



Body and Equipment Mounting Manual

FORD **RANGER** 2012

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1.1 About This Manual

1.1.1 New for this BEMM publication 12/2014

The following sections of the manual have been updated since the last publication of the BEMM 07/2014.

Battery Information

Refer to: 4.1 Battery and Cables (page 39).

1.1.2 Introduction

This manual has been written in a format that is designed to meet the needs of Vehicle Converters. The objective is to use common formats with the workshop manual which is used by technicians worldwide.

This guide is published by Ford and provides general descriptions and advice for converting vehicles. These requirements must be complied with before a Ford Dealer should take delivery of motor vehicle accessories from an external supplier either for themselves or on behalf of a motor vehicle client.

It must be emphasized that any change to the basic vehicle which does not meet the enclosed guideline standards may severely inhibit the ability of the vehicle to perform its function. Mechanical failures, structure failure, component unreliability or vehicle instability will lead to customer dissatisfaction. Appropriate design and application of body, equipment and or accessories is key to ensuring that customer satisfaction is not adversely affected.

The information contained within this publication takes the form of recommendations to be followed when vehicle modifications are undertaken. It must be remembered that certain modifications may invalidate legal approvals and application for re-certification may be necessary.

Ford cannot guarantee the operation of the vehicle if non-Ford approved electrical systems are installed. Ford electrical systems are designed and tested to function under operational extremes, and have been subjected to the equivalent of ten years of driving under such conditions.

1.1.3 Important Safety Instructions

Appropriate conversion procedures are essential for the safe, reliable operation of all vehicles as well as 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. Anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or components.

1.1.4 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.

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 it applies to multiple 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).

1.1.5 How to Use This Manual

This manual covers vehicle conversion procedures.

The pages at the start of this manual list the content, by group. A group covers a specific portion of the vehicle. The manual is divided into four groups, General Information, Chassis, Electrical, Body and Paint. The number of the group is the first number of a section number. Each title listed in the contents links to the relevant section of the manual.

In some section of the book it may refer you to see additional sections for information, links have been provided, these links are in blue text.

This manual is designed to be used online or as printed material, document links for the online version are also shown with page numbers for the printed version, this will help guide you to the start of the section which contains the relevant information.

There is also an alphabetical index at the back of the manual. As with the contents pages you will be able to link to sections. To do this just click on the page number.

All left and right-handed references to the vehicle are taken from a position sitting in the driver seat looking forward unless otherwise stated.

1.2 Commercial and Legal Aspects

1.2.1 Terminology

NOTE: Any modifications to the vehicle must be noted in the owner's handbook or new descriptive literature included with the owner's documentation.

Vehicle Converter refers to any re-seller altering the vehicle by converting the body and adding or modifying any equipment not originally specified and or supplied by Ford.

Unique component or similar wording refers to non-Ford specified or after sale fitment not covered by Ford warranty.

1.2.2 Warranty on Ford Vehicles

Please contact The National Sales Company in the country where the vehicle will be registered or refer to the vehicle Owner Guide for details of the terms of any applicable Ford warranty.

The Vehicle Converter should warrant its design, materials and construction for a period at least equal to any applicable Ford warranty.

The Vehicle Converter must ensure that any alteration made to a Ford vehicle or component does not reduce the safety, function, or durability of the vehicle or any component.

The Vehicle Converter shall be solely responsible for any damage resulting from any alteration made by the Vehicle Converter or any of its agents to a Ford Vehicle Component.

The Vehicle Converter releases Ford from all claims by any third party for any cost or loss (including any consequential damages) arising from work performed by a Vehicle Converter unless Ford has given its prior written consent to such liability.

1.2.3 Legal and Vehicle Type Approval

- All components embodied on Ford vehicles are approved to the applicable legal requirements.
- Ford vehicles have Type Approval for the intended marketing territories.

 **WARNING: Exception - Incomplete vehicles require further approval when completed by the Body Builder.**

- The Ranger range has Type Approval for many territories, although the full range of vehicles shown in this manual are not necessarily released in all territories. Check with your local Ford National Sales Company representative.
- Significant changes to the vehicle may affect its legal compliance. Strict adherence to the original design intent for brakes, weight distribution, lighting, occupant safety and hazardous materials compliance in particular is mandatory.

1.2.4 Alternative Type Approval

If significant changes are made the Body Builder must negotiate with the relevant authority. Any changes to the vehicle operating conditions must be advised to the customer.

1.2.5 Legal Obligations and Liabilities

The Vehicle Converter should consult with its legal advisor on any questions concerning its legal obligations and liabilities.

Ford recommends that the Vehicle Converter and Ford Dealer must understand their individual and joint responsibilities in supplying a safe and compliant motor vehicle fitted with safe and compliant accessories.

1.2.6 General Product Safety Requirement

The Vehicle Converter shall ensure that any vehicle it places on the market complies with all local laws relating to the safe carriage of loads on public roads. The Vehicle Converter shall also ensure that any alteration it makes to a Ford vehicle or component does not reduce its compliance with local design rules.

The Vehicle Converter must provide sufficient Load Restraint tie down points or compartmentised storage areas that enable the driver to safely carry loads that match the use criteria for which the body was designed.

The Vehicle Converter shall release Ford from all liability for damages resulting from:

- Failure to comply with these Body Equipment Mounting directives, in particular warnings.
- Faulty design, production, installation, assembly or alteration not originally specified by Ford.
- Failure to comply with the basic fit for purpose principles inherent in the original product.

WARNINGS:


 **Do not exceed the gross vehicle mass, gross train mass, axle plates and trailer plate.**

 **Do not change the tire size or load rating.**

 **Do not modify the steering system.**

 **Excessive heat can build up from the exhaust system, in particular from the catalytic converter and from the Diesel particulate filter (cDPF). Ensure adequate heat shields are maintained. Maintain sufficient clearance to hot parts.**

 **Do not modify or remove heat protection shields.**

 **Do not route any electrical cables with the Antilock Brakes System and Traction Control System cables because of extraneous signal risk. It is generally not recommended to hang electrical cables off existing looms or pipes.**

 **Do not change original location or remove warning labels provided with the base vehicle in view to the driver. Ensure that labels in view to the driver remain in full view to the driver.**

NOTE: For further information please contact your local National Sales Company representative, or Local Ford Dealer.

1.2.7 Product Liability

The Vehicle Converter shall be liable for any product liability (whether for death, personal injury, or property damage) arising from any alteration to a Ford vehicle or component made by the Vehicle Converter or any of its agents. Ford shall not be liable for any such liability (except as provided by law).

The Vehicle Converter or equipment manufacturer is liable for the:

- Operational reliability and road-worthiness of the vehicle to its original intent.
- Operational reliability and road-worthiness of any component or conversion, not listed in original Ford documentation.
- Operational reliability and road-worthiness of the vehicle as a whole (for example the body changes and/or additional equipment must not have a negative effect on the driving, braking or steering characteristics of the vehicle).
- Subsequent damage resulting from the conversion or attachment and installation of unique components, including unique electrical or electronic systems.
- Functional safety and freedom of movement of all moving parts (for example axles, springs, propeller shafts, steering mechanisms, brake and transmission linkage).
- Functional safety and freedom of the tested and approved flexibility of the body and integral chassis structure.

1.2.8 Restraints System


WARNINGS:

 **Modifications to the restraints system are not allowed.**

 **Airbags are explosive. For safe removal and storage during conversion follow the procedures in the Ford workshop manual or consult your local National Sales Company representative.**

 **Do not alter, modify or relocate the airbag, sensor and modules of the restraints system or any of its components.**

 **Attachments or modifications to the front end of the vehicle may affect the airbag fire timing and result in uncontrolled deployment.**

 **Modifications to the B-Pillar body structure may affect the side airbag fire timing and result in uncontrolled side airbag deployment.**

Refer to: 5.2 Airbag Supplemental Restraint System (SRS) (page 75).

1.2.9 Drilling and Welding

Drilling and welding of frames and body structures have to be conducted following the guidelines within this document.

1.2.10 Minimum Requirements for Brake system and Load Apportioning Valves

- It is not necessary or recommended to modify the load apportioning valves, however, if a special conversion should require modifications,
 - Maintain original settings.
 - Maintain brake certification load distribution.
- Changes to the Antilock Brake System (ABS), Traction Control System (TCS) and Electronic Stability Program (ESP) system are not permitted.

1.2.11 Road Safety

The respective instructions should be strictly observed to maintain operational and road safety of the vehicle.

1.3 Conversion Homologation

The Vehicle Converter must observe any statutory rules and regulations. When the conversion needs a new approval the following information must be quoted.






- All dimensional, weight and centre of gravity data.
- The fixing of the body to the donor vehicle.
- Operating conditions.

The responsible Technical Service may require additional information and/or testing.

NOTE: For further information please contact your local National Sales Company representative, or Local Ford Dealer.

1.4 Electromagnetic Compatibility (EMC)

WARNINGS:

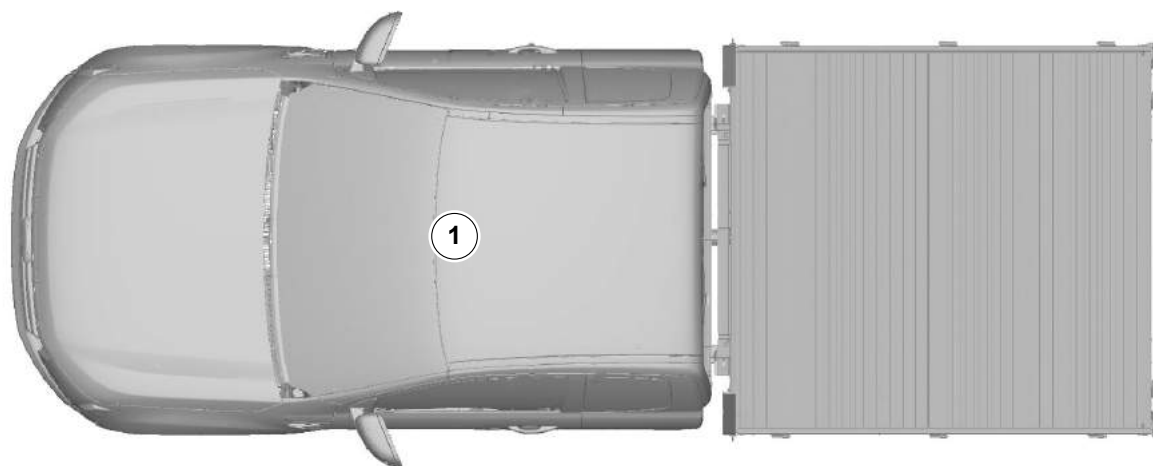
-  **Your vehicle has been tested and certified to European legislation relating to electromagnetic compatibility (2004/104/EC). It is your responsibility to ensure that any equipment fitted complies with applicable local legislation. Ensure you have any equipment fitted by properly trained technicians.**
-  **Radio frequency (RF) transmitter equipment (for example: cellular telephones, amateur radio transmitters and so on.) may only be fitted to your vehicle if they comply with the parameters shown in the following 'Frequency Overview' table. There are no special provisions or conditions for installations or use.**
-  **Do not mount any transceiver, microphones, speakers, or any other item in the deployment path of the airbag system.**
-  **Do not fasten antenna cables to original vehicle wiring, fuel pipes and brake pipes.**
-  **Keep antenna and power cables at least 100mm from any electronic modules and airbags and associated wiring.**

Frequency Overview

Frequency Band (MHz)	Maximum Output Power (W) (Peak RMS)	Antenna Position
1-30	50	1
30-54	50	1
68-87.5	50	1
142-176	50	1
380-512	50	1
806-940	10	1
806-940	2*	1
1200-1400	10	1
1710-1885	10	1
1710-1885	1*	1
1885-2025	10	1
1885-2025	1*	1
2400-2500	0.1	Anywhere

* Only for GSM/3G cellular phones, with a patch antenna installed inside of the front windscreen.

1.4.1 Suggested Antenna Location



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The antenna can be mounted on the roof of the vehicle, with the exception of cellular phone car kit antennas which transmit power below 2W. Such low powered systems should have their antenna located at the bottom of the A-pillar behind the trim or on the front windscreen.

NOTE: After the installation of RF transmitters, check for disturbances from and to all electrical equipment in the vehicle, both in the standby and transmit modes.

Check all electrical equipment:

- With ignition **ON**.
- With the engine running.
- During a road test at various speeds.

Check that electromagnetic fields generated inside the vehicle cabin by the transmitter installed do not exceed human exposure limits specified in EU directive 2004/40/EC.

1.5 Vehicle Duty Cycle Guidelines

It is necessary to take into account the customer usage profile and the anticipated vehicle duty cycles of the modified vehicle in order to choose the appropriate specification of the base vehicle.

It is necessary to select the appropriate drive, engine, gear ratio, gross vehicle mass, gross train mass, axle plates and payloads of the base vehicle to match the customer requirements.

Where possible make sure that the base vehicle is ordered with any necessary plant fit options.

NOTE: For further information please contact your local National Sales Company representative, or Local Ford Dealer.

1.5.1 Conversion Affect on Fuel Economy and Performance

Any conversion may effect the fuel consumption and performance depending on the aerodynamics and the weight added by the conversion. The published information for fuel consumption and performance of the base vehicle therefore may not be valid. It is advisable to control the weight, but without deteriorating other vehicle attributes and functions (especially those related to safety and durability).

1.5.2 Vehicle Ride and Handling Attributes

 **CAUTION: Do not exceed the axle plate, gross vehicle mass, trailer plate and gross trailer mass limits.**

Due to the displacement of the center of gravity occurred by the conversion the ride and handling attributes may be different to the base vehicle.

NOTE: This vehicle should be evaluated for safe operation prior to sale.

1.6 Jacking

WARNINGS:

⚠ Always position the vehicle on a hard level surface. If the vehicle must be jacked up on a soft surface use load spreading blocks under the jack. Always chock the wheel diagonally opposite the jacking point. Failure to follow these instructions may result in personal injury.

⚠ Do not get under a vehicle that is supported by a jack.

⚠ This jack is only intended for changing wheels.

CAUTIONS:

⚠ It is important that only the correct jacking and support locations are used at all times.

⚠ Make sure that access to the spare wheel is maintained when converting the vehicle or relocating the spare wheel.

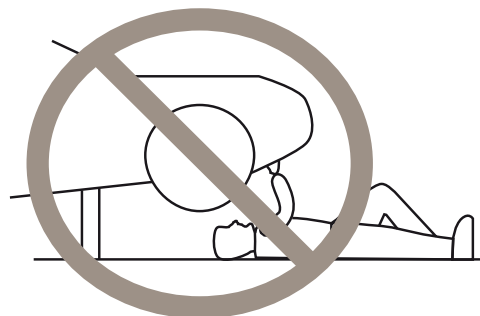
NOTE: When using the vehicle jack, refer to the owner guide for correct operating instructions.

NOTE: Make sure that reinforcements are installed to maintain the integrity of the original body structure for/at jacking points.

NOTE: Any modifications to the vehicle must be noted in the owner's handbook or new descriptive literature included with the owner's documentation.

The spare wheel winch is located above the spare wheel and can be accessed from the rear of the chassis frame.

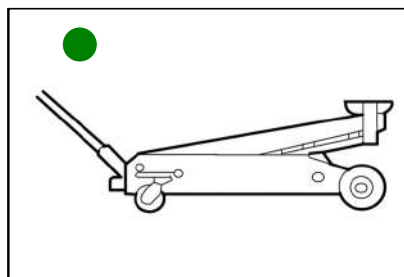
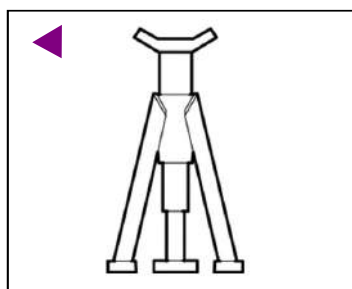
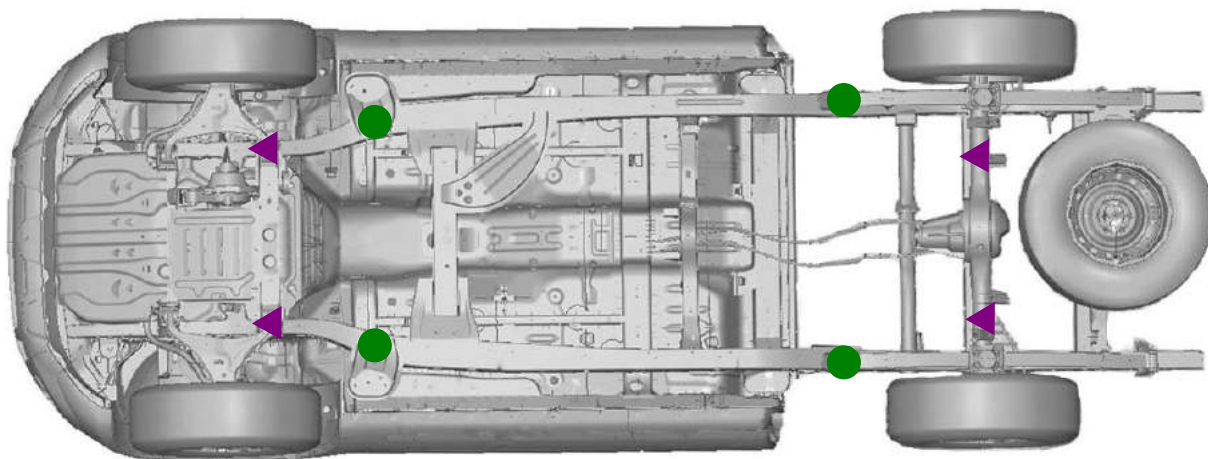
The jack must be assembled and fixed appropriately to the body to ensure safety, durability and accessibility.



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1. Ensure screwthread is adequately lubricated before use.
2. The jack should be used on level firm ground wherever possible.
3. Apply park brake fully before lifting the vehicle.
4. It is recommended that the wheels of the vehicle should be chocked, and no person should remain in a vehicle being jacked.
5. No person should place any portion of their body under a vehicle that is supported by a jack.

All Vehicles



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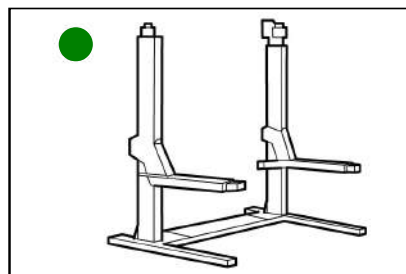
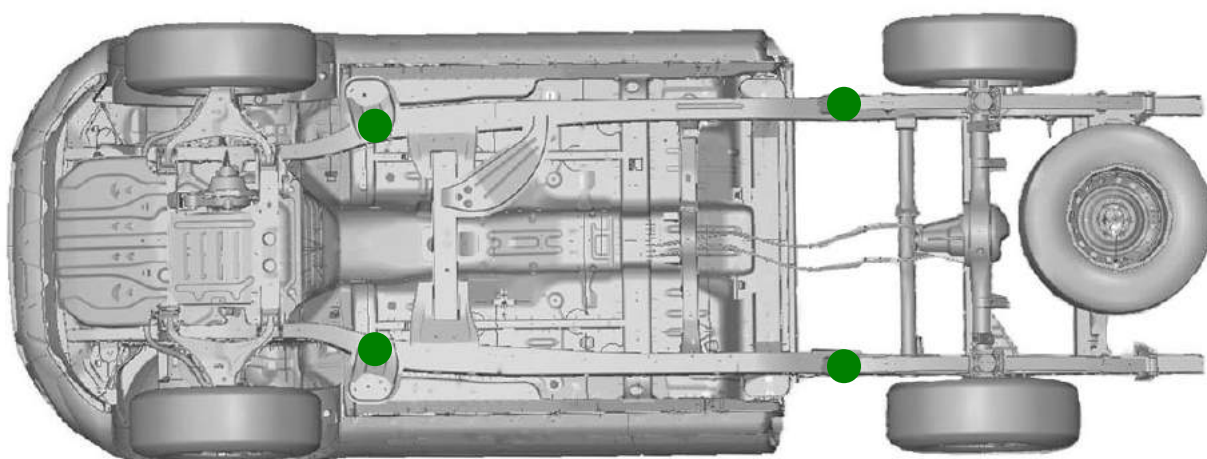
1.7 Lifting

⚠ WARNING: When lifting the vehicle with a two post lift for the removal of the engine/transmission or rear axle, make sure the vehicle is secured to the lift using vehicle retention straps to prevent tilting. Failure to follow these instructions may result in personal injury.

CAUTIONS:

- ⚠** When lifting the vehicle with a two post lift, vehicle lift arm adapters must be used under the lifting points.
- ⚠** When lifting the vehicle with a two post lift, the maximum kerb weight must not be exceeded.
- ⚠** It is important that only the correct lifting and support locations are used at all times.

All Vehicles



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1.8 Noise, Vibration and Harshness (NVH)

 **WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.**





 **CAUTION: The travel and function of pedals must not be restricted.**

Changes to the powertrain, engine, transmission, exhaust, air intake system or tires may influence the exterior noise emission. Therefore the exterior noise level of the converted vehicle has to be verified.

The interior noise levels should not be deteriorated by the conversion. Reinforce panels and structures as appropriate to avoid vibrations. Consider the usage of sound deadening material on panels.

1.9 Vehicle Transportation Aids and Vehicle Storage

CAUTIONS:

-  **Disconnect the battery if the vehicle is to be stored for more than 30 days.**
-  **Make sure that the protective covers are not removed from an incomplete vehicle until the conversion is started.**
-  **Make sure that components removed during conversion are kept clean and dry.**
-  **Make sure that components removed during conversion are refitted to the same vehicle.**

In addition:

- The windscreen wipers should be lifted off the glass and set right up.
- All air intakes should be closed.
- Increase normal tire pressure by 0.5 bar.
- The hand brake system should not be used.
- Apply suitable wheel chock to prevent roll away.

A significant risk during storage is deterioration of vehicle bodywork, therefore, appropriate storage procedures must be observed, including periodic inspection and maintenance.

Claims arising from deterioration caused by incorrect storage, maintenance or handling are not the responsibility of Ford.

Vehicle Converters must determine their own procedures and precautions, particularly where vehicles are stored in the open as they are exposed to any number of airborne contaminants.

The following may be considered a sensible approach to storage:

Short Term Storage

- Wherever possible vehicles should be stored in an enclosed, dry, well-ventilated area based on firm, well drained ground which is free of long grass or weeds and where possible protected from direct sunlight.
- Vehicles must not be parked near, under foliage or close to water as additional protection may be necessary for certain areas.

Long term storage:

- Battery to be disconnected but not removed from the vehicle.
- The wiper blades should be removed and placed inside the vehicle. Make sure the wiper arms are suitably prevented from resting on the windscreen.
- Engage first gear and release the parking brake completely. Chock the wheels first if the vehicle is not on level ground.
- Set climate controls to the "open" position to provide ventilation, where possible.

- Where protective film has been applied in manufacture it must be left on the vehicle until prepared for delivery but must be removed after a maximum storage period of six months (film is date stamped to indicate required removal date).
- Make sure that all windows, doors, hood, tailgate and luggage compartment lid are completely closed and the vehicle is locked.

The Pre Delivery Inspection (PDI) is the final opportunity to make sure a battery is fit for purpose prior to the customer taking delivery of their new vehicle. The battery must be checked and appropriate action taken prior to the vehicle being handed over to the customer. Test results must be recorded on the PDI repair order.

Batteries. To make sure the battery is maintained correctly and to assist in preventing premature failure, it is necessary to check and recharge the battery regularly while a vehicle is not in use. Where a battery is left below its optimum charge level for any length of time, it may result in premature failure of the battery.

Action / Time in storage	Monthly	Every 3 Months
Check vehicle is clean	X	-
Remove external contamination	X	-
Check battery condition - Recharge if necessary	Connected	Disconnected
Visually check tires	X	-
Check interior for condensation	-	X
Run engine for 5 minutes minimum with air conditioning switched on, where applicable	-	X

To reduce the likelihood of premature battery failure it is recommended that where:

- A battery is left connected – monthly checks should be carried out.
- A battery has been disconnected – no greater than a 3 monthly check should be carried out.

1.10 Package and Ergonomics

1.10.1 General Component Package Guidelines

WARNING: Do not modify, drill, cut or weld any suspension components, specifically the steering gear system, subframe or anti-roll bars, springs or shock absorbers including mounting brackets.

The Vehicle Converter has to ensure that sufficient clearance is maintained under all drive conditions to moving components such as axles, fans, steering, brake system etc.

The Vehicle Converter is responsible for all installed components during the conversion. The durability has to be confirmed by appropriate test procedures.

1.10.2 Driver Reach Zones

Controls and/or equipment required to be used while driving should be located within easy reach of the driver so as not to impair driver control.

1.10.3 Driver Field of View

WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.

1.10.4 Conversion Affects on Parking Aids

WARNING: Ensure that monitors mounted in the cabin meet the interior package and safety requirements.

On conversions requiring a rear camera, the reverse signal may be taken as described in the electrical section, described in reversing lamps.

Refer to: 4.3 Exterior Lighting (page 52).

1.10.5 Aids for Vehicle Entry and Exit

Steps

WARNINGS:

WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.

WARNING: If this modification alters the homologated dimensions, a new approval may be necessary.

CAUTION: Make sure that reinforcements are installed to maintain the integrity of the original body structure.

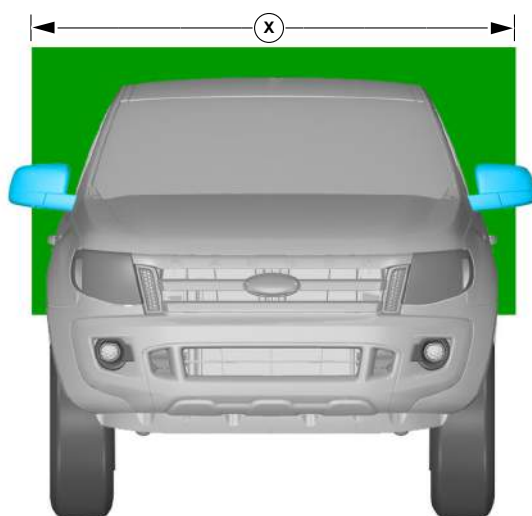
Steps can be ordered as an accessory on the base vehicle. Please check for availability.

Where additional steps are installed the required ground clearance line is to be maintained.

The Vehicle Converter must make sure that a movable step is set in the stored position when the vehicle is running. The step surface must be non-slip.

Rear View Mirrors

Rear view mirror is homologated up to 1880 mm maximum body width, see the Figure below, dimension 'X'.



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1.11 Package and Ergonomics—Specifications

1.11.1 Recommended Body Dimensions

WARNINGS:



Do not modify the wheelbase or add any type of frame extension to vehicles fitted with Electronic Stability Program (ESP).



Ensure that any mass added to the vehicle does not compromise vehicle stability.

NOTE: Extreme rear overhang may encourage unacceptable loading conditions, which could unload the front axle, producing unacceptable handling and braking characteristics. Ensure that the centre of gravity of the body and payload does not fall outside of the recommended zone.

NOTE: An excessively high centre of gravity could reduce vehicle stability. Ensure that the centre of gravity of the body and payload does not fall outside of the recommended zone.

Refer to: 1.13 (page 23).

NOTE: When extending the length of the frame rearward of the rear axle, it is recommended that the overall rear overhang is limited to a maximum of 50% of the wheelbase of the vehicle.

NOTE: If a towball is fitted to the vehicle, the body dimensions must incorporate a towball clearance zone in accordance with local requirements. For additional information, refer to Australian Standard 4177.1 and ECE 55.

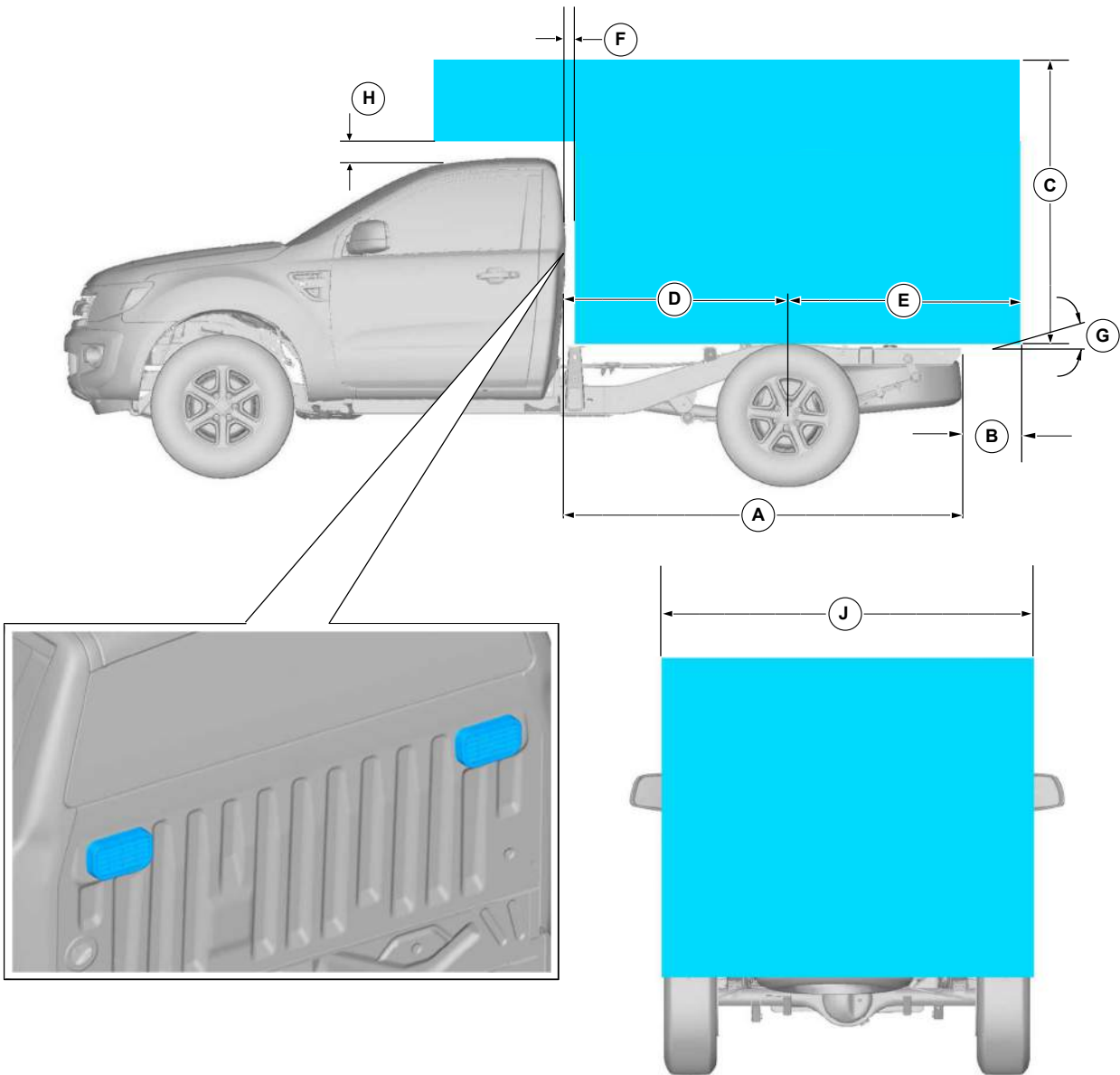
If a conversion requires more than 50% overhang, please contact one of the below.

For further information please contact your local National Sales Company representative, or Local Ford Dealer.

Load carrying structures should not be mounted onto an existing load tray or load box. Body attachment points are provided on the frame.

Refer to: 5.1 Body (page 65).

Chassis Cab Body - Single Cab Illustrated



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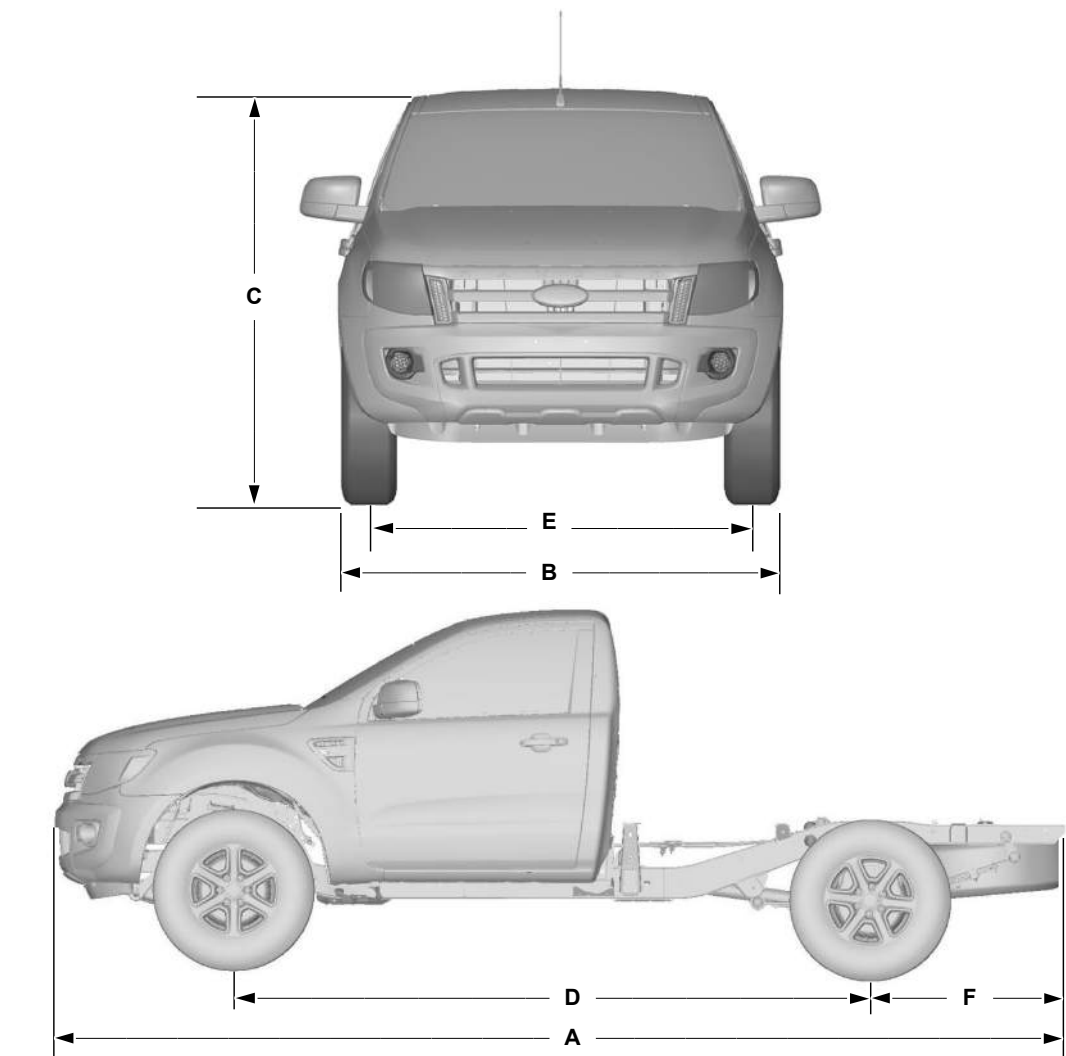
Dimensions - not to exceed for Chassis Cab body Length

Description		Dimension (mm)		
		Single Cab	Stretch Cab	Double Cab
A	Frame length behind back of cab (not including rear light cross-member)	2251	1781	1483
B	Under run bar and towing attachment legislation to be maintained			
C	Maximum recommended external body height	2400 over the top of frame, provided load distribution requirements are met		
D	Front outside of body to rear axle	1241	771	473
E	Maximum recommended rear overhang	1610 (50% of vehicle wheelbase), provided load distribution requirements are met		
F	Clearance between the back of the cab and the body	25 Minimum		
G	Ensure local lighting legislation is maintained Refer to: 4.3 Exterior Lighting (page 52) .			
H	Clearance between the top of the cab and the body	30		
J	Maximum external body width	1880		

All dimensions (shown in mm) are subject to manufacturing tolerances and refer to min specification models which do not include additional equipment. The illustrations are for guidance only.

1.11.2 Chassis Cab Body - Basic Dimensions and Weights

Chassis Cab Body - Single Cab Illustrated



E134164

Chassis Cab Body - Basic Dimensions and Weights

Description		Single Cab	Stretch Cab	Double Cab
A	Overall length (mm)	5110		
B	Overall width - excluding exterior mirrors (mm)	1850		
C	Overall height 4x2 (mm)	1703	1706	1716
C	Overall height 4x4 (mm)	1800-1806	1804 - 1810	1815 - 1821
D	Wheelbase (mm)	3220		
E	Track - front 4x2 (mm)	1590		
E	Track - front 4x4 (mm)	1560		
E	Track - rear 4x2 (mm)	1590		
E	Track - rear 4x4 (mm)	1560		
F	Rear Overhang (mm)	985		
-	Gross Vehicle Mass GVM (kg)	2925		
-	Gross Vehicle Mass GVM (kg)*	3200		
-	Front Axle Load (kg)	1325		
-	Front Axle Load (kg)*	1480		
-	Rear Axle Load (kg)	1755		
-	Rear Axle Load (kg)*	1850		

* Vehicles with increased ride height.

1.11.3 Kerb Weights and Payload

Details of vehicle kerb weights and payload capacities are given in the vehicle weights table, which is provided as a supplement to this document. Refer to the vehicle weights table for further information.

1.11.4 Front, Rear and Side Under-run Protection

WARNING: Check local legislation for legal requirements.

Front Under run Protection, Rear Under run Protection and Side Under run Protection must meet the requirements of local design rules.

1.12 Hardware—Specifications

Material Specification, Strength and Torque




Standard Hardware and Tightening Torques (Nm) Bolts/Studs: ISO 898-1, Nuts: ISO 898-2						
	Grade 4.8		Grade 8.8		Grade 10.9	
Thread Size	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
M4	1.1	1.4	2.4	3.4		
M5	2.2	2.7	4.9	6.7		
M6	3.7	4.7	8.5	11.5	11.0	15.0
M8			20.0	28.0	25.0	35.0
M10			41.0	55.0	50.0	70.0
M12			68.0	92.0	95.0	125.0
M14			113	153	150	200
M16			170.0	230.0	230.0	310.0
M18			252.0	317.0	317.5	399.4
M20			345.0	430.0	434.7	541.8
M22			470.0	590.0	592.2	743.4
M24			600.0	750.0	756.0	945.0

This torque chart is a recommendation and the converter is responsible for the optimal torque for a specific joint.

1.13 Load Distribution—Specifications

1.13.1 Load Distribution Calculations - Driver and Passenger Weight Distribution

CAUTIONS:

-  **Do not exceed the axle plated weights.**
-  **Do not exceed the gross vehicle weight.**
-  **Tire manufacturer specification must be maintained.**

NOTE: Uneven load distribution could result in unacceptable handling and braking characteristics.

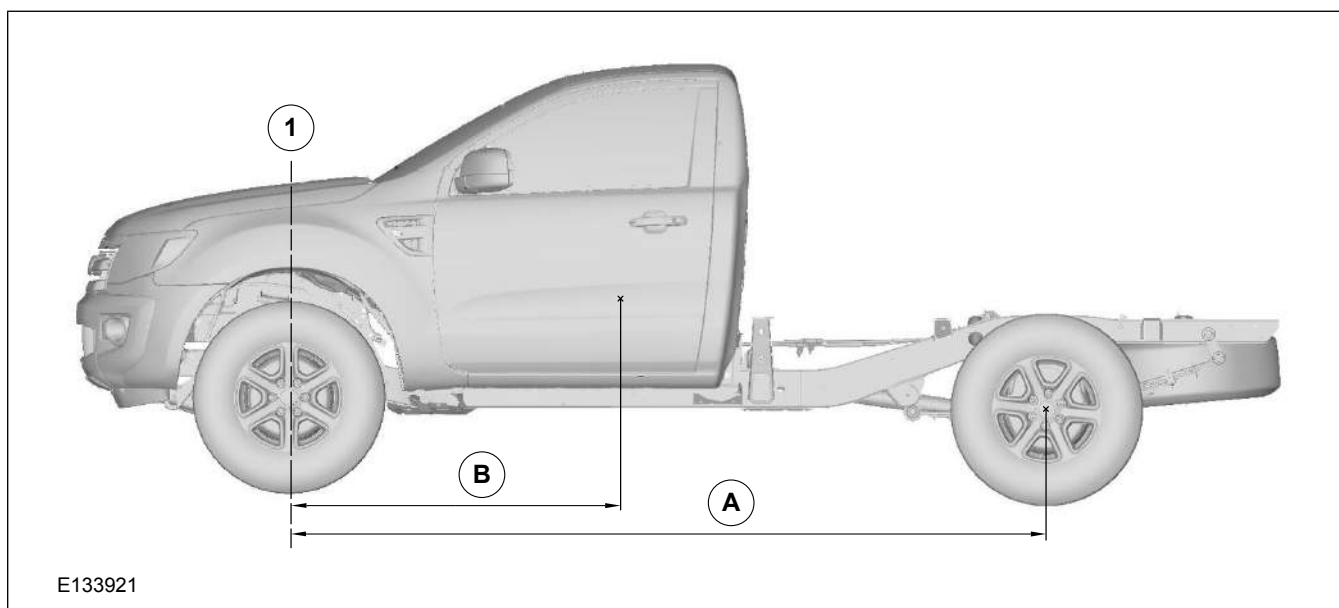
NOTE: Over loading of the vehicle could result in unacceptable ground clearance.

NOTE: The centre of mass of the body equipment and the payload it contains should be located within the dimensions given.

NOTE: Avoid one-sided load distribution.

NOTE: For further information please contact your local National Sales Company representative, or Local Ford Dealer.

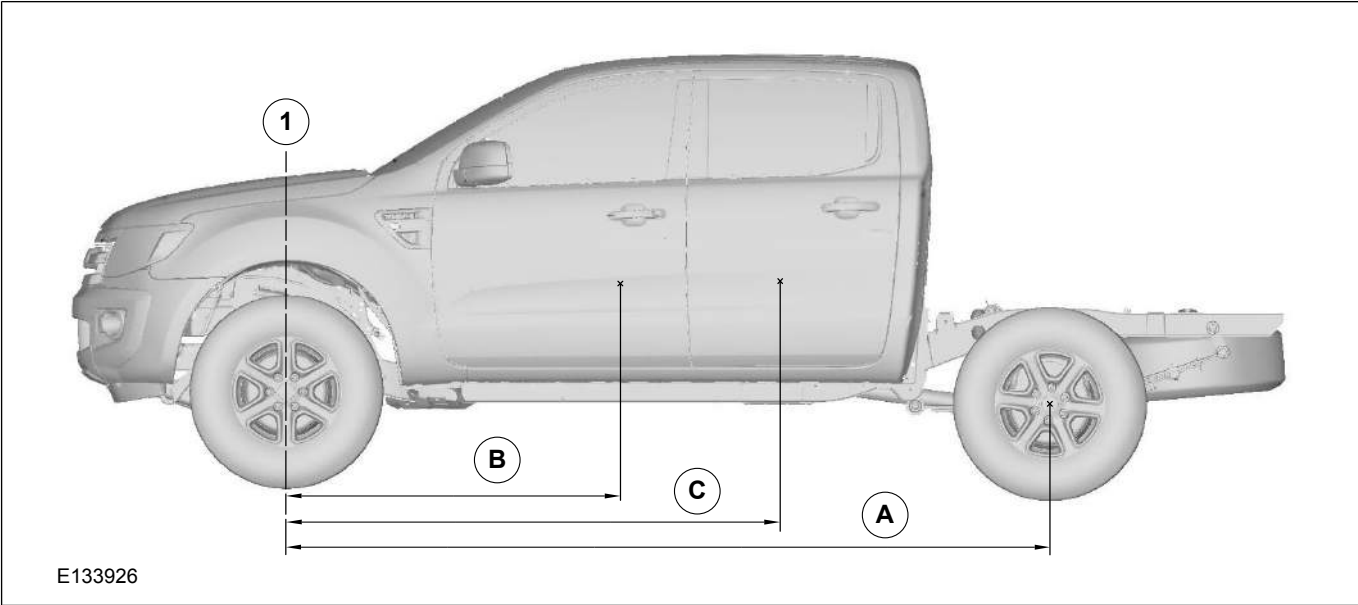
Single Cab



Single Cab Driver and Passenger Weight Distribution

'A' Wheelbase (mm)	'B' Front row seats and driver (mm)	Weight distribution per person (Kg)		
		On Front Axle	On Rear Axle	Total
3220	1490	40	35	75

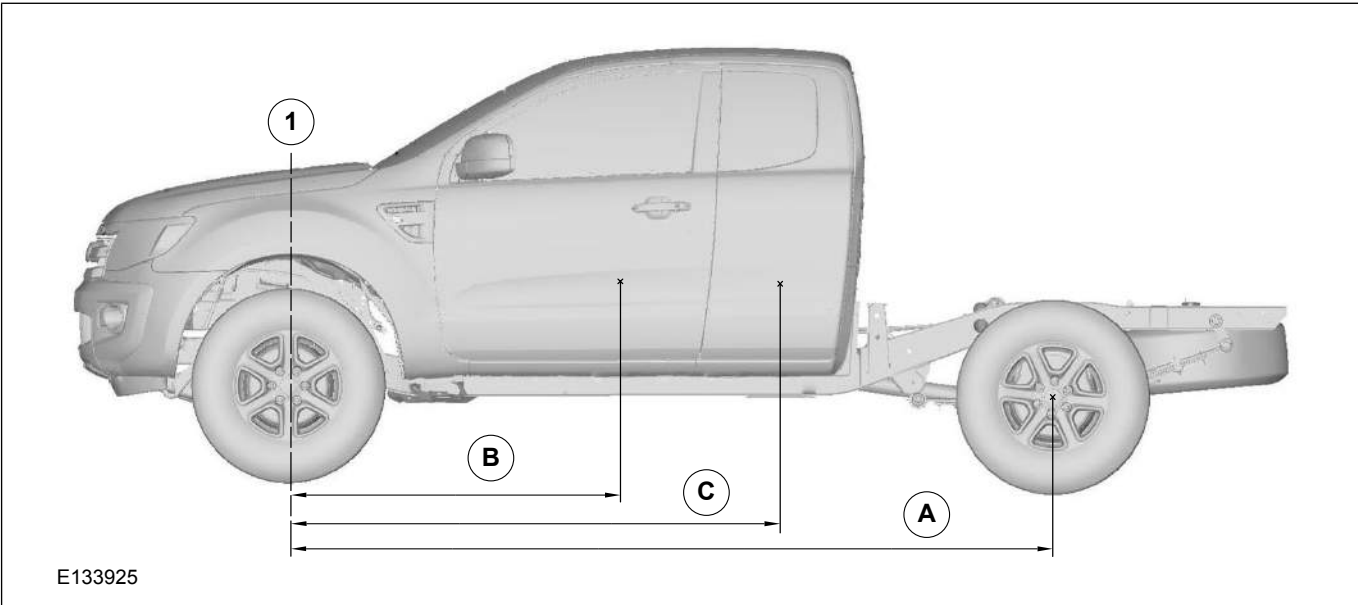
Double Cab



Double Cab Driver and Passenger Weight Distribution

'A' Wheelbase (mm)	'B' Front row seats and driver (mm)	'C' Second row seats (mm)	Weight distribution per person (Kg)		
			On Front Axle	On Rear Axle	Total
3220	1490	-	40	35	75
-	-	2310	21	54	75

Stretch Cab



RAP Cab Driver and Passenger Weight Distribution

'A' Wheelbase (mm)	'B' Front row seats and driver (mm)	'C' Second row seats (mm)	Weight distribution per person (Kg)		
			On Front Axle	On Rear Axle	Total
3220	1490	-	40	35	75
-	-	2180	24	51	75

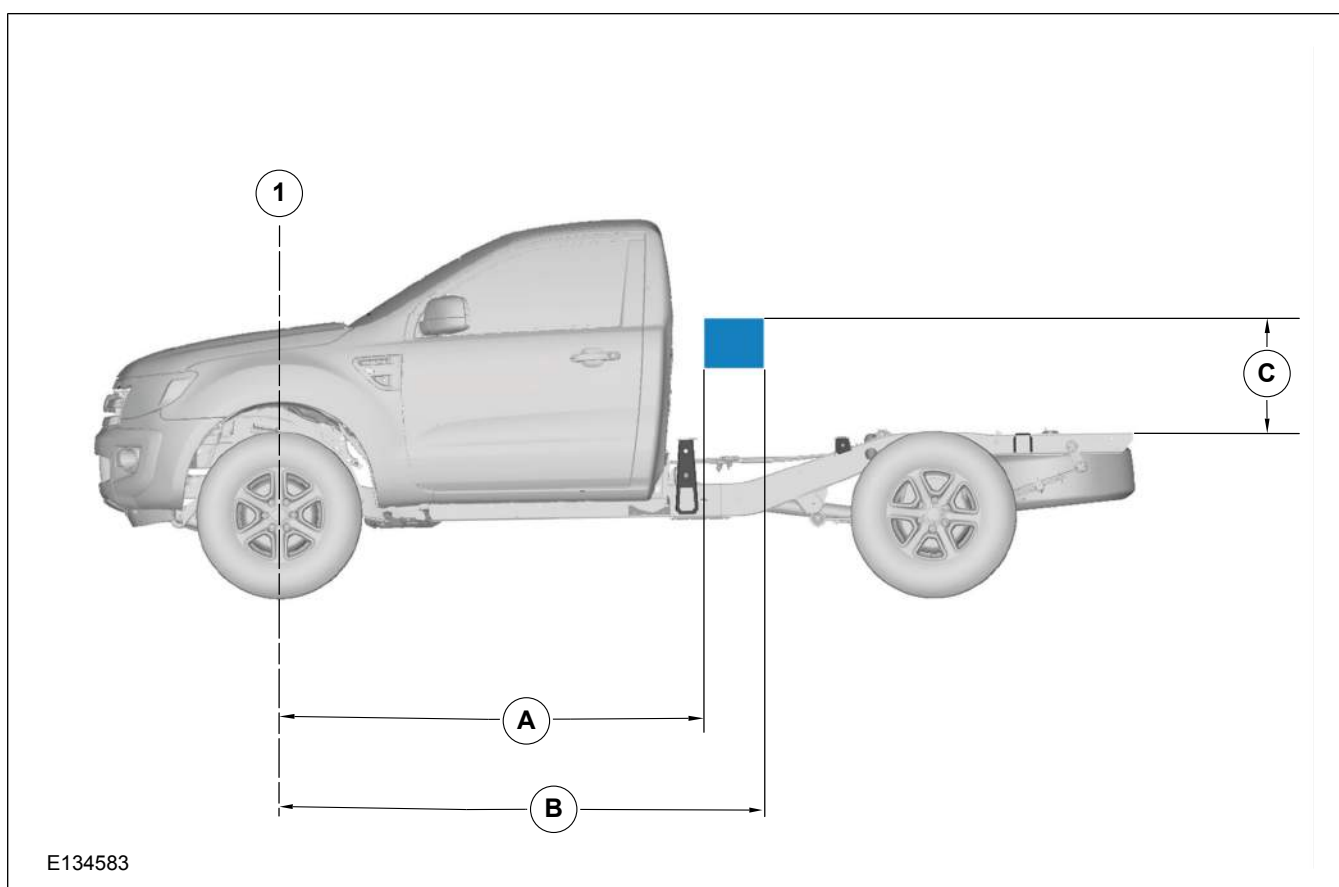
1.13.2 Center of Gravity

NOTE: Calculations shown are not inclusive of tow bar and other dealer fitted accessories.

The following charts define the recommended centre of gravity position for the mass added to the vehicle by the vehicle converter.

"Added mass" includes all added body equipment and cargo, but excludes passengers seated in standard cab seating.

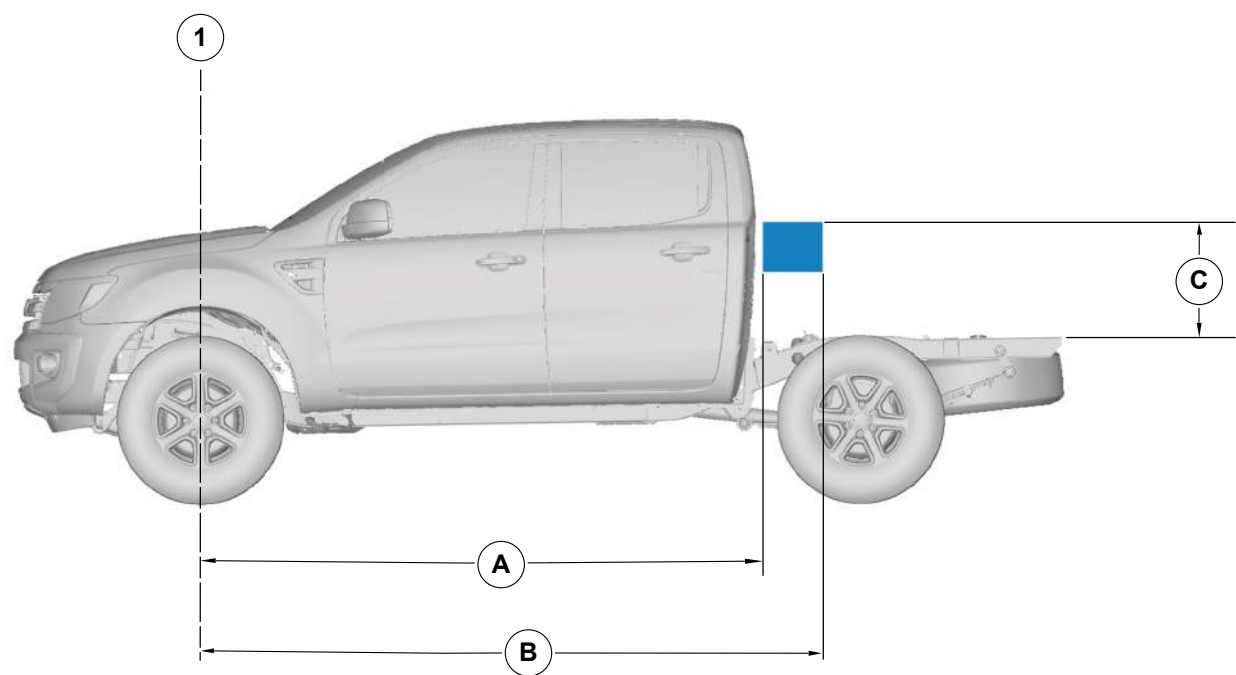
For double cab vehicles, there is a limit to the added mass that must be observed, in addition to not exceeding the gross axle and train weights.

Single Cab**Single Cab Center of Gravity Critical Zone**

Model	Recommended C of G location for added mass		
	'A' Min (mm)	'B' Max (mm)	'C' Max (mm)
4x2	1965	3220	740
4x2*	1965	3435	590
4x4	1965	3435	590

* Vehicles with increased ride height.

Double Cab



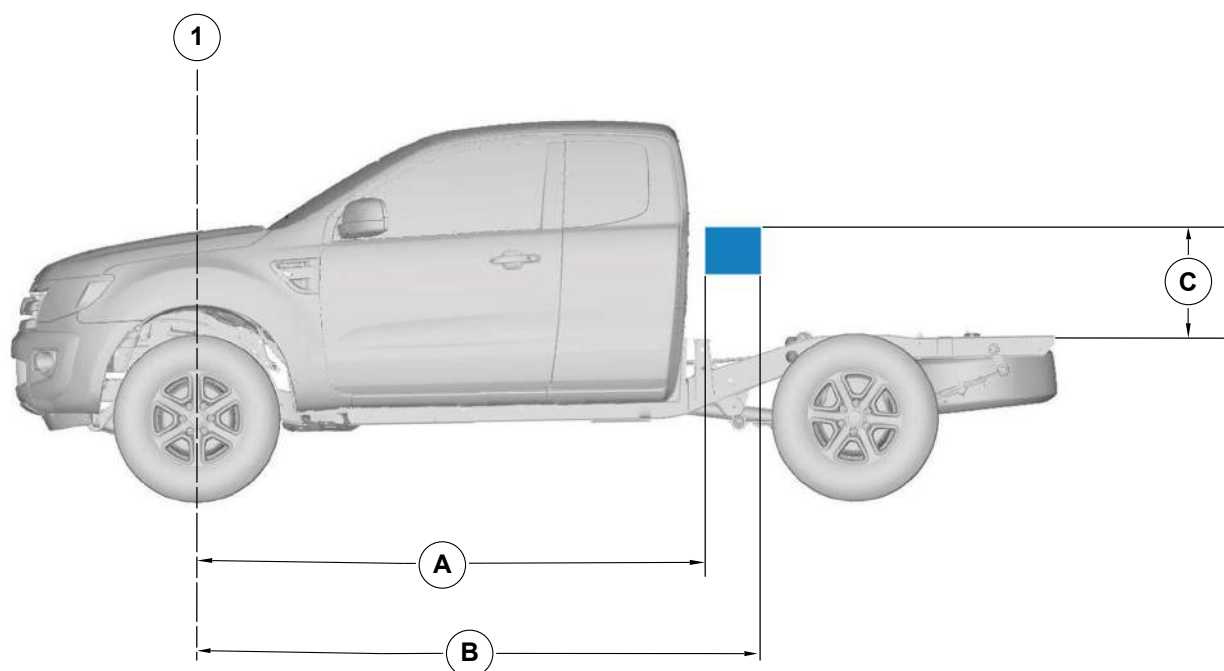
E134585

Double Cab Centre of Gravity Critical Zone

Model	Recommended C of G location for added mass			Max gross added mass (kg)
	'A' Min (mm)	'B' Max (mm)	'C' Max (mm)	
4x2	2585	3615	740	700
4x2*	2435	3615	590	625
4x4	2435	3615	590	700

* Vehicles with increased ride height.

Stretch Cab



E134584

Stretch Cab Center of Gravity Critical Zone

Model	Recommended C of G location for added mass		
	'A' Min (mm)	'B' Max (mm)	'C' Max (mm)
4x2	2395	3220	740
4x2*	2365	3435	590
4x4	2365	3435	590

* Vehicles with increased ride height.

1.14 Towing

1.14.1 Towing Requirements

When a towing device is required, the Vehicle Converter should use a Ford approved tow bar.

Refer to: 1.13 (page 23).
Load Distribution.

Refer to: 1.6 Jacking (page 12).

1.14.2 Towing

WARNINGS:

 **Do not exceed the Gross Train Weight (GTW) or towing capacities stated in this section.**

 **Ensure that the trailer nose weight falls within the specified range.**

For towing devices fitted by the Vehicle Converter the following applies:

Towing capacities - For Base series

Variant	Drive	Transmission	Without trailer brake kg (lbs)	With trailer brake kg (lbs)	Max. Gross Train Weight kg (lbs)
2.5L Petrol	4X2	Manual	750 (1654)	1500 (3307)	4425 (9755)
	4x2*	Manual	750 (1654)	1500 (3307)	4525 (9976)
	4x4	Manual	750 (1654)	1100 (2425)	4125 (9094)
2.2L Diesel (88kW)	4X2	Manual	750 (1654)	1500 (3307)	4425 (9755)
	4x4	Manual	750 (1654)	1500 (3307)	4525 (9976)
2.2L Diesel (92kW)	4x2* and 4x4	Manual	750 (1654)	1500 (3307)	4700 (10362)
2.2L Diesel (110kW)	4x2	Manual	750 (1654)	1500 (3307)	4425 (9755)
	4x2* and 4x4	Manual	750 (1654)	1500 (3307)	4700 (10362)
3.2L Diesel	4x2* and 4x4	Manual	750 (1654)	1500 (3307)	4700 (10362)

- Towing capacities must not exceed those of the unmodified vehicle.
- Any modifications to the vehicle must be noted in the owner's handbook or new descriptive literature included with the owner's documentation.
- Tow bar installations must meet the requirements of the local design rules.
- Whenever frame drilling is necessary use tube reinforcement.

Refer to: 5.5 Frame and Body Mounting (page 81).

1.14.3 Towing capacities

NOTE: The towing capacities below relate to vehicles with Ford tow bars only.

Towing capacities- For all other series

Variant	Drive	Transmission	Without trailer brake kg (lbs)	With trailer brake kg (lbs)	Max. Gross Train Weight kg (lbs)
2.5L Petrol	4X2	Manual	750 (1654)	2200 (4850)	5125 (11299)
	4x2*	Manual	750 (1654)	1700 (3748)	4900 (10803)
	4x4	Manual	750 (1654)	1100 (2425)	4300 (9480)
2.2L Diesel (88kW & 92kW)	4X2	Manual	750 (1654)	2200 (4850)	5125 (11299)
	4x2* and 4x4	Manual	750 (1654)	1600 (3527)	4800 (10582)
2.2L Diesel (110kW)	4x2	Manual	750 (1654)	2500 (5512)	5425 (11960)
	4x2* (Final drive ratio 3.31)	Manual	750 (1654)	1800 (3968)	5000 (11023)
	4x2* and 4x4 (Final drive ratio 3.55)	Manual	750 (1654)	3350 (7386) ¹ 3500 (7716) ²	5950 (13118) ¹ 6000 (13288) ²
	4x2* and 4x4	Auto	750 (1654)	3350 (7386) ¹ 3500 (7716) ²	5950 (13118) ¹ 6000 (13288) ²
3.2L Diesel	4x2* and 4x4 (Final drive ratio 3.31)	Manual	750 (1654)	1800 (3968)	5000 (11023)
	4x2* and 4x4 (Final drive ratio 3.55)	Manual	750 (1654)	3350 (7386) ¹ 3500 (7716) ²	5950 (13118) ¹ 6000 (13288) ²
	4x2* and 4x4	Auto	750 (1654)	3350 (7386) ¹ 3500 (7716) ²	5950 (13118) ¹ 6000 (13288) ²

*Vehicles with increased ride height

¹ European vehicles built before 11th March 2013, Australia and New Zealand vehicles built before 1st November 2012 and all non European/Australian/New Zealand vehicles.

² European vehicles built on or after 11th March 2013 and Australia and New Zealand vehicles built on or after 1st November 2012.

1.14.4 Trailer Nose Weight

NOTE: The maximum trailer nose weight values below relate to vehicles with Ford tow bars only.

Trailer Nose Weight

Region / Vehicle	Minimum trailer nose weight	Maximum trailer nose weight
Australia and New Zealand - Vehicles built before 1st November 2012	10% of the towed weight	335 kg
Australia and New Zealand - Vehicles built on or after 1st November 2012	10% of the towed weight	350 kg
Rest of World	6% of the towed weight	225 kg for 4x2* and 4x4
		165 kg for 4x2


* Vehicles with increased ride height.


1.14.5 Towing Specifications

For any further details and advice please consult your local National Sales Company representative, or Local Ford Dealer.

2.1 Suspension System


WARNINGS:

 **Do not modify, drill, cut or weld any suspension components, specifically the steering gear system, subframe or anti-roll bars, springs or shock absorbers including mounting brackets.**

 **The rear leaf springs are pre-stressed in manufacture and should not be altered for rate or height in any way during vehicle conversion. Adding or removing leaves may result in failure or reduced function of the spring as well as other vehicle related issues for which Ford Motor Company can not be held responsible.**

CAUTIONS:

 **Modifications to the suspension system can cause a deterioration of the vehicle handling characteristics and durability.**

 **When carrying out welding work the springs must be covered to protect them against weld splatter.**

 **Do not touch springs with welding electrodes or welding tongs.**

NOTE: Do not modify the wheelbase or add any type of frame extension to vehicles fitted with Electronic Stability Program ESP.

NOTE: Do not damage the surface or corrosion protection of the spring during disassembly and installation.

NOTE: Do not add any additional axles.

2.2 Brake System

2.2.1 General

The Brake System must be fully functional when the vehicle conversion is completed. The vehicle brake operating modes must be checked, including warning system and parking brakes.

WARNING: Do not restrict the airflow and cooling to the brake system.

NOTE: Do not obstruct the view of the brake fluid reservoir level.

The brake fluid reservoir must remain accessible for servicing and for adding brake fluid.

2.2.2 Brake Hoses

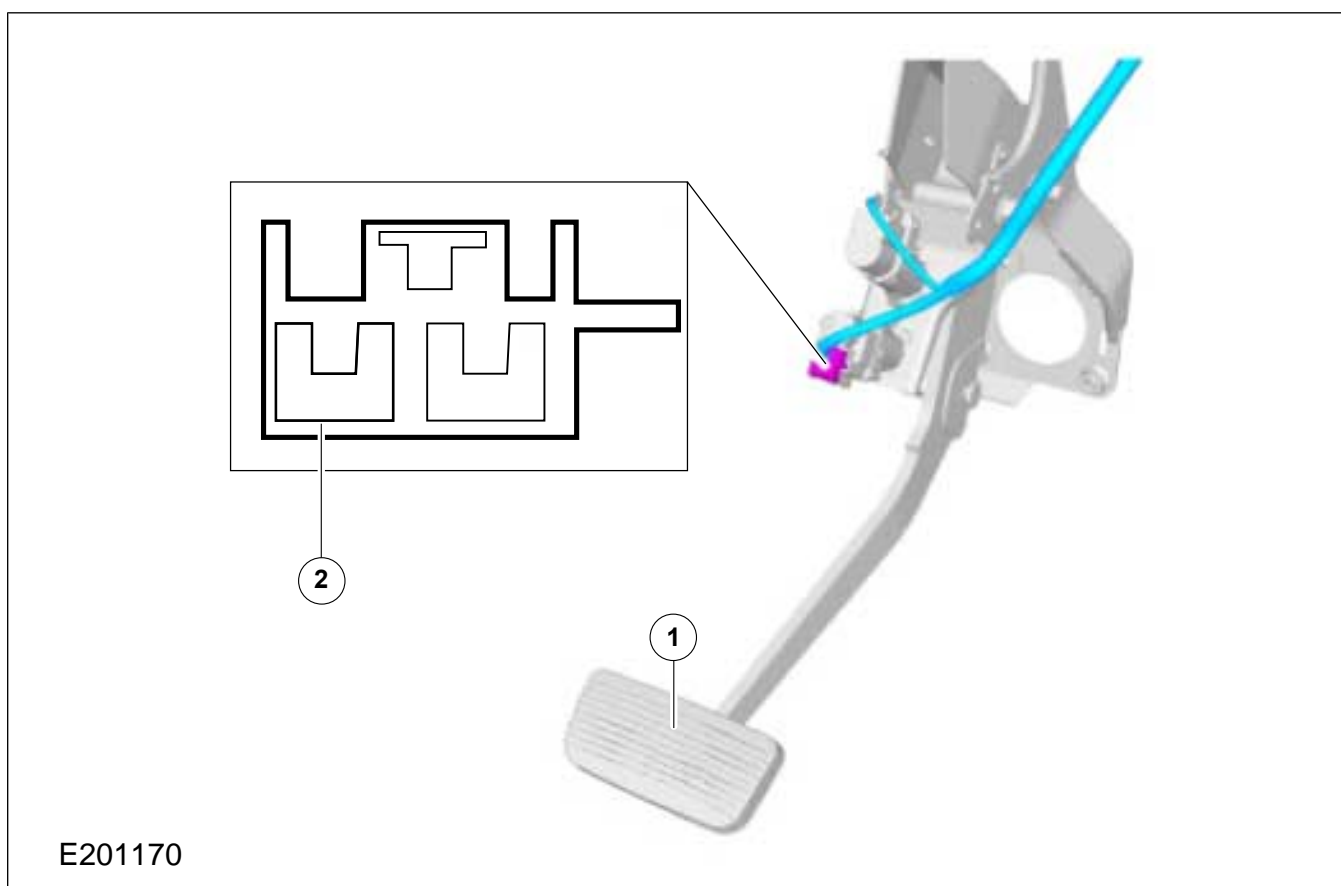
CAUTION: Make sure that the front and rear brake hoses are not twisted and are correctly located away from body and chassis components.

Front and rear brake hoses must not rub, chafe or rest on body or chassis or body components. There must be clearance under all operating conditions, between full compression and extension and full lock to lock.

Brake lines must not be used to support or secure any other component.

2.2.3 Trailer brakes

If electric trailer brakes are to be installed, they can be triggered by the brake light switch. The brake light switch is the lower of 2 switches positioned above the brake pedal inside the cabin. The maximum additional load is 1A.





Brake Light Circuit Feed




Item	Description
1	Brake Pedal
2	+12V when brake pedal is pressed

3.1 Fuel System

WARNINGS:

-  **Make sure that the modified vehicle complies with all relevant legal requirements.**
-  **Do not remove or relocate the fuel cooler when modifying vehicle.**

CAUTIONS:

-  **Ensure modifications to vehicle do not obstruct airflow to fuel cooler.**
-  **Make sure that sufficient clearance is maintained for all driving conditions to all hot and moving components.**
-  **Make sure that there are no sharp edges, including fasteners, pointing towards any fuel system component.**

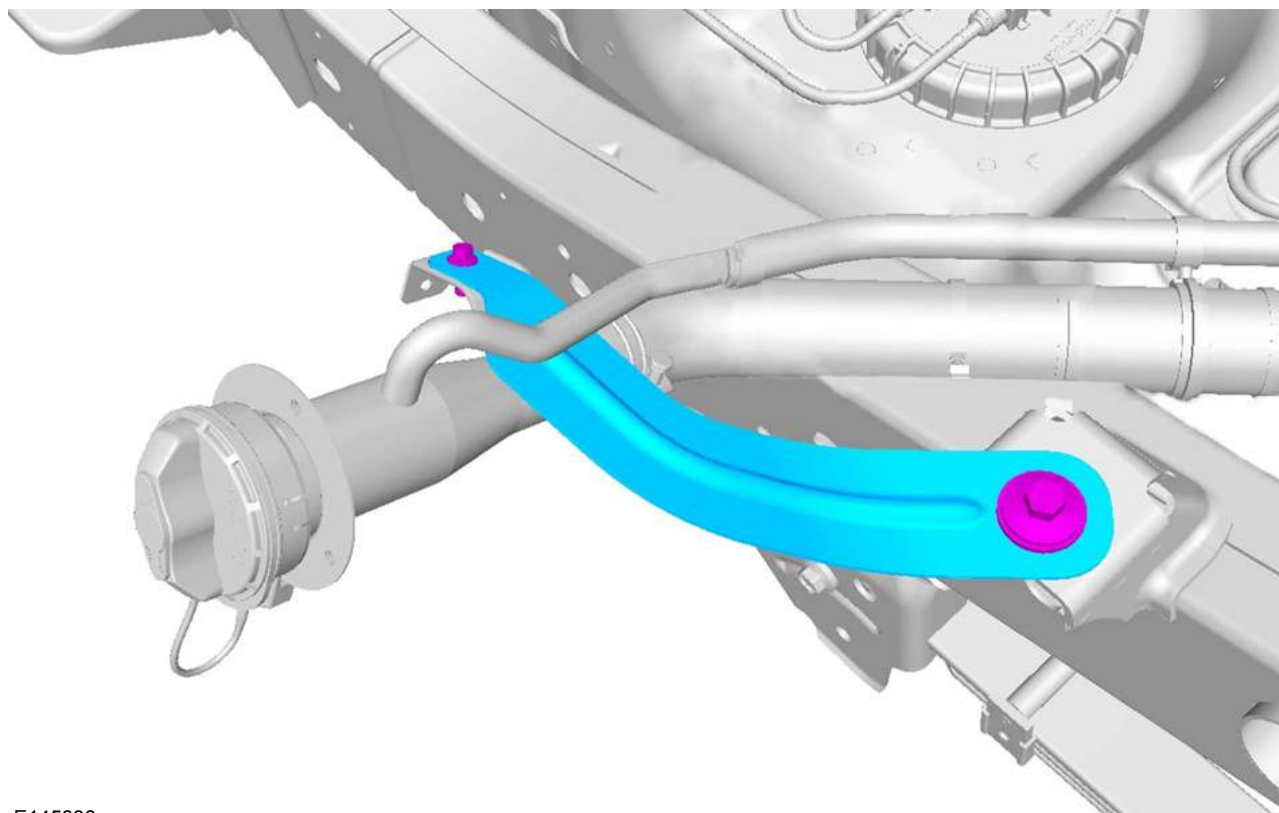
-  **The fuel filler pipe must be supported in accordance with the guidelines in this section.**

3.1.1 Fuel Filler Pipe Shipping Bracket

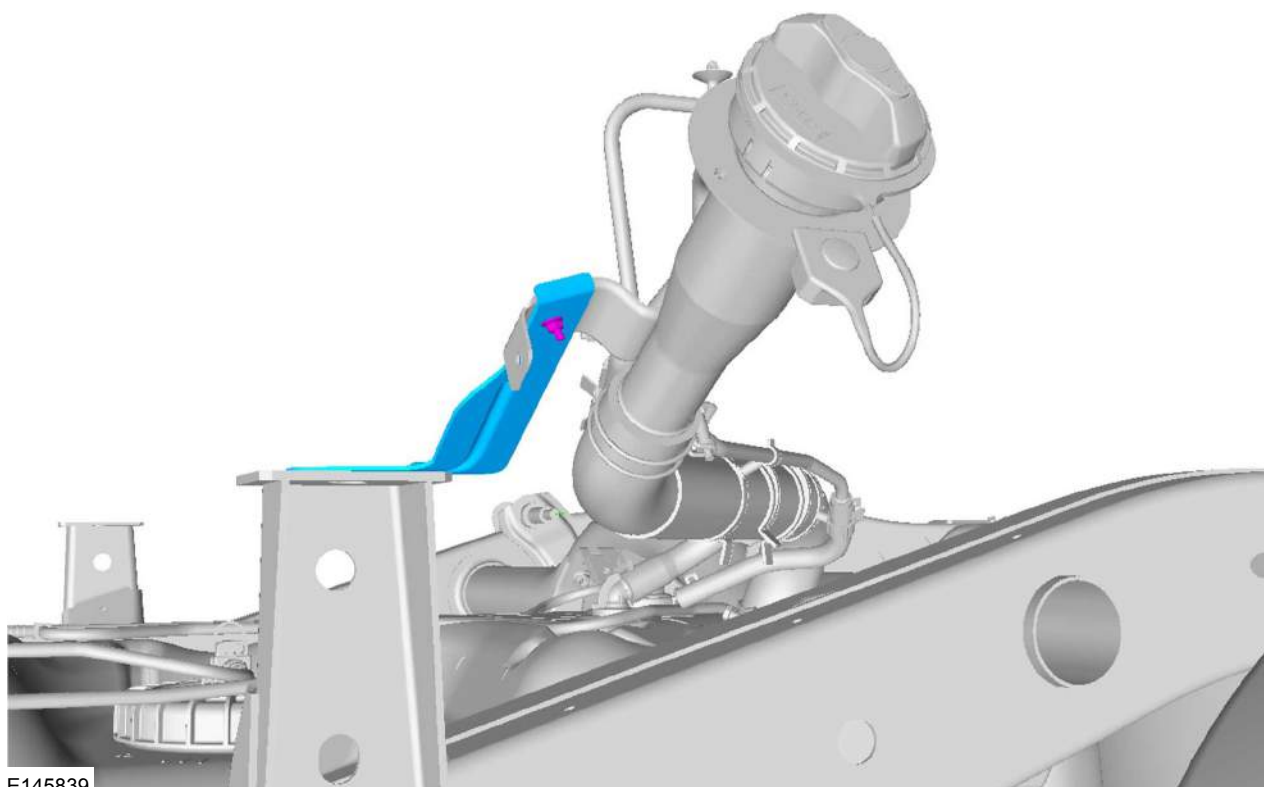
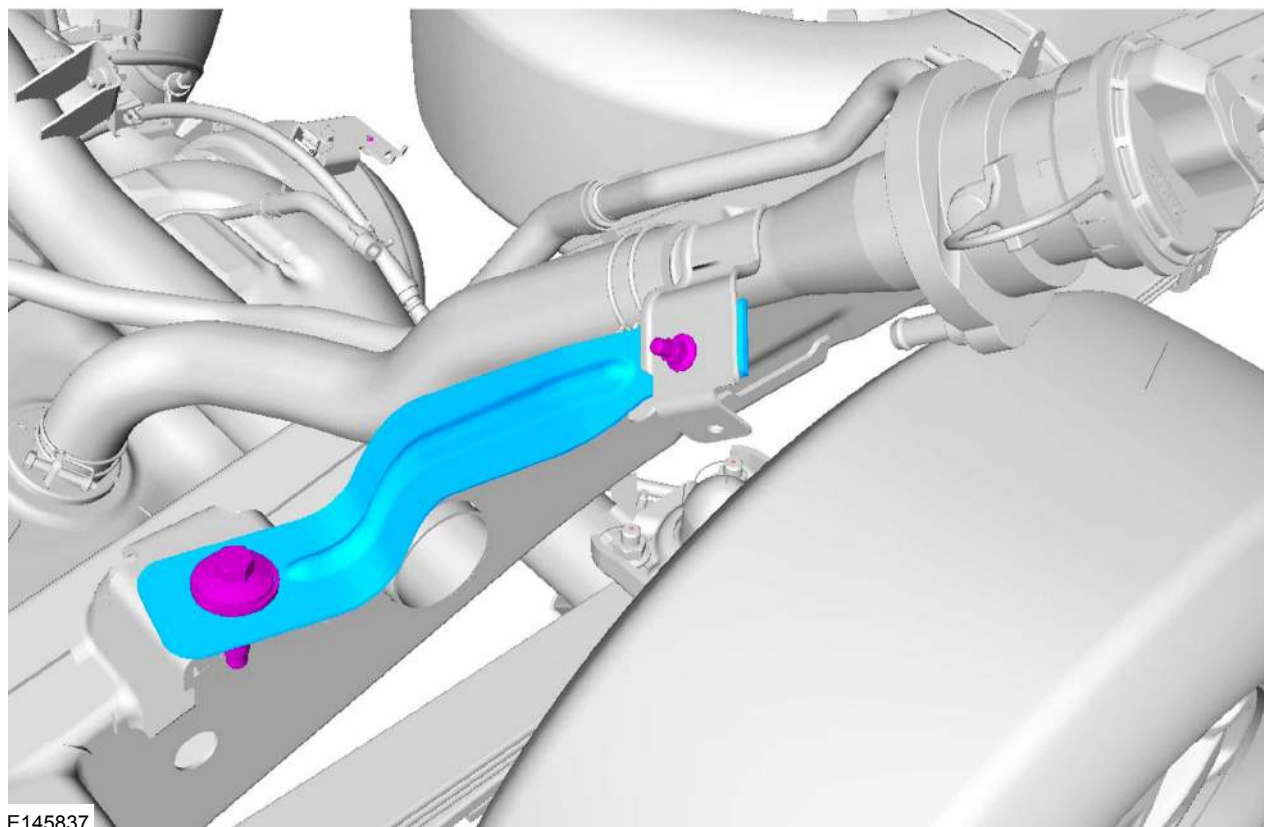
-  **CAUTION: The fuel filler pipe mounting bracket on cab chassis vehicles is designed for shipping of the vehicle only.**

The fuel filler pipe mounting bracket fitted to cab chassis vehicles is designed to be removed once the body or tray is fitted to the vehicle. The body or tray must include a fuel filler mounting that complies with the guidelines in this section. The shipping bracket can be left installed on the vehicle if desired, but only if an additional fuel filler pipe mounting bracket is used in accordance with the guidelines in this section.

Fuel Filler Pipe Shipping Bracket - Single Cab



E145838

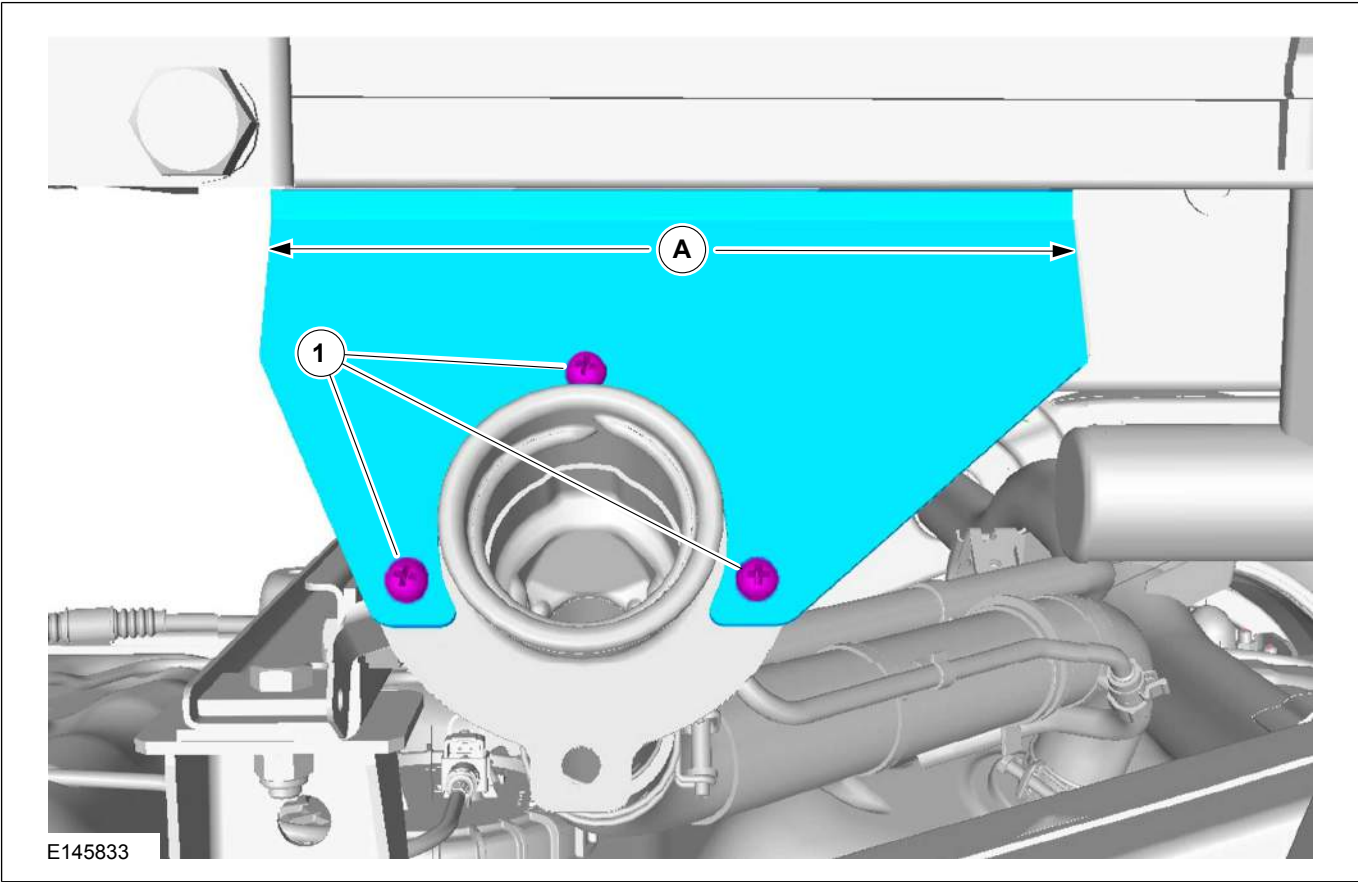
Fuel Filler Pipe Shipping Bracket - Stretch Cab**Fuel Filler Pipe Shipping Bracket - Double Cab**

3.1.2 Fuel Filler Mounting

CAUTION: Make sure that the filler neck mounting bracket is made of a conductive material, and that it provides a grounding path for the fuel filler neck.

If the vehicle body and mounting bracket does not provide a grounding path for the fuel filler neck, an earth strap must be added, connecting the filler neck to the chassis frame.

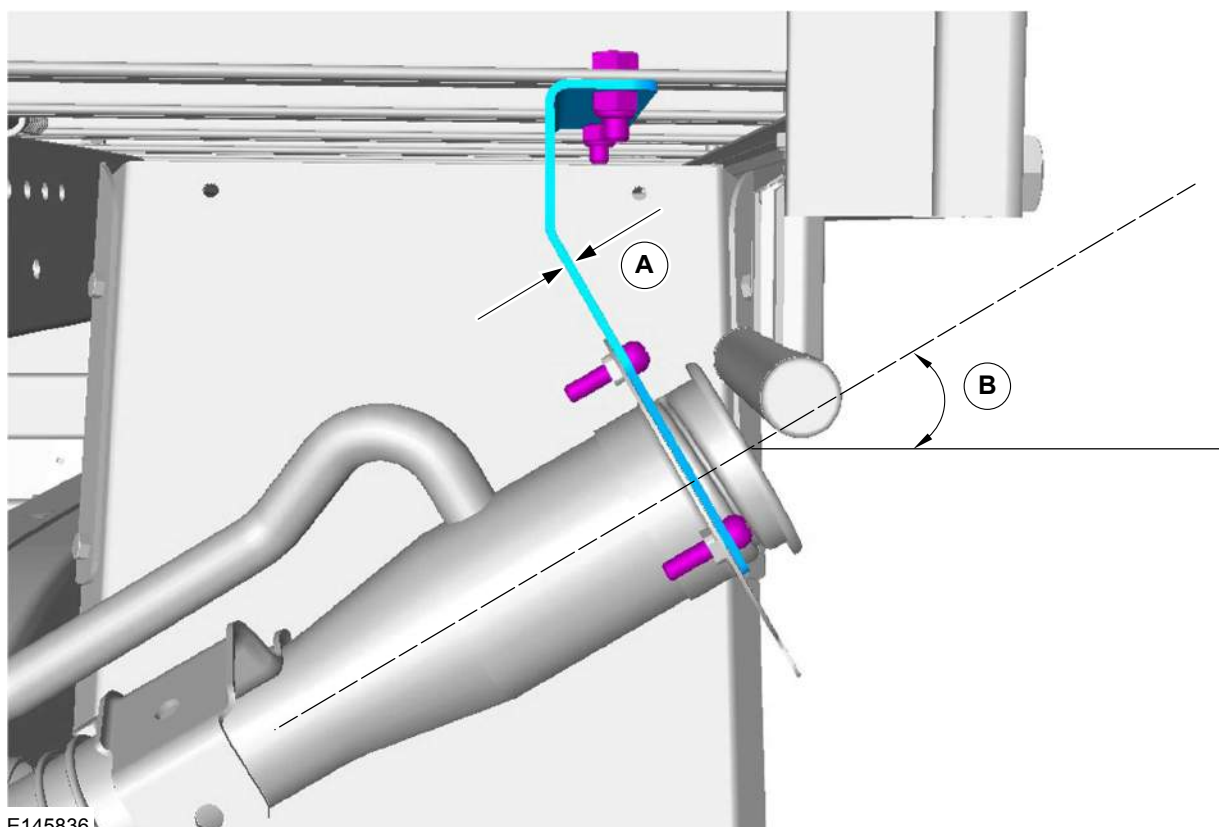
Fuel Filler Mounting Bracket



Fuel Filler Mounting Notes

Item	Description
A	180 mm minimum at the area must be adhered to above the filler neck
1	All 3x hardware fixation points on the filler neck must be utilised

Angle of Filler Neck

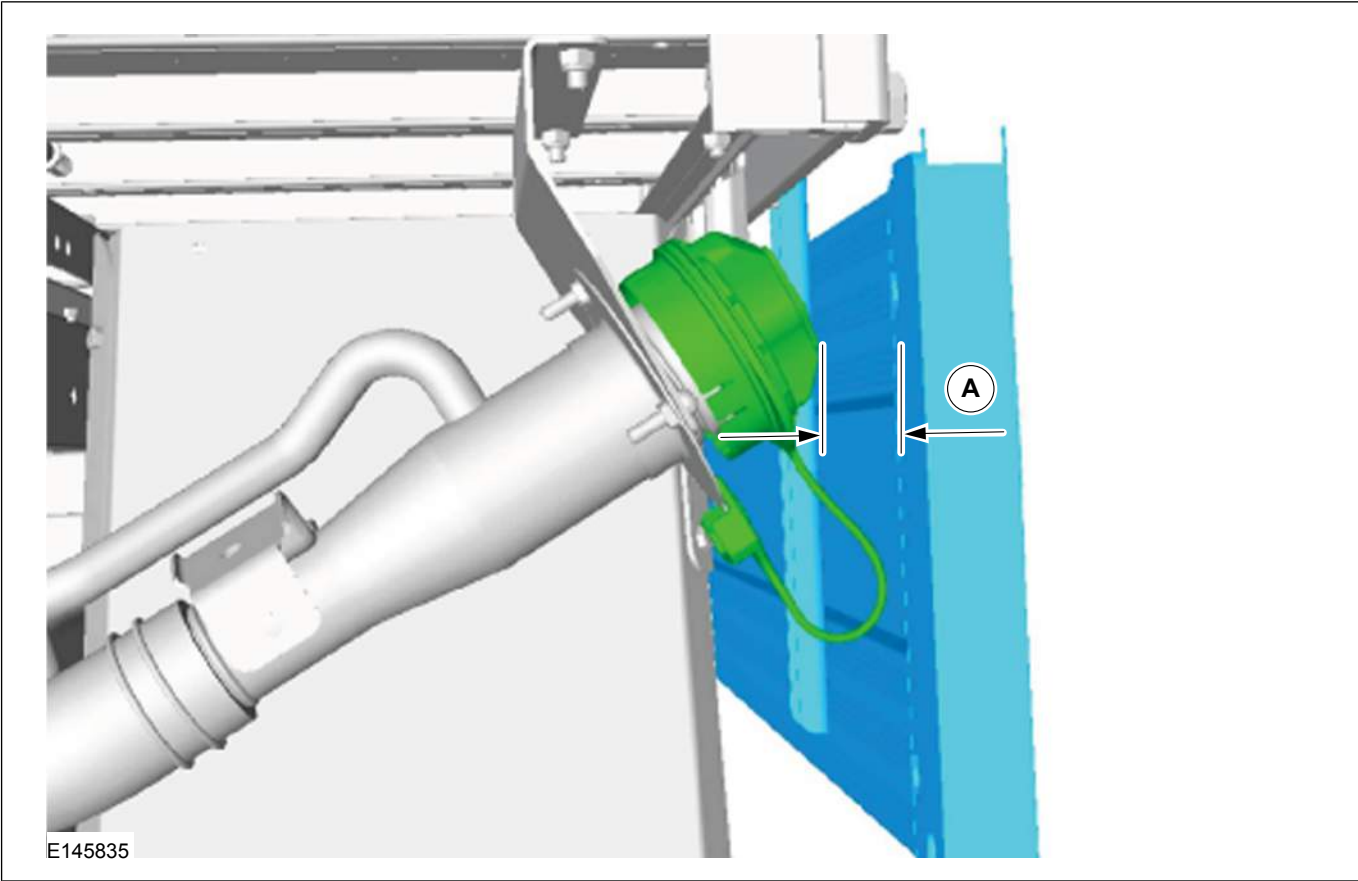


E145836

Filler Neck Installation Dimensions

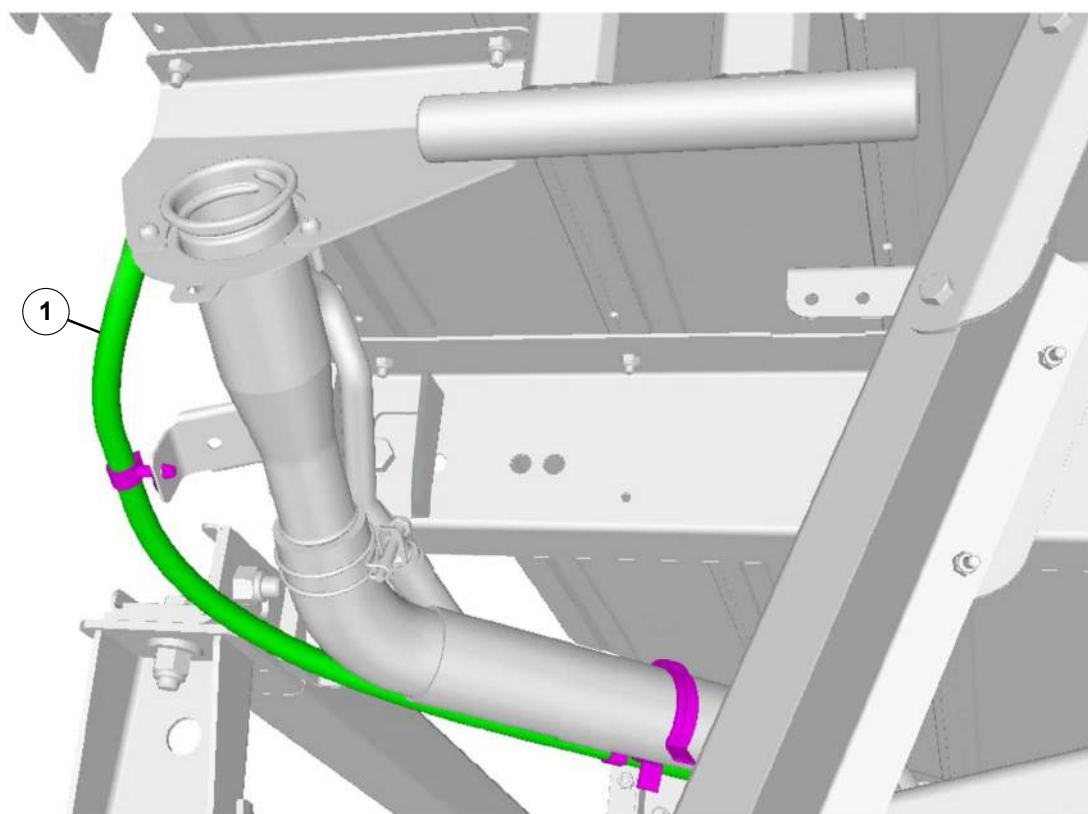
Item	Description
A	2mm minimum bracket thickness
B	30°

Clearance From Vehicle Body



Item	Description
A	At least 9mm clearance between the fuel filler cap and vehicle body, in the worst case opening angle if applicable

Axle Breather Hose and Vent Hose



E145834

Item	Description
1	The rear differential breather hose should be mounted to the filler neck/vehicle body

3.1.3 Fuel Filler Vent Hose

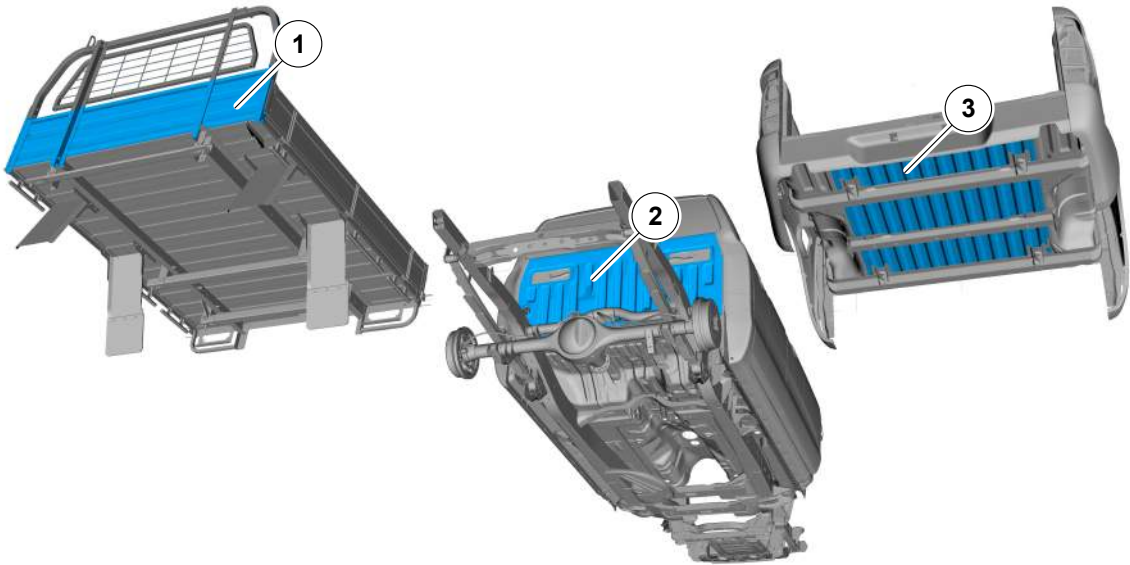
- The fuel tank vent hose should be clipped to the vehicle body, with the open end at least 600mm (4x2) or 800mm (4x4 or vehicles with increased ride height) above ground height.
- The fuel tank vent hose should be protected and positioned away from direct water spray, wheel splash and mud splash.
- The fuel tank vent hose must be pointing in a downward direction.

Fuel Filler Vent Hose



E170965

Fuel Tank Vent Hose Mounting Locations



E171721

Item	Description
1	Front lower head board of the aluminium load tray (load tray rotated for clarity)
2	Rear of the passenger cabin (cabin back panel)
3	Underside of the pick up box load tray

4.1 Battery and Cables

4.1.1 Battery Information

If a battery is disconnected, there is no requirement to reprogram the vehicle; the vehicle retains its 'normal' power management setting and remembers exactly what its previous configuration was (although the central locking latches may cycle if a door or lock latch was opened manually in the intervening period). All radio settings will be retained, but the key code needs to be entered to restore functionality. The clock will need resetting.

Battery Voltage Requirements and Testing

All voltages are to be measured with an accuracy of: $\pm 5\%$ of published values.

To maximize battery life, at the time of arrival at the vehicle converter, all batteries must have a minimum Open Circuit Voltage (OCV) of not less than 12.75 volts.

When the battery is installed and connected to the vehicle's electrical system with no load, the Closed Circuit Voltage (CCV) must not be less than 12.65 volts. When the vehicle is released to the customer, the CCV must not be less than 12.50 volts.

Surface Charge Dissipation

Prior to carrying out manual voltage checks, it is necessary to establish that the battery voltage is stable and free from surface charges, that could be present due to certain engine run conditions making the voltage readings unreliable and inaccurate.

To ensure surface charges are not present the following actions are recommended:

1. Turn the ignition key to "ON" (do not start the engine) and switch on the headlamps (main beam) and if fitted, the heated front window, rear window demister and the heater blower motor (on position II). Leave the vehicle in this condition for at least 1 minute to dissipate what ever surface charge is present in the battery.
2. Turn the ignition key to position "OFF" and switch off the loads; headlamps, heated windshield/rear window demister and heater blower motor. Leave the vehicle in this condition for at least 5 minutes, before taking a battery voltage reading.

Delayed Vehicles

Vehicles held at the vehicle convertor premises and not in use for longer than 4 days, should have the battery's negative cable disconnected. Before shipping to the customer, the battery negative cable must be re-connected and the voltage re-checked. The voltage should be not less than 12.5 volts.

Battery Charging Procedure

1. Cold batteries will not readily accept a charge. Therefore, batteries should be allowed to warm up to approximately 5°C (41°F) before charging. This may require four to eight hours at room temperature depending on the initial temperature and battery size.
2. A battery which has been completely discharged may be slow to accept a charge initially, and in some cases may not accept a charge at the normal charger setting. When batteries are in this condition, charging can be started by use of the dead battery switch on chargers that have this facility equipped.
3. To determine whether a battery is accepting a charge, follow the manufacturers instructions for the charger and the dead battery switch. If the switch is the spring-loaded type, it should be held in the ON position for up to three minutes.
4. After releasing the dead battery switch and with the charger still on, measure the battery voltage. If it shows 12 volts or higher, the battery is accepting a charge and is capable of being recharged. However, it may require up to two hours of charging, with batteries colder than 5°C (41°F) before the charge rate is high enough to show a charge on a ammeter. It has been found that all non-damaged batteries can be charged by this procedure. If a battery cannot be charged by this procedure, a new one should be installed.
5. A rapid recharge procedure has been developed for recharging batteries that have passed the load test and only need a recharge. This can be due to in-service no-start battery failures (vehicle will not crank due to low battery state of charge) or battery discharged in vehicle due to key-off loads.
6. With the cables then disconnected, the battery can be rapidly recharged by using either of the following methods:
 - Carry out a two hour charge using 20A constant current (manual setting on charger).
 - Carry out a two hour charge using a constant potential (automatic setting on charger).

- Please connect the battery charger to the vehicle ground - not the battery negative post. This is to ensure the Battery Monitoring System (if fitted) is able to identify the battery charger.

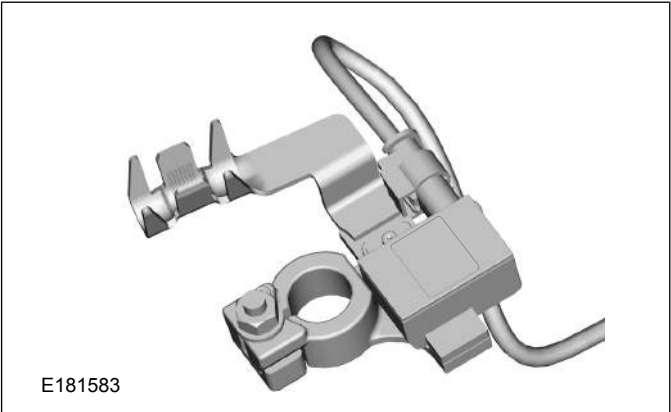
Battery Cable Fixing Torque

The battery cables should be fixed to the terminal posts with a torque of 4.8 Nm +/- 0.8Nm.

Battery Part Numbers and Usage

Ford Plant	Battery Supplier	Specifications	Size
Standard Duty Battery			
Thailand	Siam GS	60Ah, 590CCA, 105RC (Calcium Technology)	T6
South Africa	First National Battery	48Ah, 590CCA, 105RC (Silver Calcium Technology)	T6
South America	Moura	60Ah, 590CCA, 105RC (Silver Calcium Technology)	T6
Heavy Duty Battery			
Thailand	Siam GS	68Ah, 750CCA, 150RC (Calcium Technology)	T7
South Africa	First National Battery	68Ah, 750CCA, 150RC (Silver Calcium Technology)	T7
Auxiliary Battery (Vehicles with Special Equipment Pack)			
South Africa	First National Battery	80Ah, 800CCA, 140RC (VRLA AGM Deep Cycle Technology)	H7

Battery Monitor System (BMS)



Ford Ranger vehicles are equipped with a new feature called Battery Monitor System (BMS). This system measures the battery load in order to efficiently charge the battery while improving fuel economy and emissions.

It is important to ensure any additional electrical load or accessory is properly grounded to the vehicle's body, in order for the system to identify the additional load. If a connection is made to the battery negative terminal, the BMS will not identify the load or charge. This may cause the battery to be undercharged and consequently not able to re-start the vehicle.

Auxiliary Battery and with Battery Monitor System (BMS)

WARNING: Under no circumstances should a secondary battery connection be made directly to any of the vehicle's battery terminals.

NOTE: The addition of an auxiliary battery in a vehicle with BMS would cause both batteries to not reach a state of full charge. The system will only allow charging of the batteries during deceleration. Refer to Dual Batteries with Battery Monitor System (BMS) in this section.

NOTE: Disabling the BMS will negate the fuel economy benefit provided by the BMS. For vehicles equipped with BMS, an additional battery can be connected using one of the following methods:

- Use an in-vehicle battery charger (DC/DC converter) such as BCDC1220 model from Redarc (or similar) and ground it to the vehicle body.
- Request a Ford dealer to disable the BMS. Disabling the BMS enables voltage sensitive relay based dual battery systems to work.

Connection of Auxiliary Loads

WARNING: Under no circumstances should any unfused connections be made directly to any of the vehicle's battery terminals.

NOTE: Auxiliary loads must always be connected to the vehicle ground and not to the battery negative terminal.

- For auxiliary customer electrical loads, a suitable fused connection must be used.
- If multiple auxiliary loads are required, it is recommended that an auxiliary fuse box is fitted to the vehicle.
- For the connection of auxiliary exterior lighting, refer to the guidelines given in the exterior lighting section.

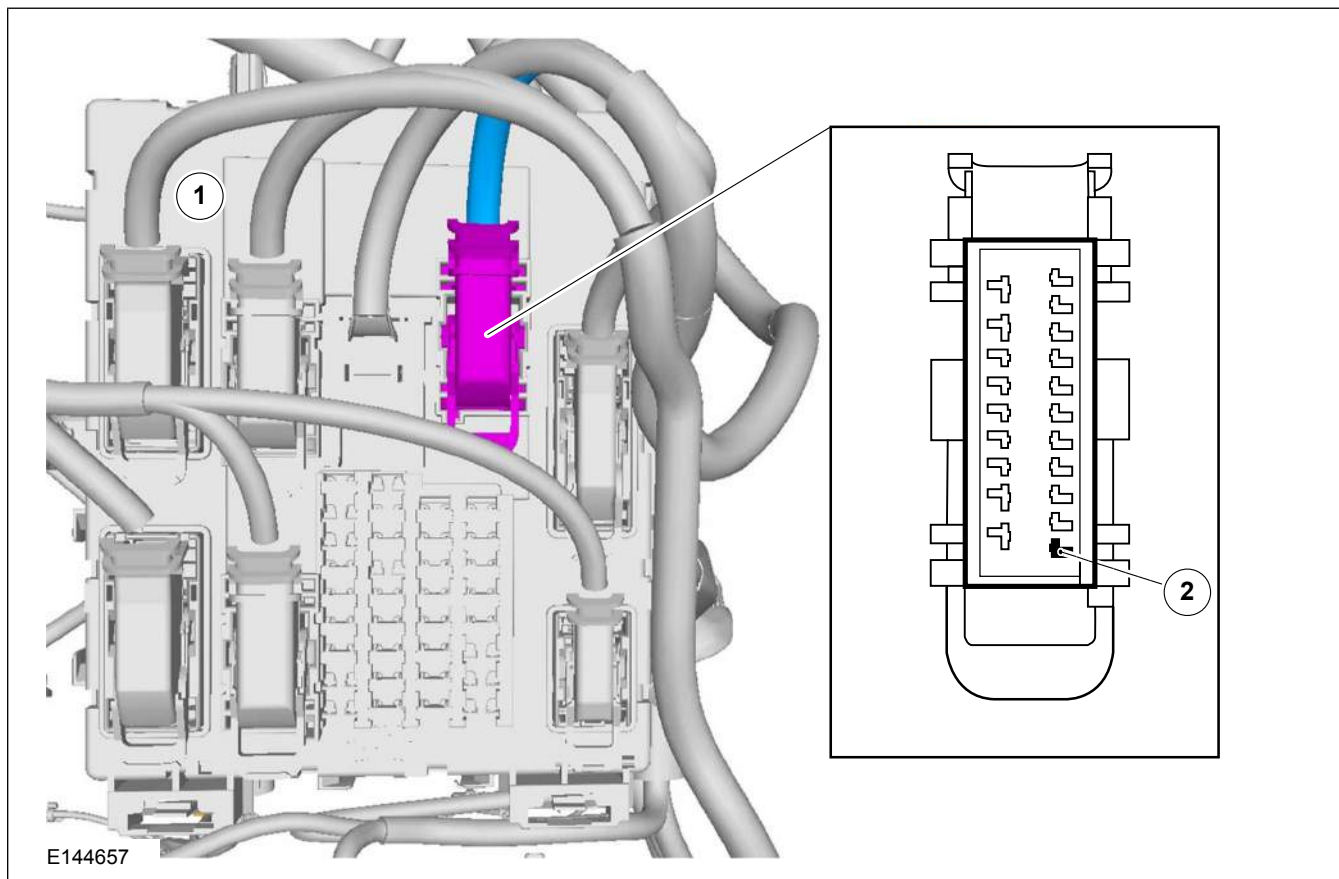
Refer to: 4.3 Exterior Lighting (page 52).

Auxiliary loads for external devices which require an ignition feed (such as UHF/CB radios) may be connected via a relay energised by the IG+ feed to the Body Control Module.

WARNING: Under no circumstances should the IG+ feed be used to drive auxiliary loads directly. A suitable relay must be used.

The Body Control Module is positioned on the driver's side of the vehicle underneath the dash panel.

IG+ Connection at Body Control Module



Item	Description
1	Body Control Module
2	IG+ Feed

Battery Rules:

WARNINGS:

WARNING: For vehicles fitted with non-sealed batteries (non-maintenance free), it is essential that regular checks are made to determine that the electrolyte (acid) levels are correctly maintained.

WARNING: When charging, ensure the battery charger is securely connected to the vehicle ground and not to the battery negative terminal. This is to ensure that the BMS identifies the battery charge.

- For external charging of batteries ensure that the maximum voltage of 14.6V is not exceeded.

4.1.2 Auxiliary Battery (Vehicles with Special Equipment Pack)

Battery Specifications

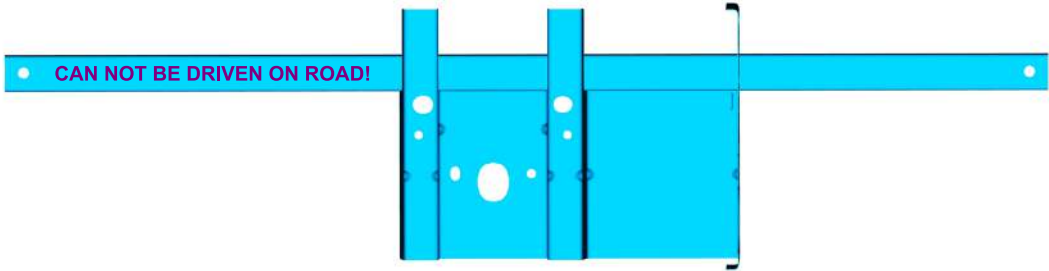
Description	Specification
Battery Type	H7 DIN VRLA/AGM
Voltage	12V
Capacity	80Ah
CCC	800A

! CAUTION: The vehicle must not be driven on the road while the auxiliary battery is mounted to the temporary battery carrier.

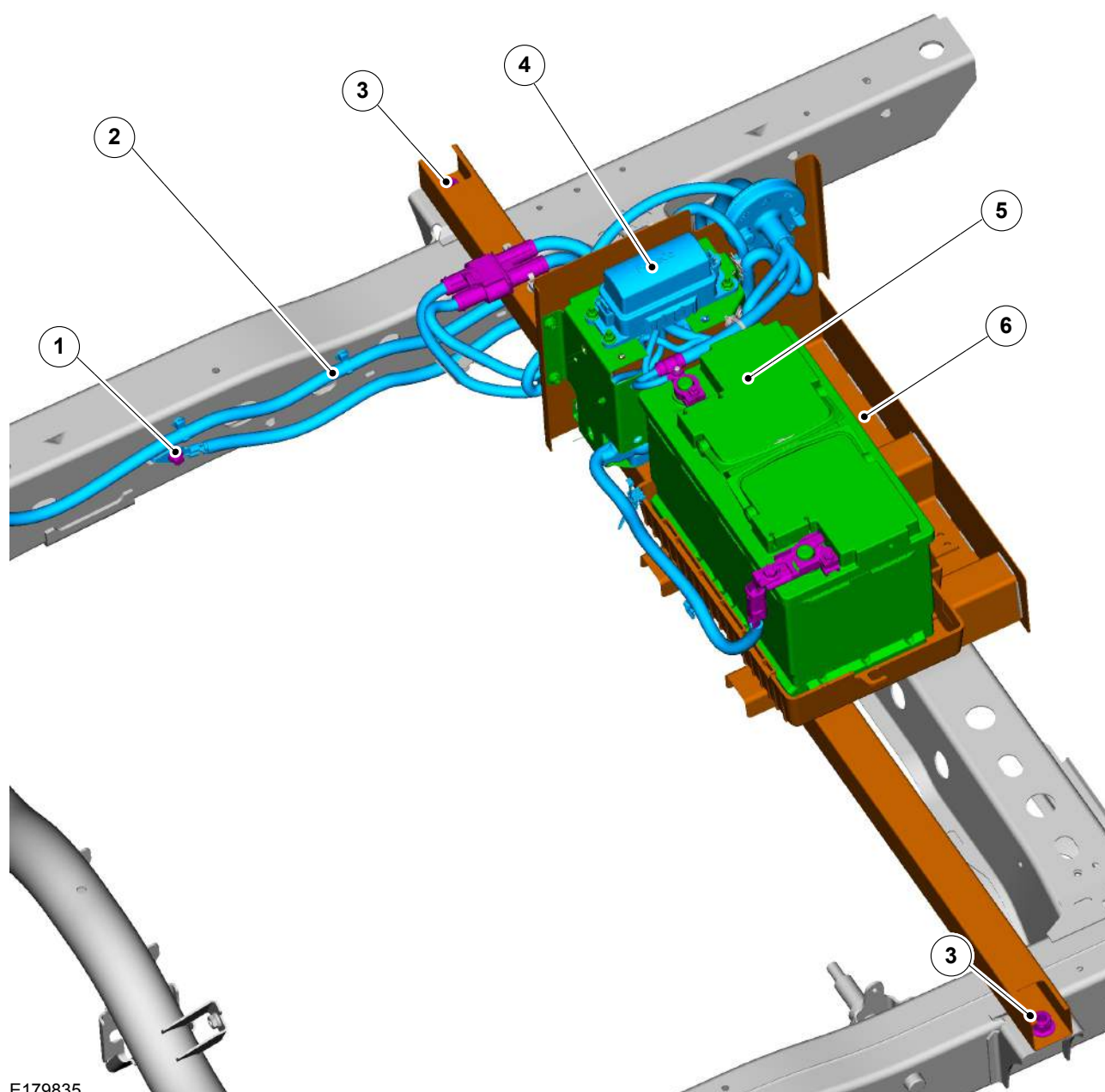
When exiting the production plant, the auxiliary battery is fitted in the load tray near the rear wheel arch for the style side (tub) variant. For the cab chassis variants, the auxiliary battery is secured on a temporary battery carrier which itself is mounted on the chassis and used for transport from the plant to the dealer.

Temporary Battery Carrier (Cab Chassis Variant Only) (Vehicles with Special Equipment Pack)

NOTE: The temporary battery carrier has to be removed before the vehicle is operated on the road or in service.



E179834










E179835

Item	Description
1	Auxiliary battery ground point
2	Battery cable (towards main battery)
3	Auxiliary battery carrier mounting bolts
4	Auxiliary battery fuse box
5	Auxiliary battery
6	Temporary battery carrier

Instructions for Auxiliary Battery Fitment (Vehicles with Special Equipment Pack)

CAUTIONS:

-  **It is important to ensure that the auxiliary battery is mounted securely, away from any moving parts and does not interfere with the operation of any closures/tailgate.**
-  **The selected location should be such that electrical components are above the 800mm water wading level and protected during off road excursions.**
-  **The attachment of the auxiliary battery should be suitably durable for off road excursions.**
-  **It is important to ensure that the auxiliary battery fitment does not crush or cause damage to any wiring either part of the auxiliary battery wiring or the vehicle wiring.**
-  **It is important that the auxiliary battery is mounted in a suitable location to enable easy access for servicing.**
-  **Ensure that the auxiliary battery cable is not kinked and is routed away from moving parts, exhaust and fuel system components. All mounting positions must be securely mounted to the vehicle body.**
-  **The location of the auxiliary battery must be carefully considered. The auxiliary battery's weight and its affect on the vehicle's centre of gravity must be taken into account when fitting it to an aftermarket body.**

NOTE: Avoid damage to the vehicle and the load tray during the auxiliary battery fitment.

NOTE: Avoid any interference with operation of the vehicle lighting system.

NOTE: Ensure that a good ground location is used; preferably use the ground point provided on the chassis rail.

NOTE: Ensure that the auxiliary battery cables and electrical harness extension are suitably located using grommets, insulation and fixing points on the vehicle body.

NOTE: Ensure that sufficient ventilation is provided for the auxiliary battery when located within enclosed spaces.

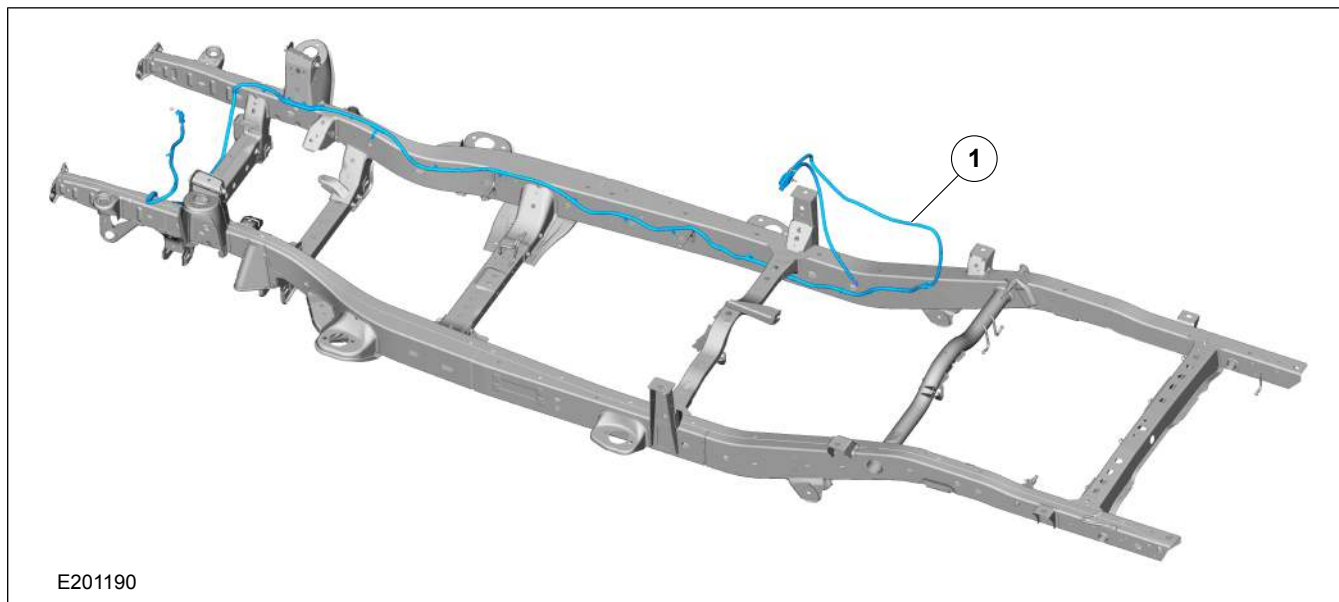
NOTE: The addition of an auxiliary battery in a vehicle with Battery Monitor System (BMS) would cause both batteries to not reach a state of full charge. The system will only allow charging of the batteries during deceleration. Refer to Dual Batteries with BMS in this section.

The auxiliary battery and temporary carrier must be completely removed from the frame in preparation for fitment to the vehicle tray or an aftermarket body.

The location of the auxiliary battery should be selected considering that the battery and the cables within the tray should be protected from contact with any items that could be placed in the load tray or within the aftermarket body. For variants fitted with an aluminium load tray, the selected location should be such that suitable space in the load tray is available for use.

The auxiliary battery cable provides a 12V / 125A charge to the auxiliary battery. The auxiliary battery cable is routed from the primary starting battery in the engine compartment, down the right hand chassis rail and terminates at the connection to the auxiliary battery wiring harness. In situations where the auxiliary battery is relocated, consideration must be made as to the routing and security of the auxiliary battery cable location.

Auxiliary Battery Cable



E201190

Item	Description
1	Auxiliary Battery Cable

4.1.3 Auxiliary Battery Relocation and use of Electrical Harness Extension (Fly Lead) (Vehicles with Special Equipment Pack)

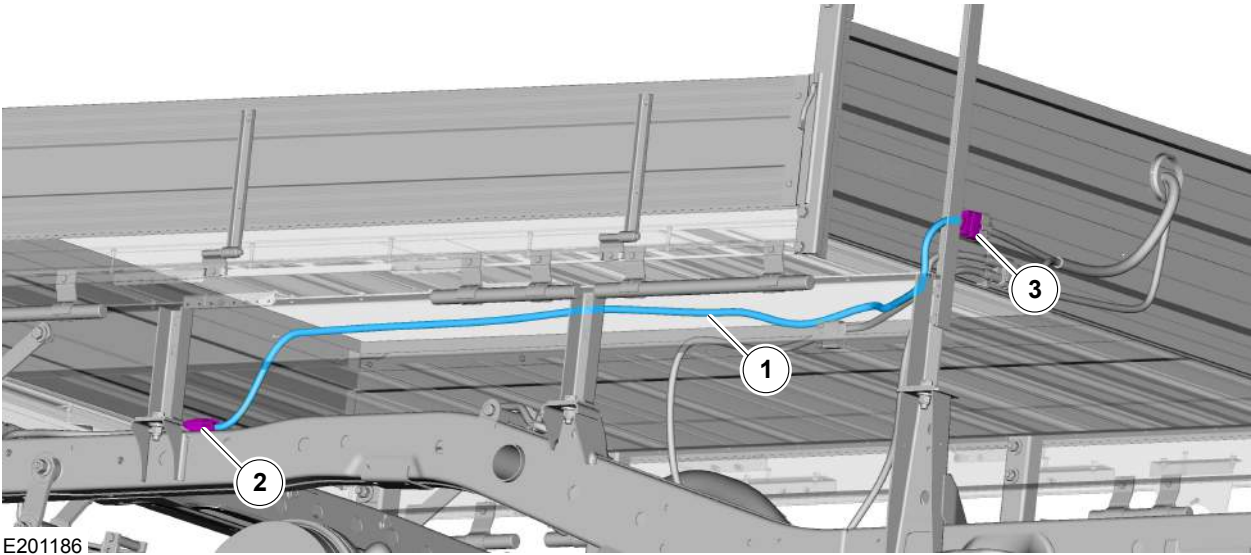
An Electrical Harness Extension (fly lead) may be required when the auxiliary battery is being relocated from the temporary battery carrier. The fly lead is required to connect the auxiliary battery wiring harness to the 16-pin connector on the vehicle wiring harness. This allows the operation of auxiliary battery powered accessories from the dash mounted switch panel within the vehicle cabin.

The electrical harness extension is available in two lengths:

- Single Cab Chassis: 1850 mm
- Double Cab Chassis: 1390 mm

When used on a vehicle fitted with an aluminium load tray, the electrical harness extension is fitted in the shown orientation:

Electrical Harness Extension (Fly Lead)



Item	Description
1	Electrical Harness Extension (fly lead)
2	Connection to the vehicle harness
3	Connection to the auxiliary wiring harness

4.1.4 Generator and Alternator

Alternator Current Output

All vehicles are fitted with 110A alternators.

4.2 Electronic Engine Controls

4.2.1 Vehicle Speed Output (Signal)

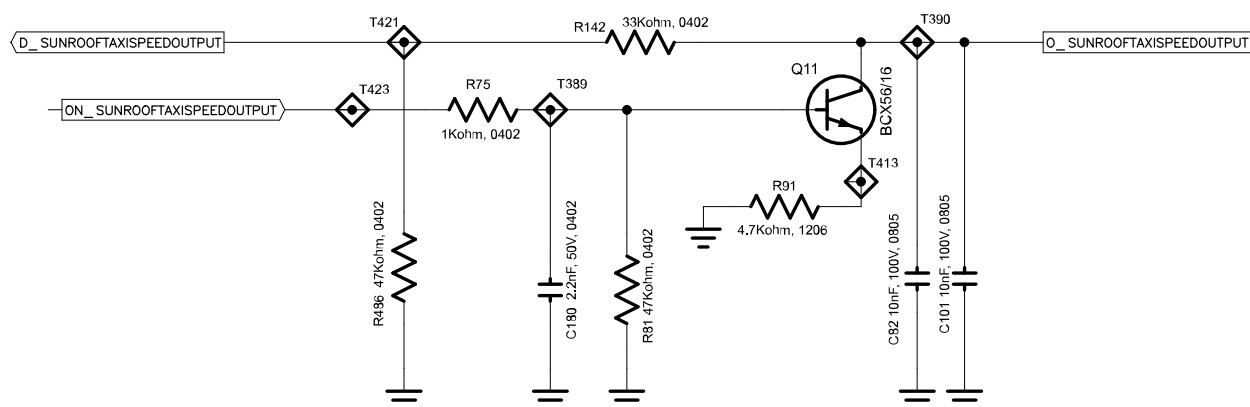
General Information

WARNING: Do not interface with the CAN (controller area network) for vehicle speed.

NOTE: A hard-wired vehicle speed signal is available if integration is required.

NOTE: The vehicle speed signal is a direct current coupled square wave that varies in frequency in proportion to vehicle speed. This provides a square wave-form (50% duty cycle) signal.

Circuit hardware



E180281

Square Wave Characteristics - Output signal

Signal Requirements	Sunroof Taxi Speed Output
Maximum High Signal	Battery Voltage
Minimum High Signal	3.67 Volts
Maximum Low Signal	1.1 Volts
Minimum Low Signal	-1.1 Volts
Maximum Ground Offset	+/- 1.0 Volts
Rise Time	$10\mu\text{ sec} \leq t_r \leq 250\mu\text{ sec}$
Fall Time	$10\mu\text{ sec} \leq t_f \leq 250\mu\text{ sec}$
Duty Cycle	50% +/- 10%
Frequency	$1.38 * v$ (Vehicle speed (CAN) km/h) \pm 2% between 1km/h - 250km/h
Minimum speed	1.38 Hz (1 kmph)
Linearity error	<0.3%
Max frequency	398 Hz
Rload	1 k ohms

Instructions for connection

1. The vehicle speed output is available on: [connector 3 pin number 52] or [connector 4 pin 3]. Choose one of the connections and populate the connector with a terminal and wire.
2. The output must be connected to a device with 1k ohms resistance (600 ohms to 2k ohms is the guideline) in order for it to work. This protects the BCM (body control module) from overcurrent risk.
3. The output must be connected to a power source.
4. Once the device is connected, reset the BCM by disconnecting the vehicle battery.
5. Reconnect the vehicle battery.

6. Turn the ignition ON.
7. The signal should now be available.

NOTE: Rload should be present and connected to battery voltage for this function to work.

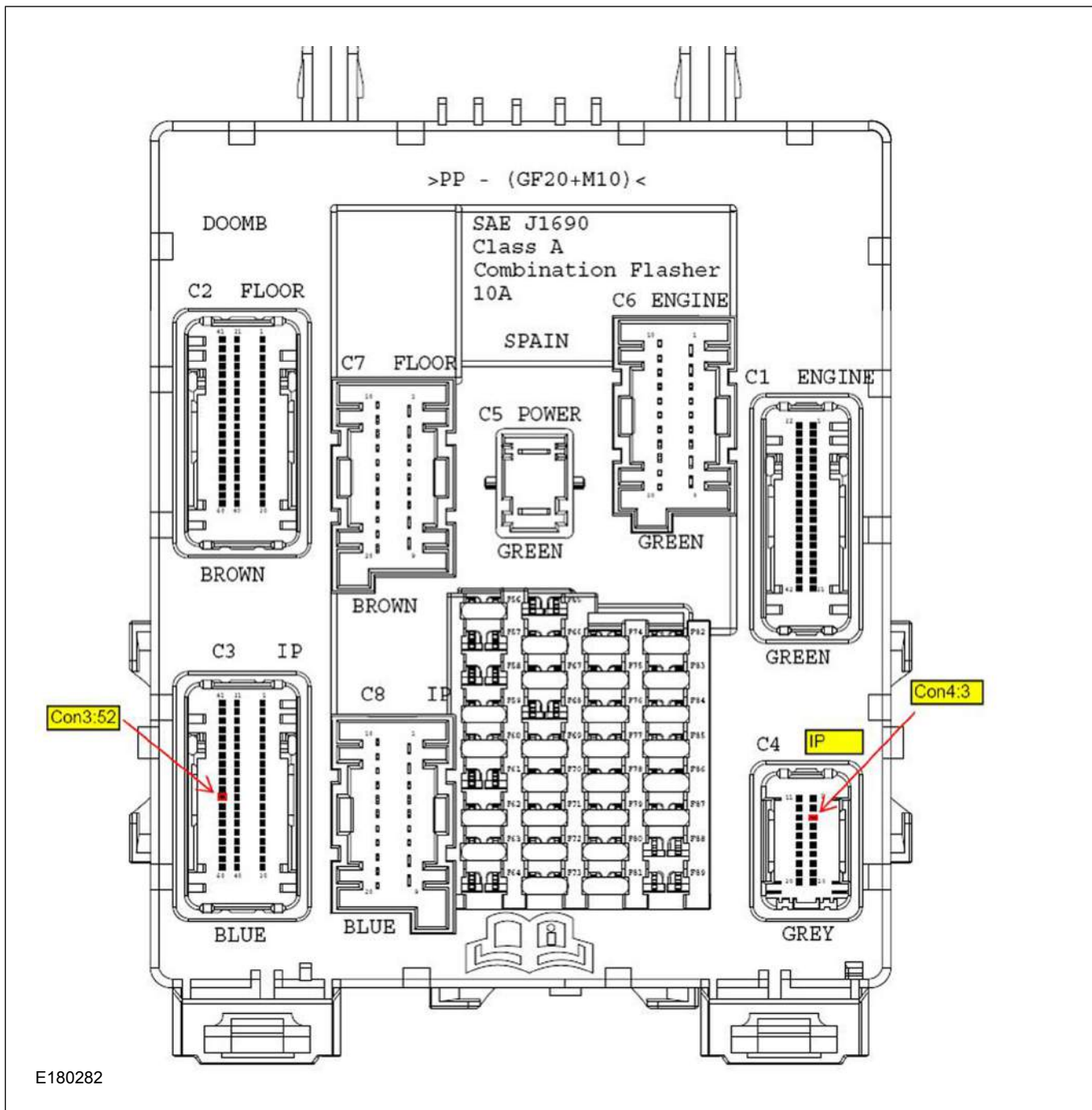
For Information Only

Terminal part number: 96AG-14474-RSA.

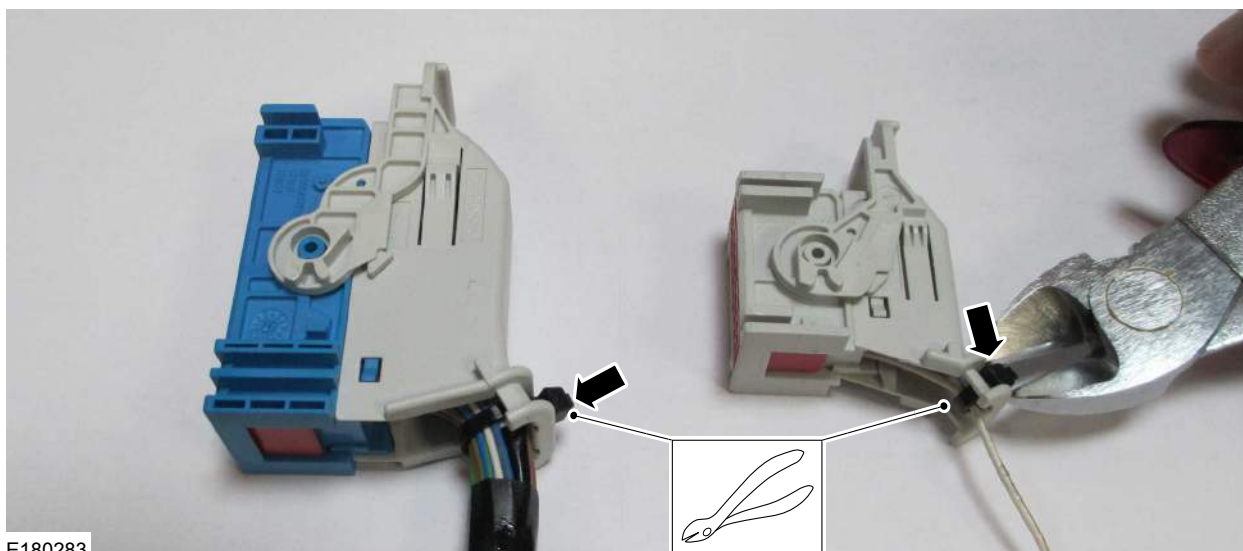
Wire size and color: 0.5 CSA, blue - green.

Terminal Insertion

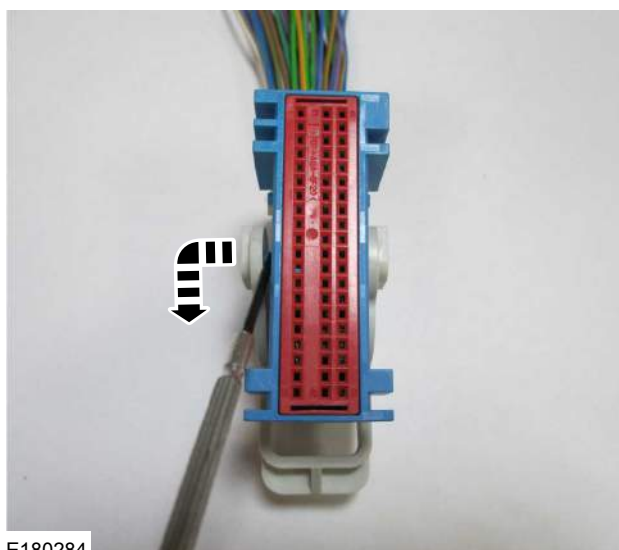
1. Connector C3 or C4 need to be unplugged in order to insert the speed signal terminal.



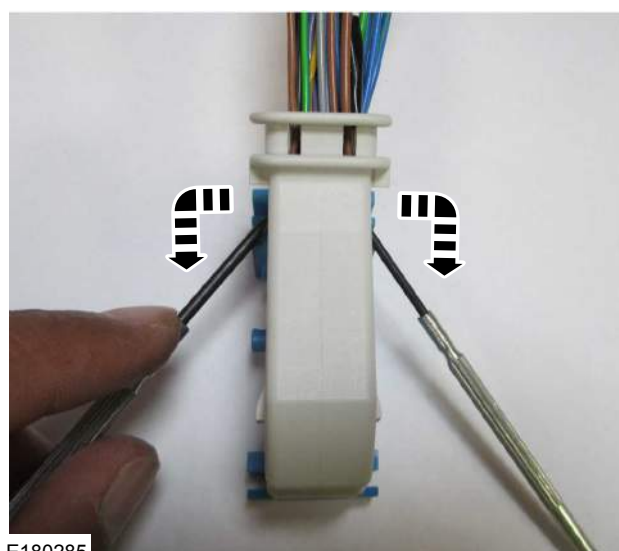
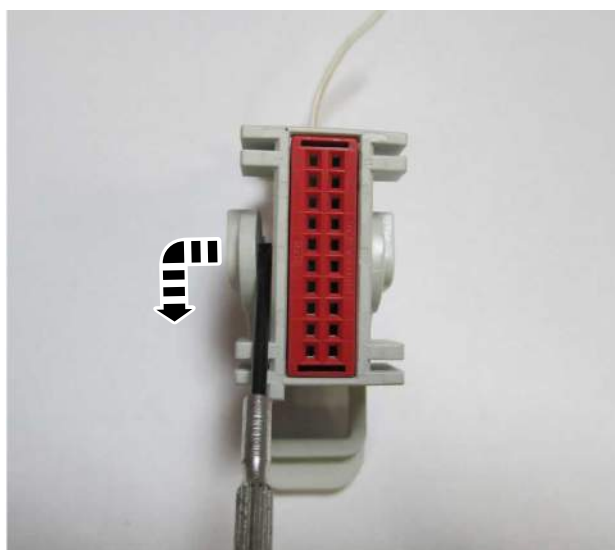
2. Once the connector C3 or C4 is removed, the grey cap needs to be removed by first removing the cable tie, and then levering up the two detents on the sides; the cap can then be slid off.



E180283

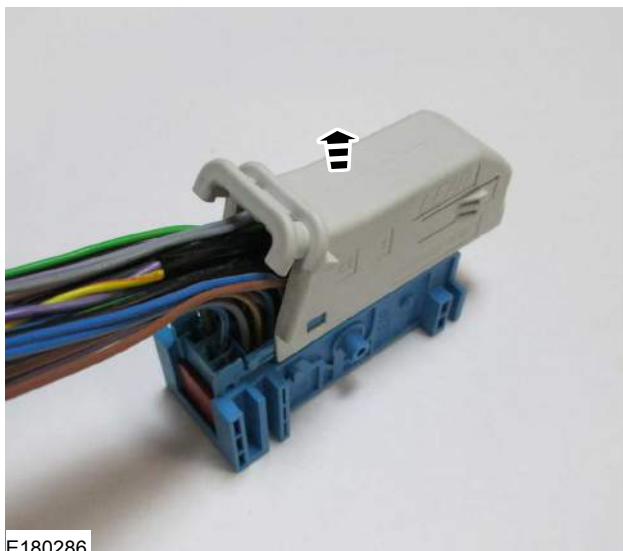


E180284

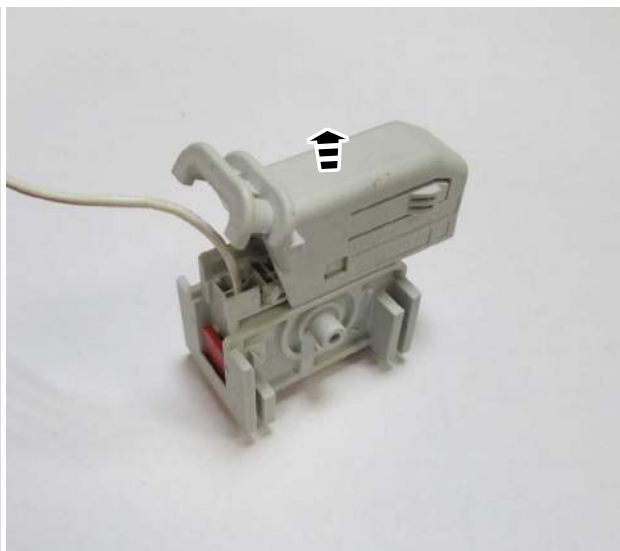


E180285

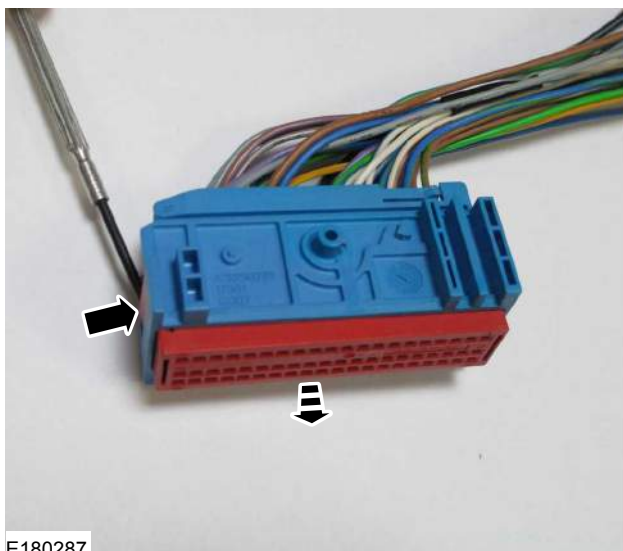




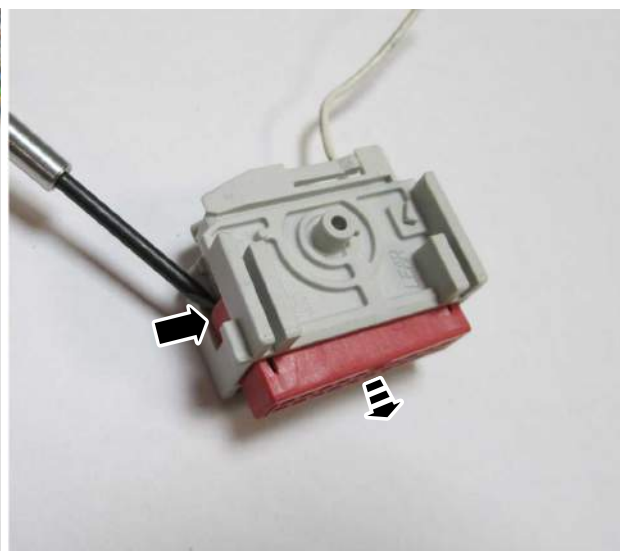
E180286



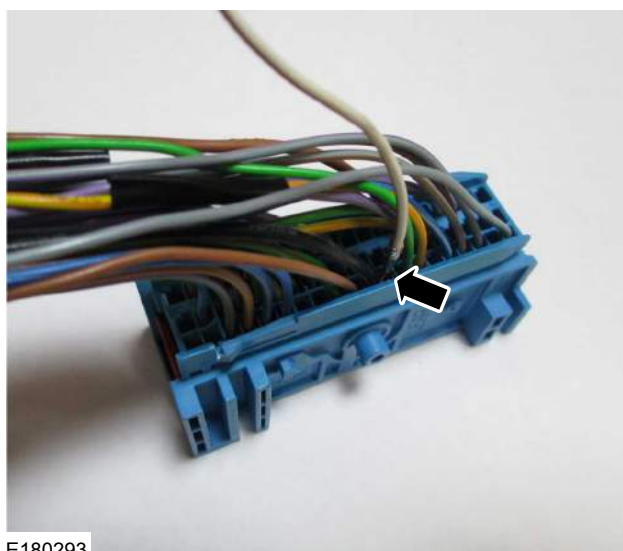
3. There is a red terminal latching plate that needs to be removed.



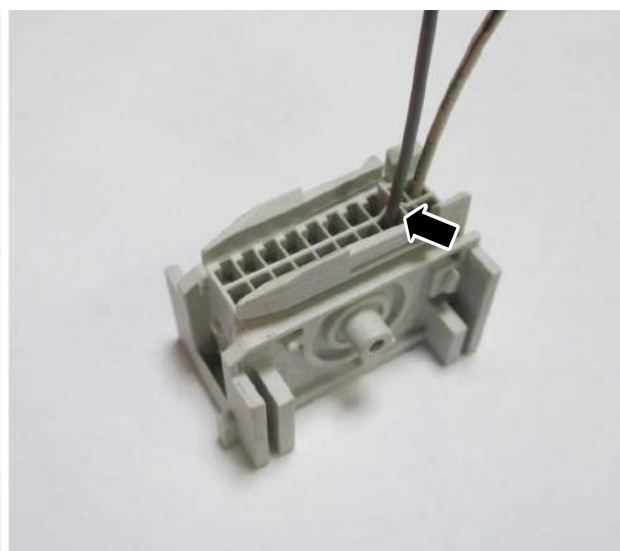
E180287



4. Insert the wire with terminal into cavity C3: 52 or C4: 3 – there is a tab on the terminal that should allow this to be inserted one way only.

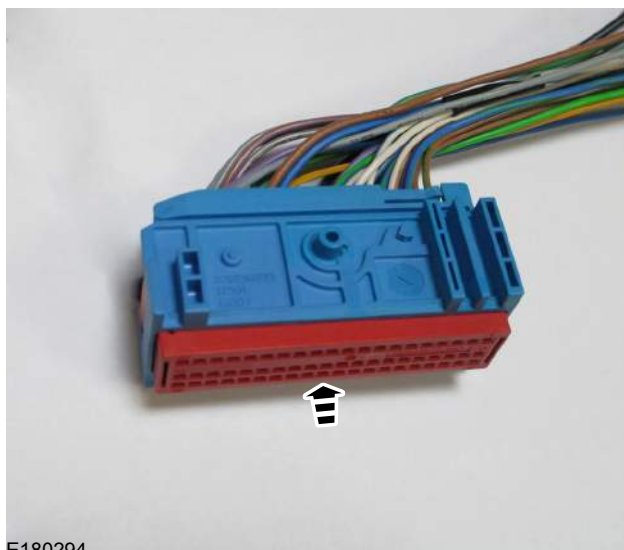


E180293

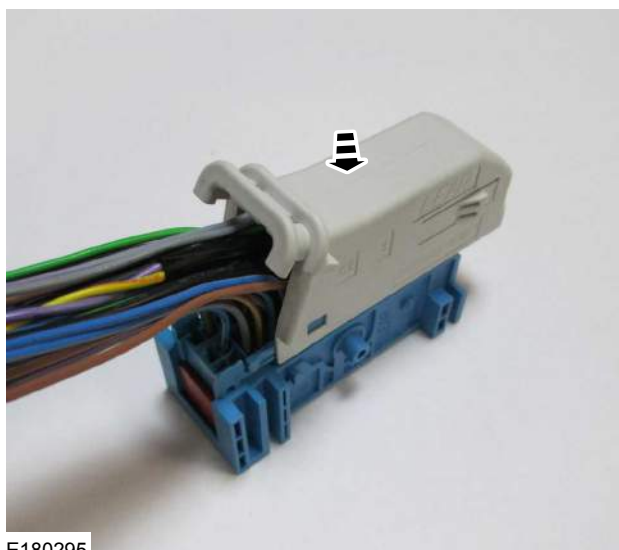


5. Slide back the terminal latching plate, refit the grey cap (and refit cable tie as required), and

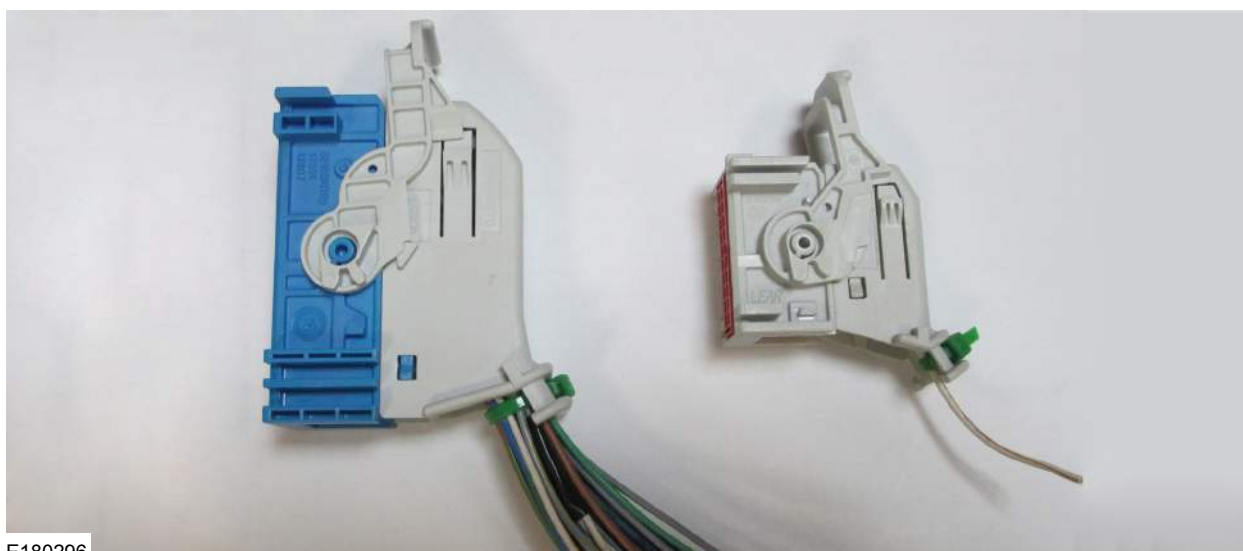
plug both connectors back into the BCM. Refit any shields/covers.



E180294



E180295



E180296

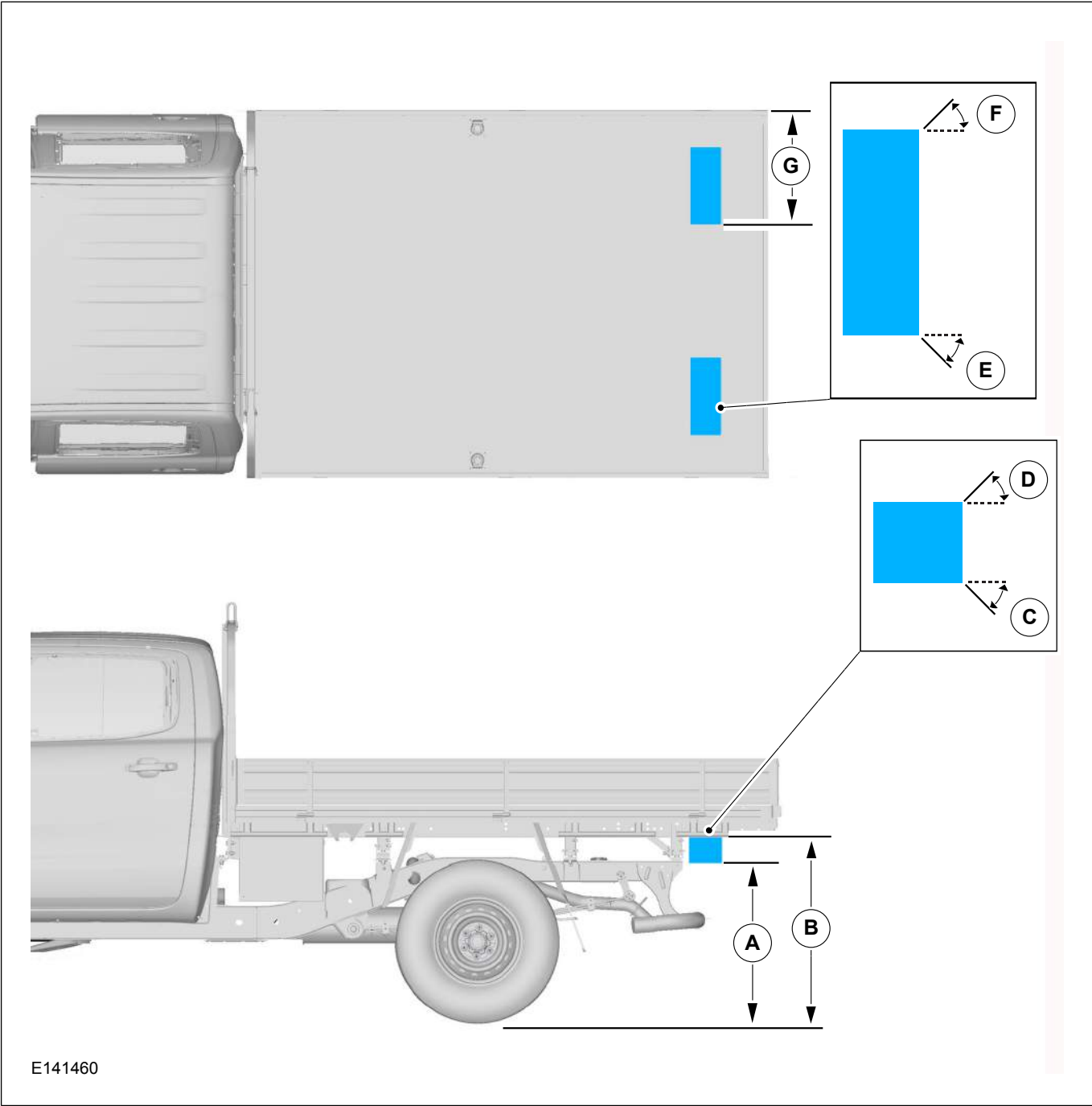
4.3 Exterior Lighting

WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.

NOTE: Chassis Cab vehicles are supplied with rear combination lamps, license plate lamps and fog lamps. Where fitted, these lamps must be mounted in accordance with the following guidelines.

4.3.1 Rear Combination lamps

Positioning of Rear Combination Lamps



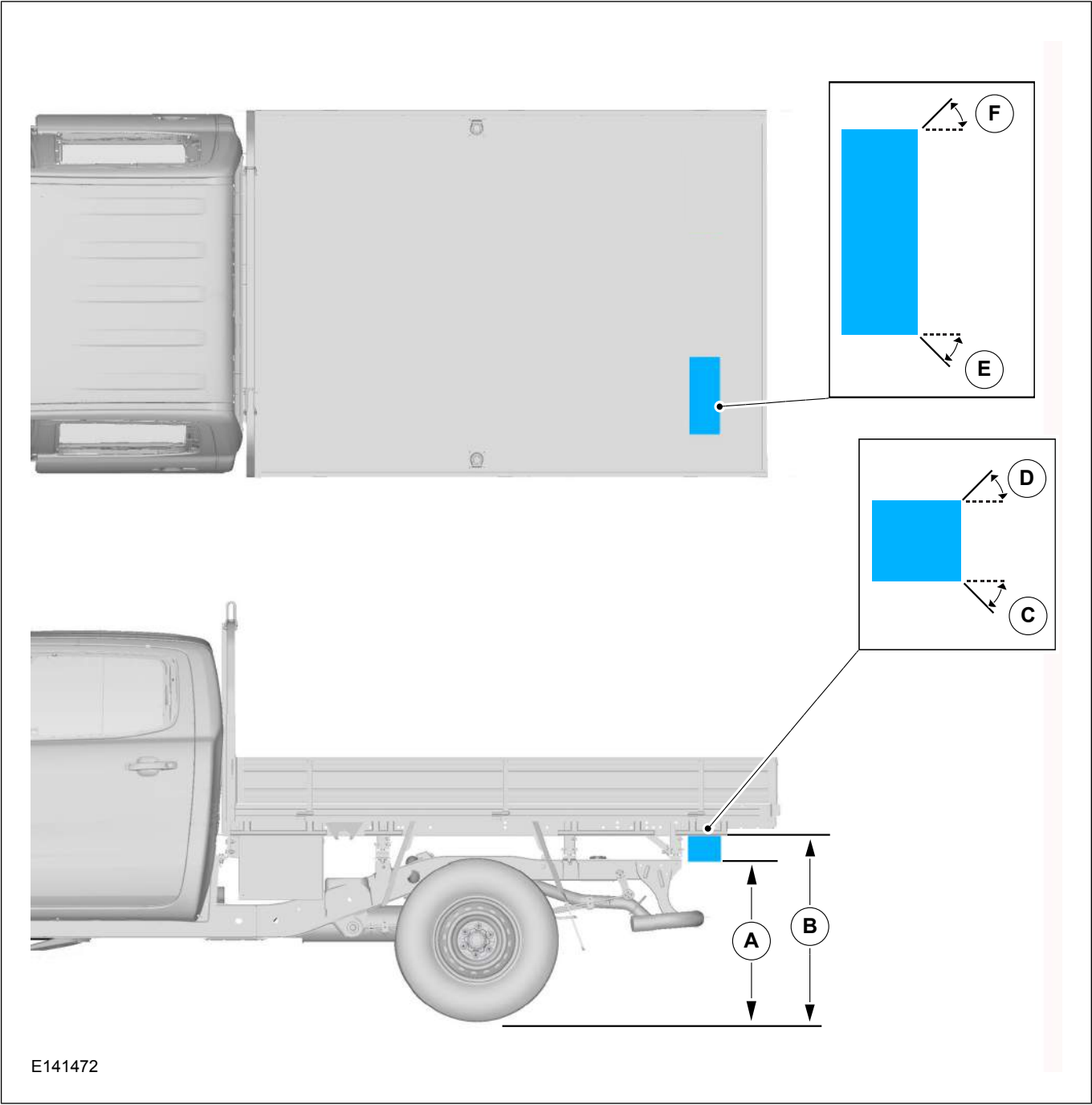
Positioning of Rear Combination Lamps

Description		Dimension
A	Minimum distance from ground to lower edge of lamp	250mm
B	Maximum distance from ground to upper edge of lamp	1200mm
C	Minimum angle of obstruction free zone downwards of the lamp	15°
D	Minimum angle of obstruction free zone upwards of the lamp	15°
E	Minimum angle of obstruction free zone towards the outside of the vehicle	80°
F	Minimum angle of obstruction free zone towards the centre of the vehicle	45°
G	Maximum distance from outer edge of vehicle to inner edge of lamp	400mm

4.3.2 Rear Fog Lamp

NOTE: Where only one rear fog lamp is fitted, it must be positioned on the vehicle centre line, or to the drivers side of the vehicle.

Positioning of Rear Fog Lamp

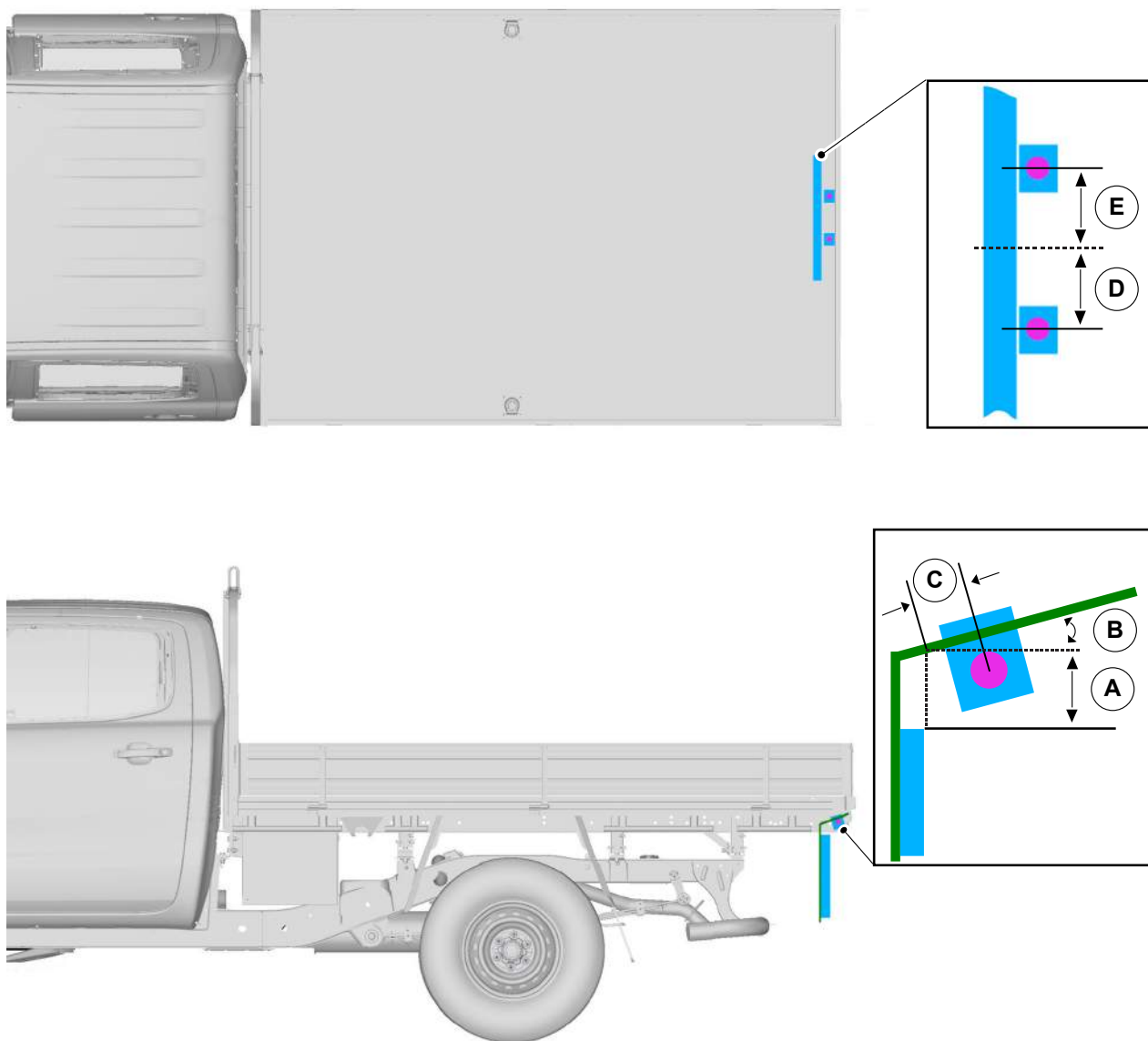


Positioning of Rear Fog Lamp

Description		Dimension
A	Minimum distance from ground to lower edge of lamp	250mm
B	Maximum distance from ground to upper edge of lamp	1000mm
C	Minimum angle of obstruction free zone downwards of the lamp	5°
D	Minimum angle of obstruction free zone upwards of the lamp	5°
E	Minimum angle of obstruction free zone towards the outside of the vehicle	25°
F	Minimum angle of obstruction free zone towards the centre of the vehicle	25°

4.3.3 Rear License Plate Lamp

Positioning of Rear License Plate Lamp



E141462

Positioning of Rear License Plate Lamp

Description		Dimension
A	Distance from rear face of license plate to centre of lamp along lamp mounting face	35mm
B	Angle between license plate and lamp mounting face	10°
C	Distance between top of rear face of license plate and lamp mounting face	35mm
D	Distance between license plate centre line and centre of lamp	175mm
E	Distance between license plate centre line and centre of lamp	175mm

4.3.4 Reversing Lamps

The reverse lamps are activated by the reverse switch on the transmission and passing through the Central Junction Box where the signal is sensed. A marginal increase in current (via a relay or buffered electrical input) is permissible to trigger a rear-view camera system, or audible device.

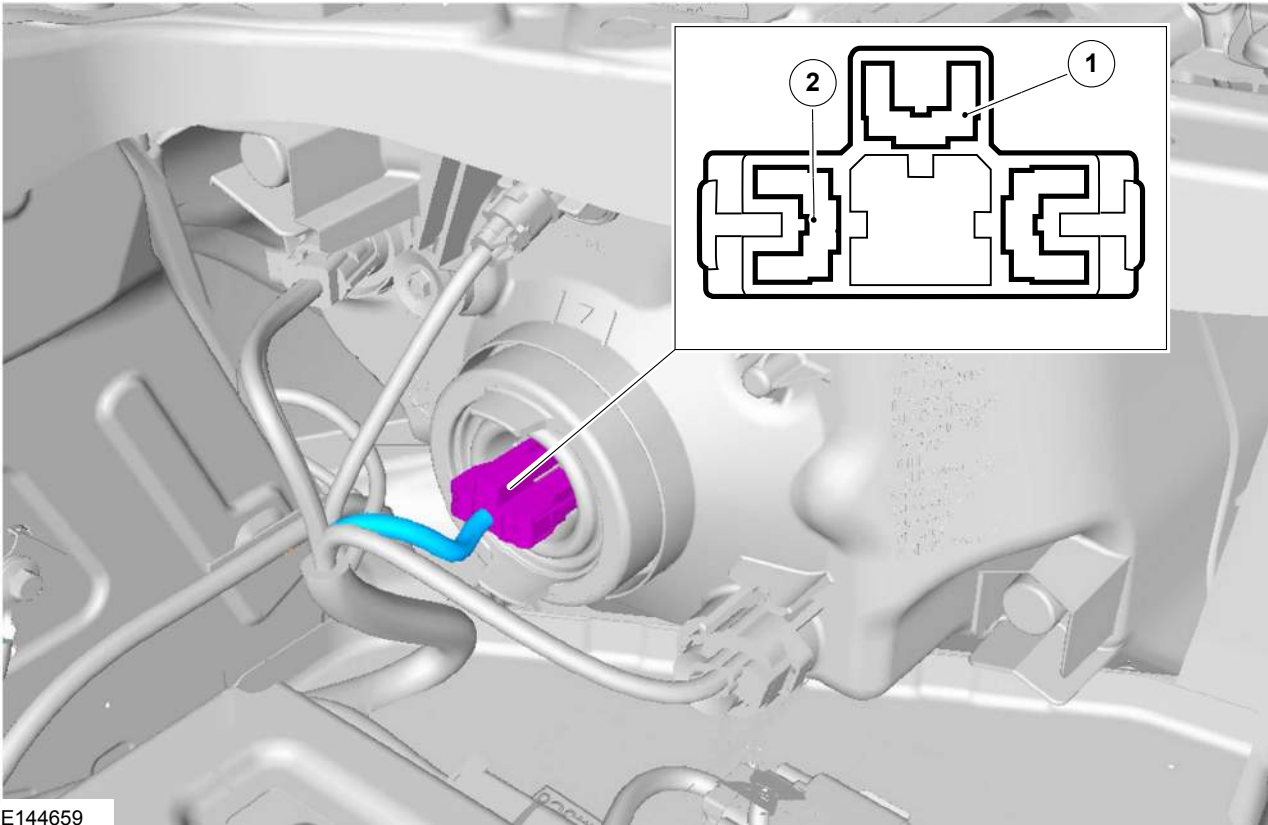
4.3.5 Additional External Lamps

When installing auxiliary tail lamps, Ford recommends that power is provided via the trailer plug control module and associated circuitry. Refer to Trailer Tow for additional information.

For all other additional exterior lamps, power must be taken through an auxiliary fuse box with a suitable switch and / or relay as required.

WARNING: Directly splicing into the vehicle wiring in order to install auxiliary lamps or other electrical devices may overload the system and impact the operation of other vehicle systems.

When installing auxiliary driving lights, power can be provided via a relay energised by the headlamp feed.



Item	Description
1	Low beam
2	High beam

Lighting Loads

Lamp	Controlling Device	Vehicle	Trailer Tow
Number plate lamp	Body control module	2x5W	28W
Position / Parking lamp	Body control module	5W	
Front direction indicator	Body control module	21W	-
Brake lamps	Body control module	21W	28W
Rear direction indicator	Body control module	21W	24W
Reverse lamp	Body control module	21W	24W
Rear fog lamp	Body control module	21W	48W

Trailer tow maximum power ratings shown, also see trailer tow below.

Lighting Fuses		
F74	20A	Headlamp
F75	15A	Front fog lamp
F76	10A	Reversing lamp

Trailer Tow

Vehicles with a factory fitted tow bar also come with a trailer plug control module for lighting. In addition to providing the trailer plug functionality, the trailer plug control module protects the primary electrical circuits of the vehicle from any electrical concern or failure that the customer's trailer may experience.

For vehicles fitted without a tow bar as standard, a genuine Ford accessory trailer tow electrical kit has been developed to enable a tow bar to be installed. The kit comprises of the trailer plug control module, trailer plug, wiring and associated hardware components.

Once the kit is installed, the vehicle must then be configured using a Ford IDS diagnostic tool. This configuration can be performed by your Ford authorised dealer.

NOTE: The trailer tow electrical kit is available from your Ford authorised dealer.

Ford recommends that all trailer tow electrical connections use the genuine Ford accessory trailer tow kit.



WARNING: Installation of aftermarket trailer tow electrical kits or directly splicing into the vehicle wiring in order to install trailer lamps or other electrical devices may overload the system and impact the operation of other vehicle systems.

When fitting low power LED (light emitting diode) lamps that require less than 2W, the lamps may flicker when in use. A trailer patch harness should be used with low power LED lamps.

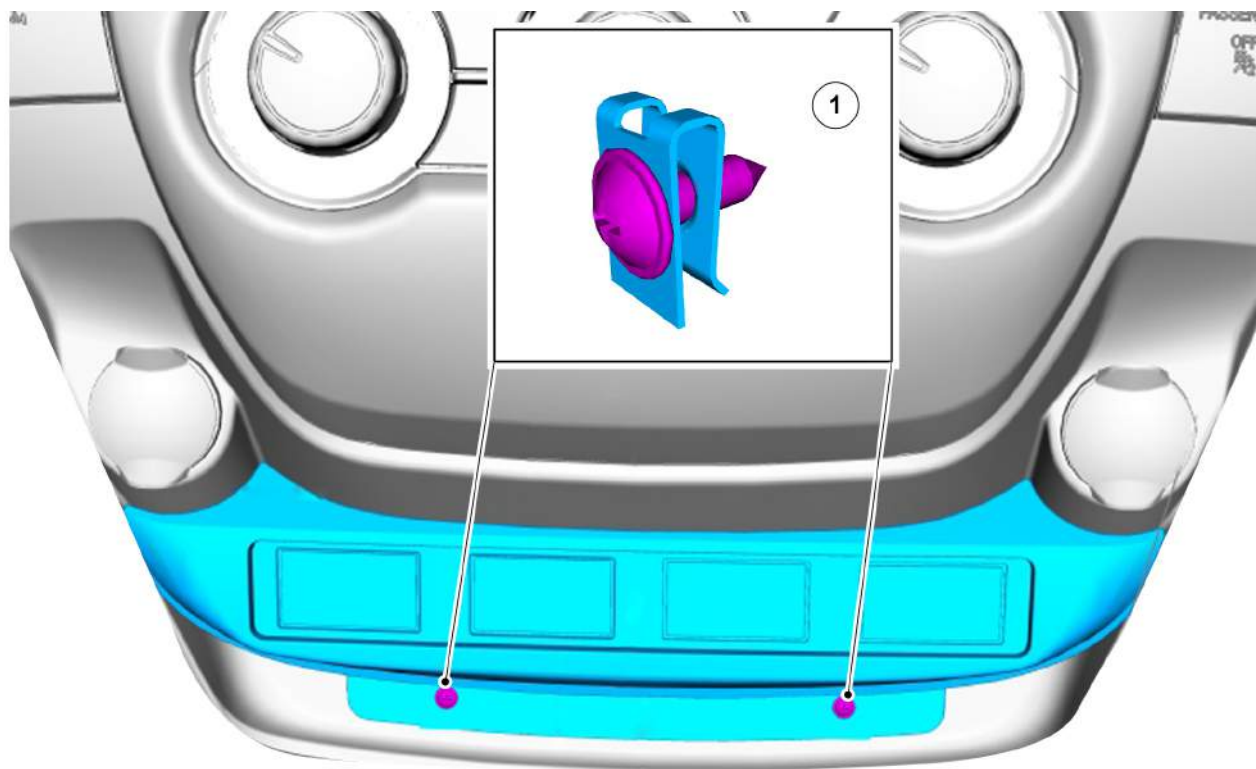


CAUTION: Do not connect the trailer patch harness to the vehicle when the trailer is not connected.

NOTE: The trailer patch harness is available from your Ford authorised dealer.

4.3.6 Additional External Lamps (Vehicles with Special Equipment Pack)

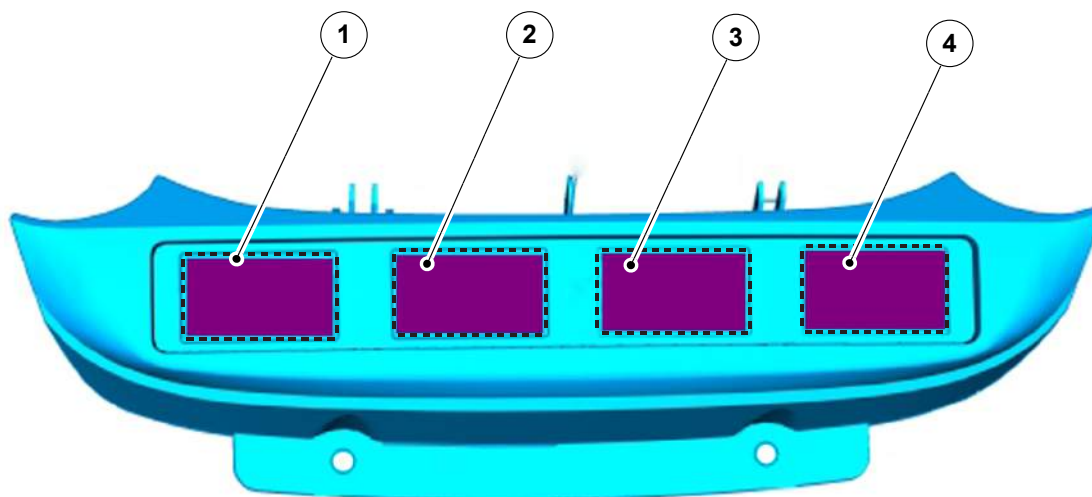
The plastic switch fascia is located at the front of the console. It can house up to four aftermarket switches. Driving Lights, LED beacon lamp and work lights can be powered via the switches on the fascia. A fourth switch is provided as a spare with 20A capacity.



E175900

Item	Description
1	U nuts

NOTE: Cut out the switch blanks with a suitable tool without damaging the plastic fascia.



E175901

Item	Description
1	Driving lights switch blank
2	Work lights switch blank
3	LED beacon lamp switch blank
4	Spare switch blank

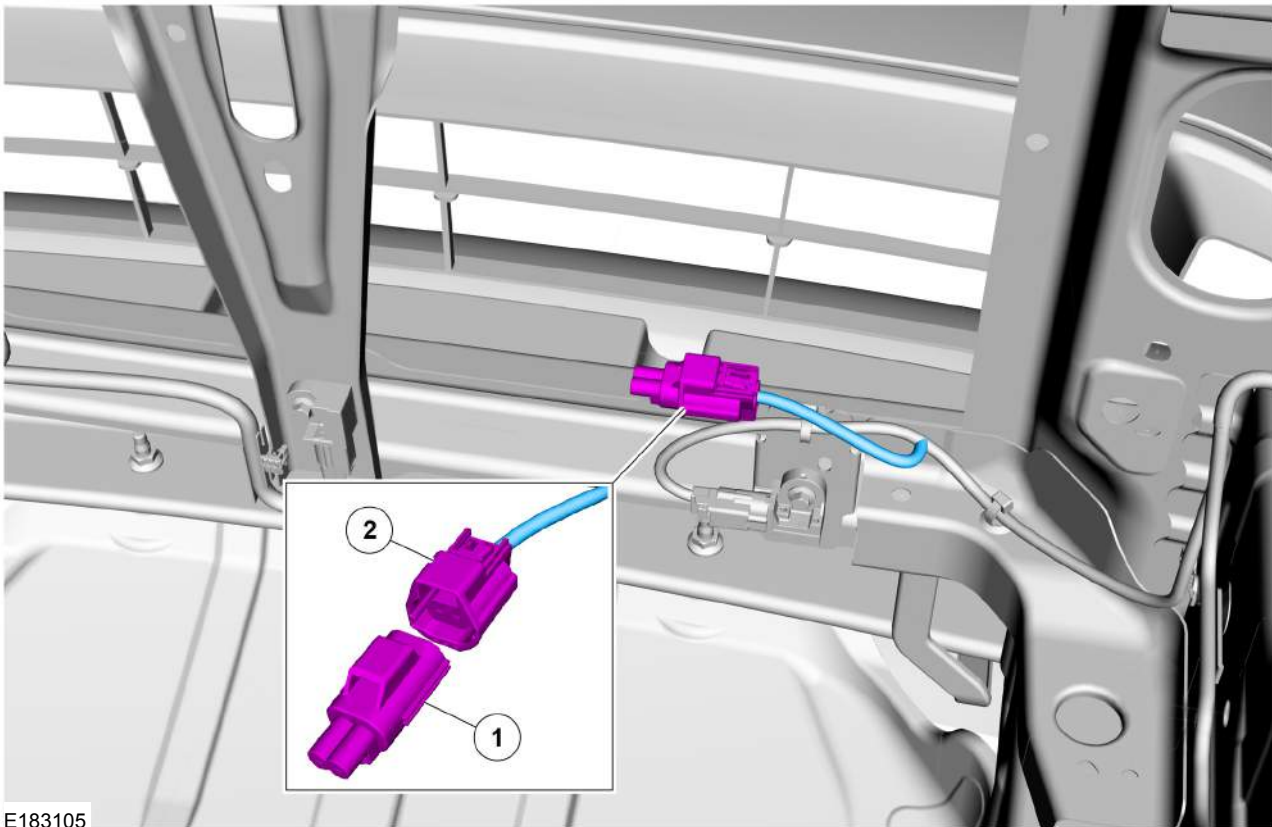
NOTE: The driving lights will only operate when the vehicles high beam is selected.

NOTE: The vehicle is equipped with a battery isolator which ensures that the main vehicle battery remains in a charged state and only the auxiliary battery becomes discharged. Once the vehicle is running the isolator will close allowing the auxiliary battery to be charged by the vehicles charging system.

NOTE: The connector for the driving light is located behind the grille.

NOTE: Discard the sealing end-cap after connecting the driving light connector.

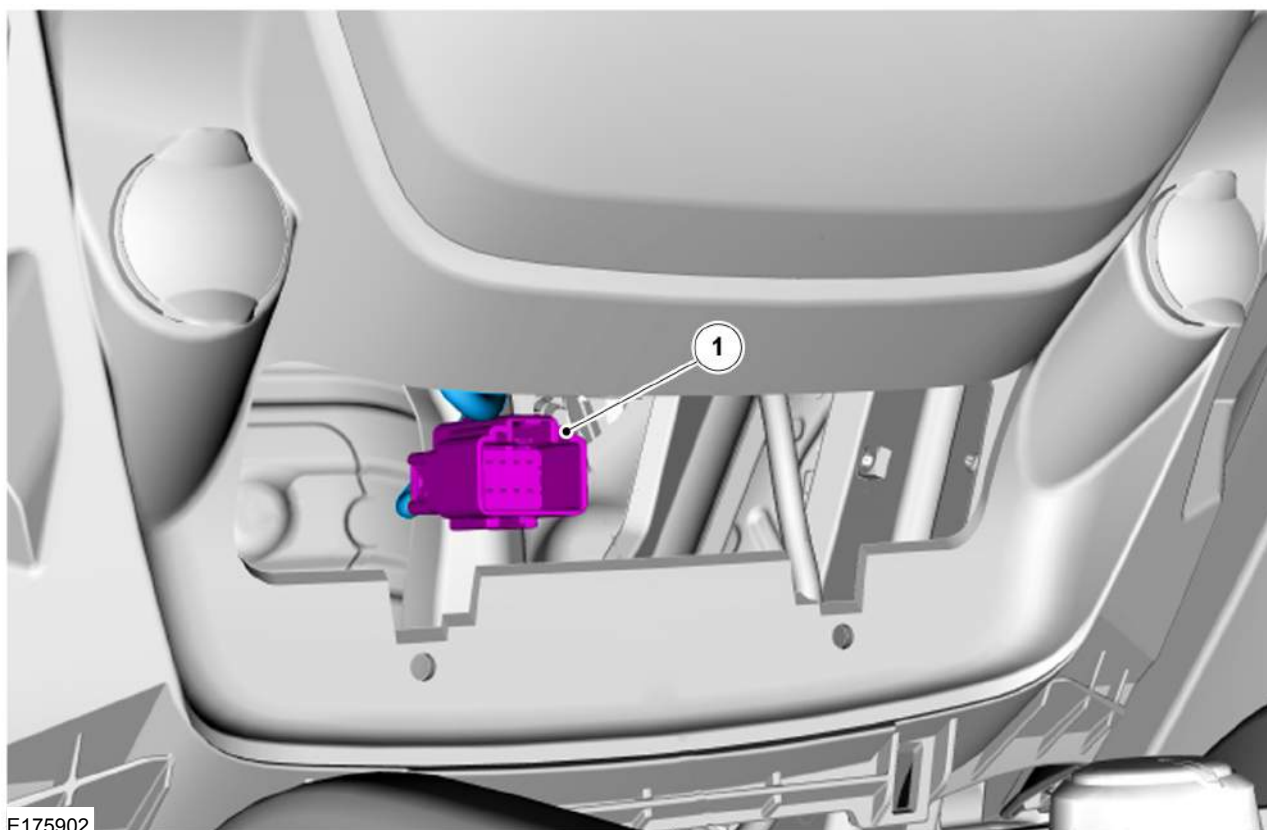
Driving Light Connector Location



E183105

Item	Description
1	Sealing end-cap
2	Driving light connector

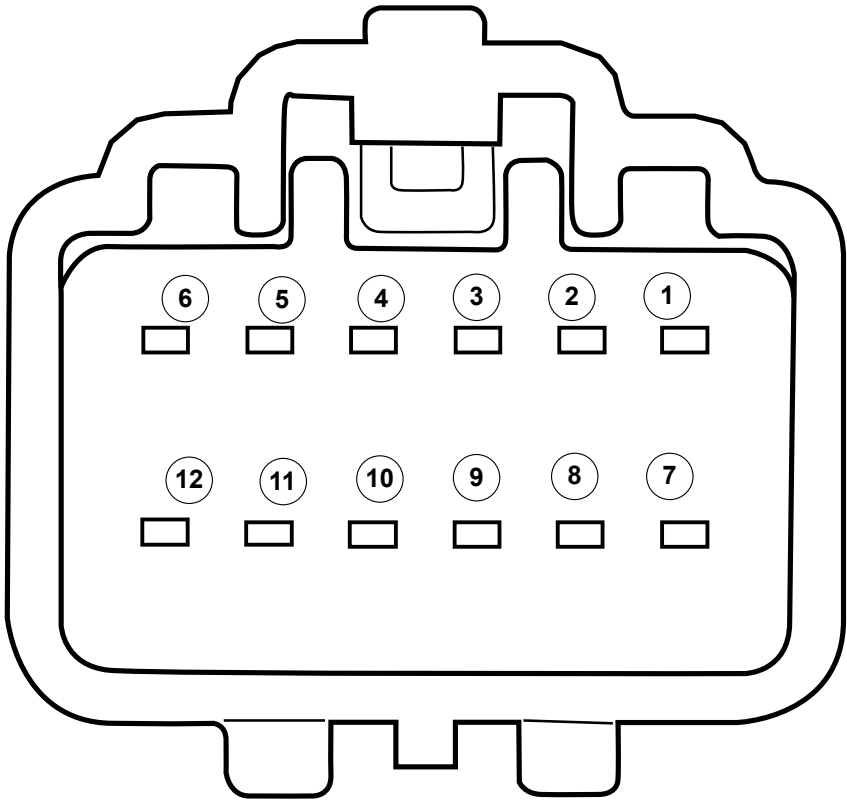
NOTE: The light switch connector is located behind the switch fascia in the vehicle.

Switch Panel Connector

E175902

Item	Description
1	Switch connector

Switch Panel Connector Details



E175903

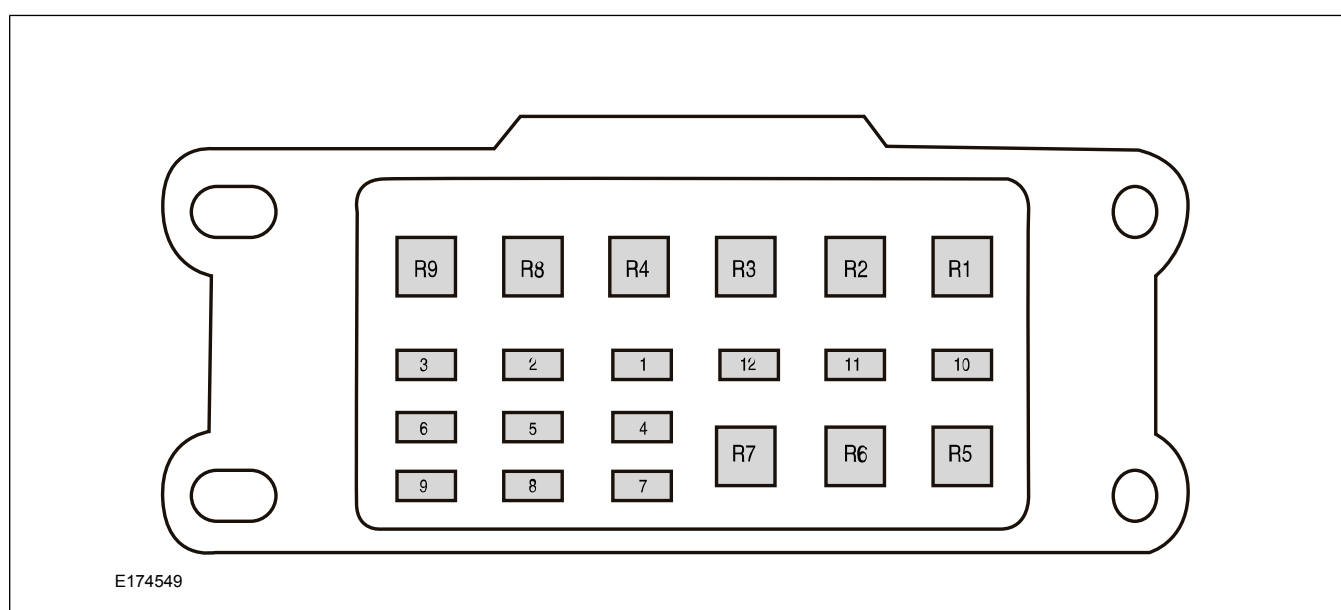
Connector Pin	Color cable	Connects to
1	VT/WH	Central electronic module control
2	BK/BU	Cross car beam ground
3	BK/BU	Cross car beam ground
4	BK/BU	Cross car beam ground
5	BK/BU	Cross car beam ground
8	VT/WH	LED beacon lamp Relay (R2)
9	BN/GN	Spare populated relay (R3)
10	GN/BN	Work lights relay (R1)
11	WH/GN	Driving lights relay
12	-	Blank (not used)

Connections for the load box lamps, LED Beacon lamp and driving lights are provided by a 16 way connector located at the rear of the auxiliary battery box below the isolator. The connector details are as follows.

Connector Pin	Color cable	Function
2	YE-GN	Brake / stop +12v (lamp Bar)
3	WH	LED beacon lamp +12v
4	VT-WH	Position / tail lamps +12V (lamp Bar)
5	GN-BU	Reverse lamps +12v (lamp Bar)
6	GY-OG	Turn right +12v (lamp Bar)
7	GY-OG	Turn left +12v (lamp Bar)
9	YE-GY	Spare +12v
10	YE-BU	Load box lamps +12v
16	BK-YE	Ground

Fuse specification chart

Auxiliary Fuse Box



Fuse	Fuse Amp Rating	Protected Components
1	25	Driving lights
2	15	Position lamp
3	10	LED beacon lamp
4	15	Work lights
5	20	Spare
6	20	Power point
7	15	Reversing lamp
8	15	Direction indicators, stop lamp
9	5	Crew chief
10	5	Disable fuse (isolator ground)
11	-	Not used
12	-	Not used

Relay Number	Protected Components
R1	Work lights
R2	LED beacon lamp
R3	Spare
R4	Position lamp
R5	Direction indicator (left)
R6	Direction indicator (right)
R7	Stop lamp
R8	Not used
R9	Not used

4.3.7 Lamps – Hazard / Direction Indication

The maximum permissible load with the standard system is:

- 3 x 5W – front and rear indicators + side repeaters (Left Hand Side)
- 3 x 5W – front and rear indicators + side repeaters (Right Hand Side)

4.3.8 Electrically operated Door Mirrors

 **WARNING: Do not tamper with the base system (controlled by Central Junction Box and multiplex architecture) and any feeds taken from the associated wiring or controller.**

NOTE: These options are not suitable for aftermarket or Body Builder fit.

5.1 Body

5.1.1 Body Structures - General Information

CAUTION: Load carrying structures should not be mounted onto an existing load tray or load box.

When carrying out vehicle conversions/modifications the following points should be considered:

- Make sure that the vehicle structural integrity is maintained.
- Do not drill into closed frame body members.
- Make sure that the design for the body alterations or additional structure disperse the load evenly.

CAUTION: Uneven load distribution could result in unacceptable handling and braking characteristics.

- Re-paint metal edges after cutting or drilling. All metal edges must comply with exterior and interior protection legislation.
- All fixings through the floor, sides or roof must be sealed.

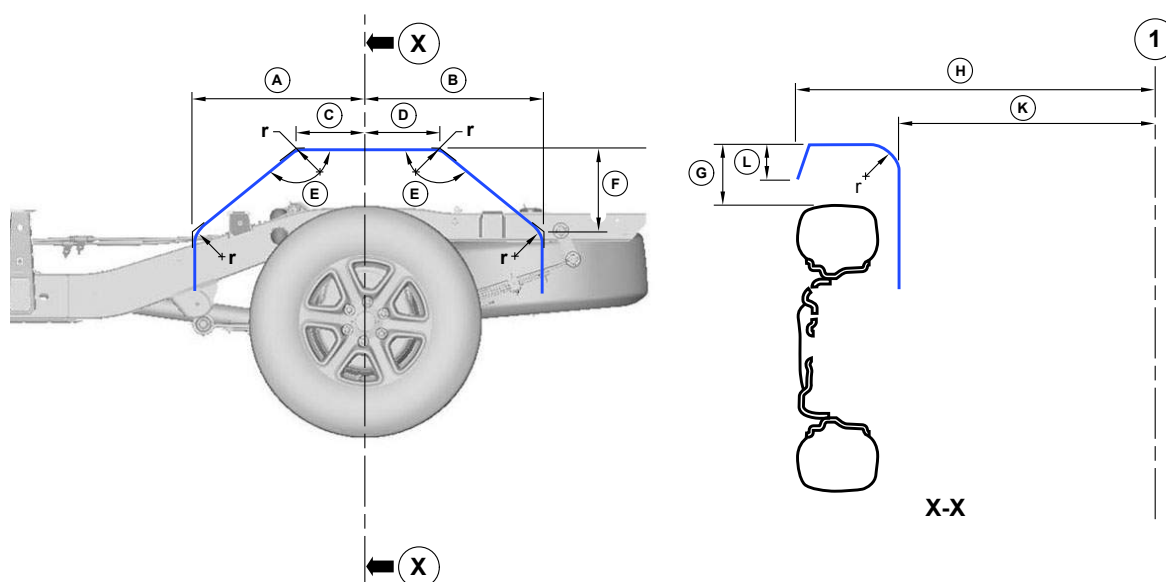
- Make sure that fixings in the 'B'-pillar area do not encroach on the seat belts or seat belt reels.

5.1.2 Integrated Bodies and Conversions

For integral structures such as ambulances or motor-homes with increased rear overhang built onto the chassis the following applies:

- Reduced departure angles, e.g. rear entry step, should be discussed with the end user / customer. Consider removable components to avoid damage on ferries or low-loaders.
- Unique spare wheel stowage may be required if obscured by rear step, check for accessibility.
- The recommended dimensions for wheelhouses on conversions are outlined in the following figure.

Wheelhouse Envelope



E134132

Wheelhouse Dimensions

Dimensio n	215/ 70R16	255/ 70R16	265/ 65R17	265/ 65R18	Dimension	215/ 70R16	255/ 70R16	255/ 70R16	265/65R17
A	455mm				G*	190mm			
B	425mm				H	914mm	915mm	922mm	922mm
C	305mm				K	588mm			
D	275mm				L	30mm			
E	110°				r	20mm			
F	420mm				l	Center line of Vehicle			
X	Section through Center of Wheelhouse								
* Dimension G is to the bottom of the swage									

5.1.3 Chassis Cab

WARNING: Excessive heat can build up from the exhaust system, in particular from the catalytic converter. Ensure adequate heat shields are maintained.

CAUTION: Uneven load distribution could result in unacceptable handling and braking characteristics.

When carrying out vehicle conversions / modifications the following points should be considered:

- Make sure that all of the reinforced holes provided in the chassis frame top surface are used for full length bodies or sub-frames, see figures shown.
- Make sure that the vehicle structural integrity is maintained.
- Do not drill into closed frame body members.
- Make sure that the design for the body alterations or additional structure disperse the load evenly.

- Re-paint metal edges after cutting or drilling. All metal edges must comply with exterior and interior protection legislation.
- All fixings through the floor, sides or roof must be sealed.

Refer to: 5.4 Corrosion Prevention (page 80).

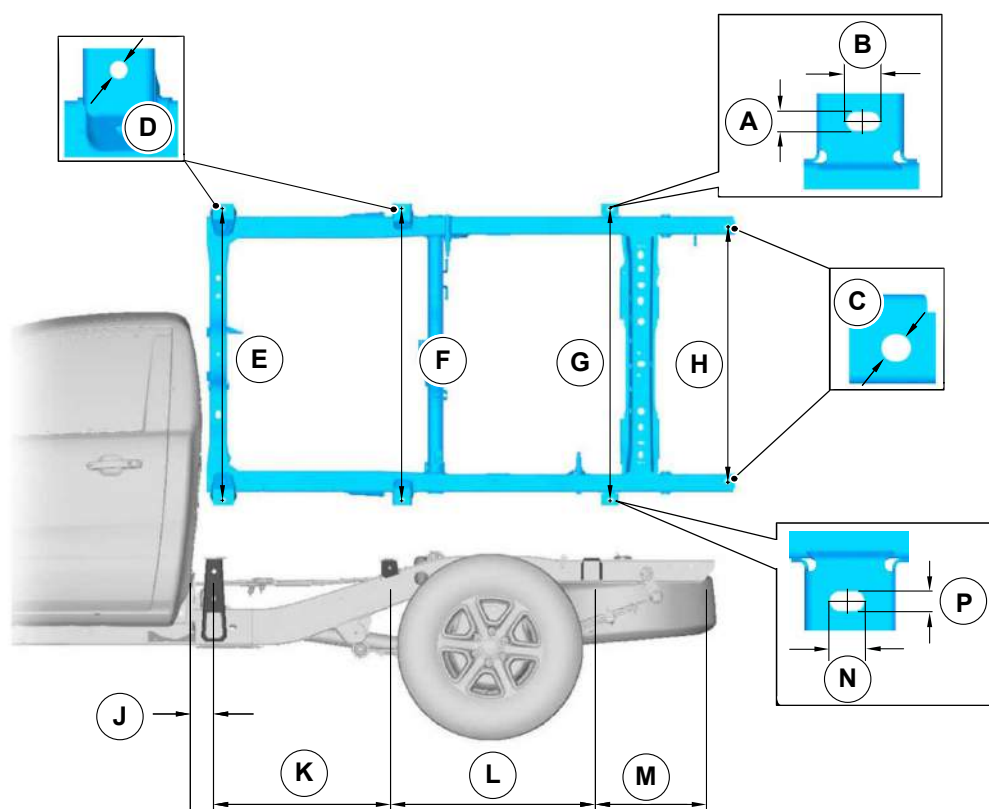
- Ensure that any additional equipment in the vicinity of the fuel tank will not damage the tank in a crash condition.

For any conversion structure attached to or mounted onto the base vehicle cab structure the following applies:

- Ensure that neither the conversion structure nor the existing vehicle structure get pre-loaded by the assembly process.
- Adhesive jointing is recommended but should be supplemented with mechanical fasteners to prevent initial peel and long term failure.
- Spread bolt loads to minimize local stress.

NOTE: The following chassis frame images and dimensions are showing the previous Ranger (J97) chassis frame above the new Ranger (P375) chassis frame for comparison purposes.

Body Attachment Holes in Chassis Frame - Single cab

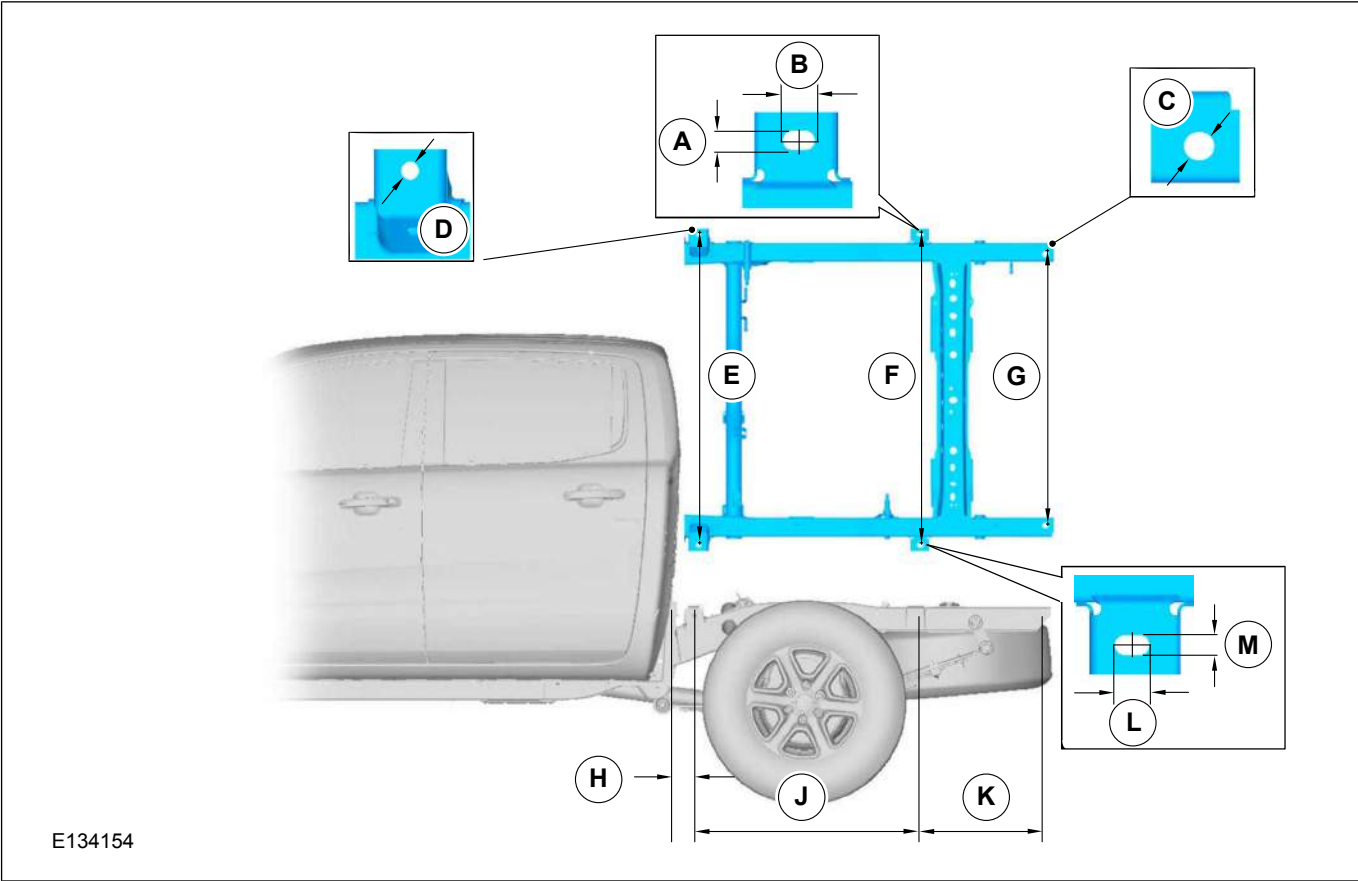


E134152

Dimensions (mm) for Body Attachment Holes in Chassis Frame - Single Cab

Dimension	P375	Dimension	P375
A	16	H	1086
B	28	J	95
C	23	K	768
D	20	L	893
E	1244	M	509
F	1244	N	26
G	1244	P	20

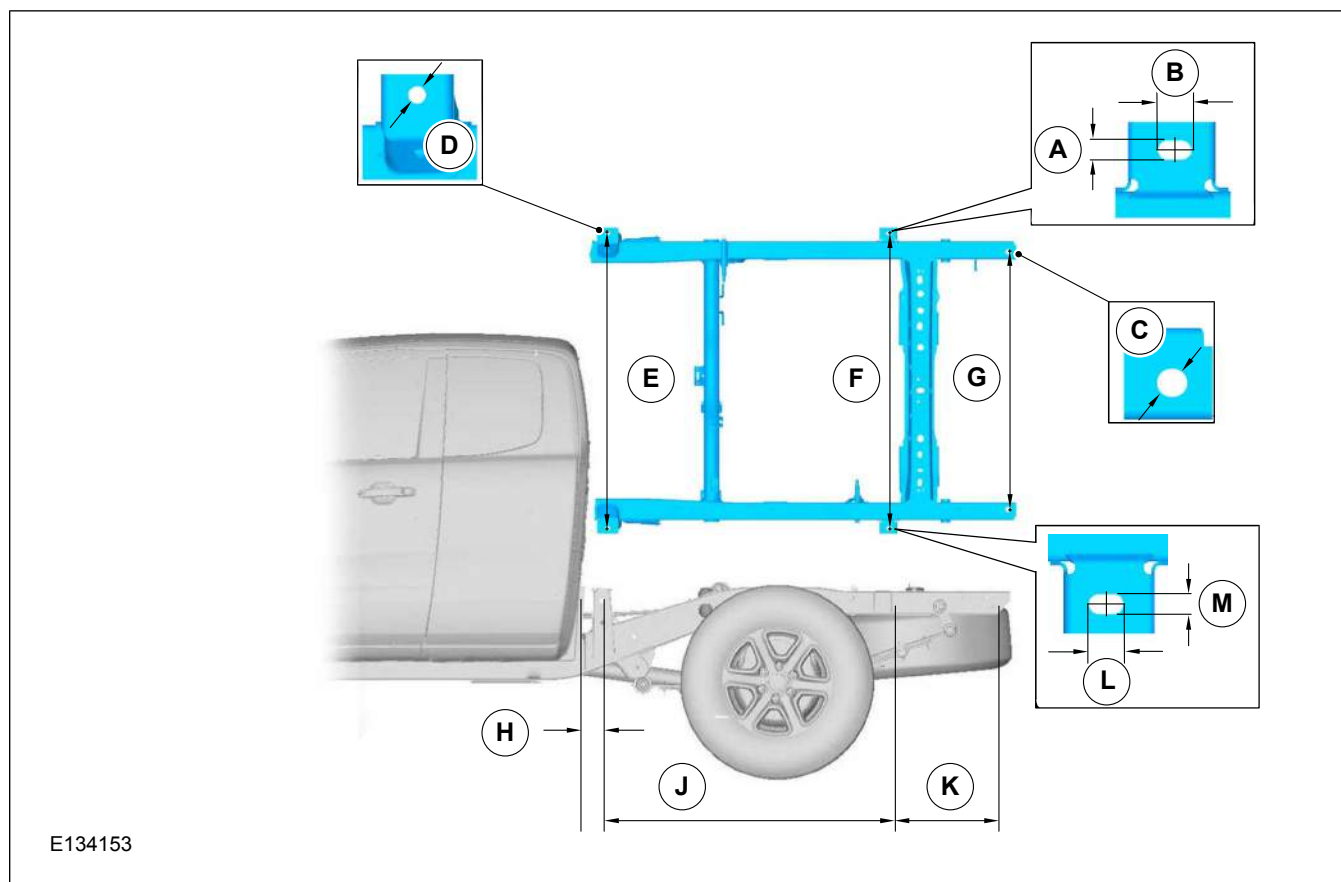
Body Attachment Holes in Chassis Frame - Double cab



Dimensions (mm) for Body Attachment Holes in Chassis Frame - Double cab

Dimension	P375	Dimension	P375
A	16	G	1086
B	28	H	95
C	23	J	893
D	20	K	509
E	1244	L	26
F	1244	M	20

Body Attachment Holes in Chassis Frame - Stretch cab



E134153

Dimensions (mm) for Body Attachment Holes in Chassis Frame - Stretch Cab

Dimension	P375	Dimension	P375
A	16	G	1086
B	28	H	95
C	23	J	1191
D	20	K	509
E	1244	L	26
F	1244	M	20

5.1.4 Front End Integrity for Cooling, Crash, Aerodynamics and Lighting

Cooling Continuous air flow through the front end and engine compartment is not to be hindered by adding any additional equipment. If uncertain please consult the Ford dealer.

Lighting Do not alter the lighting system.

Crash Do not cut, drill or weld any parts that are load path relevant in case of crash. Do not add material in the crash zone. This could affect the crash sensor calibration.

The side airbag system is not permitted if:

- A swiveling device is fitted on the front seats.
- A side wall or any other additional material or structure is attached to the B-pillar inner and/or outer area.

Static & Dynamic Sealing and Finishing Ensure proper sealing against ingress of water, salt, dust etc. after cutting or drilling the body. Use Ford approved sealing and finishing material, and underbody corrosion protection.

Refer to: 5.4 Corrosion Prevention (page 80).

5.1.5 Tipper Bodies

For tipper conversions single and double Chassis Cab versions except extended rear chassis frame can be used. All variants allow single and three way tipping.

It is recommended to have the tipping system operative only when the engine is running. It is also recommended to have the master control switch in the security of the cab. According routing of wires and hydraulic lines please refer to section hydraulic lift.

Ensure that axle plated weights including the front axle minimum are not exceeded.

For tipper sub-frames please refer to the following guidelines:

- Design for full length continuous frame with mountings for motor, pump unit, reservoir, pivot points and ram.
- Use all mounting points on chassis frame to mount sub-frame.
- Very stiff sub-frames may damage the chassis frame by preventing its natural flexing, therefore compliant mounts should be used, with up to plus and minus 12mm compliance with the vehicle laden or un-laden (whichever is worst case). Compliant mounts should be rated with a minimum of 2mm deflection per 200kg mass at each chassis frame forward mount. Compliant mounts shall have captive fail safe bolts.
- Use two M10 grade 8.8 minimum bolts, washers and self locking nuts at each solid and compliant chassis frame location.
- Sub-frame must extend to the back of the cab and attach to all mounting locations, with the forward end designed to minimize local frame stress. It is however, preferable to mount the sub-frame onto the mounting brackets with a clearance to the chassis frame top surface.
- Side tipping loads/forces must be resolved by the sub-frame. It is not recommended to strain the chassis frame.

5.1.6 Tank and Dry Bulk Carriers

Due to the high rigidity of tanks it is necessary to isolate the tank and its sub-frame from the chassis frame allowing the chassis frame to naturally flex. Please refer to the following guidelines:

- Mount tank to full length of sub-frame.
- Mount sub-frame to all chassis frame mounting points.
- The forward location mounts must be compliant to allow relative chassis frame to sub-frame deflections.
- Sub-frame must extend to the back of the cab and not contact chassis frame at forward end under worst case deflection.
- Compliant mounts should be used, with up to plus and minus 12mm compliance with the vehicle laden or un-laden (whichever is worst case). Compliant mounts should be rated with a minimum of 2mm deflection per 200kg mass at each chassis frame forward mount. Compliant mounts shall have captive fail safe bolts.
- Use two M10 grade 8.8 minimum bolts, washers and self lock nuts per chassis frame mount bracket at each solid and compliant location.

5.1.7 Bull Bar (Vehicles with Special Equipment Pack)

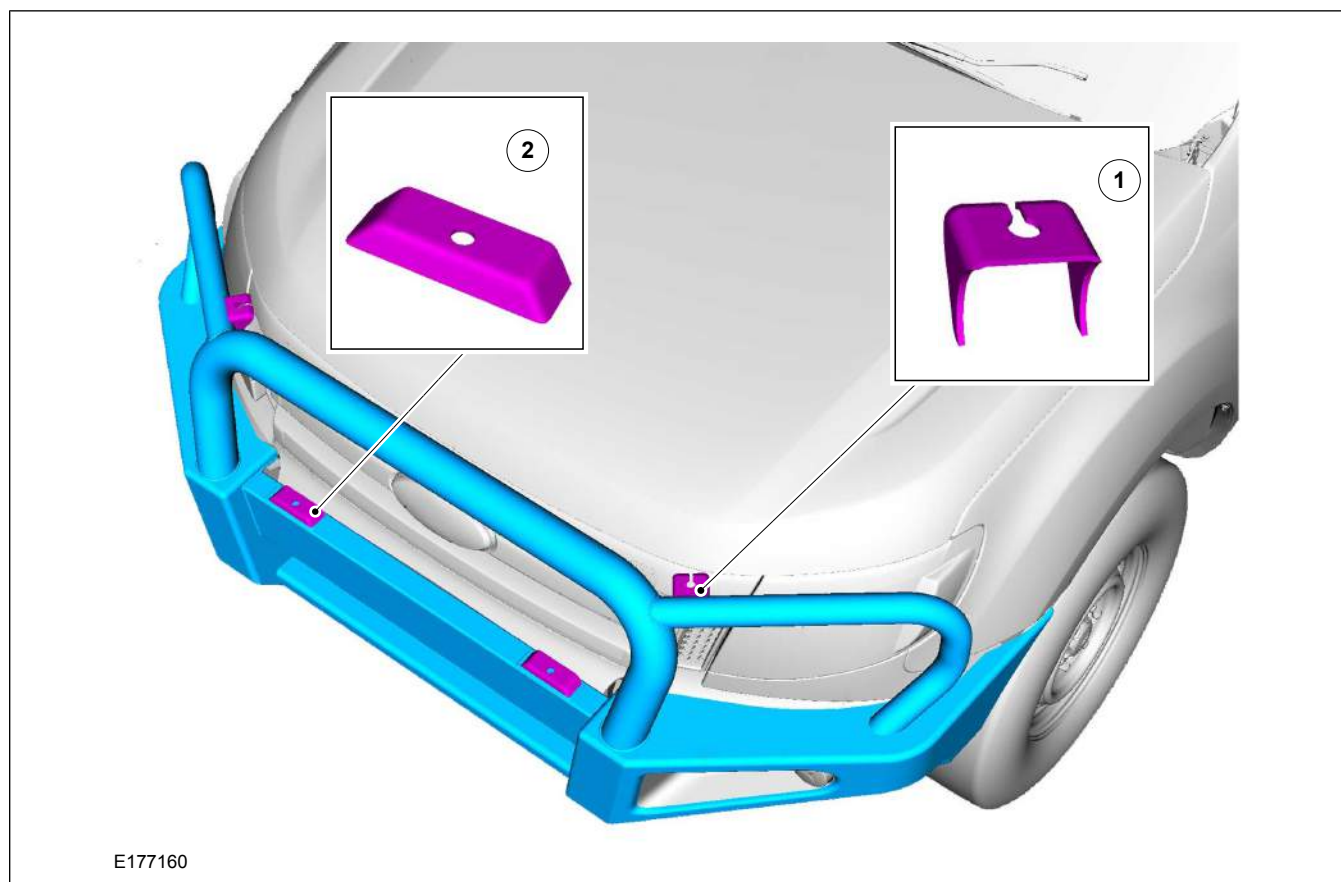
The bull bar includes brackets which are mounting points for driving lights, aerals, antennas and flags.



WARNING: Follow all accessory manufacturer's instructions when connecting accessories and equipment to the vehicle.

NOTE: Please refer to the electromagnetic compatibility (EMC) section in this book before installing any aerals or antennae.




Bull Bar Accessory Mounting Positions



Item	Description
1	Aerials, antennas and flag mounting location
2	Driving lights mounting location

Aerial/Antenna Cables Routing

WARNINGS:

-  **Ensure that the aerial/antennae cables have sufficient clearance from hot and moving parts.**
-  **Do not fasten the aerial/antenna cables to original vehicle wiring, fuel pipes and brake pipes.**
-  **Keep the aerial/antenna and power cables at least 100mm from any electronic modules and airbags and associated wiring.**

NOTE: Make sure the sealing integrity is maintained to avoid water ingress into the cabin while routing the cables through the grommet.

Aerial/Antenna cables should be routed from the engine bay into the cabin area through the existing grommet. There is a service nib provided on the grommet.

Refer to Exterior lighting - Additional external lamps for driving lights cable routing.

5.1.8 Roof Racks

Roof racks may be fitted to all variants as illustrated in figure, providing the following is satisfied:

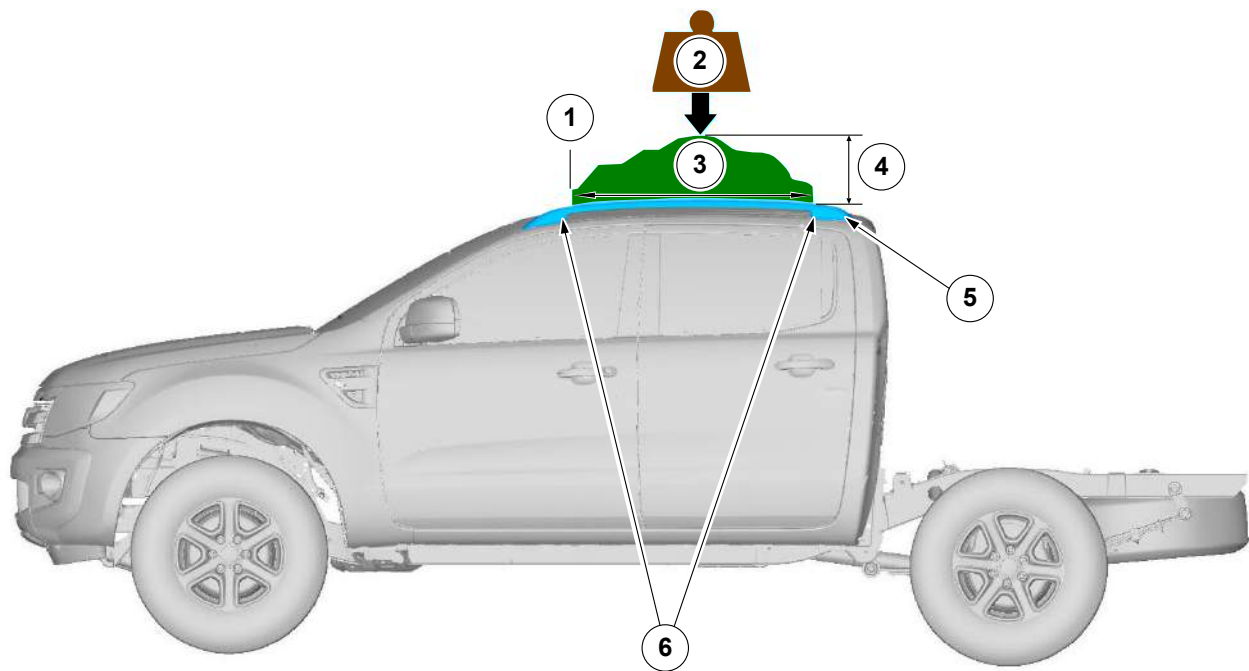
- The carried load does not exceed 80kg (Body Builder to ensure owner's hand book identifies this limitation).
- The carried load does not exceed 300mm load height (converter to ensure owner's information book identifies this limitation).
- The load is evenly distributed (converter to ensure owner's information book identifies this limitation).
- The rack and subsequent carried load is supported in the roof drip rails irrespective of rack retaining method.

Double Cab / Stretch Cab

The forgoing limitations are based on ensuring body structure integrity, vehicle handling, braking and plated axle weights. Such considerations must also be applied to any double cab and stretch cab applications, in particular steering, braking and front axle plated weight and the extra continuous loads on the “A” pillar, which should not exceed 60 kg total incremental load.

Ensure that the planned loaded vehicle operates within its designed Center of Gravity condition. For details please consult the Ford dealer.

Roof Rack Vehicle Converter Special Fit



E134129

Item	Description
1	Rear edge of front attachment point
2	80kg Maximum
3	Maximum roof rack length: Within length of drain channel
4	Maximum Load Height 300mm
5	Drain channel
6	Roof rack supports

5.1.9 Canopies

All Vehicles

WARNINGS:

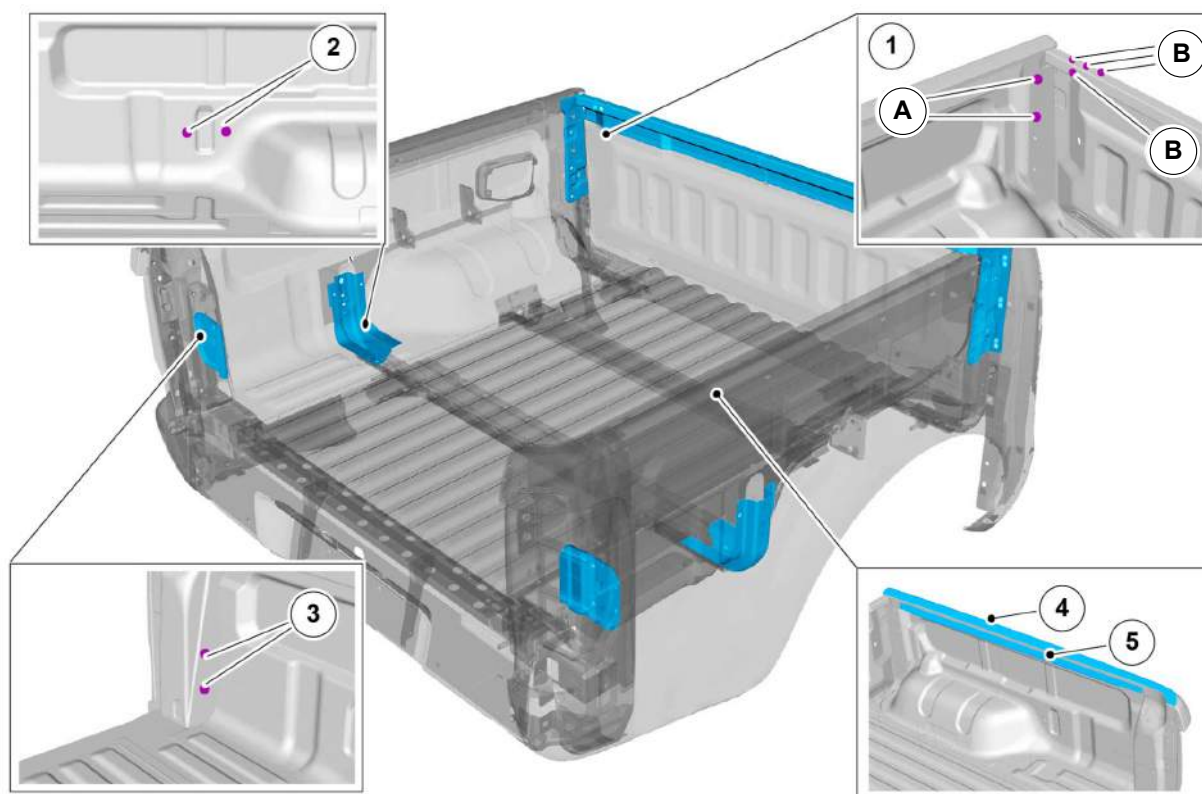
- Only use the recommended attachment points for the canopy fitment, otherwise damage may occur to the load box.
- The return flange on the load box sides should never be cut away, be drilled into, or be used otherwise for bolting of the canopy.

- The top surface of the load box sides should not bear canopy (or other) structural loading. To be used as a canopy 'sealing-surface' only.
- Canopy weight and canopy load should pass through the recommended load box structural attachment points.

NOTE: Usage of clamps for the canopy fitment are only allowed on the centre and rear portion of the load box.

NOTE: Use both points from group A and a minimum of one point from group B as front structural attachment points.

Load Box Structural Attachment Points

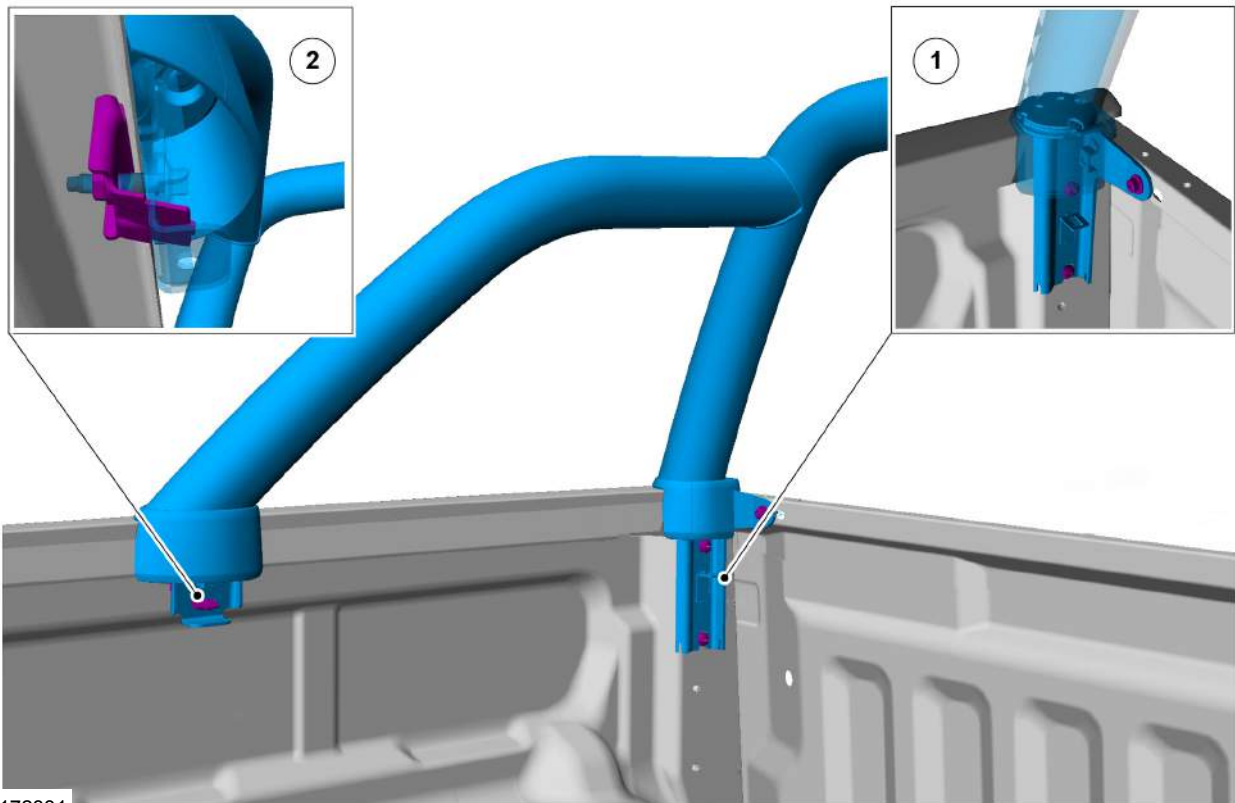


E170921

Item	Description
1	Front structural attachment points
2	Centre structural attachment points
3	Rear structural attachment points
4	Top surface of load box sides*
5	Return flange of load box sides*

*Do not cut, drill, or use these surfaces to bolt the canopy.

Example of a Sports Bar Fitment



E172331

Item	Description
1	Front mounting bracket
2	Clamped attachment

5.2 Airbag Supplemental Restraint System (SRS)

5.2.1 Air Bags

Front Seats

Side airbags are not compatible with swiveling front seats.

Do not specify the base vehicle with side airbags when planning to retrofit a swiveling device on the front seats and/or an armrest on the outer side of the front seats, this may affect the function and/or deployment of the side airbags.

The acceleration based airbag sensors for side airbags are located nearby the bottom of the C-pillar inner for RAP and DBL Cab vehicles. The pressure based airbag sensors for side airbags are located near the centre of the front doors' inner door sheet metal for all Cab styles.

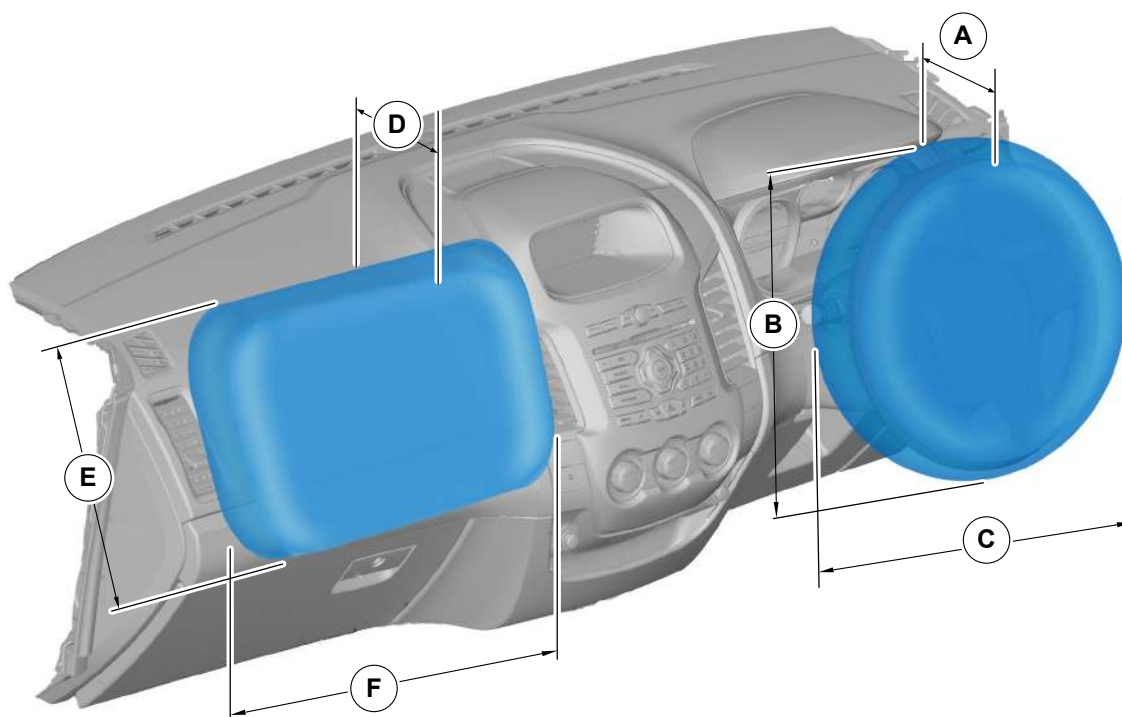


WARNING: Modifications or reinforcements in the area of the sensors may affect the side airbag fire timing and result in uncontrolled side air bag deployment.

Please note that vehicles not equipped with side airbags but equipped with front airbags only are not affected.

Drilling or grinding operations in this area are only permitted when battery cables are disconnected.

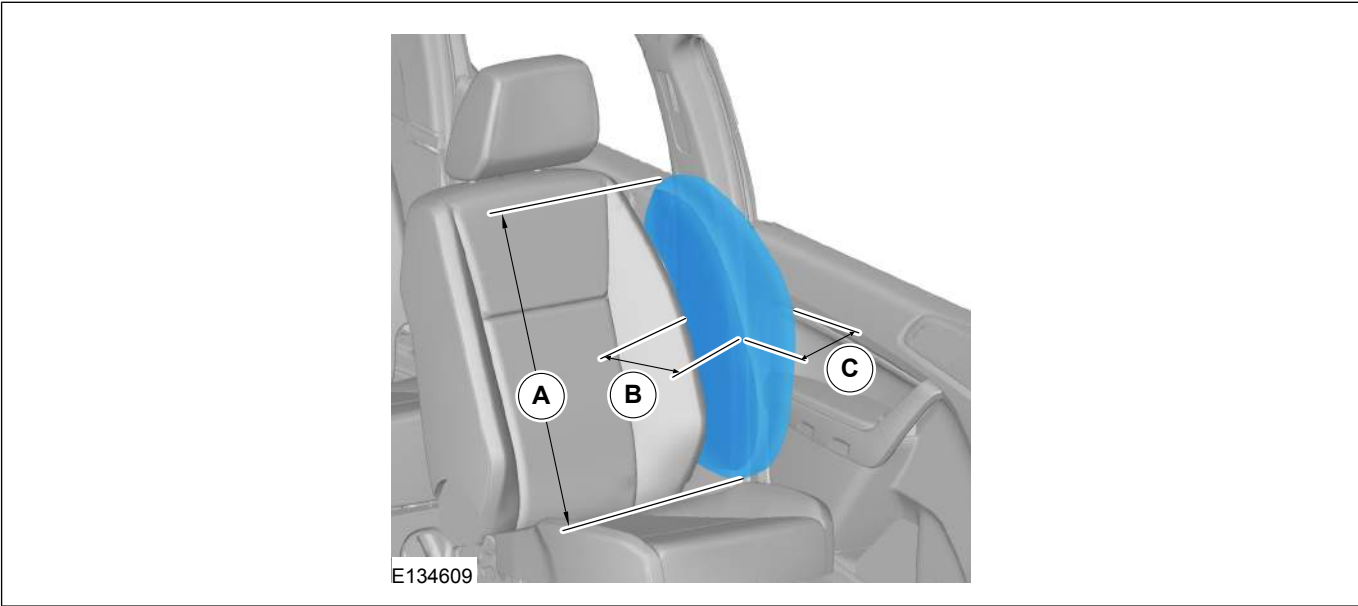
Driver and Passenger Front Airbag Deployment Zones



E134101

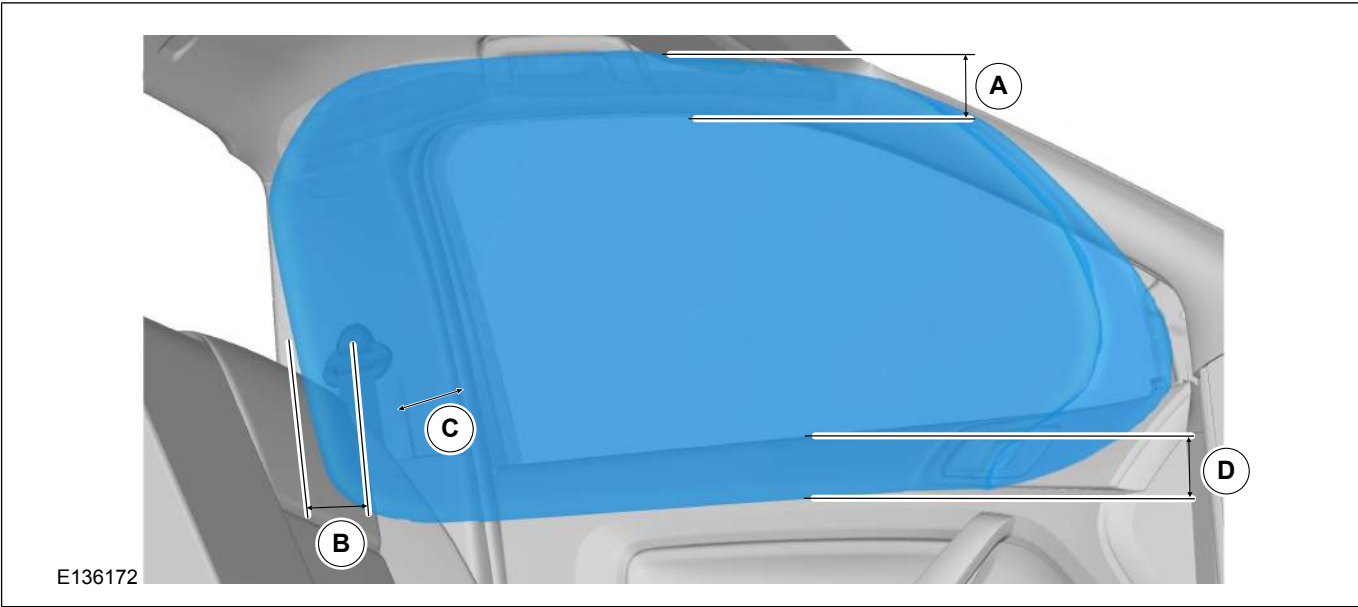
Dimensions (mm)			
A	400	D	660
B	700	E	630
C	700	F	700

Side Airbag



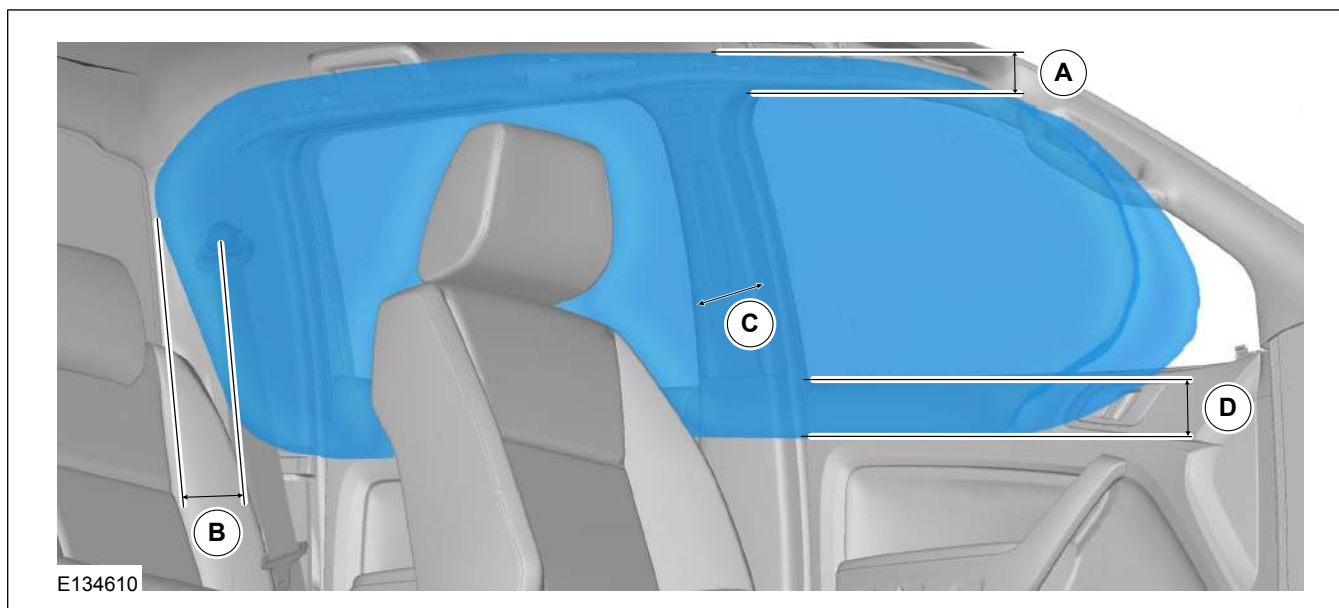
Dimensions (mm)			
A	550	C	250
B	350		

Curtain Airbag - Single cab



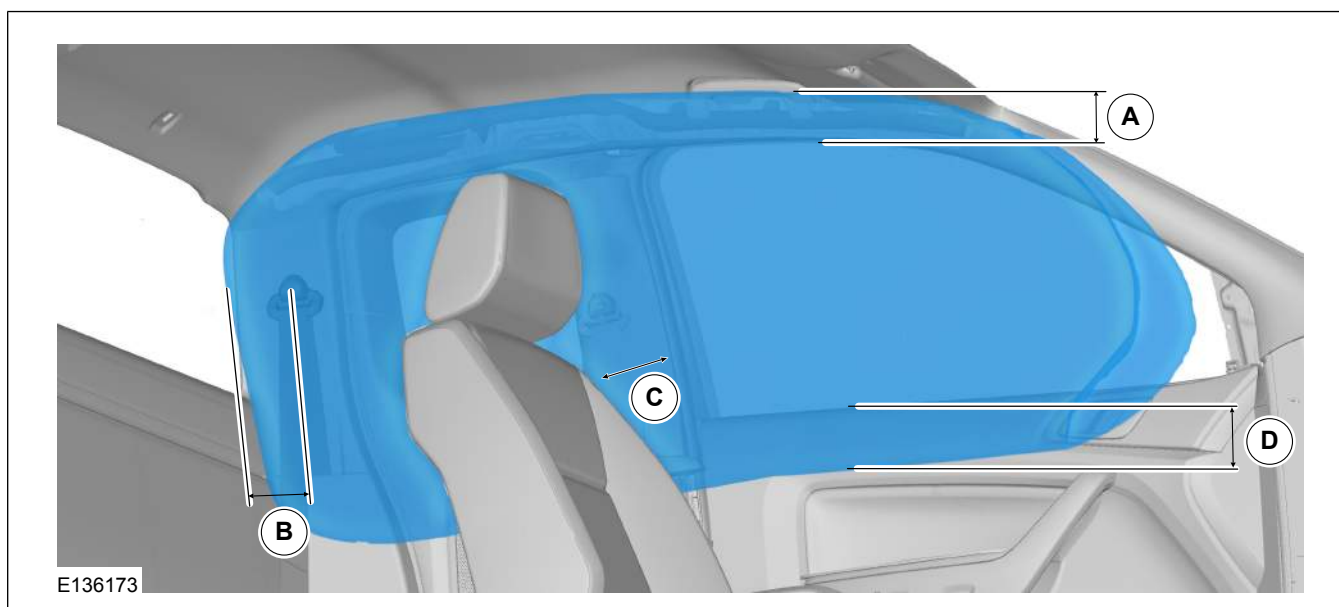
Dimensions (mm)			
A	140	C	250
B	40	D	100

Curtain Airbag - Double cab



Dimensions (mm)			
A	140	C	250
B	40	D	100

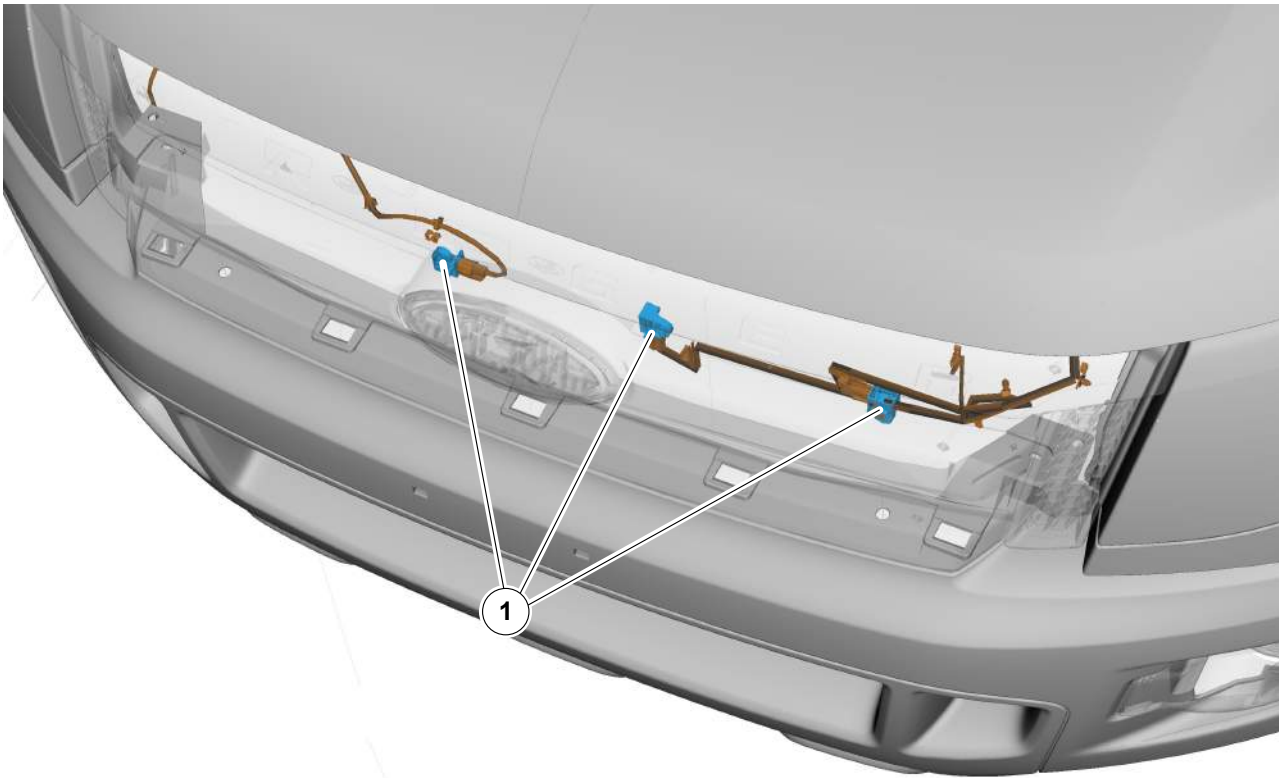
Curtain Airbag - Stretch cab



Dimensions (mm)			
A	140	C	250
B	40	D	100

5.2.2 Supplementary Restraint Sensors (Front)


 **WARNING:** Modifications or reinforcements in the area of the front supplementary restraint sensors may affect their operation.



E201479

Item	Description
1	Front SRS Impact Sensors

5.3 Safety Belt System

 **WARNING: Follow removal and installation procedures for the seat belt system to ensure correct function of the restraints system.**

The removal and reinstallation of the seat belt, restrainer or any component of the seat belt system should be avoided. However if removal and re-installation of the system is required during the conversion, follow the removal and installation guidelines of the seat belt system as described in the workshop manual. Please consult your local National Sales Company representative for further information.

When removing the seat belt system, a seat belt webbing forked retainer should be applied to the webbing 200mm below the webbing button stop. This prevents a situation where all the webbing runs back into the retractor and the retractor becomes locked.

When reinstalling, fit the retractor to the body first and gently pull the webbing out of the retractor to allow fitment of the D loop. Then remove the forked retainer. If the retractor is locked, allow a small amount of webbing to reel back into the retractor to allow the webbing lock to release. Do not attempt to release the retractor by pulling on the webbing with significant force or by manually interfering with the locking mechanism.

5.4 Corrosion Prevention

5.4.1 General

Avoid drilling into closed frame body members to avoid the risk of corrosion from swarf.

If drilling is required, however:

- Re-paint metal edges and protect against corrosion after cutting or drilling operations.
- Endeavor to remove all swarf from inside the side member and treat to prevent corrosion.
- Apply corrosion protection inside and outside of the chassis frame.

5.4.2 Repairing Damaged Paint

After cutting or reworking any sheet metal on the vehicle the damaged paint must be repaired.

Ensure all materials are compatible with the relevant Ford specifications and maintain the original performance where possible.


5.4.3 Under Body Protection and Material

 **WARNING: Do not over-coat or contaminate surfaces of components such as brakes or catalytic converters.**

Ensure all materials are compatible with the relevant Ford specifications and maintain the original performance where possible.

Some proprietary products affect the original coatings. For specifications of corrosion protection materials, please consult your local National Sales Company representative.

5.4.4 Painting Road Wheels

 **WARNING: Do not paint wheel clamp surfaces in contact with other wheels, brake drum or disc, hub and holes or surface under wheel nuts. Any further treatment in these areas may affect the wheel clamp performance and the vehicle safety. Mask the wheel when changing the color or repairing paint.**

5.4.5 Contact Corrosion

When using different materials with a different electrochemical potential, ensure that materials are isolated from each other to prevent contact corrosion caused by a potential difference.

Use appropriate isolation materials.

Where possible, choose materials with low level of electrochemical potential difference.

5.5 Frame and Body Mounting

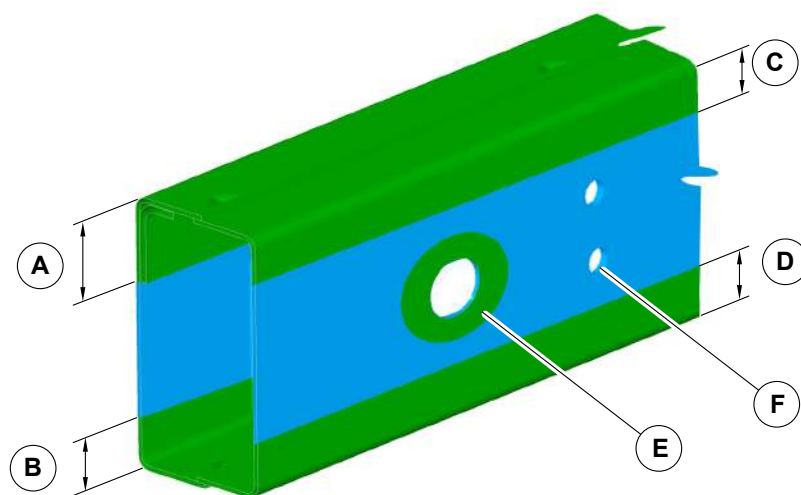
5.5.1 Mounting Points and Tubing

Holes on frame are a result of the production process. They are not designed for fixing additional equipment. Always use chassis mounts as shown in sub frame for low floor or other equipment. If additional fixings are required please follow the recommendation given in the figure shown. This does not apply to areas of load applications such as spring fixings or damper fixings.

NOTE: After drilling, deburr and countersink all holes and remove chips from the frame. Follow corrosion prevention.

Refer to: 5.4 Corrosion Prevention (page 80).

Frame Drilling and Welding



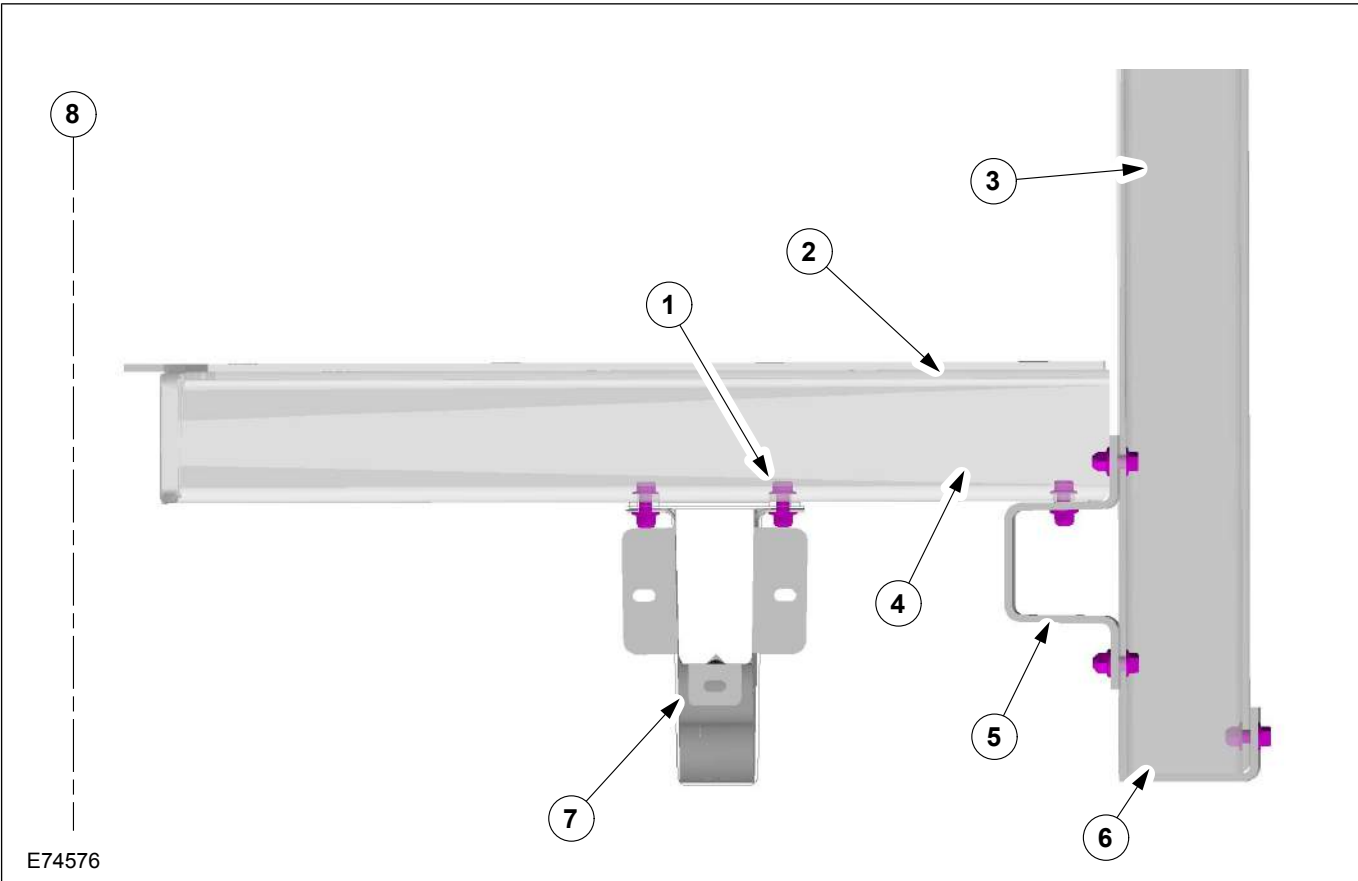
E134173

Dimensions (mm) for Body Attachment Holes in Chassis Frame Top Flange Medium Wheelbase

Item	Description
A	19 mm
B	11 mm
C	10 mm
D	10 mm
E	Do NOT enlarge chassis rail holes, or drill within the surrounding area.
F	Do not drill any more than 2 vertical holes in the chassis rail.

- No Welding is Allowed to the Vehicle Structure.
- To make holes in frames do not use a gas flame. Drill holes using sharp drills.
- Use cold riveting only when attaching brackets with rivets.
- Use high tensile bolts and appropriate nuts when bolted attachments are used.
 - Bolt Specifications :
 - Metric – Property class 8.8 or 10.9
 - Japanese – 7T or 9T
 - SAE – Grade 8 5.
- Deburr holes after drilling to fit bolts or rivets. Chamfer 1.0mm x 45 degree on the bolt head side of the hole to facilitate bolt seating.
- Holes must NOT be drilled near side member profile changes.
- Existing holes in top and bottom flanges must NOT be bored out.
- No more than two holes are to be drilled in a vertical line down from the frame web.
- Corrosion protection is to be applied post drilling operations to the vehicle. Corrosion protection & protective coatings for all modifications should conform to all local design rules.
- Reinforcements should be added to the vehicle structure where appropriate, to avoid excessive load concentrations.

Typical Design Principle of a Self-Supporting Body Structure



Item	Description
1	Use all standard locations with 2x M10 fixings
2	Floor panel
3	Body side frames
4	Floor cross members
5	Continuous floor U-profile frame
6	Longitudinal L-profile
7	Chassis frame rail of base vehicle
8	Vehicle center line of base vehicle

Also see:

[Refer to: 5.1 Body \(page 65\).](#)

5.5.2 Self-Supporting Body Structure

Bodies and structures can be judged as self-supporting providing they maintain the following rules:

- Cross members are used at each chassis mounting point, please refer to figures shown.
- Each cross member has a suitably engineered connection to the body side wall (3) or to the continuous floor frame (5), see figure shown.
- The body side wall or the continuous floor frame supports any overhang beyond the chassis frame, whether on standard frame or extended frame.

Alternatively, the self-supporting body structure can also be designed as shown in figure shown.

- This concept is based on a self-supporting structure where the floor is mounted directly onto the top surface of the chassis frame.
- See figure shown for a generic vehicle cross section where the cross members and opposing out riggers are flush with the surface of the chassis frame side members.
- It is important to the overall function of the vehicle structure that the out riggers are each connected to a continuous longitudinal floor side frame or a structural body side structure assembly.

Low floor-re-work for guidance only:

- Engineer unique cross members and out-riggers spaced at approximately 600mm maximum pitch.
- Out-rigger moment to be re-acted with cross-member between chassis frame with common through bolts where possible.

- Drill frame and add spacer tubes.
[Refer to: 5.5 Frame and Body Mounting \(page 81\).](#)
- Out-rigger outboard ends should be attached to load bearing body side / floor edge frame or body side structure (including over wheel support).
- Structural wheel box should maintain longitudinal continuity with a rigid attachment to the floor edge frame or to the body side structure.
- Floor boards should be substantially attached to cross members and outriggers, but not to the chassis frame top surface.
- Low floor exhaust heat shields.

5.5.3 Frame Drilling and Tube Reinforcing

The chassis frame may be drilled and reinforcing spacer tubes may be welded in place, providing the following is applied:

- Adhere to all details shown in figure.
- Drill and weld only side walls of the chassis frame.
- Locate and drill holes accurately, using a drill guide to ensure holes are square to frame vertical center line (note: allow for side member draft angle).
- Drill undersize and ream out to size.
- Endeavor to remove all swarf from inside side member, and treat to prevent corrosion.
- Fully weld each end of the tube and grind flat and square, in groups if applicable. Be aware of side member draft angle.
- Apply corrosion protection inside and outside of the chassis frame.
[Refer to: 5.4 Corrosion Prevention \(page 80\).](#)
- Holes should be in groups of two (2), either vertically spaced at 30 to 35mm from chassis frame top and/or bottom surface, or horizontally at 50mm minimum pitch, 30 to 35mm from top and/or bottom chassis frame surface.
- Always use M10 bolts with grade 8.8 minimum.
- Do not position tubes at the medium chassis frame height, this may create "oil canning" of the deep section side walls.
- Where possible, the outrigger moments should be resolved by matching inner cross members between the chassis side members inline with the outriggers.
- A diameter of 16.5mm is the maximum allowable hole size in the chassis frame side wall, irrespective of the usage.

Avoid drilling into closed frame body members to avoid the risk of corrosion from swarf.

[Refer to: 5.4 Corrosion Prevention \(page 80\).](#)

Drilling and welding of frames and body structure have to be conducted following the program guidelines. Please consult the Ford dealer for details.

5.5.4 Ancillary Equipment - Sub Frame Mounting

Typical sub-frames and longitudinal members for flatbed and low or drop-side bodies or equipment exceeding the standard or Regular Production Order frame length should adhere to the following guidelines:

- Flat-beds and low bodies mounted on integral longitudinal members (channel or box section metal – not wood) must use both sides of all frame mounting brackets.
- Longitudinal members must be relieved at the front end if they are to contact the chassis frame top surface, to minimize stress concentrations. It is preferable however, to mount the longitudinal onto the mounting brackets, with a clearance to the chassis frame top surface.
- Each set of brackets must use two (2) x M10 bolts grade 8.8 minimum.
- Minimum floor heights will require wheel arch boxes to clear the rear tires, see Vehicle Data sheets for relevant tire jounce.

5.5.5 Area for Fitting Additional Body Attachments to the Rear of the Bumper.

NOTE: With the vehicle on level ground and with all measurements taken rear ward of the bumper bar edge: The area designated for the fitting of attachment is defined as 220mm horizontally by 95mm vertical downward to the road surface, with a max width of 1390mm about vehicle center line.

It is not the manufactures recommendation to fit additional body attachments (Tow bars, Steps, Bicycle racks & Carriers) outside of the designated area.

5.5.6 Water Tank on Camper Vehicles

NOTE: It is recommended that a decal or label is fitted adjacent to the filler aperture identifying the correct fluid to be used, for example: 'Water only' for water tanks.

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