensor 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the front heated oxygen sensor heater control circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new front

		heater control circuit short circuit to ground <ul style="list-style-type: none"> Front heated oxygen sensor internal failure 	heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0030-12	HO2S Heater Control Circuit (Bank 1, Sensor 1) - circuit short to battery	NOTE: - Circuit U HEATER - <ul style="list-style-type: none"> Front heated oxygen sensor heater control circuit short circuit to power Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the front heated oxygen sensor heater control circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0030-13	HO2S Heater Control Circuit (Bank 1, Sensor 1) - circuit open	NOTE: - Circuit U HEATER - <ul style="list-style-type: none"> Front heated oxygen sensor heater control circuit open circuit, high resistance Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the front heated oxygen sensor heater control circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0045-13	Turbocharger/Supercharger Boost Control A Circuit/Open - circuit open	NOTE: - Circuit VNT POS- <ul style="list-style-type: none"> Variable geometry turbocharger vane actuator circuit, open circuit, high resistance Variable geometry turbocharger vane actuator internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger vane actuator circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new variable geometry turbocharger vane actuator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0046-00	Turbocharger/Supercharger Boost Control A Circuit Range/Performance - no sub type information	NOTE: - Circuit VNT POS - <ul style="list-style-type: none"> Variable geometry turbocharger vane actuator circuit, short circuit to ground, open circuit, high resistance Variable geometry turbocharger vane actuator internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger vane actuator circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new variable geometry turbocharger vane actuator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0047-00	Turbocharger/Supercharger Boost Control A Circuit Low - no sub type information	NOTE: - Circuit VNT POS - <ul style="list-style-type: none"> Variable geometry turbocharger vane actuator circuit, short circuit to ground, open circuit, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger vane actuator circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new variable geometry turbocharger vane actuator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

		<ul style="list-style-type: none"> Variable geometry turbocharger vane actuator internal fault 	
P0047-11	Turbocharger/Supercharger Boost Control A Circuit Low - circuit short to ground	<p>NOTE: - Circuit VNT POS -</p> <ul style="list-style-type: none"> Variable geometry turbocharger vane actuator circuit, short circuit to ground Variable geometry turbocharger vane actuator internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger vane actuator circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new variable geometry turbocharger vane actuator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0048-00	Turbocharger/Supercharger Boost Control A Circuit High - no sub type information	<p>NOTE: - Circuit VNT POS -</p> <ul style="list-style-type: none"> Variable geometry turbocharger vane actuator circuit, short circuit to power Variable geometry turbocharger vane actuator internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger vane actuator circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new variable geometry turbocharger vane actuator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0048-12	Turbocharger/Supercharger Boost Control A Circuit High - circuit short to battery	<p>NOTE: - Circuit VNT POS -</p> <ul style="list-style-type: none"> Variable geometry turbocharger vane actuator circuit, short circuit to power Variable geometry turbocharger vane actuator internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger vane actuator circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new variable geometry turbocharger vane actuator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0069-92	MAP - Barometric Pressure Correlation - performance or incorrect operation	<ul style="list-style-type: none"> Manifold absolute pressure sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Manifold absolute pressure sensor failure Engine control module failure 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and check the manifold absolute pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new manifold absolute pressure sensor as required. Clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P007C-11	Charge Air Cooler Temperature Sensor Circuit Low (Bank 1) - circuit short to ground	<p>NOTE: - Circuit ACT -</p> <ul style="list-style-type: none"> Air charge temperature sensor circuit, short circuit to ground Air charge temperature sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the air charge temperature sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new air charge temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

P007D-15	Charge Air Cooler Temperature Sensor Circuit High (Bank 1) - circuit short to battery or open	<p>NOTE: - Circuit ACT -</p> <ul style="list-style-type: none"> • Air charge temperature sensor circuit, short circuit to power, open circuit, high resistance • Air charge temperature sensor internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the air charge temperature sensor circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new air charge temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P007E-27	Charge Air Cooler Temperature Sensor Circuit Intermittent/Erratic (Bank 1) - signal rate of change above threshold	<p>NOTE: - Circuit ACT -</p> <ul style="list-style-type: none"> • Air charge temperature sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance • Air charge temperature sensor internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the air charge temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new air charge temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0088-00	Fuel Rail/System Pressure - Too High - no sub type information	<ul style="list-style-type: none"> • Fuel starvation • Fuel lines restricted 	<ul style="list-style-type: none"> • Check the fuel lines for any signs of damage, crimping or restrictions, replace as required
P00BC-00	Mass or Volume Air Flow A Circuit Range/Performance - Air Flow Too Low - no sub type information	<p>NOTE: - Circuit FMAF -</p> <ul style="list-style-type: none"> • Airflow disruption at sensing element of mass air flow sensor A • Frequency mass airflow sensor internal failure 	<ul style="list-style-type: none"> • Refer to the relevant section of the workshop manual and check the induction system for air leaks, and obstructions to flow. Check the condition of the air filter and examine the induction pipes for debris which could disrupt air flow at the sensing element. Clear the DTC and retest the system • If the fault persists, check and install a new frequency mass airflow sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P00BD-00	Mass or Volume Air Flow A Circuit Range/Performance - Air Flow Too High - no sub type information	<p>NOTE: - Circuit FMAF -</p> <ul style="list-style-type: none"> • Boost pressure air leak at induction system • Frequency mass airflow sensor internal failure 	<ul style="list-style-type: none"> • Refer to the relevant section of the workshop manual and check for air leaks in the boost pressure system. Clear the DTC and retest the system • If the fault persists, check and install a new frequency mass airflow sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0100-36	Mass or Volume Air Flow Sensor "A" Circuit - signal frequency too low	<p>NOTE: - Circuit FMAF -</p> <ul style="list-style-type: none"> • Frequency mass airflow sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance • Frequency mass airflow sensor internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the frequency mass airflow sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new frequency mass airflow sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0101-16	Mass or Volume Air Flow Sensor "A" Circuit Range/Performance - circuit voltage below threshold	<p>NOTE: - Circuit FMAF -</p> <ul style="list-style-type: none"> • Frequency mass airflow sensor circuit, short circuit to ground, 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the frequency mass airflow sensor circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new

		<p>high resistance, open circuit</p> <ul style="list-style-type: none"> Frequency mass airflow sensor internal failure 	<p>frequency mass airflow sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component</p>
P0101-17	Mass or Volume Air Flow Sensor "A" Circuit Range/Performance - circuit voltage above threshold	<p>NOTE: - Circuit FMAF -</p> <ul style="list-style-type: none"> Frequency mass airflow sensor circuit, short circuit to power Frequency mass airflow sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the frequency mass airflow sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new frequency mass airflow sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0104-38	Mass or Volume Air Flow Sensor "A" Circuit Intermittent - signal frequency incorrect	<p>NOTE: - Circuit FMAF -</p> <ul style="list-style-type: none"> Frequency mass airflow sensor circuit, short circuit to ground, short circuit to power, high resistance, open circuit Frequency mass airflow sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the frequency mass airflow sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new frequency mass airflow sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0107-16	Manifold Absolute Pressure/Barometric Pressure Sensor Circuit Low - circuit voltage below threshold	<p>NOTE: - Circuit MAP -</p> <ul style="list-style-type: none"> Manifold absolute pressure sensor circuit, short circuit to ground, open circuit, high resistance Manifold absolute pressure sensor internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the manifold absolute pressure sensor circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new manifold absolute pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0108-17	Manifold Absolute Pressure/Barometric Pressure Sensor Circuit High - circuit voltage above threshold	<p>NOTE: - Circuit MAP -</p> <ul style="list-style-type: none"> Manifold absolute pressure sensor blockage Manifold absolute pressure sensor circuit, short circuit to power Manifold absolute pressure sensor internal fault 	<ul style="list-style-type: none"> Refer to the workshop manual and check the manifold absolute pressure sensor is correctly connected to the air intake manifold and there are no blockages or air leaks preventing communication of pressure changes between the manifold and the sensor Refer to the electrical circuit diagrams and check the manifold absolute pressure sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new manifold absolute pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0112-11	Intake Air Temperature Sensor 1 Circuit Low (Bank 1) - circuit short to ground	<p>NOTE: - Circuit IAT -</p> <ul style="list-style-type: none"> Mass airflow/intake air temperature sensor circuit, short circuit to ground Mass airflow/intake air temperature sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the mass airflow/intake air temperature sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new mass airflow/intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0113-15	Intake Air Temperature Sensor 1 Circuit High (Bank 1)	<p>NOTE: - Circuit IAT -</p>	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the

	1) - circuit short to battery or open	<ul style="list-style-type: none"> Mass airflow/intake air temperature sensor circuit, short circuit to power, open circuit, high resistance Mass airflow/intake air temperature sensor internal failure 	<p>mass airflow/intake air temperature sensor circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system</p> <ul style="list-style-type: none"> If the fault persists, check and install a new mass airflow/intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0113-17	Intake Air Temperature Sensor 1 Circuit High (Bank 1) - circuit voltage above threshold	<p>NOTE: - Circuit IAT -</p> <ul style="list-style-type: none"> Mass airflow/intake air temperature sensor circuit, short circuit to power Mass airflow/intake air temperature sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the mass airflow/intake air temperature sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new mass airflow/intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0114-27	Intake Air Temperature Sensor 1 Intermittent/Erratic (Bank 1) - signal rate of change above threshold	<p>NOTE: - Circuit IAT -</p> <ul style="list-style-type: none"> Mass airflow/intake air temperature sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Mass airflow/intake air temperature sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the mass airflow/intake air temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new mass airflow/intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0116-26	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - signal rate of change below threshold	<p>NOTE: - Circuit ECT -</p> <ul style="list-style-type: none"> Engine coolant level or flow fault Engine coolant temperature sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Engine coolant temperature sensor internal failure 	<ul style="list-style-type: none"> Refer to the workshop manual and check the engine cooling system to ensure the coolant condition and level is correct Refer to the electrical circuit diagrams and check the engine coolant temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine coolant temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0117-11	Engine Coolant Temperature Sensor 1 Circuit Low - circuit short to ground	<p>NOTE: - Circuit ECT -</p> <ul style="list-style-type: none"> Engine coolant temperature sensor circuit, short circuit to ground Engine coolant temperature sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine coolant temperature sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine coolant temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0118-15	Engine Coolant Temperature Sensor 1 Circuit High - circuit short	<p>NOTE: - Circuit ECT -</p> <ul style="list-style-type: none"> Engine coolant 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine coolant temperature sensor circuit for short circuit to power, open circuit, high resistance. Repair

	to battery or open	temperature sensor circuit, short circuit to power, open circuit, high resistance <ul style="list-style-type: none"> Engine coolant temperature sensor internal failure 	the circuit as required, clear the DTC and retest the system <ul style="list-style-type: none"> If the fault persists, check and install a new engine coolant temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0130-00	O2 Sensor Circuit (Bank 1 Sensor 1) - no sub type information	NOTE: - Circuit UEGO VIP - <ul style="list-style-type: none"> Front heated oxygen sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the front heated oxygen sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0130-11	O2 Sensor Circuit (Bank 1 Sensor 1) - circuit short to ground	NOTE: - Circuit UEGO VIP - <ul style="list-style-type: none"> Front heated oxygen sensor circuit, short circuit to ground Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the front heated oxygen sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0130-12	O2 Sensor Circuit (Bank 1 Sensor 1) - circuit short to battery	NOTE: - Circuit UEGO VIP - <ul style="list-style-type: none"> Front heated oxygen sensor circuit, short circuit to power Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the front heated oxygen sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0130-28	O2 Sensor Circuit (Bank 1 Sensor 1) - signal bias level out of range / zero adjustment failure	NOTE: - Circuit UEGO VN - <ul style="list-style-type: none"> Front heated oxygen sensor circuit, signal is out of range Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> Check the condition and operation of the exhaust system, check for associated DTCs in the same timeline and refer to the relevant DTC index. Clear the DTC and retest the system If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P014C-00	O2 Sensor Slow Response - Rich to Lean (Bank 1 Sensor 1) - no sub type information	<ul style="list-style-type: none"> Air leakage between front heated oxygen sensor and catalyst Heated oxygen sensor rear tip damaged Heated oxygen sensor rear tip blocked Heated oxygen sensor rear tip contaminated by excessive oil consumption 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index Check the front heated oxygen sensor is correctly installed in the catalyst Check heated oxygen sensor rear tip for damage Check heated oxygen sensor rear tip for blockage Check the heated oxygen sensor rear tip for oil contamination. Carry out an oil consumption check Check the heated oxygen sensor rear tip for contamination by poor or incorrect fuel. Check that the customer is using the correct grade of fuel

		<ul style="list-style-type: none"> Heated oxygen sensor rear tip contaminated by poor or incorrect fuel 	
P0181-26	Fuel Temperature Sensor A Circuit Range/Performance - signal rate of change above threshold	<p>NOTE: - Circuit FTS -</p> <ul style="list-style-type: none"> Fuel rail temperature sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Fuel rail temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0182-11	Fuel Temperature Sensor A Circuit Low - circuit short to ground	<p>NOTE: - Circuit FTS -</p> <ul style="list-style-type: none"> Fuel rail temperature sensor circuit short circuit to ground Fuel rail temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail temperature sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0183-15	Fuel Temperature Sensor A Circuit High - circuit short to battery or open	<p>NOTE: - Circuit FTS -</p> <ul style="list-style-type: none"> Fuel rail temperature sensor circuit short circuit to power, open circuit, high resistance Fuel rail temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail temperature sensor circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0184-27	Fuel Temperature Sensor A Circuit Intermittent - signal rate of change above threshold	<p>NOTE: - Circuit FTS -</p> <ul style="list-style-type: none"> Fuel rail temperature sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Fuel rail temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0191-23	Fuel Rail Pressure Sensor A Circuit Range/Performance - signal stuck low	<p>NOTE: - Circuit RPS -</p> <p>NOTE: Poor or non start in cold conditions</p> <ul style="list-style-type: none"> Low fuel pressure The engine control module measures a signal that remains low when transitions are expected Fuel rail pressure sensor circuit, short circuit to ground Fuel rail pressure 	<ul style="list-style-type: none"> Check the fuel system low pressure circuit for leaks/damage. Check the fuel filter and fuel volume control valve for blockages. Repair as required, clear the DTC and retest the system Refer to the electrical circuit diagrams and check the fuel rail pressure sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

		sensor failure	
P0191-24	Fuel Rail Pressure Sensor A Circuit Range/Performance - signal stuck high	<p>NOTE: - Circuit RPS -</p> <ul style="list-style-type: none"> Excessive fuel pressure The engine control module measures a signal that remains high when transitions are expected Fuel rail pressure sensor circuit, short circuit to power Fuel rail pressure sensor failure 	<ul style="list-style-type: none"> Check the fuel system low pressure circuit for leaks/damage. Check the fuel filter and fuel volume control valve for blockages. Repair as required, clear the DTC and retest the system Refer to the electrical circuit diagrams and check the fuel rail pressure sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0192-16	Fuel Rail Pressure Sensor A Circuit Low - circuit voltage below threshold	<p>NOTE: - Circuit RPS -</p> <ul style="list-style-type: none"> Fuel rail pressure sensor circuit, short circuit to ground, open circuit, high resistance Fuel rail pressure sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail pressure sensor circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0193-17	Fuel Rail Pressure Sensor A Circuit High - circuit voltage above threshold	<p>NOTE: - Circuit RPS -</p> <ul style="list-style-type: none"> Fuel rail pressure sensor circuit, short circuit to power Fuel rail pressure sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail pressure sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0194-27	Fuel Rail Pressure Sensor A Circuit Intermittent/Erratic - signal rate of change above threshold	<p>NOTE: - Circuit RPS -</p> <ul style="list-style-type: none"> Fuel rail pressure sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Fuel rail pressure sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel rail pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel rail pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0196-26	Engine Oil Temperature Sensor Range/Performance - signal rate of change below threshold	<p>NOTE: - Circuit OTS -</p> <ul style="list-style-type: none"> Engine oil temperature sensor signal circuit, short circuit to ground, short circuit to power, open circuit, high resistance Engine oil temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine oil temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine oil temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0197-11	Engine Oil Temperature Sensor Circuit Low - circuit short to ground	<p>NOTE: - Circuit OTS -</p> <ul style="list-style-type: none"> Engine oil temperature sensor signal circuit, short circuit to ground Engine oil 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine oil temperature sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine oil temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in

		temperature sensor failure	operation, prior to the installation of a new module/component
P0198-15	Engine Oil Temperature Sensor Circuit High - circuit short to battery or open	<p>NOTE: - Circuit OTS -</p> <ul style="list-style-type: none"> Engine oil temperature sensor signal circuit, short circuit to power, open circuit, high resistance Engine oil temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine oil temperature sensor circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine oil temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0199-27	Engine Oil Temperature Sensor Circuit Intermittent/Erratic - signal rate of change above threshold	<p>NOTE: - Circuit OTS -</p> <ul style="list-style-type: none"> Engine oil temperature sensor signal circuit, short circuit to ground, short circuit to power, open circuit, high resistance Engine oil temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine oil temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine oil temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0200-00	Injector Circuit - No sub type information	<ul style="list-style-type: none"> Engine control module injector power or ground circuits, short circuit to ground, short circuit to power, open circuit, high resistance Engine control module failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine control module injector power and ground circuits for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system Using the manufacturer approved diagnostic system check the engine control module for related DTCs and refer to the relevant DTC index Check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0200-01	Injector Circuit - General Electric Failure	<ul style="list-style-type: none"> Engine control module injector power or ground circuits, short circuit to ground, short circuit to power, open circuit, high resistance Engine control module failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine control module injector power and ground circuits for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system Using the manufacturer approved diagnostic system check the engine control module for related DTCs and refer to the relevant DTC index Check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0200-11	Injector Circuit - circuit short to ground	<p>NOTE: - Circuit INJ A L -</p> <ul style="list-style-type: none"> Engine control module injector power or ground circuits, short circuit to ground, open circuit, high resistance Engine control module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check the engine control module for related DTCs and refer to the relevant DTC index Refer to the electrical circuit diagrams and check the engine control module injector power and ground circuits for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

P0201-01	Cylinder 1 Injector Circuit / Open - General Electrical Failure	<p>NOTE: - Circuit INJ A L, INJ A H -</p> <ul style="list-style-type: none"> Number 1 fuel injector circuit, short circuit to ground, short circuit to power, open circuit, high resistance Number 1 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 1 fuel injector circuit, for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0201-13	Cylinder 1 Injector Circuit / Open - circuit open	<p>NOTE: - Circuit INJ A L, INJ A H -</p> <ul style="list-style-type: none"> Number 1 fuel injector circuit, open circuit, high resistance Number 1 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 1 fuel injector circuit, for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0202-01	Cylinder 2 Injector Circuit / Open - General Electrical Failure	<p>NOTE: - Circuit INJ D L, INJ D H -</p> <ul style="list-style-type: none"> Number 2 fuel injector circuit, short circuit to ground, short circuit to power, open circuit, high resistance Number 2 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 2 fuel injector circuit, for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0202-13	Cylinder 2 Injector Circuit / Open - circuit open	<p>NOTE: - Circuit INJ D L, INJ D H -</p> <ul style="list-style-type: none"> Number 2 fuel injector circuit, open circuit, high resistance Number 2 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 2 fuel injector circuit, for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0203-01	Cylinder 3 Injector Circuit / Open - General Electrical Failure	<p>NOTE: - Circuit INJ B L, INJ B H -</p> <ul style="list-style-type: none"> Number 3 fuel injector circuit, short circuit to ground, short circuit to power, open circuit, high resistance Number 3 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 3 fuel injector circuit, for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0203-13	Cylinder 3 Injector Circuit / Open - circuit open	<p>NOTE: - Circuit INJ B L, INJ B H -</p> <ul style="list-style-type: none"> Number 3 fuel injector circuit, open circuit, high resistance Number 3 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 3 fuel injector circuit, for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0204-01	Cylinder 4 Injector Circuit / Open - General Electrical Failure	<p>NOTE: - Circuit INJ C L, INJ C H -</p> <ul style="list-style-type: none"> Number 4 fuel injector circuit, short circuit to ground, short 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 4 fuel injector circuit, for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy

		circuit to power, open circuit, high resistance <ul style="list-style-type: none"> Number 4 injector failure 	and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0204-13	Cylinder 4 Injector Circuit / Open - circuit open	NOTE: - Circuit INJ C L, INJ C H - <ul style="list-style-type: none"> Number 4 fuel injector circuit, open circuit, high resistance Number 4 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 4 fuel injector circuit, for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0219-00	Engine Overspeed Condition - No sub type information	<ul style="list-style-type: none"> Injector leakage Oil pullover from the sump, causing the engine to run away 	<ul style="list-style-type: none"> Check the engine oil level, correct as necessary. Clear the DTC and retest the system Check all injectors for leakage, rectify as necessary. Clear the DTC and retest the system * Check the air intake system for excessive oil, rectify as necessary. Clear the DTC and retest the system
P0251-11	Injection Pump Fuel Metering Control A - circuit short to ground	NOTE: - Circuit VCV - <ul style="list-style-type: none"> Fuel volume control valve circuit, short circuit to ground Fuel volume control valve internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel volume control valve circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel volume control valve. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0251-12	Injection Pump Fuel Metering Control A - circuit short to battery	NOTE: - Circuit VCV - <ul style="list-style-type: none"> Fuel volume control valve circuit, short circuit to power Fuel volume control valve internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel volume control valve circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel volume control valve. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0251-13	Injection Pump Fuel Metering Control A - circuit open	NOTE: - Circuit VCV - <ul style="list-style-type: none"> Fuel volume control valve circuit, open circuit, high resistance Fuel volume control valve internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel volume control valve circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel volume control valve. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0251-71	Injection Pump Fuel Metering Control A - actuator stuck	NOTE: - Circuit VCV - <ul style="list-style-type: none"> Fuel volume control valve internal fault 	<ul style="list-style-type: none"> Check and install a new fuel volume control valve. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0263-00	Cylinder 1 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> Cylinder 1 injector leakage Injector(s) circuit short circuit to ground, short circuit to power, open circuit Cylinder 1 injector failure Cylinder 1 mechanical fault 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check for related injector DTCs If there are no injector DTCs, carry out a compression or cylinder leakage test to assess the mechanical condition of the affected cylinder If injector DTCs are present, follow the candidates indicated for those codes. Refer to the electrical circuit diagrams and check injector circuits for short circuit to ground, short circuit to power, open circuit Check injectors for leakage, rectify as necessary Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

P0266-00	Cylinder 2 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> • Cylinder 2 injector leakage • Injector(s) circuit short circuit to ground, short circuit to power, open circuit • Cylinder 2 injector failure • Cylinder 2 mechanical fault 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check for related injector DTCs • If there are no injector DTCs, carry out a compression or cylinder leakage test to assess the mechanical condition of the affected cylinder • If injector DTCs are present, follow the candidates indicated for those codes. Refer to the electrical circuit diagrams and check injector circuits for short circuit to ground, short circuit to power, open circuit • Check injectors for leakage, rectify as necessary • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0269-00	Cylinder 3 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> • Cylinder 3 injector leakage • Injector(s) circuit short circuit to ground, short circuit to power, open circuit • Cylinder 3 injector failure • Cylinder 3 mechanical fault 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check for related injector DTCs • If there are no injector DTCs, carry out a compression or cylinder leakage test to assess the mechanical condition of the affected cylinder • If injector DTCs are present, follow the candidates indicated for those codes. Refer to the electrical circuit diagrams and check injector circuits for short circuit to ground, short circuit to power, open circuit • Check injectors for leakage, rectify as necessary • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0272-00	Cylinder 4 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> • Cylinder 4 injector leakage • Injector(s) circuit short circuit to ground, short circuit to power, open circuit • Cylinder 4 injector failure • Cylinder 4 mechanical fault 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check for related injector DTCs • If there are no injector DTCs, carry out a compression or cylinder leakage test to assess the mechanical condition of the affected cylinder • If injector DTCs are present, follow the candidates indicated for those codes. Refer to the electrical circuit diagrams and check injector circuits for short circuit to ground, short circuit to power, open circuit • Check injectors for leakage, rectify as necessary • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P029A-00	Cylinder 1 - Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> • Fuel lines to cylinder 1 injector blocked • Cylinder 1 injector failure • Fuel pump fault • Fuel volume control valve fault 	<ul style="list-style-type: none"> • Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 1 injector. Repair as required • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component • Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P029B-00	Cylinder 1 - Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> • Fuel lines to cylinder 1 injector blocked • Cylinder 1 injector failure • Fuel pump fault • Fuel volume control valve fault 	<ul style="list-style-type: none"> • Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 1 injector. Repair as required • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component • Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P029D-96	Cylinder 1 - Injector Leaking - component	<ul style="list-style-type: none"> • Cylinder 1 injector leakage 	<ul style="list-style-type: none"> • Check injectors for leakage • Check and install a new injector(s) as required. Refer

	internal failure		to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P029E-00	Cylinder 2 - Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> Fuel lines to cylinder 2 injector blocked Cylinder 2 injector failure Fuel pump fault Fuel volume control valve fault 	<ul style="list-style-type: none"> Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 2 injector. Repair as required Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P029F-00	Cylinder 2 - Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> Fuel lines to cylinder 2 injector blocked Cylinder 2 injector failure Fuel pump fault Fuel volume control valve fault 	<ul style="list-style-type: none"> Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 2 injector. Repair as required Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P02A1-96	Cylinder 2 - Injector Leaking - component internal failure	<ul style="list-style-type: none"> Cylinder 2 injector leakage 	<ul style="list-style-type: none"> Check injectors for leakage Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02A2-00	Cylinder 3 - Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> Fuel lines to cylinder 3 injector blocked Cylinder 3 injector failure Fuel pump fault Fuel volume control valve fault 	<ul style="list-style-type: none"> Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 3 injector. Repair as required Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P02A3-00	Cylinder 3 - Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> Fuel lines to cylinder 3 injector blocked Cylinder 3 injector failure Fuel pump fault Fuel volume control valve fault 	<ul style="list-style-type: none"> Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 3 injector. Repair as required Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P02A5-96	Cylinder 3 - Injector Leaking - component internal failure	<ul style="list-style-type: none"> Cylinder 3 injector leakage 	<ul style="list-style-type: none"> Check injectors for leakage Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02A6-00	Cylinder 4 - Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> Fuel lines to cylinder 4 injector blocked Cylinder 4 injector failure Fuel pump fault Fuel volume control valve 	<ul style="list-style-type: none"> Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 4 injector. Repair as required Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

		fault	<ul style="list-style-type: none"> Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P02A7-00	Cylinder 4 - Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> Fuel lines to cylinder 4 injector blocked Cylinder 4 injector failure Fuel pump fault Fuel volume control valve fault 	<ul style="list-style-type: none"> Check for blocked or obstructed fuel lines or other fuel restrictions to cylinder 4 injector. Repair as required Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component Check for other injector-related DTCs. If other cylinders are affected, then check operation of fuel pump and fuel volume control valve
P02A9-96	Cylinder 4 - Injector Leaking - component internal failure	<ul style="list-style-type: none"> Cylinder 4 injector leakage 	<ul style="list-style-type: none"> Check injectors for leakage Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02CC-00	Cylinder 1 Fuel Injector Offset Learning at Min Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 1 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02CD-00	Cylinder 1 Fuel Injector Offset Learning at Max Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 1 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02CE-00	Cylinder 2 Fuel Injector Offset Learning at Min Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 2 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02CF-00	Cylinder 2 Fuel Injector Offset Learning at Max Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 2 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02D0-00	Cylinder 3 Fuel Injector Offset Learning at Min Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 3 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02D1-00	Cylinder 3 Fuel Injector Offset Learning at Max Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 3 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02D2-00	Cylinder 4 Fuel Injector Offset Learning at Min Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 4 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02D3-00	Cylinder 4 Fuel Injector Offset Learning at Max Limit - no sub type information	<ul style="list-style-type: none"> Cylinder 4 injector fault, possible blockage or leak 	<ul style="list-style-type: none"> Check for blockage/leakage from the injector and rectify as necessary. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02EE-00	Cylinder 1 Injector Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit INJ A L -</p> <ul style="list-style-type: none"> Number 1 fuel injector circuit, short circuit to ground, short 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 1 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system

		<p>circuit to power, short circuit to each other, open circuit, high resistance</p> <ul style="list-style-type: none"> Number 1 injector failure 	<ul style="list-style-type: none"> If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02EE-01	Cylinder 1 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ A L -</p> <ul style="list-style-type: none"> Number 1 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance Number 1 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 1 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02EE-21	Cylinder 1 Injector Circuit Range/Performance - signal amplitude < minimum	<p>NOTE: - Circuit INJ A L -</p> <ul style="list-style-type: none"> Circuit voltage below expected range Cylinder 1 injector fault 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02EE-22	Cylinder 1 Injector Circuit Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit INJ A L -</p> <ul style="list-style-type: none"> Circuit voltage above expected range Cylinder 1 injector fault 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02EE-29	Cylinder 1 Injector Circuit Range/Performance - signal signal invalid	<p>NOTE: - Circuit INJ A L -</p> <ul style="list-style-type: none"> Circuit signal not plausible given operating conditions Cylinder 1 injector fault 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02EF-00	Cylinder 2 Injector Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit INJ D L -</p> <ul style="list-style-type: none"> Number 2 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance Number 2 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 2 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02EF-01	Cylinder 2 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ D L -</p> <ul style="list-style-type: none"> Number 2 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance Number 2 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 2 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02EF-21	Cylinder 2 Injector Circuit Range/Performance -	<p>NOTE: - Circuit INJ D L -</p>	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system

	signal amplitude < minimum	<ul style="list-style-type: none"> • Circuit voltage below expected range • Cylinder 2 injector fault 	
P02EF-22	Cylinder 2 Injector Circuit Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit INJ D L -</p> <ul style="list-style-type: none"> • Circuit voltage above expected range • Cylinder 2 injector fault 	<ul style="list-style-type: none"> • Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02EF-29	Cylinder 2 Injector Circuit Range/Performance - signal signal invalid	<p>NOTE: - Circuit INJ D L -</p> <ul style="list-style-type: none"> • Circuit signal not plausible given operating conditions • Cylinder 2 injector fault 	<ul style="list-style-type: none"> • Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02F0-00	Cylinder 3 Injector Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit INJ B L -</p> <ul style="list-style-type: none"> • Number 3 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance • Number 3 injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check number 3 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02F0-01	Cylinder 3 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ B L -</p> <ul style="list-style-type: none"> • Number 3 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance • Number 3 injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check number 3 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02F0-21	Cylinder 3 Injector Circuit Range/Performance - signal amplitude < minimum	<p>NOTE: - Circuit INJ B L -</p> <ul style="list-style-type: none"> • Circuit voltage below expected range • Cylinder 3 injector fault 	<ul style="list-style-type: none"> • Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02F0-22	Cylinder 3 Injector Circuit Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit INJ B L -</p> <ul style="list-style-type: none"> • Circuit voltage above expected range • Cylinder 3 injector fault 	<ul style="list-style-type: none"> • Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02F0-29	Cylinder 3 Injector Circuit Range/Performance - signal signal invalid	<p>NOTE: - Circuit INJ B L -</p> <ul style="list-style-type: none"> • Circuit signal not plausible given operating conditions • Cylinder 3 injector fault 	<ul style="list-style-type: none"> • Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02F1-	Cylinder 4 Injector Circuit	<p>NOTE: - Circuit INJ C L -</p>	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check

00	Range/Performance - no sub type information	<ul style="list-style-type: none"> Number 4 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance Number 4 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 4 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02F1-01	Cylinder 4 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ C L -</p> <ul style="list-style-type: none"> Number 4 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance Number 4 injector failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check number 4 fuel injector circuit, for short circuit to ground, short circuit to power, short circuit to each other, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P02F1-21	Cylinder 4 Injector Circuit Range/Performance - signal amplitude < minimum	<p>NOTE: - Circuit INJ C L -</p> <ul style="list-style-type: none"> Circuit voltage below expected range Cylinder 4 injector fault 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02F1-22	Cylinder 4 Injector Circuit Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit INJ C L -</p> <ul style="list-style-type: none"> Circuit voltage above expected range Cylinder 4 injector fault 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P02F1-29	Cylinder 4 Injector Circuit Range/Performance - signal signal invalid	<p>NOTE: - Circuit INJ C L -</p> <ul style="list-style-type: none"> Circuit signal not plausible given operating conditions Cylinder 4 injector fault 	<ul style="list-style-type: none"> Check for related DTCs and refer to the relevant DTC index. Clear the DTC and retest the system
P0300-00	Random Misfire Detected - No sub type information	<ul style="list-style-type: none"> Catalyst/exhaust system blockage Injector(s) circuit, short circuit to ground, short circuit to power, open circuit Injector(s) failure 	<ul style="list-style-type: none"> Check engine control module for related misfire DTCs and refer to this DTC index Check the fuel system for blockages, repair as required Check the catalyst/exhaust system for blockage, repair as required Refer to the electrical circuit diagrams and check injector(s) circuit for short circuit to ground, short circuit to power, open circuit Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0301-00	Cylinder 1 Misfire Detected - No sub type information	<ul style="list-style-type: none"> Catalyst/exhaust system blockage Injector(s) circuit, short circuit to ground, short circuit to power, open circuit Injector(s) failure 	<ul style="list-style-type: none"> Check engine control module for related misfire DTCs and refer to this DTC index Check the fuel system for blockages, repair as required Check the catalyst/exhaust system for blockage, repair as required Refer to the electrical circuit diagrams and check injector(s) circuit for short circuit to ground, short circuit to power, open circuit

			<ul style="list-style-type: none"> • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0302-00	Cylinder 2 Misfire Detected - No sub type information	<ul style="list-style-type: none"> • Catalyst/exhaust system blockage • Injector(s) circuit, short circuit to ground, short circuit to power, open circuit • Injector(s) failure 	<ul style="list-style-type: none"> • Check engine control module for related misfire DTCs and refer to this DTC index • Check the fuel system for blockages, repair as required • Check the catalyst/exhaust system for blockage, repair as required • Refer to the electrical circuit diagrams and check injector(s) circuit for short circuit to ground, short circuit to power, open circuit • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0303-00	Cylinder 3 Misfire Detected - No sub type information	<ul style="list-style-type: none"> • Catalyst/exhaust system blockage • Injector(s) circuit, short circuit to ground, short circuit to power, open circuit • Injector(s) failure 	<ul style="list-style-type: none"> • Check engine control module for related misfire DTCs and refer to this DTC index • Check the fuel system for blockages, repair as required • Check the catalyst/exhaust system for blockage, repair as required • Refer to the electrical circuit diagrams and check injector(s) circuit for short circuit to ground, short circuit to power, open circuit • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0304-00	Cylinder 4 Misfire Detected - No sub type information	<ul style="list-style-type: none"> • Catalyst/exhaust system blockage • Injector(s) circuit, short circuit to ground, short circuit to power, open circuit • Injector(s) failure 	<ul style="list-style-type: none"> • Check engine control module for related misfire DTCs and refer to this DTC index • Check the fuel system for blockages, repair as required • Check the catalyst/exhaust system for blockage, repair as required • Refer to the electrical circuit diagrams and check injector(s) circuit for short circuit to ground, short circuit to power, open circuit • Check and install a new injector(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0335-78	Crankshaft Position Sensor A Circuit - alignment or adjustment incorrect	<p>NOTE: - Circuit BDCPS -</p> <ul style="list-style-type: none"> • Crankshaft position sensor or reference target positioning incorrect • Crankshaft position sensor target wheel fault • Crankshaft position sensor foreign matter on sensor face, gap incorrect 	<ul style="list-style-type: none"> • Refer to the relevant section of the workshop manual and check the camshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required • Refer to the relevant section of the workshop manual and check the crankshaft position sensor for foreign matter on the crankshaft position sensor face, rectify as necessary. Check the crankshaft position sensor air gap (check at 90° intervals, should be no greater than 4.5mm), rectify as necessary
P0336-31	Crankshaft Position Sensor A Circuit Range/Performance - no signal	<p>NOTE: - Circuit BDCPS -</p> <ul style="list-style-type: none"> • Crankshaft position sensor circuit, short circuit to ground, short circuit to power, open 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the crankshaft position sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • Refer to the relevant section of the workshop manual and check the crankshaft position sensor and target wheel for correct installation, condition and

		circuit, high resistance <ul style="list-style-type: none"> • Crankshaft position sensor failure • Crankshaft position sensor target wheel fault 	alignment. Repair as required <ul style="list-style-type: none"> • If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new crankshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0336-38	Crankshaft Position Sensor A Circuit Range/Performance - signal frequency incorrect	<ul style="list-style-type: none"> • Crankshaft position sensor circuit shielding failure • Crankshaft position sensor failure • Crankshaft position sensor target wheel fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the crankshaft position sensor shielding circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new crankshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0336-64	Crankshaft Position Sensor A Circuit Range/Performance - signal plausibility failure	<ul style="list-style-type: none"> • Crankshaft position sensor circuit shielding failure • Crankshaft position sensor foreign matter on sensor face, gap incorrect • Crankshaft position sensor failure • Crankshaft position sensor target wheel fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the crankshaft position sensor shielding circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • Refer to the relevant section of the workshop manual and check the crankshaft position sensor for foreign matter on the crankshaft position sensor face, rectify as necessary. Check the crankshaft position sensor air gap (check at 90° intervals, should be no greater than 4.5mm), rectify as necessary • Refer to the relevant section of the workshop manual and check the crankshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required • If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new crankshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0336-66	Crankshaft Position Sensor A Circuit Range/Performance - signal has too many transitions/events	NOTE: - Circuit BDCPS - <ul style="list-style-type: none"> • Crankshaft position sensor circuit shielding failure • Crankshaft position sensor failure • Crankshaft position sensor target wheel fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the crankshaft position sensor shielding circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • Refer to the relevant section of the workshop manual and check the crankshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required • If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new crankshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0336-67	Crankshaft Position Sensor A Circuit Range/Performance - signal incorrect after event	NOTE: - Circuit BDCPS - <ul style="list-style-type: none"> • Crankshaft position sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance • Crankshaft position sensor failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the crankshaft position sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • Refer to the relevant section of the workshop manual and check the crankshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required • If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new crankshaft position sensor as required. Refer to the warranty policy and procedures manual, or

			determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0341-29	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor) - signal signal invalid	<p>NOTE: - Circuit CID -</p> <ul style="list-style-type: none"> The value of the signal measured by the engine control module is not plausible given the operating conditions Camshaft position sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Camshaft position sensor or reference target positioning incorrect Camshaft position sensor internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the camshaft position sensor circuit for short circuit to ground, short circuit to power. Repair the circuit as required, clear the DTC and retest the system Refer to the relevant section of the workshop manual and check the camshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new camshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0341-3A	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor) - incorrect has too many pulses	<p>NOTE: - Circuit CID -</p> <ul style="list-style-type: none"> Camshaft position sensor circuit, short circuit to ground, short circuit to power Camshaft position sensor or reference target positioning incorrect Camshaft position sensor internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the camshaft position sensor circuit for short circuit to ground, short circuit to power. Repair the circuit as required, clear the DTC and retest the system Refer to the relevant section of the workshop manual and check the camshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new camshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0342-31	Camshaft Position Sensor A Circuit Low (Bank 1 or single sensor) - no signal	<p>NOTE: - Circuit CID -</p> <ul style="list-style-type: none"> Camshaft position sensor circuit, open circuit, high resistance Camshaft position sensor or reference target positioning incorrect Camshaft position sensor internal fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft position sensor circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system Refer to the relevant section of the workshop manual and check the camshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required If no fault is found in the wiring harness and the sensor/target installation is correct, check and install a new camshaft position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0380-81	Glow Plug/Heater Circuit A - invalid serial data received	<ul style="list-style-type: none"> The engine control module has not received the expected glow plug signal via the feedback circuit Glow plug control module internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the glow plug module feedback circuit. Repair the circuit as required Check and install a new glow plug control module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0381-	Glow Plug/Heater Indicator	<p>NOTE: - Circuit GPFB -</p>	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the

12	Circuit - circuit short to battery	<ul style="list-style-type: none"> Indicator control circuit from the glow plug relay to instrument cluster, short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the indicator control circuit from the glow plug relay for short circuit to power. Repair the circuit as required
P0381-13	Glow Plug/Heater Indicator Circuit - circuit open	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> Indicator control circuit from the glow plug relay to instrument cluster, open circuit, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the indicator control circuit from the glow plug relay for open circuit, high resistance. Repair the circuit as required
P0383-11	Glow Plug Control Module 1 Control Circuit Low - circuit short to ground	<p>NOTE: - Circuit GPC -</p> <ul style="list-style-type: none"> Glow plug control module control circuit, short circuit to ground Glow plug control module internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the glow plug control module control circuit from the engine control module to the glow plug control module for short circuit to ground. Repair the circuit as required If no fault is found in the wiring harness, check and install a new glow plug control module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0384-12	Glow Plug Control Module 1 Control Circuit High - circuit short to battery	<p>NOTE: - Circuit GPC -</p> <ul style="list-style-type: none"> Glow plug control module control circuit, short circuit to power Glow plug control module internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the glow plug control module control circuit from the engine control module to the glow plug control module for short circuit to power. Repair the circuit as required If no fault is found in the wiring harness, check and install a new glow plug control module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0401-21	Exhaust Gas Recirculation A Flow Insufficient Detected - signal amplitude < minimum	<ul style="list-style-type: none"> Exhaust gas recirculation gas transfer system, mixer pipe or cooler leakage Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Check the exhaust gas recirculation gas transfer system for leakage. Clear the DTC and retest the system Check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0402-22	Exhaust Gas Recirculation A Flow Excessive Detected - signal amplitude > maximum	<ul style="list-style-type: none"> Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0403-11	Exhaust Gas Recirculation "A" Control Circuit / Open - circuit short to ground	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve circuit, short circuit to ground, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If no fault is found in the wiring harness, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0403-12	Exhaust Gas Recirculation "A" Control Circuit / Open - circuit short to battery	<p>NOTE: - Circuit EVA POS, EVA NEG -</p>	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve circuit for short circuit to power, open circuit, high resistance. Repair the

		<ul style="list-style-type: none"> Exhaust gas recirculation valve circuit, short circuit to power, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<p>circuit as required, clear the DTC and retest the system</p> <ul style="list-style-type: none"> If no fault is found in the wiring harness, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0403-13	Exhaust Gas Recirculation "A" Control Circuit / Open - open circuit	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve circuit, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If no fault is found in the wiring harness, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0404-21	Exhaust Gas Recirculation A Control Circuit Range/Performance - signal amplitude < minimum	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> Exhaust gas recirculation gas transfer system, mixer pipe or cooler leakage Exhaust gas recirculation valve circuit, short circuit to ground, short circuit to power, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Check the exhaust gas recirculation gas transfer system for leakage. Clear the DTC and retest the system Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If no fault is found in the wiring harness, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0404-22	Exhaust Gas Recirculation A Control Circuit Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve circuit, short circuit to ground, short circuit to power, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If no fault is found in the wiring harness, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0405-14	Exhaust Gas Recirculation Sensor A Circuit Low - circuit short to ground or open	<p>NOTE: - Circuit EVP -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve position sensor circuit, short circuit to ground, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve position sensor circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

P0406-12	Exhaust Gas Recirculation Sensor A Circuit High - circuit short to battery	<p>NOTE: - Circuit EVP -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve position sensor circuit, short circuit to power Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve position sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0409-77	Exhaust Gas Recirculation Sensor A Circuit - commanded position not reachable	<ul style="list-style-type: none"> Exhaust gas recirculation valve stuck open or stuck closed Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Check exhaust gas recirculation valve for a stuck open or stuck closed condition. Rectify as necessary If the fault persists, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0426-27	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - signal rate of change above threshold	<p>NOTE: - Circuit EGT 1 -</p> <ul style="list-style-type: none"> Diesel exhaust gas temperature sensor 1 failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic tool check for associated DTCs/events at the same timeline which would influence fuelling or rapid changes in exhaust temperature If the fault persists, check and install a new diesel exhaust gas temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0427-11	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - circuit short to ground	<p>NOTE: - Circuit EGT 1 -</p> <ul style="list-style-type: none"> Diesel exhaust gas temperature sensor 1 input circuit, short circuit to ground Diesel exhaust gas temperature sensor 1 failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the diesel exhaust gas temperature sensor 1 input circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new diesel exhaust gas temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0428-15	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - circuit short to battery or open	<p>NOTE: - Circuit EGT 1 -</p> <ul style="list-style-type: none"> Diesel exhaust gas temperature sensor 1 input circuit, short circuit to power, open circuit, high resistance Diesel exhaust gas temperature sensor 1 failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the diesel exhaust gas temperature sensor 1 input circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new diesel exhaust gas temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P042A-11	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 2) - circuit short to ground	<p>NOTE: - Circuit EGT 2 -</p> <ul style="list-style-type: none"> Diesel exhaust gas temperature sensor 2 input circuit, short circuit to ground Diesel exhaust gas temperature sensor 2 failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the diesel exhaust gas temperature sensor 2 input circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new diesel exhaust gas temperature sensor 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P042B-27	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 2) - signal rate of change above threshold	<ul style="list-style-type: none"> Diesel exhaust gas temperature sensor 2 failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic tool check for associated DTCs/events at the same timeline which would influence fuelling or rapid changes in exhaust temperature. Refer to the relevant DTC index. Clear the DTC and retest the system

			<ul style="list-style-type: none"> If the fault persists, check and install a new diesel exhaust gas temperature sensor 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P042D-15	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 2) - circuit short to battery or open	<p>NOTE: - Circuit EGT 2 -</p> <ul style="list-style-type: none"> Diesel exhaust gas temperature sensor 2 input circuit, short circuit to power, open circuit, high resistance Diesel exhaust gas temperature sensor 2 failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the diesel exhaust gas temperature sensor 2 input circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new diesel exhaust gas temperature sensor 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0486-11	Exhaust Gas Recirculation Sensor B Circuit - circuit short to ground	<p>NOTE: - Circuit EVP -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve position sensor circuit, short circuit to ground Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve position sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0486-15	Exhaust Gas Recirculation Sensor B Circuit - circuit short to battery or open	<p>NOTE: - Circuit EVP -</p> <ul style="list-style-type: none"> Exhaust gas recirculation valve position sensor circuit, short circuit to power, open circuit, high resistance Exhaust gas recirculation valve internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve position sensor circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0487-13	Exhaust Gas Recirculation Throttle Control Circuit A / Open - open circuit	<p>NOTE: - Circuit ETC POS, ETC NEG -</p> <ul style="list-style-type: none"> Electric throttle unit circuit, open circuit, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the electric throttle unit circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P0488-19	Exhaust Gas Recirculation Throttle Control Circuit A Range/Performance - circuit current above threshold	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> Electric throttle unit (EVA POS) circuit, short circuit to ground, short circuit to power Electric throttle unit (EVA NEG) circuit, short circuit to ground, short circuit to power Electric throttle unit internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the electric throttle unit circuits for short circuit to ground, short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0488-	Exhaust Gas Recirculation	<p>NOTE: - Circuit EVA</p>	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the

21	Throttle Control Circuit A Range/Performance - signal amplitude < minimum	<p>POS, EVA NEG -</p> <ul style="list-style-type: none"> • Electric throttle unit circuit, short circuit to ground, short circuit to power, open circuit, high resistance • Electric throttle unit actuator stuck closed • Electric throttle unit internal failure 	<p>electric throttle unit circuits for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system</p> <ul style="list-style-type: none"> • If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0488-22	Exhaust Gas Recirculation Throttle Control Circuit A Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> • Electric throttle unit circuit, short circuit to ground, short circuit to power, open circuit, high resistance • Electric throttle unit internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the electric throttle unit circuits for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0488-4B	Exhaust Gas Recirculation Throttle Control Circuit A Range/Performance - over temperature	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> • Electric throttle unit (EVA POS) circuit, short circuit to ground, short circuit to power • Electric throttle unit (EVA NEG) circuit, short circuit to ground, short circuit to power • Electric throttle unit circuits, short circuit to each other • Electric throttle unit internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the electric throttle unit circuits for short circuit to ground, short circuit to power, short circuit to each other. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0489-00	Exhaust Gas Recirculation Control Circuit Low - no sub type information	<p>NOTE: - Circuit EVA POS, EVA NEG -</p> <ul style="list-style-type: none"> • Exhaust gas recirculation valve control circuit, short circuit to ground 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve control circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system
P049D-00	Exhaust Gas Recirculation A Control Position Exceeded Learning Limit - no sub type information	<p>NOTE: - Circuit VSSENS EVP -</p> <ul style="list-style-type: none"> • The exhaust gas recirculation valve has exceeded its adaptation limits, either as a result of unusual operating conditions or a possible valve fault • Exhaust gas 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic tool check for associated DTCs/events at the same timeline which would influence the adaptation values of the exhaust gas recirculation valve. Refer to the relevant DTC index. Clear the DTC and retest the system • If the fault persists, check and install a new exhaust gas recirculation valve as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

		recirculation valve failure	
P0504-62	Brake Switch A / B Correlation - signal compare failure	<p>NOTE: - Circuit BLS, BDS -</p> <ul style="list-style-type: none"> The signals from the two switches are not what is expected 	<ul style="list-style-type: none"> Check the function of the brake light and brake pressure switches, check brake fluid levels. Rectify as necessary
P0512-11	Starter Request Circuit - circuit short to ground	<p>NOTE: - Circuit start request signal circuit -</p> <ul style="list-style-type: none"> Start request signal circuit, short circuit to ground Starter relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the start request signal circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new starter relay as required, clear the DTC and retest the system
P0512-12	Starter Request Circuit - circuit short to battery	<p>NOTE: - Circuit start request signal circuit -</p> <ul style="list-style-type: none"> Start request signal circuit between ignition switch, short circuit to power Starter relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the start request signal circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new starter relay as required, clear the DTC and retest the system
P0512-13	Starter Request Circuit - circuit open	<p>NOTE: - Circuit start request signal circuit -</p> <ul style="list-style-type: none"> Start request signal circuit, open circuit, high resistance Starter relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the start request signal circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new starter relay as required, clear the DTC and retest the system
P0531-12	A/C Refrigerant Pressure Sensor A Circuit Range/Performance - circuit short to battery	<p>NOTE: - Circuit ACPT -</p> <ul style="list-style-type: none"> Air conditioning pressure sensor circuit, short circuit to power 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and check the air conditioning pressure sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system
P0531-14	A/C Refrigerant Pressure Sensor A Circuit Range/Performance - circuit short to ground or open	<p>NOTE: - Circuit ACPT -</p> <ul style="list-style-type: none"> Air conditioning pressure sensor circuit, short circuit to ground, open circuit, high resistance 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and check the air conditioning pressure sensor circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P0606-00	Control Module Processor - no sub type information	<ul style="list-style-type: none"> Engine control module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system download the correct level of software for the vehicle, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0606-48	Control Module Processor - supervision software failure	<ul style="list-style-type: none"> Corrupt engine control module software download Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to

		<ul style="list-style-type: none"> Engine control module failure 	the installation of a new module/component
P0606-49	Control Module Processor - internal electronic failure	<ul style="list-style-type: none"> Engine control module failure 	<ul style="list-style-type: none"> Clear the DTC and retest the system. If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0607-00	Control Module Performance - no sub type information	<ul style="list-style-type: none"> Engine control module internal failure 	<ul style="list-style-type: none"> Clear the DTC and retest the system. If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0607-48	Control Module Performance - supervision software failure	<ul style="list-style-type: none"> Corrupt engine control module software Engine control module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system download the correct level of software for the vehicle, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0607-68	Control Module Performance - event information	<ul style="list-style-type: none"> A potential fault event has been logged by the engine control module 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, check for associated DTCs at the same timeline which would indicate missing information from another system, such as lost communications codes, etc. Rectify as necessary, clear the DTC and retest the system
P060A-48	Internal Control Module Monitoring Processor Performance - supervision software failure	<ul style="list-style-type: none"> Corrupt engine control module software Engine control module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system download the correct level of software for the vehicle, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P060B-48	Internal Control Module A/D Processing Performance - supervision software failure	<ul style="list-style-type: none"> Corrupt engine control module software download Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance Engine control module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P060D-46	Internal Control Module Accelerator Pedal Position Performance - calibration / parameter memory failure	<ul style="list-style-type: none"> Corrupt engine control module software Engine control module internal failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system download the correct level of software for the vehicle, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0610-00	Control Module Vehicle Options Error - no sub type information	<ul style="list-style-type: none"> Incorrect car configuration file 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system re-configure the car configuration file as required
P061A-48	Internal Control Module Torque Performance - supervision software failure	<ul style="list-style-type: none"> Corrupt engine control module software Engine control module internal 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system download the correct level of software for the vehicle, clear the DTC and retest the system If the fault persists, check and install a new engine control module as required. Refer to the warranty

		failure	policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P061B-00	Internal Control Module Torque Calculation Performance - no sub type information	<ul style="list-style-type: none"> • Corrupt engine control module software download • Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance • Engine control module failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system • Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P061B-48	Internal Control Module Torque Calculation Performance - supervision software failure	<ul style="list-style-type: none"> • Corrupt engine control module software download • Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance • Engine control module failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system • Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0620-01	Generator Control Circuit - General Electrical Failure	<p>NOTE: - Circuit LIN -</p> <ul style="list-style-type: none"> • Charging system fault • LIN alternator circuit, short circuit to ground, short circuit to power, open circuit, high resistance 	<ul style="list-style-type: none"> • Refer to the workshop manual and the battery care manual, inspect the vehicle battery and ensure it is fully charged and serviceable before performing further tests • Check the vehicle charging system performance to ensure the voltage regulation is correct • Refer to the electrical circuit diagrams and check the LIN alternator circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P0627-12	Fuel Pump A Control Circuit Open - circuit short to battery	<p>NOTE: - Circuit LPRL -</p> <ul style="list-style-type: none"> • Fuel pump control circuit, short circuit to power • Fuel pump relay internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the fuel pump control circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system • Check and install a new fuel pump relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0628-11	Fuel Pump A Control Circuit Low - circuit short to ground	<p>NOTE: - Circuit LPRL -</p> <ul style="list-style-type: none"> • Fuel pump control circuit, short circuit to ground • Fuel pump relay internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and the fuel pump control circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system • Check and install a new fuel pump relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0629-13	Fuel Pump A Control Circuit High - circuit open	<p>NOTE: - Circuit LPRL -</p> <ul style="list-style-type: none"> • Fuel pump control circuit, open circuit, high resistance • Fuel pump relay internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the fuel pump control circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • Check and install a new fuel pump relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new

			module/component
P062B-00	Internal Control Module Fuel Injector Control Performance - no sub type information	<ul style="list-style-type: none"> • Corrupt engine control module software download • Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance • Engine control module failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system • Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P062B-46	Internal Control Module Fuel Injector Control Performance - calibration / parameter memory failure	<ul style="list-style-type: none"> • Corrupt engine control module software download • Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance • Engine control module failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system • Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P062B-48	Internal Control Module Fuel Injector Control Performance - supervision software failure	<ul style="list-style-type: none"> • Corrupt engine control module software download • Engine control module ground, power supply circuit short circuit to ground, short circuit to power, open circuit, high resistance • Engine control module failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module, clear the DTC and retest the system • Refer to the electrical circuit diagrams and check the engine control module ground and power circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0630-41	VIN Not Programmed or Incompatible - ECM/PCM - general checksum failure	<ul style="list-style-type: none"> • Substituted engine control module installed as a donor 	<ul style="list-style-type: none"> • Check that the correct engine control module for the vehicle has been installed • Using the manufacturer approved diagnostic system download the correct level of software to the vehicle, clear the DTC and retest the system
P0630-81	VIN Not Programmed or Incompatible - ECM/PCM - invalid serial data received	<ul style="list-style-type: none"> • Incorrectly set bit in software 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system download the correct level of software to the vehicle, clear the DTC and retest the system
P0642-16	Sensor Reference Voltage A Circuit Low - circuit voltage below threshold	<p>NOTE: - Circuit VSSENS EVP -</p> <ul style="list-style-type: none"> • Exhaust gas recirculation valve position sensor 5 volt power supply, short circuit to ground, open circuit, high resistance 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the exhaust gas recirculation valve position sensor 5 volt power supply for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P0643-17	Sensor Reference Voltage A Circuit High - circuit voltage above threshold	<p>NOTE: - Circuit VSSENS TPS -</p>	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the throttle position sensor 5 volt power supply for short circuit to power. Repair the circuit as required, clear

		<ul style="list-style-type: none"> Throttle position sensor 5 volt power supply, short circuit to power 	the DTC and retest the system
P0645-11	A/C Clutch Relay Control Circuit - circuit short to ground	<p>NOTE: - Circuit ACCR -</p> <ul style="list-style-type: none"> Air conditioning relay circuit, short circuit to ground Air conditioning relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the air conditioning relay circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new air conditioning relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0645-12	A/C Clutch Relay Control Circuit - circuit short to battery	<p>NOTE: - Circuit ACCR -</p> <ul style="list-style-type: none"> Air conditioning relay circuit, short circuit to power Air conditioning relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the air conditioning relay circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new air conditioning relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0645-13	A/C Clutch Relay Control Circuit - circuit open	<p>NOTE: - Circuit ACCR -</p> <ul style="list-style-type: none"> Air conditioning relay circuit, open circuit, high resistance Air conditioning relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the air conditioning relay circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new air conditioning relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0652-16	Sensor Reference Voltage B Circuit Low - circuit voltage below threshold	<p>NOTE: - Circuit VSENS CID -</p> <ul style="list-style-type: none"> Camshaft position sensor 5 volt power supply, short circuit to ground, open circuit, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the camshaft position sensor 5 volt power supply for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P0653-17	Sensor Reference Voltage A Circuit High - circuit voltage above threshold	<p>NOTE: - Circuit VSENS CID -</p> <ul style="list-style-type: none"> Camshaft position sensor 5 volt power supply, short circuit to power, open circuit, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the camshaft position sensor 5 volt power supply for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P065B-16	Generator Control Circuit Range/Performance - circuit voltage below threshold	<p>NOTE: - Circuit LIN -</p> <ul style="list-style-type: none"> Generator circuit, short circuit to ground Generator internal failure 	<ul style="list-style-type: none"> Check the vehicle charging system performance to ensure the voltage regulation is correct Refer to the electrical circuit diagrams and check the generator circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new generator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P065B-17	Generator Control Circuit Range/Performance - circuit voltage above threshold	<p>NOTE: - Circuit LIN -</p> <ul style="list-style-type: none"> Generator circuit, short circuit to power Generator 	<ul style="list-style-type: none"> Check the vehicle charging system performance to ensure the voltage regulation is correct Refer to the electrical circuit diagrams and check the generator circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system

		internal failure	<ul style="list-style-type: none"> If the fault persists, check and install a new generator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P065B-87	Generator Control Circuit Range/Performance - missing message	<p>NOTE: - Circuit LIN -</p> <ul style="list-style-type: none"> The generator is missing a message from another component, possibly because of module resets 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, check for associated DTCs at the same timeline indicating other module resets, rectify as necessary. Clear the DTC and retest the system
P065C-00	Generator Mechanical Performance - No sub type information	<ul style="list-style-type: none"> Poor front end accessory drive belt tension Generator pulley loose/failure Generator failure 	<ul style="list-style-type: none"> Check the front end accessory drive belt condition/contamination and for correct tension Check the generator pulley for failure Clear the DTC and retest. If the DTC resets, check and install a new generator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0667-27	Control Module Internal Temperature Sensor 'A' Range/Performance - signal rate of change above threshold	<ul style="list-style-type: none"> Engine control module internal temperature changes greater than expected 	<ul style="list-style-type: none"> Confirm with the driver if the vehicle has been used in extreme conditions which could have resulted in temperature changes greater than expected. Clear the DTC and retest the system. If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0668-11	Control Module Internal Temperature Sensor 'A' Circuit Low - circuit short to ground	<ul style="list-style-type: none"> Engine control module internal temperature sensor failure 	<ul style="list-style-type: none"> Check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0669-15	Control Module Internal Temperature Sensor 'A' Circuit High - circuit short to battery or open	<ul style="list-style-type: none"> Engine control module internal temperature sensor failure 	<ul style="list-style-type: none"> Check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0693-11	Fan 2 Control Circuit Low - circuit short to ground	<p>NOTE: - Circuit EDF 2 -</p> <ul style="list-style-type: none"> Auxiliary air conditioning fan control circuit, short circuit to ground Cooling fan relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the auxiliary air conditioning fan control circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new cooling fan relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0693-13	Fan 2 Control Circuit Low - circuit open	<p>NOTE: - Circuit EDF 2 -</p> <ul style="list-style-type: none"> Auxiliary air conditioning fan control circuit, open circuit, high resistance Cooling fan relay fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the auxiliary air conditioning fan control circuit for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new cooling fan relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0694-12	Fan 2 Control Circuit Low - circuit short to battery	<p>NOTE: - Circuit EDF 2 -</p> <ul style="list-style-type: none"> Auxiliary air conditioning fan control circuit, short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the auxiliary air conditioning fan control circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new cooling fan relay as required. Refer to the warranty policy and procedures manual, or determine if any prior

		<ul style="list-style-type: none"> Cooling fan relay fault 	approval programme is in operation, prior to the installation of a new module/component
P06B9-00	Cylinder 1 Glow Plug Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> Cylinder 1 glow plug circuit, short circuit to ground, short circuit to power, open circuit, high resistance Glow plug module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the cylinder 1 glow plug circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new glow plug module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P06BA-00	Cylinder 2 Glow Plug Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> Cylinder 2 glow plug circuit, short circuit to ground, short circuit to power, open circuit, high resistance Glow plug module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the cylinder 2 glow plug circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new glow plug module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P06BB-00	Cylinder 3 Glow Plug Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> Cylinder 3 glow plug circuit, short circuit to ground, short circuit to power, open circuit, high resistance Glow plug module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the cylinder 3 glow plug circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new glow plug module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P06BC-00	Cylinder 4 Glow Plug Circuit Range/Performance - no sub type information	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> Cylinder 4 glow plug circuit, short circuit to ground, short circuit to power, open circuit, high resistance Glow plug module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the cylinder 4 glow plug circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new glow plug module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P06DF-00	Glow Plug Control Module 1 Memory Checksum Error - no sub type information	<ul style="list-style-type: none"> Glow plug module internal failure or compatibility issue 	<ul style="list-style-type: none"> Clear the DTC and retest the system. If the fault persists, check and install a glow plug control module as required. Clear the DTC and retest the system Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0830-00	Clutch Pedal Switch A Circuit - no sub type information	<p>NOTE: - Circuit CPP-TT -</p> <ul style="list-style-type: none"> Clutch pedal top of travel sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance Clutch pedal position switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the clutch pedal top of travel sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new clutch pedal position switch as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0A09-16	DC/DC Converter Status Circuit Low - circuit voltage below threshold	<ul style="list-style-type: none"> Engine control module power supply circuit, short circuit to 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine control module power supply circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and

		ground, open circuit, high resistance <ul style="list-style-type: none"> Engine control module internal failure 	retest system <ul style="list-style-type: none"> If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0A10-17	DC/DC Converter Status Circuit High - circuit voltage above threshold	<ul style="list-style-type: none"> Engine control module ground supply circuit short to power Engine control module internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the engine control module ground supply circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest system If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0A3B-68	Generator Over Temperature - event information	NOTE: - Circuit LIN - <ul style="list-style-type: none"> Charging system overheat Generator wiring/connectors heat damaged Possible high temperature in another module Generator failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the generator wiring and connectors for heat damage Using the manufacturer approved diagnostic system. Check for associated DTCs at the same timeline which could indicate an over temperature condition, rectify as necessary. Clear the DTC and retest the system If the fault persists, check and install a new generator as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P115A-00	Low Fuel Level - Forced Limited Power - no sub type information	NOTE: This code does not indicate a fault, only that the driver has allowed the vehicle to run low on fuel (6 litres of fuel remaining in the tank) <ul style="list-style-type: none"> Low level fuel condition 	<ul style="list-style-type: none"> Check the fuel level, add fuel if required and clear the DTC If the fault persists, use the manufacturer approved diagnostic system to check for associated DTCs at the same timeline which could indicate an issue with the fuel level sensor
P115B-68	Low Fuel Level - Forced Engine Shutdown - event information	NOTE: This code does not indicate a fault, only that the driver has allowed the vehicle to run low on fuel (6 litres of fuel remaining in the tank) <ul style="list-style-type: none"> Low level fuel condition 	<ul style="list-style-type: none"> Check the fuel level, add fuel if required and clear the DTC If the fault persists, use the manufacturer approved diagnostic system to check for associated DTCs at the same timeline which could indicate an issue with the fuel level sensor
P117E-22	Fuel Volume Regulator Control Exceeded Minimum Control Limit - signal amplitude > maximum	<ul style="list-style-type: none"> Fuel volume control valve circuit, short circuit to ground, short circuit to power, open circuit, high resistance Fuel volume control valve failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel volume control valve circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new fuel volume control valve. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1259-00	Immobilizer to PCM Signal Error - no sub type information	<ul style="list-style-type: none"> Harness fault, immobiliser input circuit from alarm module, short circuit to ground, short circuit to power, open circuit, high resistance Alarm module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the immobiliser input circuit from the alarm module for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install new alarm module as required. Clear the DTC and retest the system If the fault persists, check and install a new engine control module. Refer to the warranty policy and procedures manual, or determine if any prior

		<ul style="list-style-type: none"> Engine control module internal failure 	approval programme is in operation, prior to the installation of a new module/component
P1259-64	Immobilizer to PCM Signal Error - signal plausibility failure	<p>NOTE: - Circuit PDS/IMMO -</p> <ul style="list-style-type: none"> Harness fault, immobiliser input circuit from alarm module, short circuit to ground, short circuit to power, open circuit, high resistance Alarm module fault Engine control module internal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the immobiliser input circuit from the alarm module for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install new alarm module as required. Clear the DTC and retest the system If the fault persists, check and install a new engine control module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P132B-22	Turbocharger/Supercharger Boost Control A Performance - signal amplitude > maximum	<p>NOTE: - Circuit VNT NEG -</p> <ul style="list-style-type: none"> Turbocharger operation erratic Turbocharger overboost 	<ul style="list-style-type: none"> Check the turbocharger operation, including all linkages, actuators, etc. Rectify as necessary. Clear the DTC, retest the system
P1336-76	Crankshaft/Camshaft Sensor Range/Performance - wrong mounting position	<p>NOTE: - Circuit CID, BDCPS -</p> <ul style="list-style-type: none"> The engine control module has detected incorrectly installed components Camshaft position sensor or reference target positioning incorrect Camshaft position sensor failure Crankshaft position sensor or reference target positioning incorrect Crankshaft position sensor failure 	<ul style="list-style-type: none"> Refer to the relevant section of the workshop manual and check the camshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required. Clear the DTC and retest the system If the fault persists, check and install a new camshaft position sensor as required. Clear the DTC and retest the system Refer to the relevant section of the workshop manual and check the crankshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required. Clear the DTC and retest the system If the fault persists, check and install a new crankshaft position sensor as required. Clear the DTC and retest the system Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1336-78	Crankshaft/Camshaft Sensor Range/Performance - alignment or adjustment incorrect	<ul style="list-style-type: none"> The engine control module has detected incorrectly installed components 	<ul style="list-style-type: none"> Refer to the relevant section of the workshop manual and check the camshaft position sensor and target wheel for correct installation, condition and alignment. Repair as required. Clear the DTC and retest the system If the fault persists, check and install a new camshaft position sensor as required. Clear the DTC and retest the system
P138A-11	Glow Plug Control Module Control Circuit Range/Performance - circuit short to ground	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> Glow plug feedback input circuit, short circuit to ground Glow plug module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the glow plug feedback input circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new glow plug module as required. Clear the DTC and retest the system. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
			<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the

P138A-12	Glow Plug Control Module Control Circuit Range/Performance - circuit short to battery	<p>NOTE: - Circuit GPFB -</p> <ul style="list-style-type: none"> • Glow plug feedback input circuit, short circuit to power • Glow plug module fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the glow plug feedback input circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new glow plug module as required. Clear the DTC and retest the system. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P138A-15	Glow Plug Control Module Control Circuit Range/Performance - circuit short to battery or open	<p>NOTE: - Circuit GPC -</p> <ul style="list-style-type: none"> • Glow plug control circuit, short circuit to power, open circuit, high resistance • Glow plug module fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the glow plug control circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new glow plug module as required. Clear the DTC and retest the system. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1500-00	Vehicle Speed Sensor - no sub type information	<ul style="list-style-type: none"> • Vehicle speed sensor error • High speed CAN bus circuit, short circuit to ground, short circuit to power, open circuit, high resistance • High speed CAN bus circuit, short between CAN high and CAN low 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system, check for associated DTCs at the same timeline which could indicate a reason for the speed sensor error and refer to the relevant DTC index. Clear the DTC and retest the system • Refer to the electrical circuit diagrams and check high speed CAN bus for short circuit to ground, short circuit to power, open circuit, high resistance, short between CAN high and CAN low. Repair the circuit as required, clear the DTC and retest the system
P150A-01	Cylinder 1 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ A L, INJ A H -</p> <ul style="list-style-type: none"> • Cylinder 1 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit • Cylinder 1 fuel injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 1 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder 1 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P150B-01	Cylinder 2 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ D L, INJ D H -</p> <ul style="list-style-type: none"> • Cylinder 2 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit • Cylinder 2 fuel injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 2 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder 2 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P150C-01	Cylinder 3 Injector Circuit Range/Performance - General Electrical Failure	<p>NOTE: - Circuit INJ B L, INJ B H -</p> <ul style="list-style-type: none"> • Cylinder 3 fuel injector circuit, short circuit to ground, short circuit to power, 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 3 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder

		short circuit to another cylinder fuel injector, high resistance, open circuit <ul style="list-style-type: none"> • Cylinder 3 fuel injector failure 	3 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P150D-01	Cylinder 4 Injector Circuit Range/Performance - General Electrical Failure	NOTE: - Circuit INJ C L, INJ C H - <ul style="list-style-type: none"> • Cylinder 4 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit • Cylinder 4 fuel injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 4 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder 4 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1551-01	Cylinder 1 Injector Circuit Range/Performance - General Electrical Failure	NOTE: - Circuit INJ A L, INJ A H - <ul style="list-style-type: none"> • Cylinder 1 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit • Cylinder 1 fuel injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 1 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder 1 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1552-01	Cylinder 2 Injector Circuit Range/Performance - General Electrical Failure	NOTE: - Circuit INJ D L, INJ D H - <ul style="list-style-type: none"> • Cylinder 2 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit • Cylinder 2 fuel injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 2 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder 2 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1553-01	Cylinder 3 Injector Circuit Range/Performance - General Electrical Failure	NOTE: - Circuit INJ B L, INJ B H - <ul style="list-style-type: none"> • Cylinder 3 fuel injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit • Cylinder 3 fuel injector failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 3 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new cylinder 3 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1554-01	Cylinder 4 Injector Circuit Range/Performance - General Electrical Failure	NOTE: - Circuit INJ C L, INJ C H - <ul style="list-style-type: none"> • Cylinder 4 fuel 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check cylinder 4 fuel injector circuit for short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, open circuit, high

		<p>injector circuit, short circuit to ground, short circuit to power, short circuit to another cylinder fuel injector, high resistance, open circuit</p> <ul style="list-style-type: none"> • Cylinder 4 fuel injector failure 	<p>resistance. This circuit is a twisted pair, check both high and low sides for circuit faults. Repair the circuit as required, clear the DTC and retest the system</p> <ul style="list-style-type: none"> • If the fault persists, check and install a new cylinder 4 fuel injector as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1598-68	Engine Driven Backwards - Forced Engine Shutdown - event information	<p>NOTE: Event log information only, no action required</p> <ul style="list-style-type: none"> • The engine has been stalled and driven backwards 	<ul style="list-style-type: none"> • This DTC is set when the engine control module detects that the engine has been stalled and driven backwards, usually as a result of a stall when towing on an incline. No remedial action is necessary for this code. Clear the DTC and retest
P1631-72	Main Relay (power hold) - actuator stuck open	<p>NOTE: - Circuit PWRSTN -</p> <p>NOTE: This DTC is set when the engine management system high current relay contacts are detected stuck open by the engine control module</p> <ul style="list-style-type: none"> • Engine management system high current relay fault • Main relay control circuit fault 	<ul style="list-style-type: none"> • Check the operation of the engine management system high current relay • Refer to the electrical circuit diagrams and check the engine management system high current relay supply and control circuits for open circuits, high resistance, short circuit to ground, short circuit to power, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine management system high current relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1631-73	Main Relay (power hold) - actuator stuck closed	<p>NOTE: - Circuit PWRSTN -</p> <p>NOTE: This DTC is set when the engine management system high current relay contacts are detected stuck closed by the engine control module</p> <ul style="list-style-type: none"> • Engine management system high current relay fault • Main relay control circuit fault 	<ul style="list-style-type: none"> • Check the operation of the engine management system high current relay • Refer to the electrical circuit diagrams and check the engine management system high current relay supply and control circuits for open circuits, high resistance, short circuit to ground, short circuit to power, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine management system high current relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P1631-92	Main Relay (power hold) - performance or incorrect operation	<p>NOTE: - Circuit PWRSTN -</p> <p>NOTE: The early opening error detection is done to detect whether the main relay has been opened without any request</p> <ul style="list-style-type: none"> • Vehicle battery disconnected before engine management system relay has powered down • Engine 	<ul style="list-style-type: none"> • Check the vehicle battery has not been disconnected before the engine management system relay has powered down • Check the operation of the engine management system high current relay • Refer to the electrical circuit diagrams and check the engine management system high current relay supply and control circuits for open circuits, high resistance, short circuit to ground, short circuit to power, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine management system high current relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new

		management system high current relay fault <ul style="list-style-type: none"> • Main relay control circuit fault 	module/component
P164C-00	Internal Control Module Start-Stop Performance - no sub type information	<ul style="list-style-type: none"> • Starter has been disabled by the engine control module following a high number of failed crank attempts 	NOTE: This DTC is set when the starter has been disabled by the engine control module to protect the starting system following a high number of failed crank attempts <ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system, check for associated DTCs at the same timeline which could indicate a reason for the failed crank attempts and refer to the relevant DTC index. Clear the DTC and retest the system
P1798-00	CAN TCM/INST Circuit Malfunction - no sub type information	<ul style="list-style-type: none"> • CAN network fault between the engine control module and the instrument pack 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system, carry out a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN high and low circuits for open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P2122-16	Throttle/Pedal Position Sensor/Switch D Circuit Low - circuit voltage below threshold	NOTE: - Circuit APP2 - <ul style="list-style-type: none"> • Accelerator pedal position sensor D circuit, short circuit to ground, open circuit, high resistance • Accelerator pedal position sensor internal fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the accelerator pedal position sensor D for short circuit to ground, open circuit, high resistance. Clear the DTC and retest the system • If the fault persists, check and install a new accelerator pedal position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2123-17	Throttle/Pedal Position Sensor/Switch D Circuit High - circuit voltage above threshold	NOTE: - Circuit APP2 - <ul style="list-style-type: none"> • Accelerator pedal position sensor D circuit, short circuit to power • Accelerator pedal position sensor internal fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the accelerator pedal position sensor D for short circuit to power. Clear the DTC and retest the system • If the fault persists, check and install a new accelerator pedal position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2127-16	Throttle/Pedal Position Sensor/Switch E Circuit Low - circuit voltage below threshold	NOTE: - Circuit APP1 - <ul style="list-style-type: none"> • Accelerator pedal position sensor E circuit, short circuit to ground, open circuit, high resistance • Accelerator pedal position sensor internal fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the accelerator pedal position sensor E for short circuit to ground, open circuit, high resistance. Clear the DTC and retest the system • If the fault persists, check and install a new accelerator pedal position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2128-17	Throttle/Pedal Position Sensor/Switch E Circuit High - circuit voltage above threshold	NOTE: - Circuit APP1 - <ul style="list-style-type: none"> • Accelerator pedal position sensor E circuit, short circuit to power • Accelerator pedal position sensor internal fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the accelerator pedal position sensor E for short circuit to power. Clear the DTC and retest the system • If the fault persists, check and install a new accelerator pedal position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2141-00	Exhaust Gas Recirculation Throttle Control Circuit A Low - no sub type information	NOTE: - Circuit ETC NEG - <ul style="list-style-type: none"> • Electric throttle unit, short circuit to ground • Electric throttle 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the electric throttle unit circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior

		unit internal failure	approval programme is in operation, prior to the installation of a new module/component
P2142-11	Exhaust Gas Recirculation Throttle Control Circuit A High - circuit short to ground	<p>NOTE: - Circuit EVA POS -</p> <ul style="list-style-type: none"> • Electric throttle unit control circuit, short circuit to ground • Electric throttle unit internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the electric throttle unit control circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2142-12	Exhaust Gas Recirculation Throttle Control Circuit A High - circuit short to battery	<p>NOTE: - Circuit EVA POS -</p> <ul style="list-style-type: none"> • Electric throttle unit control circuit, short circuit to power • Electric throttle unit internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the electric throttle unit control circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new electric throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2148-00	Fuel Injector Group A Supply Voltage Circuit High - no sub type information	<ul style="list-style-type: none"> • Fuel injector power supply circuit, short circuit to ground, short circuit to power, open circuit, high resistance 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the fuel injector power supply circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system
P2228-16	Barometric Pressure Sensor A Circuit Low - circuit voltage below threshold	<p>NOTE: The barometric pressure sensor is integral to the engine control module</p> <ul style="list-style-type: none"> • Barometric pressure sensor has detected a value outside the expected range • Barometric pressure sensor failure (internal to the engine control module) 	<ul style="list-style-type: none"> • Check with the driver if the vehicle has been subjected to extreme conditions. Clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2229-17	Barometric Pressure Sensor A Circuit High - circuit voltage above threshold	<p>NOTE: The barometric pressure sensor is integral to the engine control module</p> <ul style="list-style-type: none"> • Barometric pressure sensor has detected a value outside the expected range • Barometric pressure sensor failure (internal to the engine control module) 	<ul style="list-style-type: none"> • Check with the driver if the vehicle has been subjected to extreme conditions. Clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2230-27	Barometric Pressure Sensor A Circuit Intermittent/Erratic - signal rate of change above threshold	<p>NOTE: The barometric pressure sensor is integral to the engine control module</p> <ul style="list-style-type: none"> • Barometric pressure sensor has detected a value outside the expected range • Barometric 	<ul style="list-style-type: none"> • Check with the driver if the vehicle has been subjected to extreme conditions. Clear the DTC and retest the system • If the fault persists, check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

		pressure sensor failure (internal to the engine control module)	
P2263-21	Turbocharger/Supercharger Boost System Performance - signal amplitude < minimum	<ul style="list-style-type: none"> • Induction system air leak or blockage • Boost air system leak or blockage • Manifold absolute pressure sensor failure • Turbocharger actuator sticking • Turbocharger failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check for associated DTCs at the same timeline which could indicate a boost issue and refer to the relevant DTC index • Check the induction system for leaks, blockages, etc and rectify as necessary. Clear the DTC and retest the system • Check the boost air system for leaks, blockages, etc and rectify as necessary. Clear the DTC and retest the system • Check the turbocharger actuator and oil seals, etc and rectify as necessary. Clear the DTC and retest the system
P2263-22	Turbocharger/Supercharger Boost System Performance - signal amplitude > maximum	<ul style="list-style-type: none"> • Boost air system leak or blockage • Manifold absolute pressure sensor failure • Turbocharger overboost • Turbocharger vanes stuck closed 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check for associated DTCs at the same timeline which could indicate a boost issue and refer to the relevant DTC index • Check the induction system for leaks, blockages, etc and rectify as necessary. Clear the DTC and retest the system • Check the boost air system for leaks, blockages, etc and rectify as necessary. Clear the DTC and retest the system • Check the turbocharger actuator and oil seals, etc and rectify as necessary. Clear the DTC and retest the system
P226B-00	Turbocharger/Supercharger Boost Pressure Too High - Mechanical - no sub type information	<ul style="list-style-type: none"> • Turbocharger vanes stuck closed 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check for associated DTCs at the same timeline which could indicate a boost issue and refer to the relevant DTC index • Check the turbocharger actuator and oil seals, etc and rectify as necessary. Clear the DTC and retest the system
P228C-77	Fuel Pressure Regulator 1 Exceeded Control Limits - Pressure Too Low - commanded position not reachable	<ul style="list-style-type: none"> • Fuel injector stuck open • Fuel rail pressure is outside the expected range 	<ul style="list-style-type: none"> • Check for fuel injector stuck open • Using the manufacturer approved diagnostic system, check for associated DTCs at the same timeline which could indicate an injector, pump or volume control valve fault and refer to the relevant DTC index. Rectify as necessary, clear the DTC and retest the system
P2297-00	O2 Sensor Out of Range During Deceleration Bank 1, Sensor 1 - no sub type information	<ul style="list-style-type: none"> • Oxygen concentration out of range on overrun • Front heated oxygen sensor circuit, short circuit to power, short circuit to ground, high resistance, open circuit • Front heated oxygen sensor internal failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system, check for associated DTCs at the same timeline which could indicate an injector, pump or volume control valve fault and refer to the relevant DTC index. Rectify as necessary, clear the DTC and retest the system • Refer to the electrical circuit diagrams and check the front heated oxygen sensor circuit for short circuit to power, short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new front heated oxygen sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P242B-21	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - signal amplitude < minimum	<p>NOTE: - Circuit EGT 3 -</p> <ul style="list-style-type: none"> • Post-catalyst temperature sensor 3 contaminated • Post-catalyst temperature sensor 3 circuit, 	<ul style="list-style-type: none"> • Check post-catalyst temperature sensor 3 for contamination • Refer to the electrical circuit diagrams and check the post-catalyst temperature sensor 3 circuit for short circuit to ground, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new post-catalyst temperature sensor 3 as required. Refer to

		short circuit to ground, open circuit, high resistance <ul style="list-style-type: none"> Post-catalyst temperature sensor 3 failure 	the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P242B-22	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - signal amplitude > maximum	NOTE: - Circuit EGT 3 - <ul style="list-style-type: none"> Post-catalyst temperature sensor 3 contaminated Post-catalyst temperature sensor 3 circuit, short circuit to power, open circuit, high resistance Post-catalyst temperature sensor 3 failure 	<ul style="list-style-type: none"> Check post-catalyst temperature sensor 3 for contamination Refer to the electrical circuit diagrams and check the post-catalyst temperature sensor 3 circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new post-catalyst temperature sensor 3 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P242C-11	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3 - circuit short to ground	NOTE: - Circuit EGT 3 - <ul style="list-style-type: none"> Post-catalyst temperature sensor 3 contaminated Post-catalyst temperature sensor 3 circuit, short circuit to ground Post-catalyst temperature sensor 3 failure 	<ul style="list-style-type: none"> Check post-catalyst temperature sensor 3 for contamination Refer to the electrical circuit diagrams and check the post-catalyst temperature sensor 3 circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new post-catalyst temperature sensor 3 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P242D-17	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 3 - circuit voltage above threshold	NOTE: - Circuit EGT 3 - <ul style="list-style-type: none"> Post-catalyst temperature sensor 3 contaminated Post-catalyst temperature sensor 3 circuit, short circuit to power Post-catalyst temperature sensor 3 failure 	<ul style="list-style-type: none"> Check post-catalyst temperature sensor 3 for contamination Refer to the electrical circuit diagrams and check the post-catalyst temperature sensor 3 circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new post-catalyst temperature sensor 3 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P243F-76	Diesel Particulate Filter Restriction - Soot Accumulation Too High (Bank 2) - wrong mounting position	<ul style="list-style-type: none"> Diesel particulate filter incorrectly installed Maximum soot mass Diesel particulate filter requires regeneration Customer driving routine does not allow the system to clean the particulate filter 	<ul style="list-style-type: none"> Check the diesel particulate filter is correctly installed. Clear the DTC and retest the system If the fault persists, refer to the diesel particulate filter regeneration procedure and carry out a diesel particulate filter regeneration Advise customer of driving routine required to regenerate diesel particulate filter as stated in the vehicle handbook
P244A-64	Diesel Particulate Filter Differential Pressure Too Low (Bank1) - signal plausibility failure	<ul style="list-style-type: none"> Diesel particulate filter differential pressure sensor circuit, short circuit to ground, short circuit to power, open 	NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using

		<p>circuit, high resistance</p> <ul style="list-style-type: none"> ● Diesel particulate filter differential pressure sensor fault 	<p>the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system ● If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2453-11	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - circuit short to ground	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> ● Diesel particulate filter differential pressure sensor circuit, short circuit to ground ● Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system ● If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2453-15	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - circuit short to battery or open	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> ● Diesel particulate filter differential pressure sensor circuit, short circuit to power, open circuit, high resistance ● Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor

			<p>circuit for short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system</p> <ul style="list-style-type: none"> • If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2453-21	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - signal amplitude < minimum	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> • Diesel particulate filter differential pressure sensor circuit, short circuit to ground • Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2453-22	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - signal amplitude > maximum	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> • Diesel particulate filter differential pressure sensor circuit, short circuit to power • Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2453-27	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - signal rate of change above threshold	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> • Diesel particulate filter differential pressure sensor 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following</p>

		<p>circuit, short circuit to ground, short circuit to power, open circuit, high resistance</p> <ul style="list-style-type: none"> • Diesel particulate filter differential pressure sensor fault 	<p>conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2453-29	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - signal signal invalid	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> • Diesel particulate filter differential pressure sensor circuit, short circuit to ground, short circuit to power, open circuit, high resistance • Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2454-00	Diesel Particulate Filter (DPF) Pressure Sensor A Circuit Low - no sub type information	<p>NOTE: - Circuit DPS -</p> <ul style="list-style-type: none"> • Diesel particulate filter differential pressure sensor signal circuit, short circuit to ground, short circuit to power, short circuit to each other, high resistance or open circuit • Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a</p>

			<p>large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signals, diesel particulate filter differential pressure sensor voltage - bank 1 (0x03DB). This DTC is set when the particulate pressure sensor fails a plausibility check Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2455-00	Diesel Particulate Filter (DPF) Pressure Sensor A Circuit High - no sub type information	<p>NOTE: - Circuit VSENS DPS -</p> <ul style="list-style-type: none"> Diesel particulate filter differential pressure sensor signal circuit, short circuit to power, short circuit to each other, high resistance or open circuit Diesel particulate filter differential pressure sensor fault 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signals, diesel particulate filter differential pressure sensor voltage - bank 1 (0x03DB). This DTC is set when the particulate pressure sensor fails a plausibility check Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage Refer to the electrical circuit diagrams and check the diesel particulate filter differential pressure sensor signal circuit for short circuit to power, short circuit to other circuits, high resistance or open circuit. Repair the circuit as required, clear the DTC and retest the system If the fault persists, check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2456-00	Diesel Particulate Filter (DPF) Pressure Sensor A Circuit Intermittent/Erratic - no sub type information	<ul style="list-style-type: none"> Diesel particulate filter differential pressure sensor hoses crushed, blocked, split Diesel particulate filter differential pressure sensor failure 	<p>NOTE: If a new diesel particulate filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the engine control module must learn and store the new diesel particulate filter pressure sensor offset value. The following conditions must be met to allow the diesel particulate filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from engine control module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500rpm for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30</p>

			<p>seconds for the engine control module to power down, learn and store diesel particulate filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa</p> <ul style="list-style-type: none"> • Check diesel particulate filter differential pressure sensor hoses for crushed, blocked, split • Check and install a new diesel particulate filter differential pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2459-65	Diesel Particulate Filter Regeneration Frequency (Bank 1) - signal has too few transitions / events	<ul style="list-style-type: none"> • Blocked filter regeneration process has not been initiated • Customer driving routine does not allow the system to clean the particulate filter 	<p>NOTE: If DTC is P2459-65 or AMBER warning light is displayed with no other reported messages. No repair is required, if the vehicle is driven on a highway AS DIRECTED IN THE HANDBOOK then the light will be extinguished and the system self healed, nothing more than this is required</p> <ul style="list-style-type: none"> • Refer to the diesel particulate filter regeneration procedure and carry out a diesel particulate filter regeneration • Advise customer of driving routine required to regenerate diesel particulate filter as stated in the vehicle handbook
P2463-00	Diesel Particulate Filter Restriction - Soot Accumulation (Bank 1) - no sub type information	<ul style="list-style-type: none"> • Maximum soot mass • Diesel particulate filter requires regeneration • Customer driving routine does not allow the system to clean the particulate filter 	<ul style="list-style-type: none"> • Refer to the diesel particulate filter regeneration procedure and carry out a diesel particulate filter regeneration
P246C-00	Diesel Particulate Filter Restriction - Forced Limited Power (Bank 1) - no sub type information	<ul style="list-style-type: none"> • Diesel particulate filter requires replacement 	<ul style="list-style-type: none"> • Check and install a new diesel particulate filter as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2505-13	ECM / PCM Power Input Signal - circuit open	<p>NOTE: - Circuit PWRSTN -</p> <ul style="list-style-type: none"> • Engine management system high current relay fault • Harness fault relay control circuit 	<ul style="list-style-type: none"> • Check the operation of the engine management system high current relay • Refer to the electrical circuit diagrams and check the engine management system high current relay supply and control circuits for open circuits, high resistance, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine management system high current relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2507-11	ECM / PCM Power Input Signal Low - circuit short to ground	<p>NOTE: - Circuit PWRSTN -</p> <ul style="list-style-type: none"> • Engine management system high current relay fault • Harness fault relay control circuit 	<ul style="list-style-type: none"> • Check the operation of the engine management system high current relay • Refer to the electrical circuit diagrams and check the engine management system high current relay supply and control circuits for short circuit to ground, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system • If the fault persists, check and install a new engine management system high current relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2508-12	ECM / PCM Power Input Signal High - circuit short to battery	<p>NOTE: - Circuit PWRSTN -</p>	<ul style="list-style-type: none"> • Check the operation of the engine management system high current relay • Refer to the electrical circuit diagrams and check the

		<ul style="list-style-type: none"> Engine management system high current relay fault Harness fault relay control circuit 	<p>engine management system high current relay supply and control circuits for short circuit to power, short circuit to other circuits. Repair the circuit as required, clear the DTC and retest the system</p> <ul style="list-style-type: none"> If the fault persists, check and install a new engine management system high current relay as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P253F-00	Engine Oil Deteriorated - no sub type information	<ul style="list-style-type: none"> The engine control module has detected deterioration of the engine oil 	<ul style="list-style-type: none"> Check that the oil level is correct and the oil does not appear contaminated. Renew or top up oil as required
P2564-23	Turbocharger Boost Control Position Sensor A Circuit Low - signal stuck low	<p>NOTE: - Circuit VNTP -</p> <ul style="list-style-type: none"> Variable geometry turbocharger position sensor circuit, short circuit to ground Variable geometry turbocharger fault Variable geometry turbocharger position sensor fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger position sensor circuit for short circuit to ground. Repair the circuit as required, clear the DTC and retest the system Road test the vehicle to monitor turbocharger performance, rectify as necessary If the fault persists, check and install a new variable geometry turbocharger position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P2565-24	Turbocharger Boost Control Position Sensor A Circuit High - signal stuck high	<p>NOTE: - Circuit VNTP -</p> <ul style="list-style-type: none"> Variable geometry turbocharger position sensor circuit, short circuit to power Variable geometry turbocharger fault Variable geometry turbocharger position sensor fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the variable geometry turbocharger position sensor circuit for short circuit to power. Repair the circuit as required, clear the DTC and retest the system Road test the vehicle to monitor turbocharger performance, rectify as necessary If the fault persists, check and install a new variable geometry turbocharger position sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P268C-41	Cylinder 1 Injector Data Incompatible - general checksum failure	<ul style="list-style-type: none"> Injector calibration data held in the engine control module is different to that read from the injector Injector calibration data being entered does not match the expected values 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system reprogram the injector codes
P268C-55	Cylinder 1 Injector Data Incompatible - not configured	<ul style="list-style-type: none"> Injector calibration data held in the engine control module is different to that read from the injector 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system reprogram the injector codes

		<ul style="list-style-type: none"> • Injector calibration data not stored / programmed 	
P268D-41	Cylinder 2 Injector Data Incompatible - general checksum failure	<ul style="list-style-type: none"> • Injector calibration data held in the engine control module is different to that read from the injector • Injector calibration data being entered does not match the expected values 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system reprogram the injector codes
P268D-55	Cylinder 2 Injector Data Incompatible - not configured	<ul style="list-style-type: none"> • Injector calibration data held in the engine control module is different to that read from the injector • Injector calibration data not stored / programmed 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system reprogram the injector codes
P268E-41	Cylinder 3 Injector Data Incompatible - general checksum failure	<ul style="list-style-type: none"> • Injector calibration data held in the engine control module is different to that read from the injector • Injector calibration data being entered does not match the expected values 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system reprogram the injector codes
P268E-55	Cylinder 3 Injector Data Incompatible - not configured	<ul style="list-style-type: none"> • Injector calibration data held in the engine control module is different to that read from the injector • Injector calibration data not stored / programmed 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system reprogram the injector codes
P268F-41	Cylinder 4 Injector Data Incompatible - general checksum failure	<ul style="list-style-type: none"> • Injector calibration data held in the engine control module is different to that read from the injector • Injector calibration data being entered does not match the expected values 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system reprogram the injector codes

P268F-55	Cylinder 4 Injector Data Incompatible - not configured	<ul style="list-style-type: none"> • Injector calibration data held in the engine control module is different to that read from the injector • Injector calibration data not stored / programmed 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system reprogram the injector codes
U0001-88	High Speed CAN Communication Bus - bus off	<p>NOTE: - Circuit CAN H, CAN L -</p> <ul style="list-style-type: none"> • High speed CAN bus circuit short circuit to ground, short circuit to power, open circuit, high resistance • High speed CAN bus circuit, short between CAN high and CAN low 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check high speed CAN bus for short circuit to ground, short circuit to power, open circuit, high resistance, short between CAN high and CAN low. Repair the circuit as required, clear the DTC and retest the system
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> • Car configuration signal not received • Car configuration file incorrect 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check/amend the car configuration file

General Information - Diagnostic Trouble Code (DTC) IndexDTC:

Instrument Cluster (IPC)

Description and Operation



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

NOTE: If a control module or component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval program is in operation, before the replacement of a component.

NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

NOTE: When performing voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance always take the resistance of the DMM leads into account.

NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

NOTE: If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Instrument Cluster, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Diagnosis and Testing).

DTC	Description	Possible cause(s)	Action
B1A75-01	Fuel Sender 1 - general electrical failure	<ul style="list-style-type: none"> Fuel level sender circuit: short circuit to ground Fuel level sender circuit: short circuit to power Fuel level sender circuit: open circuit Fuel sender fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel level sender and circuits. Clear the diagnostic trouble code and retest. Refer to the warranty policy and procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component
B1A81-64	Internal Trip Switch - signal plausibility failure	<ul style="list-style-type: none"> Instrument cluster fault 	<ul style="list-style-type: none"> Clear the DTC. Cycle the ignition and retest. If the DTC resets, suspect the instrument cluster. Refer to the warranty policy and procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component
P1602-31	Immobilizer/ECM Communication Error -- no signal	<ul style="list-style-type: none"> Alarm (immobilizer) - instrument cluster circuit short circuit to ground Alarm (immobilizer) - instrument cluster circuit short circuit to power Alarm (immobilizer) - instrument cluster circuit open circuit Engine control module fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the alarm (immobilizer) circuit between the instrument cluster and engine control module. Clear the DTCs and test for normal operation Refer to the warranty policy and procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component
U0001-	High Speed CAN	<ul style="list-style-type: none"> CAN bus circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power and

88	Communication Bus - bus off	<ul style="list-style-type: none"> • CAN bus circuit fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0100-87	Lost Communication With ECM/PCM A -- missing message	<ul style="list-style-type: none"> • CAN circuit: open circuit • Engine control module fault • Instrument cluster fault 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the instrument cluster and engine control module • Refer to the electrical circuit diagrams and check the power and ground connections to the engine control module. Refer to the warranty policy and procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component • Refer to the electrical circuit diagrams and check the power and ground connections to the instrument cluster. Refer to the warranty policy and procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component
U0401-68	Invalid Data Received from ECM/PCM A - event information	<ul style="list-style-type: none"> • Invalid engine speed or engine temperature signal received from the engine control module 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system, check the engine control module for related diagnostic trouble codes and refer to the relevant diagnostic trouble code index
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> • Central car configuration parameter missing or corrupted 	<ul style="list-style-type: none"> • Check correct central car configuration software is installed. Reprogram the instrument cluster as necessary using the manufacturer approved diagnostic system
U3000-17	Control Module - circuit voltage above threshold	<ul style="list-style-type: none"> • Vehicle started using a booster pack • Supply voltage has exceeded 17.4v for 12 seconds • Charging system over charging 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system clear the diagnostic trouble code and retest • Refer to the electrical circuit diagrams and check the power and ground connections to the instrument cluster • Refer to the electrical circuit diagrams and check the charging system and charging voltage and rectify as necessary
U3000-46	Control Module - calibration / parameter memory failure	<ul style="list-style-type: none"> • Power supply lost from the instrument cluster with the ignition on • Instrument cluster fault 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the power and ground connections to the instrument cluster. Using the manufacturer approved diagnostic system clear the diagnostic trouble code and retest • Check and install new instrument cluster as required. Refer to the warranty policy and procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component

General Information - Diagnostic Trouble Code Index: ABS Control Module

Description and Operation

ABS Control Module (ABS)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

NOTE: If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

NOTE: If the module or a component is suspect and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the ABS Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
C0031-14	Left Front Wheel Speed Sensor - circuit short to ground or open	<ul style="list-style-type: none"> Left front wheel speed sensor circuit short to ground, open circuit Left front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front wheel speed sensor circuit for short to ground, open circuit. Check and install a new left front wheel speed sensor as required.
C0031-25	Left Front Wheel Speed Sensor - signal shape / waveform failure	<ul style="list-style-type: none"> Left front wheel speed sensor signal circuit, short to ground Left front wheel speed sensor target ring misaligned, damaged or incorrect air gap Left front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front wheel speed sensor signal circuit for short to ground. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left front wheel speed sensor as required.
C0031-2F	Left Front Wheel Speed Sensor - signal erratic	<ul style="list-style-type: none"> Left front wheel speed sensor circuit, short to ground, high resistance Left front wheel speed sensor target ring misaligned, damaged or 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front wheel speed sensor circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left front wheel speed sensor as required.

		incorrect air gap <ul style="list-style-type: none"> Left front wheel speed sensor failure 	
C0031-31	Left Front Wheel Speed Sensor - no signal	<ul style="list-style-type: none"> Left front wheel speed sensor circuit, open circuit Left front wheel speed sensor target ring misaligned, damaged or incorrect air gap Left front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front wheel speed sensor circuit for open circuit. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left front wheel speed sensor as required.
C0031-62	Left Front Wheel Speed Sensor - signal compare failure	<ul style="list-style-type: none"> Left front wheel speed sensor signal circuit, short to ground, high resistance Left front wheel speed sensor target ring misaligned, damaged or incorrect air gap Left front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front wheel speed sensor signal circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left front wheel speed sensor as required.
C0034-14	Right Front Wheel Speed Sensor - circuit short to ground or open	<ul style="list-style-type: none"> Right front wheel speed sensor circuit short to ground, open circuit Right front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right front wheel speed sensor circuit for short to ground, open circuit. Check and install a new right front wheel speed sensor as required.
C0034-25	Right Front Wheel Speed Sensor - signal shape / waveform failure	<ul style="list-style-type: none"> Right front wheel speed sensor signal circuit, short to ground Right front wheel speed sensor target ring misaligned, damaged or incorrect air gap Right front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right front wheel speed sensor signal circuit for short to ground. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new right front wheel speed sensor as required.
C0034-2F	Right Front Wheel Speed Sensor - signal erratic	<ul style="list-style-type: none"> Right front wheel speed sensor circuit, short to ground, high resistance Right front wheel speed 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right front wheel speed sensor circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic

		sensor target ring misaligned, damaged or incorrect air gap <ul style="list-style-type: none"> Right front wheel speed sensor failure 	system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. <ul style="list-style-type: none"> Check and install a new right front wheel speed sensor as required.
C0034-31	Right Front Wheel Speed Sensor - no signal	<ul style="list-style-type: none"> Right front wheel speed sensor circuit, open circuit Right front wheel speed sensor target ring misaligned, damaged or incorrect air gap Right front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right front wheel speed sensor circuit for open circuit. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new right front wheel speed sensor as required.
C0034-62	Right Front Wheel Speed Sensor - signal compare failure	<ul style="list-style-type: none"> Right front wheel speed sensor signal circuit, short to ground, high resistance Right front wheel speed sensor target ring misaligned, damaged or incorrect air gap Right front wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right front wheel speed sensor signal circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new right front wheel speed sensor as required.
C0037-14	Left Rear Wheel Speed Sensor - circuit short to ground or open	<ul style="list-style-type: none"> Left rear wheel speed sensor circuit short to ground, open circuit Left rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left rear wheel speed sensor circuit for short to ground, open circuit. Check and install a new left rear wheel speed sensor as required.
C0037-25	Left Rear Wheel Speed Sensor - signal shape / waveform failure	<ul style="list-style-type: none"> Left rear wheel speed sensor signal circuit, short to ground Left rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Left rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left rear wheel speed sensor signal circuit for short to ground. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left rear wheel speed sensor as required.
C0037-2F	Left Rear Wheel Speed Sensor - signal erratic	<ul style="list-style-type: none"> Left rear wheel speed sensor signal circuit, short to ground, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left rear wheel speed sensor signal circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or

		<ul style="list-style-type: none"> Left rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Left rear wheel speed sensor failure 	<p>damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required.</p> <ul style="list-style-type: none"> Check and install a new left rear wheel speed sensor as required.
C0037-31	Left Rear Wheel Speed Sensor - no signal	<ul style="list-style-type: none"> Left rear wheel speed sensor circuit, open circuit Left rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Left rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left rear wheel speed sensor circuit for open circuit. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left rear wheel speed sensor as required.
C0037-62	Left Rear Wheel Speed Sensor - signal compare failure	<ul style="list-style-type: none"> Left rear wheel speed sensor circuit, short to ground, high resistance Left rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Left rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left rear wheel speed sensor circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new left rear wheel speed sensor as required.
C003A-14	Right Rear Wheel Speed Sensor - circuit short to ground or open	<ul style="list-style-type: none"> Right rear wheel speed sensor circuit short to ground, open circuit Right rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right rear wheel speed sensor circuit for short to ground, open circuit. Check and install a new right rear wheel speed sensor as required.
C003A-25	Right Rear Wheel Speed Sensor - signal shape / waveform failure	<ul style="list-style-type: none"> Right rear wheel speed sensor signal circuit, short to ground Right rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Right rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right rear wheel speed sensor signal circuit for short to ground. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new right rear wheel speed sensor as required.
C003A-2F	Right Rear Wheel Speed Sensor - signal erratic	<ul style="list-style-type: none"> Right rear wheel speed sensor circuit, short to ground, high resistance 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right rear wheel speed sensor circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or

		<ul style="list-style-type: none"> Right rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Right rear wheel speed sensor failure 	<p>damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required.</p> <ul style="list-style-type: none"> Check and install a new right rear wheel speed sensor as required.
C003A-31	Right Rear Wheel Speed Sensor - no signal	<ul style="list-style-type: none"> Right rear wheel speed sensor circuit, open circuit Right rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Right rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right rear wheel speed sensor circuit for open circuit. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new right rear wheel speed sensor as required.
C003A-62	Right Rear Wheel Speed Sensor - signal compare failure	<ul style="list-style-type: none"> Right rear wheel speed sensor signal circuit, short to ground, high resistance Right rear wheel speed sensor target ring misaligned, damaged or incorrect air gap Right rear wheel speed sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the right rear wheel speed sensor signal circuit for short to ground, high resistance. Check the wheel speed sensor target ring air gap is to specification. Check that the wheel speed sensor target ring is correctly installed, secure and is not misaligned or has drifted off center. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check and install a new wheel speed sensor target ring as required. Check and install a new right rear wheel speed sensor as required.
C0062-64	Longitudinal Acceleration Sensor - signal plausibility failure	<ul style="list-style-type: none"> Yaw rate sensor installed incorrectly Incorrect yaw rate sensor installed Yaw rate sensor circuit, intermittent high resistance, open circuit Yaw rate sensor failure Hydraulic Control Unit (HCU) failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system clear the DTC and retest. Check that the yaw rate sensor is correctly and securely installed. Check that the correct yaw rate sensor is installed. Refer to the electrical circuit diagrams and check the yaw rate sensor circuit for intermittent connections and connectors for backed out pins. Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect. If the DTC remains, suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-14	Yaw Rate Sensor - circuit short to ground or open	<ul style="list-style-type: none"> Yaw rate sensor circuit short to ground, open circuit Yaw rate sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the yaw rate sensor circuit for short to ground, open circuit. Check and install a new yaw rate sensor as required.
C0063-1C	Yaw Rate Sensor - circuit	<ul style="list-style-type: none"> Yaw rate sensor circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the yaw rate sensor supply voltage and ground circuit for short to ground, high

	voltage out of range	short to ground, high resistance, open circuit <ul style="list-style-type: none"> Yaw rate sensor failure 	resistance, open circuit. Check passenger compartment fuse 10 amp. Replace as required. <ul style="list-style-type: none"> Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-41	Yaw Rate Sensor - general checksum failure	<ul style="list-style-type: none"> Yaw rate sensor failure Hydraulic Control Unit (HCU) failure 	<ul style="list-style-type: none"> Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-49	Yaw Rate Sensor internal electronic failure	<ul style="list-style-type: none"> Yaw rate sensor failure 	<ul style="list-style-type: none"> Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-64	Yaw Rate Sensor -signal plausibility failure	<ul style="list-style-type: none"> Yaw rate sensor failure Hydraulic Control Unit (HCU) failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system clear the DTC and retest. If the DTC remains, suspect the yaw rate sensor has failed. Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect. If the DTC remains, suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-86	Yaw Rate Sensor - signal invalid	<ul style="list-style-type: none"> Yaw rate sensor failure Hydraulic Control Unit (HCU) failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system clear the DTC and retest. If the DTC remains, suspect the yaw rate sensor has failed. Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect. If the DTC remains, suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-95	Yaw Rate Sensor - incorrect assembly	<ul style="list-style-type: none"> Yaw rate sensor installed incorrectly Vehicle on a rolling road dynamometer Yaw rate sensor failure 	<ul style="list-style-type: none"> Check that the yaw rate sensor is correctly and securely installed. Ensure the vehicle is not on a rolling road or has not been on a rolling road. Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C0063-96	Yaw Rate Sensor - component internal failure	<ul style="list-style-type: none"> Yaw rate sensor failure Hydraulic Control Unit (HCU) internal failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system clear the DTC and retest. If the DTC remains, suspect the yaw rate sensor has failed. Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect. If the DTC remains, suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C101F-49	Generic Valve Failure - internal electronic failure	<ul style="list-style-type: none"> Yaw rate sensor circuit short to power, short to ground, open circuit Yaw rate sensor circuit intermittent high resistance, open circuit Yaw rate sensor failure Hydraulic Control Unit (HCU) failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the yaw rate sensor circuit for short to ground, short to power, open circuit. Check and install a new yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect. Refer to the electrical circuit diagrams and check the yaw rate sensor circuit for intermittent connection and connectors for backed out pins. If the DTC remains, suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.

C1A77-16	Valve Relay Supply Circuit - circuit voltage below threshold	<ul style="list-style-type: none"> Valve relay supply circuit short to ground, open circuit, high resistance Battery junction box fuse 1 30 amp failed 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the valve relay circuit for short to ground, open circuit, high resistance. Refer to the electrical circuit diagrams and check the valve relay fuse, replace as required.
C1A95-64	Wheel Speed Sensor - signal plausibility failure	<ul style="list-style-type: none"> Signal plausibility failure. Multiple wheel speed sensors have invalid, poor signals and are not plausible, the specific wheel speed sensor cannot be identified Under inflated tire Wheel or tire size mismatch between the front wheels Wheel speed sensor transposed on front axle, incorrectly assigned at control module cavity Damage to the wheel speed sensor circuit wiring Wheel speed sensor target ring misaligned, damaged or incorrect air gap Debris build up on the wheel speed sensor trigger face Wheel speed sensor internal failure Internal failure of the Hydraulic Control Unit (HCU) 	<ul style="list-style-type: none"> Check the tires are inflated to the correct pressures. Check the wheel rims and tires are the correct size. Refer to the electrical circuit diagrams and check the wheel speed sensor ground and signal circuits correspond to the correct cavity at the Hydraulic Control Unit (HCU). Refer to the electrical circuit diagrams and check the wheel speed sensor ground and signal circuits for short to ground, short to power, open circuit. Visually inspect the wheel speed sensor target ring teeth for missing or damaged teeth. Check the wheel speed sensor target ring is not dirty or damaged. Using the manufacturer approved diagnostic system check that each wheel corresponds correctly to its signal. Check the wheel speed sensor for debris build up on the trigger face. Check and install a new wheel speed sensor as required. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
C1B02-16	Return Pump - circuit voltage below threshold	<ul style="list-style-type: none"> Hydraulic Control Unit (HCU) supply circuit short to ground, open circuit, high resistance Battery junction box stand alone fuse 40 amp failed 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the Hydraulic Control Unit (HCU) circuit for short to ground, open circuit, high resistance. Refer to the electrical circuit diagrams and check the Hydraulic Control Unit (HCU) fuse, replace as required.
C1B02-	Return Pump -	<ul style="list-style-type: none"> Hydraulic 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system clear the DTC

49	internal electronic failure	Hydraulic Control Unit (HCU) failure	Using the manufacturer approved diagnostic system clear the DTC and retest. If the DTC remains, suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
P0571-13	Brake Switch A Circuit - circuit open	<ul style="list-style-type: none"> Brake switch A circuit high resistance, open circuit Brake switch A incorrect adjustment or failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the brake switch A circuit for high resistance, open circuit. Check brake switch A for correct installation and adjustment. Check and install a new brake switch A as required.
P186A-13	Differential Lock-up Actuator Brake Control Circuit / Open - circuit open	<ul style="list-style-type: none"> Differential lock signal circuit high resistance, open circuit Differential lock signal circuit intermittent high resistance, open circuit Differential lock switch failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the differential lock-up actuator brake control circuit for high resistance, open circuit. Refer to the electrical circuit diagrams and check the differential lock signal circuit for intermittent connections and backed out pins. Check the differential lock switch for correct installation and adjustment. Check and install a new differential lock switch as required.
U0001-88	High Speed AN Communication Bus - bus off	<ul style="list-style-type: none"> CAN bus short to ground, short to power, open circuit, short between CAN high and CAN low 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the high speed CAN bus for short to ground, short to power, open circuit, short between CAN high and CAN low.
U0074-88	Control Module Communication Bus "B" Off - bus off	<ul style="list-style-type: none"> Private CAN bus between the yaw rate sensor and the Hydraulic Control Unit (HCU), short to ground, short to power, open circuit High speed CAN bus circuit, short to ground, short to power, open circuit High speed CAN bus circuit, short between CAN high and CAN low 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the private CAN bus between the Yaw rate sensor and the Hydraulic Control Unit (HCU), for short to ground, short to power, open circuit. Refer to the electrical circuit diagrams and check the high speed CAN bus for short to ground, short to power, open circuit, short between CAN high and CAN low.
U0100-00	Lost Communication with ECM/PCM "A" - no sub type information	<ul style="list-style-type: none"> Engine Control Module (ECM) power supply circuit, open circuit, short to ground, high resistance CAN circuit short to ground, short to power, open circuit Engine Control Module (ECM) 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the Engine Control Module (ECM) power supply circuit for open circuit, short to ground, high resistance. Refer to the electrical circuit diagrams and check the high speed CAN bus for short to ground, short to power, open circuit, short between CAN high and CAN low. Clear the DTC and re-test. Check and install a new Engine Control Module (ECM) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.

		internal failure	
U0123-00	Lost Communication With Yaw Rate Sensor Module - no sub type information	<ul style="list-style-type: none"> • Incorrect yaw rate sensor installed • Yaw rate sensor circuit, open circuit • Yaw rate sensor failure 	<ul style="list-style-type: none"> • Check that the correct yaw rate sensor is installed to the vehicle. • Refer to the electrical circuit diagrams and check the Yaw rate sensor harness, for open circuit. • Check and install a new Yaw rate sensor as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
U0155-00	Lost Communication With Instrument Panel Cluster (IPC) Control Module	<ul style="list-style-type: none"> • Instrument Panel Cluster (IPC) power supply circuit, open circuit, short to ground, high resistance • CAN circuit short to ground, short to power, open circuit • Instrument Panel Cluster (IPC) internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the Instrument Panel Cluster (IPC) power supply circuit for open circuit, short to ground, high resistance. • Refer to the electrical circuit diagrams and check the high speed CAN bus for short to ground, short to power, open circuit, short between CAN high and CAN low. • Clear the DTC and re-test. Check and install a new Instrument Panel Cluster (IPC) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> • Hydraulic Control Unit (HCU) CAN controller initialisation error • Incorrect Hydraulic Control Unit (HCU) is installed to the vehicle • Car Configuration File (CCF) incorrectly configured 	<ul style="list-style-type: none"> • Check that the correct Hydraulic Control Unit (HCU) is installed to the vehicle. • Using the manufacturer approved diagnostic system correct the Car Configuration File (CCF) as required.
U0401-68	Invalid Data Received from ECM/PCM A - event information	<ul style="list-style-type: none"> • Engine Control Module (ECM) internal failure 	<ul style="list-style-type: none"> • Clear the DTC and re-test. Check for related Engine Control Module (ECM) DTCs and refer to the relevant DTC index. Check and install a new Engine Control Module (ECM) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
U1A14-00	CAN Initialisation Failure - no sub type information	<ul style="list-style-type: none"> • Hydraulic Control Unit (HCU) CAN controller initialisation error • Incorrect Hydraulic Control Unit (HCU) is installed to the vehicle 	<ul style="list-style-type: none"> • Check that the correct Hydraulic Control Unit (HCU) is installed to the vehicle. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
U3000-00	Control Module - no sub type information	<ul style="list-style-type: none"> • Hydraulic Control Unit (HCU) CAN controller initialisation error • Incorrect Hydraulic Control Unit 	<ul style="list-style-type: none"> • Check that the correct Hydraulic Control Unit (HCU) is installed to the vehicle. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.

		(HCU) is installed to the vehicle	
U3000-49	Control Module - internal electronic failure	<ul style="list-style-type: none"> Hydraulic Control Unit (HCU) internal failure 	<ul style="list-style-type: none"> Suspect the Hydraulic Control Unit (HCU) has failed. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
U3000-4B	Control Module - over temperature	<ul style="list-style-type: none"> Hydraulic Control Unit (HCU) valve overheat protection has been activated Actuation of a Hydraulic Control Unit (HCU) valve(s) for an excessive period of time 	<ul style="list-style-type: none"> Allow the Hydraulic Control Unit (HCU) to cool. Clear the DTC and retest. Check and install a new Hydraulic Control Unit (HCU) as required, refer to the Warranty Policy and Procedures manual if a module/component is suspect.
U3006-16	Control Module Input Power "A" - circuit voltage below threshold	<ul style="list-style-type: none"> Power supply voltage at the Hydraulic Control Unit (HCU) below 8.2 volts for longer than the specified time Vehicle battery voltage low Vehicle charging system fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power supply connections and wiring circuit at the Hydraulic Control Unit (HCU). Check the vehicle battery for correct voltage and condition. Check the vehicle charging system for correct operation.
U3006-17	Control Module Input Power "A" - circuit voltage above threshold	<ul style="list-style-type: none"> Power supply voltage at the Hydraulic Control Unit (HCU) above 16.8 volts for longer than the specified time Vehicle charging system fault 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check for related charging system DTCs and refer to the relevant DTC index. Check the vehicle charging system for correct operation.
U3006-1C	Control Module Input Power "A" - circuit voltage out of range	<ul style="list-style-type: none"> Power supply voltage at the Hydraulic Control Unit (HCU) below 8.2 volts for longer than the specified time Vehicle battery voltage low Vehicle charging system fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power supply connections and wiring circuit at the Hydraulic Control Unit (HCU). Check the vehicle battery for correct voltage and condition. Check the vehicle charging system for correct operation.

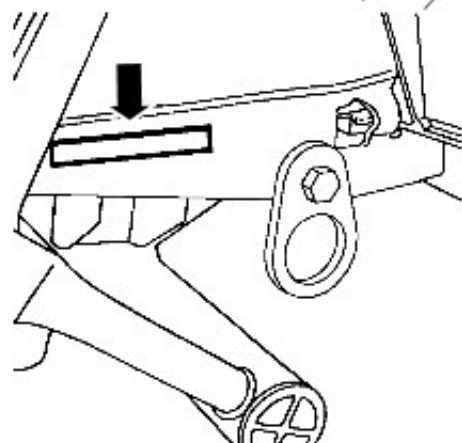
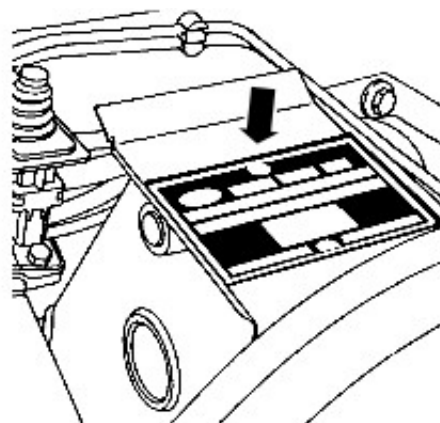
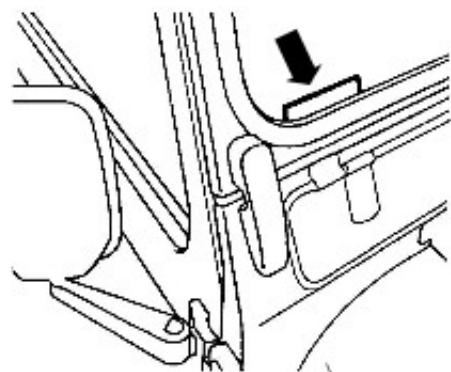
Identification Codes - Identification Codes

Description and Operation

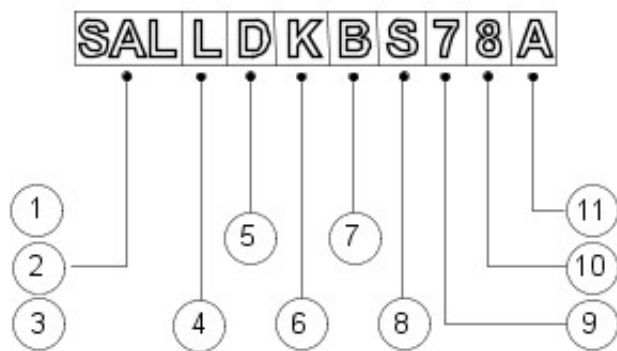
VIN Number

The VIN number is found in three locations:

- 1.** Stamped on the RH side of the chassis towards the rear of the front lashing eye.
- 2.** At the bottom of the windshield glass on the RH side of the vehicle and is visible from the outside.
- 3.** On a plate attached to the brake pedal box in the engine compartment.



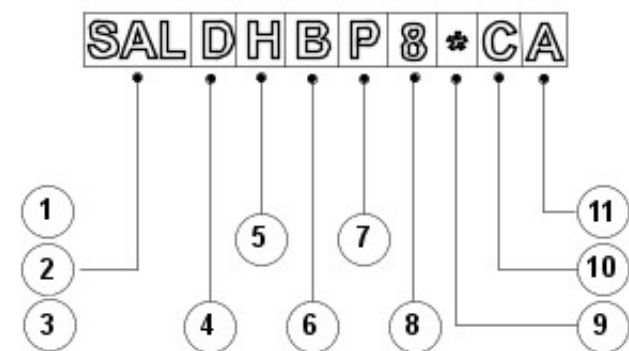
E91212



E91381

VIN number - UK, EU and ROW

VIN Position	Character	Identifies
1 - 3 - World identifier	SAL	Land Rover (UK)
4,5 - Vehicle type	LD	Defender
6 - Class	H	110 inch
6 - Class	K	130 inch
6 - Class	V	90 inch
6 - Class	B	110 inch Extra heavy duty
6 - Class	W	90 inch Extra heavy duty
7 - Body style	A	Regular
7 - Body style	B	3 Door station wagon
7 - Body style	F	4 Door Crew Cab non h/cap
7 - Body style	H	H/cap with or without 4 Door Crew Cab
7 - Body style	L	Soft Top
7 - Body style	M	5 Door Station Wagon
7 - Body style	N	Hard Top
7 - Body style	R	Single Cab Pick Up
7 - Body style	S	Double Cab Pick Up
7 - Body style	T	2 Door High Capacity Pick Up
7 - Body style	V	Crew Cab High Capacity Pick Up
7 - Body style	W	2 Door Chassis Cab
7 - Body style	X	4 Door Chassis Cab
7 - Body style	Y	5 Door Utility Station Wagon
8 - Engine	P	2.2L Euro spec (EU5)
8 - Engine	R	2.2L ROW spec (non EU5)
8 - Engine	S	2.4L Euro spec (EU4)
8 - Engine	T	2.4L ROW spec (EU2)
8 - Engine	N	2.4L 24V Military Euro spec (EU4)
8 - Engine	W	2.4L 24V Military ROW spec (EU2)
9 - Transmission and steering	7	RHD 6 speed manual transmission
9 - Transmission and steering	8	LHD 6 speed manual transmission
10 - Model year	7	2007 Model year
10 - Model year	8	2008 Model year
10 - Model year	9	2009 Model year
10 - Model year	A	2010 Model year
10 - Model year	B	2011 Model year
10 - Model year	C	2012 Model year
11 - Plant	A	Solihull
11 - Plant	C	Zimbabwe
11 - Plant	D	Thailand
11 - Plant	F	KD
11 - Plant	J	Malaysia
11 - Plant	K	Kenya
11 - Plant	P	Pakistan
11 - Plant	W	Turkey

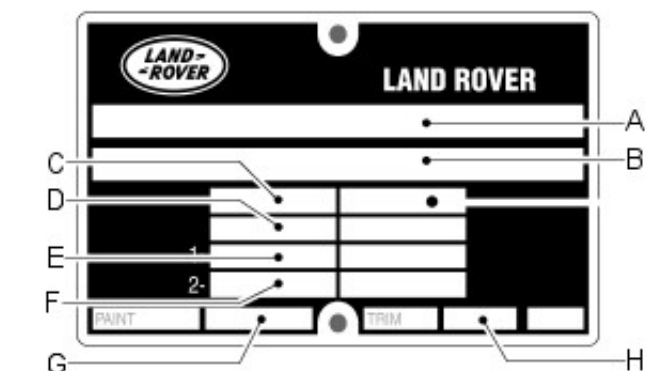


E139790

VIN number - NAS

VIN Position	Character	Identifies
1 - 3 - World identifier	SAL	Land Rover (UK)
4 - Vehicle type	D	Defender
5 - Class	H	110 inch
5 - Class	W	90 inch Extra heavy duty
6 - Body style	B	3 Door station wagon
6 - Body style	M	5 Door Station Wagon
7 - Engine	P	2.2L Euro spec (EU5)
7 - Engine	R	2.2L ROW spec (non EU5)
7 - Engine	S	2.4L Euro spec (EU4)
8 - Transmission and steering	8	LHD 6 speed manual transmission
9 - Check digit	*	Derived by calculation
10 - Model year	7	2007 Model year
10 - Model year	8	2008 Model year
10 - Model year	9	2009 Model year
10 - Model year	A	2010 Model year
10 - Model year	B	2011 Model year
10 - Model year	C	2012 Model year
11 - Plant	A	Solihull

Vehicle Identification Plate

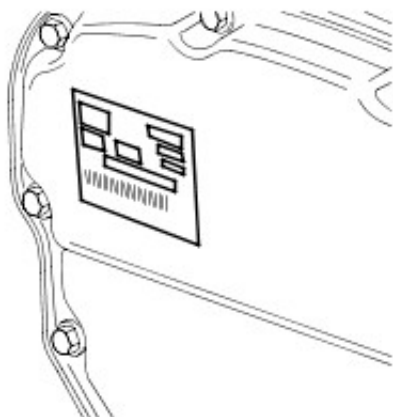


M010312

The VIN plate contains the following information:

- A** - Type approval number
- B** - Vehicle identification number
- C** - Maximum permitted laden weight for vehicle
- D** - Maximum vehicle and trailer weight
- E** - Maximum road weight - front axle
- F** - Maximum road weight - rear axle
- G** - Paint code
- H** - Trim level

Unit/Assembly Serial Number Locations

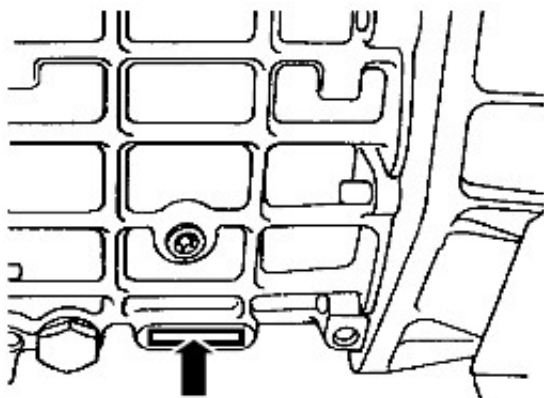


TIE0031810

Engine Identification Label

- Date and time of manufacture
- Engine part number

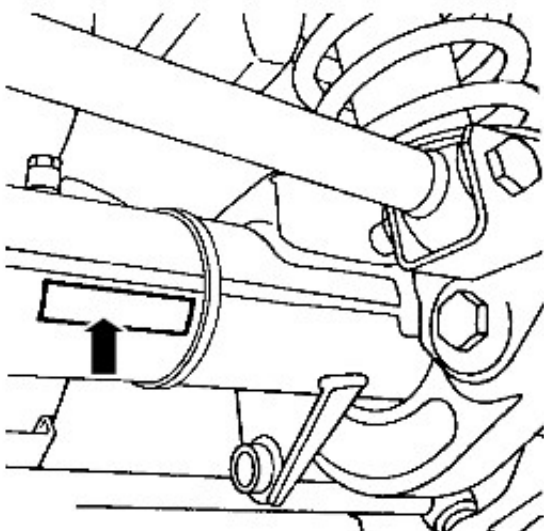
Manual Transmission Serial Number



J6091

The Manual Transmission Serial Number is stamped on a cast pad on the bottom RH side of the transmission casing.

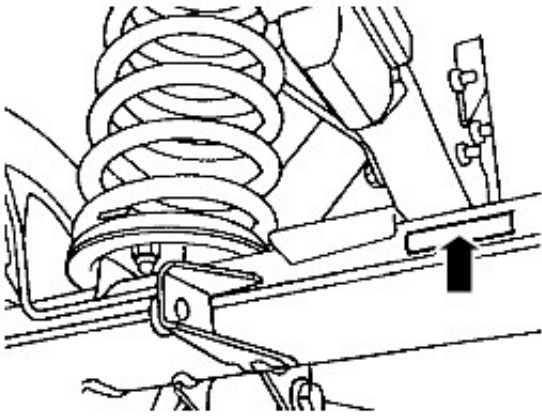
Front Axle Serial Number



J6093

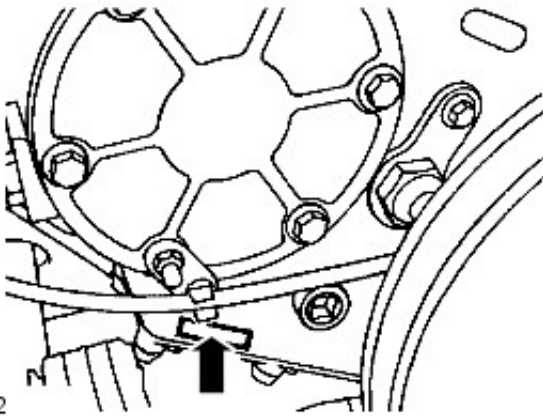
The front axle serial number is stamped on the LH side of the front axle tube, inboard of radius arm mounting bracket.

Rear Axle Serial Number



The rear axle serial number is stamped on the rear axle tube on the LH side, inboard of the spring mounting.

Transfer Case Serial Number



The transfer case serial number is stamped on the LH side of the transfer case below the mainshaft rear bearing housing adjacent to the bottom cover.

Jacking and Lifting - Vehicle Recovery

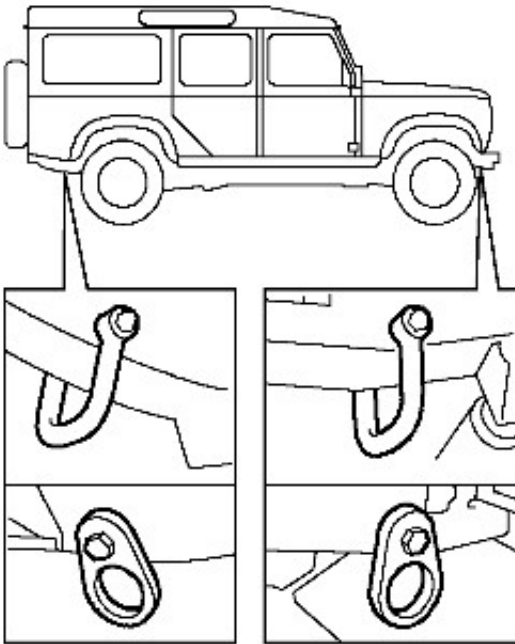
Description and Operation



CAUTION: The vehicle has permanent four-wheel drive. The following towing instructions must be adhered to:

Towing the vehicle on all four wheels with driver operating steering and brakes.

- Turn ignition key to position '1' to release steering lock.
- Select neutral in main gearbox and transfer gearbox.



J6085

- Secure tow rope, chain or cable to front towing eyes (alternative types shown).
- Release the parking brake.



CAUTION: The brake booster and power assisted steering system will not be functional without the engine running. Greater pedal pressure will be required to apply the brakes, the steering system will require greater effort to turn the front road wheels. The vehicle tow connection should be used only in normal road conditions, 'snatch' recovery should be avoided.

Transporting the vehicle by trailer

Lashing/towing eyes are provided on front and rear of the chassis side members, see J6085, to facilitate the securing of the vehicle to a trailer or other means of transportation.




CAUTION: Underbody components must not be used as lashing points.

Install vehicle on trailer and apply park brake. Select neutral in main gearbox.

Rear suspended tow by breakdown vehicle

- If the front axle is to be trailed turn ignition key to position '1' to release steering lock.
- Select neutral in main gearbox and transfer box.
- The steering wheel and/or linkage must be secured in a straight ahead position. DO NOT use the steering lock mechanism for this purpose.

Jump starting

 **WARNING:** Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames, sparks or lighted tobacco are brought near battery. When charging or using a battery in an enclosed space, always provide ventilation and shield your eyes.

Keep out of reach of children. Batteries contain sulphuric acid. Avoid contact with skin, eyes, or clothing. Also, shield eyes when working near battery to protect against possible splashing of acid solution. In case of acid contact with skin, eyes, or clothing, flush immediately with water for a minimum of fifteen minutes. If acid is swallowed, drink large quantities of milk or water, followed by milk of magnesia, a beaten egg, or vegetable oil.

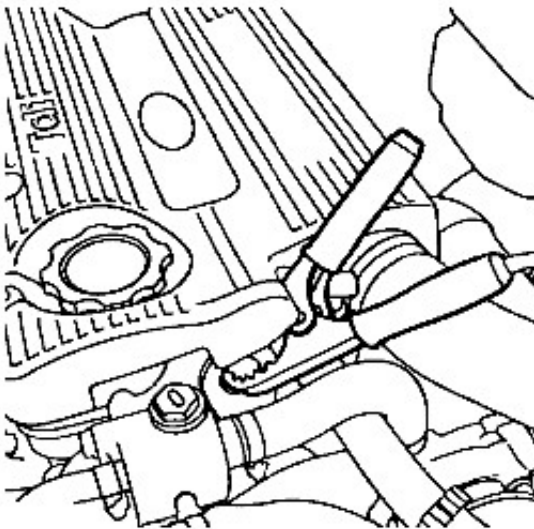
SEEK MEDICAL AID IMMEDIATELY.

To Jump Start - Negative Ground Battery


 **WARNING:** To avoid any possibility of injury use particular care when connecting a booster battery to a discharged battery.

- Position vehicles so that jump leads will reach, ensuring that vehicles DO NOT TOUCH, alternatively a fully charged slave battery may be positioned on floor adjacent to vehicle.
- Ensuring that ignition and all electrical accessories are switched off, that parking brake is applied and neutral is selected, connect the jump leads as follows;

A. Connect one end of first jumper cable to positive (+) terminal of booster battery. B. Connect other end of first jumper cable to positive (+) terminal of discharged battery. C. Connect one end of second jumper cable to negative terminal of booster battery. D. Connect other end of second jumper cable to a good earth point on the disabled vehicle (eg. engine front lifting eye, as shown in J6086), NOT TO NEGATIVE TERMINAL OF DISCHARGED BATTERY. Keep jumper lead away from moving parts, pulleys, drive belts and fan blade assembly.



J6086

 **WARNING:** Making final cable connection could cause an electrical arc which if made near battery could cause an explosion.

- If booster battery is installed in another vehicle, start engine and allow to idle.
- Start engine of vehicle with discharged battery, following starting procedure in Owners' Manual.

 **CAUTION:** If vehicle fails to start within a maximum time of 12 seconds, switch ignition off and investigate cause. Failing to follow this instruction could result in irreparable damage to catalyst, if fitted.

- Remove negative (-) jumper cable from the engine and then terminal of booster battery.
- Remove positive (+) jumper cable from positive terminals of booster battery and discharged battery.

Jacking and Lifting - Jacking

Description and Operation

General

 **WARNING:** The following instructions must be adhered to before raising the vehicle off the ground:

- Position vehicle on a solid, level surface.
- Apply the parking brake.
- Select 'P' - PARK on automatic transmission selector or 1st gear on manual transmission and 'H' High on transfer case.
- Select low range in the transfer box.

 **CAUTION:** To avoid damage occurring to the under body components of the vehicle the following jacking procedures must be adhered to.

DO NOT POSITION JACKS OR AXLE STANDS UNDER THE FOLLOWING COMPONENTS.

- **Body structure**
- **Bumpers**
- **Fuel lines**
- **Brake lines**
- **Front radius arms**
- **Panhard rod**
- **Steering linkage**
- **Rear trailing links**
- **Fuel tank**
- **Engine sump**
- **Gearbox bell housing**

Vehicle jack

The jack provided with the vehicle is only intended for use in an emergency such as changing a tire. DO NOT use the jack for any other purpose. Refer to the Owner's Handbook for the vehicle jack location points and jacking procedures.

 **WARNING:** Never work under a vehicle supported solely by the vehicle jack.

Hydraulic jack

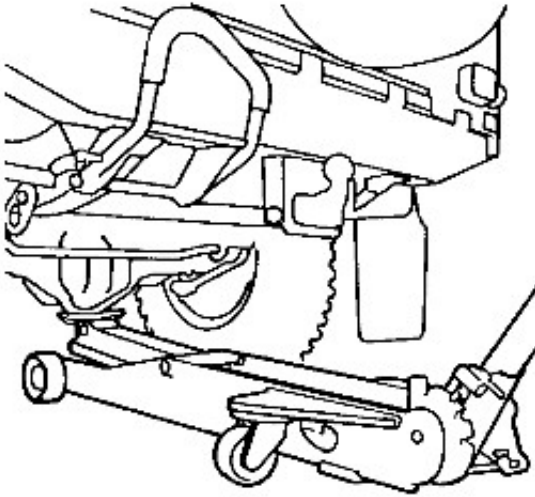
A hydraulic jack with a minimum lifting capacity of 1500 kg, (3,300 lbs) must be used.

WARNINGS:

 Do not commence work on the underside of the vehicle until suitable axle stands have been placed in the correct position.

 Always chock the wheels when jacking. The parking brake may be ineffective when the wheel(s) are off the ground.

Raising the Front of the Vehicle



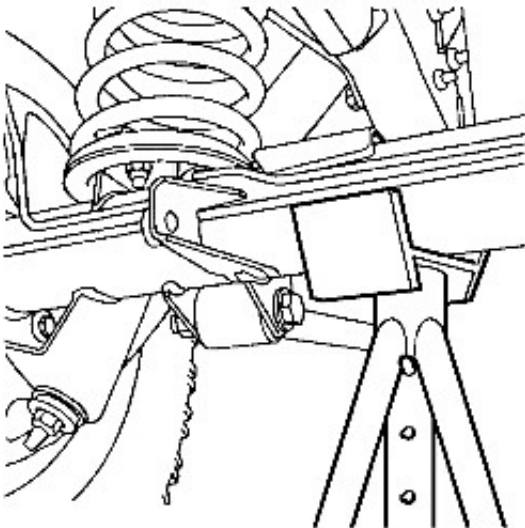
J6083

- Position cup of hydraulic arm under differential casing.

NOTE: The differential casing is not central to the axle. Care should be taken when raising the front road wheels off the ground as the rear axle has less sway stiffness.

- Raise front road wheels to enable an axle stand to be installed under left hand axle tube.
- Position an axle stand under right hand axle tube, carefully lower jack until axle sits securely on both axle stands, remove trolley jack.
- Before commencing work on underside of vehicle re-check security of vehicle on stands.
- Reverse procedure when removing vehicle from stands.

Raising the Rear of the Vehicle



J6084

- Position cup of hydraulic arm under differential casing.
- Raise vehicle to enable axle stands to be installed under left and right hand axle tubes.
- Lower jack until axle sits securely on axle stands, remove trolley jack.
- Before commencing work on underside of vehicle re-check security of vehicle on stands.
- Reverse procedure when removing vehicle from stands.

Jacking and Lifting - Lifting

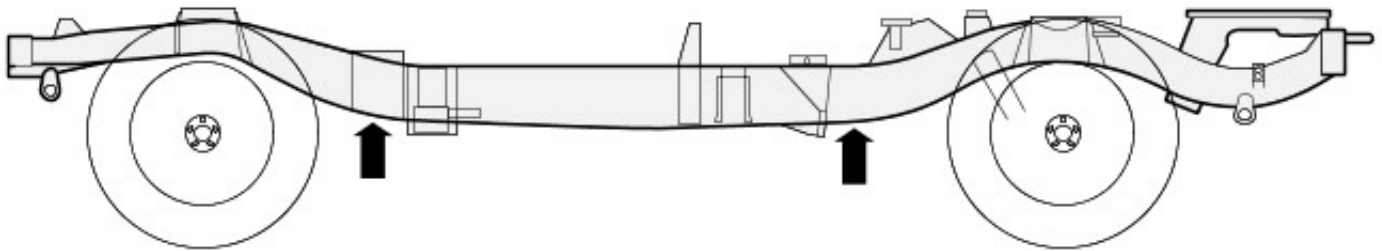
Description and Operation

Four post vehicle ramps

Position the vehicle on the ramp with the front and the rear of the vehicle equidistant from the ends of the ramp. Chock the wheels, select neutral on the transmission and where practicable apply the parking brake.

If a wheel free condition is required, use a wheel-free system which supports beneath the axle casings.

Two post vehicle ramps



E82298

WARNING: When raised to the desired height, make sure the vehicle is stable before starting work.

CAUTION: If the drive shafts are to be disconnected, release the parking brake and select neutral on the transmission in order that the shaft(s) can be rotated when the vehicle is raised to the desired height.

- Position the vehicle with the centre of the lifting pillars aligned with the front of the driver/passenger seat cushions.
- Extend the lifting arms and position the pads of each lifting arm beneath the body frame longitudinal lifting points, arrowed in the illustration.
- Raise the vehicle until the wheels are just clear of the ground and check that the pads of each lifting arm are still correctly positioned and are in full contact with the body frame longitudinals.
- Raise the vehicle to the desired height.
- Ensure that the vehicle is correctly supported on all four lifting pads, that the pads are still correctly positioned and are in full contact with the body frame longitudinals.

Road roller testing

Four wheel Rolling Road

WARNING: DO NOT attempt to drive individual wheels with vehicle supported on floor jacks or stands.

Provided that front and rear rollers are rotating at identical speeds and that normal workshop safety standards are applied, there is no speed restriction during testing except any that may apply to the tyres.

Two wheel rolling road

IMPORTANT: Use a four wheel rolling road for brake testing if possible.

If brake testing on a two wheel rolling road is necessary, it must be carried out with propeller shaft to the stationary axle removed and neutral selected in BOTH main gearbox and transfer gearbox. When checking brakes, run engine at idle speed to maintain brake servo vacuum.

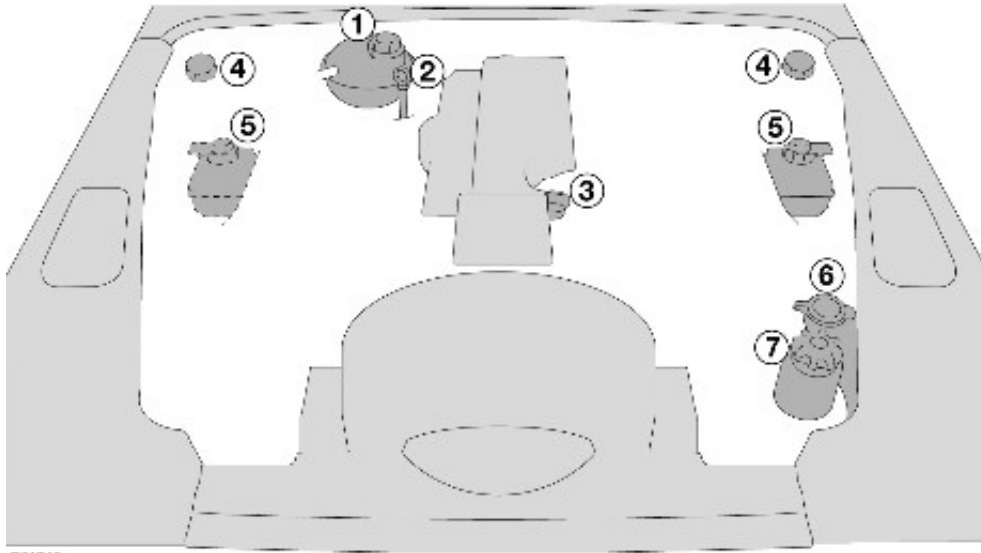
Maintenance Schedules - Maintenance Schedules - Diesel Engines

Description and Operation

Torque Specifications

Description	Nm	lb-ft
Wheel nuts - steel wheels	100	80
Wheel nuts - alloy wheels	130	96
Wheel nuts - Heavy duty wheels	170	125
Transfer box filler plug	30	22
Transfer box drain plug	30	22

Under Bonnet View

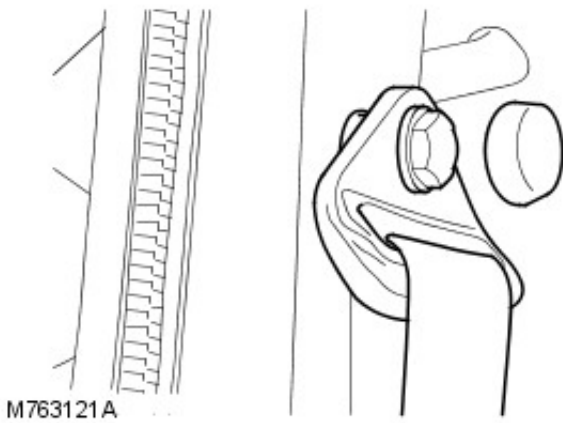


E84742

Item	Part Number	Description
1	-	Coolant expansion tank
2	-	Engine oil dipstick
3	-	Engine oil filler cap
4	-	Clutch fluid reservoir filler cap
5	-	Brake fluid reservoir filler cap
6	-	Windscreen washer reservoir
7	-	Power steering fluid reservoir

Seats and Safety Belts

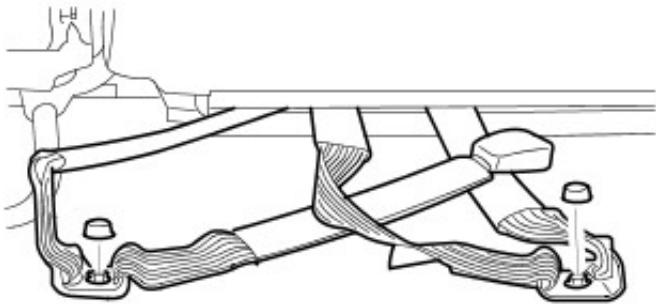
1. Check seat frames are secured to floor and show no signs of movement.
2. Check operation of seat slide and tilt mechanisms, making sure there is no excessive play between seat cushion and seat back.
3. Check tightness of accessible seat fixings.
4. Fully extract seat belt and allow it to return under its own recoil mechanism.
5. Check entire length of seat belt webbing for signs of fraying or damage. Repeat for all belts.
6. Check security of seat belt upper mountings.



7. Check security of seat belt buckle mountings.

8. Connect each belt to the correct buckle, check seat belt buckle and tongue are secure. Release seat belt buckle and check for correct operation.

9. Check tightness of accessible seat belt mountings



Lamps, Horns and Warning Indicators

1. Check side, head, fog, reversing and tail lamps for correct operation.

2. Check operation of headlamp automatic levelling system - if installed.

3. Check turn signals and hazard warning lamps for correct operation.

4. Check brake (stop) lamps for correct operation.

5. Check all exterior lamp lenses for clarity and condition; pay particular attention to headlamp and fog lamp lenses for stone chips or damage.

6. Check horn for loud, clear sound.

7. Switch on headlamps and check that side/headlamp reminder warning sounds when door is opened.

8. Check operation of interior courtesy lamps.

9. Check operation of all instrument pack warning and indicator lamps.

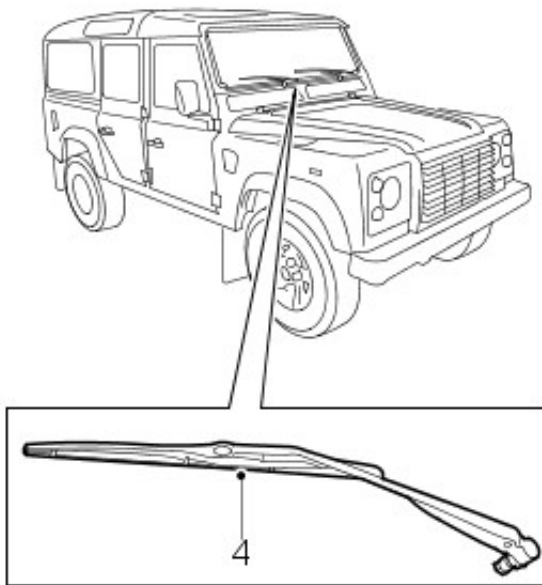
Washers and Wipers

1. Operate screen washer and switch on wipers. Check washer jets are correctly aimed and check for smooth seamless operation across screen of wiper blades at all speeds, including intermittent.

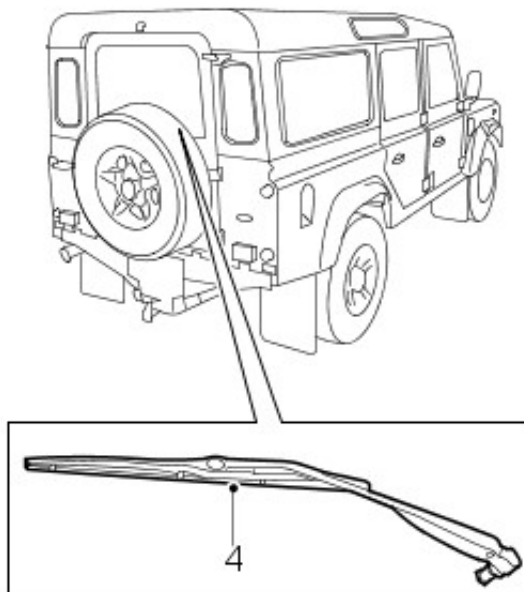
2. Repeat operation for rear screen wipers and washers.

3. Check all wiper blades for condition and signs of splits or damage.

4. Check security of wiper arms.



M100634



M100633

Parking Brake

1. With the vehicle stationary, apply the parking brake and check for correct operation. For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05 Parking Brake and Actuation, General Procedures).

Release parking brake and check for correct operation.

Battery Condition

NOTE: The vehicle may be fitted with an alarm and immobilisation system. To prevent the alarm from sounding, it is important that the following procedure is used when disconnecting the battery.

1. Remove drivers seat base.
2. Release clip securing battery cover.
3. Remove battery cover.
4. Turn the ignition switch to position 'II', and then to position '0'.
5. Remove the ignition key.

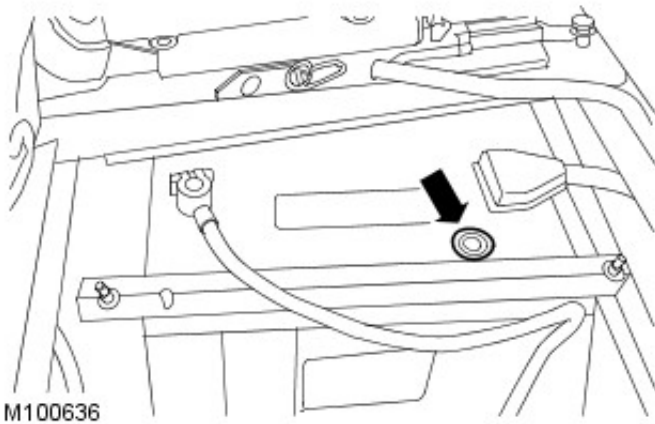
NOTE: Always disconnect the -ve terminal first. When replacing, connect the +ve terminal first.

6. Disconnect the vehicle -ve terminal within 15 seconds.
7. The battery is designed to be maintenance free, so topping-up is not possible. On the top of the battery is a battery

indicator. When the indicator shows:

- GREEN - The battery is in a good state of charge.
- DARK (turning to black) - The battery needs charging.
- CLEAR (or light yellow) - The battery needs replacing. Do not charge the battery or jump start the vehicle in this condition.
- If the green dot is missing, the battery needs charging.

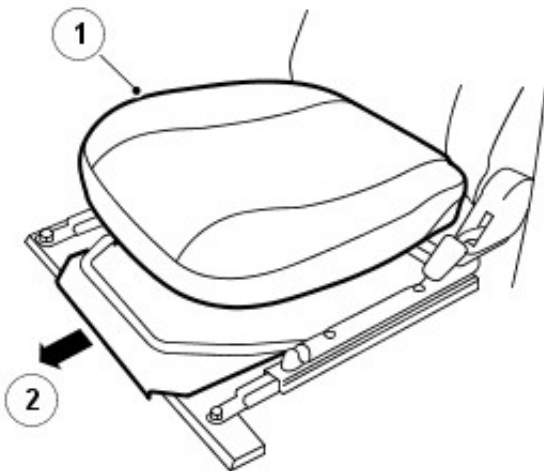
NOTE: If the indicator shows clear or yellow, tap the indicator with the handle of a screwdriver to disperse any air bubbles. If the indicator colour remains unchanged, the battery will need replacing.



8. Clean and grease battery terminals and leads with petroleum jelly.
9. Connect leads to battery (+ve first) and tighten clamp bolts.
10. Fit battery cover and secure with clip.
11. Fit drivers seat base.

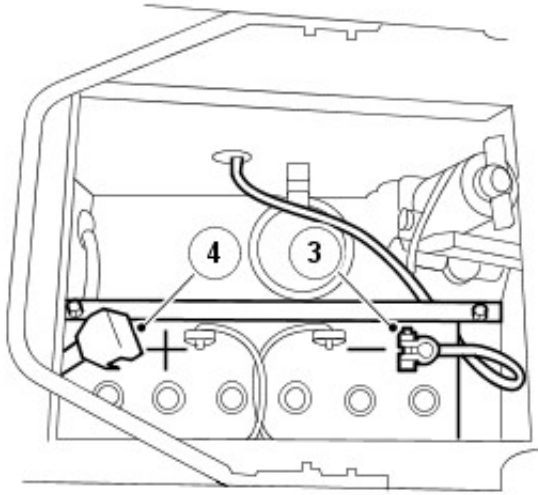
Clean Battery Terminals

1. Remove drivers seat base.
2. Release clip securing battery cover. Remove battery cover.



10M0493

3. Disconnect both battery terminals, -ve terminal first. Clean off corrosion and neutralise. Smear terminals with petroleum jelly.
4. Reconnect battery terminals +ve first, when maintenance operations have been completed.



10M0494

5. Fit battery cover and secure with clip.

6. Fit drivers seat base.

Handset Battery

NOTE: Do not remove a battery until you are ready to install the replacement. Always fit a Land Rover STC4080 or a Panasonic CR2032 replacement battery.

1. Unlock the vehicle and disarm the alarm system.

2. Turn the ignition switch to position 'II', then turn to position '0' and remove the key.



CAUTION: Do not allow moisture to get inside the handset.

3. Carefully prise the handset apart, starting from the keying end. Avoid damaging the seal between the two halves of the case.

4. Slide the battery out of its clip, taking care to avoid touching the circuit board or the contact surfaces of the clip.

5. Press and hold one of the buttons for at least 5 seconds to drain any residual power from the handset.

6. Fit the new battery, making sure that correct polarity is maintained (+ve side facing up). Finger marks will adversely affect battery life. Avoid touching the flat surfaces of the battery, and wipe clean before fitment.

7. Reassemble the two halves of the handset. Operate the Padlock symbol button at least 4 times within range of the vehicle to resynchronise the handset.

Headlamp Alignment

1. Check alignment of headlamps.

For additional information, refer to: Headlamp Adjustment (417-01 Exterior Lighting, General Procedures).

Road Wheels

1. Loosen wheel nuts. Raise vehicle for wheel free condition and remove the wheel nuts.

2. Mark the wheel to stud relationship to make sure that the wheels are refitted in the same orientation.

3. Apply a thin coat of anti-seize compound to wheel hub centre.

NOTE: When refitting road wheel nuts do not over tighten using powered tools. Make sure the wheel nuts are correctly tightened in the correct sequence.

4. Refit wheels to original hub position.

5. Tighten wheel nuts.

- Steel wheels - 100 Nm (80 lbf/ft)
- Alloy wheels - 130 Nm (96 lbf/ft)
- Heavy Duty wheels - 170 Nm (125 lbf/ft)

Tire Pressures, Condition and Tread Depth

1. Check for any apparent damage to tires, paying particular attention to side walls.

NOTE: Any adjustments to steering or suspension will be subject to additional labour and/or material cost and should not be carried out without the authorisation of the customer.

2. Look at tires treads and check for any unusual wear patterns which may indicate out of specification adjustment of steering or suspension.

NOTE: Any requirement to replace tires should be advised to the customer before any remedial work is carried out. This will be subject to additional labour and/or material cost and should not be carried out without the authorisation of the customer.

3. Measure the tread depth across the width of the tire and around the circumference. Annotate the maintenance check sheet with the lowest figure obtained from each tire.

Brake Pads, Calipers and Discs

1. With front road wheels removed, check brake pad thickness and make sure that both pads are wearing evenly.

NOTE: Any requirement to replace brake pads or brake disc should be advised to the customer as this will incur additional labour and/or material cost and should not be carried out without the authorisation of the customer.

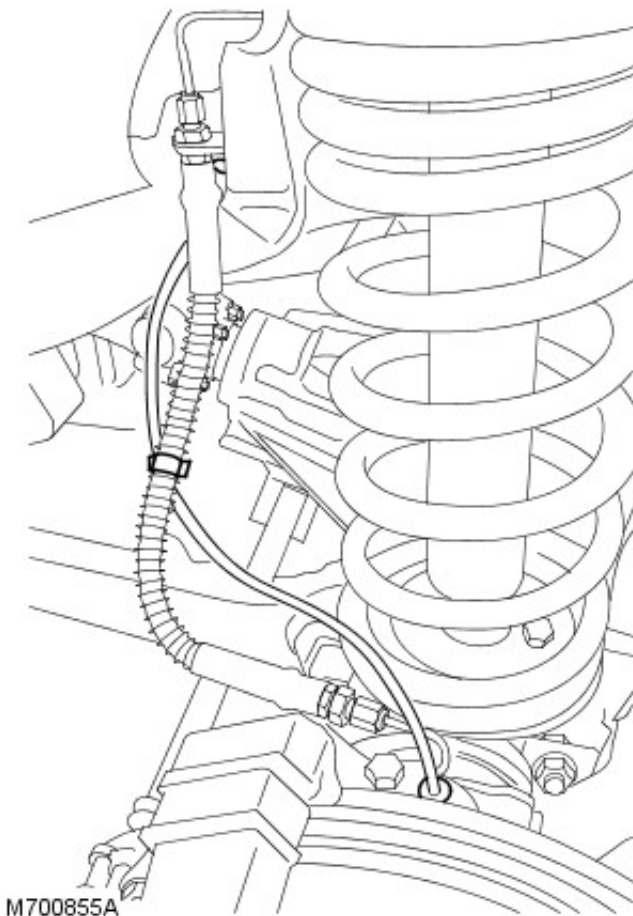
2. Check brake discs for signs of cracking, excessive scoring or oil contamination.
3. Check for any signs of brake fluid leakage from caliper seals, hoses or unions.
4. Using brake cleaner, remove excessive deposits of brake dust from pads, calipers and disc shields.

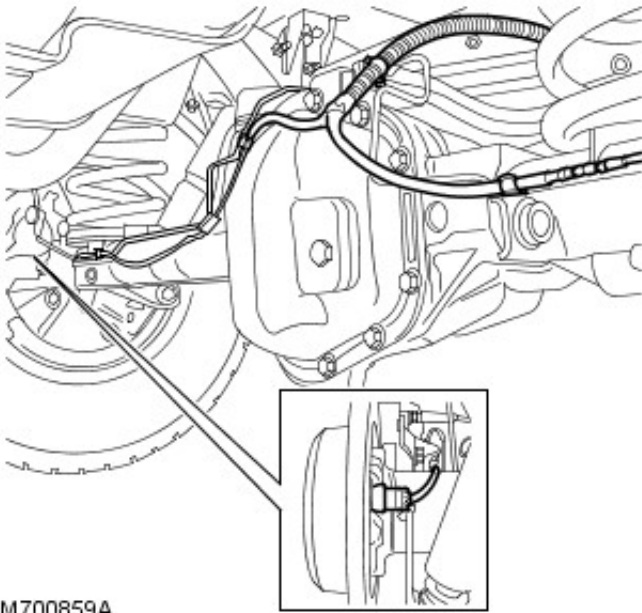
Road Wheel Speed Sensor Harness

1. Check each road wheel speed sensor harness is correctly and securely routed.

NOTE: Any requirement to replace a road wheel speed sensor should be advised to the customer as this will incur additional labour and/or material cost and should not be carried out without the authorisation of the customer.

2. Inspect each harness for chafing or damage.





Fuel Filter



WARNING: Fuel vapour is highly flammable and in contained spaces is also explosive and toxic. Always have a fire extinguisher containing FOAM, CO₂, GAS OR POWDER close at hand when handling or draining fuel.

Replace fuel filter.

For additional information, refer to: Fuel Filter (310-01 Fuel Tank and Lines - 2.4L Diesel, Removal and Installation).

Charge Air Cooler

1. Visually check for any obstructions in the radiator and charge air cooler matrix and remove debris as necessary.
2. Visually check fan blades for damage.
3. Check cooling, charge air cooler and heating systems for leaks, hoses and oil pipes for security and condition.
4. Check accessible hose clips for tightness.
5. Check coolant level, top-up if necessary

Charge Air Cooler Flush

1. Remove charge air cooler.

For additional information, refer to: Charge Air Cooler (303-12 Intake Air Distribution and Filtering - 2.4L Diesel, Removal and Installation).

2. Flush charge air cooler element using Unicorn Chemicals 'C' Solve following the manufacturers instructions.
3. Thoroughly dry charge air cooler and making sure that no trace of solvent remains in the element.

4. Install charge air cooler.

For additional information, refer to: Charge Air Cooler (303-12 Intake Air Distribution and Filtering - 2.4L Diesel, Removal and Installation).

Cooling System Top-Up

1. With engine cold, remove expansion tank filler cap.
2. Top-up with recommended mixture of coolant until level reaches mark on expansion tank.
3. Fit expansion tank filler cap.

Coolant Renew

1. Renew engine coolant.

For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 2.4L Diesel, General Procedures).

2. Fit expansion tank filler cap.

Door Locks and Hinges

1. Open each door in turn and lubricate door hinges and check strap using recommended lubricant.
2. Lubricate door lock, striker and private lock using PTFE lubricant. Remove excessive lubricant, particularly from door striker area, to avoid customer complaint.
3. Check tightness of accessible door lock and striker fixings
4. Open and close door to check for smooth, noise-free operation. Make sure door closes securely.
5. Check for smooth operation of private lock.
6. With bonnet open, lubricate hinges, striker, lock and safety catch using a suitable lubricant.

Air Cleaner Element

1. Replace air cleaner element.

For additional information, refer to: Air Cleaner Element (303-12 Intake Air Distribution and Filtering - 2.4L Diesel, Removal and Installation).

Accessory Drive Belt

Check accessory drive belt for signs of splits, fraying, oil contamination and wear.

NOTE: Any requirement to replace the accessory drive belt should be advised to the customer as this will incur additional labour and/or material cost and should not be carried out without the authorisation of the customer.

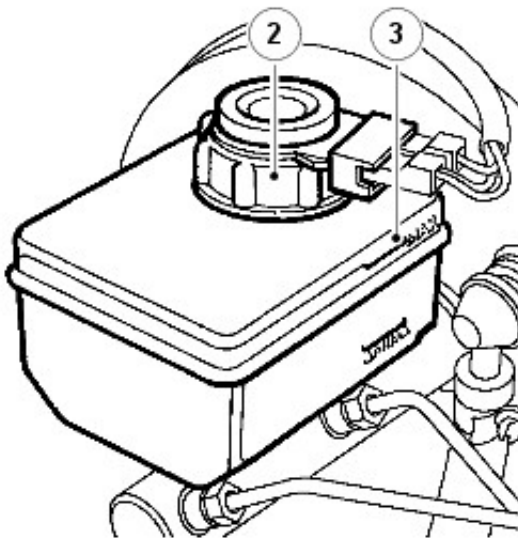
1. Renew a damaged or contaminated accessory drive belt.

Fluid Levels

Brake Fluid Reservoir

1. Check the fluid level visually through transparent side of reservoir without removing cap.
2. If level is below "MAX" mark clean the area around the reservoir filler cap and remove cap.
3. Top up to 'MAX' mark with recommended brake fluid.

For additional information, refer to: Specifications (206-00 Brake System - General Information, Specifications).

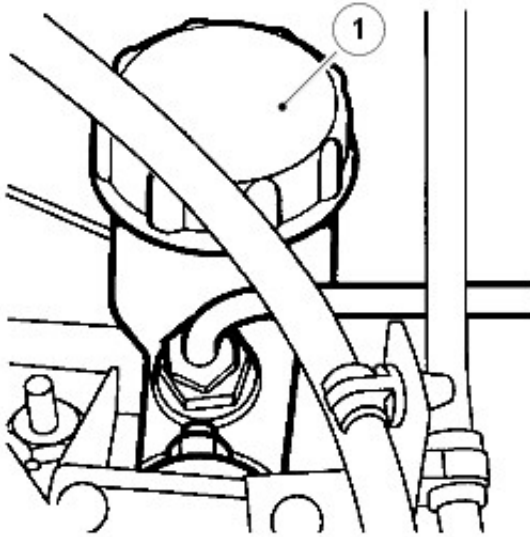


J6103

4. Reinstall the reservoir filler cap.

Clutch Fluid Reservoir

1. Clean area around clutch fluid reservoir cap, and remove cap.



J6102

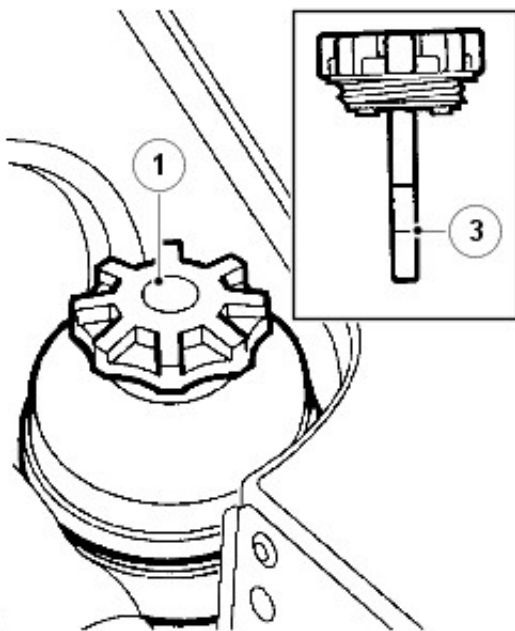
2. Check fluid level in clutch fluid reservoir.
3. Clean the area around the reservoir filler cap, remove the cap.
4. If necessary, top-up using the recommended fluid to the '**MAX**' mark on the reservoir.
For additional information, refer to: Specifications (206-00 Brake System - General Information, Specifications).
5. Reinstall the reservoir filler cap.

Power Steering Fluid



CAUTION: To prevent over filling, check/top-up the system with the engine switched off and the system cold. Make sure that the steering wheel is in the straight ahead position, do not turn the steering wheel prior to checking the fluid level.

1. Check that the fluid level is to the mid-way mark between the '**MAX**' and '**MIN**' marks on the fluid reservoir, top-up if necessary.
2. Clean the area around the reservoir filler cap, remove the cap.
3. If necessary, top-up using the recommended fluid to the mid-way mark on the reservoir.
For additional information, refer to: Specifications (206-00 Brake System - General Information, Specifications).



J6101



CAUTION: Do not fill reservoir above the '**MAX**' mark.

4. Reinstall the reservoir filler cap.

Windshield Washer Reservoir

1. Remove the windshield washer reservoir filler cap.
2. Top-up the reservoir using a mixture of an approved windshield washer fluid and water until the level is to the bottom of the reservoir filler neck.
3. Reinstall the reservoir filler cap.

Engine Oil and Filter

1. Renew engine oil and filter.
- For additional information, refer to: Engine Oil Draining and Filling (303-01 Engine - 2.4L Diesel, General Procedures).

Steering Box

1. Check steering box for leaks.
 2. Check there is no backlash in steering box with the road wheels in the straight ahead position. Adjust if necessary.
- For additional information, refer to: Steering Gear Adjustment (211-00 Steering System - General Information, General Procedures).

Manual Gearbox Oil



WARNING: Avoid excessive skin contact with used gearbox oil. Used gearbox oil contains potentially harmful contaminants which may cause skin cancer or other serious skin disorders.

1. Renew gearbox oil.
- For additional information, refer to: Transmission Draining and Filling (308-03 Manual Transmission/Transaxle, General Procedures).

Transfer Case Oil

Check and Top-Up



WARNING: Avoid excessive skin contact with mineral oil. Mineral oils remove the natural fats from the skin, leading to dryness, irritation and dermatitis.



CAUTION: The transfer case oil filler plug must not be used as a transfer case oil level plug. Failure to follow this instruction may result in damage to the vehicle.

1. Drain and measure the transfer case oil. For additional information, refer to: Transfer Case Draining and Filling (308-07A, General Procedures).
2. Refill the transfer case with the recommended oil. For additional information, refer to: Specifications (308-07A, Specifications).

Transfer Case Oil Replace



WARNING: Avoid excessive skin contact with mineral oil. Mineral oils remove the natural fats from the skin, leading to dryness, irritation and dermatitis.

1. Renew transfer case oil.
- For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).

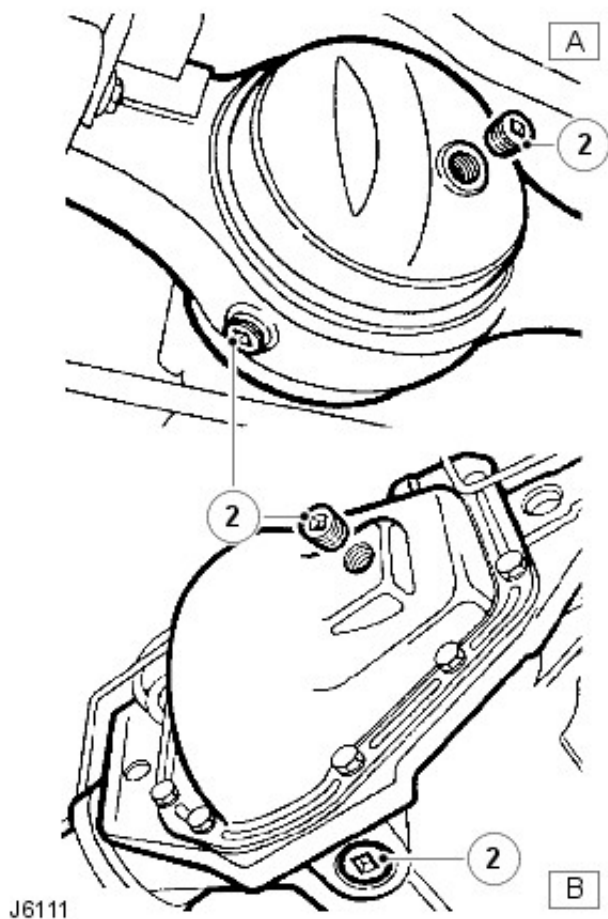
Front and Rear Axles

Check



WARNING: Avoid excessive skin contact with used axle oil. Used axle oil contains potentially harmful contaminants which may cause skin cancer or other serious skin disorders.

1. Make sure vehicle is level.
2. Using 13 mm square drive wrench, remove filler/level plug.



Item	Part Number	Description
------	-------------	-------------

A	-	Front and rear axle - 90 models; Front - 110/130 models
---	---	---

B	-	Rear axle - 110/130 models
---	---	----------------------------

3. If necessary inject new oil until oil runs out from filler/level hole. Allow excess oil to drain and wipe clean. For additional information, refer to: Specifications (205-02 Rear Drive Axle/Differential, Specifications).

4. Clean and refit filler/level plug.

Replace



WARNING: Avoid excessive skin contact with used axle oil. Used axle oil contains potentially harmful contaminants which may cause skin cancer or other serious skin disorders.

1. Make sure vehicle is level and place suitable tray under axle to be drained.

2. Using 13mm square drive wrench, remove drain and filler/level plugs from axle and allow oil to drain completely.

3. Clean and refit drain plug.

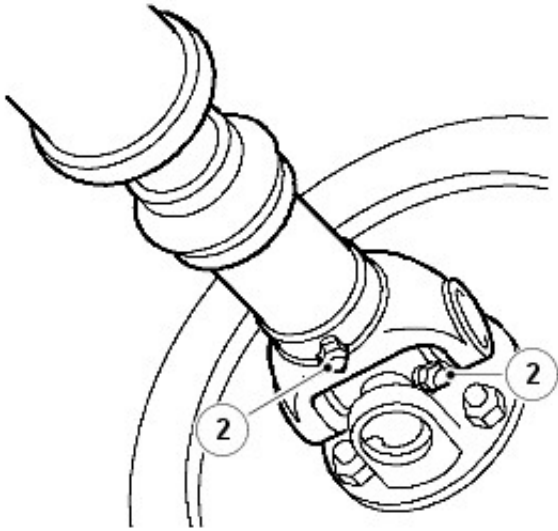
4. Inject new oil, until it runs out from filler/level hole. Allow excess oil to drain and wipe clean.

5. Clean and refit filler/level plug.

Drive Shafts

1. Clean area around front universal joint grease nipple.

2. Apply recommended grease to the grease nipple.



J6113

Clutch Pipes and Unions

1. Check clutch pipes and unions for chafing, leaks and corrosion.

Power Steering Pipes and Unions

1. Check clutch pipes and unions for chafing, leaks and corrosion.

Engine, Gearbox, Transfer Case and Axles

1. Check for oil leaks from Engine, Gearbox, Transfer box, and axles. Pay particular attention to areas around oil seals.

Exhaust System

1. Visually check condition of exhaust system for signs of damage.
2. Check condition of exhaust heat shields.
3. Check exhaust system is firmly secured and check condition of exhaust mounting rubbers, clamps and brackets.

Steering Box and Suspension

1. Check steering box fixings.
For additional information, refer to: Specifications (204-00 Suspension System - General Information, Specifications).
2. Check LH and RH front radius arm fixings. Tighten if necessary.
For additional information, refer to: Specifications (204-00 Suspension System - General Information, Specifications).
3. Check Panhard rod fixings. Tighten if necessary.
For additional information, refer to: Specifications (204-00 Suspension System - General Information, Specifications).
4. Check all rear axle fixings. Tighten if necessary.
For additional information, refer to: Specifications (205-02 Rear Drive Axle/Differential, Specifications).

Steering Ball Joints

1. Check for wear in joints by attempting to move the joint from side to side and backwards and forwards. If free movement is apparent, fit a new joint assembly.

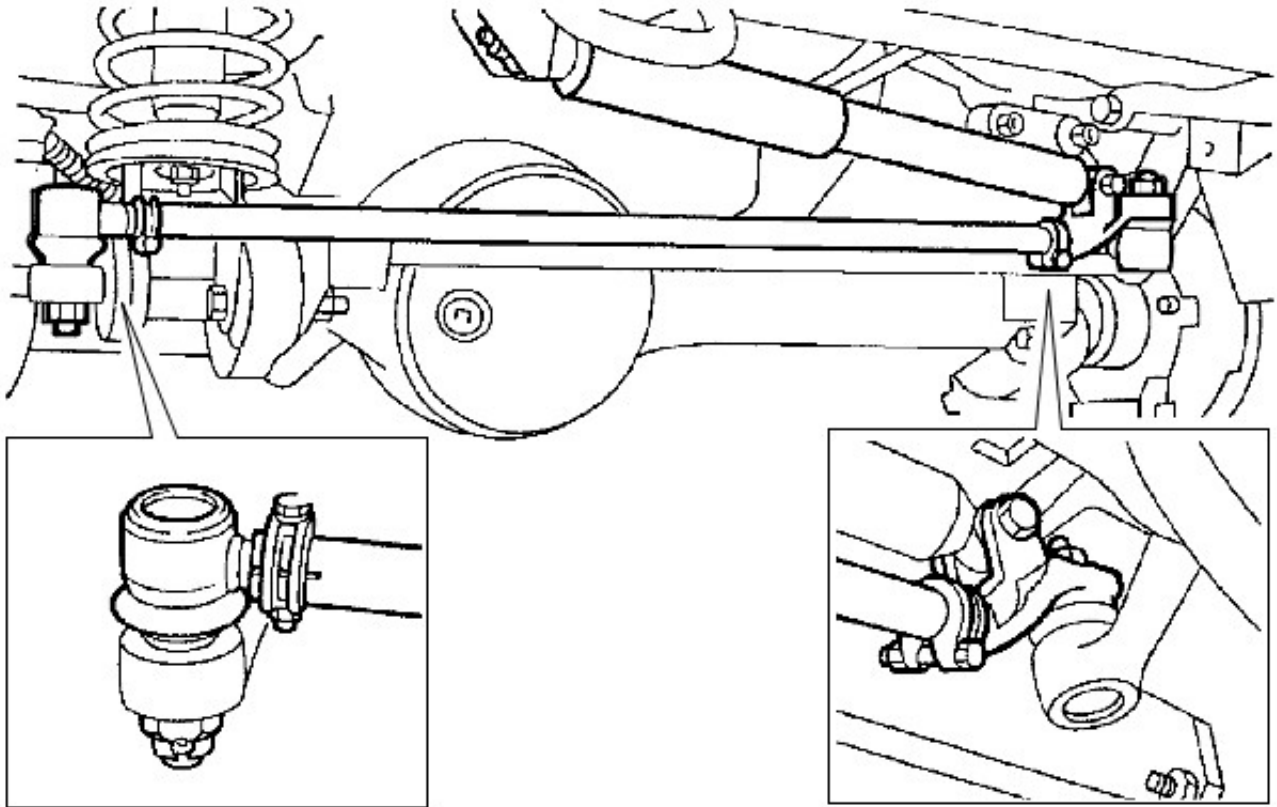


CAUTION: Do not check for wear by having an assistant move the steering wheel from side to side while observing the joint.

2. Check condition of steering ball joints paying particular attention to dust covers.

NOTE: Any requirement to replace the steering ball joints should be advised to the customer as this will incur additional labour and/or material cost and should not be carried out without the authorisation of the customer.

NOTE: Ball joints are lubricated for life during manufacture and require no further lubrication unless the rubber boot has been dislodged or damaged. All joints should be checked at specified service intervals, but more frequently if vehicle is used under arduous conditions.



M570830

Shock Absorbers

1. Check for signs of leakage from suspension dampers.
2. Check for signs of suspension damper damage.

Towing Bracket

1. Check security of towing bracket.

Engine and Transmission Mountings

1. Check condition of front LH engine mounting. Tighten fixings if necessary.
For additional information, refer to: Specifications (303-01 Engine - 2.4L Diesel, Specifications).
2. Check condition of front RH engine mounting. Tighten fixings if necessary.
For additional information, refer to: Specifications (303-01 Engine - 2.4L Diesel, Specifications).
3. Check condition of rear LH gearbox mounting. Tighten fixings if necessary.
For additional information, refer to: Specifications (308-03 Manual Transmission/Transaxle, Specifications).
4. Check condition of rear RH gearbox mounting. Tighten fixings if necessary.
For additional information, refer to: Specifications (308-03 Manual Transmission/Transaxle, Specifications).

Road Test



WARNING: Two wheel roller tests where rollers are driven by the vehicle **MUST NOT** be carried out. For details of rolling road testing,

1. Check for correct operation of starter switch. Make sure the engine starts in a correct manner. Leave the engine running.
2. With vehicle stationary, turn steering from lock to lock. Check for smooth operation and make sure there is no undue noise from the power steering pump or drive belt.
3. Depress clutch and select all gears in turn. Check for smooth notch free engagement.
4. Drive vehicle on a short road test. Check all vehicle systems for correct operation. Pay particular attention to:
 - Manual gear selection.
 - Gear selection/noise - high/low range.

- Steering for abnormal noise/effort.
- Steering for free play.
- Engine noise
- Gearbox noise or vibration
- Suspension noise or irregularities
- Body noise
- Braking system operation
- Engine performance
- Excessive exhaust smoke.
- All instruments, gauges and warning indicators.
- Heater and air conditioning systems.
- Fully extend seat belt, check operation of retraction and latching. Inertia belts lock when snatched or vehicle on slope.
- Seat reclining and latching.

5. Check for correct operation of all instruments and warning devices where practical.

6. After road test, carry out a final inspection of the vehicle on vehicle ramps.

7. Check all underbonnet fluid levels and top-up if necessary.

General

1. Endorse Service Record.

2. Report any unusual features of vehicle condition and any additional work required.

Suspension System - General Information -

Suspension	
90	
Front	Live beam axle, linear rate coil springs, coaxial telescopic nitrogen-charged hydraulic shock absorbers. Lateral axle location by fabricated steel Panhard rod and longitudinal axle location by forged steel radius arms. Stabilizer bar if alloy wheels fitted.
Rear	Live beam axle, linear rate coil springs (dual rate for heavy duty derivative), telescopic nitrogen-charged hydraulic shock absorbers. Lateral axle location by forged steel 'A' frame arms and longitudinal axle location by fabricated steel trailing links. Stabilizer bar if alloy wheels fitted.
110	
Front	Live beam axle, dual rate coil springs, coaxial telescopic nitrogen-charged hydraulic shock absorbers. Lateral axle location by fabricated steel Panhard rod and longitudinal axle location by forged steel radius arms. Stabilizer bar if station wagon or crew cab derivative.
Rear	Live beam axle, triple rate coil springs, telescopic nitrogen-charged hydraulic shock absorbers. Lateral axle location by forged steel 'A' frame arms and longitudinal axle location by fabricated steel trailing links. Stabilizer bar if station wagon or crew cab derivative.
110 heavy duty and 130	
Front	Live beam axle, linear rate coil springs, coaxial telescopic nitrogen-charged hydraulic shock absorbers. Lateral axle location by fabricated steel Panhard rod and longitudinal axle location by forged steel radius arms. Stabilizer bar.
Rear	Live beam axle, triple rate coil springs, coaxial linear rate helper springs, telescopic nitrogen-charged hydraulic shock absorbers. Lateral axle location by forged steel 'A' frame arms and longitudinal axle location by fabricated steel trailing links. Stabilizer bar.

Road spring data

Road spring	Part number	Colour code
90 2 seat utility (2400 Kg)		
Front - Driver's side	REB500200	Red/green/white
Front - Passenger side	REB500220	Red/green/orange
Rear - Driver's side	NRC 9448	Blue/red
Rear - Passenger side	NRC 9449	Yellow/white
90 2 seat utility (2550 Kg)		
Front - Driver's side	REB500200	Red/green/white
Front - Passenger side	REB500220	Red/green/orange
Rear - Driver's side	RKB101230	Green/yellow/red
Rear - Passenger side	RKB101240	Green/yellow/white
90 4 seat station wagon (2400 Kg)		
Front - Driver's side	REB500200	Red/green/white
Front - Passenger side	REB500220	Red/green/orange
Rear - Driver's side	RKB500290	Red/green/green
Rear - Passenger side	RKB500280	Red/green/red
90 4 seat station wagon (2550 Kg)		
Front - Driver's side	REB500200	Red/green/white
Front - Passenger side	REB500220	Red/green/orange
Rear - Driver's side	RKB500270	White/green/pink
Rear - Passenger side	RKB500310	White/green/purple
LHD 110 2 seat utility, 5 seat station wagon and 5 seat crew cab (3050 Kg)		
Front - Driver's side	NRC 8044	White/white
Front - Passenger side	NRC 8045	Yellow/yellow
Rear - Both sides	RKB101111	Purple/brown
RHD 110 2 seat utility, 5 seat station wagon and 5 seat crew cab (3050 Kg)		
Front - Both sides	NRC 8045	Yellow/yellow
Rear - Both sides	RKB101111	Purple/brown
LHD 110 7 seat station wagon (3050 Kg)		
Front - Driver's side	NRC 8044	White/white
Front - Passenger side	NRC 8045	Yellow/yellow
Rear - Both sides	RKB500300	White/green/green
RHD 110 7 seat station wagon (3050 Kg)		
Front - Both sides	NRC 8045	Yellow/yellow
Rear - Both sides	RKB500300	White/green/green
110 heavy duty and all 130 (3500Kg)		
Front - Driver's side	NRC 9448	Blue/red
Front - Passenger side	NRC 9449	Yellow/white

Rear - Both sides	RKB101111	Purple/brown
Rear helper springs - Both sides	RRC 3266	No colour code

Torque values - front suspension

	Nm
Drag link ball joint nut	40 + tighten to next castle slot on nut
Tie rod ball joint nut	40 + tighten to next castle slot on nut
Securing ring for mounting turret	14
Panhard rod to axle	230
Panhard rod to chassis bracket	230
Panhard rod chassis bracket to chassis	123
Radius arm to axle	210
Radius arm to chassis	176
Shock absorber (upper and lower mountings)	38
Bump stop to chassis frame	22
Stabilizer bar to stabilizer link	75
Stabilizer link to axle	40 + tighten to next castle slot on nut
Stabilizer bar to chassis bracket	45
Tie bar to Panhard rod mounting bracket	85
Tie bar to steering box	85

Torque values - Rear suspension

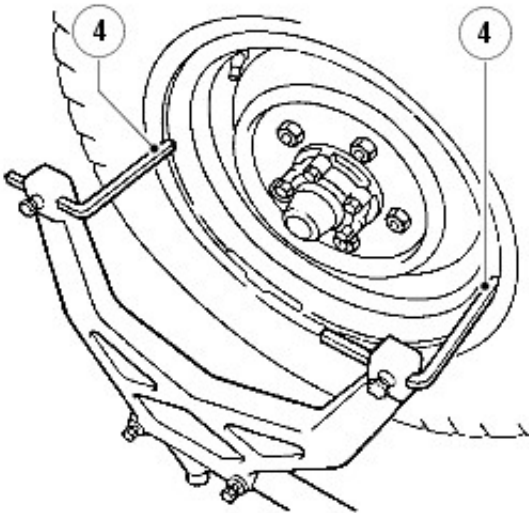
	Nm
Trailing link to chassis bush	176
Trailing link to chassis	62
Trailing link to axle	176
'A' frame ball joint to axle	176
'A' frame to ball joint	115
'A' frame to chassis bracket	
Vehicles fitted with ¾ inch UNF bolts	176
Vehicles fitted with M16 bolts	150
'A' frame to chassis bracket to chassis (if applicable)	63
Shock absorber to axle	38
Shock absorber to shock absorber upper mounting bracket	75
Shock absorber upper mounting bracket to chassis	44
Stabilizer bar to stabilizer link	75
Stabilizer link to axle	40 + tighten to next castle slot on nut
Stabilizer bar bush bracket to chassis	22
Bump stop to chassis frame	22

Suspension System - General Information - Front Toe Adjustment

General Procedures

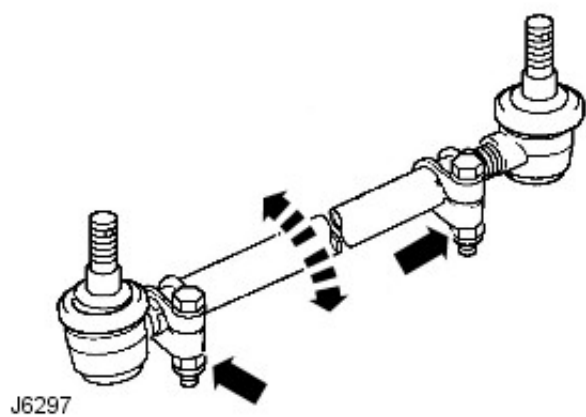
NOTE: Recognised front wheel alignment and tracking equipment should be used for this operation. Only the use of basic equipment is described below. No adjustment is provided for castor, camber or swivel pin inclinations.

1. Set vehicle on level ground with road wheels positioned straight ahead.
2. Push vehicle back and forwards to settle linkage.
3. Set up the equipment to manufacturers instructions and check alignment as advised by equipment supplier.
4. Position trammel probes on inner face of wheel, not the rims, if the latter are damaged.



J6296

5. Measure toe-out at horizontal centre-line of wheels.
6. Check tightness of clamp bolt fixings. Tighten to 14 Nm (10lbf/ft).
7. Slacken clamps at both ends of track rod.
8. Rotate track rod to increase or decrease its effective length until correct toe-out is obtained.
For additional information, refer to: Specifications (211-00 Steering System - General Information, Specifications).
9. Push vehicle rearwards turning steering wheel from side to side to settle ball joints. With road wheels set in straight ahead position, push vehicle forward a short distance.
10. Recheck track and adjust if necessary.
11. When alignment is correct, tap ball joints in direction of arrows to maximum of travel, to ensure full unrestricted movement of track rod.

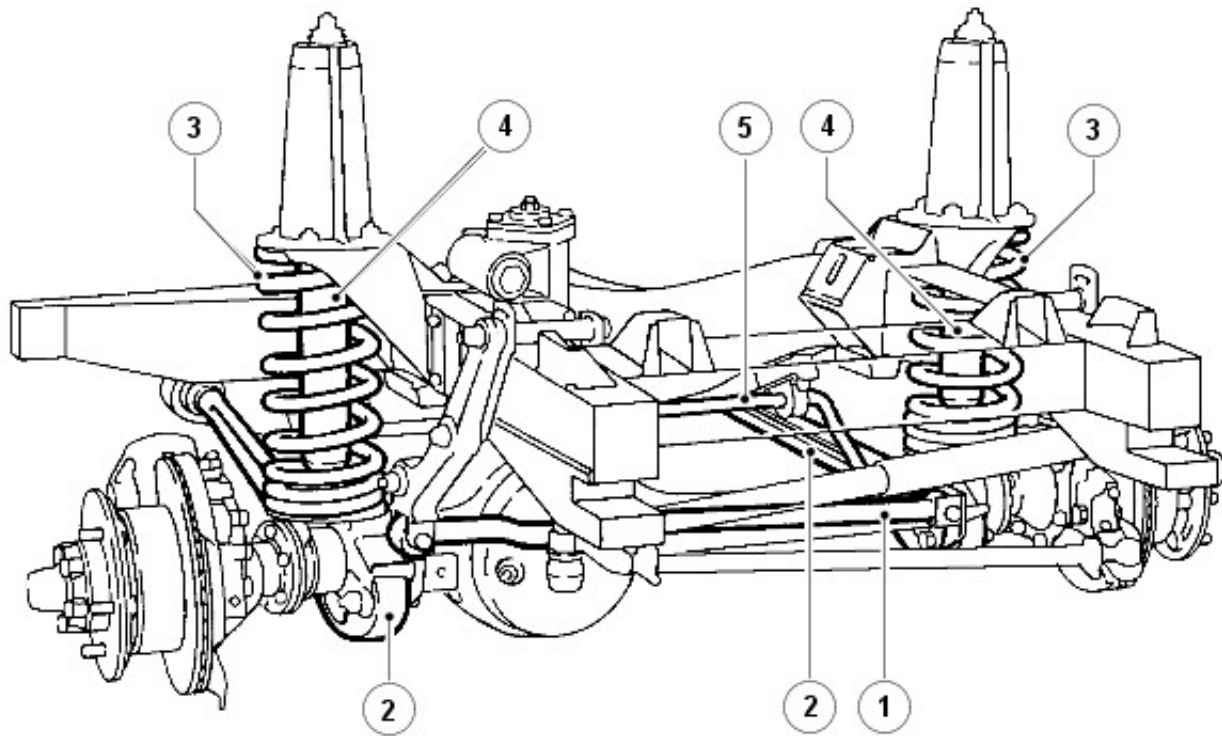


12. Tighten clamp bolts to 14 Nm (10 lbf/ft).

Front Suspension - Front Suspension

Description and Operation

Front suspension



J6268

Item	Part Number	Description
1	-	Panhard rod
2	-	Radius arms
3	-	Coil springs
4	-	Shock absorbers
5	-	Stabilizer bar

Description

The front suspension design allows maximum wheel travel and axle articulation providing good ground clearance without loss of traction or directional stability.

Long radius arms are fitted to the front axle and provide maximum axle articulation which is vital for off road performance. The radius arms are secured to fabricated mounting brackets welded to the front axle. Flexible rubber bushes are used on a stem end joint to secure the rear of the radius arms to mountings on the chassis cross member.

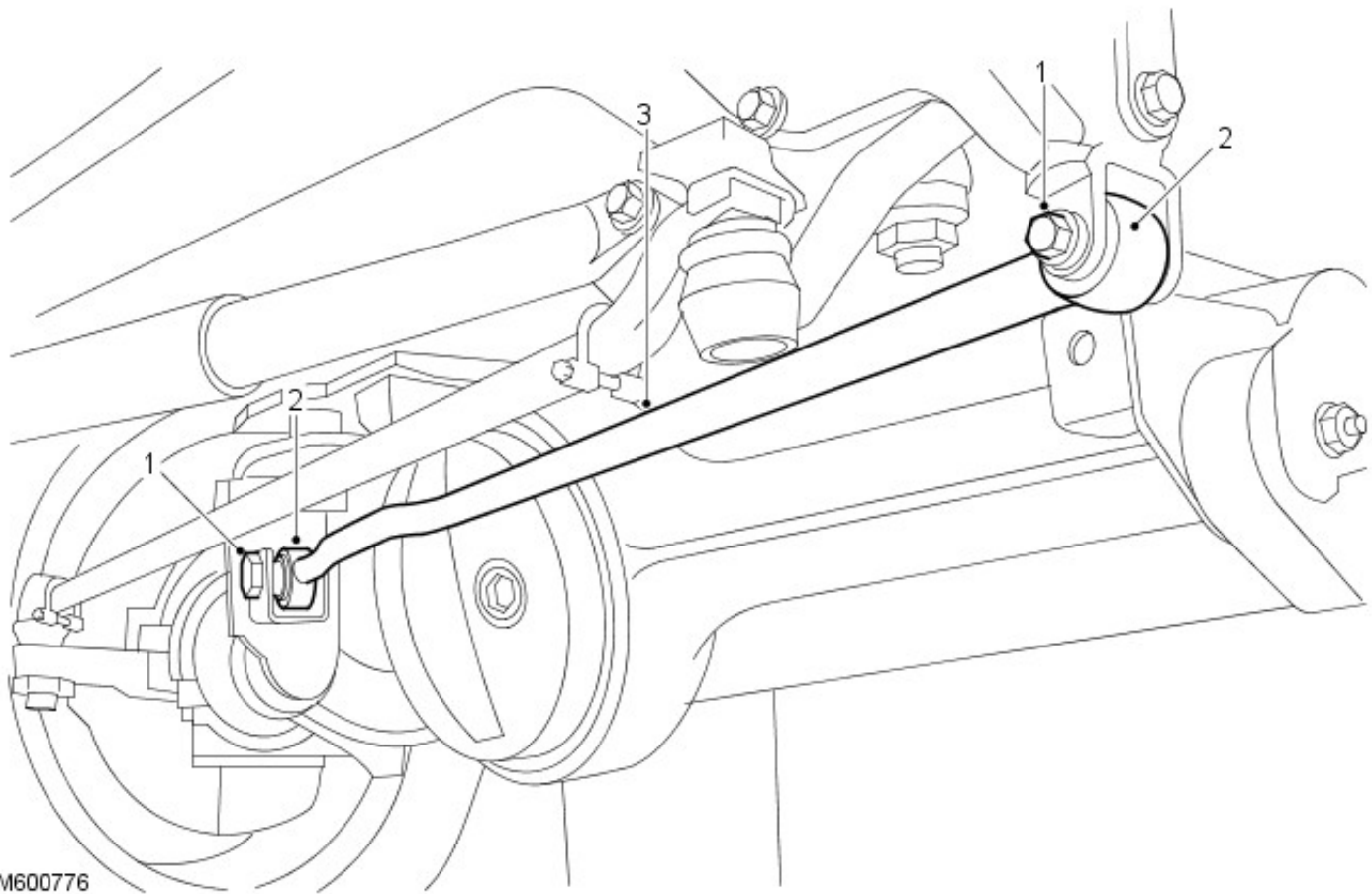
A Panhard rod, which ensures that the front axle remains centrally located, is fitted transversely and also uses ferrule rubber bush mountings at both axle and chassis locations.

Two rubber bearing bushes, with retaining straps, secure the rear of the stabilizer bar to the chassis mountings, while bushed links support the front of the bar to the front axle.

Conventional long travel coil springs and hydraulic shock absorbers are used to control body movement in all conditions. The shock absorbers are secured to fabricated towers which are bolted to the chassis. The upper and lower fixings use a single location stud with flexible rubber bushes, support washers and securing nuts. Retaining plates are used to secure the coil springs to the fabricated towers and axle mountings.

Rubber bump stops are fitted underneath the chassis, adjacent to the front road springs, and prevent possible damage that could occur should there be excessive axle to chassis movement.

Front suspension 02MY



M600776

Item	Part Number	Description
1	-	Bolts
2	-	Bushes
3	-	Panhard rod

Changes have been incorporated to improve the durability of the suspension. The current Panhard rods are forged. New Panhard rods are introduced which are fabricated from tubular steel and are handed.

The rods are fitted with larger bushes which use M16 bolts in place of the M14 bolts. The torque for the new bolts is raised to 230 Nm (170 lbf.ft).

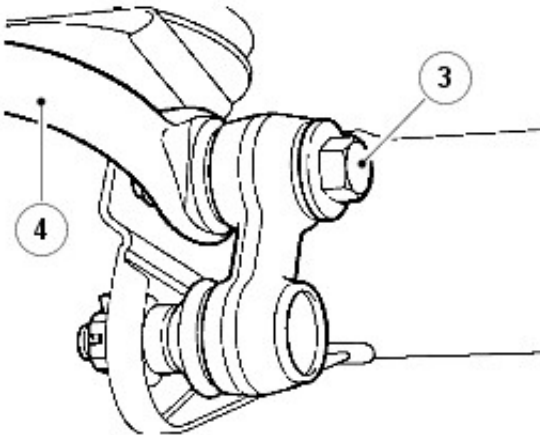
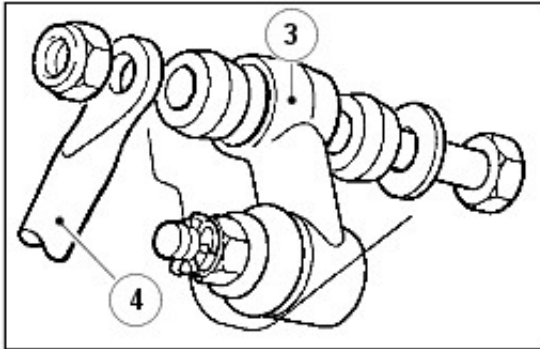
The Panhard rod support brackets are now fabricated from upgraded steel which allows the higher torque figure to be applied to the fixing bolts.

Front Suspension - Front Stabilizer Bar

Removal and Installation

Removal

1. Mark for reassembly position of rubber bushes on stabilizer bar.
2. Remove 4 nuts, bolts and washers securing both stabilizer bar bush straps to chassis mounting brackets.
3. Remove nuts, bolts, washers and rubber bushes securing stabilizer bar to both links
4. Remove stabilizer bar.



J6258

Installation

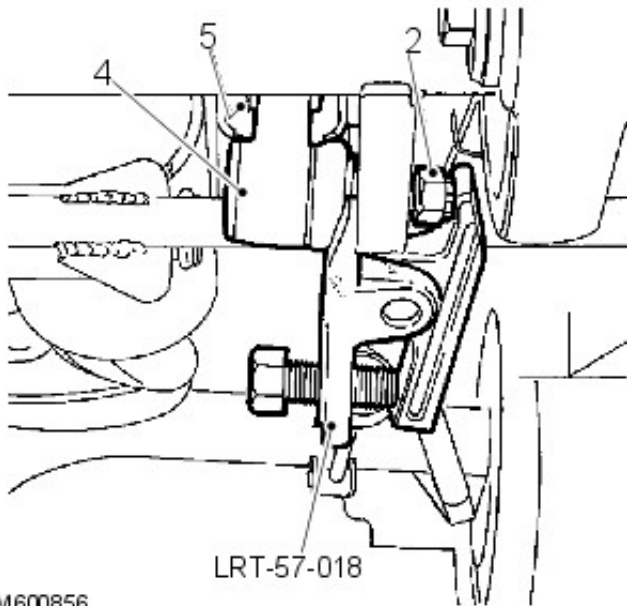
1. Position bushes on stabilizer bar. Ensure split points towards axle on RH bush and away from axle on LH bush.
2. Instal stabilizer bar with two straps. To ensure correct fit angled sides of bar should point down. Loosely instal the bolts, washers and nyloc nuts.
3. Instal bolt, washers and rubber bushes. Using new nuts fit stabilizer bar to links and tighten to 68Nm (50 lbf.ft).
4. Tighten nuts securing straps to 30Nm (22lbf.ft).

Front Suspension - Front Stabilizer Bar Link

Removal and Installation

Removal

1. Raise vehicle on ramp.
2. Remove 2 nuts, bolts, washers and rubber bushes from ball joint links.
3. Remove cotter pin and loosen castellated nut a few turns.
4. Release link joint using tool LRT-57-018 as shown.
5. Remove castellated nut and link.



M600856

Installation

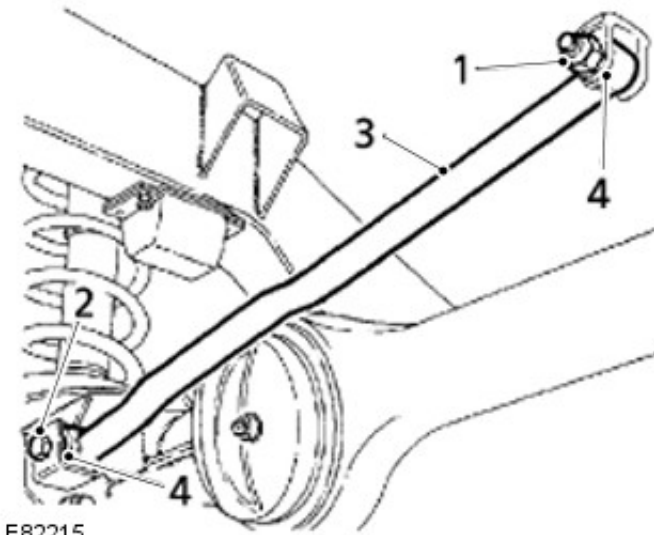
1. Fit link and castellated nut. Ensure ball joint link arm points up. Tighten nut to 40 Nm (30 lbf/ft) and fit new cotter pin.
2. Align stabilizer bar to links.
3. Fit bolts, washers and rubber bushes using new self locking nuts and secure stabilizer bar to links. Tighten fixings to 68 Nm (50 lbf/ft).
4. Lower vehicle.

Front Suspension - Panhard Rod


Removal and Installation

Removal

1. Remove fixings at mounting arm.
2. Remove fixings at axle bracket.
3. Remove panhard rod.
4. Using a suitable length of steel tubing, press out flexible bushes. Ensure tubing locates on outer edge of bush and not on rubber inner.



Installation

1.  **CAUTION:** Apply pressure to outer edge of bush, and not rubber inner.
Install replacement bushes.
2. Install panhard rod to axle bracket and mounting arm. Tighten chassis fixing (1) to 200 Nm (148 lbf.ft). Tighten axle fixing (2) to 250 Nm (184 lbf.ft).
 - **Note:** If you are re-using fixings on a vehicle built prior to VIN 735937, then tighten the axle fitting to 250 Nm (184 lbf.ft) and the chassis fixing to 230 Nm (170 lbf.ft). If a new fixing is used on any vehicle, then use the torque settings of 200 Nm and 250 Nm, respectively.

Front Suspension - Spring

Removal and Installation

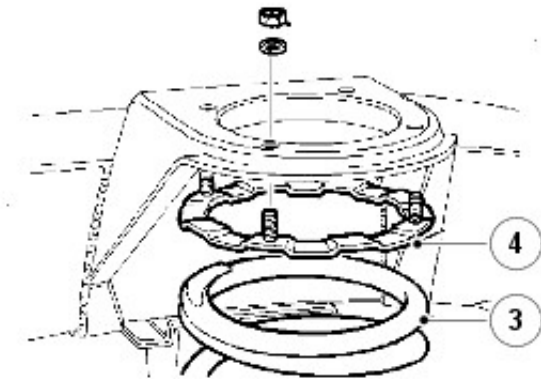
Removal

1. Remove front shock absorber.
For additional information, refer to: Shock Absorber (204-01, Removal and Installation).



CAUTION: Avoid over stretching brake hoses. If necessary, loosen hose connector locknuts to allow hoses to follow axle.

2. Lower axle sufficient to free road spring.
3. Withdraw road spring.
4. Withdraw shock absorber bracket securing ring.



RR1593M


Installation

1. Install shock absorber bracket retaining ring. Retain in position with a nut.
2. Position road spring and raise axle.
3. Remove nut retaining securing ring.
4. Install front shock absorber.
For additional information, refer to: Shock Absorber (204-01, Removal and Installation).

Front Suspension - Front Wheel Bearing and Wheel Hub

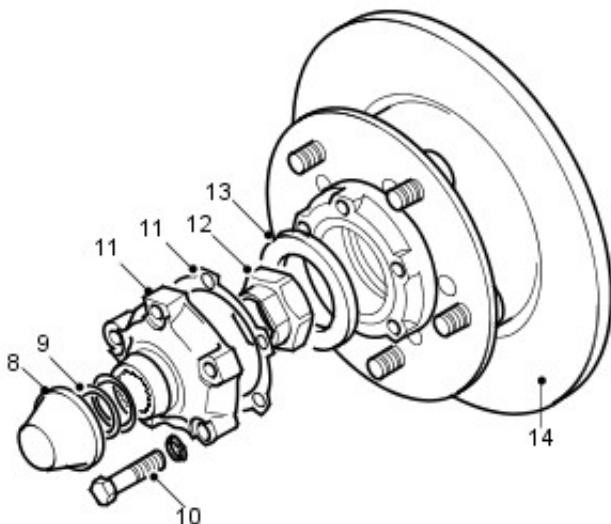
Removal and Installation

Removal

1. Raise front of vehicle.
2.  **WARNING:** Support on safety stands.
Remove front road wheel.
3. Pull back front brake caliper jump hose shield and clamp brake hose.
4. Position container collect brake fluid.
5. Loosen brake pipe to jump hose union and disconnect.

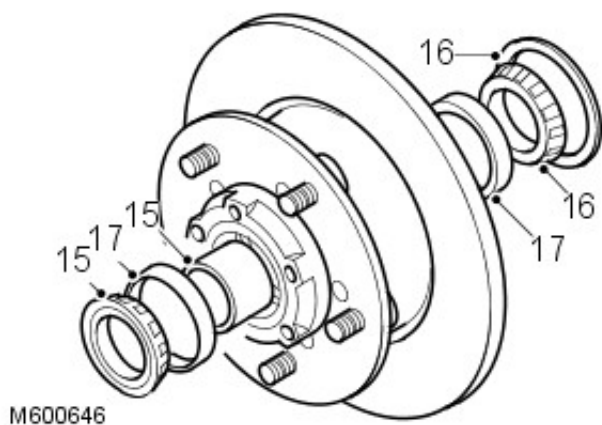
 **CAUTION:** Use 2 spanners when loosening or tightening unions.

6. Remove 2 bolts securing brake caliper to hub.
7. Remove brake caliper.
8. Remove dust cap.
9. Remove circlip and shim(s) from drive shaft.
10. Remove and discard 5 bolts securing driving member to hub.
11. Remove driving member and discard gasket.
12. Knock back staking and using a suitable socket, remove and discard hub nut.
13. Remove washer from hub.
14. Remove hub and brake disc assembly complete with bearings.



M600644A

15. Remove outer bearing and spacer from hub.
16. Remove grease seal and inner bearing from hub.
17. Remove inner and outer bearing tracks from hub.



Installation

1. Clean hub and bearing locations.
2. Instal inner and outer bearing tracks to hub.
3. Pack inner bearing with grease and fit to hub.
4. Instal new seal flush with rear face of hub using LRT-54-003 and LRT-99-003.
5. Clean stub axle.
6. Pack outer bearing with grease, fit spacer and bearing to hub.
7. Position LRT-54-019 over hub nut threads on axle casing.
8. Instal hub assembly to stub axle, remove LRT-54-019.
9. Instal washer and new hub nut and tighten to 30 Nm (22 lbf.ft).
10. Rotate and push/pull hub to settle bearings. Tighten hub nut to 210 Nm (150 lbf.ft).
11. To check hub assembly end float, mount a dial gauge using bracket LRT-99-503 to driving member bolt hole.
12. Ensure dial gauge is contacting hub nut face.
13. Move hub assembly in and out noting dial gauge reading.
14. If end float is present refer to table for correct spacer and change spacer as necessary.

End float (mm)	Spacer size (mm)	Colour code
0.00	15.5	Purple
0.025	15.4	Yellow
0.050	15.4	Yellow
0.075	15.4	Yellow
0.10	15.3	Red
0.125	15.3	Red
0.150	15.3	Red
0.175	15.2	Blue
0.200	15.2	Blue
0.225	15.2	Blue
0.250	15.2	Blue
0.275	15.1	Green
0.300	15.1	Green
0.325	15.1	Green
0.350	15.1	Green
0.375	15.0	Black
0.400	15.0	Black
0.425	15.0	Black

0.450	15.0	Black
0.475	14.9	White
0.500	14.9	White
0.525	14.9	White
0.550	14.9	White

15. When no end float is evident, remove the dial gauge and mounting bracket.
16. Stake the hub nut.
17. Clean hub and axle shaft faces.
18. Instal new driving member gasket.
19. Position driving member to hub and tighten new bolts to 65 Nm (48 lbf.ft).
20. Instal original shim(s) to drive shaft and secure with circlip.
21. Position brake caliper to hub, align fixings, instal bolts and tighten to 82 Nm (60 lbf.ft).
22. Remove plugs from brake pipe connections.
23. Connect brake pipe union to jump hose and tighten union.



CAUTION: Use 2 spanners when tightening or loosening unions.

24. Remove brake hose clamp from jump hose.
25. Bleed brake system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).
26. Instal road wheel, remove axle stand and tighten wheel nuts to 130 Nm (95 lbf.ft).
27. Operate foot brake to locate brake pads before taking vehicle on road.

Front Suspension - Wheel Studs

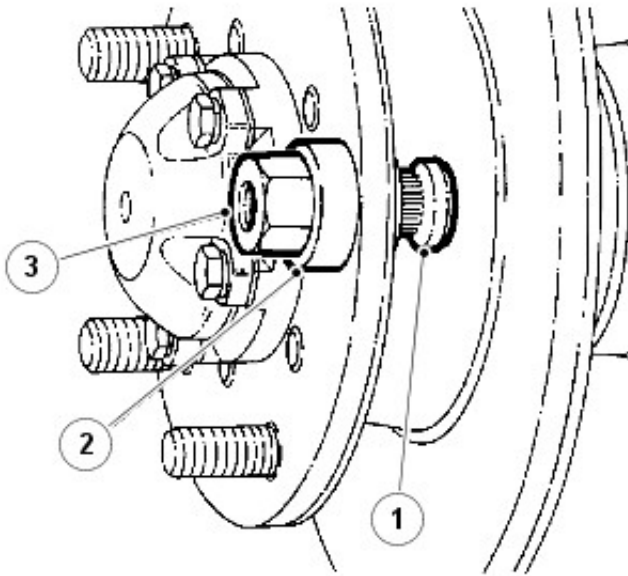
Removal and Installation

Removal

1. Remove wheel.
For additional information, refer to: Wheel and Tire (204-04, Removal and Installation).
2. Drive stud out of driveshaft flange.

Installation

1. Position stud in flange.
2. Install a suitable spacer over stud.
3. Using a M16 x 1.5 nut, a slave wheel nut is suitable, pull stud into flange until shoulder of stud abuts flange.



RR2141E

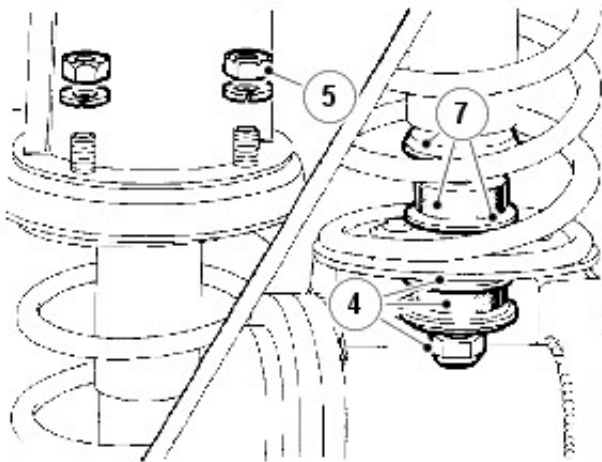
4. Refit wheel.
For additional information, refer to: Wheel and Tire (204-04, Removal and Installation).

Front Suspension - Front Shock Absorber

Removal and Installation

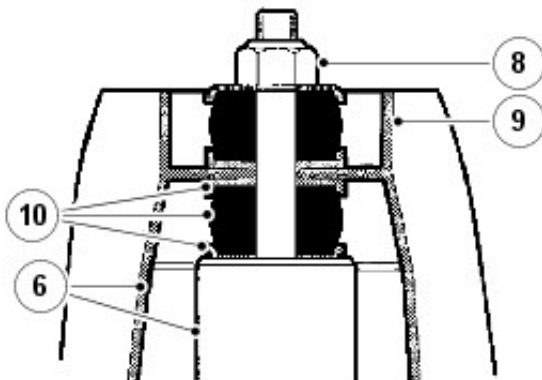
Removal

1. Loosen road wheel retaining nuts.
2. Support chassis on stands and remove road wheel.
3. Support axle weight with jack.
4. Remove shock absorber lower fixing and withdraw cupwasher, rubber bush and seating washer.
5. Remove four shock absorber bracket fixings.
6. Withdraw shock absorber and bracket assembly.
7. Withdraw lower seating washer, rubber bush and cupwasher.



RR2045E

8. Remove fixings, shock absorber to mounting bracket.
9. Withdraw mounting bracket.
10. Lift off top seating washer, rubber bush and cupwasher.



RR1595M

Installation

1. Assemble shock absorber components.
2. Position shock absorber, complete with bracket and secure with 4 fixings.



CAUTION: When tightening the nuts on both the upper and lower fixings, ensure that at least two threads are visible on the section of the bolt that extends beyond the nut.

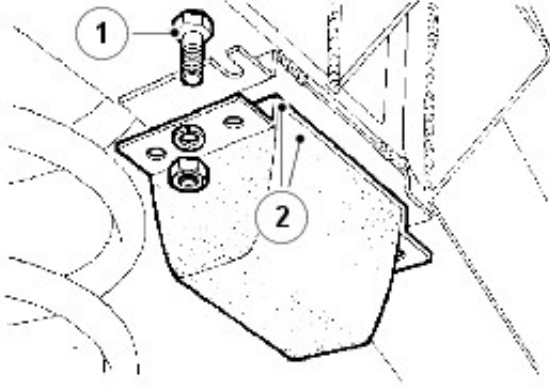
3. Secure shock absorber lower fixing.
4. Install road wheel, remove chassis stands and jack. Tighten wheel nuts to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)

Front Suspension - Bump Stop

Removal and Installation

Removal

1. Remove the bump stop.



E82216

Installation

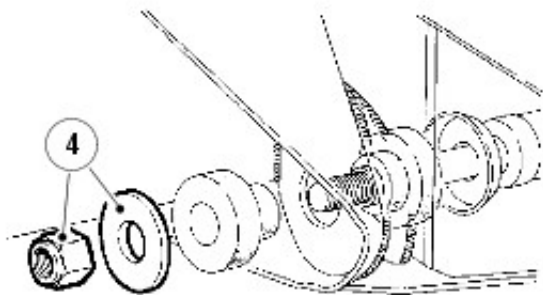
1. Position bolts in slots in chassis brackets.
2. Install the bump stop, secure with washers and nuts.

Front Suspension - Radius Arm

Removal and Installation

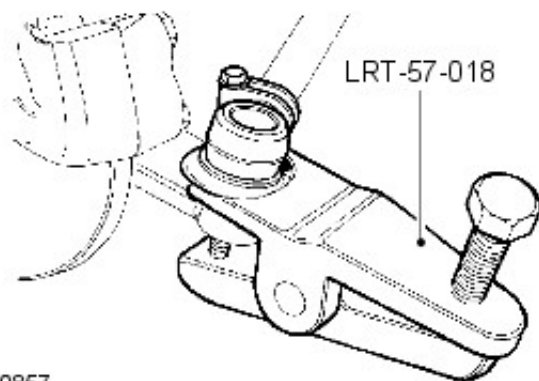
Removal

1. Loosen road wheel retaining nuts.
2. Raise front of vehicle. Support chassis on stands and remove wheel.
3. Support front axle weight with jack.
4. Remove radius arm to chassis side member fixings.



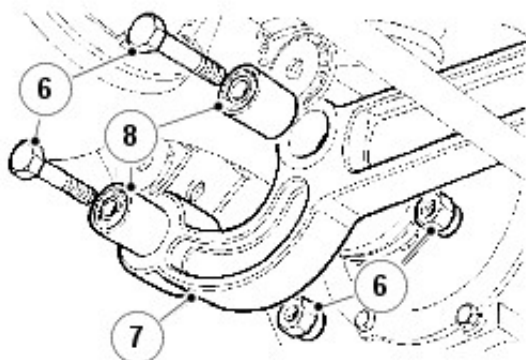
RR983

5. Disconnect track rod at ball joint using tool LRT-57-018.



M600857

6. Remove fixings, radius arm to axle.
7. Lower radius arm front end to clear axle and remove from vehicle.
8. Using suitable length of steel tubing, press out flexible bushes.



RR1592

Installation

1. Press in replacement bushes.



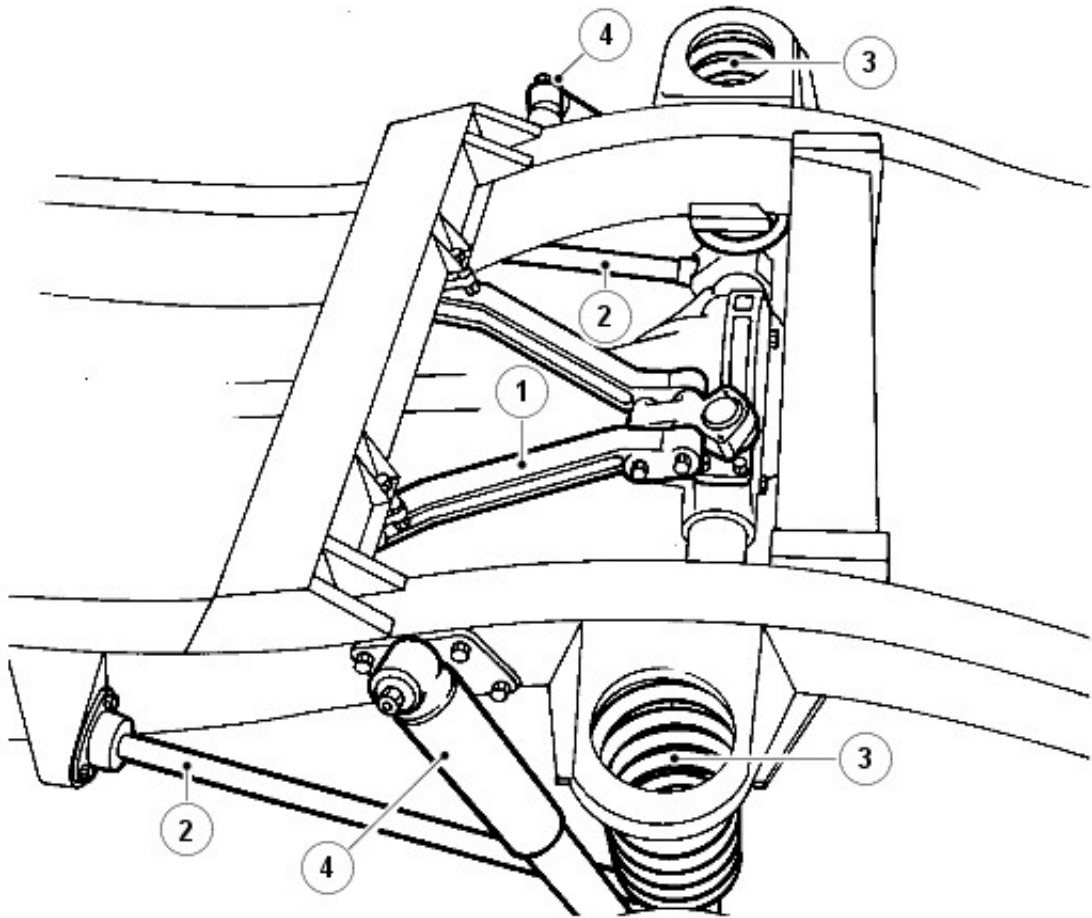
CAUTION: When pressing in new bushes press on outer edge of bush and not rubber inner.

2. Instal radius arm to axle mounting.
3. Instal track rod at ball joint.
4. Instal radius arm to chassis. Tighten bolts to 176 Nm (130 lbf.ft).
5. Fully tighten radius arm to axle fixings to 197 Nm (145 lbf.ft).
6. Instal road wheel, remove chassis stands and jack. Tighten wheel nuts to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)

Rear Suspension - Rear Suspension

Description and Operation

Rear axle suspension



J5392M

Item	Part Number	Description
1	-	'A ' frame, upper link assembly
2	-	Lower link
3	-	Coil springs
4	-	Shock absorbers

DESCRIPTION

The rear suspension design locates the rear axle with two round section steel lower link arms and a forged 'A' frame, upper link assembly. This system allows maximum axle articulation and wheel travel while maintaining roll stiffness and directional stability.

The link arm is secured by a single retaining nut to the chassis mounting, comprising a rubber bushed bracket, which is retained by three fixings. A ferrule rubber bush with a single retaining bolt is used to secure the link arm to its axle mounting.

The upper link assembly is located on the rear differential housing by a pivot ball-pin assembly. Two brackets bolted to the chassis crossmember support both sides of the 'A' frame of the link assembly, secured by single retaining bolts.

A Boge Hydromat self levelling unit can be fitted, as an option, on 110/130 models to give additional support when the vehicle is used to carry heavier loads.


Two rubber bearing bushes, with retaining straps, secure the rear of the stabilizer bar, if fitted, to the chassis mountings, while bushed links support the front of the anti-roll bar to the axle.

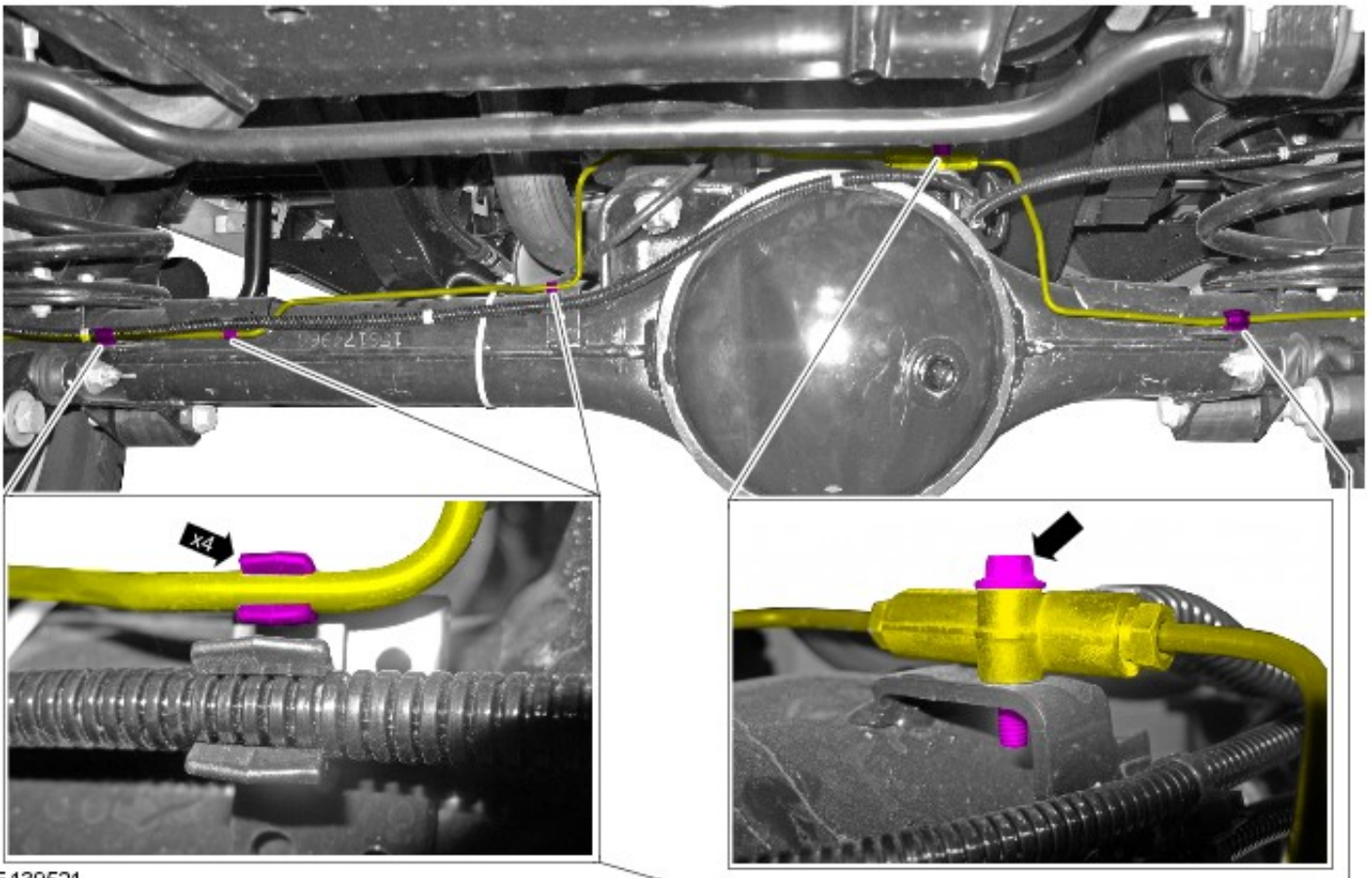
Conventional long travel coil springs and hydraulic shock absorbers are used to control body movement. The shock absorbers are secured to chassis mounting brackets and fabricated lower mountings welded to the rear axle. Retaining plates are used to secure the coil springs to the axle mounting while fabricated brackets, welded to the chassis, are used for the upper spring location.

Rear Suspension - Wheel Bearing and Wheel Hub

Removal and Installation

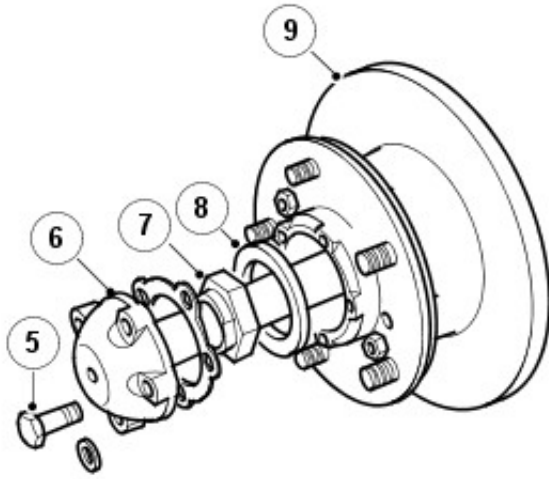
Removal

1.  **WARNING:** Support on safety stands.
Raise rear of vehicle.
2. Remove rear road wheel.
3. Remove 2 bolts securing brake caliper to hub.
4. Release caliper from disc and tie aside.
 1. Remove bolt from rear brake pipe valve to differential casing.
 2. Release both rear brake pipes from the rear axle retaining clips.



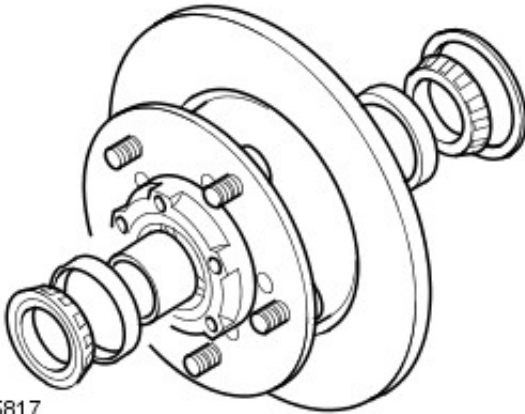
E 139521

5. Remove 5 bolts securing axle shaft.
6. Remove axle shaft and discard gasket.
7. Knock back staking, and using a suitable socket, remove and discard stake nut.
8. Remove hub nut washer.
9. Remove hub and brake disc assembly complete with bearings.



M640067

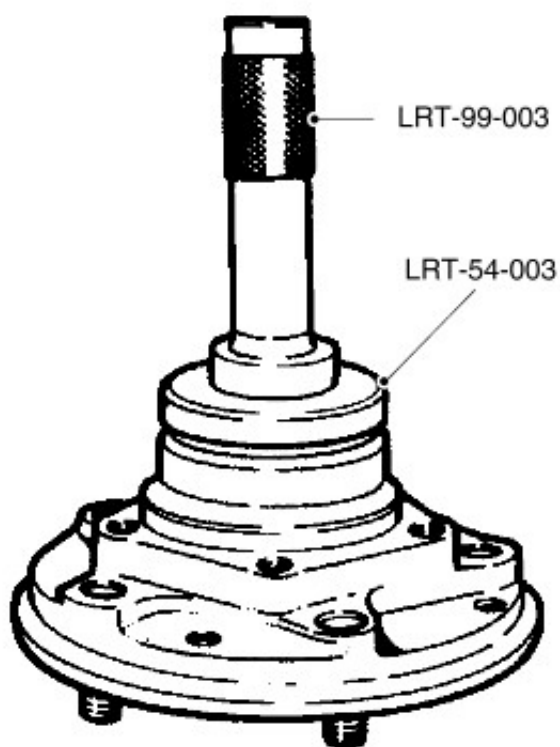
10. Remove outer bearing and spacer from hub.
11. Remove grease seal and inner bearing from hub.
12. Remove inner and outer bearing tracks from hub.



E75817

Installation

1. Clean hub and bearing locations.
2. Fit inner and outer bearing tracks to hub.
3. Pack inner bearing with grease and fit to hub.
4. Fit new grease seal flush with rear face of hub using LRT-54-003 and LRT-99-003.



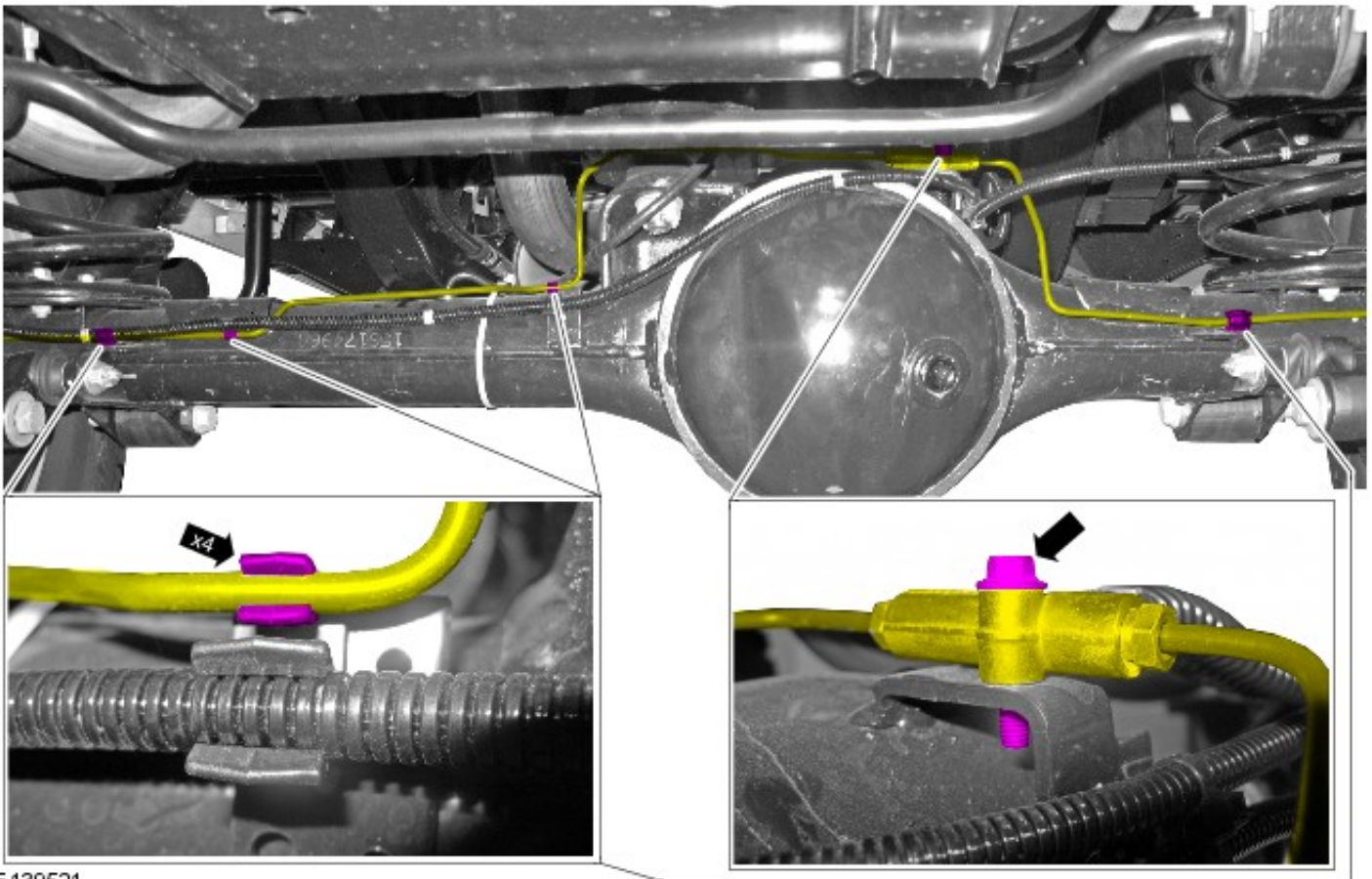
M510182

5. Clean stub axle.
6. Pack outer bearing with grease, fit spacer and bearing to hub.
7. Fit hub assembly to stub axle, remove LRT-54-019.
8. Fit washer and new hub nut and tighten to 30 Nm (22 lbf.ft).
9. Rotate and push/pull hub to settle bearings. Tighten hub nut to 210 Nm (150 lbf.ft).
10. To check hub end float, mount a dial gauge using bracket LRT-99-503 to driving member bolt hole.
11. Ensure dial gauge is contacting hub nut face.
12. Move hub in and out noting dial gauge reading.
13. If end float is present refer to table for correct spacer and change spacer as necessary.

End float (mm)	Spacer size (mm)	Colour code
0.00	15.5	Purple
0.025	15.4	Yellow
0.050	15.4	Yellow
0.075	15.4	Yellow
0.10	15.3	Red
0.125	15.3	Red
0.150	15.3	Red
0.175	15.2	Blue
0.200	15.2	Blue
0.225	15.2	Blue
0.250	15.2	Blue
0.275	15.1	Green
0.300	15.1	Green
0.325	15.1	Green
0.350	15.1	Green

0.375	15.0	Black
0.400	15.0	Black
0.425	15.0	Black
0.450	15.0	Black
0.475	14.9	White
0.500	14.9	White
0.525	14.9	White
0.550	14.9	White

14. When no end float is evident, remove the dial gauge and mounting bracket.
15. Stake the hub nut.
16. Clean hub and axle shaft faces.
17. Fit new driving member gasket.
18. Position driving member to hub and tighten new bolts to 65 Nm (48 lbf.ft).
19. Fit original shim(s) to drive shaft and secure with circlip.
20. Position caliper to hub, fit bolts and tighten to 82 Nm (61 lbf.ft).
21. Secure the rear brake pipes to the rear axle..
 1. Install rear brake pipe valve bolt to differential casing and tighten to 15Nm (11 lbf.ft)
 2. Secure both rear brake pipes to the rear axle retaining clips.



E 139521

22. Fit road wheel, remove axle stands and tighten road wheel nuts to 130 Nm (96 lbf.ft).
23. Operate brake pedal to locate brake pads before driving vehicle.
24. Check and top up brake fluid.

24. Check and top up brake fluid.

Rear Suspension - Spring

Removal and Installation

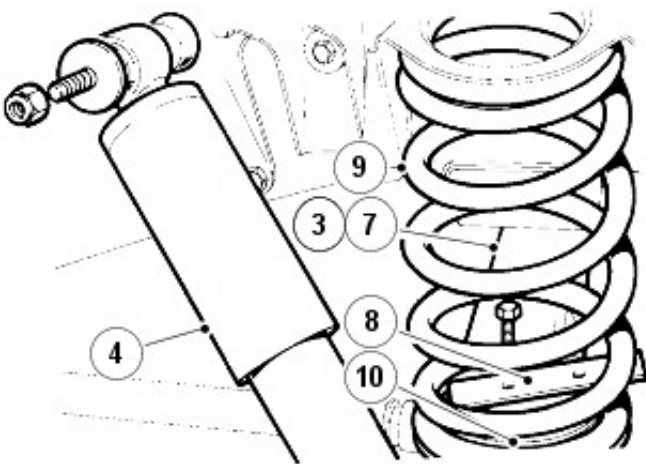
Removal

1. Loosen rear road wheel retaining nuts.
2. Support chassis on stands and remove wheels.
3. Support rear axle weight with jack.
4. Disconnect shock absorbers at one end.
5. Position coil spring compressor correctly on road spring.
6. Compress spring evenly to facilitate removal.
7. Lower axle to free road spring from upper seat.



CAUTION: Avoid lowering axle further than rear brake flexible hose will allow.

8. Remove spring retainer plate.
9. Withdraw road spring.
10. Collect spring seat.



RR3882M

Installation

1. Position spring seat on axle location.
2. Install road spring into chassis location and, using a turning motion, fit to spring seat.
3. Install spring retainer plate. Tighten bolts to 45 Nm (33 lbf.ft).
4. Secure shock absorber. Tighten upper fixing to 85 Nm (63 lbf.ft). Tighten lower fixing to 28 Nm (21 lbf.ft).
 - **Note:** For vehicles built prior to VIN 737011, discard the old fixings and tighten new fixing to the torque specified.
5. Install road wheels, remove chassis stands and jack. Tighten wheel nuts to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)

Rear Suspension - Wheel Studs

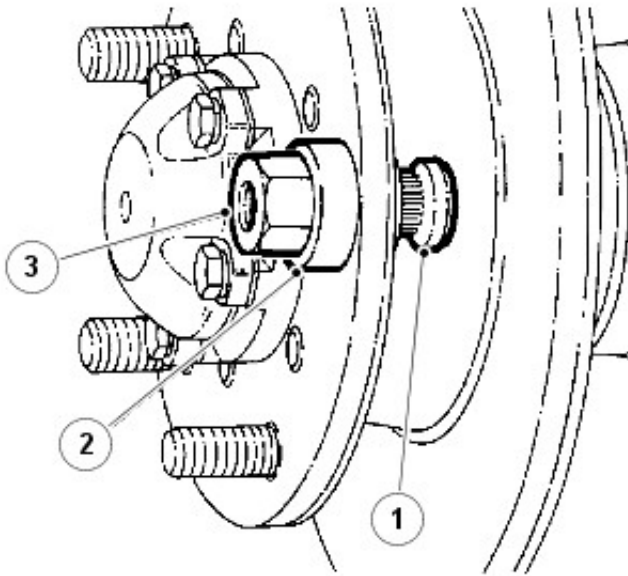
Removal and Installation

Removal

1. Remove wheel.
For additional information, refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).
2. Drive stud out of driveshaft flange.

Installation

1. Position stud in flange.
2. Install a suitable spacer over stud.
3. Using a M16 x 1.5 nut, a slave wheel nut is suitable, pull stud into flange until shoulder of stud abuts flange.



RR2141E

4. Refit wheel.
For additional information, refer to: Wheel and Tire (204-04 Wheels and Tires, Removal and Installation).

Rear Suspension - Rear Stabilizer Bar

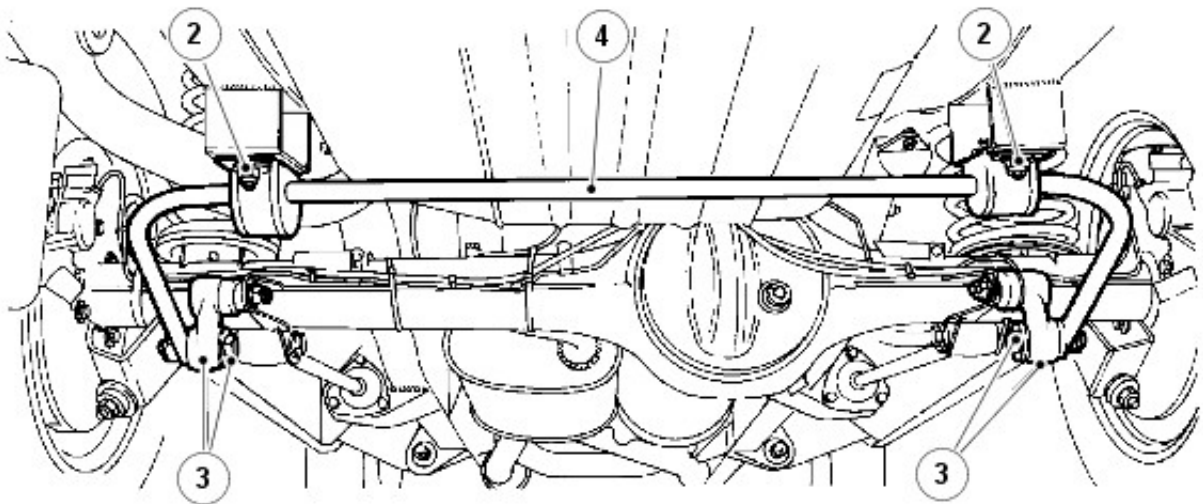
Removal and Installation

Removal

1. Note for reassembly, position of rubber bushes on stabilizer bar.
2. Remove 4 nuts, bolts and washers securing both stabilizer bar bush straps to chassis mounting brackets.
3. Remove nuts, bolts, washers and rubber bushes securing stabilizer bar to links.
4. Remove stabilizer bar.

Installation

1. Position rubber bushes on stabilizer bar. Instal joint towards axle.
2. Instal stabilizer bar with two straps. Ensure link arms point down as shown. Loosely instal, bolts, washers and new nyloc nuts.
3. Instal bolt, washers and rubber bushes. Instal anti-roll bar to links and tighten to 68Nm (50 lbf.ft).
4. Tighten nuts securing straps to 30Nm (22 lbf.ft).

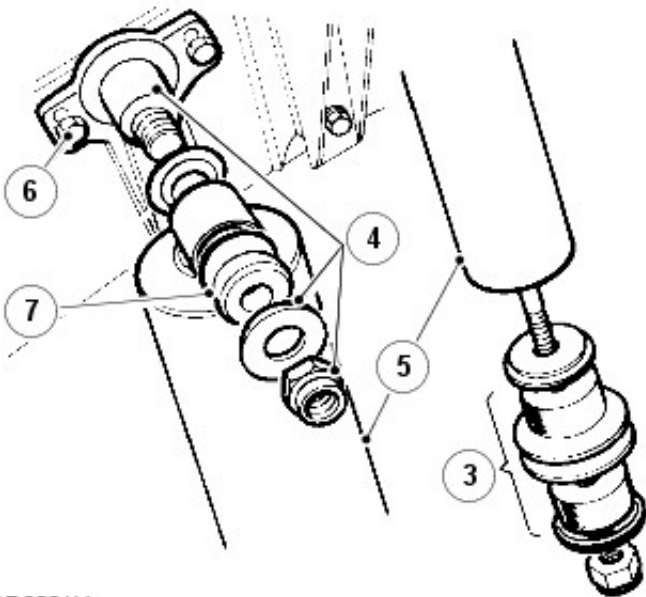


Rear Suspension - Rear Shock Absorber

Removal and Installation

Removal

1. Loosen road wheel retaining nuts.
2. Support chassis on stands. Remove road wheel and support rear axle weight with jack.
3. Remove fixings and withdraw shock absorber from axle bracket.
4. Remove upper fixings.
5. Withdraw shock absorber.
6. If required, remove mounting bracket
7. If required, remove mounting rubbers.



RR3881M

Installation

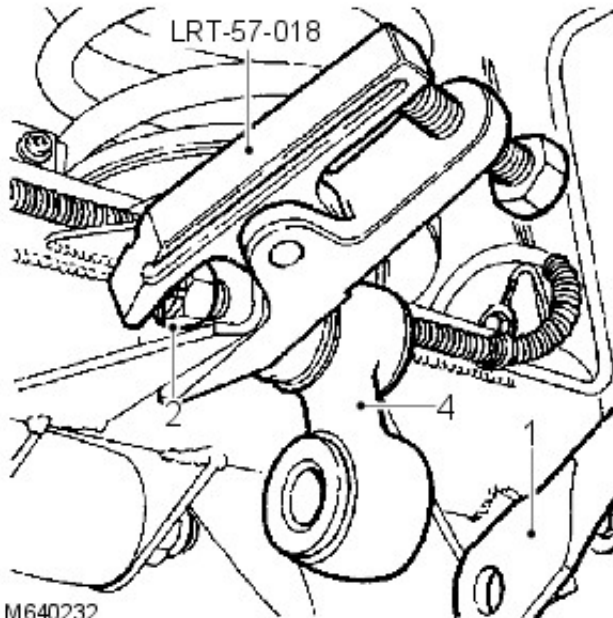
1. Position shock absorber and install upper fixings.
2. Secure shock absorber with lower fixings to axle bracket.
3. Tighten upper fixing to 85 Nm (63 lbf.ft). Tighten lower fixing to 28 Nm (21 lbf.ft).
 - **Note:** For vehicles built prior to VIN 737011, discard the old fixings and tighten new fixing to the torque specified.
4. Install road wheels, remove chassis stands and jack. Tighten wheel nuts to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)

Rear Suspension - Rear Stabilizer Bar Link

Removal and Installation

Removal

1. Remove 2 nuts, bolts, washers and rubber bushes from links and lower stabilizer bar to clear links.
2. Remove cotter pin and loosen castellated nut a few turns.
3. Release link using tool LRT-57-018 as shown.
4. Remove castellated nut and remove link.



Installation

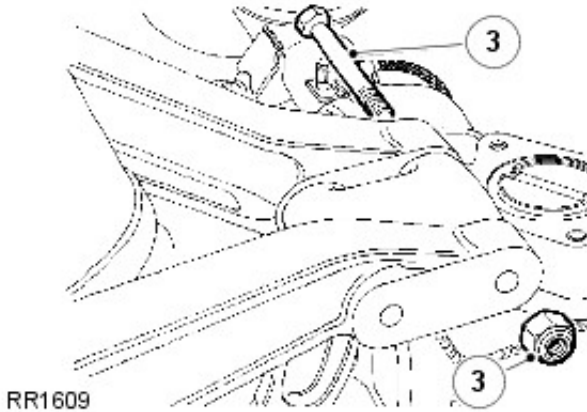
1. Install stabilizer bar link arm and castellated nut. Point link arm down as shown. Tighten fixing to 40 Nm (30 lbf.ft) and fit new cotter pin.
2. Align stabilizer bar to links.
3. Install bolts, washers and rubber bushes using new self locking nuts and secure stabilizer bar to links. Tighten to 6 8Nm (50 lbf.ft).

Rear Suspension - Upper Arm

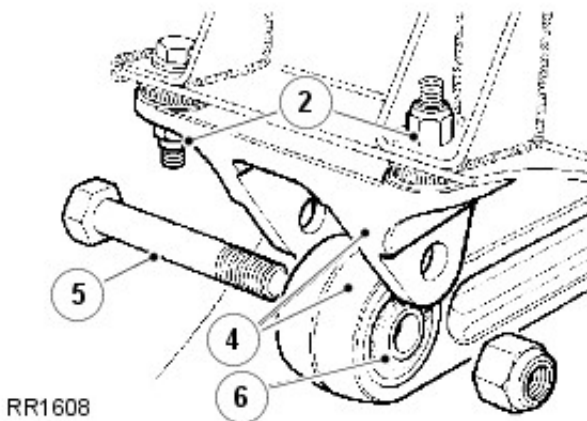
Removal and Installation


Removal

1. Support rear of chassis on stands, allow axle to hang freely.
2. Remove fixings securing upper arm bracket to frame.
3. Remove fixings securing upper arms to pivot bracket.



4. Remove upper arm, complete with frame bracket.
5. Remove bolt.
6. Separate upper arm from bracket.



7. Renew bush
8. Press out rubber bushes.
9.  **CAUTION:** Apply pressure to outer edge of bush, and not rubber inner.
Fit bush centrally in housing.

Installation

1. **NOTE:** Do not fully tighten fixings until all components are in position.
Secure upper arm to frame bracket.
2. Fit upper arm to pivot bracket and tighten fixings to 115 Nm (84 lbf/ft).
3. Fit frame bracket to chassis mounting.
4. If you are fitting a new nut to the upper arm bolt, fully tighten to

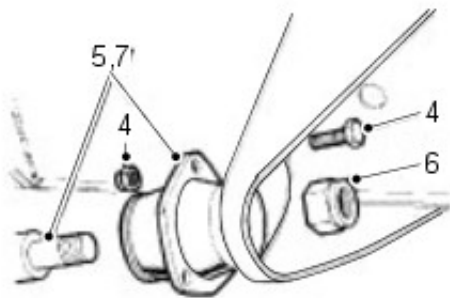
- .. If you are fitting a new nut to the upper arm bone, run, tighten to 115 Nm (84 lbf/ft). If you are refitting an existing nut, then tighten to 176 Nm (130 lbf/ft).

Rear Suspension - Lower Arm

Removal and Installation

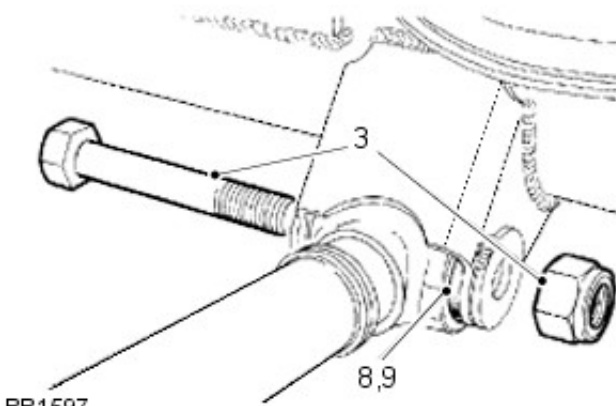
Removal

1. Site vehicle on a ramp .
2. Alternatively, support vehicle on stands under rear axle.
3. Remove lower arm rear fixings.
4. Remove mounting bracket fixings at side member bracket.
5. Remove lower arm complete.
6. Remove locknut.
7. Remove mounting bracket from lower arm.




RR1598

8. Renew bush
9. Press out rubber bushes.



RR1597

Installation

1.  **CAUTION:** Apply pressure to outer edge of bush, and not rubber inner.
Fit bush centrally in housing.
2. Fit mounting rubber to lower arm.
3. Secure mounting rubber to chassis bracket, but do not fully tighten locknut.
4. Fit lower arm to axle mounting and secure fixing to 176 Nm (130 lbf/ft).
5. Lower vehicle, allow axle to take up static laden position, and fully

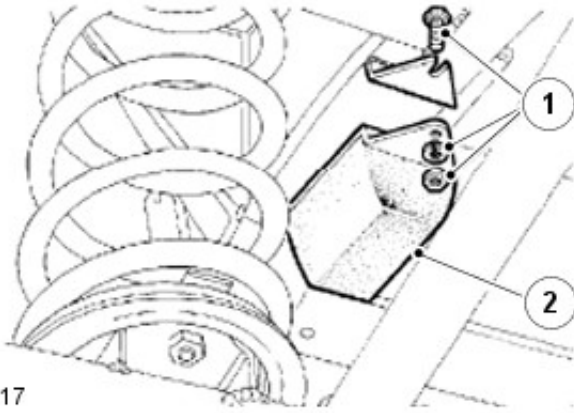
c. Lower frame, then axle to take up slack each position, and then, tighten lower arm to chassis fixing to 176 Nm (130 lbf/ft).

Rear Suspension - Axle Bump Stop

Removal and Installation

Removal

1. Remove fixings.
2. Remove bump stop.



E82217

Installation

1. Position bolts in slots in bracket.
2. Install bump stop, secure with washers and nuts.

Wheels and Tires -

Wheels - 90 Models



WARNING: Always use the same make and type of radial-ply tyres, front and rear. DO NOT use cross-ply tyres, or interchange tyres from front to rear.

Wheel type	Wheel size
Steel wheel - UK and Western Europe	6F x 16
Steel wheel - Other markets	5.5F x 16
Alloy wheel	7J x 16

Wheels



WARNING: Always use the same make and type of radial-ply tyres, front and rear. DO NOT use cross-ply tyres, or interchange tyres from front to rear.

If the wheel is marked 'TUBED', an inner tube **MUST** be fitted, even with a tubeless tire. If the wheel is marked 'TUBELESS', an inner tube must **NOT** be fitted.

Wheel type	Wheel size
Steel wheel - UK and Western Europe	6F x 16
Steel wheel - Other markets except Japan	5.5F x 16
Steel wheel - Japan	6.5J x 16
Alloy wheel	7J x 16

Tire sizes

Model	Tire size
90	205/80 R16 Radial
	265/75 R16 Radial (Multi terrain)
	7.50 R16 Radial
110 - except Japan	7.50 R16 Radial
110 Japan	7.50 R16C
130	7.50 R16 radial

Tire pressures

Model - Tire size	Front	Rear
90 - 205/80 R16	1,9 bar	2,6 bar
	28 lbf/in ²	38 lbf/in ²
	2,0 kgf/cm ²	2,7 kgf/cm ²
90 - 265/75 R16	1,9 bar	2,4 bar
	28 lbf/in ²	35 lbf/in ²
	2,0 kgf/cm ²	2,7 kgf/cm ²
90 - 7.50 R16	1,9 bar	2,6 bar
	28 lbf/in ²	38 lbf/in ²
	2,0 kgf/cm ²	2,7 kgf/cm ²
110 - 7.50 R16 (except Japan)	1,9 bar	3,3 bar
	28 lbf/in ²	48 lbf/in ²
	2,0 kgf/cm ²	3,4 kgf/cm ²
110 - 7.50 R16C (Japan)	2,2 bar	4,1 bar
	32 lbf/in ²	60 lbf/in ²
	2,3 kgf/cm ²	4,3 kgf/cm ²
130 - 7.50 R16	3,0 bar	4,5 bar
	44 lbf/in ²	65 lbf/in ²
	3,1 kgf/cm ²	4,6 kgf/cm ²

Road Wheel Nut Torque Specifications

Wheel type	Nm	lb-ft
*Steel wheels	100	80
Alloy wheels	130	96
Heavy duty wheels	170	125

*** Wheel nuts must be tightened by diagonal selection**

Wheels and Tires - Wheels and Tires

Description and Operation

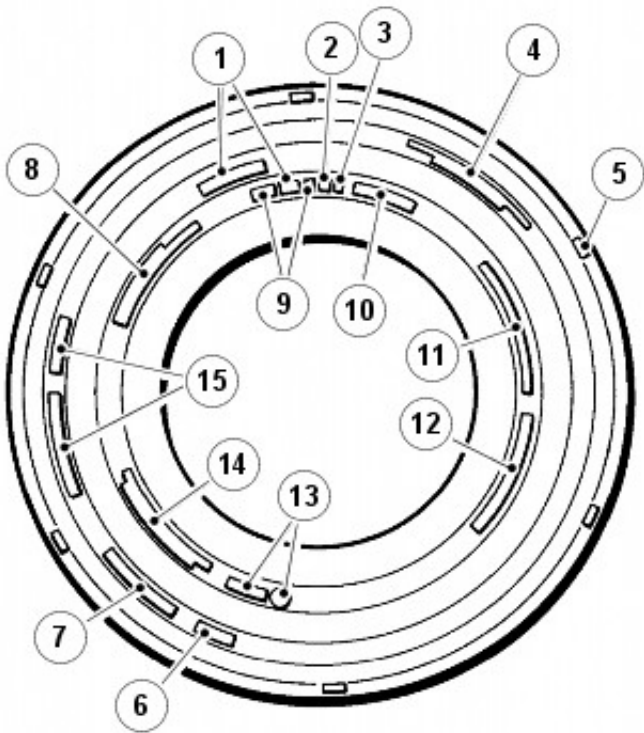
GENERAL

Dependent on specification and model type, the vehicle is equipped with pressed steel or alloy wheel rims, both using tubeless radial ply tires.

Tire codes

The text, codes and numbers moulded into the tire wall vary between tire manufacturers, however most tires are marked with the information shown in the illustrated example.

NOTE: The illustration is an example of the type of markings moulded into tires and is for guidance only. For specific tire specifications. For additional information, refer to: (204-04 Wheels and Tires, Specifications).



RR3854M

Item	Part Number	Description
1.	-	Type of tire construction - Radial Ply
2.	-	Load index - 104
3.	-	Speed symbol - S or T
4.	-	USA Tyre quality grading - Tread wear 160 Traction A temperature B
5.	-	Tread wear indicators moulded into tread pattern are located at intervals around the tire and marked by a code - E66 103S6
6.	-	Tyres with 'Mud Snow' type tread pattern are marked - M and S
7.	-	Tyre reinforcing mark - Reinforced
8.	-	USA Load and pressure specification - (900Kg(1984LBS) at 340KA (50PSI) MACS PRESS
9.	-	Tyre size - 205 16 or 235/70 R16
10.	-	Type of tire - TUBELESS
11.	-	Country of manufacture - MADE IN GREAT BRITAIN
12.	-	USA Compliance symbol and identification - DOT AB7C DOFF 267
13.	-	European type approval identification - E11 01234
14.	-	Tire construction - SIDE WALL 2 PLIES RAYON. TREAD 2 RAYON 2 STEEL

GENERAL INFORMATION



WARNING: This is a multi-purpose vehicle with wheels and tires designed for both on and off road usage. Only use wheels and tires specified for use on the vehicle.

The vehicle is equipped with tubeless 'S', 'T' or 'H' rated radial ply tires as standard equipment. The tires are of European metric size and must not be confused with the "P" size metric tires available in North America.

Vehicle wheel sets, including spare wheel, must be fitted with the same make and type of tire to the correct specification and tread pattern. Under no circumstances must cross-ply or bias-belted tires be used.



WARNING: DO NOT fit an inner tube to an alloy wheel.

For tire specification and pressures.

For additional information, refer to: (204-04 Wheels and Tires, Specifications).

Steel wheels

Tubeless tires are mounted on 5.5 or 6.5 inch wide by 16 inch diameter steel wheels.

Alloy Wheels

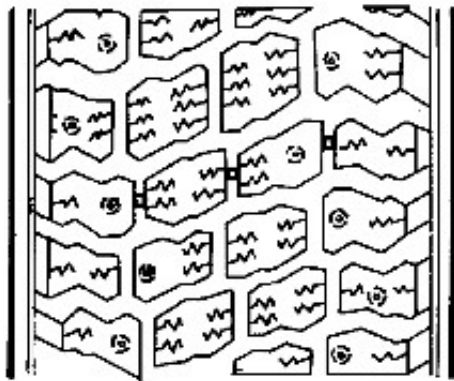
Tubeless tires are mounted on 7.0 inch wide by 16 inch diameter cast aluminium alloy wheels. The surface has a paint finish covered with a clear polyurethane lacquer. Care must be taken when handling the wheel to avoid scratching or chipping the finish. The alloy wheel rim is of the asymmetric hump type incorporating a safety hump to improve location of the tire bead in its seat. If difficulty is experienced in fitting tires to this type of rim. See

For additional information, refer to: Wheel and Tire (204-04, Removal and Installation).

TIRE INSPECTION

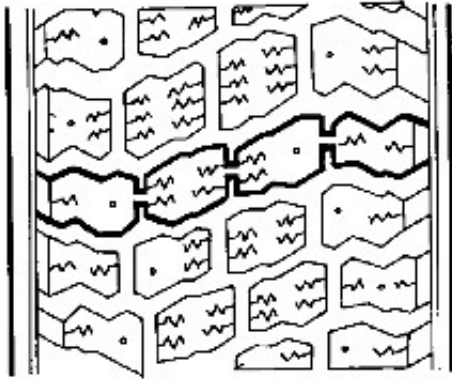
Inspect tires at weekly intervals to obtain maximum tire life and performance and to ensure compliance with legal requirements. Check for signs of incorrect inflation and uneven wear, which may indicate a need for balancing or front wheel alignment, if the tires have abnormal or uneven wear patterns. See Tire Wear Chart in this section.

Check tires at least weekly for cuts, abrasions, bulges and for objects embedded in the tread. More frequent inspections are recommended when the vehicle is regularly used in off road conditions.



RR2145E

To assist tire inspection, tread wear indicators are moulded into the bottom of the tread grooves, as shown in the illustration above.



RR2146E

When the tread has worn to a depth of 1.6 mm the indicators appear at the surface as bars which connect the tread pattern across the width of the tread as shown in the illustration above.

NOTE: DO NOT attempt to interchange tires, e.g. from front to rear, as tire wear produces characteristic patterns depending on their position. If tire position is changed after wear has occurred, the performance of the tire will be adversely affected.

NOTE: Territorial vehicle regulations governing tire wear **MUST** be adhered to.

When the indicators appear in two or more adjacent grooves, at three locations around the tire, a new tire must be fitted.

Wheel inspection

Regularly check the condition of the wheels. Replace any wheel that is bent, cracked, dented or has excessive runout.

Valve inspection

Check condition of inflation valve. Replace any valve that is worn, cracked, loose, or leaking air.

Tire pressures

Maximum tire life and performance will be obtained only if tires are maintained at the correct pressures .

Tyre pressures must be checked at least once a week and preferably daily, if the vehicle is used off road.

The tire inflation pressure is calculated to give the vehicle satisfactory ride and steering characteristics without compromising tire tread life. For recommended tire pressures in all conditions. For additional information, refer to: (204-04 Wheels and Tires, Specifications).

Always check tire inflation pressures using an accurate gauge and inflate tires to the recommended pressures only .

Check and adjust tire pressures **ONLY** when the tires are cold, vehicle parked for three hours or more, or driven for less than 3.2 km (2 miles) at speeds below 64 km/h (40 mph). Do not reduce inflation pressures if the tires are hot or the vehicle has been driven for more than 3.2 km (2 miles) at speeds over 64 km/h (40 mph), as pressures can increase by 0.41 bars (6 lb/in²) over cold inflation pressures.

Check **ALL** tire pressures including the spare. Refit the valve caps as they form a positive seal and keep dust out of the valve.

WHEEL BALANCING



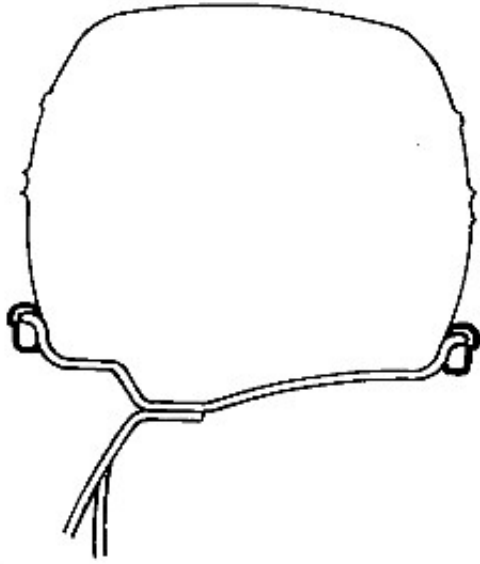
CAUTION: It is essential that all wheel balancing is carried out off the vehicle. The use of on the vehicle balancing could cause component damage or personal injury and **MUST NOT** be attempted.

NOTE: Before attempting to balance a wheel and tire assembly clean all mud and dirt deposits from both inside and outside rims and remove existing balance weights.

Remove stones from the tire tread in order to avoid operator injury during dynamic balancing and to obtain the correct balance.

Inspect tires for damage and correct tire pressures and balance according to the equipment manufacturer's instructions.

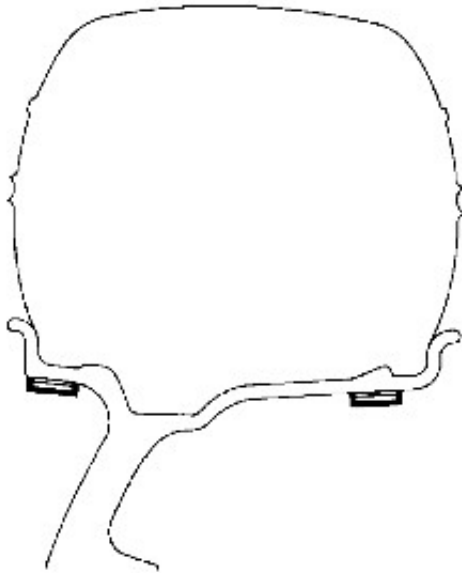
Steel wheels



RR2211M

Clean area of wheel rim and attach balance weights in position shown.

Alloy wheels

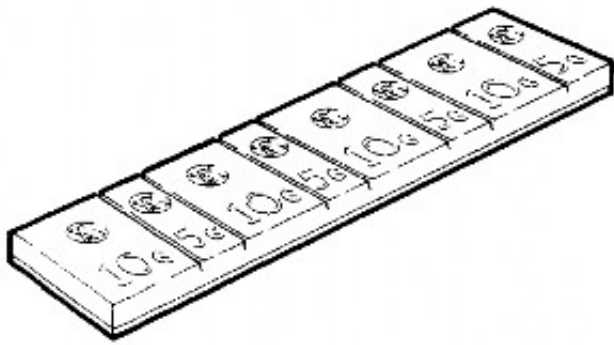


RR2138E

Clean area of wheel rim and attach adhesive balance weights in position shown. Cut through rear face of weight strip to detach required weights.



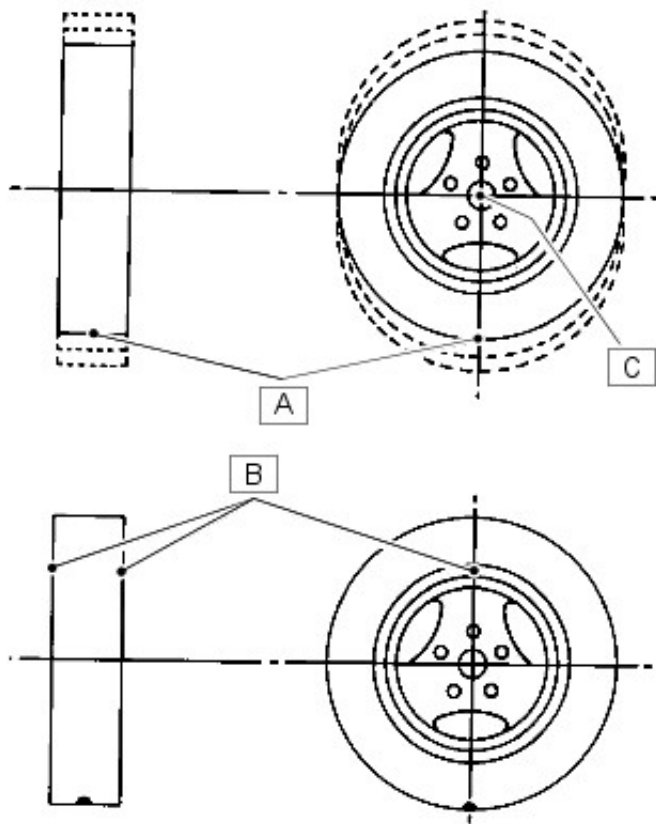
CAUTION: Use only correct adhesive balance weights to avoid damage to aluminium wheel rim. DO NOT attempt to use a steel wheel weight on an aluminium wheel.



RR2137E

Static Balance

Wheel tramp



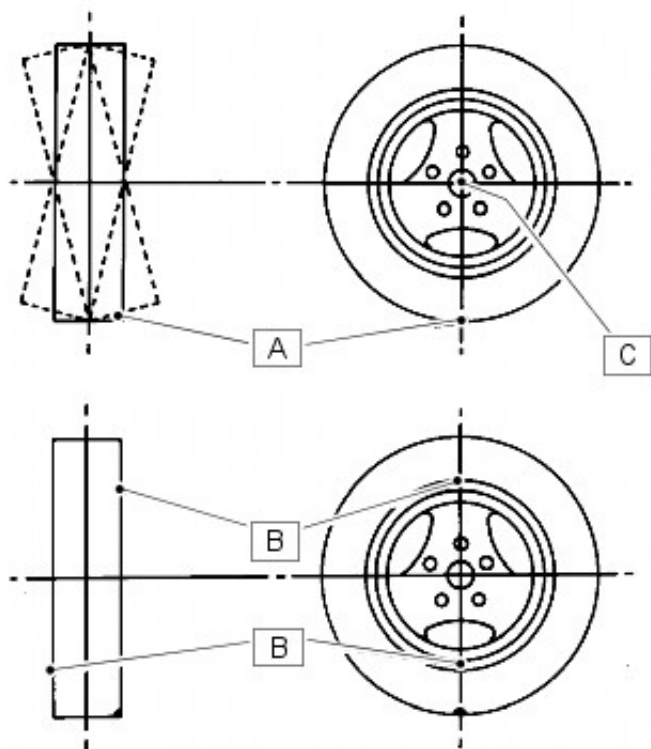
RR3829M

Item	Part Number	Description
A	-	Heavy spot.
B	-	Add balance weights here.
C	-	Centre line of spindle.

Static balance is the equal distribution of weight around the wheel. A statically unbalanced wheel will cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear.

Dynamic Balance

Wheel shimmy



RR3830M

Item	Part Number	Description
A	-	Heavy spot.
B	-	Add balance weights here.
C	-	Centre line of spindle.

Dynamic balance is the equal distribution of weight on each side of the centre line so that when the wheel spins there is no tendency for side to side movement. A dynamically unbalanced wheel will cause wheel shimmy.

Off Vehicle Balancing

Balance wheel assembly referring to equipment manufacturer's instructions.

It is essential that the wheel is located by the centre hole NOT the stud holes. To ensure positive wheel location the diameter of the locating collar on the machine shaft must be 112,80 to 112,85 mm (4.441 to 4.443 in). This diameter will ensure that the collar fits correctly within the centre hole of the wheel.

Where possible, always use the vehicle wheel retaining nuts to locate the wheel on the balancer, to avoid damaging the wheel. If this is not possible, the locating nuts must be of a similar pattern to the original wheel nuts. The use of conical type wheel nuts for this purpose may damage the surface on alloy wheels.

Cleaning

Wash the aluminium wheels using a suitable wash and wax concentrate, correctly diluted and rinse with cold clear water. DO NOT use abrasives or aluminium wheel cleaners containing acid, as they will destroy the lacquer finish.

Tire changing

Use only tire changing equipment to mount or demount tires, following the equipment manufacturer's instructions. DO NOT use hand tools or tire levers, as they may damage tire beads or the wheel rim.

Puncture repair

Remove punctured tire from wheel and repair using a combination service plug and vulcanising patch. Always follow manufacturer's instructions when using a puncture repair kit.

Only punctures in tread area are repairable, DO NOT attempt to repair punctures in tire shoulders or sidewalls.

Do not attempt to repair a tire that has sustained the following: bulges or blisters, ply separation, broken or cracked beads, wear indicators visible and punctures larger than 6 mm diameter.

⚠ CAUTION: Do not use tire sealants that are injected through valve stem to repair punctured tires, they may produce wheel corrosion and tire imbalance.

Aluminium wheel rim bead seats should be cleaned using a non-abrasive cleaner to remove the mounting lubricants and old rubber. Before mounting or demounting a tire, bead area should be well lubricated with a suitable tire lubricant.

FAULT- SYMPTOMS

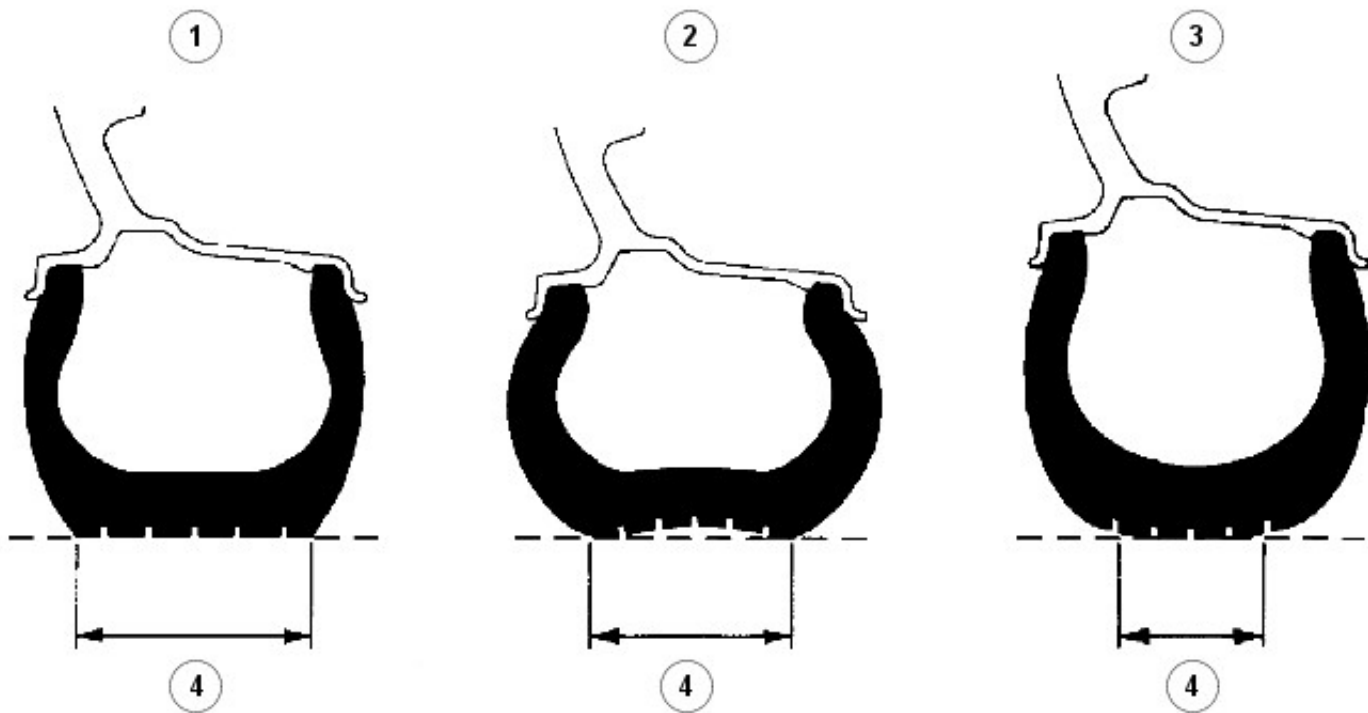
- Check tyre pressures.
For additional information, refer to: (204-04 Wheels and Tires, Specifications).
- Check condition of tyres.
- Check front wheel alignment.
For additional information, refer to: Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).
- Check wheel balance.

NOTE: In the event that any apparent vibration is not eliminated at this stage.

NOTE: In the event that any apparent vibration is not eliminated at this stage, go to steering Fault Diagnosis, Fault - Symptom (Steering vibration, road wheel shimmy/wobble).

For additional information, refer to: Steering System (211-00 Steering System - General Information, Diagnosis and Testing).

NOTE: Radial ply tyres have a flexible sidewall, which produces a sidewall bulge making the tyre appear under-inflated. This is a normal condition for radial ply tyres. Do not attempt to reduce this bulge by over-inflating the tyre.



RR2133E

Item	Part Number	Description
1.	-	Correct inflation.
2.	-	Under-inflation.
3.	-	Over-inflation.
4.	-	Tread contact with road.

Tire wear chart

⚠ CAUTION: This chart is for general guidance only and does not necessarily include every cause of abnormal tire wear.

Fault	Cause	Remedy
Rapid wear at	Tires under inflated	Inflate to correct pressure

shoulders		
	Worn suspension components; i.e. ball joints, Panhard rod bushes, steering damper	Replace worn components
Rapid wear at centre of tread	Tires over inflated	Inflate to correct pressure
Wear at one shoulder	Track out of adjustment	Adjust track to correct figure
	Bent Panhard rod	Check and replace worn or damaged components
Bald spots or tire cupping	Wheel out of balance	Balance wheel and tire assembly
	Excessive radial run out	Check run out and replace tire if necessary
	Shock absorber worn	Replace shock absorber
	Excessive braking	
Tire scalloped	Track out of adjustment	Adjust track to correct figure
	Worn suspension components	Check and replace worn or damaged components, and replace tire
	Excessive cornering speeds	

Wheels and Tires - Wheel and Tire

Removal and Installation

Removal

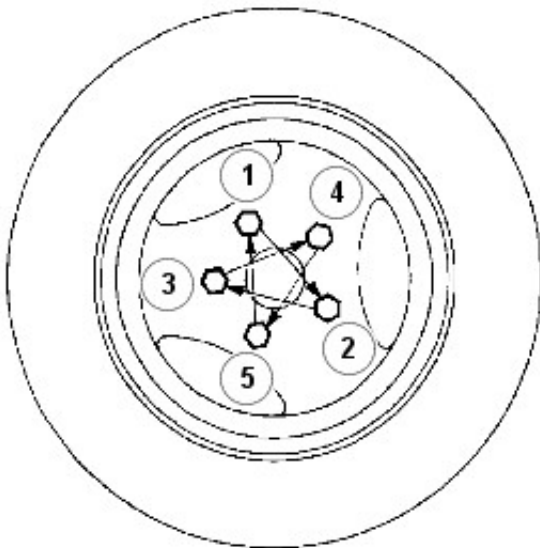


WARNING: The parking brake acts on transmission, not rear wheels, and may not hold vehicle when jacking unless following procedure is used. If one front wheel and one rear wheel is raised no vehicle holding or braking effect is possible. Wheels **MUST** be chocked in all circumstances.

1. Apply parking brake, select a gear in main gearbox and engage low gear in transfer box.
2. Loosen 5 wheel nuts.
3. Using a suitable trolley jack, raise vehicle and place on axle stands. For additional information, refer to: Jacking (100-02, Description and Operation).
4. Remove wheel nuts and carefully withdraw wheel over studs.

Installation

1. Ensure that retaining studs and nuts are clean.
2. **Alloy wheels:** Lightly coat wheel mounting spigot face with a suitable anti-seize compound to minimise possibility of adhesion between wheel and spigot face.
3. Refit wheel taking care not to damage stud threads. (Do not apply oil).
4. Fit wheel nuts and turn by hand for at least three full threads before using any form of wheel wrench.
5. Tighten nuts as much as possible using a suitable wrench.



RR2142E

6. Lower vehicle and finally tighten nuts to correct torque sequence shown.
 1. Alloy wheels - 130 Nm
 2. Steel wheels - 100 Nm
 3. Heavy duty wheels - 170 Nm

Driveshaft - Driveshaft

Description and Operation

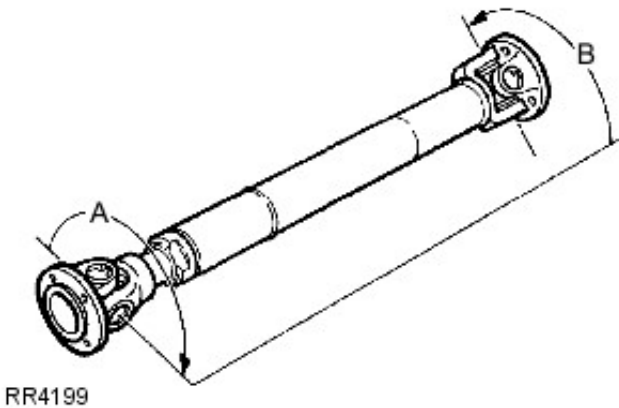
Description

The front and rear drive shafts have non-constant velocity type universal joints, with needle roller bearings. The bearing cups are pre-packed with lubricant on assembly and a grease nipple is fitted for servicing as specified, in maintenance section.

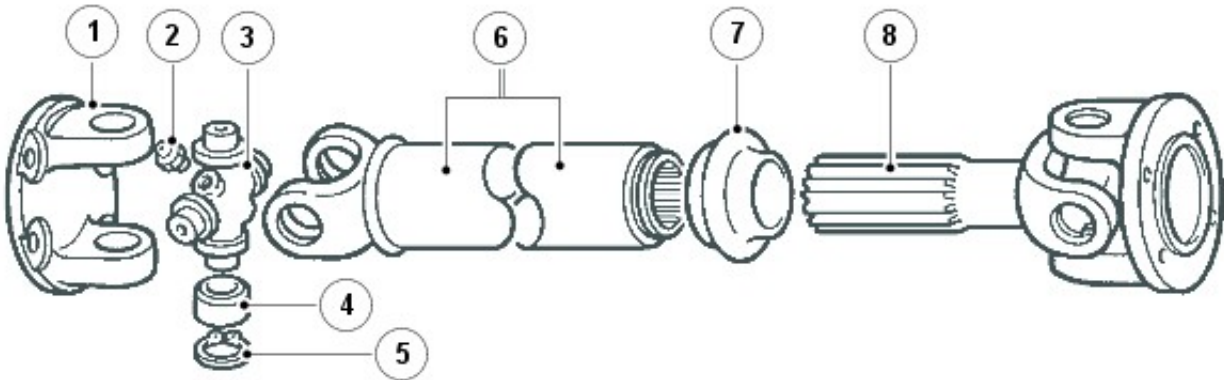
Both shafts have ball splines to accommodate the variation in distance between the axles and transmission. The splines are pre-packed with lubricant and protected by a rubber gaiter.

NOTE: This joint does not require lubrication.

The front and rear driveshafts are 'phased', with the joints at each end, A and B mis-aligned as shown.



The phasing is necessary to allow for greater variation in angular changes. On reassembly it is essential the driveshafts are realigned correctly.



J6284

Item	Part Number	Description
1.	-	Flanged yoke
2.	-	Grease nipple
3.	-	Journal spider
4.	-	Needle roller bearing
5.	-	Circlip
6.	-	Splined shaft
7.	-	Rubber gaiter (dust cap)
8.	-	Ball spline shaft

Vibration Harshness

Check the propeller shaft universal joints are not seized or worn by checking for excessive radial and axial movement. This can be done by inserting a suitable lever into the joint and checking for movement. In the event that both shafts are satisfactory, but the vibration/harshness is still present, the transfer box operation and balance of the road wheels should be checked.

Driveshaft - Front Driveshaft

Removal and Installation

Removal

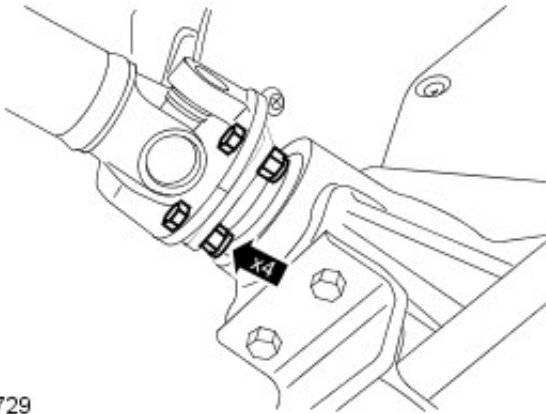
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. **NOTE:** Mark the front driveshaft to front differential drive flange.

Release the driveshaft from the front differential.

- Remove and discard the 4 nuts.

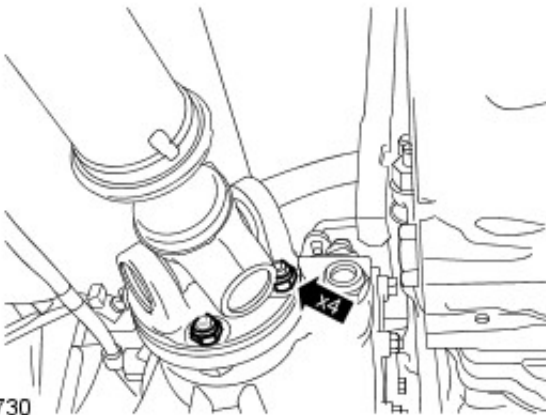


E90729

3. **NOTE:** Mark the front driveshaft to transfer case drive flange.

Remove the driveshaft.

- Remove and discard the 4 nuts.



E90730

Installation

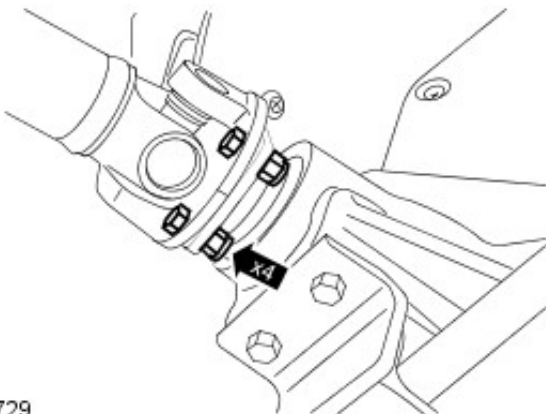
1. **NOTE:** Clean the driveshaft drive flanges and mating faces.

To install, reverse the removal procedure.

2. **NOTE:** Install new nuts.

Tighten to 47 Nm (35 lb.ft).

- Align the position of the driveshaft in relation to the drive pinion flange.



E90729

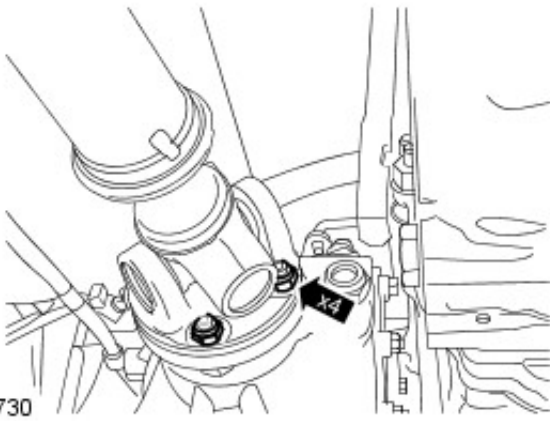
3. **NOTE:** Install new nuts.

Tighten to 47 Nm (35 lb.ft).

- Align the position of the driveshaft in relation to

the drive pinion flange.

E90730



Driveshaft - Rear Driveshaft

Removal and Installation

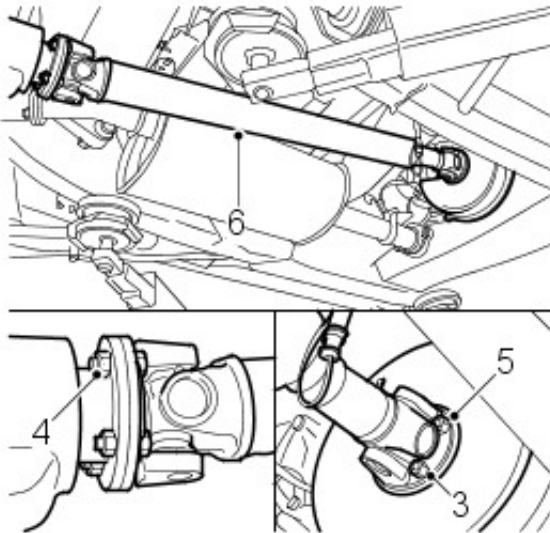
Removal

1.  **WARNING:** Support on safety stands and chock front wheels.

Raise rear of vehicle.

2. **NOTE:** Mark the rear driveshaft to parking brake flange.

Remove and discard 4 nuts securing driveshaft to parking brake flange.



M470248

NOTE: Rotation of driveshaft may be required during the above procedure.

3. **NOTE:** Mark the rear driveshaft to rear differential flange.

NOTE: Rotation of driveshaft may be required during the procedure.

Remove and discard 4 nuts securing driveshaft to rear axle flange.

4. Release driveshaft from parking brake flange.

5. Remove driveshaft.

Installation

1. Clean driveshaft flange mating faces.

2. Fit driveshaft to park brake flange bolts.

NOTE: Ensure relationship marks align.

3. Position driveshaft to rear axle flange and fit bolts.

4. **NOTE:** Rotation of driveshaft may be required during the procedure.

Fit nuts and bolts securing driveshaft to rear axle flange and tighten to 47 Nm (35 lbf.ft).

5. Fit nuts securing driveshaft to park brake and tighten to 50 Nm (37 lbf.ft).

NOTE: Rotation of driveshaft may be required during the procedure.

6. Remove stands and lower vehicle.

7. Apply parking brake.

Driveshaft - Driveshaft Universal Joint

Disassembly and Assembly

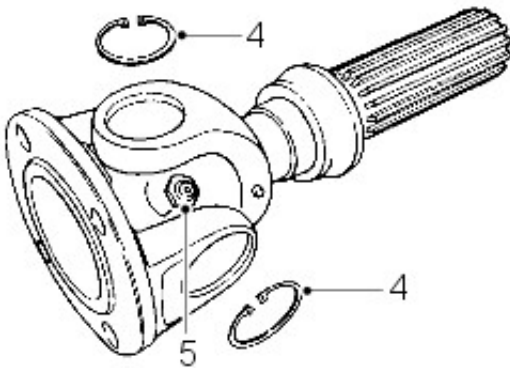
Disassembly

1. Remove driveshaft. For additional information, refer to: (205-01 Driveshaft)
Front Driveshaft (Removal and Installation),
Rear Driveshaft (Removal and Installation).
2. Thoroughly examine universal joints for signs of damage or wear.
3. Clean universal joint bearing cups and circlips.



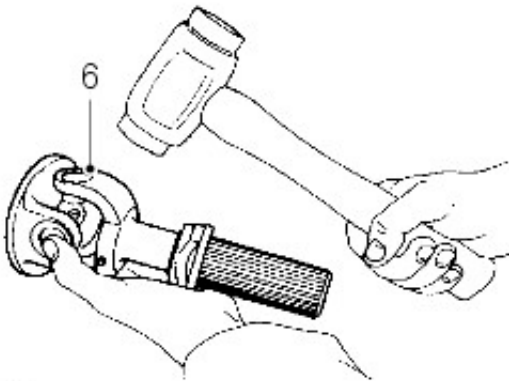
CAUTION: To ensure correct assembly and reduce possibility of imbalance, before removing driveshaft joint mark position of spider pin relative to journal yoke ears.

4. Remove circlips.
5. Note position and remove grease nipple.



M470249

6. Tap yokes to eject bearing cups.

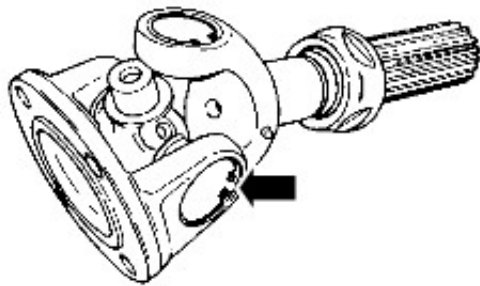
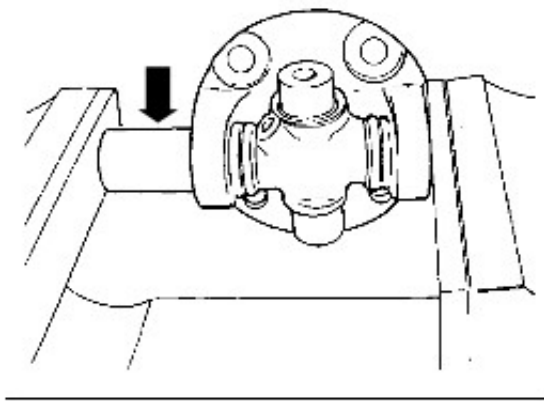


M470250

7. Remove bearing cups.
8. Remove spider.
9. Clean yokes and bearing cup locations.

Assembly

1. Remove bearing cups from new spider.
2. Check all needle rollers are present and positioned in bearing cups.
3. Enter new spider with seals into yokes of propeller shaft flange.



M470251

4. Partially insert one bearing cup into flange yoke and enter spider trunnion into bearing cup.
5. Insert opposite bearing cup into flange yoke.
6. Press both cups into place.
7. Press each cup into its respective yoke up to lower land of circlip groove. Damage may be caused to cups and seals if cups pass this point.
8. Fit circlips and check no end float exists.
9. Fit grease nipple and lubricate
10. Repeat instructions for opposite end of driveshaft as described in 3 to 9.
11. Fit driveshaft. For additional information, refer to: (205-01 Driveshaft)
Front Driveshaft (Removal and Installation),
Rear Driveshaft (Removal and Installation).

Rear Drive Axle/Differential -

Rear axle	
Type	Spiral bevel, fully floating shafts
Ratio	3.54:1

Sealers

Item	Land Rover Part No.
Rear axle differential case	STC 3811
Crown wheel to differential case bolts	STC 50552
Differential case bolts	STC 50552
Hub drive member bolts	STC 50552

Lubricants

Item	Specification
Final drive *	Molytex EP90

*** Do not use any lubricant other than that specified**

Capacities

Unit	Capacity
Differential - 90 Models	1.70 litres (3.0 pints) (1.80 US quarts)
Differential - 110 Models	2.26 Litres (4.00 pints) (2.39 US Quarts)

Torque Specifications

Description	Nm	lb-ft
Pinion housing to axle case	41	30
Crown wheel to differential case	58*	43*
Differential bearing cap to pinion housing	90	65
Differential drive flange to drive shaft	47	34
Bevel pinion nut	129	96
Lower link to axle	176	130
Pivot bracket ball joint to axle	176	130
Brake disc to hub	73*	53*

*** Apply sealant, Part No. STC 50550 to threads**

Rear Drive Axle/Differential - Rear Drive Axle and Differential

Description and Operation

Description

The welded steel rear axle casing houses a separate spiral bevel type differential unit, which is off set to the right of the vehicle centre line. The differential unit drives the rear wheels via the axle shafts and fully floating hubs which are mounted on tapered roller bearings.

Lubrication

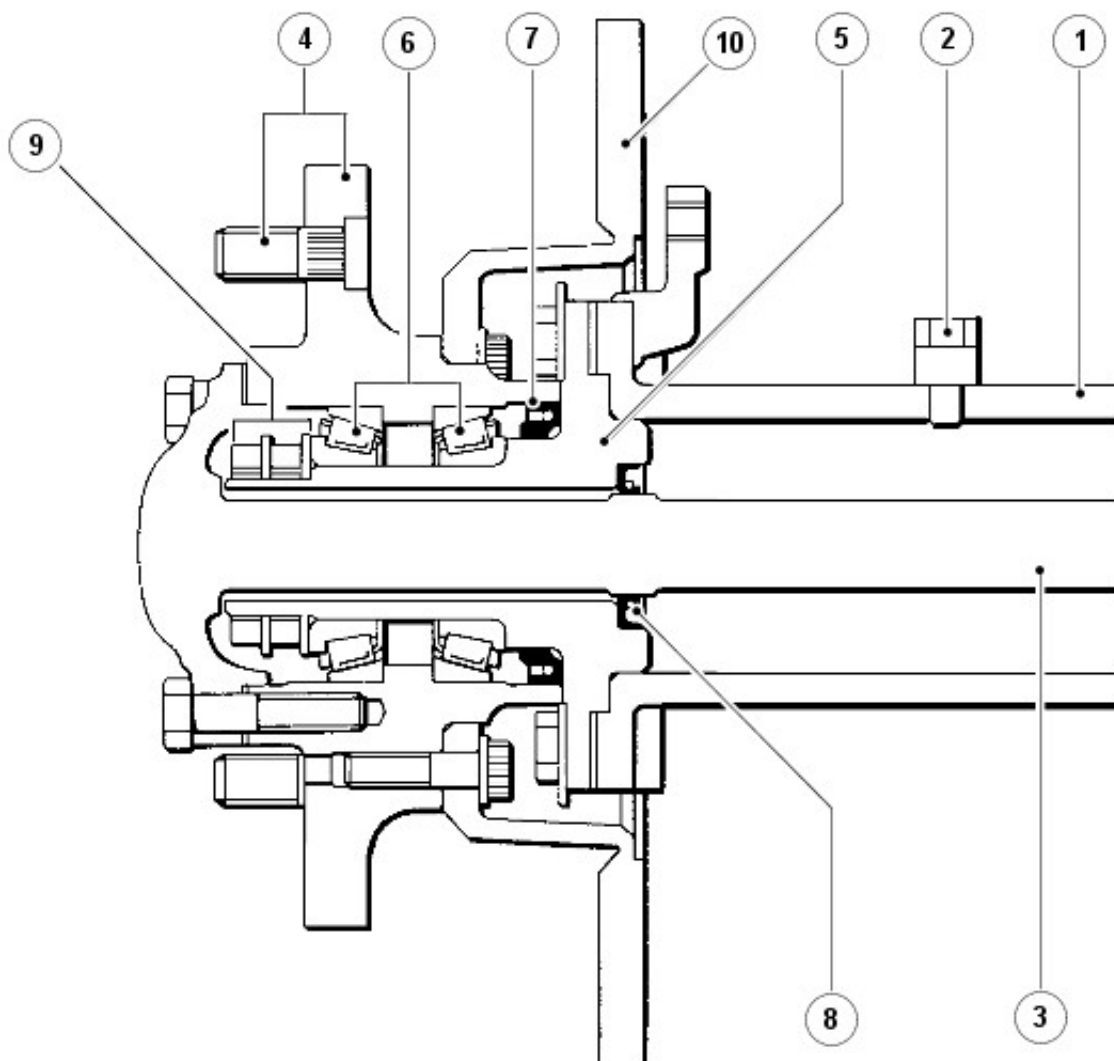
The differential is lubricated with oil and the hub bearings with grease.

The hub bearings are fitted with inner and outer seals. The outer seals prevent the differential oil mixing with the hub grease and the inner seals prevent dirt ingress into the hub.

Ventilation

Ventilation of the hub bearings is through the outer oil seals and the differential ventilation pipe, which terminates at a high level.

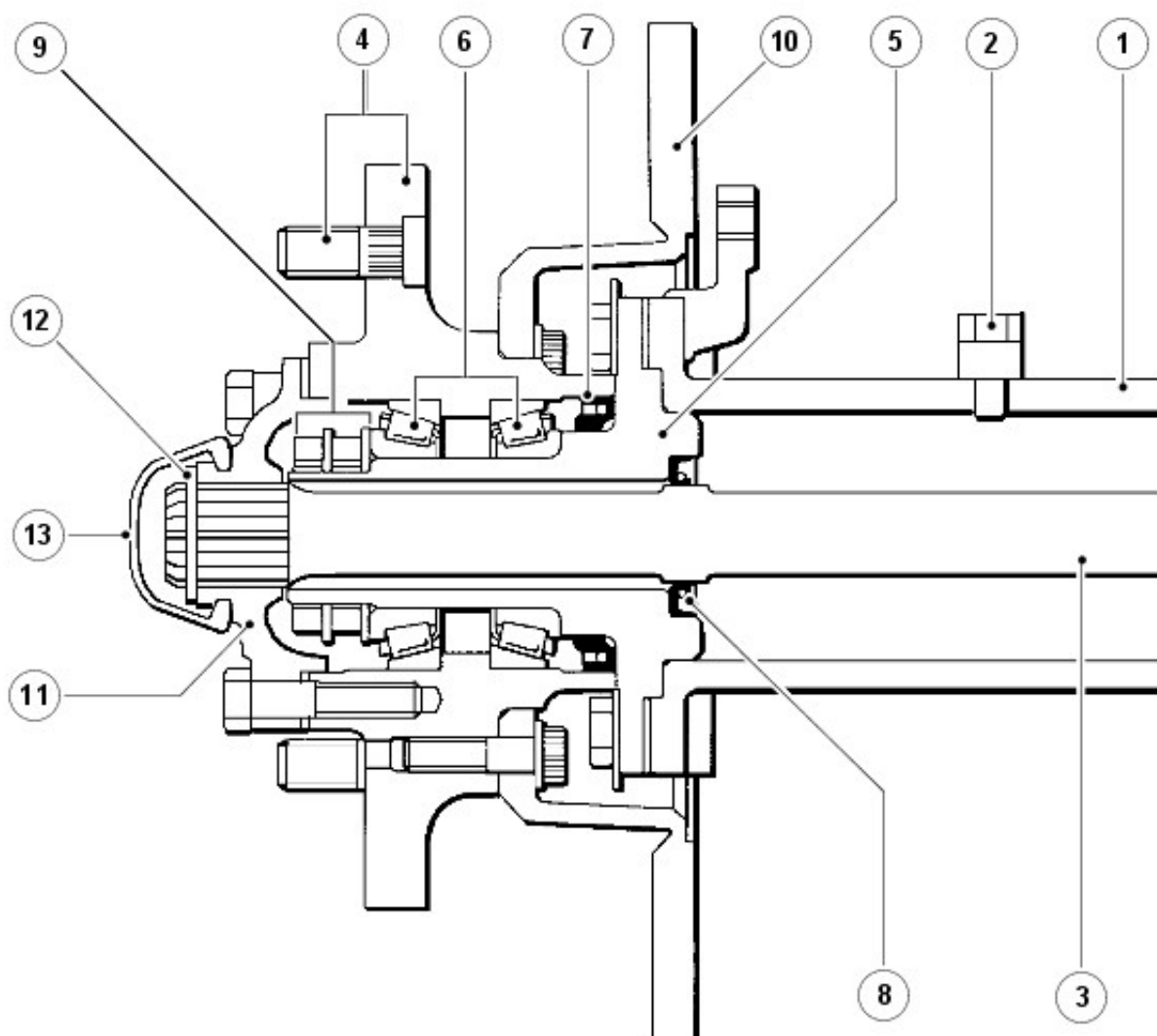
Rear axle hub - 90



J6250A

Item	Part Number	Description
1	-	Axle casing
2	-	Ventilation pipe
3	-	Axle shaft
4	-	Wheel studs and hub
5	-	Wheel bearing stub axle
6	-	Wheel bearings
7	-	Inner hub seal
8	-	Outer hub/axle shaft seal
9	-	Hub lock plate, thrust washer and nuts
10	-	Brake disc

Rear axle hub - 110/130



J6251A

Item	Part Number	Description
1	-	Axle casing
2	-	Ventilation pipe
3	-	Axle shaft
4	-	Wheel studs and hub
5	-	Wheel bearing stub axle
6	-	Wheel bearings
7	-	Inner hub seal
8	-	Outer hub/axle shaft seal
9	-	Hub lock plate, thrust washer and nuts
10	-	Brake disc
11	-	Drive flange
12	-	Drive shaft circlip
13	-	Dust cap

Rear Drive Axle/Differential - Rear Drive Axle and Differential

Diagnosis and Testing

Complaint - Oil leaks

An external leak of lubrication from the hub seals can be caused by a faulty internal seal. For example, if the seals which separate the differential from the hubs are faulty and the vehicle is operating or parked on an embankment, oil from the differential may flood one hub resulting in a lack of lubrication in the differential.

When a seal is found to be leaking check the axle ventilation system, as a blockage can cause internal pressure to force oil past the seals.

Illustrations of oil seal locations are given in Description and Operation.

REFER to: Rear Drive Axle and Differential (205-02, Description and Operation).

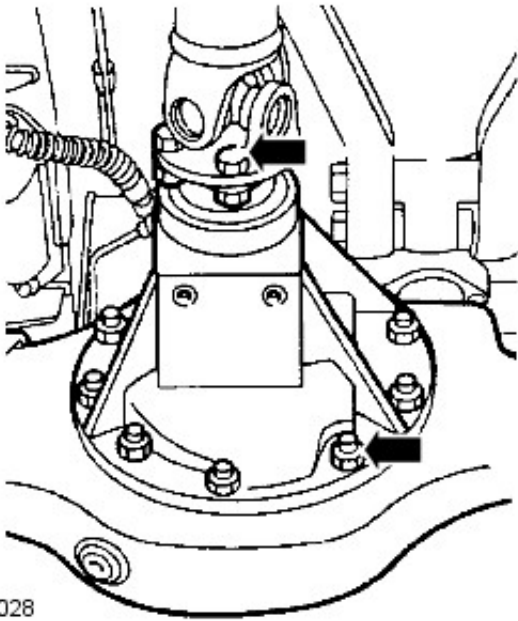
When investigating hub seal leaks check the grease for dilution with oil. Also check the differential oil level, for signs of metal particles in the oil and the condition of internal seals.

If the vehicle is driven in deep water with defective oil seals, water may contaminate the lubricants and raise the differential oil level, giving a false impression that the housing has been over filled. Do not assume that a high oil level in the differential is due to over filling or, that a low level is because of an external leak.

Rear Drive Axle/Differential - Differential Case90

In-vehicle Repair

1. Using suitable container, drain axle oil.
2. Mark differential and propeller shaft flanges to facilitate reassembly.
3. Remove 4 bolts and disconnect propeller shaft from differential. Tie aside.
4. Remove 5 hub drive member bolts and withdraw axle half shafts sufficiently to disengage from differential unit.
5. Remove 10 nuts securing differential to axle case.



51M0028

6. Withdraw differential unit.
7. **NOTE:** The differential unit can only be serviced as a complete assembly with matching drive pinion. For advice ring Land Rover Service Department.

Ensure mating faces are clean and apply a bead of sealant, Part No. STC 3811 to axle case.
8. Support differential unit and position on axle casing.
9. Secure with self locking nuts and tighten to 40 Nm (30lbf.ft).
10. Align marks on flanges and secure propeller shaft to differential. Tighten bolts to 48 Nm (35 lbf.ft).
11. Refit half shafts, using new drive member gaskets. Tighten bolts to 65 Nm (48 lbf.ft).
12. Refill axle oil with approved lubricant.
For additional information, refer to: Specifications (205-02, Specifications).

Rear Drive Axle/Differential - Drive Pinion Seal 110/130

In-vehicle Repair

NOTE: *This procedure is applicable to 110 and 130 models from the following VIN's:

- 110 Non ABS - 638164
- 110 With ABS - 638249
- 110 Heavy Duty and 130, Non ABS - 638224
- 110 Heavy Duty and 130, With ABS - 638134

1. Raise rear of vehicle.



WARNING: Do not work under a vehicle supported only by a jack. Always support the vehicle on safety stands.

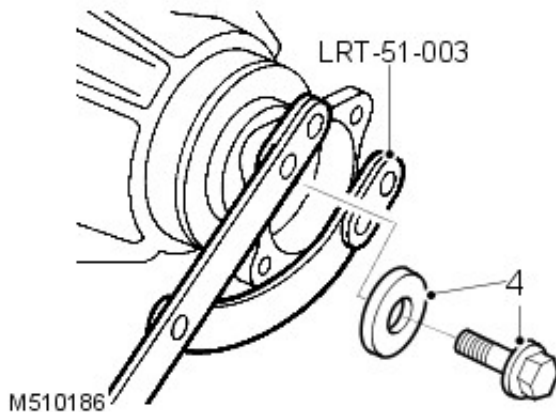
2. Reference mark the propeller shaft flanges for reassembly.

3. Remove 4 nuts and bolts securing propeller shaft to differential housing. Release propeller shaft and tie aside.



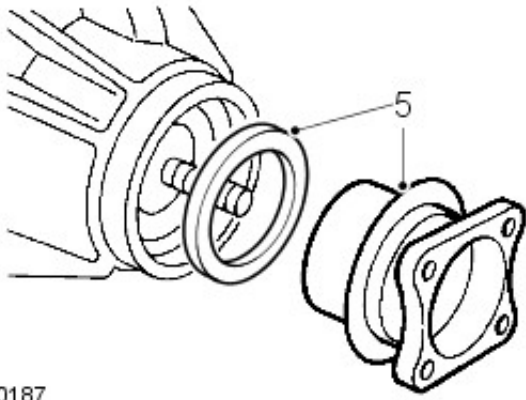
M510185

4. Using LRT-51-003 to restrain the pinion flange, remove bolt securing pinion flange.



5.  **CAUTION:** Take care to avoid damage to oil seal recess.

Remove pinion flange. Position container to catch oil spillage and using a suitable lever, remove and discard pinion oil seal.



M510187

Installation

1. Clean pinion oil seal recess and pinion flange.
2. Lubricate NEW oil seal lip with clean axle oil.
3. Using LRT-51-009 fit pinion oil seal.
4. Fit pinion flange.
5. Restrain flange using LRT-51-003 and fit bolt. Tighten bolt to 100 Nm (74 lbf.ft).
6. Position propeller shaft to differential housing and align reference marks.
7. Fit flange bolts and tighten to 48 Nm (35 lbf.ft).
8. Top-up differential oil level.
9. Remove stands and lower vehicle.

Rear Drive Axle/Differential - Drive Pinion Seal⁹⁰

In-vehicle Repair

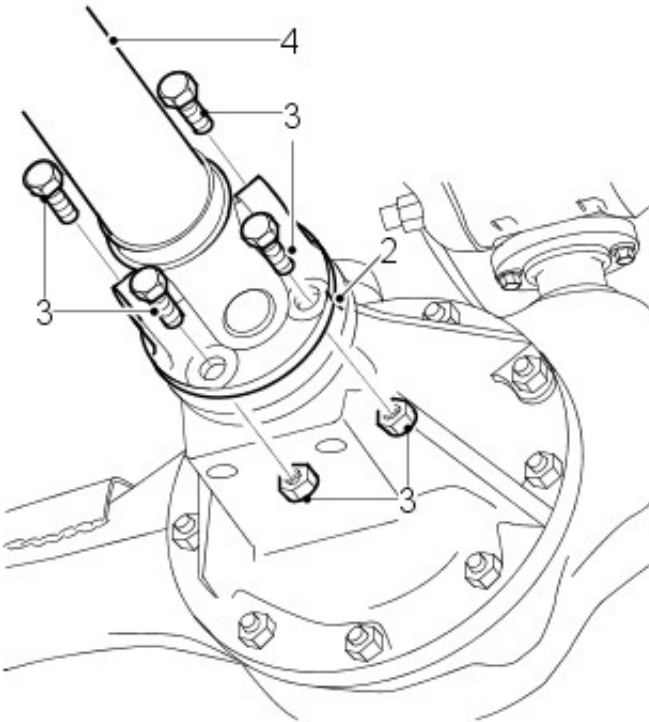
Removal

1. Raise rear of vehicle.



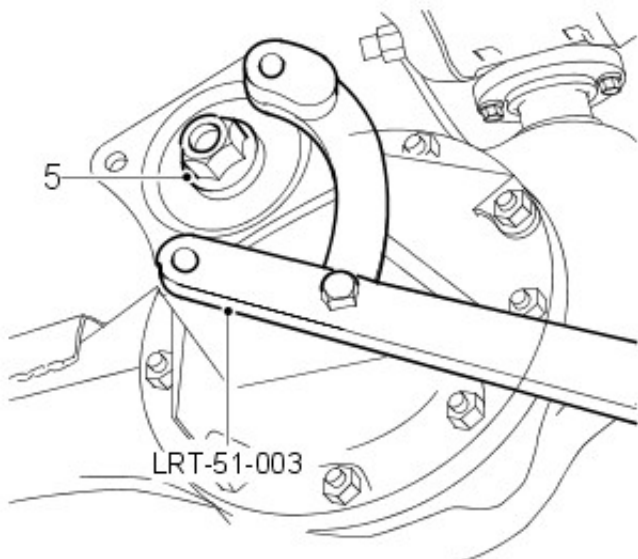
WARNING: Do not work under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Reference mark the propeller shaft flanges for reassembly.
3. Remove 4 nuts and bolts securing propeller shaft to differential housing.
4. Release propeller shaft and tie aside.



51M0048

5. Using LRT-51-003 to restrain the pinion flange, remove bolt securing pinion flange.



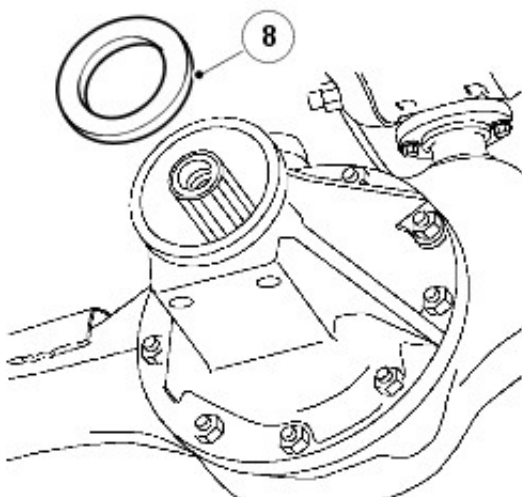
51M0049

6. Remove pinion flange.

7. Position container to catch oil spillage.

8.  **CAUTION:** Take care to avoid damage to oil seal recess.

Using a suitable lever, remove and discard pinion oil seal.



51M0050A

Installation

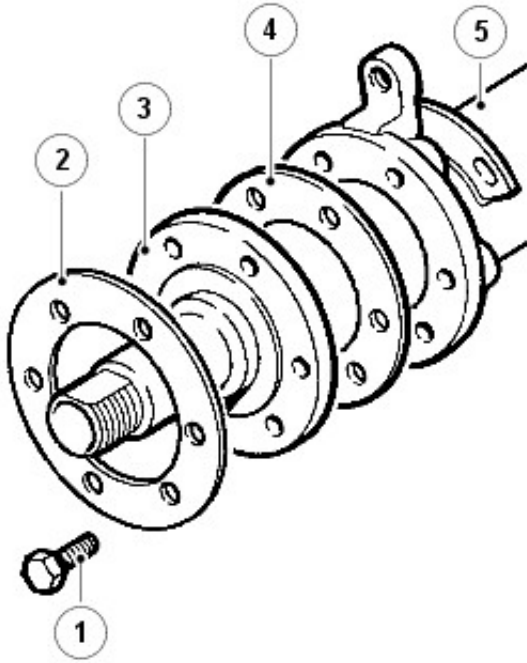
1. Clean pinion oil seal recess and pinion flange.
2. Lubricate NEW oil seal lip with clean oil.
3. Using LRT-51-010 fit pinion oil seal.
4. Clean the mating splines of the pinion flange and the differential pinion shaft.
5. Apply high strength retainer STC50554 to the pinion flange splines.
6. Instal pinion flange.
7. Restrain flange using LRT-51-003 and instal bolt. Tighten bolt to 100 Nm (74 lbf.ft).
8. Position propeller shaft to differential housing and align reference marks.

9. Instal flange bolts and tighten to 48 Nm (35 lbf.ft).
10. Remove stands and lower vehicle.
11. Top-up differential oil level.

Rear Drive Axle/Differential - Stub Shaft Pilot Bearing and Seal90

In-vehicle Repair

Removal



J6263

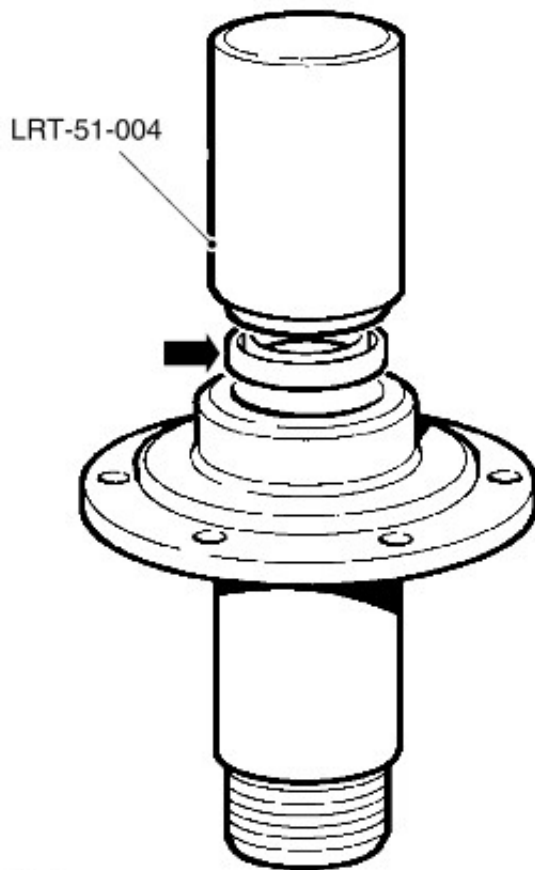
Item	Part Number	Description
1.	-	Stub shaft to axle casing bolt
2.	-	Mud shield
3.	-	Stub shaft
4.	-	Stub shaft gasket
5.	-	Axle case

NOTE: This procedure covers removal and installation of the stub shaft and oil seal.

1. Remove hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - Vehicles Built Up To: 01/1999, 90 (204-02 Rear Suspension, Removal and Installation) / Wheel Bearing and Wheel Hub (204-02 Rear Suspension, Removal and Installation).
2. Remove 6 bolts from stub shaft to axle casing; remove mud shield.
3. Remove stub shaft and gasket.
4. Remove and discard oil seal.

Installation

1. Lubricate replacement seal with EP90 oil. Fit seal, lip side trailing using tool LRT-51-004. Drive seal into housing until it is flush with rear face of stub shaft.



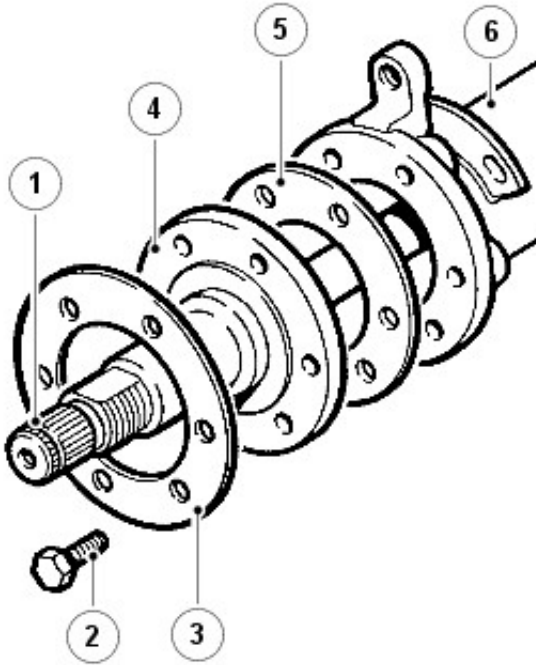
M510181

2. Fit new gasket, stub shaft and mud shield. Fit bolts and tighten to 65 Nm (48 lbf/ft).
3. Refit hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - Vehicles Built Up To: 01/1999, 90 (204-02 Rear Suspension, Removal and Installation) / Wheel Bearing and Wheel Hub (204-02 Rear Suspension, Removal and Installation).

Rear Drive Axle/Differential - Stub Shaft Pilot Bearing and Seal110/130

In-vehicle Repair

Removal



J6265

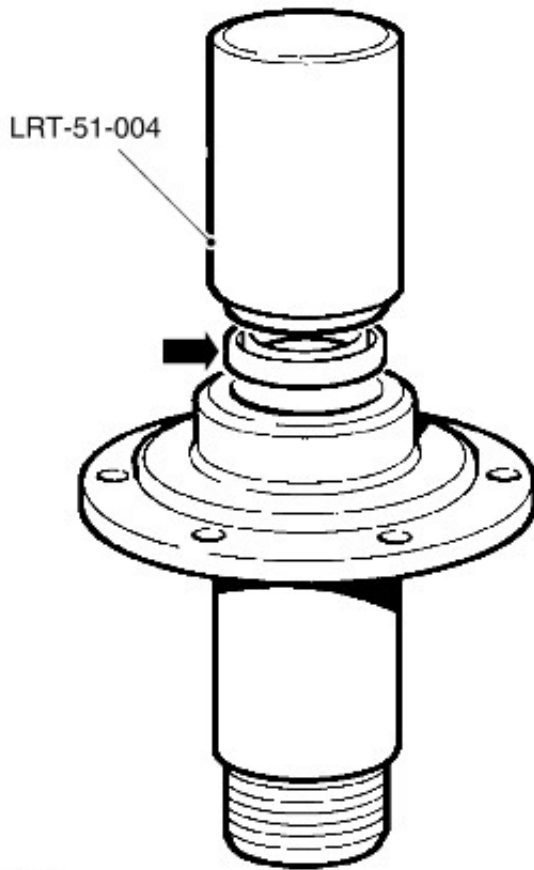
Item	Part Number	Description
1.	-	Stub shaft
2.	-	Stub shaft to axle case bolt
3.	-	Mud shield
4.	-	Stub shaft
5.	-	Stub shaft gasket
6.	-	Axle case

NOTE: This procedure covers removal and installation of the stub shaft and oil seal.

1. Remove hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - Vehicles Built Up To: 01/1999, 110/130 (204-02, Removal and Installation) / Wheel Bearing and Wheel Hub (204-02 Rear Suspension, Removal and Installation).
2. Remove 6 bolts from stub shaft to axle case; remove mud shield.
3. Remove stub shaft and gasket.
4. Remove axle shaft from axle case.
5. Remove and discard oil seal.

Installation

1. Lubricate replacement seal with EP90 oil. Fit seal, lip side trailing using tool LRT-51-004 until seal is flush with rear face of stub shaft.



M510181

2. Fit new gasket, stub shaft and mud shield. Fit bolts and tighten to 65 Nm (48 lbf/ft).
3. Fit axle shaft to axle case, avoid damaging stub shaft seal.
4. Refit hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - Vehicles Built Up To: 01/1999, 110/130 (204-02, Removal and Installation) / Wheel Bearing and Wheel Hub (204-02 Rear Suspension, Removal and Installation).

Rear Drive Axle/Differential - Axle Assembly

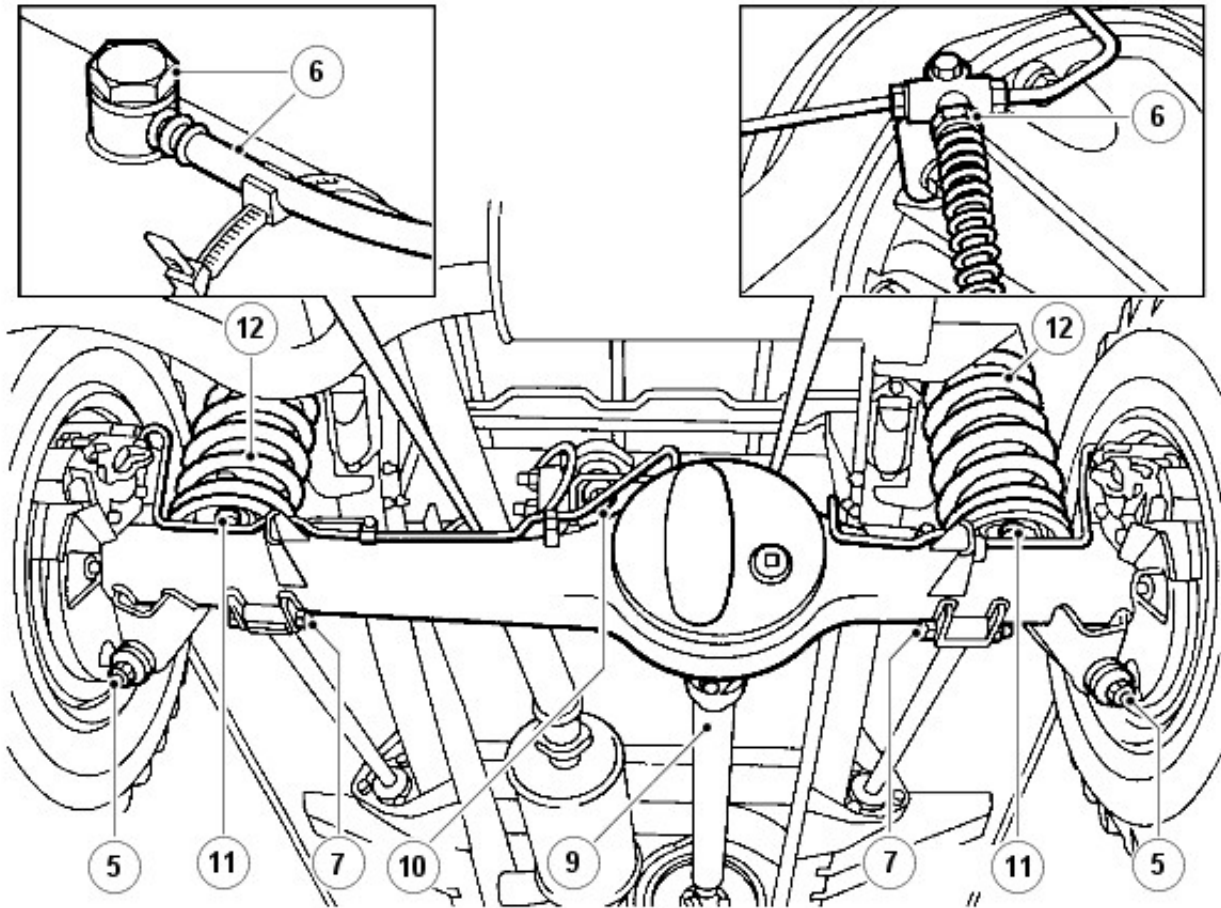
Removal and Installation

Removal



WARNING: Remove and refit of axle requires a further two persons to steady the axle when lowering or repositioning axle.

1. Drain brake system.



J6252

2. Support chassis rear.
3. Remove road wheels.
4. Support axle weight with hydraulic jack.
5. Disconnect shock absorbers.
6. Disconnect flexible brake hose at RH chassis side member and breather hose at banjo connection on axle casing.
7. Disconnect lower links at axle.
8. Mark differential and propeller shaft flanges with identification marks for assembly.
9. Remove 4 nuts and bolts, lower propeller shaft and tie to one side.
10. Disconnect pivot bracket ball joint at axle bracket.
11. Release bolts and remove coil spring retaining plates.
12. Lower axle and remove road springs.

13. If applicable, remove stabilizer bar links at axle.
For additional information, refer to: Stabilizer Bar (204-02, Removal and Installation).
14. Remove axle assembly.

Installation

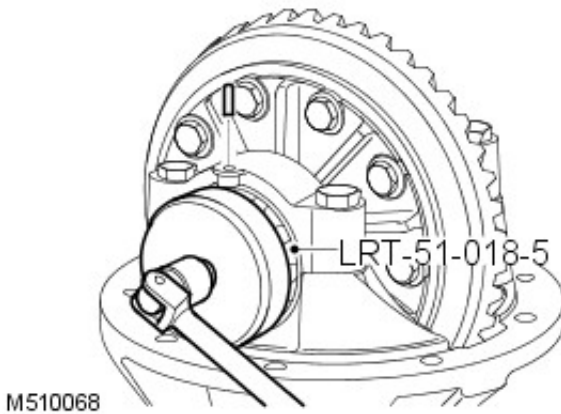
1. Position axle and fit lower links. Tighten fixings to 176 Nm (130 lbf/ft).
2. If applicable, fit stabilizer bar links to axle.
For additional information, refer to: Stabilizer Bar (204-02, Removal and Installation).
3. Raise axle and locate road springs.
4. Fit coil spring retaining plates and secure with fixing bolts.
5. Secure pivot bracket ball joint to axle bracket. Tighten fixing to 176 Nm (130 lbf/ft).
6. Align propeller shaft to differential drive flange and tighten fixings to 47 Nm (35 lbf/ft).
7. Reconnect flexible brake hose and axle breather hose.
8. Refit shock absorbers.
9. Fit road wheels and tighten to correct torque: Alloy wheels - 130 Nm (96 lbf/ft) Steel wheels - 100 Nm (80 lbf/ft) Heavy Duty wheels - 170 Nm (125 lbf/ft)
10. Remove rear chassis support.
11. Bleed brake system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).

Rear Drive Axle/Differential - Axle90/110

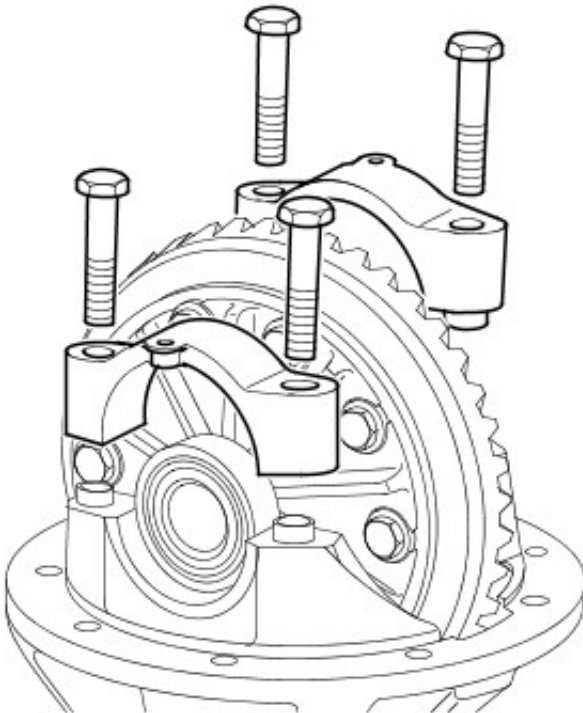
Disassembly and Assembly

Disassembly

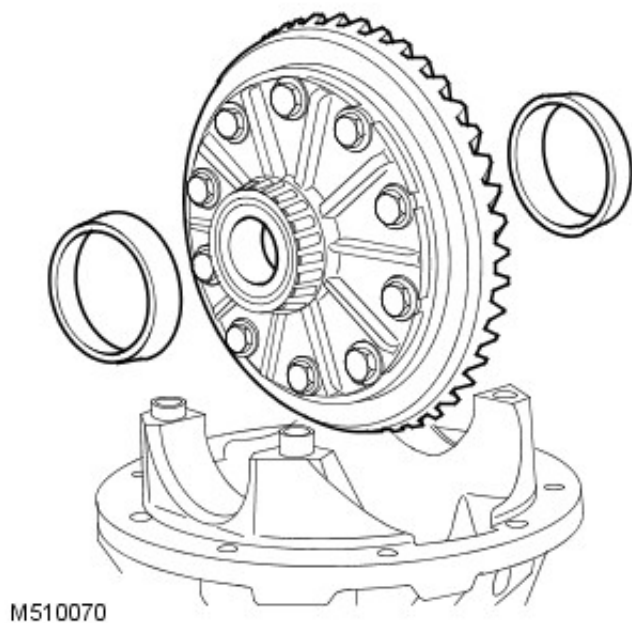
1. **NOTE:** *This procedure is only applicable to 110 models up to the following VIN's:
 - o 110 Non ABS - 638163
 - o 110 With ABS - 638248Remove differential assembly.
2. Secure differential assembly in a vice or stand.
3. Remove roll pins securing adjusting nuts, using LRT 51-018/5 loosen adjusting nuts.



4. Reference mark bearing caps to aid assembly.
5. Remove bolts securing bearing caps and remove caps.

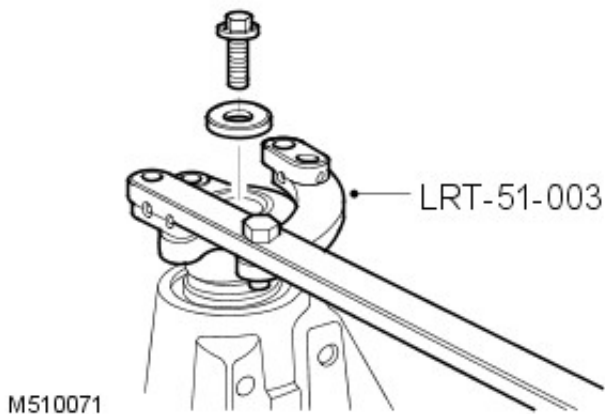


6. Remove crown wheel assembly and collect bearing outer tracks.



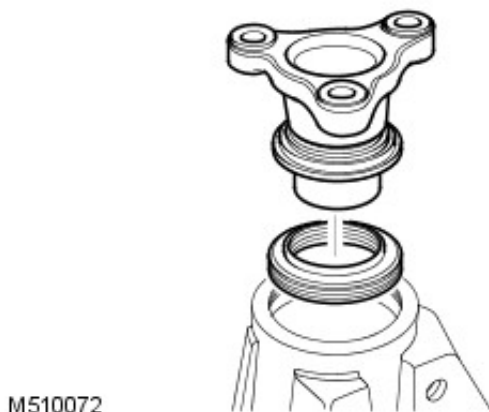
7. Mark outer tracks to bearings to aid assembly, if bearings are to be re-used.

8. Using LRT-51-003 to restrain pinion flange remove bolt and collect washer.



9. **NOTE:** Older front differentials have a square flange and an extra spacer fitted, this spacer must be removed. Later front differentials have a round flange but no spacer fitted.

Remove pinion flange



10.  **CAUTION:** Take care to avoid damage to oil seal recess.

Using a lever, remove pinion oil seal.

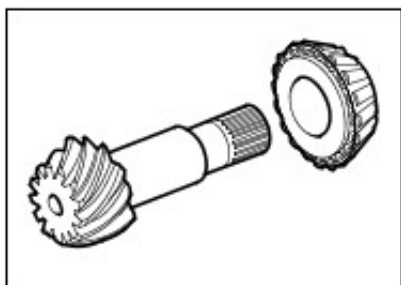
11. Carefully tap pinion from housing, collect pinion and tail bearing.

M510073

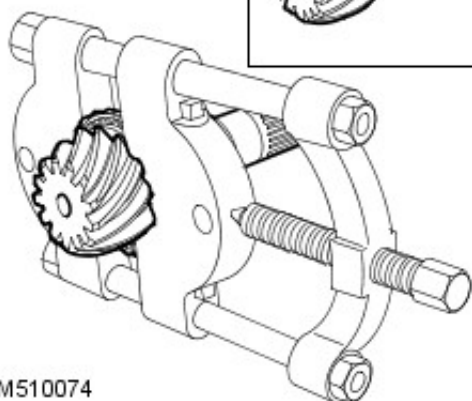


12. Remove pinion tail bearing shim and record shim size.

13. Using a puller, remove pinion head bearing.

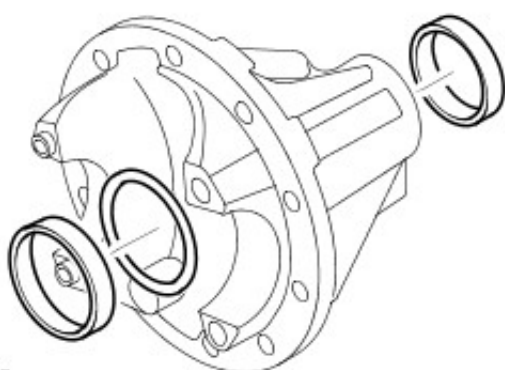


M510074



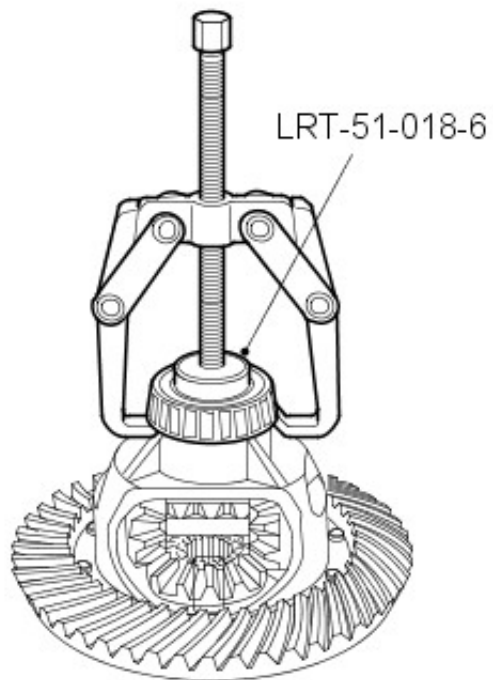
14. Remove pinion bearing races.

M510075



15. Remove pinion head bearing shim and record shim size.

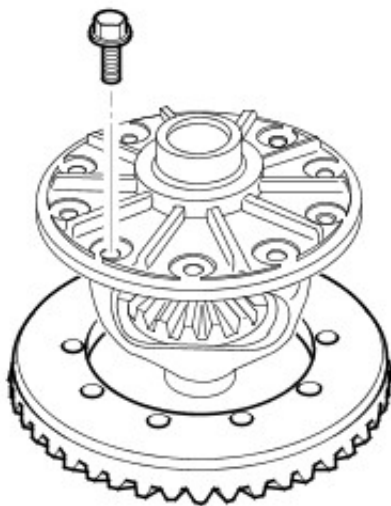
16. Using a two legged puller and LRT 51-018/6, remove the differential bearings.



M510076

17. Secure the crown wheel assembly in a vice.

18. Remove and discard 10 bolts securing the crown wheel to carrier.

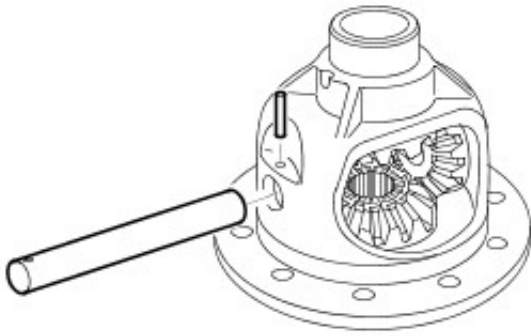


M510077

19. Carefully remove the crown wheel from the carrier.

20. **NOTE:** For vehicles with a 4mm roll pin.

Remove and discard roll pin securing carrier cross shaft and remove cross shaft.

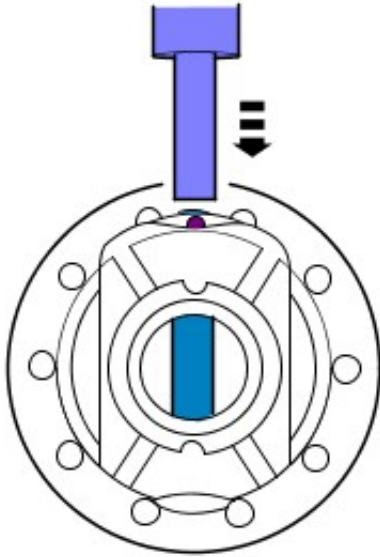


M510078

21. **NOTE:** For vehicles with 6mm roll pin.

Press out the cross shaft and shear the pin.

- Secure the planetary gear housing in the press using suitable V blocks and press out the cross shaft.

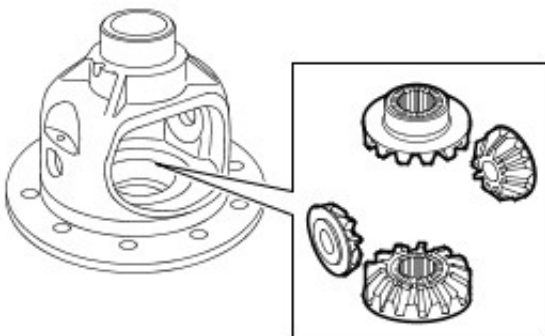


E131980

22. Rotate gears to the open part of carrier and remove planet gears.

23. **NOTE:** If the planetary gear housing has been fitted with a 4mm roll pin hole for the cross shaft, discard the planetary gear housing and replace it with one with a 6mm roll pin hole.

Remove sun gears.

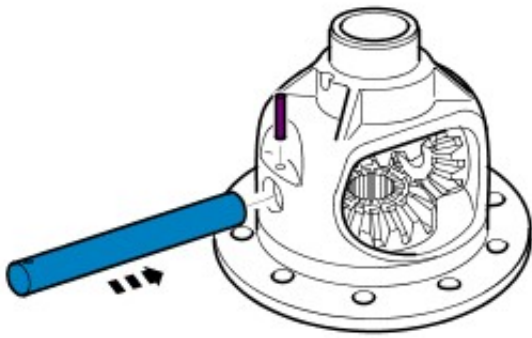


M510079

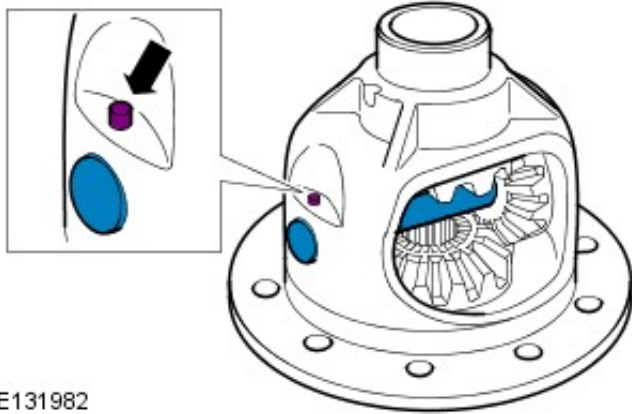
24. Clean and inspect all components for wear and damage.

Assembly

1. Instal planet gears and rotate to align cross shaft holes.
2. Instal cross shaft, ensure roll pin hole is aligned.



E131981

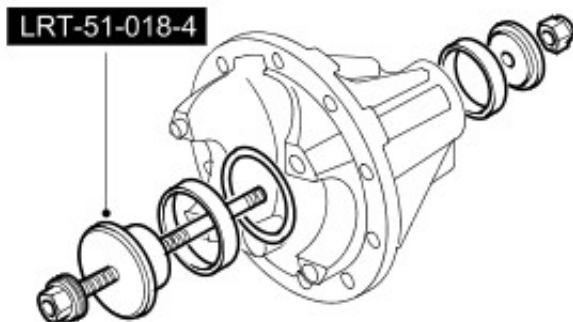


E131982

3. **NOTE:** Press the roll pin fully into the planetary gear housing (approximately 8-10mm will protrude from the housing when correctly installed).

Press the pin into the planetary gear housing.

4. Secure cross shaft with new roll pin.
5. Instal crown wheel to carrier, instal new bolts and tighten to 60 Nm (44 lbf.ft).
6. Ensure original head bearing shim is clean and free from burrs and instal under bearing race.
7. Ensure pinion bearing cup recesses are clean and free of burrs and using LRT 51-018-4 instal pinion head and tail bearing races.



M510105A

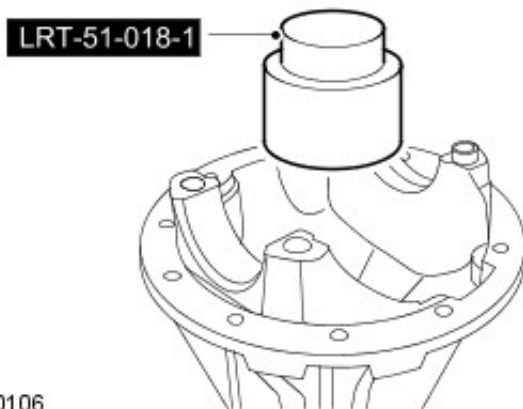
8. Instal pinion head bearing to pinion.
9. Lubricate bearings with thin oil.
10. Ensure original tail bearing shim is clean and free from burrs and instal under bearing race.
11. Instal pinion and pinion tail bearing.
12. Instal pinion flange, washer and bolt.
13. Use LRT-51-003 to restrain pinion flange.
14. Tighten pinion flange bolt to 100 Nm (74 lbf.ft).

2. Tighten pinion flange bolt to 100 Nm (74 lbf.ft).

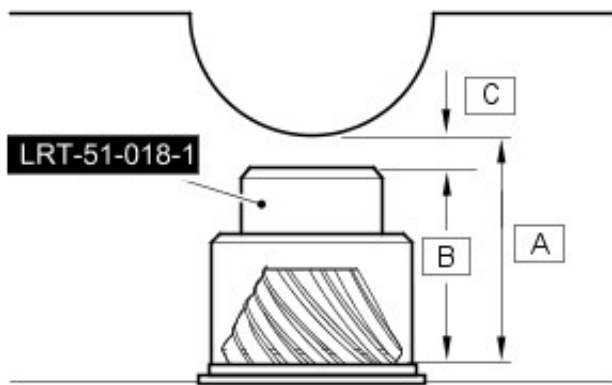
15. Check pinion for end float. Should read zero.
16. Rotate pinion several times to settle bearings, check pinion torque to turn. Torque to turn should be recorded during pinion rotation. Pinion torque to turn should be 4 to 6 Nm (3 to 4.5 lbf.ft).
17. **NOTE: To increase torque to turn, instal narrower spacer; to decrease torque to turn instal wider spacer.**

Adjust size of tail bearing shim to obtain correct pinion torque to turn, (0.025 mm = 1 Nm (0.001' = 0.7 lbf.ft) approx).
18. Position LRT-51-018/7 on surface plate, establish zero and reference DTI.
19. Ensure pinion height setting block, setting gauge and mating faces are clean and free from burrs.

20. Locate setting block LRT 51-018/1 over pinion head, ensure it is fully seated in position.



M510106

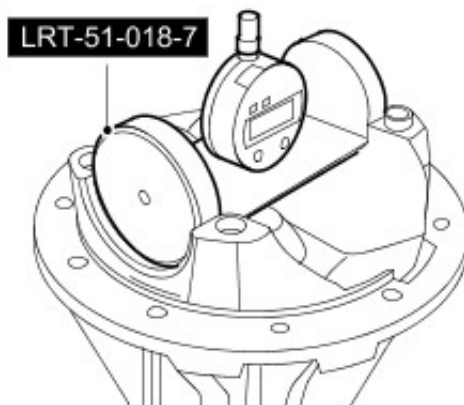


M510116

21. **CAUTION: Setting block height must be checked using figures on side of block.**

Pinion height setting procedure: 'C' = 'A' - 'B'. Subtract nominal pinion height 'A' from setting block height 'B' (on side of setting block). Example: 74.390 - 73.130 = 1.26 mm (2.929' - 2.88' = 0.049') Therefore pinion head height reading is 1.260 mm \pm 0.025 mm (0.049' \pm 0.001').

1. 'A' = Nominal pinion height setting, 74.390
2. 'B' = Setting block height.
3. 'C' = Head height setting.

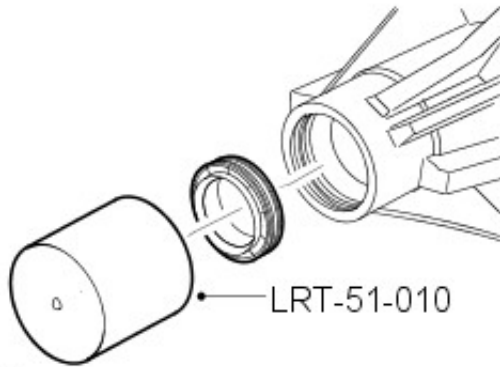


M510082

22. Align setting gauge LRT-51-018/7 to setting block, rock gauge to obtain minimum reading. If reading is lower than required reading, decrease shim size. If reading is higher than required reading, increase shim size.

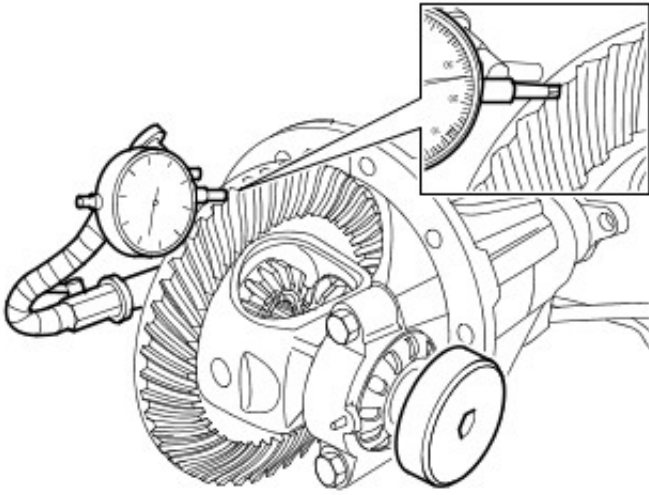
23. Using LRT-51-003 to restrain pinion flange, remove bolt and washer. Remove pinion flange.

24. Remove pinion, collect tail bearing and tail bearing shim.
25. Remove pinion head bearing outer race and shim. Discard shim. Ensure bearing race recess is clean and free from burrs.
26. Instal calculated shim, and using LRT-51-018-4 instal head bearing outer race.
27. Instal pinion, pinion tail bearing and tail bearing shim.
28. Instal pinion flange and bolt and washer. Using LRT-51-003 to restrain pinion flange, tighten bolt to 100 Nm (74 lbf.ft).
29. Rotate pinion in both directions to settle bearings.
30. Recheck pinion torque to turn, adjust if necessary.
31. Recheck pinion head height.
32. Using LRT-51-003 to restrain pinion flange, remove bolt and washer. Remove pinion flange.
33. Discard bolt.
34. Using LRT-51-010 instal pinion seal.



M510086

35. Ensure spacer and tail bearing are correctly located.
36. Instal pinion, pinion flange and washer.
37. Instal new pinion flange bolt and tighten to 100 Nm (74 lbf.ft).
38. Lightly oil differential bearings.
39. Ensure spring dowels are fitted in bearing caps.
40. Instal differential bearing outer races and locate differential assembly into housing.
41. Instal bearing caps and tighten bolts to 10 Nm (7.5 lbf.ft).
42. Instal adjusting nuts, tighten crown wheel side nut to 22 Nm (16 lbf.ft). Ensure opposing nut is loose.



M510084

43. Position DTI to check crown wheel backlash. Adjust opposing nut to obtain correct crown wheel backlash.

44. Rotate pinion in both directions to settle bearings.

45. **NOTE: Crown wheel backlash should be within 0.076 mm to 0.177 mm (0.003 in to 0.007 in).**

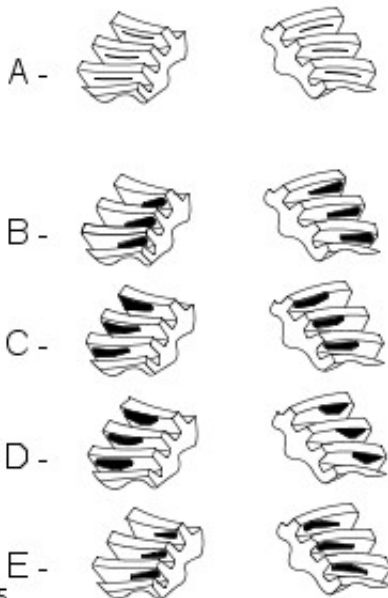
Measure in 3 places to obtain correct crown wheel backlash.

46. Align adjusting nuts to next roll pin slot, do not loosen nuts to align slots.

47. Tighten bearing cap bolts to 90 Nm (66.5 lbf.ft).

48. Secure adjusting nuts with new roll pins.

49. Apply Prussian Blue to crown wheel teeth to check tooth contact.



M510085

50. **NOTE: Note assembly torque to turn when checking tooth contact. Total torque to turn should not exceed 10.85 Nm (8 lbf.ft).**

Rotate pinion several times to obtain full tooth contact.

1. **A = Normal pattern:** The drive pattern should be centered on the gear teeth. The coast pattern should be centered on the gear teeth but may be towards the toe. There should be some clearance between the pattern and the top of the gear

teeth.

2. **B = Backlash incorrect:** Thinner pinion shim required.
3. **C = Backlash incorrect:** Thicker pinion shim required.
4. **D = Pinion shim incorrect:** Decrease backlash.
5. **E = Pinion shim incorrect:** Increase backlash.

51. Instal differential assembly.

Rear Drive Axle/Differential - Axle110/130

Disassembly and Assembly

Disassembly

1. **NOTE:** *This procedure is applicable to 110 and 130 models from the following VIN's:

- o 110 Non ABS - 638164
- o 110 Heavy Duty and 130, Non ABS - 638224
- o 110 Heavy Duty and 130, With ABS - 638134

Remove differential assembly.

2. Secure differential assembly in a vice or stand.

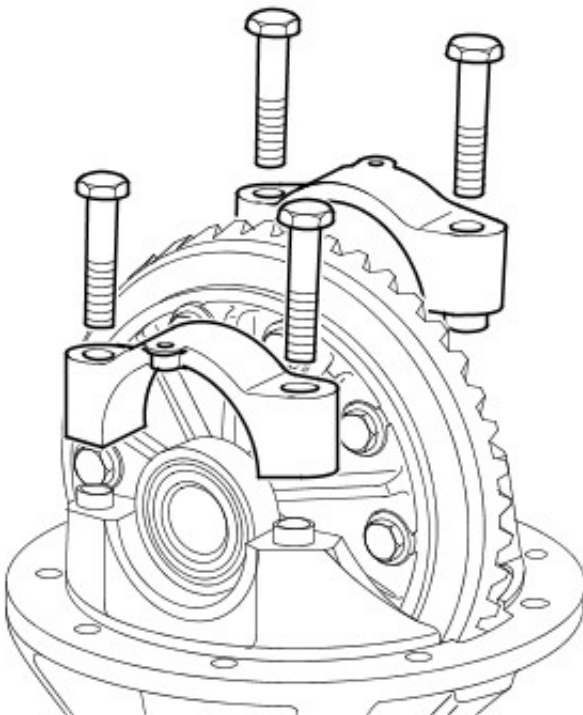
3. Remove roll pins securing adjusting nuts, using LRT 51-018/5 loosen adjusting nuts.



M510068

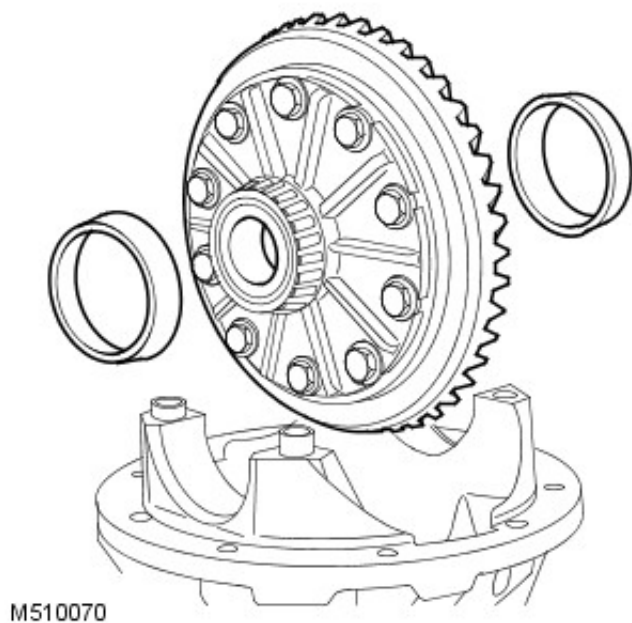
4. Reference mark bearing caps to aid assembly.

5. Remove 4 bolts securing bearing caps and remove caps.



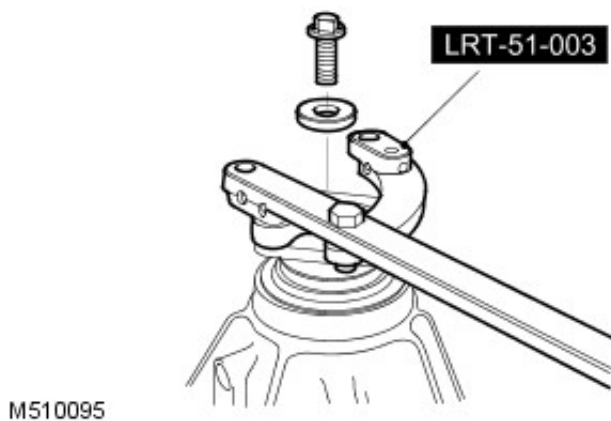
M510069

6. Remove crown wheel assembly and collect bearing outer tracks.



7. Mark outer bearing tracks if bearings are to be re-used.

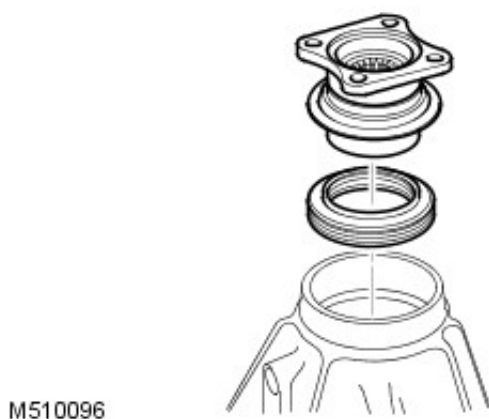
8. Using LRT-51-003 to restrain pinion flange remove bolt and collect washer.



9. **NOTE:** Older front differentials have a square flange and an extra spacer fitted, this spacer must be removed. Later front differentials have a round flange but no spacer fitted.

Remove pinion flange

10. Using a lever, remove pinion oil seal.



CAUTION: Take care to avoid damage to oil seal recess.

11. Carefully tap pinion from housing, collect pinion and tail bearing.

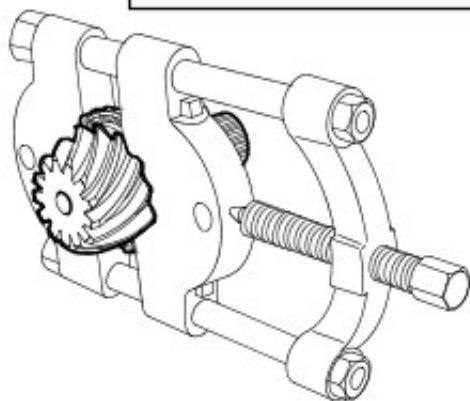
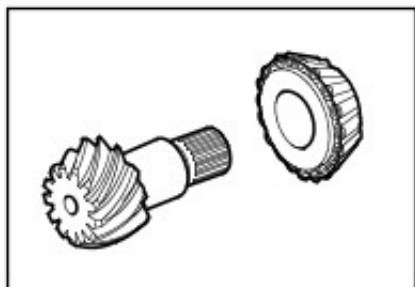
12. Remove pinion tail bearing spacer and record spacer size.



M510097

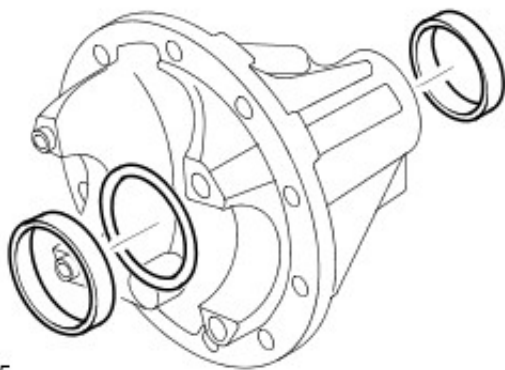
 **CAUTION:** Do not discard spacer at this stage.

13. Using a bearing puller, remove pinion head bearing, if bearing is to be replaced.



M510098

14. Remove pinion head and tail bearing tracks.

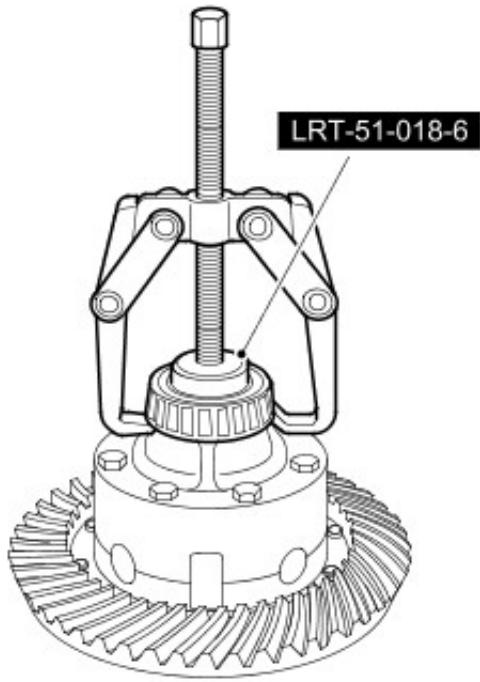


M510075

15. Remove pinion head bearing shim and record shim size.

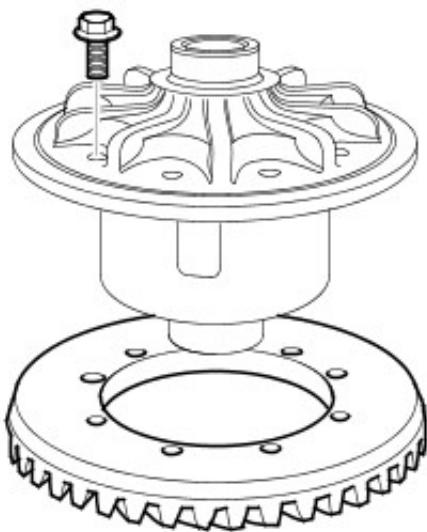
16. Using a two legged puller and IRT 51-018/6, remove

16. Using a threaded panel and LRT-51-018-6, remove the differential bearings.



M510099

17. Secure the crown wheel assembly in a vice.
18. Reference mark position of crown wheel to carrier to aid assembly.
19. Remove and discard 10 bolts securing the crown wheel to the carrier.



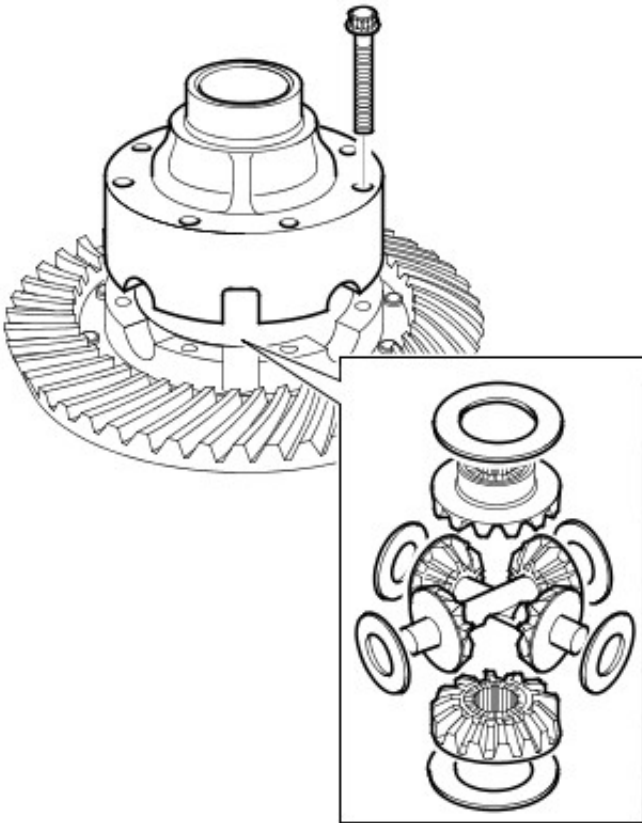
M510100

20. Carefully remove the crown wheel from the carrier.

20. Carefully remove the crown wheel from the carrier.

21. Reference mark position of differential casing to aid assembly.

22. Remove 8 bolts securing differential gear upper casing and remove casing.



M510188

23. Remove upper sun gear, recover shim.

24. Noting their fitted position, remove planet gears, cross pins; recover spherical washer from each planet gear.

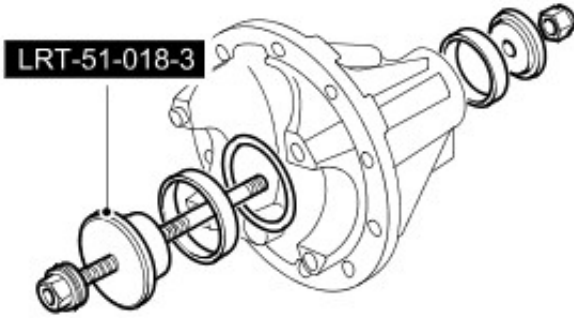
25. Remove lower sun gear from differential gear lower casing, recover shim.

26. Clean and inspect all components for wear and damage.

Assembly

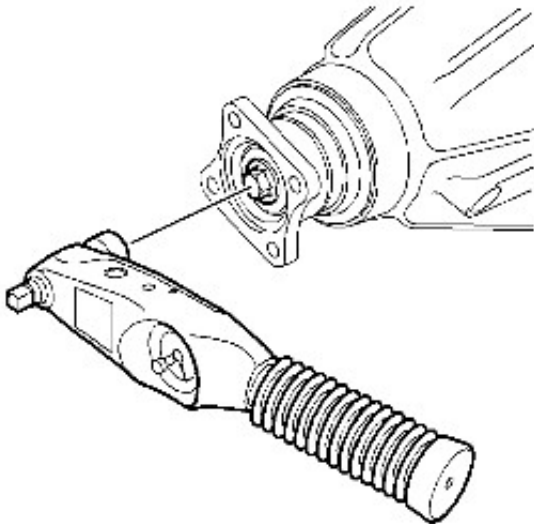
1. Lubricate sun and planet gears, spherical washers, shims and cross pins.
2. Fit shim to lower sun gear and fit sun gear to differential gear lower casing.
3. Fit all planet gears, cross shafts and spherical washers into lower casing. Ensure gears and cross shafts are fully engaged.
4. Fit shim to upper sun gear, position upper sun gear to planet gears ensuring full teeth engagement.
5. Ensuring differential gear casing reference marks are aligned, position differential gear upper casing. Fit bolts and tighten progressively by diagonal selection to 32 Nm (24 lbf.ft).
6. Fit crown wheel to carrier ensuring reference marks are aligned, fit new bolts and tighten progressively to 60 Nm (44 lbf.ft).
7. Ensure original pinion head bearing shim is clean and free from burrs, fit shim in bearing outer track recess.

8. Using LRT-51-018/3 fit pinion head and tail bearing outer tracks.



M510080A

9. Lubricate bearings with thin oil.
10. Fit pinion head bearing to pinion.
11. Fit pinion into pinion housing and hold in place.
12. Ensure original spacer is clean and free from burrs, fit to pinion shaft ensuring that groove in spacer is facing towards drive flange. Push spacer hard against pinion head bearing.
13. Fit pinion tail bearing.
14. Fit pinion flange, washer and bolt.
15. Use LRT-51-003 to restrain pinion flange.
16. Tighten pinion flange bolt to 100 Nm (74 lbf.ft).
17. Check pinion for end float. Should read zero.
18. Rotate pinion several times to settle bearings, check pinion torque to turn. Torque to turn should be recorded during pinion rotation. Pinion torque to turn should be 4 to 6 Nm (3 to 4.5 lbf.ft).



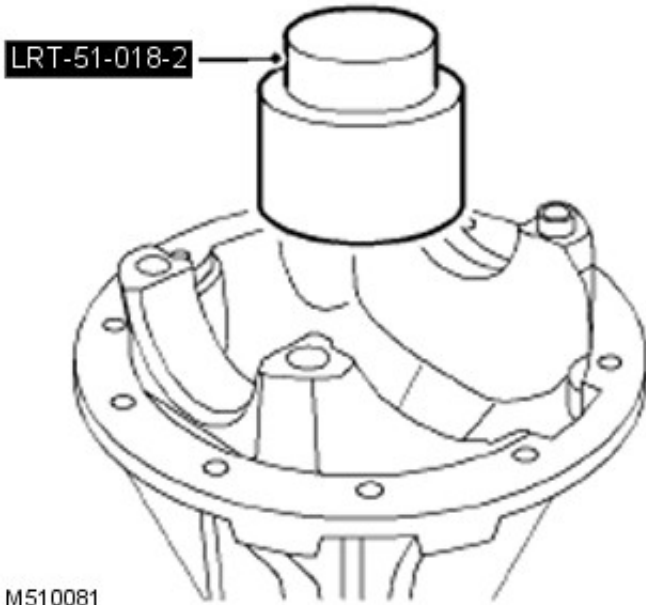
M510102

19. Adjust size of tail bearing spacer to obtain correct pinion torque to turn (0.025 mm = 1 Nm (0.001' = 0.7 lbf.ft) approx).

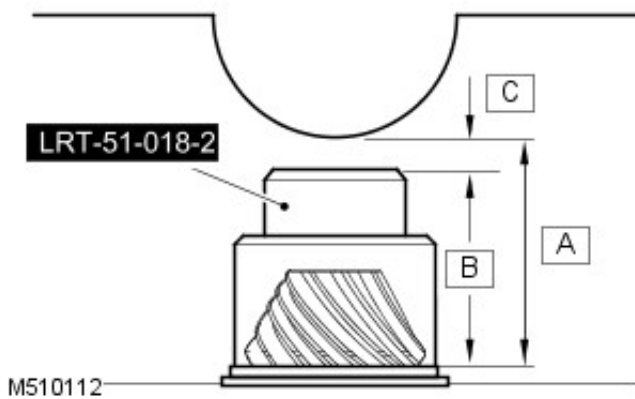
NOTE: To increase torque to turn, fit narrower spacer; to decrease torque to turn fit wider spacer.


20. Position LRT-51-018/7 on surface plate, secure DTI with grub screw, establish zero and reference DTI.
21. Ensure pinion height setting block, setting gauge and mating faces are clean and free from burrs.

22. Locate setting block LRT- 51-018/2 over pinion head, ensure it is fully seated in position.

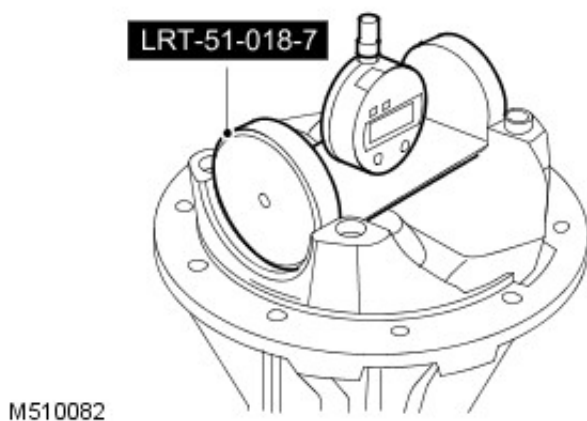


23. Pinion height setting procedure: 'C' = 'A' - 'B'. Subtract nominal pinion height 'A' from setting block height 'B' (on side of setting block) Example: $76.04 - 74.7 = 1.34$ mm ($2.993' - 2.941' = 0.053'$). Therefore pinion head height reading is 1.34 mm \pm 0.025 mm ($0.053' \pm 0.001'$).
1. 'A' = Nominal pinion height setting, 76.04.
 2. 'B' = Setting block height.
 3. 'C' = Head height setting.



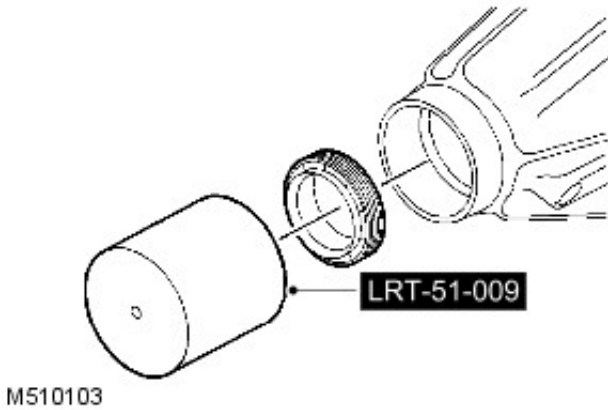
 **CAUTION:** Setting block height must be checked using figures on side of block.

24. Align setting gauge LRT-51-018-7 to setting block, rock gauge to obtain minimum reading. If reading is lower than required reading, decrease shim size. If reading is higher than required reading, increase shim size.

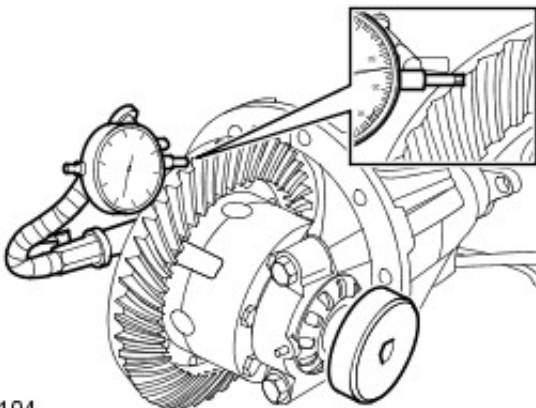


25. Using LRT-51-003 to restrain pinion flange, remove bolt and washer. Remove pinion flange.
26. Remove pinion, collect tail bearing and tail bearing spacer.
27. Remove pinion head bearing outer track and shim, discard shim. Ensure bearing track recess is clean and free from burrs.
28. Fit calculated shim and using LRT-51-018/3, fit pinion head bearing outer track.

29. Fit pinion, spacer and pinion tail bearing.
30. Fit pinion flange, bolt and washer. Using LRT-51-003 to restrain pinion flange, tighten bolt to 100 Nm (74 lbf.ft).
31. Rotate pinion in both directions to settle bearings.
32. Recheck pinion torque to turn, adjust if necessary.
33. Recheck pinion head height.
34. Using LRT-51-003 to restrain pinion flange, remove bolt and washer. Remove pinion flange.
35. Discard bolt.
36. Using LRT-51-009, fit pinion seal.



37. Ensure spacer and tail bearing are correctly located.
38. Fit pinion, flange and washer.
39. Fit new pinion flange bolt and tighten to 100 Nm (74 lbf.ft).
40. Lightly oil differential bearings.
41. Ensure dowels are fitted in bearing caps.
42. Fit differential bearing outer races and locate differential assembly into housing.
43. Fit bearing caps and tighten bolts to 10 Nm (7.5 lbf.ft).
44. Fit adjusting nuts, tighten crown wheel side nut to 22 Nm (16 lbf.ft). Ensure opposing nut is loose.
45. Position DTI to check crown wheel backlash. Adjust opposing nut to obtain correct crown wheel backlash.



46. Rotate crown wheel in both directions to settle bearings.
47. Measure crown wheel backlash in 2 positions and adjust as required.

47. Measure crown wheel backlash in 3 positions , adjust as required.

NOTE: Crown wheel backlash should be within 0.076 mm to 0.177 mm (0.003 in to 0.007 in).

48. Align adjusting nuts to next roll pin slot, do not loosen nuts to align slots.

49. Tighten bearing cap bolts to 180 Nm (133 lbf.ft).

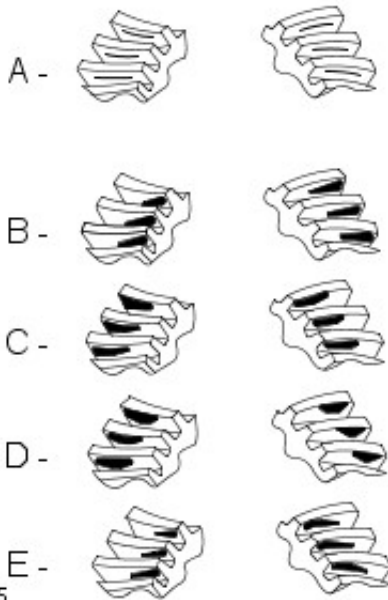
50. Secure adjusting nuts with new roll pins.

51. Apply Prussian Blue to crown wheel teeth to check tooth contact.

52. NOTE: Note assembly torque to turn when checking tooth contact. Total torque to turn should not exceed 10.85 Nm (8 lbf.ft).

Rotate pinion several times to obtain full tooth contact.

1. **A = Normal pattern:**The drive pattern should be centered on the gear teeth. The coast pattern should be centered on the gear teeth but may be towards the toe. There should be some clearance between the pattern and the top of the gear teeth.
2. **B = Backlash correct:**Thinner pinion shim required.
3. **C = Backlash correct:**Thicker pinion shim required.
4. **D = Pinion shim correct:**Decrease backlash.
5. **E = Pinion shim correct:**Increase backlash.



M510085

53. Fit differential assembly.

Front Drive Axle/Differential -

Front axle	
Type	Spiral bevel, enclosed constant velocity joints, fully floating shafts
Ratio	3.54:1
Angularity of universal joint on full lock	32°

Sealers

Front axle and final drive	Land Rover Part No.
Hub retaining bolts	STC 50552
Swivel bearing housing to axle casing bolts	STC 50552
Stub axle bolts	STC 50552
Swivel pin housing grease	STC 3435*

*Swivel pin grease used on later vehicles with filler plug only in swivel pin housing

Lubricants

Item	Specification / Land Rover part number
Final drive	Molytex EP90
Swivel pin	Molytex EP90 OR 80

Do not use any lubricant other than that specified

Capacities

Item	Capacity
Front differential	1.70 litres (3.00 pints) (1.80 US quarts)
Swivel pin housing oil/grease (each)	0.35 litres (0.60 pints) (0.37 US quarts)

Torque Specifications

Description	Nm	lb-ft
Hub driving member to hub	65*	48
Brake disc to hub	73	53
Stub axle to swivel pin housing	65*	48
Brake caliper to swivel pin housing	82	61
Upper swivel pin to swivel pin housing	65*	48
Lower swivel pin to swivel pin housing	25*	18
Oil seal retainer to swivel pin housing	11	8
Swivel bearing housing to axle case	73*	53
Pinion housing to axle case	41	30
Crown wheel to differential housing	58	43
Differential bearing cap to pinion housing	90	65
Differential drive flange to drive shaft	47	34
Mudshield to bracket lower swivel pin	11	8
Bevel pinion nut	130	
Draglink to hub arm	40	30
Panhard rod to axle bracket	88	65
Radius arm to axle	190	140
Radius arm to chassis side member	190	140

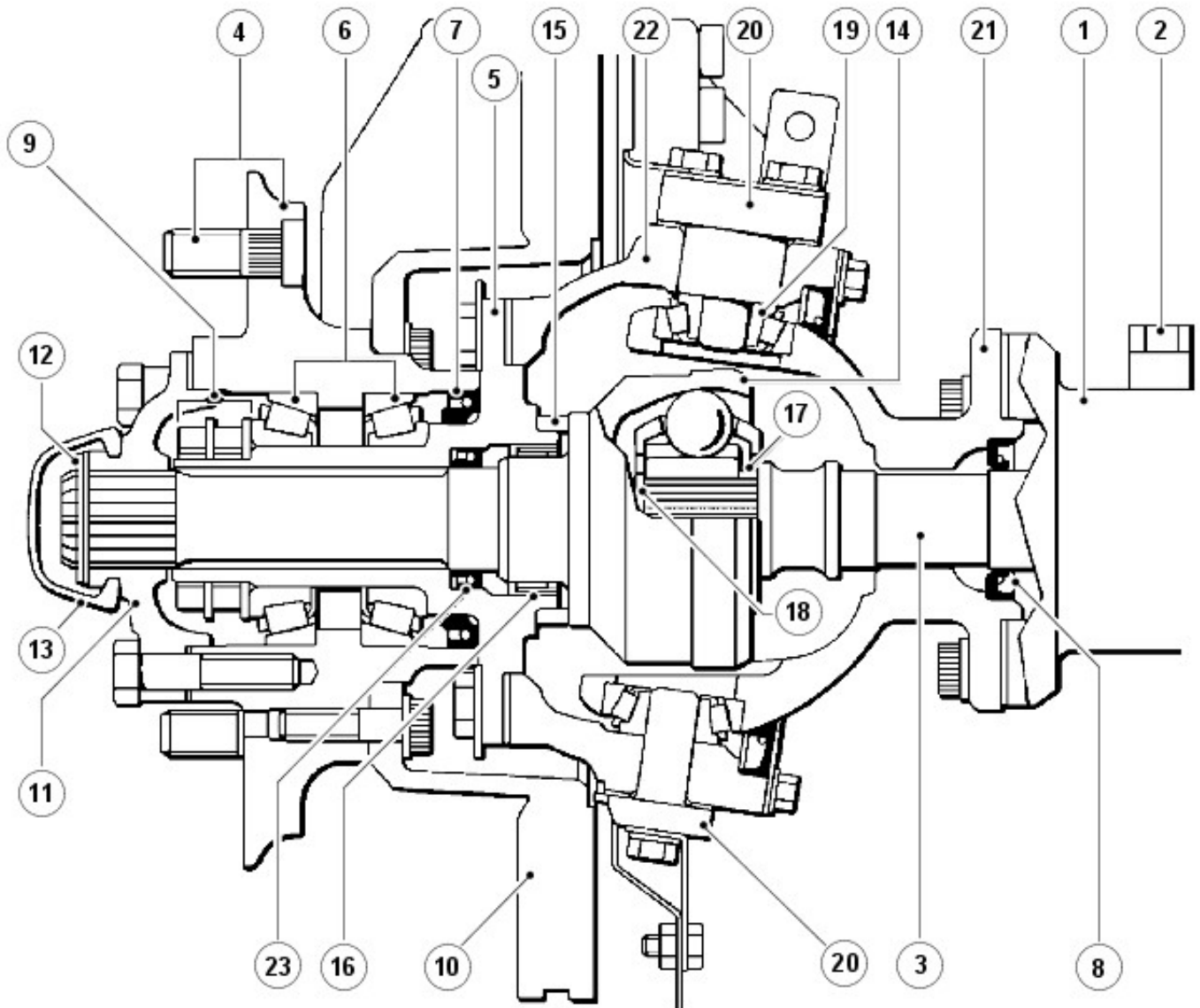
*** Apply sealant, Part No. STC 50552 To bolt threads**

Front Drive Axle/Differential - Front Drive Axle and Differential

Description and Operation

GENERAL

Front axle hub and swivel housing



J6267A

Item	Part Number	Description
1	-	Axle casing
2	-	Ventilation pipe
3	-	Axle shaft
4	-	Wheel studs and hub
5	-	Stub axle
6	-	Wheel bearings
7	-	Inner and outer hub seals
8	-	Axle shaft seal
9	-	Hub lock plate, thrust washer and nuts

10	-	Brake disc
11	-	Drive flange
12	-	Shim washer and circlip
13	-	Dust cap
14	-	Constant velocity joint/shaft
15	-	Thrust collar for CV joint
16	-	Roller bearing
17	-	Spacer
18	-	Circlip
19	-	Top and bottom swivel taper bearing
20	-	Top and bottom swivel pins
21	-	Spherical housing, seal and retainer
22	-	Swivel housing
23	-	Constant velocity shaft seal

The front differential is mounted on the LH side of the chassis.

Operation

The welded steel front axle casing houses a separate spiral bevel type differential unit, which is off-set to the right of the vehicle centre line. The differential unit drives the front wheels via the axle shafts and constant velocity joints which are totally enclosed in the spherical and swivel housings.

The front wheels are pivoted on tape roller bearings at the top and bottom of the swivel housing. The wheel hubs on all axles are supported by two taper bearings and driven by drive flanges which are splined to the one piece, stub shaft/constant velocity joint.

Lubrication

The differential, swivel pin housing and wheel hubs are individually lubricated and separated by oil seals (7) and (8), see J6267A, to prevent oil transfer across the axle when the vehicle is traversing steep inclines. The wheel bearings are lubricated with grease and the swivel housing and differential with oil. On later vehicles, identified by having only a filler plug in the swivel housing, grease is used to lubricate the housing assembly,

Ventilation

Ventilation of the differential is through a plastic pipe (2) which terminates at a high level in the vehicle axle. The swivel housings ventilate through axle shaft oil seals (8) into the differential and the hub bearings vent via the oil seals into the swivel housing.

Front Drive Axle/Differential - Front Drive Axle

Diagnosis and Testing

Complaint - Oil leaks

An external leak of lubrication from the hub seals can be caused by a faulty internal seal. For example, if the seals which separate the differential from the hubs are faulty and the vehicle is operating or parked on an embankment, oil from the differential may flood one hub resulting in a lack of lubrication in the differential.

When a seal is found to be leaking check the axle ventilation system, as a blockage can cause internal pressure to force oil past the seals.

Illustrations of oil seal locations are given in Description and Operation.

REFER to: Front Drive Axle and Differential (205-03, Description and Operation).


When investigating hub seal leaks check the grease for dilution with oil. Also check the differential oil level, for signs of metal particles in the oil and the condition of internal seals.

If the vehicle is driven in deep water with defective oil seals, water may contaminate the lubricants and raise the differential oil level, giving a false impression that the housing has been over filled. **Do not assume that a high oil level in the differential is due to over filling or, that a low level is because of an external leak.**

Front Drive Axle/Differential - Drive Pinion Seal90

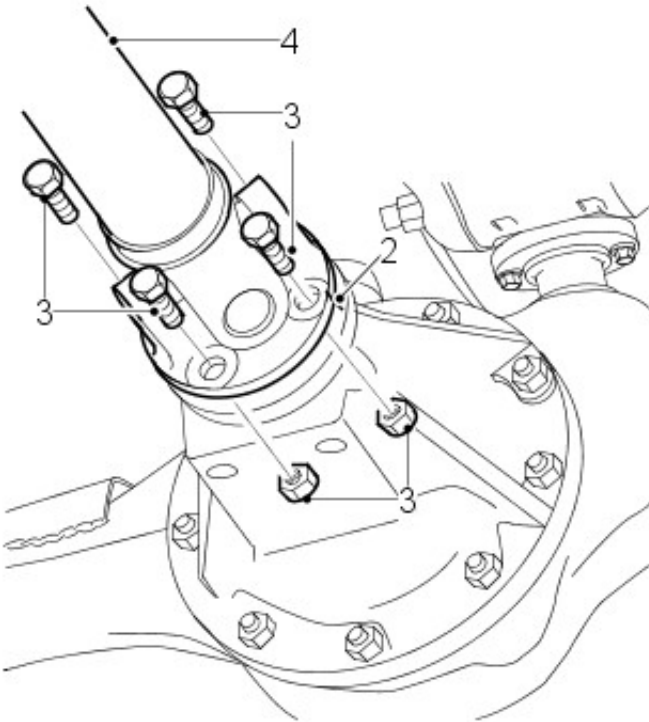
In-vehicle Repair

Removal

1.  **WARNING:** Do not work under a vehicle supported only by a jack. Always support the vehicle on safety stands.

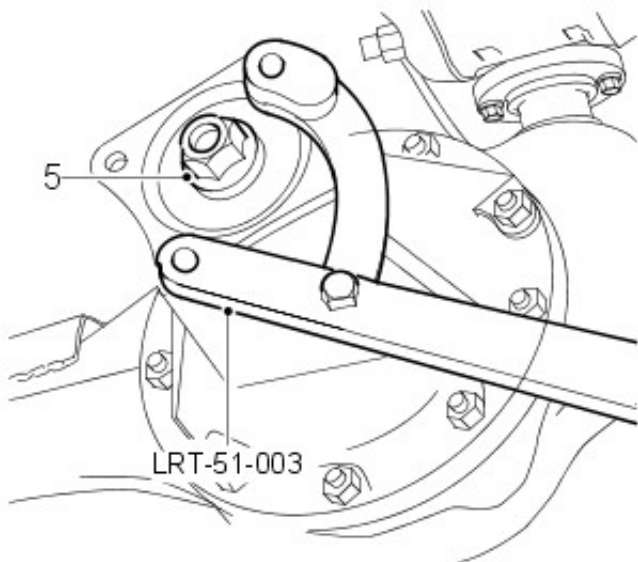
Raise front of vehicle.

2. Reference mark the drive shaft flanges for reassembly.
3. Remove 4 nuts and bolts securing drive shaft to differential housing.
4. Release drive shaft and tie aside.



51M0048

5. Using LRT-51-003 to restrain the pinion flange, remove bolt securing pinion flange.



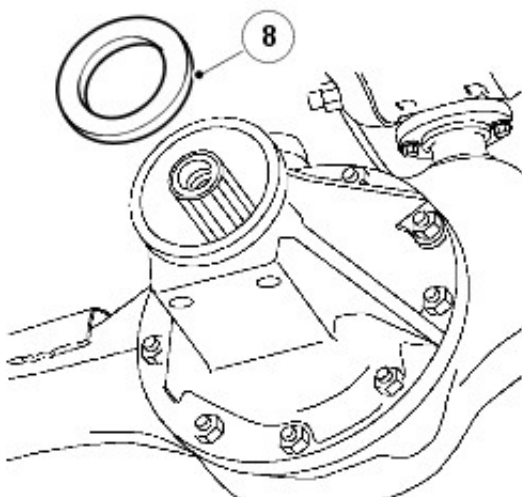
51M0049

6. Remove pinion flange.

7. Position container to catch oil spillage.

8.  **CAUTION:** Take care to avoid damage to oil seal recess.

Using a suitable lever, remove and discard pinion oil seal.



51M0050A

Installation

1. Clean pinion oil seal recess and pinion flange.

2. Lubricate oil seal lip with clean oil.

3. Using LRT-51-010 fit pinion oil seal.

4. Fit pinion flange.

5. Restrain flange using LRT-51-003 and fit bolt. Tighten bolt to 100 Nm (74 lbf.ft).

6. Position drive shaft to differential housing and align reference marks.

7. Fit flange bolts and tighten to 48 Nm (35 lbf.ft).

8. Remove stands and lower vehicle.

9. Top-up differential oil level.

Front Drive Axle/Differential - Axle Assembly

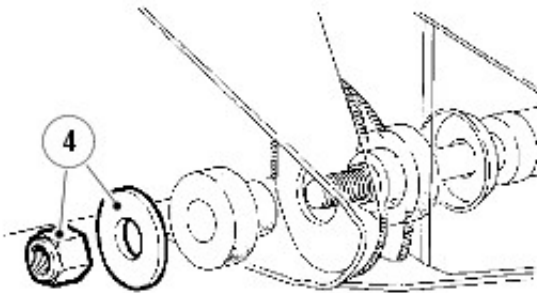
Removal and Installation

Removal



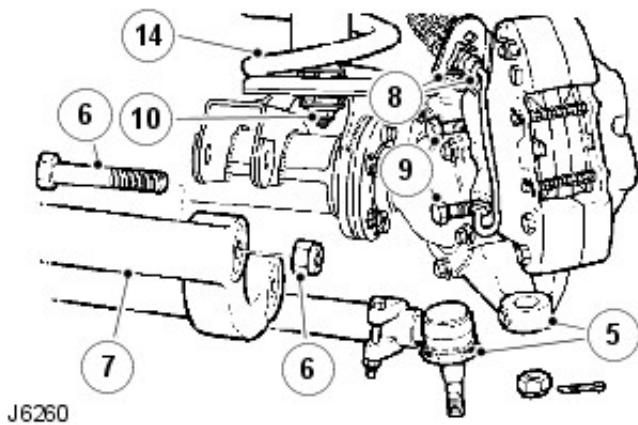
WARNING: Remove and refit of axle requires a further two persons to steady axle when lowering or repositioning axle.

1. Support chassis front.
2. Remove road wheels.
3. Support axle weight with hydraulic jack.
4. Remove radius arms to chassis frame nuts.



RR983

5. Disconnect steering damper from track rod. Using a extractor remove track rod links from swivel pin arms.
6. Remove four nuts and bolts securing radius arms to axle bracket.
7. Remove radius arms.
8. Remove bolts securing brake hose brackets . Refit bolts to prevent oil leakage.
9. Remove bolts from brake calipers and tie to one side.
10. Remove nuts and washers securing shock absorbers to axle.
11. Disconnect drag link from swivel pin housing arm.
12. Remove two nuts and bolts securing panhard rod to axle bracket. Lift rod clear of axle.
13. Mark for reassembly drive shaft flanges. Remove four nuts and bolts, tie propeller shaft to one side.
14. Release axle ventilation pipe banjo and lower axle assembly. Remove road springs.



15. Disconnect stabilizer bar link.
For additional information, refer to: Stabilizer Bar Link (204-01, Removal and Installation).
16. Remove axle assembly.
17. Transfer components to new axle, if appropriate.

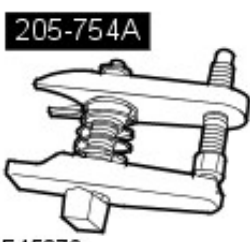
Installation

1. Position axle under vehicle, supporting left side of axle, and Instal anti-roll bar links.
For additional information, refer to: Stabilizer Bar Link (204-01, Removal and Installation).
2. Instal propeller shaft. Tighten bolts to 47 Nm (35 lbf.ft).
3. Instal panhard rod to axle bracket. Tighten bolts to 88 Nm (65 lbf.ft).
4. Instal drag link to swivel pin arm. Tighten fixings to 40 Nm (30 lbf.ft).
5. Instal shock absorbers to axle.
6. Instal brake calipers. Tighten bolts to 82 Nm (60 lbf.ft).
7. Tighten upper swivel pin bolts to 78 Nm (58 lbf.ft).
8. Instal radius arms to axle brackets. Tighten bolts to 197 Nm (145 lbf.ft).
9. Instal steering damper to track rod.
10. Instal radius arms to chassis side member. Tighten fixings to 197 Nm (145 lbf.ft).
11. Tighten track rod end to 40 Nm (30 lbf.ft) and Instal new split pin.
12. Remove chassis supports, Instal road wheels and tighten to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)


Front Drive Axle/Differential - Differential Carrier

Removal and Installation

Special Tool(s)

 <p>205-754A</p> <p>E45276</p>	<p>Ball joint separator</p> <p>205-754 (LRT-54-027)</p>
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Removal

1.  **CAUTION:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

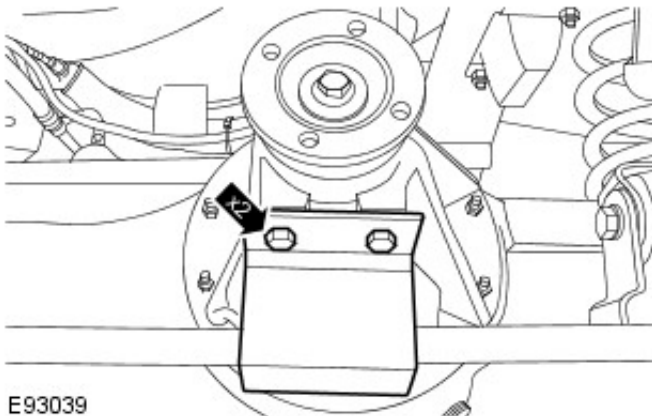
2. **NOTE:** Clean the area around the front axle assembly filler plug and the front axle assembly drain plug.


Drain the front axle assembly.

- Position a container to collect the fluid.
- Remove the filler plug.
- Remove the drain plug.

3. Remove the front wheels and tires.

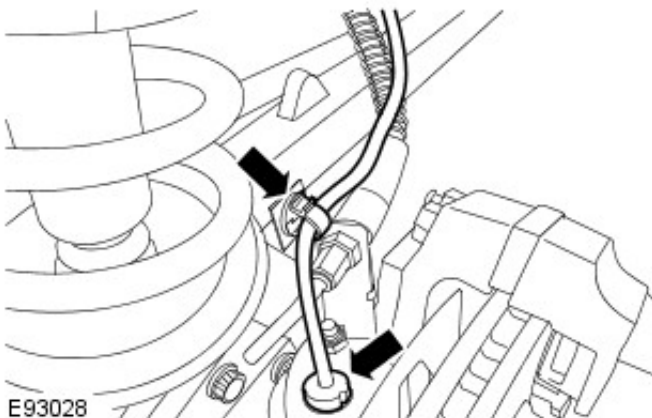
4. Remove the tie rod protector.
 - Remove the 2 bolts.




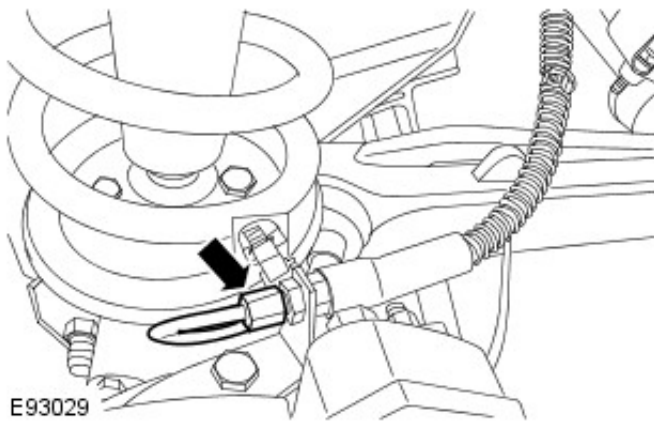
5.  **CAUTION:** Before disconnecting or removing components, make sure the immediate area around joint faces and connections are clean. Plug open connections to prevent contamination.

Release the LH front wheel speed sensor.

- Release the harness from the clip.



6.  **CAUTION:** Before disconnecting or removing components, make sure the immediate area around joint faces and connections are clean. Plug open connections to prevent contamination.

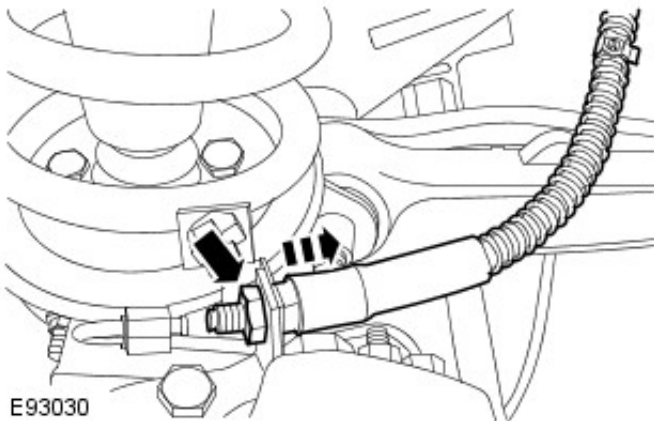


Disconnect the LH front brake pipe.

- Clamp the brake hose to prevent fluid loss.

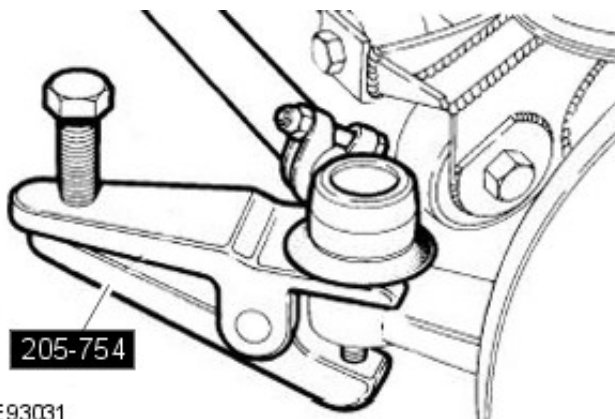
7. Release the LH front brake hose.

- Remove the nut.



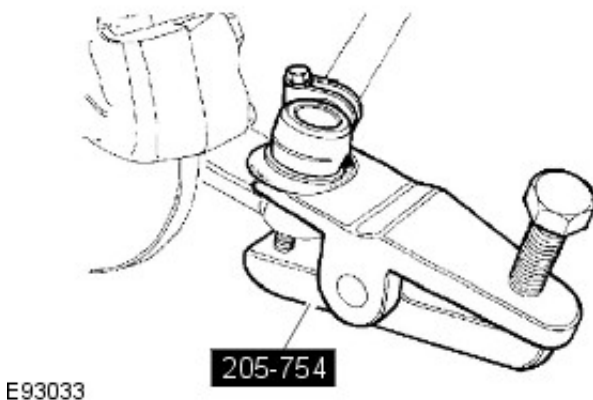
8. Using the special tool, release the drag link end.


- Remove and discard the split pin.
- Remove the nut.
- Collect the washer.



9. Using the special tool, release the LH tie rod end.

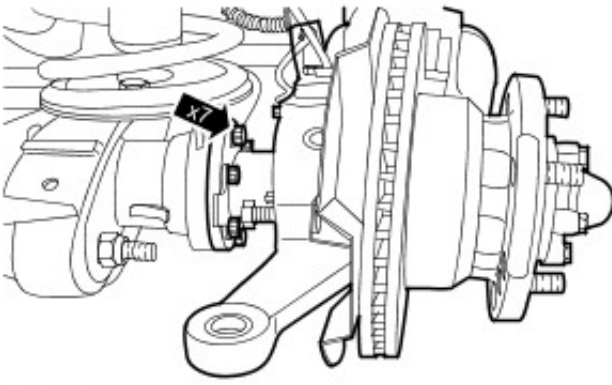
- Remove and discard the split pin.
- Remove the nut.
- Collect the washer.



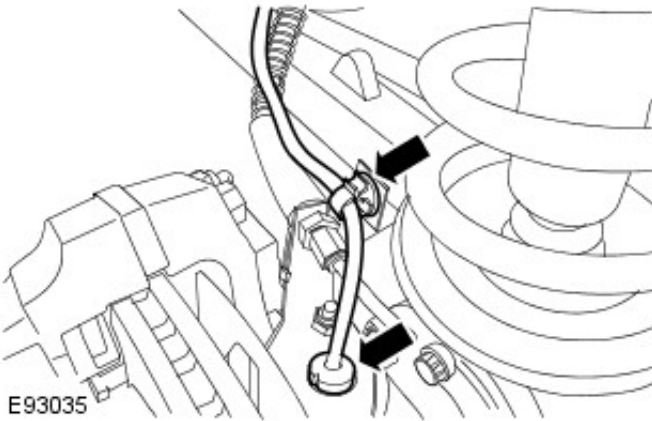
10.  **CAUTION:** Do not allow the swivel pin housing to hang on the halfshaft, failure to follow this instruction may result in damage to the vehicle.

With assistance, remove the LH swivel pin housing.

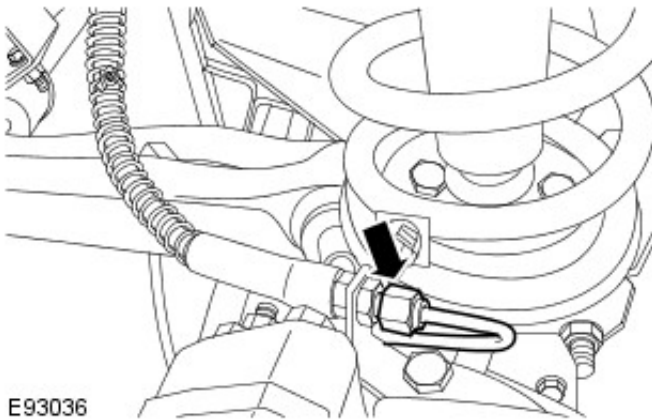
- Remove the 7 bolts.
- Remove and discard the gasket.



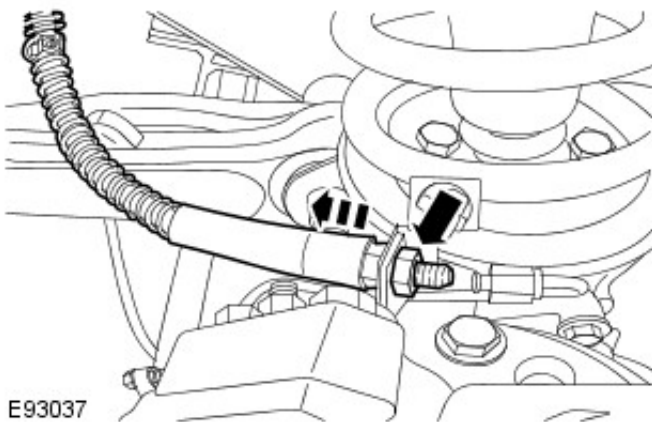
E93034




E93035



E93036




E93037

11.  **CAUTION:** Before disconnecting or removing components, make sure the immediate area around joint faces and connections are clean. Plug open connections to prevent contamination.

Release the RH front wheel speed sensor.

- Release the harness from the clip.

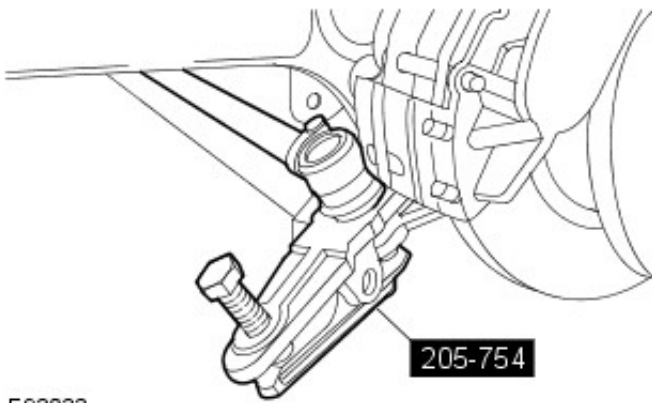
12.  **CAUTION:** Before disconnecting or removing components, make sure the immediate area around joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the RH front brake pipe.

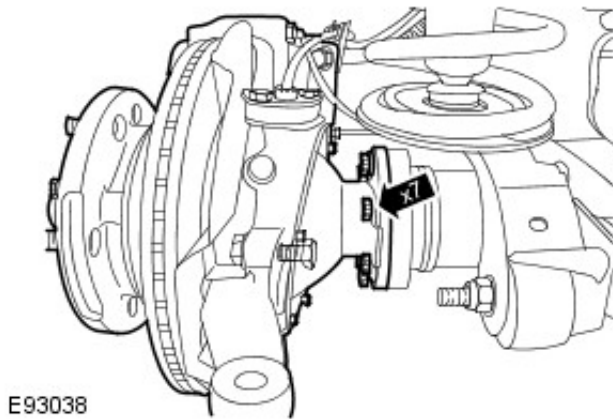
- Clamp the brake hose to prevent fluid loss.

13. Release the RH front brake hose.
- Remove the nut.


14. Using the special tool, release the RH tie rod end.
- Remove and discard the split pin.
 - Remove the nut.
 - Collect the washer.



E93032



E93038

15.  **CAUTION:** Do not allow the swivel pin housing to hang on the halfshaft, failure to follow this instruction may result in damage to the vehicle.

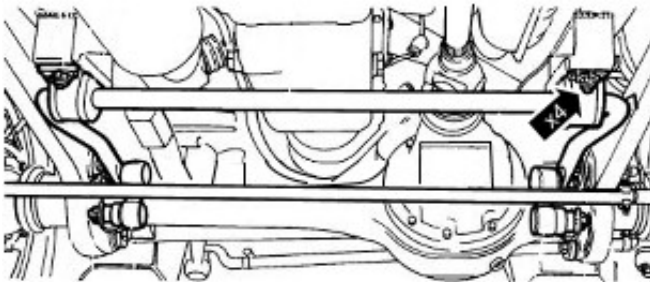
With assistance, remove the RH swivel pin housing.

- Remove the 7 bolts.
- Remove and discard the gasket.

16. **NOTE:** Discard the nuts.

Reposition the front stabilizer bar.

- Remove the 4 nuts and bolts.

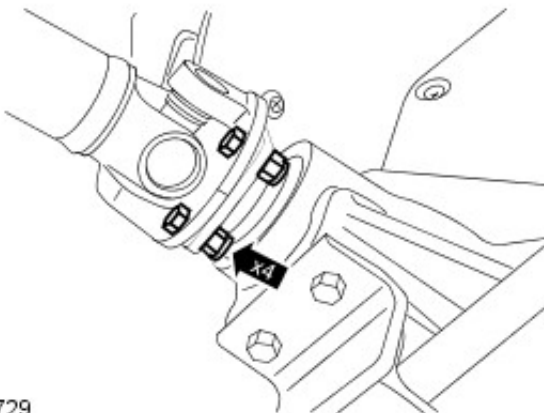


E93040

17. **NOTE:** Discard the nuts.

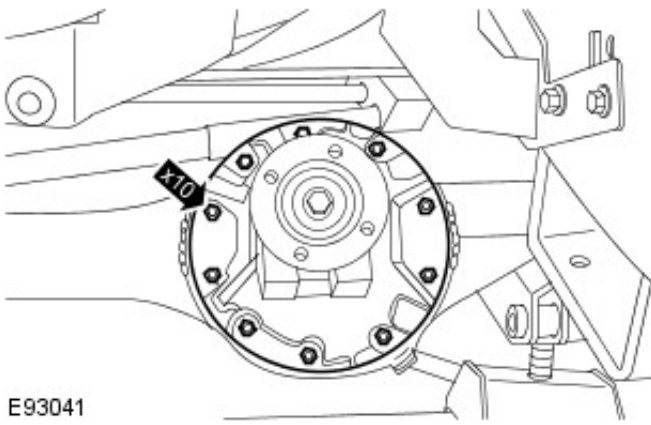
Release the front driveshaft.

- Remove the 4 nuts and bolts.
- Support the driveshaft using a suitable tie strap.



E90729

18. Remove the front differential carrier.
- Remove and discard the 10 nuts.



E93041

Installation

1. **NOTE:** Clean the component mating faces.

NOTE: Install new nuts.

Install the front differential carrier.

- Apply a bead of the specified sealant to the differential carrier mating face.
- Tighten the nuts to 41 Nm (30 lb.ft).

2. **NOTE:** Install new nuts.


Secure the front driveshaft.

- Tighten the nuts and bolts to 47 Nm (35 lb.ft).

3. **NOTE:** Install new nuts.

Secure the front stabilizer bar.

- Tighten the nuts and bolts to 68 Nm (50 lb.ft).

4.  **CAUTION:** Support the weight of the halfshaft when installing the swivel pin housing, failure to follow this instruction may result in damage to the vehicle.

NOTE: Clean the component mating faces.

With assistance, install the RH swivel pin housing.

- Install a new gasket.
- Apply the specified sealant to the bolts.
- Tighten the bolts to 73 Nm (54 lb.ft).

5. Secure the RH tie rod end.

- Install the washer.
- Tighten the nut to 40 Nm (30 lb.ft).
- Install a new split pin.

6. Secure the RH front brake hose.

- Tighten the nut to 10 Nm (7 lb.ft).

7. **NOTE:** Remove and discard the blanking caps.


Connect the RH front brake pipe.

- Tighten the union to 15 Nm (11 lb.ft).
- Remove the hose clamp.

8. **NOTE:** Remove and discard the blanking caps.

Secure the RH front wheel speed sensor.

- Secure the harness in the clip.

9.  **CAUTION:** Support the weight of the halfshaft when installing the swivel pin housing, failure to follow this instruction may result in damage to the vehicle.

NOTE: Clean the component mating faces.

With assistance, install the LH swivel pin housing.

- Install a new gasket.
- Apply the specified sealant to the bolts.
- Tighten the bolts to 73 Nm (54 lb.ft).

10. Secure the LH tie rod end.

- Install the washer.
- Tighten the nut to 40 Nm (30 lb.ft).
- Install a new split pin.

11. Secure the drag link end.

- Install the washer.
- Tighten the nut to 40 Nm (30 lb.ft).
- Install a new split pin.

12. Secure the LH front brake hose.

- Tighten the nut to 10 Nm (7 lb.ft).

13. **NOTE: Remove and discard the blanking caps.**

Connect the LH front brake pipe.

- Tighten the union to 15 Nm (11 lb.ft).
- Remove the hose clamp.

14. **NOTE: Remove and discard the blanking caps.**

Secure the LH front wheel speed sensor.

- Secure the harness in the clip.

15. Install the tie rod protector.

- Tighten the bolts 30 Nm (22 lb.ft).

16. Fill the front axle assembly with the correct amount of the specified oil.

- Install and tighten the drain plug to 60 Nm (44 lb.ft).
- Install and tighten the filler plug to 60 Nm (44 lb.ft).
- Remove the container.

17. Bleed the front brakes.

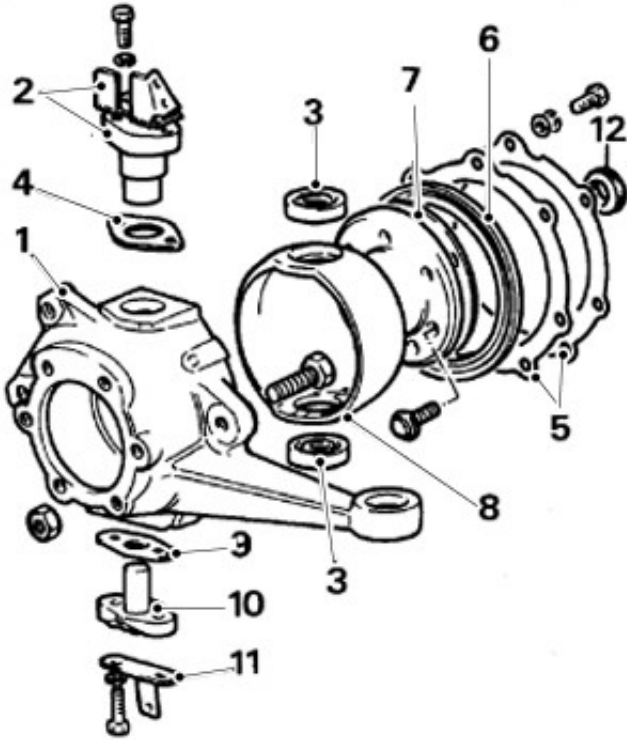
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).

18. Install the front wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Axle/Differential - Front Stub Axle, Constant Velocity (CV) Joint and Swivel Pin Housing

Disassembly and Assembly



RR980M

Item	Part Number	Description
1.	-	Swivel pin housing
2.	-	Top swivel pin and brake hose bracket
3.	-	Upper and lower swivel pin bearings
4.	-	Shim
5.	-	Retaining plate and washer
6.	-	Oil seal
7.	-	Joint washer
8.	-	Swivel bearing housing
9.	-	Joint washer
10.	-	Lower swivel pin
11.	-	Mudshield bracket
12.	-	Swivel housing inner oil seal

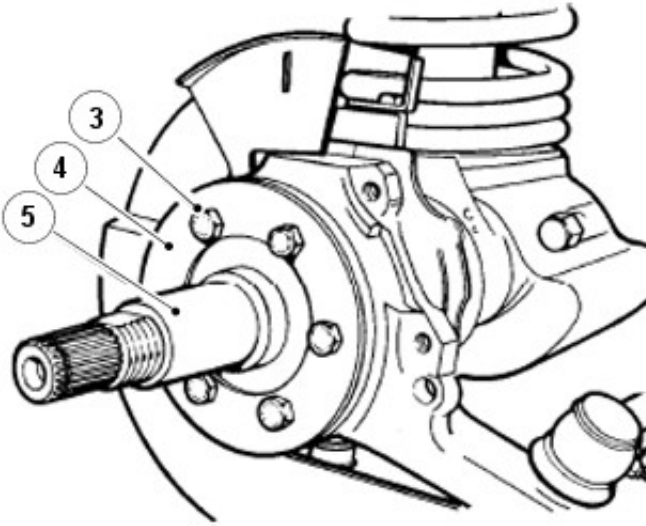
Disassembly

1. Remove front hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - Vehicles Built Up To: 01/1999 (204-01, Removal and Installation) / Front Wheel Bearing and Wheel Hub (204-01 Front Suspension, Removal and Installation).
2. **NOTE:** On later vehicles the swivel pin housing is filled with grease for life, the level and drain plugs being deleted.

Drain swivel pin housing and refit plug.
3. Remove 6 bolts retaining stub axle to swivel housing.
4. Remove mud shield.

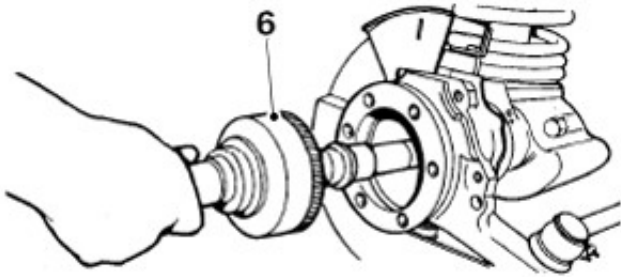
11. Remove mud shield.

5. Remove stub axle and joint washer.



J5372M

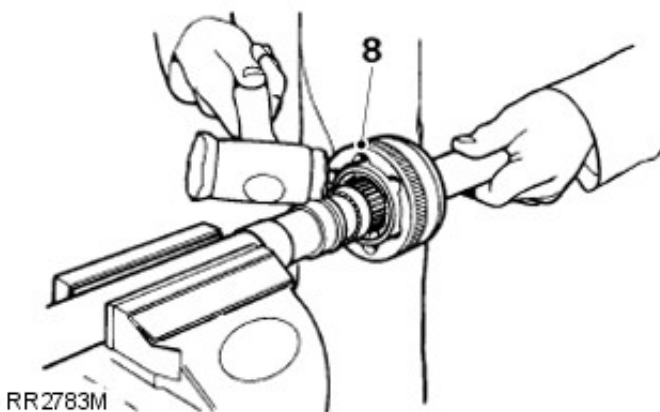
6. Withdraw axle shaft and constant velocity joint from axle casing.



RR2782M

7. Hold axle shaft firmly in a soft jawed vice.

8. Using a soft mallet drive constant velocity joint from shaft.

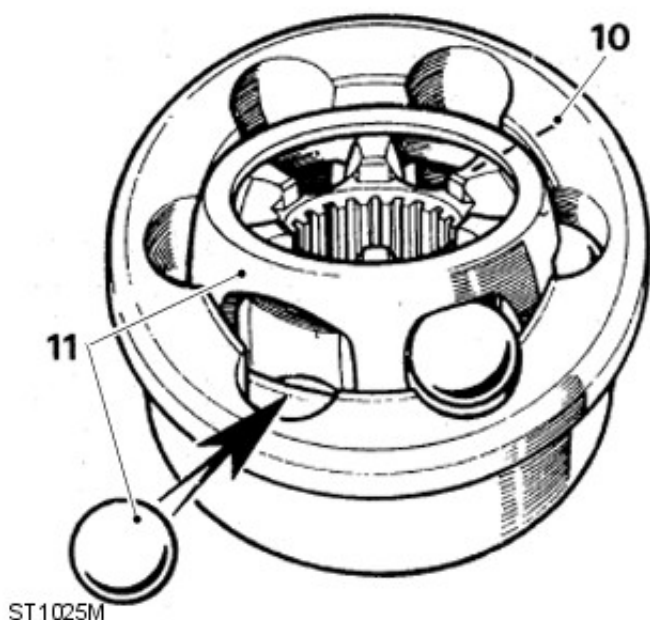


RR2783M

9. Remove circlip and collar from axle shaft.

10. Mark positions of constant velocity joint, inner and outer race and cage for reassembly.

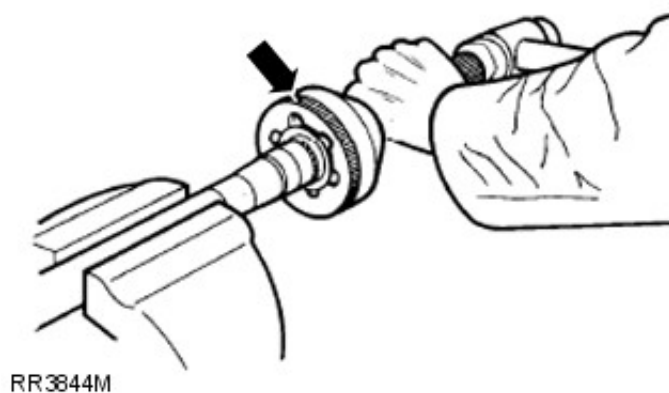
11. Swivel cage and inner race to remove balls.



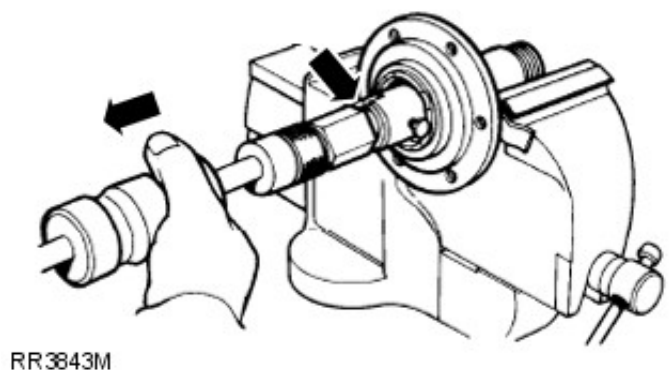
12. Examine all components, in particular, inner and outer track, cage balls and bearing surfaces for damage and excessive wear.
13. Maximum acceptable end-float on assembled joint 0,64mm. Renew if worn or damaged. Lubricate with a recommended oil during assembly.

Assembly

1. Install collar and a new circlip.
2. Engage constant velocity joint on axle shaft splines and using a soft mallet, drive joint in fully.



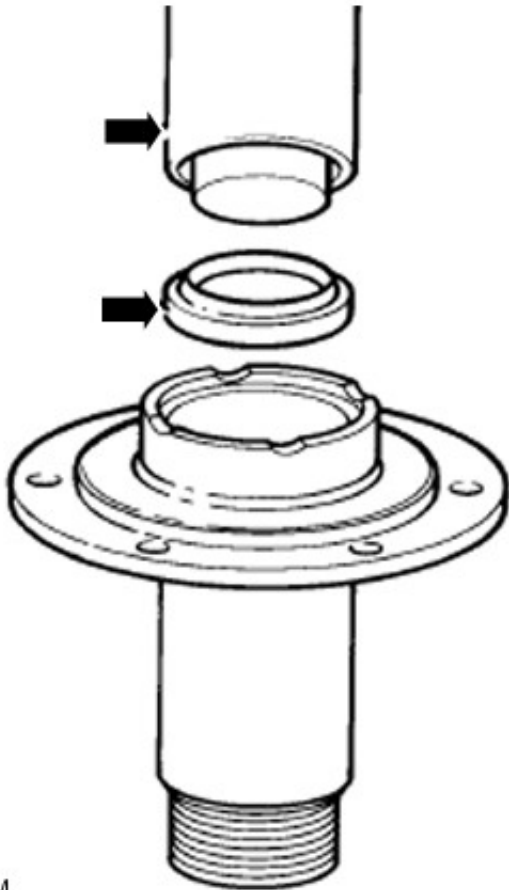
3. Drill and chisel off thrust ring taking care to avoid damaging stub axle.
4. Remove bearing and oil seal using special tool LRT-37-004 and slide hammer LRT-99-004. Ensure lip of tool locates behind bearing to drive it out.



5. Repeat instruction for removal of oil seal.

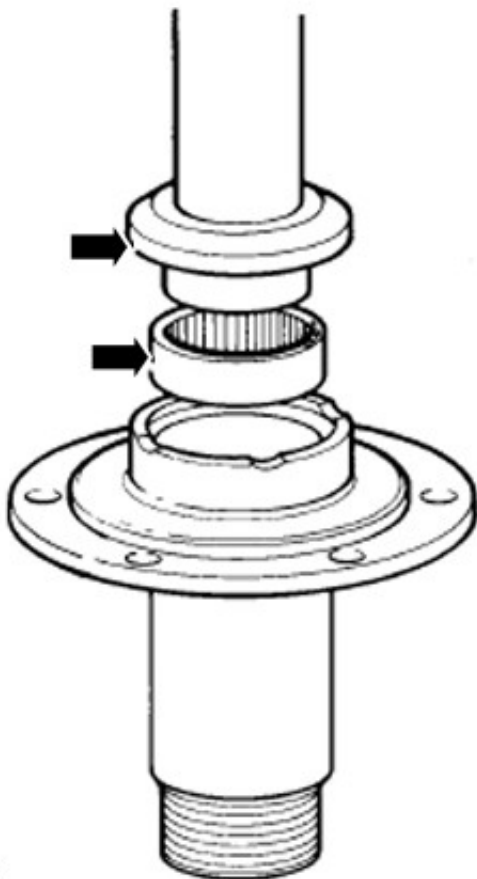
or repeat instruction for removal of oil seal.

6. Lubricate seal and lip with EP90 oil and with cavity side leading press in a new oil seal using special tool LRT-54-004.



RR3840M

7. Using special tool LRT-54-005, fit bearing with its part number visible when fitted, and flush with end face of stub axle.



RR3839M

8. Press fit a new thrust ring onto stub axle.

9. **NOTE:** Removal of oil seal and retaining plate is achieved when

9. **NOTE:** Removal of oil seal and retaining plate is achieved when swivel bearing housing is removed.

Remove bolts securing oil seal retaining plate and joint washer.
Release assembly from swivel pin housing.

10. Remove 2 bolts, retaining lower swivel pin to housing.
11. Remove brake disc shield bracket.
12. Tap lug to remove lower swivel pin and joint washer.
13. Remove two bolts retaining brake hose bracket and top swivel pin.
14. Remove bracket, top swivel pin and shims.
15. Remove swivel pin housing while retrieving lower and upper bearings.

16. **NOTE:** Use upper bearing opening to gain access to lower bearing track.

Remove lower bearing track from swivel bearing housing.

17. Remove 7 bolts retaining swivel bearing housing to axle case.

18. Remove inner oil seal from back of housing.

19. **NOTE:** Use lower bearing opening to gain access to upper bearing track.

Remove top bearing track from swivel bearing housing.

20. If worn, pitted or damaged, renew housing.

21.  **CAUTION:** Ensure bearing tracks are fitted square or damage could occur.

Install upper and lower bearing tracks into swivel bearing housing.

22. With seal lips trailing, install swivel housing inner oil seal into rear of housing. Grease seal lips.

23. Coat swivel bearing housing to axle casing bolts with sealant, Part No. STC 50552.

24. Coat both sides of joint washer with a sealing compound. Position swivel bearing housing to axle mating face.

25. Place retaining plate, joint washer and oil seal over axle flange ready for assembly.

26. Install swivel bearing housing to axle flange with 7 bolts. Tighten to 73 Nm (54 lbf.ft).

27. Grease and install upper and lower swivel pin taper roller bearings.

28. Position swivel pin housing over swivel bearing housing.

29. Coat joint washer both sides with sealing compound and position on lower swivel pin.

30. Loosely install brake shield bracket plus lower swivel pin with lug outboard to swivel pin housing.

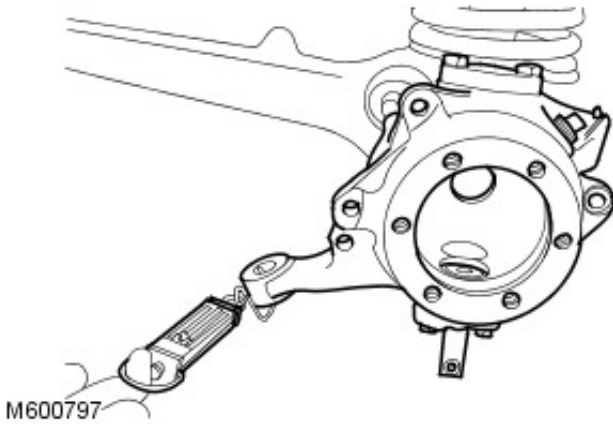
31. Loosely install top swivel pin plus existing shims and brake hose bracket to swivel pin housing.



32. Apply sealant, Part No. STC 50552 to threads of lower swivel pin bolts; tighten bolts to 25 Nm (18 lbf.ft), bend over lock tabs.

33. Apply sealant Part No. STC 50552 to threads of top swivel pin bolts, install bolts and tighten to 65 Nm (48 lbf.ft).

34. **NOTE:** Swivel housing oil seal and axle should not be fitted.

Attach a spring balance to track rod ball joint bore and pull balance to determine effort required to turn swivel pin housing. Resistance, once initial inertia has been overcome, should be 1.16 to 1.46 kg. Adjust by removing or adding shims to top swivel pin.



35. When setting is correct remove top swivel bolts, apply sealant, Part No. STC 50552 to threads of bolts. Refit bolts and tighten to 65 Nm (48 lbf.ft), and bend over lock tabs.
36. Apply recommended grease between lips of swivel oil seal.
37. Install oil seal, joint washer and retaining plate with 7 bolts and spring washers. Tighten to 10 Nm (7 lbf.ft).
38. Install tie rod and drag link and secure with new cotter pins. Tighten fixing to 40 Nm (30 lbf.ft).
39. Install brake disc shield.
40. Loosely install lock stop bolt and nut.
41. Apply a recommended grease between lips of swivel housing oil seal.
42. Secure oil seal with retaining plate and securing bolts. Tighten to 10 Nm (7 lbf.ft).
43. Install track-rod and drag link and secure with new cotter pins.
44. Loosely install lock stop bolt for later adjustment.
45. Install brake disc shield.
46.  **CAUTION:** Take care not to damage axle shaft oil seals.
Insert axle shaft, and when differential splines are engaged, push assembly in fully.
47. Place a new joint washer in position on swivel pin housing to stub axle mating face. Coat threads of stub axle bolts with sealant, Part No. STC 50552.
48.  **CAUTION:** Ensure that constant velocity joint bearing journal is butted against thrust ring on stub axle before stub axle is secured.
Install stub axle with flat at 12 O'clock position.
49. Place mud shield in position and secure stub axle to swivel pin housing with 6 bolts and tighten evenly to 65 Nm (48 lbf.ft).
50. Install brake jump hoses to brake jump hose bracket.
51. Install complete front hub assembly.

51. Install complete front hub assembly.

For additional information, refer to: Wheel Bearing and Wheel Hub - Vehicles Built Up To: 01/1999 (204-01, Removal and Installation) / Front Wheel Bearing and Wheel Hub (204-01 Front Suspension, Removal and Installation).

52. Check swivel pin housing oil drain plug is fitted.

53. Remove swivel pin level and filler plugs.

54. **NOTE: On later vehicles fill swivel pin housing with 0.33 Litres of Molytex EP 00 grease.**

Check and top up with new oil until oil runs out from level hole.

Allow excess oil to drain and wipe clean.

For additional information, refer to: Specifications (205-03 Front Drive Axle/Differential, Specifications).

55. Install swivel pin level and filler plugs.

56. Set steering lock stop bolts.

For additional information, refer to: Steering Lock Stop Adjustment (211-00 Steering System - General Information, General Procedures).

Brake System - General Information -

Brake Hydraulic Fluid

Item	Specification
* Recommended hydraulic fluid	SHELL DONAX YB DOT4 ESL FLUID



CAUTION: * If the above fluid is not available, use a low viscosity DOT 4 brake fluid meeting ISO 4925 Class 6 and Land Rover LRES22BF03 requirements.

General Specification

NOTE: Pressure reducing valves are not fitted to all 110 specifications.

Item	Specification
Front caliper	AP Lockheed, four opposed pistons
Operation	Hydraulic, self adjusting
Front disc:	
- 90 Models	Solid, outboard
- 110/130 Models	Ventilated, outboard
Disc diameter	298 mm (11.73 in)
Front disc thickness:	
- 90 Models	14.1 mm (0.56 in)
- 110/130 Models	24 mm (0.95 in)
Wear limit	1 mm (0.04 in) per side of disc
Disc run-out maximum	0.15 mm (0.006 in)
Pad area	58 cm ² (9.0 in ²)
Total swept area	801.3 cm ² (124.2 in ²)
Pad material	Ferodo 3440 non asbestos
Pad minimum thickness	3 mm (0.12 in)
Rear caliper	AP Lockheed, four opposed pistons
Operation	Hydraulic, self adjusting
Rear disc	Solid, outboard
Rear disc diameter:	
- 90 Models	290 mm (11.42 in)
- 110/130 Models	298 mm (11.73 in)
Rear disc thickness:	
- 90 Models	12.5 mm (0.49 in)
- 110/130 Models	14.1 mm (0.56 in)
Wear limit:	
- 90 Models	0.38 mm (0.015 in) per side of disc
- 110/130 Models	1 mm (0.04 in) per side of disc
Disc run-out maximum	0.15 mm (0.006 in)
Pad area:	
- 90 Models	30.5 cm ² (4.37 in ²)
- 110/130 Models	36.2 cm ² (5.61 in ²)
Total swept area	694 cm ² (106.98 in ²)
Pad material	Ferodo 3440 non asbestos
Pad minimum thickness	3 mm (0.12 in)
Parking brake	
Parking brake type	Mechanical, cable operated drum brake on the rear of the transfer gearbox output shaft
Parking brake drum internal diameter	254 mm (10.0 in)
Width	70 mm (2.75 in)
Pad material	Ferodo 3611 non asbestos
Master cylinder/Booster	
Master cylinder manufacturer	Lucas
Master cylinder type	Tandem, 25.4 mm (1.0 in) diameter
Booster type	LSC 80
Pressure reducing valve, failure conscious:	
- 90 Models	Cut-in pressure 24 bar (360 lbf/in ²), ratio 4.0:1
- 110/130 Models	Cut-in pressure 43 bar (645 lbf/in ²), ratio 2.9:1

Torque specifications

Description	Nm	lbf-ft
Brake pipe to pressure reducing valve	15	11
Brake pipe to brake calipers	15	11

Brake pipe to master cylinder	15	11
Flexible hoses to calipers	15	11
Bleed screws	15	11
Brake caliper to swivel pin housing	82	60
Brake disc bolts*	73	54
Brake drum screw	8**	6
Brake drum adjuster bolt	25	18
Booster assembly to pedal box	26	19
Pedal box to bulkhead	25	18
Master cylinder to booster	26	19

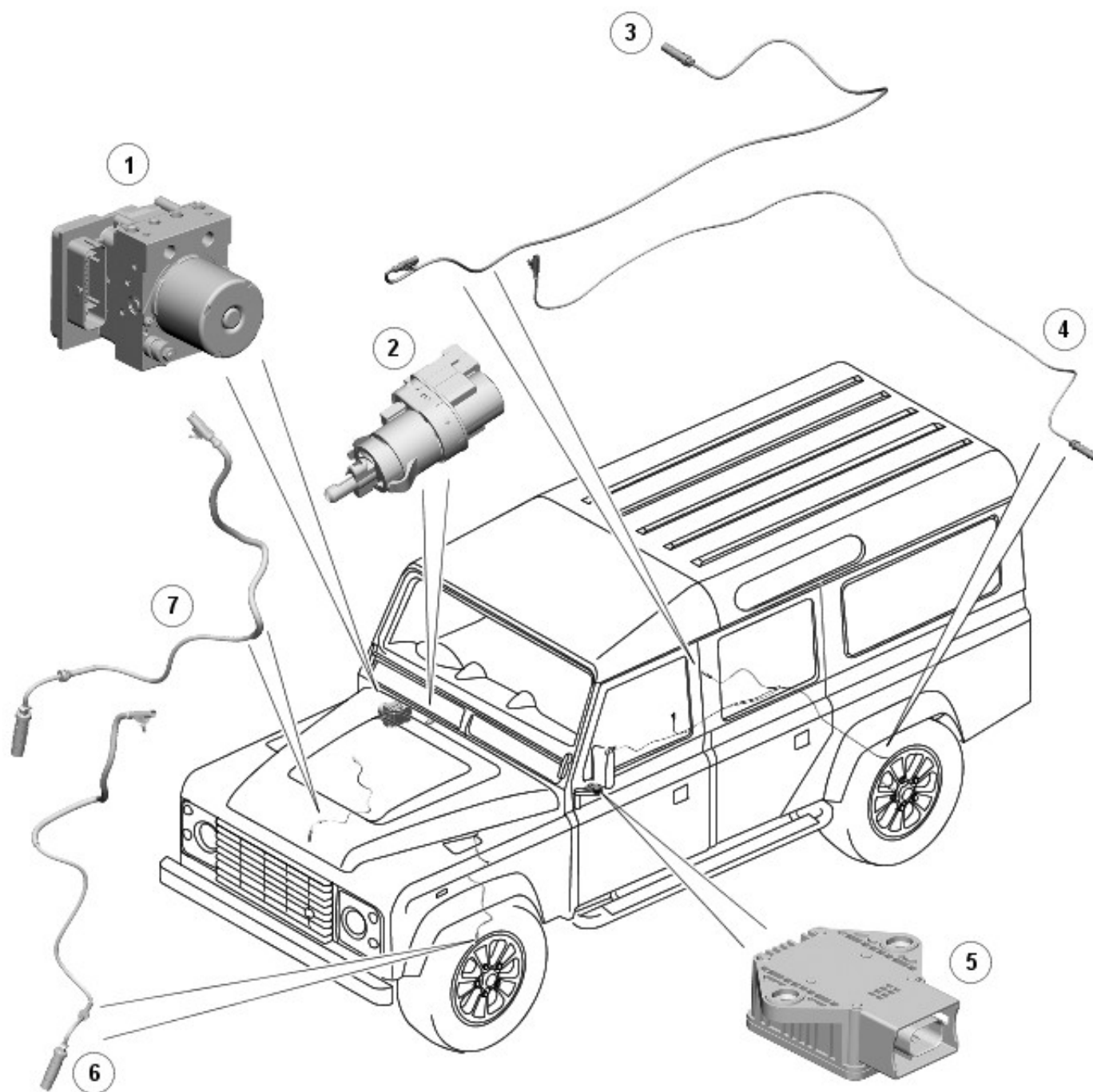
* Apply Loctite 270 before assembly

**If you are refitting old screws, tighten to 25 Nm (18 lbf-ft).

Brake System - General Information - Brake System

Description and Operation

COMPONENT LOCATION



E131333

Item	Part Number	Description
1	-	HCU (hydraulic control unit) with attached ABS (anti-lock brake system) module
2	-	Stoplamp switch
3	-	Right-hand rear wheel-speed sensor
4	-	Left-hand rear wheel-speed sensor
5	-	Yaw rate and longitudinal acceleration sensor
6	-	Left-hand front wheel-speed sensor
7	-	Right-hand front wheel-speed sensor

OVERVIEW

The anti-lock control and traction control system is based on the 4 channel Bosch 8.0 system and provides the following brake functions:

- [ABS](#)
- [EBD \(electronic brake force distribution\)](#)
- [ETC \(electronic traction control\)](#)

The system consists of the following components:

- A stoplamp switch
- Four wheel speed sensors
- A yaw rate and longitudinal acceleration sensor
- Three warning indicators in the instrument cluster
- A [HCU](#) with attached [ABS](#) module.

DESCRIPTION

STOPLAMP SWITCH

The stoplamp switch is a two-pole switch, mounted in the brake pedal bracket and operated by the brake pedal:

- The 'brake switch' pole supplies a brake pedal status signal to the [ECM \(engine control module\)](#).
- The 'brake lamp switch' pole operates the stoplamps and supplies a brake pedal status signal to the [ABS](#) module and the [ECM](#).

When the brake pedal is released:

- The 'brake switch' contacts are closed, connecting an ignition power feed from the [CJB \(central junction box\)](#) to the [ECM](#) only.
- The 'brake lamp switch' contacts are open.

When the brake pedal is pressed:

- The 'brake switch' contacts open.
- The 'brake lamp switch' contacts close, and connects an ignition power-feed from the [CJB](#) to the [ABS](#) and [ECM](#).

WHEEL SPEED SENSORS

A passive wheel speed sensor is installed in each wheel hub to provide the ABS module with a rotational speed signal from each road wheel. A lead connects each sensor to the vehicle wiring.

Each wheel speed sensor has a signal connection with the ABS module. The ABS module monitors the signals at vehicle speeds of 8 kph (5 mph) and above, the rotation of the halfshafts induces the signals which are converted into individual wheel-speeds and the overall vehicle speed by the ABS module.

The ABS module monitors the wheel-speed sensor for faults. If a fault is detected the ABS module stores a related fault code and illuminates the appropriate warning indicators, depending on the system functions affected to either: ETC, ABS, EBD.

For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

YAW RATE AND LONGITUDINAL ACCELERATION SENSOR

The yaw-rate sensor is not used by the ABS module the longitudinal sensor is only monitored.

The longitudinal acceleration sensor provides the ABS module with inputs of longitudinal acceleration.

The yaw rate and longitudinal acceleration sensor is installed on a bracket, at the left-side of the cross car-rail, and is secured with two bolts.

When the ignition switch is in position II, the yaw rate and longitudinal acceleration sensor receives an ignition power feed from the CJB. The longitudinal acceleration sensor is self-diagnosed by the ABS module . If a fault is detected the ABS module stores a related fault code and illuminates the ABS warning indicator. Fault codes can be interrogated using Land Rover approved diagnostic equipment.

DIFFERENTIAL LOCK UNIT

The ABS module monitors the signal from the differential-lock unit and depending if differential-lock is engaged or disengaged, changes the strategy of calculating the vehicle reference speed. The vehicle reference speed is calculated using the longitudinal sensor within the yaw-rate sensor in conjunction with the actual wheel speed.

When the differential-lock is engaged the front and rear axles are driven at the same speed and therefore when cornering the front axle will be traveling faster than if the differential-lock was disengaged.

If the ABS did not change the strategy of calculating the reference speed it would assume that the reference speed calculated with the differential-lock engaged, as incorrect and consequently a fault code would be stored.

INSTRUMENT CLUSTER INDICATOR LAMPS

The following indicators are installed in the instrument cluster:



1



2



3

E131391

Item	Part Number	Description
1	-	Brake warning indicator
2	-	ABS indicator
3	-	Traction control indicator

Brake Warning Indicator (Red)

When the ignition switch is first turned to position II, the brake warning indicator illuminates for approximately 3 seconds for a bulb check.

The brake warning indicator is shared by three brake systems

- Parking brake: illuminates when the parking brake is applied and while the starter switch is in position II, it will extinguish when the parking brake is fully released.
- Brake fluid level: illuminates when the brake-fluid level is low.
- Electronic Brake Force Distribution (EBD): illuminates when a fault is detected with EBD.

Operation of the brake warning indicator is controlled by a hard-wired connection from the parking brake, brake fluid reservoir cap and [ABS](#) module to the instrument cluster.

ABS Indicator (Amber)

The ABS indicator is amber colored and is continuously illuminated if there is a fault that affects ABS performance or causes the ABS function to be disabled.

Operation of the ABS warning indicator is controlled by a hard-wired connection from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the ABS warning indicator illuminates for approximately 3 seconds for a bulb check.

Traction Control Indicator (Amber)

When the ignition switch is first turned to position II, the traction control indicator illuminates for approximately 3 seconds for a bulb check.

Operation of the traction control indicator is controlled by a hard-wired connection from the ABS module to the instrument cluster.

Illuminates for minimal periods whenever traction control is operating; continuous illumination indicates a fault.

HYDRAULIC CONTROL UNIT

The [HCU](#) is a 4 channel unit that modulates the supply of hydraulic pressure to the brakes under the control of the ABS module.

The HCU is attached by three mounting bushes to a bracket on the driver-side of the engine compartment. Hydraulic pipes connect the HCU to the master cylinder and the brakes.

The primary and secondary outlets of the master cylinder are connected to primary and secondary circuits within the HCU. The primary circuit in the HCU has separate outlet ports to the front brakes. The secondary circuit in the HCU has separate outlet ports to the rear brakes. Each of the circuits in the HCU contain the following components to control the supply of hydraulic pressure to the brakes:

- A normally open, solenoid operated, pilot valve, to enable passive braking.
- A normally closed, solenoid operated, priming valve, to connect the brake fluid reservoir to the return pump during active braking.
- A return pump, to generate hydraulic pressure for active braking and return brake fluid to the reservoir.
- Normally open, solenoid operated, inlet valves and normally closed, solenoid operated, outlet valves, to modulate the hydraulic pressure in the individual brakes.

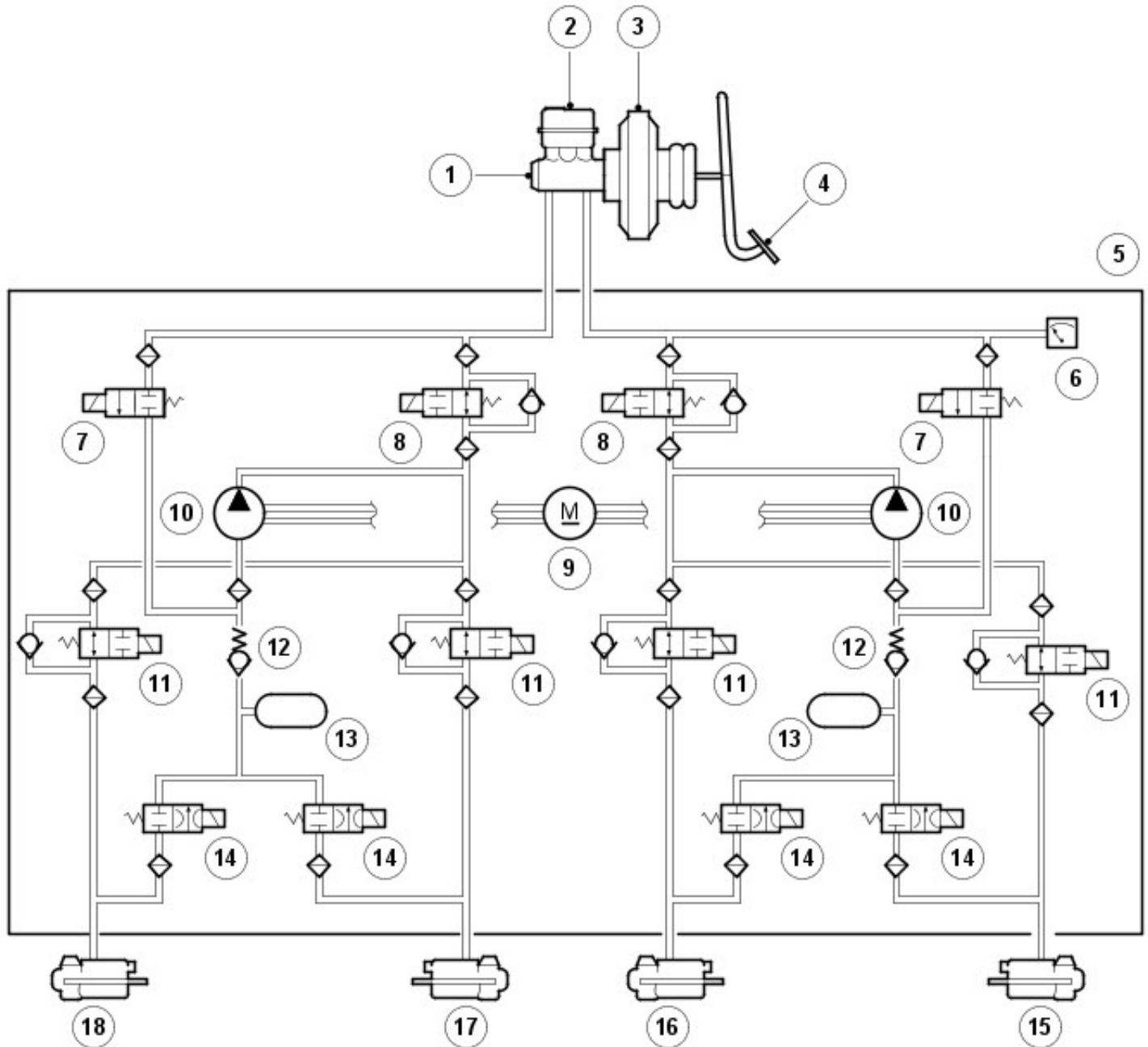
- Filters, to protect the components from contamination.

The primary circuit also incorporates a pressure sensor to provide the ABS module with a hydraulic pressure signal.

Contact pins on the HCU mate with contacts on the ABS module to provide the electrical connections from the ABS module to the return pump motor and the pressure sensor. The solenoids that operate the valves are installed in the ABS module.

Replacement HCU are supplied pre-filled. After installation on the vehicle, Land Rover approved diagnostic equipment must be used to operate the solenoid valves and the return pump to ensure correct bleeding of the HCU and brake circuits.

Schematic of the Hydraulic Control Unit



E50005

Item	Part Number	Description
1	-	Master cylinder
2	-	Reservoir
3	-	Brake booster
4	-	Brake pedal
5	-	HCU
6	-	Pressure sensor
7	-	Priming valve

8	-	Pilot valve
9	-	Return pump motor
10	-	Return pump
11	-	Inlet valve
12	-	Relief valve
13	-	Accumulator
14	-	Outlet valve
15	-	Left front brake
16	-	Right front brake
17	-	Right rear brake
18	-	Left rear brake

The HCU has three operating modes: Normal braking/EBD mode, ABS braking and active braking.

Normal Braking/EBD Mode

Initially, all of the solenoid operated valves are de-energized. Operating the brake pedal produces a corresponding increase or decrease of pressure in the brakes, through the open pilot valves and inlet valves. If the ABS module determines that **EBD** is necessary, it energizes the inlet valves for the brakes of the trailing axle, to isolate the rear brakes from any further increase in hydraulic pressure.

ABS Braking Mode

If the ABS module determines that ABS braking is necessary, it energizes the inlet and outlet valves of the related brake and starts the return pump. The inlet valve closes to isolate the brake from pressurized fluid; the outlet valve opens to release pressure from the brake into the accumulator and the return pump circuit; the reduced pressure allows the wheel to accelerate. The ABS module then operates the inlet and outlet valves to modulate the pressure in the brake to apply the maximum braking effort without locking the wheel. Control of the valves for each wheel takes place individually.

Active Braking Mode

The active braking mode is used to generate and control hydraulic pressure to the brakes for ETC (electronic traction control).

For active braking, the ABS module energizes the pilot valves and priming valves, starts the return pump and energizes all of the inlet valves. Brake fluid, drawn from the reservoir through the master cylinder and priming valve, is pressurized by the return pump and supplied to the inlet valves. The ABS module then operates the inlet valves and outlet valves, as required, to modulate the pressure in the individual brakes. Some noise may be generated during active braking.

ABS MODULE

The ABS module controls the brake functions using the HCU to modulate hydraulic pressure to the individual wheel brakes.

The ABS module is attached to the HCU on the driver-side of the engine compartment. A 38 pin connector provides the electrical interface between the ABS module and the vehicle wiring.

SYSTEM OPERATION

Anti-lock Brake System (ABS)

ABS controls the speed of all road wheels to ensure optimum wheel-slip when braking at the adhesion limit. This prevents the wheels from locking, which helps to retain effective steering control of the vehicle.

Electronic Brake Force Distribution (EBD)

EBD limits the brake pressure applied to the rear wheels. When the brakes are applied, the weight of the vehicle transfers forwards, which reduces the ability of the rear wheels to transfer braking effort to the road surface. This can cause the rear wheels to slip and make the vehicle unstable.

EBD uses the anti-lock braking hardware to automatically optimize the pressure of the rear brakes, below the point where anti-lock braking would be invoked. Only the rear axle is under EBD control.

Electronic Traction Control (ETC)

ETC attempts to optimize forward traction by braking a spinning wheel until it regains grip.

ETC is activated if an individual wheel speed is above that of the vehicle reference speed (positive slip) and the brake pedal is not pressed. The spinning wheel is braked, allowing the excess torque to be transmitted to the non spinning wheels through the drive line.

ANTI-LOCK CONTROL DIAGRAM

NOTE: **A** = Hardwired connection; **D** = High speed CAN bus **U** = Private CAN bus

- | | | |
|----|---|--------------------|
| 15 | - | Instrument cluster |
| 16 | - | CJB |
| 17 | - | Ignition switch |

BASE BRAKING SYSTEM

Master cylinder description

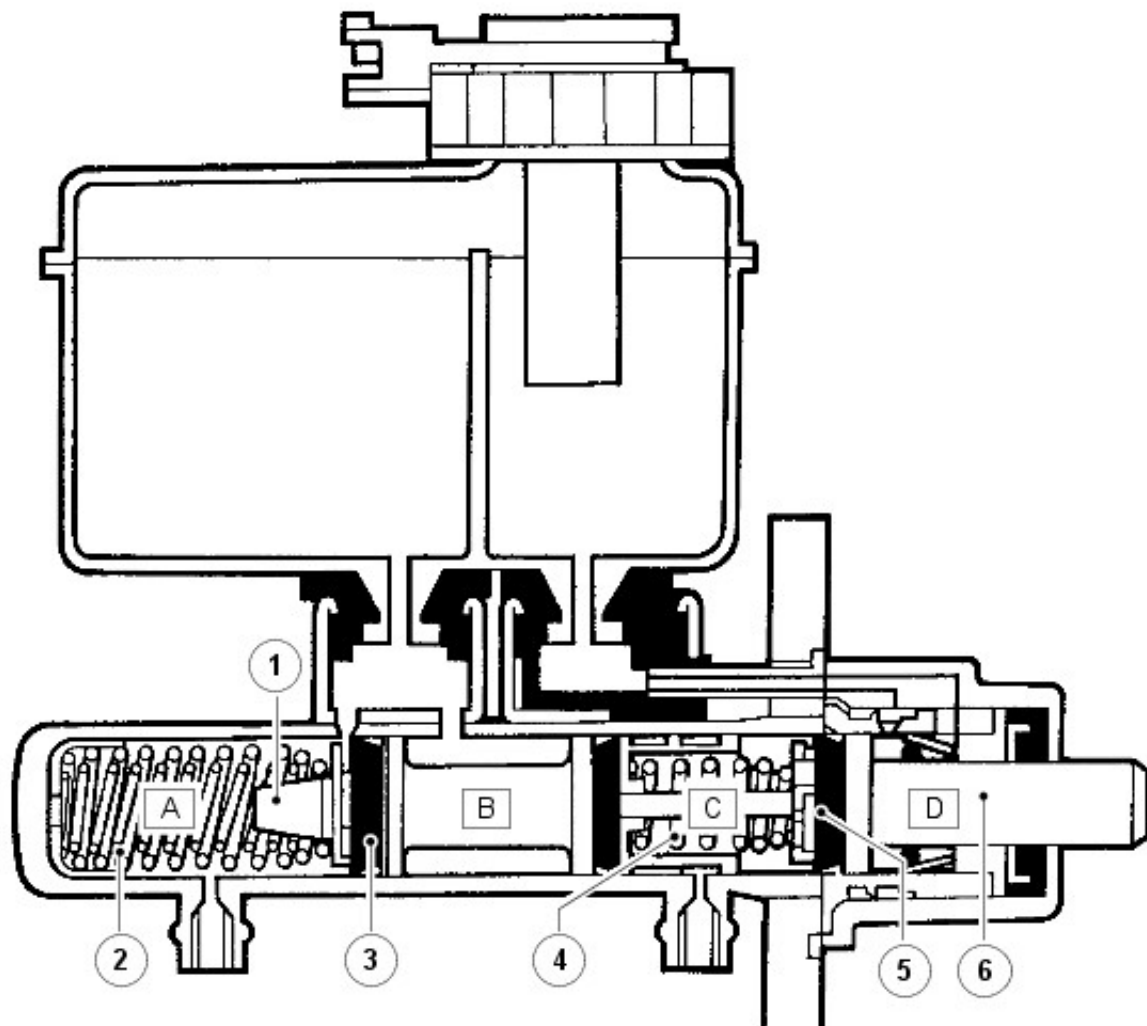
The mechanical components of the hydraulic braking system consists of four piston caliper disc brakes at the front and two piston caliper disc brakes at the rear.

Vented front brake discs are fitted as standard on 110/130 models, while 90 models have solid discs. However, on 90 models with a heavy duty chassis, vented front discs may also be fitted.

A cable controlled parking brake operates a single drum brake mounted on the output shaft of the transfer gearbox and is completely independent of the main braking system.

The basic hydraulic system involves 2 separate and independent primary and secondary circuits which permits a degree of braking should a fault occur in one of the circuits. The primary circuit operates the rear brake calipers and the secondary circuit the front brake calipers.

Master cylinder components



Item	Part Number	Description
1	-	Secondary plunger
2	-	Secondary spring
3	-	Recuperation seal
4	-	Primary spring
5	-	Recuperation seal
6	-	Primary plunger

Master cylinder operation

A tandem master cylinder, which is assisted by a light weight, short, compact servo, is fed by a divided fluid reservoir. The rear section supplies fluid for the primary circuit and the front section the secondary circuit.

When the brakes are off, the fluid can move unrestricted between the dual line system and the separate reservoirs in the fluid supply tank.

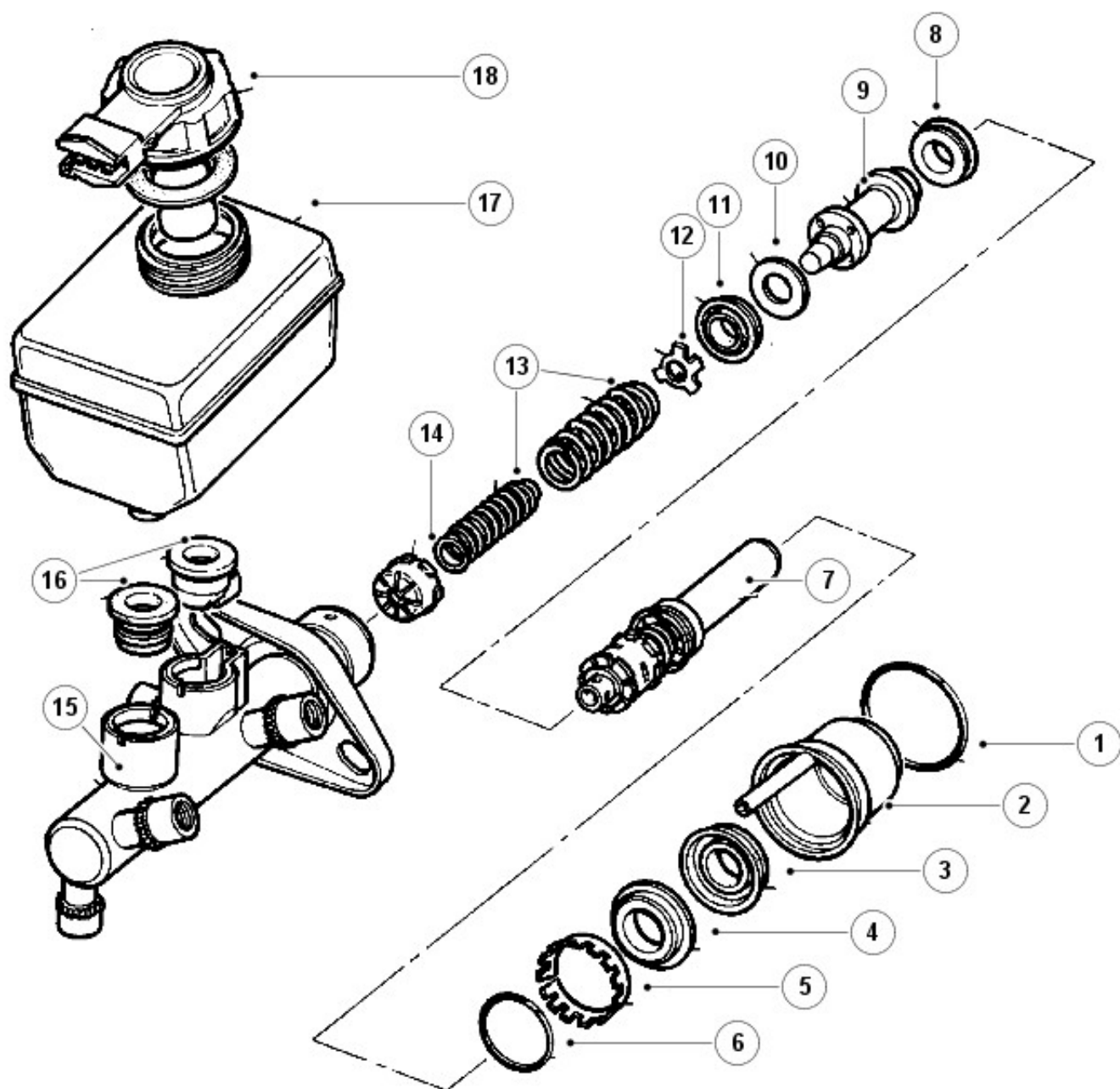
When the footbrake is applied, the primary plunger assembly moves up the cylinder bore and the pressure created acts in conjunction with the primary spring to overcome the secondary springs, thus moving the secondary plunger assembly up the bore. At the same time initial movement of both plungers takes the recuperating seals past the cut-off holes in the cylinder chambers 'A' and 'C', see graphic above, and applies pressure to the fluid in those chambers, which is directed to the respective circuits.

The fluid in chambers 'B' and 'D' is unaffected by movement of the plungers and can move unrestricted between the separate chambers and respective reservoirs in the fluid supply tank, both before and during brake application. When the brakes are released, the plunger assemblies, aided by the return springs are retracted faster than the fluid; this creates a depression between the fluid in chambers 'A' and 'C' and the recuperation seals.

The recuperation seals momentarily collapse allowing fluid in chambers 'B' and 'D' to flow through the holes in the plungers, over the collapsed seals and into chambers 'A' and 'C' respectively. The movement of fluid from one set of chambers to the other, is compensated for by fluid from the separate reservoirs in the supply tank moving through the feed holes in the cylinder. Conversely, the final return movement of the plunger assemblies causes the extra fluid in chambers 'A' and 'C' to move through the cut off holes into the fluid reservoir.

The servo unit provides controlled power assistance to the brake pedal when pressure is applied. Power is obtained from a vacuum pump located on the right-hand side of the engine cylinder block. The vacuum is applied to both sides of a flexing diaphragm, and by admitting atmospheric pressure to the rear diaphragm, assistance is obtained. The servo unit is mounted between the brake pedal and master cylinder and is linked to these by push rods. Should a vacuum failure occur, the two push rods will act as a single rod allowing the brakes to function in the normal way, although more effort will be required to operate the brake pedal.

Master cylinder overhaul components



ST3324M

Item	Part Number	Description
1	-	Water ingress seal
2	-	Transfer housing
3	-	Vacuum seal
4	-	Guide ring
5	-	Retaining ring
6	-	O-ring seal
7	-	Primary plunger assembly
8	-	'L' seal
9	-	Secondary plunger
10	-	Washer
11	-	Recuperating seal (primary cup)
12	-	Seal retainer
13	-	Springs
14	-	Swirl tube
15	-	Master cylinder body
16	-	Reservoir seals

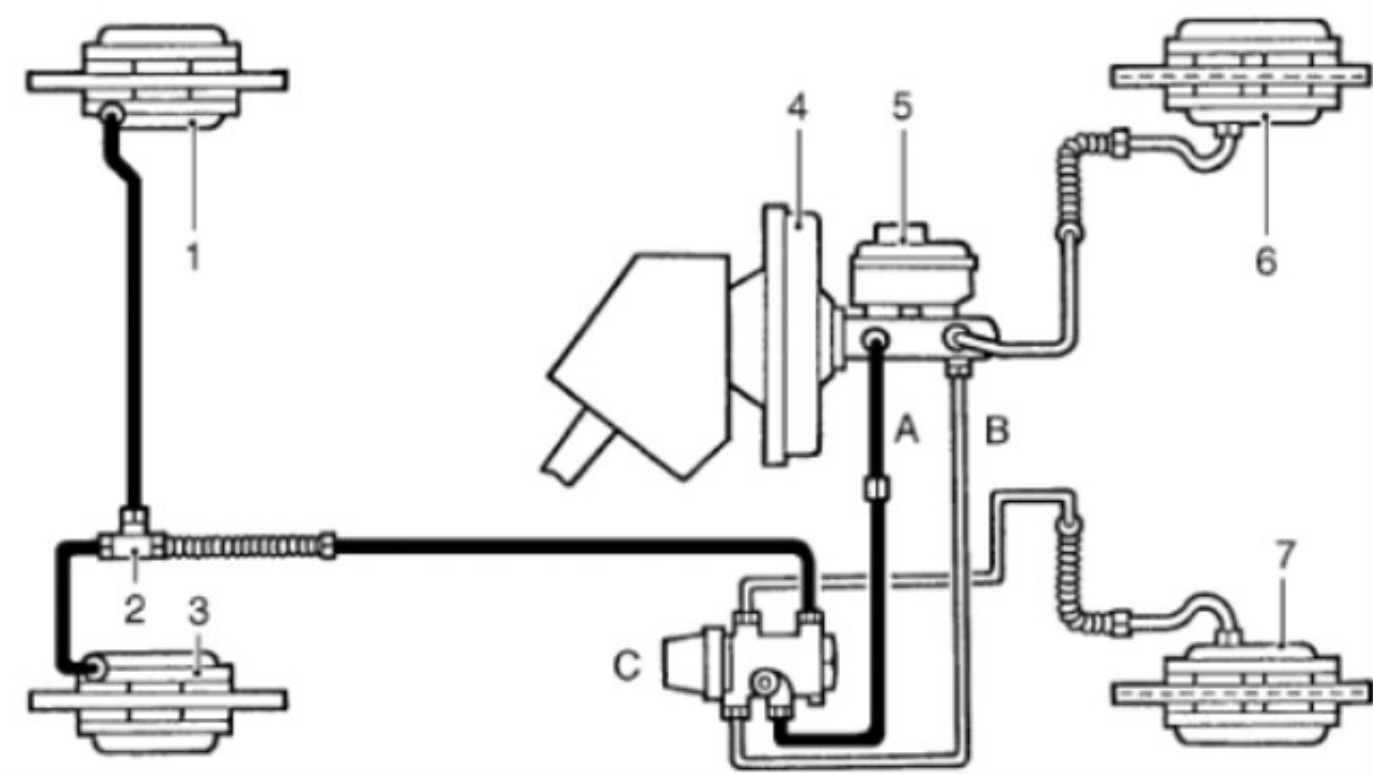
- 17 - Reservoir
- 18 - Low fluid level switch and cap

Hydraulic system

The brake system should be drained and flushed at the recommended service intervals.

On 90 models a pressure reducing valve (PRV), fitted to the right-hand bulkhead in the engine compartment, maintains the braking balance. Pressure to the rear calipers is regulated by the PRV, this valve is of the failure by-pass type, allowing full system pressure to the rear brake calipers in the event of a front (secondary) circuit failure.

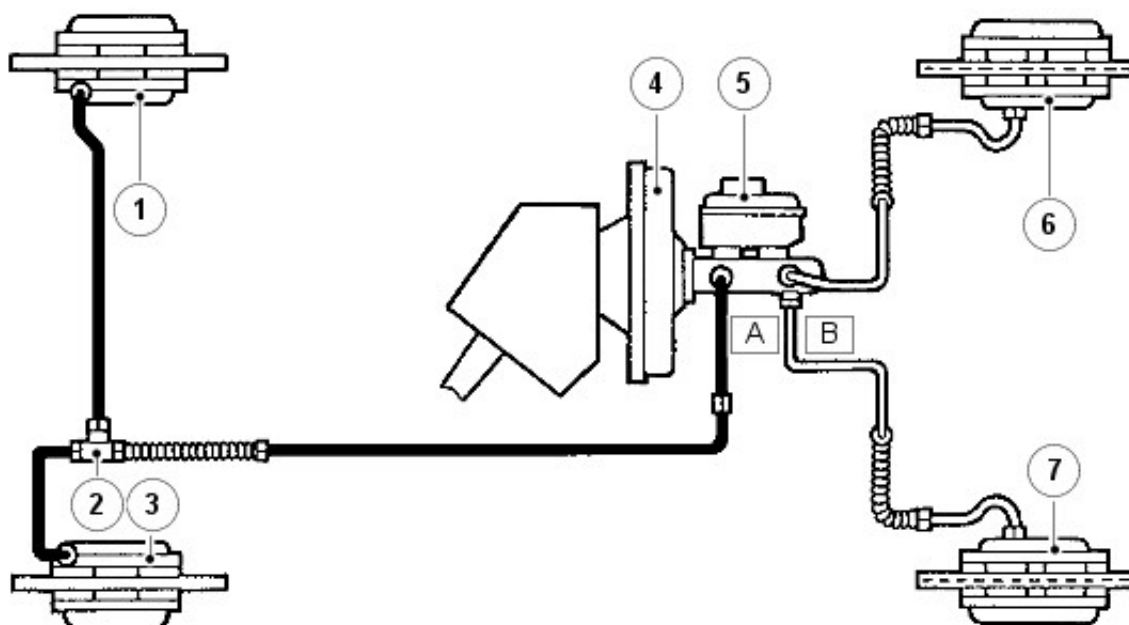
90 Models



J6322

110/130 Models

NOTE: In some countries, a pressure reducing valve may be fitted to 110 models to conform to legal requirements.

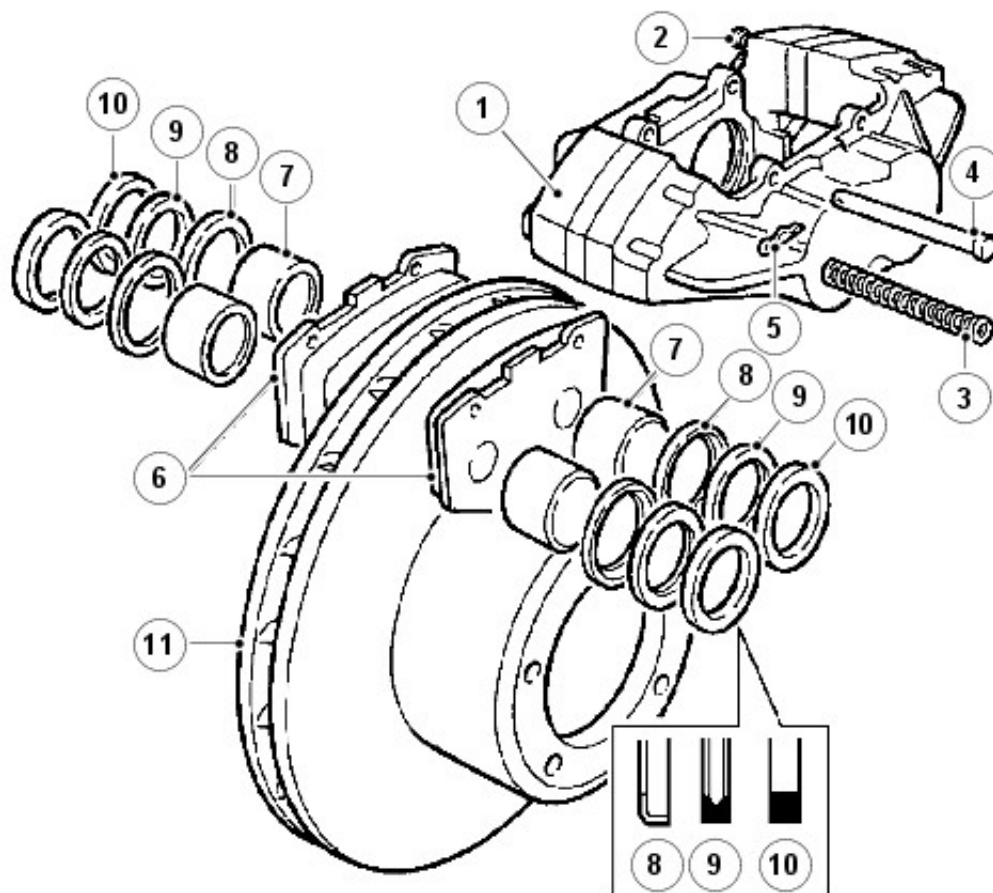


J6323

Item	Part Number	Description
A	-	Primary circuit
B	-	Secondary circuit
C	-	Pressure reducing valve
1	-	LH rear brake caliper
2	-	T Connector
3	-	RH rear brake caliper
4	-	Brake servo
5	-	Master cylinder and reservoir
6	-	LH front brake caliper
7	-	RH front brake caliper

Front brake caliper assembly

Front brake caliper components

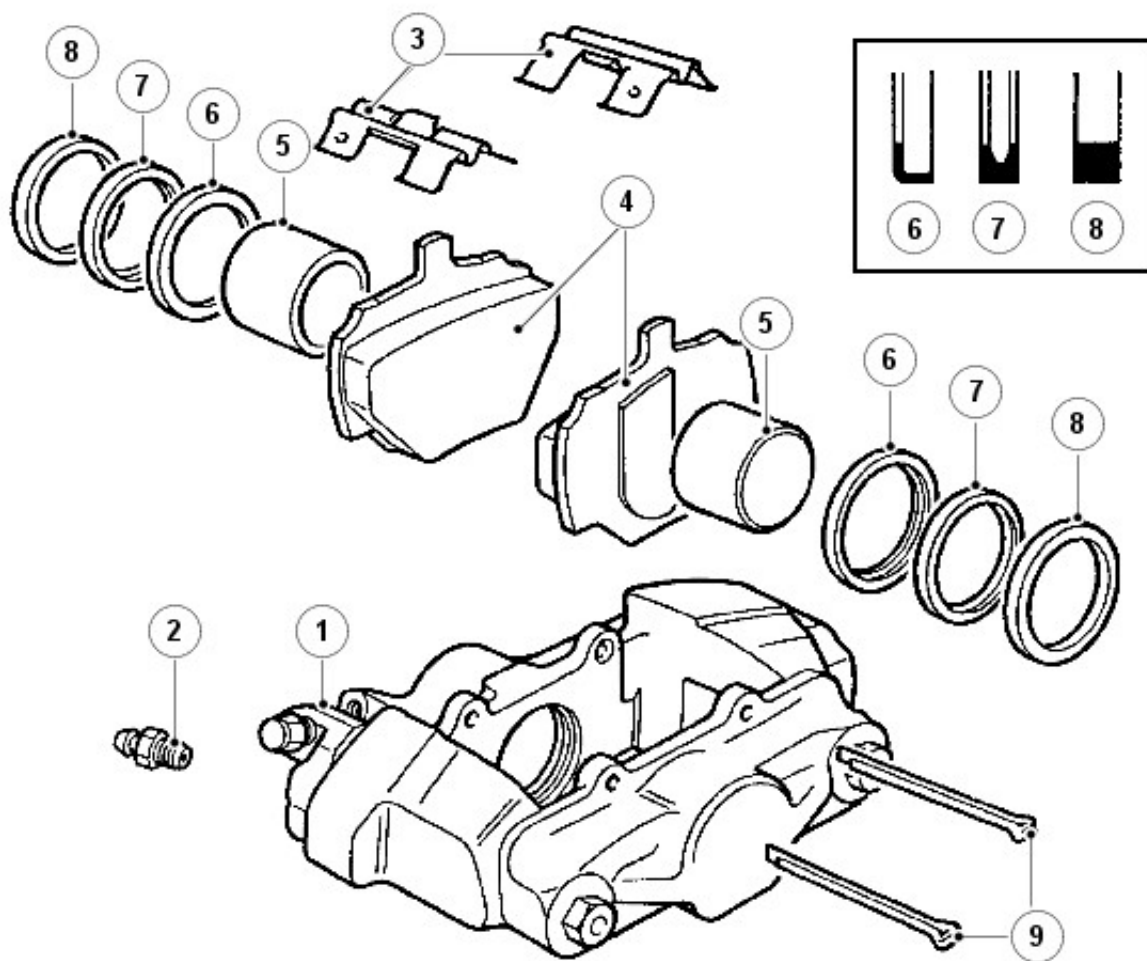


J6329

Item	Part Number	Description
1	-	Caliper
2	-	Bleed screw
3	-	Anti-rattle springs
4	-	Pad retaining pins
5	-	Split pin
6	-	Friction pads
7	-	Piston
8	-	Wiper seal retainer
9	-	Wiper seal
10	-	Fluid seal
11	-	Brake disc

Rear brake caliper assembly

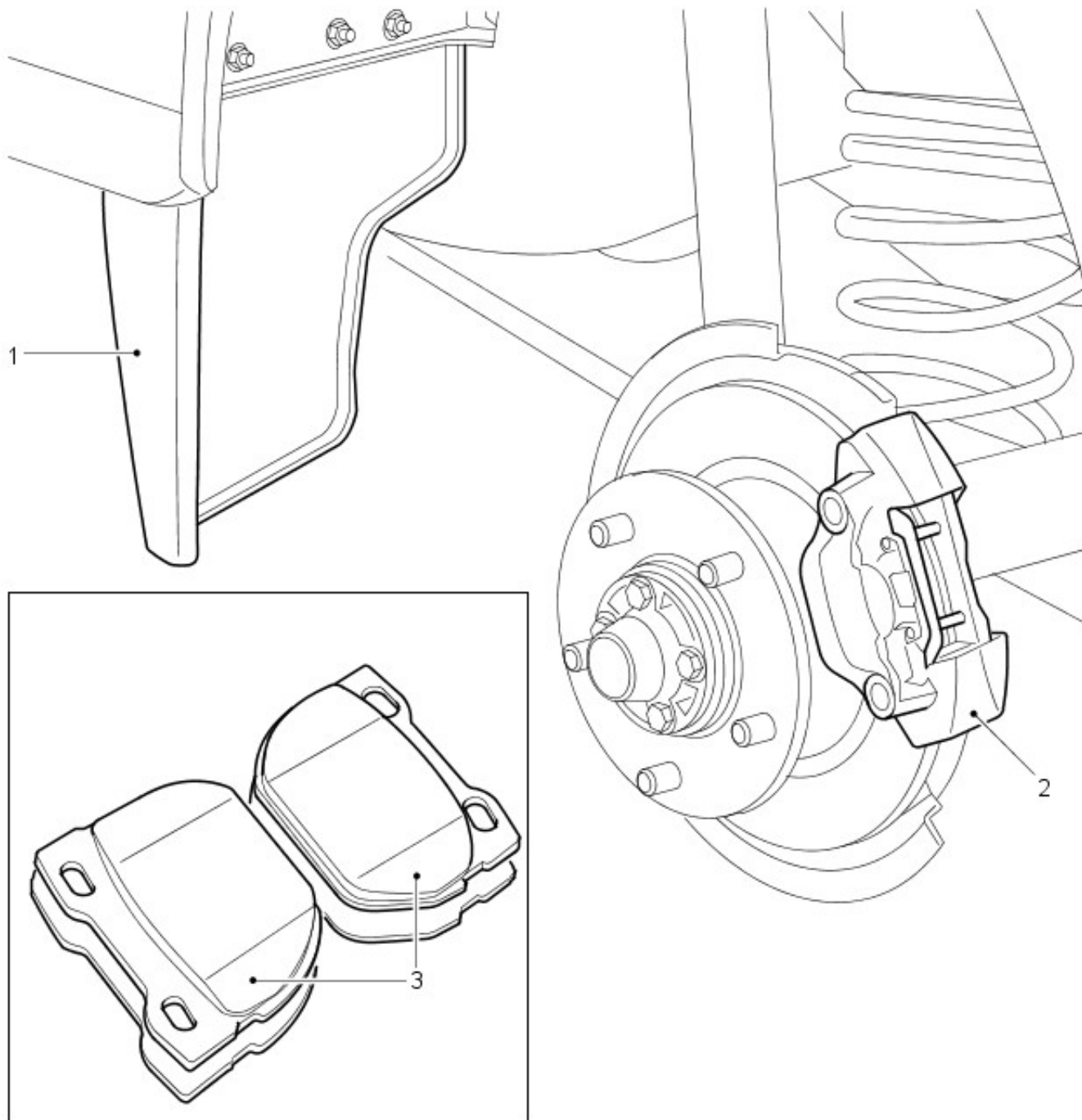
Rear brake caliper components



J6335

Item	Part Number	Description
1	-	Caliper
2	-	Bleed screw
3	-	Pad retaining springs
4	-	Brake pads
5	-	Piston
6	-	Wiper seal retainer
7	-	Wiper seal
8	-	Fluid seal
9	-	Retraining pins

Rear brake caliper installation - From 02MY



M701106A

Item	Part Number	Description
1	-	Deflector
2	-	Rear brake caliper
3	-	rear brake pads

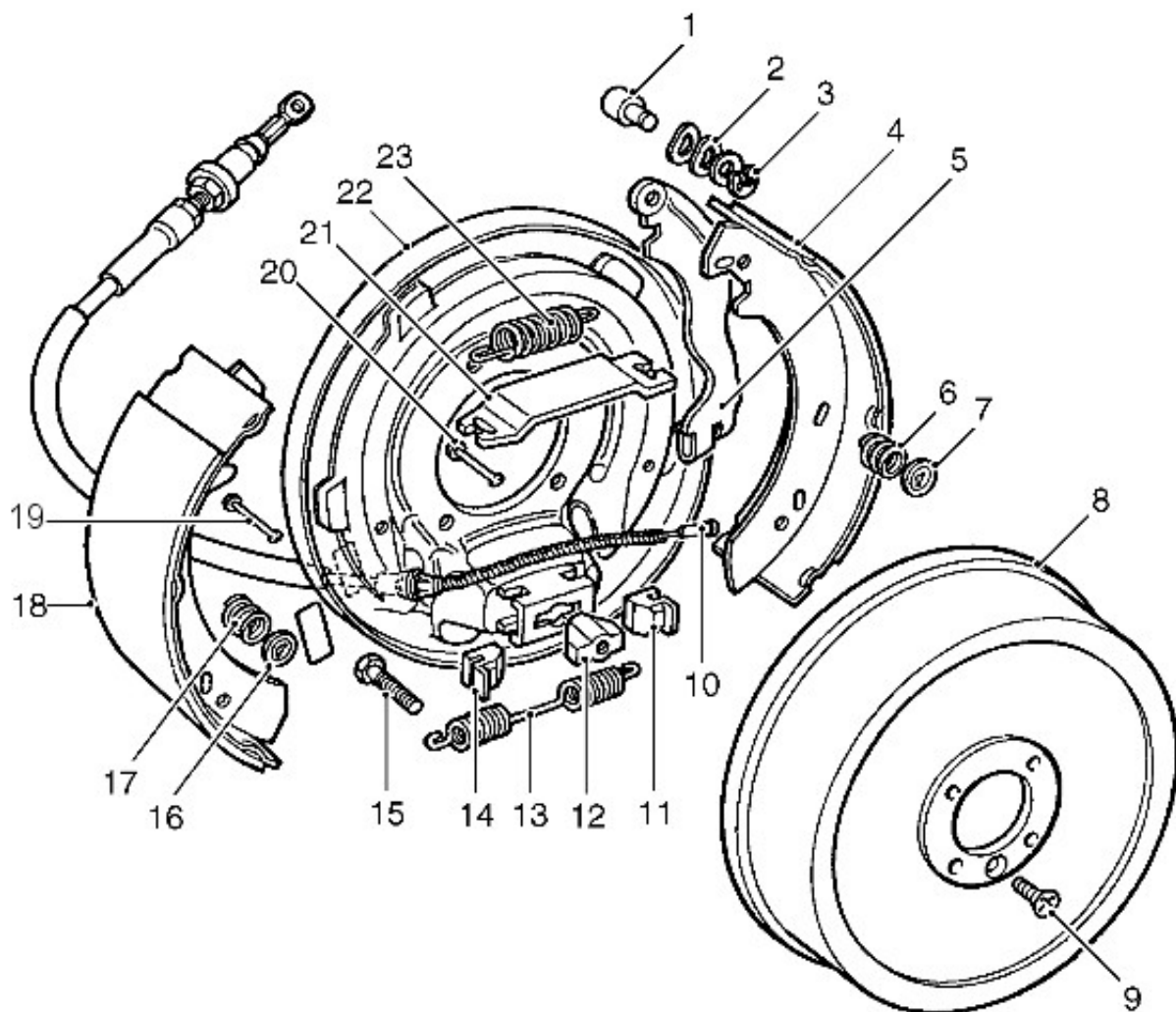
Modifications to the rear brakes have been introduced on 110 and 130 models. This is to increase the service life of the rear brake pads in harsh environments.

New rear brake calipers are introduced which allow the fitment of brake pads with a thicker friction material. The brake pads have increased leading and trailing edge chamfers which improve efficiency

Aerodynamic deflectors are located forward of the rear wheels to protect the rear calipers from the ingress of dirt, which can cause excessive pad wear. The deflectors are fitted to 90, 10 and 130 models in markets where environmental conditions can cause excessive brake pad wear.

Parking brake

Parking brake components



J6337

Item	Part Number	Description
1	-	Pin
2	-	Washer
3	-	'C' clip
4	-	Brake shoe
5	-	Cable lever
6	-	Hold down spring
7	-	Dished washer
8	-	Brake drum
9	-	Screw
10	-	Brake cable
11	-	Adjuster slide
12	-	Adjuster nut
13	-	Spring
14	-	Adjuster slide
15	-	Adjuster bolt
16	-	Dished washer
17	-	Hold down spring
18	-	Brake shoe
19	-	Hold down pin
20	-	Hold down pin
21	-	Abutment plate
22	-	Back plate
23	-	Spring

Brake System - General Information - Brake System Bleeding

General Procedures



WARNING: Do not allow brake fluid to come into contact with eyes or skin.

CAUTIONS:



Brake fluid can damage paintwork, if spilled wash off immediately with plenty of clean water.



Use only correct grade of brake fluid. If an assembly fluid is required use **ONLY** brake fluid. Do **NOT** use mineral oil, i.e. engine oil etc.



Thoroughly clean all brake calipers, pipes and fittings before commencing work on any part of the brake system. Failure to do so could cause foreign matter to enter the system and cause damage to seals and pistons which will seriously impair the efficiency of the brake system. To ensure the brake system efficiency is not impaired the following warnings must be adhered to :-

- DO NOT use any petroleum based cleaning fluids or any proprietary fluids containing petrol.
- DO NOT use brake fluid previously bled from the system.
- DO NOT flush the brake system with any fluid other than the recommended brake fluid. The brake system should be drained and flushed at the recommended service intervals. Cover all electrical terminals carefully to make absolutely certain that no fluid enters the terminals and plugs.
- Cover all electrical terminals carefully to make absolutely certain that no fluid enters the terminals and plugs.
- During bleed procedure, brake fluid level must not be allowed to fall below the MIN mark. Keep reservoir topped up to the MAX mark.
- To bleed the hydraulic circuits, four bleed nipples are provided, one at each caliper.

1. There are two methods by which air can be removed from the braking system:

1. MANUAL BLEED PROCEDURE
2. PRESSURE BLEED PROCEDURE

2. Pressure bleed procedure

1. Purpose designed equipment for pressure filling and bleeding of hydraulic systems may be used on Land Rover vehicles . The equipment manufacturers instructions must be followed and the pressure must not exceed 4.5 bar, 65lb/in.

3. Manual bleed procedure

- Equipment required
1. Clean glass receptacle
 2. Bleed hose
 3. Wrench
 4. Approx. 2 litres (3 pts) brake fluid

4. Master cylinder bleed

1. Disconnect battery negative lead
2. Depress brake pedal fully and slowly 5 times.
3. Release pedal and wait 10 seconds.
4. Repeat until firm resistance is felt at the pedal.

5. Complete circuit bleed

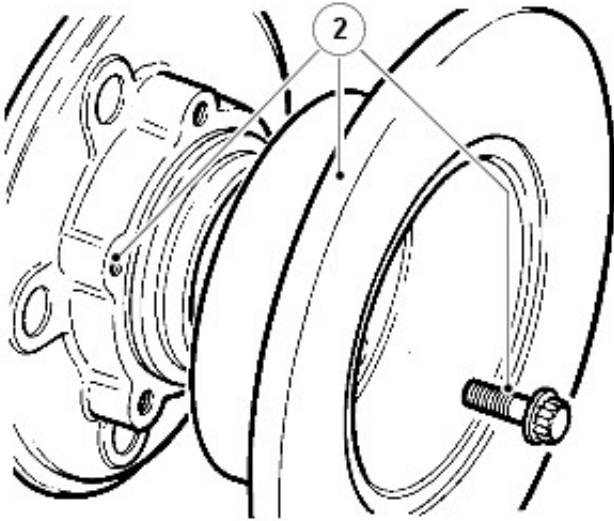
1. Disconnect battery negative lead
2. Fit bleed hose to caliper bleed screw.
3. Dip free end of bleed hose into brake fluid in bleed bottle.
4. Open bleed nipple.
5. Depress brake pedal fully several times until fluid is clear of air bubbles.
6. Keeping pedal fully depressed, tighten bleed nipple then release pedal.
7. Repeat procedure for remaining calipers.
8. Fit bleed screw protection caps.
9. Check/top-up fluid level when bleeding is complete.

Front Disc Brake - Brake Disc

Removal and Installation

Removal

1. Remove hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - 2.5L (Td5) Diesel (204-01, Removal and Installation).
2. Remove 5 hub to disc bolts.



J5369M

3. **NOTE:** On 110/130 vehicles ventilated discs are fitted as standard.

Tap disc to separate from hub.

Installation

1. Locate disc to hub.
2. Apply Loctite 270 to disc bolts and tighten to 73 Nm (54 lbf.ft).
3. Check total disc runout with a dial indicator, this must not exceed 0,15 mm, 0.006 in. If necessary reposition disc.
4. Instal hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub - 2.5L (Td5) Diesel (204-01, Removal and Installation).
5. Disc reclamation
6. **NOTE:** The disc **MUST BE** renewed if the minimum running thickness stamped on the disc is recorded.

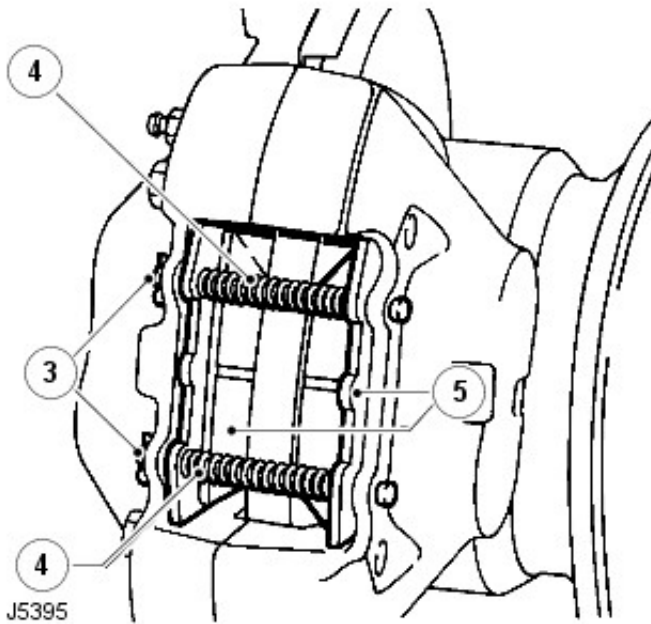
Check disc thickness. This dimension may be machined to minimum thickness of 12 mm (0.47 in.) - solid discs, 22 mm (0.90 in) - ventilated discs. Machine equal amount off each face.

Front Disc Brake - Brake Pads

Removal and Installation

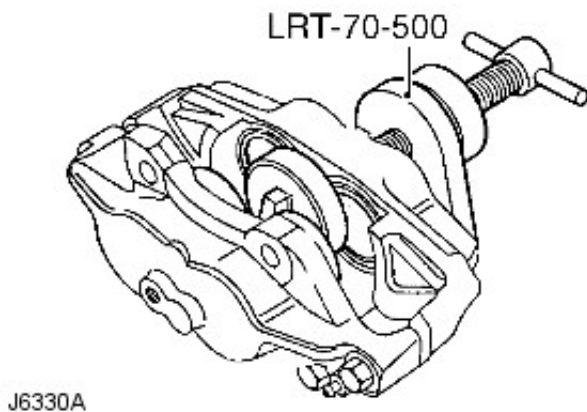
Removal

1. Remove front road wheels.
2. Clean exterior of calipers.
3. Remove split pin from retaining pins.
4. Remove pad retaining pins and anti-rattle springs.
5. Remove brake pads.



6. Clean exposed parts of pistons, using new brake fluid. Wipe away excess with a lint free cloth.

7. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.

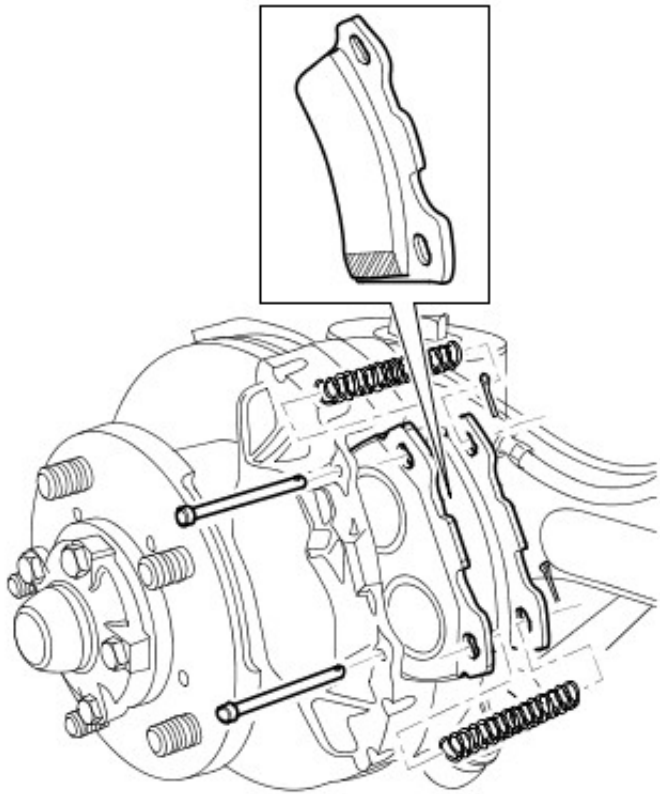


Installation

1. Instal brake pads.

NOTE: Ensure pads are correctly fitted, with leading edge chamfer fitted as shown.

2. Instal pad retaining pins and anti-rattle springs. Secure with new split pins.




M701113

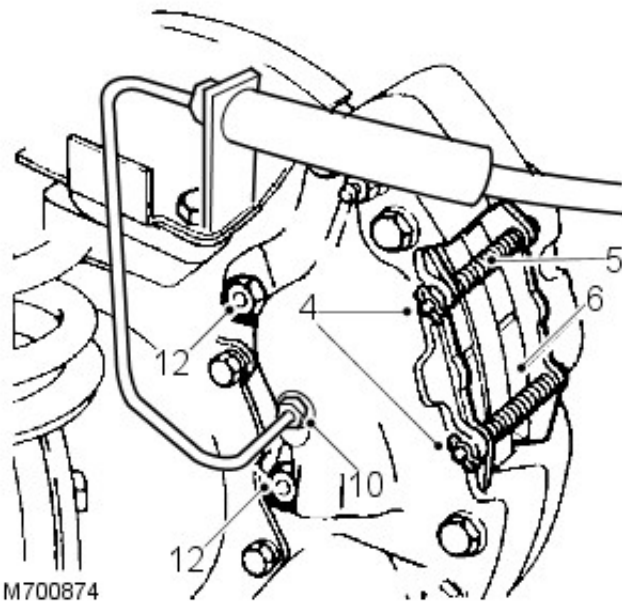
3. Apply brake pedal several times to locate pads.
4. Instal road wheels, remove chassis stands and jack. Tighten wheel nuts to 130 Nm (96 lbf.ft).
5. Check fluid reservoir. Top up if necessary, using correct grade of fluid.
For additional information, refer to: Specifications (206-00, Specifications).

Front Disc Brake - Brake Caliper

Removal and Installation

Removal

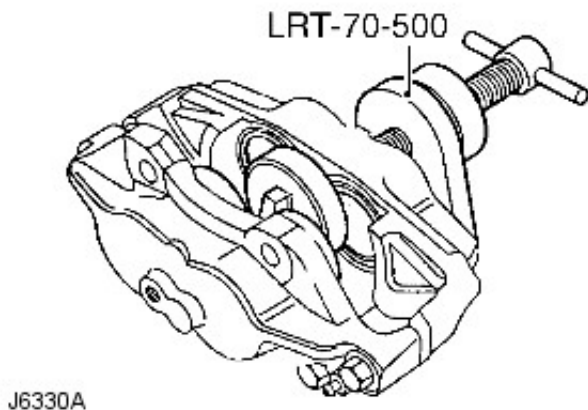
1. Loosen front road wheel nuts.
2.  **WARNING:** Support on safety stands.
Raise front of vehicle.
3. Remove road wheel.
4. Remove split pins from pad retaining pins.
5. Remove brake pad retainers and springs.
6. Remove brake pads and shim if fitted.
7. Pull back brake hose shield.
8. Clamp brake hose using a suitable clamp.
9. Position container beneath brake caliper to collect spillage.
10. Loosen brake pipe union and disconnect from caliper.
11. Plug brake pipe and caliper connections.
12. Remove 2 bolts securing caliper.



13. Remove brake caliper.

 **WARNING:** Do not separate caliper halves

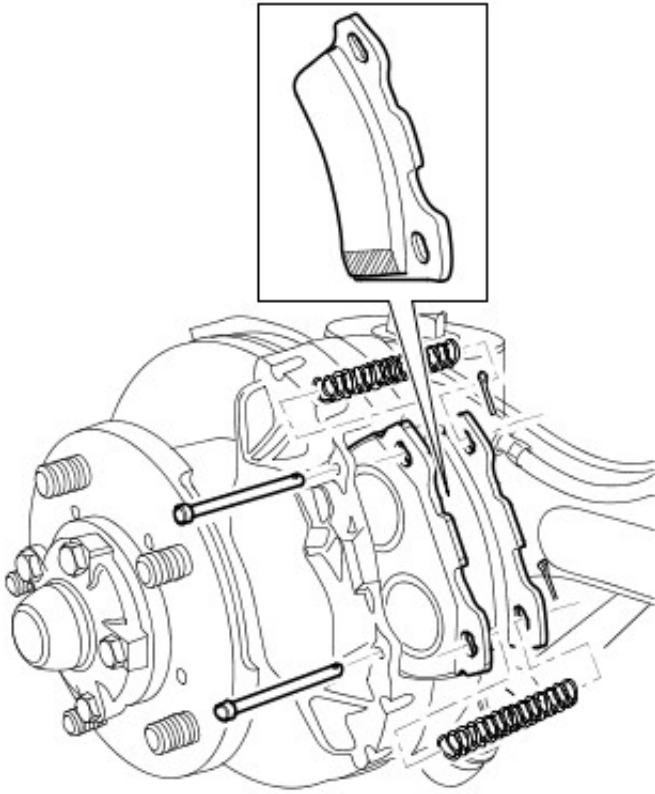
14. Clean outer surfaces of caliper using aerosol brake cleaner.
15. Using special tool LRT-70-500, clamp pistons in inboard half of caliper. Gently, keeping fingers clear, and with **CAUTION**, apply air pressure to fluid inlet port to expel pistons. It is unlikely that pistons will expel at same time, regulate rate with a suitable piece of wood between appropriate piston and caliper.



16. Finally remove pistons, identifying them with their respective bores.
17. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal. Pry retainer carefully from mouth of bore.
18. Taking care not to damage seal grooves, extract wiper seal and fluid seal.
19. Clean bores, pistons and seal grooves using clean brake fluid only. If caliper or pistons are corroded, or their condition is not perfect, new parts must be fitted.
20. Coat new fluid seal with brake fluid. Ease seal into groove in bore using only fingers, ensuring it is properly seated. Fluid seal and groove are not same in section, so when seal is seated it feels raised to touch at edge furthest away from mouth of bore.
21. Coat appropriate piston with brake fluid. Insert it squarely into bore by hand only. Do not tilt piston during insertion, leave approximately 8mm projecting from bore.
22. Coat new wiper seal with brake fluid and fit to new seal retainer. Slide assembly, seal first, over protruding piston and into bore recess. Use piston clamp to press home seal retainer and piston.
23. Clamp outboard pistons and carry out same procedure for removing and fitting outboard pistons and seals.

Installation

1. Clean caliper to hub mating faces.
2. Position caliper to hub, install bolts and tighten to 82 Nm (60 lbf.ft).
3. Remove plugs from pipe to caliper connections and wipe.
4. Connect pipe to caliper, tighten union to 15 Nm (11 lbf.ft).
5. Apply a light film of grease to rear of brake pads.
6. Install pads to calipers. From 02MY, ensure pads are correctly fitted, with leading edge chamfer fitted as shown.



M701113

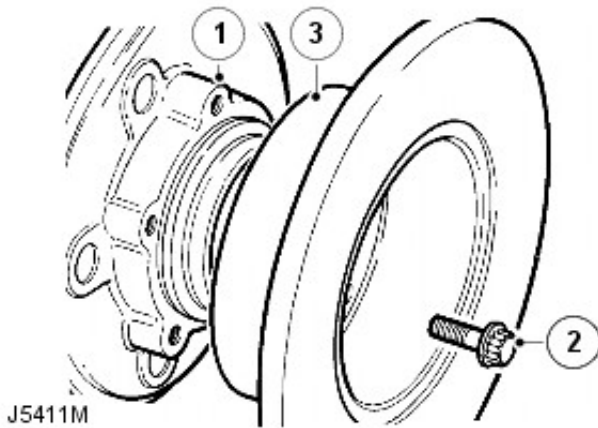
7. Install pad retainers and springs.
8. Install split pins to retainers.
9. Remove brake hose clamp.
10. Bleed brakes.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).
11. Depress brake pedal to seat pads onto discs.
12. Install road wheels, remove axle stands and tighten nuts to 130 Nm (96 lbf.ft).

Rear Disc Brake - Brake Disc

Removal and Installation

Removal

1. Remove rear wheel bearing and hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub (204-02, Removal and Installation).
2. Remove disc bolts.
3. Remove disc from rear hub.



Installation

1. Install disc to rear hub.
2. Install disc bolts. Tighten to 73 Nm (54 lbf.ft).
3. Check total disc run out, this must not exceed 0,15 mm (0.006 in).
If necessary reposition disc.
4. Install rear wheel bearing and hub assembly.
For additional information, refer to: Wheel Bearing and Wheel Hub (204-02, Removal and Installation).
5. Disc reclamation.
6. **NOTE:** The brake disc **MUST BE** renewed if the minimum running thickness stamped on the disc is recorded.

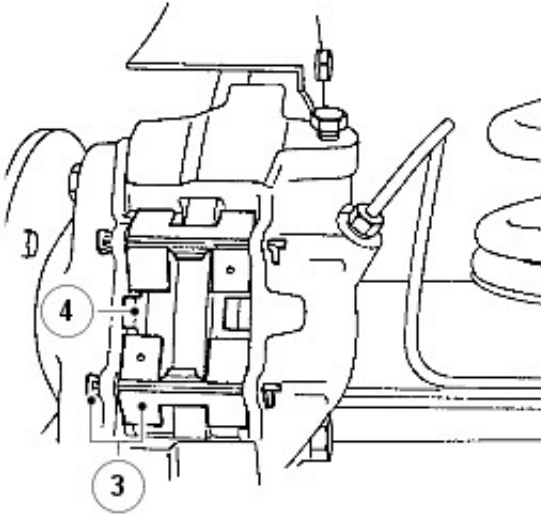
Check disc thickness. This dimension may be machined to minimum thickness of 12 mm. Machine equal amounts off each face.

Rear Disc Brake - Brake Pads90

Removal and Installation

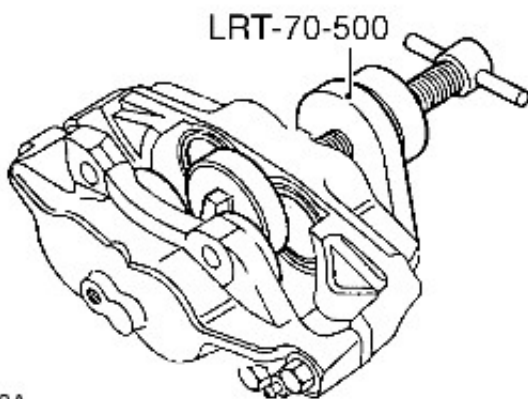
Removal

1. Remove rear road wheels.
2. Clean exterior of calipers.
3. Remove pad retaining pins and anti-rattle springs.
4. Remove brake pads and shims.



J6327

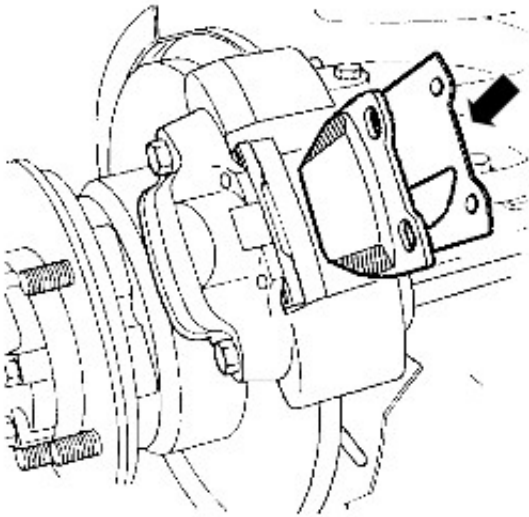
5. Clean exposed parts of pistons, using new brake fluid.
6. Wipe away excess fluid with lint free cloth.
7. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.



J6330A

Installation

1. Instal brake pads and shims. Ensure shims are correctly fitted, see illustration.



M701116

NOTE: Vehicles from 02MY have leading and trailing edge chamfers on rear pads. Shims are also fitted.

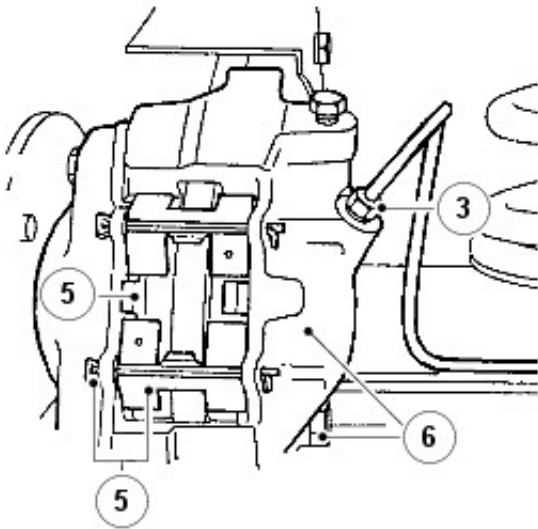
2. Instal anti-rattle springs and secure with retaining pins.
3. Apply brake pedal several times to locate pads.
4. Install road wheels, remove chassis stands and jack. Tighten wheel nuts to 130 Nm (96 lbf.ft).
5. Check fluid reservoir, top up if necessary, using correct grade of fluid.
For additional information, refer to: Specifications (206-00 Brake System - General Information, Specifications).

Rear Disc Brake - Brake Caliper90

Removal and Installation

Removal

1. Remove rear road wheels.
2. Using a recognised hose clamp, clamp flexible brake hose above rear axle.
3. Remove brake pipe from rear brake caliper.
4. Seal pipe ends to prevent ingress of dirt.
5. Remove retaining pins and springs and withdraw pads. If same pads are to be refitted, identify them for assembly in original positions.
6. Remove 2 bolts and withdraw caliper from rear axle.

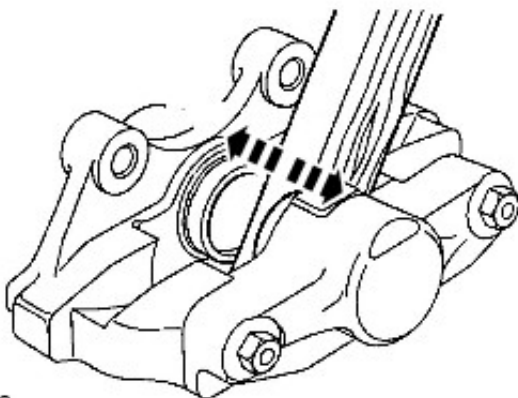


J6331



WARNING: Do not separate caliper halves.

7. Clean outer surfaces of caliper with aerosol brake cleaner.
8. WITH CAUTION expel pistons from their bores by applying air pressure to fluid inlet port. It is unlikely both pistons will expel at same time, regulate rate with a suitable piece of wood inserted between two pistons.



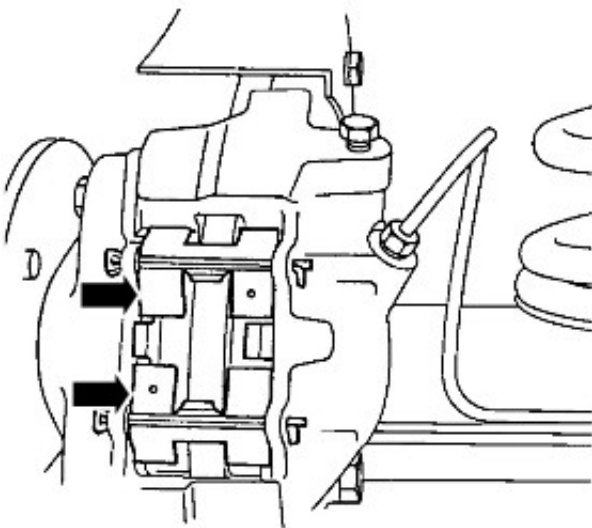
J6333

9. Finally, remove pistons keeping them identified with their respective bores.
10. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal and pry retainer carefully from mouth of bore.
11. Taking care not to damage seal grooves, extract wiper seal and fluid

12. Taking care not to damage seal grooves, extract wiper seal and install seal.

Installation

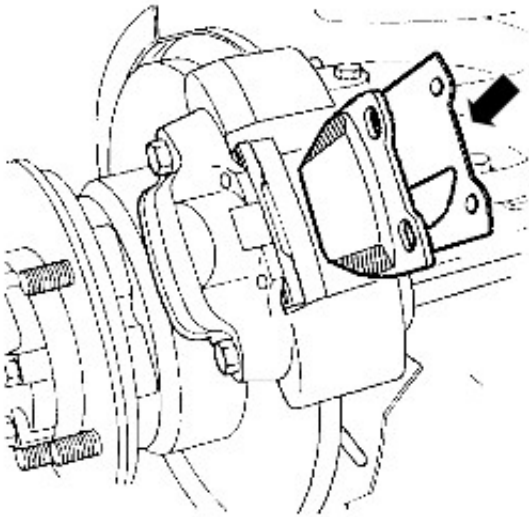
1. Clean bores, pistons and particularly seal grooves using clean brake fluid only. If caliper or pistons are corroded or their condition is not perfect new parts must be fitted.
2. Apply brake fluid to new seals. Fit seals into groove in bores. When seals are seated they feel raised to touch at edge furthest away from mouth of bores.
3. Coat pistons with brake fluid. Insert them squarely into bores. Do not tilt pistons during insertion and leave 8mm projecting from bores.
4. Coat new wiper seals with brake fluid and fit to new seal retainers. Slide assemblies, seal first, over protruding piston into bore recesses.
5. Using special tool LRT-70-500 - piston clamp, press home seal retainer and piston. Carry out same procedure for fitting outboard pistons and seals.
6. Instal calipers and pads to vehicle.
7. Instal caliper to axle, tighten 2 bolts evenly to 82 Nm (60 lbf.ft).
8. Connect brake pipe to caliper. Tighten to 15 Nm (11 lbf.ft).
9. Remove clamp from flexible brake hose.
10. **Up to 2002 MY**, insert pads and retaining springs, secure in position with new retaining pins and spread ends or fit new split pins, depending on vehicle model.



J6334

11. **NOTE:** Vehicles from 02 MY have leading and trailing edge chamfers on rear pads.

2002MY on, ensure shim are correctly fitted, see illustration.



M701116

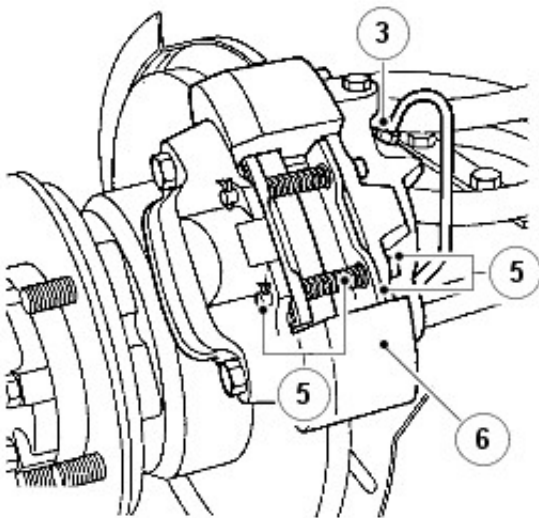
12. Bleed brake system .
For additional information, refer to: Brake System Bleeding (206-00 Brake System - General Information, General Procedures).
13. Press brake pedal firmly several times to locate pads.
14. Fit road wheels, remove axle stands. Finally tighten road wheel nuts to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)
15. Road test vehicle. Note new brake pads require 'bedding-in', for several hundred miles before brakes are at maximum efficiency.

Rear Disc Brake - Brake Caliper 110/130

Removal and Installation

Removal

1. Remove rear road wheels.
2. Using a recognised hose clamp, clamp flexible brake hose above rear axle.
3. Remove brake pipe from rear brake caliper.
4. Seal pipe ends to prevent ingress of dirt.
5. Remove retaining pins and springs and withdraw pads. If same pads are to be refitted, identify them for assembly in original positions.
6. Remove 2 bolts and withdraw caliper from rear axle.

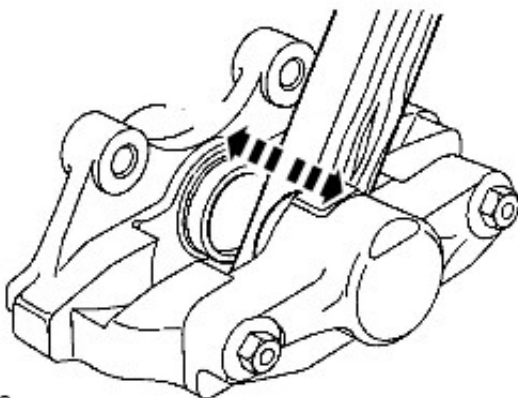


J6332



WARNING: Do not separate caliper halves.

7. Clean outer surfaces of caliper with aerosol brake cleaner.
8. WITH CAUTION expel pistons from their bores by applying air pressure to fluid inlet port. It is unlikely both pistons will expel at same time, regulate rate with a suitable piece of wood inserted between two pistons.



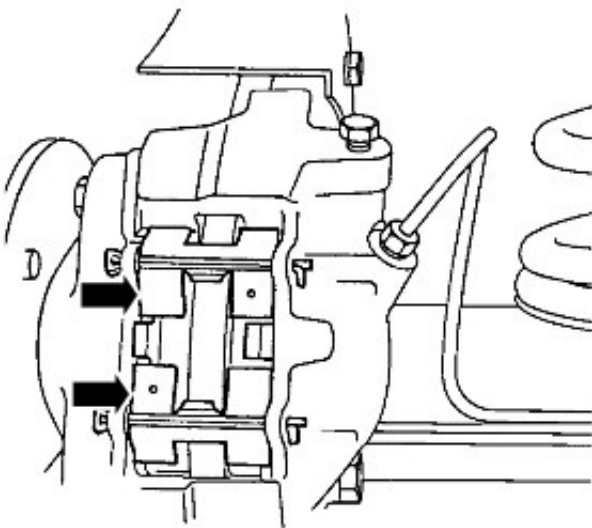
J6333

9. Finally, remove pistons keeping them identified with their respective bores.
10. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal and pry retainer carefully from mouth of bore.
11. Taking care not to damage seal grooves, extract wiper seal and fluid

22. Taking care not to damage seal grooves, extract wiper seal and install new seal.

Installation

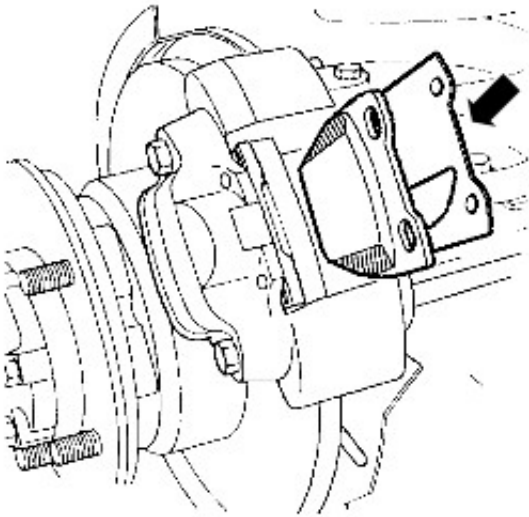
1. Clean bores, pistons and particularly seal grooves using clean brake fluid only. If caliper or pistons are corroded or their condition is not perfect new parts must be fitted.
2. Apply brake fluid to new seals. Fit seals into groove in bores. When seals are seated they feel raised to touch at edge furthest away from mouth of bores.
3. Coat pistons with brake fluid. Insert them squarely into bores. Do not tilt pistons during insertion and leave 8mm projecting from bores.
4. Coat new wiper seals with brake fluid and fit to new seal retainers. Slide assemblies, seal first, over protruding piston into bore recesses.
5. Using special tool LRT-70-500 - piston clamp, press home seal retainer and piston. Carry out same procedure for fitting outboard pistons and seals.
6. Instal calipers and pads to vehicle
7. Instal caliper to axle, tighten 2 bolts evenly to 82 Nm (60 lbf.ft).
8. Connect brake pipe to caliper. Tighten to 15 Nm (11 lbf.ft).
9. Remove clamp from flexible brake hose.
10. **Up to 2002 MY**, insert pads and retaining springs, secure in position with new retaining pins and spread ends or fit new split pins, depending on vehicle model.



J6334

11. **NOTE:** Vehicles from 02 MY have leading and trailing edge chamfers on rear pads.

2002MY on, ensure shim are correctly fitted, see illustration.



M701116

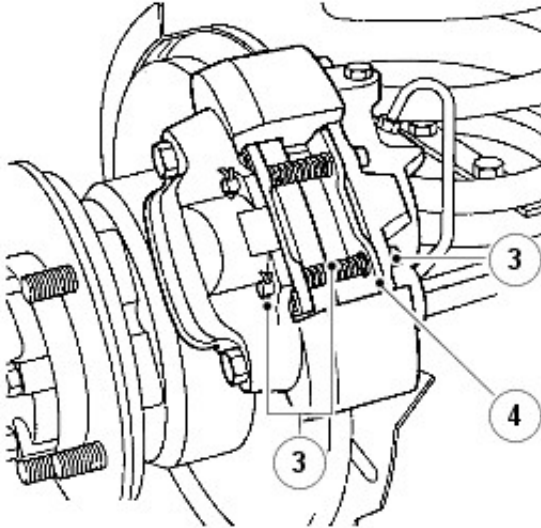
12. Bleed brake system .
For additional information, refer to: Brake System Bleeding (206-00 Brake System - General Information, General Procedures).
13. Press brake pedal firmly several times to locate pads.
14. Instal road wheels, remove axle stands. Finally tighten road wheel nuts to correct torque:
 1. Alloy wheels - 130 Nm (96 lbf.ft)
 2. Steel wheels - 100 Nm (80 lbf.ft)
 3. Heavy duty wheels - 170 Nm (125 lbf.ft)
15. Road test vehicle. Note new brake pads require 'bedding-in', for several hundred miles before brakes are at maximum efficiency.

Rear Disc Brake - Brake Pads 110/130

Removal and Installation

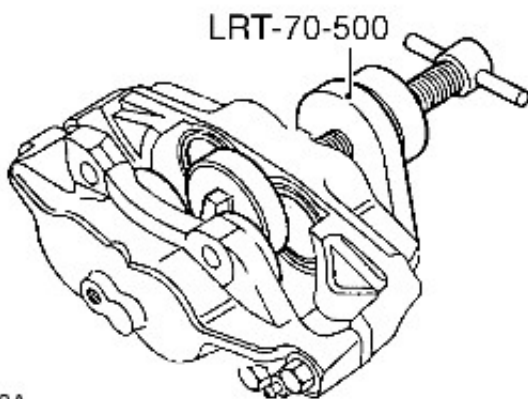
Removal

1. Remove rear road wheels.
2. Clean exterior of calipers.
3. Remove pad retaining pins and anti-rattle springs.
4. Remove brake pads and shims.



J6328

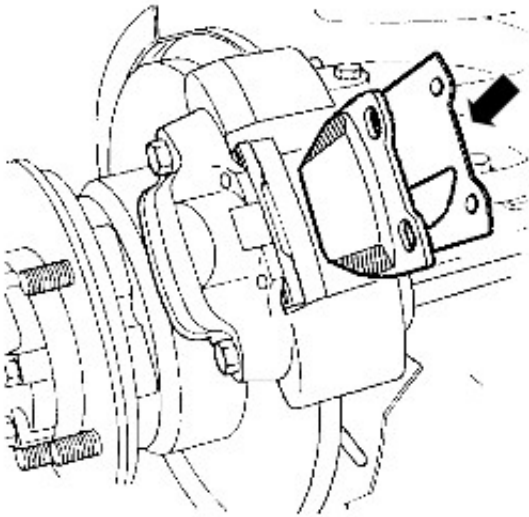
5. Clean exposed parts of pistons, using new brake fluid.
6. Wipe away excess fluid with lint free cloth.
7. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.



J6330A

Installation

1. Instal brake pads and shims. Ensure shims are correctly installed, see illustration.



M701116

NOTE: Vehicles from 02MY have leading and trailing edge chamfers on rear pads. Shims are also fitted.

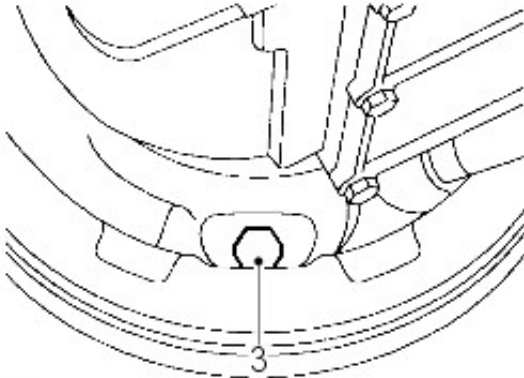
2. Instal anti-rattle springs and secure with retaining pins.
3. Apply brake pedal several times to locate pads.
4. Instal road wheels, remove chassis stands and jack. Tighten wheel nuts to 130 Nm (96 lbf.ft).
5. Check fluid reservoir, top up if necessary, using correct grade of fluid.
For additional information, refer to: Specifications (206-00, Specifications).

Parking Brake and Actuation - Parking Brake Shoe and Lining Adjustment


General Procedures

NOTE: The parking brake should be fully operational on third notch of ratchet.

1. Raise one rear wheel clear of ground and support on axle stand.
2. Release parking brake lever.
3. Tighten brake adjuster to 25 Nm (18 lbf.ft) to fully expand shoes to drum.



M700873

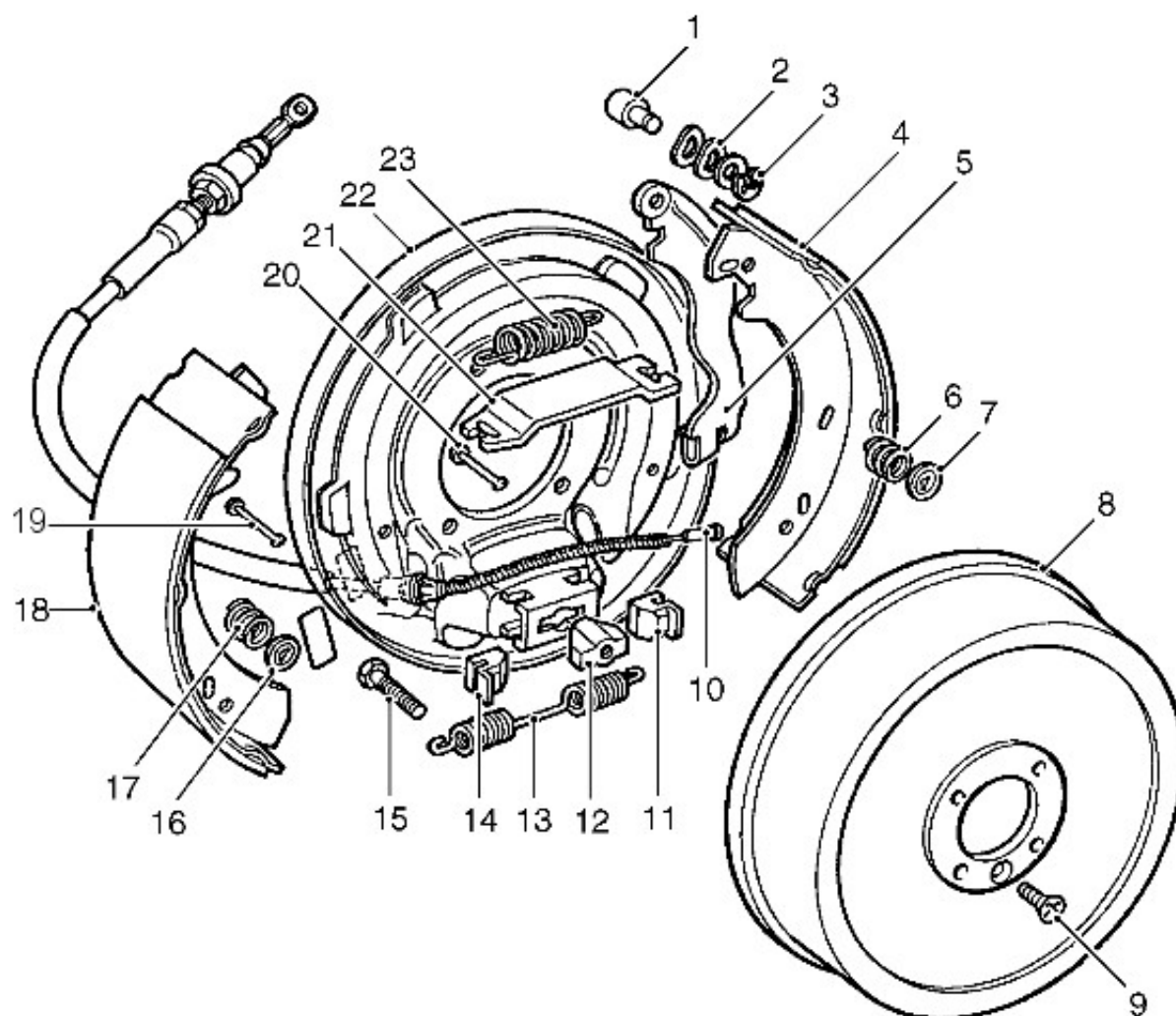
4. Back off adjuster 1½ turns, check that drum is free to rotate.
5.  **CAUTION:** Cable adjustment must ONLY be used for initial setting and to compensate for cable stretch. It MUST NOT be used to take up brake shoe wear, which MUST be adjusted at brake drum.

Check operation of parking brake lever to give pawl 2 notches free movement on ratchet before being fully operational on third notch of ratchet. Adjust parking brake accordingly if lever travel exceeds the above tolerance.
6. Remove axle stand and wheel chock.

Parking Brake and Actuation - Parking Brake Cable

Removal and Installation

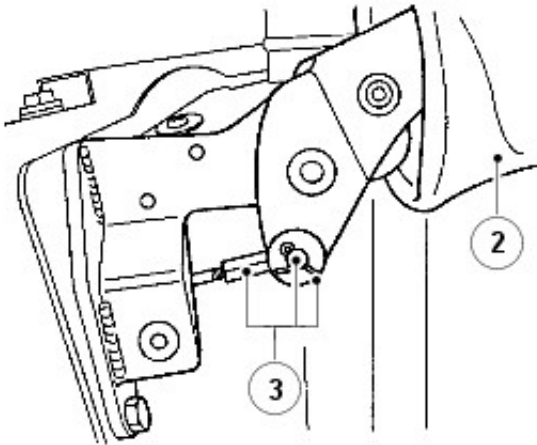
Removal



J6337

Item	Part Number	Description
1	-	Pin
2	-	Washer
3	-	'C' Circlip
4	-	Brake shoe
5	-	Cable lever
6	-	Hold down spring
7	-	Dished washer
8	-	Brake drum
9	-	Screw
10	-	Brake cable
11	-	Adjuster slide
12	-	Adjuster nut
13	-	Spring
14	-	Adjuster slide
15	-	Adjuster bolt
16	-	Dished washer
17	-	Hold down spring
18	-	Brake shoe
19	-	Hold down pin
20	-	Hold down pin
21	-	Abutment plate
22	-	Back plate

1. Park vehicle on level ground, chock road wheels and release parking brake. Alternatively, raise vehicle on ramp.
2. Remove 3 trim studs and lift up parking brake gaiter.

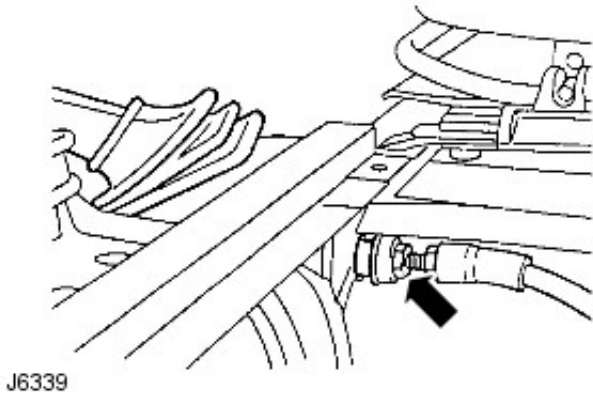


J6338

3. Remove split pin, clevis pin, washer and disconnect cable from parking brake lever.
4. Slacken off transmission brake drum adjusting screw.
5. Disconnect drive shaft from output flange.
6. Remove retaining screw and withdraw brake drum.
7. Release parking brake cable clevis from abutment on cable lever, see J6337, and pull through aperture in back plate.
8. Pull cable from heelboard and remove from vehicle.

Installation

1. Feed new cable through heelboard ensuring rubber grommet is correctly located.
2. Position cable over guide plate, insert through backplate and connect to cable lever.
3. Instal cable to parking brake lever and secure with clevis pin and split pin.
4. Instal parking brake gaiter.
5. Instal brake drum. Tighten screw to 25 Nm (18 lbf.ft).
6. Screw in and tighten adjuster bolt until brake drum will not rotate by hand.
7. Tighten adjuster bolt further to 25 Nm (18 lbf.ft) to ensure brake drum is locked.
8. Slacken off adjuster bolt by 1.5 turns to give brake shoes running clearance. Check that the drum is free to rotate.
9. Slacken locknut and adjust cable to give the parking brake pawl two notches free movement on the ratchet before being fully operational on third notch (brake shoes are fully expanded against drum).



NOTE: Cable adjustment is for a new cable or to compensate for cable stretch. Cable adjustment must not be used to take up brake shoe wear.

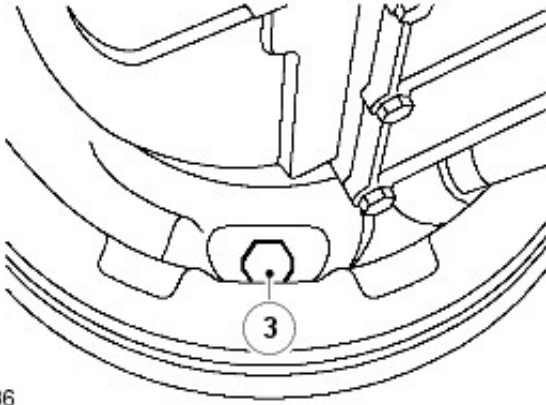
10. Instal drive shaft to output flange. Tighten fixings to 46 Nm (34 lbf.ft).
11. Remove wheel chocks and check operation of parking brake.

Parking Brake and Actuation - Shoes

Removal and Installation

Removal

1. Park vehicle on level ground, chock road wheels and release parking brake. Alternatively, raise vehicle on a ramp.
2. Disconnect rear propeller shaft from transmission output flange at brake drum.
3. Slacken off parking brake drum adjustment bolt.



J6336

4. Remove single screw securing brake drum to output flange.
5. Withdraw drum to expose brake assembly.
6. Release top and bottom springs from brake shoes, see J6337. For additional information, refer to: Parking Brake Cable (206-05, Removal and Installation).
7. Grip dished washer with a pair of pliers, depress washer and turn through 90°.
8. Remove dished washer, complete with hold down spring and pin from both shoes.
9. Move brake shoes out from adjuster slides, release from abutment plate and remove from backplate.
10. Check that springs are satisfactory for continued use. If new brake shoes are to be fitted, the springs should also be renewed.

Installation

1. Locate RH brake shoe in slide and secure brake shoe and lever assembly to backplate with hold down pin, spring and dished washer.
2. Locate LH brake shoe in slide and fit abutment plate between both brake shoes. Secure LH shoe with hold down pin, spring and dished washer.
3. Instal pull-off springs to brake shoes.
4. Instal brake drum. Tighten screw to 25 Nm (18 lbf.ft).
5. Check that hand brake lever is released.
6. Screw in and tighten adjuster bolt until brake drum will not rotate by hand.
7. Tighten adjuster bolt to 25 Nm (18 lbf.ft) to ensure brake drum is locked.

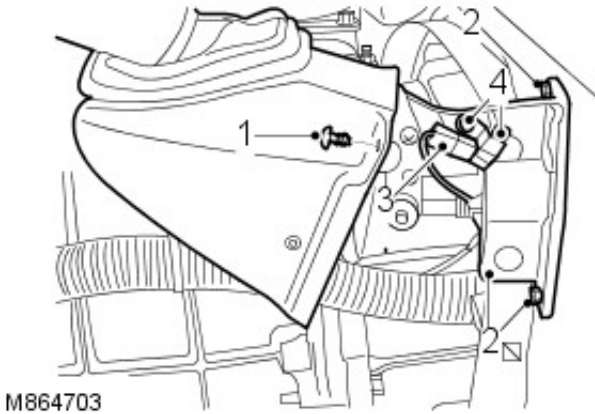
8. Slacken off adjuster bolt by 1.5 turns to give shoes a running clearance. Check that the drum is free to rotate.
9. Instal propeller shaft to output flange. Tighten fixings to 46 Nm (34 lbf.ft).
10. Remove wheel chocks and check operation of parking brake.

Parking Brake and Actuation - Parking Brake Switch

Removal and Installation

Removal

1. Release cover from parking brake lever.
2. Remove 2 bolts and release parking brake lever from body.
3. Release connector from parking brake switch.
4. Remove 2 screws securing parking brake switch to parking brake lever and remove switch.




Installation

1. Install parking brake switch to parking brake lever and tighten screws.
2. Install connector to parking brake switch.
3. Position parking brake lever and tighten bolts to 22 Nm (16 lbf.ft).
4. Position cover to parking brake lever.

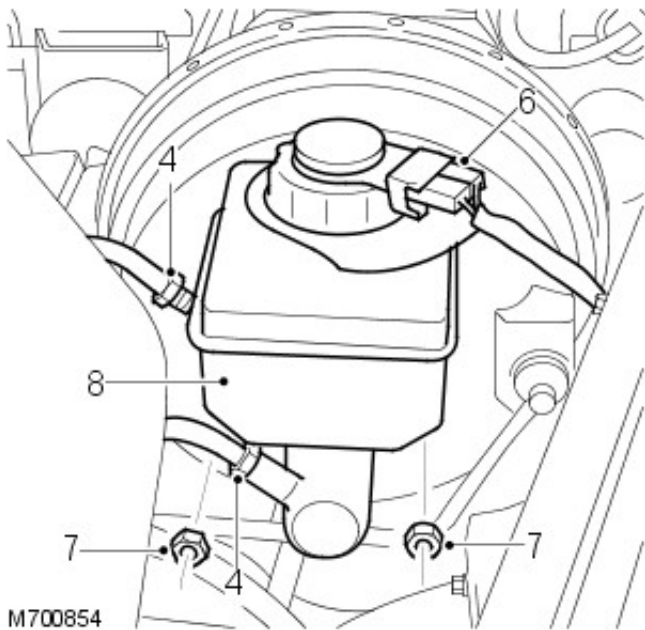
Hydraulic Brake Actuation - Brake Master Cylinder

Removal and Installation

Removal

1. Disconnect battery negative lead.
2.  **CAUTION:** Do not allow brake fluid to contact paint finished surfaces as paint may be damaged. If spilled, remove fluid and clean are with clean warm water.

Place a container under the master cylinder to collect any brake fluid spillage.
3. Clean area around master cylinder ports.
4. Loosen 2 unions securing brake pipes to master cylinder ports.
5. Disconnect both brake pipes from master cylinder. Cover, not plug, pipe ends to prevent entry of dirt.
6. Release 2 connectors from reservoir cap.
7. Remove 2 nuts securing master cylinder to brake booster.
8. Withdraw master cylinder from booster and remove.



9. Carefully ease reservoir from master cylinder by rolling it from seals.
10. **NOTE:** Master cylinder to reservoir seals are different sizes.
Remove seals from master cylinder.

Installation

1. Instal NEW seals to master cylinder, ensuring seals are fitted to correct ports.
2. Instal reservoir to master cylinder.
3. Ensuring that water ingress seal is in position, instal master cylinder to booster.
4. Instal nuts securing master cylinder to booster and tighten to 26 Nm (19 lbf.ft).
5. Connect brake pipes to master cylinder and tighten unions to 15 Nm

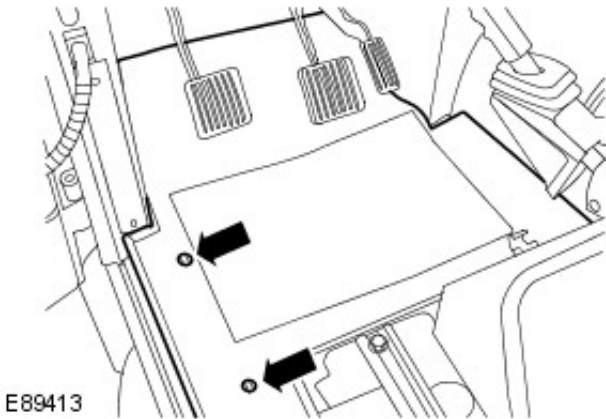
5. Connect brake pipes to master cylinder and tighten unions to 15 Nm (11 lbf.ft).
6. Instal connectors to reservoir cap.
7. Fill reservoir with recommended brake fluid.
For additional information, refer to: Specifications (206-00 Brake System - General Information, Specifications).
8. Bleed the brake system.
For additional information, refer to: Brake System Bleeding (206-00 Brake System - General Information, General Procedures).

Hydraulic Brake Actuation - Brake Pedal and Bracket

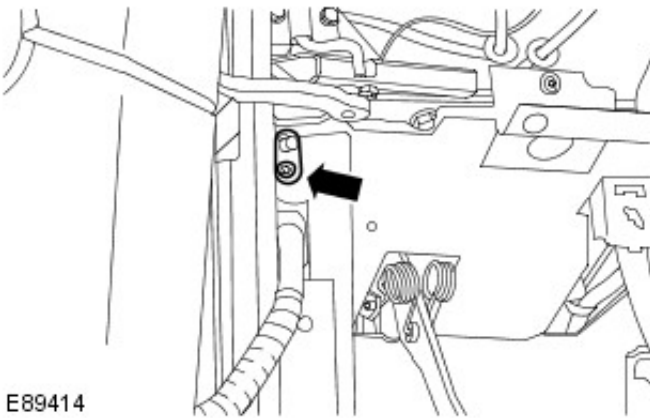
Removal and Installation

Removal

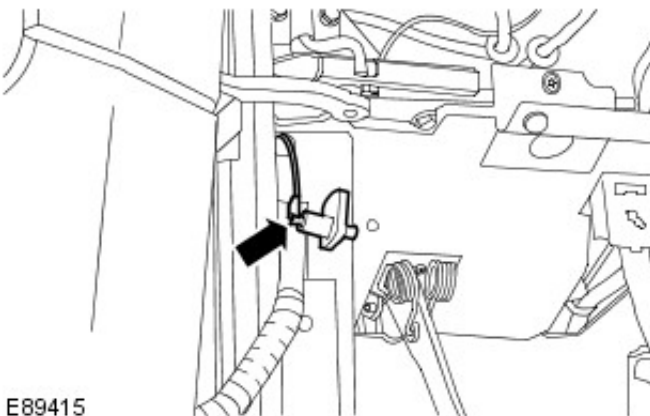
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the brake booster.
For additional information, refer to: Brake Booster (206-07 Power Brake Actuation, Removal and Installation).
3. Remove the stoplamp switches.
For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).
4. Remove the floor covering.
 - Remove the 2 clips.



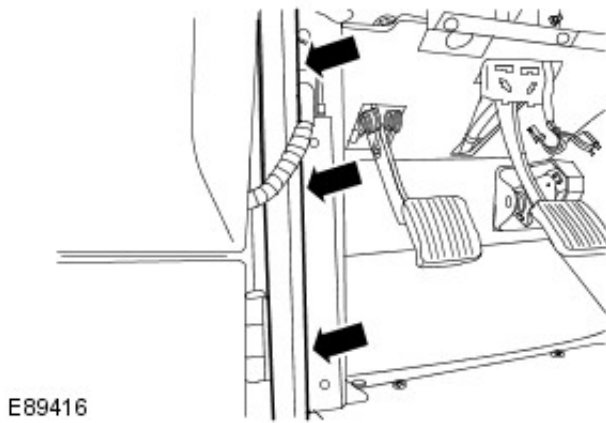
5. Release the interior lamp switch.
 - Remove the screw.



6. Remove the interior lamp switch.
 - Disconnect the electrical connector.

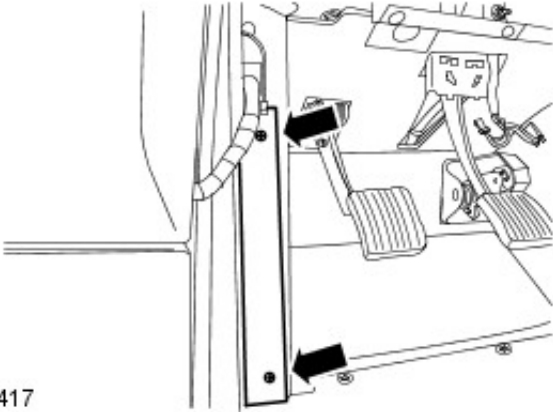


7. Release the front door aperture seal.



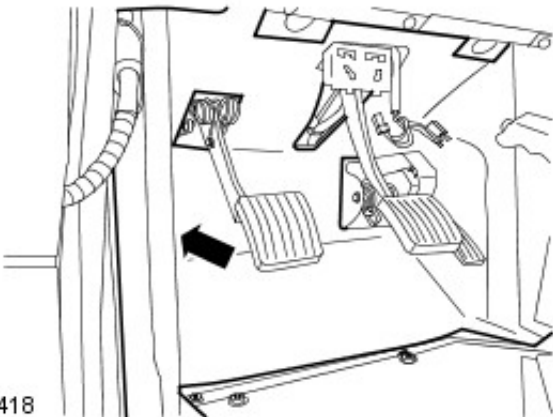
E89416

8. Remove the A-pillar trim panel.
 - Remove the 2 screws.



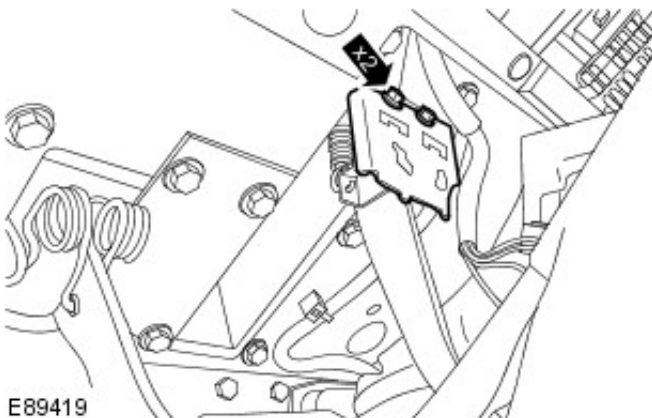
E89417

9. Release the floor covering away from the bulkhead.



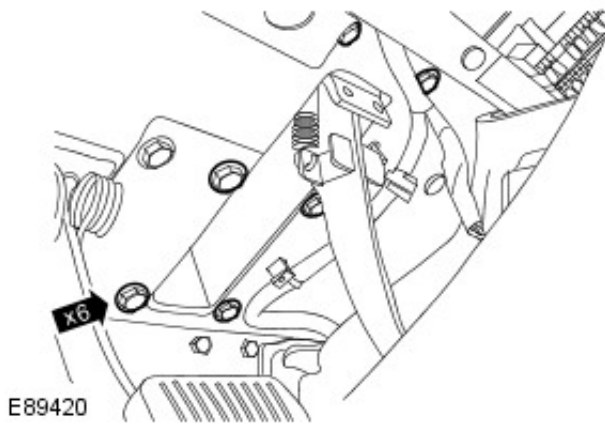
E89418

10. Remove the stoplamp switch support bracket.
 - Remove the 2 bolts.

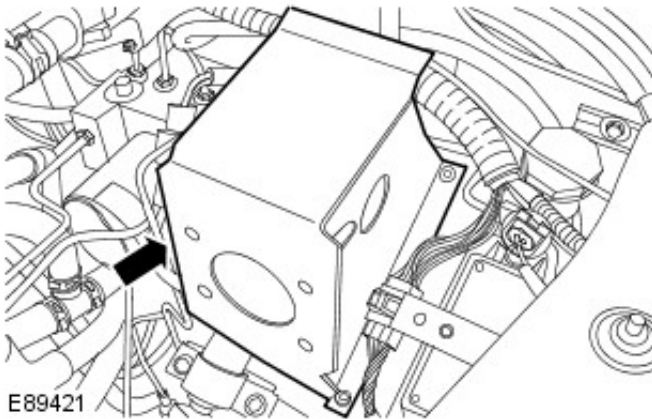


E89419

11. Release the brake pedal and bracket.
 - Remove the 6 bolts.

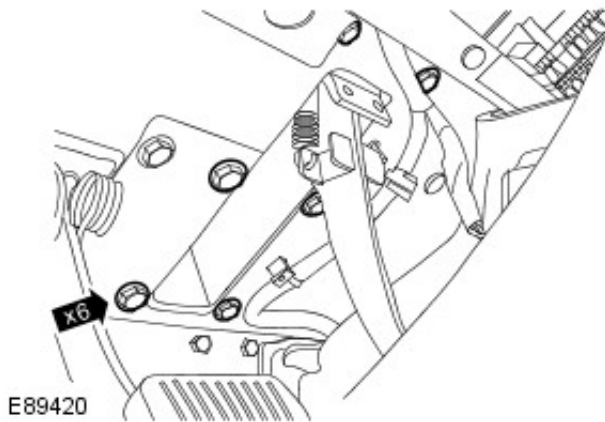


12. Remove the brake pedal and bracket.



Installation

1. To install, reverse the removal procedure.
 - Tighten to 25 Nm (18 lb.ft).



2. Tighten to 9 Nm (7 lb.ft).



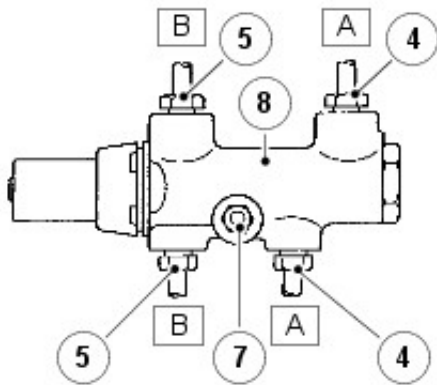
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Hydraulic Brake Actuation - Brake Pressure Control Valve

Removal and Installation

Removal

1. Disconnect battery.
2. Clean area around brake pressure control valve ports.
3. Place a container under valve to catch escaping brake fluid.
4. Disconnect primary circuit pipe unions 'A' from brake pressure control valve.
5. Disconnect secondary circuit pipe unions 'B' from brake pressure control valve.
6. Cover pipes to prevent ingress of dirt.
7. Remove single retaining nut and bolt securing brake pressure control valve to engine bulkhead.
8. Remove brake pressure control valve.



Installation

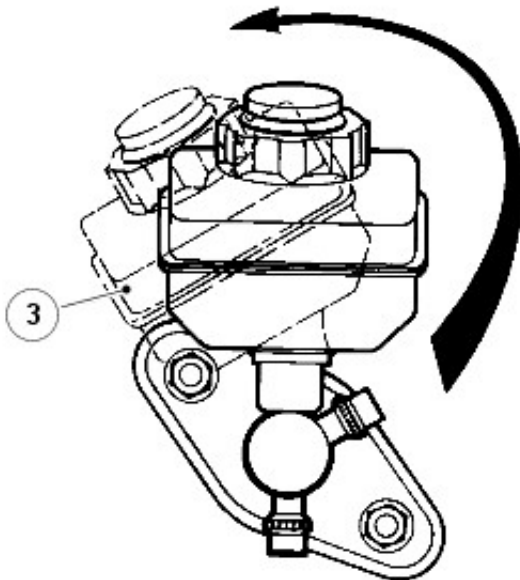
1. Fit brake pressure control valve to engine bulkhead. Tighten bolt to 15 Nm (11 lbf/ft).
2. Connect primary and secondary circuit pipes to brake pressure control valve. Tighten unions to 16 Nm (12 lbf/ft).
3. Fill brake reservoir with recommended brake fluid.
For additional information, refer to: Specifications (206-00, Specifications).
4. Bleed the brake system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).
5. Reconnect battery and road test vehicle.

Hydraulic Brake Actuation - Brake Master Cylinder

Disassembly and Assembly

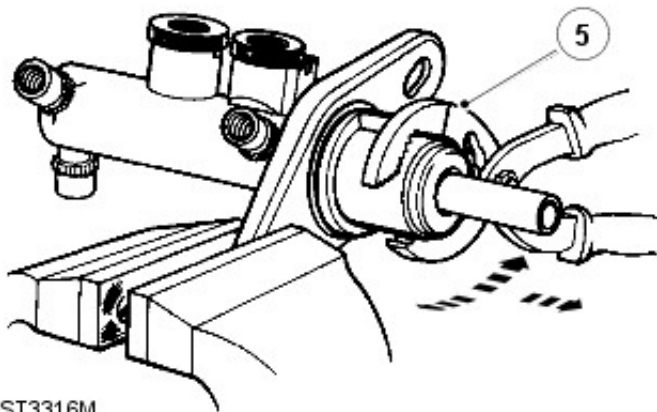
Disassembly

1. Disconnect battery and remove master cylinder from booster.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Before commencing overhaul procedure thoroughly clean master cylinder and inspect outer surfaces for damage and condition, renew complete assembly if necessary.
3. The reservoir is a push fit in master cylinder and secured by seals. Carefully ease reservoir from master cylinder by rolling it from seals as illustrated.



ST3317M

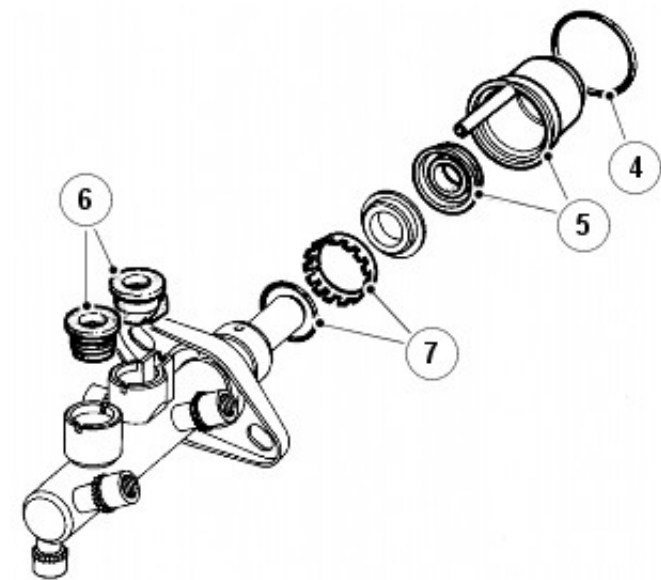
4. Using soft jaws, one either side of master cylinder flange and clamp flange in a suitable vice. Remove water ingress O-ring seal from master cylinder to booster flange and discard.



5. Hold outside of transfer housing with a suitable pair of grips, carefully pull, while working pliers in a backwards and forwards rocking motion to ease housing off master cylinder, discard housing and vacuum seal.

ST3316M

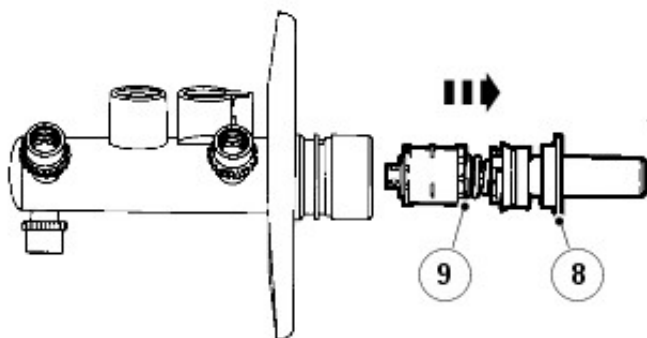
6. Withdraw 2 reservoir seals from master cylinder and note their positions in inlet ports for reassembly. Discard both seals.
7. Remove retaining ring and O-ring seal from machined outer surface of master cylinder, discard both seal and retaining ring.



ST3318M

8. Remove guide ring from mouth of master cylinder which supports primary plunger assembly and place to one side, this component is not part of master cylinder service kit and is to be refitted on assembly of unit.

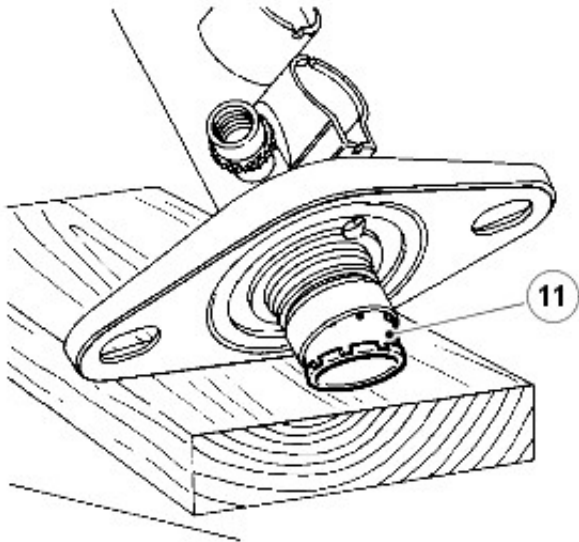
9. Pull primary plunger assembly out of master cylinder.



ST3319M

NOTE: The primary plunger assembly cannot be broken down any further and is serviced as a complete unit. Discard assembly.

10. The secondary plunger assembly will remain at bottom of master cylinder bore, plunger can be easily expelled by tapping assembly on a piece of timber until plunger appears at cylinder mouth, carefully pull plunger from master cylinder.
11. If swirl tube was not expelled at same time as secondary plunger, repeat above operation to expel it from bottom of master cylinder bore and discard.

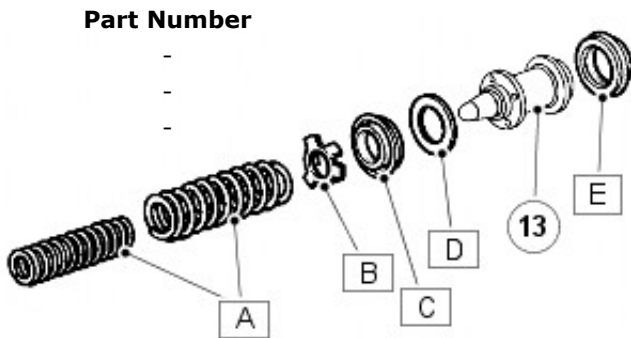


ST3320M

12. Clean all parts with Gilling cleaning fluid or unused brake fluid and place cleaned parts on to a clean sheet of paper. Inspect cylinder bore and plungers for signs of corrosion, ridges and score marks. Provided working surfaces are in perfect condition, new seals from a Gilling Service repair kit may be used.

13. Remove components above from secondary plunger and discard:

Item	Description
A	Springs
B	Seal retainer
C	Recuperating seal (primary cup)
D	Washer
E	'L' seal

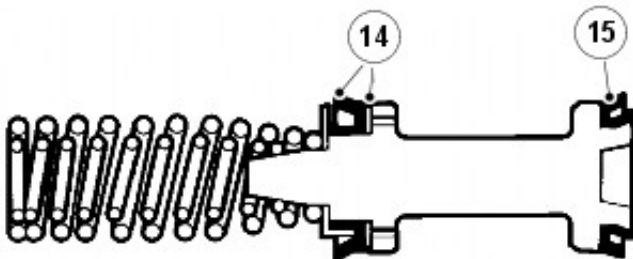


ST3321M

NOTE: A small screwdriver with end rounded and polished is required to remove 'L' seal. DO NOT damage secondary plunger.

14. Coat new seals in unused brake fluid and firstly install 'L' seal to plunger.

15. Install washer followed by recuperating seal. Install seal retainer and springs, ensure springs are correctly seated.



ST3322M

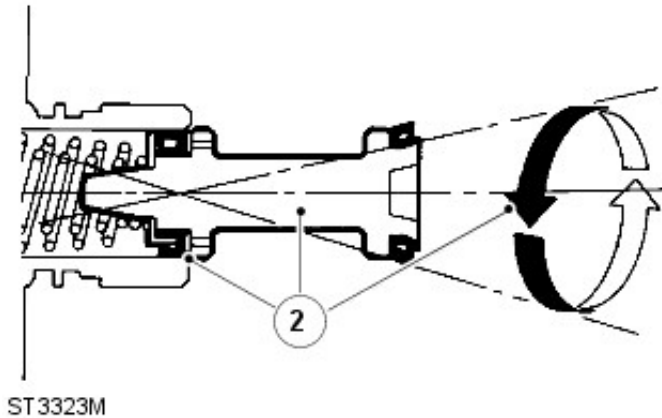
Assembly

CAUTION: It is important that the following instructions are carried out precisely, otherwise damage could be caused

to new seals when inserting plungers into cylinder bore. Generous amounts of new brake fluid should be used to lubricate parts during assembly.

NOTE: Thoroughly check that no debris is lodged in fluid passageways and drillings. If debris is found, carefully remove, re-clean cylinder and re-check.

1. Install new swirl tube to bottom of cylinder bore.



2. Lubricate secondary plunger and cylinder bore. Offer plunger assembly to cylinder until recuperation seal is resting centrally in mouth of bore. Gently introduce plunger with a circular rocking motion, as illustrated. Ensuring that seal does not become trapped, ease seal into bore and slowly push plunger down bore in one continuous movement.

3. Install primary plunger assembly using same method as for secondary plunger, push plunger down bore.

4. Install original guide ring to support primary plunger.

5. Coat a new O-ring with brake fluid and install to its respective groove on outer location surface of master cylinder.



CAUTION: O-ring should not be rolled down outer location surface of master cylinder but should be slightly stretched and eased down cylinder and into its groove. Do not over stretch seal.

6. Install a new retaining ring on outer surface of master cylinder ensuring that serrations of ring are facing mounting flange.

7. Install two new reservoir seals in their respective ports.

8. Install a new vacuum seal to either primary plunger or to bottom of transfer housing bore, open face of seal towards primary plunger guide ring.

9. Lubricate vacuum seal with brake fluid, install transfer housing to master cylinder, push housing fully up to cylinder mounting flange. Do not adjust transfer housing after fitting.

10. Lubricate a new water ingress seal with brake fluid, slightly stretch seal and ease it down housing until seal is in correct position between housing and flange.

11. Roll reservoir into top of master cylinder, reversing procedure described in instruction 3.

12. Install master cylinder to booster.
For additional information, refer to: Brake Master Cylinder (206-06, Removal and Installation).

13. Reconnect battery, and road test vehicle.

Power Brake Actuation -

Description	Nm	lb-ft
Brake vacuum pump bolts	23	17
Brake booster nuts	14	10
Brake master cylinder nuts	26	19

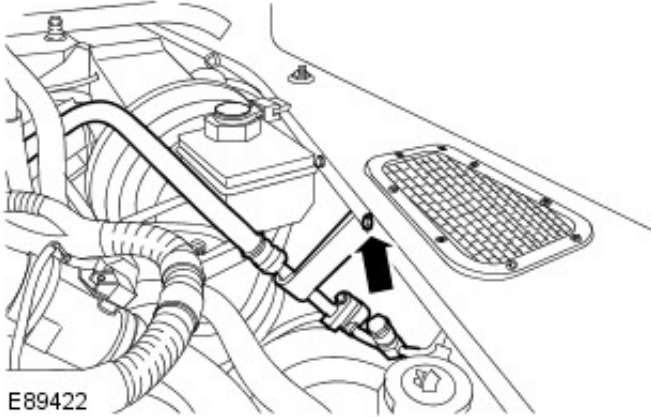
Power Brake Actuation - Brake Booster

Removal and Installation

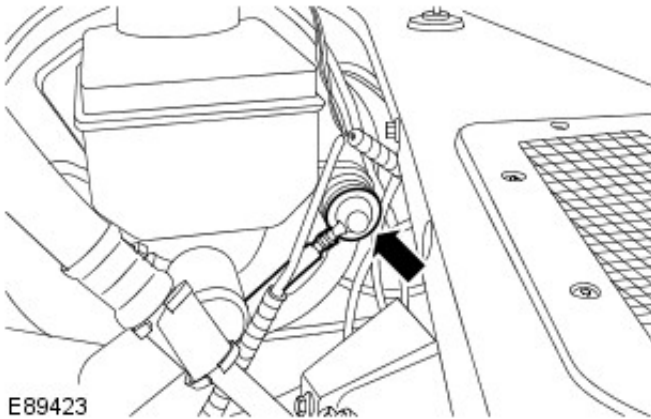
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).

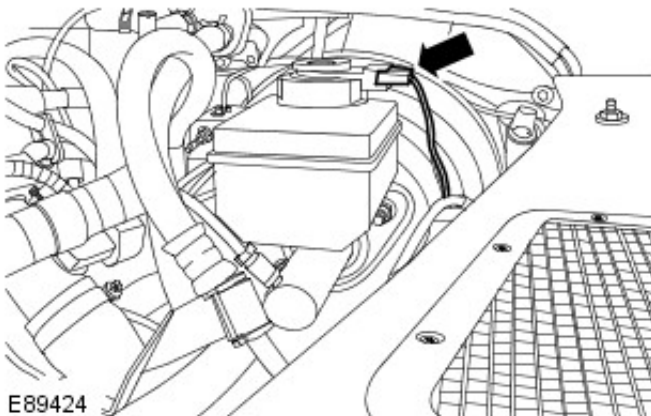
2. Release the air conditioning (A/C) high-pressure pipe.
 - Remove the bolt.



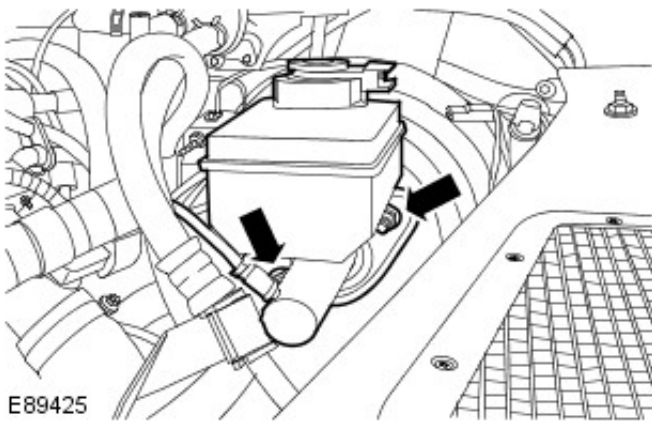
3. Release the brake booster vacuum hose.



4. Disconnect the 2 electrical connectors from the brake fluid low level warning indicator.



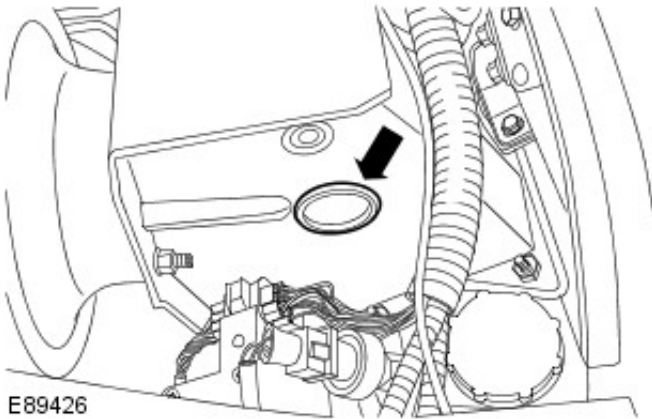
5. Release the brake master cylinder.
 - Remove the 2 nuts.



E89425

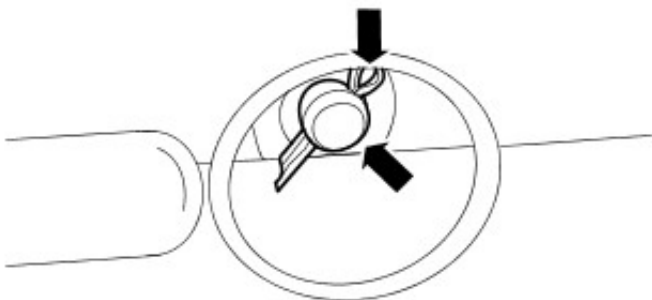
6. NOTE: RH shown, LH similar.

Remove the 2 grommets from the brake pedal box.



E89426

7. Remove the brake booster clevis pin.
- Remove and discard the split pin.

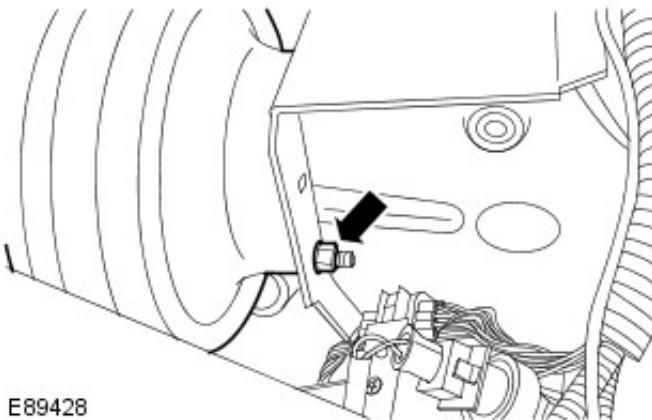


E89427

8. NOTE: RH shown, LH similar.

Remove the brake booster.

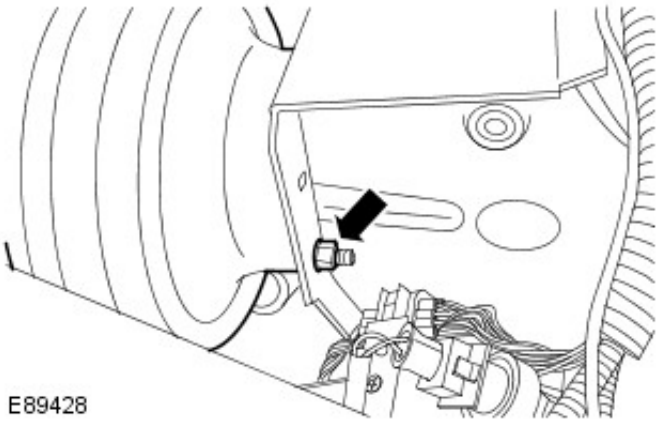
- Remove the 2 nuts.



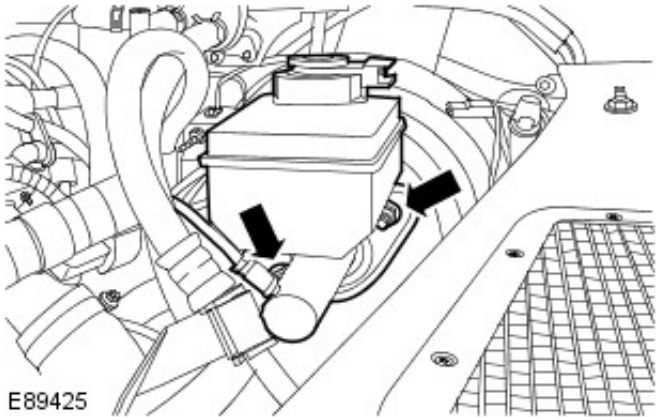
E89428

Installation

1. To install, reverse the removal procedure.
- Tighten to 14 Nm (10 lb.ft).



2. Tighten to 26 Nm (19 lb.ft).



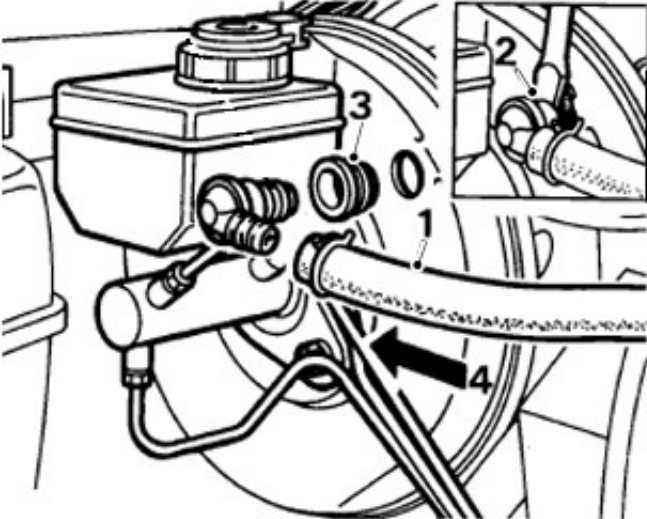
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01
Battery, Mounting and Cables, General Procedures).

Power Brake Actuation - Brake Booster Non-Return Valve

Removal and Installation

Removal

1. Disconnect brake vacuum hose from booster non return valve.
2. Carefully prise valve out with a screwdriver blade between valve and grommet. Take care not to exert too much pressure on the vacuum chamber.
3. Remove rubber grommet but be careful not to allow it to fall into the vacuum chamber.
4. Check the valve for correct operation; it should not be possible to pass air through into the booster in direction of arrow. Do not use compressed air.



E82218

Installation

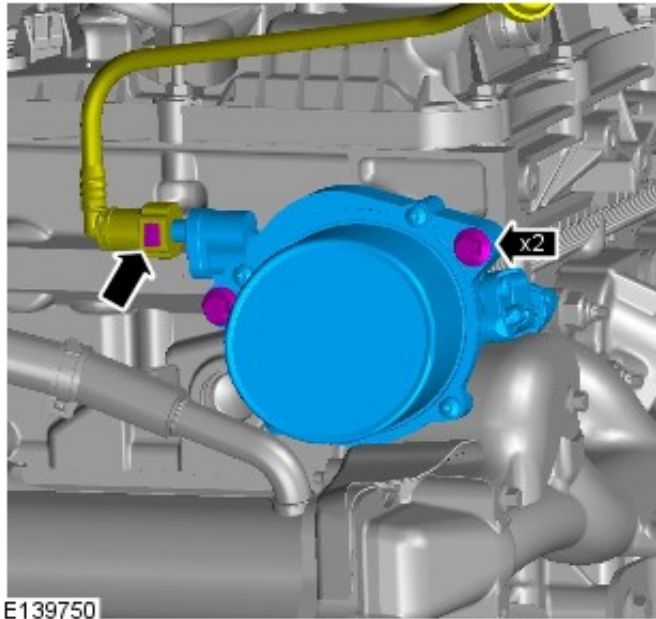
1. Install rubber grommet.
2. Smear ribs of the valve with Lucas Girling rubber grease to assist assembly, and push valve fully home.
3. Connect vacuum hose to the valve.
4. Road test vehicle.


Power Brake Actuation - Brake Vacuum Pump

Removal and Installation

Removal

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



1.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Torque: 23Nm

Installation

1. NOTE: Remove and discard the blanking caps.

NOTE: Clean the component mating faces.

To install, reverse the removal procedure.

Anti-Lock Control - Traction Control - Anti-Lock Control - Traction Control

Description and Operation

Anti-Lock Control - Traction Control

For additional information, refer to: [Brake System](#) (206-00 Brake System - General Information, Description and Operation).

Anti-Lock Control - Traction Control - Anti-Lock Control - Traction Control

Diagnosis and Testing

Principle of Operation

For a detailed description of the Anti-Lock Control - Traction Control system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).

Many of the functions forming part of the Anti-Lock Control - Traction Control System will communicate with the instrument cluster giving information to the driver about the operation of the system overall, which means that there are no real symptoms as such which are not covered by a warning lamp or a Diagnostic Trouble Code (DTC).

Inspection and Verification



WARNING: Before carrying out a road test, make sure the vehicle is safe to do so. Failure to follow this instruction may result in personal injury.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE: If a module/component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Tire size, condition and installation • Wheel speed sensor condition and installation • Wheel speed sensor target ring • Yaw rate sensor installation • Hydraulic Control Unit (HCU) condition and installation 	<ul style="list-style-type: none"> • Fuses • Power and ground circuits • Harnesses and connectors • Warning lamp operation • Wheel speed sensors • Battery junction box • Stop lamp switch • Yaw rate sensor • Differential lock switch • Anti-Lock Braking System (ABS) module • Controller Area Network (CAN) circuits

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.
 - Make sure that all DTCs are cleared following rectification.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [Diagnostic Trouble Code Index: ABS Control Module](#) (100-00 General Information, Description and Operation).

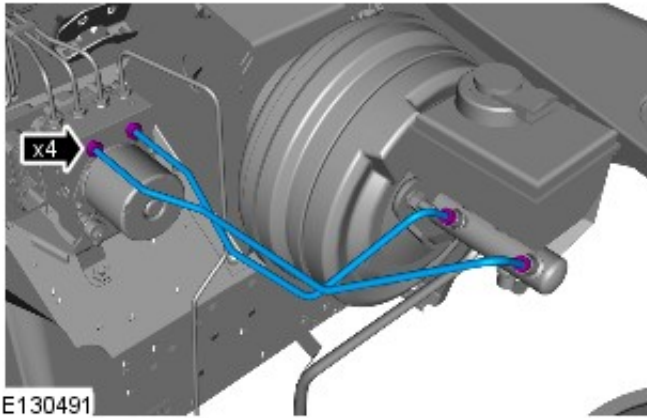
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Anti-Lock Control - Traction Control - Hydraulic Control Unit (HCU)LHD

Removal and Installation

Removal

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



1. CAUTIONS:



Be prepared to collect escaping fluids.

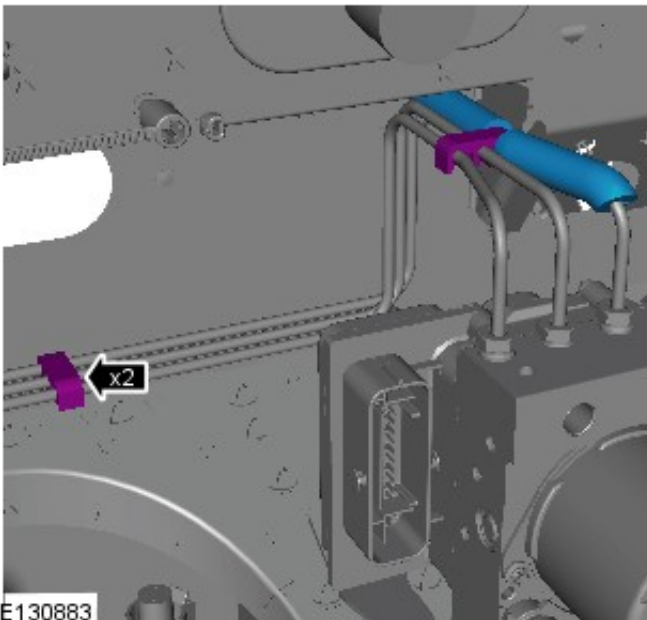


If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.



Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

2. NOTE: Note the orientation of the securing clips and foam padding.



3. CAUTIONS:



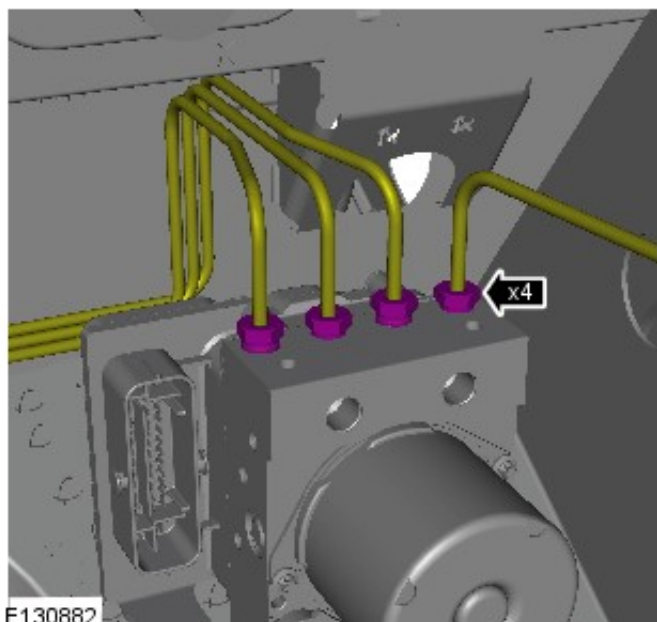
Make sure that all openings are sealed. Use new blanking caps.



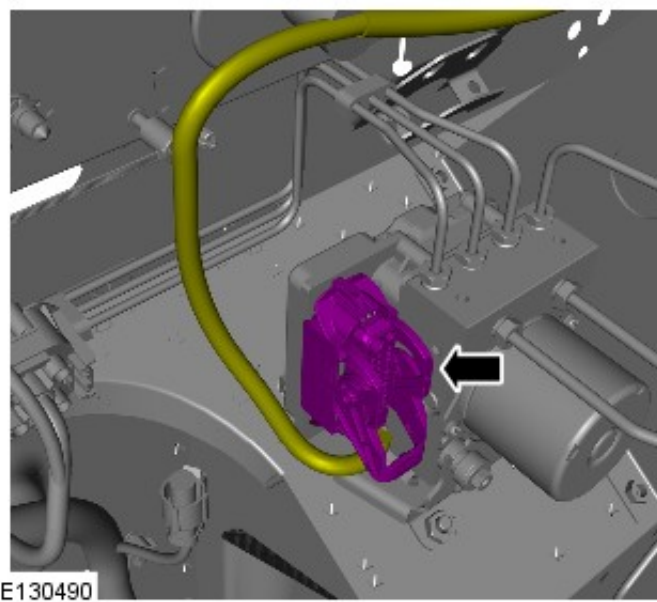
Be prepared to collect escaping fluids.



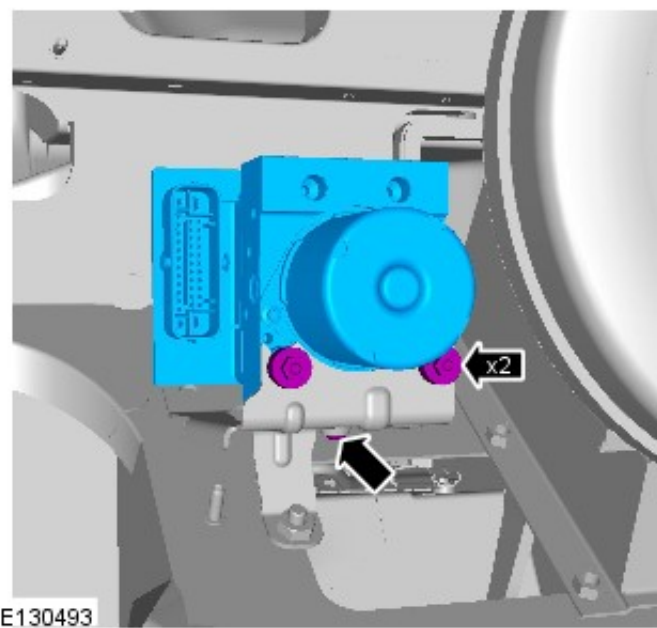
Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.



4.

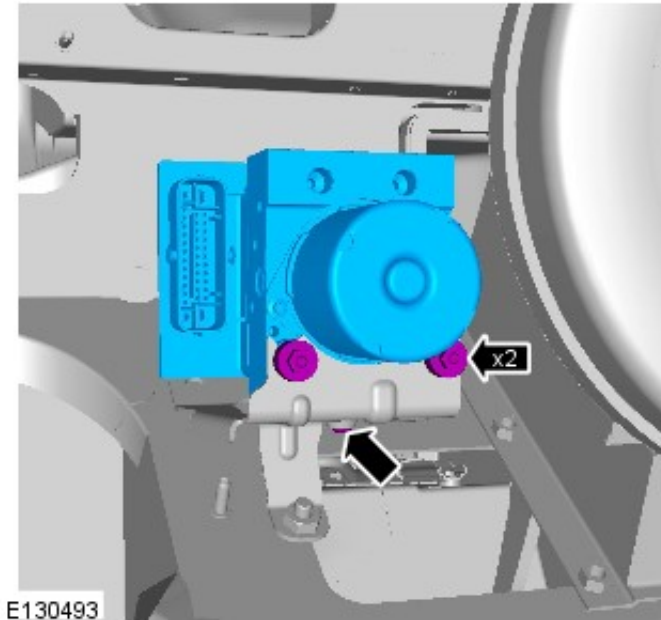


5.

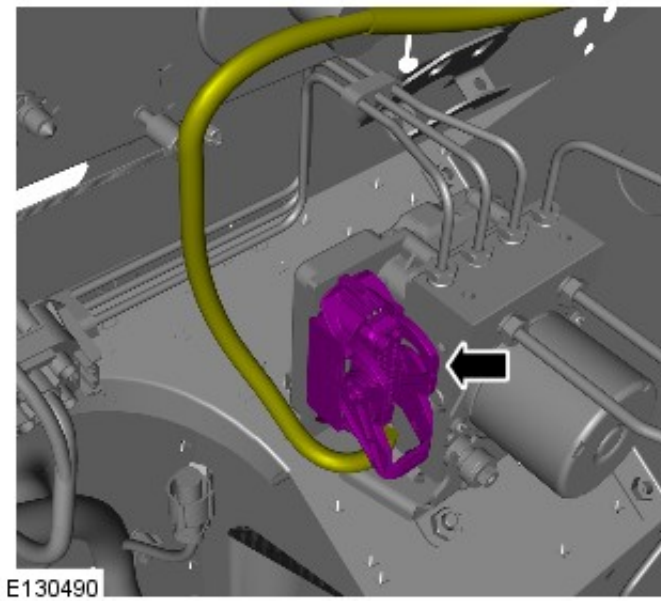



Installation

1. Torque: 8 Nm



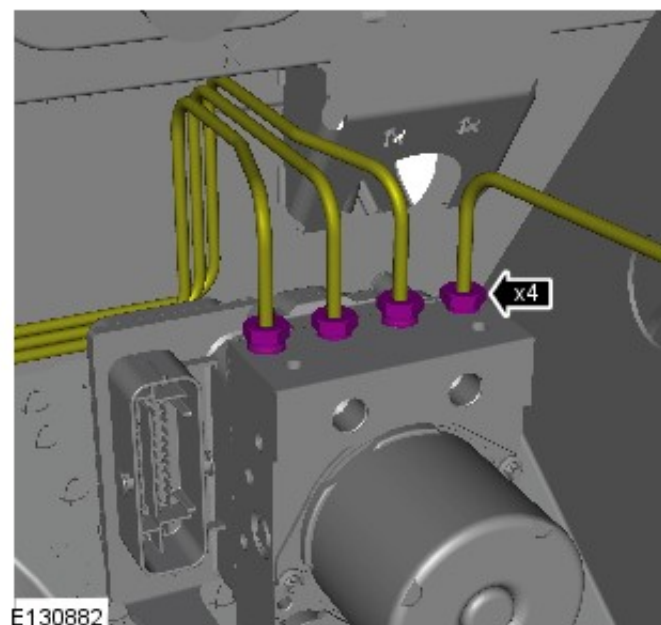
- 2.

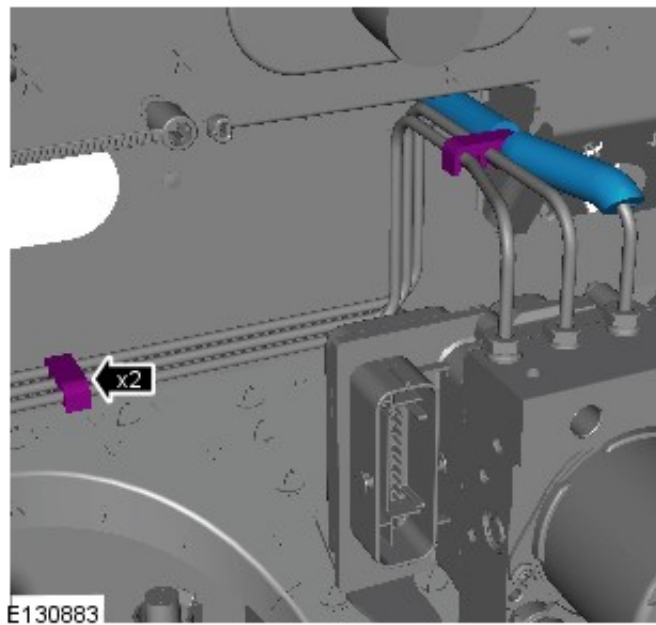


3.  CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

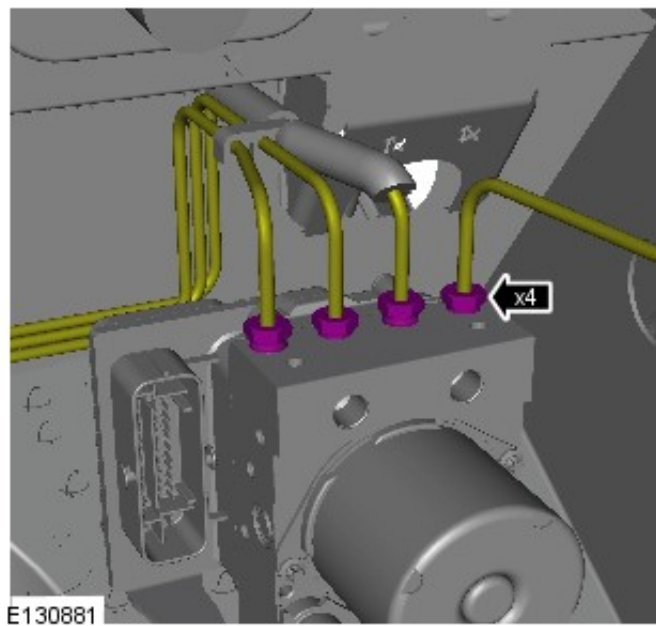
NOTE: Remove and discard the blanking caps.


NOTE: Install the brake pipe unions finger tight.



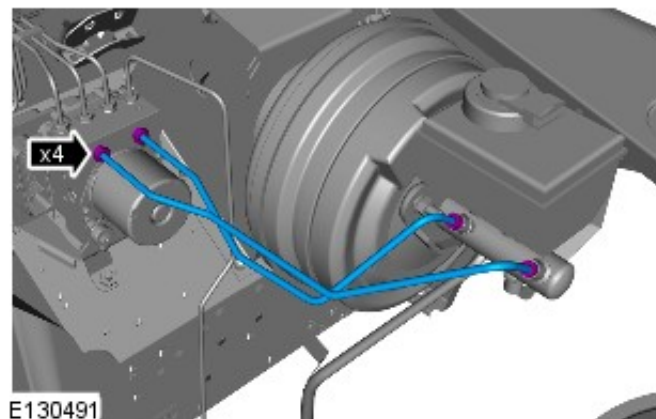



4. NOTE: Make sure that the securing clips and foam padding are installed in the same orientation as noted in the removal procedure.



5.  CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

Torque: 15 Nm



6.  CAUTION: If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.

Torque: 15 Nm

7. Refer to: Brake System Bleeding (206-00, General Procedures).

Anti-Lock Control - Traction Control - Front Wheel Speed Sensor

Removal and Installation

Removal



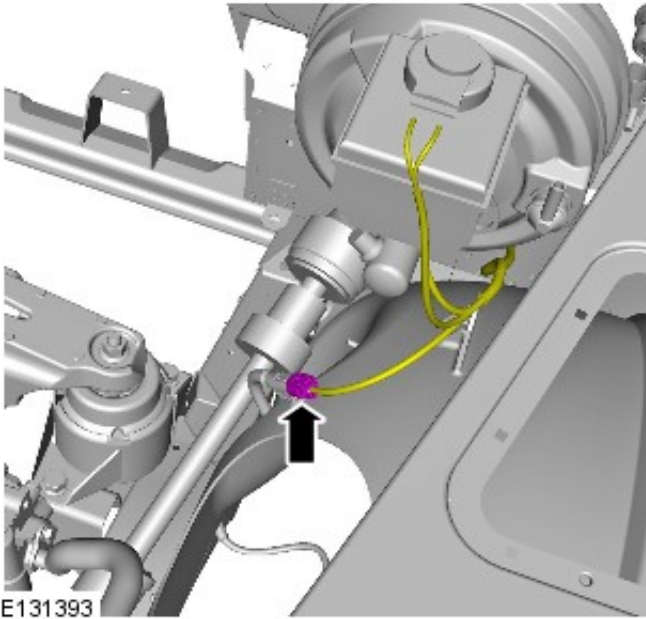
CAUTION: If the sensor is removed for any reason, a new sensor bush must be installed.

NOTE: Left-hand shown, right-hand similar.

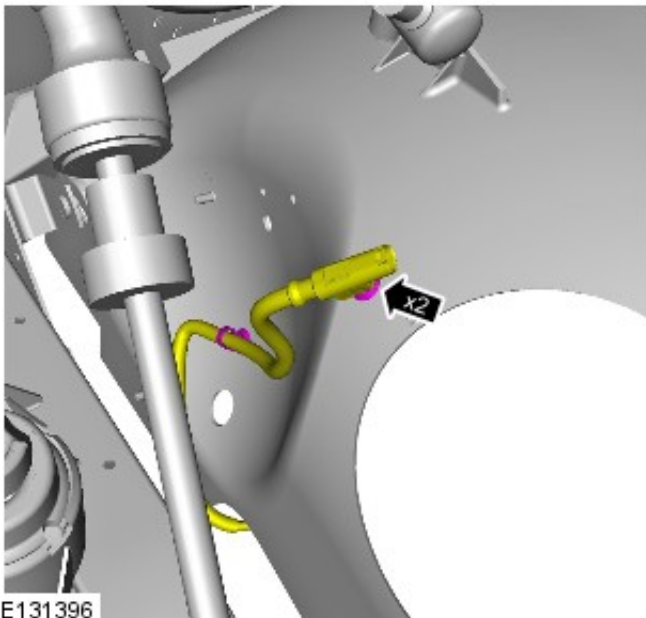
NOTE: Removal steps in this procedure may contain installation details.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. **NOTE:** LHD illustration shown, RHD is similar.



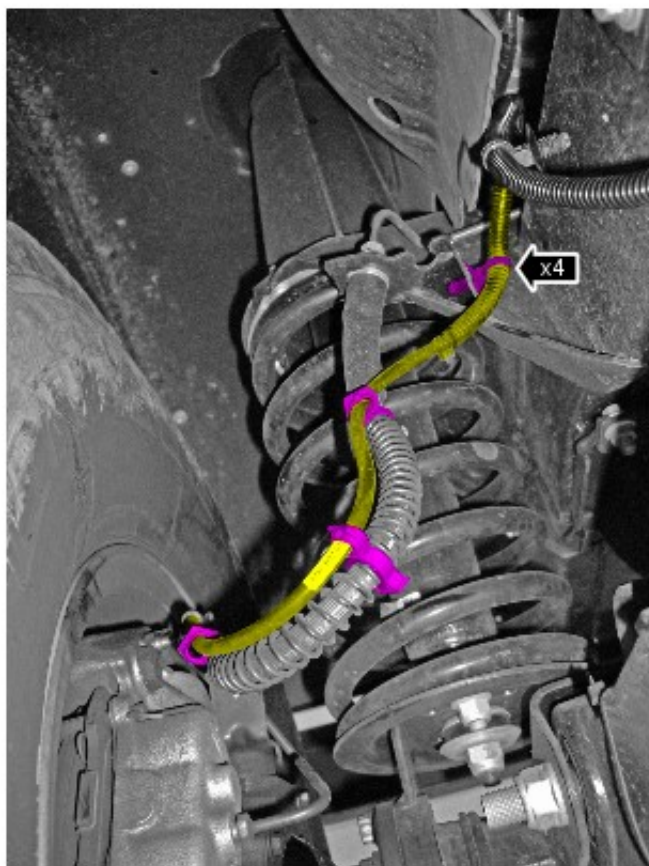
2. **NOTE:** LHD illustration shown, RHD is similar.



3.  **WARNING:** Make sure to support the vehicle with axle stands.

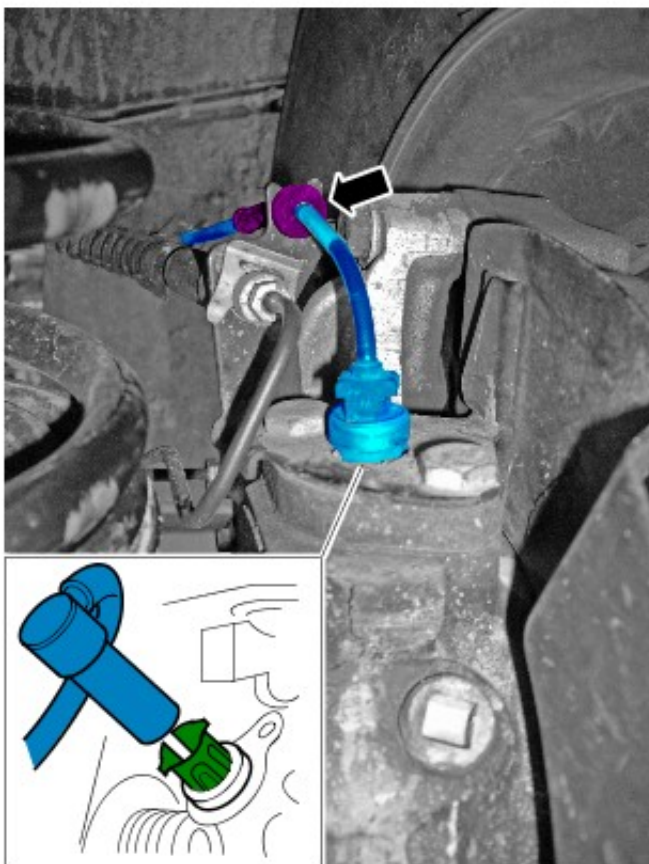
Raise and support the vehicle.

- 4.



E131394

5.  CAUTION: Carefully prise ABS sensor from the front hub.



E131395

Installation

1.  CAUTION: Clean the ABS sensor, smear with anti-seize grease.

To install, reverse the removal procedure.

Anti-Lock Control - Traction Control - Rear Wheel Speed Sensor LH

Removal and Installation

Removal



CAUTION: If the sensor is removed for any reason, a new sensor bush must be installed.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

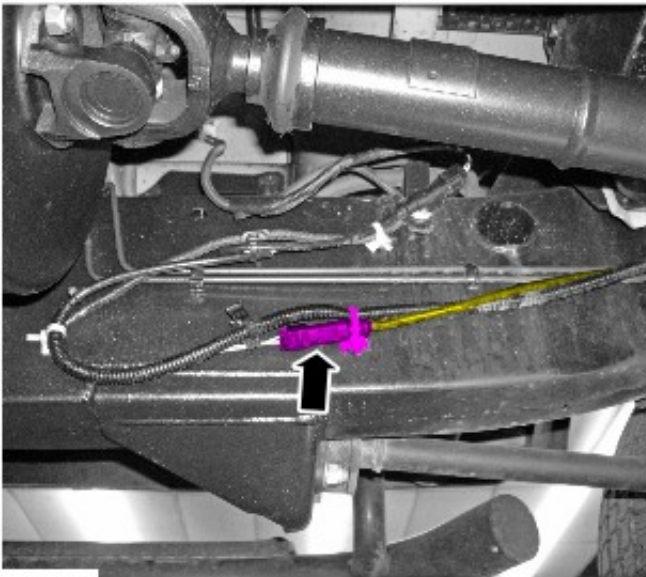
NOTE: Removal steps in this procedure may contain installation details.



1. **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

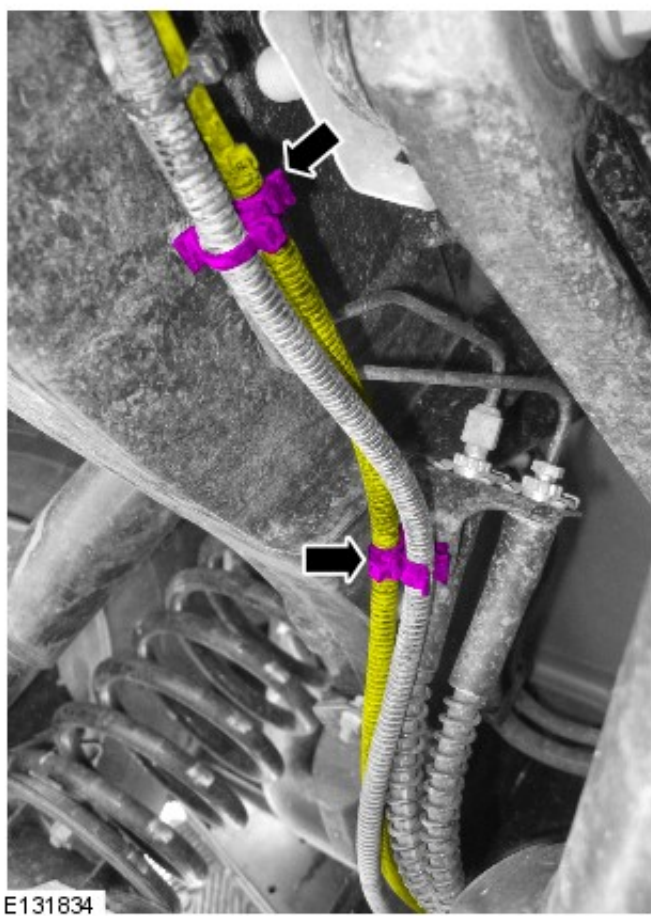
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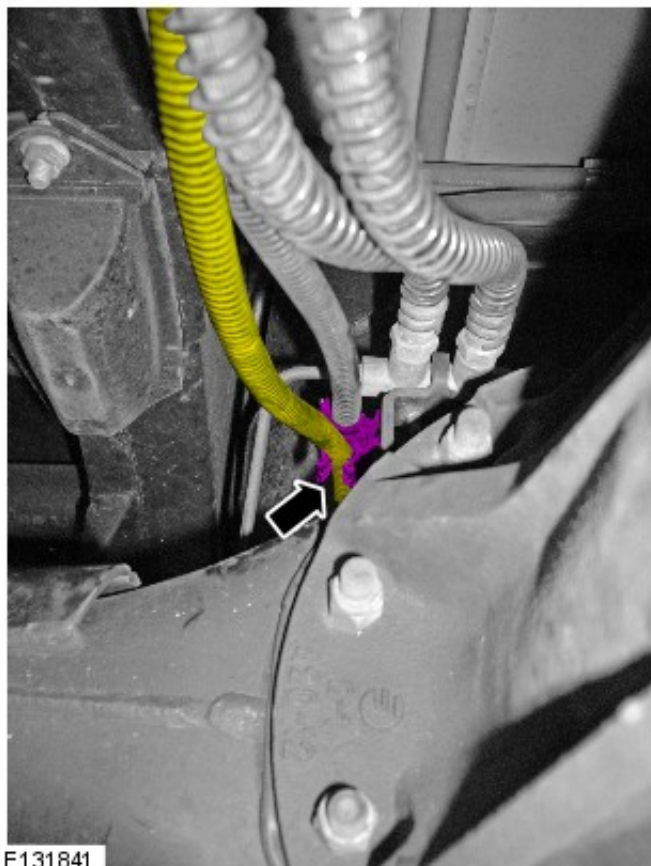
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4.

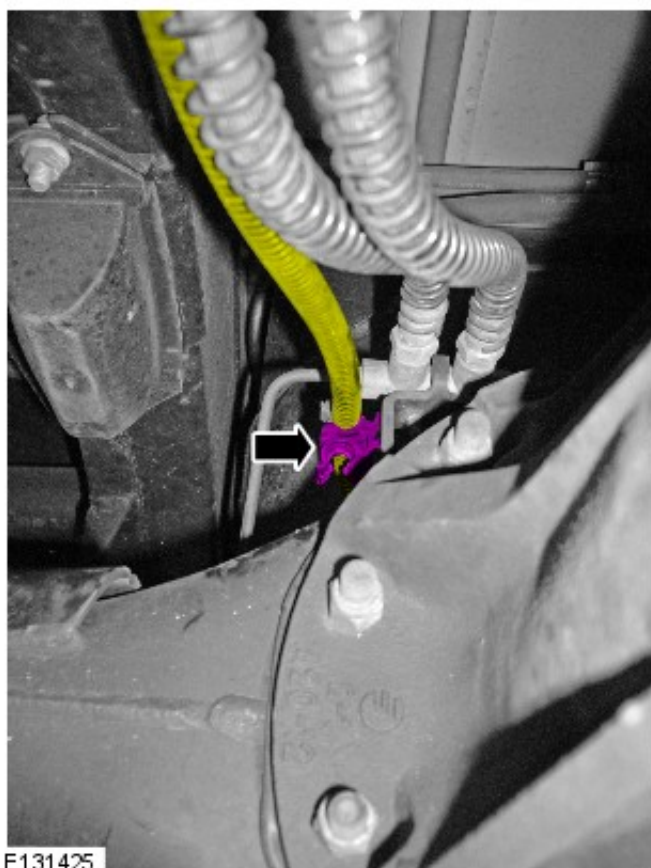


5.



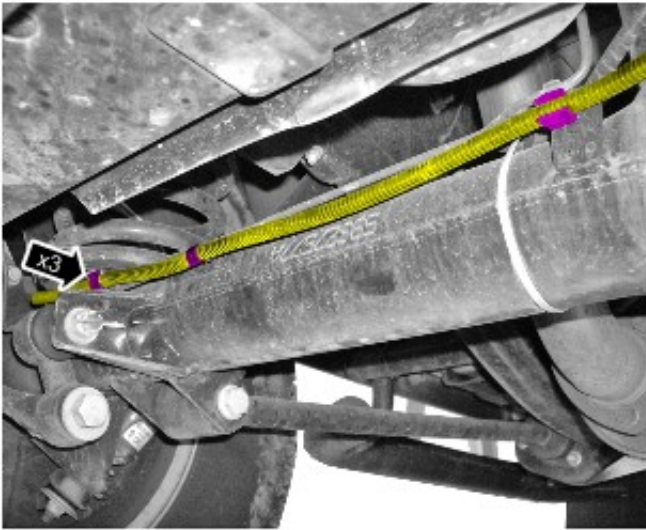
E131841

6.



E131425

7.



E131424

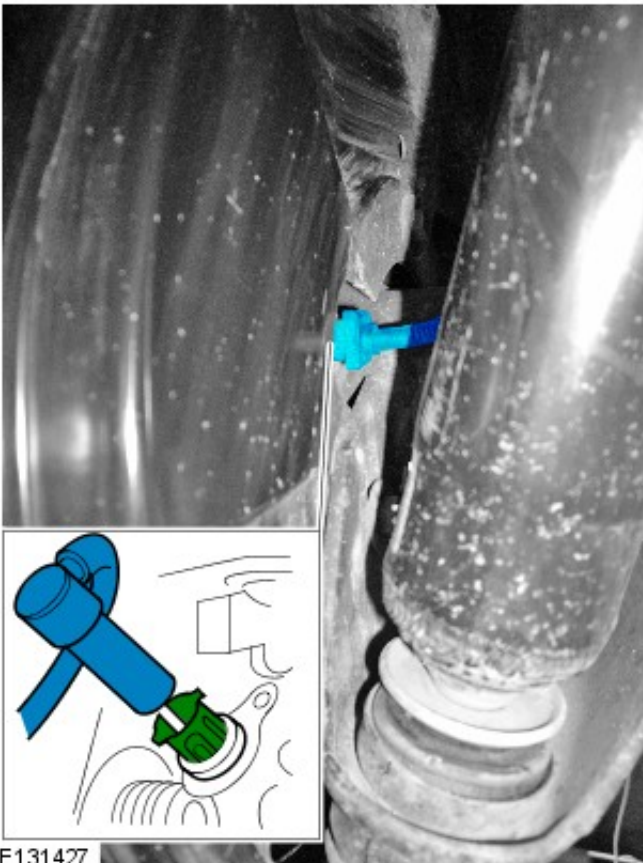
8. CAUTIONS:



Carefully prise ABS sensor from the front hub.



If the sensor is removed for any reason, a new sensor bush must be installed.



E131427

Installation



1. CAUTION: Clean the ABS sensor, smear with anti-seize grease.

To install, reverse the removal procedure.

Anti-Lock Control - Traction Control - Rear Wheel Speed Sensor RH

Removal and Installation

Removal



CAUTION: If the sensor is removed for any reason, a new sensor bush must be installed.

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

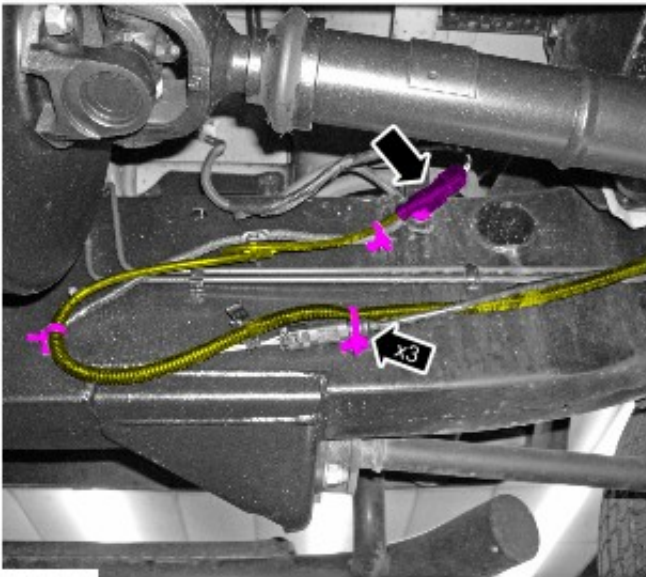
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



1. **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

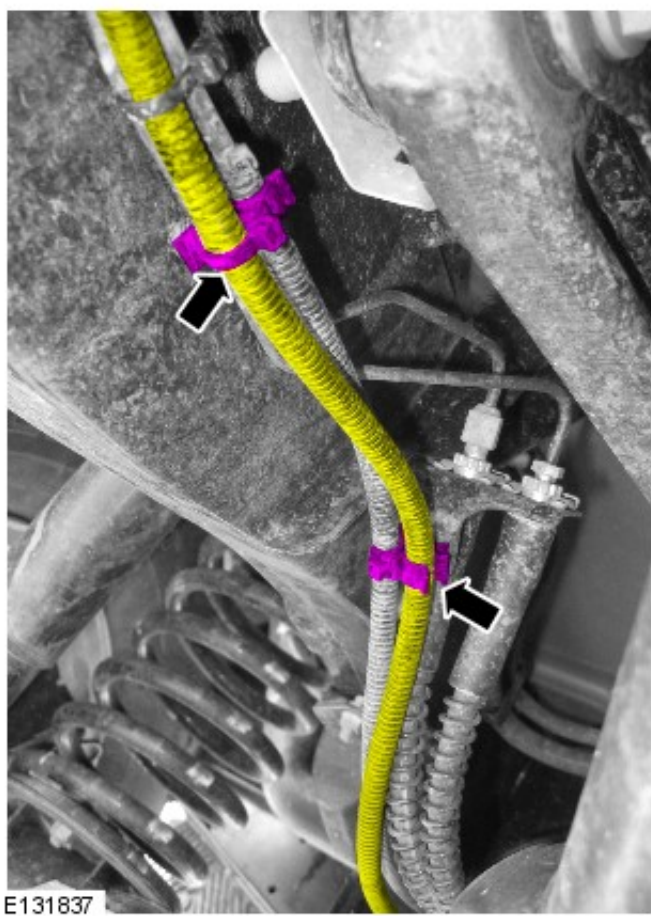
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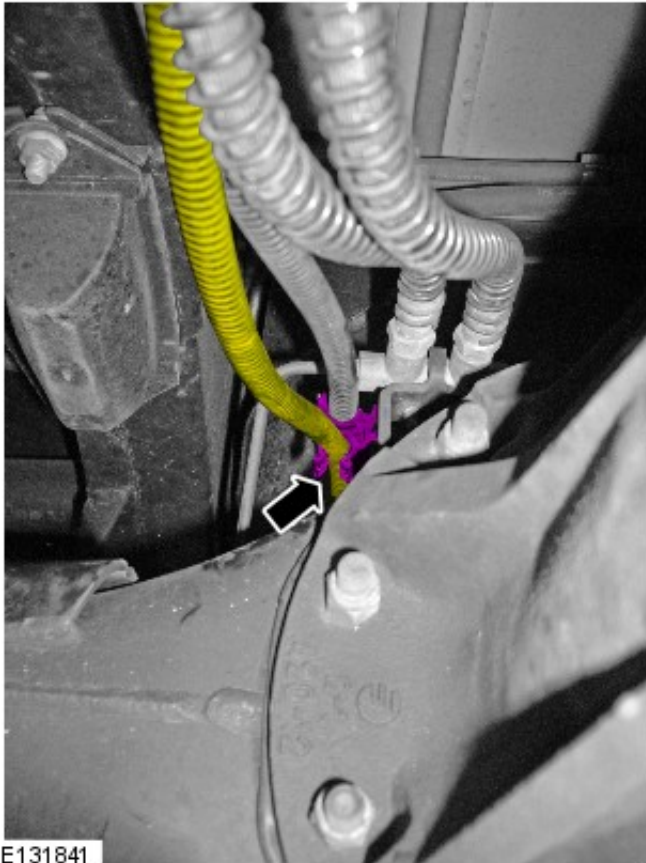
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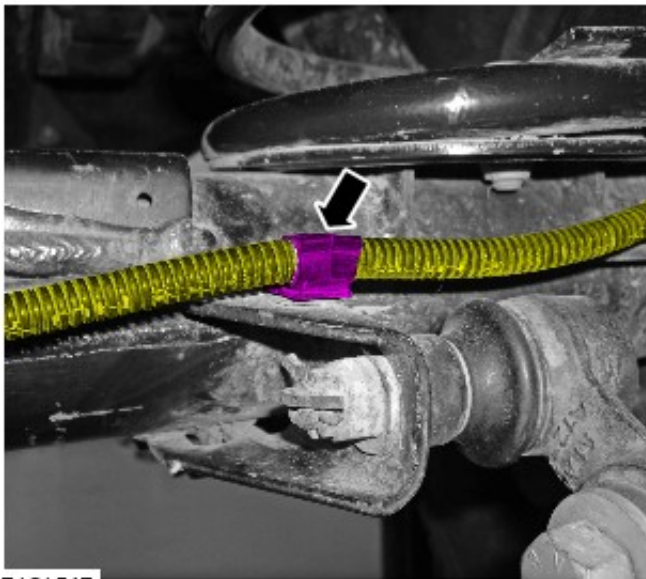
4.



5.



6.



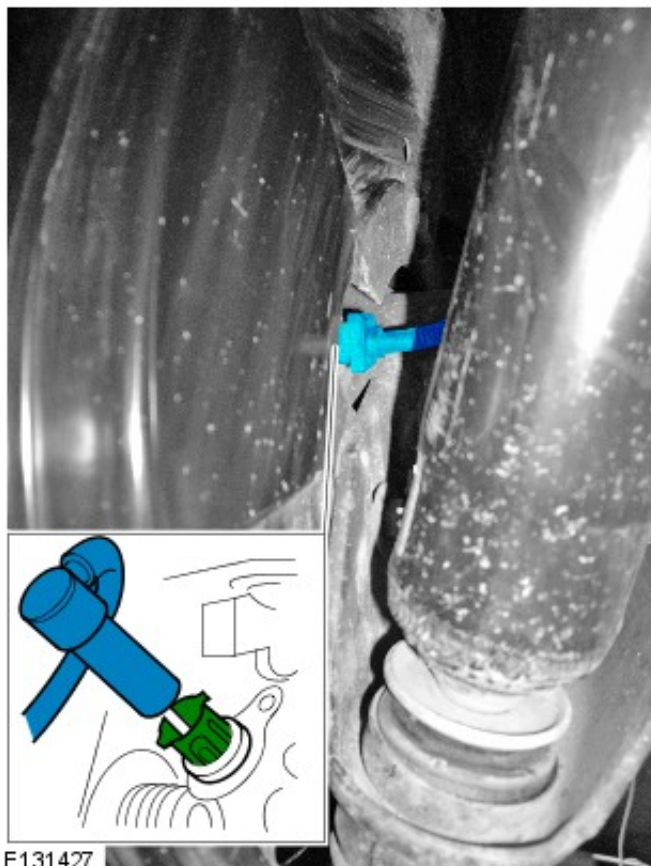
7. CAUTIONS:




Carefully prise ABS sensor from the front hub.



If the sensor is removed for any reason, a new sensor bush must be installed.



Installation

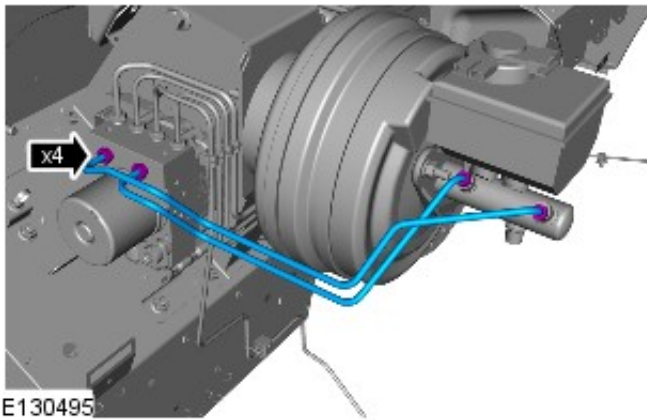
1.  **CAUTION:** Clean the ABS sensor, smear with anti-seize grease.
To install, reverse the removal procedure.

Anti-Lock Control - Traction Control - Hydraulic Control Unit (HCU)RHD

Removal and Installation

Removal

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



1. CAUTIONS:



Be prepared to collect escaping fluids.

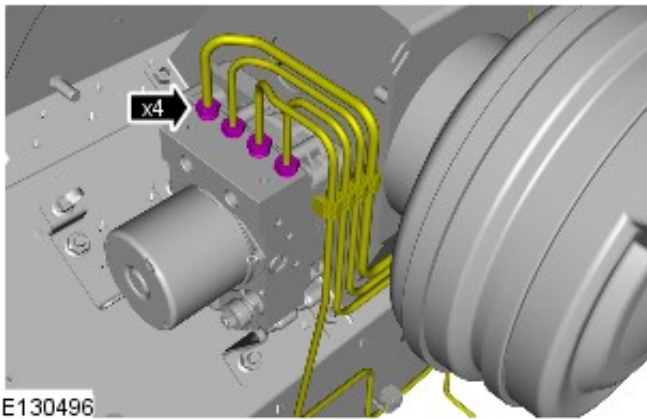


If brake fluid is spilt on the paintwork, the affected area must be immediately washed down with cold water.



Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

Torque: 15 Nm



2. CAUTIONS:



Make sure that all openings are sealed. Use new blanking caps.

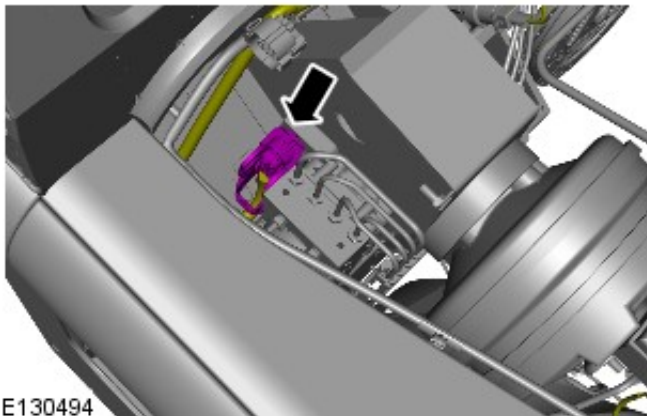


Be prepared to collect escaping fluids.



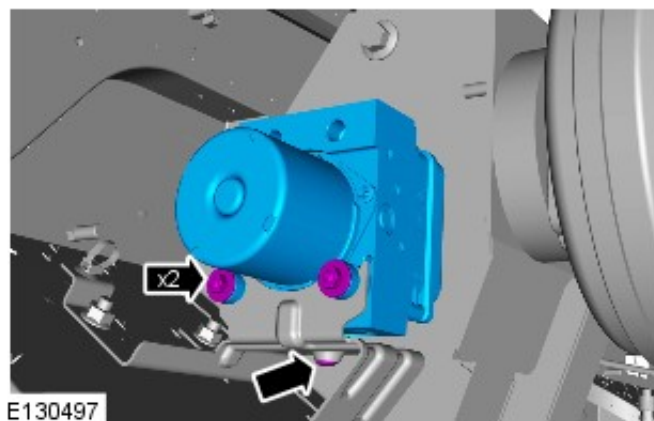
Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

Torque: 15 Nm



3.

4. Torque: 8 Nm



Installation

1. To install, reverse the removal procedure.

Anti-Lock Control - Stability Assist - Yaw Rate Sensor

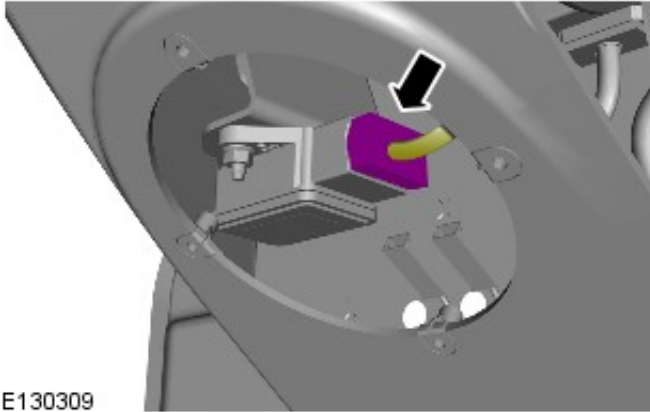
Removal and Installation

Removal

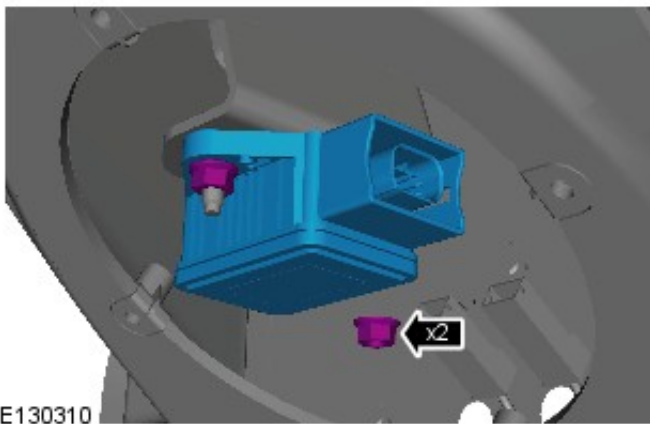
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Instrument Panel Speaker (415-03, Removal and Installation).

2.



3. Torque: 7 Nm



Installation

1. To install, reverse the removal procedure.

Steering System - General Information -

Steering

Steering geometry	
Steering wheel diameter	412 mm (16.22 in)
Front wheel alignment	-10' ± 10' toe-out
Rear wheel alignment	+5' ± 15' toe-in
Camber angle - Front	-10' ± 45'
Camber angle - Rear	-10' ± 45'
Castor angle	3° 15' ± 45'
Cross castor	1° Maximum
Cross camber - Front	1° Maximum
Cross camber - Rear	1° Maximum
Swivel pin inclination - static	7° Check with vehicle on level ground at EEC kerb weight. Rock the front of the vehicle up and down to allow it to take up normal static position.

Turning circle between kerbs	
90 Models	
265/75 x 16 tires	12.65 m (41.5 ft)
All other tires	11.70 m (38.4 ft)
110 Models	
750 x 16 tires	13.41 m (44 ft)
130 Models	
750 x 16 tires	15.24 m (50 ft)

Steering box and pump	
Steering box make and type	Adwest Varamatic - worm and roller
Steering box ratio	Variable: Straight ahead - 19.3:1 on lock - 14.3:1
Steering wheel turns - lock to lock	3.375
Steering pump make and type	JTekt P4

Power steering system

Fluids and capacities	
Power steering fluid	Texaco Cold Climate 33270
Fluid capacity - steering gear and reservoir - LHD	2.90 litres (5.0 pints)
Fluid capacity - steering gear and reservoir - RHD	3.40 litres (6.00 pints)

Torque specifications

Description	Nm	lbf-ft
Drag link to drop arm	40	30
Ball joint nuts	40	30
Clamp bolt (M6)	9	7
Steering column bracket nuts	22	16
Steering wheel nut	43	32
Tie bar to mounting nut initial torque	80	60
Tie bar to mounting nut final torque	110	80
Universal joint pinch bolt	30	22
Steering gear adjuster locknut	60	45
Steering gear drop arm nut	175	130
Steering gear sector shaft cover to steering box	75	55
Steering gear to chassis	80	60
Steering gear fluid pipes 14mm thread	15	11
Steering gear fluid pipes 16mm thread	20	15
Steering gear tie bar	80	60
Power steering pump high pressure fluid pipe	20	15
Power steering pump mounting	35	25
Power steering pump pulley bolts	10	7
Power steering pump hose clamp	3	2
Power steering pump front mounting plate bolts	9	7
Power steering reservoir hose clamp	3	2

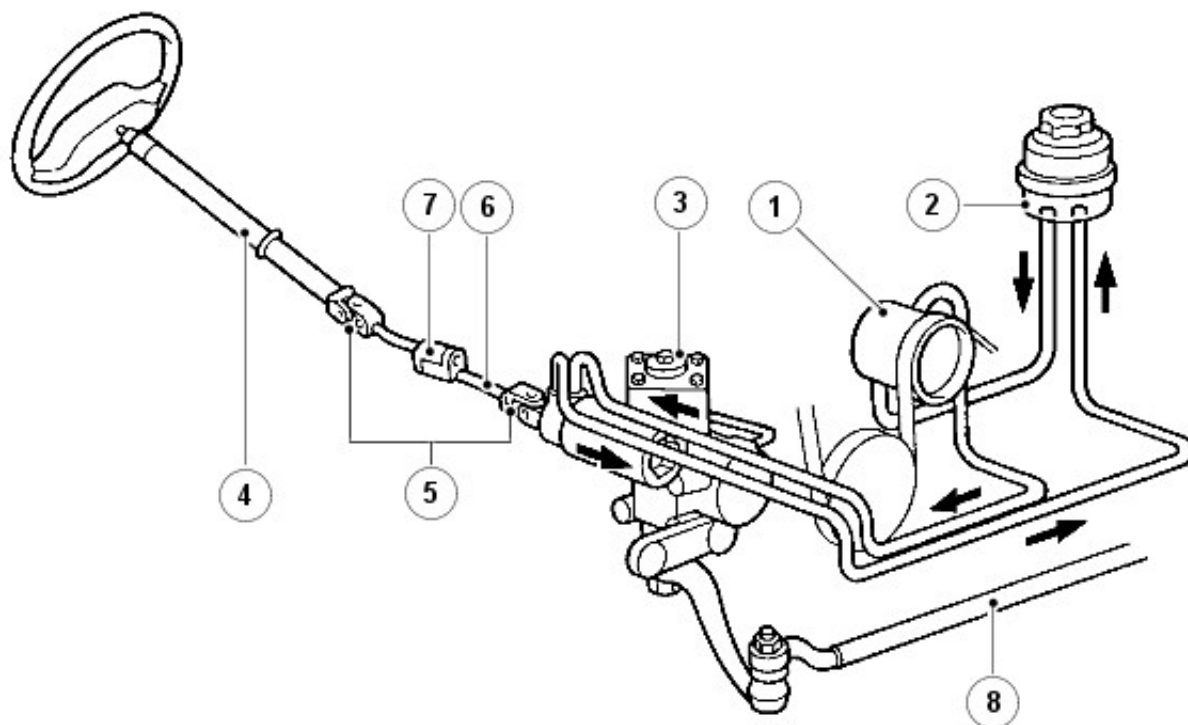
Fixing size	Nm	lbf-ft
M5	6	4.5
M6	9	7
M8	25	18
M10	45	33
M12	90	65
M14	105	77
M16	180	133
1/4 in	9	7
5/16 in	24	18
3/8 in	39	29
7/16 in	78	58
1/2 in	90	65
5/8 in	135	100

Torque specifications in the table above are for all screws and bolts used, except for those specifically referred to in the Torque specifications table.

Steering System - General Information - Steering System

Description and Operation

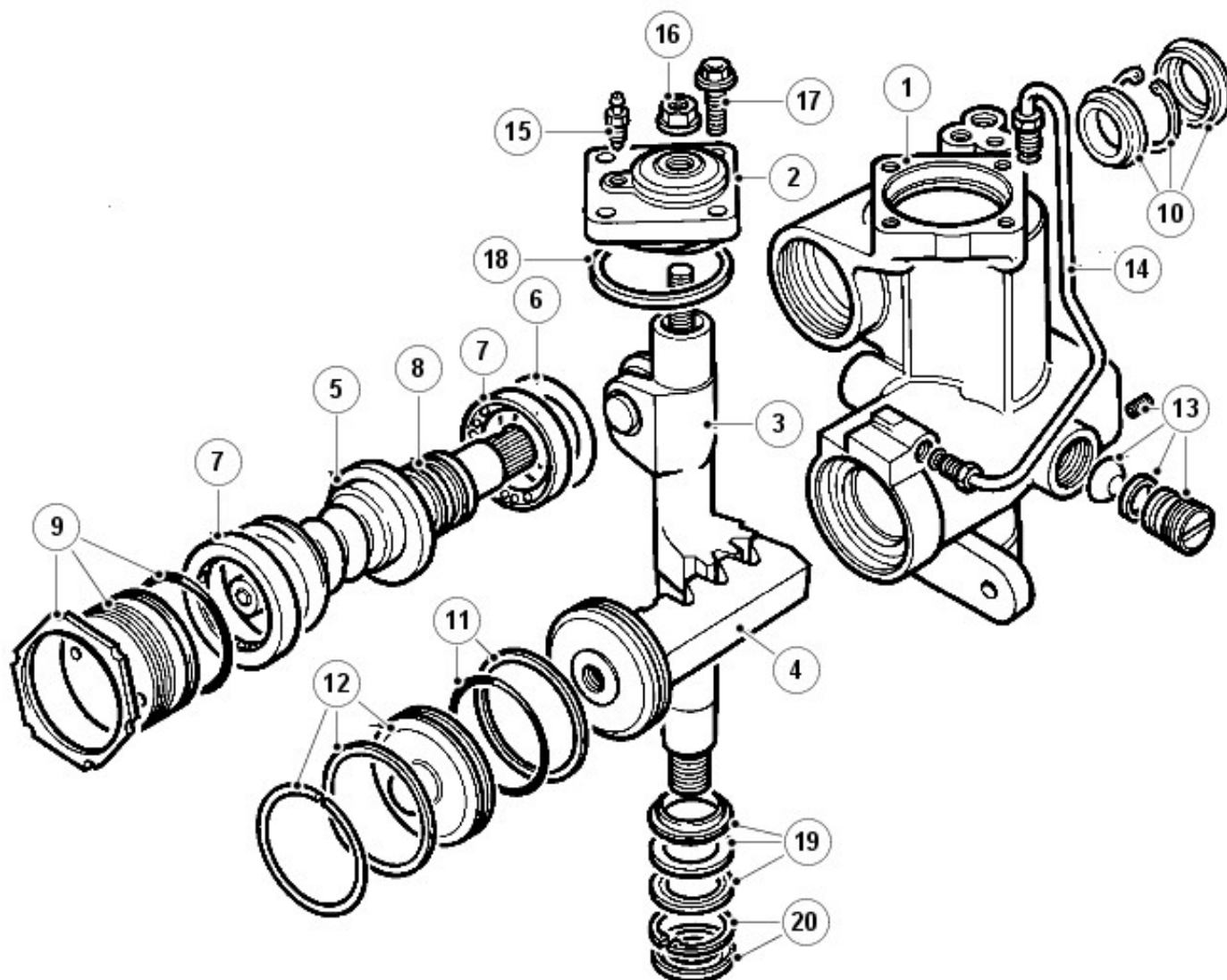
Power steering system



J6291

Item	Part Number	Description
1.	-	Hydraulic pump
2.	-	Fluid reservoir
3.	-	Steering box
4.	-	Upper column
5.	-	Universal joints
6.	-	Lower shaft
7.	-	Compression joint
8.	-	Drag link

Power steering box components



RR4149

Item	Part Number	Description
1.	-	Housing complete with sector shaft bearings
2.	-	Cover plate complete with bearing
3.	-	Sector shaft
4.	-	Hydraulic piston/rack
5.	-	Worm/valve and torsion bar assembly
6.	-	Shims for centralizing worm/valve
7.	-	Ball race
8.	-	'Teflon' seals for valve sleeve
9.	-	Bearing adjuster, locknut and seal
10.	-	Worm shaft pressure seal, circlip and dirt excluder
11.	-	'Teflon' and rubber seal for piston
12.	-	End cover seal and snap ring
13.	-	Adjustment components for piston/rack
14.	-	Hydraulic pipe
15.	-	Bleed screw
16.	-	Sector shaft adjustment lock nut with seal
17.	-	Cover plate bolts
18.	-	Cover plate seal
19.	-	Seal, washer and backup seal
20.	-	Circlip and dust cover

GENERAL

The steering system incorporates a compression joint in the lower shaft and is designed to collapse on impact. The misalignment of the upper steering column with the steering box and the inclusion of two universal joints, is also designed to prevent the column moving toward the driver under frontal impact.

The steering box is located behind the first chassis cross member and is connected to the road wheel swivel housing by a drag link and track rod. A hydraulic damper absorbs shocks in the steering, caused by road wheel deflections when operating on rough terrain.

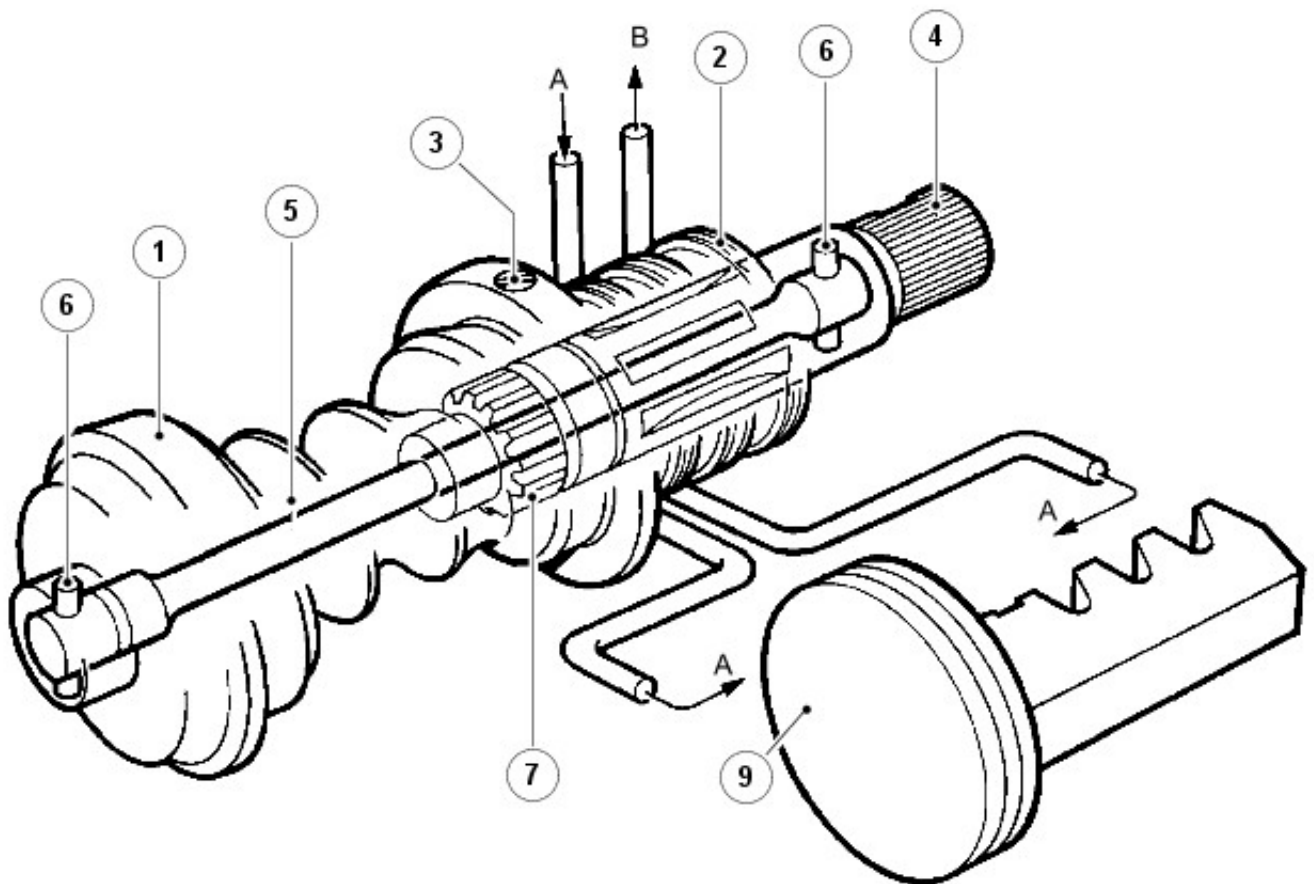
Power steering system

The power steering system comprises a hydraulic pump which is belt driven from the engine and supplied with fluid from a reservoir that also acts as a cooler.

The steering box houses a self neutralizing rotary valve which is part of the worm/valve assy and an hydraulic piston/rack to assist the mechanical operation. The rotary valve which is operated by movement of the steering wheel, directs fluid pressure to the appropriate side of the hydraulic piston/rack to provide assistance.

Rotary valve operation

Rotary valve at neutral



RR3620M

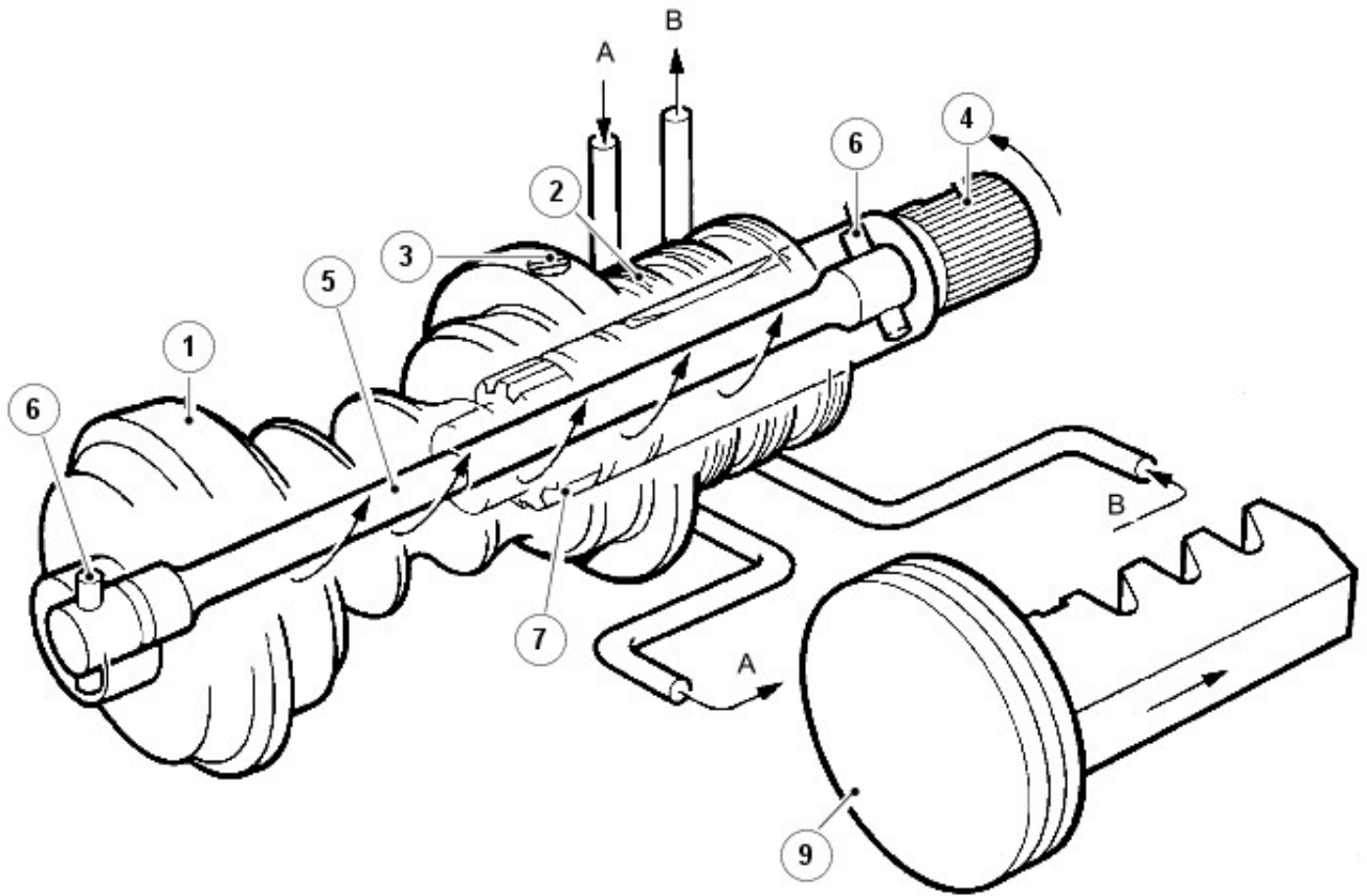
The rotary valve assembly comprises a worm (1), valve sleeve (2), input shaft (4) and torsion bar (5).

The valve sleeve is retained inside the worm by a trim screw (3), and incorporates valve ports in its inner bore. The input shaft is attached to the steering wheel via a steering shaft and steering column and incorporates valve ports in its outer diameter to align with those in the sleeve.

The torsion bar, which is secured to the worm and input shaft with pins (6) at each end, holds the valve ports in neutral alignment when there is no demand for assistance.

When there is no demand for assistance the torsion bar holds the input shaft and sleeve valve ports in neutral relationship to one another, allowing equal pump pressure (A) to both sides of the piston/rack (9). Any excess fluid flow from the pump returns to the reservoir via (B).

Rotary valve misaligned



RR3621M

When the steering wheel and input shaft is turned, steering resistance transmitted to the worm causes the torsion bar to be twisted and the valve ports to be misaligned for a right or left turn. The misalignment of the valve ports directs all fluid pressure A to one side of the piston only and allows displaced fluid B on the other side.

When demanding maximum assistance, any excessive fluid output from the pump due to high pump speed, will circulate through the regulator valve located in the pump unit, causing the temperature of the fluid and the pump to rise rapidly.



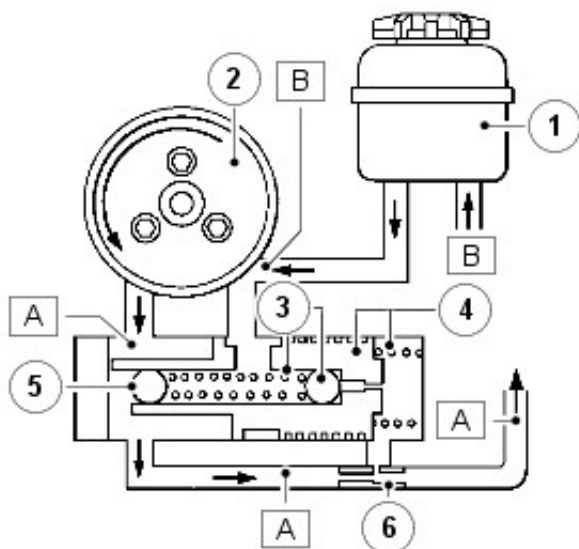
CAUTION: To avoid excessive fluid temperatures which could damage the oil seals, the steering must not be held on full lock for more than 30 seconds in one minute.

Only when the steering wheel, and the demand for assistance, is released, will the torsion bar return the valve to neutral, allowing the fluid to circulate through the reservoir where it is cooled.

In the unlikely event of mechanical failure of the torsion bar, a coarse splined connection (7) between the input shaft and worm, ensures steering control is maintained sufficient to allow the vehicle to be recovered.

Pump and regulator valve operation

No demand for assistance



J6292

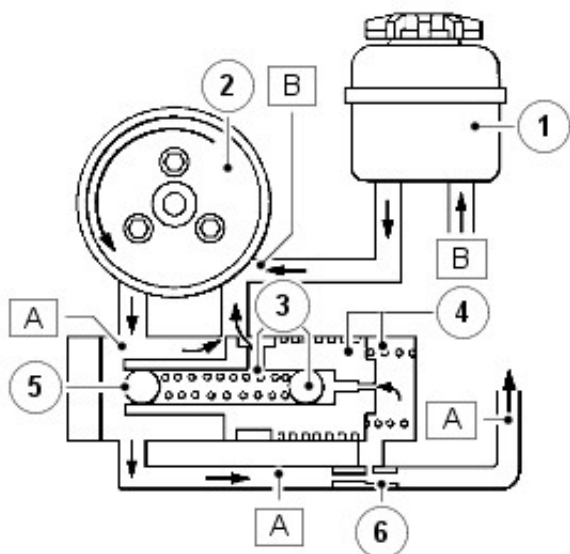
Item	Part Number	Description
1.	-	Reservoir
2.	-	Pump
3.	-	Pressure control ball valve and spring
4.	-	Flow control valve and spring
4.	-	Press fit plug (ball bearing)
5.	-	Restrictor

The pump which is belt driven from the engine is an eccentric roller type and also houses the pressure regulator and flow control valve. The pressure is controlled by a spring loaded ball valve (3) which is housed inside the flow control valve piston (4).

With no demand for assistance the rotary valve in the steering box acts as a pressure relief valve, allowing fluid (A) to flow freely through the steering box and back to the reservoir and pump inlet (B).

When the steering is turned, the rotary valve effectively stops all fluid flow through the steering box, thus causing an increase in pressure (A). This increase in pressure is felt in the flow control valve spring chamber where, at a pre-determined pressure the relief valve (3) will open and allow the pressure to escape. The fall in pressure in the flow control spring chamber, allows the flow control valve to move to the right, which in turn allows pump output (A) to escape directly into the pump inlet (B).

Assistance demanded



J6293

As soon as the steering wheel is released after making a turn, the system reverts to the condition seen in J6292 and the road wheels are returned to the straight ahead position by the mechanical steering geometry.

In the event of any hydraulic failure, steering control, though heavy, will be maintained through the mechanical components in the steering box.

Steering System - General Information - Steering System

Diagnosis and Testing

Symptom Chart

Power steering pressure faults



CAUTION: Do not hold steering wheel on full lock for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

Excessive pressure in the system is almost always caused by a faulty relief valve in the PAS pump.

Insufficient pressure in the system is usually caused by low fluid level or PAS pump drive belt slip, or one of the following: PAS system leaks, faulty PAS pump relief valve, fault in steering box valve and worm assembly, leak at piston in steering box, worn components in PAS pump or box.

Symptom	Possible Sources	Action
Insufficient power assistance	* Fluid leaks	* Check for leaks, top-up reservoir.
	* Incorrect system pressures	* Carry out pressure test.
	* Power steering pump drive belt	* Check for contamination and/or correct tension.

Steering linkage faults

Symptom	Possible Sources	Action
Excessive kickback through steering wheel	* Faulty steering damper	* Replace steering damper
	* Looseness or free play in steering linkage	* Check steering linkage and replace worn or faulty components.
	* Looseness or worn bushes in front suspension	* Check suspension and replace worn or faulty components. - When replacing suspension bushes, ALL bushes and fixings must be replaced.
	* Swivel hub resistance incorrect	* Check swivel pin bearing pre-load.

Fluid leaks



CAUTION: The steering wheel must not be held on full lock for more than 30 seconds in one minute, as this may overheat the fluid and cause damage to the oil seals.

Symptom	Possible Sources	Action
Fluid leaks from steering box	* Excessive system pressure	* Replace power steering pump. If problems persist, overhaul the steering box.
Power steering fluid leaks	* Incorrect fluid level.	* Refill or drain to the correct level.
	* Leak from hoses and/or joints.	* Slacken and re-torque unions. Replace faulty pipes or hoses.
	* Fluid escaping from filler cap.	* Bleed power steering system.
	* Worn or damaged seal in steering system component.	* Replace faulty seal(s).

Insufficient power assistance - normal castor return action

Symptom	Possible Sources	Action
Insufficient power assistance	* Incorrect tire pressures or incorrect type of tire	* Adjust tire pressures and/or replace tires.
	* Low fluid level or air locks in the system	* Top-up fluid level, bleed the fluid system.
	* Incorrect system pressures.	* Check system pressures and bleed system. If fault persists, replace power steering pump and/or overhaul steering box.

Steering heavy/stiff - poor castor return action

Symptom	Possible Sources	Action
Stiff or heavy steering	* Incorrect type of tire or incorrect pressure.	* Fit correct tires or inflate to correct pressure.
	* Universal joint incorrectly aligned or seized.	* Free off or replace universal joint, align correctly.
	* Steering box incorrectly adjusted.	* Adjust steering box. REFER to: Steering Gear Adjustment (211-00, General Procedures).
	* Steering ball joints seized.	* Replace seized components.
	* Swivel pins require lubrication or bearing preload resetting.	* Lubricate swivel pins or set bearing preload.
	* Steering box worn or seized.	* Overhaul steering box.

Steering excessively light/sensitive. Excessive free play at steering wheel



WARNING: Adjustments of steering box should not be required while in warranty period. If box is within warranty, it

must be returned to manufacturer. No attempt must be made to introduce backlash.

Symptom	Possible Sources	Action
Light steering/excessive free play	* Incorrectly adjusted steering box	* Adjust steering box. REFER to: Steering Gear Adjustment (211-00, General Procedures).
	* Worn panhard rod or radius arm bushes. Check condition of ball joints and the lower steering column shaft universal joint for wear.	* Replace worn/faulty components.

Steering vibration, road wheel shimmy - wobble

NOTE: Vibration through the steering linkage powerful enough to induce high frequency oscillation of the steering wheel, is generally caused by out of balance road wheels. However there are a number of other possible causes of this symptom which, if severe, may be described as shimmy or wobble. Regardless of the terminology used by the owner/driver to describe the symptoms, the following diagnostic checks should be carried out in the order presented.

Symptom	Possible Sources	Action
Steering vibration	* Balance of road wheel, condition/specification of tires.	* Balance wheels, replace faulty or incorrect specification tires.
	* Faulty steering damper.	* Replace steering damper.
	* Worn/alignment of universal joints.	* Replace worn components, align joints correctly.
	* Worn steering linkage ball joints, including steering box and tie rod.	* Replace worn or damaged components.
	* Worn suspension bushes. Incorrectly tightened fixings.	* Replace worn or damaged components. Ensure all fixings are tightened to correct torque with vehicle wheels on the ground. * If problem persists, fit the following damper kits: - 90 Models - STC288 (front) and STC 289 (rear) - 110/130 Models - STC290 (front) - 110 Models (levelled) - STC291 (rear) - 110 Models (unlevelled) - STC92 (rear) - 130 Models - STC293 (rear)
	* Incorrectly adjusted power steering box.	* Adjust steering box. REFER to: Steering Gear Adjustment (211-00, General Procedures).
	* Excessive hub bearing end-float.	* Check condition of hub bearings and adjust end-float as necessary.
	* Swivel joints incorrectly set.	* Adjust swivel pin bearing preload.
	* Steering geometry out of specification.	* Carry out full steering geometry check.

Steering veer

Symptom	Possible Sources	Action
Steering veer - not under baking	* Unevenly worn or faulty front tires.	* Inspect tires. Swap position (left to right) of front tires. If vehicle veers in opposite direction, replace tires. If problem solved, leave tires in new positions.
	* Steering box not centralised.	* Centralise steering box. REFER to: Steering Gear Centralization (211-00, General Procedures).
Steering veer - under braking	* Air in brake system	* Carry out bleeding procedure. REFER to: Brake System Bleeding (206-00 Brake System - General Information, General Procedures).
	* Brake pads glazed	* Remove glaze or replace brake pads.
	* Swivel pin bearing preload incorrectly set	* Adjust swivel pin bearing preload.

Directional stability

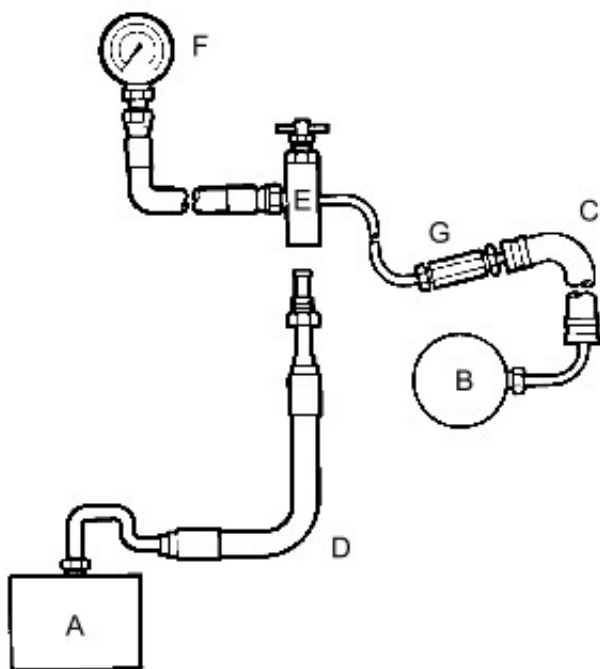
Symptom	Possible Sources	Action
Stability	* Vehicle overloaded or load incorrectly positioned.	* Check vehicle loading parameters in Owner Handbook.
	* Rear trailing link/chassis bushes worn.	* Replace worn components.
	* Worn front and rear shock absorbers.	* Replace worn components.
	* Faulty steering damper.	* Replace steering damper.
	* Road wheels out of balance.	* Balance the road wheels.

Power steering system - excessive noise

Symptom	Possible Sources	Action
Excessive noise	* Incorrect fluid level.	* Refill or drain to the correct level.
	* Hoses fouling vehicle body.	* Re-route hoses away from vehicle body.
	* PAS drive belt tension	* Re-tension drive belt.
	* Air in power steering system.	* Bleed power steering system.
	* Faulty steering box and/or pump.	* Replace faulty components.

POWER STEERING SYSTEM TEST

NOTE: If steering lacks power assistance. Check pressure of hydraulic pump before fitting new components. Use fault diagnosis chart to assist in tracing faults.



RR3959M

Item	Part Number	Description
A.	-	Steering box
B.	-	Steering pump
C.	-	Existing hose, steering box to pump
D.	-	Hose LRT-57-030
E.	-	Test adaptor LRT-57-001
F.	-	Pressure gauge LRT-57-005
G.	-	Thread adaptor LRT-57-004
H.	-	Thread adaptor LRT-57-022

1. A hydraulic pressure gauge and test adaptor is used to test the power steering system. This gauge is able to measure 140 kgf/cm². The maximum power steering system pressure is 77 kgf/cm².
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm². It is important to realise that pressure on gauge is same pressure being exerted upon steering wheel. When testing, turn steering wheel gradually while reading pressure gauge.
3. Check and maintain maximum fluid level of reservoir.
4. Examine power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check steering pump drive belt tension and renew belt if necessary.
6. Assemble test equipment and fit to vehicle, as shown in RR3959M.
7. Open tap of adaptor.
8. Bleed system, take care not to overload pressure gauge.
9. With system in good condition, pressures should be:
 1. (A) Steering wheel held on full lock and engine running at 1,000 rev/min, 70 to 77 kgf/cm².
 2. (B) Steering wheel held on full lock and engine idling, 28 kgf/cm².
 3. Checks should be carried out on both full lock positions.



CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and

possibly damaging seals.

10. Release steering wheel and with engine idling. Pressure should read below 7 kgf/cm².
11. If pressures differ to those given a fault exists.
12. To determine if fault is steering box or pump. Close adaptor tap for a maximum five seconds.
13. If gauge does not register specified pressure, pump is faulty.
14. Fit a new pump, bleed system and repeat test. If low pressure or a substantial imbalance exists, fault is in steering box valve and worm assembly.

STEERING DAMPER

NOTE: The power steering system, as well as reducing the effort required to manoeuvre the vehicle when parking, also helps to dampen any deflections of the road wheels, being transmitted back to the steering wheel.

When operating the vehicle off road, the road wheels are often deflected by ruts and boulders causing the steering wheel to turn left and right. This phenomenon is known as 'steering kickback'. To subdue the effects of 'steering kickback', a hydraulic damper is fitted in the steering linkage between the track rod and the differential casing. The damper, which offers the same resistance in extension and compression, is sealed for life.

1. Inspect damper for casing damage or leaks.
2. Clamp one end of the damper horizontally in a vice using soft jaws. Compress and extend the unit by hand. Resistance should be equal in both directions.
3. If it is felt that the unit is outside acceptable limits, fit a new steering damper.

VISUAL AND SAFETY CHECKS



WARNING: Before taking vehicle out on the public highway for road test, it is important that the following basic visual checks are carried out to ensure that the vehicle complies with legal requirements.

1. **NOTE:** This information refers to standard tyres fitted as original equipment.
Check and adjust tyre pressures.
2. Check condition of tyres. Inspect for signs of uneven wear, damage and feathering.
3. Check tread depth. Ensure that the tyre make, type and general condition are common across each axle.
4. Check wheel rims for signs of damage and excessive run out.

ROAD TEST PROCEDURE

General steering/handling problems can usually be classified into one of the categories listed and ARE GENERALLY RELATED TO THE AGE, CONDITION AND USE OF THE VEHICLE.



WARNING: Ensure that all road tests are conducted by suitably qualified drivers in a safe and legal manner, and where local traffic conditions allow.

1. Carry out visual and safety checks.
2. Confirm general nature of complaint with customer, simulating where possible the conditions under which the problem occurs. Carry out following road test procedure to establish the problem.
3. Steering load assessment - drive at 16 km/h (10 mph). Put 90° turn input into steering wheel, check self centering. The self centering should be equal on each lock but not necessarily return to exactly straight ahead without assistance from the driver.
4. Steering assessment - drive at 64 km/h (40 mph) on a straight FLAT road (no camber), check for steering veer. The vehicle should follow a straight path with NO tendency to follow a curved path. If vehicle veers towards the kerb, vehicle may be 'camber sensitive'. A small amount of veer in direction of camber is acceptable.
5. Directional stability assessment - drive at 112 km/h (70 mph) or maximum legal speed on a straight flat road. Carry out a normal lane change. Vehicle should quickly settle into a new straight path.
6. Braking assessment (medium effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply steady medium braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.
7. Braking assessment (full effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply full braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.
8. If the symptom described by the customer is stiff steering or steering niggles, carry out stiff steering procedure. If

not, proceed with basic checks and adjustments.

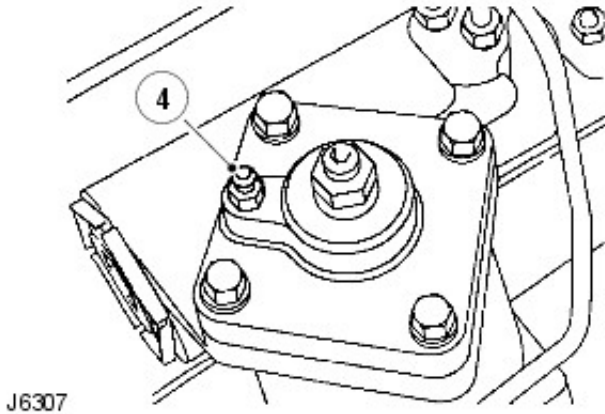
Steering System - General Information - Power Steering System Filling and Bleeding

General Procedures

1. Check that fluid level is at maximum level.
2. Run engine to normal operating temperature.
3. Recheck reservoir fluid level, top up if necessary.

4. **NOTE: Maintain maximum fluid level in reservoir. Do not increase engine speed or move steering wheel.**

With engine at idle speed, slacken bleed screw. When fluid seeps past bleed screw re-tighten screw.



5. Check fluid level.
6. Clean fluid from around bleed screw.
7. Check hose connections, pump and steering box for fluid leaks by holding steering on full lock in both directions.



CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

8. Carry out road test.
9. Check and top-up fluid level.

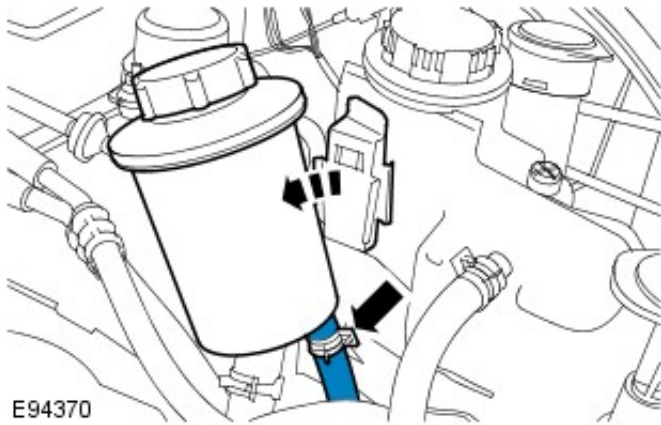
Steering System - General Information - Power Steering System Flushing

General Procedures

NOTE: If heavy steering or contamination within the power steering system is found, it is necessary to carry out the system flush procedure as detailed below. If any components have been replaced in the power steering system the procedure below must be carried out in full.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the power steering fluid reservoir cap.
2. Using a suitable syringe, remove the power steering fluid from the power steering fluid reservoir.

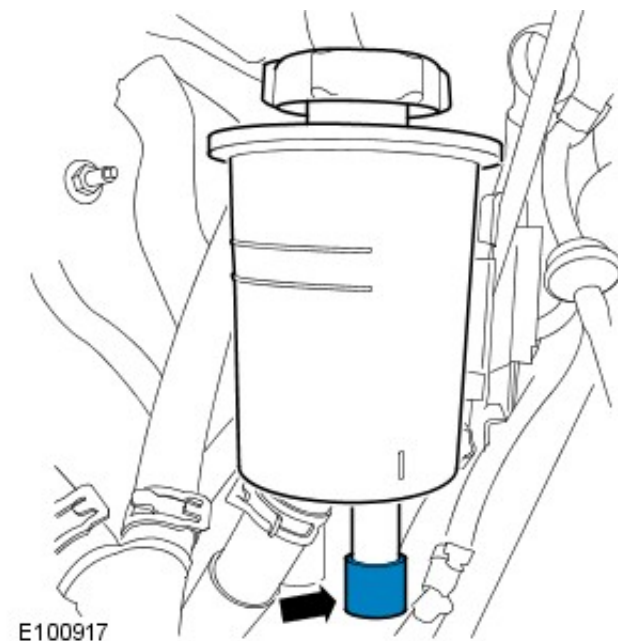


3.  **CAUTION:** Be prepared to collect escaping fluids.

NOTE: Note the orientation of the clip.

Detach the power steering fluid reservoir.

- Detach but do not remove the power steering fluid reservoir.
- Release the power steering fluid return hose from the power steering fluid reservoir.
- If a quick release coupling is fitted to the power steering return hose, release the power steering fluid return hose from the coupling by removing the clip.



4.  **CAUTION:** Be prepared to collect escaping fluids.

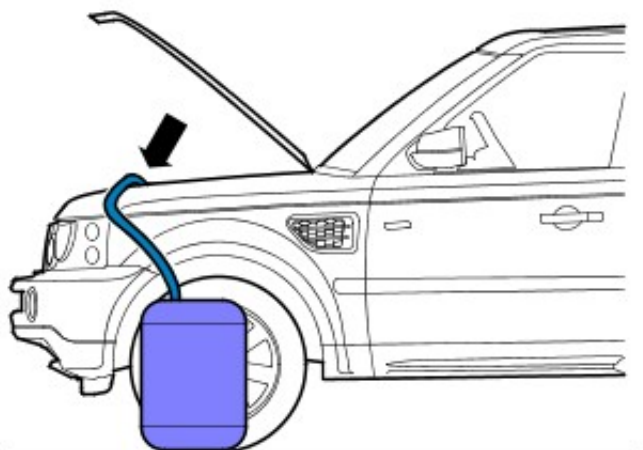
NOTE: Make sure that all openings are sealed. Use new blanking caps.

Using a suitable blanking cap, cap the power steering reservoir return pipe.

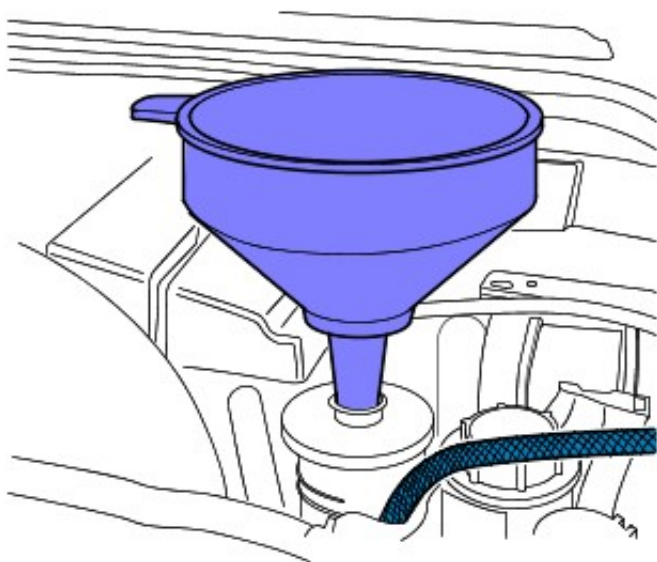
5.  **CAUTION:** Be prepared to collect escaping fluids.

NOTE: Make sure the extended pipe is not kinked or twisted and is correctly secured with hose clips.

Attach a suitable pipe to the power steering return hose to allow the fluid to drain.



E 100918




E94372

6. NOTE: The suitable funnel should have the a capacity of 4 litres and O-ring seal

NOTE: The suitable funnel must be tightly sealed to the power steering fluid reservoir to avoid fluid leakage.

Install a suitable funnel onto the power steering fluid reservoir.

7.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle with the wheels just clear of the ground.

8. **CAUTIONS:**



Steps 8 and 9 must be carried out within 2 - 3 seconds of each other. Failure to follow this instruction may result in damage to the power steering system.



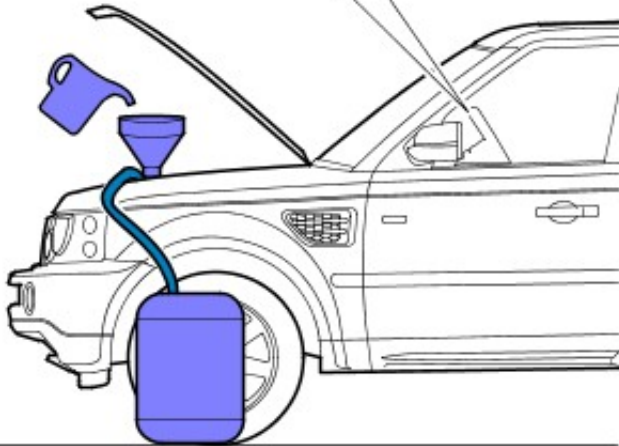
Be prepared to collect escaping fluids.

Using the suitable funnel, top up the power steering system with the specified fluid. Make sure the fluid level is maintained at two thirds full in the funnel.

9. **CAUTIONS:**



Be prepared to collect escaping fluids.



E94373



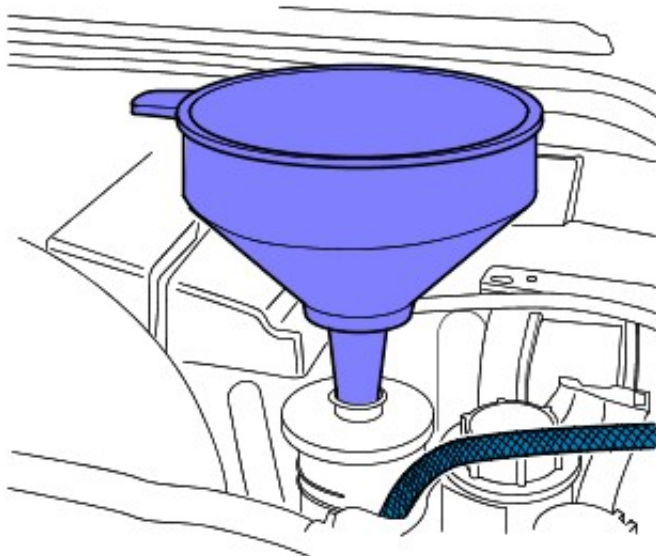
Do not allow the power steering fluid level in the power steering fluid reservoir to fall below the minimum power steering fluid level. Failure to follow this instruction may result in damage to the power steering system.



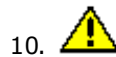
Make sure the engine is switched off as soon as the full 4 litres of power steering fluid has entered the power steering fluid reservoir.

Flush the power steering system.

- Start the engine
- With assistance turn the steering slowly lock to lock 3 times at approximately 1 revolution every 5 seconds.
- Continue to flush the power steering system until 4 litres of power steering fluid has been added to the power steering reservoir. This should take approximately 30 seconds.



E94372



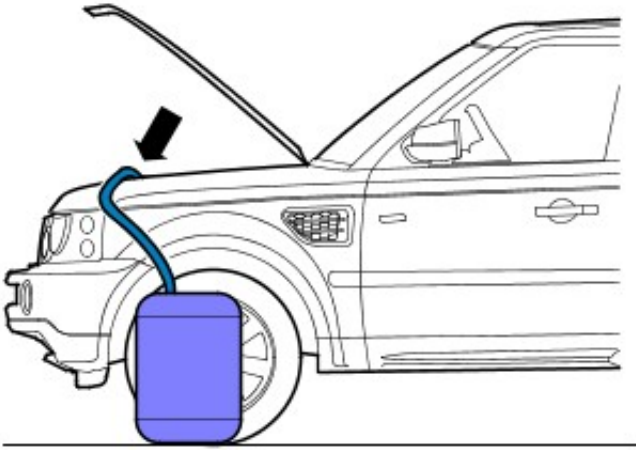
10. CAUTION: Be prepared to collect escaping fluids.

Remove the suitable funnel.



11. CAUTION: Be prepared to collect escaping fluids.

Remove the suitable pipe to the power steering return hose.



E 100918

12.  **CAUTION:** Be prepared to collect escaping fluids.


NOTE: Note the orientation of the clip.

If a quick release coupling is fitted to the power steering return hose, connect the power steering fluid return hose to the coupling by installing the clip.

13. Install a new power steering fluid reservoir.
For additional information, refer to: Power Steering Fluid Reservoir (211-02, Removal and Installation).

Steering System - General Information - Steering Gear Adjustment

General Procedures

1.  **WARNING:** Adjustments of steering box should not be required while in warranty period. If box is stiff or tight and within warranty, it must be returned to manufacturer. No attempt must be made to introduce backlash.

Apply park brake, chock wheels and jack up front of vehicle until wheels are clear of ground.

2. Support chassis front on axle stands.
3. Disconnect drag link from steering drop arm.
4. Check torque to turn.
For additional information, refer to: Steering System (211-00, Diagnosis and Testing).
5. **NOTE:** Only check for no backlash when steering box is in central position.

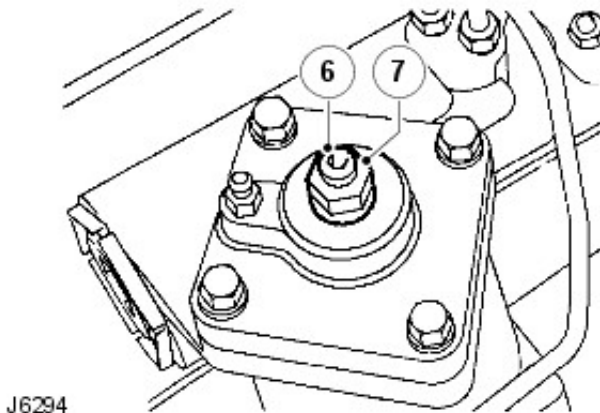
NOTE: If steering wheel is not straight, it should be repositioned
For additional information, refer to: Steering Wheel (211-04, Removal and Installation).

Centralise steering box.

For additional information, refer to: Steering Gear Centralization (211-00, General Procedures).

6. Adjustment is obtained by rocking the drop arm about centre whilst an assistant slowly tightens the steering box adjuster screw.

7. Tighten locknut when all backlash has been removed.



J6294

8. Repeat the check for backlash. If backlash exists loosen locknut and repeat adjustment procedure.
9. Turn steering wheel lock to lock and check no tightness exists.
10. Ensure front wheels are aligned and in straight ahead position.
11. Adjust drag link 924 mm between ball joint centres.
12. Connect drag link and tighten to 40 Nm (30 lbf.ft).
13. Lower vehicle to ground level and remove chocks.
14. Road test vehicle
For additional information, refer to: Steering System (211-00, Diagnosis and Testing).
15. RH drive vehicles - if steering wheel is to right, drag link is too long.
If steering wheel is to left drag link is too short. LH drive vehicles - if

steering wheel is to right, drag link is too short. If steering wheel is to left drag link is too long.

16. Adjust drag link until steering wheel points straight ahead when vehicle is travelling in a straight line.

Steering System - General Information - Steering Gear Centralization

General Procedures

1. Disconnect sector shaft arm drag link from drop arm.
For additional information, refer to: Sector Shaft Arm Drag Link (211-03, Removal and Installation).
2. Turn steering wheel on full RH lock.
3. Turn steering wheel back exactly two turns.
4. Fit sector shaft arm drag link.
For additional information, refer to: Sector Shaft Arm Drag Link (211-03, Removal and Installation).
5. Repeat operation for LH drive vehicle but turn steering wheel on full LH lock.

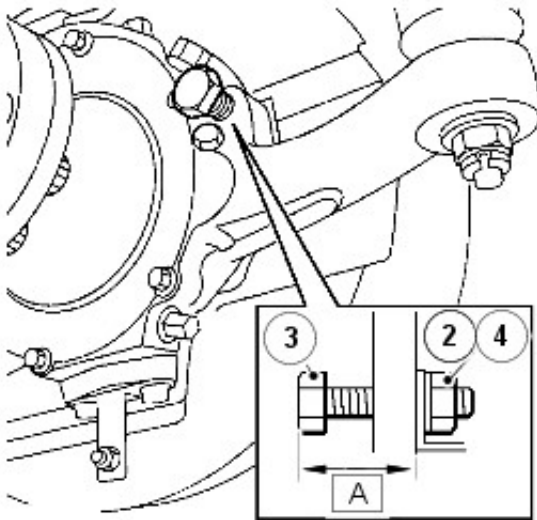
Steering System - General Information - Steering Lock Stop Adjustment

General Procedures

1. Measure clearance between tire wall and radius arm at full lock. This must be not less than 20 mm.
2. Loosen stop bolt locknut.
3. Turn stop bolt as required.
4. Tighten locknut.
5. Check clearance between tire wall and radius arm on each lock.
6. **NOTE: Alternatively lock stop adjustment may be carried out using following procedure.**

Measure stop bolt protrusion 'A'. Refer to table for correct setting.

Alloys	Size	Setting
BF Goodrich Mud Terrain	265	59.7 mm
Goodyear GT+4	235	55.7 mm
Michelin M+S 4X4	235	52.2mm
Steels	Size	Setting
Goodyear	205	55.2 mm
Michelin	205	55.2 mm
Avon	7.50	56 mm
Michelin	7.50	56 mm
Goodyear	7.50	56 mm



J6295A

7. Loosen stop bolt locknut.
8. Turn stop bolt as required.
9. Tighten locknut.
10. Check wheel position at full lock.

Power Steering -

Description	Nm	lb-ft
Power steering pump bolts	23	17
Power steering fluid reservoir nuts	4	3
Power steering high-pressure pipe union	20	15

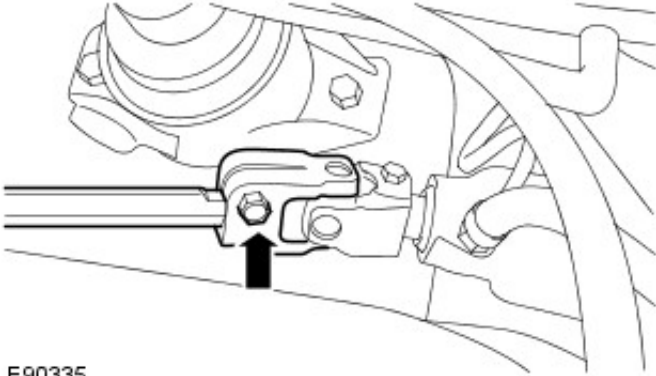
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Power Steering - Steering Gear

Removal and Installation

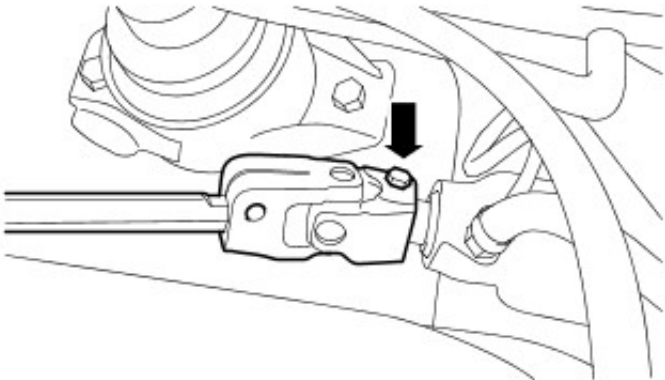
Removal

1. Center the steering wheel.
 - Lock in position, remove the ignition key.
2. Loosen the steering column lower shaft upper bolt.



E90335

3. Release the steering column lower shaft from the steering gear.
 - Remove the steering column lower shaft lower bolt.



E90336

4. **CAUTIONS:**



If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.



Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the power assisted steering (PAS) return hose from the steering gear.

- Position a suitable container to collect any power steering fluid spillage.

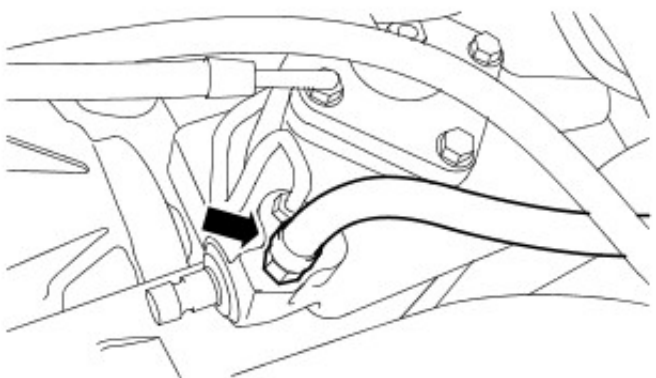
5. **CAUTIONS:**



If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.



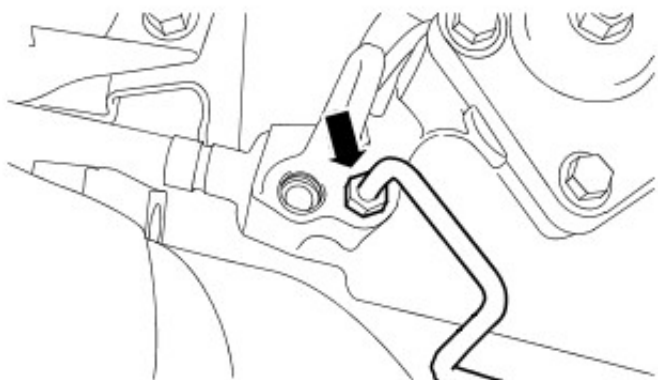
Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to




E90337

prevent contamination.

Disconnect the PAS feed pipe from the steering gear.

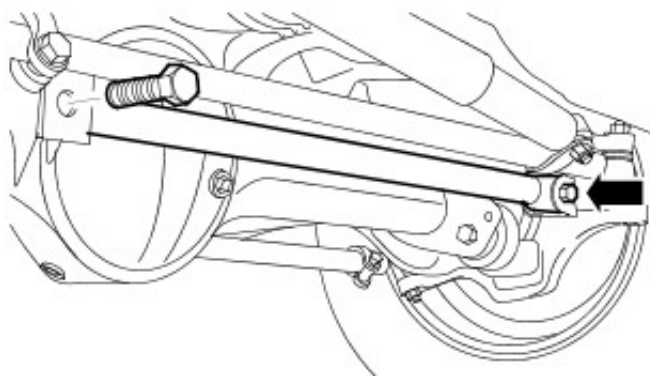


E90338


6.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

7. Remove the panhard rod.
- Remove the 2 panhard rod nuts and bolts.
 - Discard the 2 panhard rod nuts.

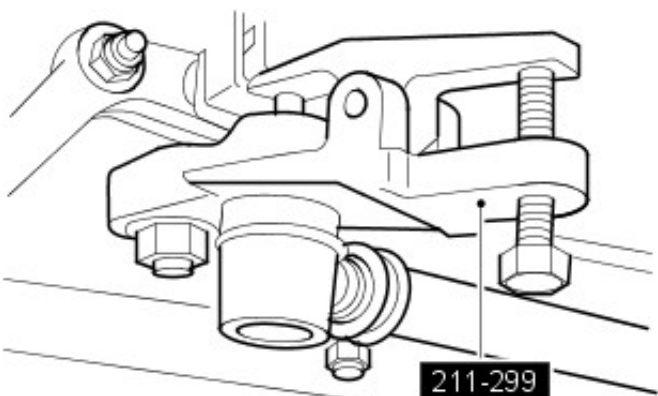


E90339

8.  **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

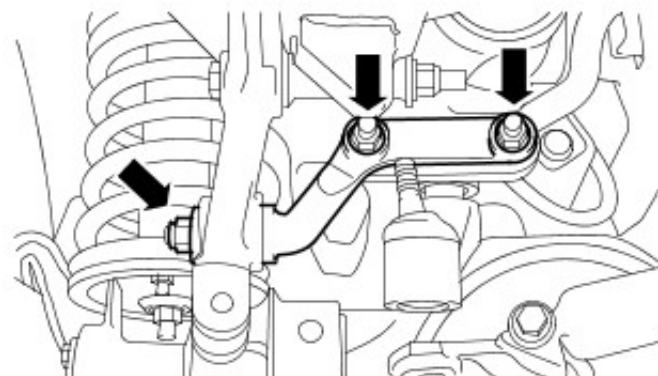
Using the special tool, release the drag link from the drop arm.

- Remove the split pin.
- Remove the drag link to drop arm nut.

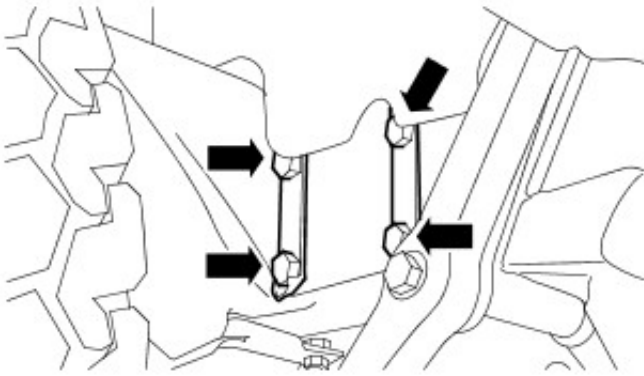


E90340

9. Remove the tie bar.



E90341



E90342

10. With assistance, remove the steering gear.

- Release the 2 tab washers.
- Remove and discard the 4 steering gear bolts.
- Remove and discard the 2 tab washers.

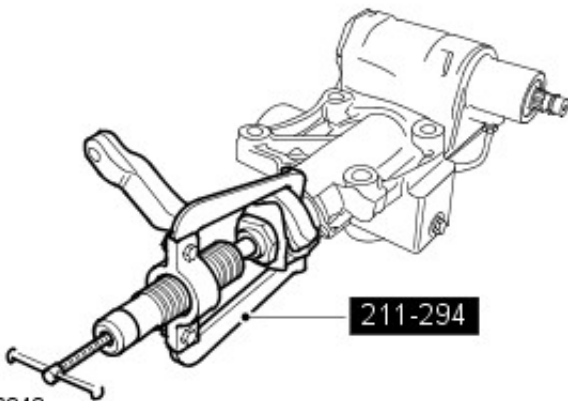
11. **NOTE:** When installing a reconditioned steering gear, complete steps 12, 13 and 14.

Release the drop arm nut lock washer.

12. Remove and discard the drop arm nut.

- Discard the drop arm nut lock washer.

13. Using the special tool, remove the drop arm from the steering gear.



E90343

Installation

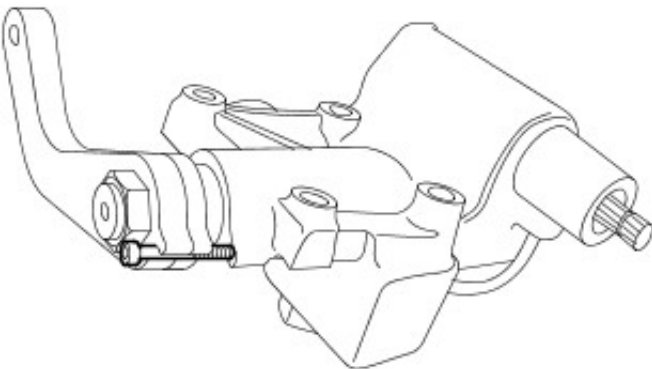
1. Clean the drop arm and steering gear mating faces.

2. **NOTE:** Install a new nut and lock washer.

Install the drop arm to the steering gear.

- Install the lock washer.
- Install but do not fully tighten the drop arm nut.

3. Install the centralizing bolt to the steering gear.



E90344

4. Secure the drop arm in a suitable vice.

5. Tighten the drop arm nut to 176 Nm (130 lb.ft).

6. Secure the drop arm nut using the lock washer.

6. Secure the drop arm nut using the lock washer.

7. Remove the steering gear assembly from the vice.

8. **NOTE: Install new bolts and tab washers.**

With assistance, install the steering gear.

- Install the tab washers.
- Install the steering gear bolts and tighten to 65 Nm (48 lb.ft).

9. Secure the steering gear bolts using the tab washers.

10. Install the tie bar to the steering gear.

- Loosely install the nuts and bolts.

11. Tighten the tie bar to panhard rod mount bracket nut to 83 Nm (61 lb.ft).

12. Tighten the tie bar to steering gear nuts and bolts to 85 Nm (63 lb.ft).


13. Secure the drag link to the drop arm.

- Install the nut and tighten to 40 Nm (30 lb.ft).
- Install the split pin.

14. **NOTE: Install new nuts.**

Install the panhard rod.


- Tighten the nuts and bolts to 230 Nm (178 lb.ft).

15.  **CAUTION:** If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.

NOTE: Inspect the O-ring seal, if there is any indication of damage install a new seal.

Connect the PAS feed pipe to the steering gear.

- Tighten to 20 Nm (15 lb.ft).

16.  **CAUTION:** If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.

NOTE: Inspect the O-ring seal, if there is any indication of damage install a new seal.

Connect the PAS return hose to the steering gear.

- Tighten to 15 Nm (11 lb.ft).

17. Check the alignment and install the steering column lower shaft to the steering gear.

- Install the steering column lower shaft lower bolt and tighten to 22 Nm (16 lb.ft).

18. Tighten the steering column lower shaft upper bolt to 22 Nm (16 lb.ft).

19. Remove the centralizing bolt from the steering gear.

20. Refill and bleed the PAS system.

For additional information, refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Fluid Reservoir

Removal and Installation

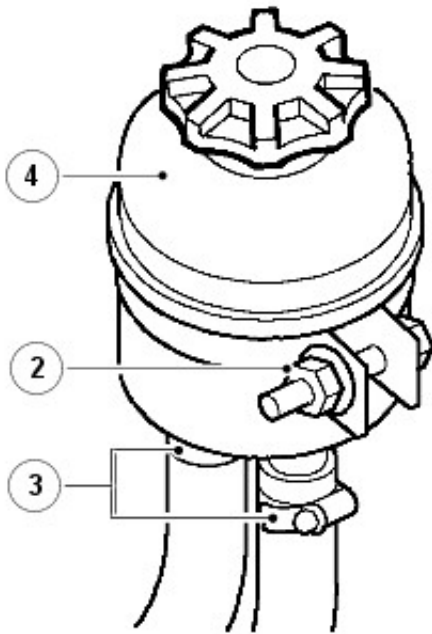
Removal

1. Position drain tin beneath reservoir.
2. Slacken mounting bracket clamp bolt and raise reservoir to gain access to feed and return hose retaining clips.
3. Slacken clips, disconnect hoses from reservoir, allow fluid to drain.

4.  **CAUTION:** Plug connections to prevent ingress of dirt.

Discard fluid drained from system. Do not allow fluid to contact paintwork, if spilled, remove fluid and clean area with warm water.

Remove reservoir.



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Installation

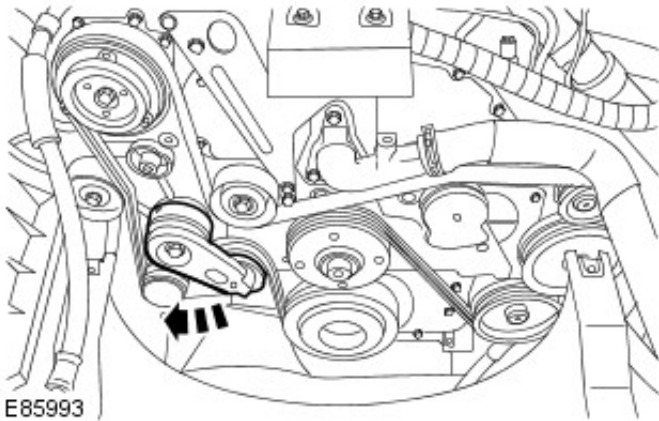
1. Position reservoir, connect feed and return hoses and tighten clips to 3 Nm (2 lbf/ft).
2. Fit reservoir in clamp, tighten clamp bolt.
3. Fill reservoir between upper mark and end of dipstick with power steering fluid.
For additional information, refer to: Specifications (211-00, Specifications).
4. Bleed power steering system.
For additional information, refer to: Power Steering System Filling and Bleeding (211-00, General Procedures).


Power Steering - Power Steering Pump

Removal and Installation

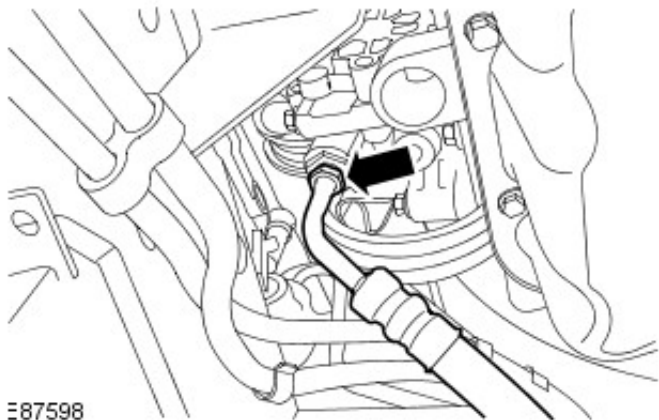
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the cooling fan.
For additional information, refer to: Cooling Fan (303-03 Engine Cooling - 2.4L Duratorq-TDCi HPCR (103kW/140PS) - Puma, Removal and Installation).
3. Release the tension from the accessory drive belt.
 - Rotate the accessory drive belt tensioner clockwise.



4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.



5. **CAUTIONS:**



Make sure that the area around the component is clean and free of foreign material.



Make sure that all openings are sealed. Use new blanking caps.

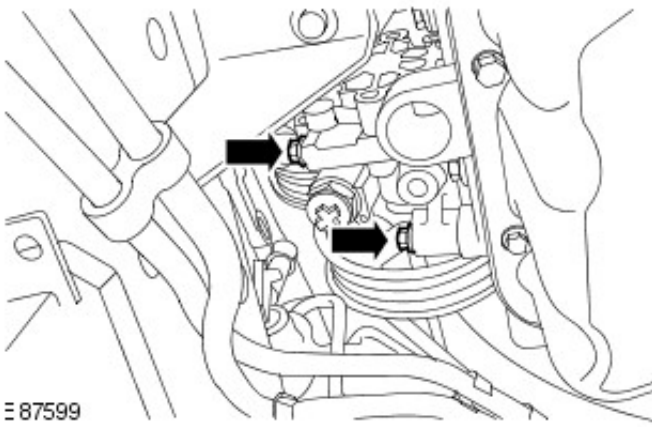


If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.

Disconnect the power steering high-pressure pipe union.

- Remove and discard the O-ring seal.

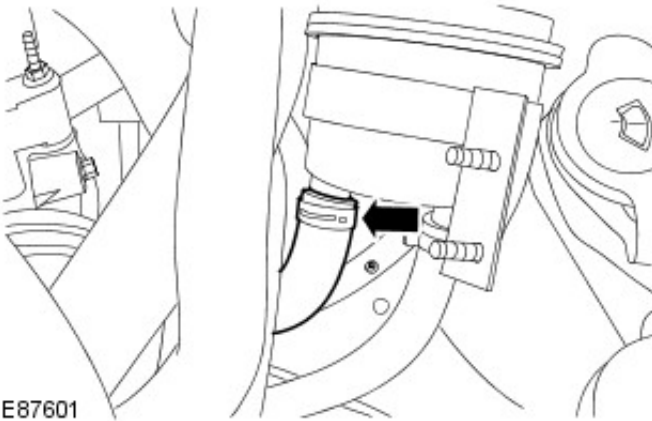
6. Remove the 2 bolts from the power steering pump.



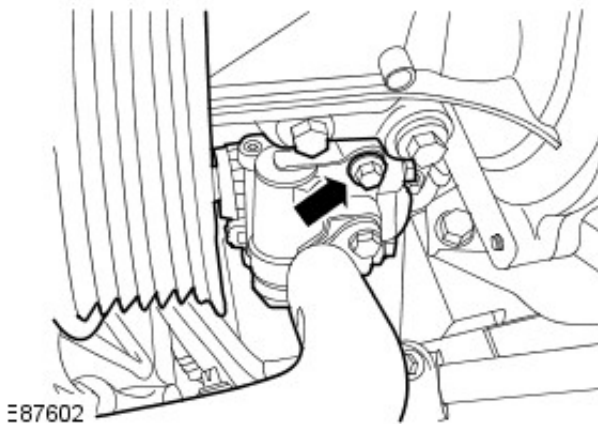
7. Release the power steering fluid reservoir.
 - Remove the 2 nuts.



8. Disconnect the power steering fluid reservoir supply hose.
 - Release the clip.

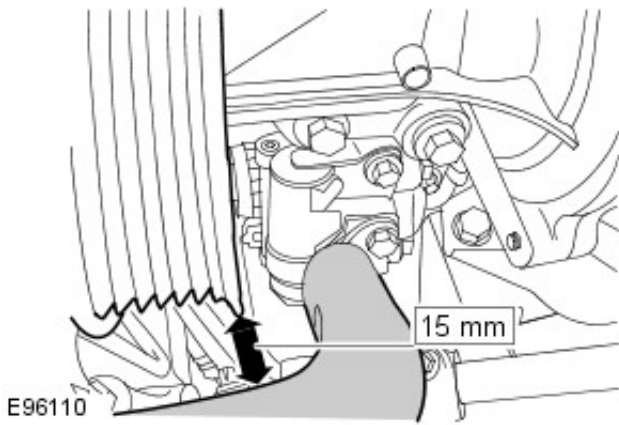



9. Remove the power steering pump.
 - Remove the bolt.



Installation

1. Install the power steering pump.
 - Tighten to 23 Nm (17 lb.ft).



2.  **CAUTION:** A 15 mm gap, or greater, must exist between the power steering pump pulley and the hose, at the rearmost edge of the pulley. Adjust the hose if required.

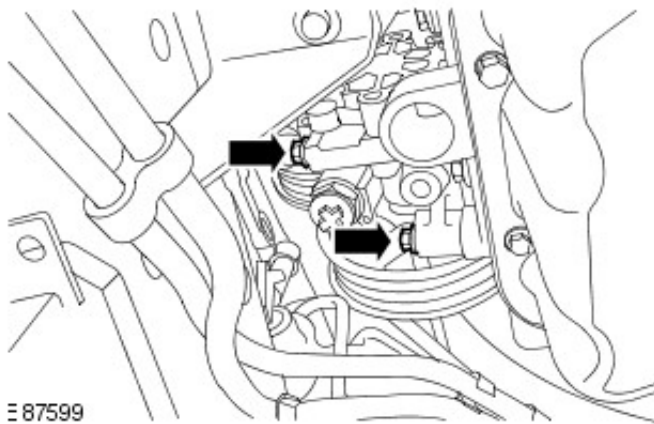
Connect the power steering fluid reservoir supply hose.

- Secure the clip.
- Check that the correct gap exists between the power steering pump pulley and the hose.

3. Secure the power steering fluid reservoir.
- Tighten to 4 Nm (3 lb.ft).



4. Tighten to 23 Nm (17 lb.ft).

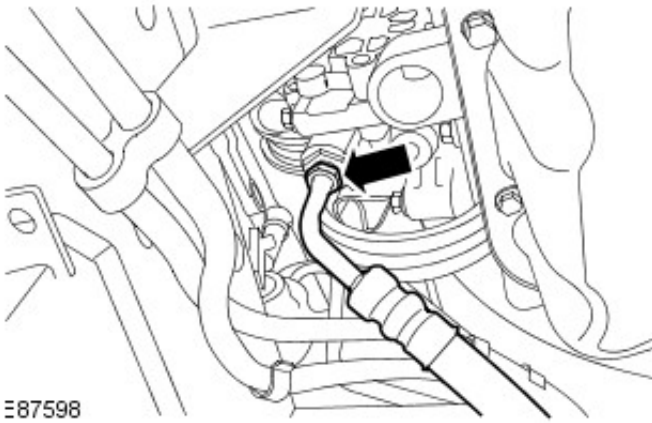


5. **NOTE:** Remove and discard the blanking caps.

NOTE: Install a new O-ring seal.

Connect the power steering high-pressure pipe union.

- Tighten to 25 Nm (18 lb.ft).



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6. Secure the accessory drive belt.
 - Rotate the accessory drive belt tensioner clockwise.
7. Install the cooling fan.
For additional information, refer to: Cooling Fan (303-03 Engine Cooling - 2.4L Duratorq-TDCi HPCR (103kW/140PS) - Puma, Removal and Installation).
8. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).
9. Fill and bleed the power steering system.
For additional information, refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

Power Steering - Steering Gear

Disassembly and Assembly

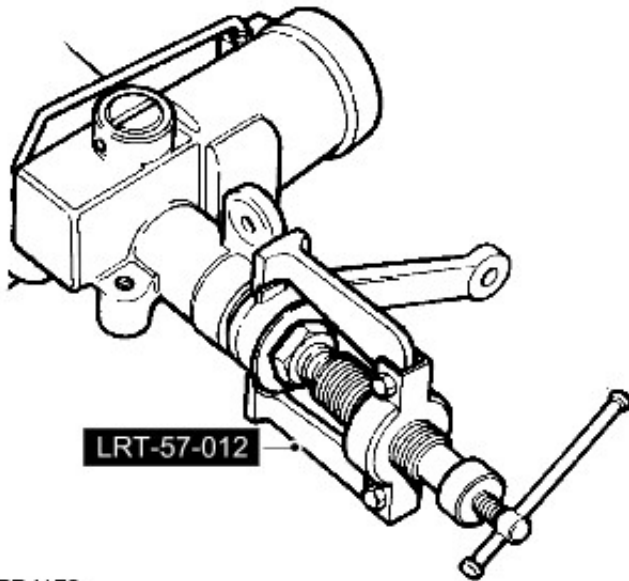
Disassembly

 **WARNING:** Wear safety glasses while removing and refitting circlips and retaining ring.

 **CAUTION:** Absolute cleanliness is essential when overhauling steering gear.

NOTE: Overhaul of steering gear should not be carried out during the warranty period.

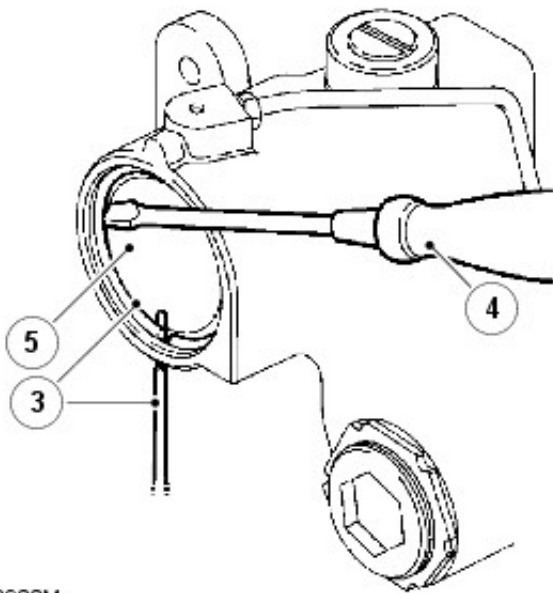
NOTE: This procedure is for Adwest steering gear only.



RR4178

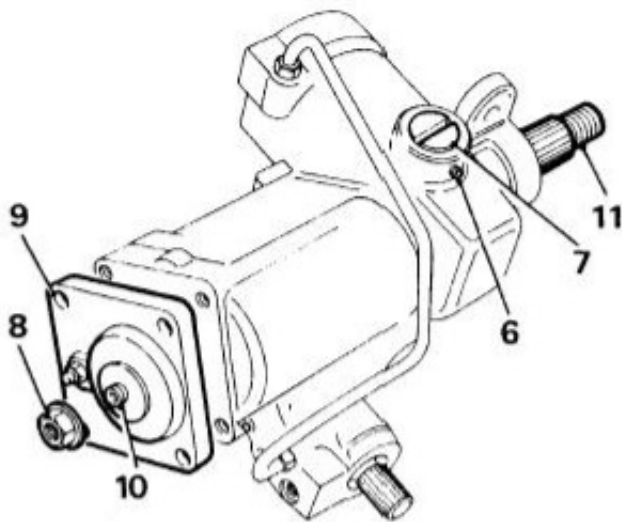
1. Remove steering gear from vehicle.
For additional information, refer to: Steering Gear (211-02, Removal and Installation).
Mark drop arm and steering gear for realignment on assembly. Remove drop arm using extractor LRT-57-012. Loosen drop arm securing nut, but do not remove before using extractor. Remove dirt excluder from output shaft.

2. Drain oil, remove blanking plugs and bleed screw. Hold steering gear over suitable container, turn input shaft from lock to lock, until oil is drained. Refit bleed screw.
3. Rotate retainer ring until one end is 12 mm from extractor hole. Using a drift through hole in cylinder, lift retaining ring from groove in cylinder bore.
4. Remove retainer ring, using a screwdriver.
5. Turn input shaft (left lock on left hand drive vehicles, right lock on right hand drive vehicles) until piston pushes out cover. Turn input shaft fully in opposite direction, applying pressure to piston.



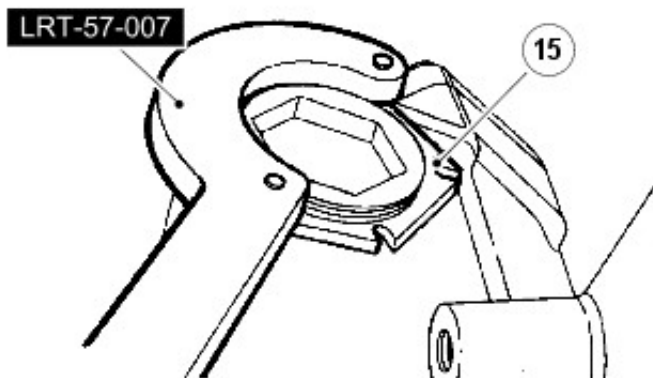
RR3922M

6. Remove set screw retaining rack pad adjuster.
7. Remove rack adjuster and pad.
8. Remove sector shaft adjuster locknut.
9. Remove four bolts from sector shaft cover.
10. Screw in sector shaft adjuster until cover is removed.
11. Slide out sector shaft.



RR924N

12. Remove piston, a bolt screwed into piston will assist removal.
13. Remove input shaft dirt excluder.
14. Remove worm adjuster locknut using 'C' wrench LRT-57-007.
15. Remove worm adjuster using wrench LRT-57-006.

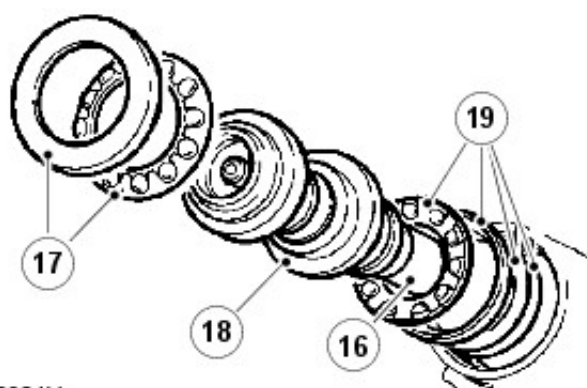


RR4179

16. Tap splined end of shaft to free bearing.
17. Remove bearing cup and caged ball bearing assembly.
18. Remove valve and worm assembly.

19. **NOTE:** If difficulty is experienced warm the casing and bearing assembly. Cool bearing cup using a mandrel and tap steering gear on a bench.

Remove inner bearing cage, cup and shim washers. Retain shims for reassembly.



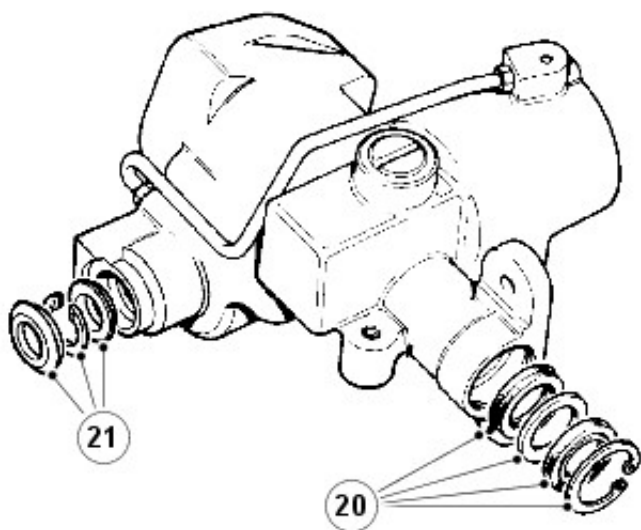
RR3924M

20. **CAUTION:** Do not remove sector shaft bearings from casing. Replacement parts are not available. If sector shaft bearings are worn fit a new steering gear.

Remove circlip and seal from sector shaft housing bore.

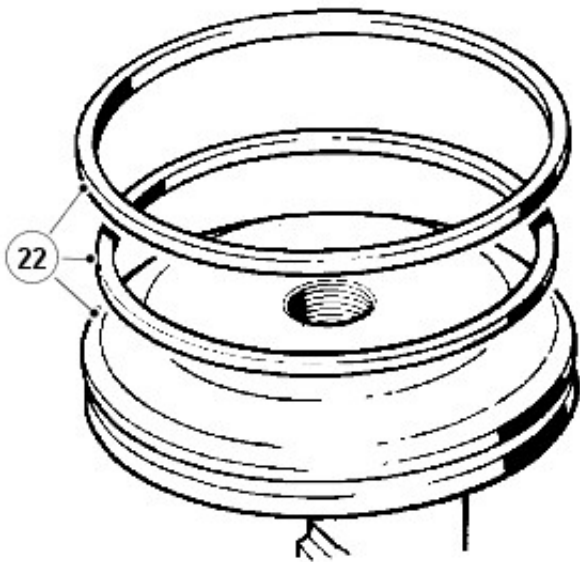
21. **CAUTION:** The use of a seal puller is recommended to prevent damage to casing, resulting in possible oil leaks.

Remove dirt excluder, circlip and seal from input shaft housing bore.



RR4180

22. Discard all rubber seals and obtain replacements.



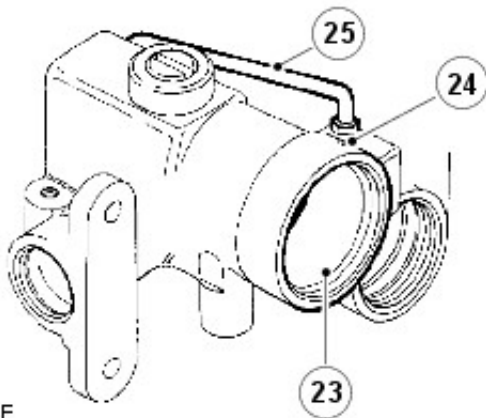
RR2350E

NOTE: A rubber seal is fitted behind plastic ring on rack piston. Discard seal and plastic ring.

23. Examine piston bore for scoring and wear.

24. Examine feed tube.

25. Fit a new feed tube if damaged. Tighten union to 22 Nm (16 lbf/ft).



RR2351E

26. Check there is no side play on roller.

27. If side play on roller exists fit a new sector shaft.

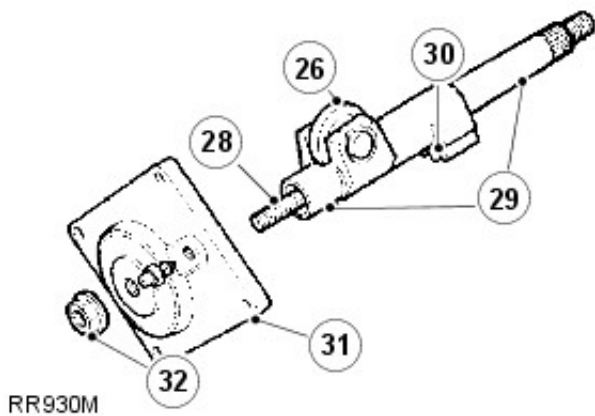
28. Check condition of adjuster screw threads. Check adjuster end float. Fit new adjuster if end float exceeds 0.15 mm.

29. Examine bearing areas on shaft for excessive wear.

30. Examine gear teeth for uneven or excessive wear.

31. Inspect cover and bearing. If worn or damaged, fit a new steering gear.

32. The locknut is also a fluid seal. Fit new nut during assembly.

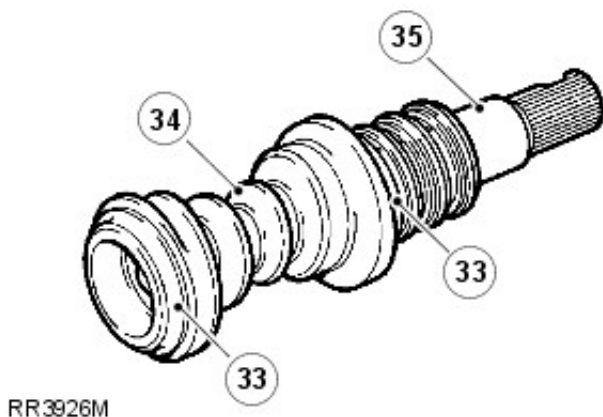


33. Examine bearing areas for wear. The areas must be smooth and not indented.

34. Examine worm track which must be smooth and not indented.

35. **NOTE: Any sign of wear makes it essential to fit new valve and worm assembly.**

Check for wear on torsion bar assembly pin. No free movement should exist between input shaft and torsion bar or between torsion bar and worm.



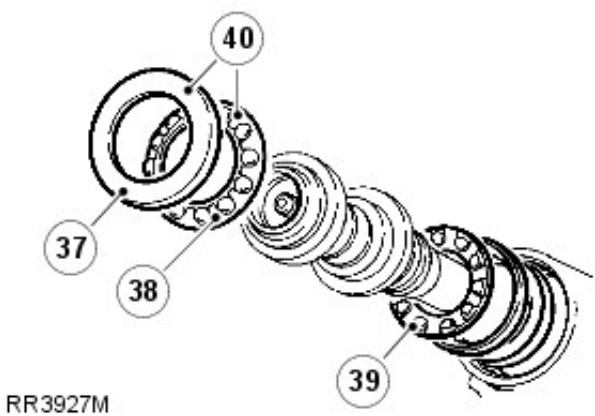
36. Examine valve rings for cuts , scratches and grooves. The valve rings should be free to rotate in grooves. Renew the valve and worm assembly if any faults are found.

37. Examine ball races and cups for wear and general condition.

38. If ball cage has worn against bearing cup, fit replacements.

39. Bearing balls must be retained by cage.

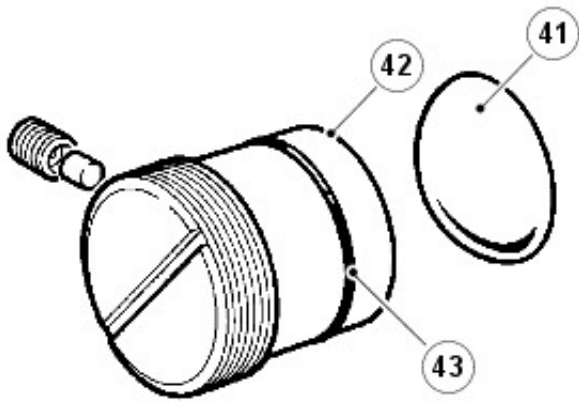
40. Bearing and cage repair is carried out by complete replacement of assembly.



41. Examine thrust pad for scores.

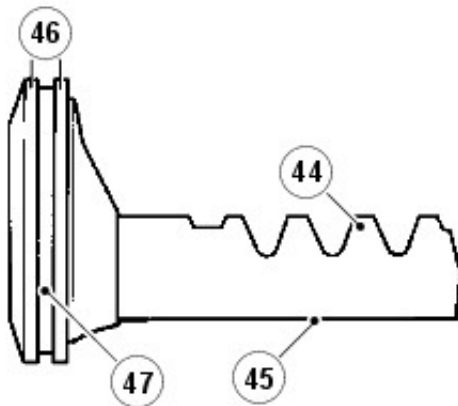
42. Examine adjuster for wear in pad seat.

43. Fit new sealing ring to rack adjuster.



RR3928M

- 44. Examine for excessive wear on rack teeth.
- 45. Ensure thrust pad bearing surface is free from scores and wear.
- 46. Ensure piston outer diameters are free from burrs and damage.
- 47. Examine seal and ring groove for scores and damage.



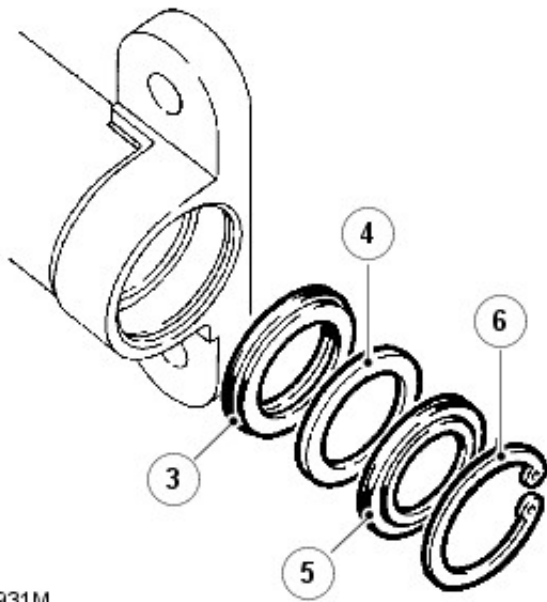
RR3929M

Assembly

1. Fit new ring to piston. Warm nylon seal and fit to piston.
2. Slide piston assembly into cylinder with rack tube outwards.

NOTE: When fitting replacement oil seals lubricate with recommended fluid and ensure absolute cleanliness.

3. Fit oil seal, lip side first.
4. Fit extrusion washer.
5. Fit dust seal, lipped side last.
6. Fit circlip.

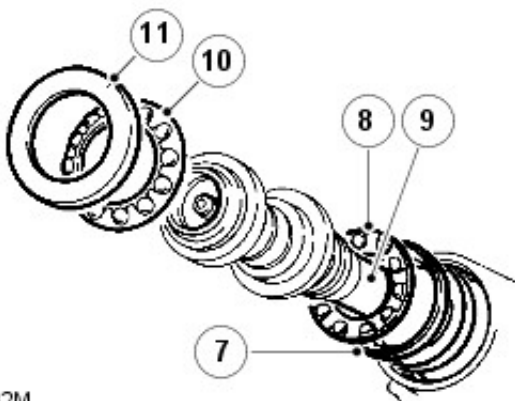


RR3931M

7. Refit original shims and inner bearing cup. Use Petroleum Jelly to aid assembly.

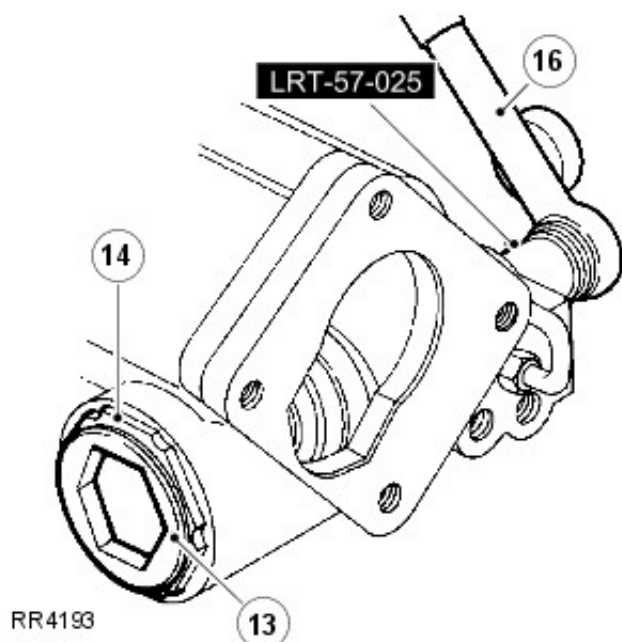
NOTE: If original shims are not used, fit shims of 0.76 mm thickness.

8. Fit inner cage and bearings assembly.
9. Fit valve and worm assembly.
10. Fit outer cage and bearings assembly.
11. Fit outer bearing cup.



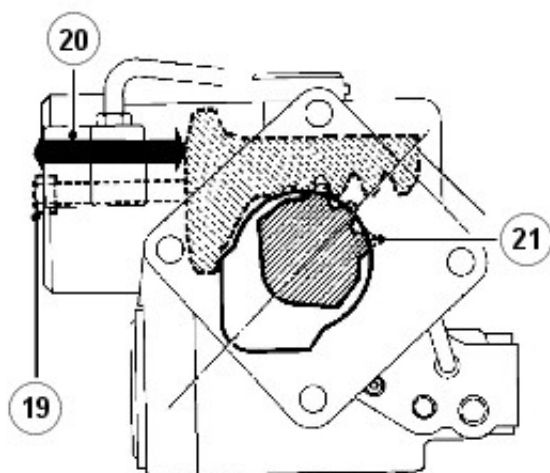
RR3932M

12. Fit new worm adjuster sealing ring.
13. Loosely screw adjuster into casing.
14. Fit locknut, do not tighten.
15. Turn in worm adjuster until end float is almost eliminated. Ensure bearing cages are seated correctly.
16. Measure maximum rolling torque of valve and worm assembly, using a torque wrench and spline socket LRT-57-025.



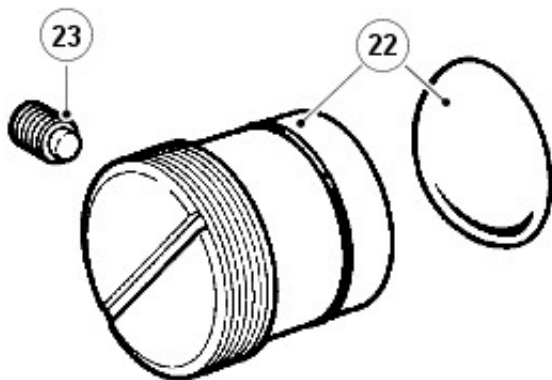
RR4193

17. Turn in worm adjuster while rotating shaft to increase figure measured to 0.56 Nm.
18. Back off worm adjuster ¼ turn. Turn in worm adjuster to increase reading by 0.21 - 0.34 Nm with locknut tight, 100 Nm (74 lbf/ft). Use worm adjusting wrench LRT-57-006 and locknut wrench LRT-57-028.
19. Screw slave bolt into piston to aid assembly.
20. Fit piston and rack so piston is 70 mm (2.75 in) from outer end of bore.
21. Fit sector shaft using seal saver LRT-57-021. Align roller with cut out in casing as shown. Push in sector shaft while rotating input shaft to allow sector roller to engage worm.



57M0660

22. Fit rack adjuster and thrust pad to engage rack. Back off half turn on adjuster.
23. Loosely fit new nylon pad and adjuster set screw assembly.



RR3935M

24. Fit new sealing ring to cover.

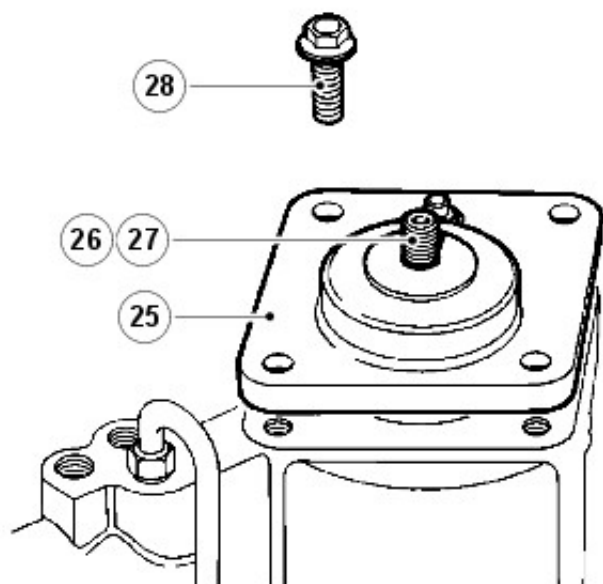
25. Align cover with casing.

26. Screw cover assembly fully on to sector shaft adjuster screw.

27. If necessary back off sector shaft adjuster screw. Tap cover in place to allow cover to joint fully with casing.

NOTE: Before tightening fixings, rotate input shaft to ensure sector shaft roller is free to move in valve worm. If initial resistance is left, turn adjuster screw approximately two turns in a clockwise direction.

28. Fit cover bolts. Tighten to 75 Nm (55 lbf/ft).

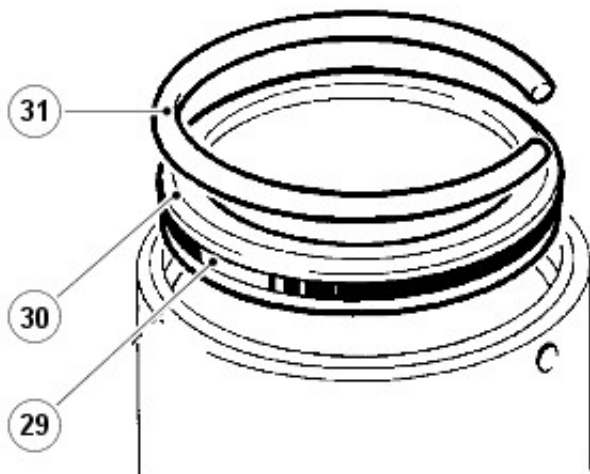


RR3936M

29. Fit new square section seal to cover.

30. Remove slave bolt from piston. Press cover into cylinder just to clear retainer ring groove.

31. Fit retaining ring to groove with one end of ring positioned 12 mm from extractor hole.

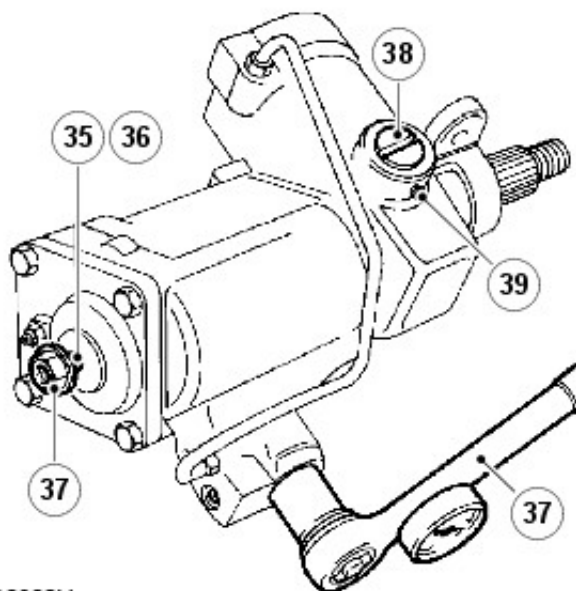


RR3937M

32. Refit drop arm and tighten nut sufficiently to ensure that no backlash exists between drop arm and sector shaft.
33. To set worm on centre, rotate input shaft to full inner-lock (full right lock for a left hand drive vehicles, full left lock for a right hand drive vehicles). Rotate input shaft back towards centre two full turns.
34. The box is now on centre and can be adjusted.
35. Hold input shaft and rock the drop arm to establish backlash is present. Continue rocking and slowly turn sector shaft adjusting screw clockwise. Continue turning adjuster screw until backlash has almost been eliminated.
36. Refit locknut and tighten.

NOTE: It is important steering gear is centralised before any adjustments are made.

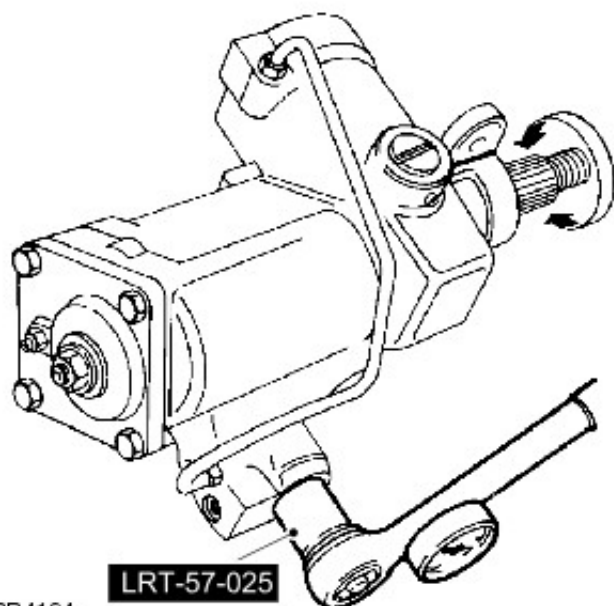
37. Check maximum rolling torque one and a quarter turns either side of centre position, using a torque wrench and spline socket LRT-57-025. Rotate adjuster screw to obtain across centre torque of 0.34 Nm plus torque figure at one and a quarter turns. Tighten adjuster locknut to 60 Nm (44 lbf/ft).
38. Turn in rack adjuster to increase figure measured in previous instruction by 0.23 - 0.34 Nm. **The final figure may be less, but must not exceed 1.35 Nm.**
39. Lock rack adjuster in position with grub screw. Tighten to 5 Nm (4 lbf/ft).
 1. With input shaft rotated from lock to lock, rolling torque figures should be greatest across centre position and equally disposed about centre position.
 2. The condition depends on the value of the shimming fitted between the valve and worm assembly inner bearing cup and casing. The original shim value will give correct torque peak position unless major components have been replaced.



RR3938M

40. With input coupling shaft toward the operator, turn shaft fully anti-clockwise.

41. Check torque figures obtained from lock to lock using torque wrench and spline socket LRT-57-025.



RR4194

42. Check also for equal engagement either side of centre.

43. Note where greatest figures are recorded relative to steering position. If greatest figures are not recorded across centre of travel (steering straight-ahead), adjust as follows:

1. If torque peak occurs **before** centre position, **add** to shim washer value.
2. If torque peak occurs **after** centre position, **subtract** from shim washer value.
3. Shims are available in the following thicknesses; 0.03 mm, 0.07 mm, 0.12 mm and 0.24 mm.

CAUTION: When reshimming valve and worm, extreme caution must be exercised to prevent seal damage during reassembly.

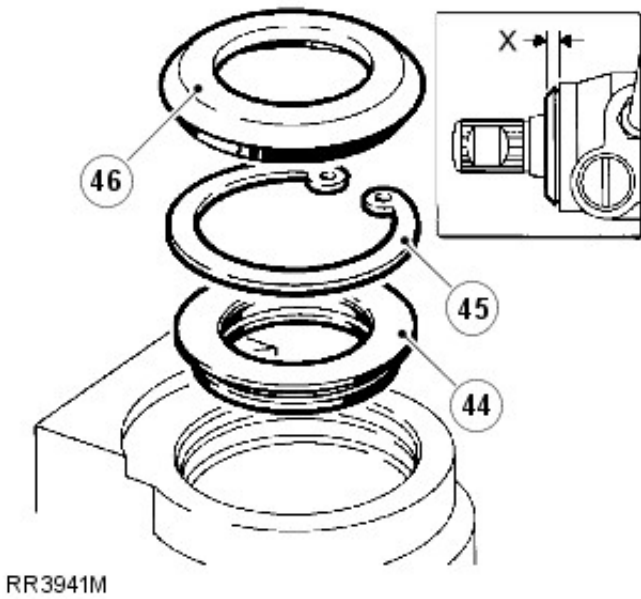
NOTE: Adjustment of 0.07mm to shim value will move torque peak area by ¼ turn on the shaft.

44. Fit seal, lip side first, into housing. Use seal saver LRT-57-016 and seal installer LRT-57-026. Note that seal is fitted to a depth of 4.75 - 5.00 mm from face of box.

45. Secure seal with circlin.

for secure seal when closed.

46. Smear inner lip of dirt excluder with PTFE grease. Fit dirt excluder using LRT-57-027. When fitted correctly outer shoulder of excluder is 4.00 - 4.50 mm from face of box, dimension X.



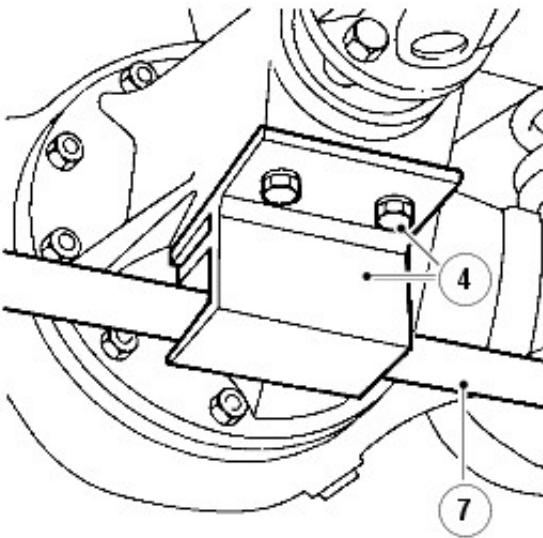
47. Remove drop arm. Smear inner lip of dirt excluder with PTFE grease and refit, ensuring outer lip is flush with casing.
48. With input shaft on centre, align assembly marks on drop arm and steering gear. Fit drop arm to steering gear using a new tab washer. Tighten to 176 Nm (130 lbf/ft), bend over tab.
49. Fit steering gear.
For additional information, refer to: Steering Gear (211-02, Removal and Installation).

Steering Linkage - Tie Rod End

Removal and Installation

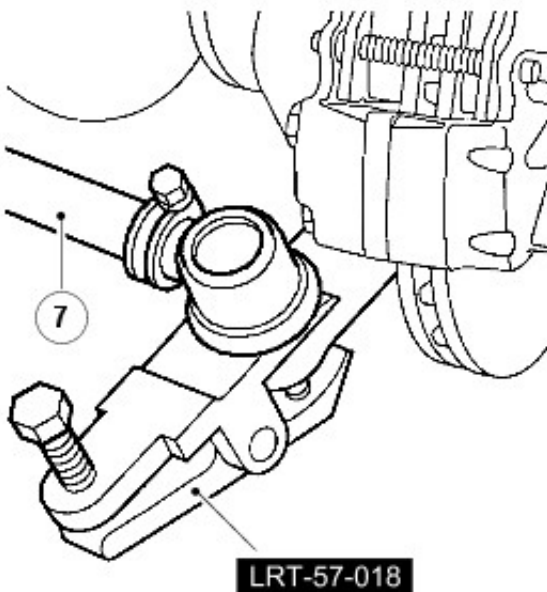
Removal

1. Park vehicle on level ground and chock rear wheels.
2. Raise vehicle and locate axle stands or use a ramp.
3. Centralise steering.
For additional information, refer to: Steering Gear Centralization (211-00 Steering System - General Information, General Procedures).
4. Unscrew 2 bolts and remove tie rod protection bracket from axle differential housing.
5. Remove split pin and castellated nut securing tie rod to swivel housing arms.
6. Disconnect tie rod ends using LRT-57-018.



J6316

7. Remove tie rod.

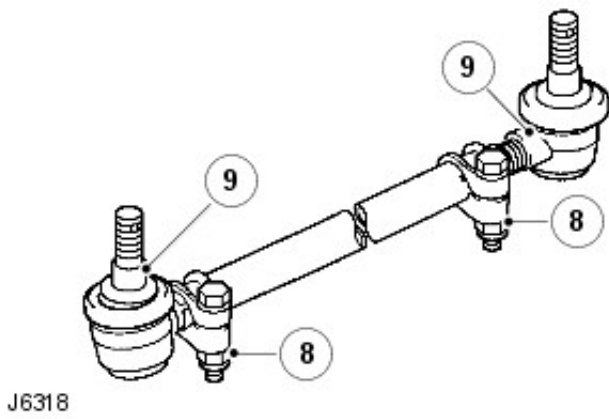


J6317

8. Slacken clamp bolts.

9. Unscrew tie rod ends.

9. Unscrew tie rod ends.



Installation

1. Fit new tie rod ends to tie rod and loosely tighten clamp bolts.
2. Screw in tie rod ends to full extent of threads and fully tighten clamp bolts.

 **CAUTION:** A tie rod that is damaged or bent must be renewed. DO NOT attempt to repair or straighten it.

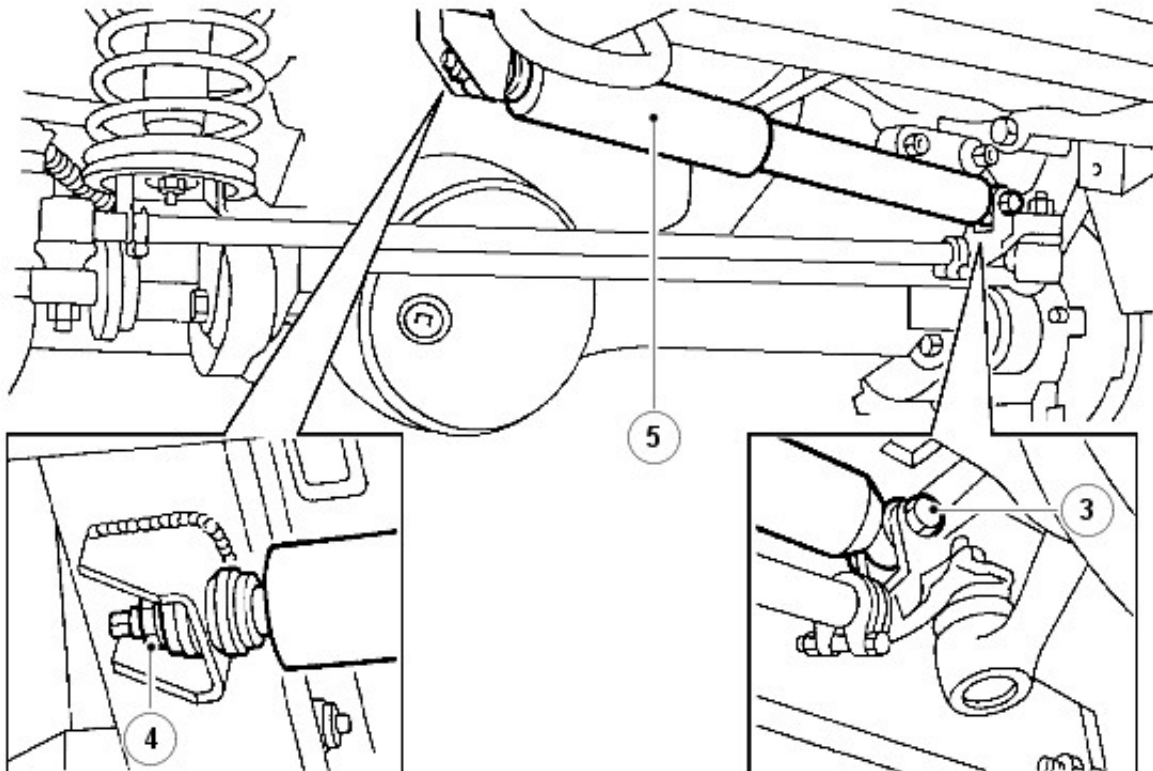
3. Fit tie rod to swivel housing arms and tighten tie rod end nuts to 44 Nm (32 lbf/ft). Fit new split pin.
4. Fit tie rod protection bracket to axle differential housing and tighten to 30 Nm (22 lbf/ft).
5. Check wheel alignment.
For additional information, refer to: Front Toe Adjustment (204-00 Suspension System - General Information, General Procedures).
6. Remove axle stands or vehicle from ramp.

Steering Linkage - Steering Linkage Damper

Removal and Installation

Removal

1. Park vehicle on level ground and chock rear wheels.
2. Raise vehicle and locate axle stands or use a ramp.
3. Remove bolt securing steering linkage damper to drag link bracket.
4. Remove retaining nuts, washers and rubber bush securing steering linkage damper to chassis mounting.
5. Withdraw steering linkage damper.



J6315

6. Check rubber bushes and washers, renew if necessary.

Installation

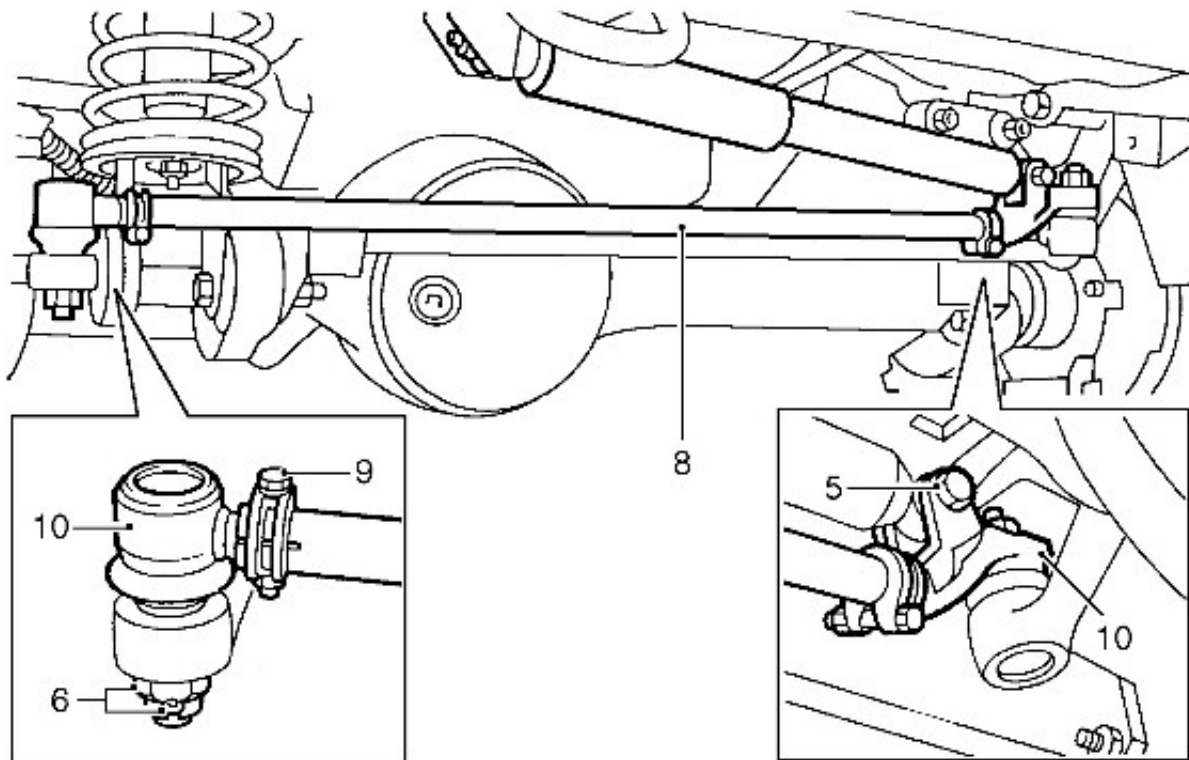
1. Ensuring rubber bushes and washers are correctly positioned, fit steering linkage damper to chassis mounting.
2. Instal steering linkage damper to drag link bracket.
3. Remove axle stands or vehicle from ramp.

Steering Linkage - Sector Shaft Arm Drag Link

Removal and Installation

Removal

1. Park vehicle on level ground and chock rear wheels.
2. Set road wheels in straight ahead position.
3. Raise vehicle and fit axle stands or use a ramp.
4. Remove front road wheel.
5. Disconnect steering damper at sector shaft arm drag link bracket.
6. Remove split pin and castellated nut securing sector shaft arm drag link ball joint to swivel housing arm.
7. Disconnect sector shaft arm drag link ball joints using LRT-57-018.
8. Remove sector shaft arm drag link.
9. Slacken clamp bolts.
10. Unscrew ball joints and remove from sector shaft arm drag link.

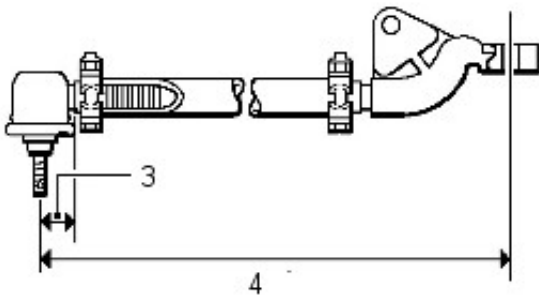


J6319


Installation

1. Clean internal threads of sector shaft arm drag link.
2. Fit new ends to sector shaft arm drag link and loosely fit clamp bolts.
3. Set ball joints to sector shaft arm drag link measurement to 28,5 mm.

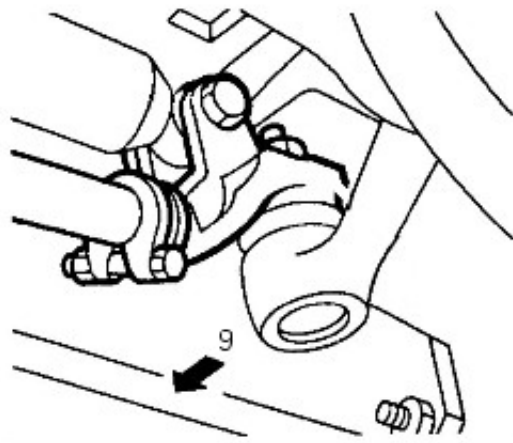
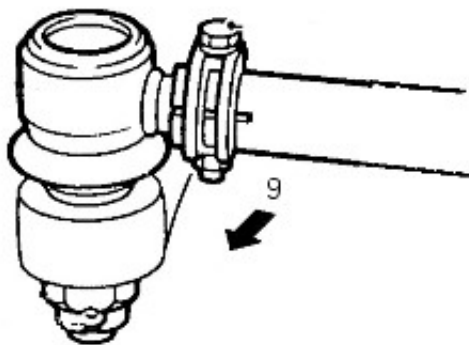
4. Adjust ball pin centres to nominal length of 924 mm, this length is adjusted during refit.




J6320

5. Centralise steering box.
For additional information, refer to: Steering Gear Centralization (211-00, General Procedures).
6. Align steering wheel, if necessary.
7.  **CAUTION:** A sector shaft arm drag link that is damaged or bent must be renewed. DO NOT attempt repair.

Fit sector shaft arm drag link to swivel housing arms and tighten nuts to 40 Nm (30 lbf/ft). Fit new split pins.
8. Ensure full steering travel is obtained between lock stops.
For additional information, refer to: Steering Lock Stop Adjustment (211-00, General Procedures).
Adjust sector shaft arm drag link length to suit.
9. Tap ball joints in direction shown so both pins are in same angular plane.



E77138

10. Tighten clamp bolts to 14 Nm (10 lbf/ft).
11. Refit road wheel and remove axle stands or vehicle from ramp.
12. Road test vehicle.
13.  **WARNING:** To correct steering wheel deviations greater than $\pm 5^\circ$ remove and reposition steering wheel.

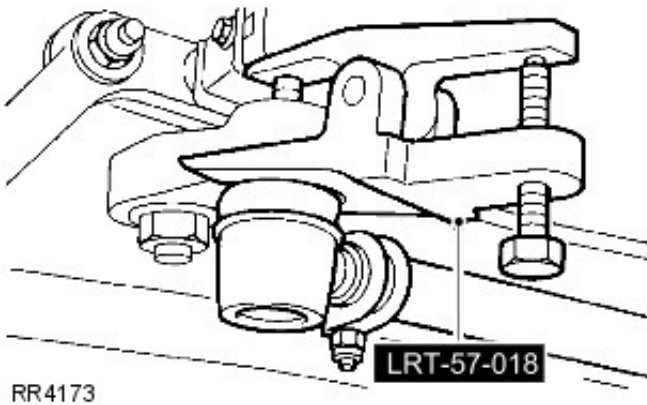
If driving straight ahead and steering wheel is offset by $0^\circ \pm 5^\circ$ in either direction, correct by adjusting sector shaft arm drag link length.

Steering Linkage - Steering Gear Drop Arm

Removal and Installation

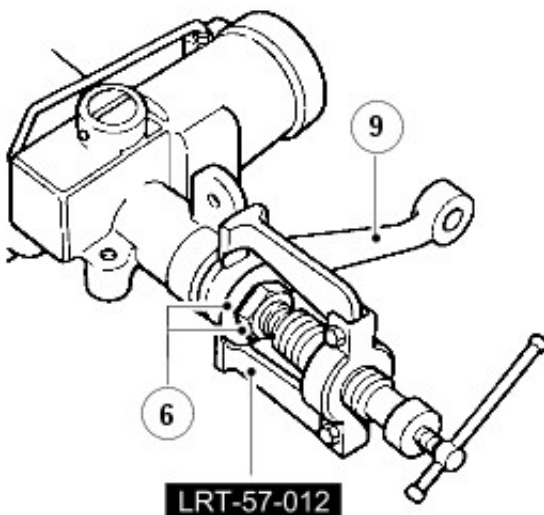
Removal

1. Park vehicle on level surface and chock rear wheels.
2. Raise vehicle and locate axle stands or use a ramp.
3. Disconnect steering linkage damper from drag link.
For additional information, refer to: Steering Linkage Damper (211-03 Steering Linkage, Removal and Installation).
4. Disconnect drag link ball joint from drop arm using extractor LRT-57-018.



RR4173

5. Mark drop arm and steering box for reassembly.
6. Bend back tabs on locking washer, slacken retaining nut, but do not remove.
7. Fit extractor LRT-57-012 and release drop arm from steering box spline.
8. Remove nut and discard locking washer.
9. Remove drop arm.



J6314

Installation

1. Centralise steering box.
For additional information, refer to: Steering Gear Centralization (211-00 Steering System - General Information, General Procedures).

2. Align reassembly marks and fit drop arm onto steering box splines.
3. Install new tab washer and retaining nut. Tighten to 176 Nm (130 lbf.ft) and bend over tab washer.
4. Install drag link to drop arm. Tighten ball joint nut to 40 Nm (30 lbf.ft).
5. Remove axle stands or vehicle from ramp.

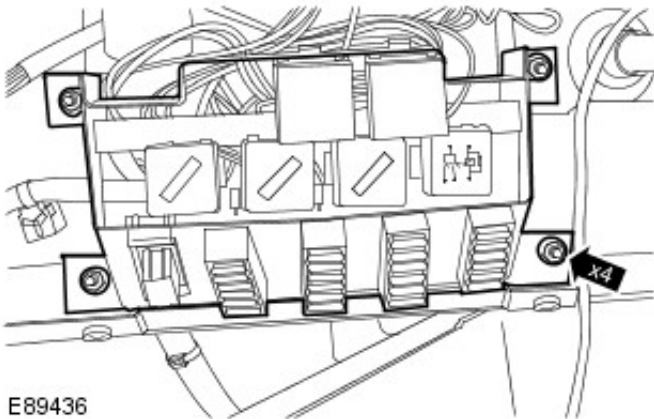
Steering Column - Steering Column

Removal and Installation

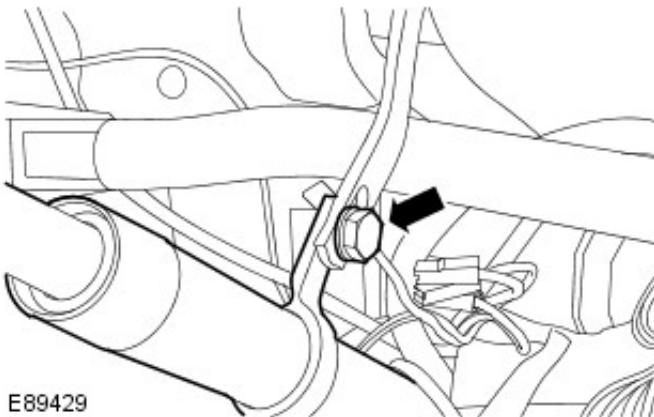
Removal

NOTE: Make sure that the wheels and tires are in the straight-ahead position.

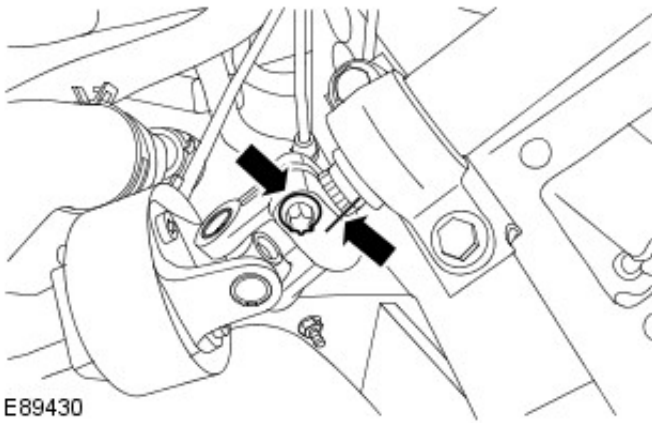
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the instrument panel.
For additional information, refer to: Instrument Panel (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the steering column lock and ignition switch housing.
For additional information, refer to: Steering Column Lock and Ignition Switch Housing (211-05 Steering Column Switches, Removal and Installation).
4. Release the central junction box (CJB) from the bulkhead.
 - Remove the 4 nuts.



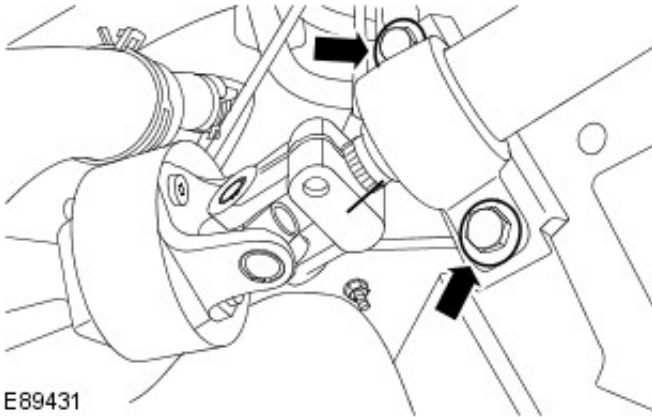
5. Release the steering column.
 - Remove the bolt.



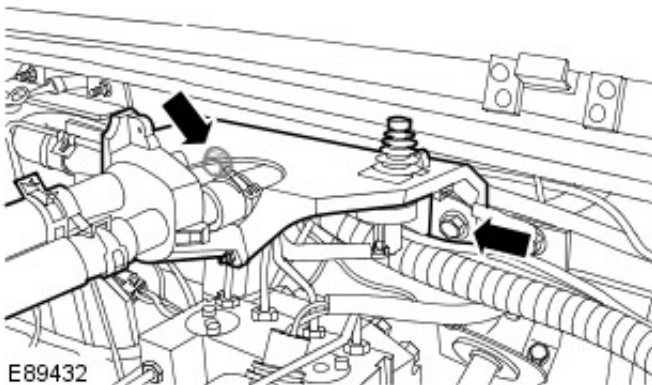
6. Remove the brake pedal and bracket.
For additional information, refer to: Brake Pedal and Bracket (206-06 Hydraulic Brake Actuation, Removal and Installation).
7. Release the steering column from the lower shaft.
 - Mark the relationship between both shafts.
 - Remove and discard the bolt.



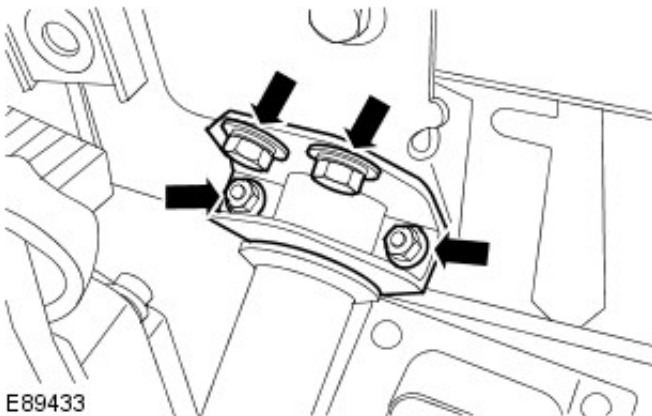
8. Release the steering column from the vehicle body.
 - Remove the 2 bolts.



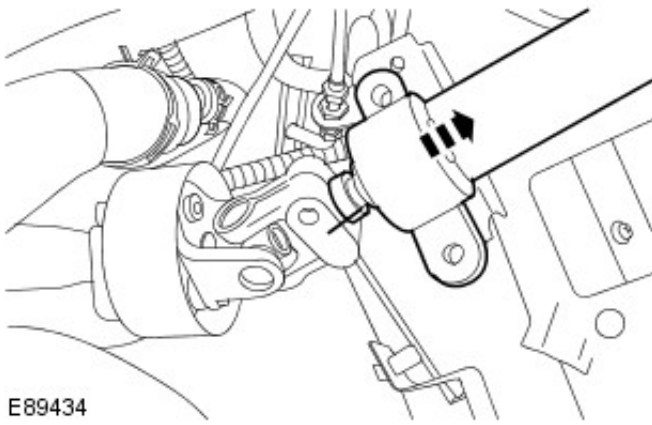
9. Release the heater control valve and bracket.
 - Remove the 2 bolts.



10. Remove the steering column upper support bracket.
 - Remove the 4 bolts.
 - Collect the rubber strip from around the steering column shaft.

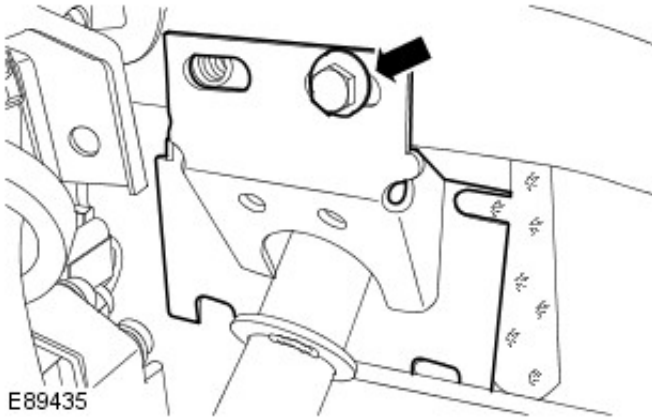


11. Remove the steering column from the steering column lower shaft.



E89434

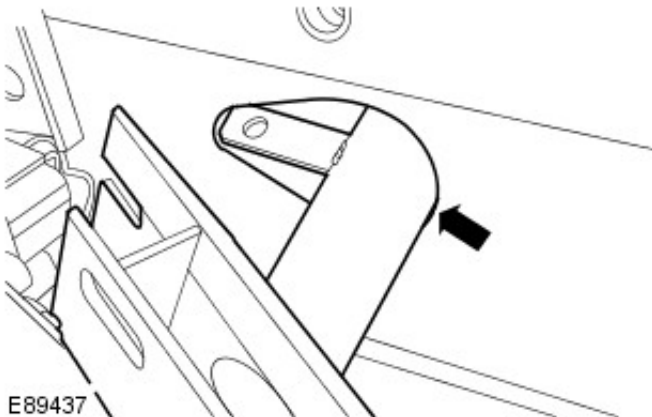
12. Release the steering column main support bracket.
 - Remove the bolt.



E89435

13. **NOTE:** The steering column must be positioned correctly to pass through the bulkhead.

Remove the steering column.

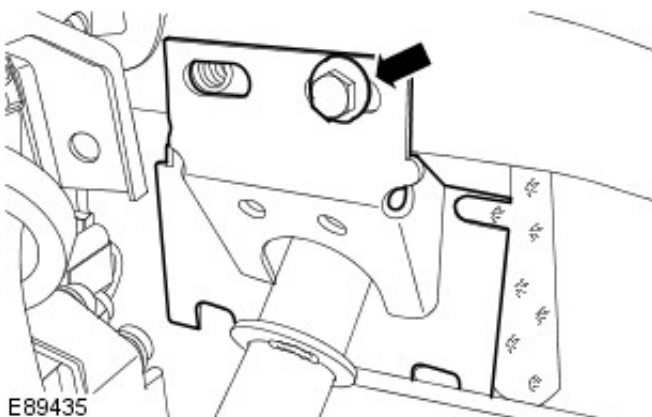


E89437

Installation

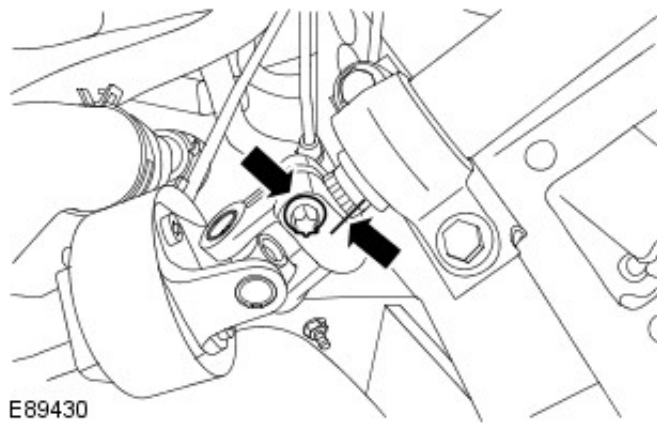
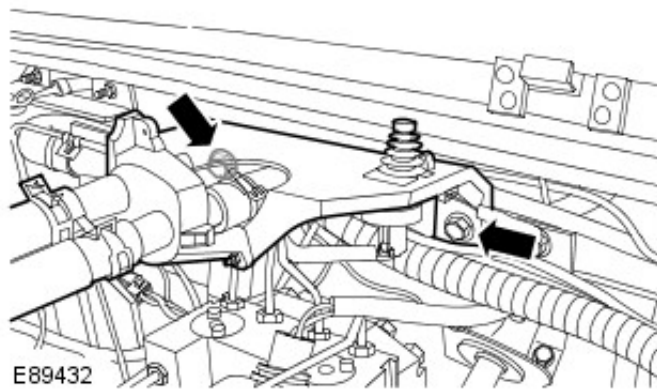
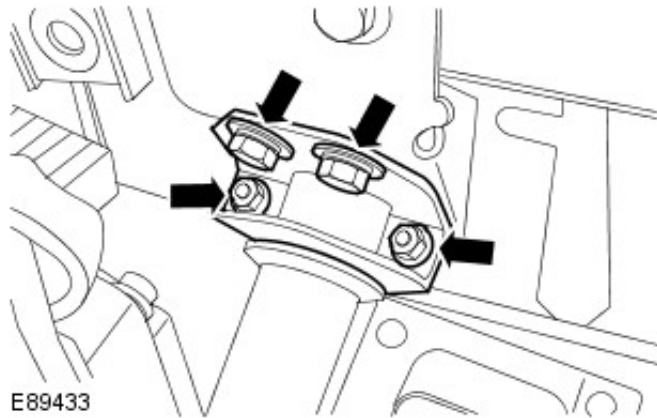
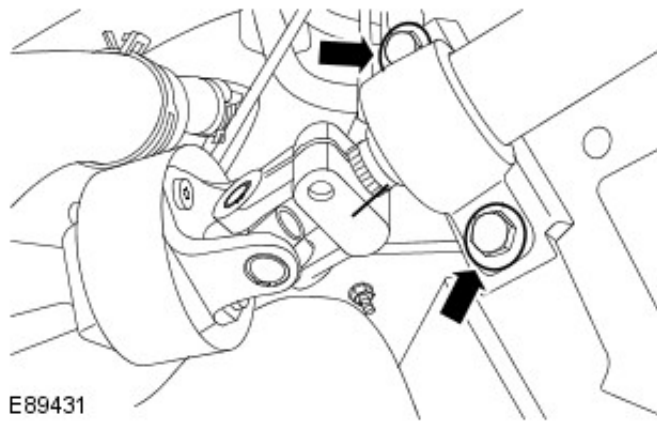
CAUTION: Care must be taken when installing the steering column to the steering column lower shaft, failure to follow this instruction may result in damage to the steering column lower shaft.

1. To install, reverse the removal procedure.
 - Tighten to 22 Nm (16 lb.ft).



E89435

2. Tighten to 22 Nm (16 lb.ft).



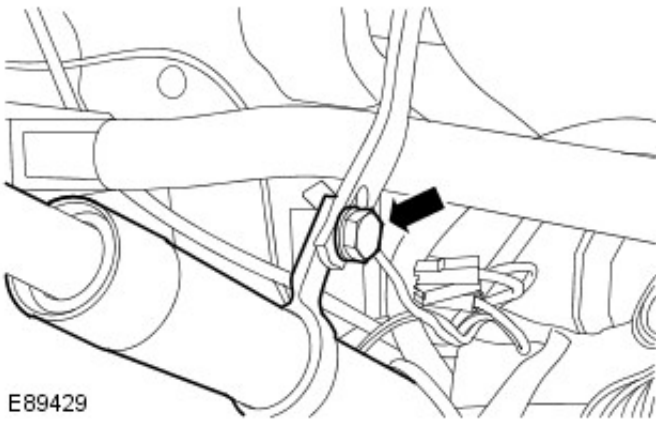
2. Tighten to 22 Nm (16 lb.ft).

3. Install the steering column upper support bracket.
 - Tighten the M6 bolts to 9 Nm (7 lb.ft).
 - Tighten the M8 bolts to 22 Nm (16 lb.ft).

4. Tighten to 22 Nm (16 lb.ft).

5. **NOTE:** Install a new bolt.
Tighten to 30 Nm (22 lb.ft).

6. Tighten to 48 Nm (35 lb.ft).



E89429

7. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01
Battery, Mounting and Cables, General Procedures).

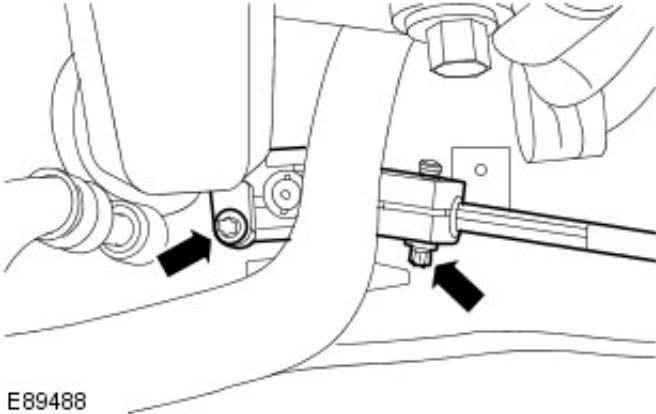
Steering Column - Steering Column Lower Shaft

Removal and Installation

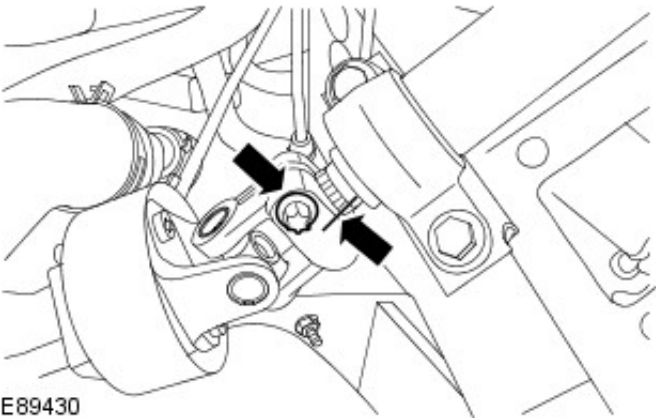
Removal

NOTE: Make sure that the wheels and tires are in the straight-ahead position.

1. Release the steering column lower shaft.
 - Remove and discard the 2 bolts.

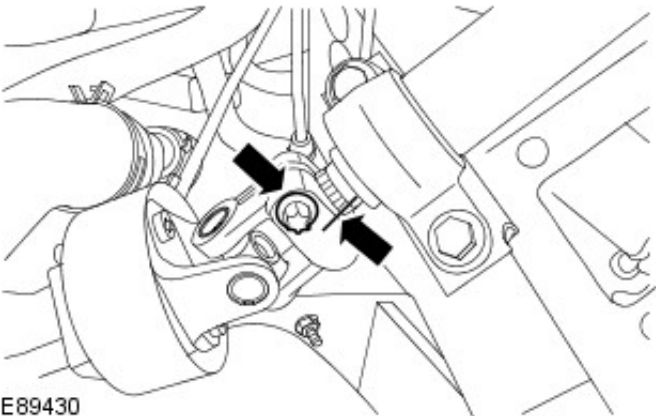


2. Remove the steering column lower shaft.
 - Mark the relationship between both shafts.
 - Remove and discard the bolt.

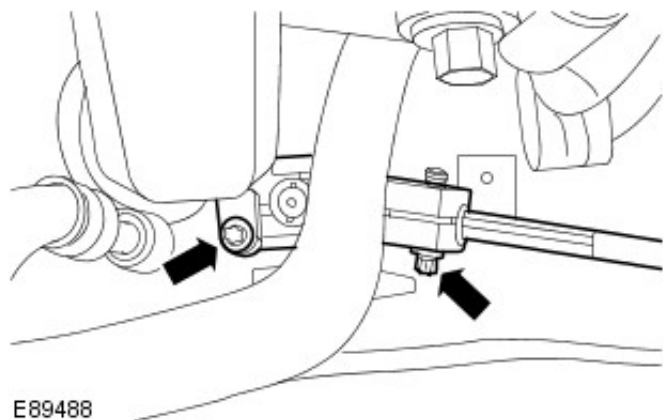


Installation

1. To install, reverse the removal procedure.
 - Tighten to 30 Nm (22 lb.ft).



2. Tighten to 30 Nm (22 lb.ft).



E89488

Steering Column - Steering Wheel

Removal and Installation

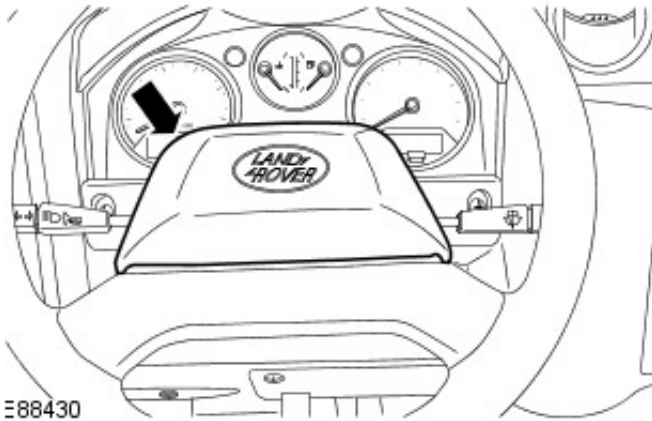
Special Tool(s)



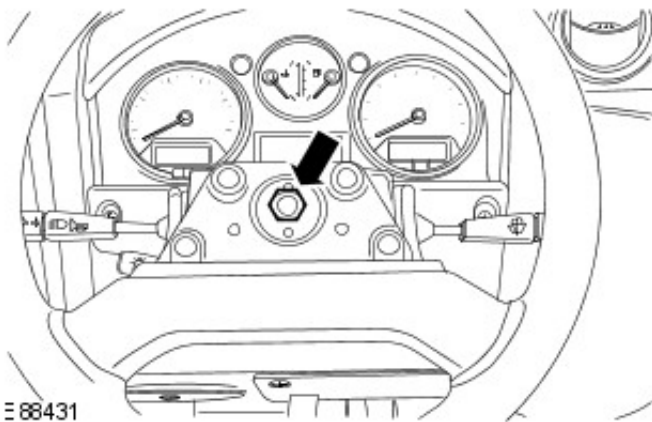
Removal

NOTE: Make sure that the wheels and tires are in the straight-ahead position.

1. Remove the steering wheel center pad.



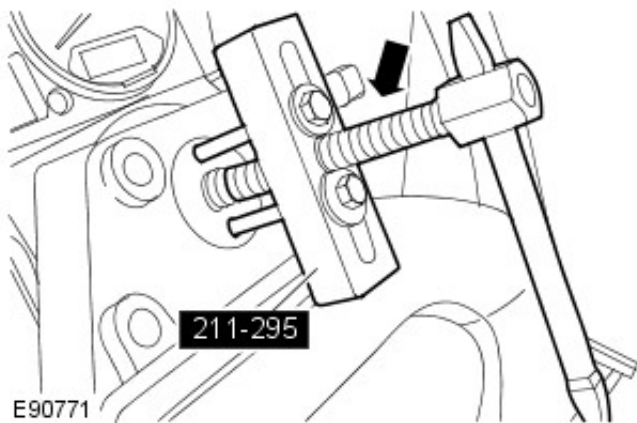
2. Remove the steering wheel nut and locking washer.



3. Mark the relationship between the steering wheel and steering column.



4. Using the special tool, remove the steering wheel.

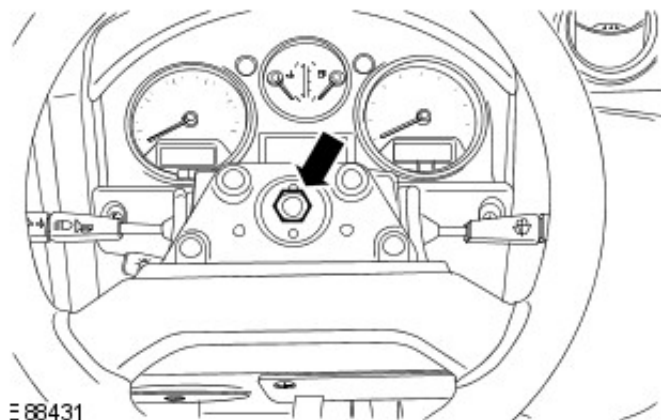


Installation

1. **NOTE:** Make sure the alignment marks are correctly aligned.

Install the steering wheel.

- Tighten to 43Nm (32 lb.ft).



2. Install the steering wheel center pad.

Steering Column Switches - Steering Column Switches

Description and Operation

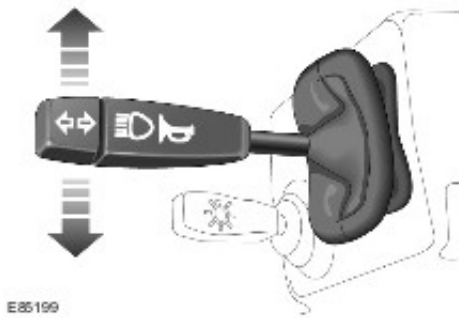
OVERVIEW

The steering column switches comprise the steering column multifunction switch and the ignition switch. Both switches are located on the steering column assembly.

The steering column multifunction switch comprises a case, which houses a turn signal indicator switch assembly and a windshield wiper switch assembly. The multifunction switch is located behind the steering wheel and is secured at the top of the steering column assembly and at the bottom of the column lock housing.

LEFT HAND COLUMN SWITCH

Turn Signal Indicator Switch

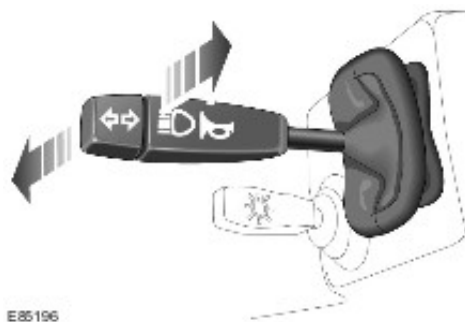


The turn signal indicator switch assembly is located in the Left Hand (LH) side of the case. The switch is connected to the main harness via a connector on the back of the switch. The switch controls the following functions:

- Left/right turn signal operation
- High/low beam operation
- Headlamp flash
- Horn operation

The turn signal indicators are operated by pushing the switch up for Right Hand (RH) indicators and down for LH indicators. The switch has a detent position, which locks the switch in the selected position until it is moved to the central off position. The LH and RH turn signal indicator switch positions are connected on separate wires to the hazard warning relay, via the hazard warning switch. When a switch position selection is made, a circuit is completed from the hazard warning relay to ground, via the selected switch position. The hazard warning relay detects the completed circuit and operates the selected turn signal indicator until the switch is moved to the central off position. The turn signal indicators can be cancelled either manually by the driver or automatically when the steering wheel is rotated to the straight ahead position.

High/Low Beam and Headlamp Flash

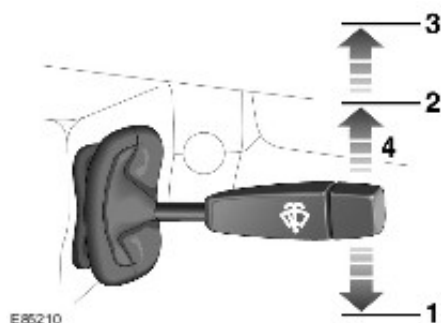


High beam is operated by pushing the switch forwards. The switch is latched in this position and the high beam is active until the switch is manually pulled rearwards. The headlamp flash function is operated by pulling the switch rearwards. The switch contacts complete a circuit and the headlamps are activated for as long as the switch is operated. The switch is non-latching in this position and the headlamp flash is switched off when the switch is released and it returns to its off position. The high beam and headlamp flash positions are connected on separate wires to the high/low beam relay and ground. When a switch selection is made, a circuit is completed from the high/low beam relay to ground via the switch contacts.

RIGHT HAND COLUMN SWITCH

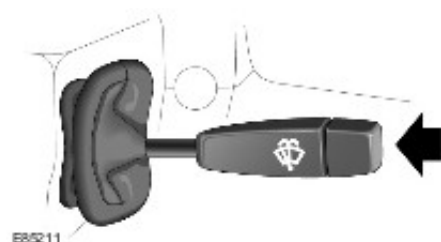
Windshield Wiper and Washer Switch Assembly

Wiper



Item	Part Number	Description
1	-	Intermittent wipe
2	-	Low speed wipe
3	-	High speed wipe
4	-	Single wipe

Washer



The windshield wiper functions are operated by moving the switch up or down. Flick wipe is selected by pushing the switch up against the spring pressure. The flick wipe switch contact is connected on a single wire to the windshield wiper delay Electronic Control Unit (ECU) and ground. When the switch is operated the circuit is completed between the delay ECU and ground. With the circuit completed the wipers operate for as long as the switch contact is made.

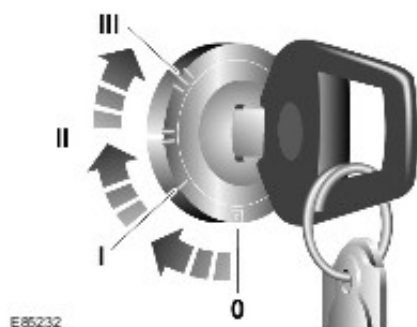
Intermittent is selected by pushing the wiper switch down, to the detent position, the wipers operate at a delay period, which is controlled by the windshield wiper delay ECU. The wipers remain in the intermittent mode until the wiper switch is moved to the off or slow/fast speed positions. The intermittent switch contact is connected between the delay ECU and ground. When the switch is moved to the intermittent position the circuit is completed. With the circuit completed, the wipers operate in intermittent for as long as the switch contact is made.

Slow speed operation is selected by pushing the wiper switch up, to the second detent position. The wipers operate at slow speed until the wiper switch is moved to the off, intermittent or fast speed positions. The slow speed switch contact is connected between the delay ECU and ground. When the switch is moved to the slow speed position the circuit is completed. With the circuit completed, the wipers operate at slow speed for as long as the switch contact is made.

Fast speed operation is selected by pushing the wiper switch up, to the second detent position. The wipers operate at fast speed until the wiper switch is moved to the off, intermittent or slow speed positions. The fast speed switch contact is connected between the delay ECU and ground. When the switch is moved to the fast speed position the circuit is completed. With the circuit completed, the wipers operate at fast speed for as long as the switch contact is made.

The windshield washers are operated by pressing the button on the end of the wash/wipe stalk located on the RH side of the steering column. When the button is pressed, the washers operate immediately and stop immediately the button is released. The washer button contact is connected between the delay ECU and ground. When the button is pressed the circuit is completed. With the circuit completed, the washers operate for as long as the contact is made.

IGNITION SWITCH



The ignition switch is located in the LH end of the steering column assembly. The switch is held in the column lock casting with 2 locking tabs, which engage in slots in the column lock casting.

The switch has a slot, which provides for the location of the drive shaft. The drive shaft passes through the column lock. This shaft is rotated by the driver when the ignition key is turned in the key barrel. This rotation turns a drum inside the

ignition switch, which moves 2 electrical contacts to select the required ignition position. A spring loaded ball locates in a seat for each of the 3 ignition switch positions, allowing the driver to feel when the required position is reached.

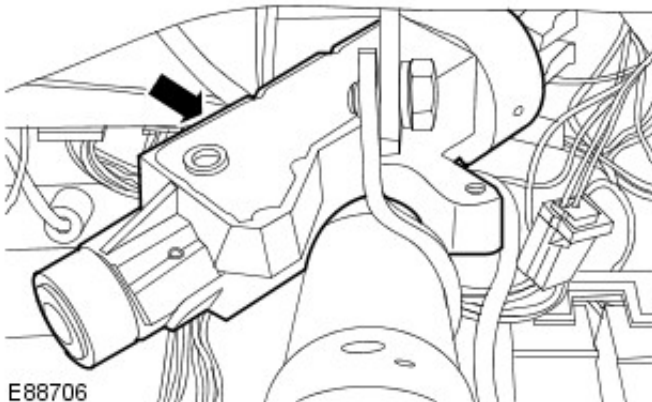
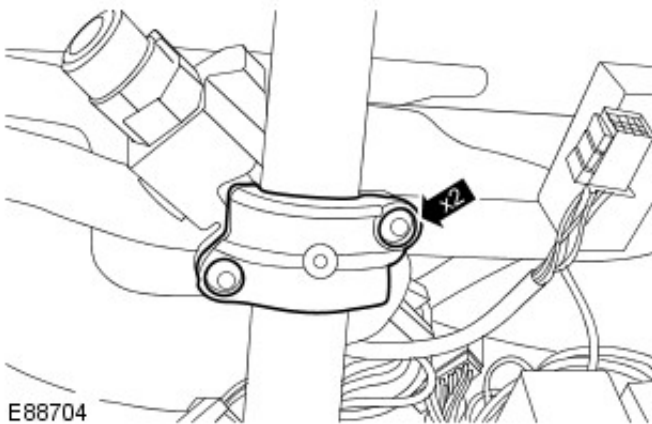
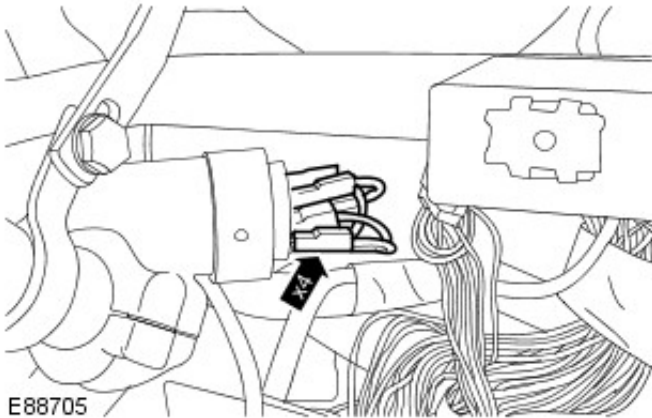
Steering Column Switches - Steering Column Lock and Ignition Switch

Housing

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the instrument panel.
For additional information, refer to: Instrument Panel (501-12 Instrument Panel and Console, Removal and Installation).
3. Disconnect the 4 electrical connectors from the ignition switch.

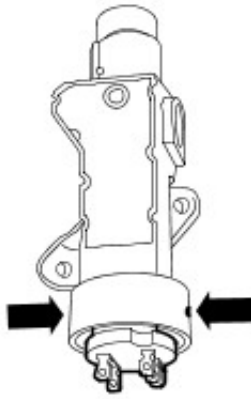


4. Remove the steering column lock lower support bracket.
 - Using suitable tools, remove and discard the 2 bolts.
 - Collect the 2 spacers from between the steering column lock and lower support bracket.
5. Remove the steering column lock and ignition switch assembly.

6. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the ignition switch.

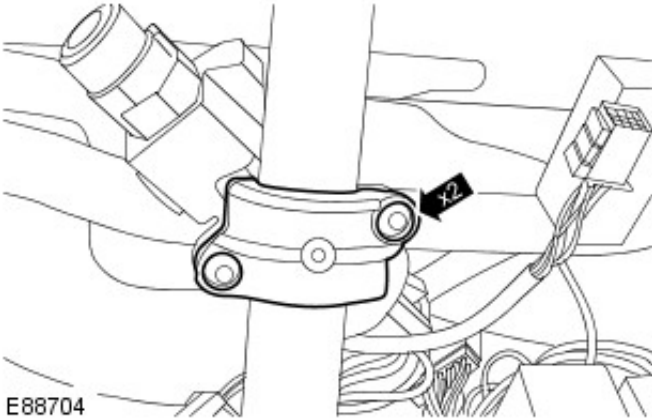
- Remove the 2 screws.



E90466

Installation

1. To install, reverse the removal procedure.
 - Tighten the bolts until the heads shear off.



E88704

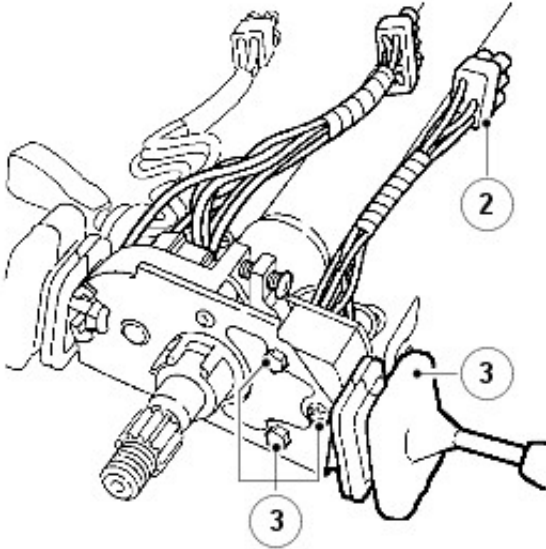
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Steering Column Switches - Steering Column Multifunction Switch RH

Removal and Installation

Removal

1. Remove steering column shroud.
For additional information, refer to: Steering Column Shrouds (501-05, Removal and Installation).
2. Disconnect switch multiplug from main harness.
3. Remove 2 screws and shake proof washer securing switch to mounting bracket.



J6439A

4. Remove switch complete with harness.

Installation

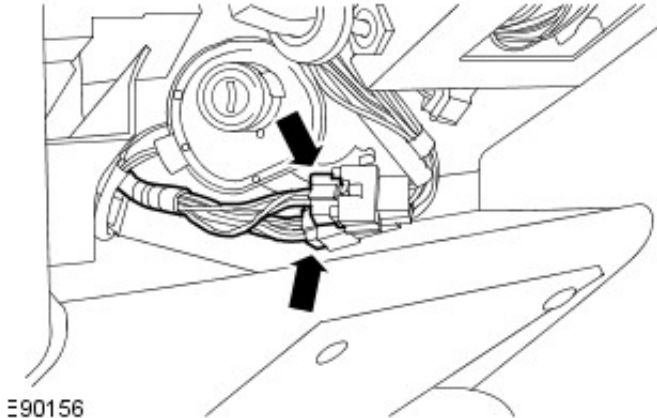
1. Fit new switch to mounting bracket.
2. Reconnect switch multiplug.
3. Fit steering column shroud.
For additional information, refer to: Steering Column Shrouds (501-05, Removal and Installation).

Steering Column Switches - Steering Column Multifunction Switch LH

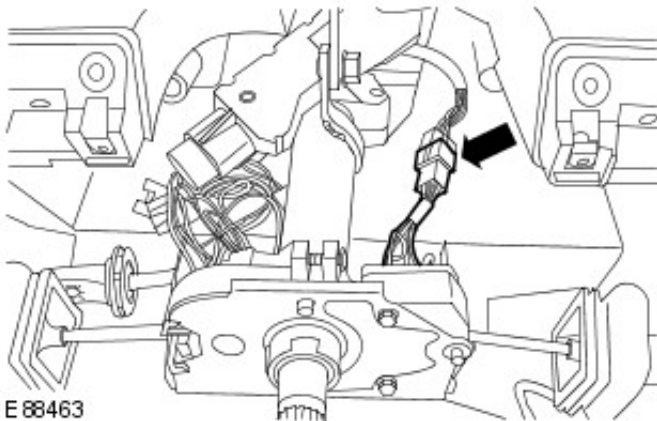
Removal and Installation

Removal

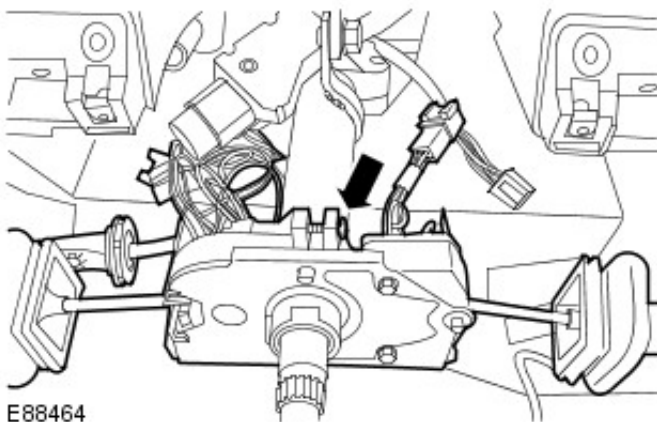
1. Remove the steering wheel.
For additional information, refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).
2. Remove the steering column shrouds.
For additional information, refer to: Steering Column Shrouds (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the 2 electrical connectors.



4. Disconnect the electrical connector.



5. Remove the steering column multifunction switch assembly.
 - Undo but do not remove the multifunction switch clamp screw.



Installation

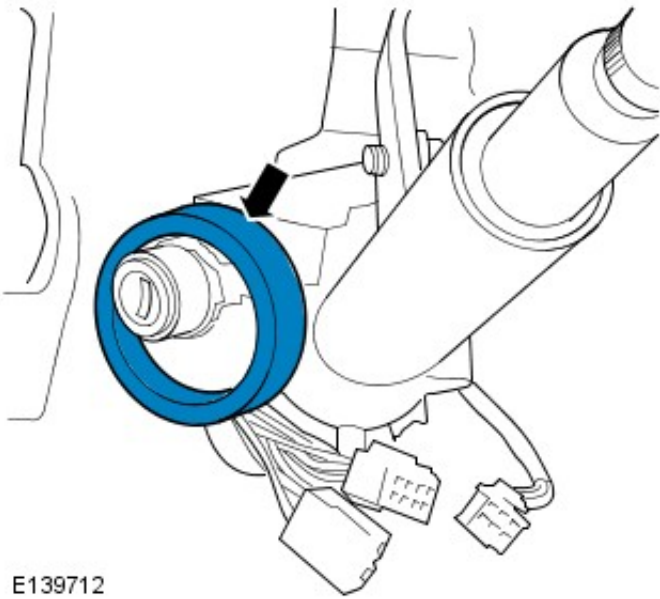
1. To install, reverse the removal procedure.

Steering Column Switches - Ignition Switch

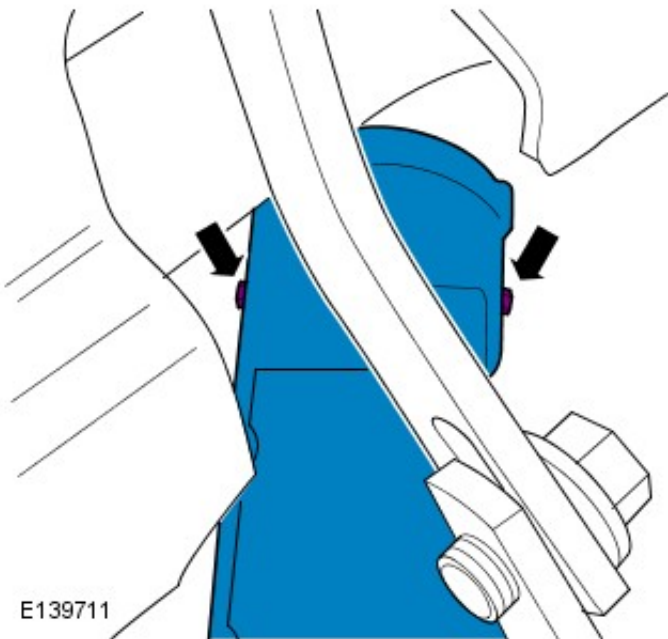
Removal and Installation


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove steering column shrouds.
For additional information, refer to: [Steering Column Shrouds](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the instrument cluster.
For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Removal and Installation).
4. Remove the passive anti theft system (PATS) transceiver from the ignition barrel.

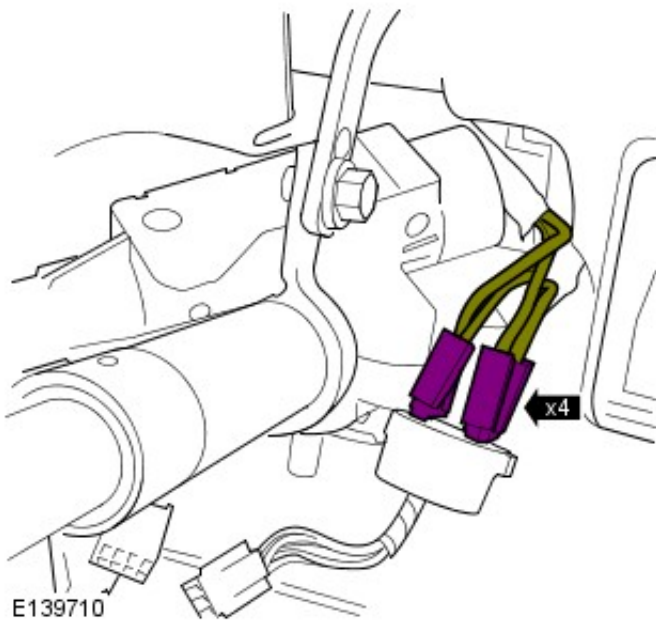


5. Remove the 2 screws.



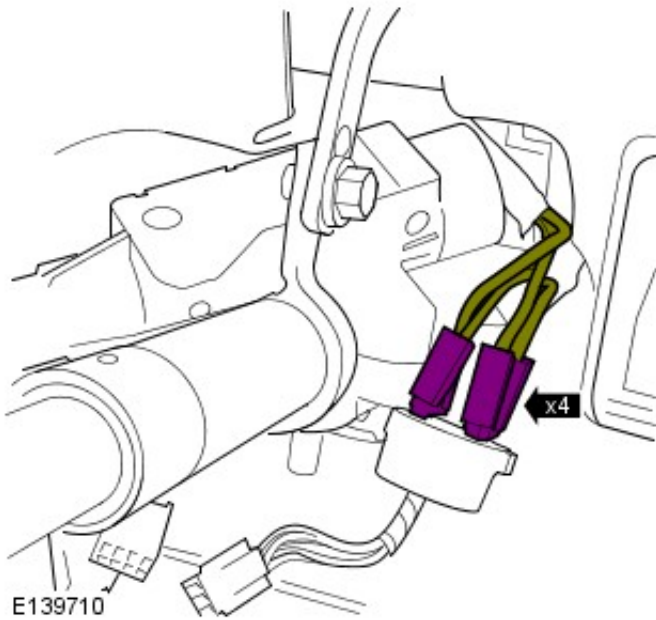
6.  **CAUTION:** Note the position of the electrical connectors prior to removal, failure to carry out this instruction may cause damage to the vehicle.

Disconnect the 4 ignition switch electrical connectors.

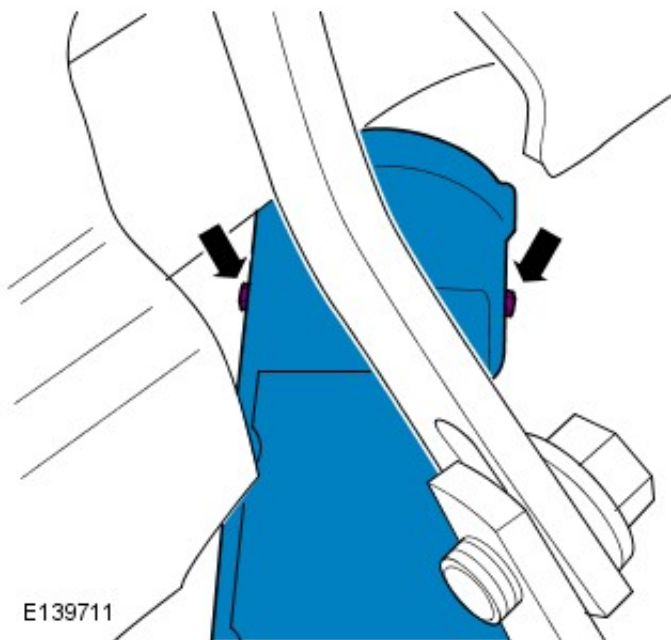


Installation

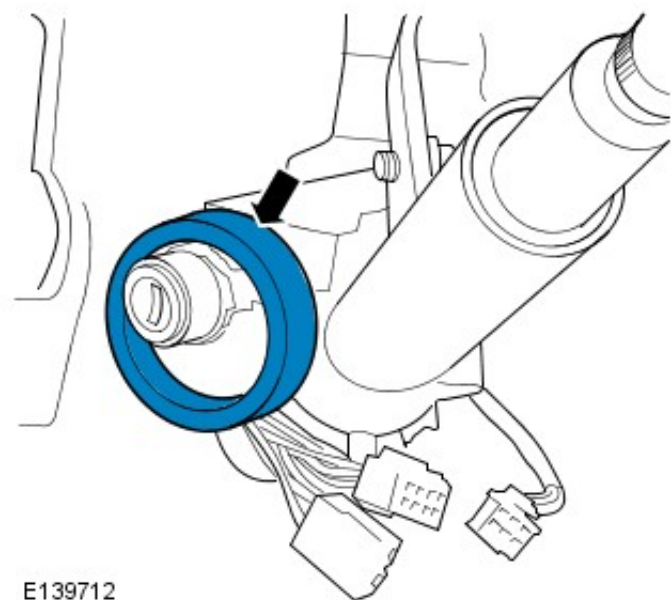
1. Connect harness leads to ignition switch as noted on removal.



2. Install the 2 screws.



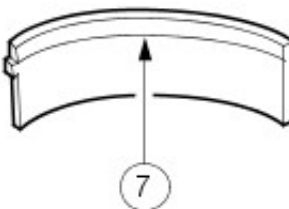
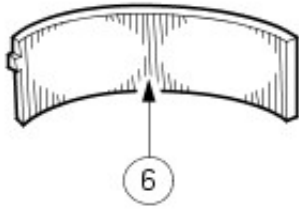
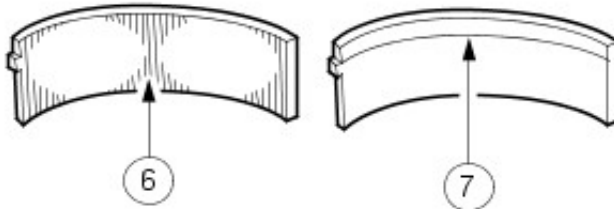
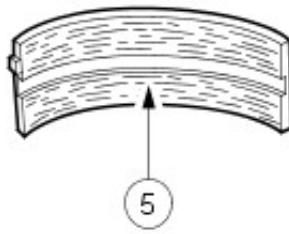
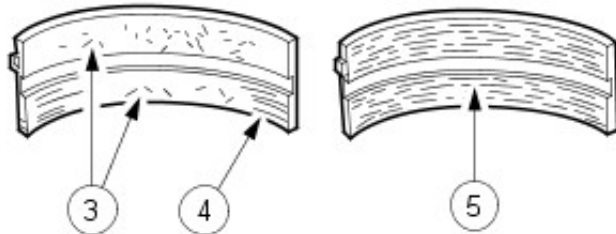
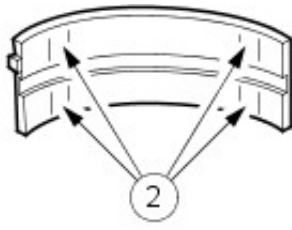
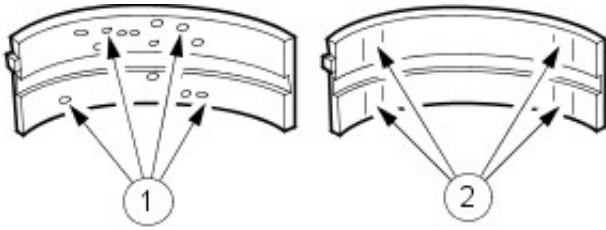
3. Install the PATS transceiver.



4. Install the instrument cluster.
For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Removal and Installation).
5. Install steering column shrouds.
For additional information, refer to: [Steering Column Shrouds](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
6. Connect the battery ground cable.
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

Engine System - General Information - ID4 2.2L Diesel - Bearing Inspection

General Procedures

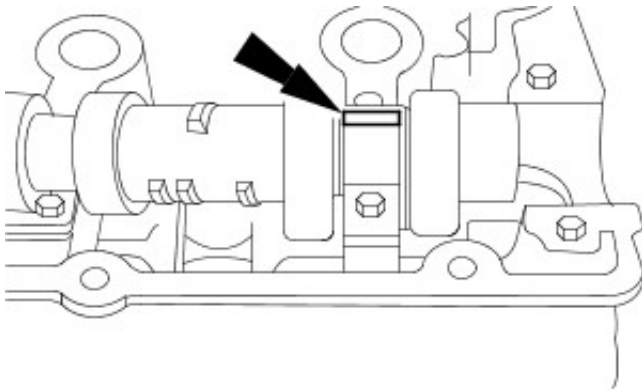


1. Inspect bearings for the following defects.

1. Cratering - fatigue failure
2. Spot polishing - incorrect seating.
3. Imbedded dirt engine oil.
4. Scratching - dirty engine oil.
5. Base exposed - poor lubrication.
6. Both edges worn - journal damaged.
7. One edge worn - journal tapered or bearing not seated.

Engine System - General Information - ID4 2.2L Diesel - Camshaft Bearing Journal Clearance

General Procedures



VUJ0001696

1. **NOTE:** Make sure that the following stages are followed exactly. The tappets or followers must be removed to carry out this measurement.

NOTE: Make sure that the camshaft is to specification.

NOTE: The bearing caps and journals should be free from engine oil and dirt.

Position on a length of plastigage on the bearing cap.

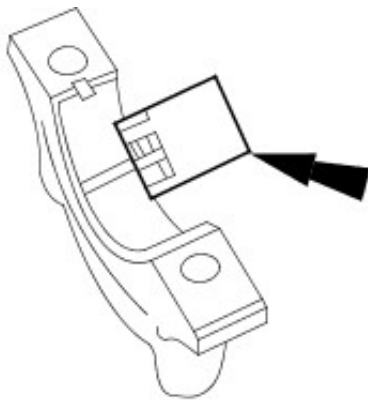
- Insert the camshaft, without lubrication, into the cylinder head.
- Position a plastigage strip, which should be equal to the width of the bearing cap, on the bearing journal.

2. Install the camshaft bearing caps.
 - Follow the relevant tightening sequence.

3. **NOTE:** Do not strike the bearing caps.

Remove the camshaft bearing caps.

- Follow the relevant loosening sequence.

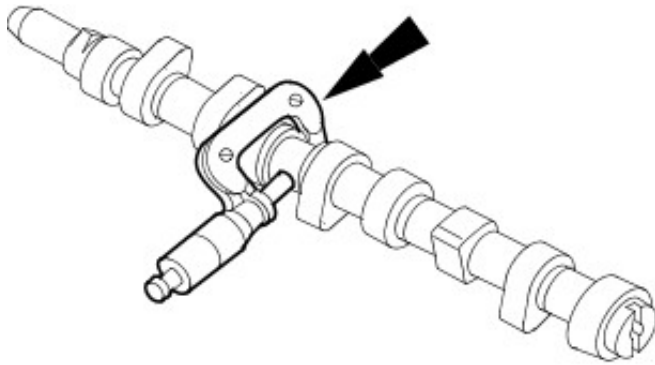


VUJ0001697

4. Using the special tool, read off the measurement.
 - Compare the width of plastigage with the plastigage scale.
 - The value that is read off is the bearing clearance.
 - If the values are not to specification install a new camshaft.

Engine System - General Information - ID4 2.2L Diesel - Camshaft Bearing Journal Diameter

General Procedures

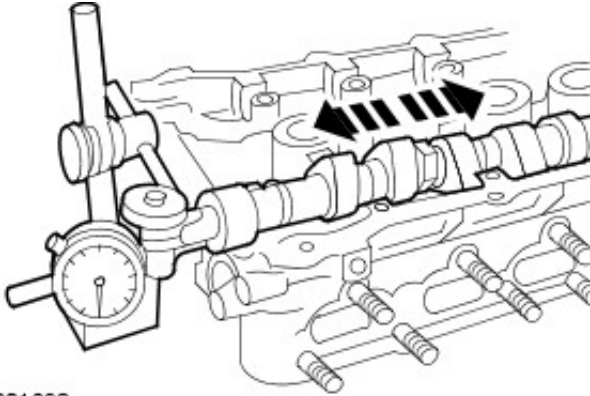


1. Determine the diameter of the camshaft journals.
 - Using a micrometer measure the diameter at 90 degrees intervals to determine if the journals are out-of-round.
 - Measure at two different points on the journal to determine if there is any tapering.
 - If the measurements are out of the specified range, install a new camshaft.

VUJ0001695

Engine System - General Information - ID4 2.2L Diesel - Camshaft End Play

General Procedures



VUJ0001698

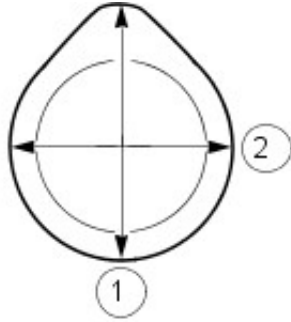
1. **NOTE:** Make sure that the camshaft is to specification.

Using the special tool, measure the end play.

- Slide the camshaft in both directions. Read and note the maximum and minimum values on the dial indicator gauge.
 1. End play = maximum value minus minimum value.
- If the measurement is out of specification, install new components.

Engine System - General Information - ID4 2.2L Diesel - Camshaft Lobe Lift

General Procedures

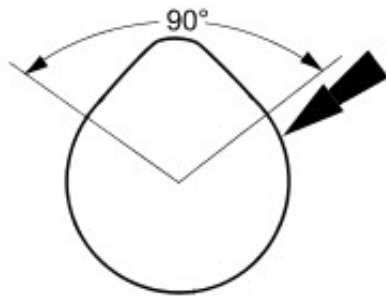


1. Measure the diameter (1) and diameter (2) with a vernier caliper.
The difference in measurements is the lobe lift.

VUJ0001699

Engine System - General Information - ID4 2.2L Diesel - Camshaft Surface Inspection

General Procedures

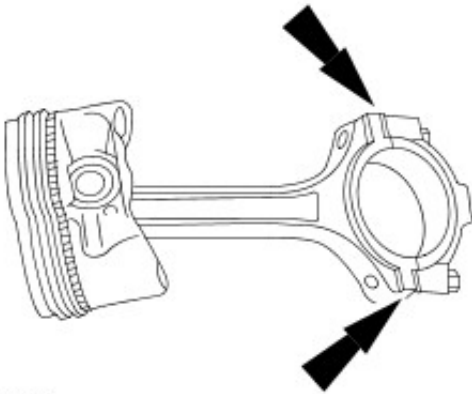



1. Inspect camshaft lobes for pitting or damage in the active area. Minor pitting is acceptable outside the active area.

VUJ0001700

Engine System - General Information - ID4 2.2L Diesel - Connecting Rod Cleaning

General Procedures



1.  **CAUTION:** Do not use a caustic cleaning solution or damage to connecting rods may occur.

Mark and separate the parts and clean with solvent. Clean the oil passages.

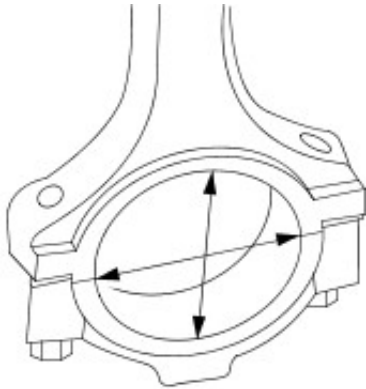
VUJ0002224

Engine System - General Information - ID4 2.2L Diesel - Connecting Rod

Large End Bore

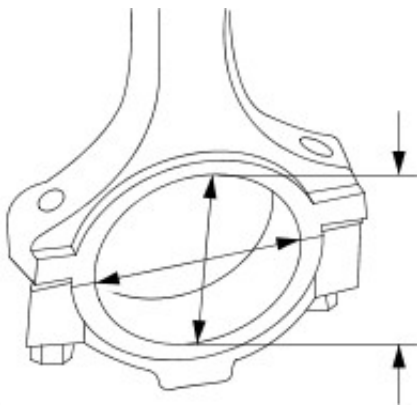
General Procedures

1. Measure the bearing bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.



VUJ0002223

2. Measure the bearing bore diameter in two directions. Verify the bearing bore is within specification.

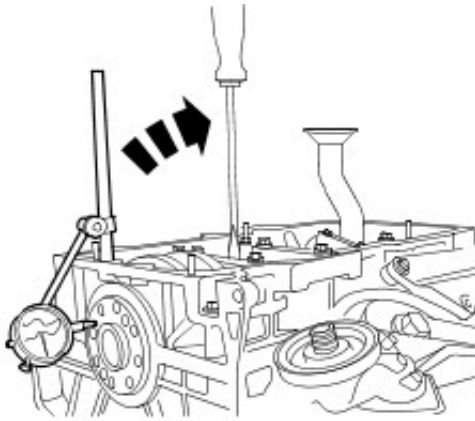


VUJ0002222

Engine System - General Information - ID4 2.2L Diesel - Crankshaft End Play

General Procedures

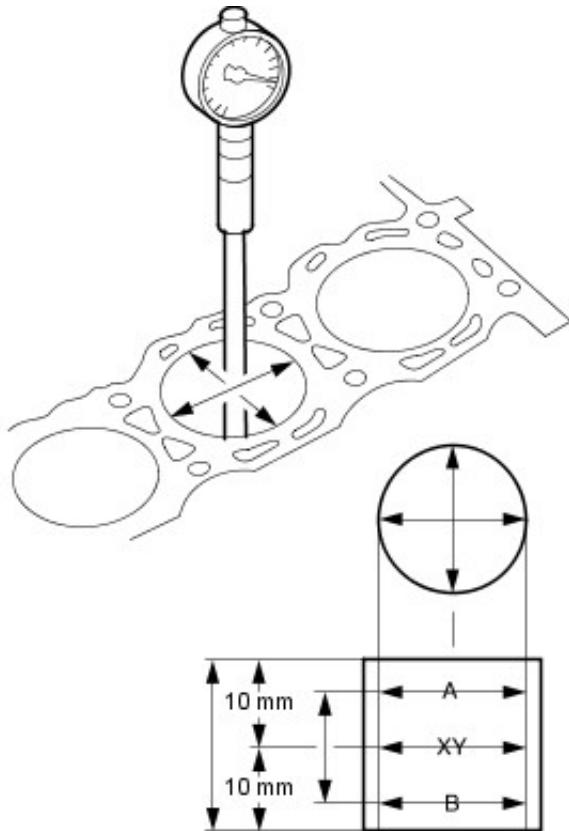
1. Using the Dial Indicator Gauge with Brackets, measure the end play.
 - Measure the end play by lifting the crankshaft using a lever.
 - If the value is out of the specification, install new thrust half rings to take up the end float and repeat the measurement.



VUJ0002235

Engine System - General Information - ID4 2.2L Diesel - Cylinder Bore Out-of-Round

General Procedures



1. **NOTE:** The main bearing caps or lower crankcase must be in place and tightened to the specified torque; however, the bearing shells should not be installed.

Measure the cylinder bore with an internal micrometer.

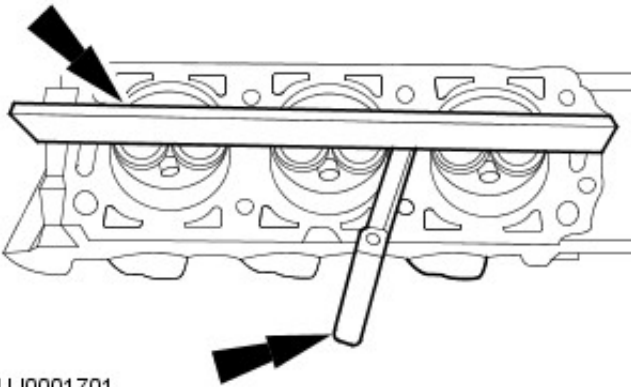
- Carry out the measurements in different directions and at different heights to determine if there is any out-of-roundness or tapering.
- If the measurement is out of the specified range, hone out the cylinder block or install a new block.

VUJ0002234

Engine System - General Information - ID4 2.2L Diesel - Cylinder Head

Distortion

General Procedures

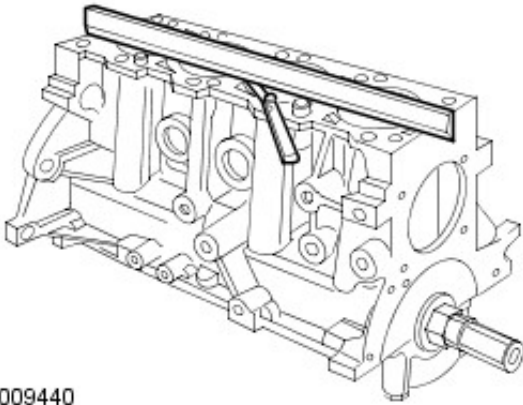


1. Measure the cylinder block/cylinder head distortion.
 - Using the special tool, measure the mating face distortion.
 - If the value is not to specification rework the mating face.

VUJ0001701

Engine System - General Information - ID4 2.2L Diesel - Cylinder Block Distortion

General Procedures



1. Using a Straight Edge and a Feeler Gauge, measure the cylinder block/cylinder head distortion.
 - Measure the mating face distortion.
 - If the value is not to specification rework the mating face (if allowed).

ELE0009440

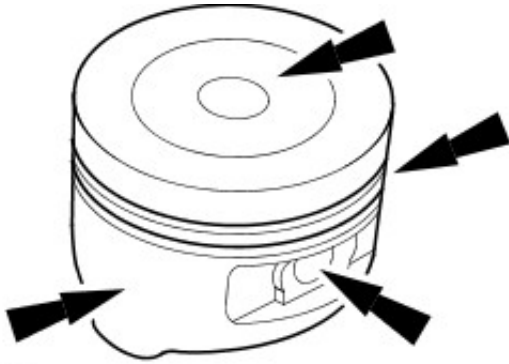
Engine System - General Information - ID4 2.2L Diesel - Exhaust Manifold Cleaning and Inspection


General Procedures

1. Inspect the cylinder head joining flanges of the exhaust manifold for evidence of exhaust gas leaks.
2. Inspect the exhaust manifold for cracks, damaged gasket surfaces, or other damage that would make it unfit for further use.

Engine System - General Information - ID4 2.2L Diesel - Piston Inspection

General Procedures



1.  **CAUTION:** Do not use any aggressive cleaning fluid or a wire brush to clean the piston.

Carry out a visual inspection.

- Clean the piston skirt, pin bush, ring grooves and crown and check for wear or cracks.
- If there are signs of wear on the piston skirt, check whether the connecting rod is twisted or bent.

VUJ0002233

Engine System - General Information - ID4 2.2L Diesel - Piston Pin

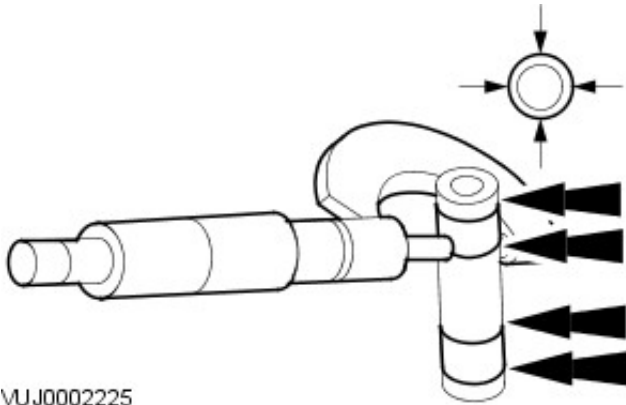
Diameter

General Procedures

1. **NOTE:** The piston and piston pin are a matched pair. Do not mix up the components.

Measure the piston pin diameter.

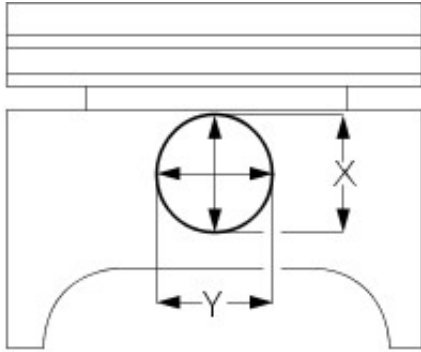
- Measure the diameter in two directions.
- If the values are not to specification, install a new piston and a new piston pin.



VUJ0002225

Engine System - General Information - ID4 2.2L Diesel - Piston Pin to Bore Diameter

General Procedures



1. **NOTE:** The piston and piston pin form a matched pair. Do not mix up the components.

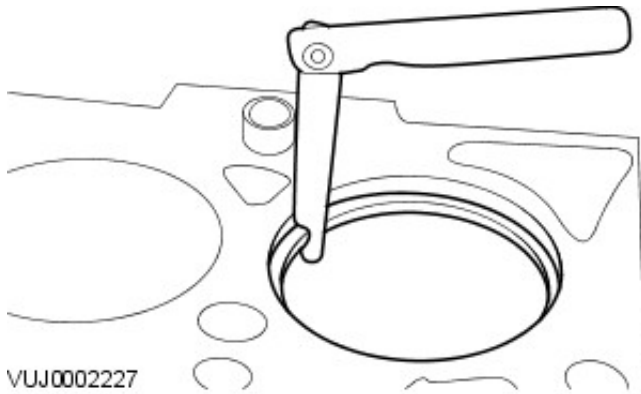
Measure the diameter of the piston pin bore.

- Measure the diameter in two directions.
- If the values are not to specification, install both a new piston and a new piston pin.

VUJ0002232

Engine System - General Information - ID4 2.2L Diesel - Piston Ring End Gap

General Procedures



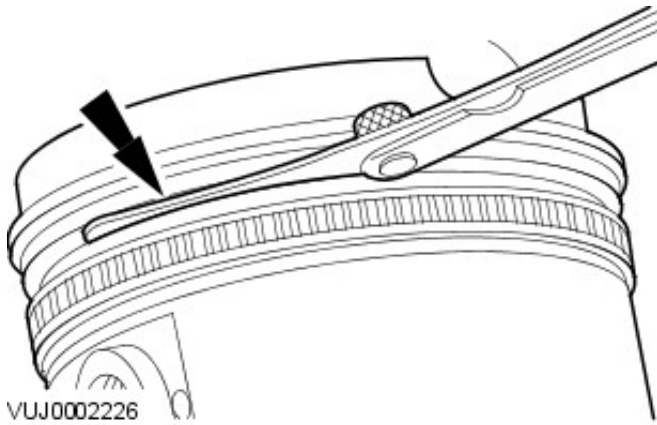
1.  **CAUTION:** Do not mix up the piston rings. Install the piston rings in the same position and location.

Using the Feeler Gauge, measure the piston ring gap.

- The values given in the specification refer to a gauge ring used during production.

Engine System - General Information - ID4 2.2L Diesel - Piston Ring-to-Groove Clearance

General Procedures



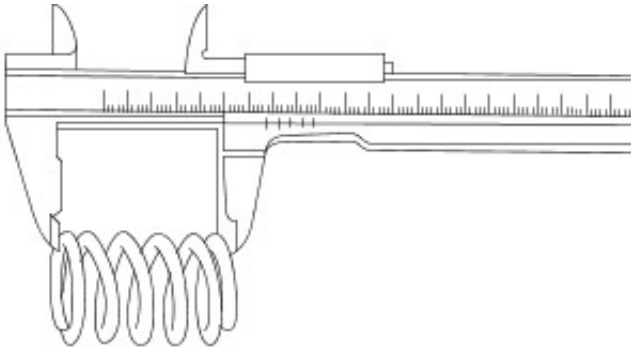
1. **NOTE:** The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.

Using the Feeler Gauge, measure the piston ring clearance.

Engine System - General Information - ID4 2.2L Diesel - Valve Spring Free Length

General Procedures

1. Using a vernier gauge, measure the free length of each valve spring. Verify the length is within specification.

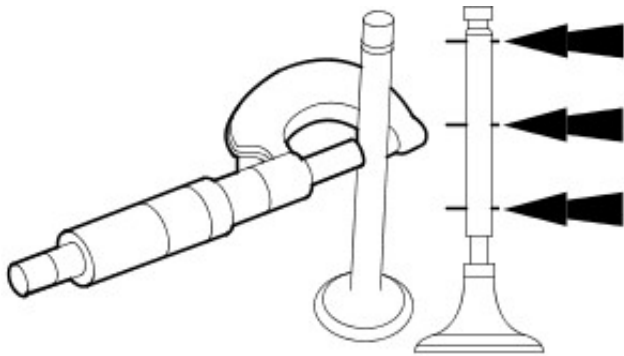


VUJ0002221

Engine System - General Information - ID4 2.2L Diesel - Valve Stem

Diameter

General Procedures



1. Using a micrometer measure the diameter of the valve stems.
 - If the measurements are not to specification, install a new valve.

VUJ0002220

Engine System - General Information - ID4 2.2L Diesel - Leakage Test Using Smoke Test Equipment

General Procedures



CAUTION: The compressed air line supply pressure must be between 3.5 and 12 bar (50 and 175 psi) for the smoke test equipment to function correctly. Do not exceed this pressure. Failure to follow this instruction may result in damage to the smoke test equipment.

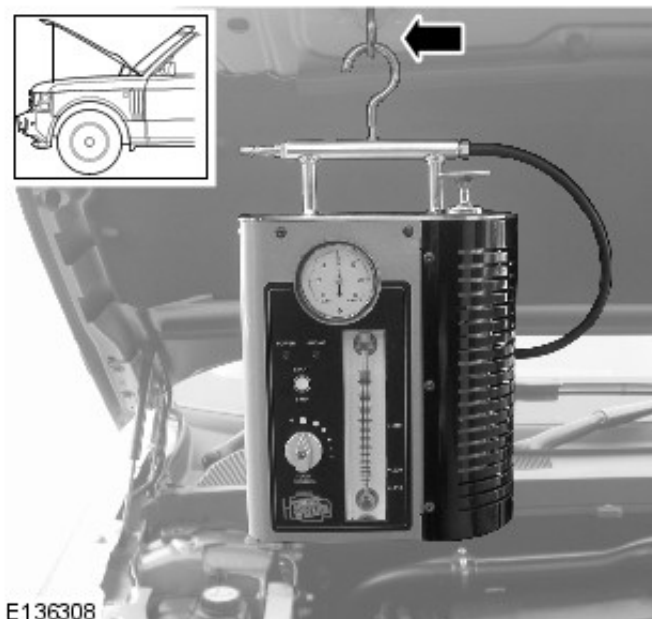
NOTE: The vehicle battery must be in good condition and fully charged before carrying out this procedure.


NOTE: On vehicles with 3.0L TDV6, it will be necessary to insert smoke at both air cleaner outlet pipes independently if the right hand turbocharger and associated hoses are to be tested.

NOTE: In some cases it may be necessary to remove undertrays, trim or engine covers to obtain access to all potential leak locations.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

NOTE: For further information regarding operation of the test equipment refer to the manufacturers operators manual supplied with the kit.



1.  **WARNING:** Use an additional support to prevent the hood from falling if the smoke test equipment is secured to the hood. Failure to follow this instruction may result in personal injury.

Install the smoke test equipment to a suitable location under the hood.

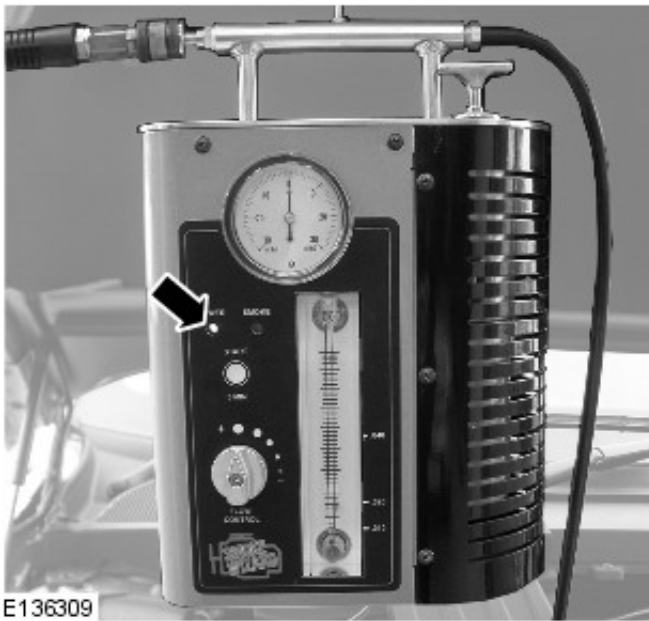
2. Connect a suitable compressed air line to the smoke test equipment.
3. Connect the smoke test equipment positive power cable to the battery positive terminal.

4.  **WARNING:** Do not connect the smoke test equipment negative cable to the battery negative terminal.

Connect the smoke test equipment negative cable to a suitable body ground point.

5. **NOTE:** A flashing green light indicates low battery voltage. In this case, place the battery on charge and make sure that the battery is fully charged before using the smoke test equipment.

Observe the power indicator lamp on the smoke test equipment. Make sure that a continuous green light is displayed.



E136309



E136310

6. NOTE: In some cases it may be necessary to remove the air cleaner(s) to allow access to the air cleaner outlet pipes.

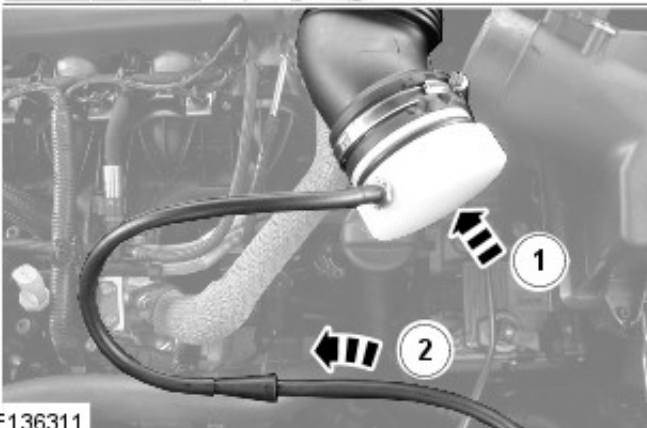
NOTE: In some cases it will be necessary to cap one of the air cleaner outlet pipes. Use the blanking caps supplied in the kit to cap the open orifice.

Disconnect the air cleaner outlet pipe(s).

7. NOTE: Make sure the smoke test equipment adapter is a good fit to the air cleaner outlet pipe. This must be an air tight seal.

Connect the smoke test equipment supply hose to the air cleaner outlet pipe.

1. Install the appropriate adapter to the air cleaner outlet pipe.
2. Connect the smoke test equipment supply hose to the adapter link hose.



E136311

8. **NOTE:** The flow control valve must be in the fully open position.

NOTE: Smoke is produced for 5 minutes. The smoke test equipment will automatically switch off after this period of time.

Switch the smoke test equipment on.



E136312

9. Remove the oil filler cap, and observe until a constant flow of smoke is visible leaving the oil filler orifice. Install the oil filler cap.
10. **NOTE:** The longer smoke is allowed to exit from a leak, the more fluorescent dye will be deposited at a leak location.

Using the torch supplied in the kit set to white light, look for escaping smoke. Alternatively, use the ultraviolet light to look for fluorescent dye deposits at the source of a leak.

Engine - ID4 2.2L Diesel -

Lubricants, Fluids and Sealers

Item	Specification
SAE 5W-30 engine oil (With DPF)	5W/30 – WSS-M2C934-B
SAE 5W-30 engine oil (Without DPF)	5W/30 – WSS-M2C913-B or C
Sealant — oil pan, camshaft carrier and engine front cover	WSE-M4G323-A4

Cylinder Head Dimensions

Description	mm
Maximum distortion — measured longitudinally and diagonally	0.10
Peak to valley height of mating surface	0.02
Cylinder head gasket thickness	
Piston protrusion of 0.310 - 0.400 mm	1.1 (one tooth)
Piston protrusion of 0.401 - 0.450 mm	1.15 (two teeth)
Piston protrusion of 0.451 - 0.500 mm	1.2 (three teeth)

Oil pressure specifications

Description	bar
Minimum oil pressure at idle speed	1.25
Minimum oil pressure at 2000 rpm	2.0

Description	Nm	lb-ft
Transmission to engine bolts	40	30
Engine mount nuts	80	59
Engine mount bolts	80	59
Engine mount bracket bolts	63	46
Valve cover bolts	10	7
+ Rocker shaft bolts		
Stage 1	10	7
Stage 2	Further 30 degrees	
Timing chain guide bolts	15	11
Timing chain tensioner nut	15	11
Timing chain tensioner bolts	15	11
Oil pump chain tensioner bolts	22	16
Camshaft sprocket bolts	35	24
Fuel injection pump sprocket bolts	33	26
Generator bolts	48	35
Generator mounting bracket bolts	25	18
Exhaust gas recirculation (EGR) valve to EGR valve outlet tube bolts	10	7
EGR valve to EGR cooler bolts	23	17
Exhaust manifold to EGR cooler bolts	23	17
Intake manifold bolts	15	11
Intake manifold to EGR valve outlet tube bolts	10	7
Coolant pump bolts	23	17
Oil level indicator tube bolt	10	7
Oil pump pickup tube bolts	10	7
Oil filter housing assembly bolts	23	17
Oil pump bolts	10	7
Oil pan drain plug	23	17
Oil pressure switch	15	11
Oil pan bolts		
Stage 1	7	5
Stage 2	14	10
Coolant manifold bolts	10	7
EGR cooler to cylinder head bolts	23	17
+ Cylinder head bolts	A	-
Engine front cover bolts	14	10
Engine front cover nuts	10	7
Glow plugs	10	7
Power steering pump bolts	23	17
Power steering pump bracket bolts	23	17
Exhaust manifold bolts	40	30
+ Exhaust manifold nuts	40	30
+ Exhaust manifold studs	20	15
Turbocharger oil return tube bolts	10	7

Turbocharger oil return tube clamp bolt	22	16
Turbocharger oil supply line banjo bolt	35	26
Engine lifting eye bolts	22	16
Crankshaft position sensor (CKP) bolt	7	5
+ Crankshaft pulley bolts		
Stage 1	45	33
Stage 2	Further 120 degrees	
Crankshaft rear oil seal carrier bolts	10	7
+ Flywheel bolts		
Stage 1	25	18
Stage 2	40	30
Stage 3	Further 48 degrees	
Crankshaft main bearing cap bolts		
Stage 1	45	33
Stage 2	80	59
Stage 3	Further 105 degrees	
Connecting rod bearing cap bolts		
Stage 1	30	22
Stage 2	Further 100 degrees	
Ladder frame bolts	23	17
Camshaft carrier bolts	A	-
Fuel injector clamp bolts		
Stage 1	6	4
Stage 2	Further 180 degrees	

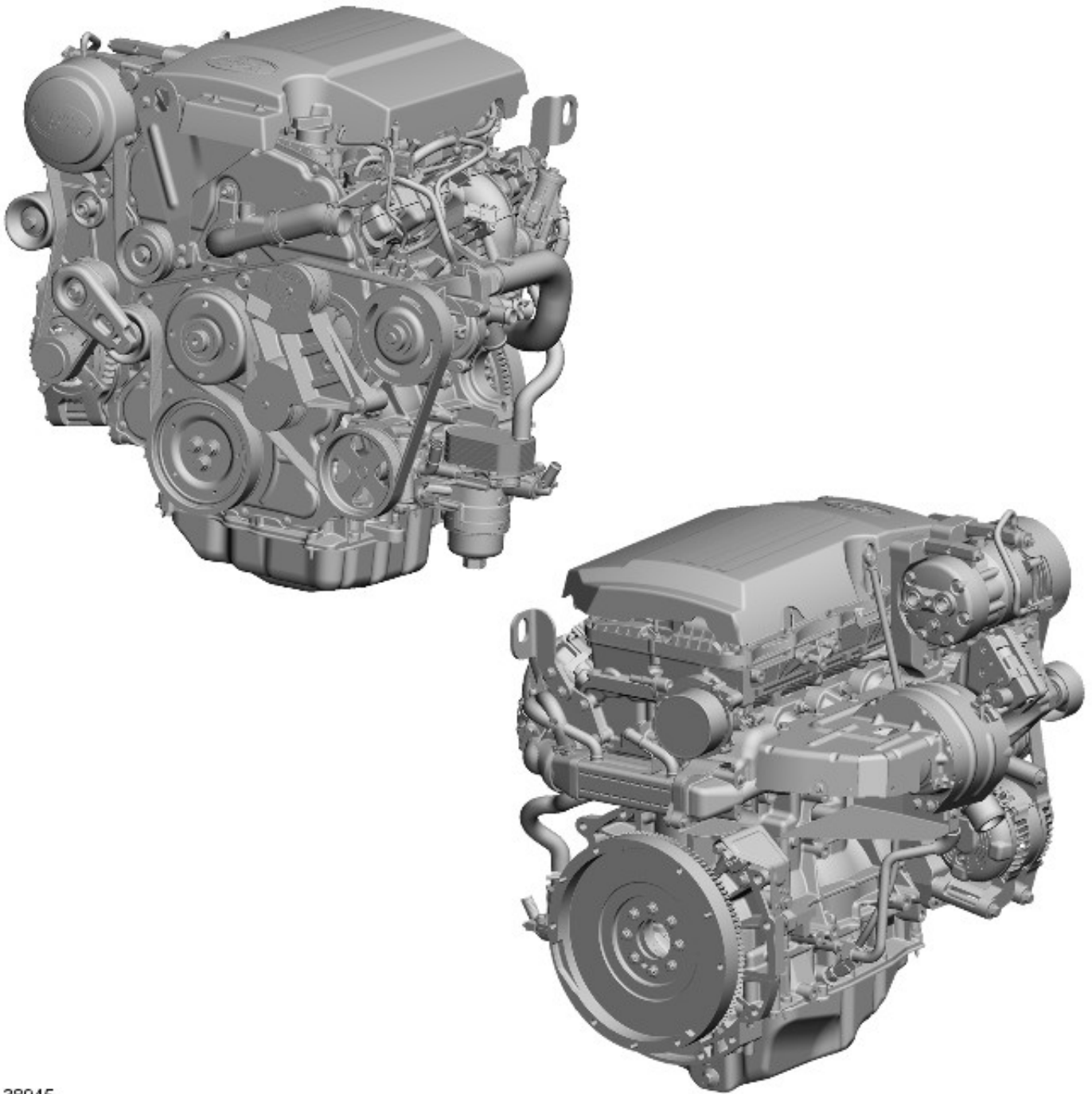
+ New nuts/bolts/studs must be installed

A - Refer to the procedure in this section

Engine - ID4 2.2L Diesel - Engine

Description and Operation

EXTERNAL VIEW



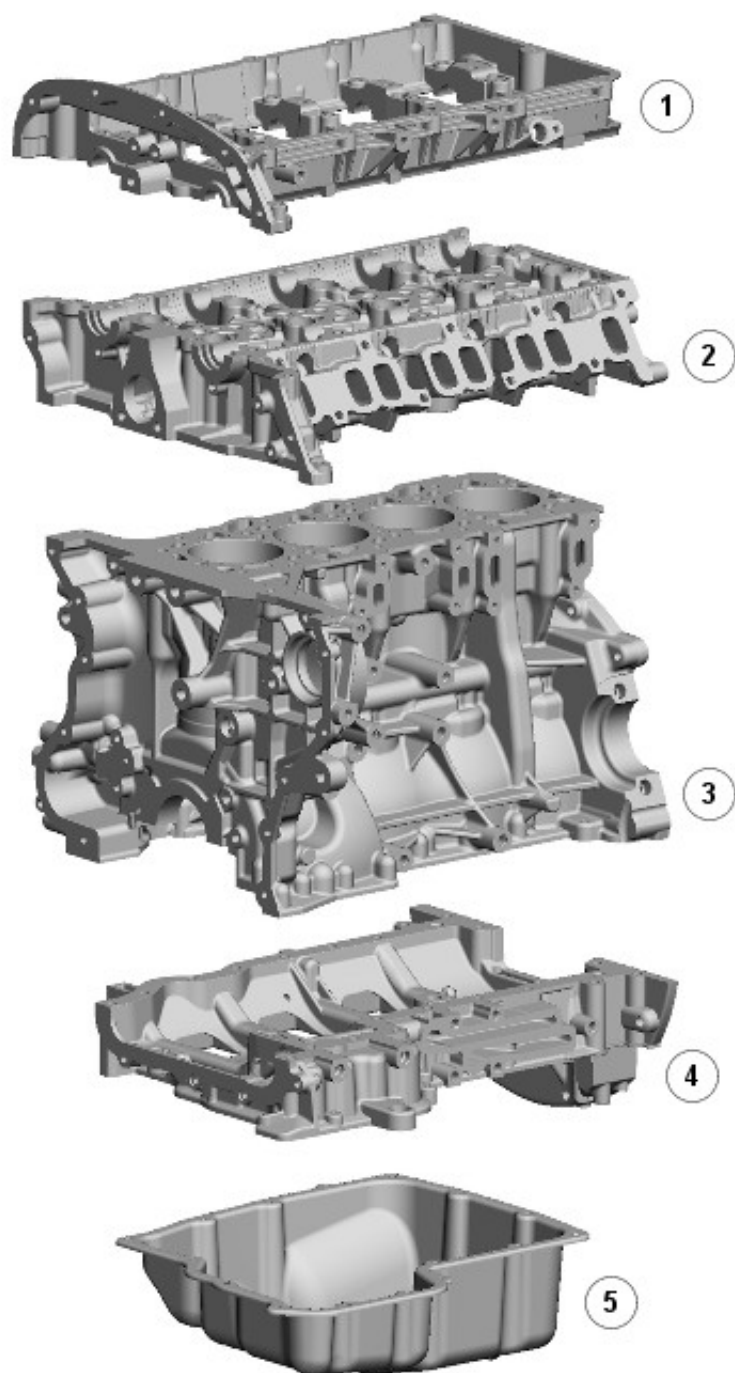
E138945

OVERVIEW

The 2.2 liter diesel engine is a 4 cylinder unit with common rail fuel injection and with four valves per cylinder operated by dual overhead camshafts. The unit is liquid cooled and turbocharged.

The cylinder block is manufactured in Compacted Graphite Iron (CGI) and is coupled with a separate aluminum 'ladder-frame' skirt stiffener to provide a lightweight, compact and very stiff bottom end of the engine. The cylinder head and camshaft carrier are cast aluminum. The single-piece oil sump is formed from pressed steel. The exhaust manifold is cast iron and includes connections for the turbocharger and [EGR \(exhaust gas recirculation\)](#) cooler. A plastic acoustic cover is fitted over the upper engine to absorb engine-generated noise.

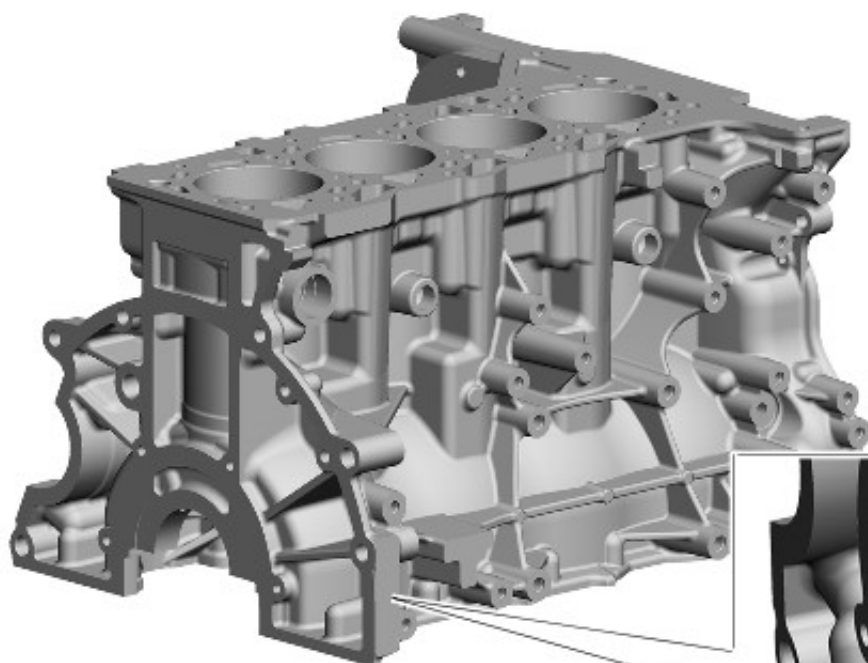
Engine Structure



E138946

Item	Part Number	Description
1	-	Camshaft carrier
2	-	Cylinder head
3	-	Cylinder block
4	-	Skirt stiffener
5	-	Oil pan

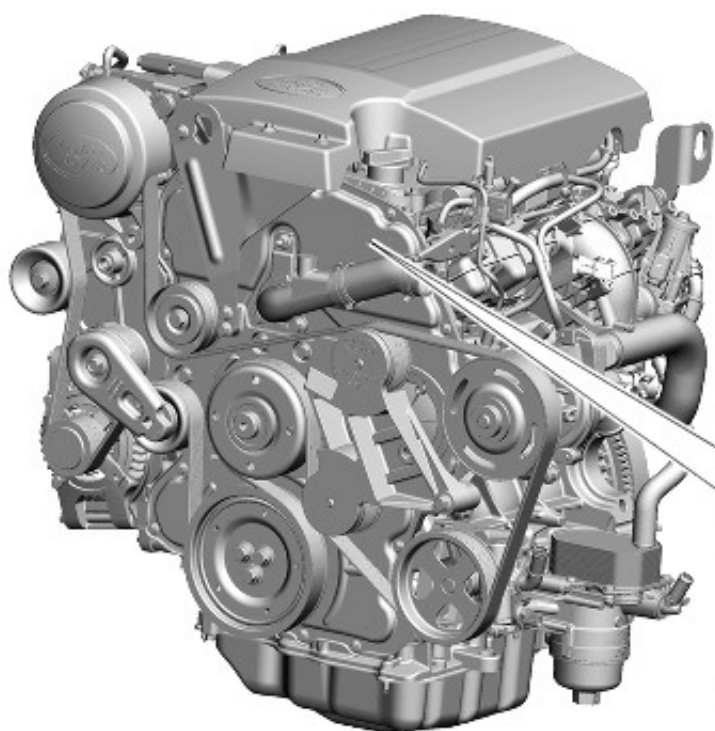
Engine Identification Stamp



E138947

The alpha-numeric engine type number (5 digits) and numeric identification number (12 digits) are stamped on the rear right side of the cylinder block. These numbers are repeated on a tamper-proof engine identification label on the timing cover.

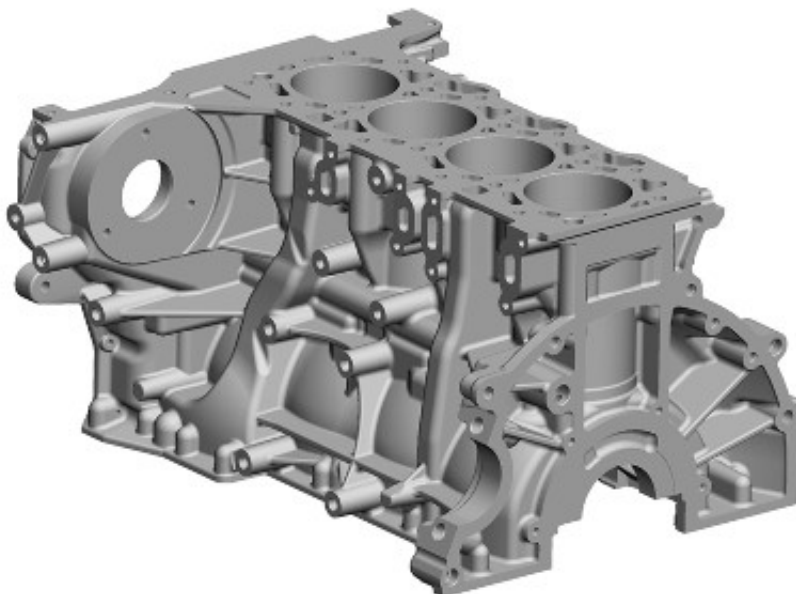
Engine Identification Label



E138948

The engine type number, DT224, is derived from **D**iesel **T**urbo, **2.2** liter, **4** cylinder. The engine identification number is derived from the date and time (24 hour clock) the block was manufactured, **DD/MM/YY/HH/MM/SS**.

CYLINDER BLOCK



E138949

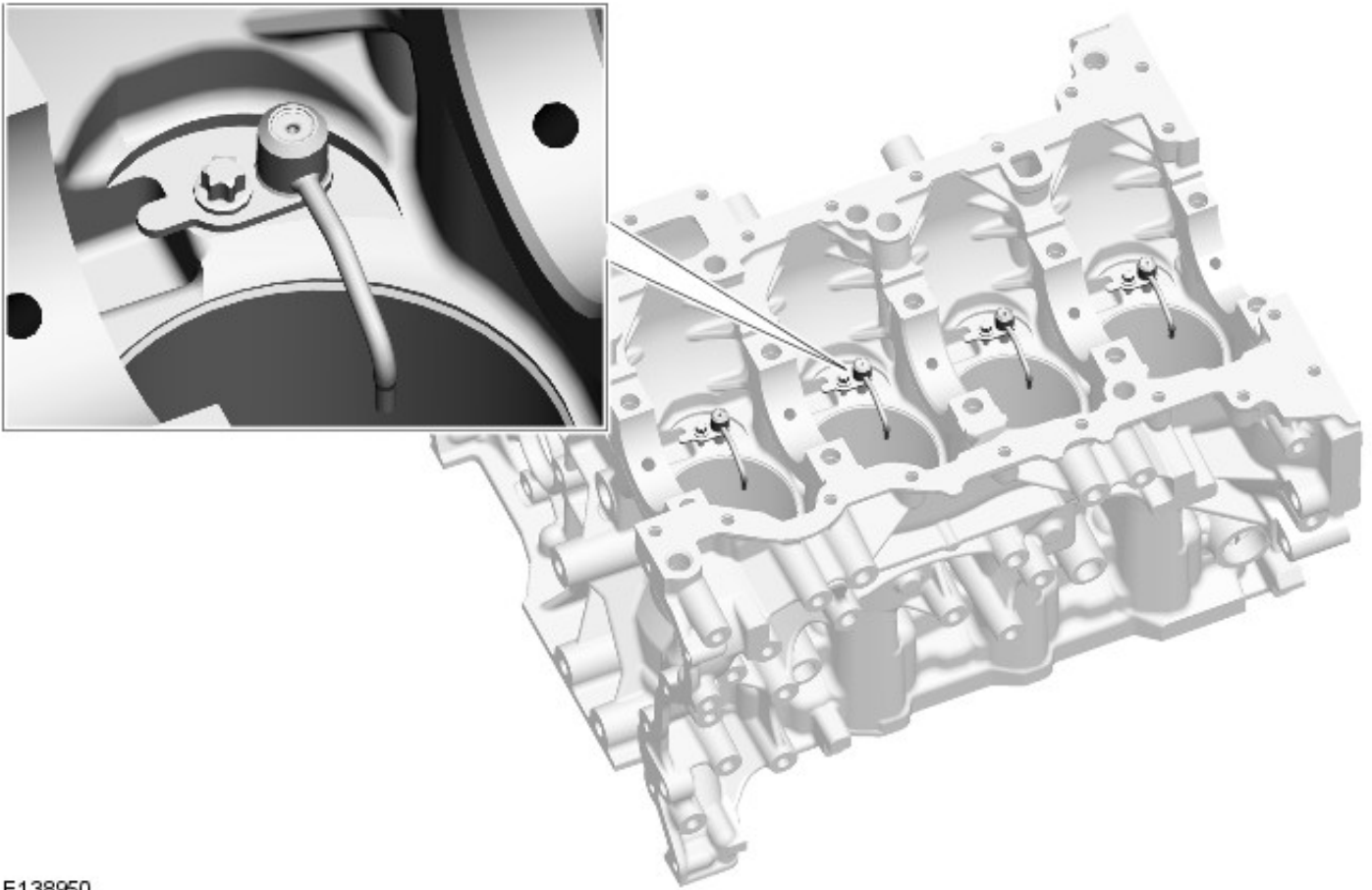
The cylinders and crankcase are contained in the cylinder block, which is of single cast CGI construction with a hollow beam structure. With this type of construction less material is required than for a conventional cast iron block, therefore reducing engine weight and length.

The cylinders are numbered consecutively from 1 to 4, with cylinder 1 at the front of the engine.

The cylinder bores are machined directly into the block. Cylinder cooling is achieved by coolant circulating through chambers in the cylinder block casting.

Passages in the cylinder block distribute engine oil to the main bearings, piston cooling jets, cylinder head and turbocharger. The passage that supplies oil to number 1 main bearing and the turbocharger contains a filter, to prevent debris entering the turbocharger and damaging the bearings.

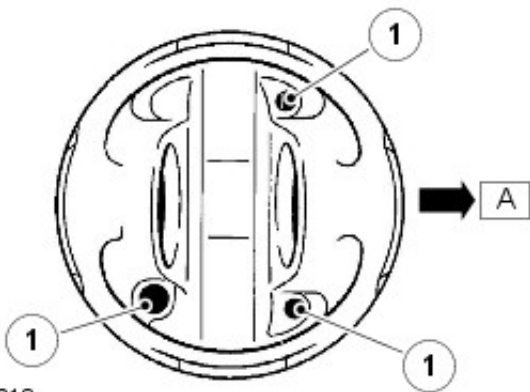
Piston Cooling Jets



E138950

Jets located in the cylinder block provide piston and piston pin lubrication and cooling. These jets spray oil on to the inside of the piston. The oil then flows through an internal wave shaped oil cooling channel to help cool the piston crown.

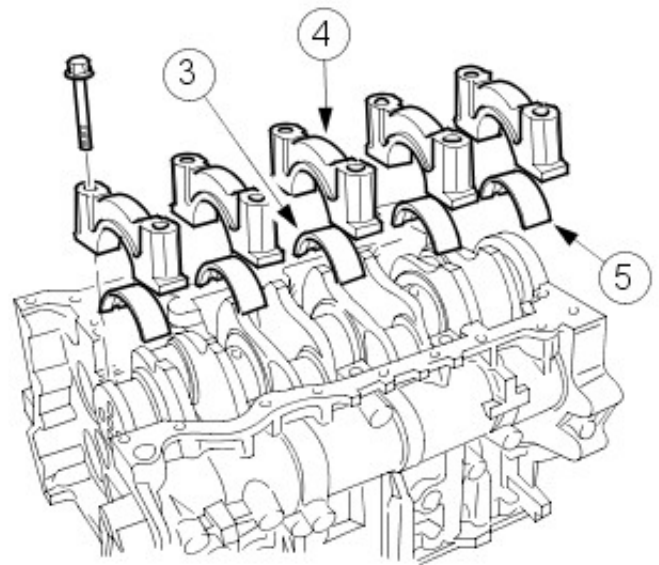
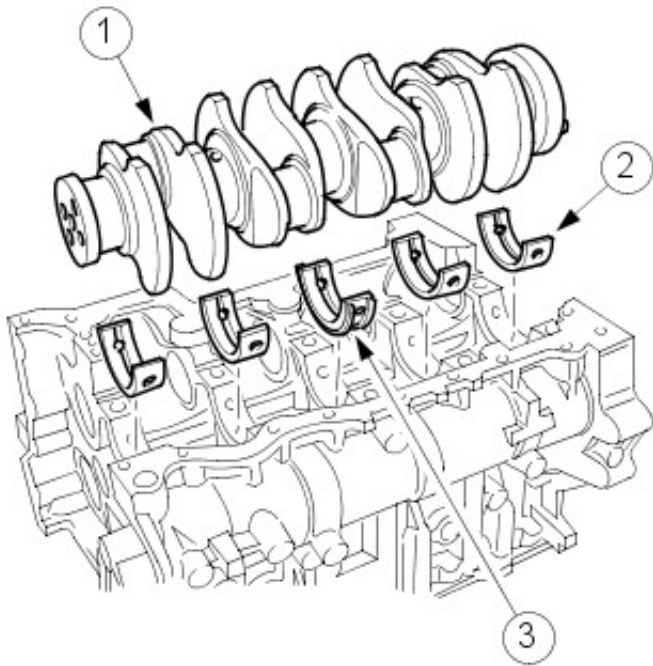
Piston Oil Cooling



E86218

Item	Part Number	Description
A	-	Front of the engine
1	-	Oil cooling channels

CRANKSHAFT



TIE0031821

Item	Part Number	Description
1	-	Crankshaft
2	-	Upper main bearing shell
3	-	Upper main bearing shell (No.3 is a thrust bearing)
4	-	Bearing cap
5	-	Lower main bearing shell

The crankshaft is forged steel and fillet rolled with induction hardened journals, which run in 5 bearings with clamped 2 layer bearing shells.

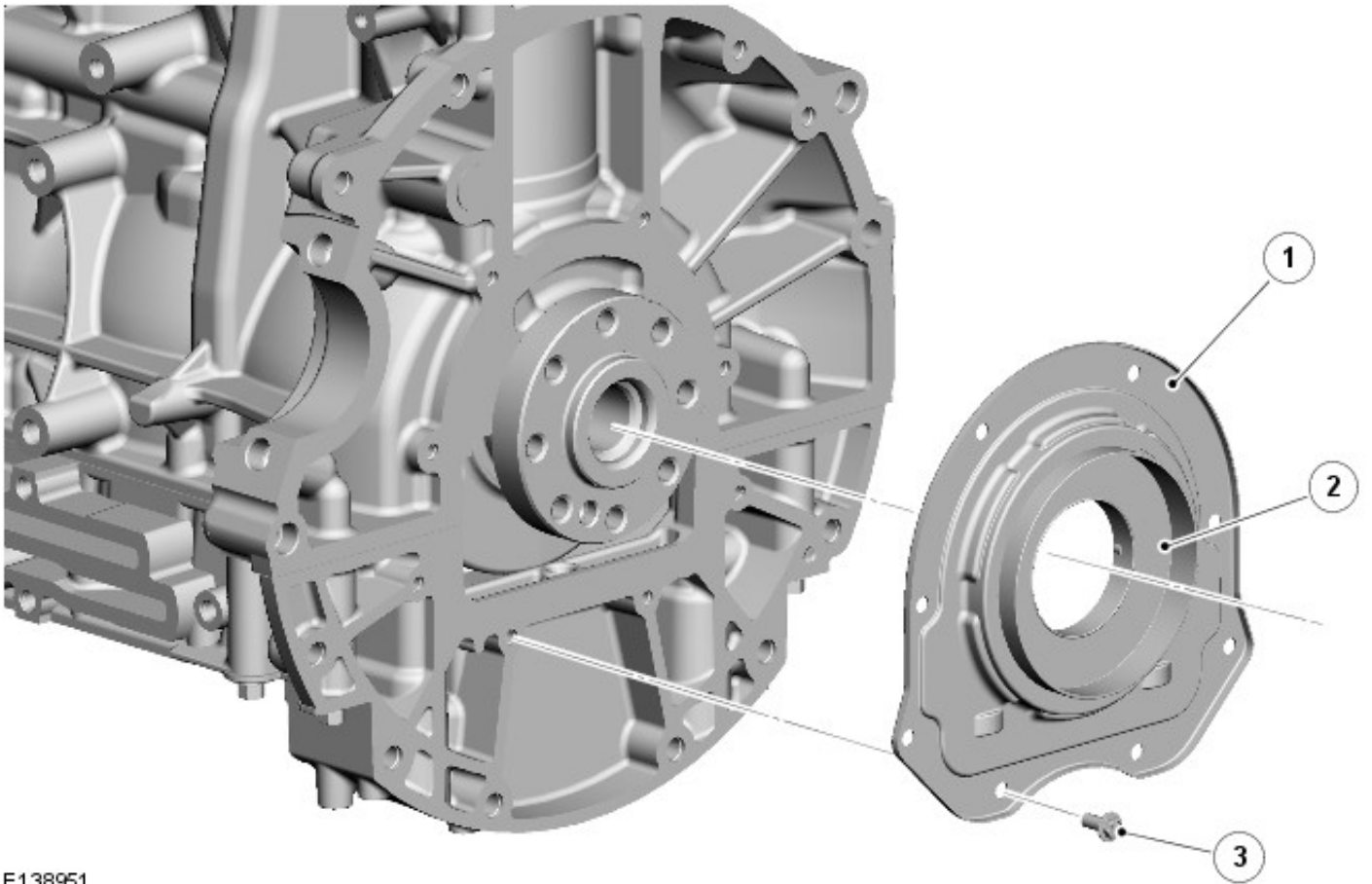
The main bearing caps are double and cross-bolted, this adds to the strength and rigidity of the engine block.

The main bearings are aluminum/tin split plain selective bearings. An oil groove in the top half of each bearing transfers oil into the crankshaft for lubrication of the connecting rod bearings. The upper and lower shells of bearing number 3 contain integral thrust washers, which limit the end float of the crankshaft.

The arrow on the bearing caps must point towards the front of the engine and are identified as follows:

Bearing Cap	Identification
1	F (front)
2	2
3	3
4	4
5	R (rear)

Crankshaft Rear Oil Seal



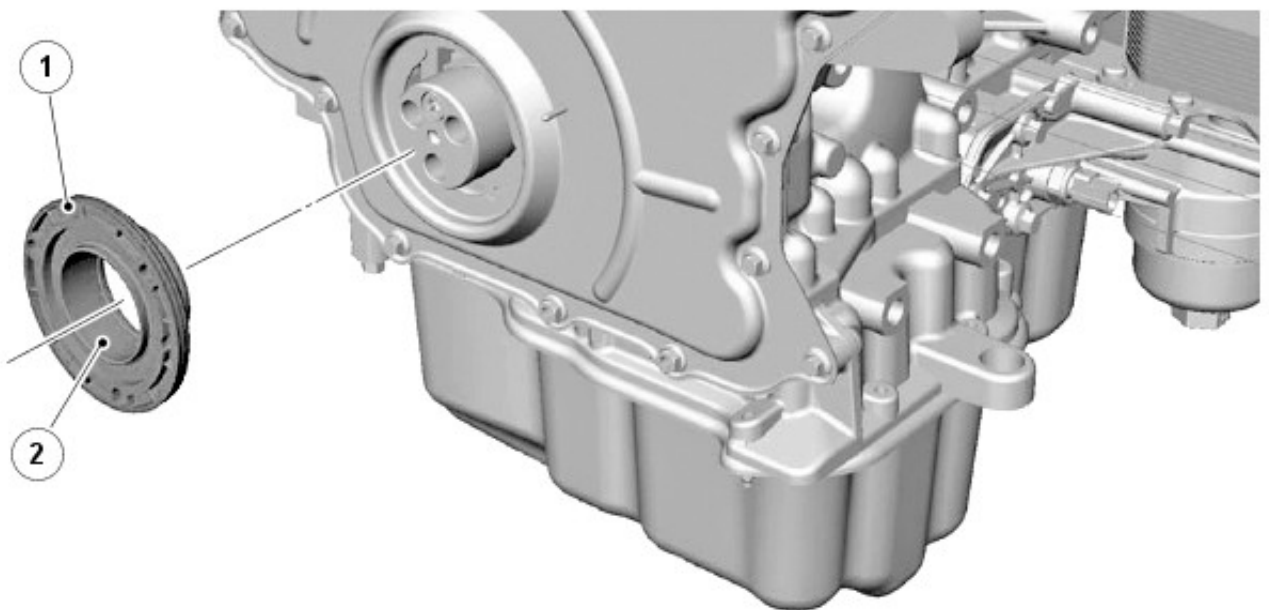
E138951

Item	Part Number	Description
1	-	Rear oil seal
2	-	Installation sleeve
3	-	Bolt (8 off)

The crankshaft rear oil seal consists of a rubber sealing element installed in a metal case attached to the rear of the cylinder block and skirt stiffener. A rubber gasket seals the metal case to the cylinder block and skirt stiffener.

A new crankshaft rear oil seal is supplied with an installation sleeve that must not be removed until the seal is fully installed.

Crankshaft Front Oil Seal



E138952

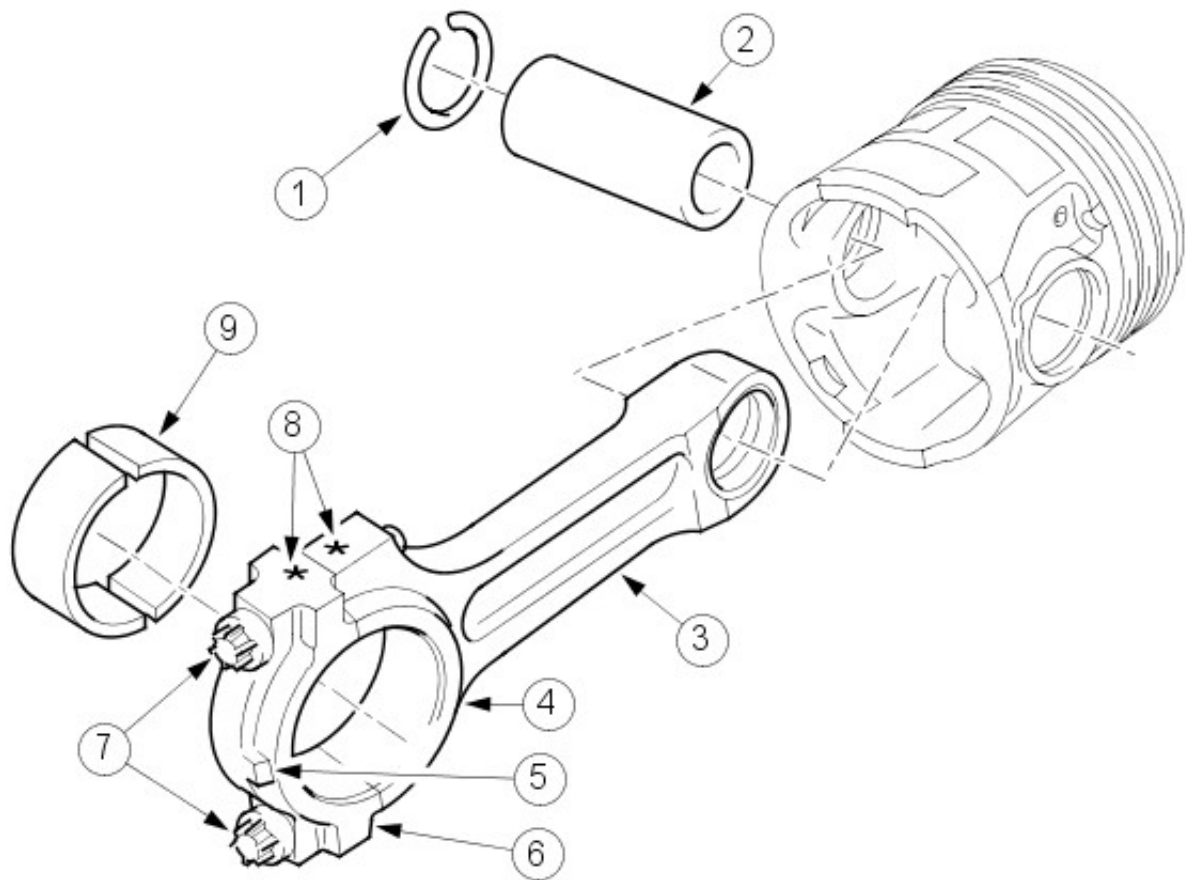
Item	Part Number	Description
1	-	Front oil seal

2 - Installation sleeve

The crankshaft front oil seal consists of a [PTFE \(polytetrafluoroethylene\)](#) seal assembly installed in the front cover. Three lugs on the outer case of the seal assembly engage with the front cover to lock the seal assembly in position.

A new crankshaft front oil seal is supplied with an installation sleeve that is pushed out when the seal is installed.

CONNECTING RODS AND PISTONS



TIE0031819

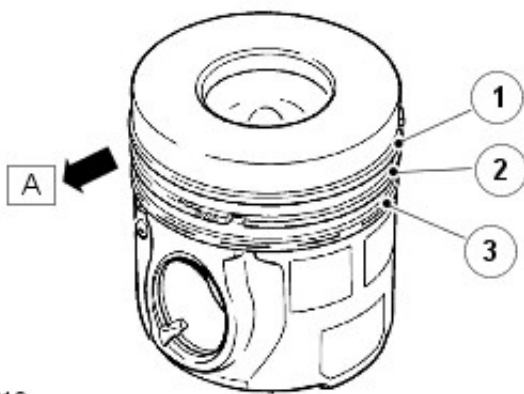
Item	Part Number	Description
1	-	Circlip
2	-	Piston pin
3	-	Connecting rod
4	-	Connecting rod bearing
5	-	Projection
6	-	Bearing cap
7	-	Retaining bolts
8	-	Identification
9	-	Bearing shell

The connecting rods are manufactured from sinter-forged steel. The selective connecting rod bearings are aluminum/tin split plain bearings. The connecting rod bearing is 'sputter coated', which is a manufacturing process that layers the bearing material to produce a higher load capacity for improved durability.

Engine oil for lubrication of the connecting rod bearings is supplied from the main bearings through passageways in the crankshaft.

The connecting rods are available in 3 different lengths. For identification, the connecting rod and bearing cap are marked with the corresponding identification code.

Piston Rings



E86219

Item	Part Number	Description
A	-	Front of the engine
1	-	Upper compression ring
2	-	Lower compression ring
3	-	Oil control ring

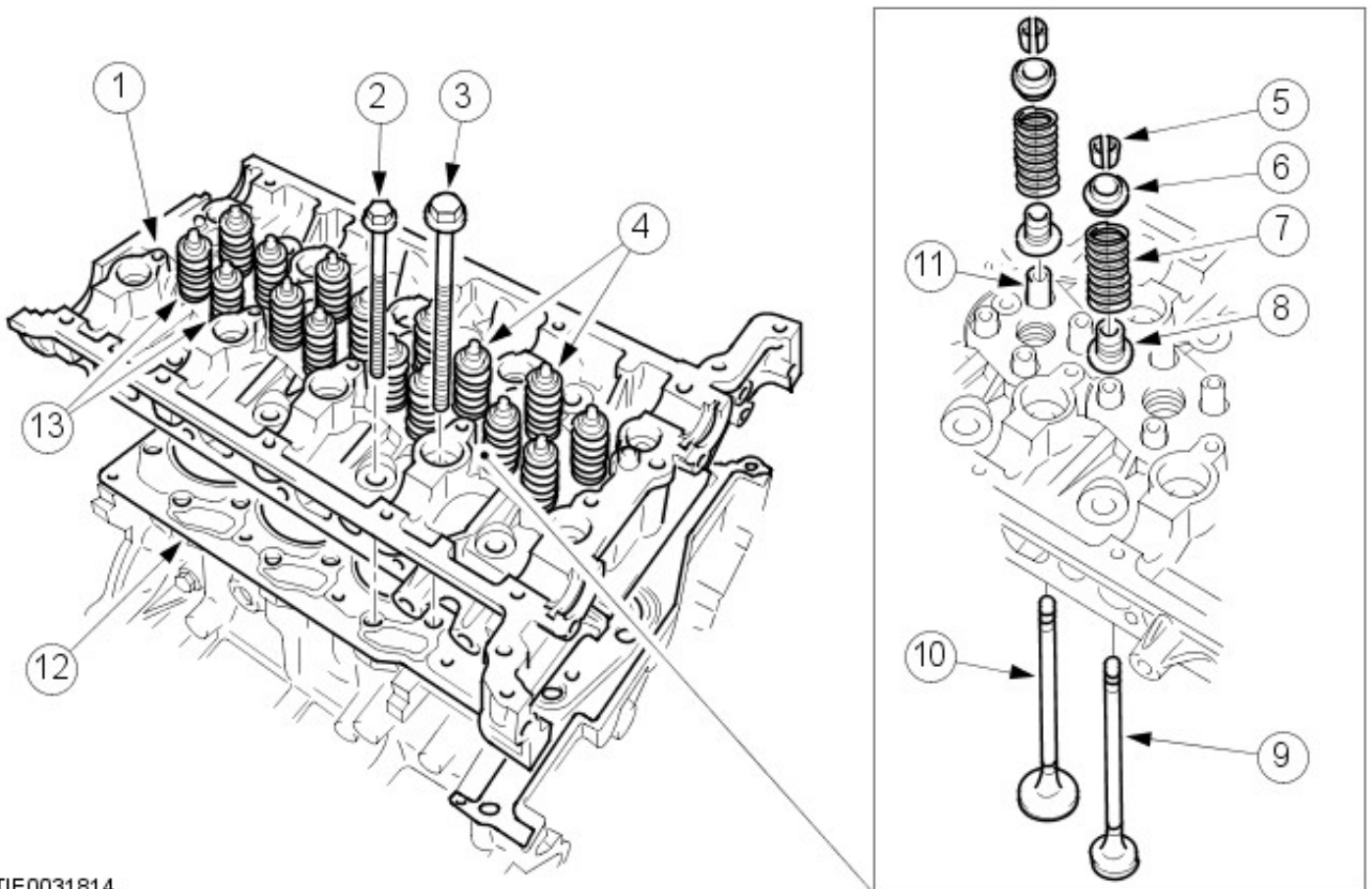
The pistons are made from aluminum alloy and are fitted with three rings. The piston crown incorporates a pronounced bowl, which forms the combustion chamber and promotes the swirl and turbulence necessary for good combustion and improved emissions. In addition, the piston also incorporates oil cooling galleries within the piston crown to enhance piston cooling.

The arrow on the piston crowns must point towards the front of the engine.

Each piston is installed on a wrist pin located in an aluminum/tin bushing in the connecting rod.

CYLINDER HEAD

Cylinder Head and Valves



TIE0031814

Item	Part Number	Description
1	-	Cylinder head
2	-	Outer cylinder head bolt (8 off)

- | | | |
|----|---|-----------------------------------|
| 3 | - | Inner cylinder head bolt (10 off) |
| 4 | - | Intake valves (16 off) |
| 5 | - | Valve collets (32 off) |
| 6 | - | Spring retainer (16 off) |
| 7 | - | Valve spring (16 off) |
| 8 | - | Valve stem oil seal (16 off) |
| 9 | - | Exhaust valve (8 off) |
| 10 | - | Intake valve (8 off) |
| 11 | - | Valve guide (16 off) |
| 12 | - | Cylinder head gasket |
| 13 | - | Valve assembly |

The cylinder head is made of gravity die cast aluminum. Four valves per cylinder provides improved cylinder charging. A compact combustion chamber and vertical fuel injectors guarantee optimum distribution of the fuel in the combustion chamber.

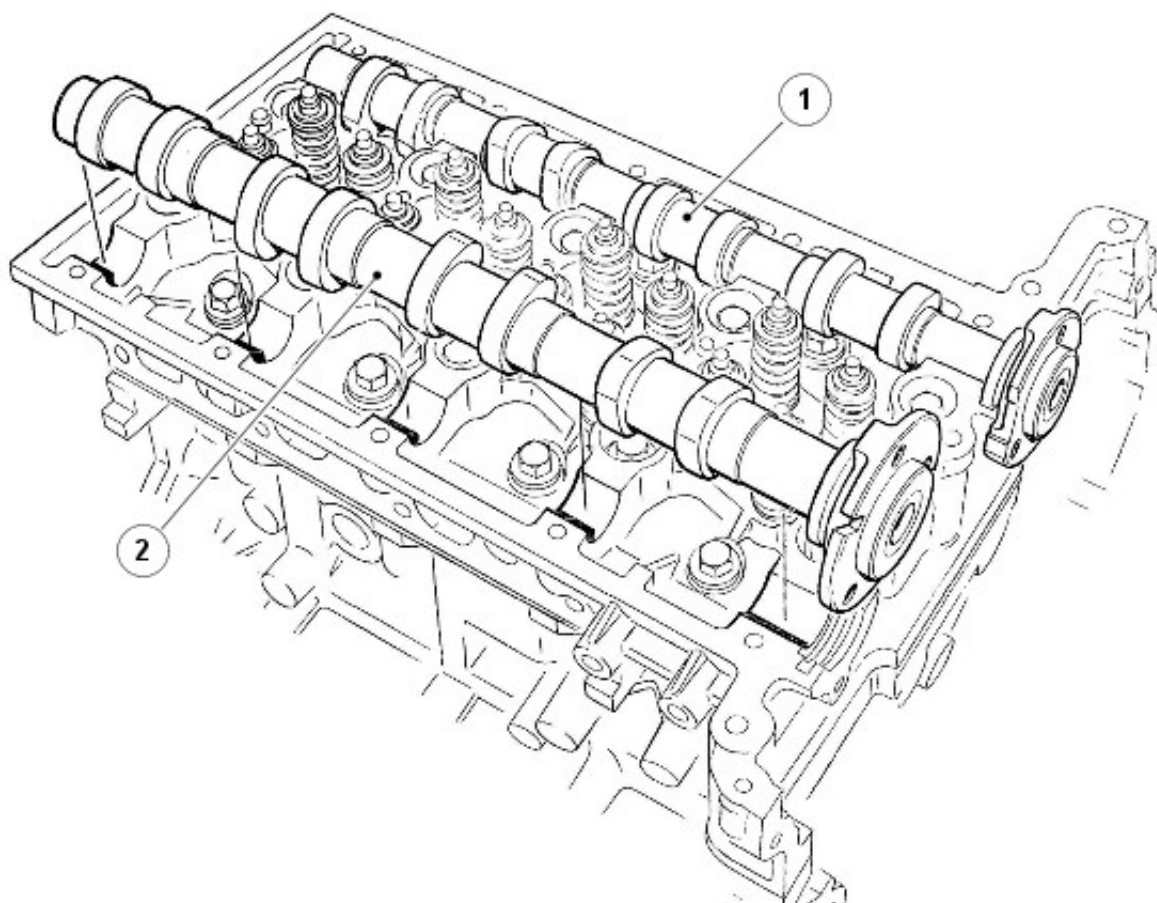
Eighteen deep-seated bolts help reduce distortion and secure the cylinder head to the cylinder block. The 8 cylinder head outer bolts are shorter than the inner bolts and are located beneath the camshafts, 4 under the inlet camshaft and 4 under the exhaust camshaft. Two hollow dowels align each cylinder head with the cylinder block.

The cylinder head has four ports machined at each cylinder location, 2 exhaust ports and 2 inlet ports. One of the inlet ports is helical and functions as a swirl port, the other is arranged laterally as a tangential port and functions as a charge port.

NOTE: The cylinder head cannot be reworked.

All valves are supported in sintered metal seats and guide inserts. Collets, valve collars and spring seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the spring seats.

Camshafts



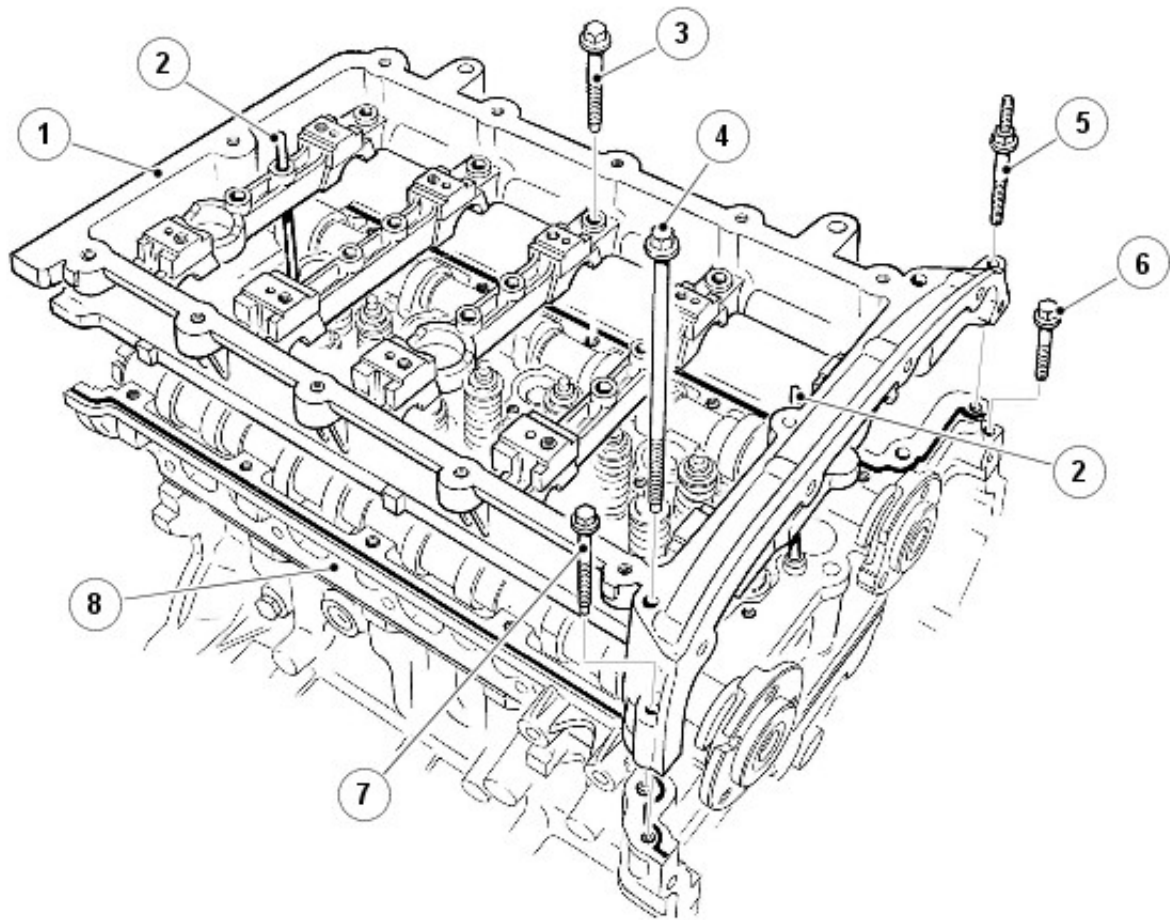
E86231

Item	Part Number	Description
1	-	Inlet camshaft
2	-	Exhaust camshaft

The camshafts are of a hollow steel tube construction, with pressed on sintered lobes and have a machined face at the front to accept the camshaft gear sprocket. The camshafts are retained in the cylinder head by the camshaft carrier. The reluctor, machined towards the rear of the inlet camshaft, enables the **CMP (camshaft position)** sensor to provide a signal, which enables the **ECM (engine control module)** to determine the position of the camshaft relative to the crankshaft.

For additional information, refer to: [Electronic Engine Controls](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Description and Operation).

Camshaft Carrier

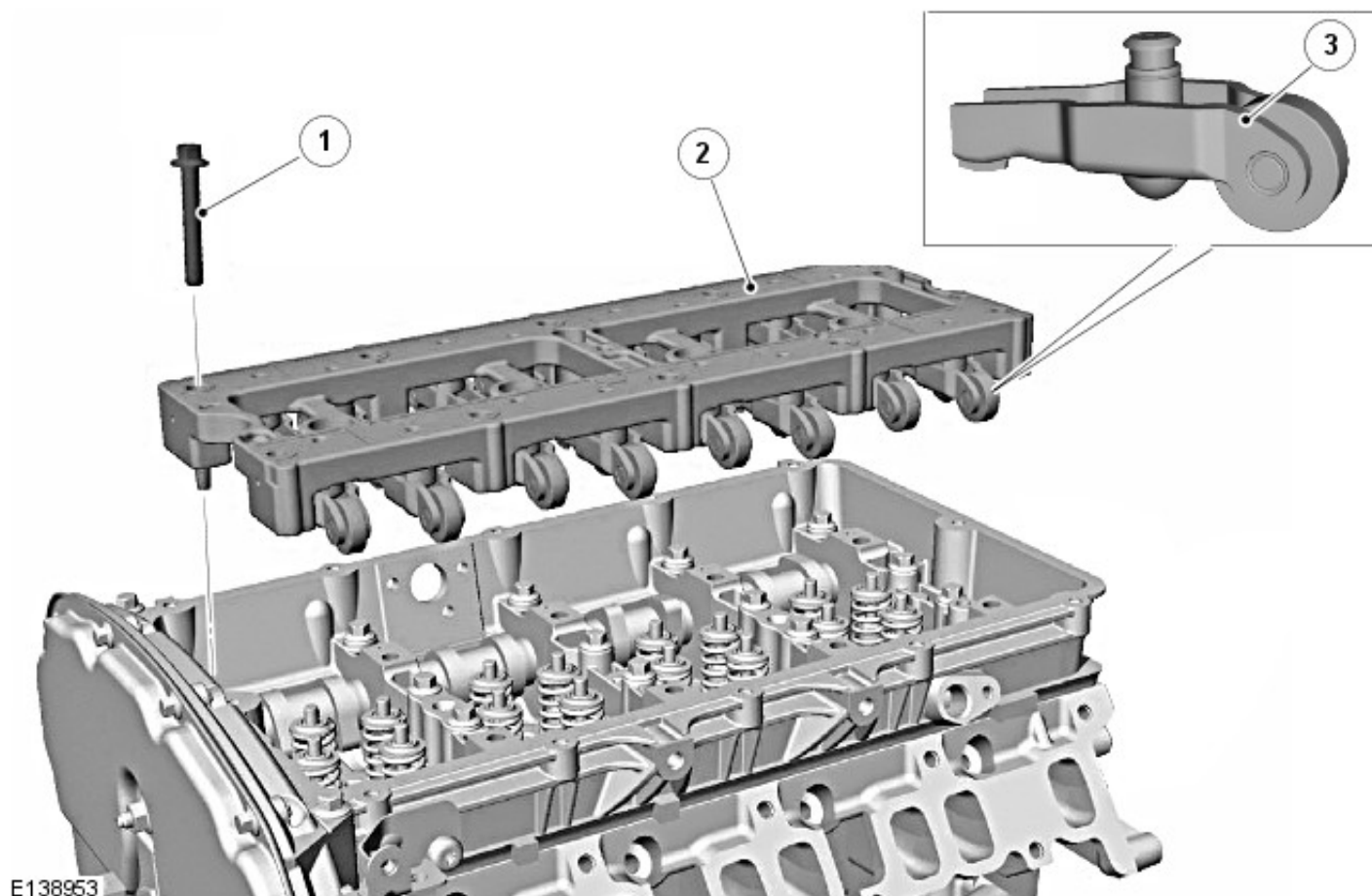


E86237

Item	Part Number	Description
1	-	Camshaft carrier
2	-	Alignment pin
3	-	Bolt (20 off)
4	-	Bolt (2 off)
5	-	Stud
6	-	Bolt
7	-	Bolt
8	-	Cylinder head

The aluminum camshaft carrier is located on top of the cylinder head and is retained by 24 bolts and a stud. Two alignment pins are used to accurately locate the carrier to the cylinder head.

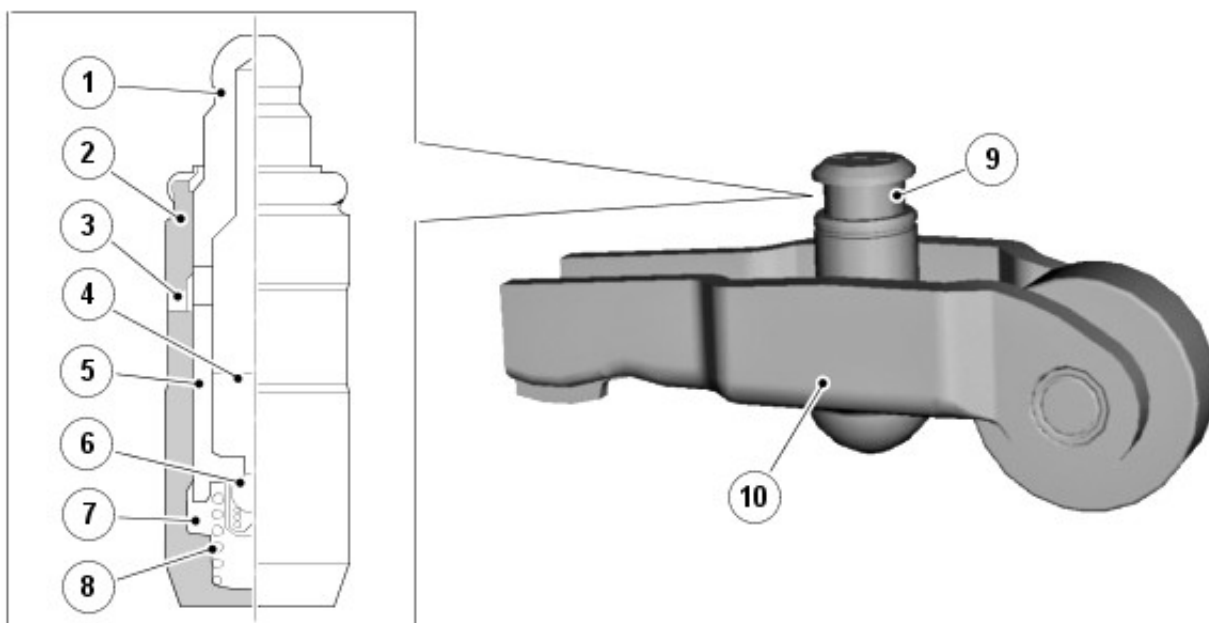
Rocker Arms



Item	Part Number	Description
1	-	Bolt (10 off)
2	-	Frame
3	-	Rocker assembly (16 off)

The valves are operated through roller-type rocker arms with integrated hydraulic lash adjusters, actuated by the camshaft lobes. The use of this type of actuation method helps reduce friction in the valve operating mechanism. The rocker arms are installed in a frame located in the camshaft carrier and secured with 10 bolts.

Lash Adjuster



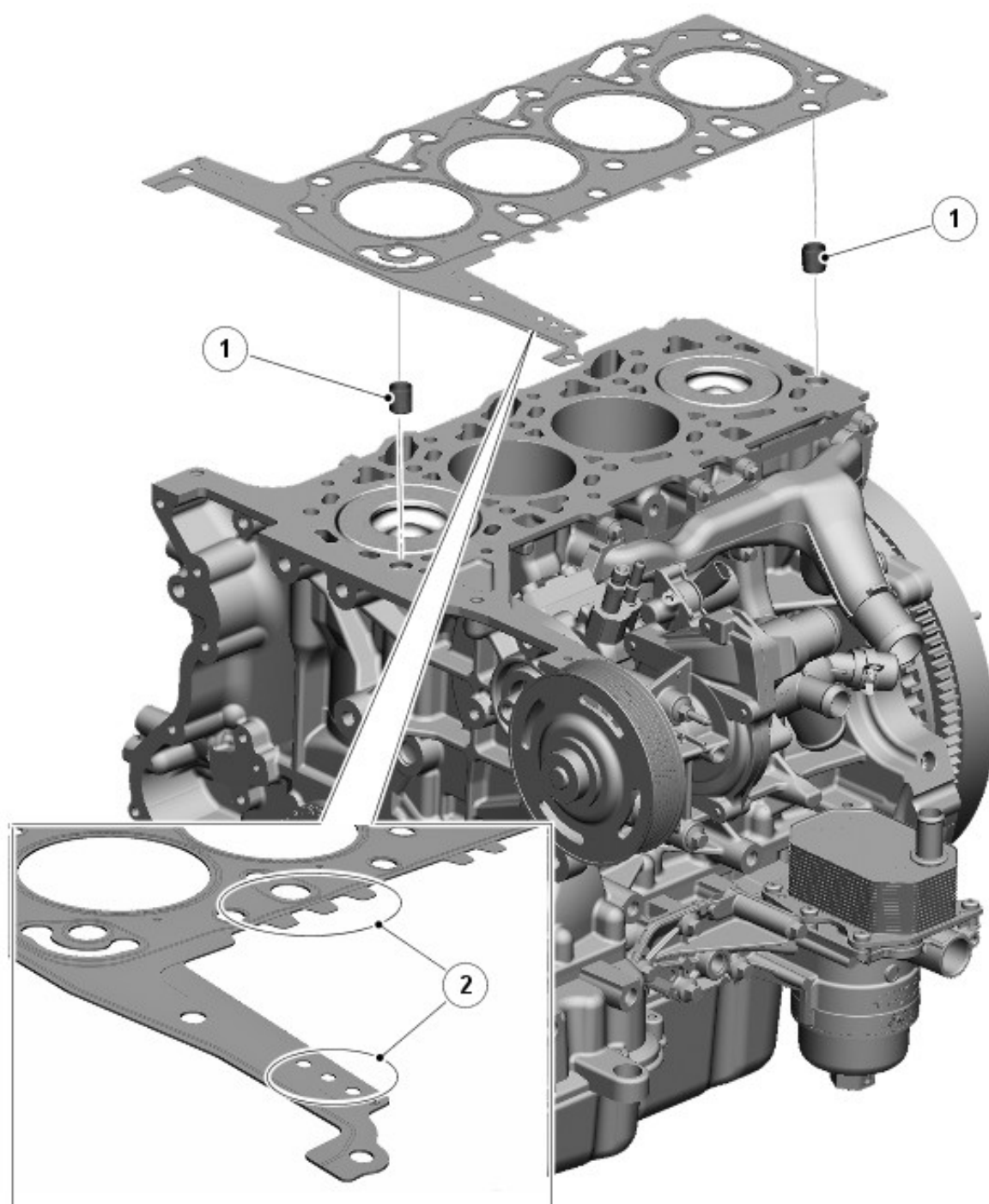
Item	Part Number	Description
1	-	Plunger cap
2	-	Hydraulic lash adjuster body
3	-	Oil hole

- | | | |
|----|---|-------------------------|
| 4 | - | Reservoir chamber |
| 5 | - | Plunger |
| 6 | - | Check ball |
| 7 | - | High-pressure chamber |
| 8 | - | Plunger spring |
| 9 | - | Hydraulic lash adjuster |
| 10 | - | Rocker arm |

The body of the hydraulic lash adjuster contains a plunger and 2 chambers for oil feed and pressurized oil. The pressurized oil is supplied to the adjusters via the main oil galleries in the cylinder head and through a hole in the side of the adjuster body. The oil passes into a feed chamber in the adjuster and then through to a separate pressure chamber via a one-way ball valve.

Oil flow from the pressure chamber is determined by the amount of clearance between the adjuster outer body and the center plunger. Oil escapes up the side of the plunger every time the adjuster is operated, the downward pressure on the plunger forcing a corresponding amount of oil in the adjuster body to be displaced. When the downward pressure from the camshaft and rocker arm is removed (i.e. after the trailing flank of the camshaft lobe has passed), oil pressure forces the adjuster's plunger up again. This pressure is not sufficient to effect the valve operation, but eliminates the clearance between the finger rocker and top of the valve stem.

Cylinder Head Gasket



Item	Part Number	Description
------	-------------	-------------

- | | | |
|---|---|----------------------------------|
| 1 | - | Dowel |
| 2 | - | Grade identification holes/teeth |

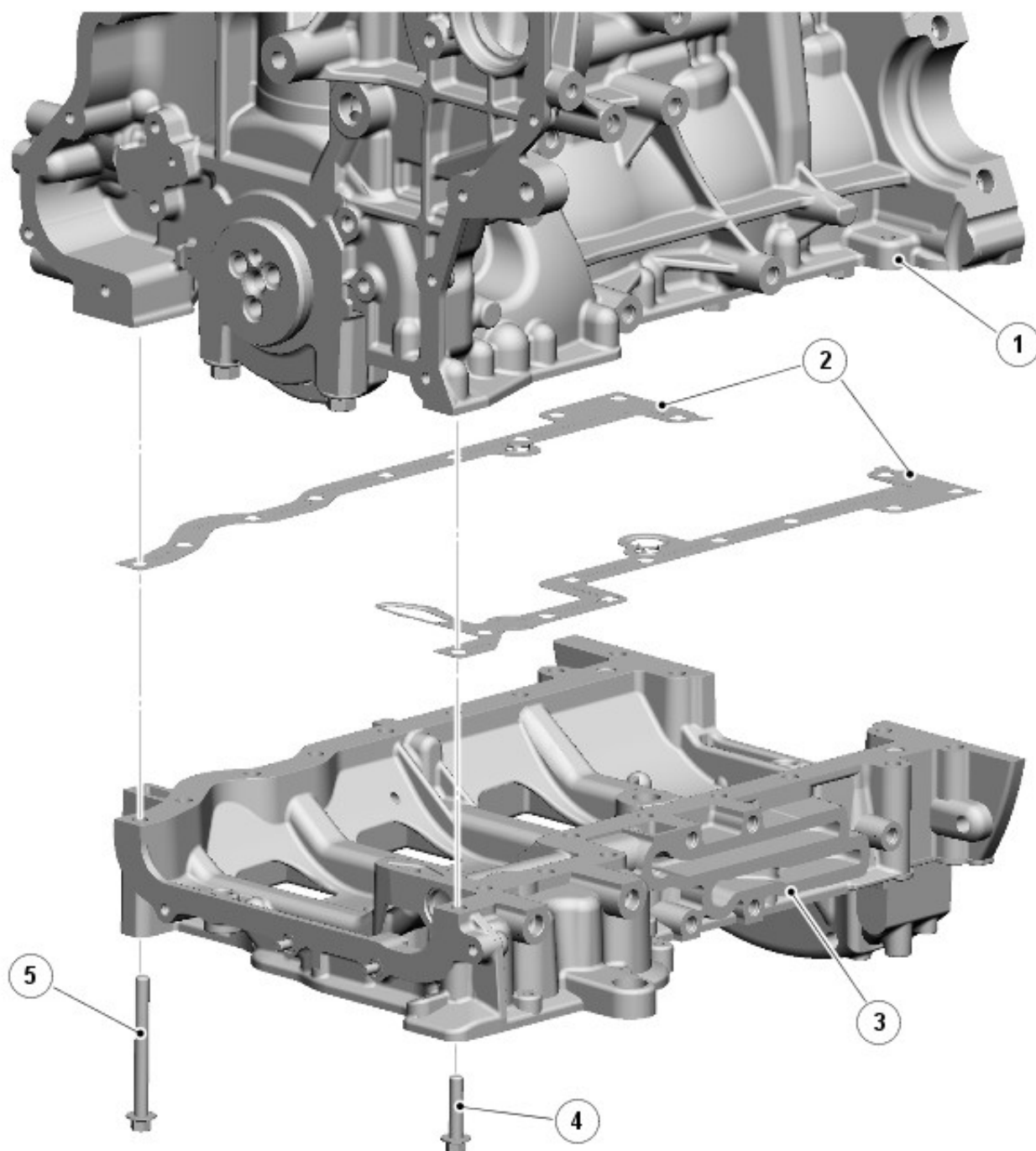
The cylinder head gasket is a 4-layer, laminated steel type that is available in 3 thickness grades. The choice of gasket grade is dependent on the maximum piston protrusion in the cylinder block. The grade of a gasket is shown by the number of identification holes and teeth incorporated into the gasket.

Two dowels ensure correct alignment of the cylinder head and gasket with the cylinder block.



CAUTION: If a cylinder head gasket is being changed, only use a new gasket with the same identification markings. If new pistons or connecting rods are fitted, measure the maximum piston protrusion height and select the appropriate gasket.

SKIRT STIFFENER



E138957

- | Item | Part Number | Description |
|------|-------------|-----------------|
| 1 | - | Cylinder block |
| 2 | - | Gaskets |
| 3 | - | Skirt stiffener |

- 4 - Bolt (3 off)
- 5 - Bolt (19 off)

The aluminum alloy skirt stiffener is fitted to the lower cylinder block to stiffen the base structure of the engine thus helping to reduce NVH (noise, vibration and harshness). The frame is made of high-pressure die cast aluminum and also incorporates an oil baffle plate to reduce oil foaming and splash.

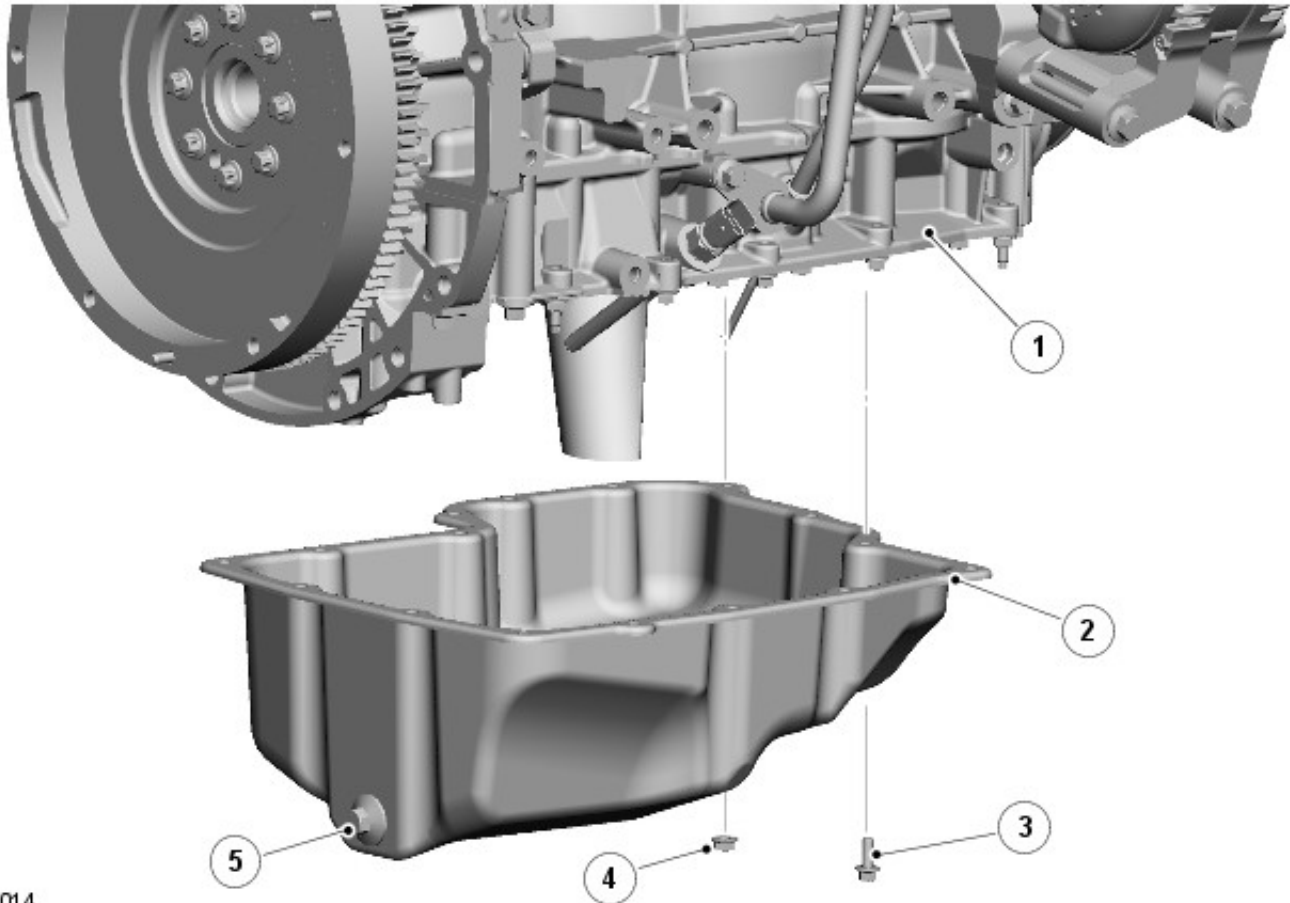
The alignment of the sides of the skirt stiffener with the cylinder block is set using a special tool. The rear face alignment is set using a suitable straight edge.

For additional information, refer to: [Engine](#) (303-01 Engine - ID4 2.2L Diesel, Assembly).

The skirt stiffener is secured to the cylinder block with 22 bolts.

Gaskets seal the joints between the skirt stiffener and the cylinder block.

OIL PAN



E139014

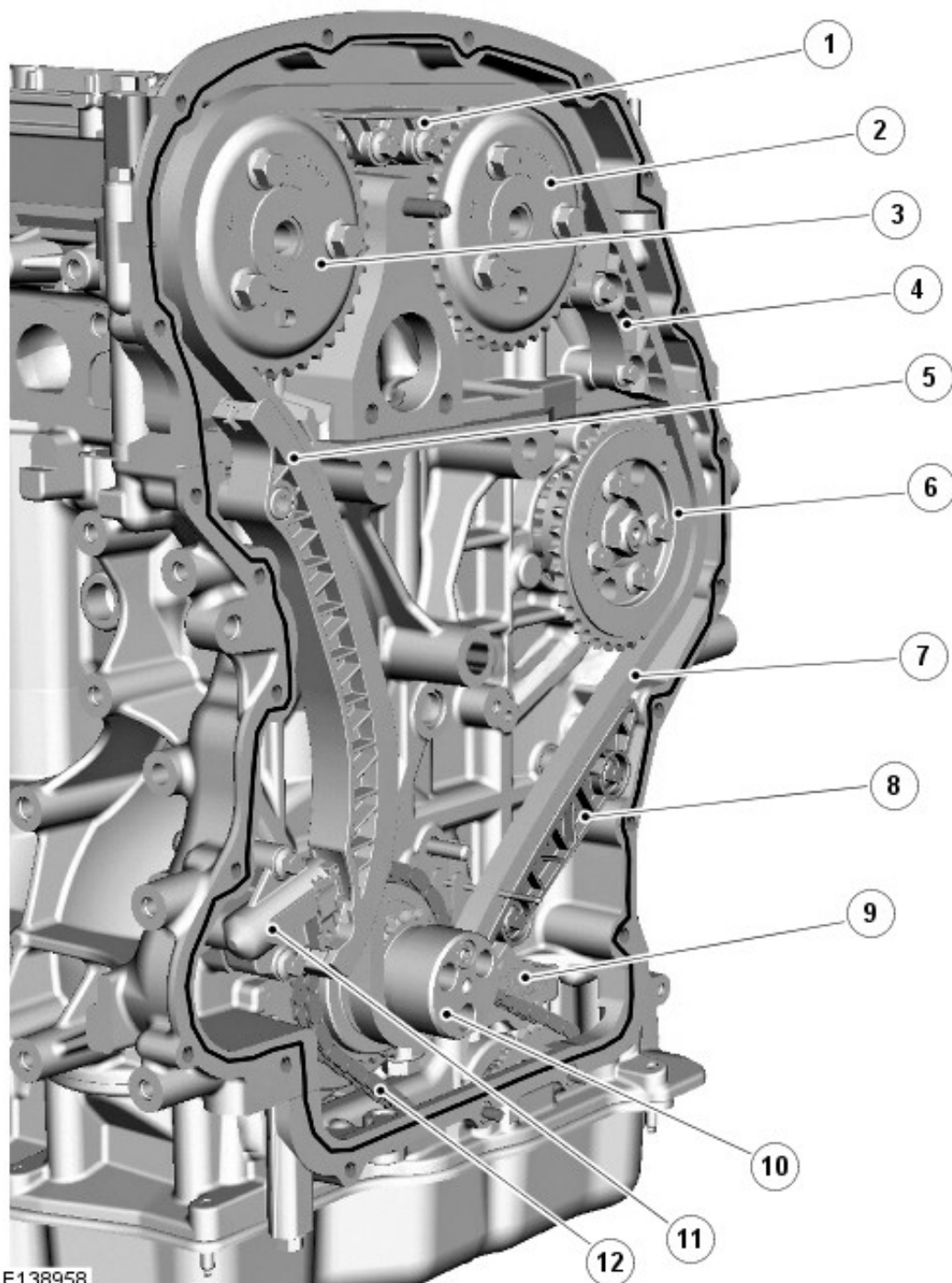
Item	Part Number	Description
1	-	Skirt stiffener
2	-	Oil pan
3	-	Bolt (11 off)
4	-	Nut (5 off)
5	-	Drain plug

The pressed steel oil pan is attached to the skirt stiffener with 11 bolts and 5 nuts. The engine oil drain plug is located in the rear face of the oil pan.

A bead of RTV (room temperature vulcanizing) sealant seals the joint between the oil pan and the skirt stiffener.

CAMSHAFT DRIVE

Drive Gear



E138958

Item	Part Number	Description
1	-	Chain guide
2	-	Inlet camshaft sprocket
3	-	Exhaust camshaft sprocket
4	-	Chain guide
5	-	Tensioner blade
6	-	High-pressure fuel pump sprocket
7	-	Primary drive chain
8	-	Lower chain guide
9	-	Secondary drive chain tensioner
10	-	Crankshaft sprocket
11	-	Hydraulic tensioner
12	-	Secondary drive chain

The primary drive chain transmits the drive from the crankshaft sprocket to the exhaust camshaft, the inlet camshaft and the high-pressure fuel pump. The secondary drive chain transmits drive from the crankshaft sprocket to the oil pump located on the underside of the skirt stiffener.

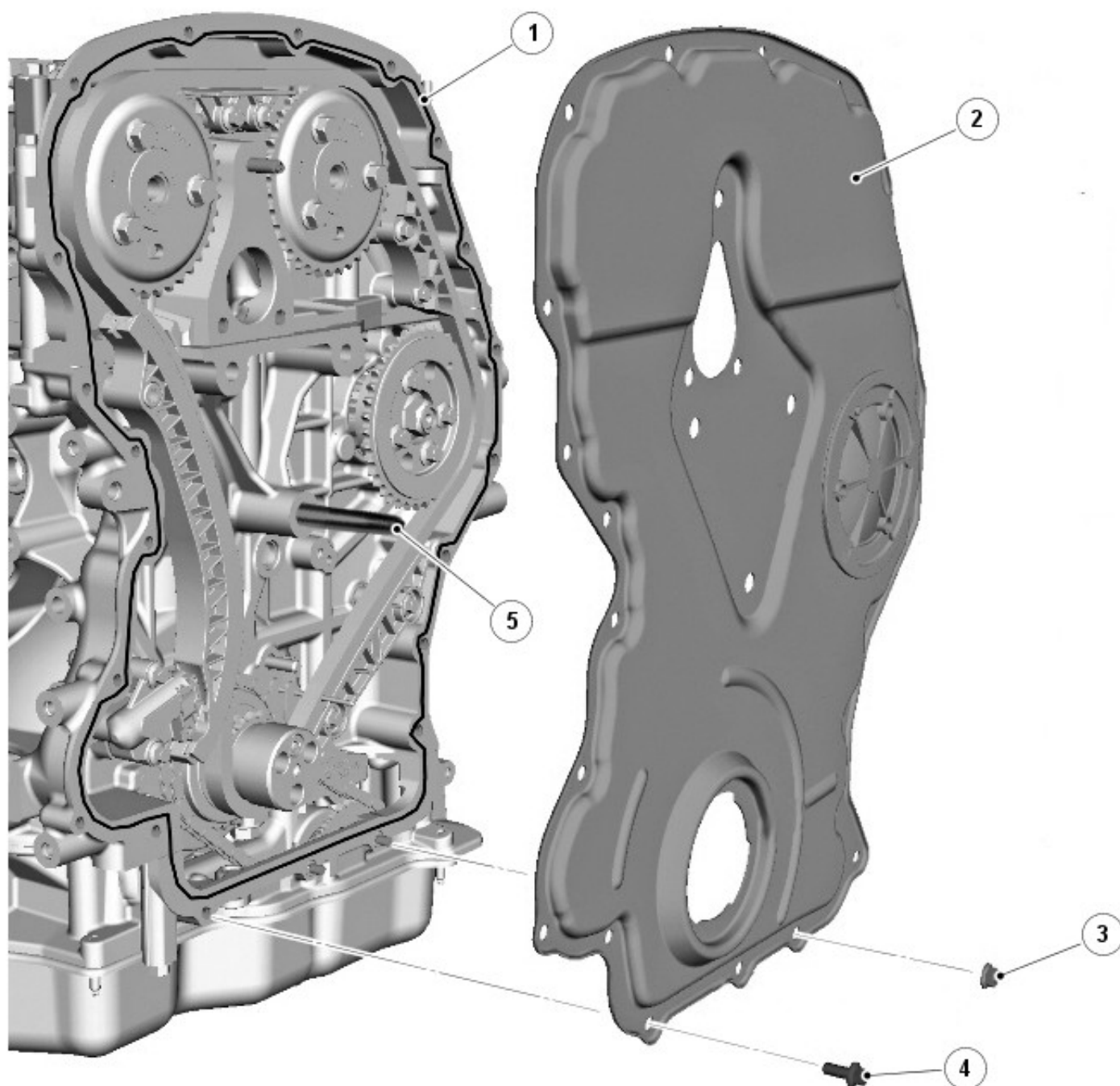
One bolt locates the crankshaft sprocket on the crankshaft, and three bolts are used to attach the engine crankshaft

pulley/ torsional vibration damper to the crankshaft via holes in the crankshaft sprocket. The inlet and exhaust camshaft sprockets are aligned on their respective camshafts using a spigot tool and a timing peg. Once they are in their correct position, three bolts are used to secure each camshaft sprocket to their camshaft.

The primary drive chain has an hydraulic tensioner, operated by engine oil, which acts on a pivoting flexible tensioner blade. Chain guides are installed on the drive side of the primary chain. The primary chain is lubricated via an oil squirt tube located centrally at the front of the engine block.

The secondary chain tensioner is spring operated and acts directly on the chain. The secondary chain is splash lubricated with oil from the skirt stiffener and oil pan assembly.

Front Cover



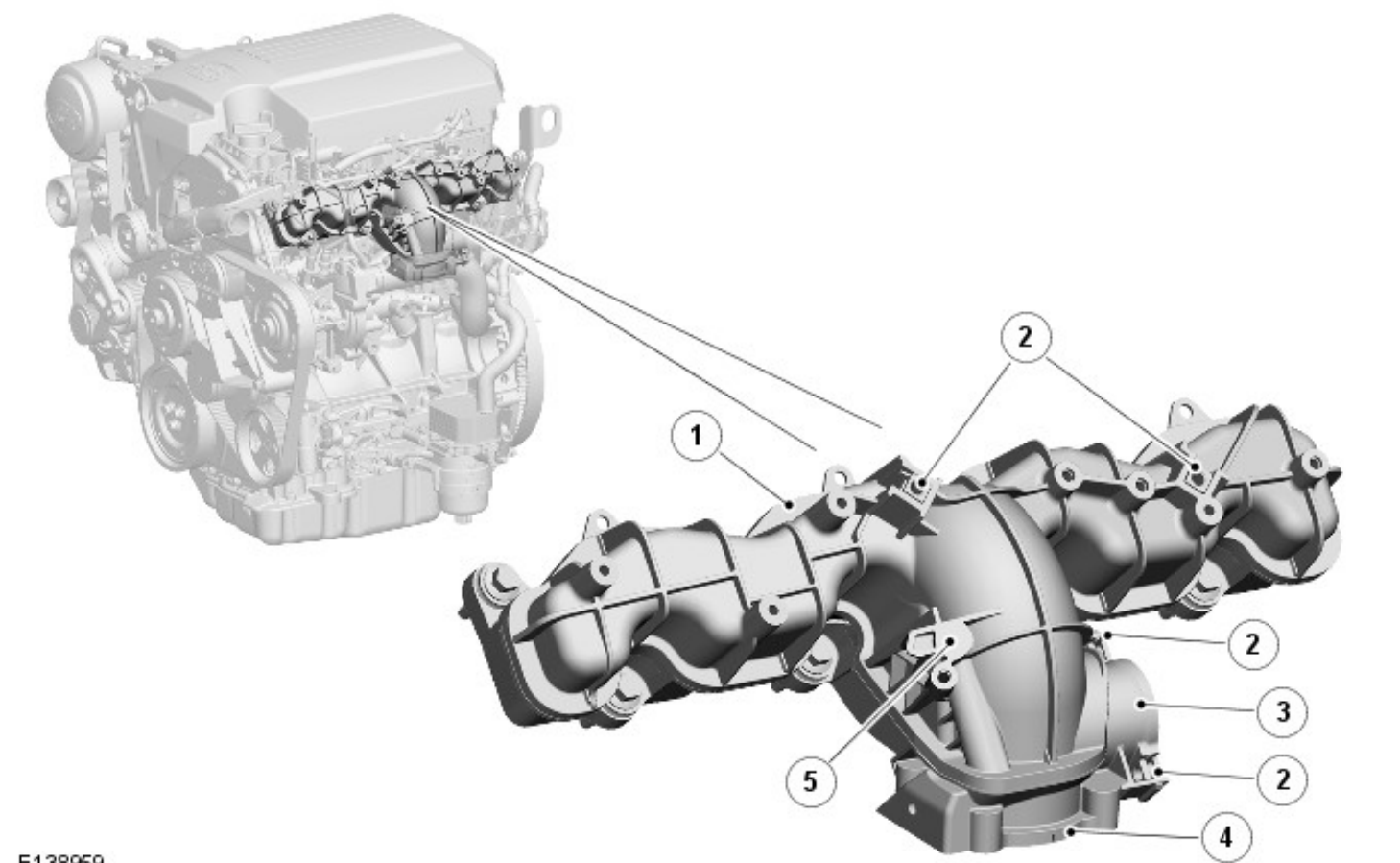
E139013

Item	Part Number	Description
1	-	Sealant bead
2	-	Front cover
3	-	Nut (2 off)
4	-	Bolt (20 off)
5	-	Guide pin

The pressed steel front cover is attached to the front of the cylinder block, the cylinder head and the skirt stiffener with 20 bolts and 2 nuts, and sealed with a bead of RTV silicon sealant.

When installing the front cover, a special locating tool is required, which fits in the crankshaft sprocket aperture, to aid the alignment of the front cover.

INTAKE MANIFOLD



E138959

Item	Part Number	Description
1	-	Intake manifold
2	-	Captive nut
3	-	EGR valve outlet tube mounting boss
4	-	Electronic throttle mounting flange
5	-	MAP (manifold absolute pressure) sensor mounting flange

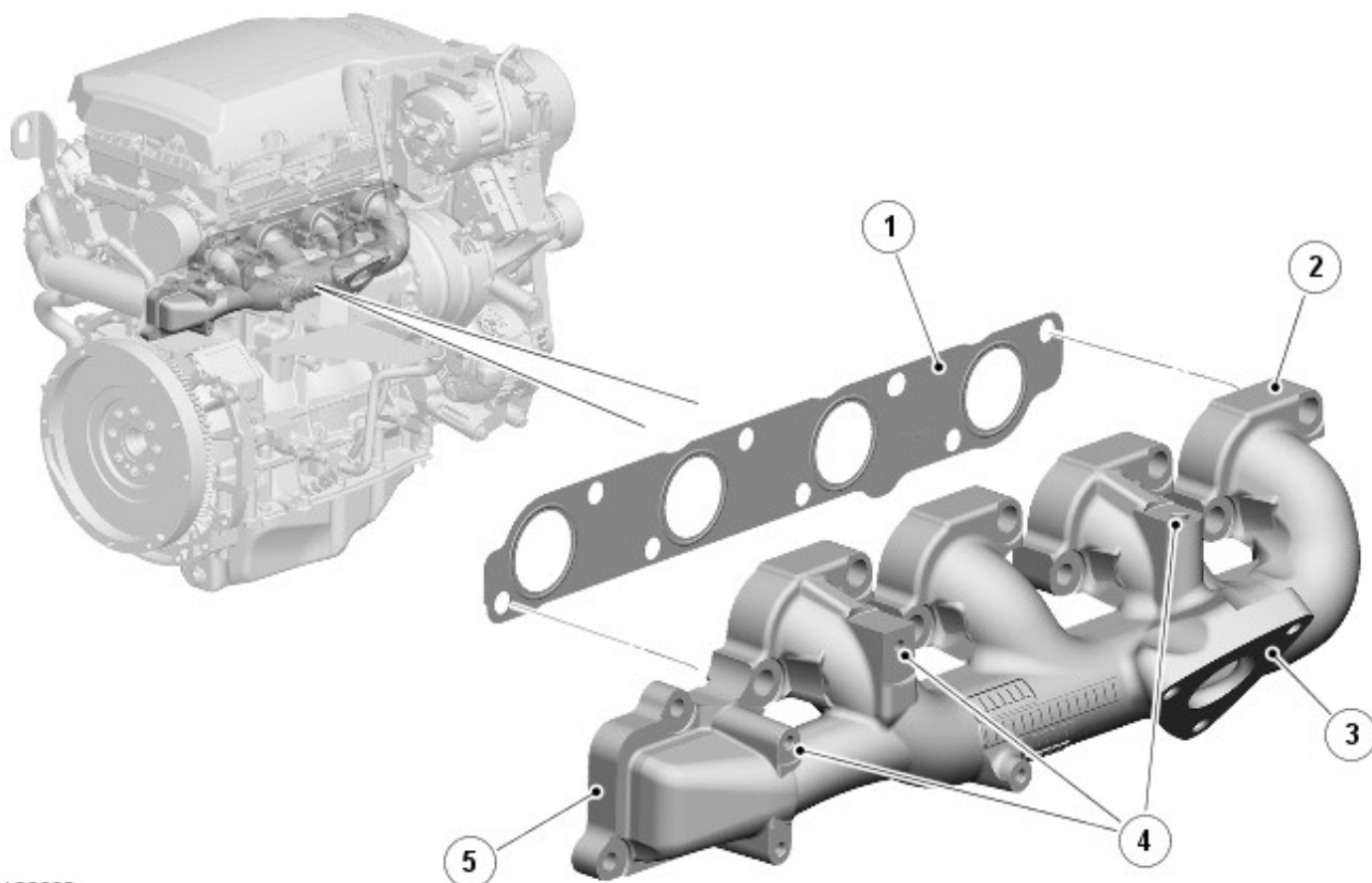
The plastic intake manifold is mounted on the [LH \(left-hand\)](#) side of the cylinder head using 9 bolts and isolator bushes. Rubber gaskets, integrated into the manifold, seal the joints between the manifold and the cylinder head.

Mounting flanges on the manifold provide for the attachment of the electronic throttle and the [MAP](#) sensor. For additional information, refer to: [Electronic Engine Controls](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Description and Operation).

A mounting boss on the manifold provides for the attachment of the [EGR](#) valve outlet tube. For additional information, refer to: [Engine Emission Control](#) (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation).

Captive nuts are installed in the manifold for the securing bolts of the [EGR](#) valve outlet tube and a fuel pipe bracket.

EXHAUST MANIFOLD



E138960

Item	Part Number	Description
1	-	Gasket
2	-	Exhaust manifold
3	-	Turbocharger mounting flange
4	-	Heat shield attachment points
5	-	EGR cooler mounting flange

The cast iron exhaust manifold is secured to the **RH (right-hand)** side of the cylinder head using 2 nuts and 6 bolts. A laminated metal gasket seals the manifold to the cylinder head.

A mounting flange towards the front of the manifold is provided for attachment of the turbocharger.

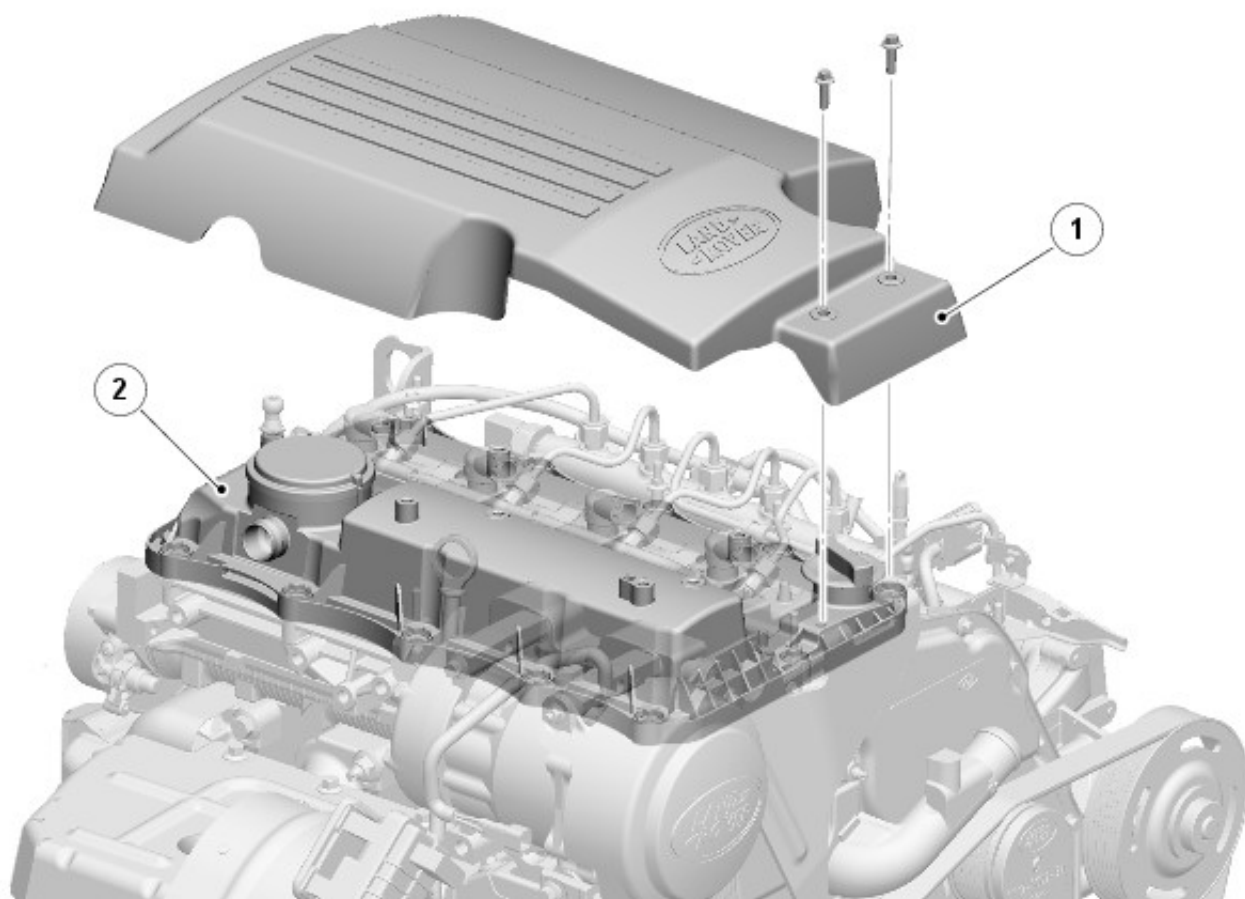
For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Description and Operation).

A second mounting flange, located on the rear of the manifold, is provided for attachment of the [EGR](#) cooler.

For additional information, refer to: [Engine Emission Control](#) (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation).

Tapped holes incorporated into bosses on the manifold provide attachment points for the exhaust heat shields.

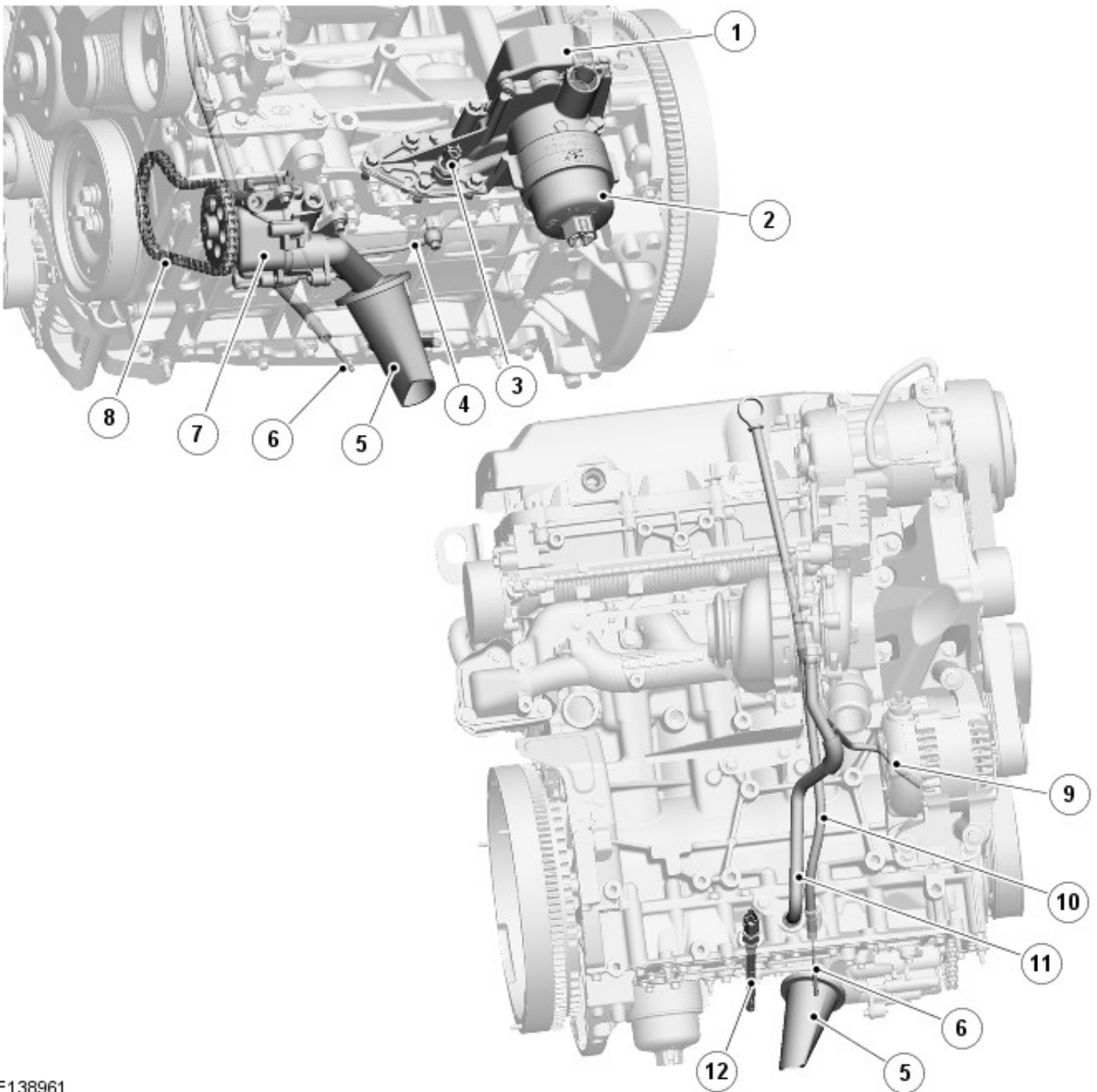
CAMSHAFT COVER AND ENGINE COVER



E138956

Item	Part Number	Description
1	-	Engine cover
2	-	Camshaft cover

LUBRICATION SYSTEM



E138961

Item	Part Number	Description
1	-	Oil cooler
2	-	Oil filter
3	-	Oil pressure switch
4	-	Feedback tube
5	-	Oil pick-up tube
6	-	Dipstick
7	-	Oil pump
8	-	Secondary drive chain
9	-	Turbocharger oil feed tube
10	-	Dipstick outer tube
11	-	Turbocharger oil drain tube
12	-	Oil temperature/low level sensor

The engine is lubricated by a forced feed oil circulation system. The main components of the system are:

- Oil pick-up
- Oil pump
- Oil filter and cooler assembly.

Oil Pick-up

The plastic oil pick-up is immersed in the oil reservoir to provide a supply to the oil pump at all normal vehicle attitudes. A mesh screen in the inlet prevents debris from entering the oil system.

Oil Pump

The oil pump is located on the [LH](#) front underside of the skirt stiffener and is secured by 4 bolts. The unit is a spur gear pump driven by the crankshaft sprocket via the secondary drive chain. An integral pressure relief valve diverts oil back to the inlet side of the pump to limit the pump outlet pressure.

Oil Filter and Cooler Assembly

The oil filter and cooler assembly is attached to the [LH](#) side of the skirt stiffener and consists of a full-flow, disposable canister-type filter and an oil cooler attached to a casting. The casting aligns with the oil galleries in the skirt stiffener and is sealed by a gasket.

The engine cooling system cools the oil in the oil cooler and is regulated by means of a separate thermostat, which prevents the flow of coolant through the oil cooler when the engine is cold, ensuring the engine oil warms up quickly. The thermostat opens at 75 ± 2 °C (167 ± 35 °F).

Oil to and from the oil cooler passes through galleries in the skirt stiffener. Hoses from the engine cooling system are connected to 2 pipes on the oil cooler for the supply and return of coolant.

An oil pressure switch is located in the casting to sense the pressure of the oil as it leaves the oil filter and cooler assembly. A warning lamp in the instrument cluster illuminates if low oil pressure is detected.

For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

Lubrication System Operation

Oil is drawn through the oil pick-up into the oil pump, then supplied to the oil filter and cooler assembly through the oil galleries in the skirt stiffener. After passing through the filter, a proportion of the oil (controlled by a restrictor in the oil filter housing) passes through the oil cooler. The return flow from the oil cooler combines with the remainder of the oil from the filter, then passes through the skirt stiffener into the cylinder block main oil gallery.

The main oil gallery has drillings that direct the oil to the cylinder head and the main bearings. Cross drillings in the crankshaft main bearings carry the oil to the connecting rod big-end bearings. Oil galleries in the cylinder head carry the oil to the camshafts and the hydraulic lash adjusters.

Oil at reduced pressure is directed towards the cylinder head via a restrictor in the cylinder block/cylinder head locating dowel. Oil then passes through a drilling in the cylinder head to the camshaft carrier, where it is directed via separate galleries to the camshaft bearings and hydraulic tappet housings. Return oil from the cylinder head drains into the sump via the cylinder head bolt passages.

Engine - ID4 2.2L Diesel - Engine

Diagnosis and Testing

Overview

As diagnosis of the different areas of the engine is covered in other sections and by general procedures, this section is limited to an oil pressure test.

For specific areas of the engine, refer to the general procedures in this section and the relevant section of the manual.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Engine oil level • Coolant level • Transmission fluid level • Fuel level • Coolant leaks • Oil leaks • Fuel leaks • Visibly damaged or worn parts • Loose or missing nuts or bolts • Fuel contamination/grade/quality • Sensor fitment/condition • Viscous fan and solenoid • Routing of pipework etc. to avoid vibrations • Contact anywhere between the driveline and chassis 	<ul style="list-style-type: none"> • Fuses • Wiring harness • Electrical connector(s) • Injectors • Glow plugs • 5 volt sensor supply • Sensor(s) • Viscous fan solenoid • Engine control module (ECM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.

Oil Pressure Check

NOTE: Prior to checking the engine oil pressure, a road test of 6 miles (10 kilometres), must be carried out. Do not attempt to attain engine normal operating temperature by allowing the engine to idle.

1. WARNINGS:



The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding. Failure to follow this instruction may result in personal injury.

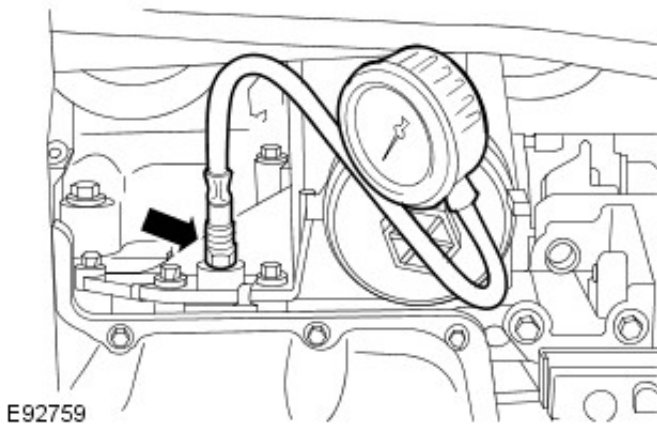


Wear protective gloves.

Remove the oil pressure sensor.

REFER to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Removal and Installation).

2. Install the oil pressure gauge and the oil pressure gauge connector.




3. Check and top-up the engine oil, if required.
4. Start and run the engine.
5. Note the oil pressure readings with the engine running at idle and at 2,000 rpm.
REFER to: [Specifications](#) (303-01 Engine - ID4 2.2L Diesel, Specifications).
6. Turn off the engine.
7. Remove the special tools.
8. Install the oil pressure sensor.
REFER to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Removal and Installation).
9. Check and top-up the engine oil, if required.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

Engine - ID4 2.2L Diesel - Engine Oil Draining and Filling

General Procedures

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

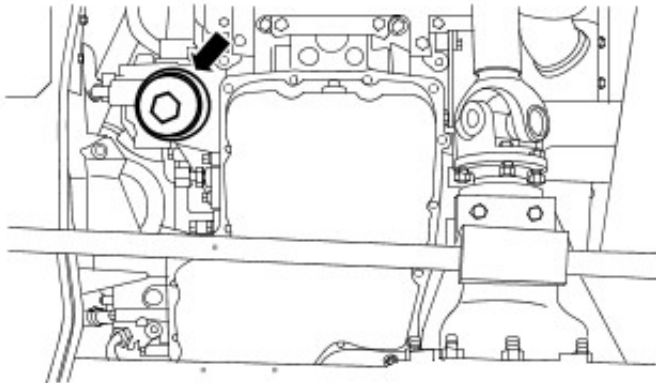
Raise and support the vehicle.

For additional information, refer to: Lifting (100-02, Description and Operation).

2. Loosen the oil filter cover 3 turns and allow the engine oil to drain.

3. **NOTE:** Position cloth to collect fluid spillage.

Remove the oil filter cover and oil filter element.



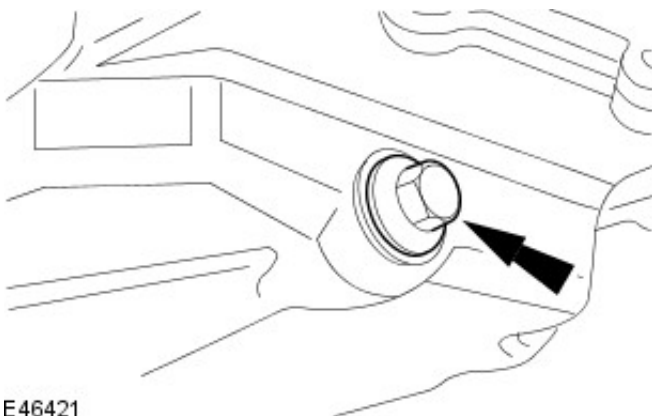
E90315

4. Remove and discard the oil filter element.
 - Remove and discard the oil filter cover O-ring seal.



E90316

5. Drain the engine oil.
 - Position a container to collect the engine oil.
 - Remove and discard the drain plug.
 - Allow the engine oil to drain.



E46421

6. Install a new drain plug.
 - Clean the component mating faces.
 - Tighten the drain plug to 23 Nm (17 lb.ft).
 - Remove the container.
7. Install a new oil filter cover O-ring seal.
 - Clean the components.
 - Lubricate the O-ring seal with clean engine oil.


8. Install a new oil filter element to the oil filter cover.
9. Install the oil filter cover and oil filter element.
 - Tighten the oil filter cover to 35 Nm (26 lb.ft).
10. Fill the engine with the recommended oil to the correct level.
11. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).
12. Check and top-up the engine oil.

Content not found

Engine - ID4 2.2L Diesel - Crankshaft Pulley

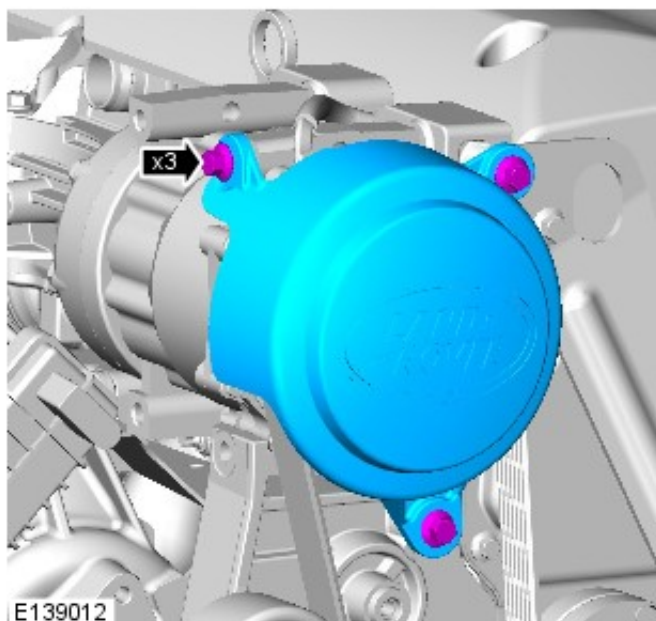
Removal and Installation

Special Tool(s)

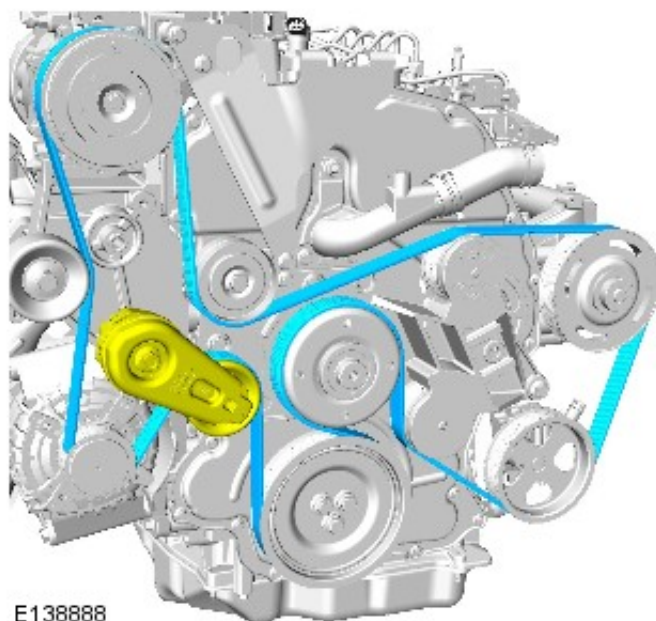
 E87614	Aligner, Engine Front Cover 303-1310
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Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).
3. Torque: 10Nm

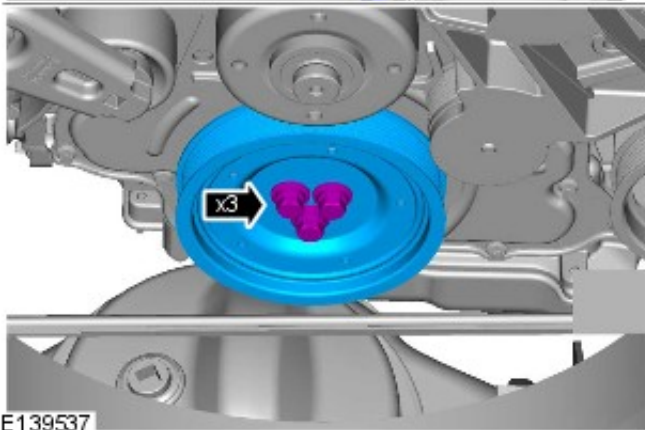
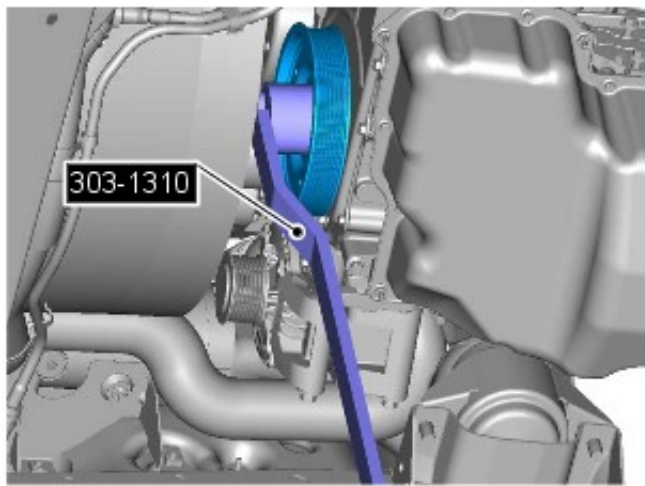


4.



5. NOTE: Apply the foot and hand brake, select 1st gear to prevent crankshft rotation.

Torque:



E139537

1. Stage : Run down 3 bolts to 20Nm
2. Stage : Run down 3 bolts to 45Nm
3. Stage : Run down 3 bolts to 90Nm
4. Stage : Turn on all 45degrees
5. Stage : Turn on all 45degrees


Installation

1. To install, reverse to removal procedure.


Engine - ID4 2.2L Diesel - Crankshaft Front Seal

Removal and Installation

Special Tool(s)


	Remover/Installer, Front Oil Seal 303-679
--	--

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

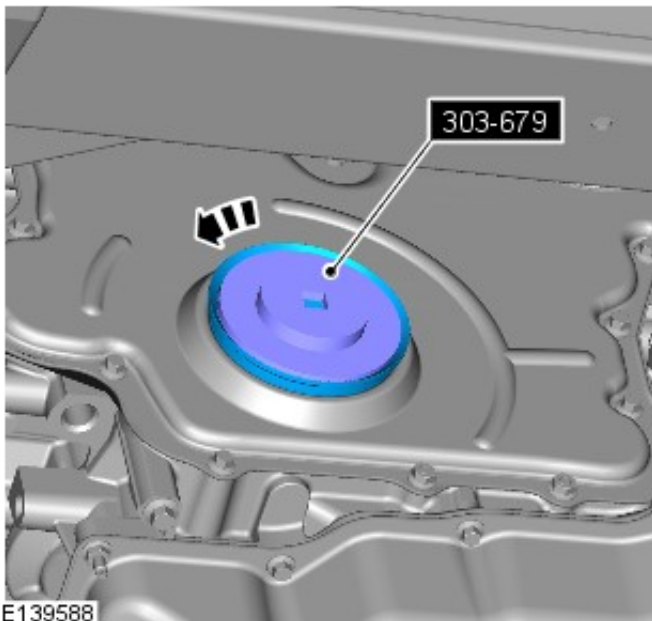
Raise and support the vehicle.

2. For additional information, refer to: [Crankshaft Pulley](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).

3.  **CAUTION:** Make sure the mating faces are clean, before the sealant is applied.

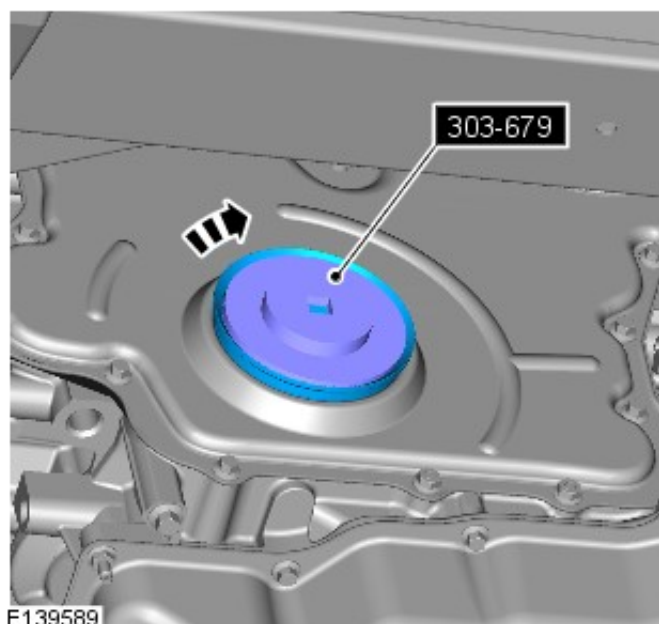
NOTE: A new crankshaft front oil seal is supplied with an alignment sleeve that will be pushed out during installation.

Tool: 303-679 (Remover/Installer, Front Oil Seal)



Installation

1. Tool: 303-679 (Remover/Installer, Front Oil Seal)




2. To install, reverse to removal procedure.

Engine - ID4 2.2L Diesel - Crankshaft Rear Seal

Removal and Installation

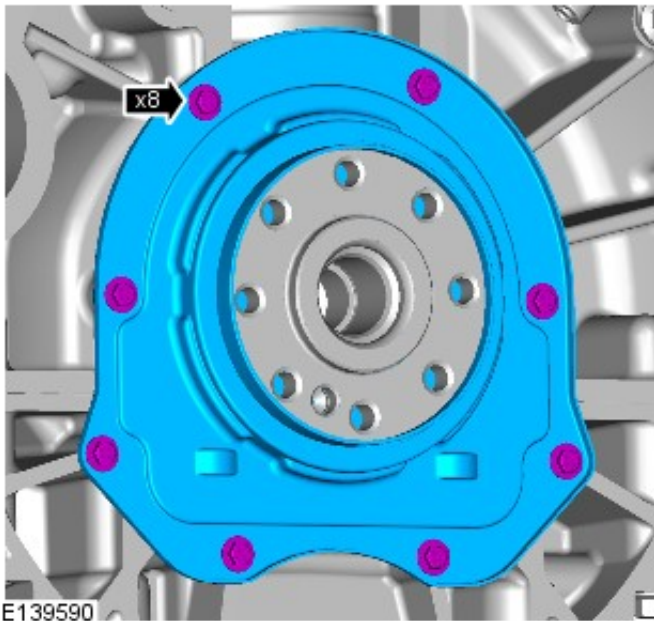
Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Flywheel](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4.



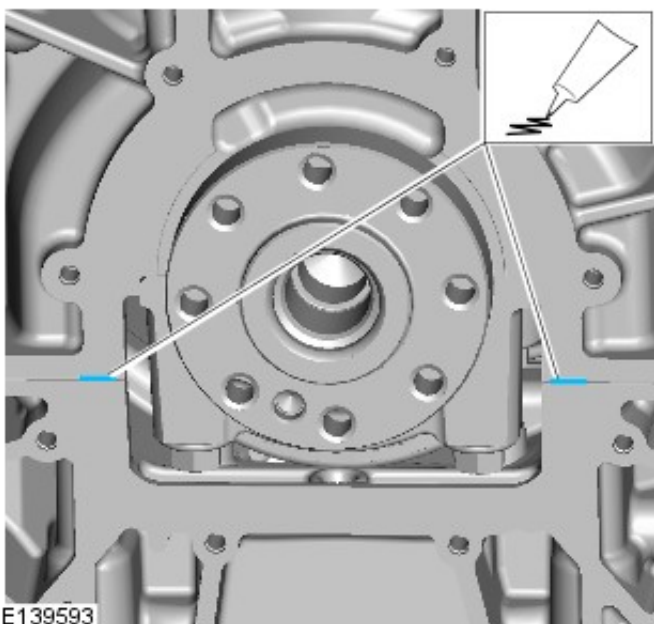
Installation

1. **NOTE:** Clean the component mating faces.

Check the 2 foam pads are located on the ladder frame gasket.

If the ladder frame gasket tabs are present, trim using a suitable tool flush to the engine block and ladder frame.

Apply a thin layer of sealant to the areas shown.



2. **CAUTIONS:**



A new crankshaft rear seal is supplied with an alignment sleeve that must not be removed until the crankshaft rear seal is fully installed. Failure to follow this instruction may result in damage to the vehicle.



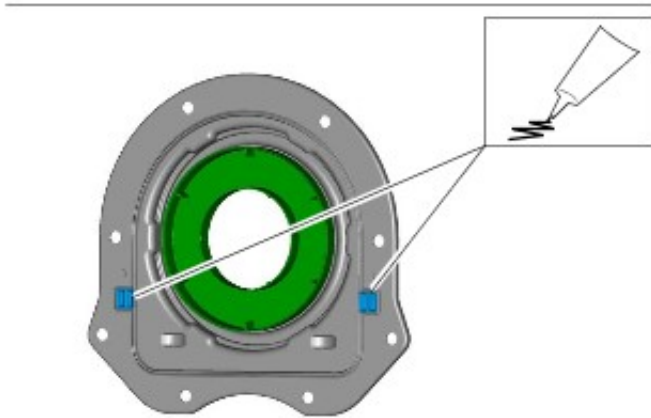
Install the new crankshaft rear seal within five minutes of applying the recommended sealant.



Do not add the sealant anywhere other than the area shown.

Using the recommended sealant completely fill the square areas shown.

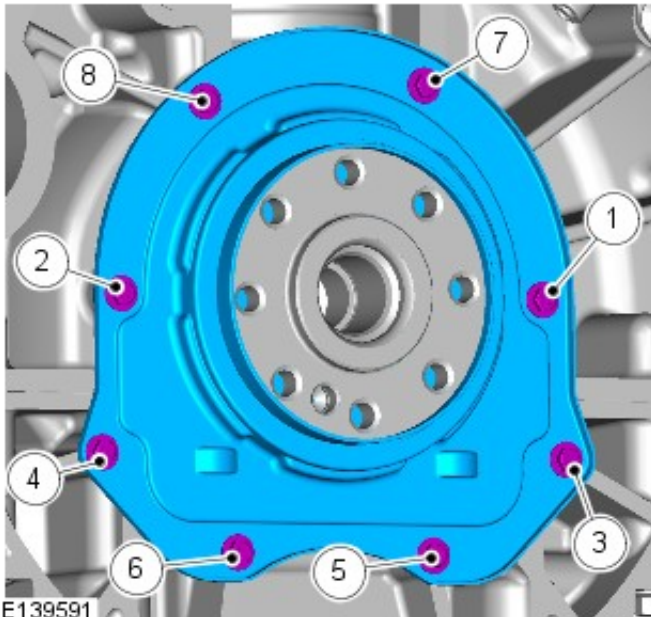
For additional information, refer to: [Specifications](#) (303-01 Engine - ID4 2.2L Diesel, Specifications).



E139592

3. Torque:

1. Stage : Hand start all bolts and tighten to 5Nm
2. Stage : Tighten the bolts to 9.5Nm in below sequence
3. Stage: Repeat to 9.5 Nm below sequence



E139591


4. Remove and discard the seal alignment sleeve.

5. To install, reverse the removal procedure.

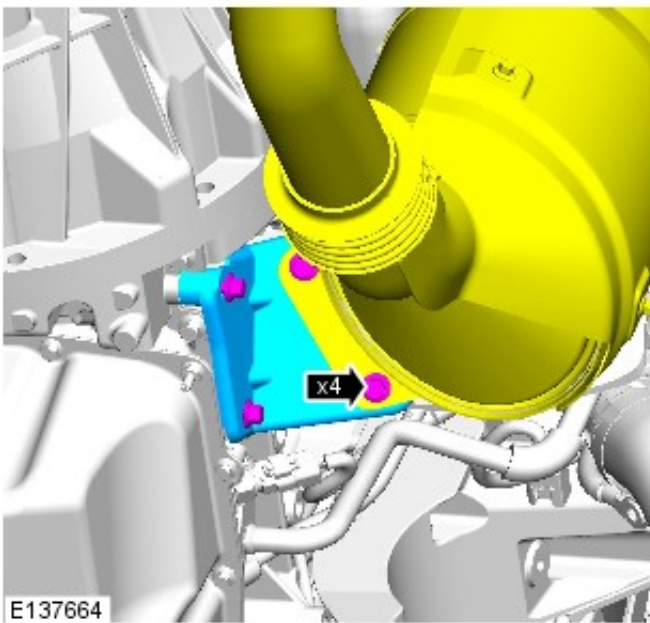
Engine - ID4 2.2L Diesel - Cylinder Head

Removal and Installation

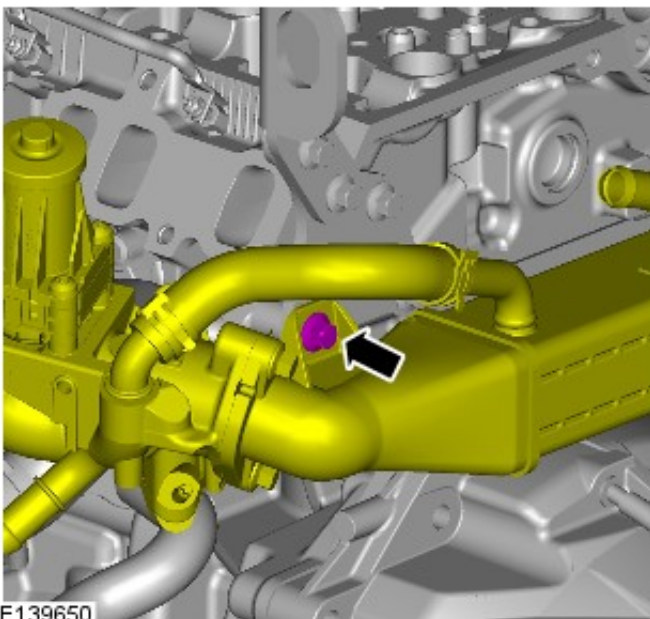
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.
Raise and support the vehicle.
2. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
3. For additional information, refer to: [Camshafts](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).
4. For additional information, refer to: [Intake Manifold](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).

5. Torque: 30Nm

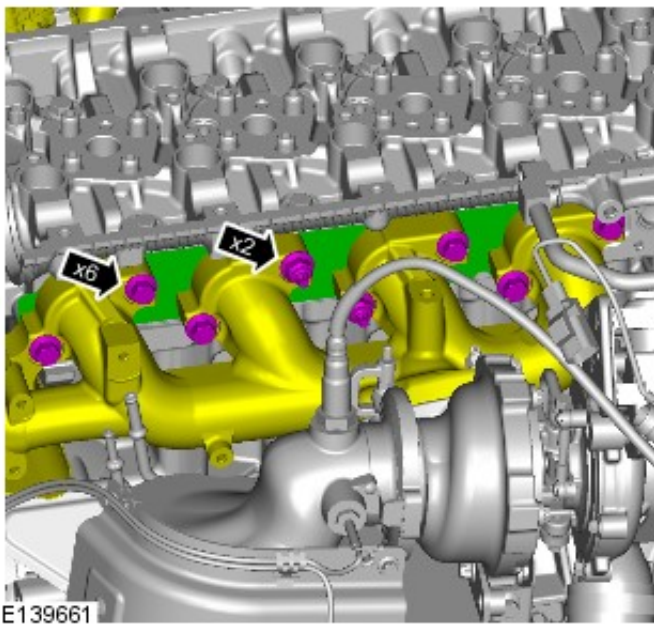


6. Torque: 25Nm

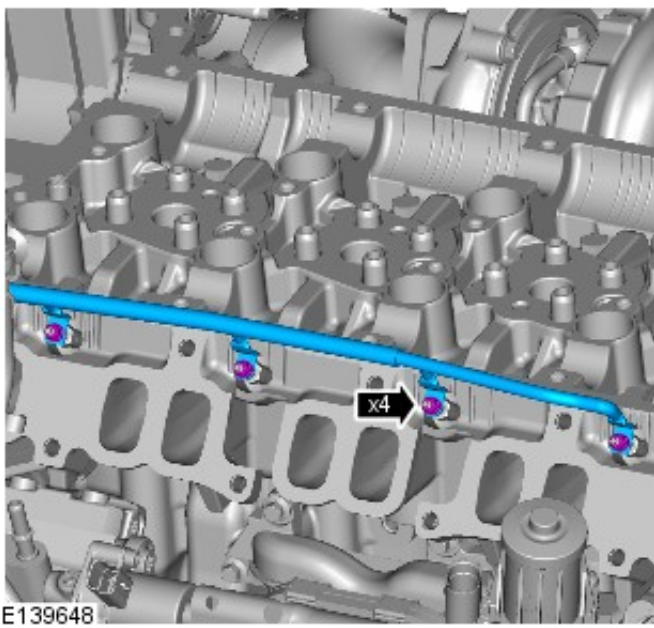


7.
 1. Stage 1: Tighten the M10 bolts and nuts to 15 Nm (11 lb.ft).

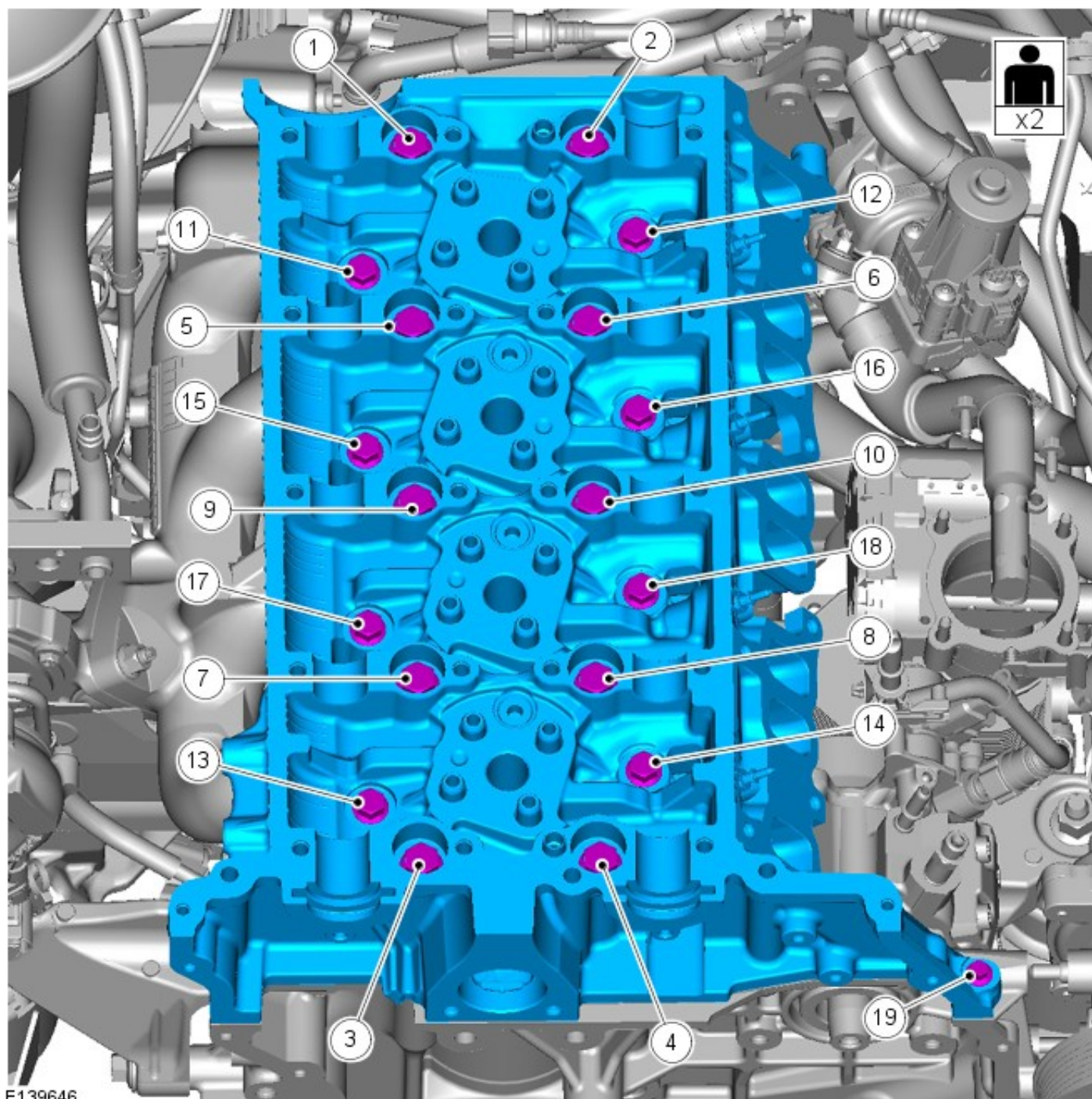
2. Stage 2: Tighten the M10 bolts and nuts to 35 Nm (26 lb.ft).



8. Torque: 3Nm



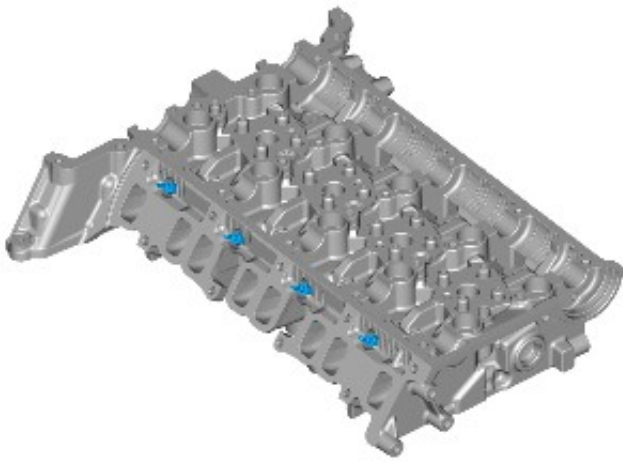
- 9.



E139646

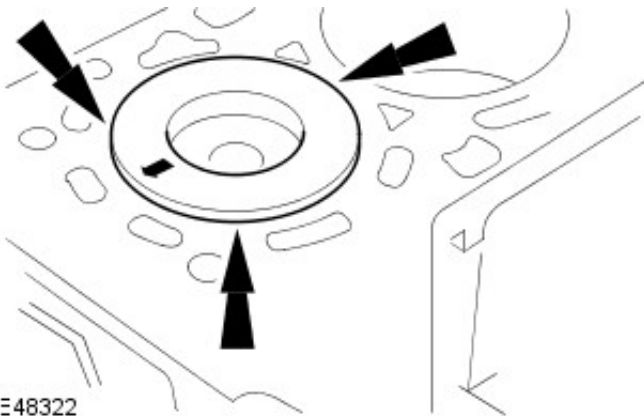
10. NOTE: Do not disassemble further if the component is removed for access only.

Torque: 13Nm




E139649

Installation



E48322

1.  **CAUTION:** Make sure that the mating faces are clean and free from foreign material.


NOTE: Measure the piston protrusion of each cylinder at top dead center (TDC).

Measure the distance between the piston crown and the cylinder block at the points indicated.

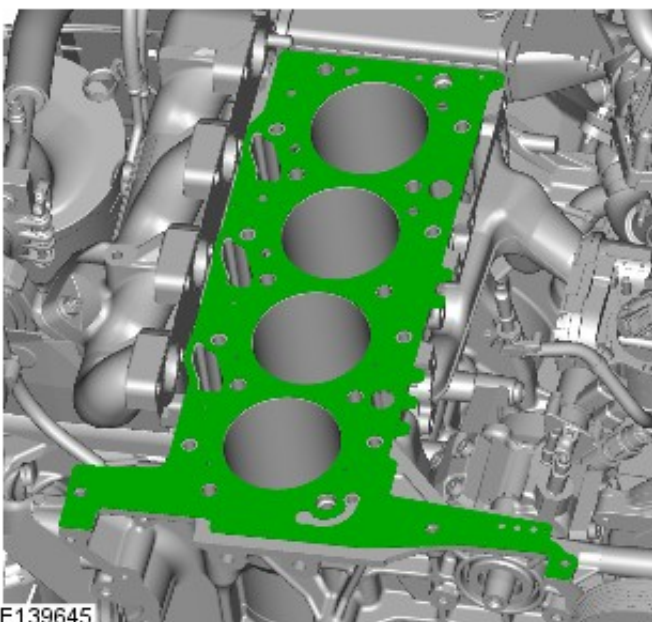
2. Determine the cylinder head gasket thickness.
For additional information, refer to: [Specifications](#) (303-01 Engine - ID4 2.2L Diesel, Specifications).

3. **CAUTIONS:**


 The thickness of the new cylinder head gasket depends on the piston protrusion (hole/tooth marked).

 Make sure that the mating faces are clean and free from foreign material.

Fit new cylinder head gasket, dry, to cylinder block.



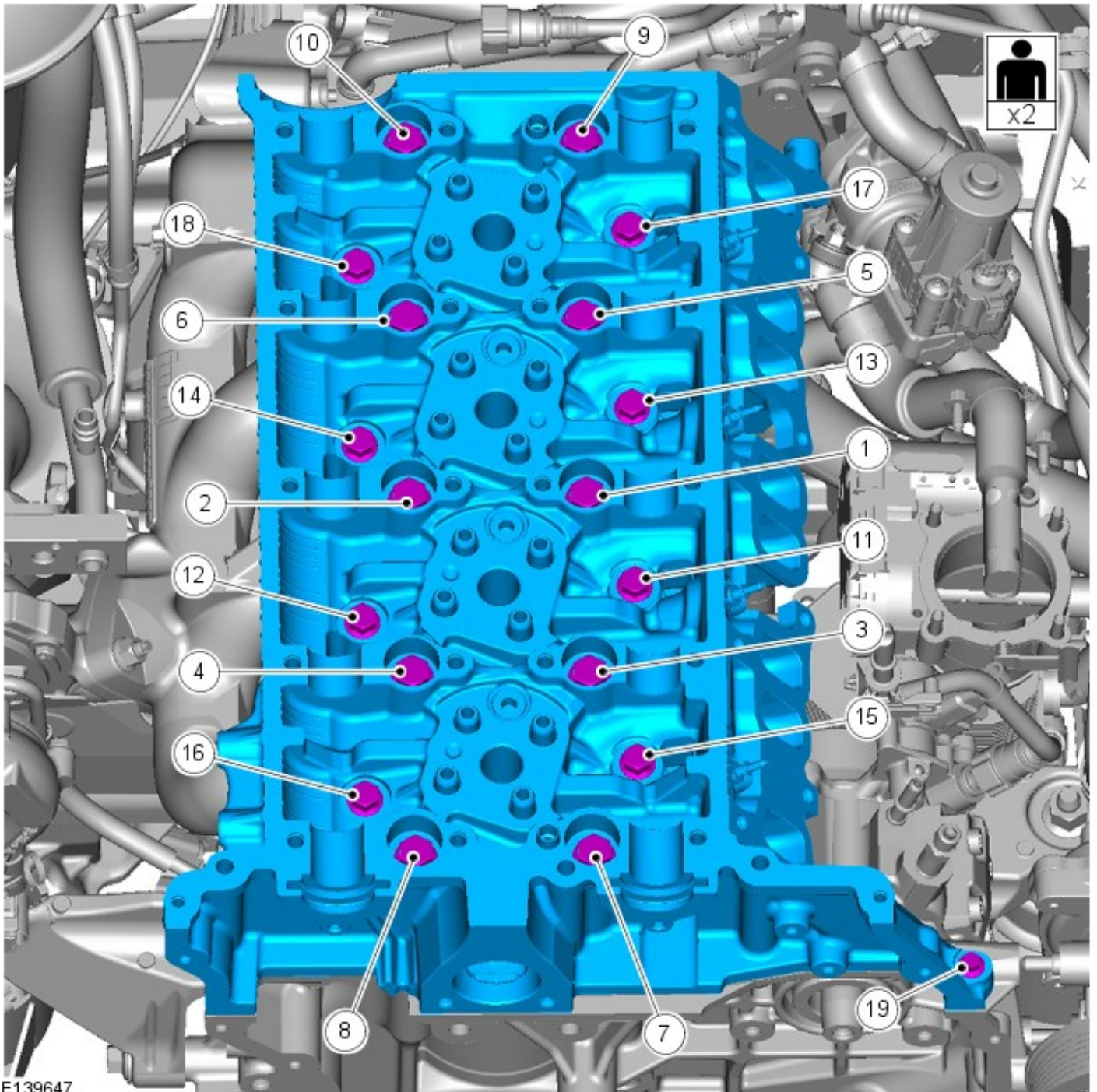
E139645

4.  **CAUTION:** Make sure that the mating faces are clean and free from foreign material.

NOTE: New bolts must be installed.

With assistance, install the cylinder head.

1. Stage 1: Tighten bolts 1 through 10 to 10Nm.
2. Stage 2: Tighten bolts 11 through 18 to 5Nm.
3. Stage 3: Tighten bolts 1 through 10 to 20Nm.
4. Stage 4: Tighten bolts 11 through 18 to 10Nm.
5. Stage 5: Tighten bolts 1 through 10 to 35Nm.
6. Stage 6: Tighten bolts 11 through 18 to 20Nm.
7. Stage 7: Tighten bolts 1 through 10 to 45Nm.
8. Stage 8: Tighten bolts 11 through 18 to 26Nm.
9. Stage 9: Tighten bolts 1 through 10 to 90 degrees.
10. Stage 10: Tighten bolts 11 through 18 to 90 degrees.
11. Stage 11: Tighten the M6 bolt to 10Nm (7 lb.ft).



E139647

5. To install, reverse to removal procedure.

Engine - ID4 2.2L Diesel - Engine Mount LH

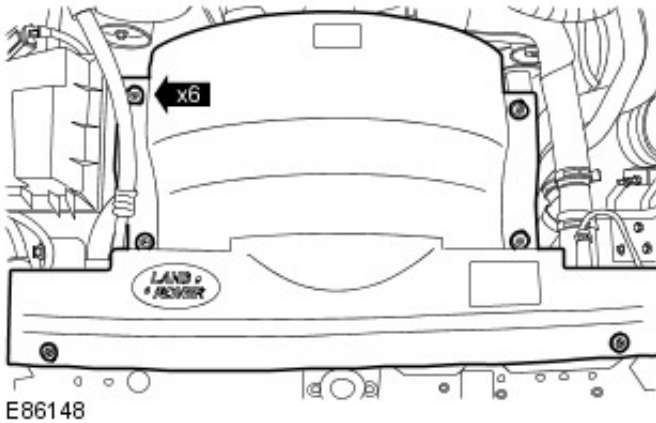
Removal and Installation

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

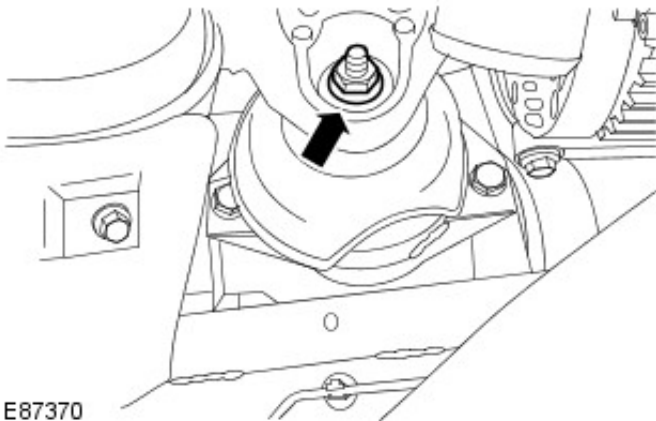
1. Disconnect the battery ground cable. For additional information, refer to:
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

2. 3. Remove the cooling fan upper shroud.

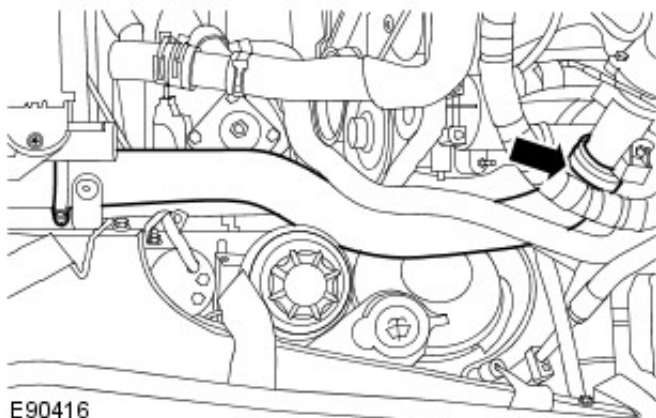


3. Remove the air cleaner outlet pipe. For additional information, refer to:
For additional information, refer to: [Air Cleaner Outlet Pipe](#) (303-12 Intake Air Distribution and Filtering - ID4 2.2L Diesel, Removal and Installation).

4. Remove the RH engine mount nut.

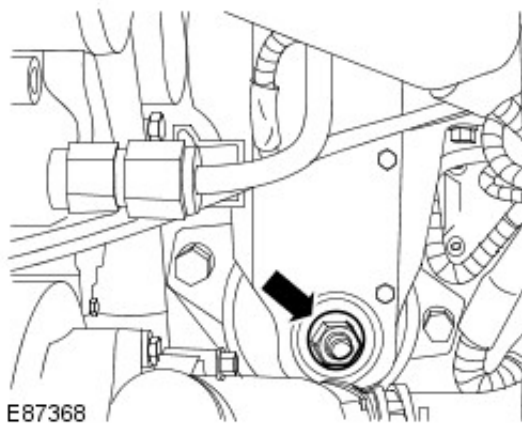


5. Disconnect the charher air cooler outlet hose.

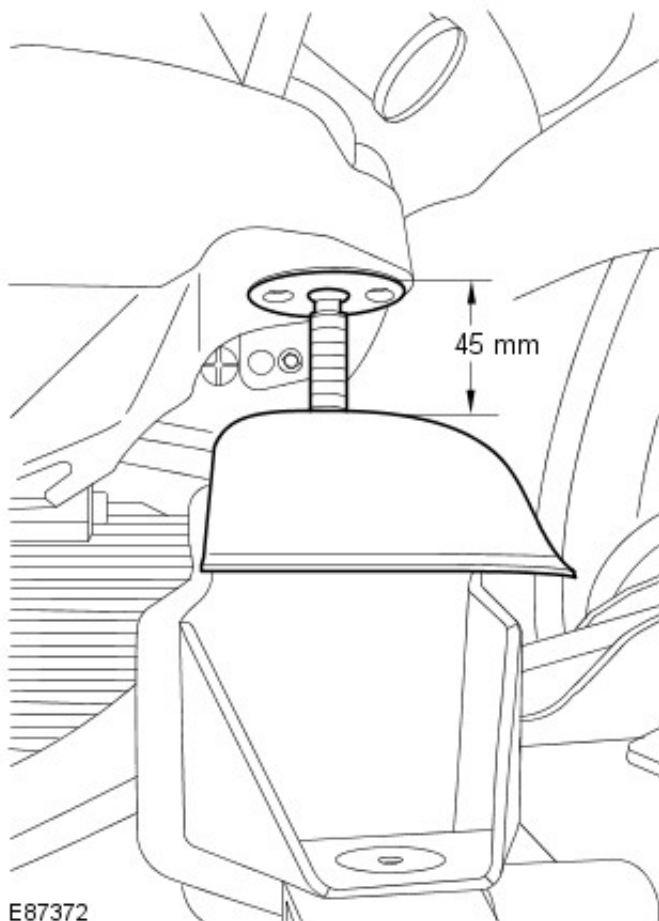


6. Remove the RH engine mount nut.

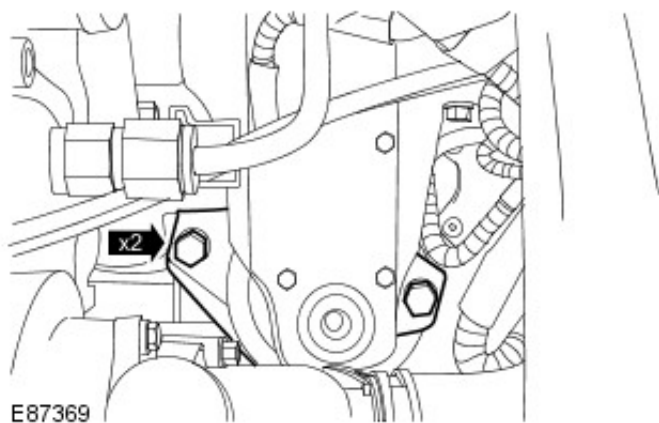
or Remove the RH engine mount nut.



7. Using a suitable hydraulic jack, raise the engine to a maximum of 45 mm (1.77 inches).

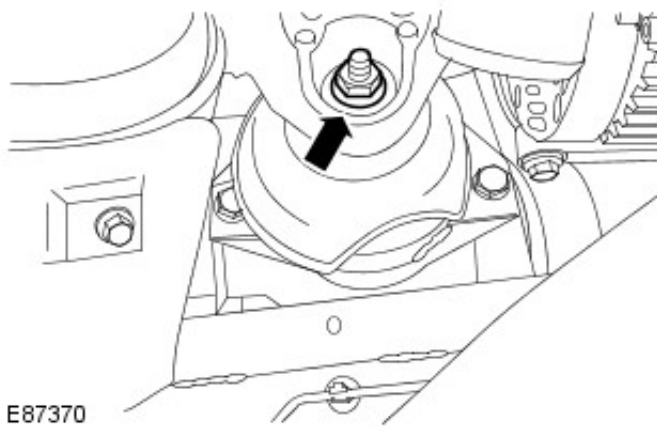
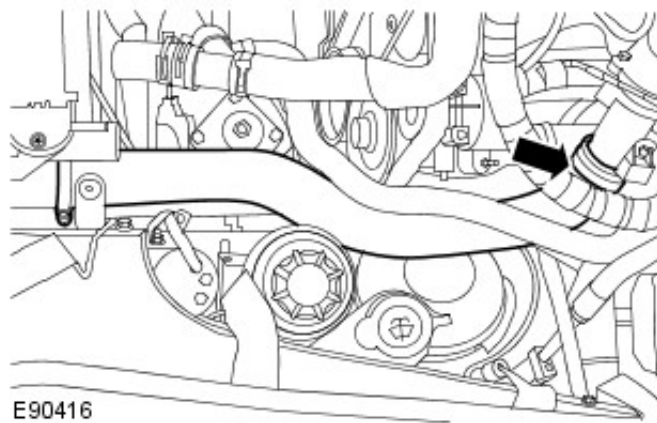
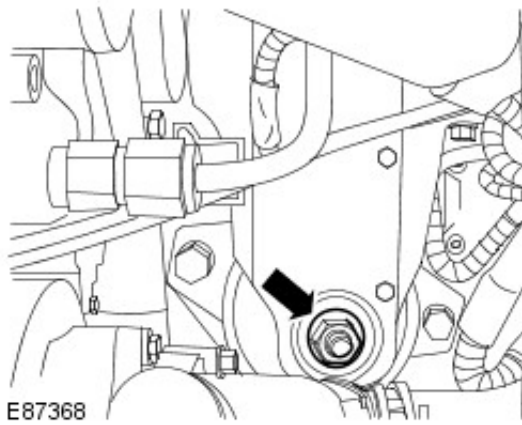
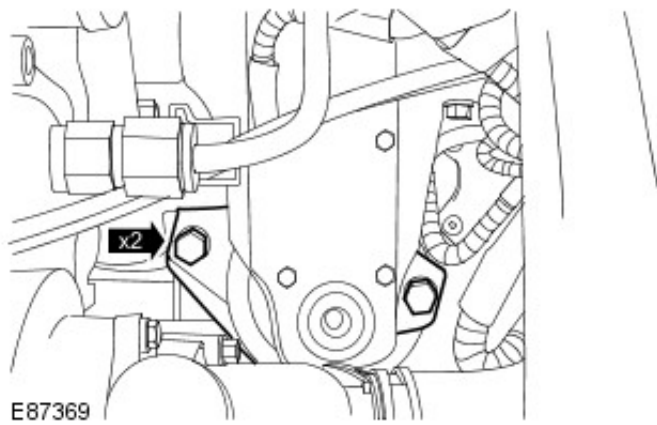


8. Remove the LH engine mount.



Installation

1. To install, reverse the removal procedure.
2. Tighten to 80 Nm (59 lb.ft).



2. Tighten to 80 Nm (59 lb.ft).

3. Tighten to 80 Nm (59 lb.ft).

4. Tighten to 3 Nm (2 lb.ft).

5. Tighten to 80 Nm (59 lb.ft).

Engine - ID4 2.2L Diesel - Engine Mount RH

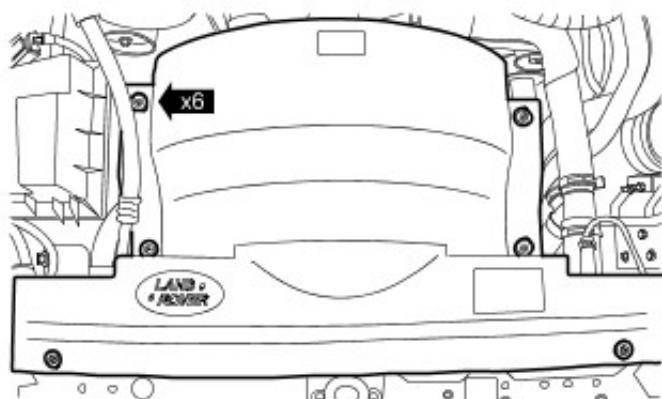
Removal and Installation

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

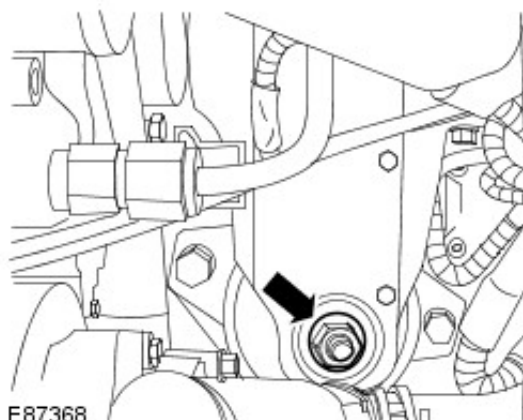
1. Disconnect the battery ground cable. For additional information, refer to:
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

2. 3. Remove the cooling fan upper shroud.



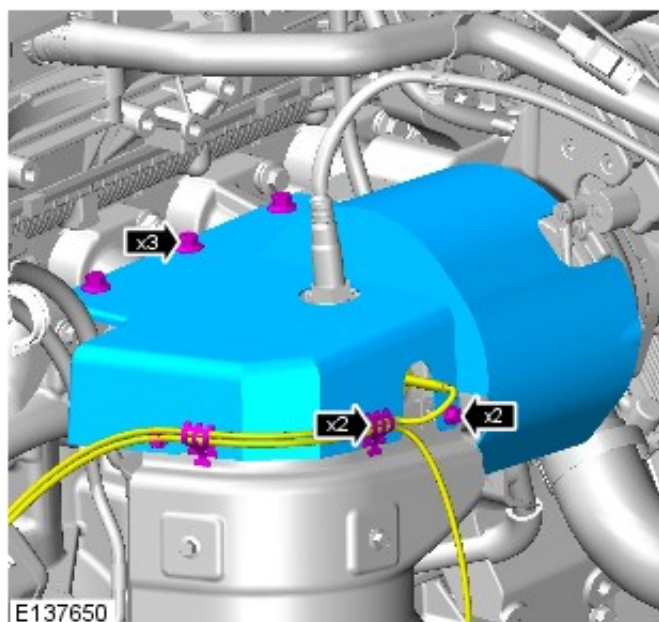
E86148

3. Remove the LH engine mount nut.



E87368

4. Remove the turbocharger heat shield.



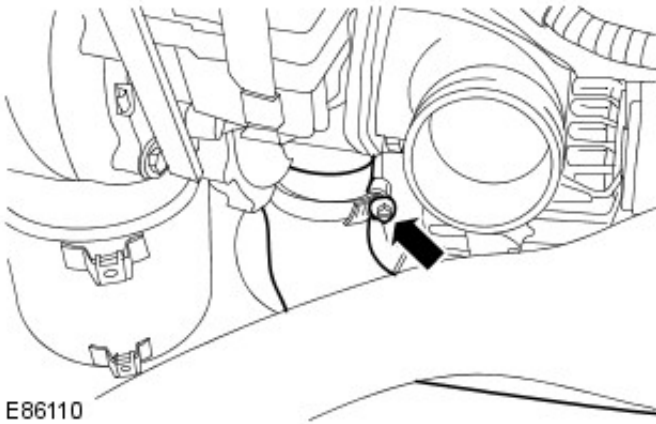
E137650

5. Remove the air cleaner outlet pipe. For additional information, refer

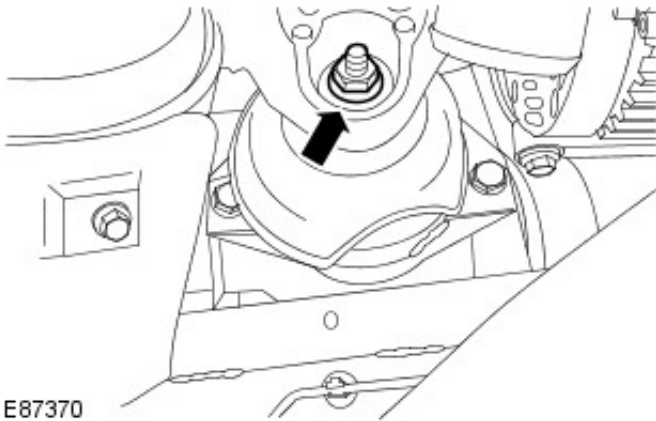
5. Remove the air cleaner outlet pipe. For additional information, refer to:

For additional information, refer to: [Air Cleaner Outlet Pipe](#) (303-12 Intake Air Distribution and Filtering - ID4 2.2L Diesel, Removal and Installation).

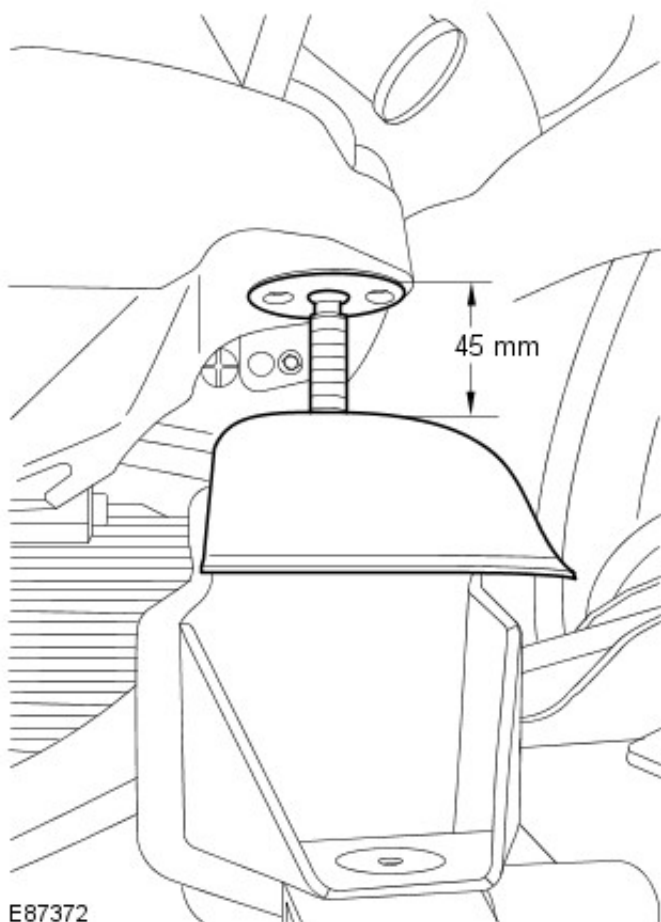
6. Disconnect the charger air cooler inlet hose.



7. Remove the RH engine mount nut.

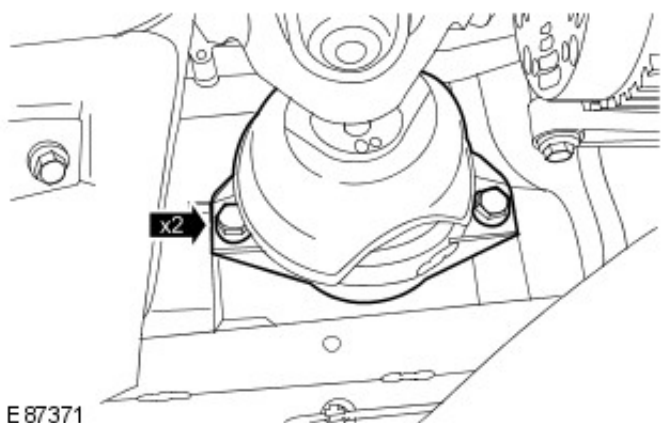


8. Using a suitable hydraulic jack, raise the engine to a maximum of 45 mm (1.77 inches).



E87372

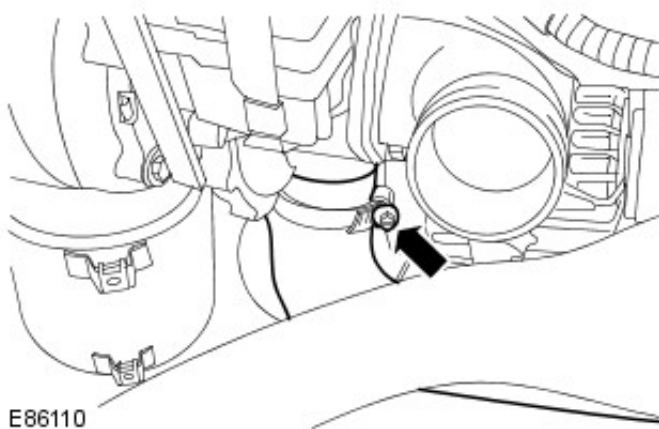
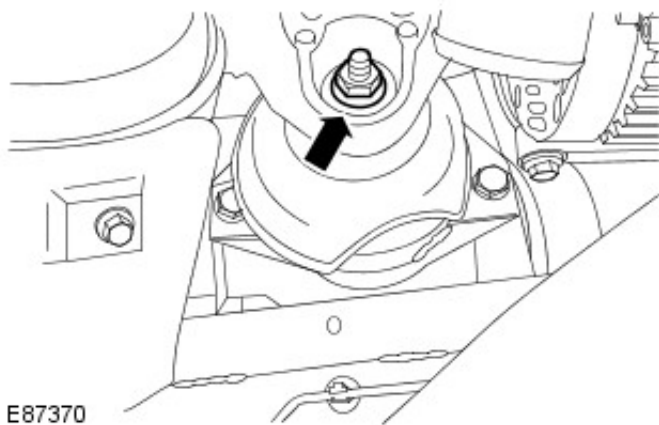
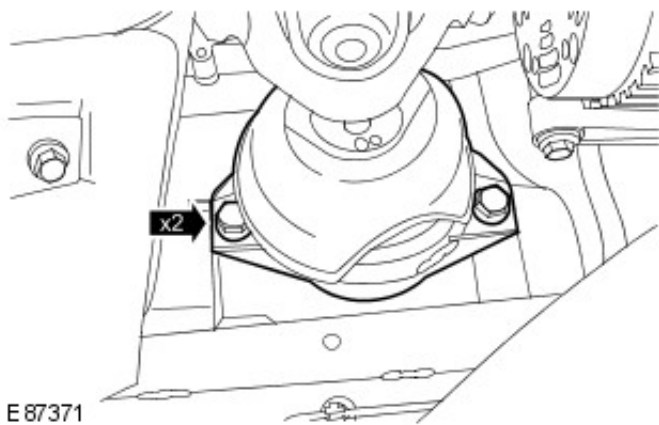
9. Remove the RH engine mount.



E87371

Installation

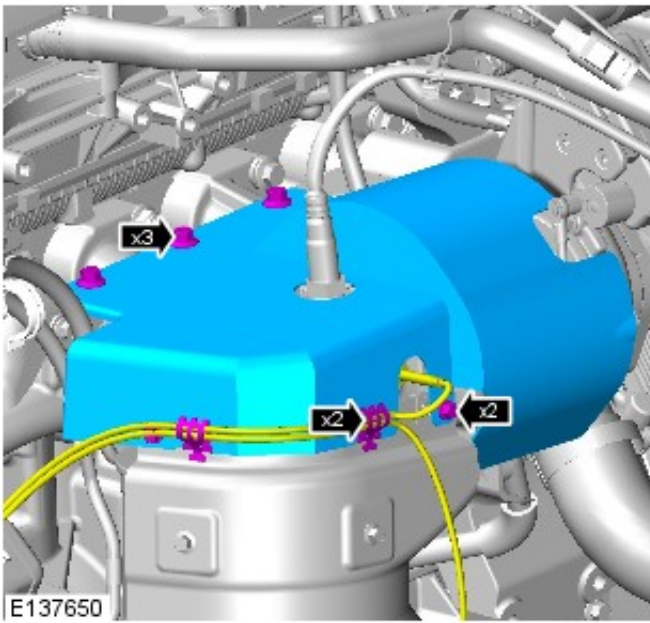
1. To install, reverse the removal procedure.
2. Tighten to 80 Nm (59 lb.ft).



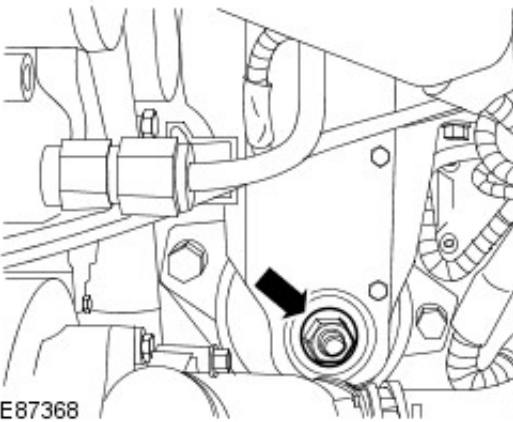
3. Tighten to 80 Nm (59 lb.ft).

4. Tighten to 3 Nm (2 lb.ft).

5. Tighten to 10 Nm (7 lb.ft).



6. Tighten to 80 Nm (59 lb.ft).




Engine - ID4 2.2L Diesel - Exhaust Manifold

Removal and Installation

Removal

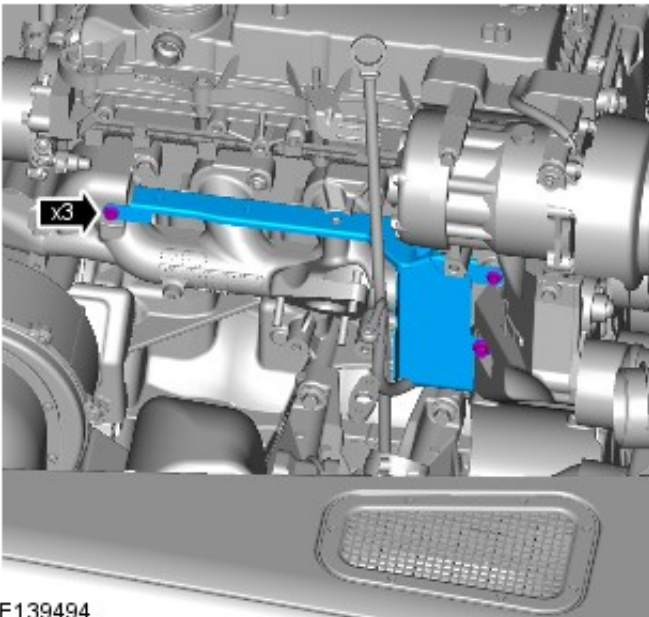
1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

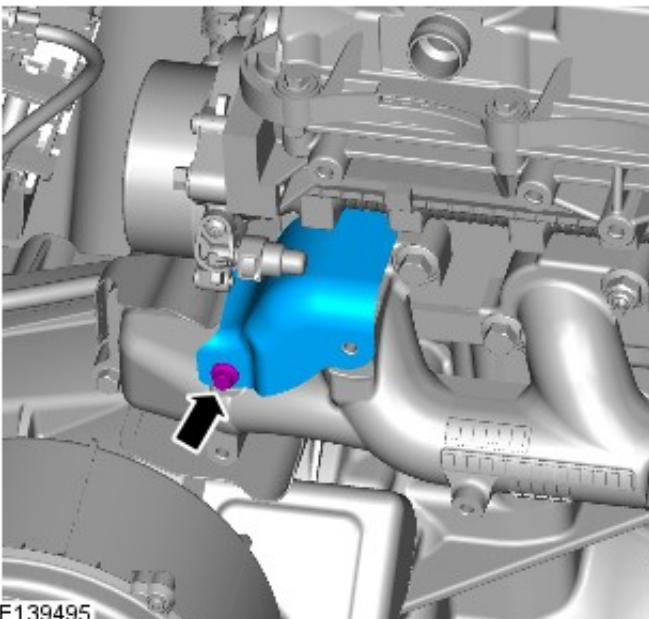
Raise and support the vehicle.

3. For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).

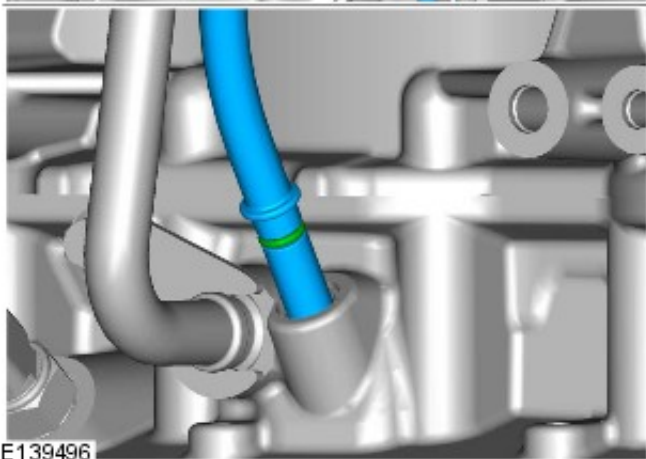
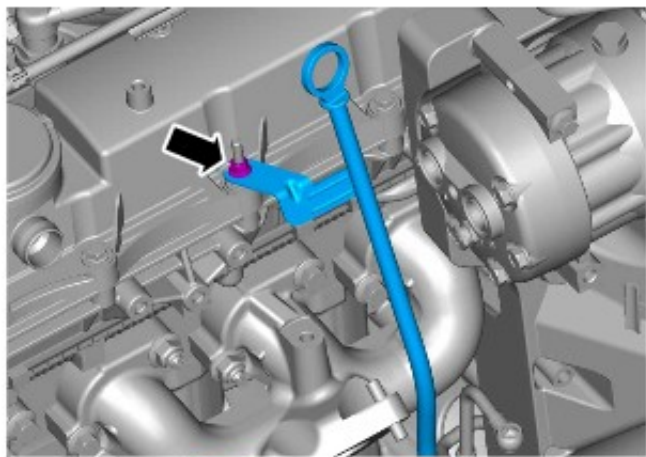
4. Torque: 10Nm




5. Torque: 9Nm

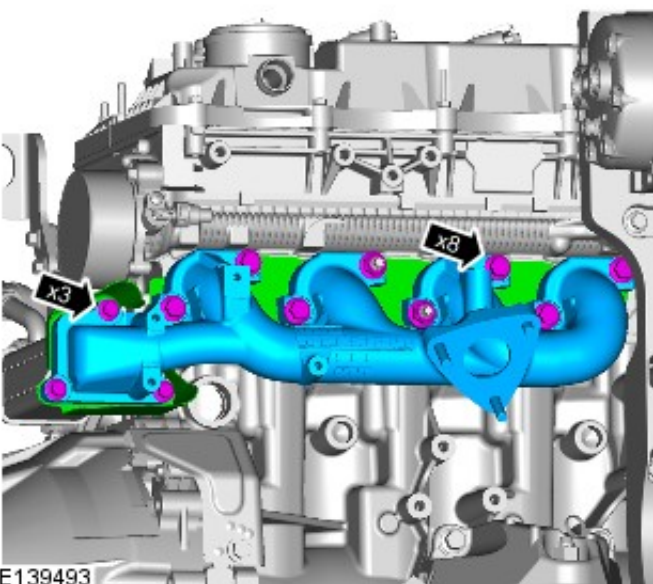


6. Torque: 10Nm



E139496

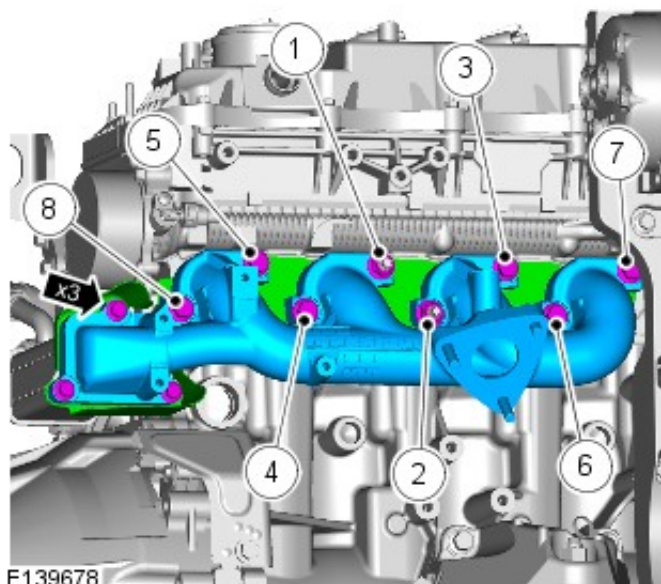
7.  **CAUTION:** Make sure that the mating faces are clean and free from foreign material.



E139493

Installation

1. **NOTE:** Install a new gasket.
1. Stage 1: Tighten the M10 bolts and nuts to 15Nm (11 lb.ft).
2. Stage 3: Tighten the M10 bolts and nuts to 35Nm (26 lb.ft).
3. Stage 4: Repeat the M10 bolts and nuts to 35Nm (26 lb.ft).
4. Tighten the M8 bolts to 25Nm (18 lb.ft).



2. To install, reverse to removal procedure.

Engine - ID4 2.2L Diesel - Intake Manifold

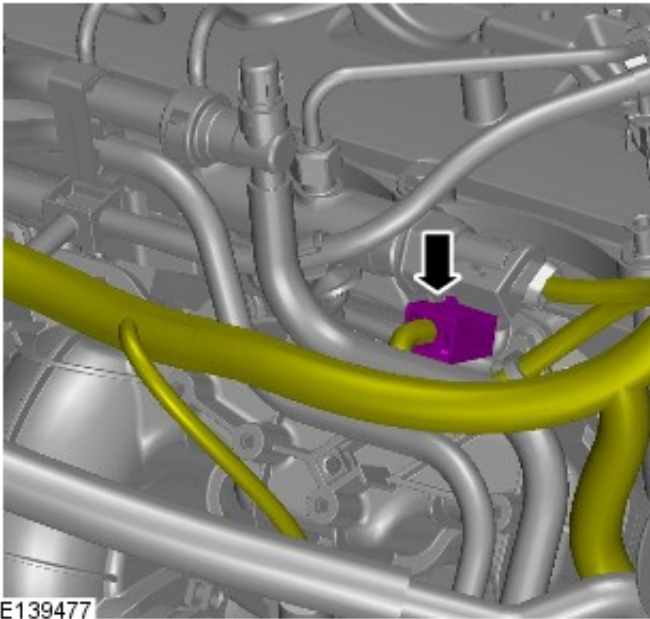
Removal and Installation

Removal

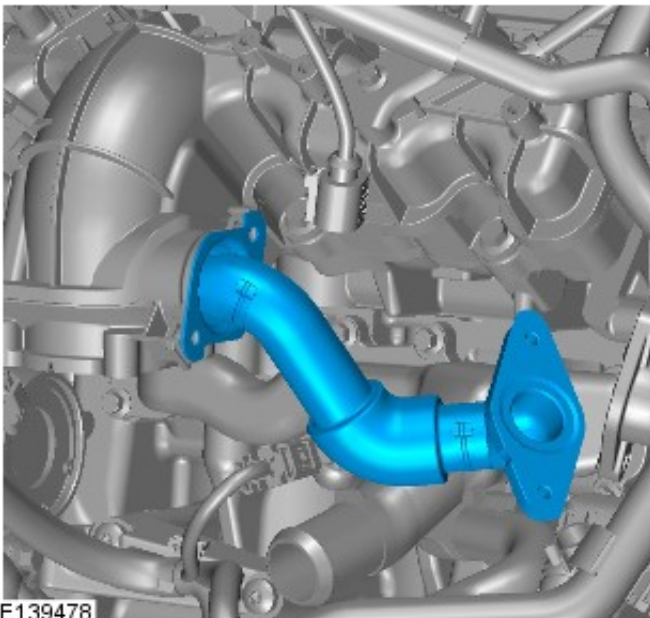
NOTE: Removal steps in this procedure may contain installation details.

1. For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve](#) (303-08 Engine Emission Control - ID4 2.2L Diesel, Removal and Installation).
2. For additional information, refer to: [Throttle Body](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Removal and Installation).

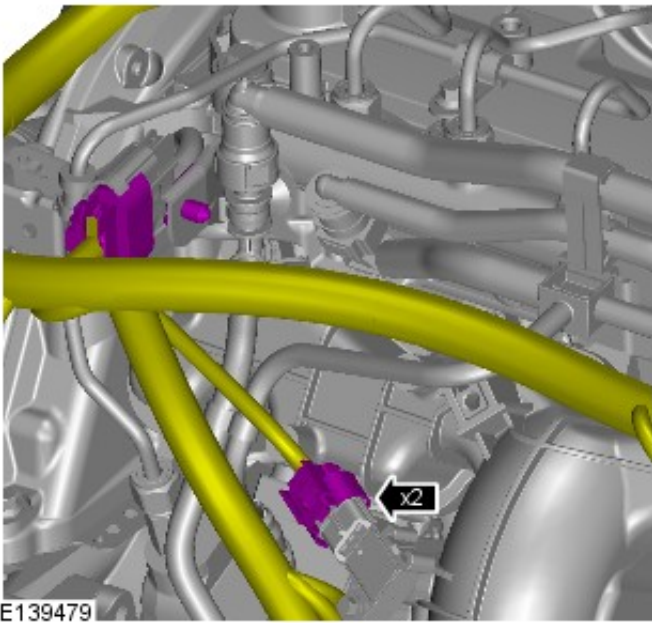
3.



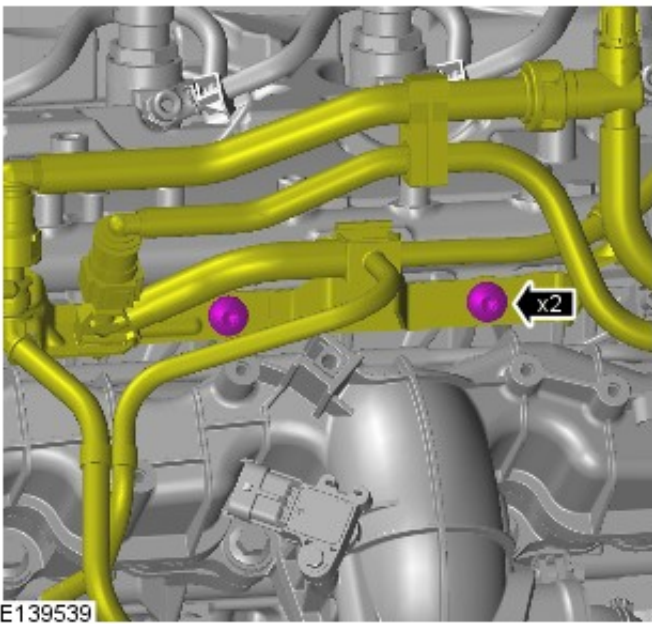
4.




5.



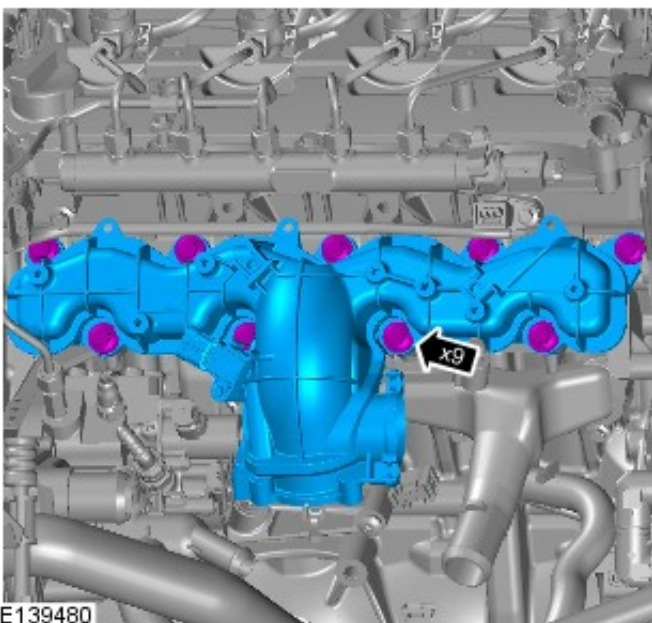
6. Torque Stage 1: 8Nm, Stage 2: 23Nm



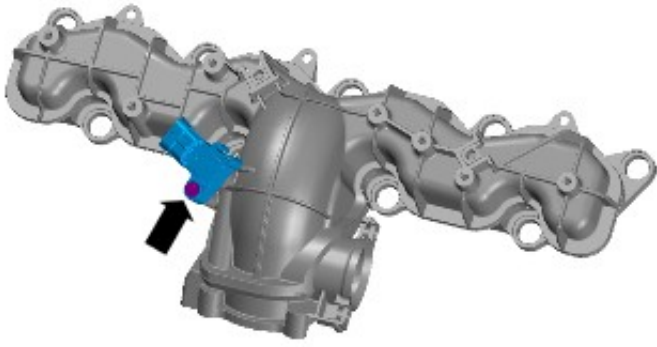
7.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

NOTE: Clean the component mating faces.

Torque: 15Nm



8. Torque: 3Nm



E139481

Installation

- 1. To install, reverse the removal procedure.

Content not found

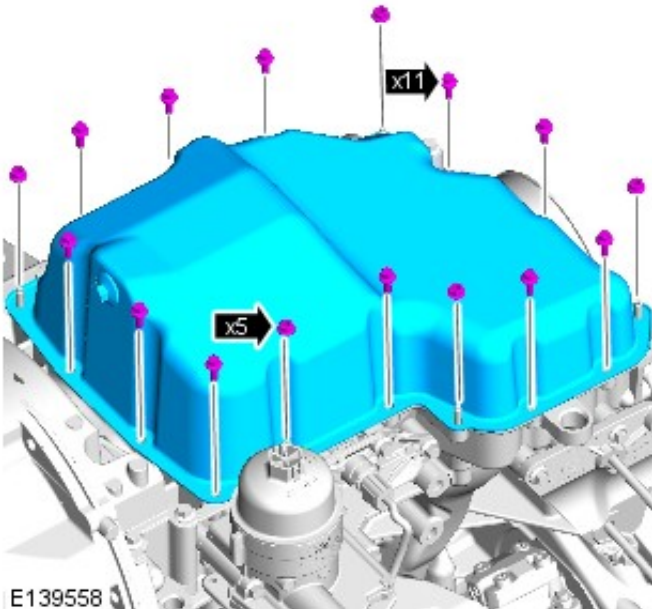
Engine - ID4 2.2L Diesel - Oil Pan


Removal and Installation

Removal

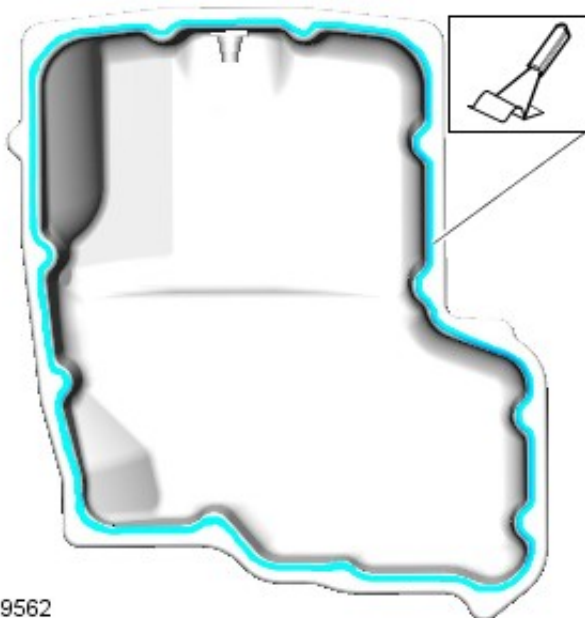
1. Raise the vehicle on lift.
2. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01 Engine - ID4 2.2L Diesel, General Procedures).

3. Remove the 16 oil pan bolts.



4.  **CAUTION: CAUTION:** Avoid damage to the oil pan mating face of the cylinder block. Failure to follow this instruction may cause damage to the vehicle.

Remove the engine oil pan.



5.  **CAUTION: CAUTION:** Avoid damage to the oil pan mating face of the cylinder block. Failure to follow this instruction may cause damage to the vehicle.

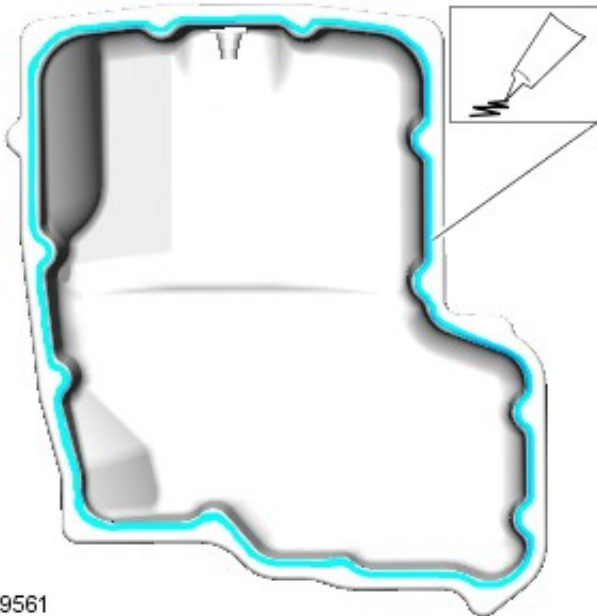
Remove the sealant from the engine.

Installation

1. **NOTE:** Clean the cylinder block mating faces.

2. **NOTE:** Clean the cylinder block mating faces.

Apply a 3mm bead of sealer WSE-M4G323-A4 to the oil pan.

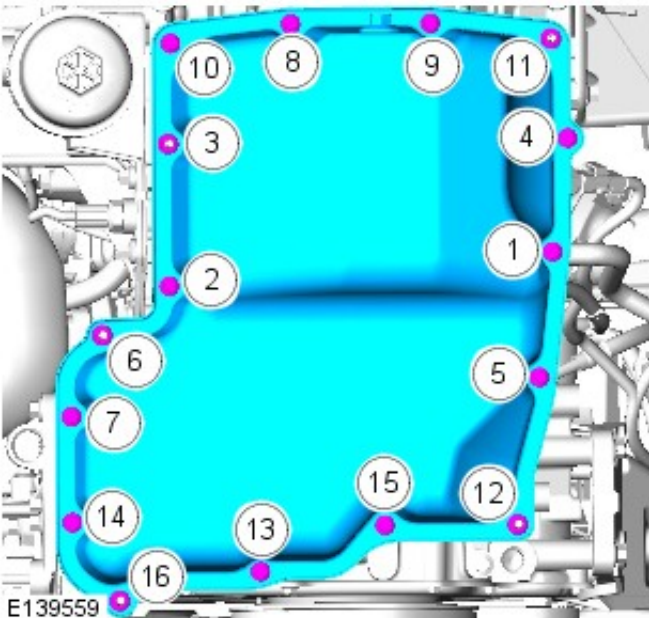


E139561

2. **NOTE:** Tighten the bolts in the sequence shown.

Install the oil pan.

1. Tighten the oil pan bolts.
2. Stage 1: Torque to 7NM
3. Stage 2: Torque to 14NM



E139559


3. Lower the vehicle.
4. Remove the engine oil filler cap.
5. Fill the engine with the recommended oil to the correct level.
6. Install the engine oil filler cap.
7. Check and top-up the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01 Engine - ID4 2.2L Diesel, General Procedures).
8. Close the bonnet.

Engine - ID4 2.2L Diesel - Oil Pump

Removal and Installation

Removal

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

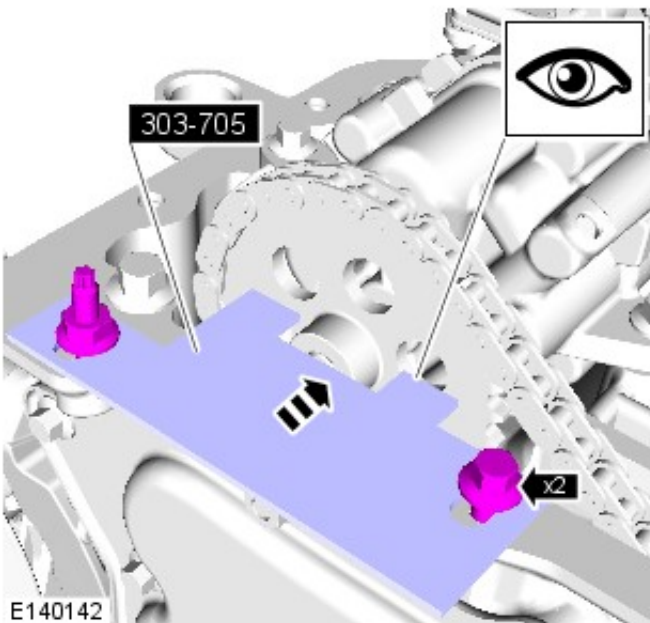
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise the vehicle on lift.

3. Remove the engine oil pan.
For additional information, refer to: [Oil Pan](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).

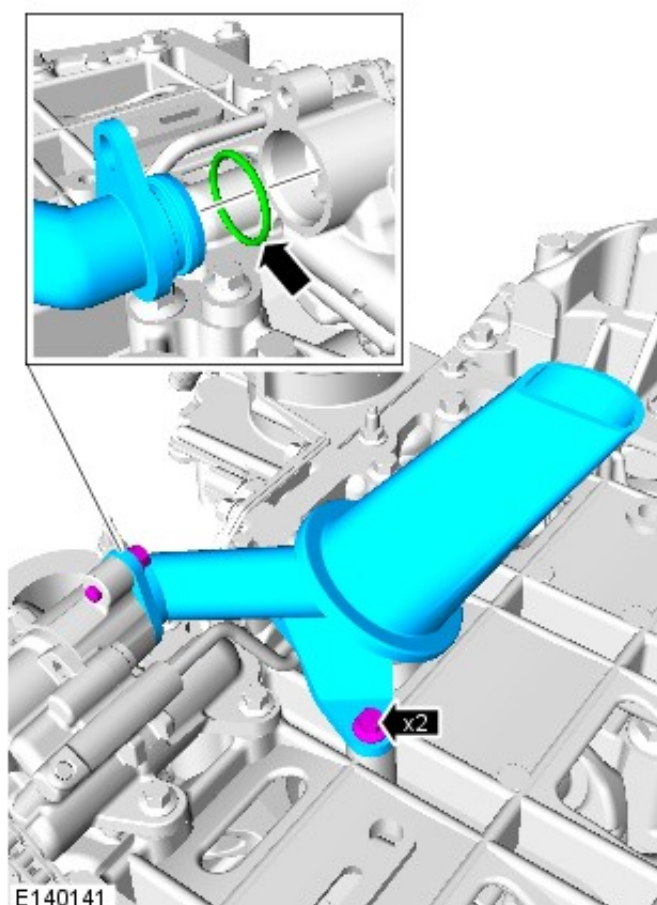
4. **NOTE:** Install the special tool so that the tool face aligns with the oil pump sprocket.

Install the special tool to the engine block.

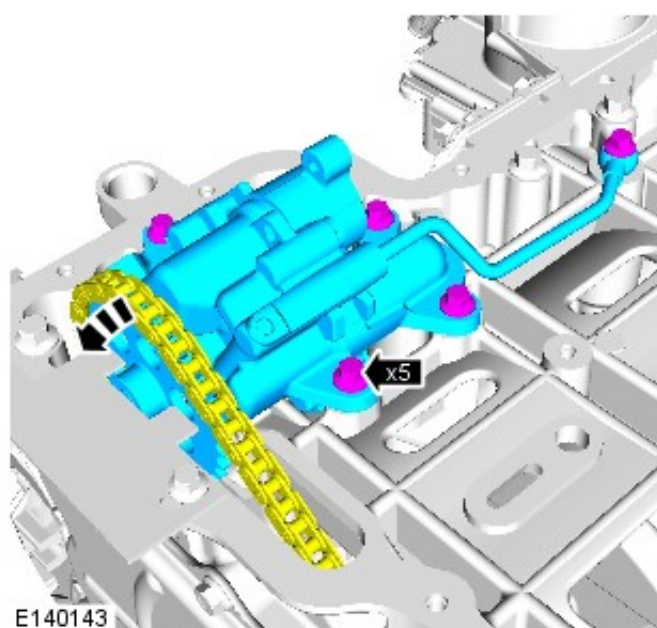


5. **NOTE:** Remove and discard the O-ring seal.

Remove the oil pickup pipe.

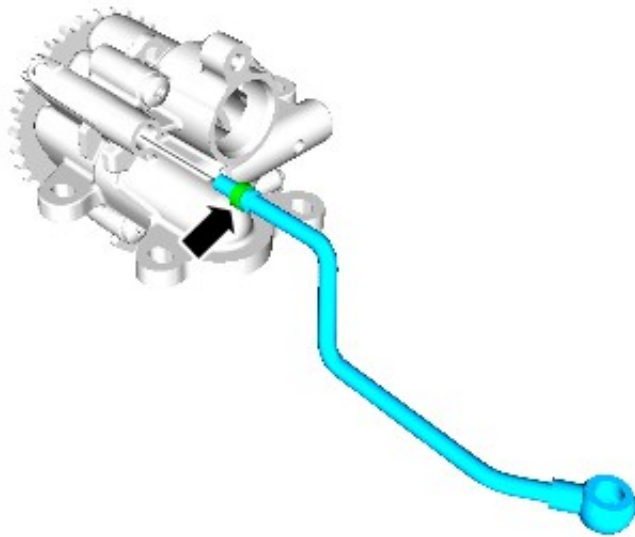


6. Remove the oil pump.



7. **NOTE:** Do not disassemble further if the component is removed for access only.

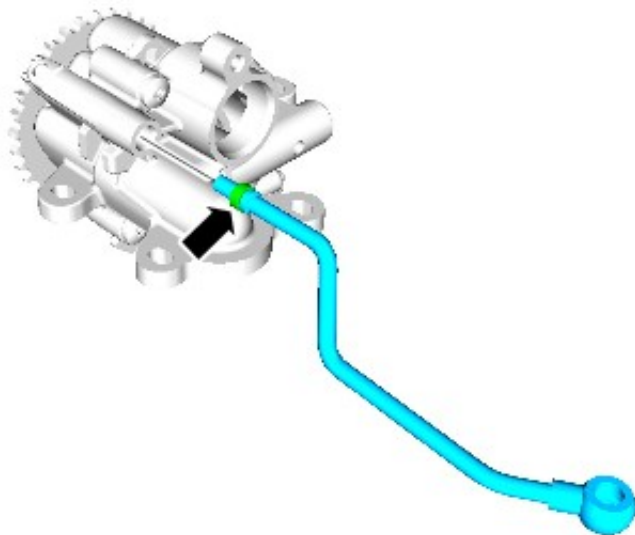
Remove the oil pump outlet pipe.



E140144

Installation

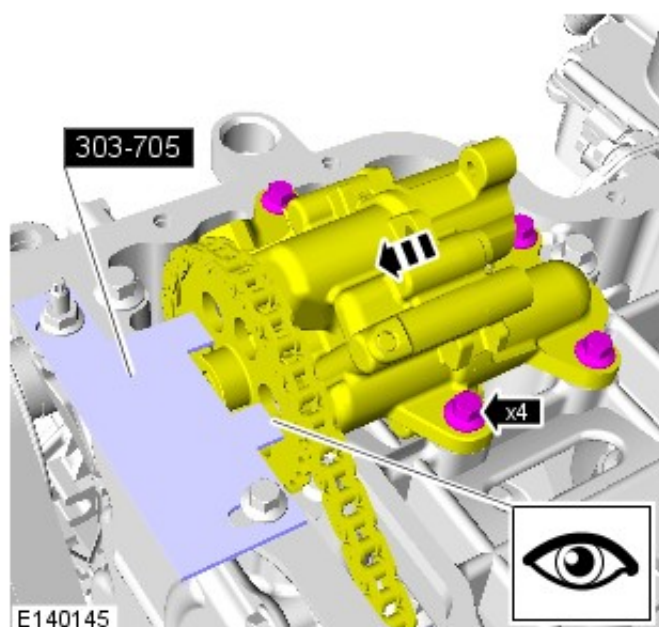
1. Install the oil pump outlet pipe.



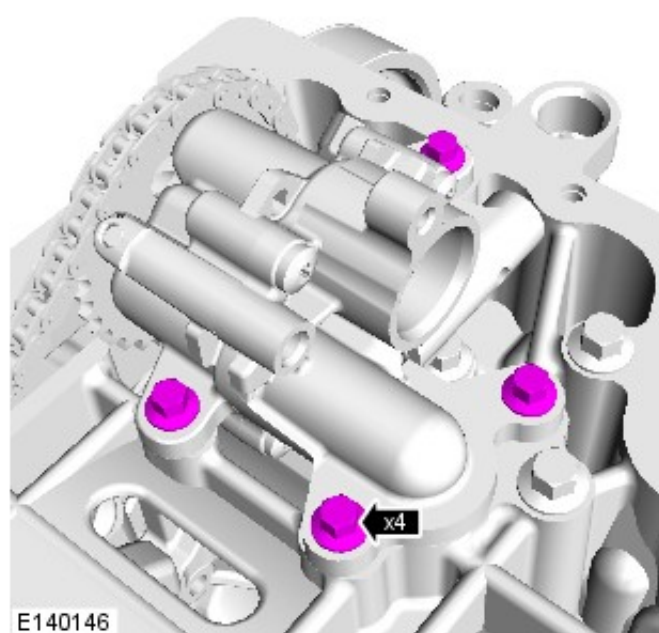
E140144

2. **NOTE: Do not tighten the bolts at this stage.**

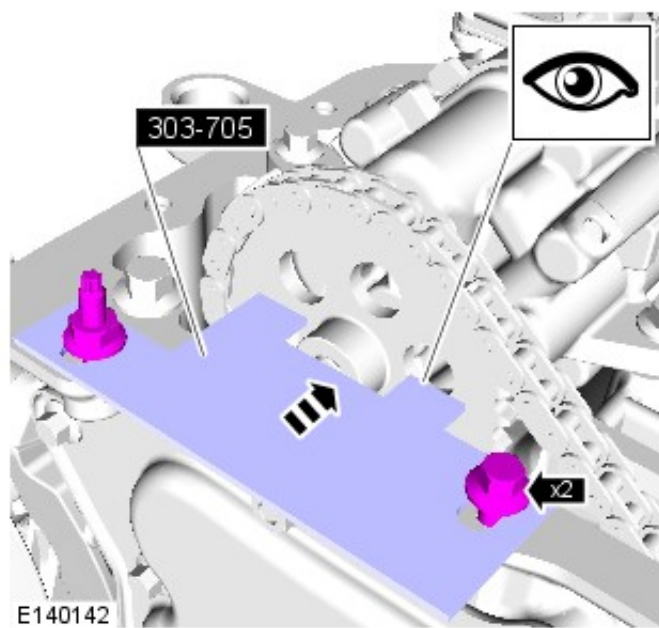
Install the oil pump so the sprocket touches the special tool.



3. Torque: 10Nm

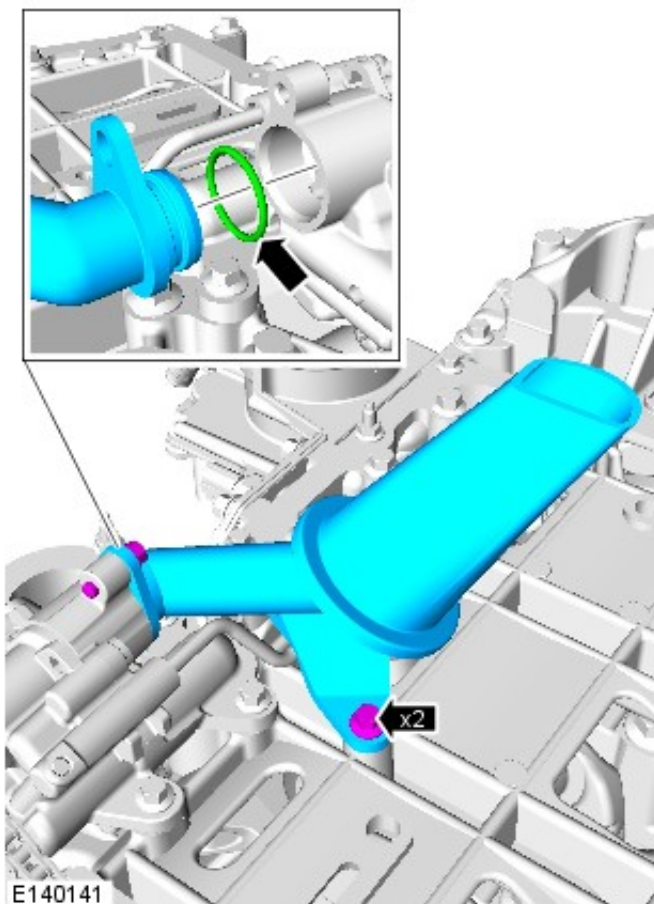


4. Remove the special tool.

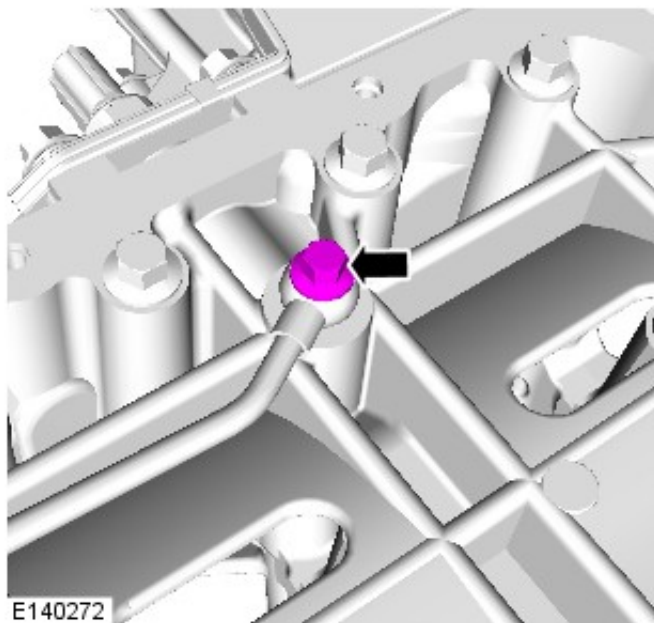


5. Torque: 10Nm

5. Torque: 20Nm.



6. Torque: 10Nm




7. Install the engine oil pan
For additional information, refer to: [Oil Pan](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).
8. Lower the vehicle.
9. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).


Engine - ID4 2.2L Diesel - Timing Cover

Removal and Installation

Special Tool(s)

	Aligner, Engine Front Cover 303-682
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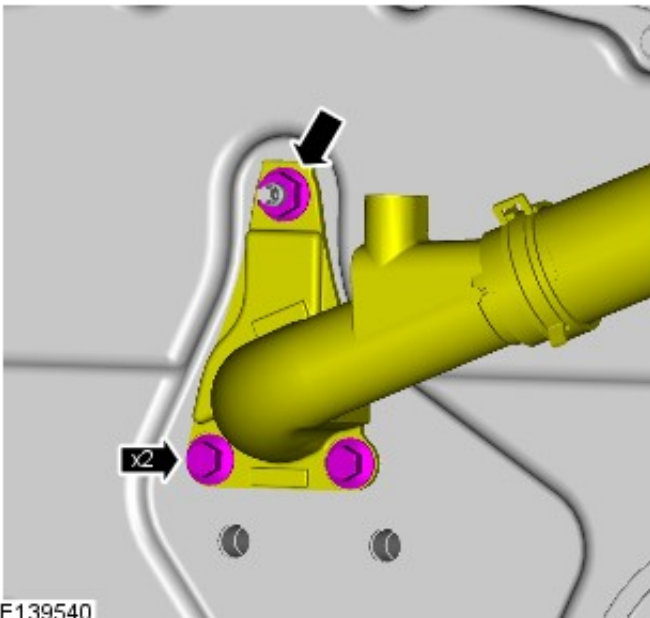
Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

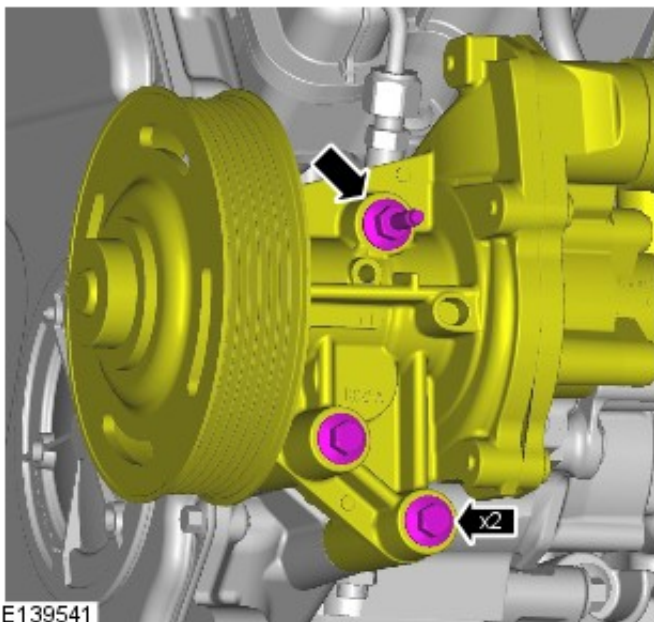
Raise and support the vehicle.
3. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).
4. For additional information, refer to: [Accessory Drive Component Bracket](#) (303-05 Accessory Drive - ID4 2.2L Diesel, Removal and Installation).
5. For additional information, refer to: [Crankshaft Front Seal](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).

6. **NOTE:** Remove and discard the O-ring seal.

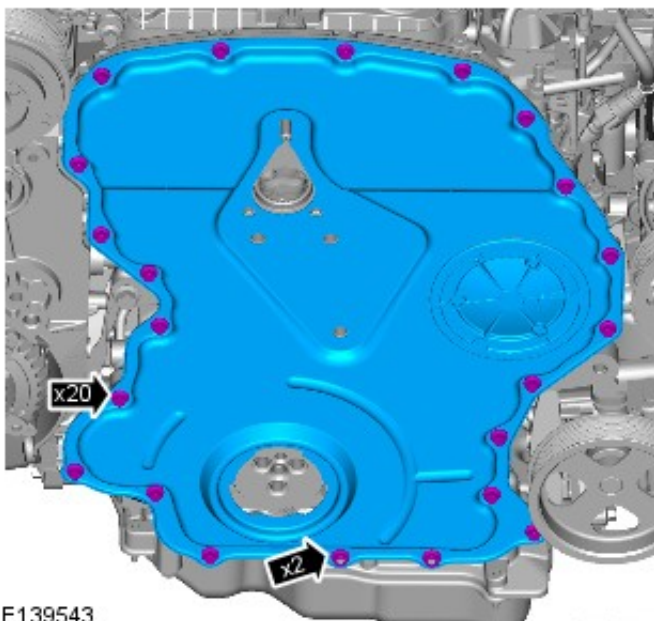
Torque: 23Nm



7. Torque: 23Nm



E139541




E139543


8.  **CAUTION:** Make sure that the mating faces are clean and free from foreign material.

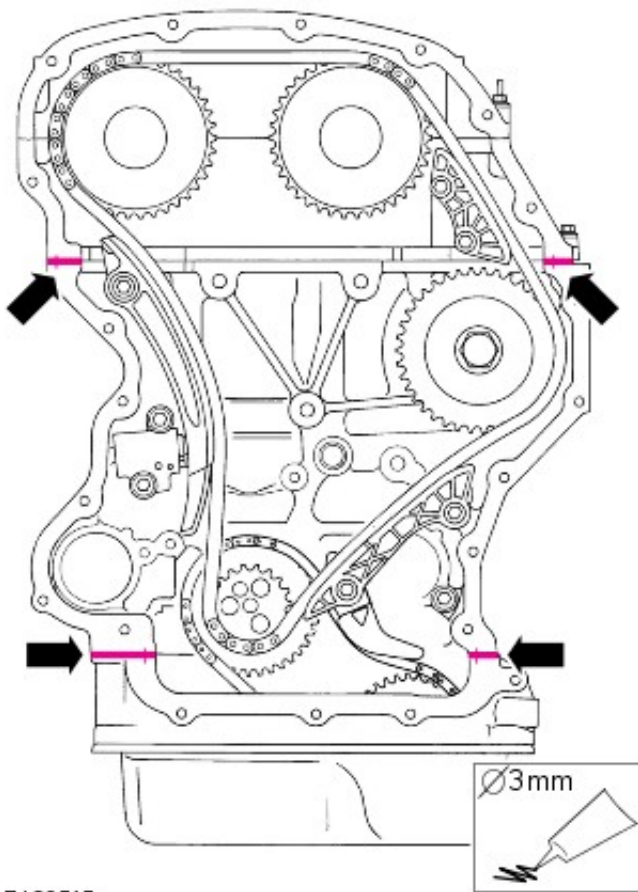
Installation

1. **CAUTIONS:**


 A new engine timing cover must be installed. Failure to follow this instruction may result in damage to the vehicle.

 Install the engine timing cover within five minutes of applying the sealer. Failure to follow this instruction may result in damage to the vehicle.

 Make sure the mating faces are clean, before the sealant is applied.




E139545

2.  **CAUTION:** Make sure the mating faces are clean, before the sealant is applied.

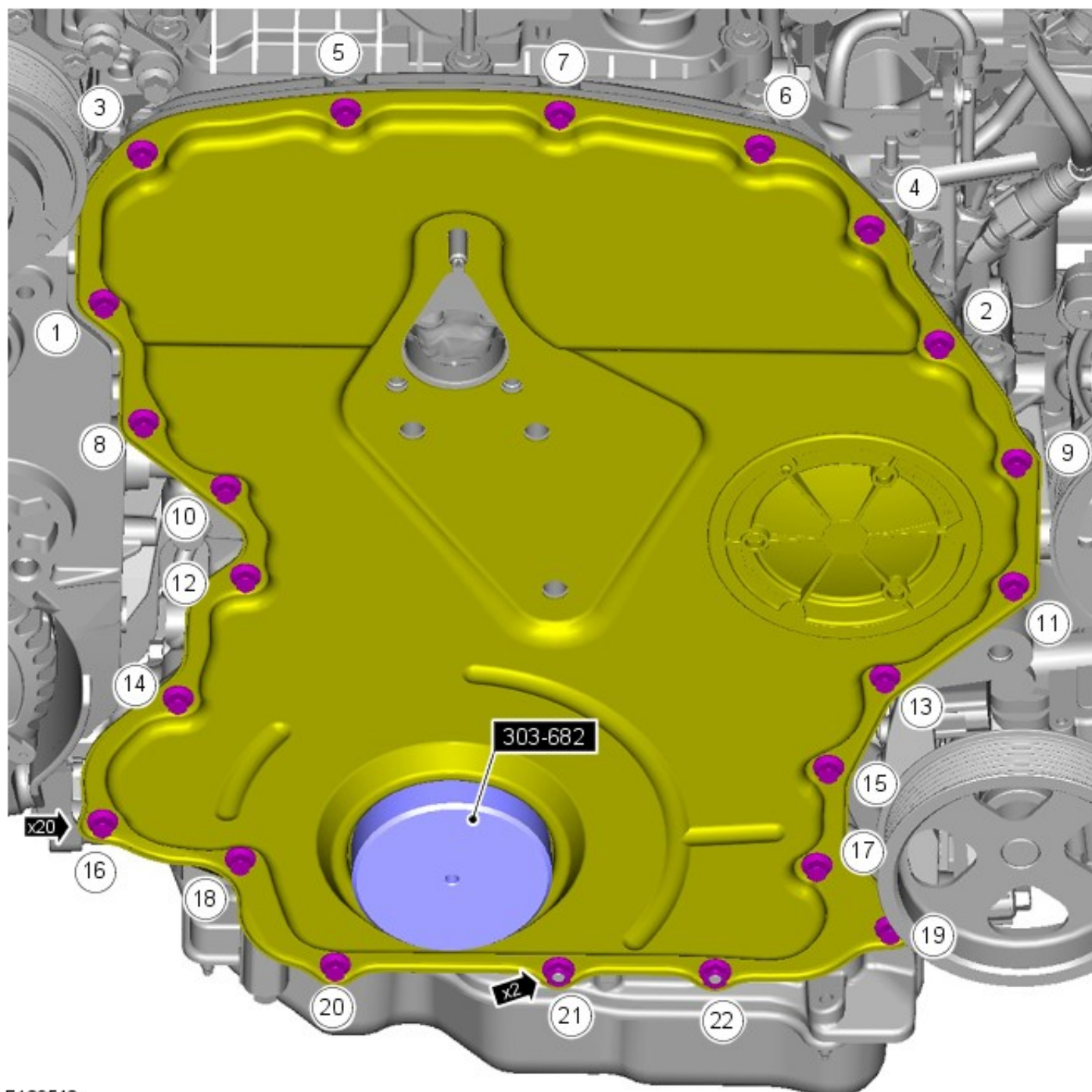


E139544

3.  **WARNING:** Make sure that the engine timing cover does not come into contact with the engine until correct position is obtained.

Tool: 303-682 (Aligner, Engine Front Cover)

1. Stage 1: Tighten the M6 bolts and nuts to 5 Nm
2. Stage 2: Tighten the M6 bolts and nuts to 10 Nm
3. Stage 3: Repeat the M6 bolts and nuts to 10 Nm



E139542

4. To install, reverse to removal procedure.

Content not found


Content not found

Engine - ID4 2.2L Diesel - Flywheel

Removal and Installation

Removal

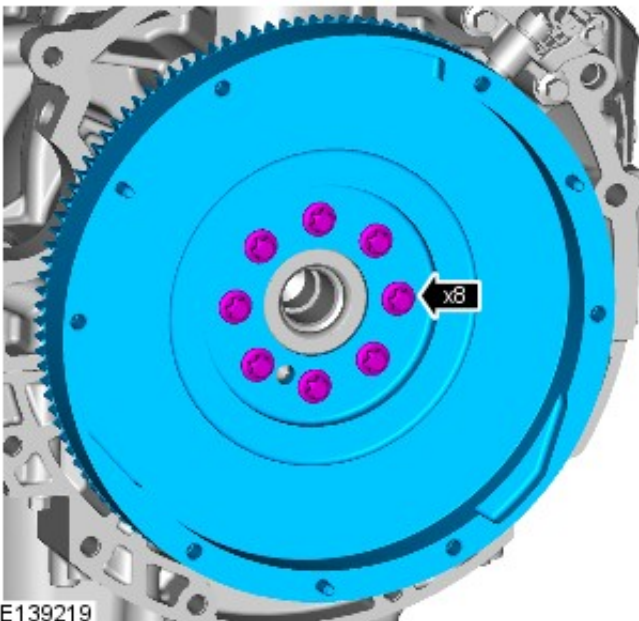
1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. For additional information, refer to: [Clutch Disc and Pressure Plate](#) (308-01 Clutch - Vehicles With: MT82 6-Speed Manual Transmission, Removal and Installation).

4.



E139219

Installation

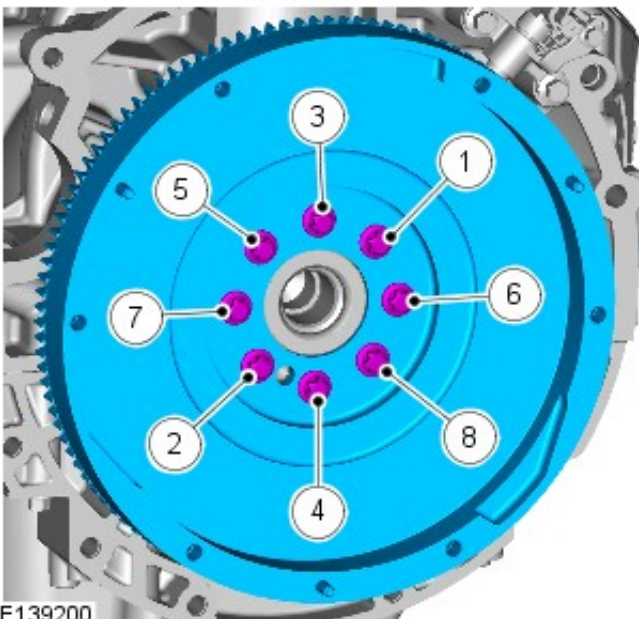
1. **NOTE:** Clean the component mating faces.

NOTE: New bolts must be installed.

NOTE: Tighten the bolts in the sequence shown.

Install the flywheel.

1. Stage 1: Tighten the bolts 1 through 8 to 25 Nm (18 lb.ft).
2. Stage 2: Tighten the bolts 1 through 8 to 45 Nm (33 lb.ft).
3. Stage 3: Tighten the bolts 1 through 8 a further 45 degrees.



E139200

2. For additional information, refer to: [Clutch Disc and Pressure Plate](#) (308-01 Clutch - Vehicles With: MT82 6-Speed Manual Transmission, Removal and Installation).

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


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Engine - ID4 2.2L Diesel - Engine

Removal

Removal

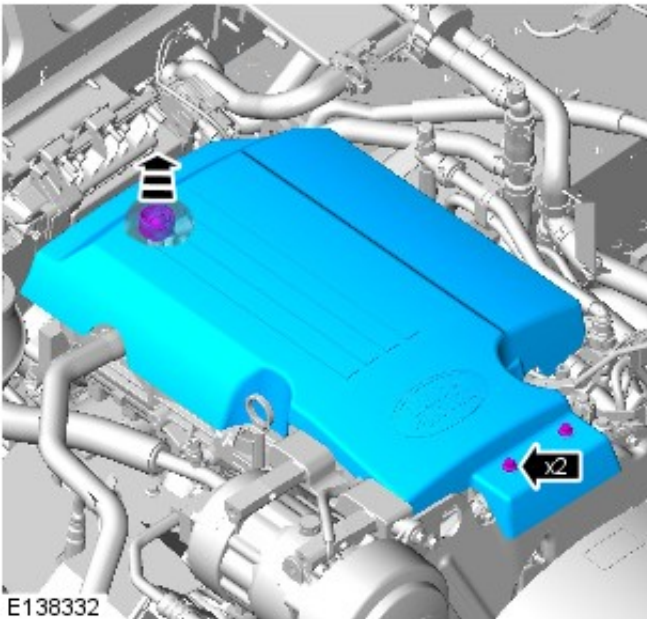
1. For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise the vehicle on a twin-post lift.

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

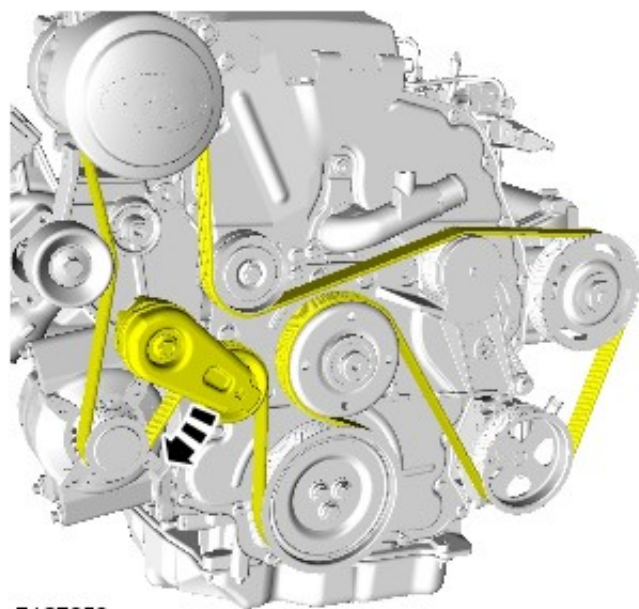
4.



5. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).

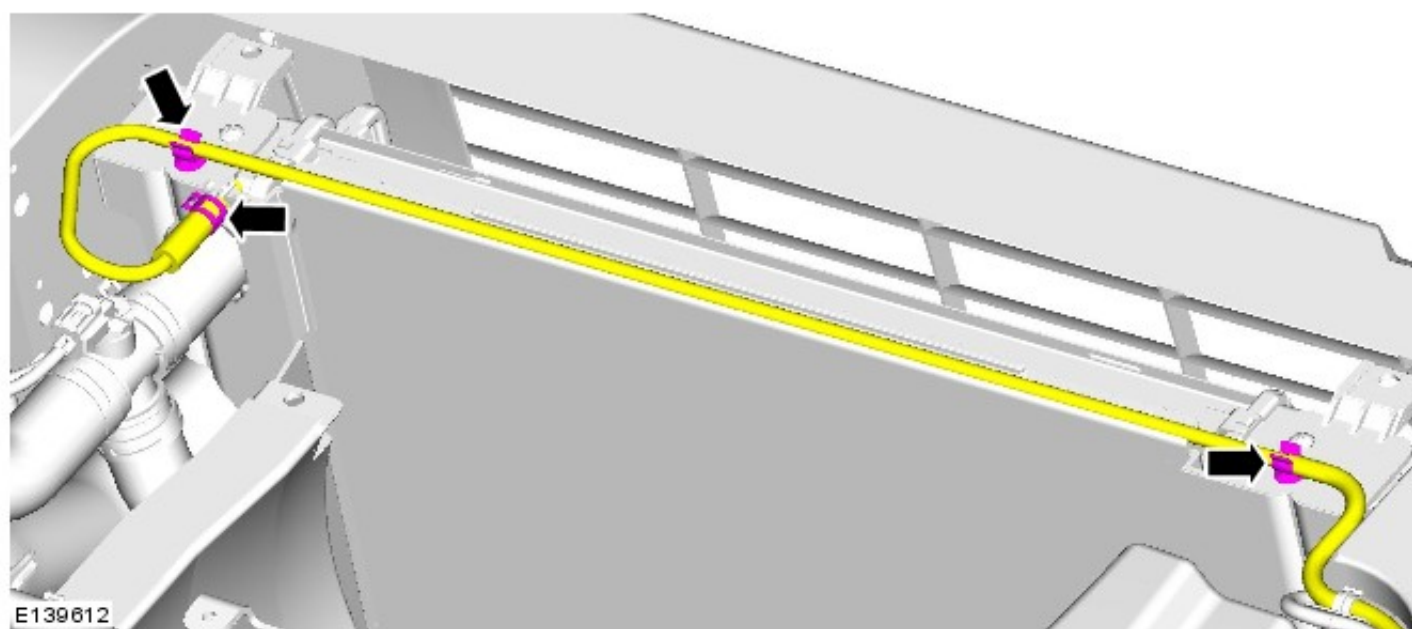
6. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).

7.



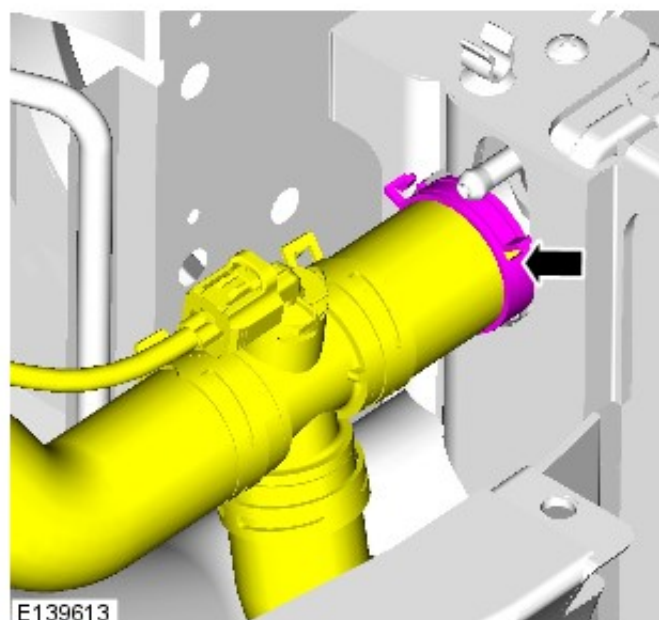
E137656

8.

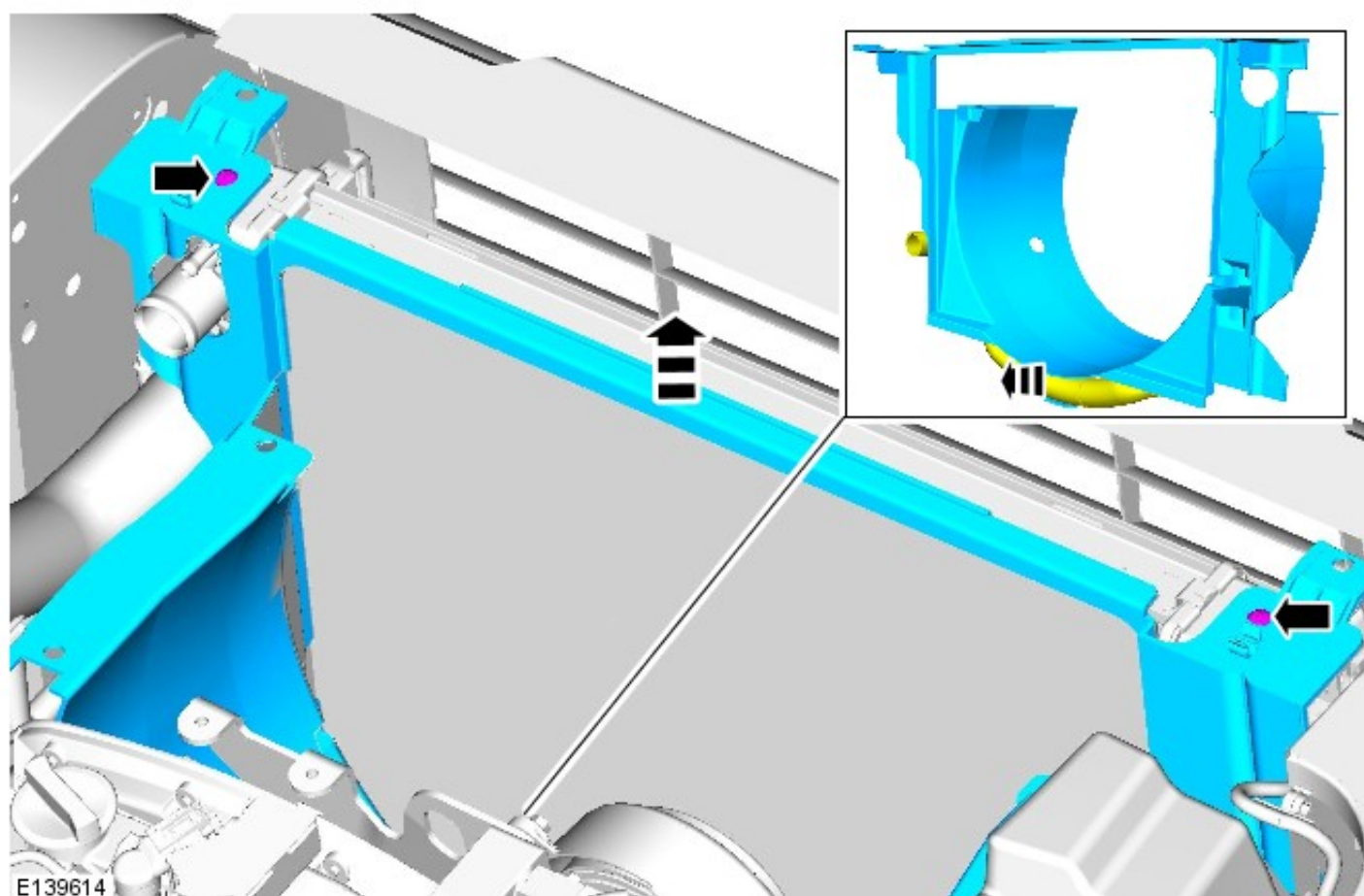


E139612

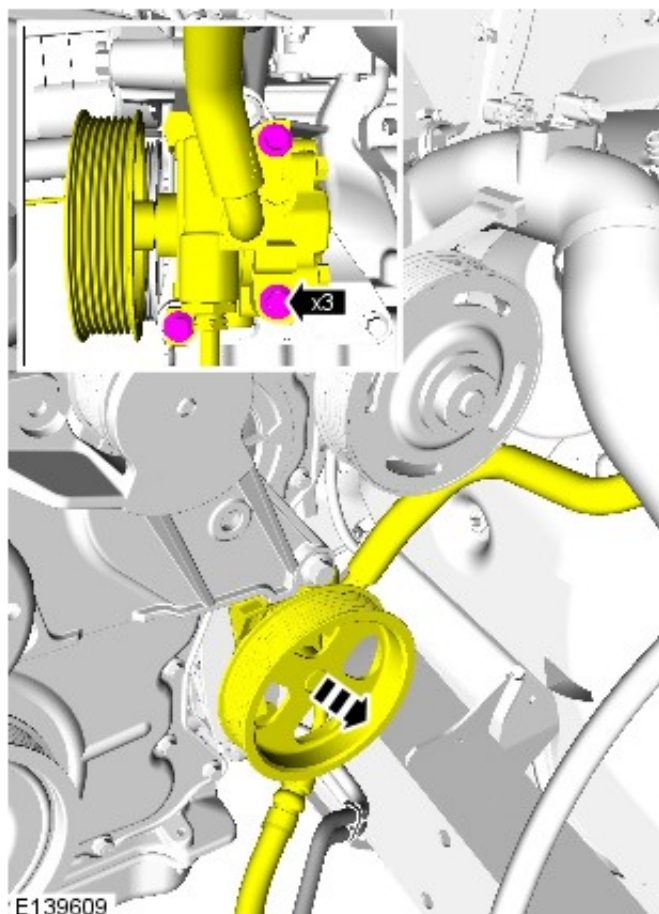
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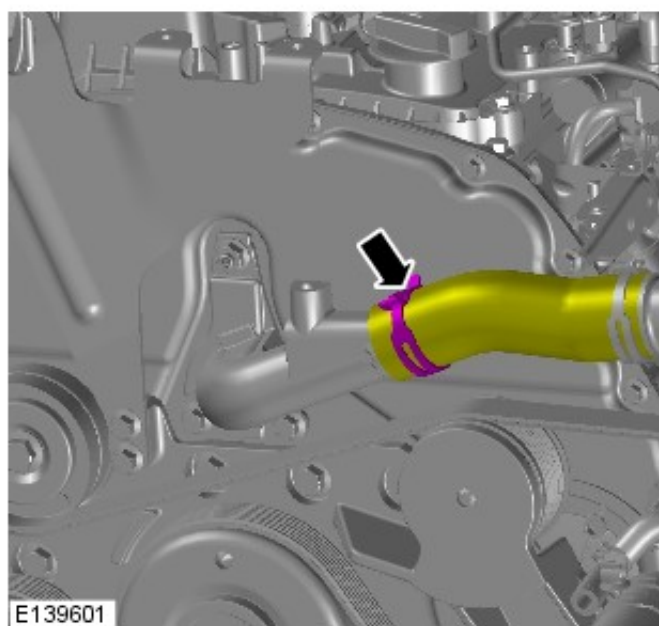
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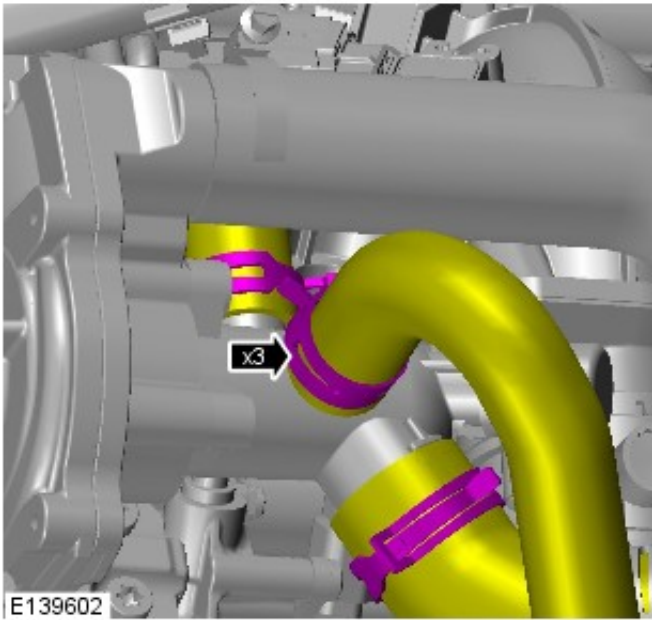
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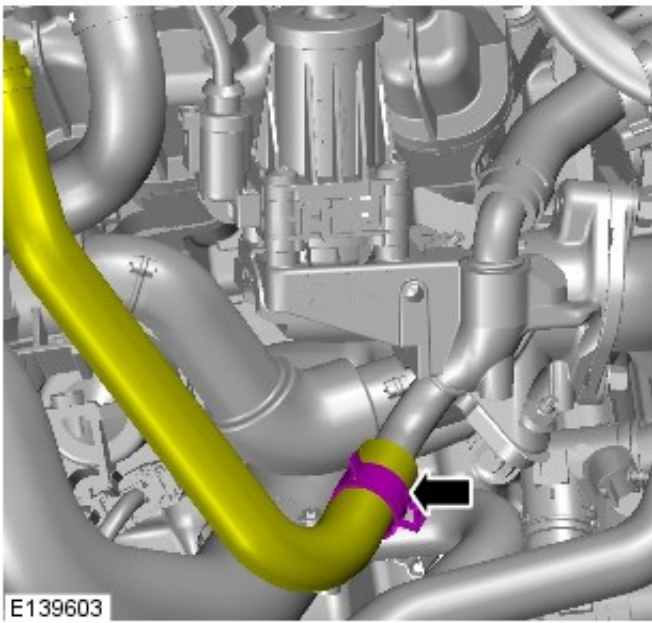
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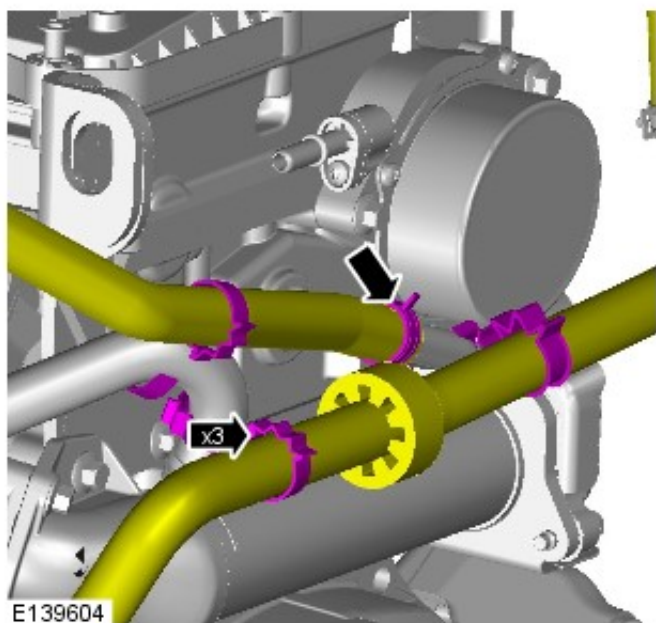
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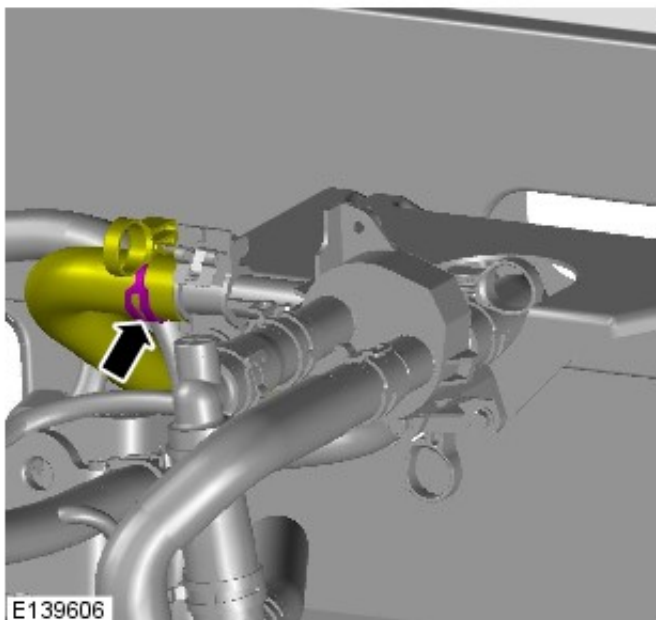
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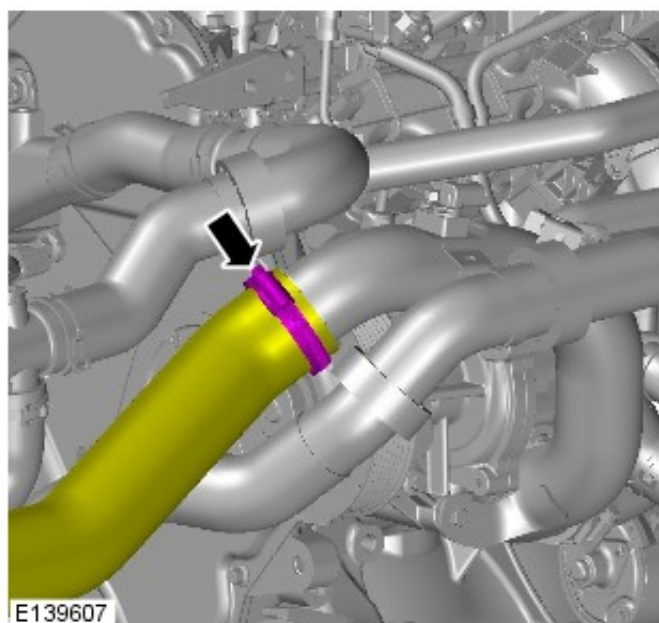
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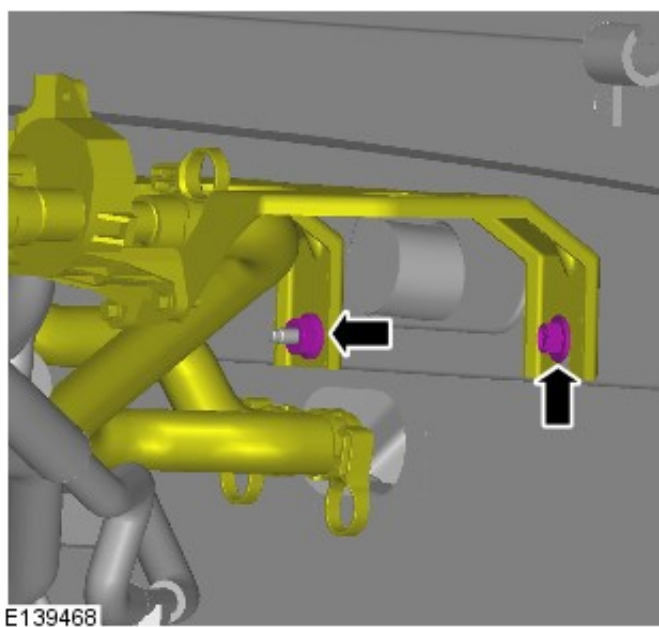
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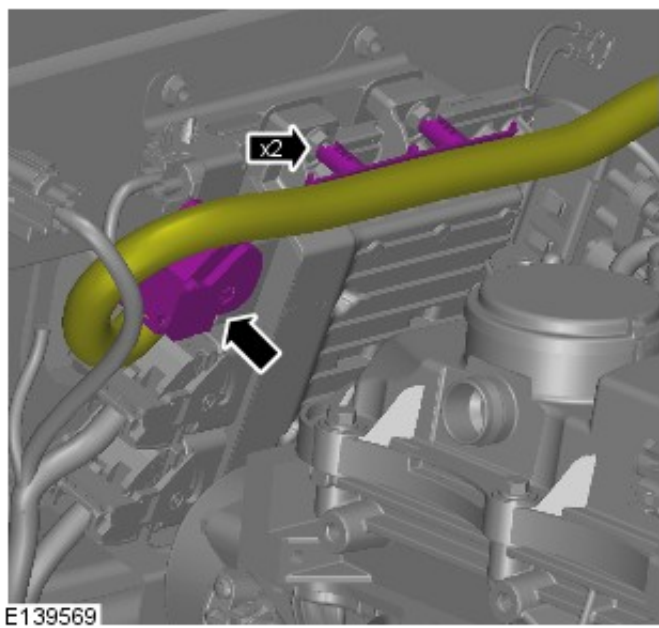
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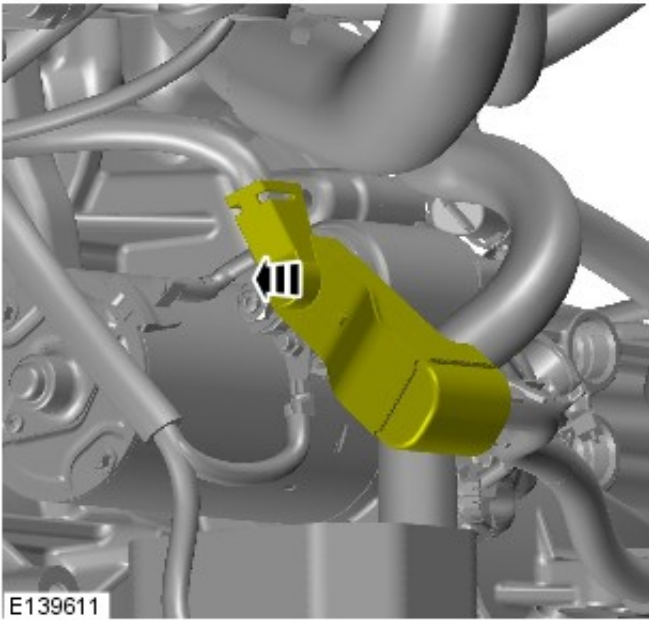
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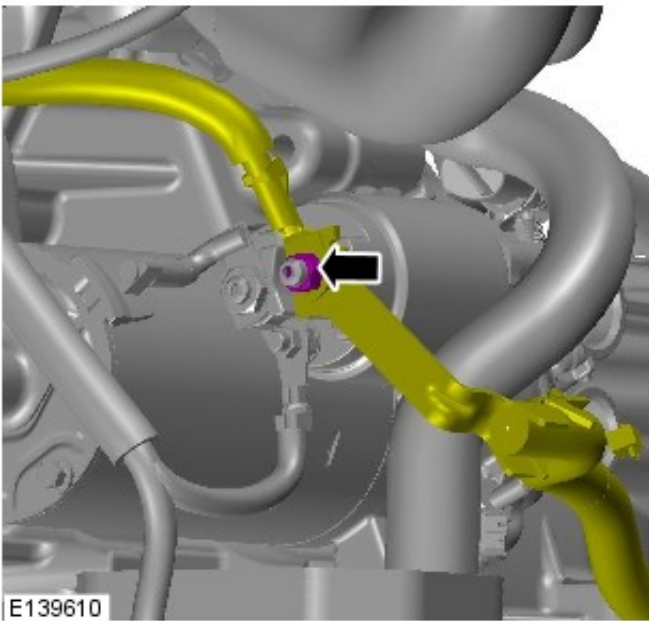
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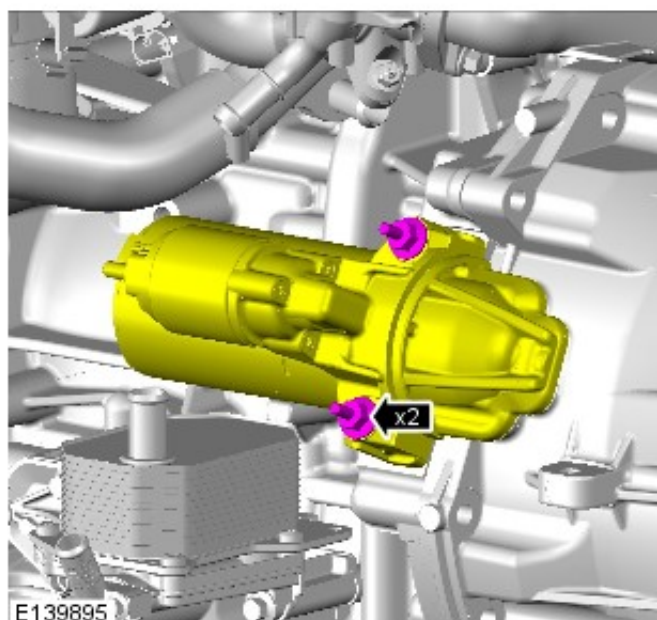
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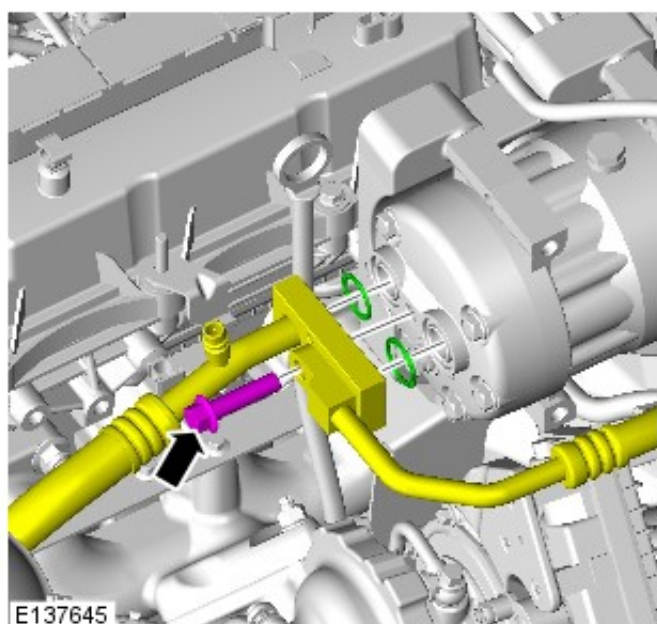
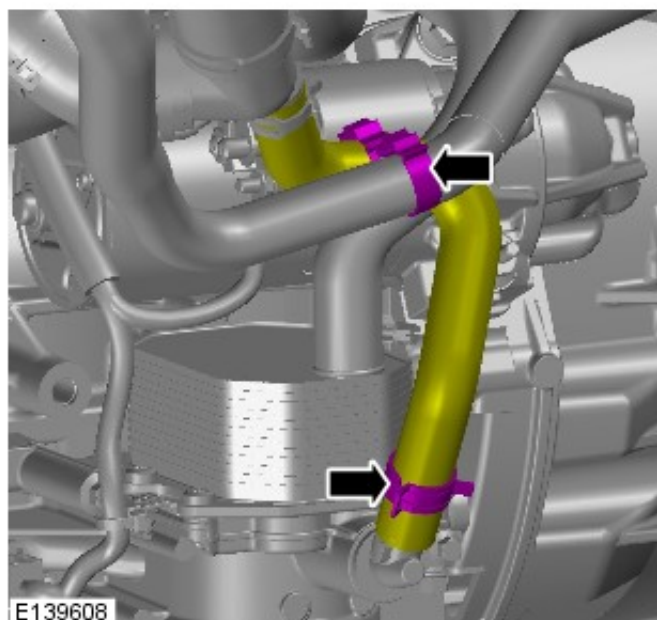
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23.



24. CAUTIONS:

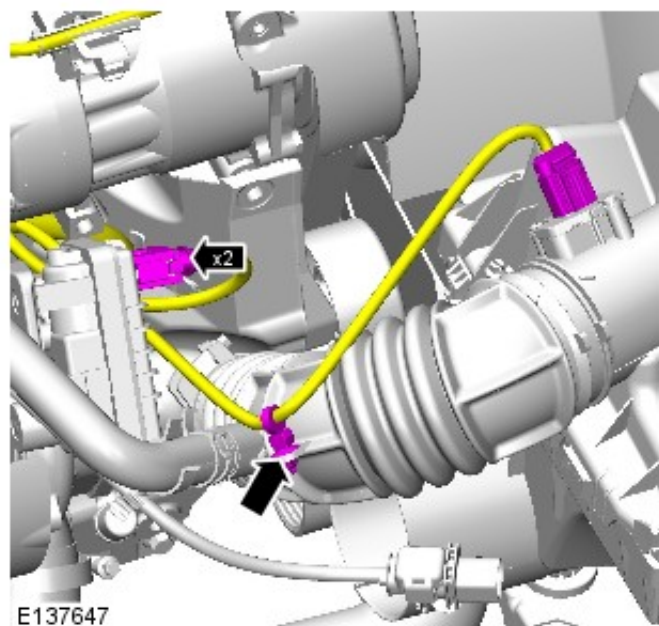


CAUTION: Remove and discard the O ring seals.

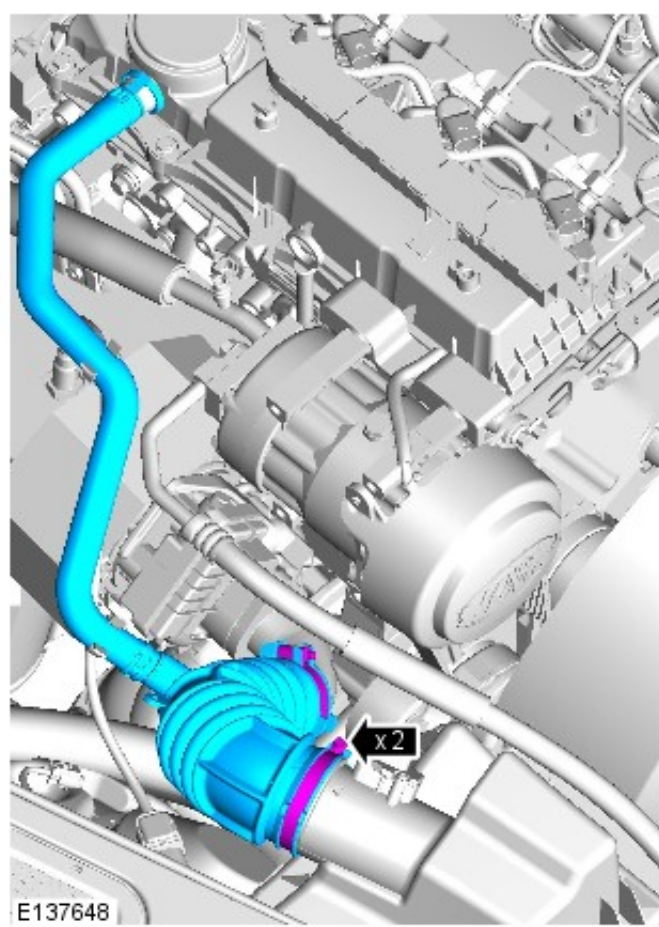


CAUTION: Make sure that all openings are sealed.
Use new blanking caps.

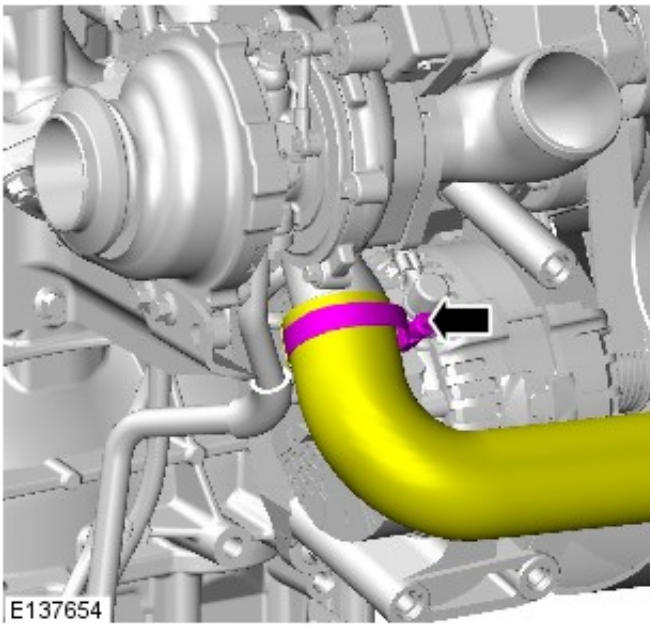
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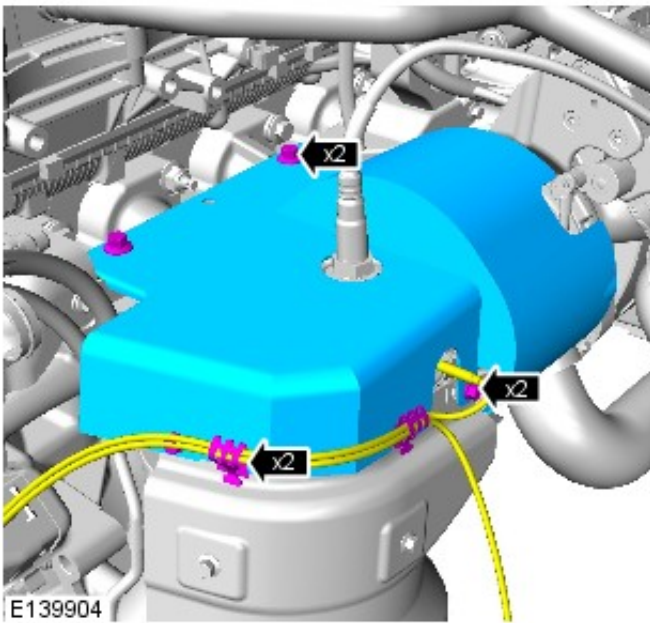
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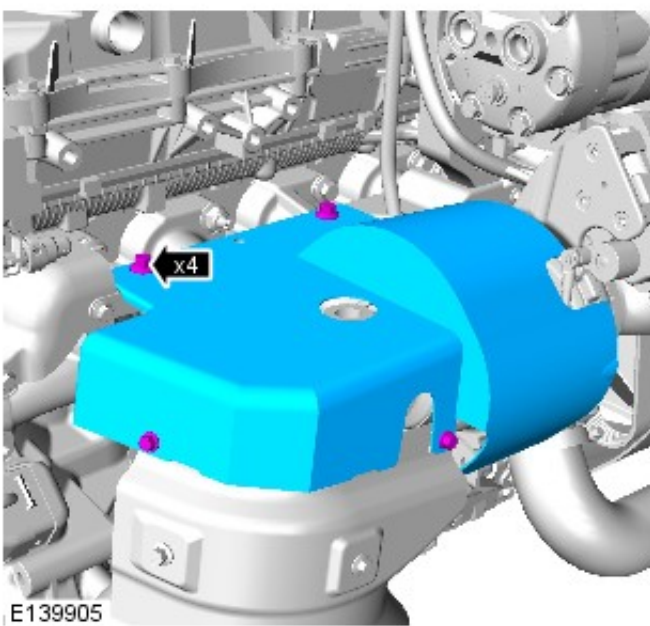
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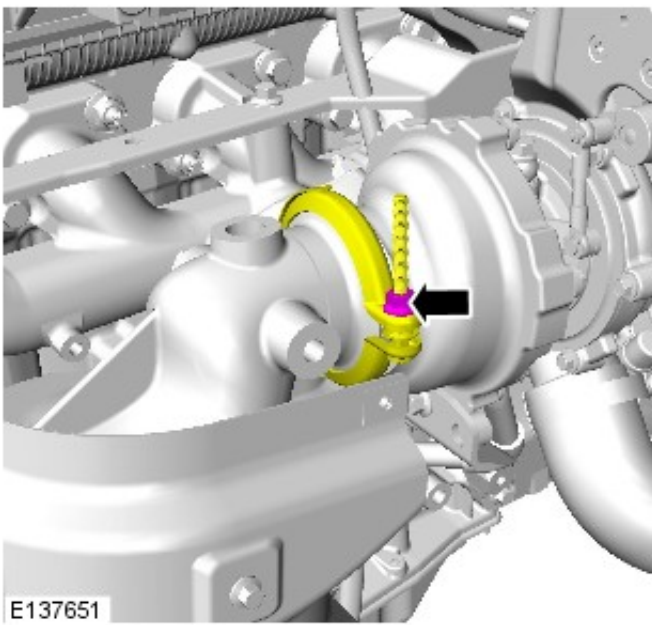
28. NOTE: Vehicles with diesel particulate filter (DPF).



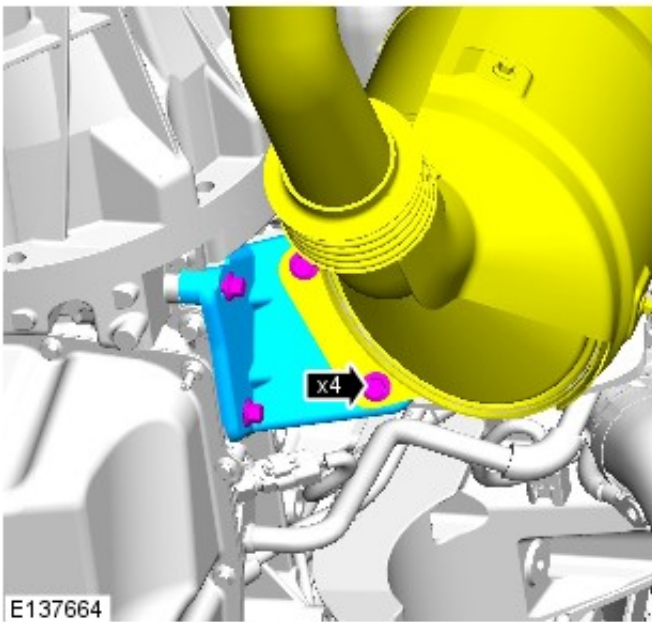
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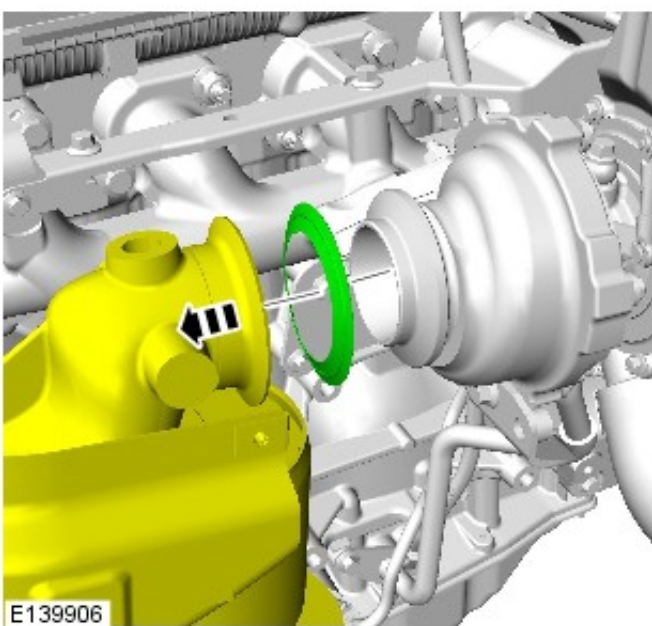
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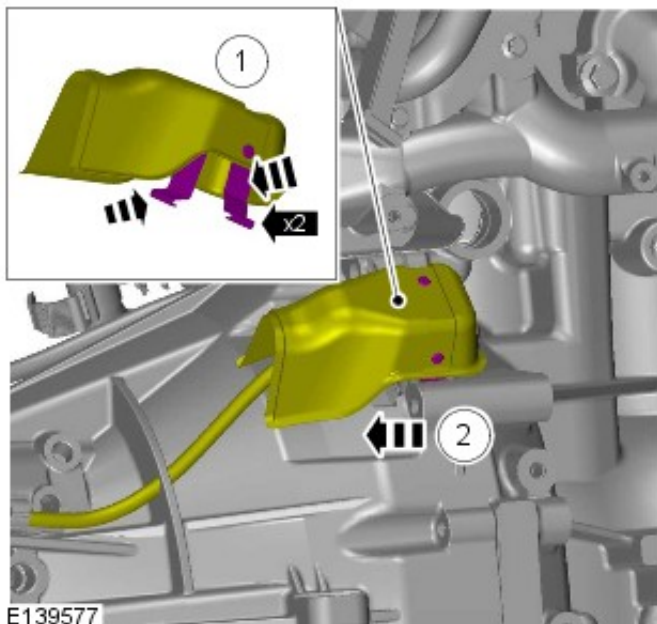
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32. NOTE: Remove and discard the gasket.

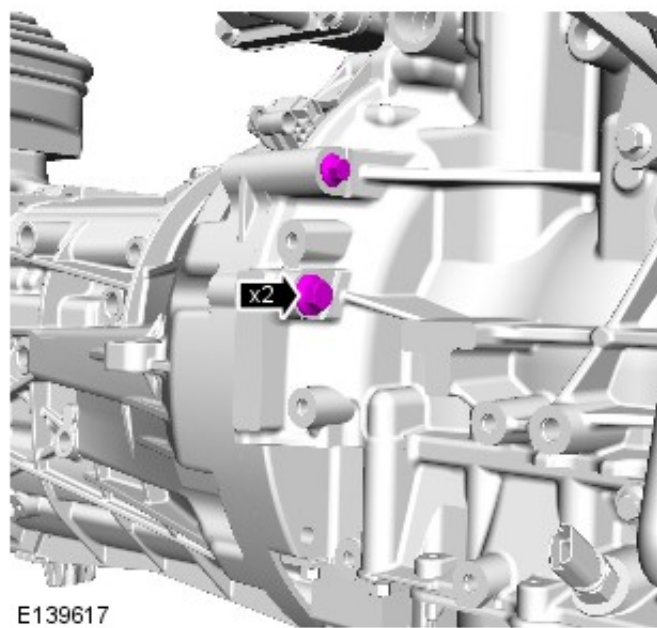
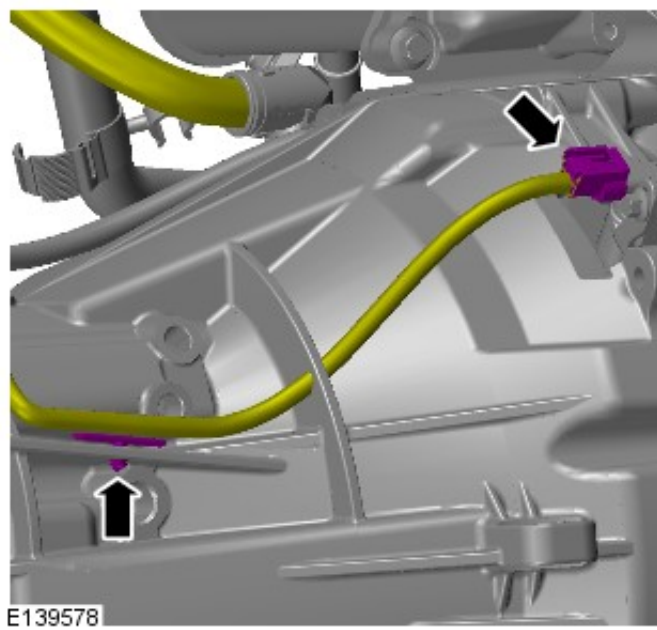


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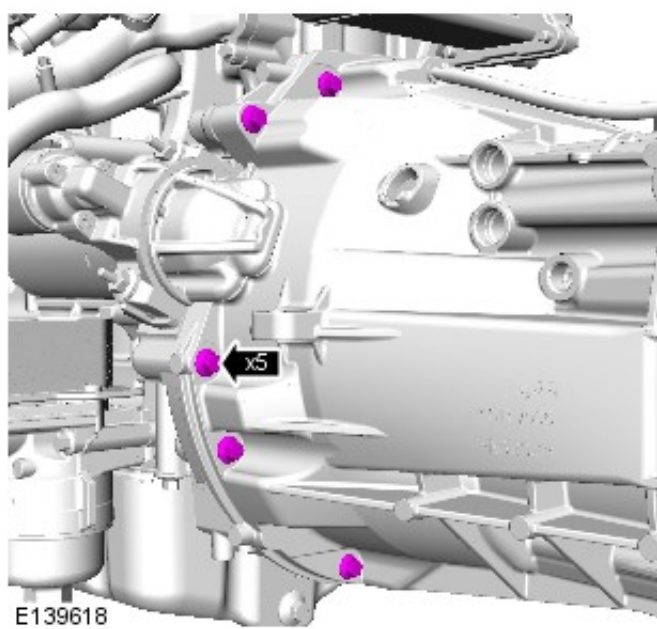
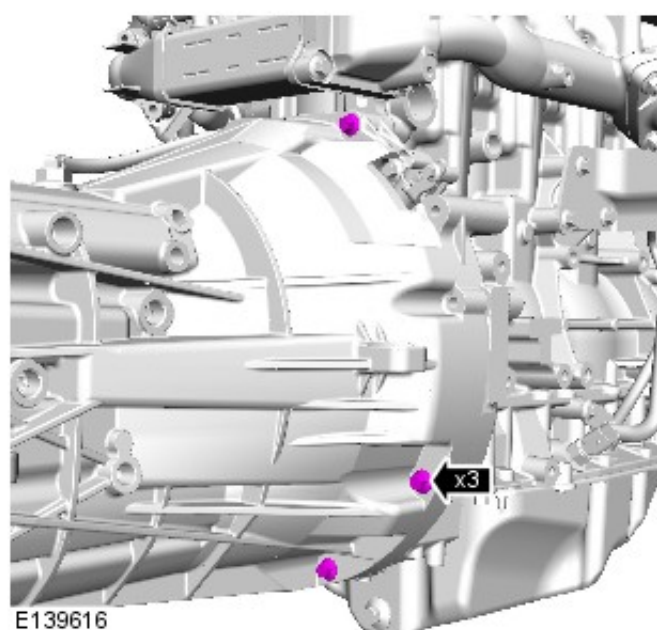
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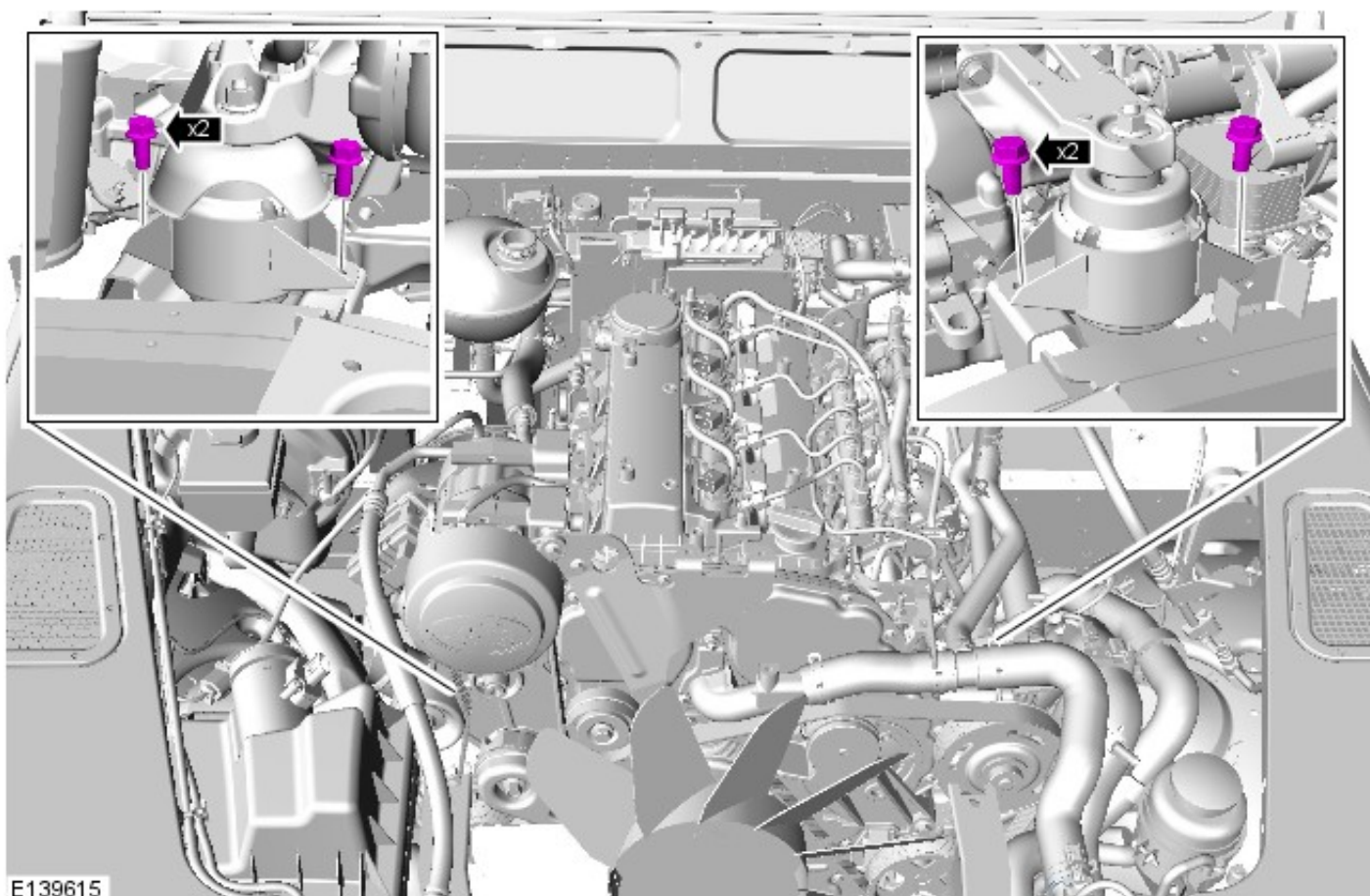
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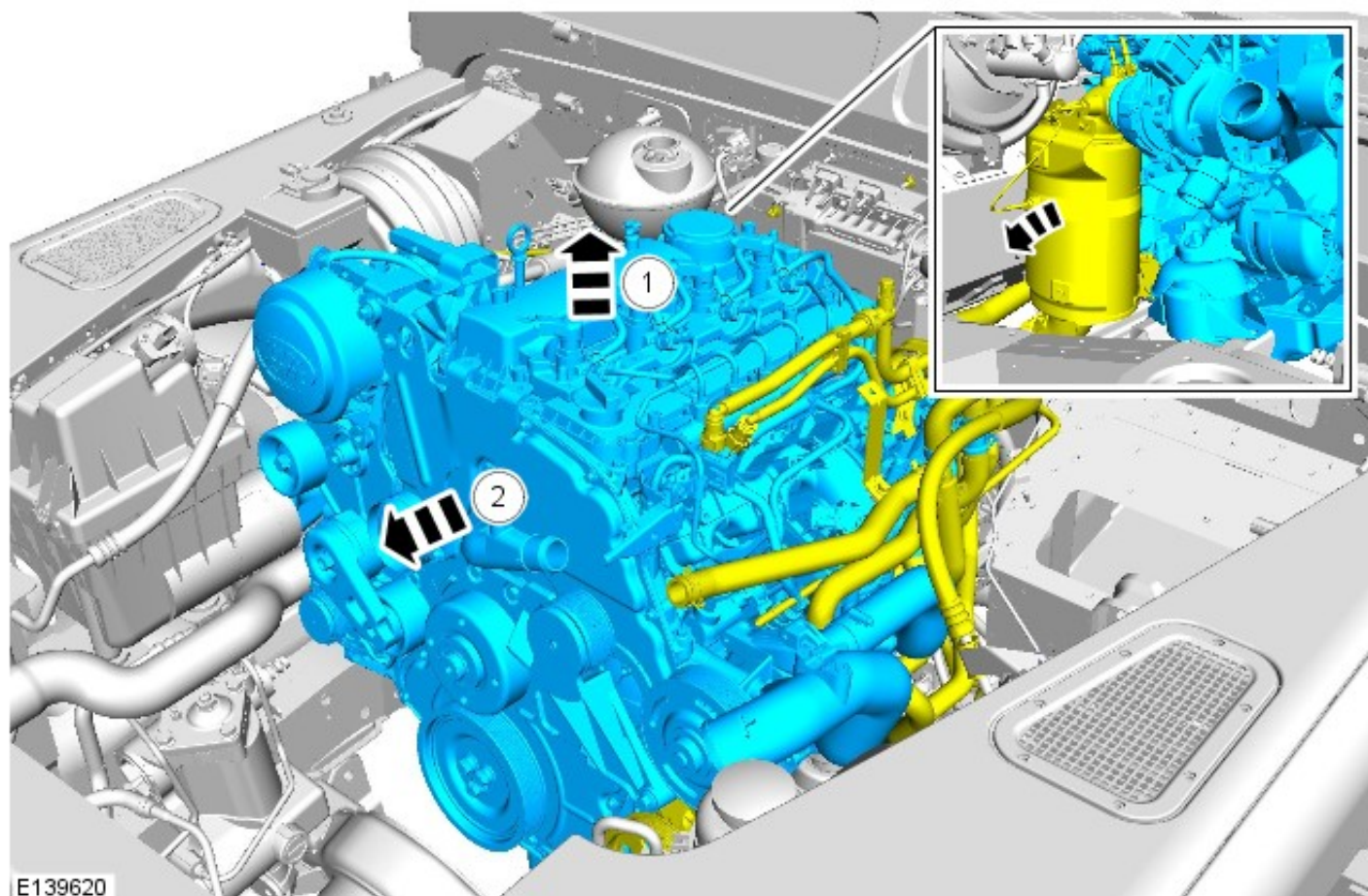
35.

36.





39.  **CAUTION:** Care must be taken to avoid damage to surrounding components.



Content not found

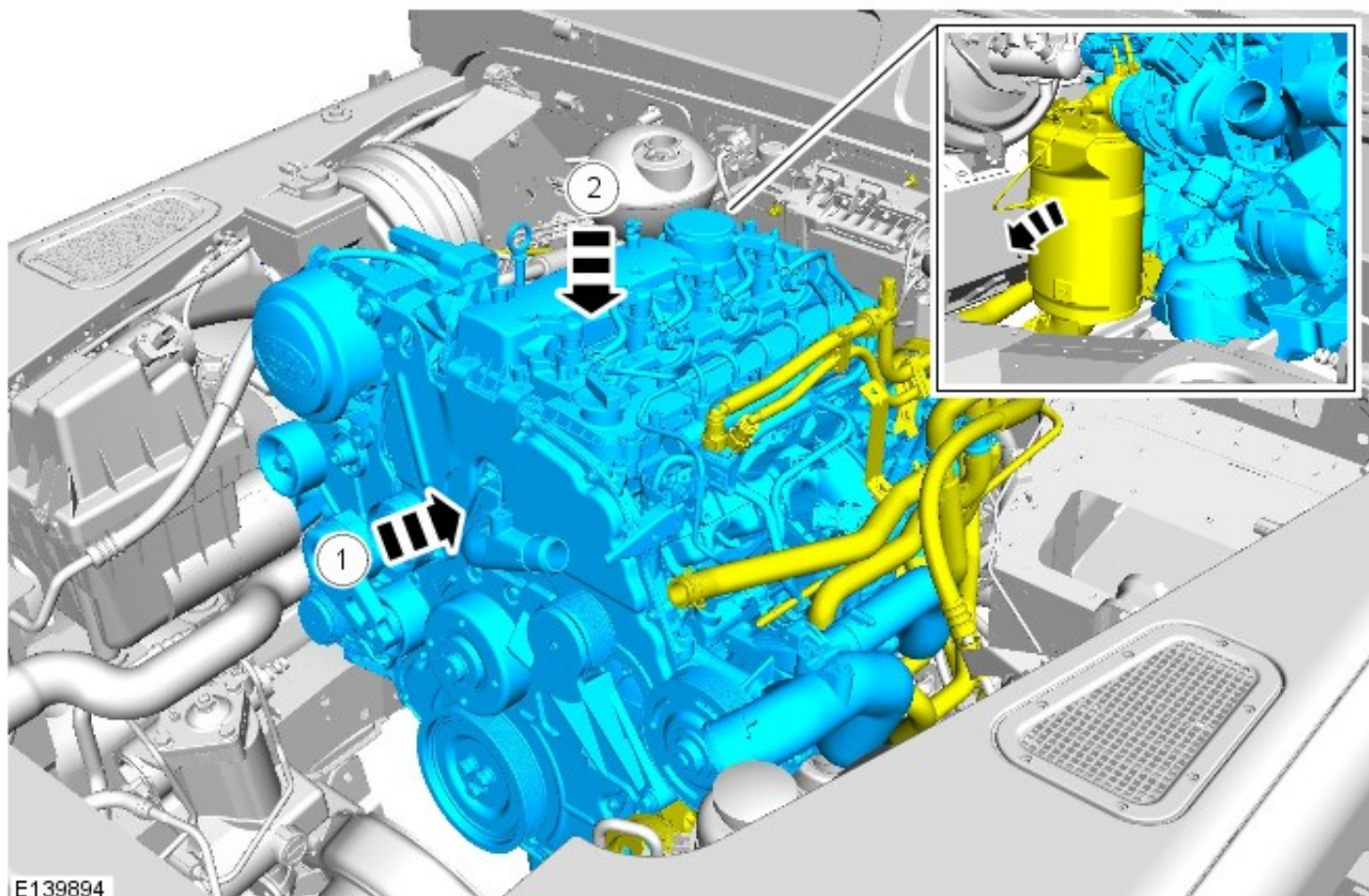
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Engine - ID4 2.2L Diesel - Engine

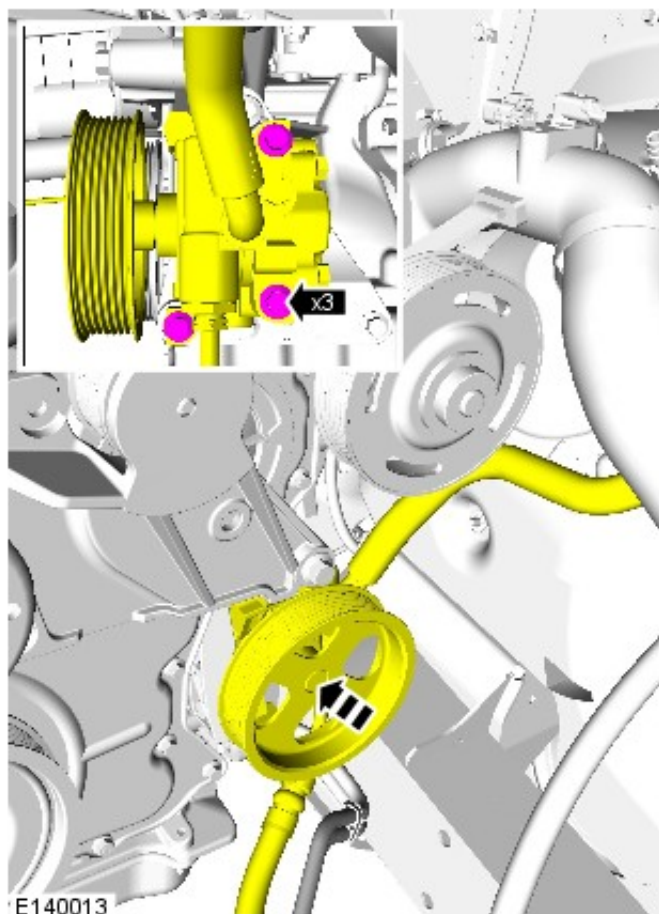
Installation

Installation

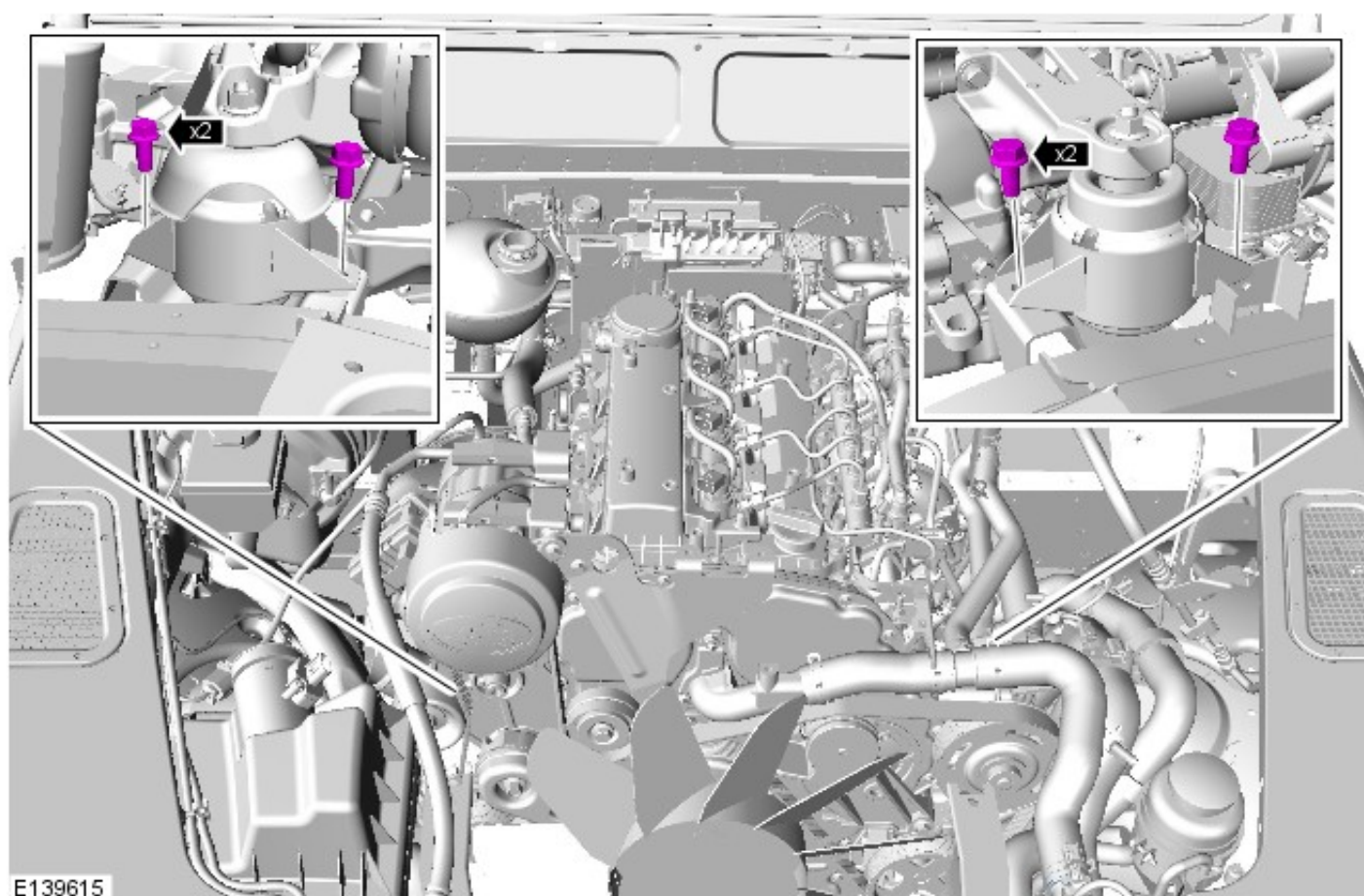
1.  **CAUTION:** Care must be taken to avoid damage to surrounding components.



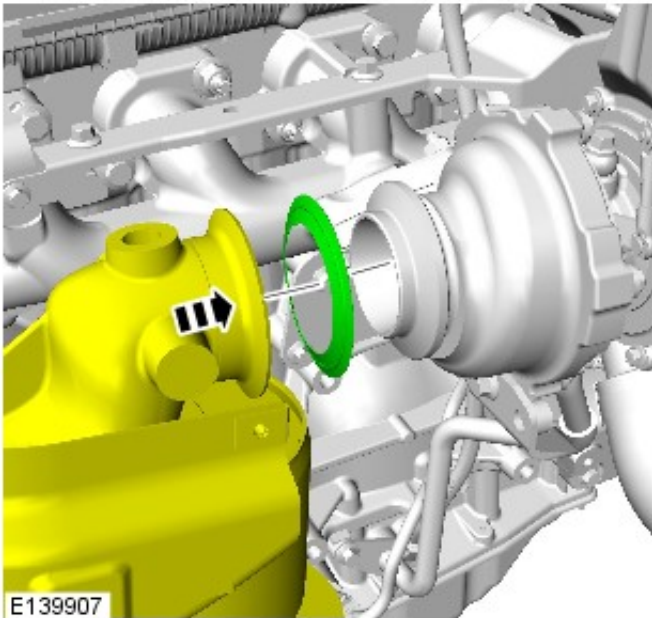
2. Torque: 23Nm



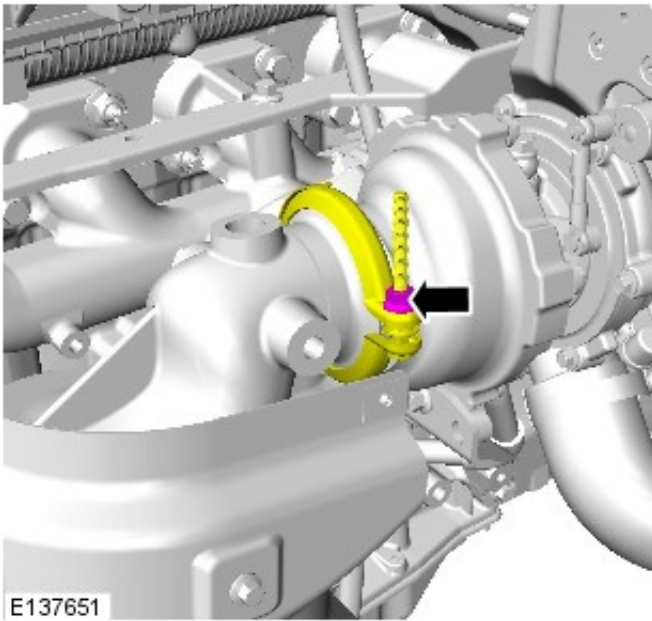
3. Torque: 80Nm




4. NOTE: Make sure a new gasket is installed.



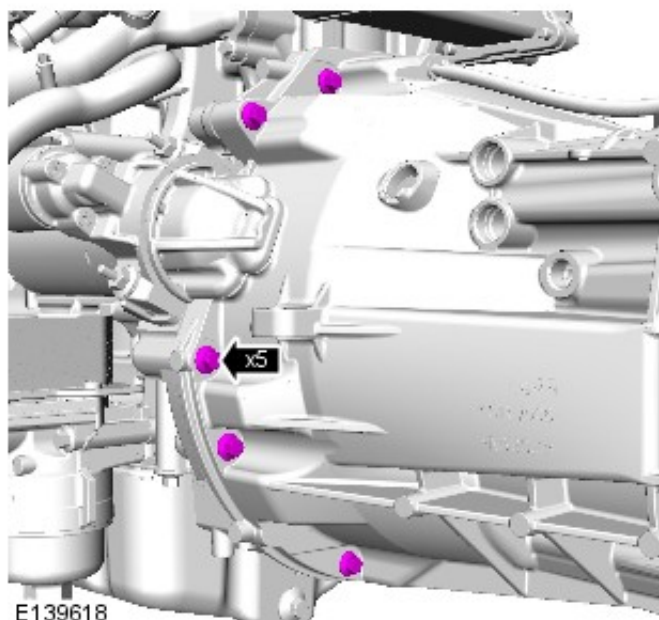
5. Torque: 10Nm



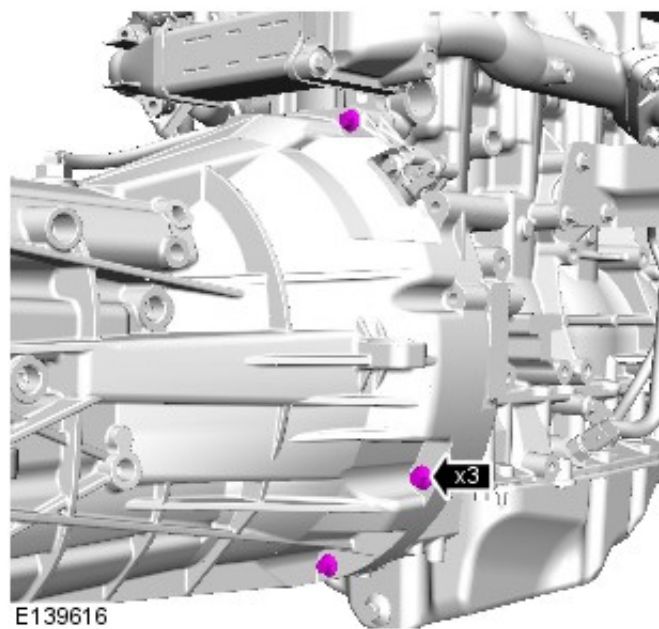
6.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

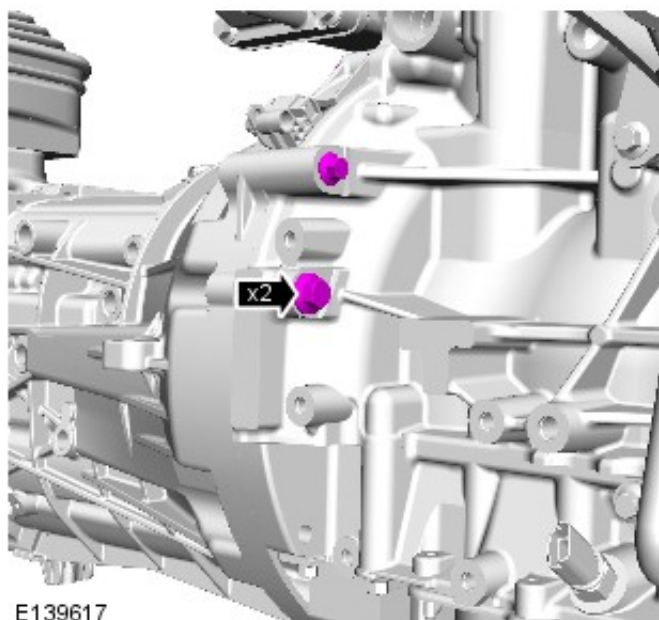
7. Torque: 40Nm



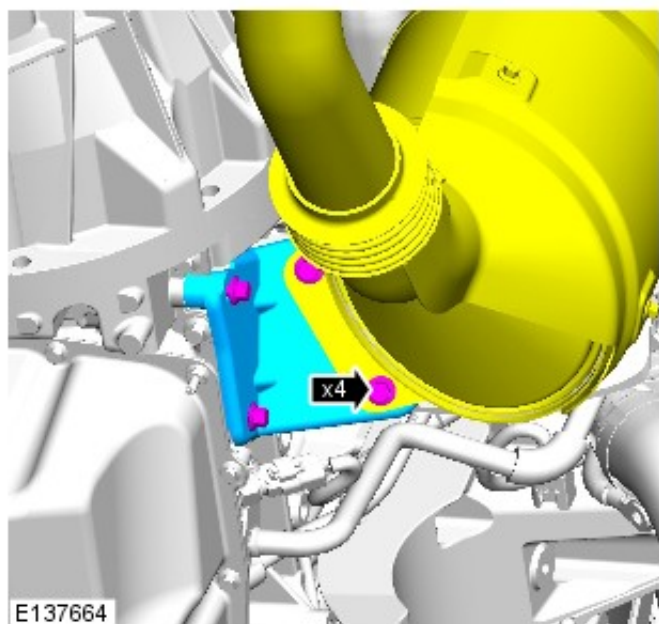
8. Torque: 40Nm



9. Torque: 40Nm

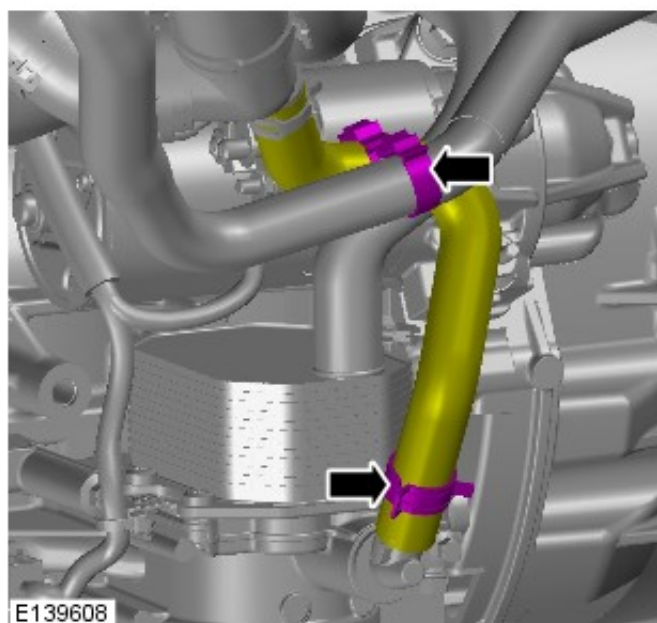


10. Torque: 25Nm

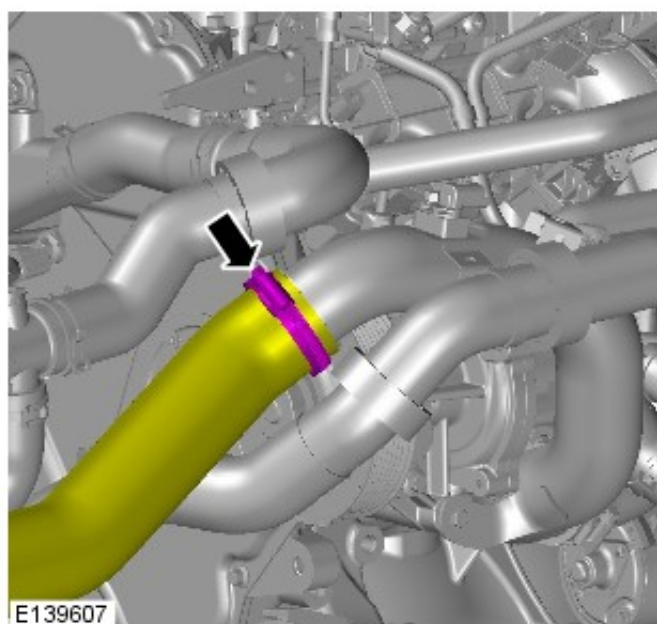


11. Lower the vehicle.

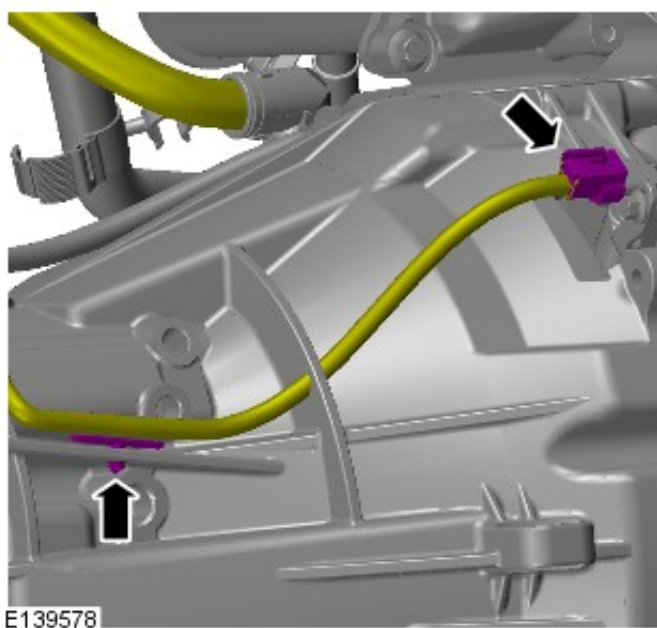
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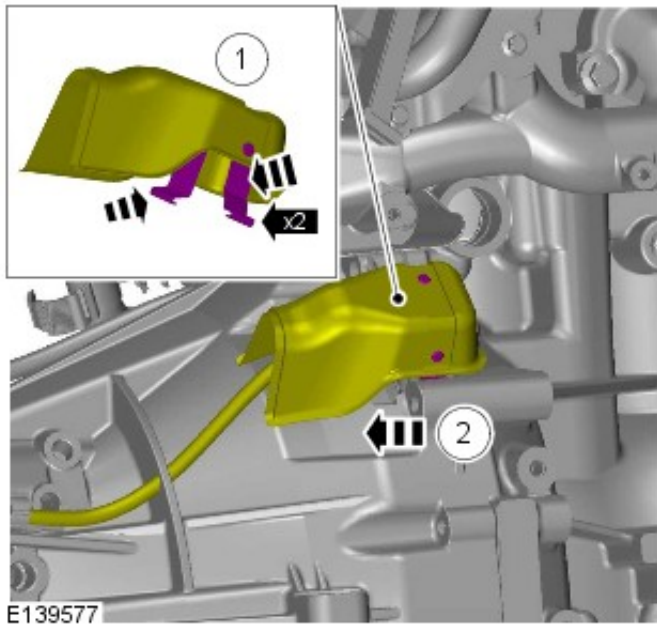
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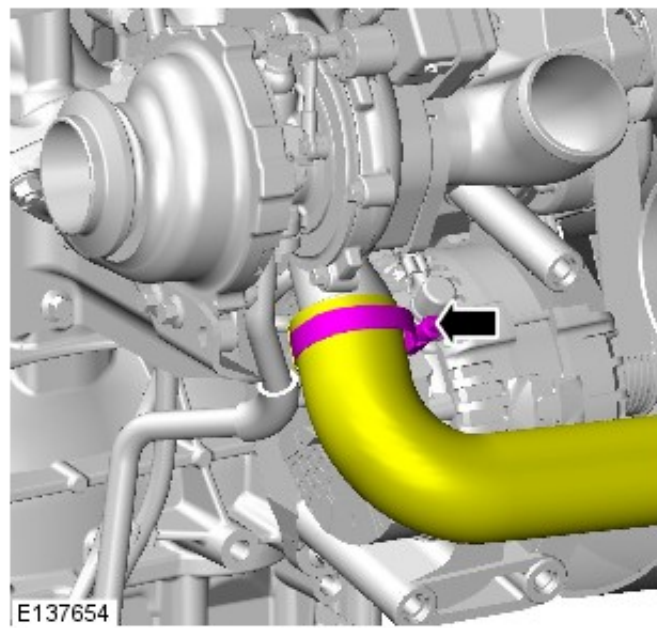
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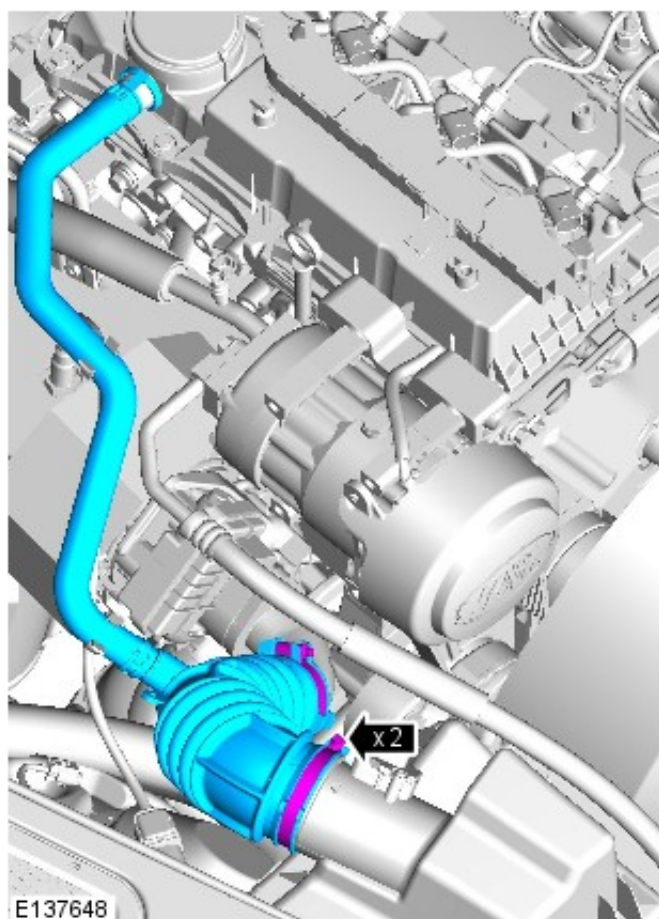
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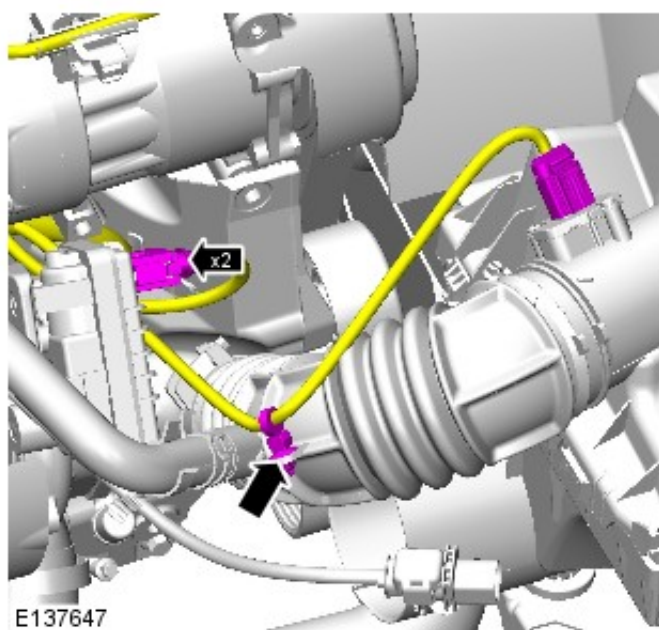
16. Torque: 3Nm



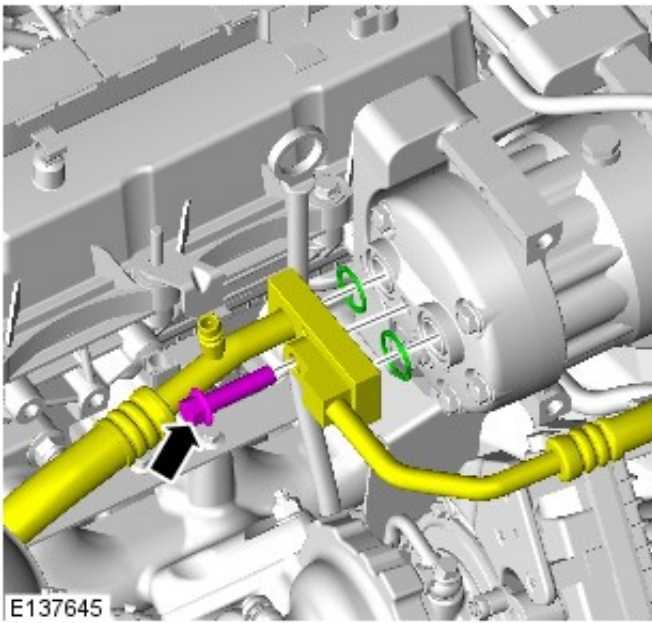
17. Torque: 3Nm



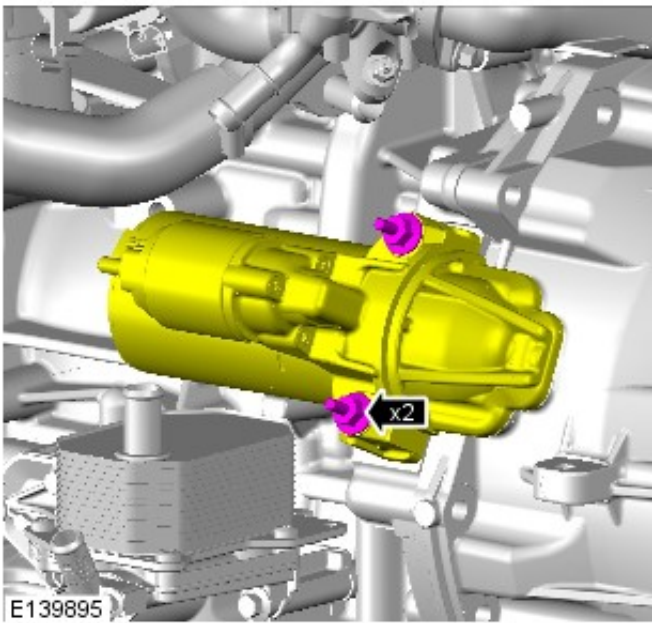
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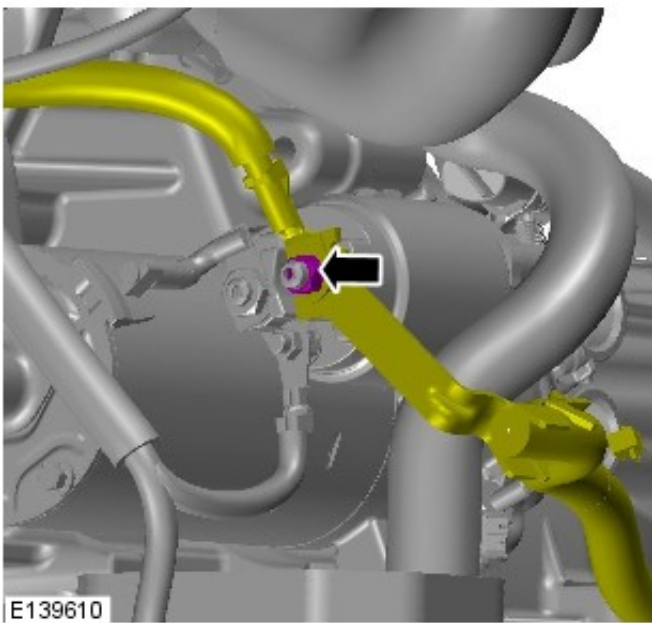
19. NOTE: Remove and discard the blanking caps.
 NOTE: Make sure that a new seals are installed.
 Torque: 30Nm



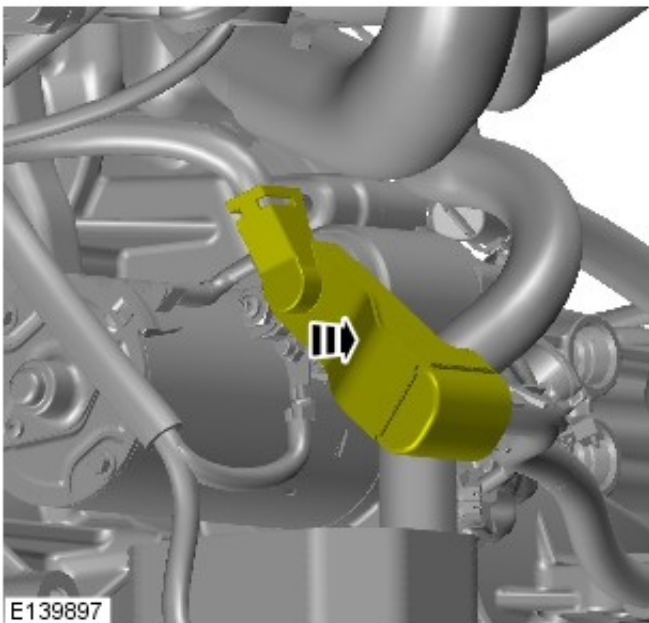
20. Torque: 35Nm



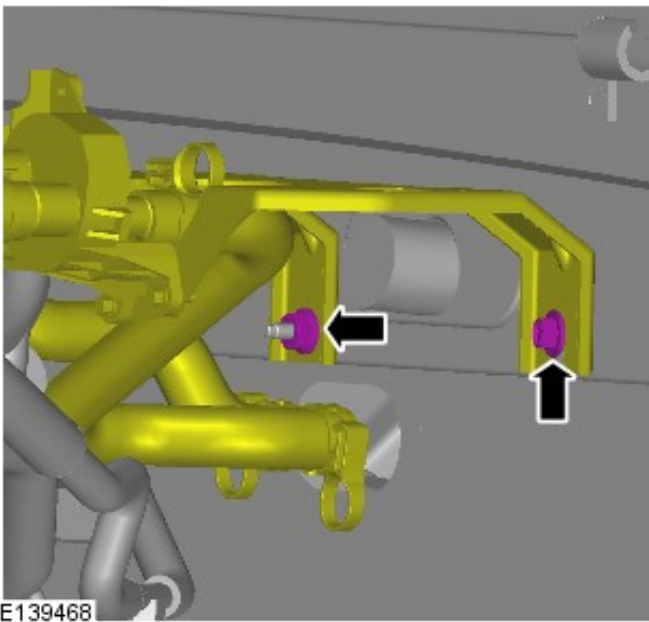
21. Torque: 12Nm



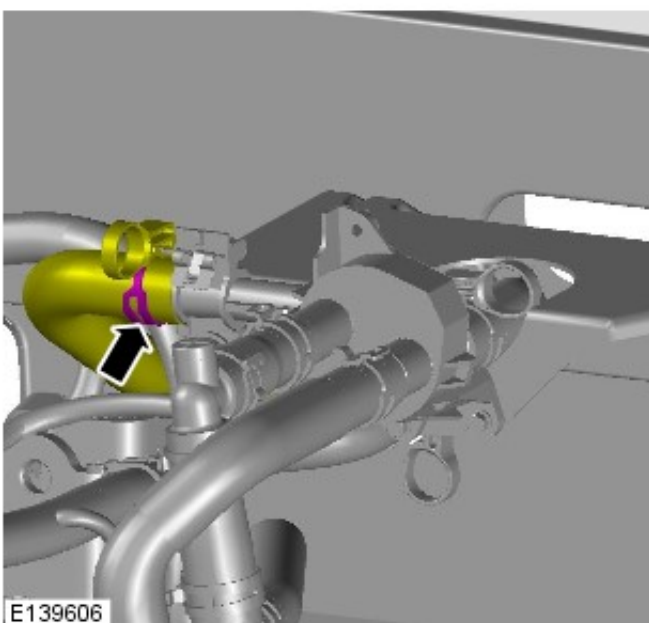
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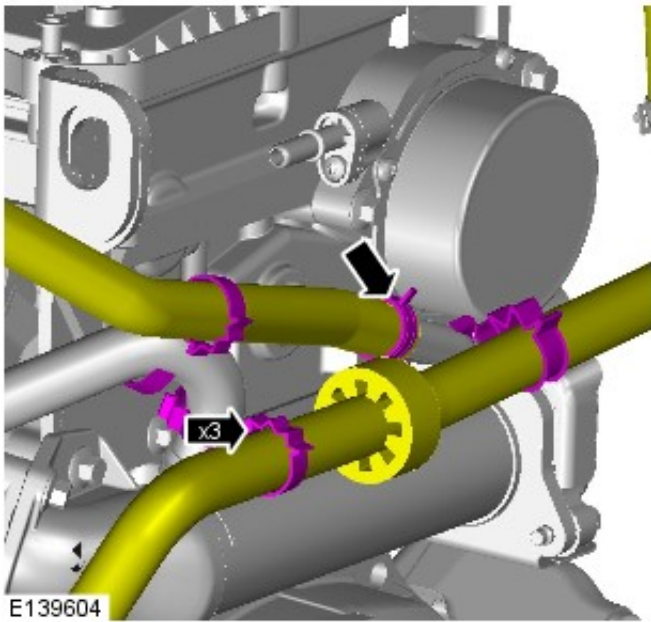
23. Torque: 10Nm



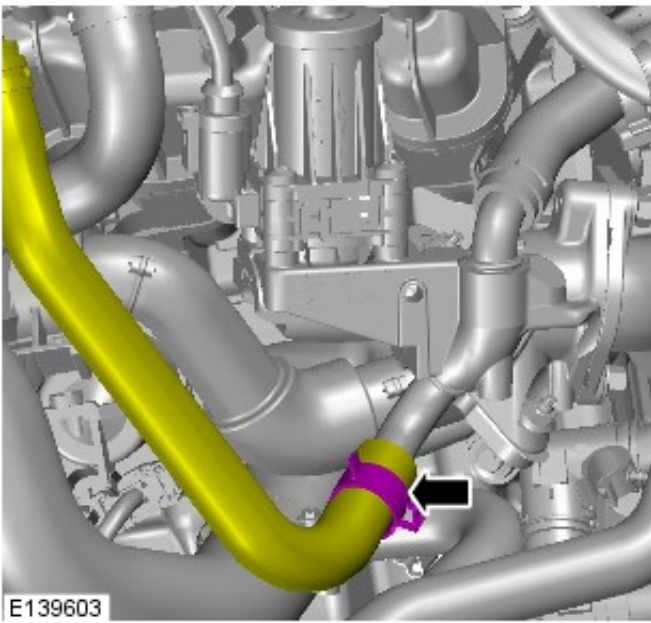
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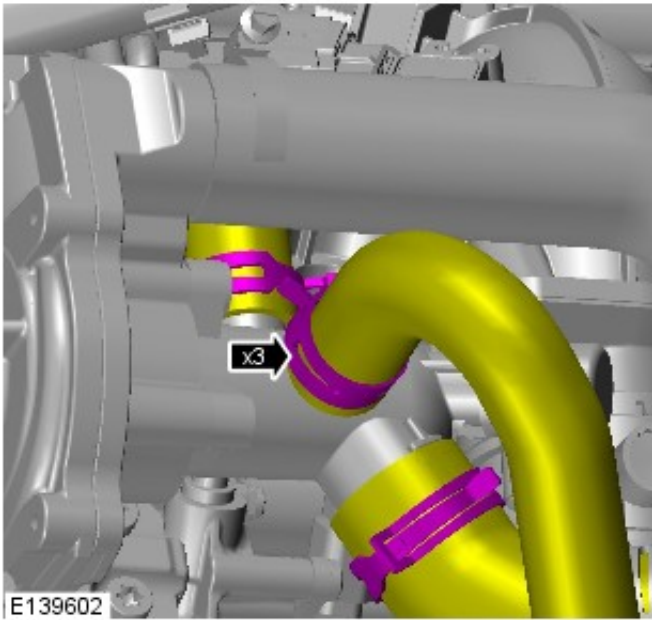
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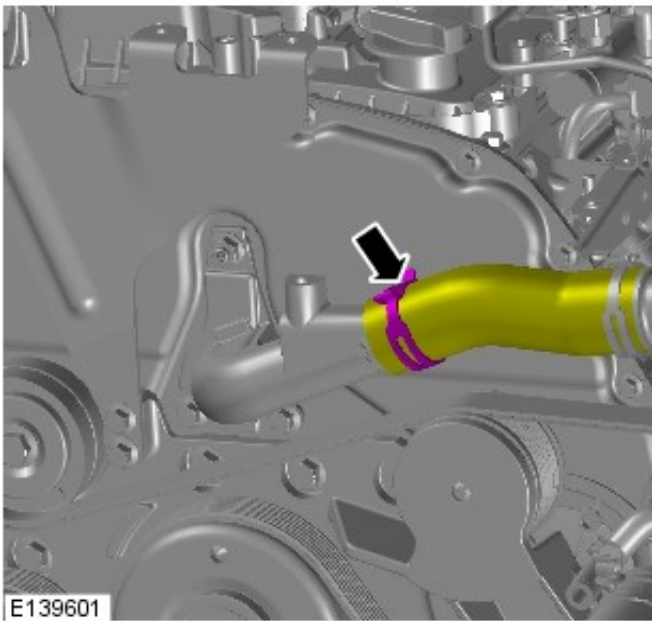
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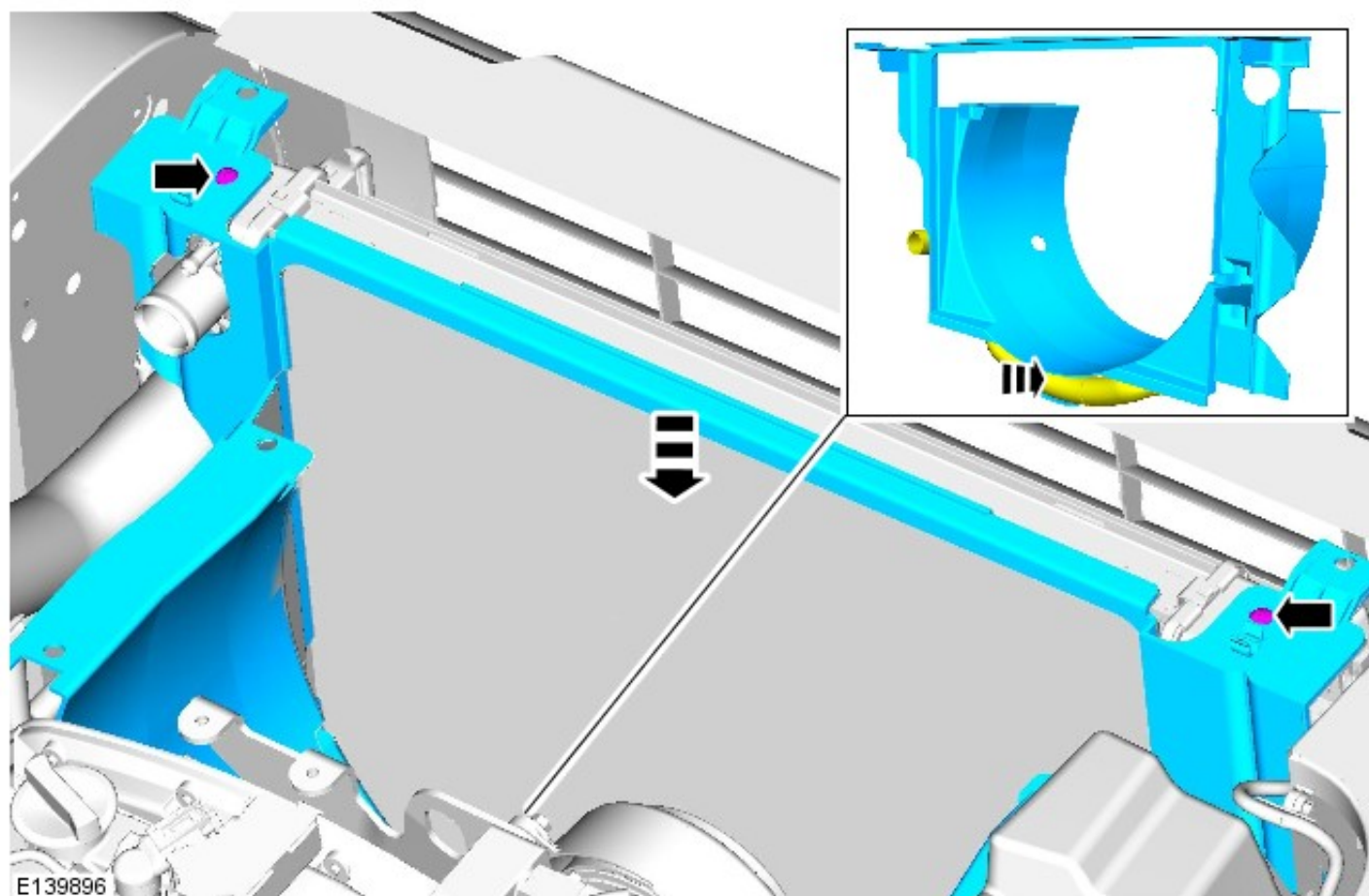
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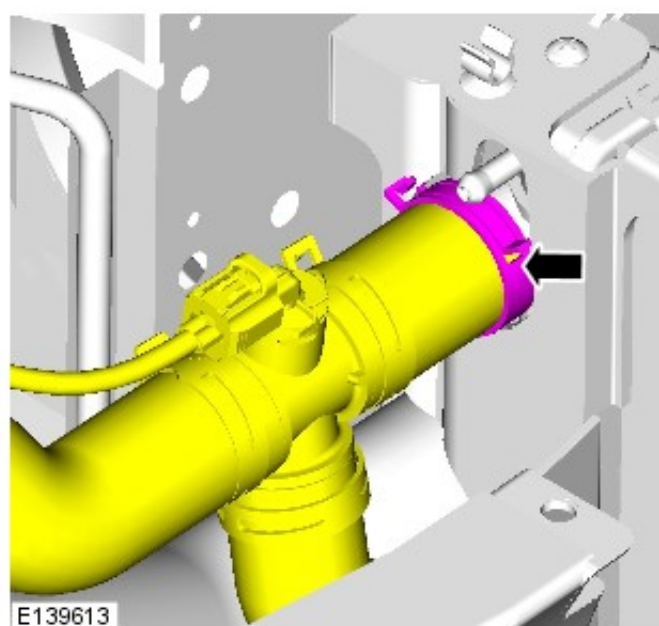
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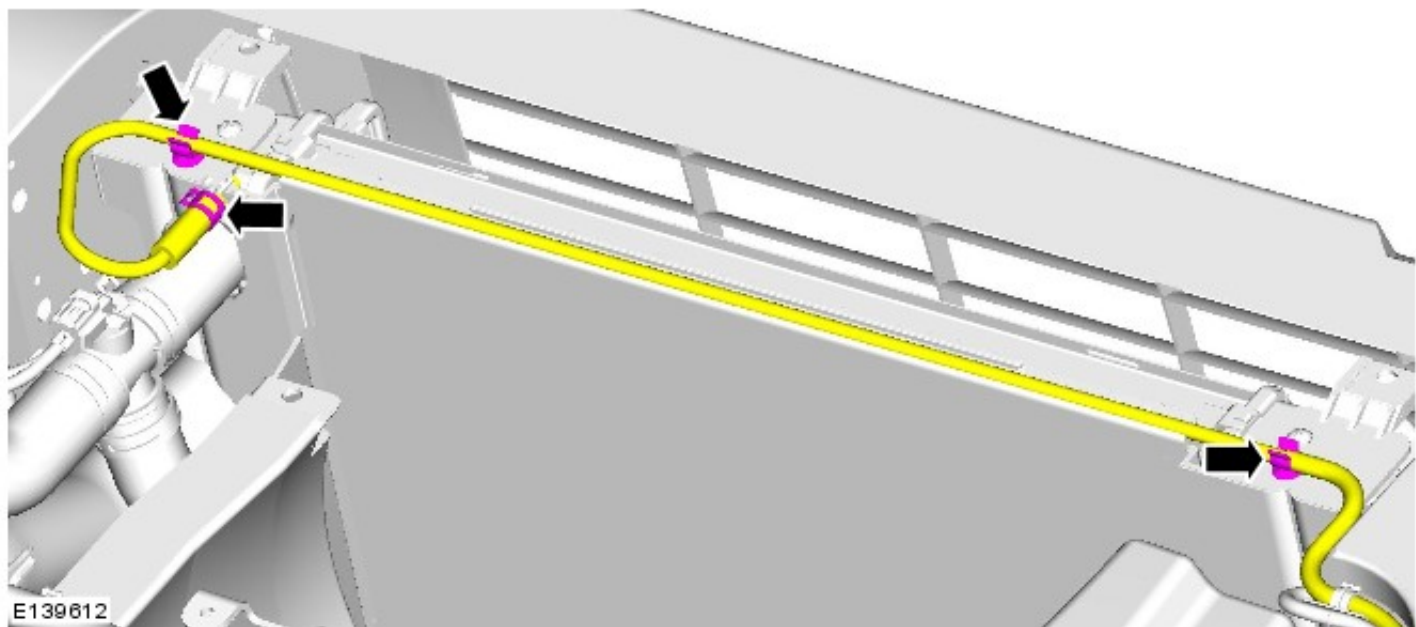
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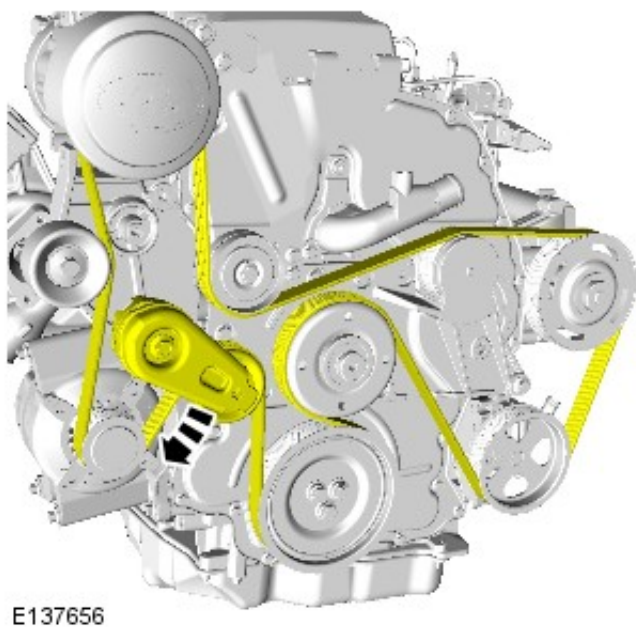
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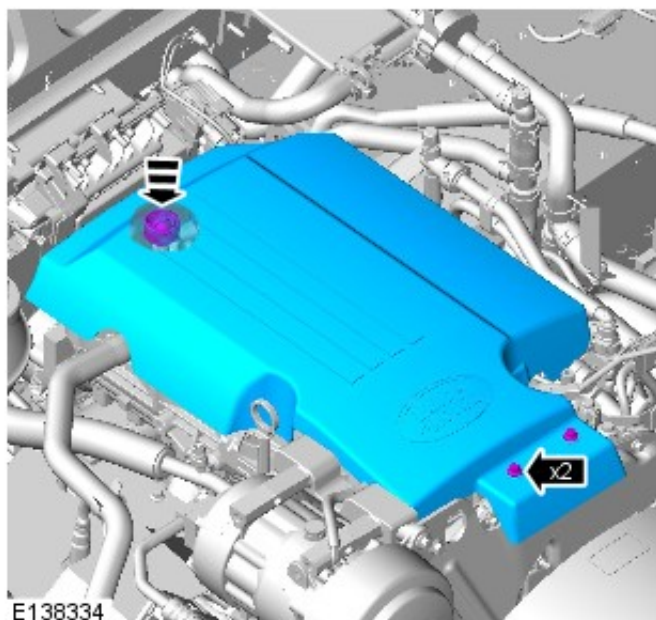


32.



33. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).

34.



35. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
36. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).
37. For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

Engine Cooling - ID4 2.2L Diesel -

Item	Specification
Anti-freeze	WAS-M97B44-D
Anti-freeze concentration - Will provide frost protection to -40°C (-40°F)	50%
Specific gravity of coolant at 20°C (68°F), to protect against frost down to -40°C (-40°F)	1.068

Item	Capacity
Cooling System	10 Liters (17.6 pints) (10.6 quarts)
Radiator	2.3 Liters (4 pints) (2.4 quarts)
Coolant Expansion Tank (To Cold Level)	1.2 Liters (2.1 pints) (1.3 quarts)

Item	Description
Cooling system type	Pressurized, thermostatically controlled with coolant expansion tank
Radiator	Cross flow
Coolant expansion tank	Remote with cold level fill mark
Pressure cap rating	100 kPa (1 bar) (15.9 lbf/in ²)
Thermostat: Starts to open	82° C (180°F)
Thermostat: Fully open	96° C (205°F)
Cooling fan	Viscous
Cooling fan control	Bi-metallic
Cooling fan diameter	475 mm (18.70 inches)
Cooling fan direction of rotation	Clockwise when viewed from front of engine
Coolant pump	Centrifugal flow impeller, belt driven from the crankshaft

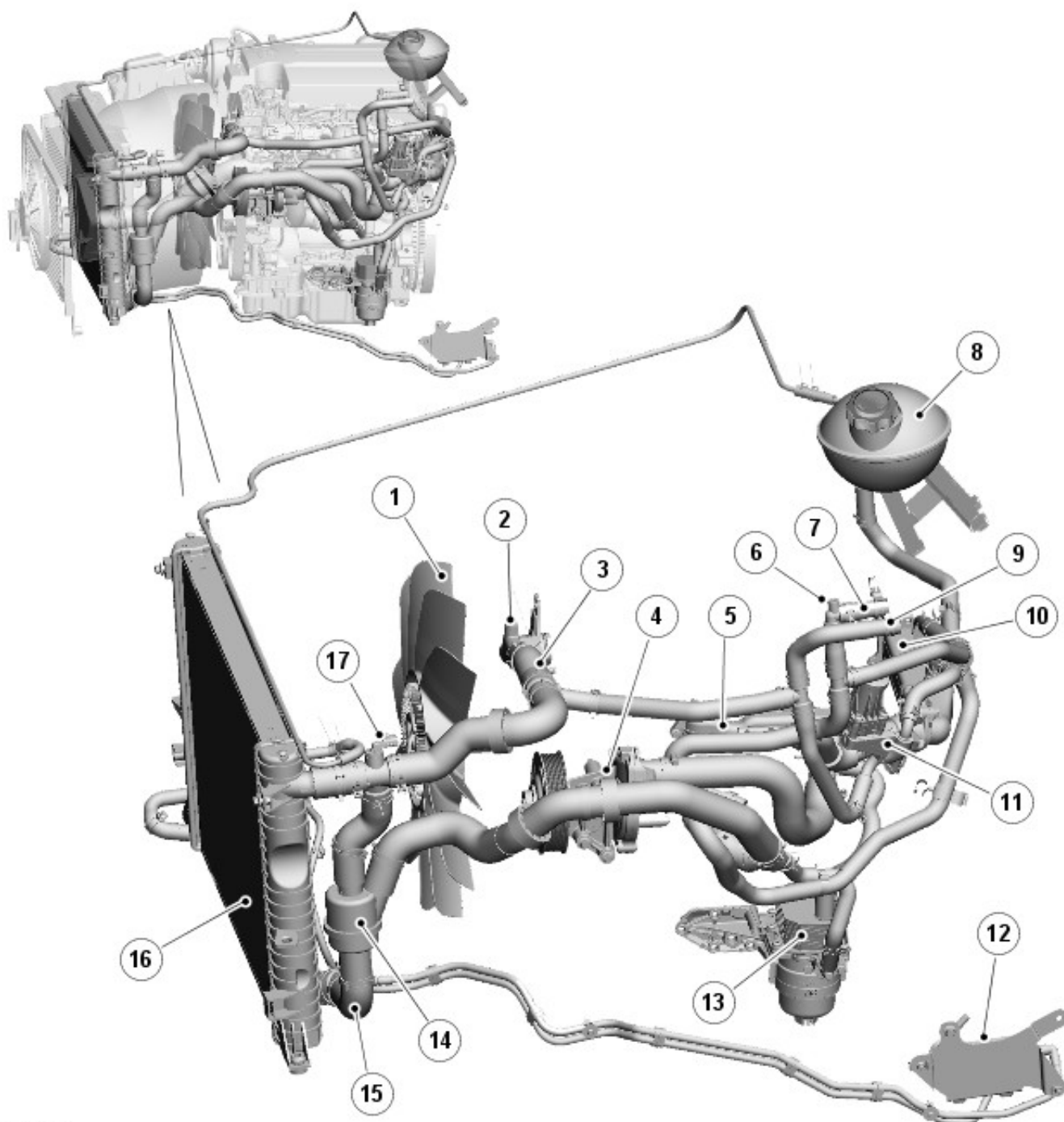
Torque Specifications

Description	Nm	lb-ft
Coolant bleed screw(s)	3	2
Coolant pump bolts	23	17
Coolant pump outlet manifold	10	7
Coolant pump hose clip	3	2
Viscous coupling bolts	10	7
Expansion tank bolt	10	7
Charge air cooler to radiator bolts	20	15
Charge air cooler inlet and outlet hose clips	3	2
Charge air cooler bracket bolts	9	7
Power steering reservoir nuts	4	3

Engine Cooling - ID4 2.2L Diesel - Engine Cooling

Description and Operation

COMPONENT LOCATION



E138698

Item	Part Number	Description
1	-	Cooling fan
2	-	Outlet connector
3	-	Radiator upper hose
4	-	Coolant pump
5	-	Distribution manifold
6	-	Bleed screw
7	-	Heater return connection
8	-	Expansion tank
9	-	Heater feed connection
10	-	EGR (exhaust gas recirculation) cooler

11	-	EGR valve
12	-	Fuel cooler
13	-	Engine oil cooler
14	-	Thermostat
15	-	Radiator lower hose
16	-	Radiator
17	-	ECT (engine coolant temperature) sensor

OVERVIEW

The cooling system employed is the bypass type, which allows coolant to circulate around the engine and the heater circuit while the thermostat is closed. The primary function of the cooling system is to maintain the engine within an optimum temperature range under changing ambient and engine operating conditions. Secondary functions are to provide:

- Heating for the passenger compartment.
For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Description and Operation).
- Cooling for:
 - The [EGR](#) valve and [EGR](#) cooler.
For additional information, refer to: [Engine Emission Control](#) (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation).
 - The engine oil cooler.
For additional information, refer to: [Engine](#) (303-01 Engine - ID4 2.2L Diesel, Description and Operation).
 - The fuel cooler.
For additional information, refer to: [Fuel Tank and Lines - ID4 2.2L Diesel](#) (310-01 Fuel Tank and Lines - ID4 2.2L Diesel, Description and Operation).

The primary components of the engine cooling system are:

- A coolant pump
- An inlet manifold and an outlet connector
- A thermostat
- A radiator
- An expansion tank
- A cooling fan
- Connecting hoses and pipes

An [ECT](#) sensor for the engine management system is installed in the radiator upper hose.

For additional information, refer to: [Electronic Engine Controls](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Description and Operation).

The coolant is circulated by a centrifugal type pump mounted on the front [LH \(left-hand\)](#) side of the engine and driven by the accessory drive belt. An outlet hose supplies coolant from the pump to a distribution manifold on the [LH](#) side of the cylinder block. The coolant flows through the cylinder block and cylinder head, to an outlet connector on the front of the cylinder head, then into the radiator upper hose.

The thermostat, installed between the radiator upper and lower hoses, regulates the coolant flow through the radiator to provide a rapid engine warm-up and then maintain a stable engine temperature. The outlet from the thermostat is directed back to the inlet side of the coolant pump.

The radiator is a cross flow type with an aluminum matrix and plastic end tanks. The end tanks have brackets which allow for the attachment of the fan cowl assembly, charge air cooler and, if fitted, [A/C \(air conditioning\)](#) condenser. The bottom of the radiator is located in rubber bushes supported by brackets on the chassis longitudinals. The top of the radiator is located in rubber bushes secured by brackets fitted to the bonnet locking platform.

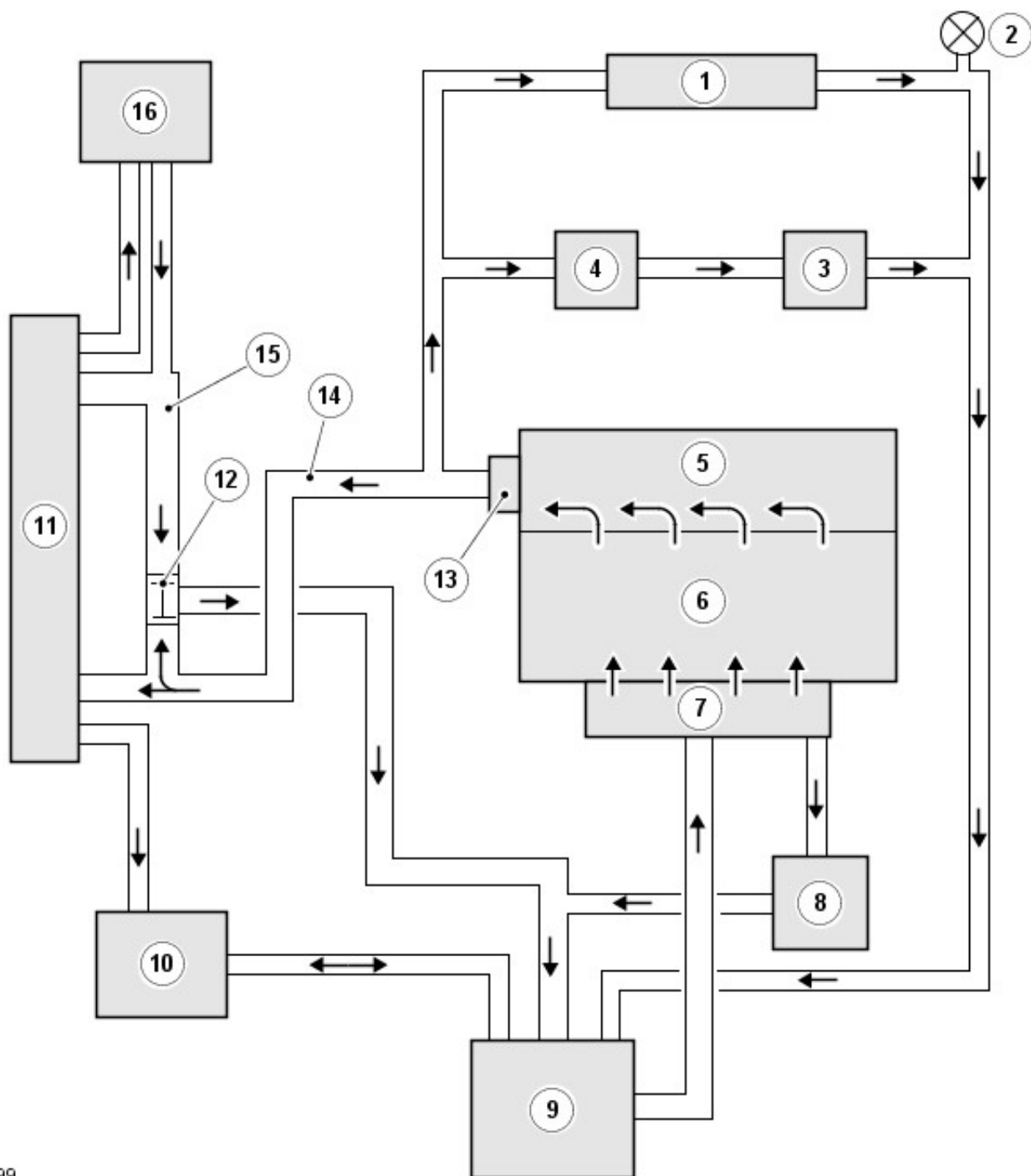
A connection on the distribution manifold supplies coolant to the engine oil cooler. The return from the engine oil cooler is connected to the hose between the thermostat and the coolant pump inlet.

The radiator upper hose has a connection for the feed to the heater matrix, [EGR](#) valve and [EGR](#) cooler. The return is connected to an inlet on the coolant pump. The heater matrix outlet hose incorporates a bleed screw to bleed air when filling the cooling system.

The feed for the fuel cooler comes from a connection on the [RH \(right-hand\)](#) end tank of the radiator. The return from the fuel cooler is connected to the radiator lower hose.

The expansion tank is fitted to the [RH](#) suspension turret in the engine compartment. The expansion tank allows for expansion of the coolant when the engine is hot, and retraction as the engine cools down, through a hose connected to an inlet on the coolant pump. A hose connected between the upper left corner of the radiator and the expansion tank ensures there is a constant flow through the expansion tank while the engine is running, to separate out any air in the system. The expansion tank filler cap provides a service fill and top-up point, and pressurizes the system during operation.

The cooling fan generates additional airflow through the radiator matrix, particularly when the vehicle is stationary. The cooling fan is an 11-bladed viscous fan, which is attached to a pulley on the engine front cover and driven by the accessory drive belt. A two-piece shroud provides an air duct between the cooling pack and the fan, and also forms a protective cover.



E138699

Item	Part Number	Description
1	-	Heater matrix
2	-	Bleed screw
3	-	EGR cooler
4	-	EGR valve
5	-	Cylinder head
6	-	Cylinder block
7	-	Distribution manifold
8	-	Engine oil cooler
9	-	Coolant pump
10	-	Expansion tank
11	-	Radiator
12	-	Thermostat
13	-	Outlet connector
14	-	Radiator upper hose
15	-	Radiator lower hose

Engine Cooling - ID4 2.2L Diesel - Engine Cooling

Diagnosis and Testing

Overview

For information on the operation of the systems:

REFER to: [Engine Cooling](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical faults.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Coolant leaks • Coolant hoses • Coolant expansion tank • Radiator • Heater core • Accessory drive belt • Viscous fan 	<ul style="list-style-type: none"> • Fuses • Fuse 29, passenger compartment • Harnesses • Loose or corroded connector(s) • Cylinder head temperature (CHT) sensor • Engine oil temperature (EOT) sensor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart

Symptom	Possible cause	Action
Coolant loss	<ul style="list-style-type: none"> • Hoses • Hose connections • Radiator • Water pump • Heater core • Gaskets • Engine casting cracks • Engine block core plugs 	Carry out a visual inspection. If there are no obvious leaks, carry out a pressure test using your workshop tester. Rectify as necessary.
Overheating	<ul style="list-style-type: none"> • Low/contaminated coolant • Thermostat • Viscous fan • Cylinder head temperature (CHT) sensor • Restricted air flow over the radiator 	Check the coolant level and condition. Carry out a pressure test using your workshop tester. Rectify as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	<ul style="list-style-type: none"> • Thermostat • Viscous fan • Electric fan 	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

Engine Cooling - ID4 2.2L Diesel - Cooling System Draining, Filling and Bleeding

General Procedures



WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

CAUTIONS:



The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the engine.



Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

1. Set the heater controls to Hot.



2. **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Remove the coolant expansion tank cap.



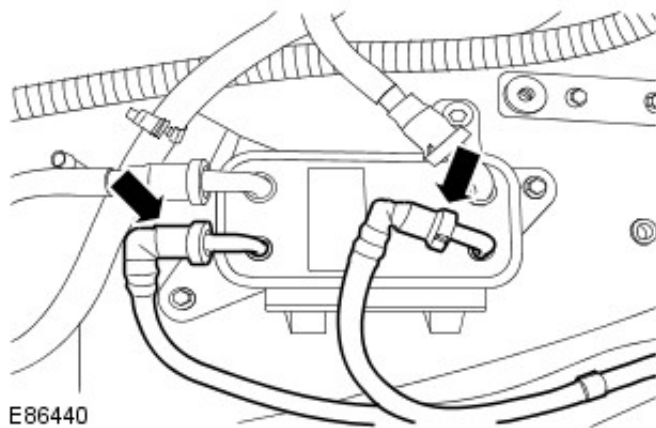
3. **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the cooling system bleed screw while the system is hot.

Loosen the cooling system bleed screw.



4. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.



5. **WARNING:** Eye protection must be worn.

NOTE: Position a container to collect the coolant.

Disconnect the 2 fuel cooler coolant pipes.

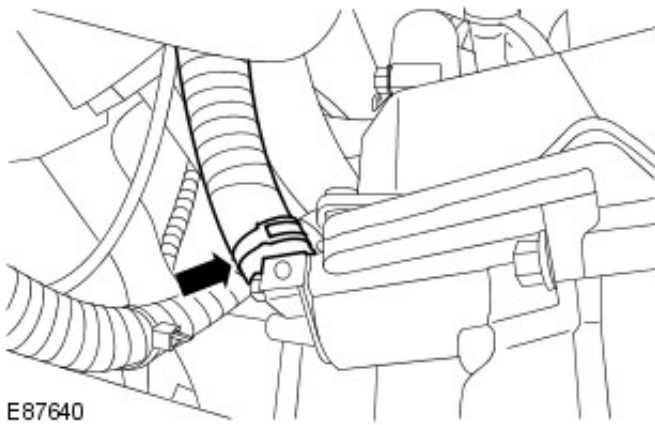
- Allow the coolant to drain.



6. **WARNING:** Eye protection must be worn.

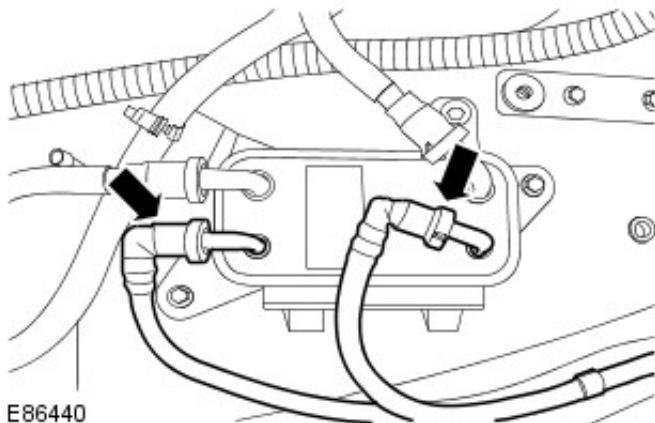
Disconnect the oil thermostat coolant hose.

- Allow the coolant to drain.

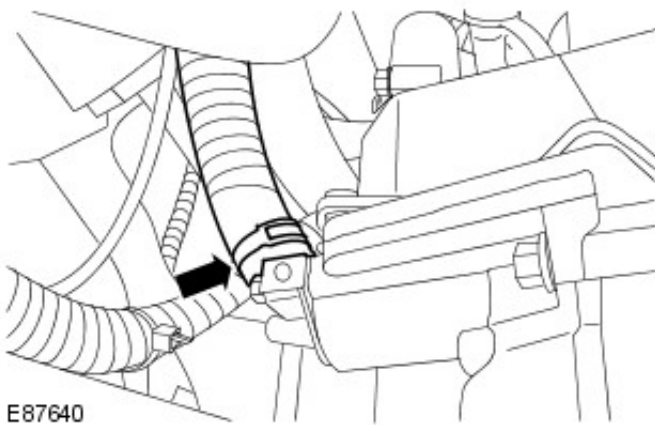


7. Remove the container.

8. Connect the 2 fuel cooler coolant pipes.



9. Connect the oil thermostat coolant hose.



10. **CAUTIONS:**



Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.



Anti-freeze concentration must be maintained at 50%.

Fill the cooling system expansion tank until the coolant level becomes static with in the "COLD FILL RANGE".

11. Tighten the cooling system bleed screw.

12. Install the coolant expansion tank cap.

13. **CAUTIONS:**



Make sure the coolant level remains above the "COLD FILL

RANGE" lower level mark.



Observe the engine temperature gauge. If the engine starts to over-heat switch off immediately and allow to cool. Failure to follow this instruction may cause damage to the vehicle.

Start and run the engine.

- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until the thermostat opens.



14. **WARNING:** Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top-up the expansion tank to 30mm above the maximum level.

Switch the engine off.

- Remove the coolant expansion cap, allow the level to settle and top-up so that the level is 30mm above the upper level.
- Allow the engine to cool.

15. Clean any spilt coolant from the vehicle.

16. Check and top-up the coolant if required.

Engine Cooling - ID4 2.2L Diesel - Cooling System Draining and Vacuum Filling

General Procedures



WARNING: To avoid having scalding hot coolant or steam blowing out of the cooling system, use extreme care when removing the coolant pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant pressure cap and turn it slowly until the pressure begins to release. Step back while the pressure is released from the system. When certain all the pressure has been released (still with a cloth) turn and remove the coolant pressure cap from the coolant expansion tank. Failure to follow these instructions may result in personal injury.


CAUTIONS:





The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the vehicle.



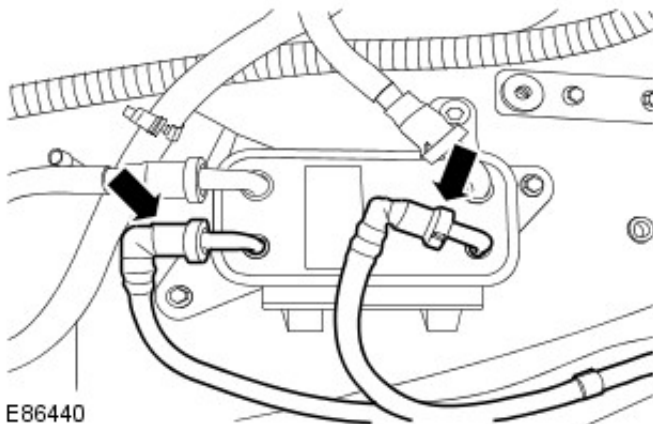
Engine coolant will damage paint finished surfaces. If spilled, immediately remove coolant and clean area with water.

1. Set the heater controls to maximum HOT.
2. Remove the hood.
For additional information, refer to: Hood (501-02, Removal and Installation).
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

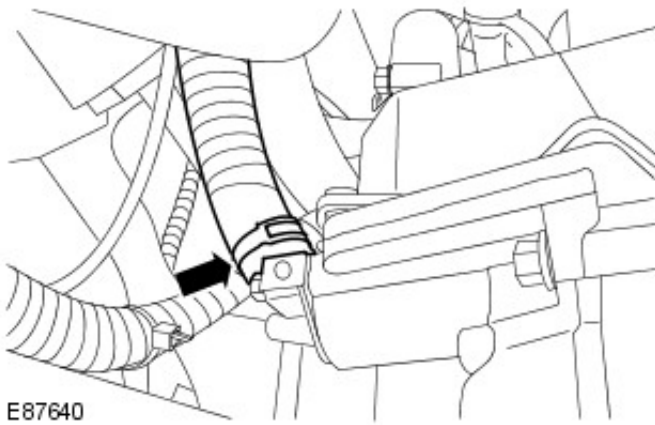
Remove coolant expansion tank filler cap.
4. Loosen the cooling system bleed screw.
5.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
6.  **WARNING:** Eye protection must be worn.

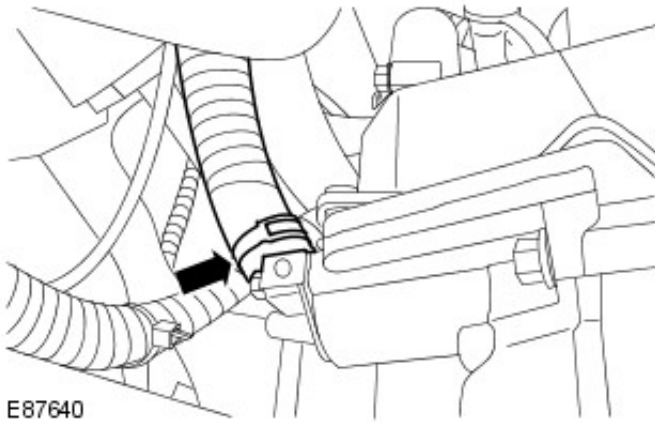
Position container to collect coolant.
7. Disconnect the 2 fuel cooler coolant pipes.
 - Allow the coolant to drain.



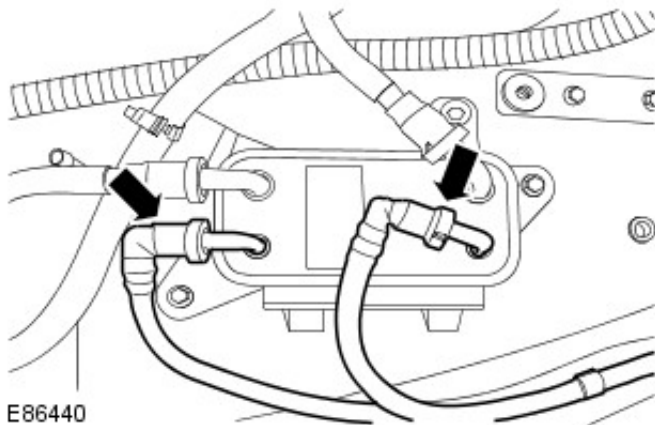
8. Disconnect the coolant hose from the engine oil cooler.
 - Release the clip.
 - Allow the coolant to drain.




9. Connect coolant hose to engine oil cooler.
 - Install the clip.



10. Connect the 2 fuel cooler coolant pipes.
 - Remove the container.

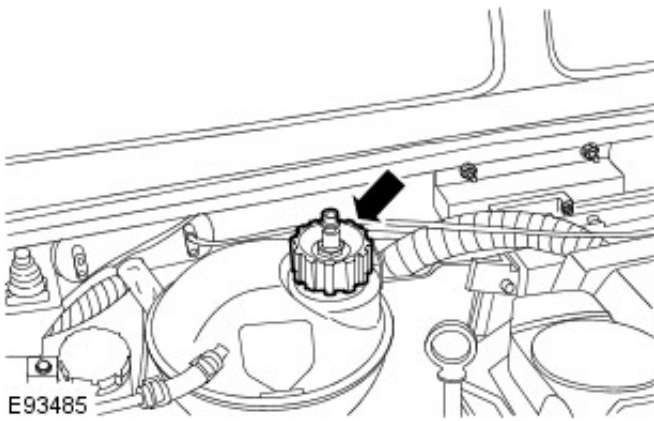


11. Tighten the cooling system bleed screw.

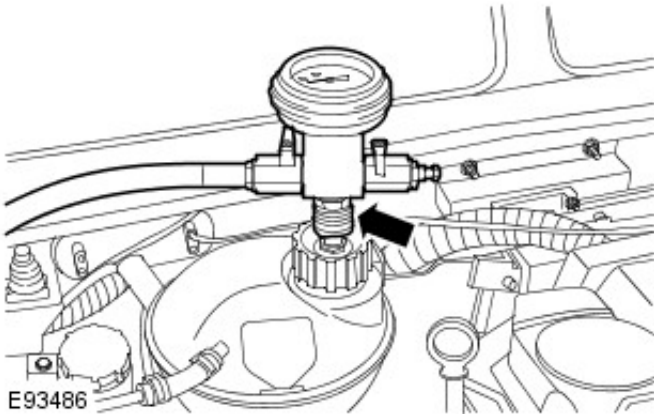
12.  **CAUTION:** The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the vehicle.

Prepare a sufficient amount of coolant to the required concentration and transfer to a container.

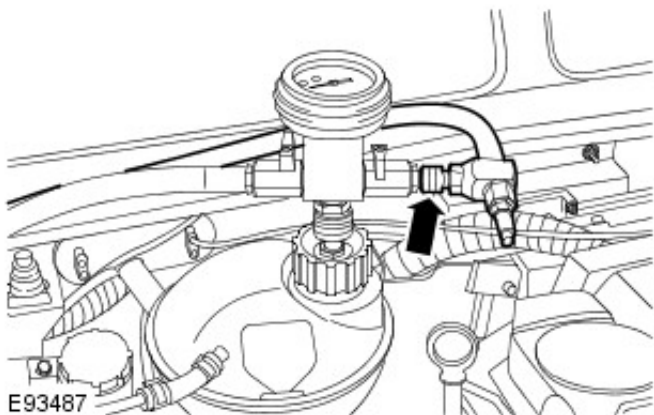
13. Install the cooling system vacuum refill adaptor to the expansion tank.



14. Install the vacuum filler gauge to the cooling system vacuum refill adaptor.

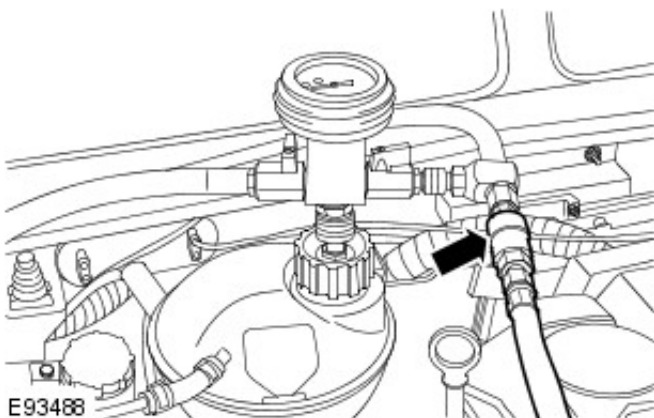


15. Install the venturi tube assembly to the vacuum filler gauge.



16. **NOTE:** Make sure both valves on gauge assembly are in the closed position.

Connect a regulated compressed air supply to the venturi tube assembly.



17. **NOTE:** Make sure air cannot enter the hose.

Position the coolant pick-up pipe into a container of clean coolant.

18. Position the evacuated air hose into a container.

19. **NOTE:** Make sure the coolant supply valve is in the

19. NOTE: Make sure the coolant supply valve is in the closed position on the vacuum filler gauge assembly.

NOTE: The coolant vacuum fill tool needs an air pressure of 6 to 8 bar (87 to 116 psi) to operate correctly.

NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

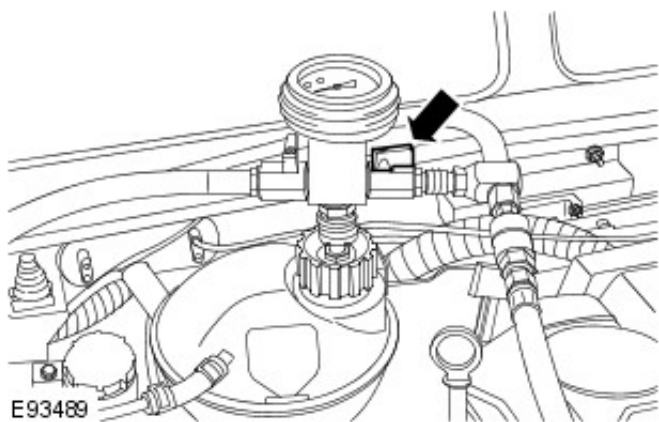
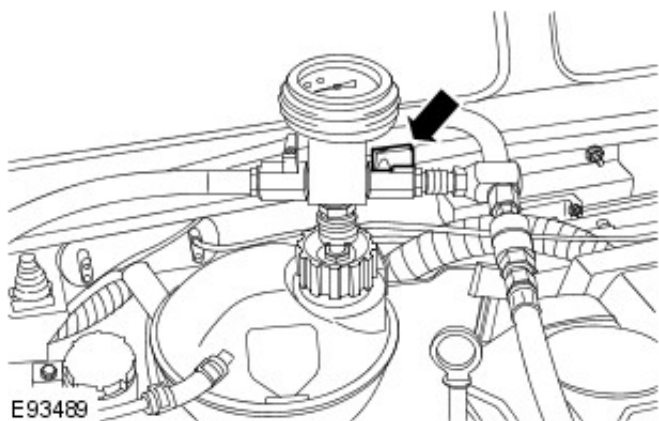
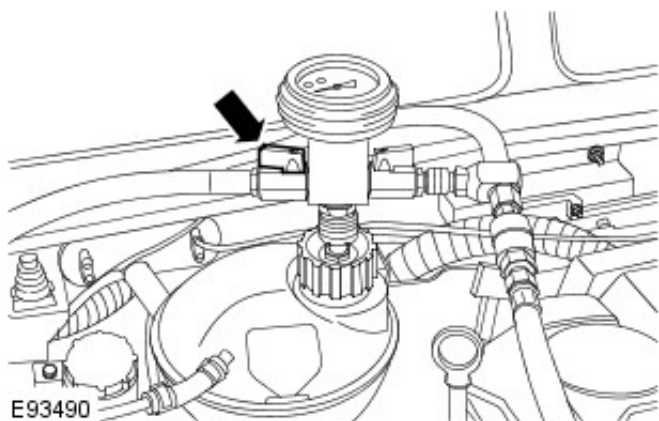
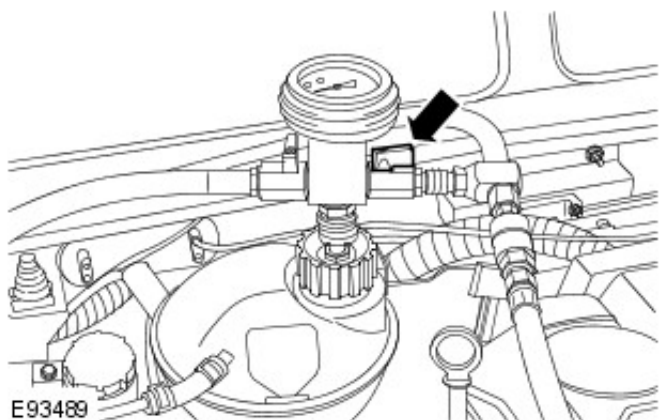
Open air supply valve.

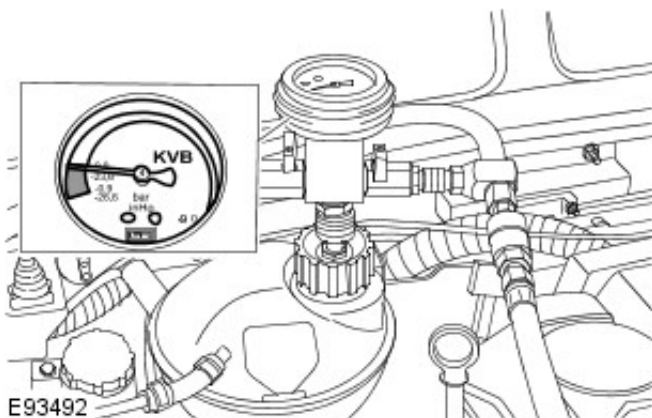
20. Open coolant supply valve for 2 seconds to prime coolant supply hose.

21. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

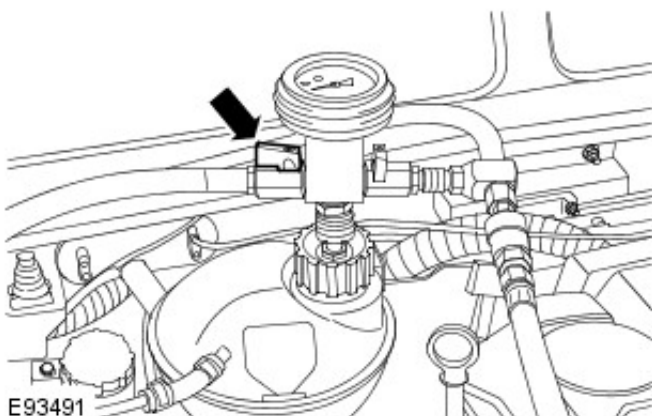
22. Close air supply valve and disconnect air supply.

23. Allow 1 minute to check vacuum is held.





24. Open coolant supply valve and allow coolant to be drawn into system.



25. When expansion tank is full and coolant movement has ceased close coolant supply valve.
26. Remove vacuum refill adaptor and gauge from expansion tank.
27. Install the coolant expansion tank filler cap.
28. Install the hood.
For additional information, refer to: Hood (501-02, Removal and Installation).

29. **CAUTIONS:**



Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.



Observe the engine temperature gauge. If the engine starts to over-heat switch off immediately and allow to cool. Failure to follow this instruction may cause damage to the vehicle.

Start and run engine.

- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until normal operating temperature is reached.

30. Switch off the engine and allow to cool.



31. **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Check and top-up the coolant level if required.

Engine Cooling - ID4 2.2L Diesel - Coolant Expansion Tank

Removal and Installation

Removal

1. WARNINGS:



Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.



Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

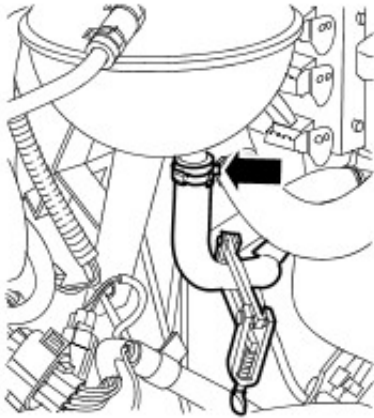


CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Release the cooling system pressure.

2. Disconnect the coolant hose.

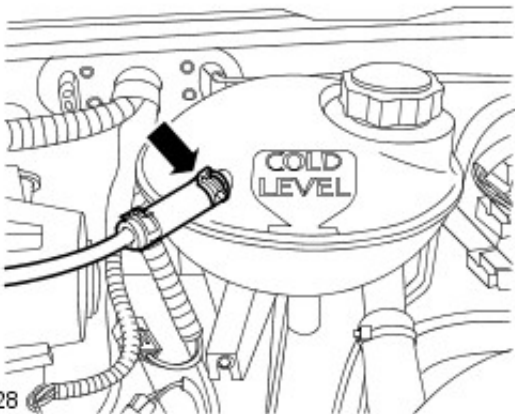
- Clamp the hose to minimize coolant loss.
- Position a container to collect the fluid spillage.
- Release the clip.



E90027

3. Disconnect the radiator bleed hose.

- Release the clip.



E90028

4. Remove the coolant expansion tank.

- Remove the bolt.

E90029



Installation

1. Install the coolant expansion tank.
 - Tighten the bolt to 10 Nm (7 lb.ft).
2. Connect the radiator bleed hose.
 - Secure with the clip.
3. Connect the coolant hose.
 - Secure with the clip.
 - Remove the hose clamp.
4. Check and top up the coolant.
 - Remove the container.


Content not found

Engine Cooling - ID4 2.2L Diesel - Cooling Fan Shroud

Removal and Installation


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
3. Remove the cooling fan.
For additional information, refer to: Cooling Fan (303-03, Removal and Installation).

4.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Release the cooling fan shroud.

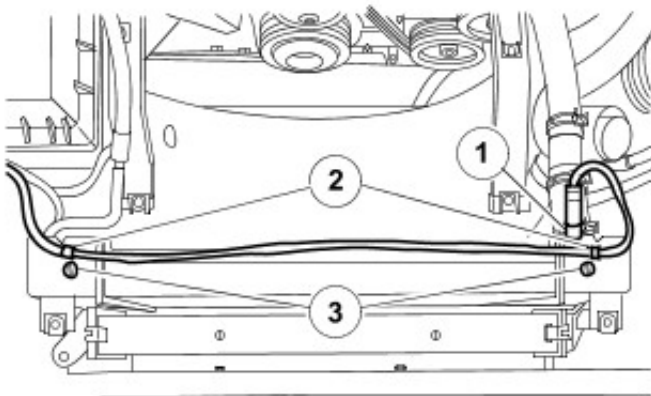
1. Disconnect the coolant expansion tank hose.
2. Release the coolant expansion tank hose from the cooling fan shroud.
3. Release the cooling fan shroud remove the 2 screws.

5.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

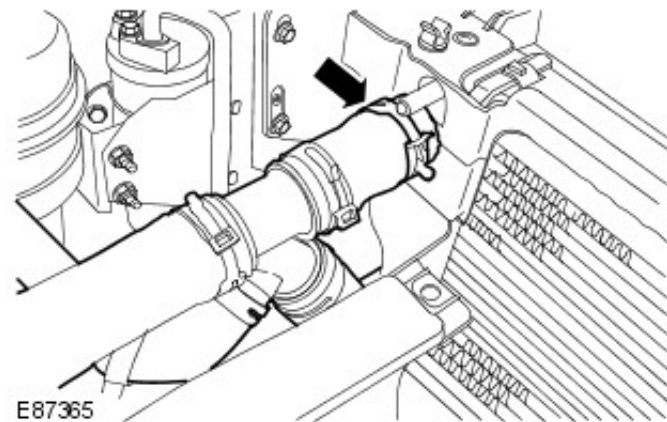
Disconnect the radiator top hose.

6. Release the thermostat from the cooling fan shroud.

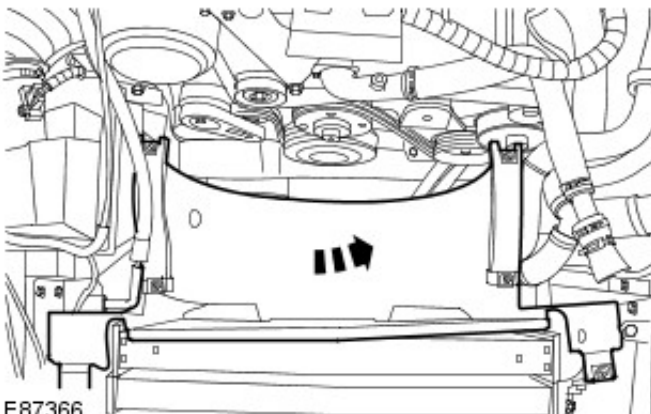
7. Remove the cooling fan shroud.



E87364



E87365



E87366

Installation

1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Engine Cooling - ID4 2.2L Diesel - Coolant Pump

Removal and Installation

Removal

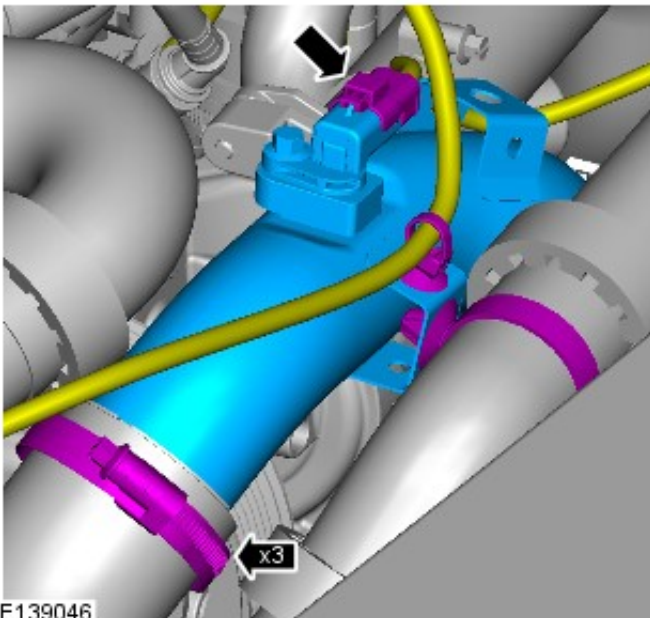
NOTE: Removal steps in this procedure may contain installation details.

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).
3. For additional information, refer to: [Accessory Drive Belt](#) (303-05 Accessory Drive - ID4 2.2L Diesel, Removal and Installation).

4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

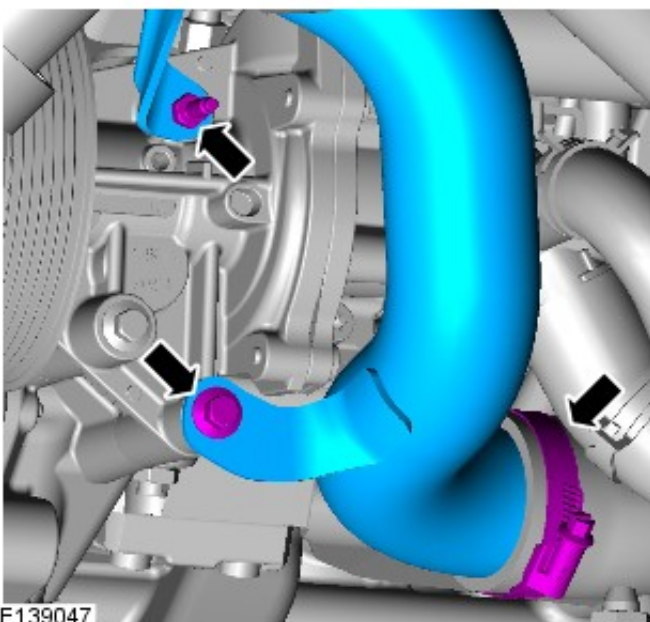
Raise the vehicle on a twin-post lift.

5. Torque: 3Nm



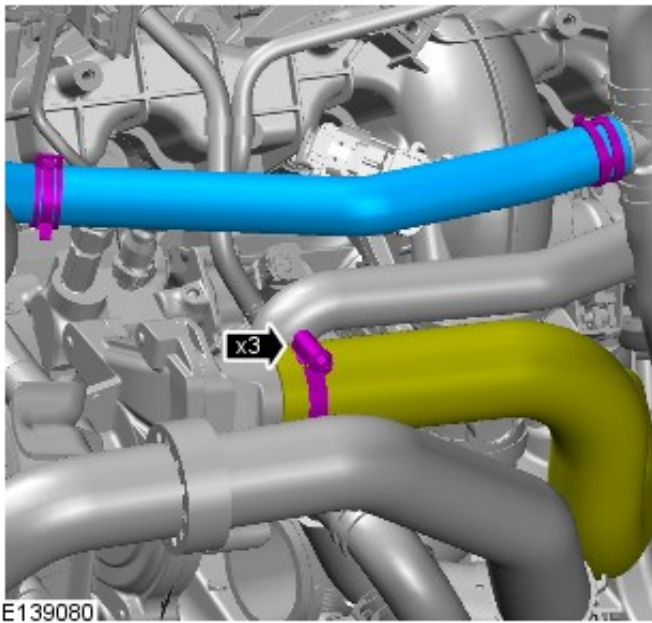
6.  **CAUTION:** Always fit clean plugs to open connections to prevent contamination.

Bolt torque: 25Nm, Nut torque: 25Nm, Hose clip torque: 3Nm

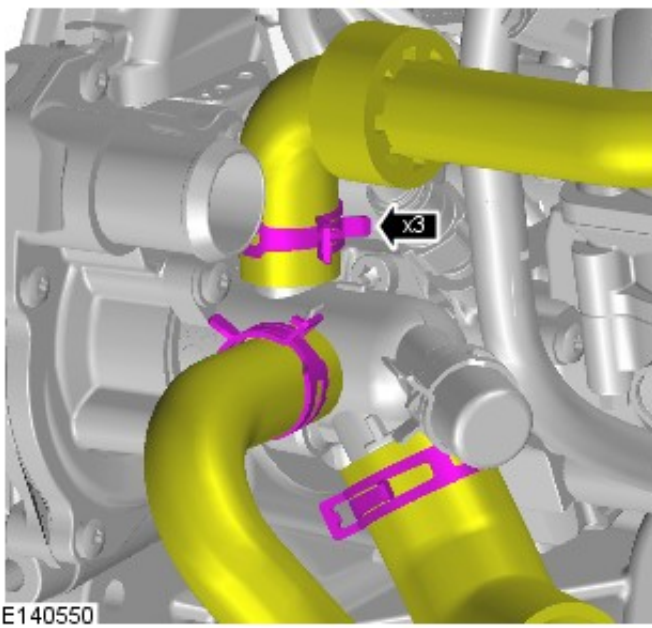


7. Torque: 3Nm

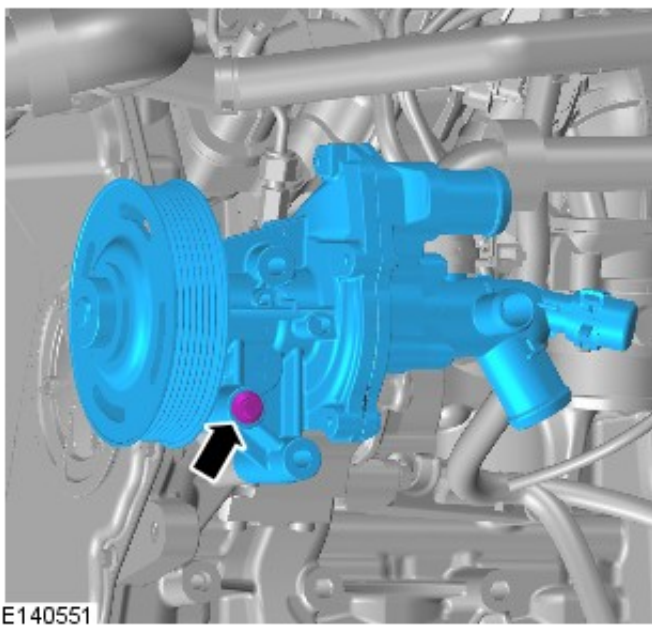
7. Torque: 51Nm



8.



9. Torque: 23Nm



Installation

1. To install, reverse the removal procedure.

Engine Cooling - ID4 2.2L Diesel - Radiator

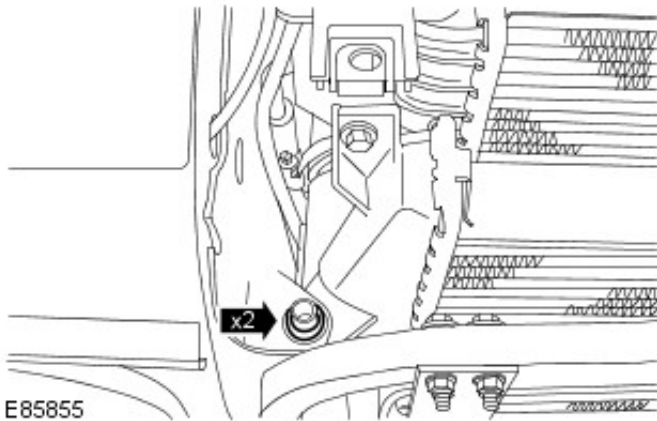
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Remove the cooling fan shroud.
For additional information, refer to: Cooling Fan Shroud (303-03, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: Hood Latch Panel (501-27, Removal and Installation).

4. **NOTE:** RH shown, LH similar.

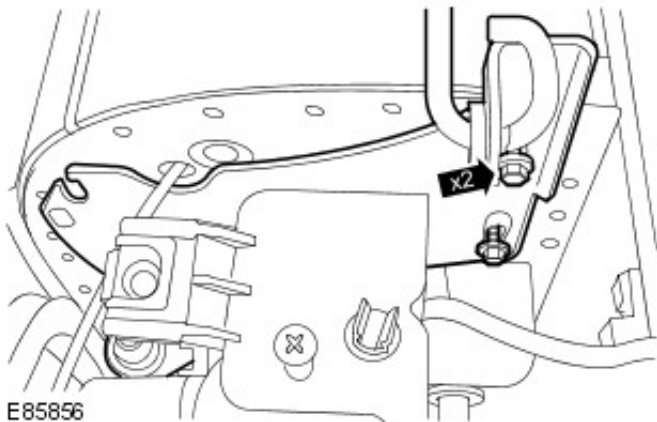
Remove the 2 O-rings.




5. **NOTE:** RH shown, LH similar.

Remove the 2 charge air cooler brackets.

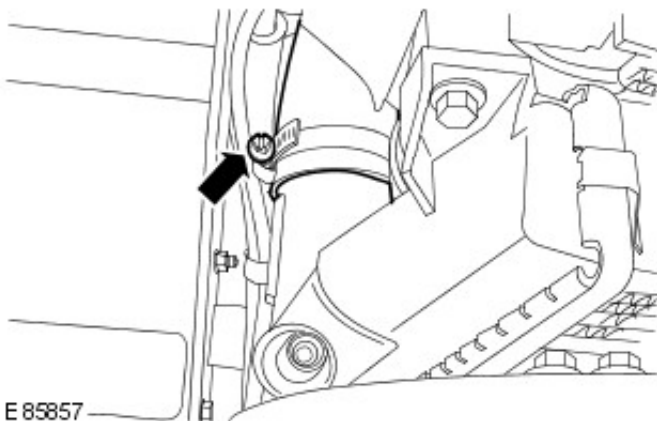
- Remove the 4 bolts.




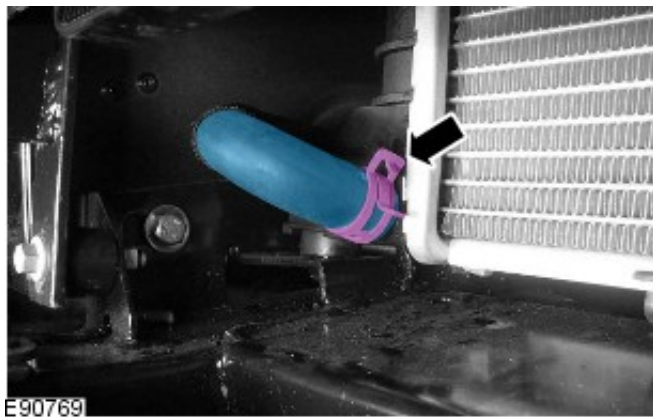
6.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

NOTE: RH shown, LH similar.


Disconnect the charge air cooler inlet hose and charge air cooler outlet hose.



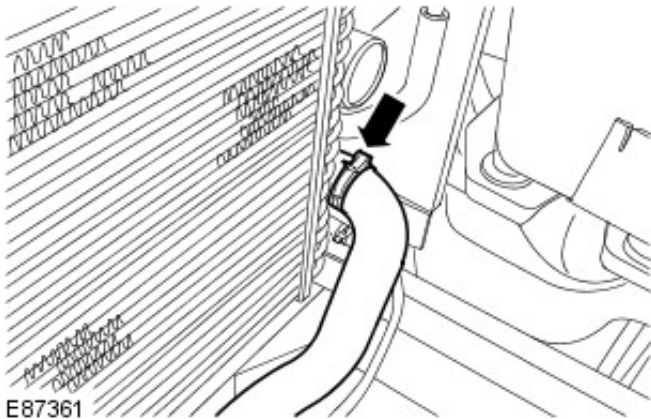
7.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.




Disconnect the fuel cooler to radiator hose.

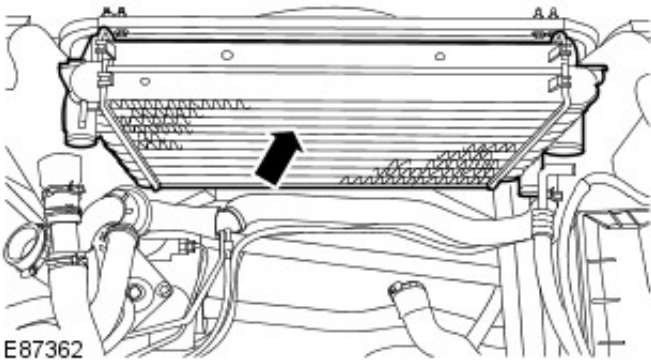
8.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Disconnect the radiator bottom hose.

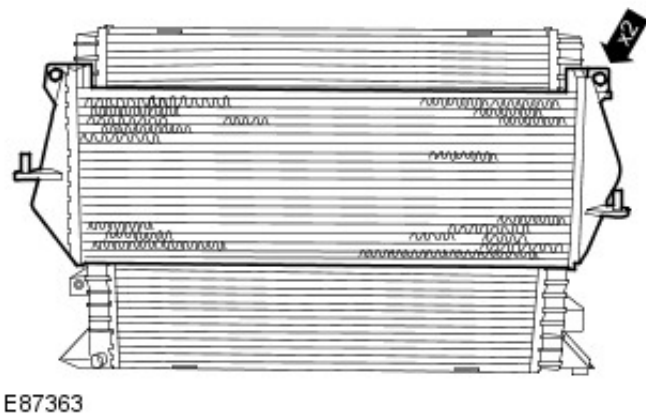


9.  **CAUTION:** Make sure that the radiator and charge air cooler are not damaged when removed.

Remove the radiator and charge air cooler assembly.

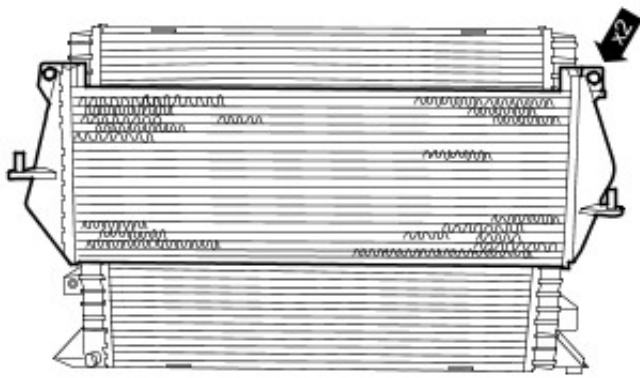


10. Remove the radiator.



Installation

1. To install, reverse the removal procedure.
 - Tighten to 20 Nm (15 lb.ft).

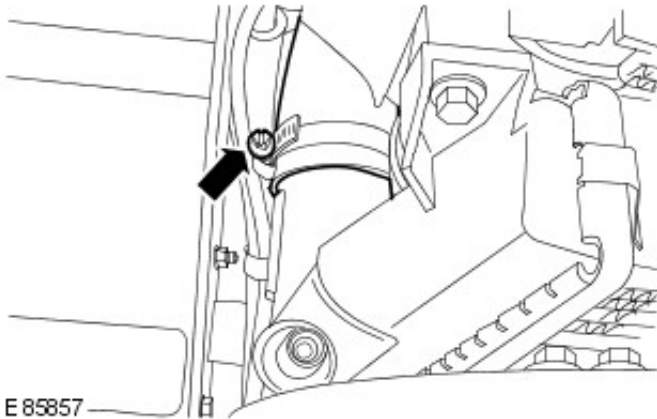


E87363

2. NOTE: Remove and discard the blanking caps.

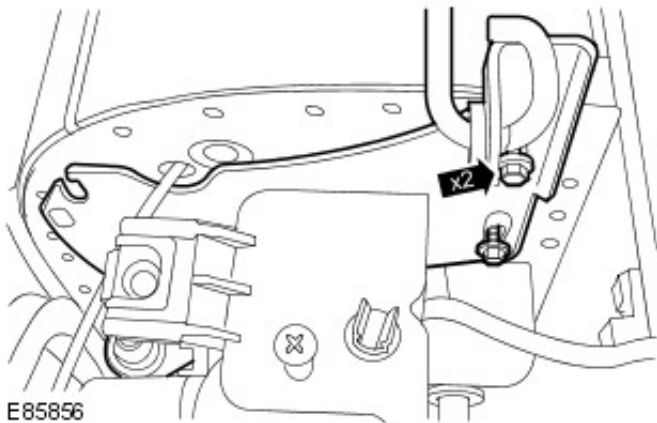
NOTE: RH shown, LH similar.

Tighten to 3 Nm (2 lb.ft).



E85857

3. Tighten to 9 Nm (7 lb.ft).



E85856

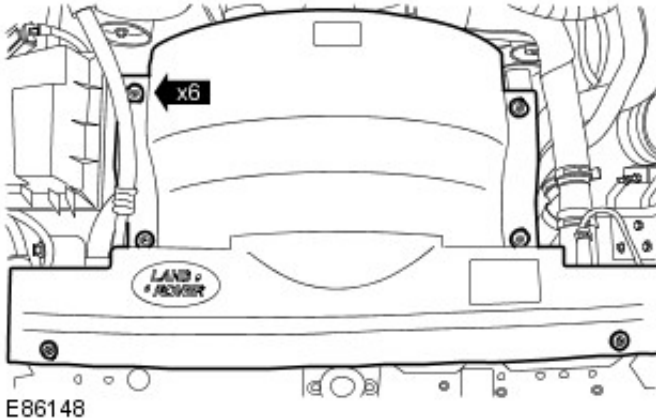
4. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Engine Cooling - ID4 2.2L Diesel - Thermostat

Removal and Installation

Removal

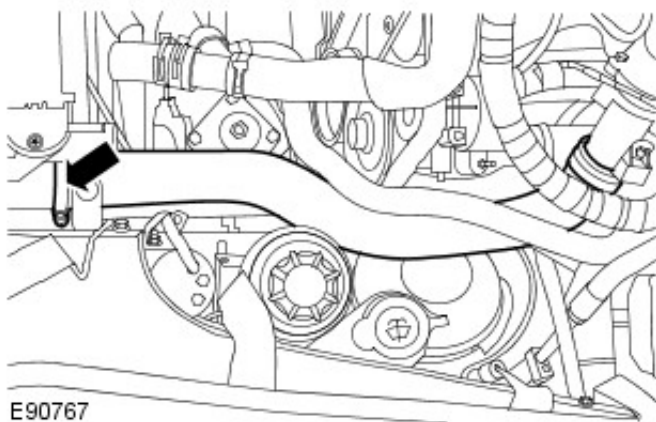
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
3. Remove the cooling fan upper shroud.
 - Release the 6 clips.



4. Release the power steering fluid reservoir.
 - Remove the 2 nuts.



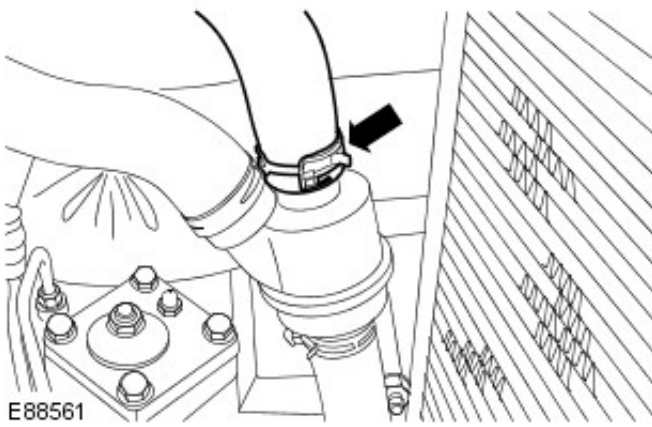
5. Disconnect the charge air cooler outlet hose.



6. **NOTE:** Cooling fan shroud removed for clarity.

Disconnect the thermostat to radiator top hose.

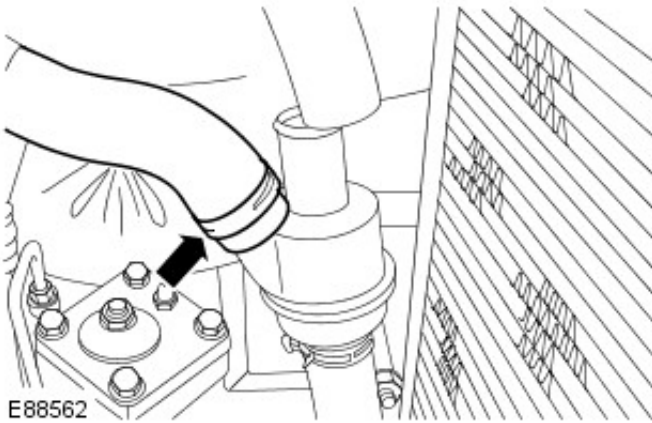
- Release the clip.



7. **NOTE:** Cooling fan shroud removed for clarity.

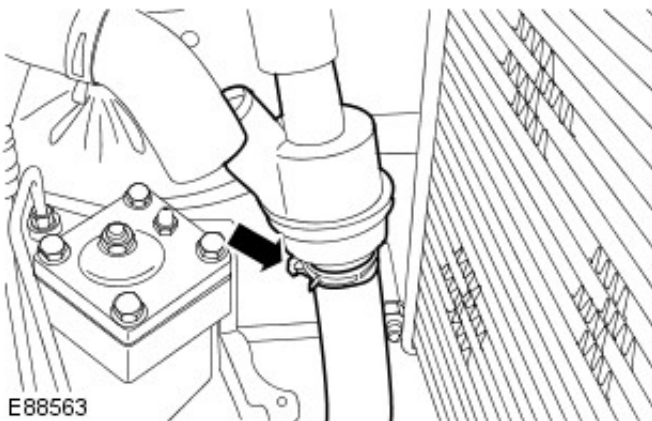
Disconnect the thermostat to coolant pump inlet hose.

- Release the clip.



8. **NOTE:** Cooling fan shroud removed for clarity.

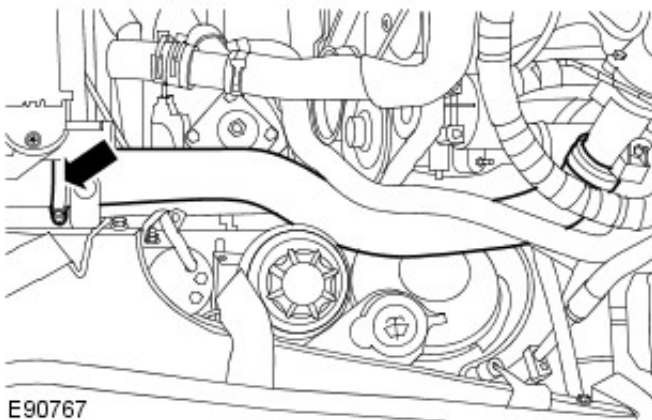
Remove the thermostat.



Installation

1. To install, reverse the removal procedure.

- Tighten to 3 Nm (2 lb.ft).



2. Tighten to 4 Nm (3 lb.ft).



≡87600

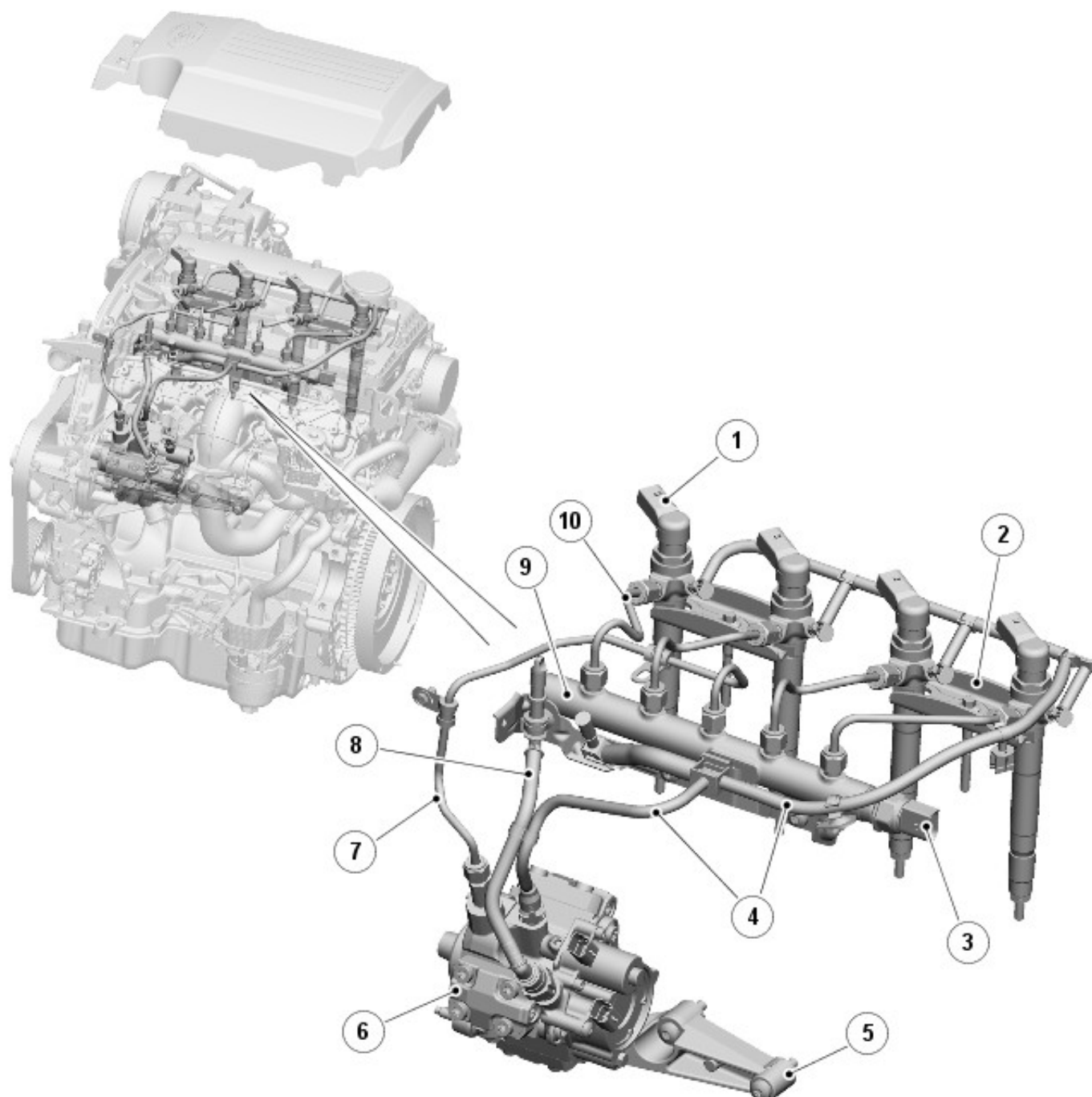
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

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Fuel Charging and Controls - ID4 2.2L Diesel - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



E139186

Item	Part Number	Description
1	-	Fuel injector (4 off)
2	-	Retaining clamp and bolt (2 off)
3	-	FRP (fuel rail pressure) sensor
4	-	Fuel leak-back tube
5	-	Support bracket
6	-	HP (high pressure) fuel pump
7	-	Fuel rail supply tube
8	-	HP fuel pump supply tube
9	-	Fuel rail
10	-	Fuel injector inlet tube (4 off)

OVERVIEW

The engine is equipped with a HP common rail fuel injection system. The system contains the following components:

- HP fuel pump
- Fuel rail
- Four fuel injectors
- HP fuel pipes.

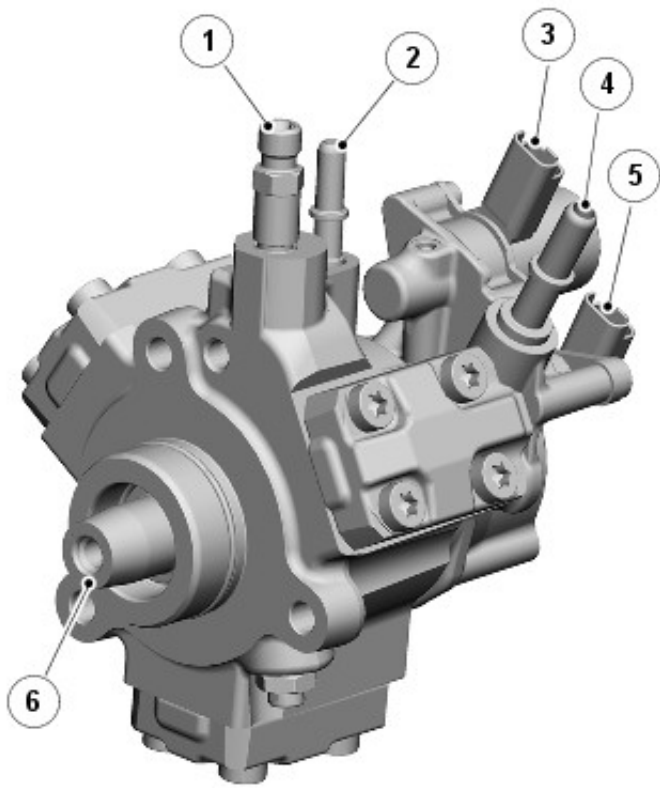
The HP fuel pump pressurizes LP (low pressure) fuel received from the fuel tank and delivers it to the fuel rail, which serves all four fuel injectors. Pressure is controlled at the optimum level for smooth operation, up to a maximum pressure of 1800 bar (26100 lbf/in²). Excess (leak-back) fuel is directed through a return line to the fuel tank.

The required fuel injection pressure is generated independently of engine speed and fuel injection events. The fuel injection timing and volume are calculated by the [ECM \(engine control module\)](#), which then energizes the appropriate fuel injector.

The common rail fuel injection system has the following features:

- High fuel injection pressures for greater atomisation of fuel (increasing performance and lowering emissions)
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

HIGH PRESSURE FUEL PUMP



E139187

Item	Part Number	Description
1	-	HP fuel outlet connection
2	-	Fuel leak-back connection
3	-	Electrical connector – VCV (volume control valve)
4	-	LP fuel inlet connection
5	-	Electrical connector – fuel temperature sensor
6	-	Drive shaft

The HP fuel pump is attached to the front left side of the cylinder block. A support bracket is attached to the rear of the pump. Drive for the pump is provided by the crankshaft via the primary chain and a sprocket on the pump drive shaft.

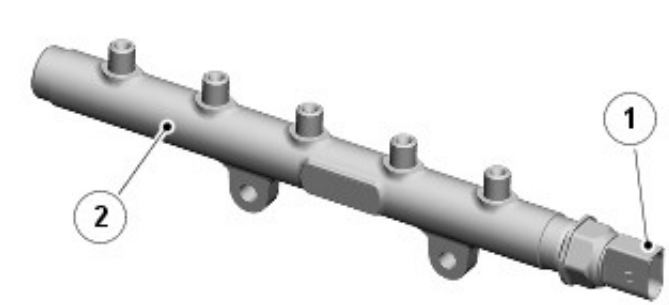
The HP fuel pump is a three element, radial plunger type pump, with the pumping elements spaced 120 degrees apart and operated by a cam on the drive shaft. The output from the pumping elements is connected to a fuel ring circuit within the pump, and provides a constant pressurized fuel supply to the fuel rail.

A controlled amount of fuel is used to cool and lubricate the pump. This fuel is then bled from the pump into the fuel leak-back tube and the return line to the fuel tank.

A VCV in the HP fuel pump, controlled by the ECM, regulates the supply to the pumping elements depending on the fuel pressure in the rail. This ensures the delivery from the pump matches the requirements of the engine. When the engine is at idle speed, pump output pressure is in the 220 - 250 bar (3190 - 3625 lbf/in²) range; at typical driving speeds, pump output pressure is in the 1300 - 1600 bar (18850 - 23200 lbf/in²) range.

A fuel temperature sensor in the HP fuel pump allows the ECM to monitor the temperature of the fuel delivered from the fuel tank. The ECM uses the temperature input to make fine adjustments to fuel injection quantity and to prevent overheating of the fuel system. If the fuel temperature becomes excessive, the ECM increases the leak-back flow to the fuel tank in order to cool the fuel. If this occurs the driver may notice a loss of performance.

FUEL RAIL



E139188

Item	Part Number	Description
1	-	FRP sensor
2	-	Fuel rail

The fuel rail stores HP fuel and minimizes pressure fluctuations in the system.

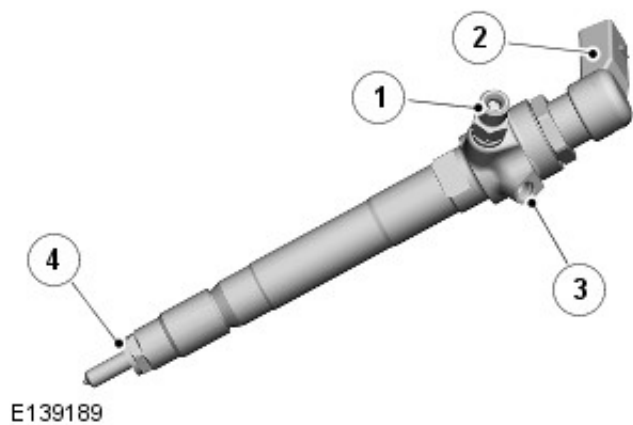
Pressure fluctuations are induced by the pumping elements of the fuel pump and the opening and closing of the solenoid valves on the fuel injectors. The fuel rail is designed so that it has sufficient volume to absorb pressure fluctuations, but a small enough volume to allow the rapid increase in pressure required for a quick engine start.

Fuel from the HP fuel pump passes through a supply tube to the fuel rail. From the fuel rail, the fuel is then sent to the individual fuel injectors via the four injector inlet tubes, which are all the same length. When fuel is taken from the fuel rail for an injection process, the pressure in the fuel rail remains almost constant.

The FRP sensor is located in the end of the fuel rail. The sensor measures the pressure of the fuel in the fuel rail. This input is then used by the ECM to control the amount of fuel delivered to the fuel rail.

If the FRP sensor fails, the engine will operate at reduced power and a DTC (diagnostic trouble code) will be triggered. The sensor is not serviceable separately, and comes as part of a new fuel rail.

FUEL INJECTORS



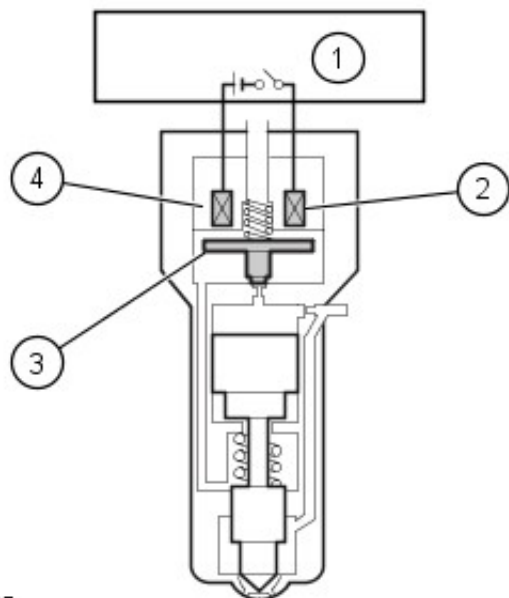
Item	Part Number	Description
1	-	HP fuel inlet connection
2	-	Electrical connector
3	-	Fuel leak-back connection

The four fuel injectors are located in the cylinder head, one between the four valves in each cylinder. Each injector is sealed into the cylinder head with a copper washer and has connections for HP fuel inlet and leak-back tubes. An electrical connector on the fuel injector connects to the **ECM** via the engine harness. The fuel injectors are operated directly by the **ECM** for fuel metering (start of injection and quantity of fuel injected).

Each fuel injector has a solenoid valve, which, when energized, allows a ball valve to lift off its seat. This allows pressurized fuel to lift a needle valve in the injector nozzle and spray a finely atomized jet of fuel into the cylinder. Fuel that spills past the ball valve is directed into the leak-back tube.

Each injector solenoid is controlled separately by the **ECM**, which provides an earth path to open the injector nozzle at the correct time and for a calculated period to provide a metered injection of fuel into the cylinder. The **ECM** uses signals from various sensors and a programmed fueling strategy to ensure that the precise amount of fuel is injected at the correct timing for maximum fuel efficiency and minimum emissions.

Fuel Injector Solenoid Valve



E70325

Item	Part Number	Description
1	-	ECM
2	-	Coil
3	-	Solenoid armature
4	-	Solenoid valve

At the beginning of an injection process, the solenoid valve is actuated with a higher pick-up current so that it opens quickly. After a short period of time, the pick-up current is reduced to a low holding current.

Inside the fuel injector there are various restrictions with extremely small diameters, which have specific manufacturing tolerances. These manufacturing tolerances are given as part of the fuel injector identification number, which is located on the electrical connector. To ensure optimum fuel metering, the **ECM** must be informed of a change of injector through the input of the new identification number using Land Rover approved diagnostic equipment. The identification number of each fuel injector must also be input if the **ECM** is replaced or if new **ECM** software is installed. If the correct identification numbers are not entered, the following faults may occur:

- Emissions compliance limits exceeded
- Increased black smoke formation
- Irregular idling
- Increased combustion noise.

The **ECM** detects injector faults based on the power consumption of the solenoid valves. In the event of a fuel injector failure, any of the following symptoms may be observed:

- Engine misfire
- Idle faults
- Reduced engine performance
- Reduced fuel economy
- Difficult cold start
- Difficult hot start
- Increased smoke emissions.

Fuel Charging and Controls - ID4 2.2L Diesel - Fuel Charging and Controls

Diagnosis and Testing

Overview

This section covers the fuel system from the fuel filter to the fuel injectors, and includes the fuel rail and pump.

For information on the operation of the systems:

REFER to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Description and Operation) / [Fuel Tank and Lines - ID4 2.2L Diesel](#) (310-01 Fuel Tank and Lines - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification



WARNING: Make sure that all suitable safety precautions are observed when carrying out any work on the fuel system. Failure to observe this warning may result in personal injury.



CAUTION: Make sure that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Low/contaminated fuel • Fuel supply/return line(s) • Fuel tank and filler pipe • Fuel leak(s) • Fuel filler cap • Fuel filter • Push connect fittings • Fuel pressure limiting valve • Fuel rail • Fuel injection pump • Exhaust gas recirculation (EGR) system 	<ul style="list-style-type: none"> • Fuses • Glow plug indicator • Inertia fuel shutoff (IFS) switch • Sensor(s) • Engine control module (ECM) • Fuel suction control valve • Fuel rail pressure sensor • Fuel temperature sensor • Fuel injector(s) • EGR system

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart

Symptom	Possible causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> • Engine control module power relay • Inertia fuel shutoff (IFS) switch • Low/contaminated fuel • Air leakage • Low-pressure fuel system fault • Blocked fuel filter • Fuel suction control valve blocked/contaminated • Fuel injection pump fault • Crankshaft position (CKP) sensor 	<p>Check that the IFS has not tripped. Check for DTC P068A-00 (Engine control module power relay de-energized - too early) if logged refer to the DTC helptext. Check the main ECM relay and circuits, refer to the electrical guides. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel injection pump fault. Check the fuel injection pump:</p> <p>REFER to: Fuel Injection Pump (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Removal and Installation).</p> <p>Check the CKP sensor circuits. Refer to the electrical guides. Install a new CKP sensor if necessary.</p> <p>REFER to: Crankshaft Position (CKP) Sensor (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Removal and Installation).</p>
Difficult to start	<ul style="list-style-type: none"> • Glow plug system fault (very cold conditions) • Low/contaminated 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p>

	<ul style="list-style-type: none"> fuel • Air leakage • Low-pressure fuel system fault • Blocked fuel filter • Fuel suction control valve blocked/contaminated • Exhaust gas recirculation (EGR) valve(s) fault 	<p>Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel suction control valve fault. For EGR valve checks:</p> <p>REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Diagnosis and Testing).</p>
Rough idle	<ul style="list-style-type: none"> • Intake air system fault • Low/contaminated fuel • Low-pressure fuel system fault • Blocked fuel filter • Fuel suction control valve blocked/contaminated • Exhaust gas recirculation (EGR) valve(s) fault 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p> <p>Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel suction control valve fault. For EGR valve checks:</p> <p>REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Diagnosis and Testing).</p>
Lack of power when accelerating	<ul style="list-style-type: none"> • Intake air system fault • Restricted exhaust system • Low fuel pressure • Exhaust gas recirculation (EGR) valve(s) fault • Turbocharger actuator fault 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p> <p>Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary:</p> <p>REFER to: Catalytic Converter (309-00 Exhaust System - 2.4L Duratorq-TDCi HPCR (103kW/140PS) - Puma, Removal and Installation).</p> <p>Check for DTCs indicating a fuel pressure fault. For EGR valve checks:</p> <p>REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Diagnosis and Testing).</p> <p>Check the actuator-vane variable geometry turbocharger actuator arm for movement</p> <p>REFER to: Turbocharger Actuator Rod (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).</p> <p>For turbocharger actuator checks:</p> <p>REFER to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).</p>
Engine stops/stalls	<ul style="list-style-type: none"> • Air leakage • Low/contaminated fuel • Low-pressure fuel system fault • High-pressure fuel leak • Fuel suction control valve blocked/contaminated • Exhaust gas recirculation (EGR) valve fault 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p> <p>Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage. Check for DTCs indicating a fuel suction control valve fault. For EGR valve checks:</p> <p>REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Diagnosis and Testing).</p>
Engine judders	<ul style="list-style-type: none"> • Low/contaminated fuel • Air ingress • Low-pressure fuel system fault • Fuel suction control valve blocked/contaminated • High-pressure fuel leak • Fuel injection pump fault 	<p>Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high-pressure fuel system for leaks. Check for DTCs indicating a fuel suction control valve fault. Check the fuel injection pump:</p> <p>REFER to: Fuel Injection Pump (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Removal and Installation).</p>
Excessive fuel consumption	<ul style="list-style-type: none"> • Low-pressure fuel system fault • Fuel suction control 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using</p>

	valve blocked/contaminated • Fuel temperature sensor leak • High-pressure fuel leak • Injector(s) fault • Exhaust gas recirculation (EGR) valve(s) fault	the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel suction control valve fault. Check the fuel temperature sensor, fuel injection pump, etc. for leaks. Check for injector DTCs. For EGR valve checks: REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Diagnosis and Testing).
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For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.
 REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

Fuel Charging and Controls - ID4 2.2L Diesel - Fuel Injection Component Cleaning

General Procedures

General Equipment

Pneumatic vacuum gun

1. WARNINGS:



Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1700 bar (24,656 lb-sq-in). Failure to follow this instruction may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Place the vehicle in a well ventilated, quarantined area and arrange ' No Smoking/Petrol Fumes' signs about the vehicle.



Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTIONS:



Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.



Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.



Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh cleaning fluid, prior to starting work on the vehicle.



Use a steel topped workbench and cover it with clean, lint-free non-flocking material.



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later

malfunction.

Using a new brush that will not lose its bristles, brush cleaning fluid onto the components being removed and onto the surrounding area.

2. Using a pneumatic vacuum gun, remove all traces of cleaning fluid and foreign material.
3. Dispose of any used cleaning fluid and the brush after completing the repair.

Fuel Charging and Controls - ID4 2.2L Diesel - Fuel Injector

Removal and Installation

Removal

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

1. WARNINGS:



WARNING: The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.



WARNING: Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



WARNING: If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



WARNING: Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



WARNING: Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 2000 bar (29,008 lb-sq-in). Failure to follow this instruction may result in personal injury.

CAUTIONS:



CAUTION: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

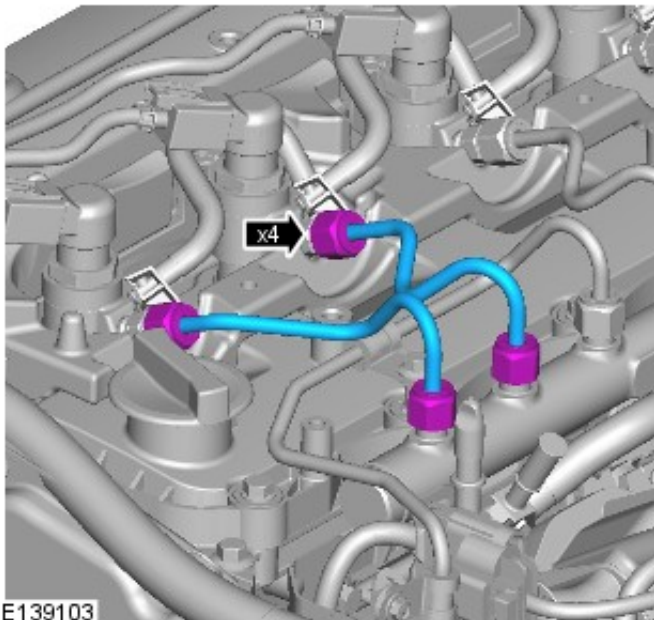


CAUTION: Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.




CAUTION: Do not disconnect the fuel injector electrical connectors with the engine running. Failure to follow this instruction may result in damage to the engine.

2. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
3. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. For additional information, refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, General Procedures).



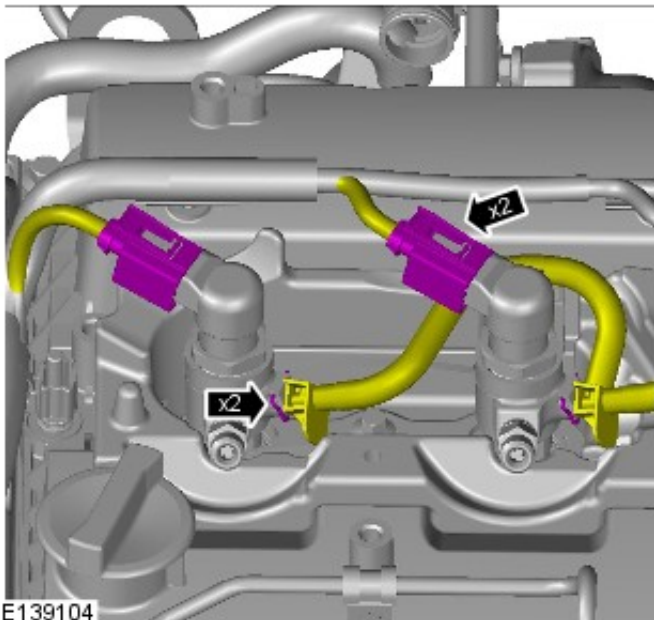
5. CAUTIONS:

 **CAUTION:** Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.


 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.


Torque stage 1: 15Nm, Stage 2: 30Nm

6.



7. CAUTIONS:

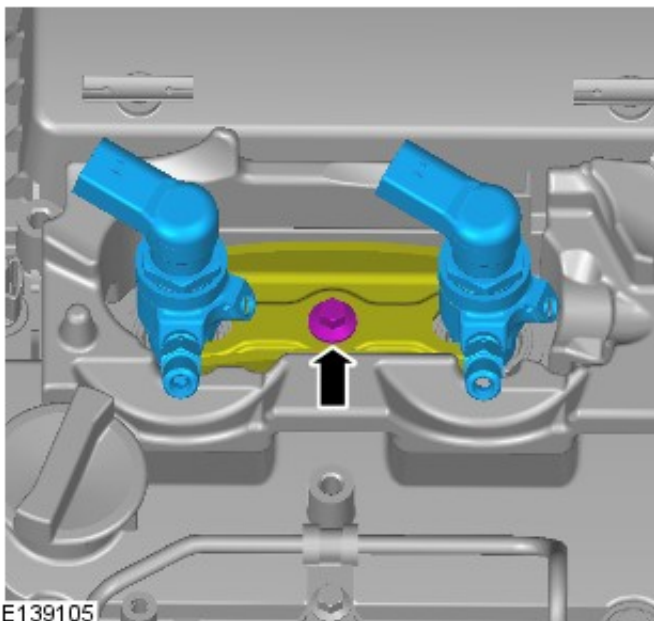
 **CAUTION:** Make sure that both fuel injectors are removed. Failure to follow this instruction may result in damage to the vehicle.

 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

NOTE: Note the position of the fuel injector clamp.

NOTE: Re use bolt only once

Torque stage 1: 6Nm, Stage 2: 360°



8. **NOTE:** Install a new fuel injector sealing washer.

or, if needed, install a new fuel injector sealing washer.



E65265

Installation

1. Record the identification code from the new fuel injector to upload into the approved diagnostic system during configuration (graphic shows an example of the identification code only).



E139815

2. **NOTE:** Check fuel pipes for leaks after starting engine.

To install, reverse the removal procedure.

Content not found

Fuel Charging and Controls - ID4 2.2L Diesel - Fuel Metering Valve

Removal and Installation

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNINGS:



The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

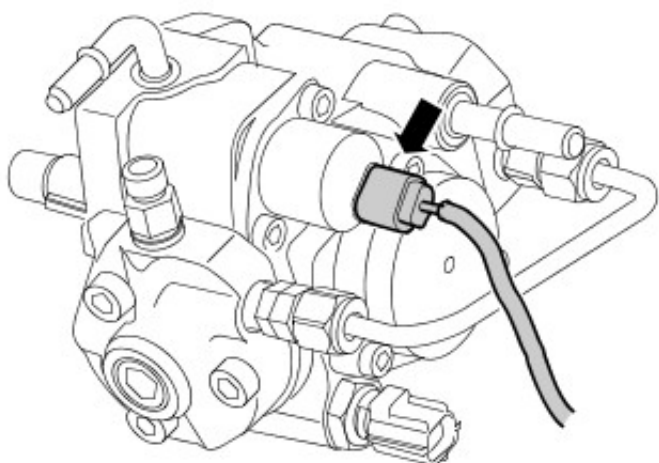


Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 2000 bar (29,008 lb-sq-in). Failure to follow this instruction may result in personal injury.



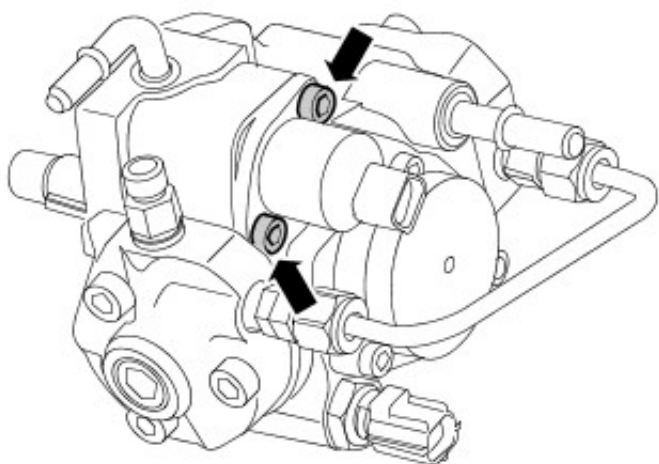
CAUTION: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

2. Open the front door.
3. Remove the front seat cushion assembly.
4. Remove the battery cover.
5. Disconnect the battery ground cable.
6. Open the bonnet.
7. For additional information, refer to: [Intake Manifold](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).
Remove the intake manifold
8. Disconnect the volume control valve (VCV) electrical connector.



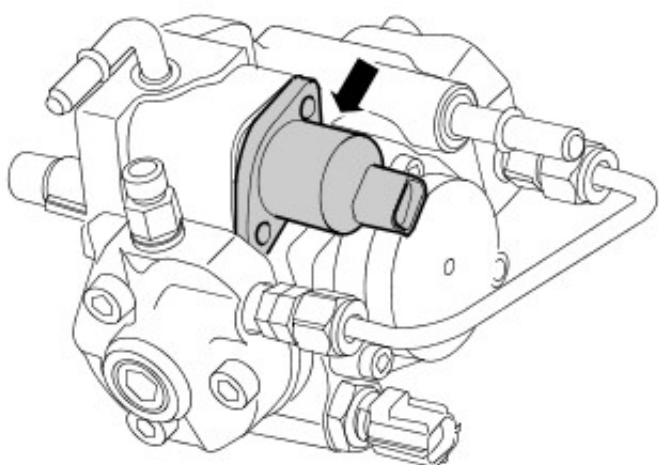
E105075

9. Remove the 2 volume control valve securing bolts.



E105076

10. Remove the volume control valve.



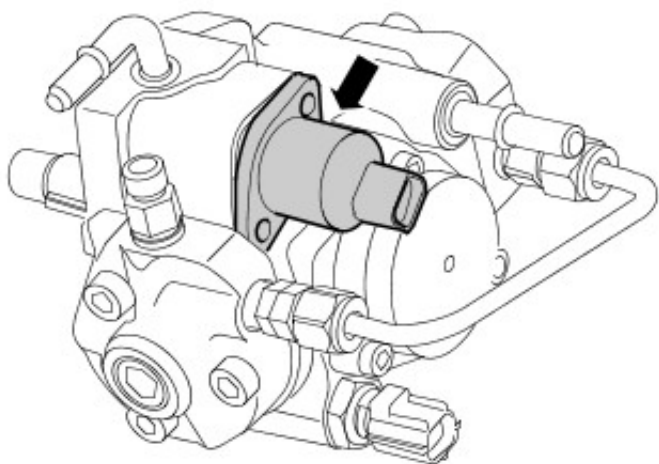
E105077

11. Using the pneumatic vacuum gun, vacuum foreign material from the

21. Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel rail.

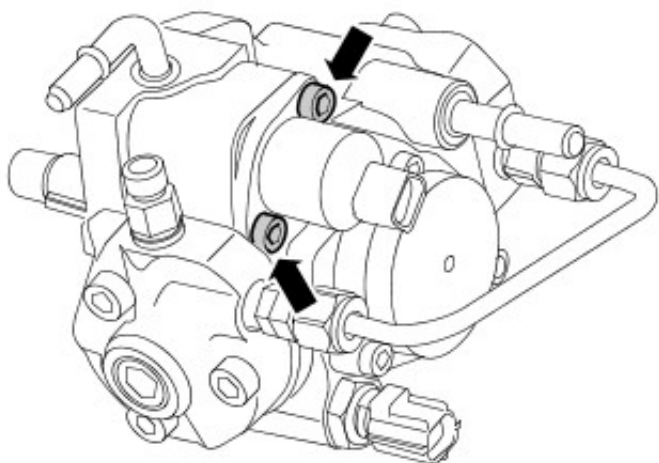
Installation

1. Install the volume control valve with new seal and gasket.



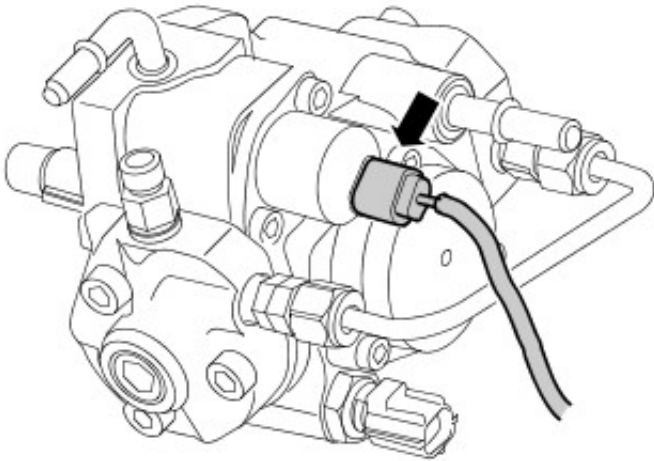
E105077

2. Install the 2 volume control valve securing bolts. Stage 1 tighten to 5 Nm (4 lb.ft). Stage 2 tighten to 8 Nm (6 lb.ft).



E105076

3. Connect volume control valve electrical connector.



E105075

4. For additional information, refer to: [Intake Manifold](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).
Remove the intake manifold
5. Close the bonnet.
6. Connect the battery ground cable.
7. Install the battery cover.
8. Install the front seat cushion assembly.
9. Close the front door.
10. Using the Land Rover approved diagnostic system carry out the pump learn procedure found in the set-up and configuration section.

Fuel Charging and Controls - ID4 2.2L Diesel - Fuel Rail

Removal and Installation

Removal

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

1. WARNINGS:



WARNING: The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.



WARNING: Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



WARNING: If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



WARNING: Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



WARNING: Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 2000 bar (29,008 lb-sq-in). Failure to follow this instruction may result in personal injury.

CAUTIONS:



CAUTION: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



CAUTION: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



CAUTION: Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



CAUTION: Do not disconnect the fuel injector electrical connectors with the engine running. Failure to follow this instruction may result in damage to the engine.



CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign

matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

2. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
3. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. For additional information, refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, General Procedures).

5. CAUTIONS:



CAUTION: Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.



CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Union torque stage 1: 15Nm, Stage 2 torque: 30Nm

6. CAUTIONS:



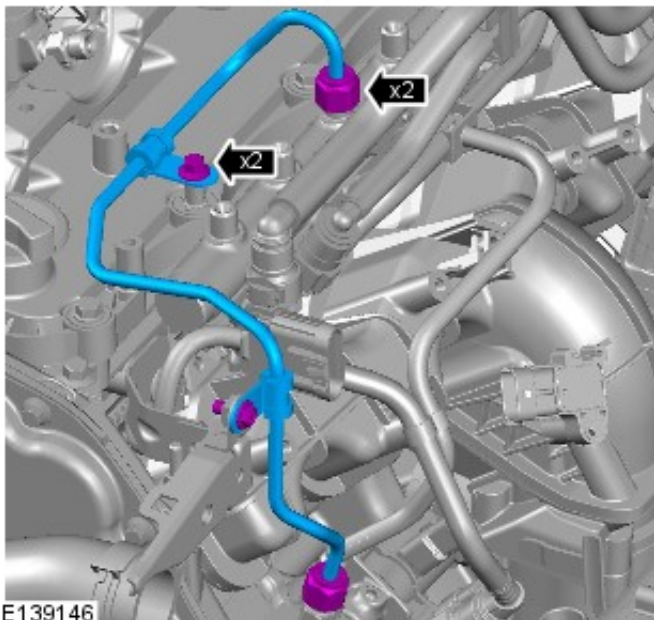
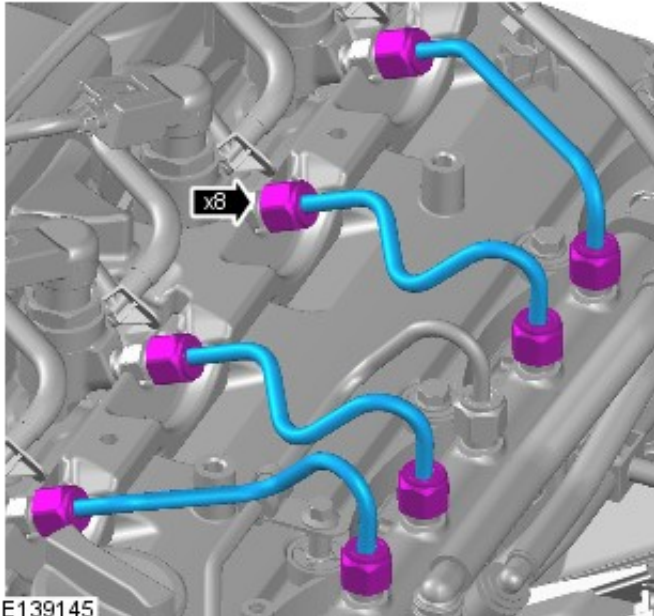
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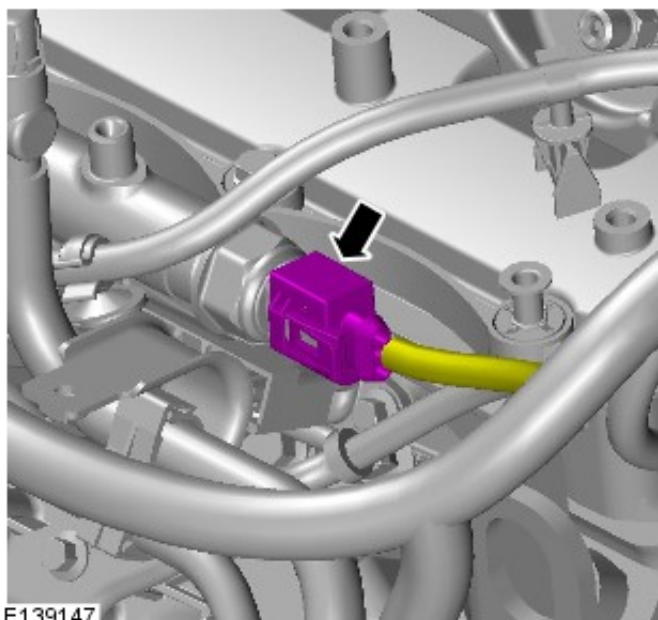


CAUTION: Make sure that all openings are sealed. Use new blanking caps.

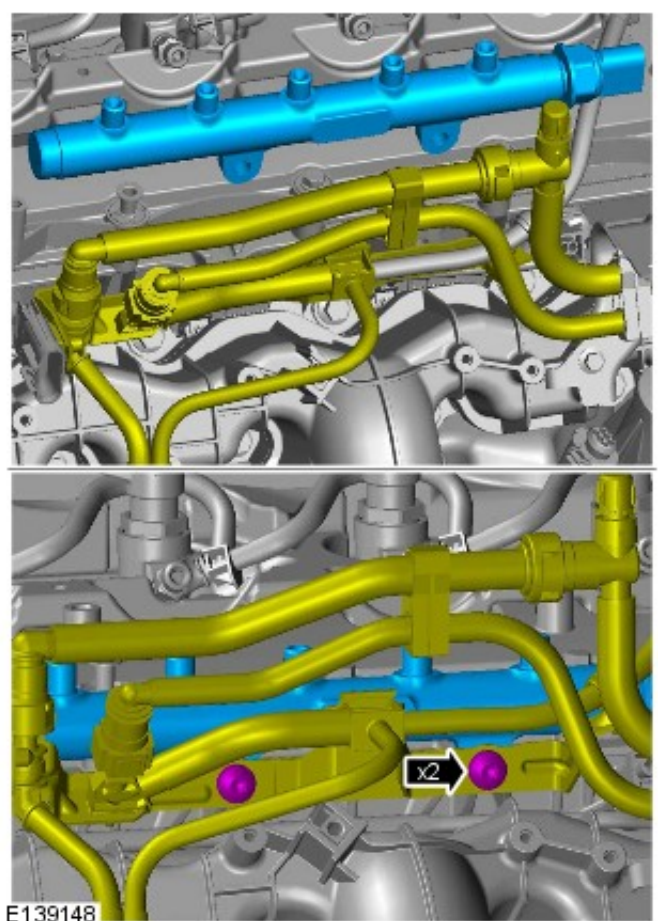
Union torque stage 1: 15Nm, Stage 2: 30Nm, Bracket bolts torque: 10Nm

7.





8. Torque stage 1: 8Nm, Stage 2: 23Nm



Installation

1. **NOTE:** Check fuel pipes for leaks after starting engine.

To install, reverse the removal procedure.


Fuel Charging and Controls - ID4 2.2L Diesel - Throttle Body

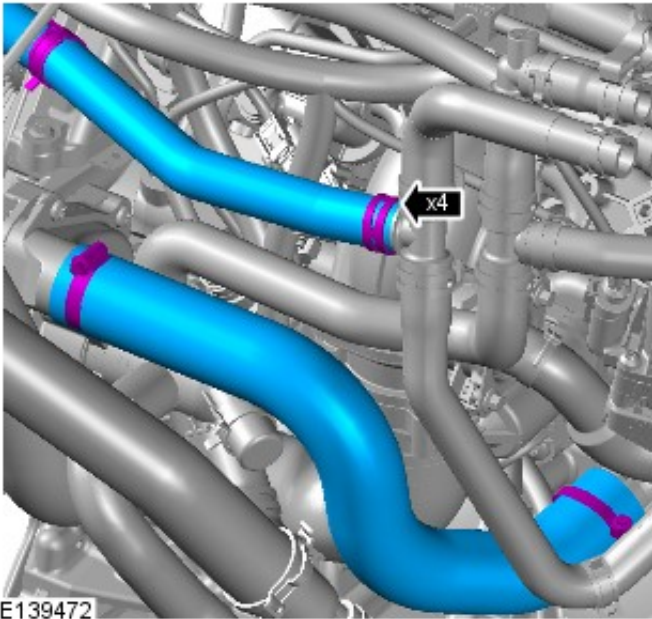
Removal and Installation

Removal

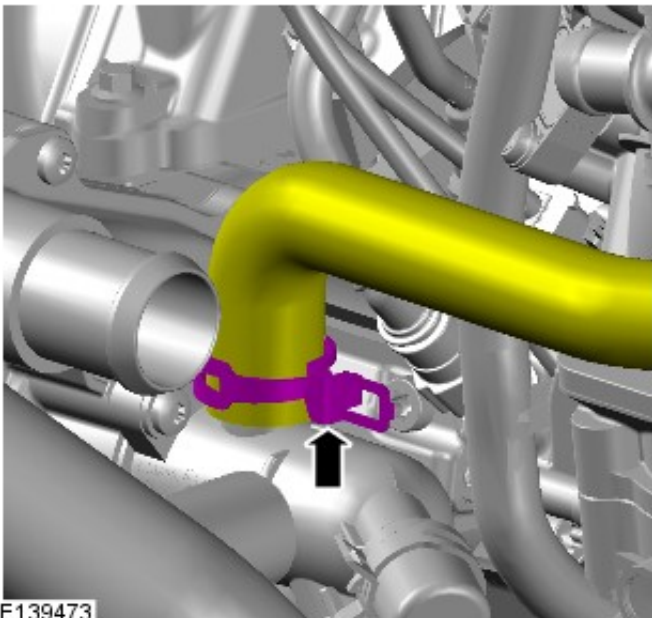
NOTE: Removal steps in this procedure may contain installation details.

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).

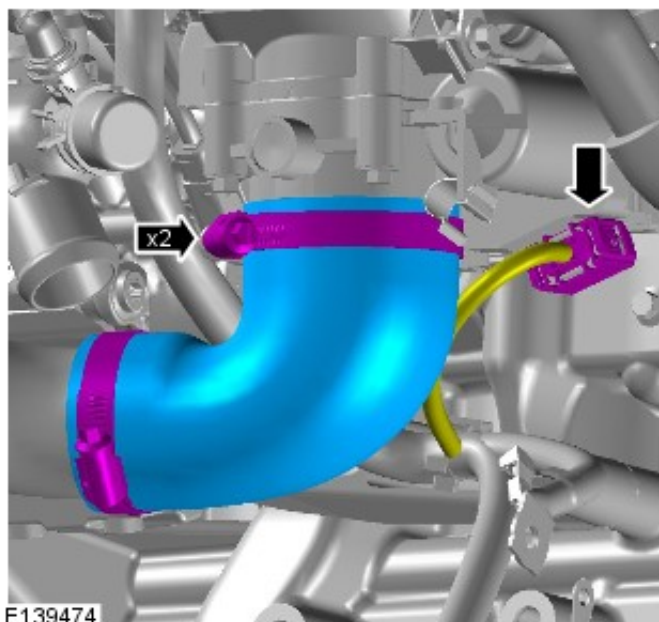
3.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



4.



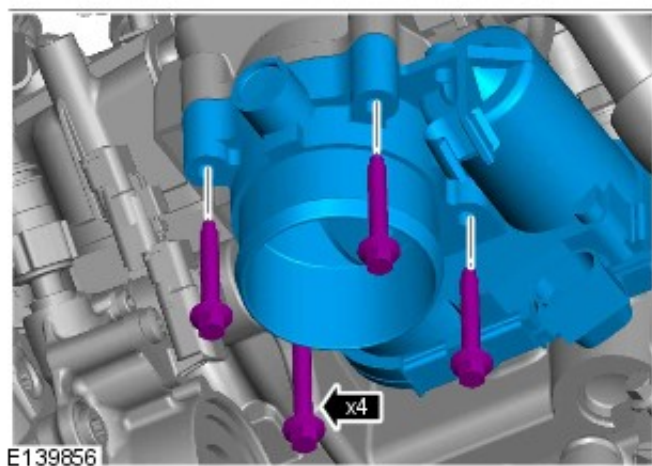
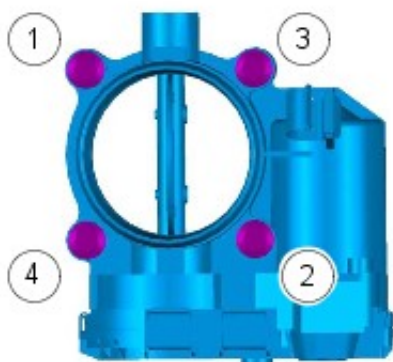
5. Torque: 3Nm



6. NOTE: Fit new gasket.

NOTE: Tighten the bolts in the indicated sequence.

Torque Stage 1: 4Nm, Stage 2: 7Nm



Installation

1. To install, reverse the removal procedure.

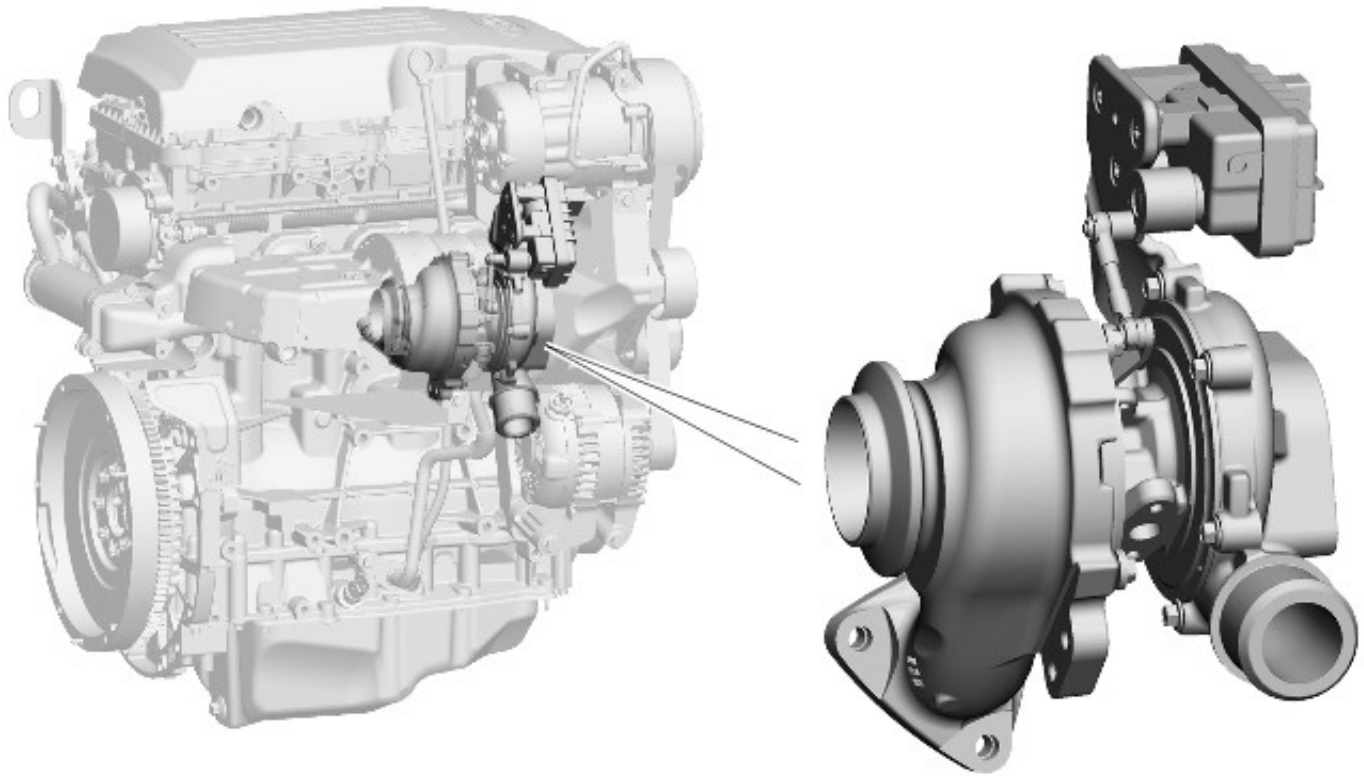
Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel -

Description	Nm	lb-ft
Turbocharger inlet duct bolts	23	17
Turbocharger nuts	23	17
Turbocharger oil return tube	10	7
Turbocharger oil supply pipe	35	26
Catalytic converter nuts	45	33
Catalytic converter lower mounting bracket bolts	30	22
Front muffler to catalytic converter nuts	30	22
Turbocharger mounting bracket	20	15
Turbocharger heat shield	10	7
Turbocharger to charge air cooler clip	3	2

Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel - Turbocharger

Description and Operation

COMPONENT LOCATION



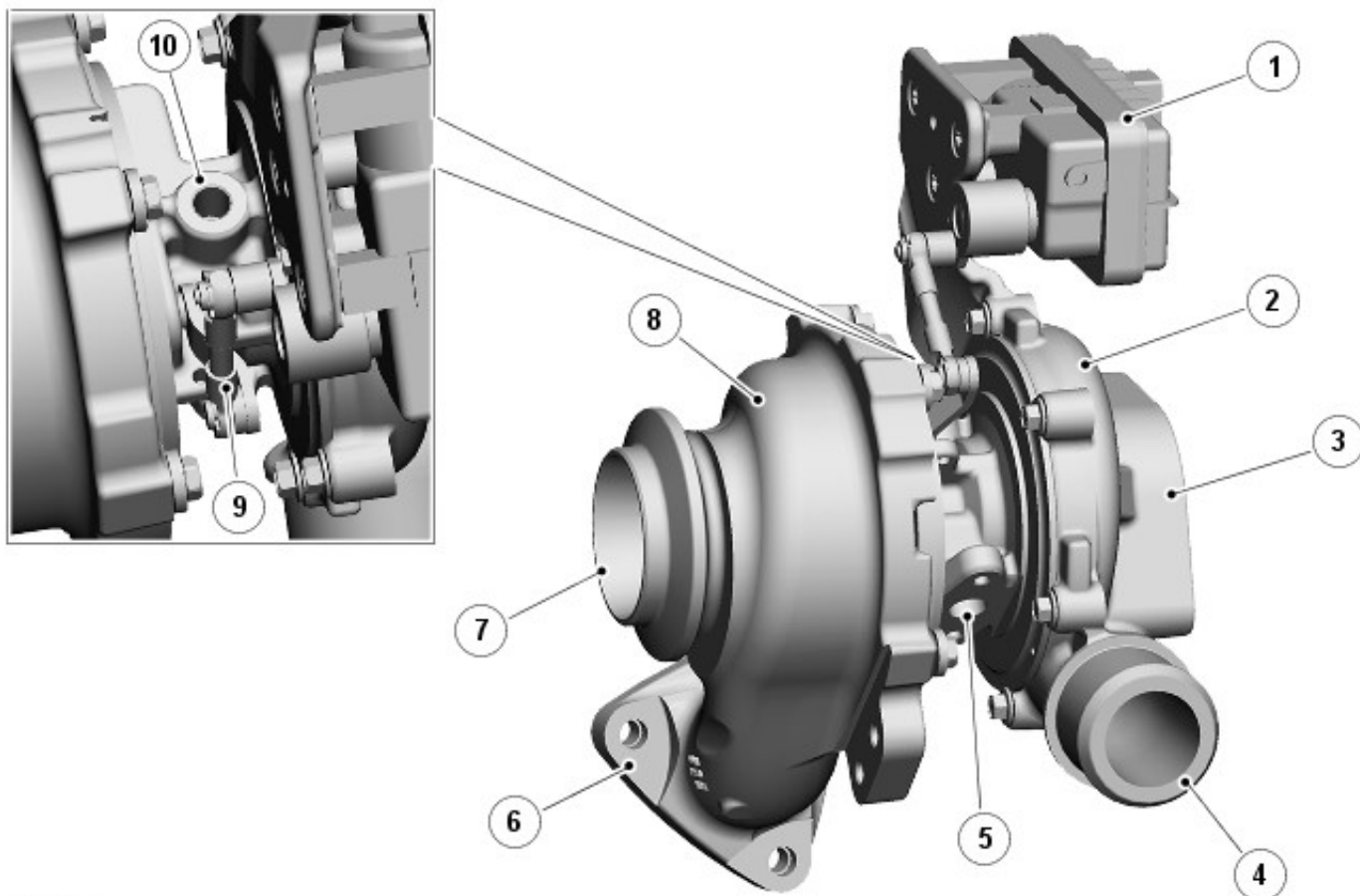
E139194

OVERVIEW

The variable vane turbocharger, fitted to the exhaust manifold, makes it possible to vary the exhaust gas flow of the turbine, dependent on engine operation. This improves the power transfer to the turbine wheel and compressor, particularly at low engine speeds, thus increasing the boost pressure. The guide vanes are opened progressively as the engine speed increases so that the power transfer always remains in balance with the required turbocharger speed and the required boost pressure level. Variable vanes facilitate better use of the exhaust gas energy so as to further improve the efficiency of the turbocharger, and thus of the engine, compared to the more conventional wastegate control.

Advantages:

- High torque at both high and low engine speeds
- Continuous and optimum adjustment for all engine speeds
- No wastegate valve required, exhaust energy is better utilized, less back-pressure in conjunction with same compressor work
- Low thermal and mechanical load improves engine power output
- Lower emissions
- Optimized fuel consumption over the entire engine speed range.



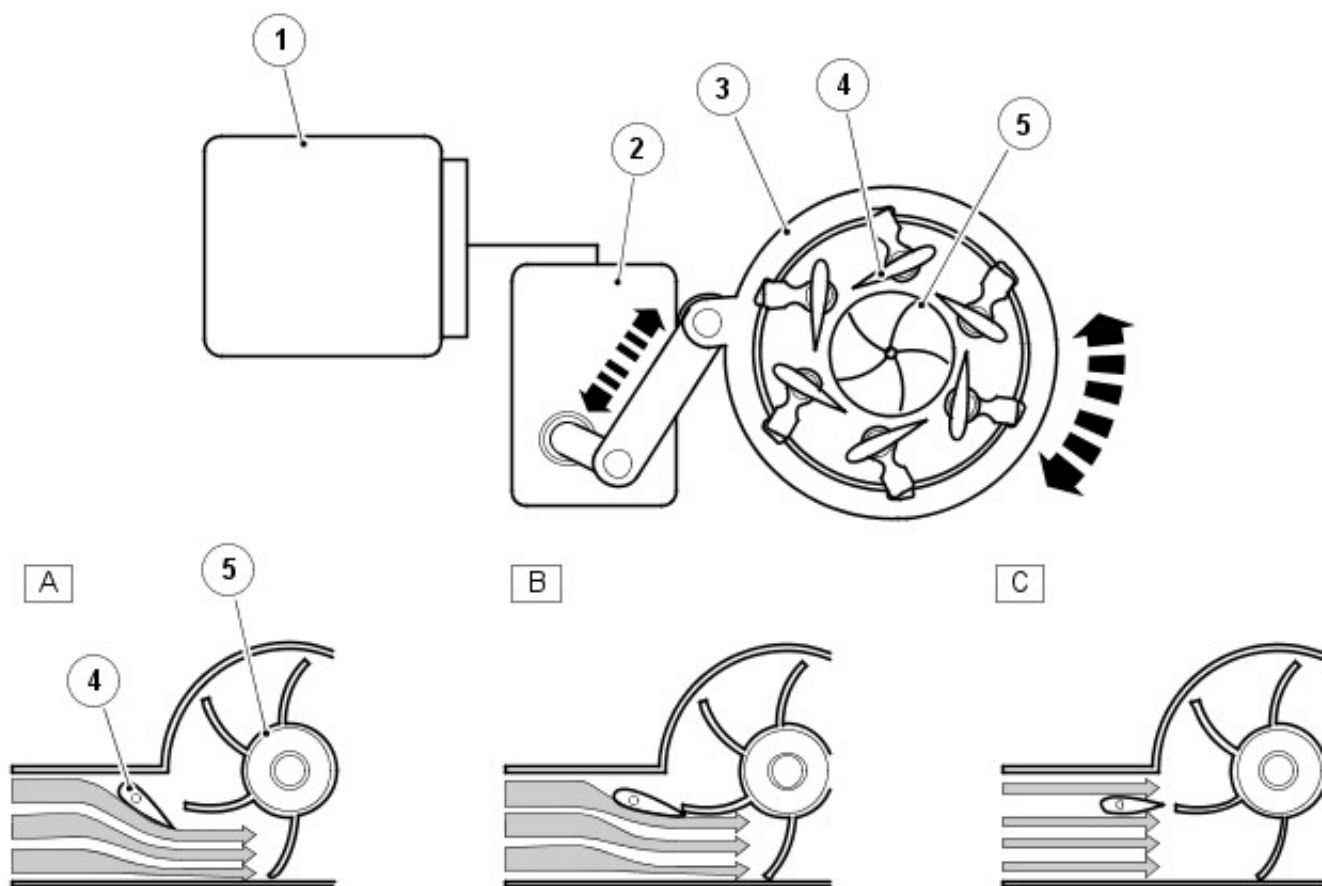
E139195

Item	Part Number	Description
1	-	Actuator motor
2	-	Compressor housing
3	-	Intake air connection
4	-	Charge air cooler connection
5	-	Oil return connection
6	-	Exhaust manifold connection
7	-	Catalytic converter/catalytic converter and DPF (diesel particulate filter) connection
8	-	Turbine housing
9	-	Rod and actuating lever
10	-	Oil feed connection

The position of the guide vanes is adjusted by a [DC \(direct current\)](#) rotary actuator via a rod and actuating lever. Operation of the actuator is controlled by the [ECM \(engine control module\)](#). A feedback potentiometer in the actuator provides the [ECM](#) with a guide vane position signal for closed loop control.

The turbocharger is designed for fail safe operation. If a fault occurs regarding the control of the unit, the vanes default to the fully open position so as to produce minimum boost. The [ECM](#) detects any malfunctions in the actuator motor and generates a [DTC \(diagnostic trouble code\)](#).

PRINCIPLES OF OPERATION



E80503

Item	Part Number	Description
A	-	Low engine speed
B	-	Moderate engine speed
C	-	Maximum engine speed
1	-	ECM
2	-	Actuator motor
3	-	Adjusting ring
4	-	Vanes
5	-	Turbine

A - Low Engine Speed

At low engine speeds the volume of exhaust gas is low so the vanes are moved towards the closed position to reduce the turbine inlet area. This reduction causes an increase in the gas velocity into the turbine wheel thereby increasing wheel speed and boost.

B - Moderate Engine Speed

As the engine speed increases and the volume of exhaust gas increases the vanes are moved towards the open position to increase the turbine inlet area and maintain the gas velocity.

C - Maximum Engine Speed

At maximum engine speed the vanes are almost fully open maintaining the gas velocity into the turbine wheel.

Barometric Pressure Sensor

When the vehicle is driven at high altitudes the ambient pressure reduces causing the compressor wheel to do less work for the same boost pressure. To prevent the turbine wheel from over-speeding under these conditions, a barometric pressure sensor, located in the ECM, protects the turbocharger by opening the vanes further to reduce the turbine wheel speed. This is known as the altitude margin of the turbocharger.

Turbocharger Lubrication

The rapid acceleration and deceleration response demands of the turbocharger rely greatly on a steady flow of clean oil. The oil supplied from the engine's lubrication system provides lubrication to the turbocharger's spindle and bearings, while

also acting as a coolant for the turbocharger center housing.

To maintain the life expectancy of the turbocharger, it is essential that the oil has a free-flow through the turbocharger and unrestricted return to the oil pan. It is therefore imperative that the engine oil is replenished at regular service intervals with the recommended quality and quantity of oil.

Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel - Turbocharger

Diagnosis and Testing

Overview

For information on description and operation:

REFER to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. WARNINGS:



The following tests may involve working in close proximity to hot components. Make sure adequate protection is used. Failure to follow this instruction may result in personal injury.



The turbocharger can continue to rotate after the engine has stopped. Do not attempt to check the turbocharger until one minute has elapsed since the engine was switched off. Failure to follow this instruction may result in personal injury.

Verify the customer concern.

2. Visually inspect for obvious mechanical or electrical faults.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> Intake air system Hose(s)/hose connections Turbocharger General engine condition. 	<ul style="list-style-type: none"> Circuit(s) Electrical connections and harnesses Turbocharger actuator Engine control module (ECM)

- If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
- Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart

Symptom	Possible source	Action
Poor performance (off-boost)	<ul style="list-style-type: none"> Turbocharger actuator fault Low/contaminated fuel Restricted intake air system General engine condition Engine control module (ECM) failure Turbocharger actuator fault 	<p>Check the actuator-vane variable geometry turbocharger actuator arm for movement</p> <p>REFER to: Turbocharger Actuator Rod (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).</p> <p>. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for restriction. Check the engine condition, compressions, etc. if there are indications of a mechanical fault. Check for DTCs indicating a module fault. Refer to the warranty policy and procedures manual if an ECM is suspect. Check the actuator-vane variable geometry turbocharger actuator arm for movement</p> <p>REFER to: Turbocharger Actuator Rod (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).</p>
No boost	<ul style="list-style-type: none"> Electrical connections and harnesses Restricted intake air system Charge air cooler restricted/leaking Turbocharger actuator failure Turbocharger failure Engine control module (ECM) failure 	<p>Check the electrical connections and harnesses. Check the intake air system for restriction/leakage. Check the turbocharger actuator and circuits. Refer to the electrical guides. Check the turbocharger for wear. Disconnect the turbocharger intake and outlet pipework and turn the turbocharger by hand. Any roughness indicates a fault. Check any up and down movement in the turbocharger shaft. Excessive movement indicates a fault. If in doubt, compare the suspect unit with a new turbocharger. Check for DTCs indicating an actuator or module fault. Refer to the warranty policy and procedures manual if an ECM is suspect.</p>
	<ul style="list-style-type: none"> Turbocharger 	

No boost/excessive noise	<ul style="list-style-type: none"> • Turbocharger actuator fault • Turbocharger failure 	<p>Check the actuator-vane variable geometry turbocharger actuator arm for movement</p> <p>REFER to: Turbocharger Actuator Rod (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).</p> <p>. Disconnect the turbocharger intake and outlet pipework and turn the turbocharger by hand. Any roughness indicates a fault. Check any up and down movement in the turbocharger shaft. Excessive movement indicates a fault. If in doubt, compare the suspect unit with a new turbocharger.</p>
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For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).


Content not found

Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel - Turbocharger

Removal and Installation

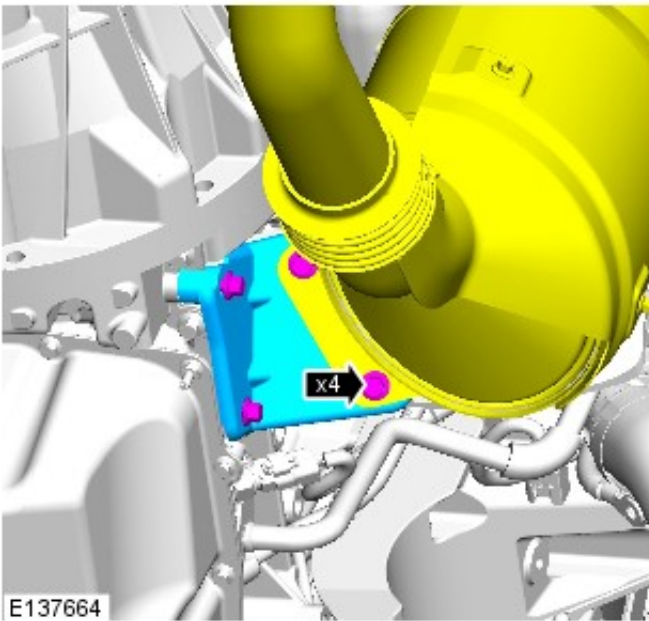
Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Generator](#) (414-02 Generator and Regulator - ID4 2.2L Diesel, Removal and Installation).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

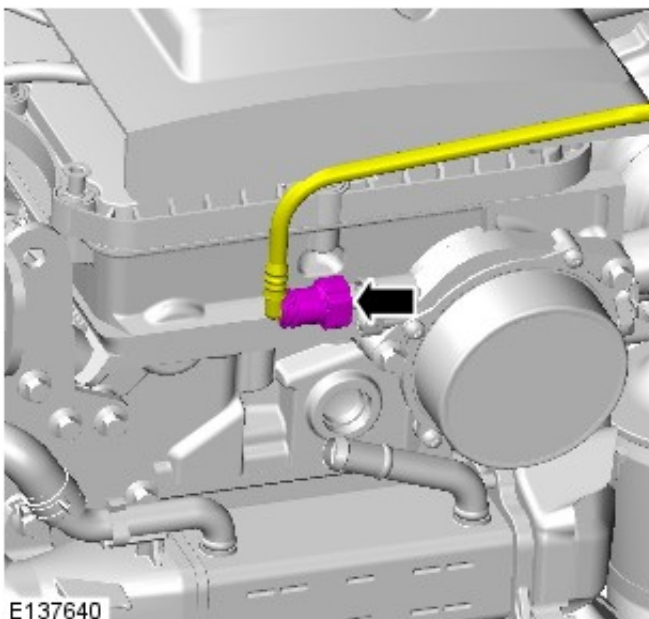
Raise and support the vehicle.

4.



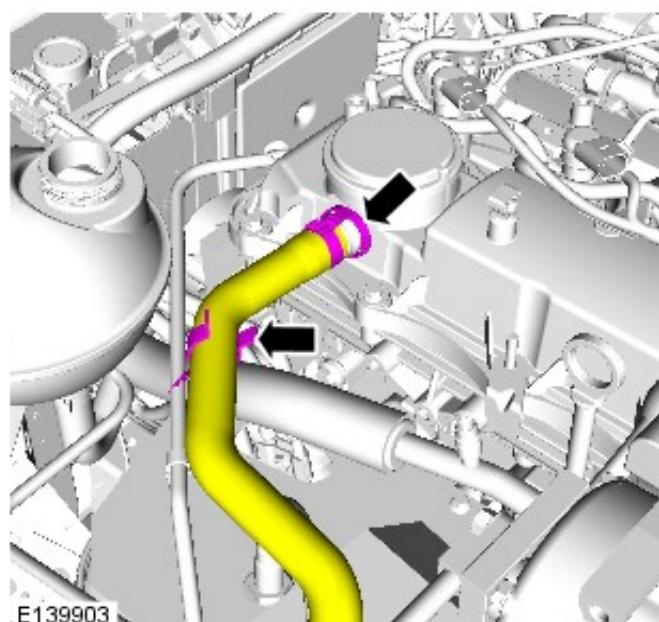
5. With assistance, carefully remove the hood.
6. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7.

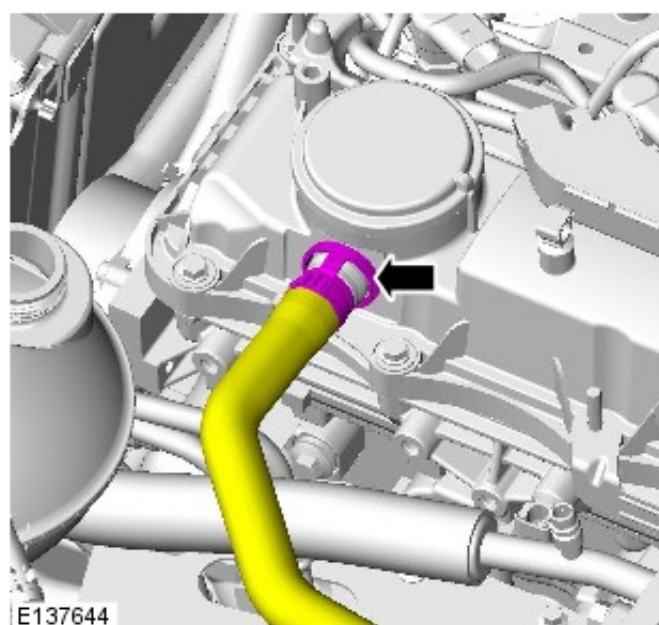


8. **NOTE:** Right-hand drive vehicles.

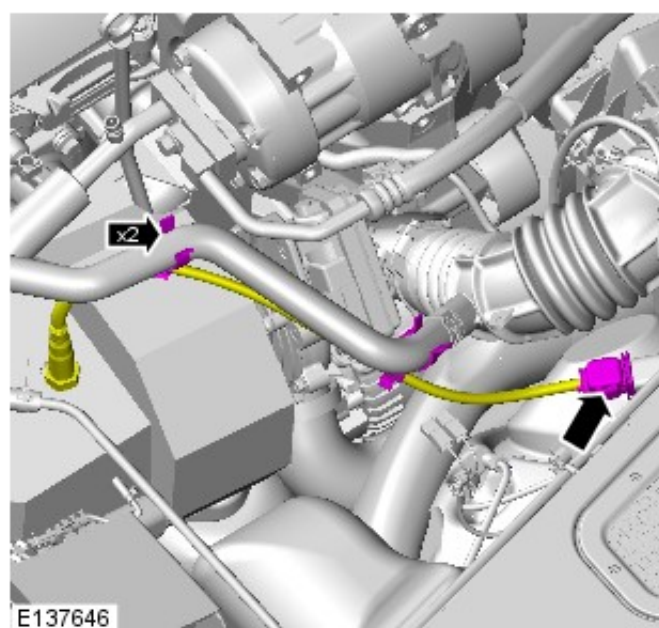
or never right hand drive vehicles.



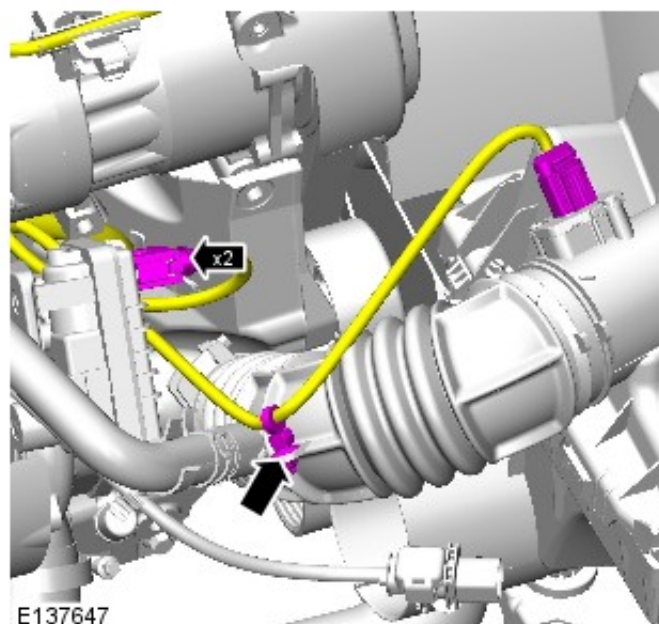
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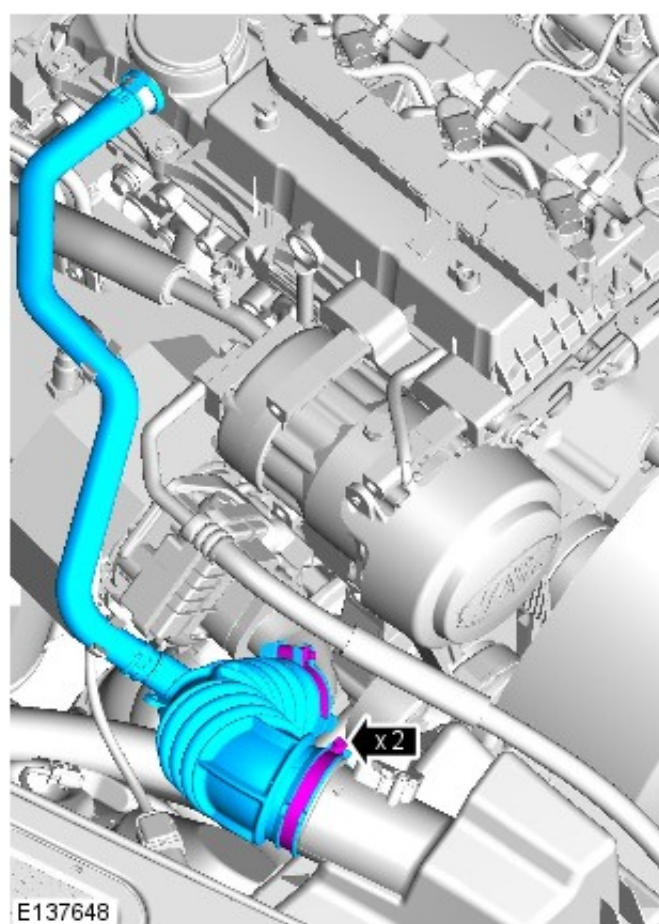


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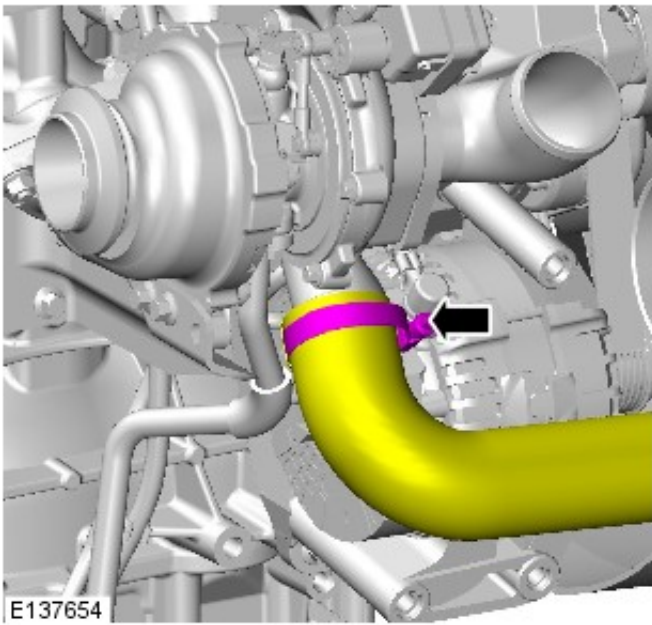


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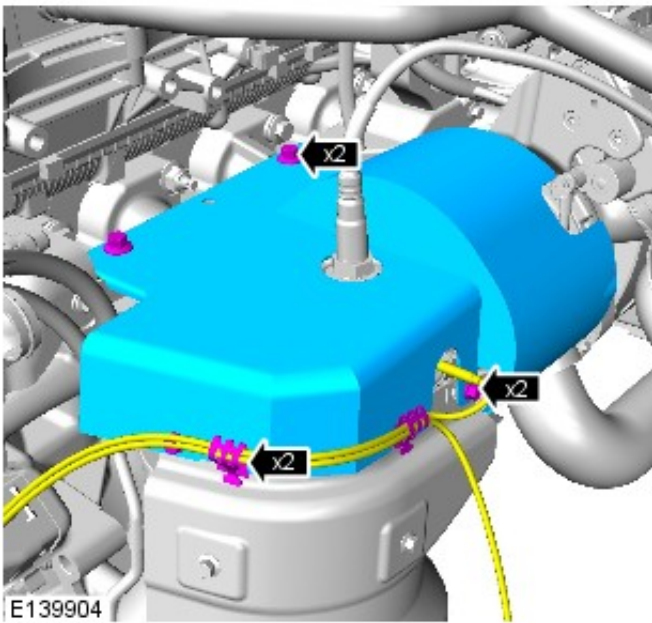
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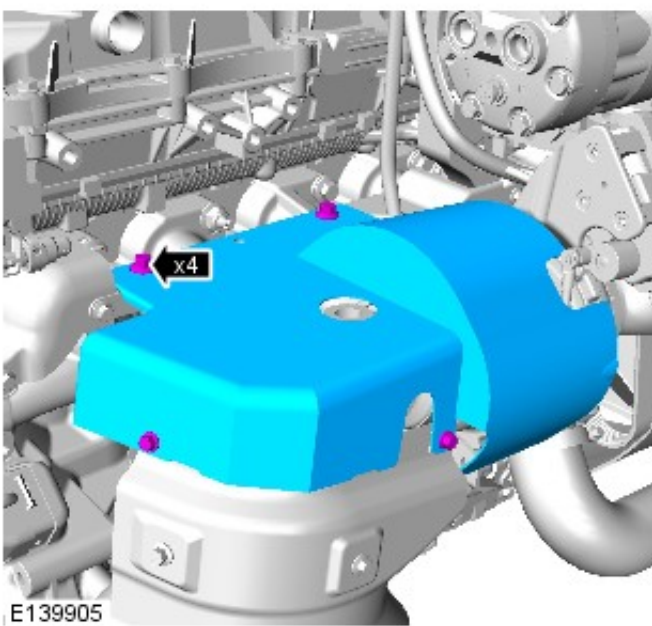
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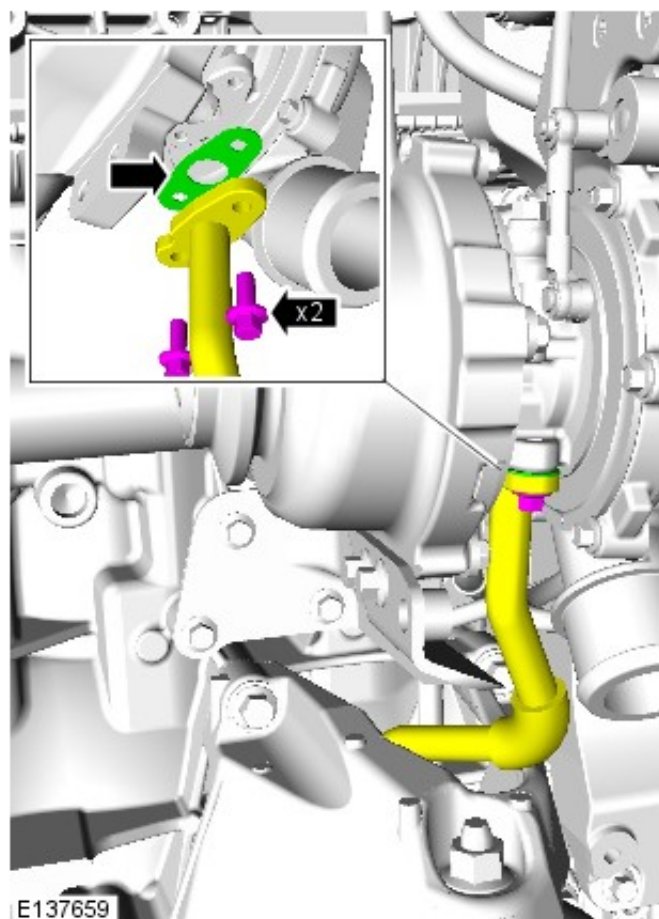
14. NOTE: Vehicles with diesel particulate filter (DPF).



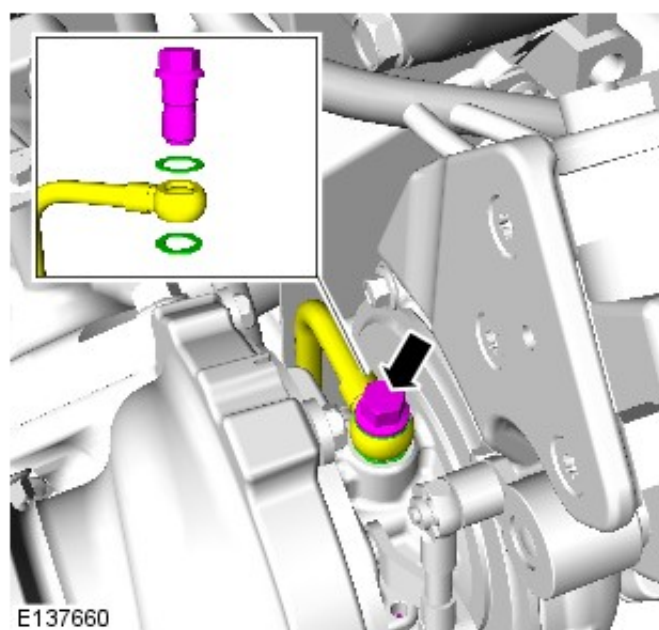
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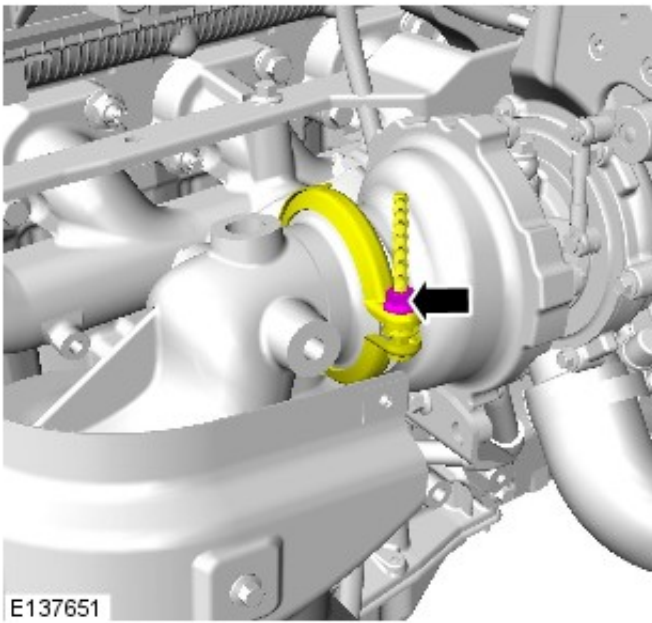
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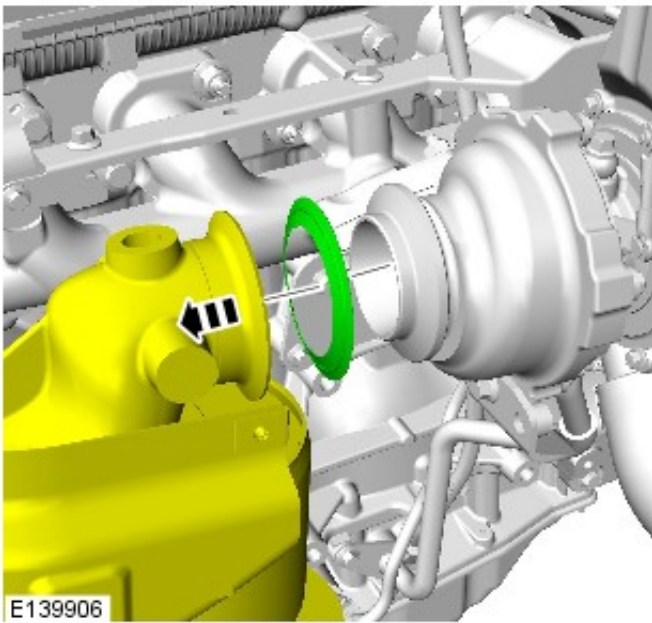
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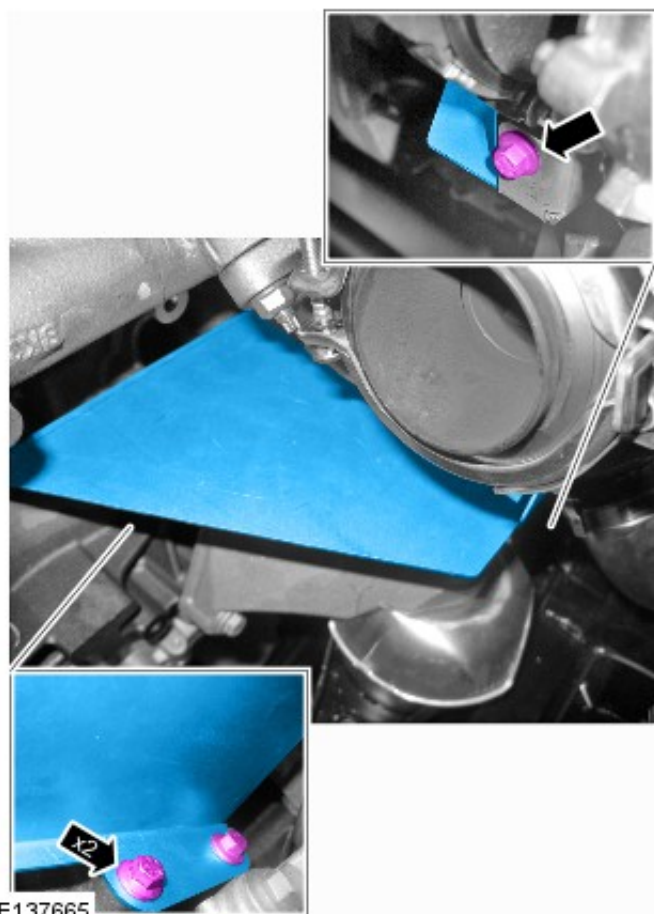
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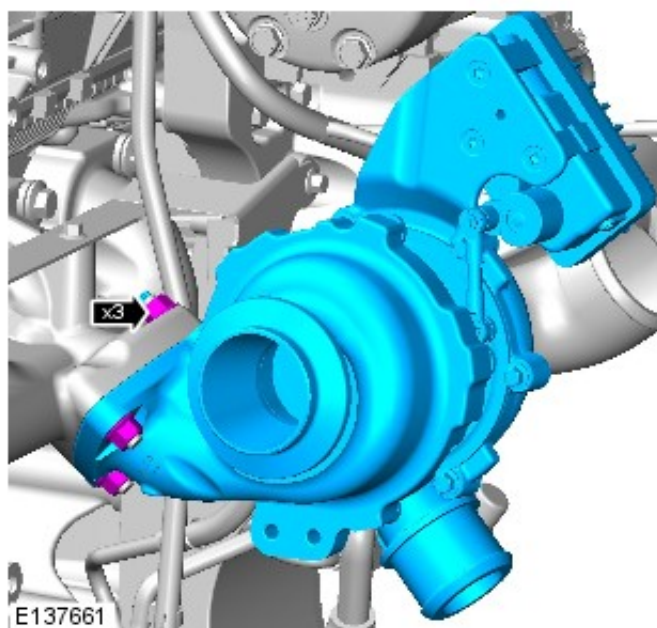
19. NOTE: Remove and discard the gasket.



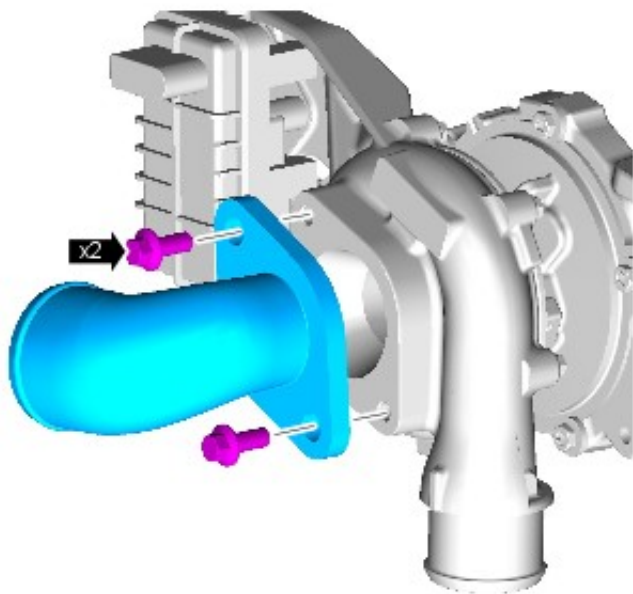
20.



21.



22. NOTE: Do not disassemble further if the component is removed for access only.



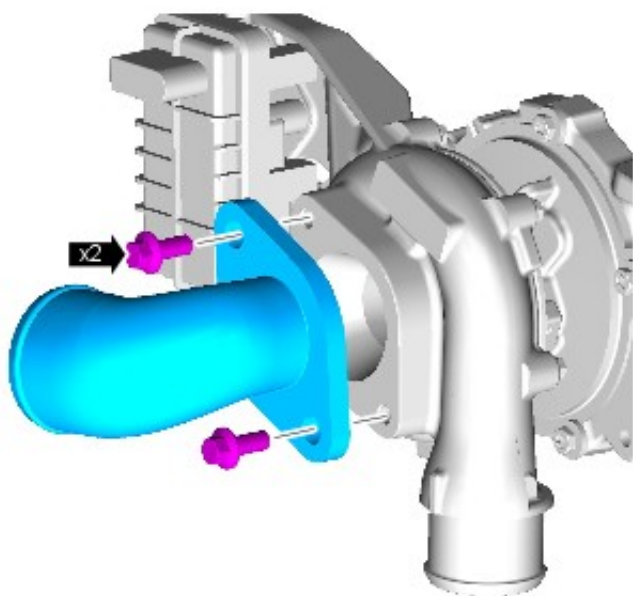
E139518

Installation

1.  **CAUTION: CAUTION:** Make sure blanking plugs are removed before component is installed.

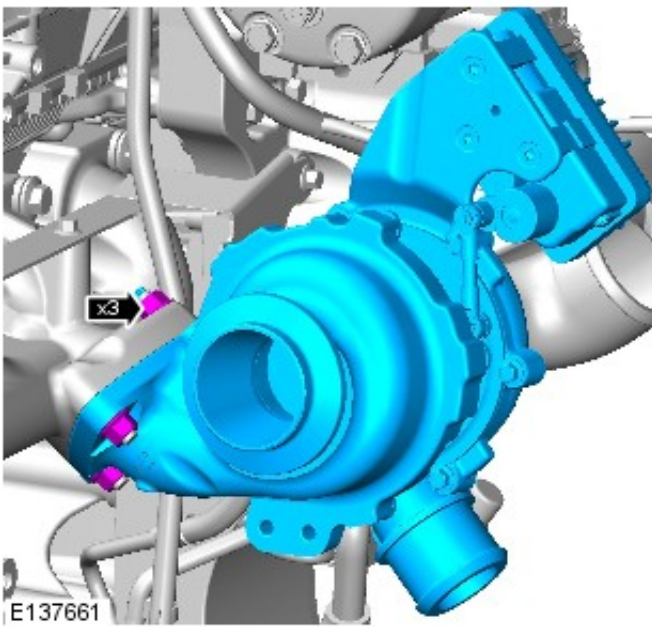
NOTE: If there are indications of damage to the O ring seal, a new seal should be installed.

Torque: 25Nm

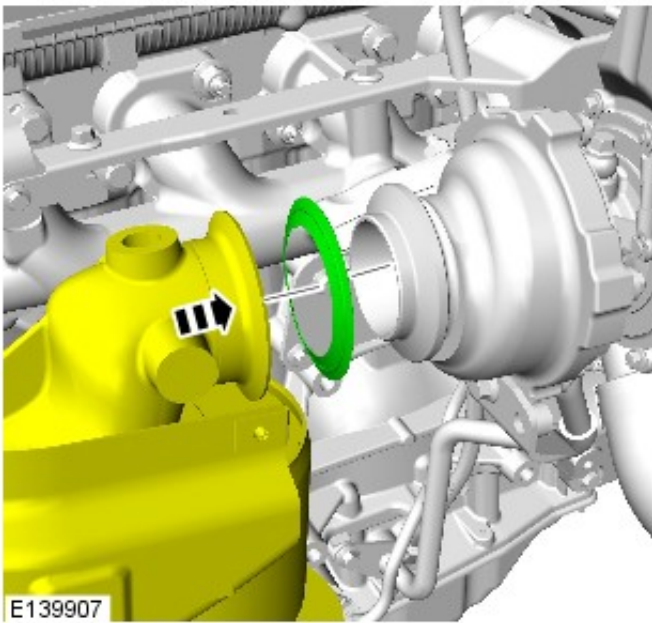


E139518

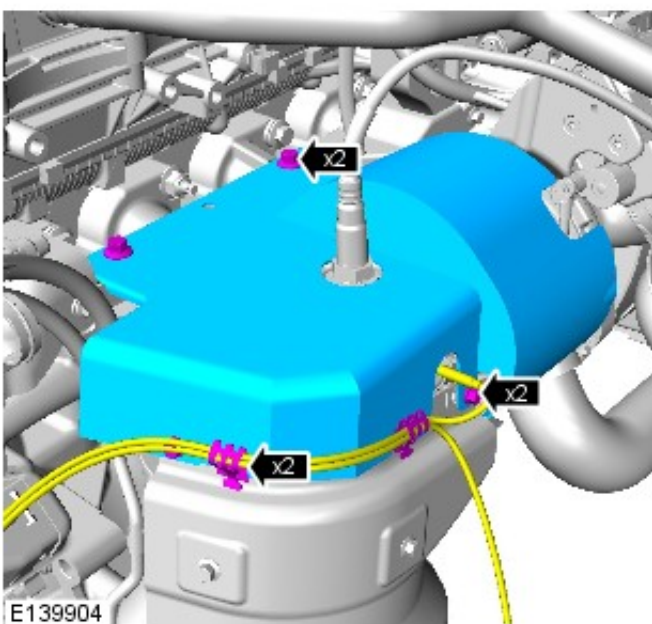
2. Torque: 23Nm



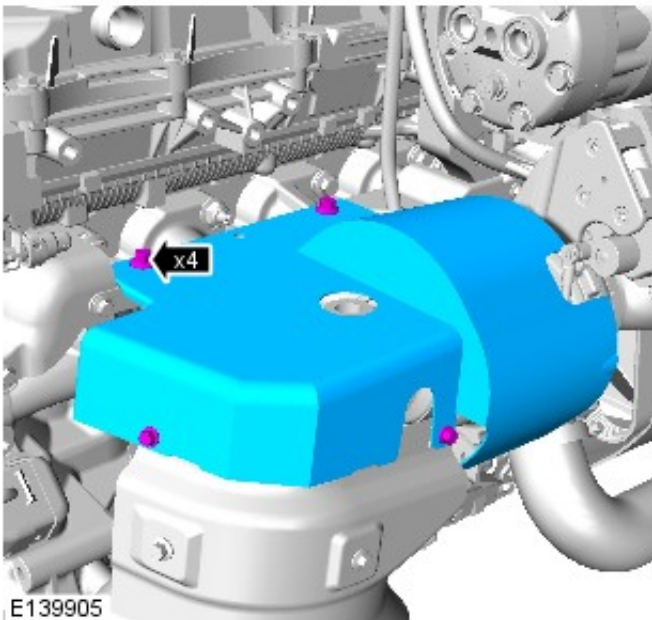
3. NOTE: Install a new gasket.



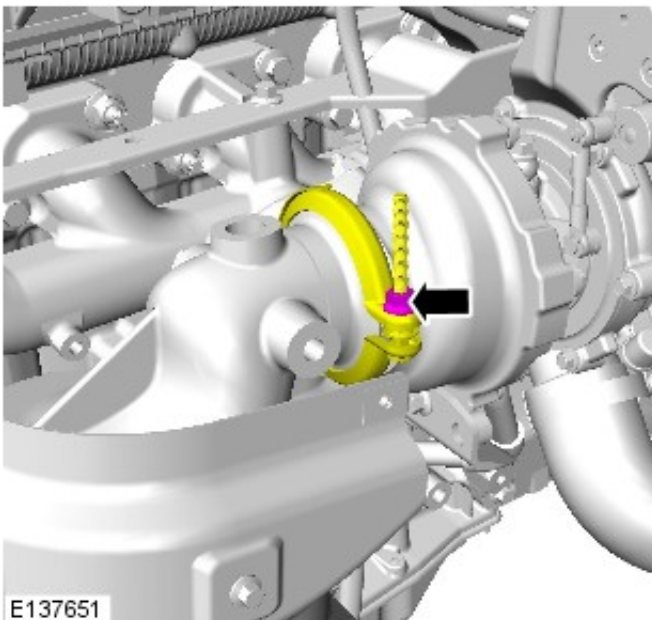
4. NOTE: Vehicles with diesel particulate filter (DPF).
Torque: 25Nm




5. Torque: 25Nm

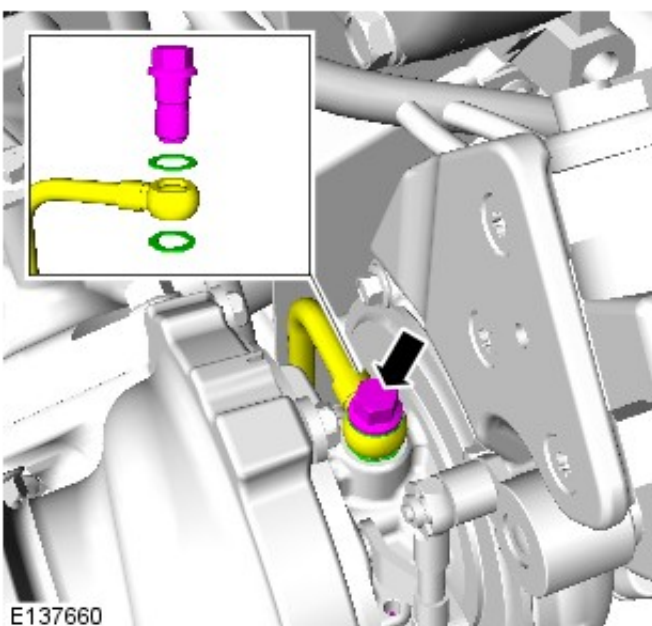


6. Torque: 10Nm



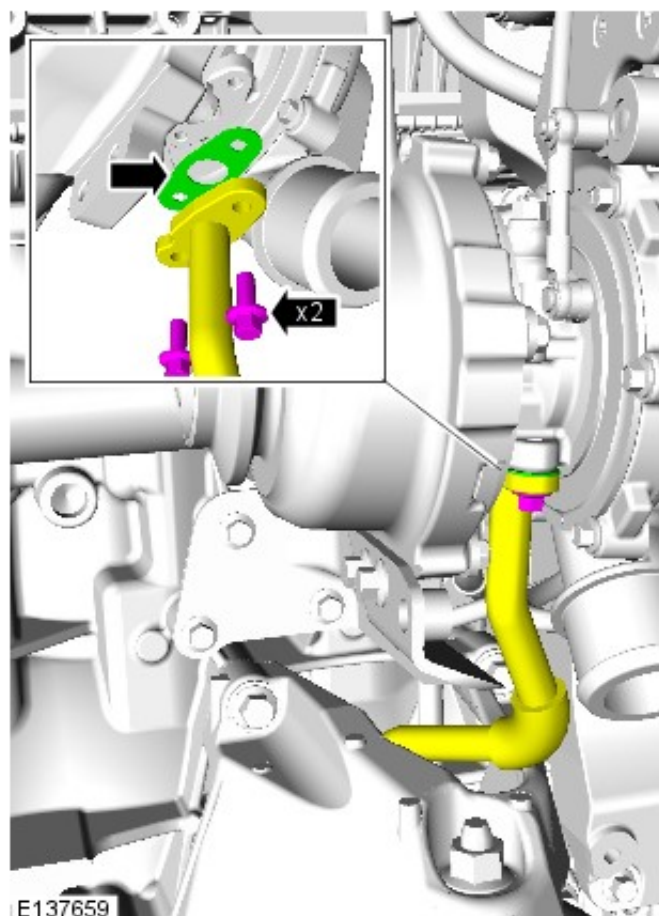
7.  CAUTION: CAUTION: Make sure that the oil feed pipe does not touch the turbo housing when secured.

Torque: 20Nm

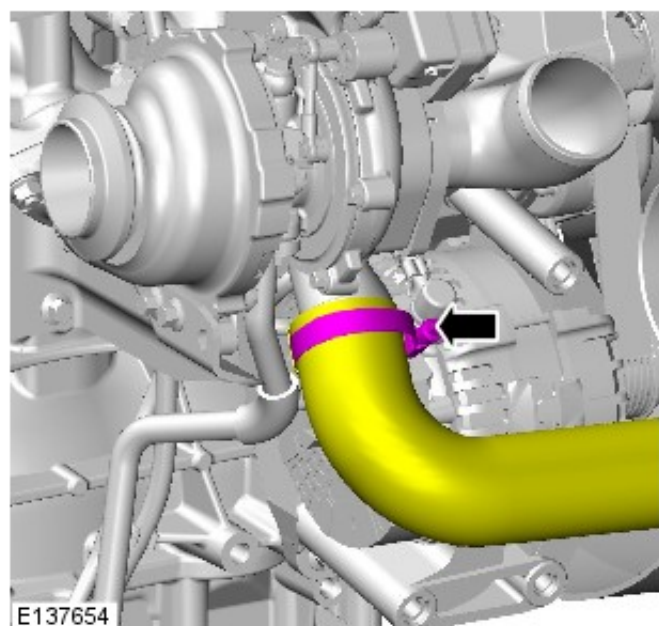


8.  **CAUTION: CAUTION:** Make sure the gasket is installed correctly.

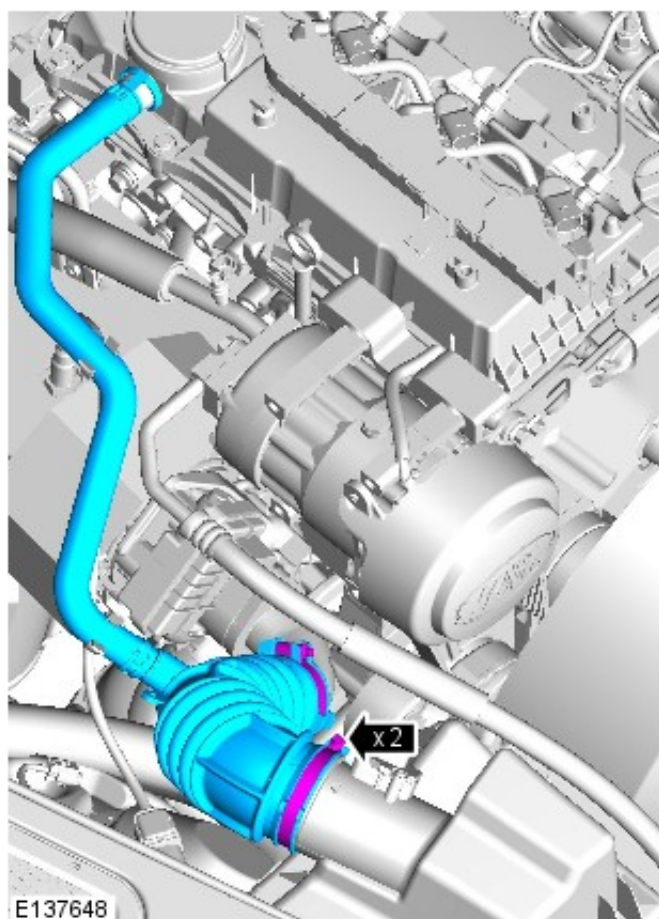
Torque: 10Nm



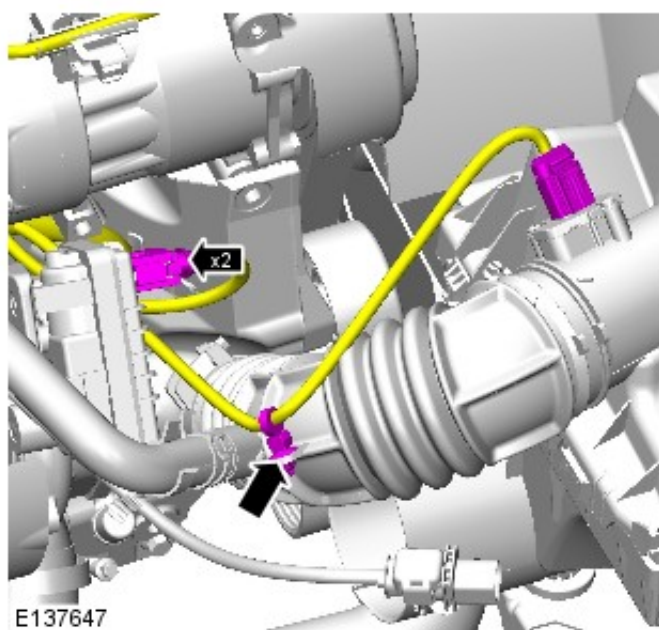
9. Torque: 3Nm



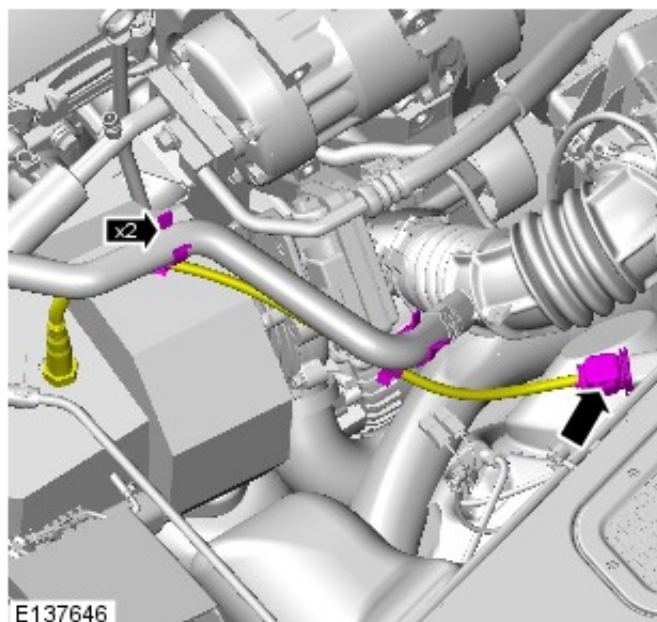
10. Torque: 3Nm



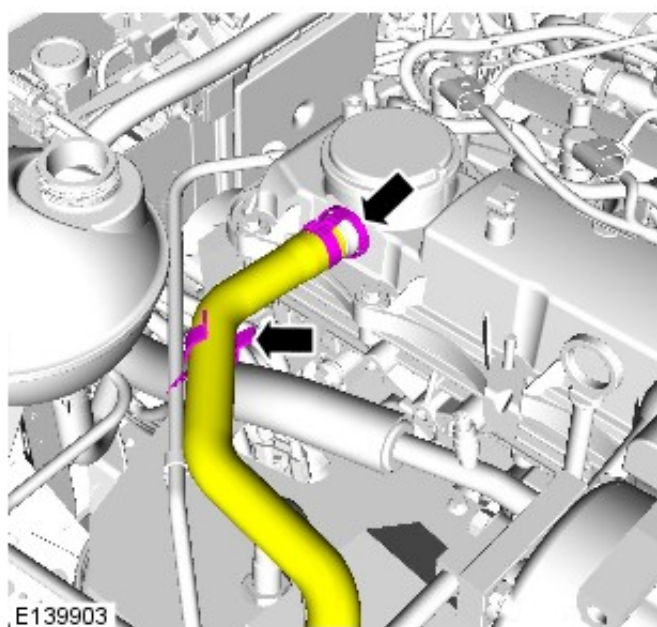
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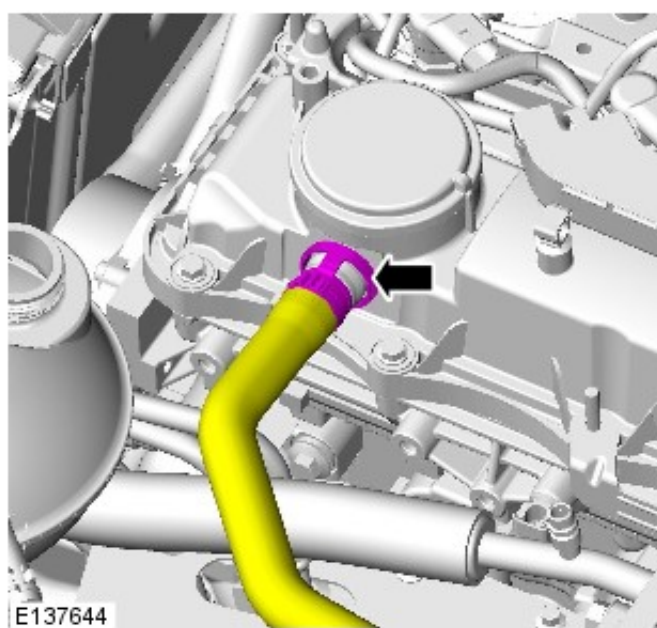
12.



13. NOTE: Right-hand drive vehicles.

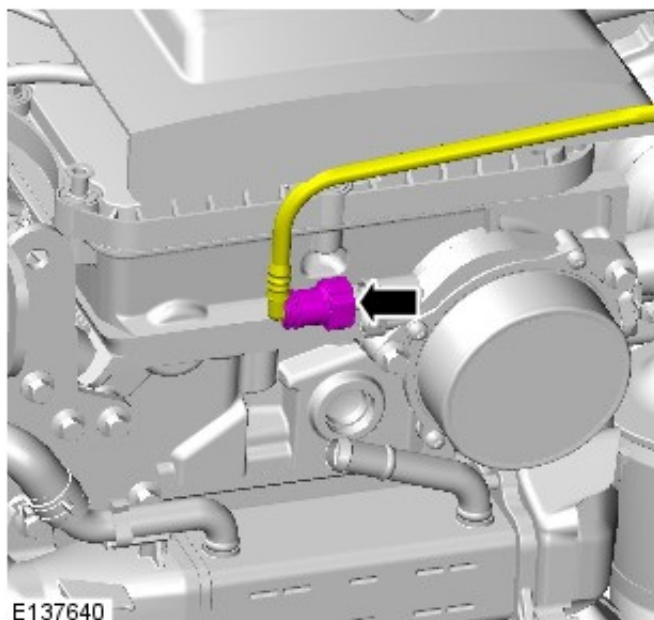


14.



15.

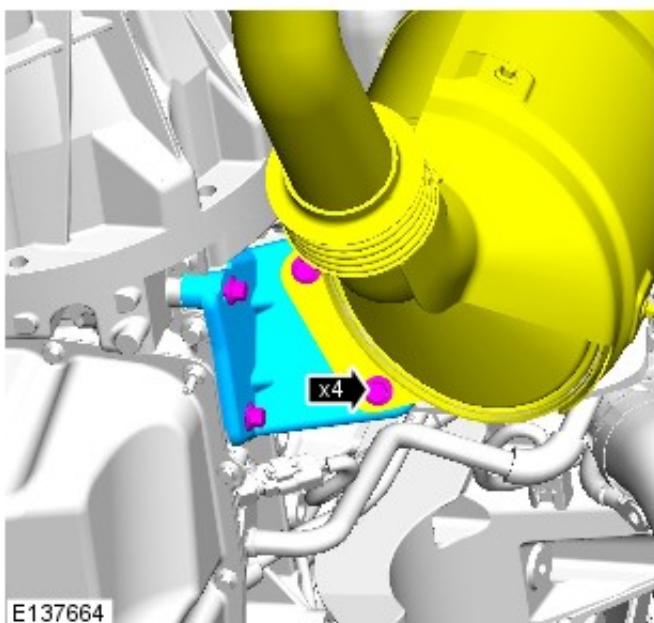
15.



16. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

17. With assistance, carefully install the hood.

18. Torque: 25Nm



19. For additional information, refer to: [Generator](#) (414-02 Generator and Regulator - ID4 2.2L Diesel, Removal and Installation).

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

Accessory Drive - ID4 2.2L Diesel -

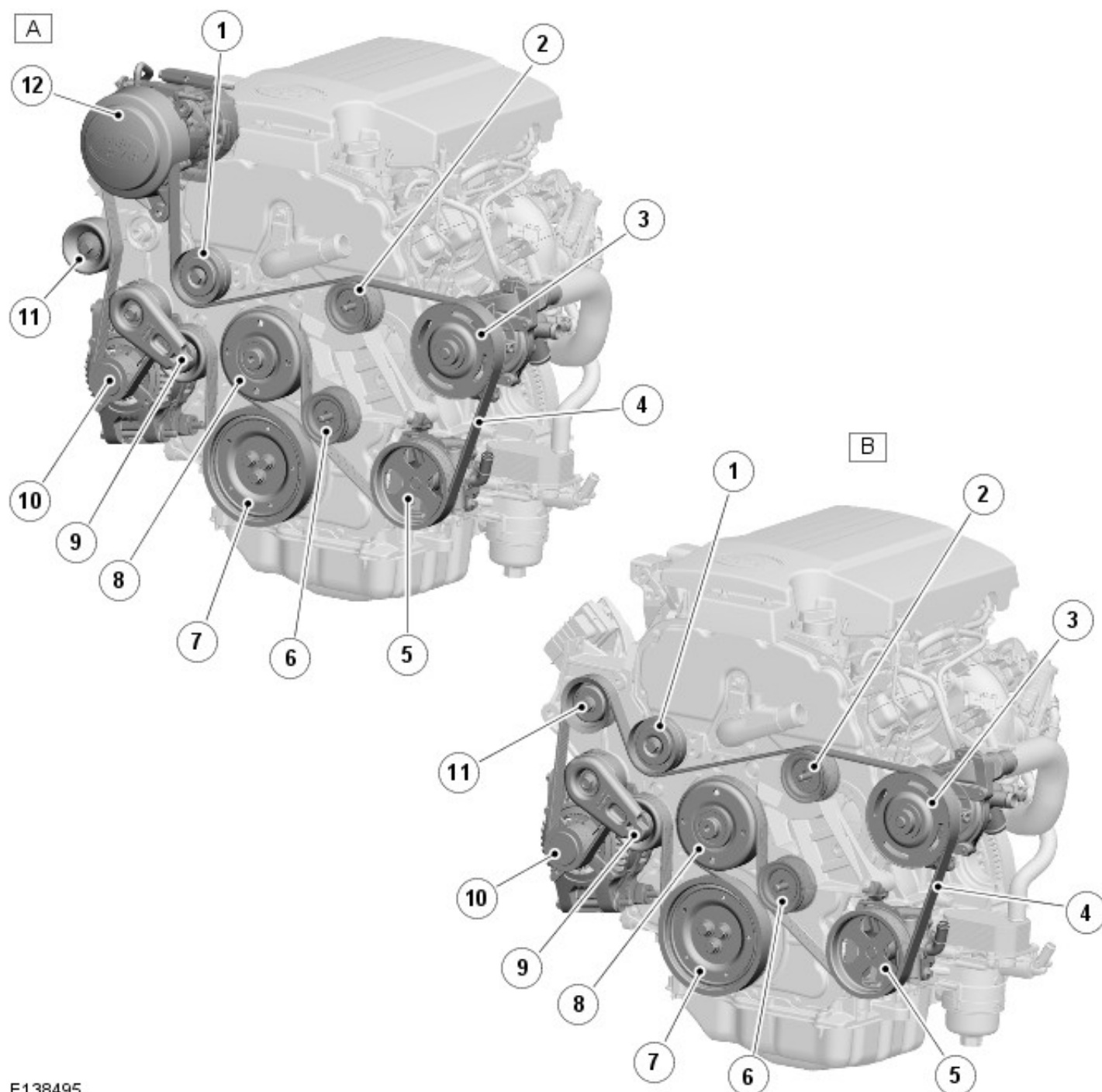
Torque Specifications

Item	Nm	lb-ft
Accessory drive component bracket bolts	48	35
Engine lifting bracket bolts	10	7
Accessory drive belt tensioner bolt	25	18
Accessory drive belt idler pulley bolt	48	35

Accessory Drive - ID4 2.2L Diesel - Accessory Drive

Description and Operation

COMPONENT LOCATION



E138495

Item	Part Number	Description
A	-	Vehicles with A/C (air conditioning)
B	-	Vehicles without A/C
1	-	Idler pulley
2	-	Idler pulley
3	-	Coolant pump
4	-	Accessory drive belt
5	-	Power steering pump
6	-	Idler pulley
7	-	Engine crankshaft pulley
8	-	Engine cooling fan pulley

9	-	Automatic tensioner
10	-	Generator
11	-	Idler pulley
12	-	A/C compressor

OVERVIEW

The accessory components, which comprise the coolant pump, power steering pump, engine cooling fan, generator and A/C compressor (where fitted), are driven by the engine crankshaft pulley via the accessory drive belt.

The belt is a maintenance free poly-V type belt, automatically pre-loaded by the automatic tensioner and routed over idler pulleys in order to maintain sufficient adhesion about the accessory component pulleys. This ensures a slip-free drive of the accessory components.

Accessory Drive - ID4 2.2L Diesel - Accessory Drive

Diagnosis and Testing

Overview

For information on the description and operation of the system:

REFER to: [Accessory Drive](#) (303-05 Accessory Drive - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical faults.

Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"> • Drive belt condition (cracking/damage/contamination) • Idler assembly • Generator • Engine cooling fan • Tensioner assembly • Engine coolant pump • Power steering pump • Air conditioning (A/C) compressor • Torsional vibration damper • Accessory drive belt

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.



CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. Use the approved diagnostic system or a scan tool to retrieve any DTCs before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart (Accessory Drive Belt)

Symptom	Possible cause	Action
Noise	<ul style="list-style-type: none"> • Belt condition • Belt tension • Pulleys misaligned • Driven components (including tensioners) 	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	<ul style="list-style-type: none"> • Belt condition • Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

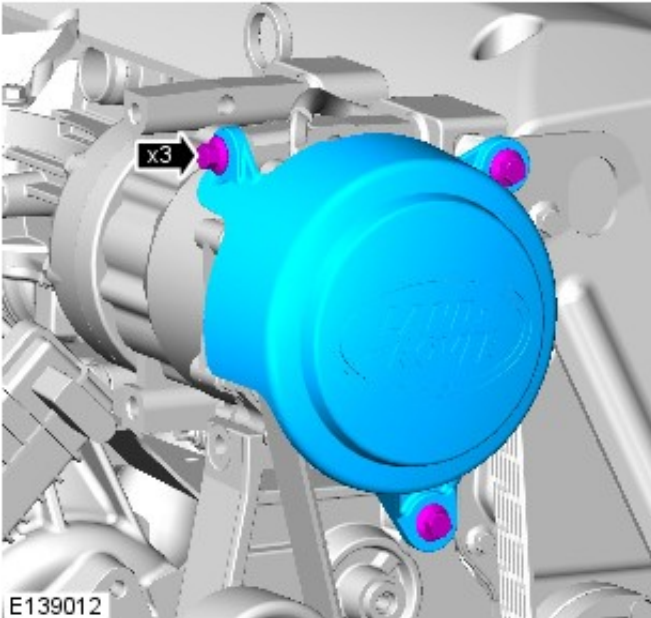
Accessory Drive - ID4 2.2L Diesel - Accessory Drive Belt

Removal and Installation

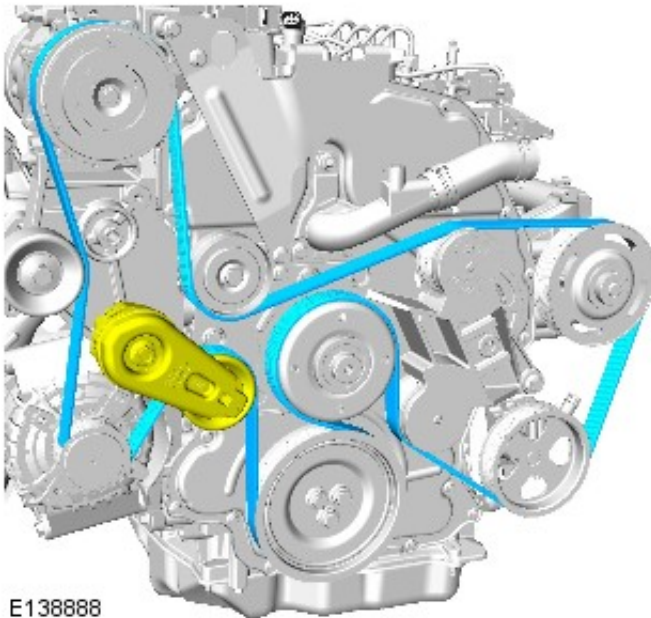
Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).

3. Torque: 10Nm



4.



Installation

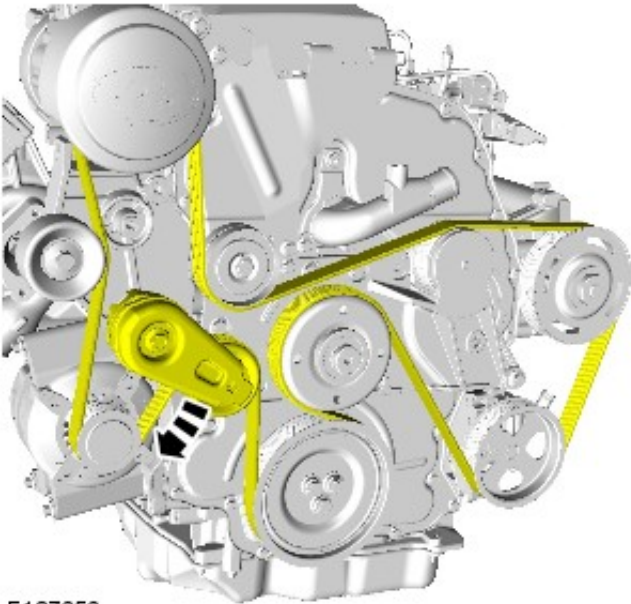
1. To install, reverse to removal procedure.

Accessory Drive - ID4 2.2L Diesel - Accessory Drive Belt Idler Pulley

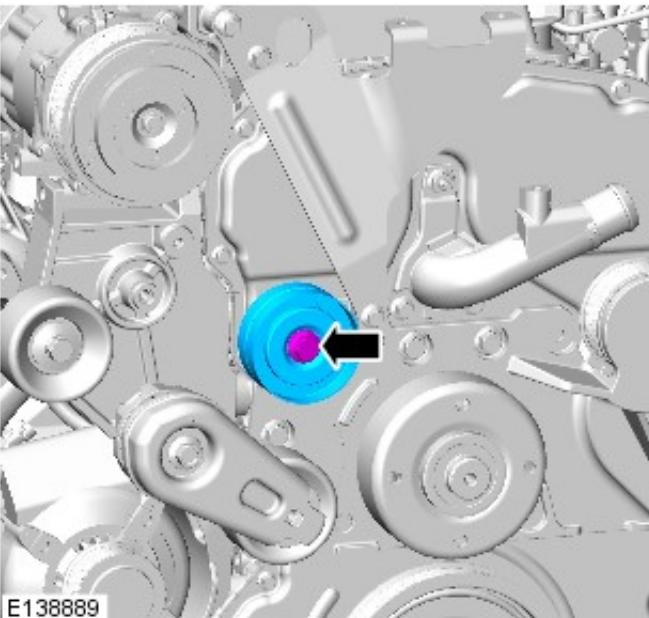
Removal and Installation

Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).
3. Release the accessory drive belt.

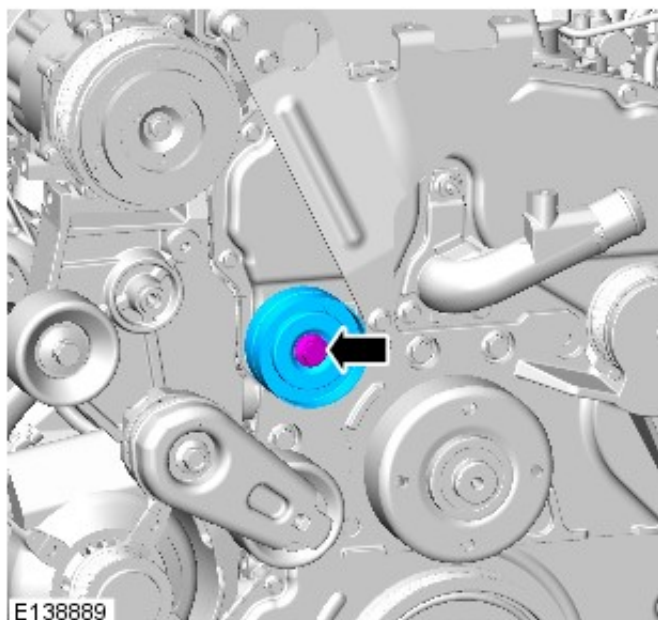


4. Remove the centre idler pulley.

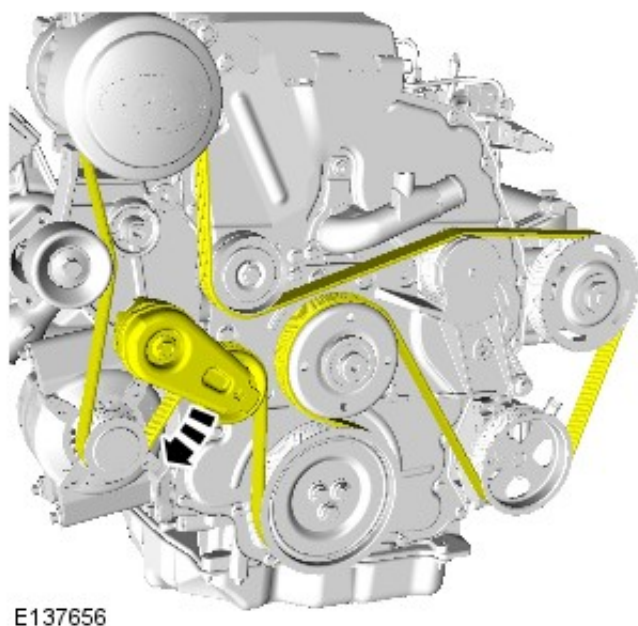


Installation

1. Torque: 48Nm



2. Install the accessory drive belt.



3. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).
4. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

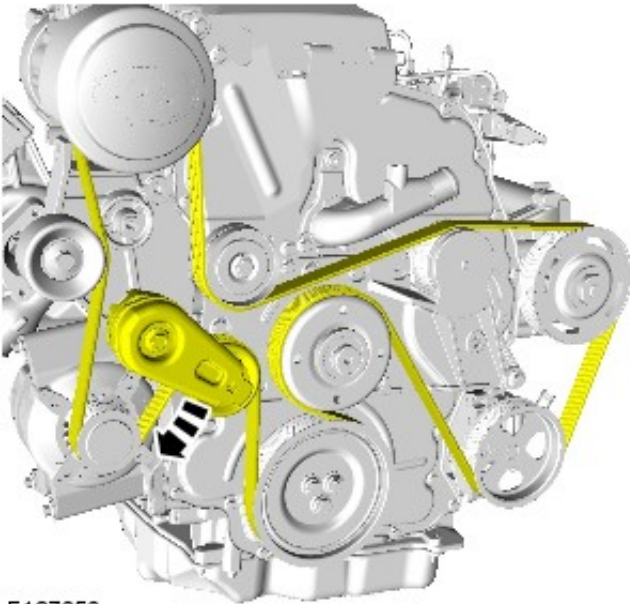
Accessory Drive - ID4 2.2L Diesel - Accessory Drive Belt Tensioner

Removal and Installation

Removal

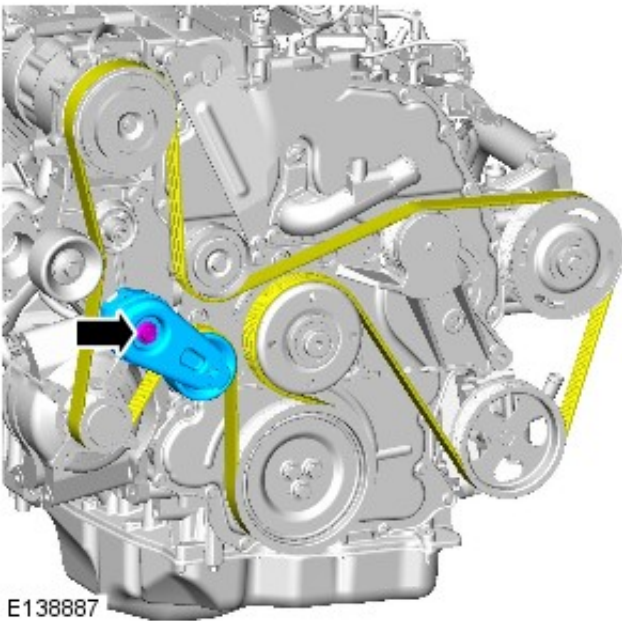
1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Cooling Fan](#) (303-03 Engine Cooling - ID4 2.2L Diesel, Removal and Installation).

3.



E137656

4. Torque: 25Nm



E138887

Installation


1. To install, reverse the removal procedure.

Accessory Drive - ID4 2.2L Diesel - Accessory Drive Component Bracket

Removal and Installation

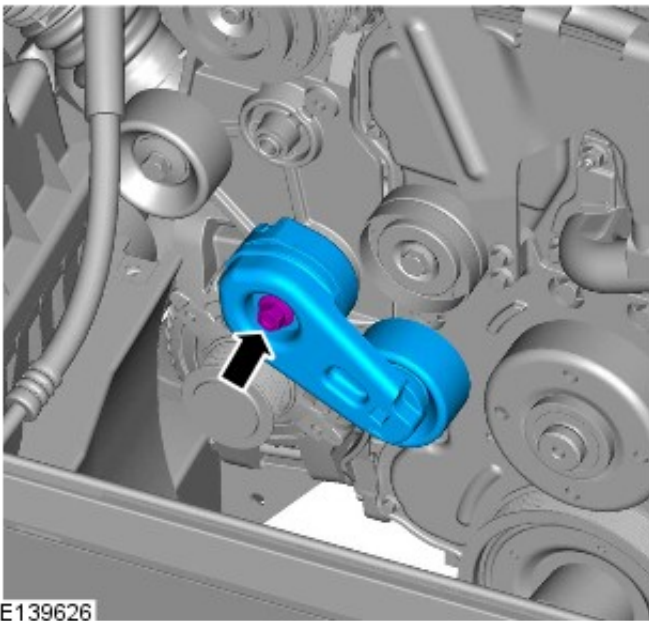
Removal

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. For additional information, refer to: [Accessory Drive Belt](#) (303-05 Accessory Drive - ID4 2.2L Diesel, Removal and Installation).

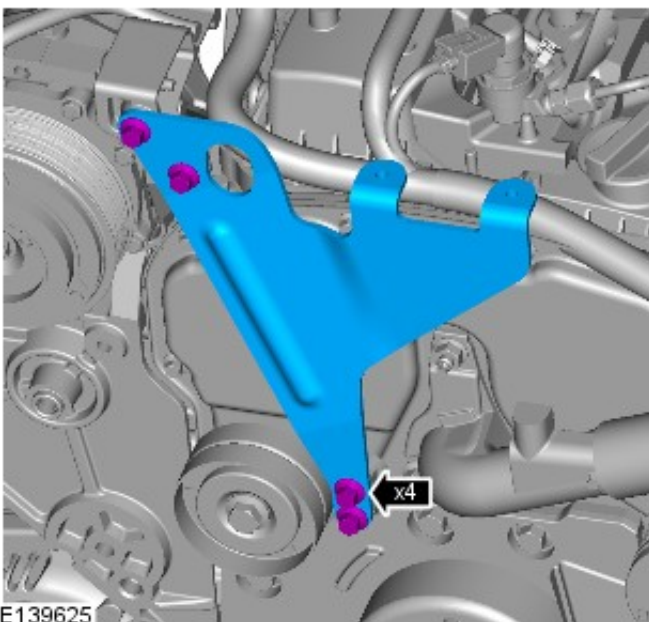
4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

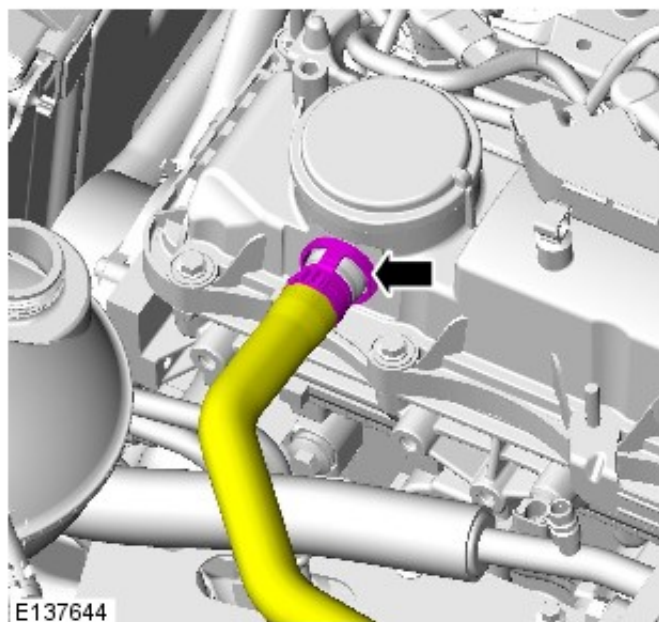
5. Torque: 47Nm



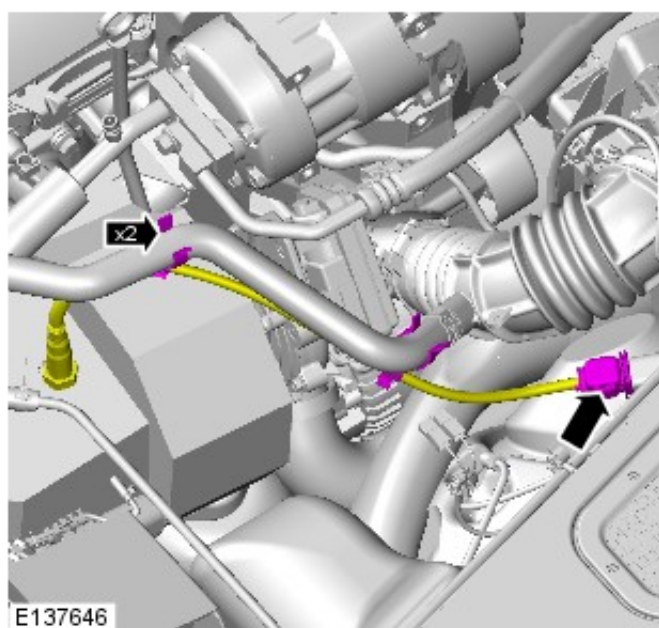
6. Torque: 48Nm



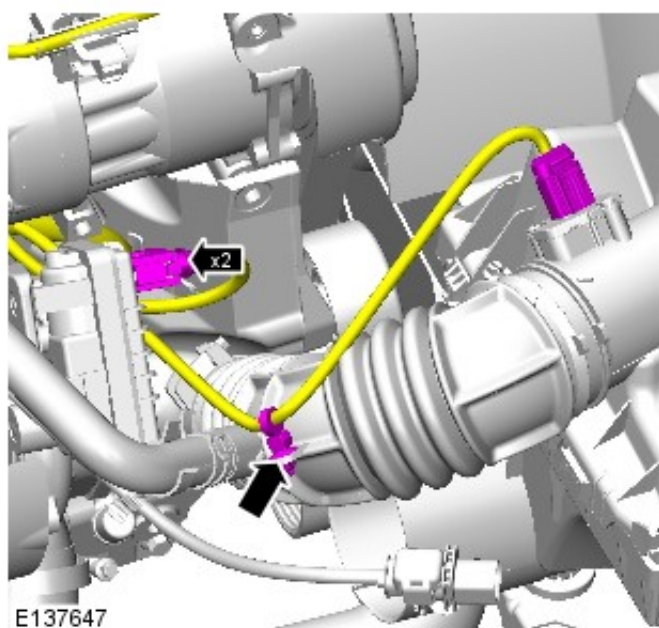
- 7.



8.

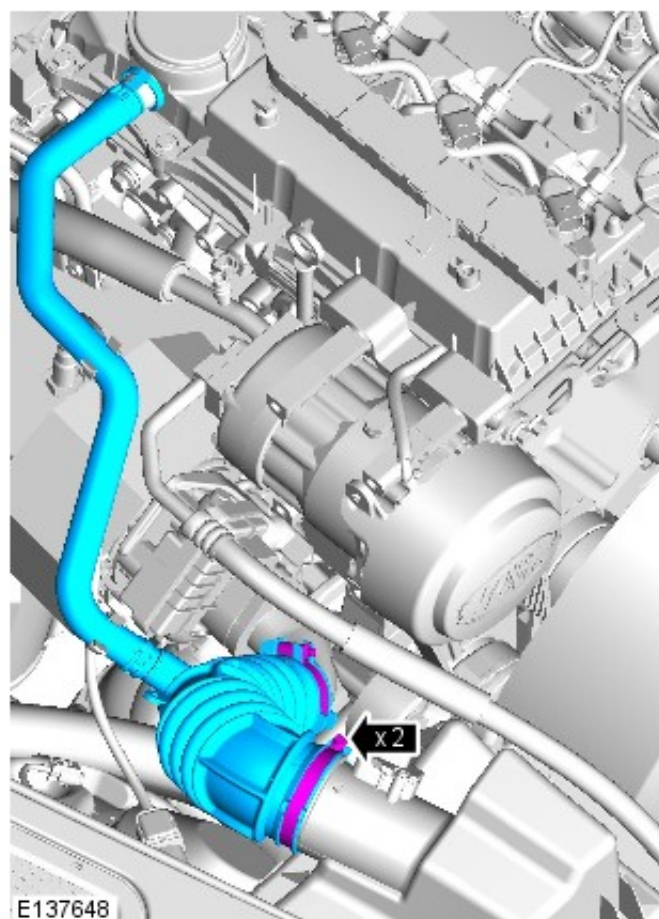


9.

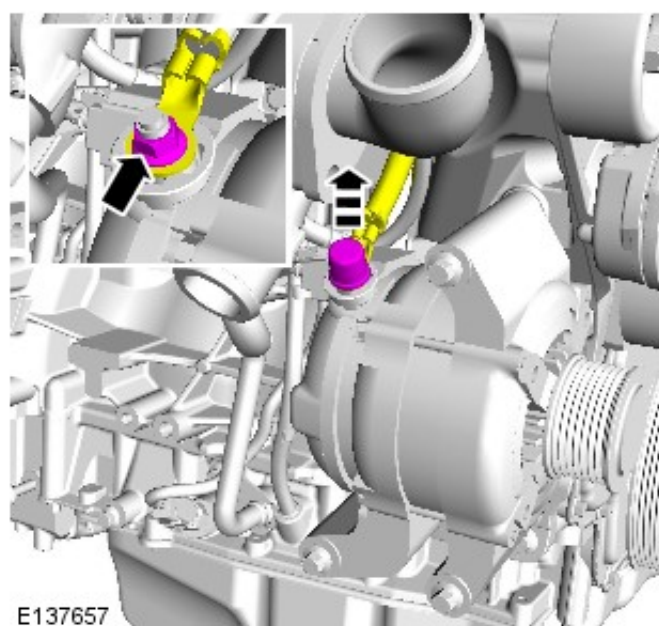


10.

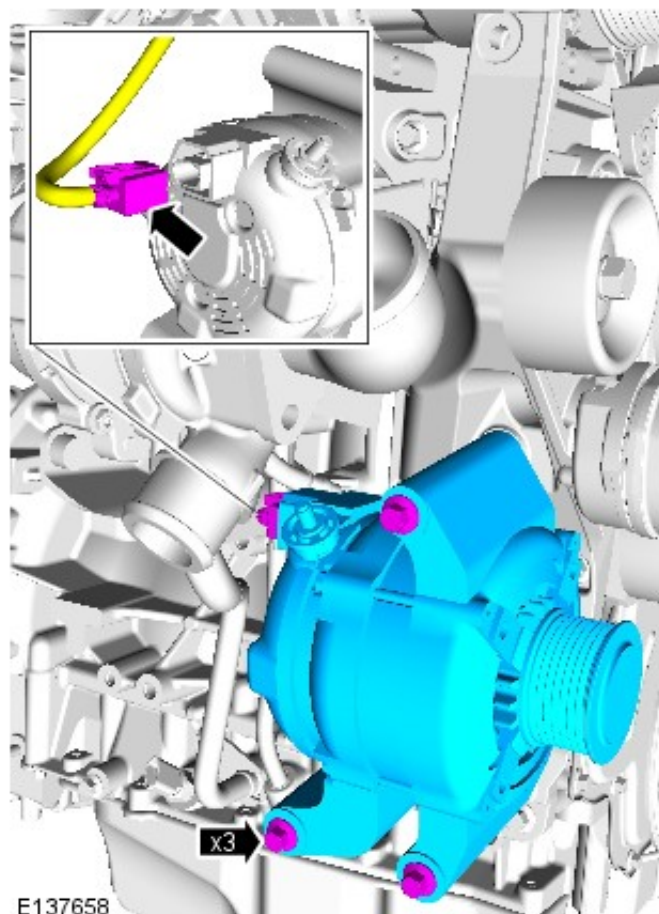
10.



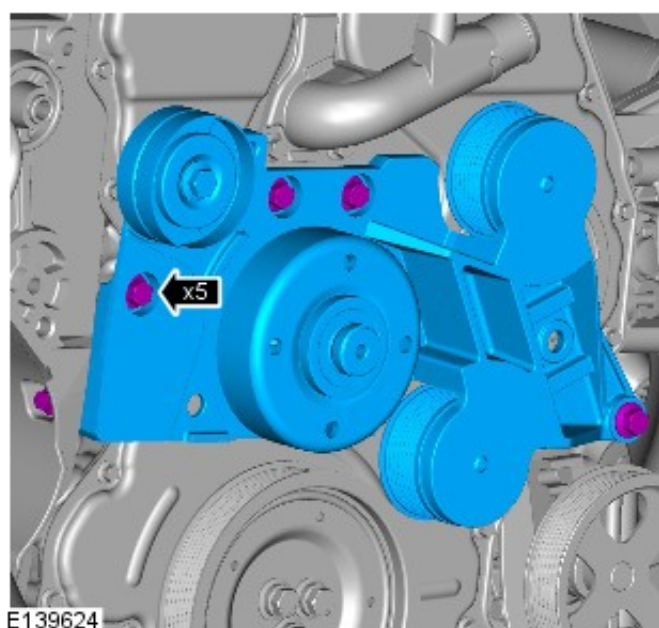
11. Torque: 10Nm



12. Torque: 48Nm



13. Torque: 47Nm



Installation

1. To install, reverse to removal procedure.

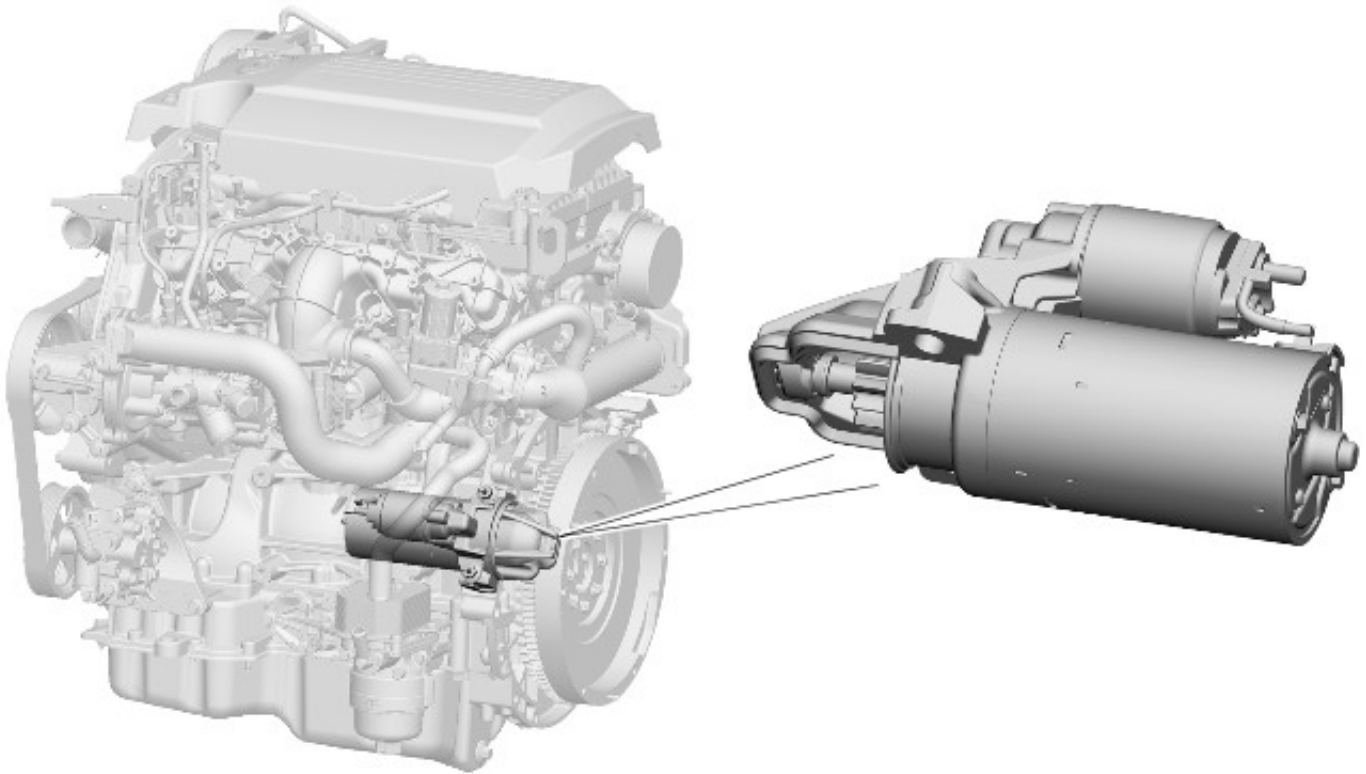
Starting System - ID4 2.2L Diesel -

Description	Nm	lb-ft
Starter motor bolts	35	26
Starter motor battery positive cable nut	12	9
Starter motor solenoid cable nut	8	6
Fuel line support bracket nut	8	6

Starting System - ID4 2.2L Diesel - Starting System

Description and Operation

COMPONENT LOCATION



E139196

OVERVIEW

The starter motor is located on the rear **LH (left-hand)** side of the engine block and protrudes through an aperture in the transmission housing to drive the flywheel ring gear. The motor is secured to the cylinder block by 2 bolts.

The starter motor is rated as 2.0 kW and is of conventional design with the motor and drive pinion in line, with the solenoid mounted above. It is of the pre-engaged type and comprises a series wound motor, an overrunning clutch and an integral solenoid. The starter motor incorporates a labyrinth seal in the front end nose casting to help with water management, sealing and drainage. The solenoid is sealed to stop water ingress and to alleviate cranking failures due to moisture.

The starter solenoid is energized by power from the starter relay in the **BJB (battery junction box)** when the ignition switch is moved to the crank position. Operation of the starter relay is controlled by the **ECM (engine control module)**. When engine cranking is requested, the **ECM** checks that a valid key code has been received before energizing the starter relay.

The power for starter operation is supplied direct from the battery positive terminal. The cables from the starter relay and the battery are connected to copper threaded studs on the solenoid. The starter mountings provide the electrical ground for the solenoid.

Starting System - ID4 2.2L Diesel - Starting System

Diagnosis and Testing

Overview

For information on the operation of the system:

REFER to: [Starting System](#) (303-06 Starting System - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Starter motor • Engine (turns freely) 	<ul style="list-style-type: none"> • Battery • Fuses • Fuse link 5, fuse box under seat • Megafuse • Starter relay • Wiring harness(es) • Damaged, loose or corroded connectors • Ignition switch • Generator • Engine control module (ECM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart


Symptom	Possible causes	Action
The engine does not crank (starter motor does not turn)	<ul style="list-style-type: none"> • Battery • Starter relay • Output circuit: high resistance • Output circuit: short circuit to power • Invalid key code received by immobilizer • Harness/connectors • Starter motor • Ignition switch • Generator • Engine seized 	Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check that the engine turns freely.
The engine does not crank (starter motor does turn)	<ul style="list-style-type: none"> • Starter motor fitment • Starter motor • Flywheel/drive plate ring gear 	Check the starter motor fitment (fasteners tight, starter motor square to engine, etc.). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	<ul style="list-style-type: none"> • Battery • Harness/connectors • Starter motor • Oil grade 	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.
Engine cranks too fast	<ul style="list-style-type: none"> • Low engine compression 	Check the engine condition and compressions.
Excessive starter motor noise	<ul style="list-style-type: none"> • Starter motor • Flywheel/drive plate ring gear • Starter motor fitment/casing 	Check the starter motor fitment (fasteners tight, motor square to engine, etc.). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

Starting System - ID4 2.2L Diesel - Starter Motor

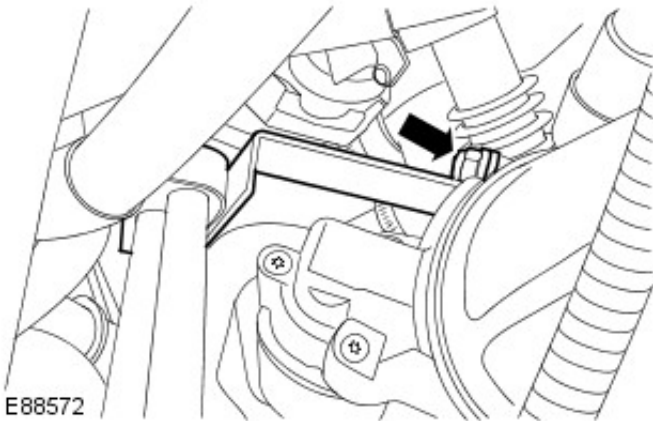
Removal and Installation

Removal

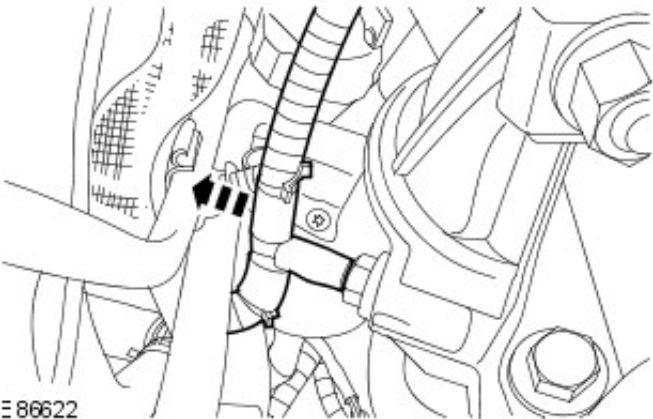
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
For additional information, refer to: Lifting (100-02, Description and Operation).

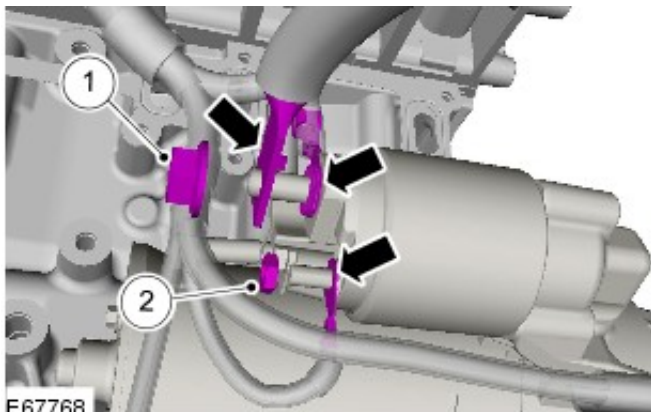
3. Remove the fuel line support bracket.
 - Remove the nut.



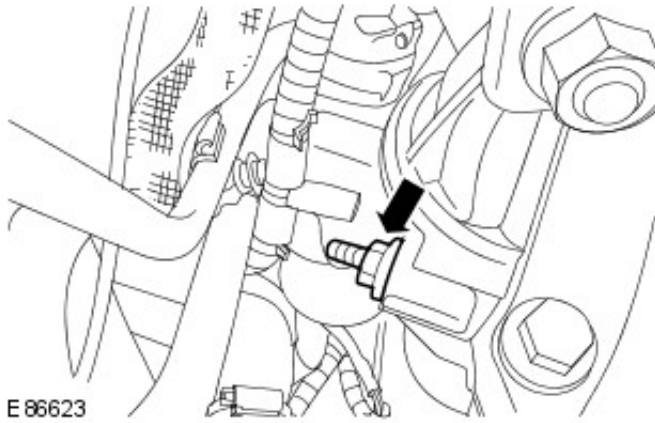
4. Release the starter motor wiring harness clip.



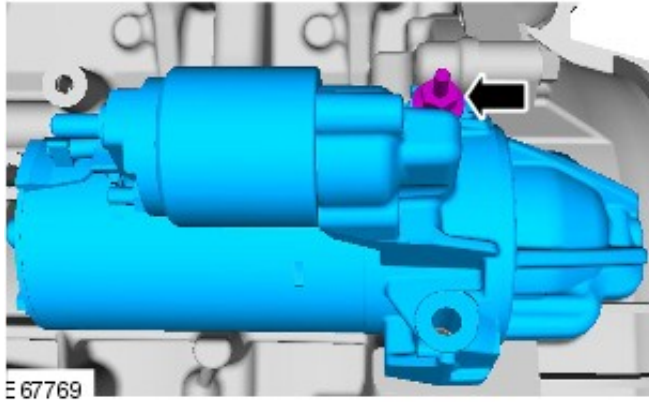
5. Release the 2 battery positive cables and the switch lead from the starter motor solenoid.
 1. Remove the battery positive cable nut.
 2. Release the starter motor switch lead nut.



6. Remove the starter motor lower bolt.

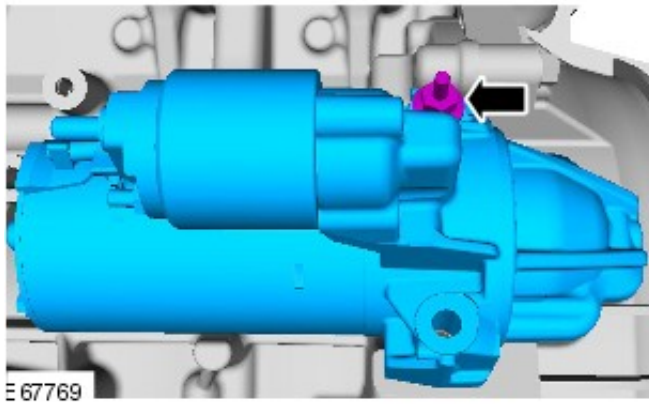


7. Remove the starter motor.

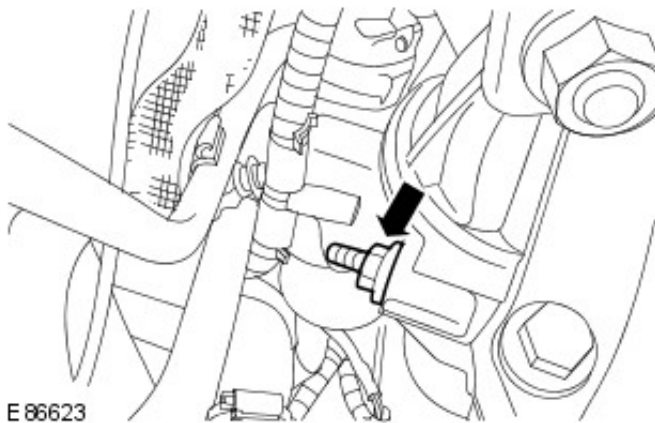


Installation

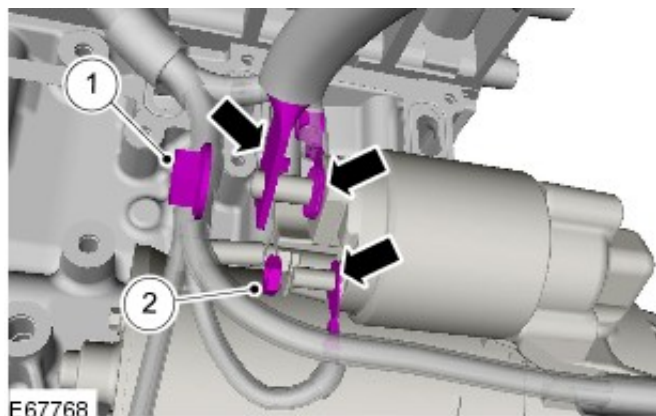
1. Install the starter motor.
 - Tighten to 35 Nm (26 lb.ft).



2. Tighten to 35 Nm (26 lb.ft).



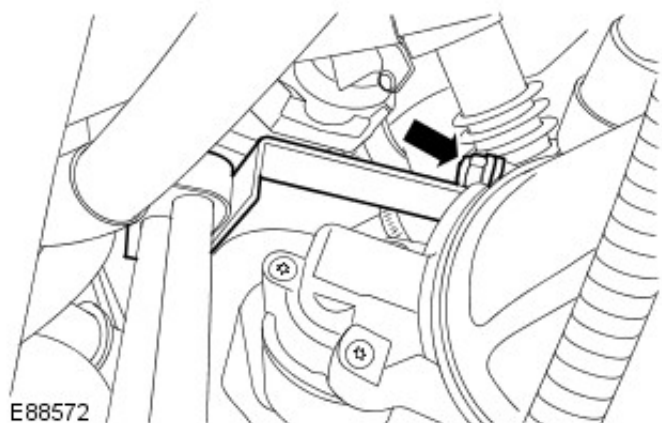
3. Secure the 2 battery positive cables and the switch lead to the starter motor solenoid.



1. Tighten to 12 Nm (9 lb.ft).
2. Tighten to 8 Nm (6 lb.ft).

4. Secure the starter motor wiring harness clip.

5. Install the fuel line support bracket.
 - Tighten to 8 Nm (6 lb.ft).



6. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

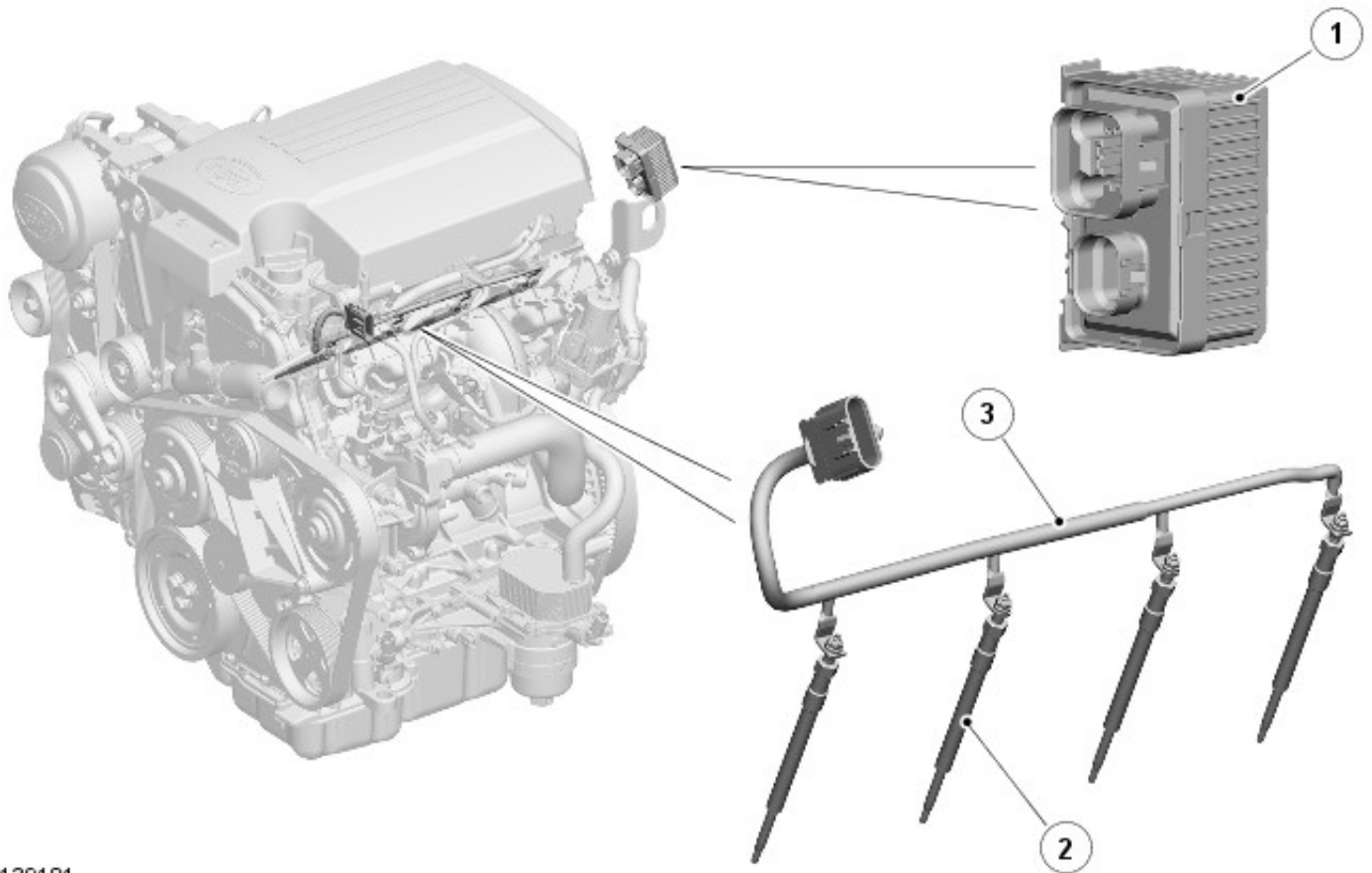
Glow Plug System - ID4 2.2L Diesel -

Item	Nm	lb-ft
Glow plug wiring harness nuts	2	1
Glow plugs	13	10

Glow Plug System - ID4 2.2L Diesel - Glow Plug System

Description and Operation

COMPONENT LOCATION



E139181

Item	Part Number	Description
1	-	Glow plug control module
2	-	Glow plug (4 off)
3	-	Glow plug wire assembly

OVERVIEW

A glow plug is installed between the inlet valves of each cylinder, to:

- Preheat the combustion chambers to aid engine starting
- Provide additional heat in the combustion chambers while the engine warms up, to reduce emissions and engine noise.

A glow plug control module, located on the [ECM \(engine control module\)](#) bracket on the engine bulkhead, powers each glow plug individually. Each glow plug is grounded through its fixing in the cylinder head. Operation of the glow plug control module is controlled by the [ECM](#), which also controls the illumination of the glow plug warning indicator in the instrument cluster.

The glow plugs are a low voltage metallic type that operate at a maximum tip temperature of 1050 °C (1922 °F), achievable within 2 seconds.

OPERATION

Power for the glow plugs is supplied to the glow plug control module from a fusible link in the [BJB \(battery junction box\)](#). Operating power for the glow plug control module is supplied from the power relay in the [BJB](#) while the ignition is on.

The power level applied to the glow plugs by the glow plug control module is contained in an input signal from the ECM. The glow plug control module incorporates diagnostic functions for the individual glow plugs and reports the diagnostic status to the ECM.

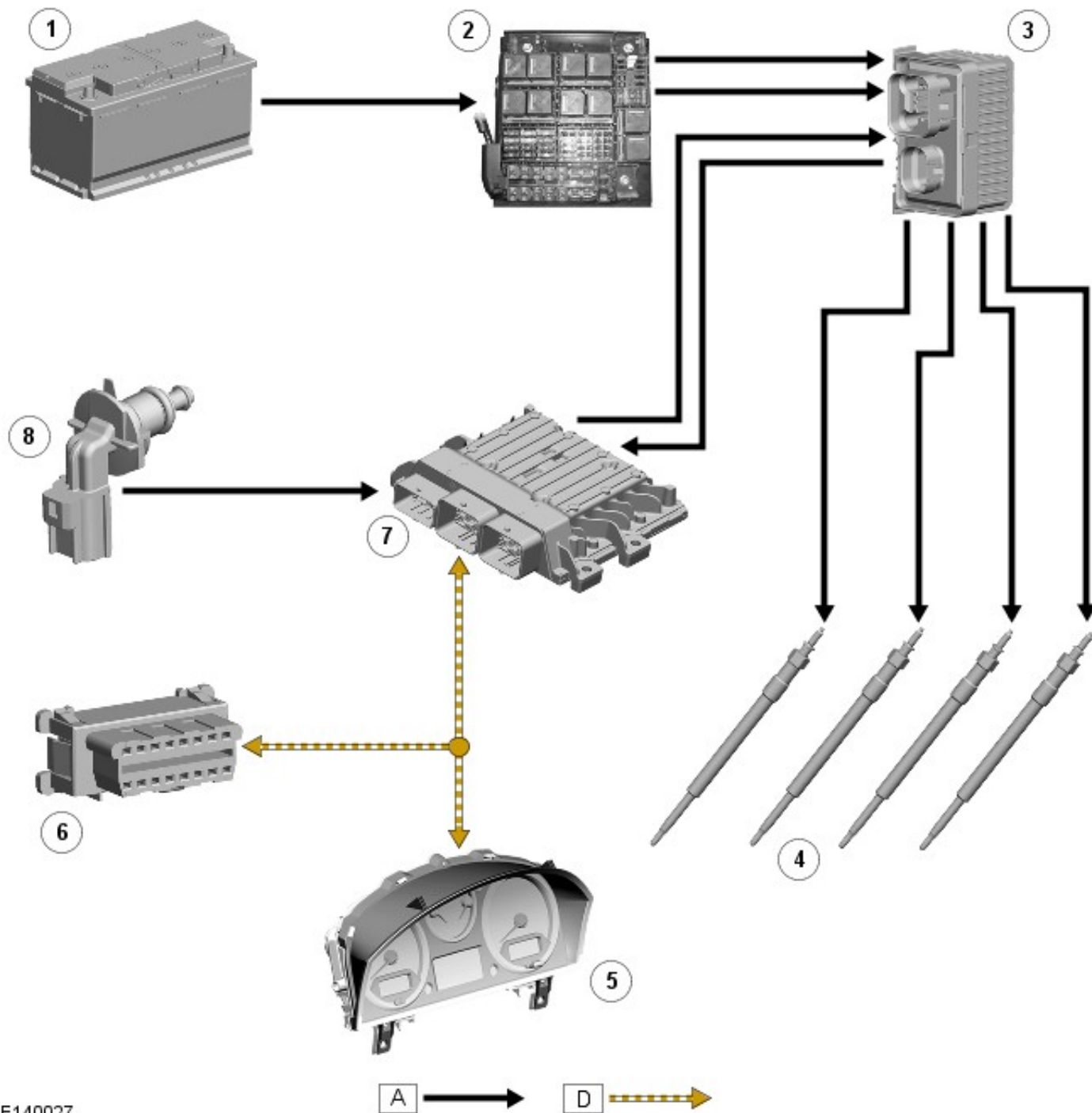
The [ECM](#) uses the signal from the [ECT \(engine coolant temperature\)](#) sensor to determine the preheat time. The lower the temperature, the longer the preheat time. There is a maximum preheat time of 2.1 seconds at -20 °C (-4 °F) or lower. At temperatures above 20 °C (68 °F) there is no preheat phase. The [ECM](#) signals the instrument cluster on the high speed

CAN (controller area network) bus to illuminate the glow plug warning indicator for the duration of the preheat phase.

Once the engine has started, if the engine temperature is less than 70 °C (158 °F) the glow plug system enters an after-glow phase. The after-glow phase lasts for a maximum of 500 seconds, or until the engine temperature reaches 70 °C (158 °F). The tip temperature of the glow plugs is reduced as the engine warms up. The ECM uses a glow plug control map of engine speed against load to determine the optimum tip temperature during the after-glow phase. At high engine loads the after-glow phase is interrupted to protect the glow plugs and improve their durability.

CONTROL DIAGRAM

NOTE: A = Hardwired; D = High speed CAN bus.



E140027

Item	Part Number	Description
1	-	Battery
2	-	BJB
3	-	Glow plug control module
4	-	Glow plug (4 off)
5	-	Instrument cluster
6	-	Diagnostic socket
7	-	ECM

Glow Plug System - ID4 2.2L Diesel - Glow Plug System

Diagnosis and Testing

Overview

For information on description and operation:

REFER to: [Glow Plug System](#) (303-07 Glow Plug System - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> • Glow plug lamp • Fuses • Link 1, fuse box under seat • Glow plug relay • Engine management relay • Wiring harness/connectors • Glow plugs • Engine control module (ECM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart

Symptom	Possible cause	Action
Poor starting (extreme weather conditions)	<ul style="list-style-type: none"> • Glow plugs inoperative/inefficient • Fuel temperature too low • The fuel system recycles fuel until operating temperature is reached to reduce this possibility 	Check the glow plug harnesses at the glow plugs and at the connections to the main harness. Refer to the electrical guides. Check for DTCs indicating a glow plug fault. Rectify as necessary. Clear the DTCs and check for normal operation.
High cold-engine emissions	<ul style="list-style-type: none"> • After-glow phase inoperative 	Check the glow plug harnesses at the glow plugs and at the connections to the main harness. Refer to the electrical guides. Check for DTCs indicating a glow plug fault. Rectify as necessary. Clear the DTCs and check for normal operation. After-glow is designed to function at engine temperatures below 50°C (122°F), below 2,500 rpm and for a maximum of 30 seconds after engine starting.
High cold-engine noise, vibration or harshness	<ul style="list-style-type: none"> • After-glow phase inoperative 	Check the glow plug harnesses at the glow plugs and at the connections to the main harness. Refer to the electrical guides. Check for DTCs indicating a glow plug fault. Rectify as necessary. Clear the DTCs and check for normal operation. After-glow is designed to function at engine temperatures below 50°C (122°F), below 2,500 rpm and for a maximum of 30 seconds after engine starting.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.

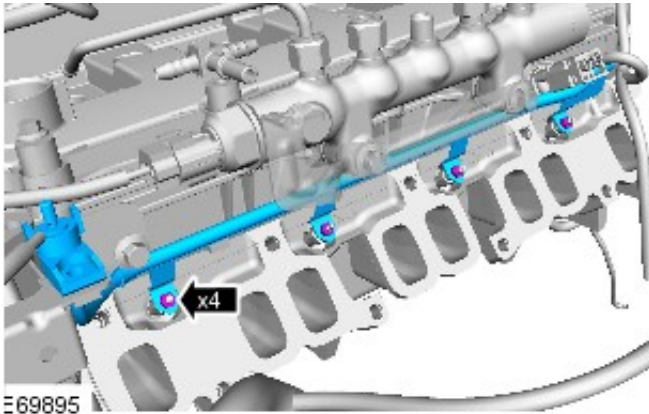
REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

Glow Plug System - ID4 2.2L Diesel - Glow Plug

Removal and Installation

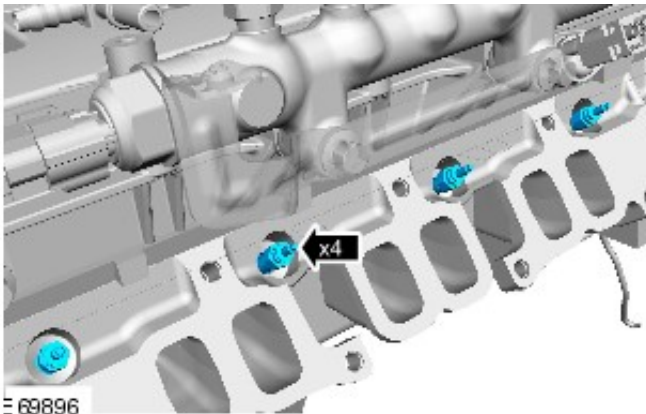
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Remove the intake manifold.
For additional information, refer to: Intake Manifold (303-01, In-vehicle Repair).
3. Release the glow plug wiring harness.
 - Remove the 4 nuts.



E69895

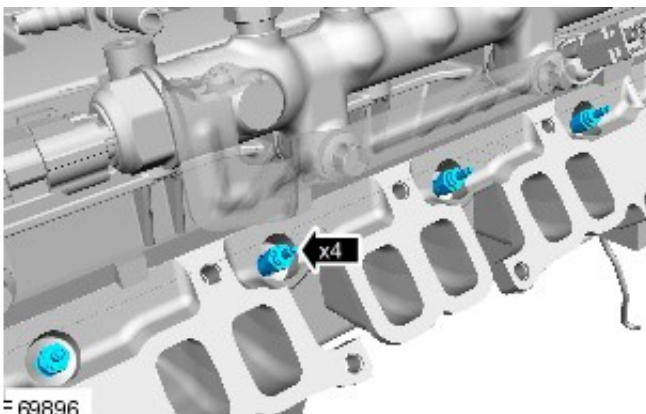
4. Remove the glow plugs.



E69896

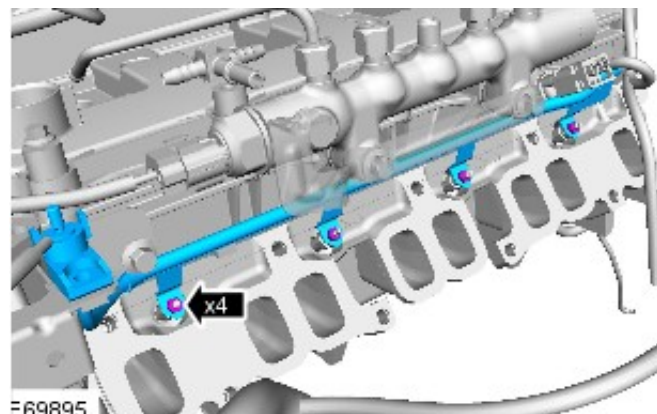
Installation

1. To install, reverse the removal procedure.
 - Tighten to 13 Nm (10 lb.ft).



E69896

2. Tighten to 2 Nm (1 lb.ft).



E69895

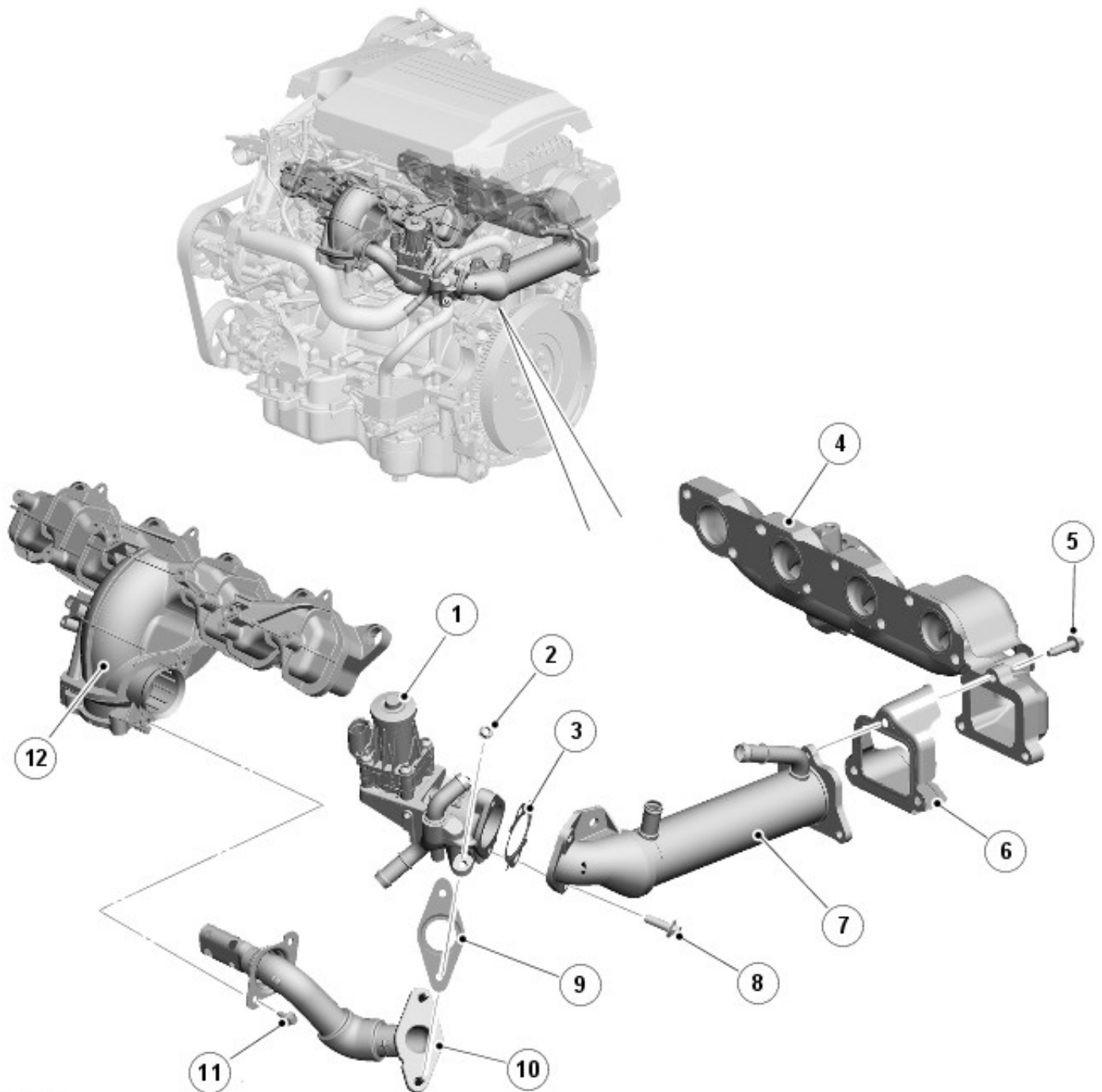
Engine Emission Control - ID4 2.2L Diesel -

Description	Nm	lb-ft
Exhaust gas recirculation (EGR) valve to EGR valve outlet tube nuts	10	7
EGR valve to EGR cooler bolts	23	17
Exhaust manifold to EGR cooler bolts	23	17
EGR valve outlet tube to intake manifold	23	17
DPF Clamp to Turbocharger	10	7
Front muffler to DPF nuts	25	18
Pressure pipe union-Pre DPF	25	18
Pressure pipe union-Post DPF	25	18

Engine Emission Control - ID4 2.2L Diesel - Engine Emission Control

Description and Operation

COMPONENT LOCATION - EXHAUST GAS RECIRCULATION

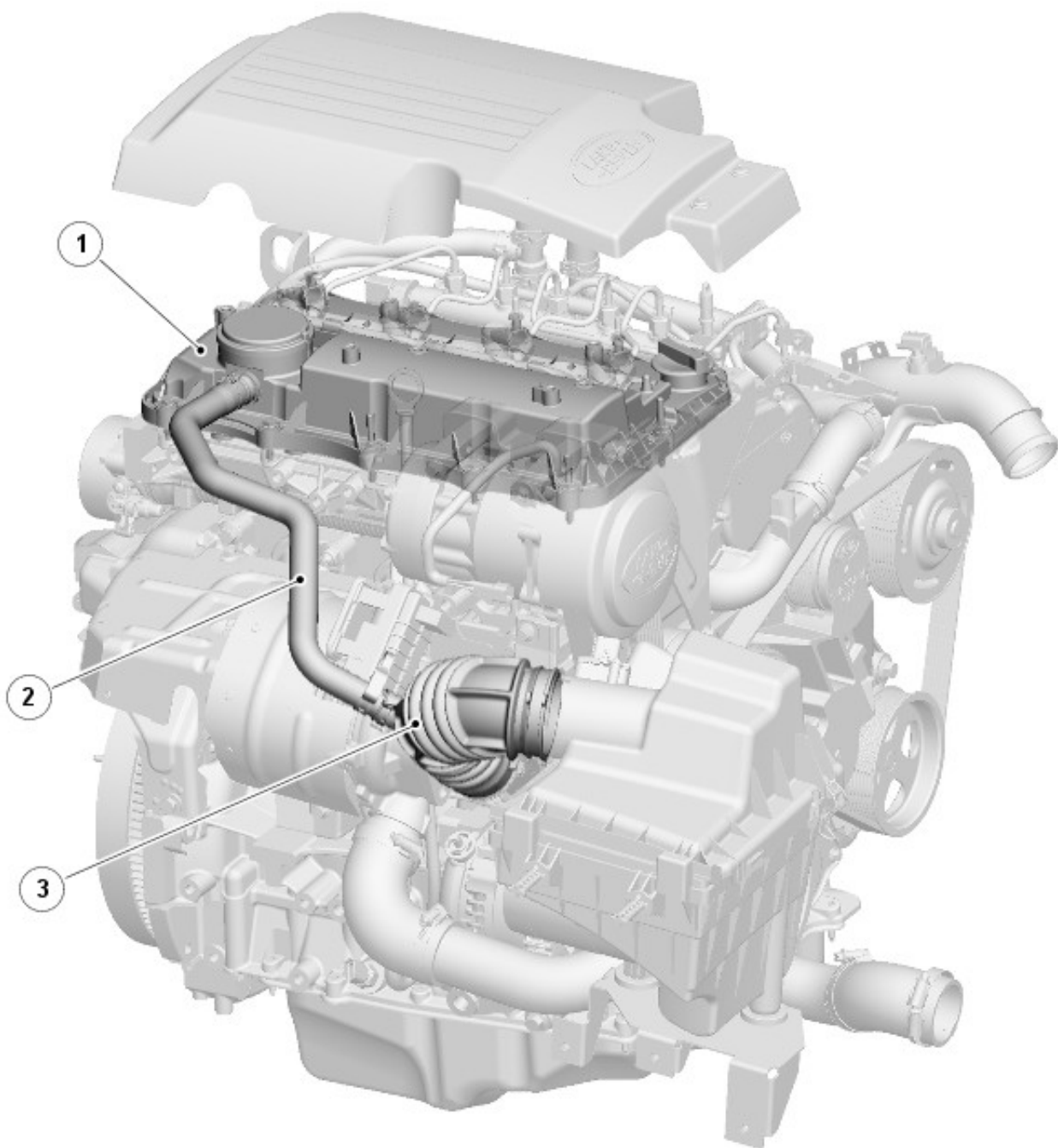


E138721

Item	Part Number	Description
1	-	exhaust gas recirculation (EGR) valve
2	-	Nut (2 off)
3	-	Gasket
4	-	Exhaust manifold
5	-	Bolt (3 off)
6	-	Gasket
7	-	EGR cooler
8	-	Bolt (2 off)
9	-	Gasket
10	-	EGR outlet tube

- 11 - Bolt (2 off)
- 12 - Intake manifold

COMPONENT LOCATION - POSITIVE CRANKCASE VENTILATION



E138722

Item	Part Number	Description
1	-	Camshaft cover
2	-	Breather hose
3	-	Turbocharger inlet duct

OVERVIEW

Engine emission control reduces the level of harmful emissions released to atmosphere from the engine. Engine emission control consists of an **EGR (exhaust gas recirculation)** system and a **PCV (positive crankcase ventilation)** system.

The **EGR** system regulates a supply of exhaust gas into the air charge entering the engine, which lowers the combustion temperature and minimizes the formation of **NOX (oxides of nitrogen)**.

The **PCV** system draws piston blow-by gases into the engine air intake to be added to the air charge. The resultant depression in the engine sump, front cover and cylinder head cover reduces the load on the joint seals in those areas.

EXHAUST GAS RECIRCULATION

The EGR system comprises:

- An EGR valve.
- An EGR cooler.
- An EGR outlet tube.

The EGR cooler is attached to the rear of the exhaust manifold. Coolant from the engine cooling system circulates through a matrix in the EGR cooler to reduce the temperature of the exhaust gas. Attached to the outlet side of the cooler is the EGR valve. The valve is motor driven, under the control of the engine control module (ECM), to allow varying amounts of exhaust gas into the intake manifold depending on the engine operation. At engine switch off the valve opens and closes several times to clear any deposits which may have accumulated during running.

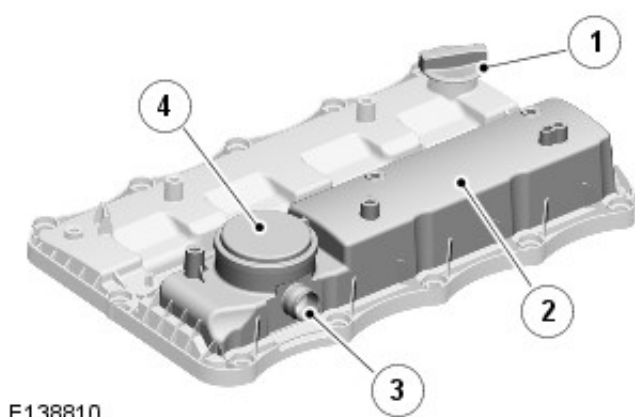
The EGR outlet tube transports the exhaust gas from the EGR valve to the intake manifold, where it is blended with the incoming charge air stream by a mixer tube.

The ECM monitors the EGR system function and stores fault codes in the event of failure. The EGR valve can also be activated for testing using Land Rover approved diagnostic equipment.

POSITIVE CRANKCASE VENTILATION

The **PCV** system consists of an oil separator, a **PCV** valve and a breather hose. The oil separator and the **PCV** valve are integrated into the **RH (right-hand)** side of the camshaft cover. The breather hose connects the camshaft cover to the turbocharger inlet duct.

Camshaft Cover



Item	Part Number	Description
1	-	Engine oil filler cap
2	-	Oil separator
3	-	Ventilation outlet
4	-	PCV

When the engine is running, the depression in the turbocharger inlet duct draws in gases from the engine sump through the oil separator, **PCV** valve and breather hose. Any oil in the gases is removed by the oil separator and drains back into the oil pan through the drain channels in the cylinder head and cylinder block. The **PCV** valve prevents reverse flow into the camshaft cover when there is minimal depression in the turbocharger inlet duct.

Engine Emission Control - ID4 2.2L Diesel - Engine Emission Control

Diagnosis and Testing

Overview

For information on description and operation:

REFER to: [Engine Emission Control](#) (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Engine breather hoses • Oil separator • Exhaust gas recirculation (EGR) pipes (check for cracks, leaks at joints or gaskets) • EGR valve • EGR cooler(s) 	<ul style="list-style-type: none"> • Fuse(s) • Wiring harness • Loose or corroded electrical connector(s) • EGR valve • Engine control module (ECM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart

Symptom (specific)	Possible cause	Action
Difficult to start	<ul style="list-style-type: none"> • Exhaust gas recirculation (EGR) valve stuck open 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p> <p>Check the EGR valve and circuits. Refer to the electrical guides. Check the mechanical condition of the EGR valve. Rectify as necessary.</p>
Poor/Erratic idle		
Lack of power when accelerating		
Engine stops/stalls	<ul style="list-style-type: none"> • Exhaust gas recirculation (EGR) valve stuck open • Breather system disconnected/restricted/blocked 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p> <p>Check the EGR valve and circuits. Refer to the electrical guides. Check the mechanical condition of the EGR valve. Check the engine breather system. Check the oil separator.</p>
Excessive fuel consumption	<ul style="list-style-type: none"> • Exhaust gas recirculation (EGR) valve stuck open • EGR not operating • Breather system restricted/blocked 	<p>REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation).</p> <p>Check for DTCs indicating an EGR valve, throttle or sensor fault. Rectify as necessary.</p>
Excessive black smoke		
Excessive emissions		
Excessive blow-by	<ul style="list-style-type: none"> • Breather system restricted/blocked 	<p>Check the engine breather hoses. Check the oil separator. REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation). Rectify as necessary.</p>
Engine oil leaks	<ul style="list-style-type: none"> • Breather system restricted/blocked 	<p>Check the engine breather hoses. Check the oil separator. REFER to: Engine Emission Control (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation). Rectify as necessary.</p>

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).


Engine Emission Control - ID4 2.2L Diesel - Exhaust Gas Recirculation (EGR) Cooler

Removal and Installation

Removal

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

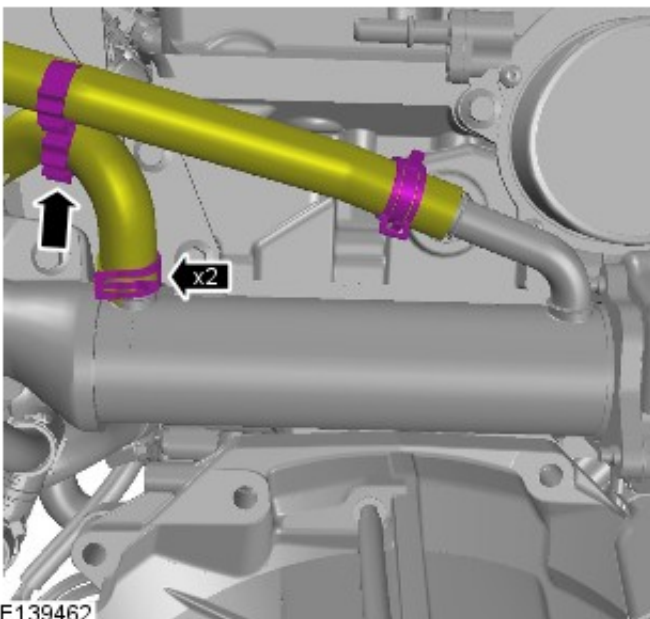
1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

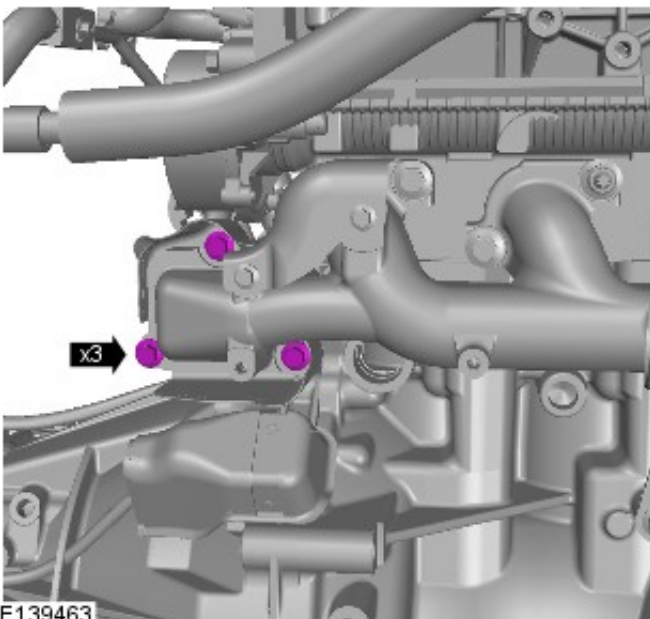
Raise and support the vehicle.

3. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).

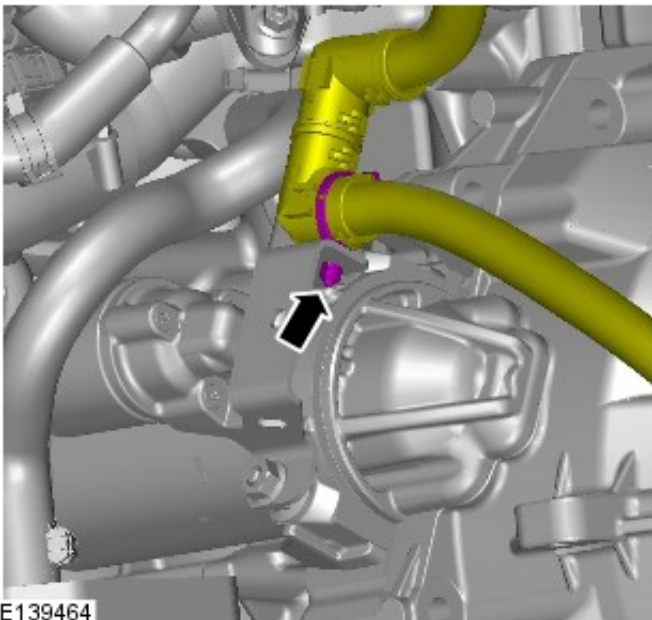
4.



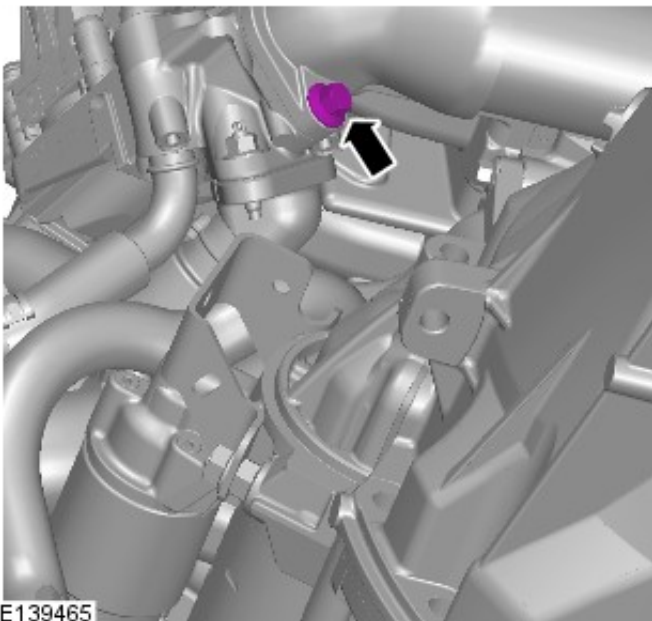
5. Torque:23Nm



6.



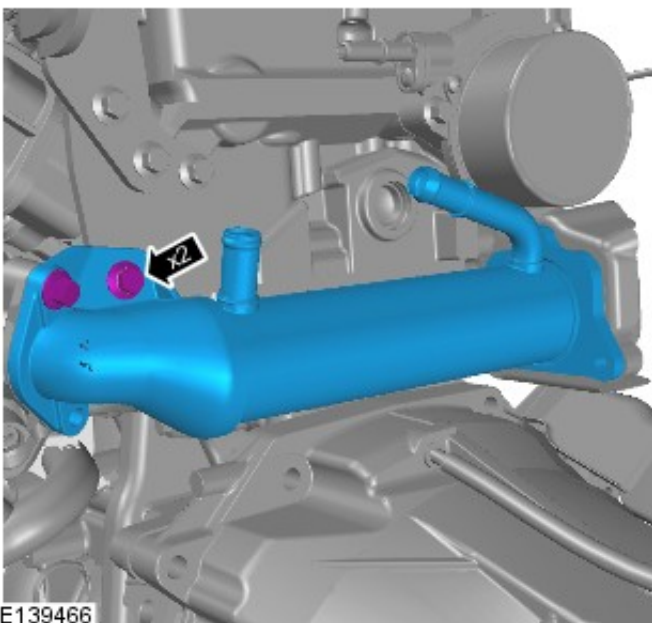
7. Torque: 23Nm



8. NOTE: Clean the component mating faces.

NOTE: Fit new gasket.

Torque 23Nm



Installation

1. To install, reverse the removal procedure.

Engine Emission Control - ID4 2.2L Diesel - Exhaust Gas Recirculation (EGR) Valve

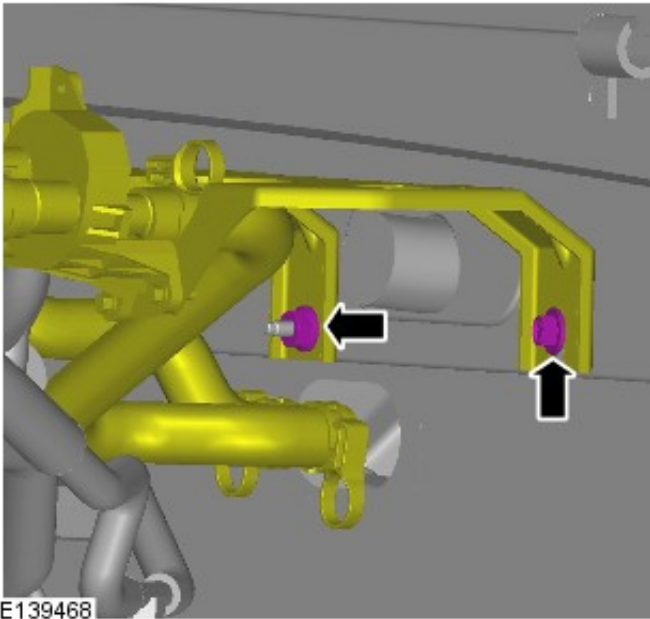
Removal and Installation

Removal

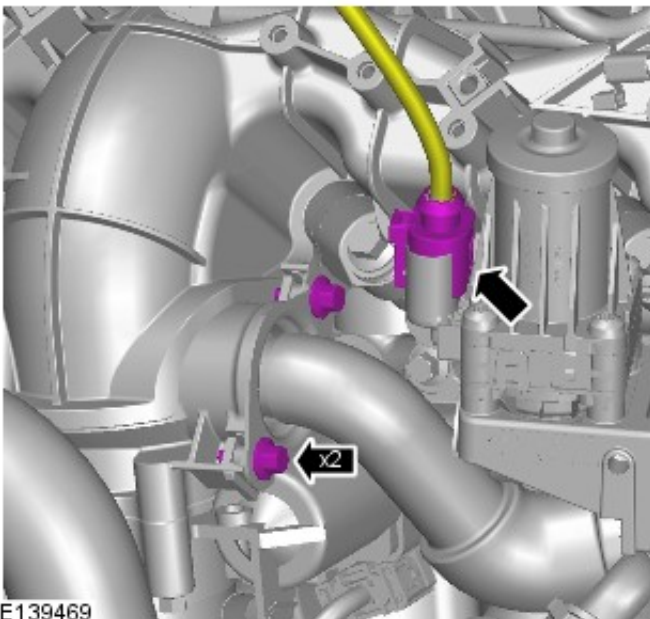
NOTE: Removal steps in this procedure may contain installation details.

1. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
3. For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03 Engine Cooling - ID4 2.2L Diesel, General Procedures).

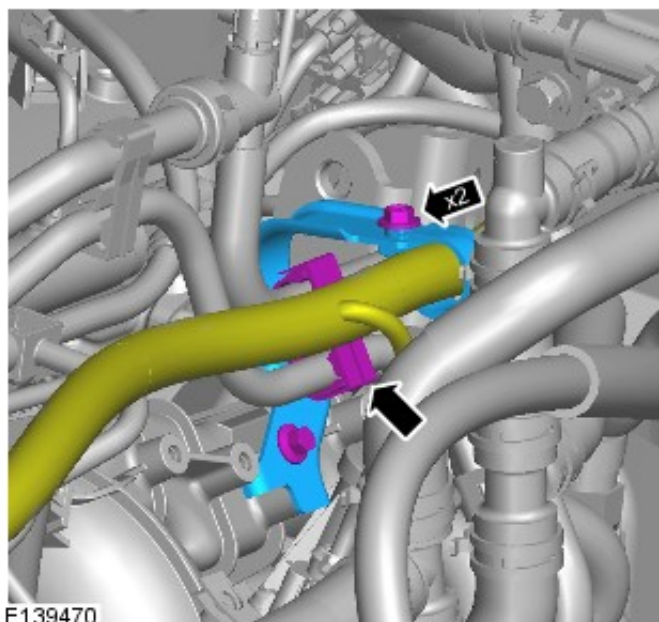
4. Torque: Bolt 22Nm Torque: Nut 6Nm



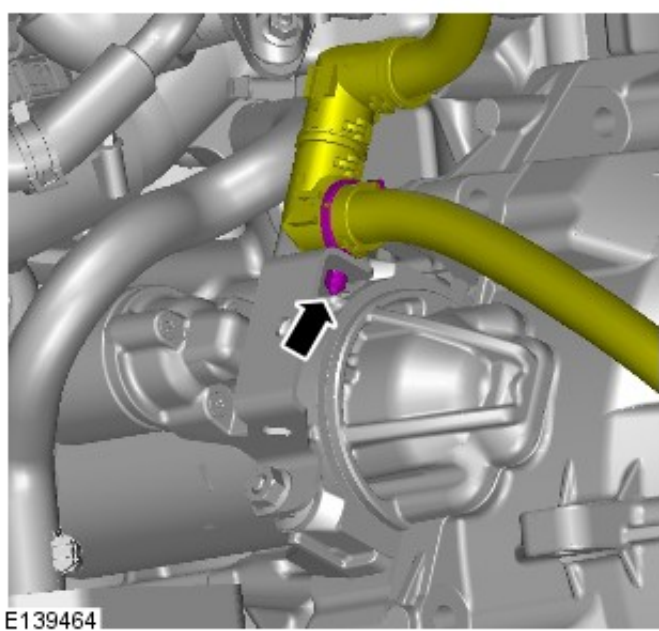
5. Torque: 23Nm



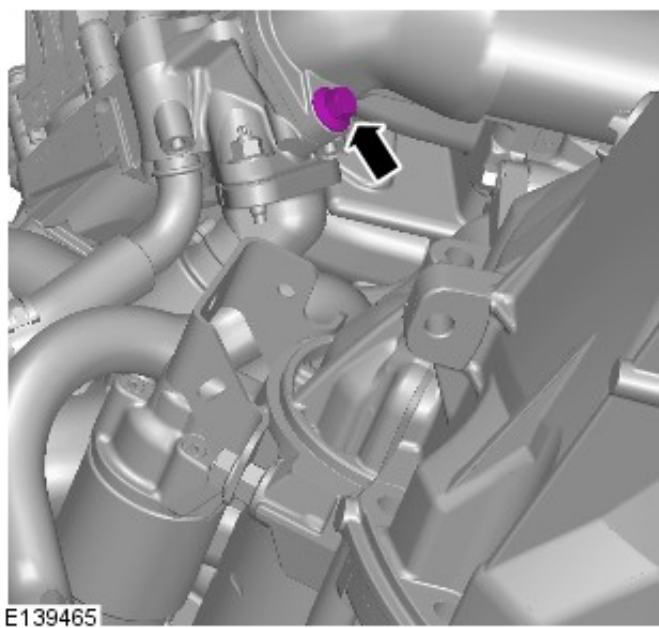
6. Torque: 10Nm



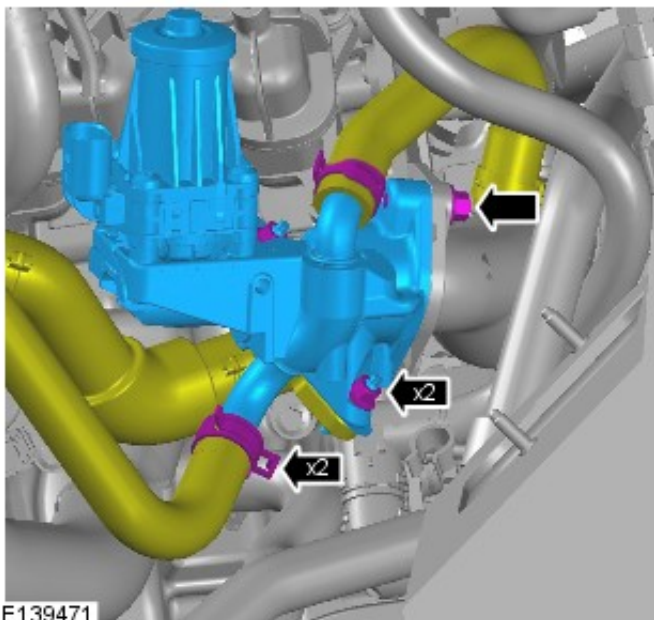
7.




8. Torque: 23Nm



9. Torque: Bolt 23Nm Torque: Nuts 10Nm



Installation

1.  **CAUTION:** Make sure that the mating faces are clean and free from foreign material.

NOTE: Install a new gasket

2. To install, reverse the removal procedure.

Intake Air Distribution and Filtering - ID4 2.2L Diesel -

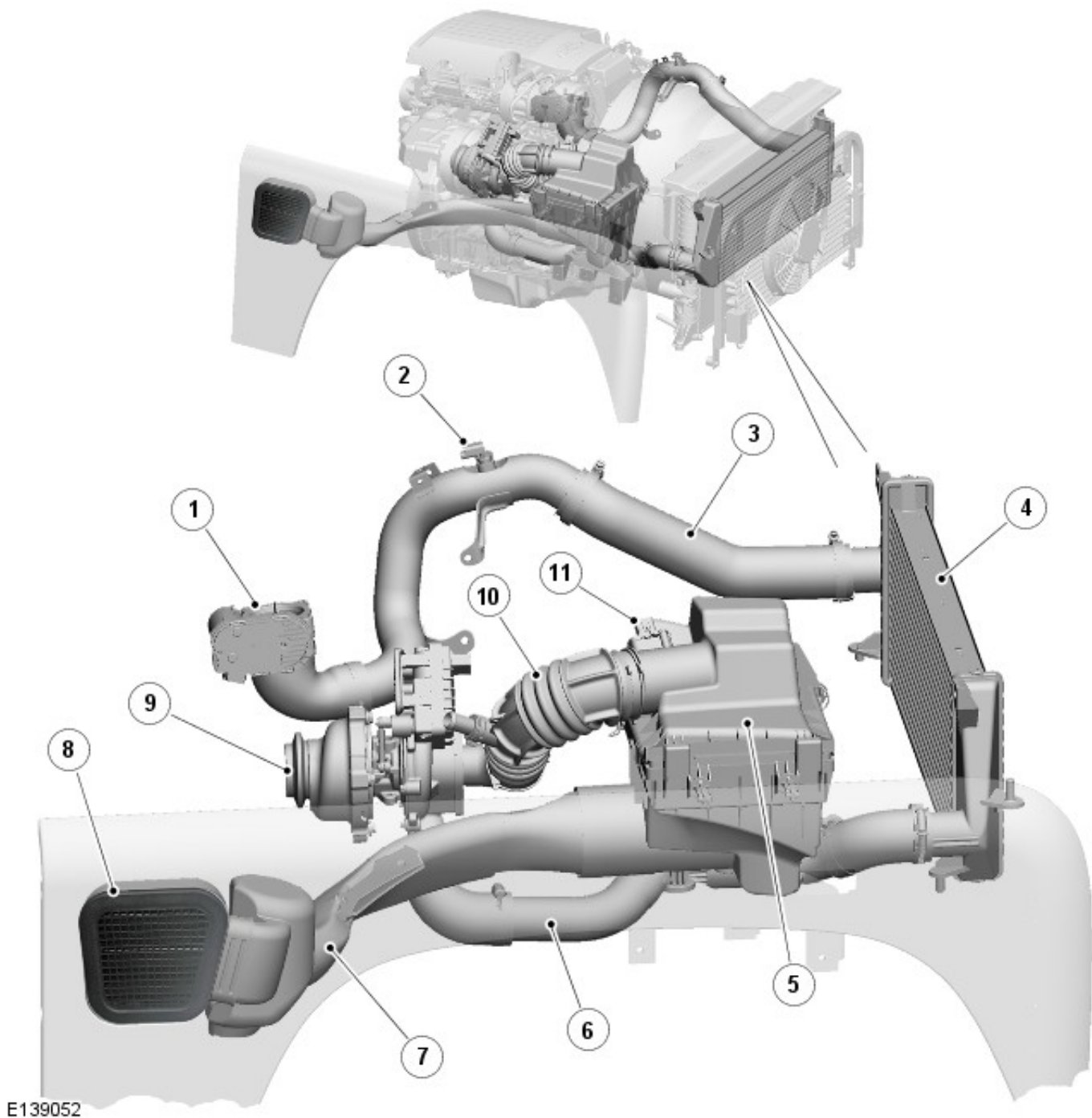
Torque Specifications

Description	Nm	lb-ft
Air cleaner bolts	13	10
A/C compressor low-pressure and high-pressure refrigerant lines bolt	30	22
Charge air cooler to radiator bolts	20	15
Charge air cooler inlet and outlet hose clips	3	2
Charge air cooler bracket bolts	9	7
Air cleaner outlet pipe clips	3	2

Intake Air Distribution and Filtering - ID4 2.2L Diesel - Intake Air Distribution and Filtering

Description and Operation

COMPONENT LOCATION



E139052

Item	Part Number	Description
1	-	Electronic throttle
2	-	Charge air temperature sensor
3	-	Duct - charge air cooler to electronic throttle
4	-	Charge air cooler
5	-	Air cleaner
6	-	Duct - turbocharger to charge air cooler
7	-	Dirty air duct
8	-	Air intake
9	-	Turbocharger

10	-	Duct - air cleaner to turbocharger
11	-	MAF (mass air flow) sensor

OVERVIEW

Ambient air is drawn in through the intake in the right-hand (RH) fender, then through the dirty air duct to the air cleaner. From the air cleaner, ducts direct the air through the turbocharger and the charge air cooler to the electronic throttle on the intake manifold.

A charge air temperature sensor is installed in the duct between the charge air cooler and the electronic throttle. For additional information, refer to: [Electronic Engine Controls](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Description and Operation).

AIR CLEANER

The air cleaner, which contains a serviceable paper filter element, is located on the RH (right-hand) front inner fender. Four rubber mounts attach the air cleaner to brackets on the inner fender.

A MAF sensor is installed in the outlet port of the air cleaner. For additional information, refer to: [Electronic Engine Controls](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Description and Operation).

CHARGE AIR COOLER

The charge air cooler is located in front of the radiator and is secured to the radiator by two bolts at the top and two location points at the bottom.

Intake Air Distribution and Filtering - ID4 2.2L Diesel - Intake Air Distribution and Filtering

Diagnosis and Testing

Overview

For information on description and operation:

REFER to: [Intake Air Distribution and Filtering](#) (303-12 Intake Air Distribution and Filtering - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Hoses and ducts: condition and fitment • Air cleaner element condition and fitment • Restricted air intake • Vacuum hoses condition and fitment • Pipework to/from turbocharger: condition and fitment • Turbocharger: condition and fitment • Charge air cooler 	<ul style="list-style-type: none"> • Fuse(s) • Wiring harness(es) • Loose or corroded electrical connector(s) • Mass air flow (MAF) sensor • Manifold absolute pressure/temperature (MAPT) sensors • Intake air temperature (IAT) sensor • IAT sensor 1 is part of the MAF sensor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before moving onto the symptom chart or DTC index.
 - Make sure that all DTCs are cleared following rectification.

Symptom Chart

Symptom	Possible causes	Action
Vehicle does not start/hard starting	<ul style="list-style-type: none"> • Restricted/blocked air intake • Restricted/blocked air cleaner element 	Check the intake air system for blockages or restriction. Rectify as necessary.
Poor performance	<ul style="list-style-type: none"> • Intake air system fault • Turbocharger fault(s) • Exhaust gas recirculation (EGR) valve fault • Low fuel pressure • Restricted exhaust system 	<p>NOTE: Confirm that the latest level throttle-EGR-inlet valve is installed. Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module</p> <p>Check the actuator-vane variable geometry turbocharger actuator arm for movement</p> <p>REFER to: Turbocharger Actuator Rod (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Removal and Installation).</p> <p>Check the intake air system for blockages or restriction. Rectify as necessary. Check for DTCs indicating a turbocharger, EGR valve or fuel pressure fault. Rectify as necessary. Check the exhaust system for evidence of damage or restriction. Rectify as necessary.</p>
Excessive intake noise	<ul style="list-style-type: none"> • Intake air leak after the turbocharger • Intake pipe disconnected/damaged after the air cleaner • Air cleaner assembly incorrectly assembled/damaged 	Check the intake air system for loose or disconnected hoses or ducts. Check the hoses and ducts for damage, splits, etc. Rectify as necessary.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00. REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

Intake Air Distribution and Filtering - ID4 2.2L Diesel - Air Cleaner

Removal and Installation


Removal

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).

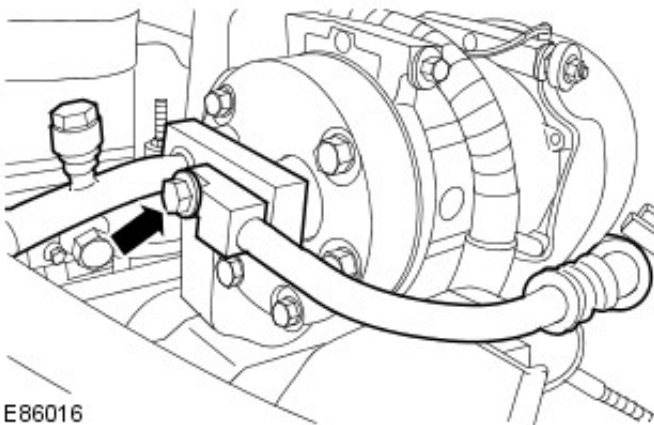
Vehicles with air conditioning

2. Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

3.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Disconnect the A/C compressor low-pressure and high-pressure refrigerant lines.

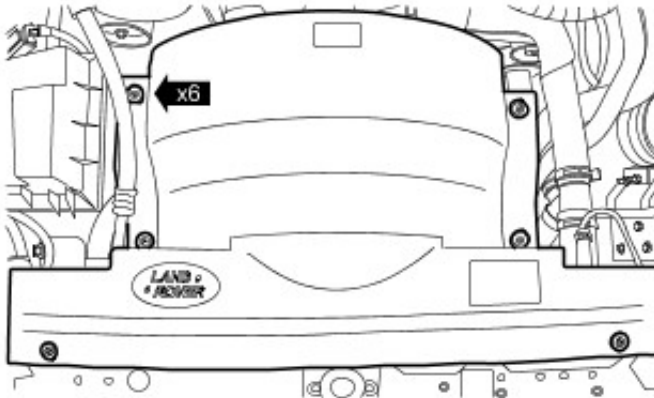
- Remove the bolt.
- Remove and discard the O-ring seal.



E86016

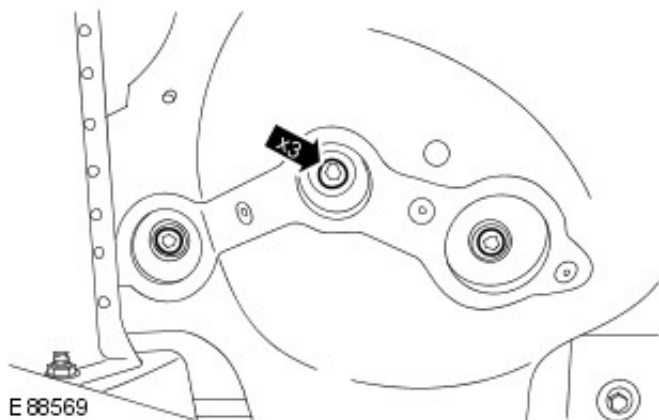
All vehicles

4. Remove the cooling fan upper shroud.
 - Release the 6 clips.

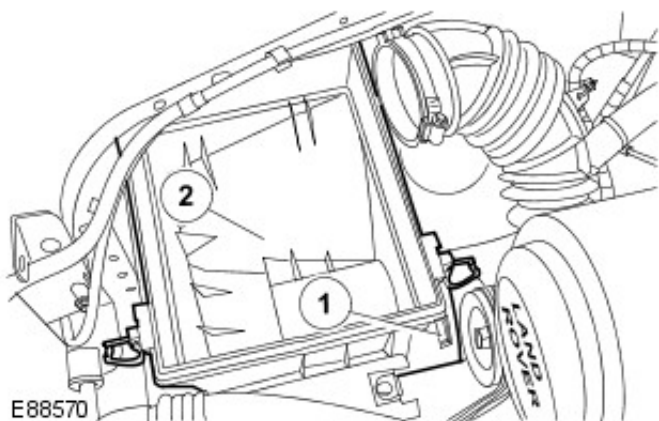


E86148

5. Remove the air cleaner element.
For additional information, refer to: Air Cleaner Element (303-12, Removal and Installation).
6. Release the air cleaner.
 - Remove the 3 bolts.



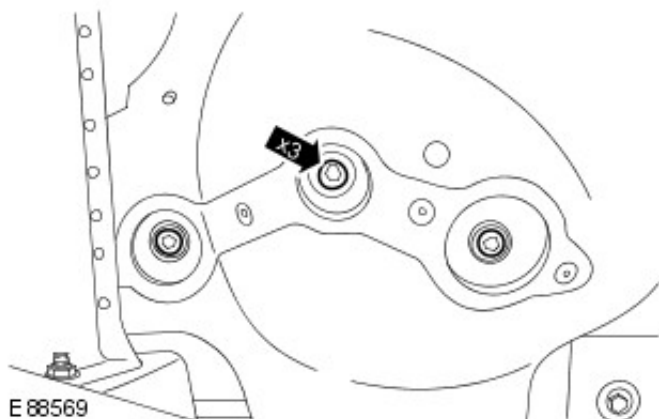
7. Remove the air cleaner.
 1. Disconnect the air cleaner intake pipe.
 2. Remove the air cleaner.



Installation

All vehicles

1. To install, reverse the removal procedure.
 - Tighten to 13 Nm (10 lb.ft).



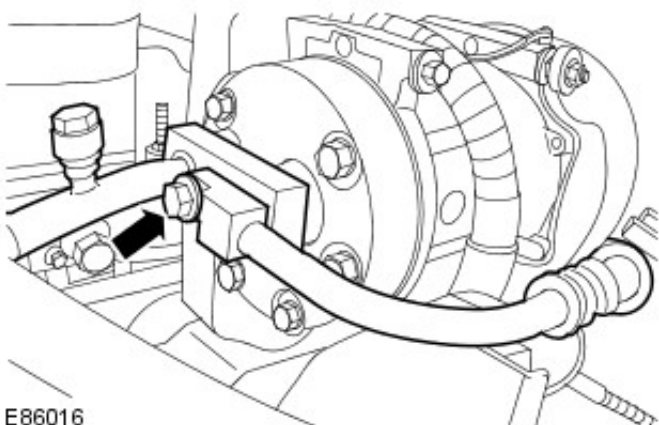
Vehicles with air conditioning

2. **NOTE:** Coat the compressor O-ring seals in clean refrigerant oil prior to installation.

NOTE: Remove and discard the blanking caps.

Tighten to 30 Nm (22 lb.ft).

- Install new O-ring seals.



All vehicles

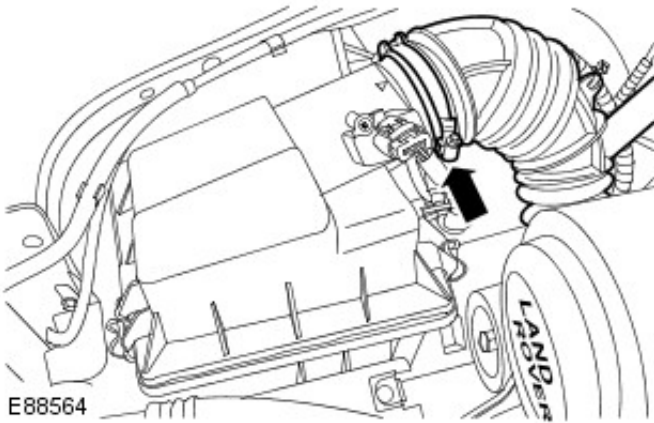
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01,
General Procedures).

Intake Air Distribution and Filtering - ID4 2.2L Diesel - Air Cleaner Element

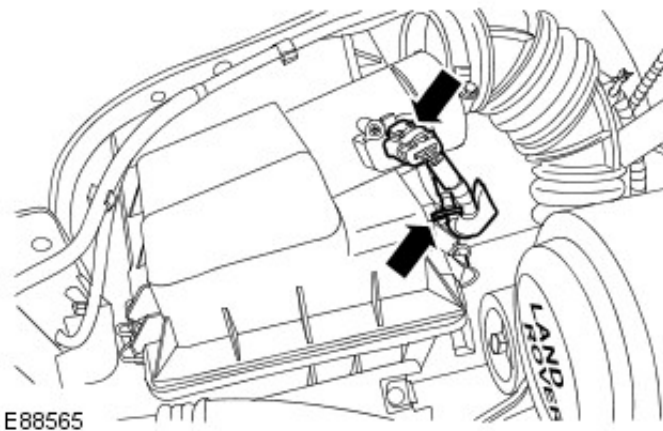
Removal and Installation

Removal

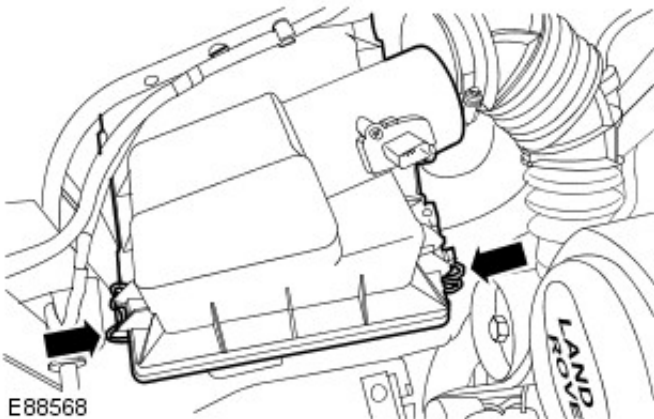
1. Release the air cleaner outlet pipe.
 - Release the clip.



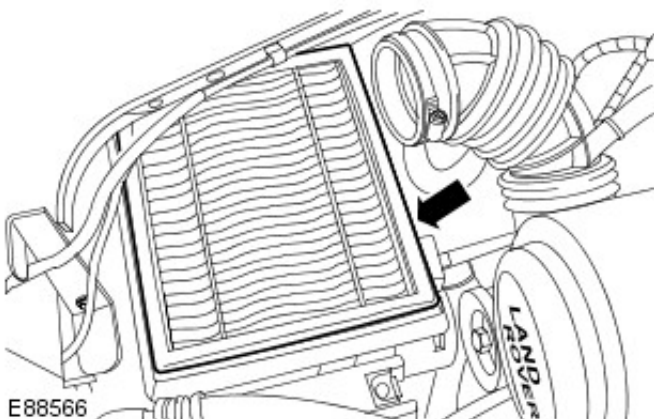
2. Disconnect the mass air flow (MAF) sensor electrical connector.
 - Release the wiring harness.




3. Remove the air cleaner housing cover.



4. Remove the air cleaner element.



Installation

1.  CAUTION: Make sure that the air cleaner housing cover rear fixing tangs are correctly located.

NOTE: Clean the base of the air cleaner.

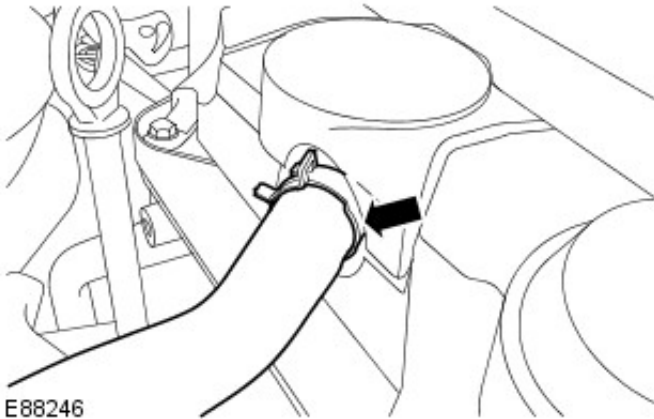
To install, reverse the removal procedure.

Intake Air Distribution and Filtering - ID4 2.2L Diesel - Air Cleaner Outlet Pipe

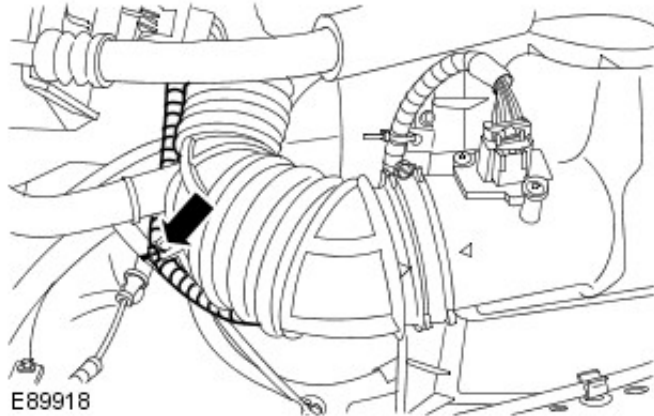
Removal and Installation

Removal

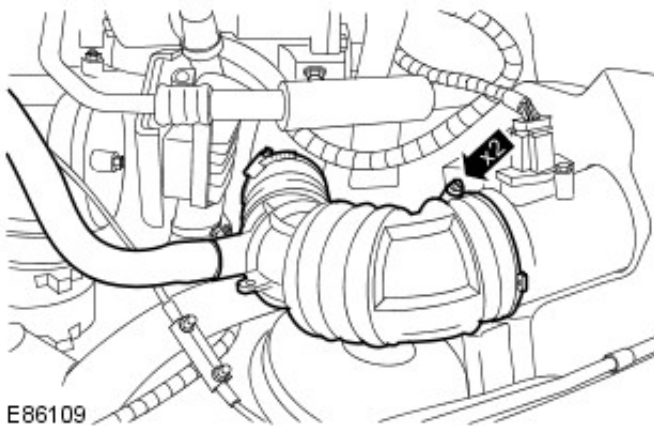
1. Release the positive crankcase ventilation (PCV) hose from the valve cover.
 - Release the clip.



2. Release the mass air flow (MAF) sensor wiring harness.



3. Remove the air cleaner outlet pipe.
 - Release the 2 clips.



Installation

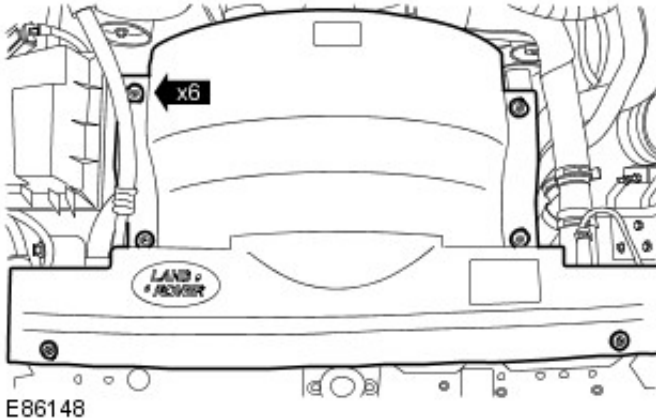
1. To install, reverse the removal procedure.

Intake Air Distribution and Filtering - ID4 2.2L Diesel - Charge Air Cooler

Removal and Installation

Removal

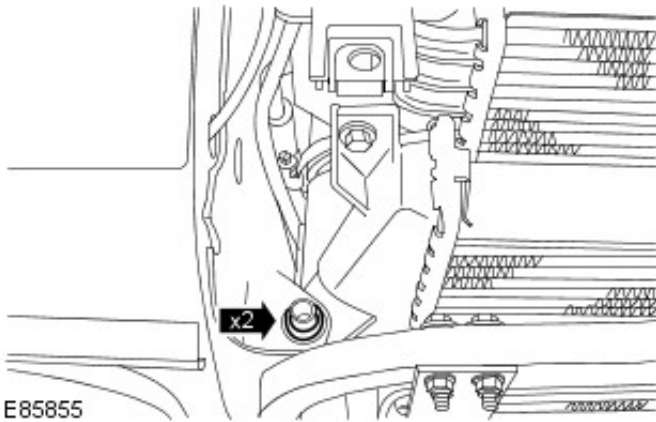
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Remove the radiator grille.
For additional information, refer to: Radiator Grille (501-08, Removal and Installation).
3. Remove the cooling fan upper shroud.
 - Release the 6 clips.



4. Remove the hood latch panel.
For additional information, refer to: Hood Latch Panel (501-27, Removal and Installation).

5. **NOTE: RH shown, LH similar.**

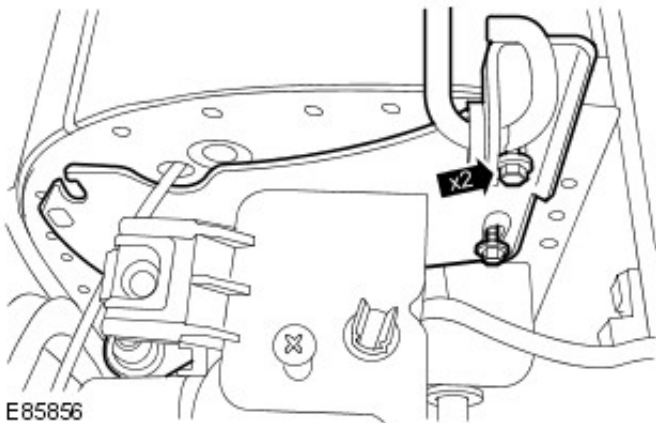
Remove the 2 O-rings.




6. **NOTE: RH shown, LH similar.**

Remove the 2 charge air cooler brackets.

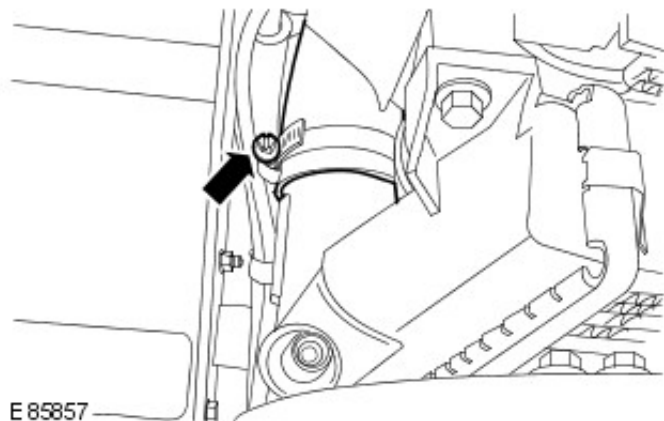
- Remove the 4 bolts.



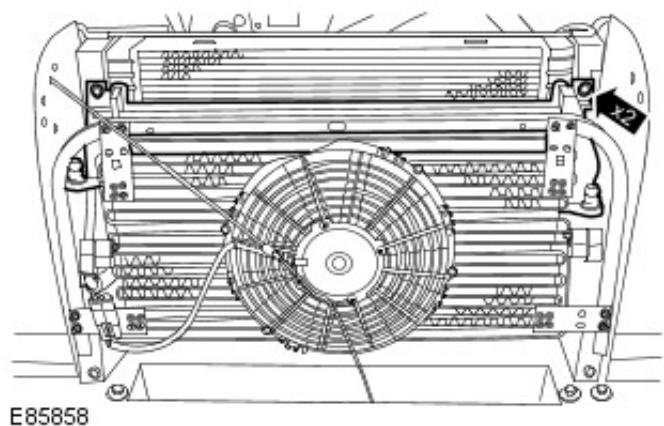
7.  **CAUTION:** Make sure that all openings are sealed.
Use new blanking caps.

NOTE: RH shown, LH similar.

Disconnect the charge air cooler inlet hose and charge air cooler outlet hose.

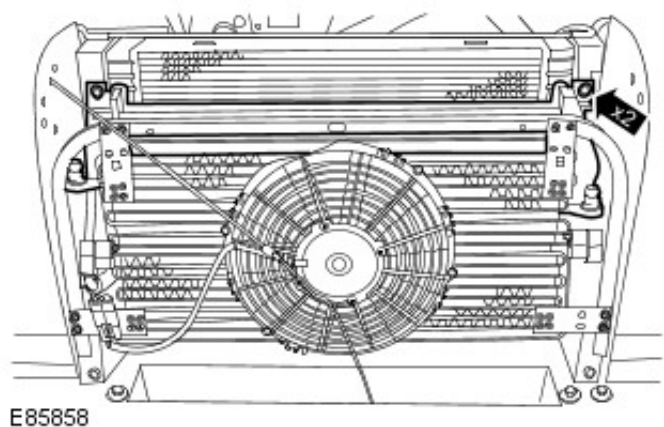


8. Remove the charge air cooler.
 - Remove the 2 bolts.

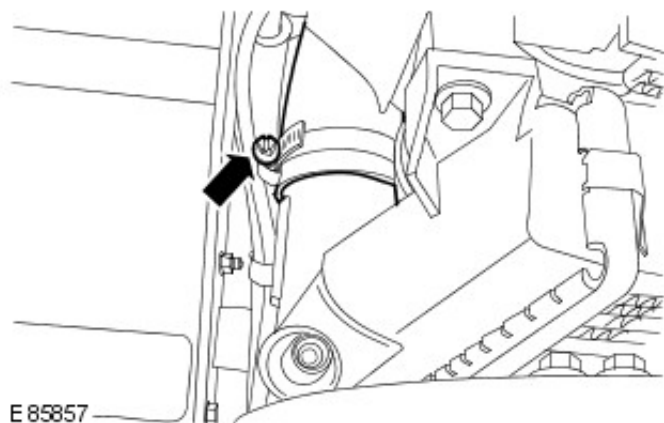


Installation

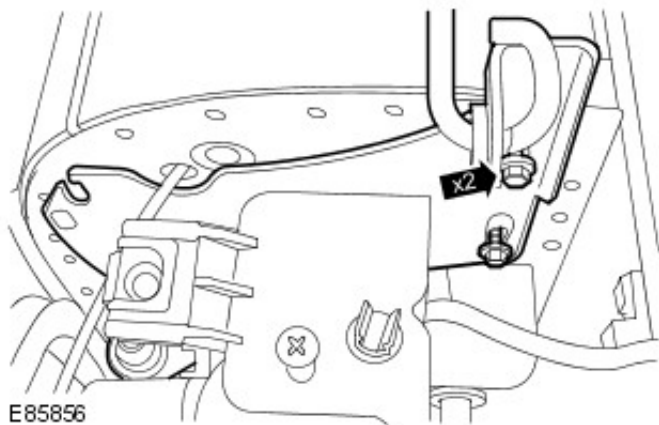
1. To install, reverse the removal procedure.
 - Tighten to 20 Nm (15 lb.ft).



2. NOTE: Remove and discard the blanking caps.
Tighten to 3 Nm (2 lb.ft).



3. Tighten to 9 Nm (7 lb.ft).



4. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01,
General Procedures).

Electronic Engine Controls - ID4 2.2L Diesel -

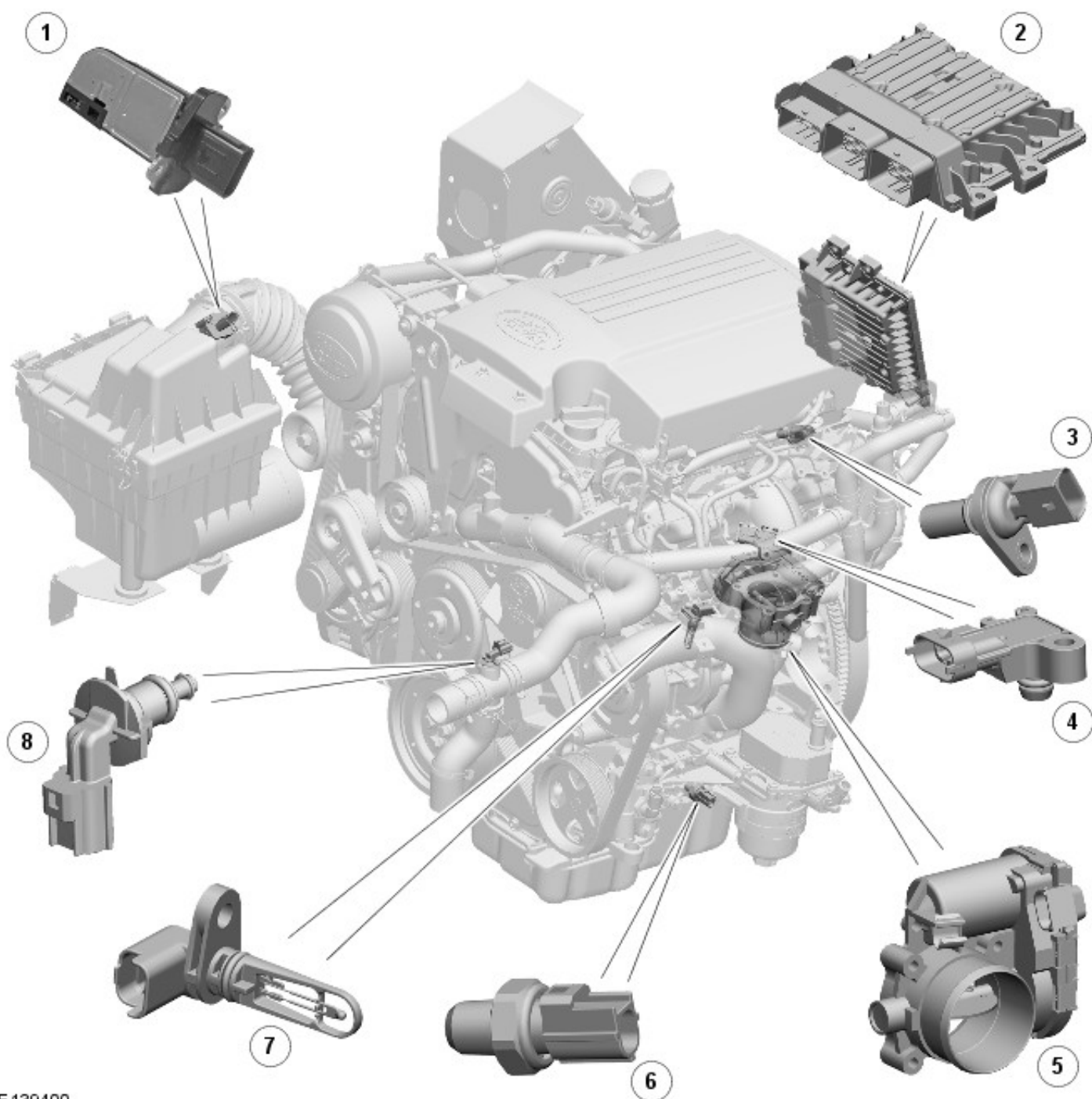
Torque Specifications

Item	Nm	lb-ft
Crankshaft position (CKP) sensor	9	6
Camshaft position (CMP) sensor	10	7
Manifold absolute pressure and temperature (MAPT) sensor	5	3
Engine oil pressure (EOP) sensor	15	11
Engine control module (ECM)	10	7
Accelerator pedal position sensor	25	18
Engine coolant temperature	N/A	N/A
Engine oil level sensor	27	20
Heated oxygen sensor	48	35
Mass air flow sensor	N/A	N/A
Post catalytic converter temperature sensor	35	26
Pre catalytic converter temperature sensor	35	26
Post DPF exhaust gas temperature sensor	35	26

Electronic Engine Controls - ID4 2.2L Diesel - Electronic Engine Controls

Description and Operation

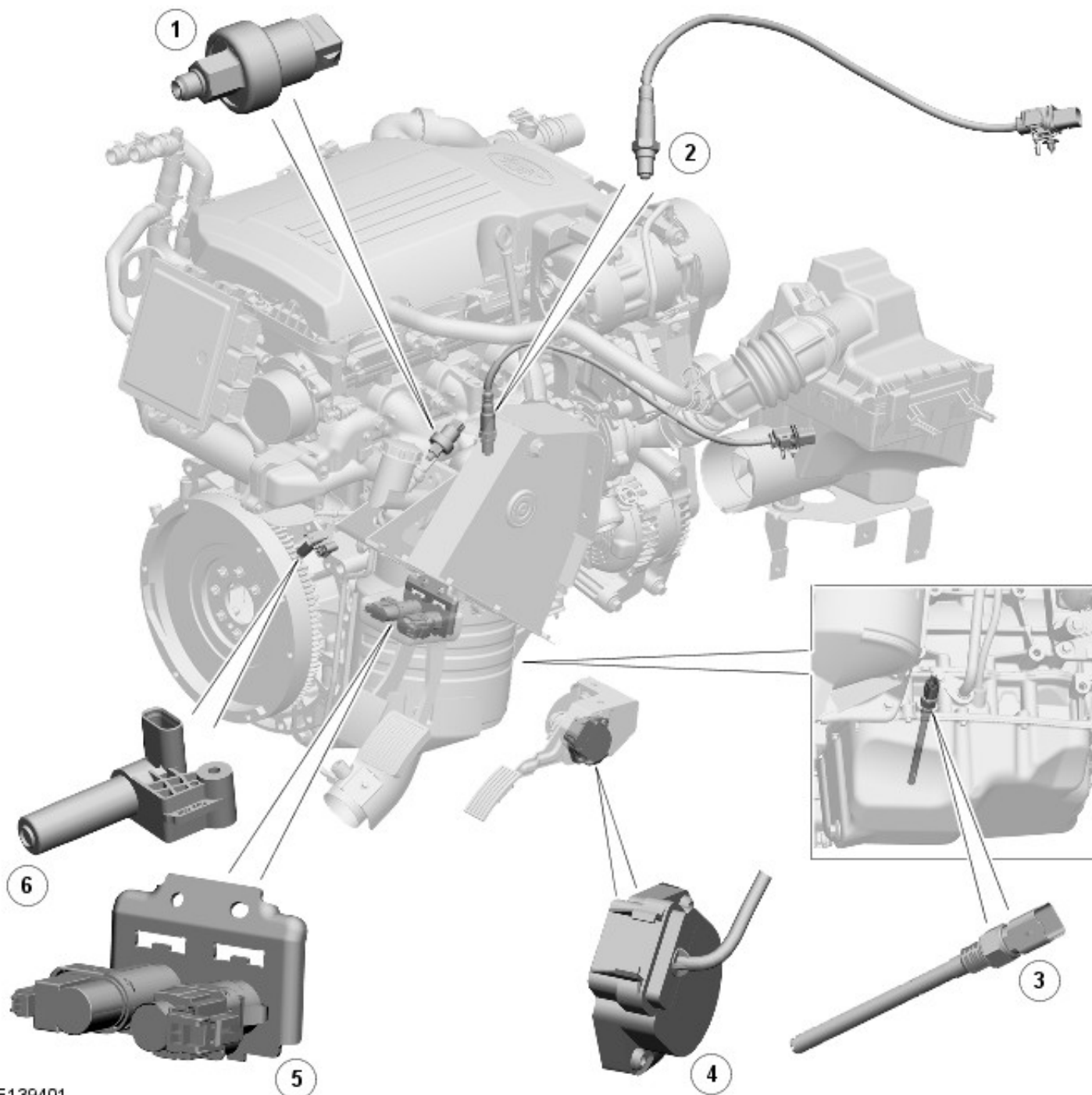
COMPONENT LOCATION - SHEET 1 OF 2



E 139400

Item	Part Number	Description
1	-	MAFT (mass air flow and temperature) sensor
2	-	engine control module (ECM)
3	-	camshaft position (CMP) sensor
4	-	manifold absolute pressure (MAP) sensor
5	-	Electronic throttle
6	-	Oil pressure switch
7	-	Charge air temperature sensor
8	-	ECT (engine coolant temperature) sensor

COMPONENT LOCATION - SHEET 2 OF 2



E139401

Item	Part Number	Description
1	-	Clutch pedal position switch
2	-	HO2S (heated oxygen sensor)
3	-	Oil level and temperature sensor
4	-	accelerator pedal position (APP) sensor
5	-	Brake pedal switches
6	-	crankshaft position (CKP) sensor

OVERVIEW

The engine management system is controlled by an ECM and is able to monitor, adapt and precisely control the fuel injection and charge air. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

The ECM processes information from the following input sources:

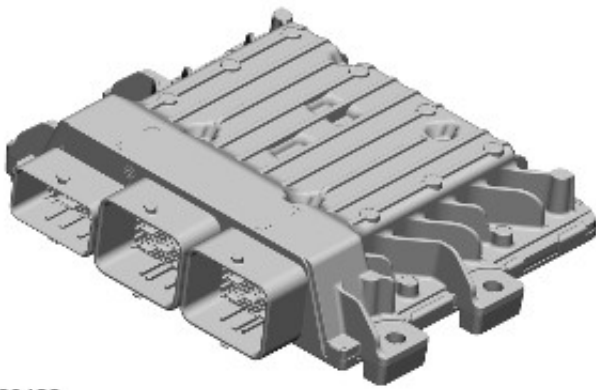
- [APP \(accelerator pedal position\)](#) sensor
- Brake pedal switches
- CMP sensor
- Charge air temperature sensor
- Clutch pedal position switch

- CKP sensor
- [ECT](#) sensor
- Electronic throttle position sensor
- [HO2S](#) (vehicles fitted with [DPF \(diesel particulate filter\)](#) only)
- [MAFT](#) sensor
- [MAP \(manifold absolute pressure\)](#) sensor
- Oil level and temperature sensor (oil temperature input only)
- Oil pressure switch
- [ABS \(anti-lock brake system\)](#) module.
For additional information, refer to: [Brake System](#) (206-00 Brake System - General Information, Description and Operation).
- [A/C \(air conditioning\)](#) pressure sensor.
For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Description and Operation).
- [A/C](#) thermostatic switch.
For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Description and Operation).
- Anti-theft system module.
For additional information, refer to: [Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation).
- Differential pressure sensor.
For additional information, refer to: [Exhaust System - ID4 2.2L Diesel](#) (309-00 Exhaust System - ID4 2.2L Diesel, Description and Operation).
- Exhaust gas temperature sensors.
For additional information, refer to: [Exhaust System - ID4 2.2L Diesel](#) (309-00 Exhaust System - ID4 2.2L Diesel, Description and Operation).
- Fuel rail pressure sensor.
For additional information, refer to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Description and Operation).
- Fuel temperature sensor.
For additional information, refer to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Description and Operation).

The ECM outputs controlling signals to the following actuators:

- Electronic throttle motor
- [HO2S](#) heater circuit
- [A/C](#) compressor clutch relay.
For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Description and Operation).
- [A/C](#) cooling fan relay.
For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Description and Operation).
- exhaust gas recirculation (EGR) valve.
For additional information, refer to: [Engine Emission Control](#) (303-08 Engine Emission Control - ID4 2.2L Diesel, Description and Operation).
- Fuel injectors.
For additional information, refer to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Description and Operation).
- Fuel pump relay.
For additional information, refer to: [Fuel Tank and Lines - ID4 2.2L Diesel](#) (310-01 Fuel Tank and Lines - ID4 2.2L Diesel, Description and Operation).
- Fuel volume control valve.
For additional information, refer to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - ID4 2.2L Diesel, Description and Operation).
- Generator.
For additional information, refer to: [Generator - ID4 2.2L Diesel](#) (414-02 Generator and Regulator - ID4 2.2L Diesel, Description and Operation).
- Glow plug control module.
For additional information, refer to: [Glow Plug System](#) (303-07 Glow Plug System - ID4 2.2L Diesel, Description and Operation).
- Instrument cluster.
For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).
- Starter relay.
For additional information, refer to: [Starting System](#) (303-06 Starting System - ID4 2.2L Diesel, Description and Operation).
- Turbocharger vane actuator.
For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - ID4 2.2L Diesel, Description and Operation).

ENGINE CONTROL MODULE



E 139402

The ECM is installed in the engine compartment, on a bracket attached to the engine bulkhead. Three connectors provide the interface between the **ECM (engine control module)** and the vehicle and engine harnesses.

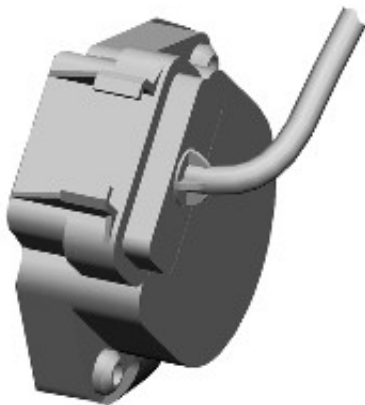
The ECM contains data processors and memory microchips. The output signals to the actuators are in the form of ground paths provided by driver circuits within the ECM. The ECM driver circuits produce heat during normal operation and dissipate this heat via the casing. Some sensors receive a regulated voltage supplied by the ECM. This avoids incorrect signals caused by voltage drop during cranking.

The ECM performs self diagnostic routines and stores fault codes in its memory. These fault codes and diagnostics can be accessed using Land Rover approved diagnostic equipment. If the ECM is to be replaced, the new ECM is supplied 'blank' and must be configured to the vehicle using Land Rover approved diagnostic equipment. A 'flash' electrically erasable programmable read only memory (EEPROM) allows the ECM to be configured with market specific or new tune information up to 14 times. If a fifteenth update is required, the ECM must be replaced. The current engine tune data can be accessed and read using Land Rover approved diagnostic equipment.

When a new ECM is fitted, it must also be synchronized to the anti-theft system module using Land Rover approved diagnostic equipment. An ECM cannot be transferred between vehicles.

The ECM is connected to the engine sensors, which allows it to monitor the engine operating conditions. The ECM processes these signals and decides the actions necessary to maintain optimum engine performance in terms of driveability, fuel efficiency and exhaust emissions. The memory of the ECM is programmed with instructions on how to control the engine. This is known as the strategy. The memory also contains data in the form of maps which the ECM uses as a basis for fueling and emission control. By comparing the information from the sensors to the data in the maps, the ECM is able to calculate the various output requirements. The ECM contains an adaptive strategy, which updates the system when components vary due to production tolerances or ageing.

ACCELERATOR PEDAL POSITION SENSOR



E 139403

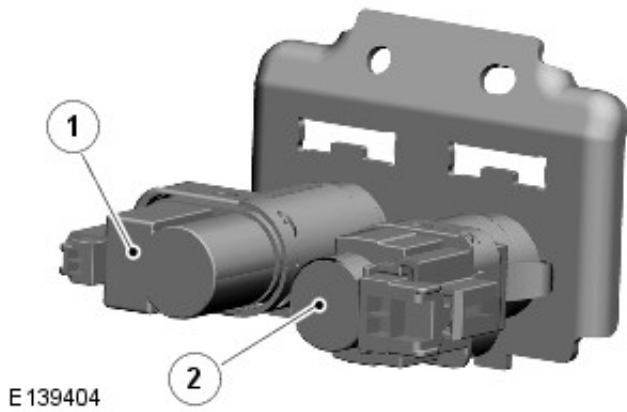
The **APP** sensor is a dual rotary potentiometer located on the right side of the accelerator pedal bracket and operated by the accelerator pedal spindle. The potentiometers have independent 5V supply and return connections with the **ECM**, and a common ground connection.

The **ECM** uses the two inputs from the **APP** sensor to determine the position, rate of movement and direction of movement of the accelerator pedal. The **ECM** then uses this data, along with information from other sensors, to achieve the optimum engine response.

If one of the inputs from the **APP** sensor fails, or there is a fault with the ground or supply connections, the **ECM** limits engine response to that produced by the first 28% of accelerator pedal travel.

If both inputs fail, there will be no response to accelerator pedal operation. The engine will idle at a raised value while the brake pedal is released, and at the normal value when the brake pedal is pressed. This allows a restricted limp-home operation.

BRAKE PEDAL SWITCHES



Item	Part Number	Description
1	-	Brake diagnostic switch
2	-	Stoplamp switch

The brake pedal switches are located under a protective cover on the pedal box and operated by the brake pedal. The switches are plunger operated two-pole switches that supply pedal status signals to the ECM. The ECM compares the signals from the two switches to ensure the correct pedal status.

While the brake pedal is released:

- The stoplamp switch contacts are open
- The brake diagnostic switch contacts are closed, connecting a ground to the ECM.

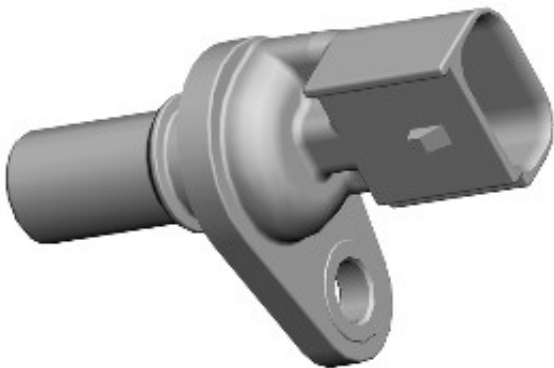
When the brake pedal is pressed:

- The stoplamp switch contacts close and connect an ignition feed from the [CJB \(central junction box\)](#) to the ECM
- The brake diagnostic switch contacts open and disconnect the ground from the ECM.

The [ECM](#) uses the brake pedal switch signals to check the plausibility of the [APP](#) sensor inputs.

In the event of a brake pedal switch failure and a single [APP](#) sensor track fault, there will be no response to accelerator pedal operation. The engine will idle at a raised value while the brake pedal is released, and at the normal value when the brake pedal is pressed. This allows a restricted limp-home operation.

CAMSHAFT POSITION SENSOR



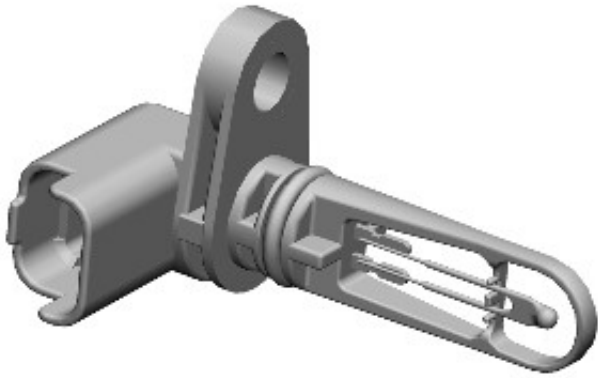
The CMP sensor is installed in the left side of the cylinder head, above the intake ports for cylinder number 4. The sensor tip is located close to a reluctor on the camshaft.

The sensor is a Hall effect sensor, which is used by the ECM at engine start-up to synchronize the CKP sensor signal to identify number one cylinder, to ensure the correct injector timing. Once the ECM has established the injector timing, the CMP sensor signal is no longer used.

The CMP sensor receives a 5V supply from the ECM. Two further connections to the ECM provide ground and signal outputs.

If a fault occurs with the CMP sensor when the engine is running, the engine will continue to run. Depending on the fault, the [ECM](#) may also restrict engine performance and signal the instrument cluster, on the high speed [CAN \(controller area network\)](#) bus, to illuminate the [MIL \(malfunction indicator lamp\)](#). Once the engine is switched off, the engine will crank, but will not restart while the fault is present.

CHARGE AIR TEMPERATURE SENSOR



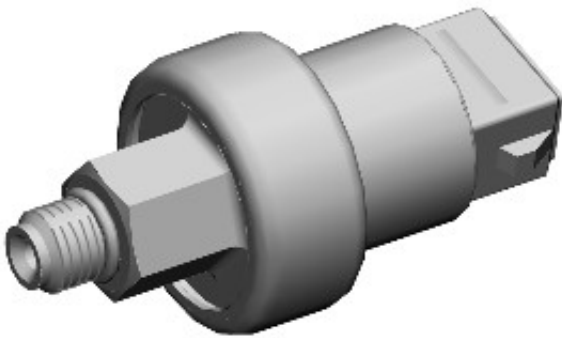
E 139406

The charge air temperature sensor is installed in the air duct between the charge air cooler and the electronic throttle.

The charge air temperature sensor is a **NTC (negative temperature coefficient)** thermistor that receives a 5V reference voltage from the ECM. The **ECM** uses the input from the sensor for fueling calculations.

If the charge air temperature sensor fails, the **ECM** uses a default charge air temperature of 20 °C (68 °F). In the event of a charge air temperature sensor failure, over fueling may occur, resulting in black smoke from the exhaust.

CLUTCH PEDAL POSITION SWITCH



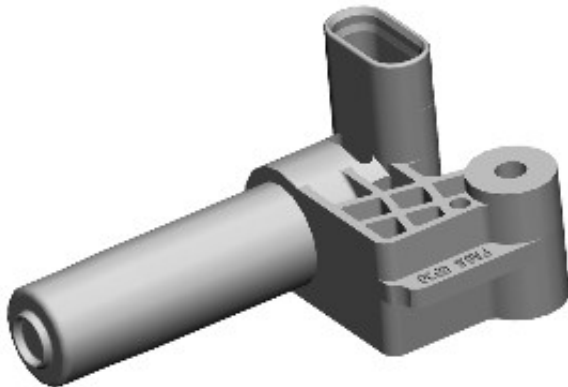
E 139407

The clutch pedal position switch is located on the clutch master cylinder.

The clutch pedal position switch is a pressure transducer type. When the clutch is pressed the switch disconnects a ground connection to the **ECM**, which reduces engine torque.

In the event of a clutch pedal switch failure, there may be some loss of driveability in the form of poor acceleration and reduced power.

CRANKSHAFT POSITION SENSOR



E 139408

The CKP sensor is attached to a bracket on the rear of the cylinder block, in the joint between the cylinder block and the transmission clutch housing. The sensor tip is aligned with a magnetic trigger wheel attached to the crankshaft. The sensor produces a square wave signal, the frequency of which is proportional to engine speed.

The CKP sensor is a Hall effect sensor that receives a 5V supply from the [ECM](#) and produces a square wave signal, the frequency of which is proportional to engine speed. The trigger wheel has two missing teeth to provide a reference point for the angular position of the crankshaft.

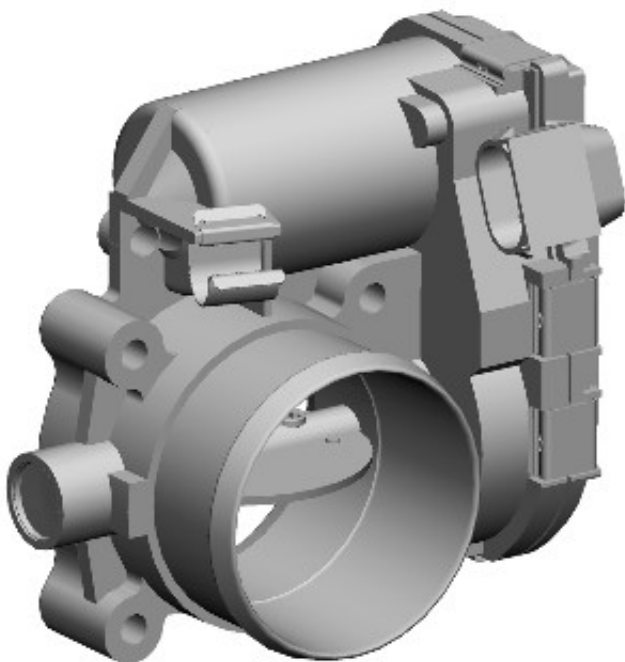
The ECM uses the signal from the CKP sensor for the following functions:

- Synchronization
- Determining fuel injection timing
- Producing an engine speed signal which is broadcast on the high speed controller area network (CAN) bus for use by other systems.

If there is a fault with the [CKP \(crankshaft position\)](#) sensor, the following symptoms may be observed:

- Engine will not start
- Rough idle, [EGR \(exhaust gas recirculation\)](#) disabled, poor acceleration and lack of power.

ELECTRONIC THROTTLE



E139429

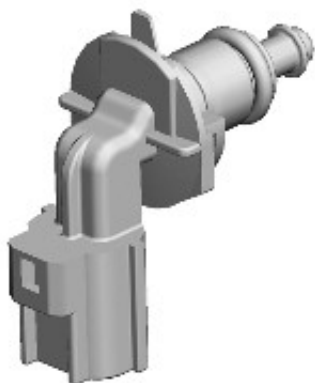
The electronic throttle is installed between the duct from the charge air cooler and the intake manifold, and is used by the [ECM](#) for [EGR](#) to control emissions, to make engine shutdown smoother, and to provide a second means of stopping the engine if other items fail.

The throttle plate is operated by an electric [DC \(direct current\)](#) motor, attached to the throttle body, which is controlled by the [ECM](#). A position sensor in the [DC](#) motor supplies a feedback signal of throttle plate position to the [ECM](#).

If there is a fault with the [DC](#) motor or the position sensor, the [ECM](#) will:

- Signal the instrument cluster, on the high speed [CAN](#) bus, to illuminate the [MIL](#)
- Disable [EGR](#) and [DPF](#) regeneration (where fitted), which results in increased emissions
- Reduce engine power output.

ENGINE COOLANT TEMPERATURE SENSOR



E108397

The engine coolant temperature (ECT) sensor is installed in the radiator upper hose, in the tee connection with the thermostat hose.

The ECT sensor is a **NTC** thermistor that receives a 5V reference voltage from the ECM. The ECM uses the temperature information for the following functions:

- Fueling calculations
- Limiting engine operation if engine coolant temperature becomes too high
- Glow plug activation time.

The ECM also transmits coolant temperature information on the high speed **CAN** bus to the instrument cluster, for temperature gauge operation.

If the **ECT** sensor fails, the following symptoms may be observed:

- Difficult cold start
- Difficult hot start
- Engine performance compromised
- Temperature gauge inoperative or inaccurate reading.

The ECM may also illuminate the **MIL**, depending on the fault.

In the event of **ECT** sensor signal failure, the ECM applies a default value of 88 °C (190 °F) coolant temperature for fueling purposes.

HEATED OXYGEN SENSOR (ONLY FITTED TO VEHICLES WITH DPF)



E139409

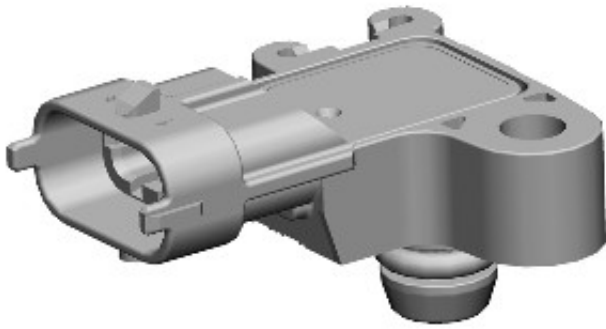
The **HO2S** is installed in the inlet of the catalytic converter and **DPF**.

The **HO2S** allows the **ECM** to measure the oxygen content of the exhaust gases, for closed loop control of the fuel:air mixture.

The heater element of the **HO2S** is controlled by a **PWM (pulse width modulation)** signal from the **ECM**. The heater element is operated immediately after each engine start and during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The **PWM** duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

If there is a fault with the **HO2S** (heater or sensor circuits) the **ECM** illuminates the **MIL** and defaults to open loop fueling.

MANIFOLD ABSOLUTE PRESSURE SENSOR



E139411

The **MAP** sensor is installed on the intake manifold. The sensor provides a voltage signal to the ECM relative to the intake manifold pressure. The **MAP** sensor has a three pin connector that provides a 5V reference supply from the ECM, a signal output to the ECM and a ground.

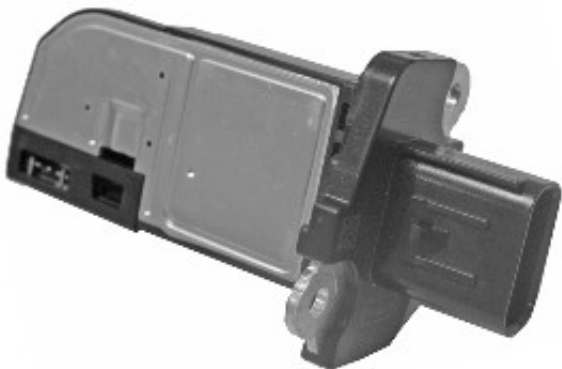
The **MAP** sensor uses a diaphragm transducer to measure pressure. The ECM uses the sensor signal for the following functions:

- Maintain manifold boost pressure
- Reduce exhaust smoke emissions when driving at high altitude
- Control of the EGR system.

If the **MAP** sensor fails, the ECM uses a default pressure of 1013 mbar (14.7 lbf/in²) absolute and may illuminate the **MIL**. In the event of a **MAP** sensor failure, the following symptoms may be observed:

- Engine speed restricted
- Rough running, engine hesitates.
- **MIL** illuminated.

MASS AIR FLOW AND TEMPERATURE SENSOR



E139410

The **MAFT** sensor is located in the outlet of the air cleaner.

The **MAFT** sensor receives a 12V supply from the power relay in the **BJB (battery junction box)** and a ground connection via the **ECM**. Two further connections to the **ECM** supply the **MAF (mass air flow)** and the temperature signals.

The temperature sensor is a **NTC** thermistor. The **ECM** uses the temperature signal to correct the fueling map for intake air temperature.

The **MAF** sensor works on the hot film principle. The sensor output is a digital signal proportional to the mass of the incoming air. The **ECM** uses this data, in conjunction with signals from other sensors, and information from stored fueling maps, to determine the precise fuel quantity to be injected into the cylinders. The signal is also used as a feedback signal for the **EGR** system.

The **ECM** checks the calculated air mass against the engine speed. If the calculated air mass is not plausible, the **ECM** uses a default air mass figure which is derived from the average engine speed compared to a stored characteristic map. The air mass value will be corrected using values for boost pressure, atmospheric pressure and ambient air temperature.

In the event of an air sensor signal failure, any of the following symptoms may be observed:

- Difficult starting
- Engine stalls after starting
- Delayed engine response
- Emission control inoperative

- Idle speed control inoperative
- Reduced engine performance
- **MIL** illuminated.

OIL LEVEL AND TEMPERATURE SENSOR



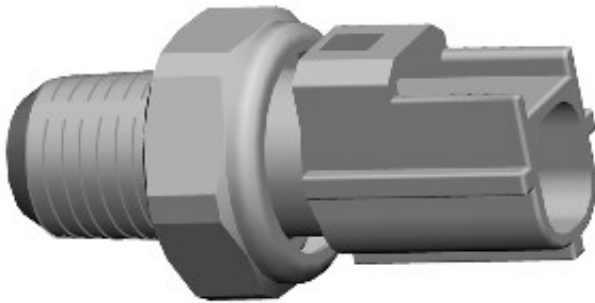
E 139412

The oil level and temperature sensor is installed in the cylinder block skirt stiffener, mid-way along the **RH (right-hand)** side of the engine.

The oil level signal is not used, as a mechanical dip stick is fitted.

The **ECM** uses the oil temperature signal to control the engine oil temperature. In extreme operation the **ECM** limits engine torque to prevent the oil temperature exceeding 140 °C (284 °F).

OIL PRESSURE SWITCH



E 139413

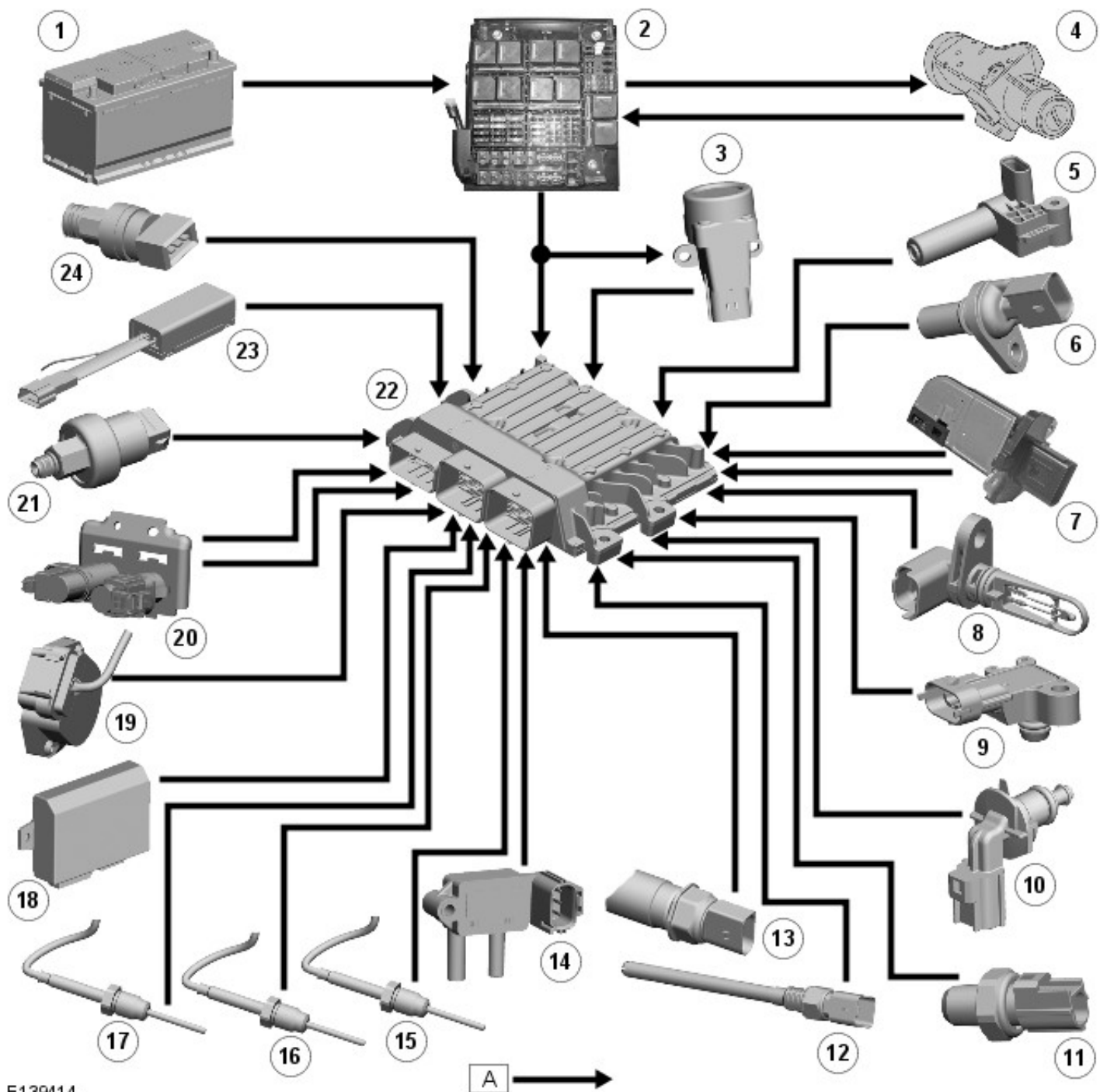
The oil pressure switch is located in the oil filter and cooler assembly.

When oil pressure is present, the oil pressure switch makes a ground connection through the switch body to the **ECM**. The switch operates at a pressure of 0.15 to 0.41 bar (2.2 to 5.9 lbf/in²). The **ECM** transmits the status of the oil pressure switch to the instrument cluster, on the high speed **CAN** bus, for operation of the low oil pressure warning indicator.

If the oil pressure switch fails, the low oil pressure warning indicator is permanently illuminated.

CONTROL DIAGRAM - SHEET 1 OF 2

NOTE: A = Hardwired.



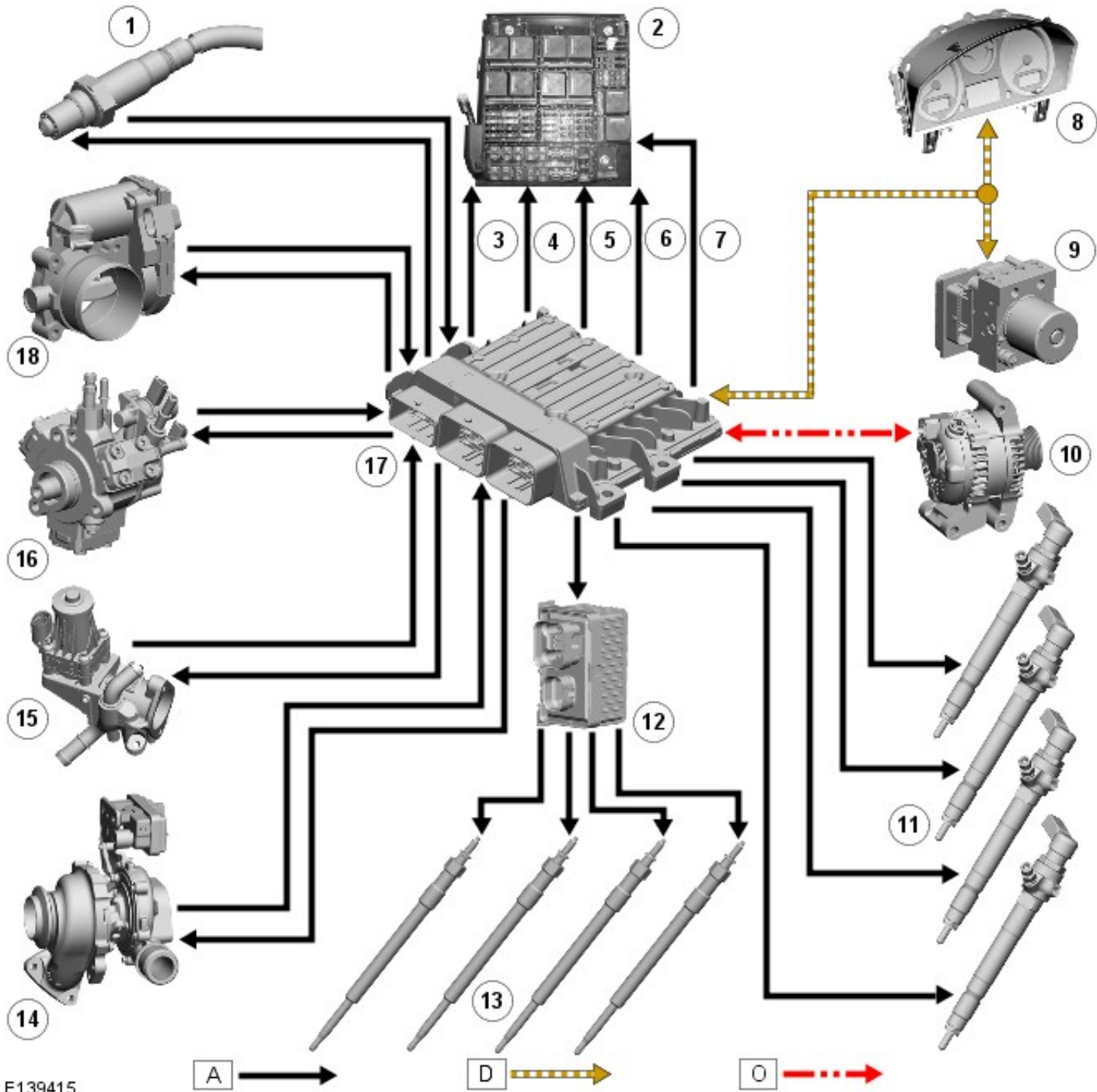
E139414

Item	Part Number	Description
1	-	Battery
2	-	battery junction box (BJB)
3	-	Inertia switch
4	-	Ignition switch
5	-	CKP
6	-	CMP sensor
7	-	MAFT sensor
8	-	Charge air temperature sensor
9	-	MAP sensor
10	-	ECT sensor
11	-	Oil pressure switch
12	-	Oil level and temperature switch
13	-	FRP (fuel rail pressure) sensor
14	-	Differential pressure sensor
15	-	Temperature sensor - pre catalytic converter
16	-	Temperature sensor - post catalytic converter

- 17 - Temperature sensor - post DPF
- 18 - Anti-theft system module
- 19 - APP sensor
- 20 - Brake switches
- 21 - Clutch switch
- 22 - ECM
- 23 - A/C thermostatic switch
- 24 - A/C pressure switch

CONTROL DIAGRAM - SHEET 2 OF 2

NOTE: A = Hardwired; D = High speed CAN bus; O = LIN (local interconnect network) bus.



Item	Part Number	Description
1	-	HO2S
2	-	BJB
3	-	To A/C compressor clutch relay
4	-	To A/C cooling fan relay

- 5 - To starter relay
- 6 - To fuel pump relay
- 7 - To main and power relays
- 8 - Instrument cluster
- 9 - anti-lock brake system (ABS) module
- 10 - Generator
- 11 - Fuel injector (4 off)
- 12 - Glow plug module
- 13 - Glow plug (4 off)
- 14 - Turbocharger
- 15 - [EGR](#) valve
- 16 - High pressure fuel pump
- 17 - Electronic throttle

Electronic Engine Controls - ID4 2.2L Diesel - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine controls, refer to the relevant Description and Operation section in the workshop manual.

REFER to: [Electronic Engine Controls](#) (303-14 Electronic Engine Controls - ID4 2.2L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle

NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

1. Verify the customer concern
2. Visually inspect for obvious signs of mechanical or electrical damage and system integrity

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Engine oil level • Cooling system coolant level • Fuel level • Fuel contamination • Fuel leaks • Front end accessory drive belt • Vacuum leaks 	<ul style="list-style-type: none"> • Fuses • Wiring harness • Electrical connector(s) • Sensor(s) • Engine control module • Transmission control module • CAN (controller area network) circuit

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index

Symptom Chart

Symptom	Possible source	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> • Low/contaminated fuel • Air intake system fault • Fuel system low pressure circuit fault • Fuel pump module fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Fuel injection pump failure • Crankshaft position sensor • Engine control module fault 	Check the fuel level/condition. Check the integrity of the air intake system and for correct installation. Check the fuel pump module operation, check the fuel system low pressure circuit for leaks/damage. Check the fuel filter, check the fuel volume control valve and fuel pressure control valve. Check the fuel injection pump. Check the crankshaft position sensor and circuits. Refer to the new module/component installation note at the top of the symptom chart if an engine control module fault is suspect
Difficult to start	<ul style="list-style-type: none"> • Glow plug system fault (very cold conditions) • Low/contaminated fuel • Air leakage • Fuel pump module 	Check the glow plugs and circuits. Check the fuel level/condition. Check the integrity of the air intake system and for correct installation. Check the fuel pump module operation, check the fuel system low pressure circuit for leaks/damage. Check the fuel filter, fuel volume control valve and fuel pressure control valve. Check the exhaust gas recirculation system

	<ul style="list-style-type: none"> fault Fuel system low pressure circuit fault Blocked fuel filter Fuel volume control valve blocked/contaminated Fuel pressure control valve blocked/contaminated Exhaust gas recirculation valve(s) fault 	
Rough idle	<ul style="list-style-type: none"> Air intake system fault Low/contaminated fuel Fuel system low pressure circuit fault Blocked fuel filter Fuel volume control valve blocked/contaminated Fuel pressure control valve blocked/contaminated Exhaust gas recirculation valve(s) fault 	Check the integrity of the air intake system and for correct installation. Check the fuel level/condition. Check the fuel system low pressure circuit for leaks/damage. Check the fuel filter, fuel volume control valve and fuel pressure control valve. Check the exhaust gas recirculation system
Lack of power when accelerating	<ul style="list-style-type: none"> Air intake system fault Diesel particulate filter blocked/restricted Restricted exhaust system Low fuel pressure Exhaust gas recirculation valve(s) fault Variable geometry turbocharger actuator fault 	Check the integrity of the air intake system and for correct installation. Check for a blocked diesel particulate filter or catalytic converter, install new components as required. Check the fuel pressure. Check the exhaust gas recirculation system. Check the variable geometry turbocharger actuators
Engine stops/stalls	<ul style="list-style-type: none"> Low/contaminated fuel Air intake system fault Fuel system low pressure circuit fault Fuel volume control valve blocked/contaminated Fuel pressure control valve blocked/contaminated High pressure fuel leak Exhaust gas recirculation valve(s) fault 	Check the fuel level/condition. Check the fuel system low pressure circuit for leaks/damage. Check for fuel system leaks, fuel volume control valve and fuel pressure control valve. Check the exhaust gas recirculation system
Engine judders	<ul style="list-style-type: none"> Low/contaminated fuel Air ingress Fuel system low pressure circuit fault Fuel metering valve blocked/contaminated Fuel volume control valve blocked/contaminated Fuel pressure control 	Check the fuel level/condition. Check the fuel system low pressure circuit for leaks/damage. Check for fuel system leaks, fuel volume control valve and fuel pressure control valve. Check the fuel injection pump

	valve blocked/contaminated <ul style="list-style-type: none"> • High pressure fuel leak • Fuel injection pump fault 	
Excessive fuel consumption	<ul style="list-style-type: none"> • Fuel system low pressure circuit fault • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Fuel temperature sensor leak • High pressure fuel leak • Injector(s) failure • Exhaust gas recirculation valve(s) fault 	Check the fuel system low pressure circuit for leaks/damage. Check the fuel volume control valve and fuel pressure control valve. Check the fuel temperature sensor, fuel injection pump, etc for leaks. Check for injector DTCs. Check the exhaust gas recirculation system

DTC failure type definitions

NOTE: Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits, DTC failure type give additional information read by the manufacturer-approved diagnostic system). The DTC failure type information is described in the table below

DTC failure type	DTC failure type description
00-0F	<ul style="list-style-type: none"> • General failure information • This category includes all other categories and is used when the fault within that failure category is unique, not amenable to standardization through assignment of a new sub type, or when the detected fault is best described by two or more sub types within that failure category
10-1F	<ul style="list-style-type: none"> • General electrical failures • This category includes standard wiring failure modes, short to ground, short to battery, open circuit and direct current quantities related by Ohm's Law
20-2F	<ul style="list-style-type: none"> • General signal failures • This category includes quantities related to amplitude, frequency or rate of change, and wave shape
30-3F	<ul style="list-style-type: none"> • Frequency modulated, pulse width modulated failures • This category includes faults related to frequency modulated and pulse width modulated inputs and outputs of the control module. This category also includes faults where position is determined by counts
40-4F	<ul style="list-style-type: none"> • System internal failures • This category includes faults related to memory, software, and internal electrical circuitry; requiring component, control module, sensor, replacement
50-5F	<ul style="list-style-type: none"> • System programming failures • This category includes faults related to operational software, calibrations, and options; remedied by configuring, programming a part of the system, control module, sensor
60-6F	<ul style="list-style-type: none"> • Algorithm based failures • This category includes faults based on comparing two or more input parameters for plausibility or comparing a single parameter to itself with respect to time
70-7F	<ul style="list-style-type: none"> • Mechanical failures • This category includes faults detected by inappropriate motion in response to control related input, controlled output
80-8F	<ul style="list-style-type: none"> • Bus signal / message failures • This category includes faults related to bus hardware and signal integrity. This category is also used when the physical input for a signal is located in one control module and another control module diagnoses the circuit or inhibits operation due to a reported failure of that circuit
90-9F	<ul style="list-style-type: none"> • Component failures • This category includes faults related to component failures including parametric, performance assembly and operating environment failures

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

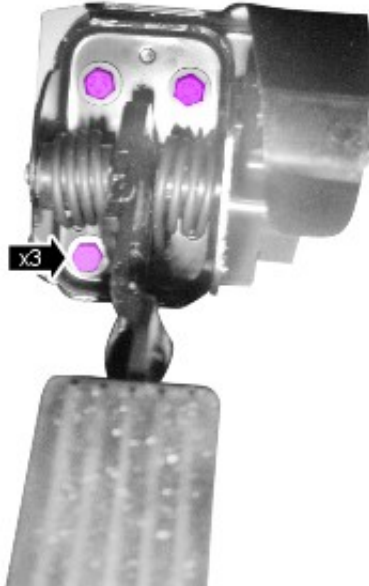
Electronic Engine Controls - ID4 2.2L Diesel - Accelerator Pedal Position (APP) Sensor

Removal and Installation

Removal

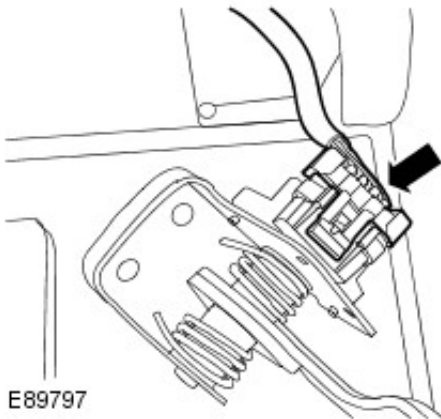
NOTE: Removal steps in this procedure may contain installation details.

1. Torque: 25Nm



E139652

- 2.



E89797

Installation

1. To install, reverse the removal procedure.

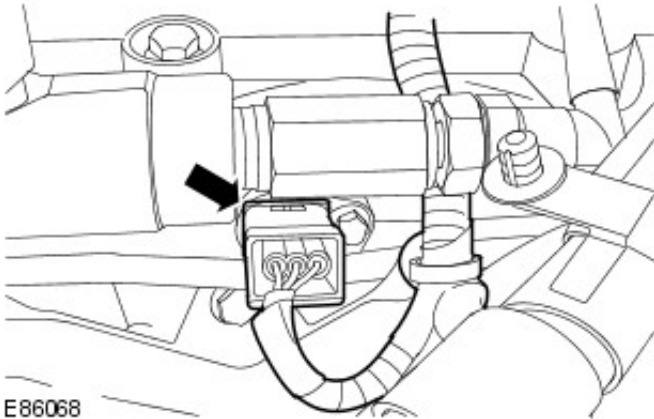
Electronic Engine Controls - ID4 2.2L Diesel - Camshaft Position (CMP) Sensor

Sensor

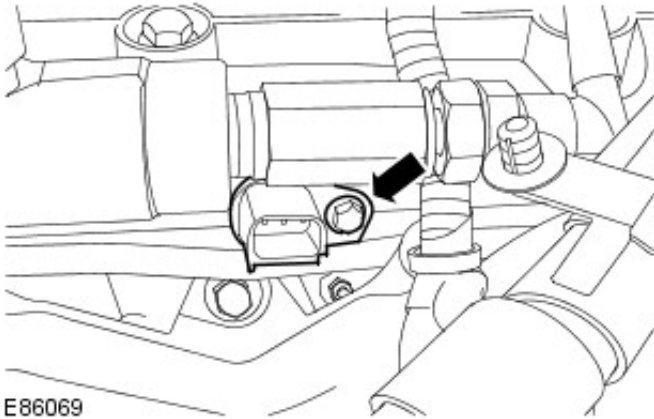
Removal and Installation

Removal

1. Disconnect the camshaft position (CMP) sensor electrical connector.



2. Remove the CMP sensor.
 - Remove the bolt.
 - Remove and discard the O-ring seal.

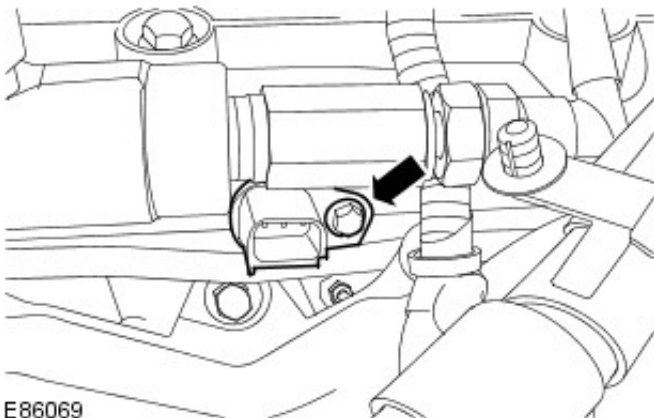


Installation

1. **NOTE: Install a new O-ring seal.**

To install, reverse the removal procedure.

- Tighten to 9 Nm (7 lb.ft).



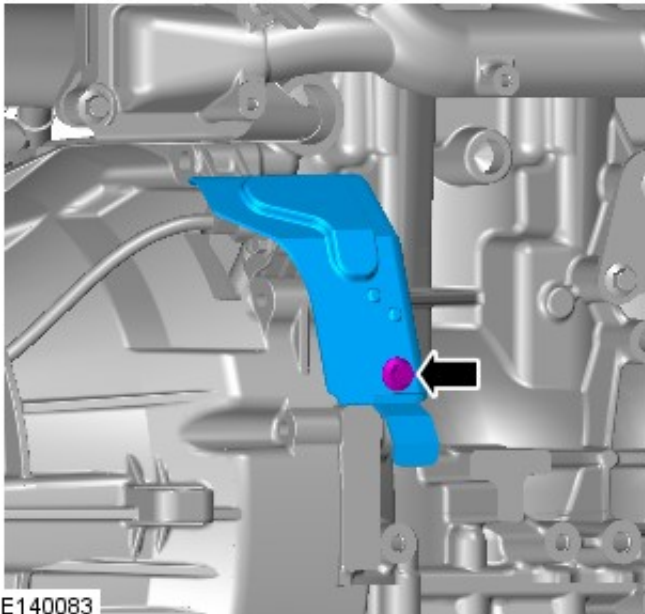
Electronic Engine Controls - ID4 2.2L Diesel - Crankshaft Position (CKP) Sensor

Sensor

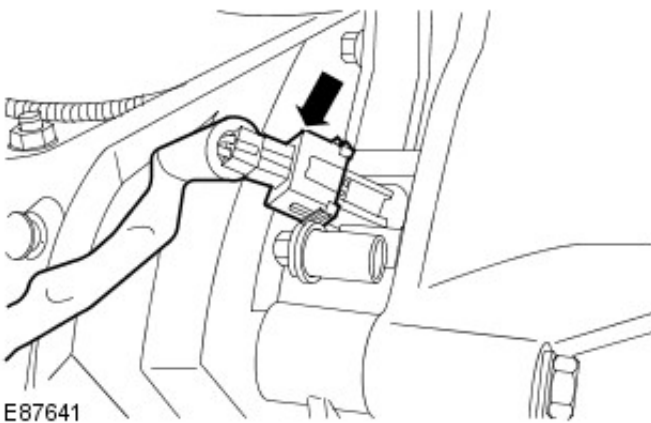
Removal and Installation

Removal

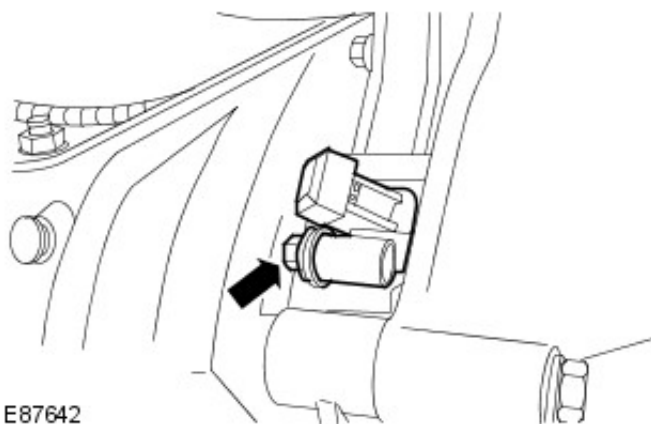
1. Remove the heat shield.



2. Disconnect the crankshaft position (CKP) sensor electrical connector.



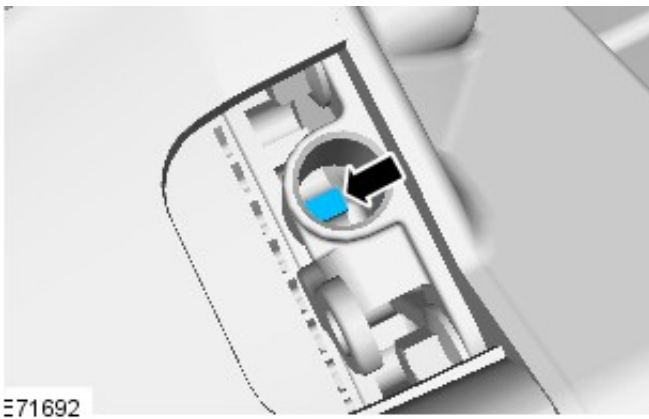
3. Remove and discard the CKP sensor.
 - Remove the bolt.



Installation

1. **NOTE:** Only turn the engine in the normal direction of rotation.

Turn the engine until a flywheel trigger tooth is visible through the CKP sensor housing.

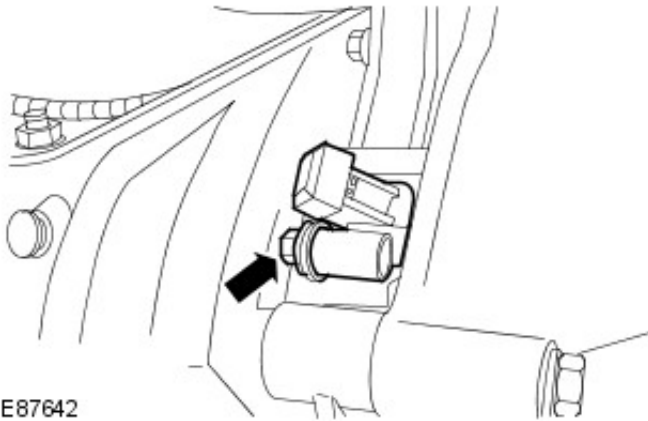


2.  **CAUTION:** The CKP sensor tip must rest on a flywheel trigger tooth. Incorrect installation may result in the CKP sensor being damaged.

NOTE: Make sure that the CKP sensor housing is clean and free from foreign material.

Install the CKP sensor.

- Tighten to 9 Nm.



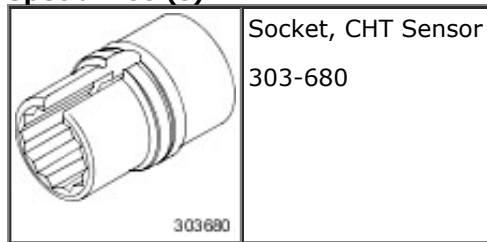
3. Connect the CKP sensor electrical connector.

4. Install the heat shield.
- Tighten to 24Nm.

Electronic Engine Controls - ID4 2.2L Diesel - Cylinder Head Temperature (CHT) Sensor

Removal and Installation

Special Tool(s)

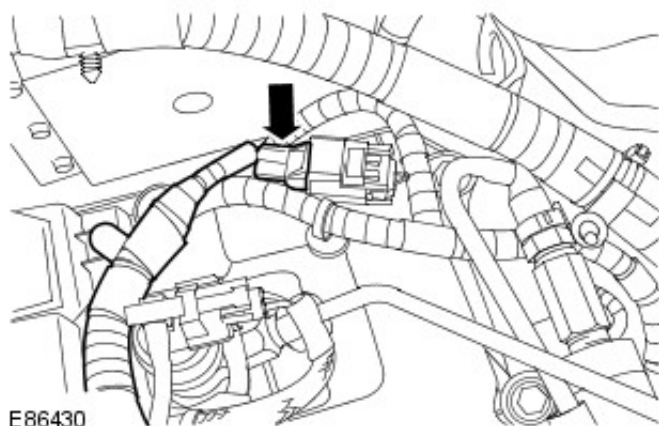


Socket, CHT Sensor
303-680

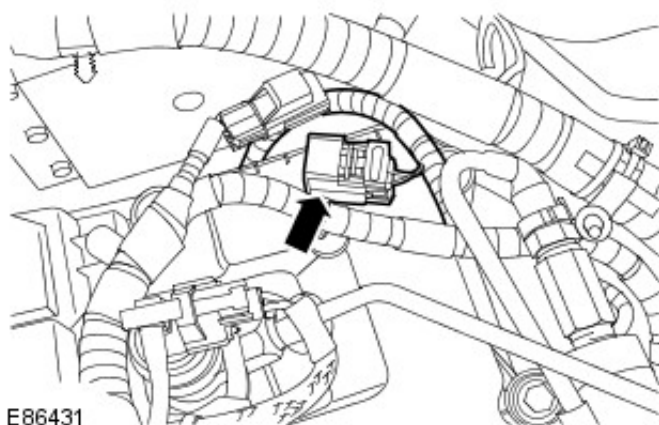
Removal

1. Remove the engine cover.
For additional information, refer to: Engine Cover (501-05, Removal and Installation).

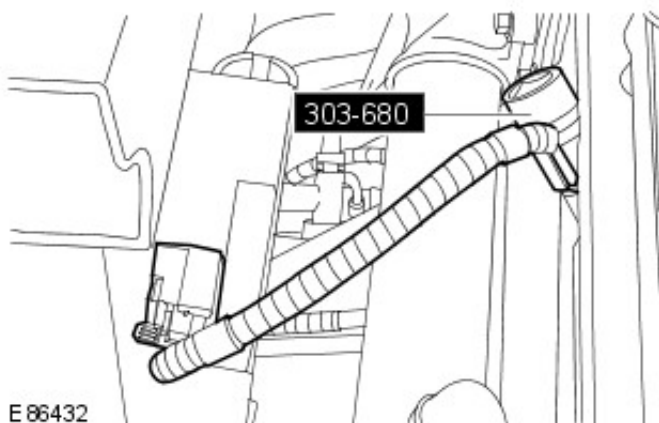
2. Disconnect the cylinder head temperature (CHT) sensor.



3. Release the CHT sensor wiring harness.

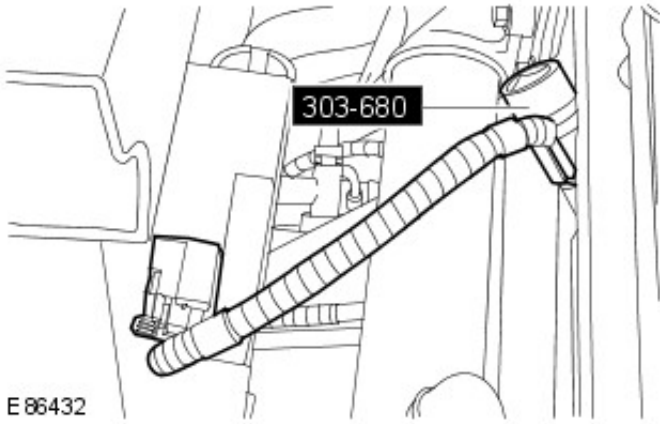


4. Using the special tool, remove the CHT sensor.



Installation


1. To install, reverse the removal procedure.
 - Tighten to 10 Nm (7 lb.ft).



Electronic Engine Controls - ID4 2.2L Diesel - Engine Control Module (ECM)

Removal and Installation

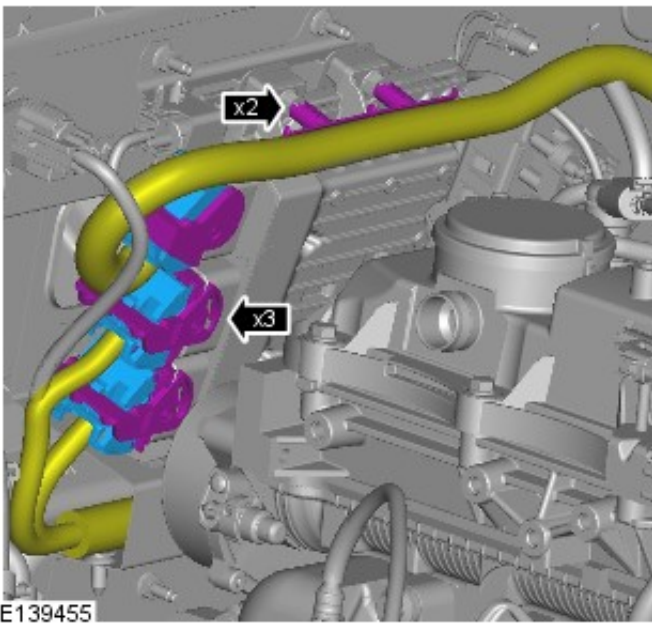
Removal

1.  **CAUTION:** Make sure that the fuel pump replacement and pilot correction learn are carried out following the download.

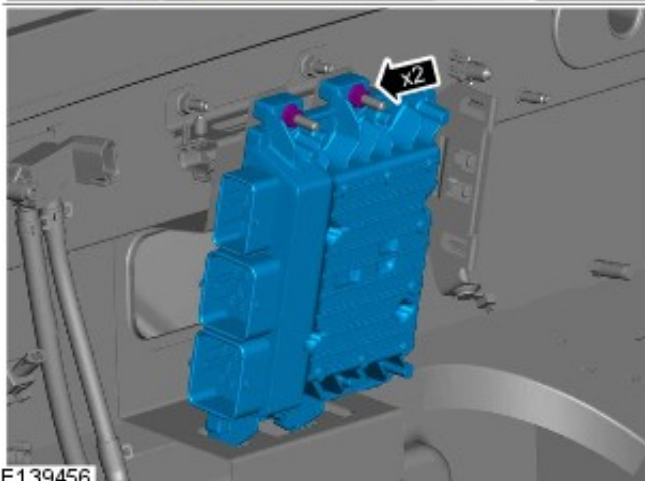
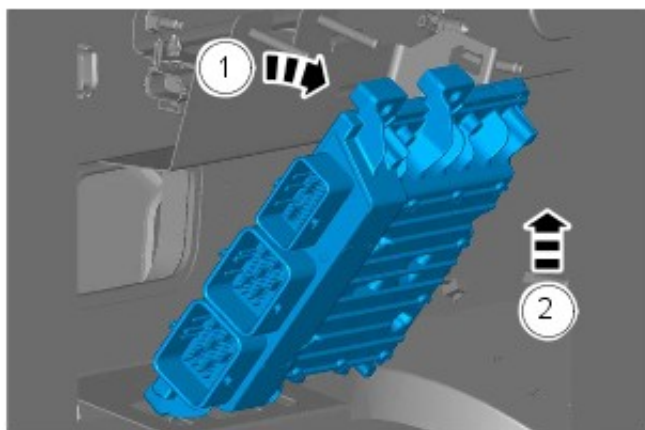
NOTE: When a new engine control module (ECM) is installed, the Land Rover approved diagnostic system must be connected to the vehicle and the ECM renewal procedure must be followed. This will allow the vehicle configuration to be uploaded into the new ECM.

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

3.



4. Torque: 10Nm



E139456

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - ID4 2.2L Diesel - Engine Coolant Temperature (ECT) Sensor

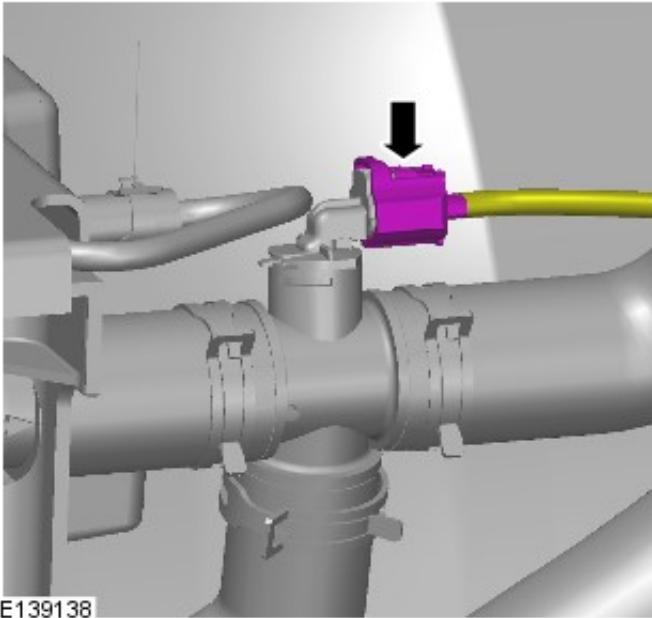
Removal and Installation

Removal

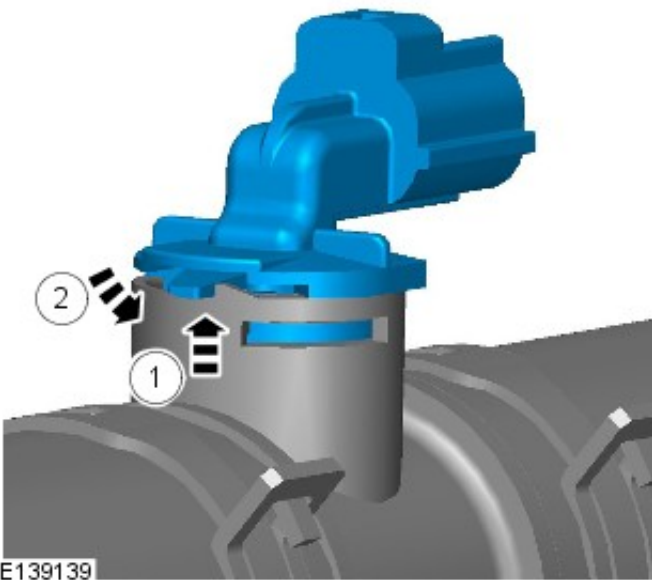
NOTE: Removal steps in this procedure may contain installation details.

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

2.



3.



Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - ID4 2.2L Diesel - Engine Oil Pressure (EOP) Sensor

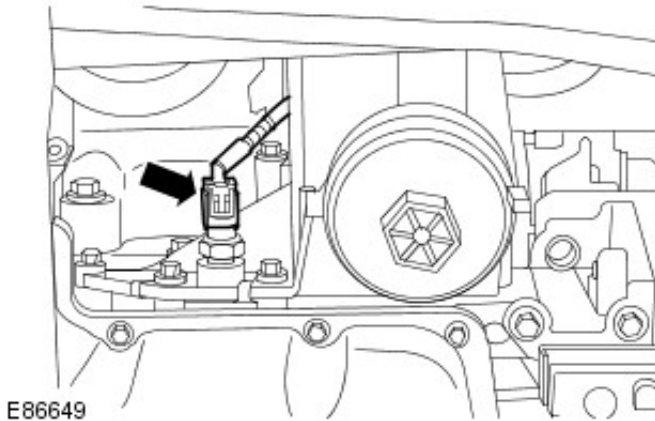
Sensor

Removal and Installation

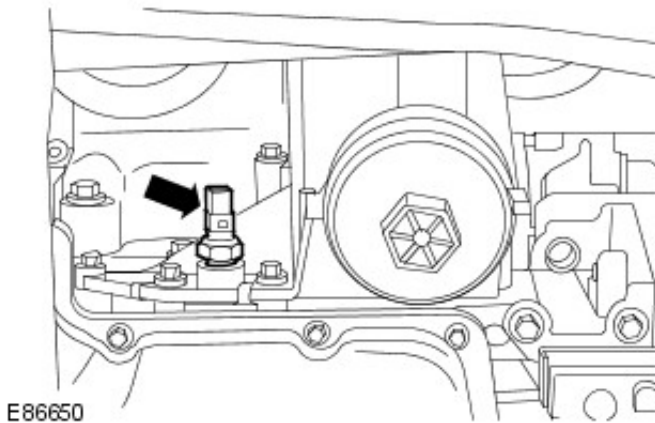
Removal

1. Raise and support the vehicle.
For additional information, refer to: Lifting (100-02, Description and Operation).

2. Disconnect the engine oil pressure (EOP) sensor electrical connector



3. Remove the EOP sensor.



Installation

1. Install the EOP sensor.
 - Tighten to 15 Nm (11 lb.ft).
2. Connect the EOP sensor electrical connector.


Electronic Engine Controls - ID4 2.2L Diesel - Engine Oil Level Sensor

Removal and Installation

Removal

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

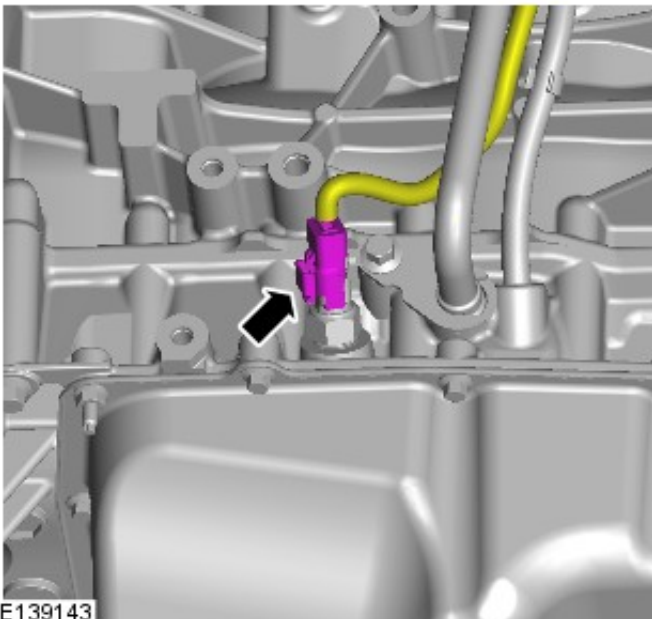
1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

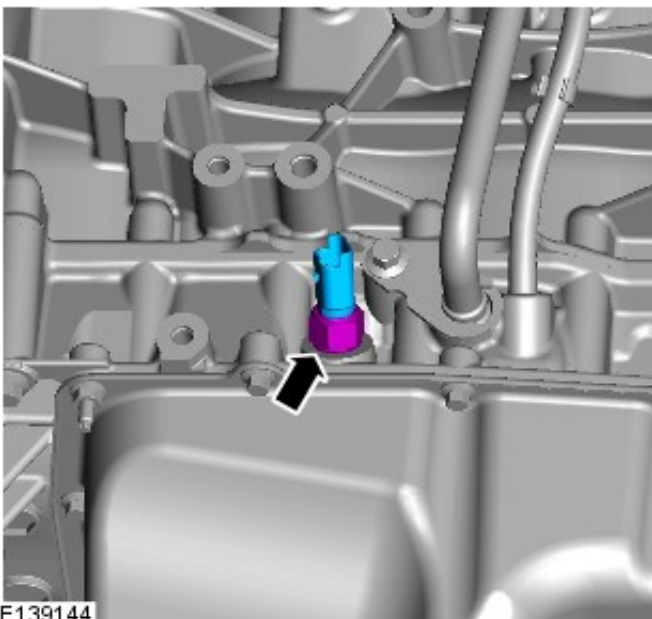
3. For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01 Engine - ID4 2.2L Diesel, General Procedures).

4.



5.  **CAUTION:** Remove and discard the O-ring seal.

Torque: 27Nm



Installation


1. To install, reverse the removal procedure.

Content not found

Electronic Engine Controls - ID4 2.2L Diesel - Heated Oxygen Sensor (H02S)

Removal and Installation

Special Tool(s)

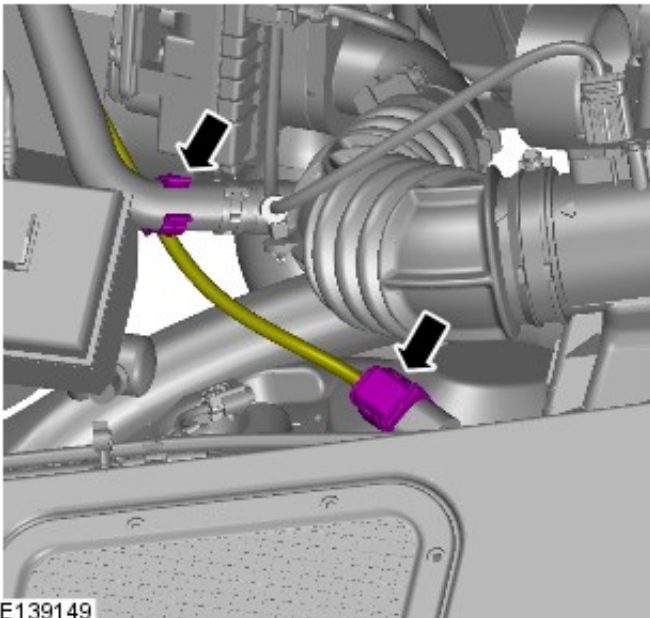
 <p>310-121</p> <p>E53465</p>	<p>Wrench, H02S</p> <p>310-121</p>
---	------------------------------------

Removal

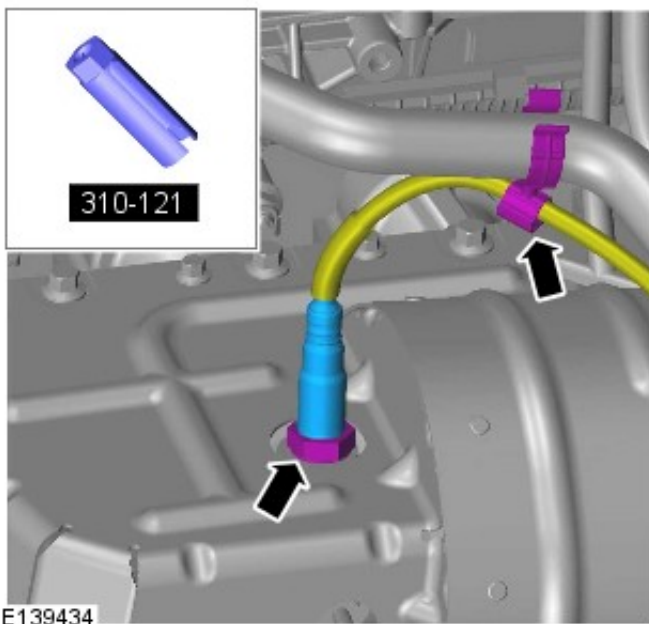
NOTE: Removal steps in this procedure may contain installation details.

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

2.



3. Torque: 48Nm Tool: 310-121 (Wrench, H02S)



Installation

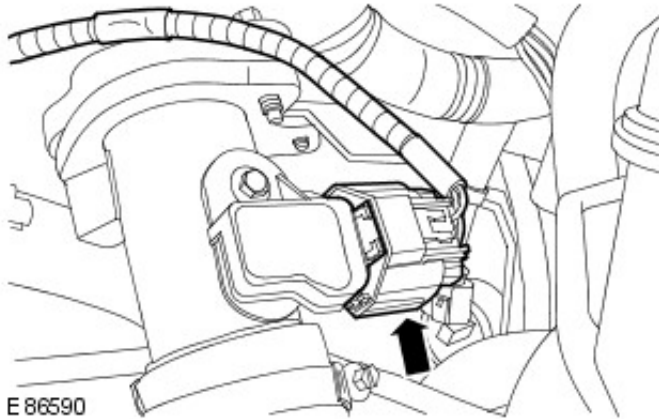
1. To install, reverse the removal procedure.

Electronic Engine Controls - ID4 2.2L Diesel - Manifold Absolute Pressure and Temperature (MAPT) Sensor


Removal and Installation

Removal

1. Disconnect the manifold absolute pressure and temperature (MAPT) sensor electrical connector.

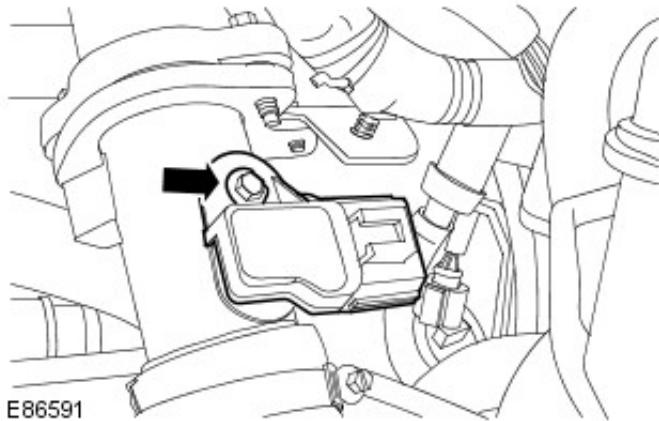


E 86590

2.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Remove the MAPT sensor.

- Remove the bolt.
- Remove and discard the O-ring seal.



E86591

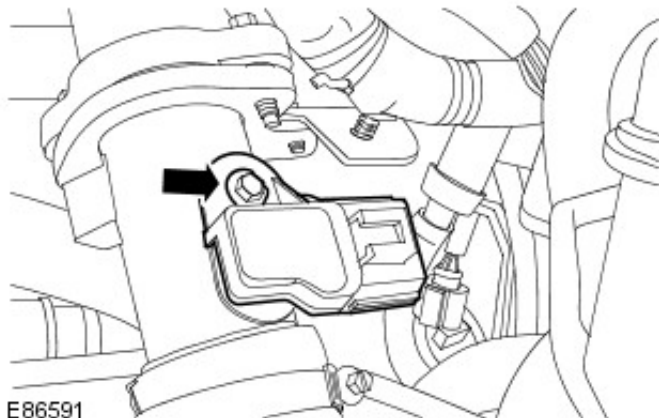
Installation

1. **NOTE:** Remove and discard the blanking caps.

NOTE: Install a new O-ring seal.

To install, reverse the removal procedure.

- Tighten to 3 Nm (2 lb.ft).



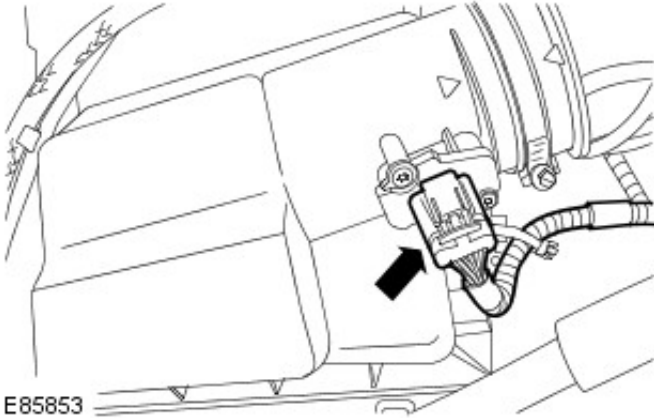
E86591

Electronic Engine Controls - ID4 2.2L Diesel - Mass Air Flow (MAF) Sensor

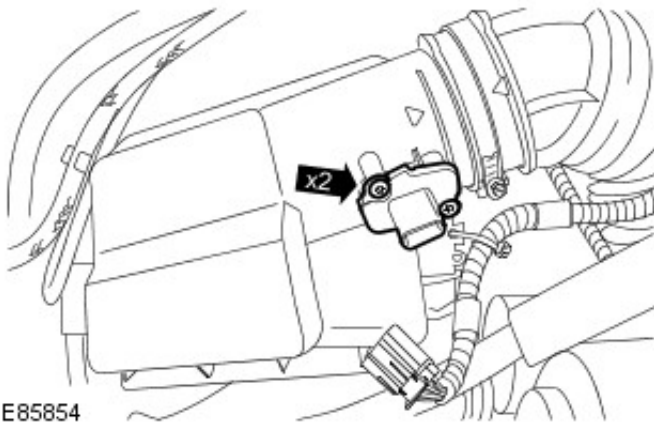
Removal and Installation

Removal

1. Disconnect the mass air flow (MAF) sensor electrical connector.



2. Remove the MAF sensor.
 - Remove the 2 screws.
 - Remove and discard the O-ring seal.



Installation

1. **NOTE:** Install a new O-ring seal.

To install, reverse the removal procedure.


Electronic Engine Controls - ID4 2.2L Diesel - Post Catalytic Converter

Temperature Sensor

Removal and Installation

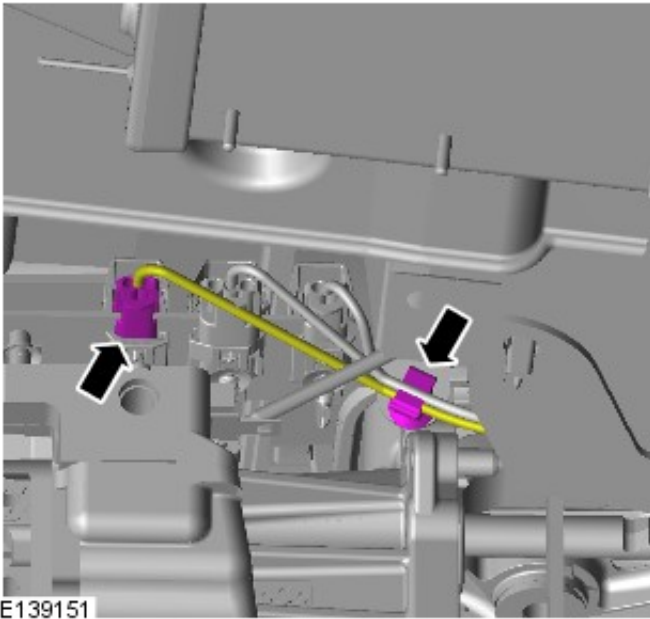
Removal

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

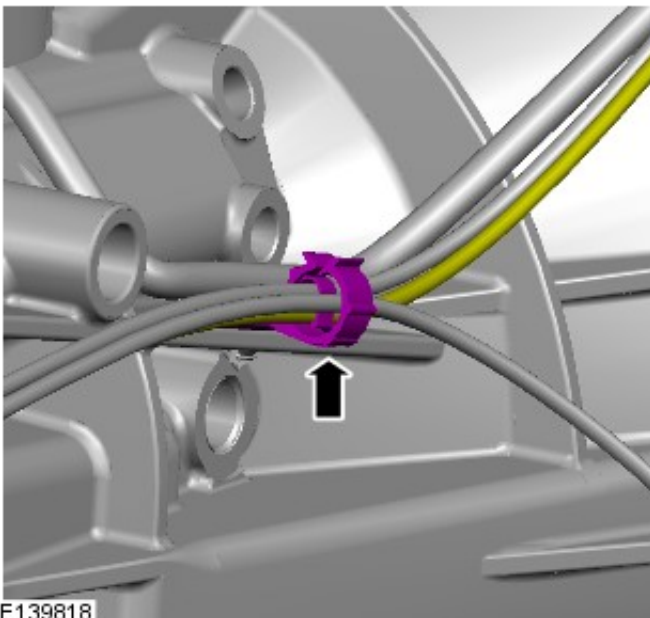
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2.



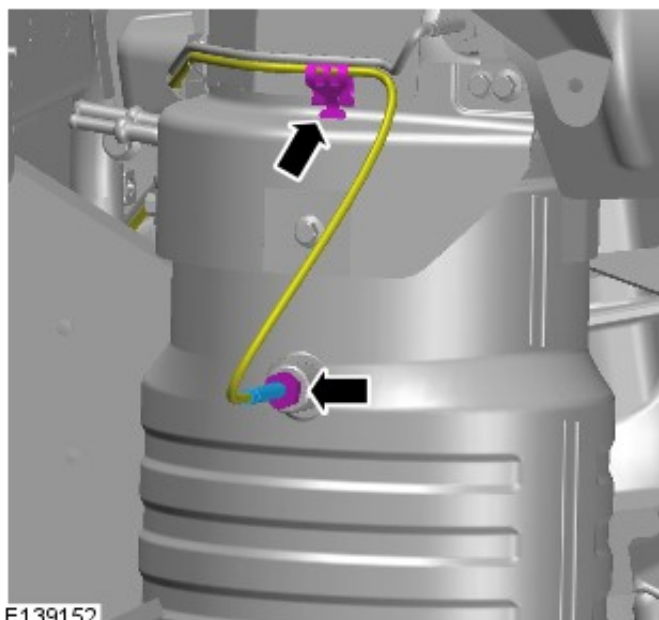
3.



4.  **CAUTION:** If accidentally dropped or knocked install a new sensor

NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

Torque: 35Nm



Installation

1. To install, reverse the removal procedure.


Electronic Engine Controls - ID4 2.2L Diesel - Pre Catalytic Converter

Temperature Sensor

Removal and Installation

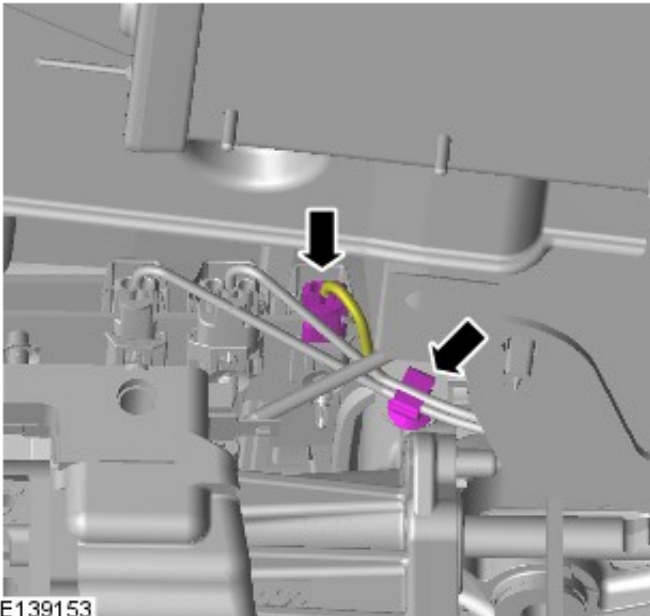
Removal

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

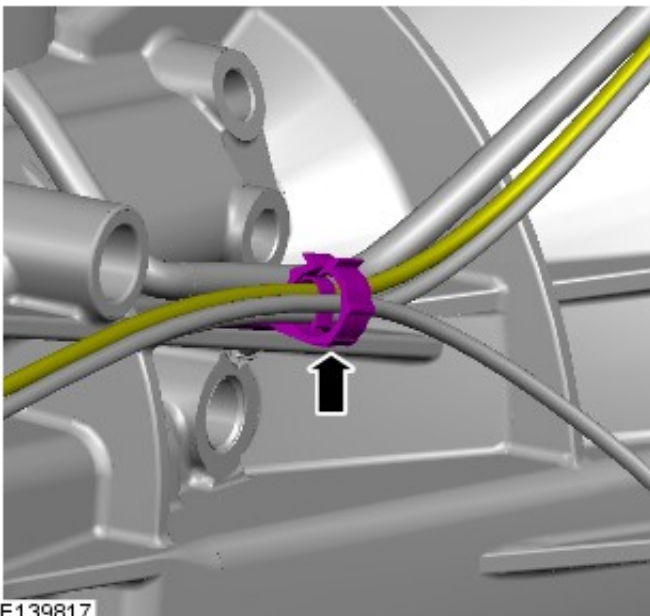
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2.



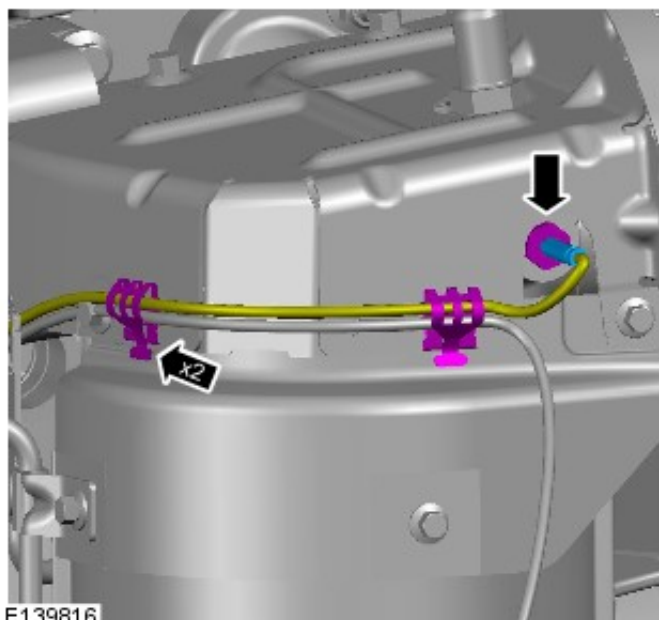
3.



4.  **CAUTION:** If accidentally dropped or knocked install a new sensor.

NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

Torque: 35Nm



E139816

Installation

1. To install, reverse the removal procedure.


Electronic Engine Controls - ID4 2.2L Diesel - Post DPF Exhaust Gas

Temperature Sensor

Removal and Installation

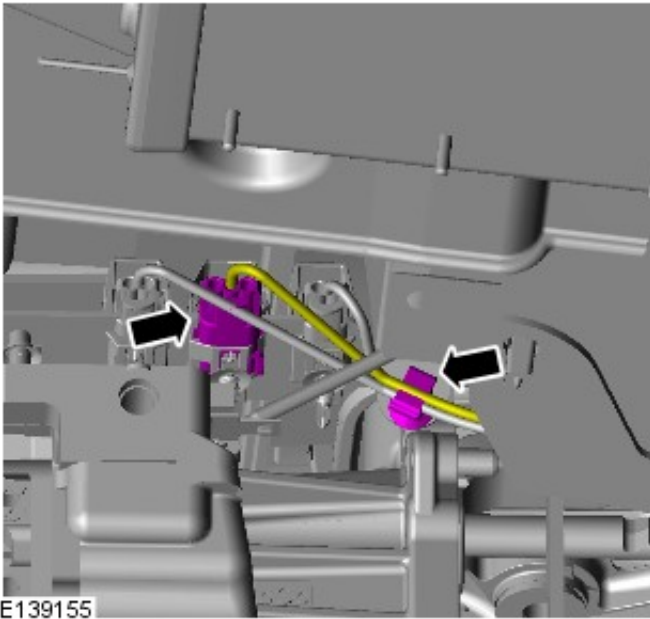
Removal

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

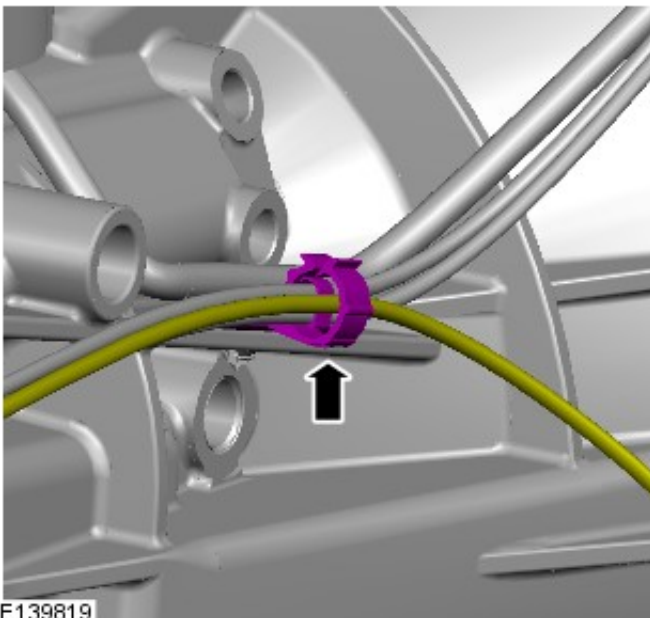
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2.



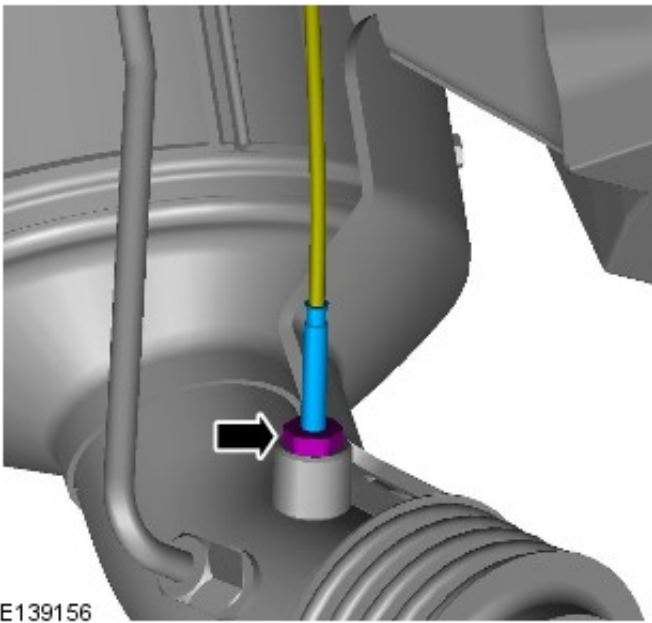
3.



4.  **CAUTION:** If accidentally dropped or knocked install a new sensor.

NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

Torque: 35Nm



E139156

Installation

- 1. To install, reverse the removal procedure.

Content not found

Clutch - Vehicles With: MT82 6-Speed Manual Transmission -

Description	Nm	lb-ft
Clutch pressure plate bolts (new bolts must be installed)	29	21

Clutch - Vehicles With: MT82 6-Speed Manual Transmission - Clutch

Description and Operation

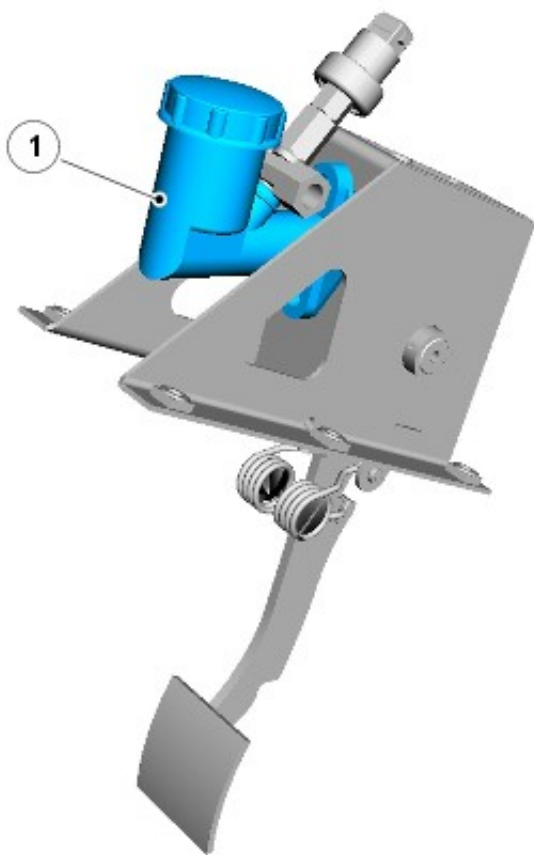
OVERVIEW

The clutch system is based on the established principle of a single driven plate and diaphragm spring clutch cover assembly hydraulically actuated from the clutch pedal. Depressing the clutch pedal transfers hydraulic fluid through the master cylinder, pipe work, and concentric slave cylinder ultimately actuating the clutch fingers to release the clutch and thus disengage drive from the crankshaft. When your foot is off the pedal, the spring pushes the pressure plate against the clutch disc, which in turn presses against the flywheel; this locks the engine to the transmission input shaft, causing them to rotate at the same speed.

The clutch system is of conventional design comprising the following major components:

- Clutch master cylinder and pressure pipes
- Concentric slave cylinder outlet assembly and peak torque limiter
- Vibration damper (Left hand drive vehicles only)
- Concentric slave cylinder
- Clutch cover assembly
- Clutch driven plate
- Flywheel

CLUTCH MASTER CYLINDER



E88782

Item	Part Number	Description
1	-	Clutch master cylinder

The clutch master cylinder is attached directly to the pedal box assembly, located in the driver's footwell.

The cylinder contains a piston assembly, with a push rod connected to the clutch pedal and spring. When the clutch pedal is depressed, it pushes on the piston, via a linkage. Pressure builds in the cylinder and lines as the clutch pedal is depressed further.

The cylinder has 2 hydraulic connections:

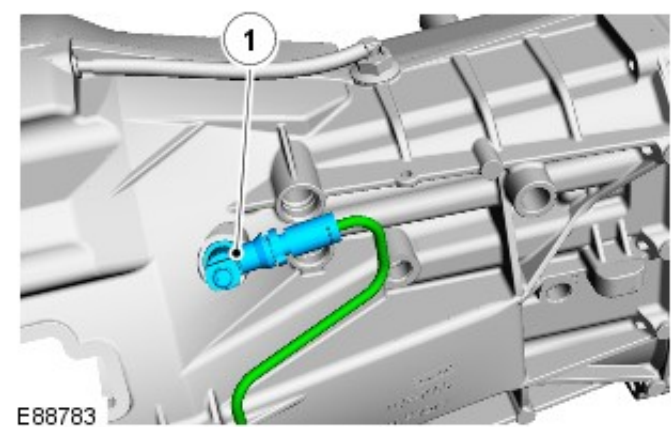
- A low pressure feed pipe (providing fluid supply from the brake fluid reservoir)
- A high pressure pipe

The pedal travel is constrained by an 'up-stop' contained within the master cylinder and a 'down-stop' contained within the

pedal box.

CONCENTRIC SLAVE CYLINDER OUTLET ASSEMBLY

NOTE: Right hand drive vehicle shown.



Item	Part Number	Description
1	-	Slave cylinder outlet assembly and peak torque limiter

The concentric slave cylinder outlet assembly connects the external pipes with the release system contained within the clutch housing. A securing bracket locates the assembly in the correct orientation and a seal is provided between the assembly and the clutch housing.

Contained within the slave cylinder outlet assembly is a peak torque limiter. This component is designed to restrict the hydraulic fluid flow during the clutch pedal up-stroke. Under normal pedal actuation this restriction can not be detected, but in the event of an unintentional pedal release (e.g. wet shoe slipping off the clutch pedal) the peak torque limiter limits the fluid return rate and protects the transmission and driveline from excessive shock loads, which might cause damage.

On left hand drive vehicles, the hydraulic pipework contains an anti-vibration damper plugged into the peak torque limiter. This is used to reduce pedal roar/vibrations during clutch operation.

CONCENTRIC SLAVE CYLINDER

The concentric slave cylinder assembly contains the release bearing and the hydraulic slave cylinder. The assembly is attached to the front end of the transmission via 3 bolts. These bolts are asymmetrically positioned to ensure correct angular location of the slave cylinder, which is also spigot-mounted for positional fit. In its free condition the slave cylinder is fully extended, but it positions itself automatically as the clutch housing is fitted to the engine. The assembly requires no setting or adjustment.

CLUTCH COVER ASSEMBLY

The clutch cover assembly comprises a pressure plate, cover and diaphragm and is mounted on and rotates with the flywheel.

The pressure plate is machined to provide a smooth surface for the drive plate to engage on. Lugs on the outer diameter of the pressure plate connect it via leaf springs to the cover. The leaf springs have leaves, which assist in pulling the pressure plate away from the drive plate when the clutch pedal is depressed.

The cover houses all pressure plate components. Shouldered rivets support the diaphragm inside the cover. The rivets heads are chamfered to allow the diaphragm to pivot when pressure is applied to it by the release bearing. Holes in the cover locate on dowels on the flywheel and further holes provide for the attachment of the cover to the flywheel. Larger holes in the cover provide ventilation for the drive plate and pressure plate and flywheel contact surfaces.

The diaphragm comprises a cast ring with fingers. The diaphragm is attached to the cover with shouldered rivets. The inner head of each rivet is chamfered to allow the diaphragm to pivot when the clutch is depressed or released. When pressure is applied to the fingers of the diaphragm by the release bearing, the diaphragm pivots on the rivets and moves away from the pressure plate, releasing the force applied to the pressure plate and allowing the drive plate to slip between the pressure plate and the flywheel.

CLUTCH DRIVEN PLATE

The clutch driven plate is sandwiched between the flywheel and the pressure plate of the clutch cover assembly. The clutch driven plate has a splined hub, which engages with the splines on the primary shaft from the transmission. The splined hub is located in an inner plate, which contains 3 compression pre-damper springs. The inner plate is retained by the springs, which can compress in both directions to cushion engine vibration at idle speed. The inner plate is located on 4 larger compression springs, which are located in a central plate. The hub is sandwiched between the central plate and the friction damper. The friction damper comprises friction washers located between the hub and the central plate. The friction washers reduce transmission noises and vibrations due to engine cyclic excitation.

FLYWHEEL

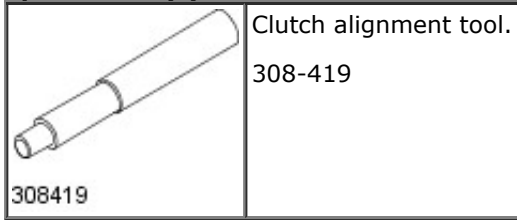
The single mass flywheel is bolted to the flange of the engine crankshaft. A dowel ensures that the flywheel is correctly located. A ring gear is located on the outside diameter of the flywheel and is seated against a flange. The ring gear is an interference fit on the flywheel and is a serviceable item, which can be replaced if damaged or worn.

The operating face of the flywheel is machined to provide a smooth surface for the clutch driven plate to engage on.


Clutch - Vehicles With: MT82 6-Speed Manual Transmission - Clutch Disc and Pressure Plate

Removal and Installation

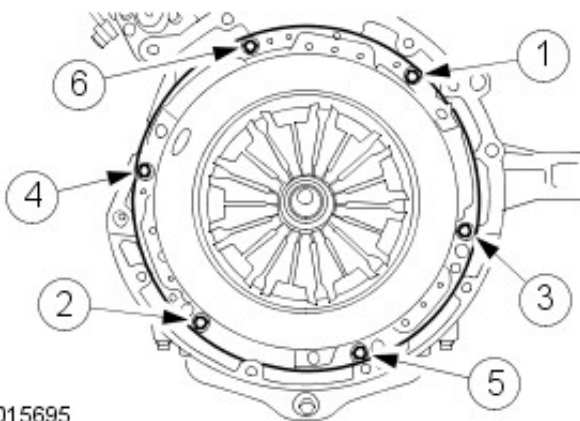
Special Tool(s)




Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
2. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect and Connect (414-01 Battery, Mounting and Cables, General Procedures).
3. Remove the transmission.
For additional information, refer to: Transmission (308-03 Manual Transmission/Transaxle, Removal).



4.  **CAUTION:** Loosen the clutch pressure plate bolts by 2 turns at a time in the sequence shown. Failure to follow this instruction may result in damage to the vehicle.


Remove the clutch disc and the clutch pressure plate.


- Remove and discard the 6 bolts.


ELE0015695

Installation

1. **CAUTIONS:**

 Make sure new bolts are installed. Failure to follow this instruction may result in damage to the vehicle.

 Apply grease of the correct specification to the pilot bearing. Failure to follow this instruction may result in damage to the vehicle.

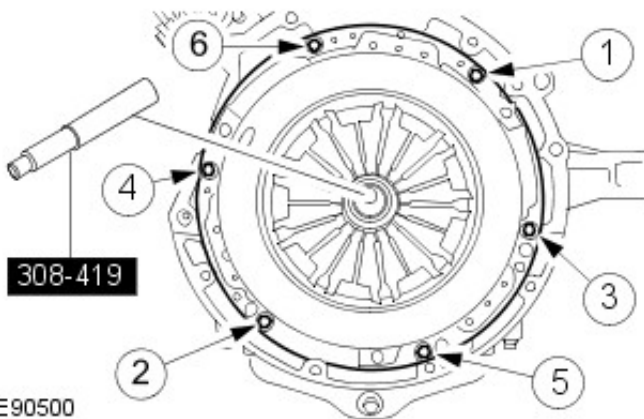
 Tighten the bolts in the sequence shown. Failure to follow this instruction may result in damage to the vehicle.

NOTE: Clean the component mating faces.

Using the special tool, install the clutch disc and the clutch pressure plate.

- Tighten the bolts to 29 Nm (21 lb.ft).

2. Remove the special tool.



2. Remove the special tool.

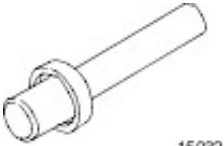

3. Install the transmission. For additional information, refer to: Transmission (308-03, Installation).

4. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).


Clutch - Vehicles With: MT82 6-Speed Manual Transmission - Pilot Bearing

Removal and Installation

Special Tool(s)

 15032	Bearing installer 205-081
 308-078 E91118	Bearing remover 303-078

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

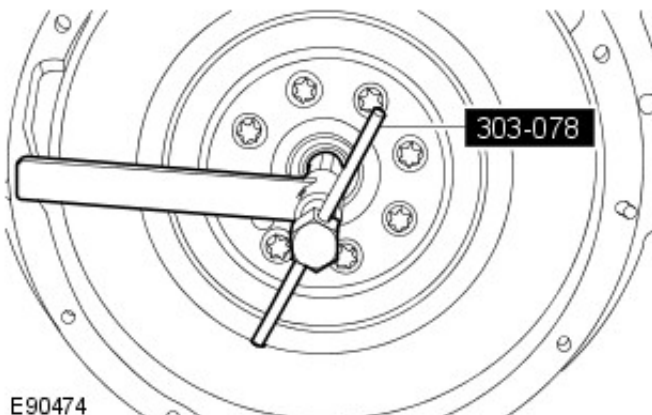
2. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
3. Remove the clutch disc and pressure plate.
For additional information, refer to: Clutch Disc and Pressure Plate (308-01, Removal and Installation).

4. Using a suitable tool, break through the pilot bearing.



E90473

5. Using the special tool, remove the pilot bearing.

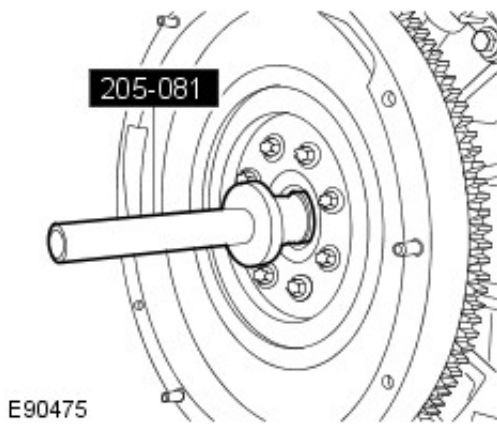


E90474

Installation

1. Using the special tool, install the pilot bearing.

1. Using the special tool, install the pilot bearing.



2. Install the clutch disc and pressure plate.
For additional information, refer to: Clutch Disc and Pressure Plate (308-01, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Clutch Controls - Vehicles With: MT82 6-Speed Manual Transmission -

Description	Nm	lb-ft
Clutch slave cylinder bolts	10	7
Clutch master cylinder to pedal box bolts	23	17
Clutch pedal box to bulkhead bolts	23	17
Clutch master cylinder push rod nuts	23	17

Clutch Controls - Vehicles With: MT82 6-Speed Manual Transmission -

Clutch Controls

Description and Operation

OVERVIEW

For additional information, refer to: Clutch - Vehicles With: 6-Speed Manual Transmission (MT82) (308-01, Description and Operation).

Clutch Controls - Vehicles With: MT82 6-Speed Manual Transmission - Clutch Master CylinderLHD

Removal and Installation

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

NOTE: Land Rover approved diagnostic equipment must be used to operate the Antilock Brake System (ABS) solenoid valves and the return pump to ensure correct bleeding of the Hydraulic Control Unit (HCU) and all the vehicle brake circuits.

1. All Vehicles.

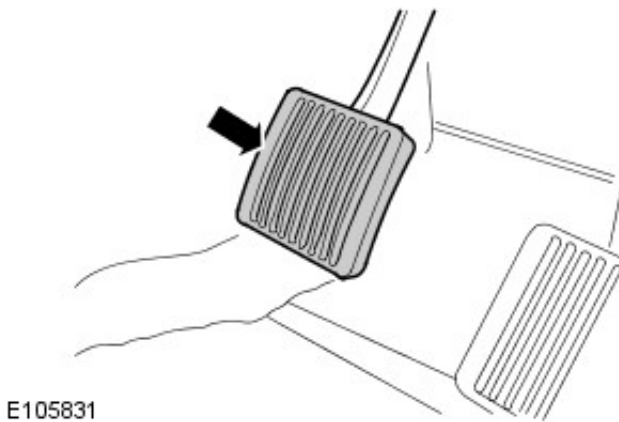
1. Remove the 2 stop lamp switches.

For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. Remove 3 screws securing closing panel to lower 'A' pillar.

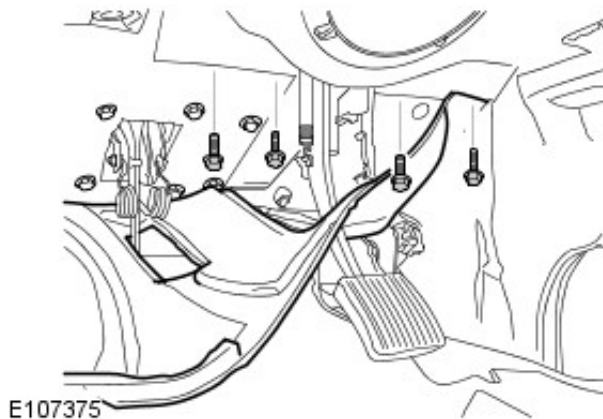


3. Remove clutch pedal rubber.



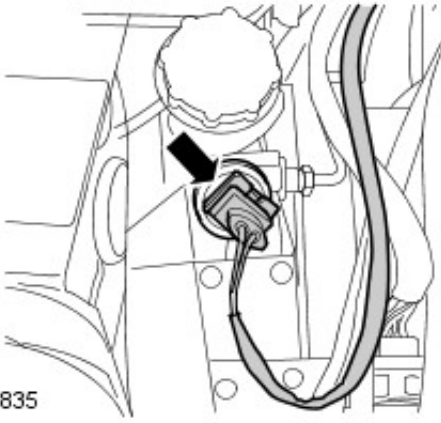
4. Release closing panel sufficient to gain access to clutch bracket bolts.

1. Remove 12 bolts securing clutch and brake pedal brackets to body.

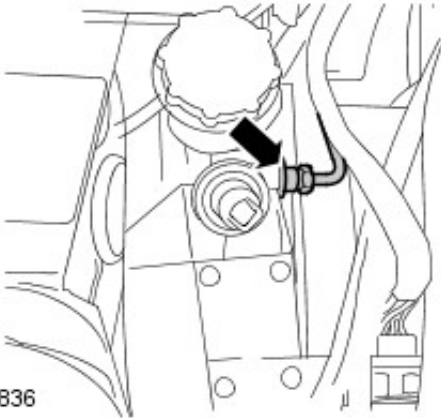



5. Disconnect multiplug clutch pedal sensor.

E105835



E105836




6.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.

CAUTIONS:

 Make sure that all openings are sealed. Use new blanking caps.

 Brake fluid will damage paint finished surfaces. If spilled, immediately remove fluid and clean area with water.

Loosen pipe union and release clutch master cylinder fluid pipe.

7.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.


CAUTIONS:

 Make sure that all openings are sealed. Use new blanking caps.

 Brake fluid will damage paint finished surfaces. If spilled, immediately remove fluid and clean area with water.

Vehicles With Anti-lock Brake System (ABS).

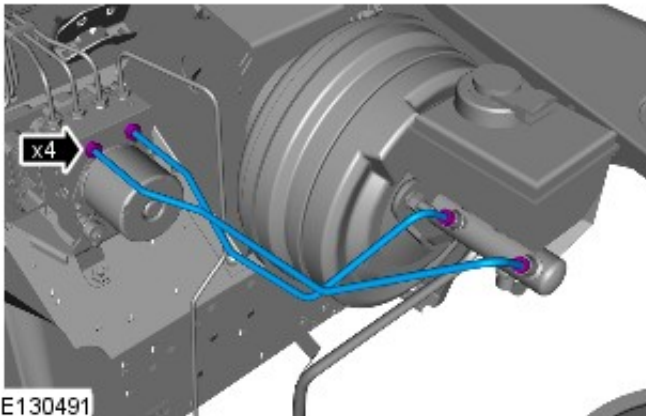
1. Remove the 2 brake pipes from the Brake Master Cylinder to the Hydraulic Control Unit (HCU).

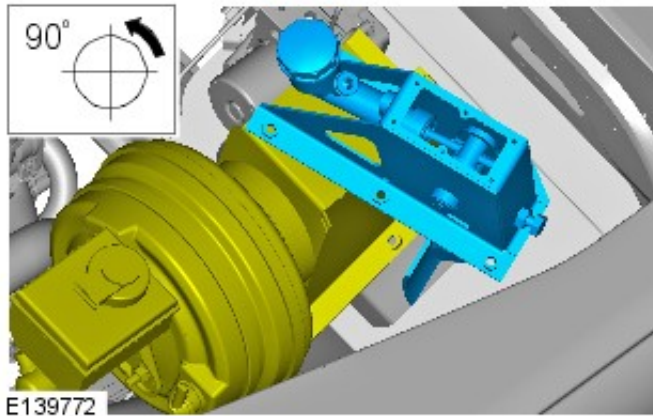
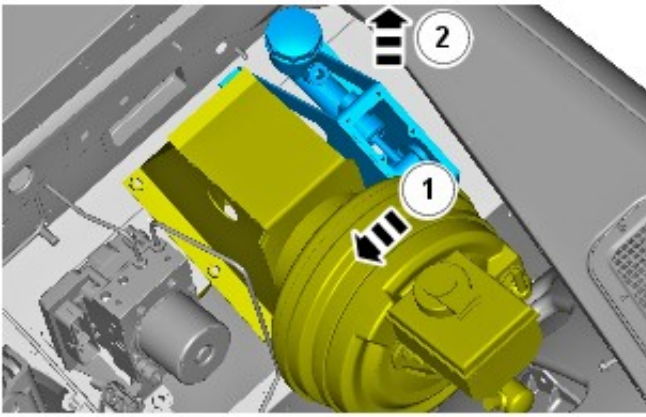
8.  **CAUTION:** Take extra care not to damage any surrounding components.

Remove the clutch pedal box and clutch master cylinder.

1. Carefully reposition the brake pedal box and master cylinder to aid removal.

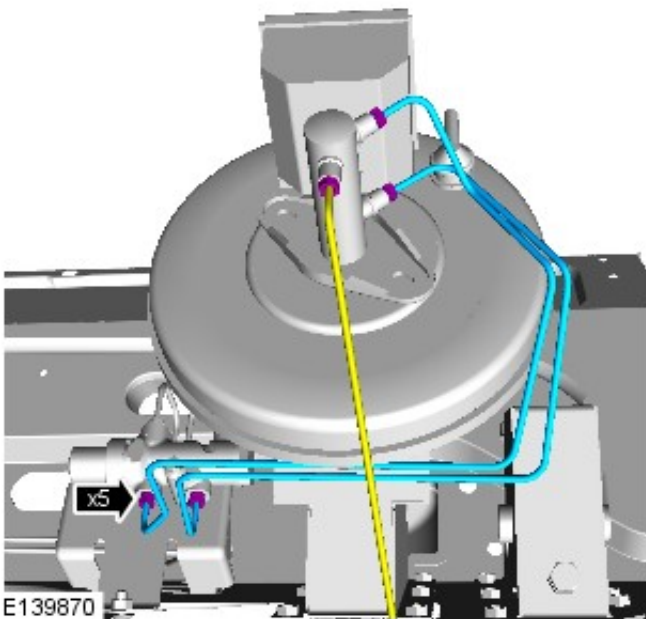
E130491






9. Vehicles With Brake Pressure Control Valve (BPCV).

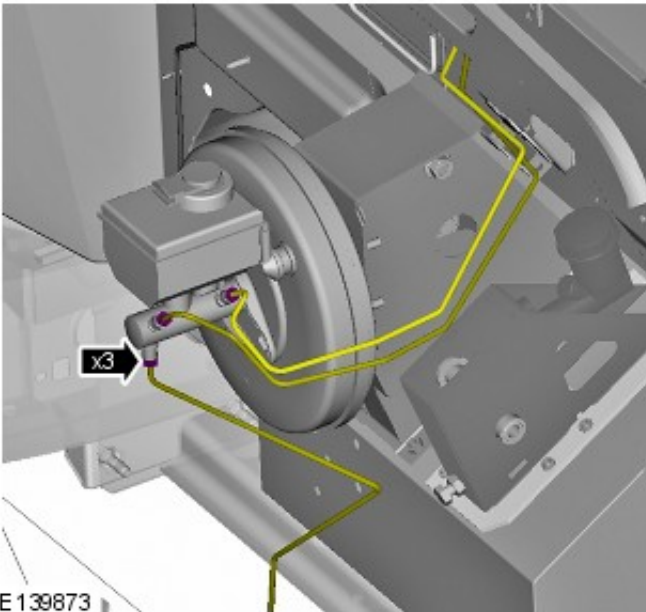
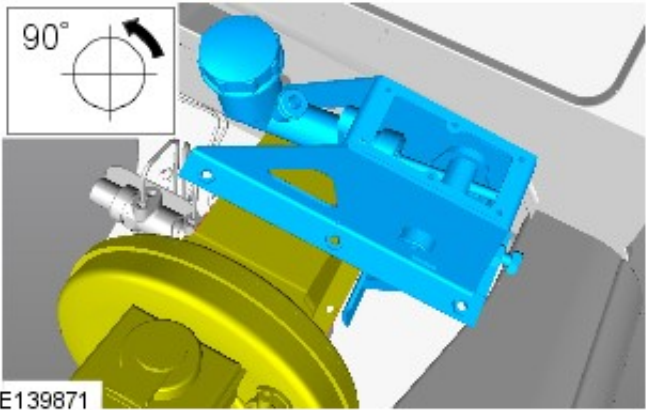
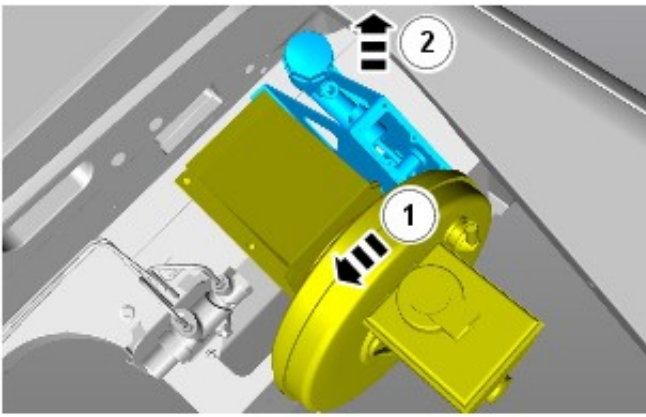
1. Remove the 2 brake pipes from the Brake Master Cylinder to the BPCV.
2. Release the front brake pipe from the Brake Master Cylinder.



10.  **CAUTION:** Take extra care not to damage any surrounding components.


Remove the clutch pedal box and clutch master cylinder.

1. Carefully reposition the brake pedal box and master cylinder to aid removal.



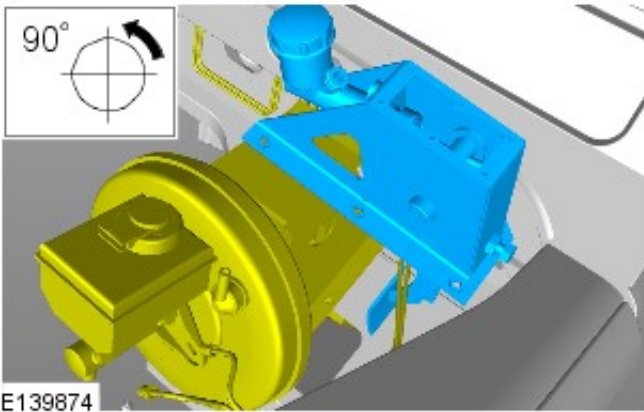
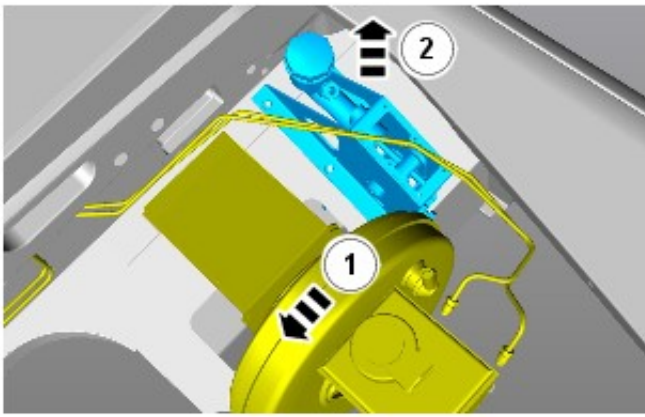
11. Vehicles With-Out ABS Or BPCV.

1. Release the 3 brake pipes from the Brake Master Cylinder.

12.  **CAUTION:** Take extra care not to damage any surrounding components.

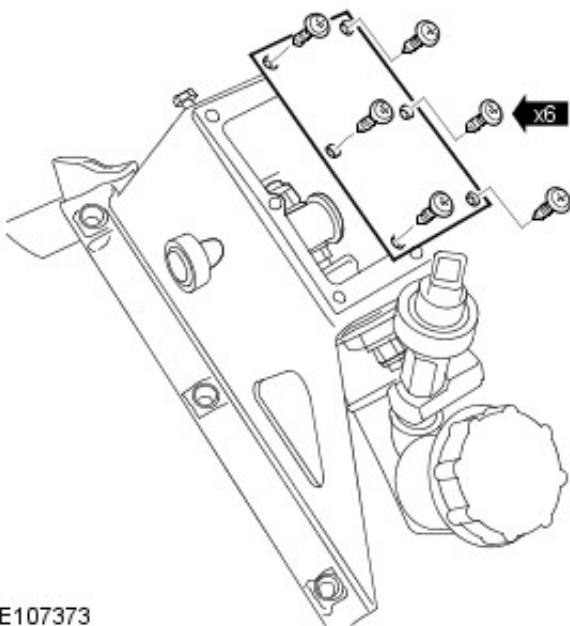
Remove the clutch pedal box and clutch master cylinder.

1. Carefully reposition the brake pedal box and master cylinder to aid removal.
2. Carefully reposition the brake pipes to aid removal.

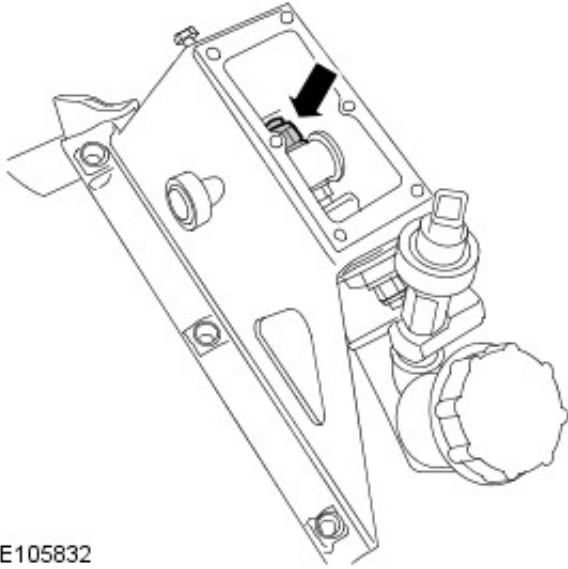


13. **All Vehicles.**

1. Remove the 6 screws, remove pedal box top cover and discard gasket.

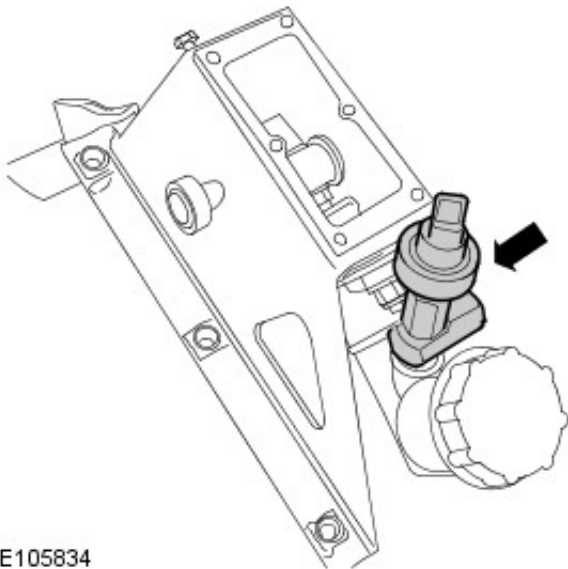


14. Remove nut securing push rod to clutch pedal trunnion.
 1. Move the clutch pedal to the fully down position.



E105832

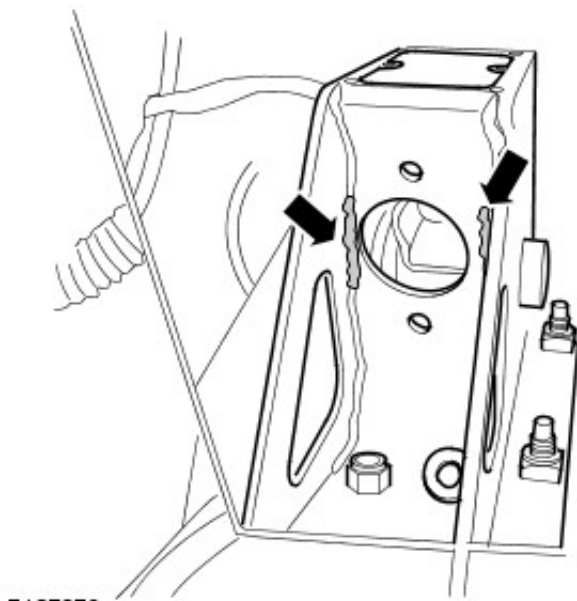
15. Remove clutch pedal sensor and pipe union from master cylinder and discard sealing washers.
 1. Remove 2 nuts and bolts, and remove clutch master cylinder from pedal bracket.



E105834

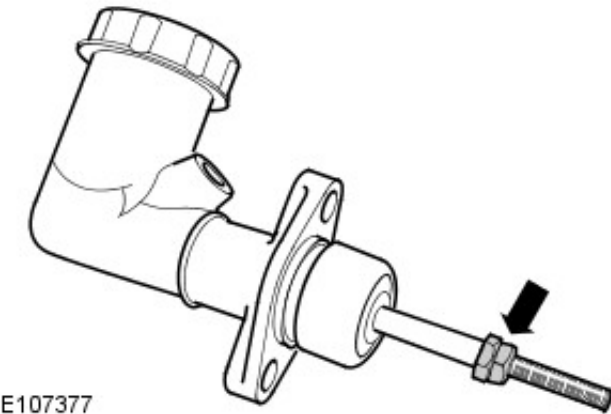
Installation

1. **All Vehicles.**
 1. Check seal on pedal box at points indicated and seal with RTV if necessary.



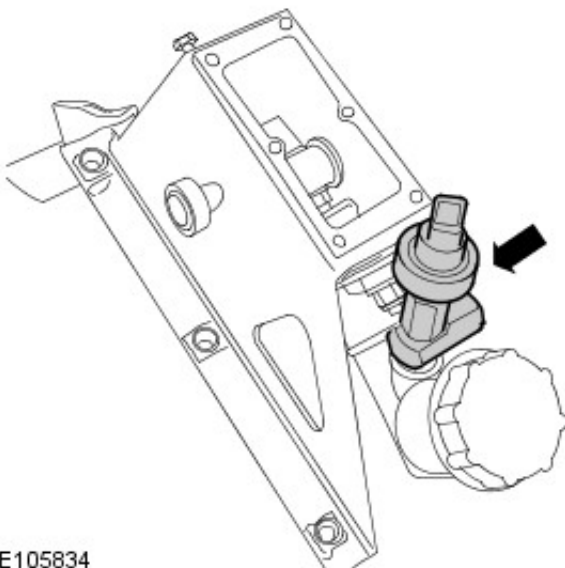
E107376

2. Install new lock nuts to master cylinder.




E107377

3. Clean sensor and pipe union.
 1. Install new gasket.
 2. Position master cylinder to pedal bracket and align push rod to pedal trunnion.
 3. Install the clutch master cylinder to the clutch pedal bracket and tighten the nuts and bolts to 23 Nm (17 lb.ft) .
 4. Install clutch pedal sensor and pipe union to master cylinder using new sealing washers and tighten to 15 Nm (11 lb.ft)

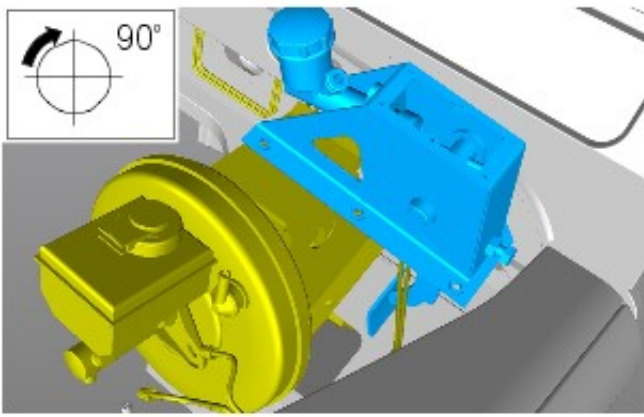


E105834

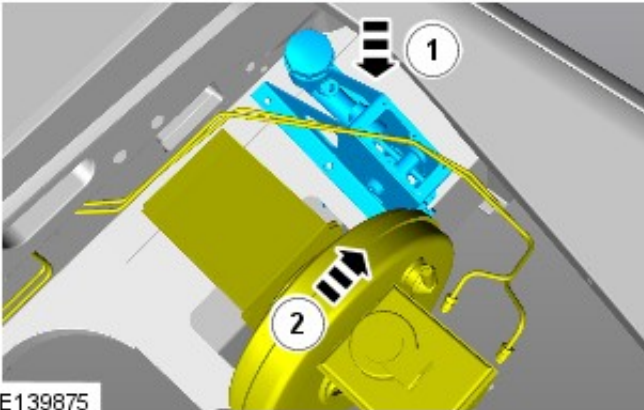
4.  **CAUTION:** Take extra care not to damage any surrounding components.

Vehicles With-Out ABS Or BPCV.

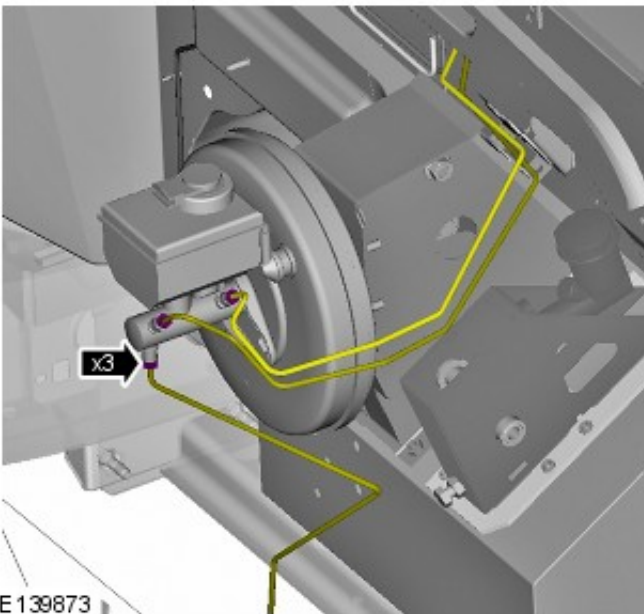
1. Install the clutch pedal box and clutch master cylinder.
2. Carefully reposition the brake pedal box and master cylinder to aid installation.




3. Carefully reposition the brake pipes to aid installation.



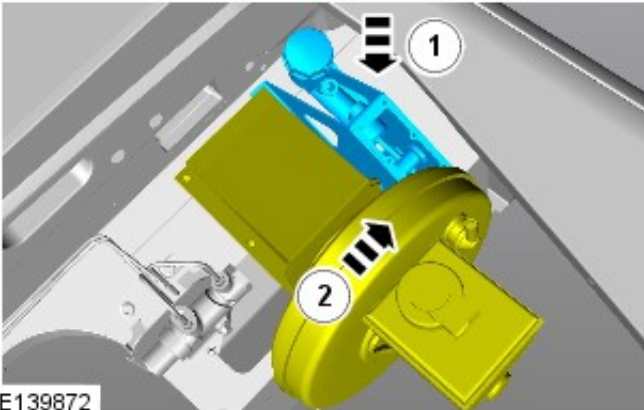
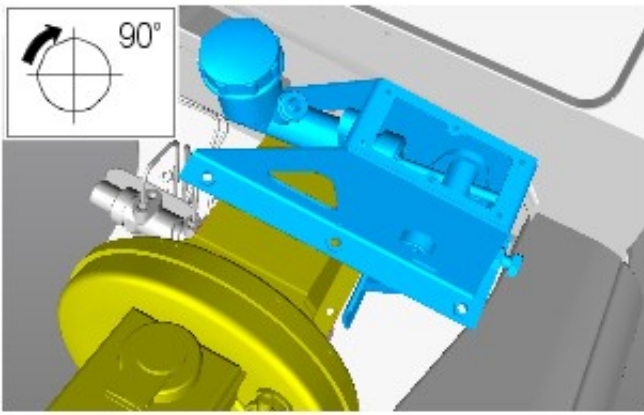
5. Secure the 3 brake pipes to the Brake Master Cylinder.
 1. Tighten the 3 brake pipe unions to 15 Nm (11 lb.ft)



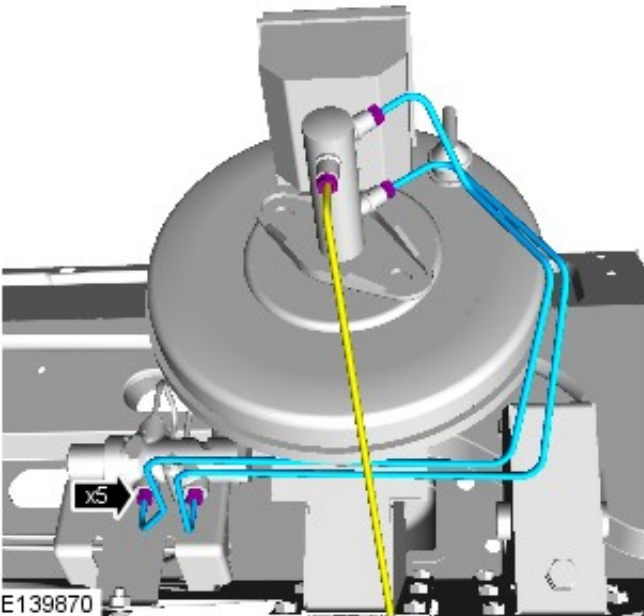
6.  **CAUTION:** Take extra care not to damage any surrounding components.

Vehicles With BPCV.

1. Install the clutch pedal box and clutch master cylinder.
2. Carefully reposition the brake pedal box and master cylinder to aid installation.




E139872



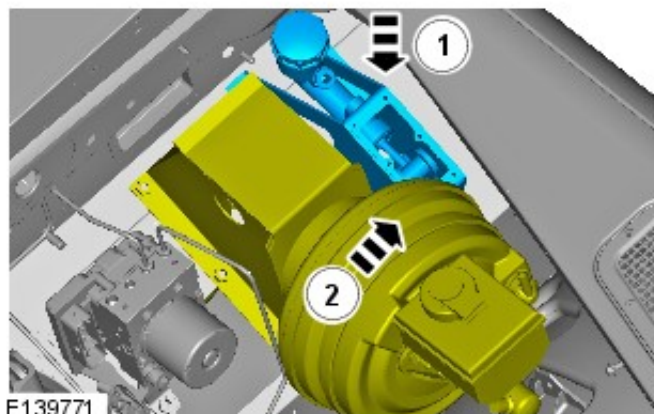
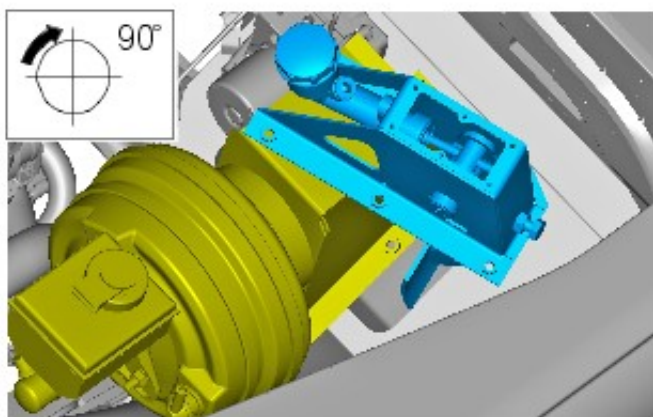
E139870

7. Install the 2 brake pipes from the Brake Master Cylinder to the BPCV.
 1. Tighten the 4 brake pipe unions to 15 Nm (11 lb.ft)
 2. Secure the front brake pipe to the Brake Master Cylinder and tighten the union to 15 Nm (11 lb.ft)
 - 2.

8.  **CAUTION:** Take extra care not to damage any surrounding components.

Vehicles With ABS.

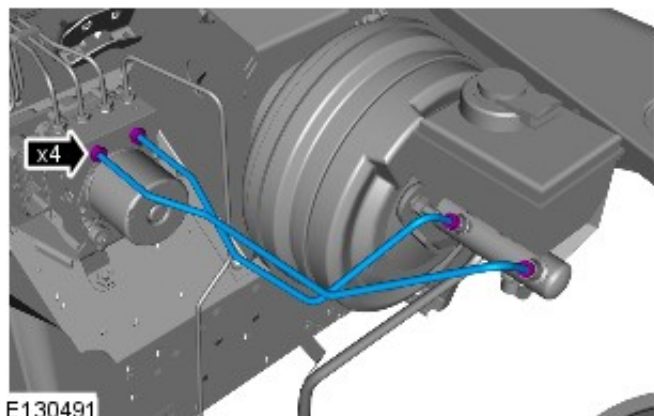
1. Install the clutch pedal box and clutch master cylinder.
2. Carefully reposition the brake pedal box and master cylinder to aid removal.



E139771

9. Install the brake pipes from the Brake Master Cylinder to the Hydraulic Control Unit (HCU).

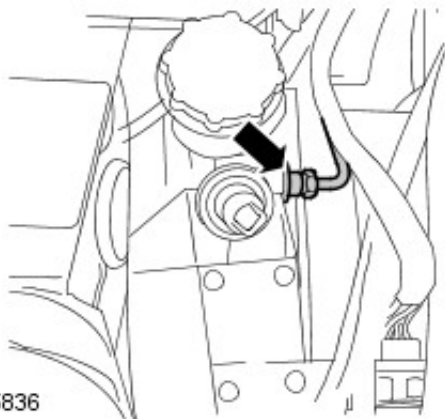
1. Tighten the 4 brake pipe unions to 15 Nm (11 lb.ft)



E130491

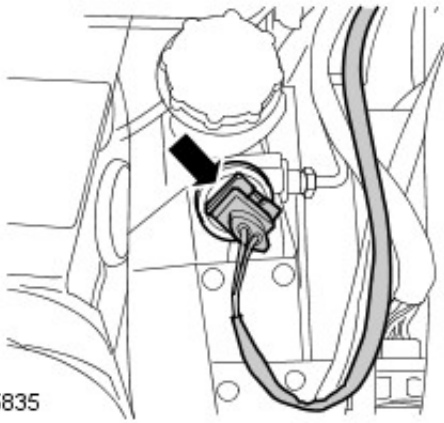
10. **All Vehicles.**

1. Install clutch master cylinder fluid pipe.
2. Clean clutch pipe union.
3. Align pipe and tighten union to 15 Nm (11 lb.ft) .

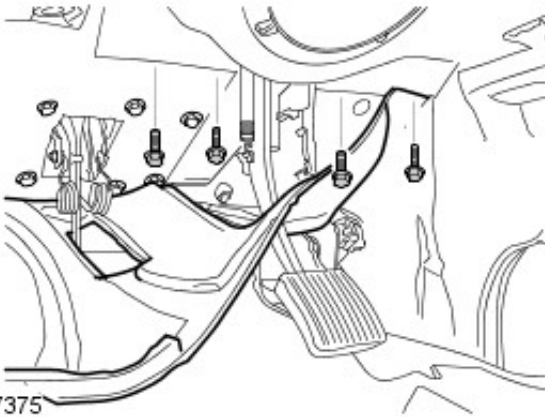


E105836

11. Connect multiplug to clutch pedal sensor.



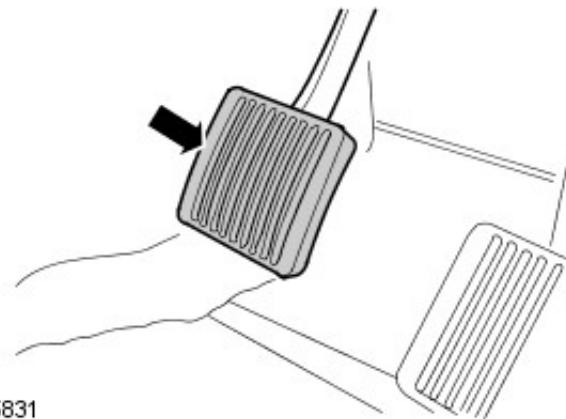
E105835



E107375

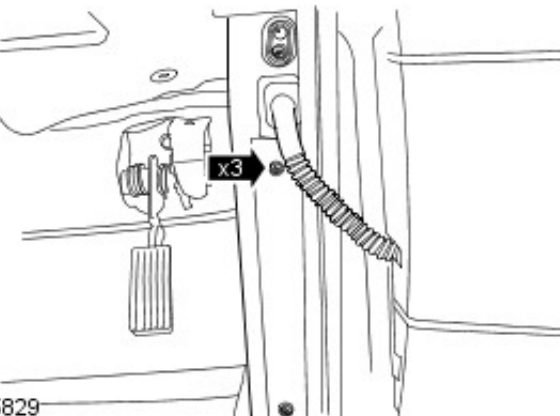
12. Install the 12 bolts securing clutch pedal bracket to body.

1. Tighten the bolts to 23 Nm (17 lb.ft)



E105831

13. Install clutch pedal rubber.

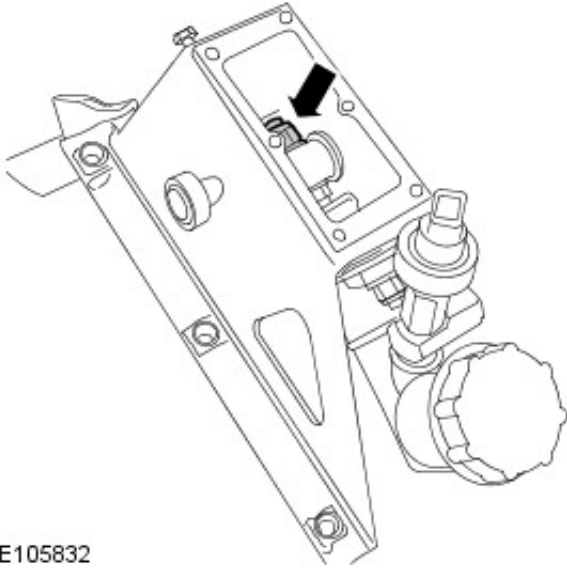


E105829

14. Position closing panel and tighten screws to lower 'A' pillar.

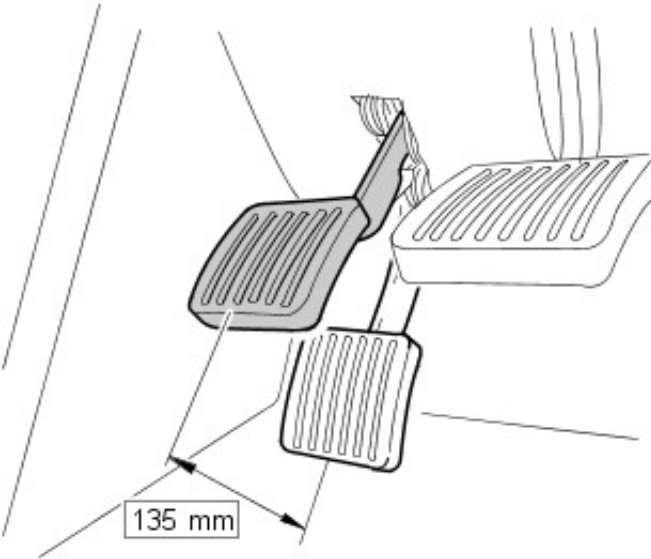
15. Install the 2 stoplamp switches.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

16. Install and lightly tighten nut securing push rod to clutch pedal trunnion.



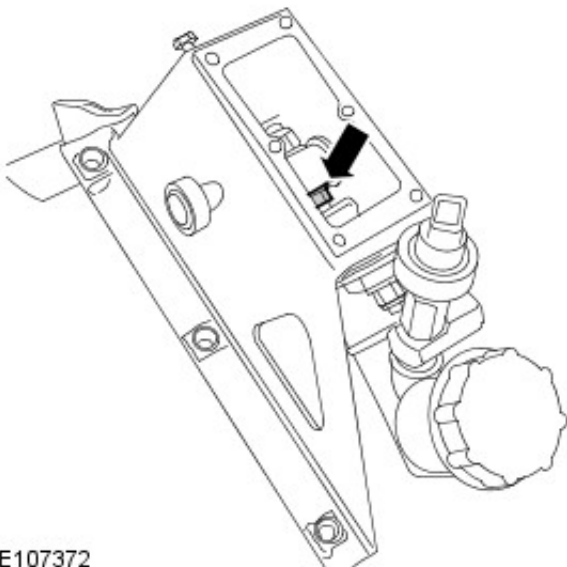
E105832

17. Check distance from lower edge of clutch pedal to down position. Correct measurement is 135 mm (5.31 in).



E107371

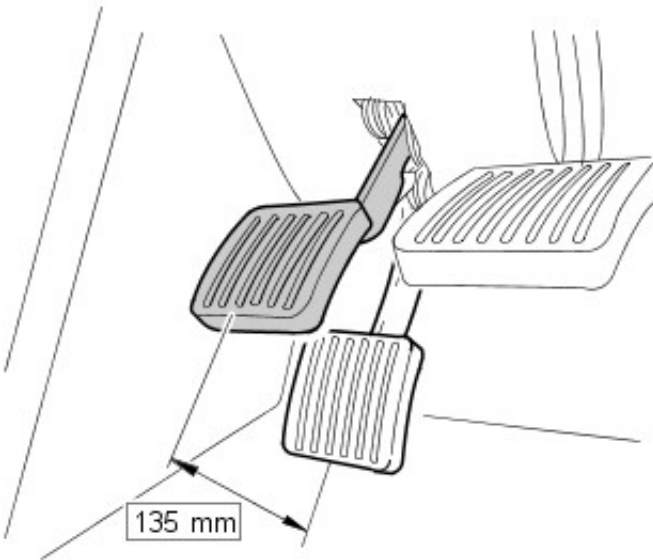
18. Adjust master cylinder push rod lock nuts until 135mm (5.31 in) is achieved.
 1. Tighten lock nuts to 23 Nm (17 lb.ft).
 2. Move the clutch pedal to the fully down position.
 3. Tighten nylon nut securing push rod to clutch pedal trunnion to 23 Nm (17 lb.ft) .



E107372

19. Check pedal travel is to correct measurement.

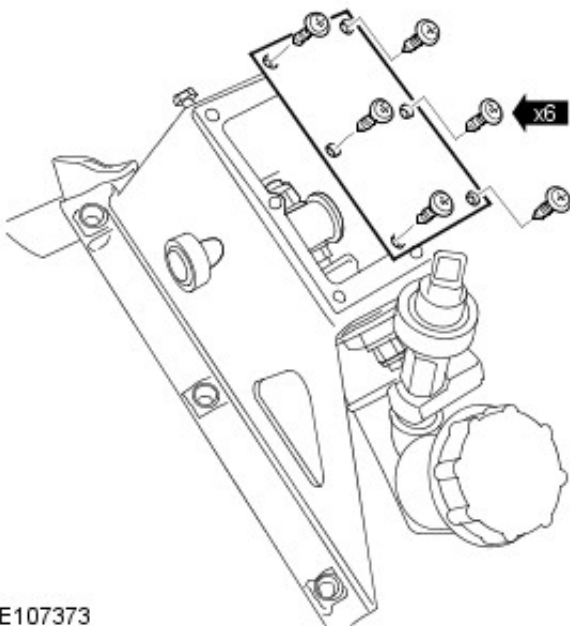
19. Check pedal travel is to correct measurement.



E107371

20. Install a new gasket to cover plate and secure with the 6 screws.

1. Tighten the screws to 3 Nm (2 lb.ft).



E107373

21. Bleed the clutch hydraulic system.

For additional information, refer to: Clutch System Bleeding (308-00 Manual Transmission/Transaxle and Clutch - General Information - Vehicles With: MT82 6-Speed Manual Transmission, General Procedures).

22. Using the Land Rover approved diagnostic equipment, bleed the complete brake system.

For additional information, refer to: [Brake System Bleeding](#) (206-00 Brake System - General Information, General Procedures).

Clutch Controls - Vehicles With: MT82 6-Speed Manual Transmission - Clutch Master CylinderRHD

Removal and Installation

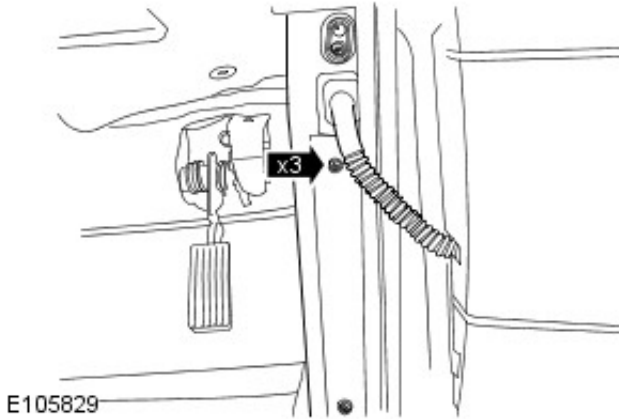
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

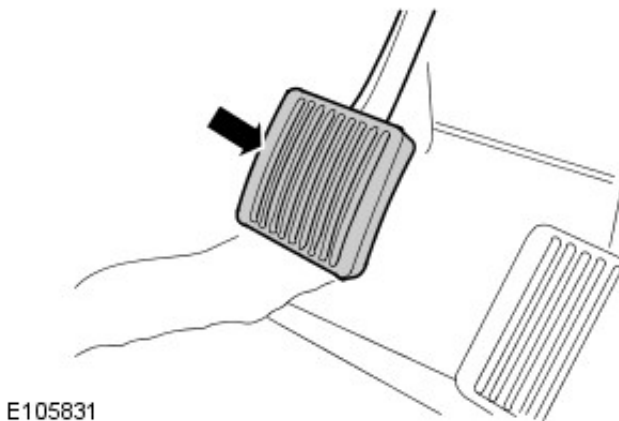
1. All Vehicles.

1. Remove the 2 stop lamp switches.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. Remove 3 screws securing closing panel to lower 'A' pillar.

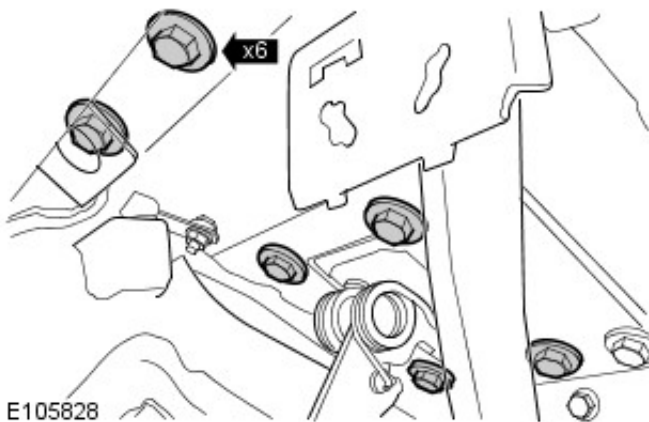



3. Remove clutch pedal rubber.



4. Release closing panel sufficient to gain access to clutch bracket bolts.

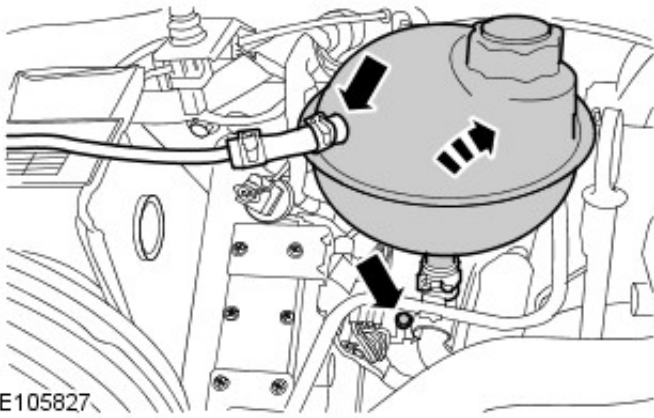
1. Remove 6 bolts securing clutch pedal bracket to body.



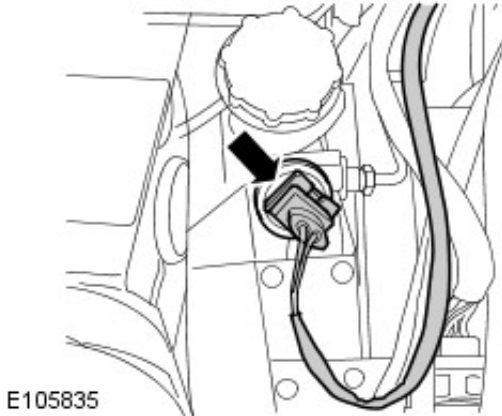
5.  **WARNING:** A small amount of fluid loss in unavoidable, position an absorbant cloth or container to collect it.


Disconnect the expansion tank return hose and plug connections.

1. Remove bolt and tie aside expansion tank.



6. Disconnect multiplug clutch pedal sensor.



7.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.

CAUTIONS:



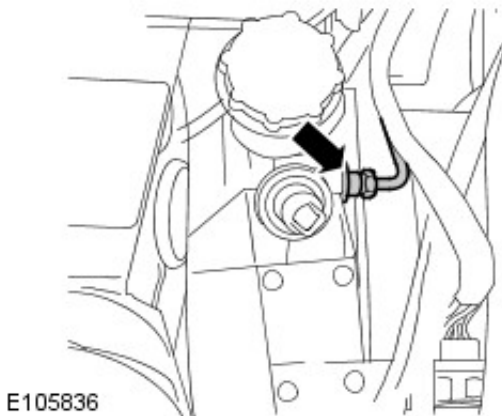
Make sure that all openings are sealed. Use new blanking caps.

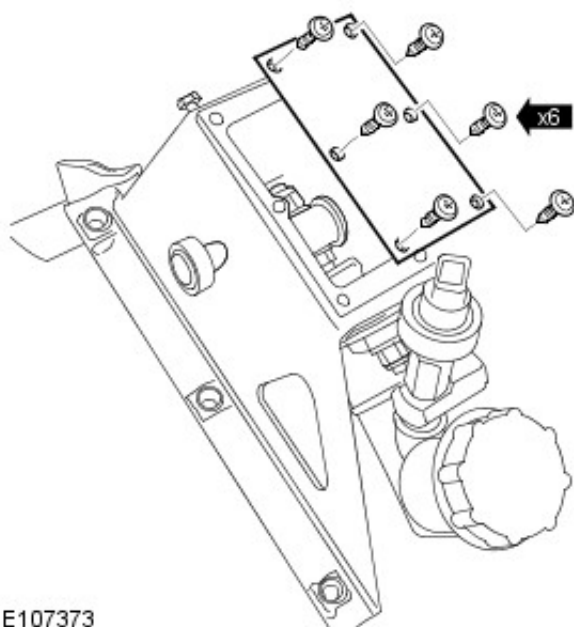


Brake fluid will damage paint finished surfaces. If spilled, immediately remove fluid and clean area with water.

Loosen pipe union and release clutch master cylinder fluid pipe.

8. Remove the 6 screws, remove pedal box top cover and discard gasket.

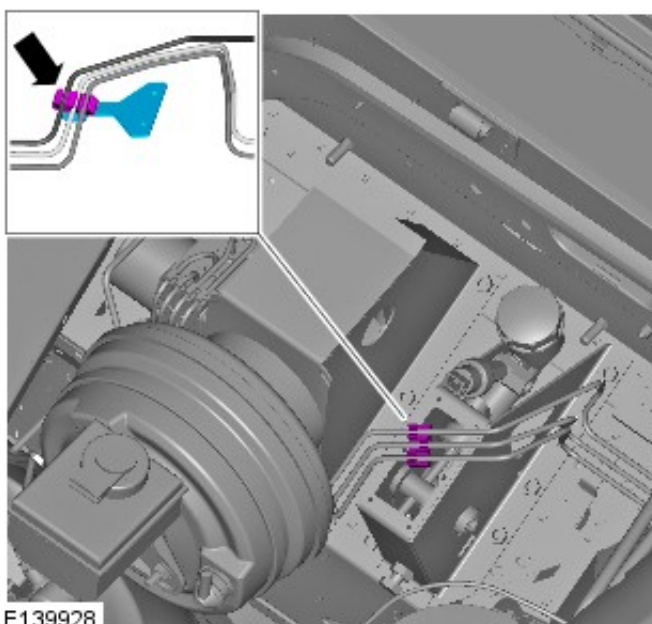





E107373

9. Vehicles With Anti-lock Brake System (ABS).

1. Remove the brake pipe retaining clip and bracket.

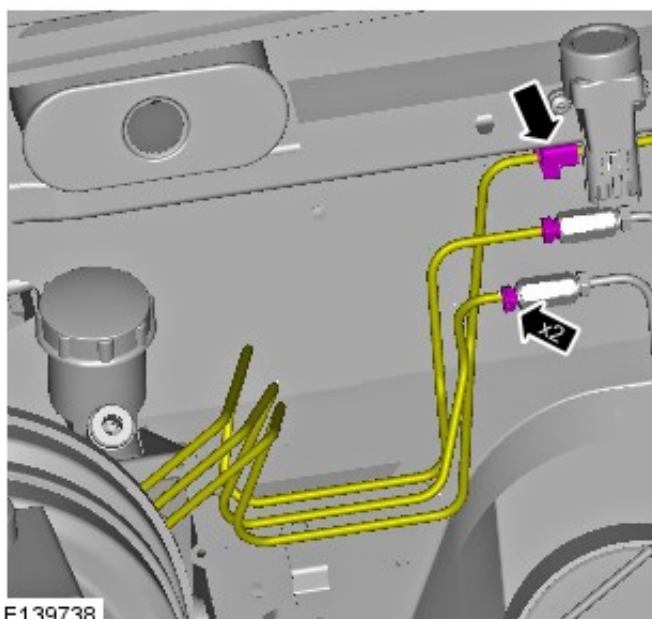


E139928

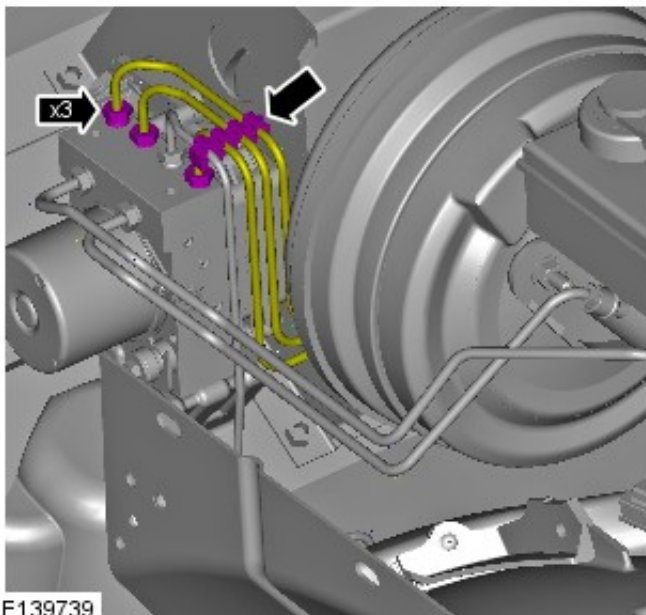
10.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.


Release the 3 brake pipes.

1. Loosen the 2 brake pipe unions at intermediate joints and release the pipes.
2. Release brake pipe from the panel clip.



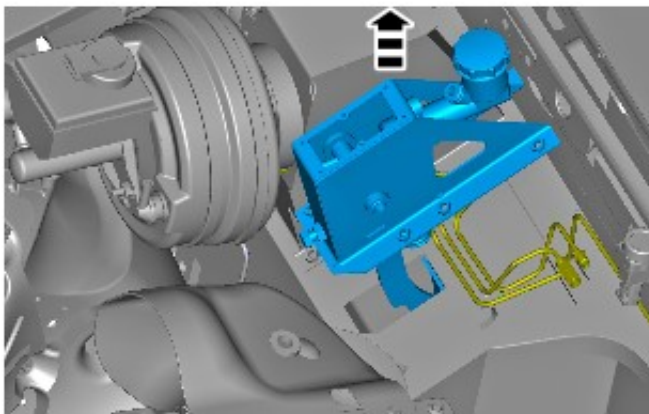
E139738




11.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.

Release the 3 brake pipes at the Hydraulic Control Unit (HCU).

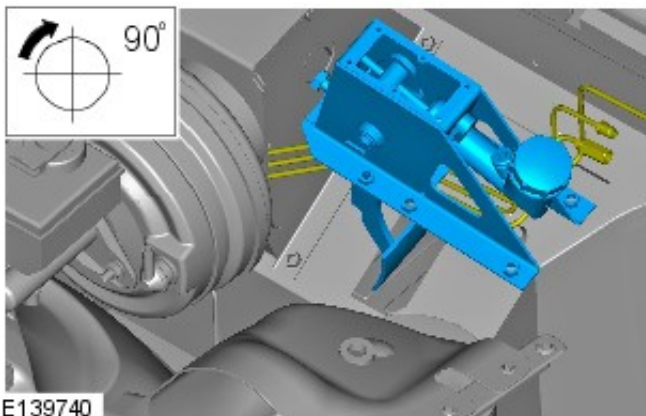
1. Loosen the 3 brake pipe unions at HCU and release the pipes.
2. Release brake pipes from the securing clip.




12.  **CAUTION:** Take extra care not to damage any surrounding components.


Remove the clutch pedal box and clutch master cylinder.


1. Carefully reposition the brake pipes to aid removal.



13.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.

CAUTIONS:

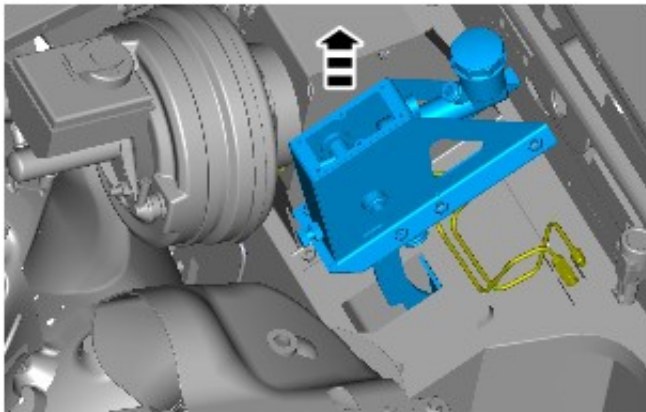
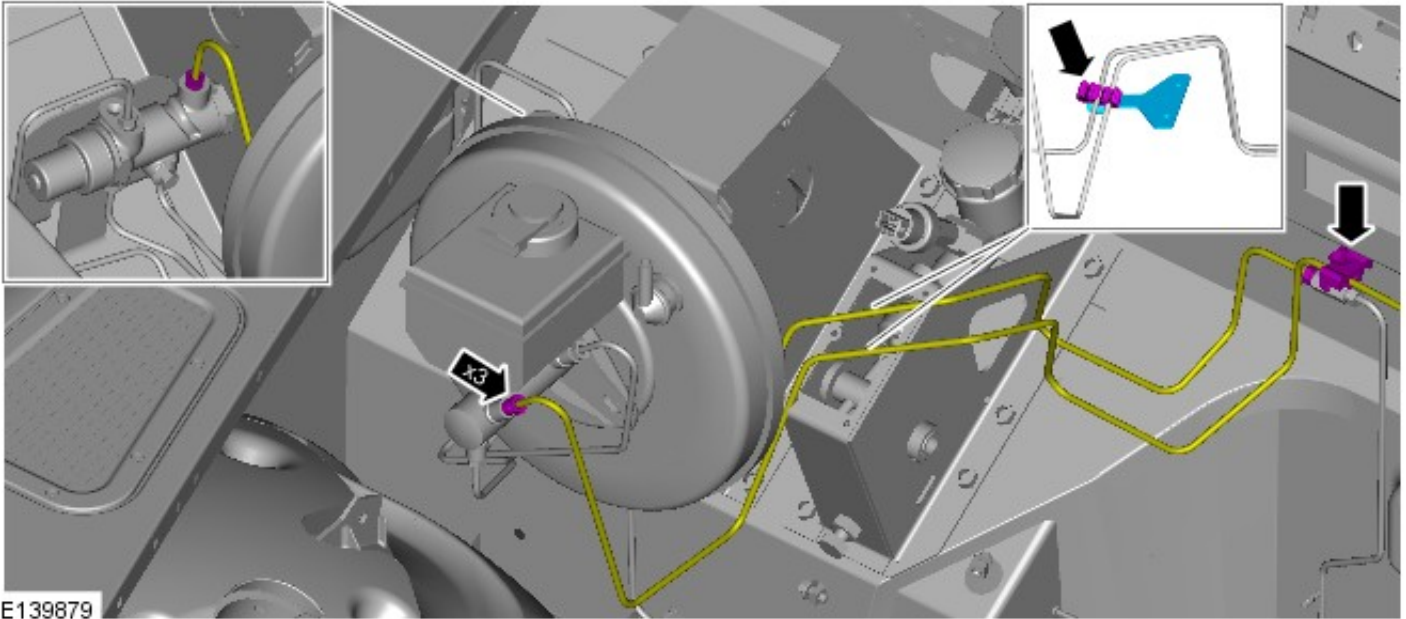
 Make sure that all openings are sealed. Use new blanking caps.


 Brake fluid will damage paint finished surfaces. If spilled, immediately remove fluid and clean area with water.

Vehicles With Brake Pressure Control valve (BPCV).

1. Release the brake pipes from the Brake Master Cylinder and the BPCV.

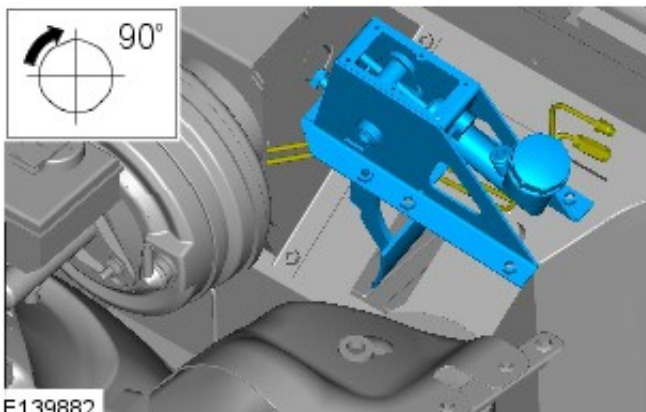
2. Loosen the brake pipe union at intermediate joint and release the pipes.
3. Release brake pipe from the panel clip.
4. Remove the brake pipe retaining clip and bracket.




14.  **CAUTION:** Take extra care not to damage any surrounding components.

Remove the clutch pedal box and clutch master cylinder.

1. Carefully reposition the brake pipes to aid removal.



15.  **WARNING:** A small amount of fluid loss is unavoidable, position an absorbant cloth or container to collect it.

CAUTIONS:

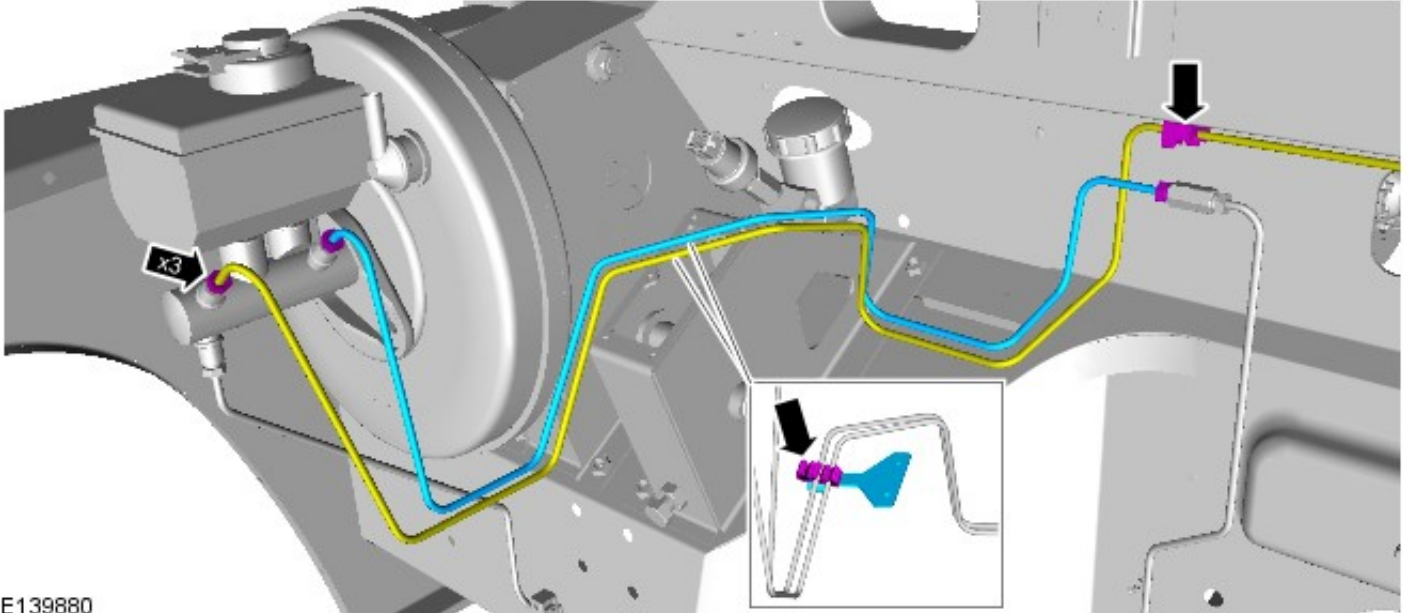
-  Make sure that all openings are sealed. Use new blanking caps.



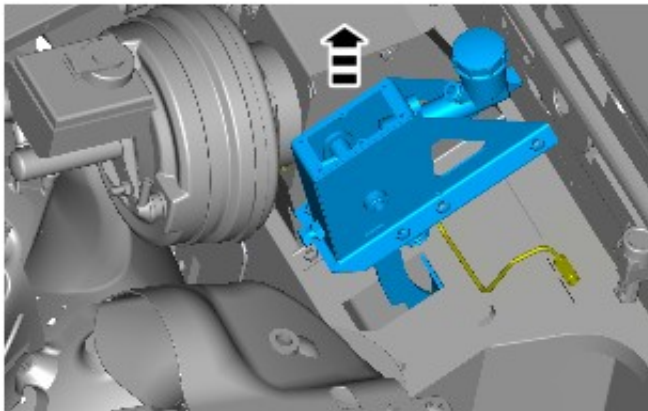
Brake fluid will damage paint finished surfaces. If spilled, immediately remove fluid and clean area with water.


Vehicles With-Out ABS Or BPCV.

1. Release the 2 brake pipes from the Brake Master Cylinder
2. Loosen the brake pipe union at intermediate joint and remove the pipe.
3. Release brake pipe from the panel clip.
4. Remove the brake pipe retaining clip and bracket.



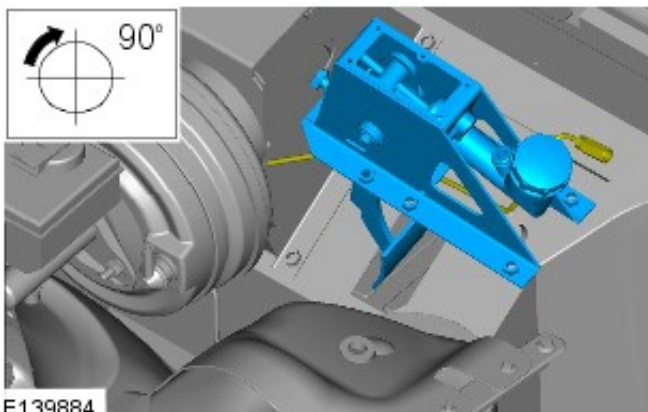
E139880



16.  **CAUTION:** Take extra care not to damage any surrounding components.

Remove the clutch pedal box and clutch master cylinder.

1. Carefully reposition the brake pipe to aid removal.

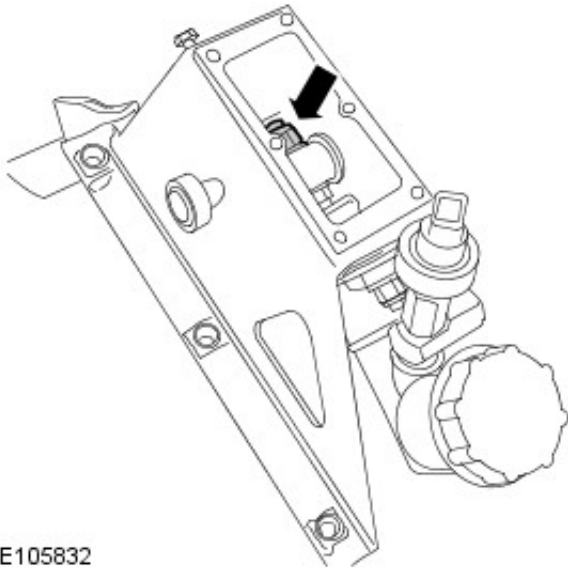


E139884

17. **All Vehicles.**

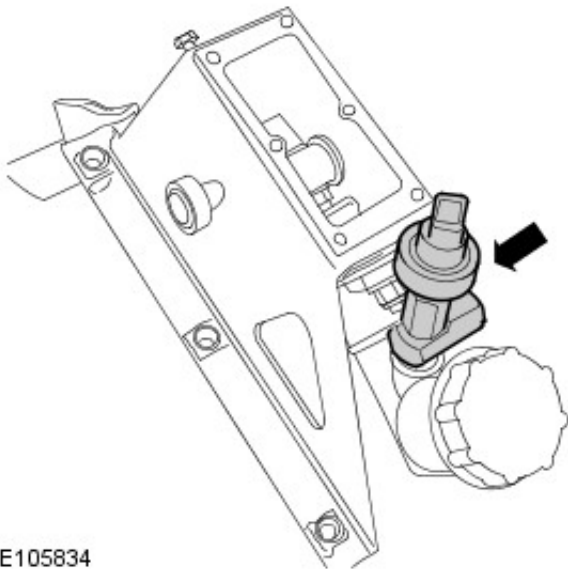
1. Move the clutch pedal to the fully down position.
2. Remove nut securing push rod to clutch pedal

trunnion.



E105832

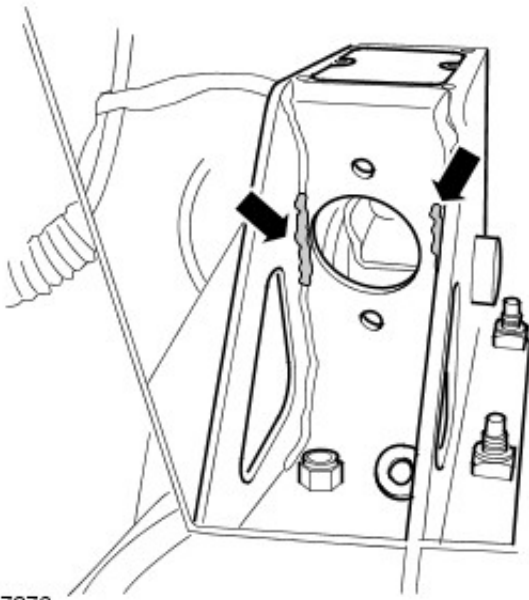
18. Remove clutch pedal sensor and pipe union from master cylinder and discard sealing washers.
 1. Remove 2 nuts and bolts, and remove clutch master cylinder from pedal bracket.



E105834

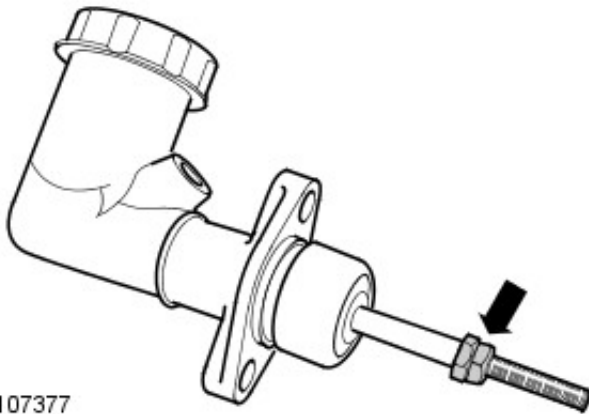
Installation

1. **All Vehicles.**
 1. Check seal on pedal box at points indicated and seal with RTV if necessary.



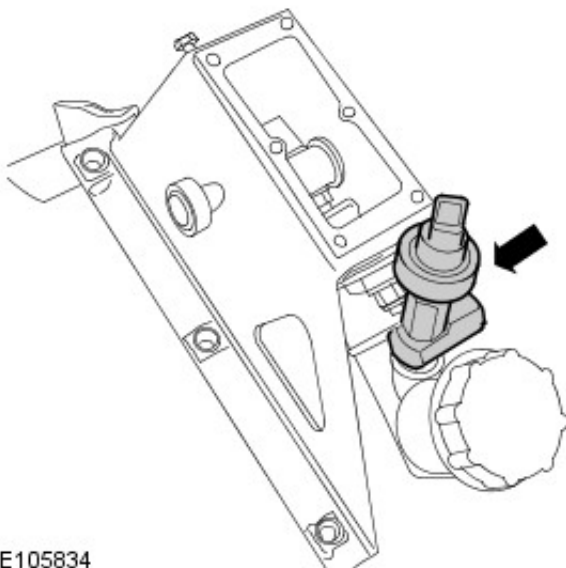
E107376

2. Install new lock nuts to master cylinder.




E107377

3. Clean sensor and pipe union.
 1. Install new gasket.
 2. Position master cylinder to pedal bracket and align push rod to pedal trunnion.
 3. Install the clutch master cylinder to the clutch pedal bracket and tighten the nuts and bolts to 23 Nm (17 lb.ft) .
 4. Install clutch pedal sensor and pipe to master cylinder using new sealing washers and tighten to 15 Nm (11 lb.ft)

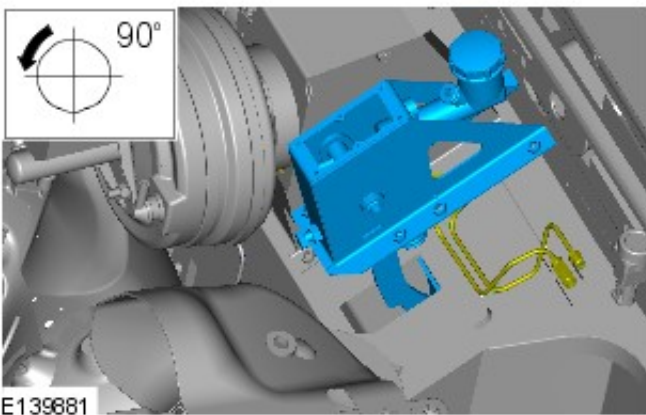
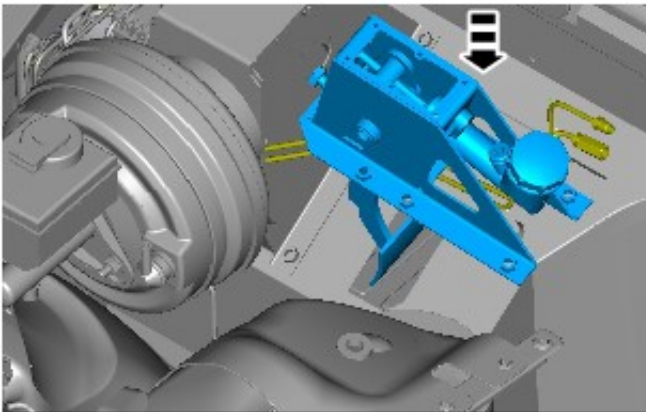
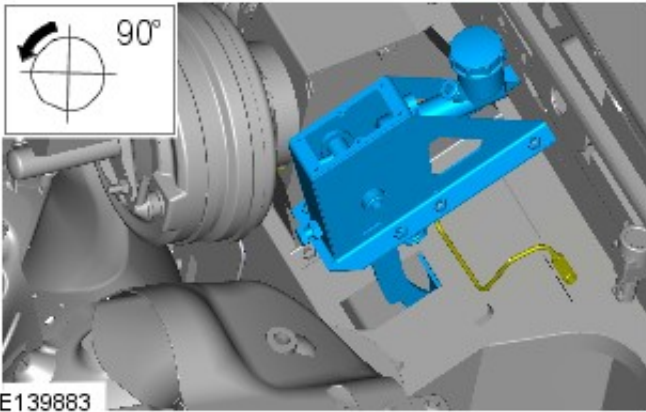
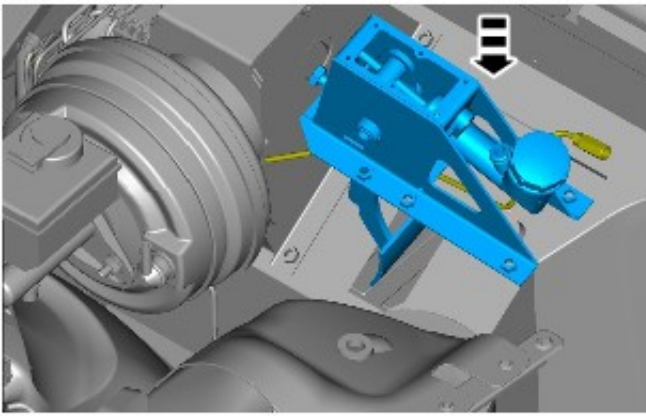



E105834

4.  **CAUTION:** Take extra care not to damage any surrounding components.

Vehicles With-Out ABS Or BPCV.


1. Install the clutch pedal box and clutch master cylinder.
2. Carefully reposition the brake pipe to aid installation..



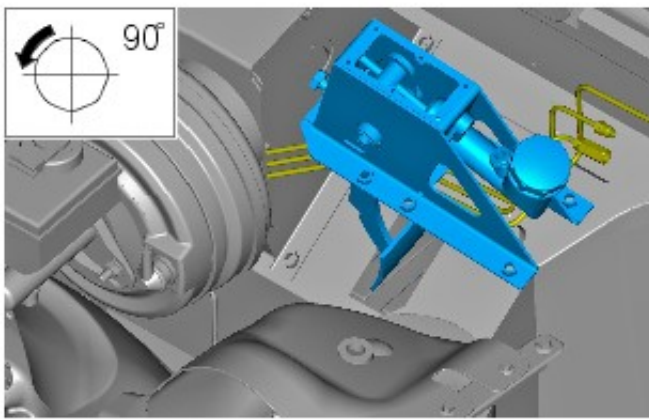
5.  **CAUTION:** Take extra care not to damage any surrounding components.

Vehicles With BPCV.

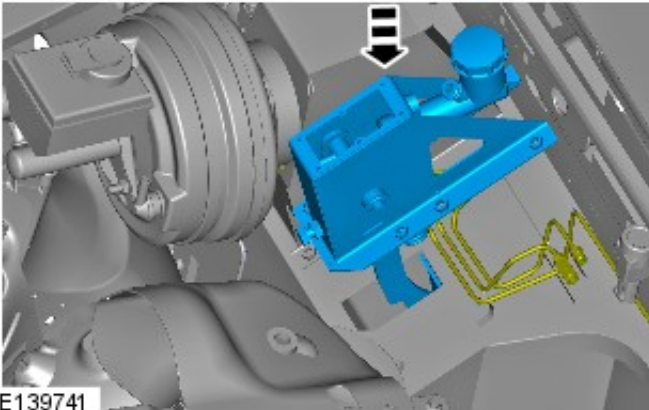
1. Install the clutch pedal box and clutch master cylinder.
2. Carefully reposition the brake pipes to aid installation..

6.  **CAUTION:** Take extra care not to damage any surrounding components.

Vehicles With ABS.



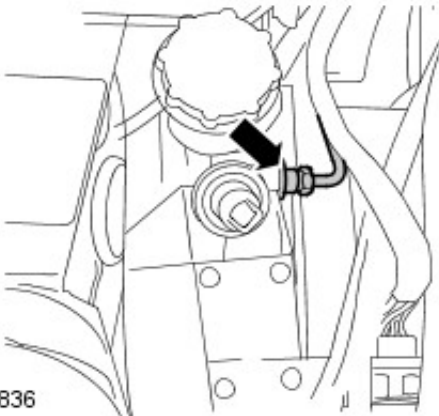
1. Install the clutch pedal box and clutch master cylinder.
2. Carefully reposition the brake pipes to aid installation..



E139741

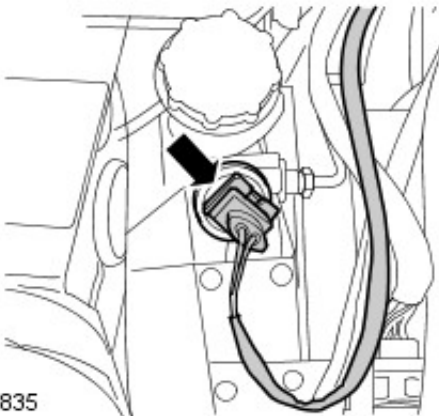
7. All Vehicles.

1. Install clutch master cylinder fluid pipe.
2. Clean clutch pipe union.
3. Align pipe and tighten union to 15 Nm (11 lb.ft) .



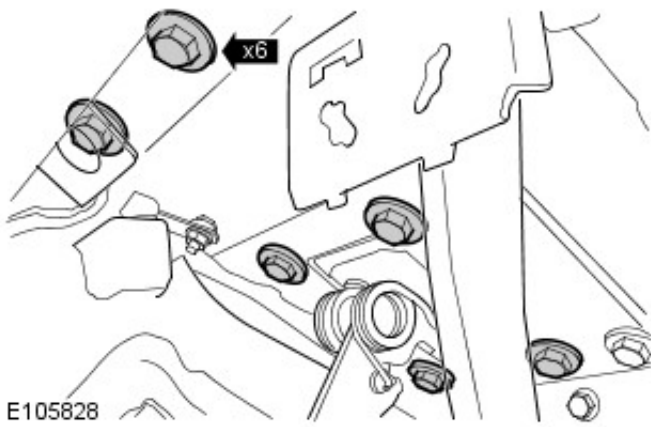
E105836

8. Connect multiplug to clutch pedal sensor.

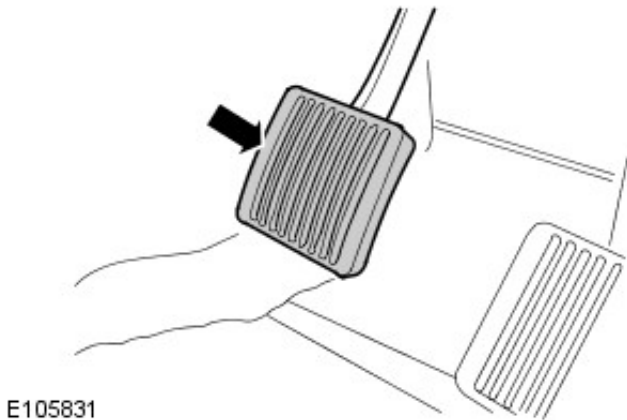


E105835

9. Install the 6 bolts securing clutch pedal bracket to body.
 1. Tighten the bolts to 23 Nm (17 lb.ft)



10. Install clutch pedal rubber.

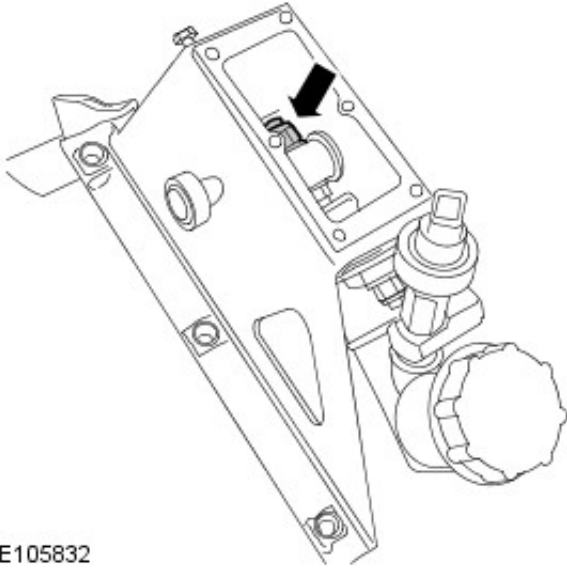


11. Position closing panel and tighten screws to lower 'A' pillar.



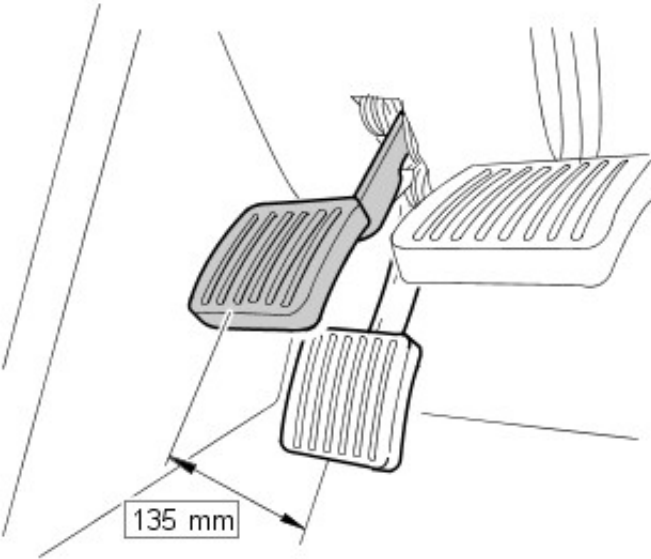
12. Install the 2 stoplamp switches.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

13. Install and lightly tighten nut securing push rod to clutch pedal trunnion.



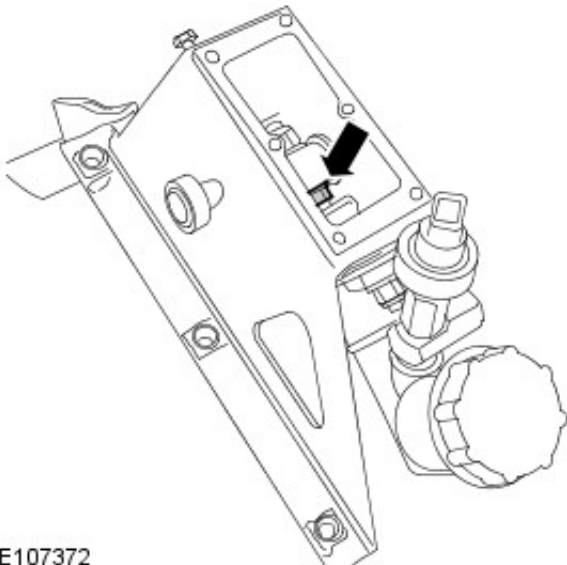
E105832

14. Check distance from lower edge of clutch pedal to down position. Correct measurement is 135 mm (5.31 in).



E107371

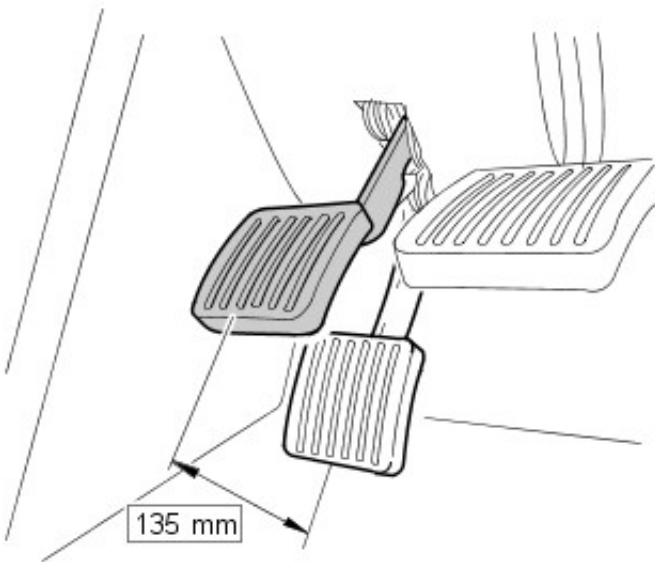
15. Adjust master cylinder push rod lock nuts until 135mm (5.31 in) is achieved.
 1. Tighten lock nuts to 23 Nm (17 lb.ft).
 2. Move the clutch pedal to the fully down position.
 3. Tighten nylon nut securing push rod to clutch pedal trunnion to 23 Nm (17 lb.ft) .



E107372

16. Check pedal travel is to correct measurement.

20. Check pedal travel to correct measurement.

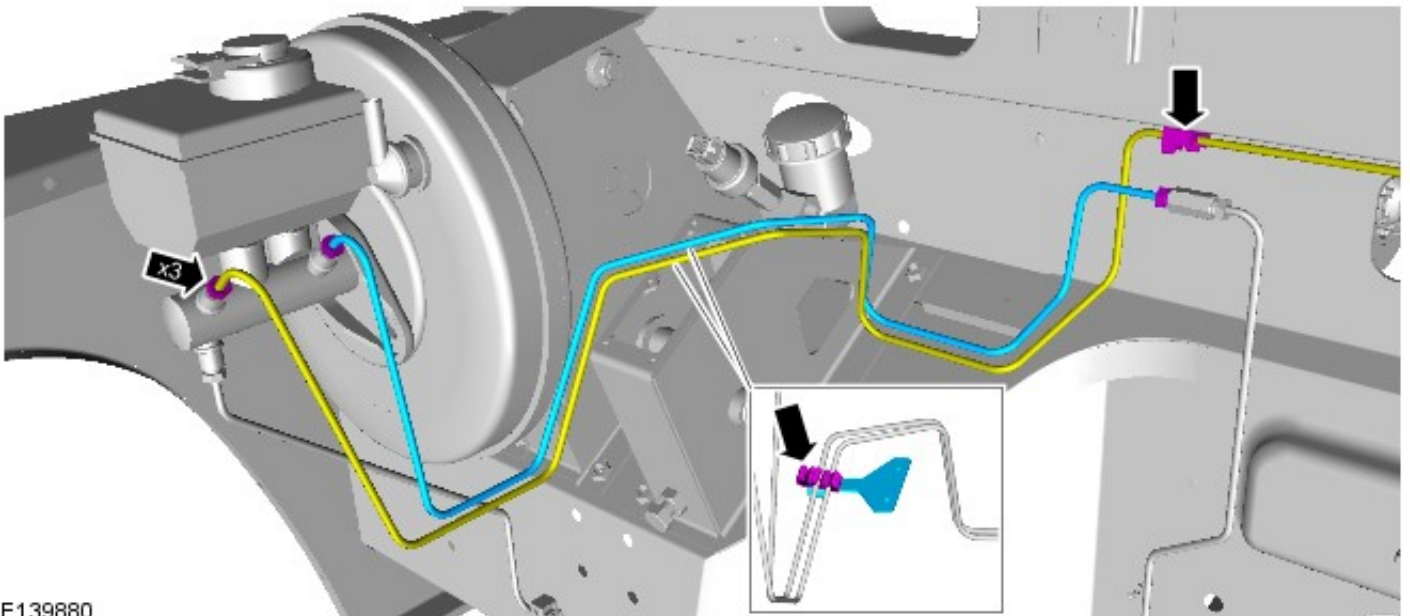


E107371

17. Bleed the clutch hydraulic system.
For additional information, refer to: Clutch System Bleeding (308-00 Manual Transmission/Transaxle and Clutch - General Information - Vehicles With: MT82 6-Speed Manual Transmission, General Procedures).

18. Vehicles With-Out ABS Or BPCV.

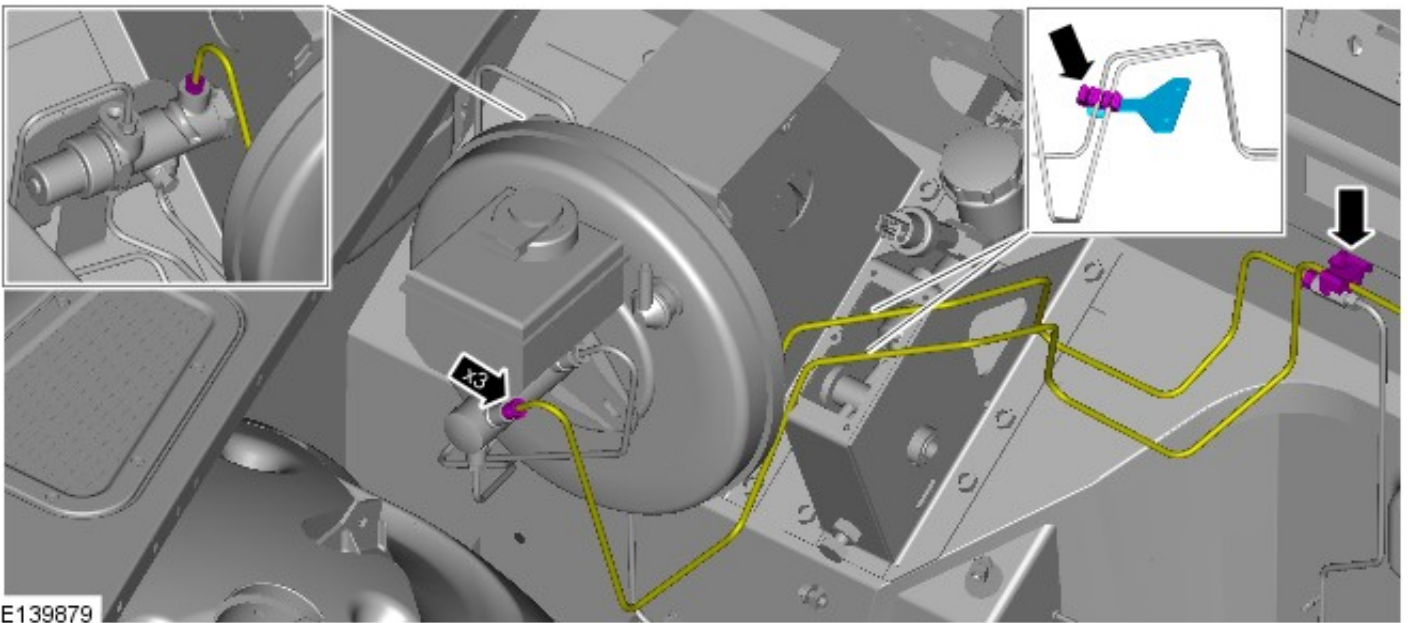
1. Install the 2 brake pipes to the Brake Master Cylinder and tighten the 2 brake pipe unions to 15 Nm (11 lb.ft)
2. Install the brake pipe union at intermediate joint and tighten to 15 Nm (11 lb.ft).
3. Secure brake pipe to the panel clip.
4. Install the brake pipe retaining clip and bracket.



E139880

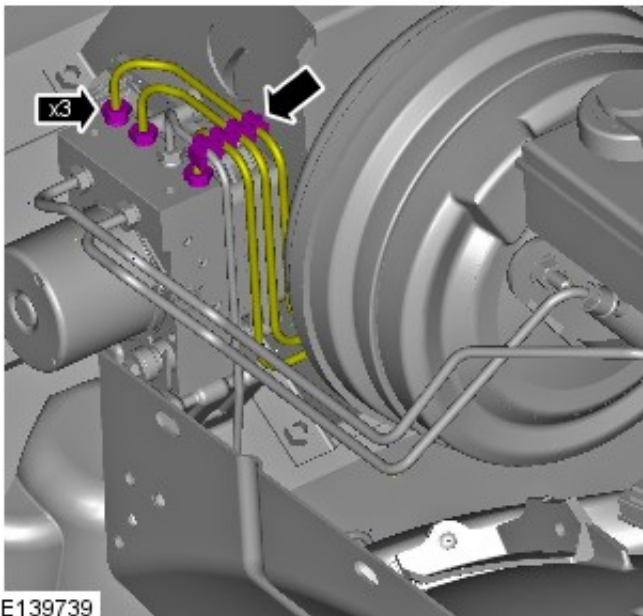
19. Vehicles With BPCV.

1. Install the brake pipes at the Brake Master Cylinder and the BPCV and tighten the 2 brake pipe unions to 15 Nm (11 lb.ft)
2. Install the brake pipe union at intermediate joint and tighten to 15 Nm (11 lb.ft).
3. Secure brake pipe to the panel clip.
4. Install the brake pipe retaining clip and bracket.



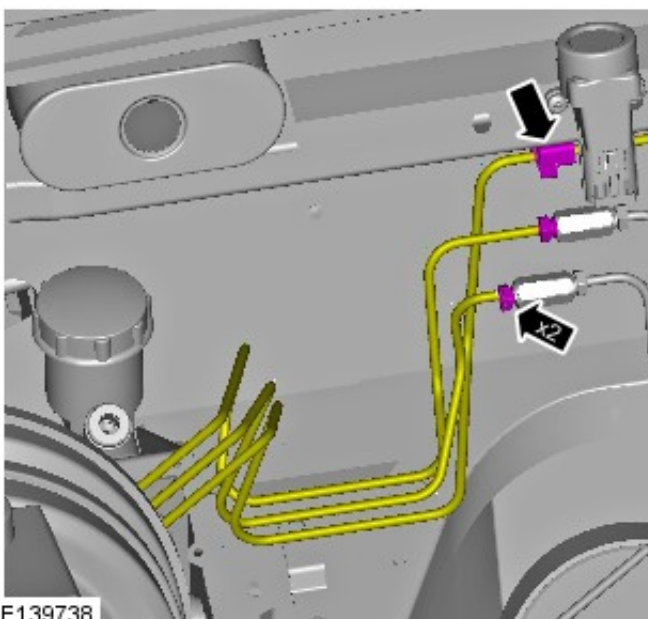
20. Vehicles With ABS.

1. Install the 3 brake pipes at the Hydraulic Control Unit (HCU).
2. Tighten the 3 brake pipe unions to 15 Nm (11 lb.ft).
3. Secure brake pipes to the securing clip.



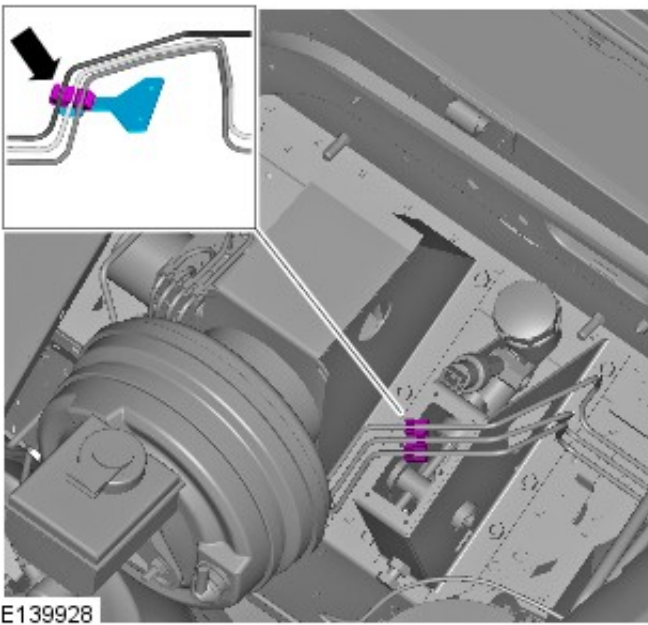
21. Install the 3 brake pipes.

1. Tighten the 2 brake pipe unions to 15 Nm (11 lb.ft).
2. Secure brake pipe to the panel clip.



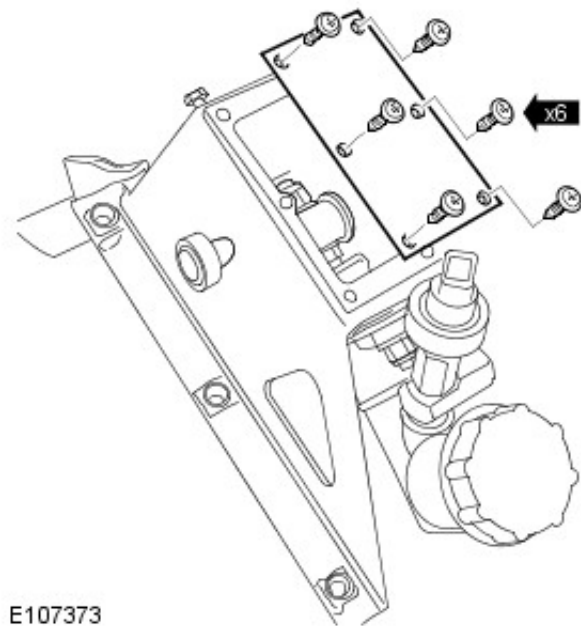
22. Install the brake line retaining clip bracket.

22. Install the brake pipe retaining clip bracket.



23. All Vehicles.

1. Install a new gasket to cover plate and secure with the 6 screws.
2. Tighten the screws to 3 Nm (2 lb.ft).



24. **NOTE:** Land Rover approved diagnostic equipment must be used to operate the Antilock Brake System (ABS) solenoid valves and the return pump to ensure correct bleeding of the Hydraulic Control Unit (HCU) and all the vehicle brake circuits.

Using the Land Rover approved diagnostic equipment, bleed the complete brake system.


For additional information, refer to: [Brake System Bleeding](#) (206-00 Brake System - General Information, General Procedures).

25. Install the coolant expansion tank.
1. Tighten the bolt to 10 Nm (8 lb.ft)
 2. Connect the coolant expansion tank return hose.
 3. Check, and if necessary top up the coolant fluid level.

Clutch Controls - Vehicles With: MT82 6-Speed Manual Transmission - Clutch Slave Cylinder

Removal and Installation

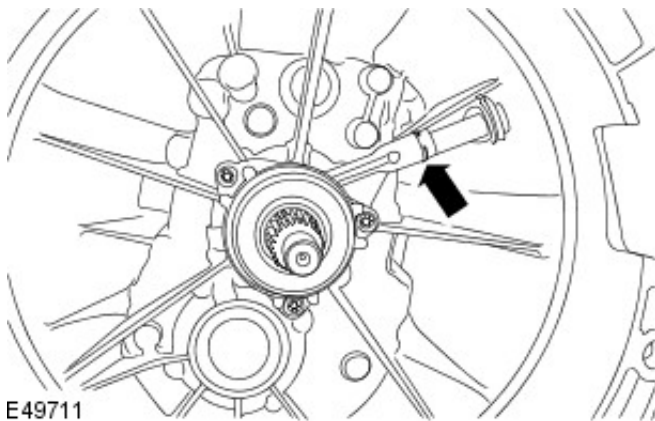
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

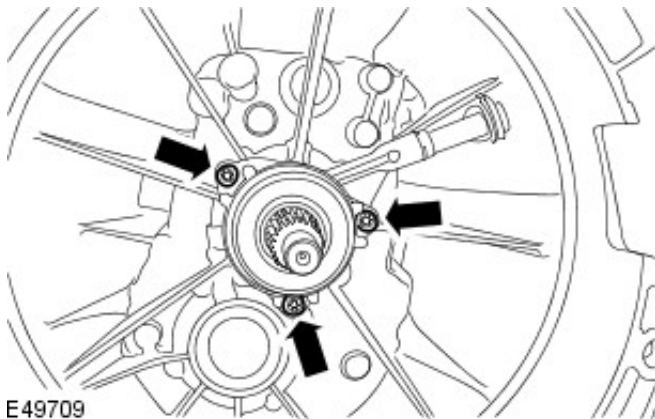
Raise and support the vehicle.

2. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
3. Remove the transmission.
For additional information, refer to: Transmission (308-03, Removal).

4. Disconnect the fluid pipe.
 - Position an absorbent cloth to collect any fluid spillage.
 - Remove the clip.



5. Remove the clutch slave cylinder.
 - Remove the 3 bolts.



Installation

1. Install the clutch slave cylinder.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Connect the fluid pipe.
 - Install the clip.
3. Install the transmission.
For additional information, refer to: Transmission (308-03, Installation).
4. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission -

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Manual transmission fluid	WSD-M2C200-C
Super DOT 4 brake fluid	ESD-M6C57-A
Sealant	WSS-M2G348-A10
Grease	ESD-M1C220-A

Capacities

Capacities	Litres	
MT82 transmission - Initial fill	2.4	
MT82 transmission - Service fill	2.2	
Description	Nm	lb-ft
Gearshift yoke securing nut	12	9
Clutch slave cylinder bolts	11	8
Reversing lamp switch	20	15
Transmission extension housing bolts	25	18
Transfer case bolts	45	33
Transmission bolts	40	30
RH transmission mount nut*	30	22
RH transmission mount bolts+	63	46
LH transmission mount nut*	30	22
LH transmission mount bolts+	63	46
Starter motor bolts	35	26
Fuel line support bracket nut	9	7
Clutch slave cylinder hose from the mounting bracket nut	25	18
Transmission wiring harness bracket nut and bolt	47	35
Transfer case breather pipe	15	11
RH earth cables to the transfer case bolt	9	7
LH earth cable to the transfer case nut	45	33
Rear driveshaft to the transfer case nut	50	37
Tail pipe to the intermediate pipe nut	25	18

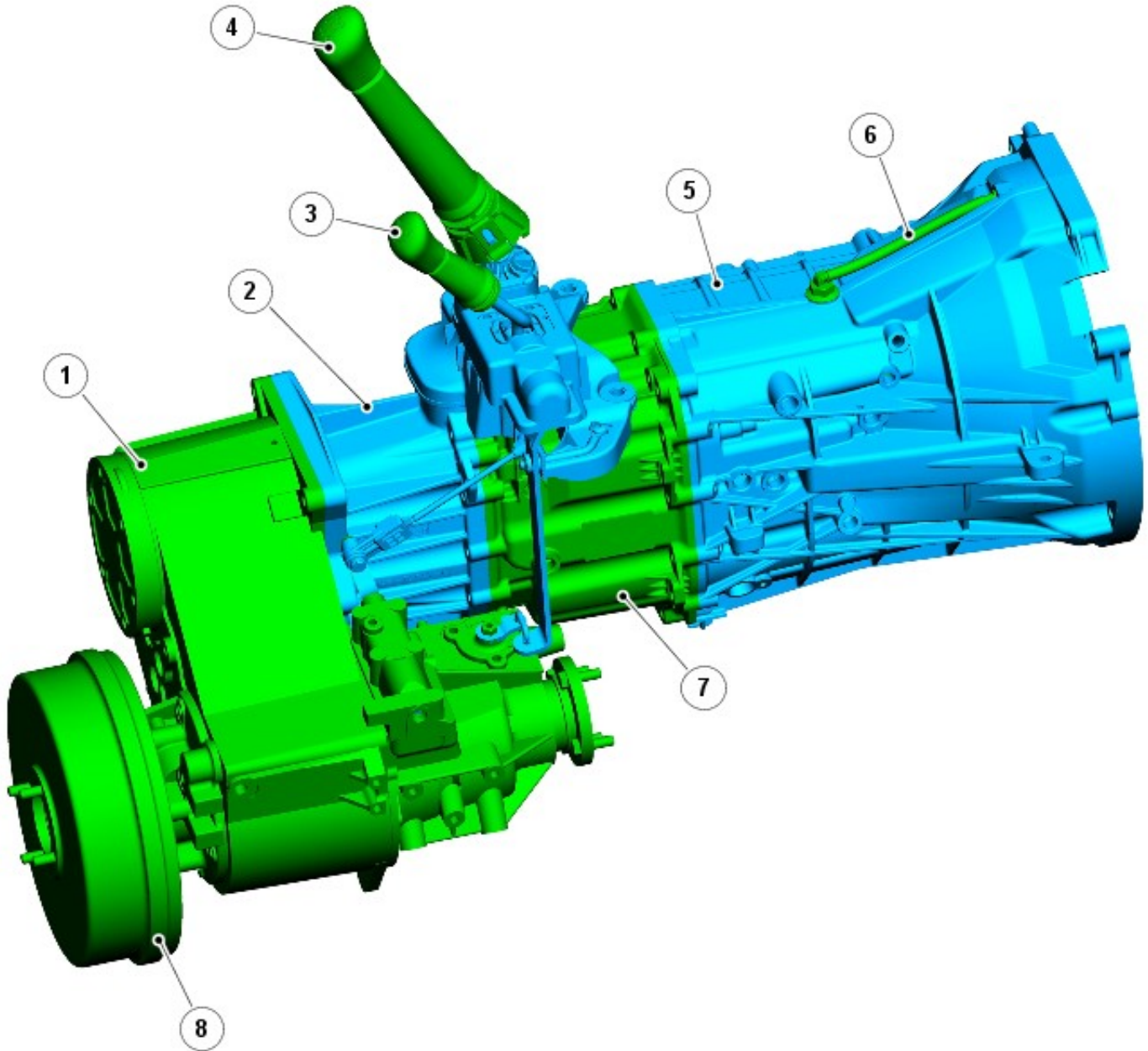
*If re-using nuts on vehicles built prior to VIN732932, tighten to 48 Nm. If replacing nuts, tighten to 30 Nm.

+If re-using bolts on vehicles built prior to VIN732932, tighten to 85 Nm. If replacing bolts, tighten to 63 Nm.

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Manual Transmission

Description and Operation

COMPONENT LOCATION



E87083

Item	Part Number	Description
1	-	Transfer box assembly
2	-	Transmission extension case
3	-	Transfer box selector lever
4	-	Gear selector lever
5	-	Transmission front casing
6	-	Breather pipe
7	-	Transmission housing
8	-	Transmission park brake

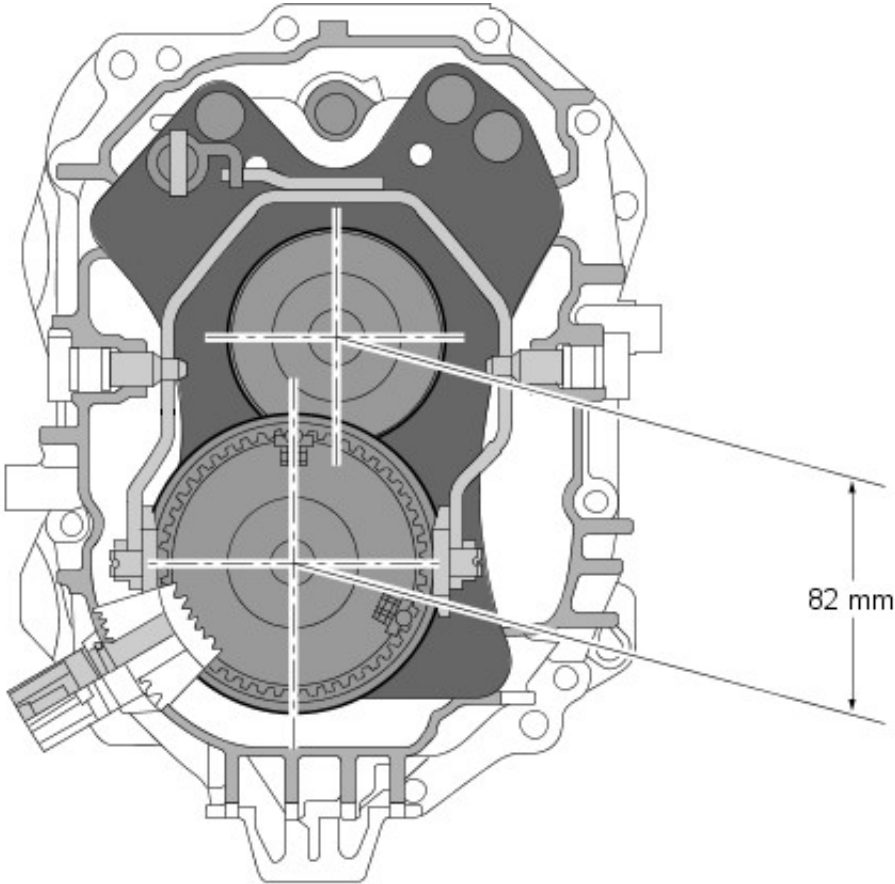
OVERVIEW

The MT82 manual transmission has 6 forward gears and a reverse. It is mounted longitudinally and has a maximum torque capacity of 360Nm. The aluminium die-cast transmission housing is bolted to the transfer box via an aluminium die-cast extension case.

The 6th gear ratio has been selected as an overdrive for economy and comfort at higher vehicle speeds. Optimum gear steps ensure highly fuel-efficient utilisation of the engine torque. This 6-speed transmission provides a wide ratio spread supporting both economy and drivability (e.g. low speed maneuvering/trailer towing).

The name MT82 is derived from the distance between the 2 shafts in the transmission:

- **M** stands for manual
- **T** stands for transmission
- **82** is the distance between the 2 shafts in milimeters (mm)



E47709

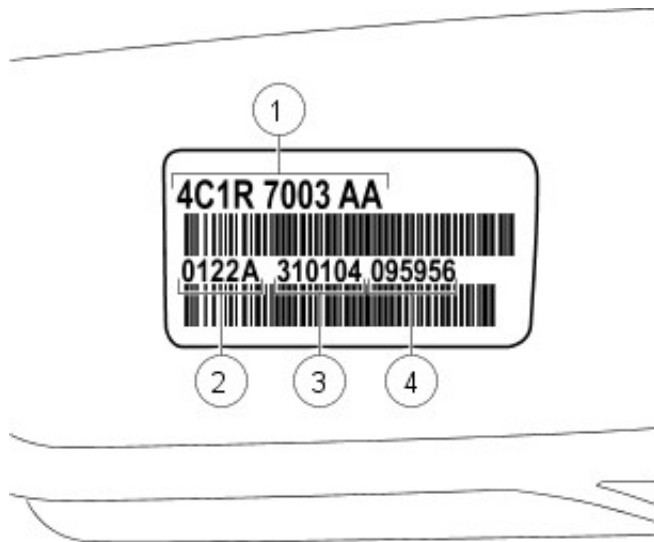
The transmission is a fill for life unit and no level check is required at service unless a leak is present.

Technical Data

Input Torque	Ratios							Dry Weight	Oil fill	Oil Specification
	1st	2nd	3rd	4th	5th	6th	Rev			
360Nm	5.441	2.840	1.721	1.223	1.00	0.742	4.935	50.8 kg	2.4L	WSD-M2C200-C

The input and output shafts are directly connected in 5th gear. This produces a gear ratio of 1:1.

Model Plate Label



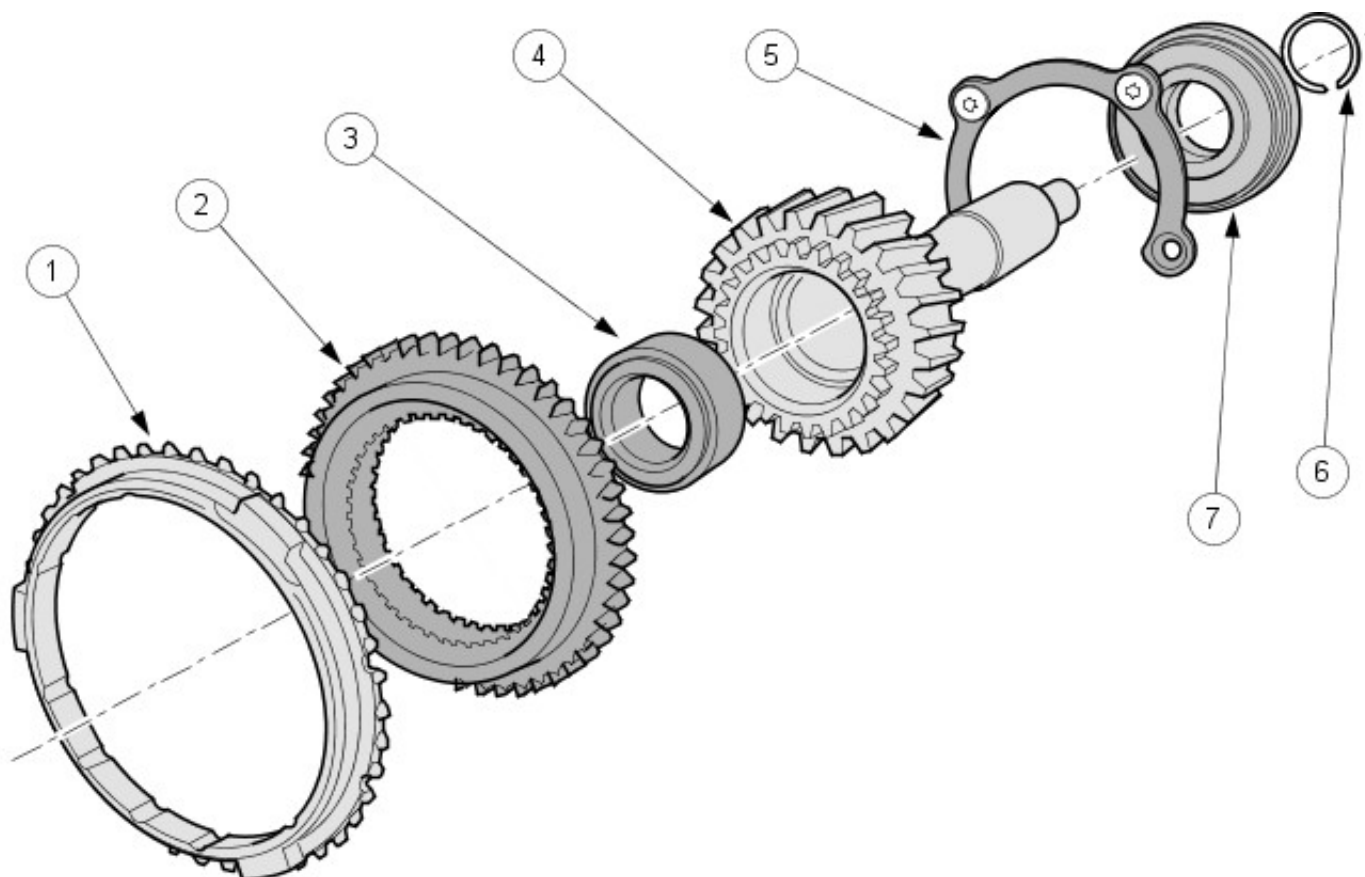
E48449

Item	Part Number	Description
1	-	Replacement part number
2	-	Place of manufacture (Halewood)
3	-	Vehicle build date
4	-	Build time

The model plate is located on the Right Hand (RH) side of the transmission, near the driveshaft drive flange.

It is only used to identify the transmission. All spare parts orders are still made using the Vehicle Identification number (VIN).

INPUT SHAFT



E47159

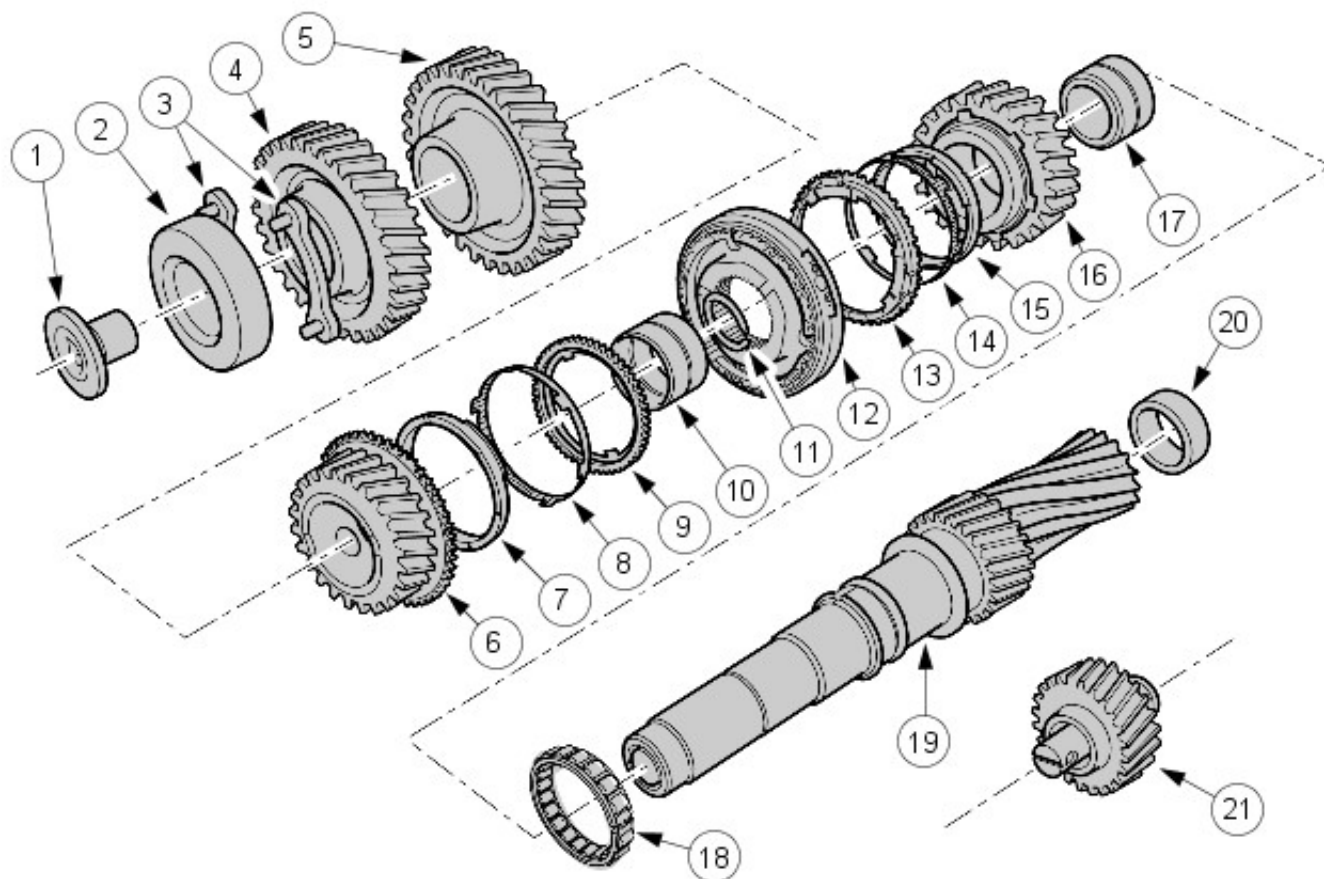
Item	Part Number	Description
1	-	5th gear synchroniser ring
2	-	Splined synchroniser, 5th gear
3	-	Output shaft pilot bearing

- 4 - Input shaft
- 5 - Bearing retaining plate
- 6 - Ball bearing circlip
- 7 - Input shaft ball bearing

The input shaft is rotationally mounted in the output shaft on the pilot bearing (3). In order to absorb the axial forces, the input shaft ball bearing (7) is additionally secured.

All the components on the input shaft can be serviced separately.

LAYSHAFT



E47153

Item	Part Number	Description
1	-	Retaining bolt
2	-	Ball bearing, layshaft
3	-	Retaining plate - bearing
4	-	Input pinion, layshaft
5	-	Gear - 6th gear
6	-	Gear wheel - 3rd gear
7	-	3rd gear synchroniser cone
8	-	Inner synchroniser ring
9	-	Outer synchroniser ring - 3rd gear
10	-	Needle bearing
11	-	Snap ring
12	-	3rd/4th gear synchroniser assembly
13	-	Outer synchroniser ring - 4th gear
14	-	Inner synchroniser ring
15	-	4th gear synchroniser cone
16	-	Gear wheel - 4th gear
17	-	Needle bearing
18	-	Centre bearing, layshaft
19	-	Layshaft
20	-	Roller bearing, layshaft

21 - Reverse gear idler

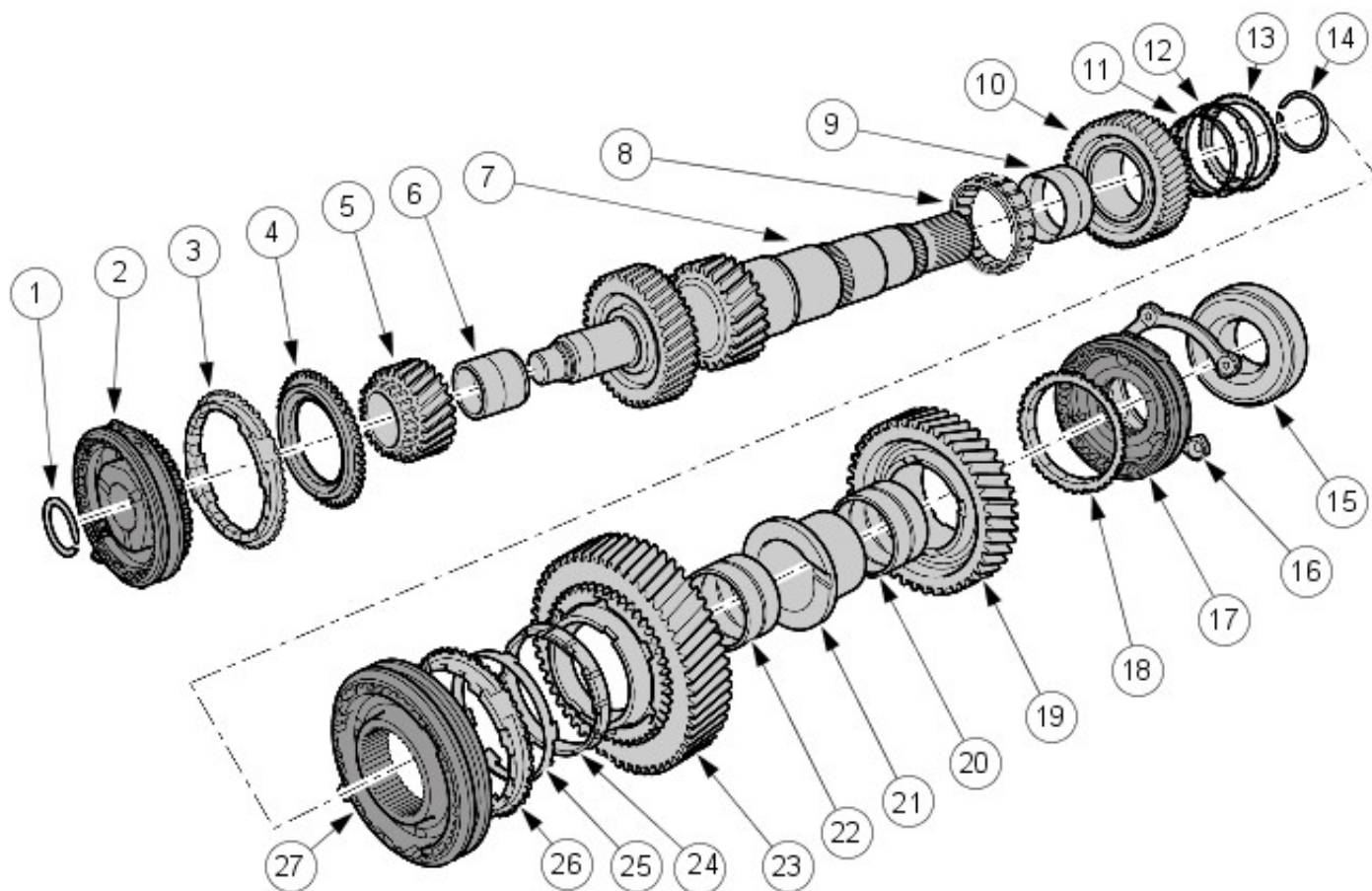
The layshaft transfers the torque from the input shaft onto the output shaft. Gear wheels and gears and the 3rd/4th gear synchroniser assembly are located on the shaft. First, 2nd and reverse gears are an integral part of the shaft.

The layshaft gearwheels and gears can be replaced individually. Because of improved manufacturing tolerances, it is no longer necessary to change the gears and gear wheels in pairs.

The layshaft is a solid shaft. In order to prevent the shaft from moving axially, it is additionally secured with a retaining bolt (1) and a bearing retaining plate (3).

The rotational direction of the output shaft is reversed by the use of the reverse gear idler (21).

OUTPUT SHAFT



E47148

Item	Part Number	Description
1	-	Snap ring
2	-	5th/6th gear synchroniser assembly
3	-	6th gear synchroniser ring
4	-	Splined synchroniser, 6th gear
5	-	Gear wheel - 6th gear
6	-	Needle bearing
7	-	Output shaft
8	-	Centre bearing - output shaft
9	-	Needle bearing
10	-	Gear wheel - 2nd gear
11	-	2nd gear synchroniser cone
12	-	Inner synchroniser ring
13	-	Outer synchroniser ring - 2nd gear
14	-	Snap ring
15	-	Ball bearing, output shaft
16	-	Retaining plate - bearing
17	-	Reverse gear synchroniser assembly
18	-	Reverse gear synchroniser ring
19	-	Gear wheel - reverse gear

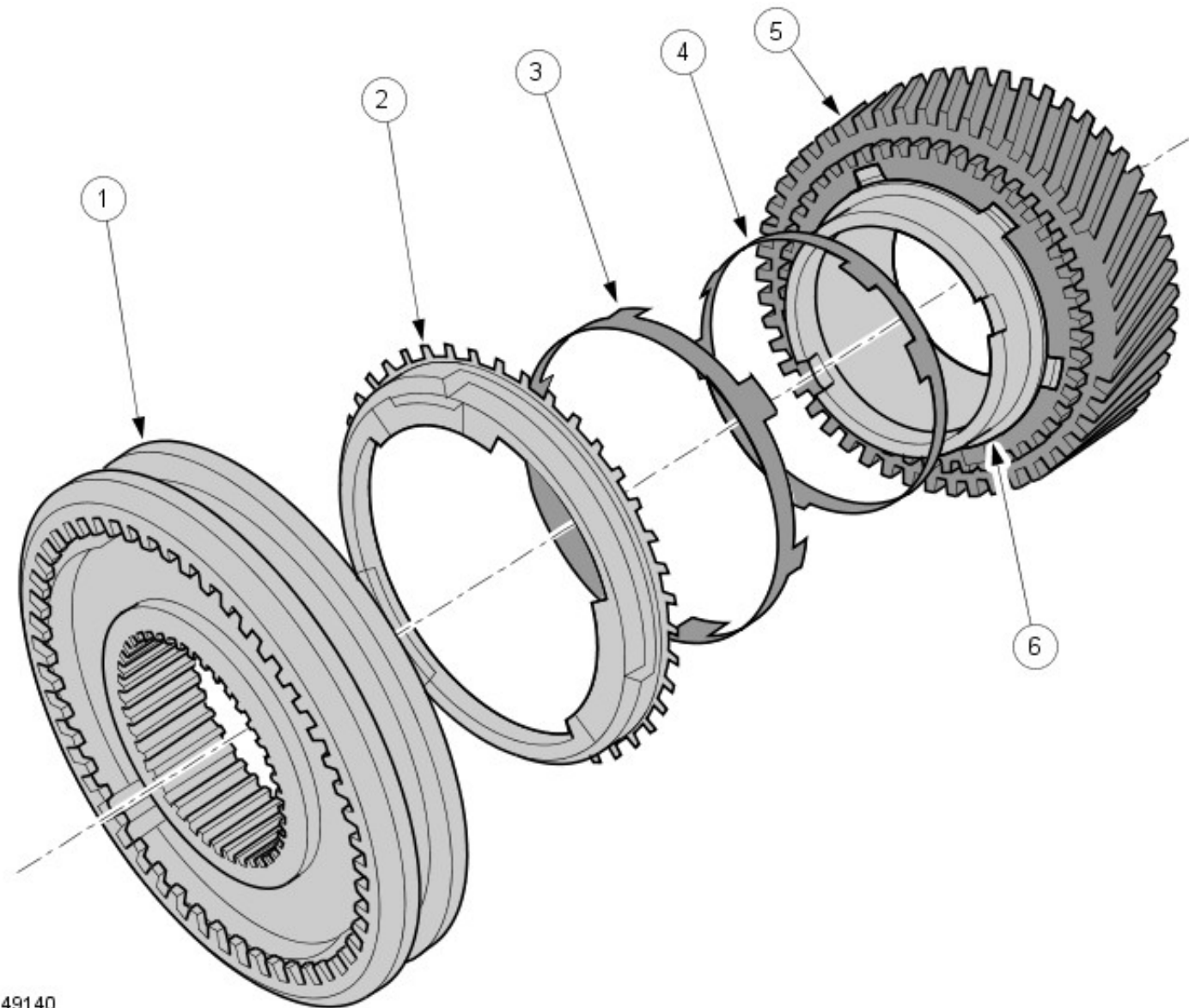
- 20 - Needle bearing
- 21 - Inner race - needle bearing
- 22 - Needle bearing
- 23 - Gear wheel - 1st gear
- 24 - 1st gear synchroniser cone
- 25 - Inner synchroniser ring - 1st gear
- 26 - Outer synchroniser ring - 1st gear
- 27 - 1st/2nd gear synchroniser assembly

The output shaft transfers torque through the output flange, to an extension shaft connected to the transfer box. 1st, 2nd, 6th and reverse gear wheels are located on the output shaft. 3rd and 4th gears are an integral part of the output shaft.

In a similar way to the input shaft, there is a splined synchroniser (4) pushed on the 6th gear gear wheel. This makes it possible to transfer the torque in 6th gear.

The output shaft gearwheels and gears can be replaced individually.

TRIPLE SYNCHRONISER ASSEMBLY



E49140

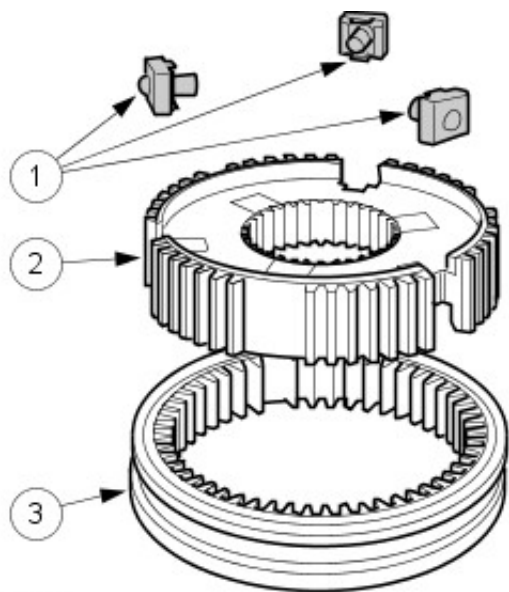
Item	Part Number	Description
1	-	1st/2nd gear synchroniser assembly
2	-	Outer synchroniser ring
3	-	Inner synchroniser ring
4	-	Synchroniser cone
5	-	Gear wheel
6	-	Conical surface

The Synchronisation assembly consists of 3 friction surfaces. The total friction surface of triple synchronisation is considerably increased by the additional conical surface (6). This leads to a reduction in the force needed to change into

1st or 2nd gear.

As the conical surface is part of the gear wheel, there is no need for an additional synchroniser ring.

SYNCHRONISER ASSEMBLY

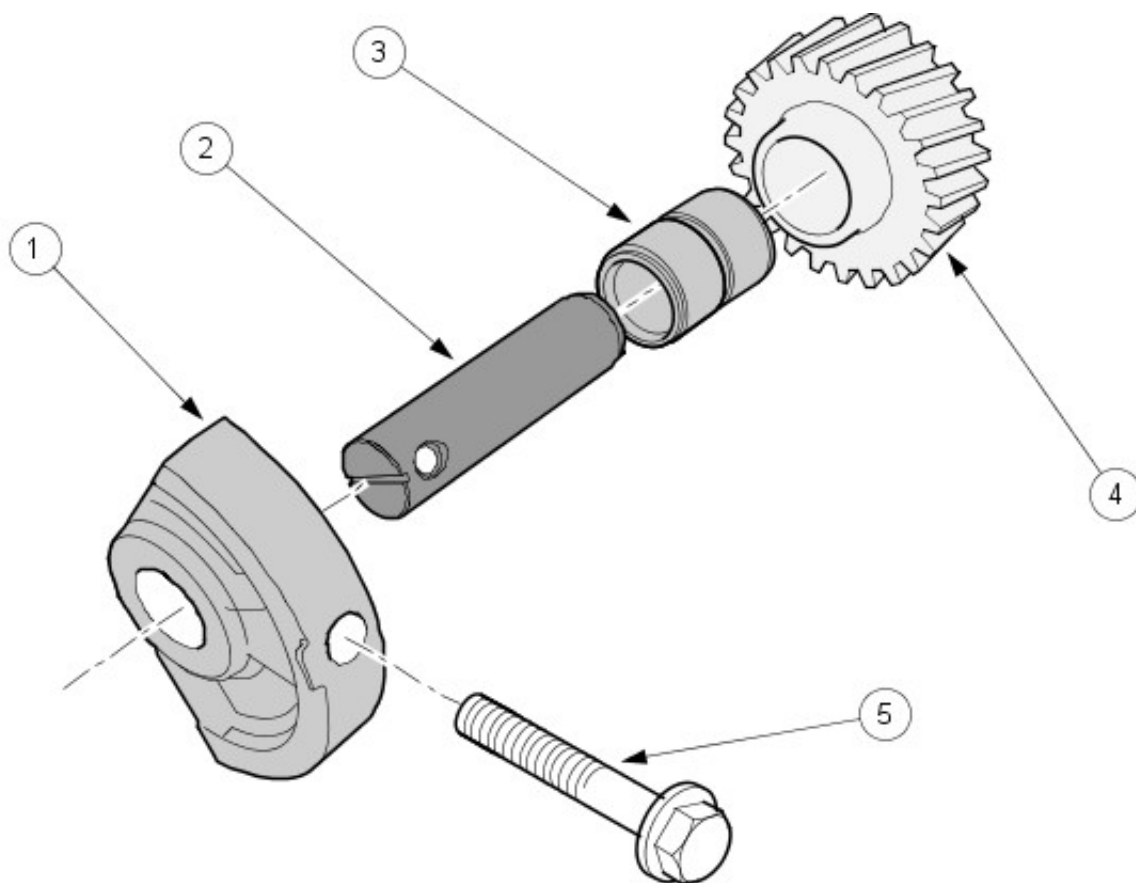


TIE38774

Item	Part Number	Description
1	-	Sliding block assembly
2	-	Synchroniser hub
3	-	Sliding collar

The pressure springs and detent balls of the sliding blocks are combined in one unit.

REVERSE GEAR IDLER



E47160

Item	Part Number	Description
1	-	Mounting
2	-	Reverse gear idler shaft

- 3 - Needle bearing
- 4 - Reverse gear idler
- 5 - Retaining bolt - reverse gear mounting

The reverse gear idler allows the direction of rotation of the output shaft to be reversed. The reverse gear idler turns on a needle bearing, which runs on the reverse gear idler shaft. The shaft is retained by the mounting (1) and a locating bore in the transmission housing.

In order to absorb the radial forces, the reverse gear idler runs on an additional mounting.

If the reverse gear idler can be replaced as an individual unit.

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Transmission Draining and Filling

General Procedures

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

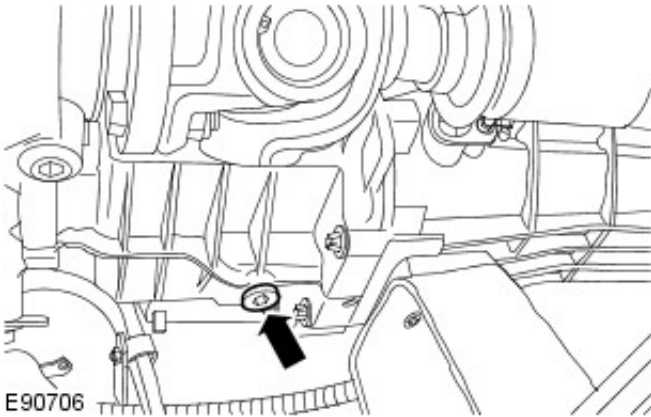
Raise and support the vehicle.

2. **NOTE:** The oil should be drained when the transmission is warm and the vehicle is standing on a level surface.

Position a container to collect the oil.

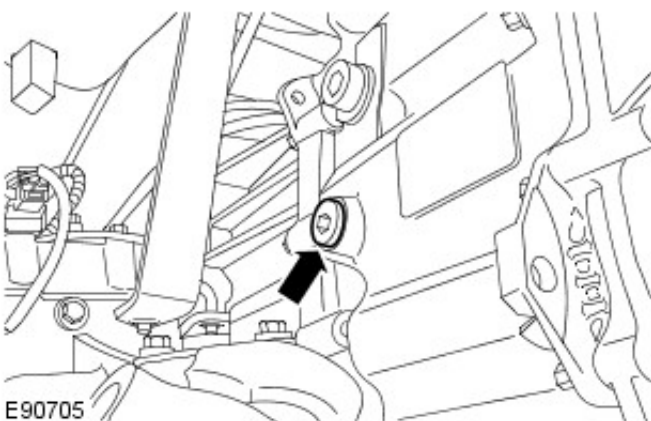
3. Clean the area surrounding the transmission drain plug.

4. Remove the transmission drain plug.
 - Allow the oil to drain.



5. Clean transmission drain plug.
6. Install the transmission drain plug and clean any oil residue from the surrounding area.
 - Tighten to 50 Nm (37 lb.ft).
7. Clean the area surrounding the transmission filler plug.

8. Remove the transmission filler plug.




9. Fill the transmission with the correct grade of oil.
For additional information, refer to: Specifications (308-03 Manual Transmission/Transaxle, Specifications).
10. Install the transmission filler plug and clean any oil residue from the surrounding area.
 - Tighten to 35 Nm (26 lb.ft).
11. Remove the container.
12. Lower the vehicle.

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Gearshift Control Shaft Seal

In-vehicle Repair

Removal

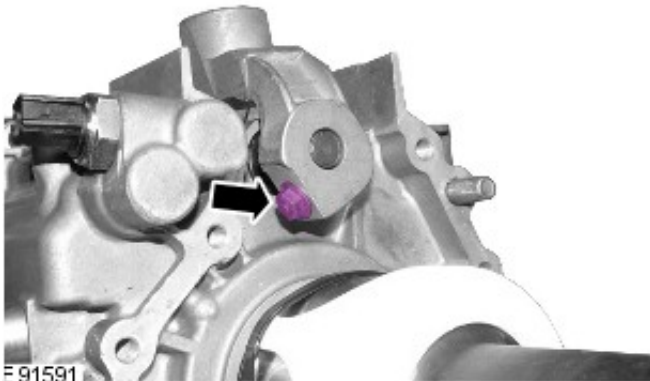
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the transfer case.
For additional information, refer to: Transfer Case (308-07 Transfer Case - 2.4L Diesel, Removal).
4. Remove the transmission extension housing.
 - Remove the 10 bolts.



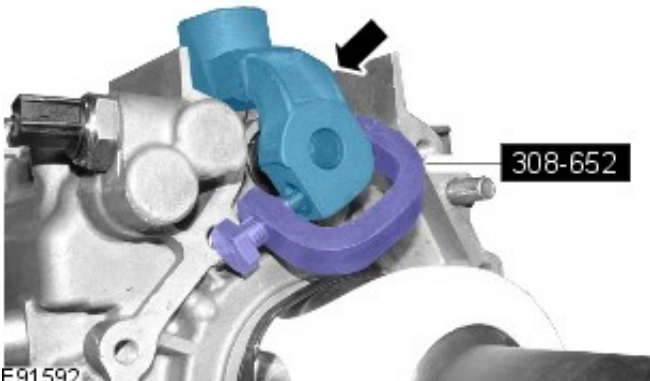
E91607

5. Remove the gearshift yoke nut.



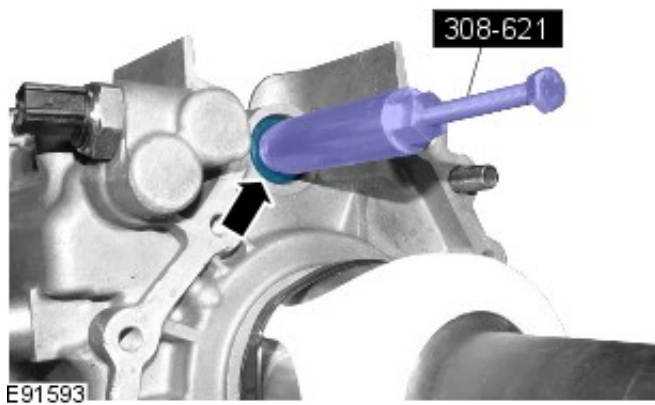
E91591

6. Using the special tool, remove the gearshift yoke.
 - Remove the pin.



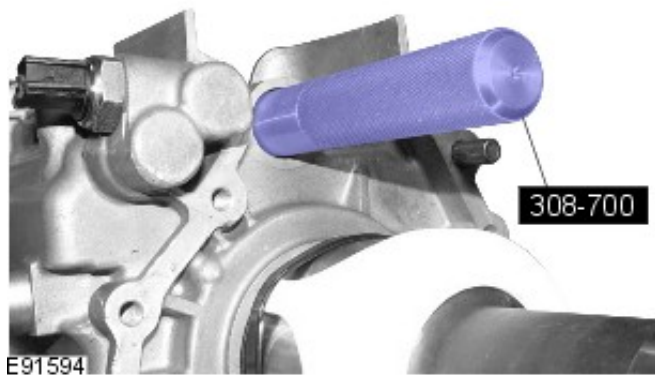
E91592

7. Using the special tool, remove the gearshift control shaft seal.

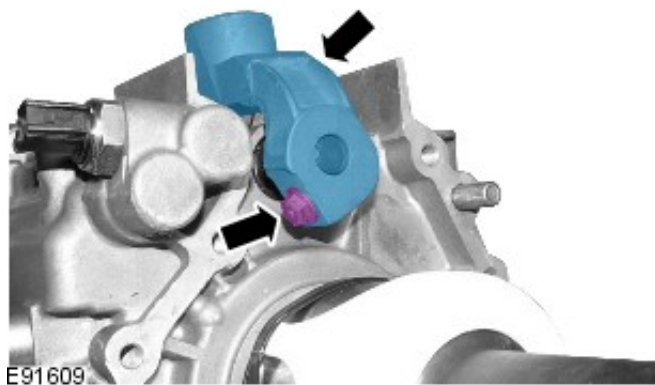


Installation

1. Using the special tool, install the gearshift control shaft seal.



2. Install the gearshift selector yoke.
 - Tighten to 12 Nm (9 lb.ft).



3. Install the transmission extension housing.
 - Tighten to 25 Nm (18 lb.ft).






4. Install the transfer case.
For additional information, refer to: Transfer Case (308-07 Transfer Case - 2.4L Diesel, Installation).
5. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).


Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Input Shaft Seal

In-vehicle Repair

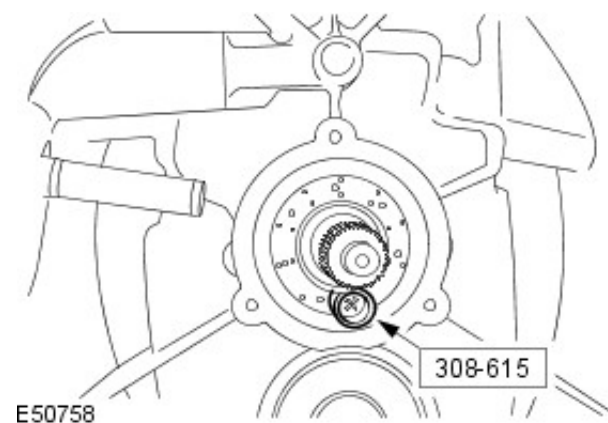
Special Tool(s)

 100012	Slide Hammer 100-012
 E52741	Remover, Seals 308-615
 E49153	Installer Input Shaft Seal 308-605

Removal

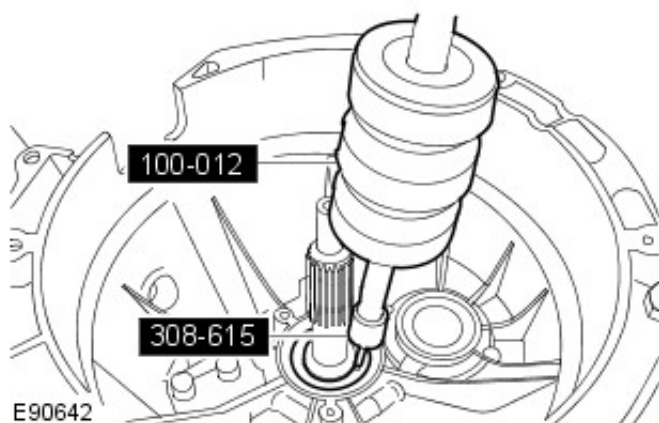
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transmission.
For additional information, refer to: Transmission Draining and Filling (308-03 Manual Transmission/Transaxle, General Procedures).
4. Remove the clutch slave cylinder.
For additional information, refer to: Clutch Slave Cylinder (308-02 Clutch Controls - 2.4L Diesel, Removal and Installation).
5. Install the special tool into the seal.



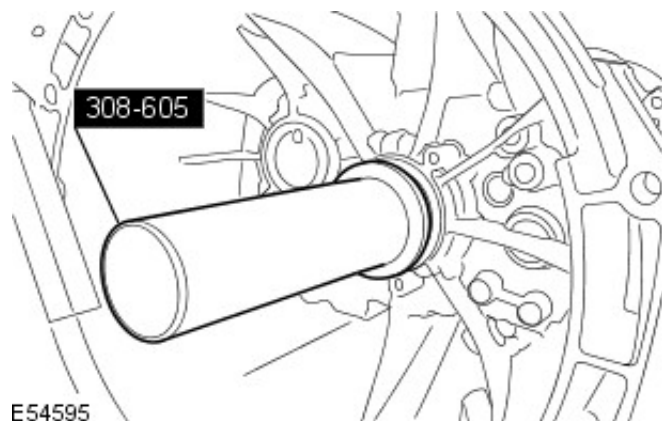
6. Using the special tools, remove and discard the input

or, using the special tools, remove and discard the input shaft seal.



Installation

1. Using the special tool, install the new input shaft seal.


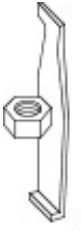


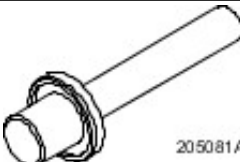

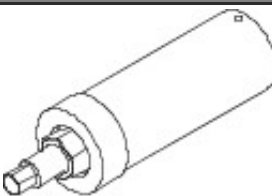


2. Install the clutch slave cylinder.
For additional information, refer to: Clutch Slave Cylinder (308-02 Clutch Controls - 2.4L Diesel, Removal and Installation).
3. Fill the transmission.
For additional information, refer to: Transmission Draining and Filling (308-03 Manual Transmission/Transaxle, General Procedures).

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Output Shaft Seal

In-vehicle Repair


Special Tool(s)

 <p>100012</p>	<p>Slide Hammer 100-012</p>
 <p>308-375</p>	<p>Seal Remover Input and Output 308-375</p>
 <p>100-012-01</p>	<p>Slide Hammer Adaptor 100-012-01</p>
 <p>308-701 E91080</p>	<p>Holding Tool, Output Flange 308-701</p>
 <p>205081A</p>	<p>Installer 205-081A</p>
 <p>308-516 E90665</p>	<p>Long Legged Puller 308-516</p>
 <p>E49064</p>	<p>Installer, Output Drive Flange Seal 308-604</p>
	<p>Adapter Slide Hammer 100-012-05</p>



Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the gearshift lever.
For additional information, refer to: Gearshift Lever (308-06 Manual Transmission/Transaxle External Controls - 2.4L Diesel, Removal and Installation).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Drain the transmission.
For additional information, refer to: Transmission Draining and Filling (308-03 Manual Transmission/Transaxle, General Procedures).
5. Remove the transfer case.
For additional information, refer to: Transfer Case (308-07 Transfer Case - 2.4L Diesel, Removal).

6. Remove the transmission extension shaft cover.
 - Remove and discard the tie strap.



E91522

7. Using a suitable tool, remove the transmission extension shaft.
 - Remove the seal.



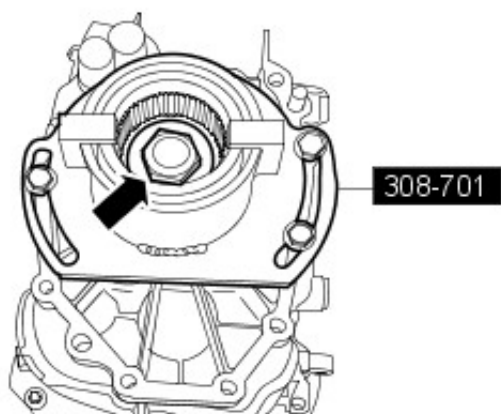
E91523

8. Remove the transmission extension housing.
 - Remove the 10 bolts.



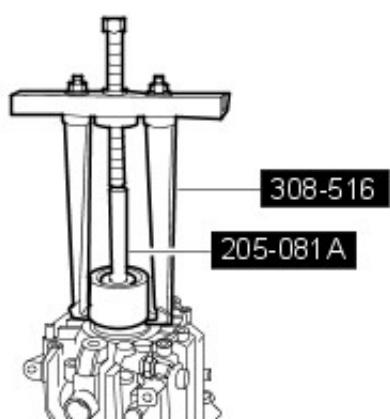
E91524

9. Using the special tool, remove the output flange securing bolt.



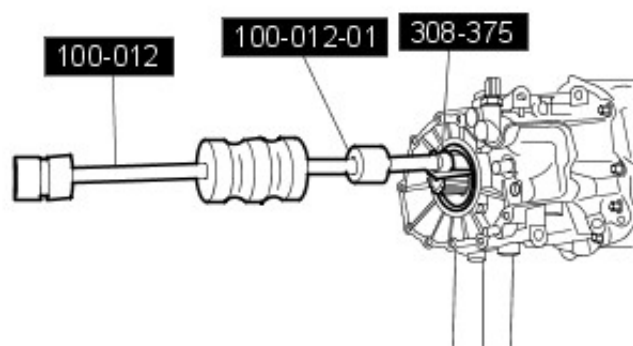
E89846

10. Using the special tools, remove the output flange.



E89847

11. Using the special tools, remove and discard the output shaft seal.

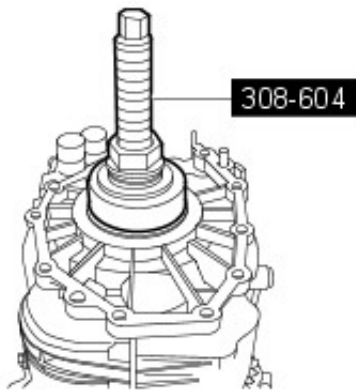


E89852

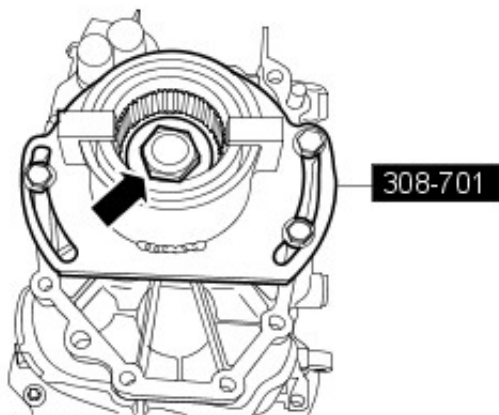
Installation


1. Using the special tool, install the output shaft seal.

E90432



E89846



2.  **WARNING:** Care should be taken when using the hot air blower. Failure to follow this instruction may result in personal injury.

NOTE: Heat the output flange to approx. 100 °C using a hot air blower.

Using the special tool, install the transmission output flange.

- Tighten the bolt to 210 Nm (155 lb.ft).
- Loosen the bolt.
- Apply thread locking compound. [adhesive](#)
- Tighten the bolt to 180 Nm (133 lb.ft).

3. Install the transmission extension shaft.
- Install the seal.

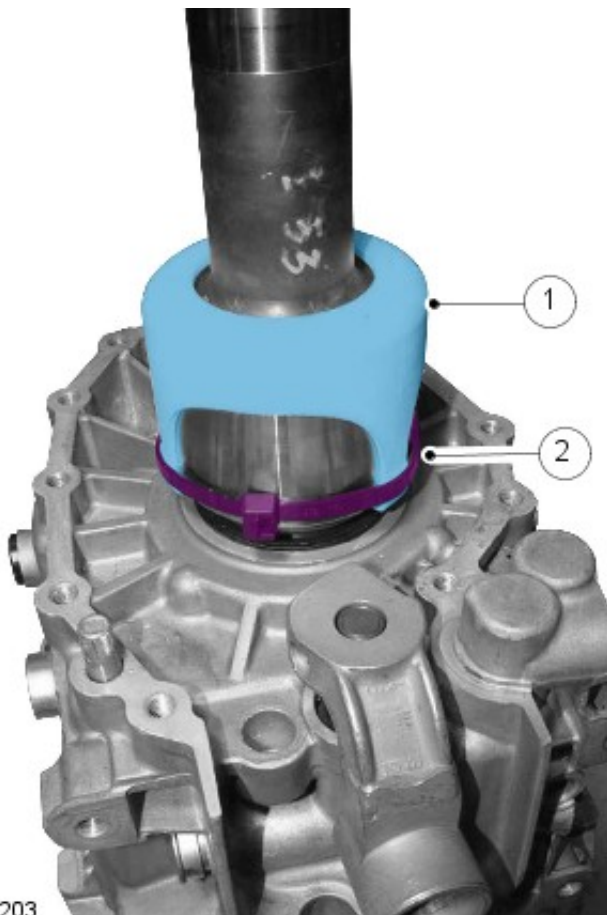


E91069

4. **NOTE:** Make sure that the tie strap joint is between the fingers of the extension shaft seal cover and that it has been cut flush.

Install the transmission extension shaft cover.

1. Install the cover.
2. Install the tie strap.



E91203

5. Install the transmission extension housing.
 - Tighten the bolts to 25 Nm (18 lb.ft).



E91067

6. Install the transfer case.
For additional information, refer to: Transfer Case (308-07 Transfer Case - 2.4L Diesel, Installation).
7. Fill the transmission.
For additional information, refer to: Transmission Draining and Filling (308-03 Manual Transmission/Transaxle, General


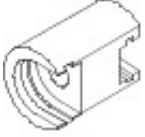
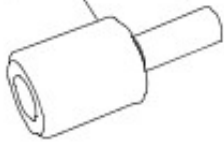
Procedures).

8. Install the gearshift lever.
For additional information, refer to: Gearshift Lever (308-06 Manual Transmission/Transaxle External Controls - 2.4L Diesel, Removal and Installation).
9. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Selector Shaft Detents

Removal and Installation

Special Tool(s)


 100012	Slide Hammer 100-012
 E 79252	Remover, Detent 308-657
 E91077	Adapter, Slide Hammer 100-012-05

General Equipment

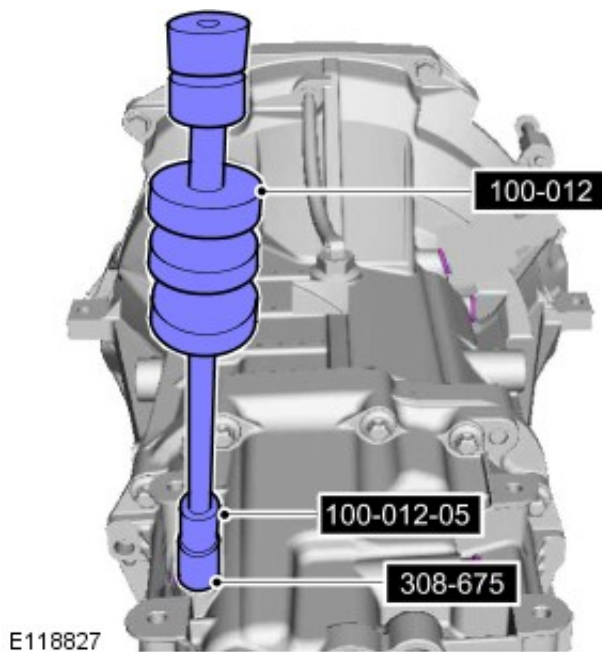
Hammer
Soft Drift


Removal

1. Remove the transmission.
For additional information, refer to: Transmission (308-03 Manual Transmission/Transaxle, Removal).

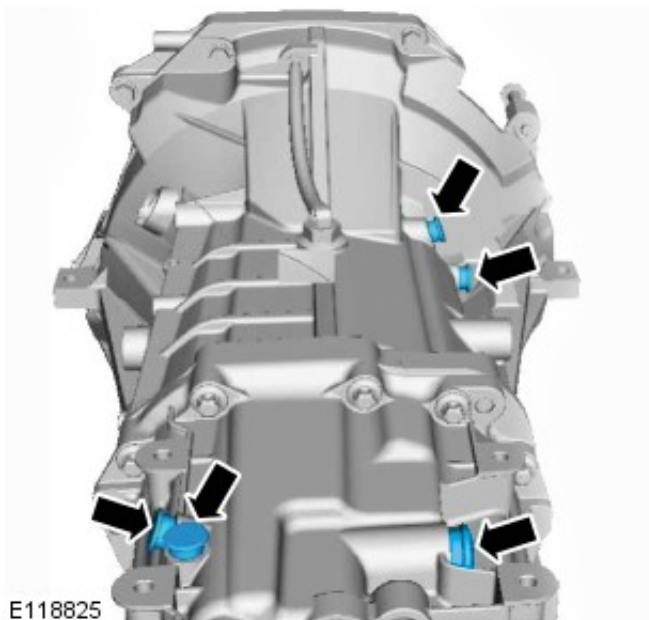
2.  **CAUTION:** Make sure area surrounding component is clean.

Assemble the special tools.



3.  **CAUTION:** Make sure area surrounding component is clean.

Using the special tools, remove the selector rod detents.

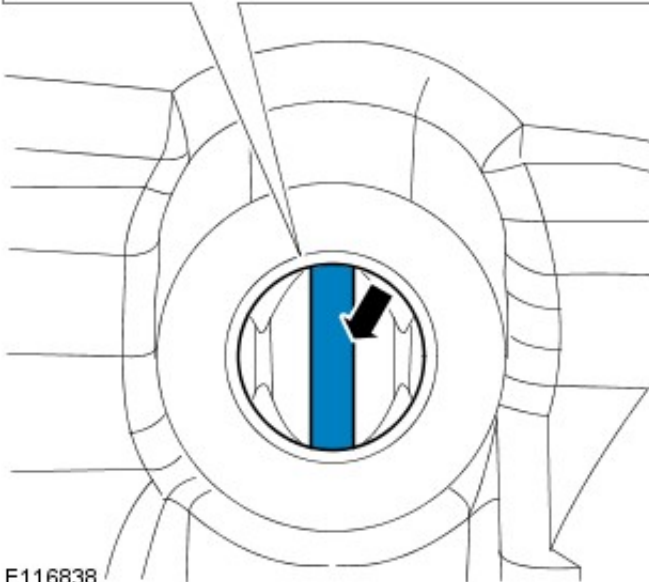
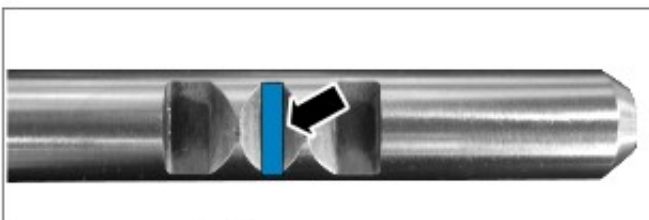


E118825

Installation

1. **NOTE:** If transmission is stuck in gear, carefully manipulate selector mechanism using a suitable flat bladed screwdriver.

Make sure all gear selector rods are aligned as shown and the gear selector linkage is free to move.

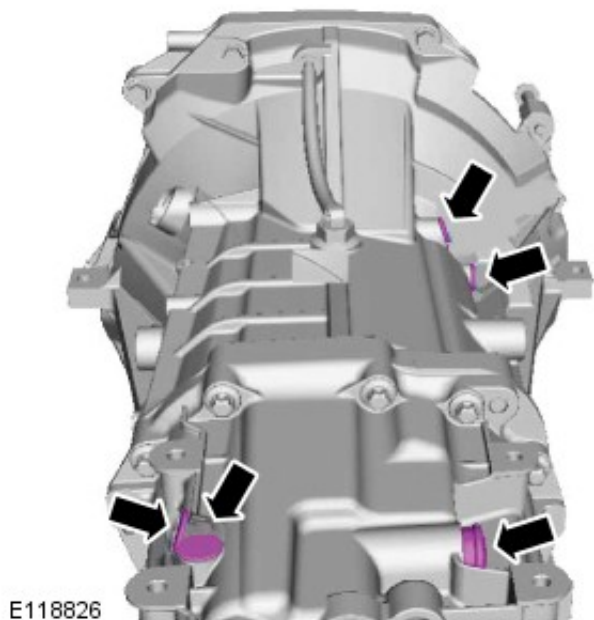


E116838

2. **CAUTION:** Make sure area surrounding component is clean.

NOTE: New selector rod detents must be seated flush with transmission casing as necessary.

Using a suitable hammer and soft drift, install the selector rod detents.


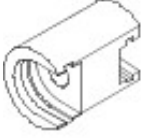




3. Install the transmission.
For additional information, refer to: Transmission (308-03 Manual Transmission/Transaxle, Installation).

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - 1st-2nd and Reverse Gear Selector Shaft Detents

Removal and Installation

Special Tool(s)

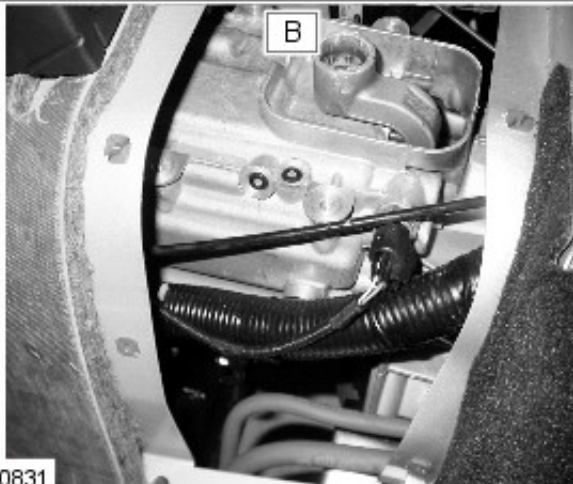
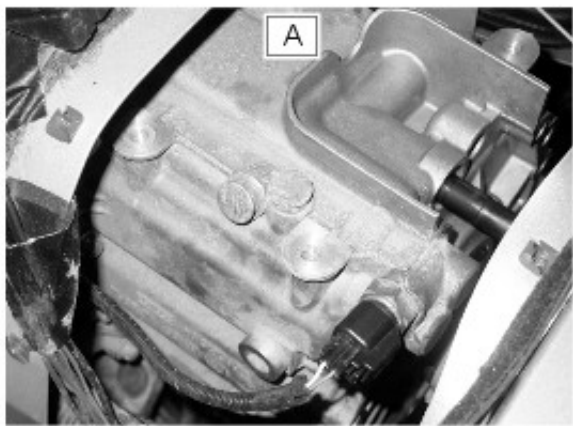
 100012	Slide-Hammer 100-012
 E 792 52	Remover, Detent 308-657
 E91077	Adapter, Slide Hammer 100-012-05
 E52741	Remover Seals 308-615

Removal

1. Remove the gearshift lever. For additional information, refer to: Gearshift Lever (308-06, Removal and Installation).

2. **NOTE: Selector shaft detent identification**

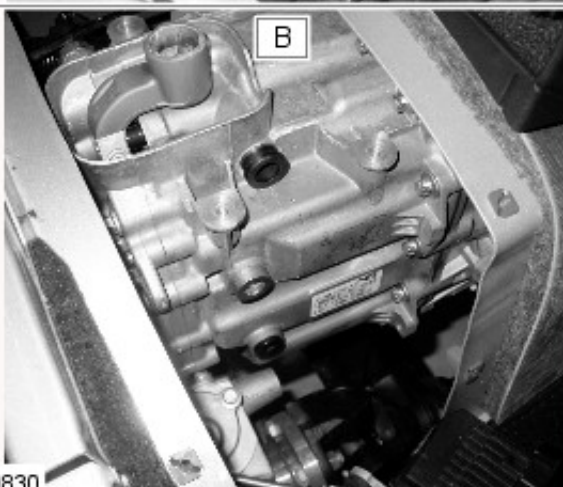
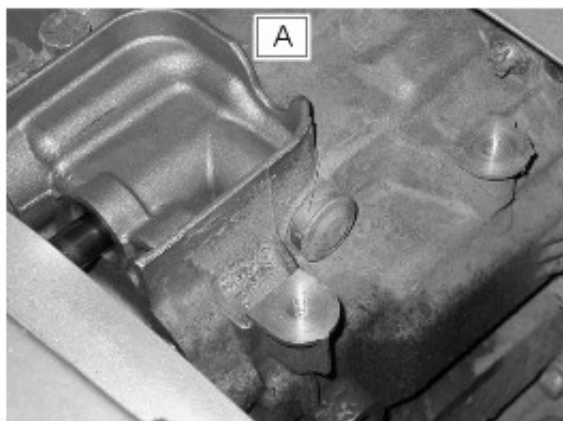
Letter **A** shows the old selector shaft detent. Letter **B** shows the later selector shaft detent.




E130831

3. **NOTE: Selector shaft detent identification**

Letter **A** shows the old selector shaft detent. Letter **B** shows the later selector shaft detent.

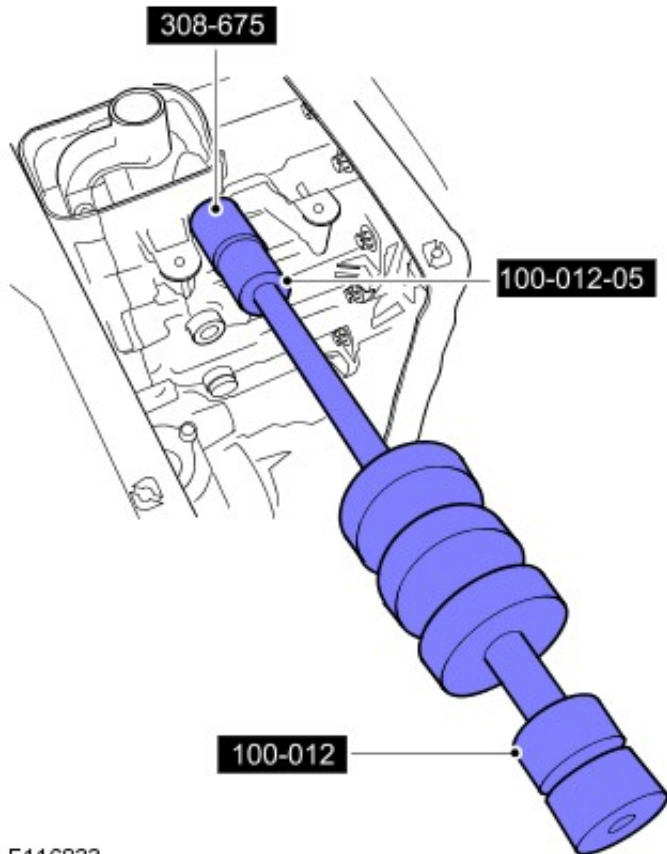


E130830

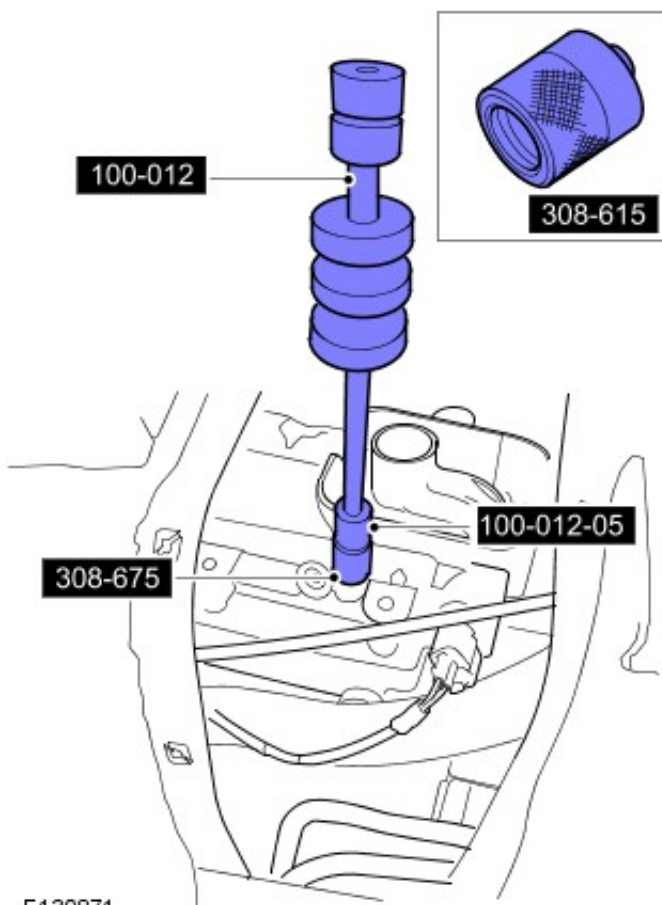
4.  **CAUTION:** Make sure area surrounding component is clean.

Using the special tools, remove the selector shaft


detent.



E116833




E130871

5.  **CAUTION:** Make sure area surrounding component is clean.

NOTE: If the selector shaft detents are the later type as indicated in the illustration, the detent removal process will require the centre of the detent to be drilled out using a 5.5 mm drill to a depth of approximately 3mm to pierce the detent casing. An M6 bolt should then be inserted through tool 308-615 and into the detent, and using the appropriate special tool, remove the detent.

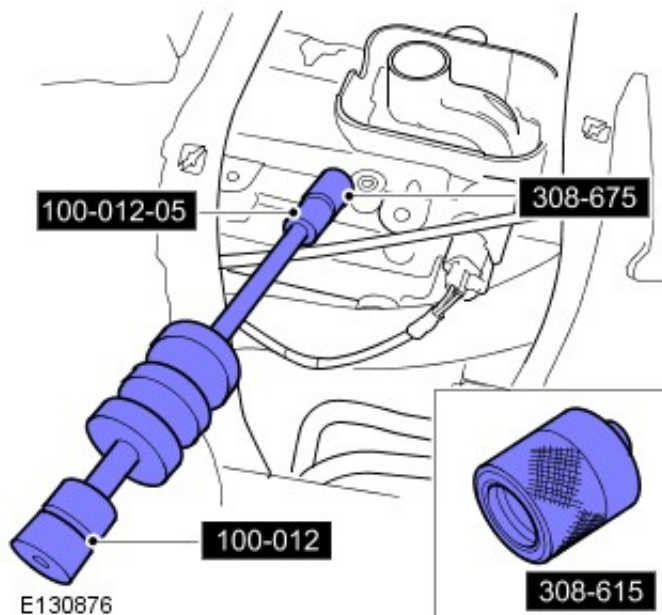
NOTE: The early type detents indicated in the illustration do not require drilling. Use the special tool shown for detent removal.

Using special tools, remove the selector shaft detent.

6.  **CAUTION:** Make sure area surrounding component is clean.

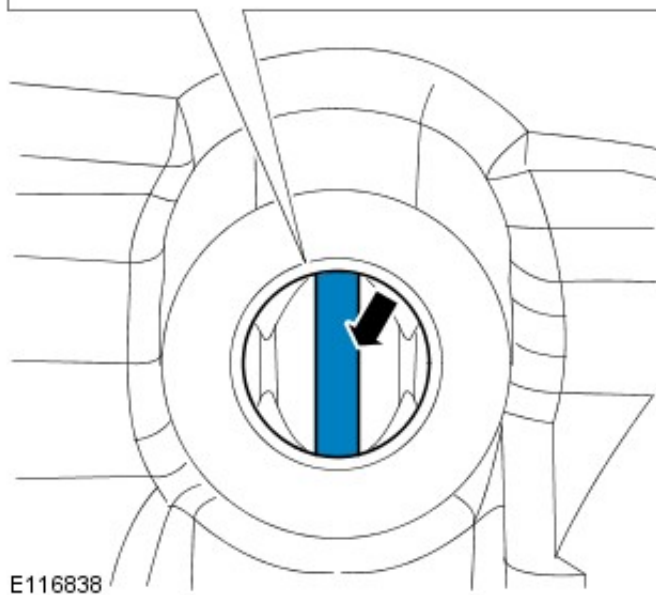
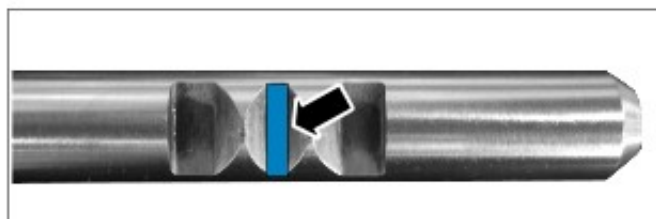
Using the appropriate special tools, remove the selector

shaft detent.



7. With the 1st, 2nd and reverse gear selector rail detents removed, the shafts must be centralized in the neutral position as indicated, viewed through the detent bores in the casting.

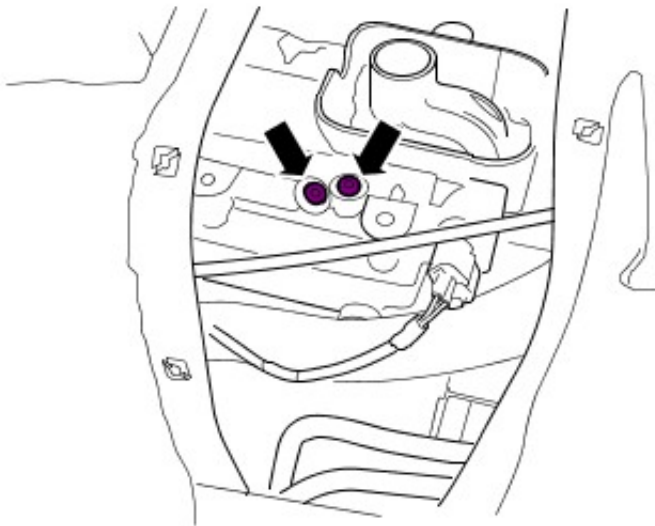
- The shafts can be centralized by carefully moving the selector to the central position using a suitable flat blade screwdriver.
- With the shafts centralized, check that 3rd and 4th gears and full cross gate movement can be achieved.



Installation

1.  **CAUTION:** New selector shaft detents must be seated flush with transmission casing.

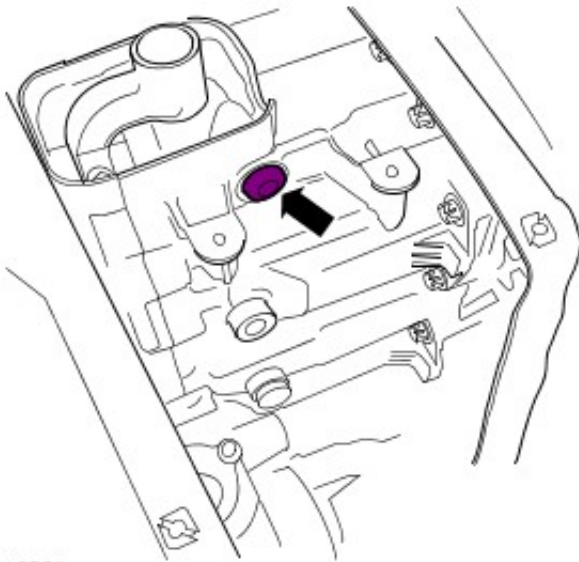
Using suitable tools, install selector shaft detents.



E116837

2.  **CAUTION:** Make sure component is fully seated against the casing.

Using suitable tools, install selector shaft detent.



E116834

3. Install the gearshift lever. For additional information, refer to: Gearshift Lever (308-06, Removal and Installation).

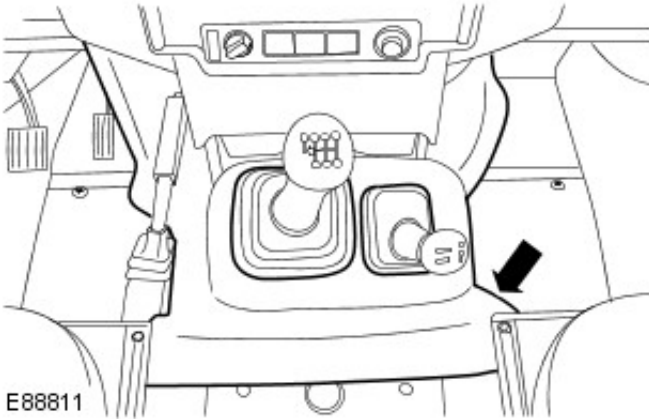
Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Transmission

Removal

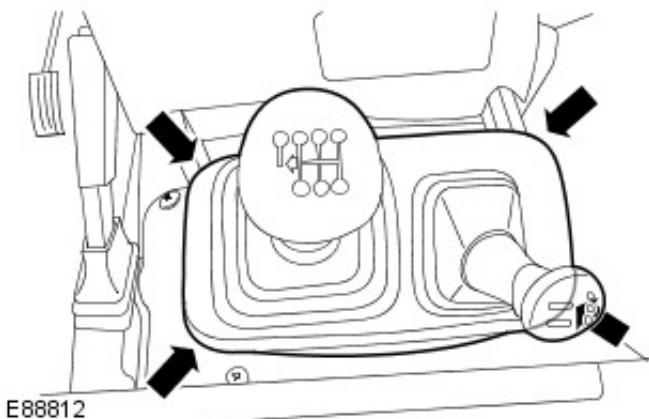
Removal


1. Open the front door.
2. For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

3. Remove the transmission cover panel carpet.

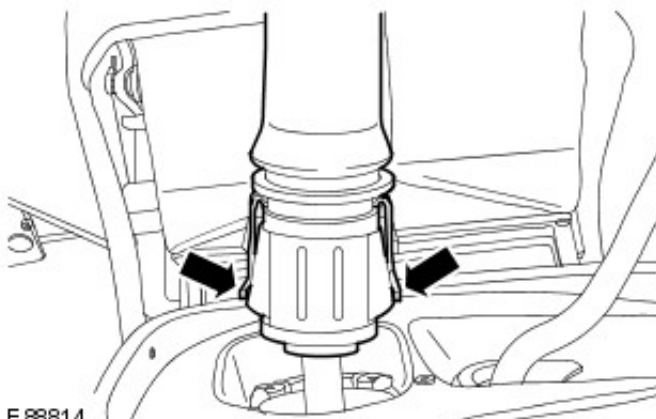


4. Release the gear selector lever gaiter, from the high-low selector lever.
 1. Release the gear selector lever gaitor from the transmission tunnel.

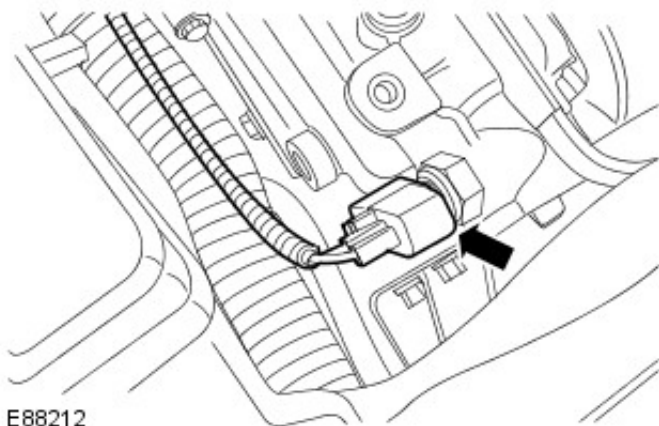


5.  **WARNING:** The gearshift lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Remove the upper gear change lever.




6. Remove the gear selector lever gaiter.
7. Disconnect the reverse light switch electrical connector.



8. Open the bonnet for access.

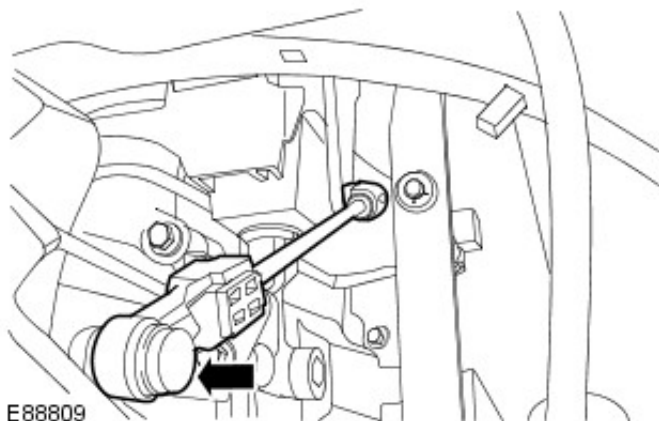
9. For additional information, refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00 Exhaust System - ID4 2.2L Diesel, Removal and Installation).

10.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

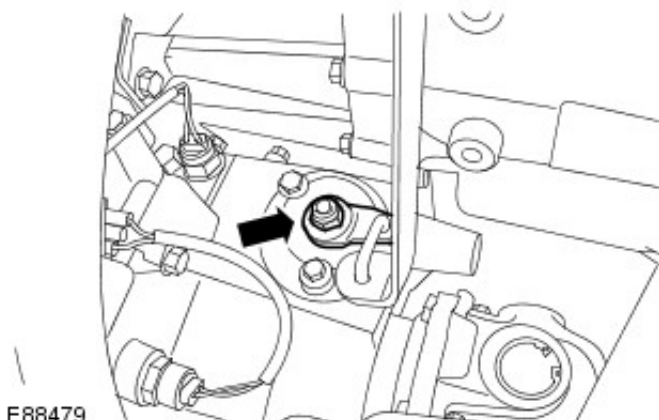
Raise the vehicle on lift.

11. For additional information, refer to: [Front Muffler](#) (309-00 Exhaust System - ID4 2.2L Diesel, Removal and Installation).

12. Release the high-low selector rod ball joint from the transfer gearbox.



13. Remove the securing nut at the lower end of pivot arm and disconnect differential lock control operating rod.



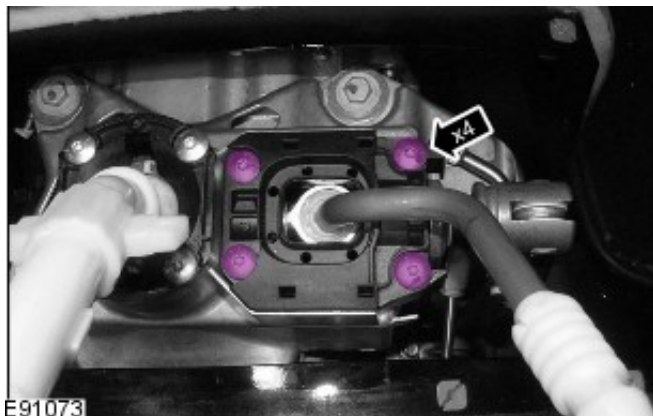
14. Lower the vehicle.

15. Open the front door.

16. Remove the foam pad from around the selector levers.

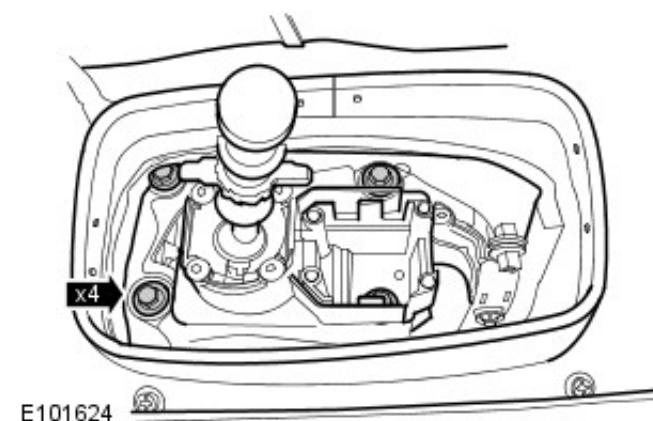



17. Remove the 4 high-low selector lever securing bolts.



18. Remove the high-low selector lever.

19. Remove the 4 gear selector housing securing bolts.



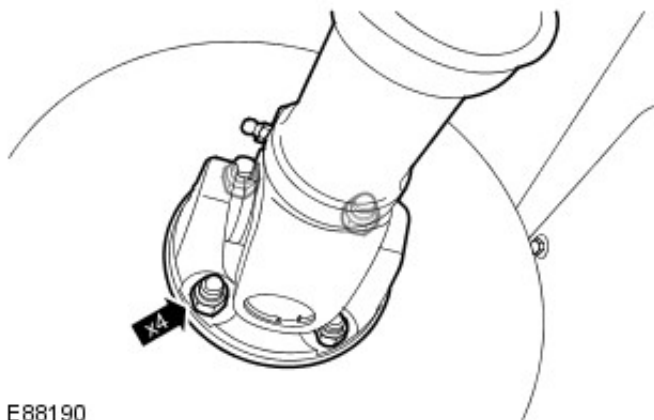
20.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise the vehicle on lift.

21. For additional information, refer to: [Front Driveshaft](#) (205-01 Driveshaft, Removal and Installation).

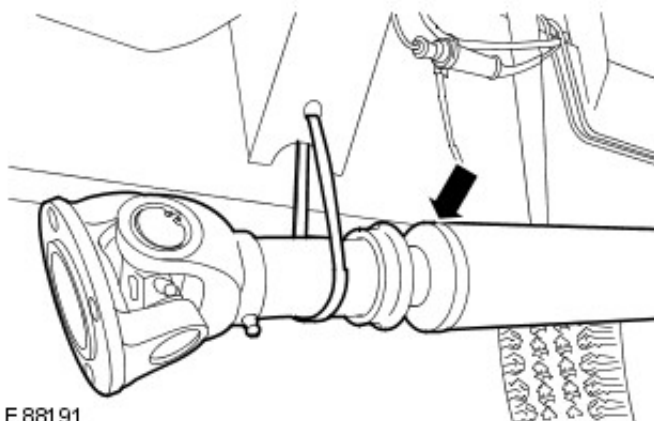
22. Displace and reposition the rear driveshaft.

1. Mark the position of the driveshaft in relation to the drive pinion flange.
2. Remove the rear driveshaft to transfer gearbox securing nuts.



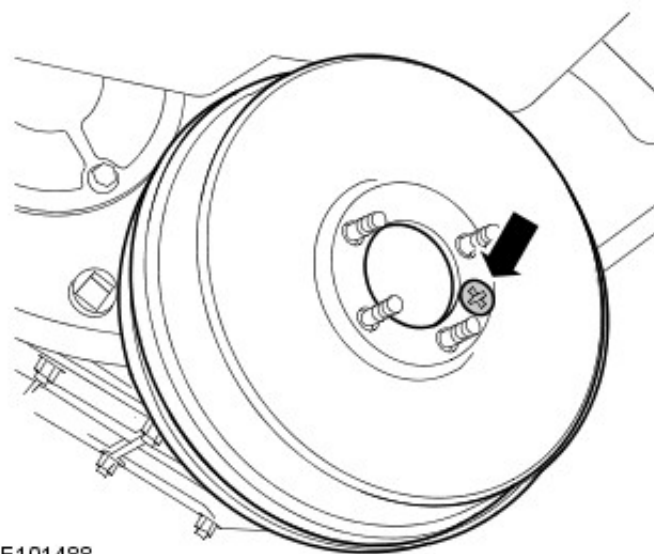
E88190

23. Using a suitable tie strap, secure the rear driveshaft to the chassis.



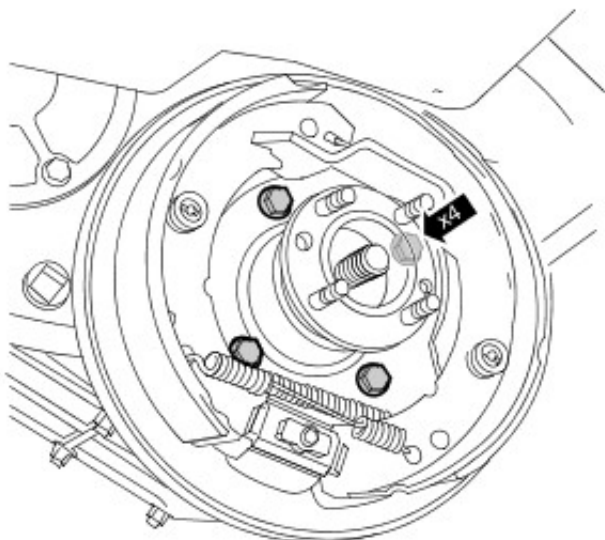
E 88191

24. Remove the parking brake drum.
 1. Remove the securing screw.



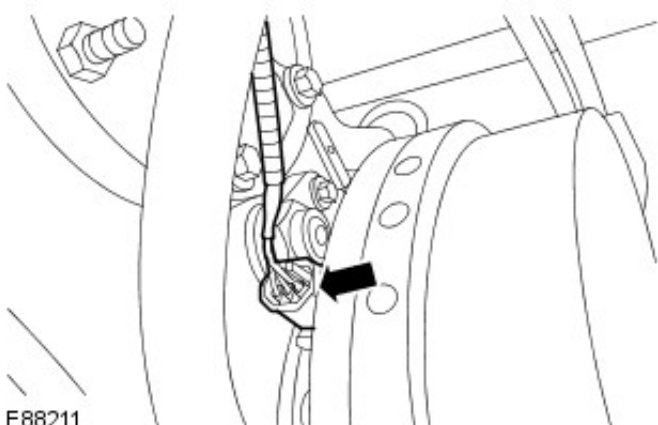
E101488

25. Remove the handbrake assembly and tie aside.



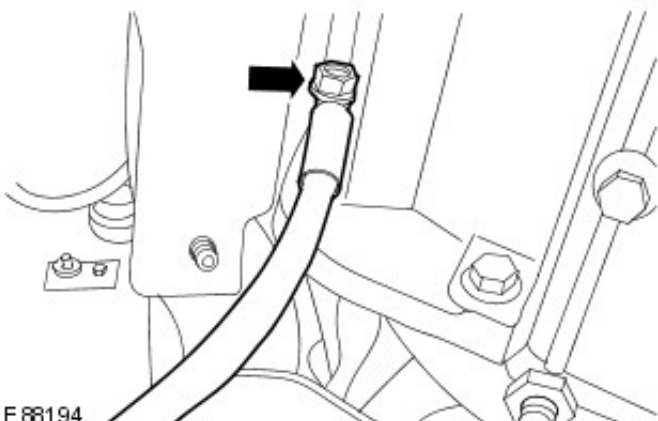
E101489

26. Disconnect the electronic speedometer drive electrical connector from the transfer gearbox.



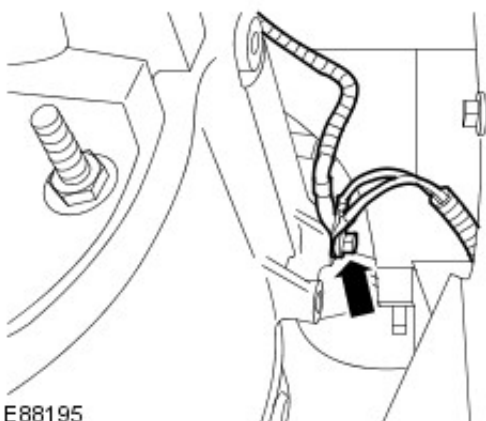
E88211

27. Remove the nut and disconnect the LH earth cable from the transfer gearbox.

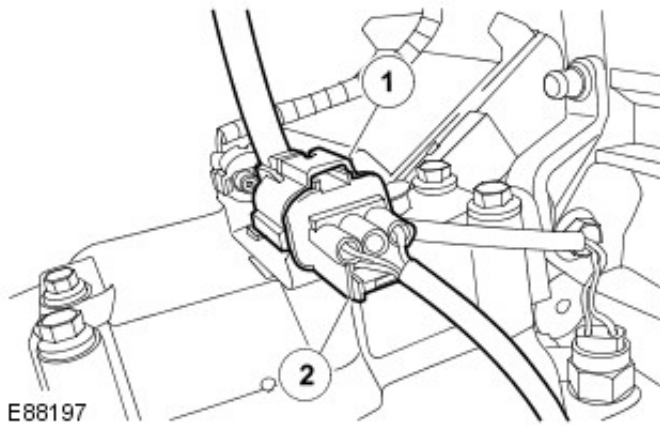


E88194

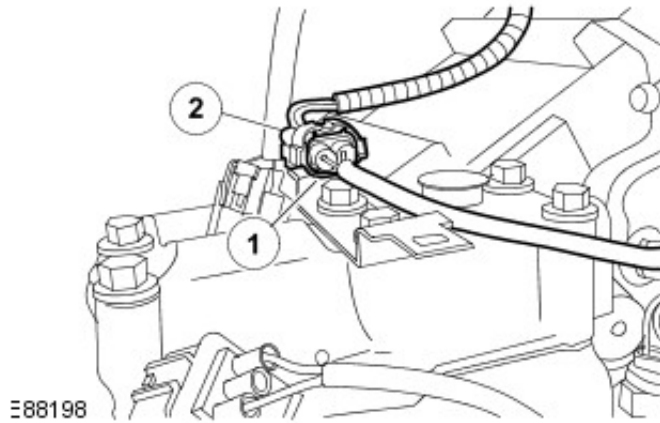
28. Remove the bolt and disconnect the RH earth cables from the transfer gearbox.



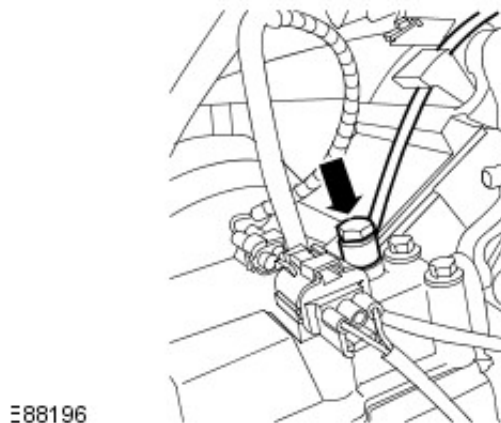
E88195



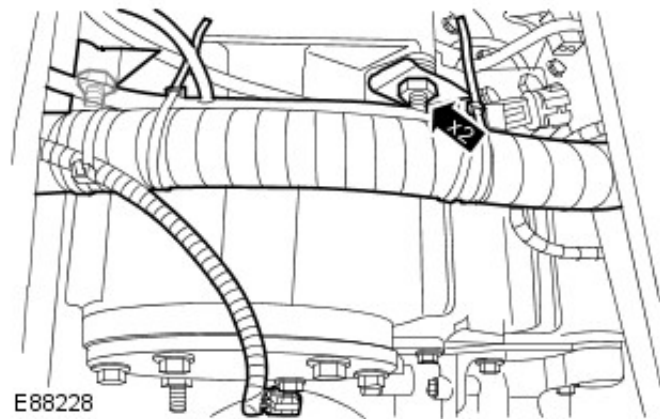
29. Displace and reposition the high-low detection switch electrical connector away from the transfer gearbox.
 1. Disconnect the high-low detection switch electrical connector.



30. Disconnect the differential lock detection switch electrical connector.
 1. Release the electrical connector from the bracket.

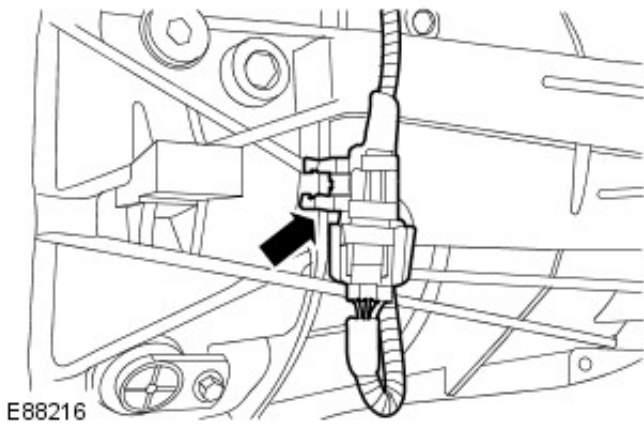


31. Release the breather pipe from the transfer gearbox.
 1. Remove the securing bolt.
 2. Remove and discard the 2 sealing washers.

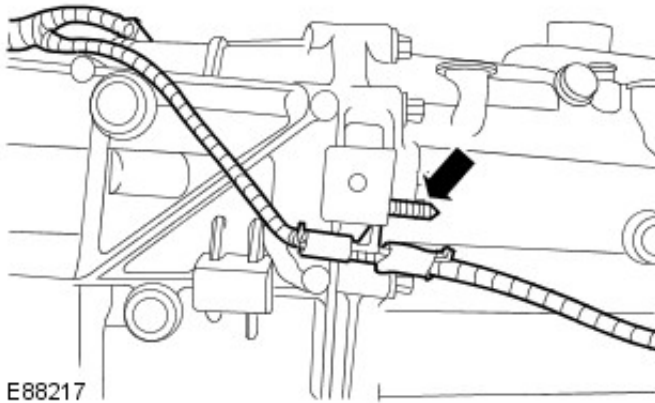


32. Remove the transmission harness retaining bracket securing nut and bolt and reposition the harness.

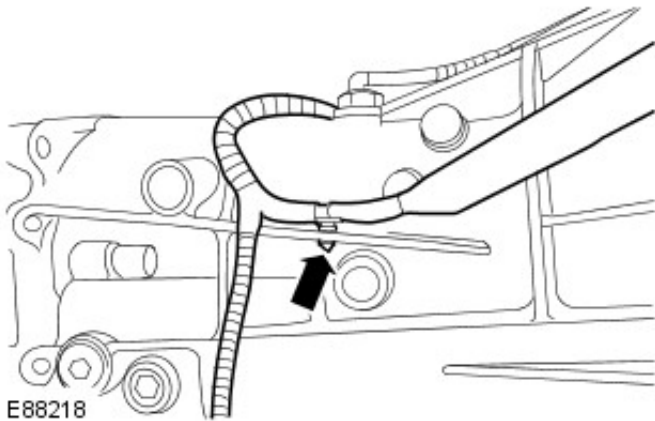
33. Release the transmission wiring harness connector and bracket from the RH side of the transmission.



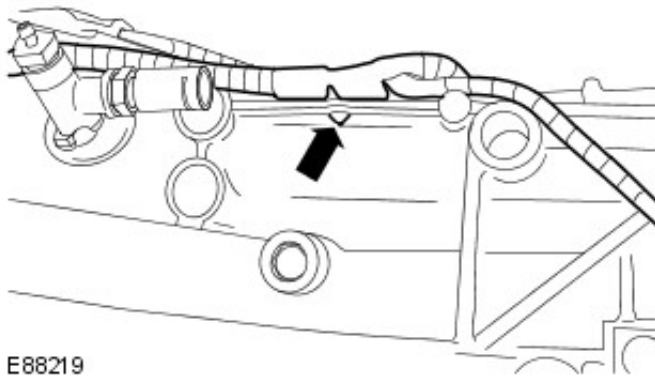
34. Release the transmission wiring harness securing clip from the LH side of the transmission.



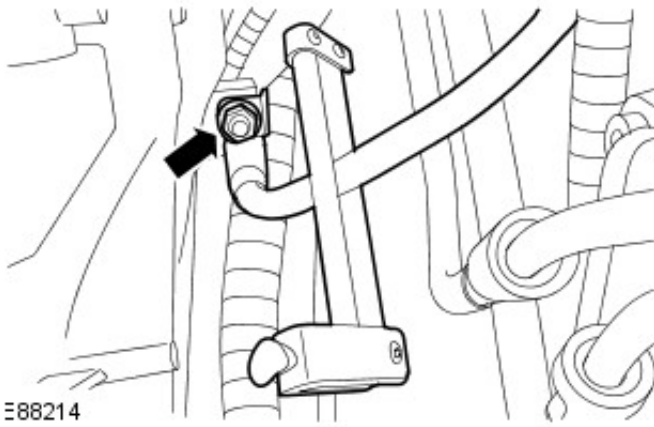
35. Release the transmission wiring harness securing clip from the RH side of the transmission.



36. Release the transmission wiring harness securing clip from the top of the transmission.

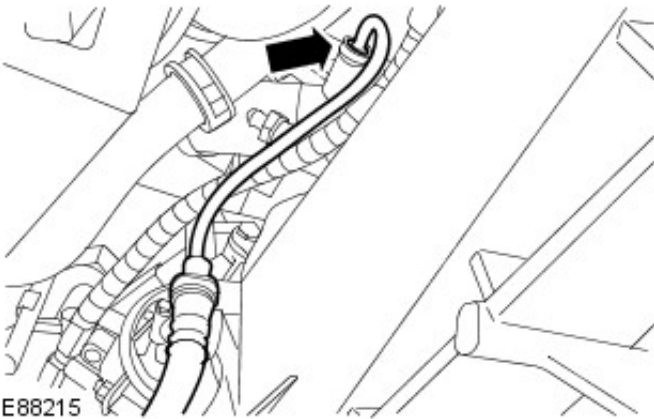


37. Remove the clutch slave cylinder fluid hose mounting bracket securing nut and bolt.
1. Install a suitable pipe clamp to the clutch slave cylinder fluid hose.

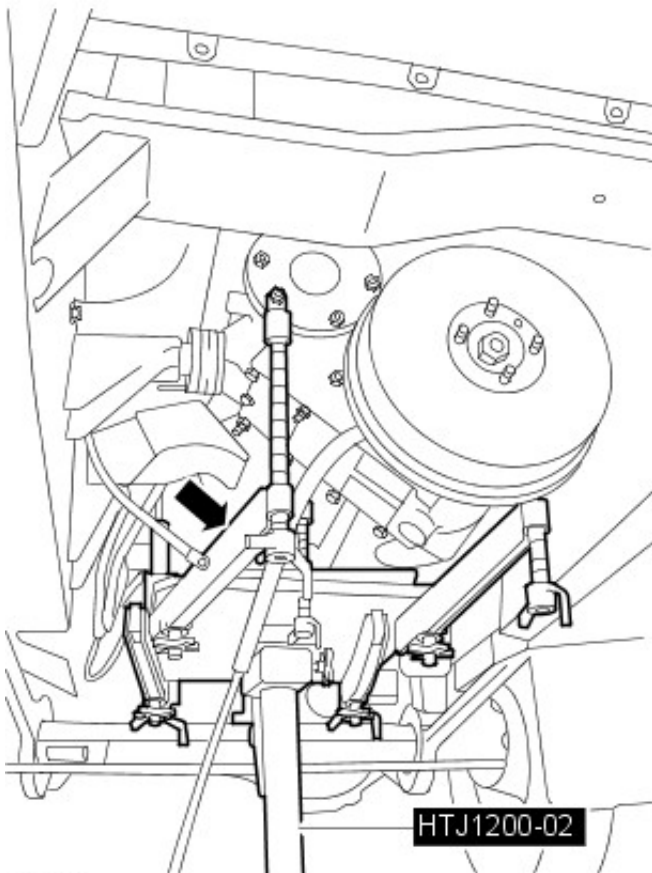


38. Disconnect the clutch slave cylinder fluid hose from the clutch slave cylinder.

1. Remove the clutch slave cylinder line clip.
2. Remove and discard the O-ring seal

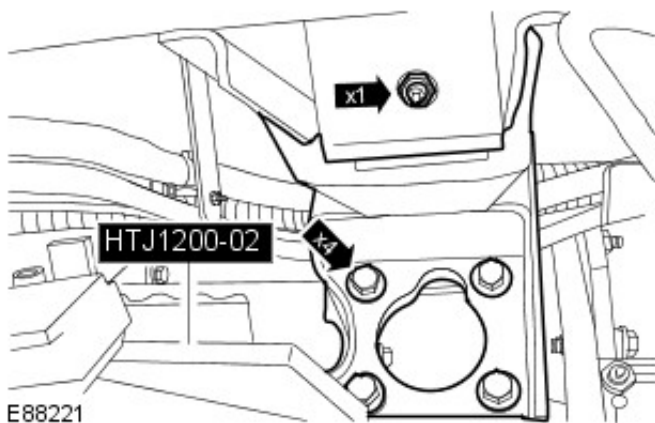


39. Install the special tool HTJ1200-02 to the transmission and transfer gearbox.

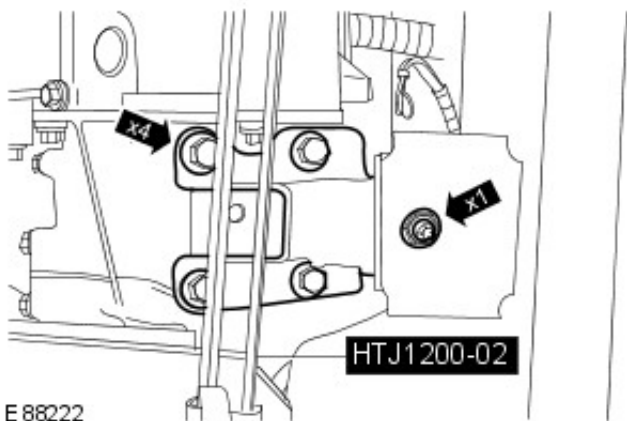


40. Remove the LH transmission mount and mounting bracket.

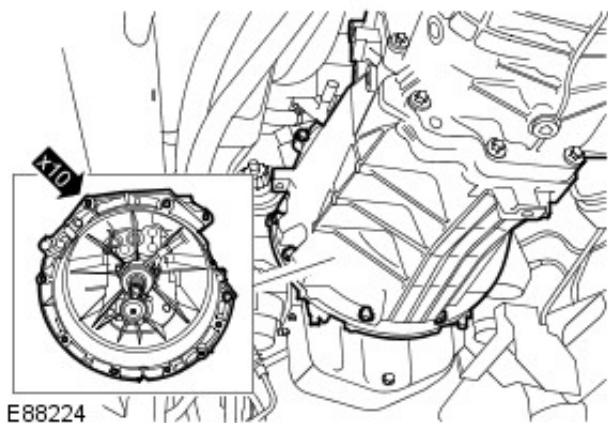
1. Remove the LH transmission mount and mounting bracket securing nuts and bolts.



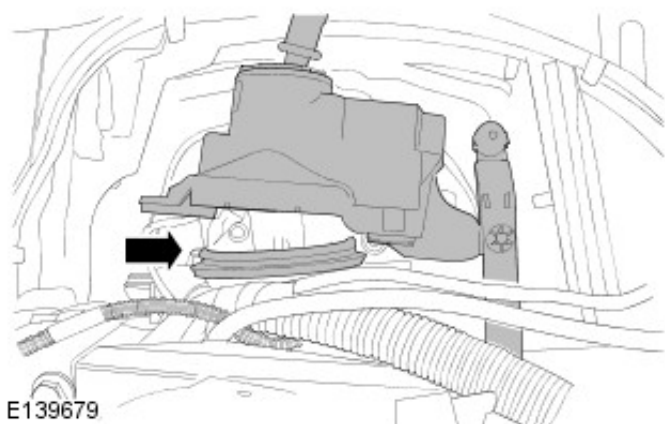
41. Remove the RH transfer gearbox mounting bracket.
1. Remove the RH transfer gearbox mount and mounting bracket securing nuts and bolts.




42. Remove the bell housing bolts.

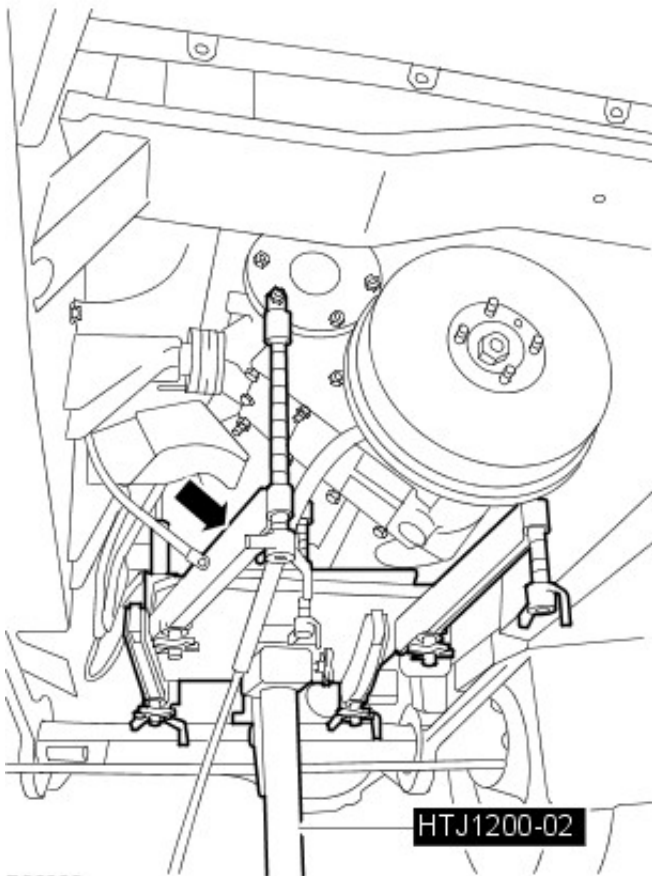


43. Remove the gear selector housing.
1. Reposition the transmission to allow access to the gear selectort housing.
 2. Remove from below the vehicle.
 3. Remove the rubber seal.



44.  **WARNING:** Disengage the transmission from the clutch by 30mm before lowering HTJ1200-02 to protect clutch from damage.

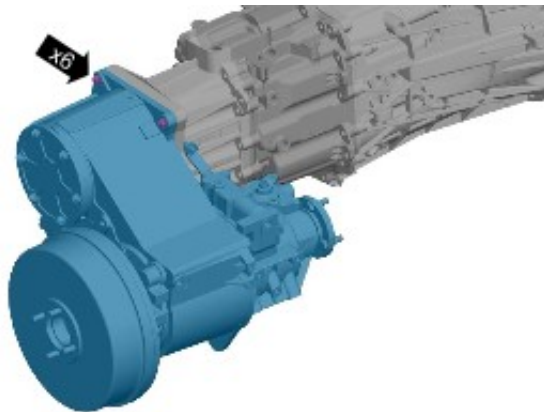
Remove the transmission and transfer gearbox from the vehicle.



E88220

45. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the transmission from the special tool.



E90815

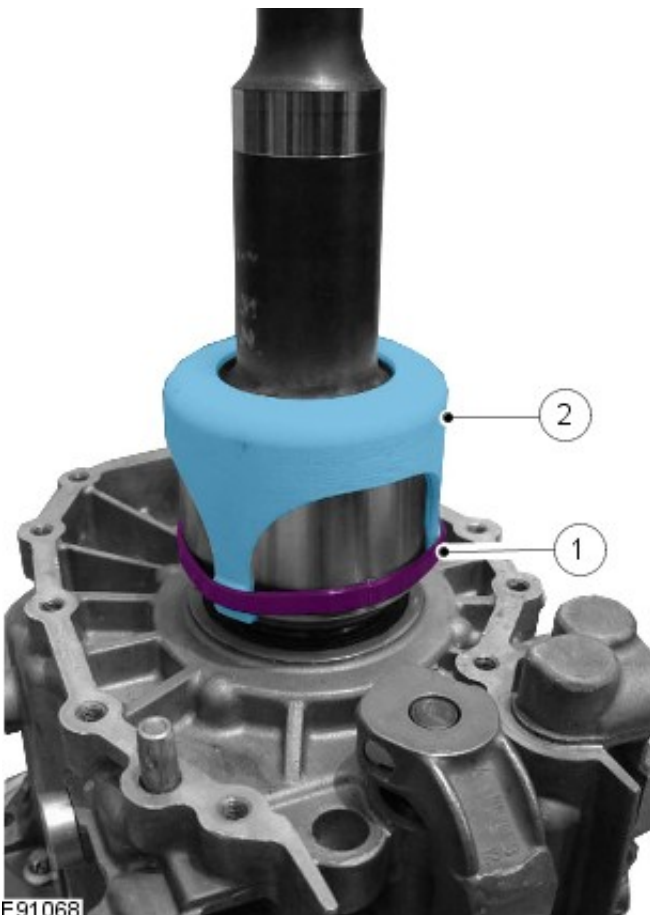
46. With assistance, remove the transfer case.
1. Remove the four bolts.
 2. Remove the two nuts.

47. Remove the transmission extension housing.
1. Remove the 10 bolts.



E91067

48. Remove the transmission extension shaft cover.
1. Remove the tie strap.
 2. Remove the cover.

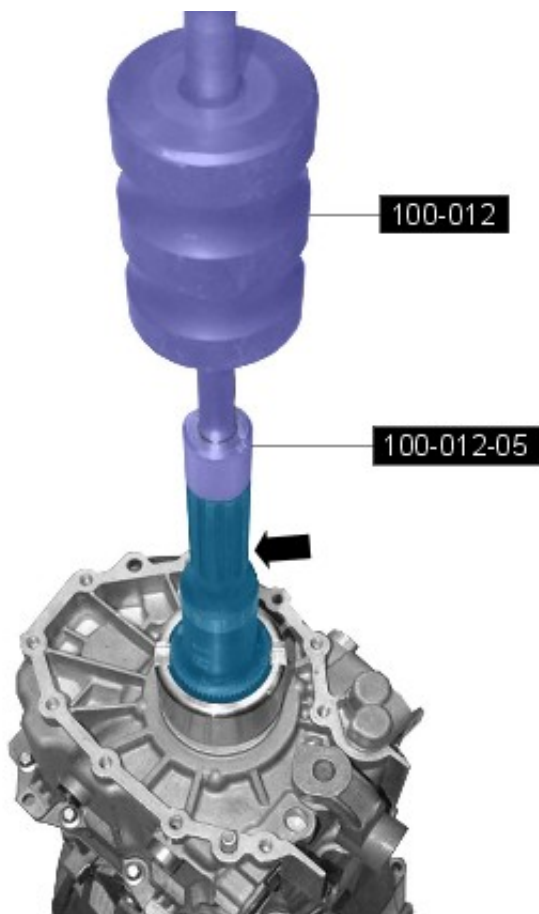


E91068

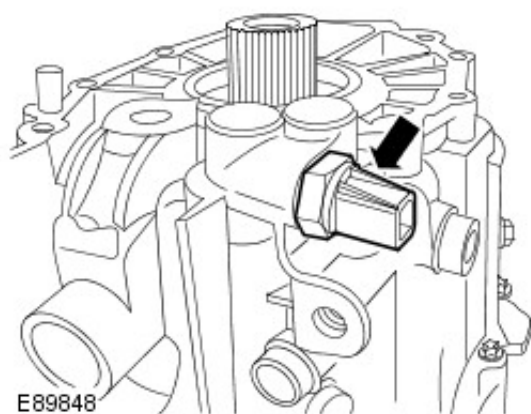
49. Remove the seal.



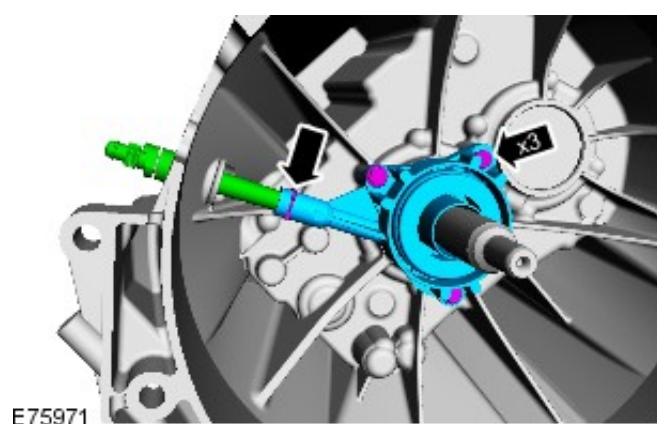
50. Using the special tools, remove the transmission extension shaft.



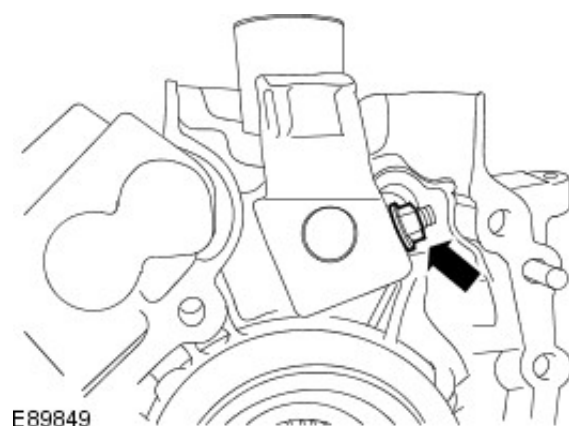
51. Remove the reversing lamp switch.



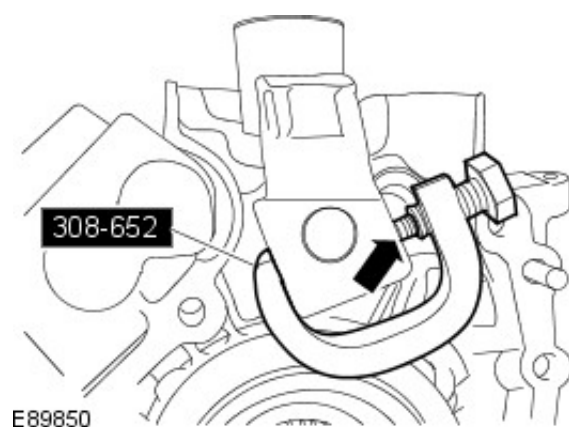
52. Remove the clutch slave cylinder.
1. Remove the connecting pipe securing clip.
 2. Remove the connecting pipe.
 3. Remove the 3 bolts.



53. Remove the gearshift yoke securing nut.



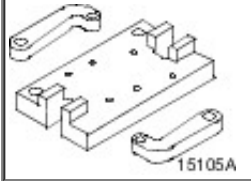
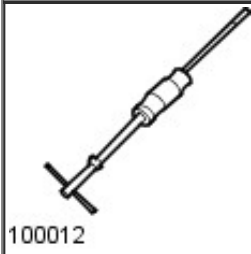

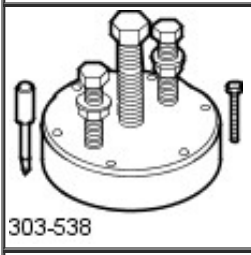

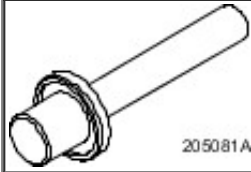
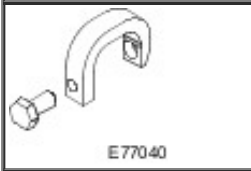

54. Using the special tool, remove the gearshift yoke.
1. Remove the pin.


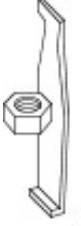
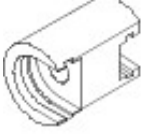
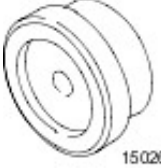
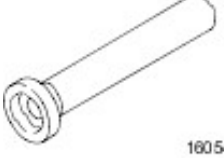
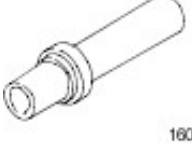

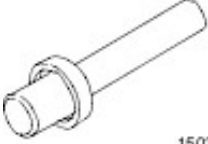




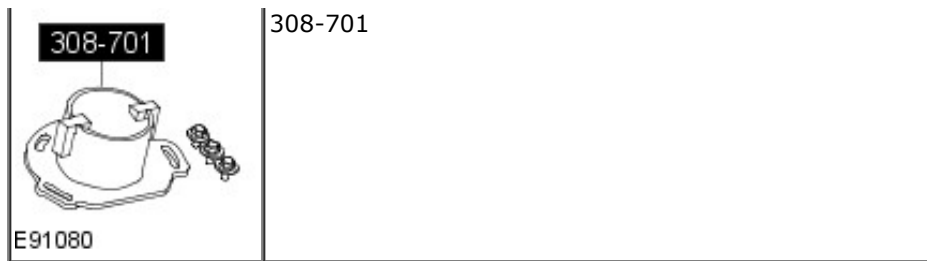
Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Transmission

Disassembly

Special Tool(s)


 <p>15105A</p>	Mounting Bracket, Engine/Differential 205-329
 <p>100012</p>	Slide Hammer 100-012
 <p>E52741</p>	Remover Seals 308-615
 <p>303-538</p>	Rear Seal Remover/Replacer. 303-538
 <p>308-516 E90665</p>	Puller 308-516
 <p>205081A</p>	Installer 205-081A
 <p>E77040</p>	Remover Slider 308-652
 <p>E52749</p>	Remover Selector Shaft Seal 308-621
	Adaptor Slide Hammer 100-012-01

 <p>100-012-01</p>	
 <p>308-375</p>	<p>Seal Remover Input & Output</p> <p>308-375</p>
 <p>E 792 52</p>	<p>Remover, Detent</p> <p>308-657</p>
 <p>15026A01</p>	<p>Adapter for 205-071 (Thrust Pad)</p> <p>205-071-01</p>
 <p>16054</p>	<p>Installer, Mainshaft Double Lip Seal</p> <p>308-150</p>
 <p>16014</p>	<p>Installer, Transmission Extension Housing Bushing/Seal</p> <p>308-044</p>
 <p>TH15091</p>	<p>Remover, Bearing/Gear</p> <p>205-310</p>
 <p>15037</p>	<p>Installer, Differential Bearing</p> <p>205-082</p>
 <p>E91079</p>	<p>Remover, Countershaft Bearing Outer Race</p> <p>100-012-06</p>
 <p>E91077</p>	<p>Adapter, Slide Hammer</p> <p>100-012-05</p>
	<p>Locking Tool, Output Flange</p>

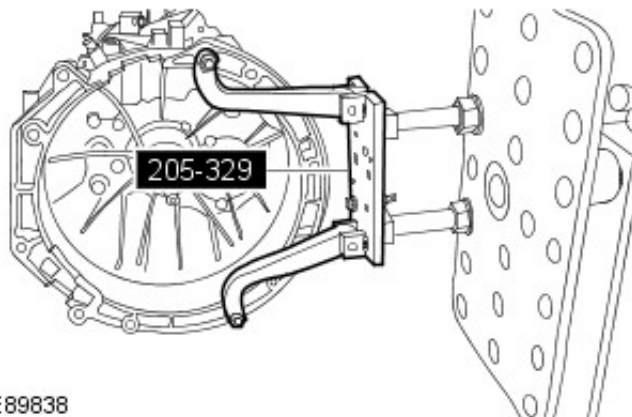


Disassembly

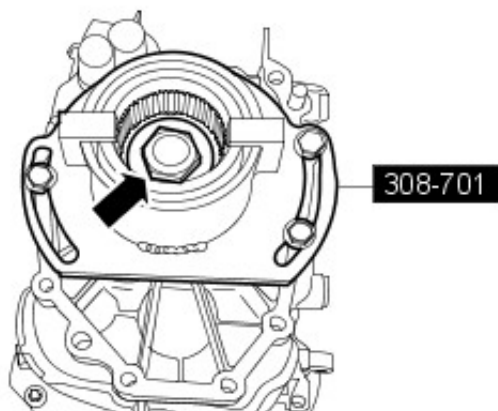
NOTE: Make sure the positions of the transmission component are marked before removal.

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

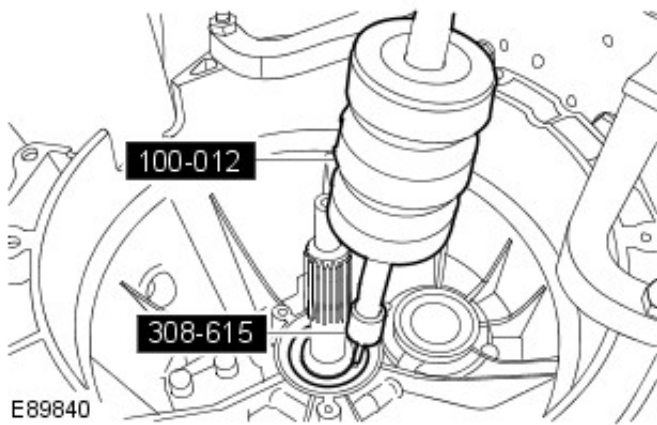
Raise and support the vehicle.
3. Drain the transmission oil.
For additional information, refer to: Transmission Draining and Filling (308-03, General Procedures).
4. Remove the transmission.
For additional information, refer to: Transmission (308-03, Removal).
5. Using the special tools, secure the transmission.



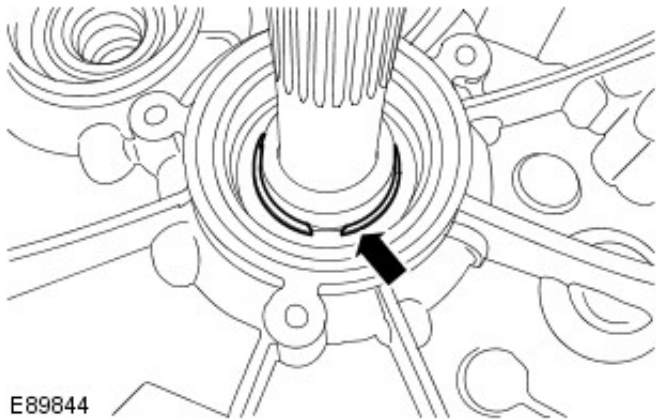
6. Using the special tool, lock the output shaft flange.
 - Remove the bolt.



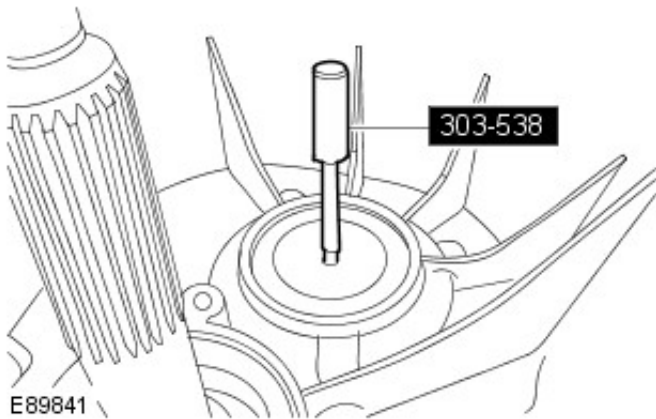
7. Using the special tools, remove and discard the input shaft seal.



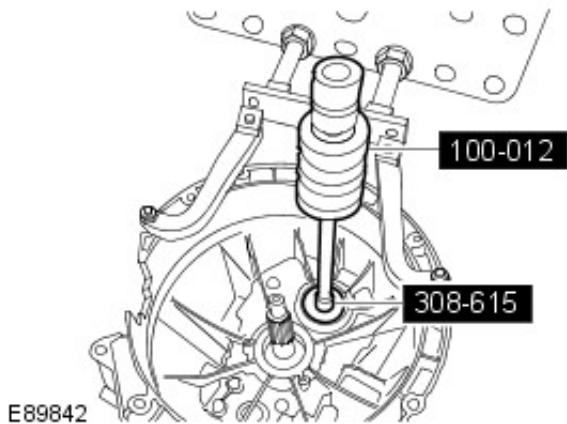
8. Remove and discard the input shaft snap ring.



9. Using the special tool, make a hole in the countershaft seal.

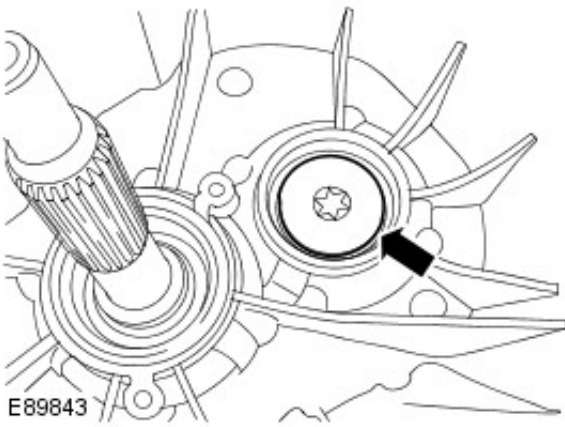


10. Using the special tools, remove and discard the countershaft seal.

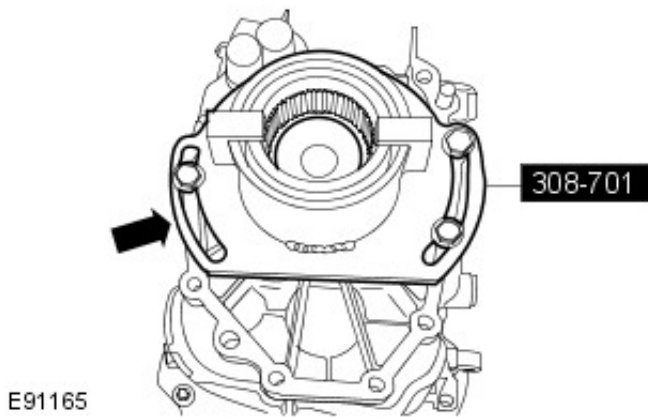


11. **NOTE:** Make sure that a gear is selected.

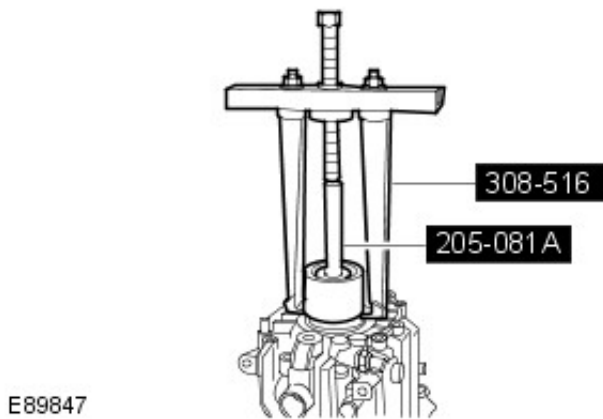
Remove the countershaft bolt.



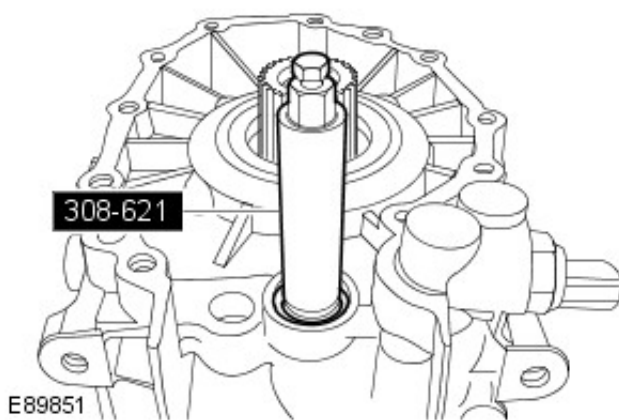
12. Remove the special tool.



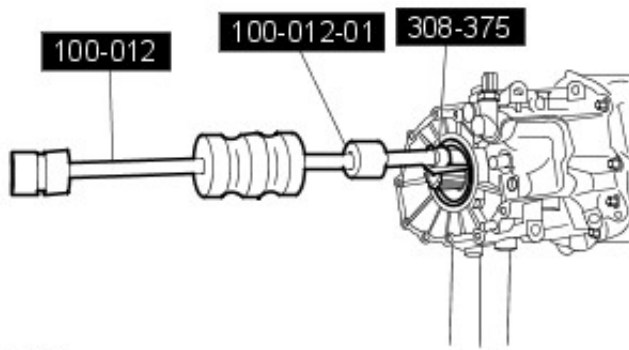
13. Using the special tools, remove the output shaft flange.



14. Using the special tool, remove the selector shaft seal.

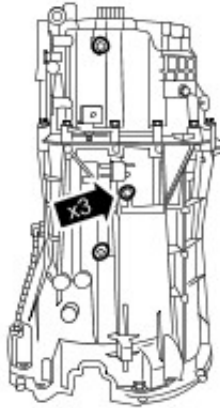


15. Using the special tools, remove the output shaft seal.



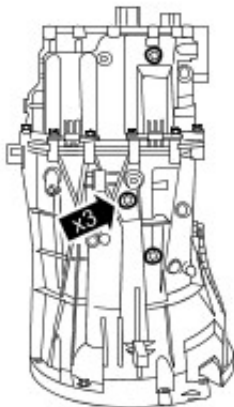
E89852

16. Remove the 3 LH selector fork bolts.



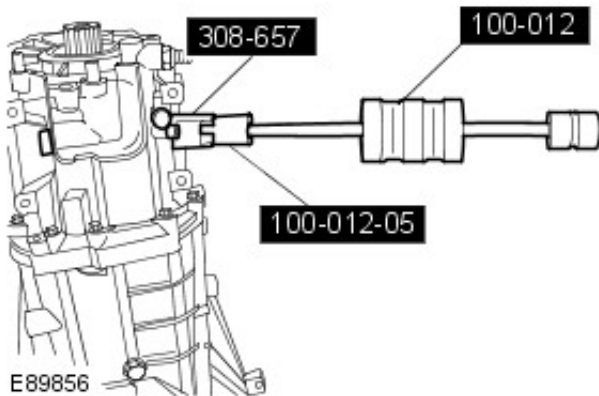
E89853

17. Remove the 3 RH selector fork bolts.



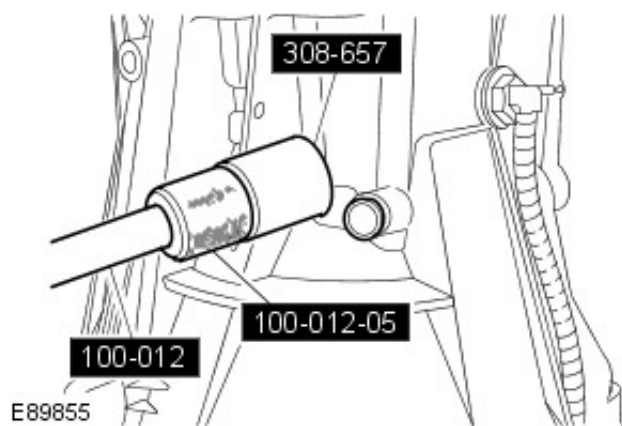
E89854

18. Using the special tools, remove the 3 selector shaft detents.

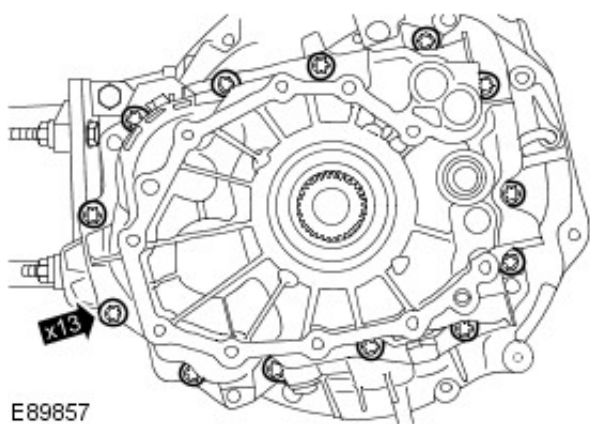


E89856

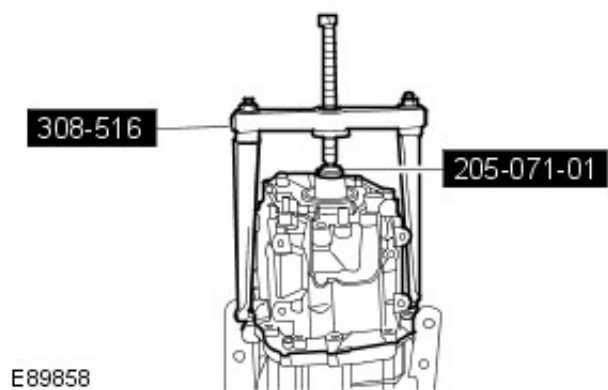
19. Remove the 2 selector shaft detents.



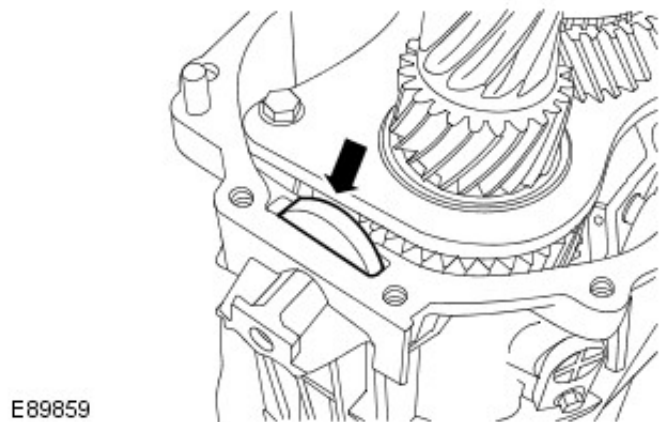
20. Remove the 13 bolts.



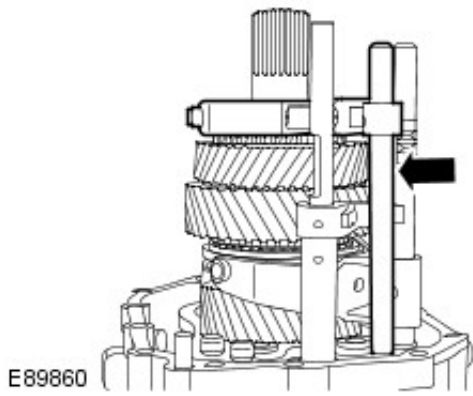
21. Using the special tools, remove the transmission housing.



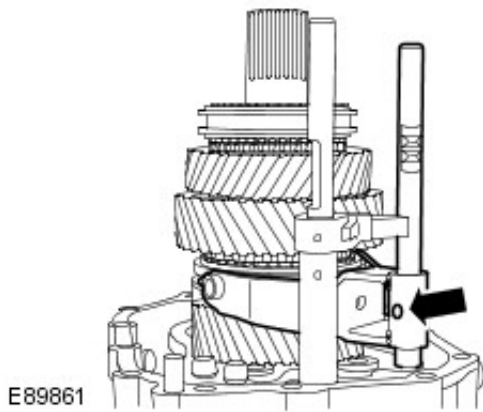
22. Remove the magnet.



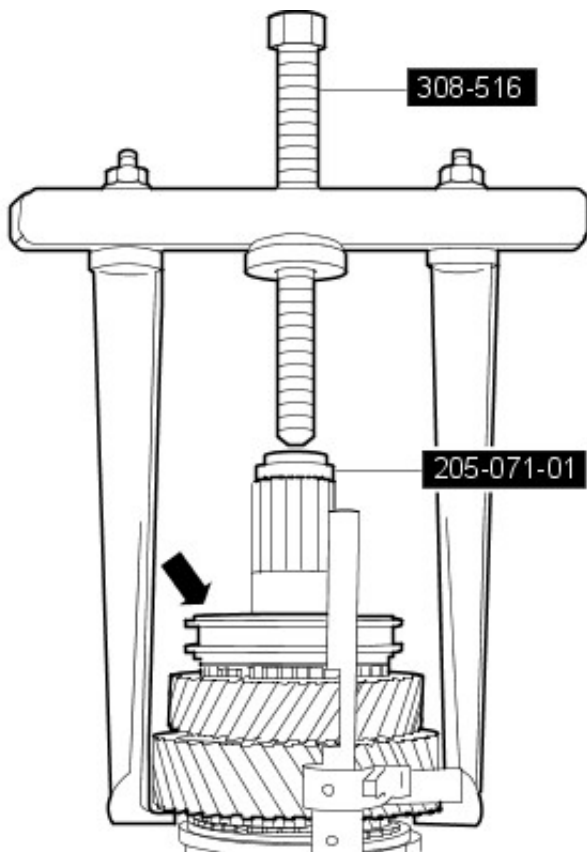
23. Remove the reverse gear selector.



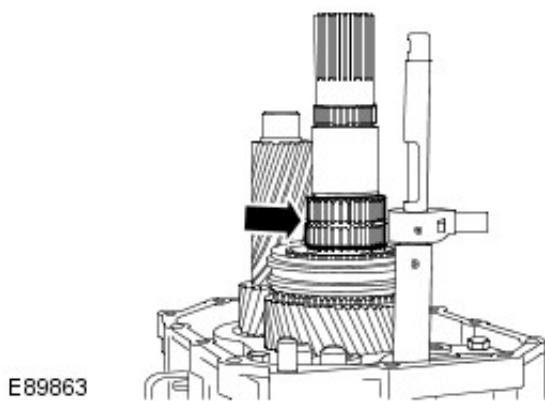
24. Remove the 1st/2nd gear selector.
- Remove and discard the pin.



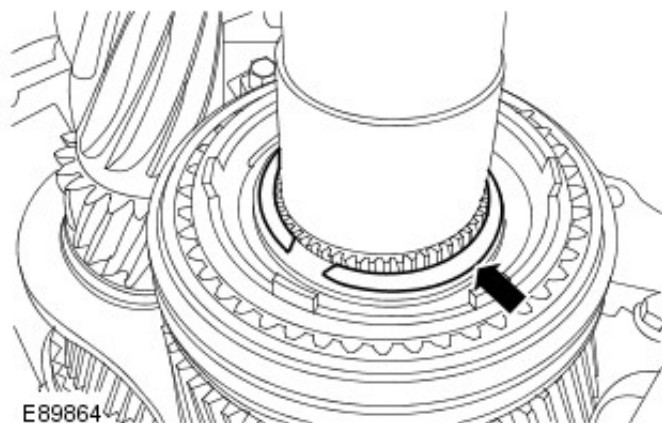
25. Using the special tools, remove the 1st and reverse gear assemblies from the output shaft.



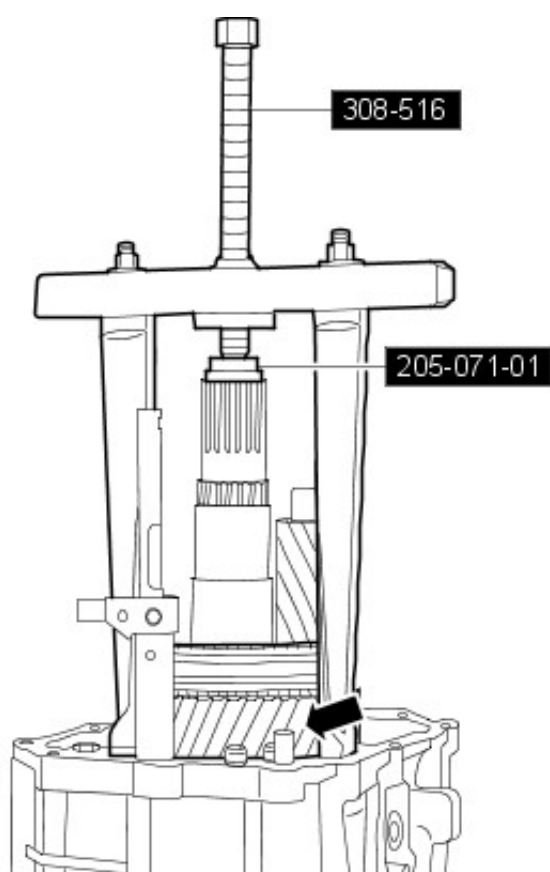
26. Remove the 1st gear bearing.



27. Remove the 1st/2nd gear synchronizer snap ring.



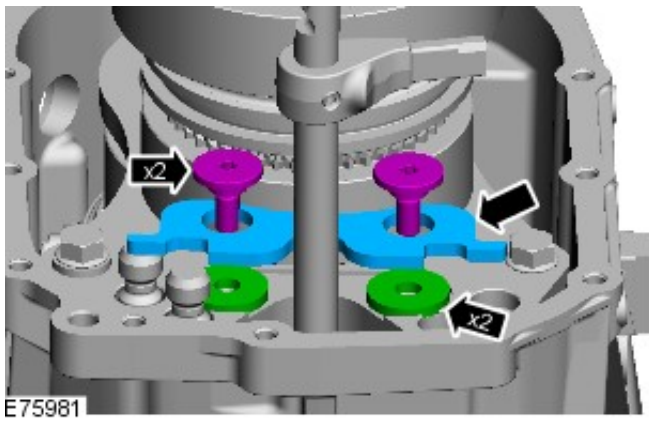
28. Using the special tools, remove the 2nd gear and 1st/2nd gear synchronizer assemblies from the output shaft.



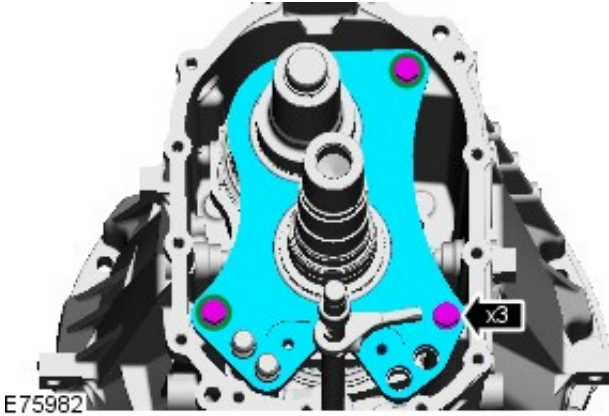
E89865

29. Remove the selector shaft locking plate.

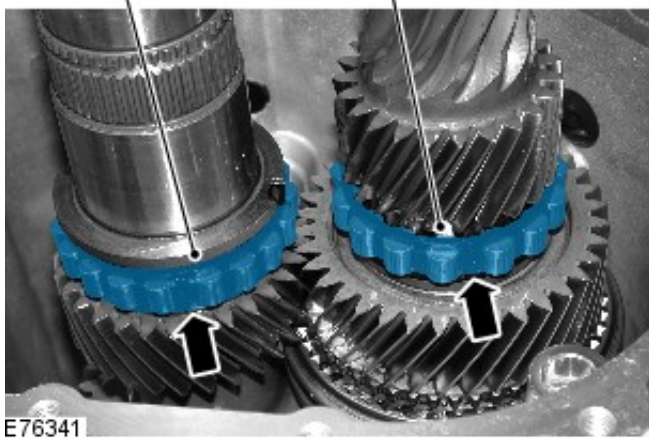
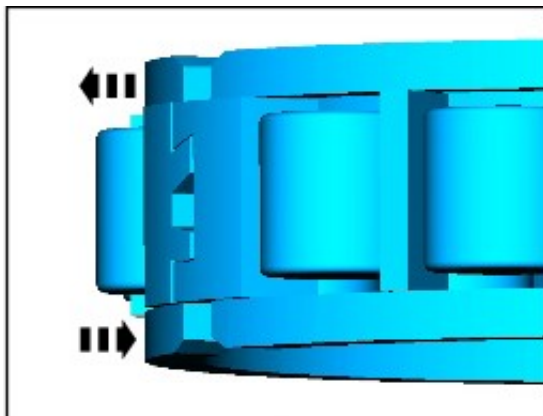
- Remove the 2 bolts.
- Remove the 2 spacers.



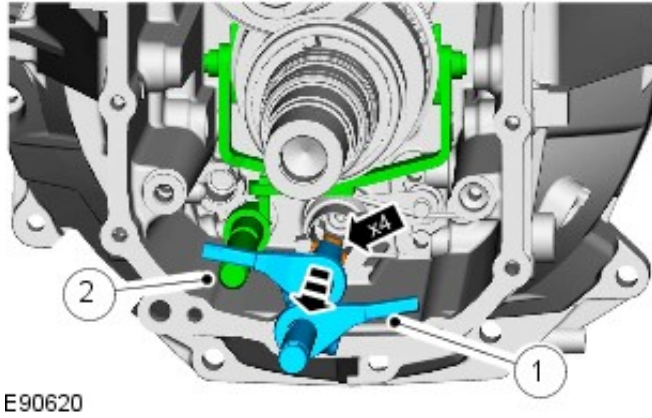
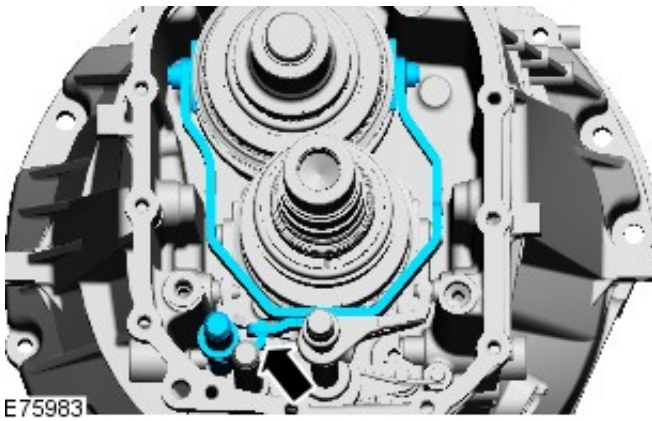
30. Remove the centre bearing mounting plate.
- Remove the 3 bolts.



31. Remove the centre bearings.



32. Remove the 3rd/4th gear selector from the transmission housing.
- Release the selector fork from the selector shaft.

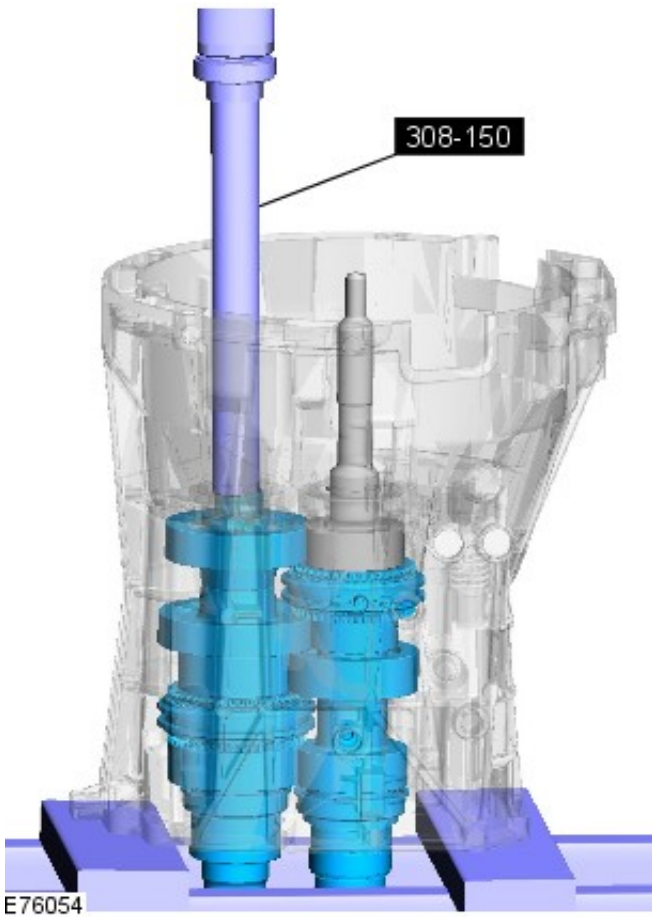


33. NOTE: Take care not to lose the 4 main selector shaft bearings.

Remove the selectors.

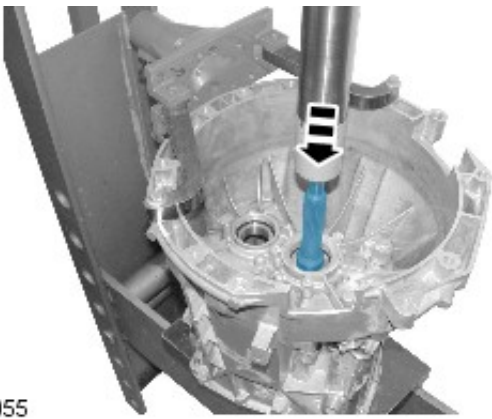
1. Remove the main selector.
2. Remove the 5th/6th selector.

34. With an assistant, remove the shaft assemblies.



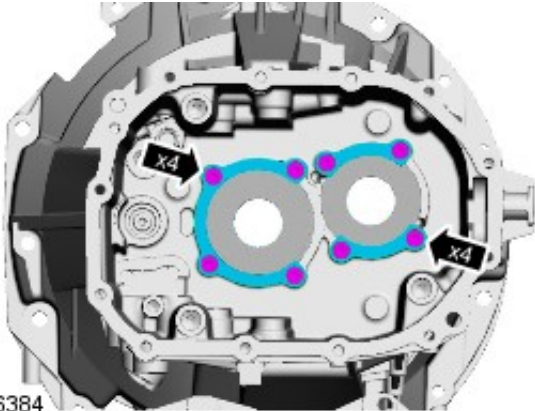
35. Remove the input shaft.

E76055



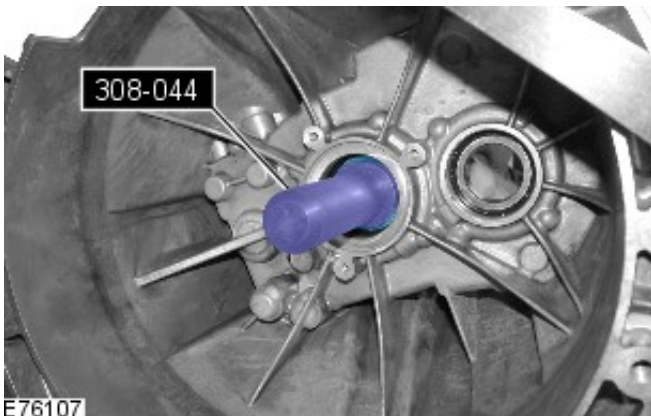
36. Remove the 2 bearing retaining plates.
- Remove the 8 bolts.

E76384



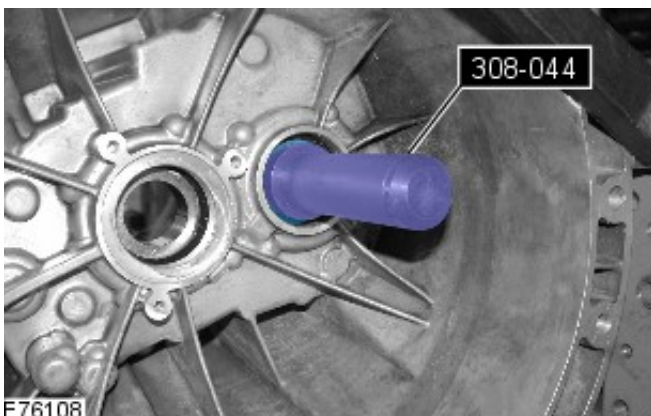
37. Using the special tool, remove the input shaft bearing.

E76107



38. Using the special tool, remove the countershaft bearing.

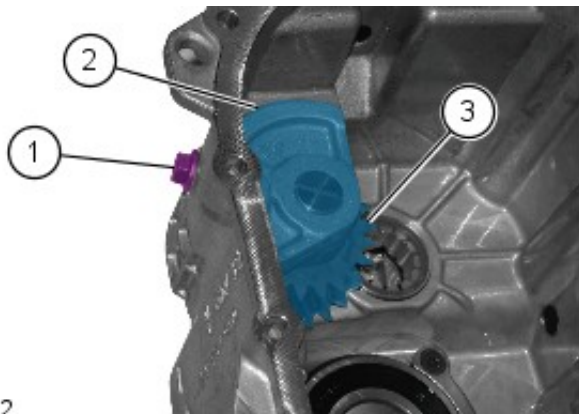
E76108



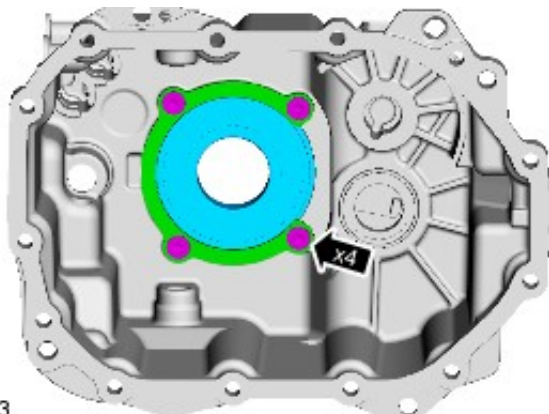
39. **NOTE:** Note the positions of the components on removal.

Remove the components in the sequence shown.

1. Reverse gear idler mounting bolt.
2. Reverse gear idler mounting.
3. Reverse gear idler.
4. Countershaft roller bearing.



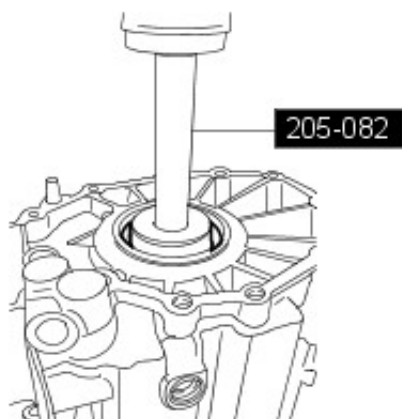
E76342



E76383

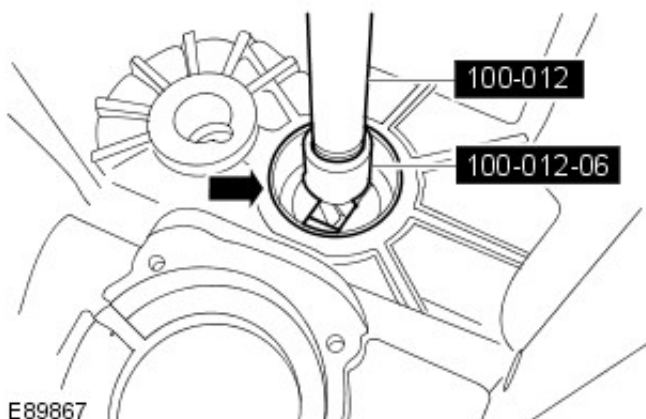
40. Remove the output shaft bearing retaining plate.
- Remove the 4 bolts.

41. Using the special tool, remove the output shaft bearing.



E90163

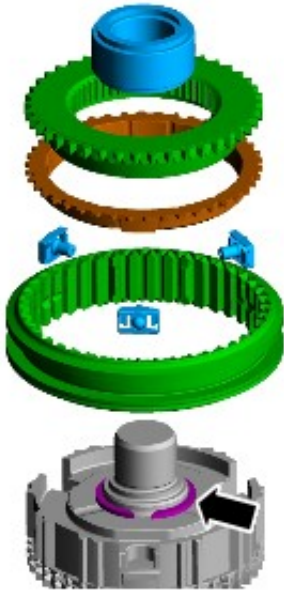
42. Using the special tools, remove the countershaft bearing outer race.



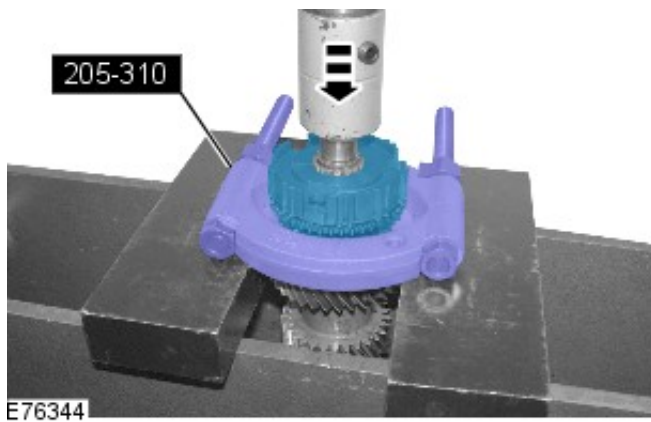
E89867

43. Remove the output shaft pilot bearing and the 5th gear synchronizer assembly from the output shaft.
- Remove and discard the snap ring.

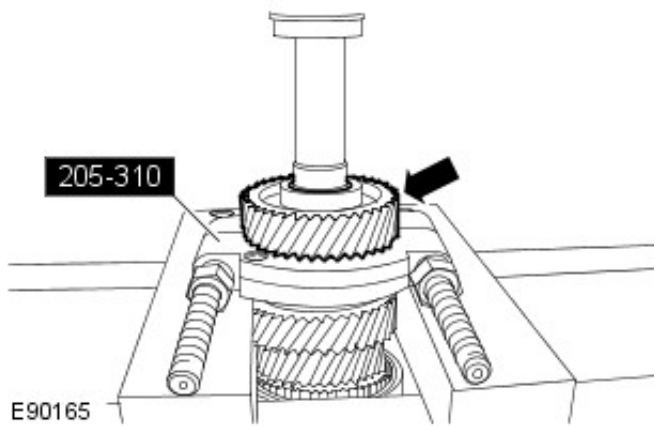
E76381



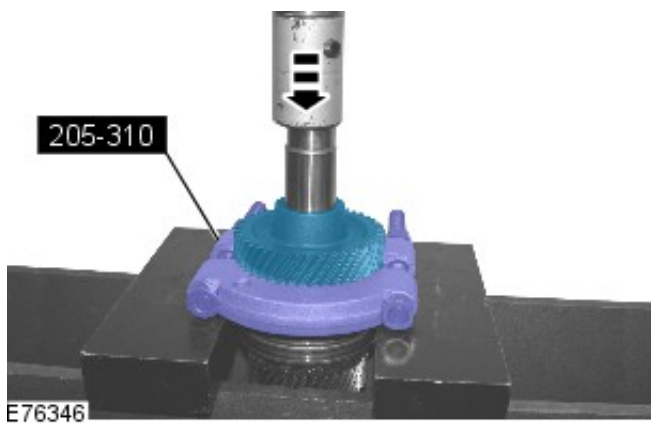
44. Using the special tool, remove the 6th gear synchronizer/hub assembly from the output shaft.



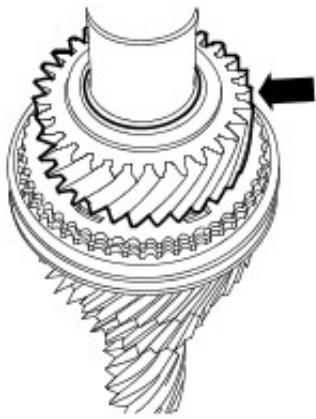
45. Using the special tool, remove the 5th gear from the countershaft.



46. Using the special tool, remove the 6th gear from the countershaft.



47. Remove the 3rd gear from the countershaft.



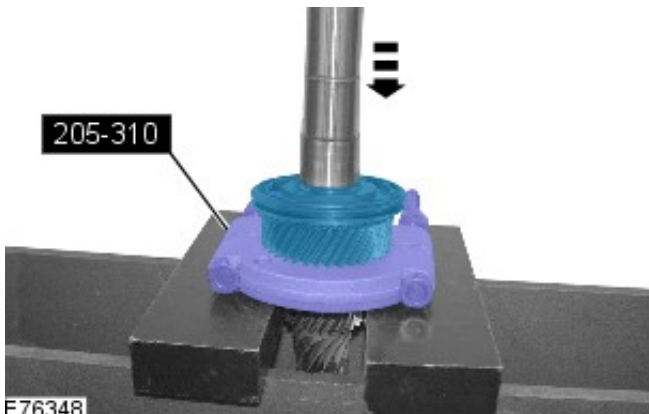
E90164

48. Remove the 3rd/4th gear synchronizer snap ring from the countershaft.



E76347

49. Using the special tool, remove the 4th gear and synchronizer assembly from the countershaft.



E76348

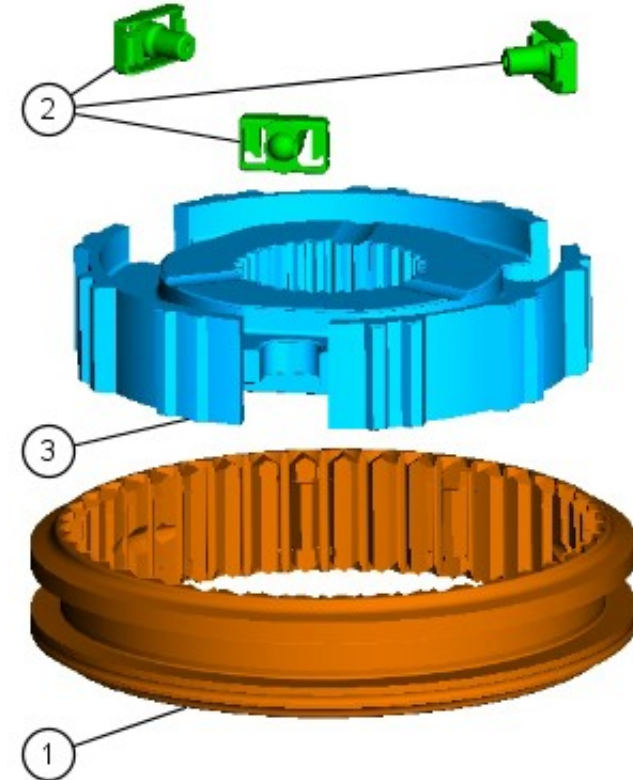
Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Synchronizers

Disassembly and Assembly of Subassemblies

Disassembly

1. **NOTE:** Make a note of/mark the installed positions of the components before removal.

1. Sliding collar.
2. Sliding block assemblies.
3. Synchronizer hub.



E80427

Assembly


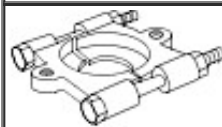
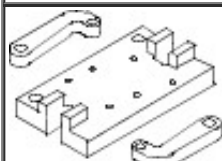

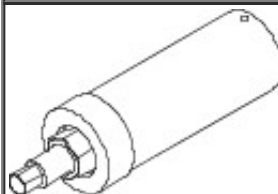

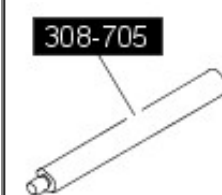

1. **NOTE:** Make sure that the components are installed in their original positions.




To install, reverse the removal procedure.

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Transmission

Assembly

Special Tool(s)

 <p>14029</p>	Installer, Front Wheel Hub Bearing Cup/Seal 204-087
 <p>TI15091</p>	Remover, Bearing/Gear 205-310
 <p>15105A</p>	Mounting Bracket, Engine/Differential 205-329
 <p>15108</p>	Protector, Axle Shaft 205-332
 <p>E49064</p>	Installer, Output Drive Flange Seal 308-604
 <p>E49153</p>	Installer, Input Shaft Seal 308-605
 <p>308-705</p> <p>E91075</p>	Handle, Bearing Installer 308-705
 <p>308-704</p> <p>E91084</p>	Installer, Countershaft Bearing 308-704
	Installer, Input Shaft Bearing 308-703

 E91083	
 E91081	Installer, Output Shaft Bearing 308-702
 E91078	Installer, Selector Shaft Seal 308-700

General Equipment

Tie Straps
Hot air gun
Hydraulic press

Materials

Name

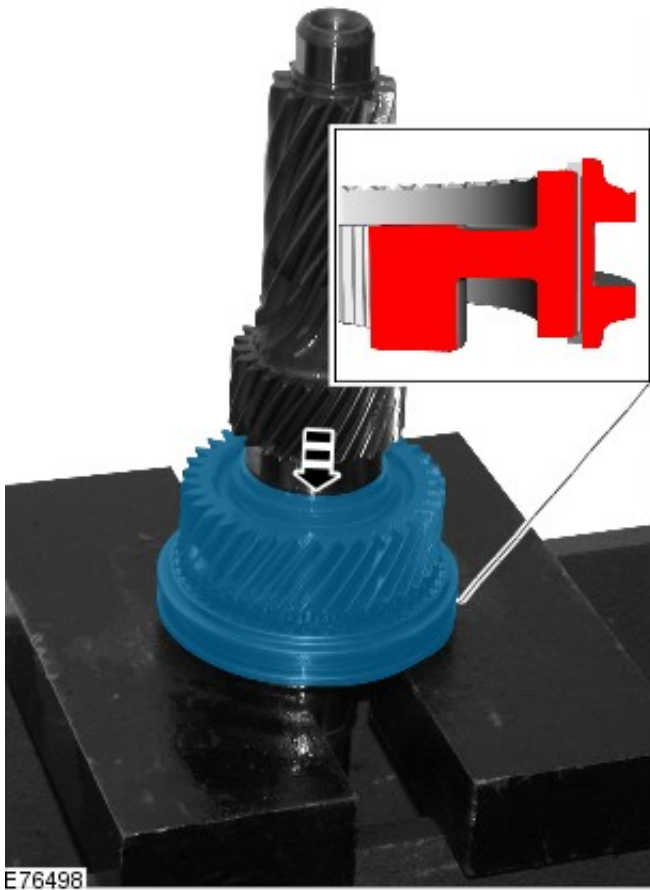
Transmission Fluid
High-Temperature Grease
Gasket Eliminator Sealant
Adhesive - Loctite 243

Specification

WSD-M2C200-C
ESD-M1C220-A
WSK-M2G348-A5
WSK-M2G349-A7

Assembly

1. **NOTE:** All synchronizer rings and needle bearings should be lubricated with clean transmission fluid prior to assembly.
[transmission fluid](#)
2. Install the 4th gear and 3rd/4th gear synchronizer assembly onto the countershaft.



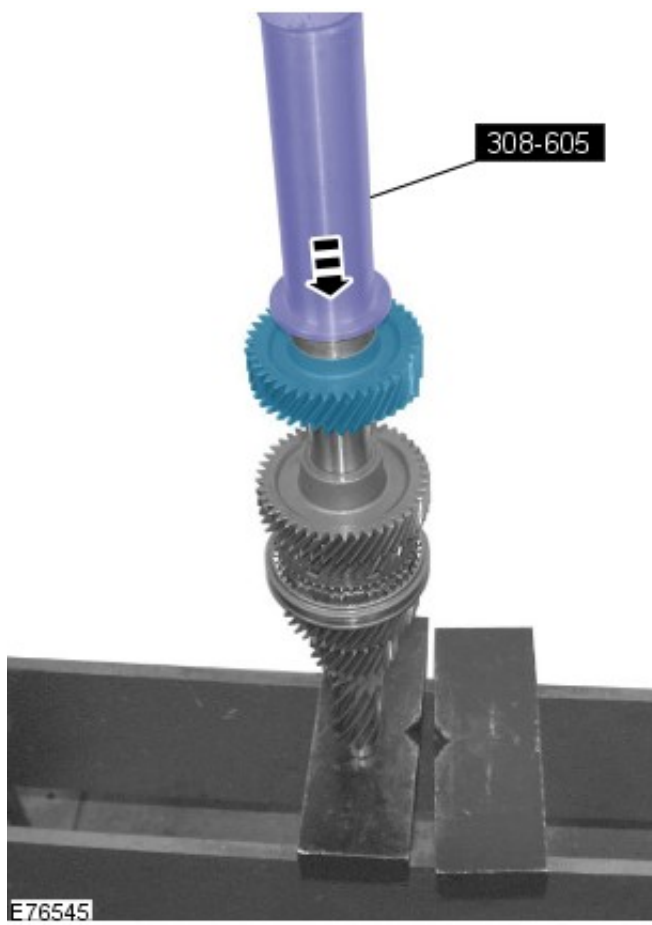
3. Install the 3rd/4th gear synchronizer assembly snap ring onto the countershaft.
 - Install a new snap ring.



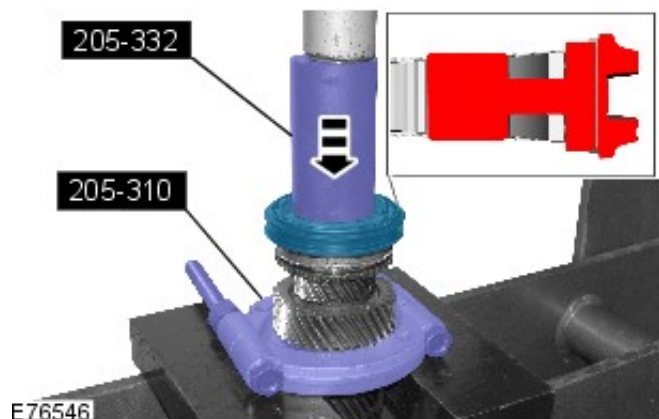
4. Using the special tool, install the 6th gear onto the countershaft.




5. Using the special tool, install the 5th gear.



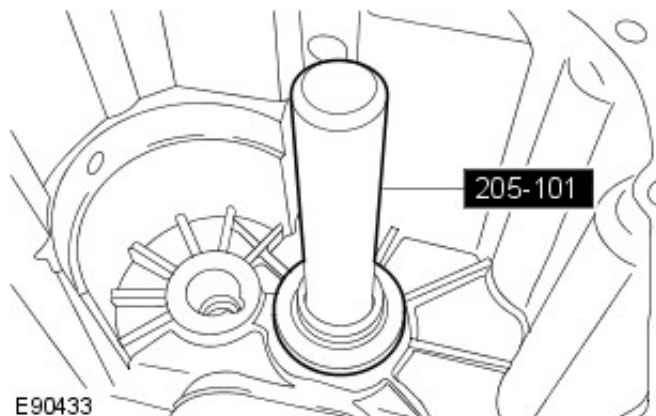
6. Using the special tools, install the 5th/6th gear synchroniser assembly onto the output shaft.




7.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

NOTE: Heat the transmission housing to approx 100 °C (212 °F) using a hot air gun.

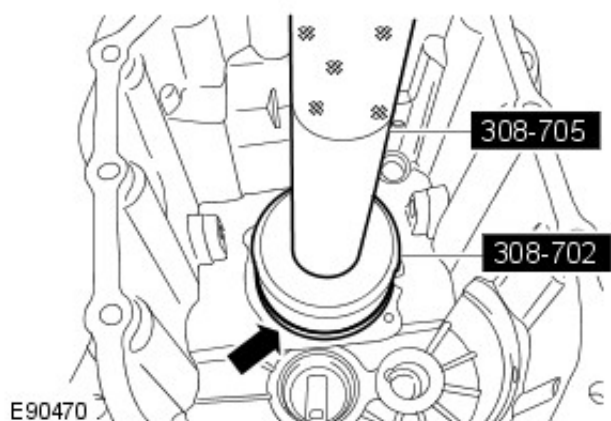
Using the special tool, install the countershaft outer bearing race into the transmission housing.



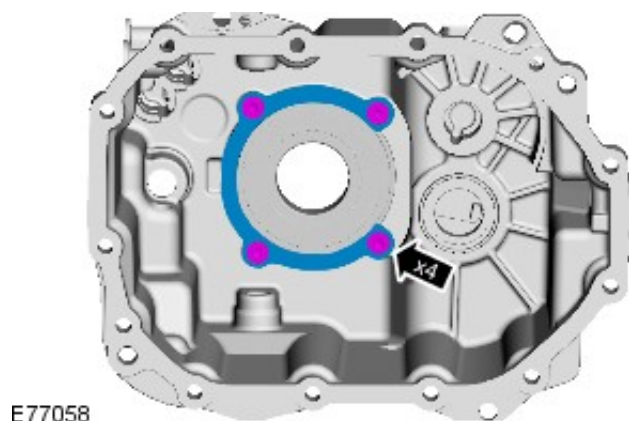
8.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

NOTE: Heat the transmission housing to approx 100 °C (212 °F) using a hot air gun.

Using the special tool, install the output shaft bearing.



9. Install the output shaft bearing retaining plate.
- Tighten the bolts to 10 Nm (7 lb.ft).

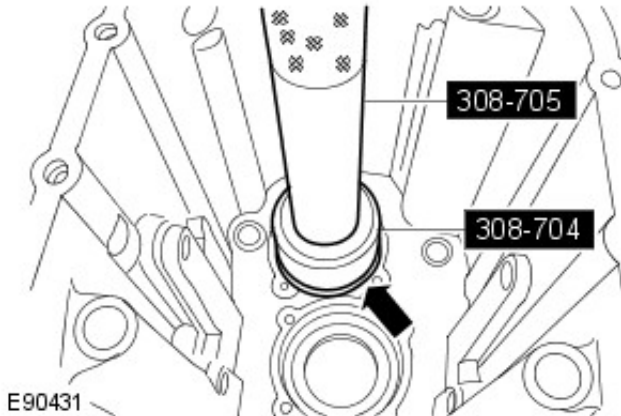
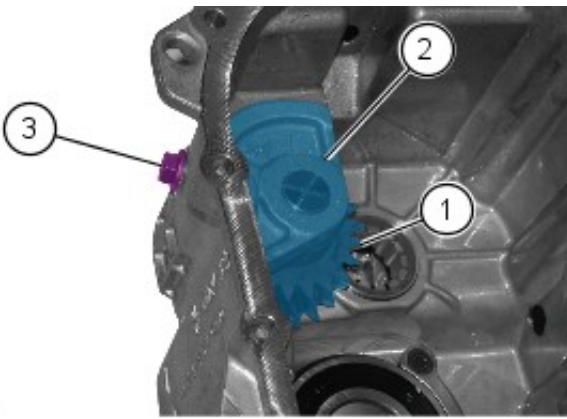


10. **NOTE:** Install the components in the positions noted on removal.

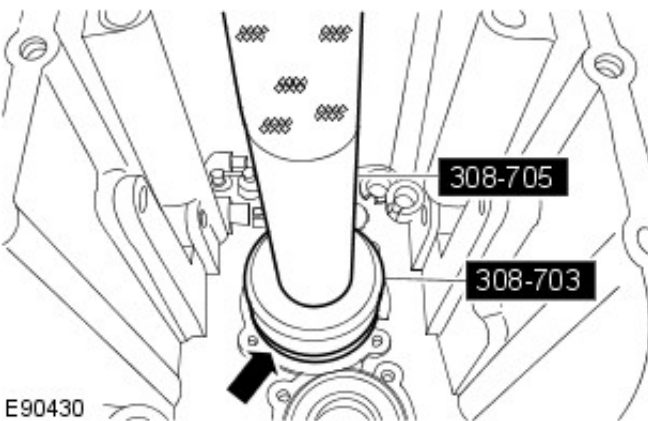
Install the components into the transmission housing using the following sequence.

1. Countershaft roller bearing.
2. Reverse gear idler.
3. Reverse gear idler mounting.
4. Tighten the bolt to 27 Nm (20 lb.ft).


E77163



E90431




E90430

11.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

NOTE: Heat the transmission housing to approx 100 °C (212 °F) using a hot air gun.

Using the special tool, install the countershaft bearing.

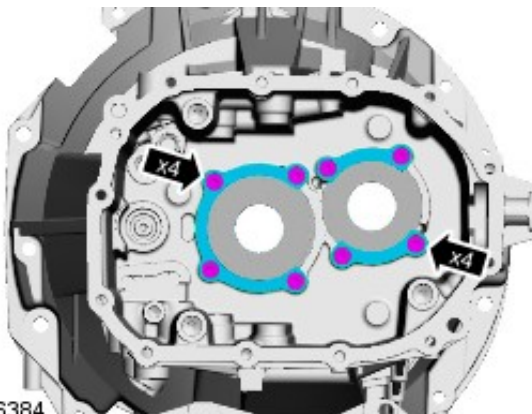
12.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

NOTE: Heat the transmission housing to approx 100 °C (212 °F) using a hot air gun.

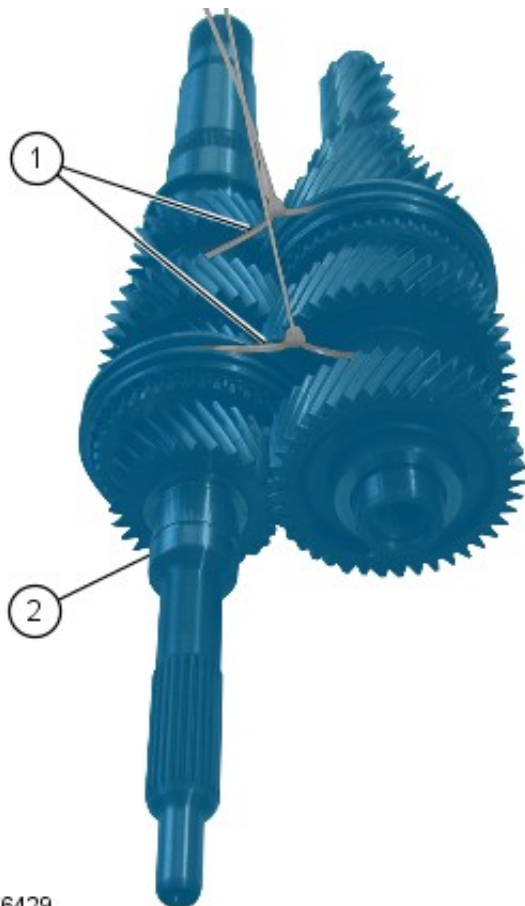
Using the special tool, install the input shaft bearing.

13. Install the bearing retaining plates.
- Tighten the bolts to 10 Nm (7 lb.ft).

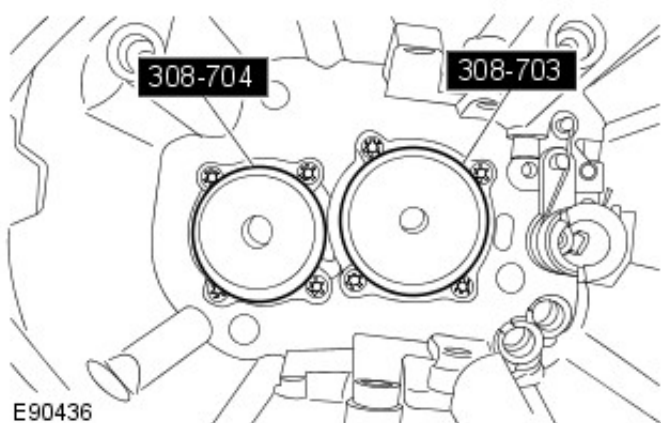
E76384




14. Secure the shaft assemblies together.
1. Use suitable tie straps at the positions shown.
 2. Make sure the input shaft does not become detached.



E76429



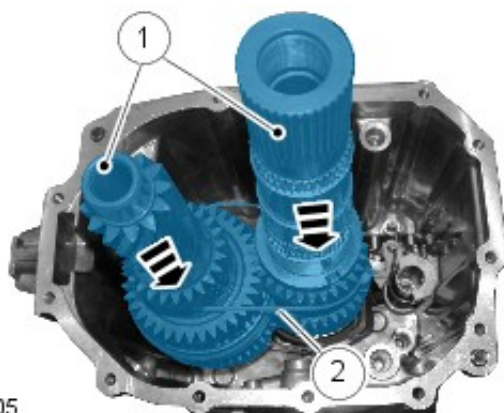
E90436

15.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

NOTE: Heat up the special tools with a hot air gun to around 100 °C and then transfer them to the bearings.

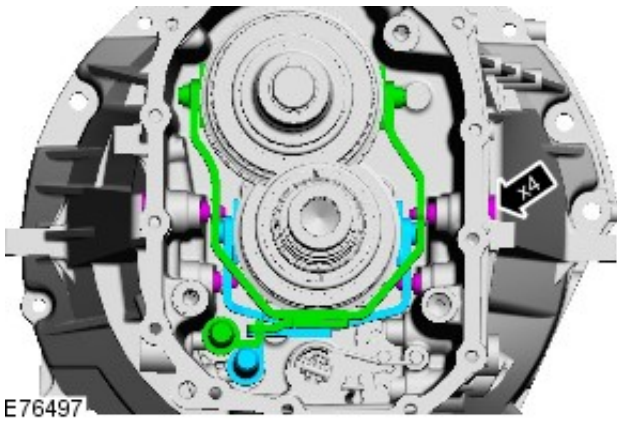
Using the special tools, apply heat to the bearing centre races.

16. Install the output shaft and countershaft assemblies.
- Remove and discard the tie straps.

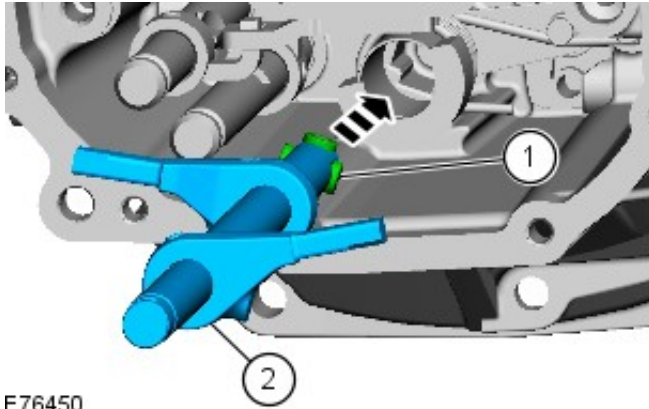


E76405

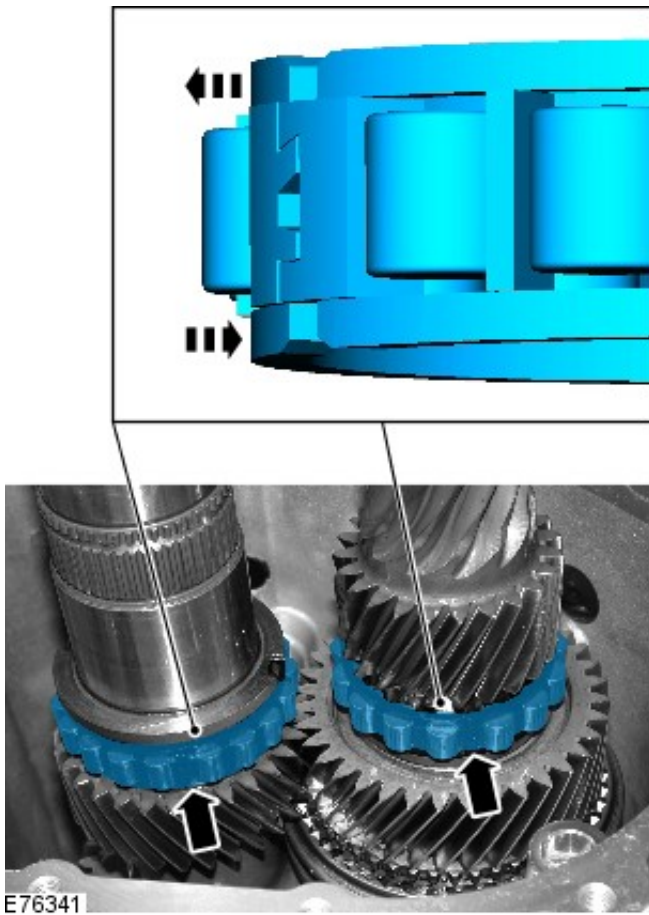
17. Install the 3rd/4th and 5th/6th gear selectors.
- Tighten the bolts to 37 Nm (27 lb.ft).



18. Install the main selector.
1. Secure the bearings with grease. [grease](#)
 2. Install the main selector.



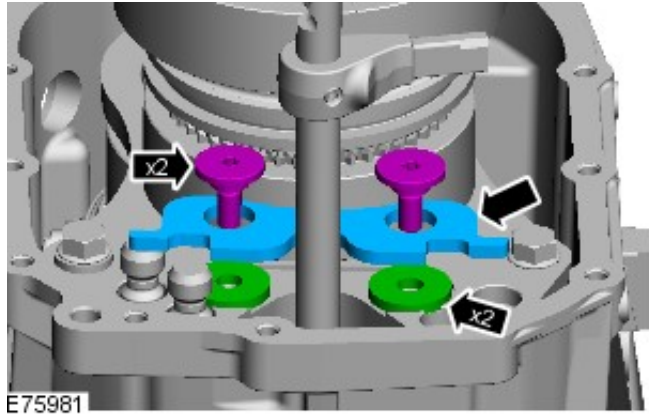
19. Install the centre bearings.



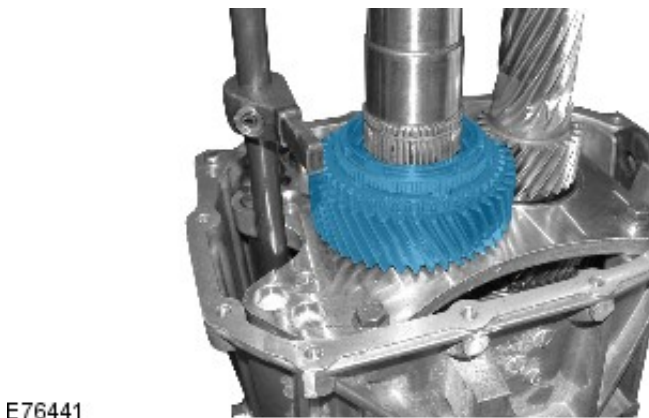
20. Install the centre bearing mounting plate.
- Tighten the bolts to 24 Nm (18 lb.ft).



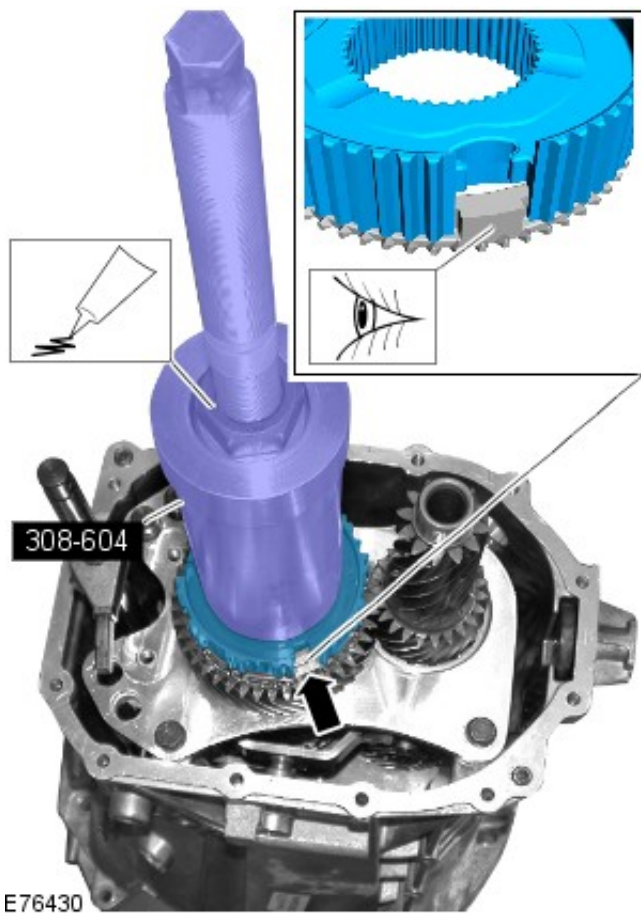
21. Install the selector shaft locking plate.
 - Install the spacers.
 - Tighten the bolts to 24 Nm (18 lb.ft).



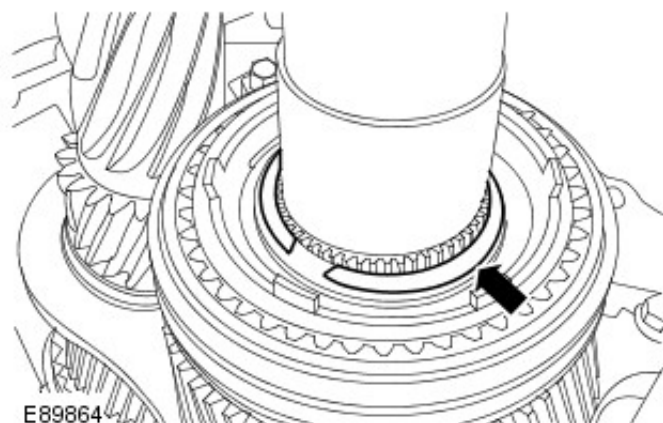
22. Install the 2nd gear and bearing onto the output shaft.



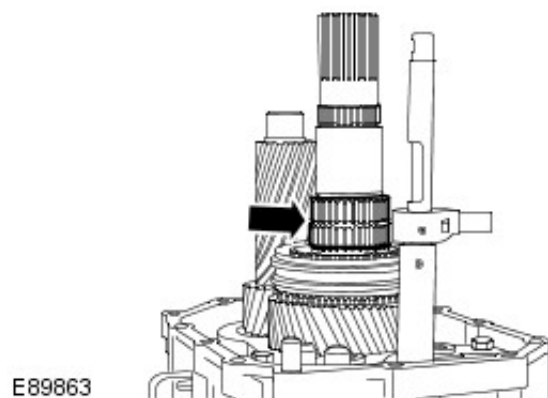
23. Using the special tools, install the 1st/2nd gear synchronizer assembly onto the output shaft.



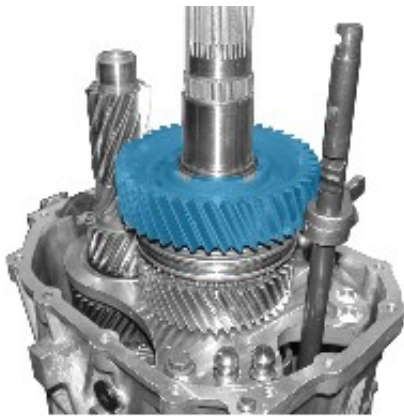
24. Install the 1st/2nd gear synchronizer snap ring.
- Install a new snap ring.



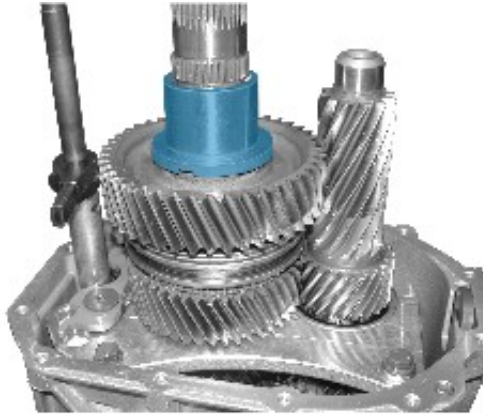
25. Install the 1st gear needle roller bearing.



26. Install the 1st gear.



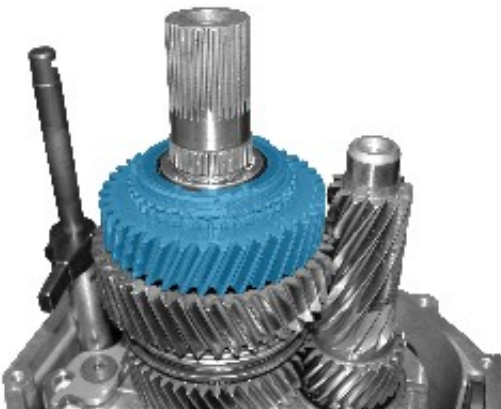
E76431




E76547



E76548



E76549

27.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

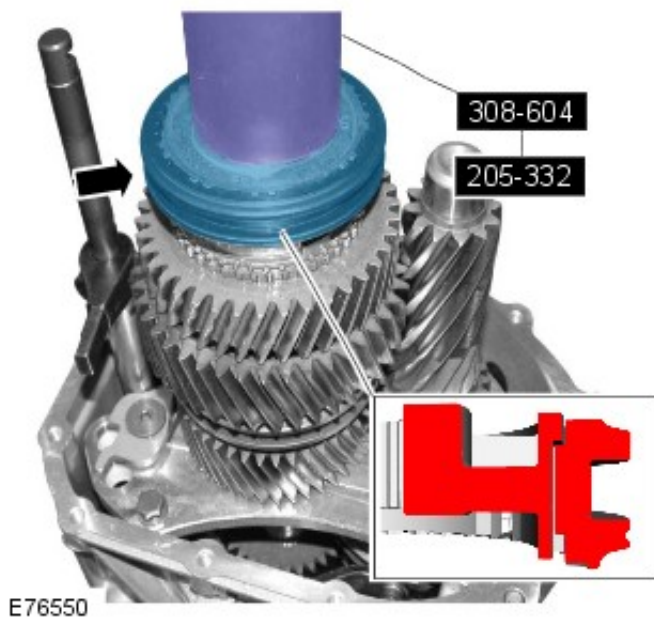
NOTE: Heat the reverse gear inner bearing race to approx 100 °C using a hot air gun.

Install the reverse gear inner bearing race.

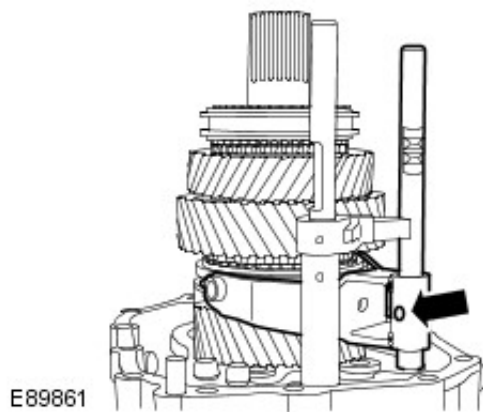
28. Install the reverse gear needle roller bearing.

29. Install the reverse gear onto the output shaft.

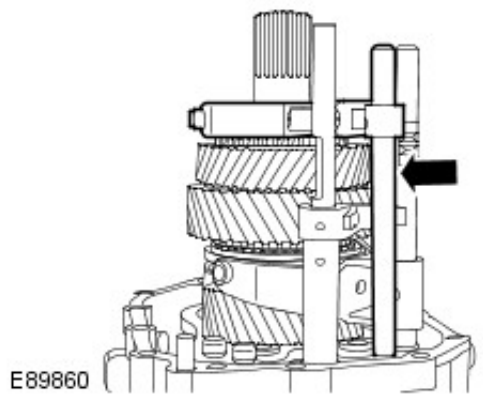
30. Using the special tool, install the reverse gear synchroniser onto the output shaft.



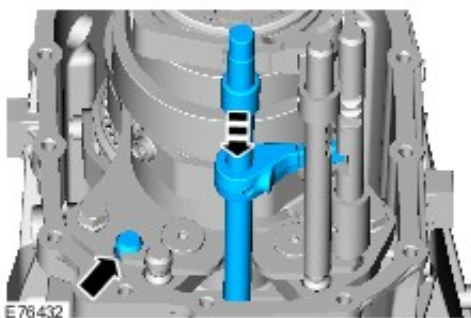
31. Install the 1st/2nd gear selector.
 - Install a new pin.



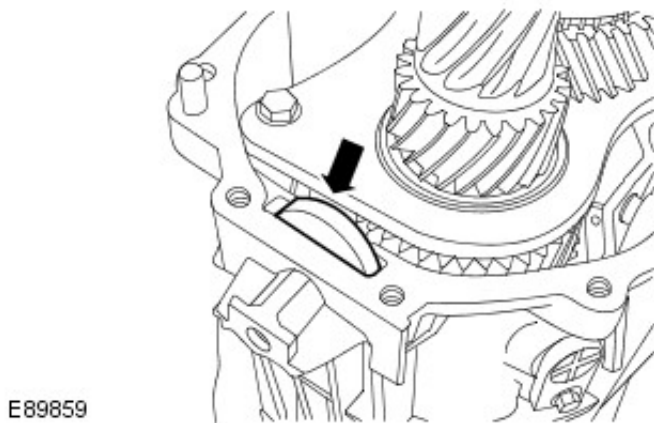
32. Install the reverse gear selector.



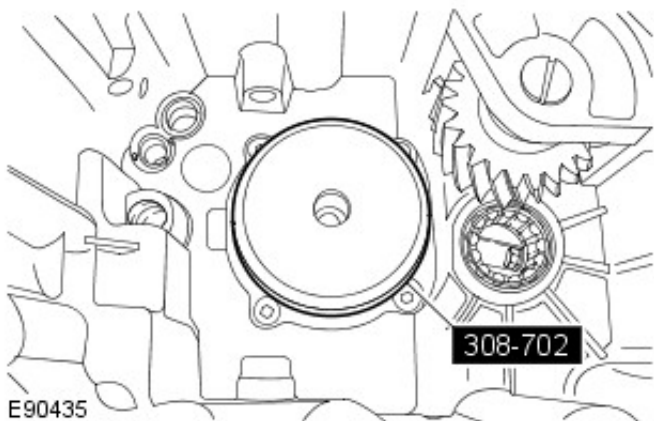
33. Select a gear.



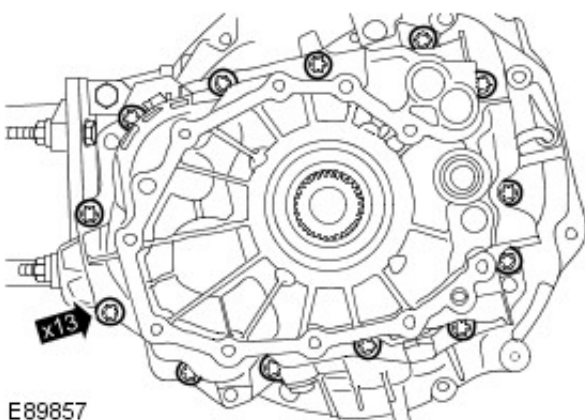
34. Install the magnet.



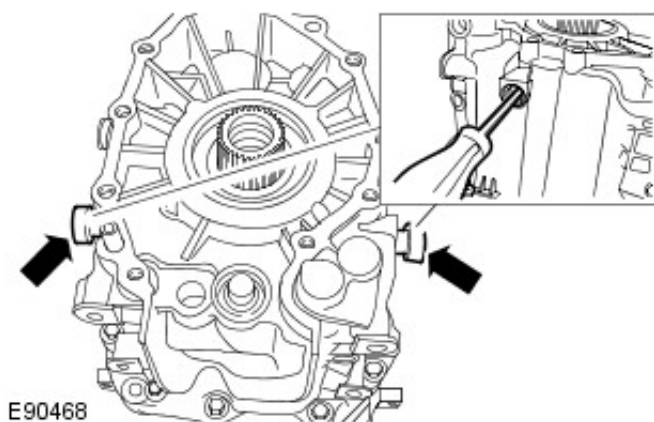
E89859




E90435



E89857



E90468

35.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

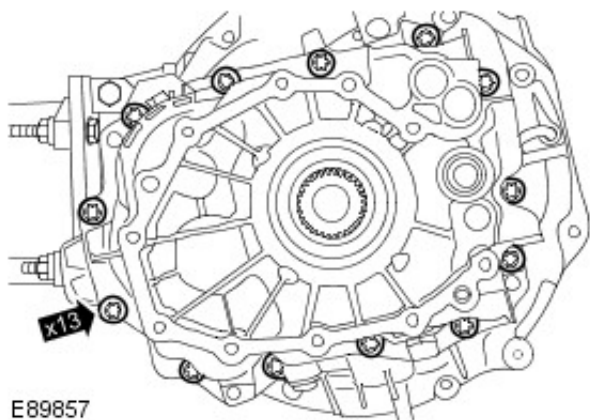
NOTE: Heat up the special tool with a hot air gun to around 100 °C and then transfer it to the bearing.

Using the special tool, apply heat to the bearing inner race.

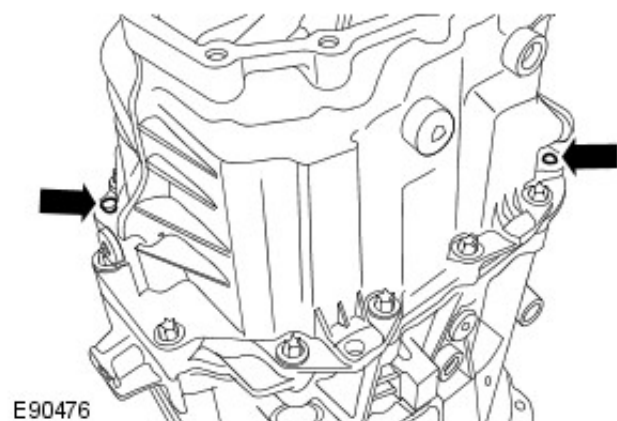
36. Install the transmission housing.
- Apply sealant to the mating surfaces. [sealant](#)
 - Loosely install the transmission housing bolts.

37. Install the reverse gear selector fork mounting bolts.
- Align the selector fork.
 - Tighten to 37 Nm (27 lb.ft).

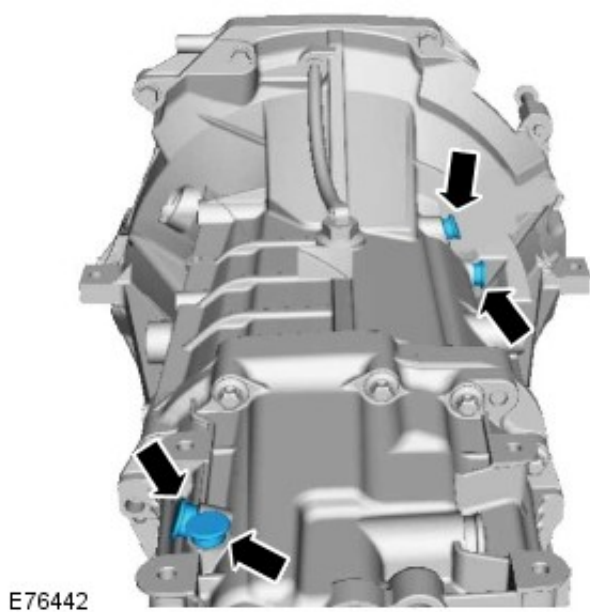
38. Tighten the transmission housing bolts, working diagonally.
- Tighten to 24 Nm (18 lb.ft).



39. Reposition the locating dowels.

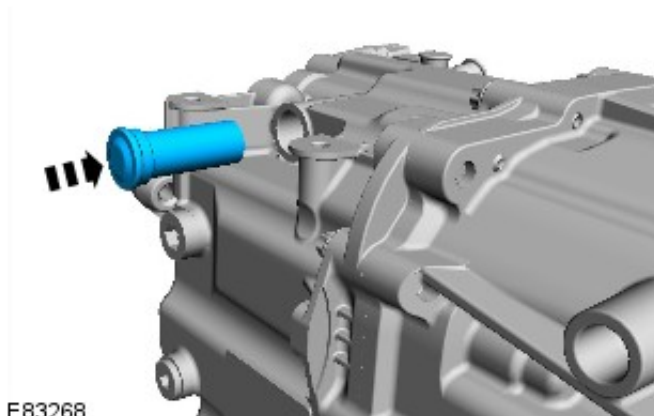


40. Install the new selector shaft detents.

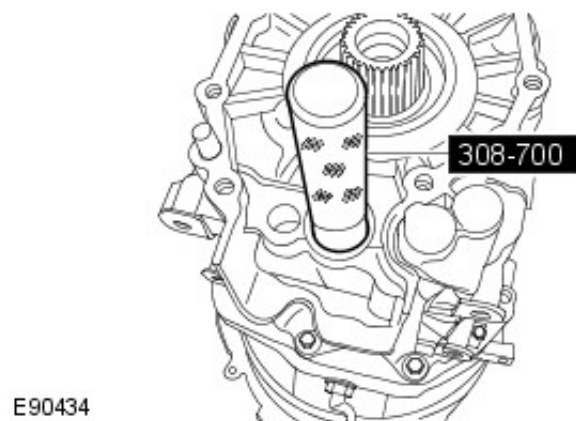


41. Move the main selector shaft to neutral.

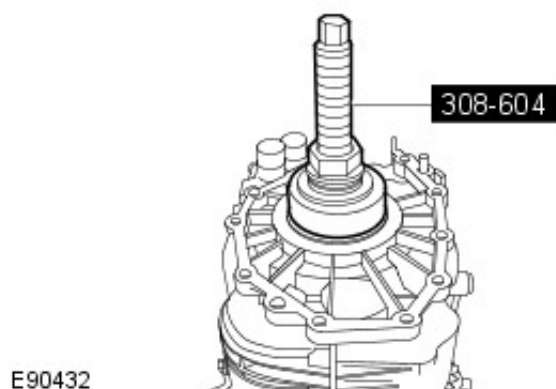
42. Install the new selector shaft detent.




43. Using the special tool, install the main selector shaft seal.



44. Install the transmission output shaft seal.

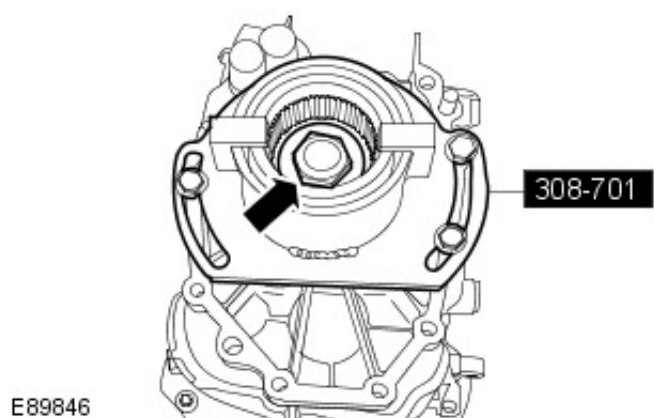


45.  **WARNING:** Care should be taken when using the hot air gun. Failure to follow this instruction may result in personal injury.

NOTE: Heat the transmission output flange to approx. 100 °C using a hot air gun.

Using the special tool, install the transmission output flange.

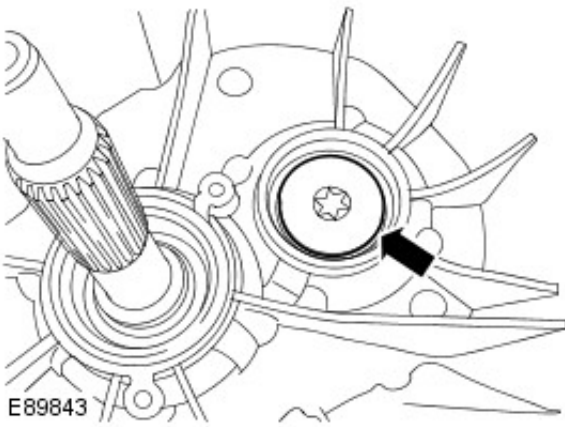
- Tighten the bolt to 210 Nm (155 lb.ft).
- Loosen the bolt.
- Apply thread locking compound. [adhesive](#)
- Tighten the bolt to 180 Nm (133 lb.ft).



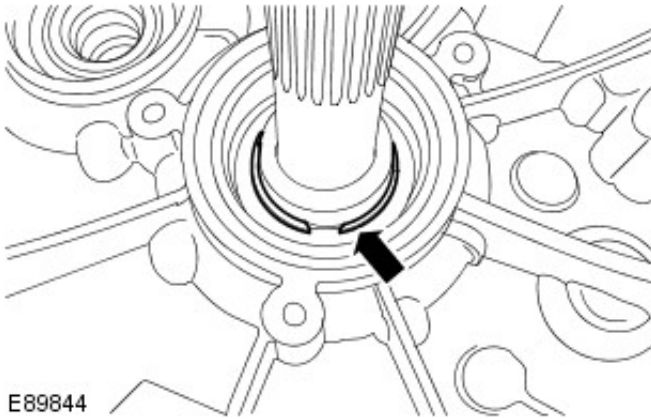
46. **NOTE:** Make sure that a gear is selected.

Install the countershaft securing bolt.

- Tighten to 95 Nm (70 lb.ft).

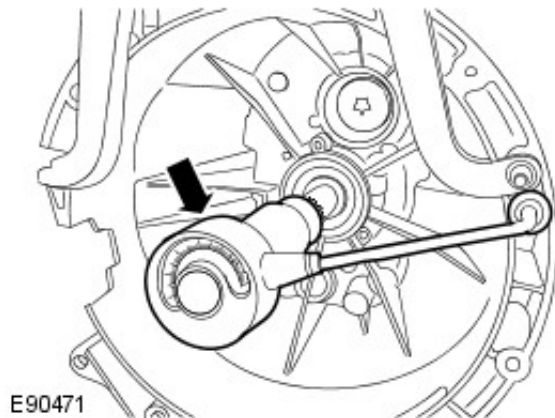


47. Install the input shaft snap ring.
- Install a new snap ring.

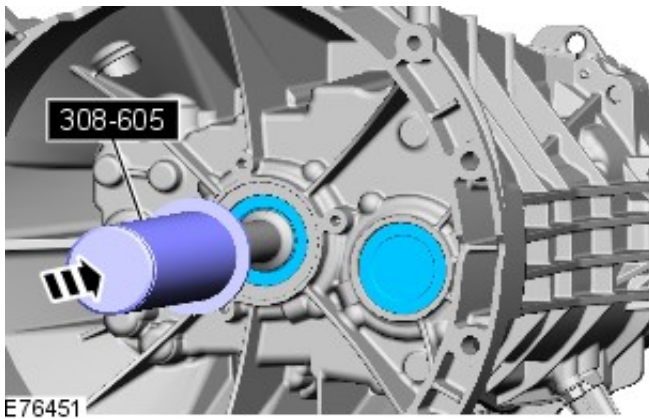


48. Rotate the transmission shafts and check the availability of all gears.


49. With a suitable tool attached, check the torque in neutral with the output flange blocked.
- Torque 1.2 max Nm (1 lb.ft).



50. Using the special tool, install the transmission input shaft seal and countershaft seal.



51. Remove the transmission from the stand.

52.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

53. Install the transmission.
For additional information, refer to: Transmission (308-03 Manual Transmission/Transaxle, Removal).
54. Fill the transmission.
For additional information, refer to: Transmission Draining and Filling (308-03 Manual Transmission/Transaxle, General Procedures).
55. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Manual Transmission/Transaxle - Vehicles With: MT82 6-Speed Manual Transmission - Transmission

Installation

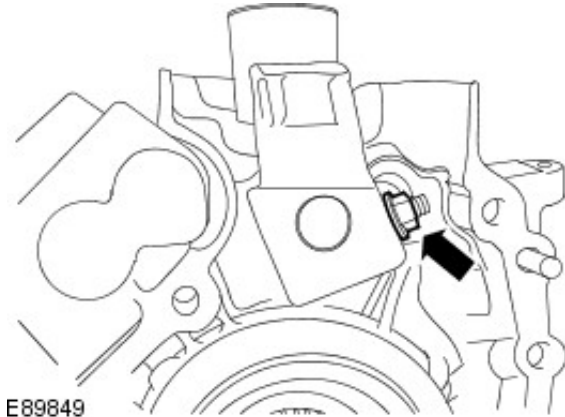
Installation

NOTE: If a new transmission is being fitted then the gearshift lever retaining bolts must be pre installed to the transmission to cut the threads. Failure to follow this instruction will increase the difficulty of fitting the gearshift lever to the transmission.

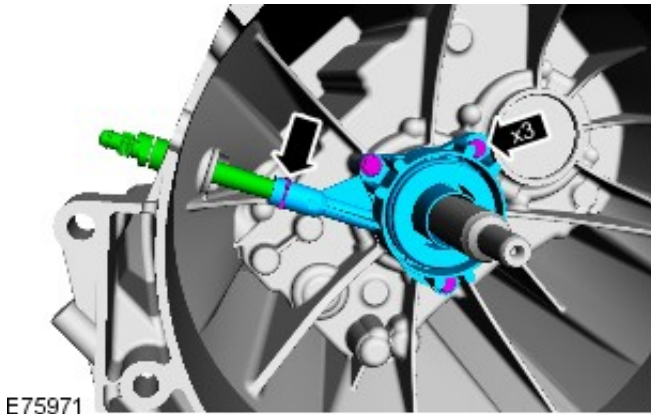
1. **NOTE:** Make sure the pin is fitted from Left to Right when viewed from the rear of the transmission.

Install the gearshift yoke.

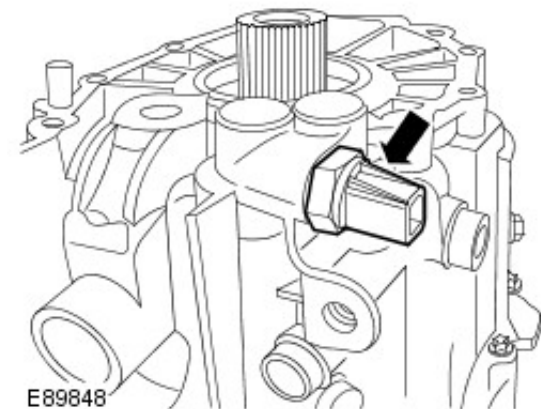
1. Install the pin.
2. Tighten the nut to 12 Nm (9 lb.ft).



2. Install the clutch slave cylinder.
 1. Tighten the bolts to 11 Nm (8 lb.ft).
 2. Install the connecting pipe.
 3. Install the connecting pipe securing clip.



3. Install the reversing lamp switch.
 1. Tighten to 20 Nm (15 lb.ft).



4. Install the seal.

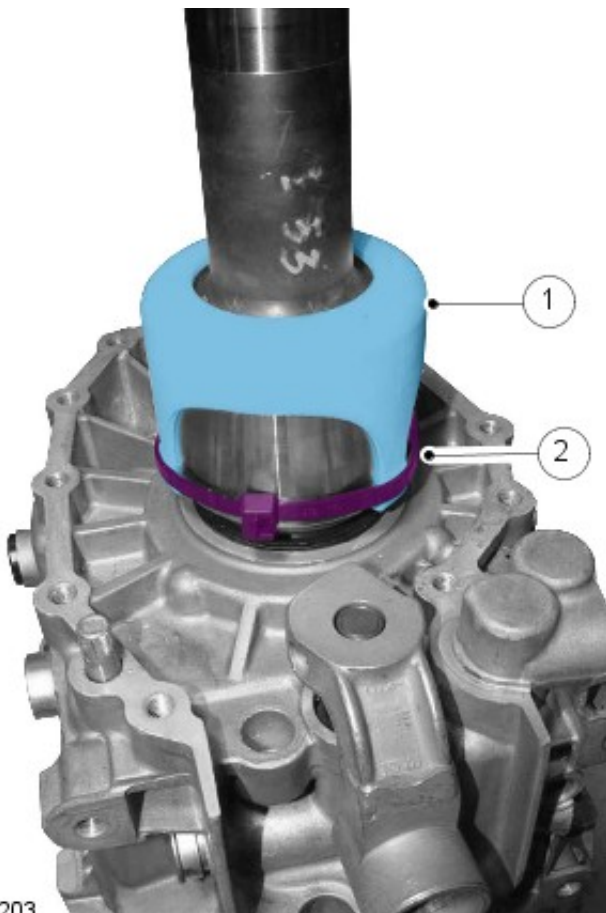


5. NOTE: Apply anti seize grease to the splines.

NOTE: Make sure that the tie strap joint is between the fingers of the extension shaft seal cover and that it has been cut flush.

Install the transmission extension shaft.

1. Install the cover.
2. Install the tie strap.



6. Install the transmission extension housing.
1. Tighten the bolts to 25 Nm (18 lb.ft).

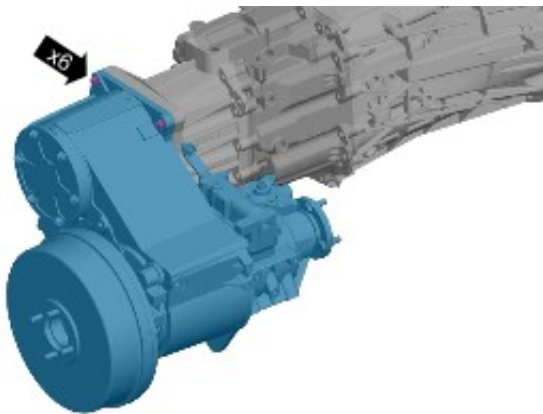


E91067

7. **NOTE:** Apply sealant STC 50552 to the bolt threads.

With assistance, install the transfer case.

1. Tighten the bolts to 45 Nm (33 lb.ft).
2. Tighten the nuts to 45 Nm (33 lb.ft).




E90815

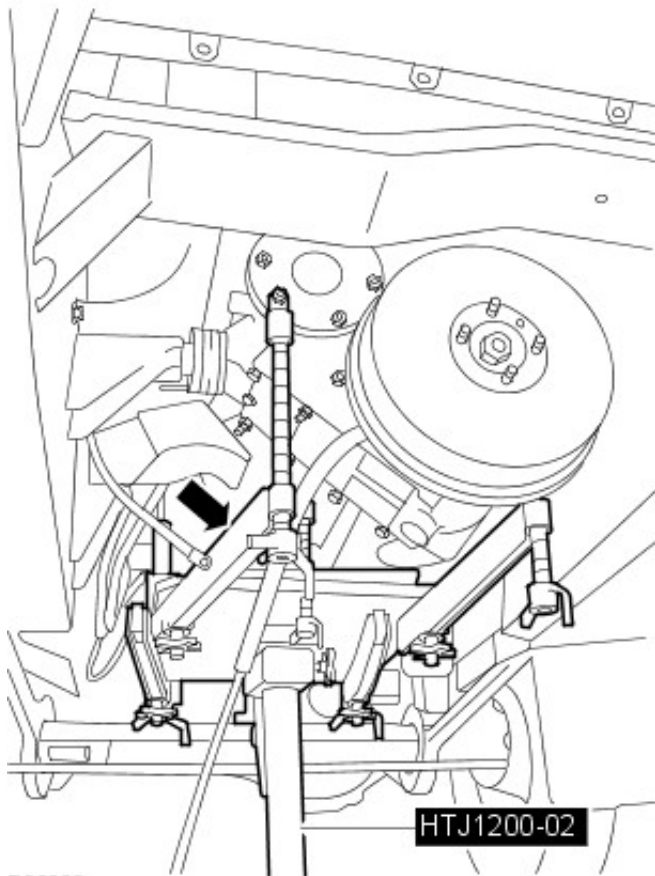
8. **NOTE:** This step must be carried out if a new transmission is being fitted.

Install the gear selector housing securing bolts to cut a new thread.

1. Remove the bolts.

9.  **CAUTION:** Care must be taken when locating the transmission to the clutch.

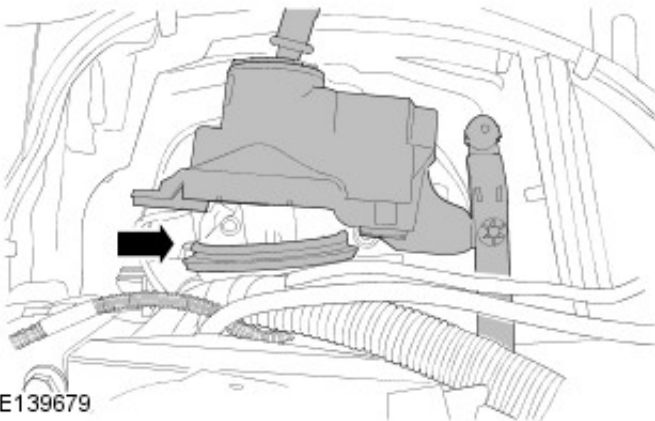
Install the transmission and transfer gearbox.



E88220

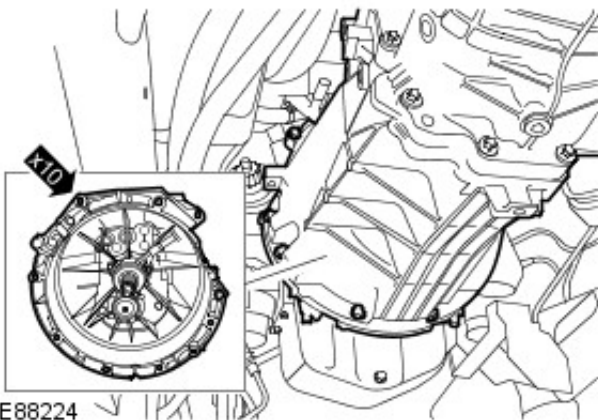
10. **NOTE:** Make sure the rubber gasket is fitted to the gearshift lever housing before installation.

Install the gear selector housing.



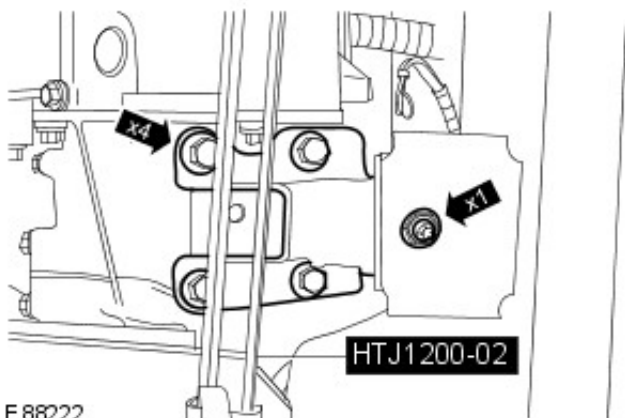
E139679

11. Install the bell housing bolts.
1. Tighten to 40 Nm



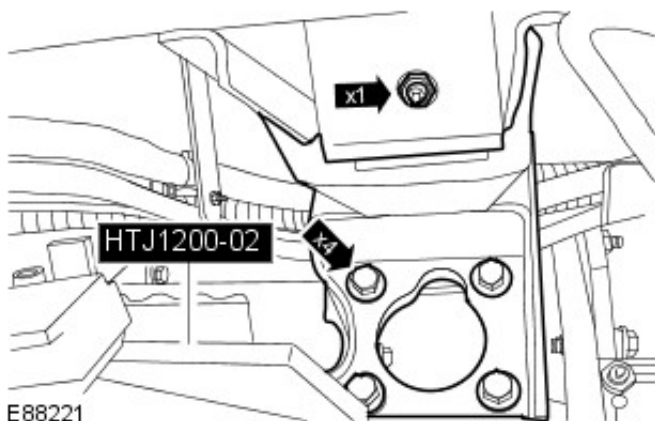
E88224

12. Install the RH transfer gearbox mounting bracket.
1. Tighten the nut to 48 Nm
2. Tighten the bolts to 85 Nm

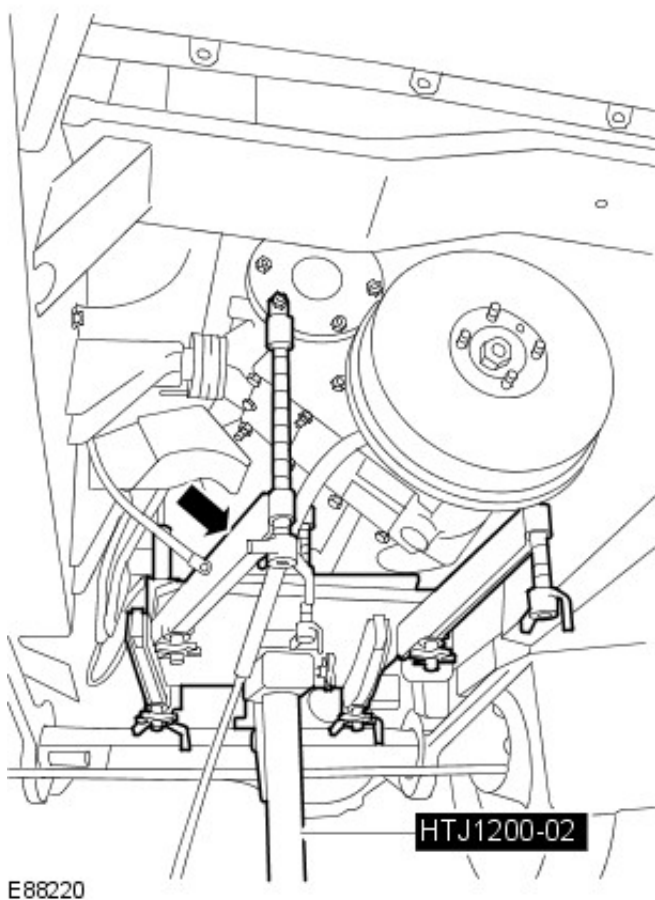


13. Install the LH transmission mount and mounting bracket.

1. Tighten the nut to 48 Nm
2. Tighten the bolts to 85 Nm

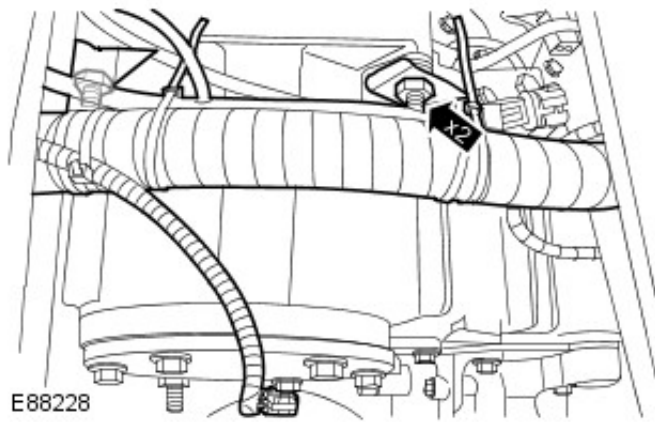
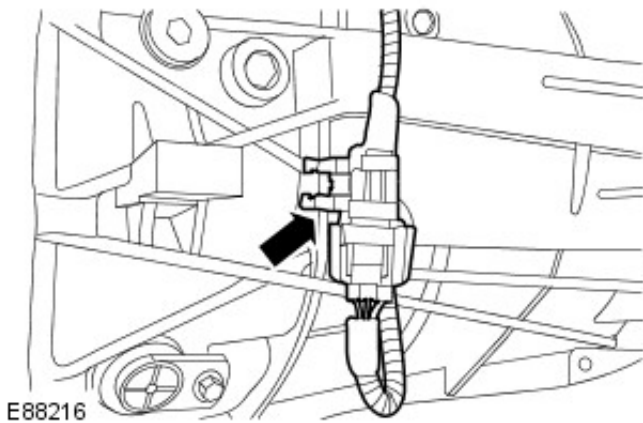
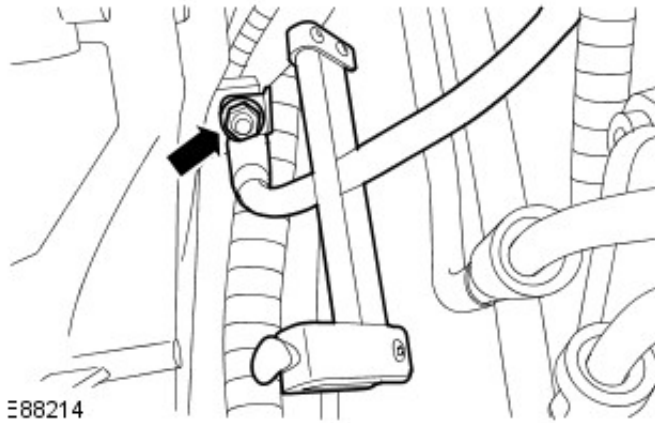
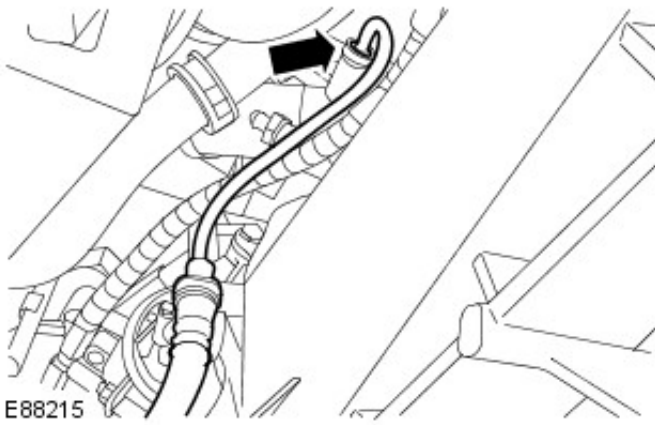


14. Remove the special tool HTJ1200-02 from the transmission and transfer gearbox.



15. Connect the clutch slave cylinder fluid hose to the clutch slave cylinder.

1. Remove the blanking plugs from the orifices.
2. Install a new clutch slave cylinder fluid hose O-ring seal.
3. Install the clutch slave cylinder line clip.



16. Install and fully tighten the clutch slave cylinder fluid hose mounting bracket securing nut and bolt.

1. Remove the pipe clamp from the clutch slave cylinder fluid hose.
2. Tighten the bolt to 25 Nm

17. Secure the wiring harness to the transmission.

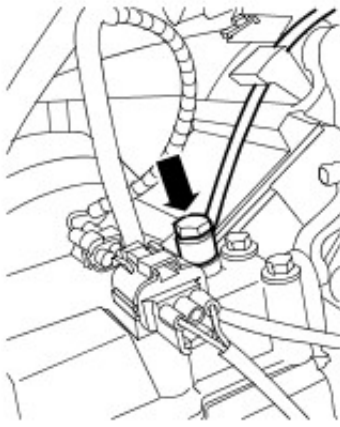
18. Reposition the transmission harness and install the transmission harness retaining bracket securing nut and bolt.

1. Tighten to 47 Nm

19. Install the transfer gearbox breather pipe.

1. Install new sealing washers onto the transfer gearbox breather pipe securing bolt.
2. Tighten to 15 Nm.

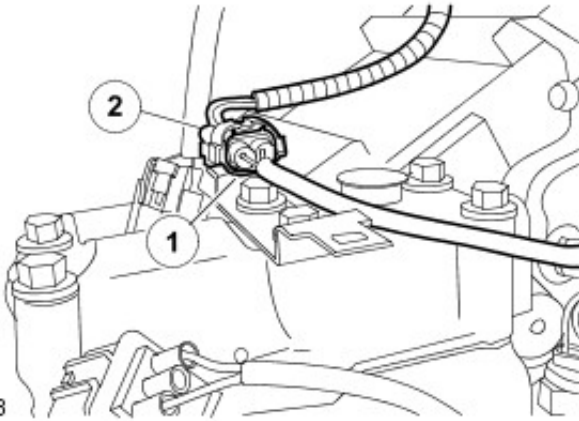
E88196



20. Connect the differential lock detection switch electrical connector.

1. Secure the electrical connector to the bracket.

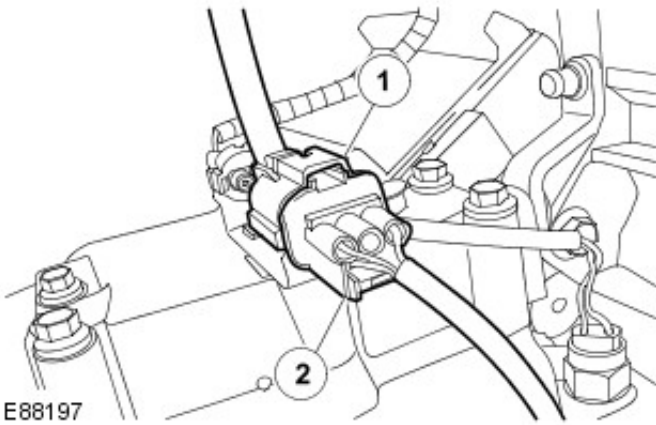
E88198



21. Reposition and secure the high-low detection switch electrical connector onto the transfer gearbox.

1. Secure the electrical connector to the bracket.

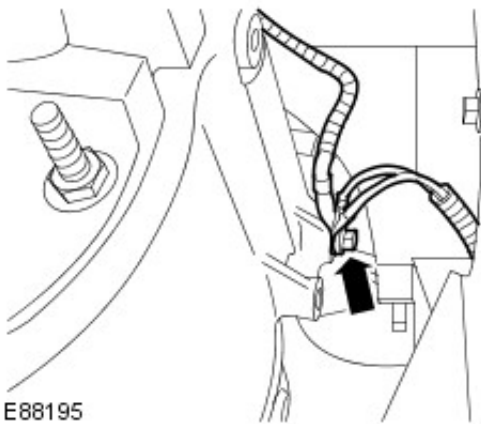
E88197



22. Install the RH transfer gearbox earth cables securing bolt.

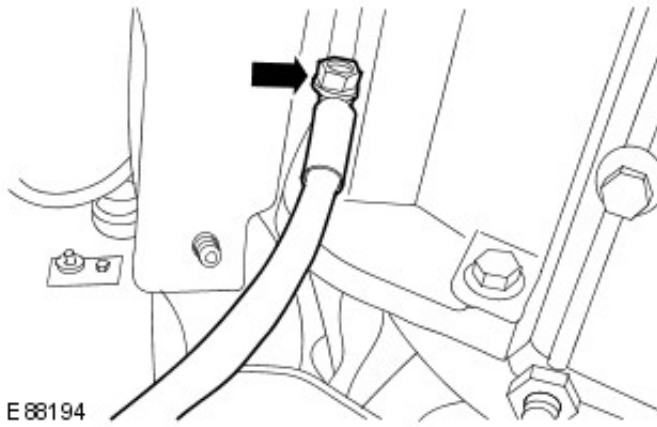
1. Tighten to 12 Nm

E88195

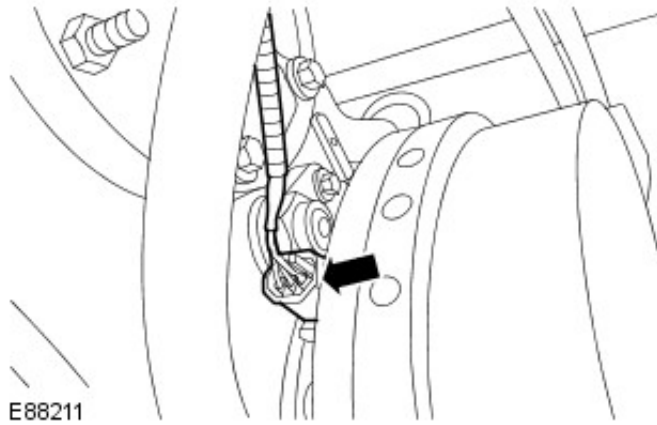


23. Install the LH transfer gearbox earth cable securing nut.

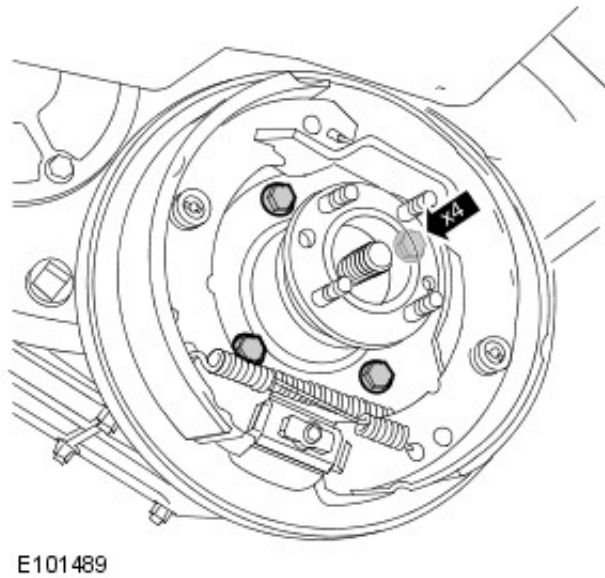
1. Tighten to 45 Nm



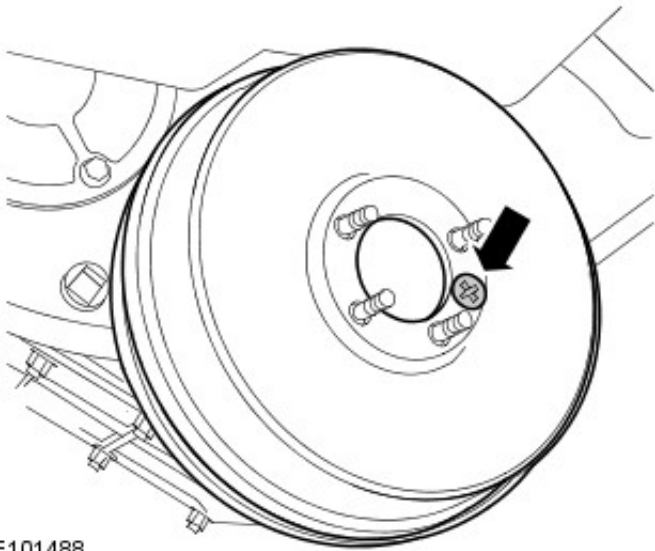
24. Connect the electronic speedometer electrical connector to the transfer gearbox.



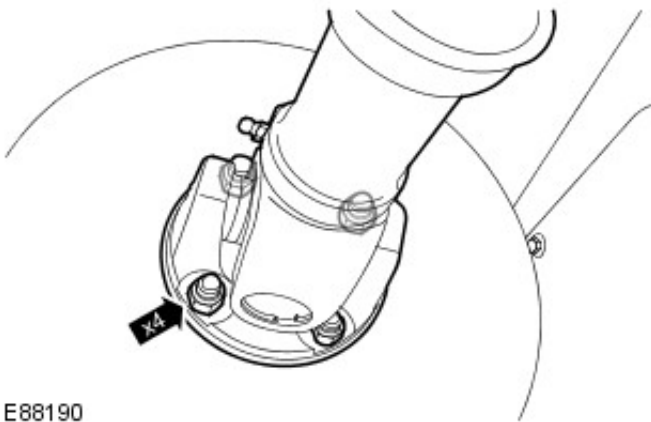
25. Install the parking brake assembly.
 1. Install the 4 securing bolts.
 2. Tighten to 73 Nm.



26. Install the parking brake drum.
 1. Install the securing screw.



E101488



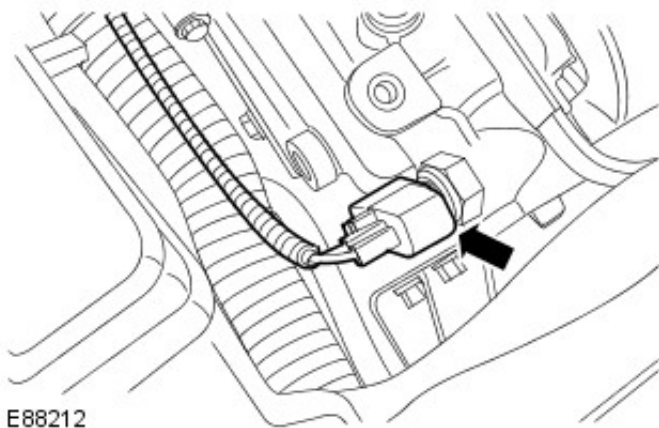
E88190

27. **NOTE:** [Align to the position noted on removal.](#)

Reposition and secure the rear driveshaft to the transfer gearbox.

1. Release the driveshaft from the chassis.
2. Install the rear driveshaft to transfer gearbox securing bolts.
3. Tighten to 47 Nm

28. For additional information, refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00 Exhaust System - ID4 2.2L Diesel, Removal and Installation).
29. For additional information, refer to: [Front Muffler](#) (309-00 Exhaust System - ID4 2.2L Diesel, Removal and Installation).
30. For additional information, refer to: [Front Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
31. Lower the vehicle.
32. Close the bonnet.
33. Open the front door.
34. Connect the reverse light switch electrical connector.



E88212

35. NOTE: Make sure that the transmission is in third gear.

NOTE: Make sure the gearshift selector lever ball joint bush and the selector yoke are centralised before installing the special tool. Install

Install the gearshift lever.

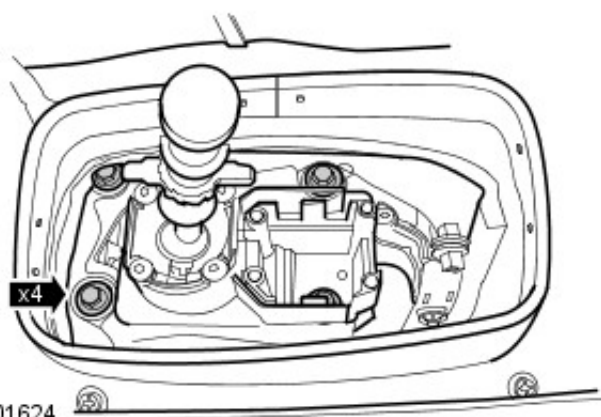
1. Install the special tool 308-561 onto the gear selector lever.



E91087

36. Tighten the 4 gear selector housing securing bolts.

1. Tighten to 25 Nm



E101624

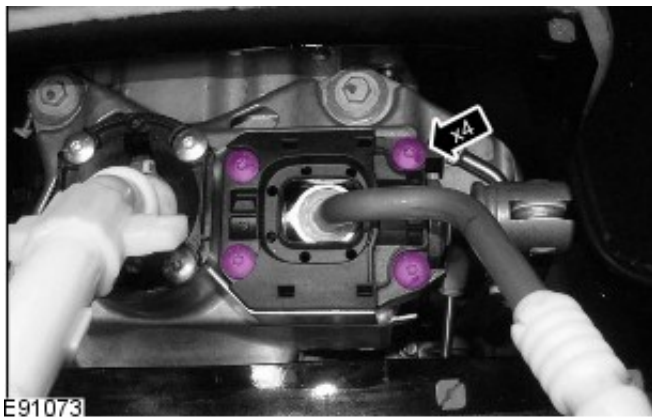
37. Remove the special tool 308-561 from the gear selector lever.



E91087

38. Install the high-low selector lever onto the gearbox.

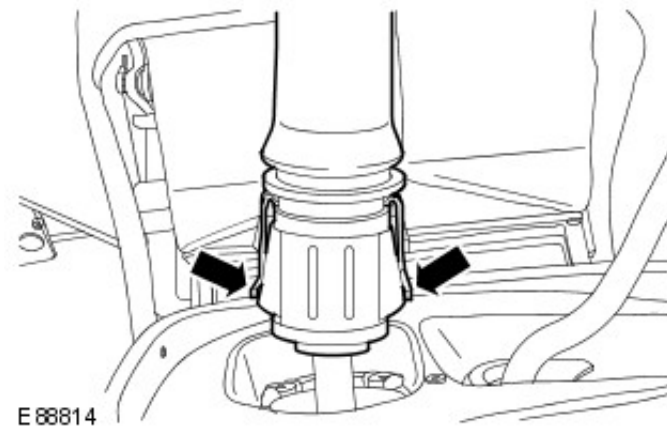
1. Tighten to 7 Nm



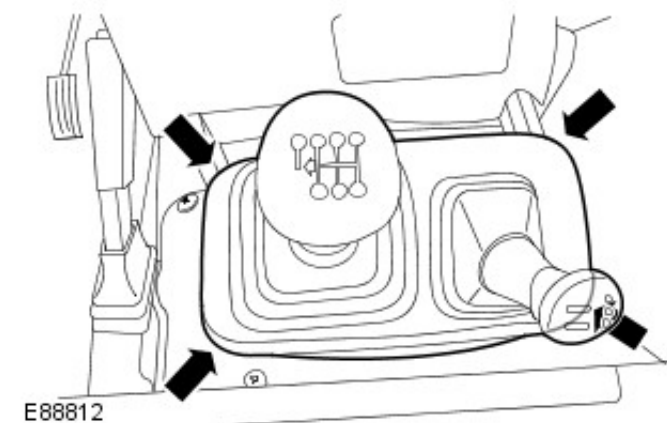
39. Install the foam pad.



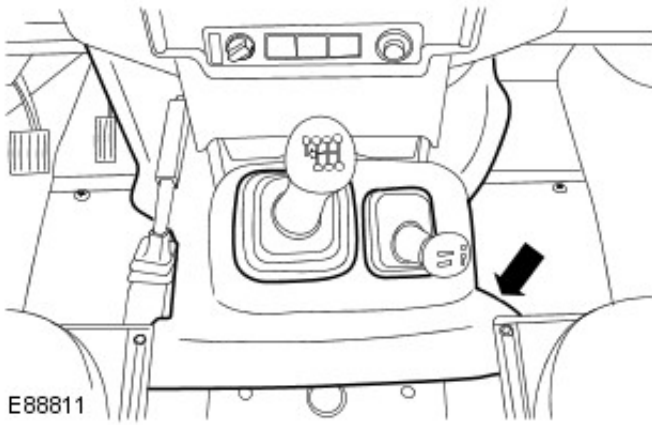
40. Install the upper gear change lever.



41. Install the gear selector lever gaiter.
 1. Secure the gear selector lever gaiter to the transmission tunnel.
 2. Secure the gear selector lever gaiter to the high-low selector lever.



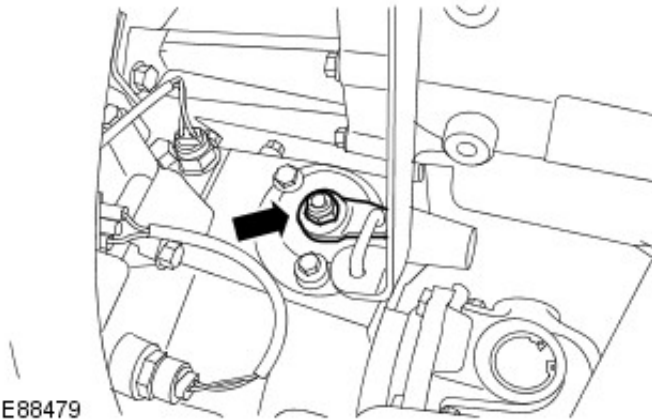
42. Install the transmission cover panel carpet.



43. For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

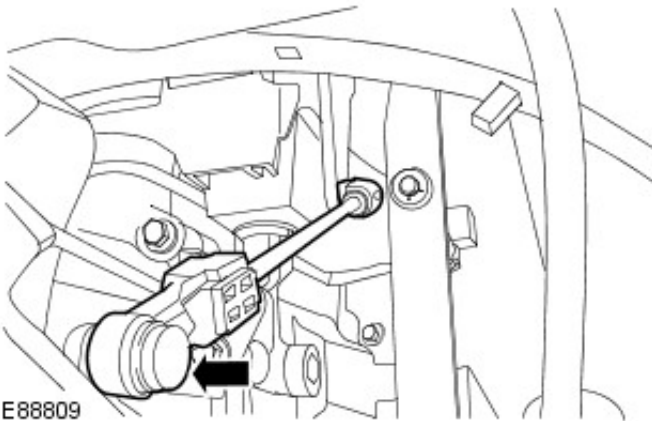
44. Raise the vehicle on lift.

45. Install a new differential lock pivot nut.
1. Tighten to 25 Nm



46. **NOTE:** Make sure the rod is fully engaged on the ball joint and not on the foam washer.

Install the high-low selector rod ball joint onto the transfer gearbox.



47. For additional information, refer to: Clutch System Bleeding (308-00, General Procedures).

48. Lower the vehicle.

49. Close the front door.

Manual Transmission/Transaxle External Controls - Vehicles With: MT82 6-Speed Manual Transmission -

Torque Specifications

Description	Nm	lb-ft
Differential lock pivot nut	25	18
Gearshift lever bolts	25	18
High/Low selector lever screws	7	5

Manual Transmission/Transaxle External Controls - Vehicles With: MT82 6-Speed Manual Transmission - External Controls

Description and Operation

OVERVIEW

For additional information, refer to: Manual Transmission - Vehicles With: 6-Speed Manual Transmission (MT82) (308-03, Description and Operation).

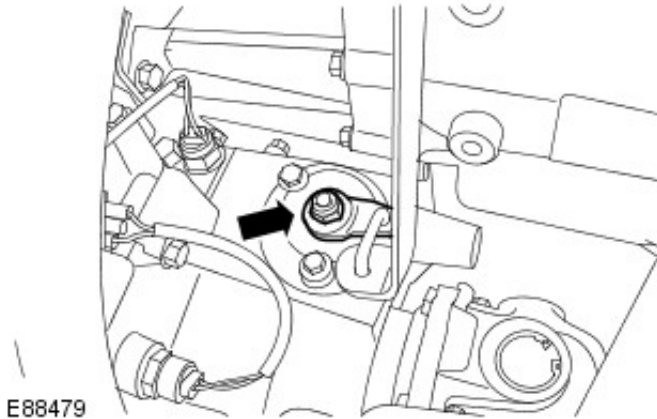
Manual Transmission/Transaxle External Controls - Vehicles With: MT82 6-Speed Manual Transmission - Gearshift Lever

Removal and Installation

Removal

1. Remove the transfer case high/low range linkage.
For additional information, refer to: Transfer Case High/Low Range Linkage (308-07, In-vehicle Repair).

2. Remove and discard the differential lock pivot nut.

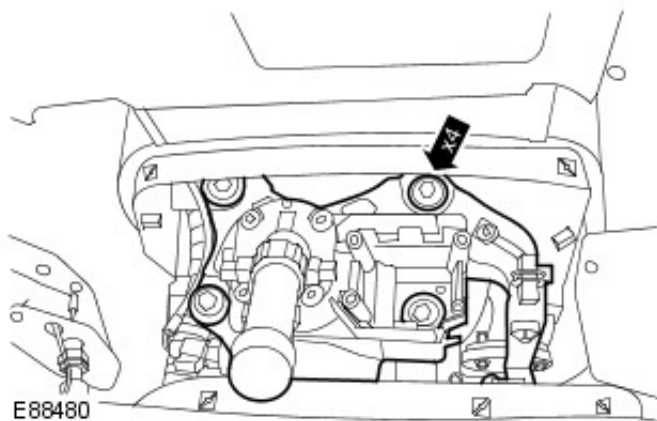


3. **NOTE:** Do not remove the 4 gearshift lever ball joint securing screws.

NOTE: Make sure the rubber seal is not damaged on removal.

Remove the gearshift lever.

- Remove the 4 bolts.



Installation

1. **NOTE:** Make sure the gearshift selector lever ball joint bush and the selector yoke are centralised before installing the special tool.

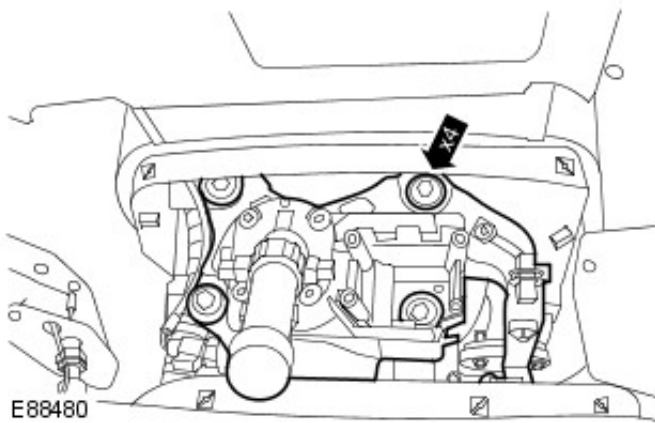
NOTE: Make sure the rubber gasket is fitted to the gearshift lever housing before installation.

Install the gearshift lever.

- Make sure 3rd gear is engaged on the transmission.
- Install the gearshift lever.
- Install the special tool onto the gearshift lever.



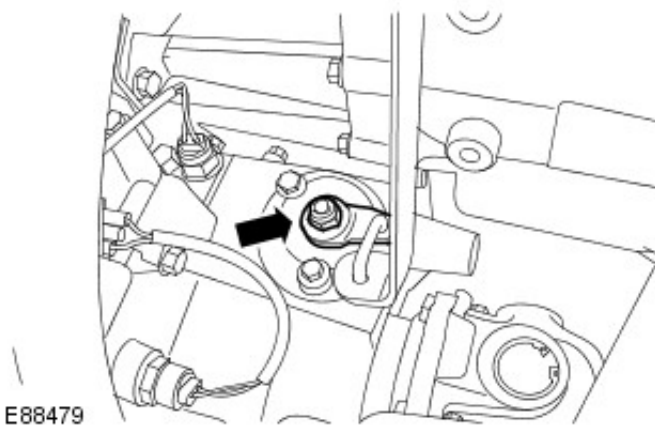
2. Tighten the bolts to 25 Nm (18 lb.ft).



3. Remove the special tool.



4. Install a new differential lock pivot nut.
 • Tighten the nut to 25 Nm (18 lb.ft).



5. Install the transfer case high/low range linkage.
 For additional information, refer to: Transfer Case High/Low Range Linkage (308-07, In-vehicle Repair).

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission -

Lubricants

Item	Specification
Recommended oil	SAE 75W/90 or SAE 80W/90, API GL5, MIL-L-2105 (inc B, C and D)
Capacity	2.3 litres, (4.0 pints)

CAUTION: Do not use any lubricant other than that specified

General Specification - LT230Q

Item	Specification
Transfer case type	LT230QRS
Specification	Two speed reduction on main gearbox output, front and rear drive permanently engaged via a lockable differential
Ratios:	
High	1.211:1
Low	3.269:1

Transfer case data

Item	Metric	Imperial
High/low selector finger width	15.90 to 15.95 mm	0.625 to 0.627 in
High/low selector fork finger width	7.37 to 7.47 mm	0.290 to 0.294 in
High/low selector shaft groove width	16.0 to 16.1 mm	0.63 to 0.64 in
High/low selector hub groove width	7.5 to 7.6 mm	0.295 to 0.30 in
Differential lock selector finger width	15.90 to 15.95 mm	0.625 to 0.627 in
Differential lock selector shaft groove width	16.0 to 16.1 mm	0.63 to 0.64 in
Differential lock selector fork finger width	7.92 to 7.9 mm	0.311 to 0.313 in
Differential lock selector spring free length	84.58 mm	3.33 in
Dog clutch selector fork groove width	8.05 to 8.20 mm	0.32 to 0.33 in
Differential front and rear half carrier gears load to turn:		
Used gears	0.45 kg	1.0 lb
New gears	1.72 kg	3.8 lb
Thrust washer thicknesses available	1.05 to 1.45 mm	0.04 to 0.06 in
In increments of:	0.10 mm	0.004 in
Total load to turn - both sun gears fitted:		
Used gears	0.90 kg	2.0 lb
New gears	3.44 kg	7.6 lb
Low range gear to high range hub clearance	0.05 to 0.15 mm	0.002 to 0.006 in
High range gear to high/low hub clearance	0.05 to 0.10 mm	0.002 to 0.004 in
Mainshaft input gear bearing pre-load	0.05 mm	0.002 in
Mainshaft input gear bearing shim thicknesses	3.15 to 4.00 mm	0.12 to 0.16 in
In increments of:	0.05 mm	0.002 in
Differential bearing pre-load	0.05 mm	0.002 in
Differential shim thicknesses available		
In increments of	0.05 mm	0.002 in
Transfer case gear train torque to turn	3.4 Nm max	30 lbf.in max

Torque Specifications

Description	Nm	lb-ft
Drain plug	30	22
Transfer case breather banjo	15	11
Differential carrier bolts	60	44
Differential bearing nut	72	53
Differential lock selector lever nut	25	18
* Front output housing bolts	25	18
* Rear output housing bolts	45	33
*** Output flange nuts	162	120
* Differential lock selector housing bolts	25	18
High/low selector housing bolts	25	18
* Intermediate shaft retaining plate bolt	25	18
*** Intermediate shaft stake nut - Selective length non-collapsible spacer	88	65
* Bottom cover bolts	25	18
* Bearing housing cover plate bolts and stud nut	25	18
Transmission brake backplate bolts	72	54
Interlock solenoid cover bolts - if fitted	10	8
** Neutral warning lamp switch	25	18

Transfer case front drive flange to drive shaft	47	33
Transfer case rear drive flange to drive shaft	50	37
Transfer case to gearbox extension case	47	33

* Apply Loctite 290 to threads

** Apply Hylomar PL32 to threads

*** New nut must be fitted

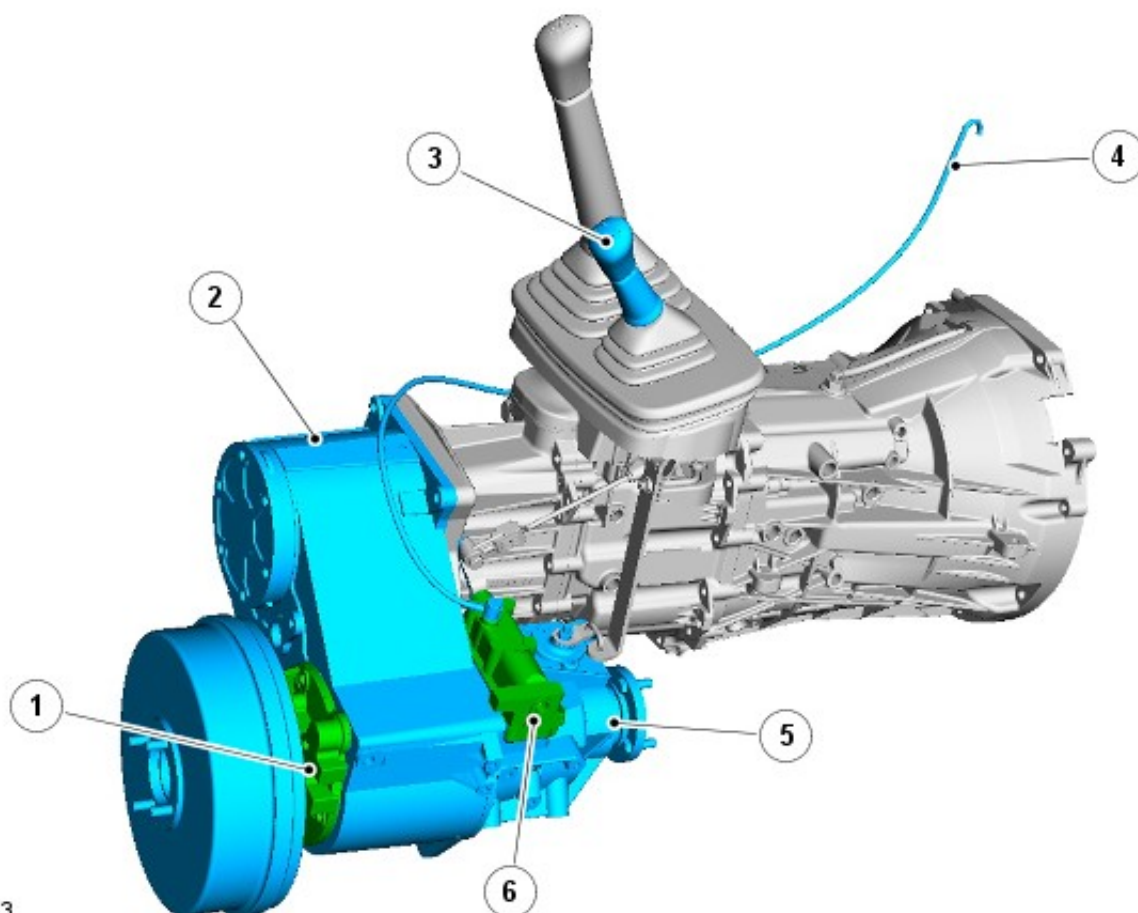
Item	Nm	lbf-ft
METRIC		
M5	6	5
M6	9	7
M8	25	18
M10	45	33
M12	90	65
M14	105	75
M16	180	130
UNF/UNC		
1/4	9	7
5/16	25	18
3/8	40	30
7/16	80	60
1/2	90	65
5/8	135	100

The table above provided torque values for screws and bolts not previously specified.

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case

Description and Operation

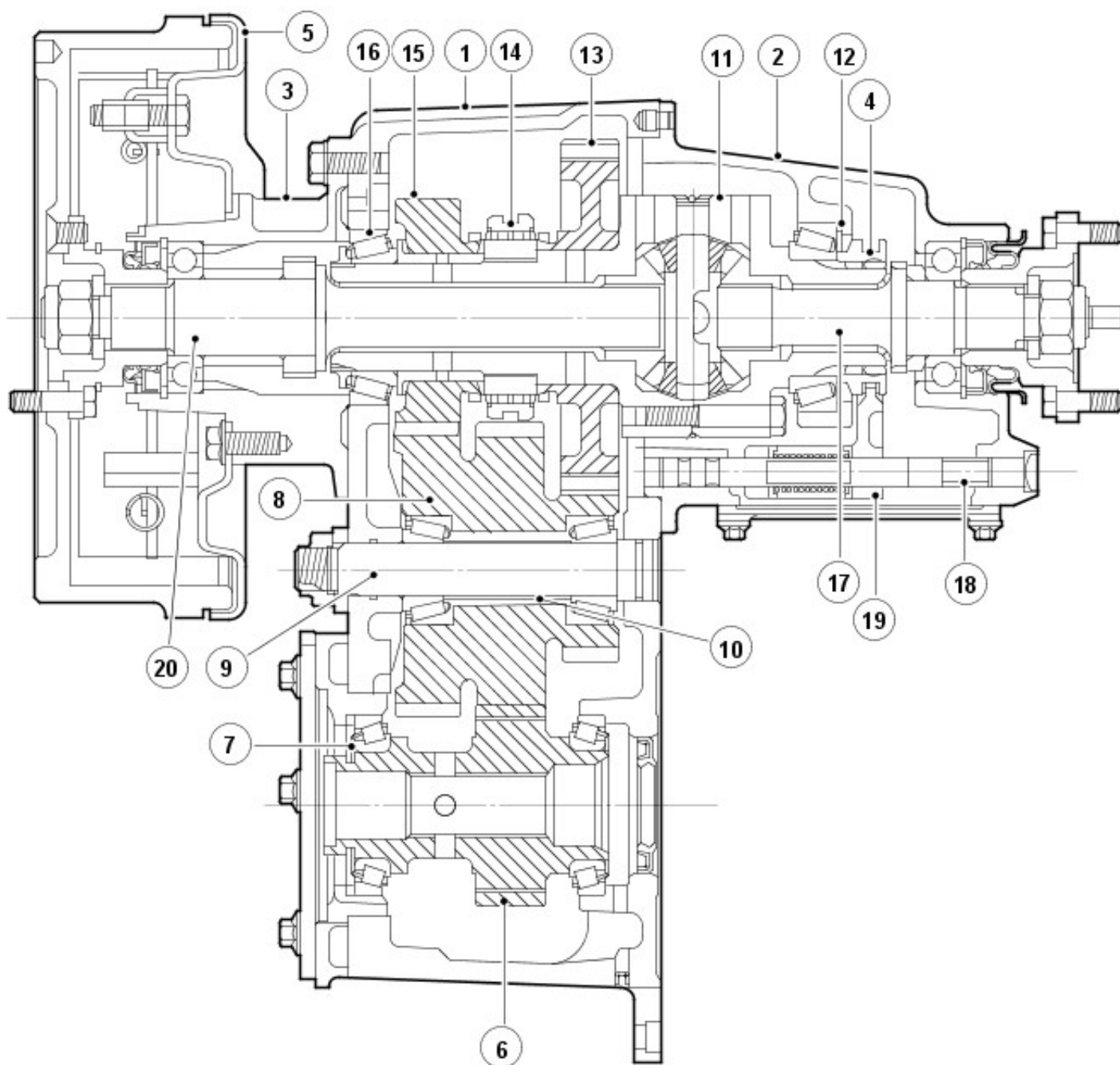
COMPONENT LOCATION



E88403

Item	Part Number	Description
1	-	Rear output housing
2	-	Main casing
3	-	Transfer box selector lever
4	-	Breather pipe
5	-	Front output housing
6	-	Selector housing

TRANSFER CASE CROSS SECTION



E88554

Item	Part Number	Description
1	-	Main casing
2	-	Front output housing
3	-	Rear output housing
4	-	Dog clutch
5	-	Transmission brake
6	-	Mainshaft input gear

7	-	Selective shim - input gear bearing pre-load
8	-	Intermediate gear cluster
9	-	Intermediate shaft
10	-	Spacer
11	-	Differential assembly
12	-	Selective shim - differential bearing pre-load
13	-	Low range gear
14	-	High/low selector sleeve and hub
15	-	High range gear and bush
16	-	Differential rear bearing
17	-	Front output shaft
18	-	Differential lock selector shaft
19	-	Selector fork
20	-	Rear output shaft

OVERVIEW

The transfer box is a permanent 4-wheel drive, 2-speed ratio reducing transmission, incorporating high and low range outputs with mechanically lockable centre differential (diff-lock). High range has a ratio of 1.211:1 and low range 3.269:1.

High/low range and diff-lock selection are made via a single lever located next to the main gear lever.

The unit is mounted at the rear of the main transmission and transmits drive to the front and rear drive axle differentials via the drive shafts.

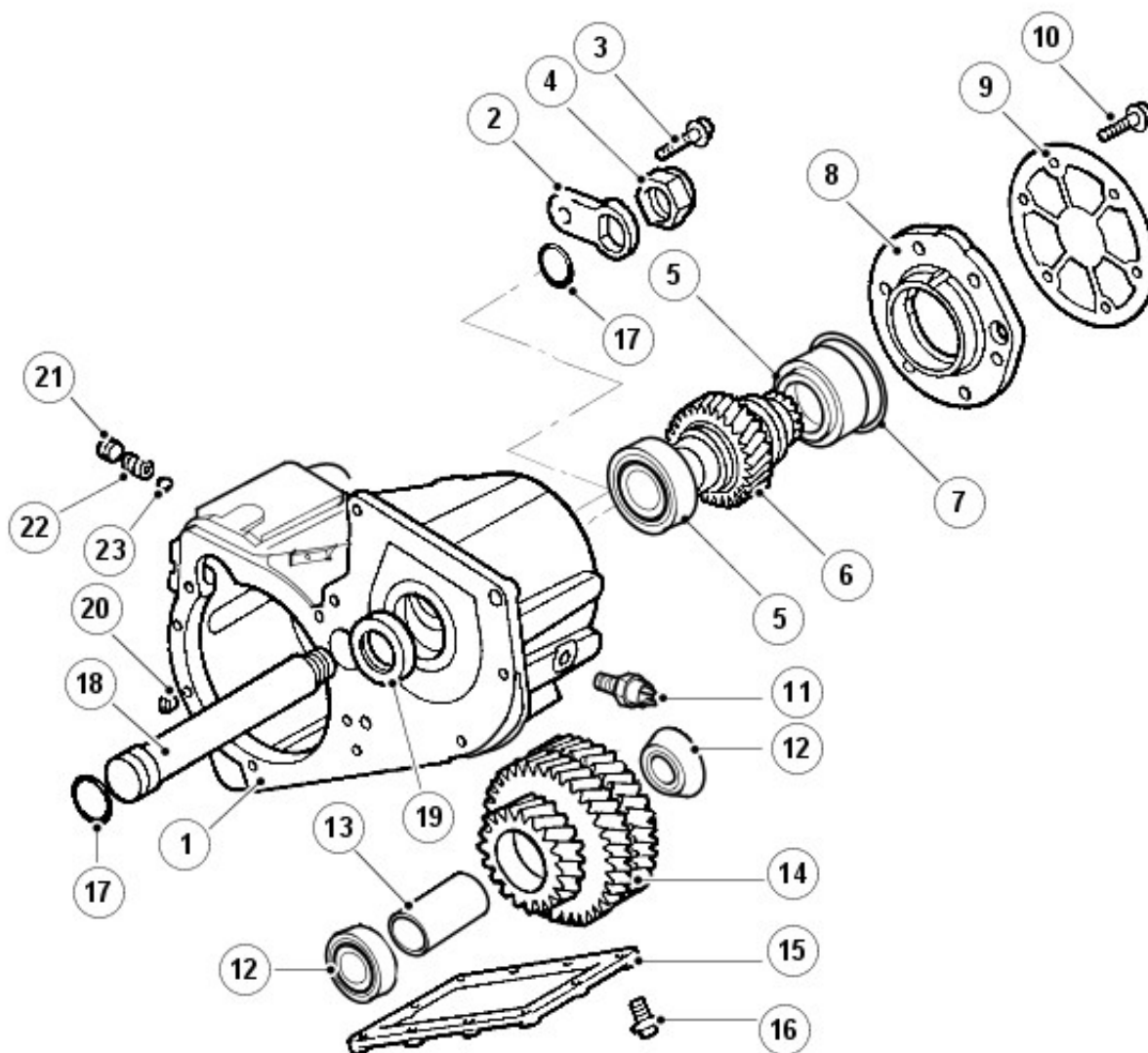
Integral with the output shafts is a differential assembly, which compensates for speed differences between the front and rear drive shafts. To improve traction and prevent all the power being transmitted to the drive axle differential offering the least traction, a diff-lock is provided. The diff-lock should only be engaged during severe off-road conditions where traction is poor and should be disengaged as soon as conditions permit, for example, when good traction is available. Selection of differential lock engages, through mechanical linkage, a dog clutch with the front output shaft, this action locks the centre differential and provides a fixed drive, giving equal power to the front and rear drive shafts.

The transfer box comprises 3 main assemblies:

- The main casing
- The front output housing
- The rear output housing

All housings and cover plates are sealed to the main casing by sealant. Output flange rotary seals are protected against mud and water ingress by mud shield flingers.

THE MAIN CASING



E88555

Item	Part Number	Description
1	-	Main casing
2	-	Retaining plate
3	-	Bolt - retaining plate
4	-	Stake nut - intermediate shaft
5	-	Bearings and outer tracks - mainshaft input gear
6	-	Mainshaft input gear
7	-	Selective shim
8	-	Mainshaft input gear bearing housing
9	-	Cover plate/power take-off cover
10	-	Bolt - cover plate
11	-	Oil temperature switch (if fitted)
12	-	Bearings and outer tracks - intermediate gears
13	-	Collapsible spacer
14	-	Intermediate gears
15	-	Bottom cover plate
16	-	Bolt - bottom cover plate
17	-	O-rings - intermediate shaft
18	-	Intermediate shaft
19	-	Mainshaft oil seal
20	-	Locating dowel
21	-	Detent plug - high/low selector
22	-	Detent spring - high/low selector

The main casing carries:

- the mainshaft input gear
- the intermediate gears
- the centre differential assembly

The front and rear output housings are bolted to either side of the main casing.

Mainshaft Input Gear

The transmission output shaft is splined into the mainshaft input gear, which is supported by taper roller bearings.

Input gear bearing pre-load is achieved by the use of a selective shim located in the bearing housing.

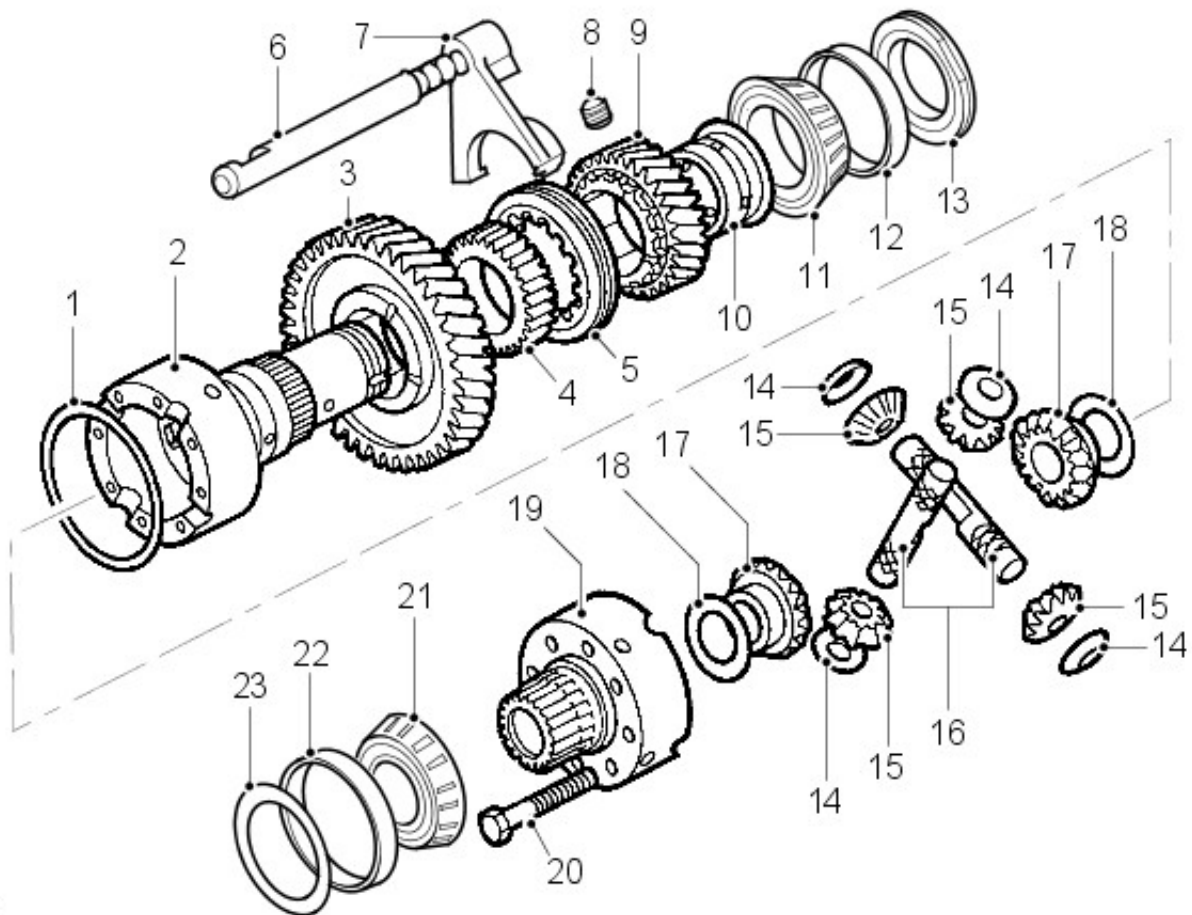
Intermediate Gears

The intermediate gear cluster is supported by the taper roller bearings located at each end of the cluster and runs on the intermediate shaft, which in turn, is supported at the front and rear by the main casing.

Intermediate gear bearing pre-load is achieved by means of a collapsible spacer positioned between the bearings, the amount of compression applied to the spacer is by means of a nut on the end of the intermediate shaft.

The bore of the intermediate gear is machined with a shoulder at each end to locate the bearings.

Centre Differential Assembly



41M7292A

Item	Part Number	Description
1	-	Retaining ring
2	-	Differential carrier - rear half
3	-	Low range gear
4	-	High/low hub
5	-	High/low selector sleeve
6	-	High/low selector shaft
7	-	High/low selector fork
8	-	Setscrew - high/low selector fork
9	-	High range gear
10	-	High range gear bush

- | | | |
|----|---|-----------------------------------|
| 11 | - | Differential rear bearing |
| 12 | - | Bearing outer track |
| 13 | - | Bearing retaining nut |
| 14 | - | Dished thrust washers |
| 15 | - | Differential planet gears |
| 16 | - | Cross shafts |
| 17 | - | Differential side gears |
| 18 | - | Selective thrust washers |
| 19 | - | Differential carrier - front half |
| 20 | - | Bolt - differential carriers |
| 21 | - | Differential front bearing |
| 22 | - | Bearing outer track |
| 23 | - | Selective shim |

The centre differential assembly is supported at the front and rear by taper roller bearings, the front bearing outer track is located in the front output housing and the rear bearing outer track is located in the main casing by the rear output housing. Bearing pre-load is achieved by means of a selective shim located in the front output housing.

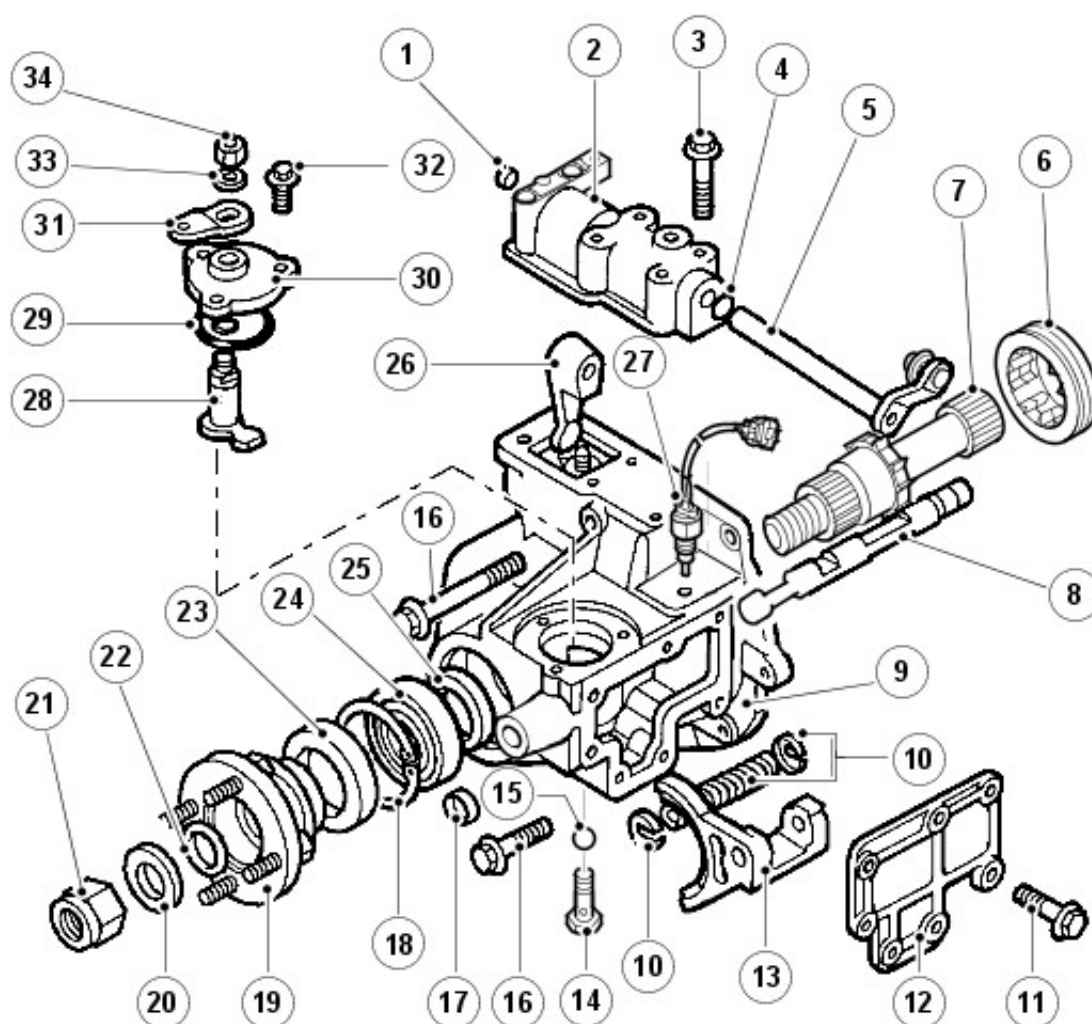
The centre differential rear shaft carries the low range gear, high/low selector sleeve and hub, high range gear and bush and the differential rear bearing; these components being secured to the shaft by a special staked nut.

The assembly comprises front and rear half carriers with integral shafts connected to differential side gears and planet gears mounted on cross shafts within the half carriers. Dished, non-selective thrust washers control the engagement of the planet gears with the differential side gears, whilst selective thrust washers are used to control engagement of the differential side gears and 'torque to turn' of the differential. The differential carrier halves are bolted together, a retaining ring providing positive location of the cross shafts.

The high/low selector shaft and fork are located at the side of the differential, movement of the shaft, fork and selector sleeve being controlled by the high/low selector finger. A spring loaded detent ball fitted in the main casing, locates in grooves in the shaft.

The selector fork is fitted with a spring assister and clips to reduce the effort required to move the selector lever.

FRONT OUTPUT HOUSING



Item	Part Number	Description
1	-	Hollow plug
2	-	High/low cross shaft housing
3	-	Bolt - high/low cross shaft housing
4	-	O-ring
5	-	High/low cross shaft and lever with cable ball end
6	-	Dog clutch
7	-	Front output shaft
8	-	Differential lock selector shaft
9	-	Front output housing
10	-	Spring and clips - differential lock
11	-	Bolt - Cover plate
12	-	Cover plate
13	-	Differential lock selector fork
14	-	Detent plug and spring - differential lock
15	-	Detent ball - differential lock
16	-	Bolt - front output housing
17	-	Plug
18	-	Circlip
19	-	Output shaft flange and mud shield
20	-	Steel washer
21	-	Self-locking nut
22	-	Felt washer
23	-	Oil seal
24	-	Output shaft bearing
25	-	Bearing spacer
26	-	High/low selector finger
27	-	Differential lock warning indicator switch
28	-	Differential lock selector finger and shaft
29	-	O-rings
30	-	Differential lock selector housing
31	-	Selector lever
32	-	Bolt - housing
33	-	Washer
34	-	Self-locking nut

The front output housing carries:

- the front output shaft and flange
- the housing and selector
- the differential lock selector shaft and fork

Front Output Shaft and Flange

The front output shaft is supported in the housing by a single bearing and is splined into the differential front sun gear.

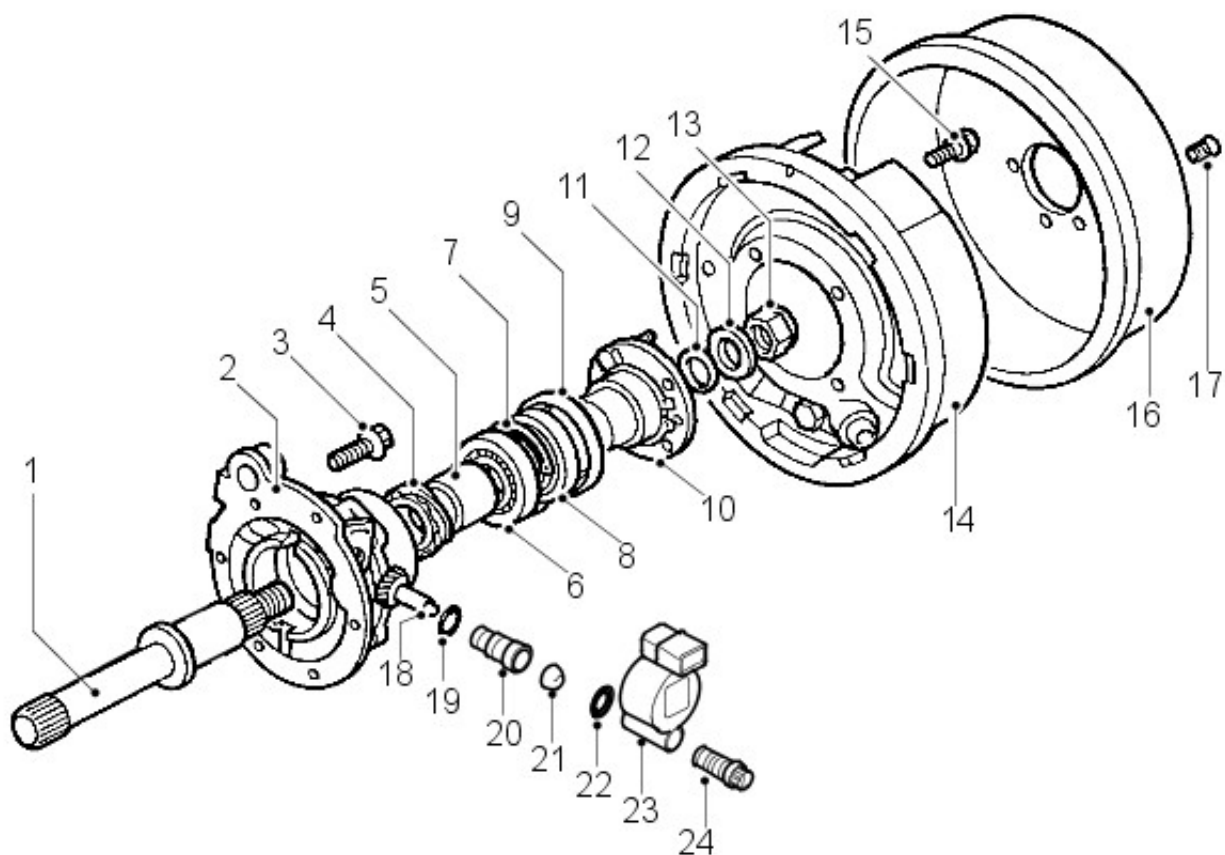
Housing and Selector Assembly

A high/low cross shaft is located in a housing bolted to the top of the output housing and is connected to the high/low selector finger, which locates in a slot in the selector shaft.

Differential Lock Selector Shaft and Fork

The differential lock selector housing is bolted to the top of the front output housing, the selector finger passes through the housing, locating in a slot in the differential lock selector shaft. The differential lock selector shaft passes through the selector fork, which is located beneath a plate bolted to the side of the output housing. The selector fork engages the dog clutch sleeve with the differential rear shaft when the splines of the sleeve and differential rear shaft are aligned. A spring loaded detent ball fitted in the output housing locates in grooves in the shaft.

REAR OUTPUT HOUSING



M417063A

Item	Part Number	Description
1	-	Rear output shaft
2	-	Rear output housing
3	-	Bolt - rear output housing
4	-	Speedometer drive gear
5	-	Spacer
6	-	Output shaft bearing
7	-	Circlip
8	-	Oil seal
9	-	Mud shield
10	-	Output shaft flange
11	-	Felt washer
12	-	Steel washer
13	-	Self-locking nut
14	-	Transmission brake backplate
15	-	Bolt - transmission brake backplate
16	-	Transmission brake drum
17	-	Countersunk screw
18	-	Speedometer driven gear
19	-	O-ring
20	-	Speedometer driven gear housing
21	-	Seal
22	-	O-ring
23	-	Vehicle speed sensor (if fitted)
24	-	Allen screw (if fitted)

The rear output housing carries the output shaft and flange and the speedometer drive and driven gears. A mechanically operated transmission brake is attached to the housing, the brake drum being attached to the output flange.

The rear output shaft is supported in the rear output housing by a single bearing and is splined into the differential rear shaft. The output shaft also carries the speedometer drive gear, which meshes with the speedometer driven gear located in the rear output housing.

A differential lock warning lamp switch operated by movement of the selector fork and shaft is screwed into the top of the

output housing.

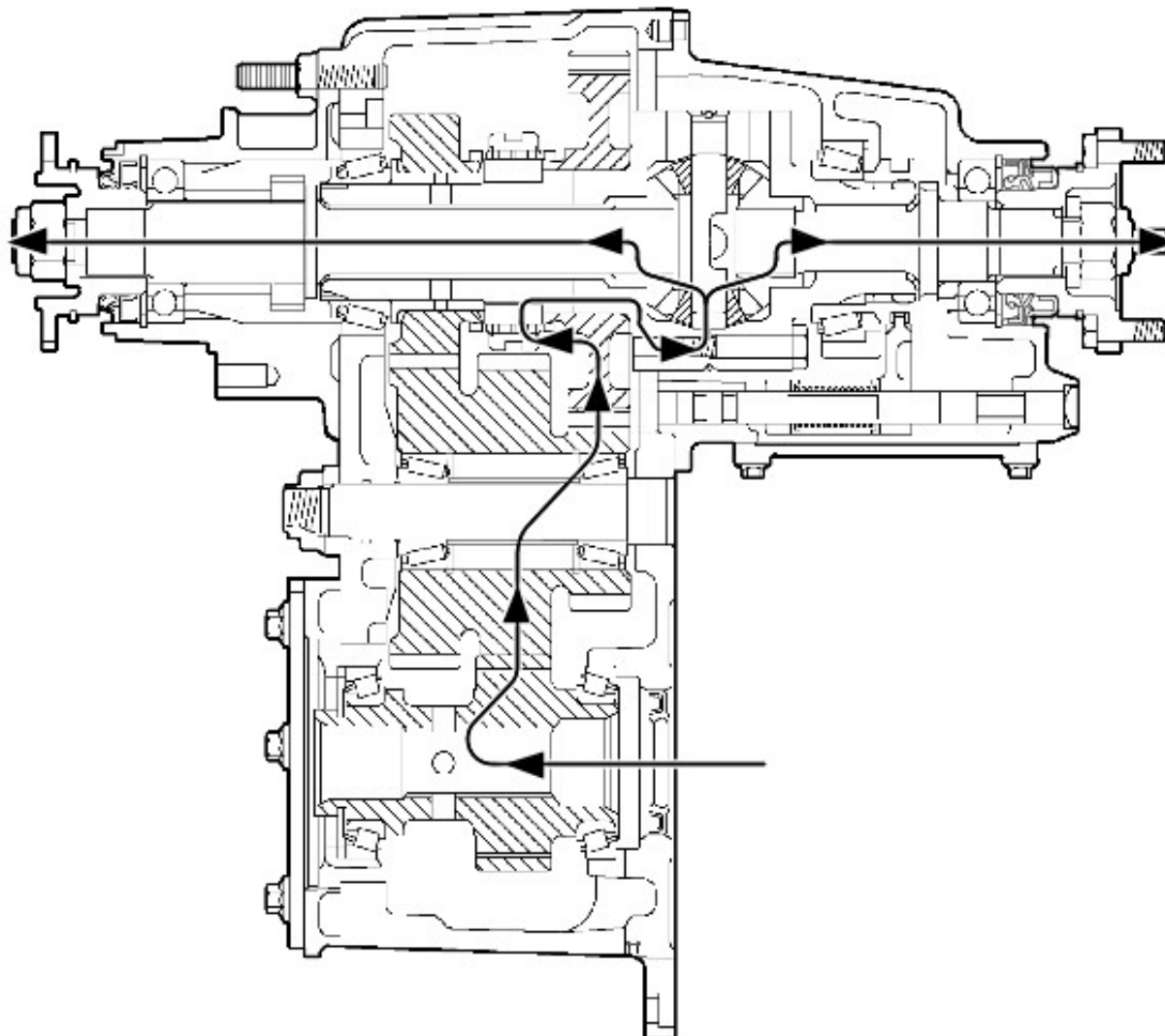
LUBRICATION

Lubrication is by splash, oil filler/level and drain plugs being located in the main casing.

Internal pressures caused by thermal expansion and contraction are avoided by the use of a plastic breather pipe venting the interior of the box to atmosphere. The pipe is attached to the top of the high/low selector housing and is routed in a continuously rising path into the engine compartment where the open end is secured to the engine cylinder block.

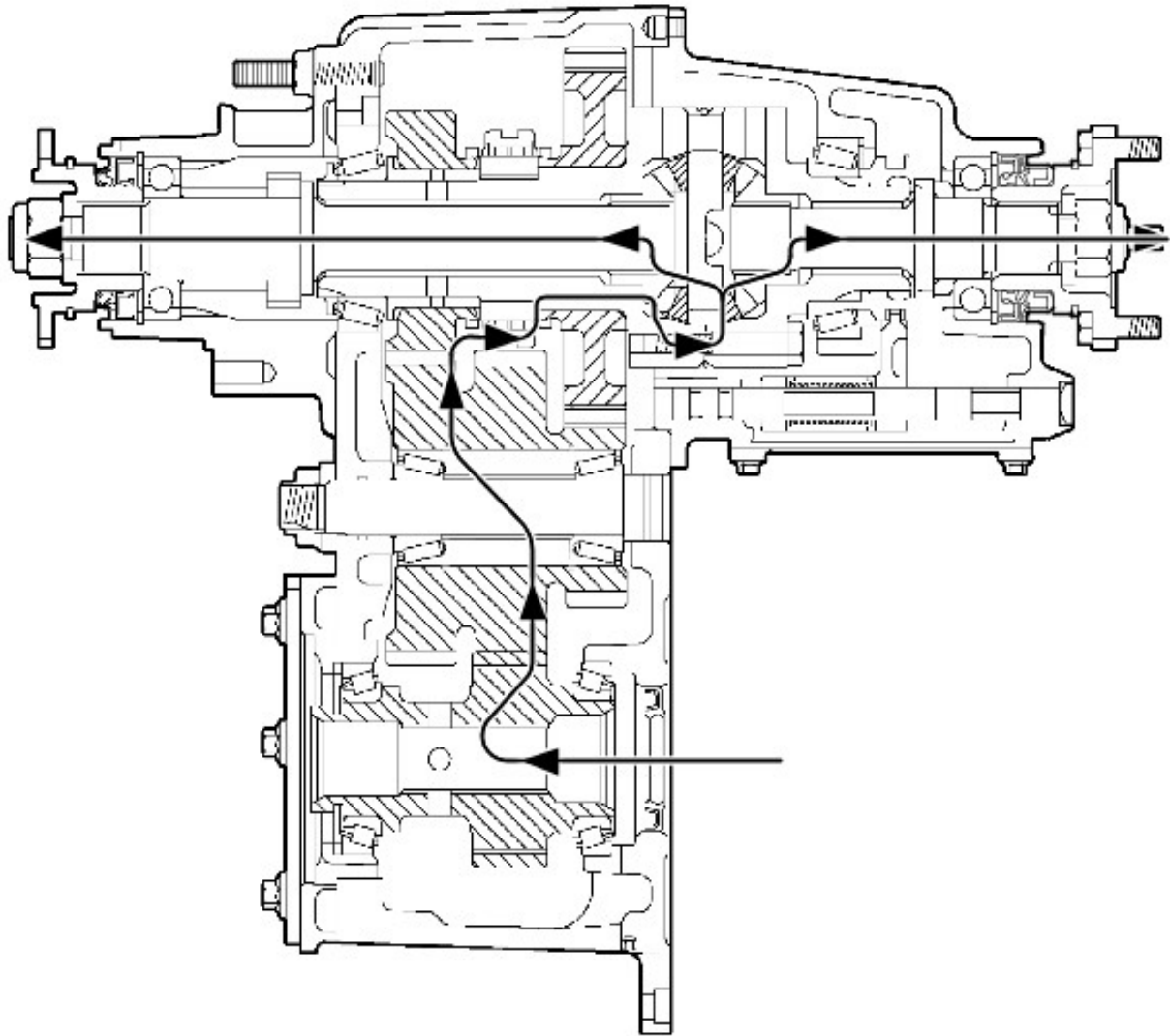
OPERATION

Power Flow - Transfer Box in LOW Range



E88559

Power Flow - Transfer Box in HIGH Range



E88560

The gearbox output shaft transmits power to the mainshaft input gear which is in constant mesh with one of the intermediate gears. The intermediate gears are in constant mesh with the high and low range output gears running on the differential rear shaft.

Power is transmitted to the output shafts via the differential assembly by locking either the high or low range gears to the differential rear shaft. This is achieved by means of the high/low selector fork, sleeve and splined hub.

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Draining and Filling

General Procedures

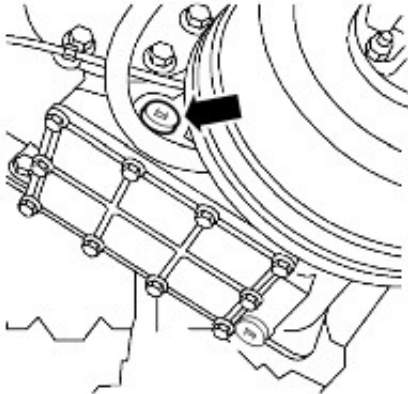
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Position a container to collect the fluid.

3. **NOTE:** Clean the area surrounding the transfer case filler/level plug.

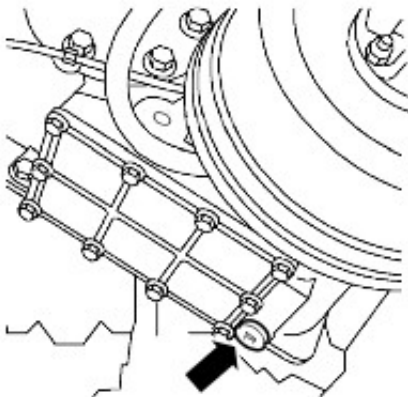
Remove the transfer case filler plug to vent the transfer case and assist with draining.



≡ 91241

4. **NOTE:** Clean the area surrounding the transfer case fluid drain plug.

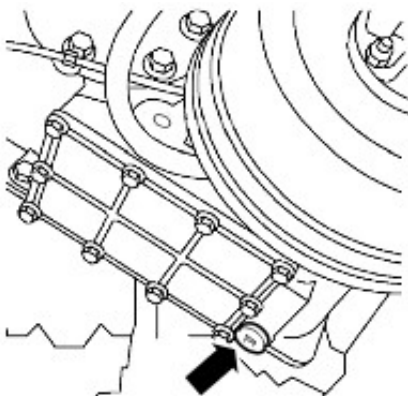
Remove the transfer case fluid drain plug.




≡ 91242

5. Allow the fluid to drain.

6. Install the transfer case drain plug and clean any oil residue from the surrounding area.
 - Tighten to 30 Nm (22 lb.ft).

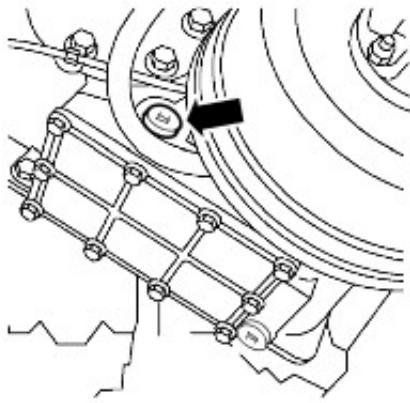


≡ 91242

7.  **CAUTION:** The transfer case oil filler plug must not be used as a transfer case oil level plug. Failure to follow this instruction may result in damage to the vehicle.

Refill the transfer case with the recommended fluid.

For additional information, refer to: Specifications (308-07 Transfer Case - 2.4L Diesel, Specifications).



8. Install the transfer case filler plug and clean any oil residue from the surrounding area.
 - Tighten to 30 Nm (22 lb.ft).


9. Remove the container.

91241

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case High/Low Range Selector Rod Adjustment

General Procedures

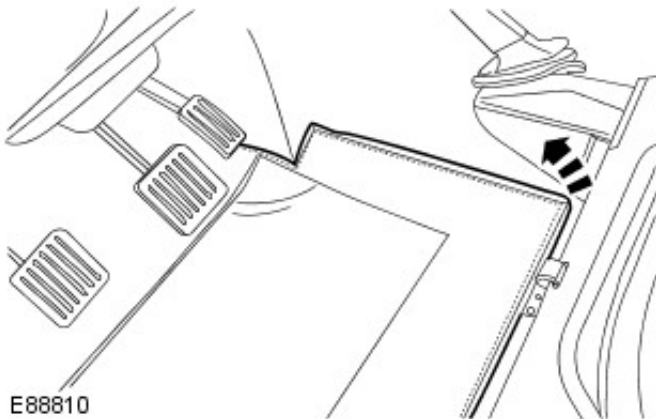
Special Tool(s)

	Locking Tool High/Low Selector 308-711
--	---

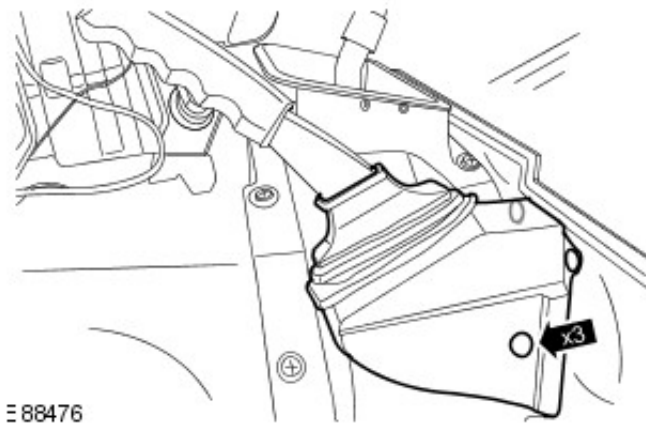
NOTE: If carrying out this procedure after replacing the transfer case high/low range selector linkage, carry out steps 13 - 19.

1. Remove the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).

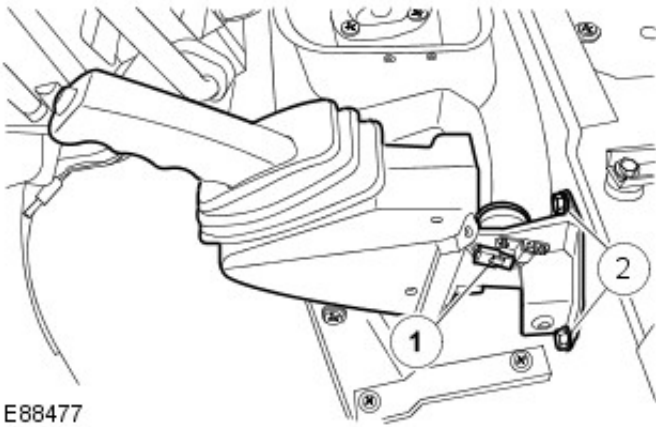
2. Reposition the LH carpet.



3. Remove the parking brake lever gaiter.
 - Remove the 3 clips.

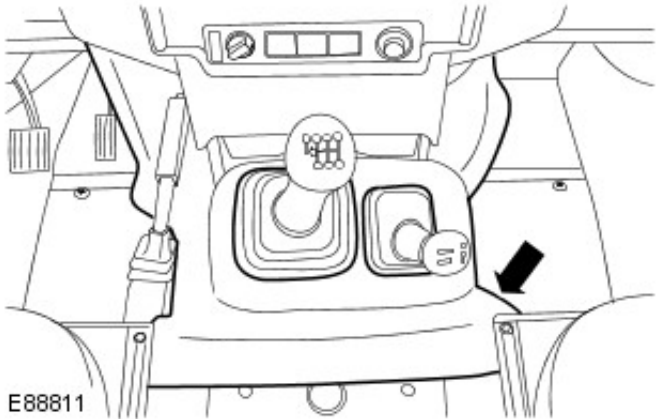


4. Release the parking brake lever.
 1. Disconnect the electrical connector.
 2. Remove the 2 bolts.



E88477

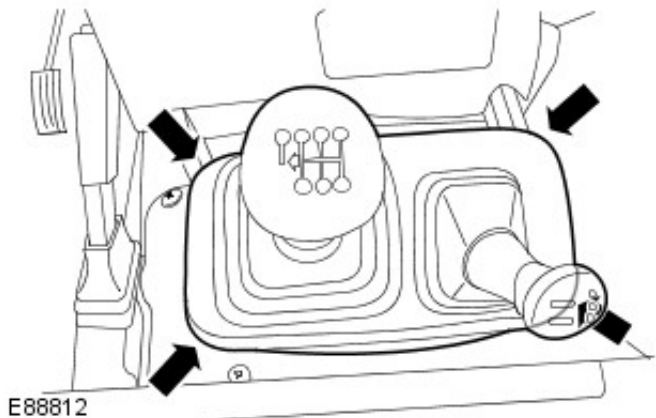
5. Remove the transmission cover panel floor covering.




E88811

6. **NOTE:** Do not detach the gaiter from the selector knobs.

Detach the gaiter from the transmission cover panel.

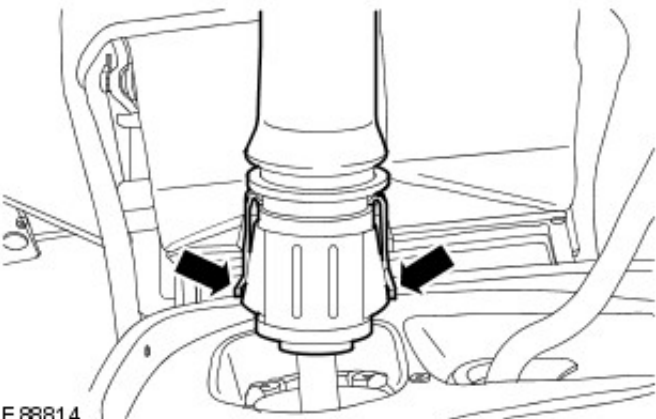


E88812


7.  **WARNING:** The gearshift lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Release the gearshift lever knob.

- Release the 2 clips.

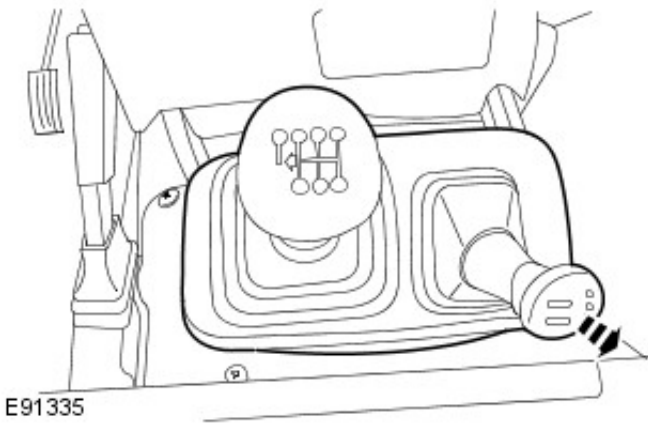


E88814

8.  **WARNING:** The high/low range selector lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Remove the gaiter and selector levers.

- Detach the high/low range selector lever.



9. Remove the transmission cover panel.
 - Remove the 11 screws.



10. **NOTE:** Position the differential lock to the left, to reduce tension on the insulation.

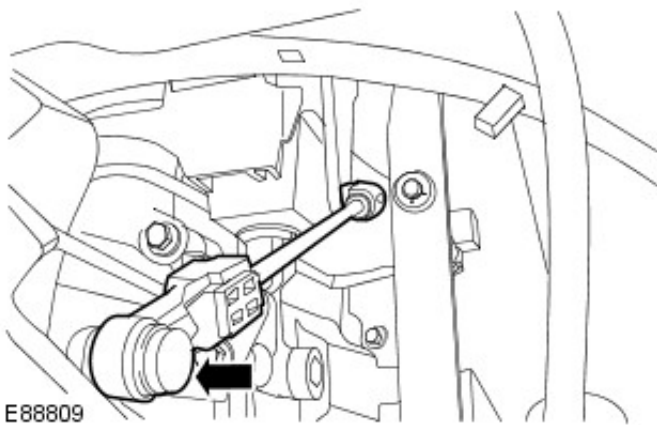
Remove the insulation pad.



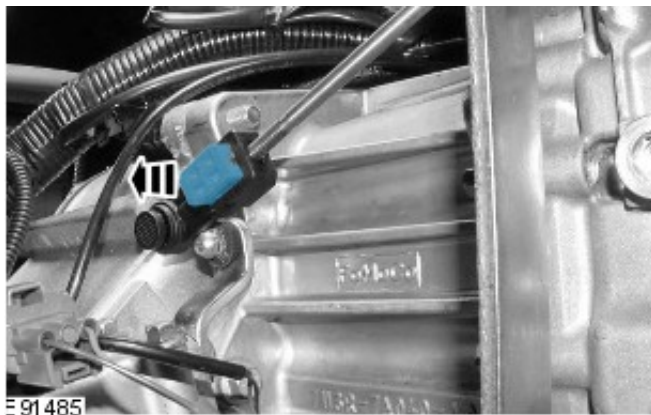
11. Remove the insulation pad support bracket.




12. Disconnect the transfer case high/low range selector rod.
 - Press the button to release the transfer case high/low range selector rod.



13. Release the adjuster.
 - Release the locking block.



14.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

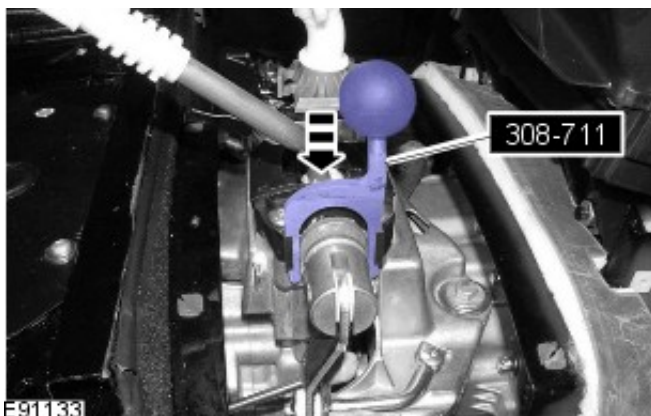
Raise and support the vehicle.

15. **NOTE:** It may be necessary to rotate the road wheels to confirm that high range is fully engaged.

Make sure that high range is fully engaged on the transfer case.



16. Using the special tool, set the transfer case high/low range selector lever in high range.
 - Insert the special tool.

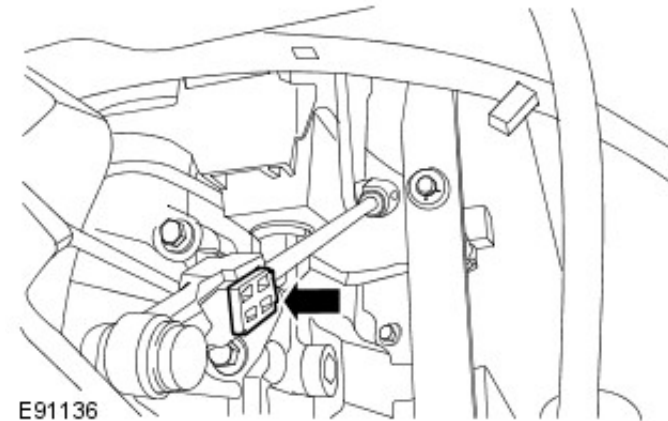


17. **NOTE:** Make sure the transfer case high/low range selector rod is fully engaged on the ball joint and not the foam washer.

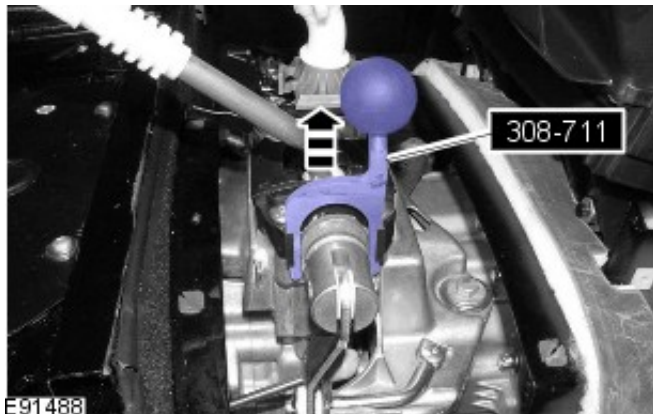


Connect the transfer case high/low range selector rod.

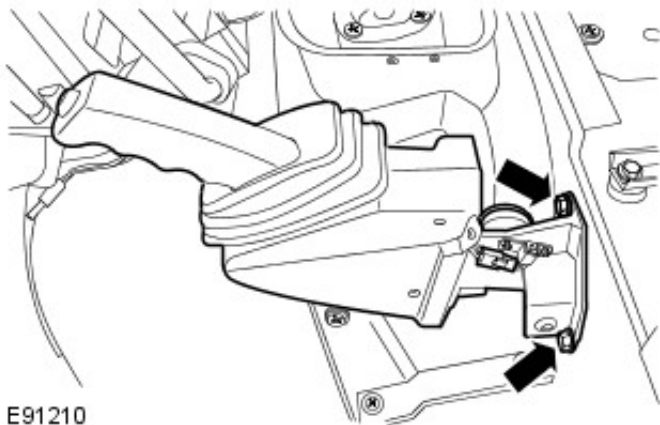
18. Push in the locking block.
 - Fully engage the locking block.



19. Remove the special tool.



20. Install the insulation pad support bracket.
21. **NOTE:** Position the differential lock to the left, to reduce tension on the insulation.
Install the insulation pad.
22. Install the transmission cover panel.
 - Install the screws.
23. Install the gaiter with the selector levers attached.
 - Install the selector levers.
 - Fully seat the gaiter.
24. Install the transmission cover panel floor covering.
25. Install the parking brake lever.
 - Tighten to 25 Nm (18 lb.ft).



E91210

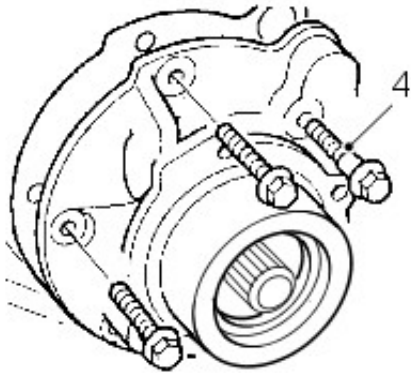
26. Install the parking brake lever gaiter.
 - Install the clips.
27. Reposition the LH carpet.
28. Install the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Extension Housing

In-vehicle Repair

Removal

1. Drain transfer case oil.
For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).
2. Remove transfer case rear output shaft seal.
For additional information, refer to: Transfer Case Rear Output Shaft Seal (308-07A, In-vehicle Repair).
3. Mark extension housing to main casing for assembly purposes.
4. Note position of shoulder bolt, remove 6 bolts securing extension housing to main casing.



M417563


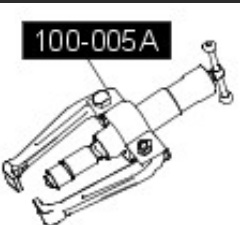

Installation

1. Clean extension housing, mating face on main casing and sealant from bolt threads.
2. Apply sealant, Part No. STC 4600 to mating flange on output shaft housing.
3. Fit extension housing to main casing ensuring that splines of output shaft are engaged in differential.
4. Apply sealant, Part No. STC 50552 to bolt threads.
5. Fit bolts and tighten by diagonal selection to 45 Nm (33 lbf.ft).
6. Fit transfer case rear output shaft seal. For additional information, refer to: Transfer Case Rear Output Shaft Seal (308-07A, In-vehicle Repair).
7. Fill transfer case with oil.
For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).


Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Front Output Shaft Seal

In-vehicle Repair

Special Tool(s)

 205053	Output Shaft Flange Holding Tool 205-053
 E91088	General Purpose Puller 100-005A
 E91089	Replacer, Oil Seal 307-479

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

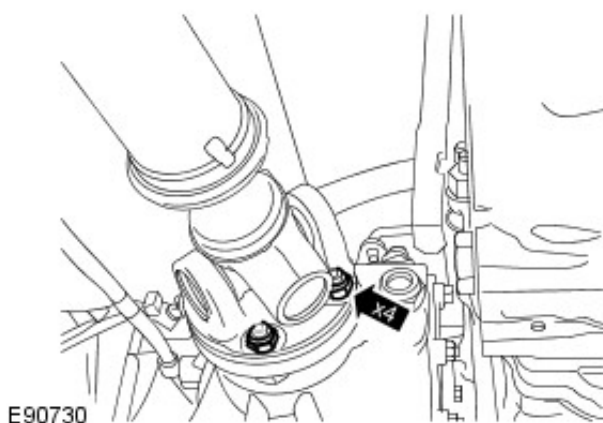
Raise and support the vehicle.

2. Drain the transfer case.
For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).

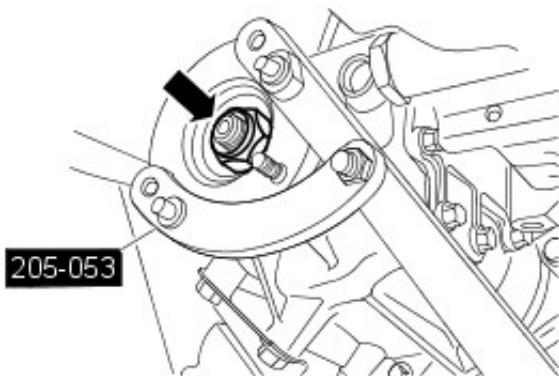
3. **NOTE:** Mark the front driveshaft to transfer case drive flange.

Release the driveshaft from the transfer case output drive flange.

- Remove and discard the 4 nuts.

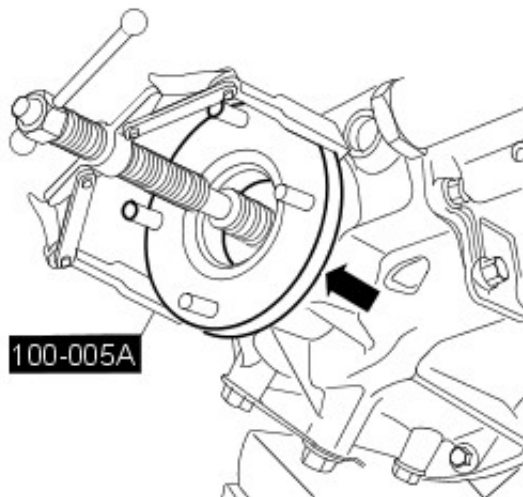


4. Using the special tool, restrain the transfer case front output flange.
 - Remove and discard the nut and felt washer.



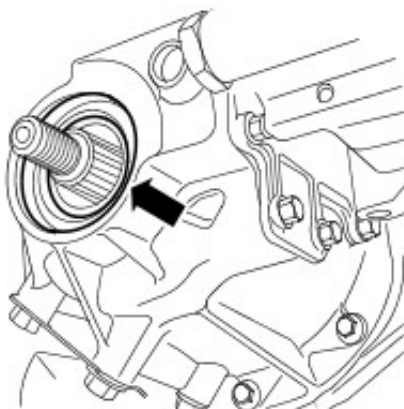
E90755

5. Remove the transfer case front output flange.
 - If necessary use the special tool to remove the transfer case front output flange.



E90756

6. Using a suitable tool, remove and discard the transfer case front output shaft seal.



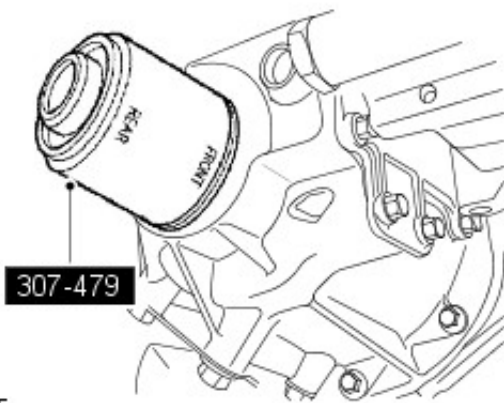
E90757

Installation

1. **NOTE:** Clean the component mating faces.

NOTE: Use end of tool marked 'FRONT' to fit seal.

Using the special tool, install a new transfer case front output shaft seal.

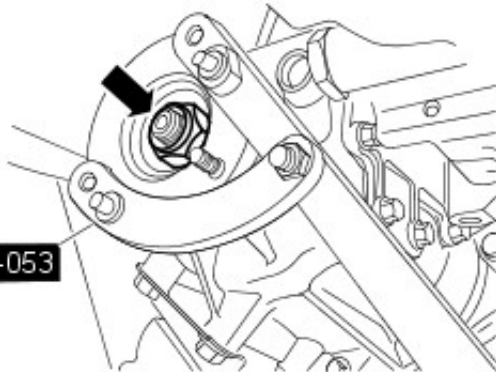


E90775

2. **NOTE: Install a new felt washer.**

Install the transfer case front output flange.

- Install the washer.
- Install a new nut and tighten to 162 Nm (120 lb.ft).

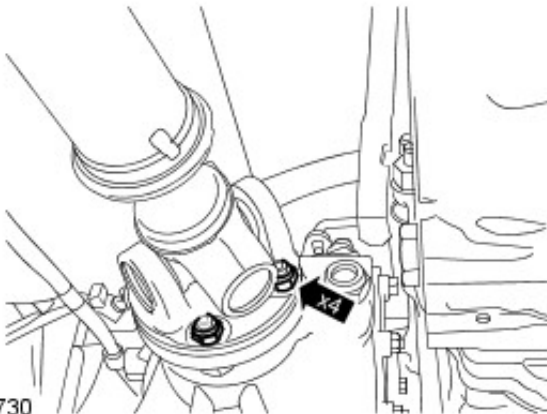


E90755

3. **NOTE: Install new nuts.**

Tighten to 45 Nm (33 lb.ft).

- Align the position of the driveshaft in relation to the drive pinion flange.



E90730

4. Fill the transfer case.

For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).

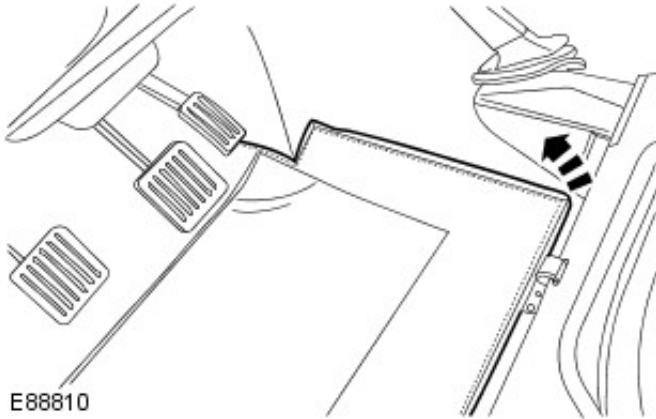
Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case High/Low Range Linkage

In-vehicle Repair

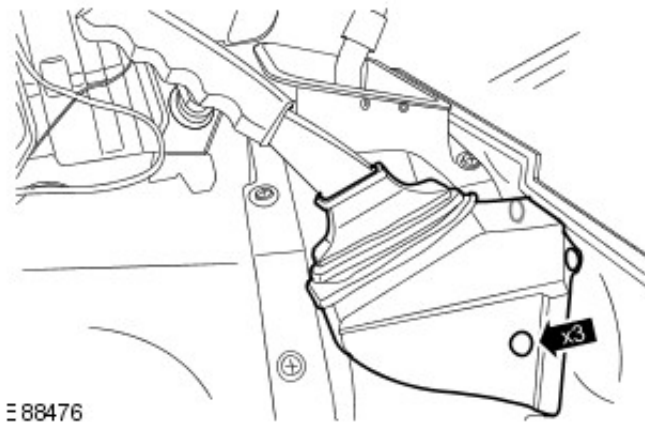
Removal

1. Remove the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).

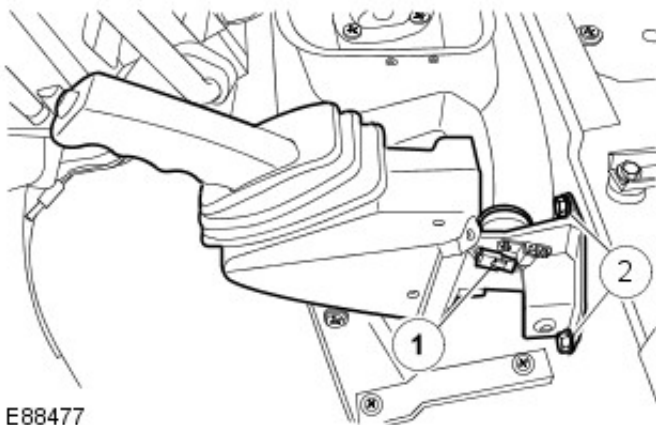
2. Reposition the LH carpet.



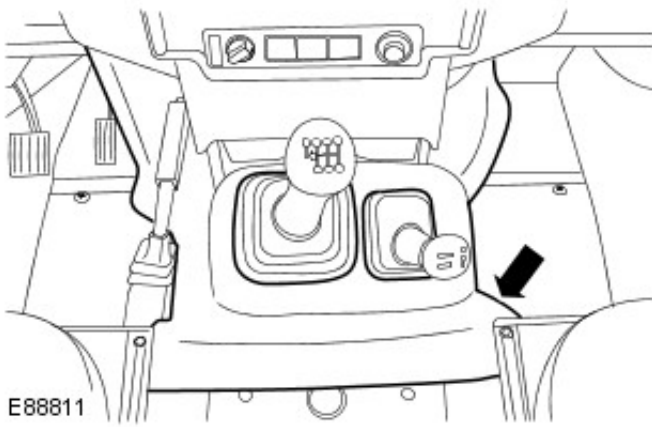
3. Release the parking brake lever gaiter.
 - Remove the 3 clips.



4. Release the parking brake lever.
 1. Disconnect the electrical connector.
 2. Remove the 2 bolts.

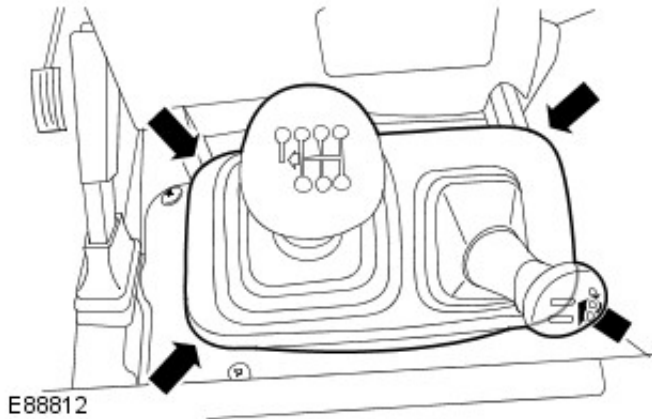


5. Remove the transmission cover panel floor covering.



6. **NOTE:** Do not detach the gaiter from the selector knobs.

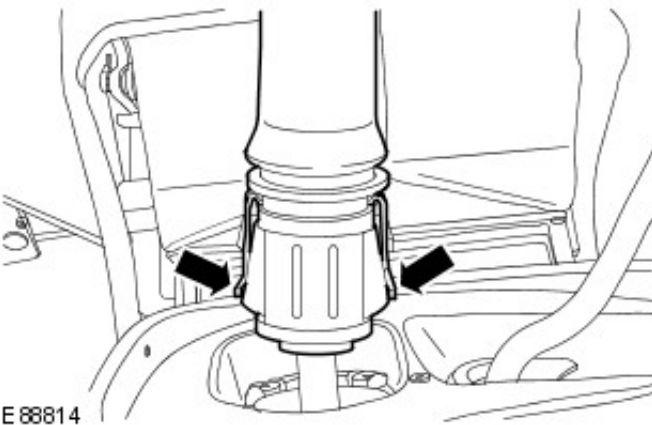
Detach the gaiter from the transmission cover panel.



7. **WARNING:** The gearshift lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Release the gearshift lever knob.

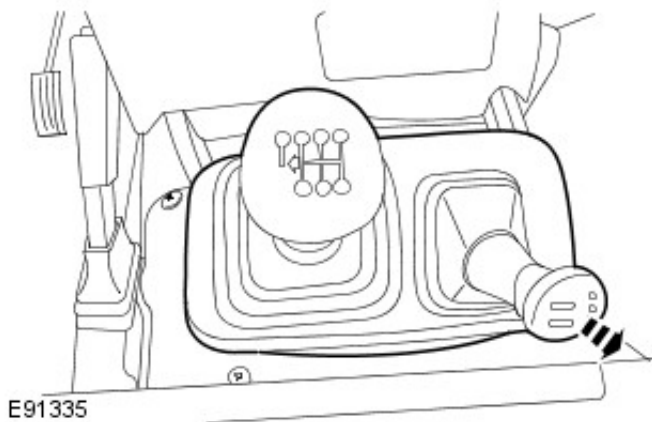
- Release the 2 clips.



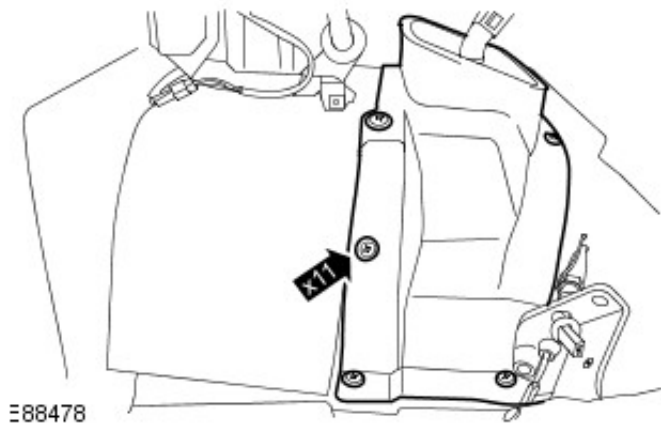
8. **WARNING:** The high/low range lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Remove the gaiter and selector levers.

- Detach the high/low range selector lever.



9. Remove the transmission cover panel.
- Remove the 11 screws.

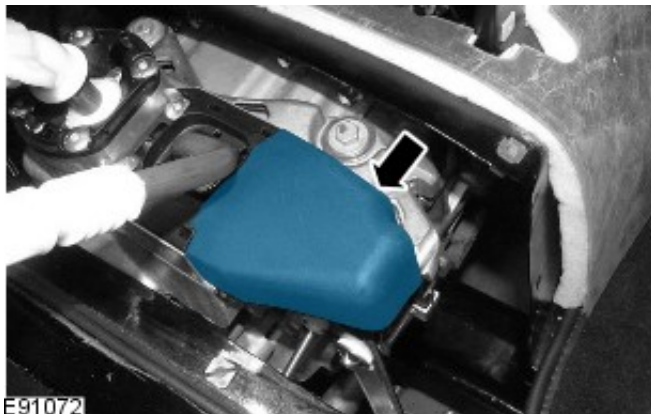


10. NOTE: To reduce tension on the insulation, position the differential lock lever to the left.

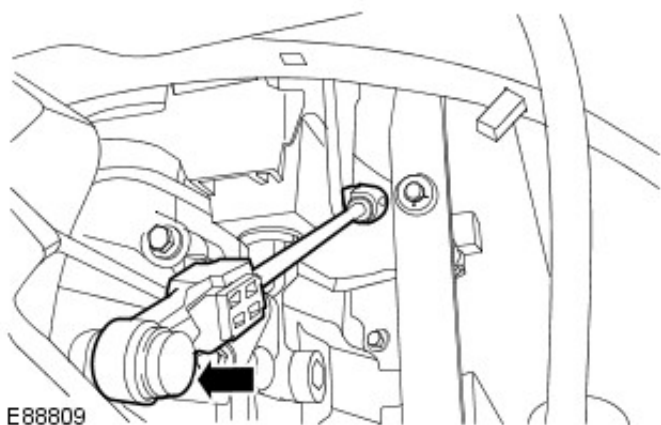
Remove the insulation pad.



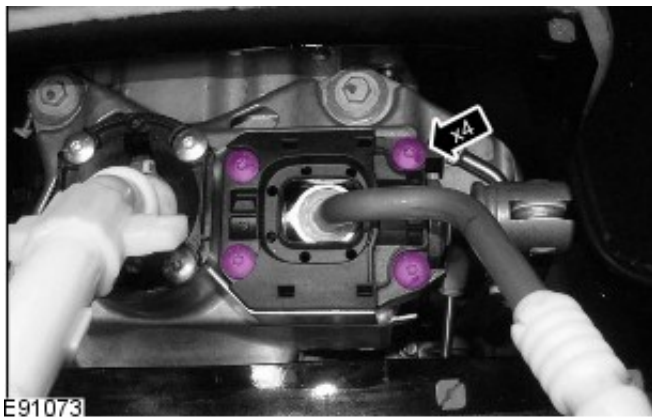
11. Remove the insulation pad support bracket.



12. Disconnect the high/low range selector rod.
- Press the button to release the fitting before disconnecting the rod.

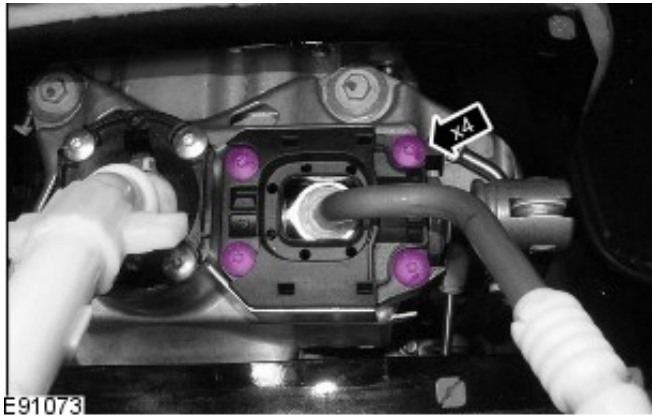


13. Remove the high/low range linkage.
- Remove the 4 screws.



Installation

1. Install the high/low range linkage.
 - Tighten to 7 Nm (5 lb.ft).

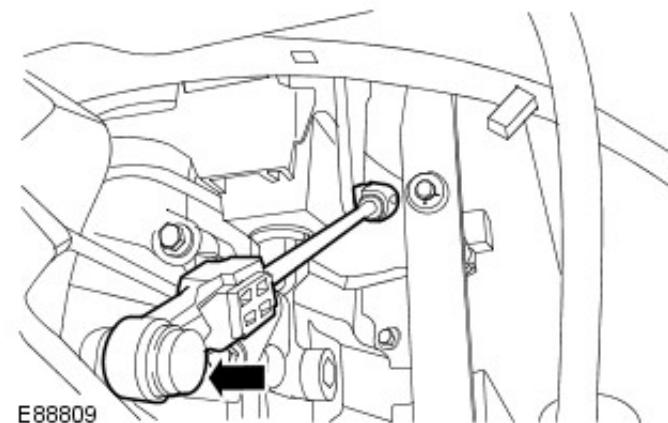


NOTE: If adjustment of the transfer case high/low range selector linkage has changed, carry out the adjustment procedure.

For additional information, refer to: Transfer Case High/Low Range Selector Rod Adjustment (308-07, General Procedures).

2. NOTE: Make sure the rod is fully engaged on the ball joint and not on the foam washer.

Connect the high/low range selector rod.

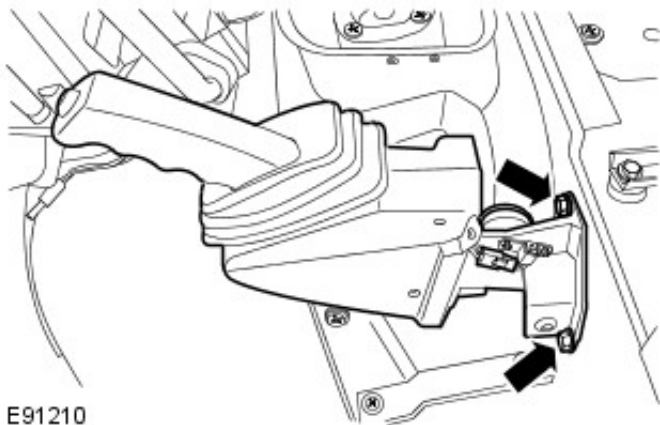


3. Install the insulation pad support bracket.
4. NOTE: Position the differential lock to the left, to reduce tension on the insulation.

Install the insulation pad.

5. Install the transmission cover panel.
 - Install the screws.
6. Install the gaiter with the selector levers attached.
 - Install the selector levers.
 - Fully seat the gaiter.
7. Install the transmission cover panel floor covering.

8. Install the parking brake lever.
 - Tighten to 25 Nm (18 lb.ft)



9. Install the parking brake lever gaiter.
 - Install the clips.


10. Reposition the LH carpet.

11. Install the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).


Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Input Shaft Seal

In-vehicle Repair

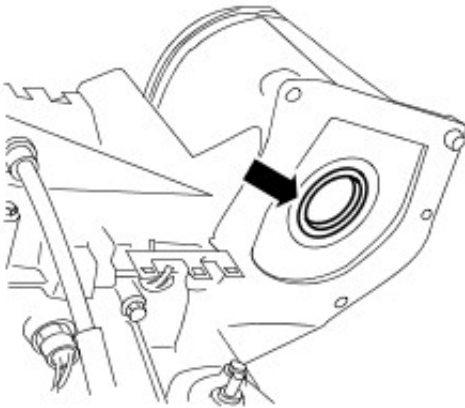
Special Tool(s)

 <p>308-518</p> <p>E90672</p>	<p>Installer, seal</p> <p>308-518</p>
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Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

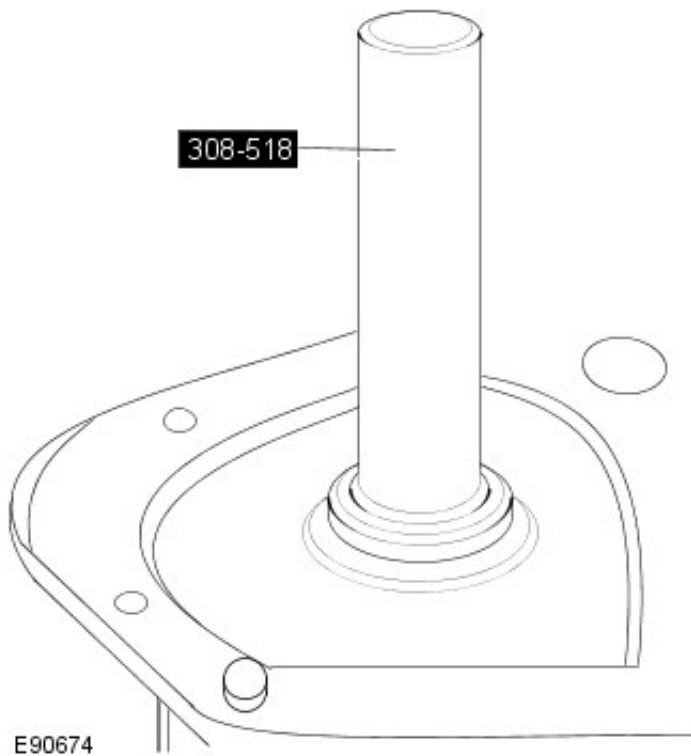
Raise and support the vehicle.
3. Remove transfer case.
For additional information, refer to: Transfer Case (308-07, Removal).
4. Remove and discard the transfer case input shaft seal.



E90673

Installation

1. Using the special tool, install a new transfer case input shaft seal.



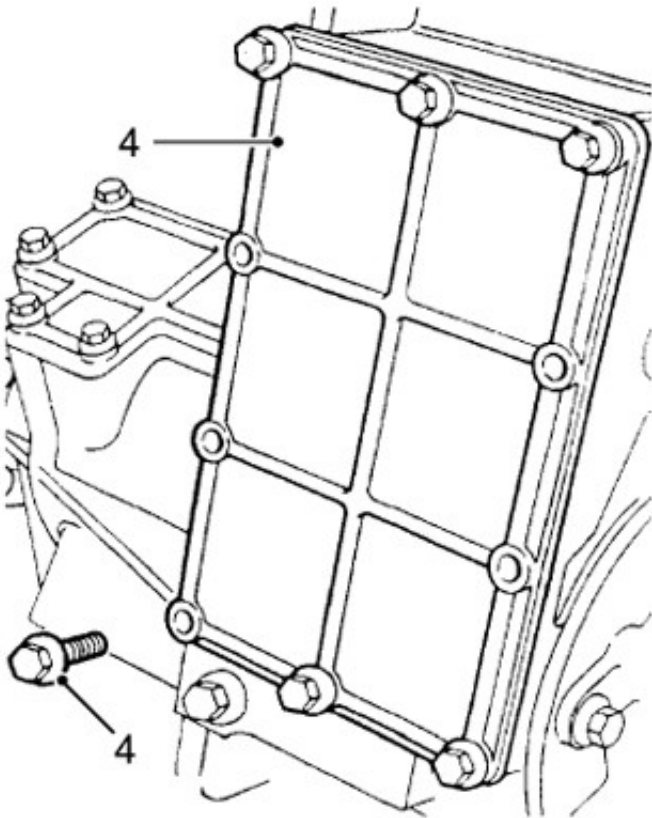
2. Install the transfer case.
For additional information, refer to: Transfer Case (308-07, Installation).
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Lower Cover

In-vehicle Repair

Removal

1. Raise vehicle on ramp.
2. Drain transfer case oil.
For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).
3. Remove 10 bolts securing lower cover to transfer case and remove cover.



M417534A

Installation

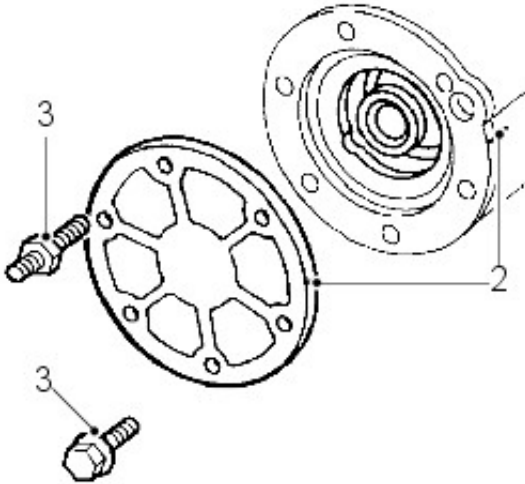
1. Clean lower cover and mating face on transfer case.
2. Clean bolt threads.
3. Apply sealant, Part No. STC 50552 to bolt threads.
4. Apply sealant, Part No. STC 4600 to lower cover sealing face.
5. Position lower cover, fit bolts and tighten to 25 Nm (18 lbf.ft).
6. Fill transfer case with oil.
For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).
7. Lower vehicle on ramp.

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Rear Cover

In-vehicle Repair

Removal

1. Raise vehicle on 4 post ramp.
2. Mark rear cover to bearing housing for assembly purposes.
3. Noting fitted position of stud bolt and harness clip bracket, remove 5 bolts and stud bolt securing rear cover.



M417547

4. Collect harness clip bracket.
5. Remove rear cover.

Installation

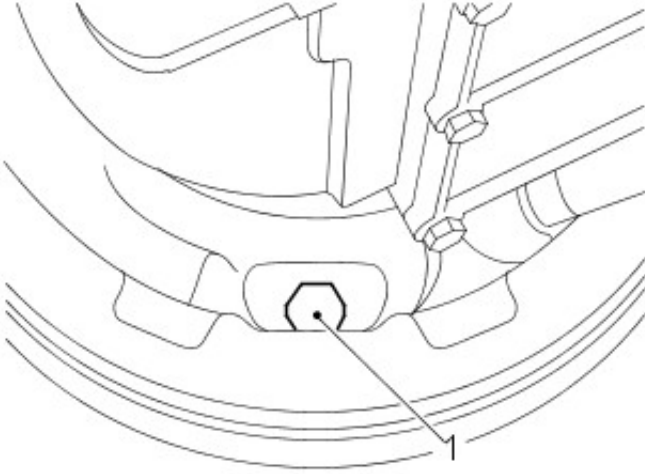
1. Clean rear cover and mating face.
2. Apply sealant, Part No. STC 4600 to rear cover mating face.
3. Align reference marks, fit rear cover.
4. Clean rear cover bolts and apply sealant, Part No. STC 50552 to threads of bolts and stud nut.
5. Position clip bracket, fit stud nut and bolts, tighten by diagonal selection to 25 Nm (18 lbf.ft).
6. Check/top-up transfer case oil.
For additional information, refer to: Transfer Case Draining and Filling (308-07 Transfer Case - 2.4L Diesel, General Procedures).
7. Lower vehicle.

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Rear Output Shaft Seal

In-vehicle Repair

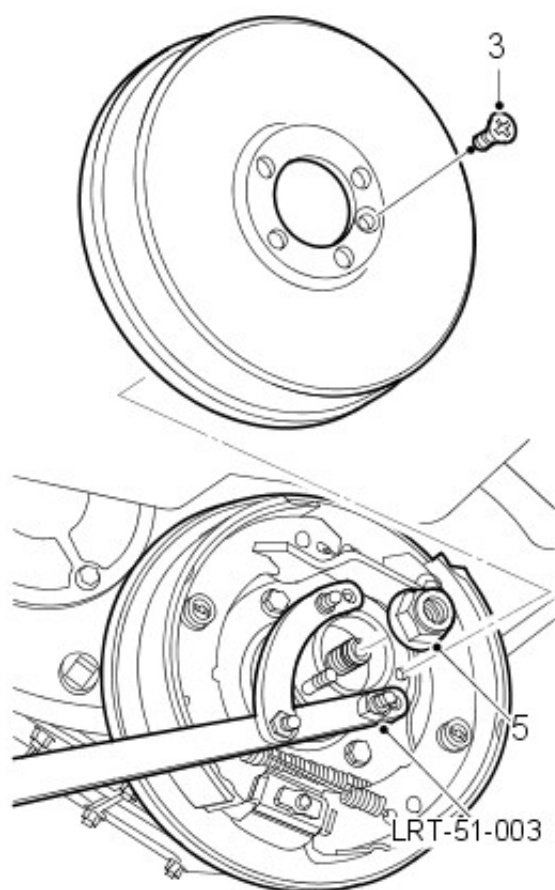
Removal

1. Loosen brake shoe adjuster bolt.



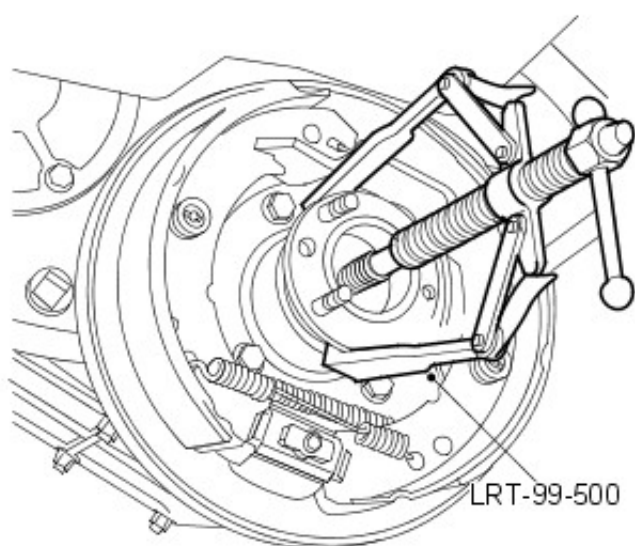
M417785

2. Remove rear drive shaft.
For additional information, refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
3. Remove screw securing brake drum.
4. Remove brake drum.
5. Restrain transfer case drive flange using LRT-51-003, remove and discard drive flange nut, remove and discard steel and felt washers.



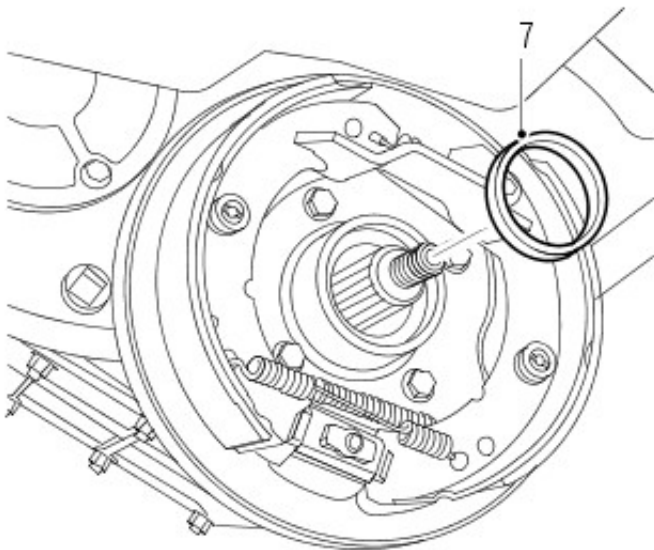
M417584

6. Using LRT-99-500 if necessary, remove drive flange from transfer case.



M417585

7. Remove and discard rear output shaft oil seal from transfer case.



M417586

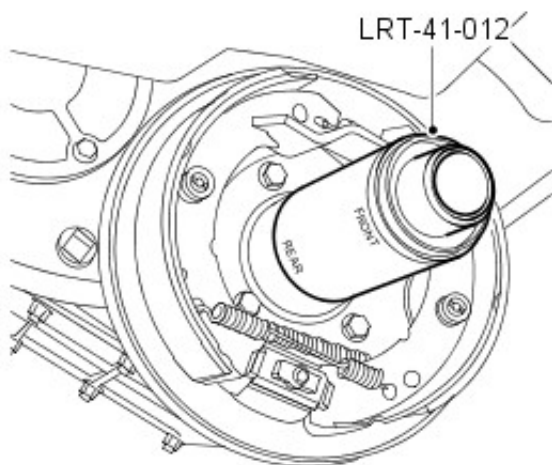
Installation

1. Clean drive flange splines, bearing and washer abutment faces to remove any oil or debris using solvent degreasing cleaner Loctite 7063.
2. Clean the seal recess, output shaft splines, threads and mating faces to remove any oil or debris using solvent degreasing cleaner Loctite 7063.


3.  **CAUTION:** Oil seal must be fitted dry.

NOTE: Use end of tool marked 'REAR' to instal seal.

Install new seal using LRT-41-012.

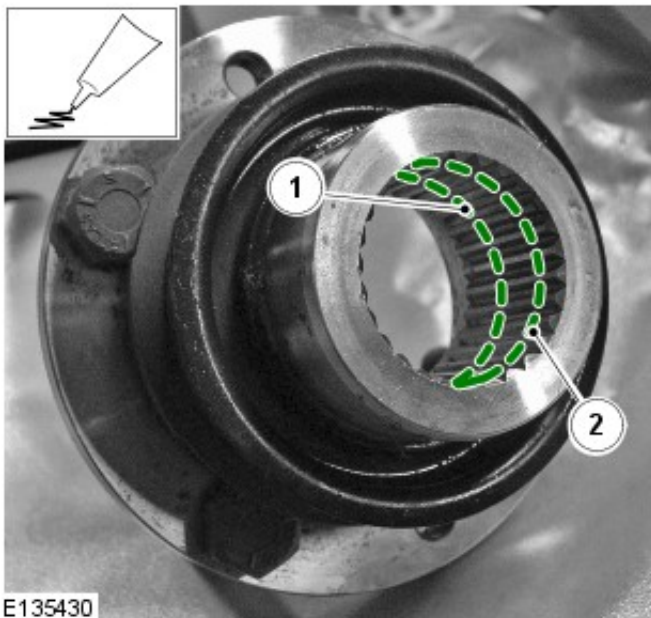


M417744

4.  **CAUTION:** Make sure that the Loctite 648 is pushed away from the bearing during installation of the drive flange. Failure to follow this instruction may result in damage to the vehicle.

Hold the drive flange at the stud end and apply Loctite 648 to the splines, as illustrated.

1. Apply a continuous bead along the splines.
2. Apply a second continuous bead 5mm from the end of the flange.



5. **NOTE: Installation of a new felt washer is not required.**

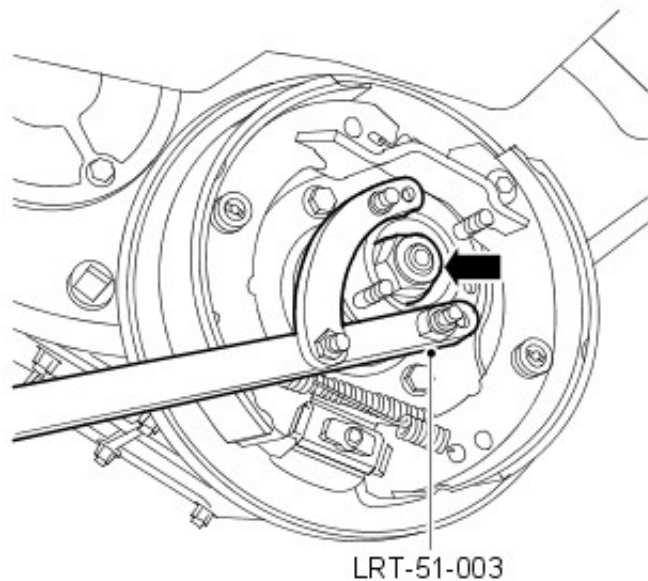
NOTE: Make sure that any excessive Loctite 648 is removed from the drive flange prior to installing the steel washer.

Install the drive flange to the output shaft, making sure that the drive flange is pushed fully home.

- Install new steel washer

6. **⚠ CAUTION:** Do not use any power tools or air operated equipment to tighten the drive flange nut.

Position LRT-51-003 install and tighten a new drive flange nut to 165 Nm (122 lbf.ft).

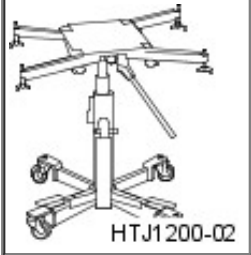



- Position brake drum and tighten screw.
- Tighten adjuster bolt to 25 Nm (18 lbf.ft) then back off 1 ½ turns.
- Check that brake drum is free to rotate.
- Install drive shaft.
For additional information, refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
- Top-up transfer case oil.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07A Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission, General Procedures).

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case

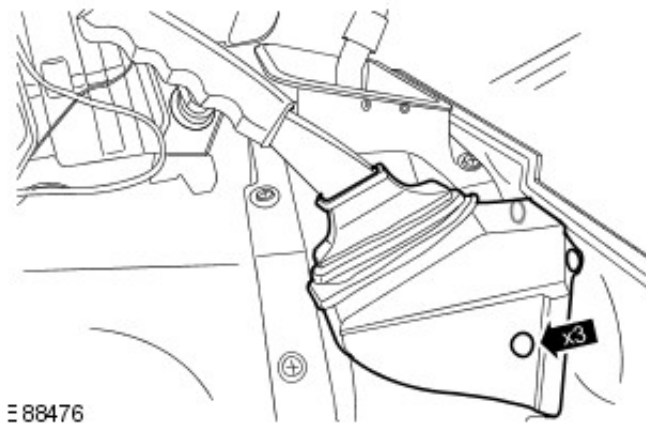
Removal

Special Tool(s)

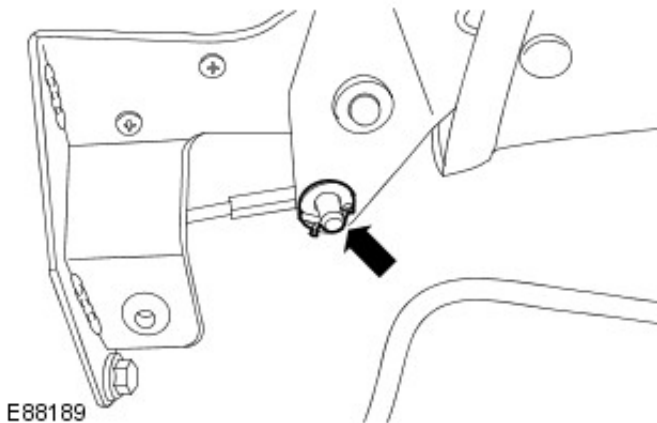
 <p>HTJ1200-02</p>	<p>Power train Assembly Jack HTJ1200-02</p>
 <p>E90632</p>	<p>Transfer Case Support 100-045</p>


Removal

1. Release the parking brake lever gaiter.
 - Release the 3 clips.



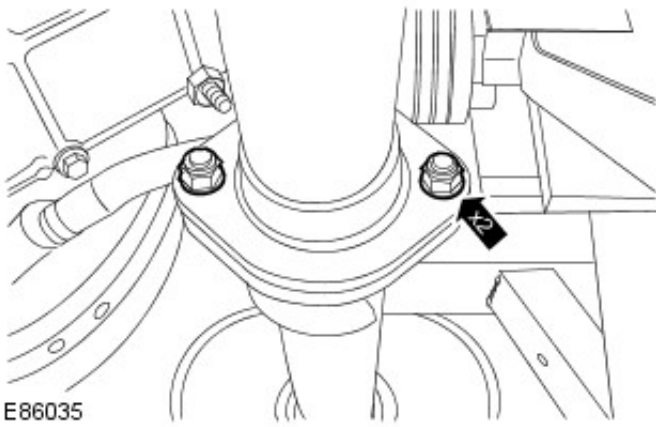
2. Remove the parking brake lever clevis pin.
 - Remove the pin.



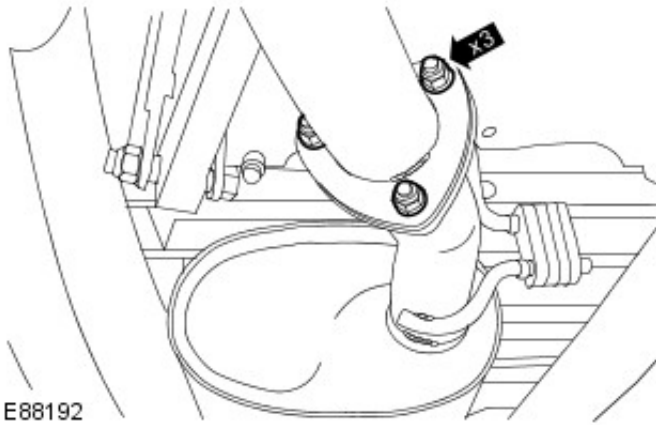
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

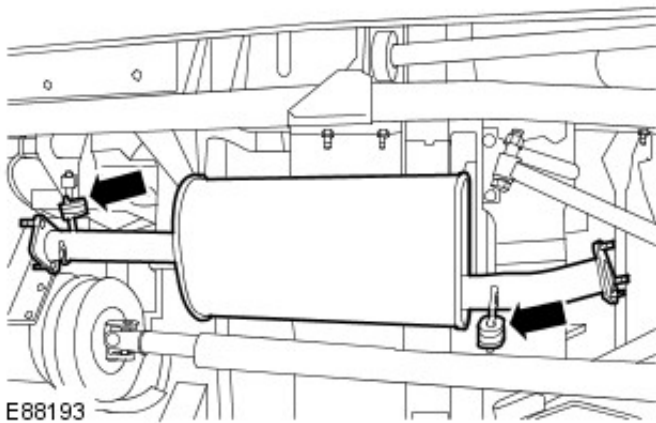
4. Release the intermediate pipe from the catalytic converter.
 - Remove and discard the 2 nuts.



5. Release the tail pipe from the intermediate pipe.
 - Remove and discard the 3 nuts.
 - Remove and discard the gasket.



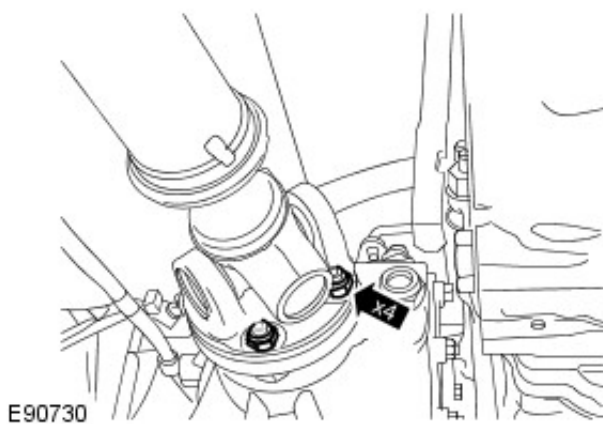
6. Remove the intermediate pipe and muffler.



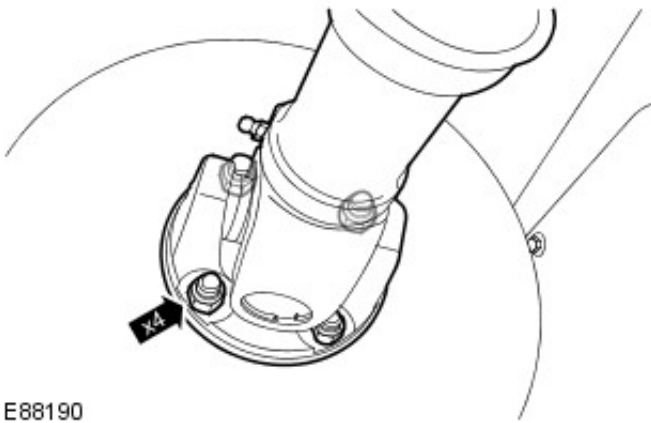
7. **NOTE:** Mark the front driveshaft to transfer case drive flange.

Remove and discard the 4 nuts.

- Using a suitable tie strap, secure the driveshaft to one side.

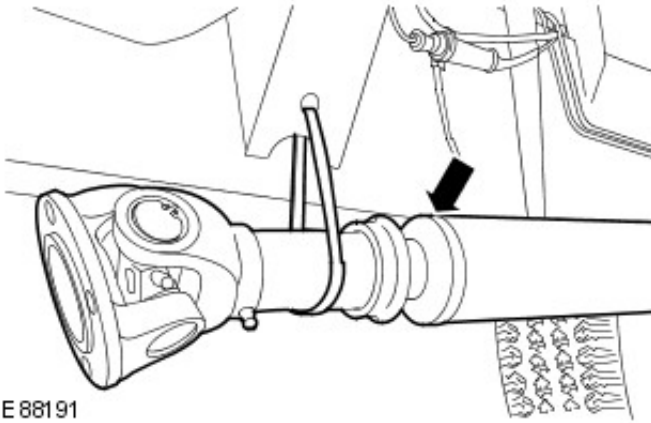


8. Remove the 4 nuts from the rear driveshaft to transfer case.
 - Mark the position of the driveshaft in relation to the drive pinion flange.



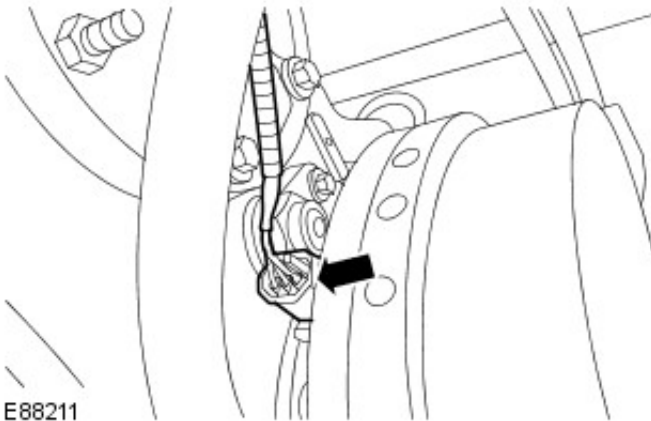
E88190

9. Using a suitable tie strap, secure the rear driveshaft to the chassis.



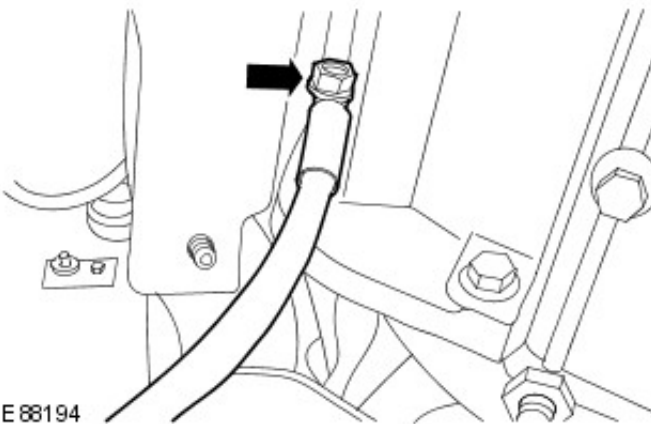
E88191

10. Disconnect the electronic speedometer electrical connector from the transfer case.



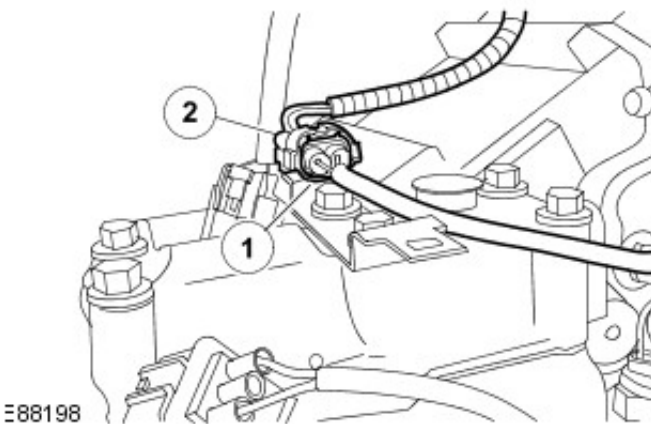
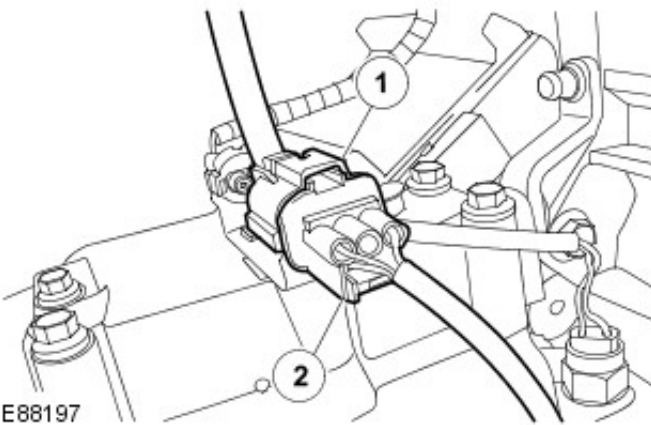
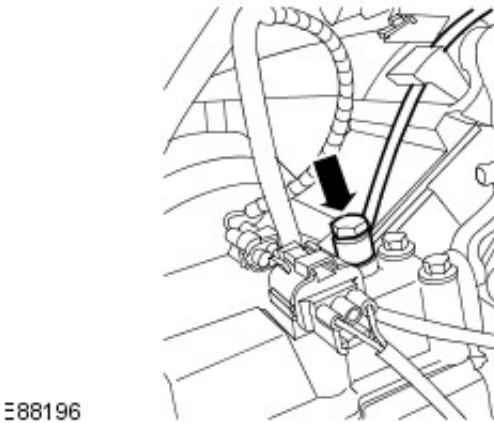
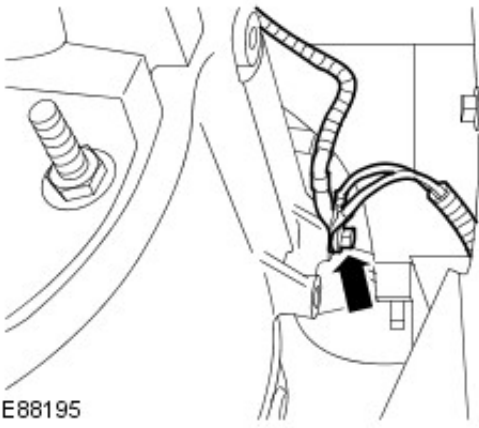
E88211

11. Disconnect the LH earth cable from the transfer case.
 - Remove the nut.



E88194

12. Disconnect the RH earth cables from the transfer case.
 - Remove the bolt.



13. **NOTE:** Make sure that all openings are sealed. Use new blanking caps.

Remove the transfer case breather pipe bolt.

- Remove and discard the sealing washers.

14. Disconnect the transmission range selector warning lamp electrical connector.

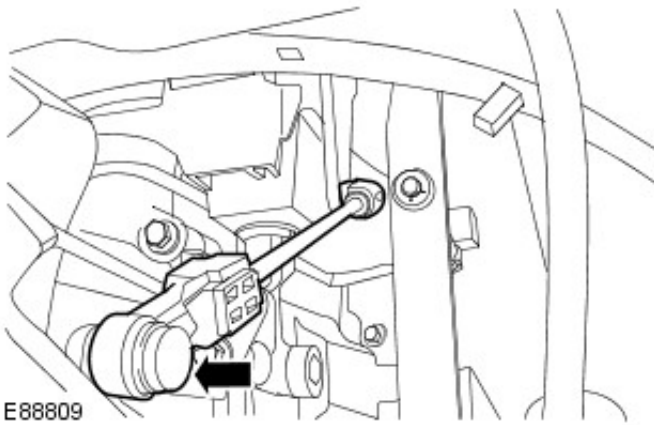
1. Disconnect the electrical connector.
2. Release the electrical connector from the bracket.

15. Disconnect the differential lock detection switch electrical connector.

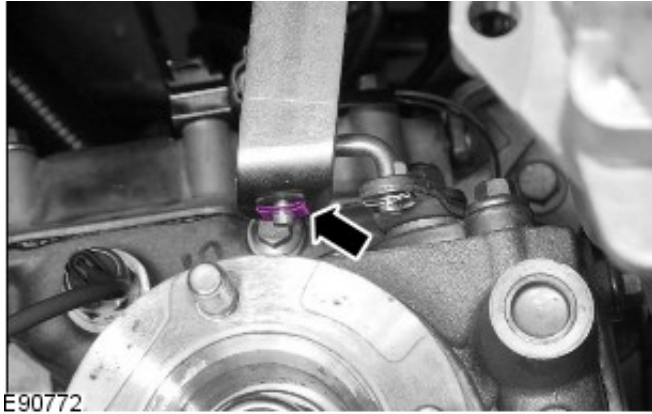
1. Disconnect the electrical connector.
2. Release the electrical connector from the bracket.

16. Disconnect the transmission range selector rod.

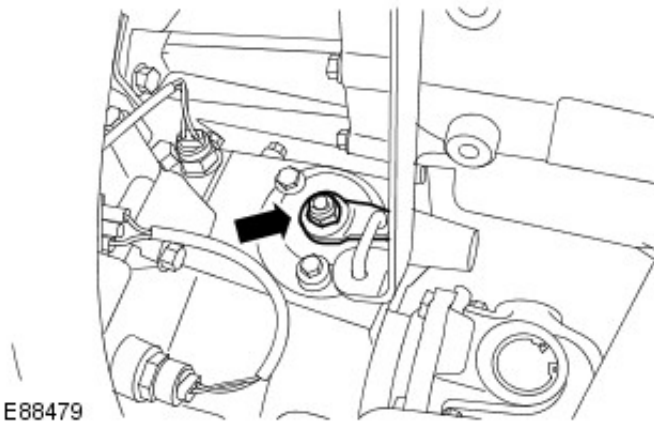
- Press the button to release the fitting before disconnecting the rod.



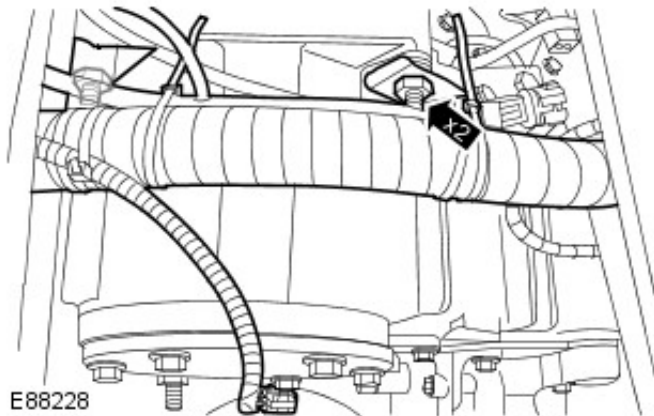
17. Remove the retaining clip at the lower end of the pivot arm.



18. Remove the differential lock control operating rod.
 - Remove the nut.

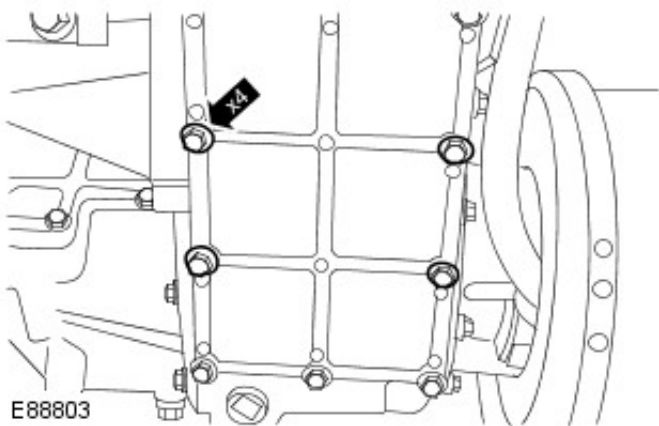


19. Release the transmission wiring harness.
 - Remove the nut and bolt.

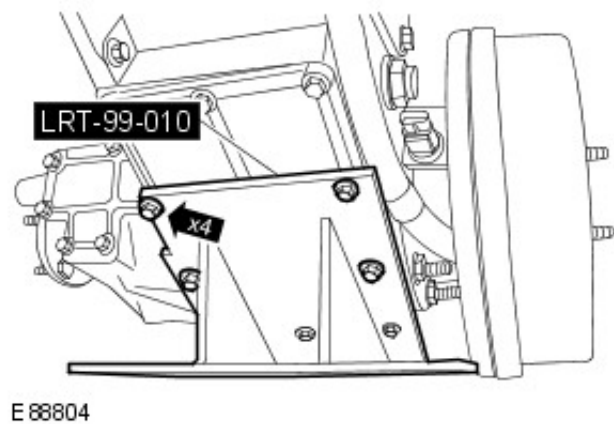


20. Drain the transfer case.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07A Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission, General Procedures).

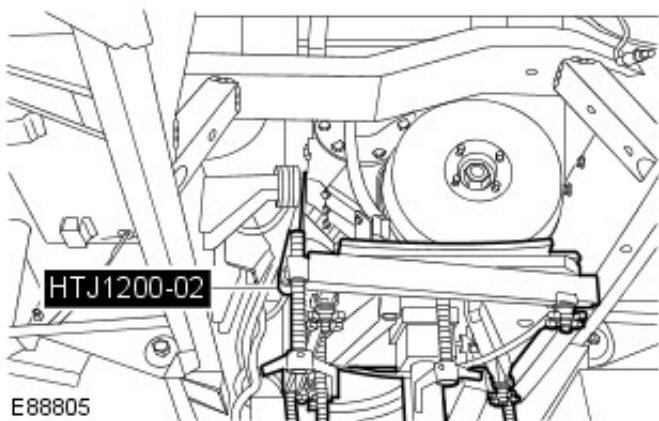
21. Remove the 4 bolts.



22. Install the special tool.



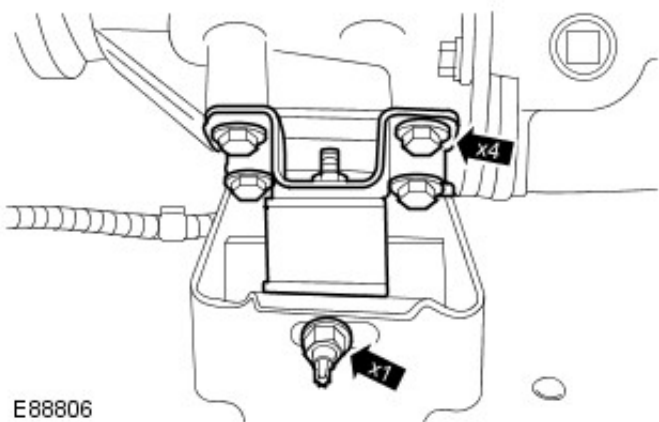
23. Install the special tool.



24. **NOTE:** Raise the transmission jack.

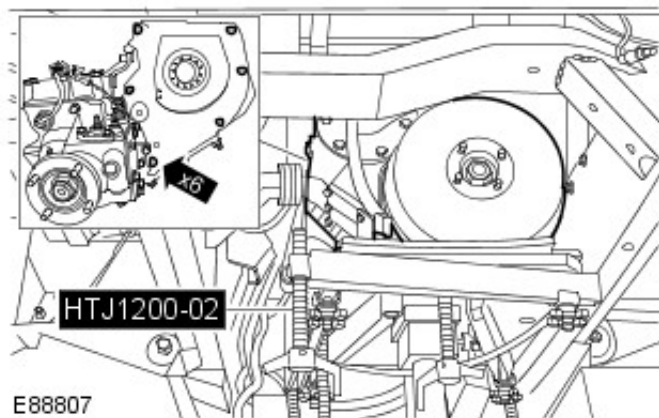
Remove the right-hand transfer case mount.

- Remove the 4 bolts.
- Remove the nut.



25. With assistance, remove the transfer case.

- Remove the 4 bolts.
- Remove the 2 nuts.





E88807

Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case

Installation

Special Tool(s)

 <p>HTJ1200-02</p>	<p>Powertrain Assembly Jack HTJ1200-02</p>
 <p>E90632</p>	<p>Transfer Case Support 100-045</p>

Materials

Name

Silicone Sealant

Specification

WSE-M4G323-A4

Installation

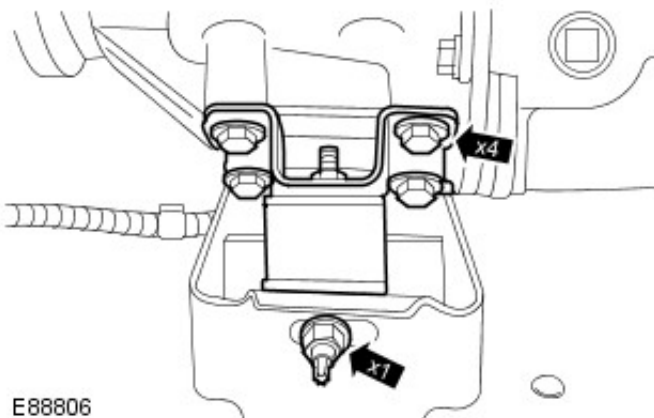
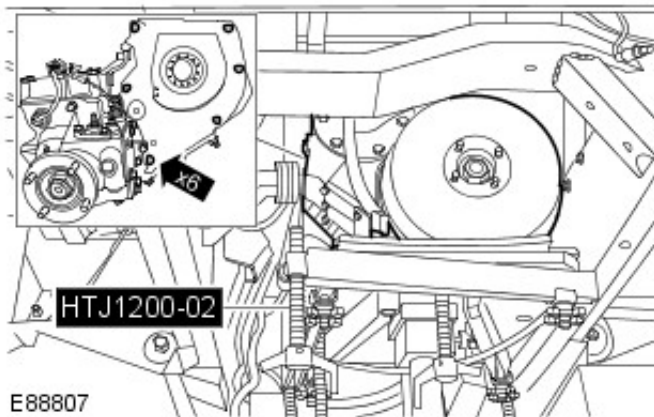
1. With assistance, install the transfer case.
 - Apply sealant to the bolt threads. [sealant](#)
 - Tighten the bolts to 45 Nm (33 lb.ft).
 - Tighten the nuts to 45 Nm (33 lb.ft).

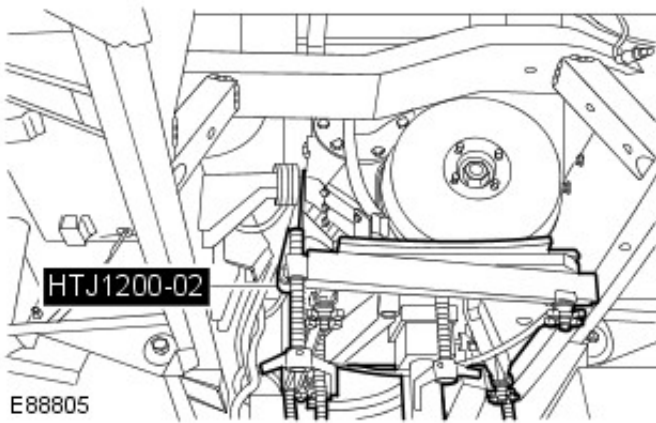
2. **NOTE:** Lower the transmission jack.

Install the right-hand transfer case mount.

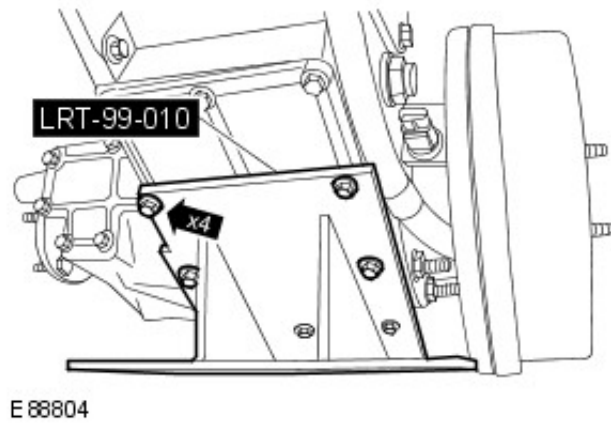
- Tighten the bolts to 85 Nm (63 lb.ft).
- Tighten the nut 48 Nm (35 lb.ft).

3. Remove the special tool.



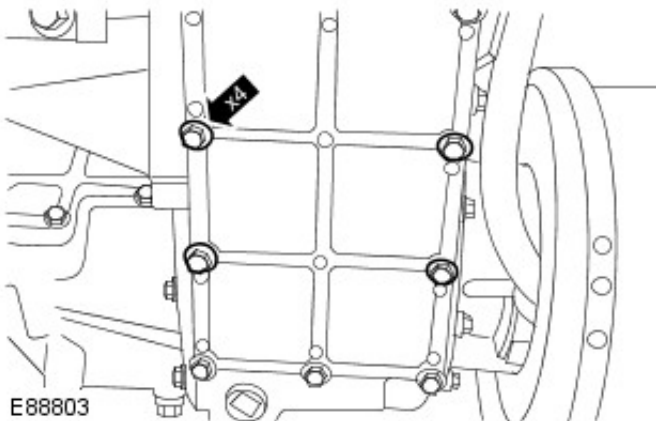


4. Remove the special tool.



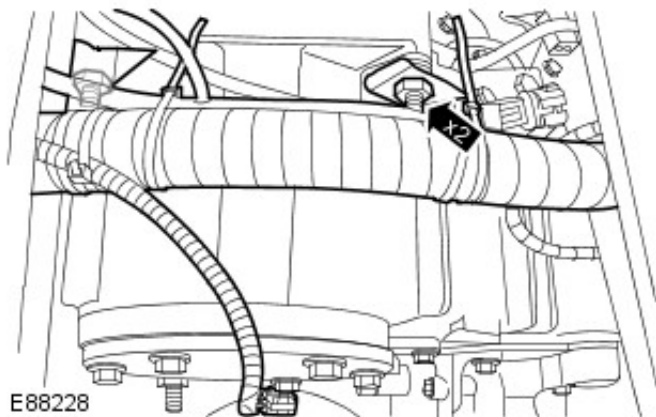
5. Install the bolts.

- Apply sealant to the bolt threads. [sealant](#)
- Tighten to 25 Nm (18 lb.ft).



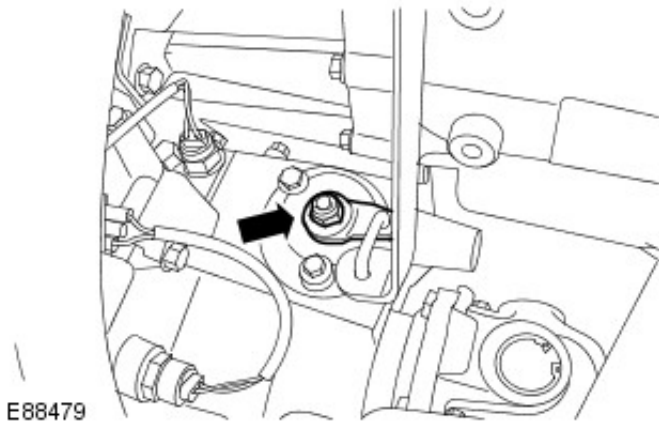
6. Secure the transmission wiring harness.

- Tighten to 45 Nm (33 lb.ft).

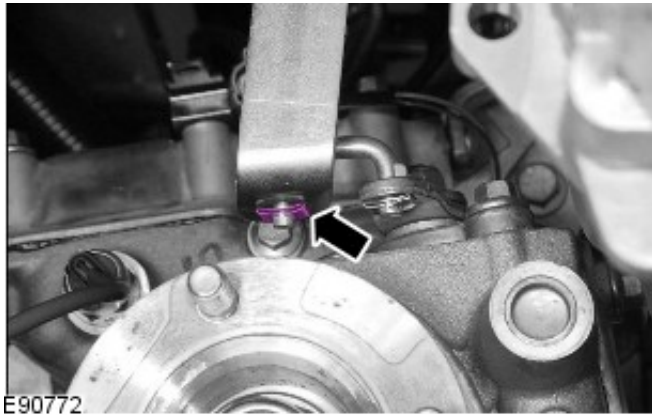


7. Install the differential lock control operating rod.

- Tighten the nut to 25 Nm (18 lb.ft).

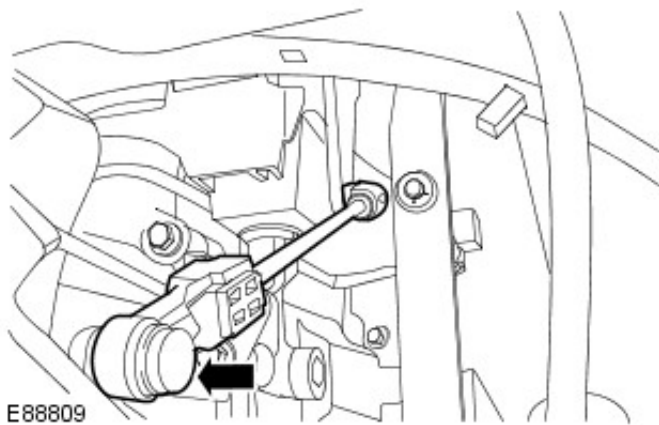


8. Install the new retaining clip at the lower end of the pivot arm.



9. **NOTE:** Make sure the rod is fully engaged on the ball joint.

Connect the high/low range selector rod.



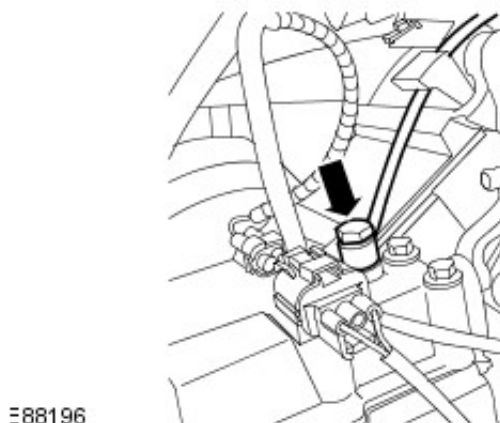
10. Connect the differential lock detection switch electrical connector.
 1. Connect the electrical connector.
 2. Secure the electrical connector to the bracket.

11. Connect the differential lock warning lamp electrical connector.
 1. Connect the electrical connector.
 2. Secure the electrical connector to the bracket.

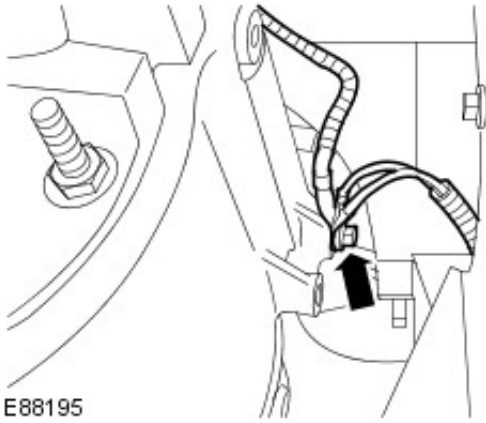
12. **NOTE:** Remove and discard the blanking caps.

Install the transfer case breather pipe bolt.

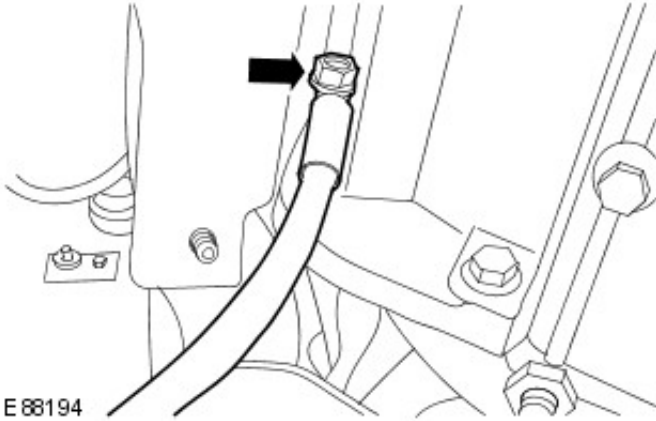
- Install new sealing washers.
- Tighten the bolt to 15 Nm (11 lb.ft).



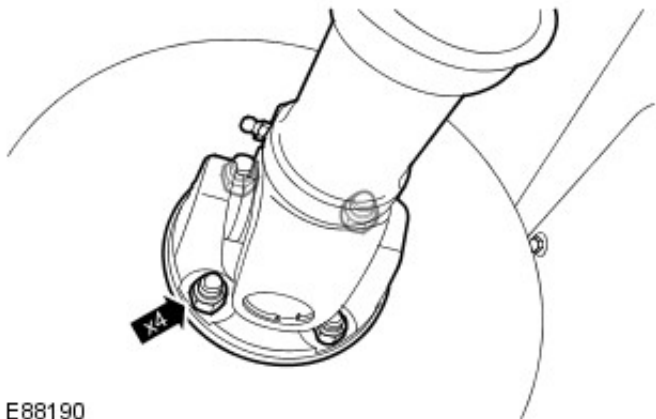
13. Tighten to 12 Nm (9 lb.ft).



14. Tighten to 45 Nm (33 lb.ft).



15. Connect the electronic speedometer electrical connector to the transfer case.



16. **NOTE:** Remove and discard the tie strap.

Tighten to 45 Nm (33 lb.ft).

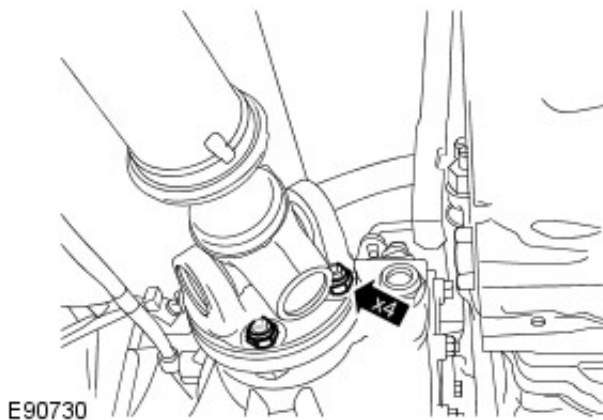
- Align the position of the driveshaft in relation to the drive pinion flange.

17. **NOTE:** Install new nuts.

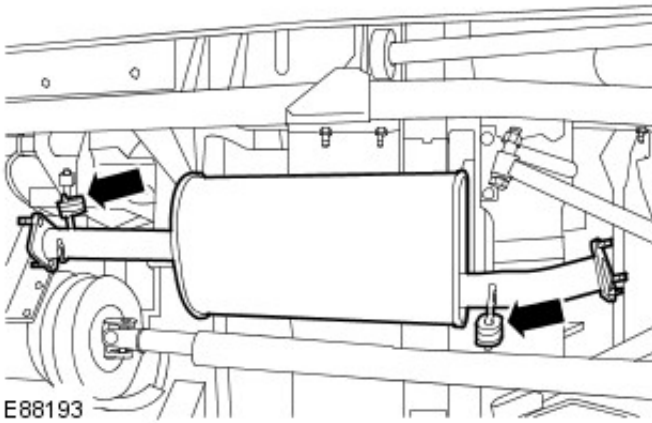
NOTE: Clean the driveshaft drive flanges and mating faces.

Tighten to 47 Nm (35 lb.ft).

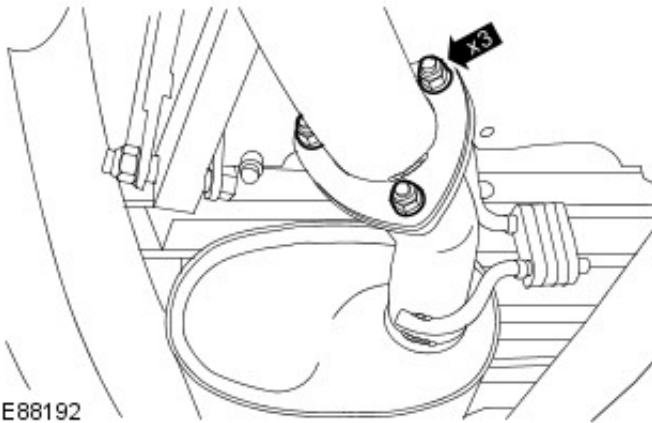
- Align the position of the driveshaft in relation to the drive pinion flange.



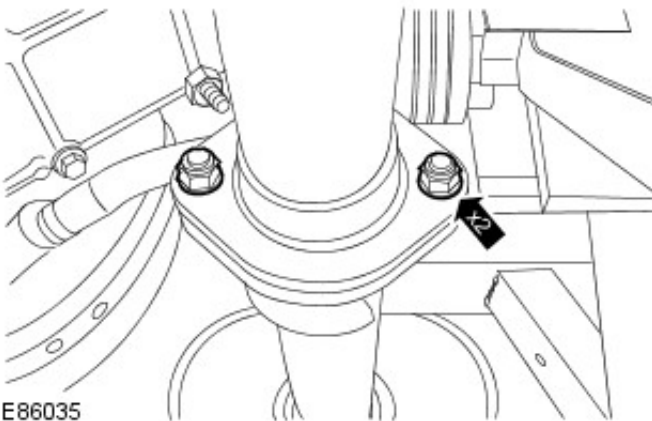
18. Install the intermediate pipe and muffler.



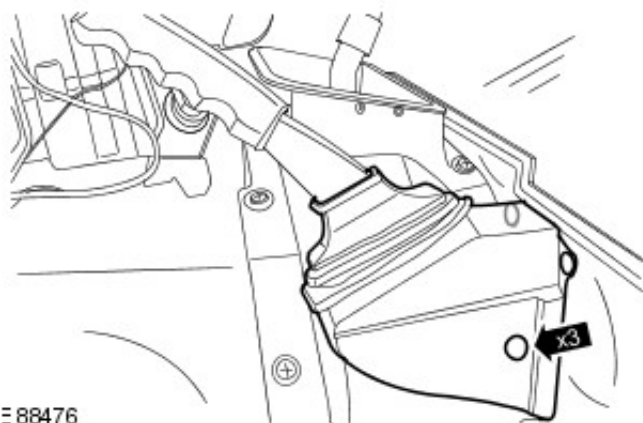
19. Secure the tail pipe to the intermediate pipe.
 - Install a new gasket.
 - Tighten the new nuts to 25Nm (18 lb.ft).



20. Secure the intermediate pipe to the catalytic converter.
 - Loosely install the new nuts.
 1. Tighten the new nuts to 25 Nm (18 lb.ft).



21. Fill the transfer case.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07A Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission, General Procedures).
22. Lower the vehicle.
23. Install the parking brake lever clevis pin.
 - Install a new pin.
24. Secure the parking brake lever gaiter.
 - Install the 3 clips.



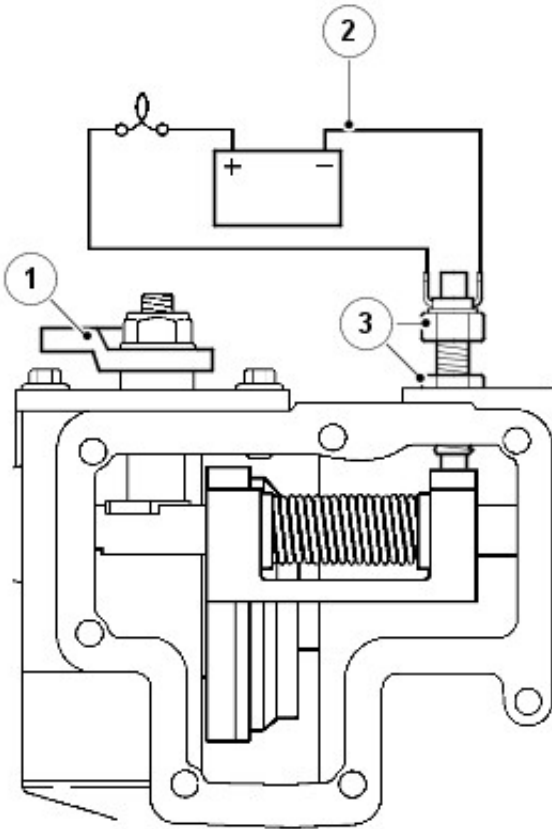
≡ 88476

Four-Wheel Drive Systems - Vehicles With: MT82 6-Speed Manual Transmission - Differential Lock Indicator Switch Adjustment

General Procedures

NOTE: This procedure is only necessary for switches fitted with a locknut in place of the threaded spacer.

1. Move differential lock selector fork to differential locked position.
2. Connect a 12V test lamp and battery to differential lock indicator switch.
3. Screw switch in until test lamp is illuminated then screw the switch in a further 1/2 turn; tighten locknut.




41M7177

4. Disengage differential lock, check that test lamp is extinguished.
5. Remove test lamp.

Four-Wheel Drive Systems - Vehicles With: MT82 6-Speed Manual Transmission - Transfer Case Low Range Indicator Switch

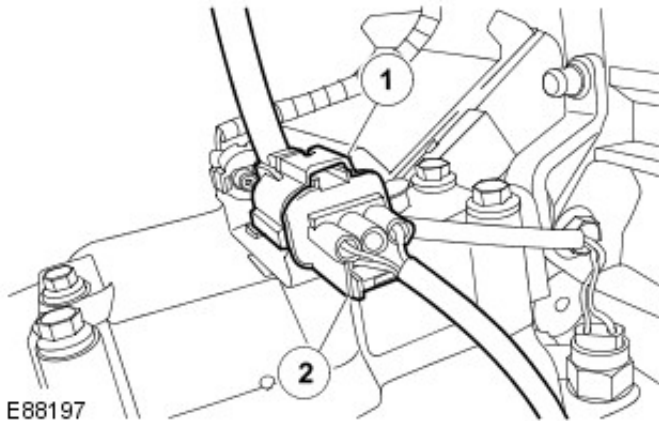
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands. Failure to follow this instruction may result in personal injury.

Raise and support the vehicle.

2. Disconnect the transfer case low range indicator switch electrical connector.
 1. Disconnect the electrical connector.
 2. Release the electrical connector from the bracket.



3. Remove the transfer case low range indicator switch.
 - Remove and discard the sealing washer.



Installation


1. To install, reverse the removal procedure.
 - Install a new sealing washer.
 - Tighten to 24 Nm (18 lb.ft).



Four-Wheel Drive Systems - Vehicles With: MT82 6-Speed Manual Transmission - Differential Lock Indicator Switch

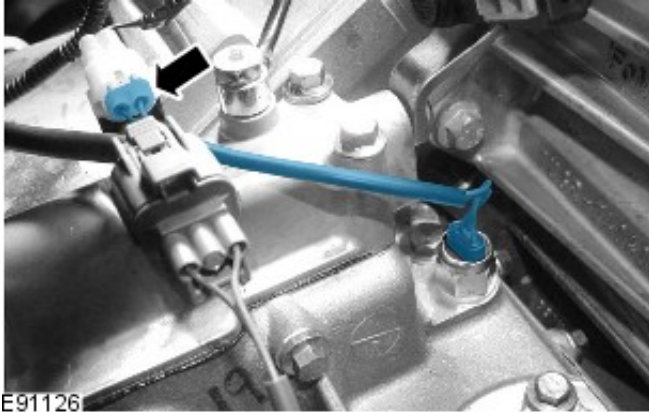
Removal and Installation

Removal

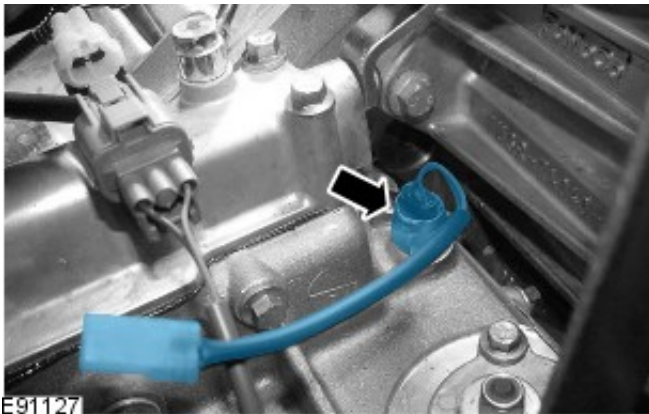
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands. Failure to follow this instruction may result in personal injury.

Raise and support the vehicle.

2. Disconnect the differential lock indicator switch electrical connector.

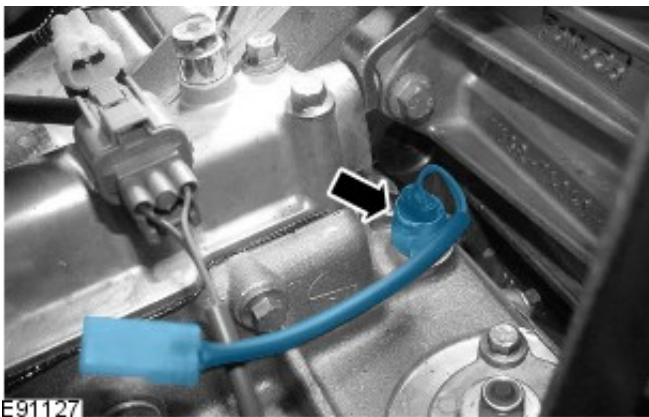


3. Remove the differential lock indicator switch.
 - Remove and discard the sealing washer.



Installation

1. To install, reverse the removal procedure.
 - Install a new sealing washer.
 - Tighten to 24 Nm (18 lb.ft).



Exhaust System - ID4 2.2L Diesel -

Lubricants, Fluids, Sealers and Adhesives

	Specifications
*Heated oxygen sensor (HO2S) removal	WD40 or suitable alternative
+Heated oxygen sensor (HO2S) threads	Apply suitable high temperature anti-seize compound to threads of sensor

*** Apply to area around sensor threads prior to removal**

+ Apply anti-seize lubricant to threads of sensor prior to installation

Torque Specifications

Description - Vehicles with DPF	Nm	lb-ft
Diesel particulate filter (DPF) to turbo clamp nut	10	7
DPF heatshield	10	7
DPF pressure pipe unions	25	18
DPF temperature sensors	25	18
+DPF heated oxygen sensor (HO2S)	47	35
DPF lower bracket bolts	25	18
Front muffler to tail pipe nuts	25	18
Front muffler to diesel particulate filter nuts	25	18
Chassis crossmember nuts and bolts	80	59

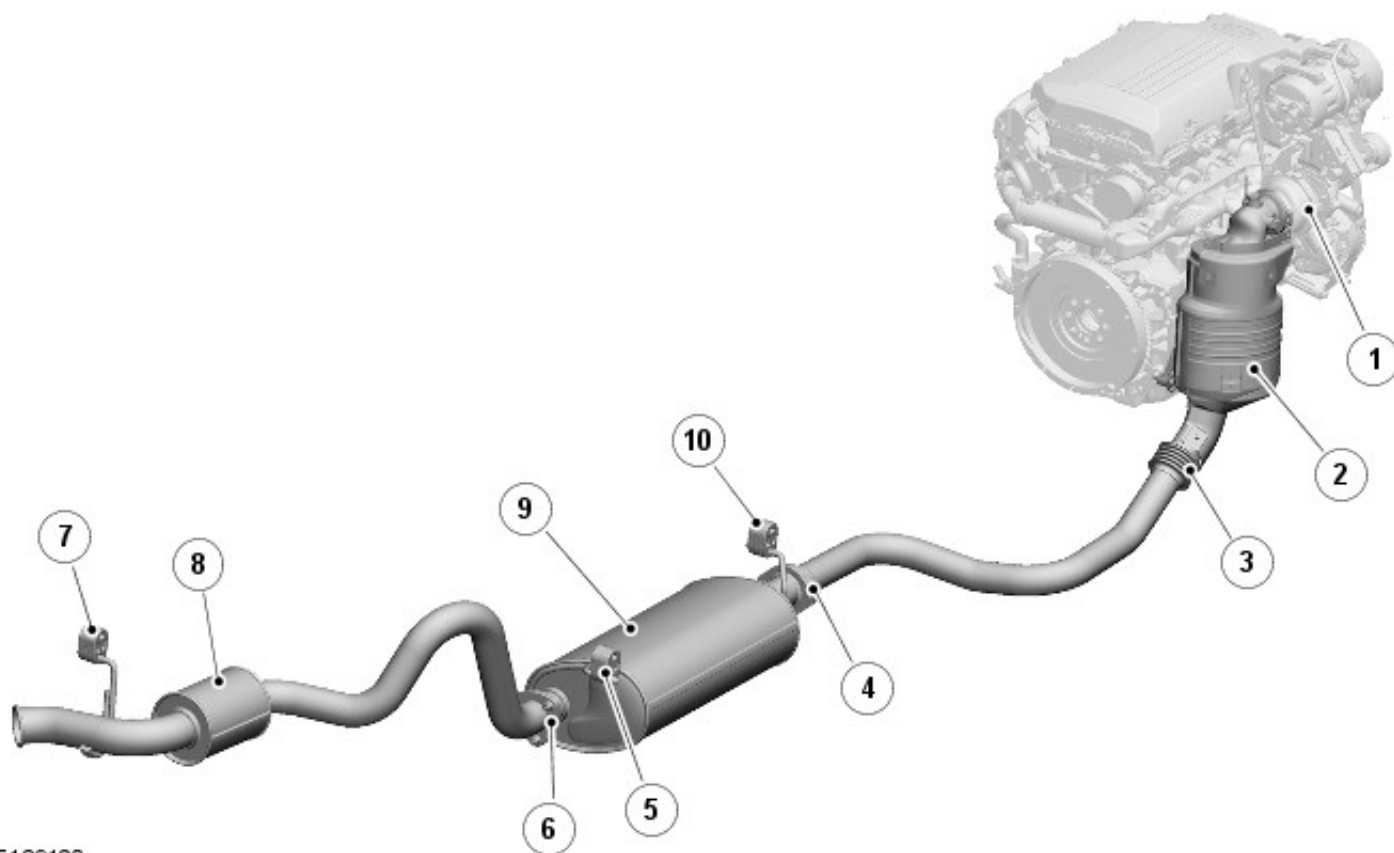
+ Apply anti-seize lubricant to threads of sensor prior to installation

Description - Vehicles without DPF	Nm	lb-ft
Catalytic Converter to turbo clamp nut	10	7
Catalytic Converter heat shield	10	7
Catalytic Converter lower bracket bolts	25	18
Catalytic Converter top bung	48	35
Catalytic Converter side bung	25	18
Front muffler to tail pipe nuts	25	18
Front muffler to diesel particulate filter nuts	25	18
Chassis crossmember nuts and bolts	80	59

Exhaust System - ID4 2.2L Diesel - Exhaust SystemID4 2.2L Diesel

Description and Operation

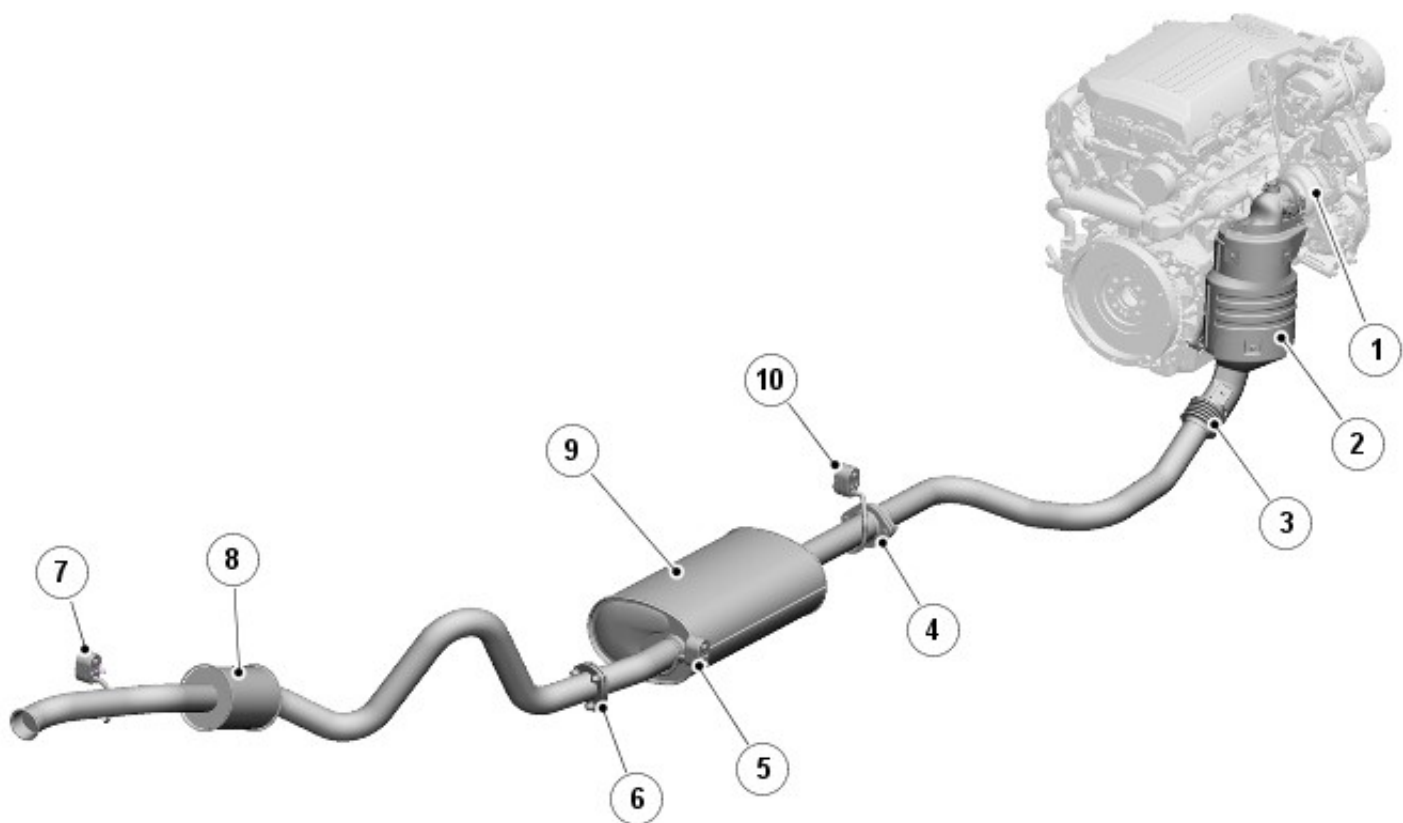
COMPONENT LOCATION - 90 VARIANT



E139120

Item	Part Number	Description
1	-	Turbocharger
2	-	Catalytic convertor/catalytic converter and DPF (diesel particulate filter)
3	-	Flexible joint
4	-	Front joint
5	-	Center hanger bar and mounting rubber
6	-	Rear joint
7	-	Rear hanger bar and mounting rubber
8	-	Rear muffler
9	-	Center muffler
10	-	Front hanger bar and mounting rubber

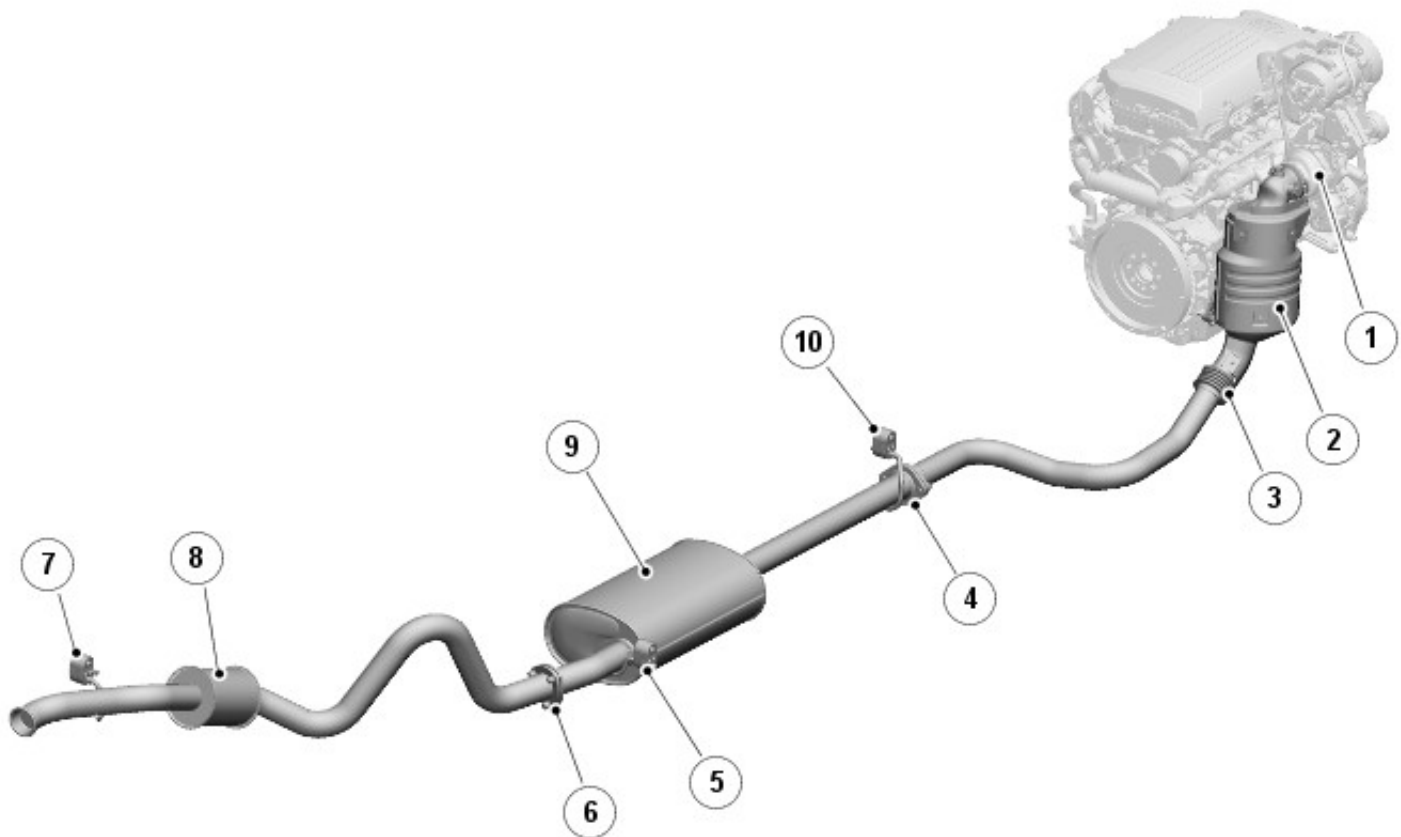
COMPONENT LOCATION - 110 VARIANT



E139121

Item	Part Number	Description
1	-	Turbocharger
2	-	Catalytic convertor/catalytic converter and DPF
3	-	Flexible joint
4	-	Front joint
5	-	Center hanger bar and mounting rubber
6	-	Rear joint
7	-	Rear hanger bar and mounting rubber
8	-	Rear muffler
9	-	Center muffler
10	-	Front hanger bar and mounting rubber

COMPONENT LOCATION - 130 VARIANT



E139122

Item	Part Number	Description
1	-	Turbocharger
2	-	Catalytic convertor/catalytic converter and DPF
3	-	Flexible joint
4	-	Front joint
5	-	Center hanger bar and mounting rubber
6	-	Rear joint
7	-	Rear hanger bar and mounting rubber
8	-	Rear muffler
9	-	Center muffler
10	-	Front hanger bar and mounting rubber

OVERVIEW

The exhaust system is fabricated from stainless steel and is supplied as three separate assemblies;

- A front section incorporating a catalytic converter (vehicles to EU4 emission standards) or a combined catalytic converter and [DPF](#) (vehicles to EU5 emission standards).
- A center section incorporating a center muffler.
- A rear section incorporating a rear muffler.

The system is attached to the underside of the body with three mounting rubbers, which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers on the underside of the vehicle body.

FRONT SECTION

The front section is connected to the turbocharger by mating flanges on the turbocharger and the catalytic converter/catalytic converter and [DPF](#), which are secured together using a gasket and a U-clamp. Two M08 bolts attach a bracket on the bottom of the catalytic converter/[DPF](#) to the skirt stiffener of the cylinder block.

The body of the catalytic converter/catalytic converter and [DPF](#) is covered by an insulation panel. M06 bolts attach upper and lower heat shields to the catalytic converter/catalytic converter and [DPF](#).

On EU5 vehicles, the catalytic converter and [DPF](#) incorporates bosses for the attachment of two pressure pipes, and the installation of a [HO2S \(heated oxygen sensor\)](#) and three temperature sensors.

The outlet pipe from the catalytic converter/catalytic converter and [DPF](#) incorporates a flexible joint to absorb vibration.

The rear of the outlet pipe locates in the inlet pipe of the center section. A loose flange on the outlet pipe locates on two studs in a flange on the inlet pipe of the center section. Two M10 nuts compress and secure the joint.

CENTER SECTION

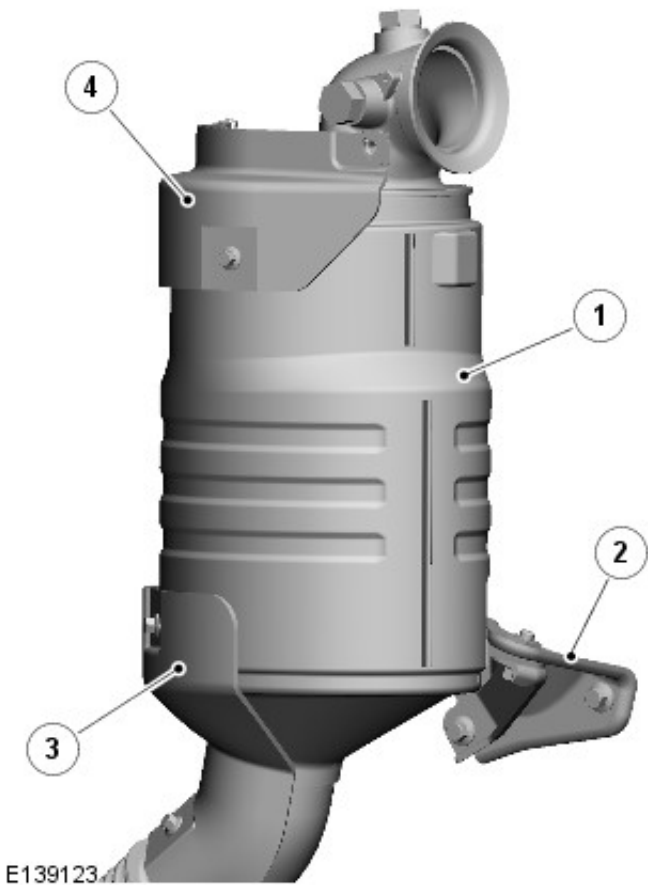
The center muffler is a 3-pass absorption construction with a capacity of 21.33 liters (1302in³). The muffler contains baffles, perforated tubes and E-glass fiber packs which reduce noise as the exhaust gases pass through the muffler. A hanger bar is welded to the muffler inlet pipe, and provides for the location of a mounting rubber. Another hanger bar is welded to the rear of the muffler on 90 variants and to the outlet pipe on 110 and 130 variants.

The outlet pipe of the center section is secured to the rear section using a flange to flange joint. The flange on the outlet pipe has three studs which locate in the rear section and are secured with M10 nuts.

REAR SECTION

The rear section uses a straight through muffler with a volume of 0.73 liters (44.55in³). A flange on the inlet pipe connects to the center section. The outlet pipe has a mounting bar welded to the left hand side, which locates in a mounting rubber.

CATALYTIC CONVERTER



Item	Part Number	Description
1	-	Insulation panel
2	-	Support bracket
3	-	Lower heat shield
4	-	Upper heat shield

The catalytic converter, which has a capacity of 1.3 liters, is fitted in the front section of the exhaust system. The catalytic converter assembly is common to vehicles with or without the [DPF](#), however, the catalyst coating specification varies depending on the market.

The catalytic converter reduces the carbon monoxide and hydrocarbons content of the exhaust gases. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called a 'washcoat'.

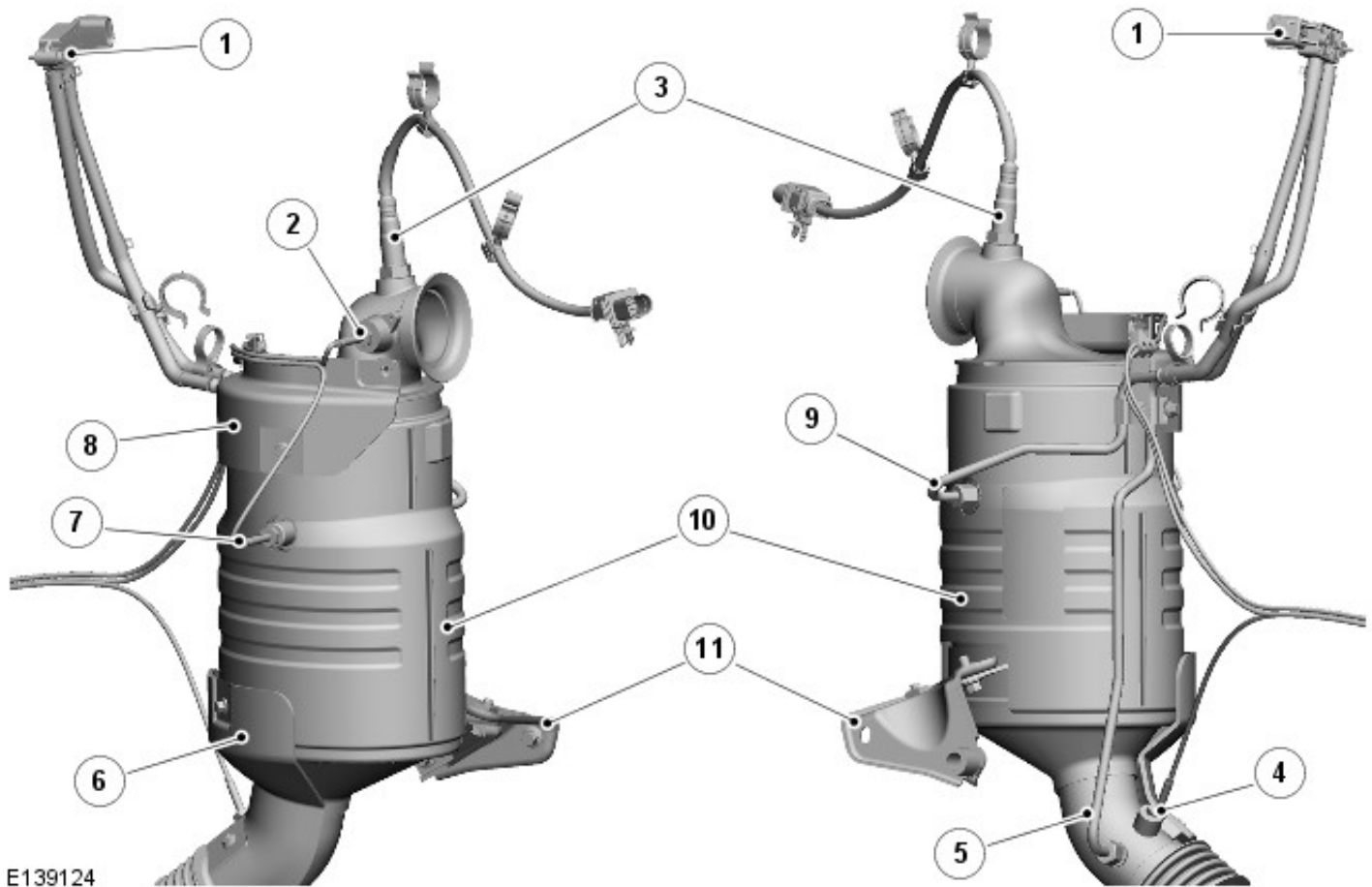
The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing platinum, which is the active constituent for converting harmful emissions into inert by-products. The platinum adds oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water respectively.

Exhaust System - ID4 2.2L Diesel - Diesel Particulate Filter - Component

Location

Description and Operation

COMPONENT LOCATION - DIESEL PARTICULATE FILTER

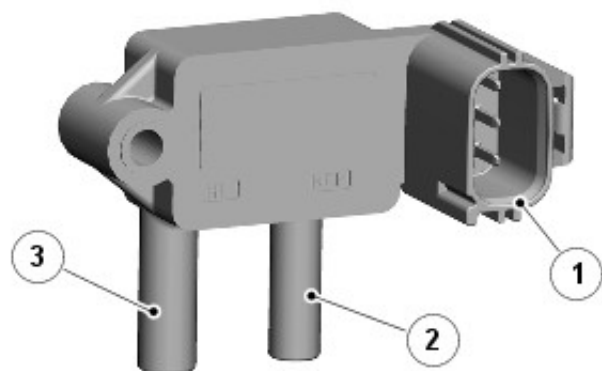


E139124

Item Description

- 1 Differential pressure sensor
- 2 Temperature sensor - pre catalytic converter
- 3 [HO2S \(heated oxygen sensor\)](#)
- 4 Temperature sensor - post [DPF \(diesel particulate filter\)](#)
- 5 Low pressure pipe - post [DPF](#)
- 6 Lower heat shield
- 7 Temperature sensor - post catalytic converter
- 8 Upper heat shield
- 9 High pressure pipe - pre [DPF](#)
- 10 Insulation panel
- 11 Support bracket

COMPONENT LOCATION - DIFFERENTIAL PRESSURE SENSOR



E139125

Item Description

- 1 Electrical connector
- 2 Low pressure - Post [DPF](#) connection
- 3 High pressure - Pre [DPF](#) connection

Exhaust System - ID4 2.2L Diesel - Diesel Particulate Filter - System

Operation and Component Description

Description and Operation

System Operation

DIESEL PARTICULATE FILTER (DPF)

Two processes are used to regenerate the DPF; passive and active.

Passive Regeneration

Passive regeneration requires no special engine management intervention and occurs during normal engine operation. The passive regeneration involves a slow conversion of the particulate matter deposited in the DPF into carbon dioxide. This process is active when the DPF temperature reaches 250°C (482°F) and is a continuous process when the vehicle is being driven at higher engine loads and speeds.

During passive regeneration, only a portion of the particulate matter is converted into carbon dioxide. This is due to the chemical reaction process which is only effective within the normal operating temperature range of 250°C to 500°C (482°F to 932°F).

Above this temperature range the conversion efficiency of the particulates into carbon dioxide increases as the DPF temperature is raised. These temperatures can only be achieved using the active regeneration process.

Active Regeneration

Active regeneration starts when the particulate loading of the DPF reaches a threshold as monitored or determined by the DPF control software. The threshold calculation is based on driving style, distance travelled and back pressure signals from the differential pressure sensor.

Active regeneration generally occurs every 250 miles (400 km) although this is dependant on how the vehicle is driven. For example, if the vehicle is driven at low loads in urban traffic regularly, active regeneration will occur more often. This is due to the rapid build-up of particulates in the DPF than if the vehicle is driven at high speeds when passive regeneration will have occurred.

The DPF software incorporates a mileage trigger which is used as back-up for active regeneration. If active regeneration has not been initiated by a back pressure signal from the differential pressure sensor, regeneration is requested based on distance travelled.

Active regeneration of the DPF is commenced when the temperature of the DPF is increased to the combustion temperature of the particles. The DPF temperature is raised by increasing the exhaust gas temperature. This is achieved by introducing post-injection of fuel after the pilot and main fuel injections have occurred.

This is determined by the DPF software monitoring the signals from the two DPF temperature sensors to establish the temperature of the DPF. Depending on the DPF temperature, the DPF software requests the [ECM \(engine control module\)](#) to perform either one or two post-injections of fuel:

- The first post-injection of fuel retards combustion inside the cylinder which increases the temperature of the exhaust gas.
- The second post-injection of fuel is injected late in the power stroke cycle. The fuel partly combusts in the cylinder, but some unburnt fuel also passes into the exhaust where it creates an exothermic event within the catalytic converter, further increasing the temperature of the DPF.

The active regeneration process takes up to 20 minutes to complete. The first phase increases the DPF temperature to 500°C (932°F). The second phase further increases the DPF temperature to 600°C (1112°F) which is the optimum temperature for particle combustion. This temperature is then maintained for 15-20 minutes to ensure complete incineration of the particles within the DPF. The incineration process converts the carbon particles to carbon dioxide and water.

The active regeneration temperature of the DPF is closely monitored by the DPF software to maintain a target temperature of 600°C (1112°F) at the DPF inlet. The temperature control ensures that the temperatures do not exceed the operational limits of the turbocharger and the catalytic converter. The turbocharger inlet temperature must not exceed 830°C (1526°F) and the catalytic converter brick temperature must not exceed 800°C (1472°F) and the exit temperature must remain below 750°C (1382°F).

During the active regeneration process the following [ECM](#) controlled events occur:

- The turbocharger is maintained in the fully open position. This minimizes heat transmission from the exhaust gas to the turbocharger and reduces the rate of exhaust gas flow allowing optimum heating of the DPF. If the driver demands an increase in engine torque, the turbocharger will respond by closing the vanes as necessary.
- The throttle is closed as this assists in increasing the exhaust gas temperature and reduces the rate of exhaust gas flow which has the effect of reducing the time for the DPF to reach the optimum temperature.
- The [EGR \(exhaust gas recirculation\)](#) valve is closed. The use of [EGR](#) decreases the exhaust gas temperature and therefore prevents the optimum DPF temperature being achieved.
- The glow plugs are occasionally activated for up to 40 seconds to provide additional heat to assist in raising the DPF temperature.

If, due to vehicle usage and/or driving style, the active regeneration process cannot take place or is unable to regenerate the DPF, the dealer can force regenerate the DPF. This is achieved by either driving the vehicle until the engine is at its normal operating temperature and then driving for a further 20 minutes at speeds of not less than 30 mph (48 km/h) or by connecting an approved Land Rover diagnostic system to the vehicle which will perform an automated static regeneration procedure to clean the DPF.

Fault Diagnosis

For details on regeneration, [DTC \(diagnostic trouble code\)](#)'s, soot levels and component checks, refer to Diagnosis and Testing.

Refer to: Diesel Particulate Filter (309-00B, Diagnosis and Testing).

DPF Control

The DPF requires constant monitoring to ensure that it is operating at its optimum efficiency and does not become blocked. The [ECM](#) contains DPF software which controls the monitoring and operation of the DPF system and also monitors other vehicle data to determine regeneration periods and service intervals.

The DPF software can be divided into three separate control software modules; a DPF supervisor module, a DPF fuel management module and a DPF air management module.

These three modules are controlled by a fourth software module known as the DPF co-ordinator module. The co-ordinator module manages the operation of the other modules when an active regeneration is requested. The DPF supervisor module is a sub-system of the DPF co-ordinator module.

DPF Fuel Management Module

The DPF fuel management module controls the following functions:

- Timing and quantity of the four split injections per stroke (pilot, main and two post injections).
- Injection pressure and the transition between the three different calibration levels of injection.

The above functions are dependant on the condition of the catalytic converter and the DPF.

The controlled injection determines the required injection level in addition to measuring the activity of the catalytic converter and the DPF. The fuel management calculates the quantity and timing for the four split injections, for each of the three calibration levels for injection pressure, and also manages the transition between the levels.

The two post injections are required to separate the functionality of increasing in-cylinder gas temperatures and the production of hydrocarbons. The first post injection is used to generate the higher in-cylinder gas temperature while simultaneously retaining the same engine torque output produced during normal (non-regeneration) engine operation. The second post injection is used to generate hydrocarbons by allowing unburnt fuel into the catalytic converter without producing increased engine torque.

DPF Air Management Module

The DPF air management module controls the following functions:

- [EGR](#) control
- Turbocharger boost pressure control
- Intake air temperature and pressure control.

During active regeneration, the [EGR](#) operation is disabled and the closed-loop activation of the turbocharger boost controller is calculated. The air management module controls the air in the intake manifold to a predetermined level of pressure and temperature. This control is required to achieve the correct in-cylinder conditions for stable and robust combustion of the post injected fuel.

The module controls the intake air temperature by actuating the [EGR](#) throttle and by adjustment of the turbocharger boost pressure control.

DPF Co-ordinator Module

The DPF co-ordinator module reacts to a regeneration request from the supervisor module by initiating and co-ordinating the following DPF regeneration requests:

- [EGR](#) cut-off
- Turbocharger boost pressure control
- Engine load increase
- Control of air pressure and temperature in the intake manifold
- Fuel injection control.

When the supervisor module issues a regeneration request, the co-ordinator module requests [EGR](#) cut-off and a regeneration specific turbocharger boost pressure control. It then waits for a feedback signal from the EGR system confirming that the [EGR](#) valve is closed.

When the [EGR](#) valve is closed, the co-ordinator module initiates requests to increase engine load by controlling the intake air temperature and pressure.

Once confirmation is received that intake conditions are controlled or a calibration time has expired, the co-ordinator module then changes to a state awaiting an accelerator pedal release manoeuvre from the driver. If this occurs or a

calibration time has expired, the co-ordinator module generates a request to control fuel injections to increase exhaust gas temperature.

DIFFERENTIAL PRESSURE SENSOR

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conjunction with other data, to calculate the accumulated amount of trapped particulates.

By measuring the pressure difference between the DPF inlet and outlet and the DPF temperature, the DPF software can determine if the DPF is becoming blocked and requires regeneration.

Component Description

DIESEL PARTICULATE FILTER (DPF)

The DPF system reduces diesel particulate emissions to negligible levels to meet current European stage 5 emission standards.

The particulate emissions are the black fumes emitted from the diesel engine under certain load conditions. The emissions are a complex mixture of solid and liquid components with the majority of the particulates being carbon microspheres on which hydrocarbons from the engine's fuel and lubricant condense.

The DPF system comprises the following components:

- Diesel Particulate Filter (DPF)
- DPF control software incorporated in the [ECM](#)
- Differential pressure sensor.

The DPF is located in the exhaust system, downstream of the catalytic converter. Its function is to trap particulate matter in the exhaust gases leaving the engine. A major feature of the DPF is its ability for regeneration. Regeneration is the burning of particulates trapped by the filter to prevent obstruction to the free flow of exhaust gasses. The regeneration process takes place at calculated intervals and is not noticeable by the driver of the vehicle.

Regeneration is most important, since an overfilled filter can damage the engine through excessive exhaust back pressure and can itself be damaged or destroyed. The material trapped in the filter is in the most part carbon particles with some absorbed hydrocarbons.

The DPF uses a filter technology based on a filter with a catalytic coating. The DPF is made from silicon carbide housed in a steel container and has excellent thermal shock resistance and thermal conductivity properties. The DPF is designed for the engine's operating requirements to maintain the optimum back pressure requirements.

The porous surface of the filter consists of thousands of small parallel channels positioned in the longitudinal direction of the exhaust system. Adjacent channels in the filter are alternately plugged at the end. This design forces the exhaust gasses to flow through the porous filter walls, which act as the filter medium. Particulate matter which are too big to pass through the porous surface are collected and stored in the channels.

The collected particulate matter, if not removed, can create an obstruction to exhaust gas flow. The particles are removed by a regeneration process which incinerates the particles.

The regeneration process uses NO_2 to remove the particles from the DPF. The NO_2 is generated by the catalytic converter upstream of the DPF. The catalytic converter produces temperatures in excess of 250°C (482°F) at which point the regeneration process is started.

DPF regeneration is controlled by the temperature of the exhaust gasses and the DPF. The DPF includes a wash coat to the filter surface which comprises platinum and other active components and is similar to the catalytic converter. At certain exhaust gas and DPF temperatures the wash coat promotes combustion and incineration of the particles in addition to oxidizing carbon monoxide and hydrocarbon emissions.

The exhaust gas and DPF temperatures are controlled by the DPF software located in the [ECM](#). The DPF software monitors the load status of the DPF based on driving style, distance travelled and signals from the differential pressure sensor and temperature sensors. When the particulate loading of the DPF reaches predetermined levels, the DPF is actively regenerated by adjusting, in conjunction with the [ECM](#), various engine control functions such as:

- fuel injection
- intake air throttle
- glow plug activation
- exhaust gas recirculation
- turbocharger boost pressure control.

The regeneration process is possible because of the flexibility of the common-rail fuel injection engine which provides precise control of fuel flow, fuel pressure and injection timing which are essential requirements to promote the efficient regeneration process.

Diesel Particulate Filter Temperature Sensors

Two temperature sensors are used in the DPF system. One is located in the turbocharger outlet elbow, adjacent to the HO2S and the second sensor is located in the DPF inlet.

The sensors measure the temperature of exhaust gas exiting the turbocharger and before it passes through the DPF and provides the information needed to calculate the DPF temperature.

The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control the DPF temperature.

Instrument Cluster Indications

For drivers who make regular short journeys at low speeds, it may not be possible to efficiently regenerate the DPF. In this case, the DPF software will detect a blockage of the DPF from signals from the differential pressure sensor and will alert the driver as follows:

The driver will be alerted to this condition by a message 'DPF FULL. See Manual'. As detailed in the Owners Handbook, the driver should drive the vehicle until the engine is at its normal operating temperature and then drive for a further 20 minutes at speeds of not less than 30 mph (48 km/h). Successful regeneration of the DPF is indicated to the driver by the 'DPF FULL' message no longer being displayed. If the DPF software detects that the DPF is still blocked, the message will continue to be displayed or an additional message 'DPF FULL VISIT DEALER' will be displayed. The driver should take the vehicle to an authorized dealer to have the DPF force regenerated using an approved diagnostic system.

Diesel Particulate Filter Side Effects

The following section details some side effects caused by the active regeneration process.

Engine Oil Dilution

Engine oil dilution can occur due to small amounts of fuel entering the engine crankcase during the post-injection phases. This has made it necessary to introduce a calculation based on driving style to reduce oil service intervals if necessary. The driver is alerted to the oil service by a message in the instrument cluster.

The DPF software monitors the driving style and the frequency of the active regeneration and duration. Using this information a calculation can be made on the engine oil dilution. When the DPF software calculates the engine oil dilution has reached a predetermined threshold (fuel being 7% of engine oil volume) a service message is displayed in the instrument cluster.

Depending on driving style, some vehicles may require an oil service before the designated interval. If a service message is displayed, the vehicle will be required have a full service and the service interval counter will be reset.

Fuel consumption

During the active regeneration process of the DPF, there will be an increase in fuel consumption. When active regeneration is operating, there will be a 100% increase in fuel consumption.

However, because active regeneration occurs infrequently, the overall effect on fuel consumption is approximately 2%. The additional fuel used during the active regeneration process is accounted for in the instantaneous and average fuel consumption displays in the instrument cluster.

DIFFERENTIAL PRESSURE SENSOR

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor to measure the inlet and outlet pressures of the DPF.

Exhaust System - ID4 2.2L Diesel - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual.

REFER to: Exhaust System (309-00A, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle

NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

1. Verify the customer concern
2. Visually inspect for obvious signs of mechanical or electrical damage

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Leaks • Metal fatigue • Pipes • Catalytic converter • Muffler(s) • Joints • Mountings • Clearance around components 	<ul style="list-style-type: none"> • Fuses • Wiring harness • Electrical connector(s) • Sensor(s) • Engine Control Module (ECM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for DTCs and refer to the DTC Index

Symptom Chart

Symptom	Possible Causes	Action
Noisy or leaking exhaust	<ul style="list-style-type: none"> • Exhaust system/components 	Install new components as necessary. Refer to the relevant section of the workshop manual
Lack of power	<ul style="list-style-type: none"> • Air intake system fault • Restricted exhaust system • Low fuel pressure • Exhaust Gas Recirculation (EGR) valve(s) fault • Turbocharger fault 	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. For EGR and turbocharger tests, refer to the relevant section of the workshop manual

DTC Index


For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.

REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel, DTC: Engine Control Module (PCM) (100-00 General Information, Description and Operation).

Exhaust System - ID4 2.2L Diesel - Muffler and Tailpipe

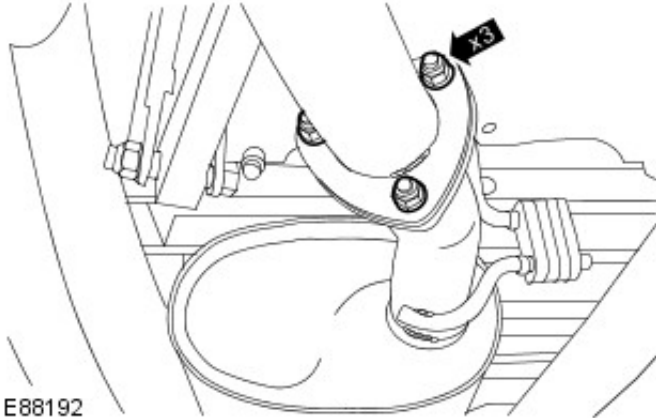
Removal and Installation

Removal

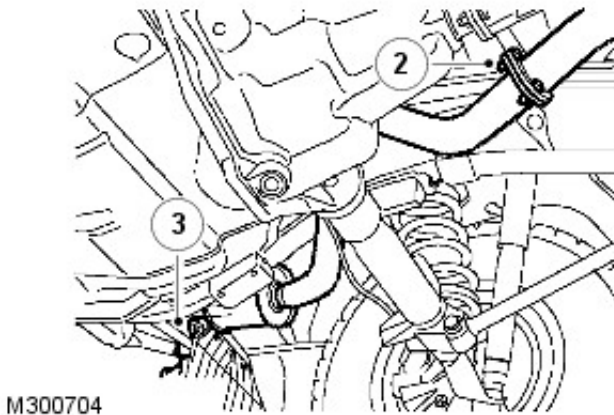
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Release the front muffler from the tail pipe.
 1. Remove and discard the 3 nuts.
 2. Remove and discard the gasket.



3. Remove the rear muffler and tail pipe.
 1. Release the rear muffler from the rubber mounting.



Installation

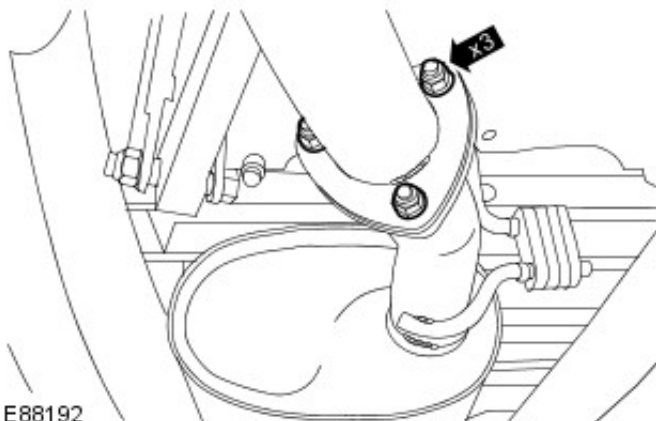
1. Install the rear muffler and tail pipe.
 1. Secure the rear muffler to the rubber mounting.

2. **NOTE:** Install a new gasket.

NOTE: Install new nuts.

Secure the front muffler to the tail pipe.

1. Tighten to 25 Nm (18 lb.ft).




Exhaust System - ID4 2.2L Diesel - Catalytic Converter

Removal and Installation

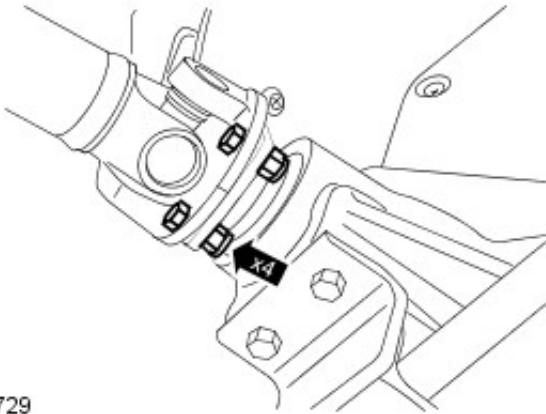
Removal

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

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

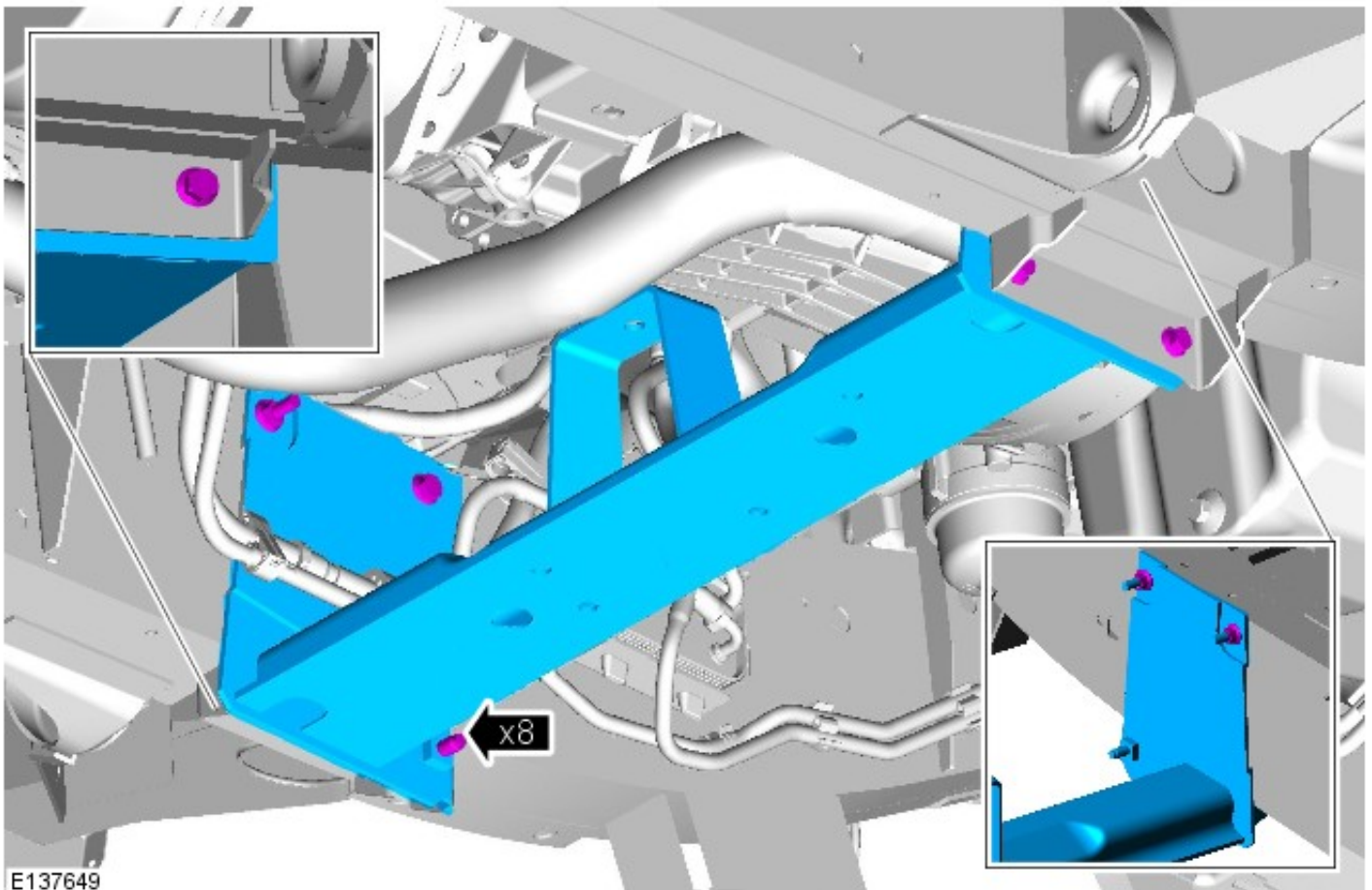
Raise and support the vehicle.

3.



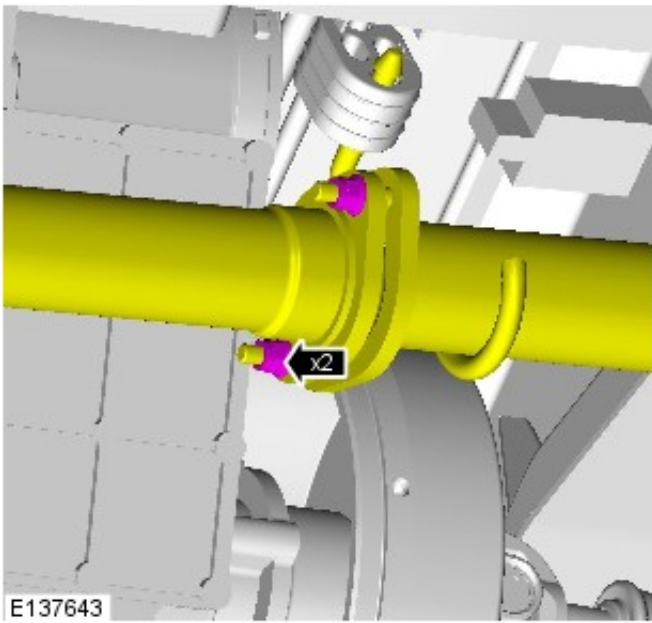
E90729

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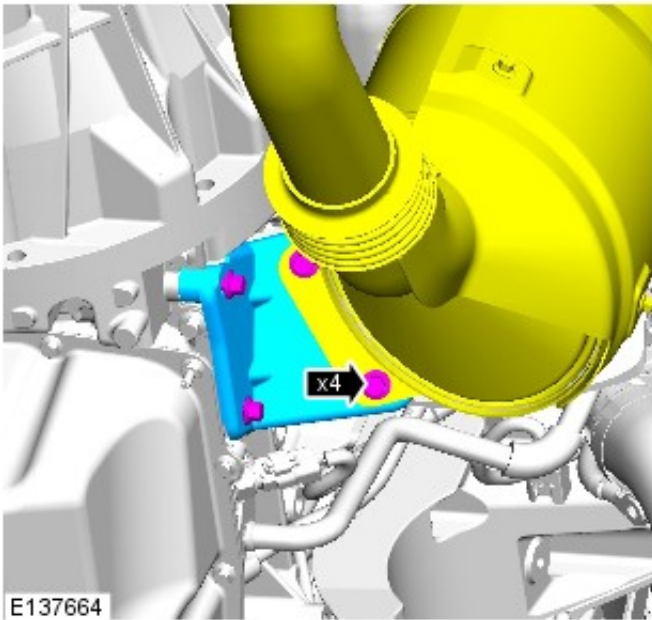


E137649

5.



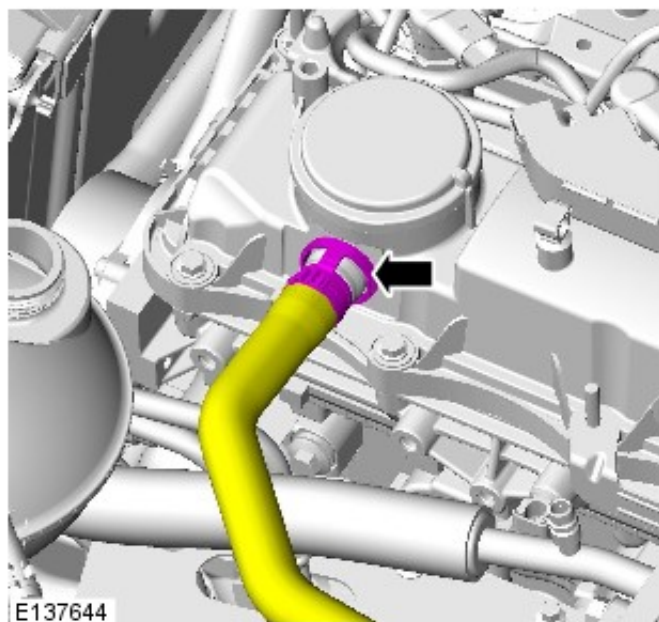
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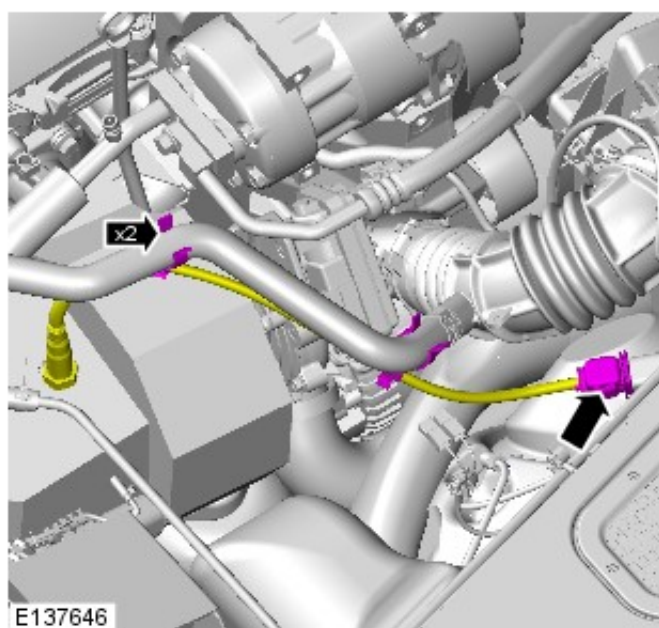
7. Lower the vehicle.

8. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

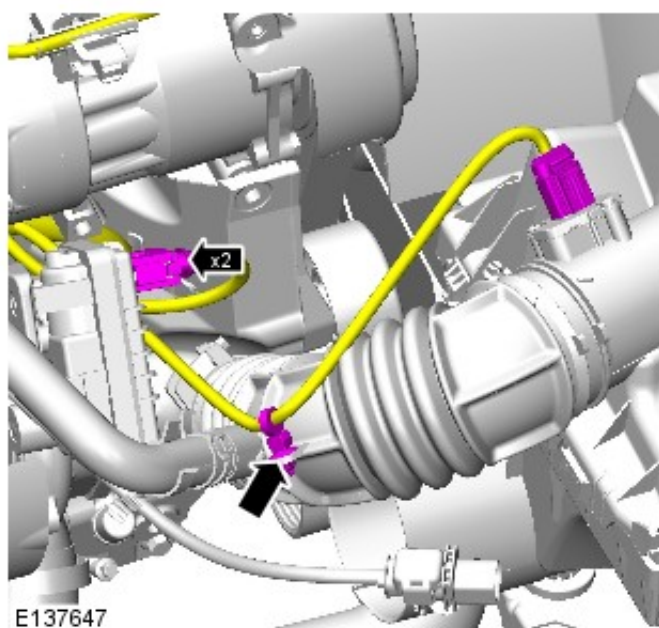
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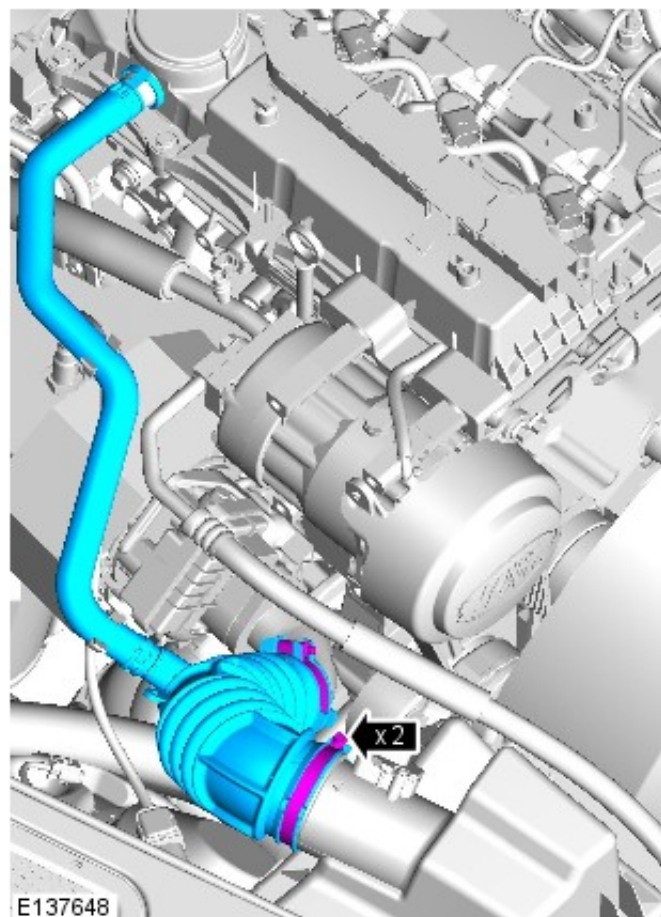
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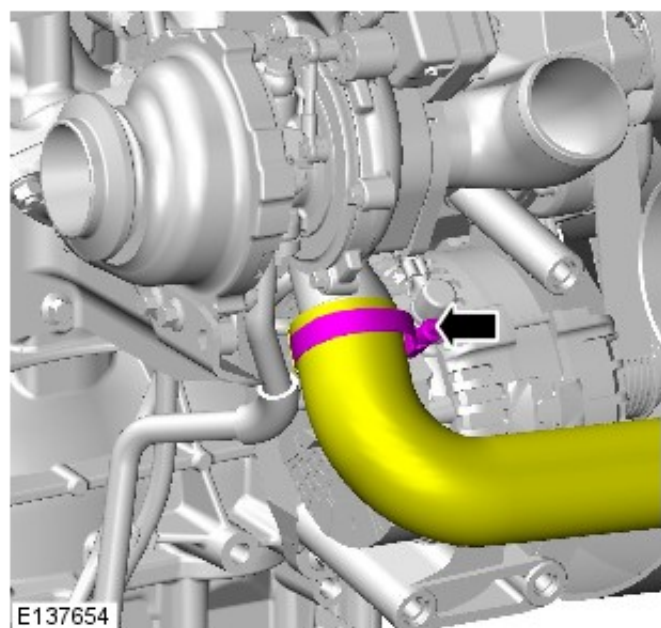


12.

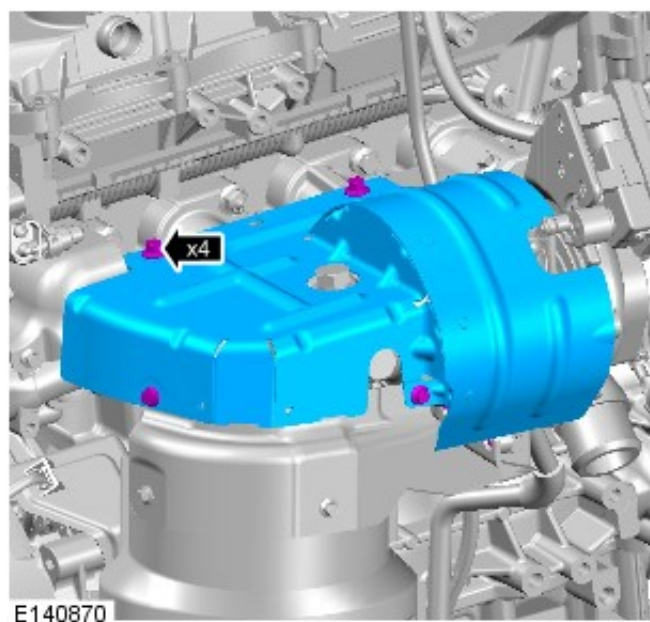


12.

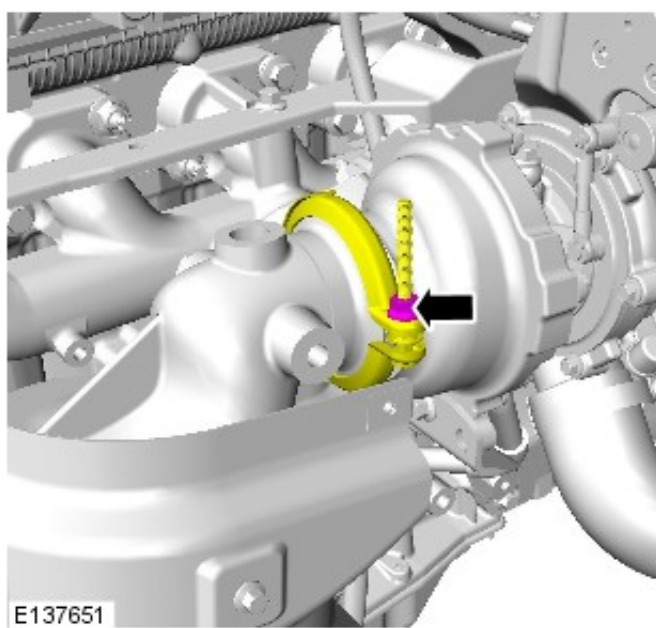
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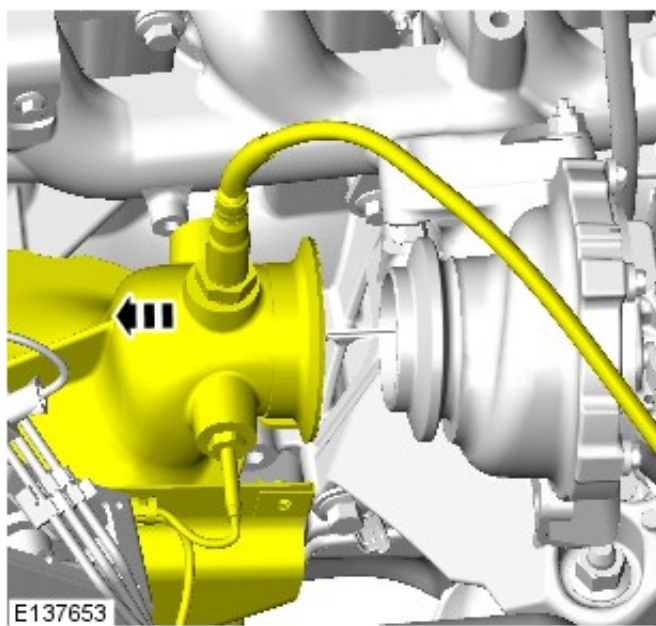
14.

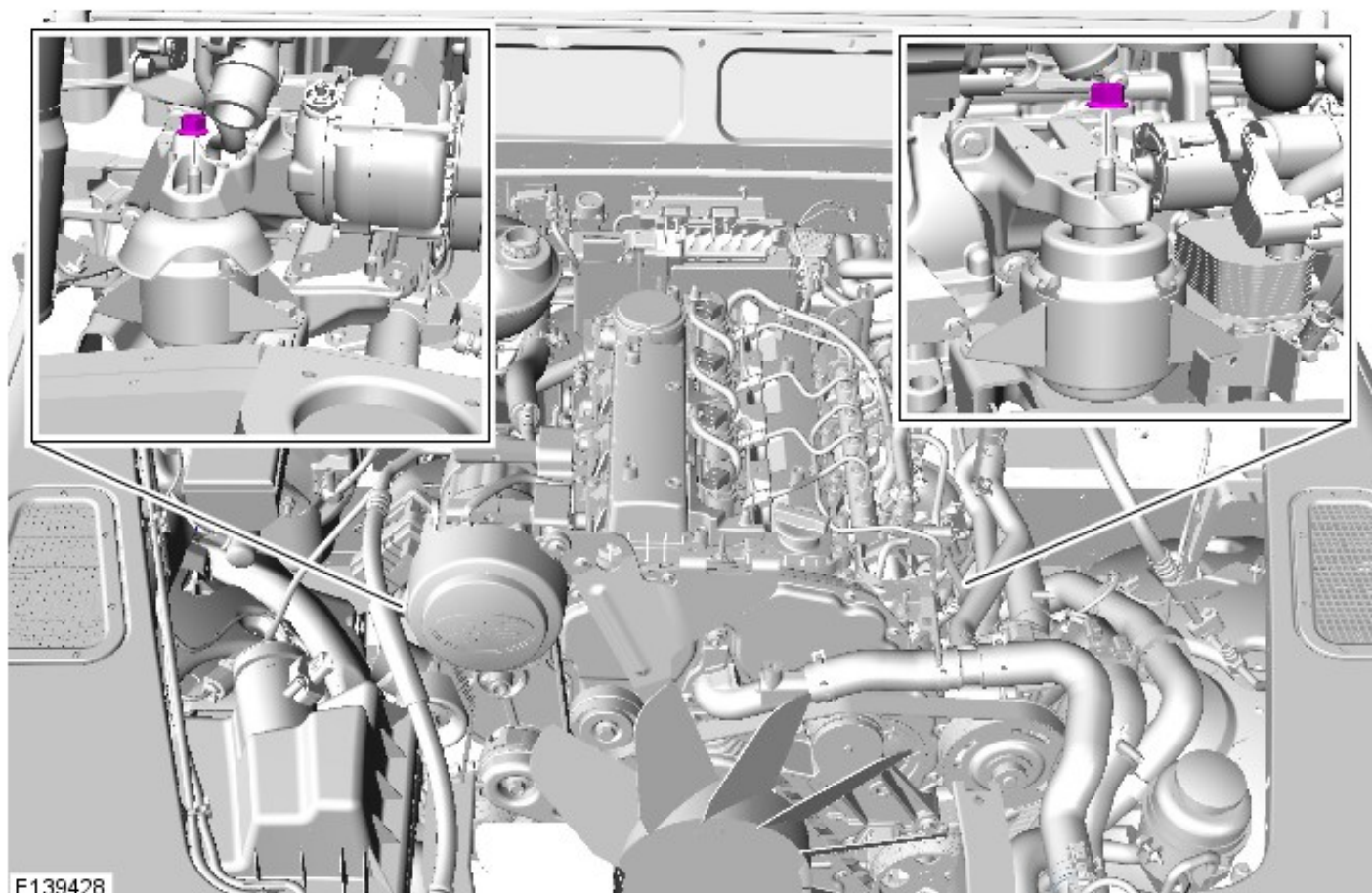


15.

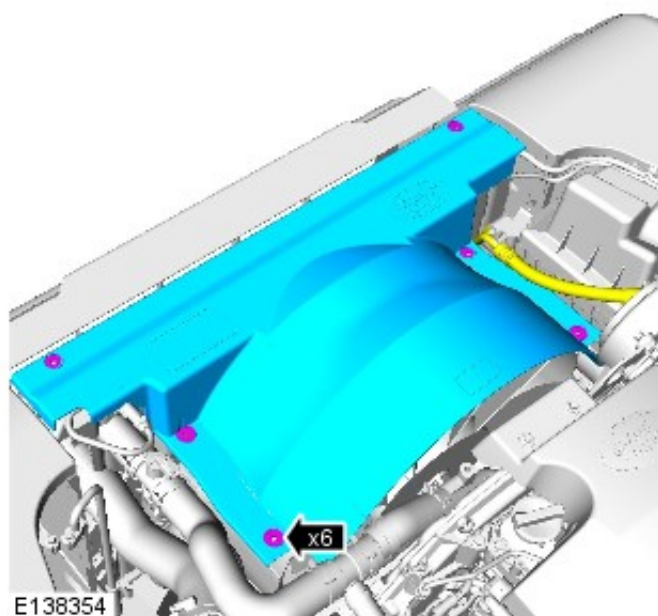



16.

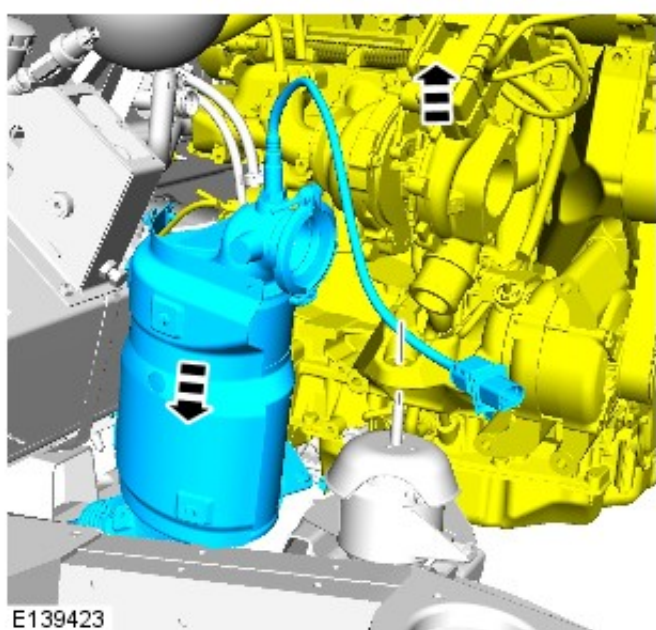
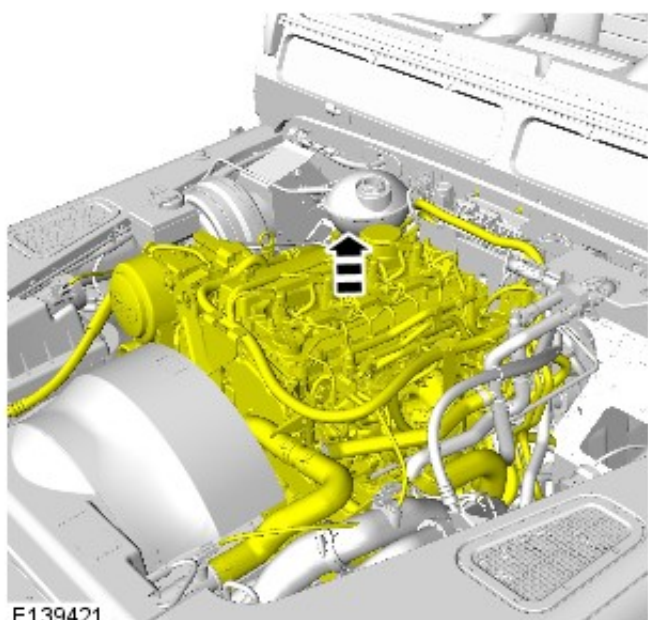




18.



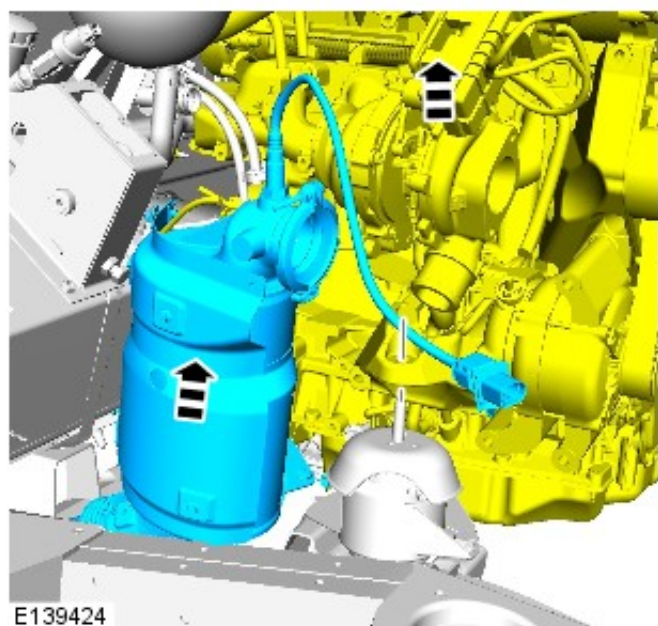
19.  **CAUTION:** Raise the engine assembly using suitable lifting equipment. Make sure the attached and surrounding components are not damaged during this step.



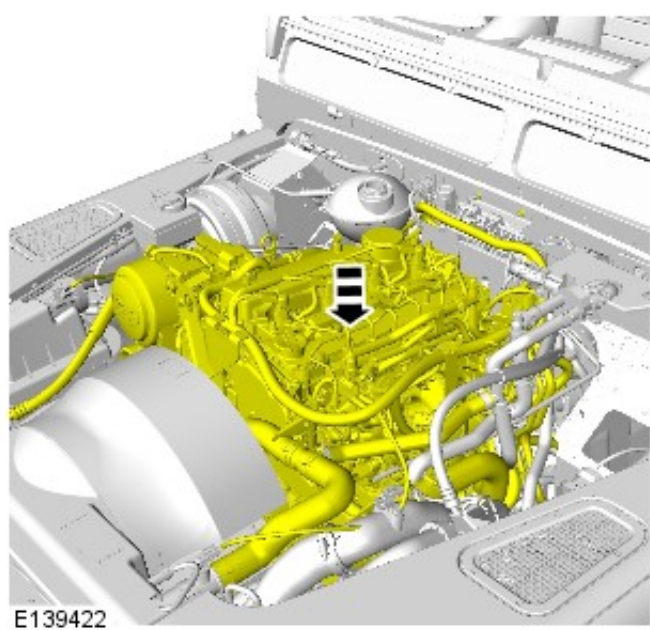
20.

Installation

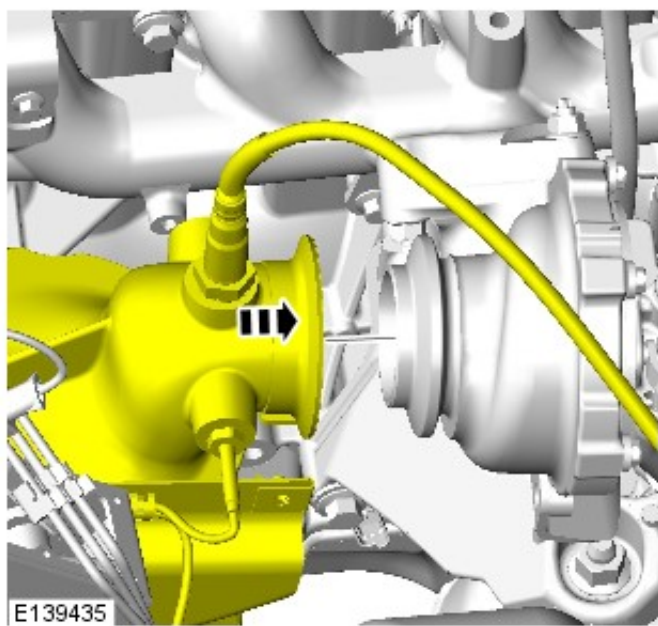
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2.

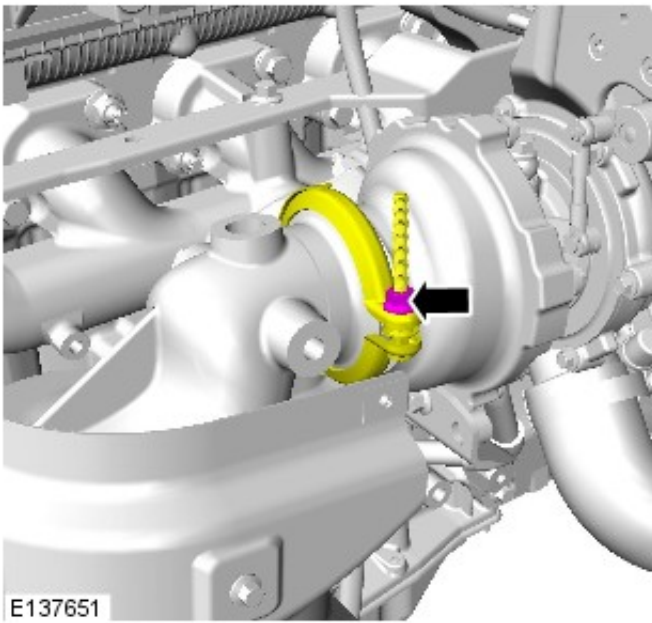


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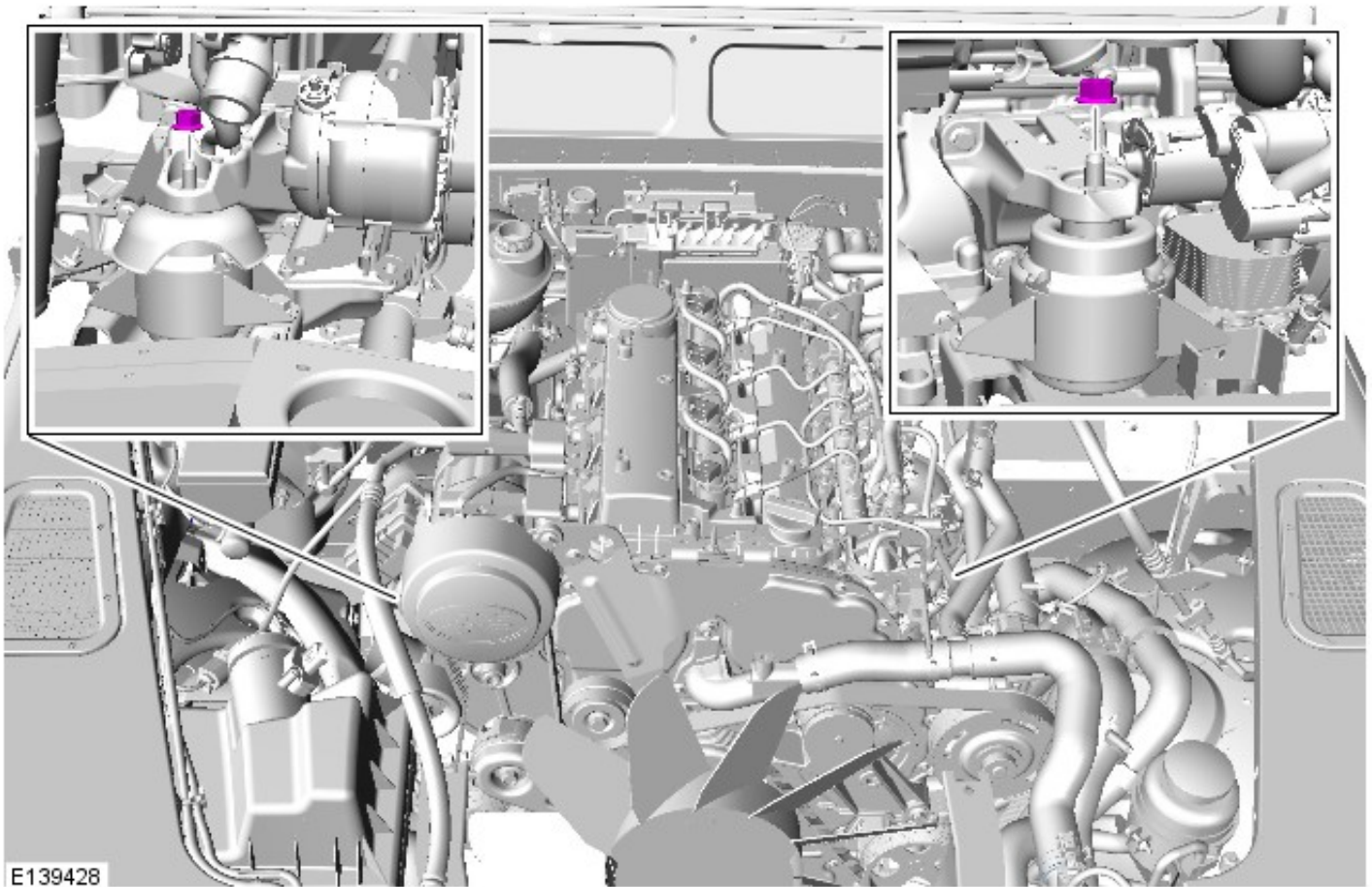


4. Torque: 10Nm

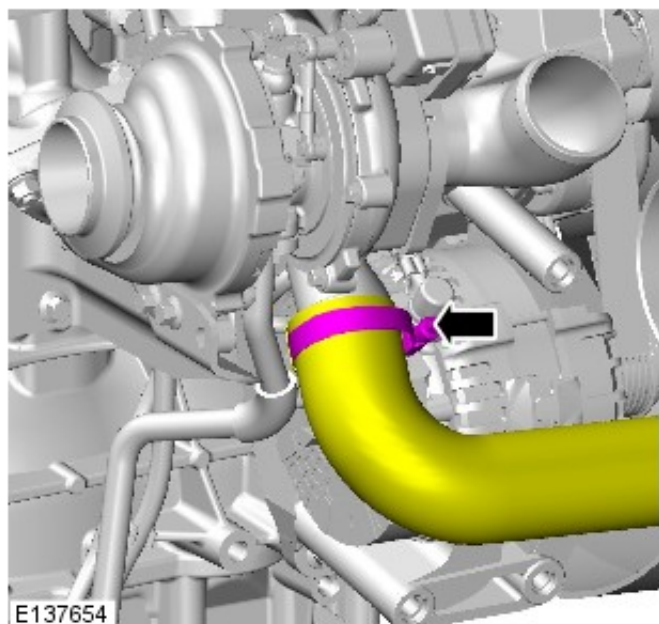
4. Torque: 20Nm



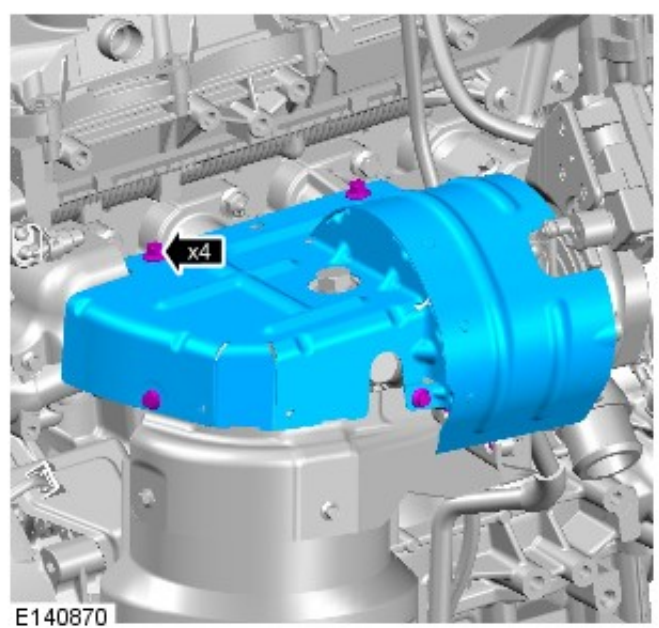
5. Torque: 80Nm



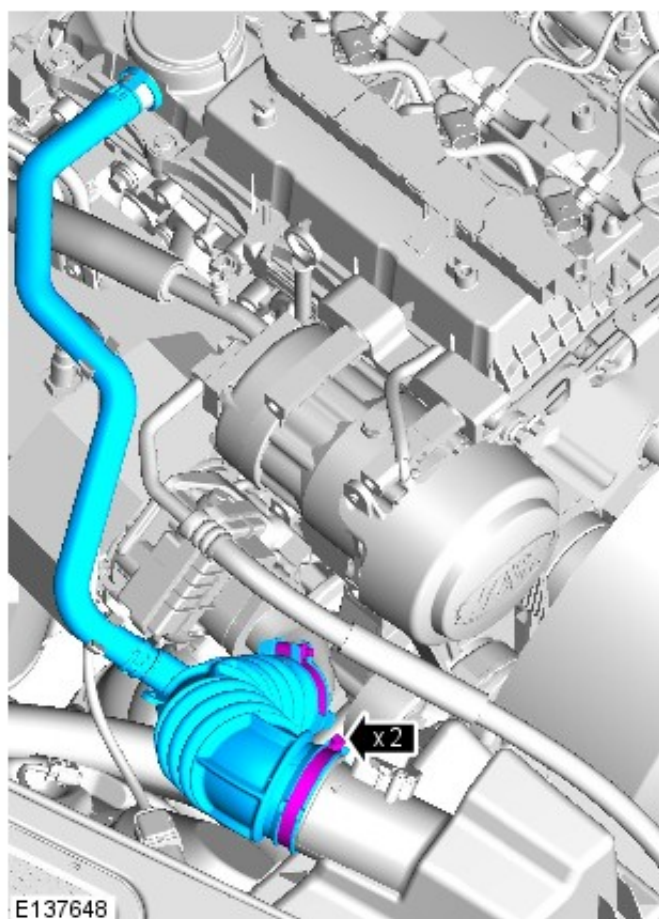
6. Torque: 3Nm



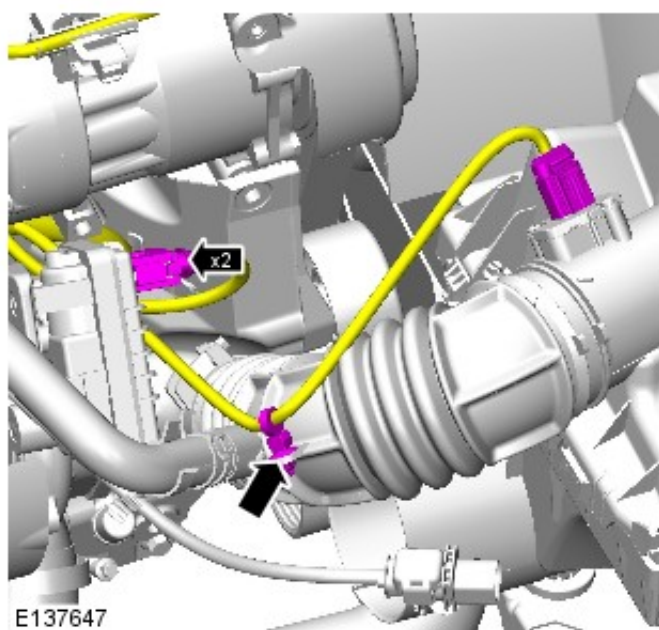
7. Torque: 10Nm



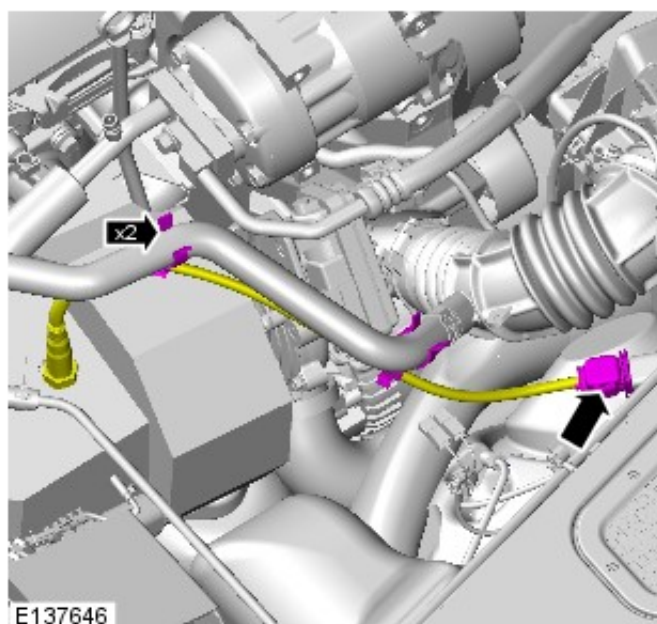
8. Torque: 3Nm



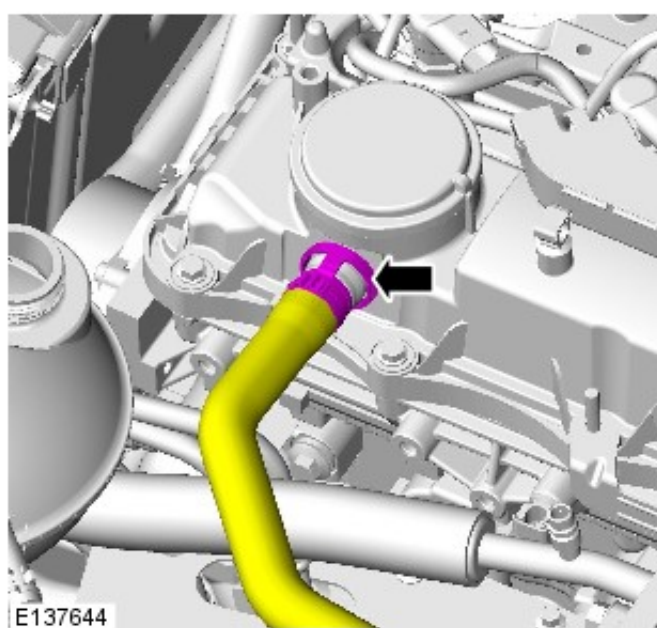
9.



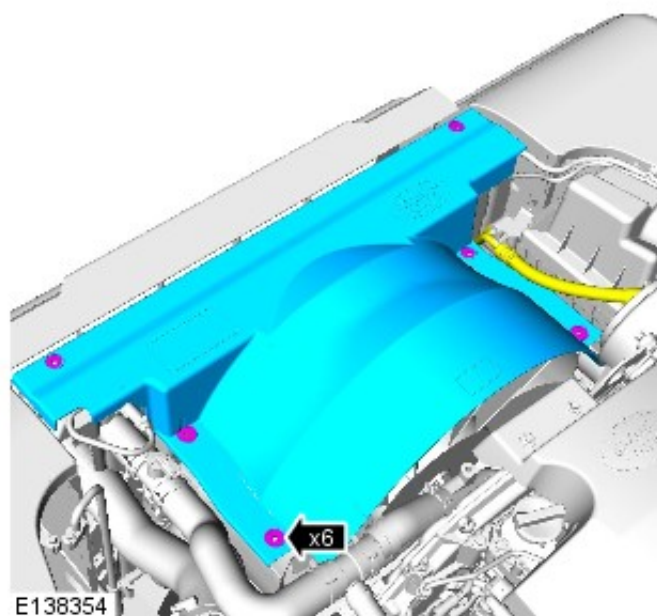
10.



11.



12.

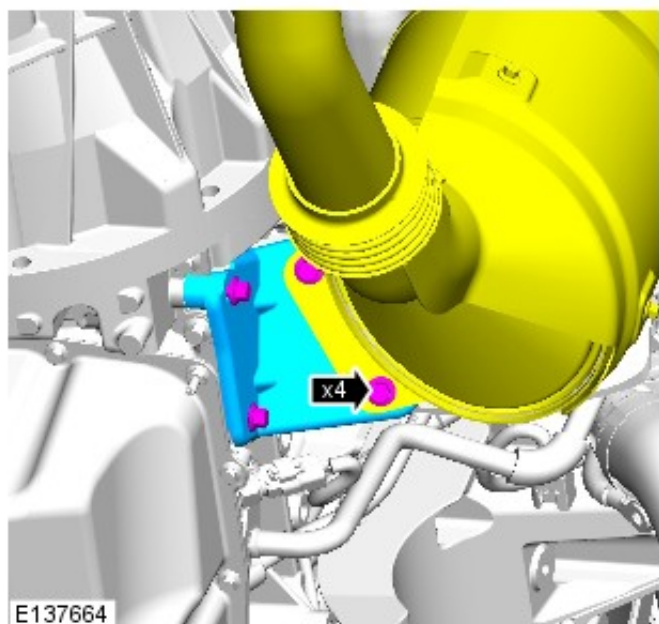


13. For additional information, refer to: [Engine Cover](#) (501-05 Interior

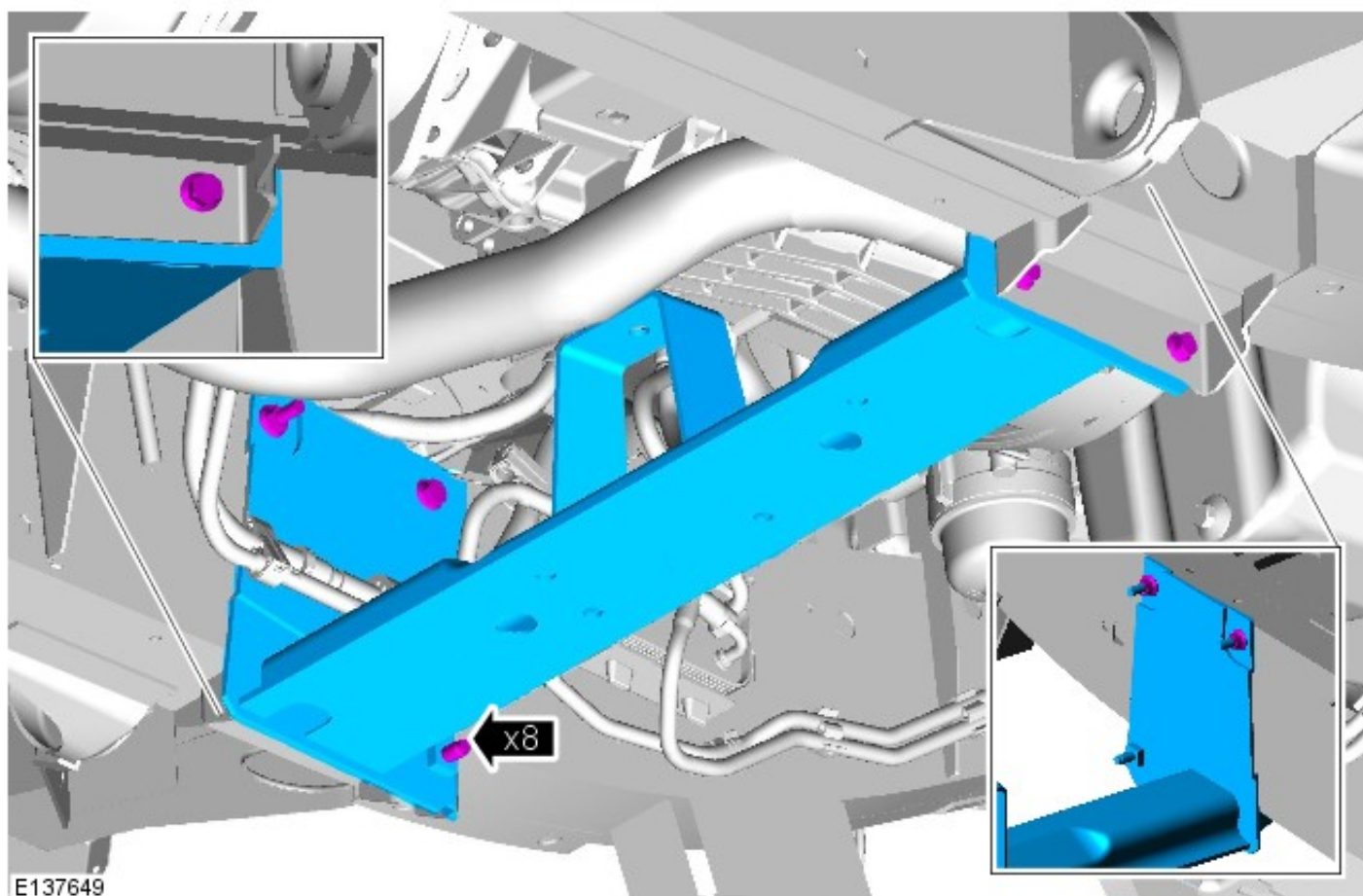
20. For additional information, refer to: [Engine Cover](#) (See 33 Interior Trim and Ornamentation, Removal and Installation).

14. Raise the vehicle on lift.

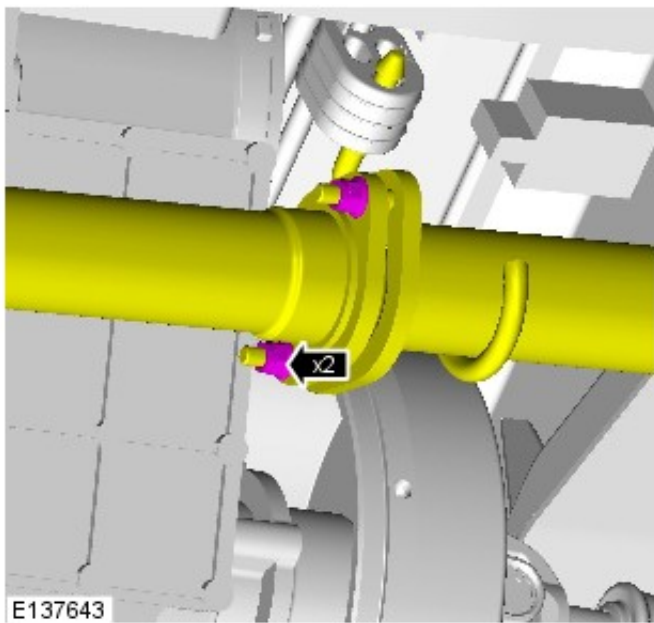
15. Torque: 25Nm



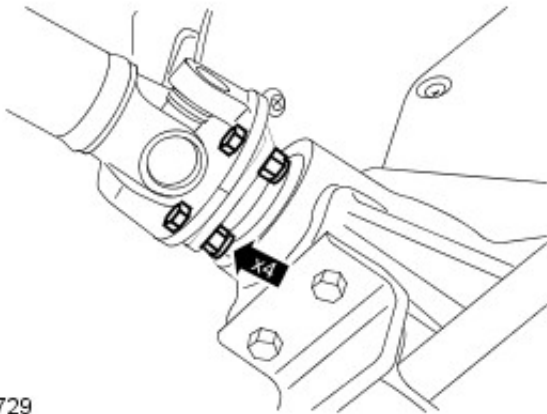
16. Torque: 80Nm



17. Torque: 25Nm



18. Torque: 47Nm



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

Exhaust System - ID4 2.2L Diesel - Front Muffler

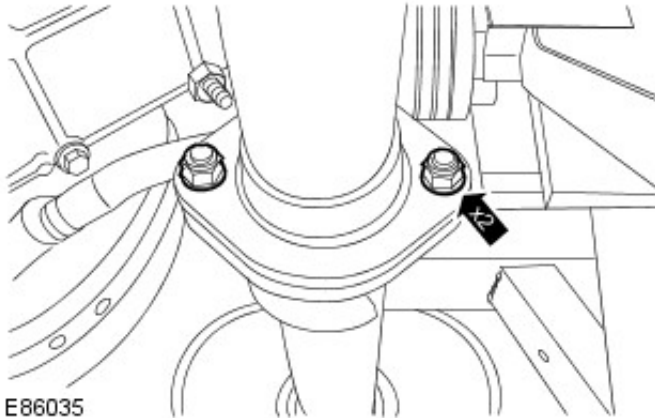
Removal and Installation

Removal

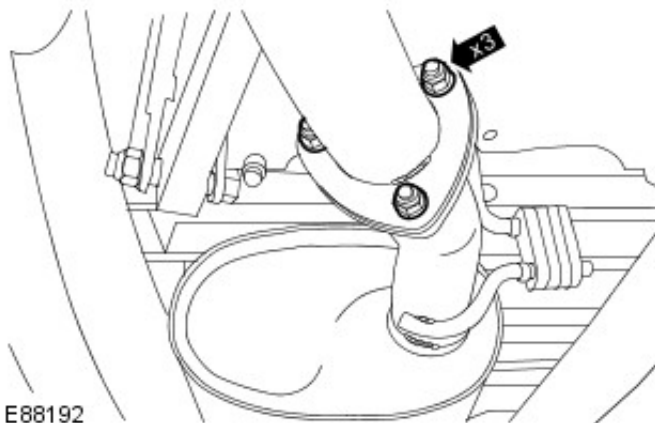
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

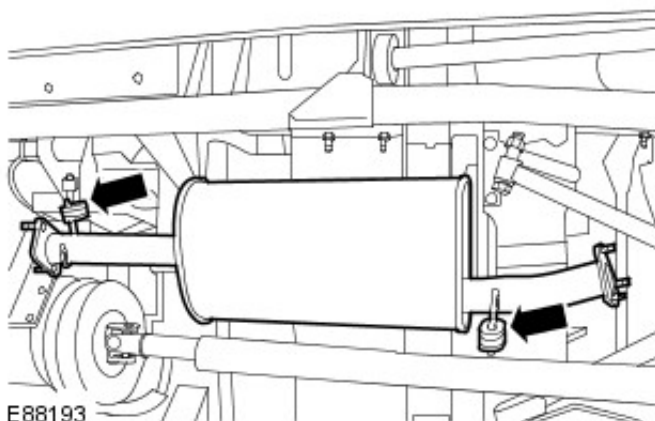
2. Release the front muffler from the diesel particulate filter.
 1. Remove and discard the 2 nuts.



3. Release the front muffler from the tail pipe.
 1. Remove and discard the 3 nuts.
 2. Remove and discard the gasket.

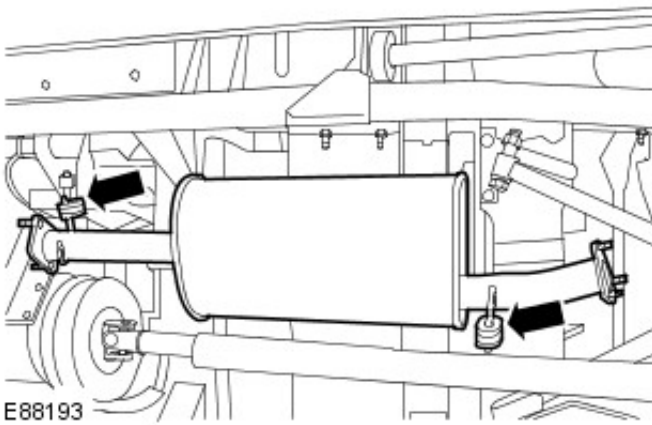


4. Remove the intermediate pipe and front muffler.
 1. Release the 2 rubber mountings.



Installation

1. Install the intermediate pipe and front muffler.
 1. Secure the 2 rubber mountings.

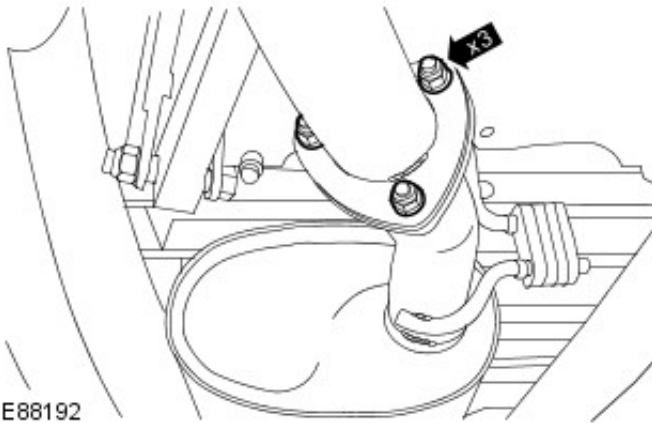


2. NOTE: Install a new gasket.

NOTE: Install new nuts.

Secure the front muffler to the tail pipe.

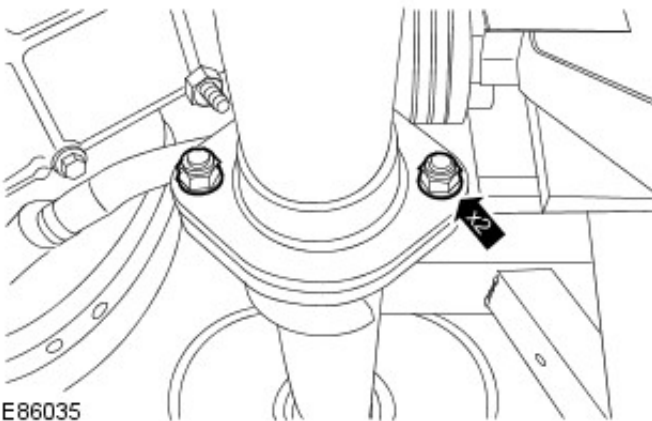
1. Tighten to 25 Nm (18 lb.ft).



3. NOTE: Install new nuts.

Secure the front muffler to the diesel particulate filter.

1. Tighten to 25 Nm (18 lb.ft).



Exhaust System - ID4 2.2L Diesel - Diesel Particulate Filter (DPF)

Removal and Installation

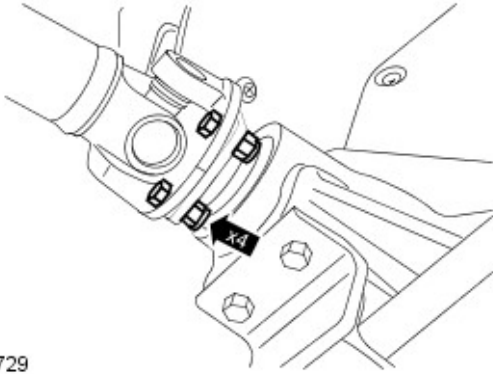
Removal

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

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

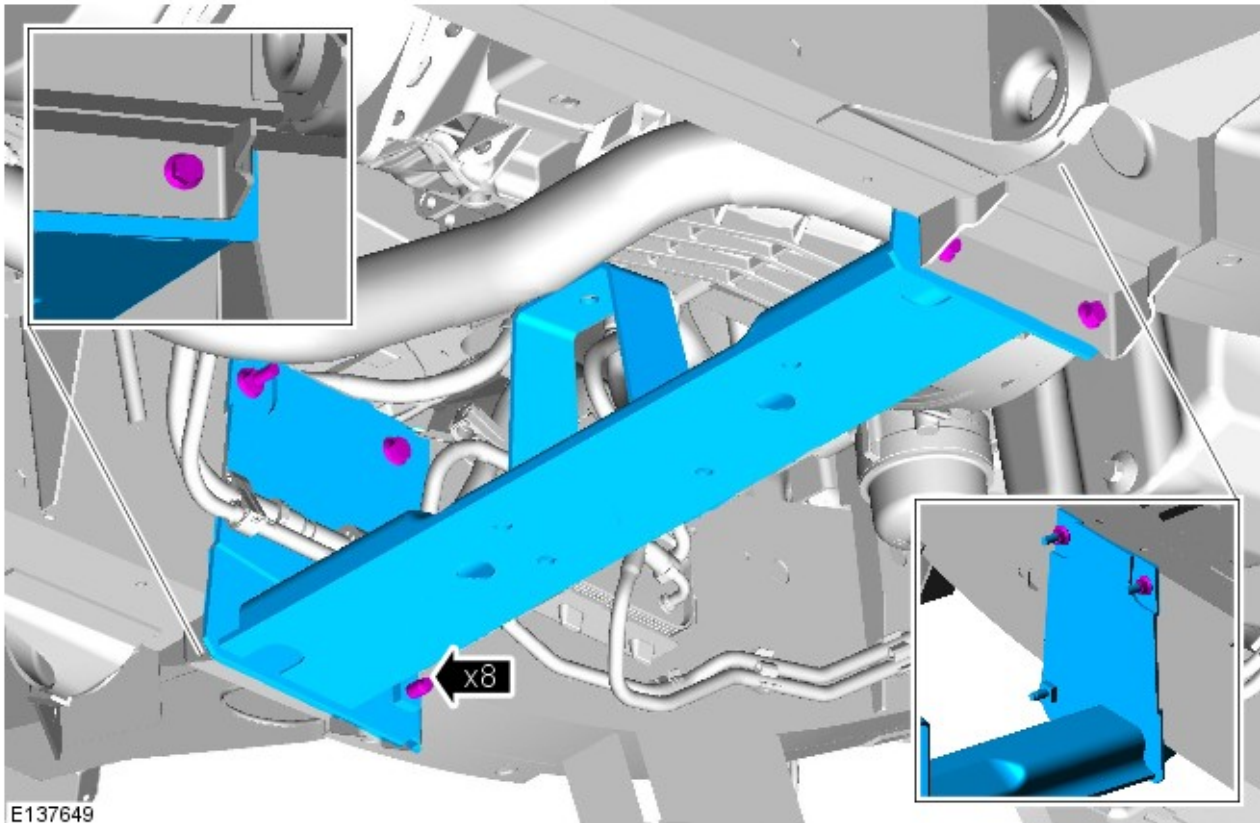
Raise and support the vehicle.

3.



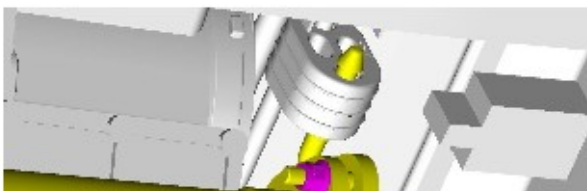
E90729

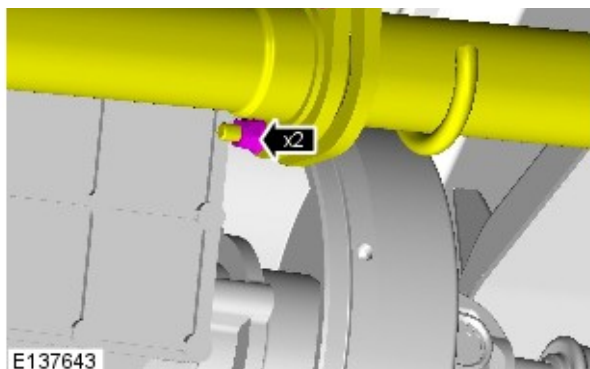
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E137649

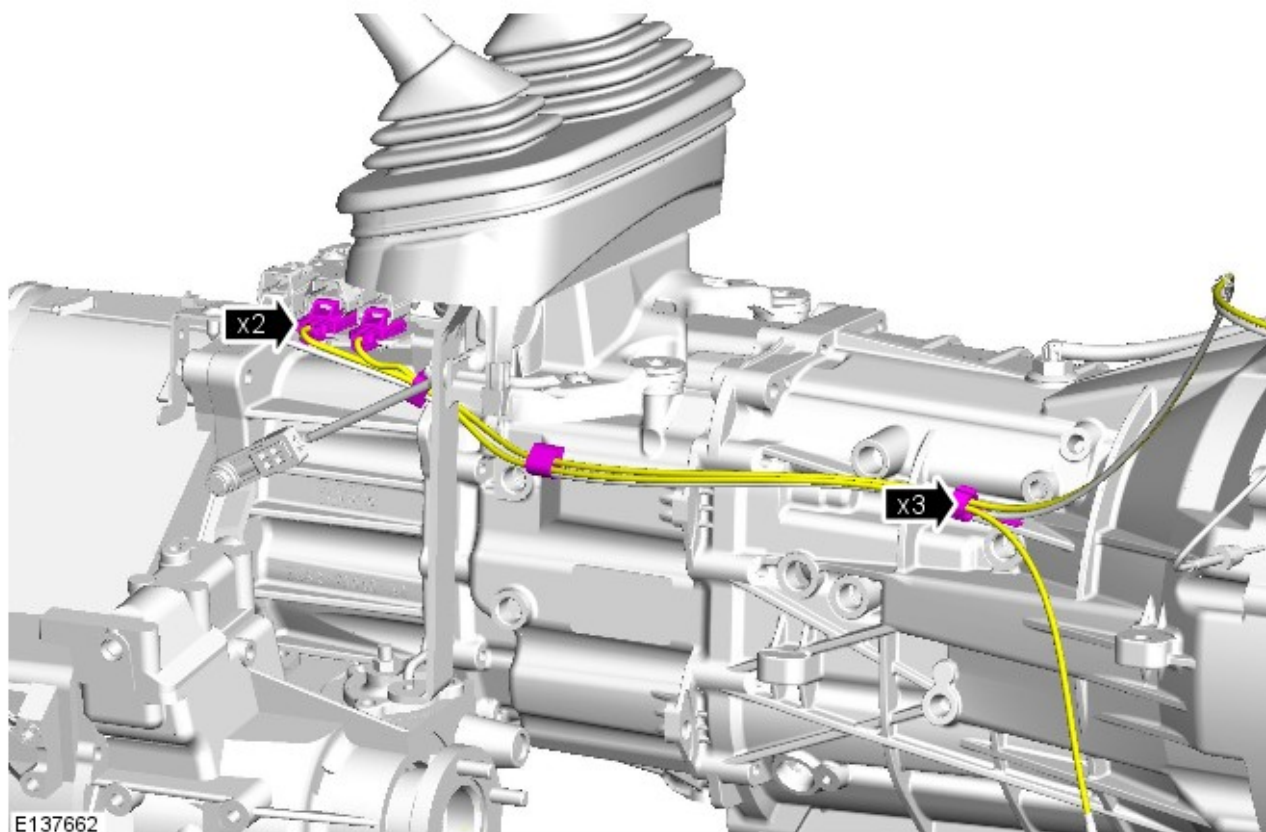
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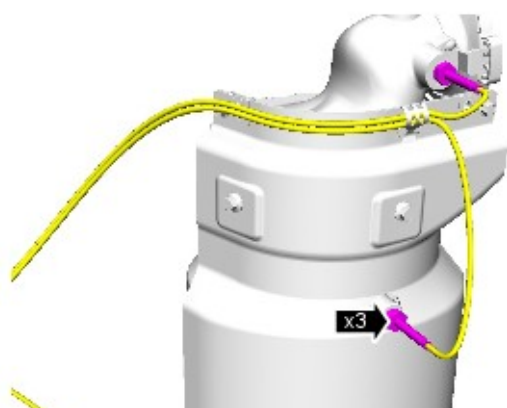
E137643

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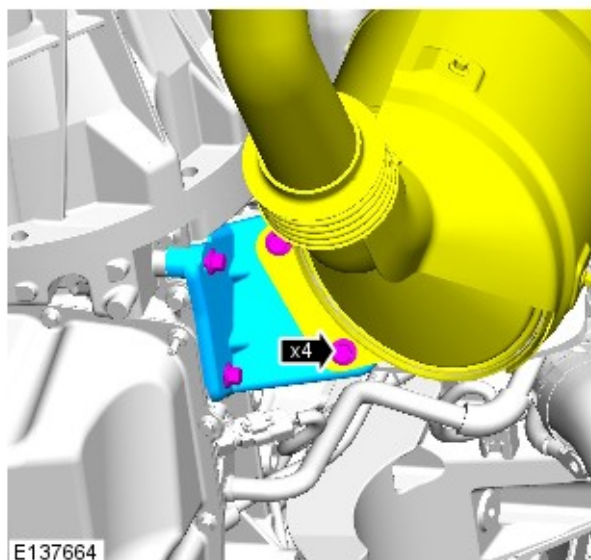
E137662

7.





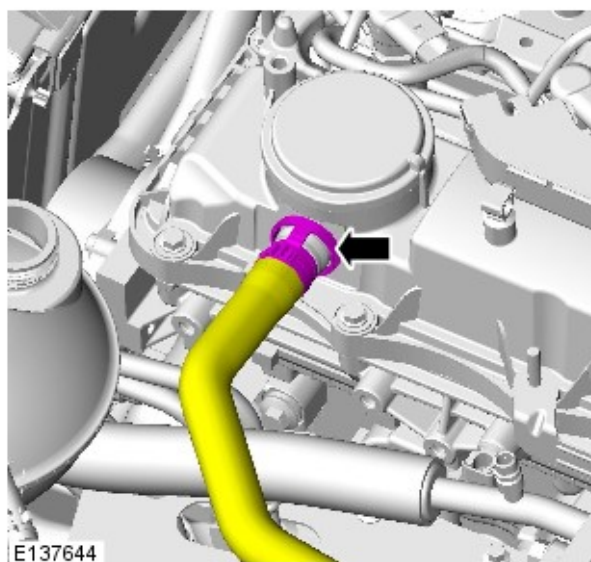
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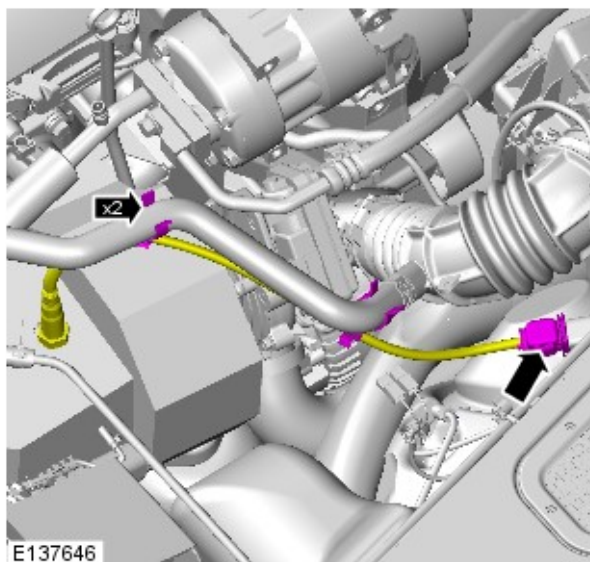
9. Lower the vehicle.

10. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

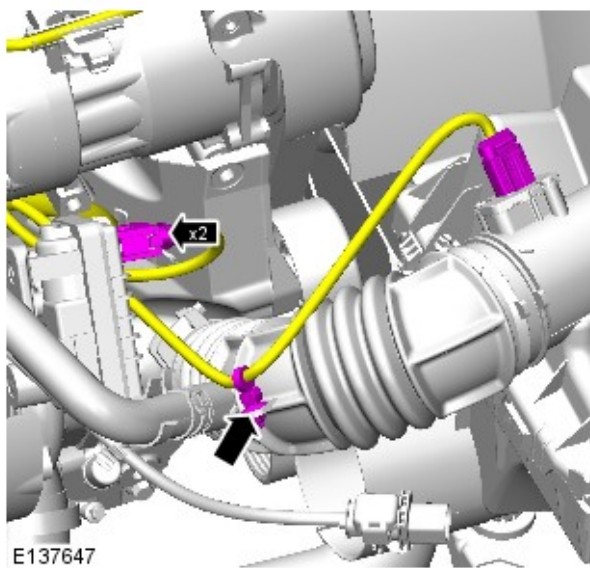
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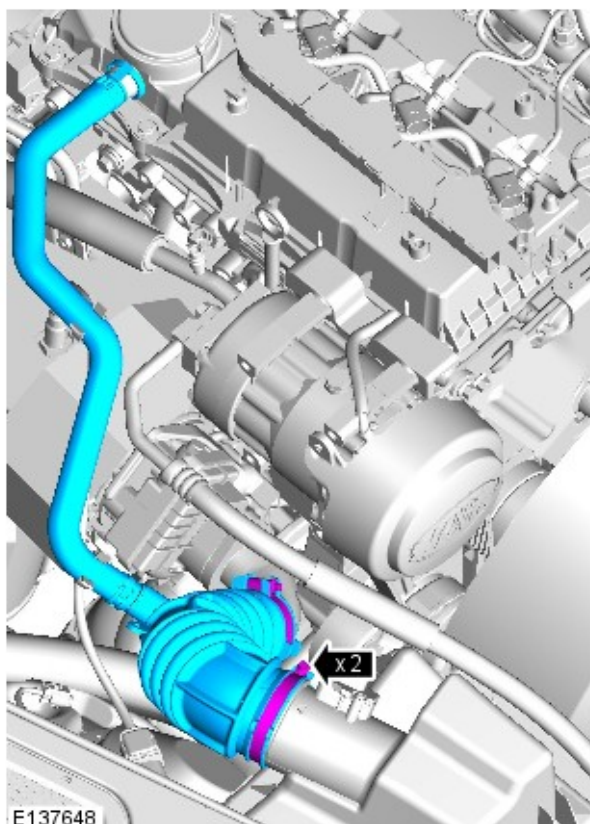
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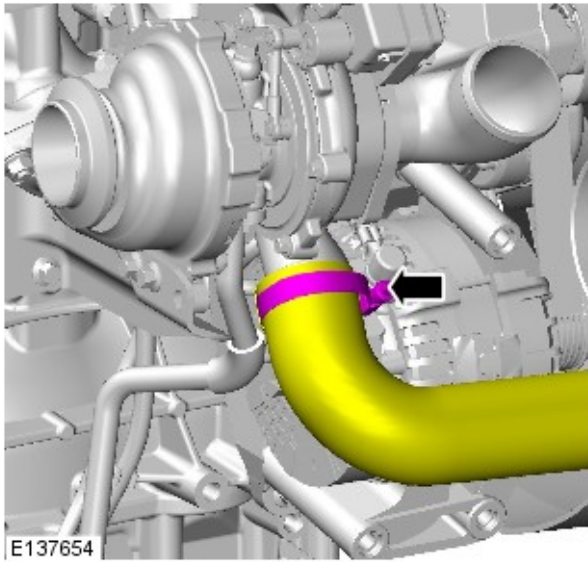
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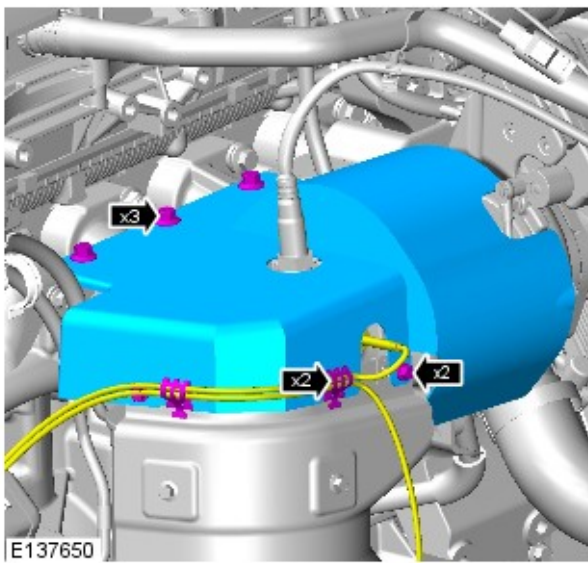
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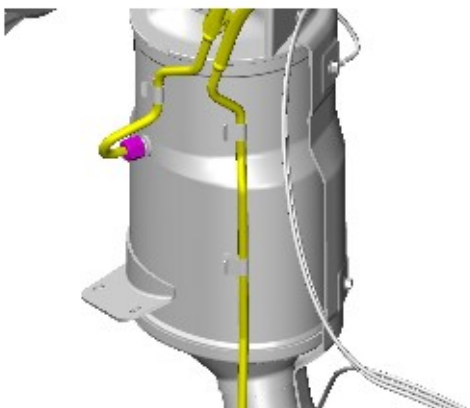
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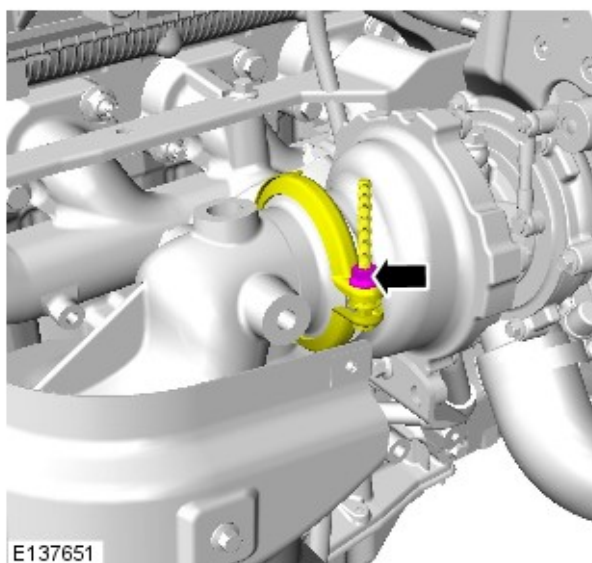


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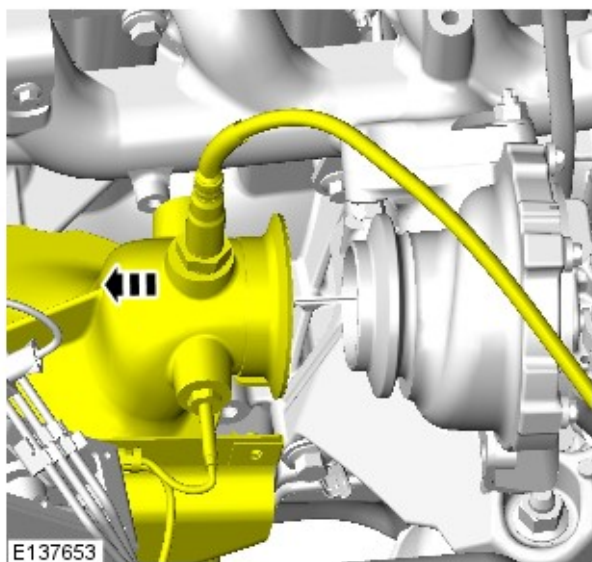
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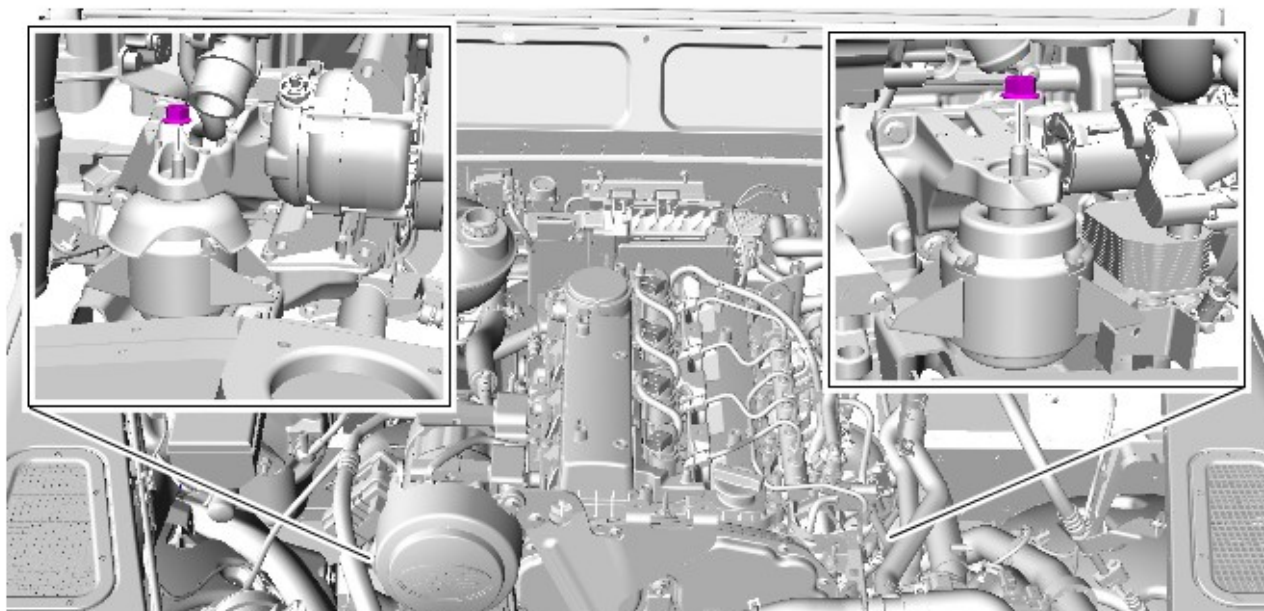


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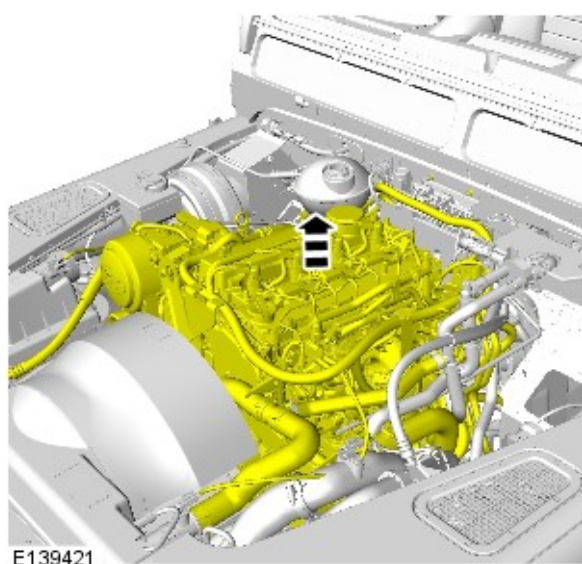
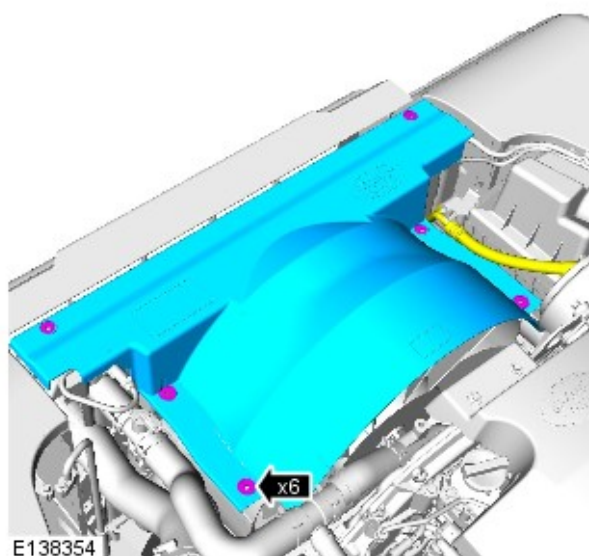



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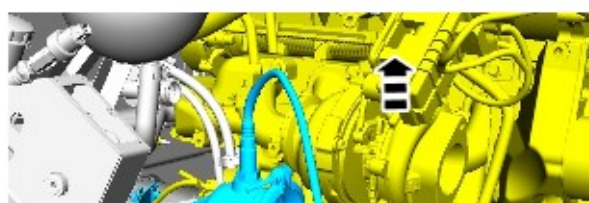




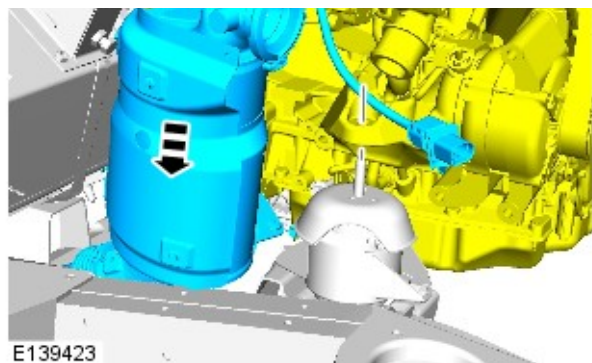
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22.  **CAUTION: CAUTION:** Raise the engine assembly using suitable lifting equipment. Make sure the attached and surrounding components are not damaged during this step.

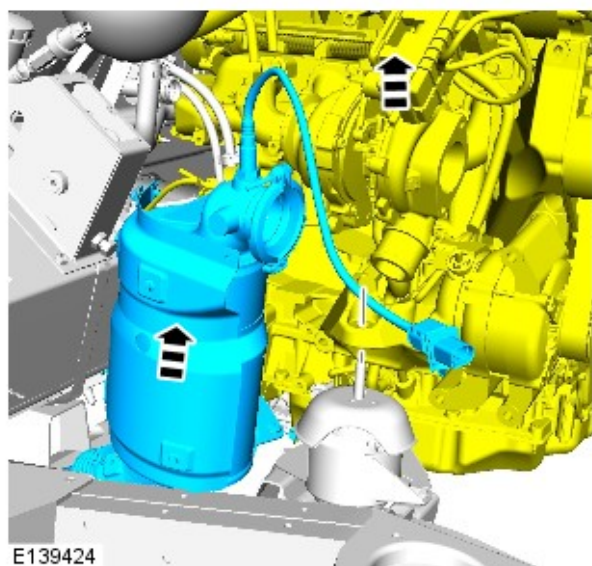


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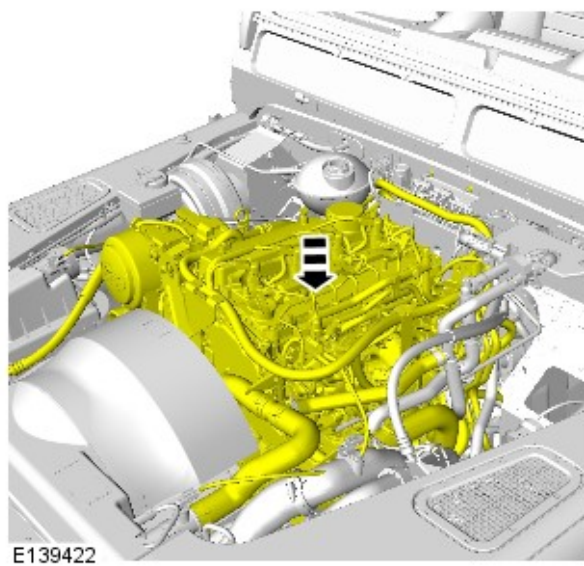


Installation

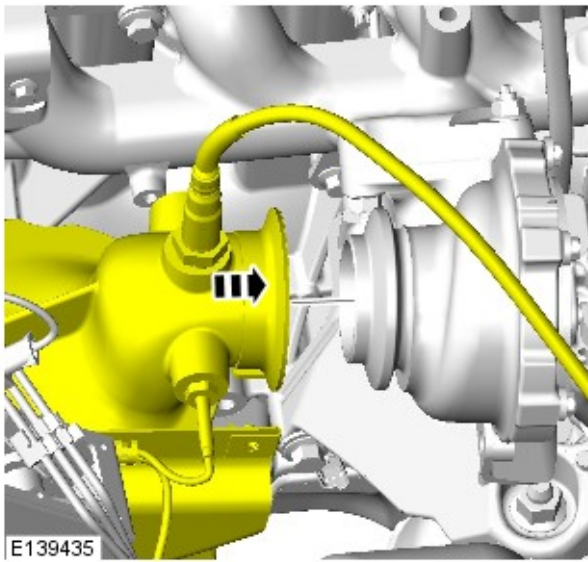
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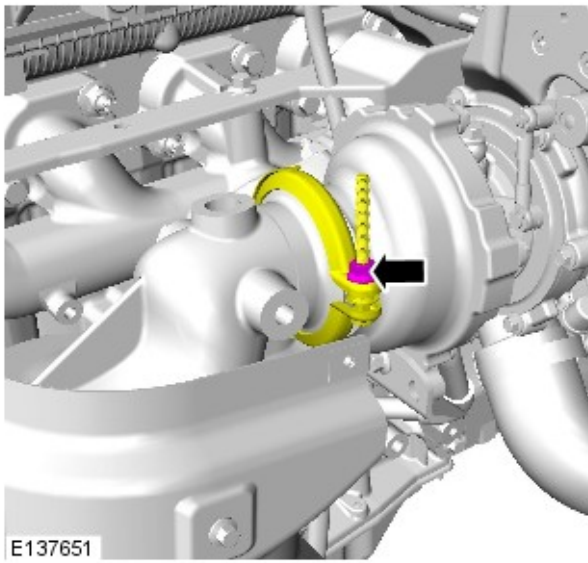
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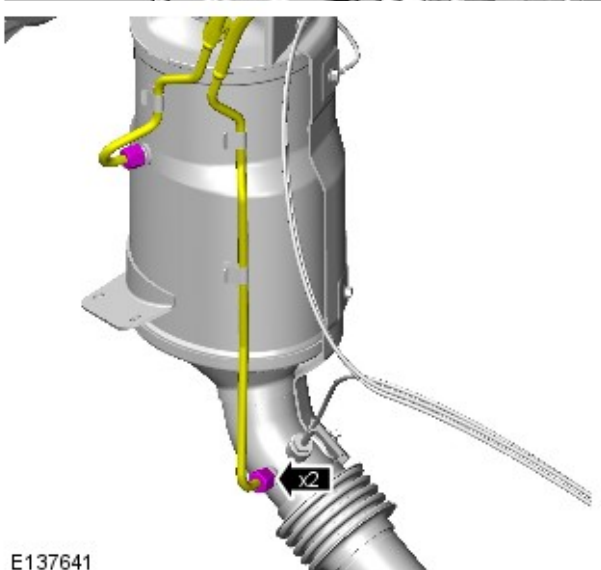
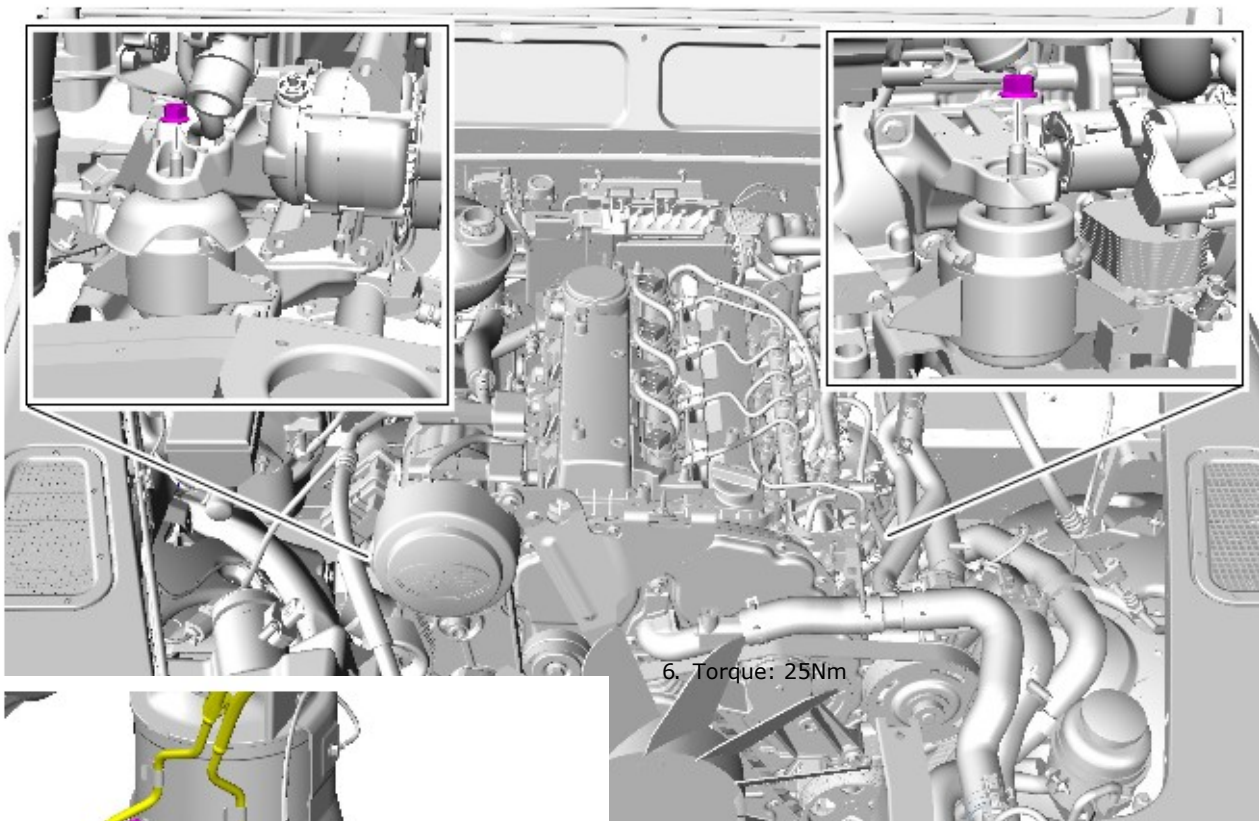
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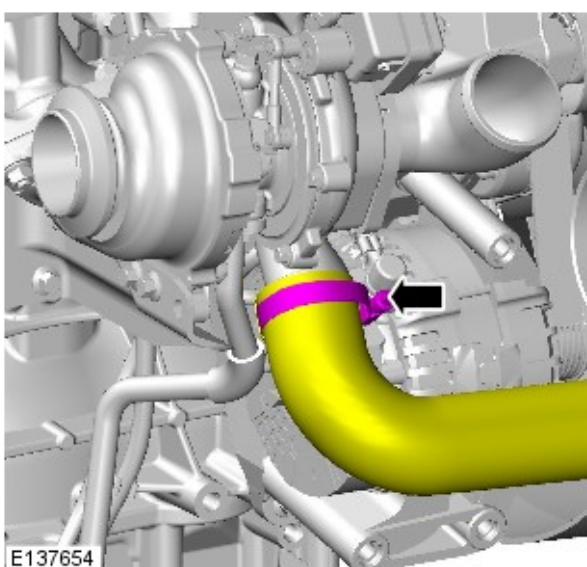
4. Torque: 10Nm



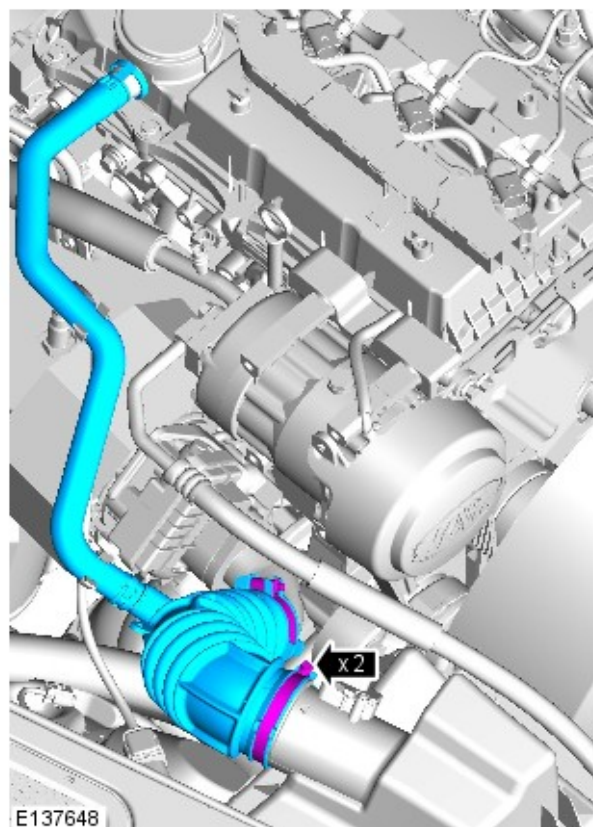
5. Torque:
80Nm



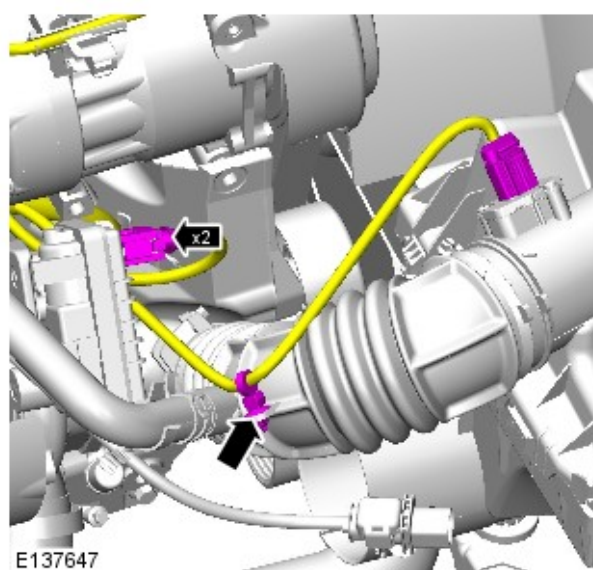
7. Torque: 3Nm



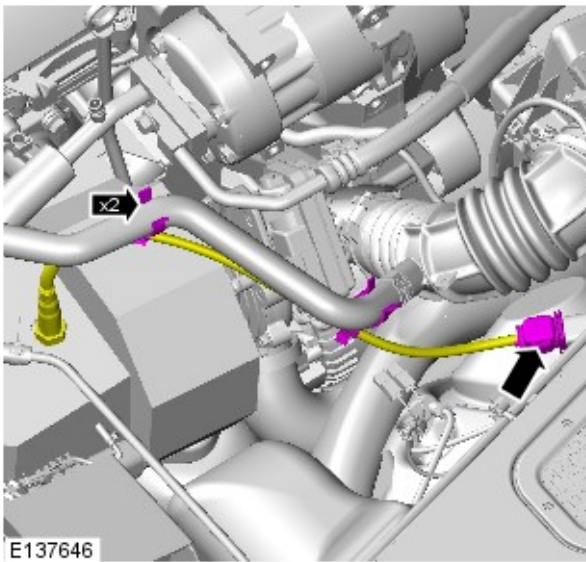
8. Torque: 3Nm



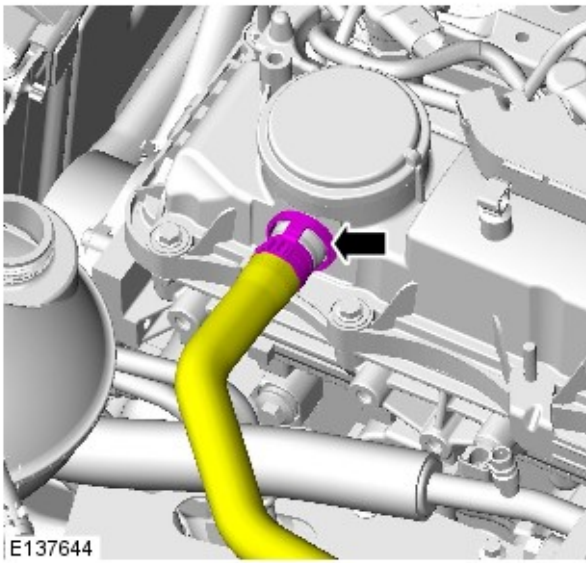
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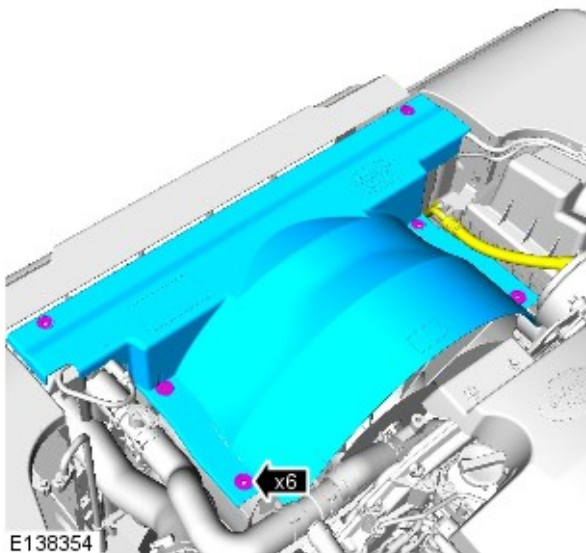
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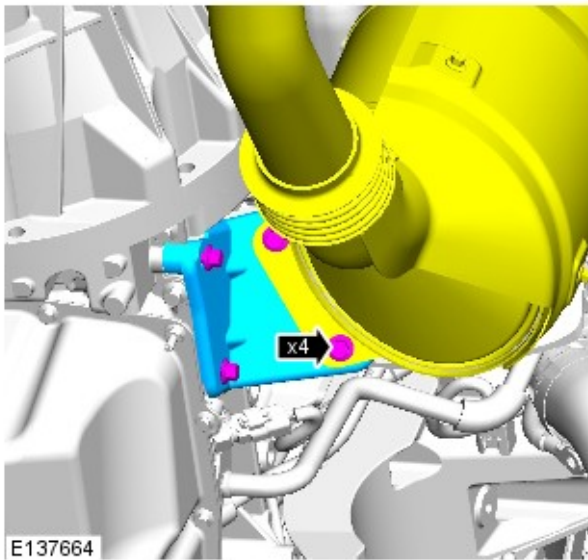
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13. For additional information, refer to: [Engine Cover](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

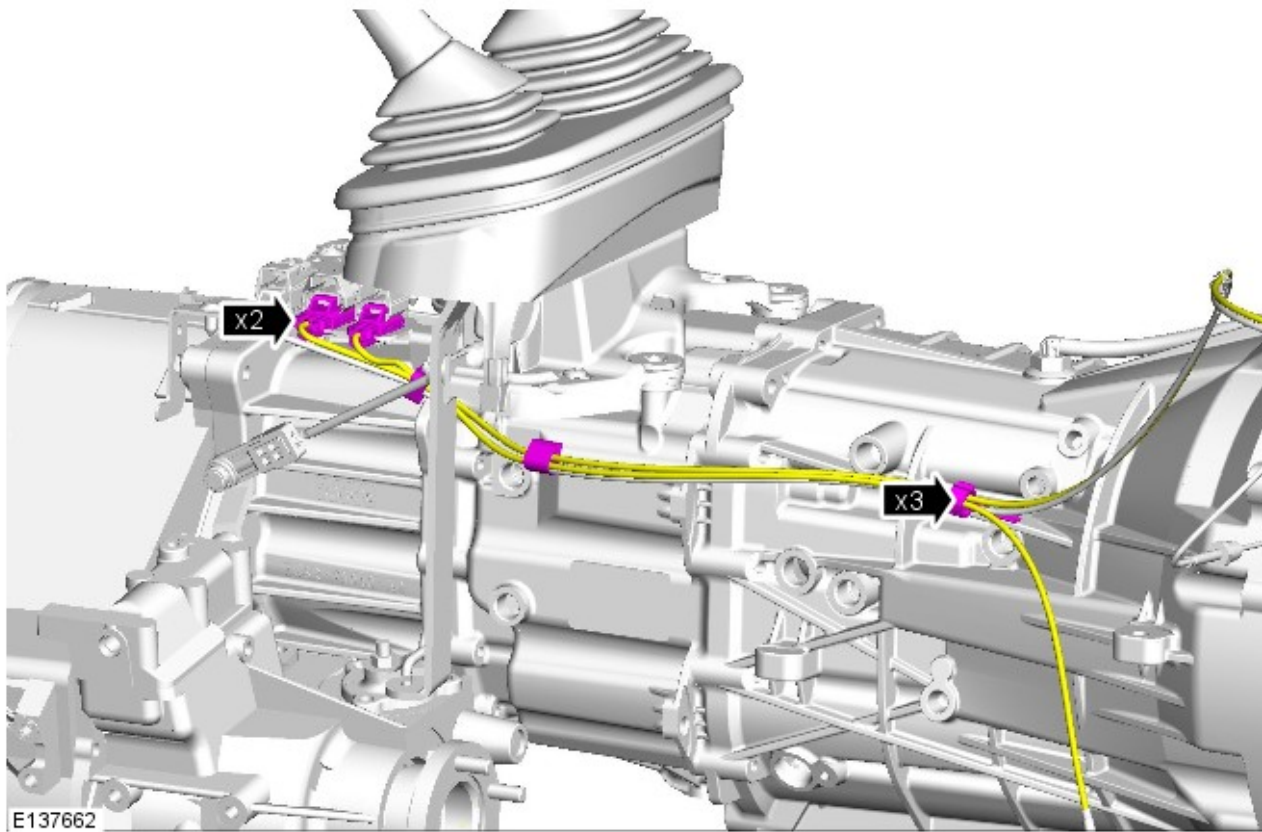
14. Raise the vehicle on lift.

15. Torque: 25Nm

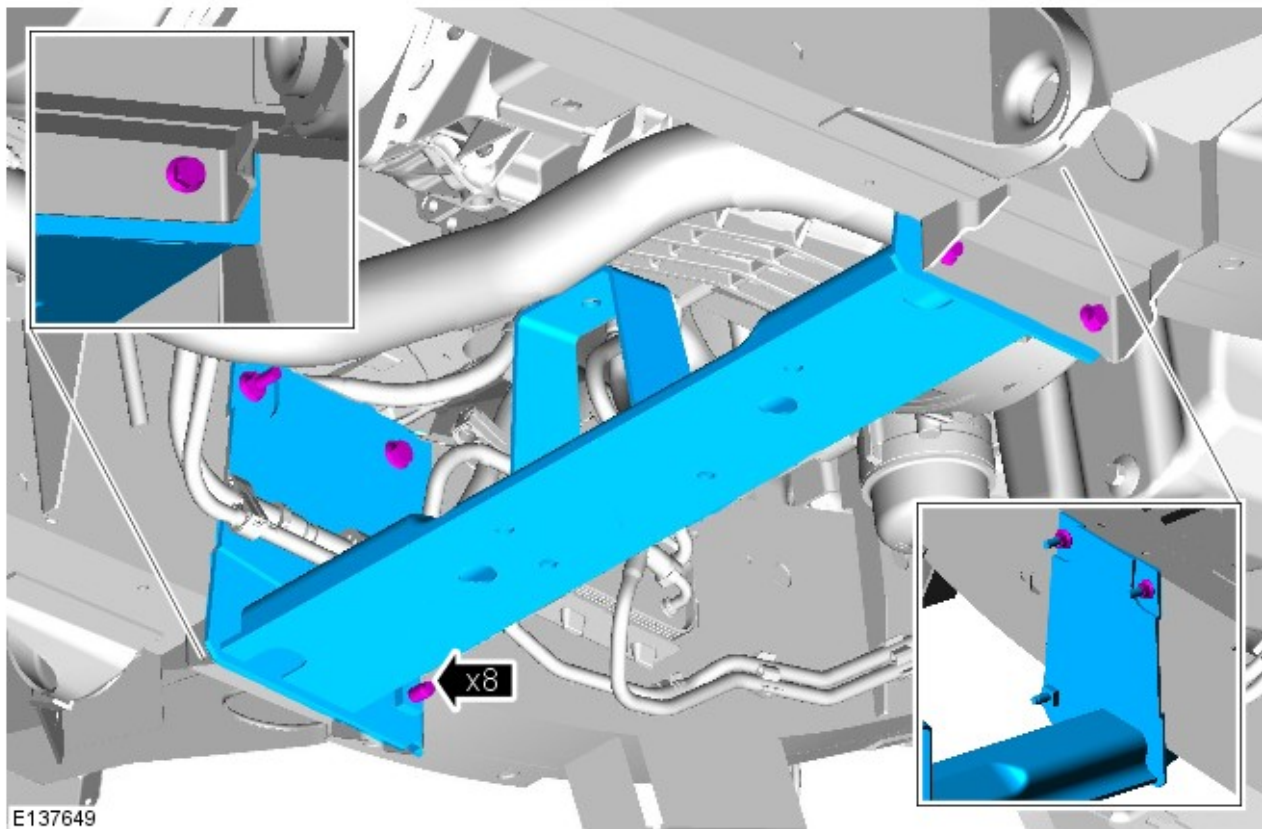


16. Torque: 25Nm

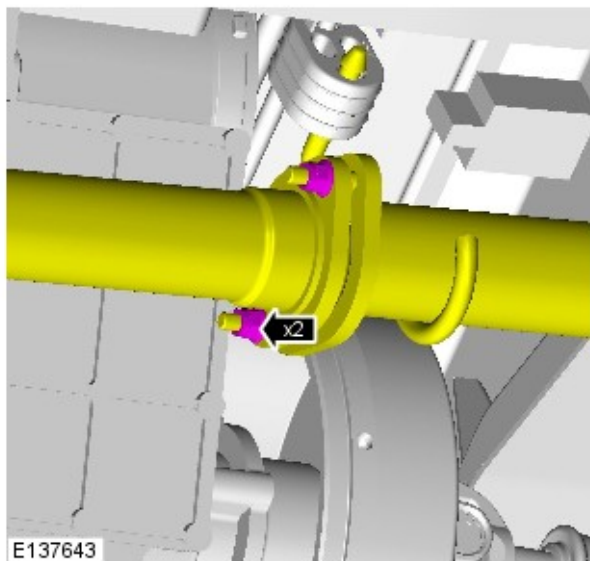
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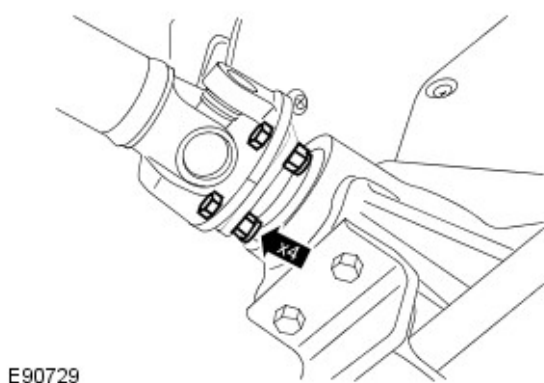
18. Torque: 80Nm



19. Torque: 25Nm



20. Torque: 47Nm



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

22. If a new unit is installed, configure using the approved diagnostic tool.

Fuel System - General Information - Diesel Filter Water Drain-Off

General Procedures

WARNINGS:



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



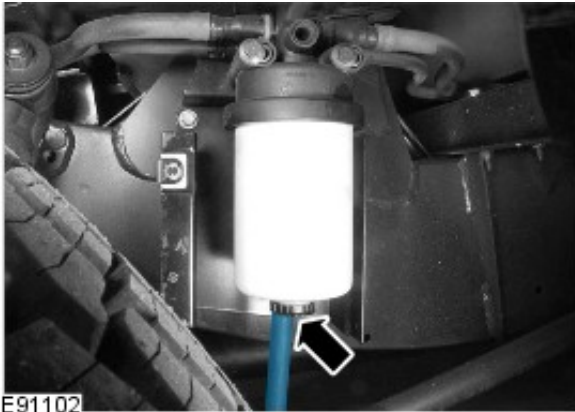
If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



CAUTION: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



E91102

1. Drain the fuel filter element.

- Attach a suitable drain tube to the fuel filter water drain off port.
- Loosen the water drain off port one complete turn and allow the fuel to drain into a container.
- Tighten the water drain off port.
- Remove the drain tube.
- Remove the container.

2. Bleed the fuel system.

For additional information, refer to: Low-Pressure Fuel System Bleeding (310-00, General Procedures).

Fuel System - General Information - Fuel Tank Draining

General Procedures

1. Remove battery cover.
2. Disconnect both leads from battery, earth lead first.



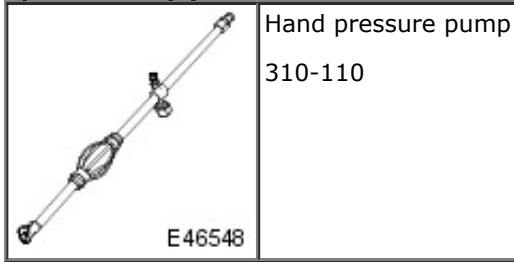
WARNING: Fuel vapour is highly flammable and in contained spaces is also explosive and toxic. Always have a fire extinguisher containing FOAM, CO2, GAS OR POWDER close at hand when handling or draining fuel.

3. Using a fuel recovery appliance, drain the fuel from the tank into a sealed container. Follow the manufacturers instructions for the connection and safe use of the appliance.
4. Remove filler cap and insert hose into filler neck.
5. Connect bowser earth line. Drain fuel.
6. Connect battery leads.
7. Fit battery cover.

Fuel System - General Information - Low-Pressure Fuel System Bleeding

General Procedures

Special Tool(s)



WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

CAUTIONS:



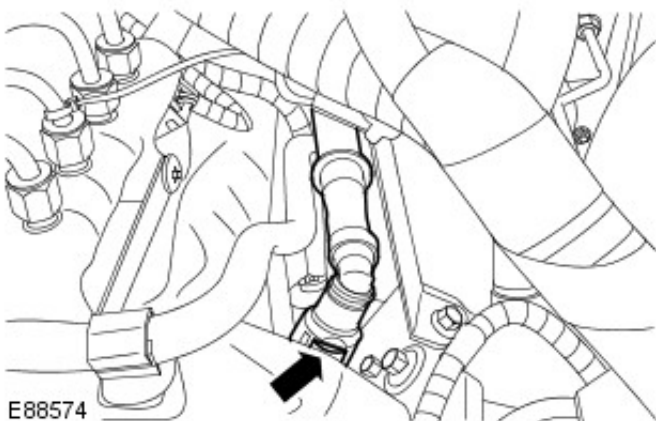
Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

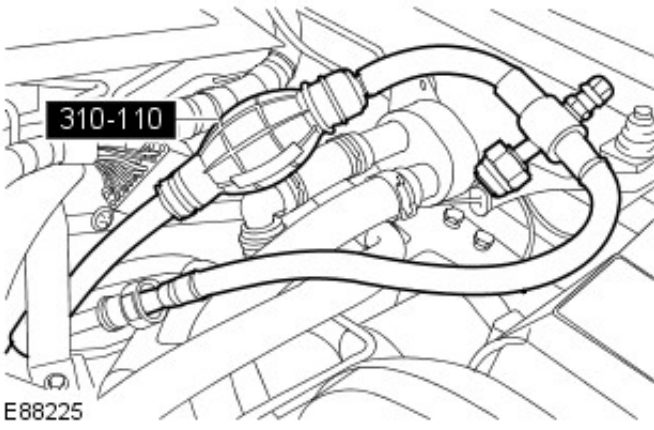


Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

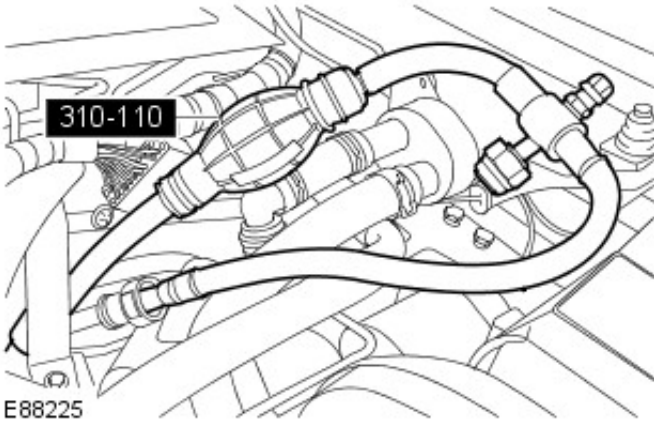
1. Disconnect the fuel injection pump supply line.
For additional information, refer to: Quick Release Coupling (310-00, General Procedures).
 - Position an absorbent cloth to collect any fluid spillage.

2. Install the special tool.
 - Operate the hand pressure pump special tool until fuel starts to flow through the clear plastic pipe and the special tool becomes firm.





3. Remove the special tool.



4. Connect the fuel injection pump supply line.
For additional information, refer to: Quick Release Coupling (310-00, General Procedures).
- Remove the absorbent cloth.

Fuel System - General Information - Quick Release Coupling

General Procedures

WARNINGS:



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CAUTIONS:



Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

1. Disconnect the fuel line quick release coupling.
 - Push the fuel line quick release buttons and pull the 2 halves of the fuel line to disconnect.

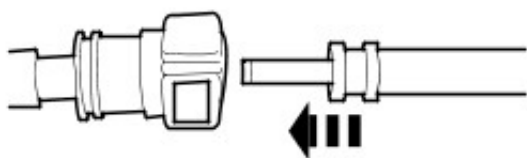


VUE0032292



2. **CAUTION:** Make sure the fuel line quick release coupling clicks into place when connecting the fuel line. To make sure that the quick release coupling is fully seated pull on the 2 halves of the fuel line.

Connect the fuel line quick release coupling.



VUE0032293

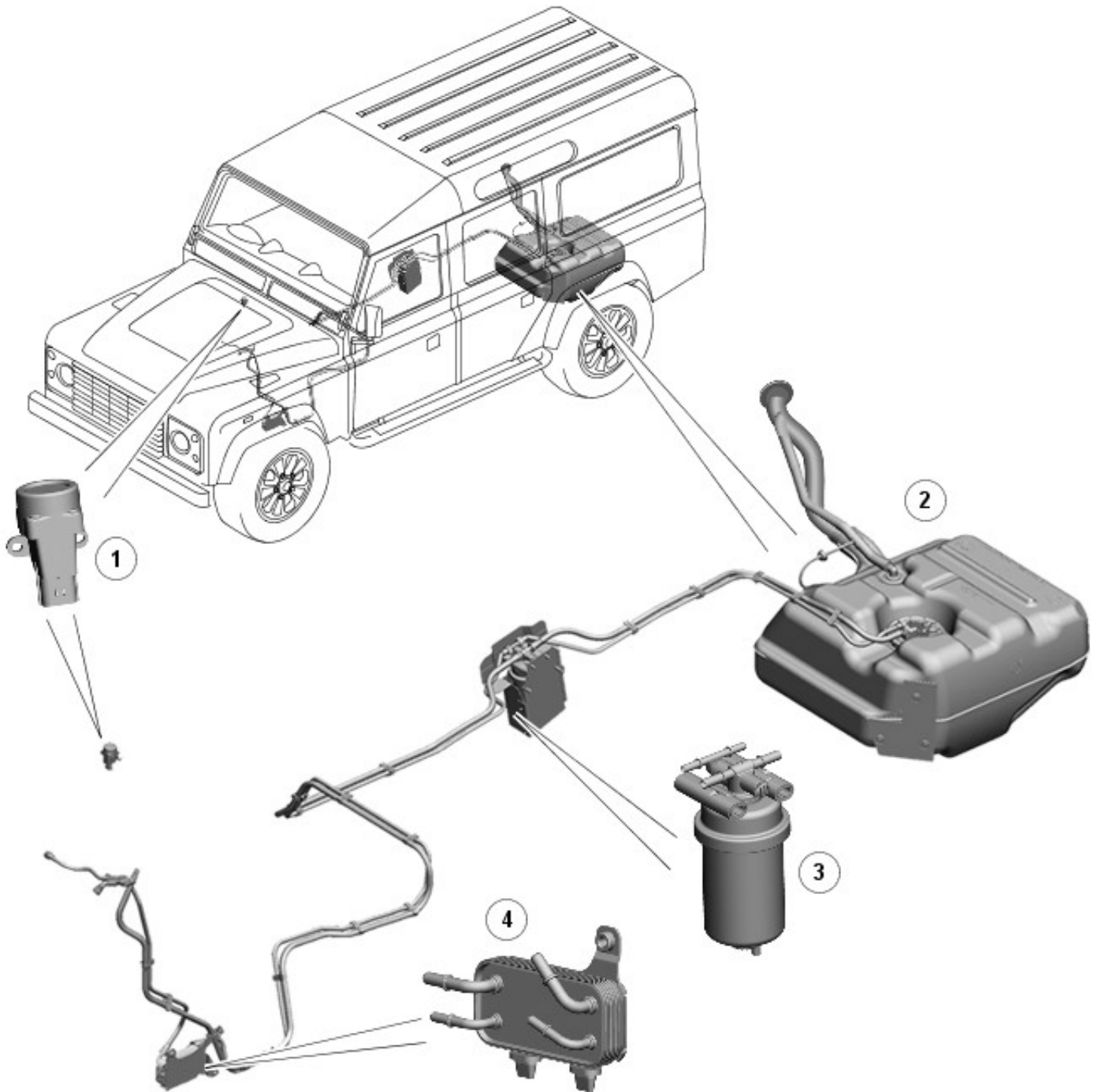
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Fuel Tank and Lines - ID4 2.2L Diesel - Fuel Tank and LinesID4 2.2L Diesel

Description and Operation

COMPONENT LOCATION

NOTE: 110 variant installation shown, installation on 90 and 130 variants similar.



E138890

Item	Part Number	Description
1	-	Inertia switch
2	-	Fuel tank
3	-	Fuel filter
4	-	Fuel cooler

OVERVIEW

The fuel tank and lines supply fuel to the fuel charging and controls system on the engine.

The fuel tank and lines consists of:

- The fuel filler pipe and hose
- The fuel tank
- The pump and sender assembly
- The fuel filter
- The fuel cooler
- Connecting fuel lines
- An inertia switch

The supply connecting line supplies fuel from the pump and sender assembly in the fuel tank to the HP (high pressure) fuel pump on the engine. The return connecting line returns excess fuel from the HP fuel pump and the fuel injectors to the filter via the fuel cooler. To prevent filter waxing at low temperatures, a thermostatic diverter in the filter routes a proportion of the warm return fuel into the filter and back into the supply line to the engine; the remainder of the fuel is routed back to the fuel tank. At higher temperatures the all of the return fuel is routed back to the fuel tank.

FUEL FILLER AND CAP

The fuel filler is located in the right hand rear quarter panel. The filler is closed by a lockable cap which screws into the filler neck. The cap has a ratchet mechanism to prevent over tightening, and seals against the filler neck to prevent the escape of fuel vapor. The filler cap has a valve which relieves pressure to atmosphere at approximately 0.12 to 0.13 bar (1.8 to 2.0 lbf/in²) and opens in the opposite direction at approximately 0.04 bar (0.7 lbf/in²) vacuum.

A HDPE (high density polyethylene) molded filler tube connects the filler to the tank via a flexible hose.

FUEL TANK

The fuel tank is located at the rear underside of the vehicle between the chassis longitudinals.

The cradle is attached to the chassis with six screws. When the cradle is attached to the chassis, the tank is positively secured via foam pads which bear against the central chassis cross beam. A protective cover is fitted to the front right hand corner of the tank and provides additional protection.

The fuel tank is manufactured from HDPE. The tank is a sealed unit with the only internal access being via the pump module flange aperture on the top of the tank.

A heat shield is attached to the front right corner of the fuel tank with three scrivenets to protect the tank from heat generated by the exhaust system.

Fuel Tank Capacities

Variant	Capacity (Useable Fuel)
90	55 liters
110/130	70 liters

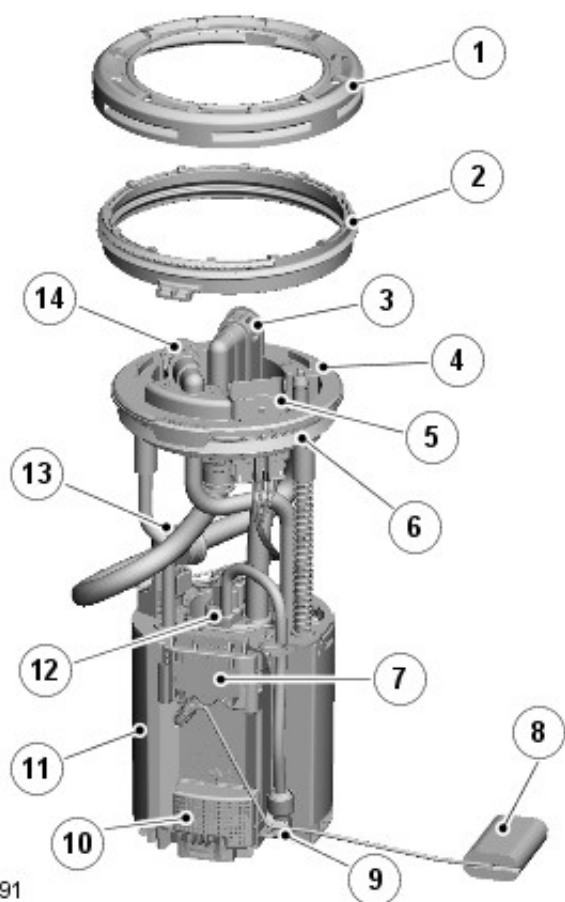
FUEL TANK BREATHER SYSTEM

The filler tube incorporates a tank vent which allows air and fuel vapor displaced from the tank when filling to vent to atmosphere via the filler neck.

A breather spout within the tank controls the tank 'full' height. When fuel covers the spout it prevents fuel vapor and air from escaping from the tank. This causes the fuel to 'back-up' in the filler tube and shuts off the filler gun. The position of the spout ensures that when the filler gun shuts off, a vapor space of approximately 10% of the tank's total capacity remains.

The breather pipe includes a two-way valve which allows for over-pressure relief one way and allows for air to enter the tank as the system operates in depression.

PUMP AND SENDER ASSEMBLY



E138891

Item	Part Number	Description
1	-	Locking ring
2	-	Adapter
3	-	Outlet connection
4	-	Mounting flange
5	-	Electrical connector
6	-	Gasket
7	-	Sender unit potentiometer
8	-	Sender unit float
9	-	Jet pump
10	-	Screen
11	-	Base
12	-	Fuel pump
13	-	Pressure relief valve
14	-	Inlet connection

The pump and sender assembly is installed in the top of the fuel tank and secured with a gasket, adapter and locking ring. Two fuel connections and an electrical connector are located in the mounting flange for attachment of the fuel lines and the vehicle wiring respectively.

The fuel pump is installed in the base of the assembly, which contains a swirl pot to provide a constant reservoir of fuel for the fuel pump. A jet pump, powered by a feed from the fuel pump, induces fuel into the swirl pot. A coarse mesh screen over the swirl pot inlet prevents the ingress of larger pieces of debris. The primary outlet from the fuel pump is connected to the fuel outlet connector in the mounting flange via a pressure relief valve. The pressure relief valve limits the pressure of the fuel supplied to the engine and releases excess fuel back into the tank. A pipe attached to the fuel inlet connector directs return fuel from the engine into the swirl pot.

The pump is an electric vane pump. Electrical power for the fuel pump is supplied from the fuel pump relay in the [BJB \(battery junction box\)](#), which is controlled by the [ECM \(engine control module\)](#). The [ECM](#) energizes the fuel pump relay while the ignition switch is in the ignition and crank positions, provided it also receives an ignition on signal from the inertia switch. If an accident occurs that activates the inertia switch, the ignition on signal from it is discontinued and the [ECM](#) then de-energizes the fuel pump relay to stop the pump.

The sender unit comprises a potentiometer operated by a float. The float rises and falls with the fuel level in the tank and moves the potentiometer accordingly.

A voltage is supplied to the potentiometer from the instrument pack. The output voltage from the potentiometer varies

according to the fuel level and is translated by the instrument pack into a fuel gauge reading.

A warning lamp in the instrument cluster illuminates if the fuel level is at or below 12 liters (3.2 US gallons).

FUEL FILTER



E86472

The fuel filter removes particulate matter from the fuel and also separates water which accumulates at the bottom of the filter.

The fuel filter is positioned on the chassis to the right of the fuel tank. The fuel feed and return to and from the engine passes through the filter. Connections are made using quick fit connectors.

A steel rear cover is attached to the chassis longitudinal by four M8 screws.

The filter is screwed to the back plate by two M8 bolts.

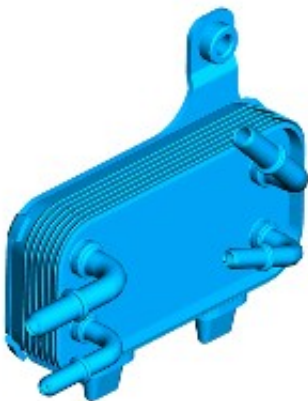
A steel protection cover is fixed onto the back cover using a ¼ turn fastener.

The filter has an internal air bleed feature which allows air into the fuel supply to the engine in small, manageable amounts.

The thermostatic diverter valve is fully closed at 45 degrees Celsius and sends fuel directly to the tank. When the diverter is open fuel is re-circulated through the filter to the engine.

The fuel filter has a replaceable twist-on canister filter element which is sealed to the filter body with rubber seals. The lower part of the canister has a screw-in cap for water draining.

FUEL COOLER



E86473

The fuel cooler uses engine coolant, from the radiator, to cool fuel returning to the tank from the HP fuel pump.

The cooler is fixed to a bracket which is attached to the inside of the left hand chassis rail. The bracket has two slots which accept two rubber covered aluminum location pegs on the cooler. An M8 bolt secures the cooler to the bracket.

The cooler has four quick fit connections. Fuel inlet and outlet and coolant inlet feed and return.

BLEED VALVE

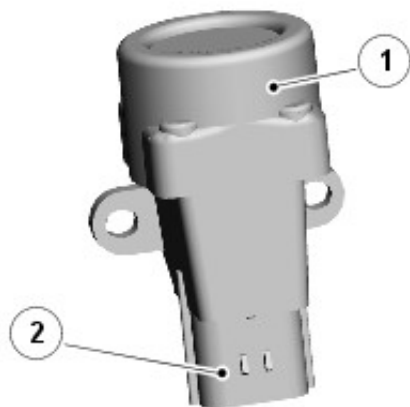
The bleed valve is located in the fuel feed line near to the HP fuel pump. It facilitates the priming of the fuel system and removes air during initial and service primes. This protects the HP fuel pump from air locking.

FUEL LINES

Three fuel line assemblies connect the feed and return flow from tank to the filter, filter to the cooler and cooler to the engine.

The fuel lines are constructed from conductive 1 mm thick nylon with 2 mm thick santoprene fire resistant, anti-abrasive coating throughout. The fuel feed line has a larger diameter than the return.

INERTIA SWITCH



E138892

Item	Part Number	Description
1	-	Rubber cap
2	-	Electrical connector

The inertia switch, when activated, causes the [ECM](#) to disable engine fuel injection and the fuel tank pump.

The inertia switch is installed in the engine compartment, on the engine bulkhead. When the ignition switch is in the ignition on and crank positions, battery voltage from the [BJB](#) is supplied to the inertia switch. While the inertia switch is in the de-activated state, the voltage passes through the normally closed contacts of the switch to the [ECM](#). If an impact of a given force occurs, the inertia switch contacts open and disconnect the voltage signal to the [ECM](#).

After it has been activated, the inertia switch can be reset by pressing down on the rubber cap.

LOW FUEL INDICATION AND RUN DRY STRATEGY

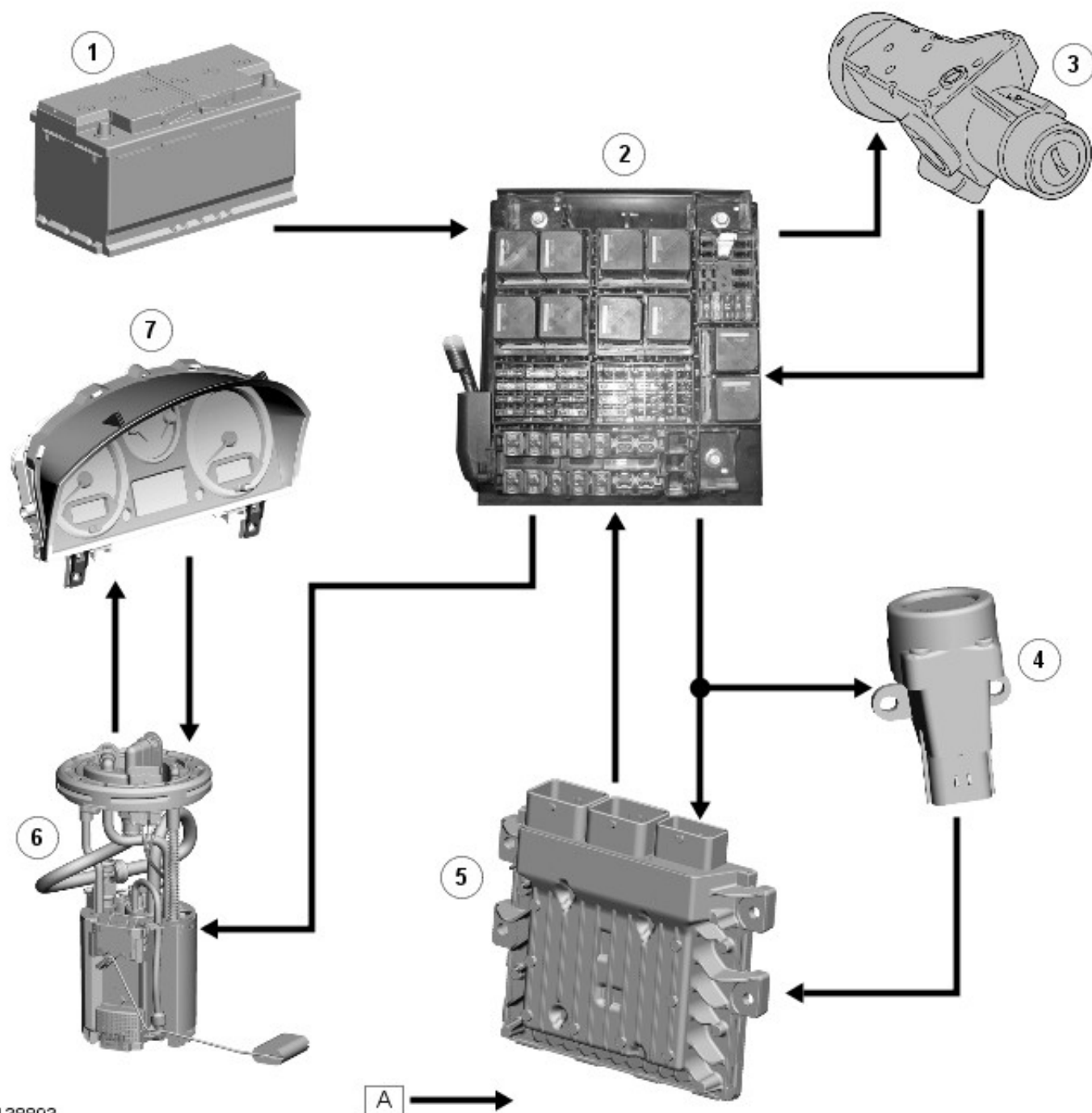
The run-dry strategy is used to maintain the systems fuel prime at fuel run out. It ensures the minimum amount of fuel is always left in the swirl pot.

The instrument cluster activates the yellow low fuel warning light (next to the fuel gauge) with 17% of fuel remaining in the tank. The fuel gauge will indicate empty with 12% of fuel left in the tank.

With 6 liters left in the tank the run-dry strategy will be invoked. An engine mis-fire will be induced for approximately 1 mile after which the engine will be shut down. The engine can be re-started in mis-fire mode and will continue to run for a further mile until the engine shuts down again. This can be repeated until the fuel suction port in the tank is uncovered and causes engine fuel starvation and loss of prime. Re-starts after run-dry shut down are not recommended.

CONTROL DIAGRAM

NOTE: [A](#) = Hardwired.



E138893

Item	Part Number	Description
1	-	Battery
2	-	BJB
3	-	Ignition switch
4	-	Inertia switch
5	-	ECM
6	-	Pump and sender assembly
7	-	Instrument cluster

Fuel Tank and Lines - ID4 2.2L Diesel - Fuel Cooler

Removal and Installation

Removal

WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



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Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

CAUTIONS:



Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.



1. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

3. CAUTIONS:

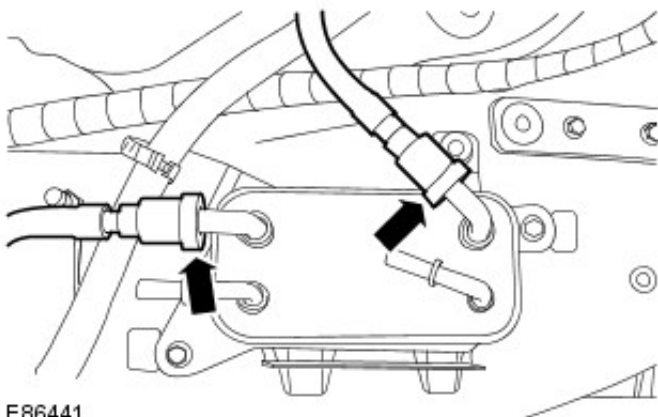


Make sure that all openings are sealed. Use new blanking caps.



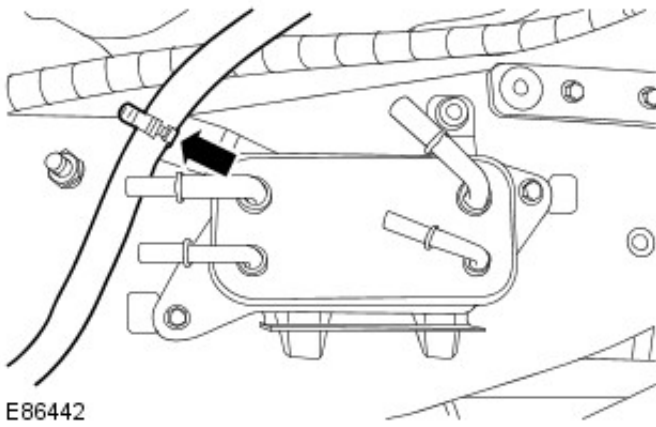
Fluid loss is unavoidable, use a suitable container to collect any fluid loss.

Disconnect the 2 fuel lines.

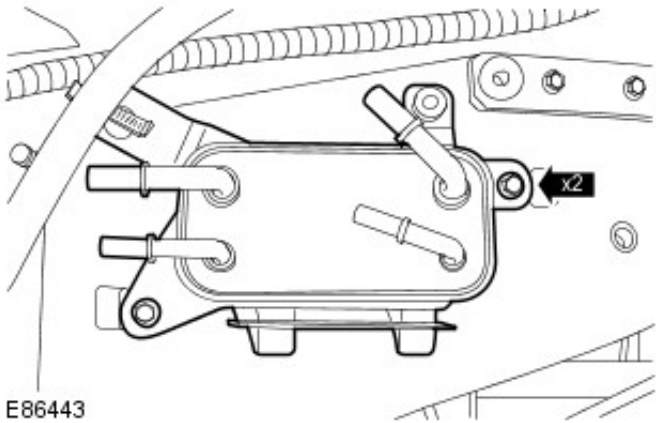


E86441

4. Release the fuel return line from the clip.



5. Remove the fuel cooler.
 - Remove the 2 bolts.



Installation

1. Install the fuel cooler.
 - Tighten the bolts to 23 Nm (17 lb.ft).
2. Secure the fuel return line in the clip.
3. **NOTE: Remove and discard the blanking caps.**
Connect the fuel lines.
4. Bleed the fuel system.
For additional information, refer to: Low-Pressure Fuel System Bleeding (310-00, General Procedures).
5. Fill and bleed the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

Fuel Tank and Lines - ID4 2.2L Diesel - Fuel Filter

Removal and Installation

Removal

WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

CAUTIONS:



Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



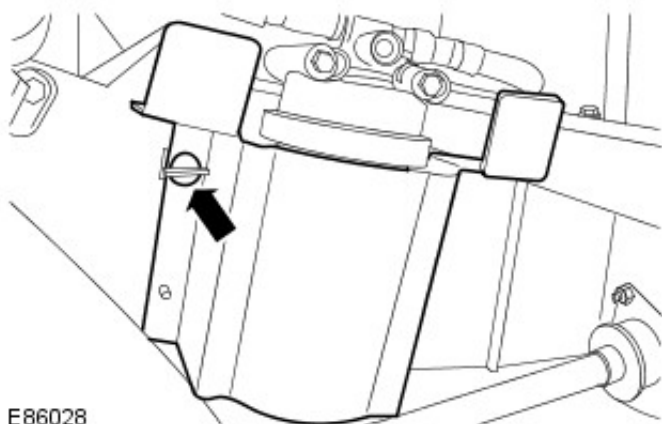
Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.



1. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the fuel filter cover.
 - Loosen the clip.



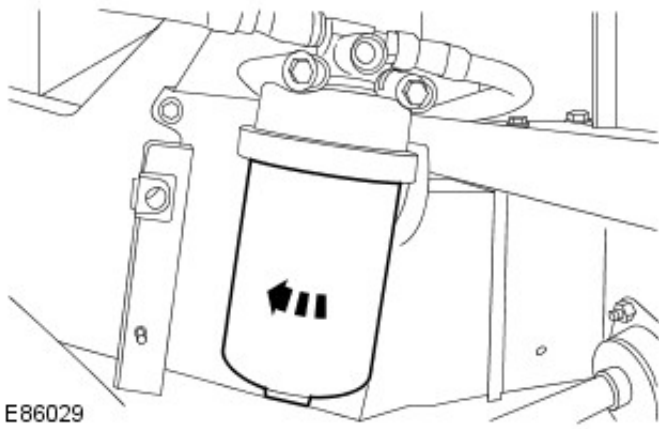
E86028




3. **CAUTION:** Make sure that the area around the component is clean and free of foreign material.

Remove the fuel filter.

- Position a container to collect the fluid spillage.



Installation

1.  **CAUTION:** Clean the component mating faces.

Install the fuel filter.

- Remove the container.

2. Install the fuel filter cover.
 - Tighten the clip.

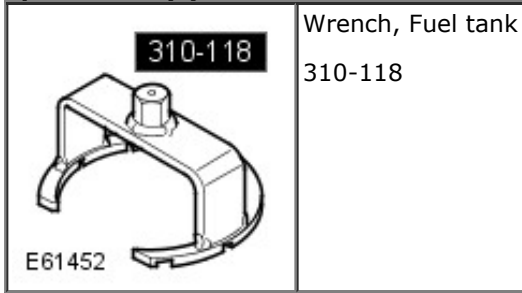
3. Bleed the fuel system.

For additional information, refer to: Low-Pressure Fuel System Bleeding (310-00, General Procedures).

Fuel Tank and Lines - ID4 2.2L Diesel - Fuel Level Sender

Removal and Installation

Special Tool(s)



Removal

WARNINGS:



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If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



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CAUTIONS:



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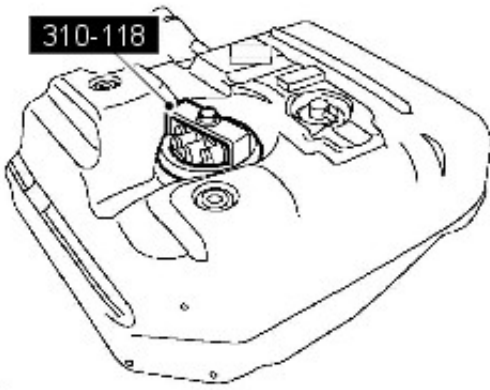
Raise and support the vehicle.

2. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).

3. Remove the fuel tank.
For additional information, refer to: Fuel Tank (310-01, Removal and Installation).

4. Remove the fuel level sender.
 - Using the special tool, remove the locking ring.
 - Remove and discard the seal.

310-118



E89875

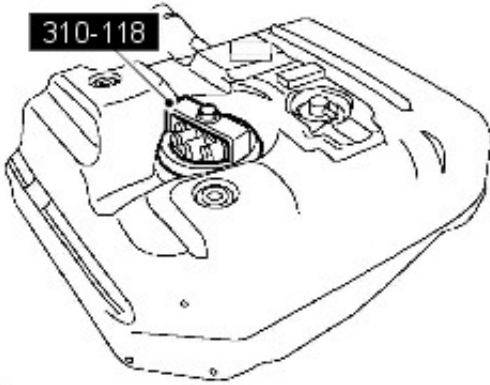
Installation

1. **NOTE:** Clean the component mating faces.

Install the fuel level sender.

- Install a new seal.
- Using the special tool, tighten the locking ring to 35 Nm (26 lb.ft).

310-118



E89875



2. Install the fuel tank.
For additional information, refer to: Fuel Tank (310-01, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Content not found

Fuel Tank and Lines - ID4 2.2L Diesel - Fuel Tank

Removal and Installation

Special Tool(s)

	Powertrain assembly jack HTJ-1200-02
	Wrench, Fuel tank 310-118

Removal

WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



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CAUTIONS:



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1. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

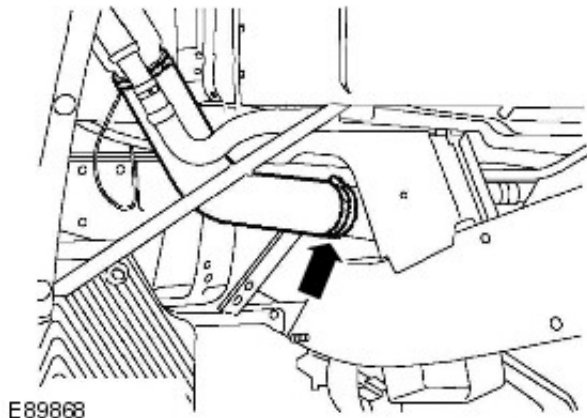
Raise and support the vehicle.


2. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).

3.  **WARNING:** The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

Drain the fuel tank.

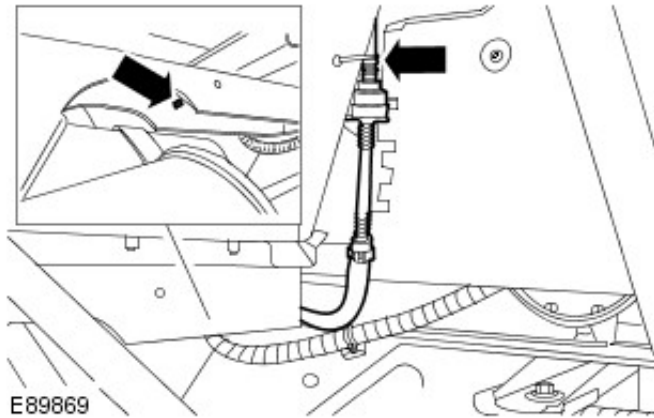
For additional information, refer to: Fuel Tank Draining (310-00, General Procedures).



4.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Disconnect the fuel tank filler pipe.

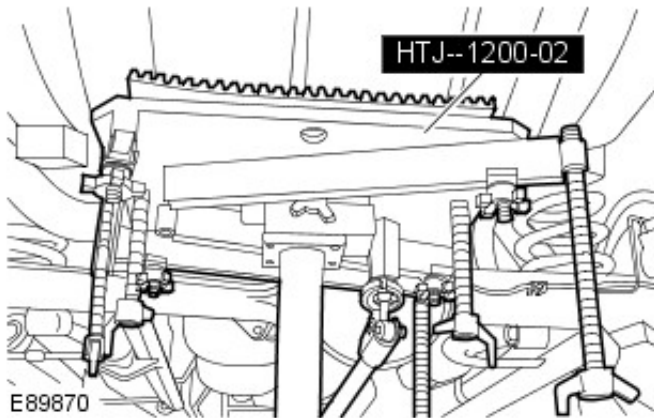
- Loosen the clip.



5. Release the fuel tank vent line.

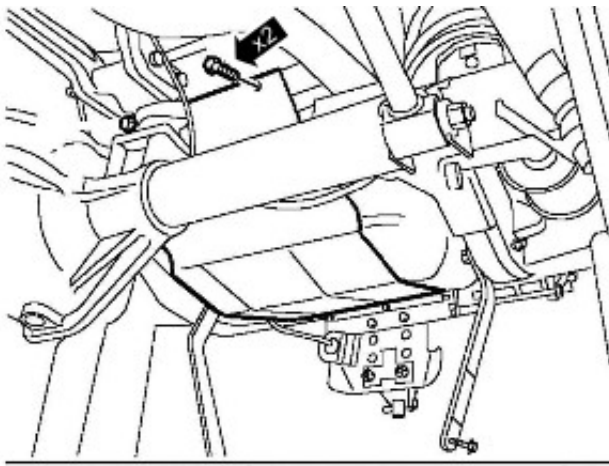
- Release from the clip.
- Cut the cable tie.

6. Using the special tool, support the fuel tank.

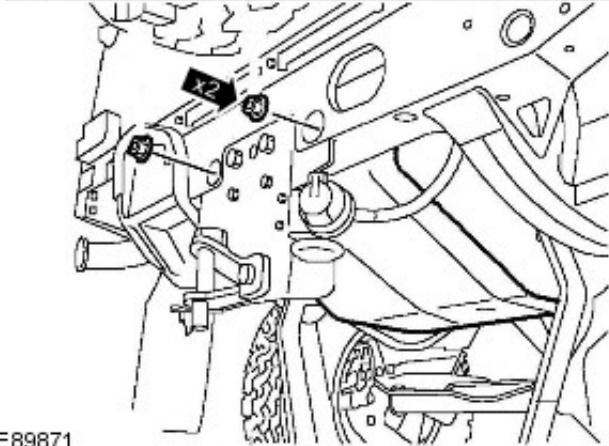


7. Lower the fuel tank.

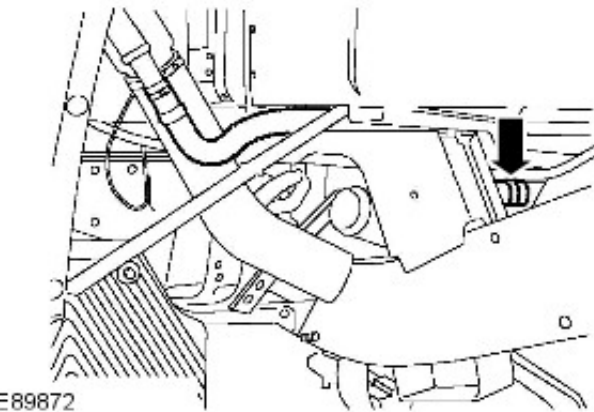
- Remove the 2 bolts.
- Remove the 2 nuts.



E89871



E89872




E89873

8.  **CAUTION:** Make sure that all openings are sealed.
Use new blanking caps.

Disconnect the fuel filler pipe breather hose.

- Release the clip.

9.  **CAUTION:** Make sure that all openings are sealed.
Use new blanking caps.

NOTE: Note the fitted position of fuel lines.

Remove the fuel tank and the fuel tank support bracket.

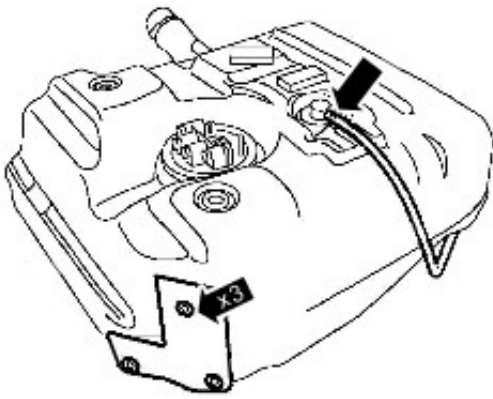
- Disconnect the 2 fuel lines.
- Disconnect the electrical connector.

10. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the fuel tank heat shield.

- Remove the 3 clips.

E89874



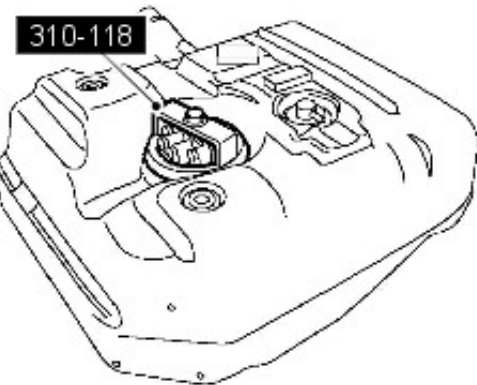
11. Remove the fuel tank vent line.

- Release the clip.

12. Remove the fuel level sender.

- Using the special tool, remove the locking ring.
- Remove and discard the seal.

E89875



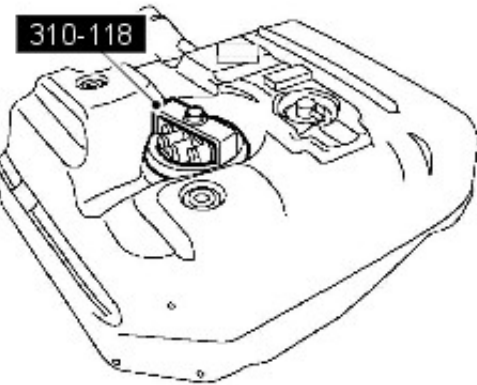
Installation

1. **NOTE:** Clean the component mating faces.

Install the fuel level sender.

- Install a new seal.
- Using the special tool, tighten the locking ring to 35 Nm (26 lb.ft).

E89875



2. Install the fuel tank vent line.

- Secure with the clip.

3. Install the fuel tank heat shield.

- Install the 3 clips.

4. **NOTE:** Remove and discard the blanking caps.

Using the special tool, raise the fuel tank and the fuel tank support bracket.

- Connect the 2 fuel lines.
- Connect the electrical connector.


5. Connect the fuel filler pipe breather hose.

- Secure with the clip.

6. Using the special tool, install the fuel tank and the fuel tank support bracket.

- Tighten the bolts 45 Nm (33 lb.ft).

- Tighten the nuts 25 Nm (18 lb.ft).
7. Secure the fuel tank vent line.
 - Secure in the clip.
 - Secure with a suitable cable tie .
 8. Connect the fuel tank filler pipe.
 - Tighten the clip.

9.  **WARNING:** The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

Refill the fuel tank.

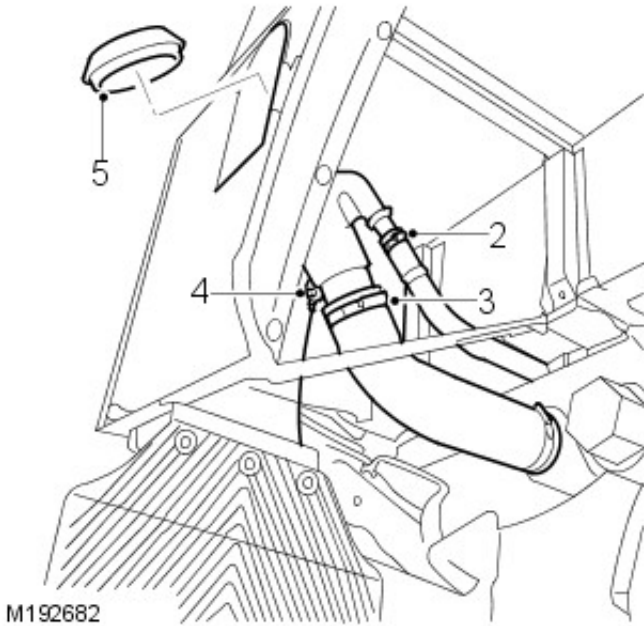
10. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Fuel Tank and Lines - ID4 2.2L Diesel - Fuel Tank Filler Pipe

Removal and Installation

Removal

1. Drain fuel tank.
For additional information, refer to: Fuel Tank Draining (310-00, General Procedures).
2. Loosen clip securing breather hose to fuel filler neck and release hose.
3. Loosen clip securing fuel filler hose to neck and release hose.
4. Remove screw and release earth lead from filler neck.
5. Remove grommet securing filler neck to body.



6. Remove filler neck from body.

Installation

1. Fit filler neck to body.
2. Coat rubber grommet with soap solution.
3. Fit rubber grommet securing filler neck to body.
4. Connect earth lead and tighten screw.
5. Connect filler hose to neck and tighten clip.
6. Fit breather hose to filler neck and secure with clip.

Climate Control System - General Information -

Lubricant

Item	Specification
Compressor oil	SP-15

Lubricant

Item	Specification
Compressor oil	SP-15
Total system capacity	600g +/- 25g
Compressor	4.56 FL. OZ

System Refrigerant Specification/Capacity

Item	Specification
Refrigerant type	R134A
Total system capacity	600g +/- 25g

General Specification

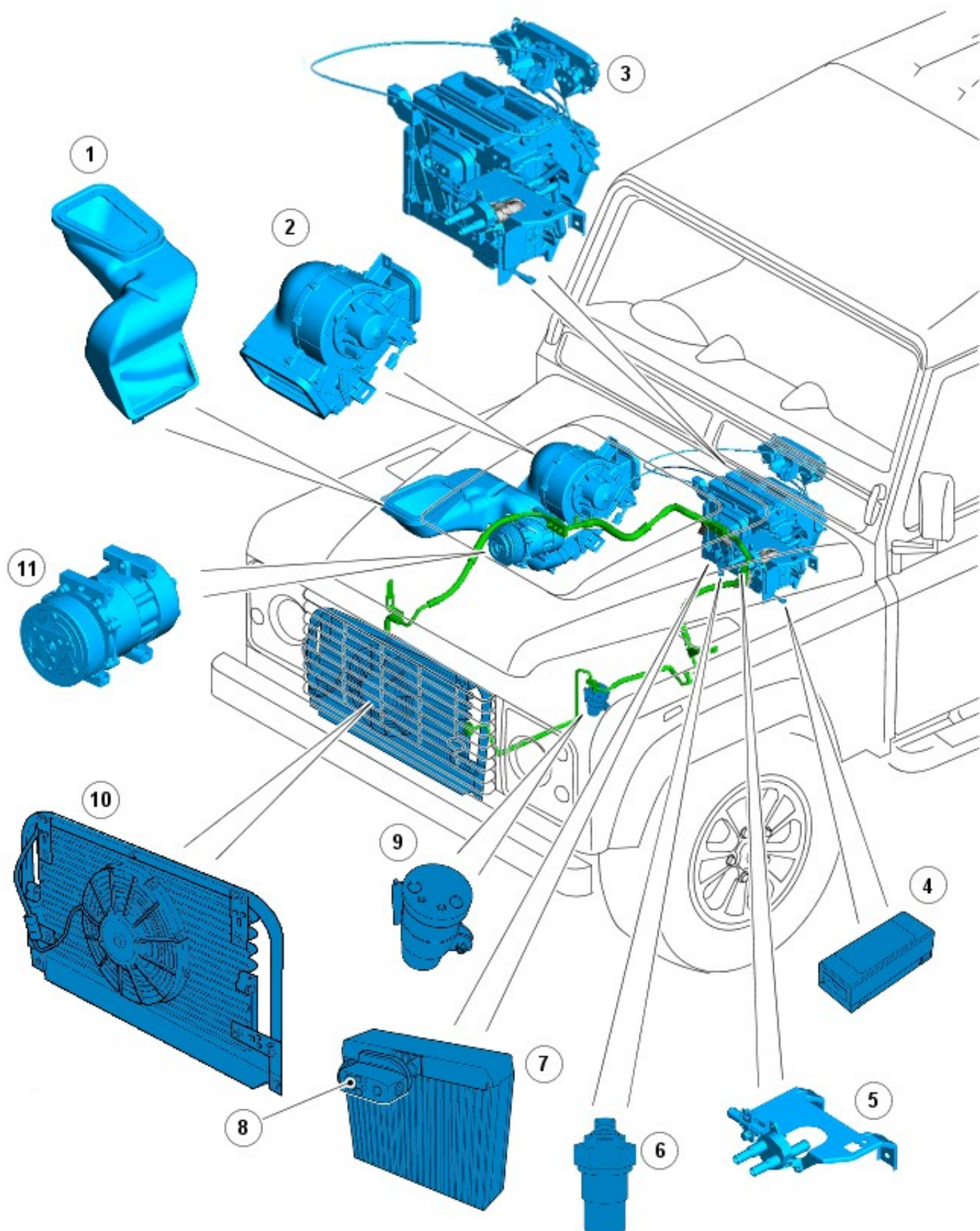
Item	Description
Compressor:	
Make	Sandan
Type	SD7H15

Climate Control System - General Information - Climate Control System

Description and Operation

COMPONENT LOCATION

NOTE: left-hand drive (LHD) vehicle shown, right-hand drive (RHD) similar.



Item	Part Number	Description
1	-	Air inlet duct
2	-	Air intake and blower assembly
3	-	Heater assembly and controls
4	-	air conditioning (A/C) thermostatic switch
5	-	Water valve and bracket assembly
6	-	A/C refrigerant pressure switch
7	-	A/C evaporator
8	-	A/C thermostatic expansion valve
9	-	A/C receiver drier
10	-	A/C condenser assembly
11	-	A/C compressor

OVERVIEW

The climate control system features heating, and where fitted, A/C operations. Heating selections are made using the left-hand (LH) rotary control mounted on the center console. The rotary control is connected via a Bowden cable to a water valve in the engine cooling system. The water valve allows a varying amount of engine coolant to flow into the heater matrix. The amount of coolant entering the heater matrix determines the heat transferred to the inlet air and thus the amount of heat transferred into the cabin.

Blower motor speed is controlled using a 4 position sliding switch. The switch allows 3 blower motor speeds to be selected by controlling the ground path for the blower motor in conjunction with a resistor pack. The blower motor and resistor pack are both located in the engine compartment.

Air distribution into the cabin is selected using the right-hand (RH) rotary control mounted on the center console. Air intake into the cabin is controlled by a 2 position sliding switch which is also located on the center console. For additional information, refer to: Air Distribution and Filtering (412-01, Description and Operation).

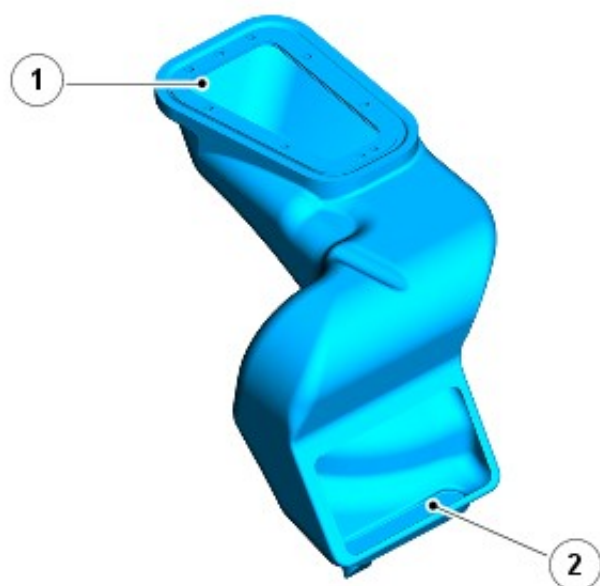
The A/C system is switched on and off using the switch located in the center console. The system will only operate when the engine is running. If A/C is requested when blower motor speed is set to 0, blower motor speed 1 will be engaged automatically.

The engine control module (ECM) monitors the engine running status and suspends A/C operation if necessary by inhibiting the compressor clutch relay.

The heated seats, heated windshield, and heated rear window systems are not part of the climate control system. For additional information, refer to:

Seats (501-10, Description and Operation),
Glass, Frames and Mechanisms (501-11, Description and Operation).

AIR INLET DUCT

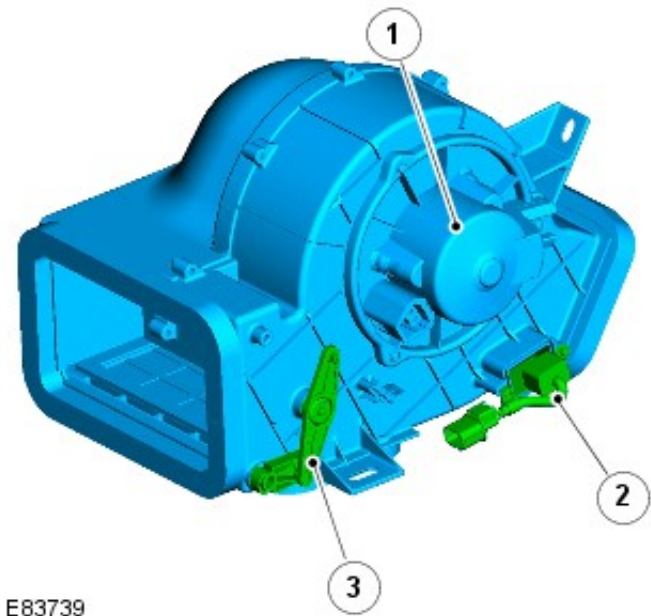


E83738

Item	Part Number	Description
1	-	Air inlet
2	-	Air outlet to blower assembly

The air inlet duct is mounted in the passenger side front fender. Air is drawn into the air inlet duct through a vent on the upper surface of the fender. The air inlet duct directs air into the air intake and blower assembly. The air intake and blower assembly features a Bowden cable operated flap which allows the user to switch between fresh or recirculated air entering the cabin.

AIR INTAKE AND BLOWER ASSEMBLY

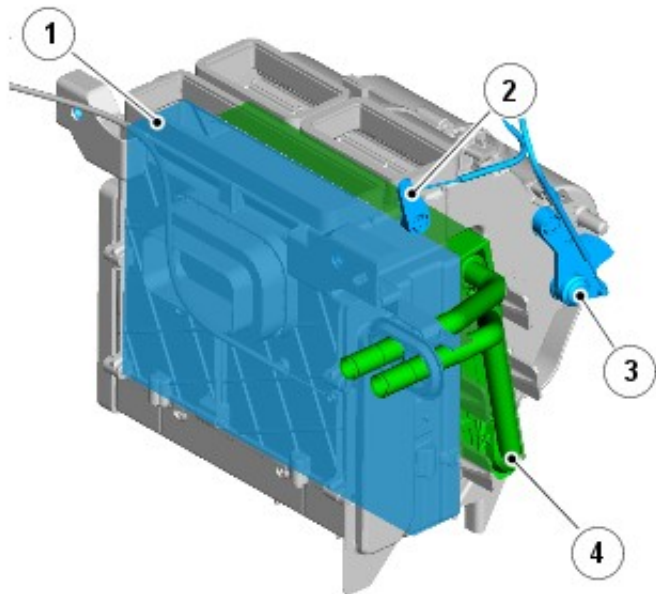


E83739

Item	Part Number	Description
1	-	Blower motor
2	-	Resistor pack
3	-	Fresh/recirculated air flap

The air intake and blower assembly is mounted on the passenger side of the engine compartment. The blower comprises a centrifugal fan powered by an electric motor. The motor is able to operate at 3 speeds, which are controlled by a resistor pack mounted on the inboard side of the blower motor casing. Air leaving the air intake and blower assembly is directed into the rear of the heater assembly.

HEATER ASSEMBLY



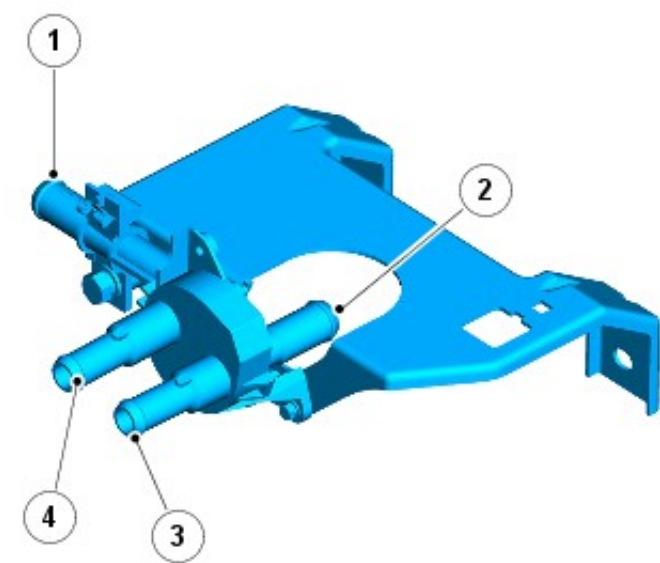
E83740

Item	Part Number	Description
1	-	Diffuser plate
2	-	Windshield/face level air distribution door cam
3	-	Footwell air distribution door cam
4	-	Heater matrix

The heater assembly is mounted behind the instrument panel on the vehicle center line. The heater assembly contains an aluminum heater matrix and a diffuser plate to deliver the required air temperature into the cabin. If the vehicle is fitted with A/C, the A/C evaporator replaces the diffuser plate in the heater assembly.

Air distribution into the cabin is controlled by 2 air distribution doors. The doors are operated via a Bowden cable from the RH rotary control on the center console.

WATER VALVE

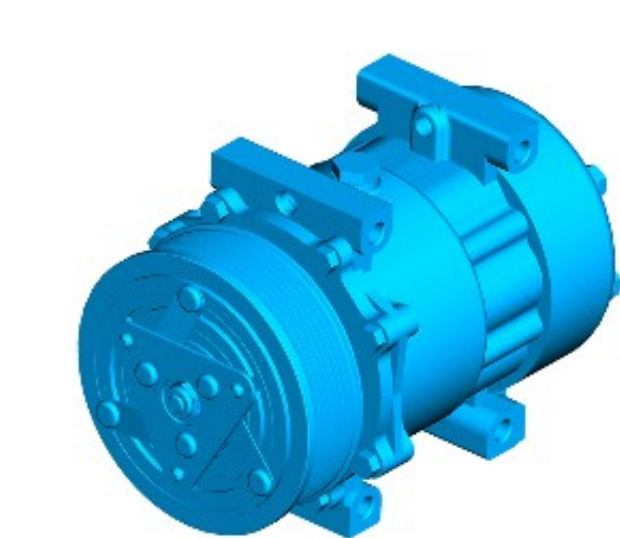


E83741

Item	Part Number	Description
1	-	Return from heater matrix
2	-	Supply to heater matrix
3	-	Supply from engine cooling system
4	-	Return to engine cooling system

The water valve is mounted at the rear of the engine compartment. A Bowden cable acts on a lever on the rear face of the water valve to vary the flow of hot engine coolant into the heater matrix. When the water valve is fully closed, no engine coolant is allowed to flow into the heater matrix. In this instance, engine coolant will flow into the water valve through inlet (3) and immediately out through the return (4).

AIR CONDITIONING COMPRESSOR



E83742

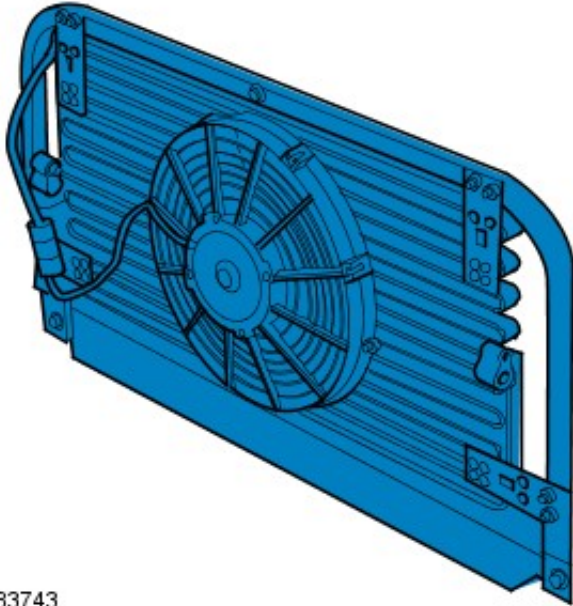
The A/C compressor circulates refrigerant around the system by compressing low pressure, low temperature vapor from the evaporator and discharging the resultant high pressure, high temperature vapor to the condenser.

The A/C compressor is a constant displacement unit which is driven by the engine accessory drive belt. To protect the

system from excessive pressure, a pressure relief valve is installed in the outlet side of the A/C compressor. The pressure relief valve vents excess pressure into the engine compartment.

Compressor clutch engagement is controlled by the ECM. The ECM receives system pressure inputs from the refrigerant pressure switch and system temperature inputs from the thermostatic switch. The ECM will de-energize the A/C compressor clutch relay on receipt of a pressure reading above or below the system limits, or a temperature reading that may cause the evaporator to freeze. For more information, refer to the '**Air Conditioning Refrigerant Pressure Switch**' and '**Thermostatic Switch**' sections below.

AIR CONDITIONING CONDENSER

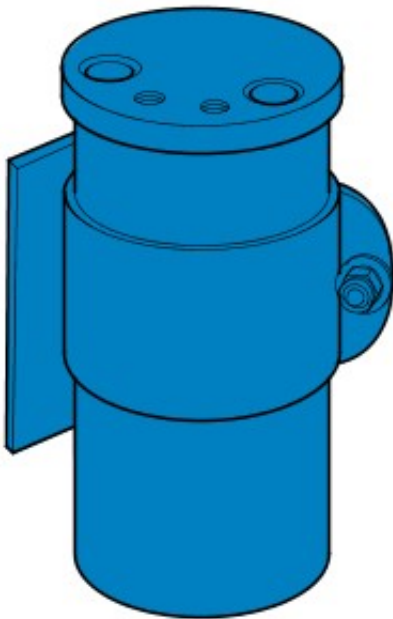


E83743

The condenser transfers heat from the refrigerant to the surrounding air to convert the high pressure vapor from the compressor into a liquid. The condenser is installed immediately in front of the radiator and is held in place by 3 brackets; 1 at the top, 2 at the bottom.

The RH end of the condenser provides a connection to the high pressure line from the A/C compressor. The LH end of the condenser provides a connection to the low pressure line to the receiver drier.

AIR CONDITIONING RECEIVER DRIER

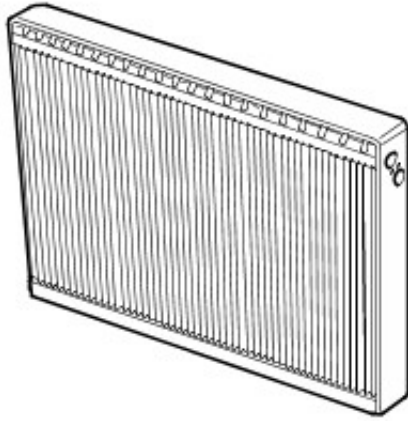


E83744

The receiver drier is mounted in the LH front corner of the engine compartment and removes solid impurities and moisture from the refrigerant. It also provides a reservoir for liquid refrigerant to accommodate changes of heat load at the evaporator.

Refrigerant entering the receiver drier passes through a filter and a desiccant pack, then collects in the base of the unit before flowing through the outlet pipe to the evaporator.

AIR CONDITIONING EVAPORATOR

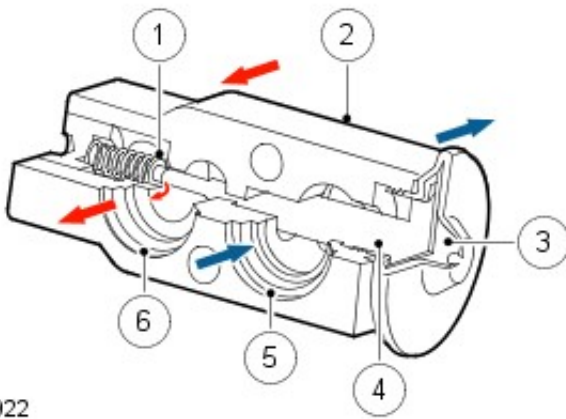


E46923

The evaporator is installed in the heater assembly. Liquid refrigerant enters the evaporator and expands, absorbing large quantities of heat as it changes state to a gas.

Most of the moisture in the air passing through the evaporator condenses into water, which drains out of the vehicle by passing through a drain tube to the underside of the vehicle.

AIR CONDITIONING THERMOSTATIC EXPANSION VALVE



E46922

Item	Part Number	Description
1	-	Metering valve
2	-	Housing
3	-	Diaphragm
4	-	Temperature sensor
5	-	Outlet passage from evaporator
6	-	Inlet passage to evaporator

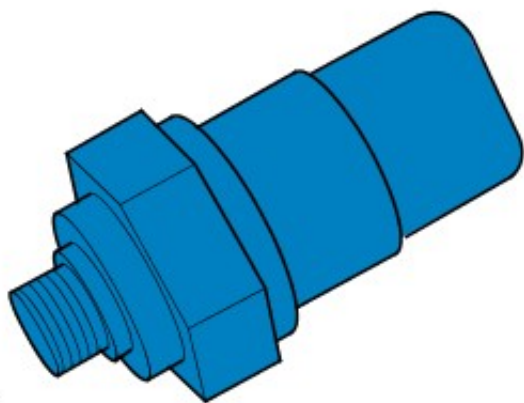
The thermostatic expansion valve meters the flow of refrigerant into the evaporator, to match the refrigerant flow with the heat load of the air passing through the evaporator.

The thermostatic expansion valve is a block type valve located behind the heater assembly, and attached to the inlet and outlet ports of the evaporator. The thermostatic expansion valve consists of an aluminum housing containing inlet and outlet passages. A ball and spring metering valve is installed in the inlet passage and a temperature sensor is installed in the outlet passage. The temperature sensor consists of a temperature sensitive tube connected to a diaphragm. The bottom end of the temperature sensitive tube acts on the ball of the metering valve. Pressure on top of the diaphragm is controlled by the evaporator outlet temperature conducted through the temperature sensitive tube. The bottom of the diaphragm senses evaporator outlet pressure.

Liquid refrigerant flows through the metering valve into the evaporator. The restriction across the metering valve reduces the pressure and temperature of the refrigerant. The restriction also changes the liquid stream of refrigerant into a fine spray, to improve the evaporation process. As the refrigerant passes through the evaporator, it absorbs heat from the air flowing through the evaporator. The increase in temperature causes the refrigerant to vaporize and increase in pressure.

The temperature and pressure of the refrigerant leaving the evaporator acts on the diaphragm and temperature sensitive tube, which regulate the metering valve opening and so control the volume of refrigerant flowing through the evaporator. The warmer the air flowing through the evaporator, the more heat available to evaporate refrigerant and thus the greater volume of refrigerant allowed through the metering valve.

AIR CONDITIONING REFRIGERANT PRESSURE SWITCH



E83745

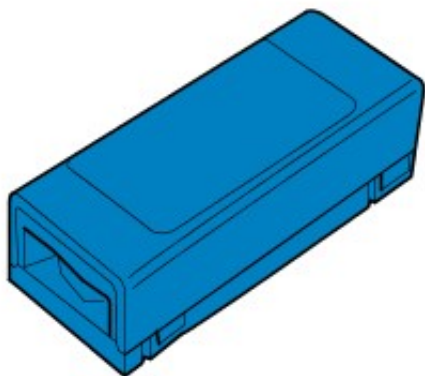
The refrigerant pressure switch is mounted monitors the high pressure side of the A/C system. The switch monitors 3 pressure ranges; high, medium and low. The pressure of refrigerant inside the system is provided to the ECM, which controls operation of the A/C compressor accordingly.

The pressure ranges monitored by the switch are as follows:

Pressure Range	Upper Limit (bar)	Lower Limit (bar)
High	32	6
Medium	15.5	12.5
Low	2.3	2

If the pressure in the system falls below 2 bar, or rises above 32 bar, the ECM will suspend A/C compressor operation by de-energizing the main relay, which subsequently de-energizes the A/C compressor clutch relay.

AIR CONDITIONING THERMOSTATIC SWITCH



E83746

The thermostatic switch is mounted on the underside of the heater assembly and measures the temperature of the air coming off the A/C evaporator. This temperature value is fed back to the ECM which controls operation of the A/C compressor accordingly.

The ECM will suspend A/C compressor operation if the temperature of the air coming off the evaporator drops to 1°C (34 °F). This prevents the evaporator from freezing. The ECM will re-instate A/C compressor operation when the temperature of the air coming off the evaporator rises to 3.5°C (38°F).

CONTROL DIAGRAM

NOTE: **A** = Hardwired



Item	Part Number	Description
1	-	Ignition switch
2	-	battery junction box (BJB)
3	-	Battery
4	-	Main relay
5	-	ECM
6	-	Cooling fan relay

7	-	Cooling fan
8	-	A/C compressor clutch relay
9	-	A/C compressor clutch
10	-	A/C refrigerant pressure switch
11	-	A/C switch
12	-	A/C thermostatic switch
13	-	Blower motor relay
14	-	Blower motor switch
15	-	Blower motor resistor pack
16	-	Blower motor
17	-	central junction box (CJB)

PRINCIPLES OF OPERATION

Heating

Heating control is achieved by varying the amount of engine coolant fed into the heater matrix. Coolant is bled from the engine cooling system and fed into the heater matrix through the water valve. The water valve is operated via a Bowden cable from the rotary heater control and varies the amount of engine coolant entering the heater matrix in response to heating demand.

If partial heating is requested, a proportion of engine coolant is returned back to the engine cooling system. If no heating is requested, the water valve returns all engine coolant back to the engine cooling system, by-passing the heater matrix.

Heat is transferred to the inlet air as it passes through the heater matrix. The heated air is then delivered into the cabin through a series of ducts, vents, and registers.

For additional information, refer to: Air Distribution and Filtering (412-01, Description and Operation).

Air Conditioning

The A/C system transfers heat from the cabin to the outside atmosphere to provide dehumidified cool air. The A/C system is a sealed closed loop system, filled with a charge weight of R134a refrigerant as the heat transfer medium. Oil is added to the refrigerant to lubricate the internal components of the A/C compressor.

Hot, high pressure gas from the compressor flows into the condenser, which allows heat to dissipate causing the gas to condense into a liquid form. The flow of liquid refrigerant into the evaporator is controlled by the thermostatic expansion valve. When in the evaporator the liquid refrigerant expands and absorbs heat from its surroundings, cooling the fins and plates of the A/C evaporator. As inlet air passes across the A/C evaporator surface it is cooled before entering the cabin through a series of ducts, vents, and registers.

For additional information, refer to: Air Distribution and Filtering (412-01, Description and Operation).

Climate Control System - General Information - Climate Control System

Diagnosis and Testing

GENERAL PRECAUTIONS

The refrigerant used in the air conditioning system is HFC (Hydrofluorocarbon) R134a.

WARNINGS:



R134a is a hazardous liquid and when handled incorrectly can cause serious injury. Suitable protective clothing must be worn when carrying out servicing operations on the air conditioning system.



R134a is odourless and colourless. Do not handle or discharge in an enclosed area, or in any area where the vapour or liquid can come in contact with naked flame or hot metal. R134a is not flammable, but can form a highly toxic gas.



Do not smoke or weld in areas where R134a is in use. Inhalation of concentrations of the vapour can cause dizziness, disorientation, uncoordination, narcosis, nausea or vomiting.



Do not allow fluids other than R134a or compressor lubricant to enter the air conditioning system. Spontaneous combustion may occur.



R134a splashed on any part of the body will cause immediate freezing of that area. Also refrigerant cylinders and replenishment trolleys when discharging will freeze skin to them if contact is made.



The refrigerant used in an air conditioning system must be reclaimed in accordance with the recommendations given with a Refrigerant Recovery Recycling Recharging Station.

NOTE: Suitable protective clothing comprises: Wrap around safety glasses or helmet, heatproof gloves, rubber apron or waterproof overalls and rubber boots.

Routine servicing, apart from visual checks, is not necessary. The visual inspections are as follows:

Condenser

With a water hose or air line, clean the fins of the condenser to remove flies, leaves, etc. Check the pipe connections for signs of oil leakage.

Compressor

Check pipe connections for signs of oil leakage. Check flexible hoses for swelling. Examine the compressor belt for tightness and condition.

Sight glass

Examine the sight glass for bubbles with the system operating. Check connections for leakage.

Evaporator

Examine the refrigeration connections at the unit.

REMEDIAL ACTIONS

WARNINGS:



Do not allow a refrigerant container to be heated by a direct flame or to be placed near any heating appliance. A refrigerant container must not be heated above 50° C.



Do not leave a container of refrigerant without its cap fitted. Do not transport a container of refrigerant that is unrestrained, especially in the boot of a car.

NOTE: Due to its low evaporating temperature of -30° C, R134a should be handled with care.

- If liquid R134a strikes the eye, do not rub it. Gently run large quantities of eyewash over the eye to raise the temperature. If eyewash is not available cool, clean water may be used. Cover eye with clean pad and seek immediate medical attention.
- If liquid R134a is splashed on the skin run large quantities of water over the area as soon as possible to raise the temperature. Carry out the same actions if skin comes into contact with discharging cylinders. Wrap affected parts in blankets or similar material and seek immediate medical attention.

- If suspected of being overcome by inhalation of R134a vapour seek fresh air. If unconscious remove to fresh air. Apply artificial respiration and/or oxygen and seek immediate medical attention.

SERVICING PRECAUTIONS

Care must be taken when handling refrigeration system components. Units must not be lifted by their hoses, pipes or capillary lines. Hoses and lines must not be subjected to any twist or stress. Ensure that hoses are positioned in their correct run before fully tightening the couplings, and ensure that all clips and supports are used. Torque wrenches of the correct type must be used when tightening refrigerant connections to the stated value. An additional spanner must be used to hold the union to prevent twisting of the pipe.

Before connecting any hose or pipe ensure that refrigerant oil is applied to the seat of the new 'O' ring but not to the threads.

Check the oil trap for the amount of oil lost.

All protective plugs on components must be left in place until immediately prior to connection.

The receiver/drier contains desiccant which absorbs moisture. It must be positively sealed at all times.



CAUTION: Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.

Use alcohol and a clean cloth to clean dirty connections. Ensure that all new parts fitted are marked for use with R134a.

Refrigerant oil

Use the approved refrigerant lubricating oil - Nippon Denso ND-OIL 8.



CAUTION: Do not use any other type of refrigerant oil.

Refrigerant oil easily absorbs water and must not be stored for long periods. Do not pour unused oil back into the container. When renewing system components, add the following quantities of refrigerant oil:

Component	Fluid quantity
Condenser	40ml
Evaporator	80ml
Pipe or hose	20ml
Receiver/drier	20ml
Total quantity of refrigerant oil in system	140ml

A new compressor is sealed and pressurised with Nitrogen gas, slowly release the sealing cap, gas pressure should be heard to release as the seal is broken.

NOTE: A new compressor should always have its sealing caps in place and these must not be removed until immediately prior to fitting

A new compressor is supplied with an oil fill of 140ml.

A calculated quantity of oil must be drained from a new compressor before fitting.

To calculate the quantity of oil to be drained:

- Remove sealing plugs from the OLD compressor.
- Invert compressor and gravity drain oil into measuring cylinder. Rotating the compressor clutch plate will assist complete draining.
- Note the quantity of oil drained (Yml).
- Calculate the quantity (Qml) of oil to be drained from the NEW compressor using the following formula: $X\text{ml} - (Y\text{ml} + 20\text{ml}) = Q\text{ml}$

Rapid refrigerant discharge

When the air conditioning system is involved in accident damage and the circuit is punctured, the refrigerant is discharged rapidly. The rapid discharge of refrigerant will also result in the loss of most of the oil from the system. The compressor must be removed and all the remaining oil in the compressor drained and refilled as follows:

- Gravity drain all the oil, assist by rotating the clutch plate (not the pulley).
- Refill the compressor with 90ml of new refrigerant oil.
- Plug the inlet and outlet ports.

Servicing Equipment

The following equipment is required for full servicing of the air conditioning system.

Recovery, recycling and charging station Leak detector Thermometer +20° C to -60° C Safety goggles and gloves

Precautions when handling refrigerant lines



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

- When disconnecting any hose or pipe connection the system must be discharged of all pressure. Proceed cautiously, regardless of gauge readings. Open connections slowly, keeping hands and face well clear, so that no injury occurs if there is liquid in the line. If pressure is noticed, allow it to bleed off slowly.
- Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.
- Any dirt or grease on fittings must be wiped off with a clean alcohol dampened cloth. Do not use chlorinated solvents such as trichloroethylene. If dirt, grease or moisture cannot be removed from inside the hoses, they must be replaced with new hoses.
- All replacement components and flexible end connections must be sealed, and only opened immediately prior to making the connection.
- Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.
- Components must not remain uncapped for longer than 15 minutes. In the event of delay, the caps must be fitted.
- Receiver/driers must never be left uncapped as they contain Silica Gel crystals which will absorb moisture from the atmosphere. A receiver/ drier left uncapped must not be used, fit a new unit.
- The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.
- A new compressor contains an initial charge of refrigerant oil. The compressor also contains a holding charge of gas when received which should be retained by leaving the seals in place until the pipes are re-connected.
- The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
- All precautions must be taken to prevent damage to fittings and connections. Slight damage could cause a leak with the high pressures used in the system.
- Always use two wrenches of the correct size, one on each fitting when releasing and tightening refrigeration unions.
- Joints and 'O' rings should be coated with refrigeration oil to aid correct seating. Fittings which are not lubricated with refrigerant oil are almost certain to leak.
- All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.
- Flexible hoses should not be bent to a radius less than 90mm radius.
- Flexible hoses should not be within 100mm of the exhaust manifold.
- Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of lines and panels transmits noise and must be eliminated.

PERFORMANCE TEST



WARNING: R134A is hazardous.

REFER to: Health and Safety Precautions (100-00, Description and Operation).

Carry out this test with hood and doors or windows open, air conditioning switched on, temperature control set to cold and blower at maximum speed. Set the air supply control to supply fresh air.

1. Close low pressure valve on refrigerant station.
2. Close high pressure valve on refrigerant station.
3. Connect a Refrigerant Station to the high and low pressure servicing connections.
4. Insert dry bulb thermometer into cold air outlet and position dry and wet bulb thermometer close to outside air inlet. Do not spill water from the wet thermometer (psychrometer).
5. Start engine and run it at 1500 rev/min for 10 minutes with air conditioning switched on.
6. Read both pressure gauges and thermometers. Check readings against table below with humidity between 60% and 80%.
7. Switch off air conditioning, stop engine, disconnect test equipment.

Performance range

Intake temperature	Outlet temperature	Low pressure	High pressure
68°F	41 - 50°F	20 - 23 lbf/in ²	116 - 190 lbf/in ²
20°C	5 - 10°C	1.4 - 1.6 bar	8.0 - 13 bar
75°F	45 - 60°F	21 - 28 lbf/in ²	130 - 200 lbf/in ²
25°C	7 - 15°C	1.5 - 2.0 bar	9.0 - 14 bar
85°F	46 - 68°F	26 - 40 lbf/in ²	190 - 230 lbf/in ²
30°C	8 - 20°C	1.8 - 2.8 bar	13 - 16 bar
95°F	52 - 72°F		
35°C	11 - 22°C	2.5 - 3.5 bar	16 - 19 bar

Ambient temperature		Compound gauge readings		High pressure gauge readings	
°C	°F	bar	lbf/in ²	bar	lbf/in ²
16	60	1,3-1,4	15-20	6,9-10,3	100-150

27	80	1,4-1,7	20-25	9,7-13,1	140-190
38	100	1,7-2,1	25-30	12,4-15,5	180-225
43	110	2,1-2,4	30-35	14,8-17,2	215-250

Climate Control System - General Information - Air Conditioning (A/C) System Recovery, Evacuation and Charging

General Procedures

WARNINGS:




The air conditioning system is charged with a high pressure, potentially toxic refrigerant. Repairs or servicing must only be carried out by an operator familiar with both the vehicle system and the charging and testing equipment. All operations must be carried out in a well-ventilated area away from open flame and heat sources. Always wear safety goggles and gloves when opening refrigerant connections.



Wear eye and hand safety protection. Open connections slowly in case liquid or pressure is present. Allow to bleed off slowly.



CAUTION: Overcharging air conditioning system will cause excessive head pressure.

1. Remove dust caps from high and low pressure connectors.
2. Connect high and low pressure hoses to appropriate connections.
3. Open valves on connectors.
4. Turn valves on refrigerant station to correct positions.
5. Turn Process switch to correct position.
6. Turn Main switch to 'ON'.
7. Allow refrigerant station to recover refrigerant from system.
8. Close valves on refrigerant station.
9. Turn Main switch to 'OFF'.
10. Close valves on connectors.
11. Disconnect high and low pressure hoses from connectors.
12. Fit dust caps to connectors.
13. Open tap at rear of station to drain refrigerant oil recovered from system.
14. Measure and record quantity of refrigerant oil recovered from system.
15. Close tap at rear of station.
16.  **WARNING:** Refrigerant must always be recycled before reuse, to ensure that the purity of the refrigerant is high enough for safe use in the air conditioning system. Recycling should always be carried out with equipment which is design certified by Underwriter Laboratory Inc. for compliance with SAE-J1991. Other equipment may not recycle refrigerant to the required level of purity. A R134a Refrigerant Recovery Recycling Recharging Station must not be used with any other type of refrigerant. Refrigerant R134a from domestic and commercial sources must not be used in motor vehicle air conditioning systems.

Measure the quantity of oil discharged from the system. Add an equal amount of new refrigerant oil to compressor before evacuation sequence.

17. CAUTIONS:



When a major repair has been carried out, a leak test should be carried out using inert gas.



Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.

Renew the receiver/drier.

18. Remove dust caps from high and low pressure connectors.
19. Connect high and low pressure hoses to appropriate connections.
20. Open valves on connectors.
21. Turn valves on refrigerant station to correct positions.
22. Turn Process switch to correct position.
23. Turn Main switch to 'ON'.
24. Allow refrigerant station to evacuate system.



CAUTION: The system must be Evacuated immediately before recharging commences. Delay between Evacuation and Recharging is not permitted.

25. If the vacuum reading is below 700 mm Hg, 28 in Hg after 15 minutes, suspect a leak in the system. Partially recharge the system and check for leaks using an electronic leak tester. Check suction lines first, then run the compressor for 5 minutes and then check the high pressure lines.

26. **WARNINGS:**



A R134a Refrigerant Recovery Recycling Recharging station must not be used with any other type of refrigerant.



R134a refrigerant from domestic and commercial sources must not be used in motor vehicle air conditioning systems.



CAUTION: When a major repair has been carried out, a leak test should be carried out using inert gas.

Close valves on refrigerant station.

27. Close valve on oil charger.
28. Disconnect yellow hose from refrigerant station.
29. Remove lid from oil charger.
30. Pour correct quantity of refrigerant oil into oil charger.
31. Fit lid to oil charger.
32. Connect yellow hose to refrigerant station.
33. Open valve on oil charger.
34. Move pointer on refrigerant gauge to mark position of refrigerant drop.
35. Slowly open correct valve on refrigerant station and allow vacuum to pull refrigerant into system.

36. Close valve on refrigerant station when correct amount of refrigerant has been drawn into air conditioning system.
37. If the full charge is not accepted by the system, start the engine and run it at 1,500 rev/min for a minimum of 2 minutes. Switch on the air conditioning system, open the vehicle windows, set the temperature control to cold and the blower switch to maximum.
38. Consult Refrigerant station instruction manual for correct procedure to complete the charge.
39. Turn Main switch to 'OFF'.
40. Close valves on connectors.
41. Disconnect high and low pressure hoses from connectors.
42. Fit dust caps to connectors.
43. Carry out performance test on air conditioning system.

Climate Control System - General Information - Refrigerant System Tests

General Procedures

1. Place the vehicle in a ventilated, shaded area free from excessive draught, with the doors and windows open.
2. Check that the surface of the condenser is not restricted with dirt, leaves, flies, etc. Do not neglect to check the surface between the condenser and the radiator. Clean as necessary.
3. Switch on the ignition and the air conditioner air flow control. Check that the blower is operating efficiently at low, medium and high speeds. Switch off the blower and the ignition.
4. Check that the evaporator drain tube is open and clear.
5. Check the tension of the compressor driving belt, and adjust if necessary.
6. Inspect all connections for the presence of refrigerant oil. If oil is evident, check for leaks, and repair as necessary.

NOTE: The compressor oil is soluble in Refrigerant R134a and is deposited when the refrigerant evaporates from a leak.

7. Start the engine.
8. Set the temperature controls to cold and switch the air conditioner blower control on and off several times, checking that the magnetic clutch on the compressor engages and releases each time.
9. With the temperature control at maximum cooling and the blower control at high speed, warm up the engine and fast idle at 1000 rev/min.
10. Repeat at 1800 rev/min.
11. Gradually increase the engine speed to the high range and check the sight glass at intervals.
12. Check for frosting on the service valves.
13. Check the high pressure hoses and connections by hand for varying temperature. Low temperature indicates a restriction or blockage at that point.
14. Switch off the air conditioning blower and stop the engine.
15. If the air conditioning equipment is still not satisfactory, carry out a pressure test as previously described in this section.

Climate Control System - General Information - Electronic Leak Detection

General Procedures



CAUTION: When a major repair has been carried out, a leak test should be carried out using an inert gas (see below).

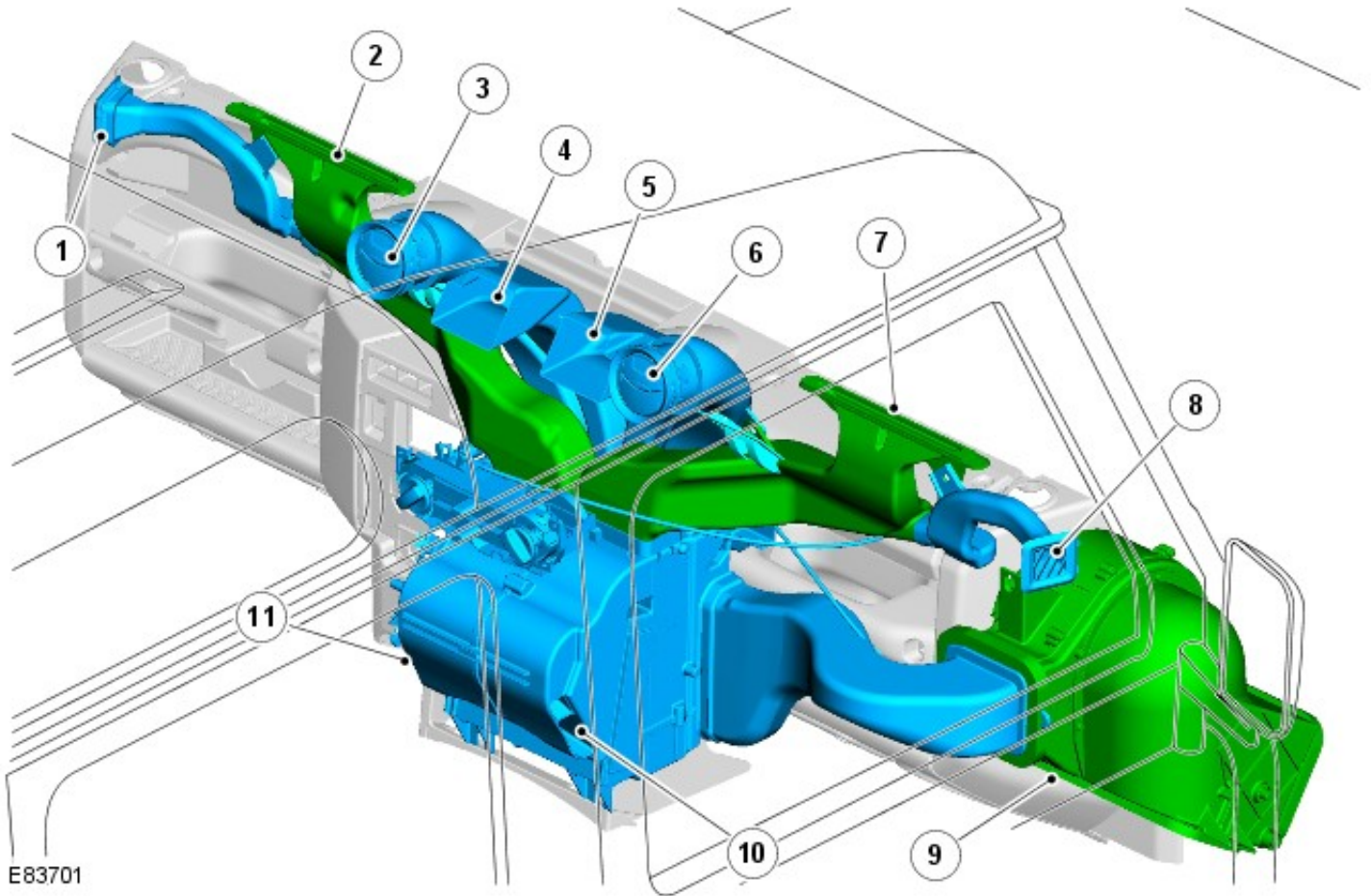
1. Place the vehicle in a well ventilated area but free from draughts, as leakage from the system could be dissipated without detection.
2. Follow the instructions issued by the manufacturer of the particular leak detector being used.
3. Commence searching for leaks by passing the detector probe around all joints and components, refrigerant gas is heavier than air.
4. Insert the probe into an air outlet of the evaporator or into the evaporator drain tube. Switch the air conditioning blower on and off at intervals of ten seconds. Any leaking refrigerant will be gathered in by the blower and detected.
5. Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.
6. Check all service valve connections, valve plate, head and base plate joints and back seal plate.
7. Check the condenser for leaks at the pipe unions.
8. If any leaks are found, the system must be discharged before rectification.
9. Rectify any leaks and recheck for leaks during evacuation prior to charging.
10. **Leak test using inert gas**
 1. Connect gas line to recharging station.
 2. Pressurise system to 3 bar (45 lbf/in²).
 3. Carry out leak test as above.

Air Distribution and Filtering - Air Distribution and Filtering

Description and Operation

COMPONENT LOCATION

NOTE: left-hand drive (LHD) vehicle shown, right-hand drive (RHD) similar.



Item	Part Number	Description
1	-	left-hand (LH) side window vent
2	-	Windshield LH vent
3	-	LH face level register
4	-	LH face level vent
5	-	right-hand (RH) face level vent
6	-	RH face level register
7	-	Windshield RH vent
8	-	RH side window vent
9	-	Recirculated air inlet
10	-	RH footwell vent
11	-	LH footwell vent

OVERVIEW

Air intake into the cabin is controlled using a 2 position sliding switch located on the center console. Either fresh or recirculated air can be selected. Selections are transmitted to the air intake and blower assembly using a Bowden cable. The air intake and blower assembly is located in the engine compartment.

Fresh air enters the system through the air inlet duct mounted in the passenger side front fender. Inlet air travels through the air intake and blower assembly to the heater assembly where it is distributed into the front of the cabin via a series of ducts, registers and vents.

NOTE: The vehicle is not fitted with a pollen filter.

When selected, recirculated air enters the system through an inlet located in the lower surface of the instrument panel, above the passenger foot well.

Air distribution into the cabin is selected using the RH rotary control mounted on the center console. A Bowden cable transmits selections to 2 air distribution doors using cams mounted on the heater assembly.

For additional information, refer to: Climate Control System (412-00, Description and Operation).

Air Distribution and Filtering - Air Inlet Duct

Removal and Installation

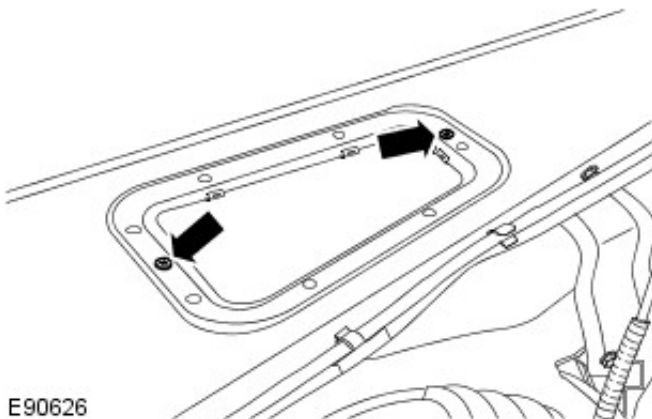
Removal

NOTE: left-hand drive (LHD) vehicle shown, right-hand drive (RHD) similar.

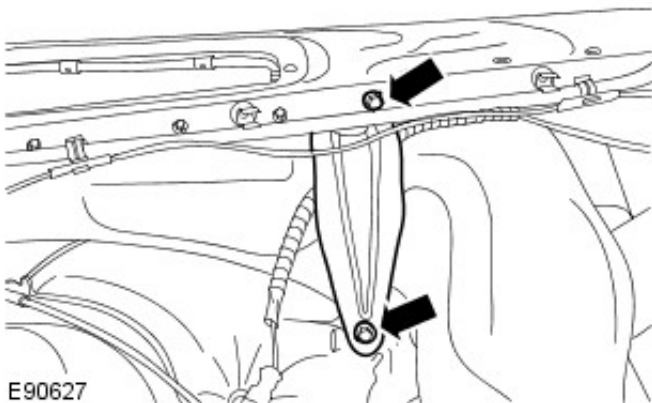
1. Remove the passenger side fresh air intake grille.



2. Remove the 2 air inlet duct upper securing screws.

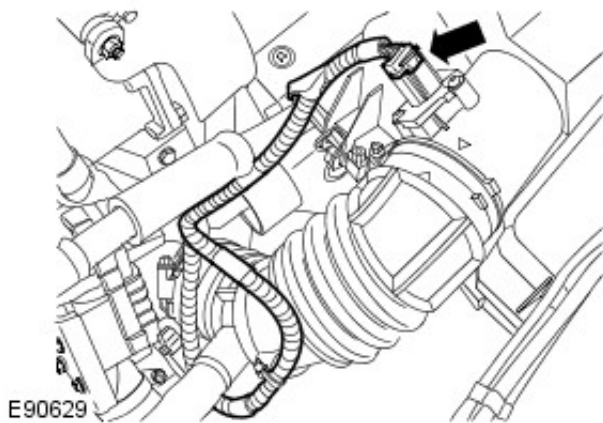


3. Remove the 2 air inlet duct retaining bracket securing bolts and retaining bracket.

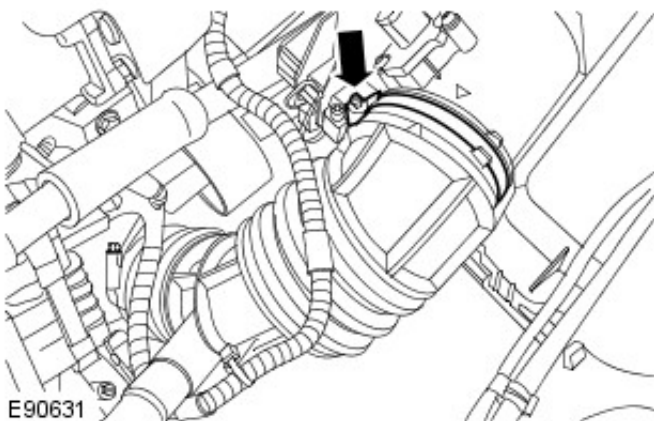


4. NOTE: Left-hand drive (LHD) vehicles only.

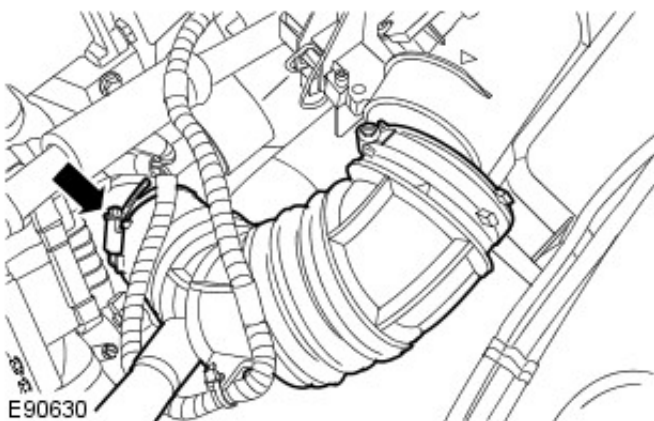
Disconnect the mass air flow (MAF) sensor electrical connector.



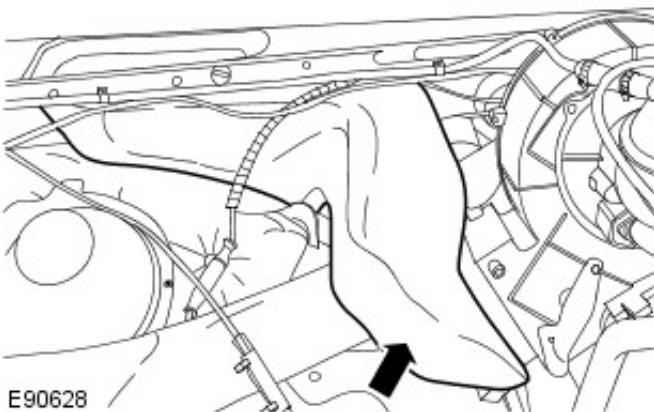
5. **NOTE: Left-hand drive (LHD) vehicles only.**
Release the air cleaner outlet pipe clip.



6. **NOTE: Left-hand drive (LHD) vehicles only.**
Release the air cleaner outlet pipe



7. Remove the air intake duct



Installation

NOTE: To prevent water ingress, make sure the air inlet duct is correctly aligned with the blower motor seal.

1. To install, reverse the removal procedure.

Heating and Ventilation -

Lubricants, Fluids and Sealers

Item	Specification
Sealant — Blower motor to blower motor housing	WSE-M4G323-A4

Torque specifications

Discription	Nm	lb-ft
Blower	15	11
Heater core and evaporator core housing	15	11
Heater control valve nut	6	4
Heater control valve bolt	22	16

Heating and Ventilation - Blower

Removal and Installation

Removal

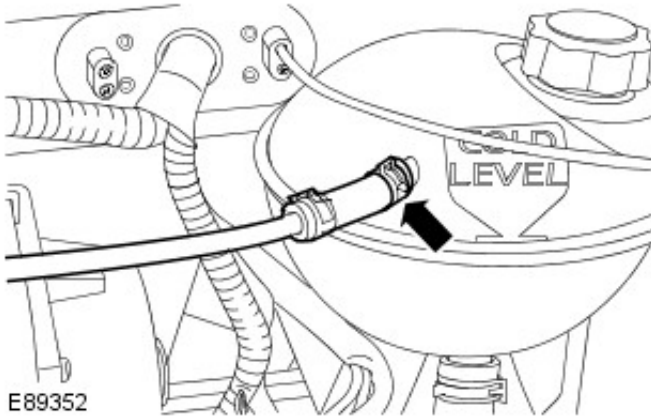
NOTE: Left-hand drive (LHD) vehicle shown, right-hand drive (RHD) similar.

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

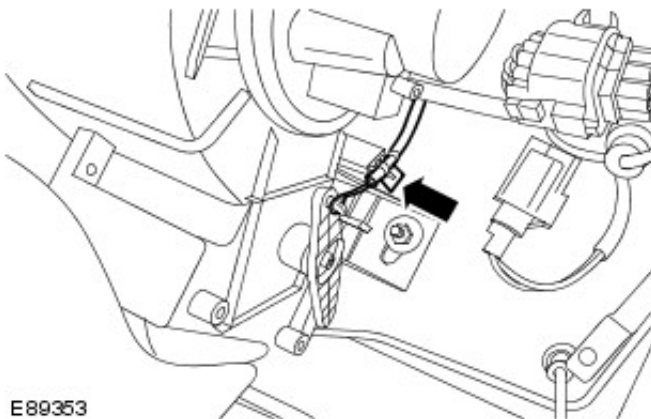
1. For additional information, refer to: [Air Inlet Duct](#) (412-01 Air Distribution and Filtering, Removal and Installation).

2. NOTE: Left-hand drive (LHD) vehicles only.

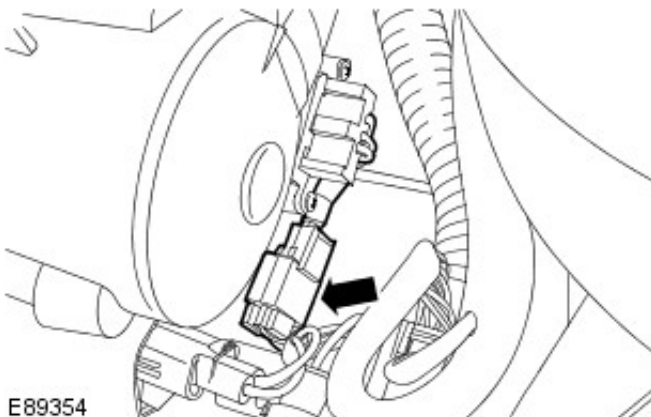
Disconnect the coolant expansion tank overflow pipe from the expansion tank.



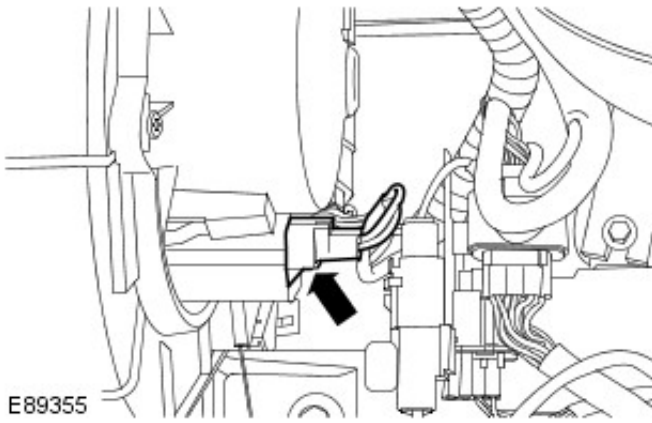
3. Disconnect the recirculation blend door control cable.



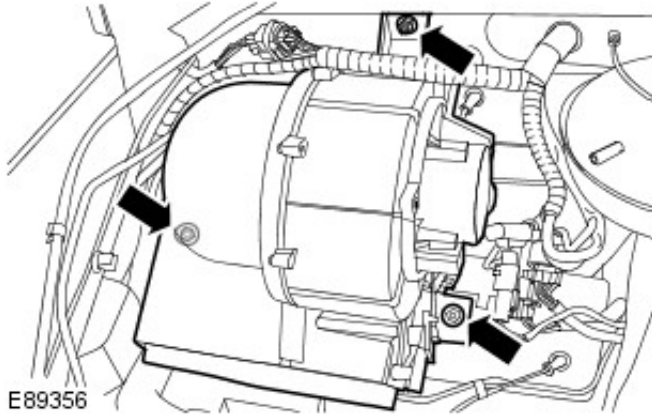
4. Disconnect the blower motor resistor electrical connector.



5. Disconnect the blower motor electrical connector.



6. Remove the blower.
Tighten to 15 Nm



Installation

1. To install, reverse the removal procedure.

Heating and Ventilation - Blower Motor

Removal and Installation

Materials

Name

Silicone Sealant

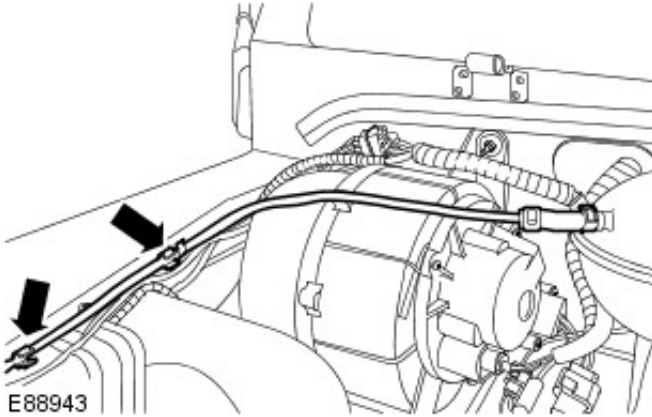
Specification

WSE-M4G323-A4

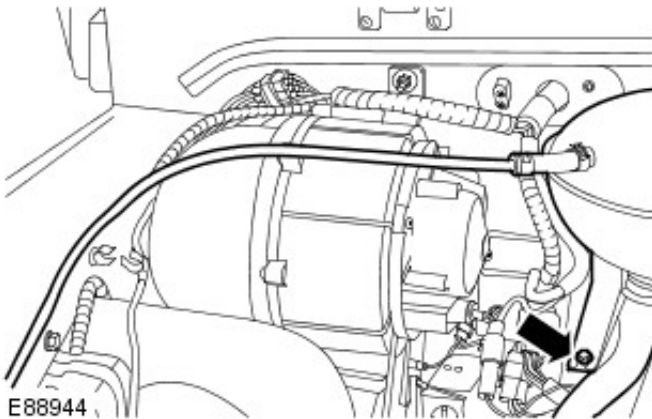
Removal

NOTE: LHD shown, RHD similar.

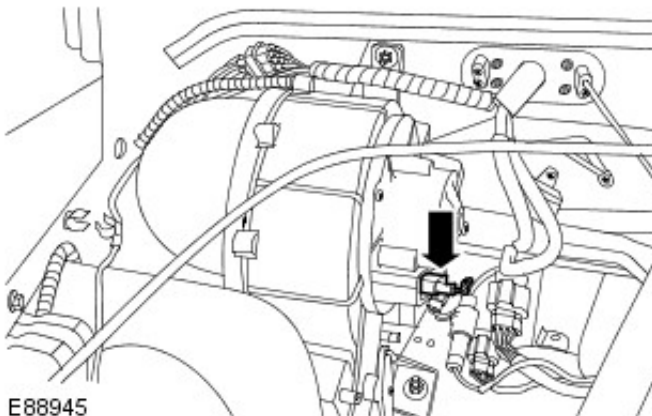
1. Release the coolant expansion tank to radiator pipe.



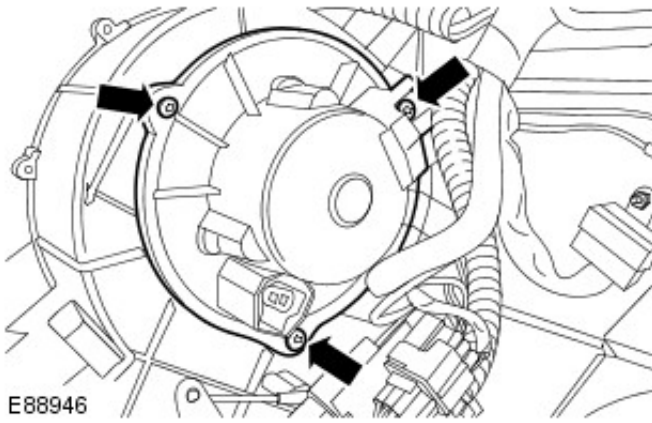
2. Release the coolant expansion tank.
 - Remove the bolt.



3. Disconnect the blower motor electrical connector.

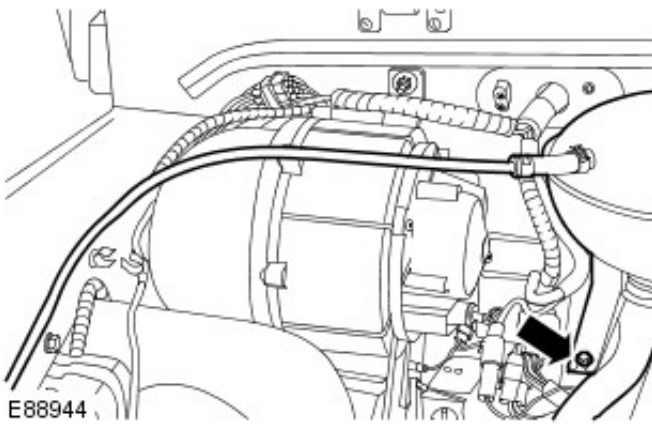


4. Remove the blower motor.
 - Remove the 3 screws.



Installation

1. To install, reverse the removal procedure.
 - Apply a bead of sealant to the mating faces of the blower motor and blower motor housing. [sealant](#)
2. Tighten to 10 Nm (7 lb.ft).

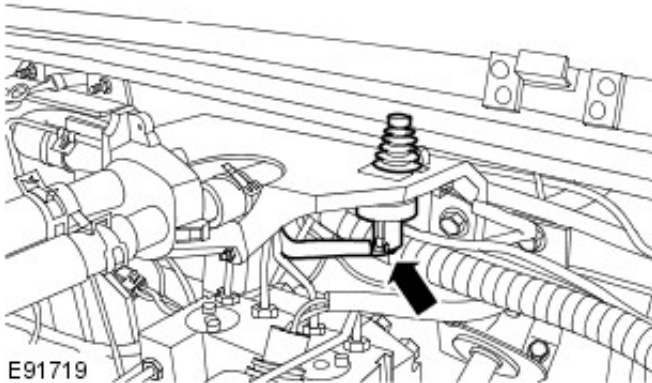


Heating and Ventilation - Heater Control Valve

Removal and Installation

Removal

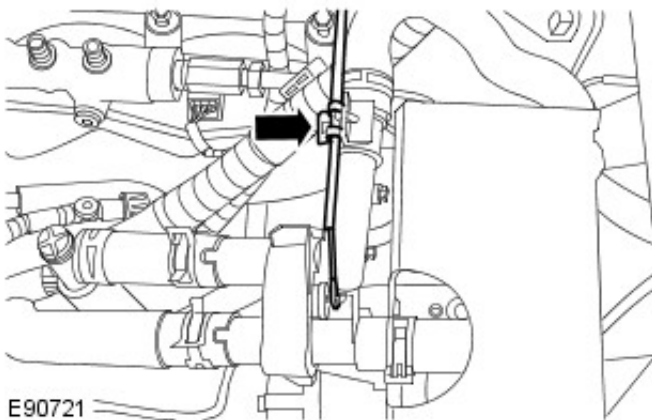
1. Remove the bonnet switch.
 - Disconnect the bonnet switch electrical connector.



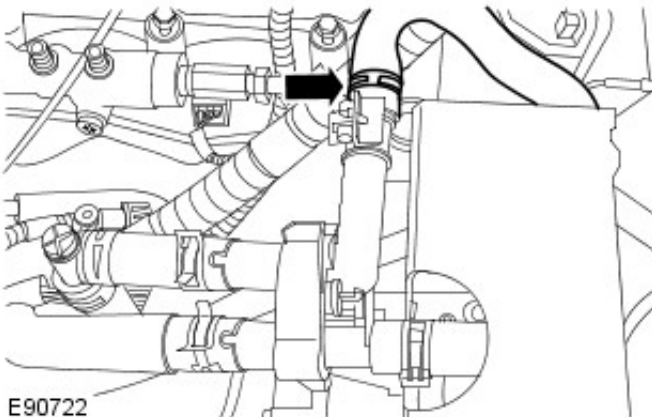
2. **NOTE:** Note the fitted position of the cable prior to removal.

Disconnect the heater control valve control cable.

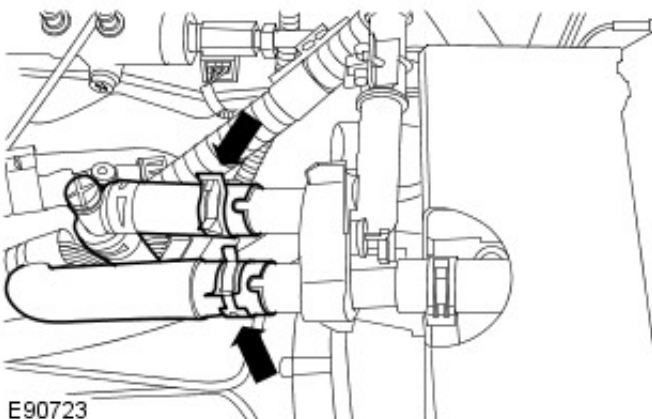
- Release the clip.



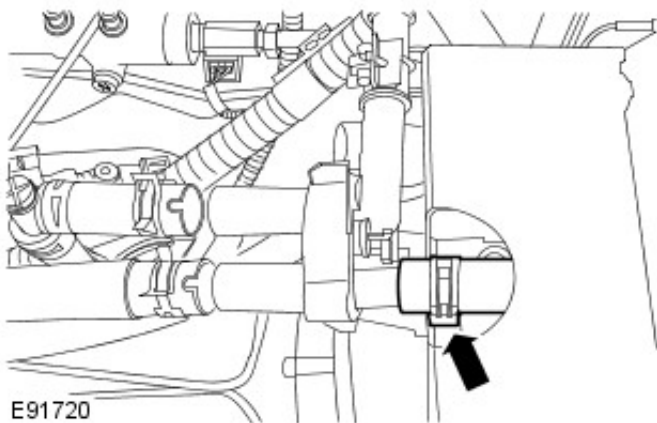
3. Disconnect the heater core feed hose.
 - Using a suitable pipe clamp, clamp the hose.
 - Release the clip.



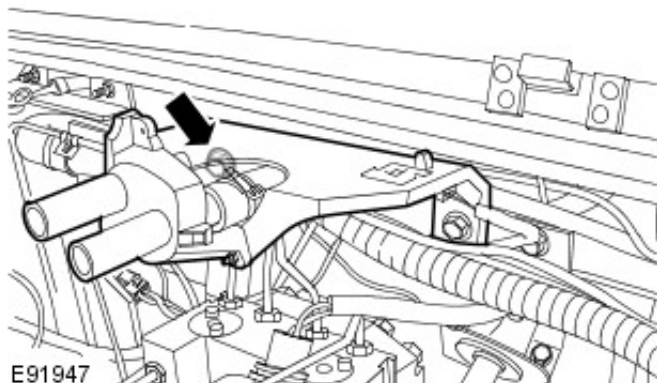
4. Disconnect the heater control valve feed and return hoses.
 - Using a suitable pipe clamp, clamp the hoses.
 - Release the 2 clips.



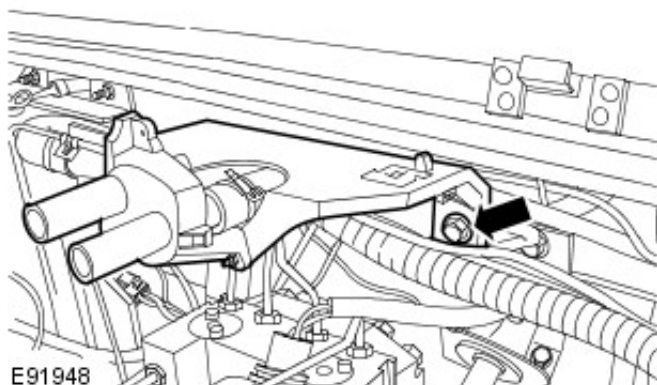
5. Disconnect the heater core return hose.
 - Release the clip.



6. Release the heater control valve.
 - Remove the nut.

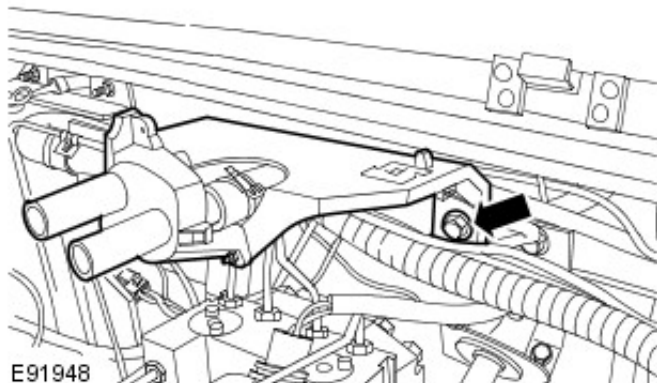


7. Remove the heater control valve.
 - Remove the bolt.

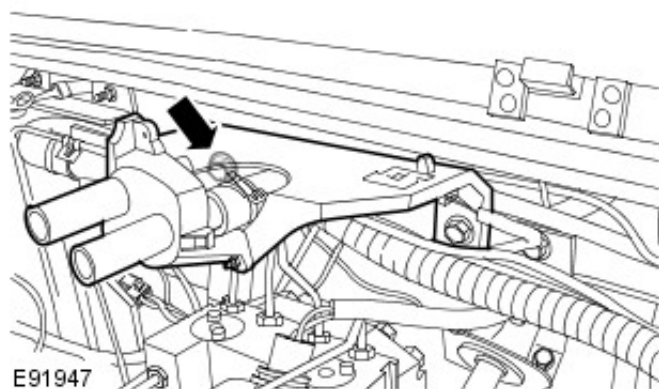


Installation

1. To install, reverse the removal procedure.
 - Tighten to 22 Nm (16 lb.ft).



2. Tighten to 6 Nm (4 lb.ft).



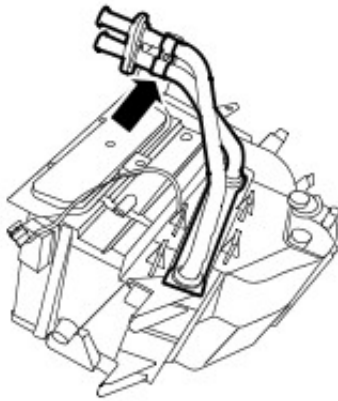
E91947


Heating and Ventilation - Heater Core

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the heater core housing.
For additional information, refer to: Heater Core Housing (412-02 Heating and Ventilation, Removal and Installation).



3.  **CAUTION:** Make sure no damage occurs to the foam seal on the heater core. Failure to follow this caution may result in damage to the component.

Remove the heater core.

- Remove the screw.
- Remove the pipe clamp.

E88665

4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the grommet from the heater core pipes.

Installation

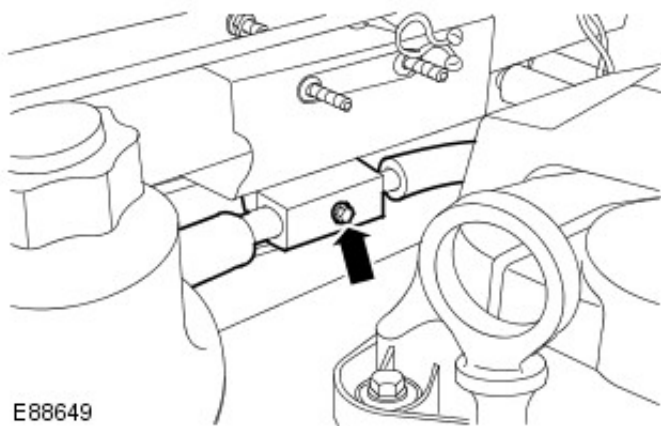
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).


Heating and Ventilation - Heater Core and Evaporator Core Housing

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
3. Remove the engine control module (ECM).
For additional information, refer to: Engine Control Module (ECM) (303-14 Electronic Engine Controls - 2.4L Diesel, Removal and Installation).



4.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Release the thermostatic expansion valve manifold and tube assembly.

- Remove the bolt.
- Remove and discard the O-ring seals.



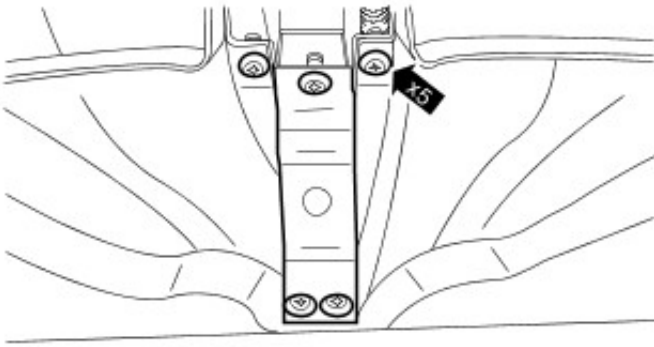
5. Disconnect the heater core hoses.
 - Using a suitable pipe clamp, clamp the heater hoses.
 - Release the 2 clips.

6. Remove the instrument panel.
For additional information, refer to: Instrument Panel (501-12 Instrument Panel and Console, Removal and Installation).

7. **NOTE:** Make sure the clips are discarded.

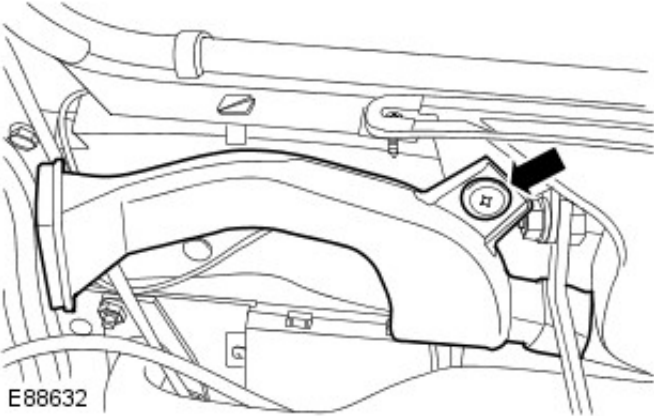
Remove the audio unit support bracket.

- Remove and discard the 5 clips.



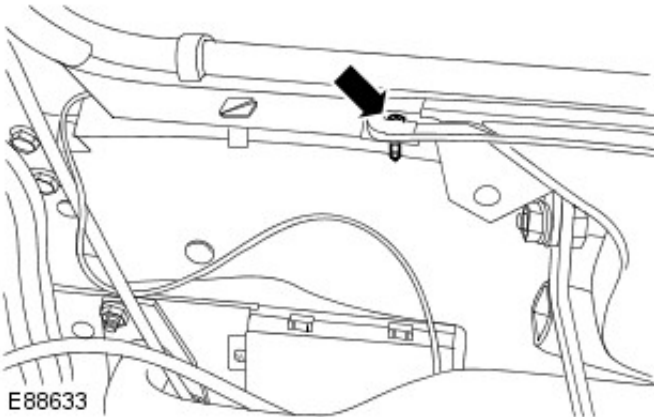
E88598

8. Remove the LH demister duct.
 - Remove the clip.



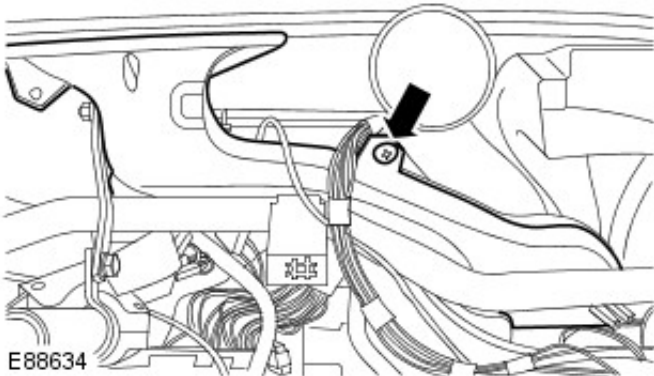
E88632

9. Release the LH defrost vent duct.
 - Remove the screw.



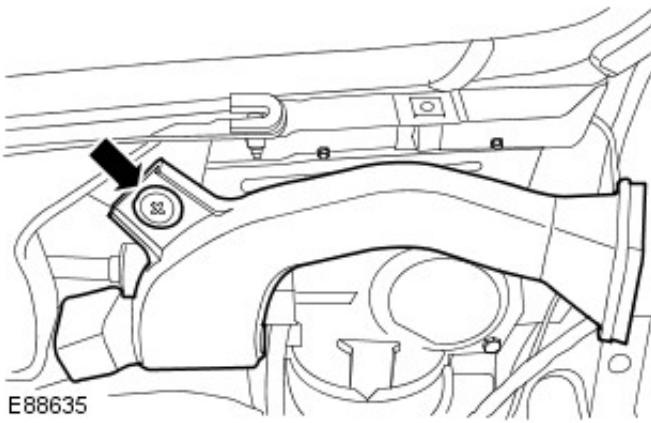
E88633

10. Remove the LH defrost vent duct.
 - Remove the clip.

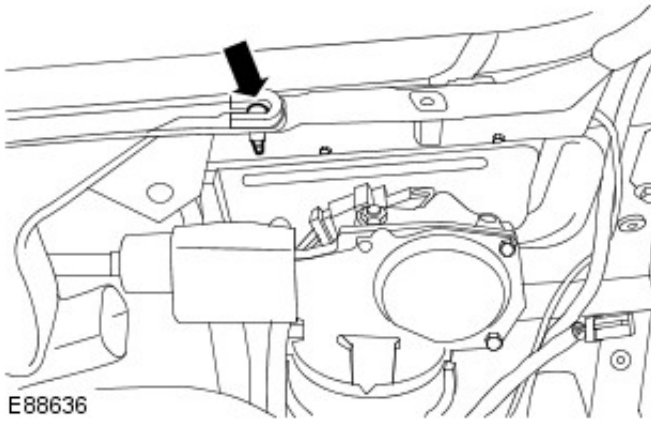


E88634

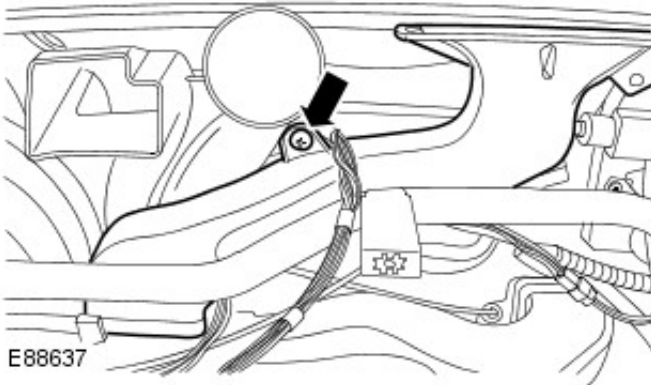
11. Remove the RH demister duct.
 - Remove the clip.



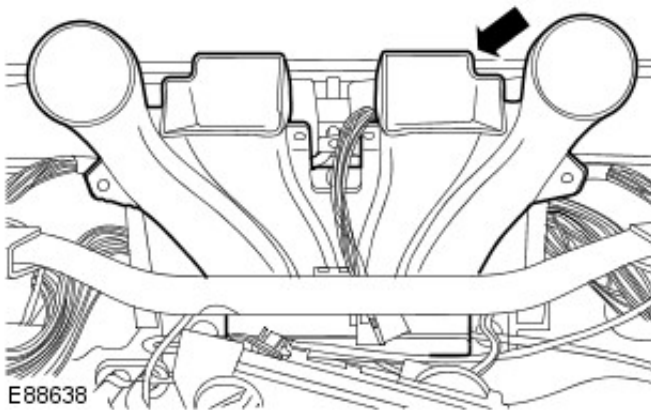
12. Release the RH defrost vent duct.
- Remove the screw.



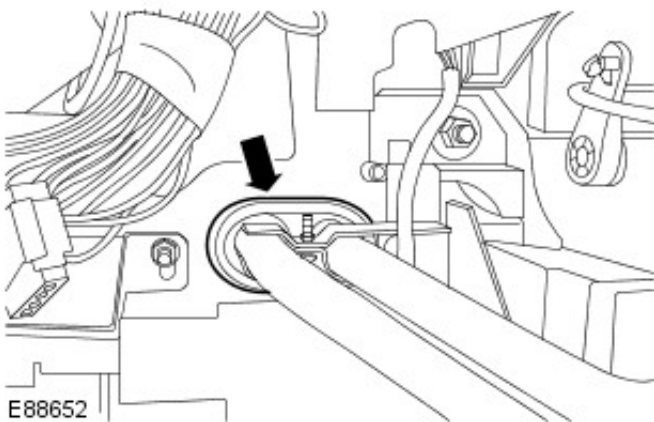
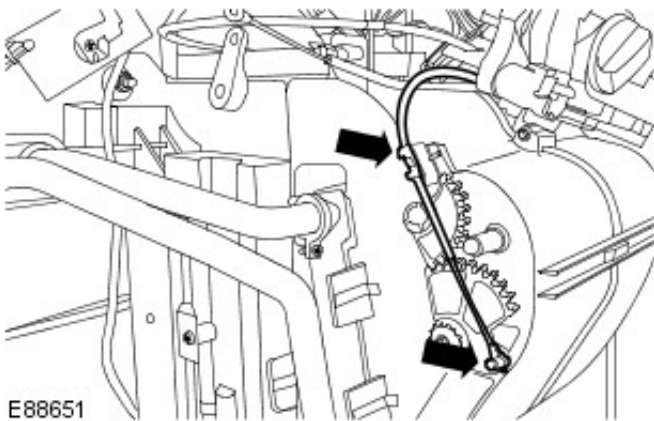
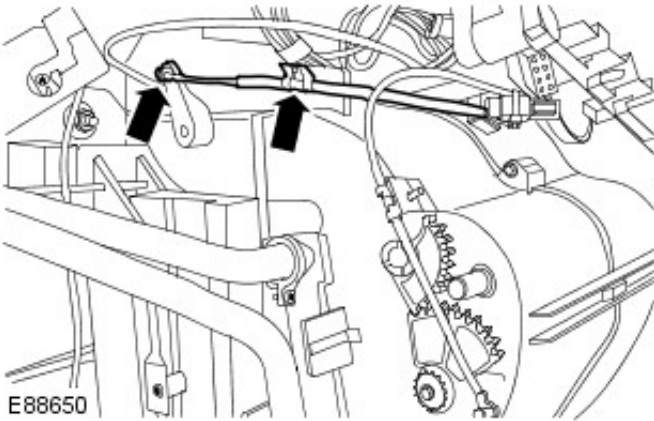
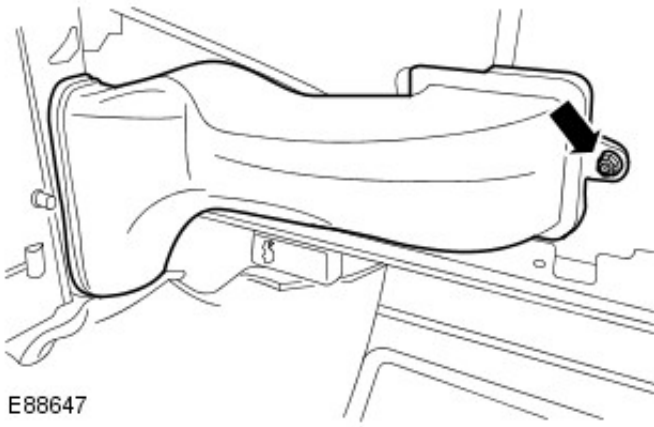
13. Remove the RH vent duct.
- Remove the clip.



14. Remove the center register duct.



15. Remove the air inlet duct.
- Remove the nut.

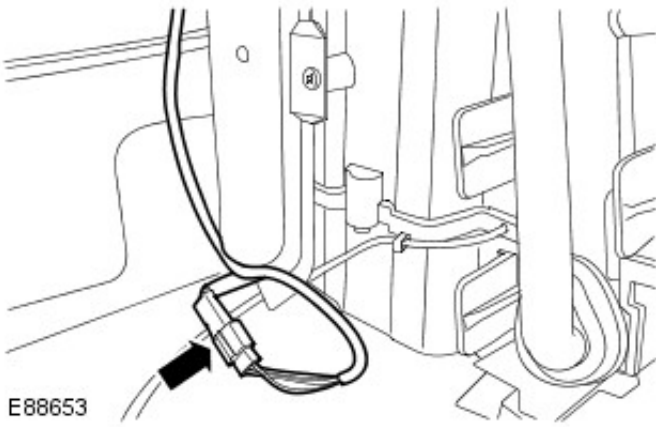


16. Disconnect the defrost duct blend door control cable.
 - Release the clip.

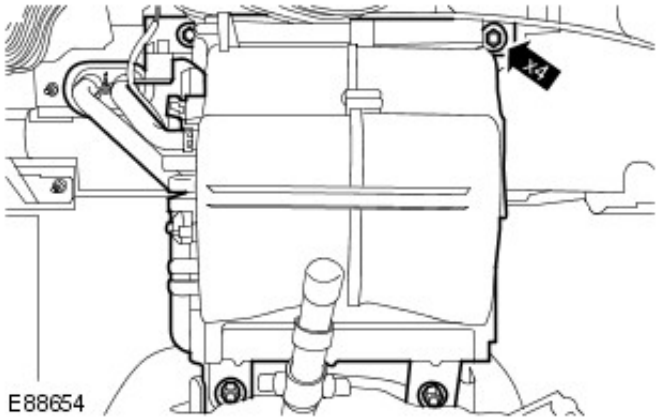
17. Disconnect the footwell duct blend door control cable.
 - Release the clip.

18. Release the grommet from the bulkhead.

19. Disconnect the de-icing switch electrical connector.



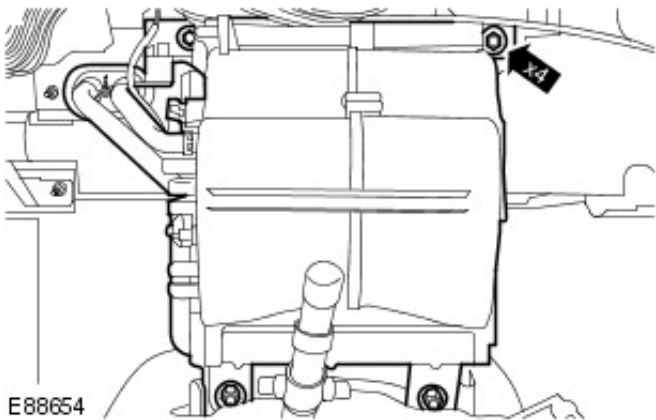
E88653



E88654

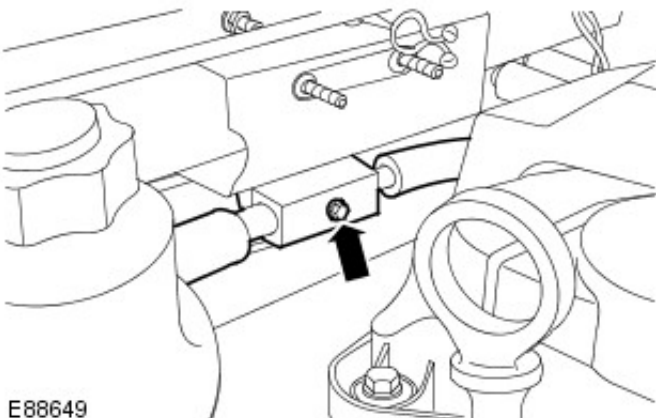
20. Remove the heater core and evaporator core housing.
 - Remove the 4 nuts.

Installation



E88654

1. To install, reverse the removal procedure.
 - Tighten to 15 Nm (11 lb.ft).



E88649

2. Tighten to 8 Nm (6 lb.ft).

3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Heating and Ventilation - Heater Core Housing

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).

2. Disconnect the heater core hoses.
 - Using a suitable pipe clamp, clamp the heater hoses.
 - Release the 2 clips.



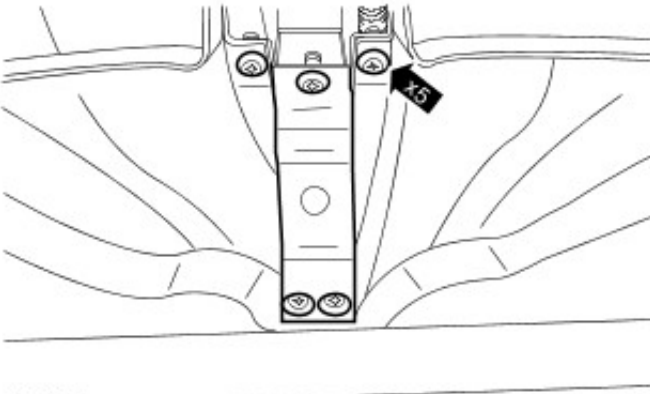
E88648

3. Remove the instrument panel.
For additional information, refer to: Instrument Panel (501-12, Removal and Installation).

4. **NOTE:** Make sure the clips are discarded.

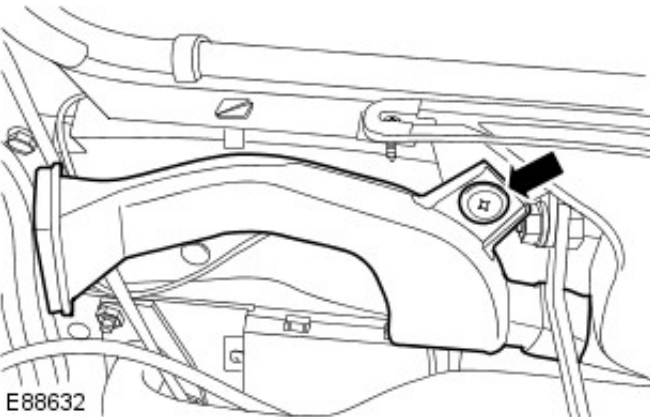
Remove the audio unit support bracket.

- Remove and discard the 5 clips.



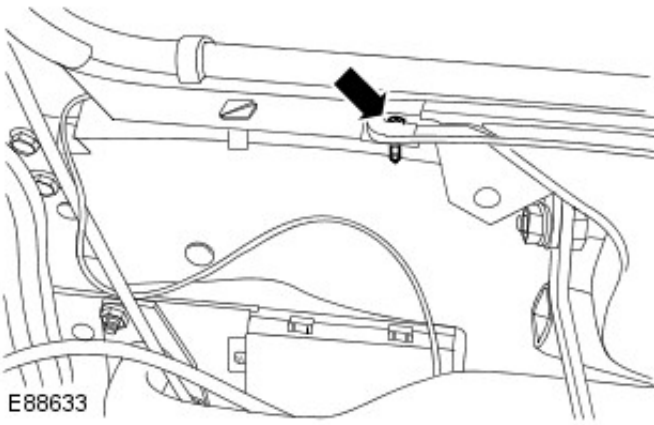
E88598

5. Remove the LH demister duct.
 - Remove the clip.

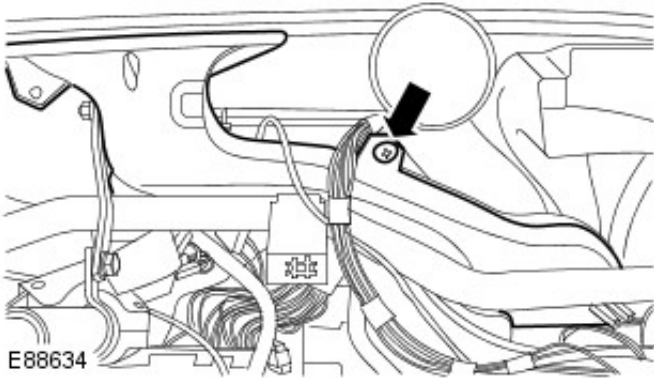


E88632

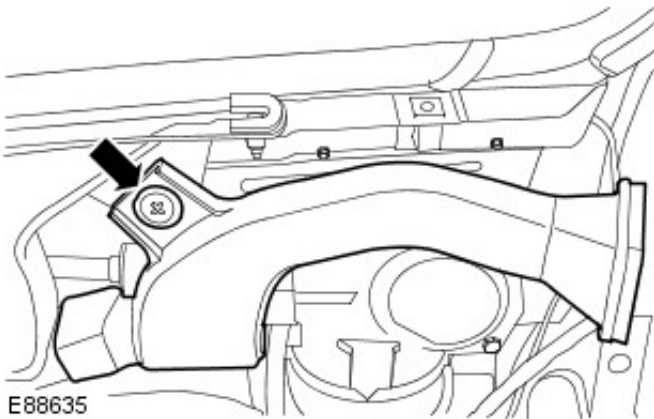
6. Release the LH defrost vent duct.
 - Remove the screw.



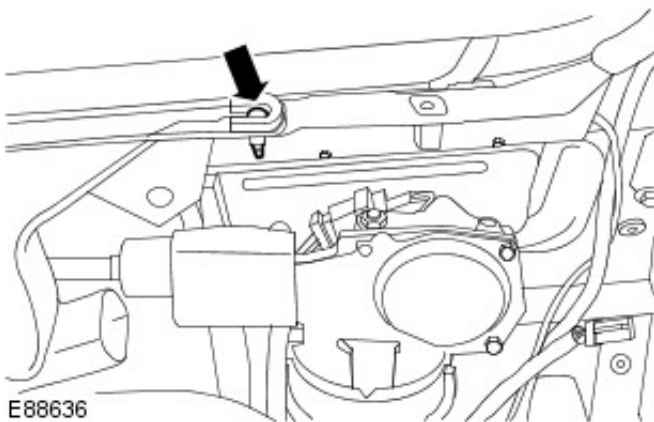
7. Remove the LH defrost vent duct.
 - Remove the clip.



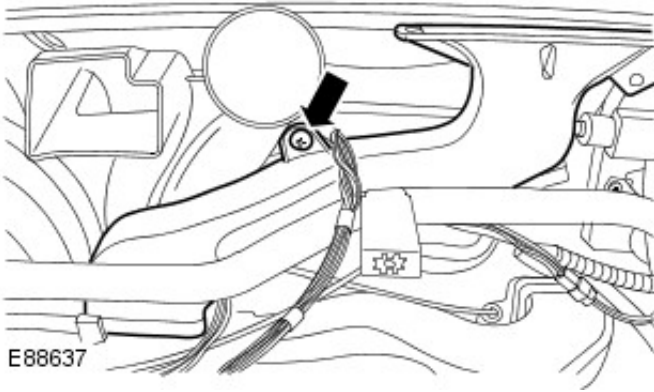
8. Remove the RH demister duct.
 - Remove the clip.



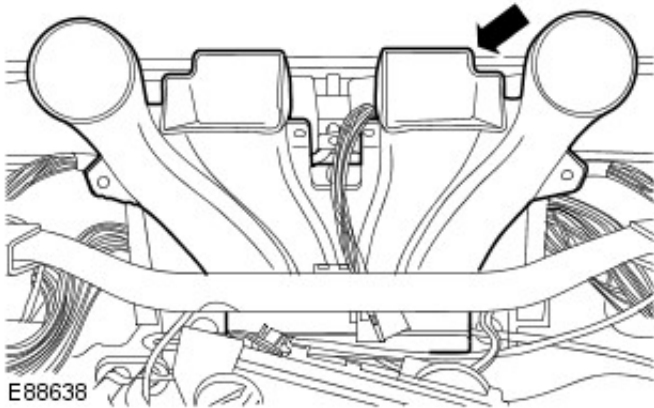
9. Release the RH defrost vent duct.
 - Remove the screw.



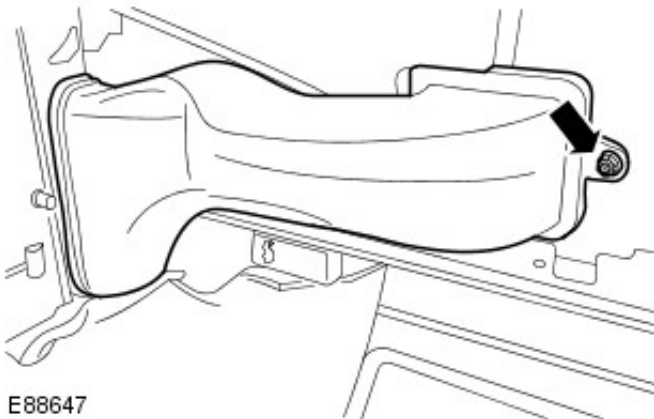
10. Remove the RH vent duct.
 - Remove the clip.



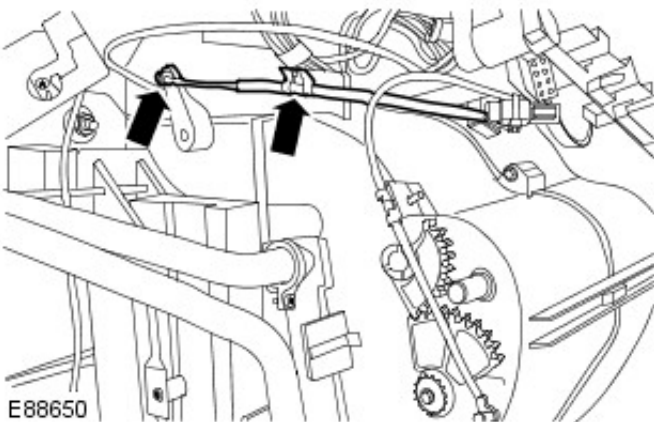
11. Remove the center register duct.



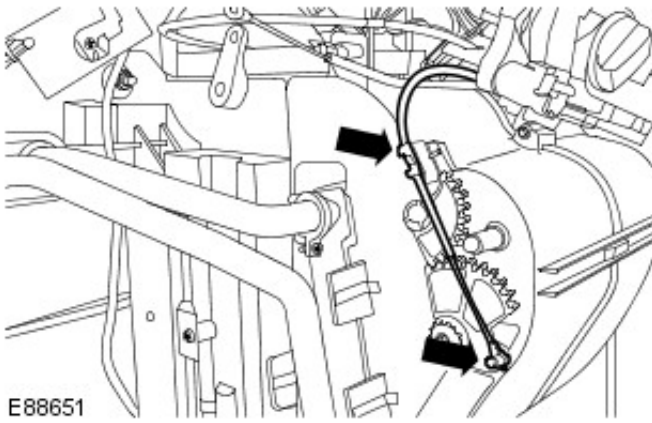
12. Remove the air inlet duct.
 • Remove the nut.



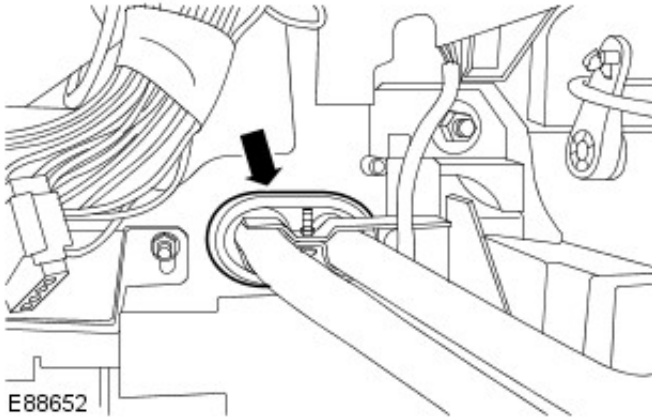
13. Disconnect the defrost duct blend door control cable.
 • Release the clip.



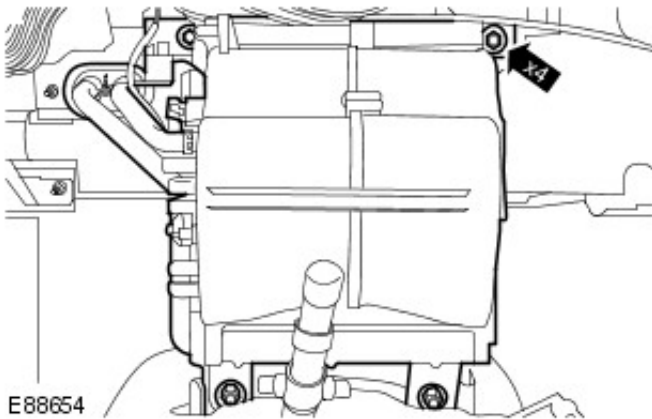
14. Disconnect the footwell duct blend door control cable.
 • Release the clip.



15. Release the grommet from the bulkhead.

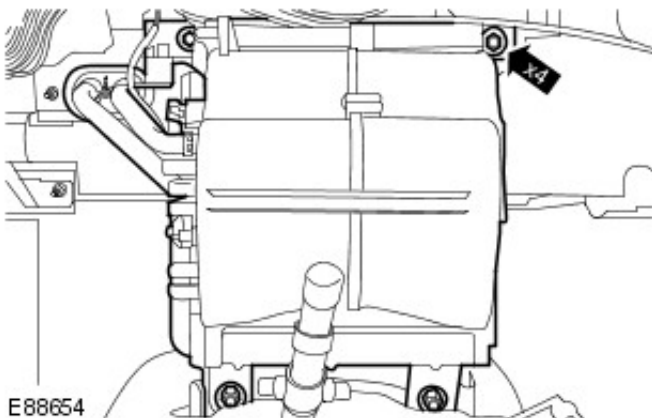


16. Remove the heater core housing.
• Remove the 4 nuts.



Installation

1. To install, reverse the removal procedure.
• Tighten to 15 Nm (11 lb.ft).



2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Air Conditioning - ID4 2.2L Diesel -

Torque Specifications

Description	Nm	lb-ft
A/C compressor bolts	48	35
A/C compressor low-pressure and high-pressure pipe bolt	30	22
A/C condenser core low-pressure and high-pressure refrigerant lines	8	6
Condenser core and condenser fan assembly bolts	15	11
Condenser fan bolts	2	1
Condenser core nuts	8	6
A/C receiver drier nuts	8	6
A/C receiver drier low-pressure and high-pressure refrigerant line bolts	8	6

Air Conditioning - ID4 2.2L Diesel - Air Conditioning (A/C) Compressor

Removal and Installation

Removal

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

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3. CAUTIONS:



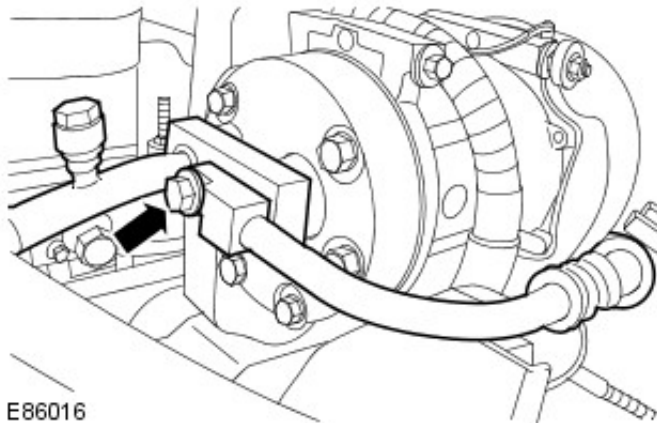
Make sure that all openings are sealed. Use new blanking caps.



Lubricate the new seals with clean refrigerant oil.

NOTE: Install new O-ring seals.

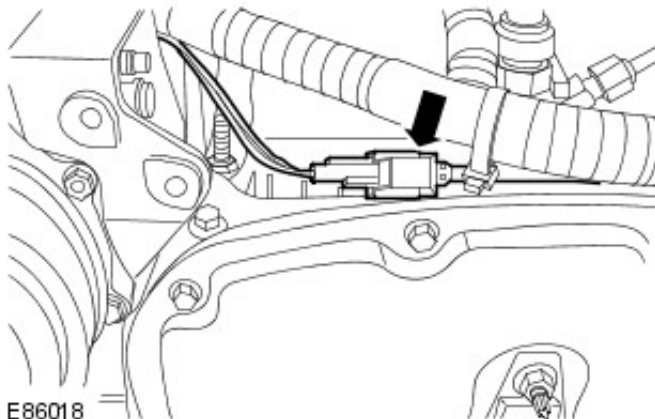
Torque: 30Nm



E86016

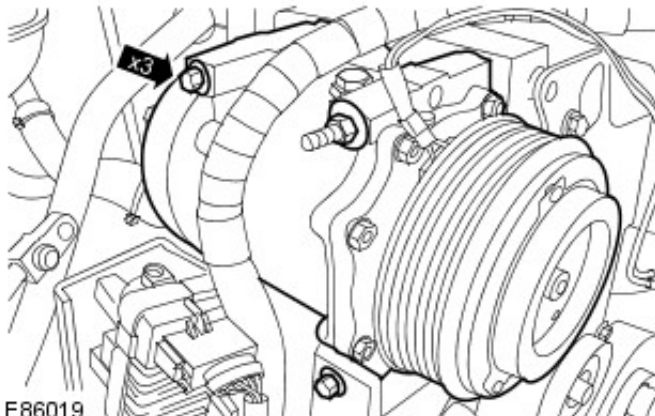
4. For additional information, refer to: [Accessory Drive Belt](#) (303-05 Accessory Drive - ID4 2.2L Diesel, Removal and Installation).

5.



E86018

6. Torque: 23Nm



E86019

Installation

1. NOTE: If a new compressor is being installed, the required amount of refrigerant oil must be drained from it.

To install, reverse the removal procedure.

Air Conditioning - ID4 2.2L Diesel - Air Conditioning (A/C) Switch

Removal and Installation

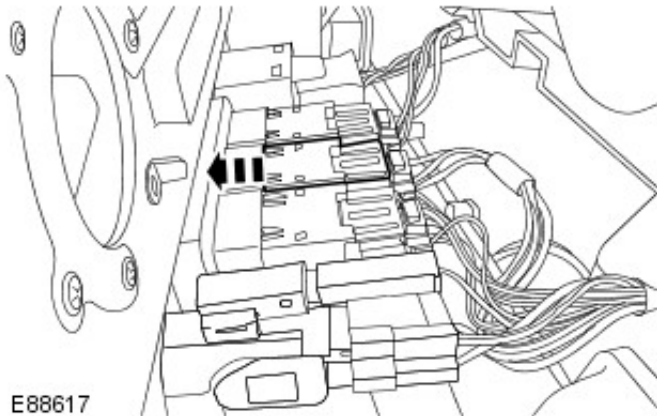
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).
3. Release the instrument panel console.



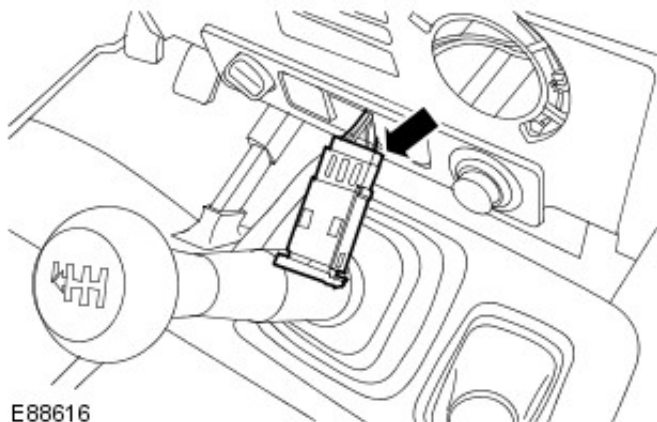
E88434

4. Release the air conditioning (A/C) switch.



E88617

5. Remove the A/C switch.
 - Disconnect the electrical connector.



E88616

Installation

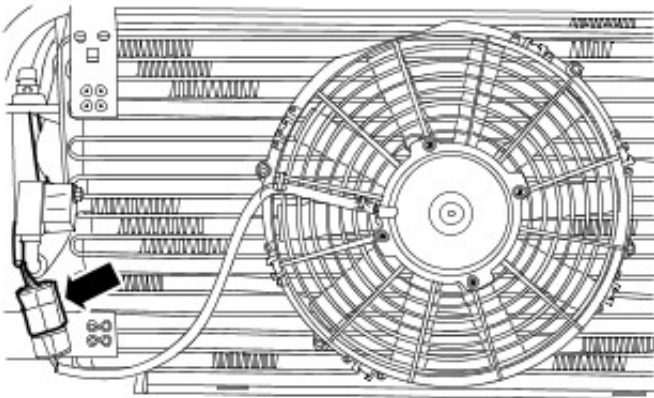
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Air Conditioning - ID4 2.2L Diesel - Condenser Core

Removal and Installation

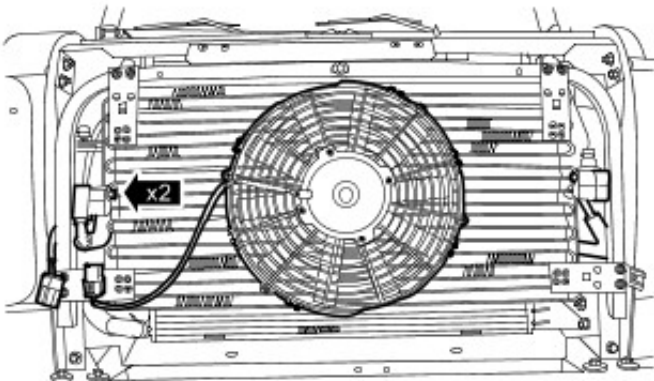
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
3. Remove the radiator grille.
For additional information, refer to: Radiator Grille (501-08, Removal and Installation).
4. Disconnect the condenser fan electrical connector.



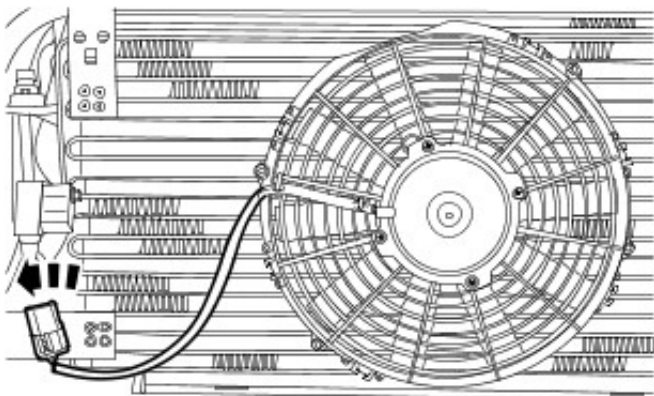
E86020

5. Disconnect the A/C condenser core low-pressure and high-pressure refrigerant lines.
 - Remove the 2 bolts.
 - Remove and discard the O-ring seals.



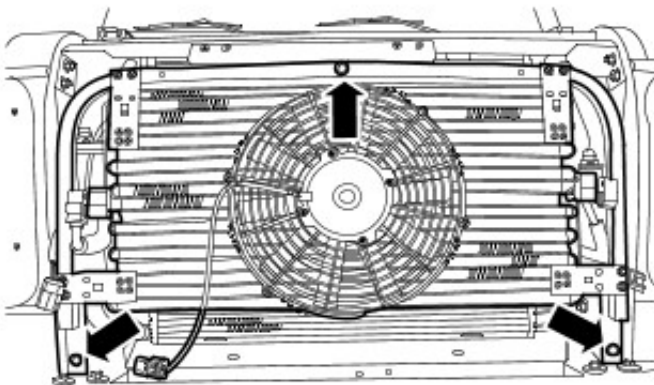
E86024

6. Release the condenser fan electrical connector.



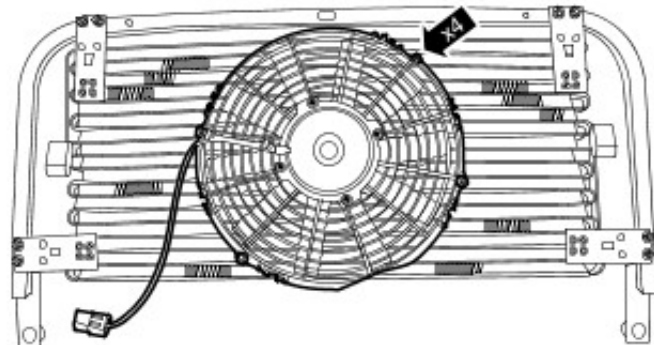
E86021

7. Remove the condenser core and condenser fan assembly.
 - Remove the 3 bolts.



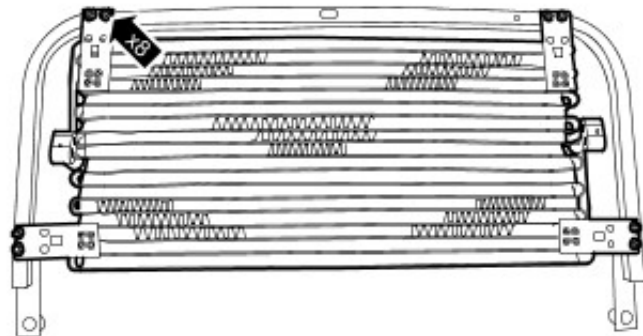
E86025

8. Remove the condenser fan.
 - Remove the 4 bolts.



E86026

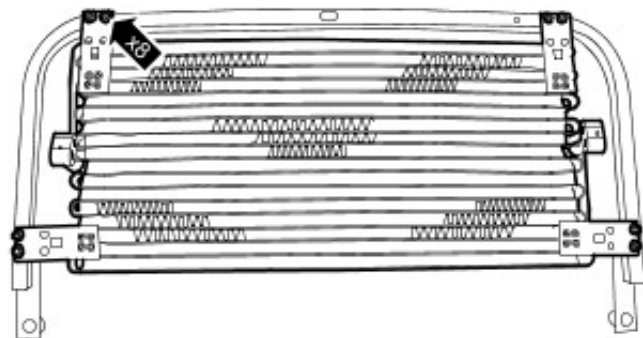
9. Remove the condenser core.
 - Remove the 8 nuts.



E86027

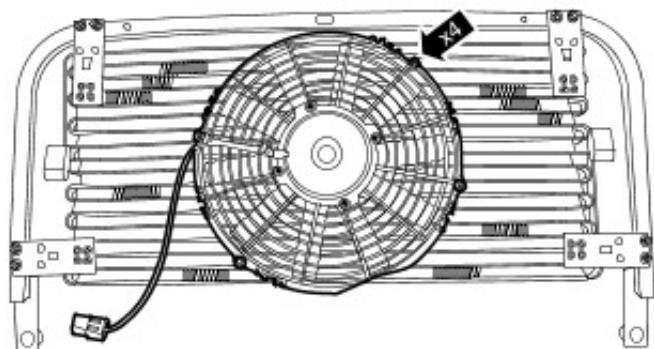
Installation

1. To install, reverse the removal procedure.
 - Tighten to 8 Nm (6 lb.ft).



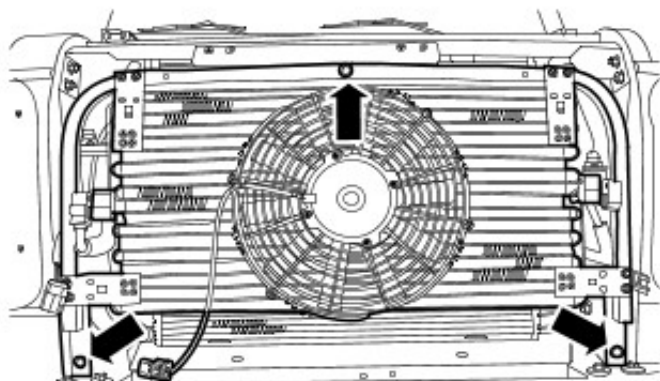
E86027

2. Tighten to 2 Nm (1 lb.ft).



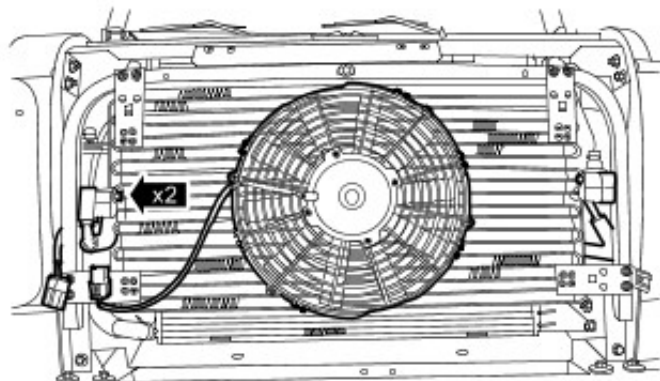
E86026

3. Tighten to 15 Nm (11 lb.ft).



E86025

4. Tighten to 8 Nm (6 lb.ft).



E86024

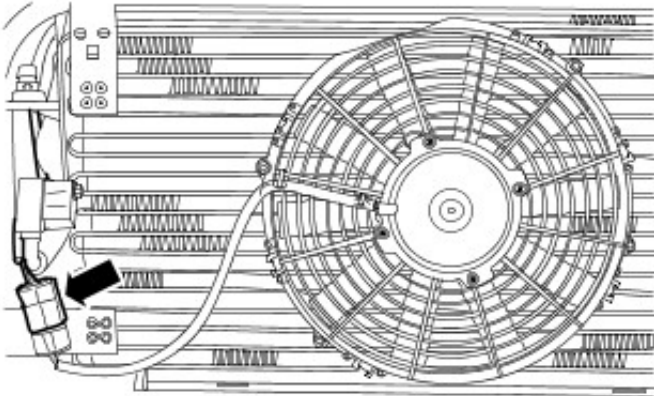
5. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Air Conditioning - ID4 2.2L Diesel - Condenser Fan

Removal and Installation

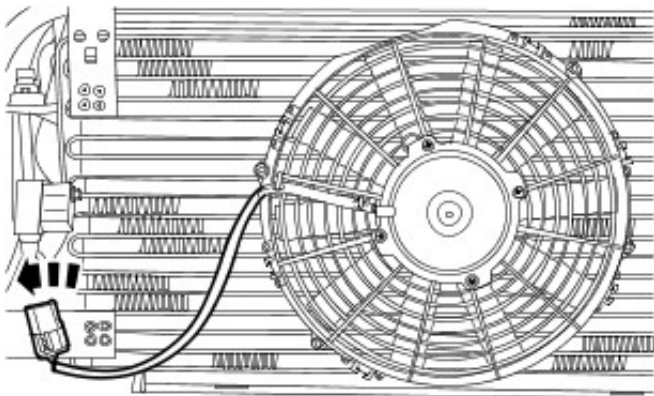
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Remove the radiator grille.
For additional information, refer to: Radiator Grille (501-08, Removal and Installation).
3. Disconnect the condenser fan electrical connector.



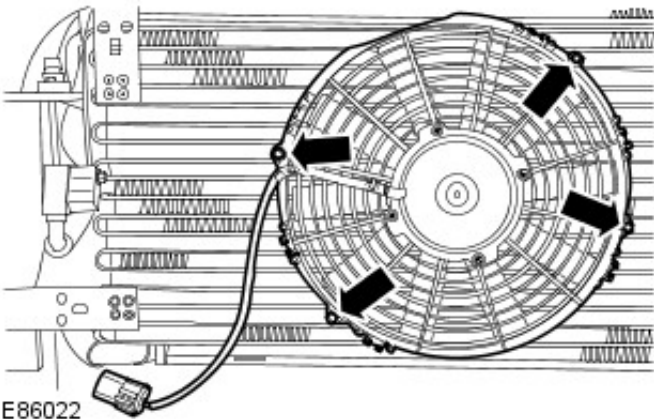
E86020

4. Release the condenser fan electrical connector.



E86021

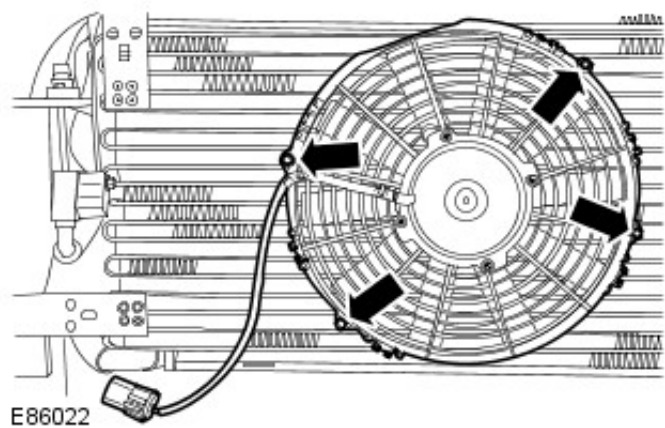
5. Remove the condenser fan.
 - Remove the 4 bolts.



E86022

Installation

1. To install, reverse the removal procedure.
 - Tighten to 2 Nm (1 lb.ft).



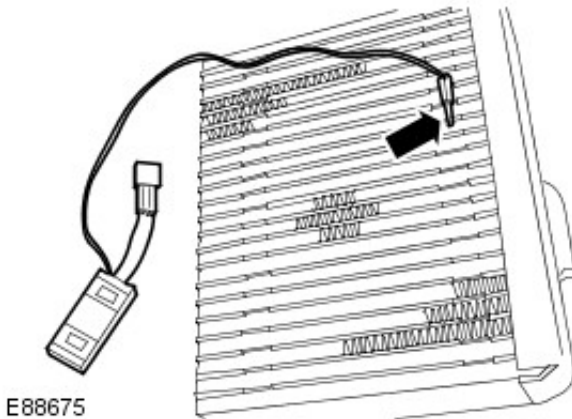
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Air Conditioning - ID4 2.2L Diesel - De-Icing Switch

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Remove the evaporator core.
For additional information, refer to: Evaporator Core (412-03, Removal and Installation).
3. Remove the de-icing switch from the evaporator core.



Installation

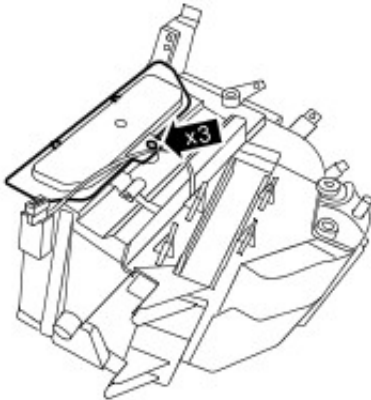
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Air Conditioning - ID4 2.2L Diesel - Evaporator Core

Removal and Installation

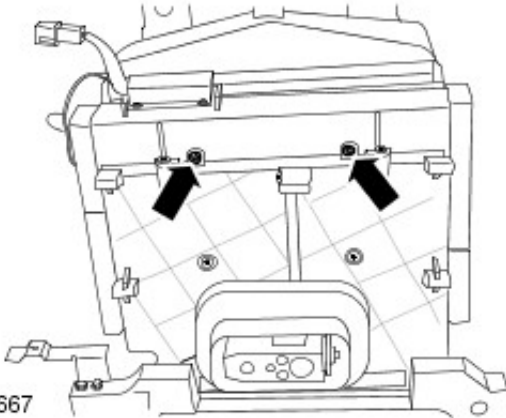
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the heater core.
For additional information, refer to: Heater Core (412-02 Heating and Ventilation, Removal and Installation).
3. Remove the evaporator core end cover.
 - Remove the 3 screws.



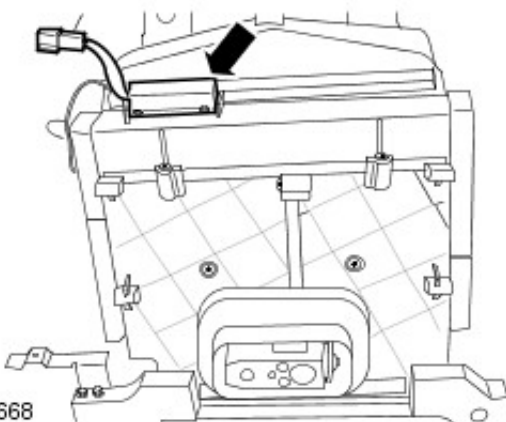
E88666

4. Release the evaporator core housing lower cover.
 - Remove the 2 screws.



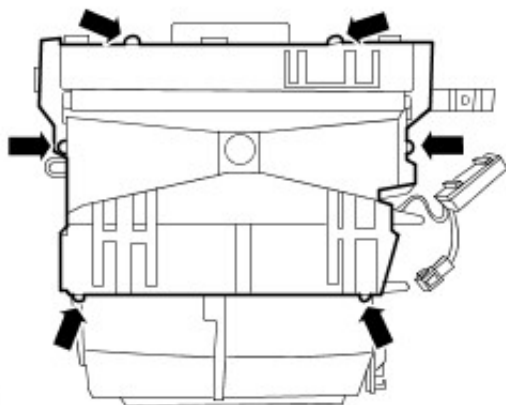
E88667

5. Release the de-icing sensor.



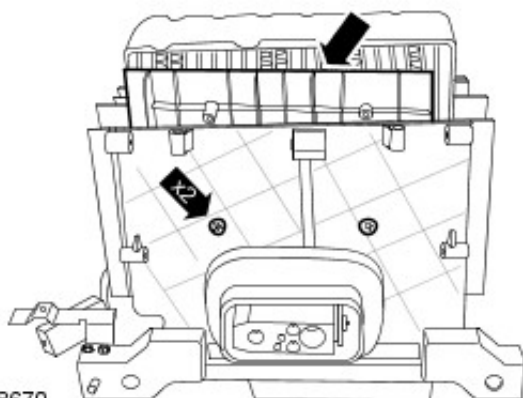
E88668

6. Remove the evaporator core housing lower cover.
 - Remove the 6 screws.



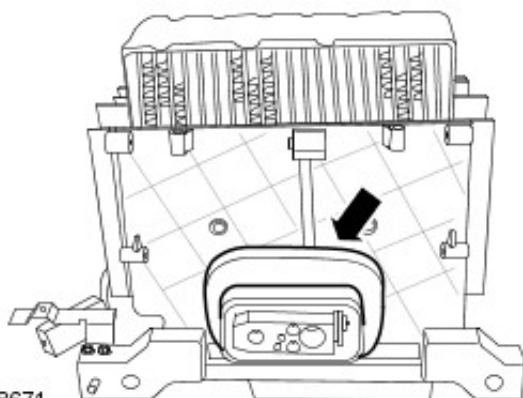
E88669

7. Remove the air flow deflector.
 - Remove the 2 screws.



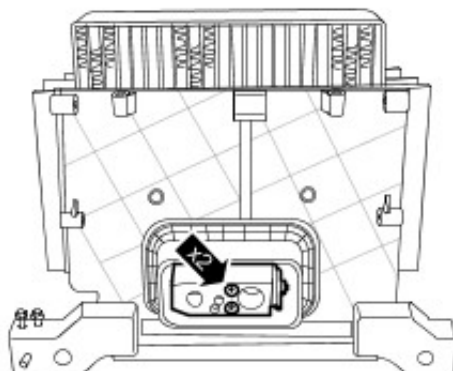
E88670

8. Remove the foam seal.



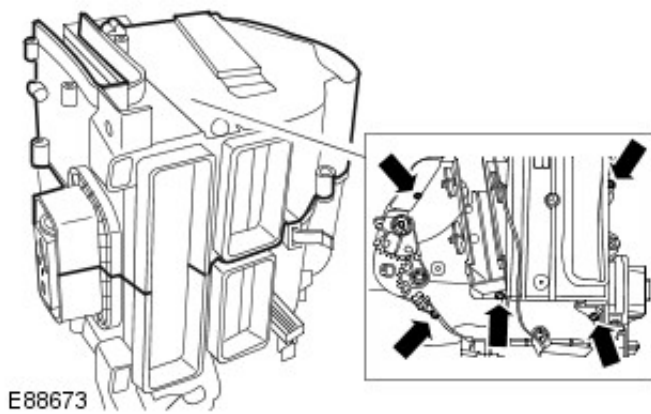
E88671

9. Remove the thermostatic expansion valve.
 - Remove the 2 bolts.
 - Remove and discard the O-ring seals.

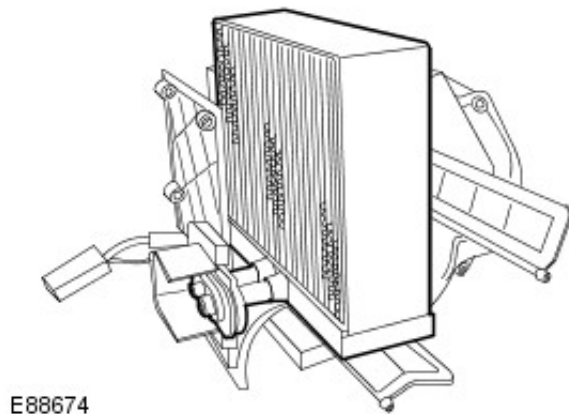


E88672

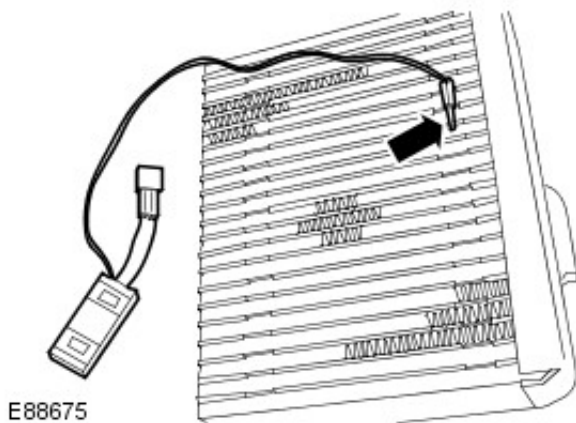
10. Separate the evaporator core housing.
 - Remove the 5 screws.



11. Remove the evaporator core.



12. Remove the de-icing switch from the evaporator core.



Installation

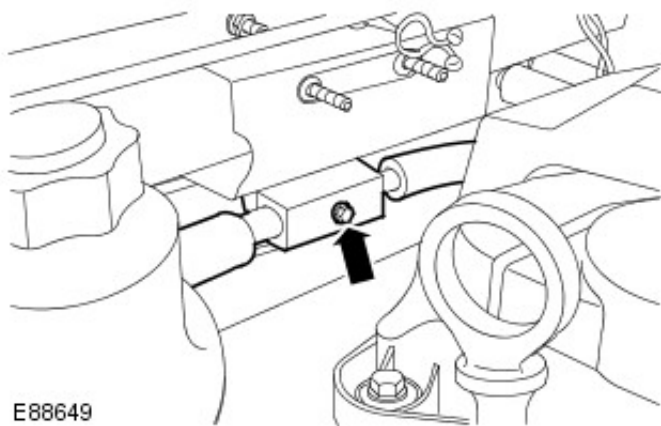
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).


Air Conditioning - ID4 2.2L Diesel - Thermostatic Expansion Valve

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
3. Remove the engine control module (ECM).
For additional information, refer to: Engine Control Module (ECM) (303-14 Electronic Engine Controls - 2.4L Diesel, Removal and Installation).

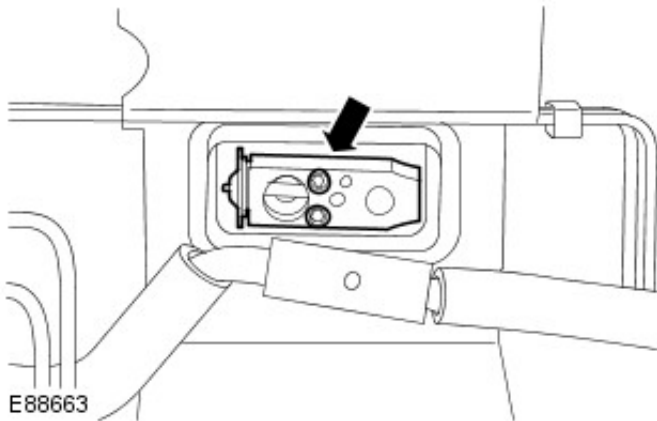


4.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Release the thermostatic expansion valve manifold and tube assembly.

- Remove the bolt.
- Remove and discard the O-ring seal.

5. Remove the thermostatic expansion valve.
 - Remove the 2 bolts.
 - Remove and discard the O-ring seals.



Installation

1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Air Conditioning - ID4 2.2L Diesel - Receiver Drier

Removal and Installation


Removal

1. Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

2. Release the power steering fluid reservoir.
 - Remove the 2 nuts.

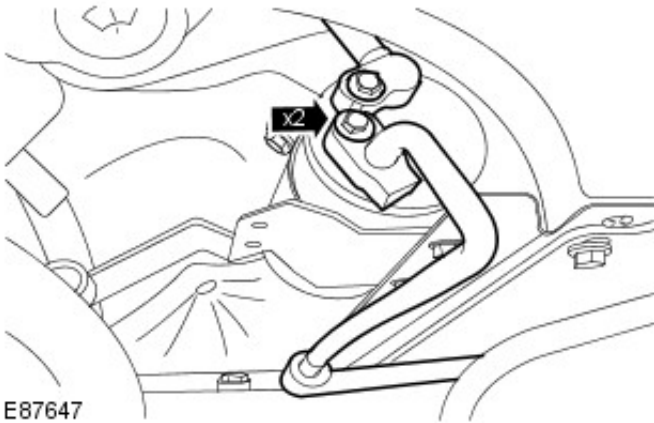


E87600

3.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

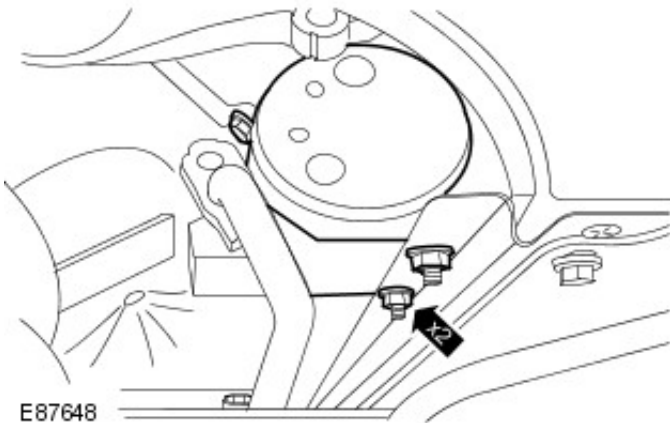
Disconnect the A/C receiver drier low-pressure and high-pressure refrigerant lines.

- Remove the 2 bolts.
- Remove and discard the O-ring seals.



E87647

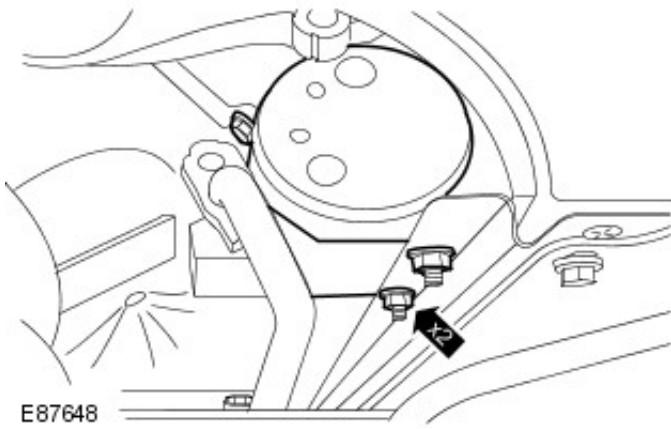
4. Remove the A/C receiver drier.
 - Remove the 2 nuts.



E87648

Installation

1. Install the A/C receiver drier.
 - Tighten to 8 Nm (6 lb.ft).

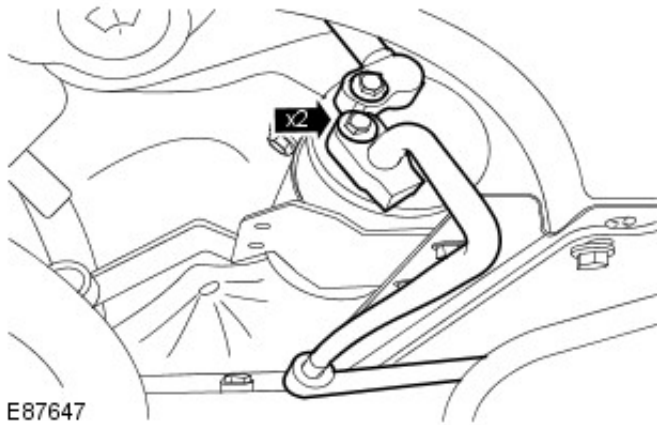


2. **NOTE:** Coat the receiver drier O-ring seals in clean refrigerant oil prior to installation.

NOTE: Remove and discard the blanking caps.

Connect the A/C receiver drier low-pressure and high-pressure refrigerant lines.

- Tighten to 8 Nm (6 lb.ft).



3. Secure the power steering fluid reservoir.
 - Tighten to 4 Nm (3 lb.ft).



4. Refill the air conditioning (A/C) refrigerant.
For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

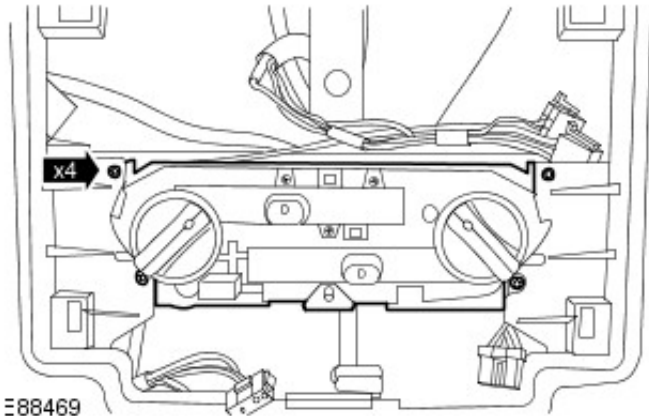
Control Components - Climate Control Assembly

Removal and Installation

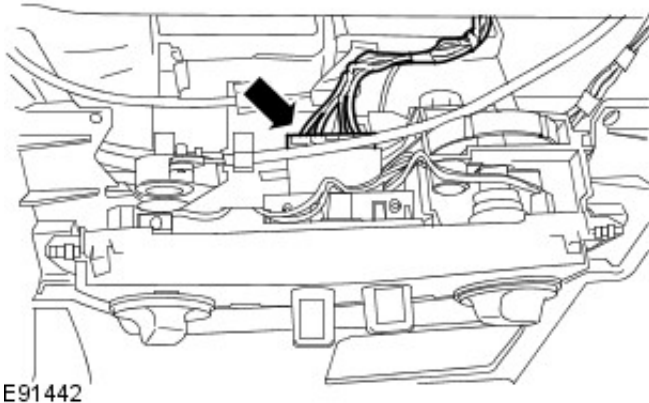
Removal

1. Remove the instrument panel console.
For additional information, refer to: Instrument Panel Console (501-12, Removal and Installation).

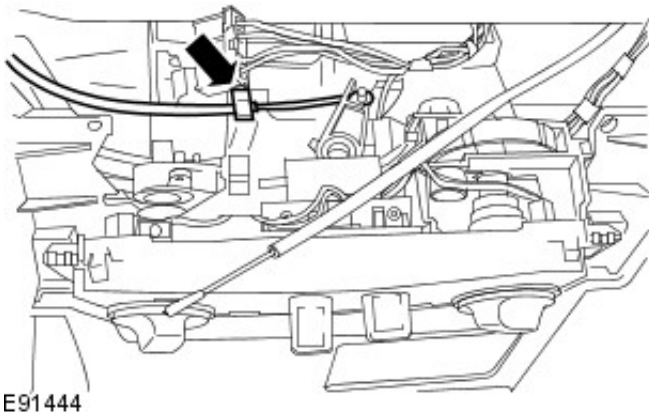
2. Release the climate control assembly.
 - Remove the 4 screws.



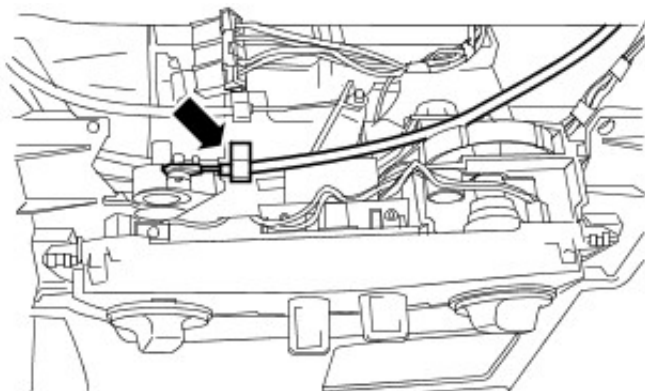
3. Disconnect the blower motor speed control switch electrical connector.



4. Disconnect the recirculation blend door control cable.
 - Release the clip.

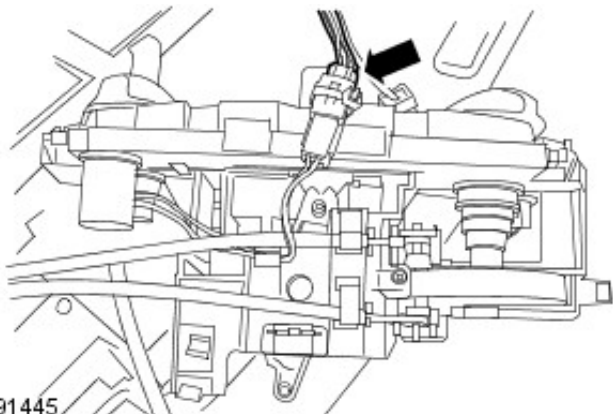


5. Disconnect the heater control valve control cable.
 - Release the clip.



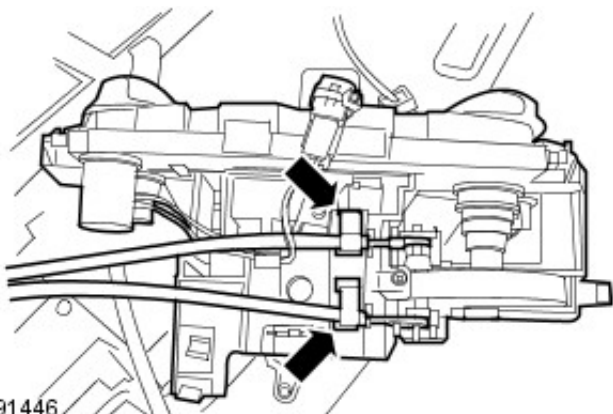
E91443

6. Disconnect the climate control assembly illumination electrical connector.



E91445

7. Remove the climate control assembly.
 - Release the clips.
 - Disconnect the 2 blend door control cables.



E91446

Installation

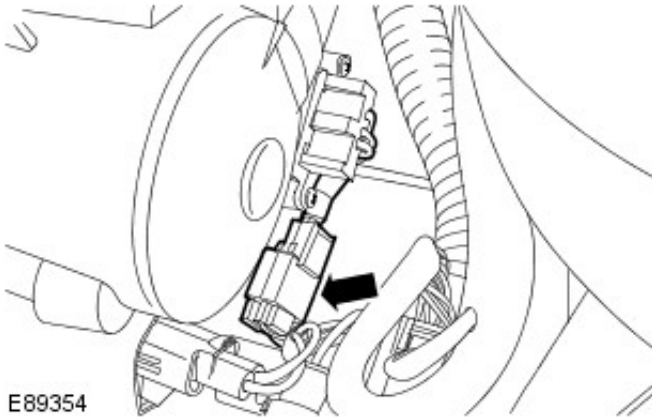
1. To install, reverse the removal procedure.

Control Components - Blower Motor Resistor

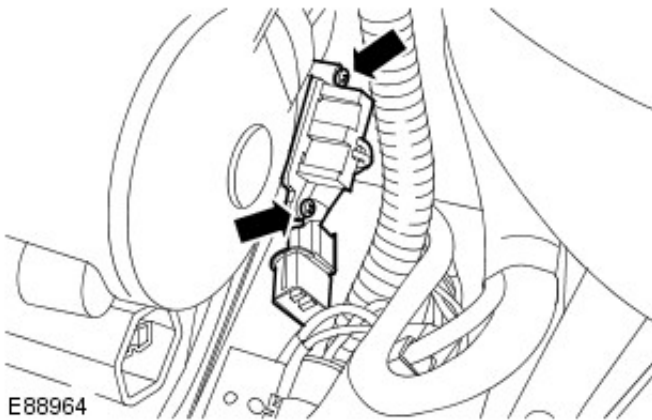
Removal and Installation

Removal

1. Disconnect the electrical connector.



2. Remove the blower motor resistor.
 - Remove the 2 screws.



Installation

1. To install, reverse the removal procedure.

Instrument Cluster -

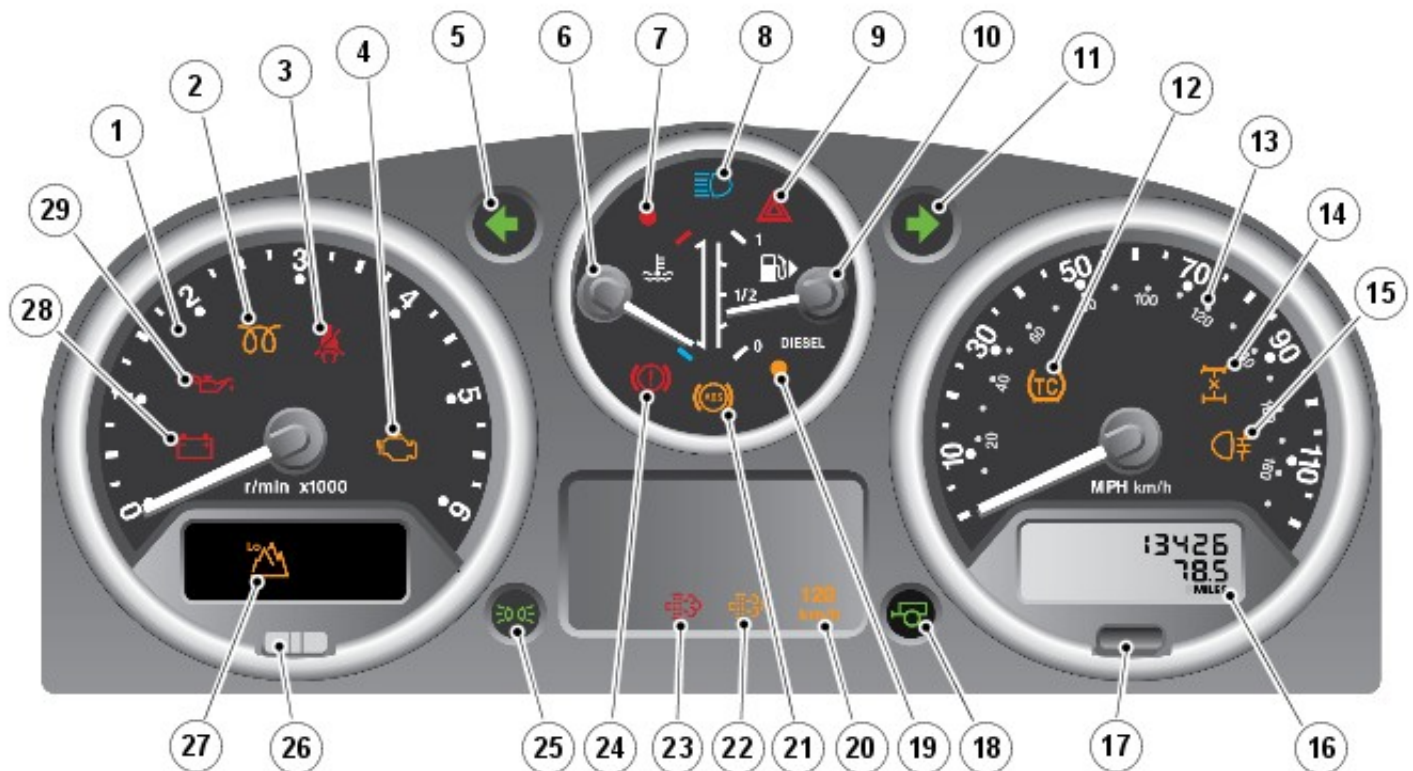
Torque specifications

Discription	Nm	lb.ft
Instrument cluster	2	1
Instrument cluster upper finisher	2	1
Instrument cluster lower finisher	2	1

Instrument Cluster - Instrument Cluster

Description and Operation

COMPONENT LOCATION



E139538

Item	Part Number	Description
1	-	Tachometer
2	-	Glow plugs active indicator
3	-	Safety belt indicator (Gulf States only)
4	-	malfunction indicator lamp (MIL)
5	-	Left turn signal indicator
6	-	engine coolant temperature (ECT) gauge
7	-	High ECT indicator
8	-	High beam indicator
9	-	Hazard flasher indicator
10	-	Fuel level gauge
11	-	Right turn signal indicator
12	-	Traction control indicator
13	-	Speedometer
14	-	Differential lock indicator
15	-	Rear fog lamp indicator
16	-	Odometer and trip meter display
17	-	Trip reset button
18	-	Trailer indicator
19	-	Low fuel indicator
20	-	Overspeed warning indicator (Saudi Arabia only)
21	-	anti-lock brake system (ABS) indicator
22	-	DPF (diesel particulate filter) regeneration indicator
23	-	DPF full indicator
24	-	Brake warning indicator

25	-	Side lamps on indicator
26	-	Anti-theft alarm indicator
27	-	Transfer box low range indicator
28	-	Ignition/No charge indicator
29	-	Low oil pressure indicator

OVERVIEW

The instrument cluster is located in the instrument panel, above the steering column. The instrument cluster comprises analogue gauges and a number of indicator lamps to display system status.

ANALOGUE GAUGES

The analogue gauges located in the instrument cluster are as follows:

- Speedometer
- Tachometer
- Fuel level gauge
- ECT gauge.

Each analogue gauge is driven by an electronic stepper motor. The characteristics of this type of motor produce damping of the pointer needle. All gauges return to their respective zero positions when the ignition is switched off.

INDICATOR LAMPS

Indicator lamps are located in various positions in the instrument cluster and can be split into 2 groups; self-controlled and externally controlled.

Self-controlled indicators are dependent on software logic within the instrument cluster for activation.

Externally controlled indicators are supplied with current from their respective systems. Engine related externally controlled indicators are illuminated by the instrument cluster on receipt of a high speed controller area network (CAN) bus message from the engine control module (ECM).

The following table shows the available indicators and indicates if they are subject to an indicator check at ignition on and if they are self or externally controlled.

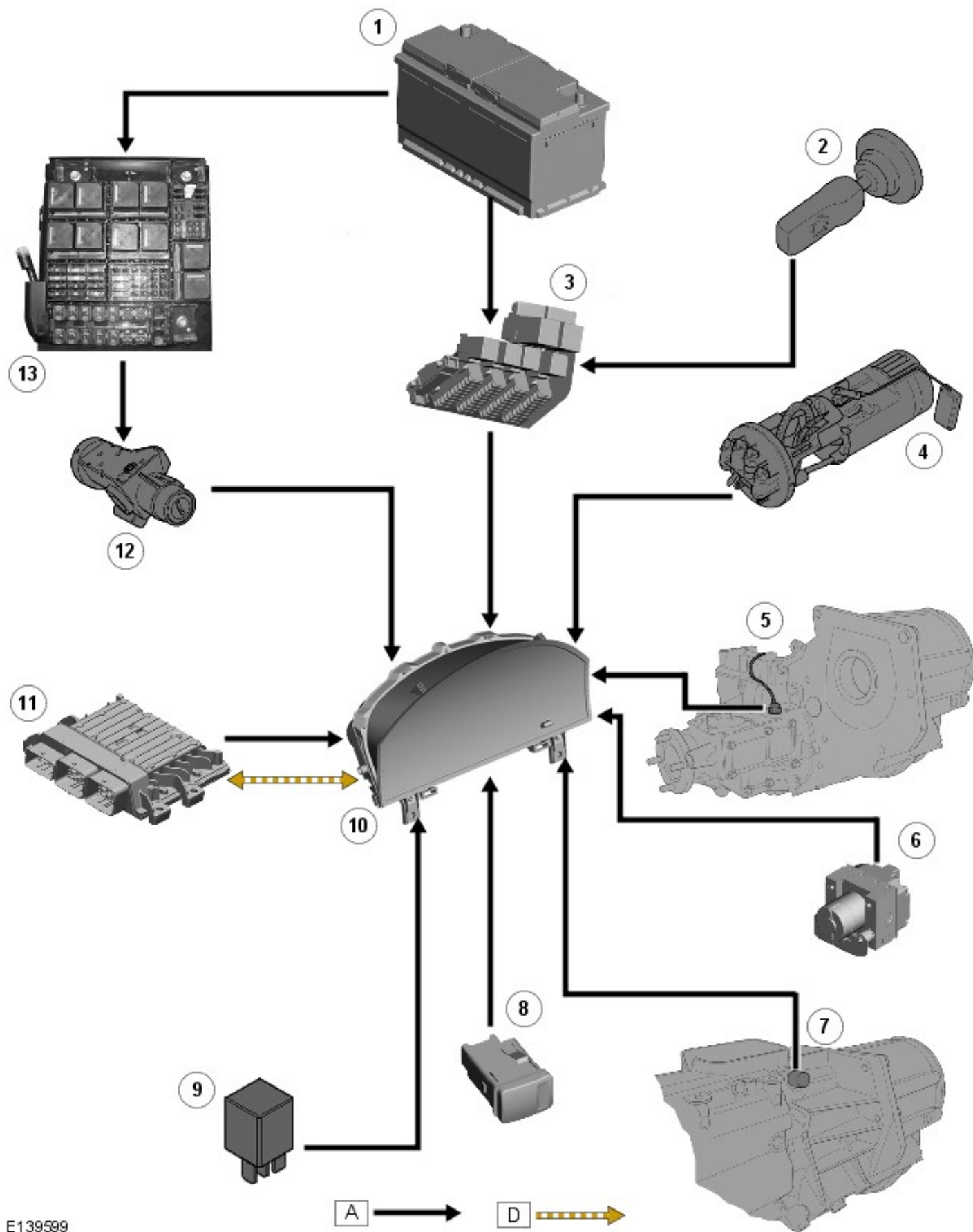
Indicator Lamp	Illumination Color	Bulb Check	Self Controlled (S)/Externally Controlled (E)
Glow plugs active	Amber	No (may illuminate at ignition on to show glow plugs active)	E
Safety belt	Red	No	E
MIL	Amber	* Yes	E
Left turn signal	Green	No	E
High ECT	Red	Yes	S
High beam	Blue	No	E
Hazard flasher	Red	No	E
Right turn signal	Green	No	E
Traction control	Amber	Yes	E
Differential lock	Amber	No	E
Rear fog lamp	Amber	No	E
Trailer	Green	No	E
Low fuel	Amber	Yes	S
Overspeed warning	Amber	Yes	S
**ABS	Amber	* Yes	E
DPF regeneration	Amber	Yes	E
DPF full	Red	Yes	E
Brake warning	Red	Yes	E
Side lamps on	Green	No	E
Anti-theft alarm	Red	No	E
Transfer box low range	Green	No	E
Ignition/No charge	Red	No	E
Low oil pressure	Red	No	E

* Bulb check performed by sub-system module, not instrument cluster.

** Instrument cluster is compatible with both WABCO and Bosch ABS modules.

CONTROL DIAGRAM - SHEET 1 OF 2

NOTE: **A** = Hardwired; **D** = High speed CAN bus.



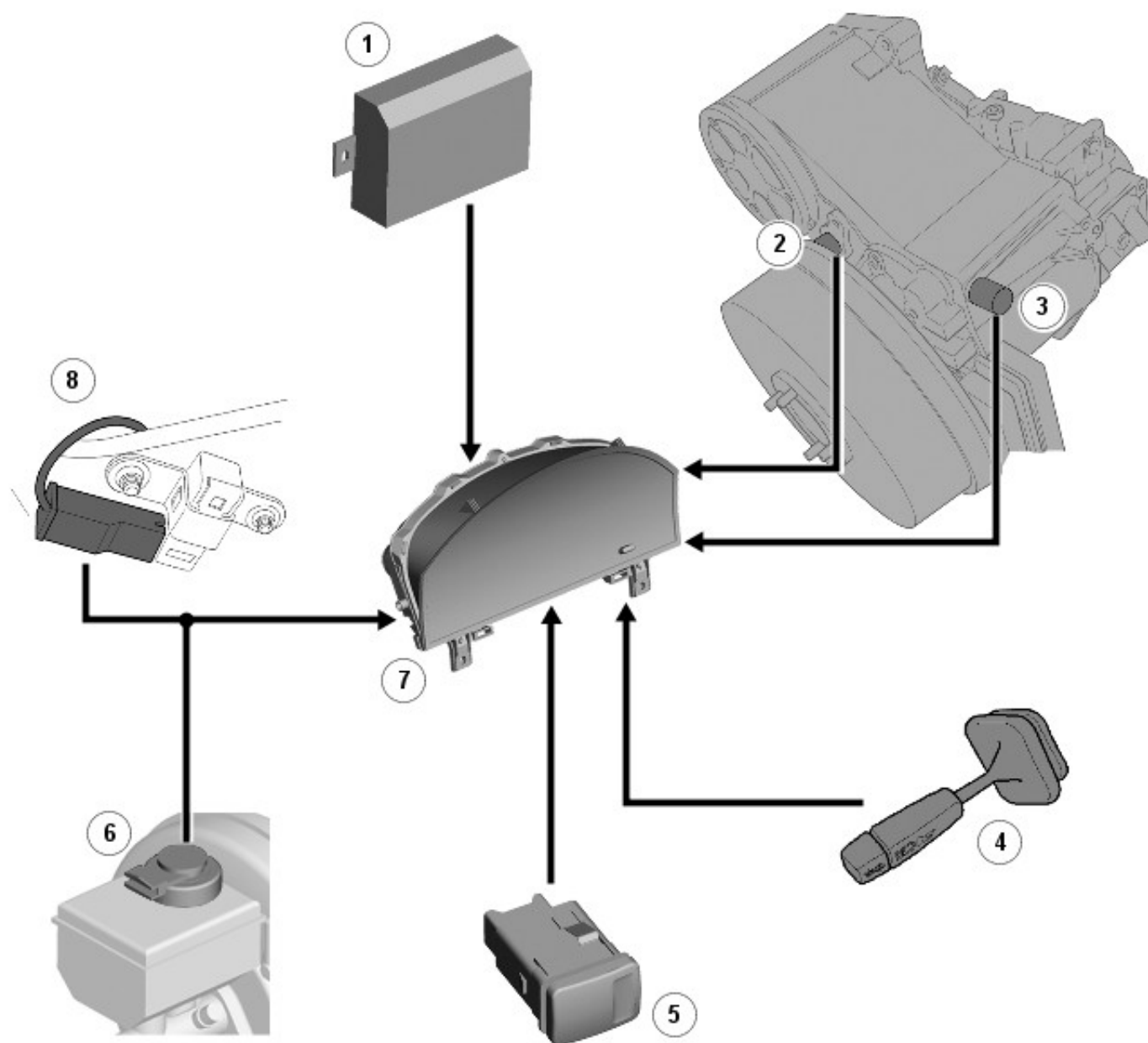
E139599

Item	Part Number	Description
1	-	Battery
2	-	Lighting switch
3	-	central junction box (CJB)
4	-	Fuel tank unit

- 5 - Differential lock switch
- 6 - ABS module
- 7 - Reverse gear switch
- 8 - Hazard flasher switch
- 9 - Hazard flasher relay
- 10 - Instrument cluster
- 11 - ECM
- 12 - Ignition switch
- 13 - battery junction box (BJB)

CONTROL DIAGRAM - SHEET 2 OF 2

NOTE: **A** = Hardwired.



E139600



Item	Part Number	Description
1	-	Anti-theft alarm control module
2	-	Vehicle speed sensor
3	-	High/Low range switch

- | | | |
|---|---|--|
| 4 | - | Column switch - turn signal indicators |
| 5 | - | Rear fog lamp switch |
| 6 | - | Brake fluid level switch |
| 7 | - | Instrument cluster |
| 8 | - | Parking brake switch |

PRINCIPLES OF OPERATION

Speedometer

The instrument cluster receives a hardwired vehicle speed signal from the vehicle speed sensor. The vehicle speed sensor is a Hall effect sensor located on the transfer box. The sensor acts on a reluctor ring located on the transfer box rear output shaft.
 For additional information, refer to: [Transfer Case](#) (308-07A Transfer Case - Vehicles With: MT82 6-Speed Manual Transmission, Description and Operation).

Tachometer

The tachometer is driven by an engine speed signal transmitted on the high speed CAN bus from the ECM. The signal is derived from the crankshaft position (CKP) sensor. The signal is received by the instrument cluster microprocessor and the output from the microprocessor drives the tachometer.

Fuel Level Gauge

The instrument cluster calculates the amount of fuel in the tank by providing a reference current to the fuel tank level sensor. The fuel tank level sensor uses a float operated Magnetic Passive Position Sensor (MAPPS) for measuring fuel tank contents.

The instrument cluster measures the returned output from the sensor, which is proportional to the level of the float arm and consequently the amount of fuel in the tank. The instrument cluster monitors the signal from the sensor at approximately 20 second intervals. This prevents the gauge needle pointer from continually moving due to the movement of fuel in the tank when cornering or braking.

Engine Coolant Temperature Gauge

The ECT gauge is driven by high speed CAN bus messages from the ECM. For normal operating temperatures the gauge needle pointer is positioned centrally in the gauge display. The needle pointer position translates to the following approximate temperatures.

Engine Coolant Temperature °C (°F)	Needle Pointer Position
Ignition off	Park position
40 (104)	Cold (blue segment)
75 - 115 (167 - 239)	Normal (central)
120 (248)	Start of hot (red segment)
125 (257)	End of hot

Glow Plugs Active Indicator

The glow plugs active indicator is illuminated by the instrument cluster software on receipt of a high speed CAN bus message from the ECM. The indicator illuminates in an amber color when the ignition is turned to position II. The indicator illumination period varies with ECT and if ECT is high, will not illuminate.

The indicator is controlled by high speed CAN bus messages from the ECM, which equate to the time the glow plugs are energized to pre-heat the combustion chambers. When the glow plug heating time is complete, the indicator is extinguished indicating to the driver that the engine can now be started.

Safety Belt Indicator

The safety belt indicator is controlled by a hardwired feed from switches located in the front seat safety belt buckles. The safety belt indicator is fitted to Gulf specification vehicles only.

Malfunction Indicator Lamp

The MIL is controlled by the instrument cluster software on receipt of a high speed CAN bus message from the ECM. The lamp is illuminated for a bulb check by the ECM when the ignition is moved to position II. The lamp is extinguished when the engine starts.

If the MIL remains illuminated after the engine is started or illuminates while driving, a fault is present and must be investigated at the earliest opportunity. Illumination of the MIL indicates there is an on-board diagnostic (OBD) fault which will cause excessive emissions output.

Left and Right Turn Signal Indicators

The turn signal indicators are controlled by the instrument cluster software on receipt of hardwired signals from the steering column switch. When the turn signal indicator switch is operated, the instrument cluster receives a signal feed

from the column switch. The instrument cluster software controls the flash rate of the indicator which flashes in a green color. During normal turn signal indicator operation the indicator flashes slowly, accompanied simultaneously by a sound from the instrument cluster sounder. If a fault exists, the instrument cluster flashes the indicator at double speed.

High Engine Coolant Temperature Indicator

The high ECT indicator is illuminated on receipt of a high speed CAN bus message from the ECM. The indicator illuminates when the ignition is turned to position II for a 3 second bulb check and is extinguished when the engine is started. If the indicator illuminates while driving, a fault in the engine cooling system has become present and the engine must be stopped at the earliest opportunity.

High Beam Indicator

The high beam indicator is controlled by the instrument cluster software on receipt of a hardwired signal from the CJB. The signal from the CJB originates from the steering column switch when high beam is selected.

Hazard Flasher Indicator

The hazard flasher indicator is controlled by the instrument cluster software on receipt of a hardwired signal from the hazard flasher switch. The hazard flasher indicators can operate with the ignition switched off, flashing both the left and right turn signal indicators simultaneously.

Traction Control Indicator

The traction control indicator is illuminated by the instrument cluster software on receipt of a hardwired signal from the ABS module. The indicator is illuminated for 3 seconds for a bulb check when the ignition switch is turned to position II. If no fault exists, the indicator is extinguished after the bulb check period.

When traction control is active, the indicator flashes to inform the driver that the system is regulating engine output.

Differential Lock Indicator

The differential lock indicator is illuminated on receipt of a hardwired signal from the differential lock switch. The indicator will illuminate at all times when the differential lock is selected and the ignition switch is in position II.

Rear Fog Lamp Indicator

The rear fog lamp indicator is illuminated on receipt of a hardwired signal from the rear fog lamp switch. The indicator will illuminate at all times when the rear fog lamps are selected on and the ignition switch is in position II.

Trailer Indicator

The trailer indicator is controlled by the instrument cluster software on receipt of a hardwired signal from the hazard flasher relay. When a trailer is connected, the hazard flasher relay energizes and provides a feed to the instrument cluster. The feed across the hazard flasher relay originates from the steering column switch. The instrument cluster software controls the flash rate of the indicator which flashes in a green color. The trailer indicator flashes slowly, accompanied simultaneously by a chime from the instrument cluster sounder, at the same rate as the turn signal indicators.

Low Fuel Indicator

The instrument cluster calculates the amount of fuel in the tank by providing a reference current to the fuel tank level sensor. If the cluster determines the level of fuel within the tank is at or below 14 liters (3.69 gallons) it will illuminate the low fuel indicator and emit a single chime. For more information, refer to 'Fuel Level Gauge' above.

Overspeed Indicator (Saudi Arabia Only)

The amber overspeed indicator is controlled by the instrument cluster software. The instrument cluster receives a hardwired vehicle speed signal from the vehicle speed sensor on the transfer box. The indicator illuminates if vehicle speed reaches 120 km/h. The indicator also illuminates when the ignition is turned to position II for a 3 second bulb check and is extinguished when the engine is started.

Anti-lock Braking System Indicator

The ABS indicator is controlled by the ABS module which transmits a hardwired signal to the instrument cluster. The indicator is illuminated in an amber color for a 3 second bulb check by the ABS module when the ignition is turned to position II. If the indicator remains illuminated or illuminates when driving, an ABS fault has occurred and the ABS function will not be available.

The ABS module will alert the driver that a diagnostic trouble code (DTC) has been stored in its memory during the bulb check process. It will do this by;

- illuminating the indicator for 0.5 seconds
- extinguishing the indicator for 0.5 seconds
- illuminating the indicator for 2 seconds.

If the indicator is illuminated for a sensor fault, the indicator will remain illuminated at the next ignition cycle, even if the

fault is rectified. When the vehicle is driven above a speed of 20 km/h (12.5 mph) the indicator will be extinguished. This allows the ABS module to perform a thorough check of the system and to establish that the output from the replaced sensor is correct.

Diesel Particulate Filter Indicators

The **DPF** indicators are illuminated on receipt of a high speed CAN bus message from the ECM. The indicators illuminate when the ignition is turned to position II for a 3 second bulb check and are extinguished when the engine is started.

If the amber **DPF** indicator illuminates while driving, the **DPF** is approaching capacity. If the red **DPF** indicator illuminates while driving, the **DPF** is full.

For additional information, refer to: [Exhaust System - ID4 2.2L Diesel](#) (309-00 Exhaust System - ID4 2.2L Diesel, Description and Operation).

Brake Warning Indicator

The brake warning indicator is illuminated for a 3 second bulb check when the ignition is turned to position II. The indicator will also illuminate if the parking brake is on, or the brake fluid falls below a pre-determined level. The instrument cluster is hardwired to the parking brake switch and the brake fluid level switch, which are connected in parallel. If either of the conditions above are met a ground path is created, illuminating the indicator.

Side Lights On Indicator

The side lights on indicator is controlled by the lighting switch. When the lighting switch is turned to the side or headlamp position, a hardwired feed is provided to the instrument cluster via the CJB. On receipt of the hardwired feed, the instrument cluster illuminates the indicator.

Anti-theft Alarm Indicator

Illumination of the anti-theft alarm indicator is controlled directly by the anti-theft alarm control module. For additional information, refer to:

[Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation),
[Anti-Theft - Passive](#) (419-01B Anti-Theft - Passive, Description and Operation).

Transfer Box Low Range Indicator

The transfer box high/low range switch is hardwired to the instrument cluster. When low range is selected, the transfer box provides a feed to instrument cluster, which subsequently illuminates the green low range indicator. The low range indicator remains permanently illuminated until high range is selected and the feed from the high/low range switch is removed.

Ignition/No Charge Warning Indicator

The ignition/no charge indicator is controlled by the instrument cluster software and illuminated on receipt of a high speed CAN bus message from the ECM. The indicator illuminates in a red color when the ignition is turned to position II and is extinguished when the engine is started.

If the indicator remains illuminated after the engine has started or illuminates when driving, the alternator charge output has failed.

Low Oil Pressure Warning Indicator

The low oil pressure indicator is controlled by the instrument cluster software and illuminated on receipt of a high speed CAN bus message from the ECM. The indicator is illuminated in a red color when the ignition switch is turned to position II. When the engine is started and the oil pressure increases the low oil pressure indicator should extinguish. If the indicator remains illuminated or illuminates when driving the vehicle should be stopped at the earliest opportunity and the engine switched off until the fault is rectified.

Instrument Cluster Replacement

If a new instrument cluster is to be fitted, Land Rover approved diagnostic equipment must be connected to the vehicle and the instrument cluster renewal procedure run. This will ensure that vehicle coding data is correctly installed in the new instrument cluster. The Land Rover approved diagnostic equipment will also record the current service interval data and restore the settings to the new instrument cluster.

Instrument Cluster - Instrument Cluster


Diagnosis and Testing

Overview

The instrument cluster is a totally electronic device which receives analogue or digital signals via hardwired or bus system for instrumentation operation. The signals which are processed by the engine control module (ECM) are transmitted via controller area network (CAN) to the instrument cluster and displayed as analogue gauge indications or warning lamp illuminations. The instrument cluster is connected to the vehicle electrical system by one connector which provides all input and output connections. No components of the instrument cluster are serviceable. The instrument cluster has two main functions to provide information to the driver of the vehicle status and to process and relay digital signals. The instrument cluster identifies the signals and displays the appropriate message in the message center. For information on the operation of the systems:

REFER to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation) / [Communications Network](#) (418-00 Module Communications Network, Description and Operation).

Car Configuration File (CCF)

 **CAUTION:** If a new instrument cluster is to be installed, the instrument cluster renewal procedure must be carried out using the approved diagnostic system. This will make sure that the car configuration file (CCF) data is correctly transferred from the ECM to the replacement instrument cluster. The CCF will also need to be updated using the approved diagnostic system if the vehicle is modified in service from its original factory specification. This can include the fitting of non-standard wheels and/or tires and optional dealer fit accessory components with an electrical interface, such as parking aid.

The CCF contains all relevant data about the specification and market condition of the applicable vehicle, immobilization codes and driver personal settings. This information is retained in the ECM and the instrument cluster enabling each system module to detect which systems and components are fitted to the vehicle. The information is continuously transferred between these two system modules to make sure that the data is constantly backed-up between the modules.

Inspection and Verification

1. Verify the customer concern.
2. Confirm which, if any, warning lights were displayed on the instrument cluster.
3. Visually inspect for obvious electrical faults.

Visual inspection

Electrical
<ul style="list-style-type: none">● Battery and passenger junction box fuses● Read diagnostic trouble codes (DTCs)● Using the approved diagnostic system or a scan tool● Damaged, loose or corroded connectors● Instrument cluster for any external damage● Electrical circuits

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. Use the approved diagnostic system or a scan tool to retrieve any DTCs before moving onto the DTC index.
 - Make sure that all DTCs are cleared following rectification.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00. REFER to: [How To Use This Manual](#) (100-00 General Information, Description and Operation).

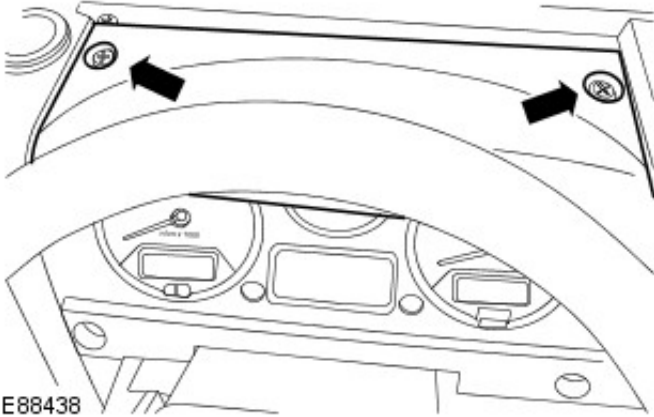
Instrument Cluster - Instrument Cluster

Removal and Installation

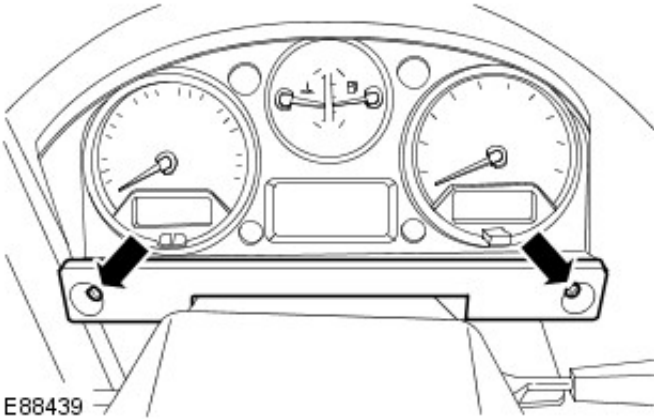
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).

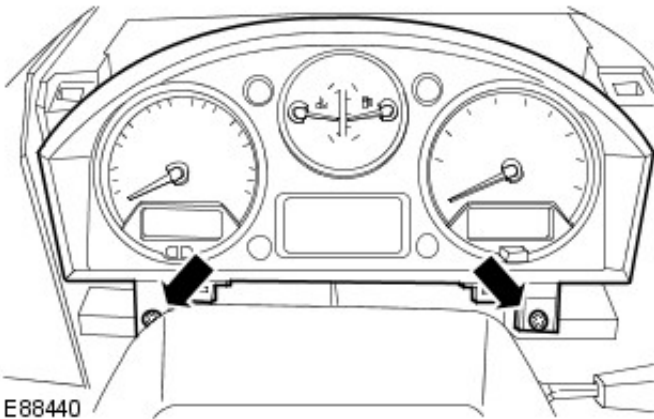
2. Remove the instrument cluster upper finisher.
 - Remove the 2 screws.



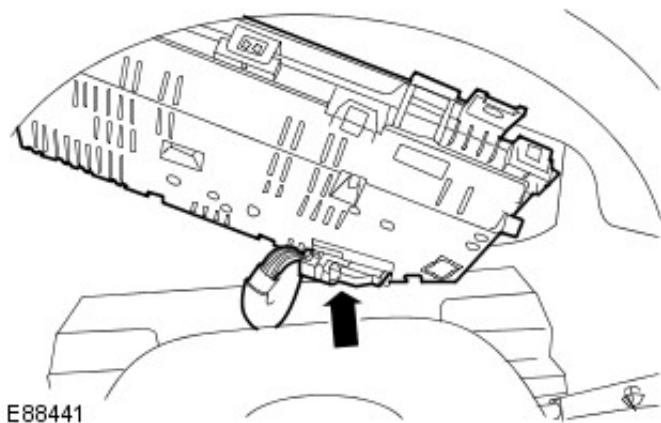
3. Remove the instrument cluster lower finisher.
 - Remove the 2 screws.



4. Release the instrument cluster.
 - Remove the 2 screws.



5. Remove the instrument cluster.
 - Disconnect the electrical connector.



E88441

Installation

1. Install the instrument cluster.
 - Connect the electrical connector.
2. Secure the instrument cluster.
 - Install the 2 screws.
3. Install the instrument cluster lower finisher.
 - Install the 2 screws.
4. Install the instrument cluster upper finisher.
 - Install the 2 screws.
5. Connect the battery ground cable.

For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).
6. Using the approved Land Rover diagnostic equipment, configure the instrument cluster.

Instrument Cluster - Instrument Cluster Lens

Removal and Installation

Removal

NOTE: Some variation in the illustration may occur, but the essential information is always correct.

1. Fully extend the steering column for access
2. Disconnect the battery ground cable.

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

3. Refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Removal and Installation).

4.



E141120

5. Copy the information from the old label on to the new label.



E141274

6.  CAUTION: Take care not to damage the dials or

buttons when removing the lens.



E141121

Installation

NOTE: Take care not to leave finger prints inside new lens when fitting.

1.



E141122

2. Refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Removal and Installation).

3. Connect the battery ground cable

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

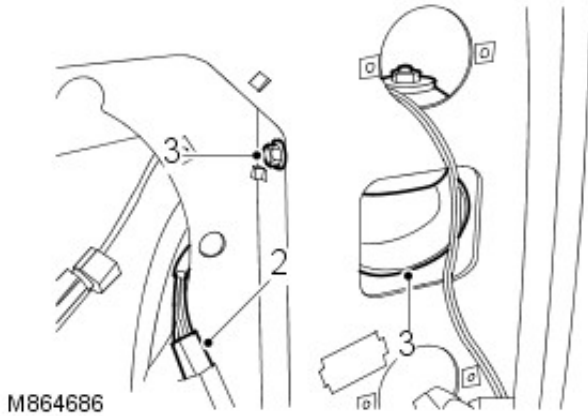
4. Reset the steering column to the original position.

Horn - Horn

Removal and Installation

Removal

1. Remove LH headlamp.
For additional information, refer to: Headlamp Assembly (417-01, Removal and Installation).
2. Disconnect horn multiplug.



3. Remove nut and remove horn from mounting bracket.

Installation

1. Position horn, tighten securing and connect multiplug.
2. Fit LH headlamp.
For additional information, refer to: Headlamp Assembly (417-01, Removal and Installation).

Clock -

Torque specifications

Description	Nm	lb-ft
Clock support bracket	1	1

Clock - Clock

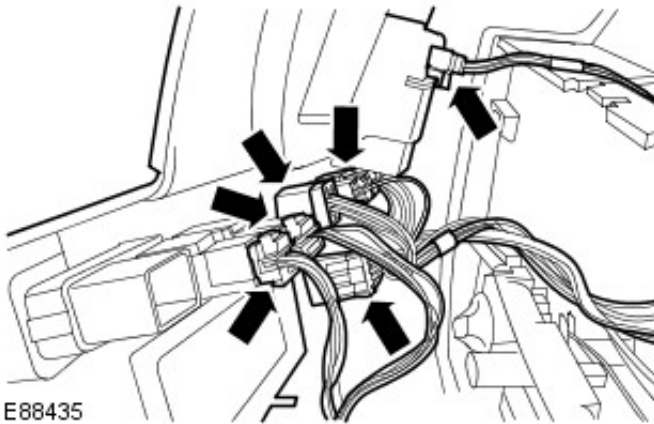
Removal and Installation

Removal

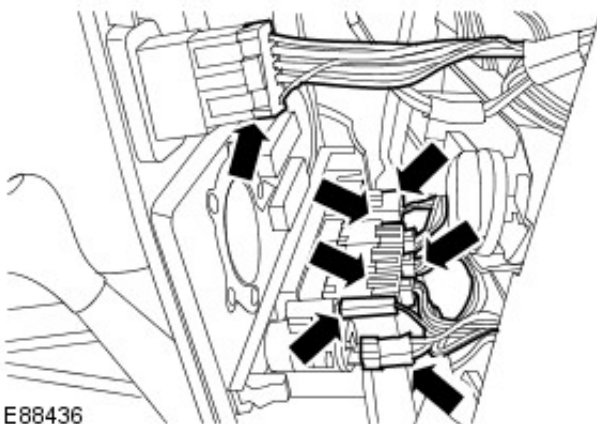
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).
3. Release the instrument panel console.



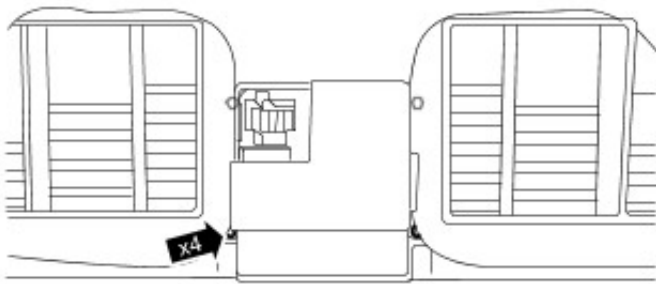
4. Disconnect the 6 electrical connectors.



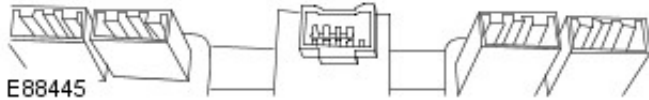
5. Remove the instrument panel console.
 - Disconnect the 7 electrical connectors.



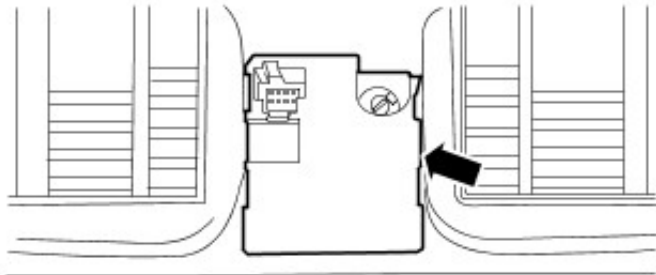
6. Remove the clock support bracket.
 - Remove the 4 screws.



E88445



7. Remove the clock.



E88446



Installation

1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Battery and Charging System - General Information - Battery Care

Description and Operation

12V LEAD ACID BATTERY CARE MANUAL FOR DEALER / RETAILER USE

1. INTRODUCTION

2. GENERAL RULES FOR BATTERY CARE

3. EQUIPMENT (MINIMUM STANDARD)

4. HEALTH AND SAFETY PRECAUTIONS

5. DETERMINING BATTERY CONDITION

6. BATTERY CHARGING AND MAINTENANCE

7. CHARGING SYSTEM TEST AND DIAGNOSIS

8. VEHICLE QUIESCENT CURRENT TESTING

APPENDIX A: BATTERY TEST PROCESS

APPENDIX B: BATTERY REPORT FORM - IN SERVICE BATTERIES ONLY

1. INTRODUCTION

This publication sets out, for the benefit of dealers / retailers worldwide, requirements for the care and maintenance of batteries, from the vehicles hand-over to the dealer / retailer to the handover to the customer or in the case of a spare part battery from its delivery to the dealer / retailer to its fitment to a customer vehicle.

It applies to all types of 12 volt Lead Acid Batteries used, whether they are conventional flooded technology or Absorbed Glass Mat (AGM) technology and also applies to both Primary and Secondary or Auxiliary Batteries.

The clearly laid out and illustrated sections guide dealers / retailers through each stage of the vehicles or spare parts receipt, storage, pre-delivery and customer hand-over. This publication can be used as a guide to the handling and care of batteries in service. It is vital to appreciate that unless each process is rigorously applied on all vehicles, the customer will receive a vehicle with a battery or a spare part battery which will not provide a satisfactory service life.

It is very important that all tests quoted throughout this publication are adhered to. If they are applied incorrectly batteries could be scrapped unnecessarily. Refer to the battery testing section for detailed information.

It is equally important therefore to note the following key points:

- Most new vehicles leave the factory with either a transit relay installed and/or have a transit mode programmed into the vehicle control modules. The transit relay must be removed and the transit mode disabled (where applicable) using an approved diagnostic system, **NOT MORE THAN 24 HOURS** before the customer takes delivery.
- 12 Volt Lead Acid Batteries rely on internal chemical processes to create a voltage and deliver current. These processes and the internal chemical structure of the battery can be damaged if the battery is allowed to discharge over a number of weeks / months, or is left in a discharged state for a lengthy time period. For this reason the battery must be tested / re-charged if necessary every month, and **MUST BE** re-charged after every three month period of storage. Refer to the vehicle storage manual and update the vehicle history sheet.
- Under no circumstances should the battery be disconnected with the engine running because under these conditions the alternator can give a very high output voltage. This high transient voltage will damage the electronic components in the vehicle. Loose or incomplete battery connections may also cause high transient voltage.
- On vehicles with conventional ignition keys, these must not be left in the ignition lock barrel when the transit relay has been removed, otherwise quiescent current will increase and the battery will discharge more rapidly.
- Two types of Lead acid batteries are used; standard Flooded type and AGM (Absorbed Glass Mat) or VRLA (Valve regulated Lead Acid) types. AGM batteries offer improved resistance to cycling as seen in stop start applications. AGM Batteries are fully sealed and cannot have the electrolyte level topped up.

Dealers and retailers involved in the storage, handling of vehicles and spare parts batteries have a responsibility to ensure that only vehicles and spare parts having a fully satisfactory battery may be processed further through the distribution selling chain.

NOTE: It is very important that test processes quoted throughout this publication are adhered to.

If they are not adhered to correctly batteries could be scrapped unnecessarily or a battery with an issue remains in use. Refer to the battery testing section for detailed information.

2. GENERAL RULES FOR BATTERY CARE

Frequency of Battery Condition Checks.

Any battery in storage whether it is in a vehicle or in spare parts inventory must have its charge status checked every 30 days as described in Appendix A, and must be recharged every 90 days as described in the "Battery Charging and Maintenance" section of this manual.

Dealer Demonstration Vehicles

Due to the high depth of discharge a dealer demonstration vehicle battery may experience, batteries that are fitted to vehicles used as dealer demonstration vehicles must be connected to a power supply / charger capable of delivering 50 Amps or more whilst the vehicle is being demonstrated and the engine is not running. This will prevent the battery from being damaged from "energy throughput " wear out during a demonstration.

Software Reflash, SDD work or Ignition On related Workshop Activities.

Due to the high electrical current demand and high depth of Discharge that can occur during vehicle software re-flash activities, SDD work or ignition on related work in the workshop, vehicles that are undergoing such activities MUST have the electrical system on the vehicle supported with a power supply / charger / vehicle maintainer capable of delivering 50 Amps or more.

Jump Starting New vehicles Before They Have Been Delivered to the Customer.

- It is the dealer / retailers responsibility to ensure the battery is not allowed to go flat by following the instructions and processes defined in this manual.
- However if circumstances dictate that a new vehicle must be jump started due to a flat battery whilst the vehicle is in the dealer / retailers care, the battery on this vehicle must be replaced with a new one prior to delivery to the customer at the dealer / retailers liability.
- The vehicle should also undergo investigation as to why the battery went flat.
- Do not connect the jump starting cable to the negative (-) terminal of the battery. Always connect to the recommended earthing point. As defined in the owners handbook or service documentation for that vehicle.

Jump Starting or Boost Charging Vehicles in Service

Do not connect the jump starting cable to the negative (-) terminal of the battery. Always connect to the recommended earthing point. As defined in the owners handbook or service documentation for that vehicle.

Charging AGM Batteries

AGM batteries must not be charged with voltages above 14.8 Volts. Doing so will damage them.

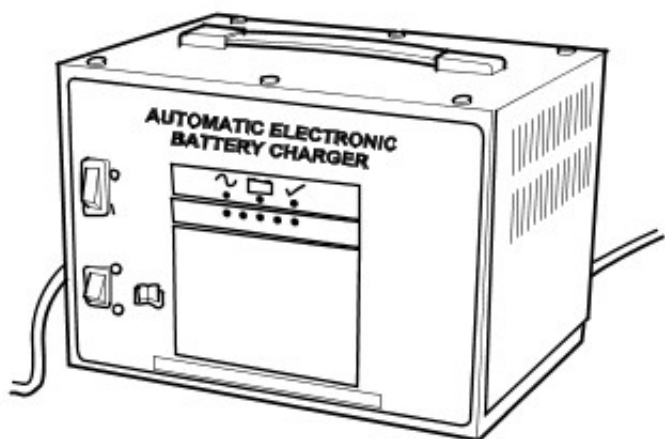
Testing AGM Batteries

Midtronics 393, 394, 493 and 494 testers are not capable of testing AGM batteries. Doing so can give an incorrect result.

When it is necessary to test an AGM battery use the Midtronics EXP1080 tester or the GR1 Diagnostics Charger.

3. EQUIPMENT (MINIMUM STANDARD) (pictures are for illustration only)

Traction Battery Charger (or similar stand-alone charger)



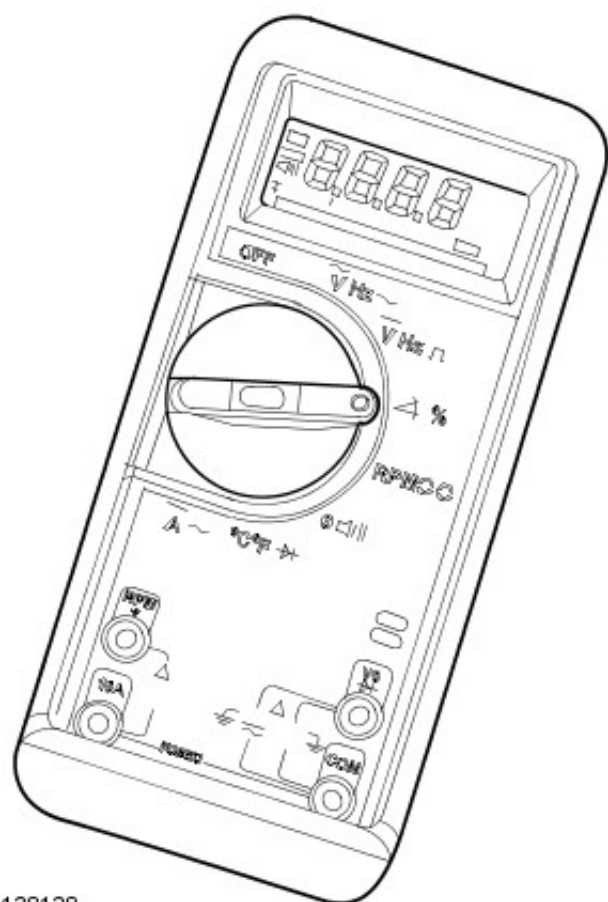
E138126

Midtronics EXP1080 Hand-Held Tester



E138131

Digital Multi-Meter or Digital Volt-Ohm Meter (DVOM)



E138128

Midtronics GR-1 Diagnostic Charger



E138129

4. HEALTH AND SAFETY PRECAUTIONS

WARNINGS:



BATTERY CELLS CONTAIN SULPHURIC ACID AND EXPLOSIVE MIXTURES OF HYDROGEN AND OXYGEN GASES. IT IS THEREFORE ESSENTIAL THAT THE FOLLOWING SAFETY PRECAUTIONS ARE OBSERVED.



Batteries emit highly explosive hydrogen at all times, particularly during charging. To prevent any potential form of ignition occurring when working in the vicinity of a battery:

- Do not smoke when working near batteries.
- Avoid sparks, short circuits or other sources of ignition in the battery vicinity.
- Switch off current before making or breaking electrical connections.
- Ensure battery charging area is well ventilated.
- Ensure the charger is switched off when: a) connecting to a battery; b) disconnecting from the battery.
- Always disconnect the ground cable from the battery terminal first and reconnect it last.



Batteries contain poisonous and highly corrosive acid. To prevent personal injury, or damage to clothing or the vehicle, the following working practices should be followed when topping up, checking electrolyte specific gravity, removal, refitting or carrying batteries:

- Always wear suitable protective clothing (an apron or similar), safety glasses, a face mask and suitable gloves.
- If acid is spilled or splashed onto clothing or the body, it must be neutralized immediately and then rinsed with clean water. A solution of baking soda or household ammonia and water may be used as a neutralizer.
- In the event of contact with the skin, drench the affected area with water. In the case of contact with the eyes, bathe the affected area with cool clean water for approximately 15 minutes and seek urgent medical attention.
- If battery acid is spilled or splashed on any surface of a vehicle, it should be neutralized and rinsed with clean water.
- Heat is generated when acid is mixed with water. If it becomes necessary to prepare electrolyte of a desired specific gravity, SLOWLY pour the concentrated acid into water (not water into acid), adding small amounts of acid while stirring. Allow the electrolyte to cool if noticeable heat develops. With the exception of lead or lead-lined containers, always use non-metallic receptacles or funnels. Do not store acid in excessively warm locations or in direct sunlight.



Due to their hazardous contents, the disposal of batteries is strictly controlled. When a battery is scrapped, ensure it is disposed of safely, complying with local environmental regulations. If in doubt, contact your local authority for advice on disposal facilities.

5. DETERMINING BATTERY CONDITION

The tools used for determining the condition of the battery will depend upon whether it is installed in a vehicle or in spare parts inventory. Concerning an installed battery, procedures will vary if the vehicle is new, or already in service with a customer.

NOTE: The term 'New Vehicle' refers to a vehicle at any part of the delivery process from leaving the factory to arriving at a port of entry, dealership, retailer, including any storage facilities en route or a vehicle being stored prior to sale at dealership / retailer.

NOTE: Midtronics 393, 394, 493 and 494 testers must not be used to test AGM batteries as these testers are not capable of correctly testing AGM batteries and can give an incorrect result. For AGM battery testing use the EXP1080 tester or the GR1 Diagnostics charger.

NEW VEHICLES

A Midtronics tester should be used to assess the condition of the battery for new vehicles. The test results should be recorded on the Storage History Sheet (see Vehicle Storage manual).

Scenario 1 - Dealership / Retailer (Responsibility: Dealer / Retailer)

1. Within 24 hours of arrival at the dealer / retailer proceed as follows:

- Perform a Midtronics battery test (See Appendix A.)
- Carry out the recommended actions accordingly.

2. If the Midtronics result is "Good Battery" the vehicle may be stored.

- For all new vehicles in storage the transit relay MUST be fitted, or the Transit Mode enabled where used. For vehicles without a transit relay or a Transit Mode, the battery negative cable MUST BE DISCONNECTED from the battery.

3. The battery must be tested and/or re-charged every month and MUST be re-charged after every three month period.

4. Record your test results on the Storage History Sheet (see Vehicle Storage Manual) to indicate when a re-charge will be necessary.

Scenario 2 - Delivery to the Customer (Responsibility: Dealer / Retailer)

NOTE: It is essential that the following actions are conducted in the 24 hours prior to the agreed hand over time:

1. Perform a Midtronics Battery test (See Appendix A).
2. Carry out the recommended actions accordingly.
3. The vehicle should only be released to the customer if Midtronics has tested the battery as "Good Battery"

Spare Part Batteries

Lead acid batteries will, as a result of natural chemical processes, slowly self discharge themselves over a period of time (even when open circuit and no electrical load applied).

In the case of spare parts batteries, a Midtronics tester should be used to assess the condition of new spare parts batteries.

The batteries must be stored such that they cannot get wet and are not in direct sunlight.

Any batteries which are dropped must be scrapped. This applies even if no external damage is apparent.

Scenario 1 - Spare Part Batteries Within Dealer Stock But Not Yet Fitted To A Vehicle (Responsibility: Dealer / Retailer)

1. For a battery in the Dealer parts or in ready to use stock but not yet fitted to a vehicle the following rules must be followed:

- Check the battery condition on receipt by performing a Midtronics battery test (See Appendix A).
- Batteries should only be returned to storage if the Midtronics tester indicates "Good Battery".
- The battery condition should be rechecked every 30 days by performing a Midtronics battery test (See Appendix A).
- If required batteries should be recharged as described in the "Battery Charging and Maintenance" section of this manual.

2. 2 All batteries must be controlled via a FIFO (First In First Out) process to ensure aged batteries are not held and the batteries are not allowed to age unnecessarily.

VEHICLES IN SERVICE

The Midtronics hand-held tester or the Midtronics Diagnostic Charger are the preferred tools to assess battery condition for vehicles in service. The test results should be recorded on the In-Service Battery Report Form (See Appendix B).

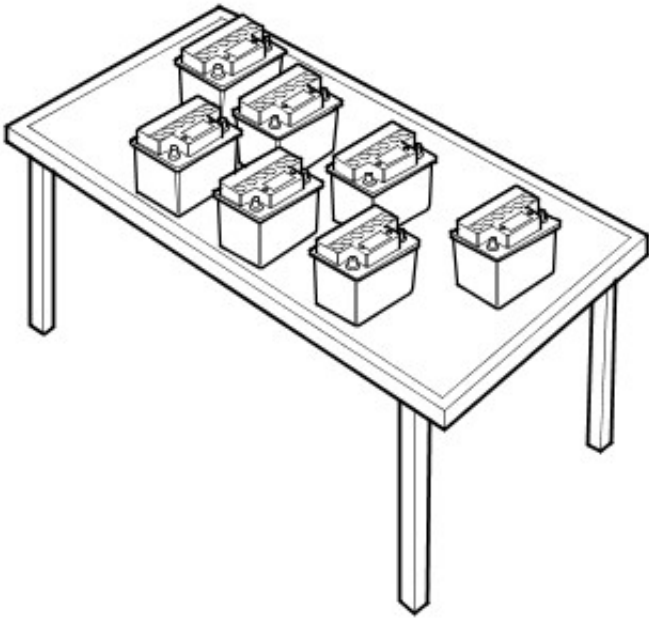
Midtronics Testing - In-Service Testing Only

NOTE: The battery surface charge must be removed before this test in accordance with the procedure in Appendix A. Ensure that the battery terminal connectors are clean. When connecting the Midtronics testing equipment, connect the RED clip to the positive (+) battery terminal first, and then connect the BLACK clip to the negative (-) battery terminal. Rock the clips backward and forward to ensure a good connection to the battery.

1. Perform a Midtronics battery test (See Appendix A).
2. Carry out the recommended actions accordingly.

6. BATTERY CHARGING AND MAINTENANCE

BATTERY CHARGING



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It is essential that a suitably ventilated defined area exists in each dealership / retailer for battery charging. Likewise, an area should be allotted for scrap batteries, and clearly indicated as such. It is recommended that dealers / retailers always have fully charged batteries ready for use. However the battery **MUST BE** tested and charged if necessary every month, and charged after three months irrespective of any test.

CAUTIONS:



Batteries must be re-charged after a maximum of 3 months storage (see Storage History sheet in the New Vehicle Storage Manual).



It is very important that when charging batteries using the traction charger or other stand-alone chargers that the charger is set for the correct type of battery before charging commences. If the wrong switch is selected the result would be a battery that is not charged fully and / or overheating can occur. Follow the manufacturers operating instructions.



Do not charge AGM batteries with voltages over 14.8 volts as this will damage the battery.

To bring a serviceable but discharged battery back to a fully charged condition proceed as follows:

- Check and if necessary top-up the battery electrolyte level.
- Charge the battery using the Midtronics Diagnostic Charger (USA) or Traction Charger (all other markets) following the manufacturers operating instructions.

NOTE: When using the Midtronics Diagnostic Charger, automatic mode must always be used. After charging and analysis, the charger may display 'Top-Off Charging', press STOP to end. Do not stop charging until the current falls to 5A or less, otherwise the battery will not be fully charged.

POST-CHARGE TEST METHODS

New Batteries, Batteries in Storage and In-Service Batteries

The purpose of this test is to ensure that the charging process has fully charged the battery.

NOTE: IT IS RECOMMENDED THAT THIS TEST IS CONDUCTED AT LEAST 24 HOURS AFTER THE CHARGE CYCLE IS COMPLETED.



 **CAUTION:** DO NOT connect the tester to any other circuit or chassis point.

1. Attach the Midtronics Tester to the battery.
2. Follow the instructions on the tester to test the battery. Ensure the correct battery type and size is selected.
3. Perform the action based on the tester results (see the tester results chart in the Vehicles in Service sub -section of Determining Battery Condition Section).
4. Enter the readings and test code obtained on the In Service Battery Report Form.

NOTE: Midtronics 393, 394, 493 and 494 testers must not be used to test AGM batteries as these testers are not capable of correctly testing AGM batteries and can give an incorrect result. For AGM battery testing use the EXP1080 tester or the GR1 Diagnostics charger.

BATTERY REPLACEMENT

If it is determined that a battery requires replacement, always refer to the appropriate section of the workshop manual for instructions on removing and installing the battery from the vehicle.

On in service vehicles fitted with a Battery Monitoring System (BMS), the BMS module must be reset following the installation of a new battery. The BMS module reset procedure must be performed using an approved diagnostic system.

CHECK/TOP-UP BATTERY ELECTROLYTE – Only Applicable to certain Flooded Types of Battery.

WARNINGS:



AGM TECHNOLOGY BATTERIES ARE FULLY SEALED FOR LIFE AND NO ATTEMPT SHOULD BE MADE TO CHECK OR TOP UP THE ELECTROLYTE LEVEL.



BEFORE CHECKING AND TOPPING-UP THE BATTERY ELECTROLYTE, REFER TO THE HEALTH AND SAFETY PRECAUTIONS SECTION.

Check to ensure the battery is of a type suitable for topping up. These types of batteries will have cell plugs visible on the top face of the battery or a removable access panel to allow access to the cells.

On batteries with a clear or opaque case and level marks, check the electrolyte level by visual inspection of the maximum level indicator mark on the battery casing indicating adequate level above the battery separators.

On batteries with black cases, remove the cell plugs or access panel and ensure the electrolyte level is level with the indicator in the cell hole. A flashlight may be required to see the electrolyte level on this type of battery.



CAUTION: DO NOT overfill.

If the electrolyte level is low, top-up using distilled water.

Maintenance free and Valve Regulated (AGM) batteries are sealed and therefore cannot be topped up.

CHARGING SYSTEM TEST AND DIAGNOSIS

For all vehicles, refer to the Charging System - Diagnosis and Testing in section 414-00 of the Workshop Manual.

VEHICLE QUIESCENT CURRENT TESTING

NOTE: On vehicles fitted with a Battery Monitoring System (BMS), the diagnostic routine for quiescent drain testing in the approved diagnostic system should be utilized.

NOTE: If a customer complains of a vehicle battery that discharges continuously or when left for a prolonged period of time, it is recommended that a quiescent drain test is performed as described below.

NOTE: The battery drain should be measured using an approved diagnostic system or a Digital Multi-Meter (DVOM).

The vehicle should be in the locked/armed state (for example vehicle alarm fully armed), all doors, engine and luggage compartment lids are open and latched (so as to appear closed from an electrical point of view). The test should take place after the vehicle has entered shutdown mode. The time taken for this to occur after the ignition is switched off varies according to model - Refer to Quiescent Drain in section 414-00 of the Workshop Manual.

NOTE: When the vehicle is armed, the effect of the security system Light Emitting Diode (LED) flashing is to cause a pulsation in the measured current drain. In this case, either the average current should be taken (using a Digital Multi-Meter (DVOM) with an averaging system) or the current reading taken, ignoring the brief high current peaks.

EQUIPMENT

Approved diagnostic system with current probe or Digital Multi-Meter (DVOM) with current probe.

METHOD OF MEASUREMENT

Using an Approved Diagnostic System

1. Switch off all electrical loads and ensure that the ignition is off.
2. Connect the current probe to the approved diagnostic system.
3. Calibrate the probe.
4. Install a clamp around the battery lead/junction box lead.
5. Go to the Quiescent Current Testing section.

Using a Digital Multi-Meter (DVOM)

NOTE: Do not use an in-line DVOM to measure the quiescent drain on vehicles fitted with an electronic throttle. The current exceeds the maximum amount the fuse in the DVOM is capable of handling.

1. Switch off all electrical loads and ensure that the ignition is off.
2. Connect the current probe to the DVOM.
3. Calibrate the probe.
4. Install a clamp around the battery lead/junction box lead.
5. Go to the following Quiescent Current Testing section.

QUIESCENT CURRENT TESTING

1. Switch ignition to 'on' or select ignition mode in keyless vehicles and switch to 'off' (do not crank).
2. Remove key from ignition switch (where applicable).
3. Open and latch all doors, hood and luggage compartment lid.
4. Lock the vehicle using the remote function on the remote handset. (Single lock only to avoid volumetric alarm arming).
5. Remove any other potential electrical drains such as accessories plugged into accessory sockets.
6. Record the amperage readings after the shutdown period. The model specific Amperage readings for quiescent drain are referenced in Quiescent Drain in section 414-00 of the Workshop Manual

7. Record the final reading on the battery report form Appendix B.

NOTE: The preferred method of testing following an excessive current consumption figure is to use a current probe around individual junction box leads to the various suspected circuits to identify a potential cause. This is in preference to the old method of removing fuses for the following reasons:

- Many modules take a considerable time to power down. Each time a fuse is removed and re-fitted, the quiescent drain current may take an extended period of time to return to normal (typically up to 45 minutes).
- The drain may be caused by a module remaining active and preventing the quiescent drain from reducing to normal levels.
- The drain may be caused by a relay winding that is activated. Pulling the fuse can allow this to 'reset' and the drain will be lost and go un-diagnosed.

APPENDIX A BATTERY TEST PROCESS

It is recommended that this test is conducted at least 24 hours after the vehicle engine has been run or the battery charged to avoid the need of surface charge removal or if this time constraint is unacceptable due to circumstances, then conduct the charge strip removal process.

Part 1 - Surface Charge Removal

NOTE: Before carrying out a battery test you must ensure that there is no battery surface charge present.

NOTE: The battery may be tested either on a bench or on the vehicle.

- In the case of on-vehicle testing, the battery must be isolated from the vehicle by removal of the battery negative (-) cable from the battery terminal before the measurement is taken unless the vehicle has a transit relay fitted or is in transit mode.

A vehicle which has had its battery charged or been driven in a 24 hour period before the test, must have its surface charge removed using one of the following methods:

1. If 24 hours have passed since the last time the engine was run or the battery charged, proceed to 'Part 2 - Battery Test'.
2. Turn on the ignition. Switch on the headlamps on high beam for a minimum 3 minutes.
3. Switch off the headlamps. For vehicles tested after the transit relay has been removed, disconnect the battery by removal of the negative (-) cable. Vehicles with a transit relay fitted or with a low current transport mode enabled do not need to have the battery disconnected.
4. Wait a maximum of 5 minutes before recording test results for any battery measurements.

Part 2 - Battery Test

NOTE: The battery surface charge must be removed before this test in accordance with the procedure in Part 1 above. Ensure that the battery terminal connectors are clean. When connecting the Midtronics testing equipment, connect the RED clip to the positive (+) battery terminal first, and then connect the BLACK clip to the negative (-) battery terminal. Rock the clips backward and forward to ensure a good connection to the battery.

NOTE: Midtronics 393, 394, 493 and 494 testers must not be used to test AGM batteries as these testers are not capable of correctly testing AGM batteries and can give an incorrect result. For AGM battery testing use the EXP1080 tester or the GR1 Diagnostics charger.



CAUTION: DO NOT connect the tester to any other circuit or chassis point other than the battery negative terminal.

1. Attach the Midtronics tester to the battery.
2. Follow the instructions on the tester to test the battery. Ensure the correct battery type and size is selected.
3. Perform the action based on the tester results (see table below).
4. Enter the readings and test code obtained on the Battery Report Form (Appendix B) or equivalent which records as a minimum the technician's name, Vehicle Identification Number (VIN), Date of check, Midtronics code and Battery Voltage from the Midtronics tester.

At the end of the test, the battery negative (-) cable should be re-attached to the battery terminal.

TESTER RESULTS	ACTION
GOOD BATTERY	Return to service.
GOOD RE-CHARGE	Fully charge battery and return to service.
CHARGE AND RE-TEST	Fully charge battery. Remove surface charge. Re-test battery. If same result replace battery.
REPLACE BATTERY OR BAD CELL BATTERY	Verify surface charge removed. Disconnect battery from vehicle and re-test. If result repeats after surface charge removal, replace battery. DO NOT RECHARGE.
UNABLE TO DO TEST	Disconnect battery from vehicle and re-test.

APPENDIX B : BATTERY REPORT FORM - IN SERVICE BATTERIES ONLY

NOTE: Fields marked with * are mandatory and must be completed.

General Information		YES / NO		YES / NO	
Customer Name:			Dealer/Retailer Code:	*	
Repair Order Number:		*	Battery Date Code:	*	
Repair Order Date:		*	Number of Times Battery Charged:	*	
Repair Order Date:			Technicians Name:	*	
Vehicle Identification Number (VIN):		*	Technicians Signature:	*	
Give a detailed description of the symptoms experienced by the customer (attach a separate sheet if necessary)					
-					
-					
-					
-					
-					
-					
-					
Diagnostics (Battery Testing)					
1: Loose battery clamps		Yes	*	No	*
2: Loose hold down clamps		Yes		No	
3: Corroded terminal posts		Yes	*	No	*
4: Physical damage/leaks		Yes		No	
5: Low electrolyte		Yes	*	No	*
6: FEAD belt tension		OK	*	Not OK	*
7: Surface charge removed		Yes	*	No	*
8: Voltage (appendix A)		Yes	*	No	*
9: Quiescent Drain		mA	*		
10: Vent tube correctly installed		Yes		No	
11: Midtronics test					
Code before charging		*			
If Midtronics indicates that the battery needs re-charging, charge the battery for 24 hours					
Code after charge		*			
Result after charge		*			
If "good and re-charge" charge the battery for an additional 24 hours.					
If "charge and re-test" for both before and after 24 hours charge renew the battery					
Only renew the battery if "renew battery", "bad cell" or charge and re-test has been displayed twice.					
Comments					
-					
-					
-					
-					
-					

Battery and Charging System - General Information - Quiescent Drain

Description and Operation

QUIESCENT DRAIN - TYPICAL VALUES

NOTE: The quiescent drain after the initial shutdown period should not exceed the value shown in the table.

Land Rover Quiescent Drain Values

MODEL	SHUT DOWN PERIOD (minutes)	TYPICAL VALUES BATTERY DRAIN (mA)
Range Rover (LM) - Up to 2009MY	30	16.0 - 18.0
Range Rover (LM) - From 2010MY	20 (after lock/arm condition) ²	<30
	33 (unlocked)	<30
Range Rover Sport (LS) - Up to 2007MY	20	<22
Range Rover Sport (LS) - From 2007MY to 2010MY	30	<25
Range Rover Sport (LS) - From 2010MY	3 (after lock/arm condition) ²	<30
	33 (unlocked)	<30
Range Rover Evoque (LV) - From 2012MY	20 (after lock and arm condition)	<20
Discovery 3/LR3 (LA) - Up to 2007MY	20	<22
Discovery 3/LR3 (LA) - From 2007MY to 2010MY	30	<25
Discovery 4/LR4 (LA) - From 2010MY	3 (after lock/arm condition) ²	<30
	33 (unlocked)	<30
Freelander 2/LR2 (LF) - From 2007MY	35 (single locked or unlocked)	<23.6
	12 (double locked)	<23.6
Freelander (LN) - Up to 2007MY	10	24-25 - without Becker Navigation system
	10	27-28 - with Becker Navigation system
Defender (LD) - 1998MY to 2007MY	30	<21
Defender (LD) - from 2007MY	<30	<30
Discovery Series 2 (LT)	30	<30

NOTE:

1. The total current drain will be higher if certain approved accessories are fitted (for example: tracker, trailer module, etc.)
2. Applies to vehicles without Tire Pressure Monitoring System (TPMS). Vehicle shut-down period with TPMS is approximately 15 minutes.

Battery and Charging System - General Information - Charging System

Diagnosis and Testing

Principles of Operation

For a detailed description of the charging system, refer to the relevant Description and Operation section in the workshop manual. REFER to:

[Battery Care](#) (414-00 Battery and Charging System - General Information, Description and Operation),
[Battery and Cables](#) (414-01, Description and Operation),
[Generator - ID4 2.4L Diesel](#) (414-02, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

NOTE: Check the vehicle battery condition and state of charge before condemning any of the charging system components. For additional information, refer to the battery care manual.

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to section 100-00. REFER to: (100-00)

Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) (Description and Operation),
 Diagnostic Trouble Code (DTC) Index - DTC: Instrument Cluster (IPC) (Description and Operation).

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Generator • Drive belt • Drive belt tensioner • Generator pulley • Check the security of the generator fixings 	<ul style="list-style-type: none"> • Generator • Battery • Mega-fuse • Engine/generator ground connection • Harness(s) • Electrical connector(s) • Engine Control Module (ECM) • Central junction box (Freelander 2 only)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

NOTE: Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer-approved diagnostic system).

NOTE: When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE: If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

Symptom	Possible Cause	Action
Charge warning lamp does not illuminate	<ul style="list-style-type: none"> • Warning lamp/circuit - fault • Generator - internal fault • CAN Bus - circuit fault 	<ul style="list-style-type: none"> • Check the warning lamp function with the ignition on and the engine off • Repair the circuit as necessary • Check for DTCs indicating a generator, CAN or engine control module fault

	<ul style="list-style-type: none"> Engine control module - internal fault 	
Charge warning lamp stays on/battery discharges	<ul style="list-style-type: none"> Accessory drive belt - fault Generator pulley slipping on shaft Generator - internal fault Battery cable - fault CAN Bus - circuit fault Engine control module internal fault Central junction box 	<ul style="list-style-type: none"> Check the battery and generator cables Refer to the electrical guides Check for DTCs indicating a generator fault Check the accessory drive belt condition and tension Check that the pulley does not rotate independently of the generator Check for DTCs indicating a CAN, central junction box or engine control module fault
Charge warning lamp intermittent	<ul style="list-style-type: none"> Accessory drive belt slipping Battery cable - fault Generator - circuit fault Generator - internal fault CAN Bus - circuit fault 	<p>NOTE: Use of a power pack or boost charger may bring the warning lamp on until disconnected</p> <ul style="list-style-type: none"> Check the accessory drive belt condition and tension Check the battery and generator cables refer to the electrical guides Check for DTCs indicating a generator or CAN circuit fault
Battery discharges without the charge warning lamp staying on	<ul style="list-style-type: none"> Battery - fault Battery quiescent drain Intermittent generator - fault 	<ul style="list-style-type: none"> Check the battery condition Check for battery quiescent drain Check for DTCs indicating a generator fault If no other reason for discharge can be found, check the circuit. Refer to the electrical guides
Noise (mechanical)	<ul style="list-style-type: none"> Accessory drive belt slipping 	<ul style="list-style-type: none"> Check the accessory drive belt condition and tension Disconnect the accessory drive belt and check that the generator rotates freely

Test Procedure

PINPOINT TEST A : BOSCH NON-BMS GENERATOR DIAGNOSTIC FLOW CHART	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: MIDTRONICS BATTERY TEST	
NOTE: The battery must be fully charged and any battery defects rectified before continuing with generator diagnosis	
NOTE: The voltmeter must display readings to three decimal places (i.e. 0.001V)	
NOTE: Ignition on is position 2 on a keyed ignition system	
NOTE: Ignition on is two short presses of the start button (power mode 6) with keyless ignition system	
	1 Using a Midtronics hand held tester or the Midtronics GR-1 diagnostic charger, carry out the "Midtronics battery test" as detailed in the battery care manual. REFER to: Battery Care (414-00 Battery and Charging System - General Information, Description and Operation).
	2 Record battery diagnostic result on the provided form
	Does the battery pass the "Midtronics battery test"? Yes GO to B1. No Rectify any battery defects before continuing with generator diagnosis GO to Pinpoint Test B.

PINPOINT TEST B : BOSCH NON-BMS GENERATOR DIAGNOSTIC FLOW CHART	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: GENERATOR OUTPUT	
NOTE: Freelander 2 = The heated rear screen is timed to operate for 12 minutes	
NOTE: Defender = The heated rear screen is timed to operate for 8 minutes	
	1 Connect a voltmeter to the vehicle battery
	2 Switch ignition state to on (engine off)

	3 Turn off all electrical loads e.g. (blower, radio, interior lights etc.)
	4 Start the engine, switch on the heated rear screen <ul style="list-style-type: none"> Ensure the heated rear screen is on (see note above) and that the air conditioning system is off.
	5 Wait 90 seconds
	6 Record the battery voltage (V1) shown on the multimeter
	Does battery voltage (V1) = 14.8 volts or greater at idle? Yes Install a new generator. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component No GO to B2.

B2: BATTERY VOLTAGE AT IDLE

	1 Using battery voltage reading (V1)
	Does battery voltage (V1) = 13 volts or greater at idle (But less than 14.8 volts)? Yes GO to B3. No GO to Pinpoint Test C.

B3: BATTERY WARNING LAMP

	1 The battery voltage is (V1) = 13 volts or greater at idle (but less than 14.8 volts)
	Is the battery warning lamp illuminated? Yes GO to Pinpoint Test C. No The generator output is within the expected range, Do not replace the generator . If customer concern is still evident contact dealer technical support

PINPOINT TEST C : BOSCH NON-BMS GENERATOR DIAGNOSTIC FLOW CHART

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: CIRCUIT CHECKS	
NOTE: Freelander 2 = Charge warning lamp is driven by the central junction box (from the powertrain control module) to the instrument panel cluster via the CAN bus	
NOTE: Defender = Charge warning lamp is driven by the powertrain control module to the instrument panel cluster via the CAN bus	
	1 Freelander 2 = Refer to the electrical circuit diagrams and check the (LIN) circuit between the generator and the engine control module for short circuit to ground, short circuit to power, open circuit, high resistance faults
	2 Defender = Refer to the electrical circuit diagrams and check the (D+ and ALTMON) circuits between the generator and the engine control module for short circuit to ground, short circuit to power, open circuit, high resistance faults
	Are any circuit faults evident? Yes Repair the circuit as required GO to Pinpoint Test B. No GO to Pinpoint Test D.

PINPOINT TEST D : BOSCH NON-BMS GENERATOR DIAGNOSTIC FLOW CHART

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: CIRCUIT CHECKS 1	
NOTE: Freelander 2 = The heated rear screen is timed to operate for 12 minutes	
NOTE: Defender = The heated rear screen is timed to operate for 8 minutes	
	1 Connect a voltmeter to the vehicle battery
	2 Switch ignition state to on (engine off)
	3 Turn off all electrical loads e.g. (blower, radio, interior lights etc.)
	4 Start the engine, switch on the heated rear screen <ul style="list-style-type: none"> Ensure the heated rear screen is on (see note above) and that the air conditioning system is off.
	5 Voltage measurement <ul style="list-style-type: none"> Measure the voltage drop between the generator body and battery negative terminal and record the value (V2)
	Does the voltage drop value (V2) = less than 0.3 Volts ? Yes GO to D2. No Switch off engine. Circuit check. Refer to the electrical circuit diagrams, check the generator body

	and battery negative cables for loose or corroded connections. Repair any circuit faults, retest the generator GO to Pinpoint Test B.
D2: CIRCUIT CHECKS 2	
	1 Voltage measurements <ul style="list-style-type: none">• Measure the voltage drop between the generator B+ terminal and battery positive terminal and record value (V3)
	Does the voltage drop value (V3) = less than 0.3 Volts ? Yes Install a new generator. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component No Switch off engine. Circuit check. Refer to the electrical circuit diagrams check the generator B+ terminal and positive battery cables for loose or corroded connections. Repair any circuit faults, retest the generator GO to Pinpoint Test B.

Battery, Mounting and Cables -

Torque specifications

Description	Nm	lb-ft
Battery terminal nuts	5	4
Battery clamp nuts	9	7
Battery ground cable to transmission stud	30	22

Battery, Mounting and Cables - Battery Disconnect and Connect

General Procedures

WARNINGS:



Batteries normally produce explosive gases which may cause personal injury, therefore do not allow lighted substances to come near the battery. When charging or working near the battery always shield your face and protect your eyes. Always provide adequate ventilation. Failure to follow these instructions may result in personal injury.



Batteries contain sulphuric acid, avoid contact with skin, eyes or clothing. Shield your face and protect your eyes when working near the battery to guard against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately for a minimum of 15 minutes and seek prompt medical attention. If swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.



CAUTION: Make sure the engine is not running before disconnecting the battery ground cable. Failure to follow this instruction may result in damage to the vehicles electrical system.

NOTE: This procedure should be used to disconnect the battery while carrying out repairs that refer to the battery being disconnected.

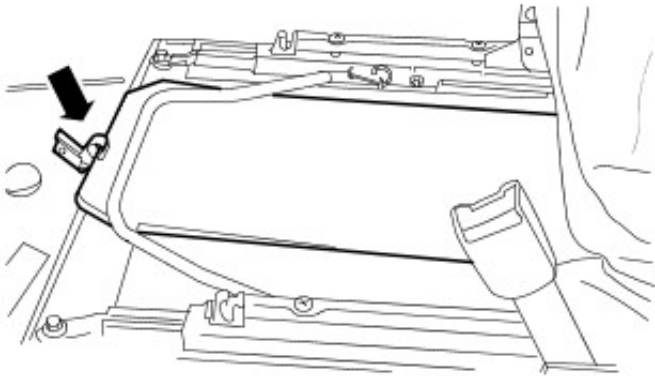
NOTE: Before disconnecting the battery make sure that no data is required from the engine control module (ECM), as battery cable disconnection will erase any fault codes and idle/drive values held in the keep alive memory (KAM).

1. Obtain and record the audio unit keycode and preset radio frequencies.
2. Remove the LH front seat cushion.
For additional information, refer to: Front Seat Cushion (501-10 Seating, Removal and Installation).


3. **NOTE:** RH illustration is shown, LH is similar.

Remove the battery cover.

- Release the clip.

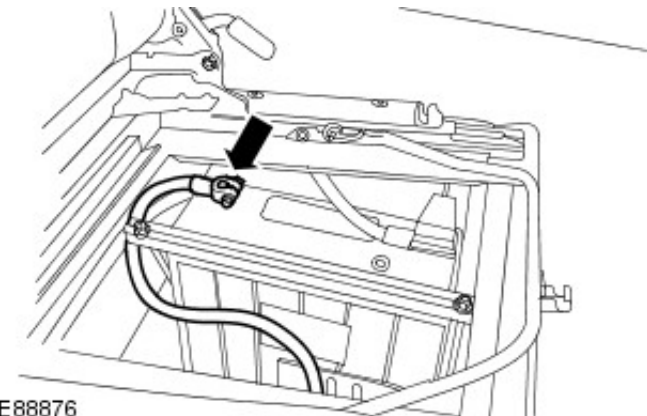


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4.  **CAUTION:** Failure to follow the procedure below could result in the alarm sounder self activating when the battery is disconnected.

Disconnect the battery ground cable.

- Loosen the nut.
- Turn the ignition key to the run position.
- Turn the ignition key to the off position.
- Within 17 seconds of turning the ignition key to the off position, release the battery ground cable from the battery.



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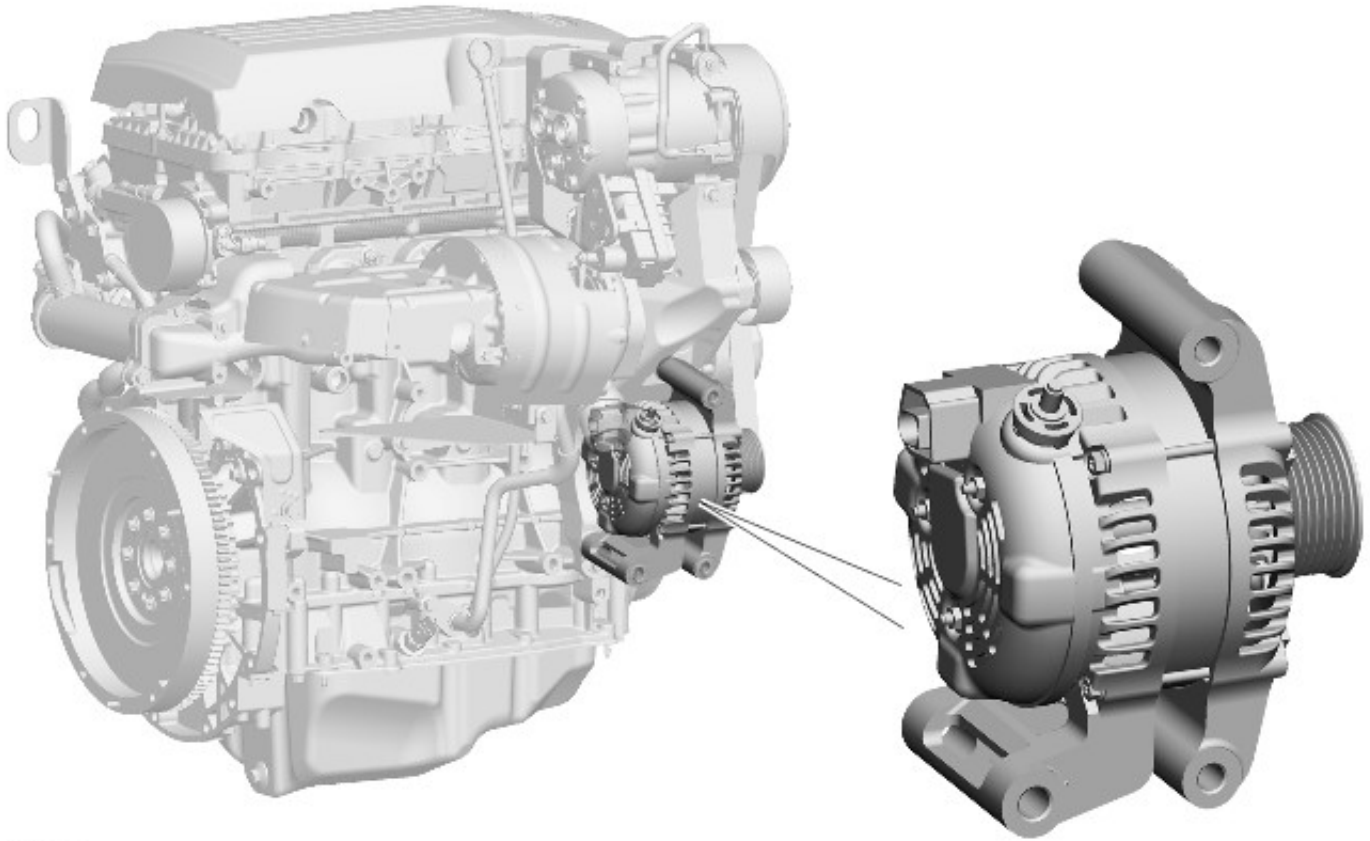
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Generator and Regulator - ID4 2.2L Diesel - Generator

Description and Operation

COMPONENT LOCATION



E139192

OVERVIEW

The generator is a self exciting type located at the front **RH (right-hand)** side of the engine and driven by the accessory drive belt. The generator is rated at 85/150 amps.

The generator pulley incorporates a one-way clutch that reduces **NVH (noise, vibration and harshness)** and improves the life of the accessory drive belt. The one-way clutch prevents the generator from driving the belt (causing 'belt whip'), due to the high rotational inertia of the generator internal components, during transients in engine speed.

A rectifier and a regulator are incorporated into the generator. The rectifier converts the **AC (alternating current)** produced in the stator coils of the generator into the **DC (direct current)** required by the vehicle electrical system. The regulator controls the output voltage from the generator and provides feedback of various parameters, including fault information, to the **ECM (engine control module)**.

Generator output is supplied to the battery, via the starter motor, from a threaded copper post on the generator casing. A single pin electrical connector on the rear of the casing provides a **LIN (local interconnect network)** bus interface for communication between the regulator and the **ECM**. The generator mountings provide the electrical ground for the generator.

Generator output is controlled by the **ECM**, which sends information regarding charging voltage to the generator on the **LIN** bus. The **ECM** calculates the charging voltage using a software based battery temperature model, which uses the intake air temperature, road speed, coolant temperature and engine running timers to estimate the electrolyte temperature. This value is then used to select the appropriate charging voltage based upon the charging characteristic of the battery.


The **LIN** bus is also used to communicate fault messages from the generator to the **ECM**. If a fault occurs, a **DTC (diagnostic trouble code)** is stored in the **ECM** and, if necessary, after a short delay the **ECM** sends a high speed **CAN (controller area network)** bus message to the instrument cluster to illuminate the ignition/no charge warning indicator.

During engine starting, the ignition/no charge warning indicator is illuminated when the ignition is energized, and is extinguished when the engine starts and the **ECM** detects a generator output voltage.

Generator and Regulator - ID4 2.2L Diesel - Generator

Removal and Installation

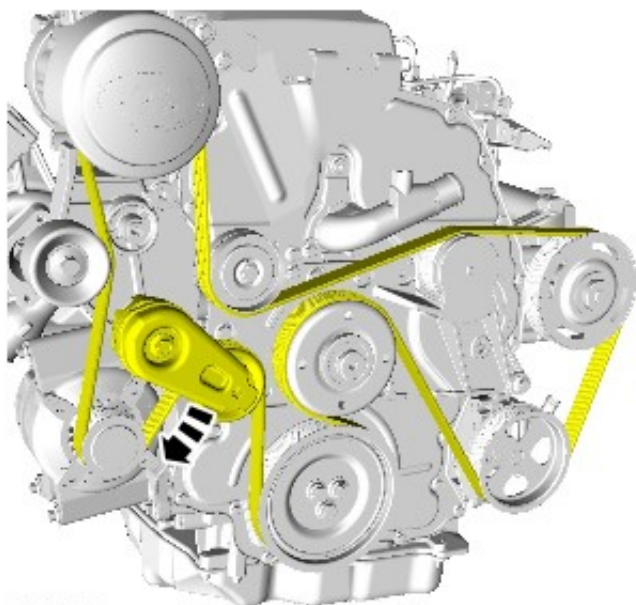
Removal

1.  **WARNING: WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

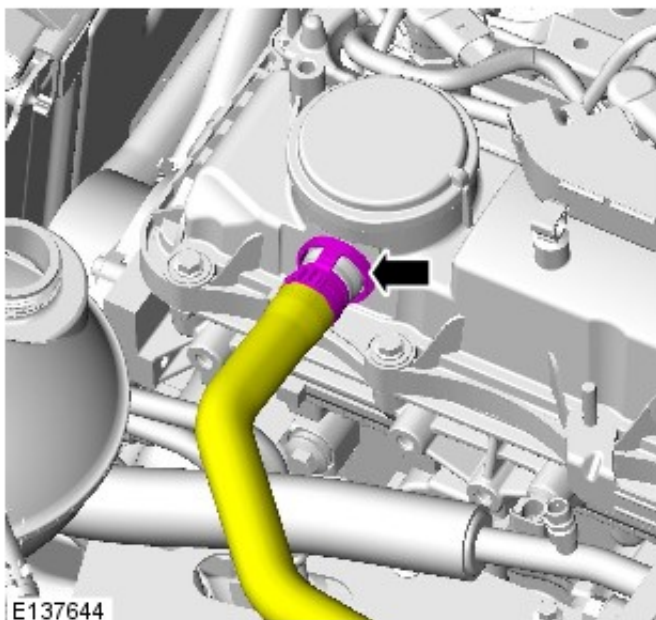
2. For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

3.



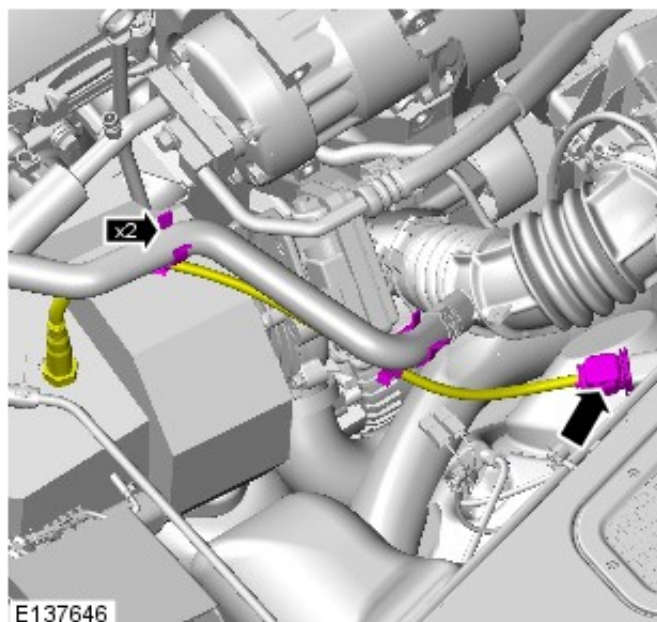
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4.

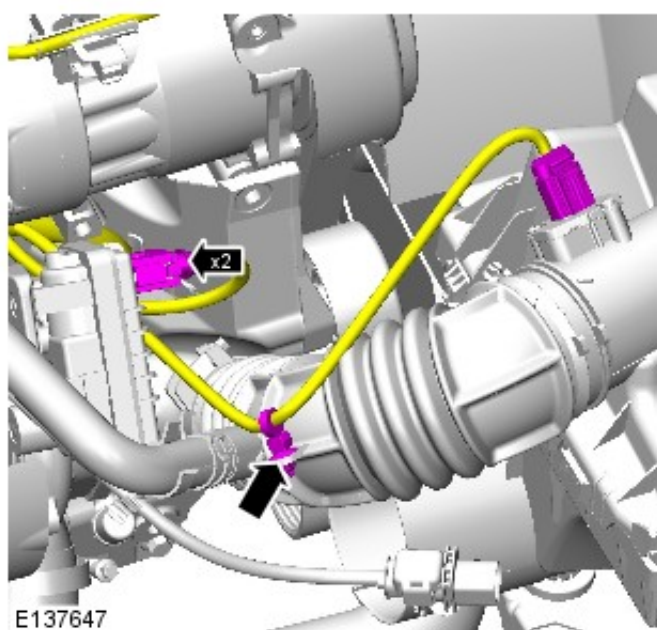


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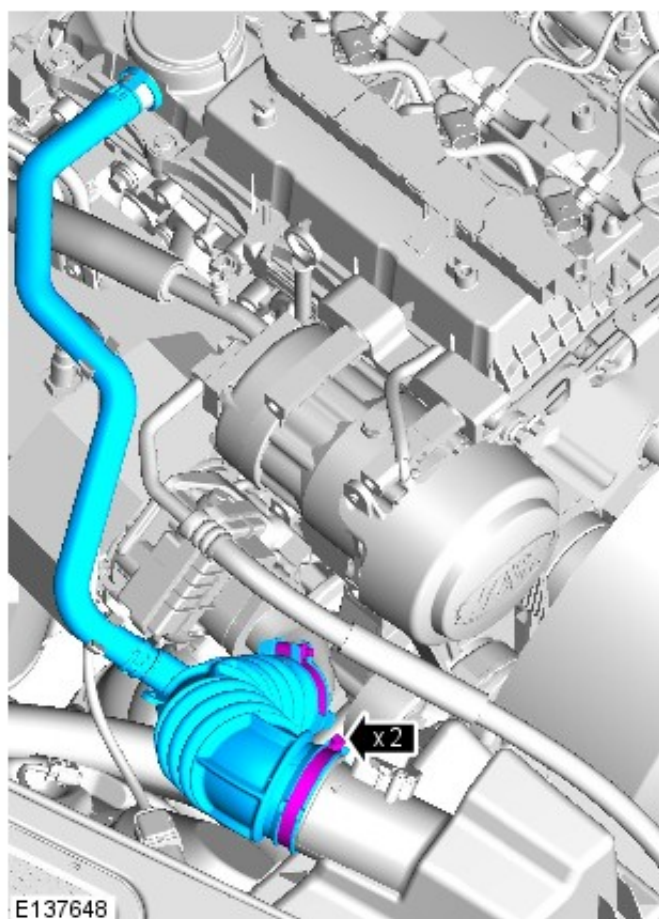
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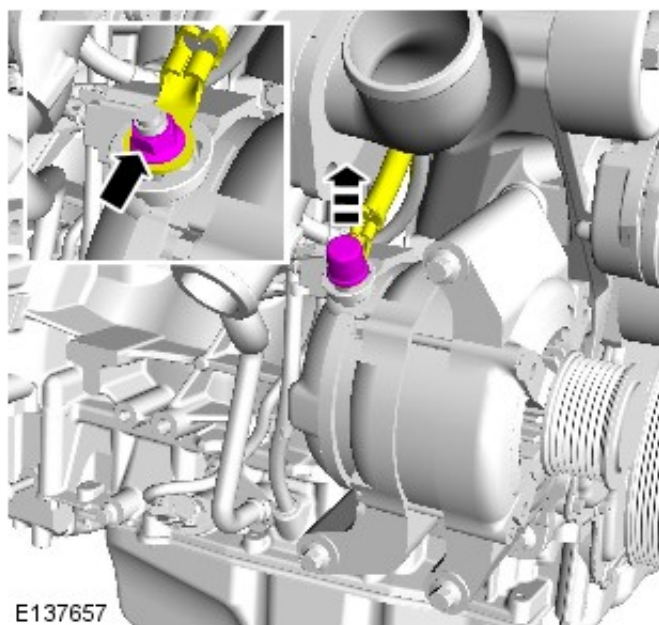
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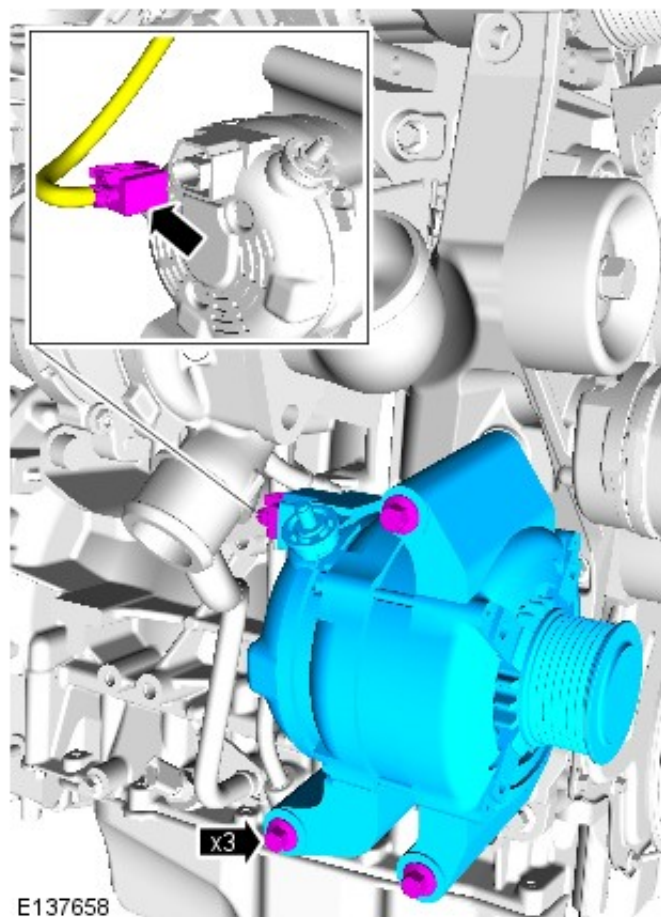
7.



8. Torque: 10Nm



9. Torque: 48Nm



E137658

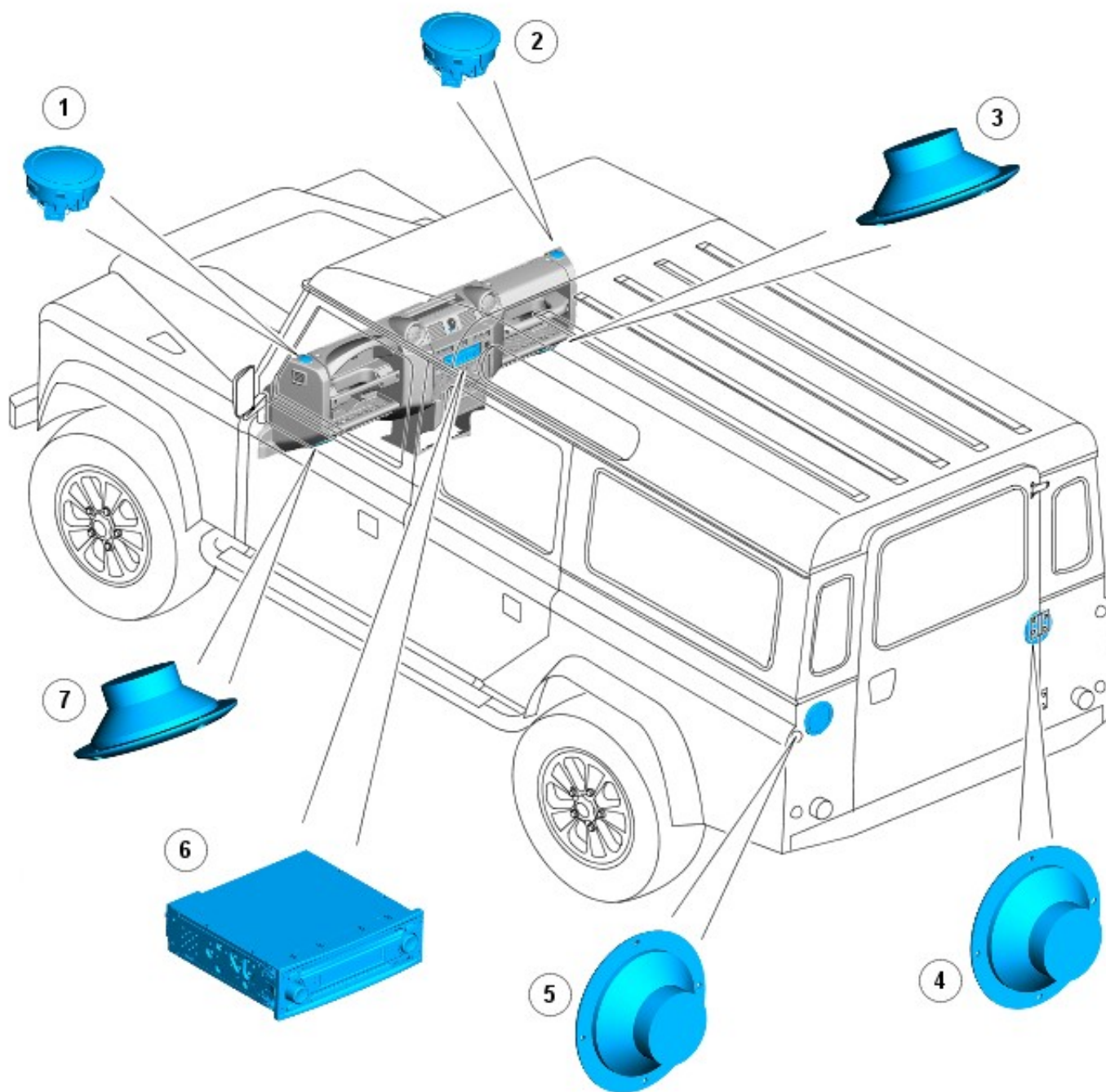
Installation

1. To install, reverse the removal procedure.

Audio Unit - Audio System

Description and Operation

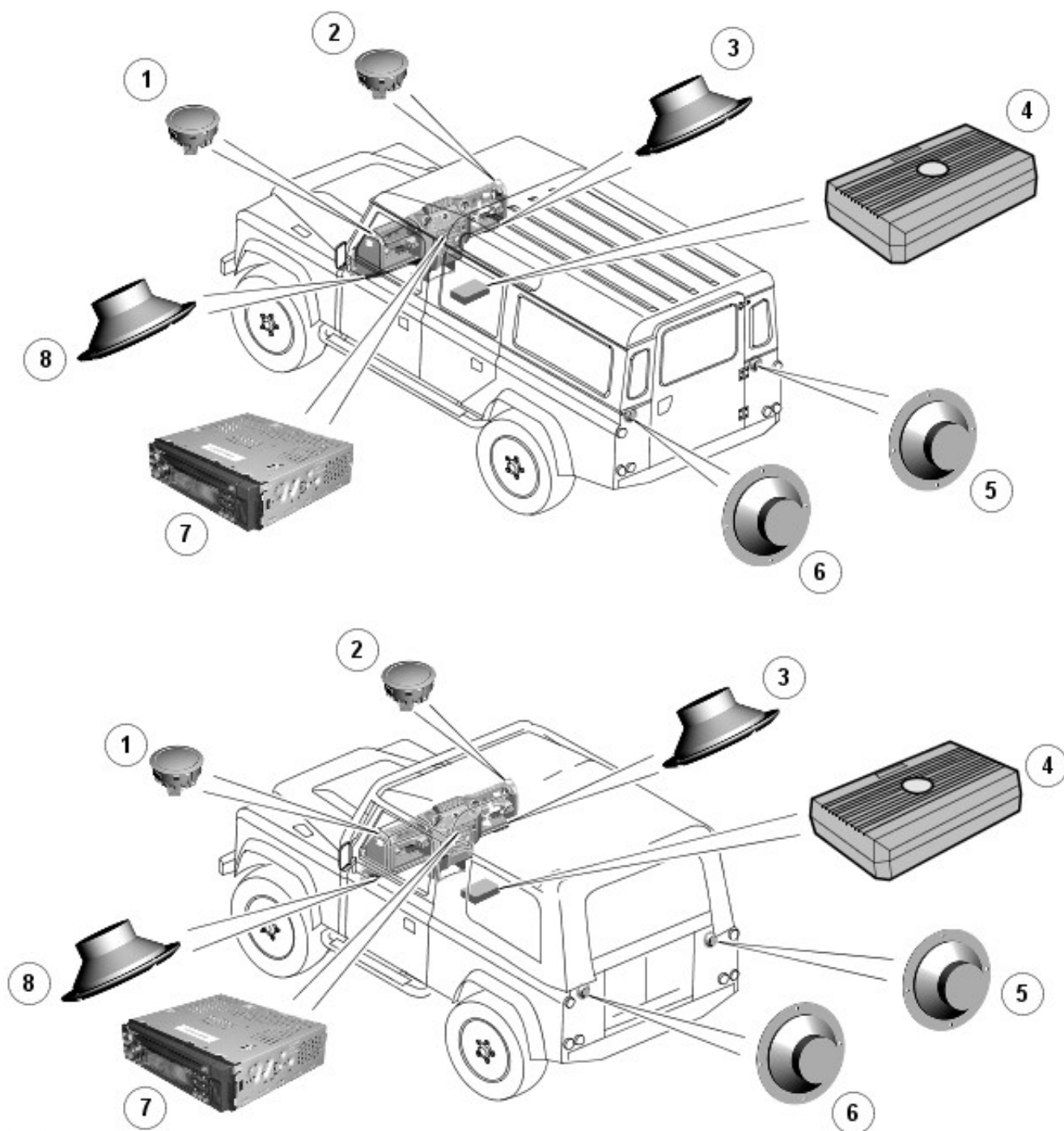
COMPONENT LOCATION - MODELS FROM 2007MY (NOT SVX (60TH ANNIVERSARY) MODEL)



E86512

Item	Part Number	Description
1	-	Front left-hand (LH) high range speaker
2	-	Front right-hand (RH) high range speaker
3	-	Front RH mid range speaker
4	-	Rear RH mid range speaker
5	-	Rear LH mid range speaker
6	-	Audio head unit
7	-	Front LH mid range speaker

COMPONENT LOCATION - SVX (60TH ANNIVERSARY) MODEL



E101273

Item	Part Number	Description
1	-	Front LH high range speaker
2	-	Front RH high range speaker
3	-	Front RH mid range speaker
4	-	Sub-woofer
5	-	Rear RH mid range speaker
6	-	Rear LH mid range speaker
7	-	Audio head unit
8	-	Front LH mid range speaker

OVERVIEW

The audio system comprises a CD tuner unit which directly drives up to 6 speakers. The audio head unit is located in the center of the instrument panel. The head unit combines the following functions:

- AM/FM radio
- Audio CD player
- MP3 CD player
- RDS traffic information receiver

The audio system has no diagnostic capabilities and is not connected to any of the vehicles other systems.

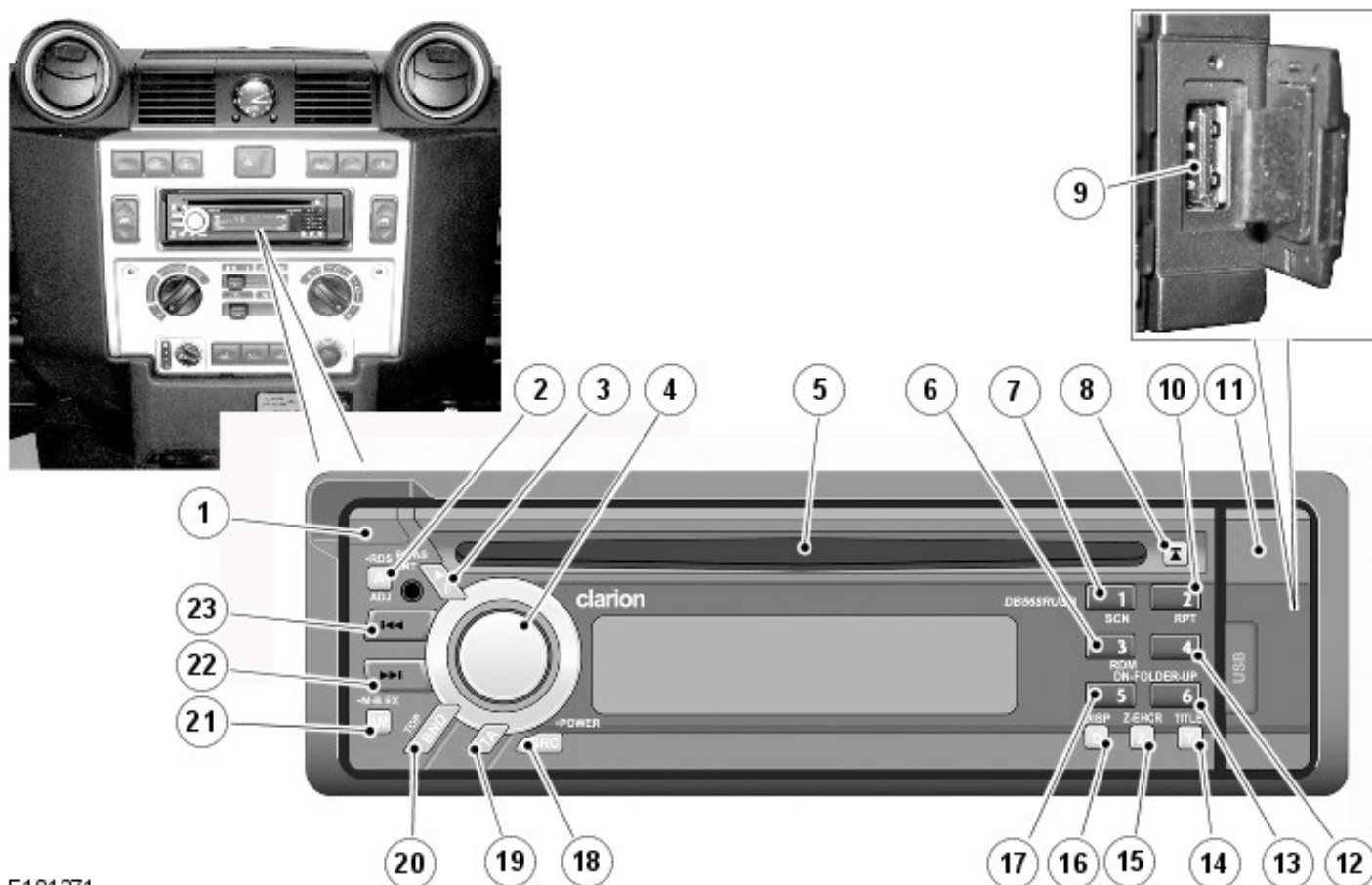
SVX (60th Anniversary) Model

The SVX model has an upgraded head unit, speakers and also a sub-woofer. The head unit has the addition of a universal serial bus (USB) port and is also MP3/WMA compatible.

The 90 model also has two additional speakers located in the rear of the load space.

DESCRIPTION - SVX (60TH ANNIVERSARY) MODEL

Clarion® Head Unit DB568RUSB



E101271

Item	Part Number	Description
1	-	Detachable control panel release button
2	-	Auto Frequency (AF) button
3	-	Pre-set scan button/autostore - radio mode or play/pause a track - compact disc (CD)/MP3/WMA/USB mode
4	-	Volume rotary control and function select
5	-	CD insertion/eject slot
6	-	Station pre-set/store 3 button - radio mode or Random play (RDM) button- CD/MP3/WMA/USB mode
7	-	Station pre-set/store 1 button - radio mode or Scan (SCN) button- CD/MP3/WMA/USB mode
8	-	CD eject button
9	-	USB port
10	-	Station pre-set/store 2 button - radio mode or repeat play button - CD/MP3/WMA/USB mode
11	-	USB port cover
12	-	Station pre-set/store 4 button - radio mode
13	-	Station pre-set/store 6 button or select folder up (UP) button for MP3/WMA/USB folder options and for CD-DA or MP3/WMA selection with a multi-session disc
14	-	Title display - MP3/WMA/USB mode
15	-	'Z' sound enhancer button
16	-	Display change button
17	-	Station pre-set/store 5 button or select folder down (DN) button for MP3/WMA/USB folder options and for CD-DA or MP3/WMA selection with a multi-session disc

18	-	Power on/off and mode select button
19	-	Traffic announcement button
20	-	Switch band/seek tuning/manual tuning - radio mode or play first track - CD/MP3/WMA/USB mode
21	-	Audio mode (bass/treble/balance/fade) or Magna bass selection mode
22	-	Select station - radio mode or select track forwards - CD/USB mode or fast forward - CD/USB mode
23	-	Select station - radio mode or select track backwards - CD/USB mode or fast reverse - CD/USB mode

The head unit is located in a central position in the instrument panel, above the heater controls. The head unit locates in an ISO standard radio cage which is specific to the Clarion® head unit. Two special tools are required to remove the head unit from the cage once installed.

A link harness is used to connect the Clarion® head unit to the existing In-Car Entertainment (ICE) harness connectors. The link harness plugs into the existing ICE connector on the main harness and has four phono plugs and one connector to provide the connections to the Clarion® head unit. The phono plugs provide the speaker outputs and are colored red and white. Two of the plug wires have a blue tracer for identification. Two phono plugs connect to the top 2 phono sockets in the head unit and the two phono plugs with the blue tracer connect to the center 2 phono sockets on the head unit. The phono sockets on the head unit are also colored red and white to ensure the correct connections are made and the speaker polarity is correct. The connector also plugs into the rear of the head unit. The aerial plug is a male plug which connects into a socket on the rear of the head unit.

If iPod connectivity is installed an additional iPod audio connectivity module and link harness is used. The audio connectivity module is located on the cross car beam to the right of the head unit and is secured with a zip tie. This harness plugs into the existing ICE connector and the head unit link harness connects to the iPod audio connectivity module link harness. The audio connectivity module has a lead for the antenna connection. The lead from the antenna is plugged into the module antenna connection and the antenna lead from the module then connects into the head unit antenna connector.

The Clarion® DB568RUSB head unit features a detachable control panel which can be removed for security. The panel is released by pressing the button at the top LH corner of the unit. The panel will be released and can be removed and stored in the supplied case. The panel can be refitted by locating the RH end of the panel in the slots in the head unit and gently pushing the LH end of the panel towards the unit until the catch engages.

A USB port is located in the RH hand end of the unit and can be accessed by opening a cover on the detachable control panel. The port allows the use of a customer supplied USB memory device to allow access to a large range of music files in both MP3 and WMA formats. The unit can read the files and folder structures and data from the memory device and play the music directly via the USB port. It is not recommended to use this port for iPod connection.

Full operating instructions and unit features are detailed in the owner literature supplied with the vehicle.

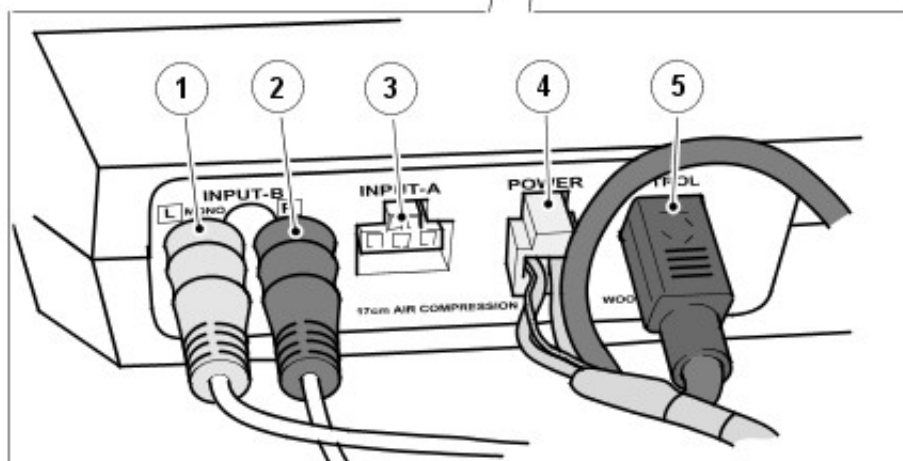
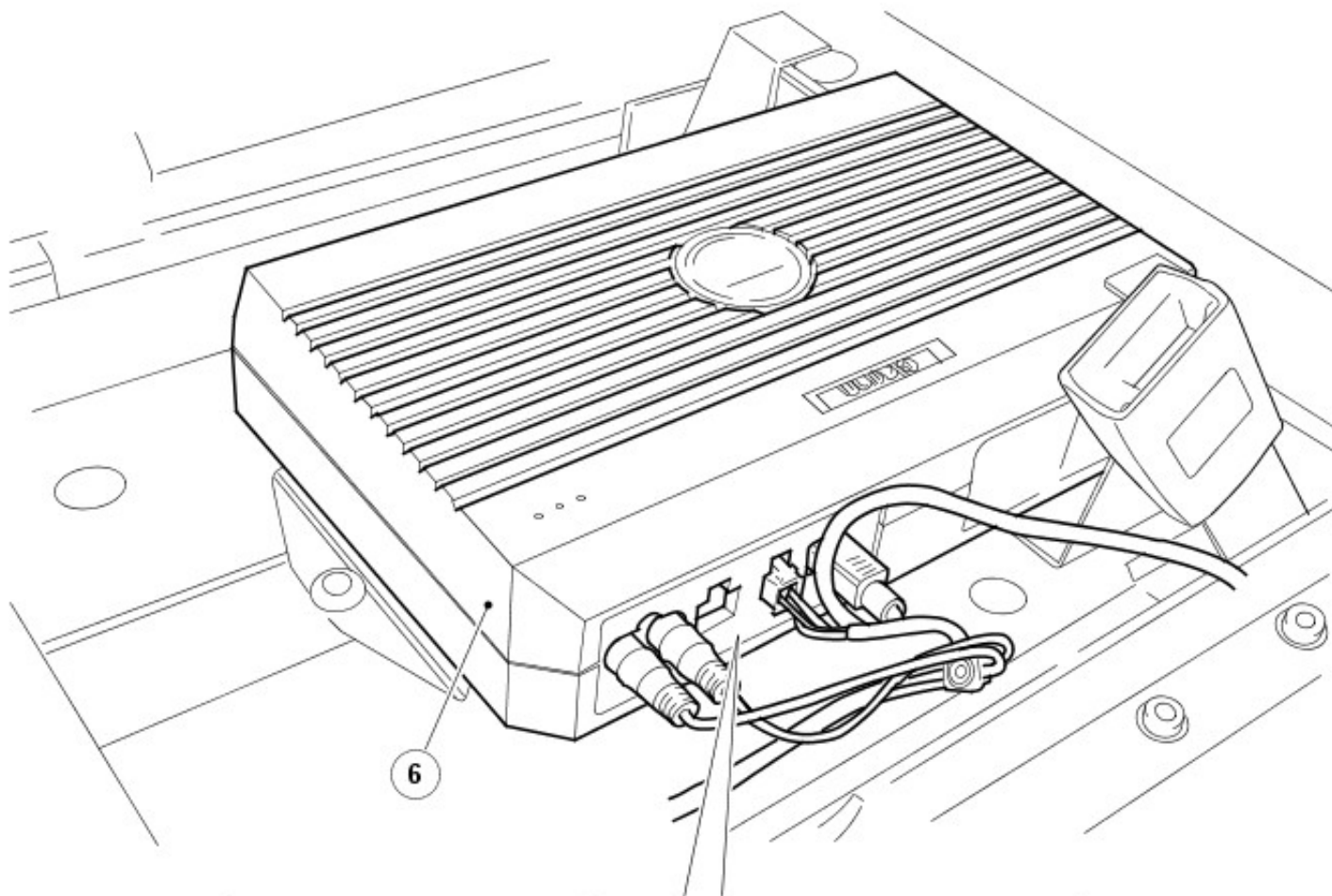
An auxiliary input socket is located inside the cubby box. The socket allows for the additional connection of an MP3 player or other storage device via a single pin jack plug.

Specifications

- Power supply voltage: 14.4 Volts (10.8 to 15.6 Volts allowable) - Negative earth
- Current consumption: less than 15 Amperes
- Speaker impedance: 4 Ohms (4 to 8 Ohms allowable)
- Audio maximum power output: 200 Watts (50 Watts X 4 channels)
- Audio power output: 4 X 25 Watts
- USB 1.1 and 2.0 compatible with transfer rate of 12 Mbps maximum
- MP3 and WMA compatible
- FM frequency range: 87.5 to 108 MHz
- MW frequency range: 531 to 1602 kHz
- AM frequency range: 153 to 279 kHz

The speakers installed in the SVX vehicle are upgraded from the standard fitment and are also supplied by Clarion®. These speakers are connected to the existing speaker harnesses by link leads which allow for the different connector specifications required for the Clarion® speakers.

Clarion Sub-Woofer SRV313



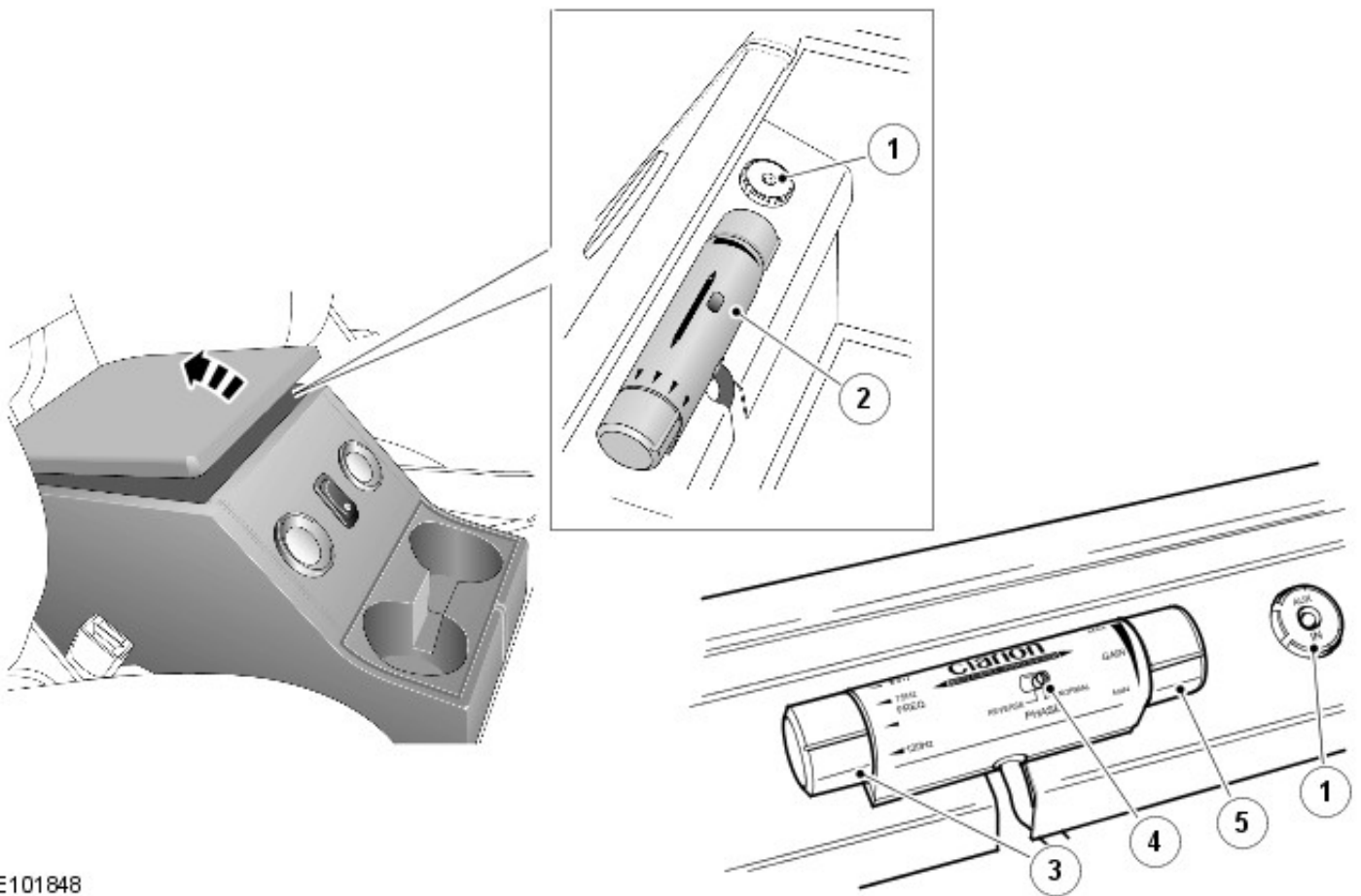
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Item	Part Number	Description
1	-	LH phono plug speaker input
2	-	RH phono plug speaker input
3	-	Not used
4	-	Power and ground connector
5	-	Remote control connector
6	-	Sub-woofer unit

The Clarion® SRV313 sub-woofer is located on the cabin floor below the center cubby box and is secured to the floor with two self-tapping screws.

The sub-woofer is connected to the head unit via a link cable from the head unit. Two phono plugs provide speaker inputs for LH and RH inputs and are colored white and red respectively for identification and connect into the 'Input B' sockets (the 'Input A' socket is not used). A power supply socket provides power and ground for unit power. A 'Remote Control' socket allows for the connection of the remote control unit.

Remote Control and Auxiliary Socket



E101848

Item	Part Number	Description
1	-	Auxiliary socket
2	-	Remote control
3	-	Frequency control
4	-	Phase switch
5	-	Gain volume control

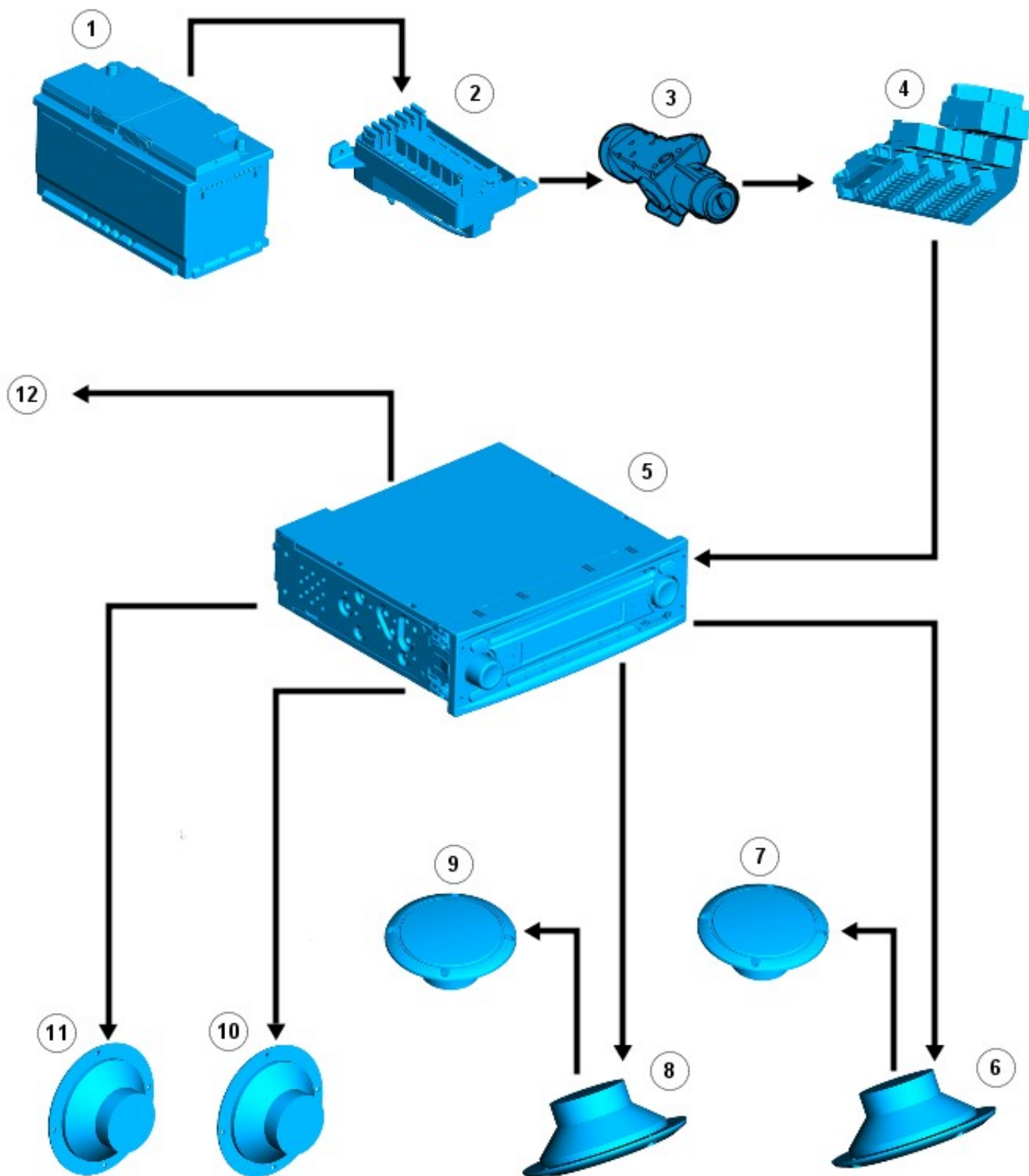
The remote control unit is located in the front of the cubby box and is accessible by lifting the cubby box lid. The remote control has a rotary control on the LH end which allows for adjustment of the sub-woofer bass output by adjusting the cut-off frequency of the low-pass filter. Four selections are available; 50/75/100 and 120 Hz. The sub-woofer will only output frequencies below the selected Hz level. The rotary control on the RH end of the remote control provides for adjustment of the speaker 'gain' and can be used to adjust the sub-woofer volume output, independent of the head unit volume control. A switch on the remote control allows for the sub-woofer phase to be switched between normal and reverse. Clarion recommend for this application the setting is the 'normal' phase.

An auxiliary input socket is located adjacent to the remote control. The socket allows for the connection of an additional auxiliary audio input, an MP3 player for example.

Sub-Woofer Specifications

- 120 Watt high power amplifier with low pass filter
- 17 cm counter drive woofer with dualneodymium magnet
- Air compression structure with die-cast aluminum enclosure
- Wired remote control for gain control/low pass filter (selectable 50/75/100/120 Hz) /phase filter
- Dual 4 Ohm voice coils.

CONTROL DIAGRAM - MODELS FROM 2007MY (NOT SVX (60TH ANNIVERSARY) MODEL)



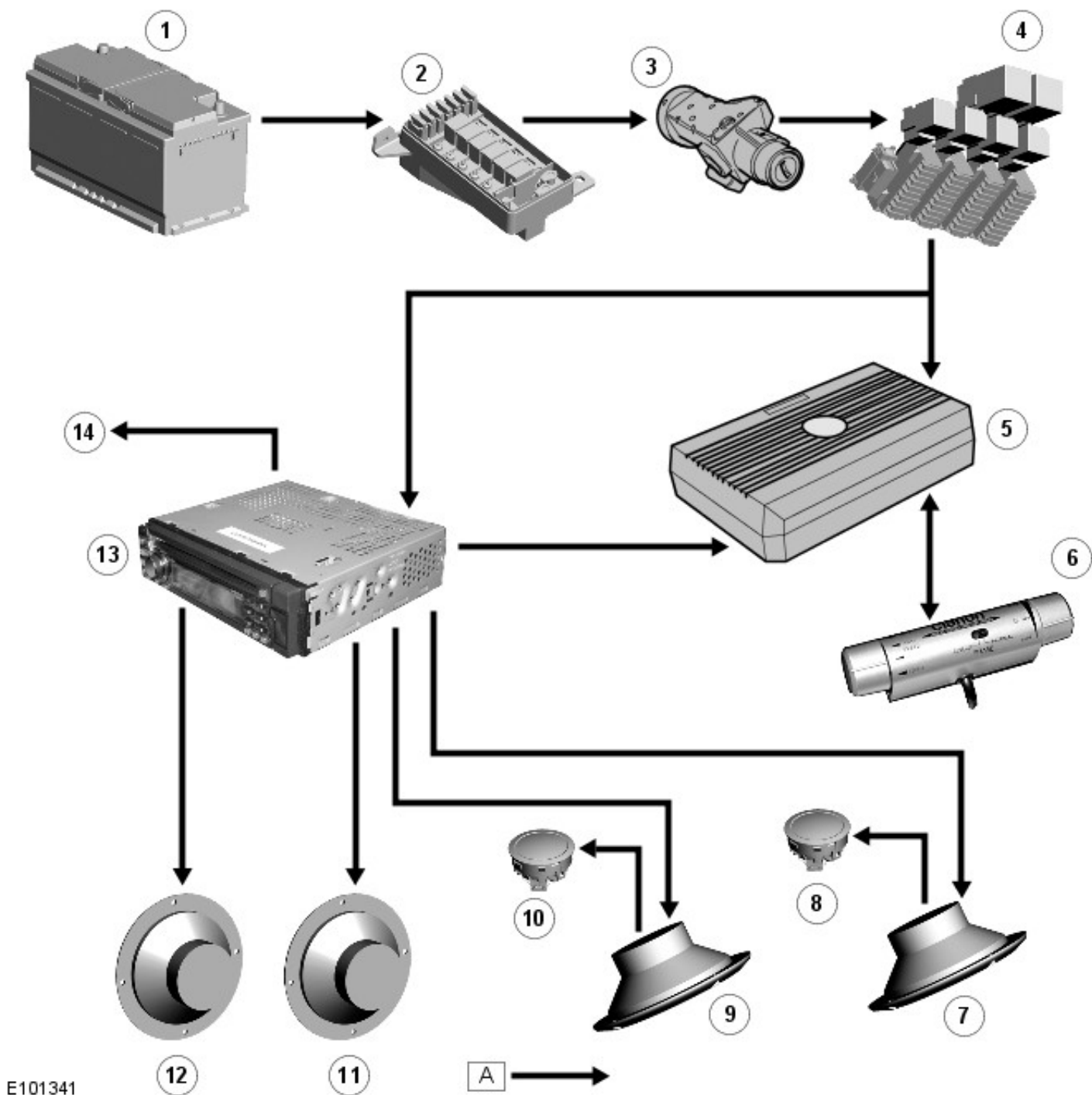
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A →

Item	Part Number	Description
1	-	Battery
2	-	battery junction box (BJB)
3	-	Ignition switch
4	-	central junction box (CJB)
5	-	Audio head unit
6	-	Front RH mid range speaker

- 7 - Front RH high range speaker
- 8 - Front LH mid range speaker
- 9 - Front LH high range speaker
- 10 - Rear RH mid range speaker
- 11 - Rear LH mid range speaker
- 12 - Antenna

CONTROL DIAGRAM - SVX (60TH ANNIVERSARY) MODEL



E101341

Item	Part Number	Description
1	-	Battery
2	-	BJB
3	-	Ignition switch
4	-	CJB
5	-	Sub-woofer
6	-	Sub-woofer remote control
7	-	Front RH mid range speaker
8	-	Front RH high range speaker

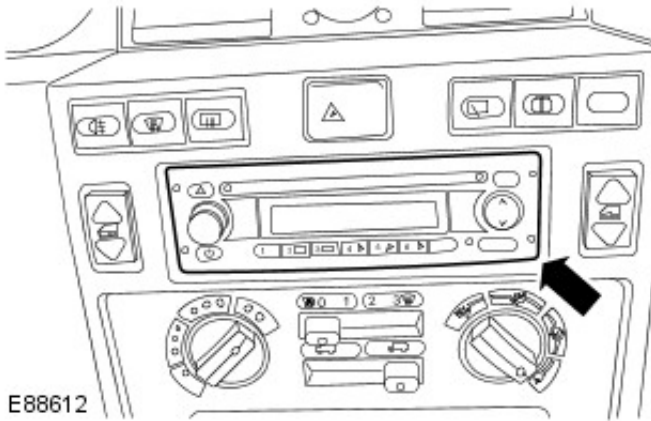
9	-	Front LH mid range speaker
10	-	Front LH high range speaker
11	-	Rear RH mid range speaker
12	-	Rear LH mid range speaker
13	-	Audio head unit
14	-	Antenna

Audio Unit - Audio Unit

Removal and Installation

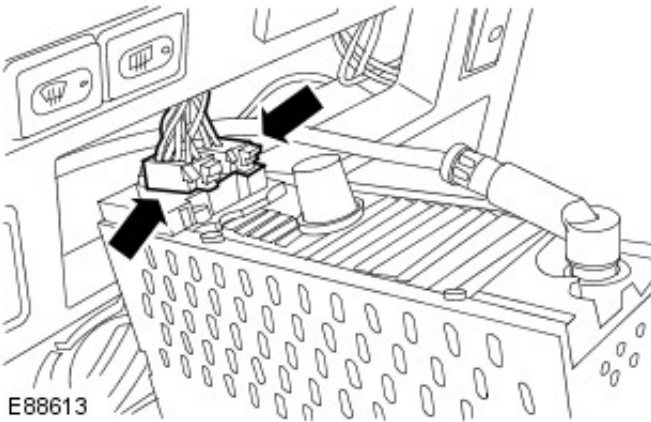
Removal

1. Using the audio unit removal tools, release the audio unit.



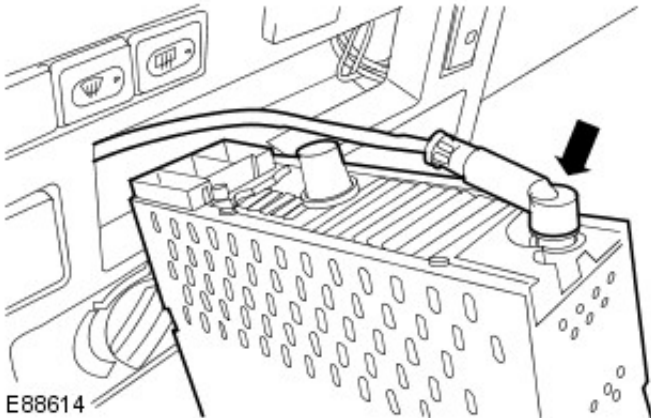
E88612

2. Disconnect the 2 electrical connectors from the audio unit.



E88613

3. Remove the audio unit.
 - Disconnect the antenna cable.



E88614

Installation

1. To install, reverse the removal procedure.

Information and Entertainment System - Navigation System

Description and Operation

COMPONENT LOCATION - SVX (60th ANNIVERSARY) MODEL



E 101755

Item	Part Number	Description
1	-	Personal Travel Assistant navigation unit
2	-	Cradle
3	-	Electrical connector
4	-	External speaker (located behind instrument panel)

OVERVIEW

The satellite navigation system is a standard fitment on the SVX model and is available as an accessory fitment on other models. The unit is known as the 'Land Rover Personal Travel Assistant' and its use and operation is covered in a separate instruction book supplied with the vehicle.

The Personal Travel Assistant provides a comprehensive navigation system, which assists the driver by providing a route to a selected destination. The map and turn information which is displayed on the touch screen is supplemented by voice

guidance.

The Personal Travel Assistant is also equipped with additional features, which can be accessed via the Tools menu:

- media player
- picture viewer
- calculator
- language guide
- currency converter
- unit converter.

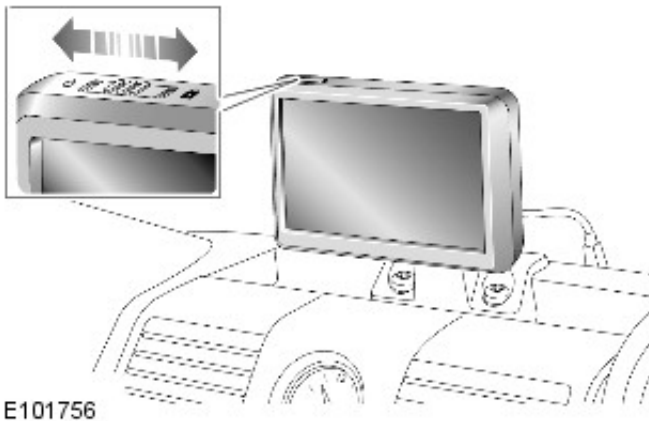
 **WARNING:** In the interests of road safety, only operate, adjust or view the system when it is safe to do so.

The Personal Travel Assistant must be able to locate satellite signals in order to operate. The strength of these signals can vary depending on the location. Near tall buildings or trees, the signal strength may be affected. When a strong signal is being received, the bars at the top left of the main menu are green, when the signal deteriorates, the bars turn red or become clear with a red 'x' appearing on the bars.

DESCRIPTION

On the SVX model, the satellite navigation unit is a 'Garmin™' manufactured unit with Land Rover specific software installed. The unit is self-contained with its own internal battery. The vehicle wiring harness connections provide for connection to the external speaker and the power supply for internal battery charging and powering the unit while it is connected to the vehicle.

The unit uses a remote external speaker for the voice and audio output. The speaker is located below the driver's side center air vent, behind the instrument panel. The unit however, also has its own internal speaker allowing the unit to be used when not in the vehicle.

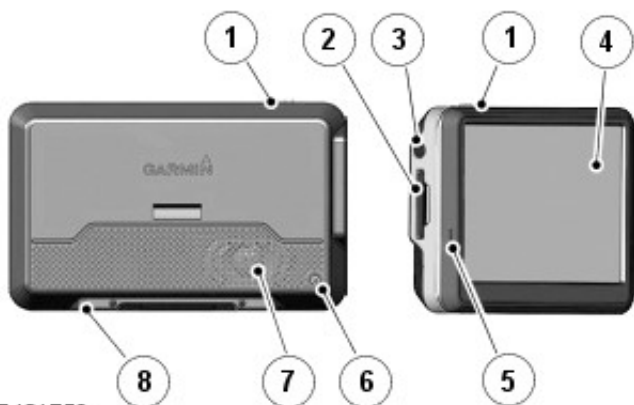


The unit can be switched on using a spring loaded switch on the top of the unit. To switch the unit on, push the switch to the left. To subsequently switch the unit off, push the switch to the left a second time. The unit can be locked to prevent inadvertent operation by sliding the switch on the top of the unit to the right.



The satellite navigation unit is mounted on a bracket which is secured to the top of the instrument panel with 2 bolts. The bracket houses a cradle with a connector which allows the unit to be secured into position and also connected electrically to the vehicle electrical system and the navigation speaker. The cradle is mounted on a ball which allows the unit to be adjusted vertically and horizontally so that it can be moved to face the passenger or driver's seat positions. The unit clips into position on the bracket and can be released by pressing a release catch on the bottom of the cradle, tilting the top of the unit forwards and removing the unit from the cradle.

Garmin™ Nuvi 750 Unit Details

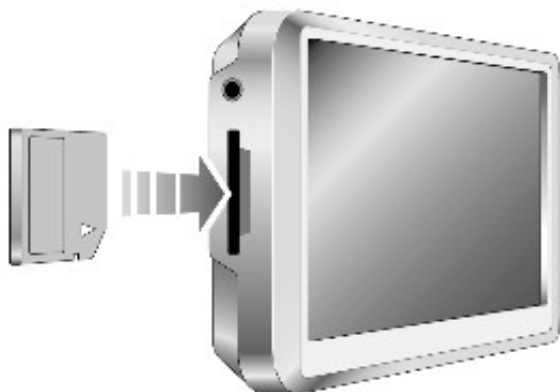


E101759

Item	Part Number	Description
1	-	On/Off/Lock switch
2	-	SD card slot
3	-	Earphone/audio out jack plug
4	-	liquid crystal display (LCD)
5	-	Microphone (not used)
6	-	External antenna connector
7	-	Internal speaker
8	-	universal serial bus (USB) connector

The Personal Travel Assistant uses a wide-screen, LCD with a white backlight and touch screen functionality. The screen has a 480 X 272 pixel display.

On the left-hand (LH) end of the unit a 3.5 mm jack plug allows for the connection of audio headphones. A slot, below the jack plug, provides for the insertion of an SD memory card. The card can be used to store music and pictures which can be played and displayed on the unit. The unit can play MP3, MP3U and MP3U8 playlist files, display pictures in JPEG format and play audio books in AA format.



E101758

On the underside of the unit are two plugs. The larger, centrally positioned, plug mates with a similar plug in the cradle and connects the unit to the vehicle electrical system. The smaller plug provides for the connection of a USB cable to allow the unit to be connected to a computer to allow software upgrades to be installed.

The unit contains an integral lithium-ion battery which cannot be replaced. A battery icon is displayed in the LCD and indicates the status of the internal battery. If the unit is to be discarded, it must be disposed of according to local regulations. The battery, once fully charged has a battery charge time of between 3 and 7 hours, depending on unit usage.

Trouble Shooting

Problem	Solution
Unable to receive satellite signals	Ensure the unit is not in an enclosed garage or car park and away from tall buildings and trees. Remain stationary for several minutes to allow the unit to establish satellite connection.
The unit will not charge in the vehicle	The unit will only charge if the temperature is between 0 and 45°C (32 and 113°F). At temperatures above or below this range or if the unit is placed in direct sunlight or in a hot environment, the battery will not charge.
How to clear all user data	Hold finger on lower right-hand (RH) corner of touch screen and turn the unit on. Continue to press corner of touch screen until message appears. Touch 'Yes' to clear all user data.
The unit is locked up or	If the touch screen stops functioning, turn the unit off and then on again. If this does not correct the problem, slide the power on/off switch to the left and hold for 8 seconds. The unit will switch off. Switch

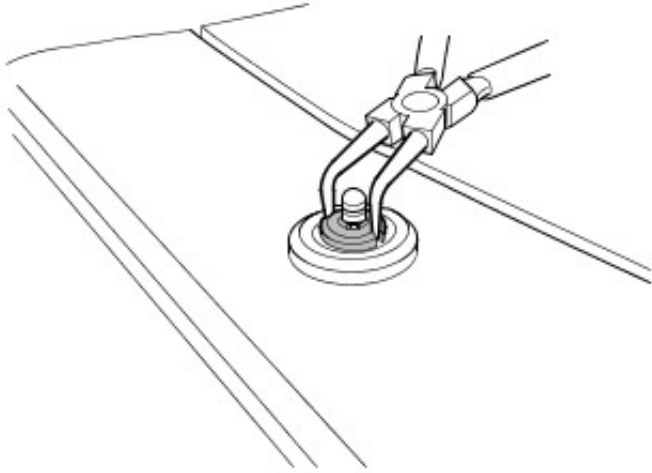
frozen	the unit back on again and it will operate normally.
Touch screen is not responding to touch	Turn the unit off and then back on again. Slide the on/off switch to the right (lock position). Hold a finger on the touch screen for approximately 30 seconds until the calibration screen appears. Follow the on-screen instruction.
The battery gauge seems inaccurate	Allow the unit to fully discharge. Then, fully charge the unit without disrupting the charge cycle.

Antenna - Antenna

Removal and Installation

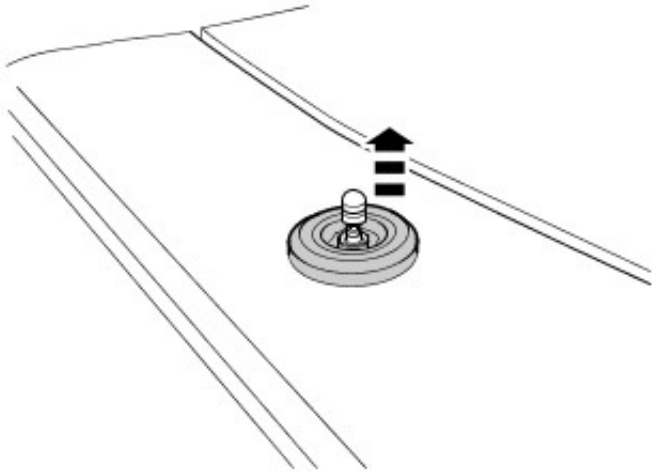
Removal

1. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01, Removal and Installation).
2. Remove the retaining nut from the antenna mast.



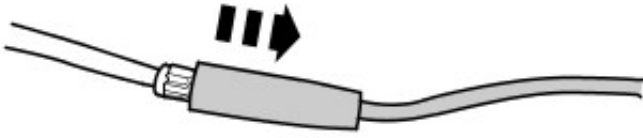
E128760

3. Release antenna assembly from the fender.



E128759

4. Disconnect the antenna cable.



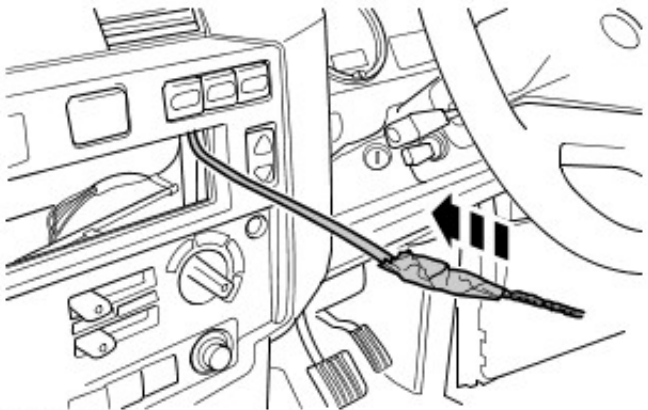
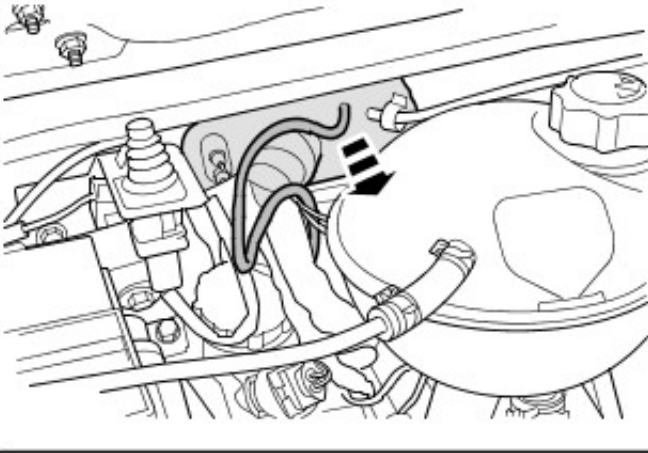
E128757

5. Attach a suitable length of string to the antenna cable.



E128754

6. Remove the antenna cable.



E128753

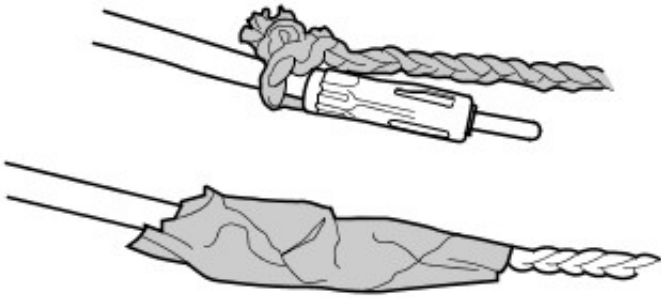
7. Release the string from the antenna cable.

Installation

1. **NOTE:** Using suitable tape, secure the antenna cable

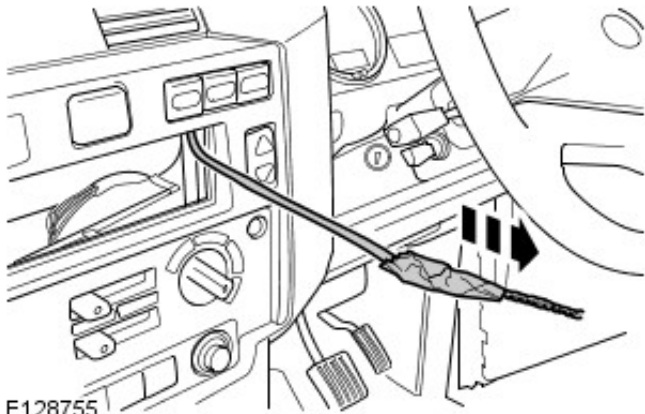
2. ~~Never~~ Using ductable tape, secure the antenna cable and string to aid installation.

Attach the string to the new Aerial cable.



E128756

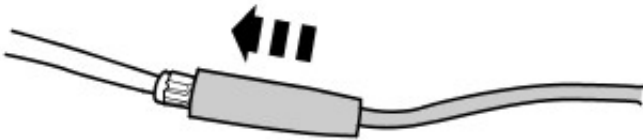
2. Install the antenna cable.



E128755

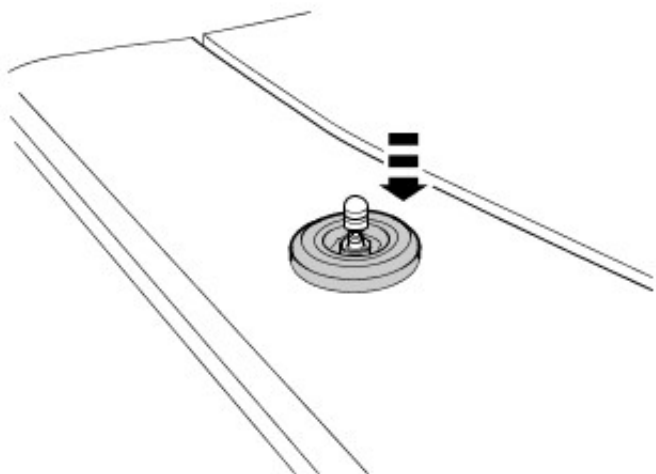
3. Release the string from the antenna cable.

4. Connect the antenna cable.



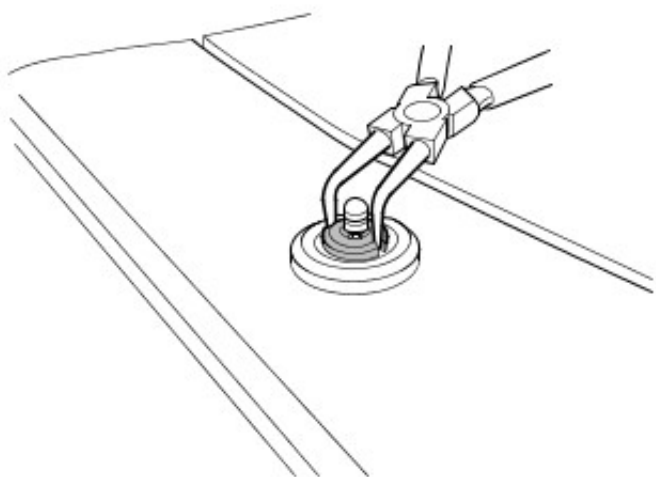
E128758

5. Install the antenna assembly in the front fender.



E128903

6. Install the antenna assembly retaining nut.



E128760

7. Install the audio unit.
For additional information, refer to: Audio Unit (415-01, Removal and Installation).

Speakers - Speakers

Description and Operation

OVERVIEW

For additional information, refer to: Audio System (415-01, Description and Operation).

Speakers - Instrument Panel Speaker

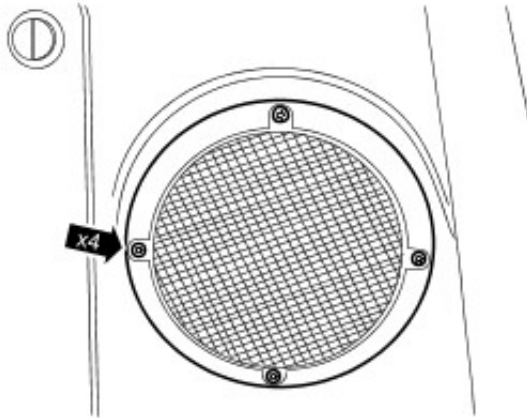
Removal and Installation

Removal

1. **NOTE:** RH shown, LH similar.

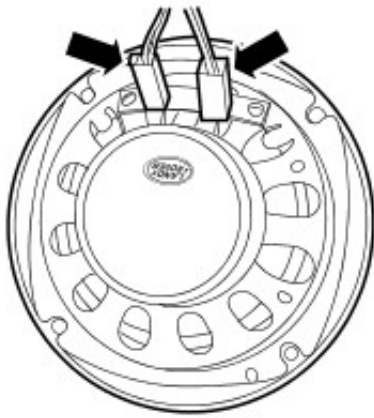
Release the instrument panel speaker.

- Remove the 4 screws.



E88719

2. Remove the instrument panel speaker.
 - Disconnect the 2 electrical connectors.



E88720

Installation

1. To install, reverse the removal procedure.

Speakers - D-Pillar Speaker

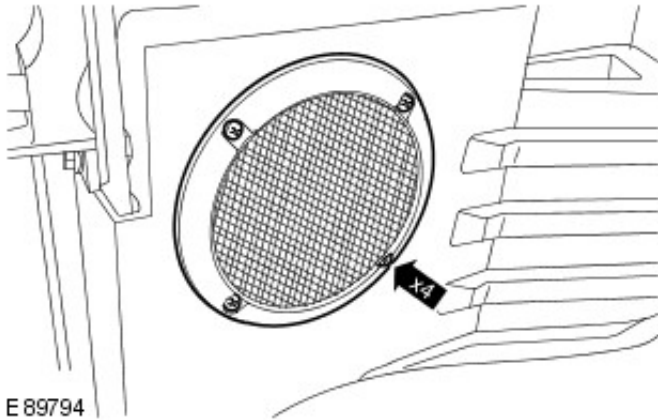
Removal and Installation

Removal

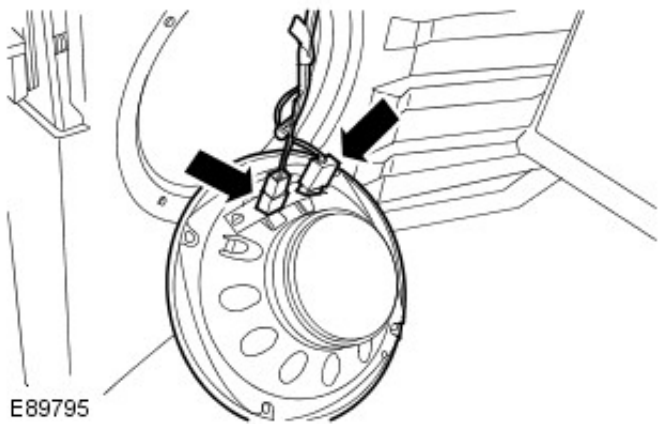
1. **NOTE:** LH shown, RH similar.

Release the speaker.

- Remove the 4 screws.



2. Remove the speaker.
 - Disconnect the 2 electrical connectors.



Installation

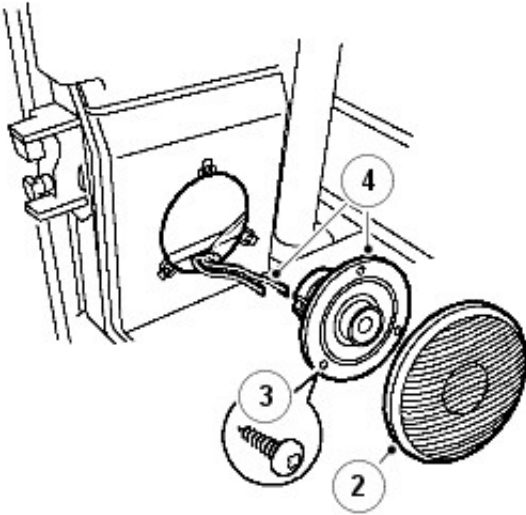
1. To install, reverse the removal procedure.

Speakers - Rear Door Speaker

Removal and Installation

Removal

1. Raise rear seat cushion and fit stowage strap.
2. Carefully prise grille from speaker.
3. Remove 3 screws and withdraw speaker from trim panel.
4. Disconnect 2 electrical leads and remove speaker.



J6066

Installation

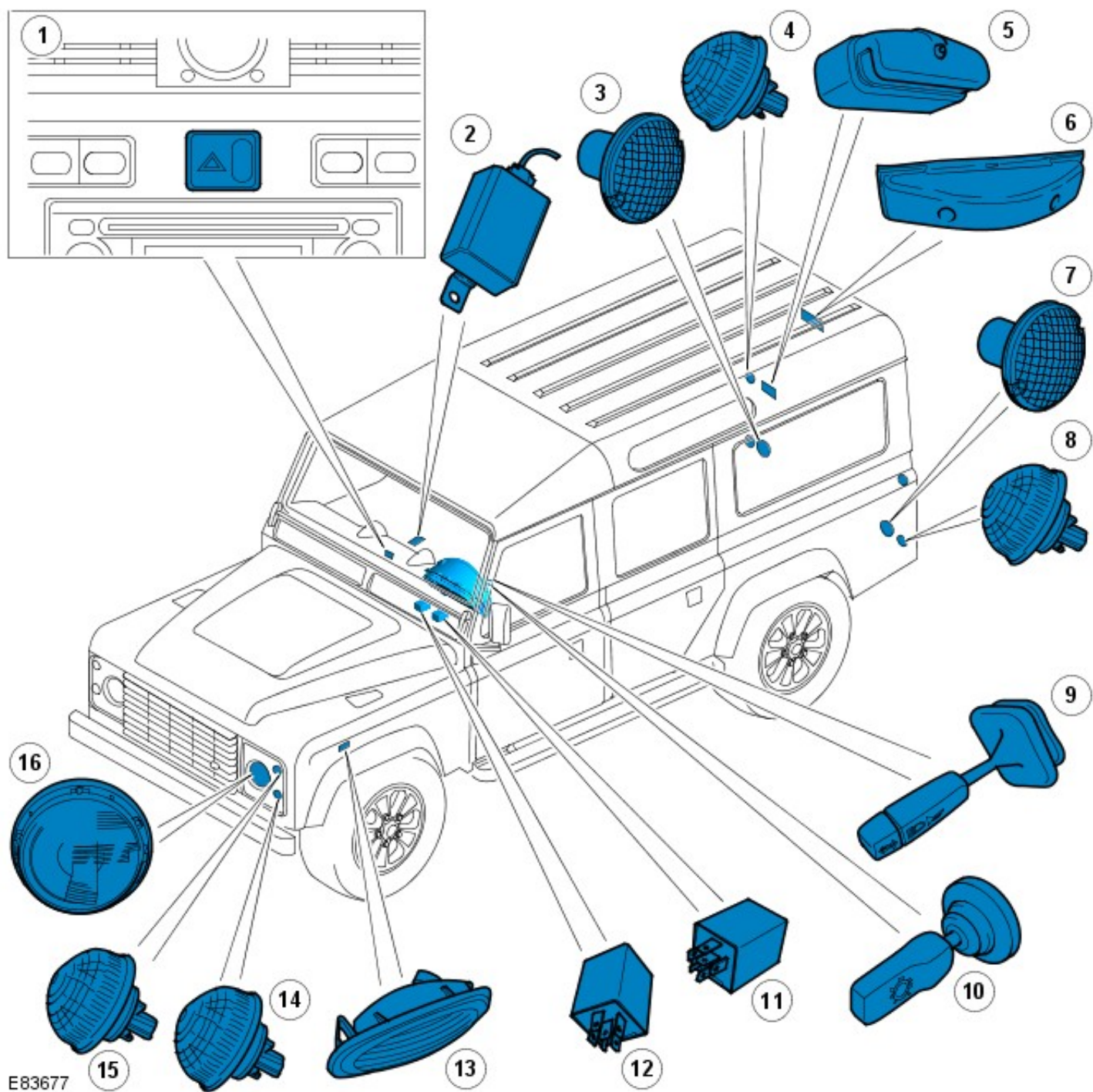
1. Connect 2 electrical leads, position speaker and secure with screws.
2. Position grille and press firmly to secure.

Content not found

Exterior Lighting - Exterior Lighting

Description and Operation

COMPONENT LOCATION - MODELS FROM 2007MY (NOT SVX (60TH ANNIVERSARY) MODEL)



Item	Part Number	Description
1	-	Hazard flasher switch
2	-	Fog lamp control module
3	-	Rear fog lamp
4	-	Rear tail/Stop lamp
5	-	License plate lamp
6	-	High mounted stop lamp
7	-	Reverse lamp
8	-	Rear turn signal indicator lamp
9	-	Steering column multifunction switch
10	-	Lighting control switch

- 11 - Headlamp relay
- 12 - Hazard flasher relay
- 13 - Side turn signal indicator lamp
- 14 - Front turn signal indicator lamp
- 15 - Side lamp
- 16 - Headlamp

COMPONENT LOCATION - SVX (60TH ANNIVERSARY) MODEL

NOTE: 90 model shown, 110 model similar



E101604

Item	Part Number	Description
1	-	Hazard flasher switch
2	-	Fog lamp control module
3	-	Steering column multifunction switch
4	-	Lighting control switch
5	-	Headlamp relay
6	-	Hazard flasher relay

7	-	Side turn signal indicator lamp (2 off)
8	-	Auxiliary high beam lamp (2 off)
9	-	Front turn signal indicator lamp (2 off)
10	-	Headlamp - incorporating integral side lamp
11	-	Rear tail/Stop lamp (2 off)
12	-	Rear fog lamp or reverse lamp (depending on market)
13	-	High mounted stop lamp (Not 90 models)
14	-	Licence plate lamp
15	-	Rear fog lamp or reverse lamp (depending on market)
16	-	Rear turn signal indicator lamp (2 off)

OVERVIEW

Operation of the exterior lamps is controlled via the lighting control switch and the steering column multifunction switch. The lighting control switch is a 3 way switch mounted on the left-hand (LH) side of the steering column. When pushed forward to the first position the switch will provide a battery feed to the side lamps, tail lamps and number plate lamps irrespective of ignition switch position. When pushed forward to the second position, the lighting control switch will also provide a feed to the headlamp relay.

The steering column multifunction switch is mounted forward of the lighting control switch on the LH side of the steering column and allows the driver to switch between headlamp high beam, low beam and flash operation. The steering column multifunction switch is provided a feed by the headlamp relay, which becomes energized when the ignition switch is turned to position II.

Where fitted, a 4 position rotary headlamp leveling switch is mounted on the instrument panel to allow the driver to raise or lower headlamp alignment according to the load being carried in the vehicle. A motor mounted on the rear of each headlamp adjusts the alignment of the headlamps in response to movements in switch position.

Operation of the turn signal indicator lamps is also controlled using the steering column multifunction switch. The steering column multifunction switch is provided an ignition switch feed from the hazard flasher relay. When the switch is moved to the left or right turn position, the switch contacts close and a feed is provided to the relevant turn signal indicator lamps. A feed is also provided to the instrument cluster to illuminate the turn signal warning indicator.

The hazard flasher switch is located on the instrument panel and operates the LH and right-hand (RH) turn signal indicator lamps simultaneously when pressed. The hazard flasher switch is provided a constant battery feed and will operate the turn signal indicator lamps irrespective of ignition switch position. When pressed, the hazard flasher switch also provides a feed to the instrument cluster to illuminate the hazard flasher warning indicator.

The stop lamps are controlled by the stop lamp switch, which is mounted on top of the brake pedal. When the brake pedal is pressed the switch contacts close allowing an ignition switch feed to power the stop lamps.

The reverse lamp is controlled by the reverse gear switch, which is mounted on the transmission. When reverse gear is selected the switch contacts close allowing an ignition switch feed to power the reverse lamp.

Operation of the rear fog lamp is controlled by the fog lamp control module, which is located beneath the RH front seat. The control module is provided an ignition switch feed from the energized headlamp relay via the central junction box (CJB). The control module monitors the condition of the fog lamp switch. When the switch is pressed, the switch contacts close and a ground path is created. When the control module registers the ground path it provides a feed to the rear fog lamp and the instrument cluster.

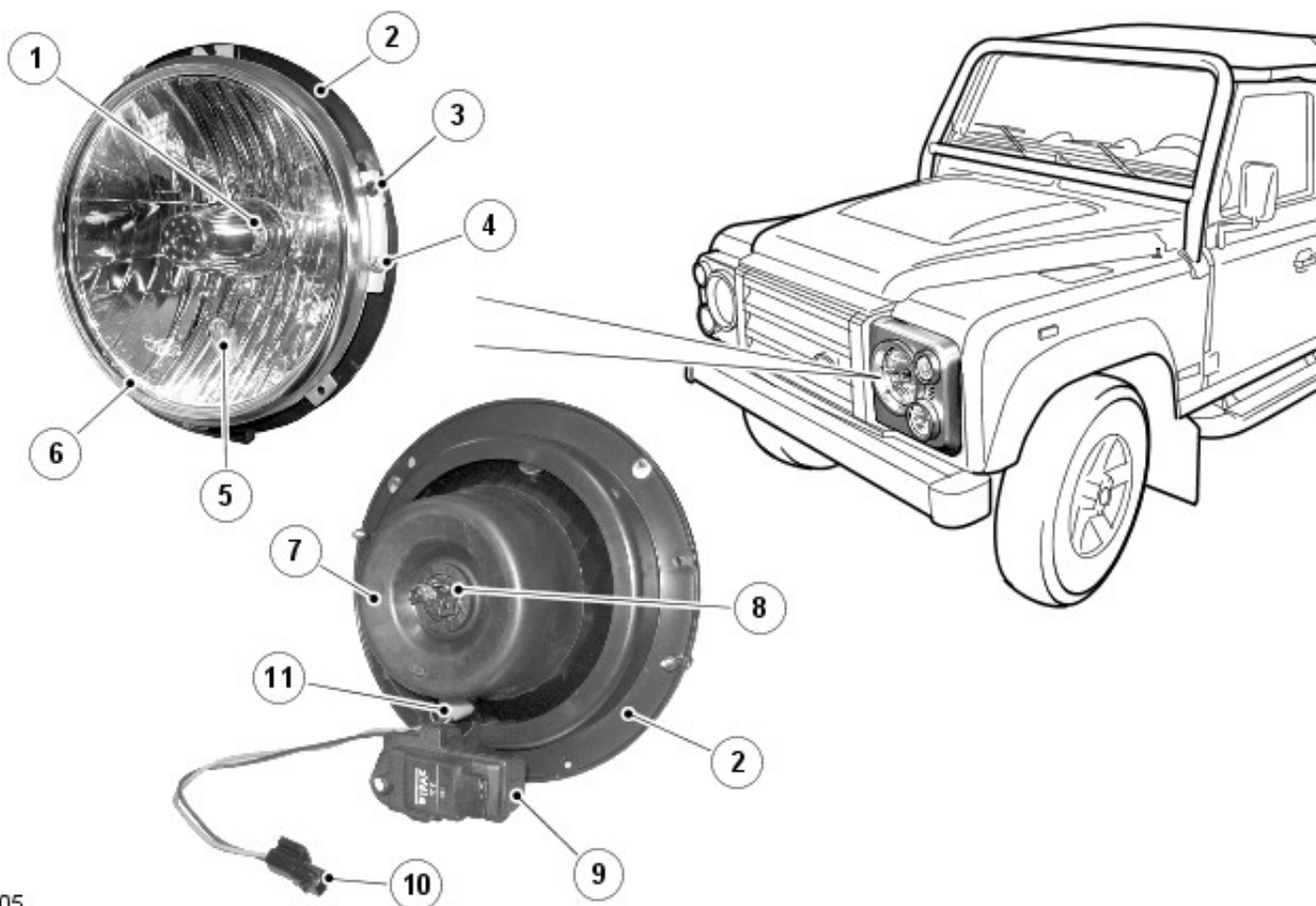
SVX (60th Anniversary) Model

The exterior lighting system on the 2008MY SVX model is as described above with the following differences:

- light emitting diode (LED) rear lights
- halogen headlamps with a complex surface reflector and integral side lamp
- separate high beam driving lamps
- new front turn signal indicator lamps.

DESCRIPTION - SVX (60TH ANNIVERSARY) MODEL

Headlamp



E101605

Item	Part Number	Description
1	-	Halogen bulb
2	-	Headlamp mounting
3	-	Headlamp securing screw
4	-	Headlamp beam alignment screw
5	-	Side lamp bulb
6	-	Headlamp assembly
7	-	Rubber cover
8	-	Headlamp bulb connections
9	-	Headlamp adjustment motor (if fitted)
10	-	Side lamp connector
11	-	Side lamp bulb holder

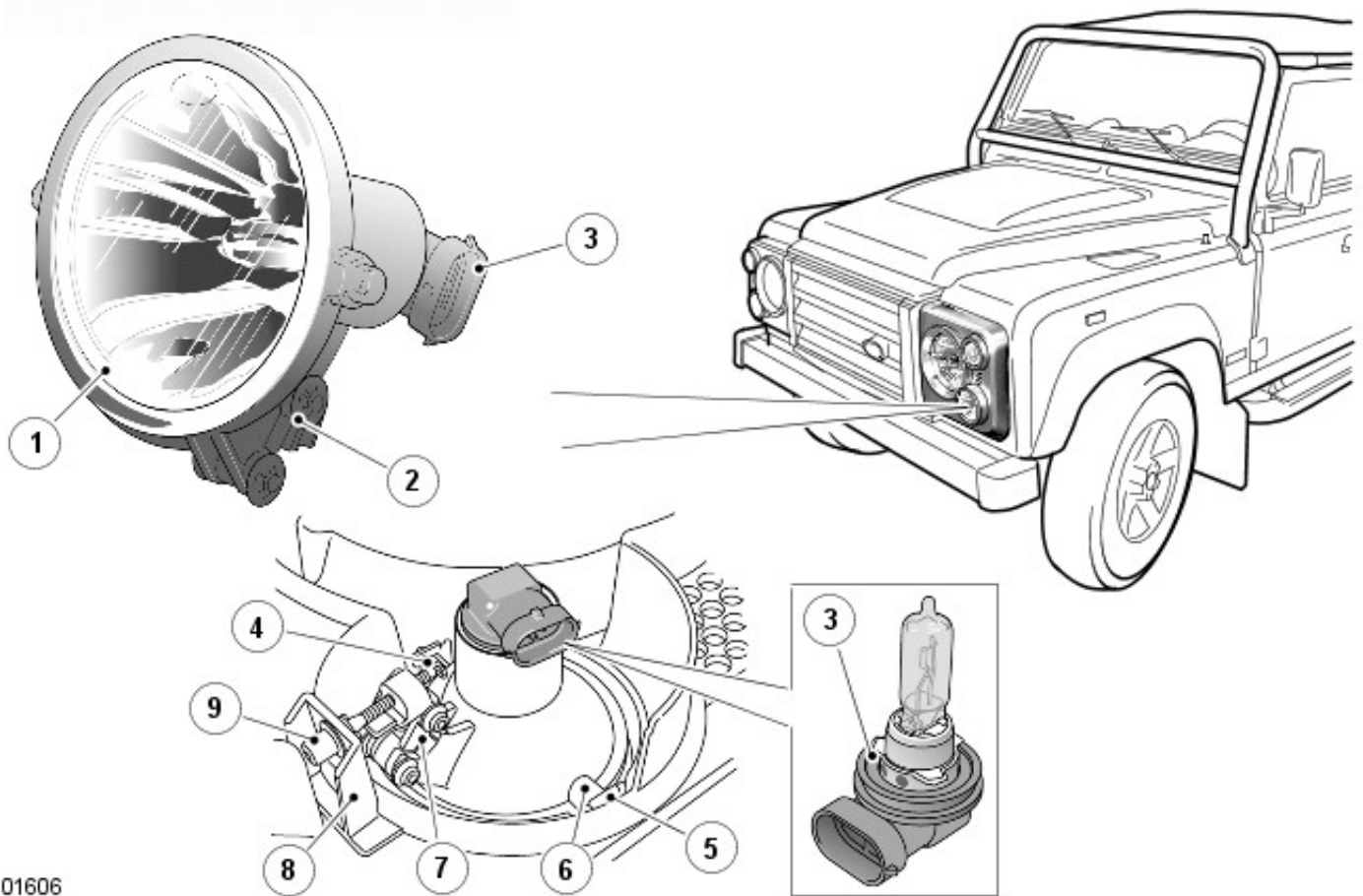
The headlamp is a unique unit to the SVX model. The headlamp is a Wipac unit with a reflector divided into parabolic segments, with each segment having a different focal length. The headlamp uses a H4 60/55W halogen bulb which is retained in the rear of the headlamp with a wire clip. The headlamp also houses the sidelamp which is located in a hole in the headlamp lens. The side lamp uses a W5W bayonet fitting bulb which is located in a rubber holder. A harness connector from the side lamp connects into the existing side lamp connector in the main wiring harness.

The RH headlamp unit is connected into the main wiring harness. The LH headlamp is connected to the main harness via a link harness which also supplies power to the auxiliary driving lamps.

Where fitted, an electric motor mounted on the rear of the headlamp allows for the electrical adjustment of the headlamp alignment.

The headlamp is secured to a metal mounting plate, which is attached to the fender, with 4 self-tapping screws.

Auxiliary High Beam Lamp



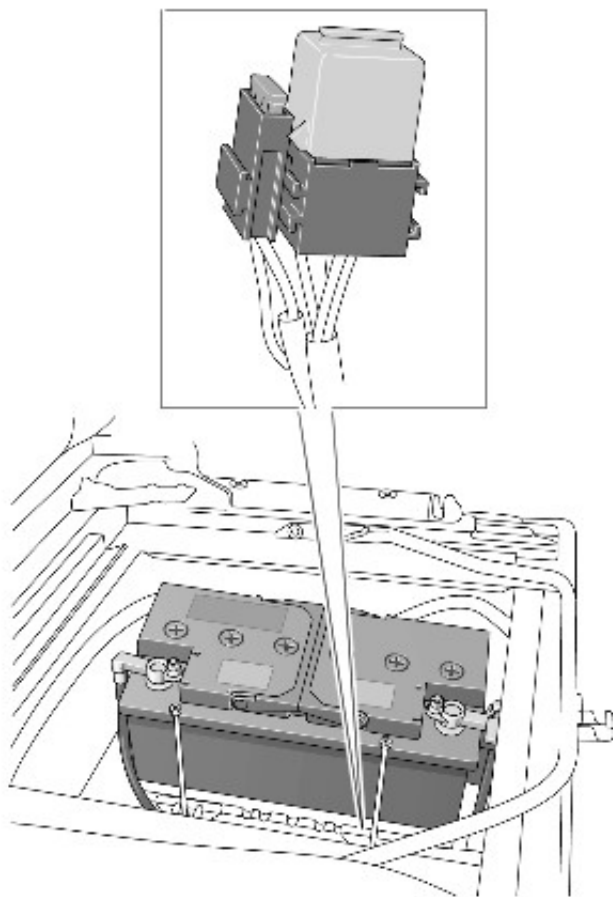
E101606

Item	Part Number	Description
1	-	Auxiliary high beam lamp assembly
2	-	Adjustment lever
3	-	Electrical connector and halogen bulb holder
4	-	'R' clip
5	-	Pivot plate (2 off)
6	-	Pivot pin (2 off)
7	-	Pivot lever
8	-	Headlamp surround
9	-	Alignment adjustment screw

The auxiliary high beam lamp is unique to the SVX model. The lamp is located within the headlamp surround. Two metal plates are a press fit into the surround and 2 pivot pins on the lamp locate in the plates which allow the lamp unit to pivot up and down in a vertical direction. This allows the vertical aim of the lamp to be adjusted using a worm and screw mechanism located on the lamp. The adjustment screw locates in a hole on a moulded boss on the headlamp surround. A washer is fitted to the screw on each side of the boss and are secured with circlip. The two washers and the circlip retain the screw in the boss, which allows the rotary motion of the screw to be transferred to linear movement of the lamp allowing the alignment to be adjusted. The screw is accessible through a hole in the underside of the lamp surround.

The auxiliary high beam lamp uses a H9 65W halogen bulb which is located in an integral holder. The holder is rotated to lock or remove in the rear of the lamp unit. Access to the bulb requires removal of the headlamp surround.

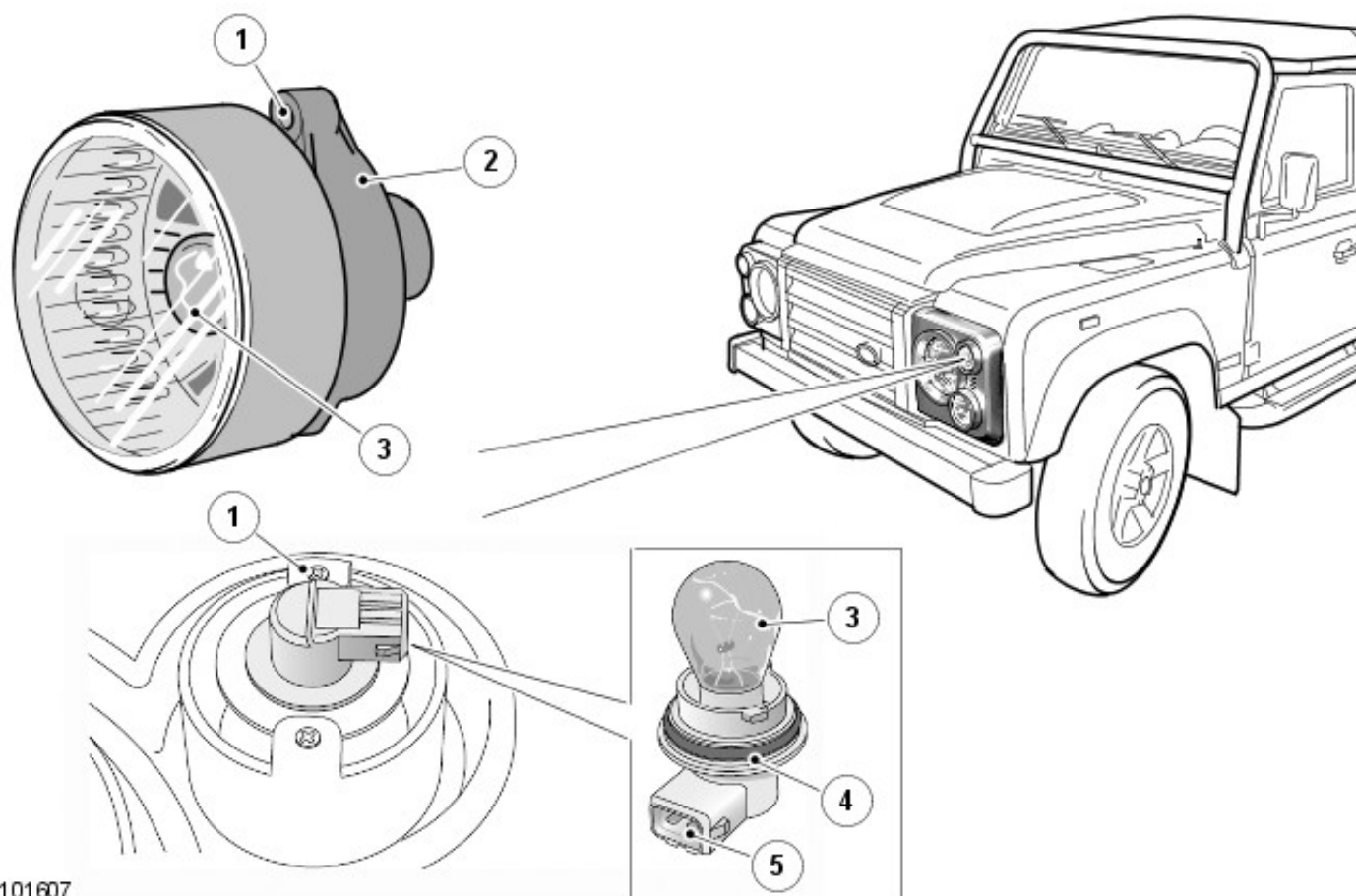
Auxiliary High Beam Lamp Relay and Fuse



E101920

The auxiliary lamps are connected via the headlamp link harness. A high beam feed from the LH headlamp is supplied from the link harness and activates a dedicated auxiliary high beam lamp relay which is located in the battery junction box (BJB), adjacent to the battery. The relay and auxiliary lamp circuit is protected by a 15 Amp fuse located on the side of the relay. Activation of the relay allows a direct battery feed to power the auxiliary lamps.

Front Turn Signal Indicator Lamp



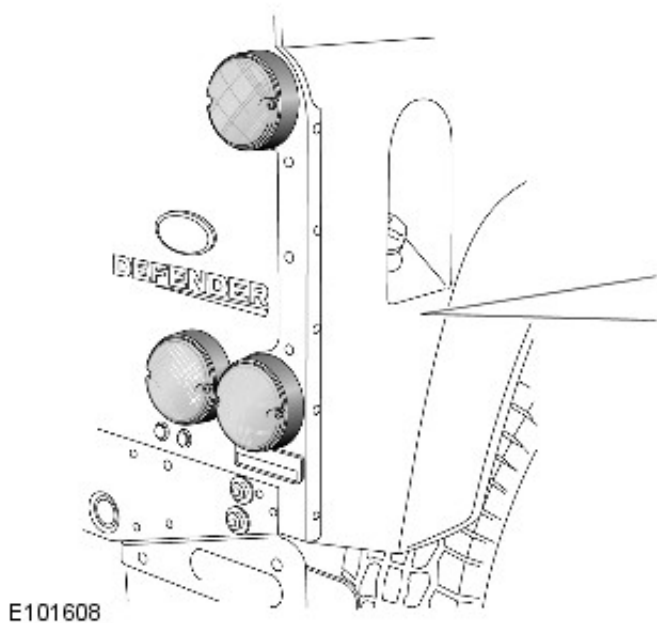
E101607

Item	Part Number	Description
1	-	Turn signal indicator lamp attachment hole (2 off)
2	-	Turn signal indicator lamp assembly
3	-	Turn signal indicator bulb
4	-	Bulb holder
5	-	Electrical connector

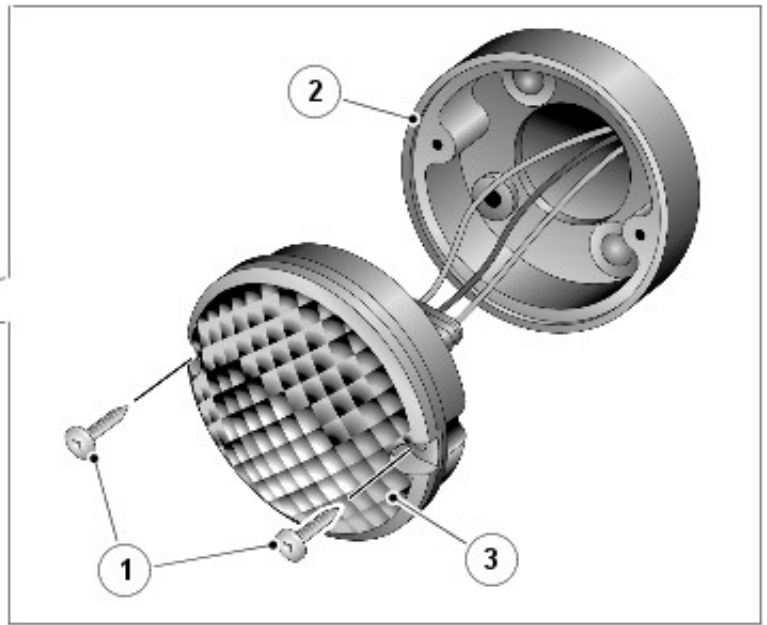
The front turn signal indicator lamp is unique to the SVX model. The lamp is located within the headlamp surround and is positioned on 2 lugs integral with the surround and secured with 2 self-tapping screws.

The lamp uses a PY21W Diadem bulb which is located in a holder in the rear of the lamp assembly. The holder has an integral connector which allows for connection to the main wiring harness via a short link harness which converts the main harness connector to the connector on the holder. The holder is rotated to lock or remove in the rear of the lamp unit. Access to the bulb requires removal of the headlamp surround.

LED Rear Lamps



E101608



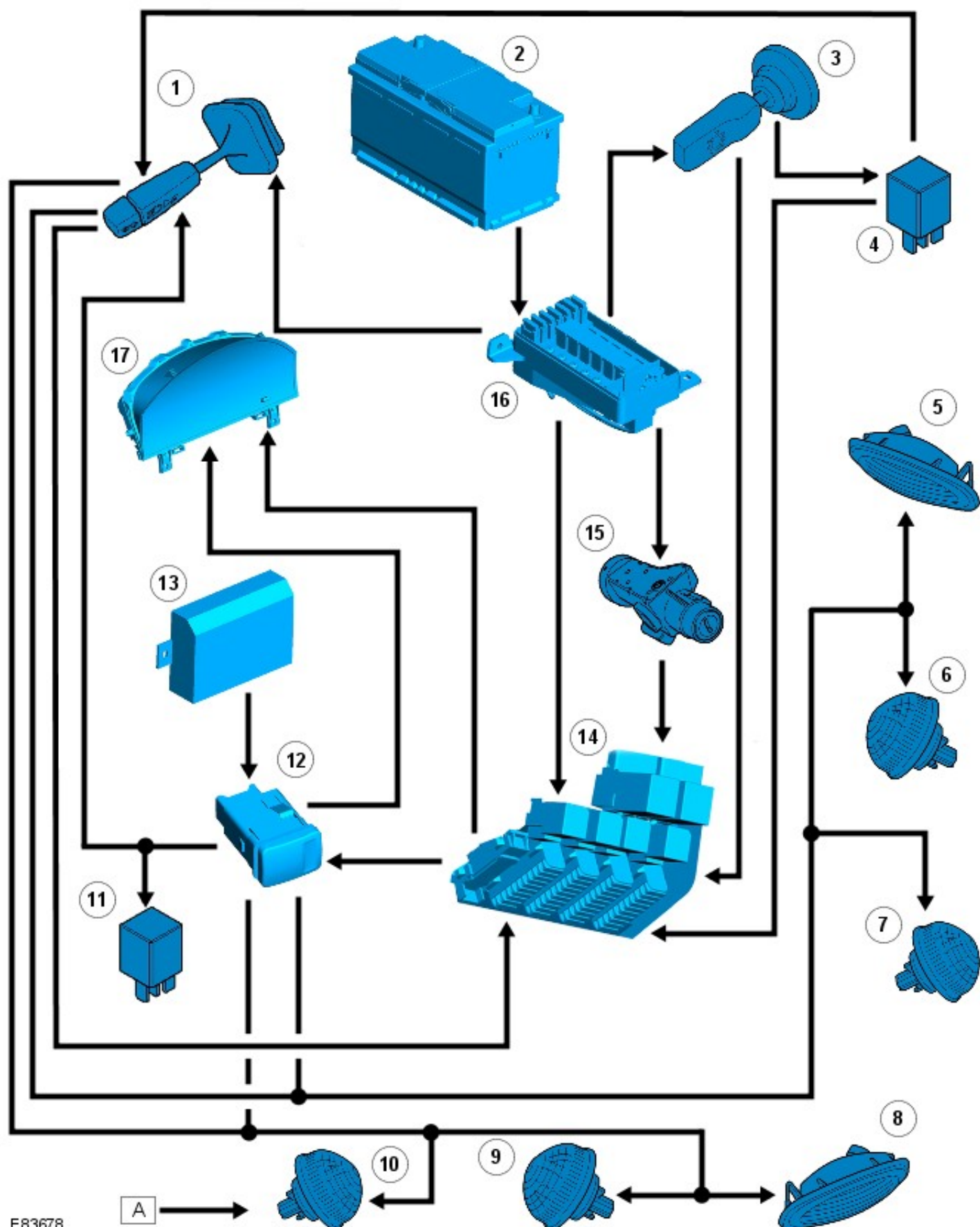
Item	Part Number	Description
1	-	Screw (2 off)
2	-	Housing
3	-	LED lamp assembly

The LED rear lamps are unique to the SVX model. The lamps all look similar when not illuminated with a white opaque lens. Once activated, the LED's illuminate in the applicable color for the lamp function.

The 2 upper rear lamps provide for the tail lamps and brake lamps. The inner of the lower lamps operate with the turn signal indicators. On left-hand drive (LHD) vehicles, the LH outer rear lamp is the rear fog lamp and the RH outer rear lamp is the reverse lamp. These 2 lamps alternate positions on a right-hand drive (RHD) vehicle.

CONTROL DIAGRAM - SHEET 1 OF 2 - MODELS FROM 2007MY (NOT SVX (60TH ANNIVERSARY) MODEL)

NOTE: **A** = Hardwired



E83678

Item	Part Number	Description
1	-	Column switch
2	-	Battery
3	-	Lighting switch
4	-	Headlamp relay
5	-	RH side turn signal indicator lamp
6	-	RH front turn signal indicator lamp

7	-	RH rear turn signal indicator lamp
8	-	LH side turn signal indicator lamp
9	-	LH front turn signal indicator lamp
10	-	LH rear turn signal indicator lamp
11	-	Hazard flasher relay
12	-	Hazard flasher switch
13	-	Anti-theft system module
14	-	CJB
15	-	Ignition switch
16	-	BJB
17	-	Instrument cluster

CONTROL DIAGRAM - SHEET 2 OF 2 - MODELS FROM 2007MY (NOT SVX (60TH ANNIVERSARY) MODEL)

NOTE: **A** = Hardwired

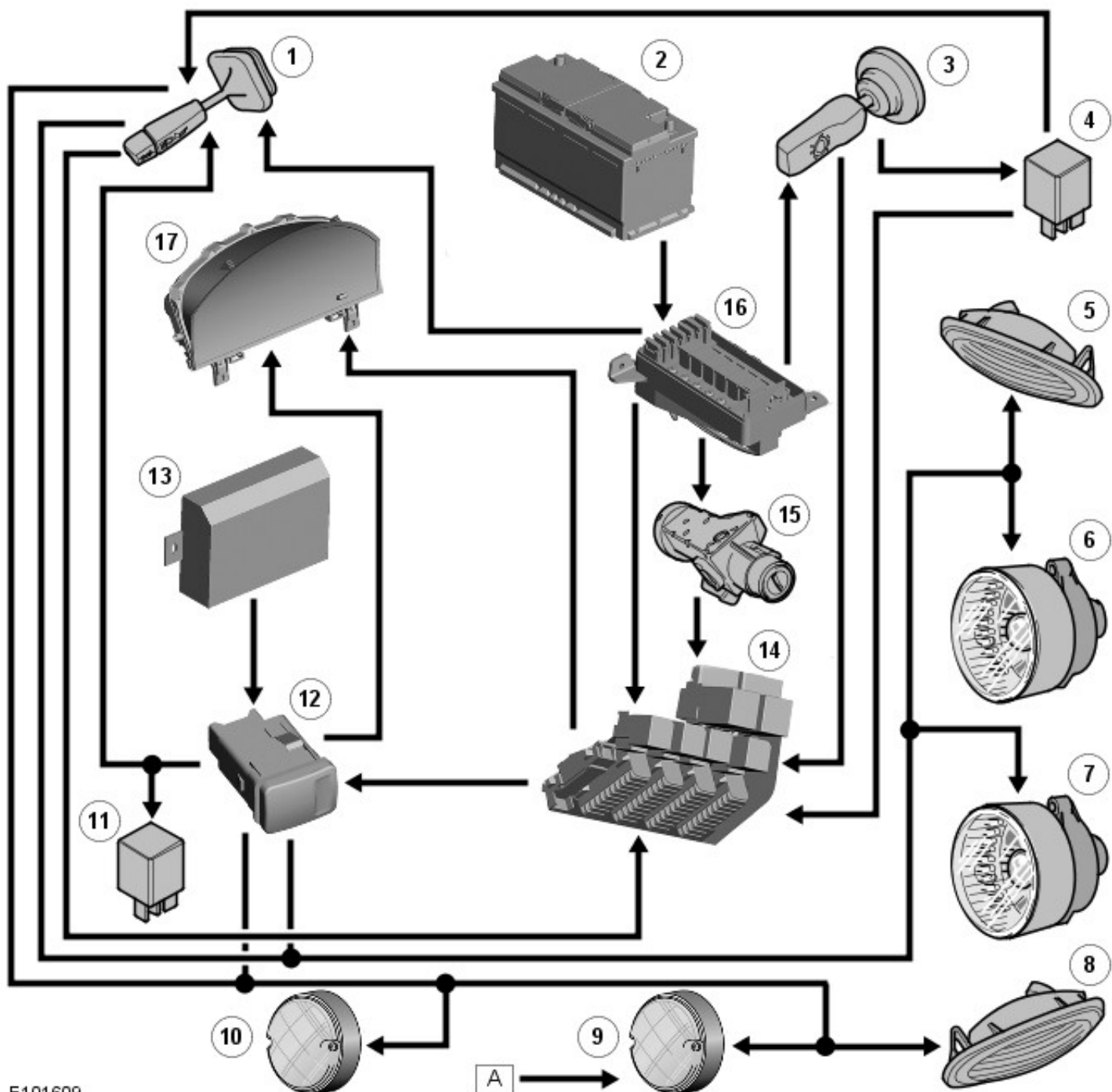


Item	Part Number	Description
1	-	LH stop lamp
2	-	Brake pedal switch
3	-	RH stop lamp
4	-	Reverse lamp
5	-	Reverse gear indicator switch
6	-	Fog lamp switch

- 7 - Fog lamp control module
- 8 - Fog lamp
- 9 - LH headlamp
- 10 - LH side lamp
- 11 - RH headlamp
- 12 - RH side lamp
- 13 - LH tail lamp
- 14 - License plate lamp
- 15 - RH tail lamp
- 16 - RH headlamp levelling motor (if fitted)
- 17 - Headlamp levelling switch (if fitted)
- 18 - LH headlamp levelling motor (if fitted)
- 19 - CJB

CONTROL DIAGRAM - SHEET 1 OF 2 - (SVX (60TH ANNIVERSARY) MODEL)

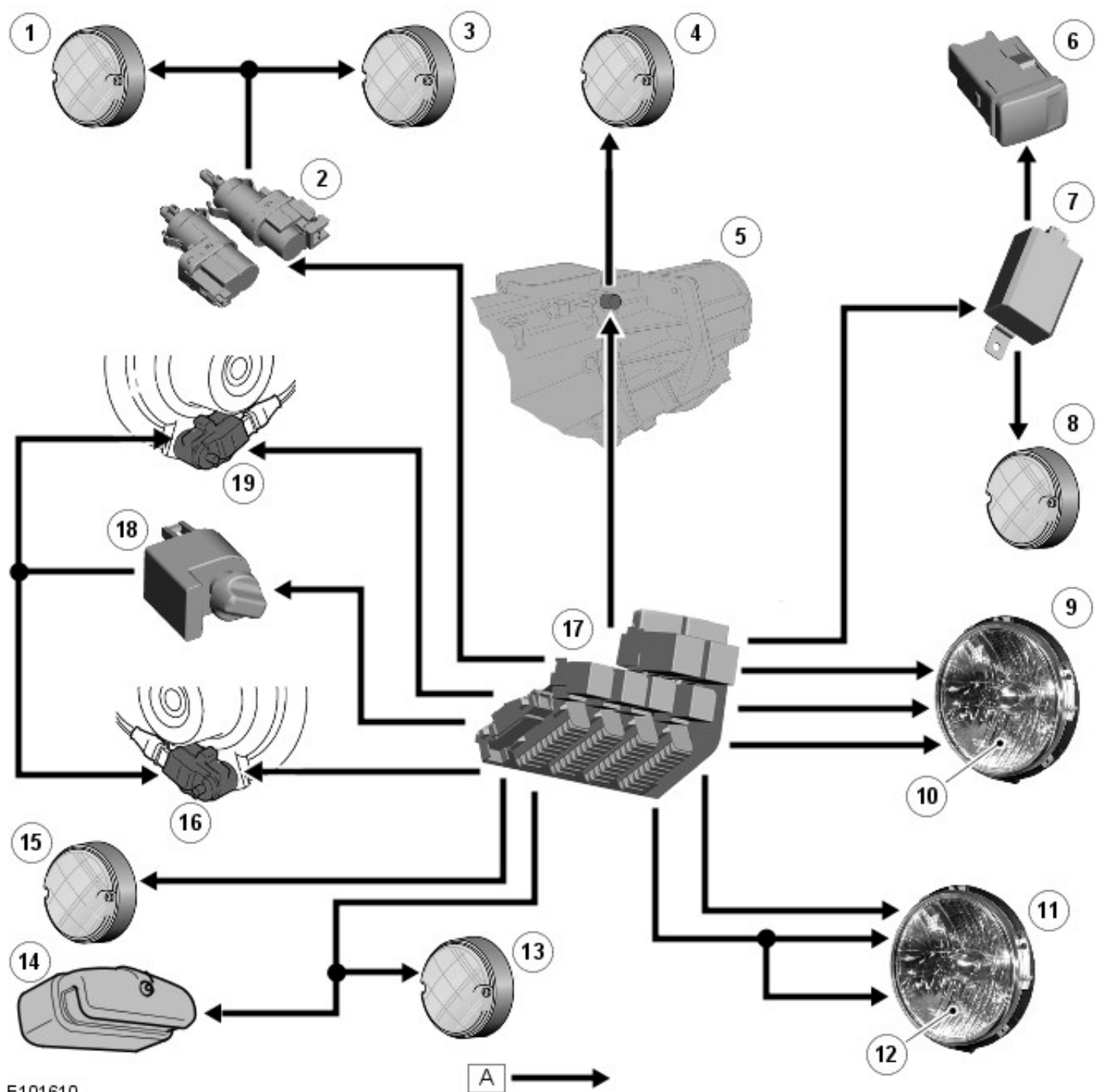
NOTE: A = Hardwired



Item	Part Number	Description
1	-	Steering column multifunction switch
2	-	Battery
3	-	Lighting control switch
4	-	Headlamp relay
5	-	RH side turn signal lamp
6	-	RH front turn signal lamp
7	-	LH front turn signal lamp
8	-	LH side turn signal lamp
9	-	RH rear turn signal lamp
10	-	LH rear turn signal lamp
11	-	Hazard flasher relay
12	-	Hazard flasher switch
13	-	Anti-theft system module
14	-	CJB
15	-	Ignition switch
16	-	BJB
17	-	Instrument cluster

CONTROL DIAGRAM - SHEET 2 OF 2 (SVX (60TH ANNIVERSARY) MODEL)

NOTE: **A** = Hardwired



E101610

Item	Part Number	Description
1	-	LH stop lamp
2	-	Brake pedal switch
3	-	RH stop lamp
4	-	Reverse lamp
5	-	Reverse gear indicator switch
6	-	Fog lamp switch
7	-	Fog lamp control module

8	-	Fog lamp
9	-	LH headlamp
10	-	LH side lamp
11	-	RH headlamp
12	-	RH side lamp
13	-	LH tail lamp
14	-	License plate lamp
15	-	RH tail lamp
16	-	RH headlamp levelling motor (if fitted)
17	-	CJB
18	-	Headlamp levelling switch (if fitted)
19	-	LH headlamp levelling motor (if fitted)

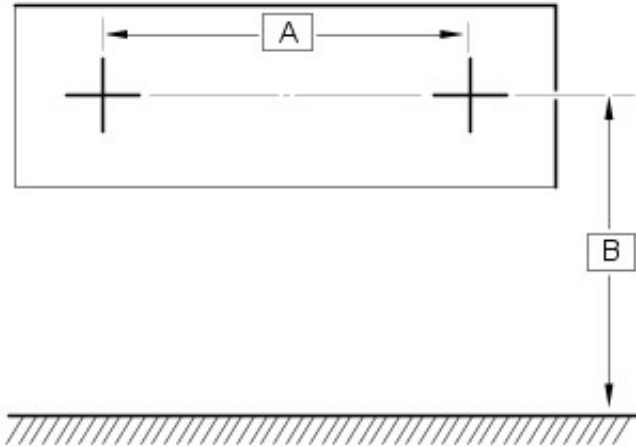
Exterior Lighting - Headlamp Adjustment

General Procedures

1. **NOTE:** Check main beam alignment using beam setting equipment. Should this not be available the beam can be temporarily checked and adjusted as follows.

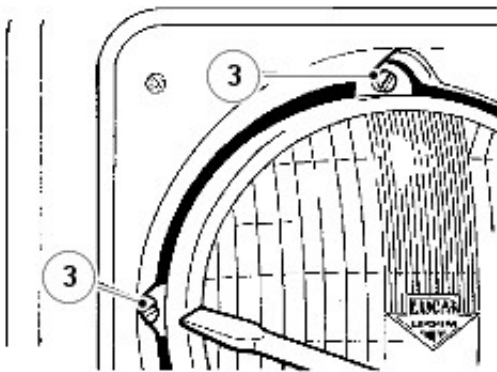
Position vehicle, unladen, on level ground with tyres correctly inflated, approximately 4 metres from a wall or screen, marked as illustrated below.

2. The beam centres 'A' are measured horizontally on the vehicle and dimension 'B' vertically from the ground.



ST1719M

3. Switch on main beam and adjust setting, as necessary, with trimmer screws.



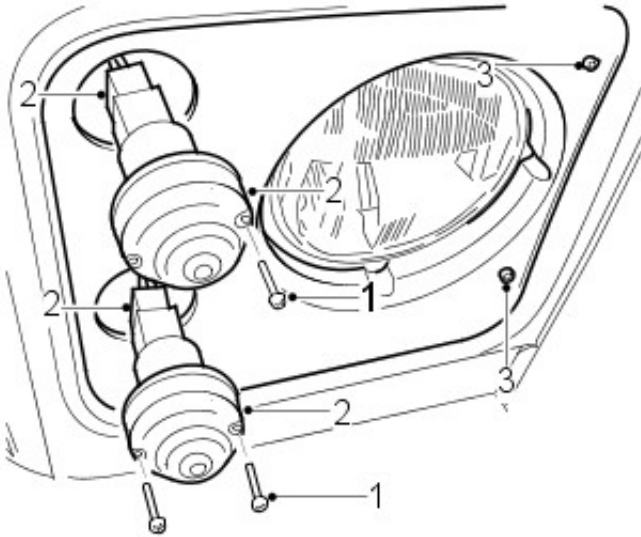
J6450

Exterior Lighting - Headlamp Assembly

Removal and Installation

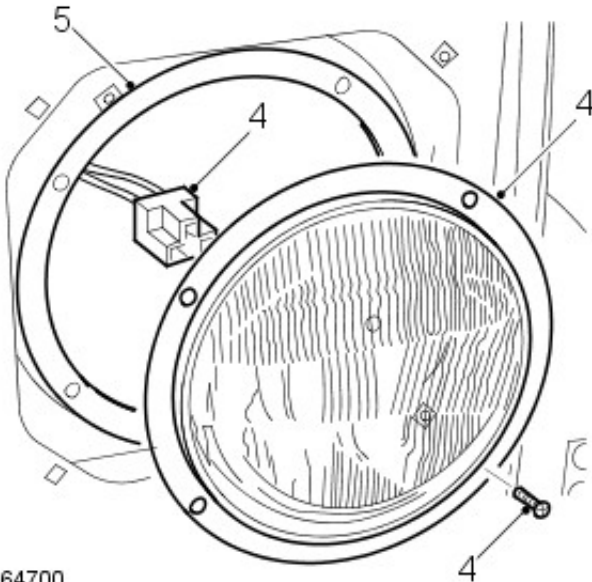
Removal

1. Remove 4 screws and release side and turn signal lamps from fender.
2. Disconnect multiplugs and remove side and turn signal lamps.
3. Remove 2 screws and remove headlamp finisher.



M864699

4. Remove 4 screws securing headlamp to fender, disconnect multiplugs and remove headlamp.
5. Remove headlamp seal.



M864700

Installation

1. Fit headlamp seal.
2. Position headlamp, connect multiplugs, fit and tighten headlamp screws.
3. Fit headlamp finisher and secure with screws.

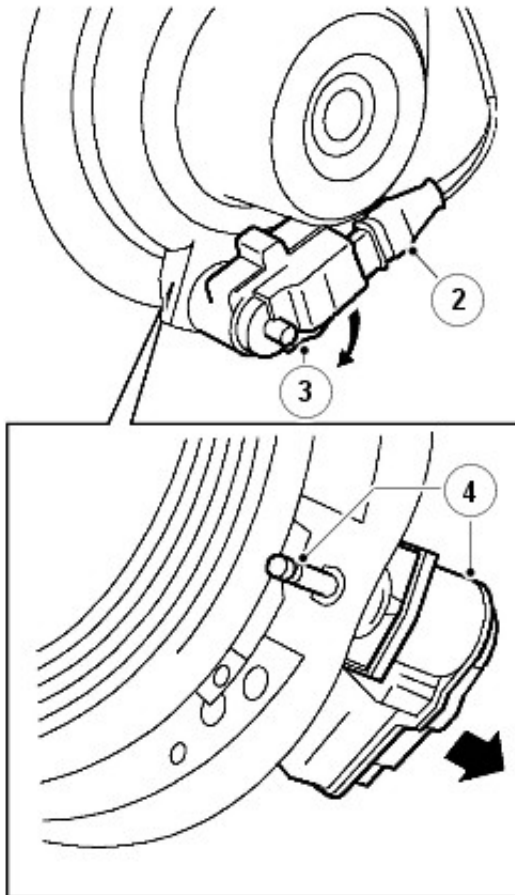
4. Position side and turn signal lamps, connect multiplugs and secure with screws.
5. Reset headlamp alignment.
For additional information, refer to: Headlamp Adjustment (417-01, General Procedures).

Exterior Lighting - Headlamp Leveling Motor

Removal and Installation

Removal

1. Remove headlamp assembly.
For additional information, refer to: Headlamp Assembly (417-01, Removal and Installation).
2. Disconnect headlamp leveling motor harness plug.
3. Rotate headlamp leveling motor anti-clockwise to release retaining lugs from mounting bracket on headlamp body.
4. Release headlamp leveling motor spindle from retaining slot on headlamp bezel and withdraw headlamp leveling motor from mounting bracket.



J6447

Installation

1. Instal headlamp leveling motor into mounting bracket and locate motor spindle into slot in headlamp bezel.
2. Press in headlamp leveling motor and rotate clockwise to engage retaining lugs behind mounting bracket.
3. Connect headlamp leveling motor harness plug.
4. Fit headlamp assembly.
For additional information, refer to: Headlamp Assembly (417-01, Removal and Installation).

Exterior Lighting - Headlamp Leveling Switch

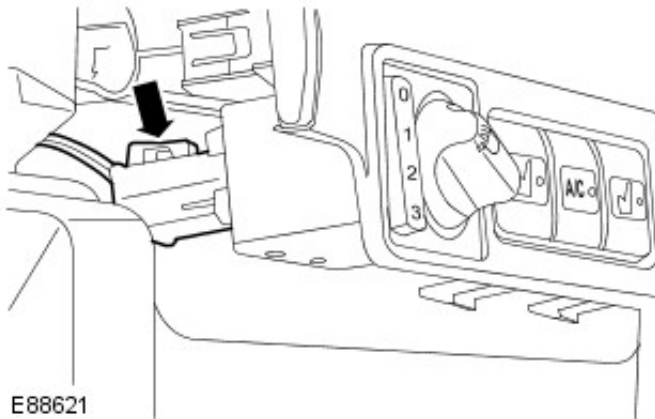
Removal and Installation

Removal

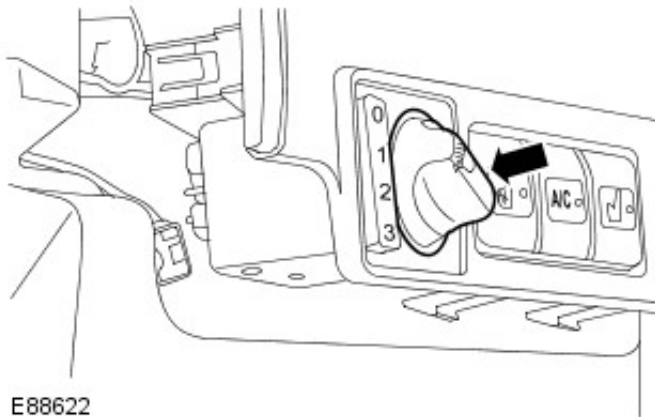
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).
3. Release the instrument panel console.



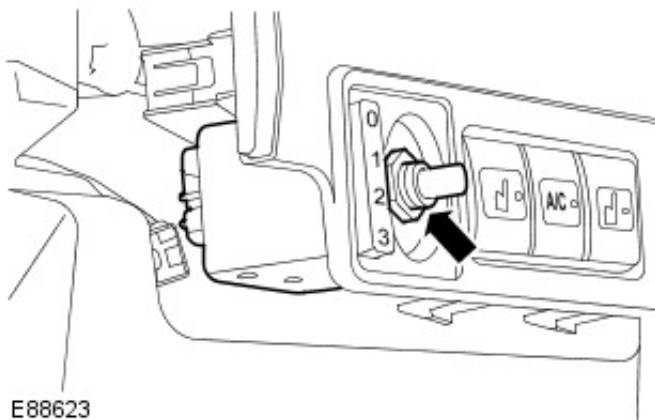
4. Disconnect the electrical connector.



5. Remove the headlamp leveling selector knob.



6. Remove the headlamp leveling switch.
 - Remove the nut.



E88623

Installation

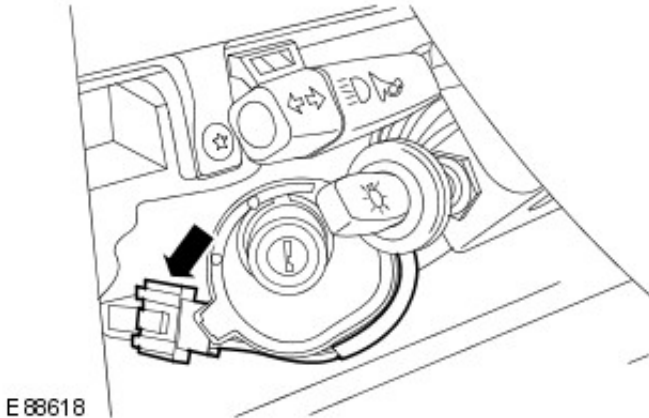
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01
Battery, Mounting and Cables, General Procedures).

Exterior Lighting - Headlamp Switch

Removal and Installation

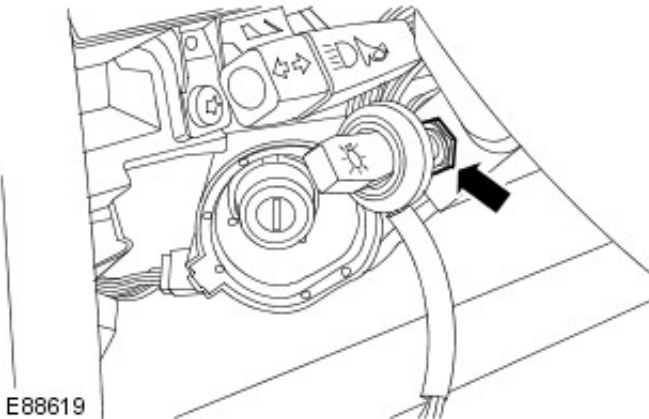
Removal

1. Remove the steering column shrouds.
For additional information, refer to: Steering Column Shrouds (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Disconnect the electrical connector.



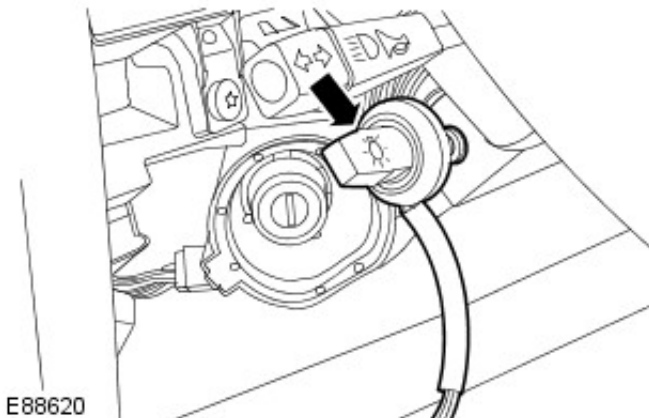
E88618

3. Release the nut.



E88619

4. Remove the headlamp switch.



E88620

Installation

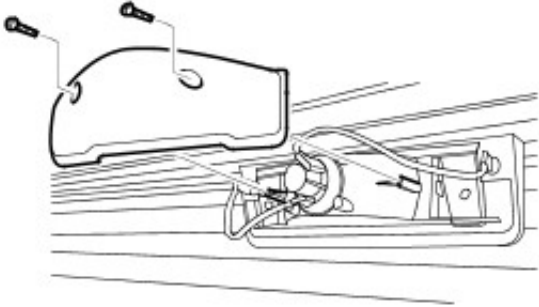
1. To install, reverse the removal procedure.

Exterior Lighting - High Mounted Stoplamp

Removal and Installation

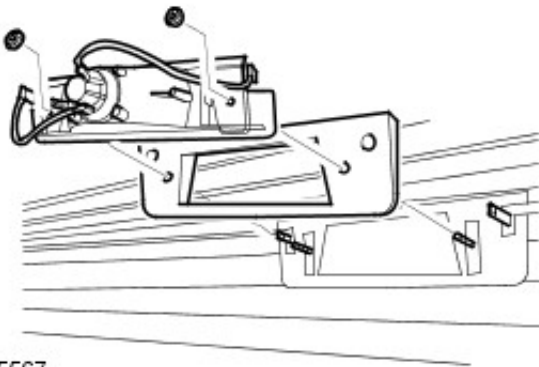
Removal

1. Open rear door.
2. Remove 2 screws and cover from the high mounted stoplamp.



M865536

3. Remove insulated cover from connector, release catches and disconnect connectors taking care not to damage screen element.
4. Remove nuts securing lamp to rear screen, withdraw high mounted stoplamp, collect seals and washers.



M865567

5. Remove rubber backing pad, taking care not to damage screen obscuration band.

Installation

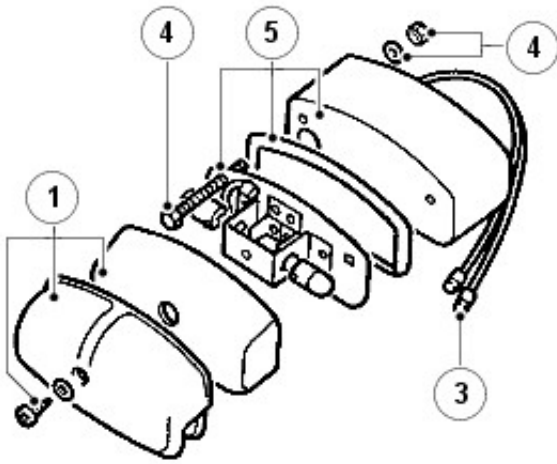
1. Clean obscuration band and fit new backing pad.
2. Fit high mounted stoplamp, seals and washers. Fit nuts and tighten to 3 Nm (2.2 lbf.ft).
3. Insulate connectors, and connect to rear screen.
4. Fit cover to high mounted stoplamp and secure with screws.

Exterior Lighting - License Plate Lamp

Removal and Installation

Removal

1. Remove single screw and remove lamp cover and lens.
2. Unscrew 2 fixings and remove metal cover to gain access to lamp fixings and harness leads inside vehicle.
3. Disconnect lamp leads from harness.
4. Remove 2 bolts, nuts and washers securing lamp to vehicle body.
5. Remove bulb holder, complete with rubber seal and mounting plinth.



J6380

Installation

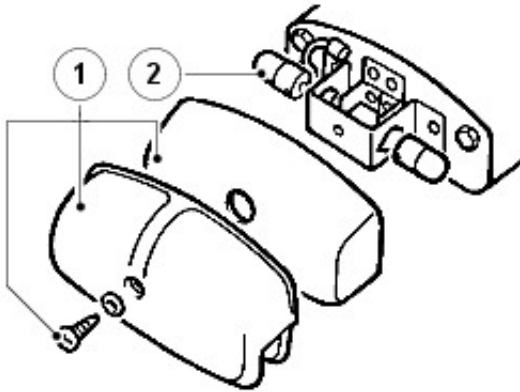
1. Feed lamp unit leads through vehicle body and secure bulb holder, seal and plinth.
2. Instal lamp leads to harness connectors.
3. Instal cover to conceal lamp fixings.
4. Instal lens and lamp cover.

Exterior Lighting - License Plate Lamp Bulb

Removal and Installation

Removal

1. Remove single screw securing lamp cover and lens to bulb holder.
2. Remove bulb/s from holder.



J6379

Installation

1. Install new bulb/s.
2. Install lamp lens and cover.

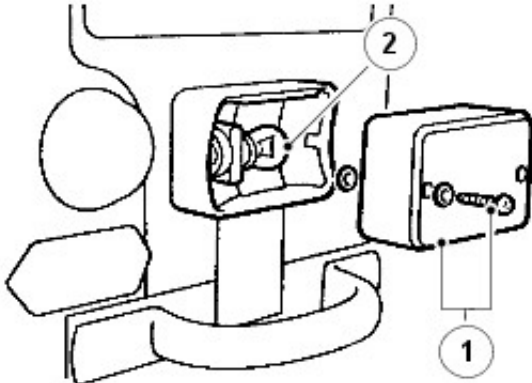
Exterior Lighting - Rear Fog Lamp Bulb

Removal and Installation

Removal

NOTE: This procedure covers removal and installation of reversing lamp bulb and rear fog lamp bulb.

1. Remove two screws with sealing washers and remove lens from lamp body.
2. Push and twist bulb to release from holder.



J6381

3. Clean interior of lamp and lens.

Installation

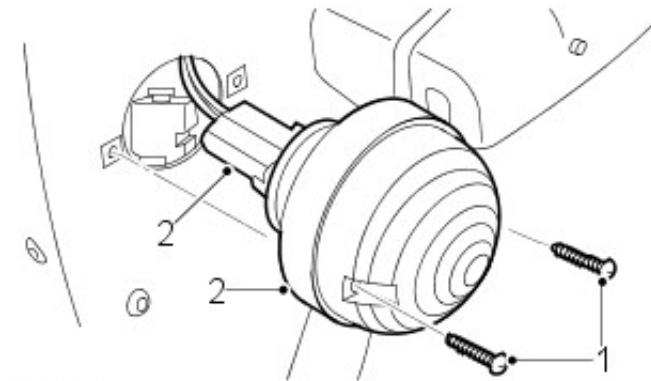
1. Fit new bulb.
2. Fit lens to lamp body.

Exterior Lighting - Rear Lamp Assembly

Removal and Installation

Removal

1. Remove 2 screws securing rear lamp to body.
2. Disconnect multiplug and remove lamp.



M864690

Installation

1. Position rear lamp and connect multiplug.
2. Fit and tighten lamp securing screws.

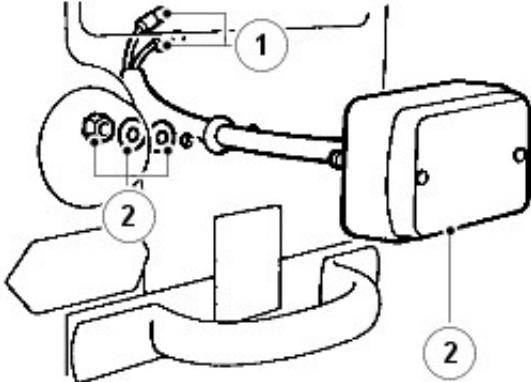
Exterior Lighting - Reversing Lamp

Removal and Installation

Removal

NOTE: This procedure covers removal and installation of the reversing lamp and the rear fog lamp.

1. From underneath the vehicle, lift protective flap and disconnect lamp leads at harness connectors.
2. Unscrew 2 nuts and washers and withdraw lamp unit from vehicle.



J6382

Installation

1. Feed lamp leads through grommet and locate lamp studs in vehicle body.
2. Fit retaining nuts and reconnect lamp leads to vehicle harness.

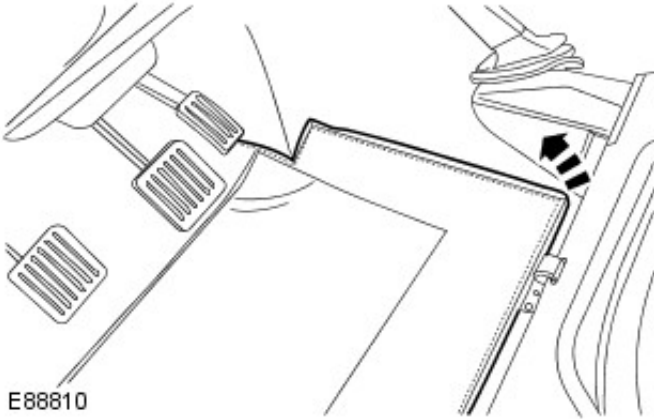
Exterior Lighting - Reversing Lamp Switch

Removal and Installation

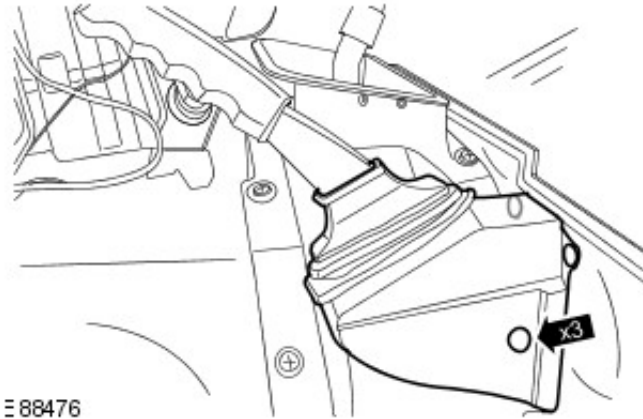
Removal

1. Remove the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).

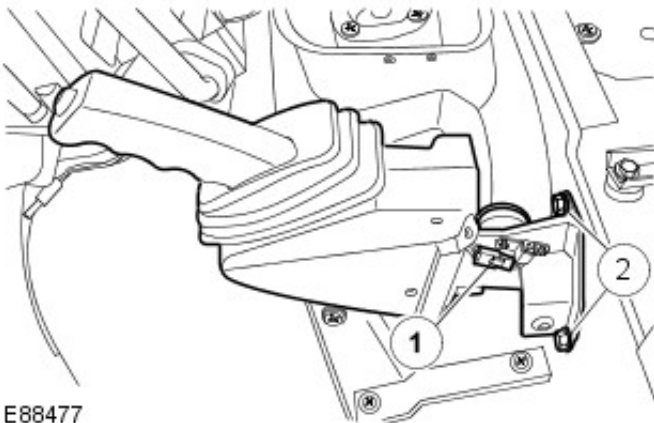
2. Reposition the LH carpet.



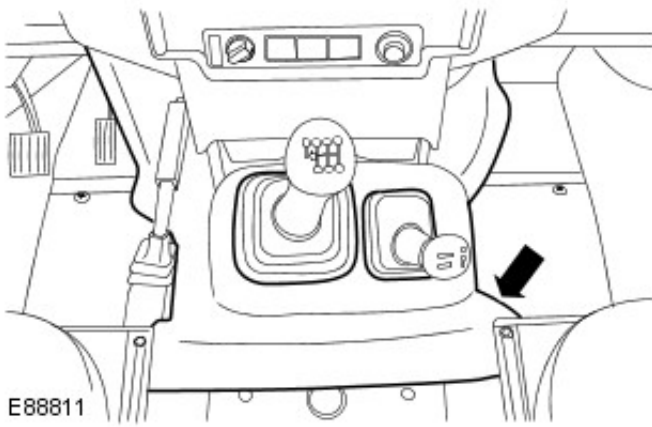
3. Release the parking brake lever gaiter.
 - Remove the 3 clips.



4. Release the parking brake lever.
 1. Disconnect the electrical connector.
 2. Remove the 2 bolts.

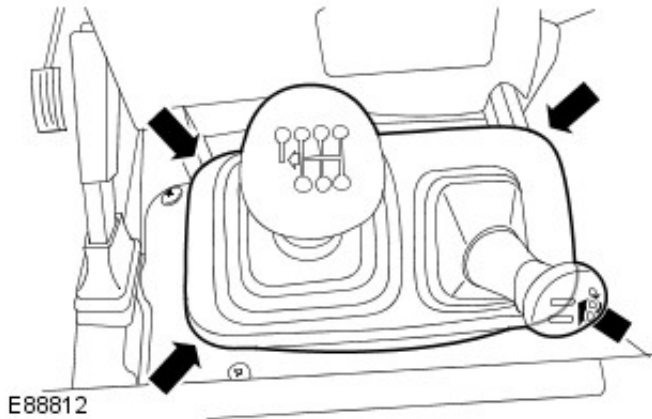


5. Remove the transmission cover panel floor covering.



6. **NOTE:** Do not detach the gaiter from the selector knobs.

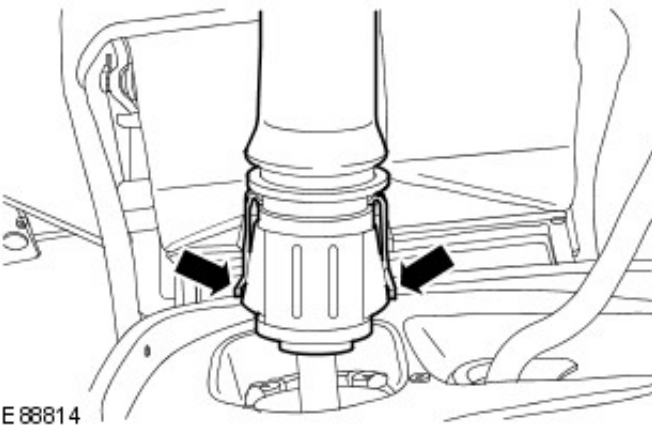
Detach the gaiter from the transmission cover panel.



7. **WARNING:** The gearshift lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Release the gearshift lever knob.

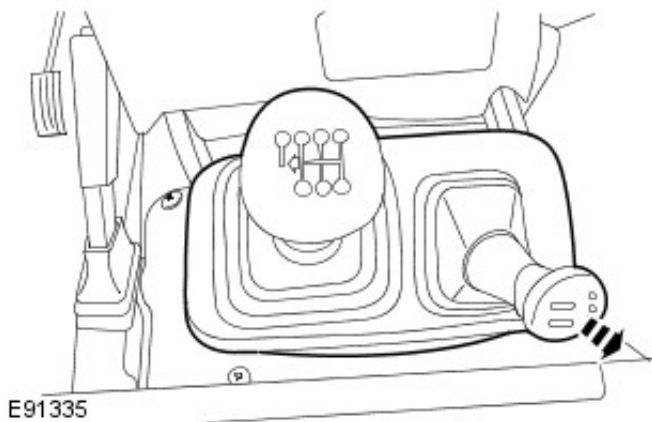
- Release the 2 clips.



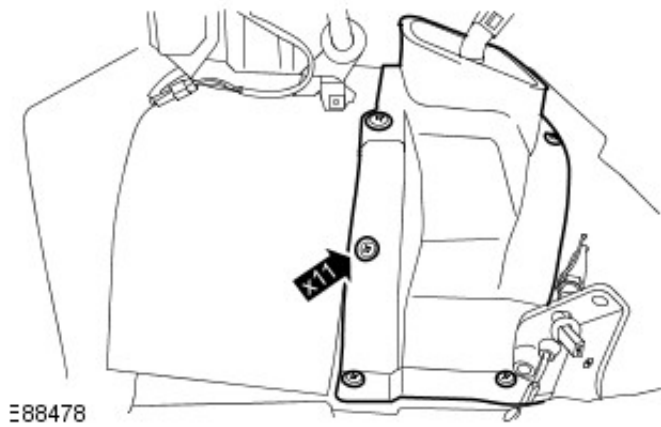
8. **WARNING:** The high/low range lever knob will be released suddenly, keep face clear during removal. Failure to follow this instruction may result in personal injury.

Remove the gaiter and selector levers.

- Detach the high/low range selector lever.

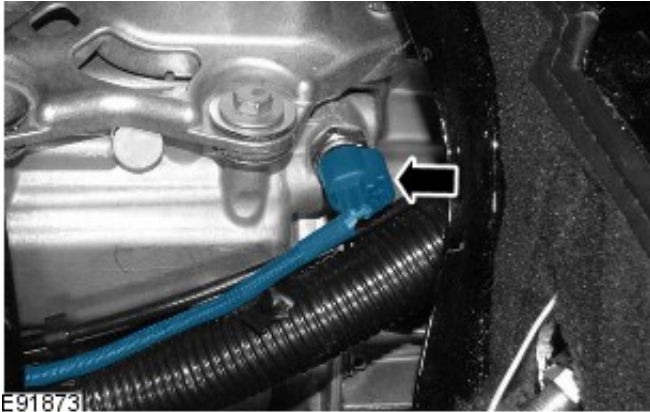


9. Remove the transmission cover panel.
- Remove the 11 screws.



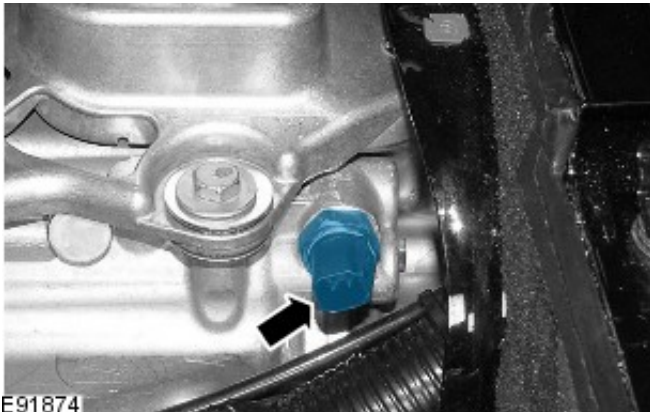
E88478

10. Disconnect reversing lamp switch connector.



E91873

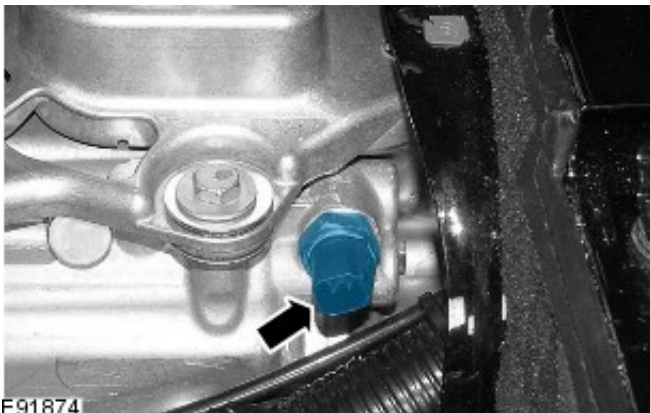
11. Remove the reversing lamp switch.
 • Remove and discard the O-ring seal.



E91874

Installation

1. Install the reversing lamp switch.
 • Install a new O-ring seal.
 • Tighten to 20 Nm (15 lb/ft).



E91874

2. Connect the reversing lamp switch electrical connector.

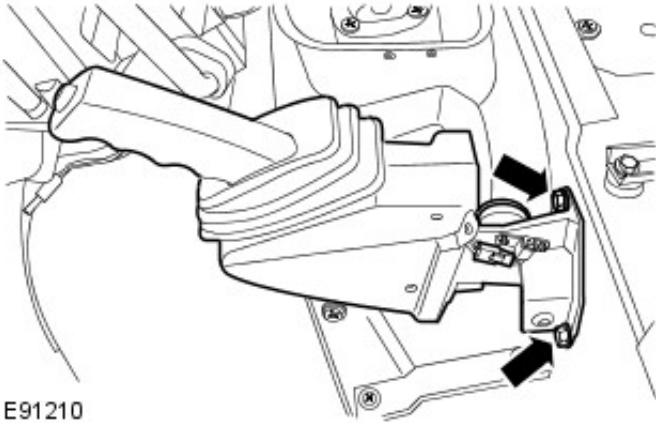
3. Install the transmission cover panel.
 • Install the screws.

4. Install the gaiter with the selector levers attached.
 • Install the selector levers.

- Fully seat the gaiter.

5. Install the transmission cover panel floor covering.

6. Install the parking brake lever.
- Tighten to 25 Nm (18 lb.ft)



7. Install the parking brake lever gaiter.

- Install the clips.

8. Reposition the LH carpet.

9. Install the floor console.

For additional information, refer to: Floor Console (501-12, Removal and Installation).

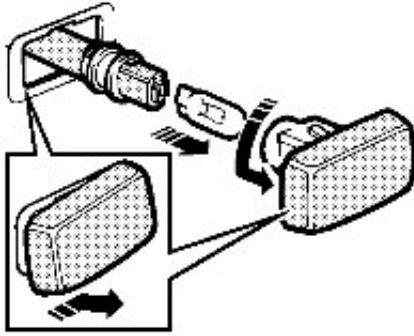
Exterior Lighting - Side Marker Lamp

Removal and Installation

Removal

NOTE: This procedure covers removal and installation of the side repeater lamp.

1. Push lens firmly to the right.
2. Lift left edge and withdraw lamp unit from wing.
3. Twist bulb holder and release from lens.
4. Pull bulb from holder.



J6378

Installation

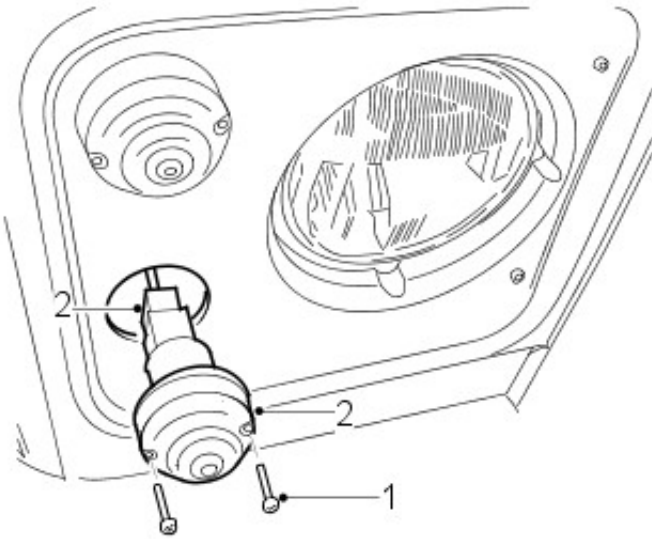
1. Fit new bulb, if necessary.
2. Fit bulb holder to lens.
3. Locate lamp unit in wing and push firmly to the left to secure.

Exterior Lighting - Side Turn Signal Lamp

Removal and Installation

Removal

1. Remove 2 screws securing side turn signal lamp to front fender.
2. Disconnect multiplug and remove lamp.



M864696

Installation

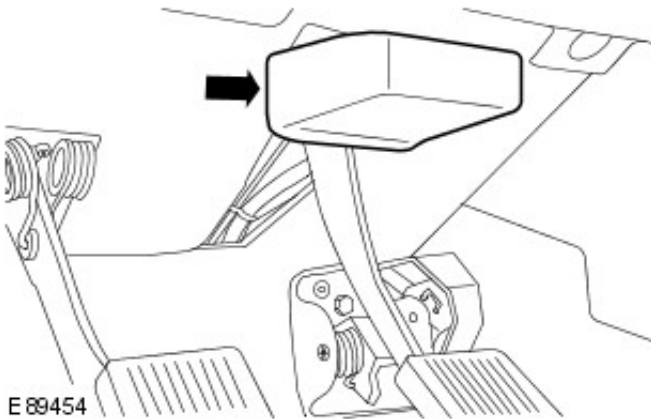
1. Position side turn signal lamp and connect multiplug.
2. Fit and tighten lamp securing screws.

Exterior Lighting - Stoplamp Switch

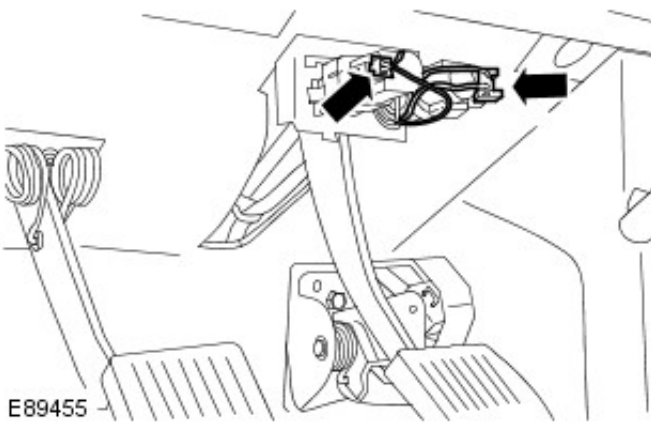
Removal and Installation

Removal

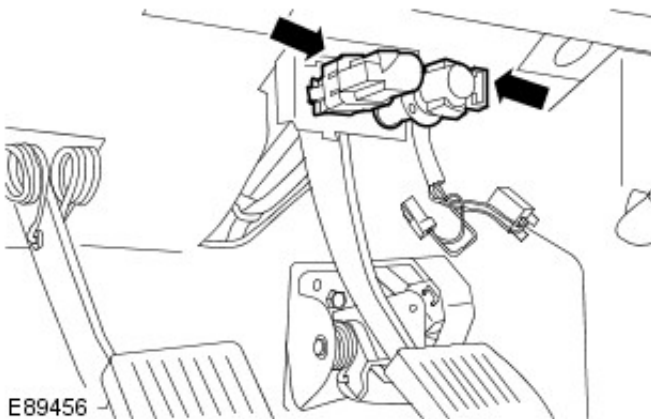
1. Remove the stoplamp switch cover.




2. Disconnect the electrical connectors.



3. Remove the stoplamp switches.



Installation

1.  **CAUTION:** Make sure that the brake pedal is kept in the rest position and is not pressed or moved during the installation of the stoplamp switch. Failure to follow this instruction may result in damage to the vehicle.

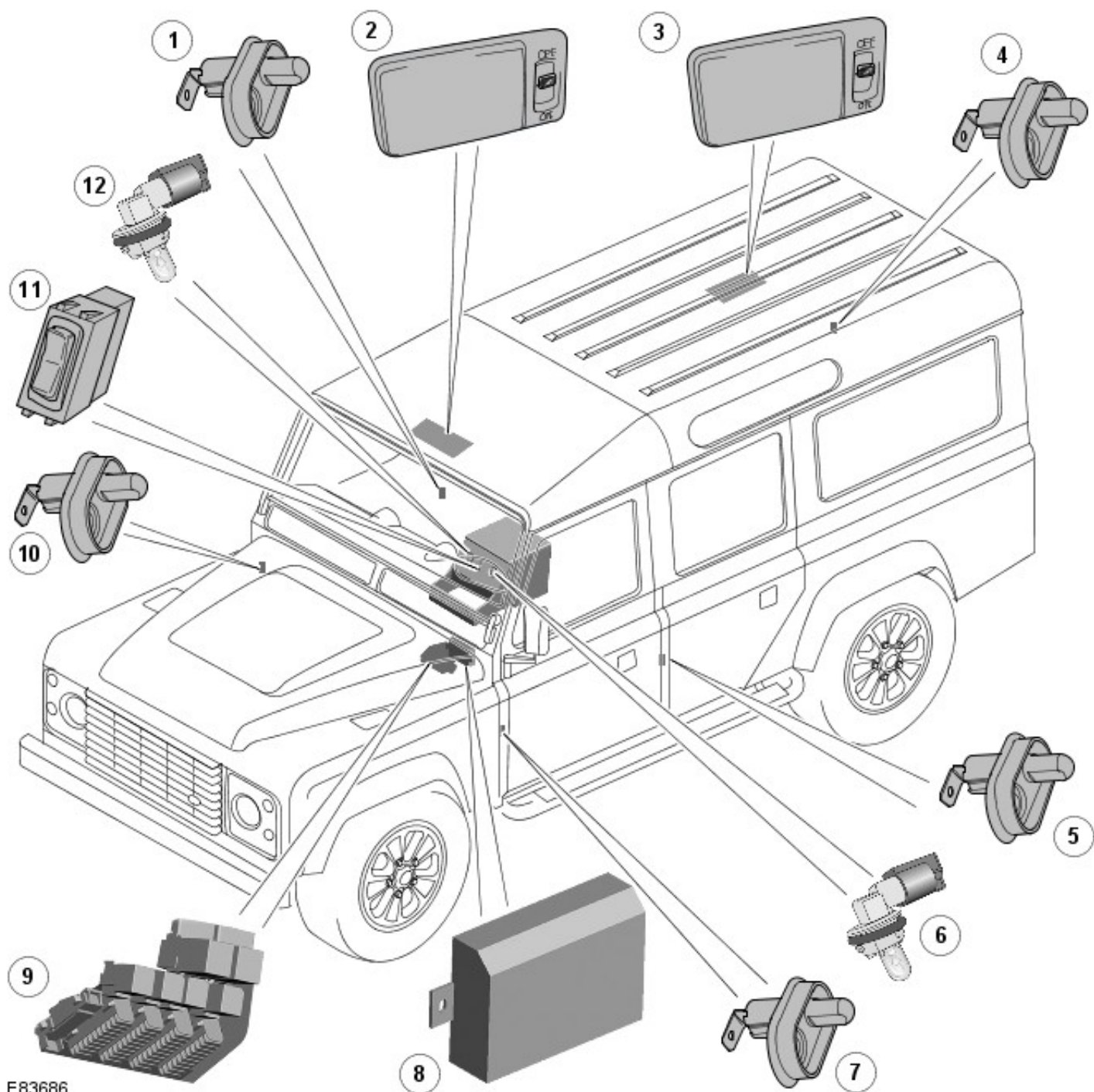
To install, reverse the removal procedure.

Interior Lighting - Interior Lighting

Description and Operation

COMPONENT LOCATION

NOTE: left-hand drive (LHD) vehicle shown, right-hand drive (RHD) similar.



E83686

Item	Part Number	Description
1	-	right-hand (RH) rear door switch (if fitted)
2	-	Front interior lamp
3	-	Rear interior lamp (Not 90 model)
4	-	Tail door switch (Not 90 model)
5	-	left-hand (LH) rear door switch (if fitted)
6	-	Map reading lamp (SVX (60th anniversary) model only)
7	-	Drivers door switch
8	-	Anti-theft system module
9	-	central junction box (CJB)

- | | | |
|----|---|--|
| 10 | - | Passenger door switch |
| 11 | - | Map reading lamps switch (SVX (60 anniversary) model only) |
| 12 | - | Map reading lamp (SVX (60th anniversary) model only) |

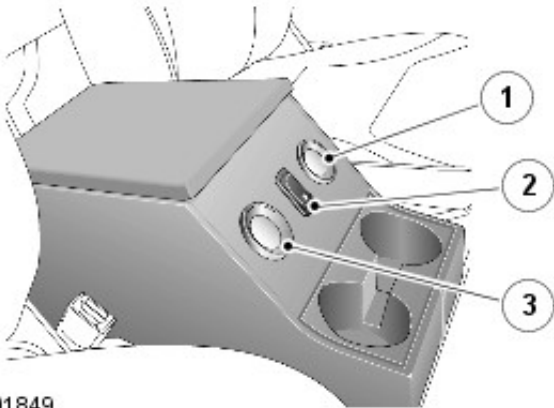
OVERVIEW

Each interior lamp contains a 3 way switch, allowing always on, always off, or automatic operation. When in the always on position, the interior lamp is provided with a battery voltage feed from the CJB. When in the automatic position, operation of the interior lamps is controlled by the anti-theft system module. The anti-theft system module monitors the condition of the doors, including the tail door, through a series of switches. If any of the doors are opened a ground path is created through the relevant switch. When the anti-theft system module registers a ground path it illuminates the interior lamps. If the door(s) are subsequently closed, the anti-theft system module will extinguish the interior lamps after a period of 15 seconds.

The anti-theft system module will also illuminate the interior lamps if it receives a valid unlock signal from the remote radio frequency (RF) handset.

For additional information, refer to: Anti-Theft - Active (419-01A, Description and Operation).

SVX (60th Anniversary) Model



E101849

Item	Part Number	Description
1	-	LH map reading lamp
2	-	Map reading lamps control switch
3	-	RH map reading lamp

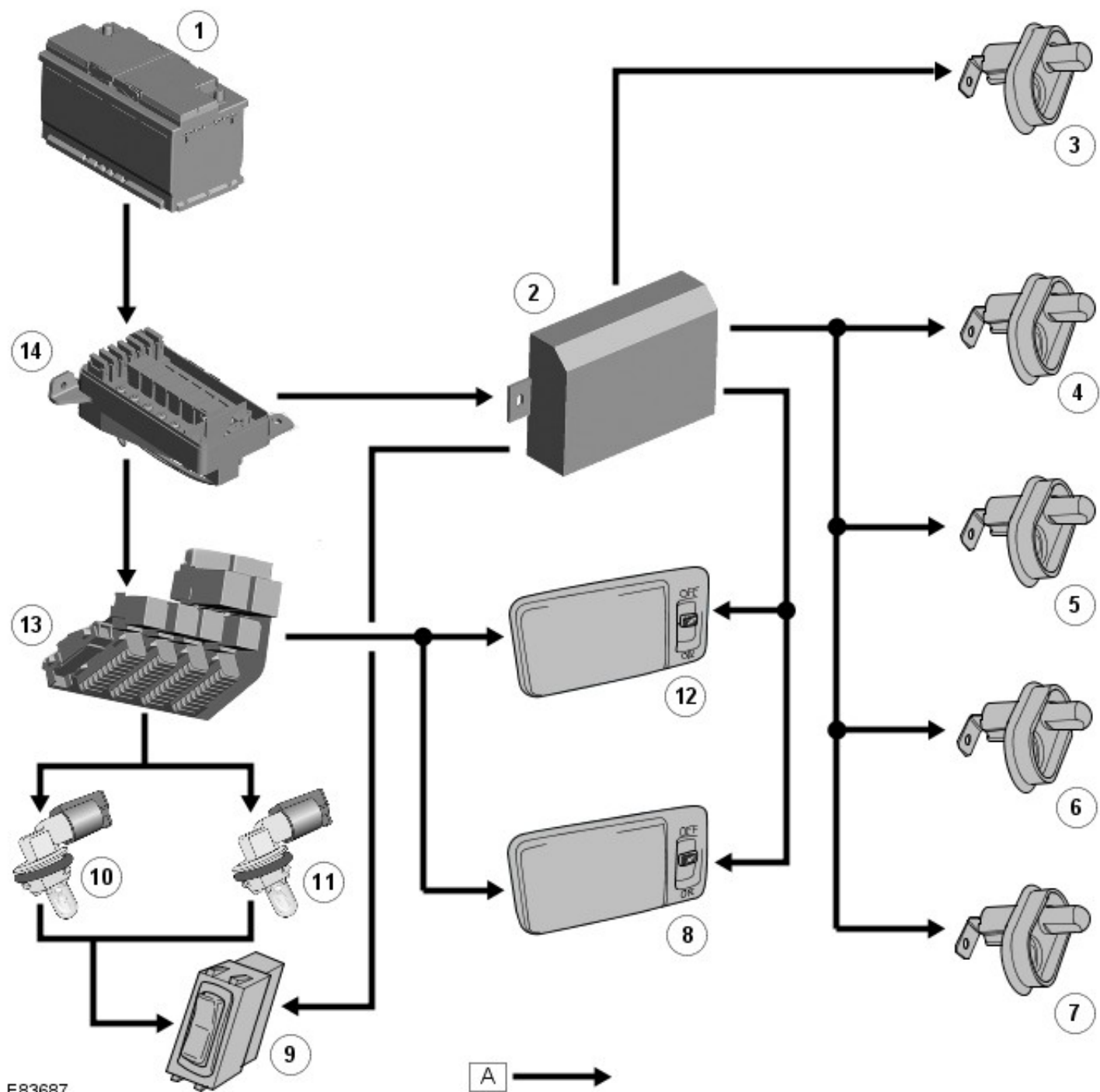
The SVX model has all the interior lighting features of the standard models but with the addition of 2 map reading lamps.

The map reading lamps are located on the forward face of the cubby box with a control switch positioned between them. The lamps use a W3W bulb. The bulb can be replaced by carefully levering the lamp from the cubby box using a suitable tool and removing the bulb holder from the rear of the lamp.

The map reading lamps are connected directly to the vehicle battery via fuses in the CJB and the battery junction box (BJB). Therefore the map reading lamps can be operated independent of the ignition switch position. Each lamp receives a battery voltage supply and the lamp illuminates when the switch is operated which completes a ground path.

CONTROL DIAGRAM

NOTE: **A** = Hardwired



E83687

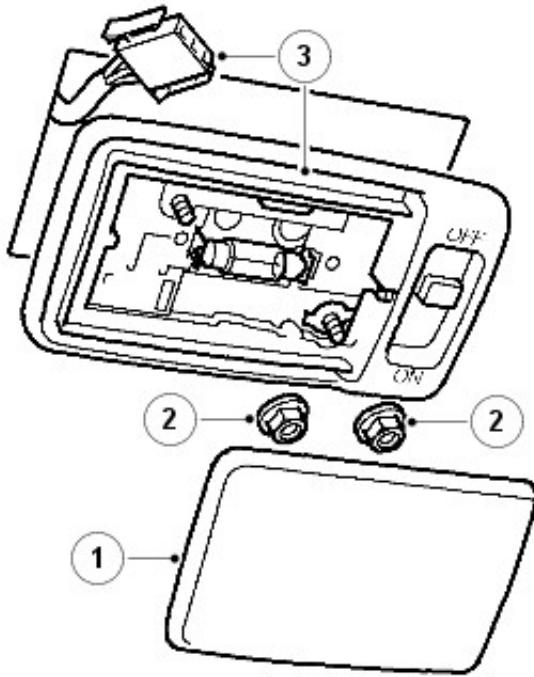
Item	Part Number	Description
1	-	Battery
2	-	Anti-theft system module
3	-	Drivers door switch
4	-	Passenger door switch
5	-	Tail door switch
6	-	LH rear door switch (if fitted)
7	-	RH rear door switch (if fitted)
8	-	Rear interior lamp
9	-	Map reading lamps switch (SVX (60th anniversary) model only)
10	-	LH map reading lamp (SVX (60th anniversary) model only)
11	-	RH map reading lamp (SVX (60th anniversary) model only)
12	-	Front interior lamp
13	-	CJB
14	-	BJB

Interior Lighting - Interior Lamp

Removal and Installation

Removal

1. Prise lens cover from lamp unit.
2. Remove 2 nuts securing lamp unit to headlining and roof mounting bracket.
3. Remove lamp unit from mounting bracket studs and disconnect harness plug.



J6063

4. Remove interior lamp.

Installation

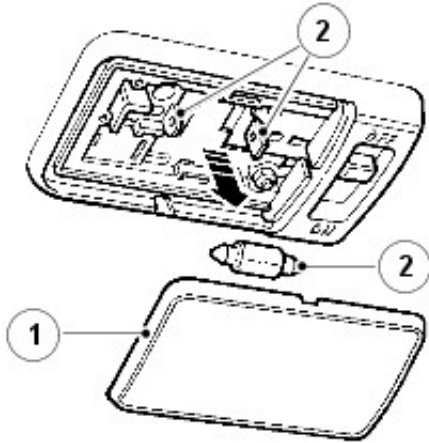
1. Reconnect harness plug and locate lamp unit on mounting bracket studs. Ensure lamp switch eyelet is correctly seated on lamp unit base.
2. Secure lamp unit to mounting bracket and fit lamp lens.

Interior Lighting - Interior Lamp Bulb

Removal and Installation

Removal

1. Prise lens from lamp unit.
2. Spread bulb holder contacts and release bulb.



J6383

Installation

1. Spread bulb holder contacts and fit new bulb.
2. Fit lamp lens.

Module Communications Network - Communications Network

Description and Operation

OVERVIEW

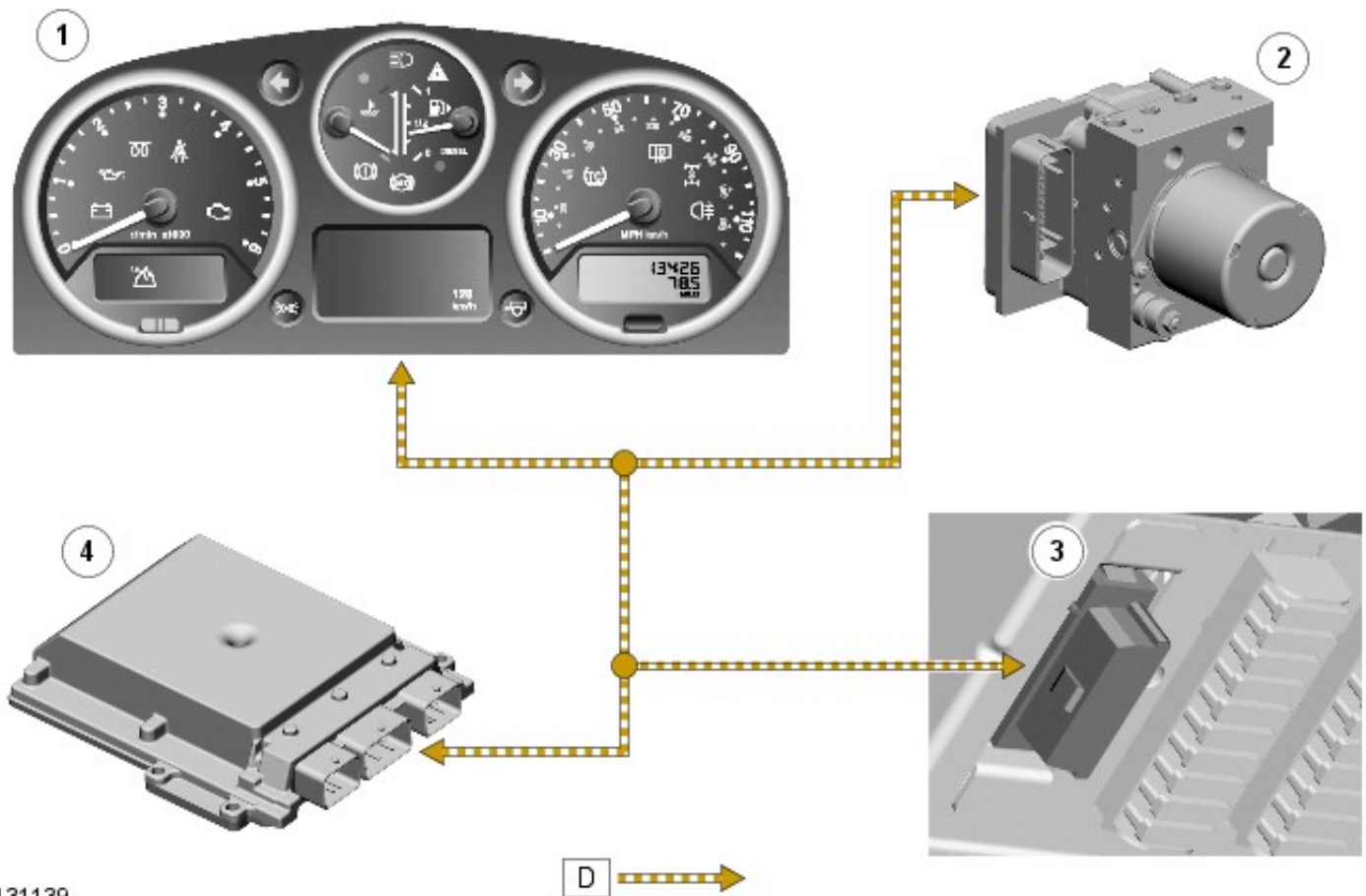
A high speed controller area network (CAN) bus is used to transfer data between the engine control module (ECM), instrument cluster and ABS modulator.

The diagnostic socket is also connected to the high speed CAN bus and allows the Land Rover approved diagnostic system to interrogate both the ECM, instrument cluster and ABS modulator software.

The CAN bus is a high-speed broadcast network where control modules automatically transmit information every few microseconds. Information is broadcast down a pair of twisted wires, known as 'CAN high' and 'CAN low'. Information is transmitted on the CAN bus as a voltage difference between the 2 wires.

CONTROL DIAGRAM

NOTE: **D** = High speed CAN bus



E131139

Item	Part Number	Description
1	-	Instrument cluster
2	-	ABS modulator
3	-	Diagnostic socket
4	-	ECM

Wiring Harnesses - Wiring Harness

Description and Operation

Introduction



CAUTION: Do **not** use any other heat shrink sleeve other than the approved glue lined heat shrink sleeve mentioned in the repair procedure.

The purpose of this document is to promote quick and efficient minor repair to harness connectors or cables using approved methods and the wiring harness repair kit. Repairs may only be made to cables and connectors which have been mechanically, **not electrically** damaged. It also applies where the whole extent of the damage can be clearly identified and rectified.

Care and neatness are essential requirements in making a perfect repair.

Caution:

At the time of this first issue of the Harness Repair Guide, do not approve repairs to any of the following circuits:

- Any media orientated system transport network harnesses.
- Supplement restraint system (SRS) firing circuits (Air bags).
- Link lead assemblies, which are unique to safety critical circuits such as anti-lock brake system (ABS) and thermocouple circuits. An example of this is the ABS wheel speed sensors with moulded connectors.
- 4. Screened cables, leads and wiring harness(s).

If any harness(s) with defective electrical connector terminals or wires from the above circuits are a concern, new components must be installed.

Repair Kit



CAUTION: Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

The wiring harness repair kit has been produced which comprises:

- Pre-terminated wiring harness(s) of different sizes and types
- Three sizes of butt splice connectors
- A selection of colored cable identification sleeves
- Two sizes of glue lined heat shrink sleeves
- Crimping pliers
- A wire cutter and insulation stripper
- An electrical connector terminal extraction handle and tips

A suitable heat source, for shrinking heat shrink sleeves will be required.

The pre-insulated diamond grip range of electrical connector terminals and in-line, butt splice connectors contained within the wiring harness repair kit are the **only** acceptable product for the repairs of wiring harnesses. The butt connectors not only grip the wire but also the insulation, making a very secure joint.

If an electrical connector terminal is not included in the wiring harness repair kit then approval for the repair is **NOT** given and in these circumstances a new wiring harness must be installed.

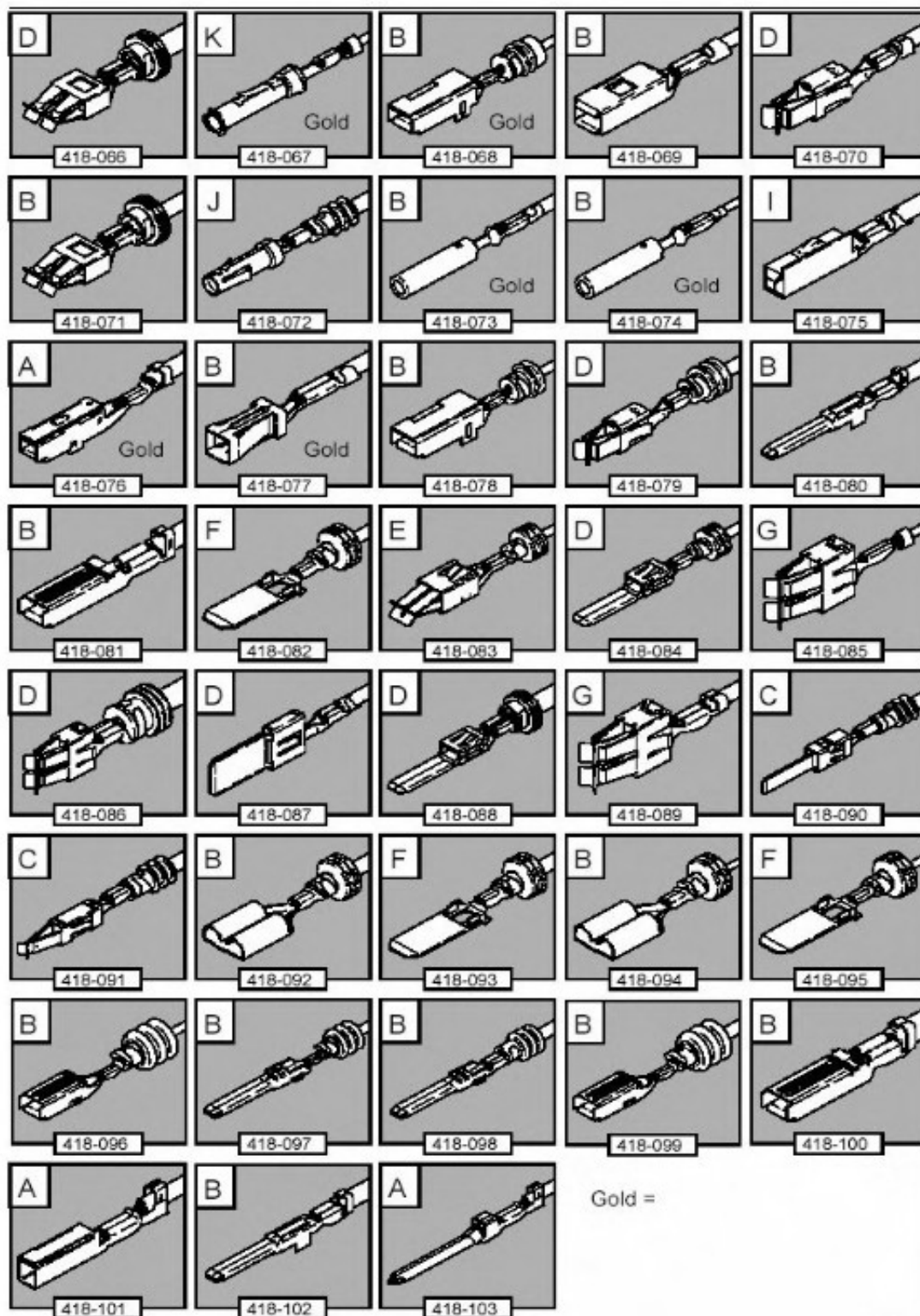
Pre-Terminated Wiring Harness(s) and Butt Splice Connectors

All pre-terminated wiring harness(s) and butt splice connectors in the wiring harness repair kit are contained in bags which can be resealed after use. Each bag is marked with the part number of the items stored within the bag. Each storage compartment in the wiring harness repair kit is identified with the corresponding part number. Make sure that pre-terminated wiring harness(s) and connectors are not mixed up it is advisable to only open one bag at a time and to reseat the bag securely before opening another bag. Also, replace the bag in its mating part number compartment within the case.

The pre-terminated wiring harness(s) are supplied with the insulation in one of three colors, red, blue or yellow. The colors do not apply to any particular circuit but to the harness wire size. See the Relationship Table in the Repair Method section.

Butt splice connectors are also supplied with red, blue or yellow coverings, which must be matched to the pre-terminated wiring harness insulation color.

Pre-Terminated Wiring Harness(s)



E130741

The illustration shows:

- The pre-terminated wiring harness(s) which are included in the wiring harness repair kit
- The part number of the pre-terminated wiring harness
- The letter showing the extractor tip which must be used to remove this type of electrical connector terminal
- Those electrical connector terminals which are gold

Some of the pre-terminated wiring harness(s) have seals installed to the insulation for sealed connector applications. It is essential for prevention of moisture ingress that a sealed pre-terminated wiring harness must be used where a sealed

terminal was removed.



CAUTION: Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

Two sizes of heat shrink sleeving are supplied in the wiring harness repair kit. Each heat shrink sleeve contains a sealant glue. These must be used when connecting wiring harness(s) or electrical connector terminal(s) at all times. The smaller diameter heat shrink sleeve is to be used with the red and blue butt splice connectors and the larger diameter sleeve with the yellow butt splice connectors.

For ease and speed, some of the pre-terminated wiring harness(s) may already have the insulation partly stripped at the splice end. If the repair requires insulation to be stripped from the cable, refer to the Relationship Table for the correct length of insulation to be stripped.

The Pre-Terminated Wiring Harness(s) illustration shows the electrical connector terminal type, the part number of the pre-terminated wiring harness and the letter of the extractor tip which must be used to extract the electrical connector terminal from the connector housing. Additionally, those electrical connector terminal(s) which are gold are identified, all others are therefore, tinned and not gold.

Wiring Harness Cable Identification Sleeves

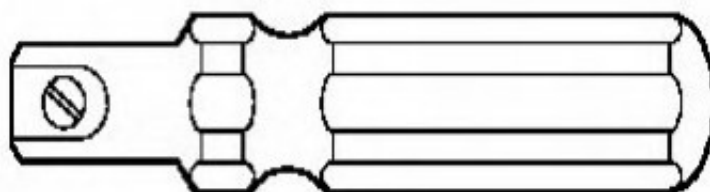
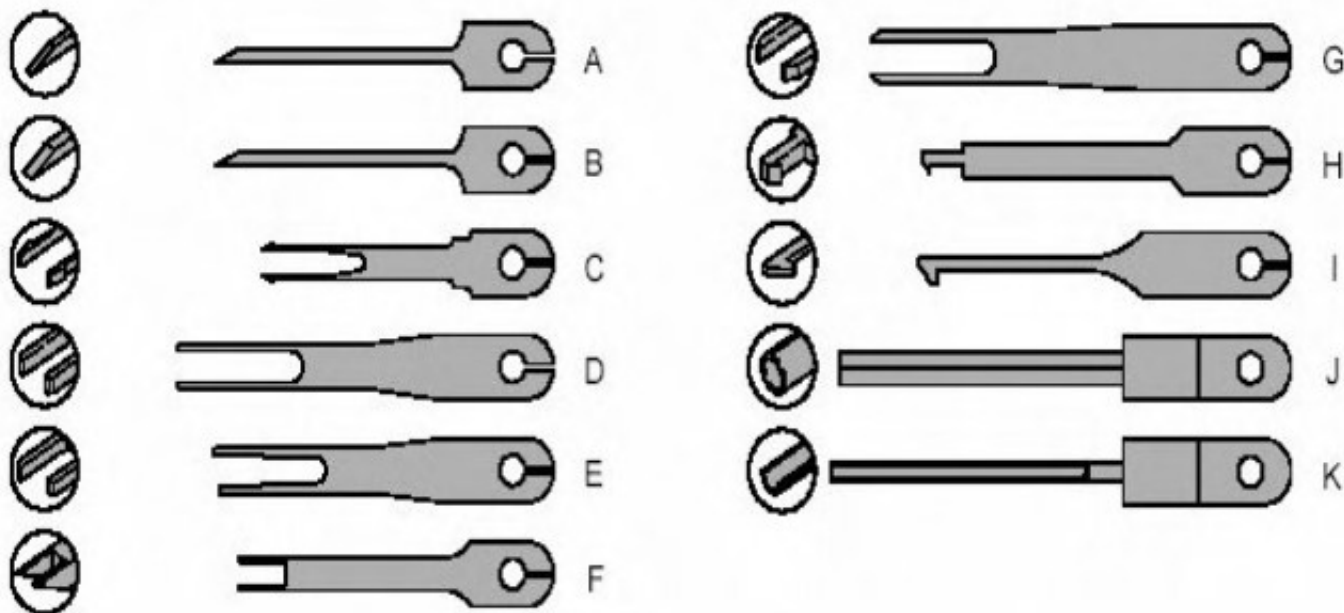
A selection of colored sleeves are contained in the wiring harness repair kit for maintaining the wiring harness cable identification on the pre-terminated wiring harness. Place the correct colored sleeve(s) over the pre-terminated wiring harness insulation as near to the electrical connector as possible with the main wiring harness cable color nearest to the electrical connector.

For example, if the original wiring harness cable color is pink with a black trace put the pink wiring harness cable identification sleeve on the pre-terminated wiring harness first followed by a black sleeve, and slide both along the wiring harness cable to the electrical connector terminal.

Extraction Handle and Tips

The extraction handle, in conjunction with the correct tip, is used to remove a terminal from an electrical connector. Each tip contained in the wiring harness repair kit is marked with an identification letter, A to K inclusive. Each tip has been specially designed to extract a particular type of electrical connector terminal. The use of any other tool is **not** recommended and is liable to cause damage to the electrical connector. The tip is fastened to the handle by a screw which holds the tip firmly yet allows it to be easily replaced.

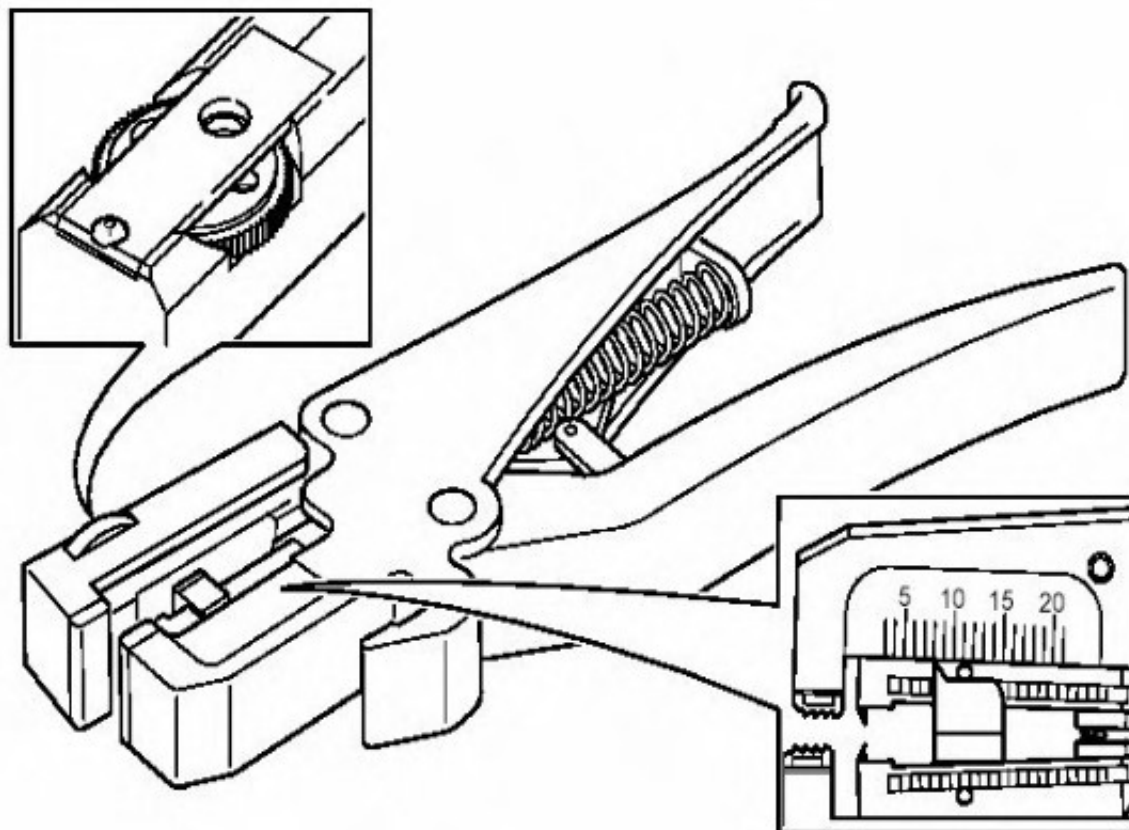
Extraction Handle and Tips



Insulation Stripper

The moving jaw has an adjuster wheel which has a series of holes in it. Turning the wheel and placing the cable in the matching size hole will automatically adjust the jaw to the correct pressure. Note that some wiring harness(s) may have a harder insulation and slight adjustment of the wheel may be needed to make a clean strip but exercise care not to damage the wire.

Insulation Stripper

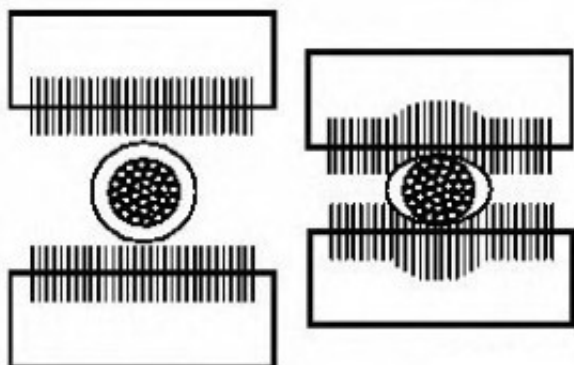


E130743

By pressing the outer edges of the wiring harness cable length stop together the adjuster can be slid up or down the jaw. This decreases or increases the length by which the wiring harness cable insulation will be stripped from the pre-terminated wiring harness or wiring harness wire. The adjuster has a position indicator to align with a graduated scale and this sets the correct length in millimetres, of insulation to be stripped. The amount of insulation to be stripped is shown in the Relationship Table.

The illustration shows the insulation stripper tool and a wiring harness correctly gripped in the jaws. A wire cutter is provided on the outer side of the fixed jaw.

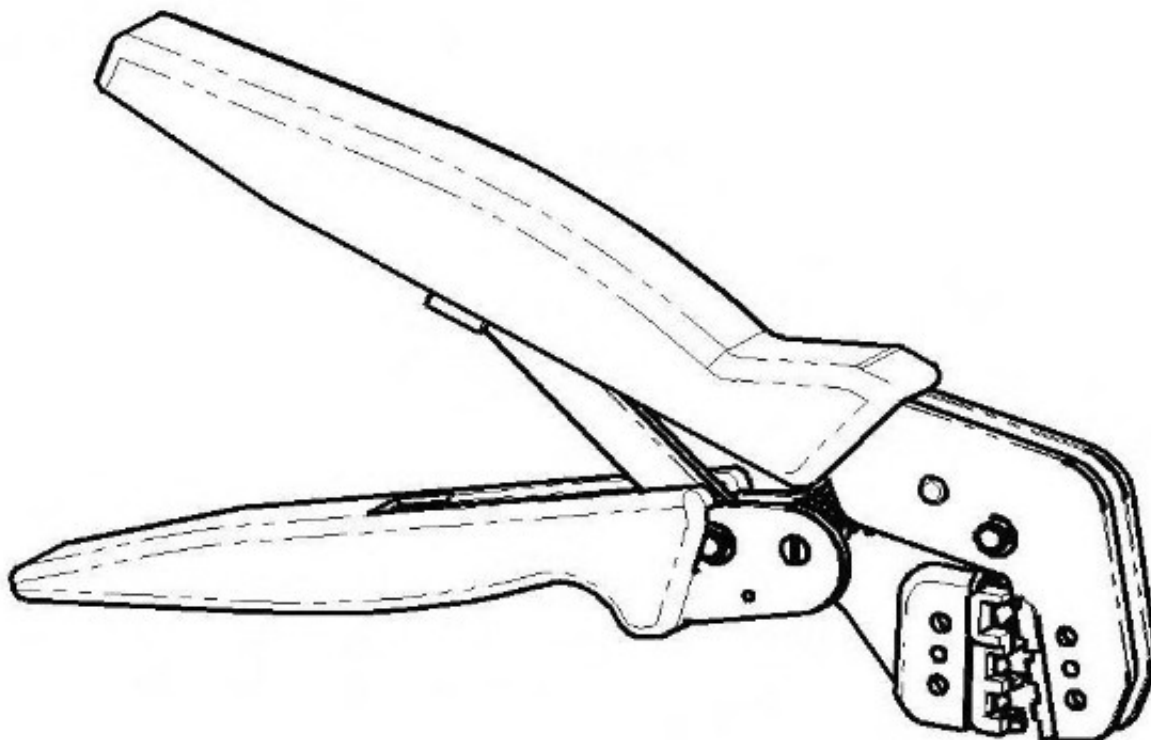
Cable Correctly Gripped in Stripper Blades



E130744

Crimping Pliers

Crimping Pliers



E130745

The crimping pliers have a moving jaw and a stationary jaw, with three different sized crimping enclosures. Each of the enclosures is identified by a red, blue or yellow coloured dot which corresponds to the three colours of the pre-terminated wiring harness(s) and butt splice connector colors.

List of Parts

Description	Part Number	Quantity
Wiring Harness Repair Kit	418-S065	1
Pre-Terminated Wiring Harness(s)	418-066 to 418-103 inclusive	10 each
Glue Lined Heat Shrink Pack – small diameter	418-104	25 per pack
Glue Lined Heat Shrink Pack – larger diameter	418-105	10 per pack
Case Assembly Comprising – carry case, lid, inner lid, base, insert, trays foam spacers	418-106	1
Butt Splice Connector – Red	418-107	50 per pack
Butt Splice Connector – Blue	418-108	50 per pack
Butt Splice Connector – Yellow	418-109	20 per pack
Extraction Tool Handle	418-110	1
Extraction Tip Pack consists of 2 spare screws plus	418-S111	1
Tip A	418-118	1
Tip B	418-119	1
Tip C	418-120	1
Tip D	418-121	1
Tip E	418-122	1
Tip F	418-123	1
Tip G	418-124	1
Tip H	418-125	1
Tip I	418-126	1
Tip J	418-127	1
Tip K	418-128	1
Sleeve Identification Pack – for Red insulation	418-112	500

Sleeve Identification Pack – for Blue insulation	418-113	500
Sleeve Identification Pack – for Yellow insulation	418-114	500
Instruction Manual	JTP 593	1
Crimping Pliers	YRW500010	1
Wire Stripping Tool	418-117	1

Items can be ordered from:

SPX United Kingdom Limited

Ironstone Way

Brixworth

Northants

NN6 9UD

United Kingdom

Telephone: +44 (0) 1327 704461

Fax: +44 (0) 1327 706632

Repair Methods



CAUTION: Several different types and sizes of terminal may be found in a single electrical connector housing.

It is necessary to identify:

- The conductor (wire) size of the affected wiring harness
- The electrical connector range from which the damaged wiring harness is to be removed
- The terminal type

Use of the approved diagnostic tool will greatly assist in the quick identification of electrical connectors and faulty pin terminal(s).

Reference can also be made to the vehicle Electrical Guides, held by Dealers, to identify wiring harness(s) and electrical connector(s).

By using the Relationship Table, the wiring harness conductor (wire) size can be related to a suitable pre-terminated wiring harness by the color of the insulation. Also, the correct length of insulation to be stripped from the wiring harness lead is identified.

Relationship Table

CABLE RANGE	SPLICE	STRIP LENGTH
0.35 mm ² to 1.50 mm ²	RED	6.00 to 7.00 mm
1.00 mm ² to 2.50 mm ²	BLUE	6.00 to 7.00 mm
4.00 mm ² to 6.00 mm ²	YELLOW	9.00 to 9.50 mm

Electrical Connector Terminal Extraction

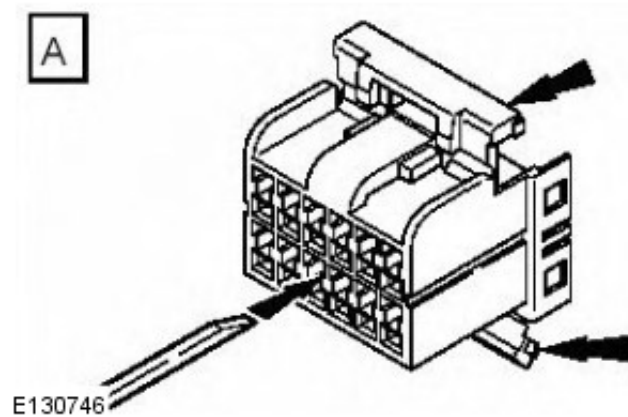
It must be noted that some electrical connector(s) have anti-backout devices which prevent the terminals from being removed from the electrical connector. Some examples of these are shown in following illustrations. The anti-backout device must be released before attempting to remove the terminal from the electrical connector. Some anti-backout devices require a special tip to release the device and these have been included in the kit. Most can be released by carefully using a suitable small screwdriver.

Various types of electrical connector have seals installed internally or externally to prevent moisture ingress. These normally do not have to be removed but make sure that they are installed when the electrical connectors are connected.

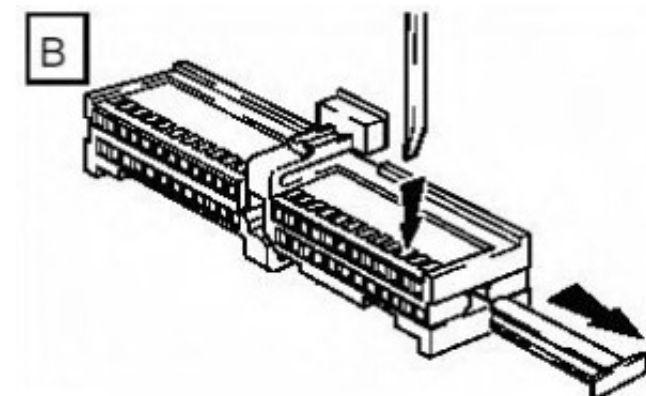
The illustrations show examples of each tip used on different types of electrical connector(s). There are a large number of different types of electrical connector used on vehicles therefore only one example using each tip is shown. Technicians experience and judgement will dictate which type of tip should be used for those electrical connector(s) which are not shown. Care should be exercised to avoid further damage when removing the terminals from the electrical connector.

NOTE: Examples of the extraction tips and anti-backout tips.

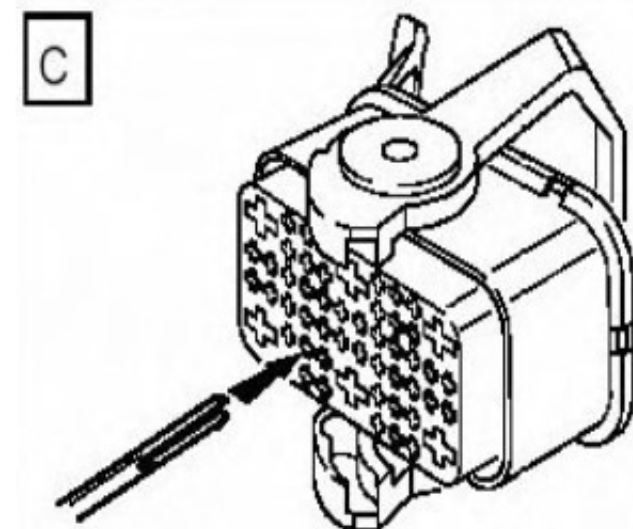
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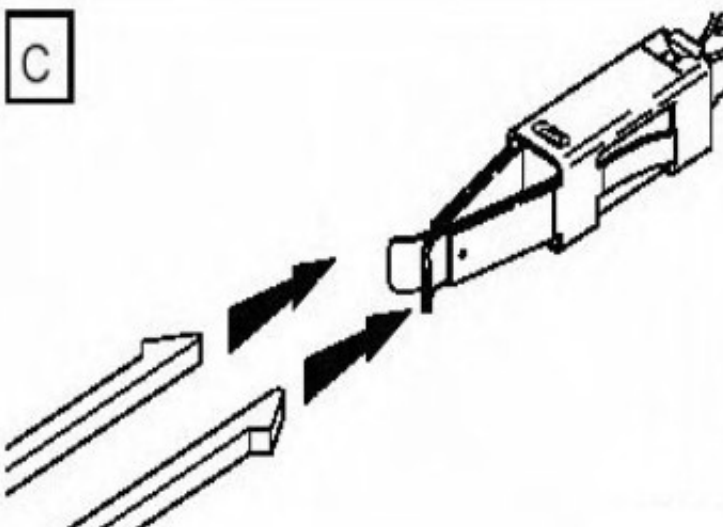
B



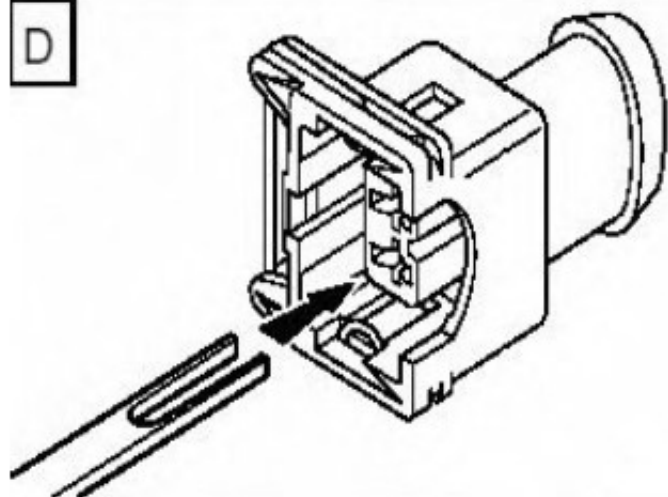
C



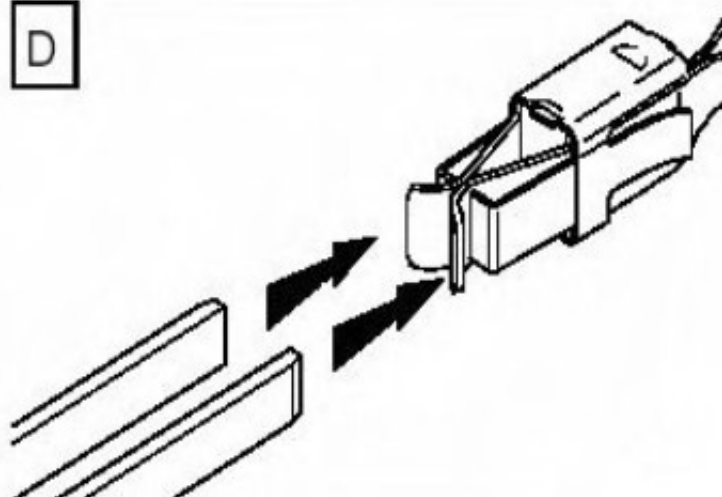
C



D

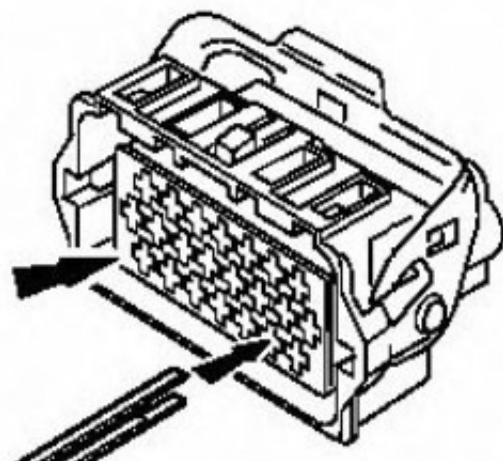


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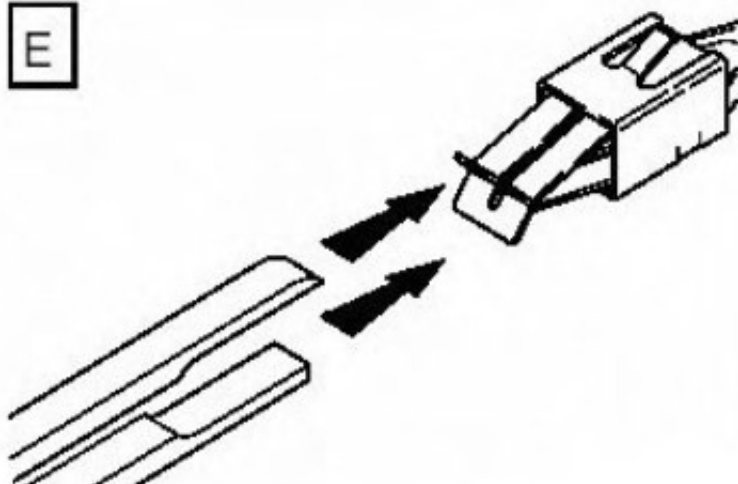


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E

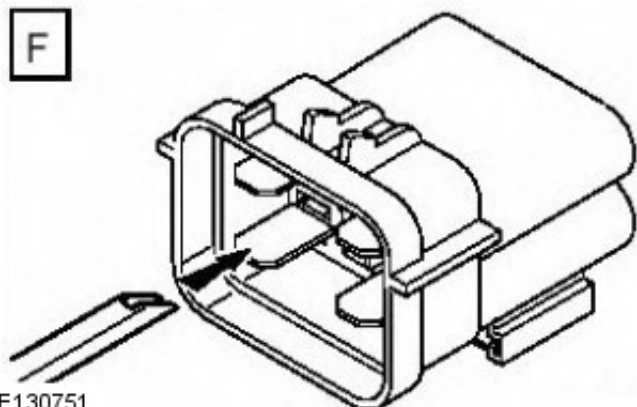


E

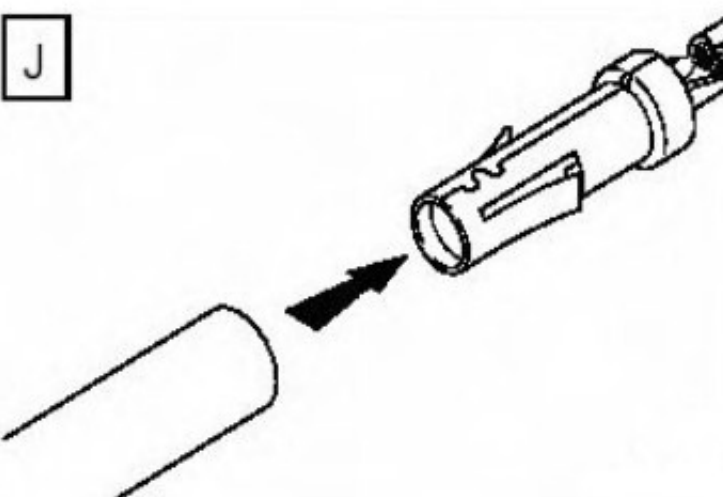
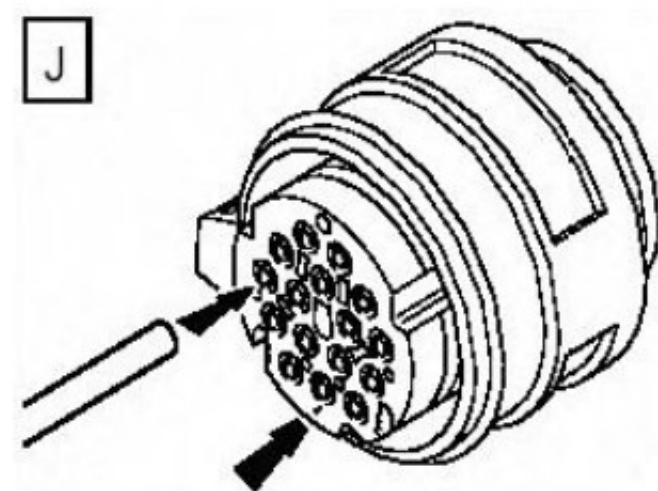
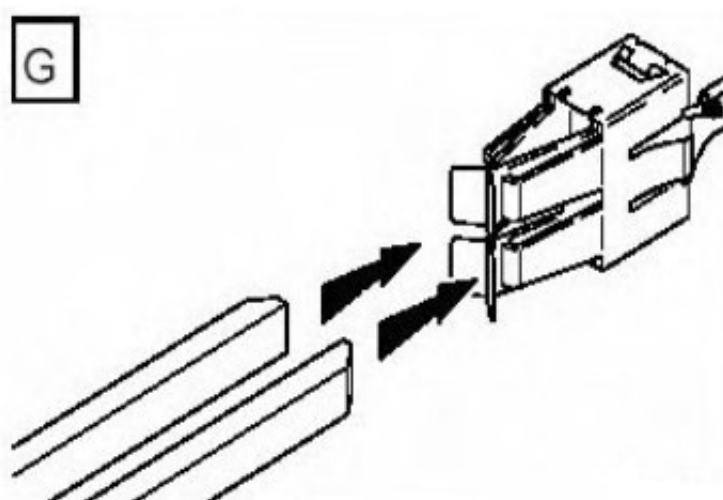
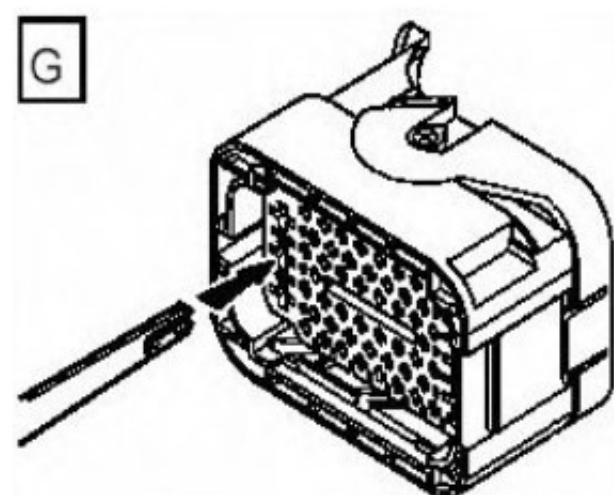
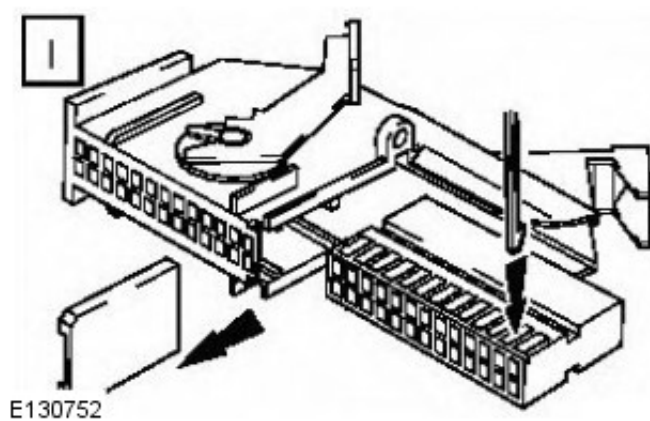


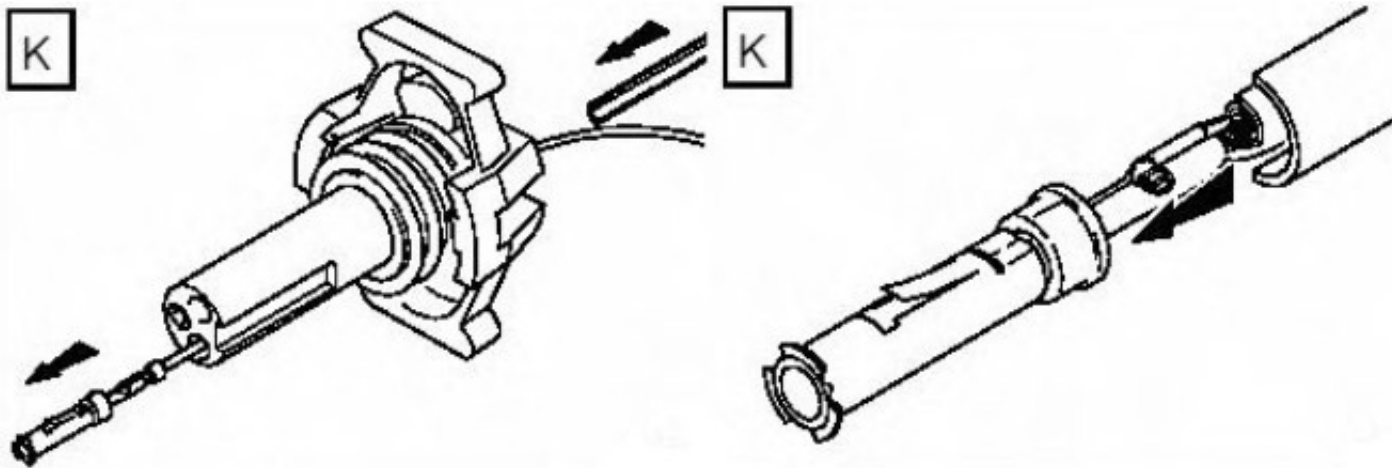
E130750

F



E130751





130755

NOTE: The chart shows the electrical connector types, terminal pins/sockets, extractor tip and anti-backout tip.

Electrical connector terminal type	Pin or socket	Extractor tip	Anti-backout tip
Multilock 040 series	D	A	
Multilock 040 series	B	A	
Multilock 070 series	B	B	
Multilock 040 series	D	B	
Econoseal III 070 series	D	B	
Econoseal III 070 series	B	B	
Econoseal III 070 series	B	B	
Econoseal III J2	D	B	
Econoseal III 250 series	B	F	
Econoseal III 250 series	D	B	
Econoseal III 250 series	B	F	
Econoseal III 250 series	D	B	
Micro-timer II 1.5mm	D	C	
Micro-timer II 1.5mm	B	C	
Std power timer 4.8 flat	D	G	
Std power timer 5.8 flat	B	D	
Std power timer 5.8 flat	B	D	
Std power timer 2.8 flat	D	D	
Std power timer 4.8 flat	D	G	
Std power timer 5.8 flat	B	D	
Ford 2.8 flat	D	E	H
Multilock 070 series	D	B	
Multilock 070 series	B	B	
Junior power timer 2.8 flat	D	D	
Sumitomo TS90 connector	B	B	H
Modu IV gold plated	D	B	
Multilock 040 series gold plated	D	A	
Micro qualock	D	I	
EECV	D	B	
EECV	D	B	
Kostal dia 1.50 series	D	J	
AMP 6.3 flat	D	B	
Junior power timer 2.8 flat	D	D	
2.8 series	D	B	I
Sumitomo TS90 connector	D	B	H
Ducon 0.60 gold plated	D	K	
AMP 6.3 flat	D	D	
Econoseal III 250 series	B	F	

Repair Procedure

CAUTIONS:




Do not use crimping pliers, insulation strippers, butt splice connectors, heat shrink sleeves or pre-terminated wiring harness(s) that are not supplied with the Jaguar wiring harness repair kit. Each part has been designed to be used only with the other parts in this wiring harness repair kit.



Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

It is not correct to make more than five repair joints on the wiring harness to any electrical connector and if more damage is found at the same electrical connector then a new wiring harness must be installed.

- Remove the faulty terminal from the electrical connector using the extractor tool and correct tip. Make sure that any anti-backout device is released before trying to remove the terminal.
-  **CAUTION:** : A number of electrical connector terminals are gold plated or gold flashed. When defective, they must be installed with a gold pre-terminated wiring harness(s) from the wiring harness repair kit. It is not always easy to identify the female as gold but the male pins are visually easier, therefore always check both male and female terminals to identify those which are gold. Under no circumstances are gold and tin terminals to be mixed as this will lead to early failure of the electrical contact.

NOTE: Never use a harness lead with a smaller diameter than the original harness lead.

Select the correct size and type of pre-terminated wiring harness and butt splice connector from the wiring harness repair kit.


- Using the wire cutter on the stripping tool, cut the pre-terminated wiring harness and the harness cable to the required length.
- NOTE:** See illustration: **Stripping Insulation**

From the Relationship Table, find the correct length of insulation to be stripped from the pre-terminated wiring harness and set the adjustable cable length stop to the correct length. Place the pre-terminated wiring harness in the wire stripper and remove the insulation.

- Put the cable identification sleeve(s) on to the wiring harness with the main cable colour nearest to the terminal.
- During this next step do not overtighten. Place the selected butt splice connector in the crimping tool, matching the aperture and the butt connector colours. Make sure that the window indentation in the butt connector is resting over the guide bar on the lower jaw. Partially close the grip until the butt connector is securely held in the aperture. This will give support to the butt connector while the pre-terminated wiring harness is inserted into it.
- NOTE:** See illustration: **Splice Correctly Located**

Insert the pre-terminated wiring harness into the butt connector and make sure that the wire is against the wire stop. Close the grip firmly, crimping the lead to the butt connector. When the handles have been completely closed the butt connector will be freed from the tool as the handles are released. If the handles have not been completely closed then the jaws will hold the butt connector and it cannot be removed from the tool until the crimp is fully made by closing the handles completely.

- Make sure that the harness cable has been squarely cut and the correct length of insulation removed. If more than one splice is needed the butt connectors must be not be crimped to the wiring harness at the same distance from the connector. The splices must be staggered to prevent a bulk of splices in the same area of the wiring harness.
- It is preferable to cover the butt splice joint with heat shrink sleeve. This is desirable not essential, except where the electrical connector is a sealed electrical connector. Use the smaller diameter sleeve for red and blue pre-terminated wiring harness(s) and the large diameter sleeve for the yellow pre-terminated wiring harness(s). It is advisable to place the heat shrink over the completed joint but in some instances the sleeve will not pass over the terminal. Check, and if required, place the correct size sleeve onto the harness cable or pre-terminated wiring harness before crimping the butt splice to the wiring harness.
- Place the harness cable into the butt splice with the splice window over the guide bar. Make sure that the cable harness wire is against the stop in the butt splice, crimp the butt splice connector to the wiring harness.
- Gently pull the harness cables each side of the butt splice to make sure that a secure joint has been made.

-  **WARNING:** Do not use a naked flame in areas where fuel or oil have been spilt. Clean the area of residual oil and fuel and wait until the fuel spill has fully evaporated.

CAUTIONS:



When using a heat source make sure that it is localised and causes no damage to surrounding materials.



Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

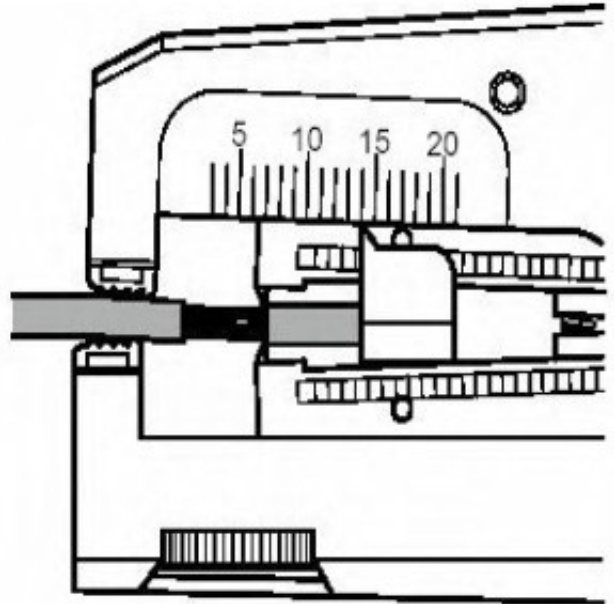
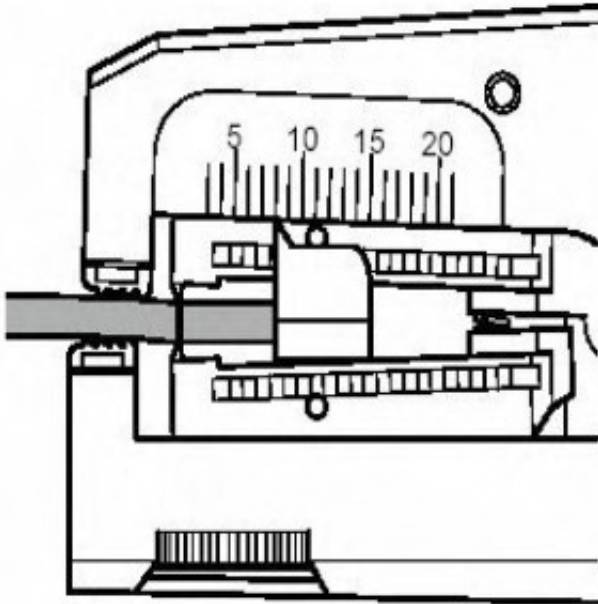
Using a suitable heat source, shrink the sleeve over the butt splice.

- If further pre-terminated wiring harness(s) are to be installed to the same electrical connector, make sure that the lead is cut at a different length to the previous joint. This makes sure that the splices will, where possible, be staggered on the wiring harness and prevent a bulk of splices in one area.
- When all of the splices have been made, fit the terminal(s) to the electrical connector, taking care that the

terminals are correctly orientated.

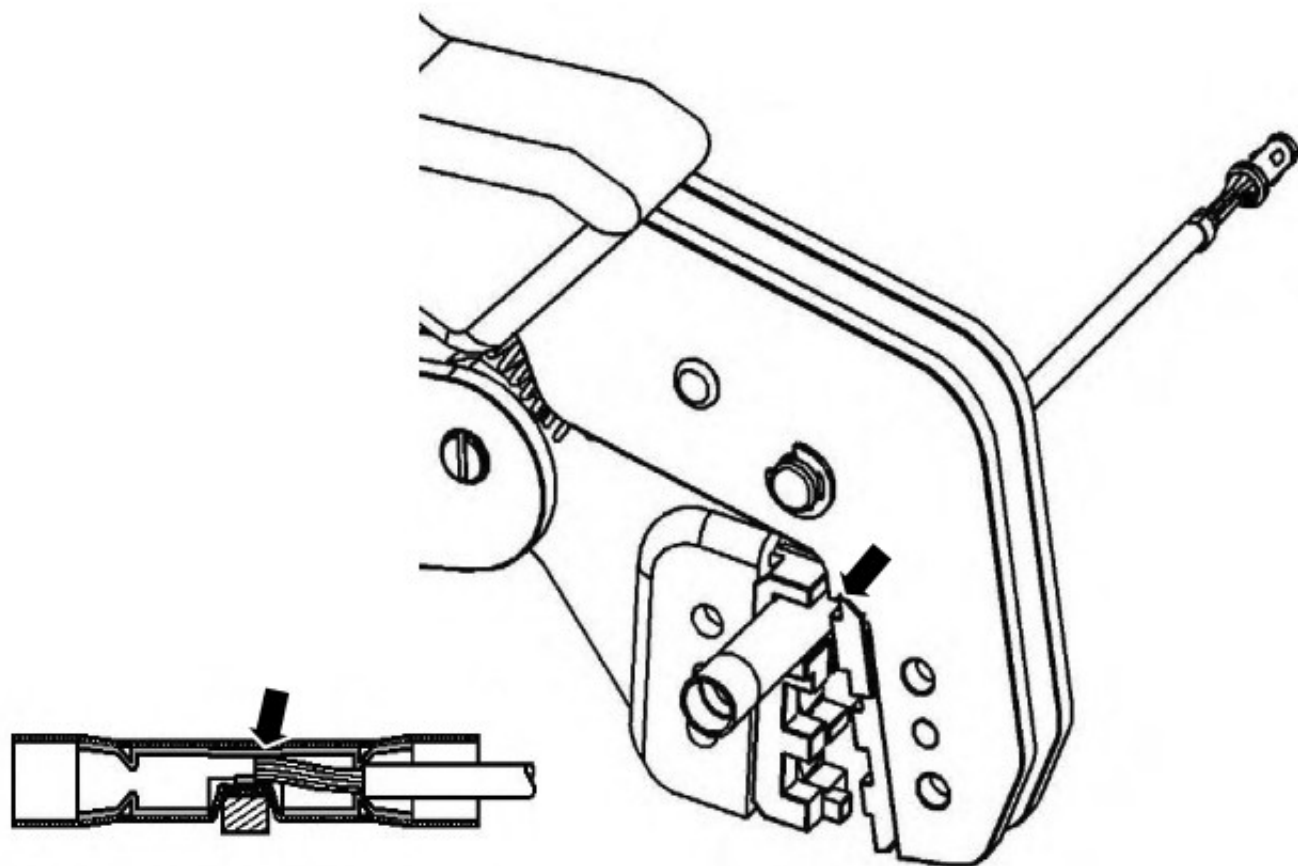
- Install the wiring harness cover and secure with adhesive electrical tape. Do not cover the wiring harness right to the electrical connector as the terminals must have a little movement and not be firmly bound to the electrical connector or wiring harness. Make sure that the cable identification sleeve(s) are showing at the wiring harness electrical connector.

Stripping Insulation



E130756

Splice Correctly Located



E130757

Wiring Harnesses - Wiring Harness Repair

General Procedures

1. For additional information, refer to: Wiring Harness (418-02, Description and Operation).

Wiring Harnesses - Engine Wiring Harness

Removal and Installation

Removal

CAUTIONS:



Make sure that the wiring harness is not twisted or damaged on removal. Failure to follow this instruction may result in damage to the vehicle.



Take extra care not to damage the wiring harness clips.

NOTE: Note the position of the wiring harnesses to aid installation.

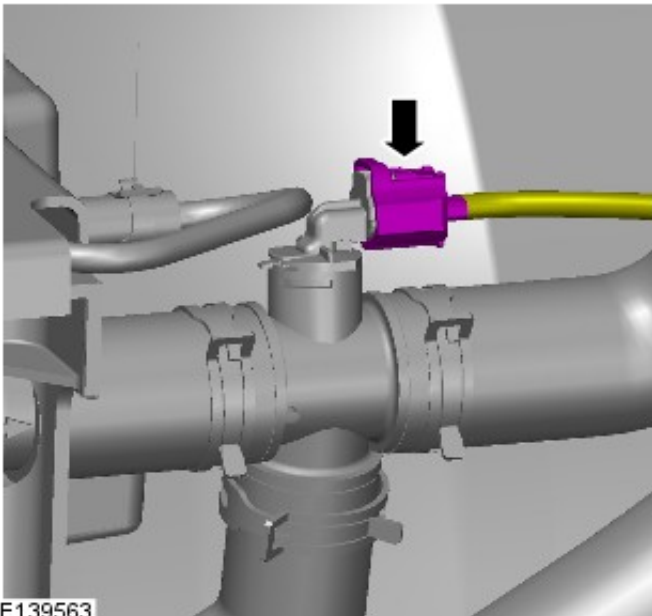
1. For additional information, refer to: [Intake Manifold](#) (303-01 Engine - ID4 2.2L Diesel, Removal and Installation).



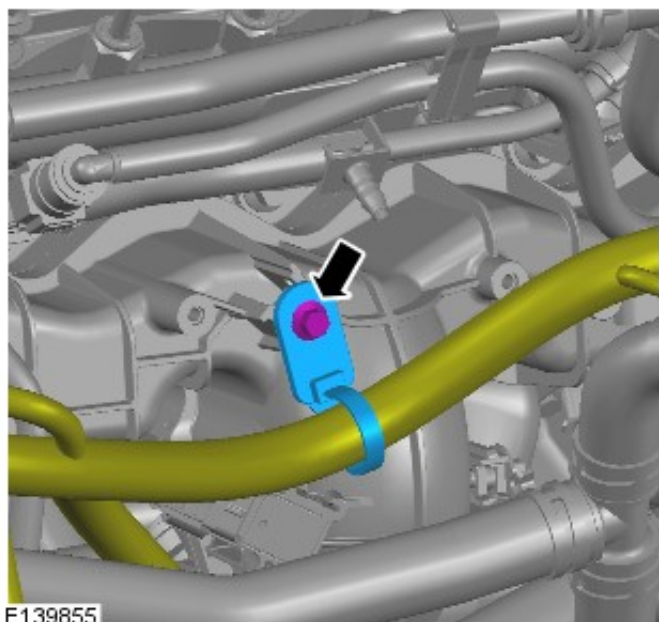
2. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

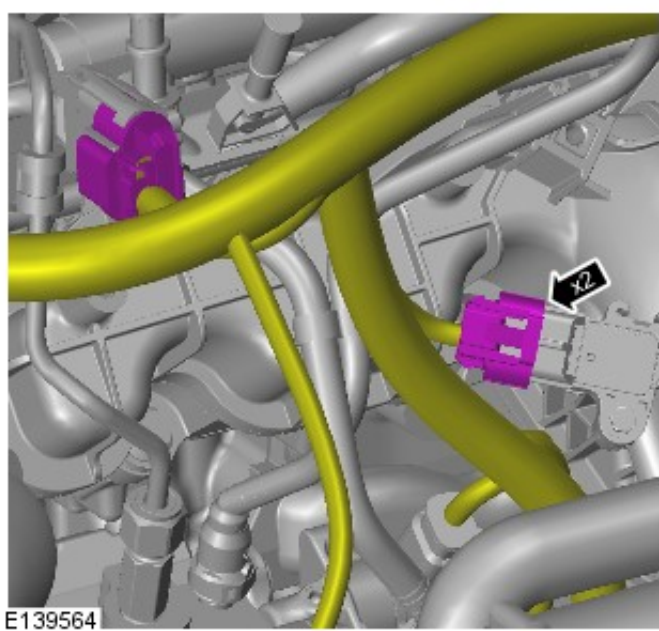
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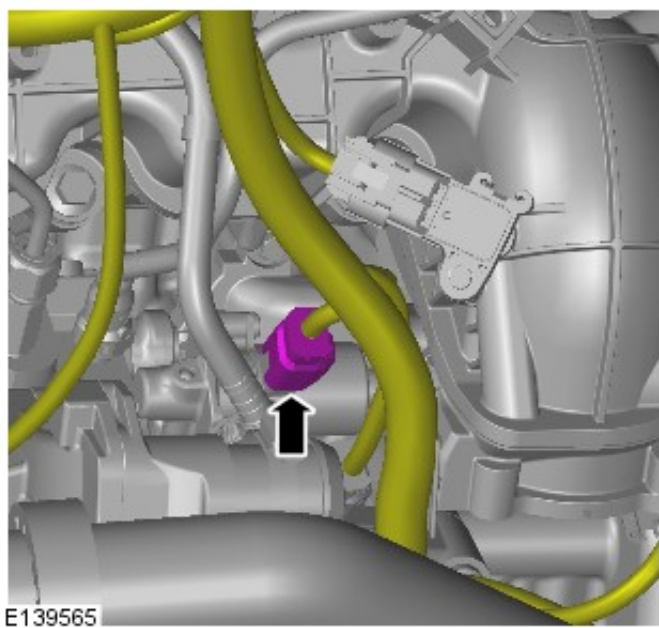
4. Torque: 5Nm



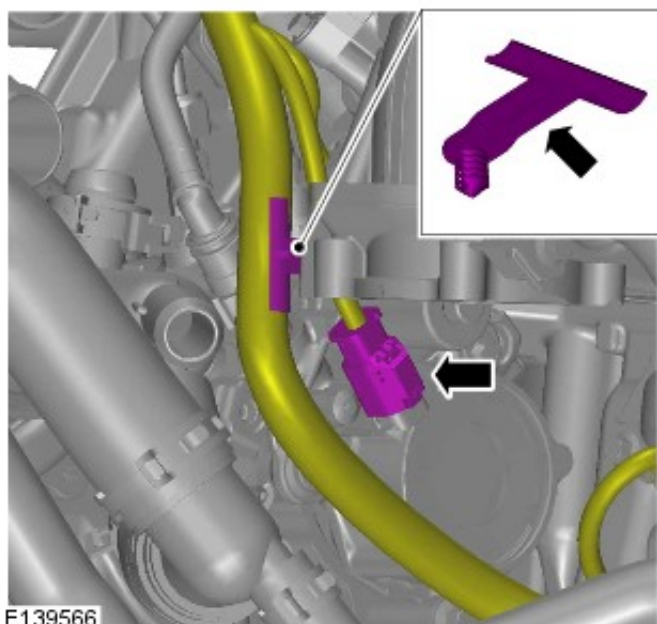
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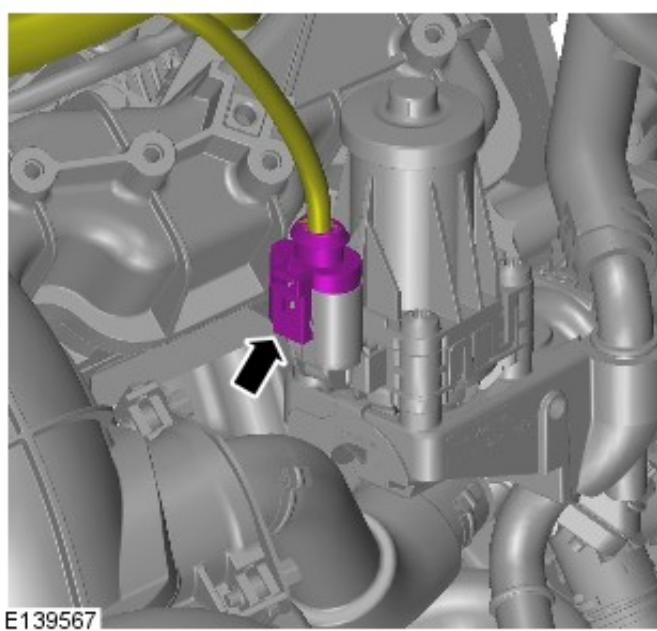
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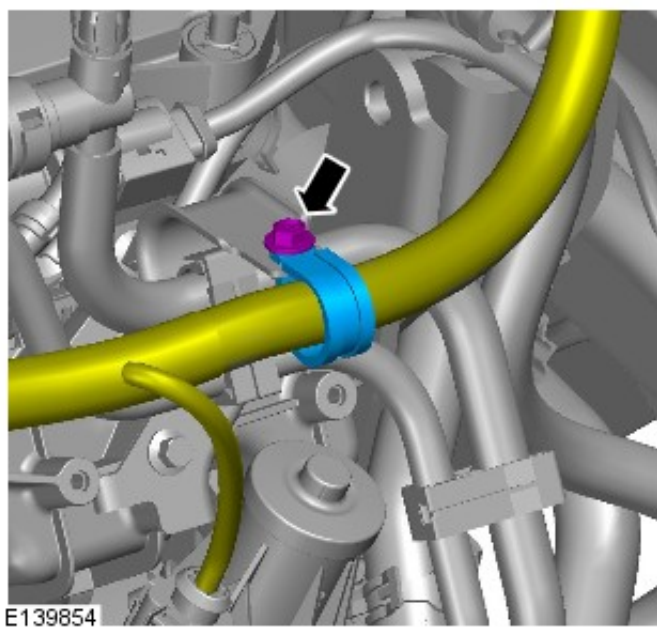
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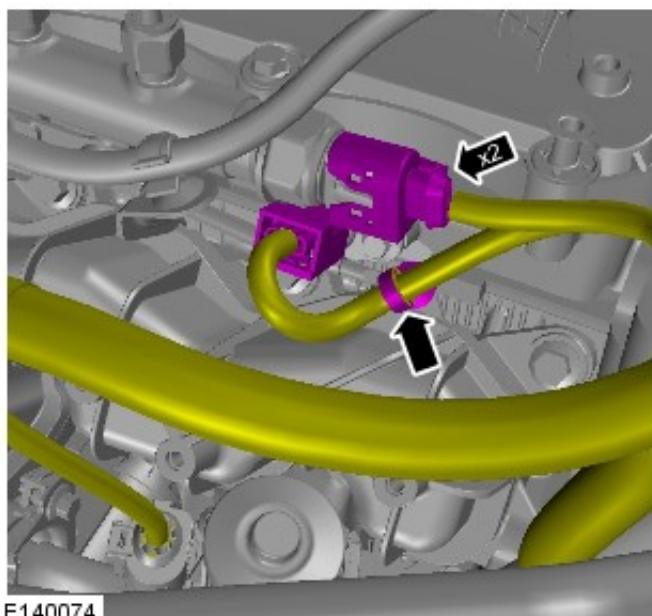
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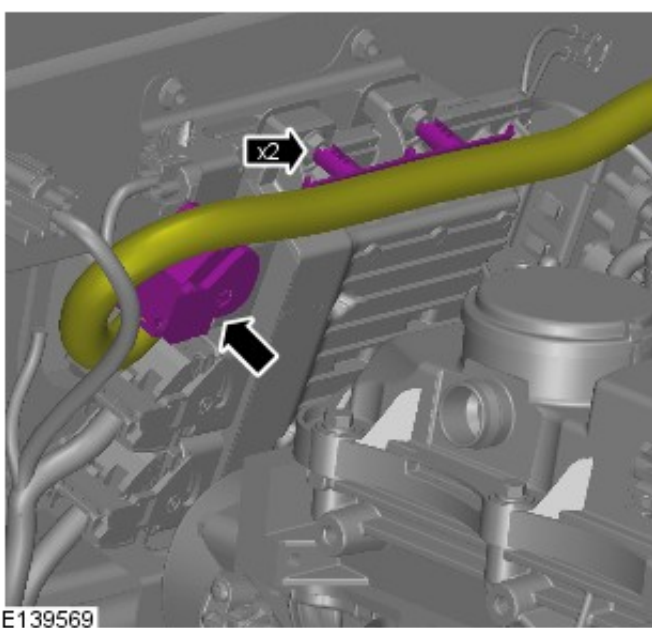
9. Torque: 10Nm



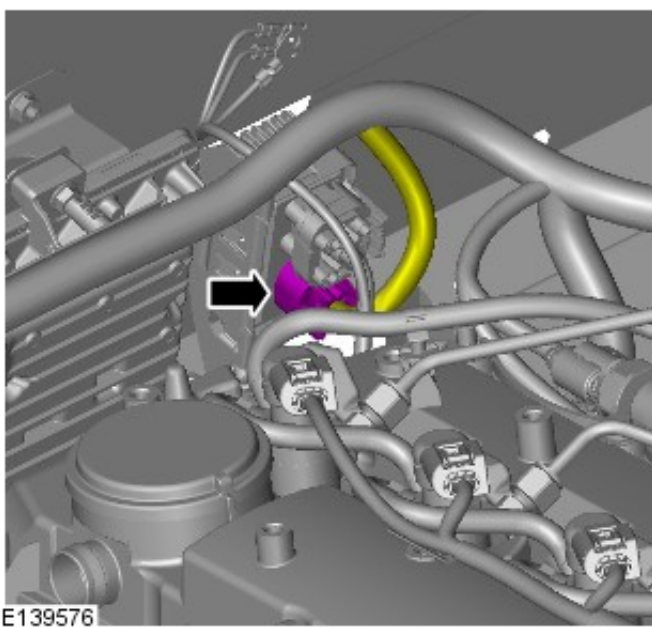
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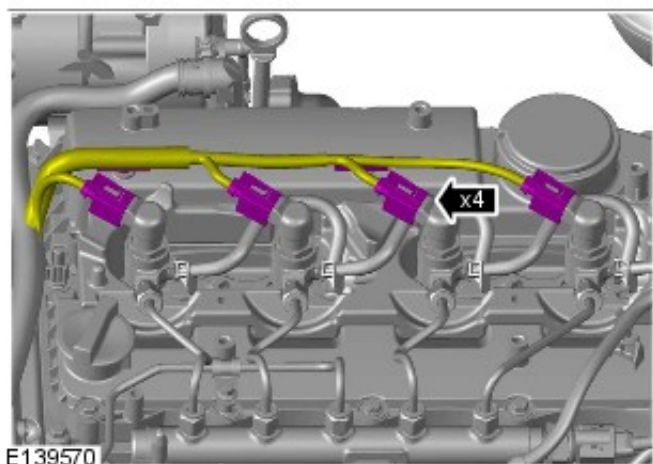
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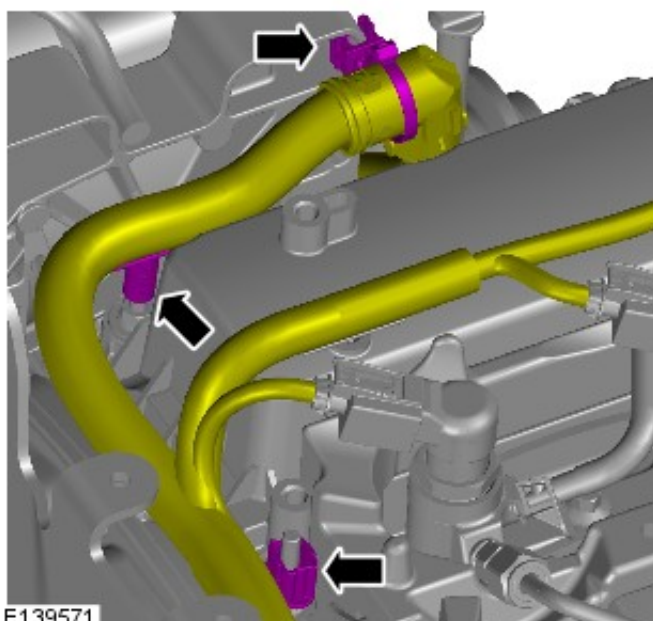


13.



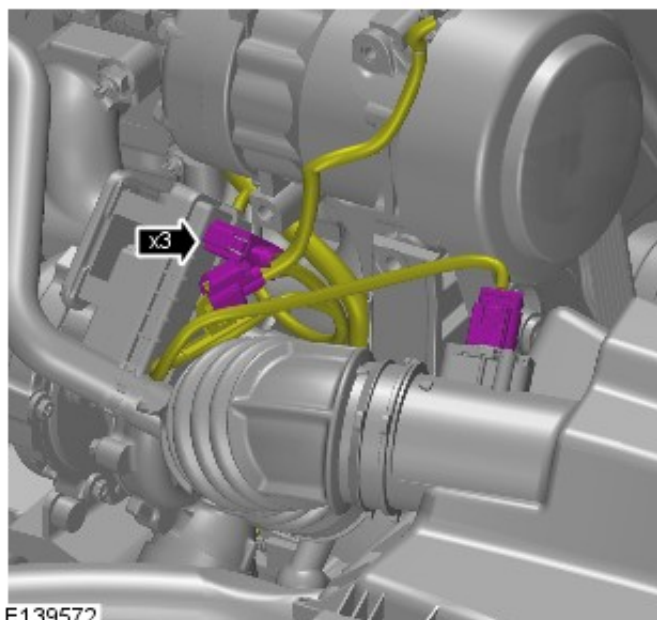
E139570

14.



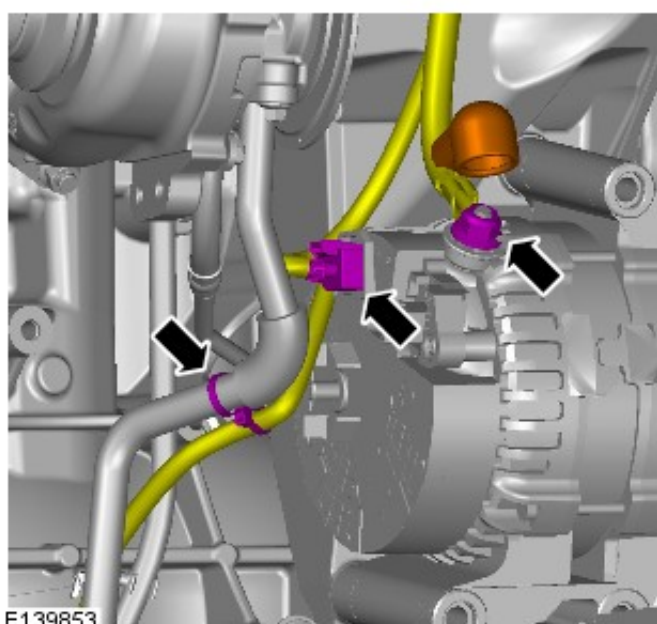
E139571

15.



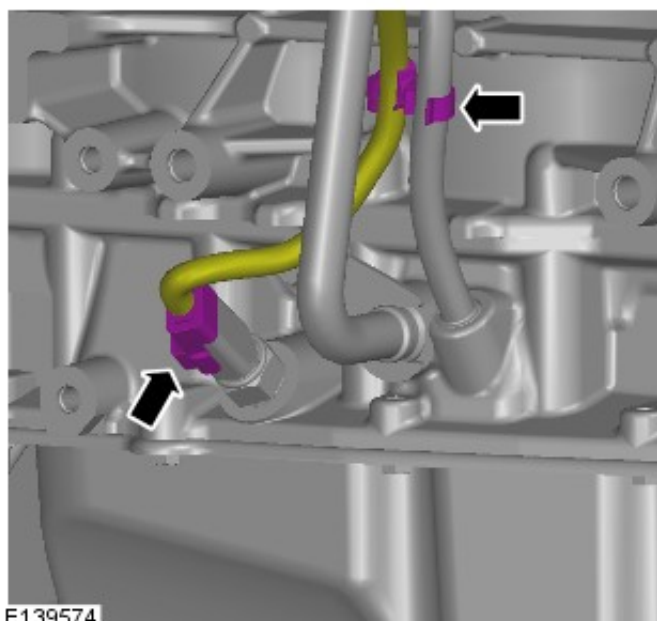
E139572

16. Torque: 8Nm



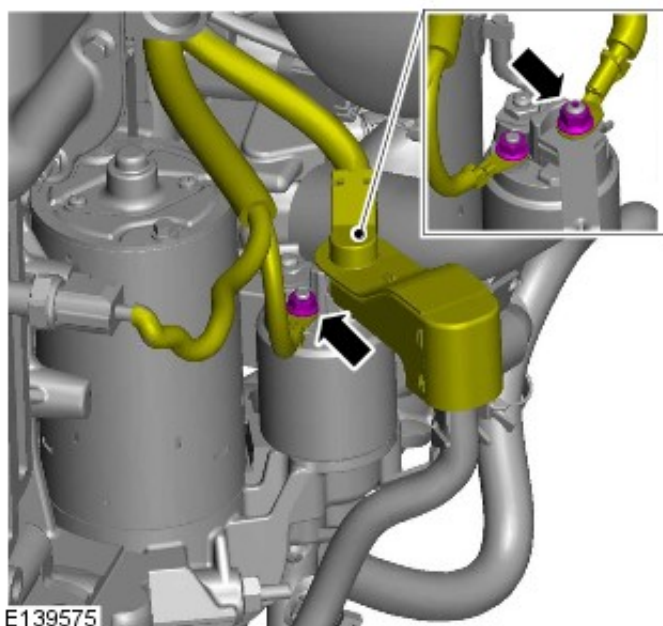
E139853

17.

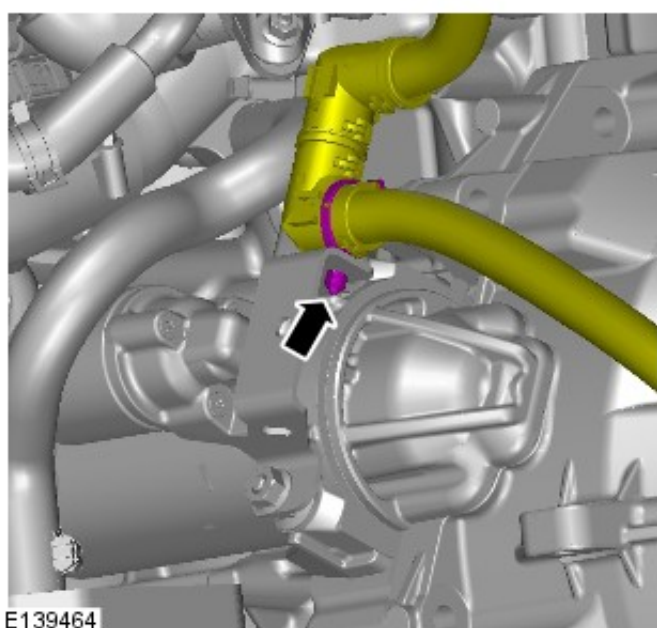


E139574

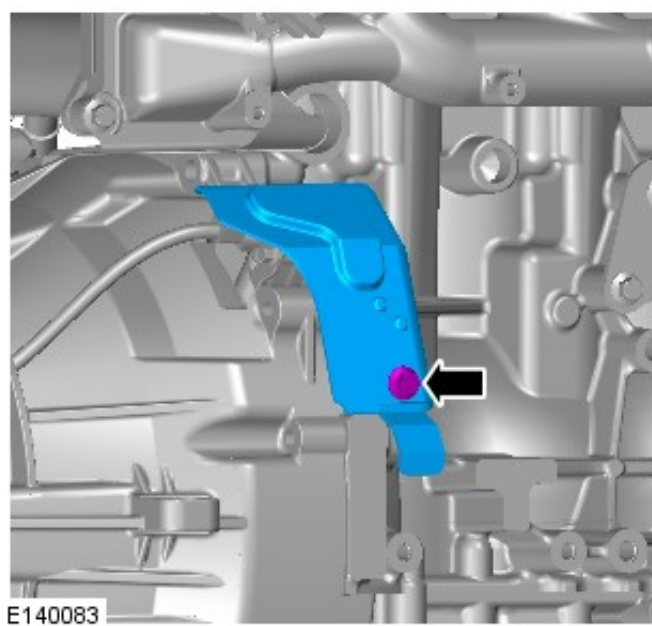
18. Positive cable nut torque: 12Nm, Solenoid cable nut torque: 8Nm



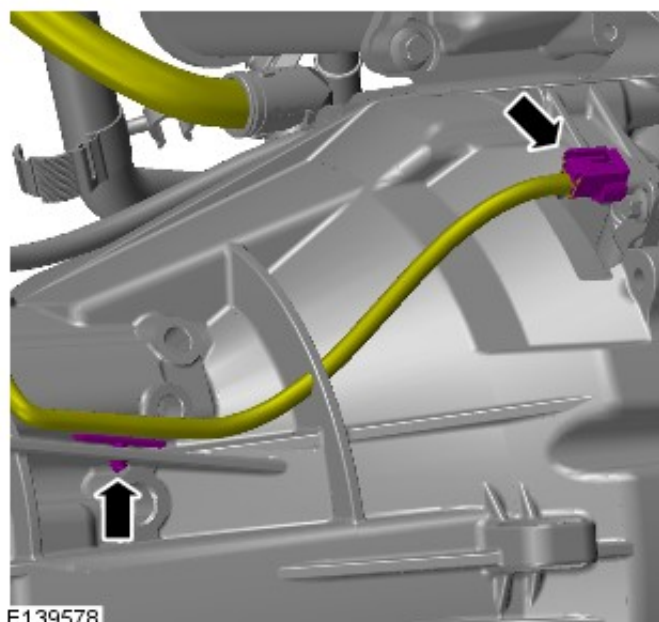
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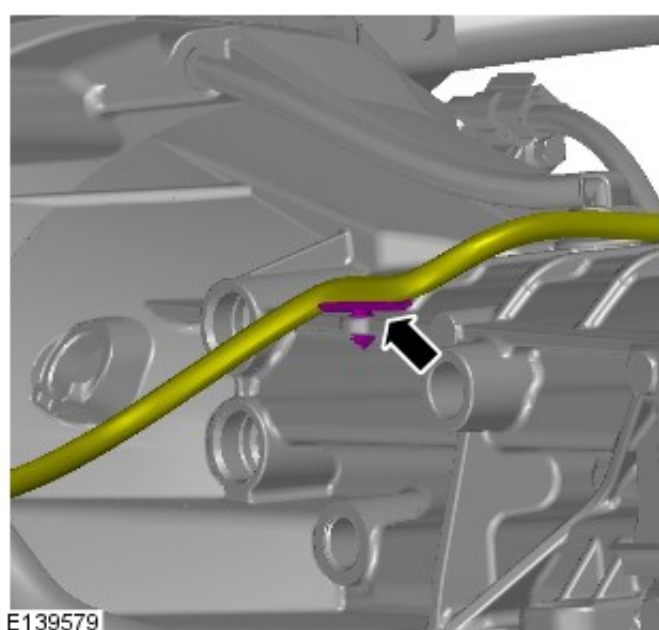
20. Torque: 24Nm



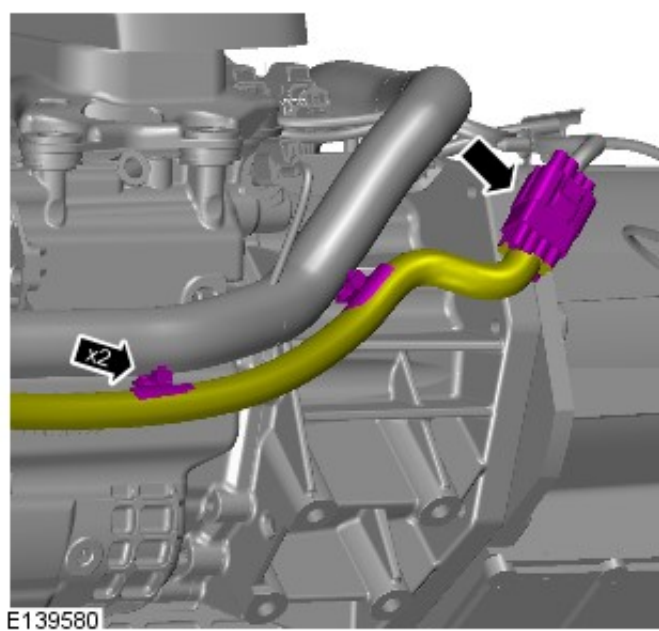
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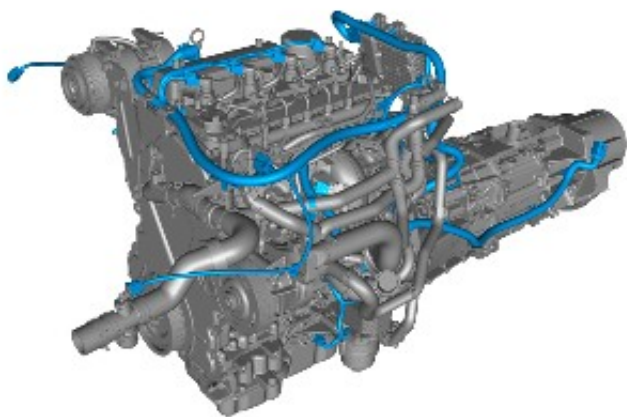
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23.



24.



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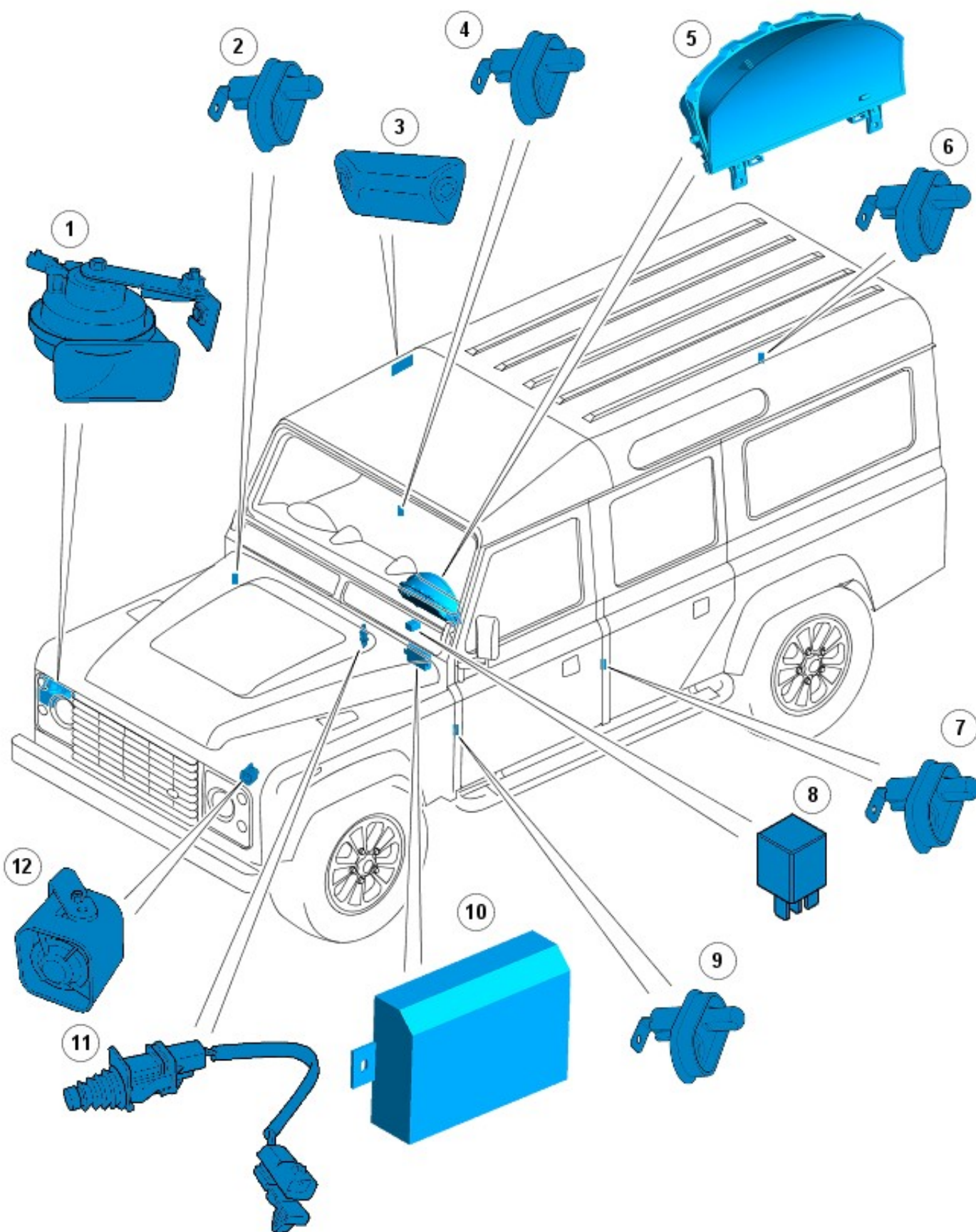
Installation

1. To install, reverse the removal procedure.

Anti-Theft - Active - Anti-Theft - Active

Description and Operation

COMPONENT LOCATION



E83588

Item	Part Number	Description
------	-------------	-------------

1	-	Anti-theft alarm horn (if fitted)
2	-	right-hand (RH) front door switch
3	-	Intrusion detection module (90/110 station wagon shown)
4	-	RH rear door switch (if fitted)
5	-	Instrument cluster
6	-	Tail door switch
7	-	left-hand (LH) rear door switch (if fitted)
8	-	Anti-theft alarm horn relay (if fitted)
9	-	LH front door switch
10	-	Anti-theft system module
11	-	Hood switch
12	-	Battery backed sounder (if fitted)

OVERVIEW

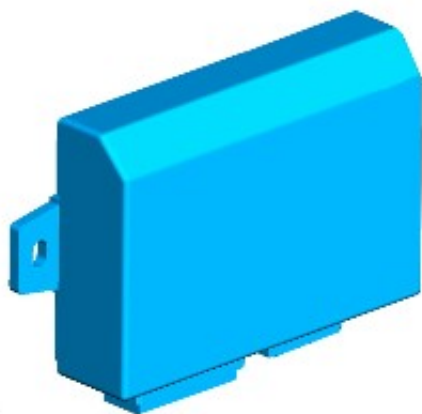
The 10AS anti-theft system monitors the hinged panels for unauthorized opening. The system also monitors intrusion within the cabin. Depending on market specification, the vehicle may be fitted with either a battery backed sounder or an anti-theft alarm horn.

The controlling software for the active anti-theft system is contained within the anti-theft system module. The anti-theft system module also controls;

- the passive anti-theft system (engine immobilization).
For additional information, refer to: Anti-Theft - Passive (419-01B, Description and Operation).
- the central locking system.
For additional information, refer to: Handles, Locks, Latches and Entry Systems (501-14, Description and Operation).
- interior lighting.
For additional information, refer to: Interior Lighting (417-02, Description and Operation).
- the hazard flashers.
For additional information, refer to: Exterior Lighting (417-01, Description and Operation).

The active anti-theft system is armed by pressing the lock button on the remote handset or using the vehicle key in the drivers door lock. Using the remote handset will arm both the perimeter and volumetric anti-theft systems. Using the vehicle key will only arm the perimeter anti-theft system.

ANTI-THEFT SYSTEM MODULE



E83589

The anti-theft system module is located behind the instrument cluster and receives a permanent battery supply from the battery junction box (BJB). The control module incorporates a radio frequency (RF) receiver and antenna to receive signals transmitted from the remote handset.

Depending on market specification, the module will operate at one of two frequencies. This is identified by a label mounted on the module casing. The table below shows the frequencies available for each market.

Frequency	Markets
433 MHz	Europe, Gulf States, South Africa
315 MHz	North America, South East Asia, Japan, Australia

The anti-theft system module also incorporates an internal inertia switch. In the event of an impact of sufficient severity to trigger the inertia switch when the ignition switch is in position II, the anti-theft system module will unlock all doors and operate the hazard flashers. The anti-theft system module will remain in this mode of operation for 2 minutes. To deactivate the hazard flashers and restore the anti-theft system module to its normal mode of operation, the ignition switch should be turned to position 0 and back to position II after the 2 minute period has expired.

REMOTE HANDSET



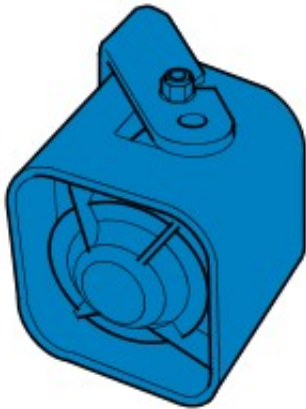
E83590

The remote handset is used to arm and disarm the anti-theft alarm system. The handset comprises a lock and unlock button. Internally, the handset contains a printed circuit board capable of transmitting RF signals, and a battery.

The remote handset RF code comprises 2 parts. The first part is a fixed code that is unique to the handset. The second part is a rolling code which changes in accordance with a pre-determined pattern. The code is received by the anti-theft system module, which is able to store information on up to 4 different handsets.

If the remote handset battery falls below a pre-determined level, the handset will transmit an additional RF signal code to the anti-theft system module. This signal is relayed to the instrument cluster indicator which emits 2 rapid flashes every 0.5 seconds to inform the driver that the remote handset battery needs replacing.

BATTERY BACKED SOUNDER



E83591

Depending on market specification, the vehicle may be fitted with a battery backed sounder. The battery backed sounder is located in the LH front fender, behind the headlamp. The battery backed sounder is tamper proof and as the name suggests contains its own power supply. This allows it to operate even if it is disconnected from the vehicle power supply. For added security all wires leading to and from the battery backed sounder are colored black.

If the battery backed sounder is disconnected without first being disarmed it will sound for 4 minutes 30 seconds, if not reset in the interim. The alarm cycle in this period will be made up of a 30 second continuous tone, followed by a 5 second silent interval.

To disarm the battery backed sounder, to allow for its disconnection, the following sequence must be carried out:

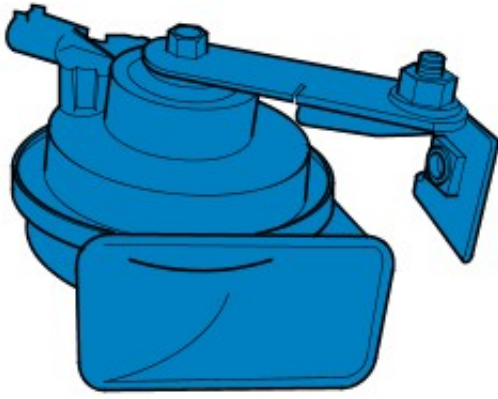
- Turn the ignition switch to position II then back to position 0,
- Disconnect the vehicle battery within 17 seconds of switching off the ignition,
- Disconnect the battery backed sounder.

If the battery backed sounder is triggered by a battery disconnection it can be reset by turning the starter switch to position II provided the remote control is on the same key ring as the key, or is in close proximity to the ignition switch.

If the battery backed sounder is triggered by the perimeter or volumetric anti-theft systems, it can be reset by either:

- pressing a button on the remote handset, or
- by turning the starter switch to position II provided the remote control is on the same key ring as the key, or is in close proximity to the ignition switch.

ANTI-THEFT ALARM HORN

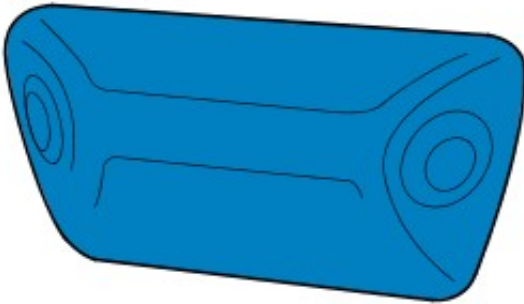


E83592

Vehicles not fitted with a battery backed sounder are fitted with an anti-theft alarm horn. The anti-theft alarm horn is located in the RH front fender, behind the headlamp. Power supply to the anti-theft alarm horn is controlled by the anti-theft system module via a relay located beneath the drivers seat.

If the anti-theft system is triggered, the anti-theft alarm horn will emit either a pulsed or continuous tone depending on market legislation.

INTRUSION DETECTION MODULE



E83593

The intrusion detection module monitors movement within the vehicle cabin. The module is located;

- at the top of the RH B pillar on 90/110 station wagons
- on the front of the headlining, adjacent the interior mirror on 90/110 pick-ups
- on the RH side of the headlining, above the front door on 130 crew cabs.

The intrusion detection module emits a series of ultrasonic sound waves. By measuring the returned sound wave the intrusion detection module can first determine a 'foot print' of the vehicle cabin, and then determine if movement has taken place within this area.

The intrusion detection module is connected directly to the anti-theft system module. If movement is detected in the cabin, the intrusion detection module provides a pulsed voltage signal to the anti-theft module, triggering the alarm.

INSTRUMENT CLUSTER



E83594

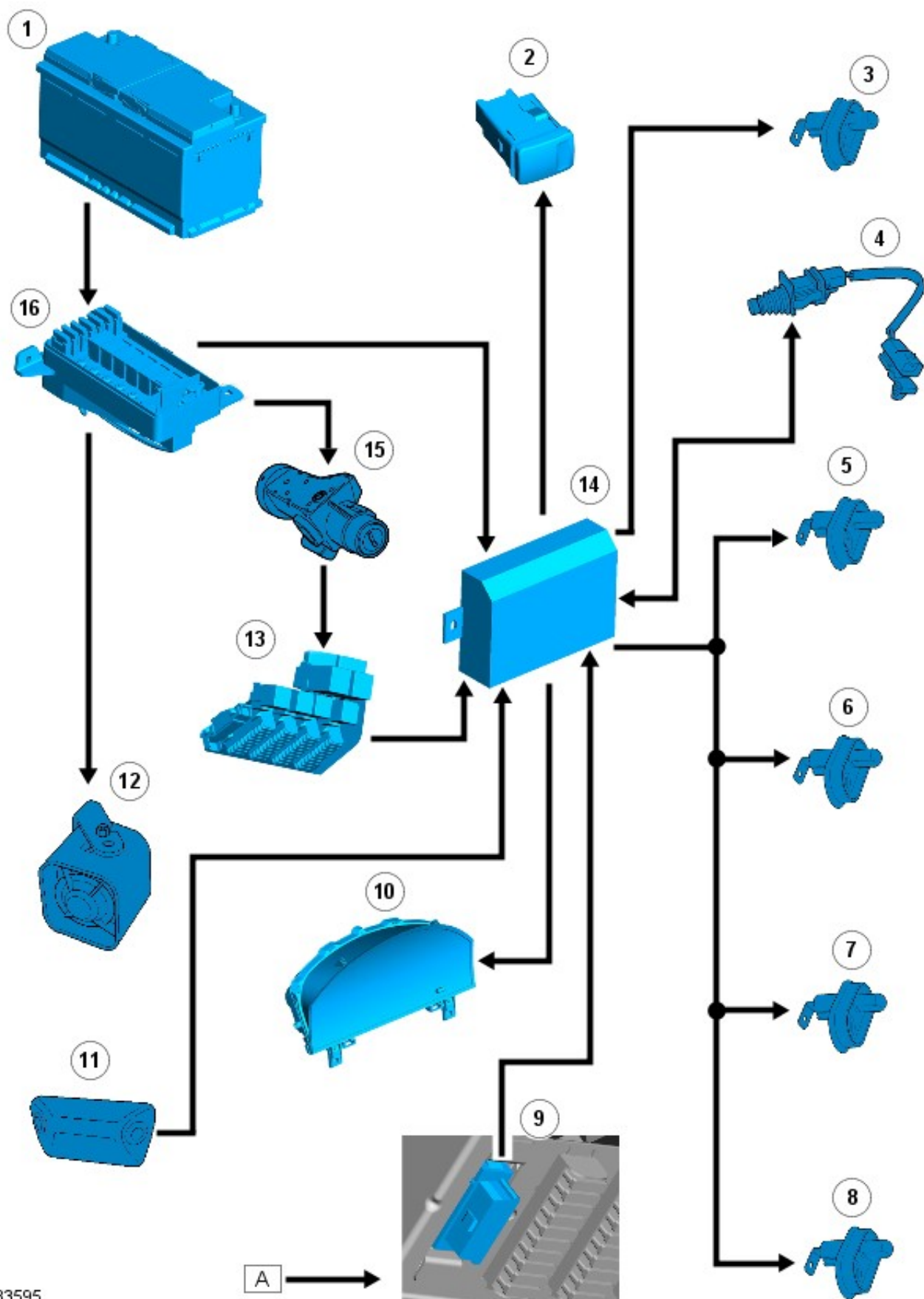
1

Item	Part Number	Description
1	-	Anti-theft indicator

The instrument cluster contains the anti-theft indicator. The indicator provides a visual anti-theft system status. When the anti-theft system is armed, the indicator will flash quickly (8 Hz) for a 10 second period. During this period, the anti-theft system module will arm the system. After the 10 second period, the indicator will flash slowly (1 Hz), acting as a deterrent to thieves. Illumination of the anti-theft indicator is controlled by the anti-theft system module.

CONTROL DIAGRAM - BATTERY BACKED SOUNDER

NOTE: **A** = Hardwired



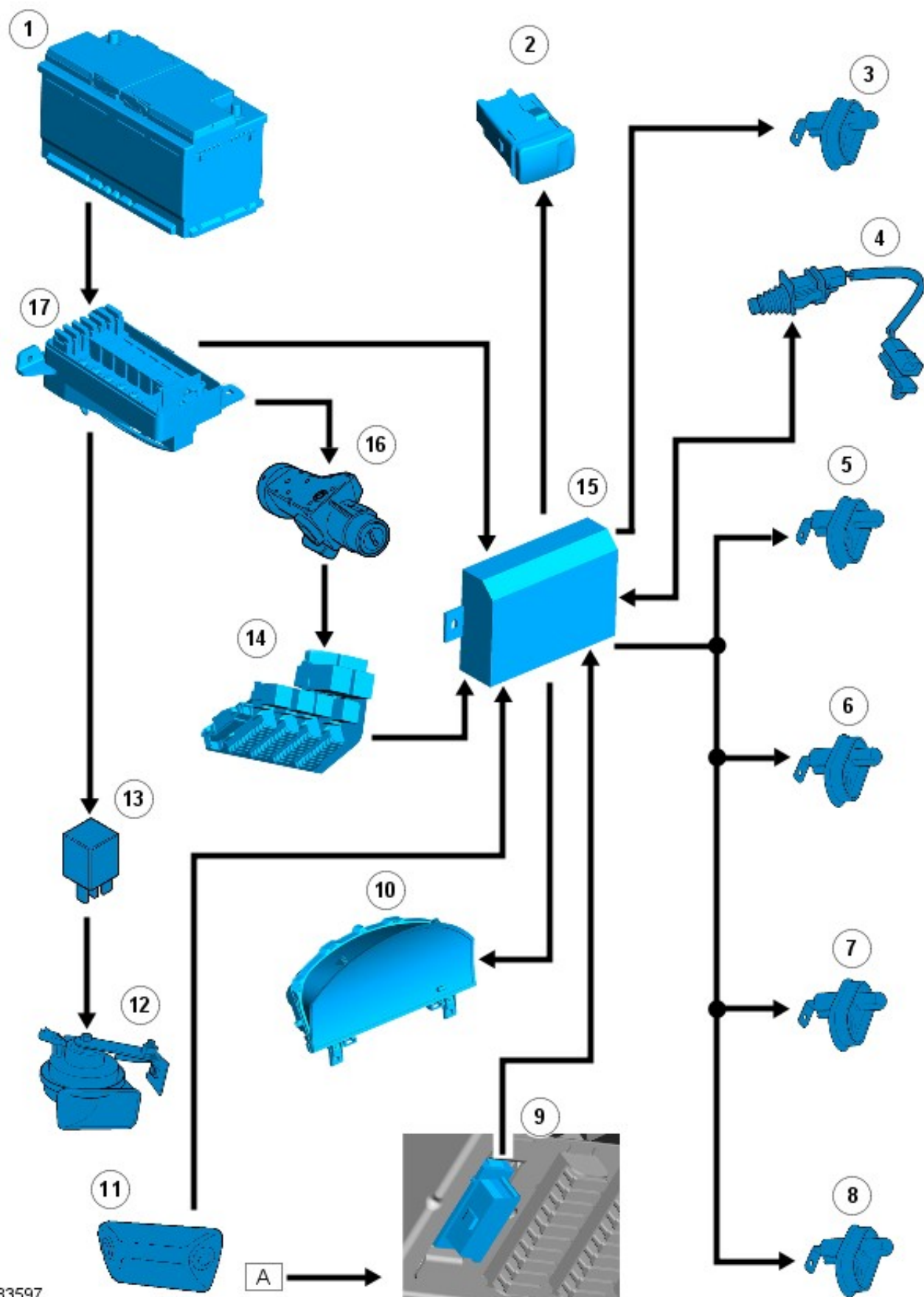
E83595

Item	Part Number	Description
1	-	Battery
2	-	Hazard flasher switch
3	-	Driver's door switch
4	-	Hood switch
5	-	Front passenger door switch
6	-	RH rear door switch (if fitted)

7	-	LH rear door switch (if fitted)
8	-	Tail door switch
9	-	Diagnostic socket
10	-	Instrument cluster
11	-	Intrusion detection module
12	-	Battery backed sounder
13	-	central junction box (CJB)
14	-	Anti-theft system module
15	-	Ignition switch
16	-	BJB

CONTROL DIAGRAM - ANTI-THEFT ALARM HORN

NOTE: **A** = Hardwired



E83597

Item	Part Number	Description
1	-	Battery
2	-	Hazard flasher switch
3	-	Driver's door switch
4	-	Hood switch
5	-	Front passenger door switch
6	-	RH rear door switch (if fitted)

7	-	LH rear door switch (if fitted)
8	-	Tail door switch
9	-	Diagnostic socket
10	-	Instrument cluster
11	-	Intrusion detection module
12	-	Anti-theft alarm horn
13	-	Anti-theft alarm horn relay
14	-	CJB
15	-	Anti-theft system module
16	-	Ignition switch
17	-	BJB

PRINCIPLES OF OPERATION

On receipt of a valid code from the remote RF handset, the anti-theft system module will arm both the perimetric and volumetric anti-theft systems. The anti-theft system module will also arm the passive immobilization system. For additional information, refer to: Anti-Theft - Passive (419-01B, Description and Operation). Once armed, the anti-theft system can be triggered up to 3 times in any one arming cycle.

Perimetric Protection

Perimetric protection is the monitoring of each hinged panel, namely the doors, tail door and hood, for unauthorized entry. The anti-theft system module monitors the condition of each hinged panel through a series of hardwired connections.

The driver's door switch and the hood switch are connected to the anti-theft system module on individual wires. The remaining hinged panels are wired in parallel and connected to the anti-theft system module on a single wire.

All the switches are open circuit. If a hinged panel is opened, the switch contacts close and a ground path is generated. The switch ground paths are through the vehicle body, except for the hood switch which is provided a ground path via the anti-theft system module. When the anti-theft system module registers a ground path it determines a hinged panel has been opened and triggers the alarm.

Volumetric Protection

Volumetric protection monitors movement within the cabin. When the system is first armed, the anti-theft module suspends volumetric protection for 15 seconds. This allows air in the cabin to settle and prevents nuisance triggers. The anti-theft system module monitors movement in the vehicle cabin using the intrusion detection module. The anti-theft system module will not initiate volumetric protection unless the intrusion detection module detects no disturbances for 15 seconds. If, during the 15 second arming period movement is detected, the 15 second period will re-start from 0.

Volumetric protection can be disabled in one of two ways:

- By locking the vehicle with the key in the driver's door rather than using the remote RF handset.
- By locking the vehicle with the remote RF handset while the driver's door is open. If the driver's door is subsequently shut, only the perimetric system will be armed.

Visual Indications

NOTE: Visual and audible warnings are dependent on market legislation.

When the anti-theft system is armed the anti-theft system module will flash the hazard flashers 3 times. The hazard flashers are controlled by 2 outputs from the anti-theft system module; one for the LH lamps, one for the RH lamps. To illuminate the hazard flashers, the output from the anti-theft system module is at battery voltage. To extinguish the lamps, the output is driven to ground.

The anti-theft system module will also control operation of the instrument cluster indicator. The module will flash the indicator at a rate of 8 Hz for 10 seconds, followed by a 1 Hz flashing rate.

If the anti-theft system is triggered, the anti-theft system module will flash the hazard flashers for 30 seconds at 0.5 second intervals.

Audible Indications

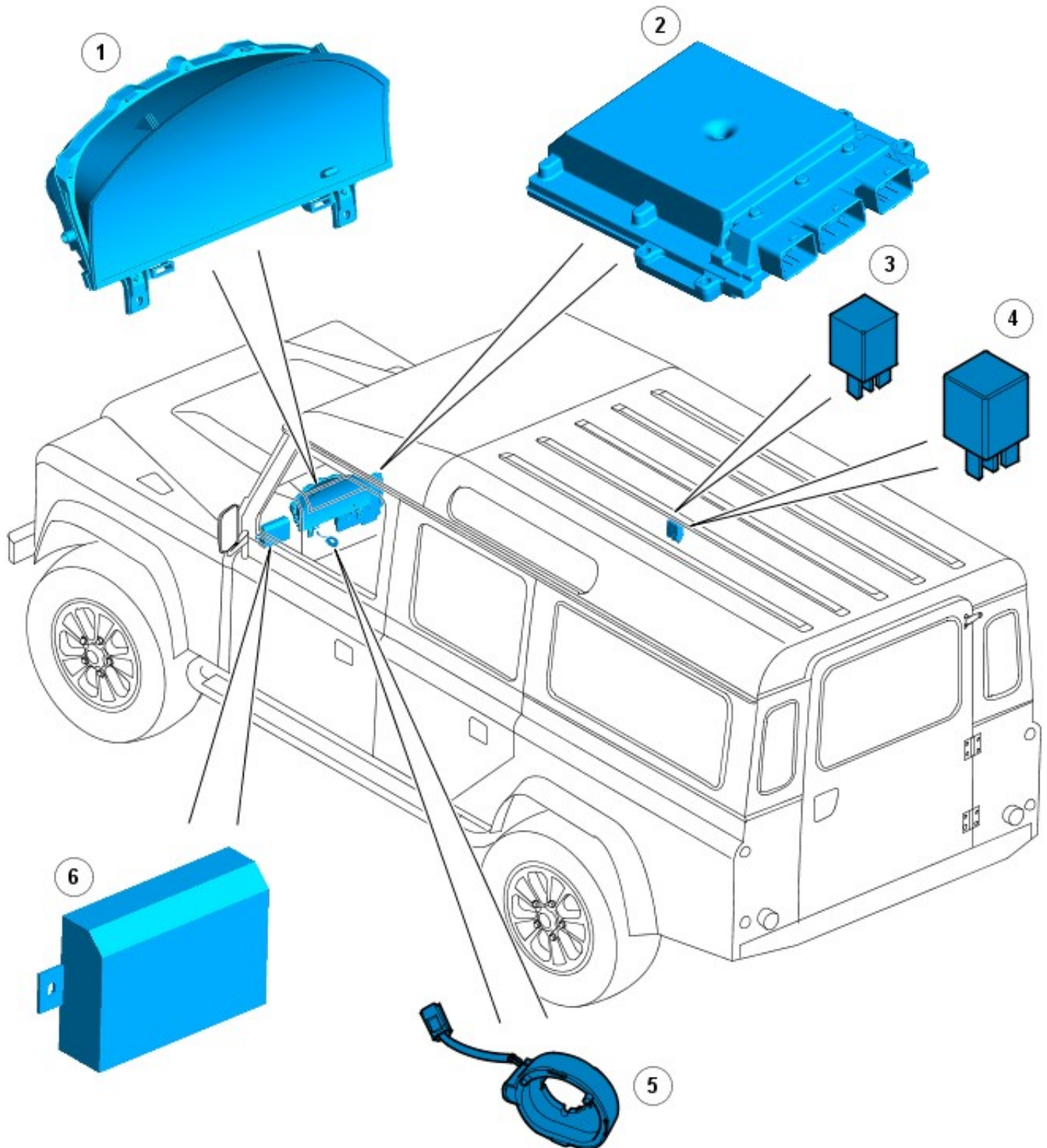
If the anti-theft system is triggered, the anti-theft system module will activate the sounder. Depending on market legislation, the sounder is either an anti-theft alarm horn or a battery backed sounder. Again, depending on market legislation, the sounder may emit either a continuous or pulsed tone.

The anti-theft system module provides a battery voltage feed to, depending on vehicle specification, the battery backed sounder or the anti-theft alarm horn relay. To power the sounder, the anti-theft system module removes the feed and provides a ground path.

Anti-Theft - Passive - Anti-Theft - Passive

Description and Operation

COMPONENT LOCATION



E87499

Item	Part Number	Description
------	-------------	-------------

1	-	Instrument cluster
2	-	engine control module (ECM)
3	-	Starter relay
4	-	Glow plug relay
5	-	Transceiver coil
6	-	Anti-theft system module

OVERVIEW

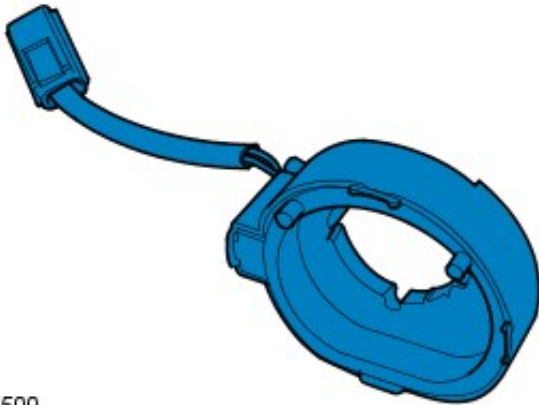
The 10AS anti-theft system works in conjunction with the ECM to control the passive anti-theft system. The passive anti-theft system immobilizes the engine by inhibiting the starter relay and fuel injectors until a valid code is received from the remote Radio Frequency (RF) handset.

The passive anti-theft system features 2 levels of protection:

- Engine immobilization only
 - Engine immobilization plus perimetric and volumetric anti-theft alarm protection.
- For additional information, refer to: [Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation).

The anti-theft system module activates the engine immobilization system 30 seconds after the key is removed from the ignition switch and the driver's door is opened. If the key is removed from the ignition switch and the drivers door is not opened, the anti-theft system module will activate the engine immobilization system after a period of 5 minutes.

TRANSCIEVER COIL



E87500

The transceiver coil comprises a coil mounted around the ignition barrel. When the ignition switch is turned to position II, the anti-theft system module provides a permanent battery voltage feed and a pulsed voltage feed to the transceiver coil. This creates a magnetic field around the ignition barrel, which collapses and restores in relation to the pulsed power feed from the anti-theft system module. The fluctuating magnetic field activates the remote RF handset which transmits a mobilization signal.

ANTI-THEFT SYSTEM MODULE



E83589

The anti-theft system module is located behind the instrument cluster and works in conjunction with the ECM to control the passive anti-theft system. The anti-theft system module receives a permanent battery supply and an ignition switch supply from the central junction box (CJB).

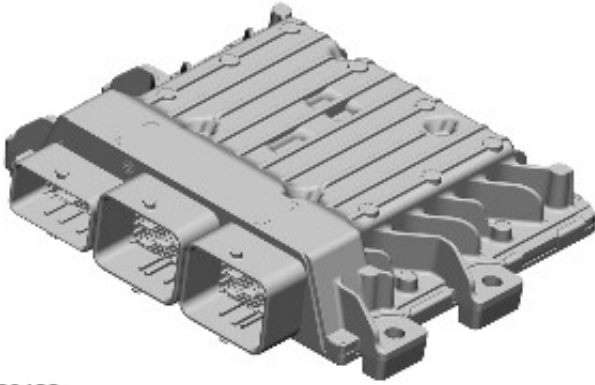
A mobilization code is transmitted to the anti-theft system module by the remote RF handset. The mobilization code is received via the anti-theft system module antenna, which hangs below the module. The anti-theft system module determines if a valid code is received from the remote RF handset by comparing the received code with one stored in its

memory.

The anti-theft system module also controls;

- The active anti-theft system.
For additional information, refer to: [Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation).
- The central locking system.
For additional information, refer to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).
- Interior lighting.
For additional information, refer to: [Interior Lighting](#) (417-02 Interior Lighting, Description and Operation).
- The hazard flashers.
For additional information, refer to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

ENGINE CONTROL MODULE

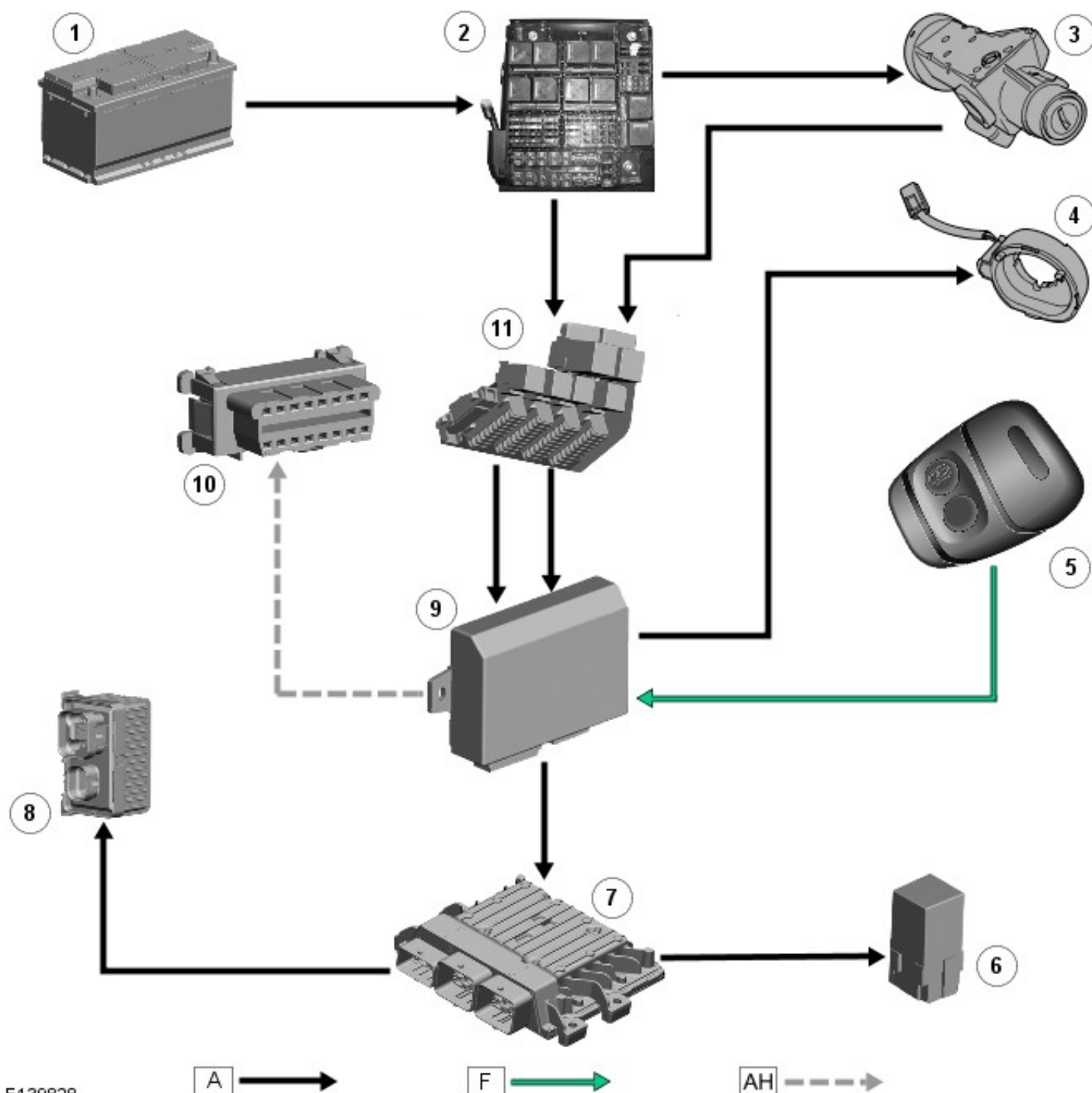


E 139402

The ECM is mounted on the engine compartment bulkhead and works in conjunction with the anti-theft system module to control the passive anti-theft system.

CONTROL DIAGRAM

NOTE: **A** = Hardwired; **F** = RF Transmission; **AH** = Serial communication line.



E139828

Item	Part Number	Description
1	-	Battery
2	-	battery junction box (BJB)
3	-	Ignition switch
4	-	Transceiver coil
5	-	Remote handset
6	-	Starter relay
7	-	ECM
8	-	Glow plug control module
9	-	Anti-theft system module
10	-	Diagnostic socket
11	-	CJB

PRINCIPLES OF OPERATION

The anti-theft system module receives a permanent battery supply from the **CJB (central junction box)**. When the vehicle key is placed in the ignition barrel and turned to position II (ignition on), the anti-theft system module also receives an ignition power supply from the CJB.

When the anti-theft system module receives the ignition switch feed it activates the transceiver coil by supplying a battery voltage feed.

The pulsed feed from the anti-theft system module causes the magnetic field created by the transceiver coil to collapse and restore. The fluctuating magnetic field activates the remote RF handset to transmit a mobilization code to the anti-theft system module.

The anti-theft system module receives the mobilization code via its antenna. This code is compared to a value in its memory. If the codes match, the anti-theft system module provides a mobilization signal to the ECM, which will energize the starter relay and the fuel injectors to allow the engine to be started.

Emergency Key Access

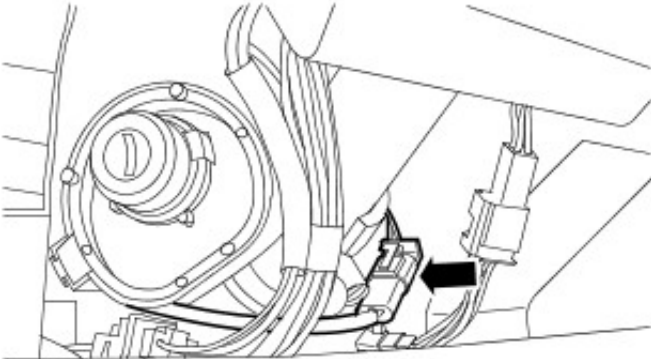
If the vehicle is immobilized and the remote RF handset is not available, the emergency key access procedure will allow the engine to be mobilized using the vehicle key. For information on the emergency key access feature, refer to the Owners Handbook.

Anti-Theft - Passive - Passive Anti-Theft System (PATS) Transceiver

Removal and Installation

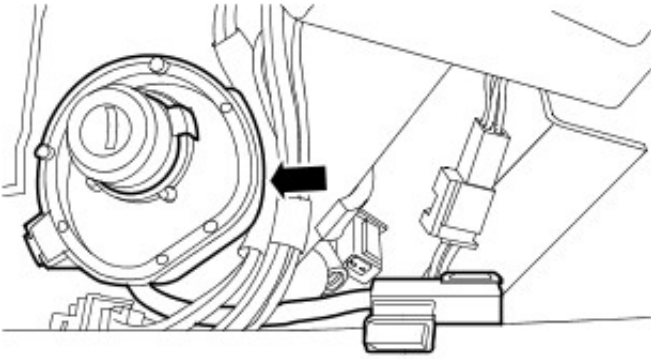
Removal

1. Remove the steering column shrouds.
For additional information, refer to: Steering Column Shrouds (501-05, Removal and Installation).
2. Disconnect the passive anti-theft system (PATS) transceiver electrical connector.



E90130

3. Remove the PATS transceiver.



E90131

Installation

1. To install, reverse the removal procedure.

Anti-Theft - Passive - Passive Anti-Theft System (PATS) Module

Removal and Installation

Removal

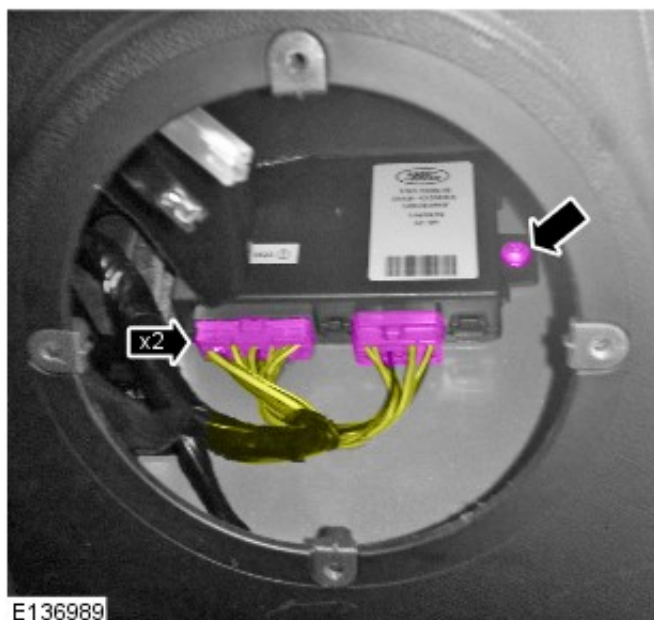
1. Remove the LH front seat cushion.
2. Release the retaining clip and remove battery access cover.
3. Slacken the battery negative lead clamp bolt.
4. Turn the ignition switch on.
5. Turn the ignition switch off and remove key.
6. **NOTE: Operation 6 needs to be carried out within 15 seconds to avoid activating battery backed-up alarm sounder, if fitted.**
Disconnect the battery ground cable.
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01, General Procedures).
7. Remove the steering wheel.
For additional information, refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).
8. Remove the steering column shrouds.
For additional information, refer to: [Steering Column Shrouds](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - Remove drivers side facia rubber mat.
9. Remove the drivers side instrument panel speaker.
For additional information, refer to: [Instrument Panel Speaker](#) (415-03 Speakers, Removal and Installation).
10. **NOTE: RH shown, LH similar.**
Remove the left hand module screw.



11. **NOTE: RH shown, LH similar.**

Remove the passive anti-theft system module.

- Remove the right hand module screw.
- Disconnect both the multi-plugs.



Installation

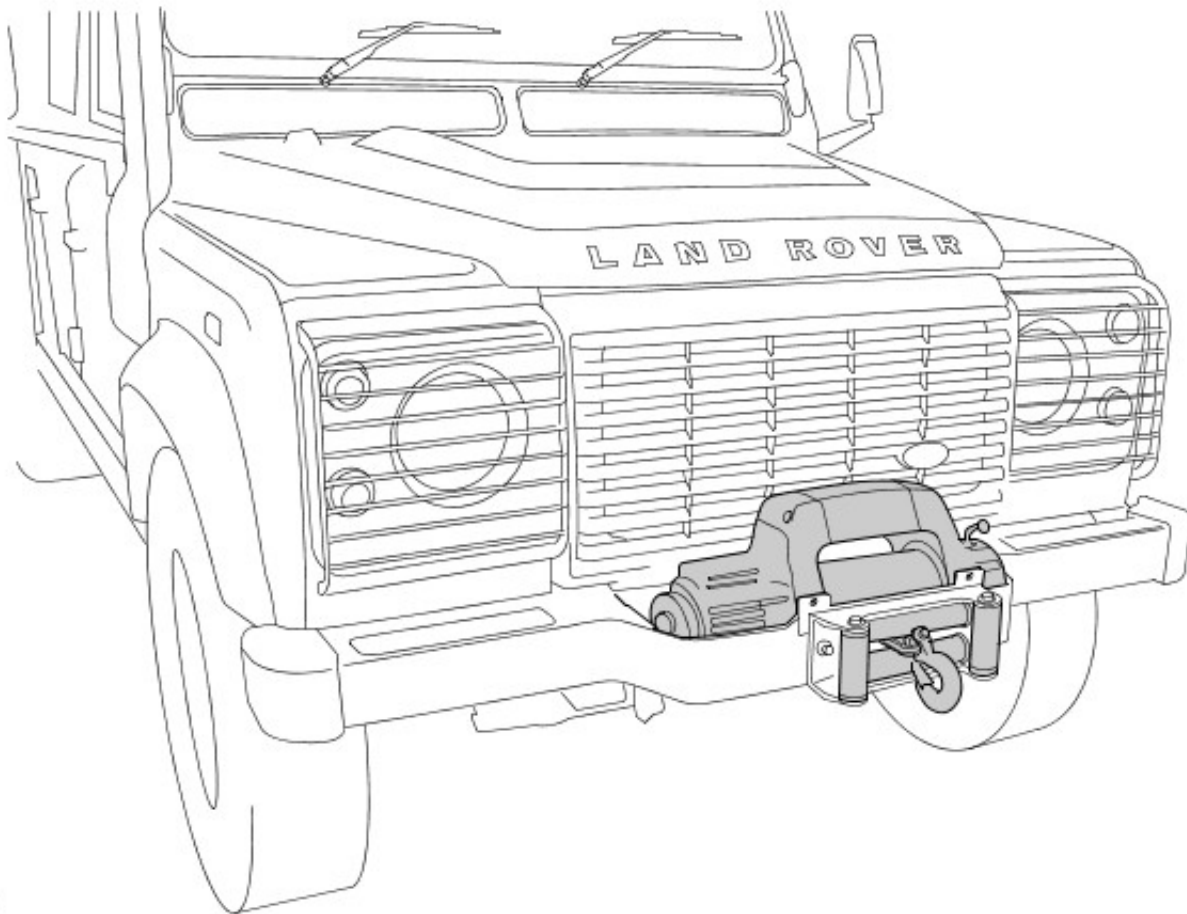
1. To install, reverse the removal procedure.

Content not found

Winch - Winch - Component Location

Description and Operation

COMPONENT LOCATION



E136854

Winch - Winch - Overview

Description and Operation

OVERVIEW

The 9.5Ti winch is manufactured by WARN in the U.S.A. The winch features a Gen II Series Wound winch motor.

The winch has 3-stage planetary gearing and full-face contact drum seals, motor and end housing gaskets for extreme duty water resistance. The winch remote control has a thermometric indicator which gives the operator information about motor temperature during the winching operation.

9.5Ti Winch

SPECIFICATIONS:

- WARN Part number: 66260 (12V)
- Rated Line Pull: 9,500 lbs. (4310 kgs) single-line
- Intended Use/Application: Vehicle Recovery
- Motor: Gen II Series Wound
- Remote Control: Remote switch, 12 ft (3.7m) lead
- Geartrain: 3-Stage Planetary Gear Ratio: 156:1
- Lubrication: 76 Moly low temperature grease
- Clutch (freespooling): Sliding Ring Gear
- Brake: Automatic Direct Drive Cone
- Wire Rope: 125', 5/16" diameter (38m, 8mm dia.)
- Fairlead: Roller
- Recommended Battery: 650 CCA minimum for winching
- Battery Leads: 2 gauge, 100" (2.54m)
- Finish: High-gloss dark gray powder coat
- Drum Diameter/Length: 2.5"/9.0" (6.4cm/23cm)
- Weight: 89 lbs. (36.3 kgs.).

12V DC PERFORMANCE SPECIFICATIONS:

Line Pull Lbs.(Kgs.)	Line Speed FT./min(M/min.)	Motor Current	Pull by layer Layer/Lbs(Kgs.)
0	62 (18.9)	47 Amps	1/9500 (4313)
2000 (910)	16.3 (4.97)	160 Amps	2/8650 (3927)
4000 (1814)	11.8 (3.60)	230 Amps	3/7920 (3595)
6000 (2720)	9.31 (2.84)	305 Amps	4/7400 (3359)
8000 (3630)	7.59 (2.31)	370 Amps	5/6940 (3150)
9500 (4310)	6.67 (2.03)	425 Amps	-

The above performance figures are based on the first layer of the drum.

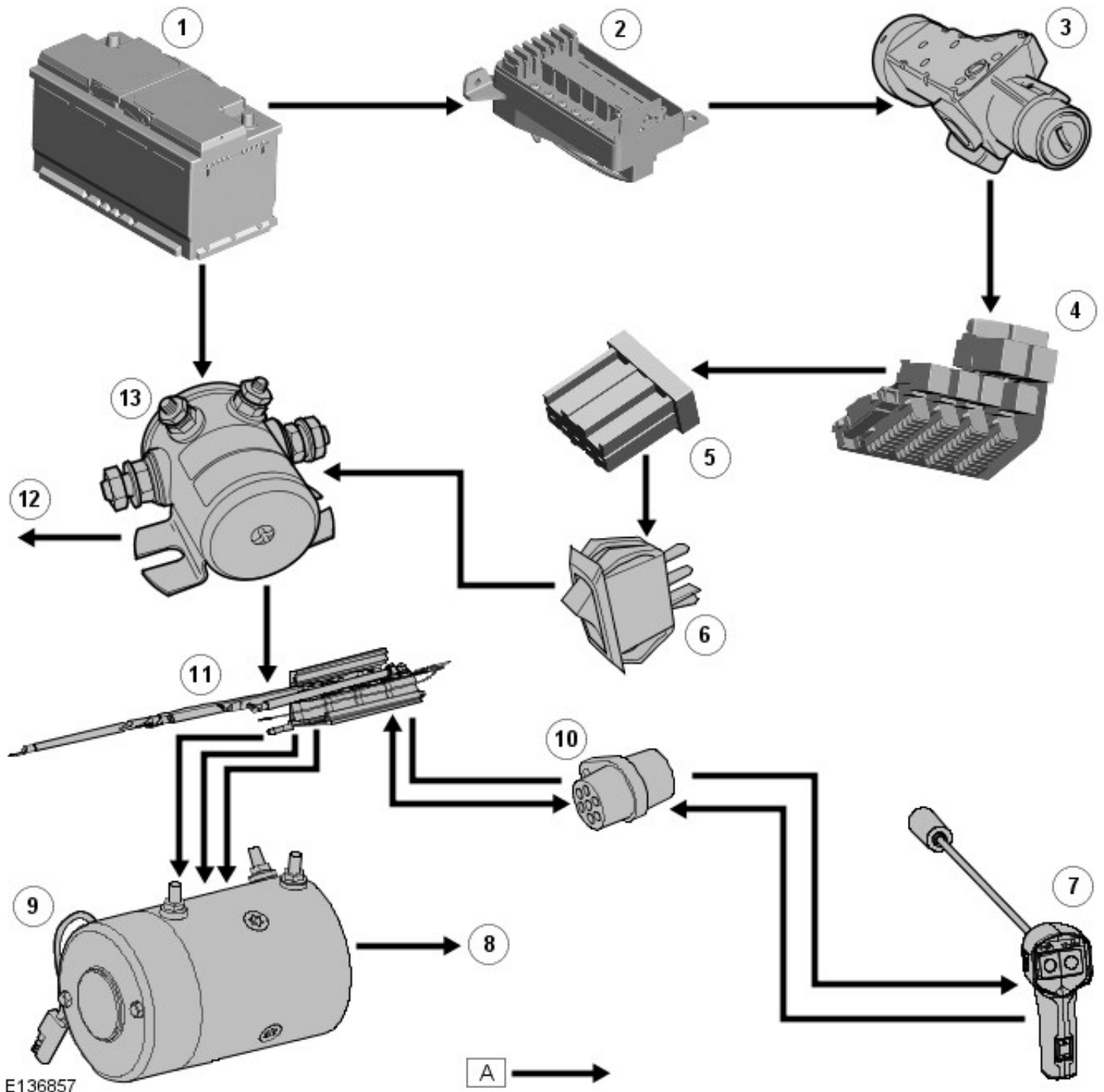
Winch - Winch - System Operation and Component Description

Description and Operation

Control Diagram

NOTE: A = Hardwired

Vehicle connection

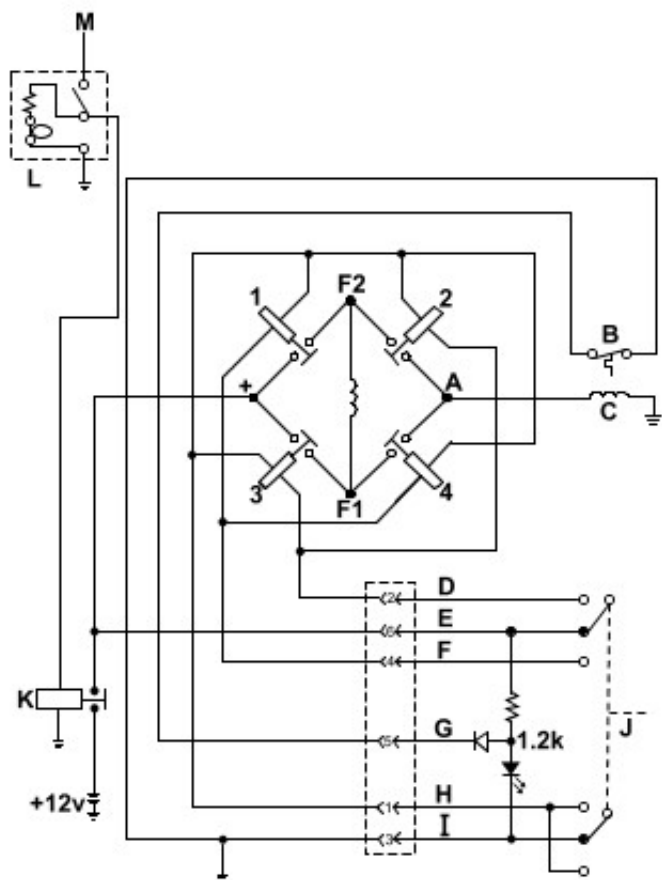


E136857

Item Description

- 1 Battery
- 2 Battery Junction Box (BJB)
- 3 Ignition switch
- 4 Passenger fusebox
- 5 Harness connector C0072-1 - Heated rear window switch (ref only)
- 6 Winch power interrupt solenoid power on/off switch
- 7 Remote control
- 8 Ground

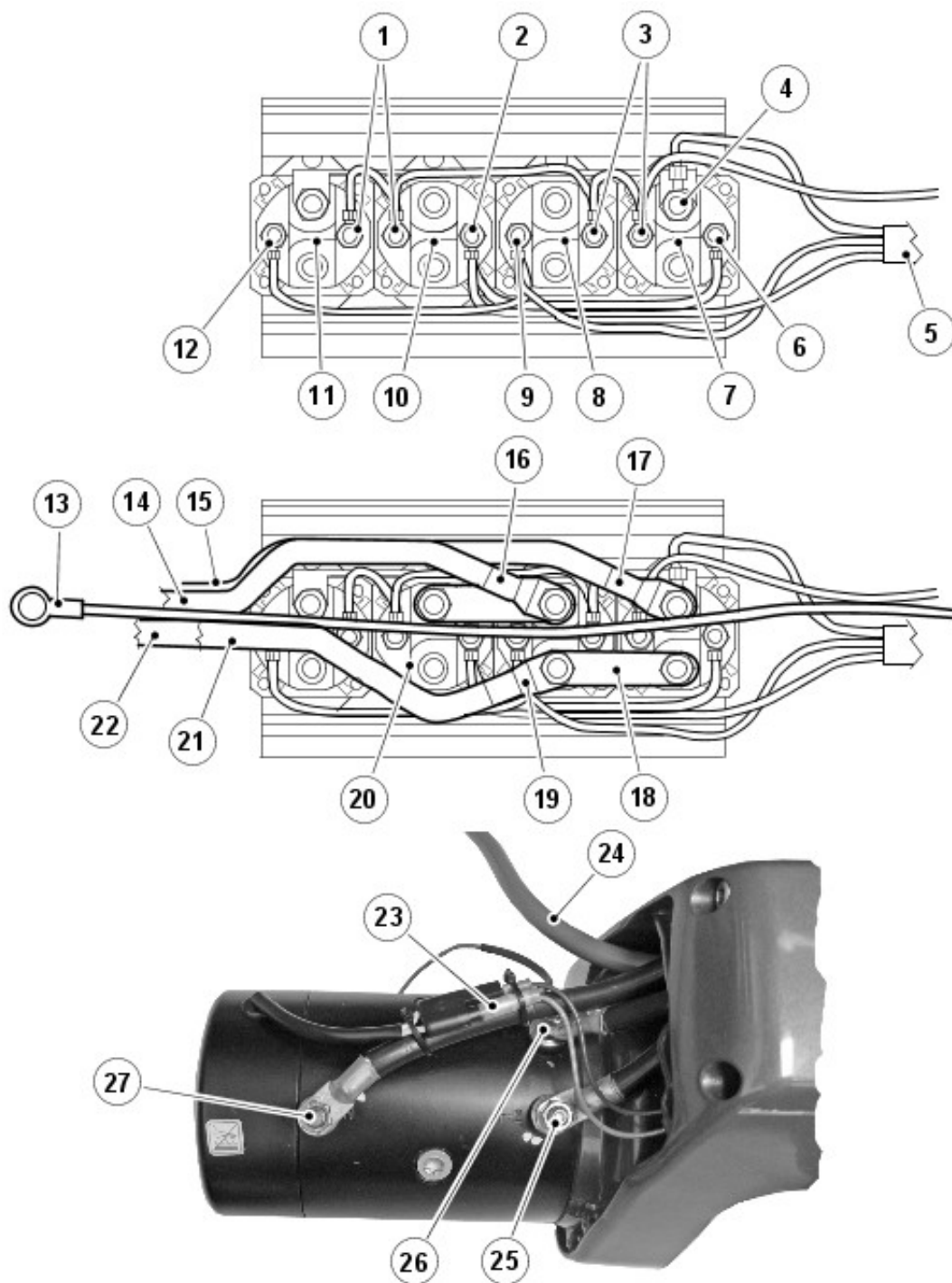
- 9 Winch motor
 - 10 Remote control socket
 - 11 Control box
 - 12 Winch power interrupt solenoid ground
 - 13 Winch power interrupt solenoid
- Winch Schematic Electrical Circuit Diagram



E137093

Item Description

- A Field
 - B Thermal protection device - normally closed
 - C Armature
 - D White wire
 - E Red wire
 - F Green wire
 - G Blue wire
 - H Brown wire
 - I Black wire
 - J Remote control assembly (power in/out)
 - K Winch power interrupt solenoid
 - L Winch power interrupt solenoid power On/Off switch (mounted on instrument panel)
 - M 12V Ignition supply from heated rear window switch
- Winch Motor/Control Box Connections



E137094

Item Description

- 1 Brown wire
- 2 Green wire
- 3 Brown wire from socket
- 4 Red wire from socket
- 5 Remote control harness
- 6 Green wire
- 7 Solenoid No. 1
- 8 Solenoid No. 2
- 9 White wire
- 10 Solenoid No. 3
- 11 Solenoid No. 4
- 12 White wire
- 13 Control ground
- 14 Armature cable A (to winch motor)
- 15 Positive (+) cable (to power interrupt solenoid)
- 16 Armature cable A terminal

- 17 Battery positive (+) cable terminal
- 18 Buss bar (3 per assembly)
- 19 Field cable F2 terminal
- 20 Field cable F1 terminal
- 21 Field cable F2 (to winch motor)
- 22 Field cable F1 (to winch motor)
- 23 Thermal protection device connector
- 24 Positive (+) cable (to power interrupt solenoid)
- 25 Field cable connection F2
- 26 Field cable connection F1
- 27 Armature cable connection A

System Operation

OPERATION



WARNING: Observe all Warnings and Cautions detailed in the WARN Winch Operator's Guide and the WARN Basic Guide to Winching Techniques before and during winch operation.

The winch motor is powered by the vehicle battery. The motor provides rotational power to the gear mechanism, which in turn rotates the winch drum and winds the cable.

A remote control assembly is used to operate the winch. The remote lead plugs into a remote control socket which is connected to the control box and allows the operator to control the winch winding direction while standing at a safe distance from the wire rope.

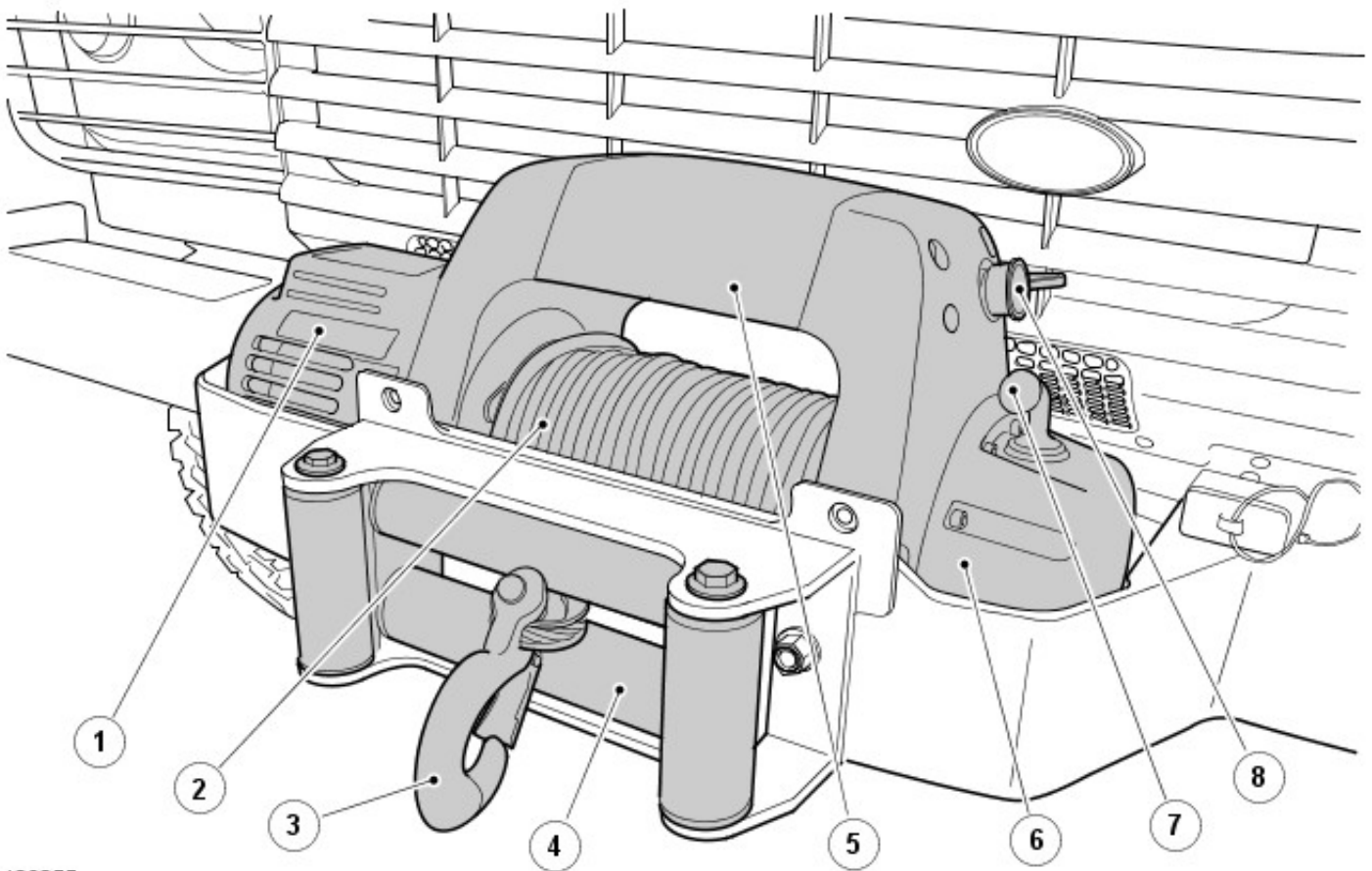
The remote control includes an **LED (light emitting diode)** indicator which illuminates when the motor has reached a maximum acceptable temperature. The motor is not disabled and the operator must allow the winch to cool and proceed with winch operation only when the indicator is extinguished.

A clutch allows rope to be pulled off the drum without motor operation. Refer to the WARN Basic Guide to Winching Techniques.

Component Description

DESCRIPTION

Winch



E 136855

Item Description

- 1 Motor
- 2 Winch drum and wire rope
- 3 Latching hook
- 4 Fairlead
- 5 Control box (hidden)
- 6 Gear train housing
- 7 Clutch lever
- 8 Remote control socket

The winch is mounted on the front bumper, required for winch fitment. The winch is secured to the bracket with four bolts, washers and nuts.

The winch control box is integrated in the winch housing, above the winch drum.

The winch control box manages the power supplies to the winch motor and also receives the input from the remote control for winch operation. A remote control socket is located at the **LH (left-hand)** end of the winch housing and allows for the connection of the remote control.

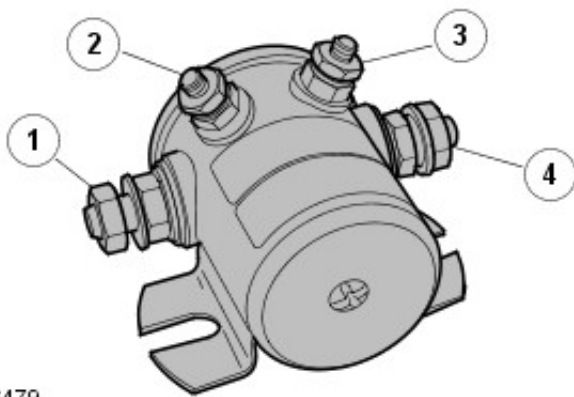
The winch will operate with the ignition on, the winch power interrupt solenoid power on/off switch in the 'on' position and the engine not running, but this is not recommended due to excessive battery drain. Therefore it is recommended that the engine is running at all times when the winch is in operation.

Winch/Vehicle Electrical Connections

A blue wire is spliced into harness connector C0072-1, which is the connector for the heated rear window switch. The blue wire is connected to the winch power interrupt solenoid power on/off switch which is located outboard of the center of the instrument panel. From the switch, a white wire is routed from the instrument panel into the battery box where it connects with the winch power interrupt solenoid. This connection provides the ignition on power supply to the winch power interrupt solenoid to energize the solenoid relay when the ignition is on and the winch power interrupt solenoid on/off switch is in the 'on' position.

A red cable is attached from the battery positive (+) terminal to the positive terminal on the solenoid. This connection is the main power supply to the winch power interrupt solenoid for the winch motor and control box. The winch power interrupt solenoid is located in the battery box, below the **LH** front seat. A large red wire from the winch power interrupt solenoid is routed to the winch control box. Power is not supplied to the winch control box until the winch power interrupt solenoid power on/off switch on the instrument panel is switched to the on position, which is confirmed by the switch illuminating.

Winch Power Interrupt Solenoid

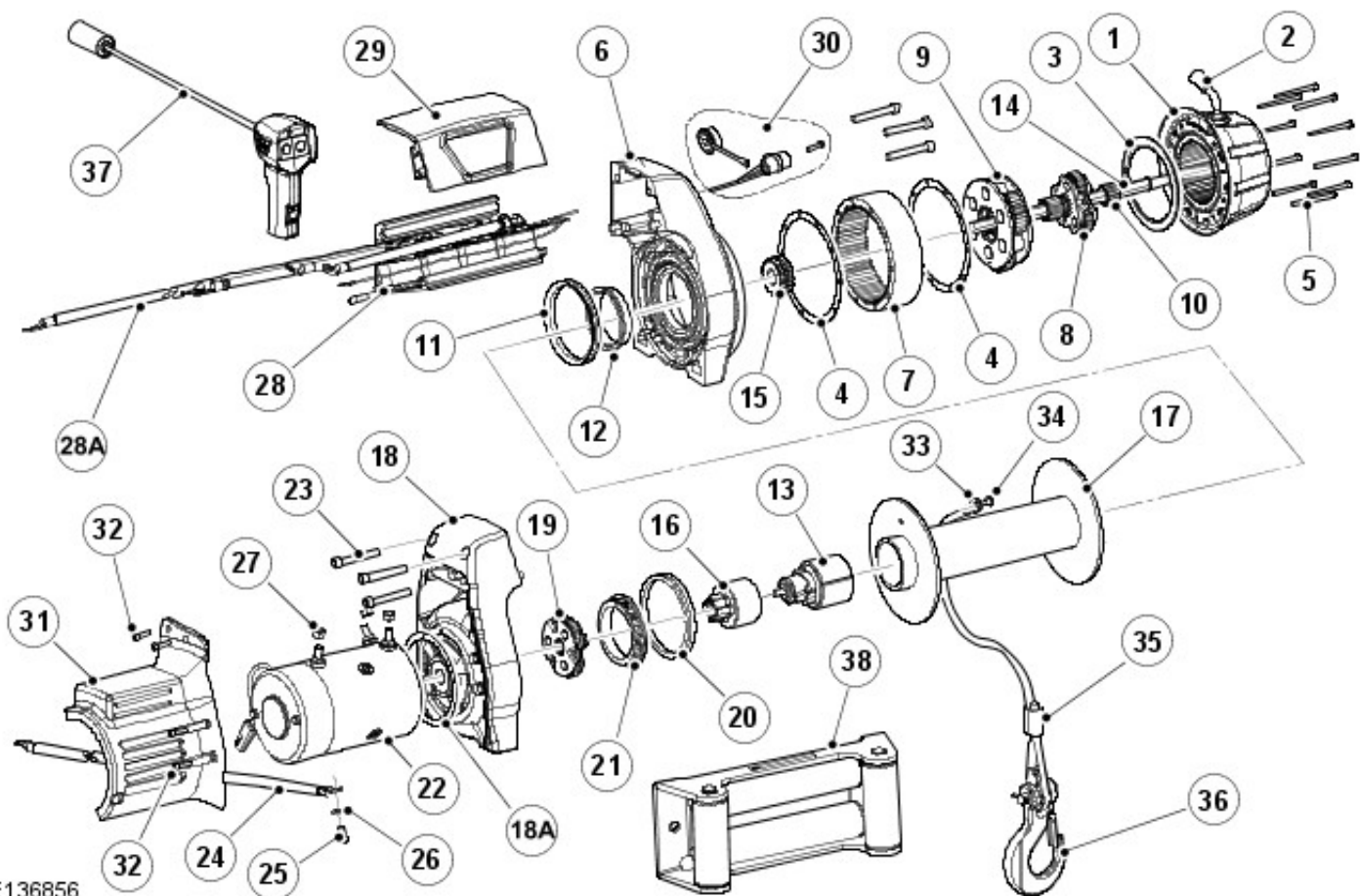


E136479

Item Description

- 1 Power to winch motor
- 2 Ground
- 3 Solenoid power supply (ignition on)
- 4 Power supply from vehicle battery positive (+)

Winch Exploded View



E136856

Item Description

- 1 End housing assembly
- 2 Clutch lever
- 3 Nylon thrust washer
- 4 Housing gasket
- 5 Socket head capscrew (10 off)
- 6 Gear support drum
- 7 Ring gear
- 8 Planet carrier assembly (stage 2)
- 9 Planet carrier assembly (stage 3)
- 10 Sun gear

- 11 V-ring seal
- 12 Drum bushing
- 13 Brake assembly
- 14 Drive shaft
- 15 Drive spline
- 16 Motor coupler
- 17 Drum assembly
- 18 Motor support drum
- 18A Motor gasket
- 19 Planet carrier assembly (stage 1)
- 20 V-ring seal
- 21 Drum bushing
- 22 Motor
- 23 Socket head capscrew (6 off)
- 24 Electrical cable (black)
- 25 Hexagon head capscrew
- 26 Washer
- 27 Nut
- 28 Control pack assembly 9.5Ti
- 28A Electrical cable (red)
- 29 Control pack assembly cover
- 30 Remote control socket assembly
- 31 Motor cover
- 32 Socket head capscrew (4 off)
- 33 Terminal kit
- 34 Button head capscrew
- 35 Wire rope assembly
- 36 Latching hook
- 37 Remote control assembly
- 38 Fairlead roller
- 39 Seal kit

NOTE: The WARN part numbers for the above components are listed on the WARN web site: www.warn.com

Winch - Winch

Diagnosis and Testing

Principle of Operation

For a detailed description of the winch system and operation, refer to the relevant Description and Operation section in the workshop manual. REFER to: (419-12 Winch)

[Winch](#) (Description and Operation),

[Winch](#) (Description and Operation),

[Winch](#) (Description and Operation).

Inspection and Verification



WARNING: Observe all Warnings and Cautions detailed in the WARN Winch Operator's Guide before and during winch operation.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

1. Verify the customer concern.
2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Incorrect installation • Winch motor • Gearbox • Wire rope 	<ul style="list-style-type: none"> • Fuses • Battery (650 CCA minimum) • Loose, corroded or damaged electrical connections • Winch power interrupt solenoid • Control box • Remote control

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

Symptom Chart

Symptom	Possible causes	Action
No winch operation	<ul style="list-style-type: none"> • Battery/power or ground supply fault • Remote control internal failure • Control box internal failure • Winch motor internal failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams, check the winch power interrupt solenoid supply fused link ((Fuse 14 to vin 798535)(Fuse 15 from vin 798536)) passenger compartment fuse box • For midtronics battery test GO to Pinpoint Test A. • For remote control circuit checks GO to Pinpoint Test C. • For winch circuit checks GO to Pinpoint Test B.
No winch operation (Clicking sound when remote control switch is activated)	<ul style="list-style-type: none"> • Battery/power or ground supply fault • Control box internal failure 	<ul style="list-style-type: none"> • For midtronics battery test GO to Pinpoint Test A. • For winch circuit checks GO to Pinpoint Test B.
Winch lacks power, pulls slowly, stalls	<ul style="list-style-type: none"> • Battery/power or ground supply fault • Winch motor internal failure • Gearbox internal failure 	<ul style="list-style-type: none"> • For midtronics battery test GO to Pinpoint Test A. • For winch circuit checks GO to Pinpoint Test B.
When the remote control is activated, winch operates in only one direction	<ul style="list-style-type: none"> • Battery/power or ground supply fault • Remote control internal failure • Control box internal failure 	<ul style="list-style-type: none"> • For remote control circuit checks GO to Pinpoint Test C. • For winch circuit checks GO to Pinpoint Test B.
Difficulty in spooling rope from drum by hand	<ul style="list-style-type: none"> • Wire rope incorrectly wound on drum (Rubbing/binding) • Distorted drum flange • Worn drum bushings 	<ul style="list-style-type: none"> • Confirm the rope is spooled correctly onto the drum • Install a new winch as required. REFER to: Winch (419-12 Winch, Removal and Installation). • Refer to the warranty policy and procedures manual, or determine if any prior approval

		programme is in operation, prior to the installation of a new module/component
	<ul style="list-style-type: none"> Damaged free spool clutch (inside gear train) Corroded clutch ring gear 	<ul style="list-style-type: none"> Install a new winch gearbox as required. REFER to: Winch Gear Assembly (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
Winch does not hold load	<ul style="list-style-type: none"> Rope is spooled onto the drum in the wrong direction Winch drum brake is worn or broken 	<ul style="list-style-type: none"> Confirm the rope is spooled correctly onto the drum Confirm the clutch is fully engaged Install a new winch as required. REFER to: Winch (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
Remote control fault	<ul style="list-style-type: none"> Winch remote connector terminals damaged Remote switch internal failure 	<ul style="list-style-type: none"> For remote control circuit checks GO to Pinpoint Test C.
Remote control thermal indicator (LED) illuminated	<p>NOTE: If the temperature at the motor brushes reaches 205+ C (400+ F) the thermal switch will open, the LED in the remote will illuminate</p> <ul style="list-style-type: none"> Thermal trip fault 	<ul style="list-style-type: none"> Allow the winch motor to cool, check for correct operation Install a new winch motor as required. REFER to: Winch Motor (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
Clutch lever fault	<ul style="list-style-type: none"> Cable under load Clutch or gearbox mechanism internal failure 	<ul style="list-style-type: none"> Rotate clutch lever on winch. If clutch lever will not rotate, remove tension from the rope and hook by powering out for about 1 second Attempt to rotate the clutch lever with tension removed. If clutch lever still does not rotate, Install a new winch gearbox as required. REFER to: Winch Gear Assembly (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

PINPOINT TEST A : BATTERY TEST

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: MIDTRONICS BATTERY TEST	
	1 Confirm that the vehicle battery charged, in good condition, and the correct specification (650 CCA minimum)
	2 Using a Midtronics hand held tester or the Midtronics GR-1 diagnostic charger, carry out the "Midtronics battery test" as detailed in the battery care manual. Refer to (Service/Maintenance information/Battery care manual)
	3 Record battery diagnostic result on the provided form
	Does the battery pass the "Midtronics battery test"? Yes Check for correct operation, refer to the symptom chart above if customer concern is still evident No Install a new battery as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation

PINPOINT TEST B : CIRCUIT CHECKS

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: WINCH POWER INTERRUPT SOLENOID - CONNECTIONS	
NOTE: The winch power interrupt solenoid supplies power to the winch control box	

NOTE: The ignition feed is supplied to the switch to energize the winch power interrupt solenoid

	1 Refer to the landrover electrical circuit diagrams, check the winch power interrupt solenoid supply fused link (Fuse 14 to vin 798535)(Fuse 15 from vin 798536) passenger compartment fuse box
	2 Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
	3 Confirm the circuit connections to the winch power interrupt solenoid (Terminal 1 - power to winch control box, Terminal 2 - solenoid ground, Terminal 3 - solenoid power (From C0072-1 via switch), Terminal 4 - battery supply) are correctly located, clean and secure
	Are all the connections to the winch power interrupt solenoid, clean and secure? Yes GO to B2. No Clean and secure the electrical connections. Check for correct winch operation

B2: WINCH POWER INTERRUPT SOLENOID - OPERATION

	1 With the ignition state on, and the remote control connected
	2 Using a multimeter, check for battery voltage between terminal 1 (power to winch control box) and terminal 2 (winch power interrupt solenoid ground)
	Is battery voltage present? (approx. 12 volts) Yes GO to B3. No Replace the winch power interrupt solenoid as required. REFER to: Winch Solenoid (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation

B3: POWER SUPPLY - CONTROL BOX

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

NOTE: The winch power interrupt solenoid supplies power to the winch control box

	1 With the ignition state on, and the remote control connected
	2 Using a multimeter, check for battery voltage between the red power feed to the control box and vehicle ground
	Is battery voltage present? (approx. 12 volts) Yes GO to B4. No Carry out circuit checks to investigate the loss of supply. Rectify as required. Check for correct winch operation

B4: CONTROL BOX INPUT - REMOTE CONTROL

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

NOTE: The winch control box controls the winch motor direction

NOTE: Power out - The remote control supplies power to remote connector **terminal 2** and grounds **terminal 1**

NOTE: Power in - The remote control supplies power to remote connector **terminal 4** and grounds **terminal 1**

	1 Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
	2 Using a multimeter, monitor terminal 2 (White), terminal 4 (Green) and terminal 1 (Brown)
	Do the terminals 2 (Power out) and 4 (Power in) (Power) and terminal 1 (Ground) respond correctly when the remote control is used? Yes GO to B5. No Carry out circuit checks to investigate the loss of supply. Rectify as required. Check for correct winch operation

B5: CONTROL BOX - OUTPUT

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

NOTE: When activated the winch control box supplies power to the winch motor

NOTE: Power out - The control box supplies power to the winch motor terminal **F1** and connects winch motor terminal **F2** to terminal **A**(Armature)

NOTE: Power in - The control box supplies power to the winch motor terminal **F2** and connects winch motor terminal **F1** to terminal **A**(Armature)

	1 Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
	2 Using a multimeter, monitor terminals F1, F2
	Do the terminals F1, and F2 respond correctly when the remote control is used? Yes GO to B6. No Check the connections to the control box. If all the connections are clean and secure, install a new

control box as required.

REFER to: [Winch Control Unit](#) (419-12 Winch, Removal and Installation).

. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation

B6: WINCH MOTOR CONNECTIONS



WARNING: Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

1 Refer to the winch circuit diagrams

REFER to: [Winch](#) (419-12 Winch, Description and Operation).

2 Check the connections to the winch motor

Are all the connections clean and secure?

Yes

[GO to B7.](#)

No

Clean and secure the electrical connections. Check for correct winch operation

B7: WINCH MOTOR TEST



WARNING: Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

1 Disconnect the positive lead from the battery (leave the ground lead attached)

2 Label and disconnect the three cables that run from the control pack to the three posts on the winch motor

3 Stamped next to the three posts on the winch motor will be **A**, **F1** and **F2**. Connect a test cable (Jump leads work well) from **A** to **F1** and supply power from the battery to **F2**. The winch motor should operate

4 Connect a test cable from **A** to **F2** and supply power from the battery to **F1**. The winch motor should operate in the opposite direction

Does the motor operate in both directions?

Yes

Check for correct operation, refer to the symptom chart above if customer concern is still evident

No

Check the connections to the winch motor. If all the connections are clean and secure, install a new winch motor as required.

REFER to: [Winch Motor](#) (419-12 Winch, Removal and Installation).

Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation

PINPOINT TEST C : REMOTE CONTROL

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: REMOTE CONTROL - CONTINUITY TEST	
NOTE: Visually inspect the winch remote connector terminals for damage, repair or replace as required	
NOTE: The winch remote should be tested for continuity using a multimeter	
1	With the winch remote disconnected check for continuity, using the instructions below
2	Move the switch to the power out position - Check for continuity between terminals (1) and (3) , Check for continuity between terminals (2) and (6)
3	Move the switch to the power in position - Check for continuity between terminals (1) and (3) , Check for continuity between terminals (4) and (6)
	Did the winch remote pass the continuity test (Resistance less than 1 ohm)?
Yes	Check for correct operation, refer to the symptom chart above if customer concern is still evident
No	Install a new winch remote as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation

Winch - Licence Plate Panel

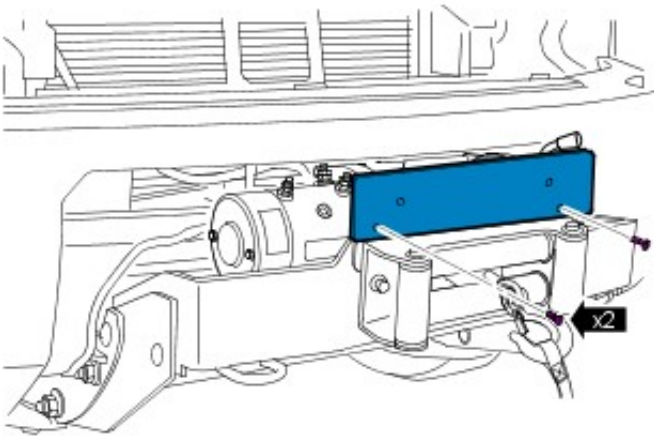
Removal and Installation

Removal

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

1. If installed: Remove the license plate.

2.



E137298

Installation

1. To install, reverse the removal procedure.

Winch - Winch

Removal and Installation

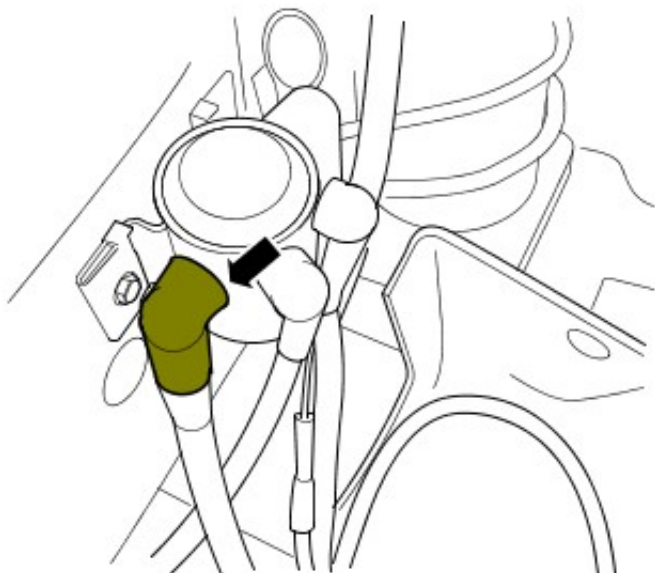
Removal



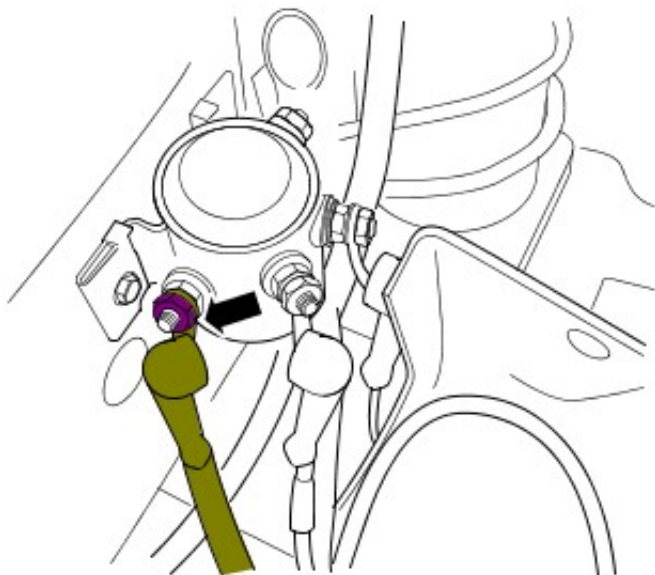
CAUTION: Note the cable routes and position of the wiring harness clips to aid installation.

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

2.



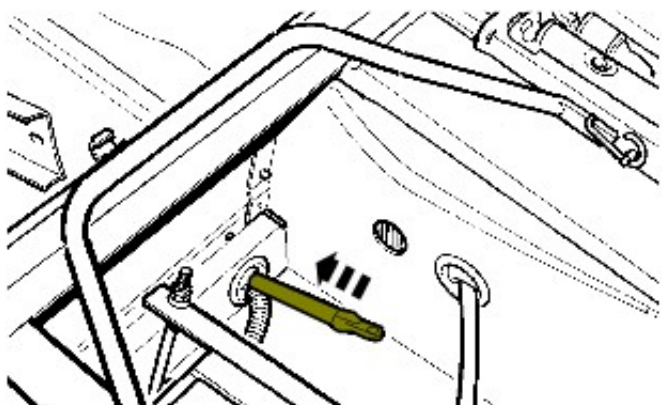
E139161



E139162


3.  **CAUTION:** To prevent damage to components, use an additional wrench when loosening or tightening terminals.

4.

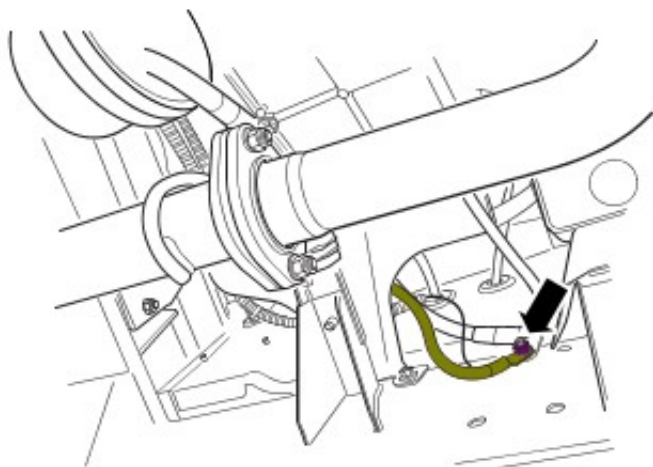


E138522

5. Refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

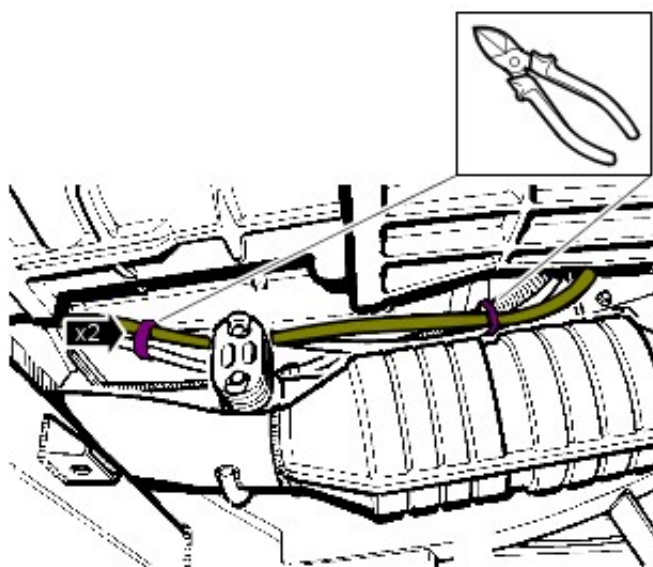
6.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

7.



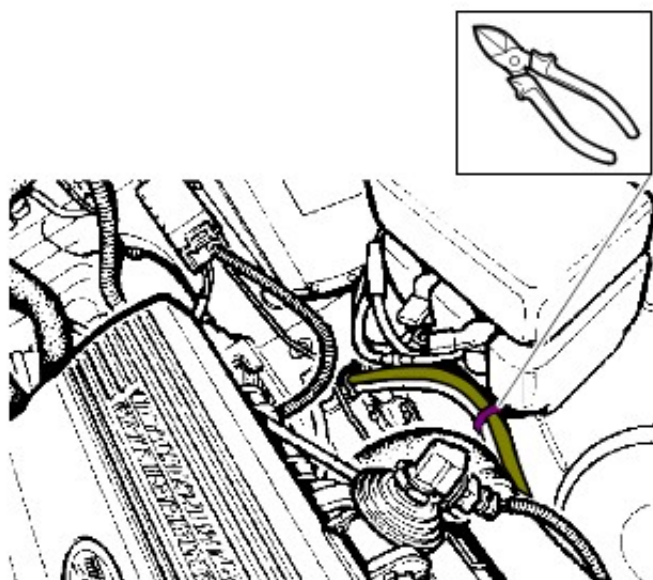
E138519

8.



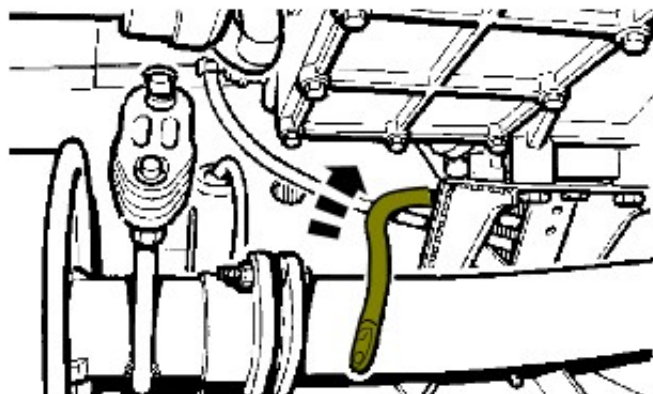
E138517

9.



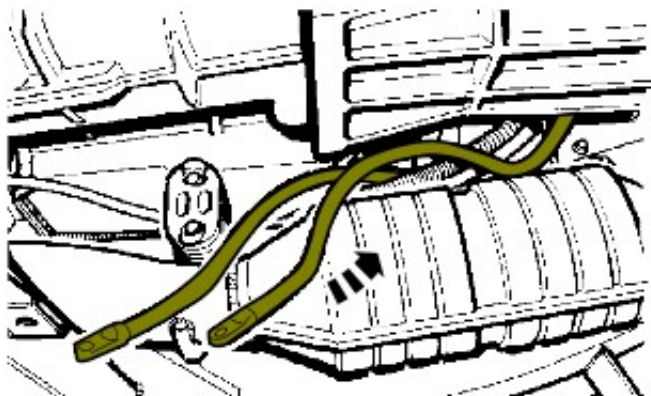
E138518

10.



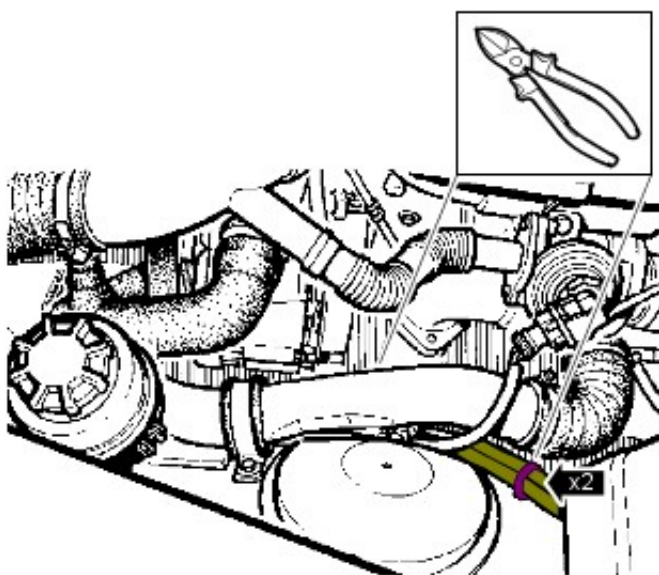
E138520

11.



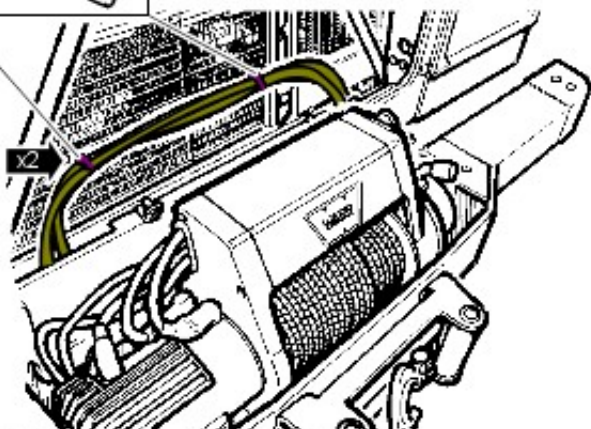
E138524

12.



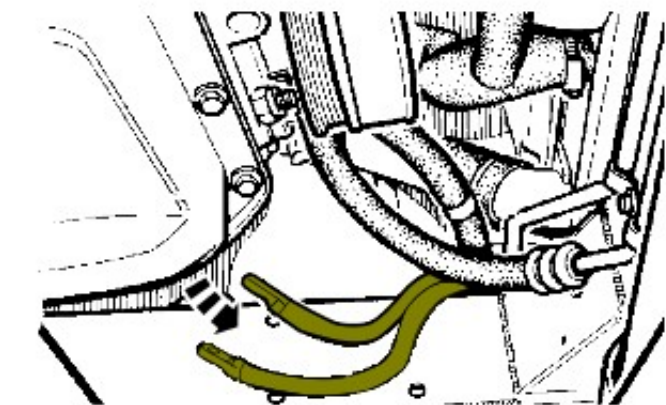
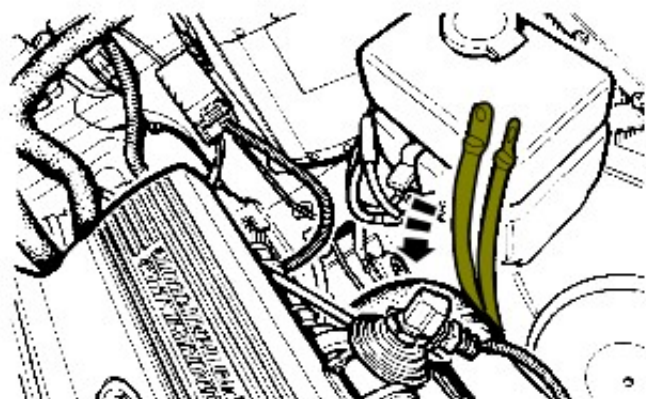
E138525

13.



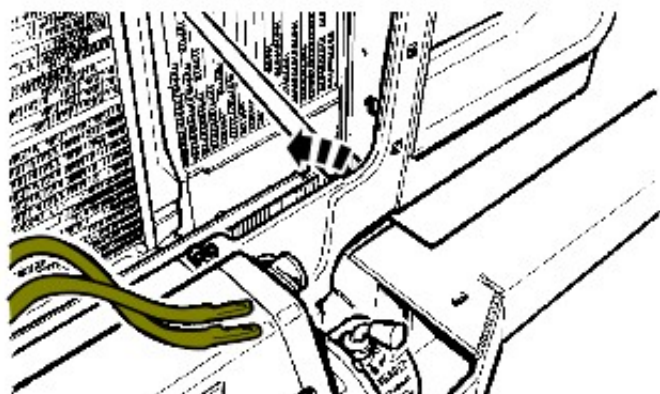
E138526

14.



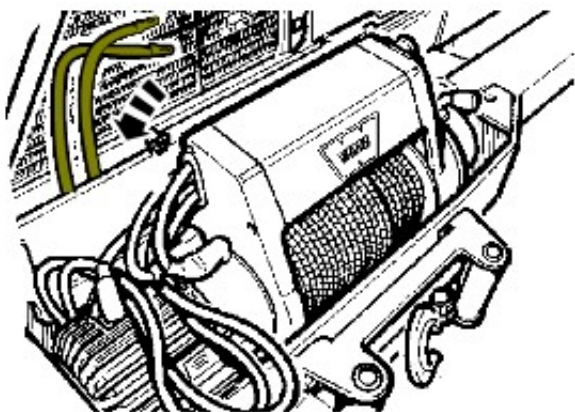
E138527

15.



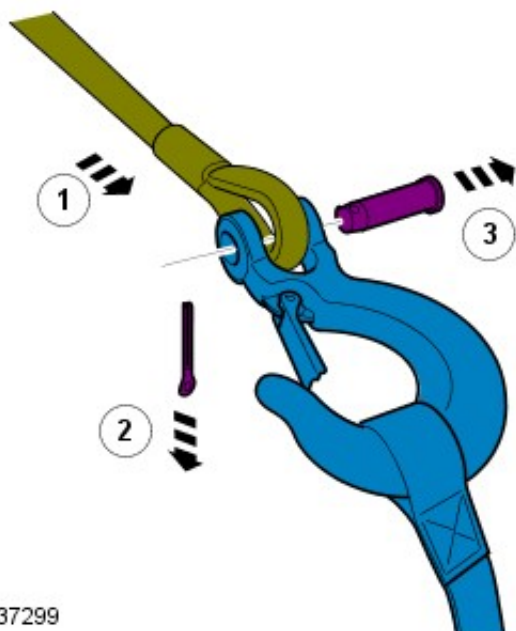
E138528

16.



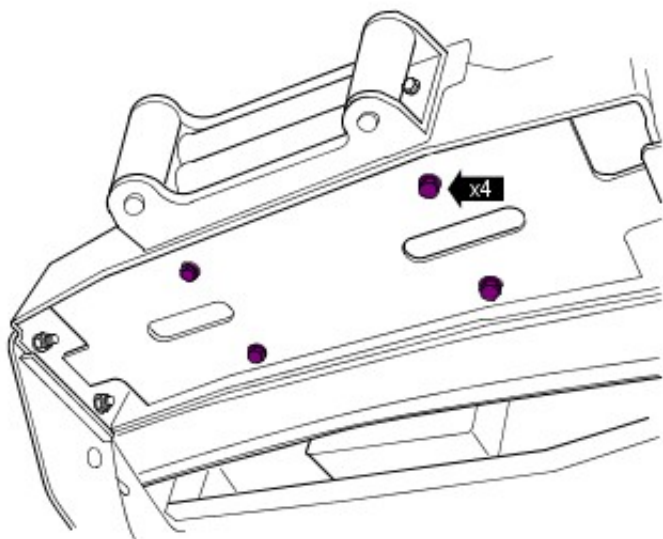
E138529

17.



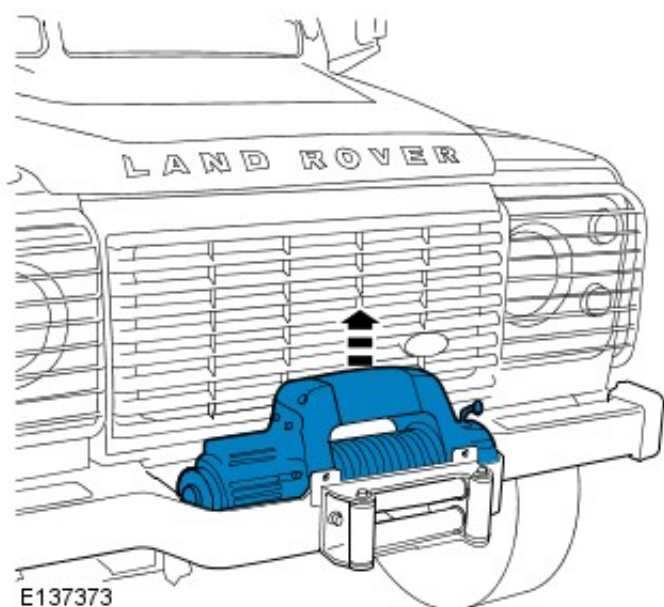
E137299

18.



E137302

19.  **WARNING:** This step requires the aid of another technician.



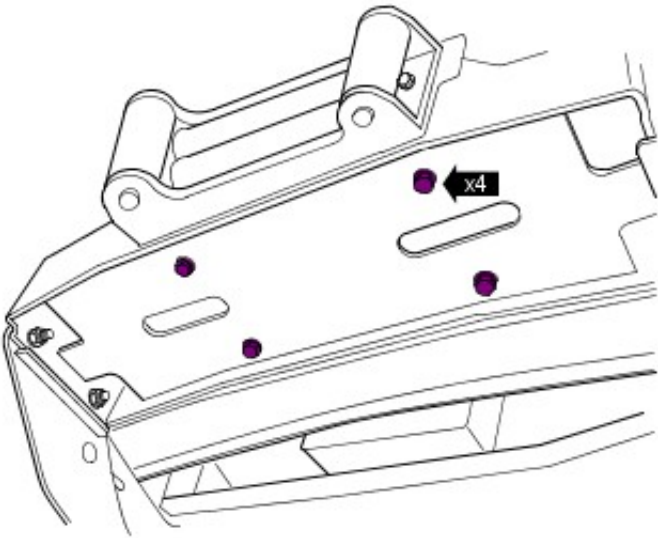
E137373

Installation

1.  **WARNING:** This step requires the aid of another technician.

Install the winch.

2. Tighten the bolts to 40 Nm.



E137302

3. Install the winch hook.

4. **CAUTIONS:**



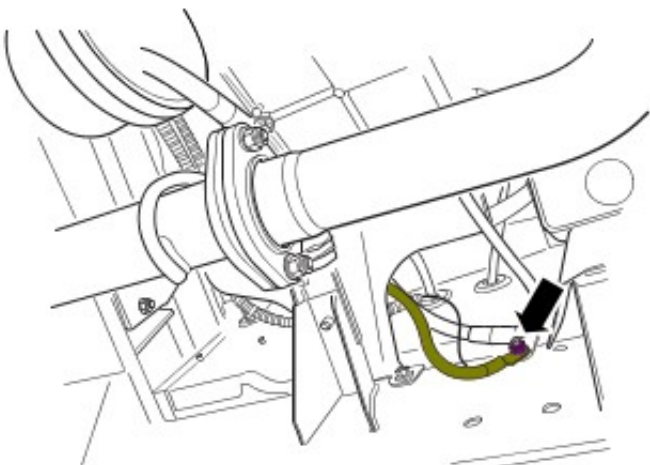
Install the cables following the routes noted on removal.



Clip in the positions noted on removal.

Install the winch power and ground cables.

5. Tighten to 25 Nm.



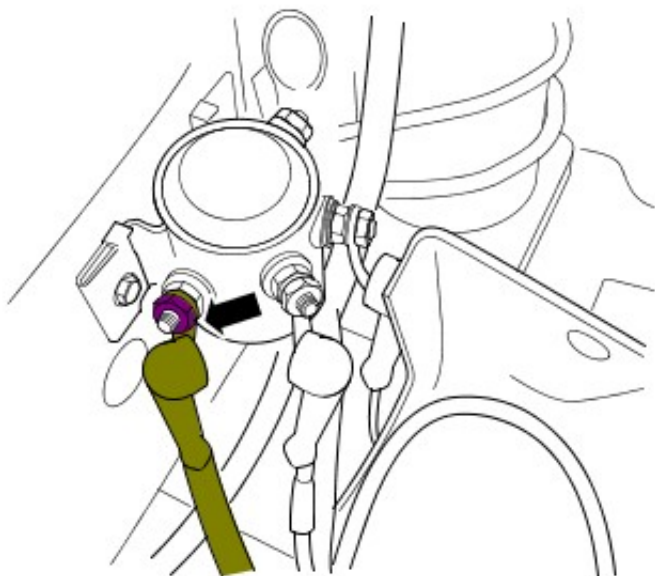
E138519

6. Feed the winch power cable into the battery box.



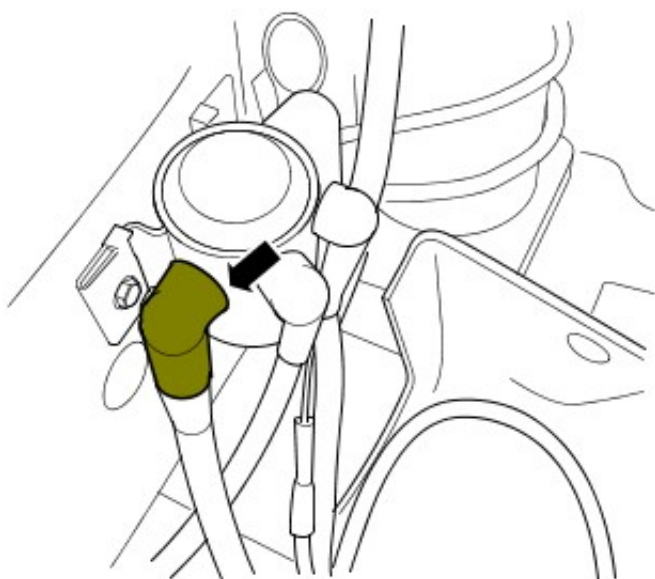
7. **CAUTION:** To prevent damage to components, use an additional wrench when loosening or tightening terminals.

Tighten to 7.3 Nm.



E139162

8.



E139161

9. Refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
10. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

Content not found

Winch - Winch Cable Roller Assembly

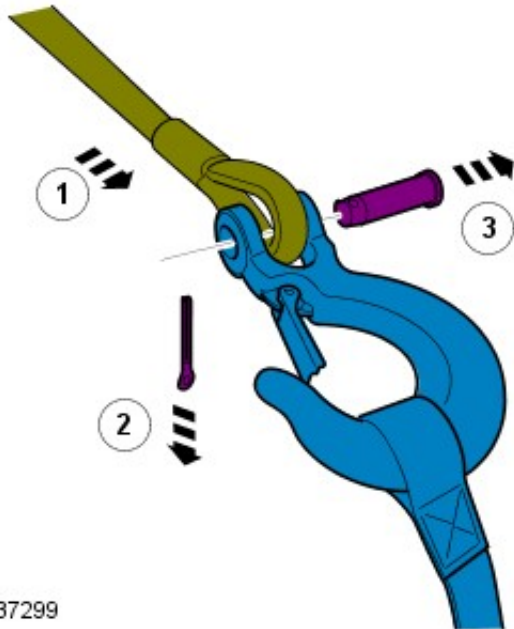
Removal and Installation

Removal

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

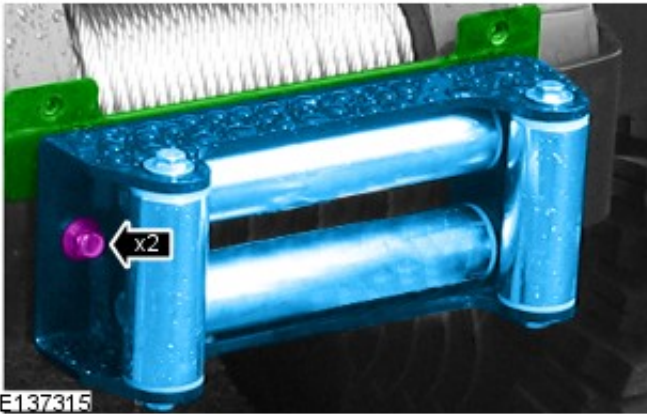
1. Refer to: [Licence Plate Panel](#) (419-12 Winch, Removal and Installation).

2.



E137299

3. Torque: 43 Nm.



Installation

1. To install, reverse the removal procedure.

Winch - Winch Control Unit

Removal and Installation

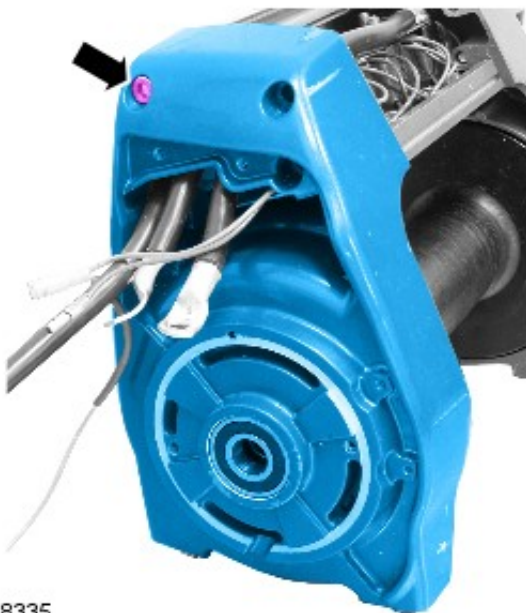
Removal

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


1. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: [Winch Motor](#) (419-12 Winch, Removal and Installation).
3. Torque: 27 Nm.



E139560



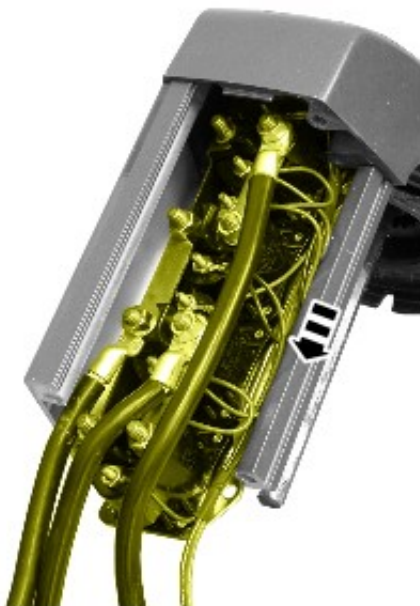
E138335

4.  CAUTION: Make sure the first stage gear is correctly engaged with the motor coupler.

Torque: 27 Nm.

- 5.

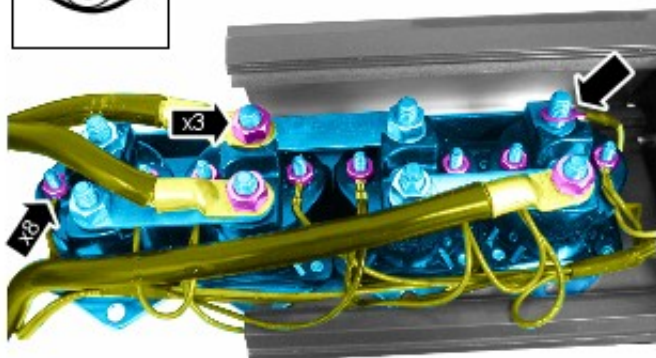
E138336



6. **NOTE:** Note the orientation of the electrical connectors and wiring harness.

Torque:

Large terminals 7 Nm
Small terminals 10 Nm



E138337

Installation

1. To install, reverse the removal procedure.

Winch - Winch Gear Assembly

Removal and Installation

Removal

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

1. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: [Winch](#) (419-12 Winch, Removal and Installation).
3. **NOTE:** Mark the components to aid installation.

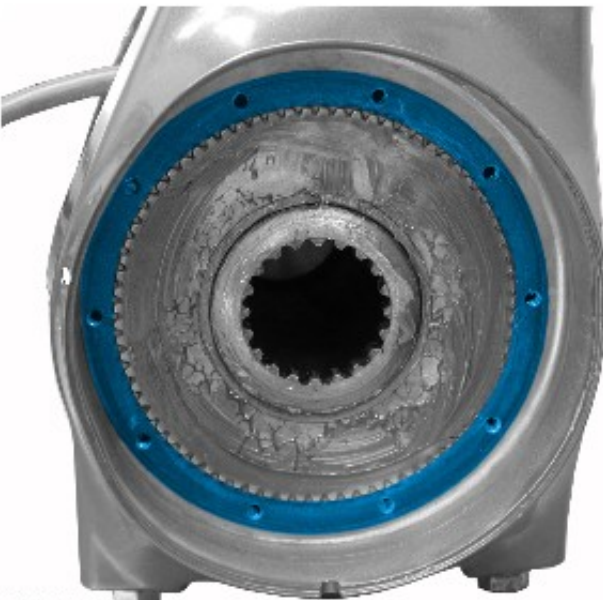
Torque: 10 Nm.



E138321

4. **NOTE:** Remove and discard the gasket.

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



E138322

Installation

1. **NOTE:** Align to the position noted on removal.

NOTE: Make sure a new gasket is installed.

To install, reverse the removal procedure.

Winch - Winch Motor

Removal and Installation

Removal

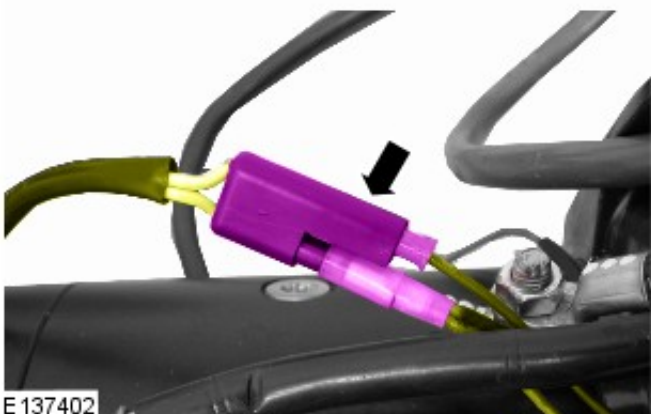
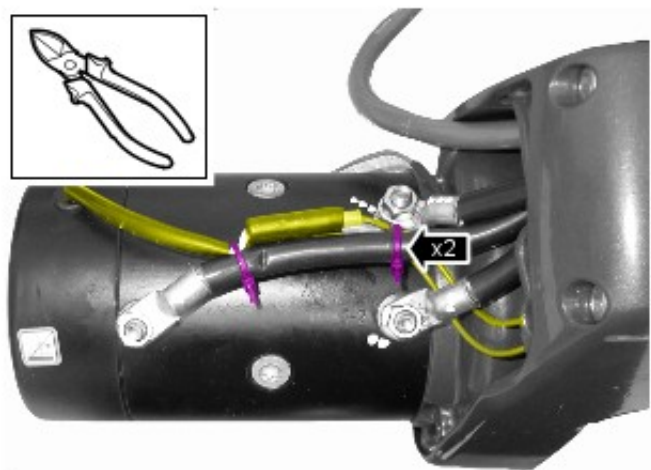
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: [Winch](#) (419-12 Winch, Removal and Installation).
3. Torque: 7 Nm.



E139555

4.



E137402



E137403

5. CAUTIONS:



Mark the position of the cables to aid installation.



To prevent damage to components, use an additional wrench when loosening or tightening terminals.

Torque: 25 Nm.

6. CAUTIONS:



If the armature is dislodged from the motor, the motor brushes will need to be reset to allow reinstallation.

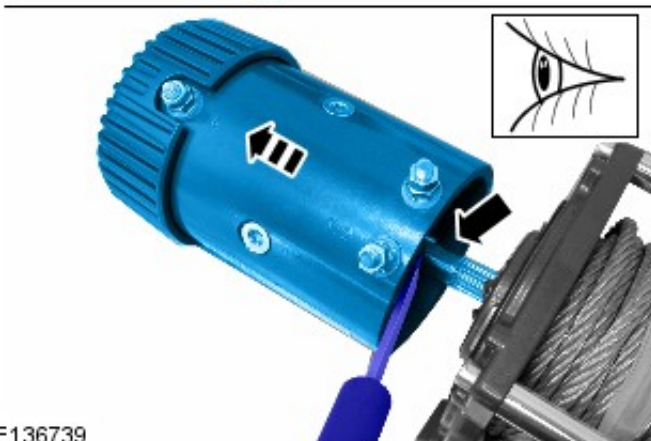


Make sure that the armature shaft is removed with the motor housing.



Use a suitable tool if required to move the armature with the motor.

Torque: 8 Nm.



E136739

Installation

1. To install, reverse the removal procedure.

Winch - Winch Solenoid

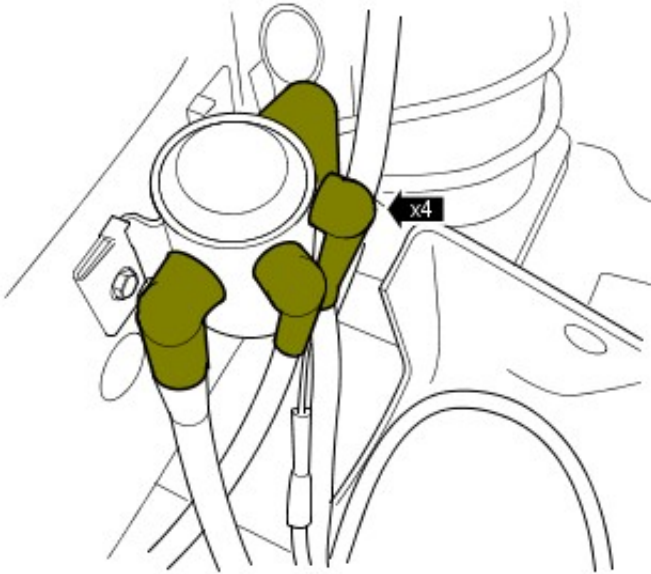
Removal and Installation

Removal

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

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

2.



E137376

3. CAUTIONS:



Note the position of the electrical cables prior to disconnection.

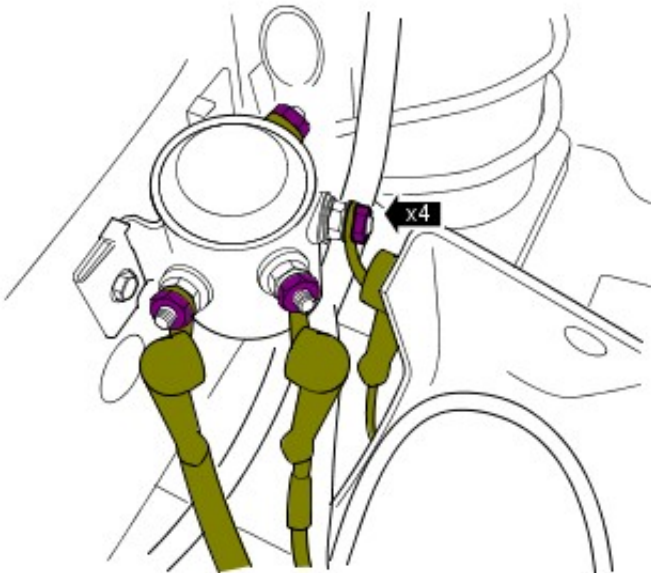


To prevent damage to components, use an additional wrench when loosening or tightening terminals.

Torque:

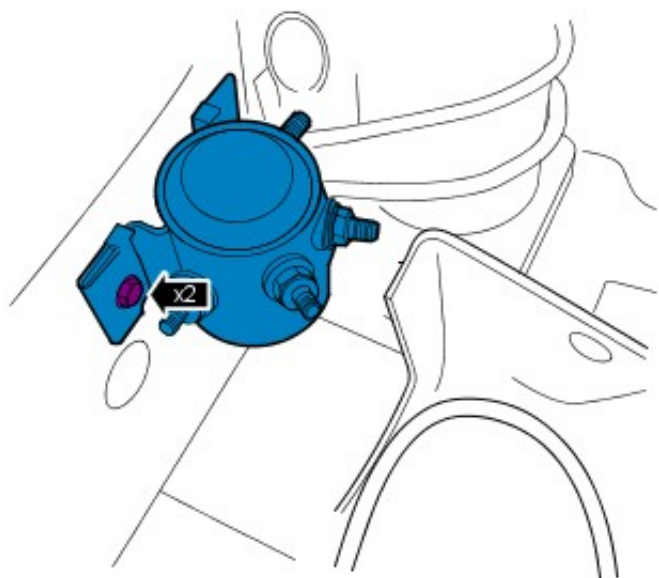
Two center terminals 10 Nm

Two outer terminals 7 Nm



E137377

4. Torque: 10 Nm.



E137378

Installation

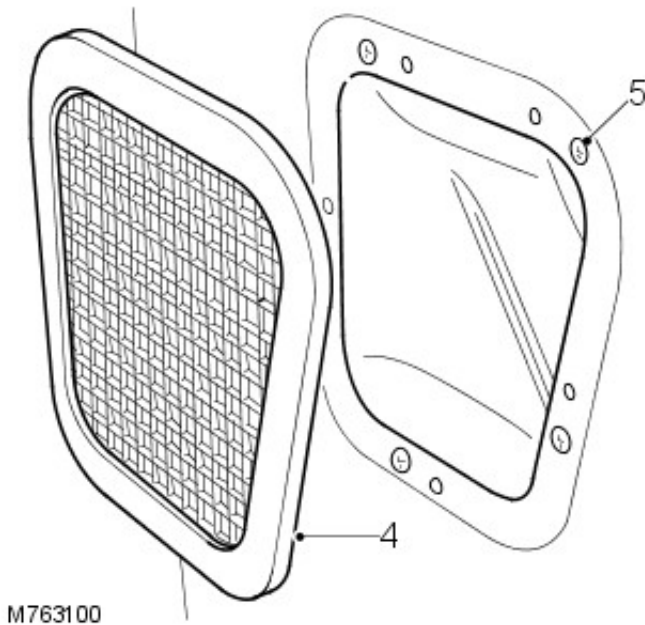
1. To install, reverse the removal procedure.

Front End Body Panels - Fender

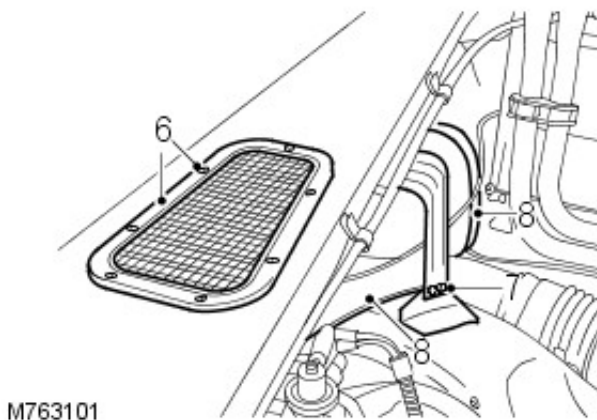
Removal and Installation

Removal

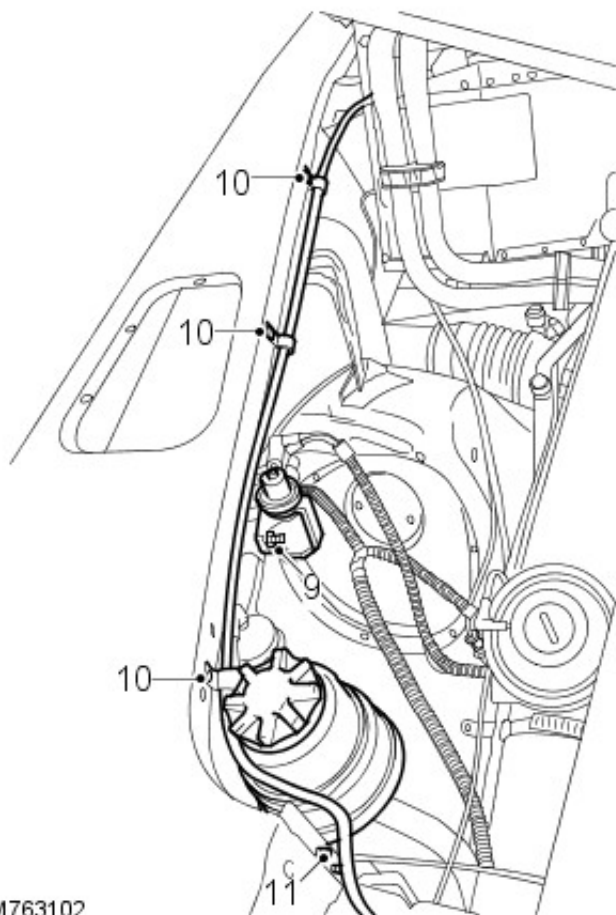
1. Remove fender splash shield.
For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).
2. Remove radiator grille.
For additional information, refer to: Radiator Grille (501-08, Removal and Installation).
3. Release fixings and remove cooling fan shroud.
4. Remove air cleaner grille from front fender.
5. Remove 4 screws securing air intake elbow to fender.



6. Remove 7 screws and remove heater air intake grille from fender.
7. Remove 2 bolts securing heater air intake bracket to inner fender. Remove bracket.
8. Remove heater air intake from fender and collect seal.

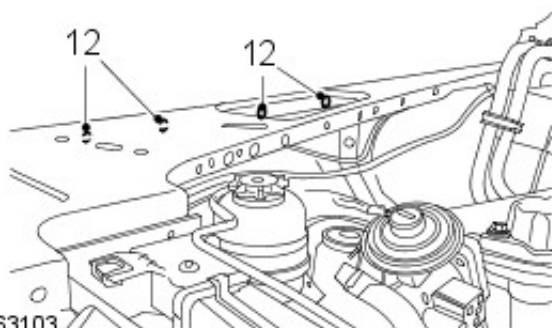


9. Remove 2 bolts securing EGR solenoid to inner fender and lay aside.
10. Remove 3 studs securing expansion tank pipe to inner fender.
11. Remove 2 bolts securing PAS reservoir to inner fender and lay aside.



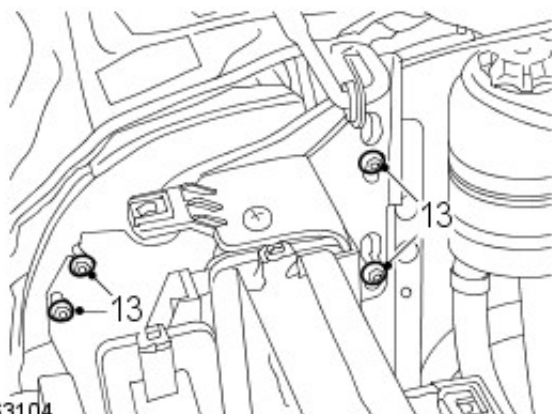
M763102

12. Remove 4 bolts securing outer fender to inner fender.



M763103

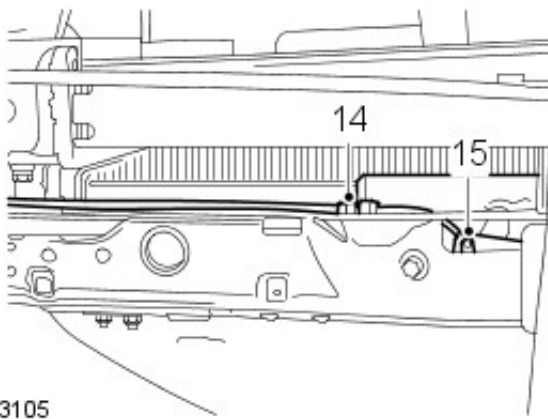
13. Remove 4 bolts securing radiator mounting bracket to fender.



M763104

14. Loosen screw and release hood lock inner cable from hood lock.

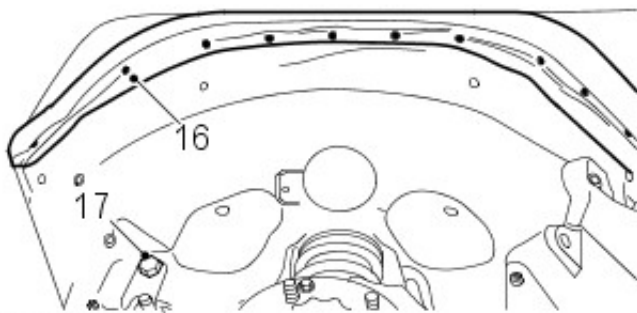
15. Release hood lock outer cable from hood lock.



M763105

16. Push centre pins from studs securing wheel arch extension to fender, remove studs and remove wheel arch extension.

17. Remove bolt securing inner and outer fender to chassis.

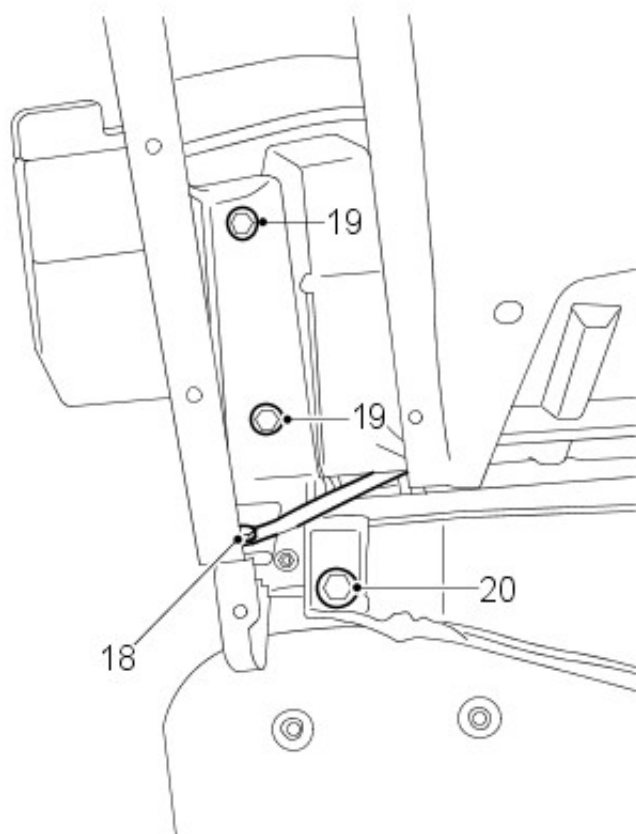


M763106

18. Remove nut and bolt securing support stay to fender.

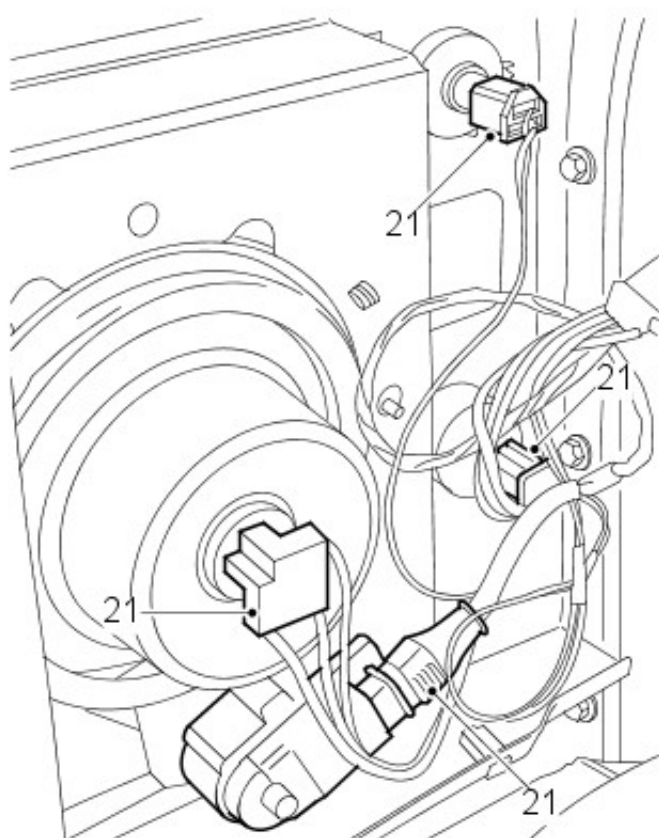
19. Remove 4 bolts securing fender to 'A' post.

20. Remove bolt securing fender to bulkhead.



M763107

21. Disconnect headlamp, side lamp, repeater and side turn lamp multiplugs.

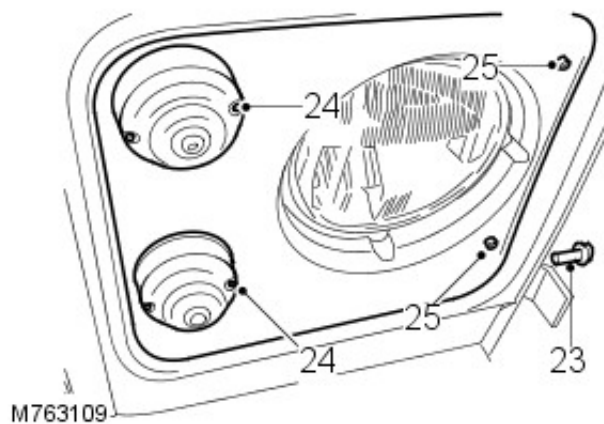


M763108

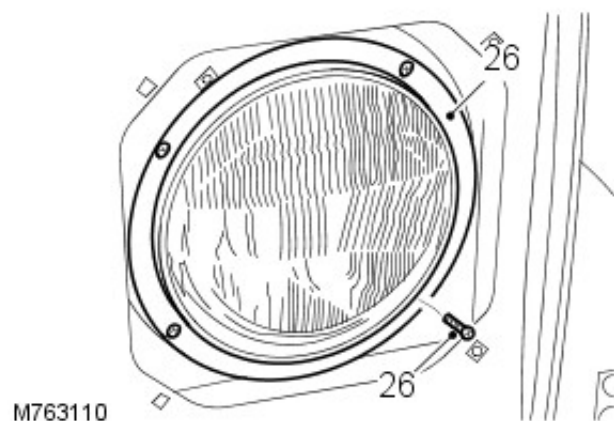
22. With assistance, remove fender.
23. Remove bolt, remove grille support bracket.
24. Remove 4 screws securing side lamp and side turn lamp.

24. Remove 2 screws securing side lamp and side turn lamp.

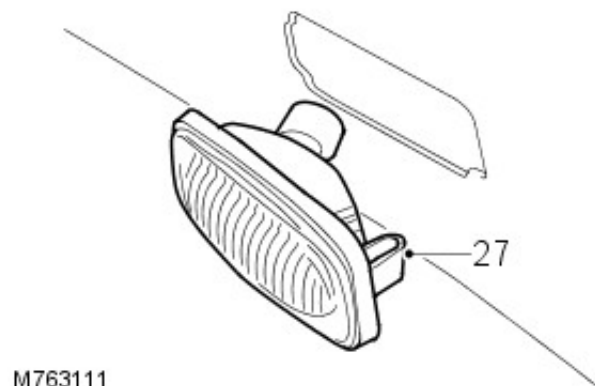
25. Remove 2 screws securing headlamp finisher to fender, remove finisher.



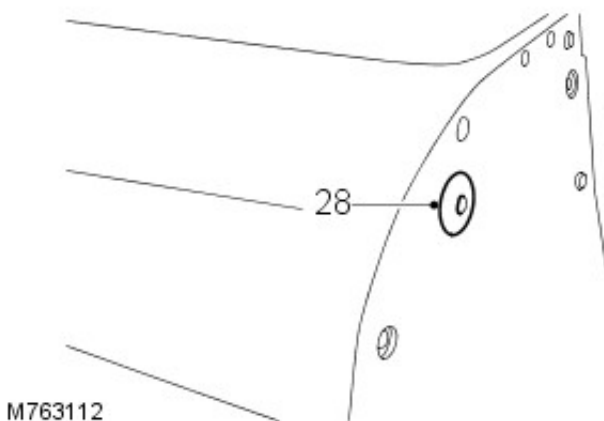
26. Remove 4 screws and remove headlamp from fender, collect sealing ring.



27. Release side repeater lamp from fender.



28. Remove hood cable grommet.



Installation

1. Fit hood cable grommet.

2. Fit side repeater lamp to fender.
3. Fit headlamp sealing ring, fit headlamp and tighten screws.
4. Fit headlamp finisher, side lamp and side turn lamps and tighten screws.
5. Fit grille support bracket and tighten bolt.
6. With assistance, position and align fender to body and locate hood cable to fender.
7. Connect headlamp, side lamp, side turn lamp and side repeater lamp multiplugs.
8. Fit bolt securing fender to bulkhead.
9. Fit bolts securing fender to 'A' post.
10. Fit nut and bolt securing support stay to fender.
11. Fit bolt securing inner and outer fender to chassis.
12. Fit bolts securing radiator bracket to fender.
13. Fit bolts securing outer fender to inner fender.
14. Align fender and finally tighten all bolts.
15. Position wheel arch extension to fender, and fit securing studs.
16. Position PAS reservoir to fender and tighten bolts.
17. Position expansion tank pipe and secure with studs.
18. Position EGR solenoid and tighten bolts.
19. Position heater air intake seal and fit air intake.
20. Fit heater air intake bracket and tighten bolts.
21. Fit heater air intake grille and tighten screws.
22. Align air cleaner intake elbow, tighten screws and fit grille.
23. Fit fender splash shield.
For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).
24. Position hood release cable to lock and tighten screw.
25. Fit cooling fan shroud.
26. Fit radiator grille.
For additional information, refer to: Radiator Grille (501-08, Removal and Installation).

Front End Body Panels - Fender Splash Shield

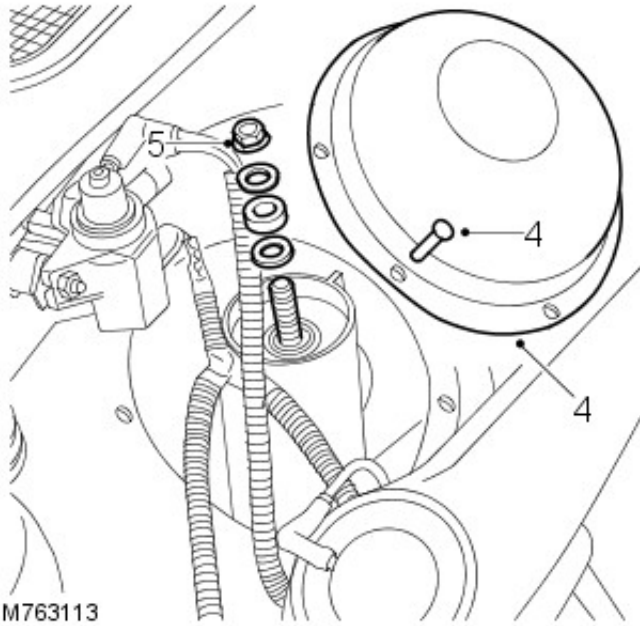
Removal and Installation

Removal

1.  **WARNING:** Support on safety stands.

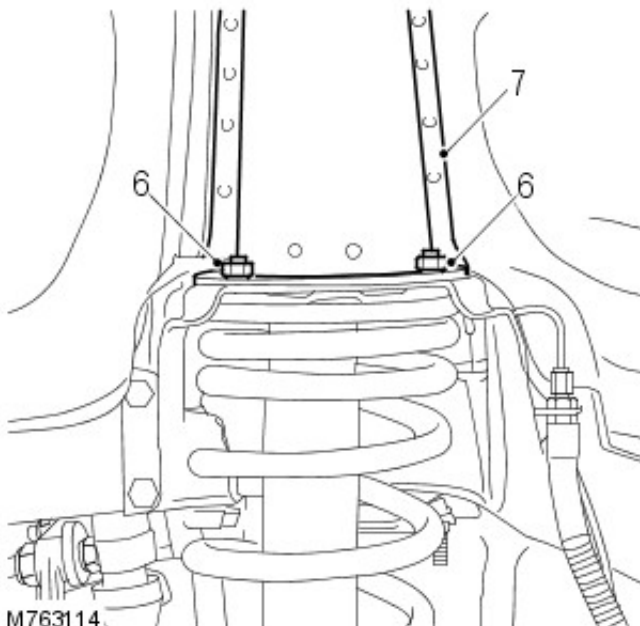
Raise front of vehicle.

2. Remove front wheel.
3. Support axle weight with jack.
4. Remove 6 screws securing damper top cover to inner wing, remove cover.
5. Remove nut securing damper to top mounting bracket and collect rubber bush and 2 washers.



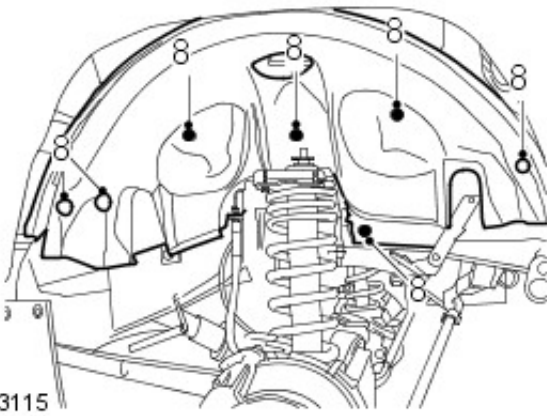
6. Remove 4 nuts securing damper to mounting bracket and collect washers.

7. Remove damper top cover.



8. Remove 4 screws and 3 studs securing fender splash shield to inner wing. Remove fender splash shield.

M763115



Installation

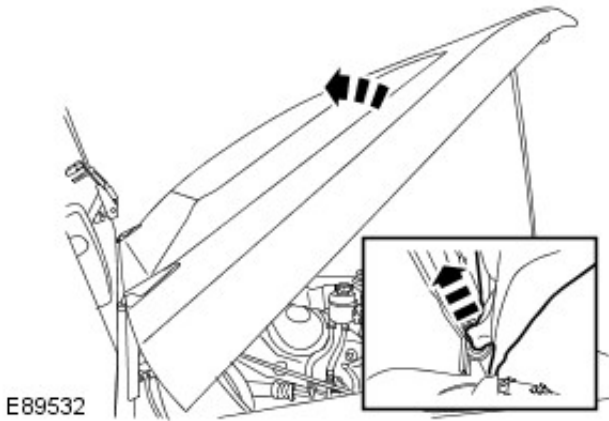
1. Position fender splash shield, secure with screws and studs.
2. Fit damper mounting bracket and tighten nuts.
3. Position damper to mounting bracket, fit rubber bush and washers and tighten nut.
4. Fit damper cover to inner wing and secure with screws.
5. Fit road wheel.
6. Remove stands and lower vehicle.

Front End Body Panels - Hood

Removal and Installation

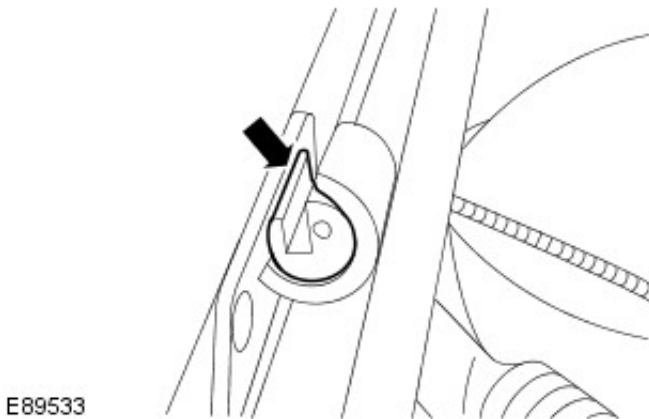
Removal

1. Remove the hood.
 - With assistance, remove the hood in an upwards direction.



Installation

1. To install, reverse the removal procedure.
 - Make sure the hood guides are inline with the hinge bracket.



Body Closures - Body Closures Vehicles Built From: 07/2001

Description and Operation

Front Seat Recline

Front seat recline has been improved by removing the bulkhead situated behind the front seats. This enables the front seats to be reclined further than previous Defender 90's.

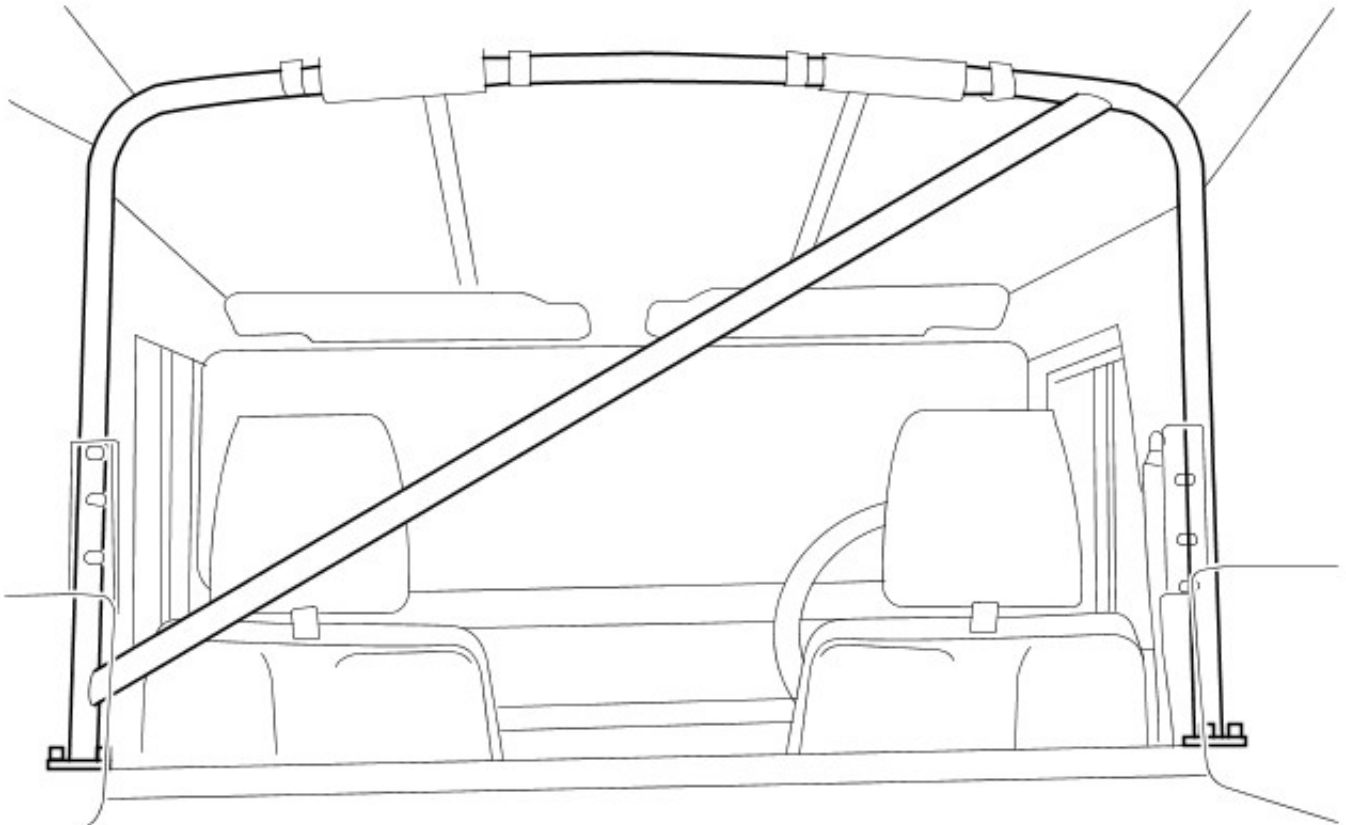
This change is only applicable to 90 county station wagon models. Six seat derivatives of this model will provide greater incline of the front seats and increased cabin space.

Soft Top

The soft top is replaced by an improved version manufactured from PVC. The PVC soft top gives the following improvements:

Improvements

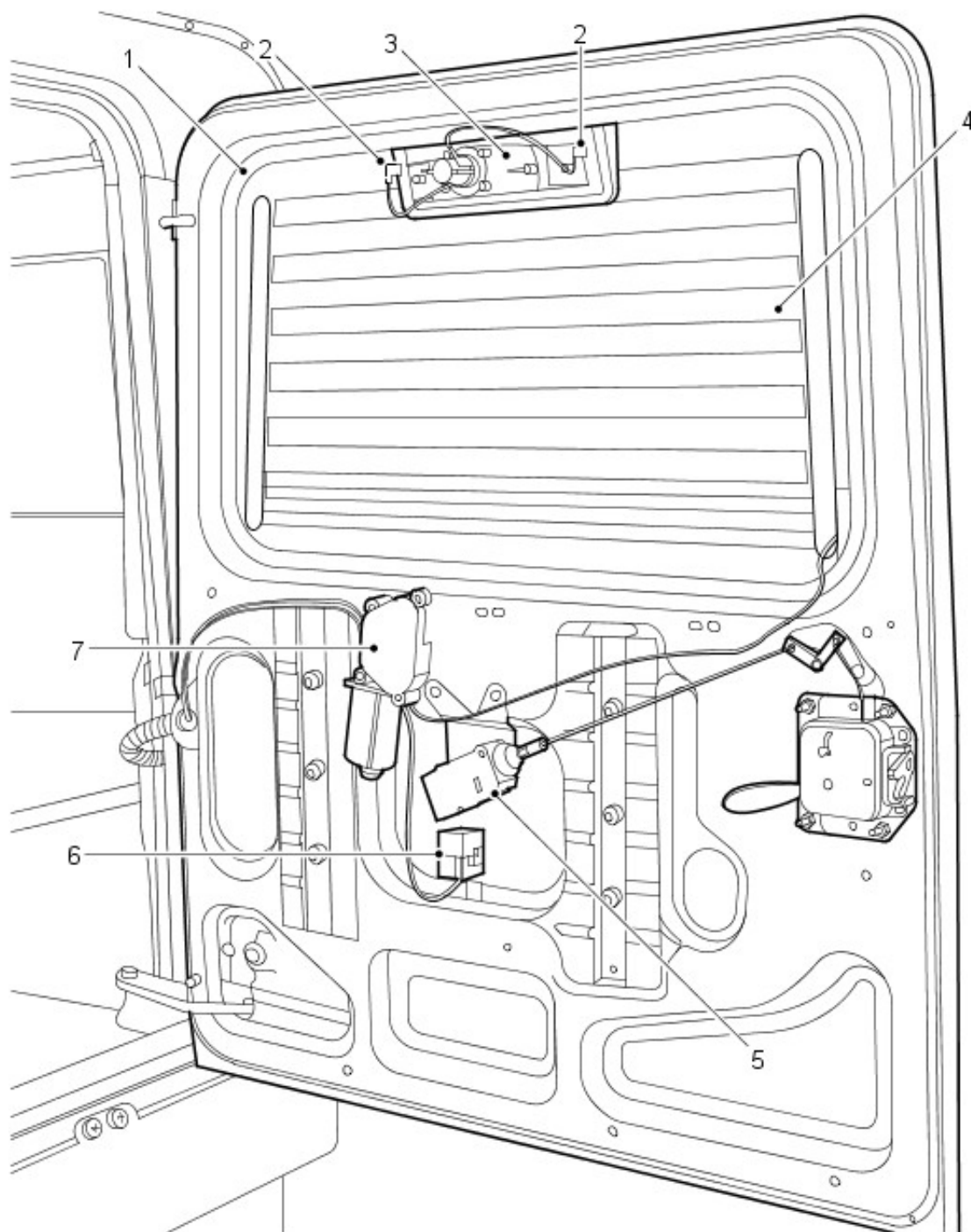
- Resistance to shrinkage
- No zips
- Resistant to dust and water ingress
- Weld seams and joints
- Non cotton base construction
- Easy to clean
- Beach bar



M764218

A beach bar, currently used on military vehicles only, will be introduced for fitment on all 02MY soft top vehicles. The bar is located behind the front seats and is manufactured from large diameter steel tubing with a diagonal bar which gives additional rigidity.

Tail door



M764217

Item	Part Number	Description
1	-	Rubber window seal
2	-	CHMSL earth connection
3	-	CHMSL
4	-	Tail door glass and HRW element
5	-	Tail door CDL actuator
6	-	Rear wiper relay
7	-	Wiper motor

The tail door is now a one piece outer skin pressing located on a reinforced steel, zinc plated frame. This gives improved build quality, water integrity and minimal welding.

A new tail door glass is introduced with a one piece continuous rubber seal. The tail door glass has a revised Heated Rear Window (HRW) element on the glass which removes the need to route wires up the sides of the frame. The HRW element now has integral Lucar connections in the element which provide the earth connections for the new centre high mounted stop lamp.

The inner trim panel is new and accommodates the CDL actuator and linkages.

The new tail door also contains a relay for rear wiper motor operation. Refer to the Wipers section for details.

Because the new tail door uses the current hinges and latch and retains the same geometry as the previous tail door, the

new tail door assembly is available as a service item for current vehicles.

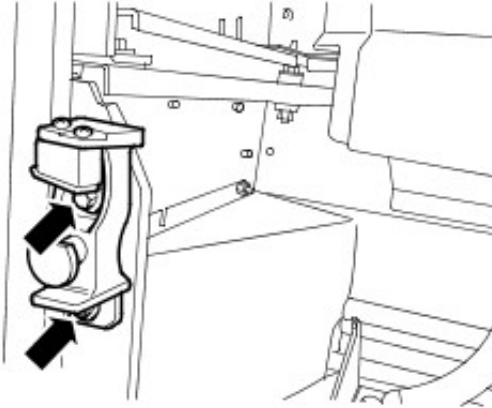
Body Closures - Taildoor Striker Adjustment

General Procedures

1. **NOTE:** Before adjusting the taildoor striker, ensure the spare wheel is fitted to taildoor.

Loosen screws securing taildoor striker.

2. Adjust taildoor striker and tighten screws.



M764240

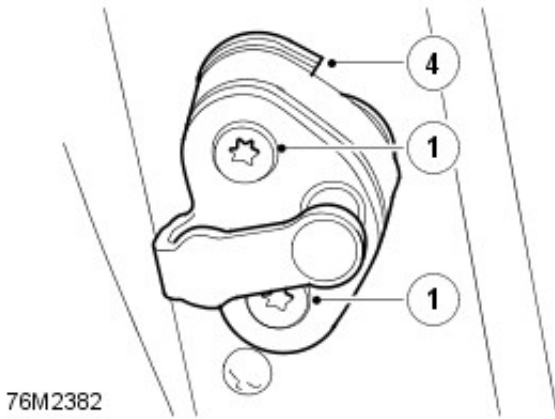
3. Close taildoor and check for correct latching with taildoor lock.
4. Carry out further adjustment as necessary. If full adjustment cannot be achieved carry out following.
5. Remove taildoor striker and nut plate.
6. Elongate holes in body metal which is sandwiched between taildoor striker and nut plate.
7. Refit taildoor striker and adjust as necessary.

Body Closures - Door Striker Adjustment

General Procedures

NOTE: This procedure covers adjustment of striker on front and rear doors.

1. Loosen Torx bolts securing striker to B-pillar or C-pillar.
2. Adjust alignment of striker vertically and horizontally, lightly tighten bolts.
3. Close door, check for correct latching with door lock and for centering on striker.
4. Add or remove packing shims as necessary. Fully tighten bolts.



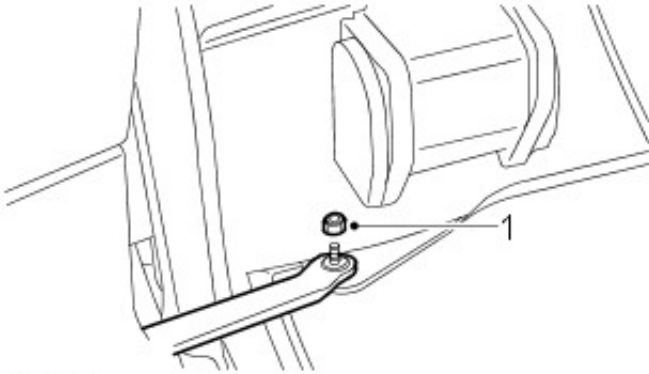
5. Carry out further adjustment as necessary. If full adjustment cannot be achieved carry out following:
6. Remove striker and nut plate.
7. Elongate striker bolt holes in B-pillar or C-pillar to increase movement in direction required.
8. Refit striker and adjust as necessary.

Body Closures - Door

Removal and Installation

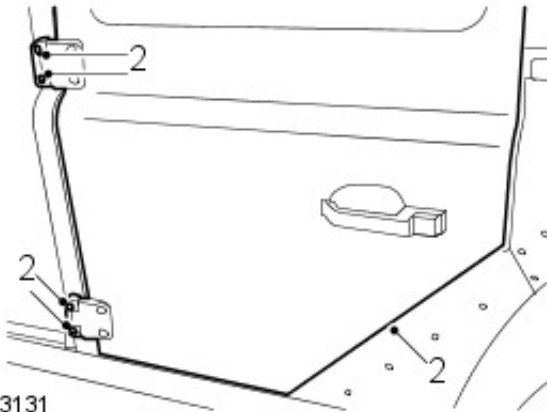
Removal

1. Remove nut securing door check strap.



M763130

2. With assistance remove 4 bolts securing door to body and remove door.



M763131

Installation

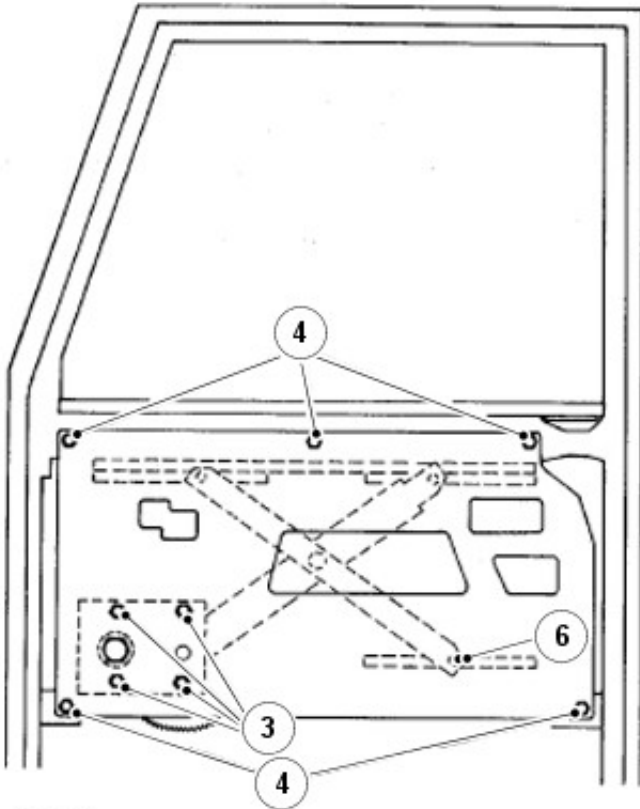
1. With assistance position door and fit but do not tighten bolts.
2. Align door to body aperture and tighten bolts.
3. Fit and tighten check strap nut.

Body Closures - Front Door Reinforcement Panel

Removal and Installation

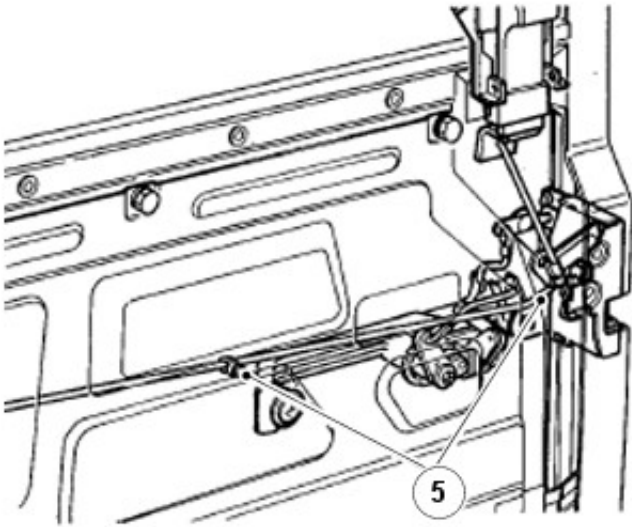
Removal

1. Remove door trim panel and plastic sheet.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).
2. Remove plastic sheet.
3. Remove 4 screws securing window regulator to mounting panel.
4. Remove 5 screws securing mounting panel to door frame.



E 82225

5. Release remote control lever rod from latch mechanism and from plastic clip in mounting panel.
6. Slide window regulator arm from mounting panel channel and remove panel with remote control lever and rod.



E82226

Installation

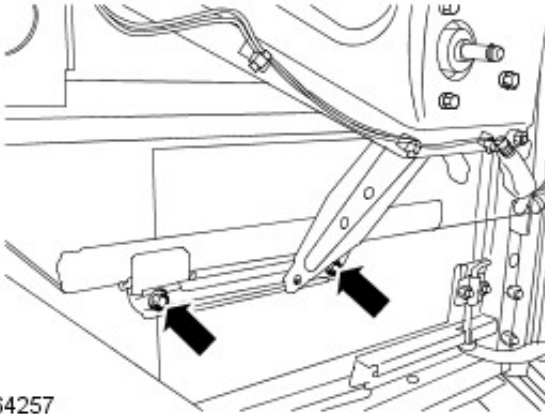
1. Engage window regulator arm in mounting panel channel.
2. Connect remote control rod to latch mechanism and secure with clip.
3. Install mounting panel and retain with 5 screws.
4. Secure window regulator to mounting panel with 4 screws.
5. Raise and lower window to check for free movement.
6. Install plastic sheet, and door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Body Closures - Rear Door Reinforcement Panel

Removal and Installation

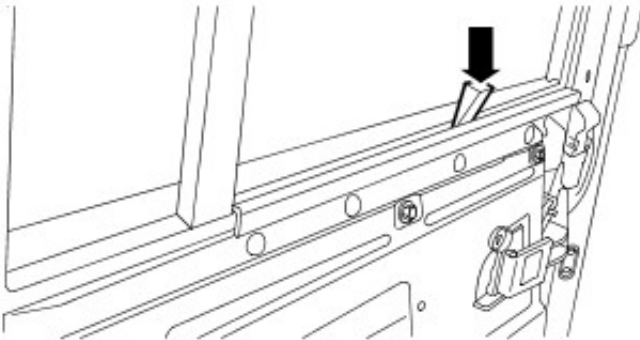
Removal

1. Remove rear door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).
2. Remove plastic sheet from the door.
3. Lower the glass and remove 2 bolts securing door glass to regulator.



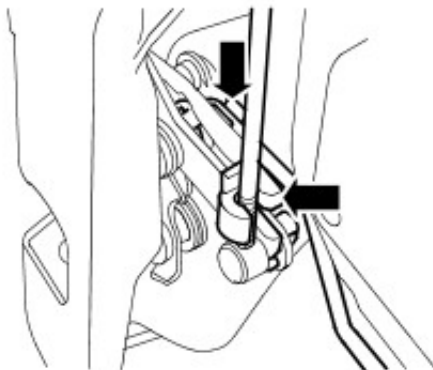
M764257

4. Release glass from regulator, raise and wedge in raised position.



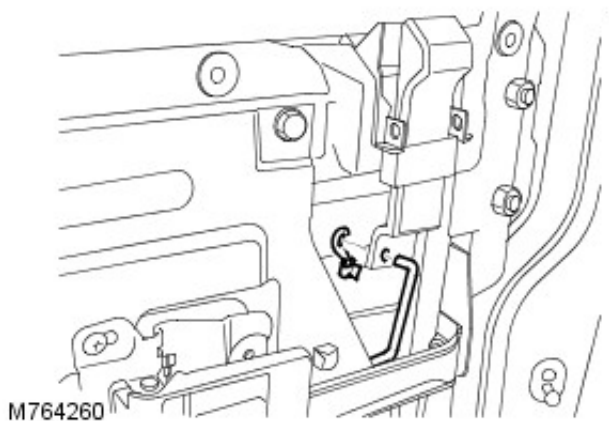
M764258

5. Release clip, detach and remove door lock motor link.

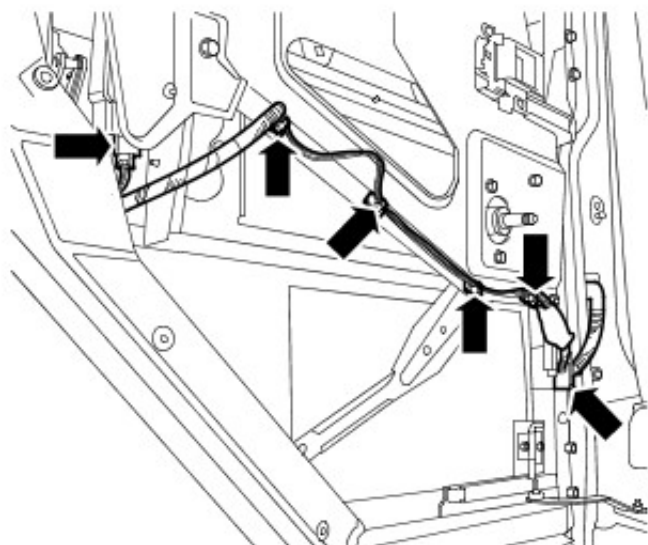


M764259

6. Release clip and disconnect interior handle link from latch mechanism.
7. Remove clip and disconnect push button link.



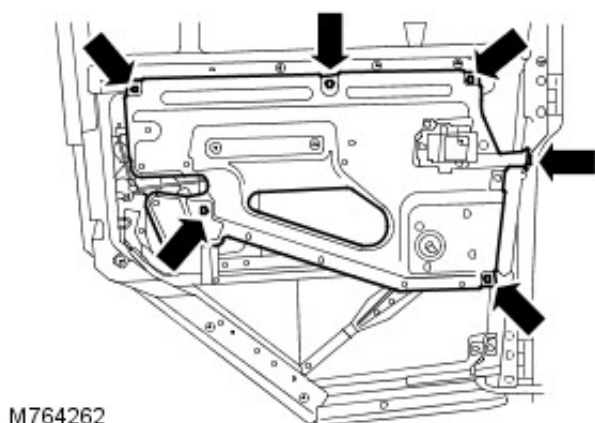
8. Release clips securing harness to door reinforcement panel.



9. Disconnect multiplug from door lock motor.

10. Release harness sleeve and withdraw harness from door.

11. Remove 5 bolts and 1 nut securing door reinforcement panel.



12. Remove door reinforcement panel.

Installation

1. Position door reinforcement panel assembly, fit bolts and nut and tighten to 10 Nm (7lbf.ft).
2. Connect multiplug to door lock motor.
3. Secure harness clips and sleeve.

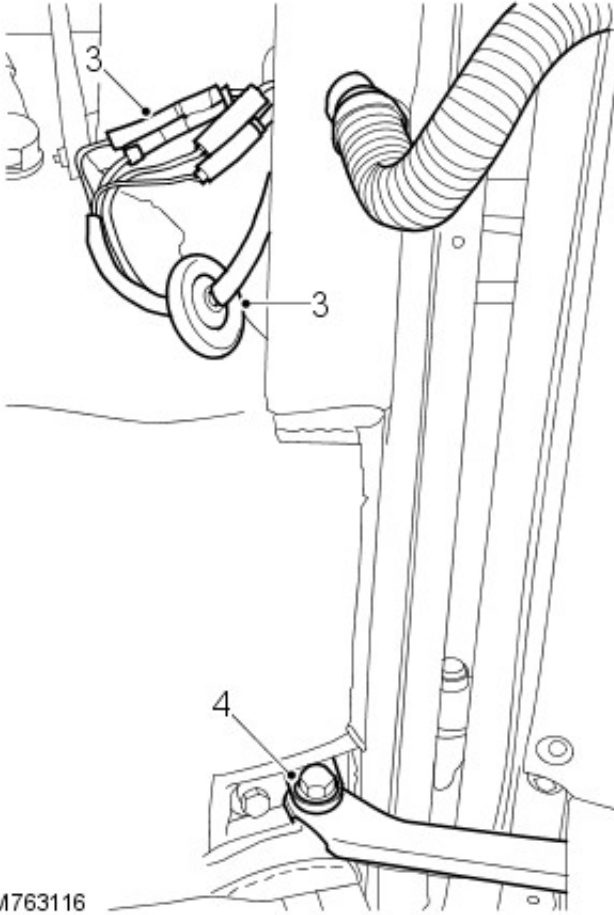
4. Connect interior handle link to latch and secure with clip.
5. Connect link to push button and fit clip.
6. Fit and secure door lock motor link.
7. Remove wedges, lower the glass and locate to regulator. Fit bolts and tighten to 6 Nm (4 lbf.ft).
8. Raise and lower glass to check operation.
9. Fit plastic sheet to the door.
10. Fit rear door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

Body Closures - Taildoor

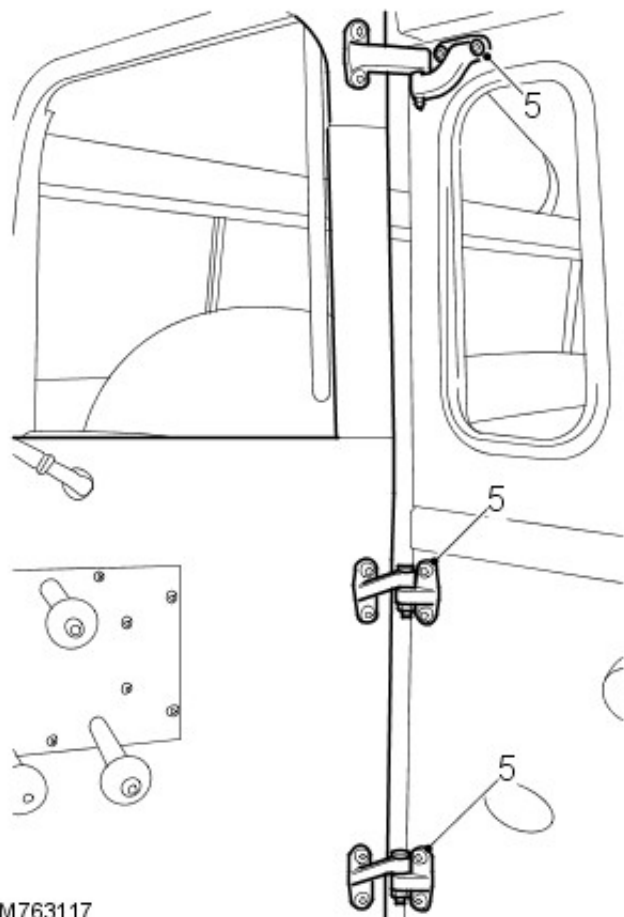
Removal and Installation

Removal

1. Remove 3 nuts and remove spare wheel.
2. Remove bolt securing check strap to body.
3. Release harness grommet from harness cover, disconnect connectors and multiplug.
4. Release harness cover and harness from body.



5. With assistance, remove 6 screws securing taildoor hinges to body and remove taildoor.



M763117

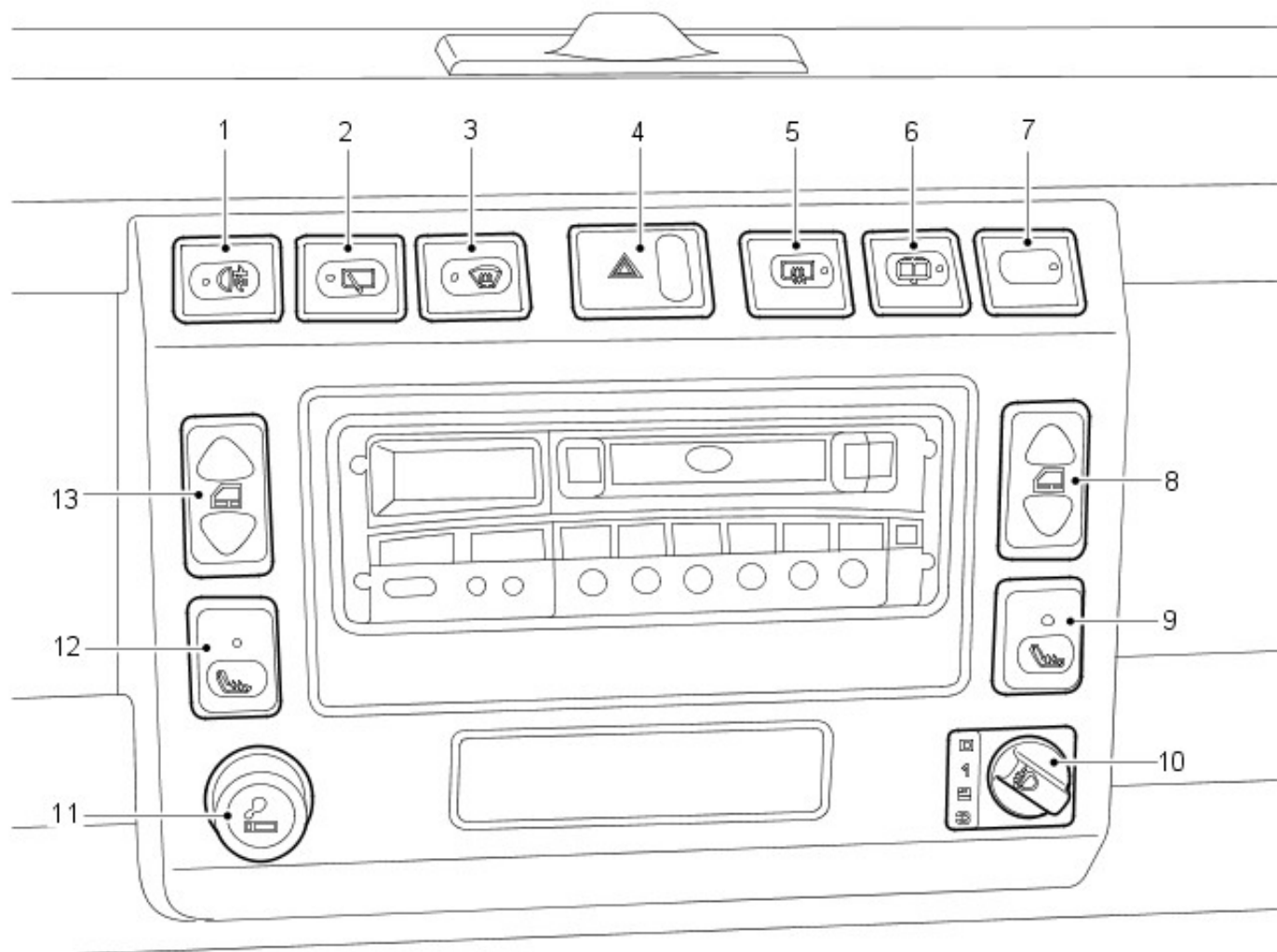
Installation

1. With assistance, position taildoor and fit but do not tighten bolts.
2. Position check strap and tighten bolt.
3. Align taildoor to body and tighten bolts.
4. Position harness through body and secure harness cover.
5. Secure harness connectors and multiplug.
6. Secure harness grommet to body.
7. Position spare wheel to taildoor and tighten nuts.
8. Adjust taildoor striker.
For additional information, refer to: Taildoor Striker Adjustment (501-03, General Procedures).

Interior Trim and Ornamentation - Interior Trim

Description and Operation

Fascia Console



M865561A

Item	Part Number	Description
1	-	Rear fog lamp switch
2	-	Rear wiper switch
3	-	Heated front screen switch (if fitted)
4	-	Hazard warning lamp switch
5	-	Heated rear window switch
6	-	Rear washer switch
7	-	Front fog lamps switch (if fitted)
8	-	RH front window switch
9	-	RH heated front seat switch (if fitted)
10	-	Headlamp levelling control switch
11	-	Cigar lighter (if fitted)
12	-	LH heated front seat switch (if fitted)
13	-	LH front window switch

The console comprises a plastic moulding secured to the fascia with five screws. The new console allows existing switches to be repositioned and has provided the opportunity to commonise the switches with other Land Rover models.

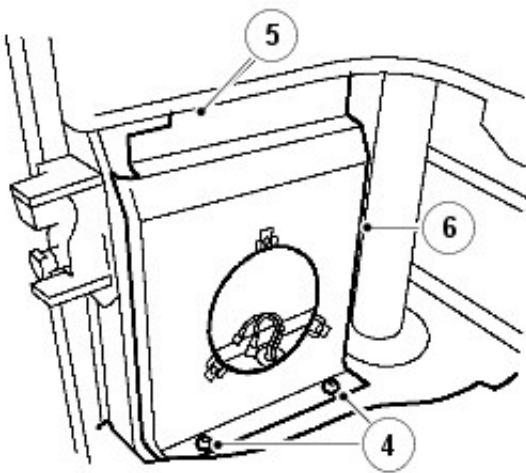
A central cut-out in the console provides for the installation of the radio, where fitted, or a coin tray for markets without a standard radio installation.

Interior Trim and Ornamentation - Cowl Side Trim Panel

Removal and Installation

Removal

1. Raise the seat cushion and fit stowage strap.
2. Remove the rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the rear door speaker.
For additional information, refer to: Rear Door Speaker (415-03 Speakers, Removal and Installation).
4. Peel back carpet and remove 2 screws securing cowl side trim panel to wheel arch.
5. Prise top edge of cowl side trim panel down to release from body channel.
6. Remove the cowl side trim panel.



J6051

Installation

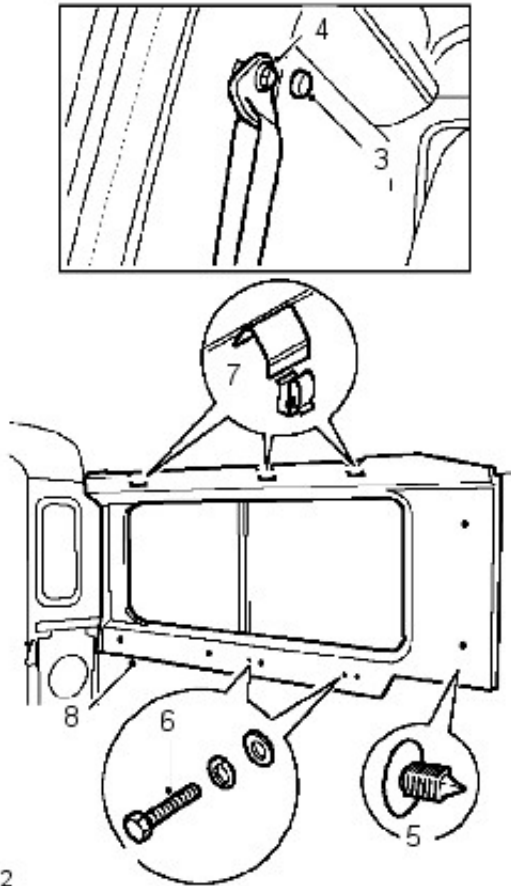
1. Position the cowl side trim panel on wheel arch.
2. Press top edge of cowl side trim panel down firmly and locate under body channel.
3. Secure cowl side trim panel to wheel arch with screws and reposition carpet.
4. Fit the rear door speaker.
For additional information, refer to: Rear Door Speaker (415-03 Speakers, Removal and Installation).
5. Fit the rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

Interior Trim and Ornamentation - C-Pillar Upper Trim Panel90/Station Wagon

Removal and Installation

Removal

1. Remove rear seat squab.
For additional information, refer to: Rear Seat Backrest (501-10 Seating, Removal and Installation) / Rear Seat Backrest (501-10, Removal and Installation).
2. Remove rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Prise cap from front seat belt upper guide retaining bolt.
4. Unscrew retaining bolt and remove seat belt from 'B' pillar.
5. Carefully prise trim stud from 'B' pillar.
6. Remove 4 bolts securing side trim panel to body side.
7. Release top edge of side trim panel by striking upwards with the hand to disengage 3 spring clips.



J6362

8. Lift trim panel from window surround and remove from vehicle.

Installation

1. Install new spring clips to the 3 brackets on top edge of side trim panel.
2. Align trim panel, ensuring it is correctly positioned around side window.
3. Locate trim panel spring clips on inner cant rail and press firmly down to secure top edge of trim panel.

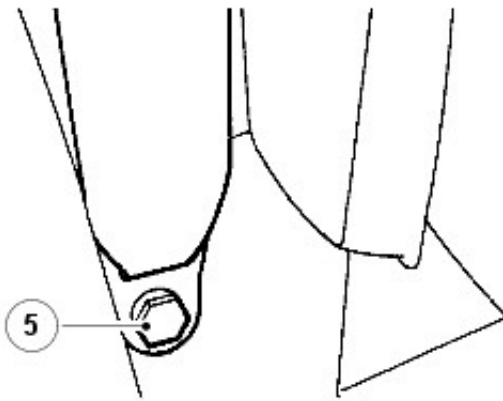
4. Align bosses of trim panel with body side fixing holes and secure with 4 bolts and washers. Do not fully tighten at this stage.
5. Install trim stud to secure bottom edge of trim panel to 'B' pillar.
6. Secure seat belt guide to 'B' pillar, tighten bolt to 32 Nm (24 lbf.ft) and install cap.
7. Install rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Install rear seat squab.
For additional information, refer to: Rear Seat Backrest (501-10 Seating, Removal and Installation) /
Rear Seat Backrest (501-10, Removal and Installation).

Interior Trim and Ornamentation - C-Pillar Upper Trim Panel110/Station Wagon

Removal and Installation

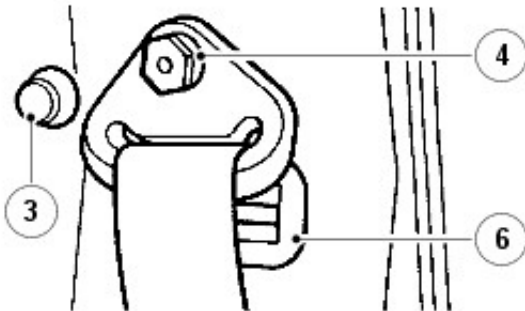
Removal

1. Remove rear bench seat.
For additional information, refer to: Rear Bench Seat (501-10, Removal and Installation) / Third Row Seat (501-10, Removal and Installation).
2. Remove rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Prise finisher cap from rear seat belt upper guide bracket retaining bolt.
4. Unscrew bolt and remove guide bracket from 'C' pillar.
5. Remove bolt securing seat belt to wheel arch mounting.



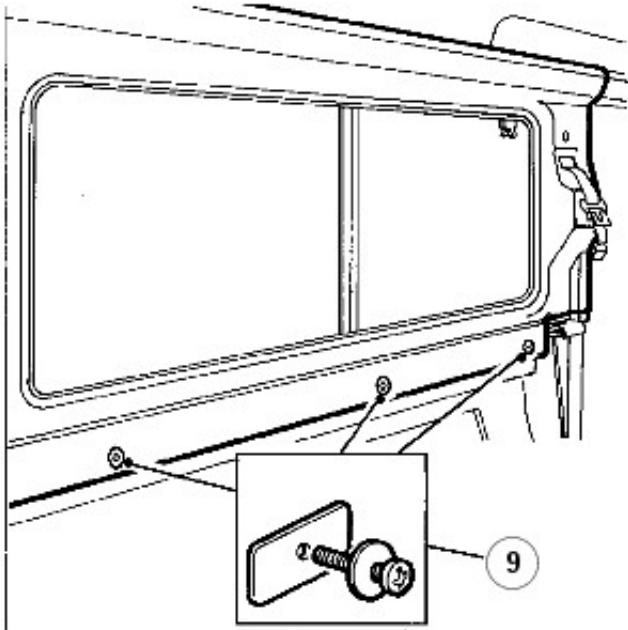
J6367

6. Prise trim panel cap fastener from 'C' pillar.



J6366

7. Remove seat belt aperture finisher from side trim panel.
8. Remove screw and release seat belt clip from 'C' pillar.
9. Remove fixings securing bottom edge of trim panel to body side.



J6368

10. Release top edge of trim panel by striking upwards with the hand to disengage 3 spring clips.
11. Lift trim panel from window surround and feed seat belt through panel aperture.
12. Remove trim panel from vehicle.

Installation

1. Install new spring clips to the 3 brackets on top edge of side trim panel.
2. Feed seat belt through aperture in trim panel and install finisher.
3. Align trim panel, ensuring it is correctly positioned around side window.
4. Locate trim panel spring clips on inner cant rail and press firmly down to secure top edge of trim panel.
5. Align bosses of trim panel with body side fixing holes and secure with bolts or screws. If individual type seats are fitted do not fully tighten fixings at this stage.
6. Install seat belt clip to 'C' pillar.
7. Install trim panel cap fastener to 'C' pillar.
8. Install seat belt to wheel arch. Tighten bolt to 32 Nm (24 lbf.ft).
9. Install seat belt guide bracket to 'C' pillar. Tighten bolt to 32 Nm (24 lbf.ft) and fit finisher cap.
10. Install rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

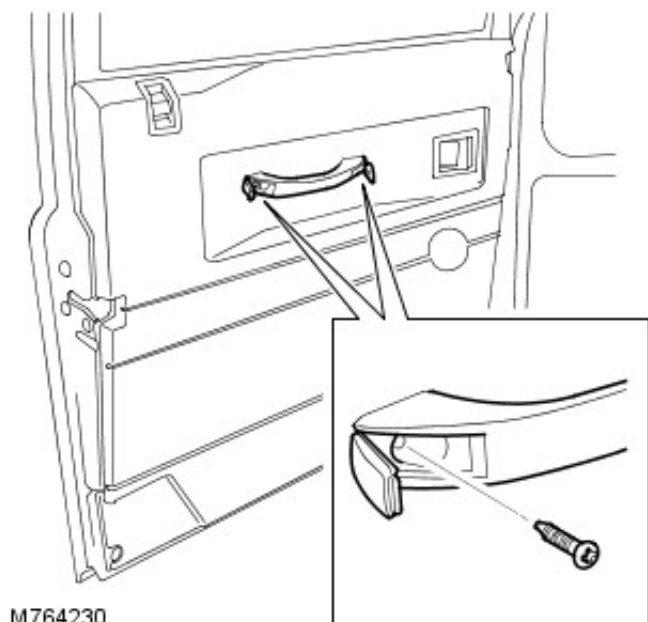
11. Install rear bench seat.
For additional information, refer to: Rear Bench Seat (501-10, Removal and Installation) /
Third Row Seat (501-10, Removal and Installation).

Interior Trim and Ornamentation - Front Door Trim Panel

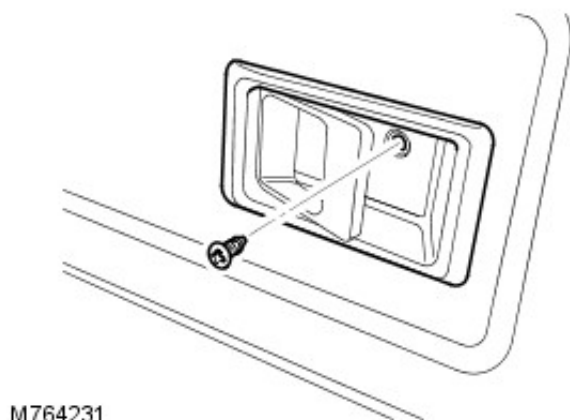
Removal and Installation

Removal

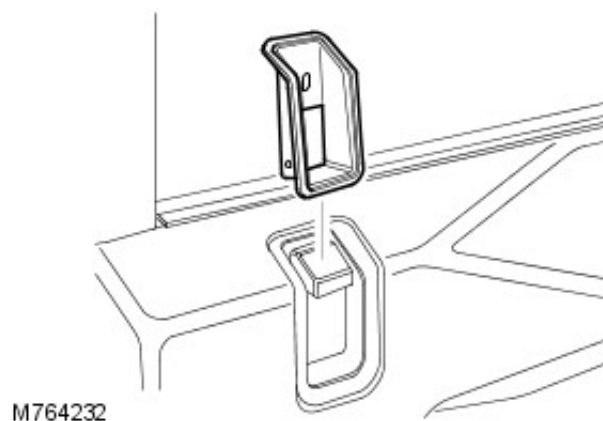
1. Remove 2 screws securing door pull and remove door pull.



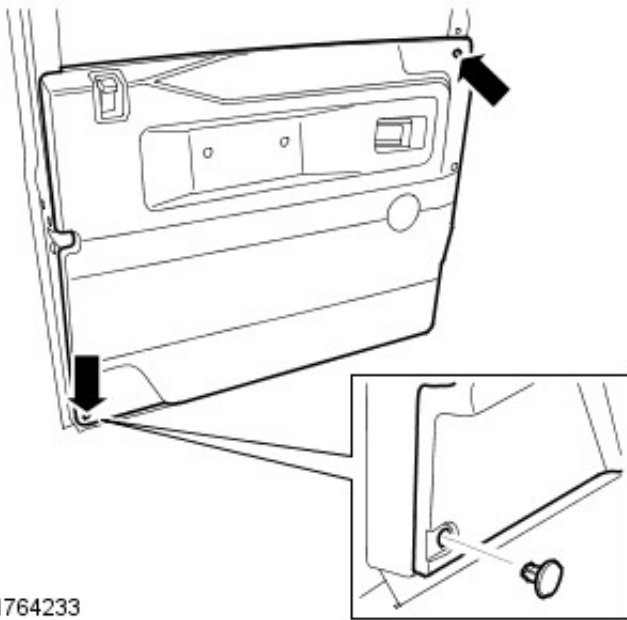
2. Remove screw securing door release escutcheon and remove escutcheon.



3. Remove sill button guide.



4. Remove 2 studs securing trim casing.

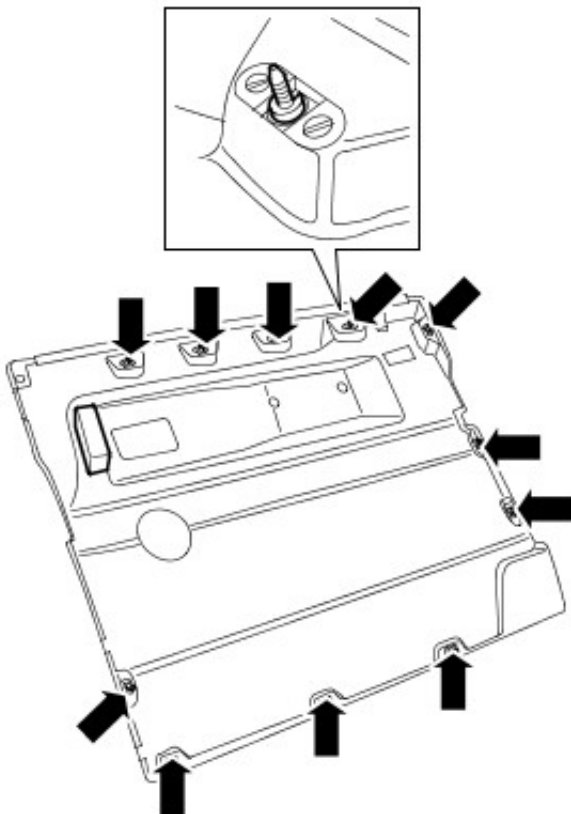


M764233

5. Using a trim removal tool, release 11 fasteners and remove trim casing.

6. **NOTE: Do not carry out further dismantling if component is removed for access only.**

Remove fasteners and anti-vibration pad from trim casing



M764234

Installation

1. Instal anti-vibration pad and fasteners to trim casing.
2. Position trim casing, align fasteners with holes in door and press firmly into position.
3. Instal trim studs to casing.
4. Instal sill button guide.
5. Instal escutcheon to door handle and secure with screws.

5. Instal escutcheon to door handle and secure with screw.

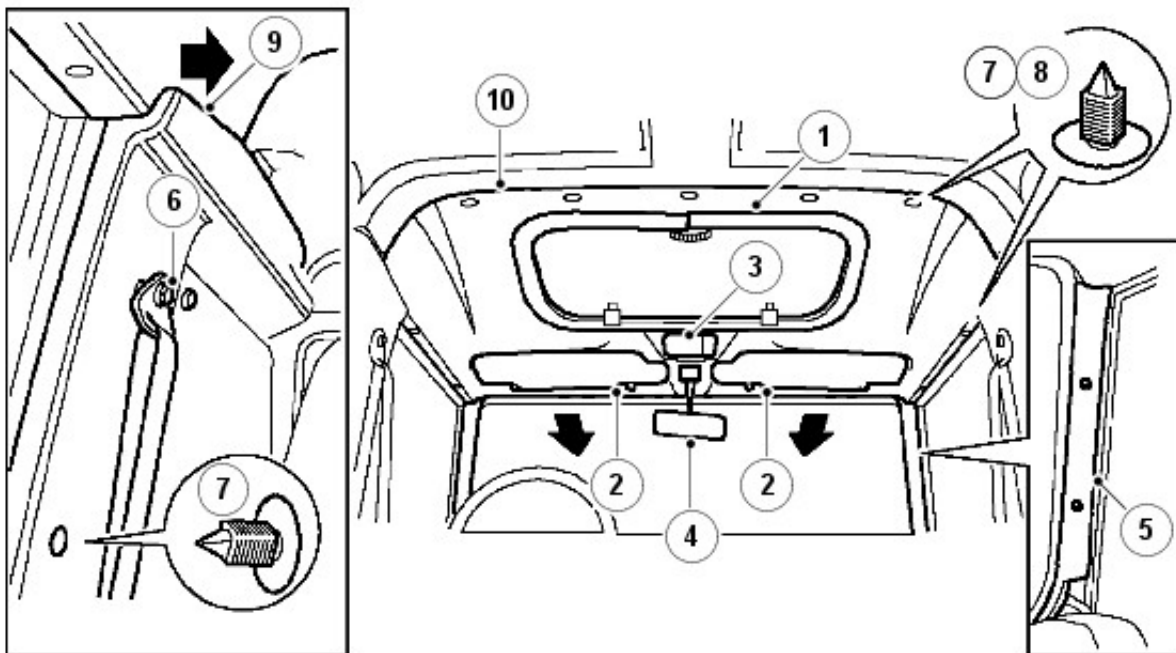
6. Instal door pull and secure with screws.

Interior Trim and Ornamentation - Front Headliner90/Station Wagon

Removal and Installation

Removal

1. Remove sun roof headlining finisher.
2. Remove sun visors.
For additional information, refer to: Sun Visor (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove interior lamp.
For additional information, refer to: Interior Lamp (417-02 Interior Lighting, Removal and Installation).
4. Remove interior mirror and mounting plate.
For additional information, refer to: Interior Mirror (501-09 Rear View Mirrors, Removal and Installation).
5. Remove 4 retaining screws and detach both 'A' post trims.
6. Remove caps and unscrew front seat belt fixing bolts from 'B' posts.
7. Carefully prise side trim panel cap fastener from 'B' posts.
8. Carefully prise 2 cap fasteners, from both sides, securing headlining to body at door aperture.
9. Carefully prise out 5 cap fasteners securing front and rear headlinings to roof.
10. From both sides, pull side trim panel inwards enough to release rear corners of front headlining.



2. NEVER take care not to bend the headlining on removal and refitting.

Lower headlining and remove from vehicle.

Installation

1. With assistance, raise headlining to roof.
2. Carefully pull side trim panel inwards, on both sides, and slide headlining behind trim panel.
3. Position front headlining into recess of rear headlining and secure both to roof mounting brackets with 5 cap fasteners.
4. Secure both sides of front headlining to body at door apertures with cap fasteners.
5. Fit side cap fasteners at 'B' posts.
6. Secure seat belts to 'B' posts and tighten bolts to 32 Nm (24 lbf/ft). Fit caps to bolts.
7. Fit 'A' post trims.
8. Fit interior mirror.
For additional information, refer to: Interior Mirror (501-09 Rear View Mirrors, Removal and Installation).
9. Fit interior lamp.
For additional information, refer to: Interior Lamp (417-02 Interior Lighting, Removal and Installation).
10. Fit sun visors.
For additional information, refer to: Sun Visor (501-05 Interior Trim and Ornamentation, Removal and Installation).
11. Fit sun roof headlining finisher.

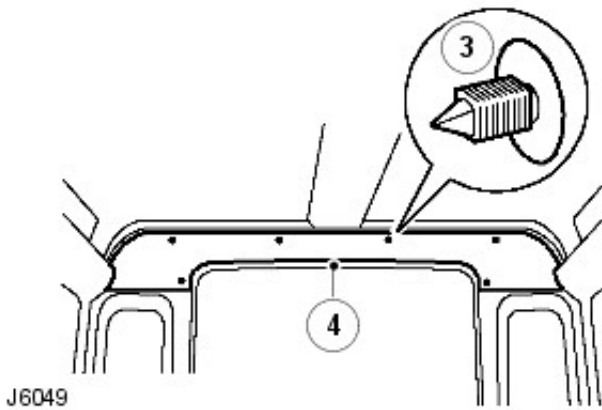
Interior Trim and Ornamentation - Headliner Rear Trim

Panel90/110/Station Wagon

Removal and Installation

Removal

1. Remove rear quarter trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05, Removal and Installation).
2. Remove rear grab handles.
For additional information, refer to: Rear Grab Handle (501-05, Removal and Installation).
3. Carefully prise out 6 trim studs securing rear end lining to mounting brackets.
4. Remove headliner rear trim panel.



Installation

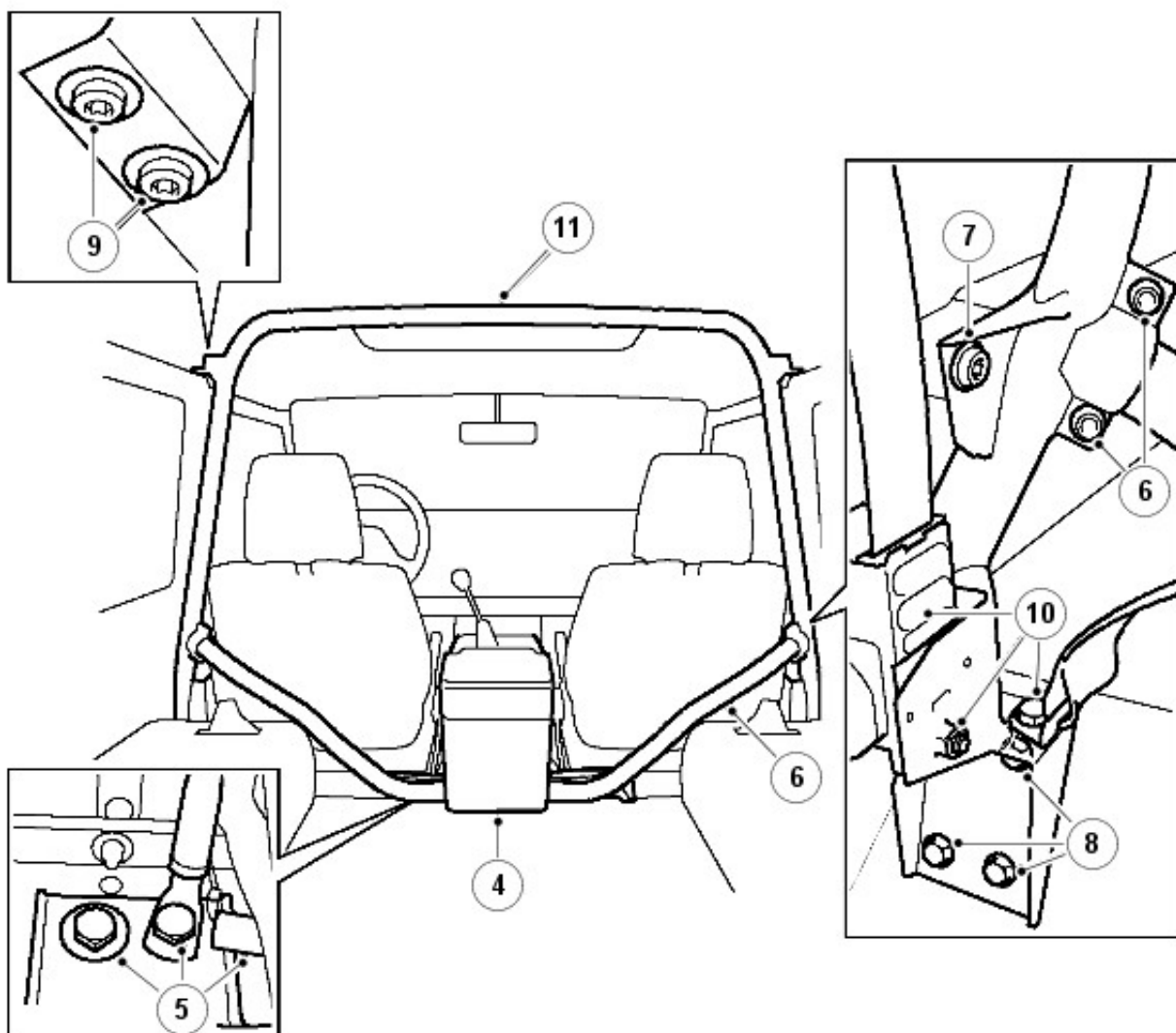
1. Position rear end lining on mounting brackets and secure with 6 trim studs.
2. Install rear grab handles.
For additional information, refer to: Rear Grab Handle (501-05, Removal and Installation).
3. Install rear end trim panel.
For additional information, refer to: Rear Quarter Trim Panel (501-05, Removal and Installation).

Interior Trim and Ornamentation - Interior Rollover Bar

Removal and Installation

Removal

1. Remove rear seat cushions.
For additional information, refer to: Rear Outer Seat Cushion (501-10, Removal and Installation) / Rear Seat Cushion (501-10, Removal and Installation).
2. Remove cowl side trim panels.
For additional information, refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove C-pillar upper trim panel.
For additional information, refer to: C-Pillar Upper Trim Panel - 4.0L, 90 (501-05, Removal and Installation) / Cowl Side Trim Panel (501-05, Removal and Installation).
4. Remove floor console extension.
For additional information, refer to: Floor Console Extension (501-12, Removal and Installation).
5. Remove 4 bolts securing centre section of rollover bar and seat belt stalks to floor.
6. Remove 2 torx bolts and nuts from both sides and detach centre section of rollover bar assembly.
7. Remove torx bolt, from both sides, securing rollover bar to body side mounting brackets.
8. Remove 3 bolts and washers, from both sides, securing lower rollover bar brackets to front of wheelarch.
9. Remove 2 torx bolts and washers, from both sides, securing rollover bar upper mountings to roof fixing brackets and carefully lower complete assembly to floor.
10. Unscrew retaining bolts, from both sides, and remove front seat belt inertia reels and rear seat belts from rollover bar mounting.
11. Supporting from both sides, raise and tilt rollover bar rearwards to clear wheel arches.



76M2381

12. **NOTE:** Assistance may be required to remove rollover bar.

Remove rollover bar from vehicle.

Installation

1. Supporting from both sides, position rollover bar, engage struts in rear corners and front of side panels. Align on floor.
2. Secure front seat belt inertia reels and rear seat belts to rollover bar mountings. Tighten bolts to 32 Nm (24 lbf.ft).
3. Raise rollover bar assembly and secure to roof mounting brackets. Tighten bolts to 45 Nm (33 lbf.ft).
4. Secure rollover bar to wheel arches. Tighten bolts to 45 Nm (33 lbf.ft).
5. Secure rollover bar to body side mounting brackets, tightening bolts to 45 Nm (33 lbf.ft).

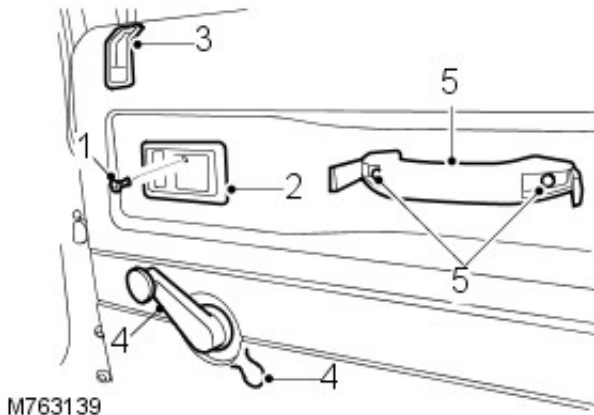
6. Secure centre section to main rollover bar, but do not fully tighten fixing bolts at this stage.
7. Secure seat belt stalks and rollover bar floor mounting brackets to chassis. Tighten bolts to 32 Nm (24 lbf ft.).
8. Fully tighten rollover bar centre section retaining bolts to 45 Nm (33 lbf.ft).
9. Fit floor console extension.
For additional information, refer to: Floor Console Extension (501-12, Removal and Installation).
10. Fit C-pillar upper trim panel.
For additional information, refer to: C-Pillar Upper Trim Panel - 4.0L, 90 (501-05, Removal and Installation) /
Cowl Side Trim Panel (501-05, Removal and Installation).
11. Fit cowl side trim panels.
For additional information, refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).
12. Fit rear seat cushions.
For additional information, refer to: Rear Outer Seat Cushion (501-10, Removal and Installation) /
Rear Seat Cushion (501-10, Removal and Installation).

Interior Trim and Ornamentation - Rear Door Trim Panel

Removal and Installation

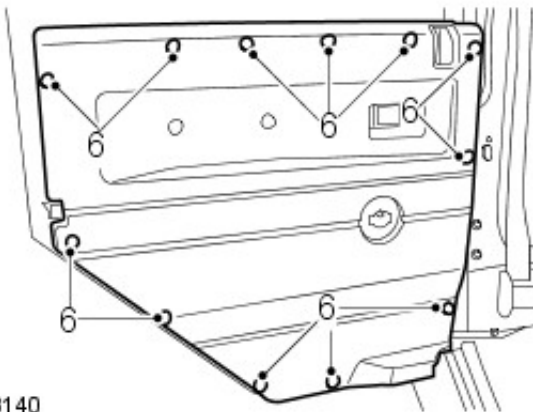
Removal

1. Remove screw securing door handle escutcheon.
2. Remove escutcheon.
3. Remove interior lock button bezel.
4. Remove retaining clip and remove door glass regulator handle.
5. Release covers and remove 2 screws securing door pull to door.



M763139

6. Carefully release 12 clips securing trim casing to door and remove door casing.



M763140

Installation

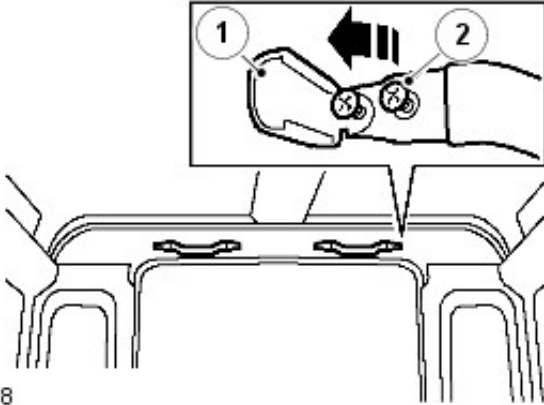
1. Instal trim casing to door and secure with clips.
2. Instal door glass regulator handle.
3. Instal escutcheon to door handle and tighten screw.
4. Instal door lock button bezel.
5. Instal door pull and secure with screws.

Interior Trim and Ornamentation - Rear Grab Handle90/110/Station Wagon

Removal and Installation

Removal

1. Carefully prise top and bottom edges of finisher caps from grab handle and then hinge outwards to gain access to fixing screws.
2. Remove 4 fixing screws and detach grab handle from rear end trim panel.



J6048

Installation

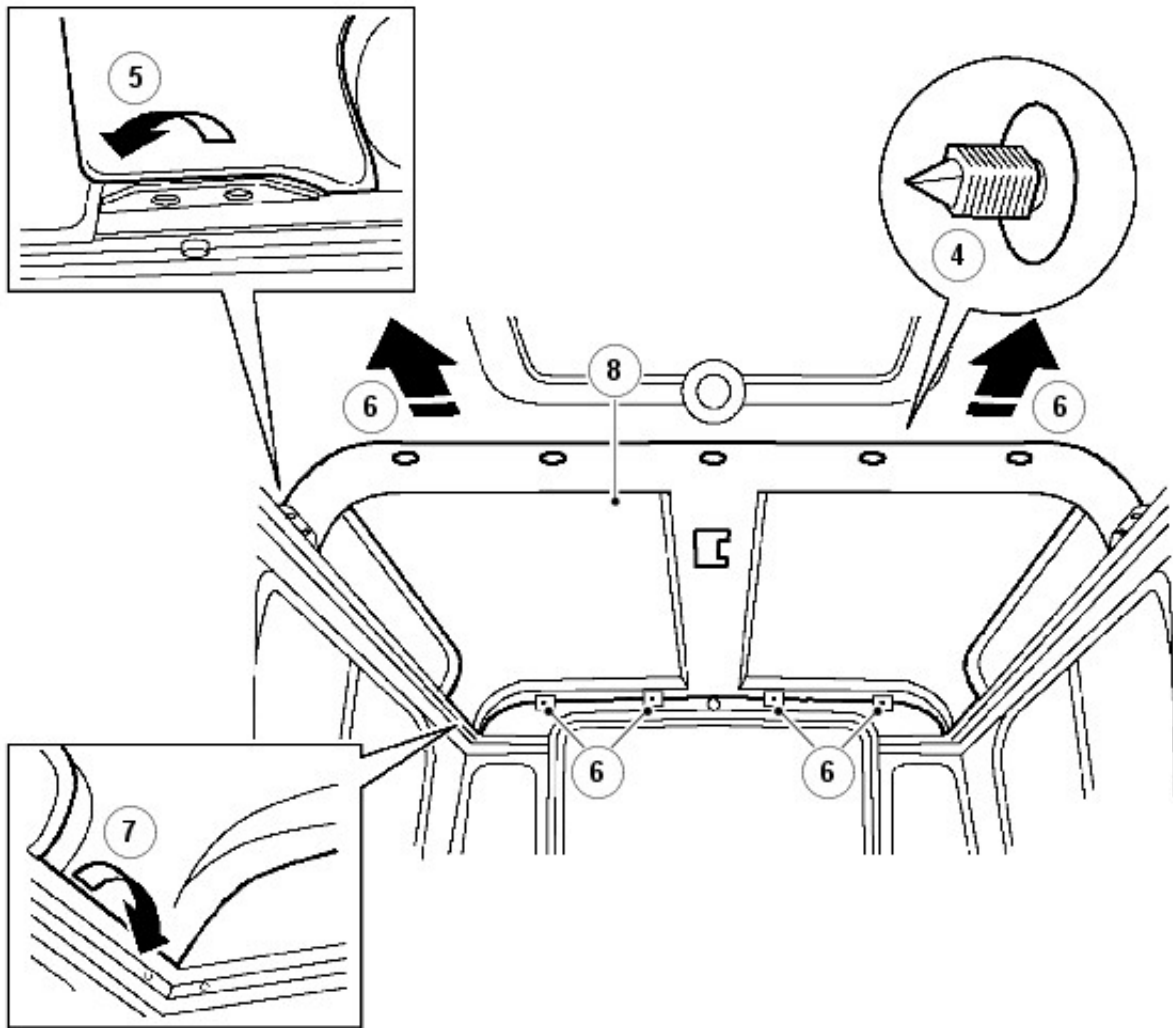
1. Position grab handle on rear end trim panel and secure with 4 fixing screws.
2. Press finisher caps over screws.

Interior Trim and Ornamentation - Rear Headliner90/Station Wagon

Removal and Installation

Removal

1. Remove C-Pillar upper trim panels. For additional information, refer to: (501-05 Interior Trim and Ornamentation)
C-Pillar Upper Trim Panel - 90 (Removal and Installation),
C-Pillar Upper Trim Panel - 110 (Removal and Installation).
2. Remove headliner rear trim panel.
For additional information, refer to: Headliner Rear Trim Panel - 90/110 (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove rear interior lamp.
For additional information, refer to: Interior Lamp (417-02 Interior Lighting, Removal and Installation).
4. Carefully prise out 5 trim studs securing rear and front headliner to roof mounting brackets.
5. Release front corners of headliner from cant rail, on both sides.
6. Pull headliner forwards sufficiently to clear rear end lining mounting brackets.
7. Release rear corners of headliner from cant rail, on both sides.
8. **NOTE: Take care not to bend headliner on removal and refitting.**
Lower rear headliner from roof and remove from vehicle.



J6363

Installation

1. With assistance, position rear headliner to roof and locate rear corners in cant rail.
2. Push headliner rearwards and position over rear end lining mounting brackets.
3. Locate front corners of headliner in cant rail.
4. Position front edge of rear headliner over front headliner and secure with trim studs.
5. Adjust rear headliner to achieve good fit at all corners.
6. Instal rear interior lamp.
For additional information, refer to: Interior Lamp (417-02 Interior Lighting, Removal and Installation).
7. Instal headliner rear trim panel.
For additional information, refer to: Headliner Rear Trim Panel -

90/110 (501-05 Interior Trim and Ornamentation, Removal and Installation).

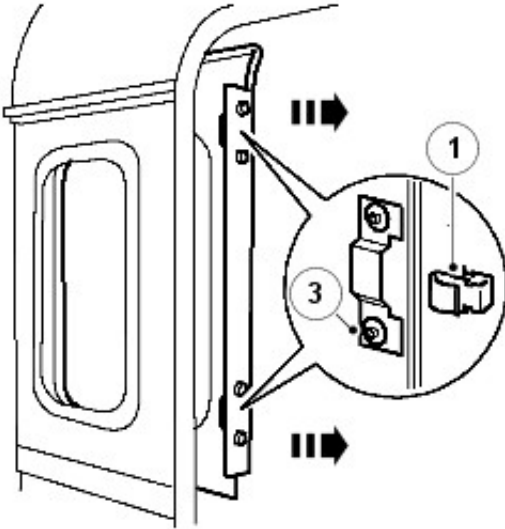
8. Instal C-pillar upper trim panels. For additional information, refer to:
(501-05 Interior Trim and Ornamentation)
C-Pillar Upper Trim Panel - 90 (Removal and Installation),
C-Pillar Upper Trim Panel - 110 (Removal and Installation).

Interior Trim and Ornamentation - Rear Quarter Trim Panel

Removal and Installation

Removal

1. Pull edge of rear quarter trim panel firmly to release 2 spring retaining clips from vertical rail at door aperture.
2. Remove rear quarter trim panel.
3. Remove spring clips from the 2 brackets on side of trim panel.



J6045

Installation

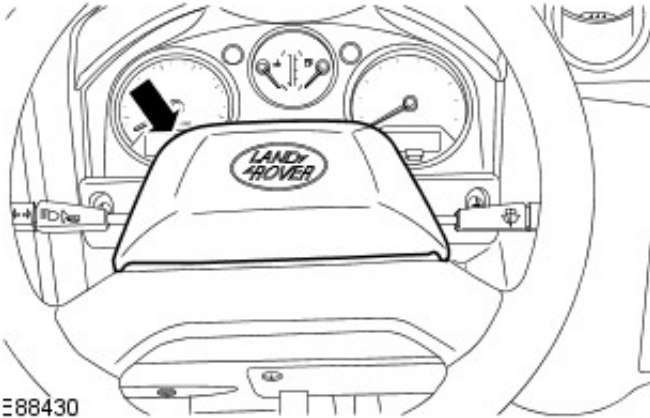
1. Instal new spring clips to the 2 brackets on side of trim panel.
2. Position outboard edge of trim panel in corner to abut quarter trim panel and locate spring clips on vertical rail.
3. Press edge of trim panel firmly to secure in position.

Interior Trim and Ornamentation - Steering Column Shrouds

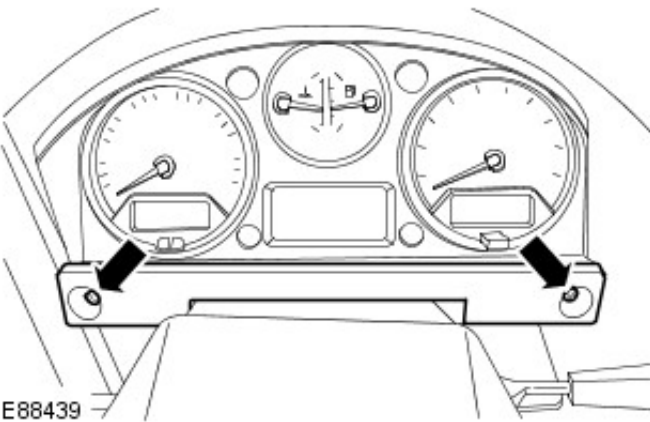
Removal and Installation

Removal

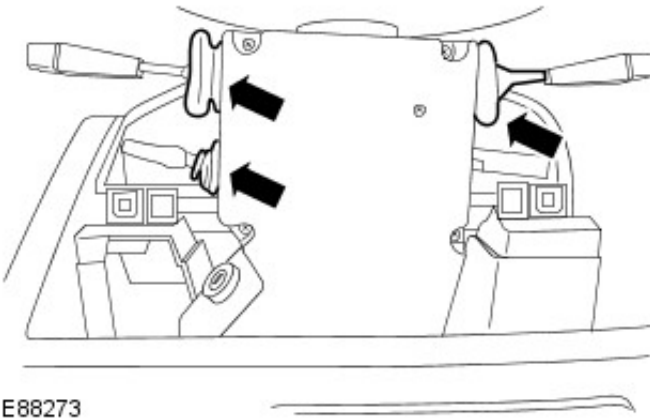
1. Remove the steering wheel center pad.



2. Remove the instrument cluster lower finisher.
 - Remove the 2 screws.



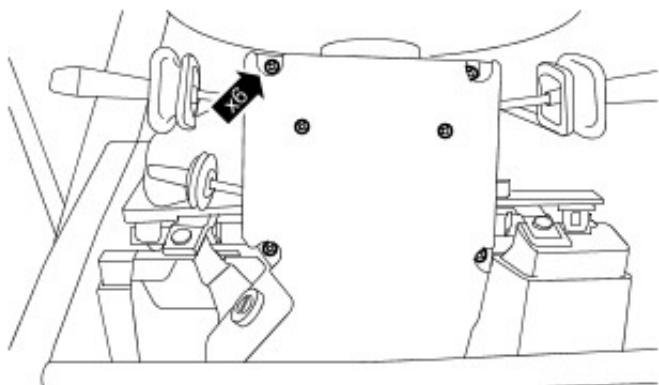
3. Release the 3 grommets from the steering column shrouds.



4. Remove the grommet.

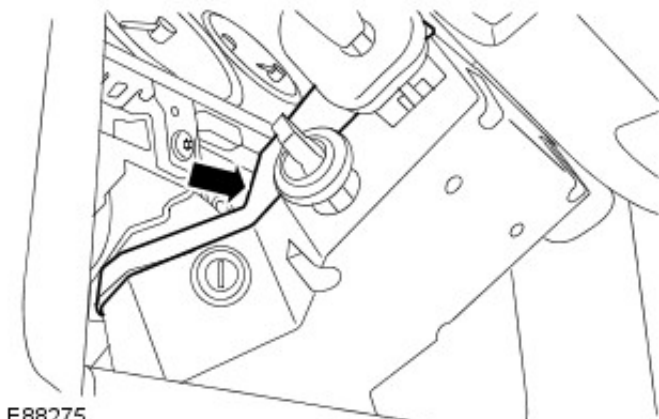


5. Remove the 6 screws.



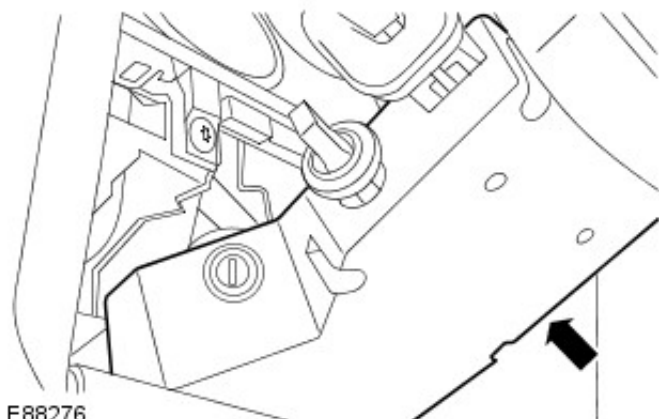
E88274

6. Remove the upper steering column shroud.



E88275

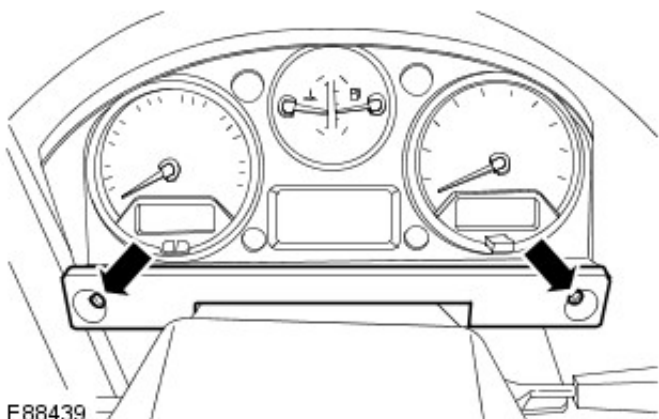
7. Remove the lower steering column shroud.



E88276

Installation

1. To install, reverse the removal procedure.
 - Tighten to 2 Nm (1 lb.ft).



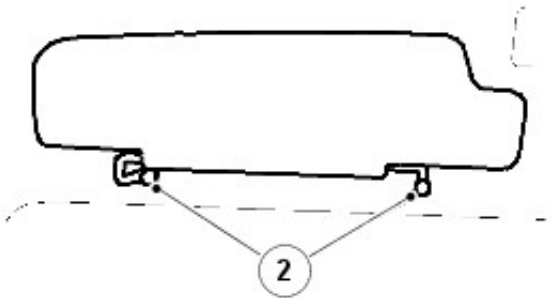
E88439

Interior Trim and Ornamentation - Sun Visor

Removal and Installation

Removal

1. Raise sun visor.



J6053

2. Remove 2 screws and collect sun visor.

Installation

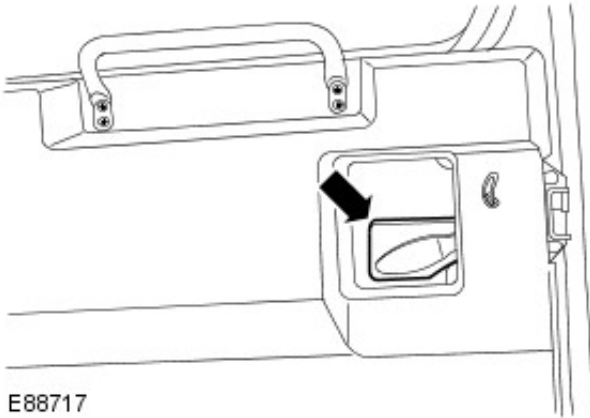
1. Position sun visor and secure with 2 screws.

Interior Trim and Ornamentation - Taildoor Trim Panel

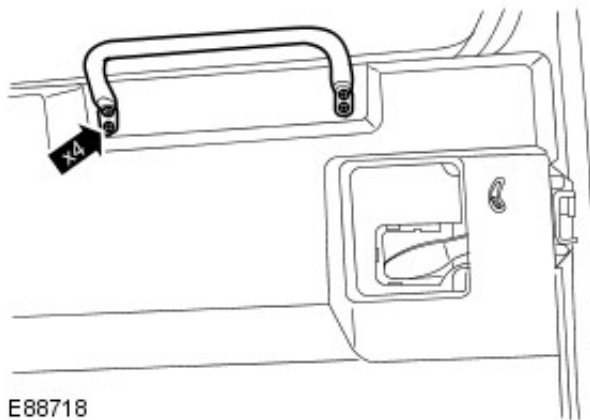
Removal and Installation

Removal

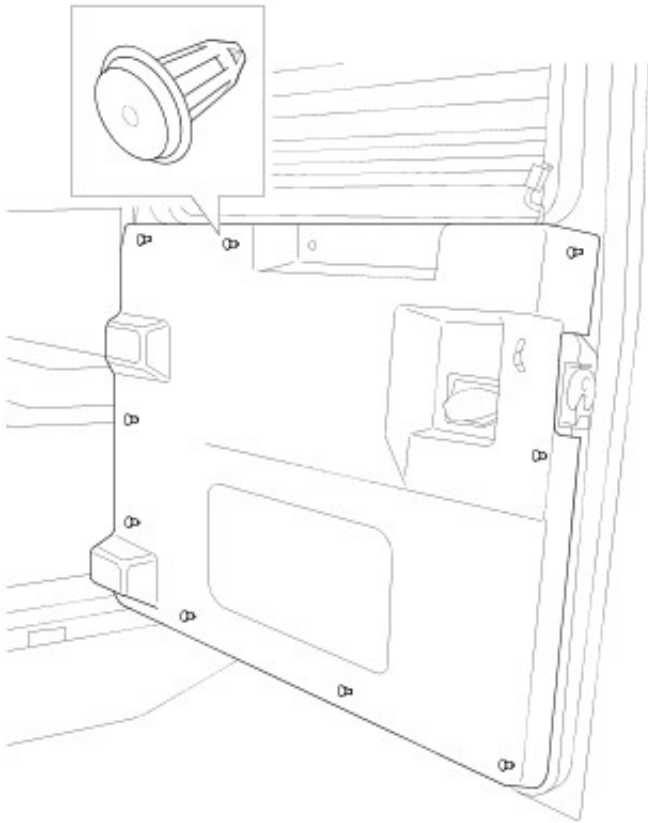
1. Remove the taildoor trim panel trim finisher.



2. Remove the taildoor grab handle.
 - Remove the 4 screws.



3. Remove the taildoor trim panel.
 - Release the 9 clips.



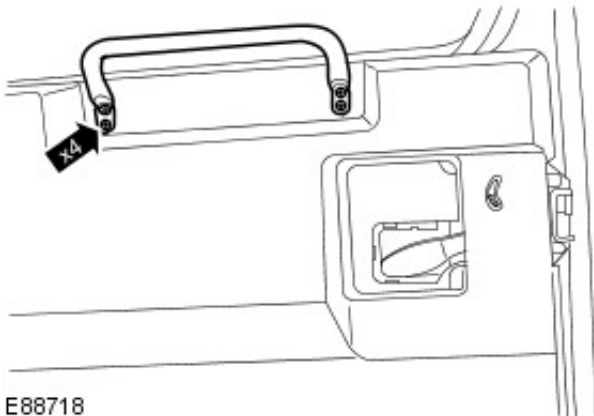
E91086

4. **NOTE:** Do not carry out further dismantling if component is removed for access only.

Remove the 9 clips from the taildoor trim panel.

Installation

1. To install, reverse the removal procedure.
 - Tighten to 6 Nm (4 lb.ft).



E88718

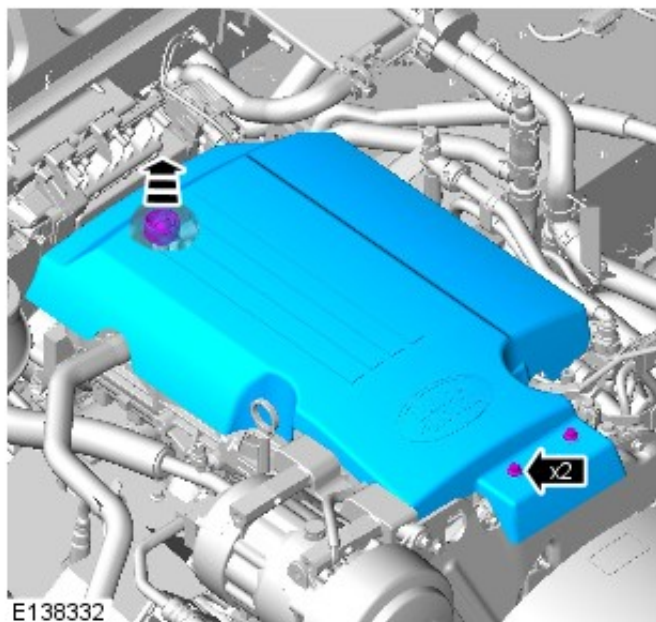
Interior Trim and Ornamentation - Engine Cover

Removal and Installation

Removal

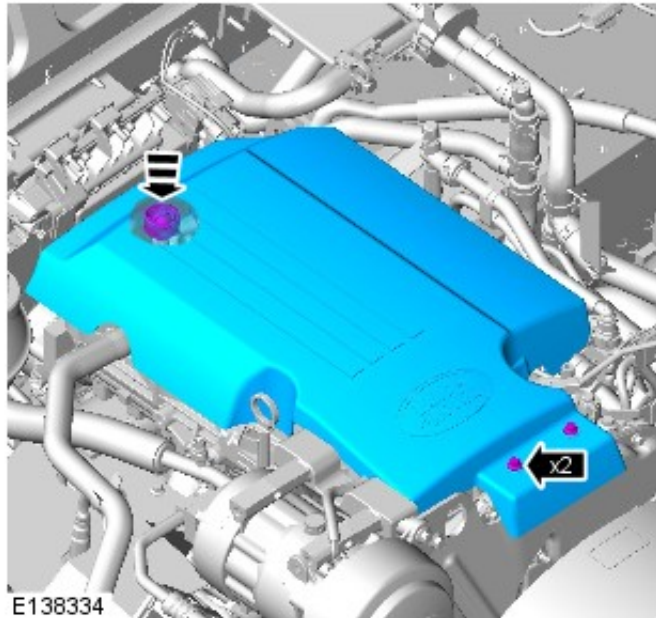
1. Open the bonnet.

2.



Installation

1. Torque: 10 Nm



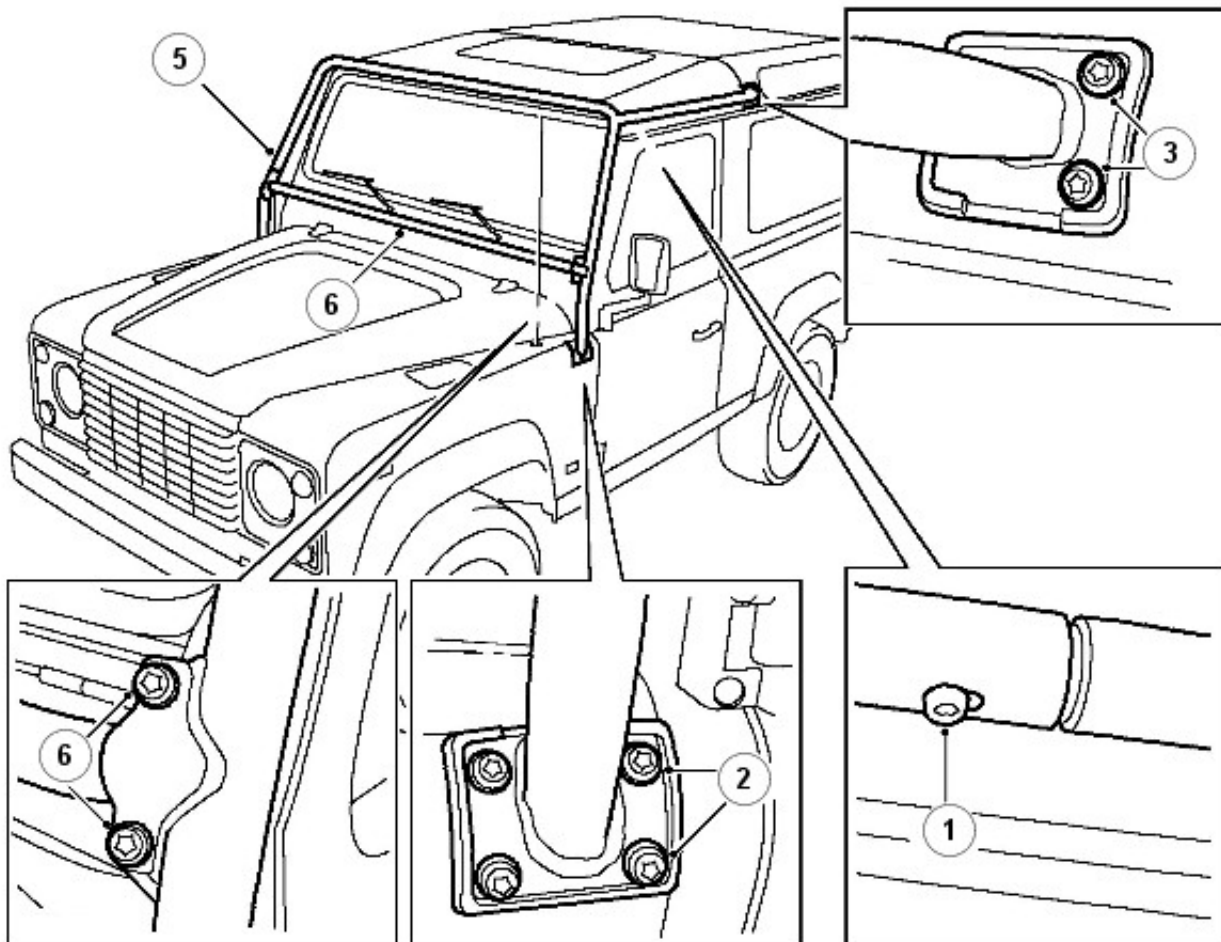
2. Close the bonnet.

Exterior Trim and Ornamentation - Exterior Rollover Bar

Removal and Installation

Removal

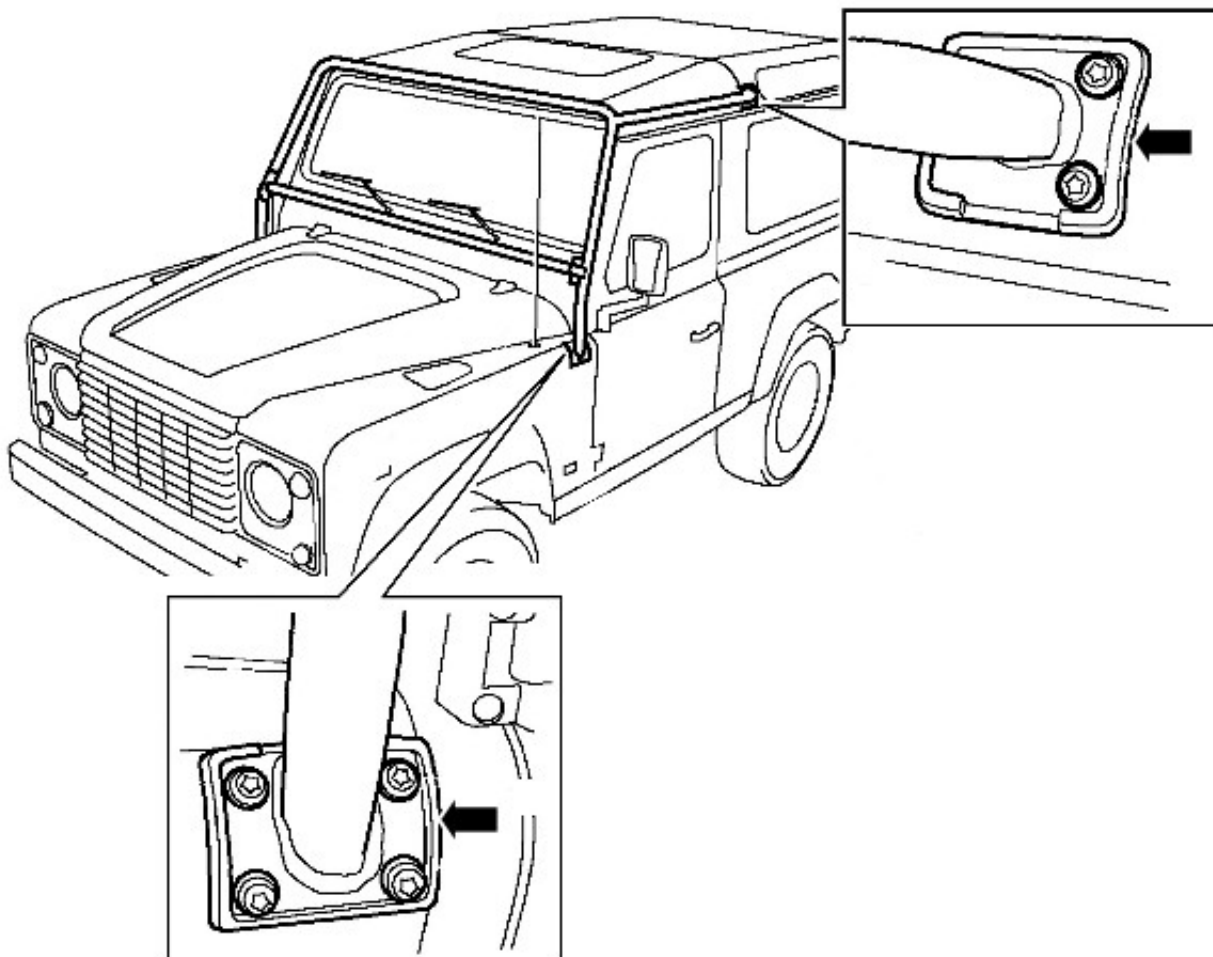
1. Remove Torx bolt, from both sides, securing top of rollover bar to roof mounted bar.
2. With assistance to support rollover bar at windshield, remove 4 Torx bolts, from both sides, securing rollover bar to fender mounting.
3. Remove two Torx bolts, from both sides, securing top bar to roof mounting.
4. Slide top bars rearwards to disengage from main rollover bar assembly.
5. Lift main rollover bar assembly from vehicle.
6. If necessary, remove 2 Torx bolts and nuts, from both sides, and detach lower cross bar from main rollover bar.



E82155

Installation

1. Locate lower cross bar into main rollover bar mounting brackets and secure with Torx bolts and nuts tightened to 25 Nm (18 lbf.ft).
2. Ensure rubber gaskets are fitted correctly to rollover bar mounting brackets.



E82105

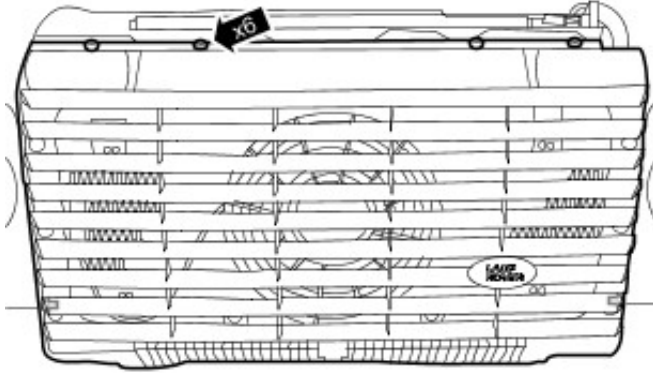
3. With assistance, lift rollover bar assembly and position on fenders.
4. Slide top bars into main rollover bar, position on roof mounting and secure with Torx bolts to 25 Nm (18 lbf.ft.).
5. Secure rollover bar to both fender mountings with Torx bolts. Tighten to 25 Nm (18 lbf.ft.).
6. Secure top bars to main rollover bar and tighten fixing bolts to 25 Nm (18 lbf.ft.).

Exterior Trim and Ornamentation - Radiator Grille

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01, General Procedures).
2. Remove the radiator grille.
 - Remove the 6 screws.



E86147

Installation

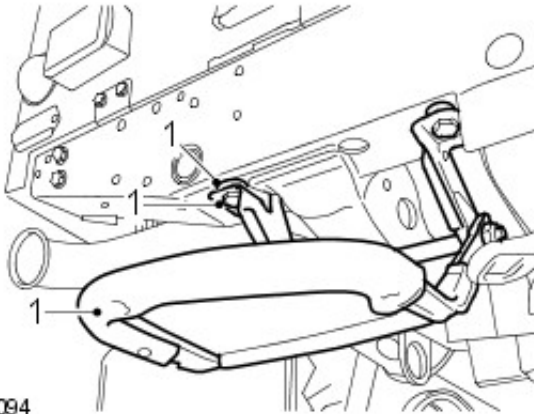
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01, General Procedures).

Exterior Trim and Ornamentation - Rear Folding Step

Removal and Installation

Removal

1. Remove 2 bolts securing step to chassis member, remove step and collect spacers.



M763094

Installation

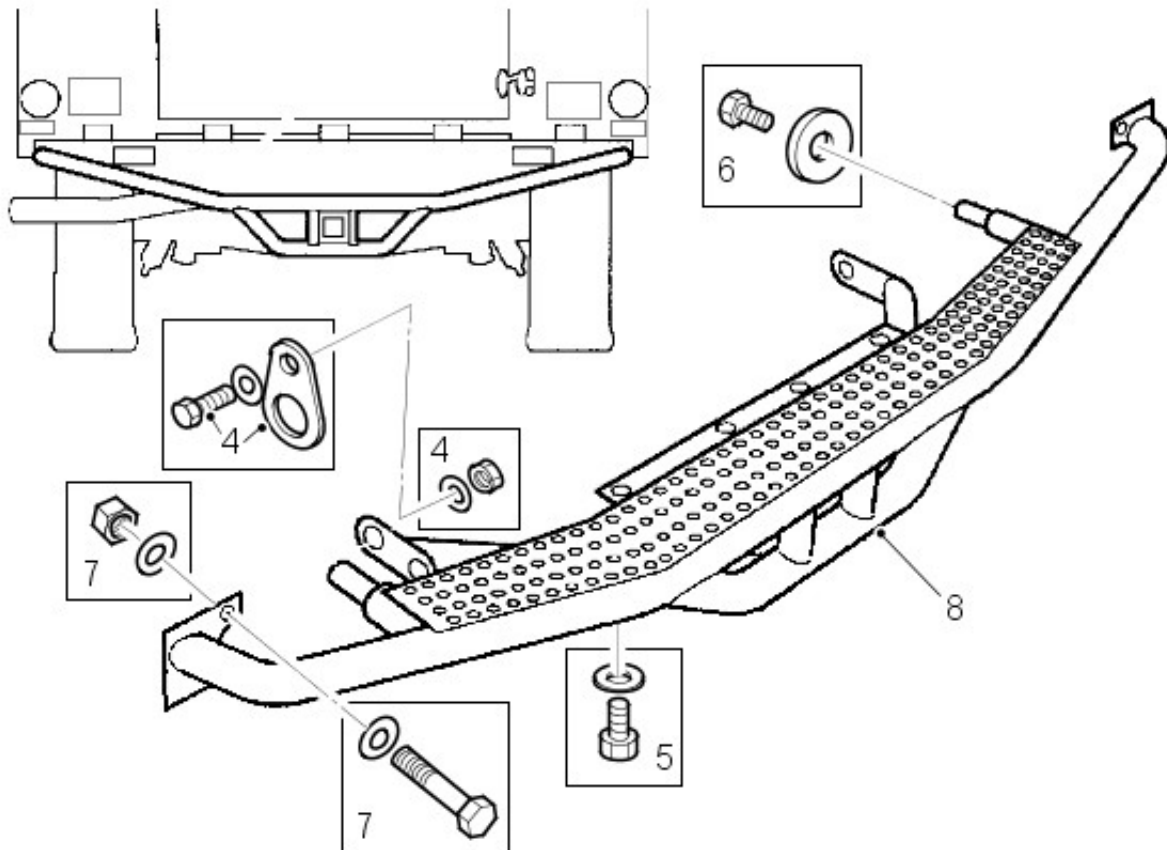
1. Position step, fit spacer washers and tighten bolts.

Exterior Trim and Ornamentation - Towbar

Removal and Installation

Removal

1. Remove 4 bolts securing stabilizer bar to rear undershield.
2. Remove 6 bolts securing rear undershield to chassis.
3. Remove rear undershield.
4. Remove bolt, washer and nut from both sides, securing tow bar lower mounting brackets and towing eyes to chassis.
5. Remove 4 bolts and spring washers securing tow bar centre mounting bracket to chassis.
6. Remove both bolts securing 2 tow bar locating tubes in chassis rear cross member.
7. Remove 2 bolts securing tow bar top mounting brackets to chassis.
8. With assistance, withdraw tow bar assembly from chassis.



E82156

Installation

1. With assistance, lift tow bar assembly and locate both tubes in chassis crossmember.
2. Secure top tow bar mounting brackets to chassis but do not fully tighten fixings.
3. Secure tow bar locating tubes to rear of chassis and tighten bolts to 25 Nm (18 lbf.ft).
4. Secure tow bar centre mounting bracket to underside of chassis and

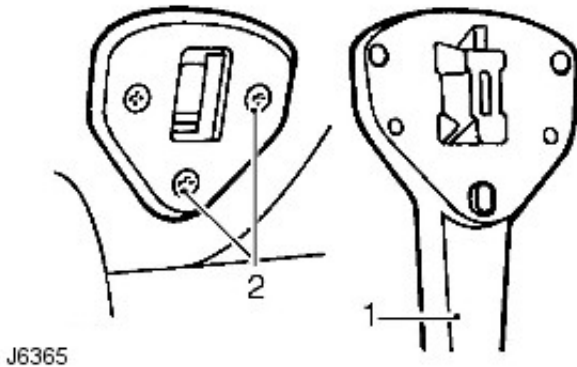
- .. Secure tow bar center mounting bracket to underside of chassis and tighten bolts to 25 Nm (18 lbf.ft).
5. Position towing eyes to lower mounting brackets and secure to chassis and tighten bolts to 25 Nm (18 lbf.ft).
6. Fully tighten tow bar top mounting bracket bolts to 25 Nm (18 lbf.ft).
7. Fit rear undershield and secure to chassis with bolts.
8. Fit bolts securing rear stabilizer bar and tighten to 30 Nm (22 lbf.ft).

Rear View Mirrors - Interior Mirror

Removal and Installation

Removal

1. Prise interior mirror arm from mounting plate.
2. Remove 3 screws and remove mounting plate from headlining.



J6365

Installation

1. Install mounting plate to headlining.
2. Locate lower lug of mirror arm in mounting plate aperture.
3. Press mirror arm firmly to engage the spring clip.

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Seating -

Torque Specifications

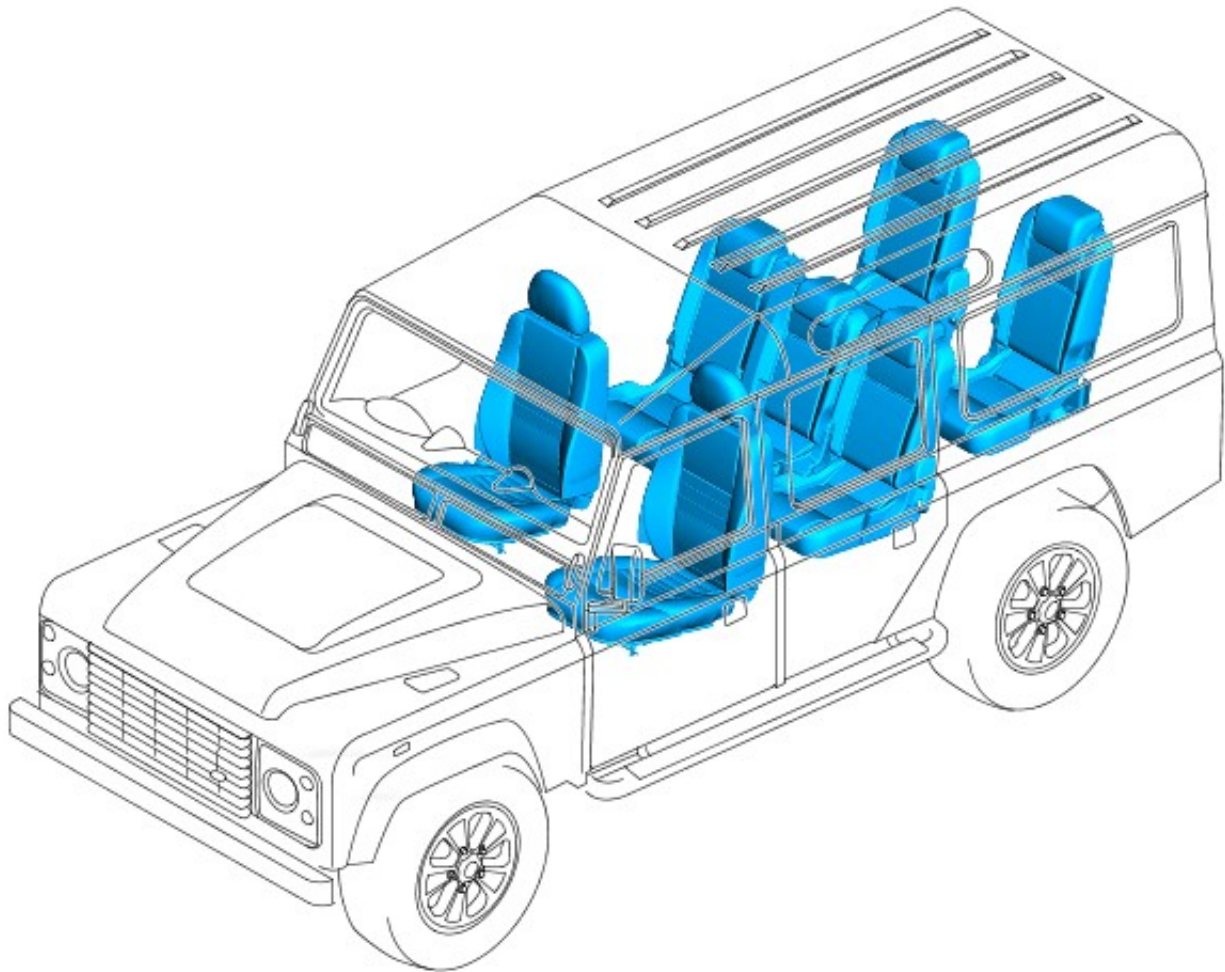
Description	Nm	lb-ft
Rear seat base stop bolt	23	17
Rear seat bolts	23	17
Rear seat nuts	23	17
+ Front seat backrest nuts and bolts	23	17
Front seat bolts	23	17
Third row seat bolts	23	17
Third row seat nuts	23	17
Third row seat nut and bolt	23	17

+ New nuts must be installed

Seating - Seats

Description and Operation

COMPONENT LOCATION



E83752

OVERVIEW

Vehicles from 2007 model year are fitted with an all new seating system. The front seats are manually adjustable for reach and recline. Some vehicles may also feature heated front seats. The heated front seats will only operate when the ignition is switched on.

The second row seats feature a 60/40 split and are able to be folded forward to increase the loadspace in the rear of the vehicle. Defender 110 Station Wagons are fitted with 2 forward facing third row seats. The third row seats can be stowed at the side of the cabin to increase the loadspace in the rear of the vehicle. For more information on seat stowage, refer to the Owners Handbook.

PRINCIPLES OF OPERATION

Heated Front Seats

When the ignition switch is in position II (ignition on) a feed is provided to the window lift relay coil via the central junction box (CJB). The ground path for the relay coil is controlled by the left-hand (LH) and right-hand (RH) heated seat switches. When either switch is pressed, the relay energizes and provides a battery voltage feed to the appropriate seat heater elements. Both seats contain 2 heating elements; 1 in the cushion, 1 in the backrest, which are wired in series.

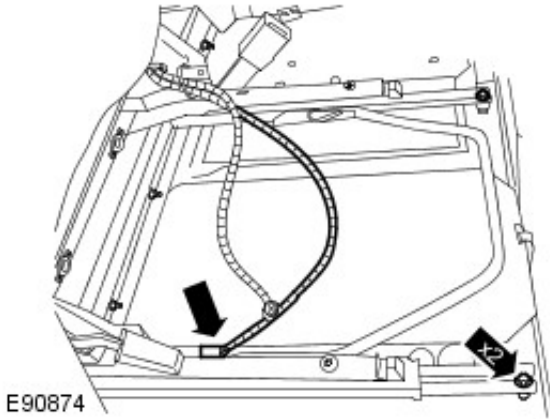
The cushion elements in both front seats contain a thermostatically controlled switch. When the cushion element temperature reaches $37 \pm 3^{\circ}\text{C}$ ($98 \pm 3^{\circ}\text{F}$) the thermostat cuts the supply to both the cushion and backrest elements. When the temperature of the cushion element falls below $28 \pm 3^{\circ}\text{C}$ ($82 \pm 3^{\circ}\text{F}$) the thermostat reinstates the supply to both heater elements.

Seating - Front Seat

Removal and Installation

Removal

1. Remove the front seat cushion.
For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).
2. Remove the front 2 bolts from the front seat.
 - Disconnect the front seat heater mat electrical connector.



3. Remove the front seat.
 - Slide the front seat forwards.
 - Remove the 2 bolts.
 - Collect the 8 spacer washers.



Installation

1. To install, reverse the removal procedure.
 - Tighten the bolts to 23 Nm (17 lb.ft).

Seating - Front Seat Backrest

Removal and Installation

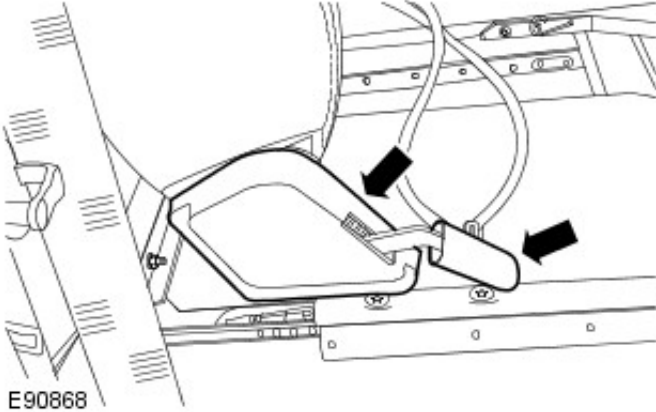
Removal



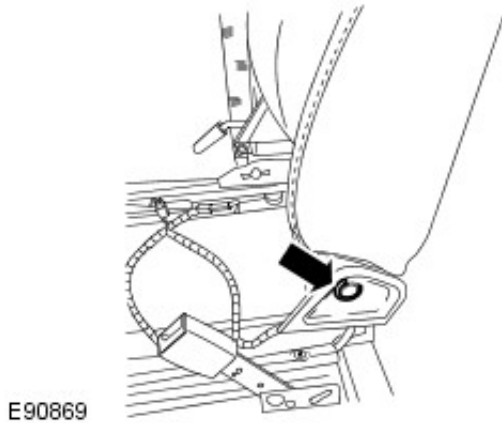
CAUTION: Do not attempt to adjust or dismantle the front seat tilt mechanism, the front seat backrest must be replaced as a complete assembly, failure to follow this instruction may result in damage to the vehicle.

1. Remove the front seat cushion.
For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).

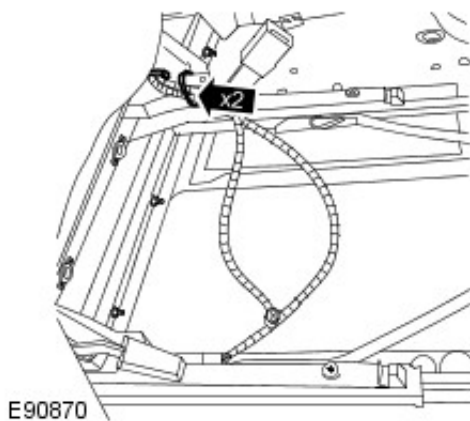
2. Remove the front seat backrest hinge cover.
 - Remove the front seat recliner handle.



3. Remove the front seat backrest hinge clip.



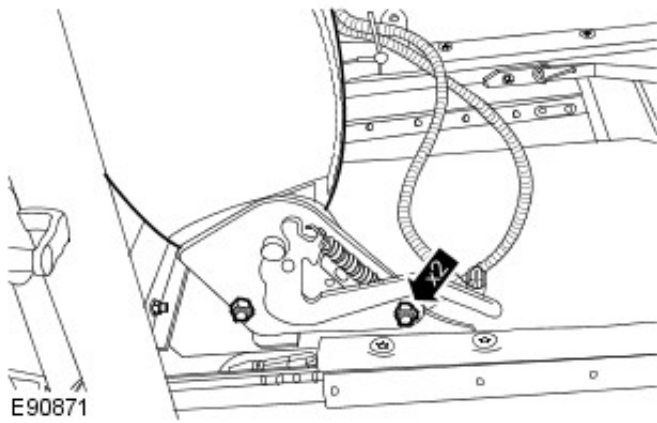
4. Release the front seat heater mat wiring harness.
 - Remove and discard the 2 cable ties.



5. **NOTE:** Discard the nuts.

Remove the front seat backrest.

- Remove the 2 nuts and bolts.



Installation

1. **NOTE:** New nuts must be installed.

Install the front seat backrest.

- Tighten the nuts and bolts to 23 Nm (17 lb.ft).

2. Secure the front seat heater mat wiring harness.
 - Install new cable ties.

3. Install the front seat backrest hinge clip.

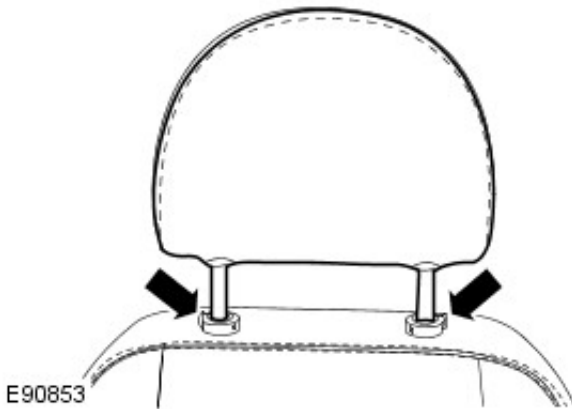
4. Install the front seat backrest hinge cover.
 - Install the front seat recliner handle.

Seating - Front Seat Backrest Cover

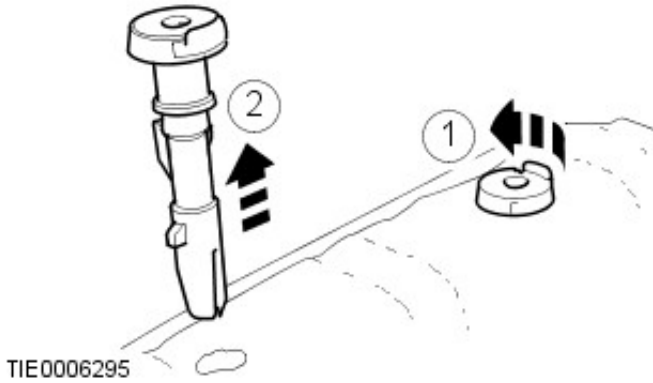
Removal and Installation

Removal

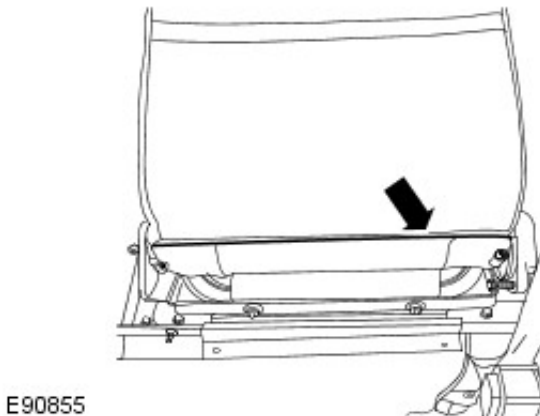
1. Remove the front seat head restraint.
 - Release the 2 clips.



2. Remove the front seat head restraint guides.
 - Turn the front seat head restraint guides 90 degrees counter clockwise.



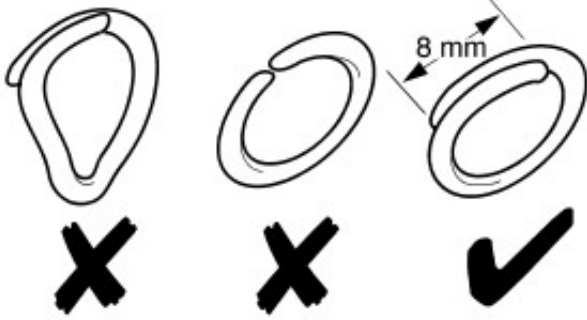
3. Release the front seat cover lower closing strip.




4. Remove the front seat backrest cover.
 - Remove and discard the 11 hog rings.



Installation



1.  **CAUTION:** Care must be taken when installing the hog rings, failure to follow this instruction may result in damage to the vehicle.

NOTE: Use hog ring pliers to close the hog rings. Do not use any other tool. The hog rings must be closed to overlap as illustrated.

To install, reverse the removal procedure.

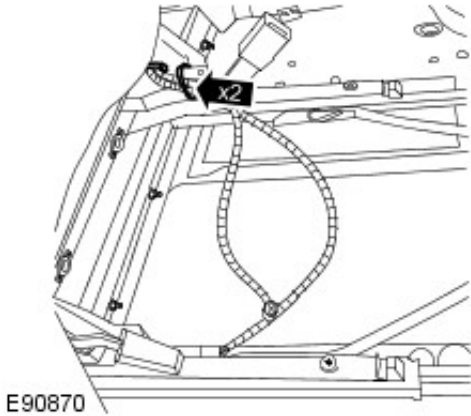
VUJ0005059

Seating - Front Seat Backrest Heater Mat

Removal and Installation

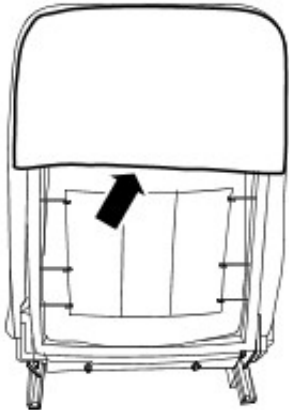
Removal

1. Remove the front seat backrest cover.
For additional information, refer to: Front Seat Backrest Cover (501-10, Removal and Installation).
2. Release the front seat heater mat wiring harness.
 - Remove and discard the 2 cable ties.



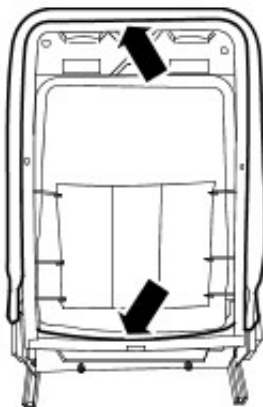
E90870

3. Remove and discard the front seat backrest foam backing.



E90850

4. Remove and discard the front seat backrest cushion.

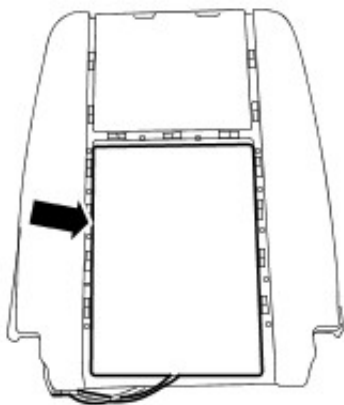


E90851

Installation

1. Install the front seat backrest heater mat to the front seat backrest cushion.

E90852



2. **NOTE: Clean the component mating faces.**

Install the front seat backrest cushion.

- Secure the front seat backrest cushion using a suitable adhesive.

3. Install the front seat backrest foam backing.

4. Secure the front seat heater mat wiring harness.

- Install new cable ties.

5. Install the front seat backrest cover.

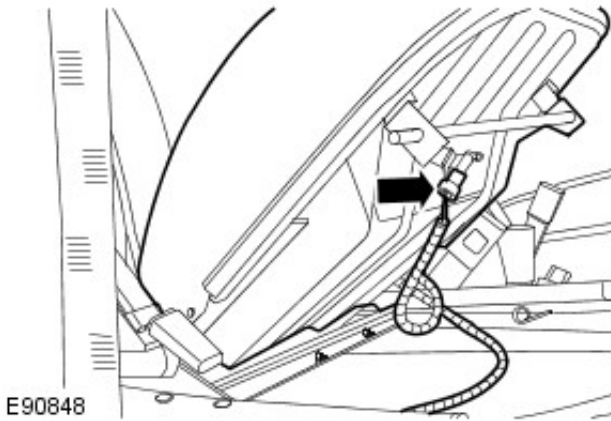
For additional information, refer to: Front Seat Backrest Cover (501-10, Removal and Installation).

Seating - Front Seat Cushion

Removal and Installation

Removal

1. Remove the front seat cushion.
 - Lift the front edge of the front seat cushion.
 - Disconnect the front seat cushion heater mat electrical connector.



E90848

Installation

1. To install, reverse the removal procedure.

Seating - Front Seat Cushion Cover

Removal and Installation

Removal

1. [NOTE: The front seat cushion cover is part of the front seat cushion and cannot be serviced separately.](#)

Remove the front seat cushion.

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

Installation

1. Install the front seat cushion.
For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).

Seating - Front Seat Cushion Heater Mat

Removal and Installation

Removal

1. [NOTE: The front seat cushion heater mat is part of the front seat cushion and cannot be serviced separately.](#)

Remove the front seat cushion.

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

Installation

1. Install the front seat cushion.
For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).

Seating - Heated Seat Switch

Removal and Installation

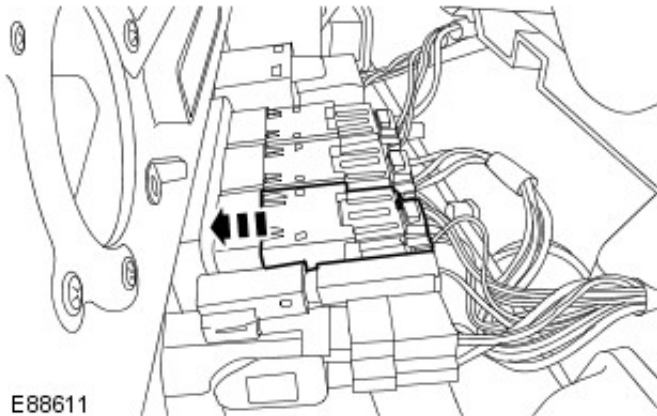
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).
3. Release the instrument panel console.



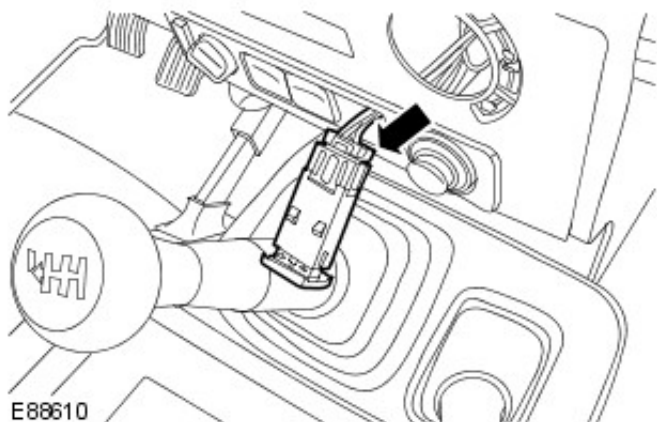
E88434

4. Release the heated seat switch.



E88611

5. Remove the heated seat switch.
 - Disconnect the electrical connector.



E88610

Installation

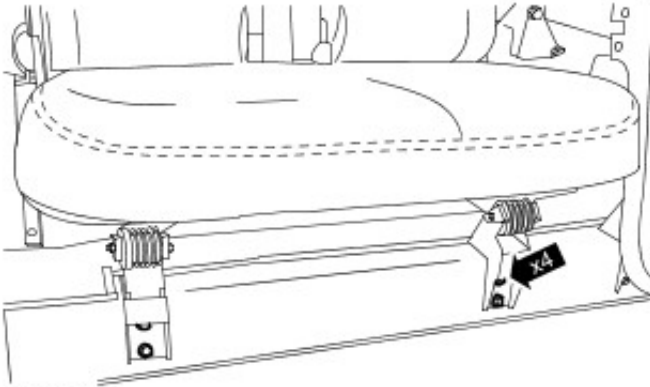
1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Seating - Rear Seat

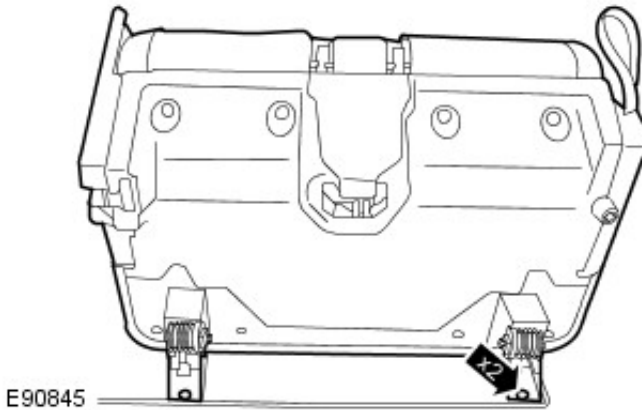
Removal and Installation

Removal

1. Release the front edge of the rear seat.
 - Remove the upper 2 bolts.
 - Loosen the lower 2 bolts.



2. Remove the rear seat.
 - Tilt the rear seat forwards.
 - Remove the 2 nuts.



Installation

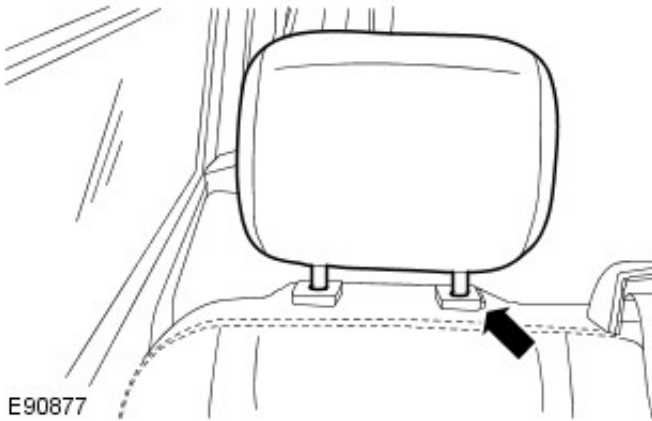
1. Install the rear seat.
 - Tighten the nuts to 23 Nm (17 lb.ft).
 - Lock the rear seat back in to position.
2. Secure the front edge of the rear seat.
 - Tighten the bolts to 23 Nm (17 lb.ft).

Seating - Rear Seat Backrest

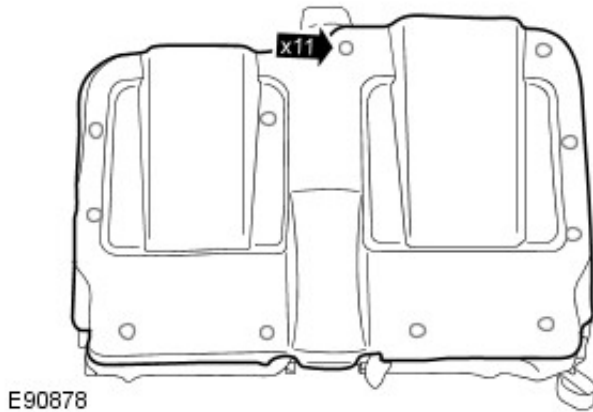
Removal and Installation

Removal

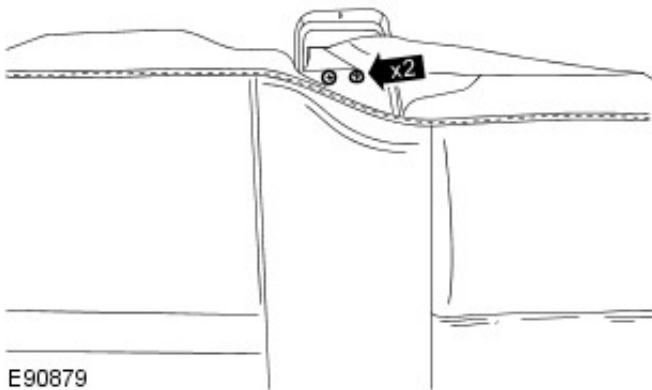
1. Remove the 2 rear seat head restraints.
 - Release the 2 clips.



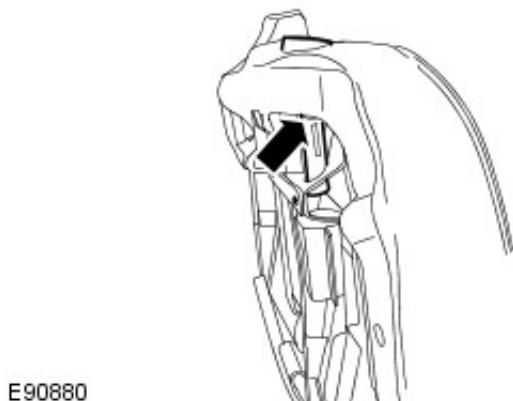
2. Remove the rear seat backrest trim panel.
 - Release the 11 clips.



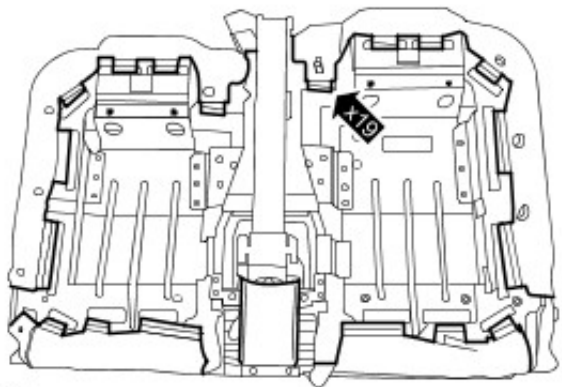
3. Reposition the rear center safety belt guide cover.
 - Remove the 2 screws.



4. Remove the 4 rear seat head restraint guides.
 - Release the 4 clips.



5. Remove the rear seat backrest.
 - Release the 19 clips.



E90881

Installation

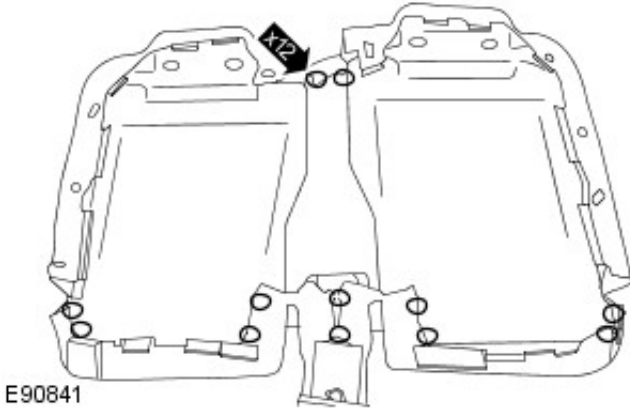
1. Install the rear seat backrest.
 - Secure the 19 clips.
2. Install the rear seat head restraint guides.
3. Secure the rear center safety belt guide cover.
 - Tighten the screws.
4. Secure the rear seat backrest trim panel.
 - Secure with the clips.
5. Install the rear seat head restraints.

Seating - Rear Seat Backrest Cover

Removal and Installation

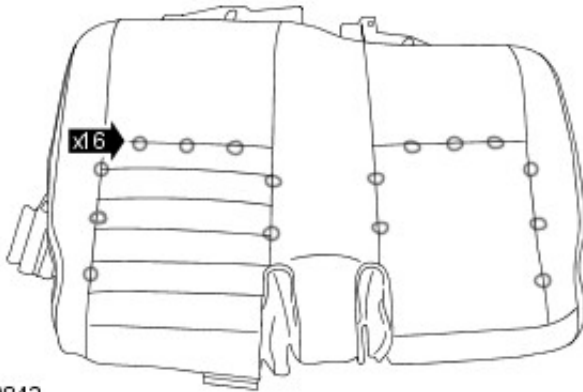
Removal

1. Remove the rear seat backrest.
For additional information, refer to: Rear Seat Backrest (501-10, Removal and Installation).
2. Release the rear seat backrest cover.
 - Remove and discard the 12 hog rings.



E90841

3. Remove the rear seat back rest cover.
 - Remove and discard the 20 hog rings.

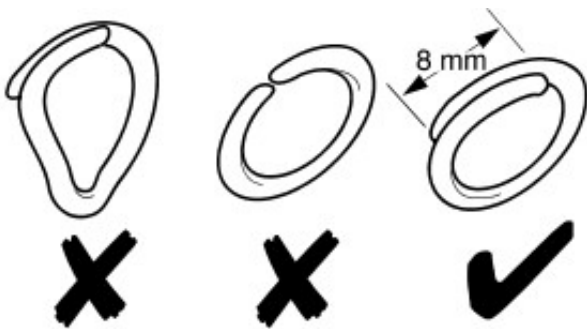


E90842

Installation

1. **NOTE:** Use hog ring pliers to close the hog rings. Do not use any other tool. The hog rings must be closed to overlap as illustrated.

To install, reverse the removal procedure.



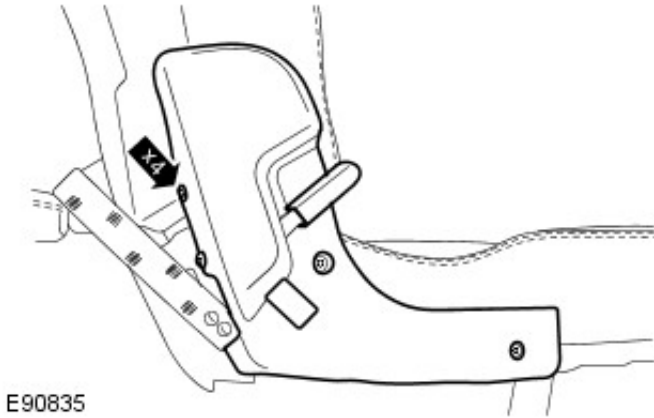
VUJ0005059

Seating - Rear Seat Cushion

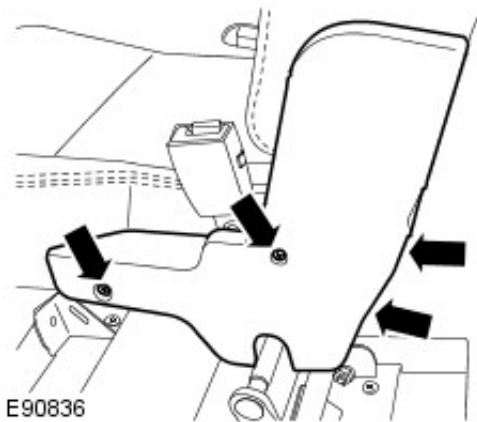
Removal and Installation

Removal

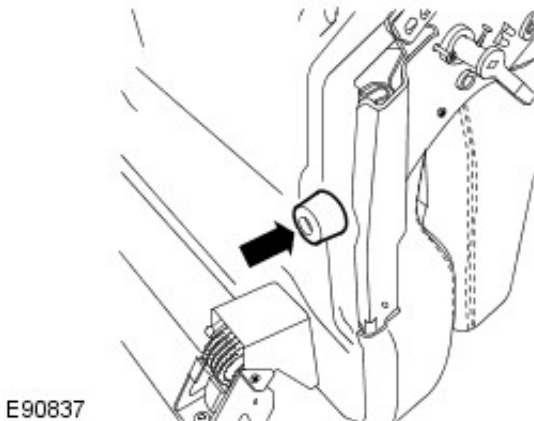
1. Remove the rear seat outer hinge trim panel.
 - Remove the rear seat recliner handle.
 - Remove the 4 screws.



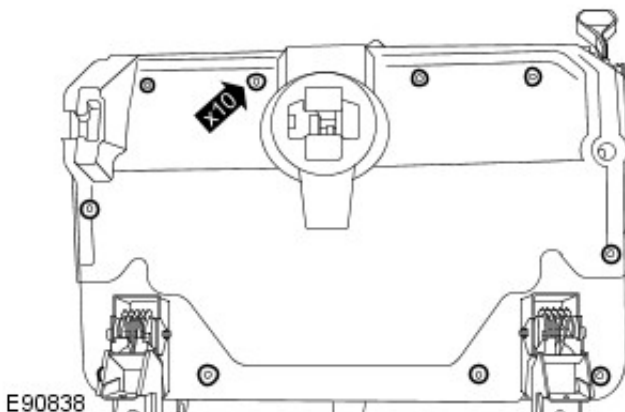
2. Remove the rear seat inner hinge trim panel.
 - Remove the 4 screws.



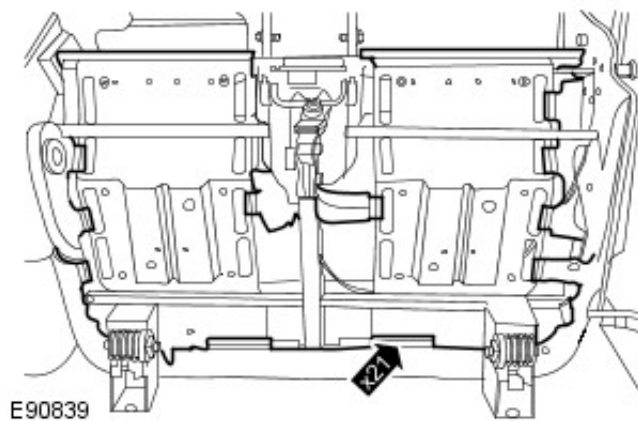
3. Remove the rear seat base stop.
 - Remove the bolt.
 - Collect the plastic washer.



4. Remove the rear seat cushion trim panel.
 - Remove the 10 clips.



5. Remove the rear seat cushion.
 - Release the 21 clips.



Installation

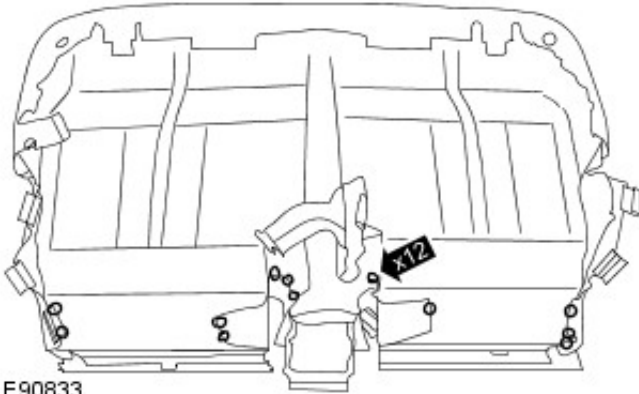
1. Install the rear seat cushion.
 - Secure the clips.
2. Install the rear seat cushion trim panel.
 - Install the clips.
3. Install the rear seat base stop.
 - Install the plastic washer.
 - Tighten the bolt to 25 Nm (17 lb.ft).
4. Install the rear seat inner hinge trim panel.
 - Tighten the screws.
5. Install the rear seat outer hinge trim panel.
 - Tighten the screws.
 - Install the rear seat recliner handle.

Seating - Rear Seat Cushion Cover

Removal and Installation

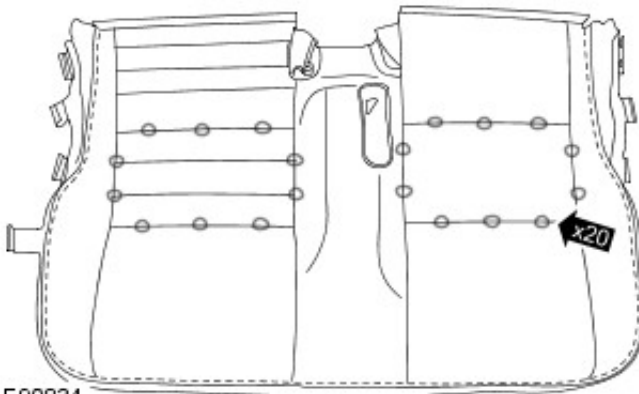
Removal

1. Remove the rear seat cushion.
For additional information, refer to: Rear Seat Cushion (501-10, Removal and Installation).
2. Release the under side of the rear seat cushion cover.
 - Remove and discard the 12 hog rings.



E90833

3. Remove the rear seat cushion cover.
 - Remove and discard the 20 hog rings.

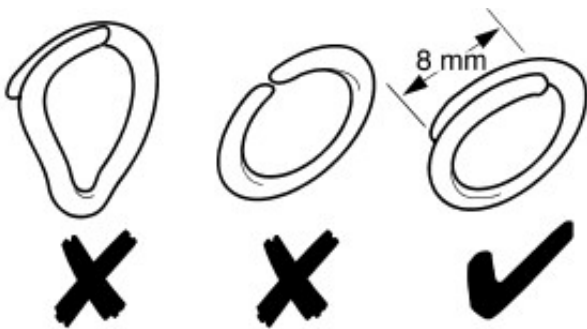


E90834

Installation

1. **NOTE:** Use hog ring pliers to close the hog rings. Do not use any other tool. The hog rings must be closed to overlap as illustrated.

To install, reverse the removal procedure.



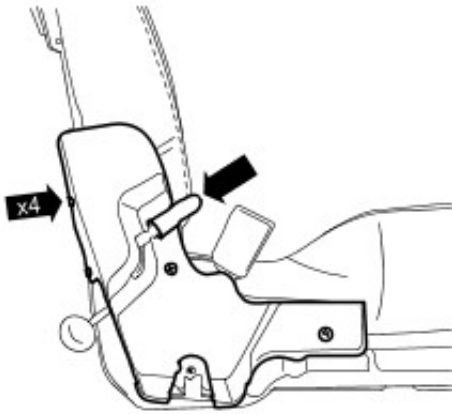
VUJ0005059

Seating - Third Row Seat

Removal and Installation

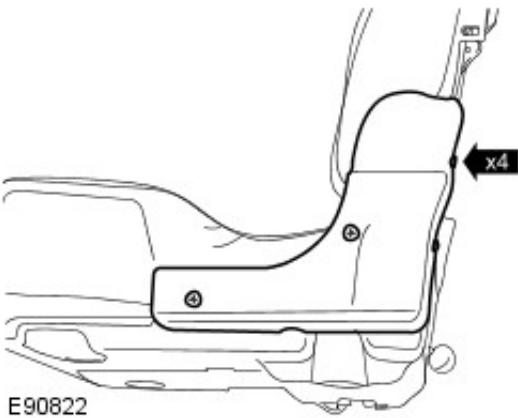
Removal

1. Remove the third row seat inner hinge trim panel.
 - Remove the third row seat recliner handle.
 - Remove the 4 screws.



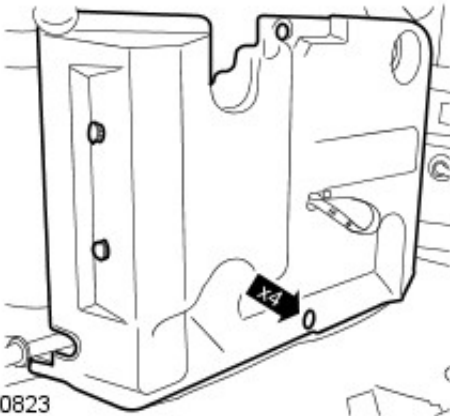
E90821

2. Remove the third row seat outer hinge trim panel.
 - Remove the 4 screws.



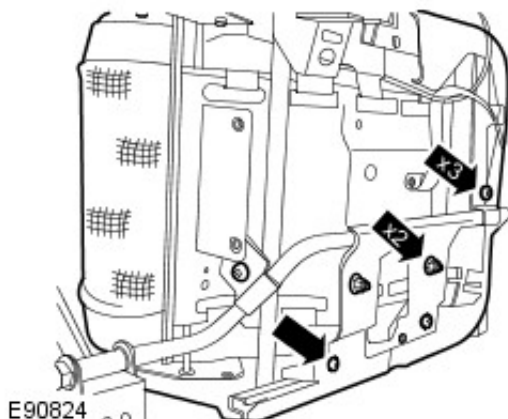
E90822

3. Remove the third row seat lower trim panel.
 - Remove the 4 clips.



E90823

4. Remove the third row seat.
 - Remove the nut and bolt.
 - Remove the 2 nuts.
 - Remove the 3 bolts.
 - Collect the 2 plastic washers.



E90824

Installation

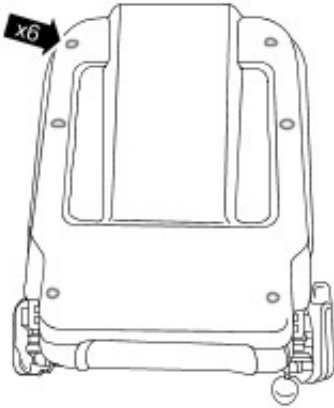
1. Install the third row seat.
 - Install the plastic washers.
 - Tighten the nuts to 23 Nm (17 lb.ft).
 - Tighten the bolts to 23 Nm (17 lb.ft).
 - Tighten the nut and bolt to 23 Nm (17 lb.ft).
2. Install the third row seat lower trim panel.
 - Install the clips.
3. Install the third row seat outer hinge trim panel.
 - Tighten the screws.
4. Install the third row seat inner hinge trim panel.
 - Tighten the screws.
 - Install the third row seat recliner handle.

Seating - Third Row Seat Backrest

Removal and Installation

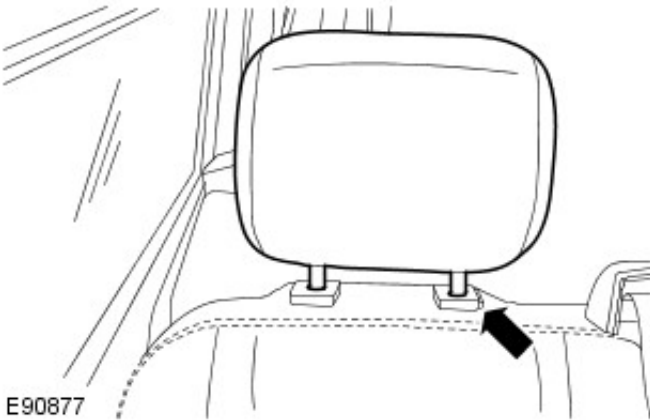
Removal

1. Remove the third row seat backrest trim panel.
 - Release the 6 clips.



E90829

2. Remove the third row seat head restraint.
 - Release the clip.



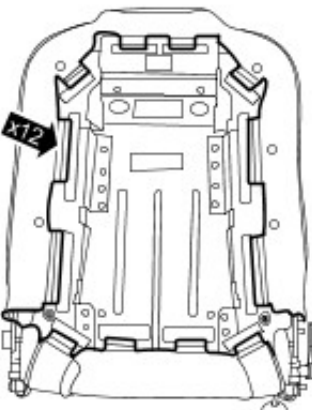
E90877

3. Remove the 2 third row seat head restraint guides.
 - Release the 2 clips.



E90880

4. Remove the third row seat backrest.
 - Release the 12 clips.



E90830

Installation

1. To install, reverse the removal procedure.

Seating - Third Row Seat Backrest Cover

Removal and Installation

Removal

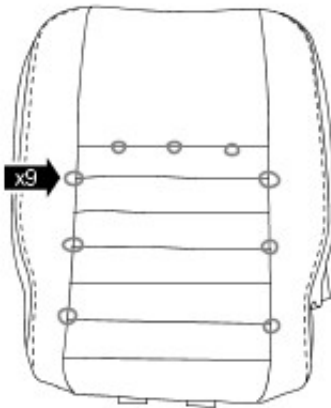
1. Remove the third row seat backrest.
For additional information, refer to: Third Row Seat Backrest (501-10, Removal and Installation).

2. Release the third row seat backrest cover.
 - Remove and discard the 4 hog rings.



E90831

3. Remove the third row seat backrest cover.
 - Remove and discard the 9 hog rings.

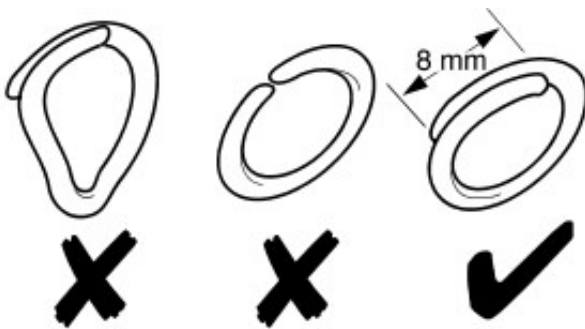


E90832

Installation

1. **NOTE:** Use hog ring pliers to close the hog rings. Do not use any other tool. The hog rings must be closed to overlap as illustrated.

To install, reverse the removal procedure.



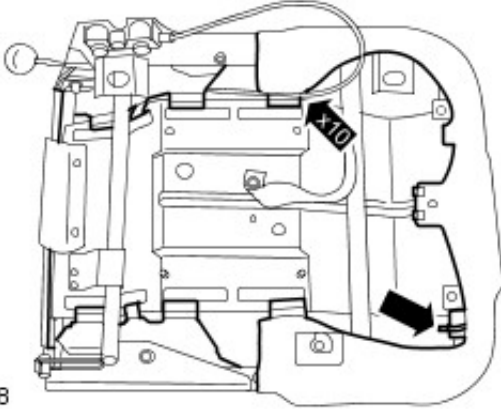
VUJ0005059

Seating - Third Row Seat Cushion

Removal and Installation

Removal

1. Remove the third row seat.
For additional information, refer to: Third Row Seat (501-10, Removal and Installation).
2. Remove the third row seat cushion.
 - Remove and discard the cable tie.
 - Release the 10 clips.



E90828

Installation

1. To install, reverse the removal procedure.

Seating - Third Row Seat Cushion Cover

Removal and Installation

Removal

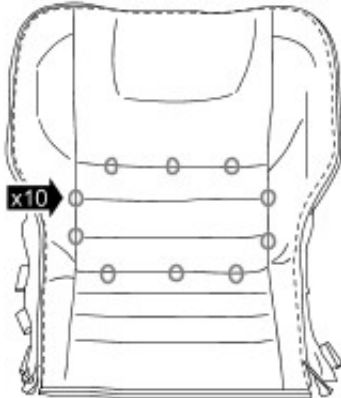
1. Remove the third row seat cushion.
For additional information, refer to: Third Row Seat Cushion (501-10, Removal and Installation).

2. Release the third row seat cushion cover.
 - Remove and discard the 4 hog rings.



E90825

3. Remove the third row seat cushion cover.
 - Remove and discard the 10 hog rings.

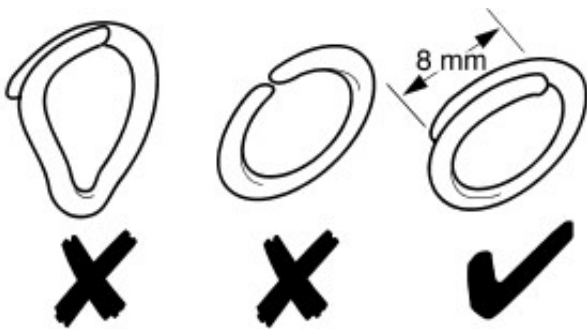


E90826

Installation

1. **NOTE:** Use hog ring pliers to close the hog rings. Do not use any other tool. The hog rings must be closed to overlap as illustrated.

To install, reverse the removal procedure.

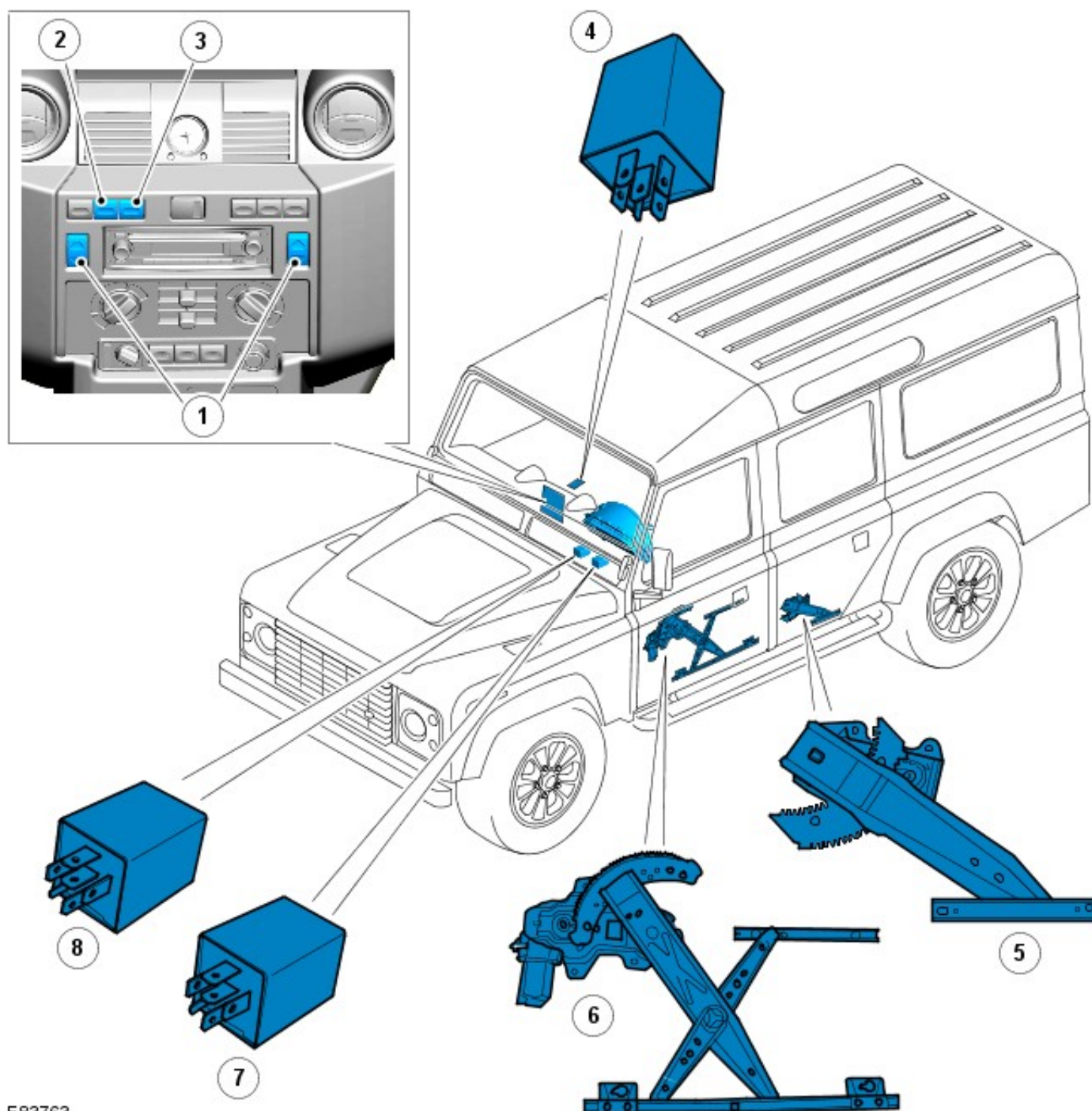


VUJ0005059

Glass, Frames and Mechanisms - Glass, Frames and Mechanisms

Description and Operation

COMPONENT LOCATION



E83763

Item	Part Number	Description
1	-	Window lift switches
2	-	Heated windshield switch
3	-	Heated rear window switch
4	-	Heated windshield module
5	-	Rear door window regulator (if fitted)
6	-	Front door window regulator and motor assembly
7	-	Heated rear window relay
8	-	Window lift relay

OVERVIEW

Window Lift

The front window lift system comprises a motor in each front door and 2 rocker switches mounted in the center console. The window lift system will only operate when the ignition switch is in position II (ignition on) and features anti-trap functionality.

The rear window lift system (if fitted) comprises a handle and manually operated door window regulator in each rear door.

Heated Windshield and Rear Window

The heated windshield contains a single heating element which is powered for up to a maximum of 8 minutes when selected. The system is only operational when the engine is running.

The heated rear window also contains a single heating element and will operate with the ignition switch in position II (ignition on). The heated rear window isn't constrained to an operational time limit.

PRINCIPLES OF OPERATION

Window Lift

The window lift relay coil is energized by an ignition feed from the central junction box (CJB). The energized relay provides a battery voltage feed to the left-hand (LH) and right-hand (RH) window lift switches.

Each window lift switch has 2 connections with its respective window lift motor; feed and return. These lines switch depending on the direction of travel requested using the switch. In each case, the motor is provided a ground path through its switch.

Each motor has thermal cut-out protection. If the window reaches the top or bottom of its travel, or hits an obstruction, the thermal cut-out will sense the increased load on the motor and cut the power supply to the motor brush contacts. Thermal cut-out time is between 3.5 to 5 seconds, with a re-start time of between 1 to 10 seconds.

Heated Windshield

Operation of the heated windshield is controlled by the heated windshield module. The heated windshield module is located behind the instrument cluster and receives an engine running signal from the engine control module (ECM). The heated windshield module also monitors the condition of the heated windshield switch. If the switch is pressed, a ground path is created. If both these signals are in place, the heated windshield module provides a feed to the heated windshield element until either;

- the switch is pressed a second time
- 8 minutes elapses
- or the engine is stopped.

Heated Rear Window

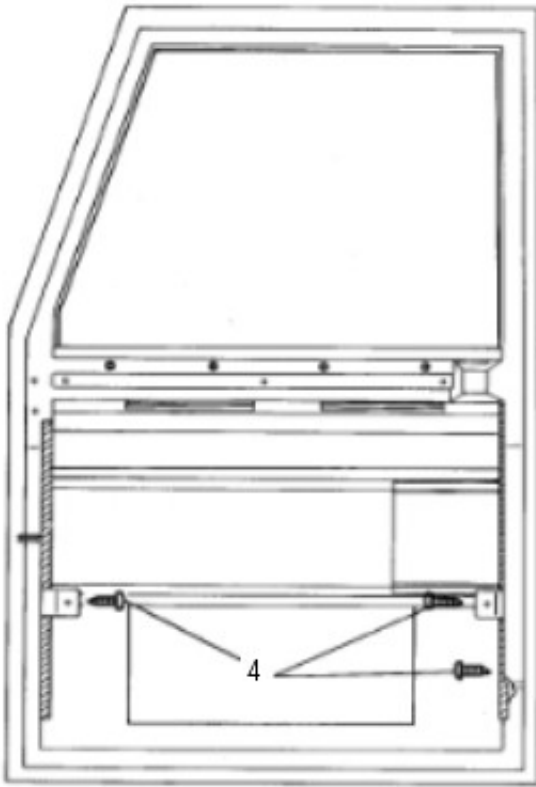
The heated rear window switch is located in the center console and is provided an ignition feed from the CJB. When the switch is pressed, a feed is provided to the heated rear window relay coil. The now energized heated rear window relay provides a battery voltage feed from the CJB to the heated rear window element.

Glass, Frames and Mechanisms - Front Door Window Glass

Removal and Installation

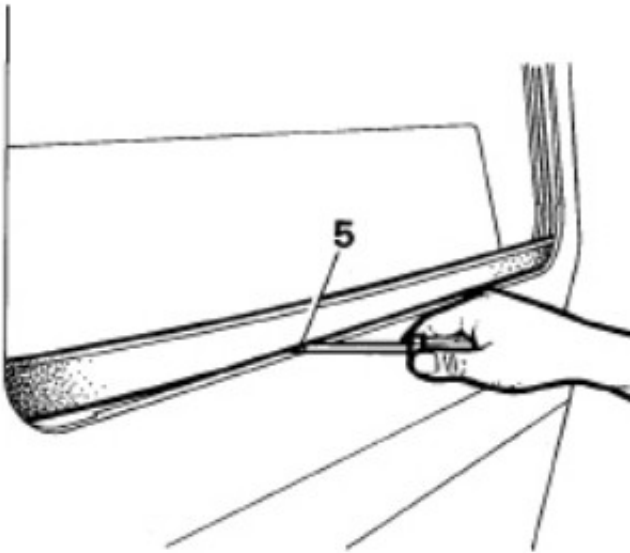
Removal

1. Remove front door reinforcement panel.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).
2. Remove window regulator.
For additional information, refer to: Front Door Window Regulator and Motor (501-11, Removal and Installation).
3. Push glass up to top of its travel and support with a suitable length of timber.
4. Remove 2 self tapping screws securing window glass runner on latch side of door and single screw from hinge side.



ST1976M

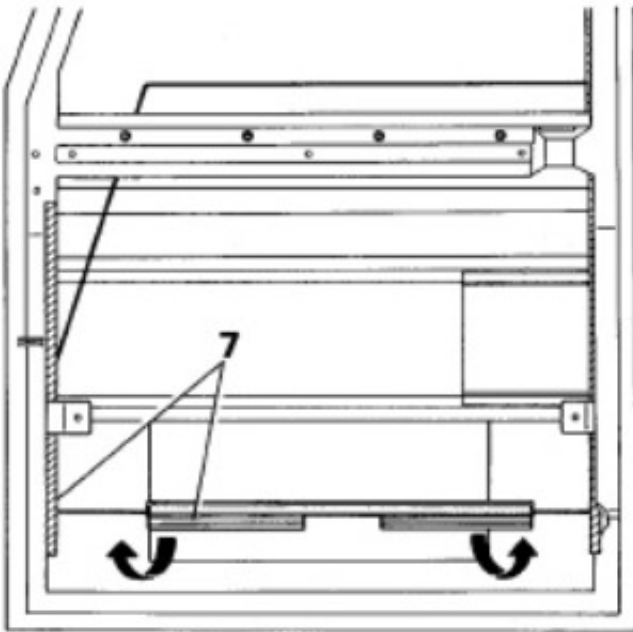
5. Taking care not to damage paint, prise exterior waist weather strip from door.



ST1966M

6. Remove timber support and lower glass to bottom of door.

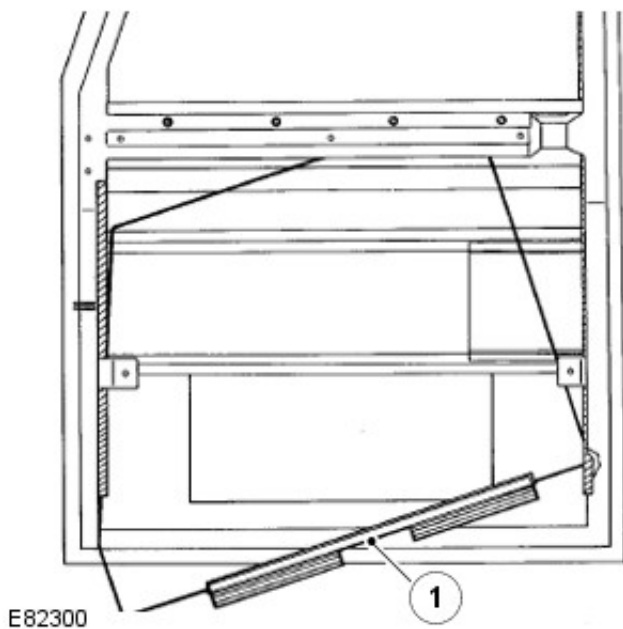
7. Ease runner from glass at hinge side of door, lift glass over bottom edge of door and withdraw.



ST1968M

Installation

1. Insert glass into runners at an angle as illustrated.



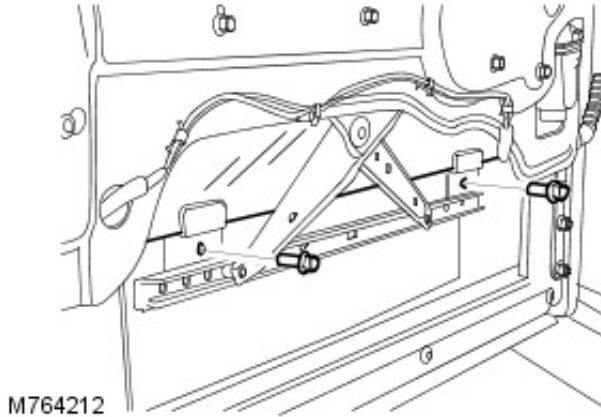
2. Whilst lifting glass, position it squarely in runners, raise to top of travel and insert timber support.
3. Secure hinge side runner with single screw ensuring that packing strip is in position.
4. Locate packing strip and secure opposite runner with 2 screws. Ensure that all 3 screw heads are well below bottom of runners to prevent damage to glass.
5. Locate regulator in window lift channels.
6. Install window regulator.
For additional information, refer to: Front Door Window Regulator and Motor (501-11, Removal and Installation).
7. Install front door reinforcement panel.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).

Glass, Frames and Mechanisms - Front Door Window Regulator and Motor

Removal and Installation

Removal

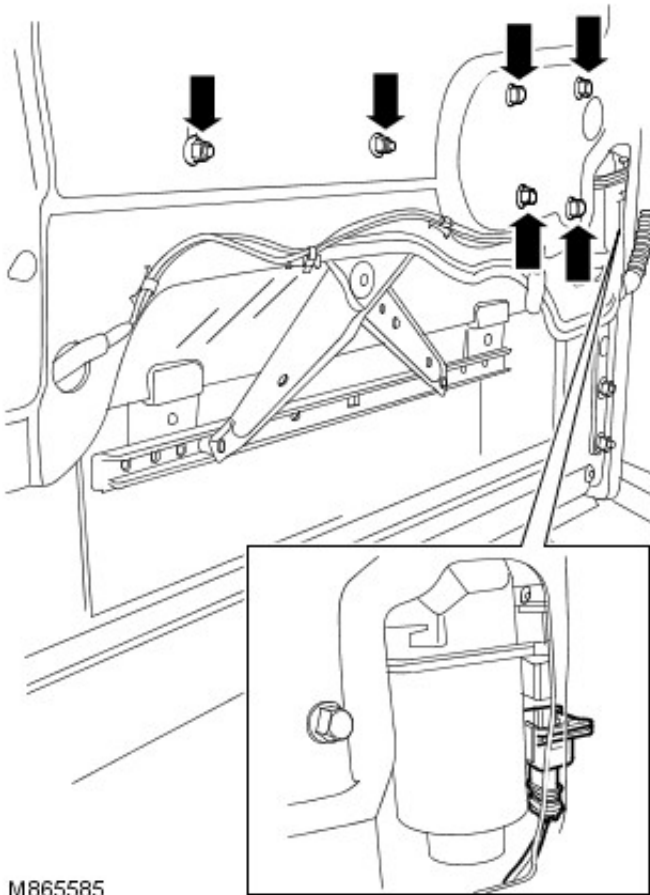
1. Remove door trim panel. For additional information, refer to: Front Door Trim Panel - Vehicles Built From: 07/2001 (501-05, Removal and Installation).
2. Remove plastic sheet.
3. Lower glass and remove 2 bolts securing door glass to regulator.



4. Release glass from regulator, raise and wedge in raised position.



5. Disconnect multiplug from motor.
6. Remove 4 bolts and 2 nuts securing motor and regulator assembly.



M865585

7. Release and remove motor and regulator assembly.

Installation

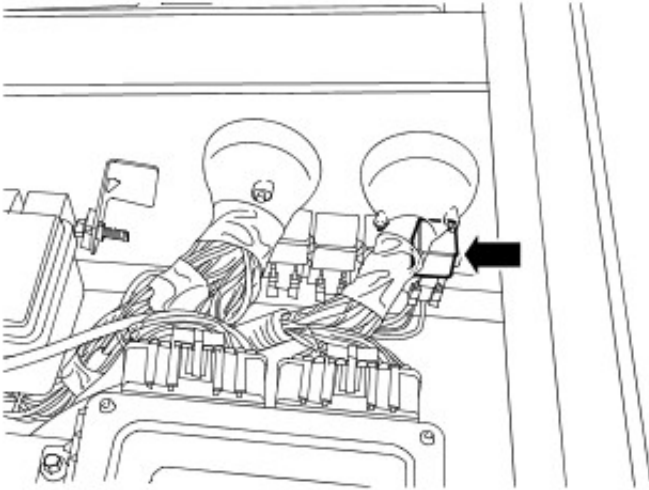
1. Install motor and regulator assembly, install nuts and bolts and tighten to 10 Nm (7 lbf.ft).
2. Connect multiplug to motor.
3. Remove wedges, lower glass and locate to regulator. Install bolts and tighten to 6 Nm (4 lbf.ft).
4. Raise and lower glass to check operation.
5. Install plastic sheet.
6. Install door trim panel. For additional information, refer to: Front Door Trim Panel - Vehicles Built From: 07/2001 (501-05, Removal and Installation).

Glass, Frames and Mechanisms - Heated Windshield Relay

Removal and Installation

Removal

1. Remove front seat cushion.
2. Release clip and remove compartment cover.
3. Locate and release heated windshield relay from bracket.



M865586

4. Remove heated windshield relay.

Installation

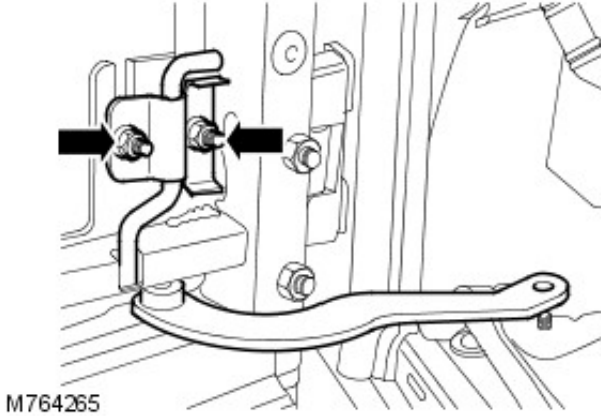
1. Fit heated windshield relay.
2. Fit heated windshield relay to mounting bracket.
3. Fit and secure cover.
4. Fit seat cushion.

Glass, Frames and Mechanisms - Rear Door Window Glass

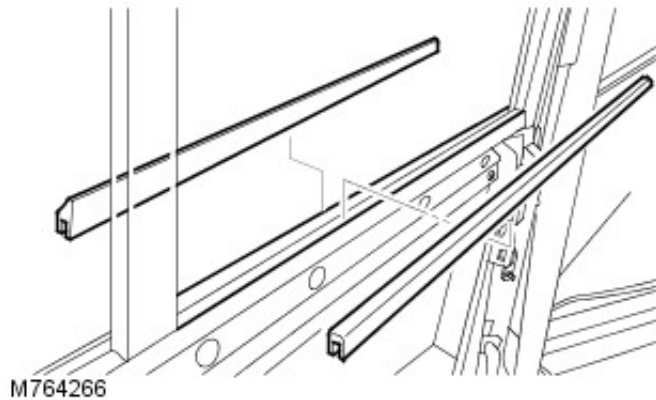
Removal and Installation

Removal

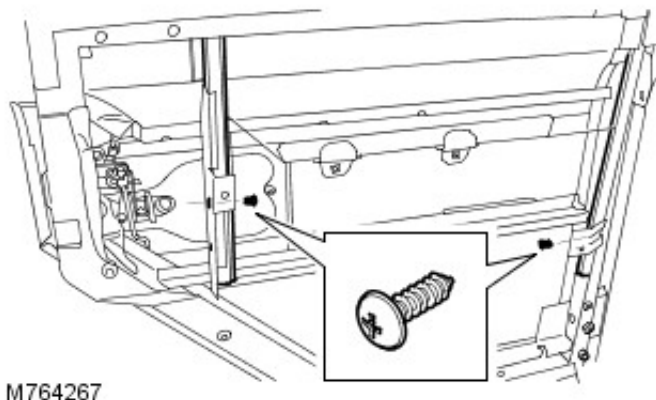
1. Remove rear door reinforcement panel.
For additional information, refer to: Rear Door Reinforcement Panel (501-03, Removal and Installation).
2. Loosen 2 nuts and remove door check strap torsion bar and plate.



3. Remove check strap.
4. Remove inner and outer waist seal.



5. Remove screw from each glass channel.



6. Lower glass to bottom of door, lift over lower edge and withdraw from door.

Installation

1. Insert glass into channels and carefully push to top of frame.
2. Secure glass channels with screws. Ensure screw heads are down below bottom of channels to prevent damage to glass.

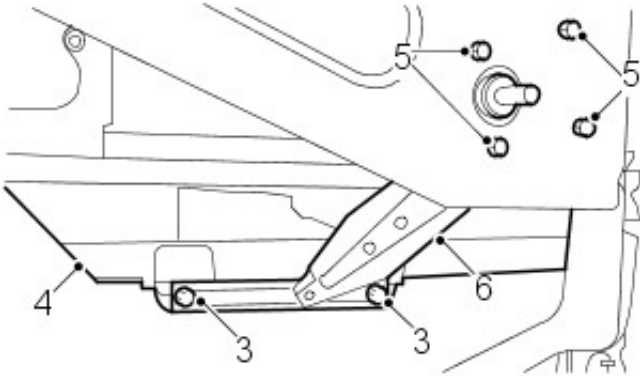
3. Install inner and outer waist seal to door.
4. Install check strap.
5. Install check strap torsion bar and tighten nuts to 10 Nm (7 lbf.ft) .
6. Instal rear door mounting panel.
For additional information, refer to: Rear Door Reinforcement Panel (501-03, Removal and Installation).

Glass, Frames and Mechanisms - Rear Door Window Regulator and Motor

Removal and Installation

Removal

1. Remove rear door trim casing.
For additional information, refer to: Rear Door Trim Panel - Vehicles Built From: 07/2001 (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Carefully release plastic sheet from rear door.
3. Remove 2 bolts securing door glass to regulator.
4. Raise glass and secure with a suitable wedge.
5. Remove 4 bolts securing glass regulator assembly to door.
6. Manoeuvre regulator through access hole at bottom of the door.



M763141

Installation

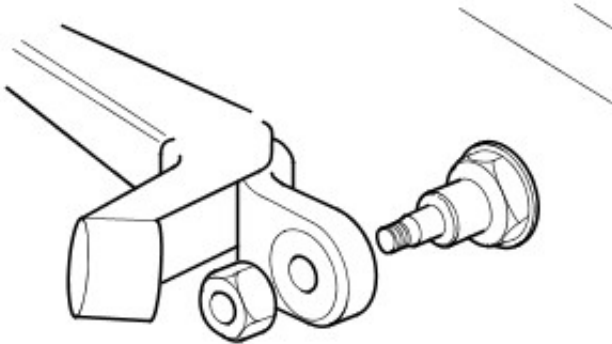
1. Clean mating face of regulator and door glass.
2. Lubricate regulator with grease.
3. Position regulator in door and secure with bolts.
4. Remove wedge holding glass and align glass to regulator.
5. Secure glass to regulator and install and tighten bolts.
6. Install plastic sheet to rear door.
7. Install rear door trim casing.
For additional information, refer to: Rear Door Trim Panel - Vehicles Built From: 07/2001 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Glass, Frames and Mechanisms - Taildoor Window Glass

Removal and Installation

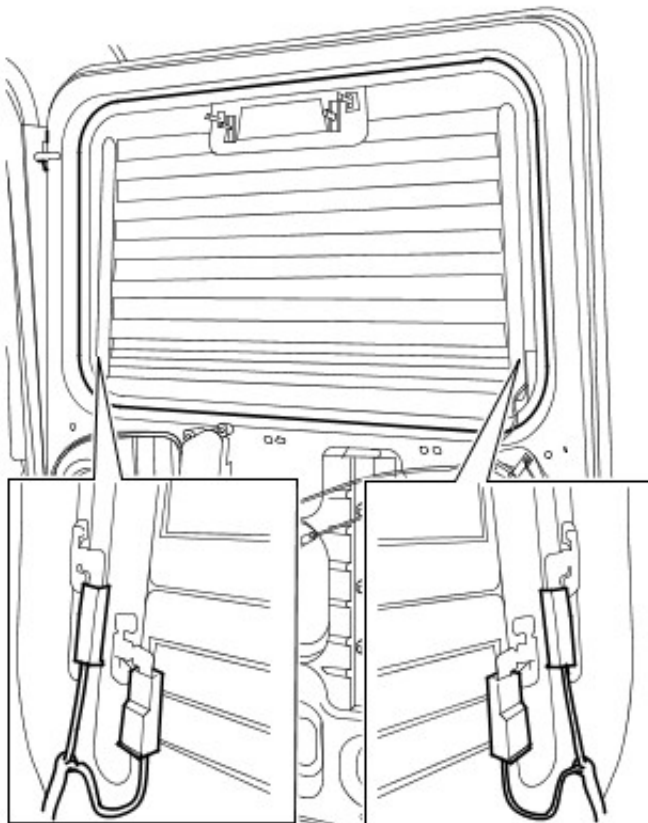
Removal

1. Remove spare wheel from taildoor.
2. Raise nut cover, remove nut and release wiper arm.



M764252


3. Open taildoor.
4. Remove high mounted stop lamp.
For additional information, refer to: High Mounted Stoplamp (417-01, Removal and Installation).
5. Remove 4 connectors from heated rear window.



M764253

6.  **WARNING:** Wear suitable eye protection when removing and refitting glass.

With assistance, from inside of vehicle apply pressure to glass, relieve seal lip and carefully remove glass.

7.  **CAUTION:** Lay glass on felt covered supports and be careful not to damage the obscuration band. Do not stand on edge as this can cause chips which subsequently develop into cracks.

Remove seal from glass.

Installation

1. Clean glass and install seal. Ensure seal is fully located on glass.
2. Thoroughly clean the taildoor window mounting flange.
3. Install drawstring to seal.
4. Lubricate seal.
5. With assistance, position glass and seal to taildoor window aperture, locate lower edge and instal seal using drawstring.
6. Clean glass and check seal fit.
7. Fit connectors to heated rear window.
8. Install high mounted stop lamp.
For additional information, refer to: High Mounted Stoplamp (417-01, Removal and Installation).
9. Install wiper arm to spindle, align blade to window and tighten nut to 18 Nm (13 lbf.ft).
10. Install spare wheel and tighten nuts to 45 Nm (33 lbf.ft).

Glass, Frames and Mechanisms - Window Control Switch

Removal and Installation

Removal

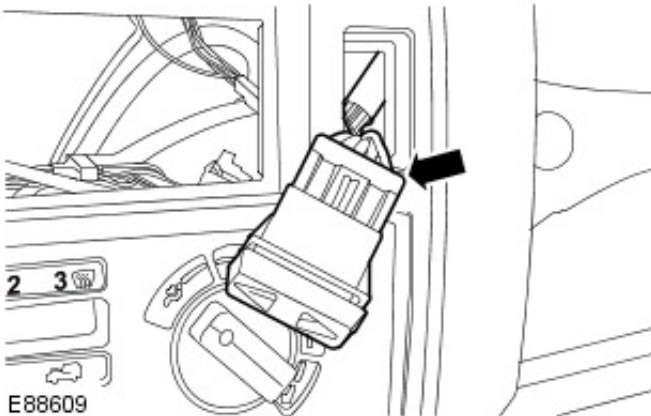
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).

3. **NOTE: RH shown, LH similar.**

Release the window control switch.



4. Remove the window control switch.
 - Disconnect the electrical connector.



Installation

1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Instrument Panel and Console -

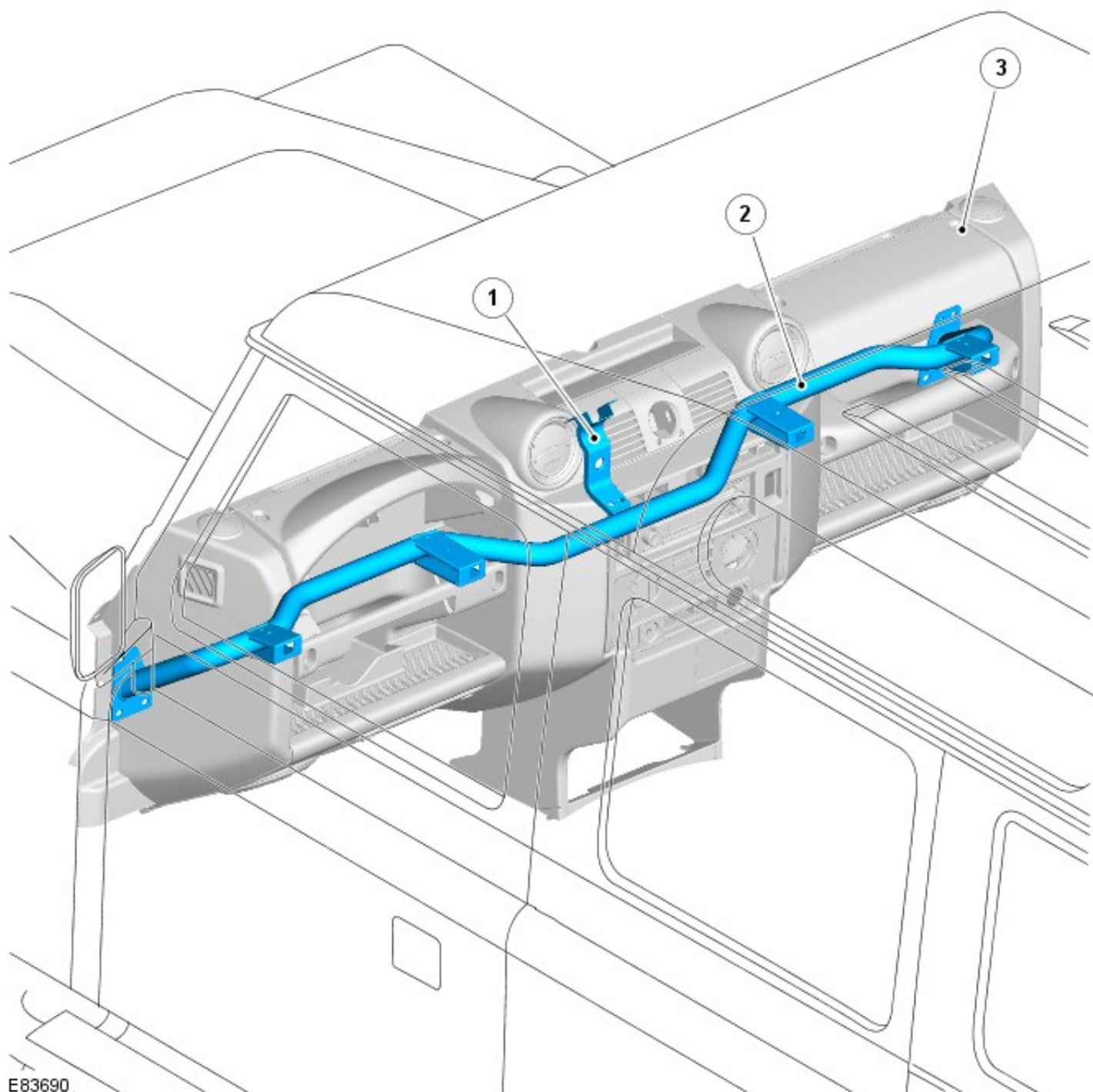
Torque specifications

Description	Nm	lb-ft
Instrument panel Torx 30 screw	2	1
Instrument panel Torx 20 screw	1	1
Instrument panel console	2	1
Grab handle	7	5

Instrument Panel and Console - Instrument Panel

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Central support
2	-	Cross car rail
3	-	Instrument panel

OVERVIEW

Vehicles from 2007 model year feature an all new instrument panel. In addition to providing a location for various system switches and controls, the instrument panel also houses an all new instrument cluster and climate control system. For additional information, refer to:

Instrument Cluster (413-01, Description and Operation),
 Climate Control System (412-00, Description and Operation),
 Air Distribution and Filtering (412-01, Description and Operation).

Mounted behind the instrument panel is a tubular steel cross car rail. Three weld bolts are located on either end of the cabin bulkhead to provide the mounting points for the cross car rail. If the cross car rail is removed, the nuts securing the rail in position must be discarded and replaced with new items.

The cross car rail is non-handed, meaning the same rail can be fitted to left-hand drive (LHD) and right-hand drive (RHD) vehicles.

The cross car rail features 4 mounting brackets. The driver's side brackets provide mounting points for the instrument panel finisher; the passenger side brackets provide mounting points for the instrument panel grab handle. The mounting brackets contain expanding nuts, which must be replaced every time the instrument panel is removed.

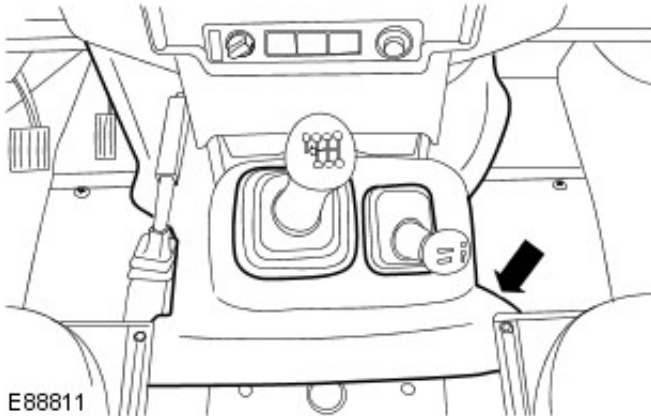
A central support bracket is secured to the cross car rail by 2 plastic scrivenets. A further plastic scrivenet secures the top of the bracket to the cabin bulkhead. The central support bracket provides a mounting point for the audio system head unit and supports the in-board ends of the climate control system air ducts. The air ducts are secured to the central support bracket by a further 2 plastic scrivenets. If any of the plastic scrivenets are removed, they must be discarded and replaced with new items.

Instrument Panel and Console - Instrument Panel

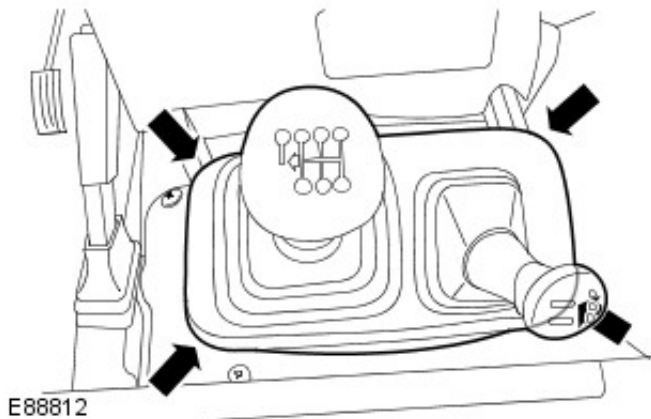
Removal and Installation

Removal

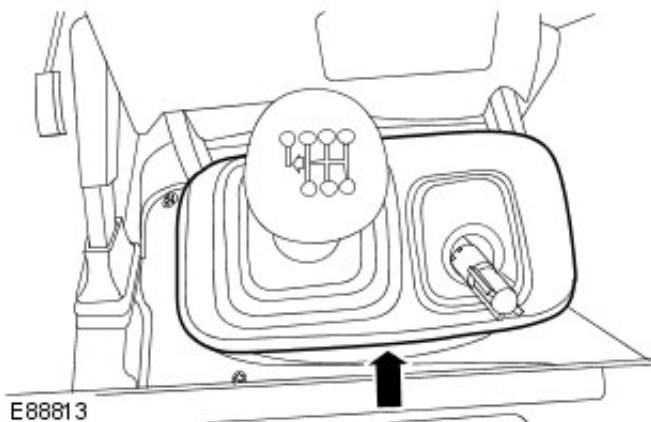
1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the floor console.
For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the transmission cover panel floor covering.



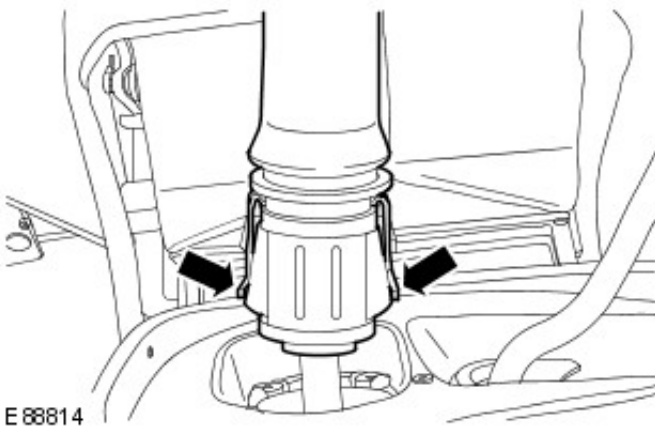
4. Remove the high/low gear selector lever.



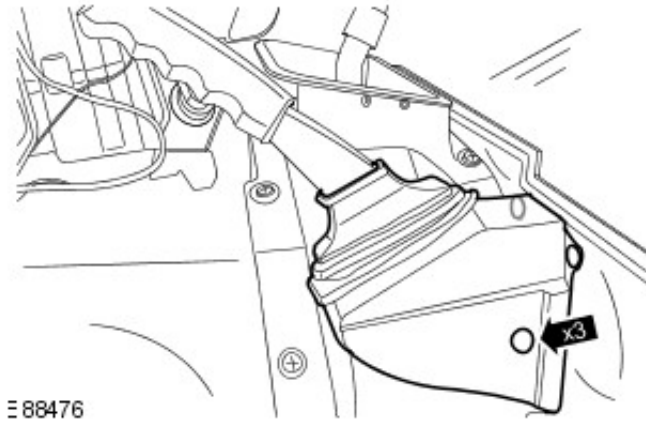
5. Release the gear shift lever.



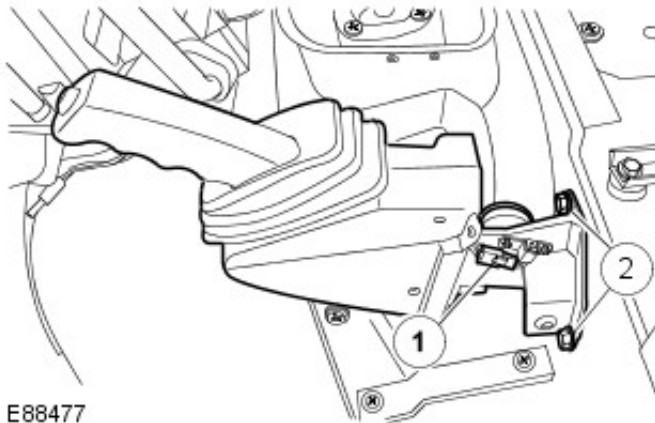
6. Remove the gear shift lever.
 - Release the 2 clips.



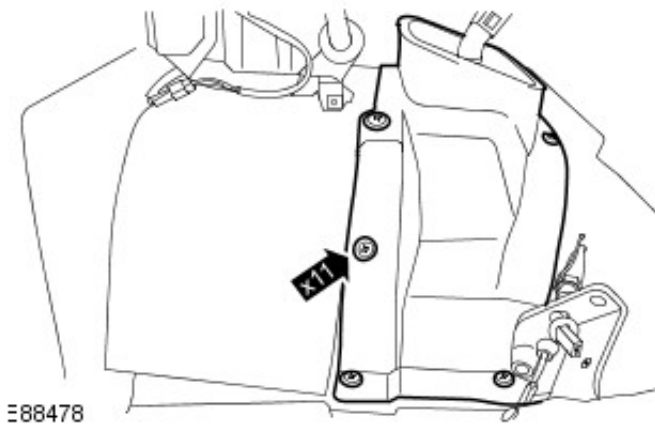
7. Release the parking brake lever gaiter.
- Remove the 3 clips.



8. Release the parking brake lever.
1. Disconnect the electrical connector.
 2. Remove the 2 bolts.



9. Remove the transmission cover panel.
- Remove the 11 screws.

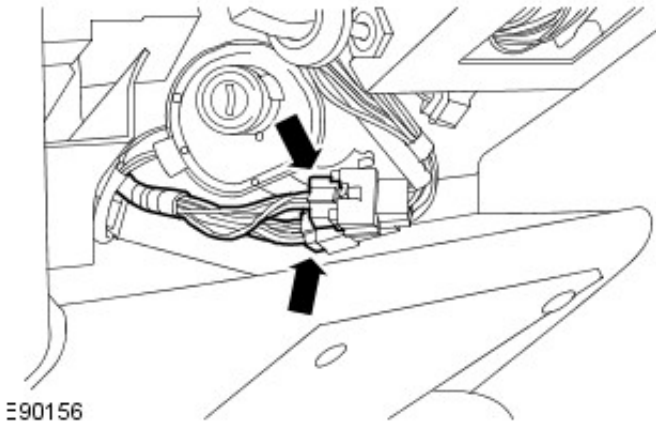


10. Remove the steering wheel.
For additional information, refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).
11. Remove the instrument cluster.
For additional information, refer to: Instrument Cluster (413-01

Instrument Cluster, Removal and Installation).

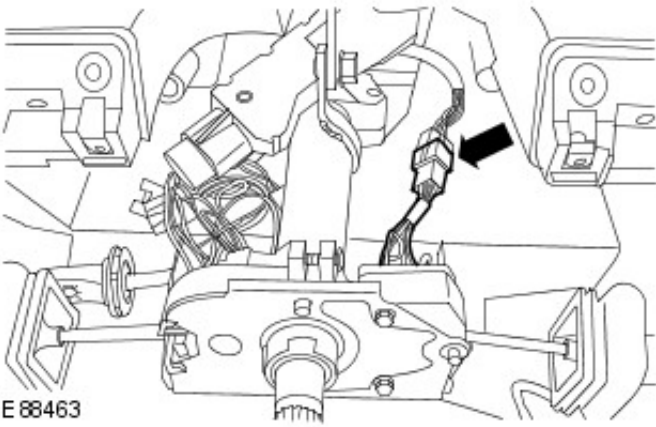
12. Remove the steering column shrouds.
For additional information, refer to: Steering Column Shrouds (501-05 Interior Trim and Ornamentation, Removal and Installation).

13. Disconnect the 2 electrical connectors from the multifunction switch.



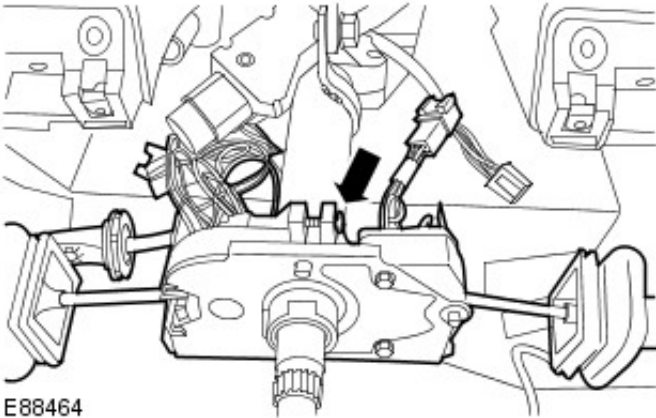
E90156

14. Disconnect the windshield wiper switch electrical connector.



E88463

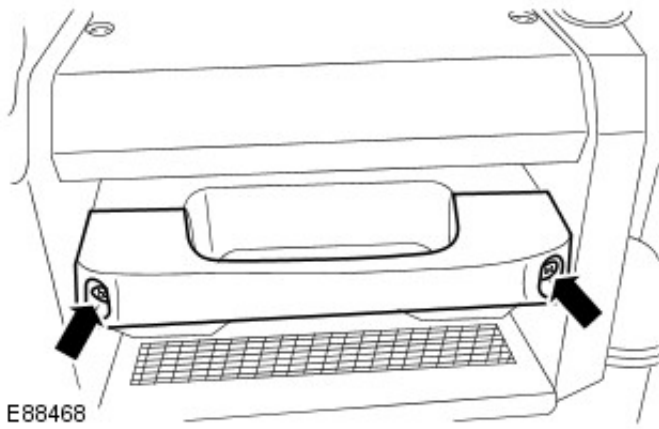
15. Remove the multifunction switch assembly.
 - Undo but do not remove the multifunction switch clamp screw.



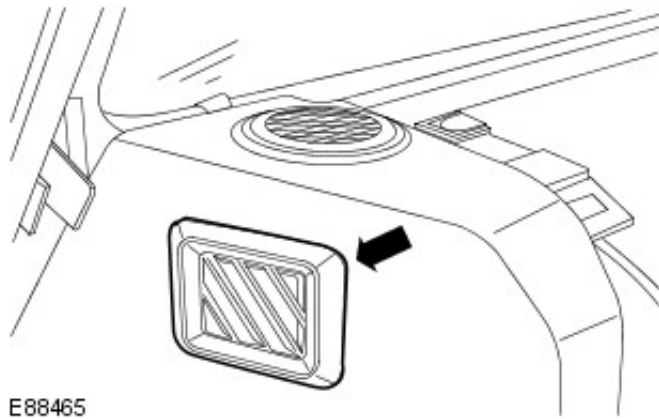
E88464

16. Remove the instrument panel console.
For additional information, refer to: Instrument Panel Console (501-12 Instrument Panel and Console, Removal and Installation).

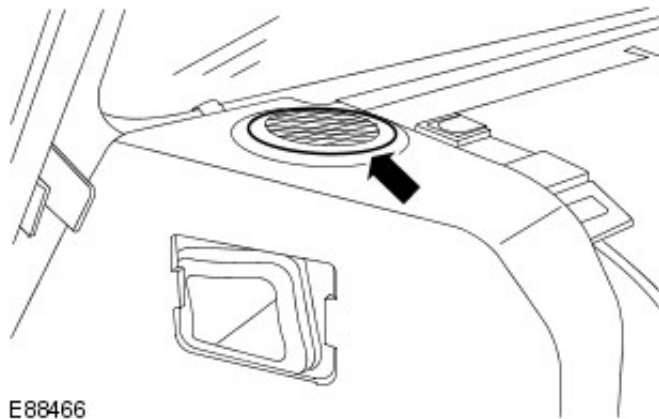
17. Remove the passenger side grab handle.
 - Remove the 2 screws.



18. **NOTE:** Left-hand shown, right-hand similar.
Remove both side demister vent finishers.



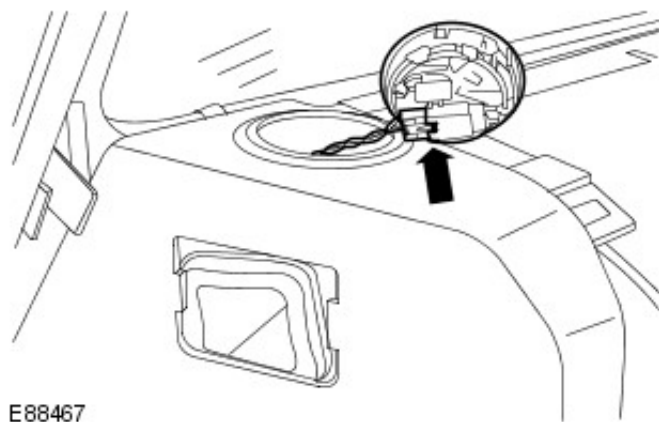
19. **NOTE:** Left-hand shown, right-hand similar.
Release both instrument panel speakers.



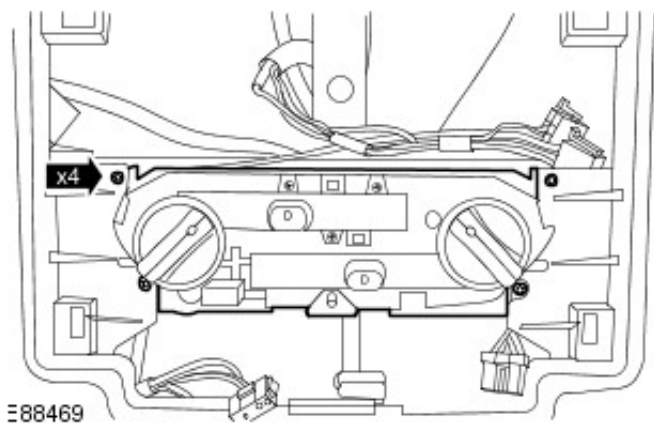
20. **NOTE:** Left-hand shown, right-hand similar.

Remove both instrument panel speakers.

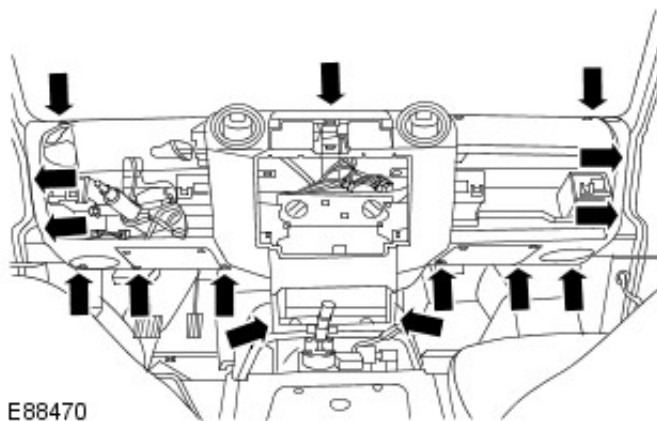
- Disconnect the electrical connector.



21. Release the climate control switch panel.
- Remove the 4 screws.

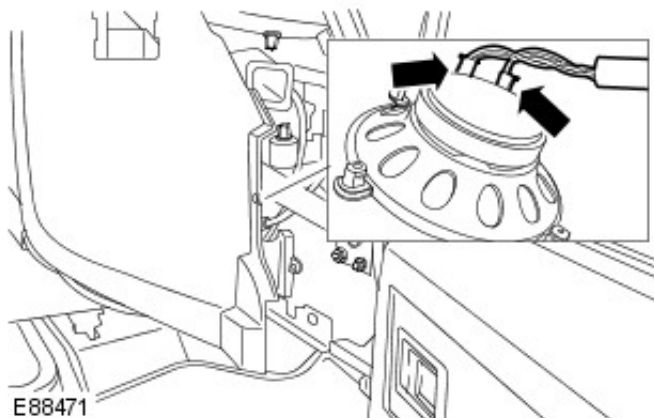


22. Release the instrument panel.
- Remove the 15 screws.

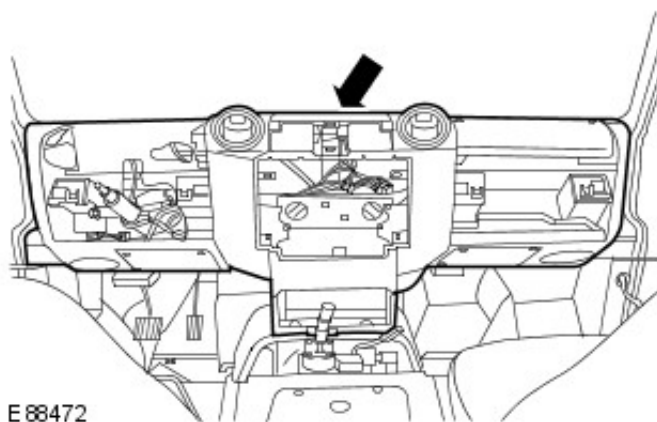


23. **NOTE:** RH shown, LH similar.

Disconnect the 4 electrical connectors from the instrument panel speakers.



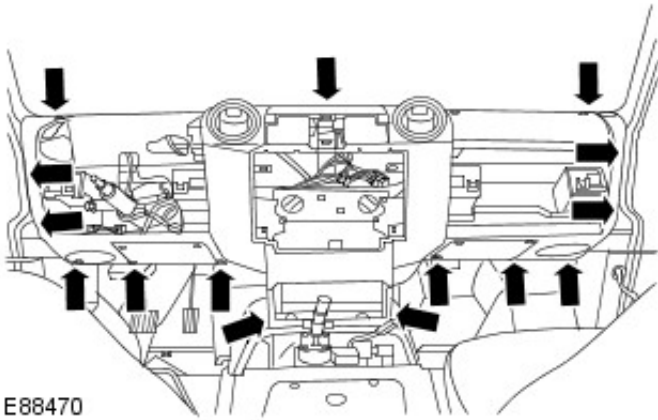
24. With assistance, remove the instrument panel.



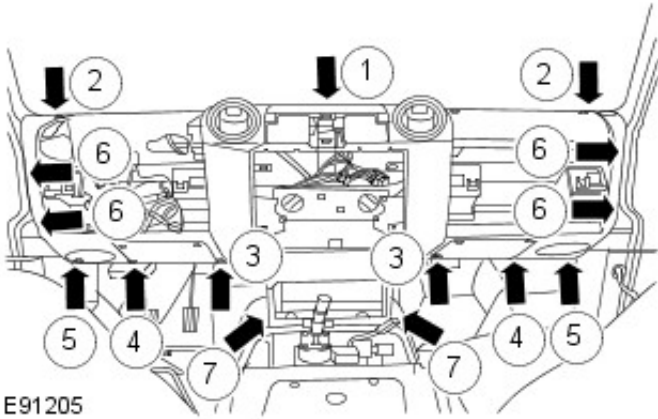
Installation

1. With assistance, install the instrument panel.
2. Connect the 4 electrical connectors to the instrument panel speakers.

3. Loosely install the instrument panel screws.

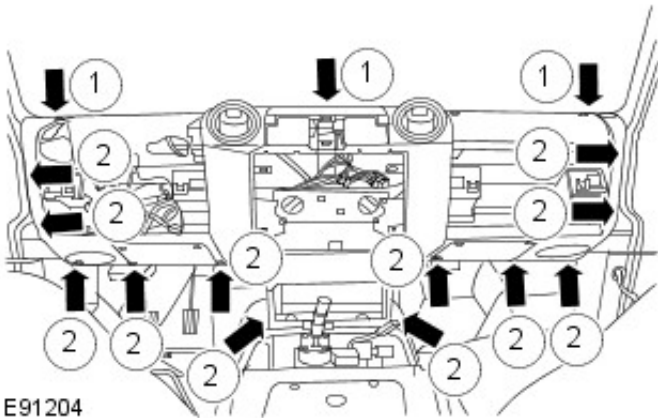


4. Tighten the screws in the order indicated in the illustration shown.



5. Tighten the screws.

1. Tighten to 2 Nm (1 lb.ft).
2. Tighten to 1 Nm (1 lb.ft).



6. Secure the climate control switch panel.

- Install the 4 screws.

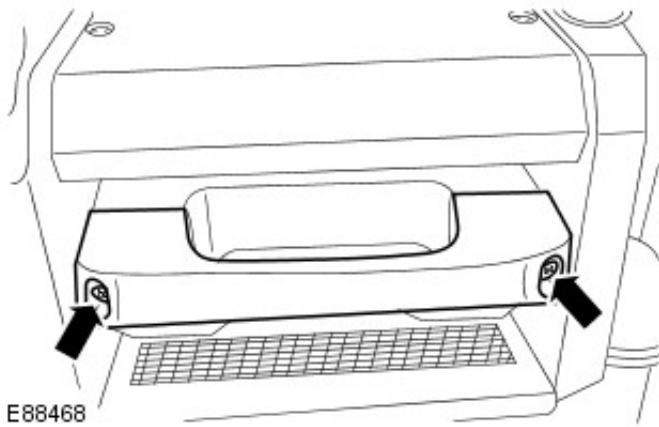
7. Install both instrument panel speakers.

- Connect the electrical connectors.

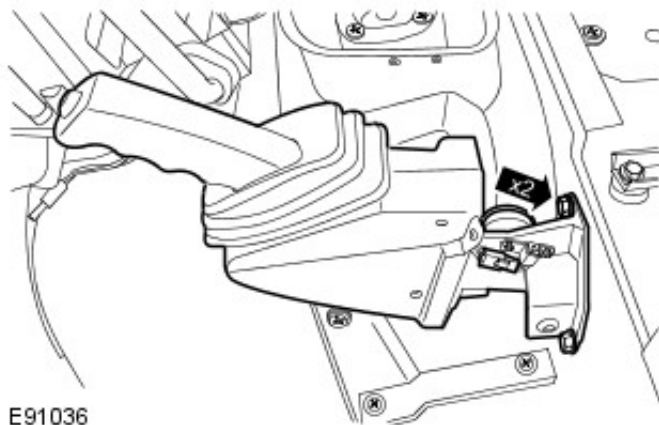
8. Install both side demister vent finishers.

9. Install the passenger side grab handle.

- Tighten to 7 Nm (5 lb.ft).



10. Install the instrument panel console.
For additional information, refer to: Instrument Panel Console (501-12 Instrument Panel and Console, Removal and Installation).
11. Install the multifunction switch assembly.
 - Connect the 3 electrical connectors.
 - Fully tighten the multifunction switch clamp screw.
12. Install the steering column shrouds.
For additional information, refer to: Steering Column Shrouds (501-05 Interior Trim and Ornamentation, Removal and Installation).
13. Install the instrument cluster.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Removal and Installation).
14. Install the steering wheel.
For additional information, refer to: Steering Wheel (211-04 Steering Column, Removal and Installation).
15. Install the transmission cover panel.
 - Install the 11 screws.
16. Secure the parking brake lever.
 - Tighten to 25 Nm (18 lb.ft).



17. Attach the parking brake lever gaiter.
 - Install the 3 clips.
18. Install the gear shift lever.
19. Attach the gear shift lever.
20. Install the high/low gear selector lever.
21. Install the transmission cover panel floor covering.
22. Install the floor console.
For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).
23. Connect the battery ground cable.

20. Connect the battery, ground cable.

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

Instrument Panel and Console - Instrument Panel Console

Removal and Installation

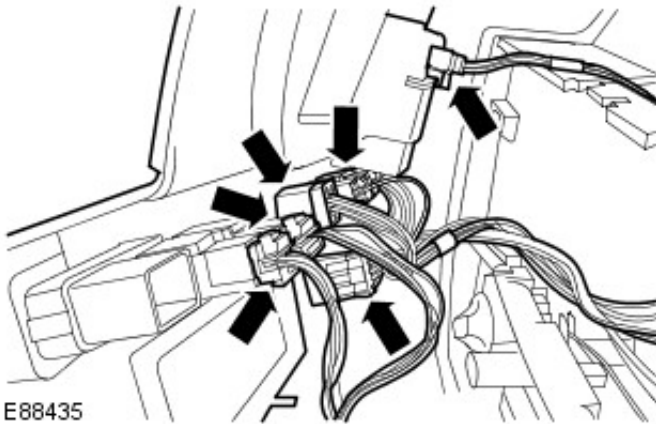
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).
3. Release the instrument panel console.
 - Remove the 2 screws.



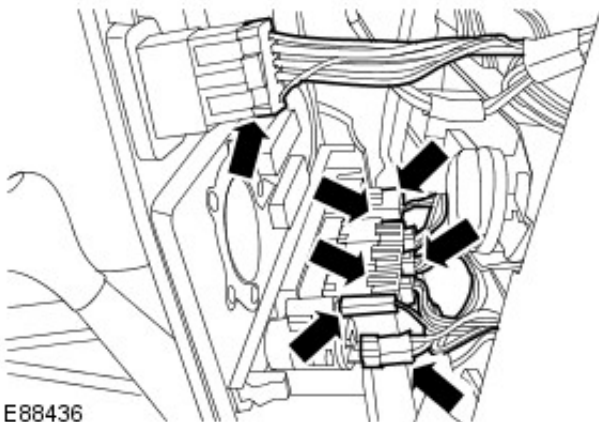
E88434

4. Disconnect the 6 electrical connectors from the instrument panel console.



E88435

5. Remove the instrument panel console.
 - Disconnect the 7 electrical connectors.



E88436

Installation

1. To install, reverse the removal procedure.
2. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Instrument Panel and Console - In-Vehicle Crossbeam

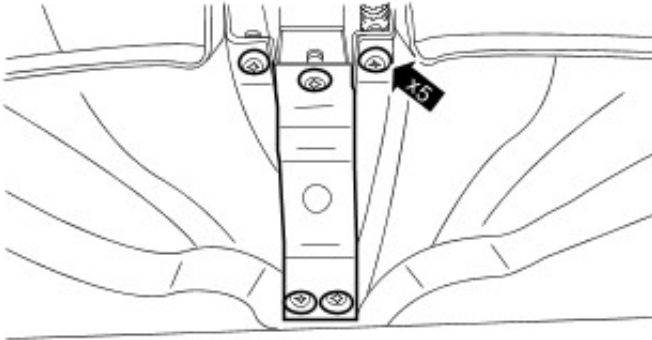
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the instrument panel.
For additional information, refer to: Instrument Panel (501-12 Instrument Panel and Console, Removal and Installation).
3. **NOTE: Make sure the clips are discarded.**

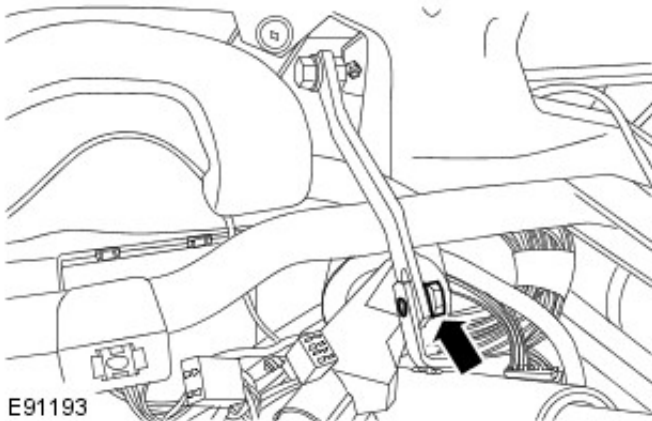
Remove the audio unit support bracket.

- Remove and discard the 5 clips.



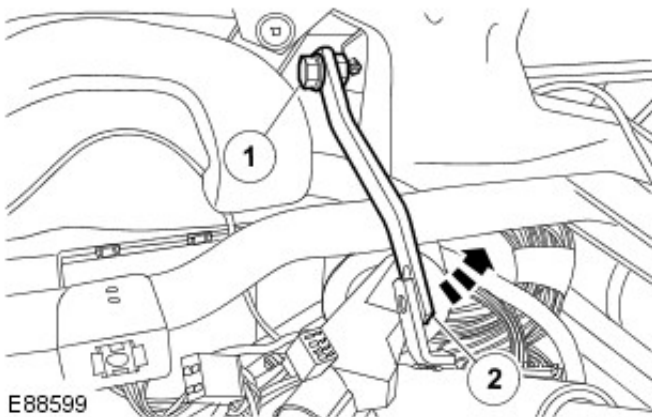
E88598

4. Release the steering column bracket.
 - Remove the bolt.



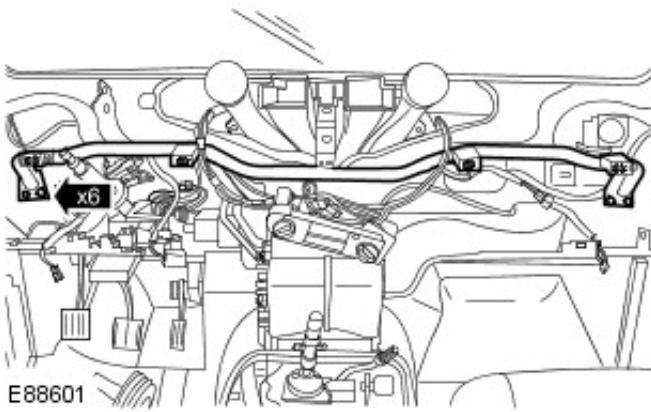
E91193

5. Reposition the steering column bracket.
 1. Undo but do not remove the bolt.
 2. Reposition the bracket.



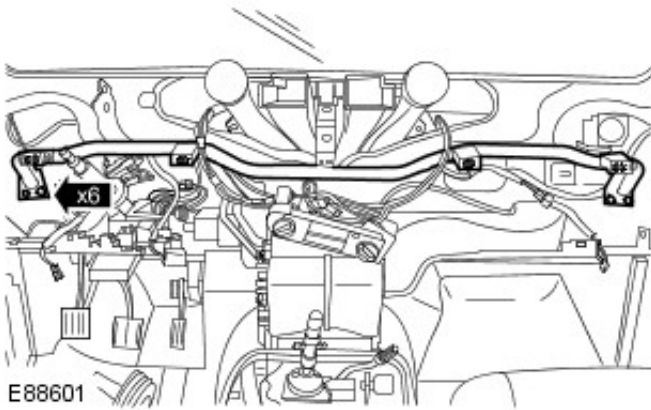
E88599

6. Remove the in-vehicle crossbeam.
 - Remove and discard the 6 nuts.

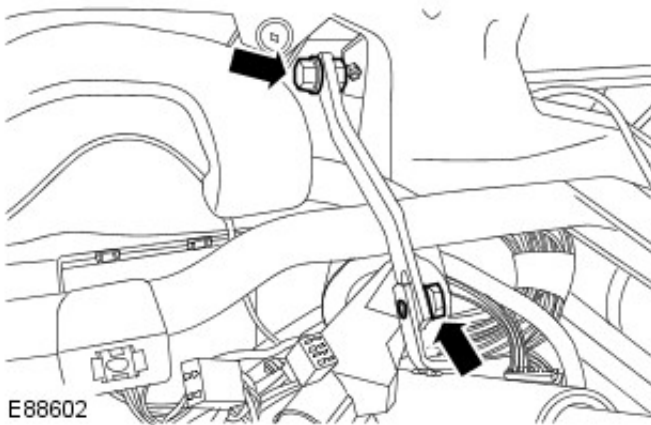


Installation

1. To install, reverse the removal procedure.
 1. Tighten to 23 Nm (17 lb.ft).



2. Tighten to 22 Nm (16 lb.ft).



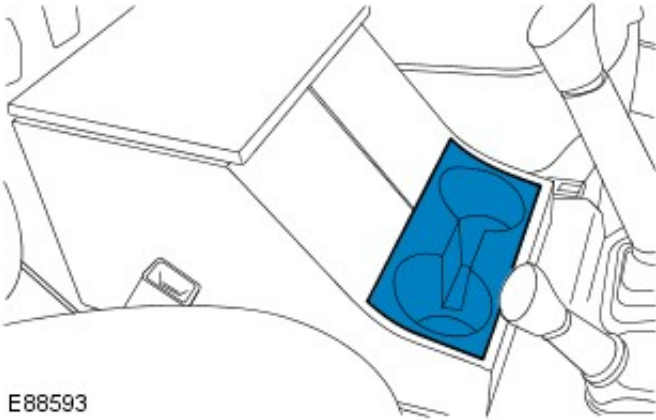
3. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01 Battery, Mounting and Cables, General Procedures).

Instrument Panel and Console - Floor Console

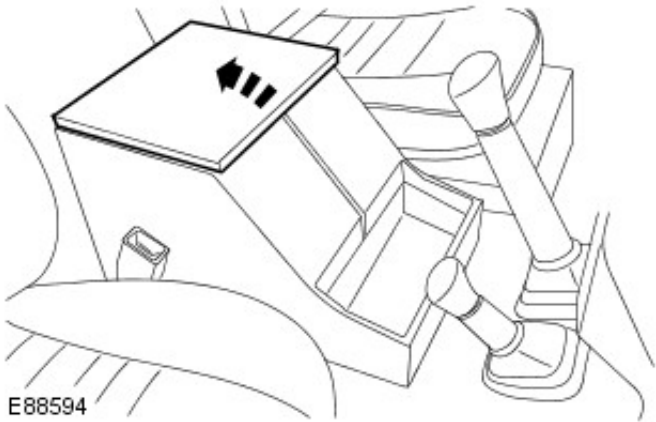
Removal and Installation

Removal

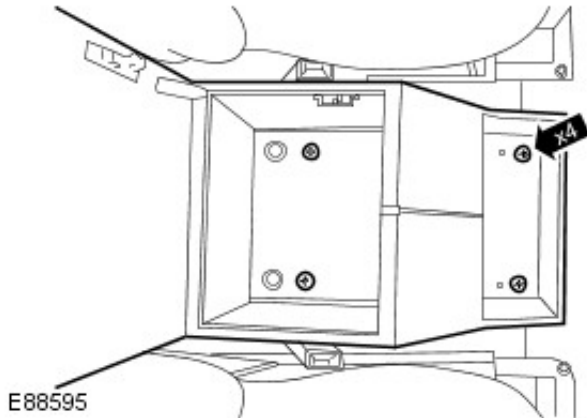
1. Remove the cup holder.



2. Open the floor console lid.



3. Remove the floor console.
 - Remove the 4 screws.



Installation

1. To install, reverse the removal procedure.

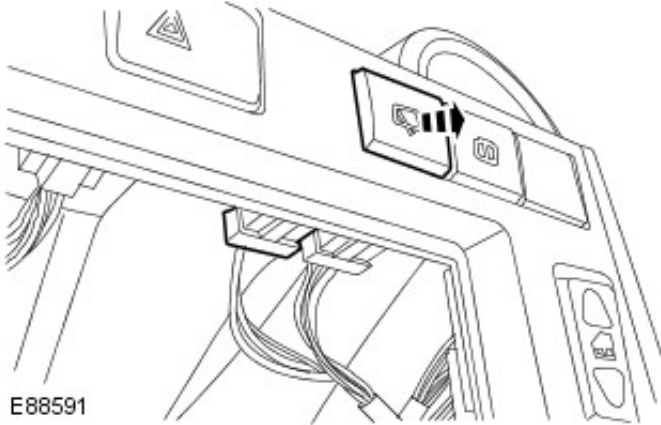
Instrument Panel and Console - Instrument Panel Switches

Removal and Installation

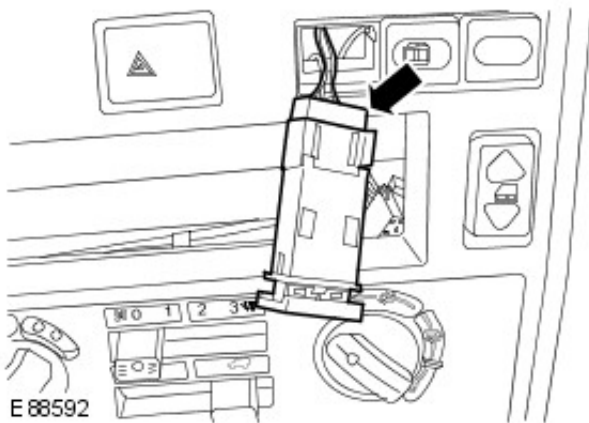
Removal

NOTE: Rear window wiper switch shown, other instrument panel switches similar.

1. Remove the audio unit.
For additional information, refer to: Audio Unit (415-01 Audio Unit, Removal and Installation).
2. Release the instrument panel switch.



3. Remove the instrument panel switch.
 - Disconnect the electrical connector.



Installation

1. To install, reverse the removal procedure.

Handles, Locks, Latches and Entry Systems -

Torque specifications

Discription	Nm	lb.ft
Taildoor latch	10	7

Handles, Locks, Latches and Entry Systems - Handles, Locks, Latches and Entry Systems

Description and Operation

CENTRAL DOOR LOCKING

Central Door Locking (CDL) operates on all doors on Station Wagon and County Station Wagons. On all other Defender variants, CDL operates on the driver and front and rear passenger doors only. CDL is operated by pressing the appropriate button on the remote handset, using the vehicle key in the drivers door lock or using the drivers door sill button.

The CDL system uses electrically operated door latches, which are controlled by the anti-theft system module located behind the instrument pack. The anti-theft system module receives a permanent power supply from the [CJB \(central junction box\)](#). Each CDL latch motor is connected by two wires to the anti-theft system module, which alternately supplies power and earth connections to drive each motor to the lock or unlock positions.

If the latch motors are continually operated in a short period of time, the anti-theft system module will suspend all CDL latch motor operation for 15 seconds to prevent the motors from overheating. Before suspension occurs the anti-theft system module ensures that all the doors are left in the unlocked condition.

If the vehicle is locked, and the key is in the ignition switch or the ignition is on and the anti-theft system module inertia switch is tripped, all doors will be unlocked immediately and the hazard warning lamps will operate. To prevent accidental relocking, all latch motors will be inhibited until the anti-theft system module senses that the drivers door is opened with the key removed from the ignition switch.

Locking of the vehicle using the remote handset is inhibited with the key in the ignition switch.

Slam Locking

With the introduction of CDL, slam locking of the drivers door is disabled. If an attempt is made to slam lock the vehicle, the anti-theft system module will unlock all doors.

CDL Using the Drivers Door Sill Button

Each door has a sill button to allow that door to be individually locked from inside the vehicle. The drivers door sill button has additional functionality which allows all doors to be locked from inside the vehicle from this one button.

When the driver door sill lock button is depressed, the CDL system enters a sill locked state, where all doors are locked but immobilisation and perimetric and volumetric sensing is suspended. CDL using the drivers sill lock button can be achieved with or without the key in the ignition switch and without the ignition being on.

If the CDL is in the sill locked state and the lock button on the remote handset is pressed, the volumetric and perimetric functions of the alarm system will become active and active engine immobilisation will be invoked.

CDL Using the Key

The driver and the passenger front doors are fitted with key barrel locks. Using the vehicle key in the passenger door will only lock or unlock that door. Using the key in the drivers door will operate the CDL system and lock or unlock all doors.

NOTE: The passenger door key barrel is connected to the door latch and has no electrical input to the anti-theft system module. The driver door key barrel is also connected to the door latch and its operation is monitored by the ECU only via the latch motor and the two wires connected to it.

When the vehicle is locked using the key in the drivers door, only CDL and perimetric protection is invoked. Volumetric protection and active immobilisation is not initiated.

CDL Using the Remote Handset

The remote handset has two buttons; lock and unlock. A single press on the lock button will lock all doors and invoke perimetric and volumetric protection and active immobilisation. Remote locking is inhibited if the transponder coil senses that the key is in the ignition switch.

When the vehicle is locked, a single press of the unlock button will unlock all doors and disable perimetric and volumetric protection. Immobilisation is only disabled using the transponder coil and the remote handset or the EKA procedure.

Anti-theft Alarm Indicator



E83594

1

Item	Part Number	Description
1	-	Anti-theft alarm indicator

1 - Anti-theft alarm indicator

In addition to the alarm system status indications, the Anti-theft alarm indicator also displays CDL system status.

The system confirms that the drivers door is open by illuminating the indicator for the 10 second confirmation period. If any other door or the hood is open, the indicator remains unlit for the 10 second confirmation period. After the 10 second confirmation period the indicator reverts to the slow flash deterrent mode if the alarm is armed.

Interior Lamp Functionality

The anti-theft system module controls the interior lamp functionality. When the lamps are extinguished, they fade out to the off condition over a 2 second period.

The lamps are turned on by:

- Disarming the alarm using the remote handset
- Opening any door.

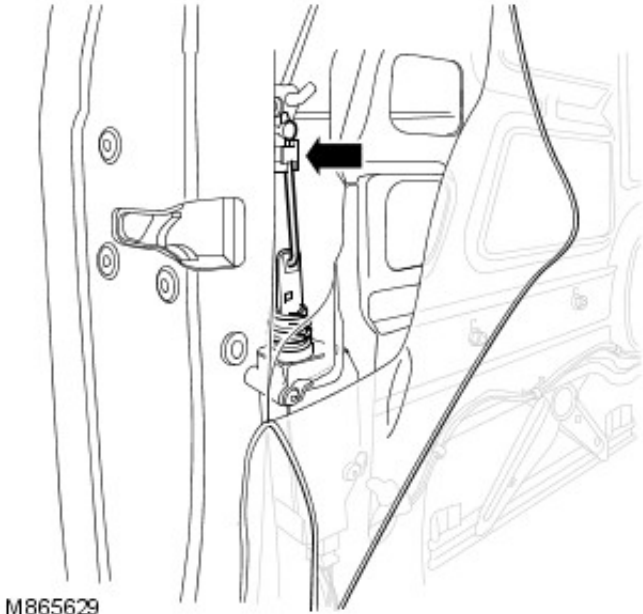
When the lamps are on, they will be extinguished by the following actions:

- If all doors are closed, the lamps will be extinguished after a 15 second delay period.
- If any door is left open, the lamps will be extinguished after an 8 minute delay period.
- If one of the above delay periods is active and the ignition is switched on or the alarm is armed, the lamps will be extinguished.

Handles, Locks, Latches and Entry Systems - Latch Cable Adjustment

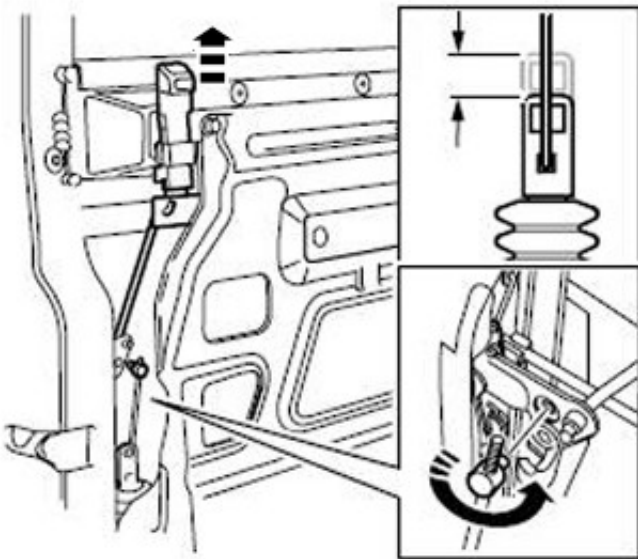
General Procedures

1. Remove door trim panel.
For additional information, refer to: Front Door Trim Panel - Vehicles Built From: 07/2001 (501-05, Removal and Installation).
2. Carefully peel back plastic sheet to expose mechanism.
3. Release clip and detach solenoid link from latch.



M865629

4. Ensure sill button is fully raised.
5. Fully extend solenoid actuator then lower $3.5 \text{ mm} \pm 1.00 \text{ mm}$.
6. Whilst holding actuator in this position, adjust length of link, until link pin is aligned with hole in latch lever.
7. Connect link and secure with clip.



E79255

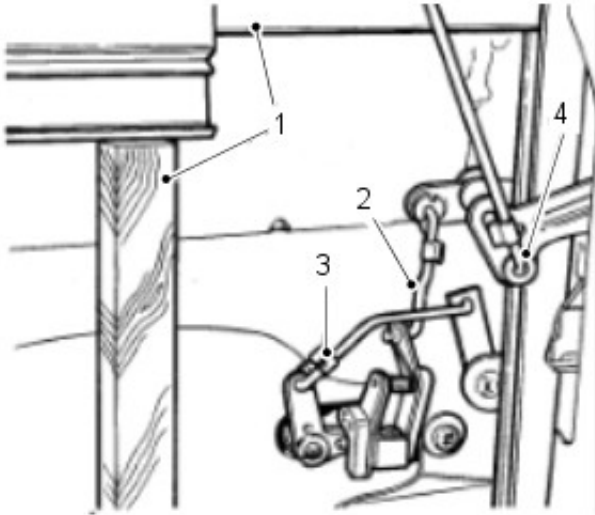
8. Secure plastic sheet.
9. Instal door trim panel.
For additional information, refer to: Front Door Trim Panel - Vehicles Built From: 07/2001 (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Front Door Latch

Removal and Installation

Removal

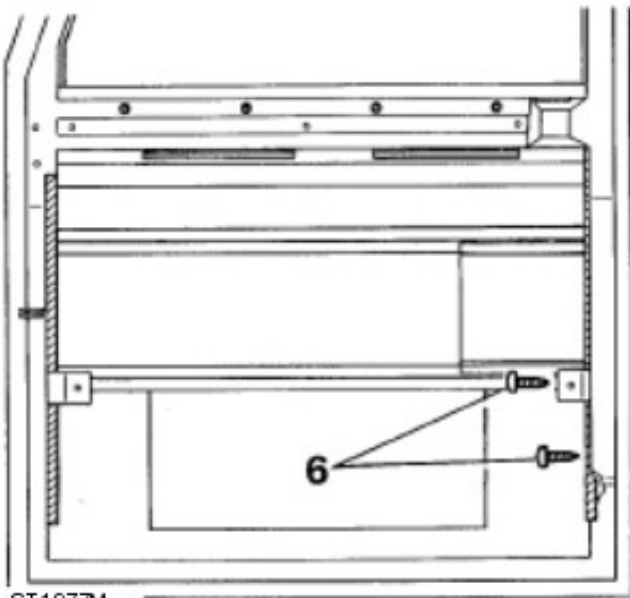
1. Remove door reinforcing panel and support glass with timber.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).
2. Disconnect control rod from handle operating lever.
3. Disconnect control rod from locking lever on handle.
4. Disconnect push button control rod and linkage from latch mechanism.



ST1983M

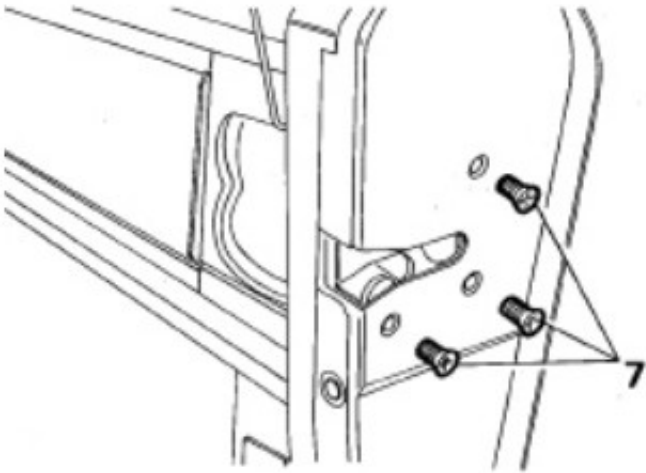
5. Remove 2 screws and remove handle assembly from door.

6. Remove 2 self-tapping screws retaining lower end of window glass runner.



ST1977M

7. Remove 3 screws securing latch assembly to door.



ST1975M

8. Whilst taking care not to damage runner, ease runner away from latch and manoeuvre latch assembly from door.

Installation

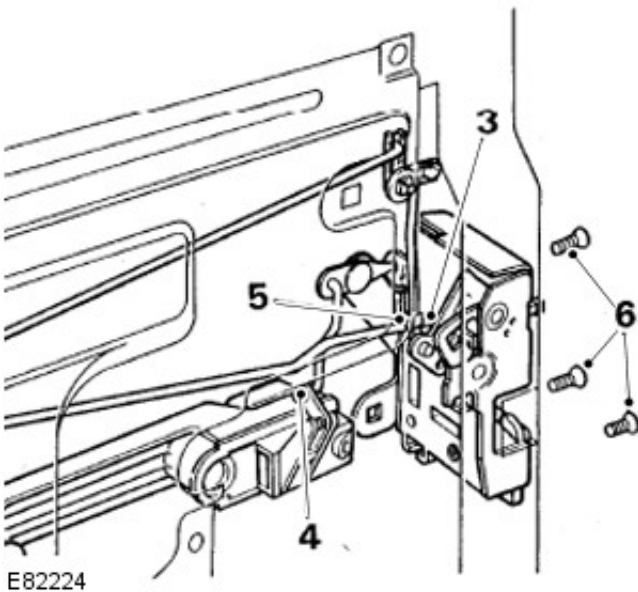
1. Carefully ease window runner away, sufficiently to enable latch to be located into position.
2. Secure latch to door with 3 screws.
3. Secure window runner with 2 screws ensuring that packing strip is in position and that screw heads are below bottom of runner to prevent damage to glass.
4. Install handle with 2 screws, ensuring that bezels are in position.
5. Connect control rod to handle operating lever and secure with spring clip.
6. Connect control rod to locking lever and retain with spring clip.
7. Connect push button control rod and linkage to latch lever and secure with spring clip.
8. Install mounting panel.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Rear Door Latch

Removal and Installation

Removal

1. Remove door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).
2. Peel-back sufficient of plastic sheet to reveal latch.
3. Release remote control lever rod from latch assembly.
4. Disconnect door outer handle control rod from latch assembly.
5. Disconnect door locking button remote control rod from latch mechanism.
6. Remove 3 retaining screws and withdraw latch assembly from door.



Installation

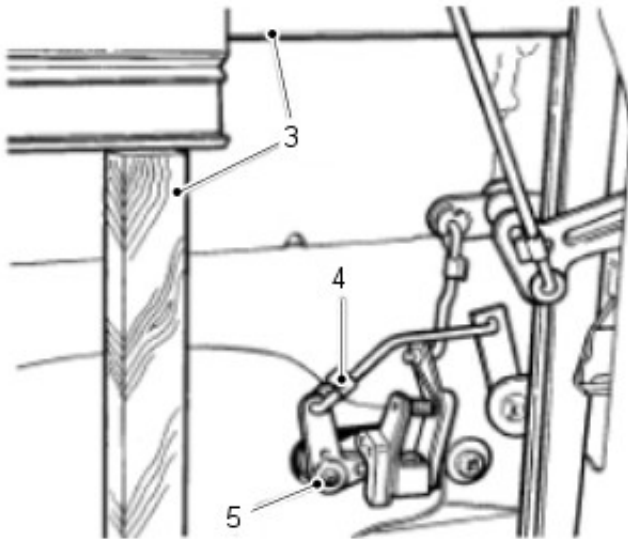
1. Install latch assembly to door and secure with 3 screws, noting that uppermost screw is longer.
2. Connect remote control levers to latch mechanism reversing instructions 3, 4 and 5.
3. Re-seal plastic sheet and install door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Door Lock Cylinder

Removal and Installation

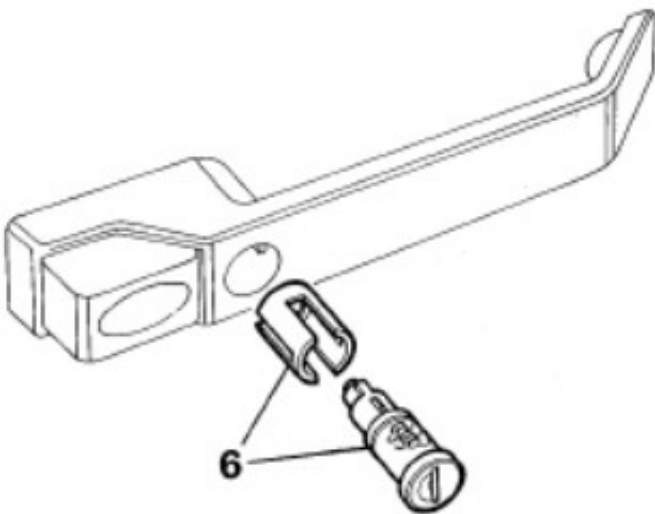
Removal

1. Remove door trim panel and plastic sheet.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).
2. Remove reinforcement panel.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).
3. Raise and support glass to gain access to latch mechanism.
4. Release spring clip and disconnect rod from lock operating lever.
5. Remove single screw and withdraw lock lever assembly.



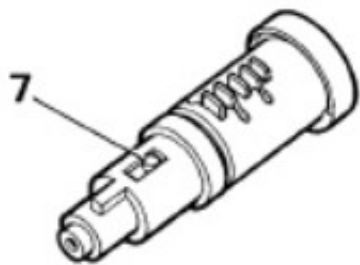
ST1981M

6. Withdraw lock barrel from exterior door handle complete with locking sleeve.



ST1980M

7. To remove barrel from plastic retaining sleeve, depress spring loaded button and withdraw sleeve.

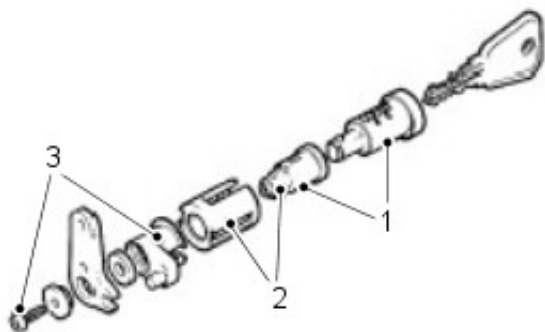


ST1979M

Installation

NOTE: If a new barrel is being installed, check that number on barrel coincides with number on accompanying key.

1. Push plastic retaining sleeve over barrel until spring loaded peg locks it into position.
2. Install barrel and plastic sleeve assembly to locking sleeve and insert into exterior handle reversing instruction 6.
3. Assemble lock lever components as illustrated and from inside of door panel, install them to barrel assembly with single screw.



ST1978M

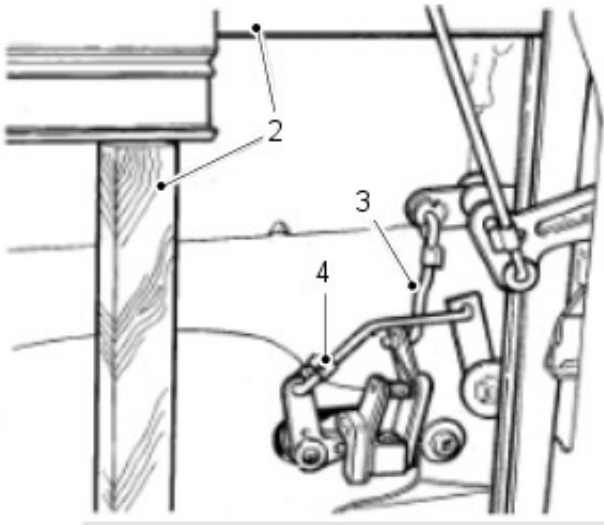
4. Connect operating rod to lock lever and secure with spring clip, reversing instruction 4.
5. Install front door reinforcement panel.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).
6. Install plastic sheet.
7. Install door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Exterior Front Door Handle

Removal and Installation

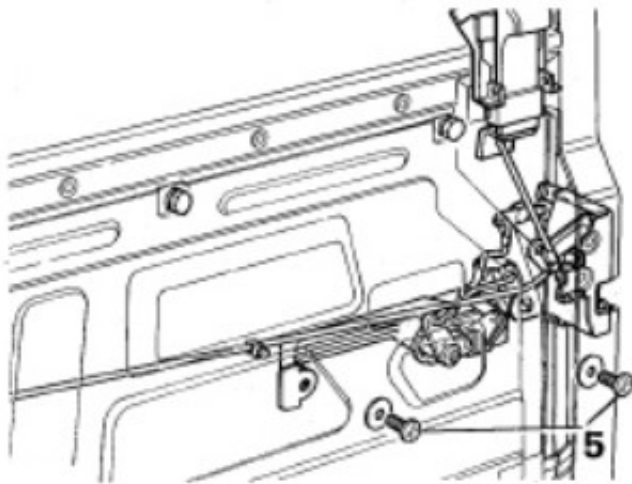
Removal

1. Remove door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).
2. Remove door reinforcement panel and support glass with timber.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).
3. Disconnect operating rod from handle mechanism.
4. Disconnect rod from locking barrel lever.



ST1982M

5. Remove 2 screws and withdraw handle assembly.



ST1970M

Installation

1. Install handle to door ensuring that two bezels are in position - flat faces towards door, and secure with 2 screws.
2. Connect rod to handle operating lever and secure with spring clip.
3. Connect rod to locking barrel lever and secure with spring clip.

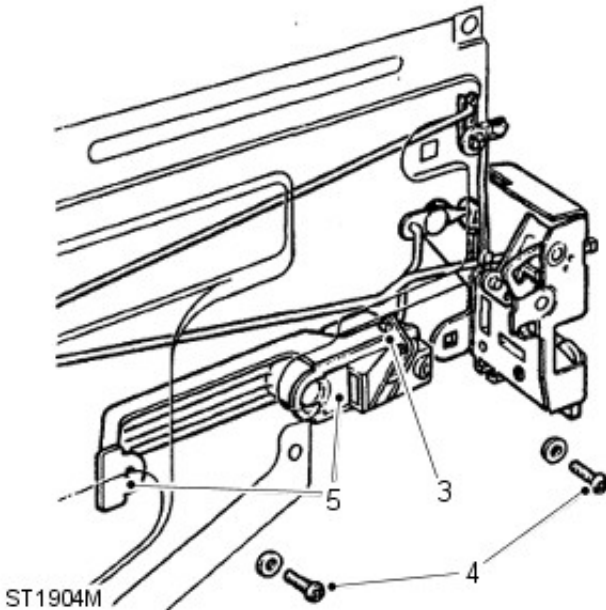
3. Connect rod to locking barrel lever and retain with spring clip.
4. Install door reinforcement panel.
For additional information, refer to: Front Door Reinforcement Panel (501-03, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Exterior Rear Door Handle

Removal and Installation

Removal

1. Remove door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).
2. Peel back sufficient of plastic sheet to gain access to handle mechanism.
3. Disconnect actuating rod from handle operating lever.
4. Remove 2 screws and withdraw handle and bezels.



Installation

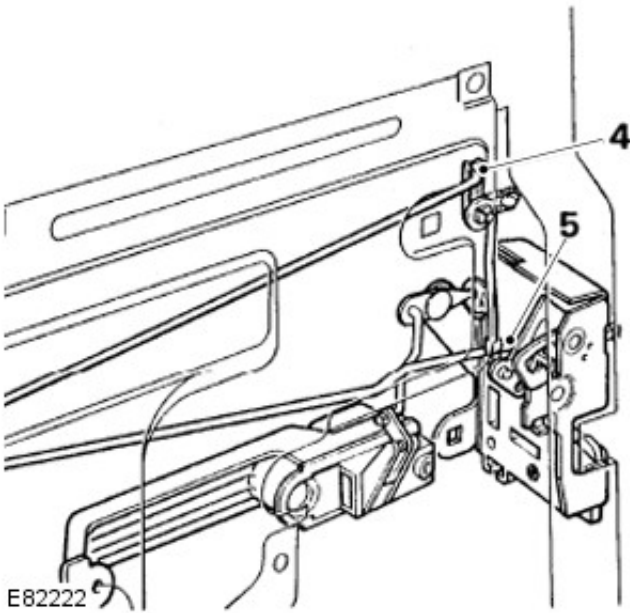
1. Install handle to door ensuring that both bezels are in position - flat faces towards door and secure with 2 screws.
2. Connect actuating rod to handle operating lever and secure with spring clip.
3. Re-seal plastic sheet.
4. Install door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Interior Rear Door Handle

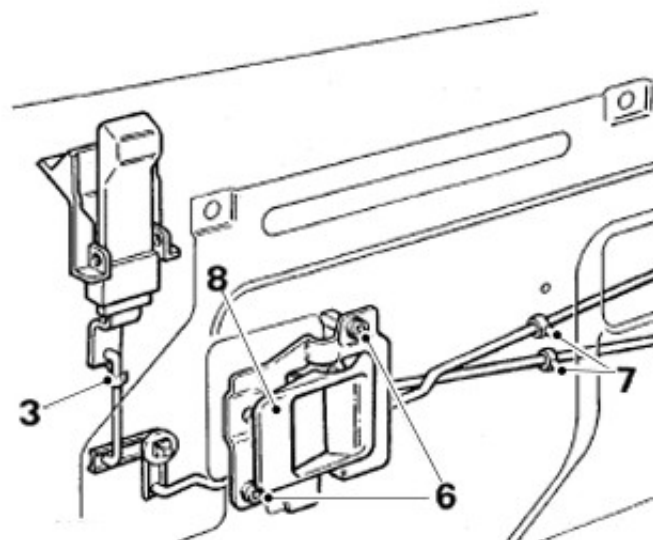
Removal and Installation

Removal

1. Remove door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).
2. Peel-back sufficient of plastic sheet to gain access to remote lever.
3. Remove spring clip and disconnect control rod from push button.
4. Release spring clip and disconnect short locking button control rod from latch mechanism.
5. Disconnect long remote control rod from latch assembly.



6. Remove 2 screws securing remote control lever to mounting panel.
7. Release control rods from plastic retaining clips located in mounting panel.
8. Withdraw remote control lever and rods from door.



E82223

Installation

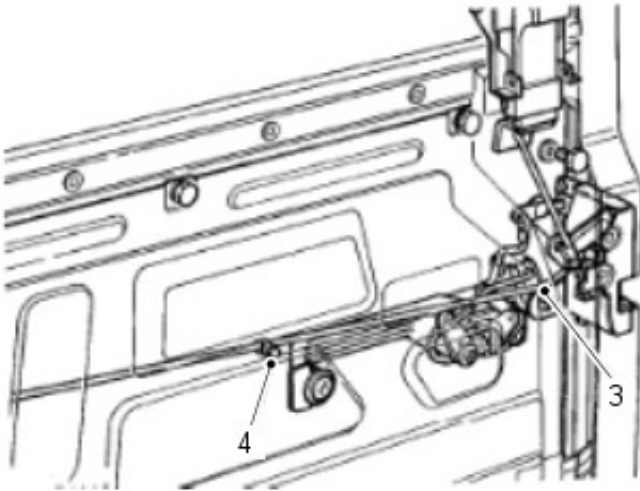
1. Install plastic retaining clips to rod assembly into position and secure with 2 screws.
2. Connect control rods to latch assembly and secure with clips.
3. Install plastic retaining rod clips to mounting panel.
4. Connect control rod to push button and secure with clip.
5. Re-seal plastic sheet and install door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Interior Front Door Handle

Removal and Installation

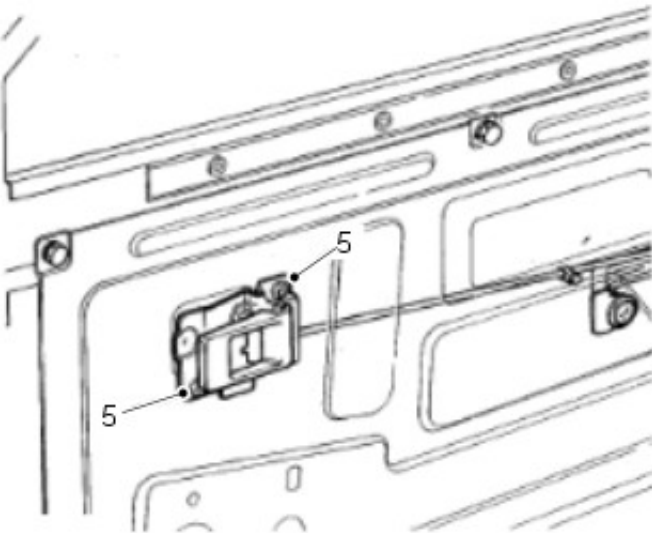
Removal

1. Remove door trim casing.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).
2. Peel back sufficient of plastic sheet to gain access to remote lever.
3. Release spring clip and disconnect control rod from latch mechanism.
4. Release control rod from plastic clip in mounting panel.



ST1971M

5. Remove 2 screws securing remote control lever to mounting panel and withdraw lever and control rod.



ST1972M

Installation

1. Feed control rod into position and loosely secure lever to mounting panel with 2 screws.
2. Connect control rod to latch mechanism and secure with spring clip.
3. Tighten control lever retaining screws.

3. Tighten control lever retaining screws.

4. Secure control rod to plastic clip in mounting panel.

5. Secure plastic sheet.

6. Install door trim casing.

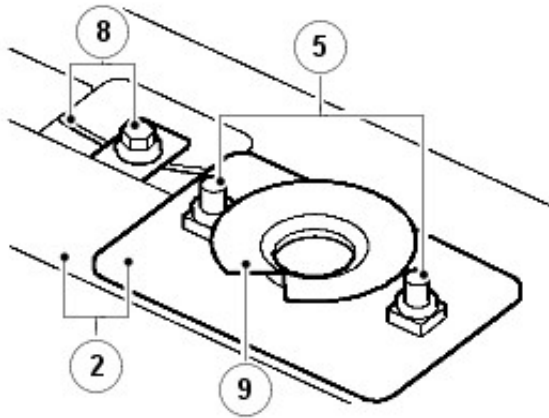
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Hood Latch

Removal and Installation

Removal

1. Open hood.
2. Mark position of guide plate and lock to hood platform.
3. Remove 8 screws securing grille.
4. Remove grille.
5. Remove 2 bolts securing guide plate and lock.
6. Remove guide plate.
7. Release spring securing lock to hood platform.
8. Slacken clamping bolt securing hood release cable.
9. Remove lock.



J6371

Installation

1. Fit spring between lock and hood platform.
2. Position lock and guide plate to hood platform and nip up bolts.
3. Position guide plate and lock to position marks and tighten bolts to 10 Nm (7 lbf/ft).
4. Fit cable to lock and tighten clamping bolt.
5. Check operation of release cable and adjust if necessary.
6. Fit grille and tighten securing screws.
7. Close hood.

Handles, Locks, Latches and Entry Systems - Hood Latch Release Handle

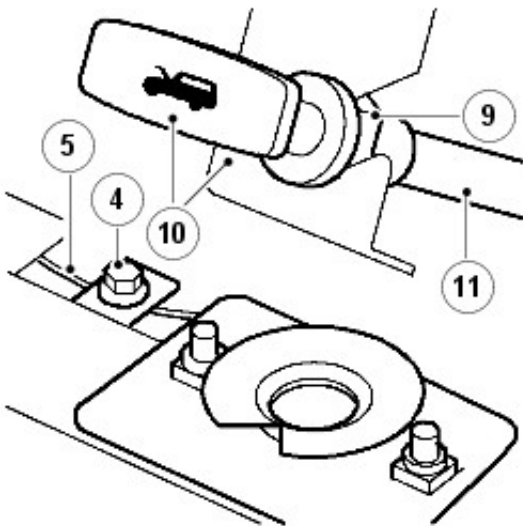
Removal and Installation

Removal

1. [NOTE: Hood release cable renew](#)

Open hood.

2. Remove 8 screws securing grille.
3. Remove grille.
4. Slacken clamping bolt securing hood release cable.
5. Remove cable from lock.
6. Release cable from clip on underside of hood platform.
7. Feed cable through valance and collect grommet.
8. Release cable from clip fixed to wheelarch under expansion tank.
9. Loosen clamping nut securing hood release handle to mounting bracket.
10. Remove hood release handle from mounting bracket.
11. Withdraw cable through bulkhead.



J6372

Installation

1. Feed cable through bulkhead and fit hood release handle to mounting bracket. Tighten clamping nut.
2. Route cable behind expansion tank and fit to securing clip.

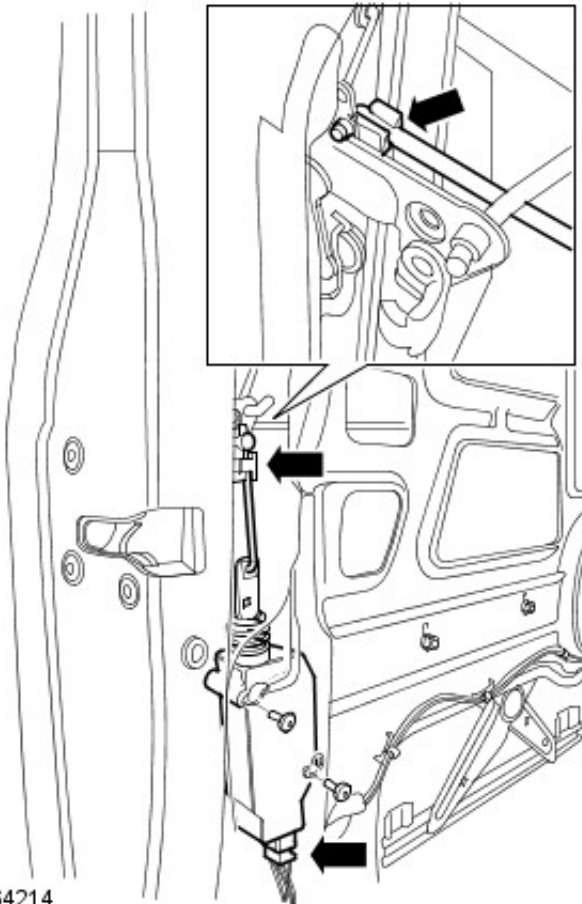
3. Feed cable through valance.
4. Fit grommet between cable and valance.
5. Fit cable to securing clip on underside of hood platform.
6. Fit cable to lock and tighten clamping bolt.
7. Check operation of release cable and hood lock and adjust if necessary.
8. Fit grille and tighten screws.
9. Close hood.

Handles, Locks, Latches and Entry Systems - Front Door Lock Actuator

Removal and Installation

Removal

1. Remove door trim panel.
For additional information, refer to: Front Door Trim Panel - Vehicles Built From: 07/2001 (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Carefully peel back plastic sheet to expose mechanism.
3. Release clip, detach and remove lock solenoid link.
4. Loosen 2 screws securing solenoid, release solenoid from mounting panel, disconnect multiplug and remove solenoid.



M764214

Installation

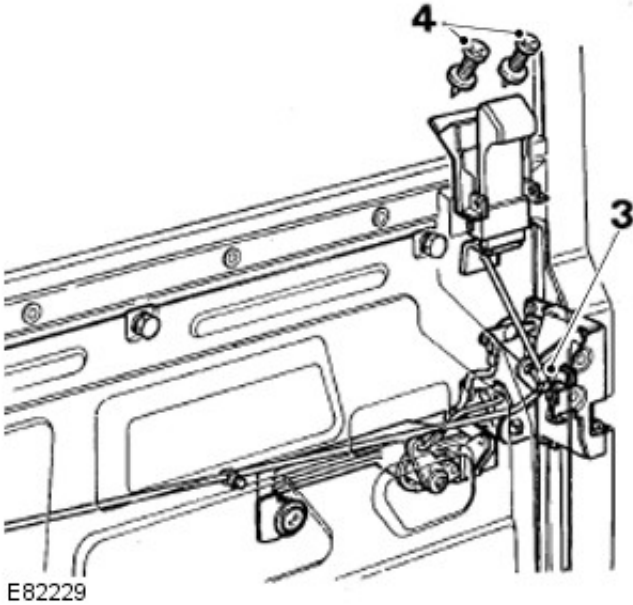
1. Connect multiplug to solenoid, locate solenoid to mounting panel and tighten screws.
2. Instal and secure link.
3. Adjust door latch cable.
For additional information, refer to: Latch Cable Adjustment (501-14 Handles, Locks, Latches and Entry Systems, General Procedures).
4. Refit plastic sheet.
5. Fit door trim panel.
For additional information, refer to: Front Door Trim Panel - Vehicles Built From: 07/2001 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Front Door Push Button Rod and Linkage

Removal and Installation

Removal

1. Remove door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).
2. Peel back sufficient of plastic sheet to expose mechanism.
3. Release spring clip and disconnect operating rod from latch mechanism.
4. Remove 2 screws and withdraw push button rod and linkage.



Installation

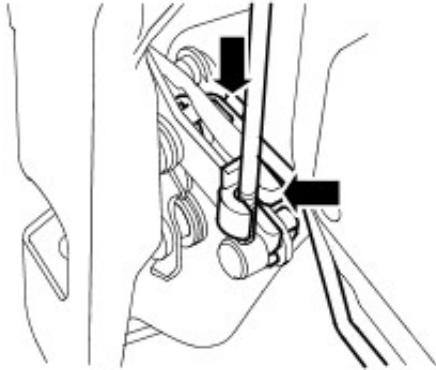
1. Secure push button rod and linkage to door with 2 screws.
2. Connect operating rod to latch mechanism and secure with spring clip.
3. Re-seal plastic sheet and install door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Rear Door Lock Actuator

Removal and Installation

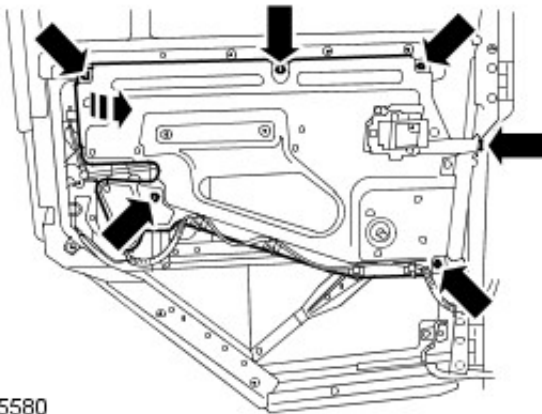
Removal

1. Remove door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).
2. Carefully peel back plastic sheet to expose mechanism
3. Release clip, detach and remove lock solenoid link.
4. Release clip and disconnect interior handle link from latch mechanism.



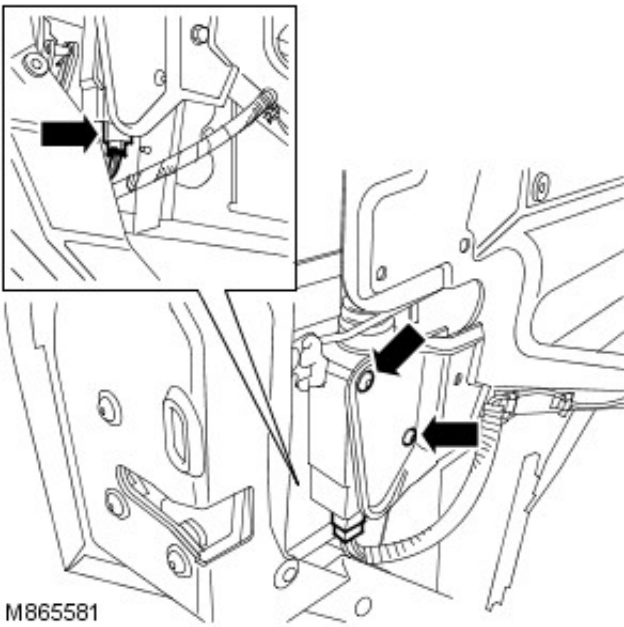
M764259

5. Remove 3 bolts securing mounting panel.
6. Loosen remaining bolts and nut, ease mounting panel away from door and retain in this position for access.



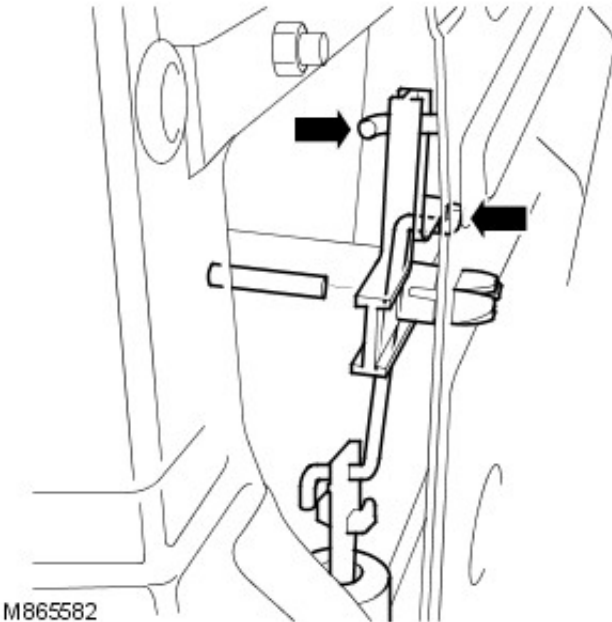
M865580

7. Disconnect multiplug from solenoid.
8. Remove 2 screws securing solenoid.



9. Remove centre pin from bellcrank pivot and release pivot from mounting panel.

10. Release bellcrank from sill button link and remove from lock solenoid link.



11. Remove door lock solenoid.

12. Remove link from solenoid.

Installation

1. Install link to solenoid, position solenoid, install bellcrank and connect to sill button link.
2. Secure bellcrank to mounting panel and install centre pin.
3. Align solenoid and install and tighten screws.
4. Connect multiplug to solenoid.
5. Install mounting panel bolts and tighten all bolts and nut to 10 Nm (7 lbf.ft).
6. Connect interior handle link to latch and secure with clip.
7. Install and secure solenoid link.

7. Install and secure door hinge.

8. Install plastic sheet.

9. Install door trim panel.

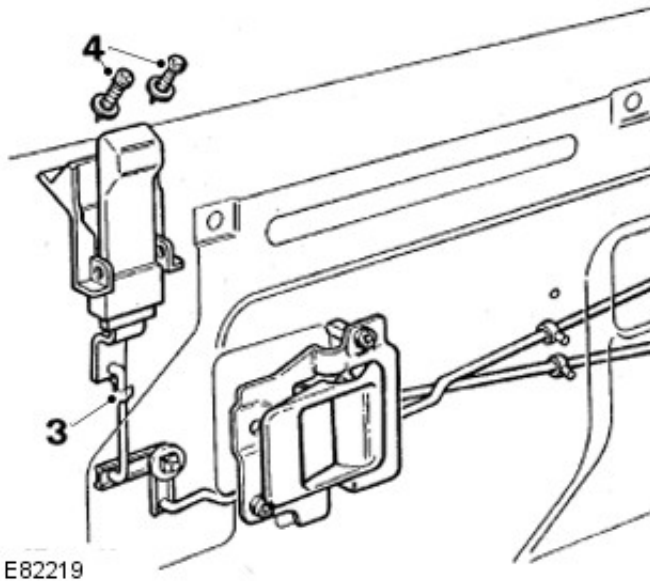
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Rear Door Push Button and Linkage

Removal and Installation

Removal

1. Remove door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).
2. Peel back sufficient of plastic sheet to reveal mechanism.
3. Release spring clip securing button to operating rod and withdraw rod from button.
4. Remove 2 screws securing button to door panel and remove button.



Installation

1. Secure locking button assembly to door panel with 2 screws.
2. Install operating rod to button assembly and secure with spring clip.
3. Re-seal plastic sheet and install door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

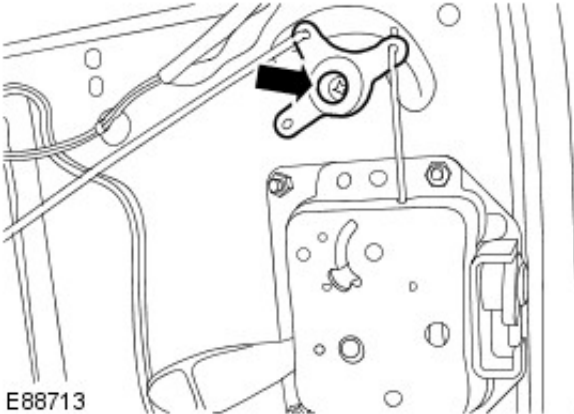
Handles, Locks, Latches and Entry Systems - Taildoor Latch

Removal and Installation

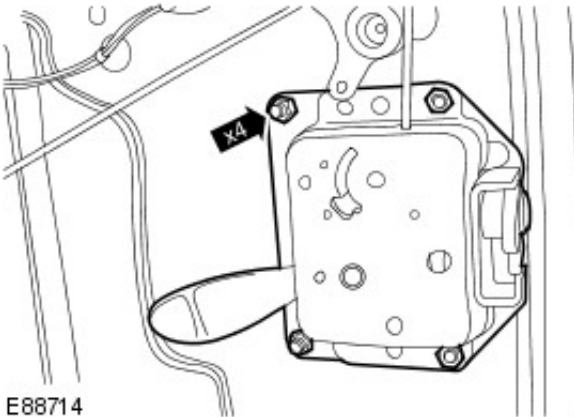
Removal

1. Remove the taildoor trim panel.
For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).

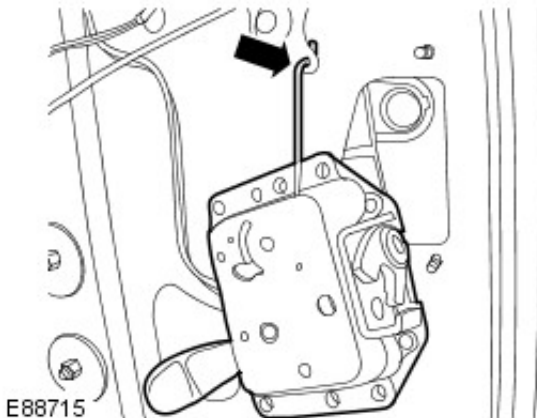
2. Release the central locking control rod pivot.
 - Remove the screw.



3. Release the taildoor latch.
 - Remove the 4 nuts.



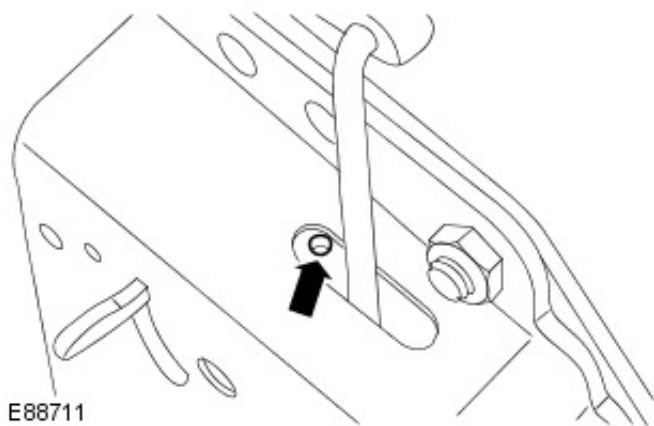
4. Remove the taildoor latch.
 - Disconnect the taildoor latch from the control rod pivot.



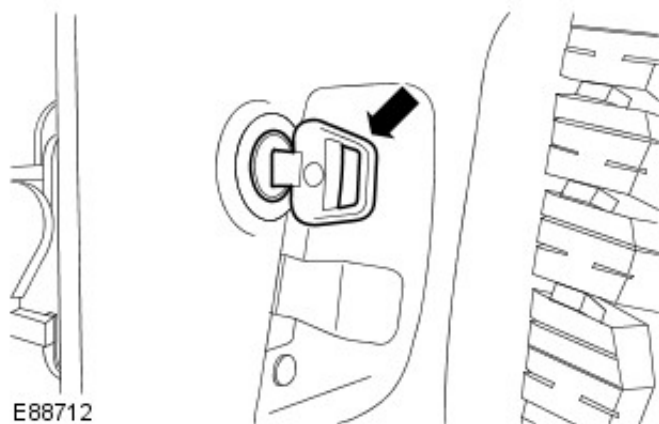
5. **NOTE: Do not carry out further dismantling if component is removed for access only.**

NOTE: Make sure the latch is in the locked position.

Using a suitable tool release the lock cylinder.

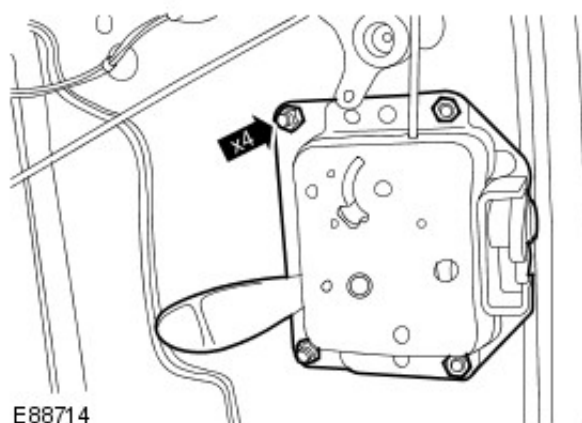


6. Insert the key and remove the lock cylinder.



Installation

1. To install, reverse the removal procedure.
 - Tighten to 10 Nm (7 lb.ft).



Handles, Locks, Latches and Entry Systems - Taildoor Lock Cylinder

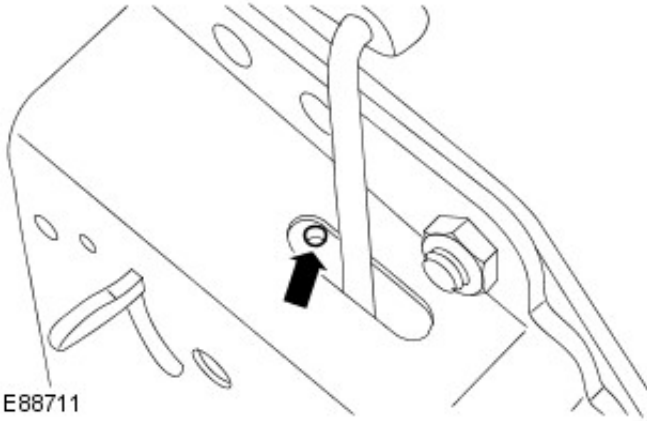
Removal and Installation

Removal

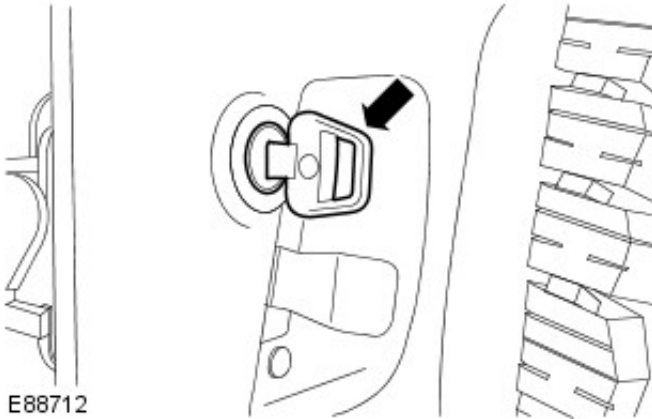
1. Remove the taildoor trim panel.
For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).

2. **NOTE: Make sure the latch is in the locked position.**

Using a suitable tool release the lock cylinder.



3. Insert the key and remove the lock cylinder.



Installation

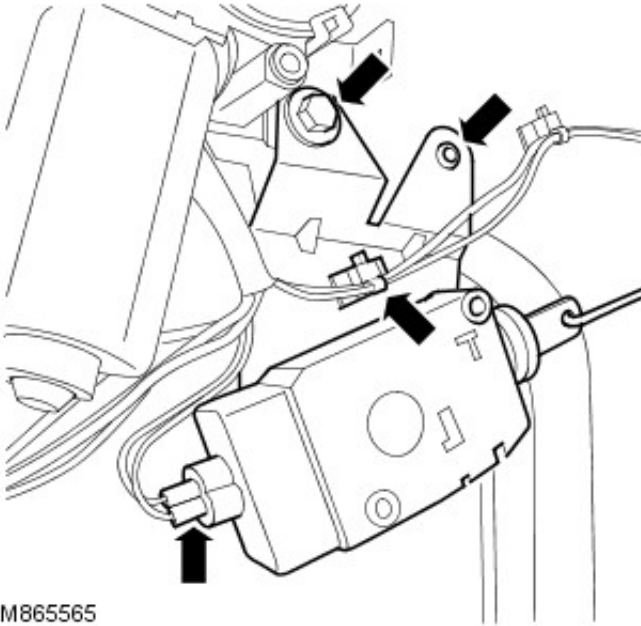
1. To install, reverse the removal procedure.

Handles, Locks, Latches and Entry Systems - Taildoor Lock Motor

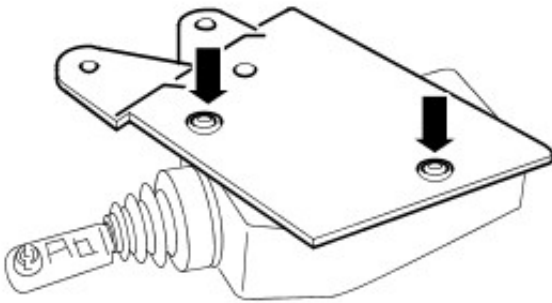
Removal and Installation

Removal

1. Remove tail door trim panel.
For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).
2. Disconnect multiplug from taildoor lock motor.
3. Remove bolt and screw securing taildoor lock motor to taildoor.
4. Release clip securing harness to taildoor lock motor mounting bracket.
5. Remove taildoor lock motor assembly from operating rod.



6. Remove 2 screws securing taildoor lock motor to mounting bracket.



Installation

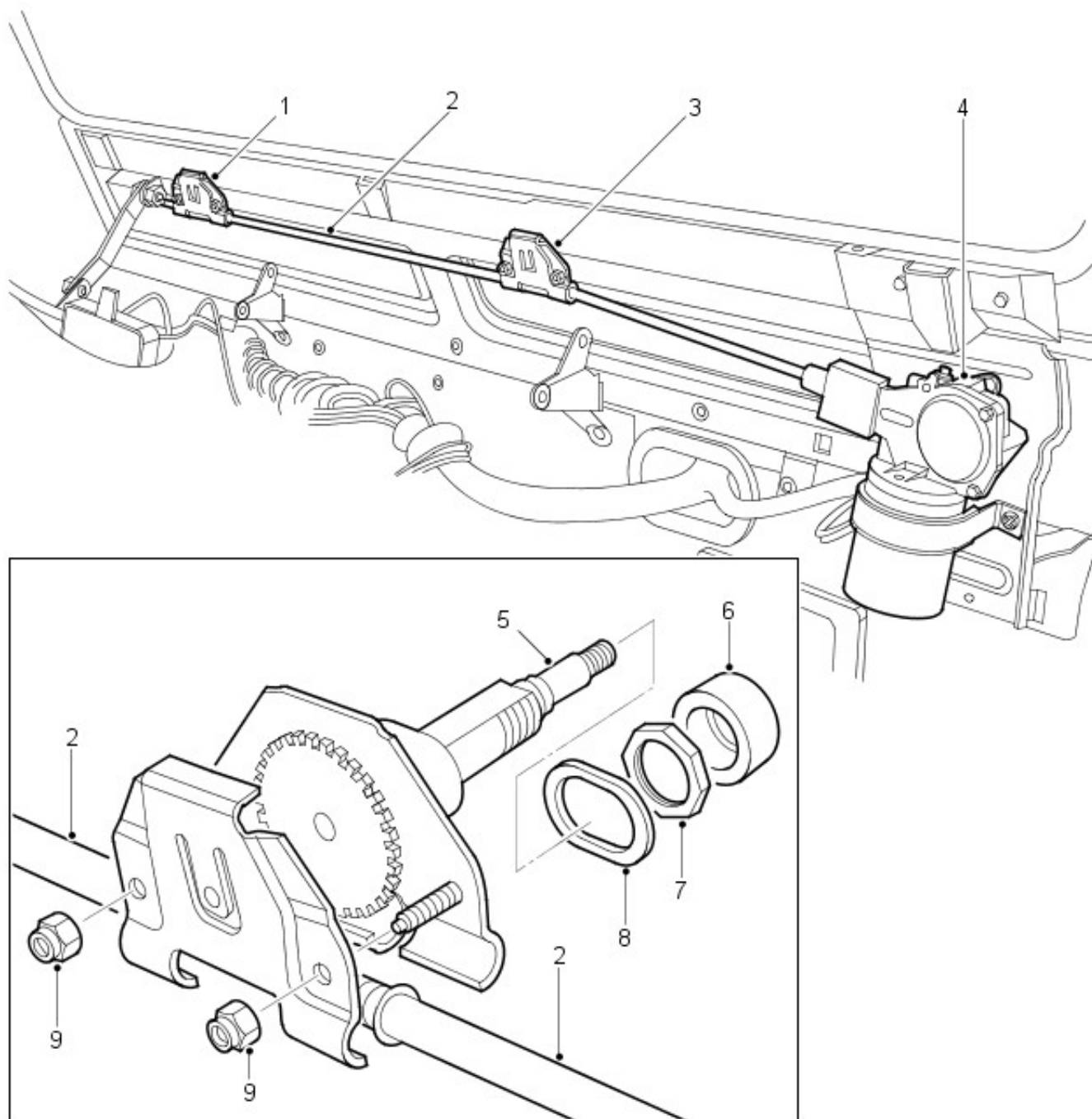
1. Install taildoor lock motor to mounting bracket and secure with screws.
2. Connect operating rod to taildoor lock motor.
3. Install taildoor lock motor to door, fit screw and tighten bolt to 6 Nm (4 lbf.ft).
4. Position harness to taildoor lock motor mounting bracket and secure with clip.

5. Connect multiplug to taildoor lock motor.

6. Install taildoor trim panel.
For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).

Wipers and Washers - Wipers and Washers

Description and Operation



M840391A

Item	Part Number	Description
1.	-	LH wheelbox
2.	-	Cable
3.	-	RH wheelbox
4.	-	Wiper motor
5.	-	Spindle with DIN taper arm attachment
6.	-	Spacer
7.	-	Locknut
8.	-	Seal
9.	-	Locknuts

WINDSCREEN WIPERS

Although windscreen wiper functionality remains the same, the mechanical architecture has undergone significant

changes, for 2002 Model year. The body structure has undergone some minor changes to house the revised wiper linkage.

A modified wiper motor is introduced which is balanced to reduce operation noise. The brush plate is fitted with capacitors to reduce radio interference and a thermal cut-out is introduced to prevent motor burnout. The motor also contains a new park switch which also reduces operation noise. A common motor is now used on both LHD and RHD variants.

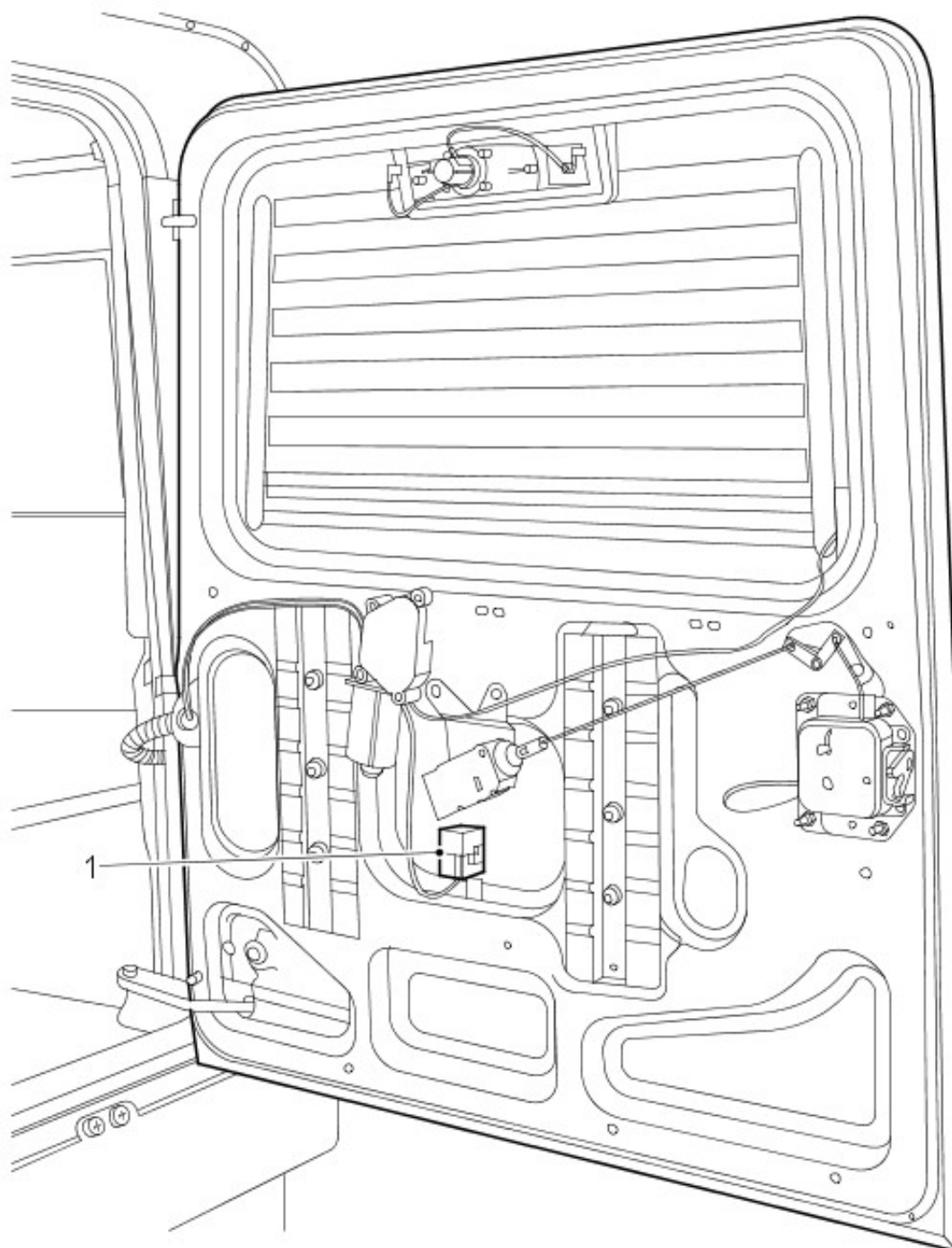
The motor is repositioned on the bulkhead which allows a straighter drive cable run. The straighter run reduces load on the cable allowing a stiffer cable to be used. The stiffer cable and the incorporation of a reduced friction material reduces torsion wind-up of the cable and results in smoother wiper operation and a reduction of blade over travel.

New, larger wheel boxes are fitted in an inverted position from the previous installation. The bulkhead mounting holes are larger with flats for positive location of the wheel box spindle. The wheel boxes now feature a 40 tooth gear ratio in lieu of a 32 tooth gear. This reduces backlash and load and further reduces blade over travel. The wheel box casings are secured with locknuts.

The wheel box spindles now have a splined DIN taper fitting for the new wiper arms which are secured on the spindle with an M8 nut. The taper improves arm retention.

A new grease is introduced which improves wiper operation at very low temperatures.

REAR WIPER



M865569

Item	Part Number	Description
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1. - Rear wiper relay

The rear wiper system is unchanged except for the addition of a wiper motor relay into the electrical circuit, at 2002 model year.

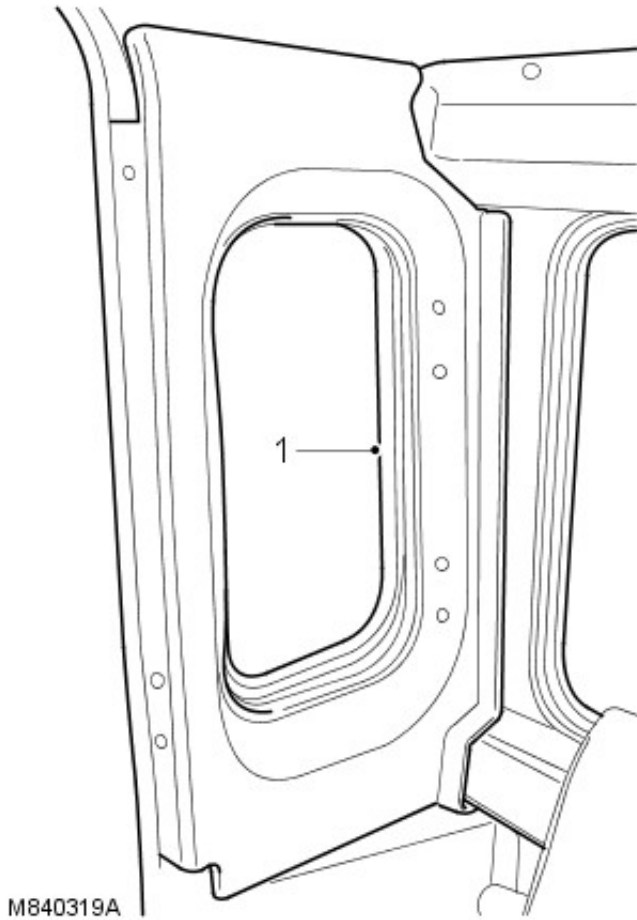
The new rear wiper relay is located in the tail door, below the wiper motor. The relay coil is energised by a feed supplied from the rear wiper switch. When the relay contacts close, a feed is supplied via the ignition switch (position II) and a fuse in the passenger compartment fuse box, through the relay contacts to the wiper motor.

Wipers and Washers - Rear Window Washer Jet

Removal and Installation

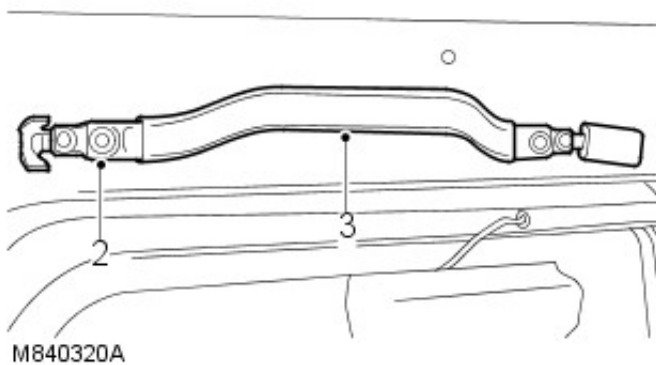
Removal

1. Release and remove both rear side window finishers.

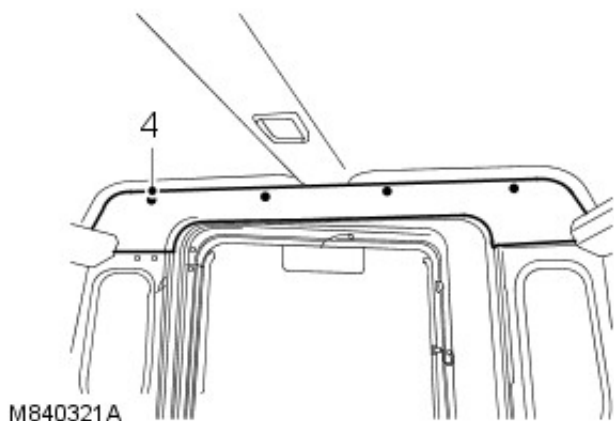


2. Remove 8 screws securing both rear grab handles.

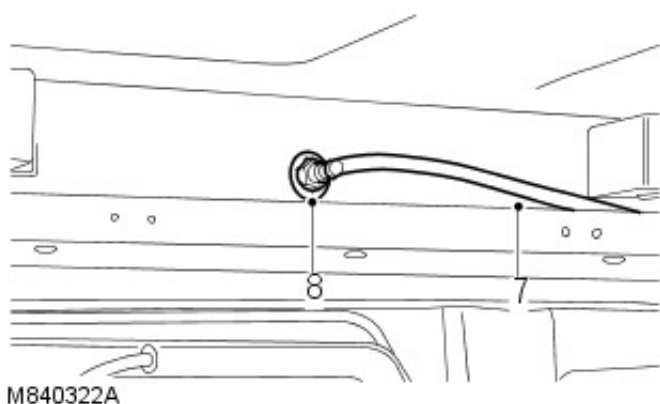
3. Remove both rear grab handles.



4. Remove 4 trim studs securing upper rear finisher to body.



5. Release and remove upper rear finisher.
6. Position drain tin to collect any fluid spillage.
7. Disconnect washer tube from jet.
8. Remove nut securing washer jet to body.



9. Remove rear window washer jet.

Installation

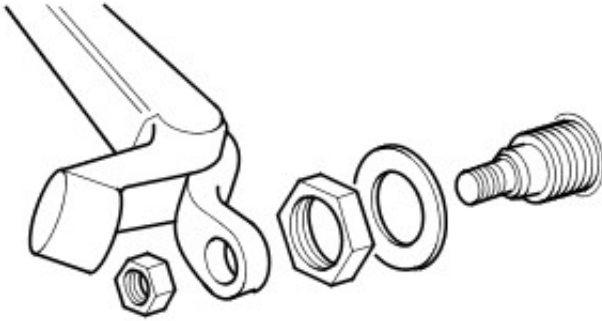
1. Fit rear window washer jet to body and secure with nut.
2. Connect washer tube to jet.
3. Remove drain tin.
4. Fit upper rear finisher and secure with trim studs.
5. Fit both rear grab handles and secure with screws.
6. Fit both rear side window finishers.

Wipers and Washers - Rear Window Wiper Motor

Removal and Installation

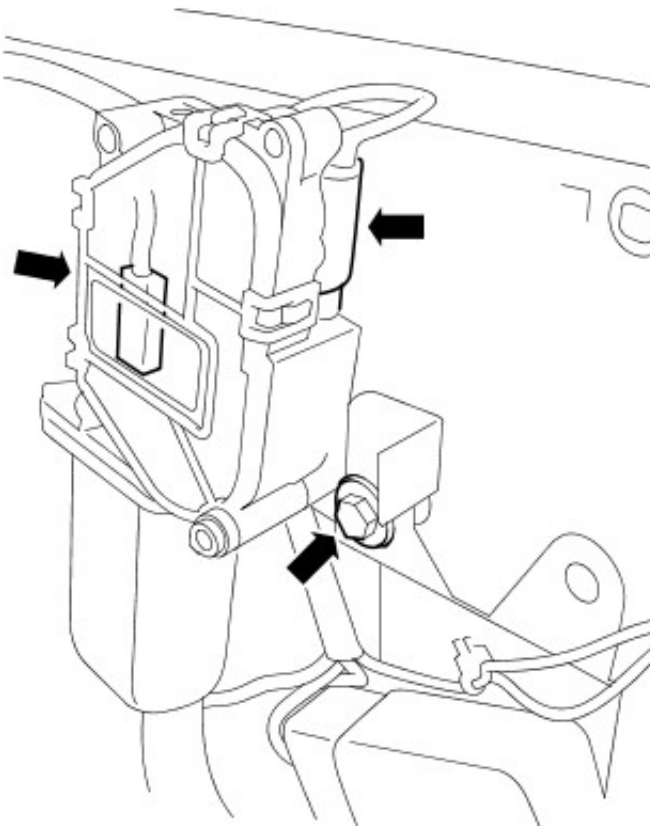
Removal

1. Remove spare wheel from taildoor.
2. Raise nut cover, remove nut and release wiper arm.



M840392

3. Remove nut and collect washer securing wiper motor to taildoor.
4. Open taildoor.
5. Remove taildoor trim casing.
For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).
6. Remove bolt securing door locking solenoid to taildoor.



M840393

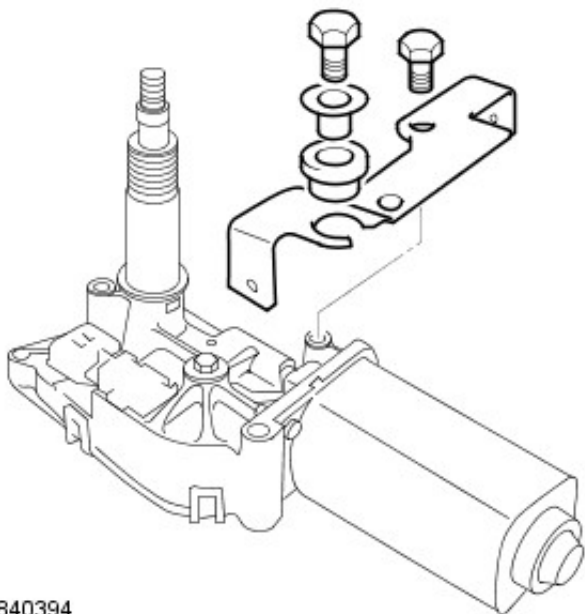
7. Pivot both assemblies and withdraw wiper motor from taildoor.
8. Disconnect multiplugs from wiper motor.

NOTE: For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).

9. **NOTE:** Do not carry out further dismantling if component is removed for access only.

Remove wiper motor assembly.

10. Remove 2 bolts securing wiper motor to mounting bracket, remove bracket.



M840394

Installation

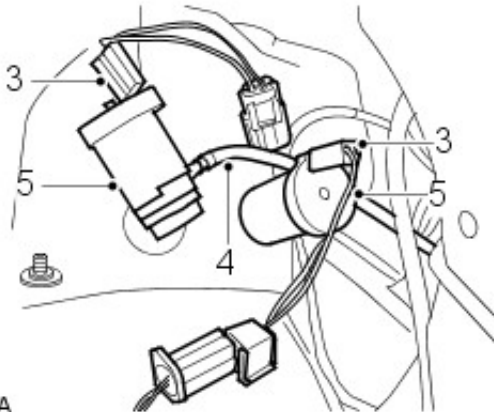
1. Fit mounting bracket to motor and tighten bolts to 10 Nm (7 lbf.ft).
2. Fit motor spindle to rear door, connect multiplugs and push motor fully home. Align motor mounting bracket with solenoid mounting bracket, fit bolt and tighten to 10 Nm (7 lbf.ft).
3. Fit taildoor trim casing.
For additional information, refer to: Taildoor Trim Panel (501-05, Removal and Installation).
4. Fit washer and nut to rear wiper assembly, tighten nut to 3 Nm (2.2 lbf.ft).
5. Fit wiper arm to spindle, align blade to glass and tighten nut to 17 Nm (13 lbf.ft).
6. Close nut cover.
7. Fit spare wheel and tighten nuts to 45 Nm (33 lbf.ft).

Wipers and Washers - Windshield Washer Pump

Removal and Installation

Removal

1. Remove headlamp.
For additional information, refer to: Headlamp Assembly (417-01 Exterior Lighting, Removal and Installation).
2. Position drain tin to collect any fluid spillage.
3. Disconnect multiplug from washer pump.
4. Disconnect hose from washer pump.
5. Release washer pump from reservoir and discard sealing washer.



M840323A

Installation

1. Fit new sealing washer and secure pump to reservoir.
2. Connect hose and multiplug to washer pump.
3. Fit headlamp.
For additional information, refer to: Headlamp Assembly (417-01 Exterior Lighting, Removal and Installation).
4. Fill reservoir with screen cleaning fluid.

Wipers and Washers - Windshield Wiper Motor

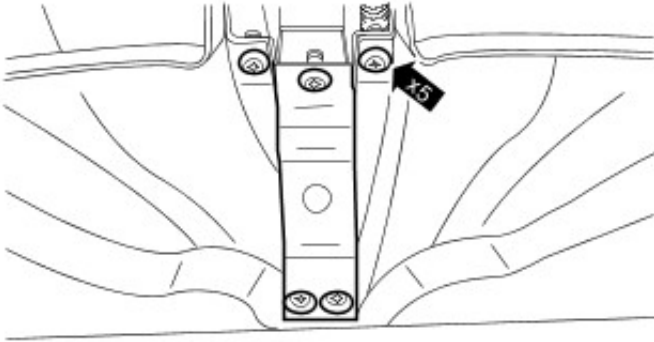
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Battery Disconnect (414-01 Battery, Mounting and Cables, General Procedures).
2. Remove the instrument panel.
For additional information, refer to: Instrument Panel (501-12 Instrument Panel and Console, Removal and Installation).
3. **NOTE: Make sure the clips are discarded.**

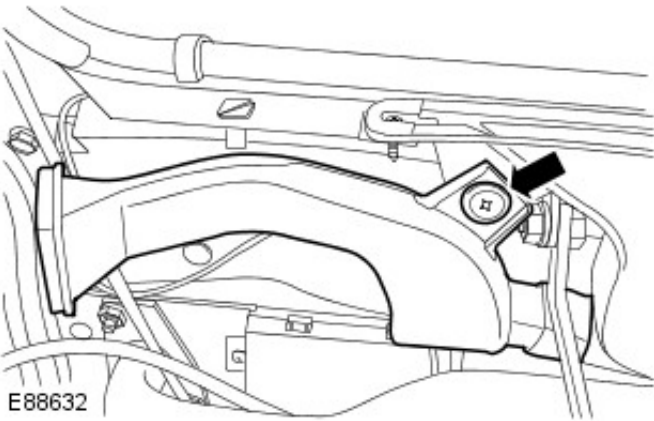
Remove the audio unit support bracket.

- Remove and discard the 5 clips.



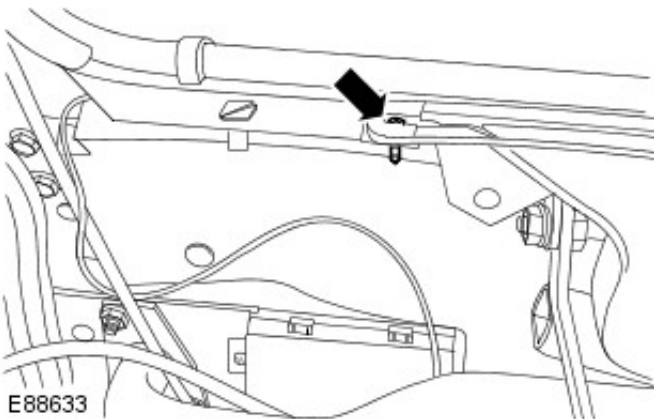
E88598

4. Remove the LH demister duct.
 - Remove the clip.



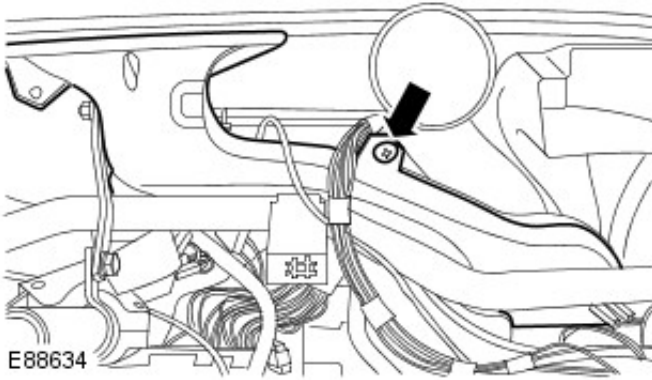
E88632

5. Release the LH defrost vent duct.
 - Remove the screw.

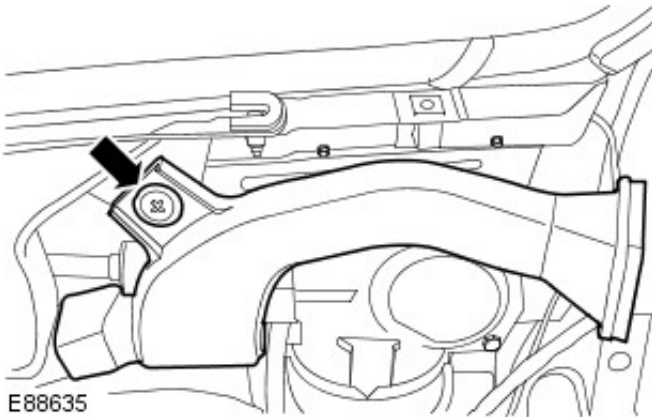


E88633

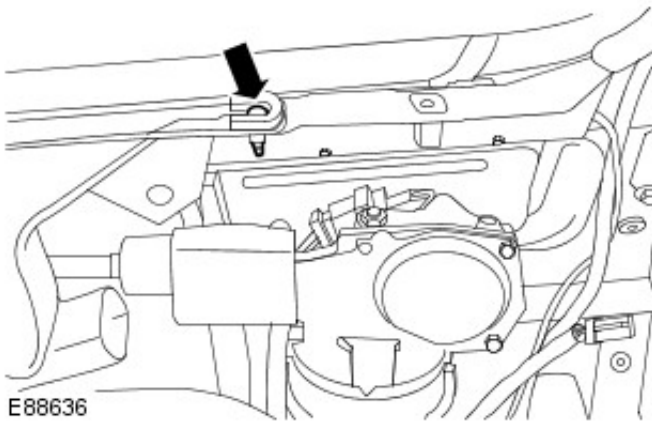
6. Remove the LH defrost vent duct.
 - Remove the clip.



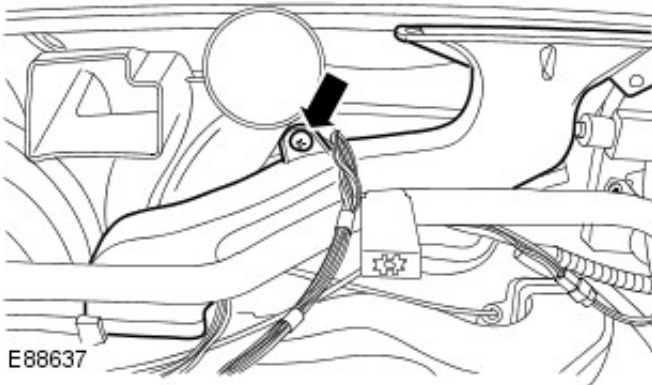
7. Remove the RH demister duct.
 - Remove the clip.



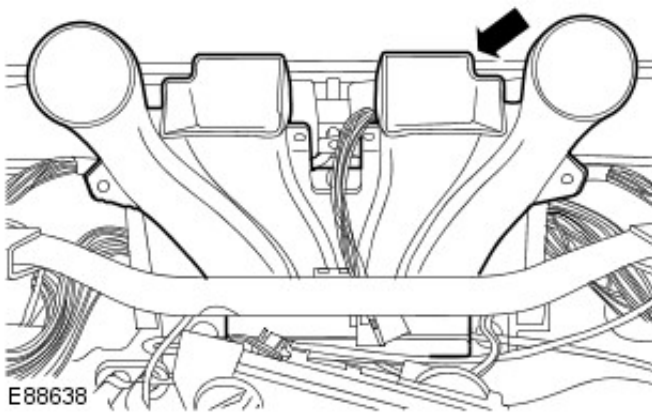
8. Release the RH defrost vent duct.
 - Remove the screw.



9. Remove the RH vent duct.
 - Remove the clip.

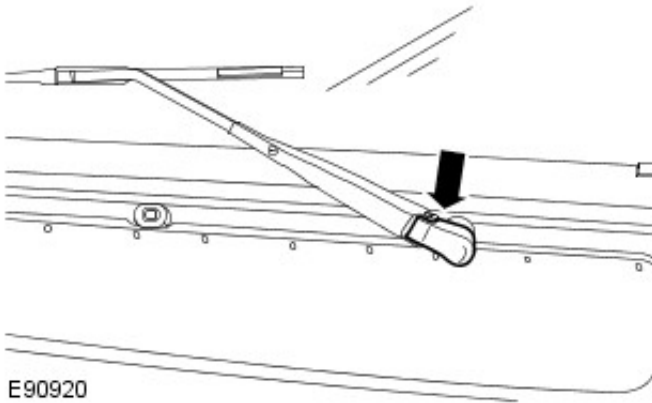


10. Remove the center register duct.



11. NOTE: RH shown, LH similar.

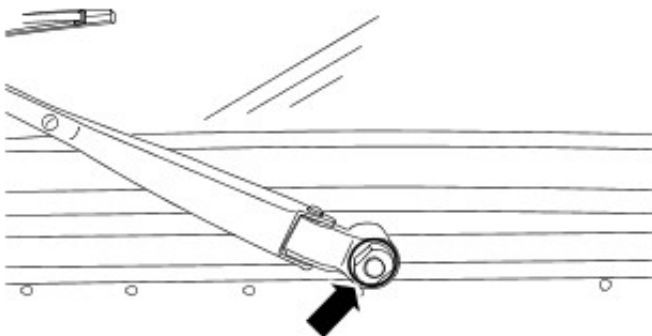
Remove the windshield wiper arm nut cover.



12. NOTE: RH shown, LH similar.

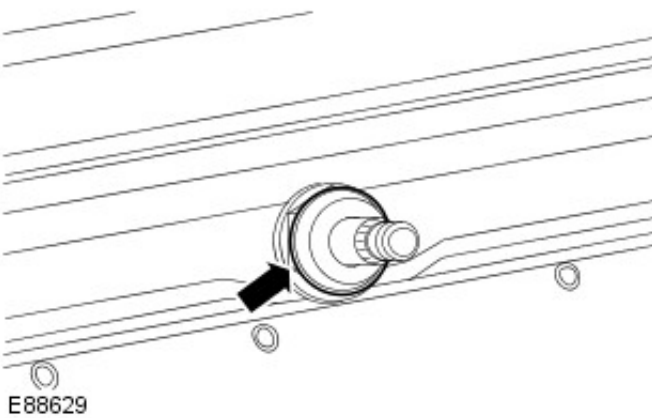
Remove the windshield wiper arm.

- Remove the nut.



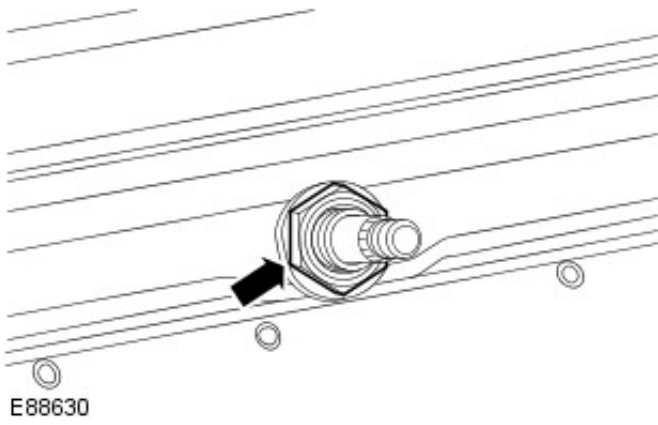
13. NOTE: RH shown, LH similar.

Remove the windshield wiper linkage spindle nut cover.



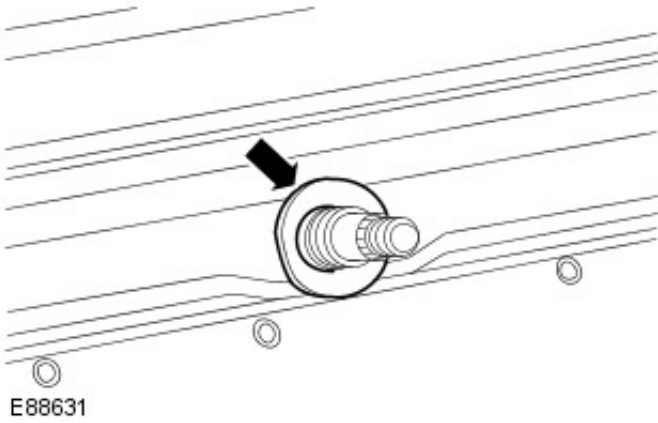
14. NOTE: RH shown, LH similar.

Remove the windshield wiper linkage spindle nut.

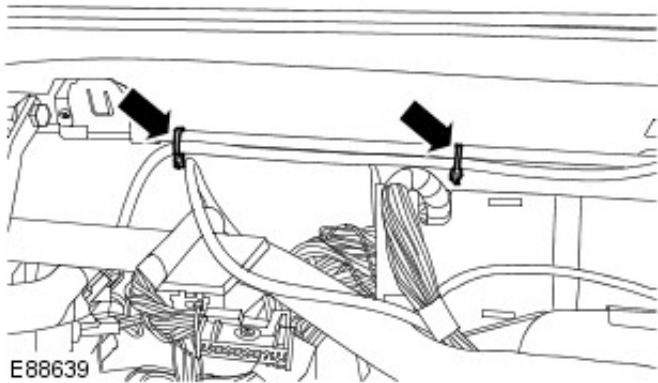


15. **NOTE:** RH shown, LH similar.

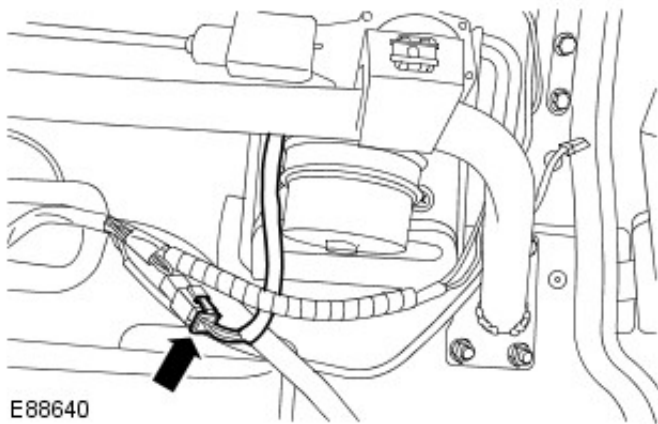
Remove and discard the windshield wiper linkage spindle foam seal.



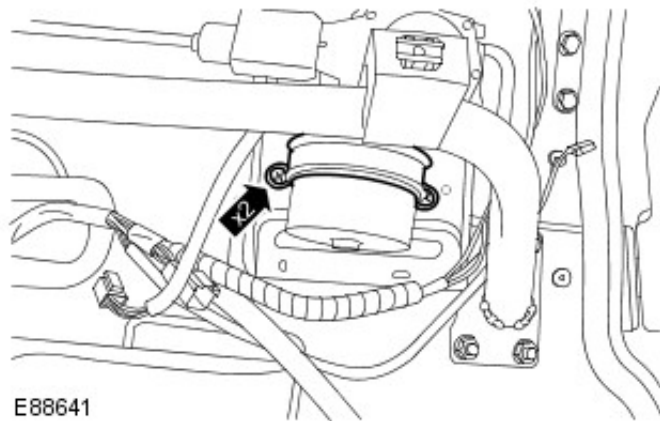
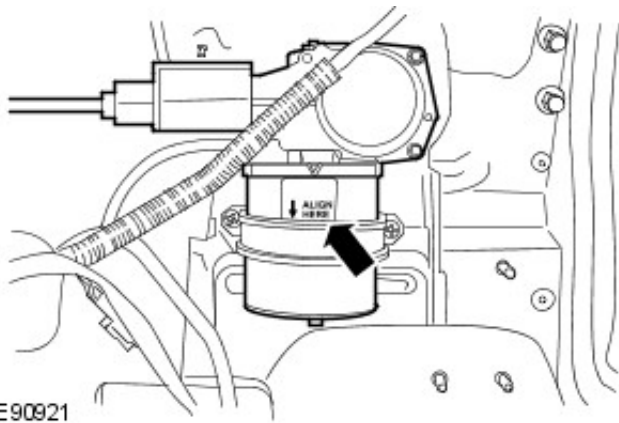
16. Remove and discard the 2 tie straps.



17. Disconnect the windshield wiper motor electrical connector.

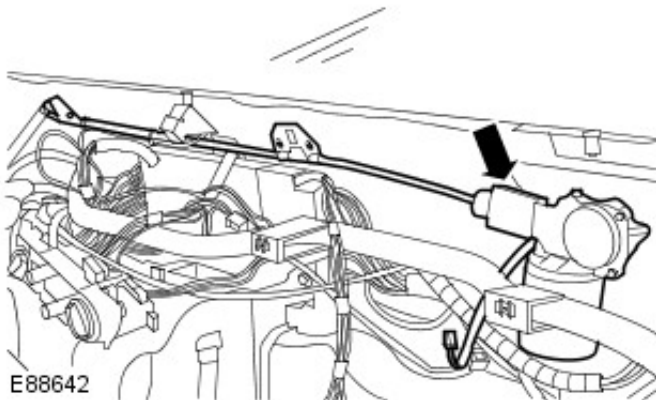


18. Note the fitted position of the component prior to removal.



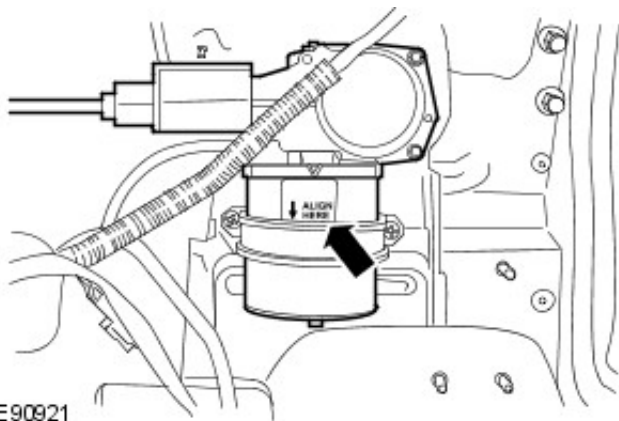
19. Release the windshield wiper motor.
 - Remove the 2 screws.

20. Remove the windshield wiper motor.

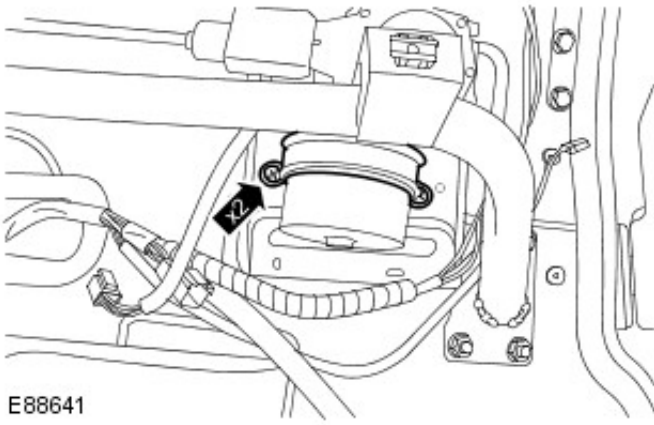


Installation

1. To install, reverse the removal procedure.
2. Install the windshield wiper motor to its original fitted position.



3. Tighten to 5 Nm (4 lb.ft).



E88641

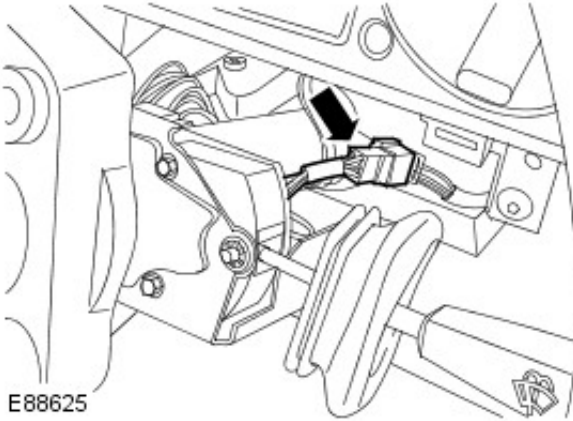
4. Connect the battery ground cable.
For additional information, refer to: Battery Connect (414-01
Battery, Mounting and Cables, General Procedures).

Wipers and Washers - Windshield Wiper/Washer Switch

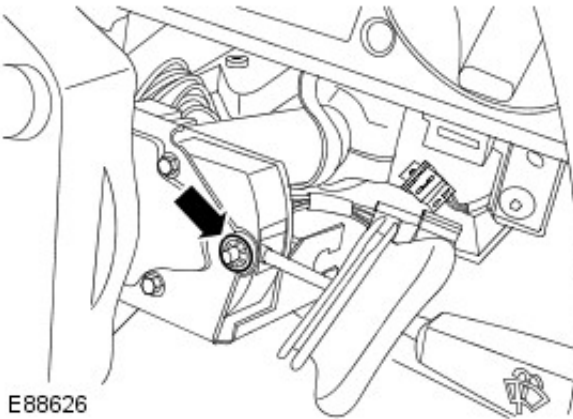
Removal and Installation

Removal

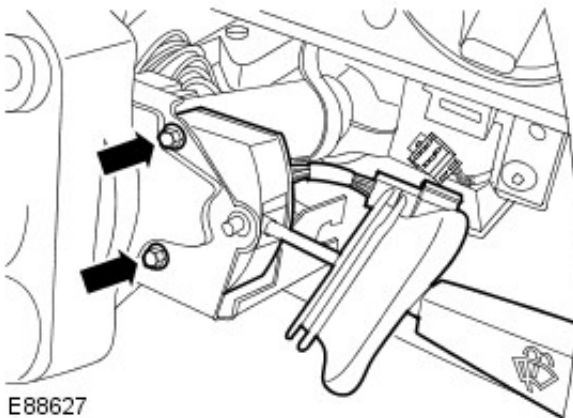
1. Remove the steering column shrouds.
For additional information, refer to: Steering Column Shrouds (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Disconnect the electrical connector.



3. Remove and discard the clip.



4. Remove the windshield wiper switch.
 - Remove the 2 screws.



Installation

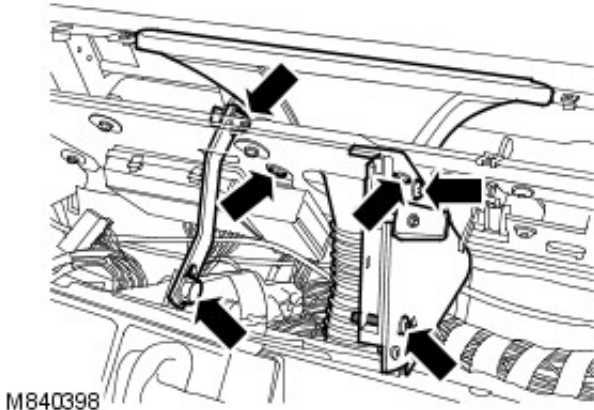
1. To install, reverse the removal procedure.

Wipers and Washers - Wiper Mounting Arm and Pivot Shaft

Removal and Installation

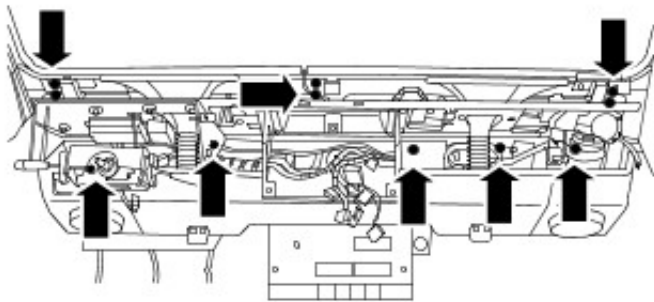
Removal

1. Disconnect battery negative lead.
2. Remove steering column shroud.
For additional information, refer to: Steering Column Shrouds (501-05, Removal and Installation).
3. Remove windshield wiper motor.
For additional information, refer to: Windshield Wiper Motor (501-16, Removal and Installation).
4. Remove 2 screws and move heater fan switch aside.



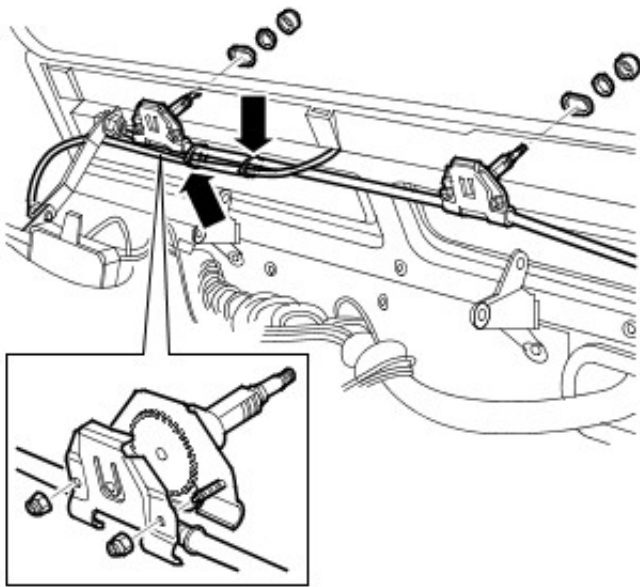
M840398

5. Remove 2 screws securing drivers side demister duct.
6. Disconnect demister tube and remove duct.
7. Remove bolt and nut and bolt securing steering column support bracket and remove bracket.
8. Remove 11 screws securing fascia support rail.



M840399

9. Remove cable ties securing washer tube to windshield wiper rack tube.
10. Loosen fully 4 nuts securing backplates to wiper mounting arm and pivot shaft and remove windshield wiper rack tubes.
11. Remove seals from wheel box spindles.
12. Remove 2 nuts securing wiper mounting arm and pivot shaft and remove sealing washers.



M840400

13. Carefully pull fascia support rail from bulkhead sufficiently to remove wiper mounting arm and pivot shaft.

Installation

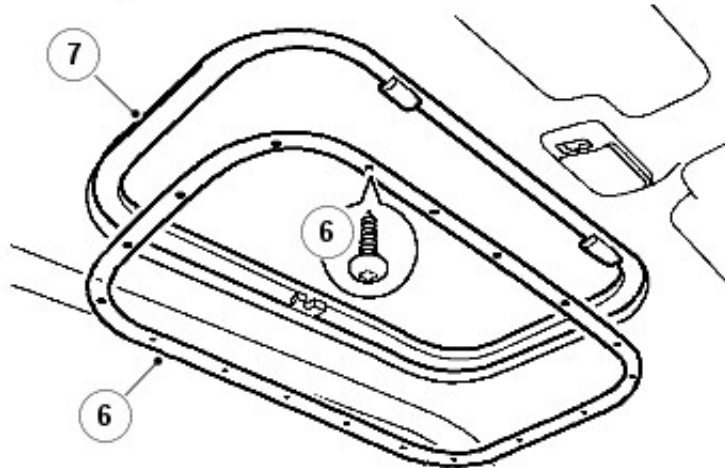
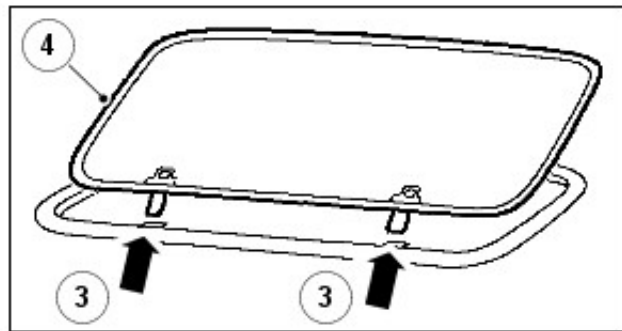
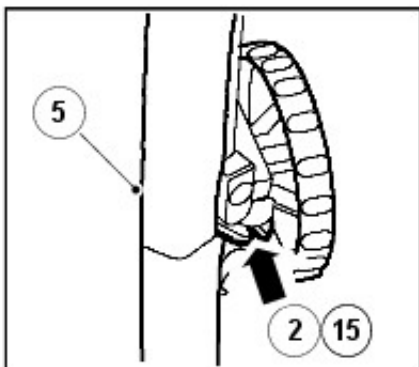
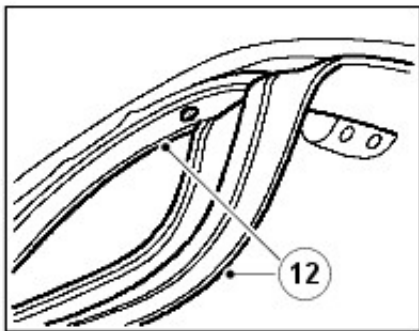
1. Loosen fully but do not remove nuts securing wheel box back plates.
2. Grease wiper mounting arm and pivot shaft.
3. Fit wiper mounting arm and pivot shaft, fit sealing washers and tighten nuts to 5 Nm (3.7 lbf.ft).
4. Fit spindle seals.
5. Fit wiper rack tubes and tighten wiper mounting arm and pivot shaft nuts sufficiently to hold tubes. Tighten wheel box back plate nuts to 6 Nm (4 lbf.ft) after fitting windshield wiper motor.
6. Align washer tube to rack tube and secure with cable ties.
7. Align fascia support rail and secure with screws.
8. Fit steering column support bracket and tighten bolt and nut and bolt to 45 Nm (33 lbf.ft).
9. Fit demister duct to tube, align relay bracket and secure duct with screws.
10. Position heater fan switch and secure with screws.
11. Fit windshield wiper motor.
For additional information, refer to: Windshield Wiper Motor (501-16, Removal and Installation).
12. Fit steering column shroud.
For additional information, refer to: Steering Column Shrouds (501-05, Removal and Installation).
13. Connect battery negative lead.

Roof Opening Panel - Roof Opening Panel

Removal and Installation

Removal

1. Open roof opening panel fully.
2. Disengage spring lock from operating handle catch.
3. Holding roof opening panel at both sides, release hinges from locating brackets at front of outer frame.
4. Remove roof opening panel.
5. Starting from centre rear, peel headlining finisher from inner frame.
6. Remove 18 screws securing inner frame to outer frame and detach inner frame.
7. **NOTE: Assistance may be required to remove the sun roof assembly.**
Lift outer frame from roof.



J6054

Installation

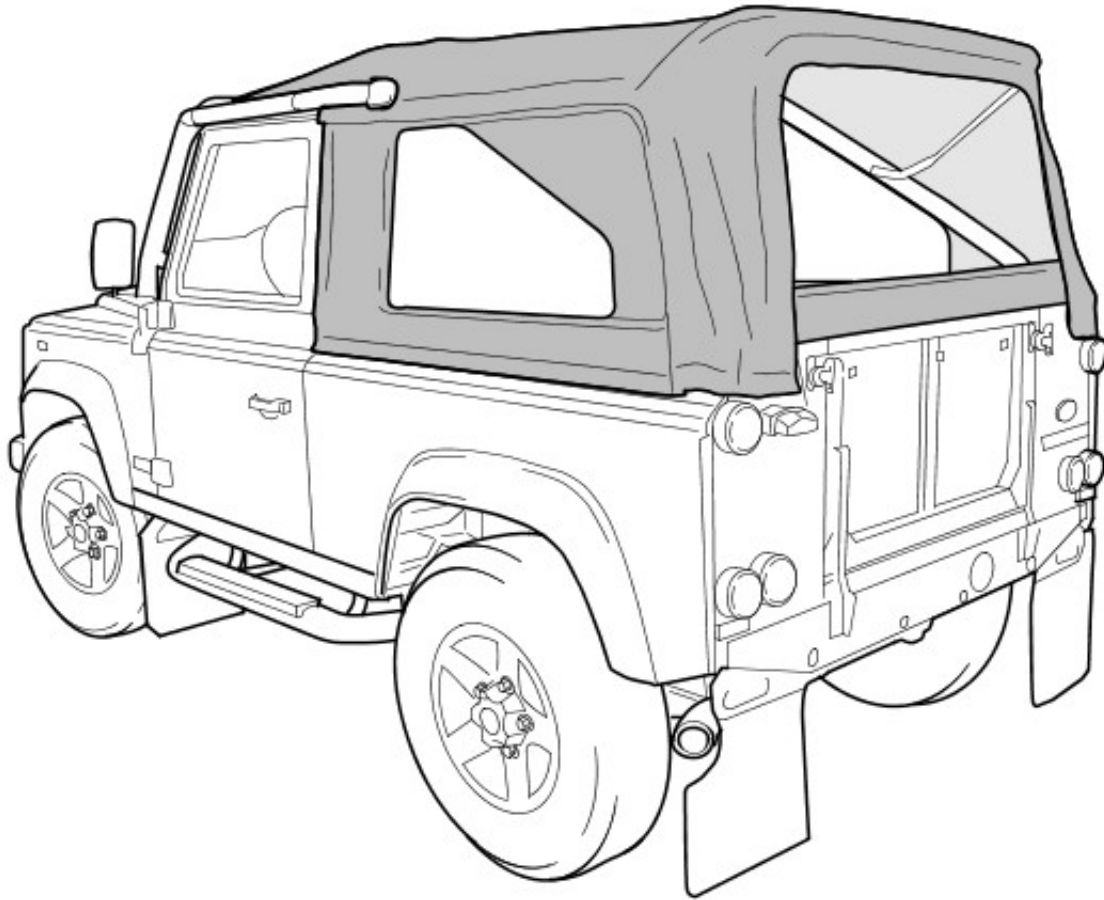
1. Clean roof area around outer frame seating.
2. Position outer frame on roof.
3. Instal inner frame to headlining and secure to outer frame with 18 screws but do not fully tighten.
4. Check alignment of inner and outer frames with roof mounting and headlining, adjust as necessary, and fully tighten fixing screws to 10 Nm (7 lbf.ft).

5. Starting from centre rear, instal headlining finisher lip into locating channel of inner frame.
6. Press finisher firmly over inner frame and continue around complete frame, ensuring finisher lies flat on headlining.
7. Fit roof opening panel hinges fully into locating brackets on outer frame and lower the glass panel.
8. Engage operating handle catch with spring lock of outer frame and close roof opening panel.

Convertible Top - Convertible Top

Description and Operation

SVX (60th ANNIVERSARY) MODEL - CONVERTIBLE TOP



E101948

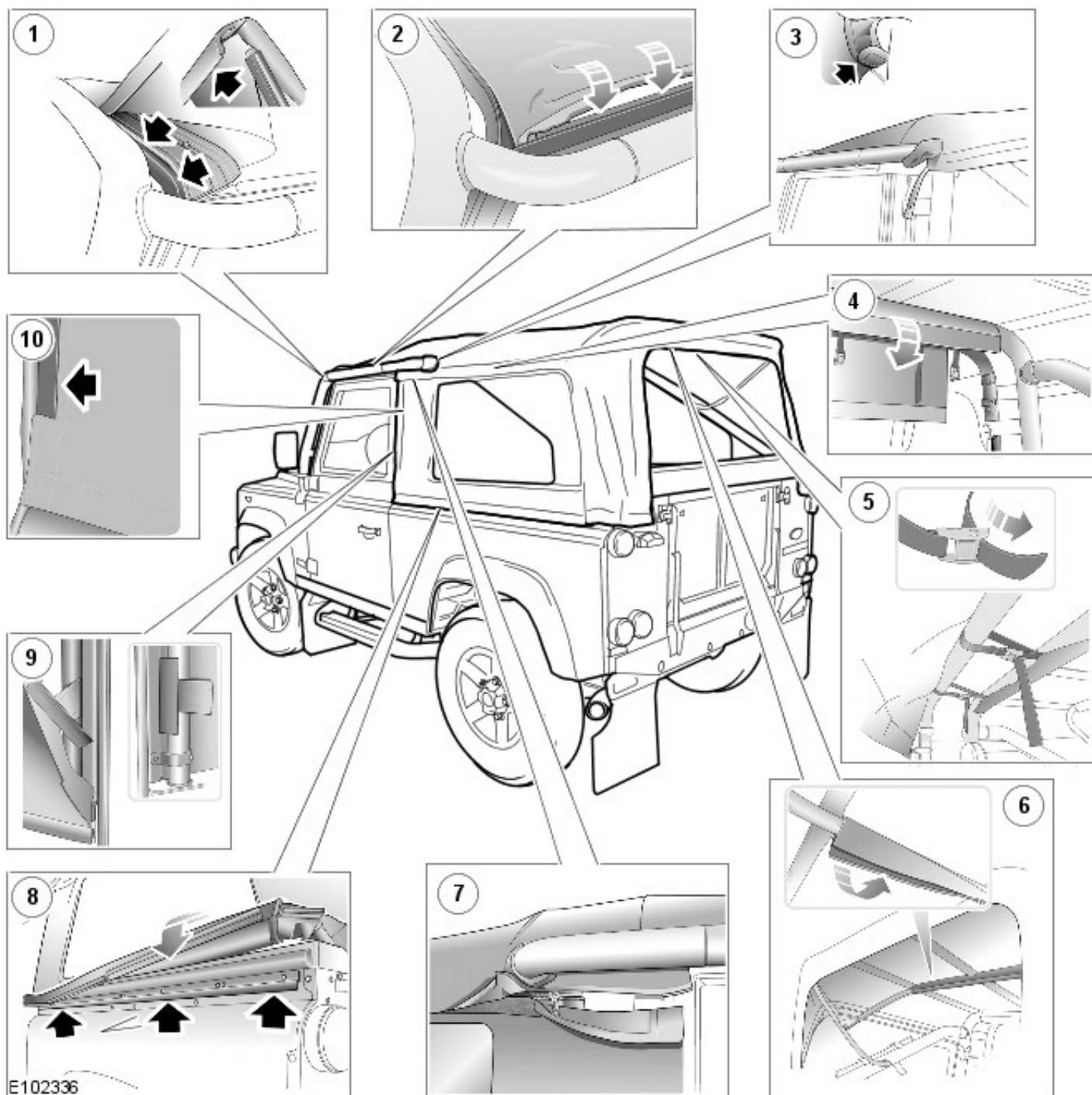
OVERVIEW

The convertible top is new for the SVX 90 model. The top has removable side windows and rear window which are secured with zips.

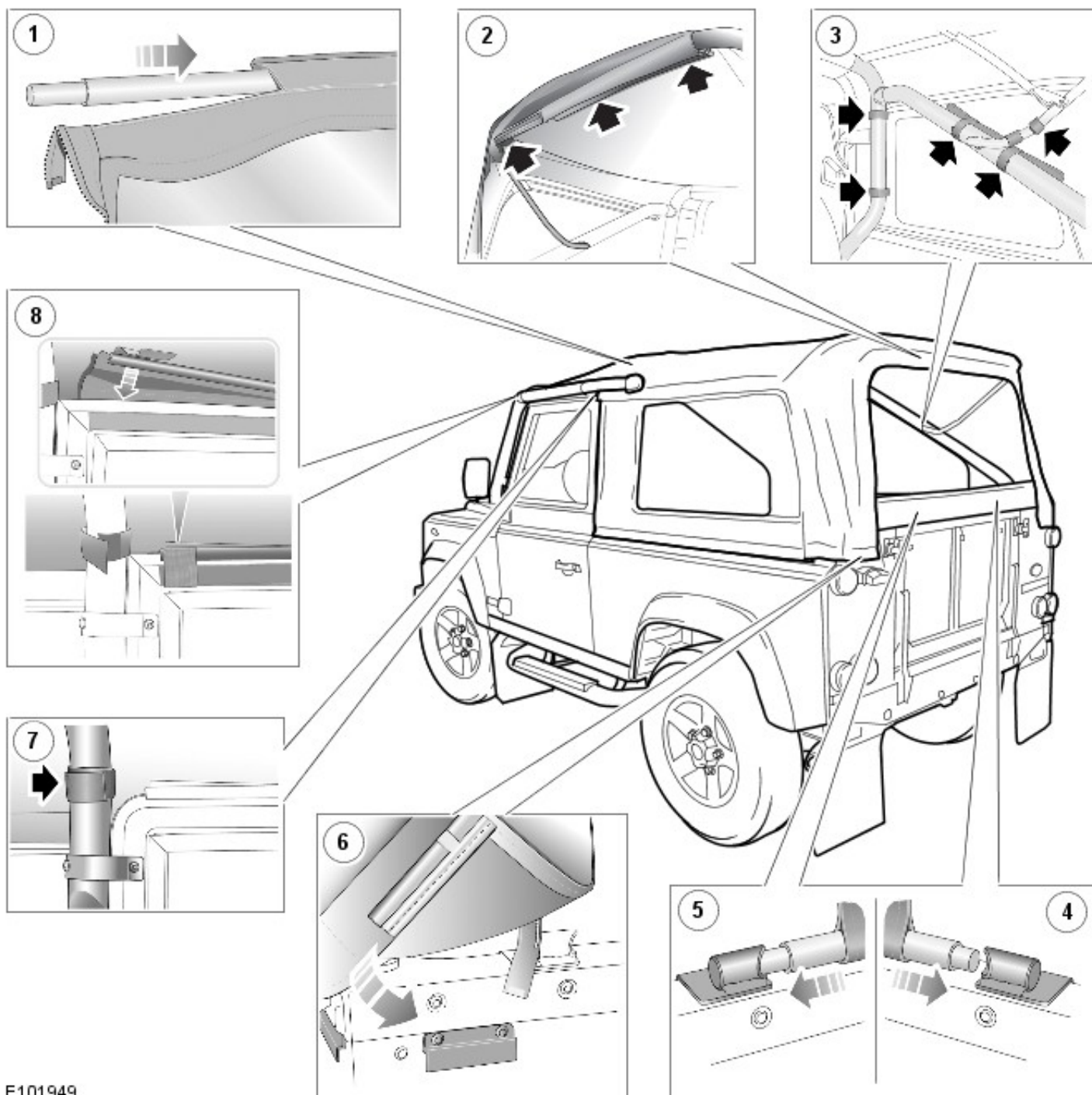
DESCRIPTION

The convertible top is manufactured from canvas panels stitched together, to form a taught, waterproof covering over the cab and load area of the vehicle.

Convertible Top Attachment - Sheet 1



Item	Part Number	Description
1	-	Location of leading edge into locating channel above the windscreen
2	-	Location of outer edges into locating channel above doors
3	-	Velcro strap attachment to support frame where the support frame protrudes from the hood
4	-	Rear part of flap extension pull over support frame
5	-	Three fixing straps located over forward frame bar and tension applied using buckles
6	-	Velcro fixing at rear of convertible top to hinged frame section
7	-	Side window zip attachment
8	-	Attachment to the rail on the body at each side of the load area
9	-	Forward vertical edge of window panel ,elastic strap plate located between frame and vertical body channel
10	-	Plate positioned across gap between frame and vertical body section



E101949

Item	Part Number	Description
1	-	Metal spring loaded rod through the bottom edge stitched section of the window panel
2	-	Rear section to rear support frame attachment
3	-	Five velcro fixings on each side of the convertible top to frame and hinged frame
4	-	Metal spring loaded rod location in right-hand (RH) receiver tube
5	-	Metal spring loaded rod location in left-hand (LH) receiver tube
6	-	Rear corner section location in rail on rear body
7	-	Velcro strap to support frame above safety belt anchor point
8	-	Location into interior locating channel in rail above door door and velcro strap location to door frame

It is recommended that fitting and removal of the convertible top is performed by two people.

The rear pivoting support frame is secured with a velcro strap which must be removed to allow the frame to be extended to its support position.

The leading edge of the top is located in channels at the top of the windshield. Channels above each door also provide location for the outer edge of the top and once installed are secured in position with further location in an inner channel. Velcro straps near to the seat belt upper anchor point secure the top to the support frame. Three additional velcro straps secure the top onto the door frame.

The convertible top at the rear of the cab area is secured with two flaps which are attached with velcro. From inside the vehicle, the rearmost of the two flaps is wrapped around the support frame. Tension for the top is provided by three straps. The center strap is pulled over the forward frame bar and pulled through the buckle to tension the top. This process is repeated with the two outer straps which provide tension evenly over the top. The rear most flap is wrapped around the support frame, concealing the straps. The forward flap is also wrapped around the support frame in the opposite direction and the velcro attached to the rearmost flap, secures the flaps together.

On the outside of the convertible top, velcro straps are used to secure the top to the support frame where it protrudes from the top.

The top is secured at the rear with a flap which locates on the hinged section of the rear support frame and secured with velcro.

The handed side windows are zipped into position in the top. The top is attached to the rail on the body at each side of the load area. The top is pulled down tightly to locate in the rail which applies tension to the top.

An elastic strap with a bridge plate attached, is positioned from the outside of the vehicle, through a gap between the support frame and the vehicle body. The plate is positioned across the support frame and the vehicle body to secure and the elastic strap maintains the tension on the front vertical edge of the side window and ensures they are located tightly into the body channel.

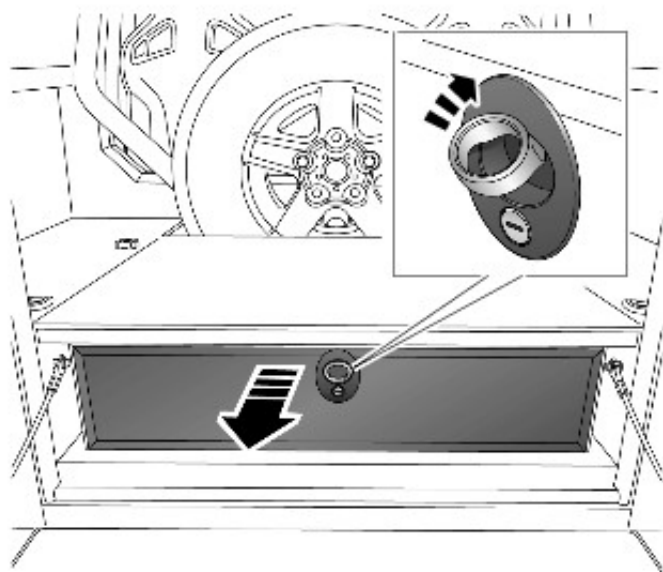
At the rear of the vehicle, each corner of the top is attached to small rails on either side of the tail gate. The top is pulled down tightly which applies tension to the top.

Five velcro straps are located on each side of the convertible top and secure the top to the support frame and the hinged frame.

A metal spring loaded rod locates through a slot in the lower part of the rear window which is zipped in position. The spring loaded rod locates in 2 receiver tubes attached to the top edge of the tail gate.

Removal is a reversal of the fitting process.

Stowage Locker



E101950

When the convertible top is removed, it can be carefully folded and stored in the locker in the rear of the load area. The locker has a hinged lid which can be locked for security using the vehicle key.

Ensure the convertible top and window panels are dry before folding and storing in the locker.

Convertible Top Care Points

Do not use an automatic car wash. Doing so will cause damage to the hood.

Some high pressure cleaning systems are sufficiently powerful to damage hood fabrics. Never aim a high pressure water jet at zips or seals.

If the hood is stained, it should be cleaned within 24 hours of the incident occurring, otherwise the stain may become permanent.

Never use spirit, petrol or chlorine based cleaning agents, or wash/wax compounds to clean the hood and windows - wax polishes will become ingrained in the textured finish.

Use a soft brush to remove dust and flaking dirt from the hood (not the windows), then soak with a mild soap and water solution to soften encrusted dirt and remove stains, prior to washing.

Wash using a mild soap and water solution, before rinsing the hood with clean lukewarm or cold water. Rinse until all traces of soap are removed.

Ensure the hood is dry before folding or removing

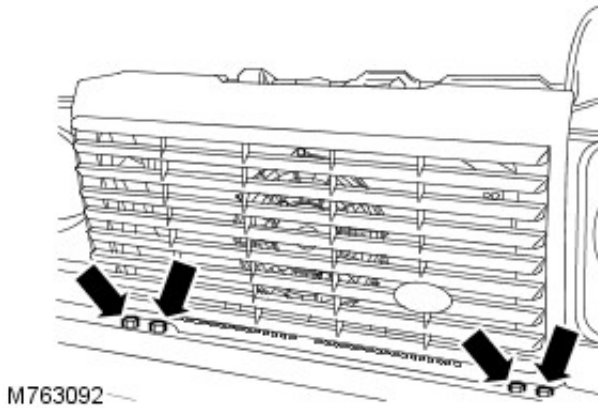
Improper cleaning and lack of care may cause damage to the hood and window panels, resulting in water penetration.

Bumpers - Front Bumper

Removal and Installation

Removal

1. Remove 6 screws and remove front grille.
2. Remove 4 through bolts securing front bumper to chassis longitudinals.



3. Remove front bumper.

Installation

1. Instal front bumper to chassis longitudinals and secure with bolts.
2. Instal front grille and secure with screws.

Safety Belt System -

Torque Specifications

Description	Nm	lb-ft
Front safety belt retractor bolt	31	23
Front safety belt upper anchor bolt	31	17
Front safety belt lower anchor bolts	10	7
+ Front safety belt buckle M10 bolt	22	16
Front safety belt buckle M8 bolt	22	16
Rear safety belt retractor bolt	31	17
Rear safety belt upper anchor bolt	31	17
Rear safety belt lower anchor bolt	31	17
Rear center safety belt retractor bolt	31	17
Rear safety belt buckle bolt	31	17
Third row safety belt retractor bolt	31	17
Third row safety belt upper anchor bolt	31	17
Third row safety belt lower anchor bolt	31	17
Third row safety belt buckle bolt	31	17

Safety Belt System - Safety Belt System

Description and Operation

COMPONENT LOCATION



E85612

OVERVIEW

A three point safety belt is installed at each seat position. All the safety belts have Emergency Locking Retractors (ELR).

ELR retractors incorporate a liftshaft locking system with webbing sensor and car sensor activating mechanisms. The webbing sensor activates the locking system if the webbing is subjected to a sharp pull. The car sensor activates the locking system if the vehicle is subjected to sudden deceleration or a severe tilt angle.

FRONT SAFETY BELTS

The retractor of each front safety belt is attached to the related B pillar. The webbing runs from the retractor through an upper mounting, attached to the B pillar, to an anchor point on the front seat.

The buckle for each front safety belt is to the vehicle body inside of the related front seat frame.

SECOND ROW SAFETY BELTS

The retractor of each outboard second row safety belt is attached to the body immediately behind the D pillar. The webbing runs from the retractor, through an upper mounting on the D pillar, to an anchor point at the front of the related wheel arch.

The retractor for the center second row safety belt is installed in the top of the seat back. The webbing runs from the retractor, over the top of the seat, to an anchor point at the base of the seat frame.

The buckles for the second row safety belts are attached to the related seat frame.

THIRD ROW SAFETY BELTS (110 only)

The retractor of each third row safety belt is attached to the E pillar. The webbing runs from the retractor, through a mounting on the E pillar to an anchor point on the floor. The buckles for the third row safety belts are attached to the related seat frame.

BELTMINDER (GULF MARKETS ONLY)

The belt minder function provides warnings to the driver if the appropriate front safety belts are not fastened when driving. The belt minder function is controlled by the instrument cluster
For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

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Safety Belt System - Safety Belt System

Diagnosis and Testing

Principle of Operation

For a detailed description of the safety belt system and operation, refer to the relevant description and operation section of the workshop manual REFER to: [Safety Belt System](#) (501-20 Safety Belt System, Description and Operation).

Safety Information

WARNINGS:



To avoid accidental deployment the back-up power supply must be depleted before beginning any work on the SRS system or its components. Failure to follow this instruction may result in personal injury



Do not use a multimeter to probe an SRS module. It is possible for the power from the multimeter battery to trigger the activation of the module. Failure to follow this instruction may result in personal injury

NOTE: Do not to use a cellular phone or to have a cellular phone in close proximity when working on the SRS system or components

Power supply depletion

Before beginning any work on the SRS system or related components:

1. Remove the ignition key
2. Disconnect the battery leads, ground first
3. Wait 2 minutes for the power circuit to discharge

There are comprehensive instructions on the correct procedures for SRS system repairs, refer to the relevant section of the workshop manual

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle

NOTE: Check and rectify basic faults before beginning diagnostic routines including pinpoint tests

1. Verify the customer concern by operating the safety belt
2. Visually inspect for obvious signs of mechanical or electrical damage


Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Check for the installation of non-standard accessories which may affect or obstruct the function of the safety belt system • Frayed or damaged webbing • Missing or damaged button stop • Pretensioner(s) Buckles/Stalks 	<ul style="list-style-type: none"> • Fuses • Wiring harness fault • Correct engagement of electrical connectors • Loose or corroded connections • Warning lamp bulb(s) • Impact sensor(s) • Buckle sensor(s) • Pretensioner(s) • Belt tension sensor(s) • Restraints control module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. If the cause is not visually evident, carry out the test methods described below, alternatively check for diagnostic trouble codes and refer to the relevant diagnostic trouble code index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Restraints Control Module (RCM) (100-00 General Information, Description and Operation).

Symptom Chart for Safety Belt Rows 1, 2 and 3

Symptom	Possible Causes	Action
Safety belt jammed - Webbing tight	<ul style="list-style-type: none"> Backlock effect-in action (webbing retracted quickly and came to sudden stop) Safety belt retractor not installed correctly Rear centre belt only. Mini-button (webbing travel limit stop) missing and seat squab has been moved causing tight fit Automatic locking retractor activated (clicking – during retraction only) 	<ul style="list-style-type: none"> GO to Pinpoint Test A. GO to Pinpoint Test F. GO to Pinpoint Test H. See the automatic locking retractor description below
Seat squab will not fold/jammed	<p>NOTE: Rear centre belt only</p> <ul style="list-style-type: none"> Mini-button (webbing travel limit stop) missing and seat squab has been moved causing excessive tension 	<ul style="list-style-type: none"> GO to Pinpoint Test H.
Safety belt jammed - Webbing loose	<ul style="list-style-type: none"> Safety belt webbing trapped in seat Safety belt retractor webbing guide loose Twist in webbing Interference in webbing routing D-loop not rotating correctly 	<ul style="list-style-type: none"> GO to Pinpoint Test B. GO to Pinpoint Test C. GO to Pinpoint Test D. GO to Pinpoint Test E. GO to Pinpoint Test G.
Safety belt - Intermittent jamming	<ul style="list-style-type: none"> Safety belt retractor not installed correctly 	<ul style="list-style-type: none"> GO to Pinpoint Test F.
Safety belt - Slow retraction	<ul style="list-style-type: none"> Safety belt retractor webbing guide loose Twist in safety belt webbing Interference in webbing routing Safety belt retractor not installed correctly D-loop not rotating correctly Foreign object/debris 	<ul style="list-style-type: none"> GO to Pinpoint Test C. GO to Pinpoint Test D. GO to Pinpoint Test E. GO to Pinpoint Test F. GO to Pinpoint Test G. GO to Pinpoint Test E.
Safety belt - Not retracting	<ul style="list-style-type: none"> Safety belt retractor webbing guide loose Twist in safety belt webbing D-loop not rotating correctly Interference in webbing routing Foreign object/debris 	<ul style="list-style-type: none"> GO to Pinpoint Test C. GO to Pinpoint Test D. GO to Pinpoint Test G. GO to Pinpoint Test E. GO to Pinpoint Test E.
Safety Belt - Not extracting	<ul style="list-style-type: none"> Backlock effect-in action (webbing retracted quickly and came to sudden stop) Safety belt retractor not installed correctly Safety belt retractor webbing guide loose Twist in safety belt webbing D-loop not rotating correctly Interference in webbing routing Foreign object/debris Automatic locking retractor activated (clicking – during retraction only) 	<ul style="list-style-type: none"> GO to Pinpoint Test A. GO to Pinpoint Test F. GO to Pinpoint Test C. GO to Pinpoint Test D. GO to Pinpoint Test G. GO to Pinpoint Test E. GO to Pinpoint Test E. See the automatic locking retractor description below
Safety belt - Noisy during operation	<ul style="list-style-type: none"> Automatic locking retractor activated (clicking–during retraction only) Interference in webbing routing (rubbing) 	<ul style="list-style-type: none"> GO to Pinpoint Test B. GO to Pinpoint Test E.
Safety belt buckle - Not latching / jammed	<ul style="list-style-type: none"> Foreign object/debris 	<p> CAUTION: Do not insert any objects or tools into the buckle head</p> <ul style="list-style-type: none"> GO to Pinpoint Test I.

Inertia Reel Safety Belts

The vehicle is equipped with (two row one), (three row two), and (two row three (seven seat versions only)) inertia reel safety belts

These safety belts are "**dual sensitive**" which means that they have:

- Car sense system - A vehicle motion sensor, which locks the safety belt webbing under braking, cornering, on steep hills and in adverse camber conditions, when parked on a steep incline or driveway or two wheels on a high curb**
- Webb sense system - A webbing motion sensor, which locks when the safety belt webbing is extracted suddenly**

The safety belts in the following positions are equipped with an automatic locking retractor function:

Carline	Market	Seat position	Automatic Locking Retractor Installed	From Model Year
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Defender (L316)	All	All	No	2007
Discovery / Range Rover Sport (L319/L320)	All	Driver	No	2008
Discovery / Range Rover Sport (L319/L320)	US	Passenger	Yes	2005
Discovery / Range Rover Sport (L319/L320)	All	Driver	No	2005
Discovery / Range Rover Sport (L319/L320)	ROW	Passenger	No	2005
Discovery (L319)	All	Row 2	Yes	2005
Discovery (L319)	All	Row 3	Yes	2005
Range Rover Sport (L320)	All	Row 2	Yes	2006
Freelander (L359)	All	Driver	No	2007
Freelander (L359)	ROW	Passenger	No	2007
Freelander (L359)	US	Passenger	Yes	2007
Freelander (L359)	ROW	Row 2	No	2007
Freelander (L359)	US	Row 2	Yes	2007
Range Rover Evoque (L358)	All	Driver	No	2011
Range Rover Evoque (L358)	ROW	Passenger	No	2011
Range Rover Evoque (L358)	US	Passenger	Yes	2011
Range Rover Evoque (L358)	ROW	Row 2	No	2011
Range Rover Evoque (L358)	US	Row 2	Yes	2011
Range Rover (L322)	All	Driver	No	2003
Range Rover (L322)	ROW	Passenger	No	2003
Range Rover (L322)	US	Passenger	Yes	2003
Range Rover (L322)	ROW	Row 2	No	2003
Range Rover (L322)	US	Row 2	Yes	2003

The **automatic locking retractor function** is a feature to secure a child seat or heavy load to the seat

Activation	Deactivation
<p>NOTE: When automatic locking retractor is activated, no further webbing can be drawn from the safety belt retractor, prior to disengagement of the automatic locking. This can be mistaken as a jammed safety belt retractor</p> <p>Activated by total extraction of the webbing</p> <p>When activated the automatic locking retractor is identified by a clicking noise during webbing retraction</p>	<p>Automatic locking retractor is deactivated by allowing the webbing to retract until the clicking stops (close to park position)</p> <p>When deactivated the automatic locking retractor safety belt changes state, from a static safety belt to an automatic safety belt</p>

Safety Belt Locking Test

With the vehicle stationary and on level ground take firm hold of the safety belt webbing (on the tongue side of the upper safety belt anchor) and withdraw sharply, **the retractor should lock**. Preventing further webbing release (**repeat this test 3 times**). Any safety belt retractor which fails to lock **must not be used** and a **new safety belt must be installed**.

DTC Index

For a list of diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00 or for removal and installation/description and operation see Section 501-20

Diagnostic Guide Inertia Reel Safety Belts

PINPOINT TEST A : BACKLOCK	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: BACKLOCK	
1	Visually inspect the condition of the suspect safety belt
2	Draw a maximum of 20mm of the webbing from the safety belt retractor with moderate force. Then release the webbing
3	Check for correct operation twice
	Does the webbing move freely then retract correctly?
	Yes No further action required
	No For first row safety belt GO to Pinpoint Test C . For second and third row safety belts GO to Pinpoint Test B .

PINPOINT TEST B : WEBBING-TRAPPED IN SEAT

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: WEBBING-TRAPPED IN SEAT	
	1 Visually inspect the condition of the suspect safety belt
	2 Lift the seat base or release the seat backrest as required
	3 Free the trapped webbing, allow the webbing to retract Note: If the automatic locking retractor is activated, allow the webbing to retract until the clicking stops
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes No further action required No GO to Pinpoint Test C.

PINPOINT TEST C : SAFETY BELT RETRACTOR-WEBBING GUIDE LOOSE	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: SAFETY BELT RETRACTOR-WEBBING GUIDE LOOSE	
	1 Refer to 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and safety belt retractor
	2 Check the webbing is not trapped or twisted and is centrally located on the safety belt retractor spindle
	3 Attempt to withdraw the webbing from the safety belt retractor NOTE: If the safety belt webbing is jammed, the automatic locking retractor could be engaged
	4 To release the automatic locking retractor, manually wind the webbing onto the spindle until the automatic locking retractor deactivates (clicking stops)
	5 Fully extract webbing
	6 Confirm webbing guide location is correct , Confirm the fixing lugs are correctly located in the retractor frame
	7 Allow webbing to retract
	8 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test D.

PINPOINT TEST D : TWIST IN WEBBING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: TWIST IN WEBBING	
	1 Refer to section 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point)
	2 Twist the webbing back the correct way in the loop
	3 Pass the twist through the pillar loop or escutcheon as required
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test E.

PINPOINT TEST E : INTERFERENCE-WEBBING ROUTING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: INTERFERENCE-WEBBING ROUTING	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point)
	2 Remove obstructions and foreign objects ensure the webbing does not catch or rub
	3 Confirm the safety belt does not contact the wiring harness
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action

	required
No	GO to Pinpoint Test F .

PINPOINT TEST F : SAFETY BELT RETRACTOR-INCORRECT INSTALLATION

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: SAFETY BELT RETRACTOR-INCORRECT INSTALLATION	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and the safety belt retractor
	2 Refer to the 501-20 removal and installation section of the workshop manual, correctly reinstall the safety belt retractor ensure that the locating "T bar" and "anti rotation pins" are correctly located
	3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component


PINPOINT TEST G : D-LOOP NOT ROTATING CORRECTLY

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
G1: D-LOOP NOT ROTATING CORRECTLY	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and the safety belt retractor
	2 Ensure there are no obstructions and the webbing does not catch or rub, the D loop (anchor point) rotates correctly and if installed the confirm the height adjuster operates correctly
	3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

PINPOINT TEST H : MINI BUTTON-MISSING/DAMAGED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
H1: MINI BUTTON-MISSING/DAMAGED	
NOTE: This test applies to the rear centre safety belt retractor installed in the seat back	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove the seat cushion and the plastic escutcheon at the top of the seat back (where the webbing exits to expose the lower anchor fixing point of the center safety belt)
	2 Remove the lower anchorage of the safety belt
	3 With the seat back correctly latched, allow up to 20mm webbing to retract, then extract the webbing
	Is the mini-button (webbing travel limit stop) correctly installed to the webbing and in good condition? Yes Feed the mini-button back through the plastic escutcheon if required. Correctly reinstall the escutcheon to the seat back, extract the webbing then allow to retract, ensure the mini-button comes to rest outside the escutcheon stop No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

PINPOINT TEST I : SAFETY BELT BUCKLE-NOT LATCHING/JAMMED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
I1: SAFETY BELT BUCKLE-NOT LATCHING/JAMMED	
 CAUTION: Do not insert any objects or tools into the buckle head	
	1 Visually inspect the buckle head for evidence of damage. If damaged replace as required
	2 Depress the buckle release (red button) and (Using a torch) carry out visual inspection for any evidence of debris/material or foreign objects in the buckle head
	3 If required remove the pretensioner from the vehicle. Remove the seat. Remove the pretensioner from the seat frame

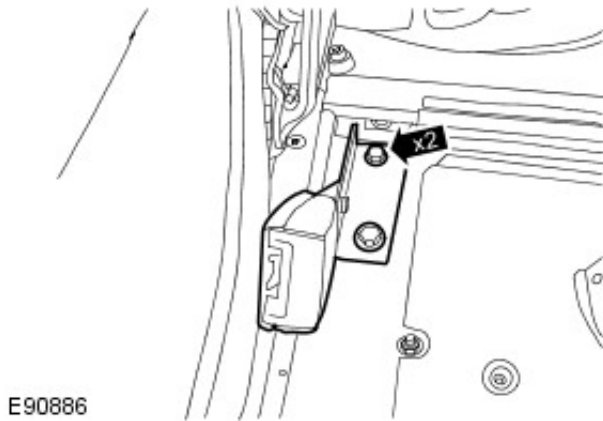
	4 Do not insert any objects or tools buckle head With the buckle removed invert and attempt to shake out any debris
	5 Attempt to latch the tongue in the buckle
	Does the seat belt buckle operate correctly Yes Reinstall any components, no further action required No Replace the pretensioner, Refer to section 501 20

Safety Belt System - Front Safety Belt Buckle

Removal and Installation

Removal

1. Remove the front safety belt buckle.
 - Remove the M8 bolt.
 - Remove and discard the M10 bolt.



Installation

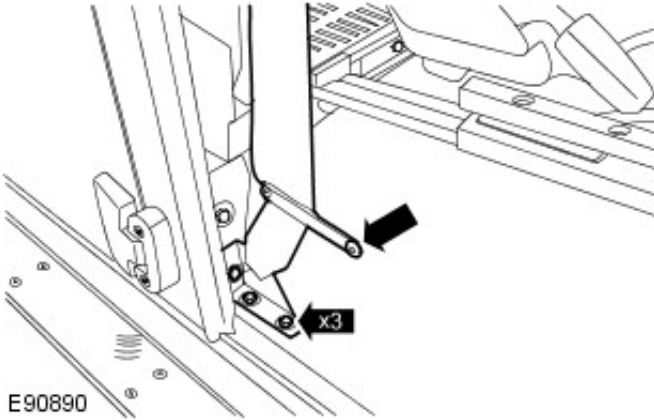
1. Install the front safety belt buckle.
 - Tighten the new M10 bolt to 23 Nm (17 lb.ft).
 - Tighten the M8 bolt to 23 Nm (17 lb.ft).

Safety Belt System - Front Safety Belt Retractor

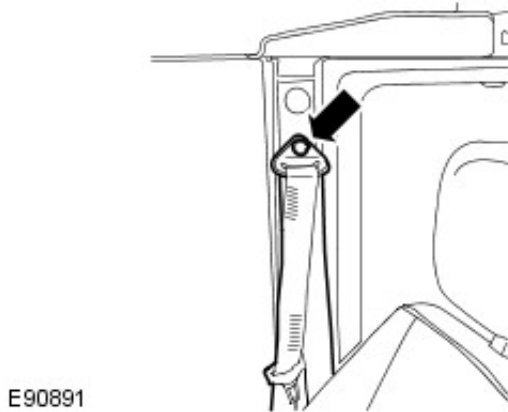
Removal and Installation

Removal

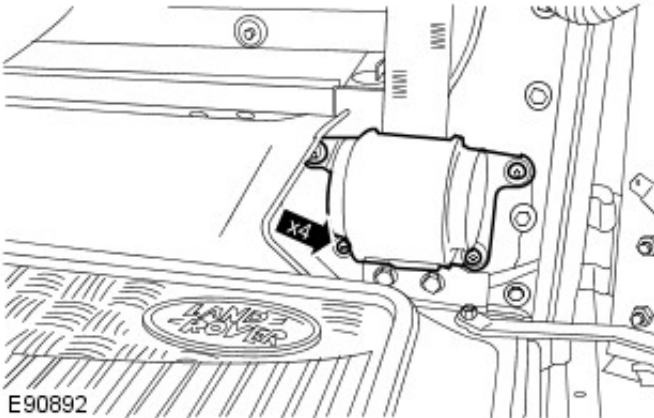
1. Release the front safety belt lower anchor.
 - Remove the 3 bolts.
 - Remove the clip.



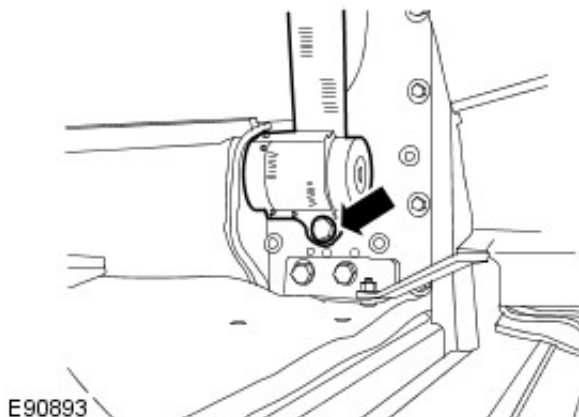
2. Release the front safety belt upper anchor.
 - Remove the bolt cover.
 - Remove the bolt.



3. Remove the front safety belt retractor trim.
 - Remove the 4 scrivenets.



4. Remove the front safety belt retractor.
 - Remove the bolt.



Installation

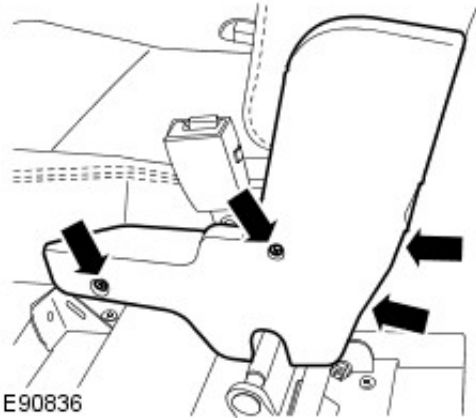
1. Install the front safety belt retractor.
 - Tighten the bolt to 31 Nm (23 lb.ft).
2. Install the front safety belt retractor trim.
 - Install the scrivenets.
3. Secure the front safety belt upper anchor.
 - Tighten the bolt to 31 Nm (23 lb.ft).
 - Install the bolt cover.
4. Secure the front safety belt lower anchor.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Install the clip.

Safety Belt System - Rear Center Safety Belt Buckle

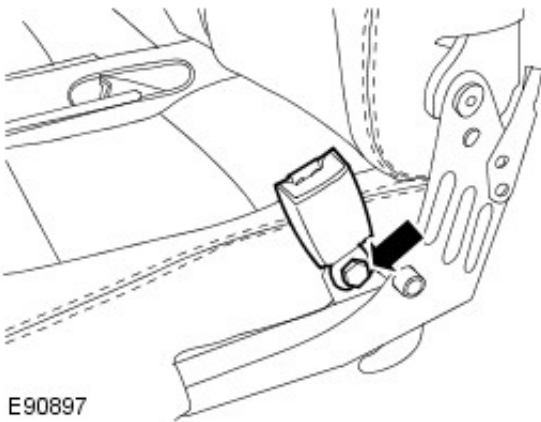
Removal and Installation

Removal

1. Remove the RH rear seat inner hinge trim panel.
 - Remove the 4 screws.



2. Remove the rear center safety belt buckle.
 - Remove the bolt.



Installation

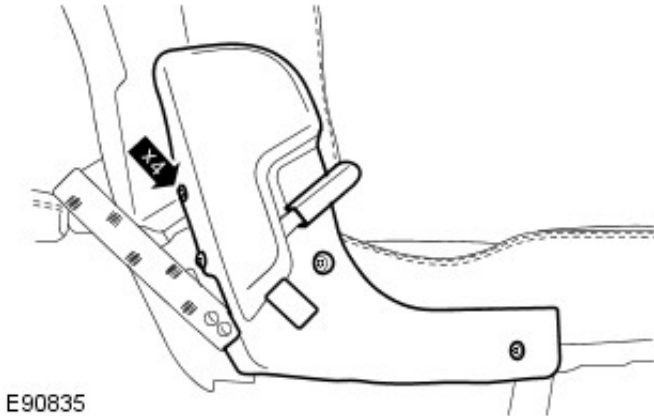
1. To install, reverse the removal procedure.
 - Tighten the bolt to 31 Nm (23 lb.ft)

Safety Belt System - Rear Center Safety Belt Retractor

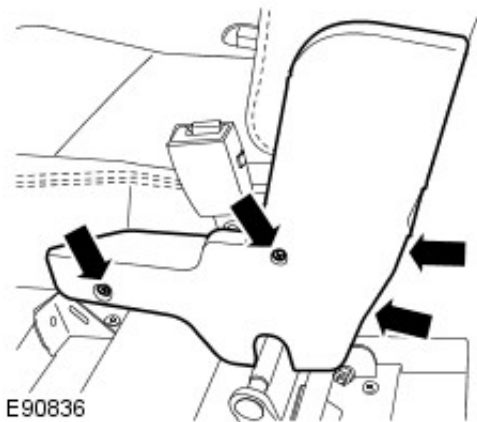
Removal and Installation

Removal

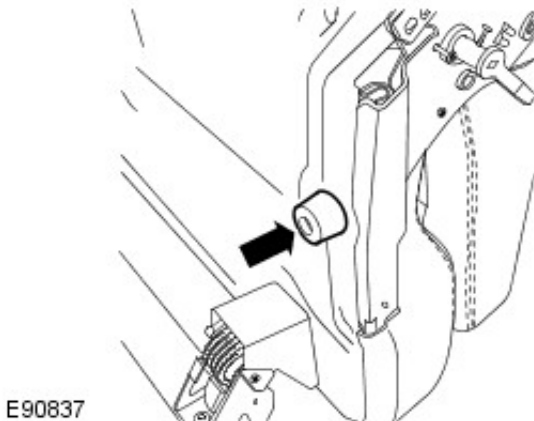
1. Remove the rear seat outer hinge trim panel.
 - Remove the rear seat recliner handle.
 - Remove the 4 screws.



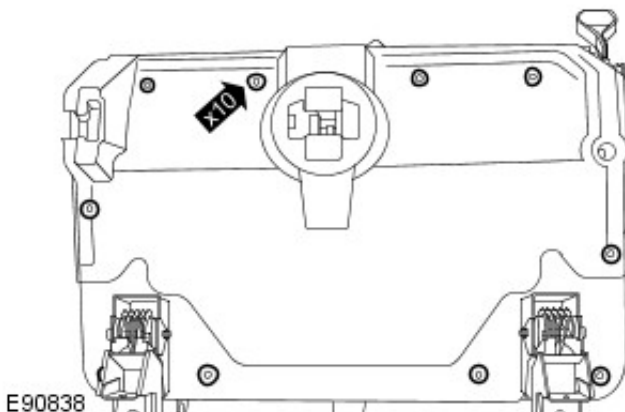
2. Remove the rear seat inner hinge trim panel.
 - Remove the 4 screws.



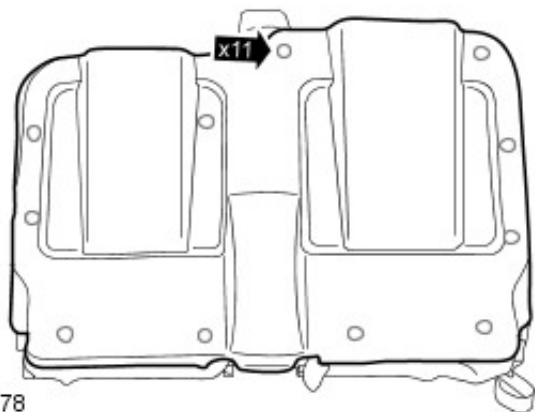
3. Remove the rear seat base stop.
 - Remove the bolt.
 - Collect the plastic washer.



4. Remove the rear seat cushion trim panel.
 - Remove the 10 clips.

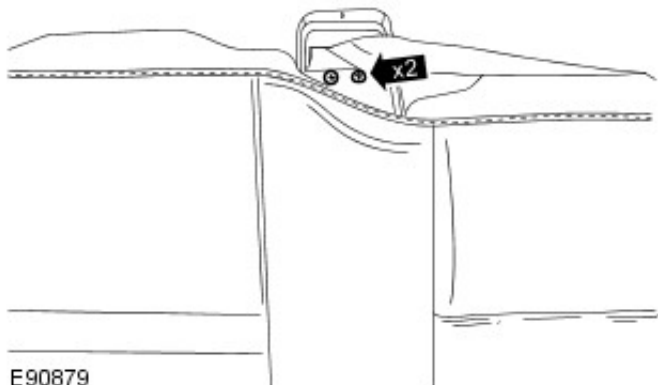


5. Remove the rear seat backrest trim panel.
- Release the 11 clips.



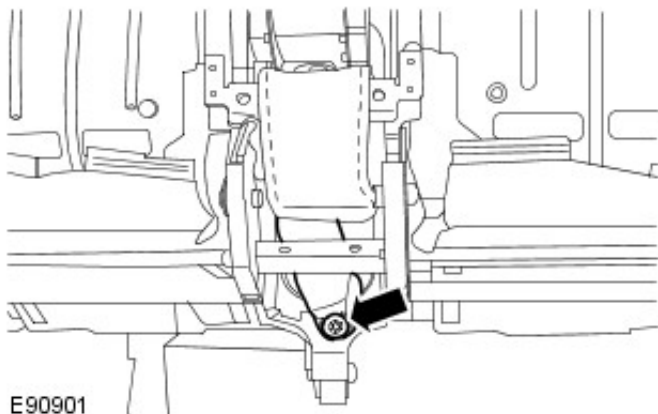
E90878

6. Reposition the rear center safety belt guide cover.
- Remove the 2 screws.



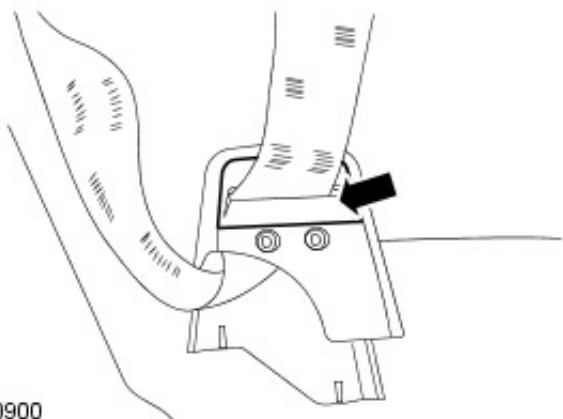
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7. Release the rear center safety belt lower anchor.
- Remove the bolt.



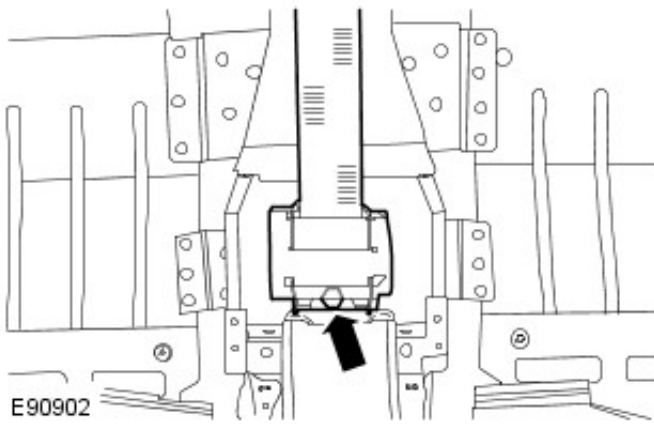
E90901

8. Remove the rear center safety belt guide cover.
- Remove the rear center safety belt guide cover finisher.



E90900

9. Remove the center rear safety belt retractor.
- Remove the bolt.



Installation

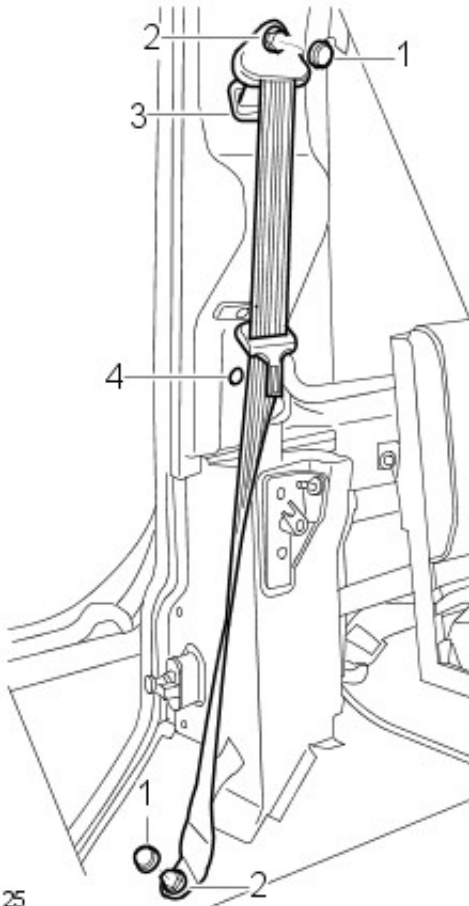
1. Install the center rear safety belt retractor.
 - Tighten the bolt to 31 Nm (23 lb.ft).
2. Install the rear center safety belt guide cover.
 - Install the rear center safety belt guide cover finisher.
3. Secure the rear center safety belt lower anchor.
 - Tighten the bolt to 31 Nm (23 lb.ft).
4. Secure the rear center safety belt guide cover.
 - Tighten the screws.
5. Install the rear seat backrest trim panel.
 - Secure with the clips.
6. Install the rear seat cushion trim panel.
 - Install the clips.
7. Install the rear seat base stop.
 - Install the plastic washer.
 - Tighten the bolt to 23 Nm (17 lb.ft).
8. Install the rear seat inner hinge trim panel.
 - Tighten the screws.
9. Install the rear seat outer hinge trim panel.
 - Tighten the screws.
 - Install the rear seat recliner handle.

Safety Belt System - Rear Safety Belt Retractor

Removal and Installation

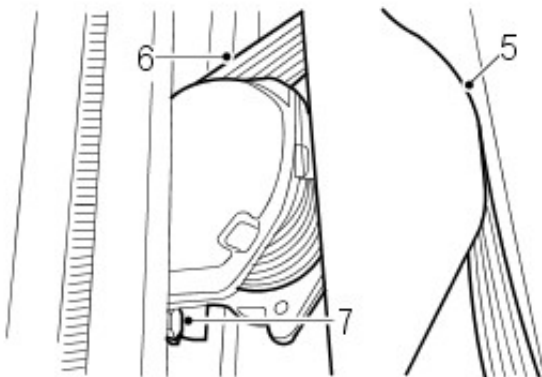
Removal

1. Remove cap from seat belt guide bolt.
2. Remove seat belt upper and lower securing bolts.
3. Remove seat belt guide from D-pillar finisher.
4. Remove 2 studs securing finisher to D-pillar.



M763125

5. Release finisher from body upper rail and D-pillar.
6. Pull seat belt through D-pillar finisher.
7. Remove bolt securing seat belt to D-pillar and remove belt assembly.



M763126

Installation

1. Position seat belt assembly to D-pillar and tighten bolt to 32 Nm (24 lb.ft).

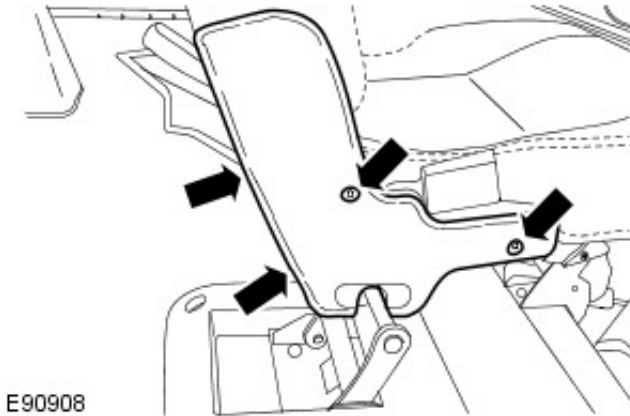
2. Extend seat belt and position through D-pillar post finisher.
3. Install and tighten seat belt upper and lower securing bolts to 32 Nm (24 lb.ft).
4. Secure D-pillar post finisher to body upper rail.
5. Install belt guide to D-pillar post finisher and install finisher retaining studs.
6. Install cap to seat belt bolt.

Safety Belt System - Rear Safety Belt Buckle LH

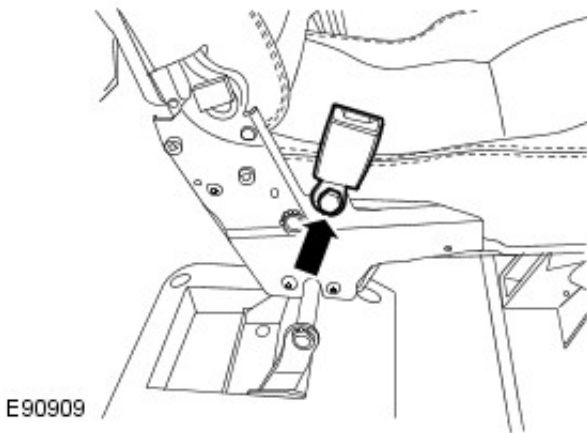
Removal and Installation

Removal

1. Remove the LH rear seat inner hinge trim panel.
 - Remove the 4 screws.



2. Remove the LH rear safety belt buckle.
 - Remove the bolt.



Installation

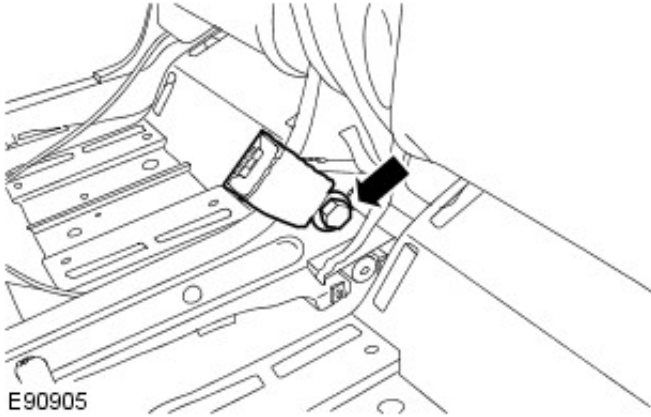
1. To install, reverse the removal procedure.
 - Tighten the bolt to 31 Nm (23 lb.ft)

Safety Belt System - Rear Safety Belt Buckle RH

Removal and Installation

Removal

1. Remove the rear seat cushion.
For additional information, refer to: Rear Seat Cushion (501-10, Removal and Installation).
2. Remove the RH rear safety belt buckle.
 - Remove the bolt.



Installation

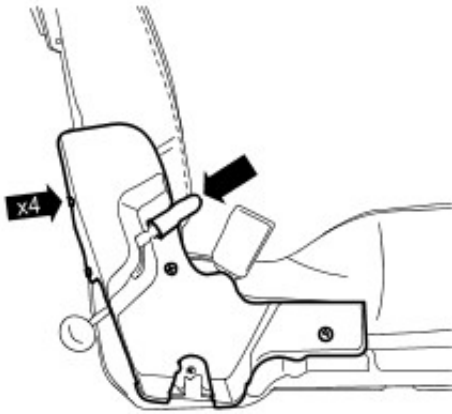
1. To install, reverse the removal procedure.
 - Tighten the bolt to 31 Nm (23 lb.ft).

Safety Belt System - Third Row Safety Belt Buckle

Removal and Installation

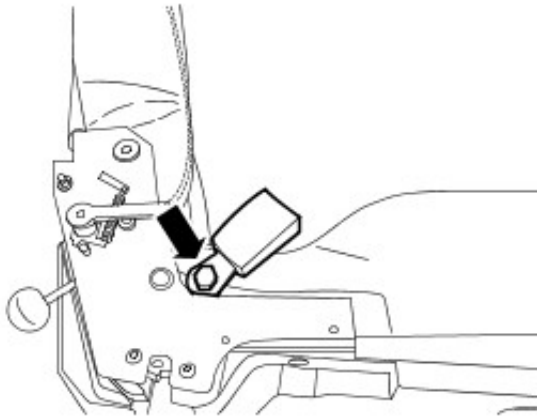
Removal

1. Remove the third row seat inner hinge trim panel.
 - Remove the third row seat recliner handle.
 - Remove the 4 screws.



E90821

2. Remove the third row safety belt buckle.
 - Remove the bolt.



E90910

Installation

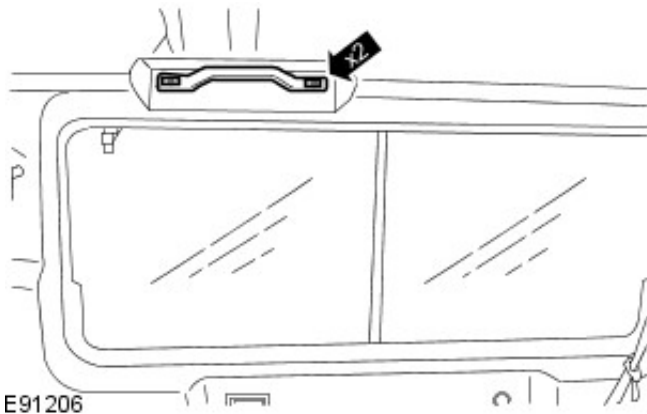
1. To install, reverse the removal procedure.
 - Tighten the bolt to 31 Nm (23 lb.ft).

Safety Belt System - Third Row Safety Belt Retractor

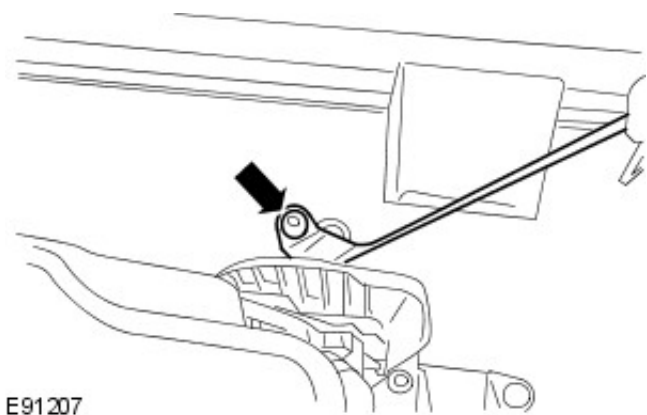
Removal and Installation

Removal

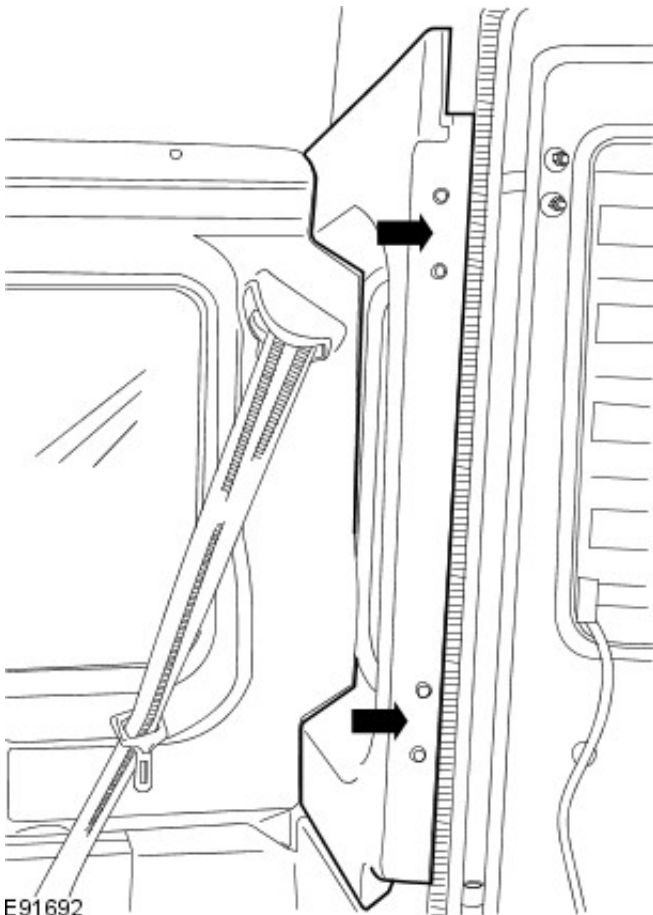
1. Remove the grab handle.
 - Remove the 2 grab handle screw covers.
 - Remove the 2 screws.



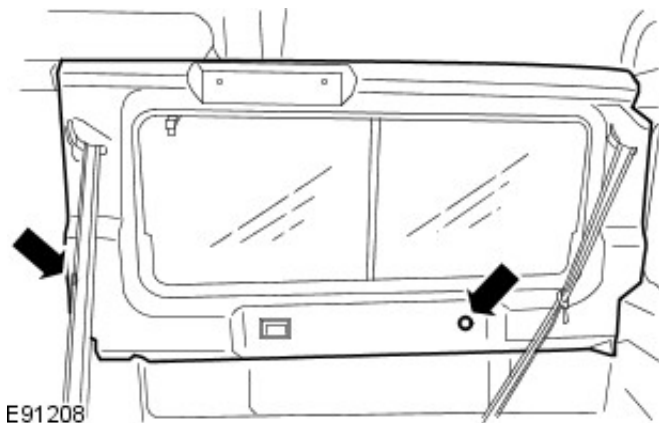
2. Release the third row safety belt lower anchor.
 - Remove the bolt.



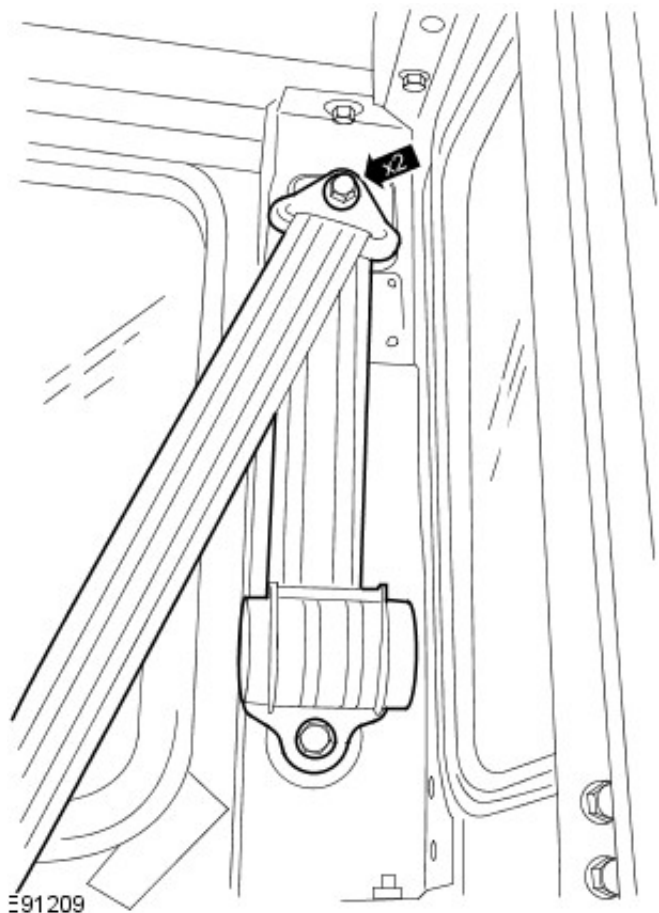
3. Remove the rear quarter trim panel.
 - Release the 2 clips.



4. Reposition the C-pillar trim panel.



- Remove the 2 lower clips.
- Move the C-pillar trim panel upwards to release the 2 upper clips.



5. Remove the third row safety belt retractor.
 - Remove the 2 bolts.

Installation

1. Install the third row safety belt retractor.
 - Tighten the bolts to 31 Nm (23 lb.ft).
2. Secure the C-pillar trim panel.
 - Install the clips.
3. Install the rear quarter trim panel.
 - Secure with the 2 clips.
4. Secure the third row safety belt lower anchor.
 - Tighten the bolt to 31 Nm (23 lb.ft).
5. Install the grab handle.
 - Tighten the screws.
 - Install the grab handle screw covers.

Body Repairs - General Information - Body Repairs

Description and Operation

General Information

Body shells are of rivetted, bolted and welded construction and are bolted to the chassis frame.

It is essential that design dimensions and strength are restored in accident rectification. It is important that neither structural weakness nor excessive local stiffness are introduced into the vehicle during body or chassis repair.

Repairs usually involve a combination of operations ranging from straightening procedures to renewal of either individual panels or panel assemblies. The repairer will determine the repair method and this decision will take into account a balance of economics between labour and material costs and the availability of repair facilities in both equipment and skills. It may also involve considerations of vehicles down-time, replacement vehicle availability and repair turn-around time.

It is expected that a repairer will select the best and most economic repair method possible, making use of the facilities available. The instructions given are intended to assist a skilled body repairer by expanding approved procedures for panel replacement with the objective of restoring the vehicle to a safe running condition and effecting a repair which is visually acceptable and which, even to the experienced eye, does not advertise the fact that it has been damaged.

This does not necessarily mean that the repaired vehicle will be identical in all respects with original factory build. Repair facilities cannot always duplicate methods of construction used during production.

The panel repairs shown in this section are all based on a 110 Station Wagon. Therefore all illustrations and text relate only to this model. Although certain areas of the vehicle, such as the front end, are relevant to all models.

Operations covered in this Manual do not include reference to testing the vehicle after repair. It is essential that work is inspected and suspension geometry checked after completion and if necessary a road test of the vehicle is carried out, particularly where safety related items are concerned.

Where major units have been disconnected or removed, it is necessary to ensure that fluid levels are checked and topped up when necessary. It is also necessary to ensure that the repaired vehicle is in a roadworthy condition in respect of tyre pressures, lights, washer fluid etc.

Body repairs often involve the removal of mechanical and electrical units as well as associated wiring. Where this is necessary use the relevant section in this manual.

Taking into consideration the differences in body styles, steering and suspension systems as well as engine and suspension layouts, the location of the following components as applicable to a particular vehicle is critical:

- Front suspension upper damper mountings
- Front suspension or sub frame mountings
- Engine mountings on RH and LH chassis longitudinals
- Rear suspension upper damper mountings
- Rear suspension mountings or lower pivots
- Steering rack mountings

Additional points which can be used to check alignment and assembly are:

- Inner holes in cross member - side - main floor
- Holes in valance front assembly
- Body to chassis mounting holes
- Holes in rear floor
- Holes in rear lower panels or extension rear floor
- Fuel tank mountings

Apertures for windscreen, backlight, bonnet and doors can be checked by offering up an undamaged component as a gauge and also by measuring known dimensions.

For additional information, refer to: Body and Frame (501-26, Description and Operation).

Straightening

Whenever possible, chassis structural members should be cold straightened under tension. Do not attempt to straighten with a single pull, but rework the damaged area using a series of pulls, releasing tension between each stage and using the opportunity to check alignment.

Body jig

Unless damage is limited to cosmetic panels, all repair work to body members must be carried out on a body jig, to ensure that impact damage has not spread into more remote parts of the body structure. Mounting on a jig will also ensure that the straightening and panel replacement procedures do not cause further distortion. If original dimensions cannot be satisfactorily restored by these methods, damaged structural members should be replaced. Damaged areas should be cut away using a high speed saw, NOT an oxy-acetylene torch.

As a rule, body dimensions are symmetrical about the centre line. A good initial check for distortion is therefore to

measure diagonally and to investigate apparent differences in dimensions.

Inspection

Every accident produces individual differences in damage. Each repair is influenced by the extent of the damage and by the facilities and equipment available for its rectification.

Most accident damage can be visually inspected and the approximate extent of the damage assessed. Sometimes deformation will extend beyond the area of direct damage, and the severity of this must be accurately established so that steps may be taken to restore critical body components to their original dimensions.

An initial check of critical dimensions can be carried out by means of drop checks or (preferably) trammels. Gauges are available which will check accurately for body twist. Where repairs necessitate renewal of a critical body component it is recommended that a body jig is used.

ELECTRONIC CONTROL UNITS (ECU's)

The ECU's fitted to Defender vehicles make it advisable to follow suitable precautions prior to carrying out welding repair operations. All ECU's must be disconnected before any welding operations take place. Harsh conditions of heat and vibration may be generated during these operations which could cause damage to the units.

PAINT PROCEDURES

Replacement Panels

Service panels are supplied with a cathodic primer coating as part of the panel protection, and in compliance with the vehicle's Corrosion Warranty where applicable. DO NOT remove this primer before paint refinishing. In the event of localised surface damage or imperfections, ensure that the minimum of primer is removed during rectification work for effective repair.

Rectify damage by panel beating or straightening. To remove corrosion or paint runs on outer surfaces, abrade primer coat in the affected area as necessary using the following procedure:

- Clean the panel using a solvent wipe.
- Treat exposed areas of metal with an etch phosphate process.
- Re-treat the affected area using either a separate acid-etch primer and two-pack surfacer, or an integrated etch primer/filler.

Bolted Panels

Before fitting bolt-on panels, ensure that all mating and adjacent surfaces on the vehicle and replacement panel are free from damage and distortion. Rectify if necessary as described in this section, and apply preformed strip sealer where specified.

Welded Panels

- Remove primer from the immediate vicinity of new and existing panel flanges, cleaning to bright metal finish.
- On joints to be spot welded, apply weld-through zinc rich primer to joint faces of both flanges. Make spot welds while primer is still wet or according to the manufacturer's instructions.
- Dress accessible weld seams.
- Clean panel using solvent wipe.
- Treat bare metal with an etch phosphate process.
- Re-treat repaired areas.
- It is not satisfactory to use weld-through, zinc rich primers in conjunction with MIG welding.

Sectioned Panels

When replacing part or sectioned panels, the basic procedure is the same as for welded panels described above, with the following variations:

1. Remove primer from both new and existing joint faces, cleaning to a bright metal finish.
2. Where an overlap joint with the existing panel is to be spot welded, apply weld-through, zinc rich primer to both joint faces and spot weld while the primer is still wet or according to the manufacturer's instructions.
3. MIG weld joints where applicable.
4. Clean the panel with a solvent wipe.
5. Treat bare metal areas using an etch phosphate process.
6. Re-prime affected areas as necessary as for rectifying transit damage. See this section.
7. Treat the inner faces of lap or butt joints with a suitable cavity wax. See Sealing and Corrosion Protection.

Clinch Panels (eg Door skins etc.)

1. Abrade primer on new and existing panel joint faces, and clean using a solvent wipe.

2. Apply metal-to-metal adhesive where applicable.
3. Where joints are to be spot welded, apply suitable weld-through, zinc rich primer to weld areas.
4. Where joints are to be MIG welded, apply zinc rich primer in adjacent areas but leave the welded area untreated.
5. To retain the panel whilst clinching the flanges, tack spot weld or plug weld as appropriate.
6. Clean the panel with a solvent wipe.
7. Treat bare metal areas with a suitable etch phosphate process.
8. Re-prime affected areas as necessary as for rectifying transit damage. See this section.
9. Replacement doors, bonnets and tailgates must be treated with a suitable seam sealer on clinched seams, following the primer coat.

Paint Refinishing

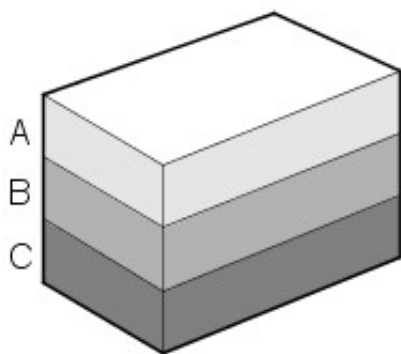
1. Seal all accessible exterior and interior seams with an approved seam sealer. Certain joints such as sill lower flange seams must be left unsealed.
2. Apply a suitable anti-chip primer where specified.
3. Apply a two-pack paint refinishing system.
4. Repair any damage to underbody sealers either at this stage or before paint operations.

Paint Repairs

Before carrying out paintwork repairs, the vehicle must be thoroughly cleaned 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 prior to paint application.

Abrade damaged paintwork where bare metal has been exposed until the metal is clean and extends beyond the area of immediate damage. Treat the bare metal with an etch phosphate to remove all traces of rust and 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. Those surfaces not receiving paint must be treated with a cavity wax following paint operations.



M772108B

Item	Part Number	Description
A	-	Two-pack top coat
B	-	Two-pack primer filler and etch primer
C	-	Etch phosphate

GENERAL WELDING PRECAUTIONS

The following pages show the procedures to follow when using welding for repairs. No resistance spot welds have been used in any of the repairs.

The aluminium alloy used on all Defender models is a combination of aluminium and magnesium. When converting a MIG welder for use on aluminium it is essential the following components are changed. The materials shown in brackets are the correct materials to use:

When carrying out welding operations the following criteria must be observed:



M772122

Item	Part Number	Description
A	-	MIG Plug welds
B	-	MIG seam weld

Seat Belt Anchorages

Seat belt anchorages are safety critical. When making repairs in these areas it is essential to follow design specifications.

Where possible, the original production assembly should be used, complete with its seat belt anchorages, or the cut line should be so arranged that the original seatbelt anchorage is not disturbed.



WARNING: Body parts incorporating seat belt anchorages **MUST** be renewed completely if damaged beyond repair, as the welds in these areas are safety critical and cannot be disturbed.

All welds within 250mm (9.9in.) of seat belt anchorages must be carefully checked for weld quality, including spacing of spot welds. A crack detection process must be carried out in these areas.

PANEL REPLACEMENT PROCEDURE

General

This information is designed to explain the basic panel removal and replacement method. This standard method may vary slightly from one vehicle to another. The main criterion in removal and replacement of body panels is that Land Rover's original standard is maintained as far as possible.

All repair processes and procedures shown relate to Aluminium panels.

Remove Panel

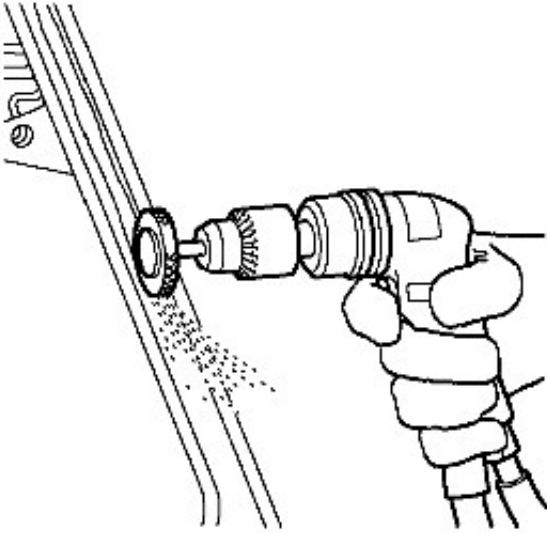


WARNING: Ensure breathing mask and protective glasses are worn during operations where Aluminium particles are removed.



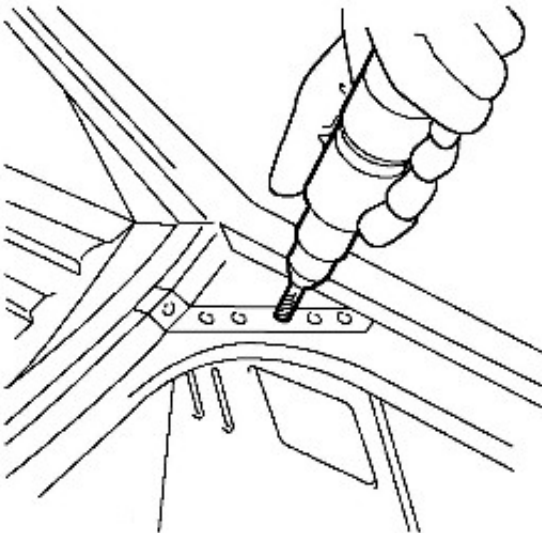
CAUTION: Never use a sanding disc that has previously been used on steel, as iron deposits could be left on the surface of the Aluminium.

NOTE: In wheel arch areas it may be necessary to soften underbody coating using a hot air gun, prior to exposing spot welds.



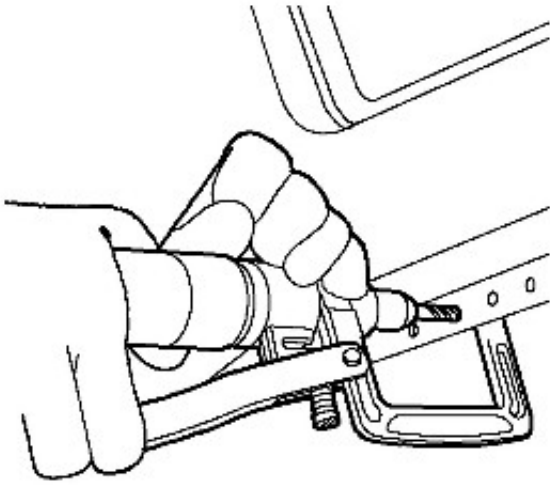
77M1357

1. Expose resistance spot welds. For those spot welds which are not obviously visible, use a rotary drum sander or wire brush fitted to an air drill, or alternatively a hand held wire brush.



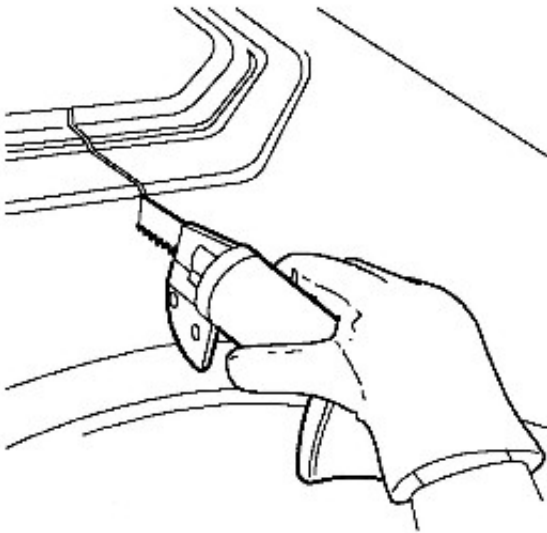
77M1358

2. Cut out welds using a cobalt drill.



77M1359

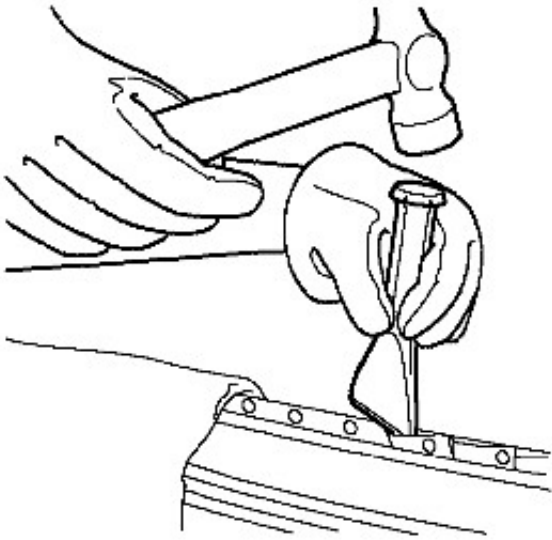
3. Alternatively, use a clamp-type spot weld remover.



77M1360

4. Cut away the bulk of the panel as necessary using an air saw.

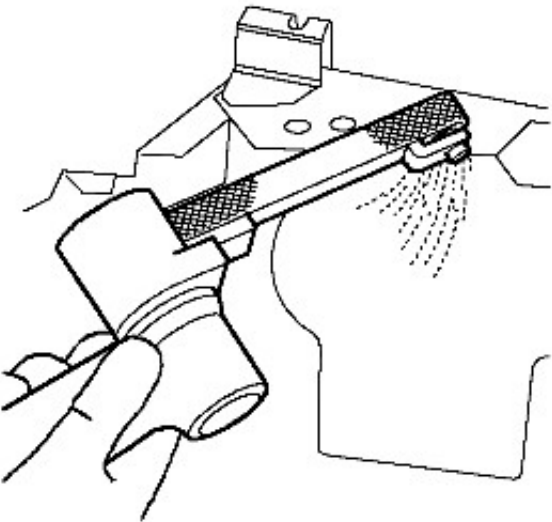
NOTE: On certain panel joints MIG welds and braze should be removed using a sander where possible, before cutting out the panel bulk.



77M1361

5. Separate the spot welded joints and remove panel remnants using hammer, bolster chisel and pincers.

Prepare old surfaces



77M1362

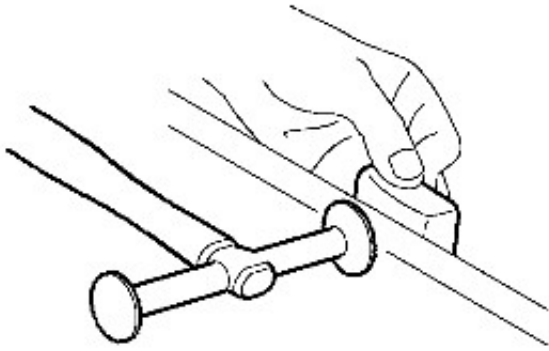
6. Clean all panel joint edges to a bright smooth finish, using a belt type sander.

 **WARNING:** Care must be taken to avoid excessive heat build up which may be caused by this equipment.

 **CAUTION:** Where significant straightening is required, heat must be applied to the area to avoid stretching the Aluminium.

All tools used for working with Aluminium must be kept separate from those used on steel.

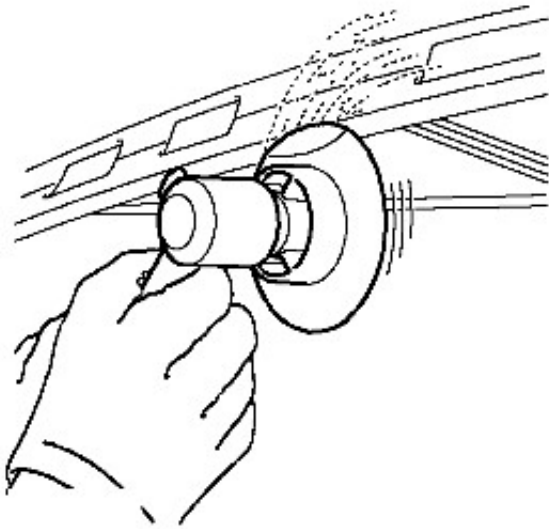
NOTE: Prior to sanding, remove remaining sealant using a hot air gun to minimise the risk of toxic fumes caused by generated heat.



M771720

7. Straighten existing joint edges using shaping block and hammer.

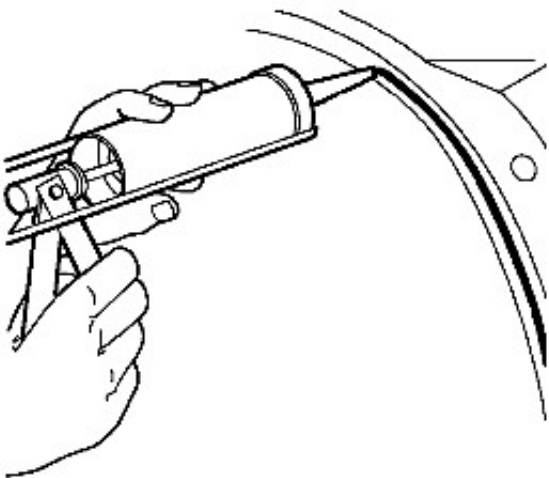
Prepare new surfaces



77M1366

8. Prepare new panel joint edges for welding by sanding to a bright finish,. This must include inner as well as outer face.

9. Drill holes in new panel, in the equivalent spot weld positions.



77M1368

10. Apply adhesive sealant to panel joint surfaces.

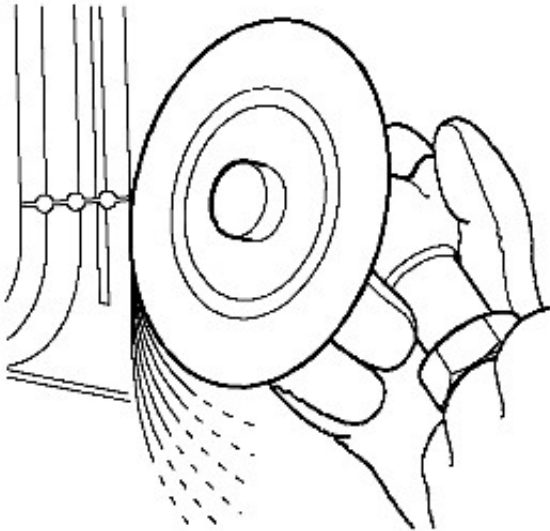
 **CAUTION:** Do not use Petroleum Spirit, Alcohol or Paint Thinners to clean mating faces.

11. All mating faces that have sealant applied to them must be cleaned using a suitable solvent. The majority of aluminium sealants have a primer/pre-treatment included with them.

Offer up and align

Offer up new panel and align with associated panels. Clamp into position using welding clamps or Mole grips. Where a joggle or brace joint is being adopted, make a set in the original panel joint edge or insert a brace behind the joint.

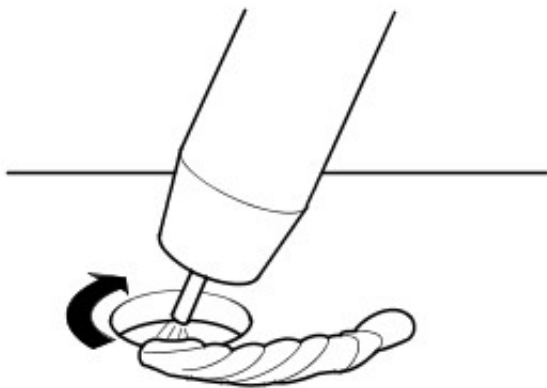
NOTE: In cases where access for welding clamps is difficult, it may be necessary to use tack welds.



77M1373

12. Dress MIG tack welds using a sander with 36 grit disc or a belt type sander where access is limited.

Welding



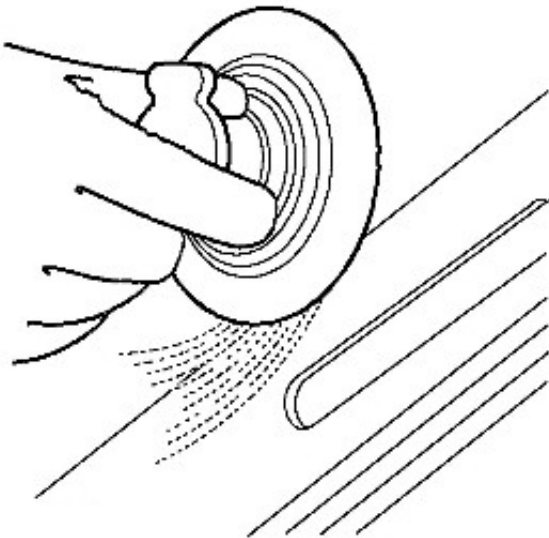
M772123

13. When plug welding, begin weld approximately 15 mm (0.6 in) from hole. This will allow the weld area to be preheated which will enhance weld penetration. It will also allow the operator to see more easily where penetration takes place. Fill hole with weld by moving in a circular direction around the hole.



M772124

14. When MIG seam welding, do not carry out lengthy operations. Divide the welds into short operations, this will reduce the chances of overheating the work piece which in turn will avoid distortion and strain.



77M1376

 **CAUTION:** Only use a Stainless Steel wire brush for Aluminium.

15. Dress all welds using a sander with 36 grit disc or a belt type sander and/or wire brush.

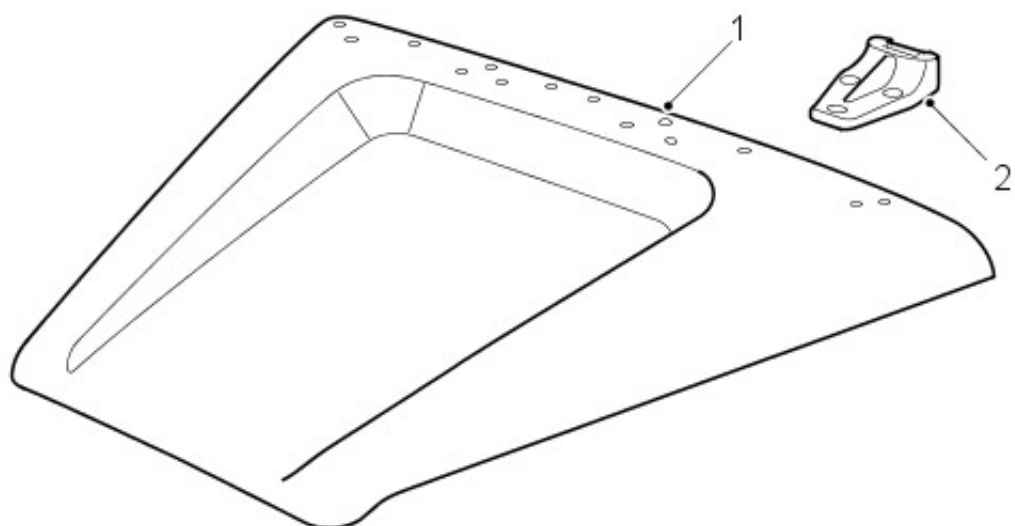
Body Trim

The panel repair operations itemise body trim components which must be removed for access during each repair

Because of the unpredictable nature of accident damage, the items listed make no allowance for any difficulties which may be found in removal and only apply to an undamaged vehicle. No allowance is made for any difficulties which may be found during panel removal. Damaged body trim items must be renewed as necessary following body repairs.

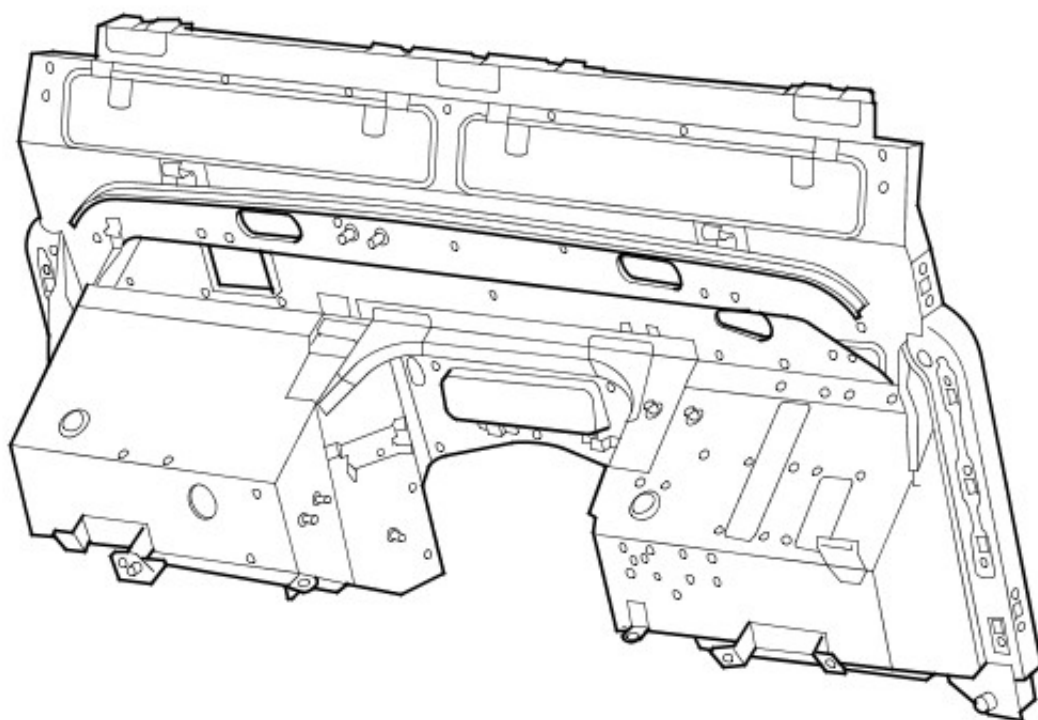
SERVICEABLE PANELS

Front end panels



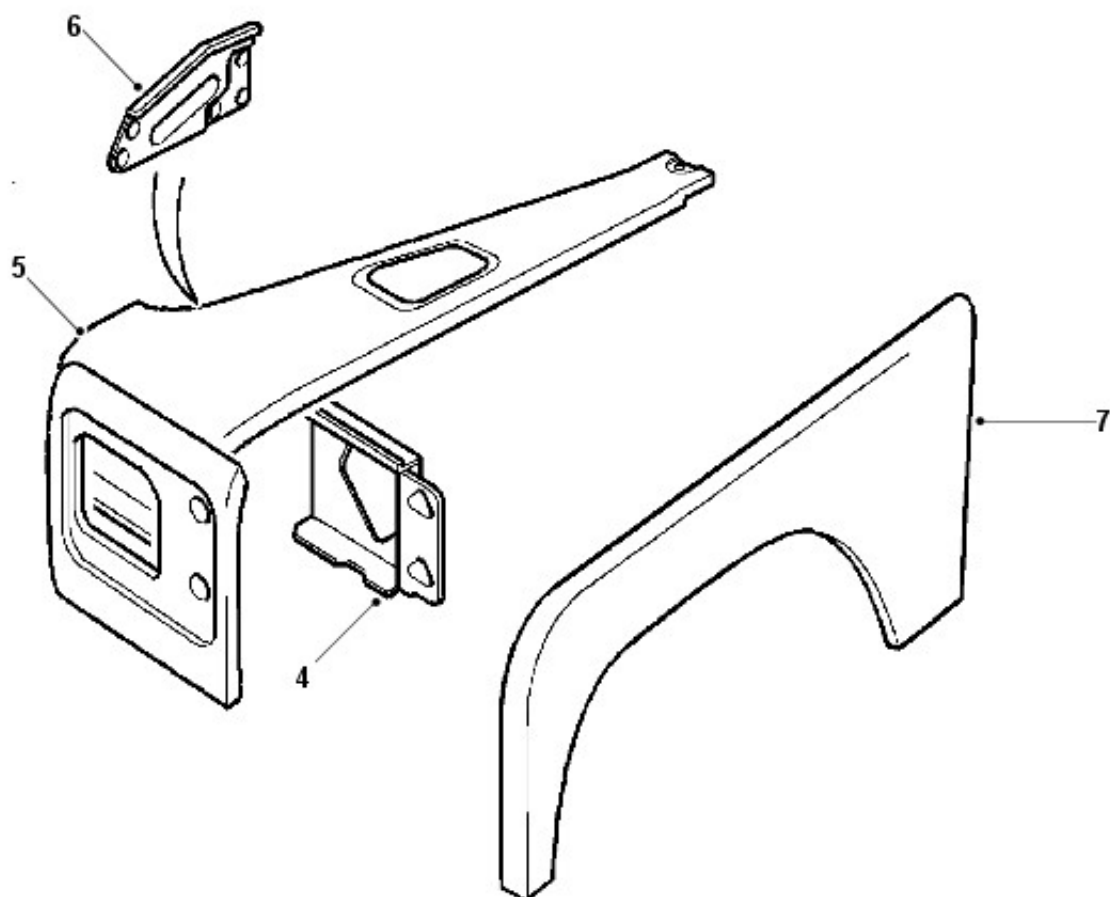
M772097A

Item	Part Number	Description
1.	-	Hood
2.	-	Hinges



M772076A

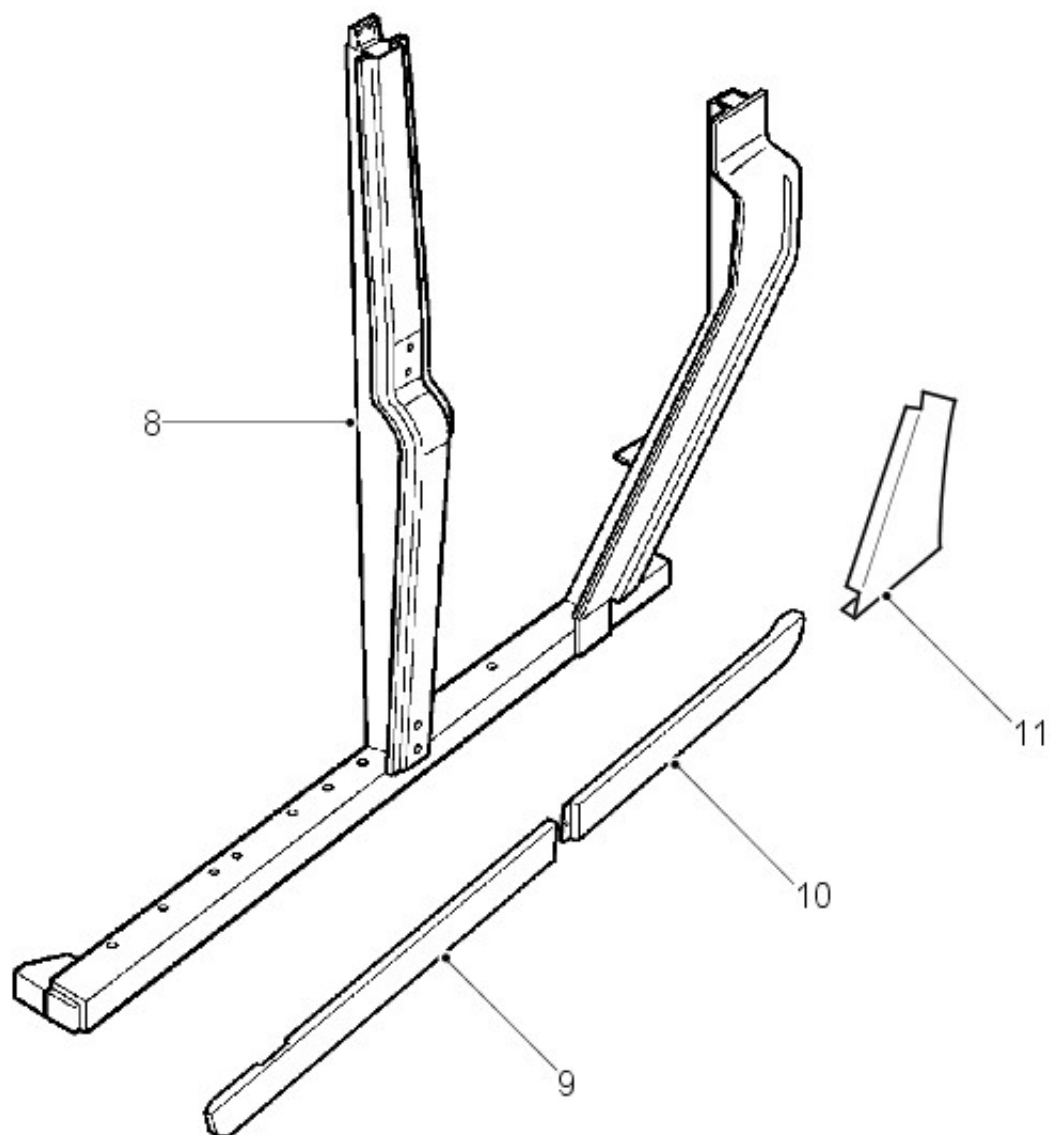
Item	Part Number	Description
3.	-	Bulkhead



M772095C

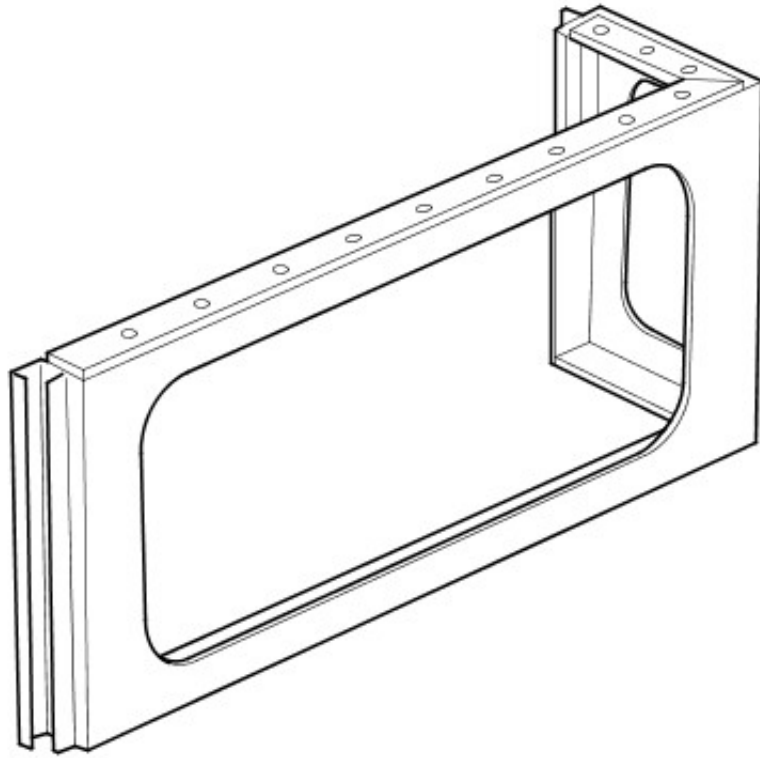
Item	Part Number	Description
4.	-	Headlamp mounting panel - inner
5.	-	Fender upper assembly
6.	-	Headlamp reinforcement panel
7.	-	Fender lower

Body side panels



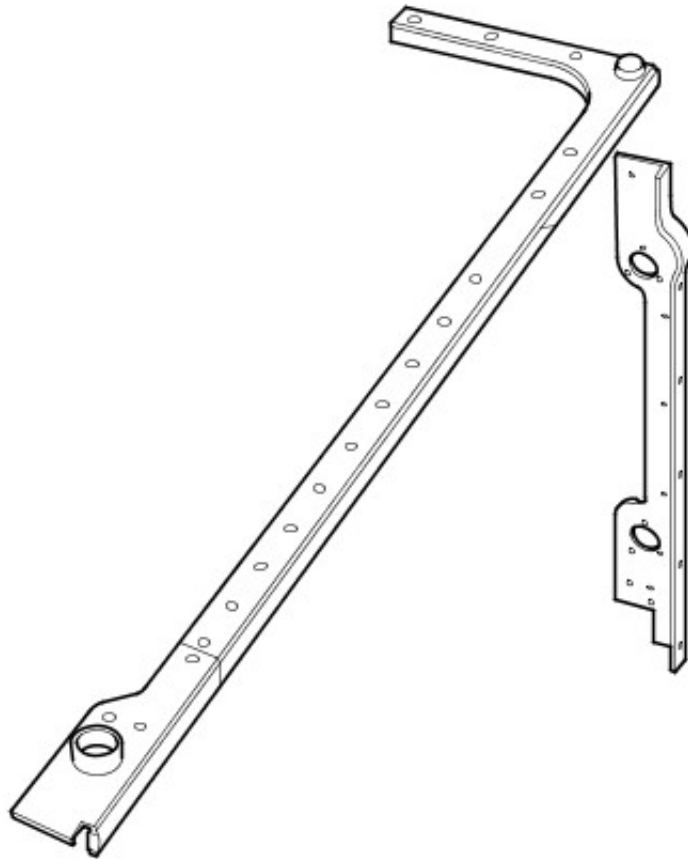
M772110B

Item	Part Number	Description
8.	-	'B/C' and 'D' post assembly
9.	-	Rocker panel - front
10.	-	Rocker panel - rear
11.	-	Dogleg - lower panel



M772104A

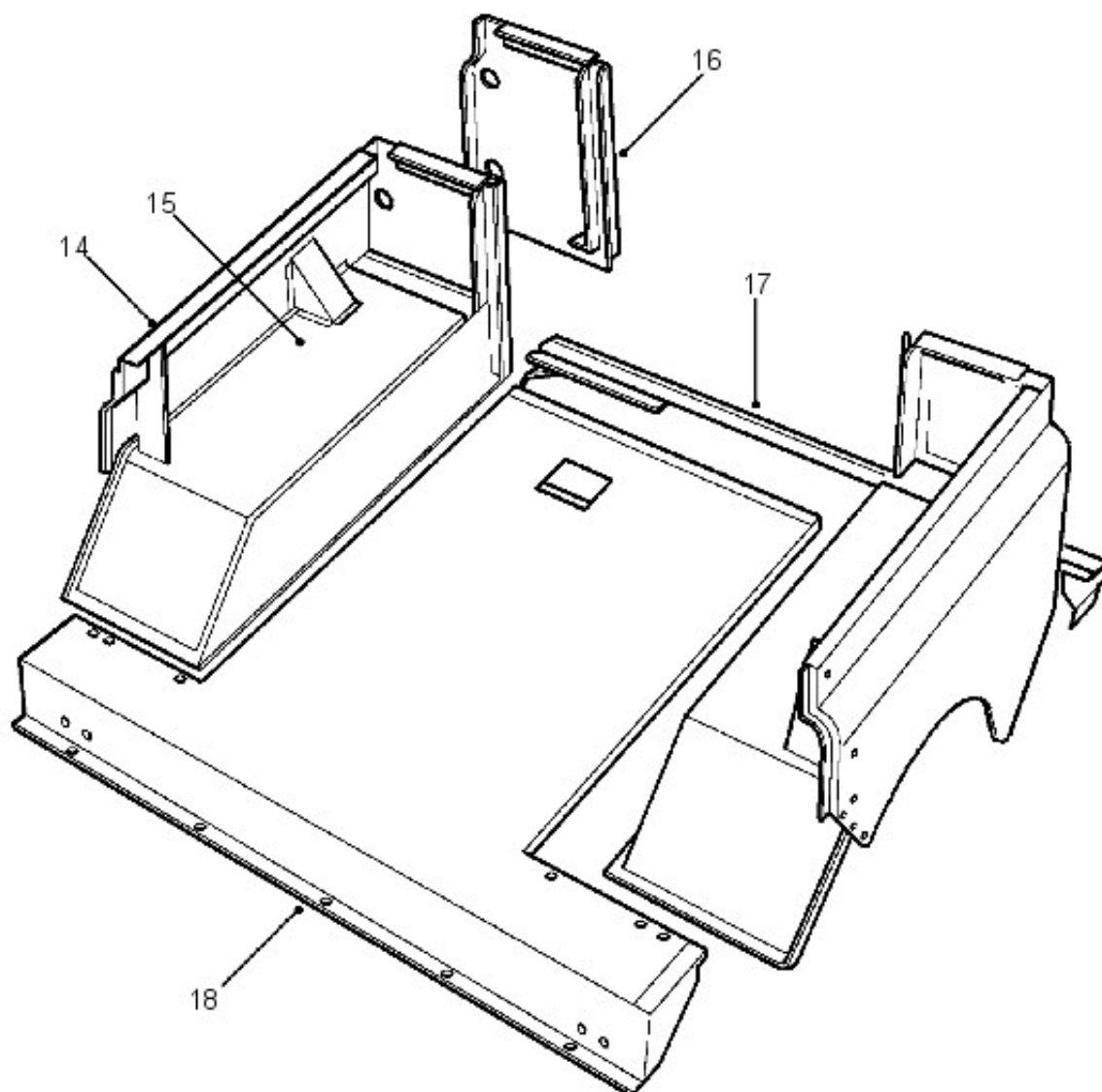
Item	Part Number	Description
12.	-	Body side rear - upper



M772100A

Item	Part Number	Description
13.	-	Body side cappings

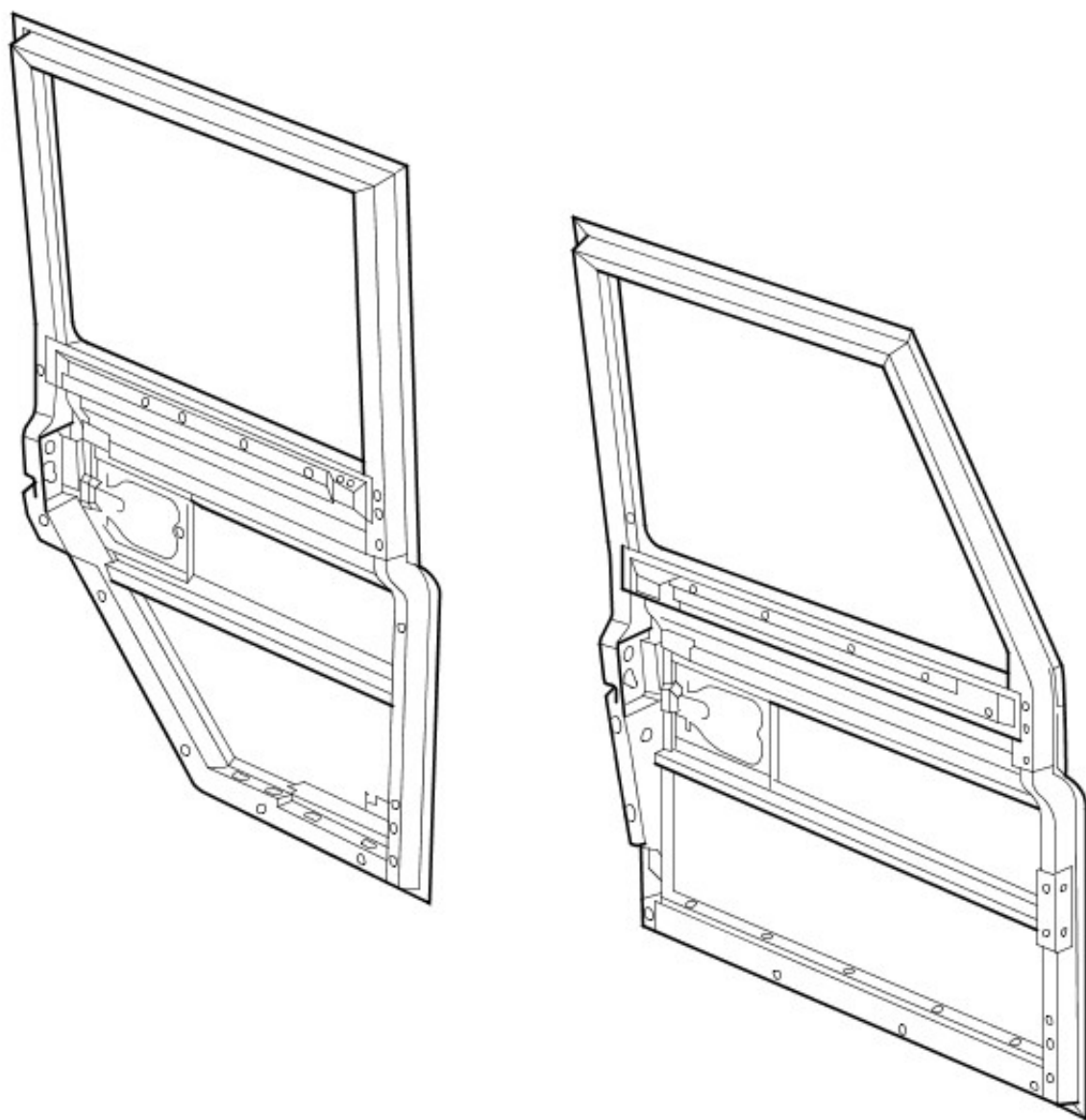
Rear end panels



M772094B

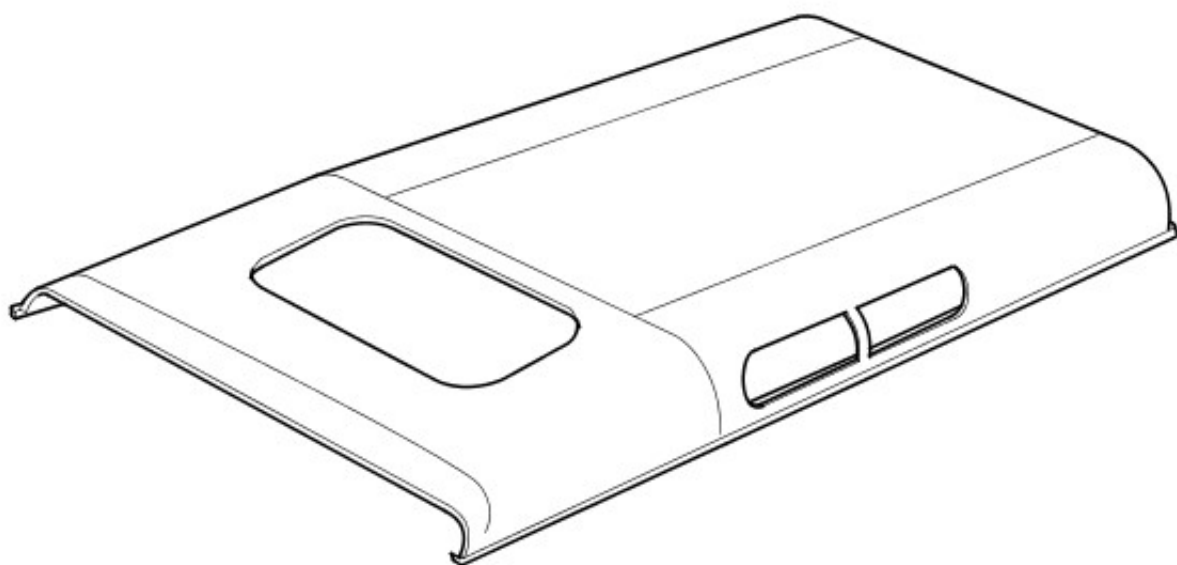
Item	Part Number	Description
14.	-	Body side panel - lower
15.	-	Body side panel - lower - assembly
16.	-	Rear lamp panel
17.	-	Rear panel
18.	-	Rear floor

NOTE: From 2002 Model year, the taildoor skin is one panel.



M772077A

Item	Part Number	Description
19.	-	Door assemblies



M772092A

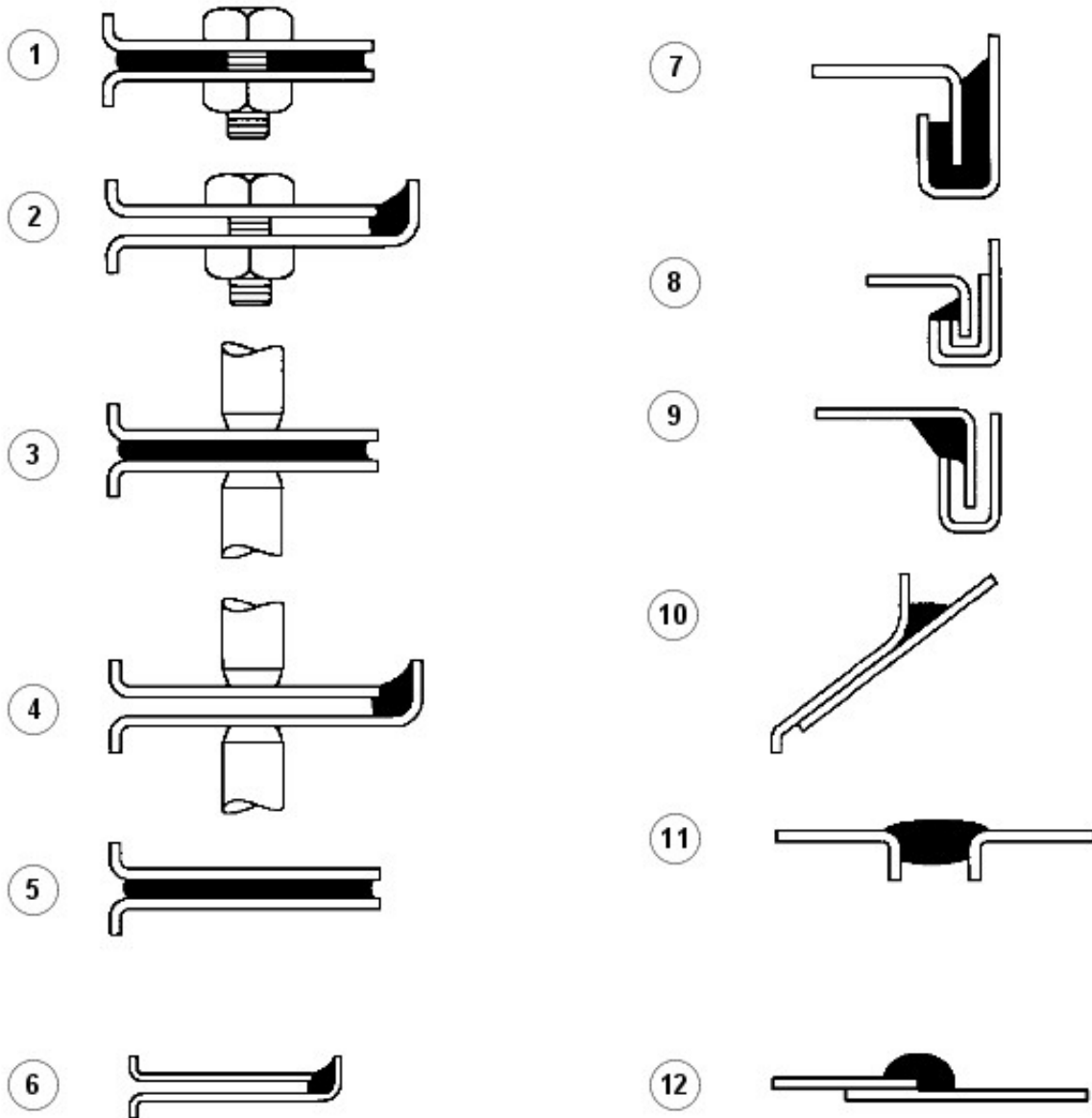
Item	Part Number	Description
20.	-	Roof

Body Repairs - Corrosion Protection - Corrosion Protection

Description and Operation

APPROVED MATERIALS

Joint types



77M1584

Item	Part Number	Description
1.	-	Between bolted panels
2.	-	Between bolted panel edges
3.	-	Between spot welded panels
4.	-	Between spot welded panel edges
5.	-	Between bonded panels
6.	-	Between bonded panel edges
7.	-	Clinch joints (type a)
8.	-	Clinch joints (type b)
9.	-	Clinch joints (type c)

- 10. - Gaps between panels (type a)
- 11. - Gaps between panels (type b)
- 12. - Lap joint

DESCRIPTION USAGE	SUPPLIER	PART NUMBER
CAVITY WAXES		
Inner cavity wax (transparent)	3M	(08909, 08919, 08929)
Inner cavity wax (amber)	3M	(08901, 08911, 08921)
Cavity wax	Croda	(PW57)
ENGINE BAY WAXES/LACQUERS		
Atrolan engine bay wax and cosmetic wax	Astors	DA3243/1
Engine bay cosmetic wax/lacquer	Croda	PW197
Engine bay cosmetic wax/lacquer	Dinal	4010
MISCELLANEOUS MATERIALS		
Flexible parts repair - rubber modified polypropylene parts	3M	(05900)
Aerosol Auto adhesive (trim) - impact adhesive for trim parts	3M	(08080)
Water shedder repair	Teroson	
Sound dampening foam	Gurit Essex	Betacore 7999
SEAM SEALERS		
Body caulking - type (b) gaps between panels	3M	08568
Drip Chek Clear - bolted, spot welded and bonded panel edges; type (a) and (b), gaps between panels; type (c) clinch joints	3M	08401
Drip Chek Heavy - type (b), gaps between panels; type (c) clinch joints	3M	08531
Flexseal Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; type (a) and (b), gaps between panels; type (c) clinch joints	3M	(08684, 08689, 08694)
Polyurethane Sealer (sachet)	3M	(08703, 08783, 08788)
Sprayable sealer - type 12 lap joints	3M	(08800, 08823)
Super seam sealer - type 12 lap joints	3M	(08357)
Weld Thru Sealer - between spot welded panels	3M	(08625)
Betafill Clinch and Brushable Sealer (Black, Grey, White)	Gurit Essex	10211/15/20
Clinch joint and underbody coating (Grey, Beige)	Gurit Essex	(10101, 10707)
Leak-Chek Clear - between bolted panels; spot welded and bonded panel edges; type (c) clinch joints	Kent industries	(10075)
Putty - type (a) and (b) gaps between panels	Kent industries	
Polyurethane seam sealer - between bolted panels, spot welded and bonded panel edges; type (a) and (b), gaps between panels	PPG	(6500)
Polyurethane seam sealer - between bolted panels, spot welded and bonded panel edges; type (a) and (b), gaps between panels	Teroson	92
Terolan Light seam sealer - bolted, spot welded and bonded panel edges; type (a) and (b), gaps between panels; between bonded panels; type (c) clinch joints	Teroson	
Terosan Special Brushable Seam sealer - lap joints 12	Teroson	
Terostat Sprayable seam sealer - bolted, spot welded and bonded panel edges; type (a) and (b), gaps between panels	Teroson	9320
Terostat 1K PU seam sealer (SE20) - type (a) and (b), gaps between panels, spot welded and bonded panel edges;	Teroson	
Sealing compound - bolted, spot welded and bonded panel edges; type (b), gaps between panels	Wurths	8901001/-/6
STRUCTURAL ADHESIVES		
Automotive structural adhesive - between bonded panels; type 5 and 7	3M	08122
Two part structural Epoxy - between bonded and spot welded panels; type (a) clinch joints	Ciba Geigy	XB5106/7
UNDERBODY SEALERS		
Body Schutz	3M	08861
Spray Schutz	3M	08877
Crodapol Brushable Sealer	Croda	PV75
Terotex Underseal (CP02)	Teroson	9320
UNDERBODY WAXES		

Stone chip coating (smooth)	3M	08158/9
Underbody wax	Croda	PW61
Underbody wax	Dinol	Tectacote 205
WELD-THRU PRIMERS		
Weld-thru coating	3M	05913
Zinc spray	3M	09113
Zinc rich primer	ICI	P-565 634

APPLICATION EQUIPMENT

SATA Schutz Gun Model UBE

Specifications	
Air consumption	200 litres/min (7 ft ³ /min) @ 45 psi
Weight	660 grams (23.3 oz)

Manufactured and supplied by:

Sata Gmbh

Minden Industrial Ltd.

16 Greyfriars Road

Moreton Hall

Bury St. Edmunds

Suffolk IP32 7DX

Tel. (01284) 760791

The Sata Schutz Gun is approved for the re-treatment of vehicle underbody areas with protective coatings as supplied in 1-litre (1.76pt.), purpose-designed, 'one-way' containers. The screw thread fitting (female on the gun) will fit most Schutz-type packs.

NOTE: Always clean gun after use with the appropriate solvent.

Full operating details are supplied with the equipment.

Sata HKD1 Wax Injection Equipment

The Sata HKD1 is approved by Land Rover for use in all cavity wax re-treatment operations. The equipment comprises a high quality forged gun with 1-litre capacity pressure feed container, a flexible nylon lance, 1100 mm (43.3 in) straight steel lance and hooked wand lance. A quick-change coupling is a standard fitting to enable lances to be easily interchanged. The lances each have their own spray pattern characteristics to suit the type of box section to be treated.

The Sata HKD1 is covered by a 12 month warranty. All replacement parts and service are obtainable from the suppliers.

Cooper Pegler Falcon Junior Pneumatic (Airless)

Manufacturer and supplier:

Cooper Pegler and Co. Ltd.

Burgess Hill

Sussex RH15 9LA

Tel. 04 446 42526

Intended primarily for applying transit wax, the Falcon Junior pneumatic sprayer has a 5-litre (1 gal.) container with integral hand pump. This high quality unit provides a simple and effective means of wax spraying without the need for compressed air or additional services.

A selection of nozzles, lances and hoses together with a trigger valve assembly incorporating a filter enable the sprayer to be used in a variety of applications. These include general maintenance, wax injection and paint application. All parts are fully replaceable and include a wide range of nozzle configurations.

The Falcon Junior is fitted with Viton seals and is guaranteed for 12 months.

3M Application Equipment

Manufacturer:

3M UK PLC

Automotive Trades Group

3M House
PO Box 1
Market Place
Bracknell
Berks. RG12 1JU
Tel. (01344) 858611

All 3M equipment is available from local trade factors or 3M refinishing factors.

3M Caulking Gun 08002

A lightweight, robust metal skeleton gun designed to accommodate 325 mm (12.8 in) cartridge for dispensing sealants etc. This gun facilitates rapid cartridge loading and features a quick-release lever for accurate material ejection and cut-off control.

3M Pneumatic Cartridge Gun 08012

An air line fed gun for application of 3M cartridge products. Excellent ease of application for a smooth sealant bead, and incorporates a regulator valve for additional control.

Other 3m applicator equipment available:

3M Pneumatic Applicator Guns

Air line fed gun for application of 3M sachet sealers (Part No. 08006 for 200 ml (6 fl oz) and 310 ml (9 fl oz) sachets, and Part No. 08007 for all size sachets including 600 ml (18 fl oz).

3M Applicator Gun 08190

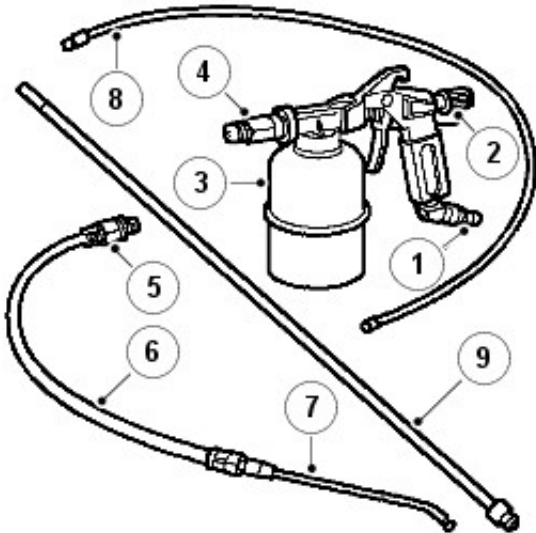
For application of 3M Structural Adhesive 08120.

3M Inner Cavity Wax Applicator Gun

Features 750 mm (29.6 in) flexible tube and using 1-litre (1.76 pt) canisters, this approved equipment is available from all 3M refinishing factors.

Heavy Duty Manual Gun

Cavity wax application equipment and techniques



77M1383

Item	Part Number	Description
1.	-	Air inlet
2.	-	Flow control (spray pattern adjustment)
3.	-	Pressure cup (1 litre [1.7 pt] capacity). Maximum pressure 140 psi (9.7 bar, 9.8 kg/cm²).
4.	-	Gun connector
5.	-	Lance nipple connection
6.	-	Flexible lance

7. - Rigid directional hook wand (forward cone spray pattern)
8. - Flexible nylon 1100mm (43.3in.) lance with 360° spray pattern
9. - Rigid 1100mm (43.3in.) lance with 360° spray pattern

When re-treating wax-injected areas which have been disturbed during repairs, it is necessary to use a compressed air spray gun with integral pressure cup and a selection of interchangeable lances.

The following points must be observed during use, according to the attachments fitted:

- Use the rigid or flexible lance attachments with 360° spray dispersal when treating enclosed areas, to ensure maximum coverage.
- Where openings are restricted, use the hook nozzle to provide a more directional spray

1100 mm (43.3in.) Rigid Lance: The nozzle on the rigid lance produces a 360° circular spray pattern combined with a forward-directed spray. Although wax is distributed to all box section surfaces in a single stroke, effective and complete coverage is best achieved in long, straight structures and box section cavities by spraying on both outbound and return strokes of the lance.

The rigid lance also provides the positional accuracy required in shaped sections, by allowing visual assessment.



CAUTION: Do not force the lance into access holes when using this attachment.

1100 mm (43.3in.) Flexible Nylon Lance: This lance is similar in pattern to the rigid version, but provides the additional penetration needed for curved sections or in places where access is difficult. Its main limitation is a lack of positional accuracy inside box sections.

Carry out spraying on the outward stroke of the lance. Withdraw the lance slowly to ensure sufficient coverage. **DO NOT withdraw the lance too quickly.**

Keep the nylon tube of the lance away from the edges of the access hole to eliminate abrasion and extend the life of the tube. Take care to ensure that spraying ceases just before the nozzle emerges from the access hole. To assist this process, apply RED paint to the final 30mm (1.2in.) of the nozzle.

Hook Nozzle on Flexible Lance: The rigid hook produces a highly atomised, forward-directed, fully conical spray pattern having long range and good dispersion characteristics. This combination has good directional capabilities for the treatment of short, narrow sections and may also be used for direct spraying of inner wheel arches etc.

Position the flat area at the end of the lance at 180° to the nozzle spray direction. This will help to guide the spray more accurately when it is concealed in a box section or access hole.

NOTE: Keep all wax injection/application equipment clean. Use white spirit for this purpose immediately after wax injection operations.

For general spraying move the nozzle in an arc from side to side, to ensure full coverage.

Precautions during Body Repairs and Handling

Take care when handling the vehicle in the workshop. PVC underbody sealers, seam sealers, underbody wax and body panels may be damaged if the vehicle is carelessly lifted.

Always follow the correct lifting, jacking and towing procedures as shown in GENERAL INFORMATION DATA, Information section, paying particular attention to the following points:

Steam Cleaning and Dewaxing

Due to the high temperatures generated by steam cleaning equipment, there is a risk that certain trim items could be damaged and some adhesives and corrosion prevention materials softened or liquified.

Adjust the equipment so that the nozzle temperature does not exceed 90°C (194°F). Take care not to allow the steam jet to dwell on one area, and keep the nozzle at least 300mm (11.8in.) from panel surfaces.

Do NOT remove wax or lacquer from underbody or underbonnet areas during repairs. Should it be necessary to steam clean these areas, apply a new coating of wax or underbody protection as soon as possible.

CORROSION PROTECTION

The following information details the materials that are applied during manufacture for corrosion protection.

Factory Treatments

The Defender is treated with the following anti-corrosion materials in production:

- A PVC based underbody sealer material which is sprayed onto the underfloor, wheel arches and undersill areas.
- An application of cavity wax which is sprayed into enclosed cavities and box sections.
- A final coating of underbody wax to cover the complete underfloor including components but excluding brake discs, exhaust system and propeller shafts.
- A coat of protective lacquer applied to the whole body.
- A coat of protective wax applied to the engine bay and wheel arch areas.

NOTE: Do not apply wax to engine bay of Td5 models.

In addition to the above measures, all steel parts are zinc-coated both sides.

Underbody Sealer

Underfloor areas and outer sill panels are treated with a Plastisol PVC underbody sealer. This material is not suitable for re-treatment.

When repairing areas of underbody sealer, strip the factory-applied material back to a suitable break point, ensuring that a clean metal surface is exposed and that the edge of the existing material adheres soundly to the panel.



CAUTION: Ensure that suspension units, wheels, tyres, power unit, driveshafts, exhaust and brakes (including all mounting points) are shielded prior to application of fresh underbody sealer

NOTE: Application of new underbody sealer must be carried out between primer and surfacer paint operations. Areas where seam sealer is used should be re-treated as necessary before application of underbody sealer.

Blanking plugs and grommets in the floor pan (except those used for wax injection) **MUST** be fitted before underbody sealer application. Heat-fusible plugs which have been disturbed should either be refitted with the aid of a hot air blower or replaced with rubber grommets.

Cavity Wax

Cavity wax is applied to certain box sections. The information given on the following pages is intended as a guide and shows the areas to be treated with cavity wax, as well as the access holes used during manufacture.

Underbody Wax

A coat of underbody wax is applied to the entire underbody inboard of the sill vertical flanges, and covers all moving and flexible components **EXCEPT** for wheels and tyres, brakes and exhaust. The wax is applied over paints and underbody sealers.



CAUTION: Old underbody wax must be completely removed from a zone extending at least 200 mm (7.9 in) beyond the area where new underbody sealer is to be applied.

The underbody wax must be reinstated following all repairs affecting floor panels.

Engine Bay Wax

Reinstate protective engine bay wax disturbed during repairs using the approved material.

Wheel Arch Wax

Reinstate protective wheel arch wax disturbed during repairs using the approved material.

Stone Chip Resistant Paint/Primer

Re-treat all areas protected with factory-applied anti-chip primer with suitable approved material in repair.

Inspections during Maintenance Servicing

It is a requirement of the Land Rover Corrosion Warranty that the vehicle body is checked for corrosion by an authorised Land Rover dealer at least once a year, to ensure that the factory-applied protection remains effective.

Service Job Sheets include the following operations to check bodywork for corrosion:

NOTE: Wash the vehicle and ensure that it is free from deposits prior to inspection. It is part of the owner's responsibility to ensure that the vehicle is kept free of accumulations of mud which could accelerate the onset of corrosion. The Dealer **MUST** wash the vehicle prior to inspection of bodywork if the customer has offered it in a dirty condition, and pay special attention to areas where access is difficult.

NOTE: The checks described above are intended to be visual only. It is not intended that the operator should remove trim panels, finishers, rubbing strips or sound deadening materials when checking the vehicle for corrosion and paint damage.

With the vehicle on a lift, and using an inspection or spot lamp, visually check for the following:

NOTE: The presence of small blisters in PVC underbody sealer is acceptable, providing they do not expose bare metal.

Special attention must be paid to signs of damage caused to panels or corrosion material by incorrect jack positioning.

It is essential to follow the correct jacking and lifting procedures. See GENERAL INFORMATION DATA, Information section.

With the vehicle lowered, visually check for evidence of damage and corrosion on all painted areas, in particular the following:

Where bodywork damage or evidence of corrosion is found during inspection, rectify this as soon as is practicable, both to

minimise the extent of the damage and to ensure the long term effectiveness of the factory-applied corrosion protection treatment. Where the cost of rectification work is the owner's responsibility, the Dealer must advise the owner and endorse the relevant documentation accordingly.

Where corrosion has become evident and is emanating from beneath a removable component (e.g. trim panel, window glass, seat etc.), remove the component as required to permit effective rectification.

Underbody Protection Repairs

When body repairs are carried out, always ensure that full sealing and corrosion protection treatments are restored. This applies both to the damaged area, and also to areas where protection has been indirectly impaired as a result of accident damage or repair operations.

Prior to straightening out or panel beating, remove all corrosion protection material in the damaged area. This applies in particular to panels coated with wax, PVC underbody sealer, sound deadening pads etc.



WARNING: DO NOT use oxy-acetylene gas equipment to remove corrosion prevention materials. Large amounts of fumes and gases are liberated by these materials when they burn.

Equipment for the removal of tough anti-corrosion sealers offers varying degrees of speed and effectiveness. The compressed air-operated scraper (NOT an air chisel) offers a relatively quiet mechanical method of removal using an extremely rapid reciprocating action. During use, direct the operating end of the tool along the work surface.

The most common method is by the use of a hot air blower with integral scraper.



CAUTION: High temperatures can be generated with this equipment which may cause fumes. Always exercise care in its use.

Another tool, and one of the most efficient methods, is the rapid-cutting 'hot knife'. This tool uses a wide blade and is quick and versatile, able to be used easily in profiled sections where access is otherwise awkward.

Use the following procedure when repairing underbody coatings:

Underbody Wax

NOTE: Where repairs include the application of finish paint coats in the areas requiring underbody wax, paint operations must be carried out BEFORE wax application.

After refitting mechanical components, including hoses, pipes and small fixtures, mask off the brake discs and apply a coat of approved underbody wax.

Underbonnet Wax

Where repairs have involved replacement of engine bay panels, treat the entire engine compartment including all components, clips and small fixtures with an approved underbonnet lacquer or wax.

Proprietary Anti-Corrosion Treatments

The application of proprietary anti-corrosion treatments in addition to the factory-applied treatment could invalidate the Corrosion Warranty and should be discouraged. This does not apply to approved, compatible, preservative waxes which may be applied on top of existing coatings.

Fitting Approved Accessories

When fitting accessories it is important that the vehicle's corrosion protection is not affected, either by breaking the protective coating or by introducing a moisture trap.

DO NOT screw self-tapping screws directly into the body panel but fit plastic inserts first. Protect the edges of holes drilled into panels, chassis members and other body parts with a suitable zinc rich or acid etch primer, followed by a protective wax coating brushed onto the surrounding area.

DO NOT affix unpainted metal surfaces of any accessory directly to the vehicle bodywork unless they are suitably protected. Where metal faces are bolted together always interpose a suitable interface material such as weldable zinc rich primer, extruded strip or zinc tape.

CAVITY WAX

Box sections treated with cavity wax are shown in this section. Repairs affecting these areas must include re-treatment with an approved cavity wax, using the access points illustrated. In addition, all interior surfaces which have been disturbed during repairs must be wax injected whether they have been treated in production or not. This includes all box members, cavities, door interiors etc. It is permissible to drill extra holes for access where necessary, provided these are not positioned in load-bearing members. Ensure that such holes are treated with a suitable zinc rich primer, brushed with wax and then sealed with a rubber grommet.

Prior to wax injection, ensure that the cavity to be treated is free from any contamination or foreign matter. Where necessary, clear out any debris using a compressed air supply.

Carry out wax injection after final paint operations.

During application, ensure that the wax covers all flange and seam areas and that it is applied to all repaired areas of both new and existing panels.

NOTE: Apply cavity wax **AFTER** the final paint process and **BEFORE** refitting of any trim components.

It should also be noted that new panel assemblies and body shells are supplied without wax injection treatment which must be carried out after repairs.

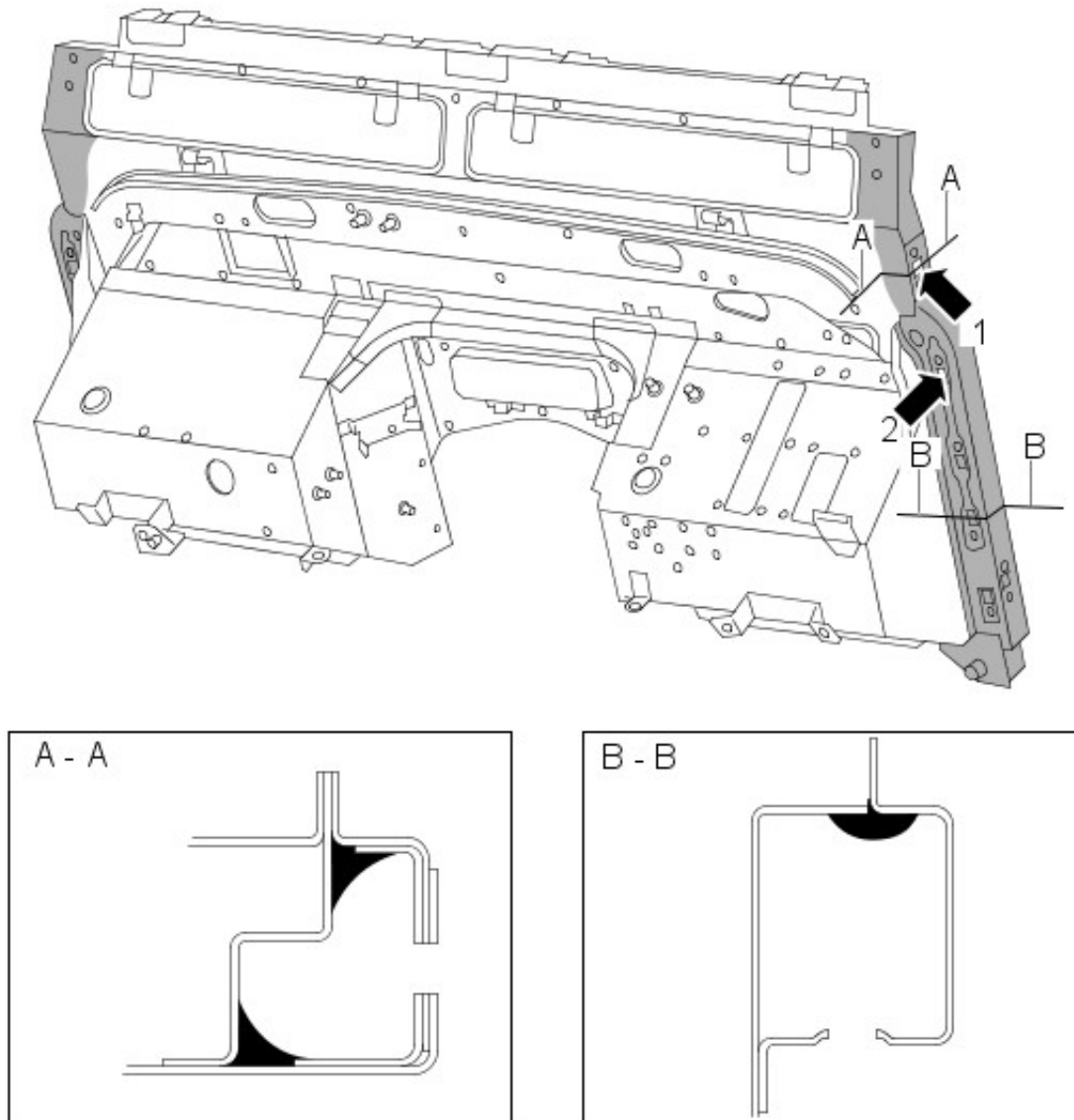
Effective cavity wax protection is vital. Always observe the following points:

- Complete all finish paint operations before wax application.
- Clean body panel areas and blow clean cavities if necessary, before treatment.
- Maintain a temperature of 18°C (64°F) during application and drying.
- Check the spray pattern of injection equipment.
- Mask off all areas not to be wax coated and which could be contaminated by wax overspray.
- Remove body fixings, such as seat belt retractors, if contamination is at all likely.
- Move door glasses to fully closed position before treating door interiors.
- Treat body areas normally covered by trim before refitting items.
- Check that body and door drain holes are clear after the protective wax has dried.
- Keep all equipment clean, especially wax injection nozzles.

The following Illustrations show the treatment areas and Injection holes for Cavity Wax application.

All areas symmetrically opposite to those shown are also treated.

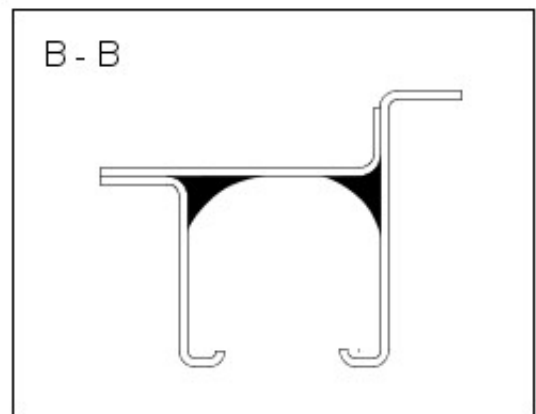
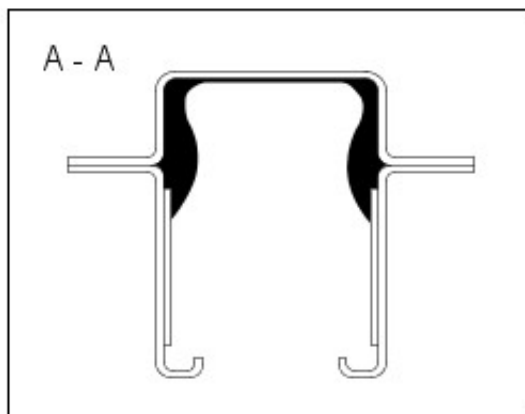
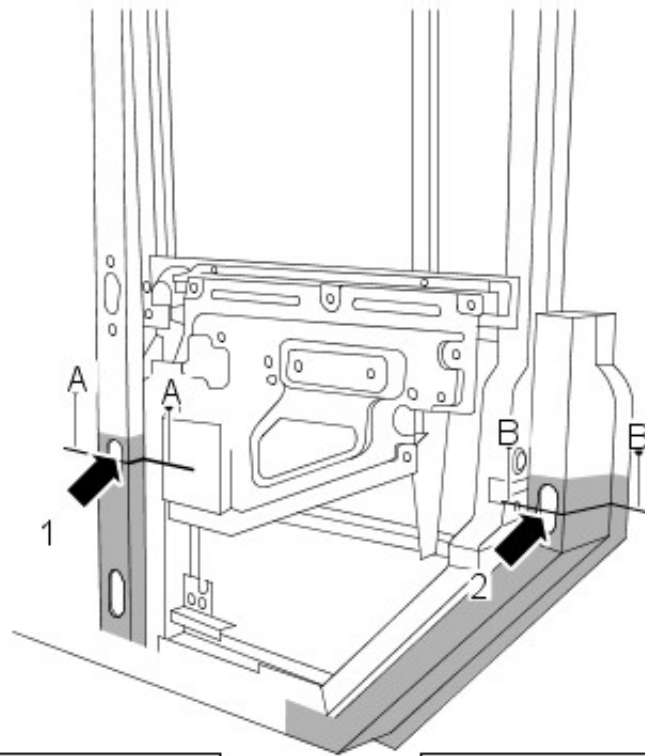
Bulkhead assembly



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Section A-A and B-B show application areas of cavity wax. Arrows 1 and 2 show application holes.

'B/C' post assembly

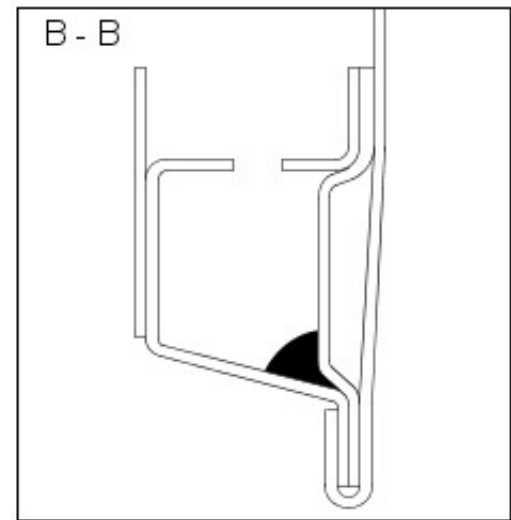
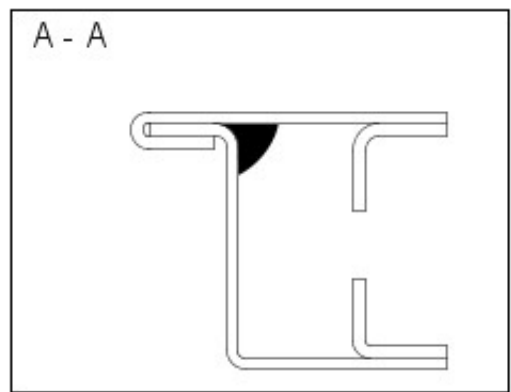
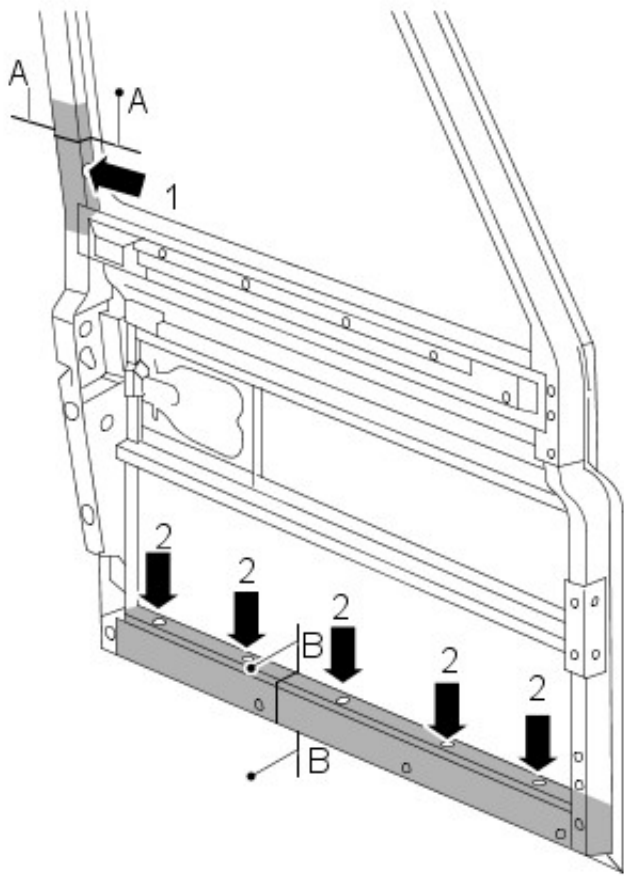


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Section A-A shows application area of cavity wax for the 'B/C' post. Arrow 1 shows application hole.

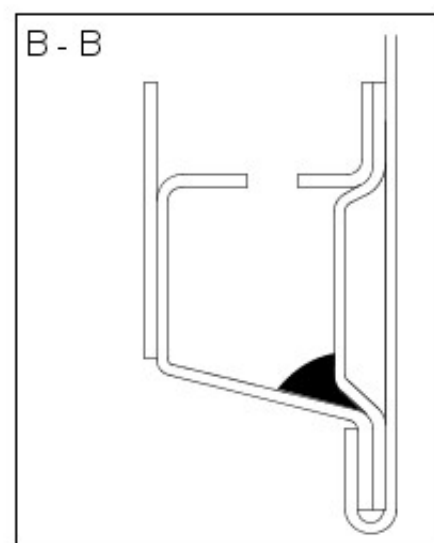
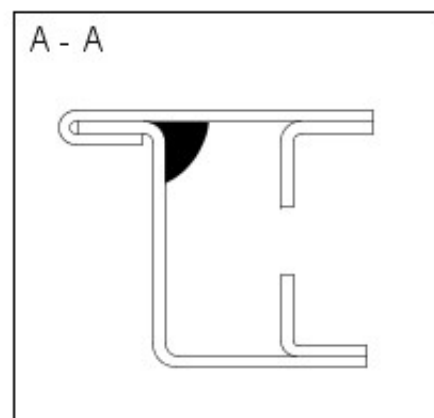
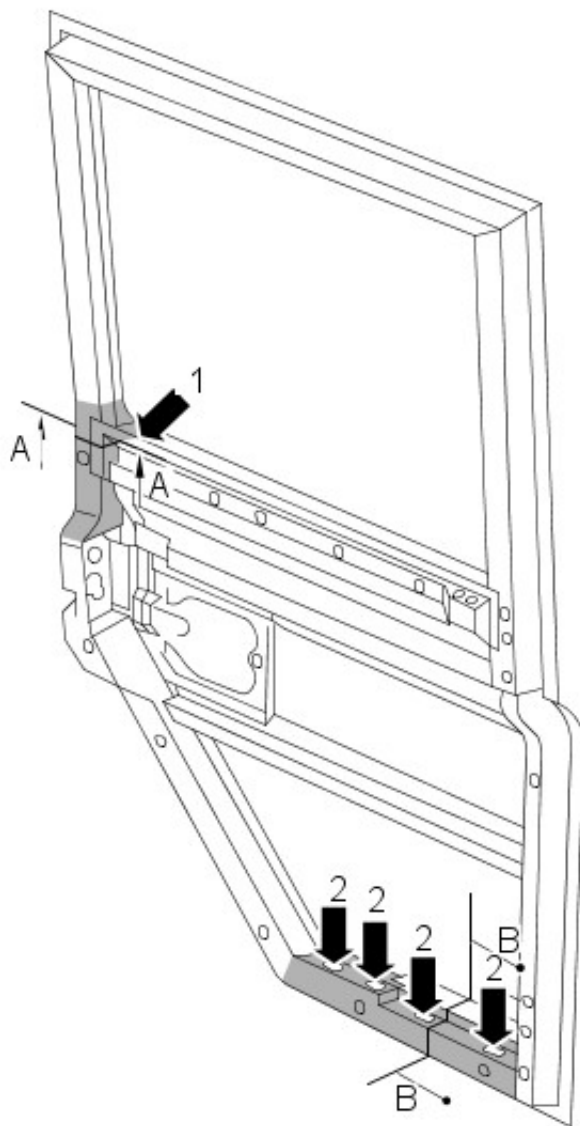
Section B-B shows application area of cavity wax for the 'D' post. Arrow 2 shows application hole.

Front door



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Section A-A and B-B show application areas of cavity wax for the front door. Arrows 1 and 2 show the application holes.
Rear door



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Section A-A and B-B show application areas of cavity wax for the rear door. Arrows 1 and 2 show the application holes.

SEALANTS AND ADHESIVES

Structural Adhesive

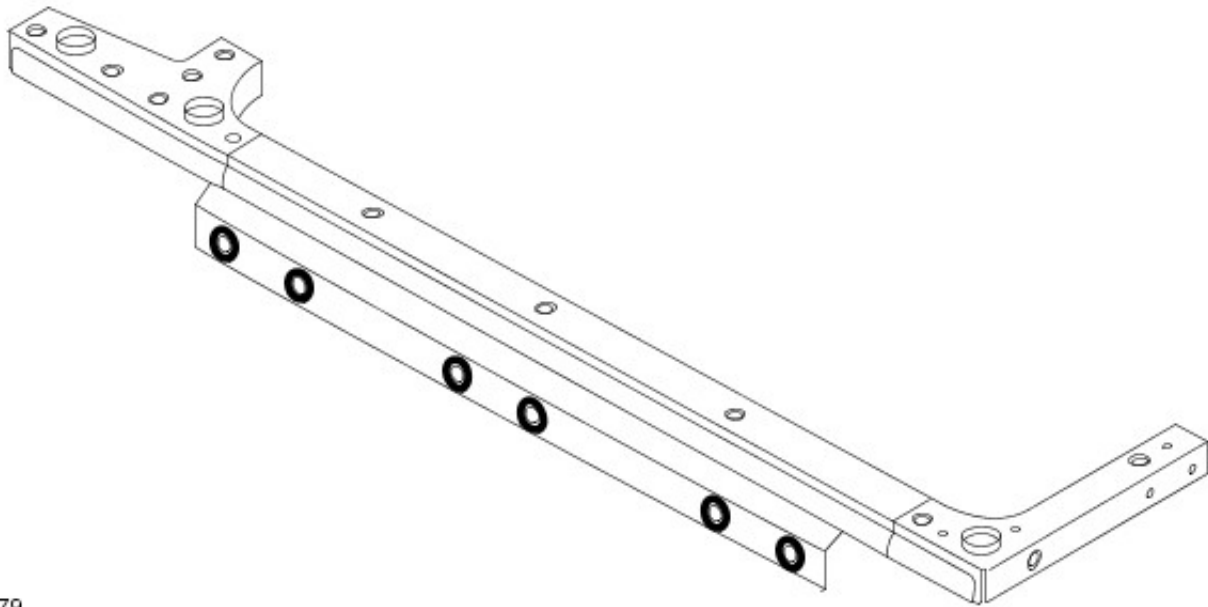
Metal-to-metal adhesive is applied to critical joint areas during factory assembly. The material used is a high-temperature, heat cured, nitrile phenolic which serves both to bond two metal surfaces and also to seal the joint against ingress of dust, water, petrol and fumes. This material is not suited for service use, and should be substituted in repair using a suitable medium strength adhesive.

When separating a joint treated with metal-to-metal adhesive, to avoid distortion it is recommended that the joint be gently heated until the bond weakens sufficiently to permit panel separation.

NOTE: DO NOT carry out MIG welding on a joint area which has been treated with metal-to-metal adhesive until all traces of adhesive have been removed.

The following Illustrations show the treatment areas for Structural Adhesive. All areas symmetrically opposite to those shown are also treated.

Body side capping



M772079

Structural adhesive applied around body side lower fixing holes

Seam sealers

A heat cured, PVC Plastisol sealer is applied to joint areas during factory assembly. This material is not suitable for service use.

Carry out seam sealing after the application of primer and before the surfacer and final paint coats. Ensure that surfaces are first cleaned of all grease and oil. Apply the sealer material to the joint as a bead, either by hand or using an applicator gun. Where necessary, brush sealer well into the joint and wipe smooth using a cloth soaked with solvent such as Shell SBP3. This will ensure an acceptable cosmetic finish.

Apply sealer to ALL accessible joints following repair work. Be aware that damage to a vehicle can often result in deflection to those areas of the body which are remote from the impact. The sealers in these areas can therefore be disturbed by subsequent straightening and repair operations. Check joints in the vicinity of the area undergoing repair for evidence of cracked sealer, clean them out as required and re-treat them with fresh sealer using the following procedure:

Where joints are inaccessible following the reassembly or fitment of components, ensure that a paste-type sealer is applied to such joints. Certain seams also become inaccessible after the completion of panel repairs. In such instances the paint process should be carried out and sealers applied before final assembly.

Provided access is adequate, apply the sealer to both sides of the repair joint. Where access is limited to one side only (e.g. box sections), inject the affected box member with cavity wax.

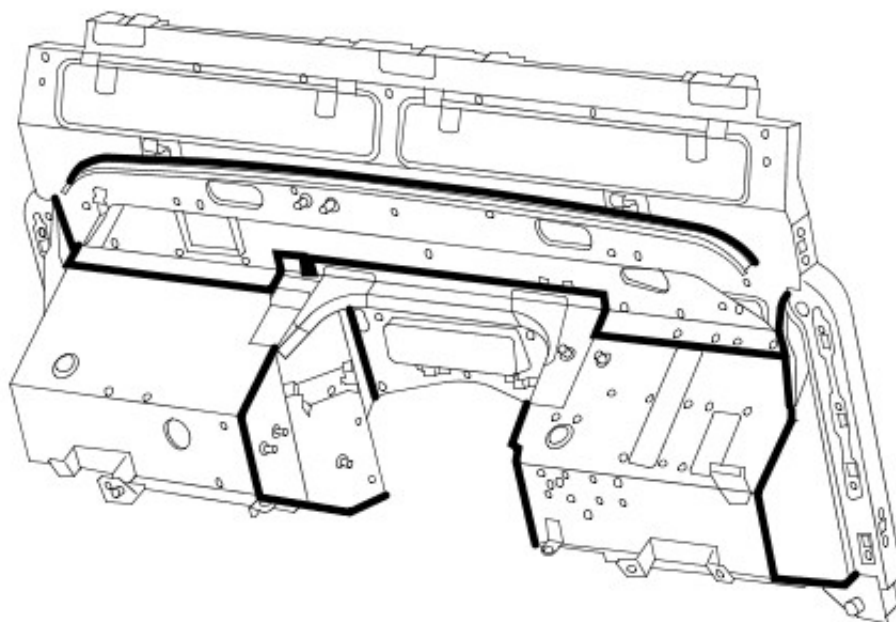


CAUTION: ALWAYS deploy an extractor unit to remove toxic fumes when using oxy-acetylene equipment to remove panels treated with wax and sealers.

The following Illustrations show the treatment areas for Seam Sealing.

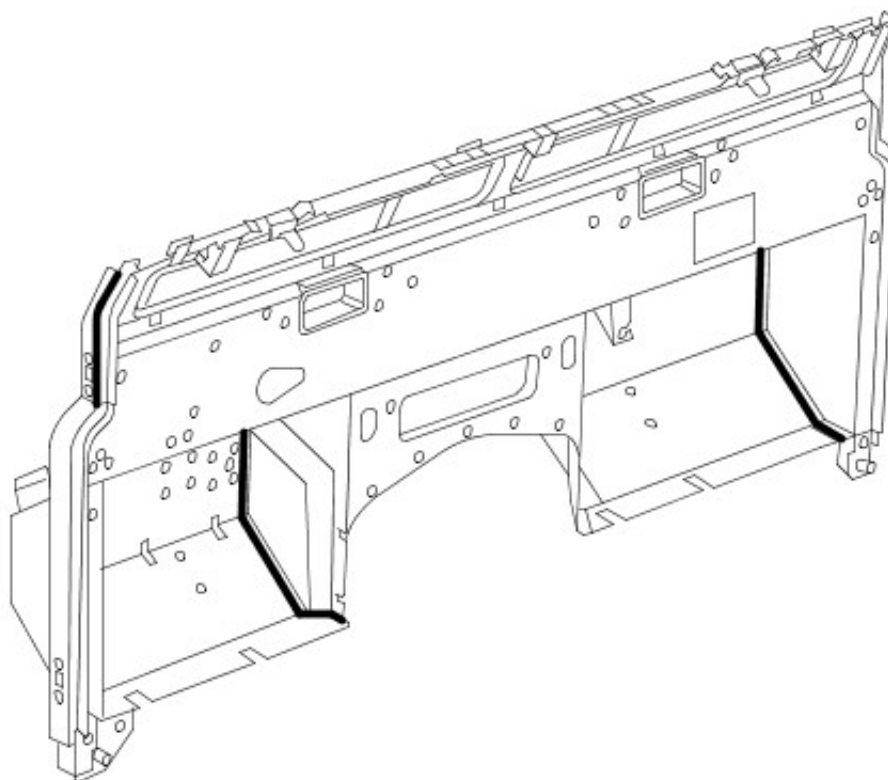
All areas symmetrically opposite to those shown are also treated.

Seam sealing on bulkhead assembly - front view



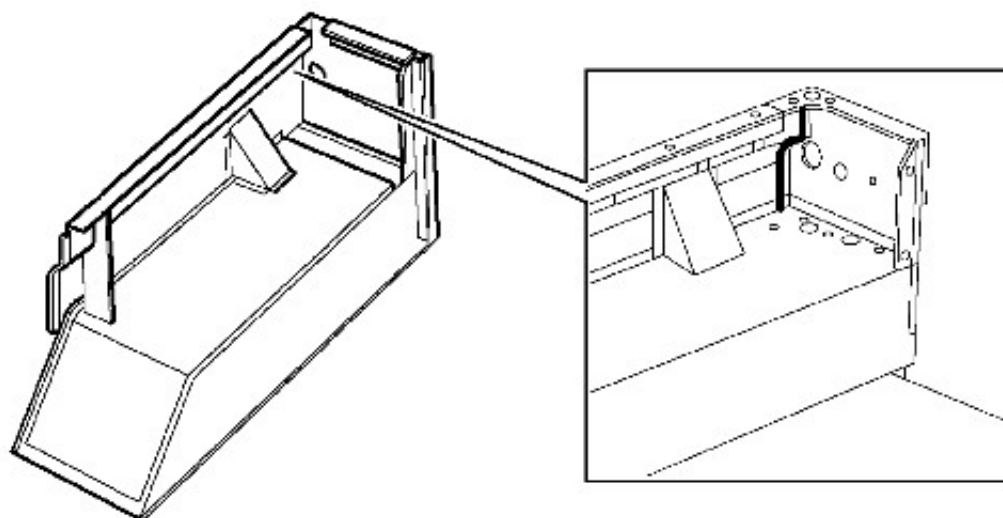
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Seam sealing on bulkhead assembly - rear view



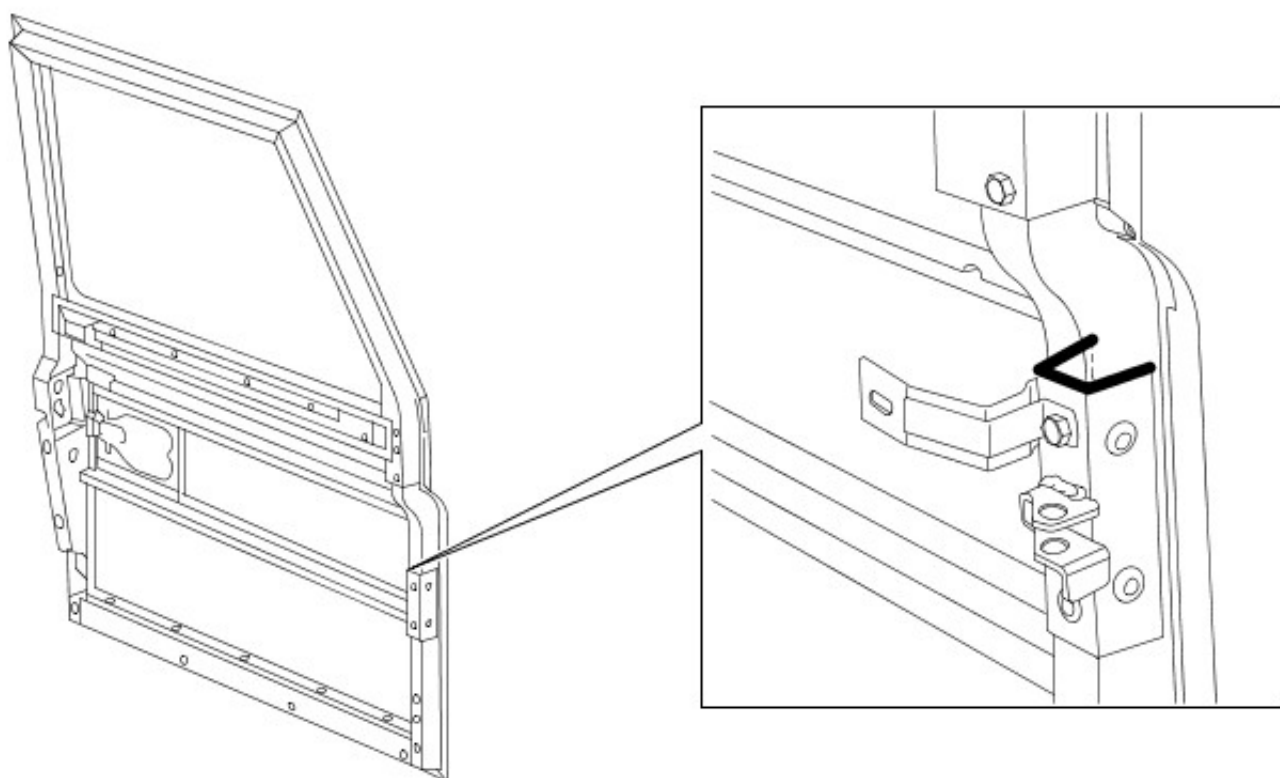
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Seam sealer on body side assembly



M772084A

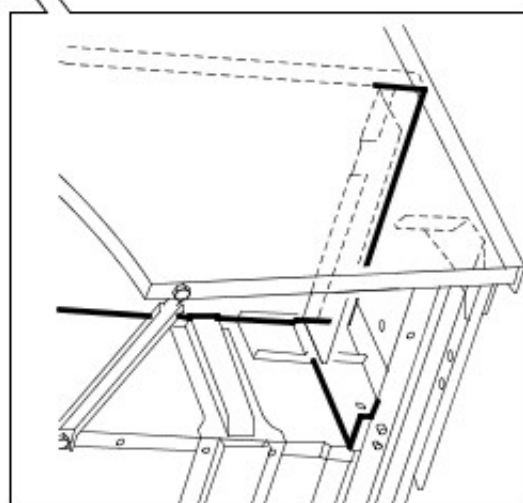
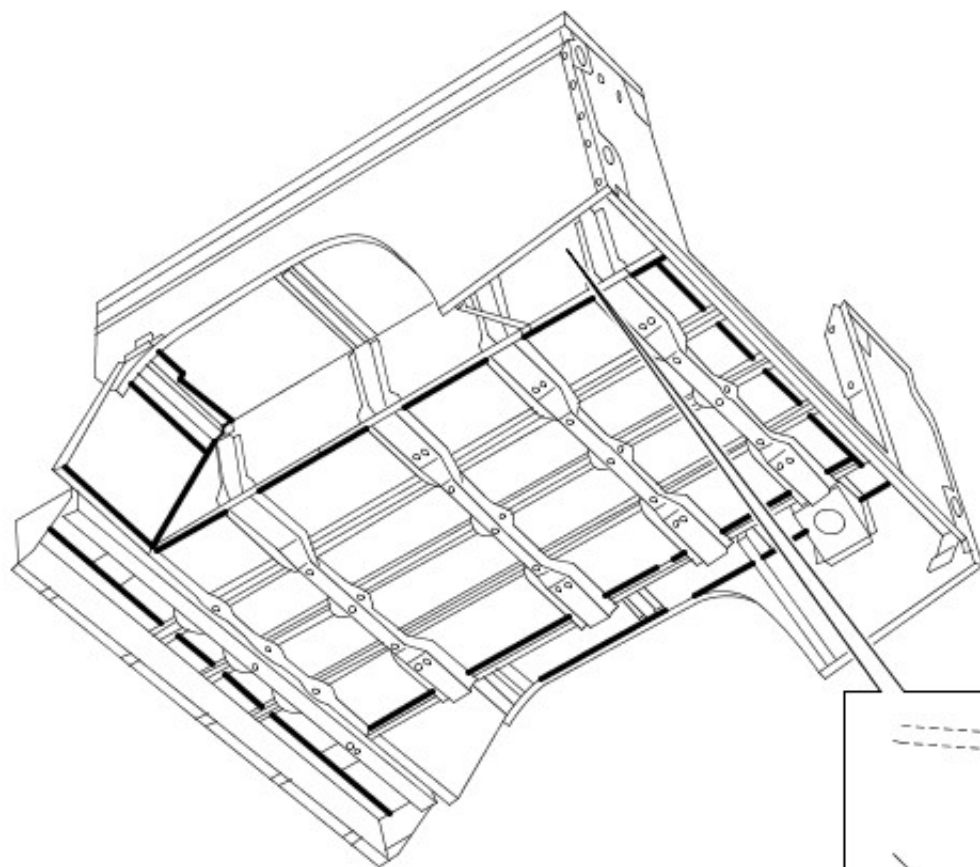
Seam sealer on front door




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NOTE: Seam sealer to be wiped after application for cosmetic purposes.

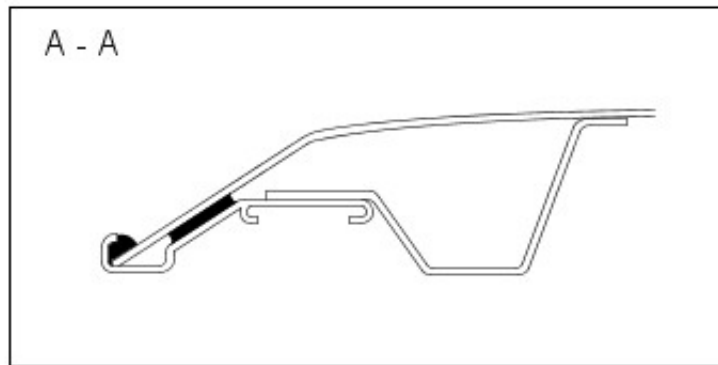
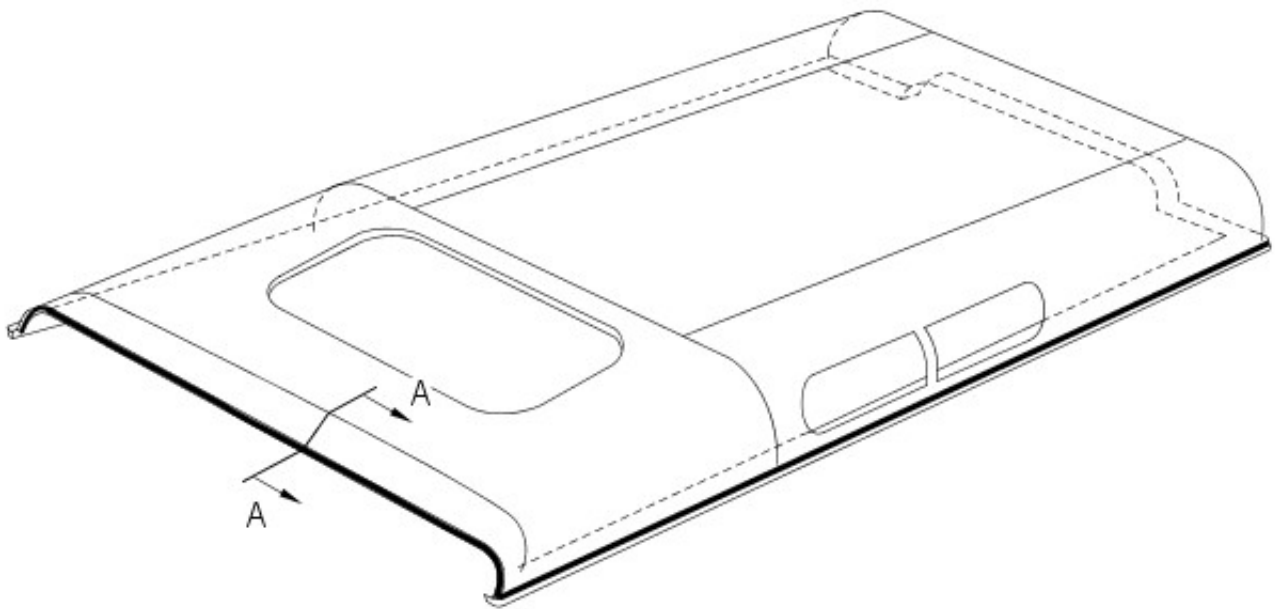
Seam sealer on rear end assembly



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 **CAUTION:** Do not block drain holes when applying seam sealer.

Seam sealer on roof assembly

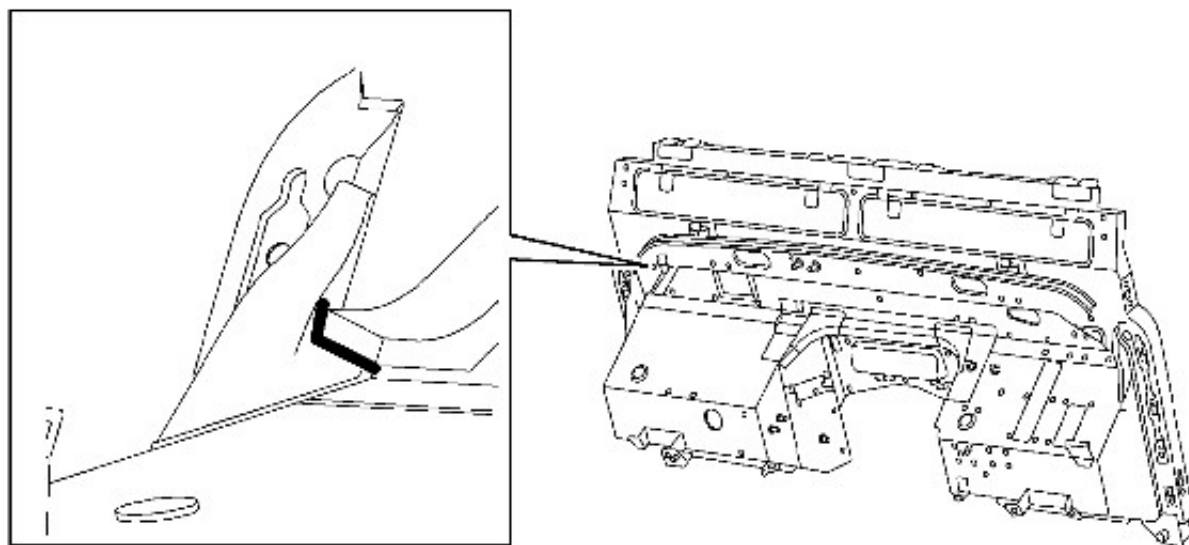


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Putty application areas

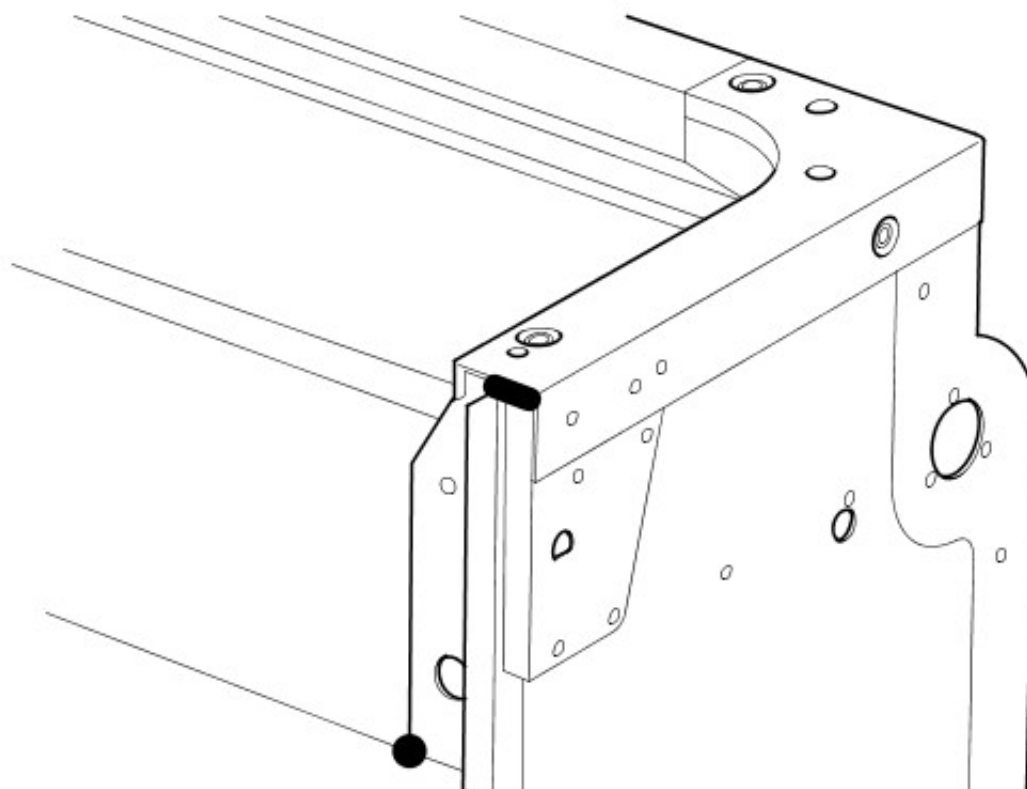
The following Illustrations show the treatment areas for Putty application. All areas symmetrically opposite to those shown are also treated.

Putty location on bulkhead assembly



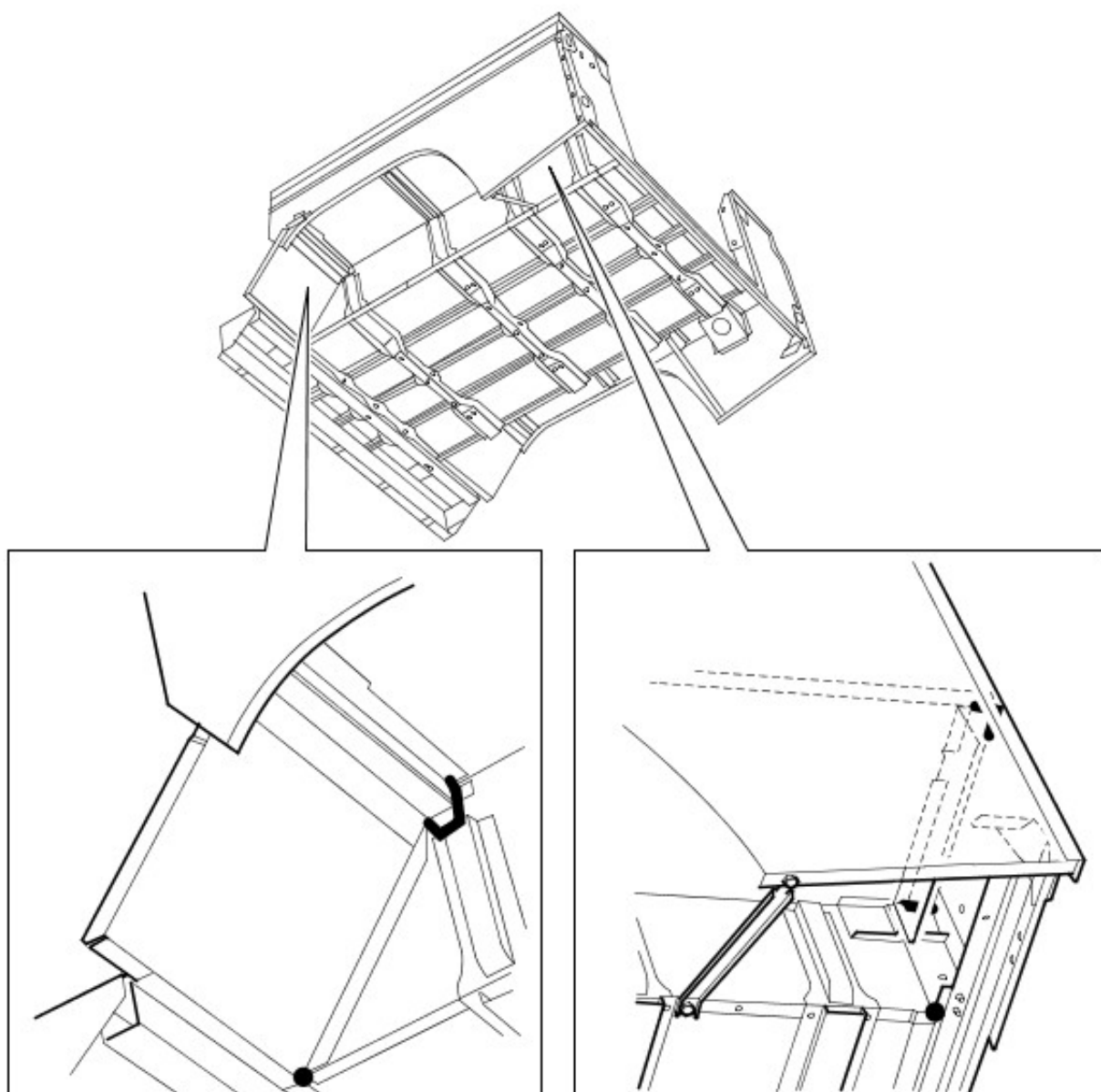
M772086A

Putty location on rear end



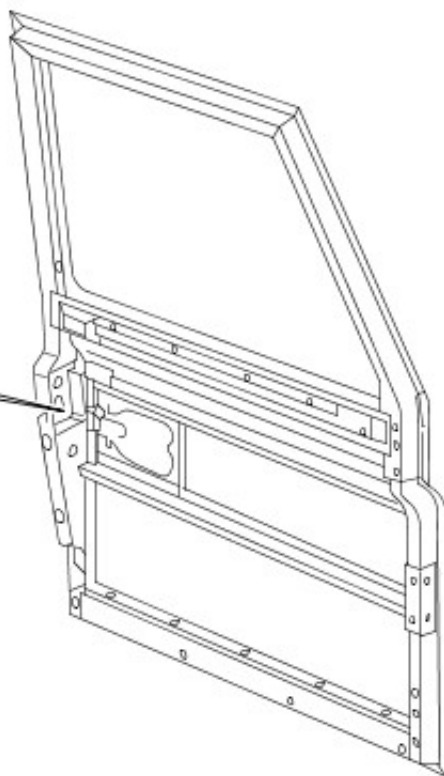
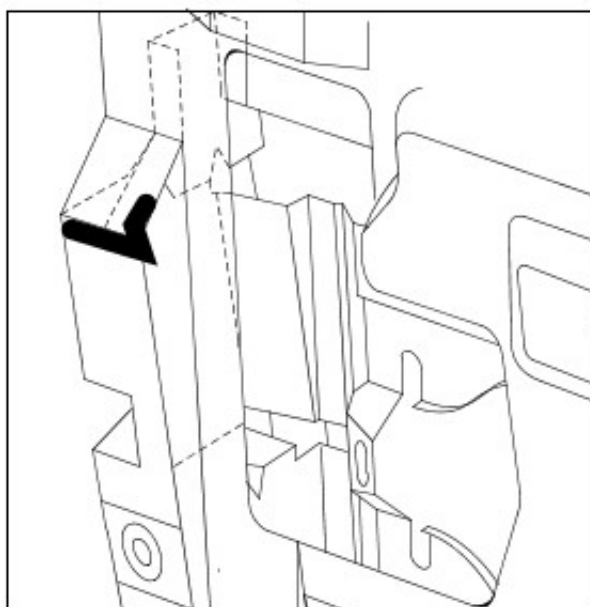
M772087A

Putty location on underside of vehicle



M772088A

Putty location on front door

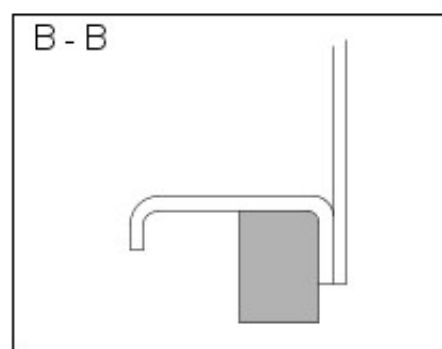
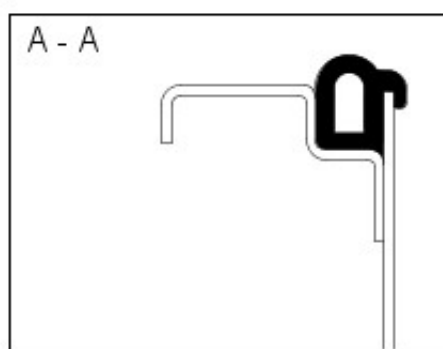
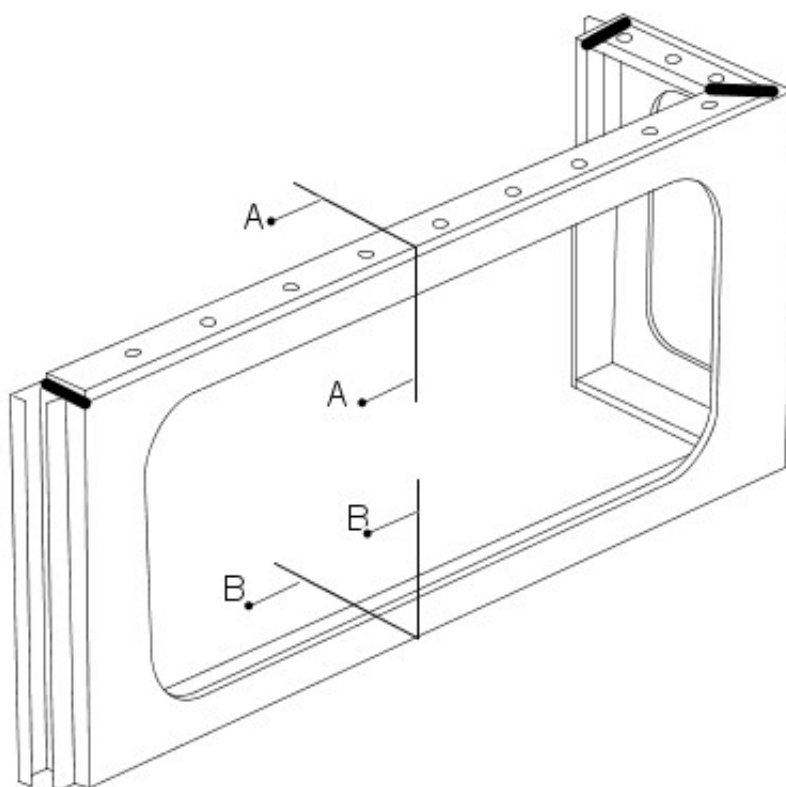


M772089A

Foam/rubber seal application areas


The following Illustrations show the location of foam/rubber seals. All areas All areas symmetrically opposite to those shown are also treated.

Body side rear



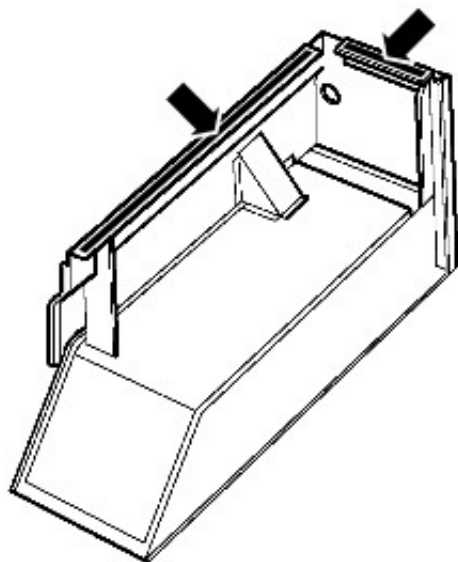
M772093A

Section A-A shows a rubber seal in position on the body side rear upper assembly.

 **CAUTION:** Ensure rubber seal is correctly seated into channel.

Section B-B shows a foam seal located on the bottom edge of the body side rear upper assembly. It is fixed to the panel using double sided tape.

Body side lower



M772080A

 **CAUTION:** Ensure seals are fitted before refitting assembly.

The arrows indicate the position of two foam seals.

Body Repairs - Water Leaks - Water Leak

Diagnosis and Testing

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

Water Leak Diagnostic Procedure

Introduction

This procedure has been developed to aid diagnosis and rectification of water ingress on Defender vehicles with the aim of providing a **right first time fix**.

The procedure provides suggested points of water ingress and guidelines for a recommended fix.

Prerequisites

It is assumed the technician working on the vehicle will be at least **level 3 trained** and normal vehicle service protection equipment will be used where appropriate i.e. seat covers, wing covers etc.

Water Leak Diagnosis

There are certain basic tools required for effective water leak detection the following are a few recommendations.

Basic tools
Hosepipe
Water supply
Pressure Washer
Watering Can
Torch
Mirror (telescopic type)
Air supply
Boning tool (Nylon shaped block for trim removal)

There are several adaptations of tools that can be used, for example a watering can rose attached to a hosepipe to create a spray, or a new sealant tube nozzle attached to a hosepipe can be very effective to direct water into awkward corners, there are also several ready made hosepipe nozzles available from DIY stores which can be switched through several different water patterns, and finally not forgetting a normal car wash. With the exception of a car wash initial diagnosis is more accurate if carried out by **two people**, one inside and one outside the vehicle, the person outside can direct the water onto the areas where the leak is suspected to be entering, and the person inside can inspect with a 12 volt hand lamp to confirm the entry point.

It is worth bearing in mind that the location that the water appears in the interior of the vehicle, may not be the leak source, **for example water lying in the passenger footwell could be entering on the drivers side and running across, behind the fascia**. In order to find the water entry point, trim or components may have to be removed.

Staining

Often when water has been entering over a period of time, the water entry point can be located visually by following the stains or tracks left by the leak.

Sealing Water Leaks

There are different substances that can be used to seal water leaks, putty type sealant and wet/paste sealant. Examples of these are bostic (dum-dum) "303 glasticon" and "betafill 10210" which is a white paste and "terostat 33" which is clear.

NOTE: Do not use silicon based sealers as these will cause problems if any subsequent paint operations are required.

Careful consideration needs be given as to the substance used to seal a water leak, for example an external seam on a white vehicle would require white or clear sealant, dum-dum is best used in concealed places to fill larger gaps. The sealant should be applied in a manner that it does not look unsightly when finished, if used in a box section or under a carpet, applying and smoothing over should be ok, but on the external panels or visible areas the sealant should be "wiped" into the gap and any excess removed with a suitable spirit that will not harm the vehicles paintwork

Once the water entry point has been confirmed, the suspect area must be sufficiently dried prior to the application of any sealing compound the use of a compressed air will assist

Symptom Chart

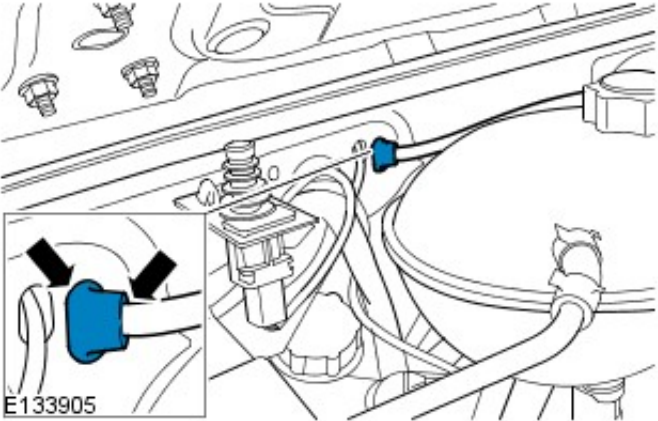
Water Ingress Paths And Recommended Repair Procedure

NOTE: Carry out a water leak test and visual inspection of any suspect or wet areas once the water entry point has been determined refer to the symptom chart below.

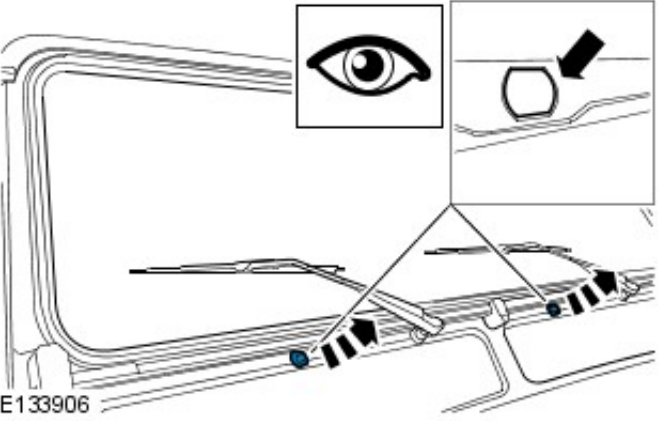
Symptom - Water Collecting	Possible Water Entry Points	Action - To Be Carried Out Once The Water Entry Point Has Been Confirmed
In footwell (entry point - front area)	<ul style="list-style-type: none"> • Heater cable grommet • Wiper grommet • Windscreen seal • Footwell seams • Floor seams • Hood release grommet • Pedal box grommet • Blower box • Air intake duct to blower join • Air intake • Clutch/brake pedal box • Windscreen surround frame 	<ul style="list-style-type: none"> • For heater cable grommet GO to Pinpoint Test A. • For wiper grommet GO to Pinpoint Test B. • For windscreen seal GO to Pinpoint Test C. • For footwell seams GO to Pinpoint Test D. • For floor seams GO to Pinpoint Test E. • For hood release grommet GO to Pinpoint Test F. • For pedal box grommet GO to Pinpoint Test G. • For blower box GO to Pinpoint Test I. • Air intake duct to blower join GO to Pinpoint Test H. • For air intake GO to Pinpoint Test J. • For clutch/brake pedal box GO to Pinpoint Test K. • For windscreen surround frame GO to Pinpoint Test L.
In footwell (entry point - front door area)	<ul style="list-style-type: none"> • Door seal • Water shedder • Door latch/door edge • Rear tub capping • Upper to lower body joint (waist side) • Roof to "A" post joint 	<ul style="list-style-type: none"> • For door seal GO to Pinpoint Test M. • For water shedder GO to Pinpoint Test N. • For door latch/door edge GO to Pinpoint Test O. • For rear tub capping GO to Pinpoint Test P. • For upper to lower body joint (waist side) GO to Pinpoint Test Q. • For roof to "A" post joint GO to Pinpoint Test R.
In footwell (entry point - rear door area)	<ul style="list-style-type: none"> • Door seal • Water shedder • Door latch/door edge • Rear tub capping • Upper to lower body joint (waist side) • Roof to upper body side joint 	<ul style="list-style-type: none"> • For door seal GO to Pinpoint Test M. • For water shedder GO to Pinpoint Test N. • For door latch/door edge GO to Pinpoint Test O. • For rear tub capping GO to Pinpoint Test P. • For upper to lower body joint (waist side)GO to Pinpoint Test Q. • For roof to upper body side joint GO to Pinpoint Test S.
In footwell (entry point - A post area)	<ul style="list-style-type: none"> • Door seal • Windscreen hinge • Main harness grommet • Air-con pipe grommet 	<ul style="list-style-type: none"> • For door seal GO to Pinpoint Test M. • For windscreen hinge GO to Pinpoint Test T. • For main harness grommet GO to Pinpoint Test U. • For air-con pipe grommet GO to Pinpoint Test V.
In rear luggage compartment/seating area (entry point - lower body side/rear)	<ul style="list-style-type: none"> • Rivets in body side • Tail lights/rear end capping 	<ul style="list-style-type: none"> • For rivets in body side GO to Pinpoint Test W. • For tail lights/rear end capping GO to Pinpoint Test X.
In rear luggage compartment/seating area (entry point - upper body side/rear)	<ul style="list-style-type: none"> • Corners of upper body quarter panels • Upper to lower body joint (waist rear) 	<ul style="list-style-type: none"> • Corners of upper body quarter panels GO to Pinpoint Test Y. • For waist seal rear (waist rear)GO to Pinpoint Test Z.
In rear luggage compartment/seating area (entry point - tail door)	<ul style="list-style-type: none"> • Rear end door • Upper to lower body joint 	<ul style="list-style-type: none"> • Rear end doorGO to Pinpoint Test AA. • For upper to lower body joint GO to Pinpoint Test Q.

	<ul style="list-style-type: none"> • Roof to upper body joint 	<ul style="list-style-type: none"> • For roof to upper body joint GO to Pinpoint Test S.
In rear luggage compartment/seating area (entry point - roof)	<ul style="list-style-type: none"> • Roof seam • Alpine light's (if installed) • Front corner seams • Drain channel crack 	<ul style="list-style-type: none"> • For roof seam GO to Pinpoint Test AB. • For alpine light's (if installed) GO to Pinpoint Test AC. • For front corner seams GO to Pinpoint Test AD. • For drain channel crack GO to Pinpoint Test AE.

PINPOINT TEST A : HEATER CABLE GROMMET

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: HEATER CABLE GROMMET	
	1 Apply sealant around the outer edge of the grommet and onto the grommet to cable joint
	2 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
	3 Remove excess sealant from the body area
	4 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST B : WINDSCREEN WIPER GROMMET

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: WINDSCREEN WIPER GROMMET	
	1 Remove the grommets, check the grommet and hole apertures for abnormalities/distortion. Apply sealant to the outer edge of the grommet and reinstall
	2 Remove excess sealant from the body area
	3 Materials required: sealant (clear or black), gloves, spirit wipe, cloth
	4 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle?

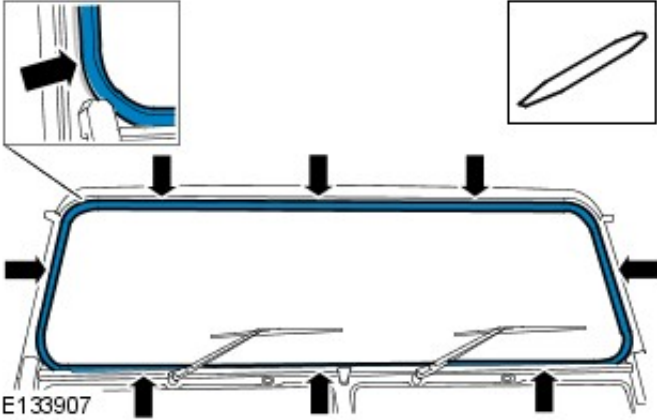
Yes

Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above

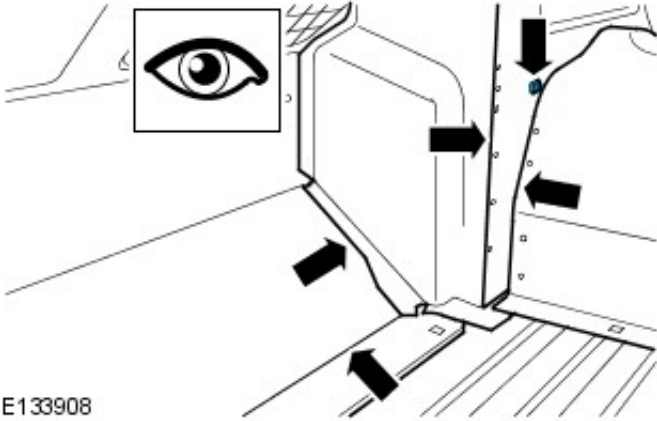
No

Reinstall any trim/panels or component that have been displaced

PINPOINT TEST C : WINDSCREEN SEAL

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: WINDSCREEN SEAL	
	1 Using a "boning" tool, lift the edge of windscreen seal and insert the sealant gun nozzle, apply a bead of sealant between the seal and outer frame
	2 Remove excess sealant from the body area
	3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth, "Boning" tool
	4 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST D : FOOTWELL SEAMS

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: FOOTWELL SEAMS	
	NOTE: A 12 volt hand lamp shone underneath the vehicle and viewed from the interior may assist in tracing leak paths
	1 Lift or remove floor mats/carpets. With the hood open carefully direct water from the top, down the scuttle panel and under the vehicle. There are several seams within the footwell, water entry may be from any or all of these, also visually check and seal, the grommets and apertures in the front of the tunnel area as required
	2 Run sealant along the seams and wipe into joint with a gloved hand. Grommets can be removed and sealant applied around the outer edge before reinstalling
	3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
	4 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle?

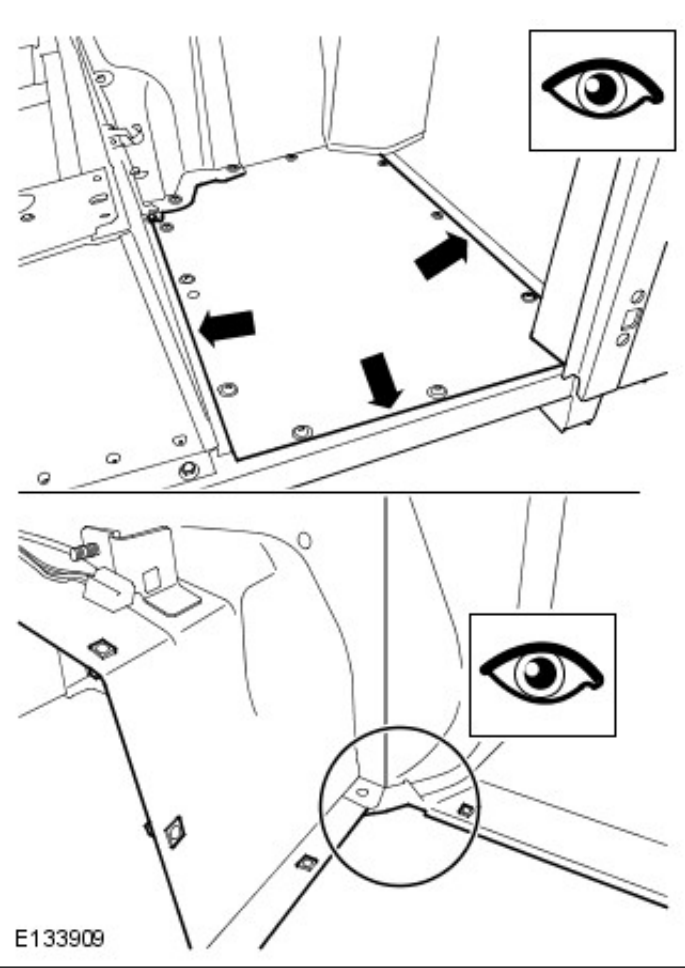
Yes

Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above

No

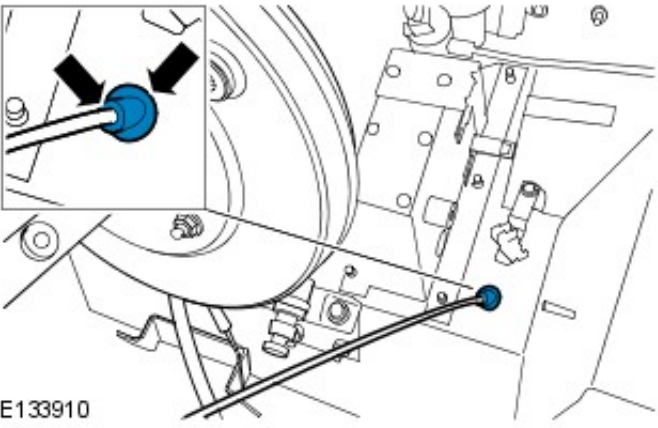
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST E : FLOOR SEAMS

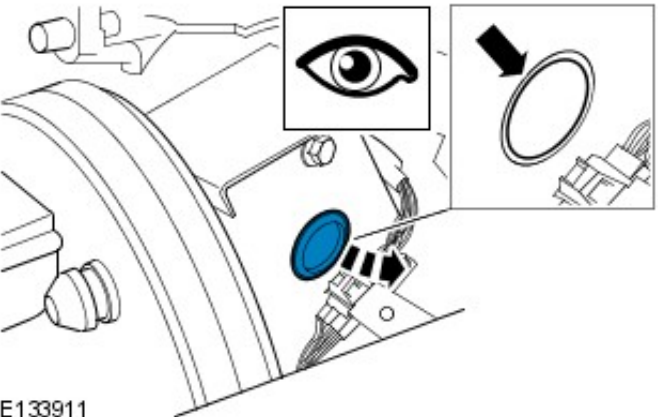
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: FLOOR SEAMS	
NOTE: The floor plate is secured using screws and a foam construction gasket	
 E133909	1 Lift or remove floor mats/carpets. With the hood open carefully direct water from the top, down the scuttle panel and under the vehicle
	2 Pay particular attention to the corners of the floor panel as there is an overlap condition where multiple panels meet, apply sealant and wipe it into the overlapping panel edges and corners this should prevent further water entry. Sealant can be added to the gasket of the removable floor plate as required
	3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
	4 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST F : HOOD RELEASE GROMMET

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: HOOD RELEASE GROMMET	
	1 Apply sealant around the outer edge of the grommet and onto the grommet to cable joint

 <p>E133910</p>	
	2 Remove excess sealant from the body area
	3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
	4 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>

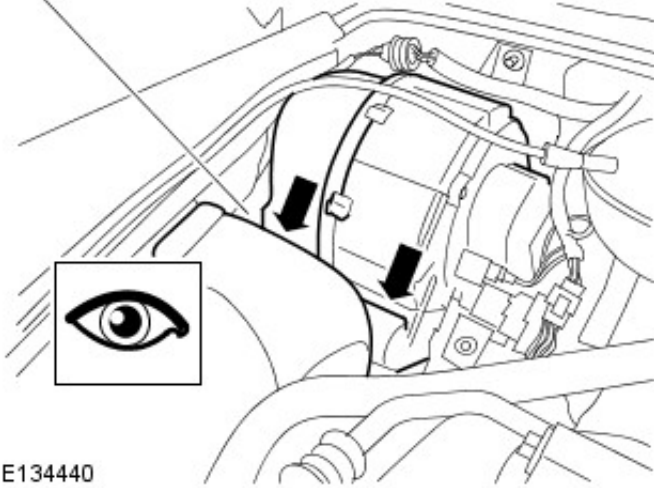
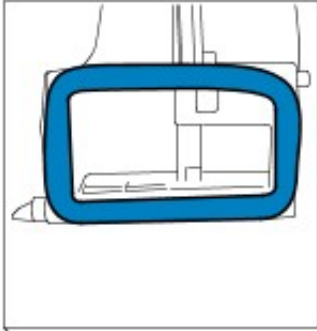
PINPOINT TEST G : PEDAL BOX GROMMET

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
G1: PEDAL BOX GROMMET	
 <p>E133911</p>	1 Remove the grommet and check both the grommet and hole aperture for abnormalities/distortion, apply sealant to the outer edge of the grommet and reinstall
	2 Remove excess sealant from the body area
	3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
	4 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>

PINPOINT TEST H : AIR INTAKE DUCT TO BLOWER

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
H1: AIR INTAKE DUCT TO BLOWER	
NOTE: The wing install process is to lower the wing into place along the face of the scuttle panel, this can displace the foam seal attached to the blower box	
	1 Check the condition and location of the foam gasket joint

between the air intake duct, and the blower box installed to the scuttle panel

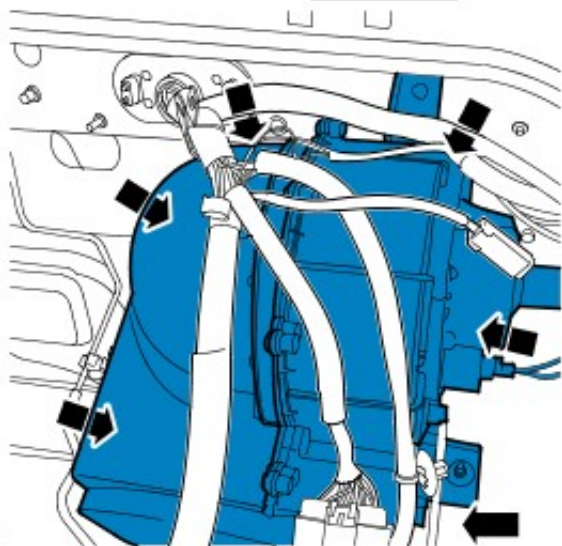
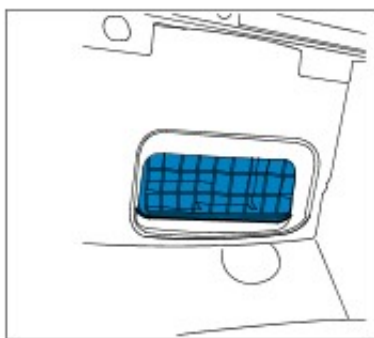


E134440

2	If possible apply sealant to the aperture with the wing installed
3	If it is not possible to seal the aperture with the wing installed, remove the wing to complete the repair
4	Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
5	Allow the sealant to cure, and retest suspect area for water entry
<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>	

PINPOINT TEST I : BLOWER BOX

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
I1: BLOWER BOX	
	<p>1 Direct water around the blower box, if a leak is found and it is possible to identify the particular area of the leak then sealant can be applied to the seam where the blower box sits on the bulkhead and wiped in if possible</p>

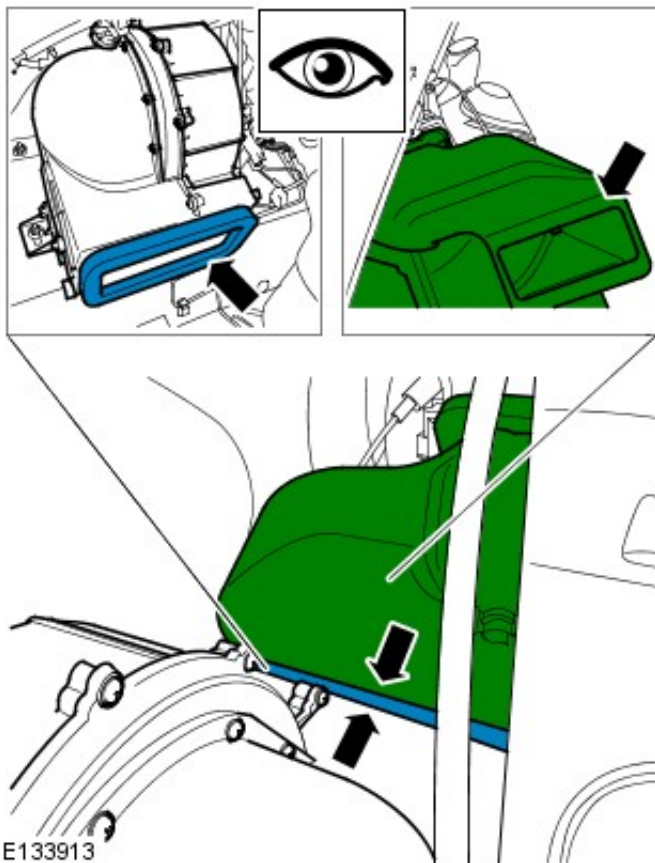


E133912

- 2** If it is not possible to highlight the actual area of the ingress the remove the blower box and check the integrity of the foam gasket, replace gasket as required, adding a fine bead of sealant to the gasket before carefully reinstalling to ensure a good seal
 - 3** On some 07 model year vehicles there may be water actually dripping through the blower box grille in the passenger footwell, this is caused by a problem with the sealing of the two halves of the blower box itself, and replacement of the blower box is recommended
 - 4** Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth, replacement gasket, blower box
 - 5** Allow the sealant to cure, and retest suspect area for water entry
- Is water still entering the vehicle?
- Yes**
Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above
- No**
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST J : AIR INTAKE

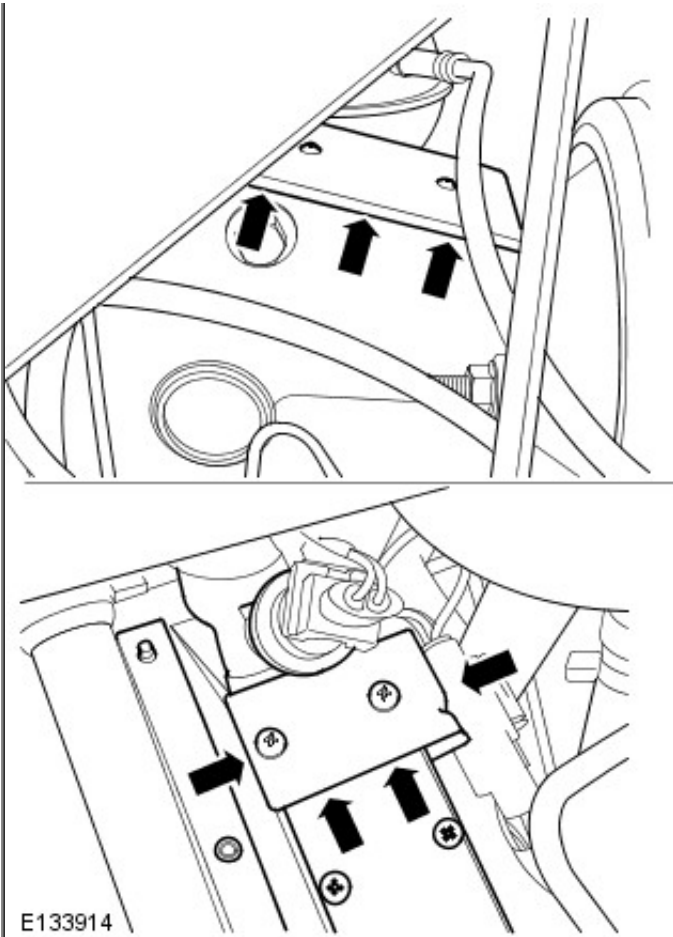
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
J1: AIR INTAKE	
	1 Ensure that the interfaces shown in Fig 1 and Fig 2 are correctly made, no ripples or damage. Fig 3 indicates the 2 faces when installed



- 2** For repairs to a minor water ingress issue, it may be possible to apply a bead of sealant to affected area and smooth in
 - 3** For removal and installation of the wing air duct (fig 1). Care must be taken to ensure a good mating interface between the duct and foam gasket on the blower
 - 4** Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth
 - 5** Allow the sealant to cure, and retest suspect area for water entry
- Is water still entering the vehicle?
- Yes**
Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above
- No**
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST K : CLUTCH/BRAKE PEDAL BOX

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
K1: CLUTCH/BRAKE PEDAL BOX	
	<ol style="list-style-type: none"> 1 Apply sealant around the pedal box seams, wipe sealant into seams



E133914

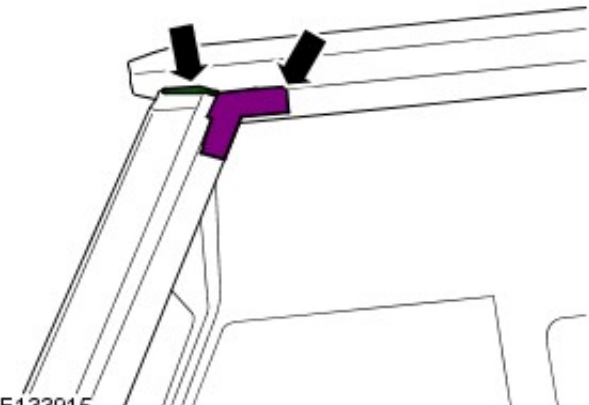
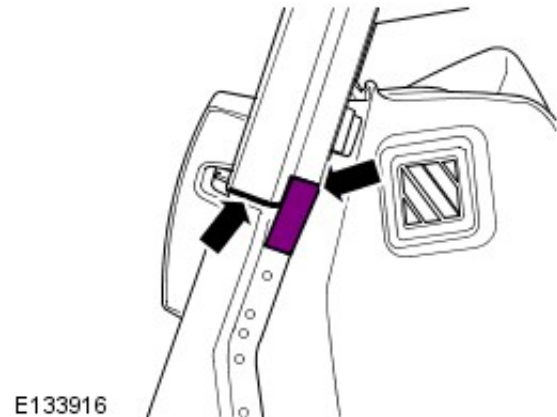
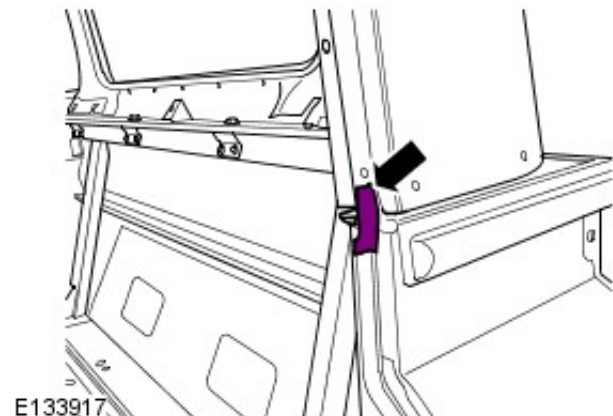
- 2 Remove excess sealant from the body area
 - 3 Materials required: sealant (clear or black), gloves, spirit wipe, cloth
 - 4 Allow the sealant to cure, and retest suspect area for water entry
- Is water still entering the vehicle?
- Yes**
Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above
- No**
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST L : WINDSCREEN SURROUND FRAME

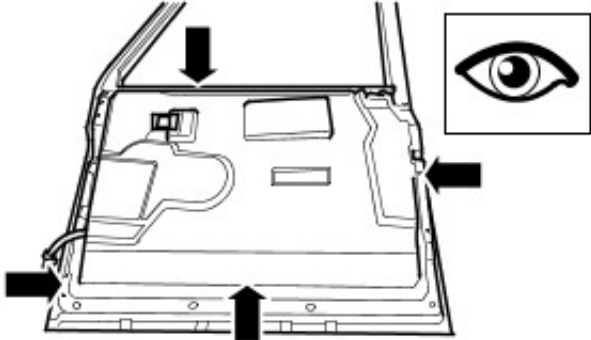
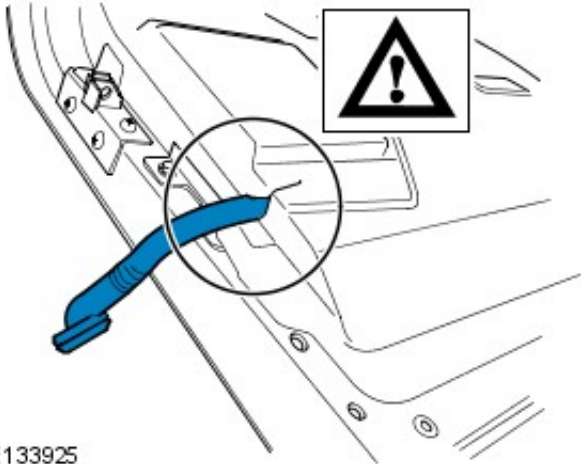
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
L1: WINDSCREEN SURROUND FRAME	
<p>E134933</p>	<ol style="list-style-type: none"> 1 Visually inspect the joint condition between the side casting and the centre extrusion for pinholes and cracks at the top and bottom on both sides
	<ol style="list-style-type: none"> 2 Apply sealant to the joint if pinholes and cracks 3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth 4 Remove excess sealant from the body area

	5 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

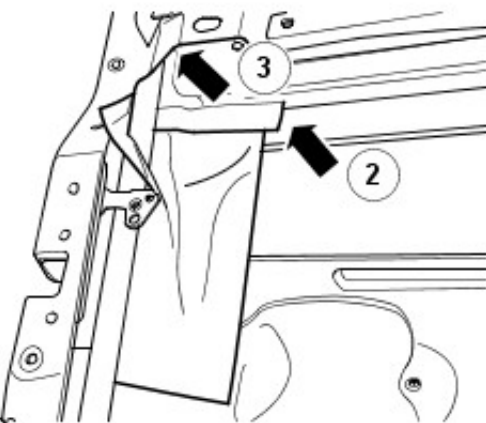
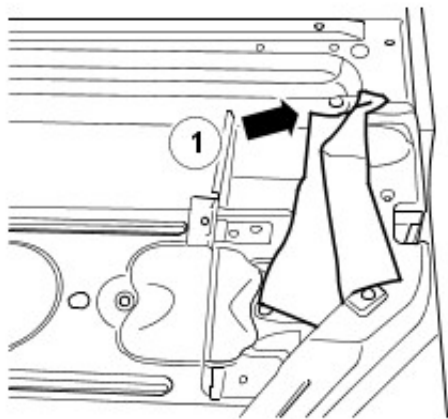
PINPOINT TEST M : DOOR APERTURE SEAL (PATCH'S)

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
M1: DOOR APERTURE SEAL (PATCH'S)	
 <p>E133915</p>	<p>1 Install the "L" shaped door joint patch ensuring the apex of the patch is aligned with the apex of the roof/A post joint. Once installed the patch should be free from creases/bubbles. Apply a thin bead of sealant approx 30 - 50mm long between roof and A post flange. Smooth sealant into flange area</p>
 <p>E133916</p>	<p>2 Install the door joint patch ensuring the patch is aligned with the flange. Patch should be free from creases/bubbles. Apply a thin bead of sealant approx 20 - 40mm long across the windscreen casting and scuttle panel joint flange. Apply sealant to the scuttle panel to windscreen casting joint to ensure a water tight seal. Smooth sealant into flange area</p>
 <p>E133917</p>	<p>3 Attach the door joint patch ensuring the patch is aligned with the flange. The patch should be free from creases/bubbles. Apply a thin bead of sealant approx 20 - 40mm long across the body side and lower body flange. Smooth sealant into flange area. Ensure there is no gap between the waist seal and the newly applied sealant</p>
	4 Remove excess sealant from the body area
	5 Materials required: sealant (clear/body coloured) door joint patch(s)
	6 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes

	<p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>
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PINPOINT TEST N : WATER SHEDDER	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
N1: WATER SHEDDER	
  E133925	<p>NOTE: Care Point – check that the drainage holes in the bottom of the door are not blocked with sealant/dirt or debris (if vehicle has been off road)</p> <p>1 Visual check all around edge of shedder, looking for areas of poor adhesion of the butyl sealant between the shedder and the door panel. Due to the complexity of the convoluted tube joint (circled) this is an area for careful inspection, as it a typical leak path. Repairs can be made by rolling or pressing the butyl seal to improve adhesion or by additional sealant / dum-dum in the localized area</p>
	2 Check the condition of the flip seal at the bottom of the door if damaged or misaligned may allow water ingress
	3 Materials required: "paint" roller, sealant, dum-dum
	4 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>

PINPOINT TEST O : DOOR LATCH/DOOR EDGE	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
O1: DOOR LATCH/DOOR EDGE	
NOTE: Water leak path is visible down the edge of the door and into the A post/footwell/sill area of the vehicle	
	<p>NOTE: Use of a mirror and torch will assist</p> <p>1 Remove the door casing. Remove the door shedder to gain access to the latch mechanism. Check along the top of the latch shedder for damage/poor adhesion (Fig 1)</p>

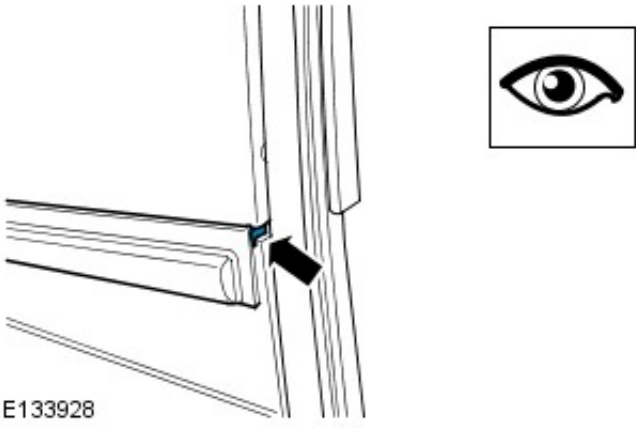


E133926

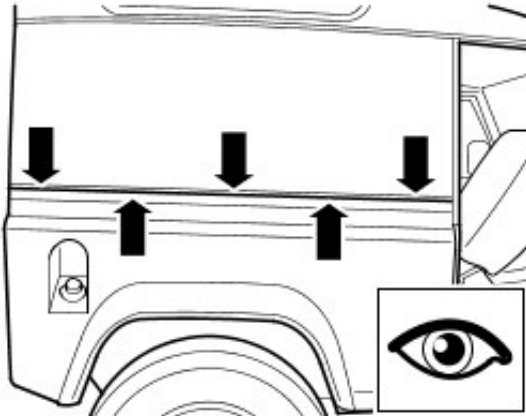
- 2 Apply sealant / dum-dum along the top of the latch shedder (fig 2)
 - 3 Apply sealant to the panel joints above the latch shedder but underneath the glass run channel (Fig 3)
 - 4 Materials required: sealant, dum-dum, tools (for door casing removal), **door shedder – must be replaced**
 - 5 Allow the sealant to cure, and retest suspect area for water entry
- Is water still entering the vehicle?
- Yes**
Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above
- No**
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST P : REAR TUB CAPPING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
P1: REAR TUB CAPPING	
NOTE: Whilst it is not necessary to remove the door aperture seal to complete this repair, care must be taken to ensure the repair seals any gaps up to and including the joint seal	
	<ol style="list-style-type: none"> 1 Apply small bead of sealant or dum-dum into the capping to body side joint (as arrow indicates)

 <p>E133928</p>	
	2 Critical visual area = high quality of sealant finish required
	3 Materials required: sealant, dum-dum
	4 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>

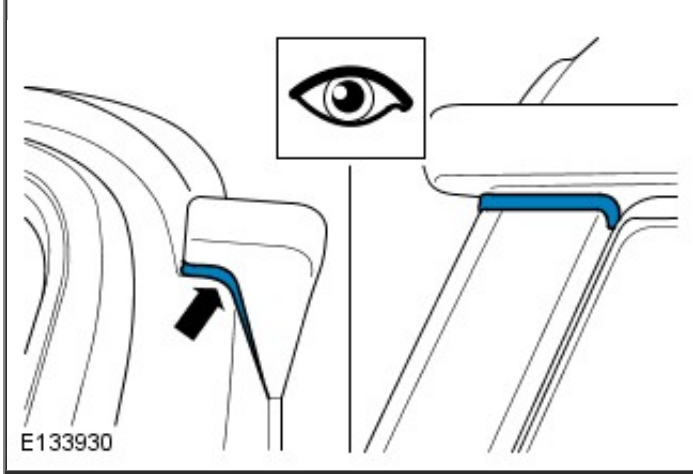
PINPOINT TEST Q : UPPER TO LOWER BODY JOINT (WAIST SIDE)

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1: UPPER TO LOWER BODY JOINT (WAIST SIDE)	
NOTE: The seal between the upper and lower body (waist seal) is made from a type of memory foam, the latest seal is in three sections which lock together, the seal is stuck to the upper body side but is not stuck to the rear tub	
NOTE: A key area to inspect is the welded joint of the lower body capping. Sometimes the seal can be slightly inboard of the joint leaving a small cavity, by slackening off all the fixings of the body side it is possible with a plastic tool to push the seal back outwards closing the cavity. If it is a small cavity it is possible to seal the cavity with a small amount of sealant wiped into the cavity and any excess cleaned off, if the vehicle is a model that is trimmed inside then the cavity can also be sealed from the inside, a larger amount of sealant may be used if it will be hidden in normal usage by the interior trim	
NOTE: Should the seal itself require replacement the upper body side can be removed without removing the roof panel itself by removing the upper and lower fixings and slackening the front and rear fixings, the roof panel can then be supported using a temporary support whilst the upper body side is removed to facilitate the seal change	
 <p>E133929</p>	1 Care must be taken to ensure that the seal between the roof and upper body side is not compromised, and the seal across the front between the windscreen surround and the roof is still correct after installation
	2 Materials required: sealant (clear or black), gloves, spirit wipe, cloth, tools, seals as required
	3 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p>

No

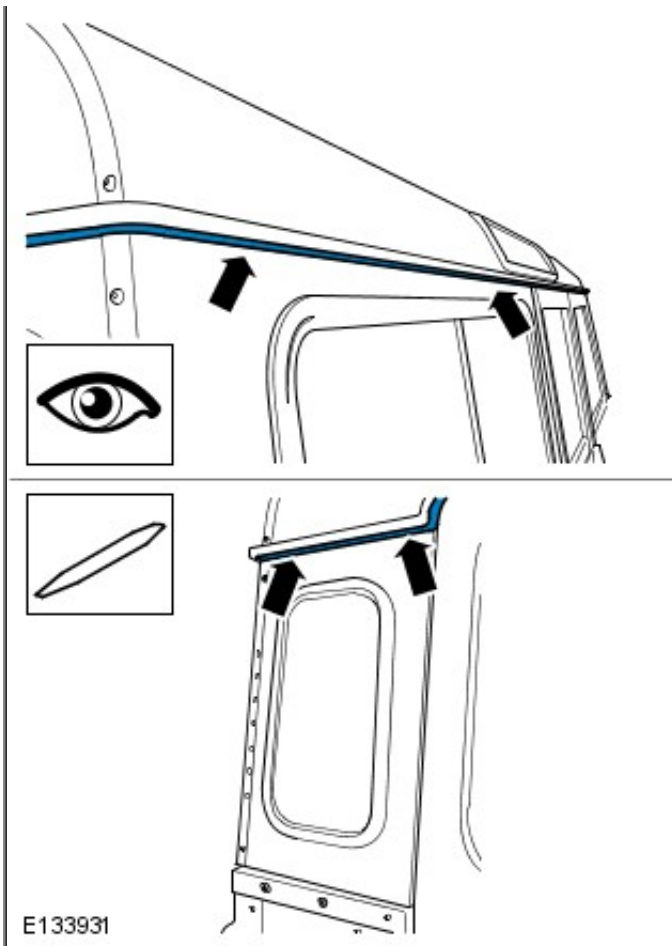
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST R : ROOF TO "A" POST JOINT

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
R1: ROOF TO "A" POST JOINT	
NOTE: On some vehicles the gap at the top of the roof is filled with "dum-dum" on later vehicles this was changed to black, repair with original material	
	1 Fill any gaps with sealant or dum-dum and wipe off excess
	2 For leaks above this area refer to (front corner seams) GO to Pinpoint Test AD. or (Drain Channel Seal) GO to Pinpoint Test AE.
	3 Materials required: sealant (black or white as appropriate) or dum-dum (black), gloves
	4 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST S : ROOF TO UPPER BODY GASKET

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
S1: ROOF TO UPPER BODY GASKET	
NOTE: Visually inspect the roof area to ensure that the gasket is installed / seated correctly. Check for lumps / ripples or trapped conditions, as these are the probable cause of the water ingress	
	1 Undo/slacken the fixing bolts on the inside of the roof (as required lower the headlining to access the fixings on some derivatives). Working outside of the vehicle, using a non metallic tool (boning tool) prize out the gasket to ensure correct fit. Re-tighten the roof



E133931

2 It is not usually necessary to use sealant in this repair however if the gasket appears to require additional sealing medium, a small run of sealant is acceptable. Care should be taken not to distort the gasket when applying the sealant

3 Materials required: boning tool, tools, sealant

4 Allow the sealant to cure, and retest suspect area for water entry

Is water still entering the vehicle?

Yes

Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above

No

Reinstall any trim/panels or component that have been displaced

PINPOINT TEST T : WINDSCREEN HINGE

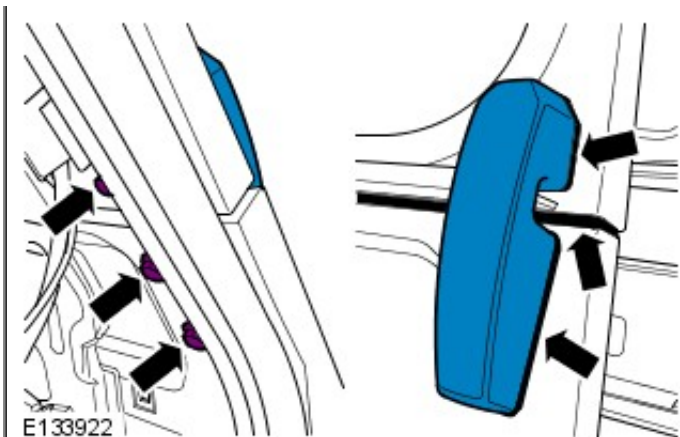
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
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T1: WINDSCREEN HINGE

NOTE: For pre-2009MY vehicles or if there was a significant leak around this area, it may be pertinent to apply sealant along the scuttle panel to windscreen casting join prior to reinstalling the hinge

NOTE: Critical visual area = high quality of sealant finish required

1 From inside the vehicle undo the 3 fixings that hold the windscreen hinge in place. Remove the hinge from the vehicle. Remove the existing gasket and any residue of adhesives or sealant. Re-fit the hinge gasket. Apply a small amount of sealant around each fixing hole



E133922

- 2** Materials required: sealant, windscreen hinge gasket
- 3** Allow the sealant to cure, and retest suspect area for water entry
- Is water still entering the vehicle?
- Yes**
Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above
- No**
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST U : MAIN HARNESS GROMMET

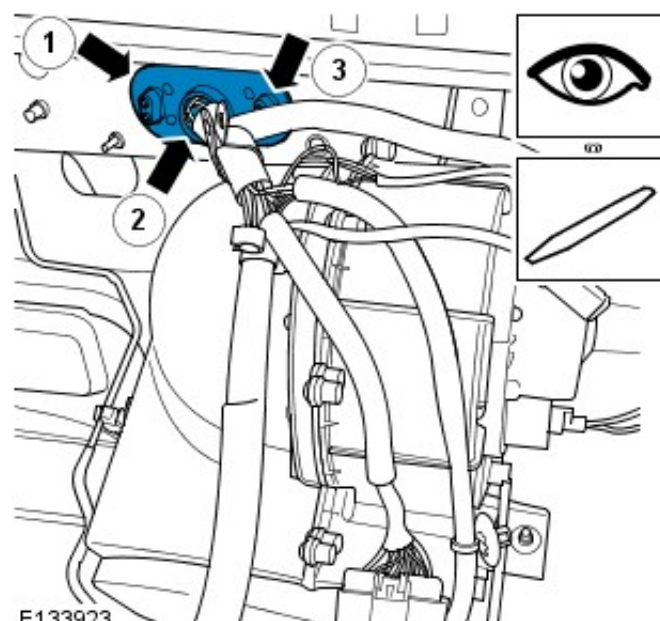
TEST CONDITIONS

DETAILS/RESULTS/ACTIONS

U1: MAIN HARNESS GROMMET

NOTE: Visually inspect the grommet looking for areas of poor seating

NOTE: Inspect the "U" channel to skuttle panel for distortion between spot welds allowing water to seep onto the grommet

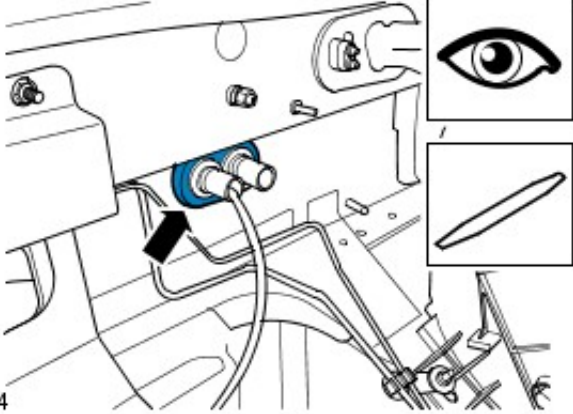


E133923

- 1** Use a boning tool to re-seat the grommet. Additional sealant should be applied around the outer edges of the grommet and the body panel
- 2** On occasions it maybe necessary to seal the main harness collar in addition to outer grommet. This will be evident during re-test
- 3** Materials required: sealant, boning tool
- 4** Allow the sealant to cure, and retest suspect area for water entry
- Is water still entering the vehicle?
- Yes**
Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above
- No**

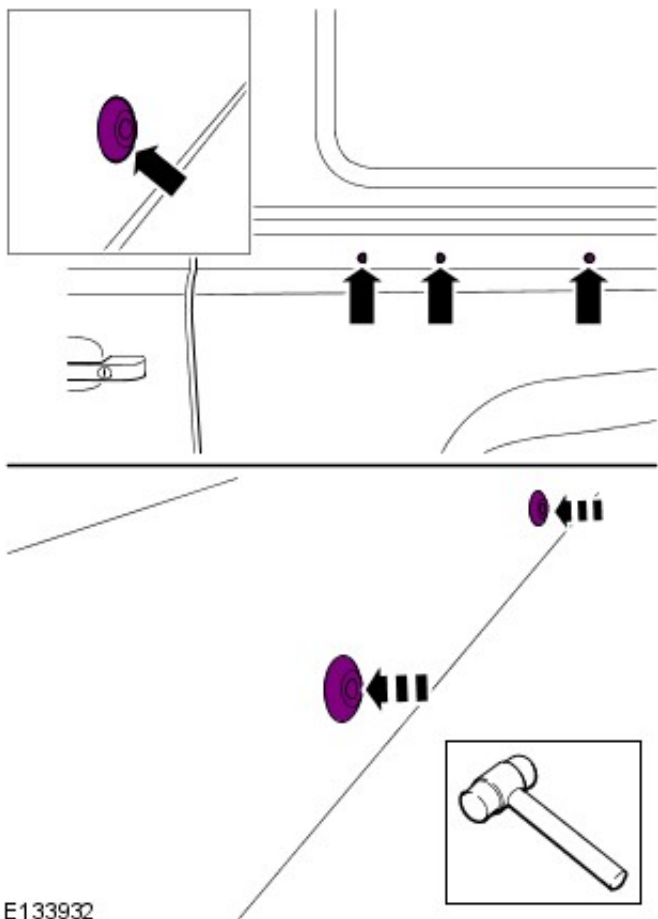
Reinstall any trim/panels or component that have been displaced

PINPOINT TEST V : AIR CONDITIONING PIPE GROMMET

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
V1: AIR CONDITIONING PIPE GROMMET	
NOTE: Visual inspect around grommet looking for areas of poor seating	
 E133924	1 Use a boning tool to re-seat the grommet. Additional sealant should be applied around the outer edges of the grommet and the body panel
	2 Materials required: sealant, boning tool
	3 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST W : RIVETS IN BODY SIDE

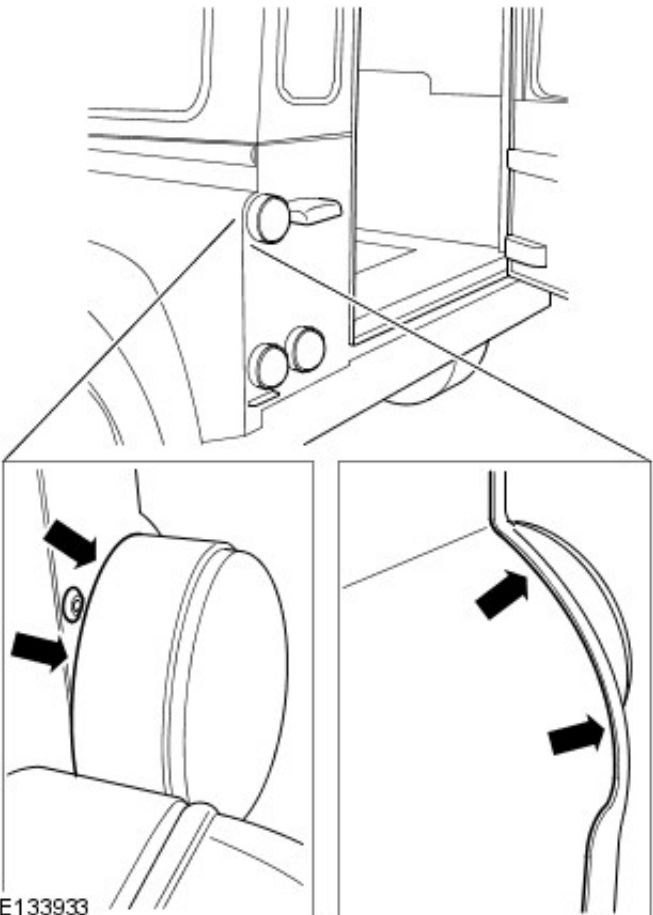
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
W1: RIVETS IN BODY SIDE	
	1 Apply sealant around the rivet and wipe excess away with spirit wipe, the rivet can also be tightened by tapping lightly with a mallet and a nylon block

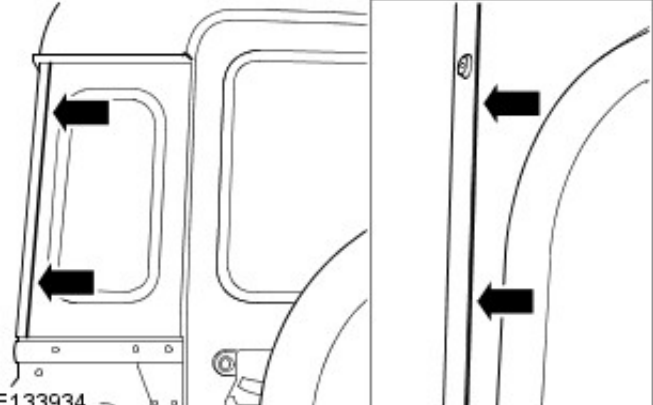


E133932

<p>2 If leak is still present the rivet should be drilled and replaced, and then painted with a touch up stick</p>
<p>3 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth, hammer, nylon block, rivet, rivet gun, touch up stick</p>
<p>4 Allow the sealant to cure, and retest suspect area for water entry</p>
<p>Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced</p>

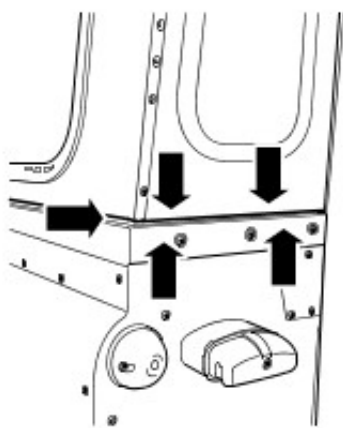
PINPOINT TEST X : TAIL LIGHTS/REAR END CAPPING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p>X1: TAIL LIGHTS/REAR END CAPPING</p>	<p>1 To seal the rear seam, squeeze sealant into the seam then smooth into the gap, wipe sealant into the joint then clean away an excess sealant with a spirit dampened cloth</p>

 <p>E133933</p>	
	2 To seal the rear lamp remove rear lamp and apply sealant around circumference of lamp base, re fit and wipe away any excess sealant
	3 Materials required: sealant (clear/body coloured), gloves, spirit wipe cloth
	4 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes</p> <p>Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No</p> <p>Reinstall any trim/panels or component that have been displaced</p>

PINPOINT TEST Y : CORNERS OF UPPER BODY QUARTER PANELS	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
Y1: CORNERS OF UPPER BODY QUARTER PANELS	
 <p>E133934</p>	1 Squeeze sealant into seam then smooth into gap, wipe away an excess sealant
	2 Materials required: sealant (clear/body coloured), gloves, spirit wipe, cloth

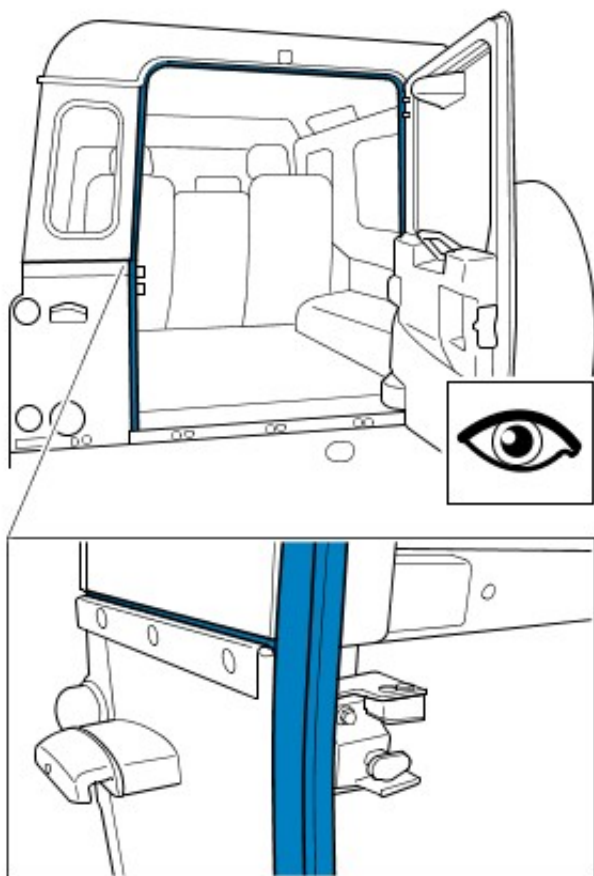
	3 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST Z : UPPER TO LOWER BODY JOINT (WAIST REAR)

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
Z1: UPPER TO LOWER BODY JOINT (WAIST REAR)	
NOTE: The seal between the upper and lower body (waist seal) is made from a type of memory foam, the latest seal is in three sections which lock together, the seal is stuck to the upper body side but is not stuck to the rear tub	
NOTE: Sometimes the seal can be slightly inboard of the joint leaving a small cavity, by slackening off all the fixings of the body side it is possible with a plastic tool to push the seal back outwards closing the cavity. If it is a small cavity it is possible to seal the cavity with a small amount of sealant wiped into the cavity and any excess cleaned off, if the vehicle is a model that is trimmed inside then the cavity can also be sealed from the inside, a larger amount of sealant may be used if it will be hidden in normal usage by the interior trim	
NOTE: Should the seal itself require replacement the upper body side can be removed without removing the roof panel itself by removing the upper and lower fixings and slackening the front and rear fixings, the roof panel can then be supported using a temporary support whilst the upper body side is removed to facilitate the seal change	
 <p>E133935</p>	1 Care must be taken to ensure that the seal between the roof and upper body side is not compromised, and the seal across the front between the windscreen surround and the roof is still correctly located
	2 Materials required: sealant (clear or black), gloves, spirit wipe cloth, tools for removal as required, seals as required
	3 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST AA : REAR END DOOR

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
AA1: REAR END DOOR	
	NOTE: Due to the location of the spare wheel, the rear end door may become miss-aligned to the body due to fixing torque relaxation. Check/set the torque of the fixing to 22 newton metres (plus or minus 3 newton metres)
	1 Check the profile and set/alignment of rear end door, adjust as required

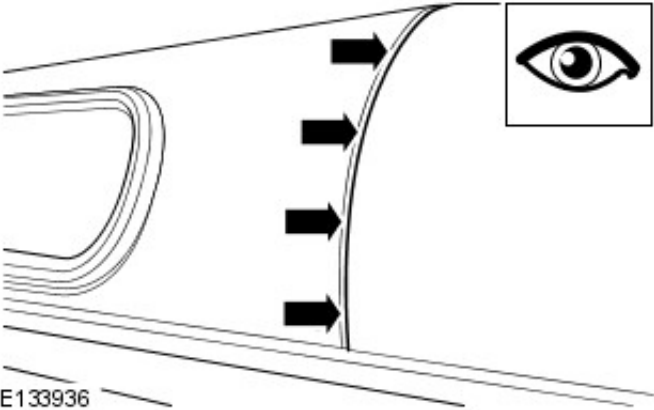


E134439

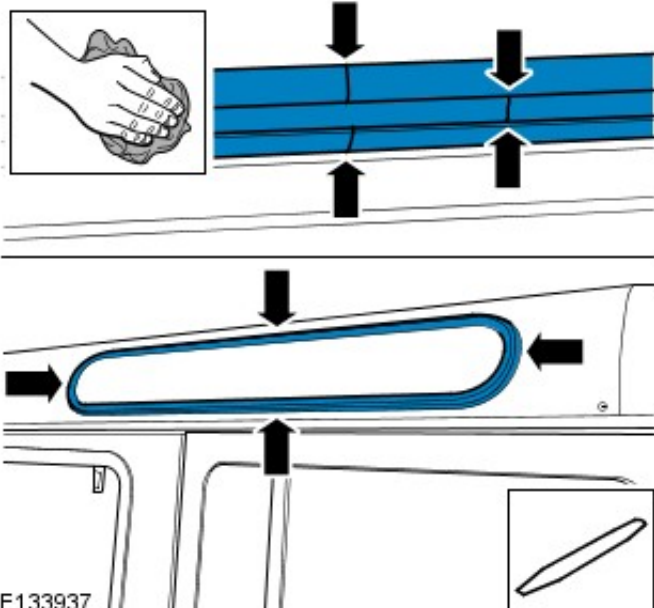
	2 Check the aperture seal bubble section for splits due to door misalignment
	3 Check condition, location and security of aperture seal replace as required
	4 At the waist join, check for patches and sealant quality (See waist seal instructions above)
	5 Materials required: Aperture seal (replace as required), sealant (clear/body coloured), gloves, spirit wipe cloth, touch up stick
	6 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST AB : ROOF SEAM

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
AB1: ROOF SEAM	
NOTE: High visibility area excess sealant must be wiped away leaving no residue or evidence of repair	
	1 Visual inspect the entire roof seam looking for irregularities in the flange edge condition. Check for gaps between the panels and panel joint conditions. Apply sealant as required

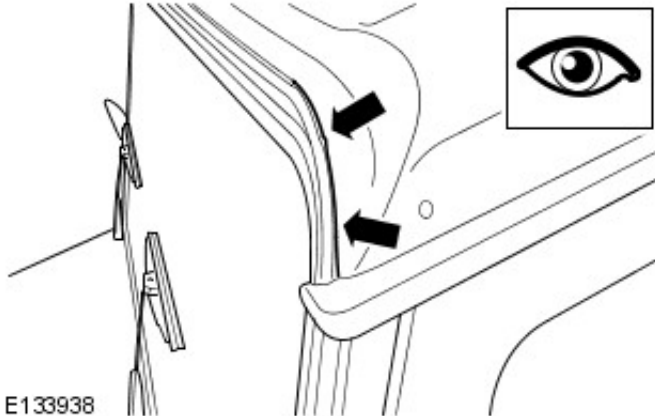
 <p>E133936</p>	
	2 Materials required: sealant (body coloured preferred or clear), cloth, spirit wipe, gloves
	3 Allow the sealant to cure, and retest suspect area for water entry
	<p>Is water still entering the vehicle?</p> <p>Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above</p> <p>No Reinstall any trim/panels or component that have been displaced</p>

PINPOINT TEST AC : ALPINE LIGHTS

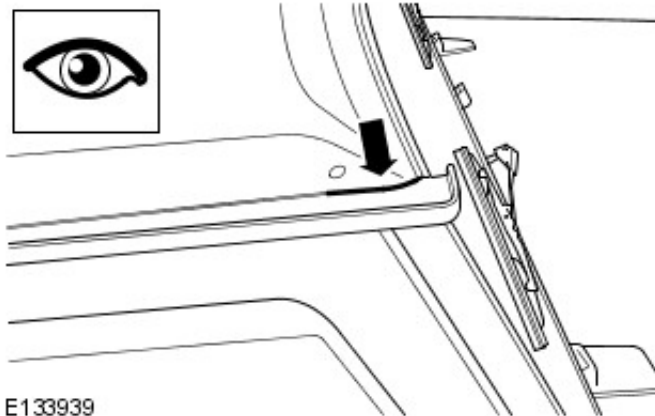
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
AC1: ALPINE LIGHTS	
NOTE: High visibility area excess sealant must be wiped away leaving no residue or evidence of repair	
 <p>E133937</p>	<p>1 Gasket joint leaks - Using black sealant, seal between the joint edges of the gasket</p>
	<p>2 Gasket to roof leaks - Due to the design of the gasket seal this is a very rare leak path. The leak is probably caused by deformation to the gasket which should be evident by visual check. The gasket should be re-seated and re-tested prior to completing this repair. Using the boning tool carefully lift the outer edge of the gasket seal. Working around the alpine light, lift and apply sealant between the gasket and the roof panel. Care must be taken to ensure that the roof is not damaged or scratched whilst sealing the alpine light</p>
	<p>3 For leaks through the centre (lace section) apply sealant between the joint and wipe away an excess sealant</p>
	<p>4 Materials required: sealant (clear/black), boning tool, cloths, spirit wipe, gloves</p>

	5 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST AD : FRONT CORNER SEAMS

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
AD1: FRONT CORNER SEAMS	
NOTE: Arrow indicates the usual area for front roof cracks (wisp cracks)	
NOTE: Care point – it may be necessary to touch up the paint work using a paint touch up stick	
 <p>The diagram shows a side view of a vehicle's front corner where the roof meets the side panel. A black arrow points to a crack in the roof's paint/sealant. An inset image shows an eye icon, indicating a visual inspection point. The diagram is labeled E133938.</p>	1 Apply sealant into the cracked area then remove excess sealant
	2 Materials required: sealant (clear/body coloured) cloth, spirit wipe, gloves, paint
	3 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

PINPOINT TEST AE : DRAIN CHANNEL SEAL

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
AE1: DRAIN CHANNEL SEAL	
NOTE: Before any repairs take place ensure that the issue is not caused by an incorrectly installed or non approved roof rack	
 <p>The diagram shows a close-up of a vehicle's drain channel. A black arrow points to a crack in the sealant. An inset image shows an eye icon, indicating a visual inspection point. The diagram is labeled E133939.</p>	1 If the crack is minor it can be repaired by applying clear/body coloured sealant and then wiping it into the crack with a gloved hand. If the crack is larger the vehicle may require a body shop repair which will require the body sealant scraping out of the channel, replacing with new body sealant and repaint
	2 Materials required: sealant (clear/body coloured), cloth, spirit wipe, gloves

	3 Allow the sealant to cure, and retest suspect area for water entry
	Is water still entering the vehicle? Yes Carry out a water leak test and visual inspection of any suspect or wet areas, once the water entry point has been determined refer to the "Water Ingress Paths And Recommended Repair Procedure" above No Reinstall any trim/panels or component that have been displaced

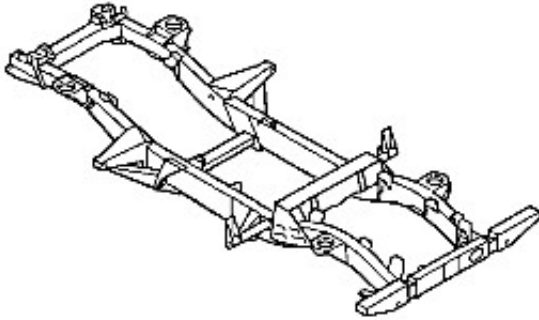
Body Repairs - Vehicle Specific Information and Tolerance Checks - Body and Frame

Description and Operation

CHASSIS AND BODY

Chassis

The chassis on all Defender variants are of the box section, ladder type construction, manufactured from 2 mm (14swg) steel and treated with zinc phosphate, cathodic electro coated, followed by waxing in the rear cross member.



J6348

Outriggers and angled brackets welded to the chassis support suspension and axle components and are also used as body mounting points. A detachable box section cross member, located between the two chassis longitudinals is fitted to facilitate main gearbox and transfer box assembly removal.

Should chassis damage occur, a comprehensive range of components are available, including body support outriggers, cross members and radius arm mounting brackets. ALWAYS fit genuine parts that are fully guaranteed and to original equipment specification, fitted with Land Rover's BS 5135 welding standard.

Body



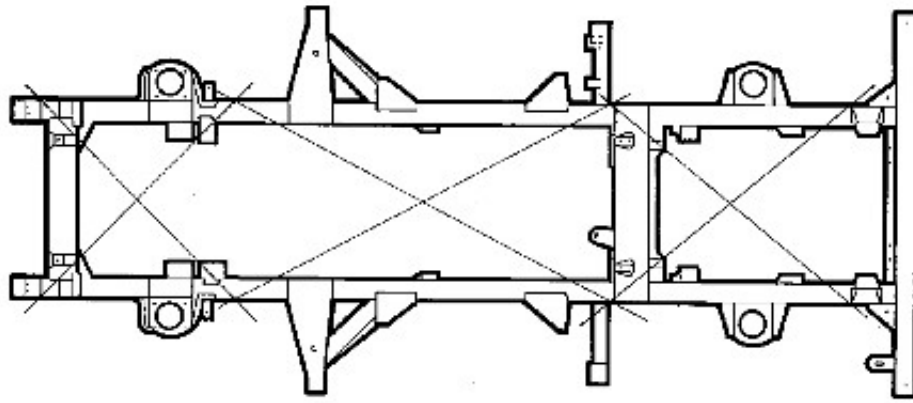
M764325

All body panels, with the exception of the fascia bulkhead, are manufactured from aluminium alloy. Galvanized steel is used for the front wheel arches to give optimum protection. Most panels are also treated with zinc phosphate and cathodic electro coated with polyester surfacer, and are bolted to the welded chassis.

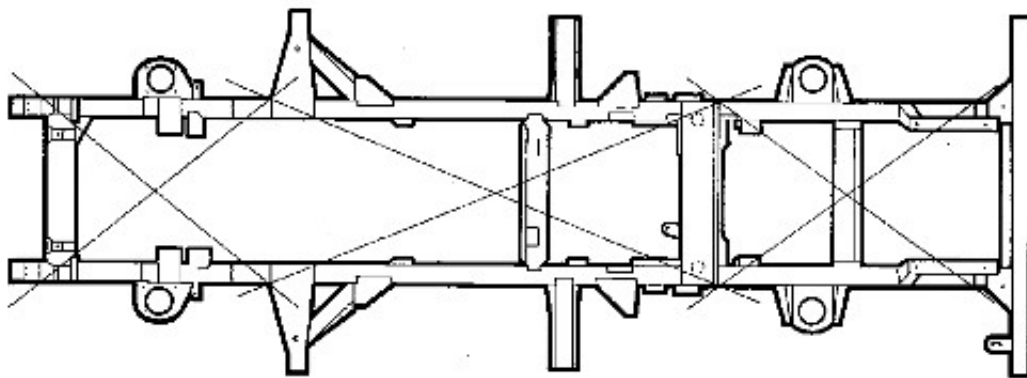
CHASSIS FRAME ALIGNMENT

With the vehicle assembled, a check for chassis squareness can be made as follows:

- **1.** Place the vehicle on a level floor.
- **2.** Mark measuring points at approximately the locations shown in LR4412M ensuring that the marks are exactly opposite on each side of the chassis frame.
- **3.** Hold a plumb line against each of the measuring points in turn and mark the floor directly beneath the plumb-bob.
- **4.** Move the vehicle and measure diagonally between the marks made on the floor, if the chassis is square the diagonals between the related measuring points should agree within 9,50 mm.
- **5.** Chassis frame dimensional checks can be made, with the vehicle upper structure removed, referring to the applicable illustration and associated key.



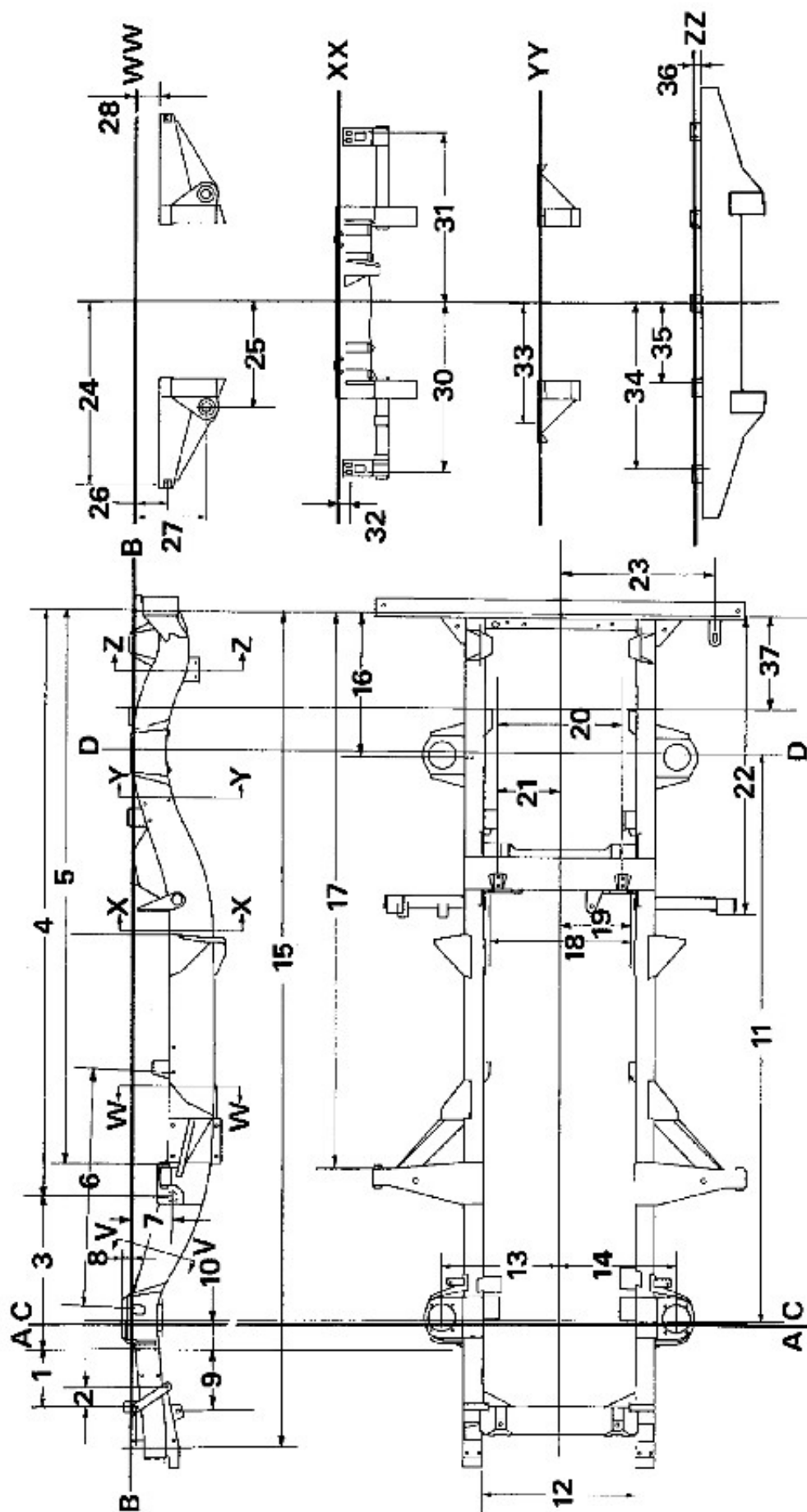
LAND ROVER 90



LAND ROVER 110

LR4412M

90 Chassis



M772128

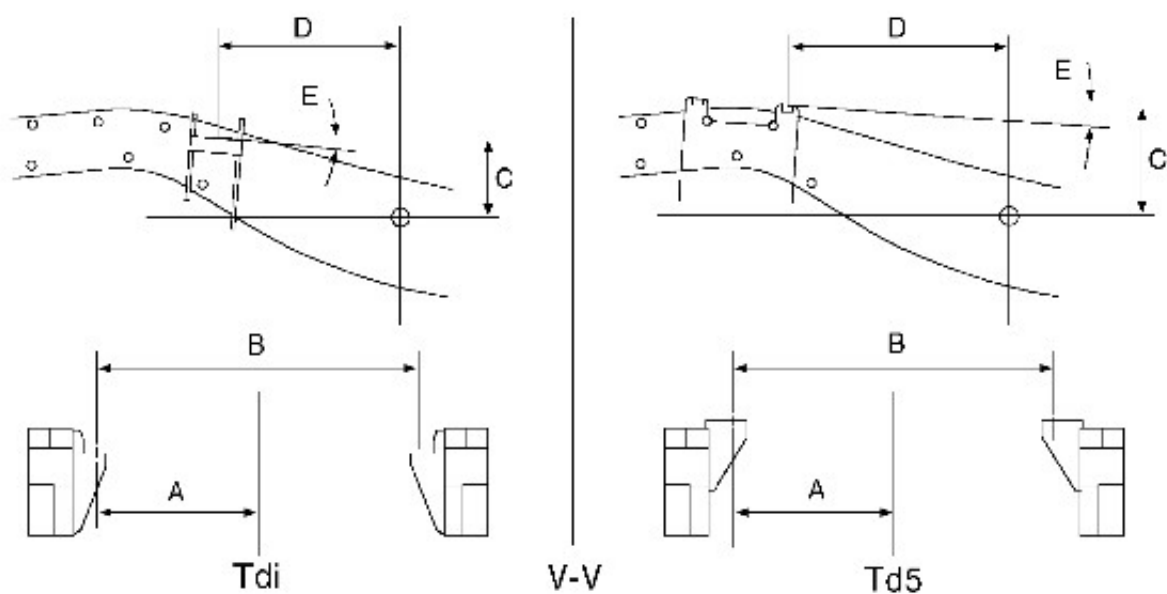
Chassis alignment dimensions

No./Letter	Dimension
A	Front datum
B	Chassis Datum
C	Front axle centre line

D	Rear axle centre line
1.	239,0 - 236,5 mm
2.	82,0 - 79,5 mm
3.	633 mm
4.	2420,6 - 2418,6 mm
5.	2306,4 - 2305,4 mm
6.	981,2 - 978,7 mm
7.	182,7 mm
8.	41,5 - 37,0 mm
9.	252 - 250 mm
10.	110 mm
11.	2360mm - Wheelbase
12.	636 - 634 mm
13.	488 - 482 mm
14.	488 - 482 mm
15.	3431,1 - 3426,1 mm
16.	588,3 - 586,3 mm
17.	2313,8 - 2311,8 mm
18.	590,5 mm
19.	295,25 mm
20.	519,30 - 517,30 mm
21.	259,80 - 258,50 mm
22.	1242,6 - 1240,6 mm
23.	642,5 - 639,5 mm
24.	750,9 mm
25.	439,5 - 436,5 mm
26.	136,5 mm
27.	299,5 - 295,5 mm
28.	103 - 100 mm
29.	131,5 - 126,5 mm
30.	705,5 - 704,5 mm
31.	705,5 - 704,5 mm
32.	42,2 - 40,2 mm
33.	491 - 486 mm
34.	594,2 - 593,4 mm
35.	283,0 - 282,2 mm
36.	32,25 - 31,25 mm
37.	397 - 395 mm

Engine mounting dimensions - section V-V

NOTE: The engine mounting bracket dimensions are applicable to all models



M772129

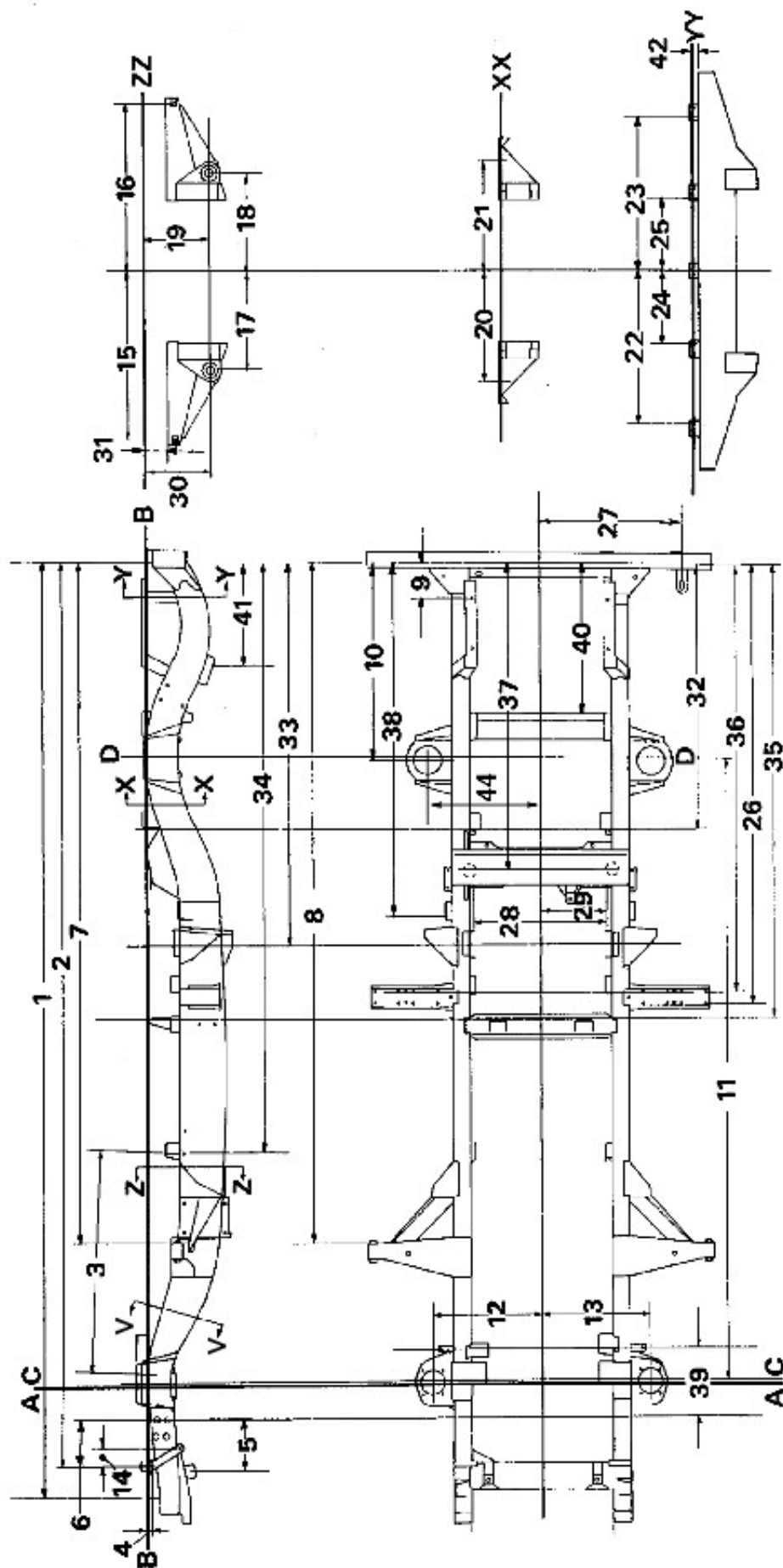
Tdi dimensions

Dimension	value
A	276.5 mm
B	553 mm
C	127.9 mm
D	317.4 mm
E	4 °

Td5 dimensions

Dimension	value
A	273.2 mm
B	546.5 mm
C	187.8 mm
D	347.3 mm
E	4 °

110 Chassis



M772127

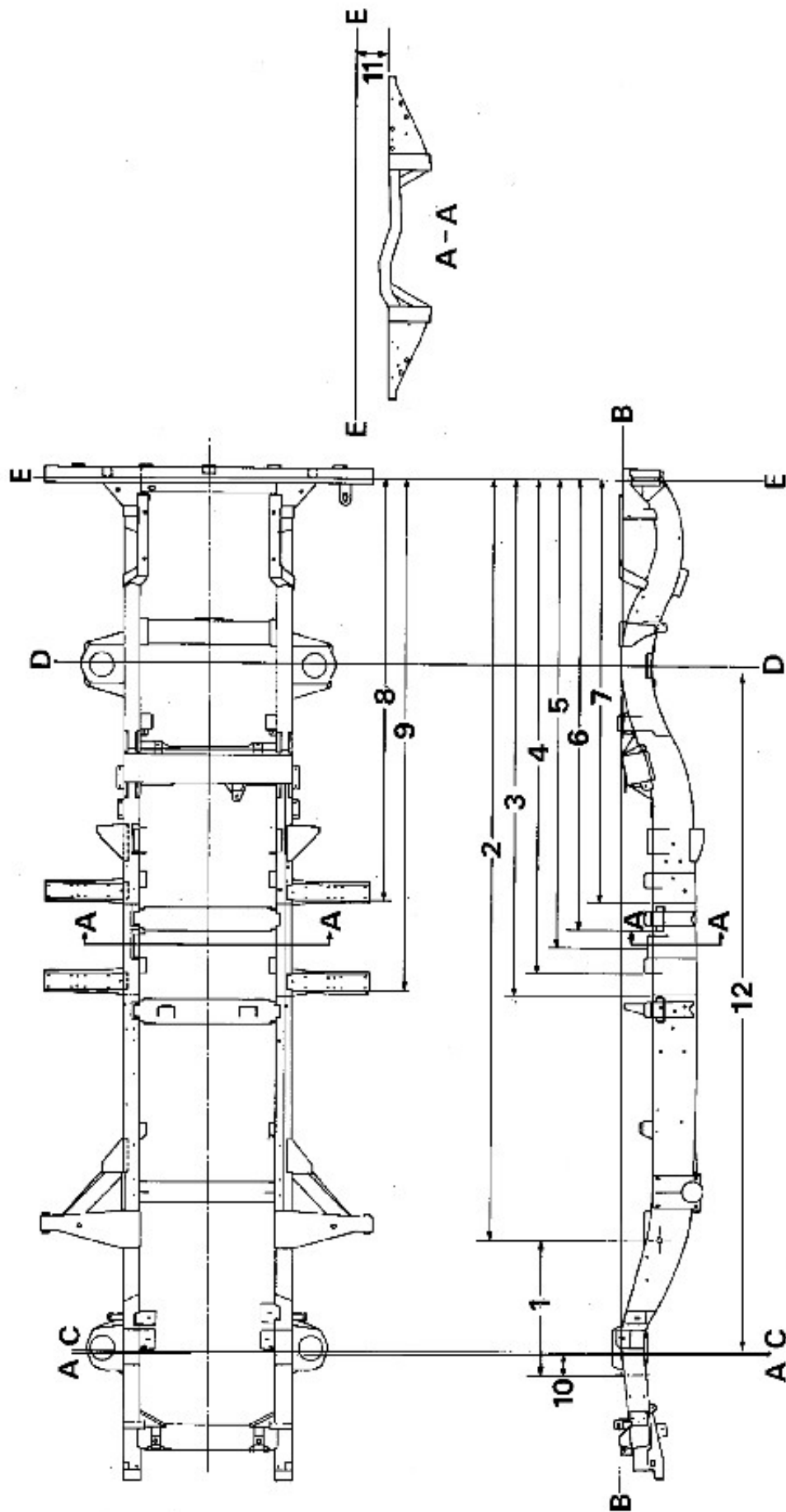
Chassis alignment dimensions

No./Letter	Dimension
A	Front datum
B	Chassis Datum
C	Front axle centre line

D	Rear axle centre line
1.	4148 - 4143 mm
2.	4009,5 - 4005 mm
3.	978,7 - 981,2 mm
4.	22 - 20 mm
5.	252 - 250 mm
6.	239 - 236,5 mm
7.	3023,3 - 3022,3 mm
8.	3030,7 - 3028,7 mm
9.	155 - 153 mm
10.	871,2 - 869,2 mm
11.	2794 mm - Wheelbase
12.	488 - 482 mm
13.	488 - 482 mm
14.	82 - 79,5 mm
15.	750,9 mm
16.	750,9 mm
17.	440,5 - 435,5 mm
18.	440,5 - 435,5 mm
19.	299,5 - 295,5 mm
20.	500 - 495 mm
21.	500 - 495 mm
22.	594,2 - 593,4 mm
23.	594,2 - 593,4 mm
24.	283 - 282,2 mm
25.	283 - 282,2 mm
26.	1970 - 1968 mm
27.	642,9 - 639,5 mm
28.	750,9 mm
29.	290,5 mm
30.	295,5 mm
31.	299,5 - 295,5 mm
32.	103 - 100 mm
33.	1177,5 - 1175,5 mm
34.	1692,5 - 1689,5 mm
35.	2610 - 2606 mm
36.	2040,5 - 2037,5 mm
37.	1912,5 - 1909,5 mm
38.	1359 - 1357 mm
39.	1573 - 1571 mm
40.	270 - 268 mm
41.	665,5 - 663,5 mm
42.	440 - 438 mm
43.	32,25 - 31,25 mm

Section V-V is through the engine mountings. Dimensional information can be found in the 90 engine mounting dimensions.

130 Chassis



M772126

Chassis alignment dimensions

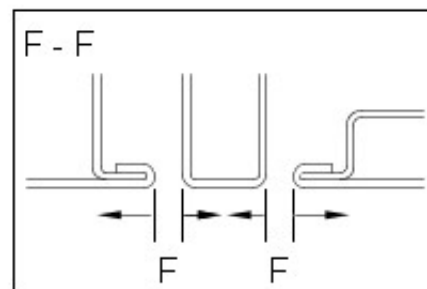
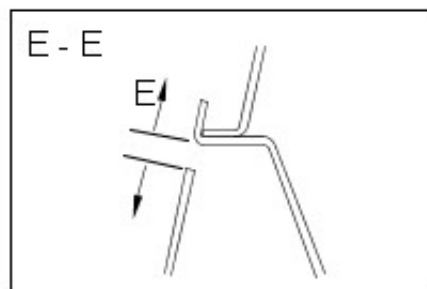
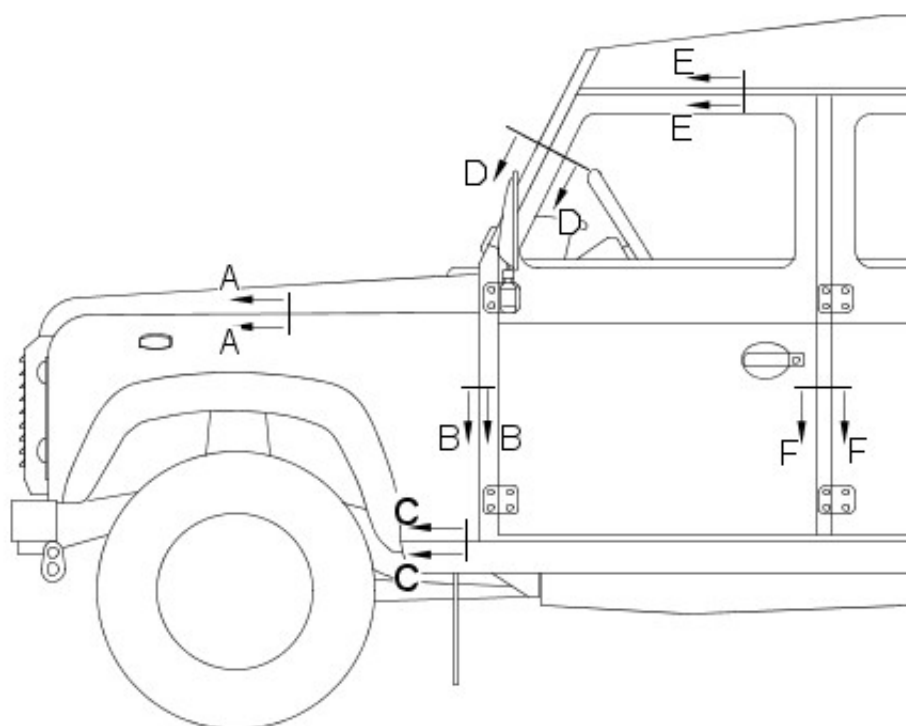
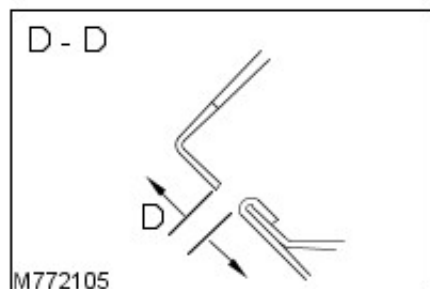
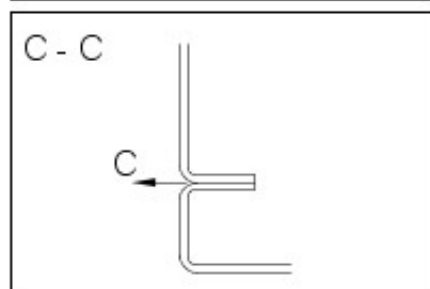
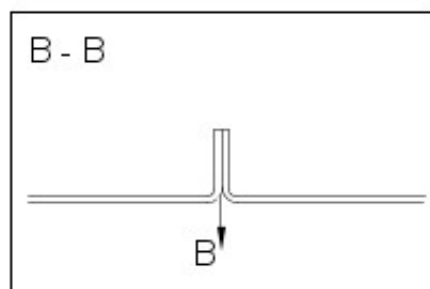
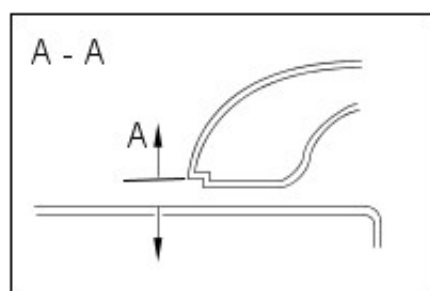
NOTE: The above dimensions are for the Land Rover 130 chassis frame. For additional measurements, refer to the Land Rover 110 chassis frame drawing and alignment dimensions.

No./Letter	Dimension
A	Front datum

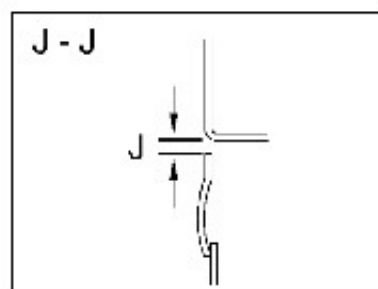
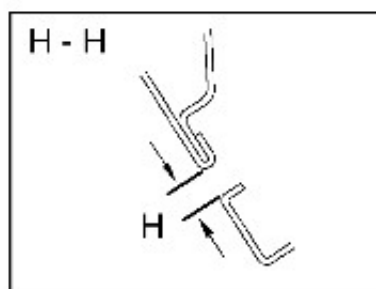
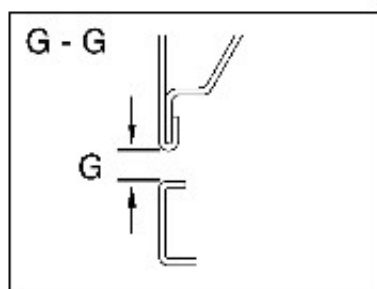
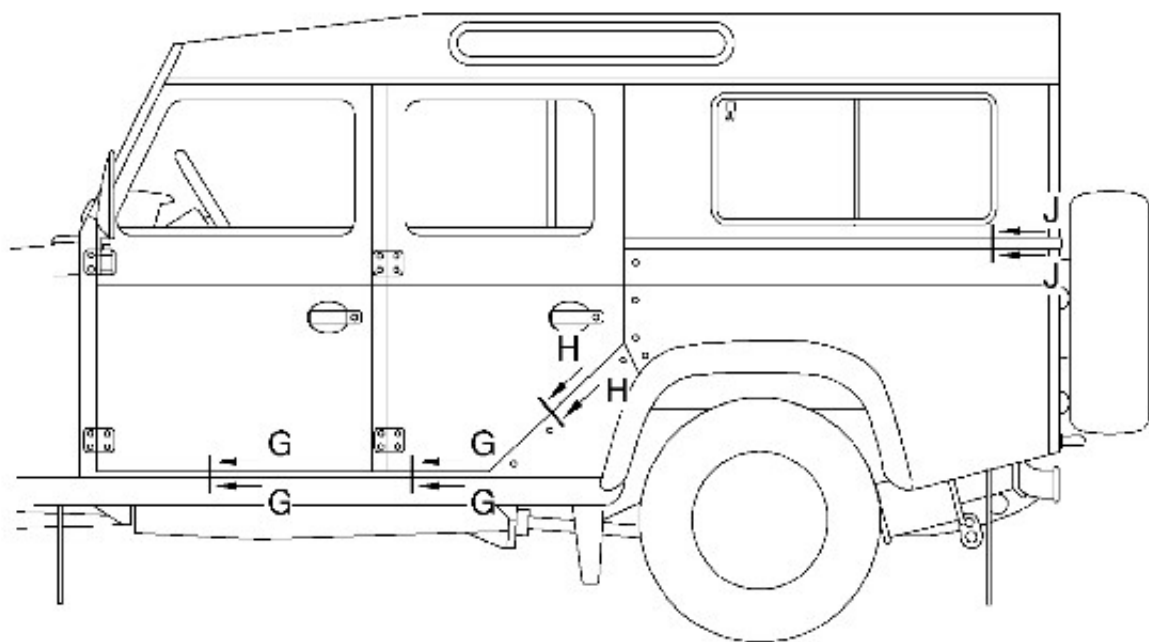
B	Chassis Datum
C	Front axle centre line
D	Rear axle centre line
E.	Chassis Datum, section A-A
1.	663,0 mm reference only
2.	3569,3 - 3567,3 mm
3.	2421,8 - 2419,8 mm
4.	2317,5 - 2314,5 mm
5.	2188,3 - 2185,3 mm
6.	2119,5 - 2117,3 mm
7.	1990 - 1988 mm
8.	1970 - 1968 mm
9.	2401,8 - 2399,8 mm
10.	110,0 mm reference
11.	149,7 - 146,7 mm reference dimension
12.	3225,8 mm wheelbase

GAP AND PROFILE INFORMATION

The following information is to be used as a guide to assist the technician in refitting exterior body panels and trim items, to achieve a correctly aligned and cosmetically acceptable vehicle.

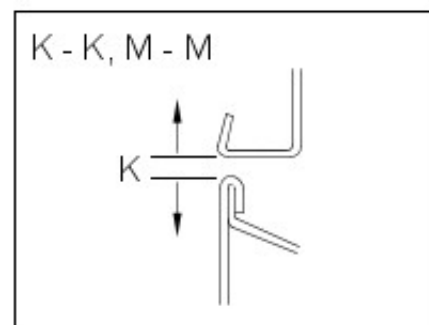
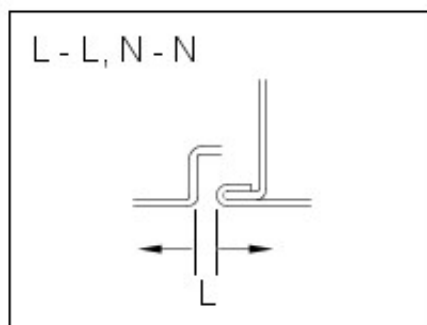
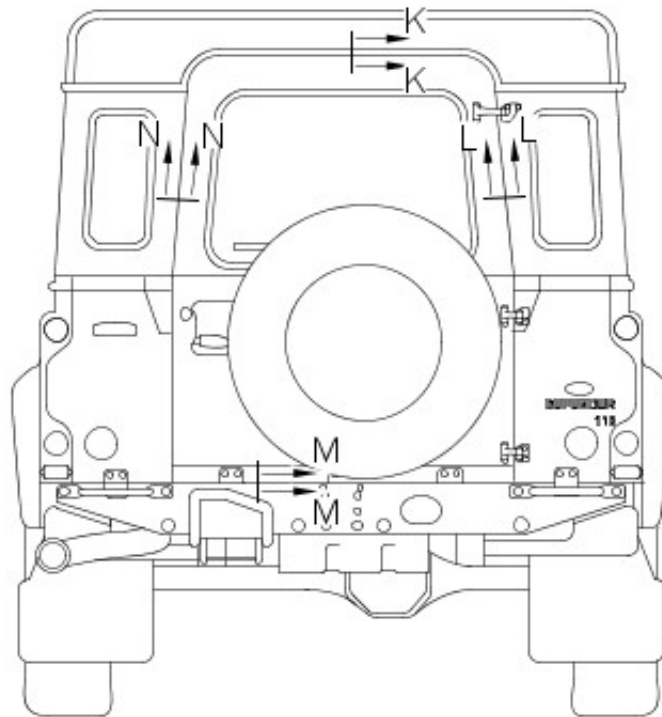


- Section A-A, Bonnet to wing gap A = 3 - 8 mm. To be parallel within 2 mm
- Section B-B, Wing to 'A' post lower, gap B = 0. Profile = ± 1 mm
- Section C-C, Wing to sill, gap C = 0. Profile = ± 1 mm
- Section D-D, Screen aperture to door frame, gap D = 5 - 9 mm
- Section E-E, Door frame to roof, gap E = 7 - 11 mm
- Section F-F, Front and rear door to 'B'/'C' post, gap F = 7 - 11 mm



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- Section G-G, Door to sill gap $G = 7 - 11$ mm. Door profile to sill = 0 to = + 2 mm
- Section H-H, Rear door to body gap $H = 7 - 11$ mm. Door profile to body = 0 to = + 3 mm
- Section J-J, Body side lower to body, gap $J = 0 - 4$ mm. To be parallel within 2 mm



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- Section K-K, Roof to taildoor, gap K = 7 - 9 mm. Profile = ± 1 mm
- Section L-L, N-N, Body side to taildoor, gap L = 56 - 7 mm. Profile = ± 1 mm
- Section M-M, Body rear to taildoor, gap M = 7 - 9 mm