

FORD **Ranger** 2019

Body and Equipment Mounting Manual



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1.1 About this Manual

1.1.1

It is recommended to review this manual in full. The BEMM is a live document which can be viewed on www.etis.ford.com/BEMM or <http://www.fordtechservice.dealerconnection.com/>. It is the vehicle converters responsibility to review the online version for the most current information prior to starting any conversion.

1.1.2 Introduction

NOTE: Printed copies are uncontrolled.

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 they compromise neither their personal safety nor the vehicle integrity by their 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 serious injury or death.

 **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.

1.1.6 Low Level and High Level Vehicles

 **WARNING:** Prior to work on any vehicle being undertaken it is critical to identify the type of electrical architecture the vehicle at hand is equipped with. Failure to identify the type of electrical architecture present on the vehicle prior to work being undertaken may cause electrical damage or have safety implications.

Ford Ranger vehicles are equipped with one of two electrical architectures.

Refer to: [4.7 Fuses and Relays \(page 70\)](#).

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, electrical systems, 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, including 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 regulatory standards.

The Vehicle Converter must provide sufficient Load Restraint tie down points or compartmentalised 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 combination mass, axle ratings and trailer rating.**

 **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 (DPF). 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 Anti-lock Brakes System and Traction Control System cables because of extraneous signal risk. Do not 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 in the base vehicle remain in full view to the driver after any conversion.**

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).
- Any 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: Airbag Supplemental Restraint System (SRS) (page ?).

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)

1.4.1

WARNINGS:

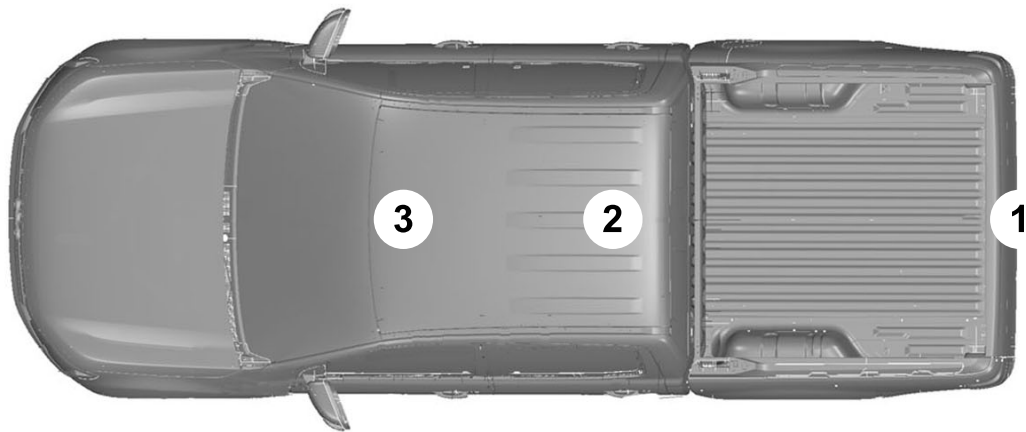
⚠ Do not place objects or mount equipment on or near the airbag cover, on the side of the seatbacks (of the front seats), or in front seat areas that may come into contact with a deploying airbag. Failure to follow these instructions may increase the risk of personal injury in the event of a crash.

⚠ 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.

NOTE: We test and certify your vehicle to meet local electromagnetic compatibility legislation or equivalent, where applicable. It is your responsibility to make sure that any equipment an authorized dealer installs on your vehicle complies with local regulatory standards.

NOTE: Any radio frequency transmitter equipment in your vehicle (such as cellular telephones and amateur radio transmitters) must keep to the parameters in the following table. We do not provide special provisions or conditions for installations or use.



Frequency Band MHz	Maximum Output Power Watts (Peak RMS)	Antenna Position
1-30	50	1
50-54	50	2, 3
68-88	50	2, 3
142-176	50	2, 3
380-512	50	2, 3
806-870	10	2, 3

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

Check all electrical equipment:

- with the ignition ON
- with the engine running
- during a road test at various speeds

NOTE: Check that electromagnetic fields generated inside your vehicle cabin by the transmitter installed do not exceed applicable human exposure requirements.

1.5 Vehicle Duty Cycle Guidelines

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

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.

A high numeric gear ratio is recommended for vehicles with customer requirements for:

- High payload
- Trailer tow
- Frequent stop-and-go cycles
- High altitude and gradients
- Terrain conditions such as found on building and construction sites

1.5.1 Vehicle Ride and Handling Attributes

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

Conversions to the base vehicle that change the center of gravity may affect the ride and handling attributes.

NOTE: All vehicles should be evaluated for safe operation prior to sale.

1.6 Jacking

WARNINGS:

-  **Ensure screwthread is adequately lubricated before use.**
-  **The jack should be used on level firm ground wherever possible.**
-  **Switch the ignition off and apply park brake fully before lifting vehicle.**
-  **It is recommended that the wheels of the vehicle be chocked, and that no person should remain in a vehicle that is being jacked.**
-  **No person should place any portion of their body under a vehicle that is supported by a jack.**
-  **WARNING: Do not get under a vehicle that is supported by a jack.**

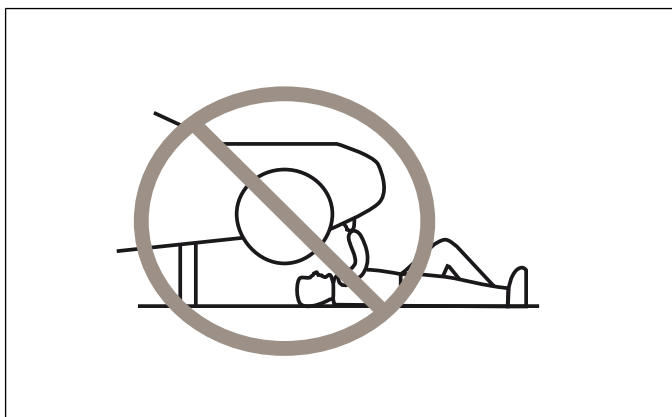
 **WARNING: The jack supplied with this vehicle is only intended for changing wheels. Do not use the vehicle jack other than when you are changing a wheel in an emergency.**

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

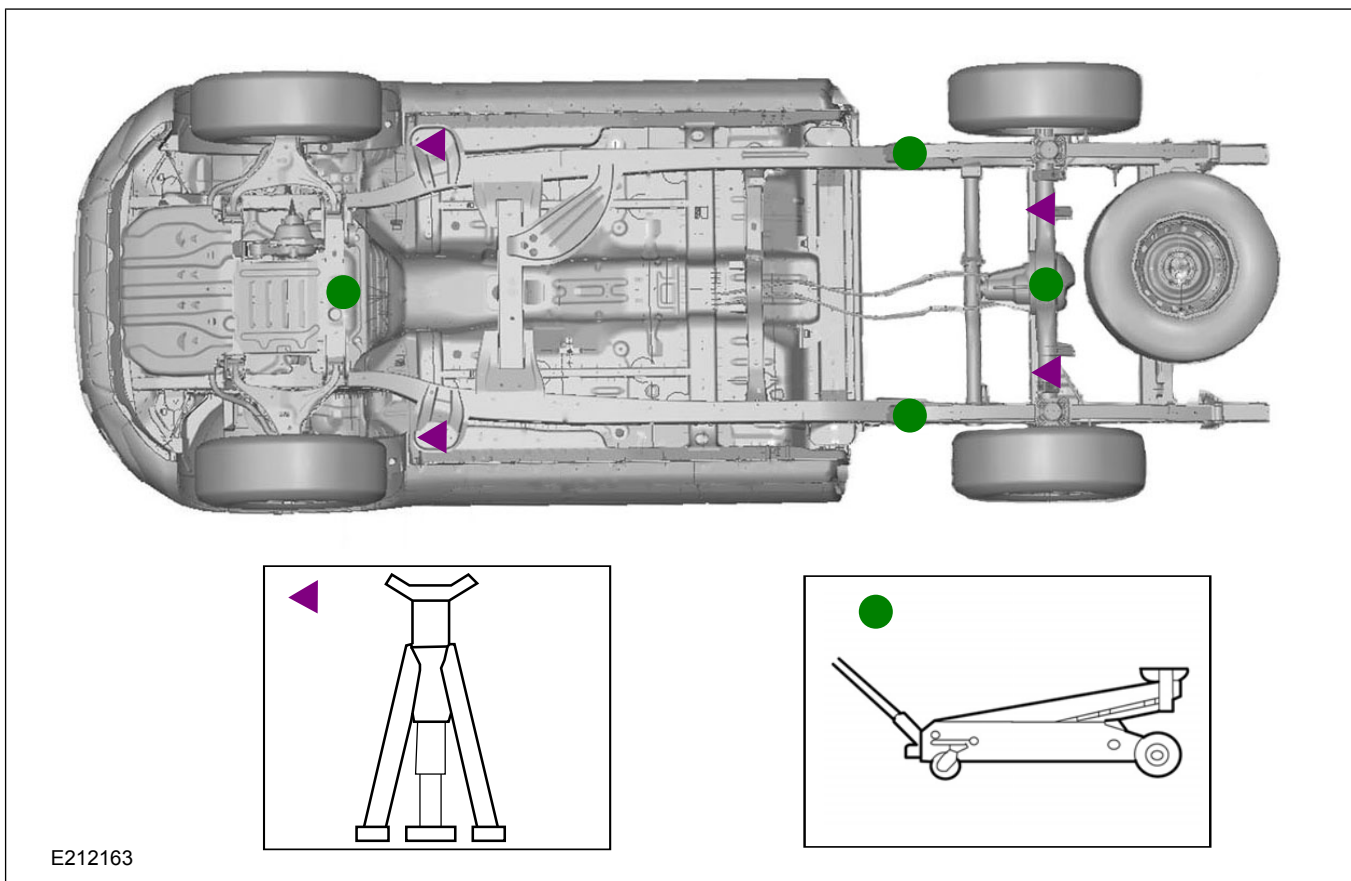
NOTE: When using the vehicle jack, refer to the owner guide for correct operating instructions.

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.



Vehicle Jacking Points and Axle Stand Positions



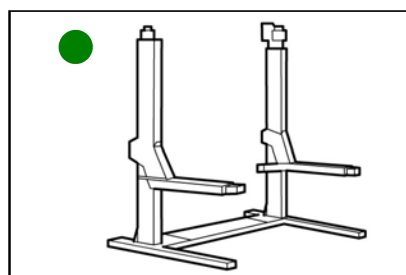
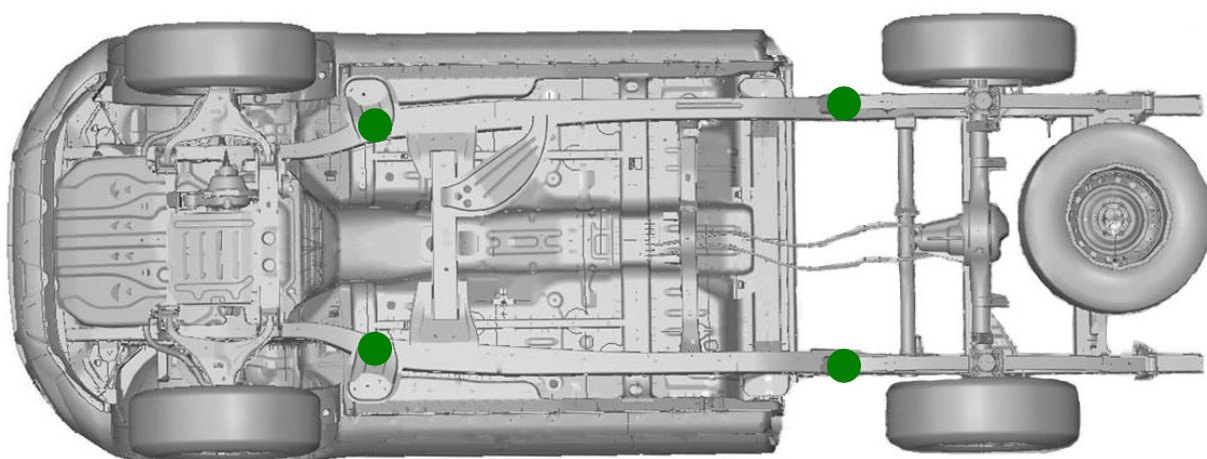
1.7 Lifting

⚠ 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 serious injury or death.

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.**

Changes to the powertrain, engine, transmission, exhaust, air intake system or tires may influence the exterior noise emissions. 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.**
-  **Transport Mode includes a calibration feature to reduce the risk of fuel injector nozzle corrosion. Exiting Transportation Mode prior to upfitting/ conversion increases the risk of early life injector failure.**

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 chocks 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 until coolant gauge reaches temperature (60 °C) with aircon switched on, where applicable	-	X

Protection from Injector Nozzle Corrosion During the Upfitting/Conversion Process

Ford Engineering has identified a concern with the fuel injectors on the 2.0L EcoBlue / Duratorq engine whereby the injector nozzle can become corroded.

This is caused by condensation which forms on the nozzle when the engine is new and run repeatedly for very short periods of time when the engine is cold (less than 60 degrees centigrade). Fuel injectors may fail as a consequence, either during vehicle storage or early time in service.

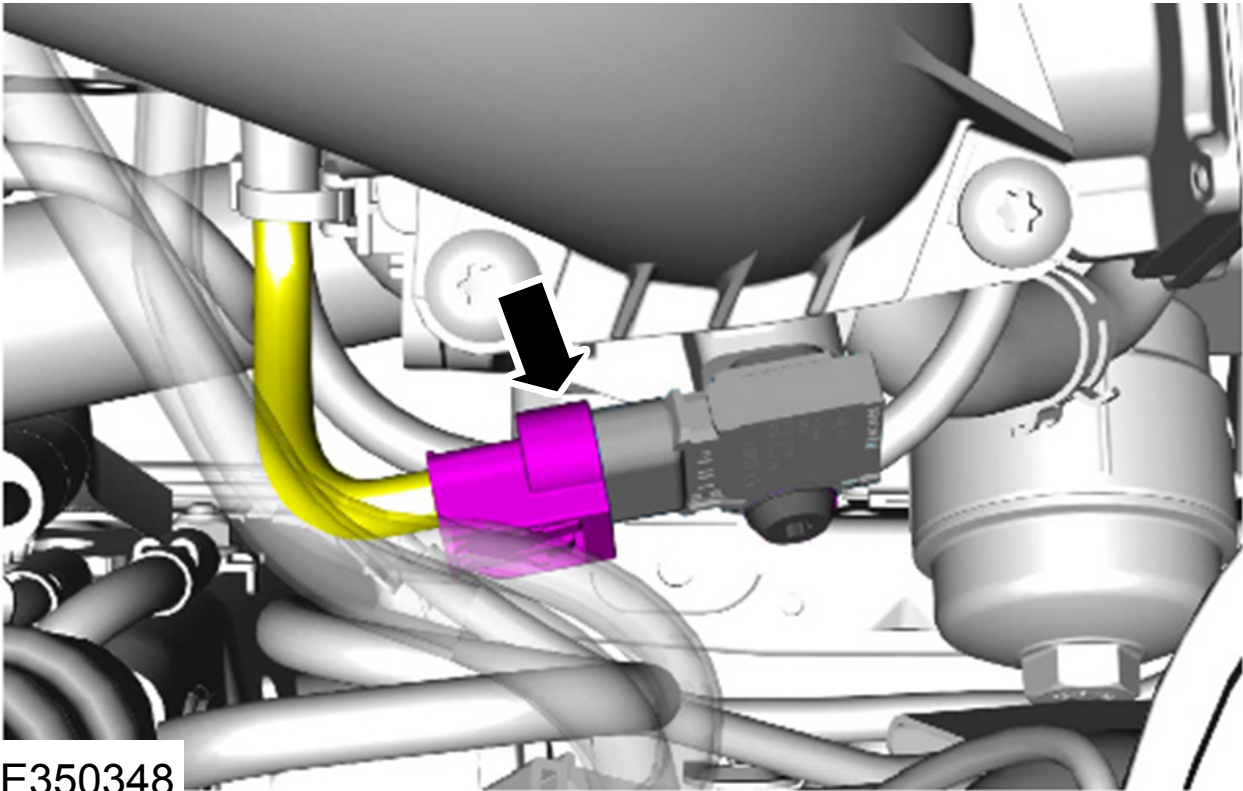
If the vehicle cannot be left in transportation mode then the procedure to disconnect the Manifold Absolute Pressure (MAPT) sensor electrical connector, until the vehicle is prepared for delivery to the customer, should be followed to achieve the same result.

Experience shows that vehicles undergoing a conversion where the engine is regularly started for short periods of time when cold, are most at risk; for example, vehicles undergoing a Motorhome conversion.

Vehicles held in storage for long periods of time are particularly susceptible to this concern, for example vehicles awaiting or undergoing a conversion.

To overcome this and protect fuel injectors from early time-in-service failures, the Manifold Absolute Pressure Temperature (MAPT) must be disconnected by following the following simple procedure.

Procedure for disconnecting the Manifold Absolute Pressure Temperature (MAPT) sensor



- Disconnect the electrical connector.
- Start and stop the engine 4 times to ensure that the Malfunction Indicator Lamp (MIL) is illuminated and corresponding information message is displayed in the instrument cluster.
 - The vehicle can be operated safely with the MAP sensor disconnected during any conversion that the vehicle may be undergoing, for example a Motorhome conversion.
- Before the vehicle is handed over to the customer, the Manifold Absolute Pressure Temperature (MAPT) must be reconnected and the engine must be started 4 times to turn off the Malfunction Indicator Lamp (MIL), remove the information message and restore the engine's normal power and torque outputs.

NOTE: When the Manifold Absolute Pressure Temperature (MAPT) sensor is disconnected, the vehicle must only be used at the storage facility and NOT on public roads.

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 must 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 must 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 Effects 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 reversing lamps section.

Refer to: Exterior Lighting (page ?).

1.10.5 Aids for Vehicle Entry and Exit

Steps

WARNINGS:

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

 **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.**

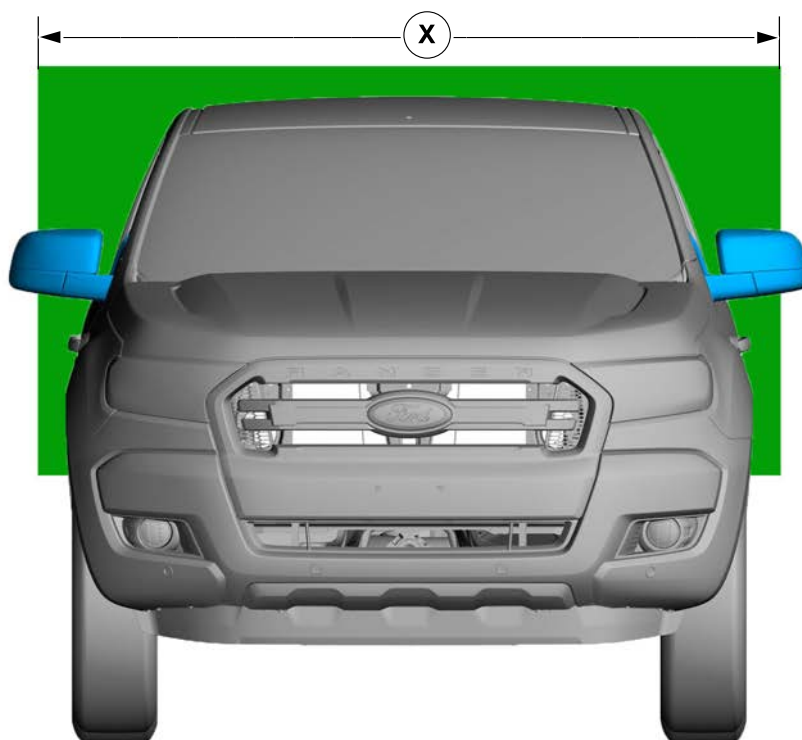
Steps can be ordered as an accessory on the base vehicle. Please check for availability.

Where additional steps are installed the required ground clearance line must 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

NOTE: Overall width with exterior rear view mirrors extended is 2163 mm.



E278311

Item	Description
X	Maximum Body Width: 1860mm

1.10.6 Registration Plates

Front Registration Plate

WARNINGS:

-  **The mounting of a registration plate to the front of the vehicle must comply with local regulatory standards.**
-  **No part of a vehicle registration plate may be obscured by standard equipment, regular production options or equipment, in line with local regulatory standards.**

The registration plate must be affixed to the front of the motor vehicle forward of and parallel to the front 'Axle' in line with local regulatory standards.

Rear Registration Plate

WARNINGS:

-  **The mounting of a registration plate to the rear of the vehicle must comply with local regulatory standards.**
-  **No part of a vehicle registration plate may be obscured by standard equipment, regular production options or equipment, in line with local regulatory standards.**

The registration plate must be affixed to the rear of the motor vehicle in line with local regulatory standards.

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: (page ?).

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.

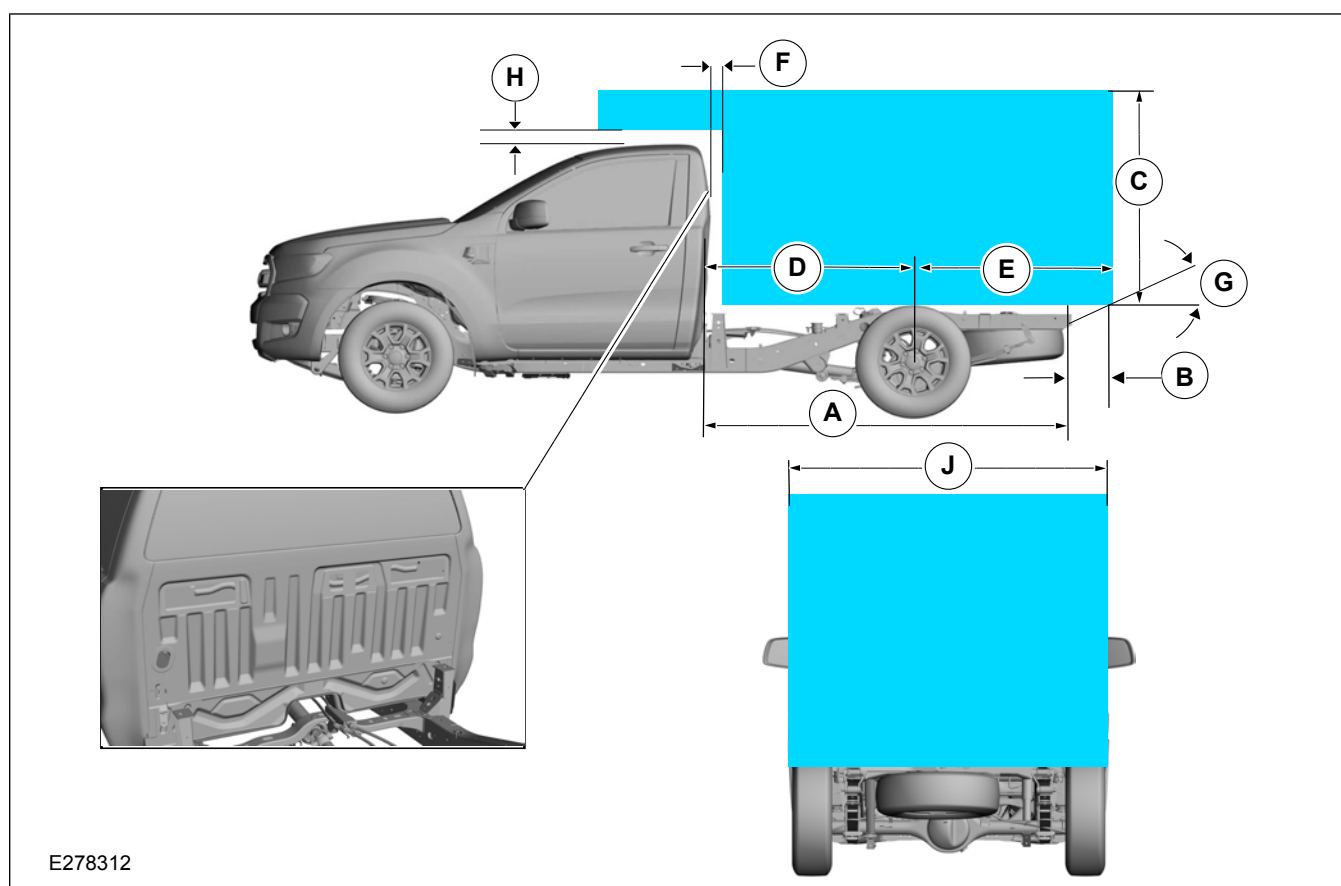
NOTE: If a towball is fitted to the vehicle, the body dimensions must incorporate a towball clearance zone in accordance with local regulatory standards. For additional information, refer to local regulatory standards.

If a conversion requires more than 50% overhang, 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: Body (page ?).

Chassis Cab Body - Single Cab Illustrated



E278312

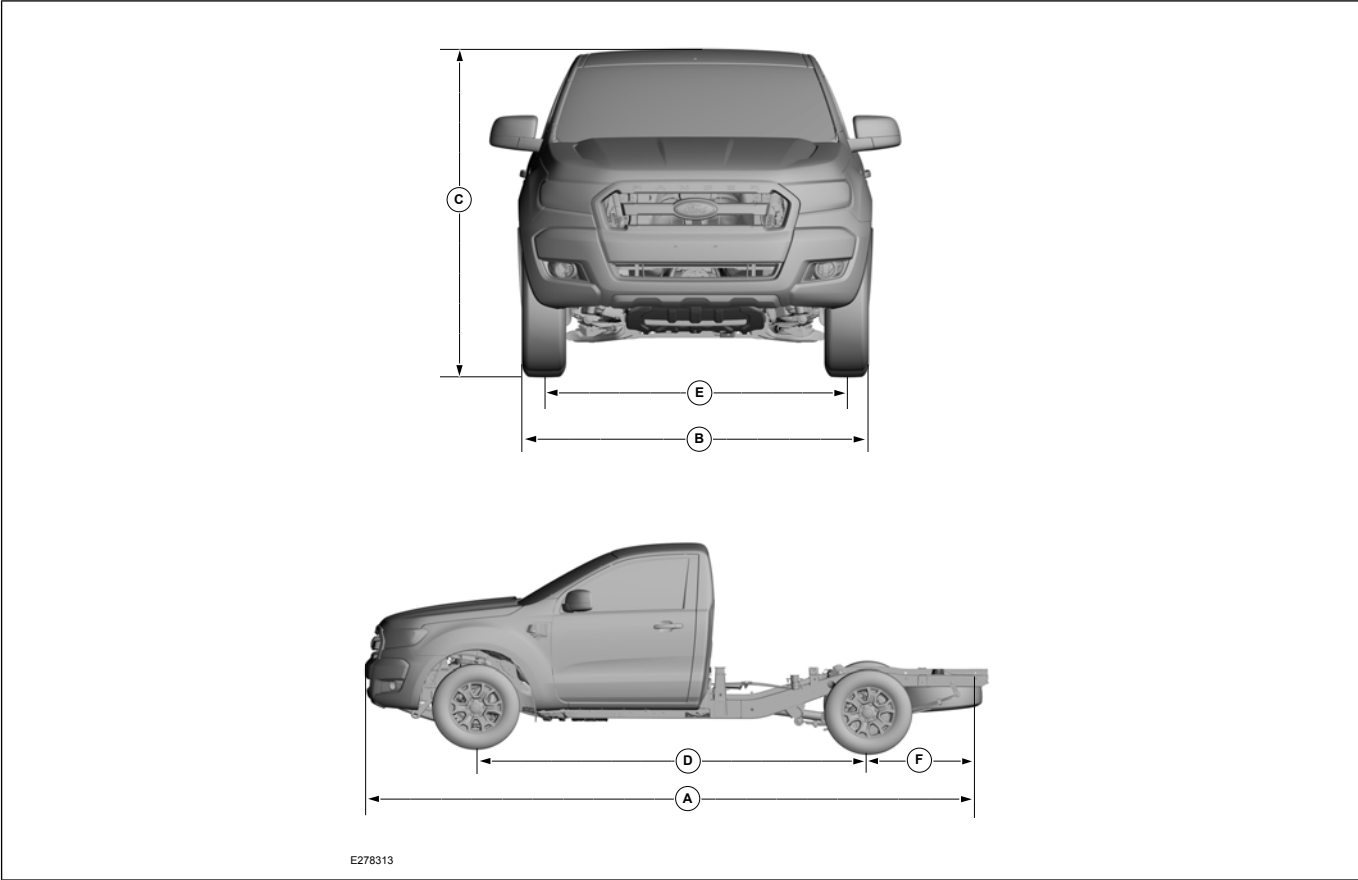
Dimensions - not to exceed for Chassis Cab body Length

Description		Dimension (mm)		
		Single Cab	Super 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: Exterior Lighting (page ?) .			
H	Clearance between the top of the cab and the body	30		
J	Maximum external body width	1860		

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



Chassis Cab Body - Basic Dimensions and Weights

Description		Single Cab	Double Cab
A	Overall length (mm)	5110	
B	Overall width - excluding exterior mirrors (mm)	1860	
C	Overall height 4x2 (mm)	1703	1716
C	Overall height 4x4 (mm)	1800-1806	1815 - 1821
D	Wheelbase (mm)	3220	
E	Track - front (mm)*	1590	
E	Track - front (mm)**	1560	
E	Track - rear (mm)*	1590	
E	Track - rear (mm)**	1560	
F	Rear Overhang with rear bumper where fitted (mm)	985	1234
-	Front Axle Load (kg)*	1325	
-	Front Axle Load (kg)**	1480	
-	Rear Axle Load (kg)*	1755	
-	Rear Axle Load (kg)**	1850	

* 4x2 vehicles with low ride height.

** 4x2 Vehicles with increased ride height / 4x4 vehicles.

1.11.3 Kerb Mass and Payload

WARNING: Check local legislation for legal requirements.

Details of vehicle kerb mass and payload capacities can be provided by your local National Sales Company representative.

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 ratings.**
-  **Do not exceed the gross vehicle mass.**
-  **Tire manufacturer specification must be maintained.**

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

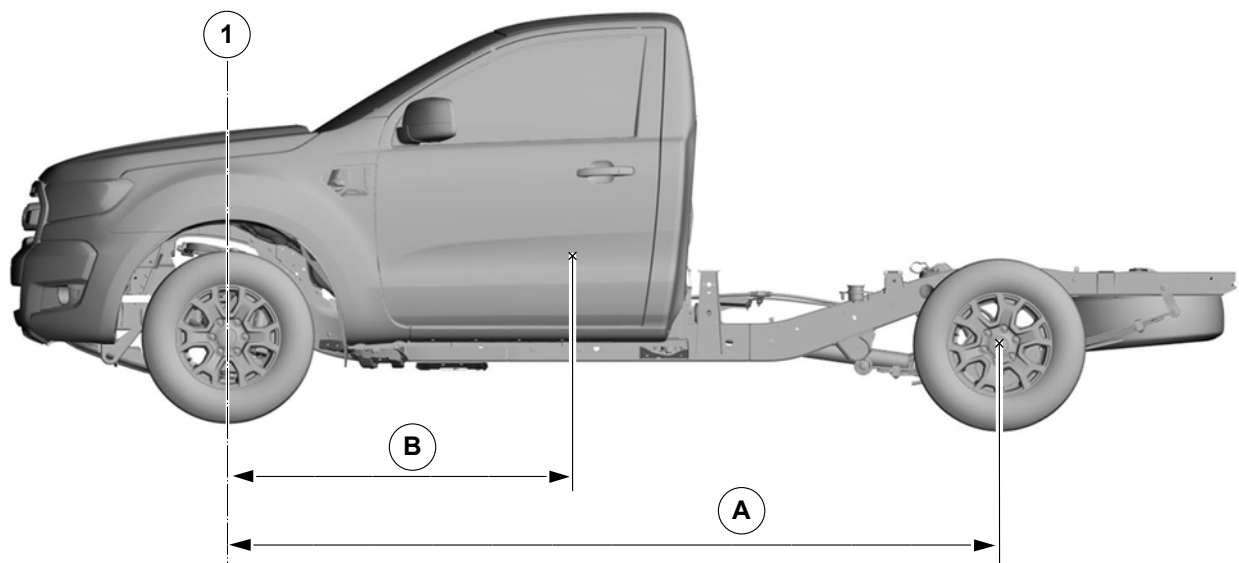
NOTE: Over loading of the vehicle could result in unacceptable ground clearance.

NOTE: The center 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.

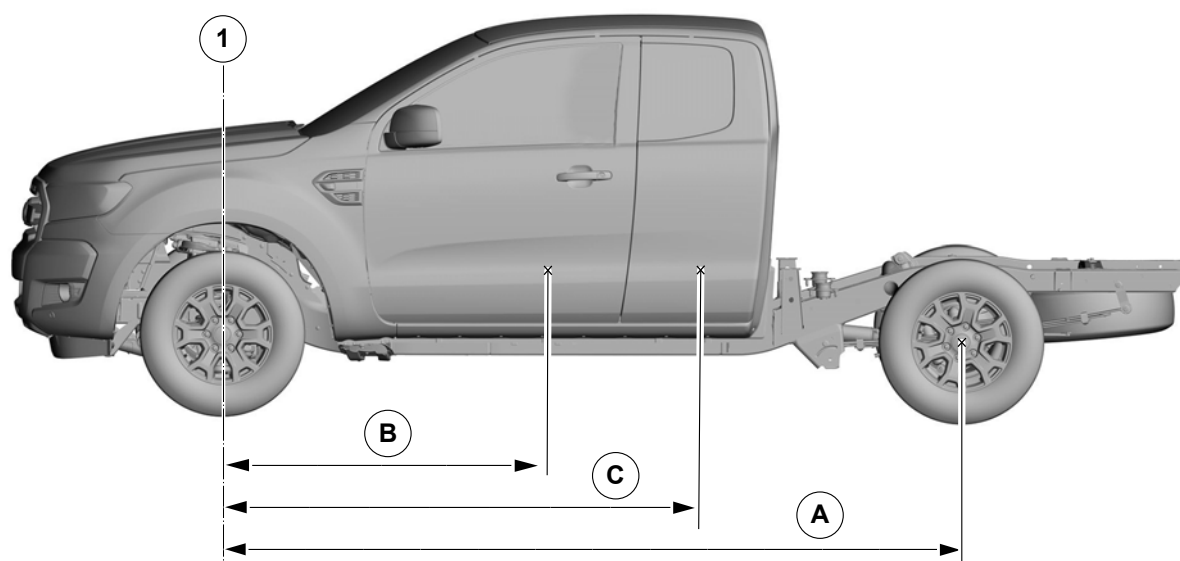
Single Cab



E278314

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

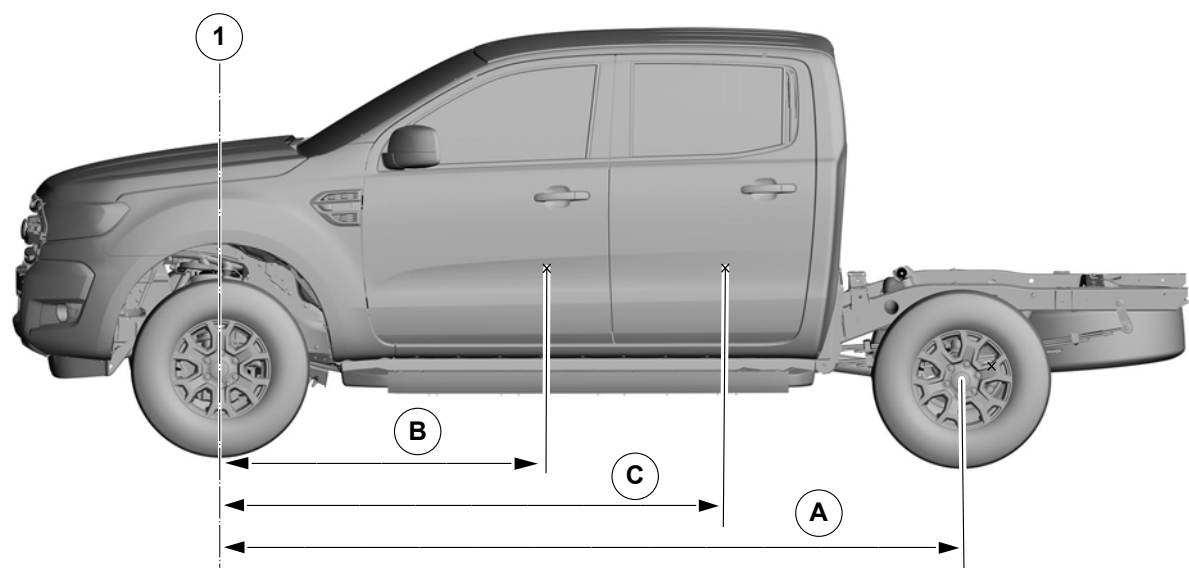
Super Cab

E278316

Super 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

Double Cab



E278315

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

1.13.2 Center of Gravity

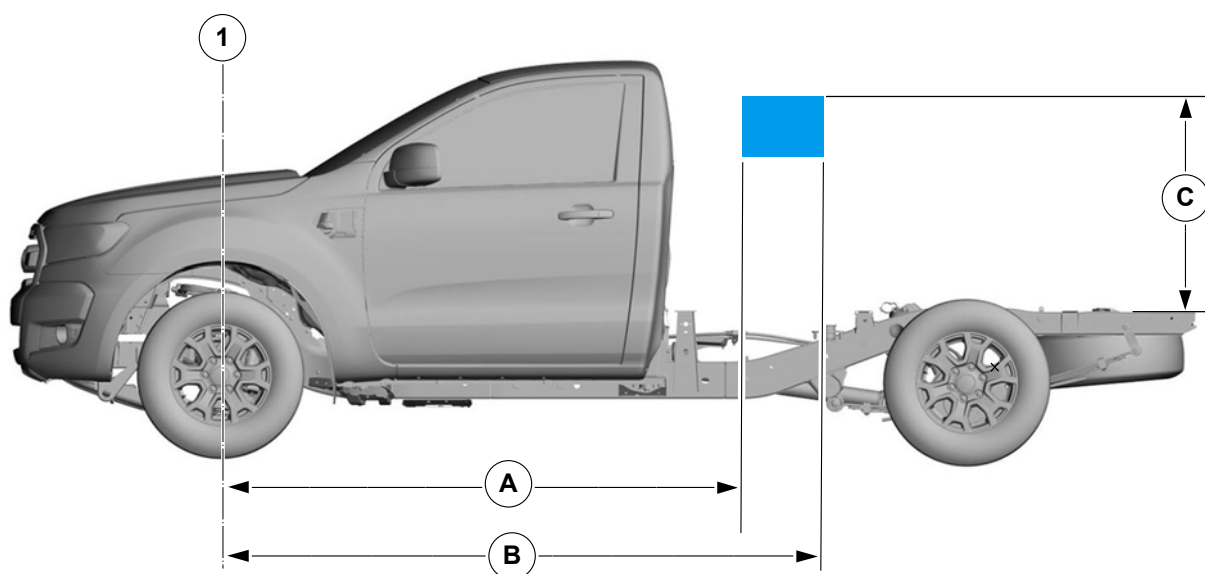
NOTE: Calculations shown are not inclusive of tow bar and other dealer fitted accessories.

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



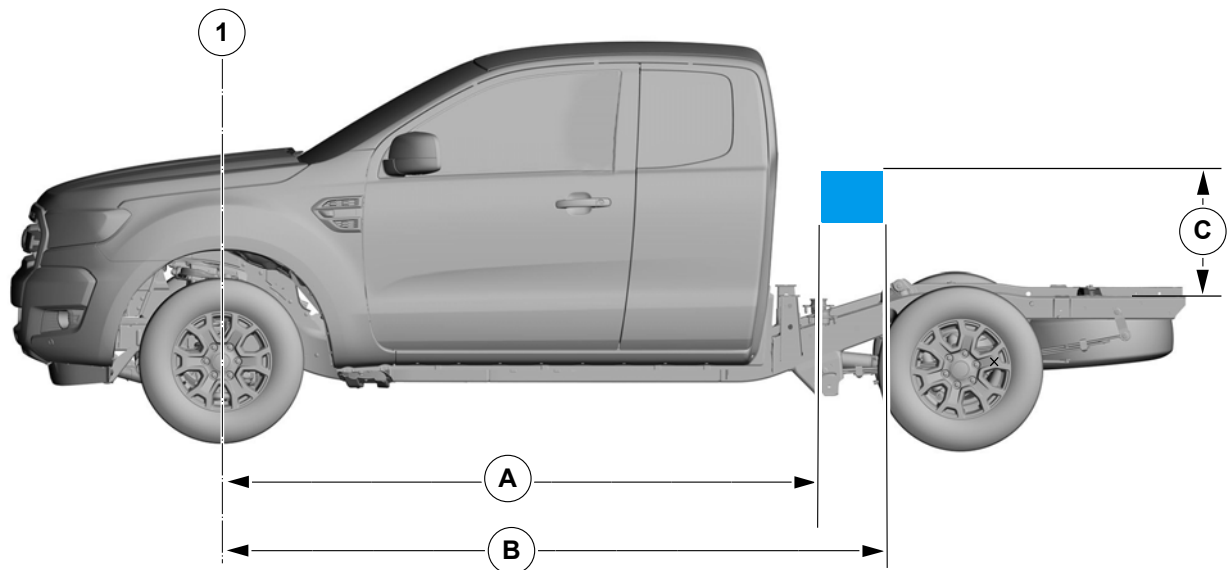
E278317

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

* 4x2 vehicles with increased ride height

Super Cab



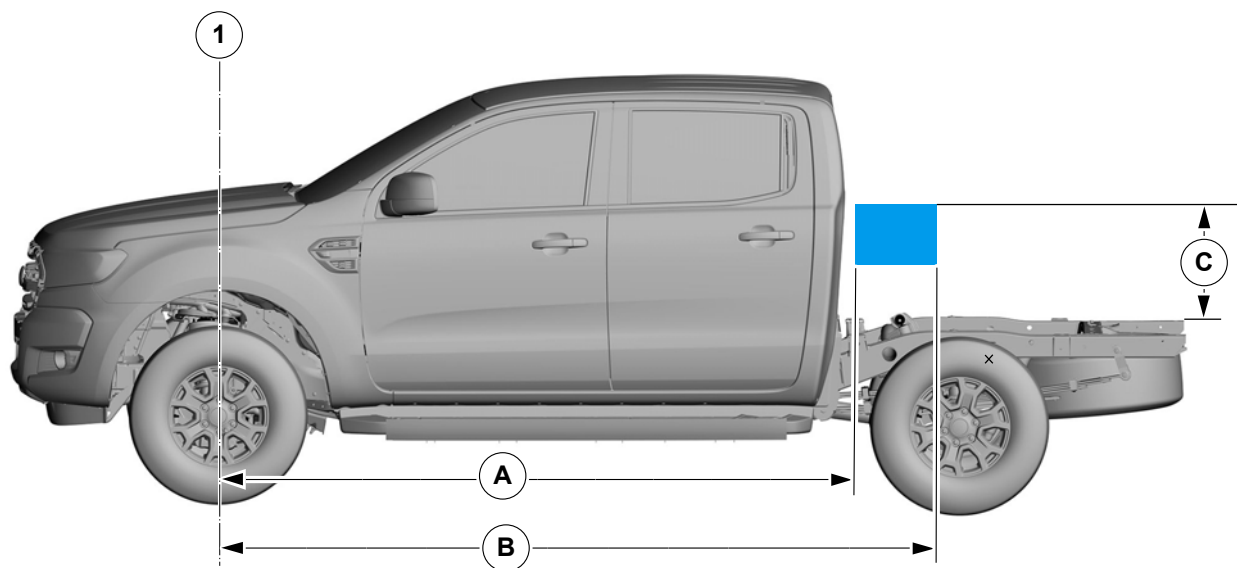
E278319

Super 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

* 4x2 vehicles with increased ride height

Double Cab



E278318

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

* 4x2 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: (page ?).
Load Distribution.

Refer to: Jacking (page ?).

1.14.2 Towing

WARNINGS:

 **Do not exceed the Gross Combination Mass (GCM) or towing capacities for your specific vehicle. Refer to the vehicles owner guide for specifications related to the towing capacities and local regulatory standards.**

 **Ensure that the trailer towball download weight falls within the specified range.**

 **Towing trailers beyond the maximum recommended gross trailer weight exceeds the limit of your vehicle and could result in engine damage, transmission damage, structural damage, loss of vehicle control, vehicle rollover and personal injury.**

 **Do not cut, drill, weld or modify the trailer hitch. Modifying the trailer hitch could reduce the hitch rating.**

 **Do not exceed the maximum vertical load on the tow ball. Failure to follow this instruction could result in the loss of control of your vehicle, personal injury or death.**

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

- Towing capacities must not exceed those of the unmodified vehicle.
- Any modifications to the vehicle must be noted in the vehicle owner guide descriptive literature included with the owners documentation.
- Tow bar installations must meet the requirements of the local regulatory standards.
- Whenever frame drilling is necessary use tube reinforcement.

Refer to: 5.5 Frame and Body Mounting (page 94).

1.14.3 Towing Capacities and Specifications

NOTE: Refer to the vehicles owner guide for specifications related to the towing capacities and local regulatory standards.

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 cannot 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.

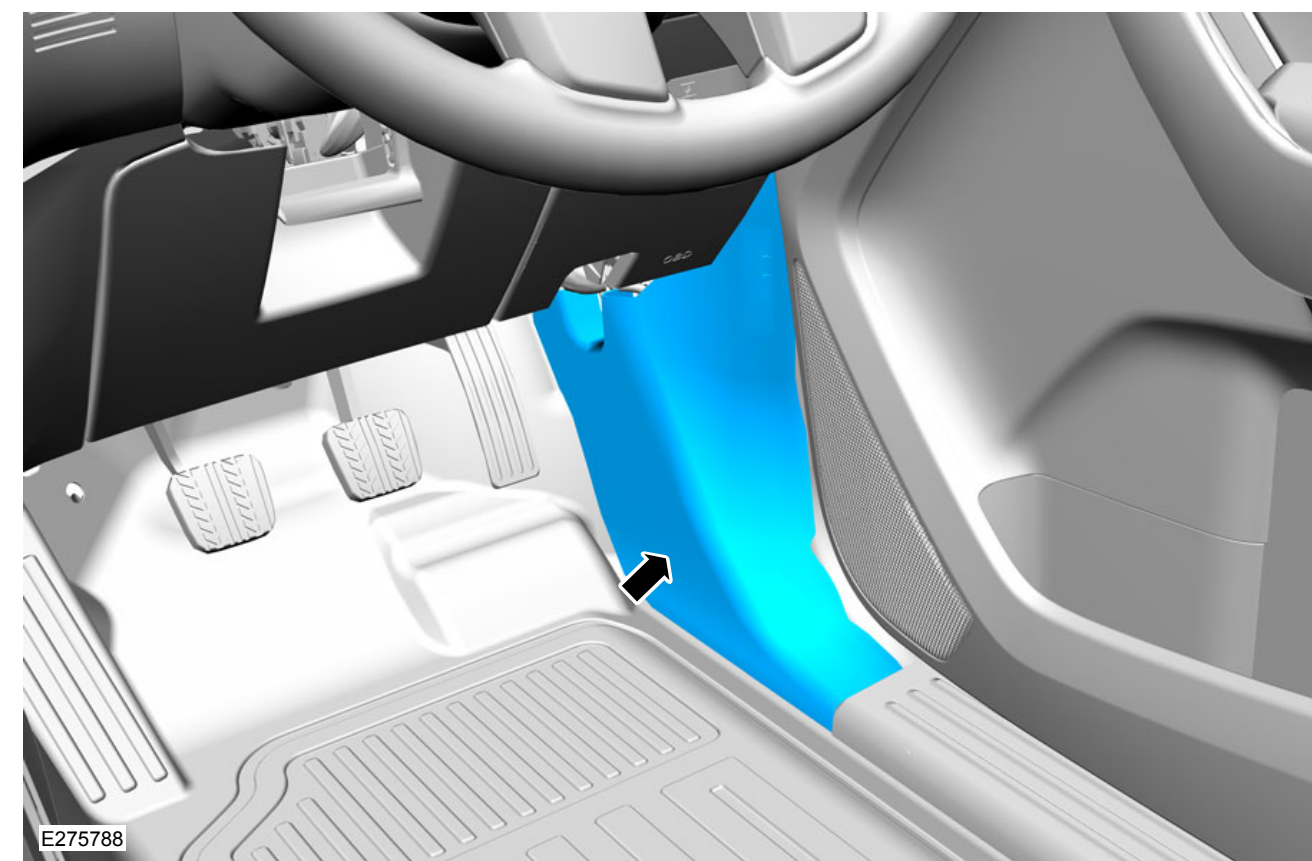
Brake lines must not be used to support or secure any other component.

2.2.3 Trailer Brakes

WARNING: A pre-installed trailer brake wire provides a pulsed brake signal of varying frequencies. This pulsed signal is not a direct current (DC) signal. The Ford-approved FLA Trailer Brake Controller (p/n VGB3Z2C405E) is compatible with these pulsed signals. If another aftermarket brake controller is installed, the vehicle owner or installer must ensure that it is compatible with all pulsed signals from the pre-installed trailer brake wire. Failure to ensure compatibility of your brake controller may result in loss of vehicle control, which could result in serious injury or death. If clarification is required on the specifications of the pulsed signals, please contact your Authorised Ford Dealer.

NOTE: Ford new-vehicle warranty is provided for the Ford Licensed Accessory (FLA) Trailer Brake Controller (TBC) when it is fitted to the vehicle by a Authorised Ford Dealer (Part Number VGB3Z2C405E). Ford is not responsible for warranty and performance of other aftermarket brake controllers which are not approved by Ford.

Trailer Brake Connection



NOTE: RHD (right-hand drive) shown, LHD (left-hand drive) similar.

A pre-installed wire is located behind the A-Pillar kick panel and is marked TRAILER BRAKE CONTROLLER.

Contact your Authorised Ford Dealer for further information on Ford Licensed Accessories and the Ford Approved Trailer Brake Controller.

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 (if equipped) when modifying the 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.**
-  **Transport Mode includes a calibration feature to reduce the risk of fuel injector nozzle corrosion. Exiting Transportation Mode prior to upfitting/ conversion increases the risk of early life injector failure.**

Procedure for protection from Injector Nozzle Corrosion During the Upfitting/Conversion Process:

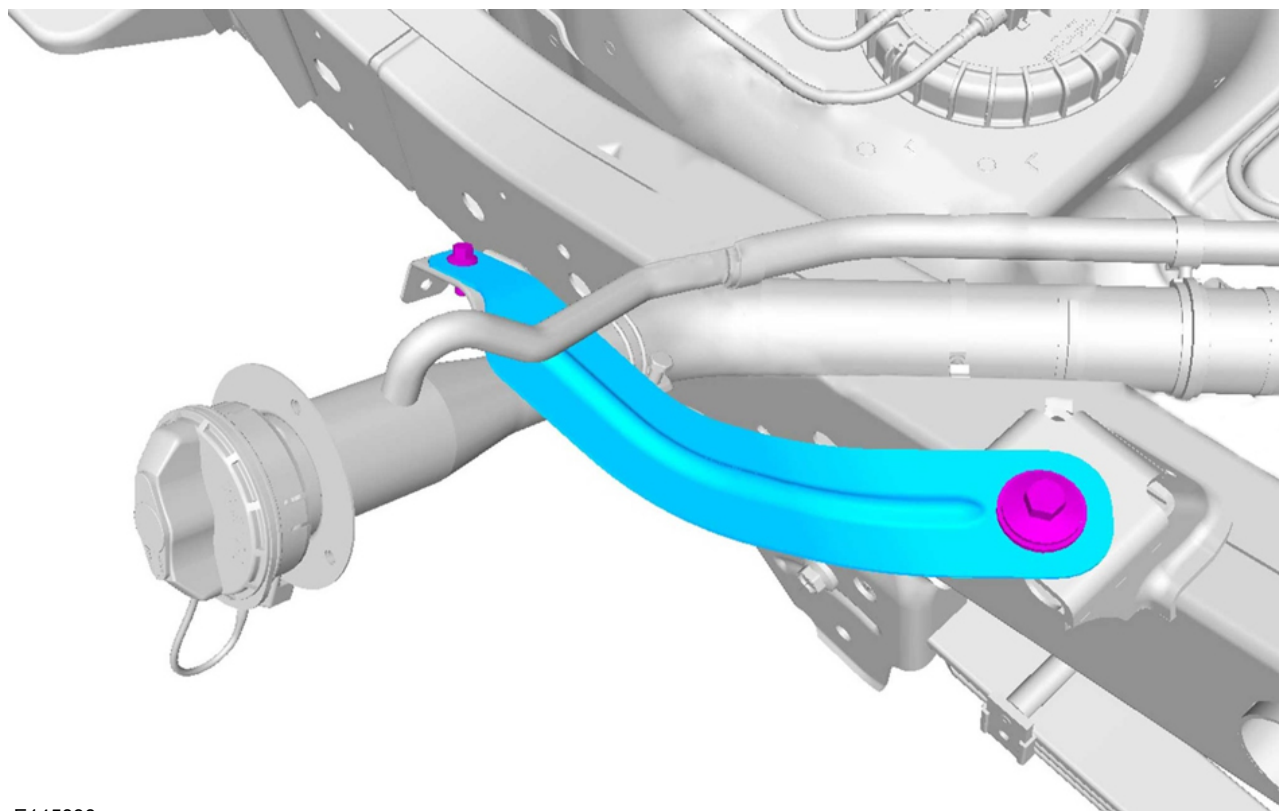
Refer to: 1.9 Vehicle Transportation Aids and Vehicle Storage (page 15).

3.1.1 Fuel Filler Pipe Shipping Bracket (if equipped)

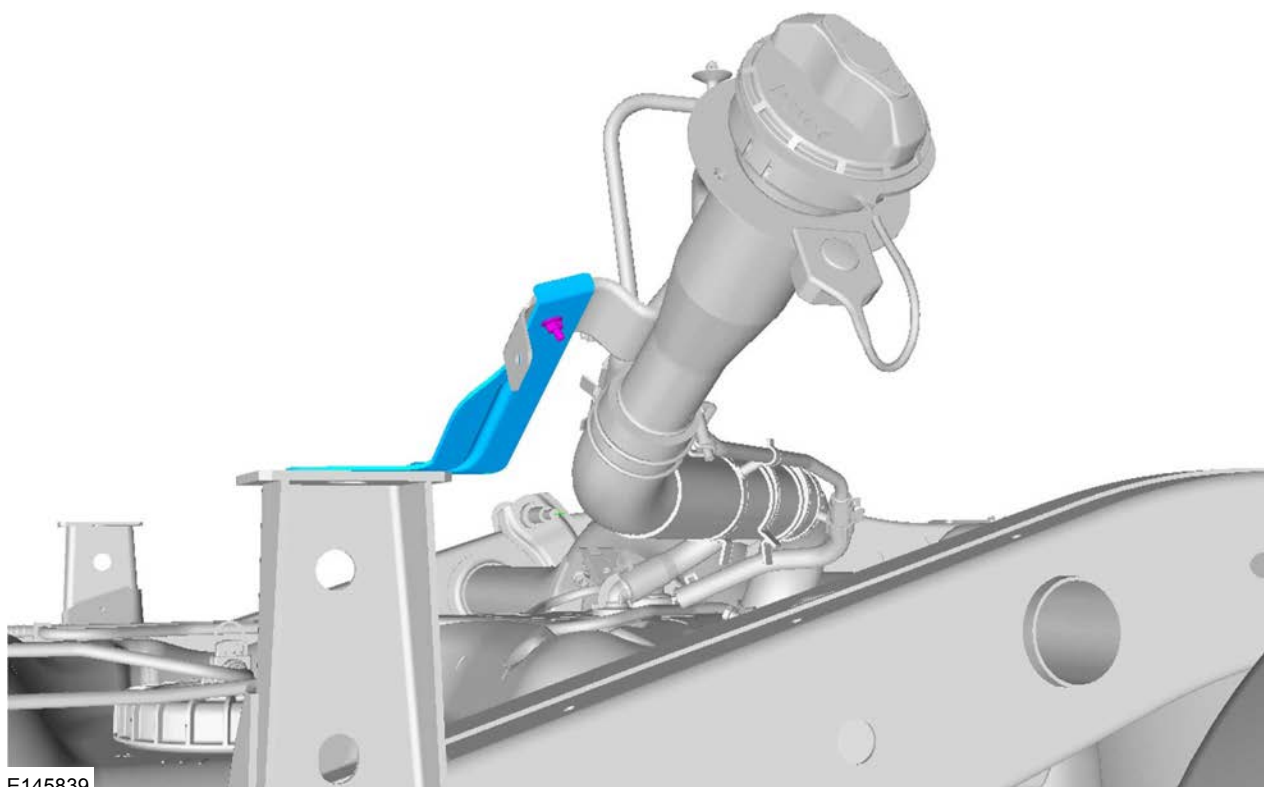
-  **CAUTION: The fuel filler pipe shipping mounting bracket on cab chassis vehicles is designed for shipping of the vehicle only.**

The fuel filler pipe shipping 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.

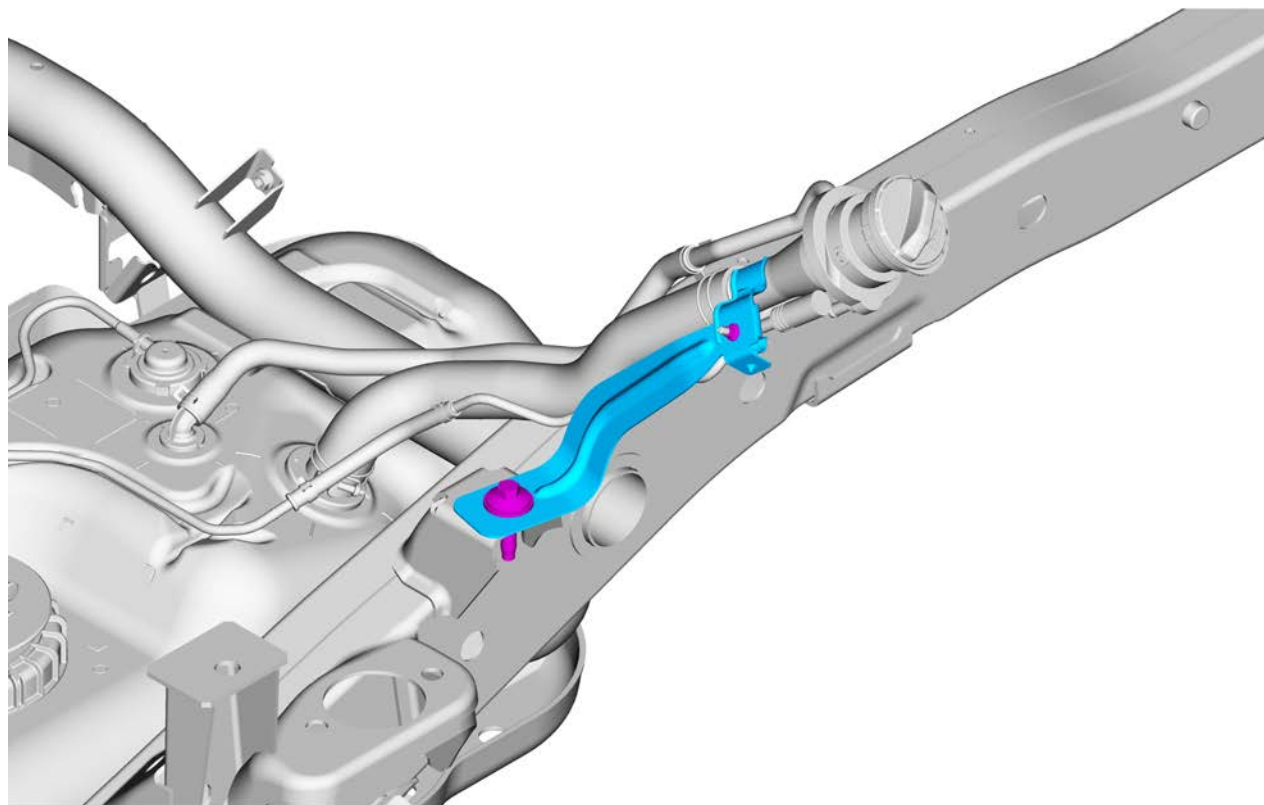
Fuel Filler Pipe Shipping Bracket - Single Cab



E145838

Fuel Filler Pipe Shipping Bracket - Super Cab

E145839

Fuel Filler Pipe Shipping Bracket - Double Cab

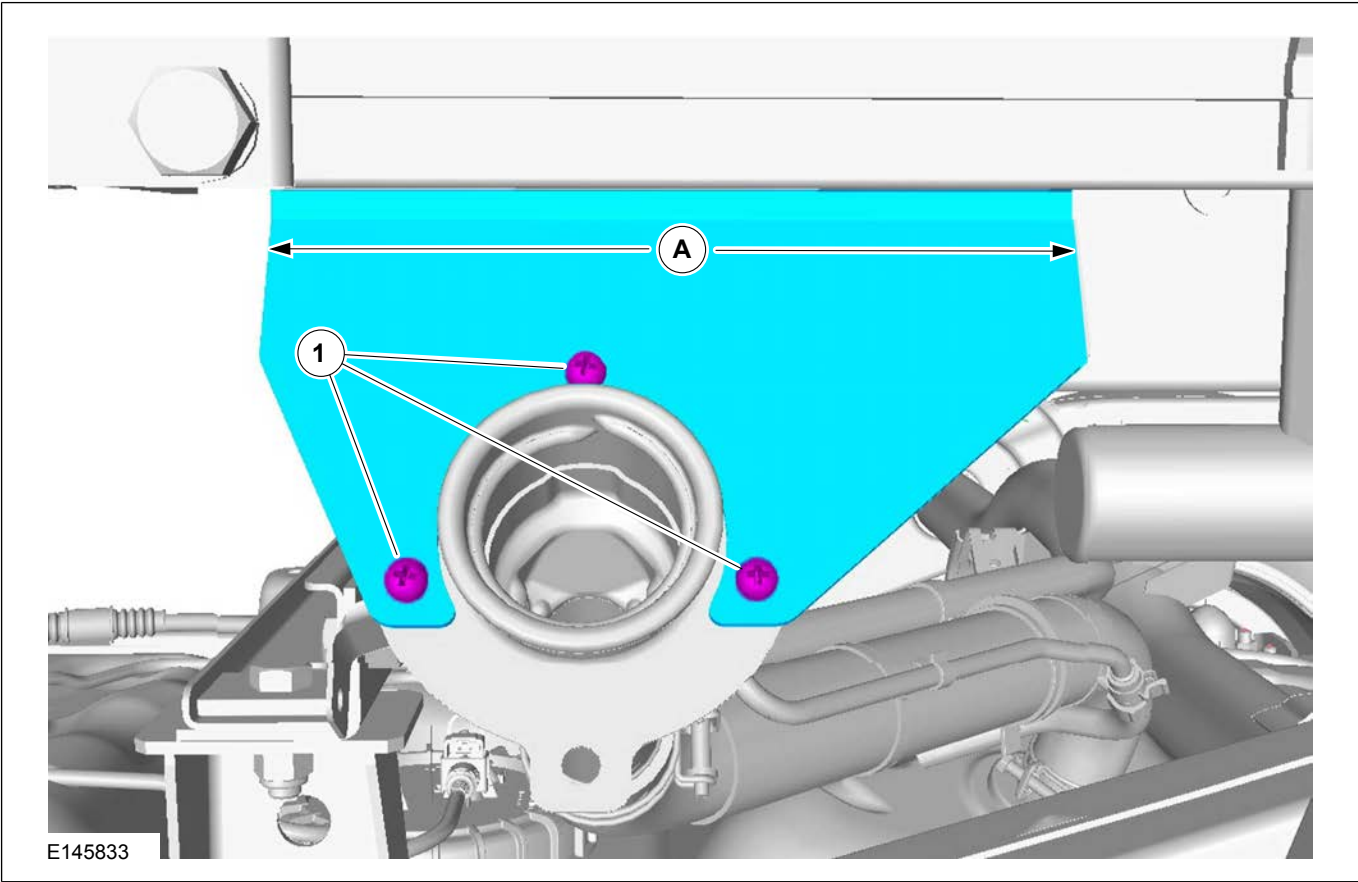
E213151

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.

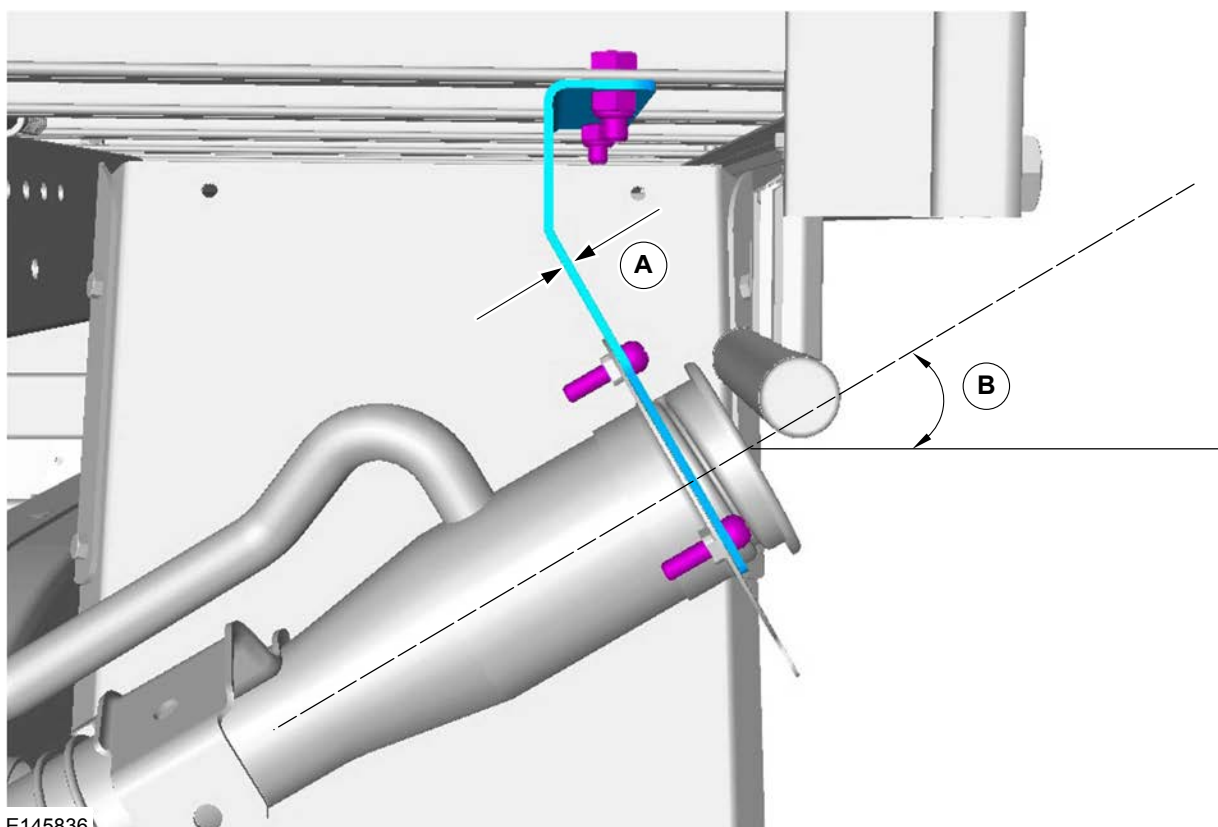
Fuel Filler Mounting Bracket



Fuel Filler Mounting Notes

Item	Description
A	The width of the bracket, where it joins the body to be at least 180 mm
1	All 3x hardware fixation points on the filler neck must be utilised

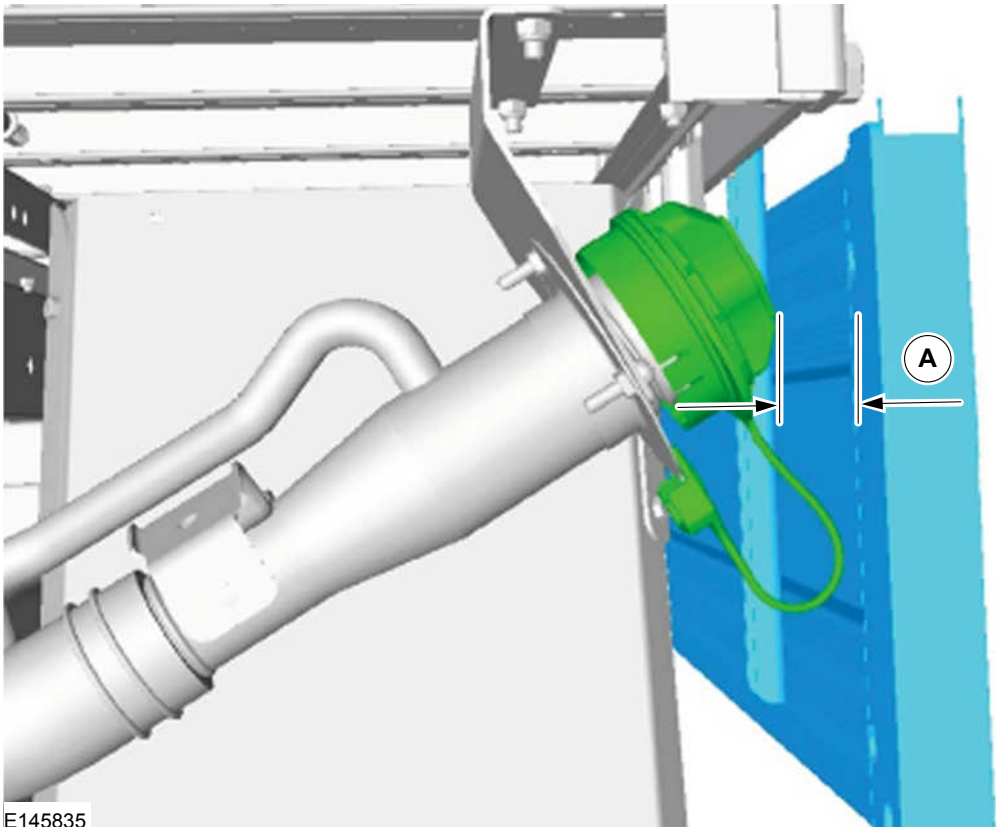
Angle of Filler Neck



Filler Neck Installation Dimensions

Item	Description
A	2mm minimum bracket thickness
B	30° - angle to be maintained to ensure good flow of fuel when refueling and prevent flow back.

Clearance From Vehicle Body

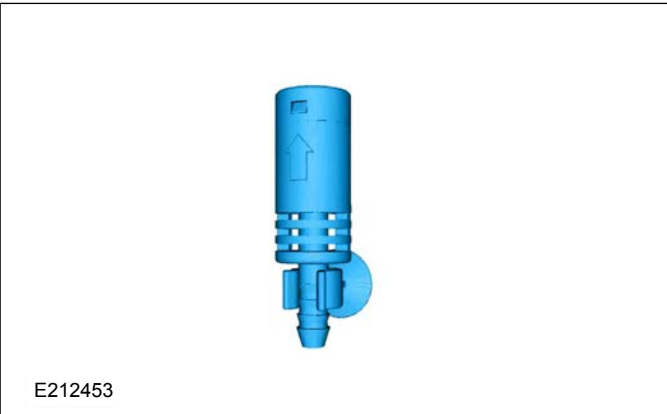


Item	Description
A	At least 9mm clearance between the fuel filler cap and vehicle body, in the worst case opening angle if applicable

3.1.3 Fuel Filler Vent Hose

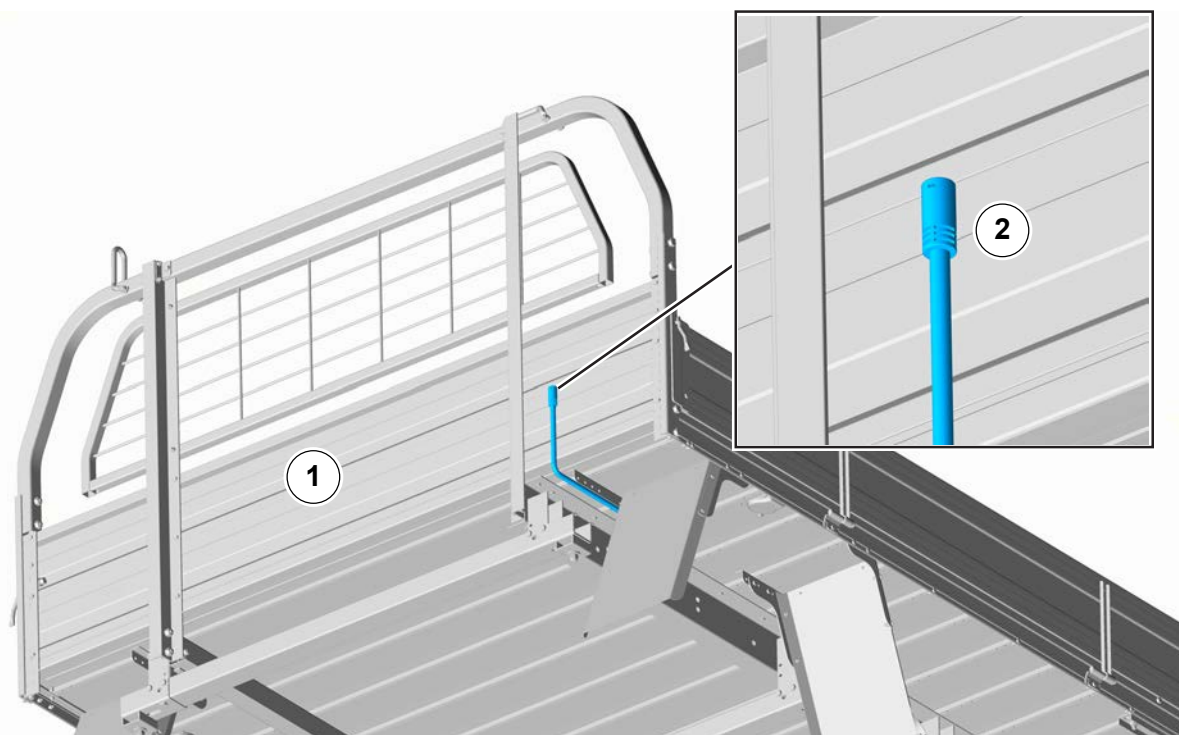
- The fuel tank vent hose and breather cap should be rerouted from the shipped position to the position described in this document in order to maintain water wading specifications and prevent water ingress into the fuel system.
- The supplied fuel tank breather cap must be used.
- A length of fuel grade flexible hose should be clipped to the vehicle body, with the open end at least 600 mm (4x2) or 800 mm (4x4 or 4x2 hi-rider) above ground height. It is recommended to measure this height when the vehicle is fully loaded.
- The fuel tank vent hose should be protected and positioned away from direct water spray, wheel splash and mud splash, and water drainage holes that may be present.
- The fuel tank vent hose breather cap must be upright with its arrow pointing UP.

Fuel Filler Vent Breather Cap



NOTE: See your authorised dealer to confirm the correct part number for your vehicle.

Example of Fuel Tank Vent Hose Mounting Location



E212452

Item	Description
1	Front Lower Head Board of a Load Tray (load tray rotated for clarity)
2	Fuel Tank Vent Hose

3.1.4 Long Range Fuel Tanks

NOTE: Long Range Fuel Tanks are not engineered by Ford Motor Company and Ford Motor Company makes no determination as to the fit, finish, quality or durability of these parts.

NOTE: Whilst functionality will be improved by this modification, distance to empty calculations may express some discrepancy compared to standard parts and calculations.

Following installation of a long range fuel tank, distance to empty (DTE) functionality will be reduced.

To improve system functionality, using IDS/FDRS as appropriate:

- Plug IDS/FDRS into vehicle
- Allow IDS/FDRS to read parameters and show applicable menus
- In Configuration Parameter; Select Fuel Tank Capacity Volume (Tank Size A);
- Select appropriate option following the dialogue selections: Fuel Tank Capacity > Configuration Description
 - Standard 80L
 - 140L ARB Long Range Tank

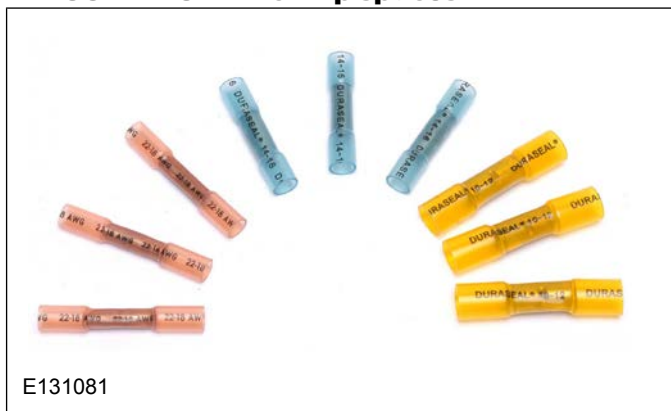
3.1.5 Axle Breather Vent Hose

The rear differential breather hose should be mounted to the filler neck/vehicle body. Where required due to the fitment of an auxiliary body, aftermarket additions, or the relocation of the fuel filler, the axle vent hose routing must follow the relocated fuel tank venting. A length of fuel grade flexible hose should be clipped to the vehicle body, with the open end at least 600 mm (4x2) or 800 mm (4x4 or 4x2 hi-rider) above ground height. It is recommended to measure this height when the vehicle is fully loaded. A vent breather cap may be used on the axle breather vent hose.

4.1 Wiring Installation and Routing Guides

4.1.1 Wiring Splicing Procedures

TYCO-RAYCHEM crimp splices



Ford Motor Company strongly advises against the use of wire splicing due to the variable and unpredictable nature of the joint created. However, if it is decided that a wire splice is unavoidable, it must be made using **DuraSeal Heat-Shrinkable, Environmentally Sealed, Nylon-Insulated Crimp Splices** (manufactured by TYCO-RAYCHEM). For example the D406 series. As a further process to improve the splice integrity, the splice should be further sealed with a suitable heat shrink tubing. See Figure E131081.

4.2 Battery and Cables

4.2.1 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. The window control module will also need to be reset. Refer to the vehicle's owner manual for further information.

Battery Voltage Requirements and Testing

All voltages are to be measured with an accuracy of: + / - 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 on the headlamps for 5 seconds, or the parking lamps for 15 seconds.
2. Turn off all electrical loads (including lamps, fan, heater etc).
3. Wait 10 minutes.

Delayed Vehicles

Vehicles held at the vehicle converter 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

WARNINGS:

-  **Always observe the battery charger equipment manufacturer's instructions.**
-  **Do not jump/slave start using a battery charging system from another vehicle.**
-  **Do not overfill a battery as this can cause acid leakage that will result in damage to the vehicle and possible personal injury.**

CAUTIONS:

-  **Do not rely on the generator to recharge a discharged battery. It would take in excess of eight hours of continuous driving with no additional loads placed on the charging system.**
-  **Make sure that the battery electrolyte reaches the indicated maximum mark.**
-  **Connect the battery charger cables to the battery before switching the battery charger on.**
-  **Switch the battery charger off before disconnecting the battery charger cables from the battery.**

NOTE: Ford batteries generally require no maintenance however, in certain conditions, it is possible for the electrolyte in a battery to fall below the minimum level.

NOTE: The use of the Midtronics GR-590 Battery Management Center, which has been specifically designed for use on silver calcium type batteries is recommended. Once connected to the battery, the battery charger detects the state of battery charge and then applies the appropriate charge rate and duration. When the battery is fully charged, the battery charger switches to stand-by, keeping the battery in a fully charged state preventing excessive gassing and overcharging. The Midtronics GR-590 Battery Management Center also incorporates a software program that has the capability to assist in the recovery of deeply discharged (sulphated) batteries.

NOTE: Charging methods and types of battery chargers vary widely. Whichever method is utilized it must be carried out carefully to avoid damage to the battery and possible personal injury. Specific instructions accompanying each battery charger and must be followed exactly. Safeguards provided by the equipment manufacturer should not be disregarded by the operator.

NOTE: A battery which has been stored in a highly discharged state may be slow to accept a charge at first. In such cases the initial charging rate may be so low that the ammeter on some battery testers will not show any indication of charge for 5 to 10 minutes.

NOTE: Automatic battery chargers are also protected against reverse polarity connection and require no adjustment or monitoring.

NOTE: Slow-charging will readily restore a battery to a full state of charge and, since the charging current is relatively low, the possibility of overcharging a battery are minimized. The charge rate used should be approximately equal to 5% of the reserve capacity of the battery being charged (approximately three to six Amps depending on battery size). The charging current should be adjusted 10 minutes after initial setting and again after 1 hour before being left to charge the battery for between 8 and 12 hours.

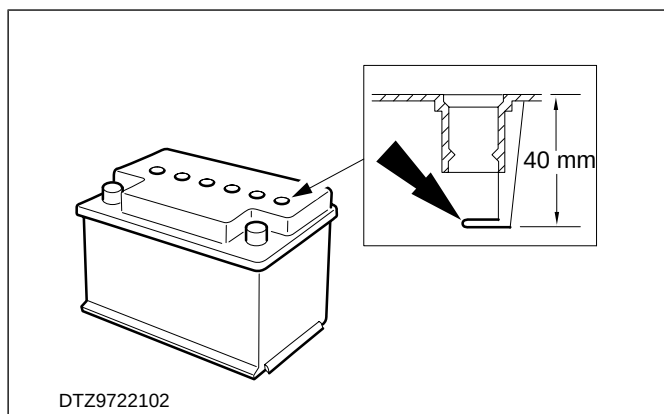
NOTE: A constant voltage battery charger will charge a battery at a set maximum voltage. The voltage used depends upon the design and condition of the battery charger and the age and temperature of the battery. This type of battery charger initially charges at a high rate of current that reduces as battery voltage is restored. When using a constant voltage battery charger, the charging current should be recorded after five minutes and the battery charger switched off when the charging current falls to one-third of the recorded value, or after eight hours whichever occurs first.

NOTE: Multiple battery chargers are designed to charge a number of batteries, simultaneously. Of the two different types of multiple battery chargers available, only those that charge batteries in series should be used and it is important that batteries are of the same or very similar ratings and voltages. Multiple battery chargers that charge batteries in parallel are not recommended.

NOTE: The use of a fast (boost) battery charger is not recommended as it can cause damage to a battery. Fast charging will only restore a battery to a state of charge that will enable it to carry out it's critical function of cranking the engine. Fast charging will not restore a battery to a full state of charge and must therefore be followed by a period of slow charging. Excessively fast charging can cause damage to a battery. For this reason, charging times must be carefully controlled. Fast battery chargers vary widely in design so it is very important to strictly adhere to the equipment manufacturer's instructions. A charge of 30 amps for up to 30 minutes is the most common fast charging application. If the battery is very discharged and requires additional restoration, an additional charge of 20 amps for a period up to one and a half hours should be applied. Fast charging for a period in excess of two hours significantly increases the risk of causing damage to the battery.

NOTE: When connecting and disconnecting the battery from the vehicle, make sure that the battery ground cable is disconnected first and connected last and that all electrical items are switched off. Record the audio unit keycode and preset radio frequencies before disconnecting the battery.

1. Remove the battery.
2. Disconnect the battery ground cable



NOTE: The maximum battery electrolyte level is approximately 40 mm below the very top of the battery casing. This corresponds to a point just below the lower rim of the battery casing.

3. Check that the battery electrolyte reaches the indicated maximum level. Top up with distilled/de-ionized water, as necessary.
4. Connect the positive red clamp from the battery charger to the positive battery terminal.
5. Connect the negative black clamp from the battery charger to the negative battery terminal.
6. Follow the instructions supplied with the battery charger to charge the battery.
7. To disconnect the battery charger, reverse the connection procedure.

Battery Cable Fixing Torque

The battery cables should be fixed to the terminal posts with a torque of 4.8 Nm $\pm$ 0.8Nm.

Battery Rules:

WARNINGS:

⚠ 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.

⚠ 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.

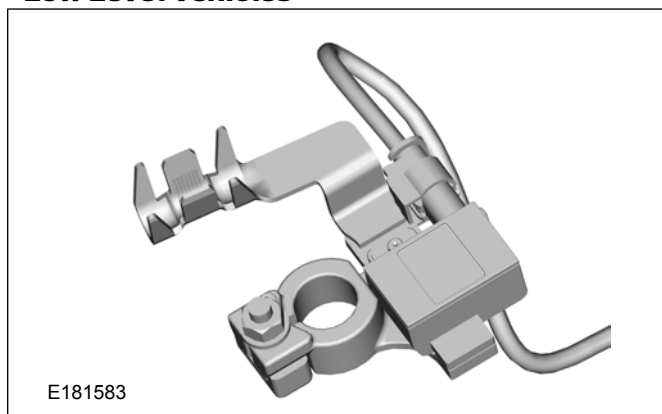
Battery Part Numbers and Usage

Ford Plant	Type	Specifications	Size
Thailand	Standard Duty Battery	75Ah, 750CCA	H7
	Auto Start - Stop Battery	80Ah, 800CCA, AGM Deep Cycle Technology	H7

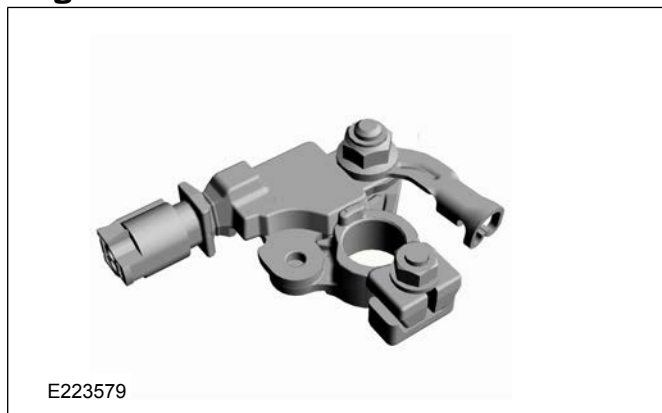
If the battery type on a vehicle is changed to other compatible derivatives it is required to reconfigure the vehicle to the new battery types from the dealer. Central car configuration can be updated at a dealership.

Battery Monitor System (BMS)

Low Level Vehicles



High Level Vehicles



Ford Ranger vehicles are equipped with a 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 fitted to vehicles with a Battery Monitor System (BMS)

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.

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

NOTE: Ensure the auxiliary battery connection is safely secured using suitable fixtures to reduce vibration damage or contact with surrounding components.

For vehicles equipped with BMS, an additional battery can be connected using one of the following methods:

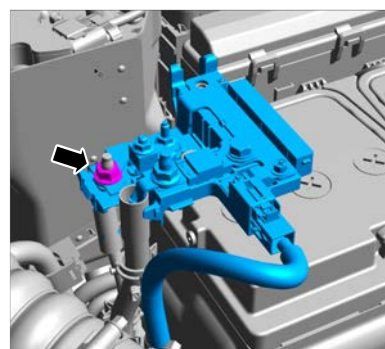
1. Use an in-vehicle battery charger (DC/DC converter) such as BCDC1220 model from Redarc (www.redarc.com.au) (or similar), connected via an additional terminal to the starter post terminal on the B+ using a 30A fused connection and grounded to the vehicle body, in the shown locations.

NOTE: The additional terminal must be installed on top of the starter post terminal using the existing nut.

NOTE: The maximum thickness of the additional terminal being installed on top of the starter post terminal must be no more than 2.0 mm.

NOTE: Ensure the existing nut is reused.

B+ Connection for Auxiliary Battery Charging

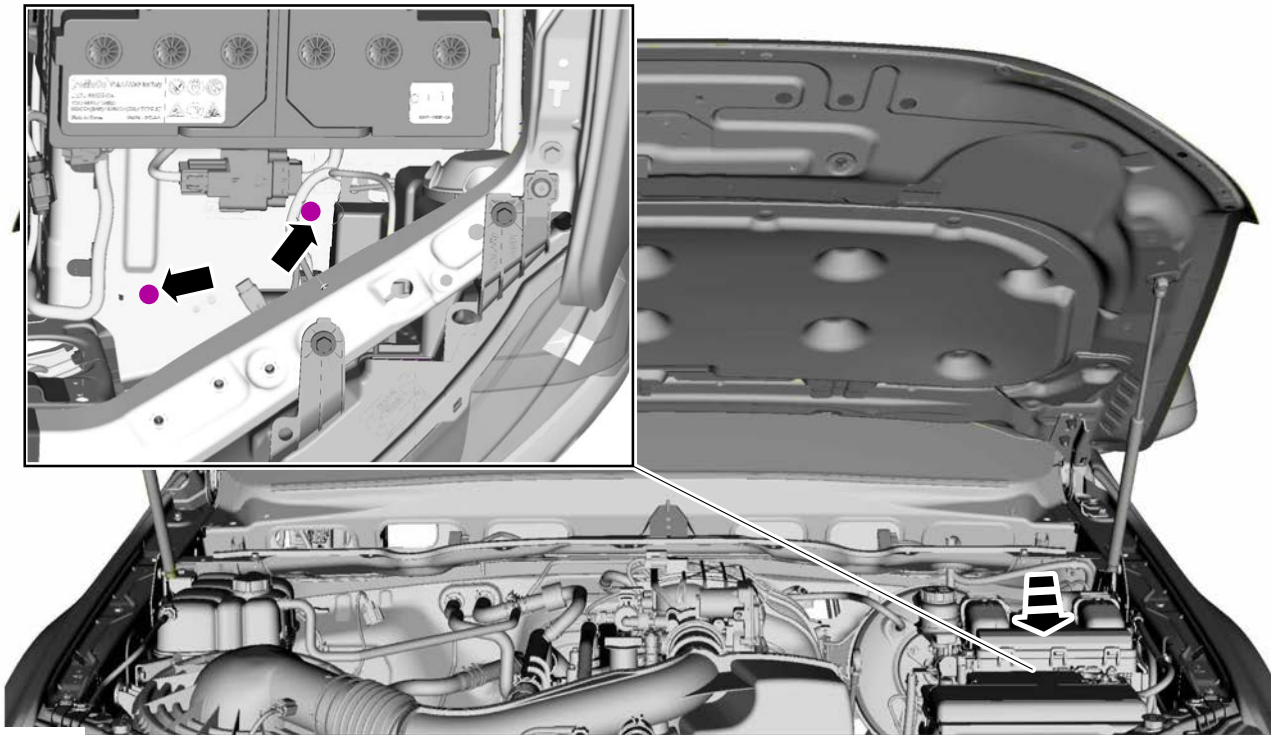


E251317

The B+ connection should be fixed to the terminal posts using the existing nut with a torque of 13.5 Nm +/- 2.1 Nm.

NOTE: Ensure the fused connection is secured using suitable fixtures to reduce vibration damage or contact with surrounding components.

Grounding points for in-vehicle battery charger



E251326

Item	Description
1	Possible ground connection points using W705661-S901.

The ground point connection should be tightened to torque of 12 Nm +/- 1.8 Nm.

- 2. Request a Ford dealer to disable the BMS.
Disabling the BMS enables voltage sensitive relay based dual battery systems to work.

Auxiliary Battery fitted to vehicles without a Battery Monitor System (BMS)

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

NOTE: Make sure the fused connection is safely secured using suitable fixtures to reduce vibration damage or contact with surrounding components.

An auxiliary battery charging system can be connected using one of the following methods:

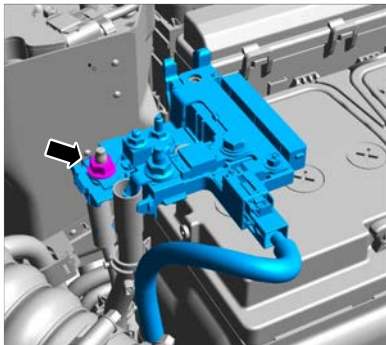
- 1. Use an in-vehicle battery charger (DC/DC converter) such as BCDC1220 model from Redarc (www.redarc.com.au) (or similar), connected via an additional terminal to the starter post terminal on the B+ using a 30A fused connection and grounded to the vehicle body, in the shown locations.

NOTE: The additional terminal must be installed on top of the starter post terminal using the existing nut.

NOTE: The maximum thickness of the additional terminal being installed on top of the starter post terminal must be no more than 2.0 mm.

NOTE: Ensure the existing nut is reused.

B+ Connection for Auxiliary Battery Charging

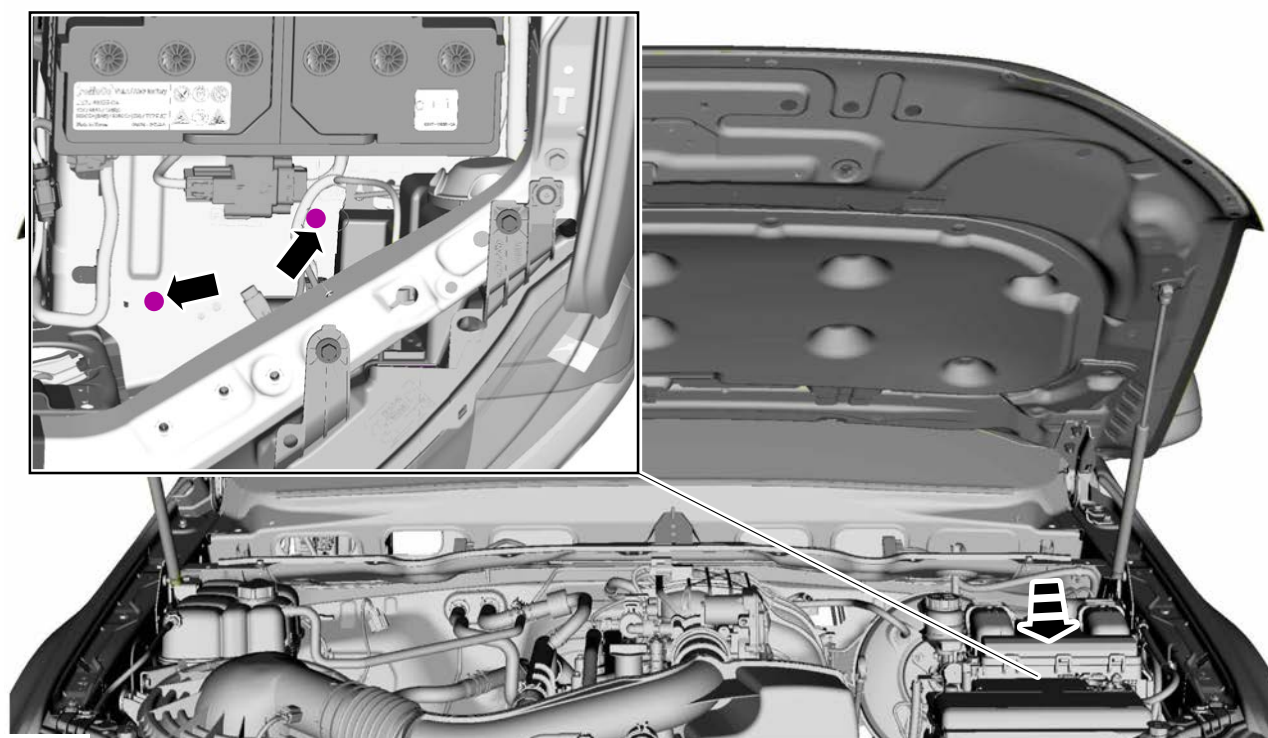


E251317

The B+ connection should be fixed to the terminal posts using the existing nut with a torque of 13.5 Nm +/- 2.1 Nm.

NOTE: Make sure the fused connection is secured using suitable fixtures to reduce vibration damage or contact with surrounding components.

Grounding points for in-vehicle battery charger



E251326

Item	Description
1	Possible ground connection points using W705661-S901.

The grounding point connection should be tightened to torque of 12 Nm $\pm$ 1.8 Nm.

Connection of Auxiliary Loads - Low Level Vehicles

WARNINGS:

⚠ Make sure all electrical connections and wiring comply with local regulatory standards.

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

⚠ An increase in battery drain due to an auxiliary load will void the battery warranty.

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.

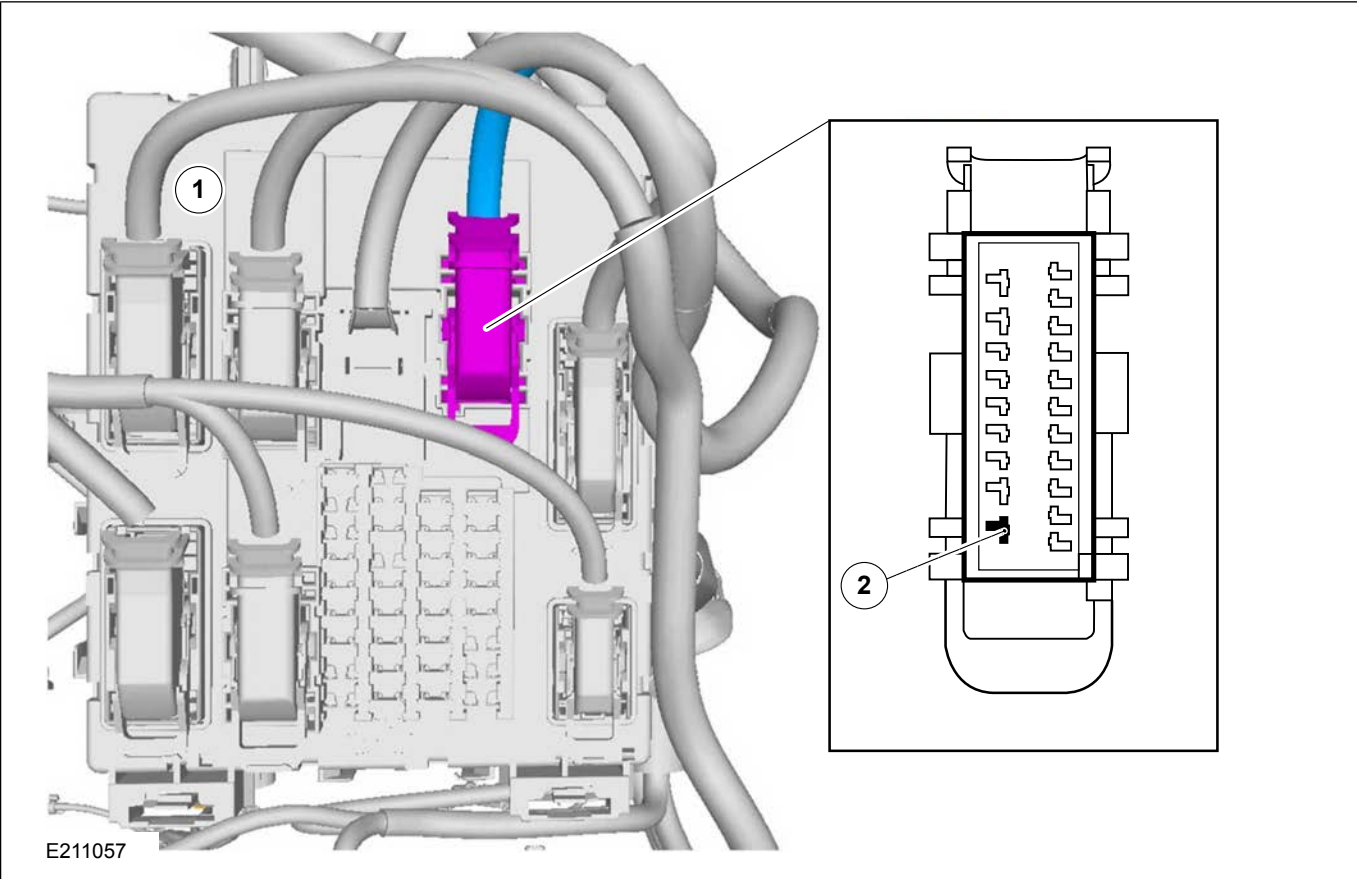
[Refer to: Exterior Lighting \(page ?\).](#)

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

Connection of Auxiliary Loads - High Level Vehicles

WARNINGS:

-  **Make sure all electrical connections and wiring comply with local regulatory standards.**
-  **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.

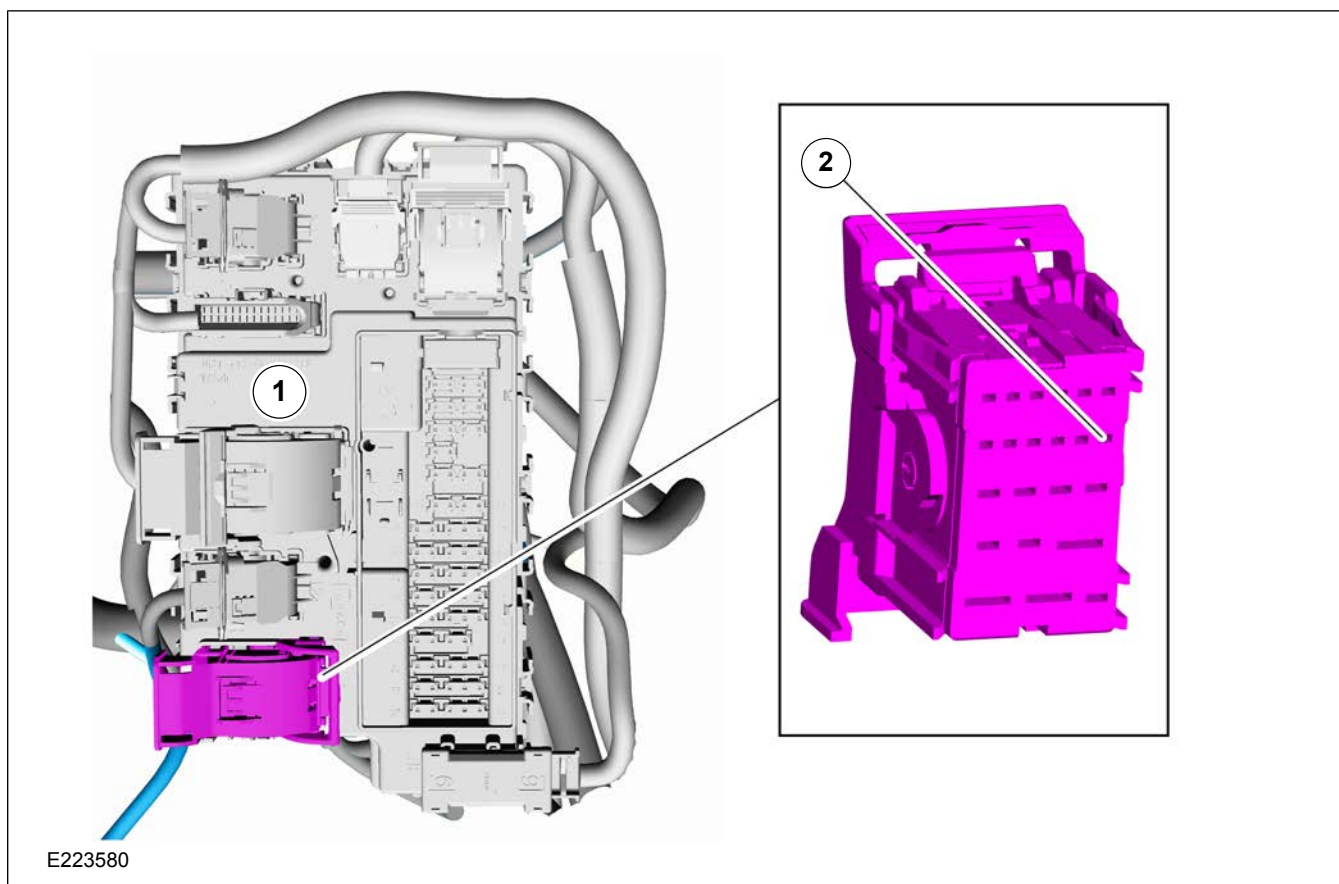
[Refer to: Exterior Lighting \(page ?\).](#)

Auxiliary loads for external devices which require an ignition feed (such as UHF/CB radios) may be connected via a relay energised by a 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

Part Numbers

Description	Part Number / Service Part Number	Manufacturer
Connector	CU5T-14489-XA	TE (Tyco Electronics)
Pin	7C3T-14474-DA / DU2Z-14474-DA	Molex

4.2.2 Generator and Alternator

Alternator Current Output

See your local authorised dealer to identify the alternator output current specifications for your vehicle.

4.3 Parking Aid

WARNINGS:

 **To help avoid personal injury, always use caution when in reverse (R) and when using the sensing system.**

 **The system may not detect objects with surfaces that absorb reflection. Always drive with due care and attention. Failure to take care may result in a crash.**

 **Traffic control systems, inclement weather, air brakes, external motors and fans may affect the correct operation of the sensing system. This may cause reduced performance or false alerts.**

 **The system may not detect small or moving objects, particularly those close to the ground.**

NOTE: Keep the sensors, located on the bumper or fascia, free from snow, ice and large accumulations of dirt. If the sensors are covered, the system's accuracy can be affected. Do not clean the sensors with sharp objects

NOTE: If your vehicle sustains damage to the bumper or fascia, leaving it misaligned or bent, the sensing zone may be altered causing inaccurate measurement of obstacles or false alerts.

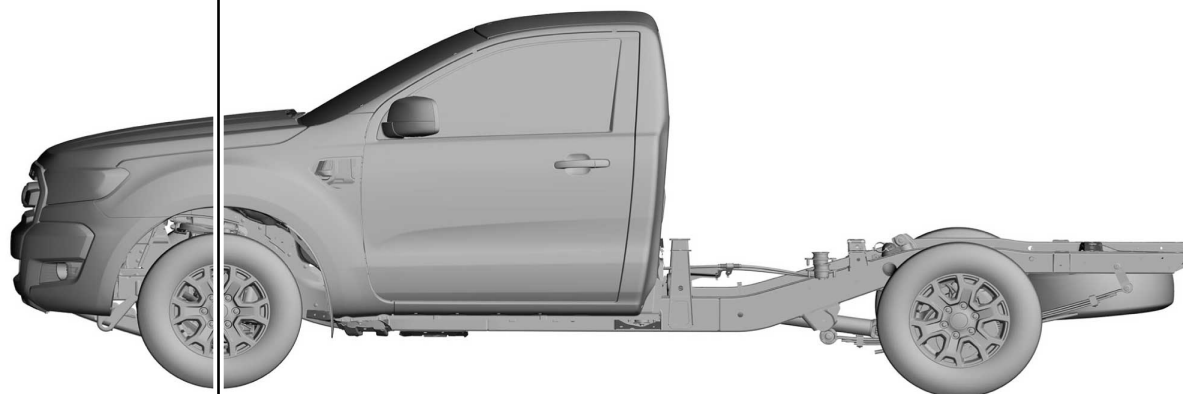
NOTE: Certain add-on devices installed around the bumper or fascia may create false alerts. For example, large trailer hitches, bike or surfboard racks, license plate brackets, bumper covers or any other device that may block the normal detection zone of the system. Remove the add-on device to prevent false alerts

The parking aid sensing system warns the driver of obstacles within a certain range of your vehicle. The system turns on automatically whenever you switch the ignition on. The system can be switched off through the information display menu or from the pop-up message that appears once you shift the transmission into reverse (R). If a fault is present in the system, a warning message appears in the information display. See the vehicle owner manual for further information on the correct operation of the parking aid system.

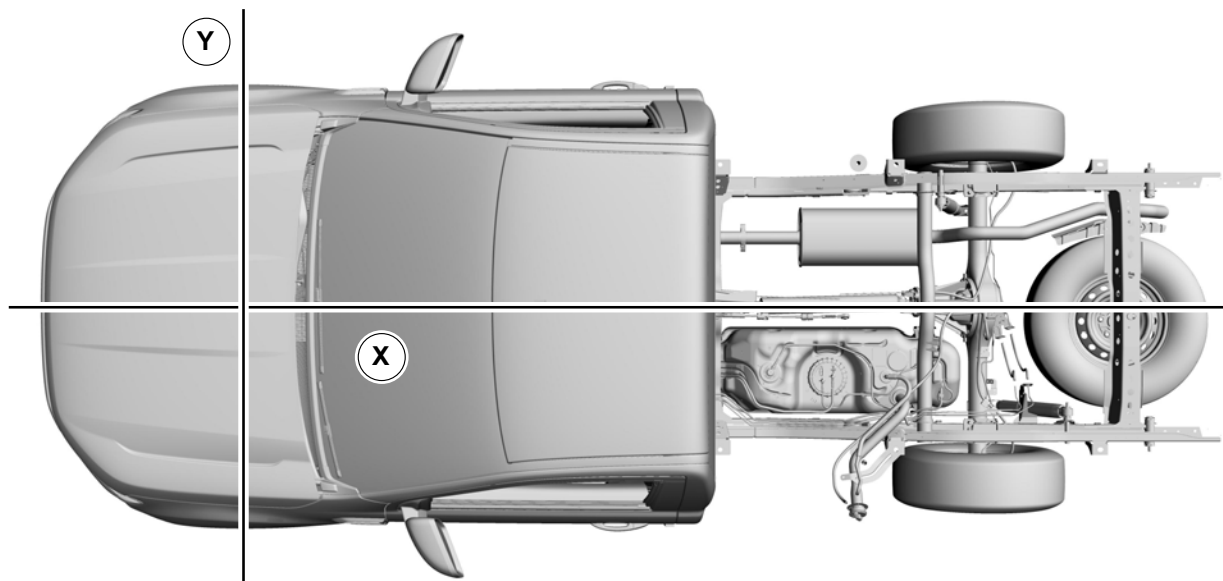
Protection assemblies mounted on the front of the vehicle, such as Bull Bars/Nudge Bars and frontal crash and animal strike protection assemblies may require that the front parking aid sensors are relocated to a different position than the original Ford positioning. The below guidelines and details should be followed to maintain suitable operation of the parking aid system by ensuring the sensor detection angles are maintained in a suitable specification.

Where possible, front parking aid sensors should not be moved from the original positions on the X, Y and Z plane. Maintaining the sensors location on these planes is important for correct operation of the system.

Vehicle Location Planes



Z



Y

X

E292617

4.3.1 Sensor Location

NOTE: Relocated sensors must be installed in the same position as originally fitted in the bumper bar. Make sure that each sensor is installed in the correct corresponding position.

Front Parking Aid Sensor Location



E292623

Sensor	Number
Front Right Outer	1
Front Right Inner	2
Front Left Inner	3
Front Left Outer	4

Front Parking Aid Sensor - Critical Angles and Heights

Inner Sensor Angle	Inner Sensor Height	Outer Sensor Angle	Inner Sensor Height
within range of 2-4 degrees*	Less than or equal to 440mm above the ground	within range of 2-4 degrees*	N/A

* degrees above the horizontal plane.

4.4 Electronic Engine Controls

4.4.1 Vehicle Speed Output (Signal) (Low Level Vehicles Only)

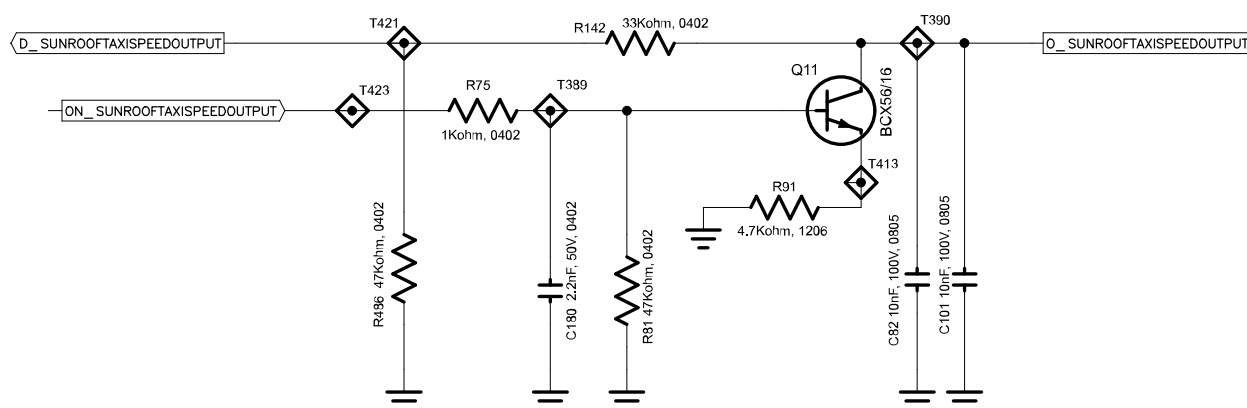
General Information

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	10μ sec <= tr <= 250μ sec
Fall Time	10μ sec <= tf <= 250μ sec
Duty Cycle	50% +/- 10%
Frequency	1.38 * v (Vehicle speed (CAN) km/h) ± 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

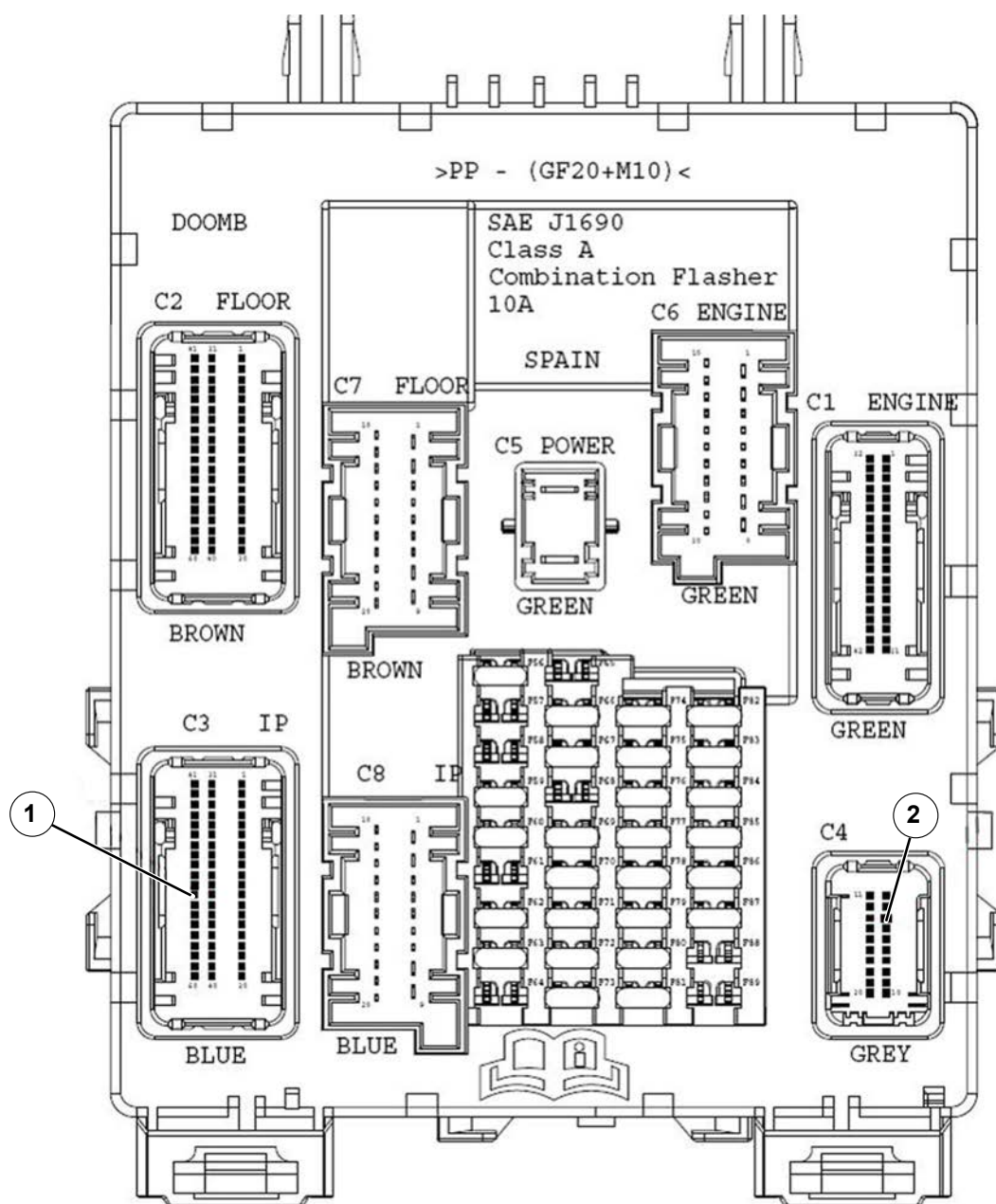
1. The vehicle speed output is available on: [connector 3 pin number 52] or [connector 4 pin 3]. Choose one of the connections and populate the connector with a terminal and wire.
2. The output must be connected to a device with 1k ohms resistance (600 ohms to 2k ohms is the guideline) in order for it 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.

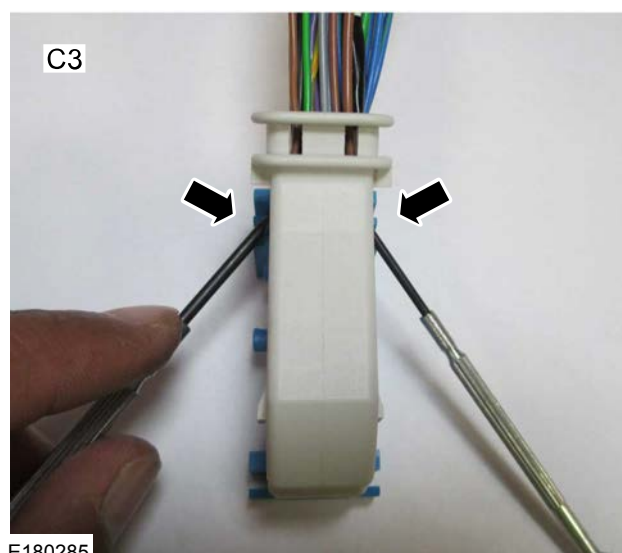
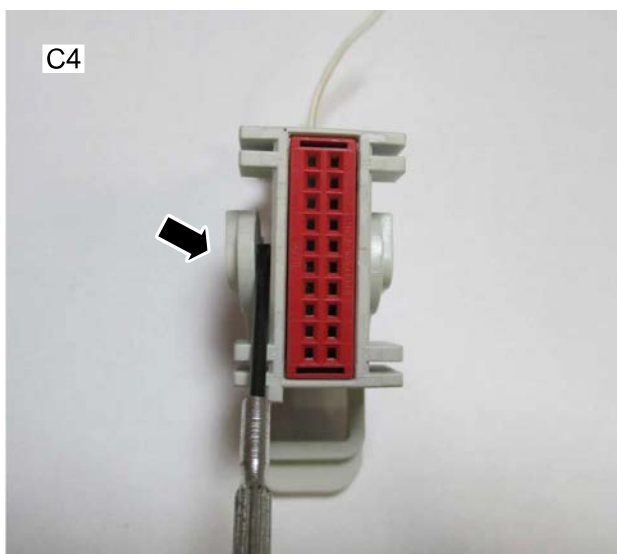
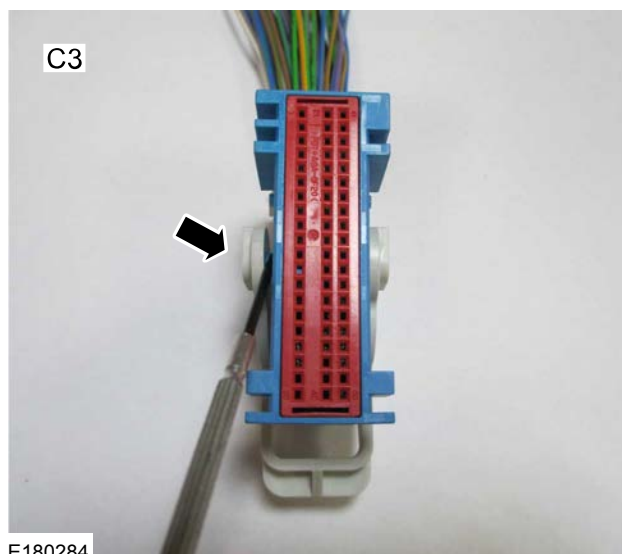
Wire size and color: 0.5 CSA, blue - green.

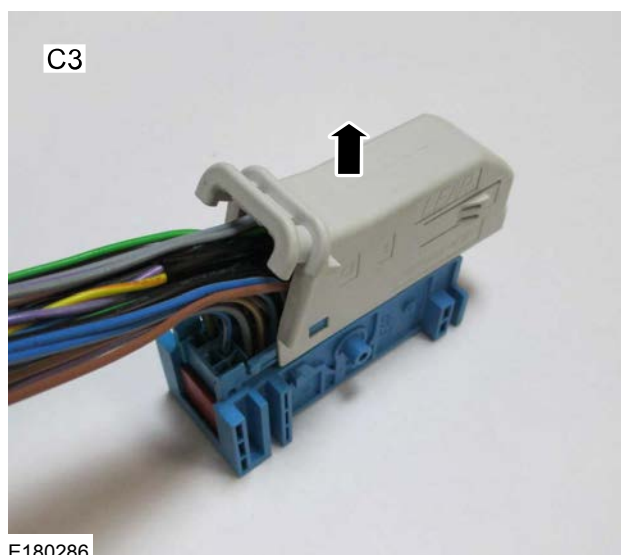


E180282

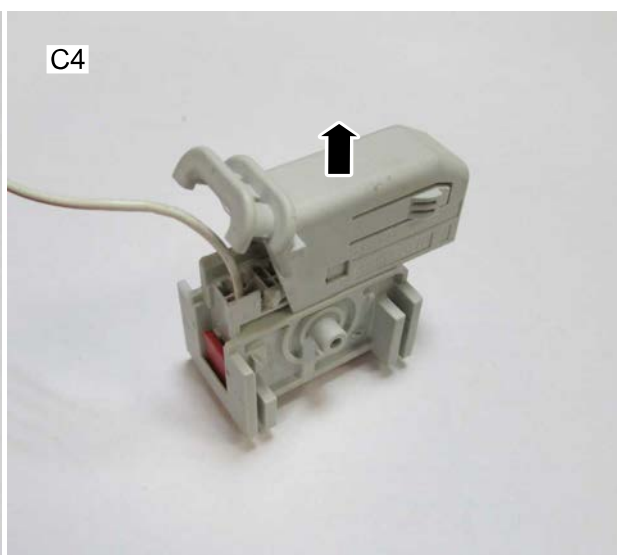
Item	Description
1	Connector C3 Pin 52
2	Connector C4 Pin 3

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.

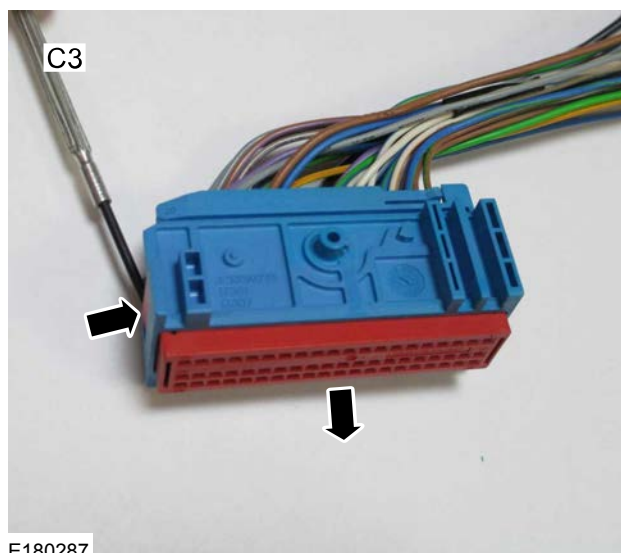




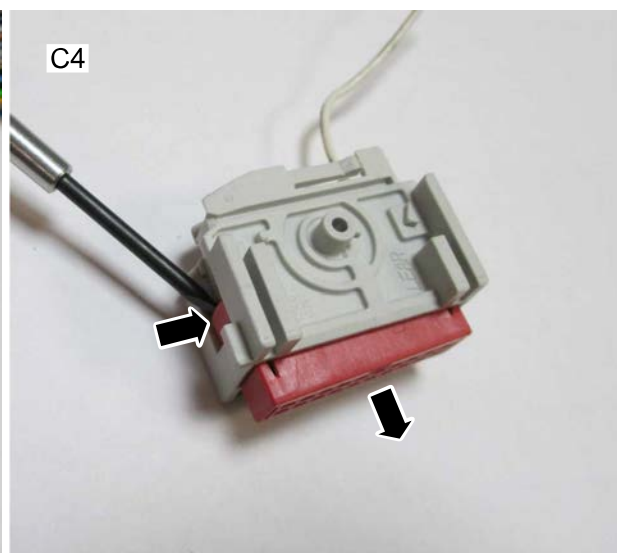
E180286



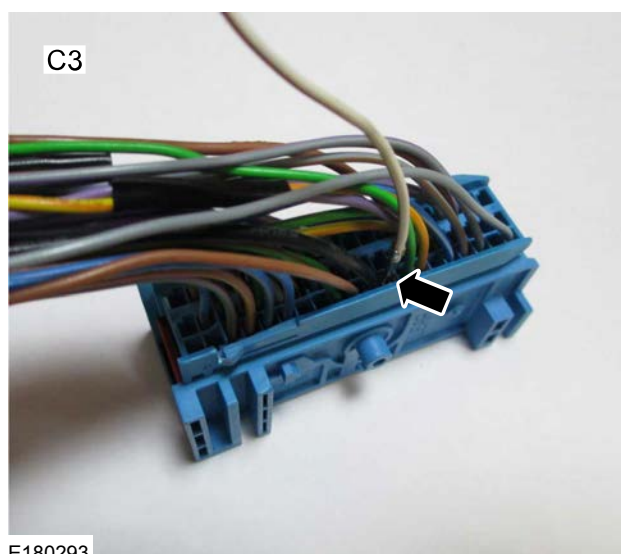
3. There is a red terminal latching plate that needs to be removed.



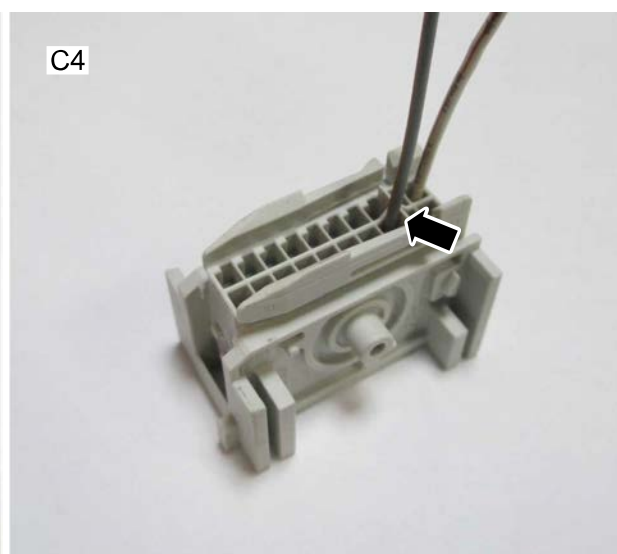
E180287



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.

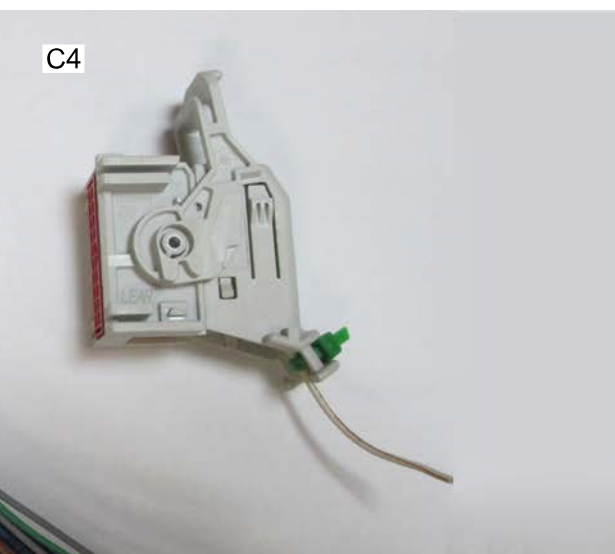
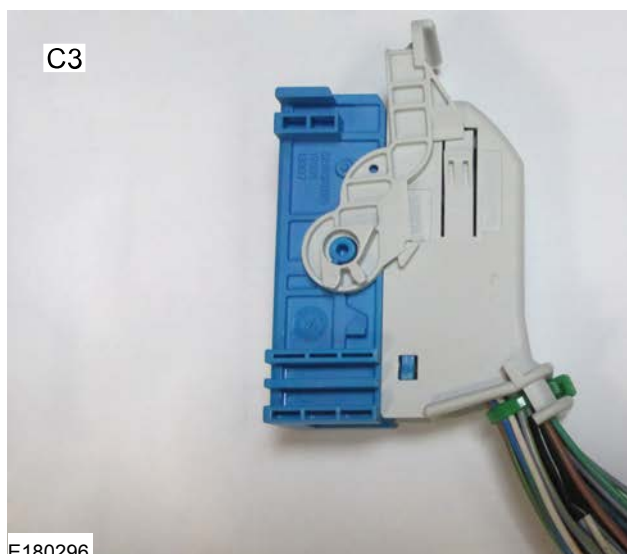
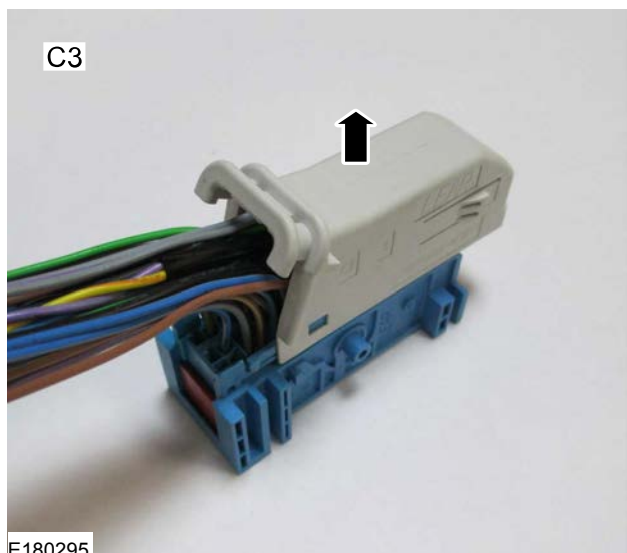
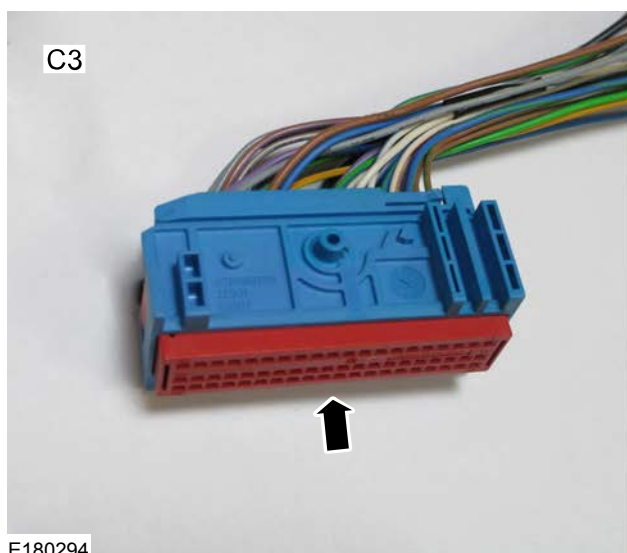


E180293



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

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



4.4.2 Vehicle Speed Output (Signal) (High Level Vehicles)

 **WARNING: Do not attempt to take a speed signal output form high level vehicles.**

A solution to take a speed signal output from the BCM on high level vehicles is not currently available.

4.5 Exterior Lighting

WARNINGS:



Make sure that the modified vehicle complies with all local regulatory standards.



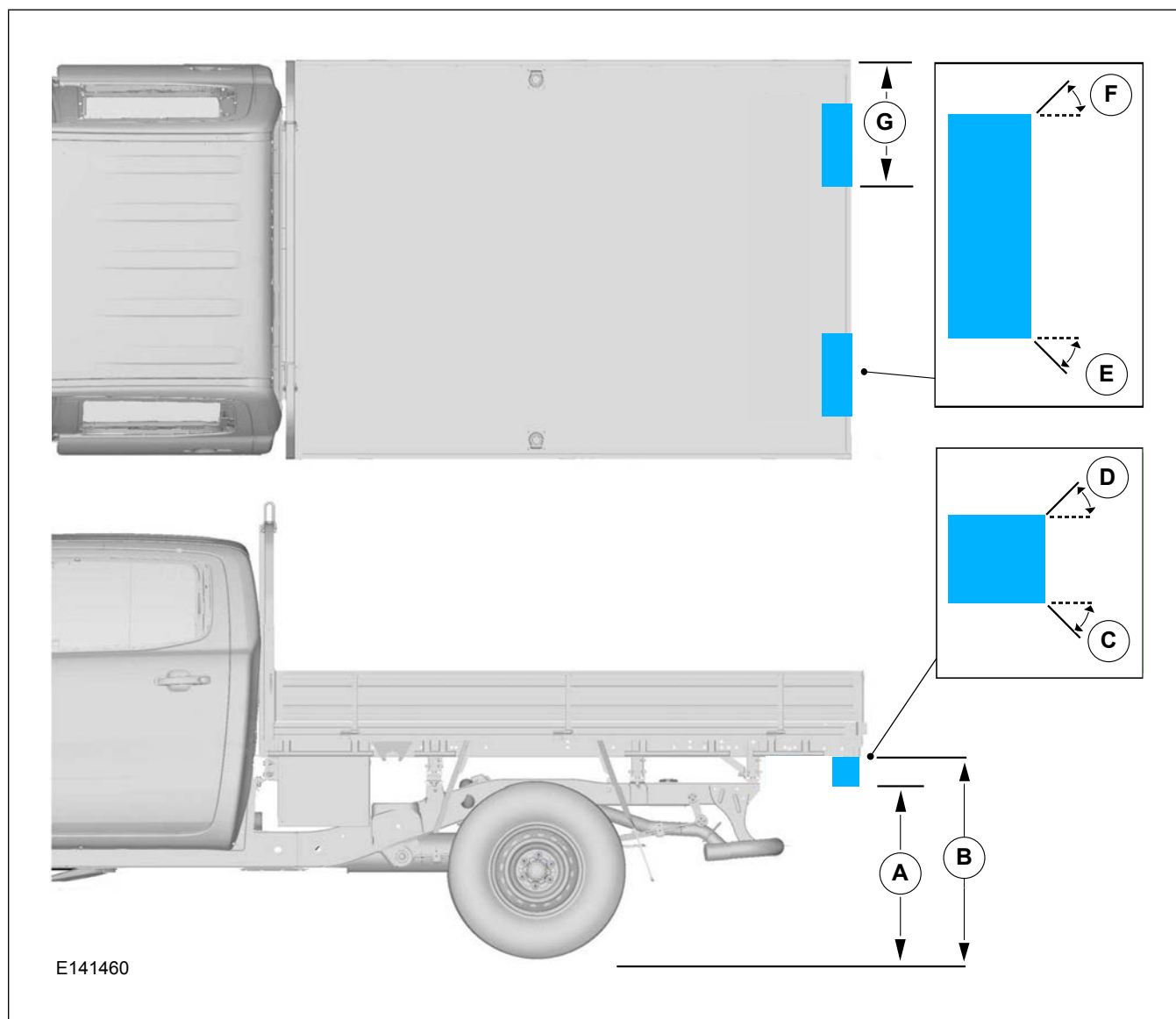
Make sure all electrical connections and wiring comply with local regulatory standards.

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.

NOTE: Prior to work on any vehicle being undertaken it is critical to identify the vehicle level (low level or high level) by the type of electrical architecture the vehicle at hand is equipped with. Failure to identify the type of electrical architecture present on the vehicle prior to work being undertaken may cause electrical damage or have safety implications.

[Refer to: 4.7 Fuses and Relays \(page 70\).](#)

4.5.1 Rear Combination lamps

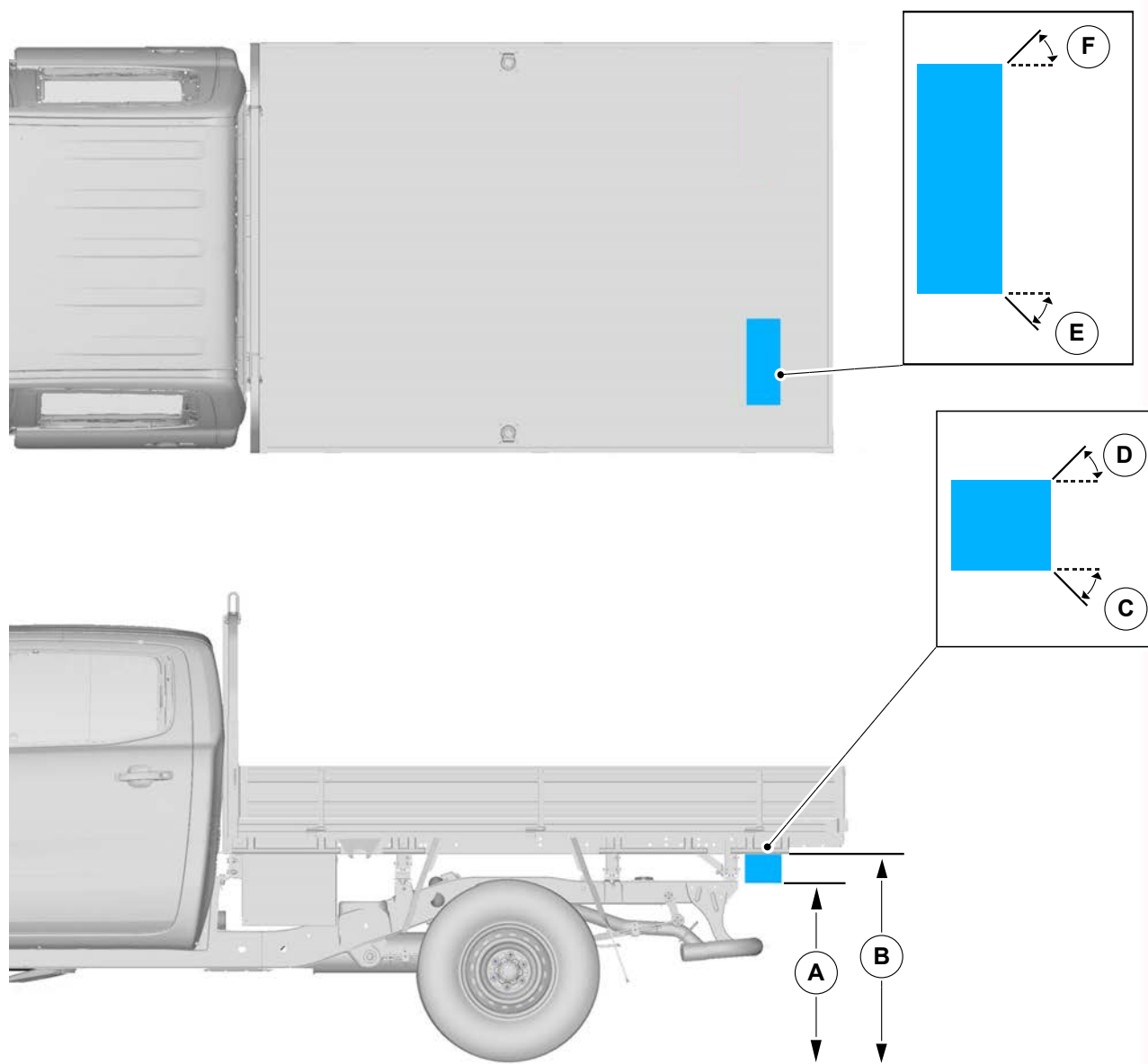


Positioning of Rear Combination Lamps

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

4.5.2 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.

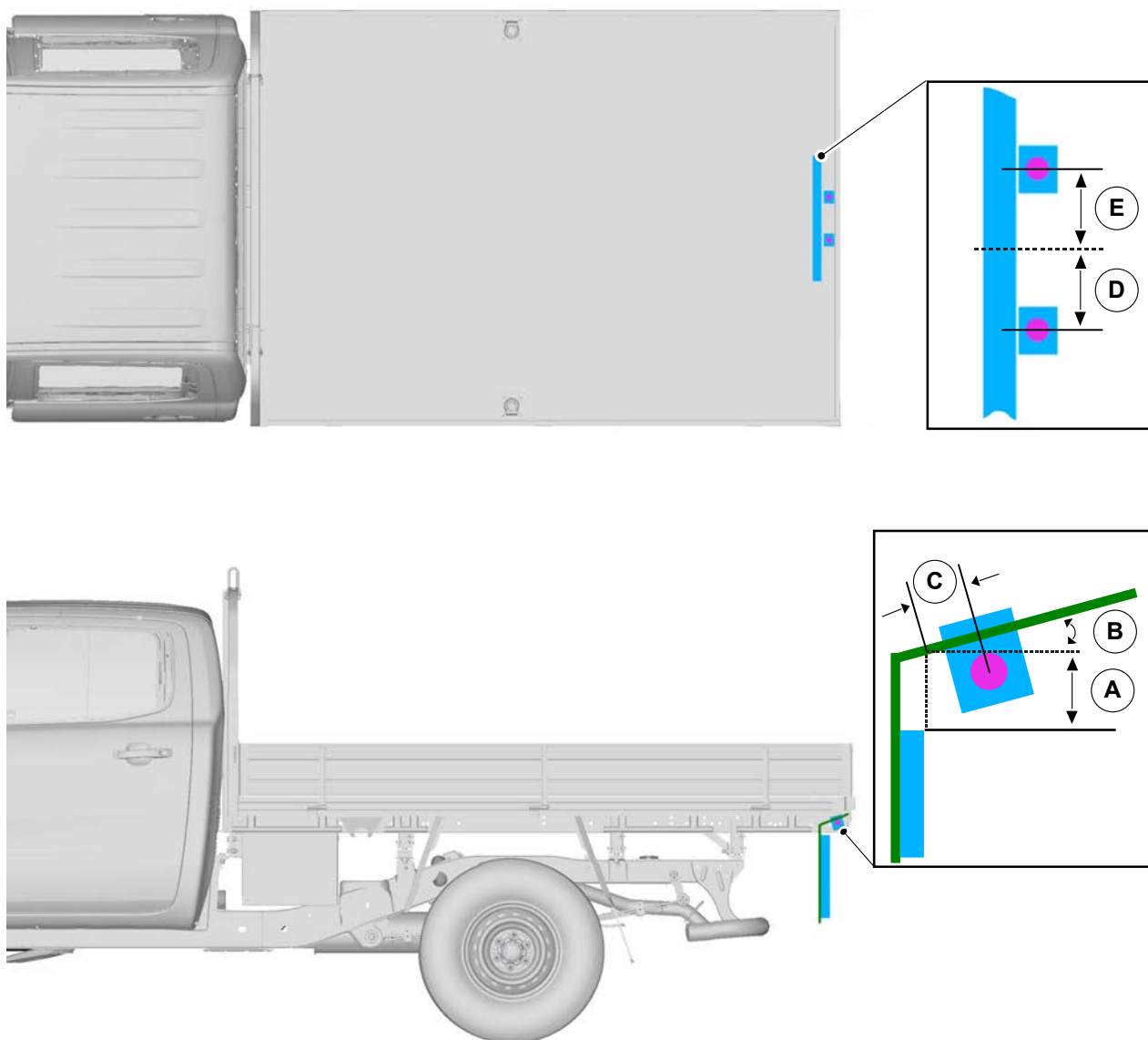


E141472

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°

4.5.3 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

4.5.4 Reversing Lamps, Rear View Camera, Reversing Alarm (Manual Transmission)

The reverse lamps are activated by the reverse switch on the transmission, through connector C169 to the Central Junction Box where the signal is sensed. A marginal increase in current (via a relay or buffered electrical input) is permissible to provide power to a rear-view camera, auxiliary reverse lighting, or an audible warning device.

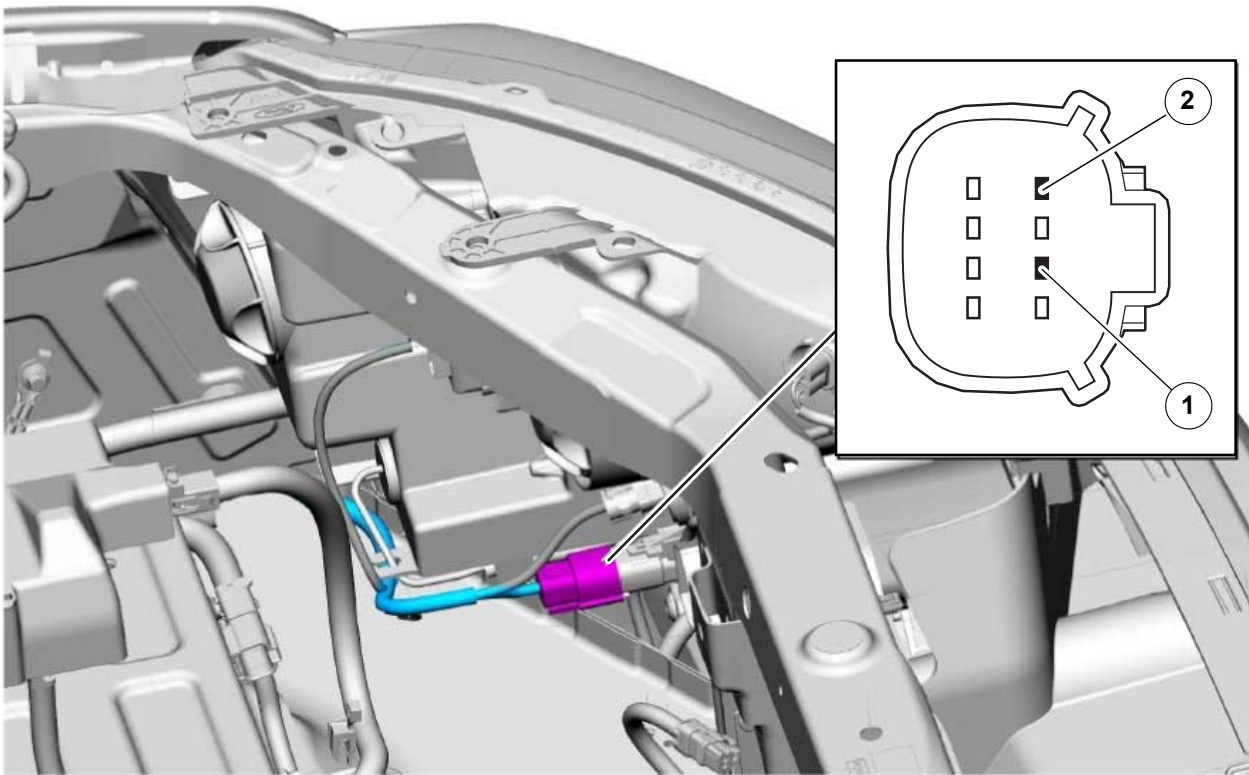
4.5.5 Additional External Lamps - (Low Level Vehicles Only)

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



E210761

Item	Description
1	Low beam
2	High beam

Lighting Fuses		
F20	10A	Headlamp
F75	15A	Front fog lamp
F76	10A	Reversing lamp

4.5.6 Trailer Towing

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

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

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 towing 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.

 **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.**

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

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 draw 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.

NOTE: The trailer detect circuit is part of the Ford Trailer Tow module, it can only be implemented on vehicles with power locking and perimeter or CAT 1 alarms.

The Trailer Tow Module (TTM) can support pure LED trailer lamps as long as each circuit exceeds 500mA, below this and the system will not detect a trailer has been connected and shuts down all outputs (sleep mode). It is recommended to target a 550mA minimum load to allow for system tolerances. This would need to be obtained with a supplemental load resistor, if the LED lighting circuits are below this threshold.

Each output driver could handle a current of 15A but it is not recommended to always run to this maximum. A higher current is interpreted as short circuit. If a short circuit is detected the related output will be switched off. The following table shows the recommended output maximums per circuit.

NOTE: Not all features and outputs are supported in all markets. Refer to your authorised Ford Dealer for further information.

Trailer Tow Module Connections- Low Level Vehicles

Component Terminal Number	Feature	Current (A)		Voltage (V)	
		Min	Max	Min	Max
Connector A					
1	Right Direction Indicator	0.5	3	6	-
2	Battery Charge Out - where used	-	10	9	16
3	Stop Left	0.5	4	6	-
4	Not used	-	-	-	-
5	Not used	-	-	-	-
6	Reverse Lamp	0.5	4	6	-
7	Stop Right	0.5	4	6	-
8	Fog Lamp	0.5	2	6	-
9	Not used	-	-	-	-
10	Left Direction Indicator	0.5	3	6	-
11	Not used	-	-	-	-
12	Position Lamp	0.5	7	6	-
Connector B					
1	Not used	-	-	-	-
2	Term 30 (Ubat)	-	30	6	16
Connector C					
1	CAN H	-	0.1	6	-
2	CAN L	-	0.1	6	-
3	Brake Line In (Vehicle -)	-	0.1	6	-
4	Ground	-	1	6	-
5	Trailer Detect Output	-	0.1	-	16

Trailer Tow Module Connections- High Level Vehicles

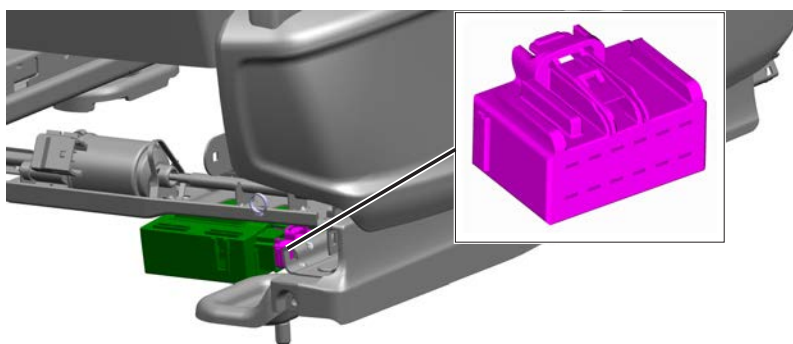
Component Terminal Number	Feature	Current (A)		Voltage (V)	
		Min	Max	Min	Max
Connector A					
1	Left Direction Indicator	0.5	3	6	-
2	Right Direction Indicator	0.5	3	6	-
3	Position Lamp	0.5	7	6	-
4	Not used	-	-	-	-
5	Reverse Lamp	0.5	4	6	-
6	Battery Charge Out - where used	-	10	9	16
7	Stop Lamp	0.5	4	6	-
8	Fog Lamp	0.5	2	6	-
9	Not used	-	-	-	-
10	Not used	-	-	-	-
11	Not used	-	-	-	-
12	Not used	-	-	-	-
Connector B					
1	B(+) Fuse 87 (40A) BJB	-	-	-	-
2	B(+) Fuse 73 (30A) BJB	-	-	-	-
Connector C					
1	Ground	-	1	6	-
2	CAN L	-	0.1	6	-
3	CAN H	-	0.1	6	-
4	Not used	-	-	-	-

4.5.7 Auxiliary Lighting Loads (Low Level Vehicles Only)

NOTE: Connections for auxiliary lighting loads must be low and stable current draw.

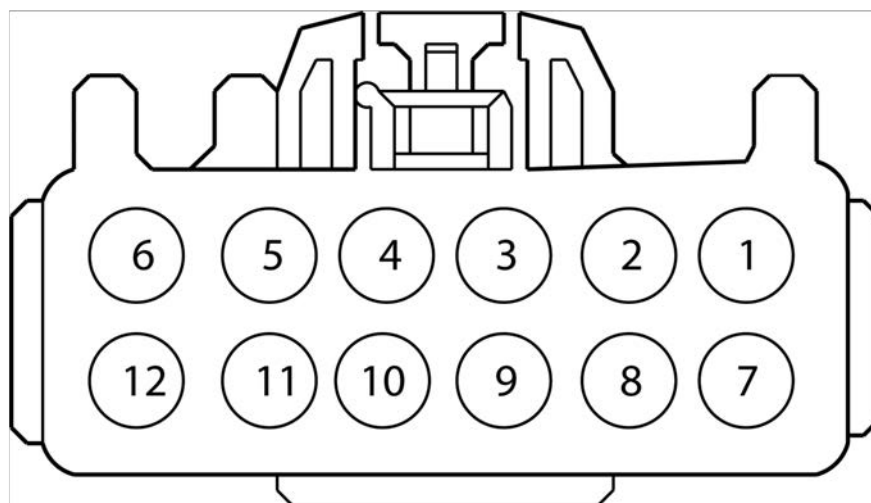
Trailer Tow Module (if equipped)

Connections for auxiliary lighting loads can be made via the trailer tow module (TTM) located under the passenger seat. See Trailer Towing in this section.



E223617

TTM Connector - Detail



E231982

4.5.8 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)

4.5.9 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.

4.5.10 Centre High Mount Stop Lamp (CHMSL) - Canopy Fitment - Low Level Vehicles

WARNING: The maximum current load that can be applied to the CHMSL circuit is **1.72A** for incandescent globes, and **0.38A** for LED lamps. Do not exceed the rated load.

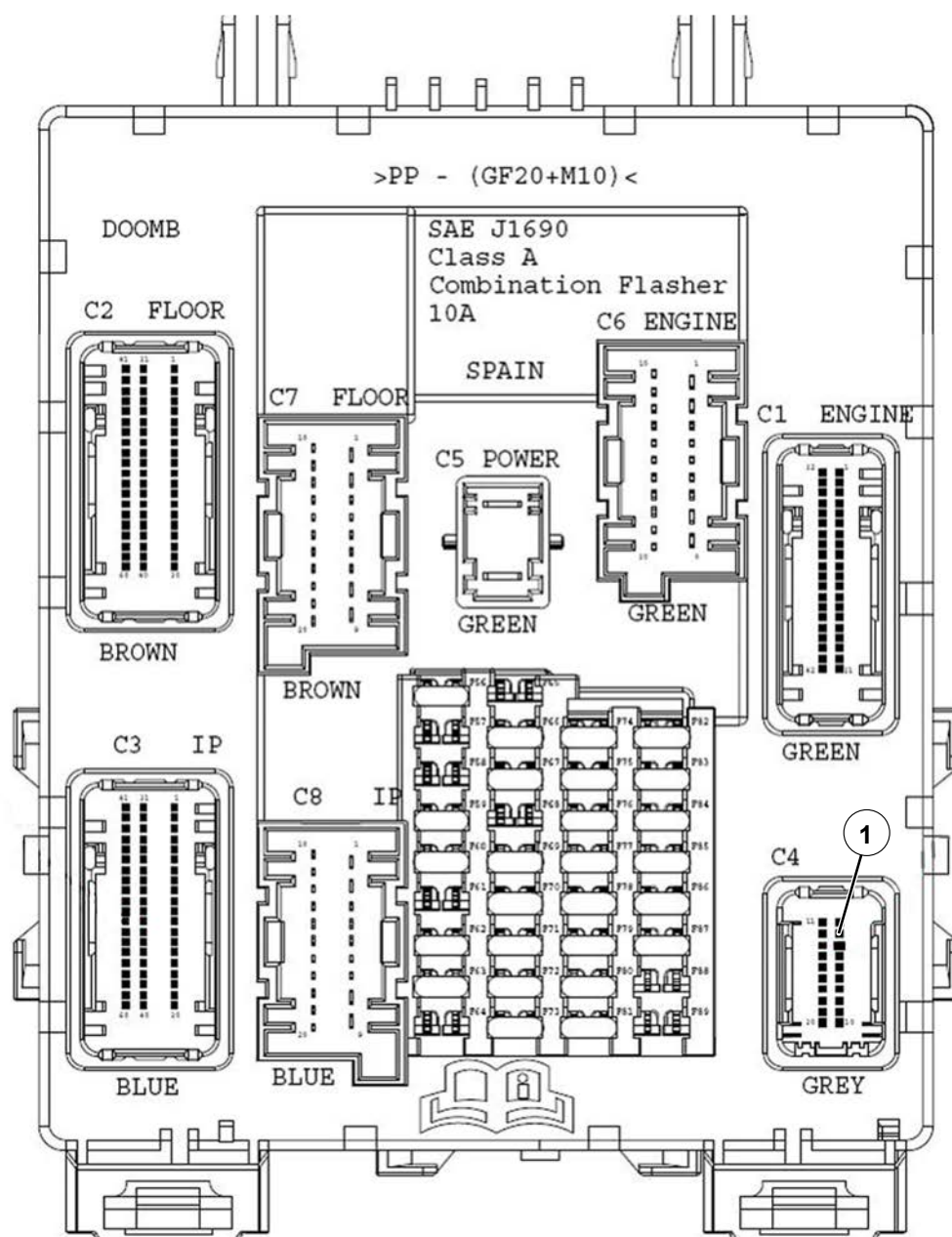
NOTE: Disable the original vehicle mounted CHMSL if the canopy CHMSL is intended to be the primary CHMSL.

NOTE: The CHMSL circuit is pulse width modulated (PWM).

NOTE: Check the operation of the CHMSL prior to customer handover.

NOTE: When replacing the factory fitted CHMSL with a canopy mounted CHMSL, the same type must be used. Replace a bulb/incandescent type only with a bulb/incandescent. Replace and LED type only with an LED type.

When installing a canopy equipped with a CHMSL, a feed for the CHMSL can be taken from the BCM (Connector 4, Pin 2).



E229158

Item	Description
1	BCM CHMSL Feed (Connector 4, Pin 2).

4.5.11 Centre High Mount Stop Lamp (CHMSL) - Canopy Fitment - High Level Vehicles

WARNINGS:

⚠ The maximum current load that can be applied to the CHMSL circuit is 1.72A for incandescent globes, and 0.38A for LED lamps. Do not exceed the rated load.

⚠ Make sure all wiring is insulated and routed securely.

NOTE: The fitment of a canopy to high level vehicles equipped with a combined CHMSL / Cargo Lamp requires that the cargo lamp feature be disabled.

NOTE: Disable the original vehicle mounted CHMSL if the canopy CHMSL is intended to be the primary CHMSL.

NOTE: The CHMSL circuit is pulse width modulated (PWM).

NOTE: Check the operation of the CHMSL prior to customer handover.

NOTE: When replacing the factory fitted CHMSL with a canopy mounted CHMSL, the same type must be used. Replace a bulb/incandescent type only with a bulb/incandescent. Replace and LED type only with an LED type.

When fitting a canopy to vehicles equipped with a combined CHMSL / Cargo Lamp, the lamp housing may be impacted by the canopy. Check the canopy to CHMSL clearance, and if required, follow the below procedure.

A replacement CHMSL (without cargo lamp function) needs to be installed. A patch harness with a 2-pin connector is then spliced into the vehicles CHMSL circuit wiring allowing a canopy with an integrated CHMSL to take a stop lamp circuit feed from the 2-pin connector. The original 3-pin connector is then taped back.

Follow the steps to install the replacement CHMSL lamp housing:

1. Remove the combination CHMSL / Cargo Lamp following the workshop manual instructions.

NOTE: When cutting off the stop lamp circuit wires from the 3-pin CHMSL connector, stagger the cuts to allow for cleaner and less bulky splice joins.

2. Locate the 3-pin CHMSL / Cargo Lamp Connector. Cut off the stop lamp circuits (pin 1 yellow-grey or white-blue, pin 2 black-violet or black-yellow or black-blue) leaving the violet wire (pin 3) connected to the 3-pin CHMSL connector.
3. Tape back the 3-pin connector with the violet coloured wire.
4. Splice the replacement 2-pin connector and patch harness to the cut wires:
 1. Yellow + Grey wire (or alternate color - see above) to Yellow + Grey wire.
 2. Black + Violet wire (or alternate color - see above) to black + Violet wire.
5. Insulate the spliced joins with heat shrink.
6. Route the canopy CHMSL wiring through a suitable grommet into the passenger compartment, route it behind the trim panels and connect it to the replacement 2-pin connector.
7. Install the replacement CHMSL to the vehicle following the workshop manual instructions.

4.6 Handles, Locks, Latches and Entry Systems

4.6.1 Central Locking

NOTE: Additional locks will not be covered by the vehicle alarm or operate BCM controlled lighting.

The central locking function is controlled by the BCM (located under the instrument panel). The vehicle locks are operated by surface mounted relays in the BCM – these are only capable of powering one lock each.

It is possible to add an additional lock(s) with the use of relays triggered by the BCM outputs.

NOTE: The location of additional relays should be considered carefully. A suitable mounting location away from the passenger compartment will allow for a safer install and reduced noise in the passenger compartment.

Depending on the functionality required, the pins used will emulate the basic locking/unlocking operation of an existing lock. The coil of the additional relays (i.e. one relay for lock all, one relay for unlock all) should be added across the relevant pin and a suitable ground point. Power (B+) for the additional relays should be taken from a suitably fused B+ feed.

Relay selection for installation of an additional lock(s) must parallel the run time of the BCM surface mount relays.

BCM Output for Central Locking (Low Level Vehicles)

BCM	Pin	Circuit	Fuse	Function
C2280E	1	CPL11	BCM Fuse 70	CTRL MOD. - DOOR LOCK # ALL LOCK
C2280E	8	CPL13	BCM Fuse 70	CTRL MOD. - DOOR LOCK # ALL UNLOCK

BCM Output for Central Locking (High Level Vehicles)

BCM	Pin	Circuit	Fuse	Function
C2280F	35	CPL11	BCM Fuse 24	CTRL MOD. - DOOR LOCK # ALL LOCK
C2280F	32	CPL13	BCM Fuse 24	CTRL MOD. - DOOR LOCK # ALL UNLOCK

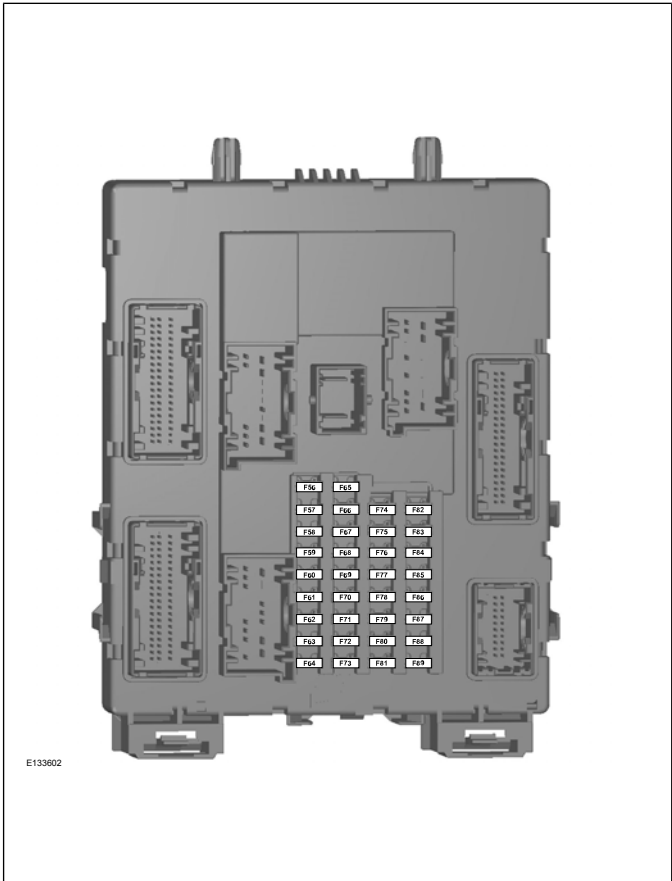
4.7 Fuses and Relays

4.7.1 Low Level and High Level Vehicles

⚠ WARNING: Prior to work on any vehicle being undertaken it is critical to identify the type of electrical architecture the vehicle uses. Failure to identify the type of electrical architecture present on the vehicle prior to work being undertaken may cause electrical damage or have safety implications.

This manual provides information that may or may not apply depending on the exact vehicle model the vehicle converter is working on. The PX Ranger MkII is built in varying specification levels, spread across two different electrical architecture types. Identification of which type a vehicle is equipped with can be aided visually checking the passenger compartment fuse box.

Passenger Compartment Fuse Box - Low Level Vehicles



Passenger Compartment Fuse Box - High Level Vehicles



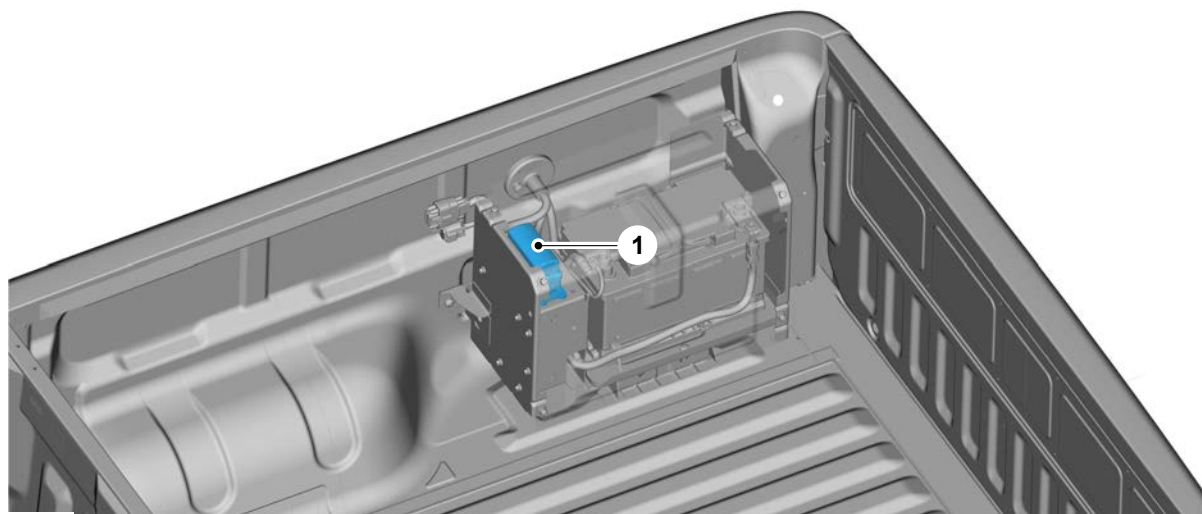
4.7.2 Auxiliary Battery and Fuse Box - Low Level Vehicles

NOTE: High level vehicles cannot be fitted with the factory installed auxiliary battery and fuse box.

An auxiliary battery and associated fuse box is available as an option on low level vehicles called a Special Equipment Pack. The option code for the Special Equipment Pack is AALSA. The auxiliary battery and fuse box provides electrical outputs for the addition of auxiliary electrical loads to be supplied off the auxiliary battery.

4.7.3 Auxiliary Fuse Box (Vehicles with Special Equipment Pack) (Low Level Vehicles Only)

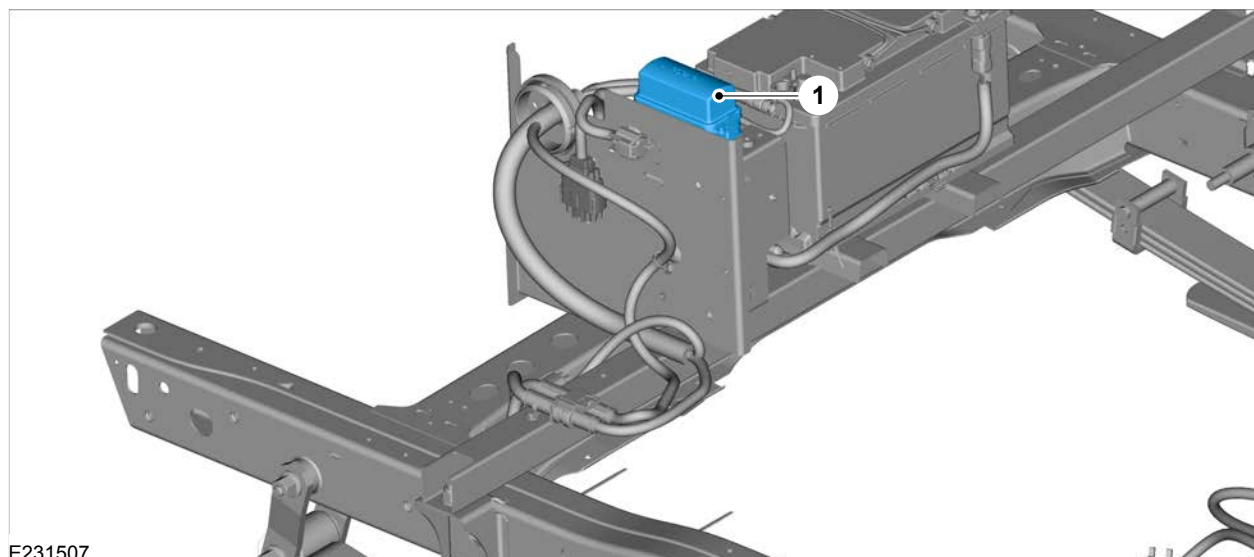
Vehicles with a Load Box (Vehicles with Special Equipment Pack) (Low Level Vehicles Only)



E231508

Item	Description
1	Auxiliary Fuse box

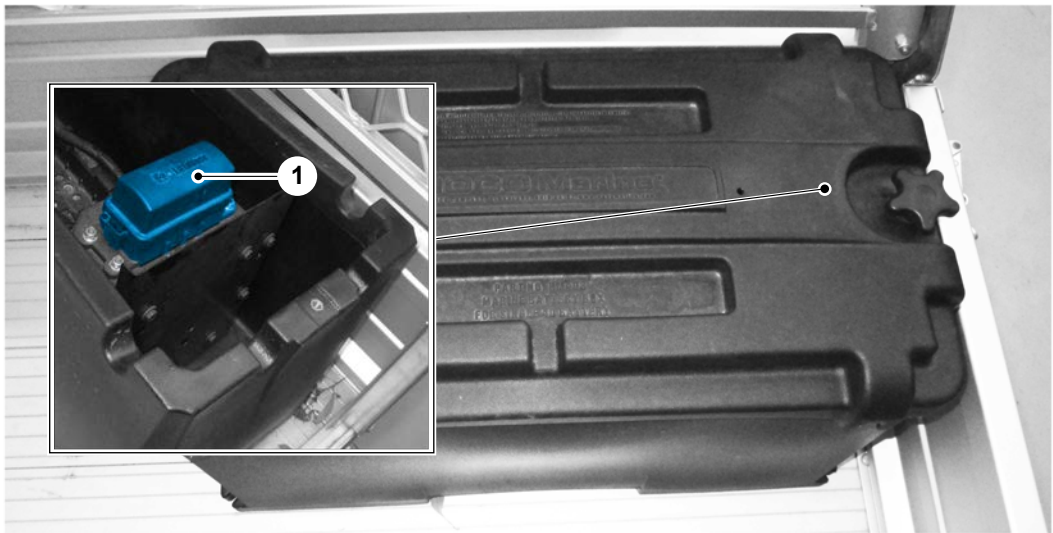
Vehicles with Temporary Battery Carrier (Cab Chassis Variant Only) (Low Level Vehicles Only) (Vehicles with Special Equipment Pack)



E231507

Item	Description
1	Auxiliary Fuse box

Cab Chassis Vehicles with Tray (Low Level Vehicles Only) (Vehicles with Special Equipment Pack)

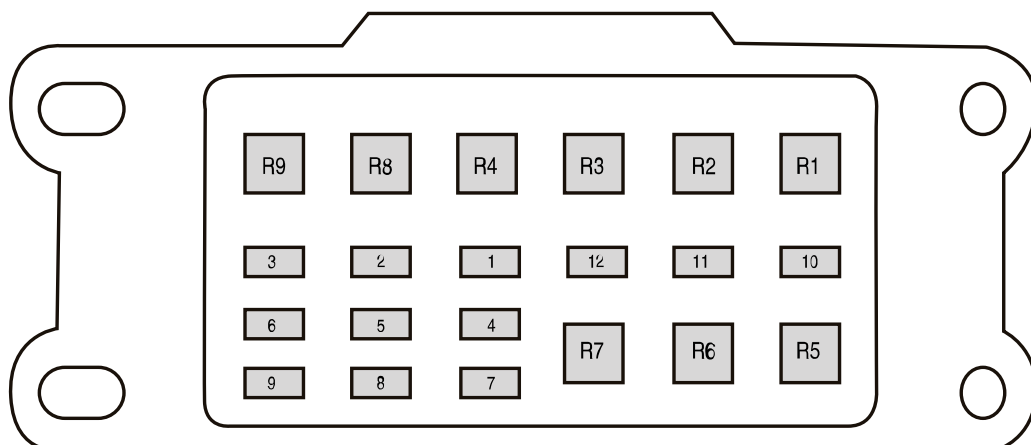


E231509

Item	Description
1	Auxiliary Fuse box

Auxiliary Fuse Specification Chart

NOTE: On delivery of the vehicle, ensure Fuse F10 is engaged into its location correctly. Fuse F10 is intentionally not fully engaged during manufacturing, to prevent depletion of the auxiliary battery during shipping and transit.



E174549

Fuse	Fuse Amp Rating	Protected Components
1	25	Driving lights
2	15	Position lamp
3	10	LED (light emitting diode) 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	Auxiliary battery 'disable' fuse (isolator ground).
11	-	Not used
12	-	Not used

Relay Chart

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

5.1 Body

5.1.1 Body Structures - General Information

 **WARNING: All external or internal projections must comply with local regulatory standards.**

 **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 and drilling. All metal edges must comply with exterior and interior protection local regulatory standards.
- 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.

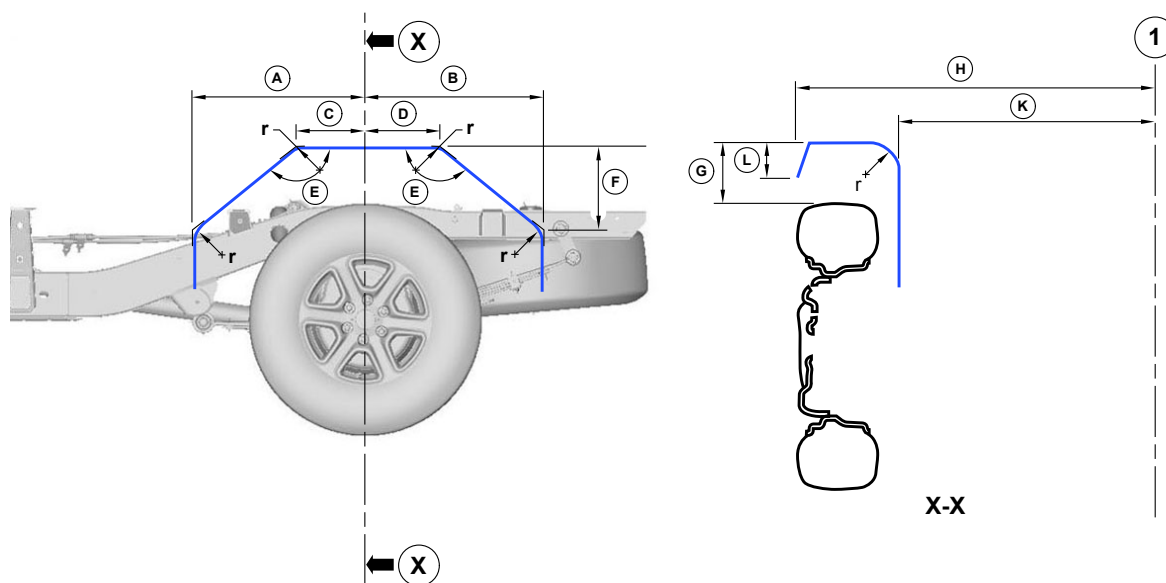
5.1.2 Integrated Bodies and Conversions

 **WARNING: All wheelhouse envelopes must comply with local regulatory standards.**

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

Wheel Guard Dimensions

Wheel Guard Dimensions									
Dimension	215/ 70R16	255/ 70R16	265/ 65R17	265/ 60R18	Dimension	215/ 70R16	255/ 70R16	265/ 65R17	265/60R18
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 Wheel Guard								
* Dimension G is to the bottom of the swage									

* 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 and drilling. All metal edges must comply with exterior and interior protection local regulatory standards.
- All fixings through the floor, sides or roof must be sealed.

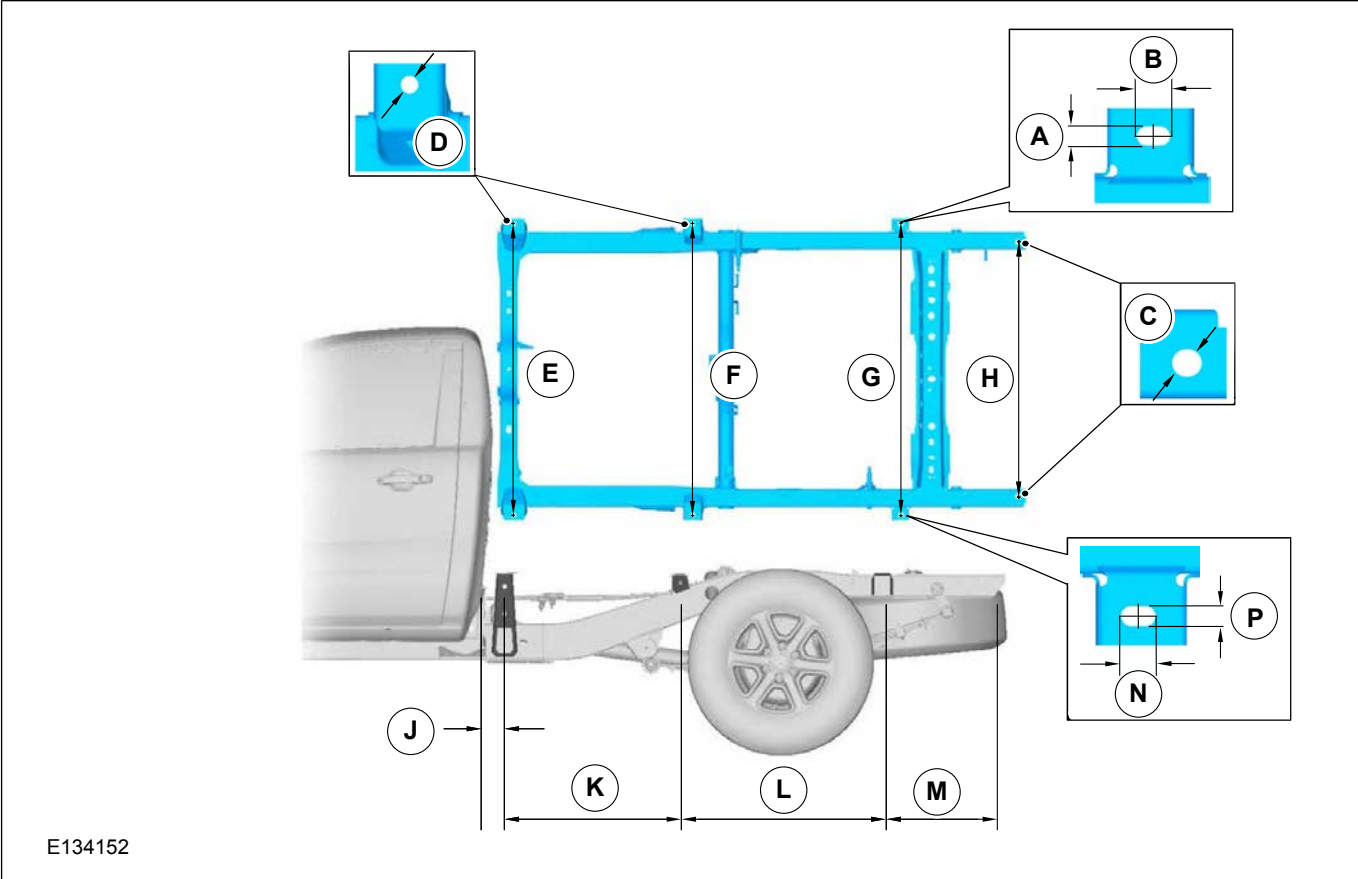
Refer to: 5.4 Corrosion Prevention (page 93).

- 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.

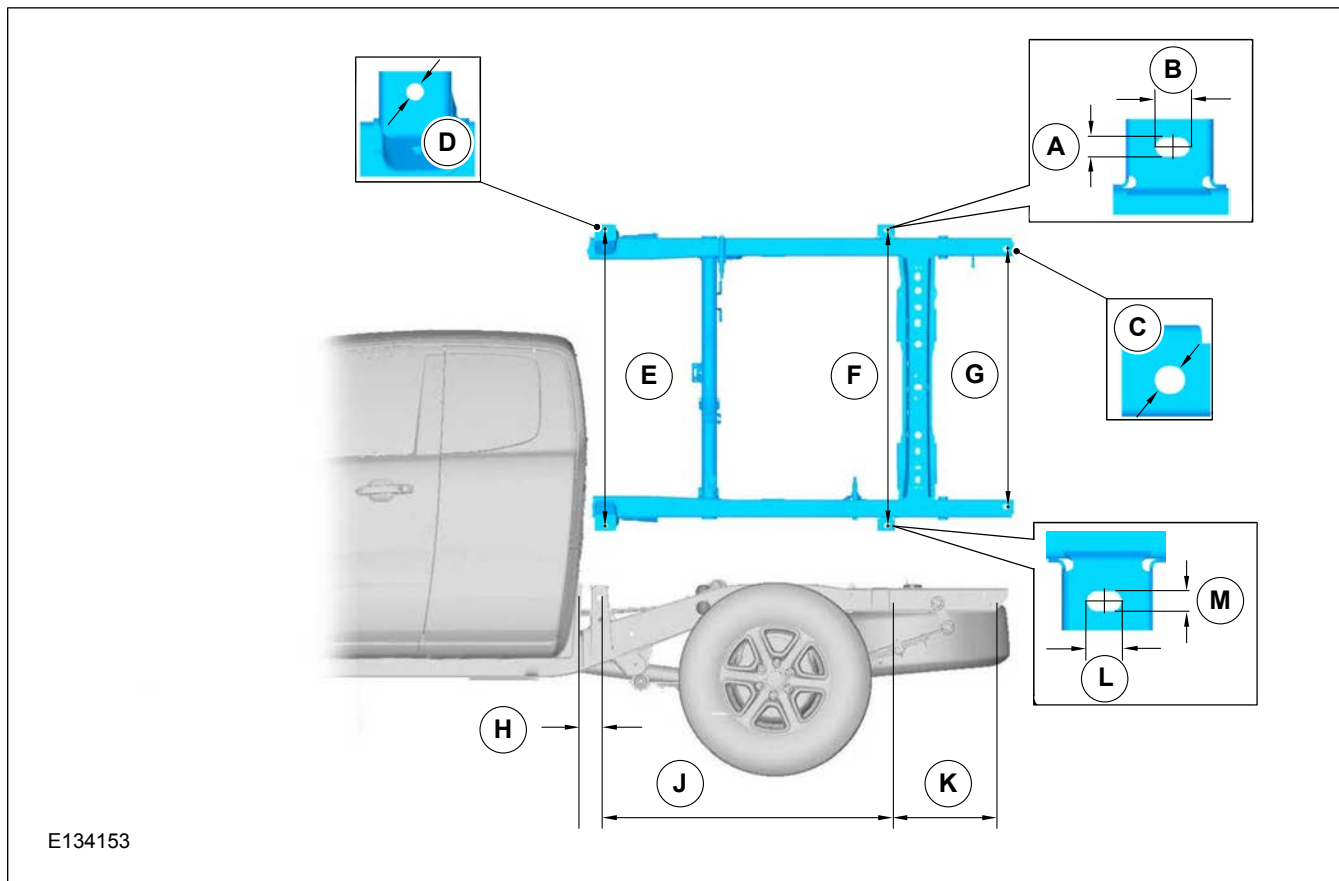
Body Attachment Holes in Chassis Frame - Single cab



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

Dimension		Dimension	
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

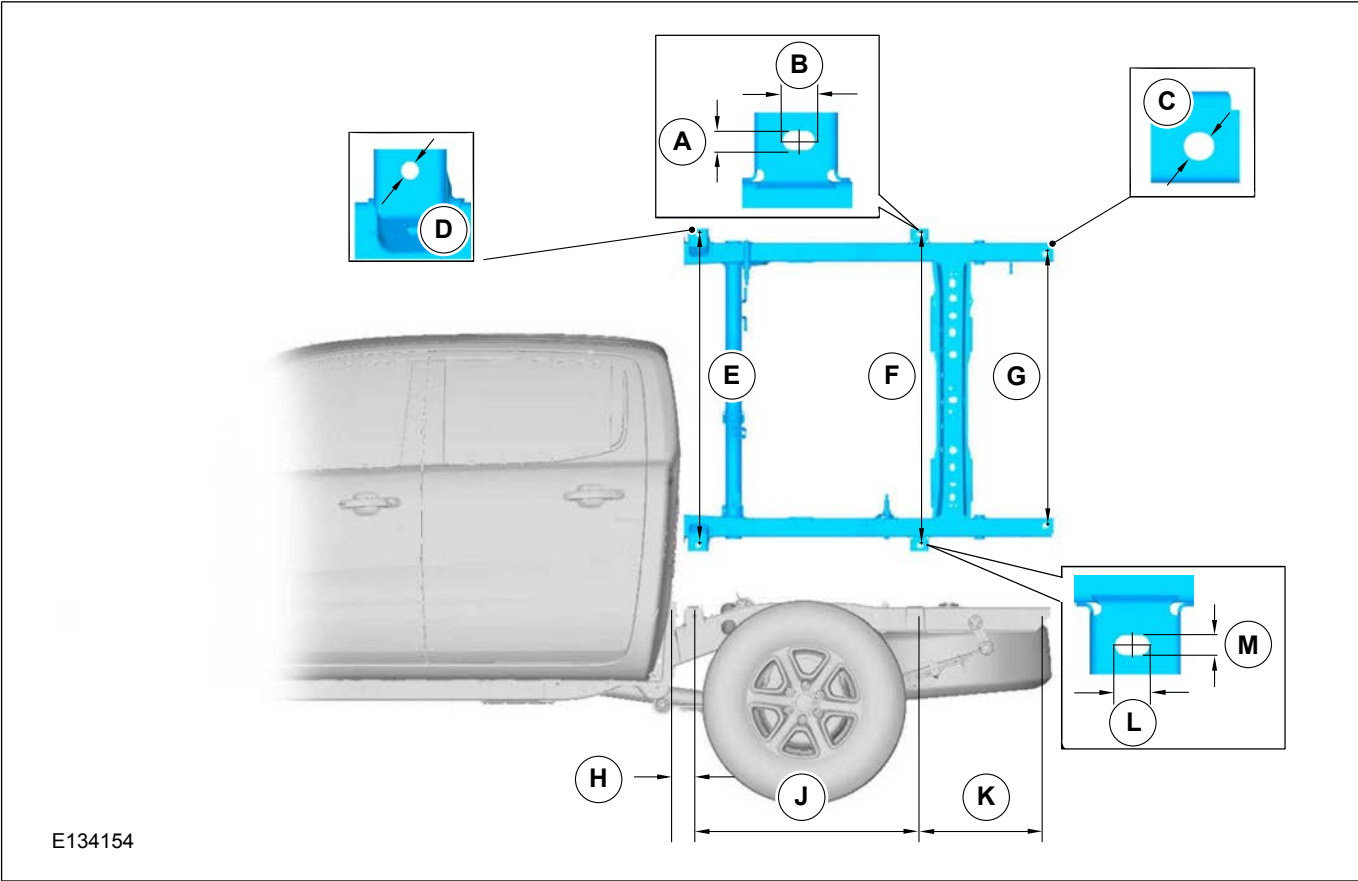
Body Attachment Holes in Chassis Frame - Super cab



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

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

Body Attachment Holes in Chassis Frame - Double cab



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

Dimension		Dimension	
A	16	G	1086
B	28	H	95
C	23	J	893
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 93).

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 Genuine Ford Accessory Bull Bar

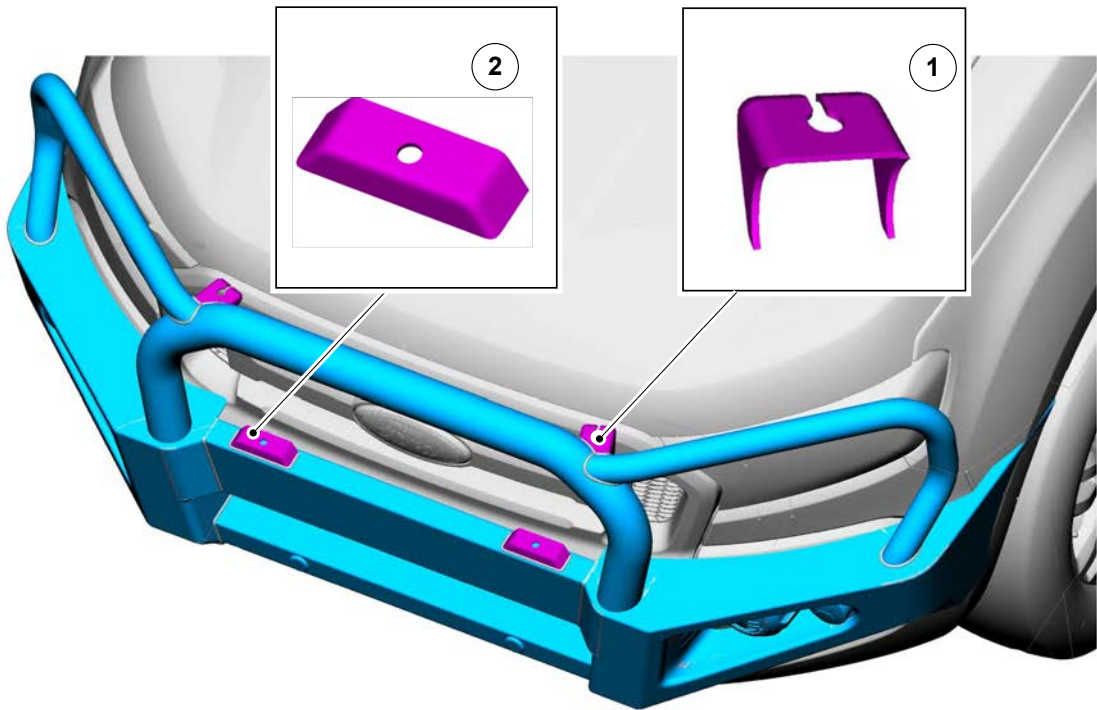
The Genuine Ford Accessory bull bar includes brackets which are mounting points for driving lights, aerials, antennas and flags.

WARNINGS:

-  **Follow all accessory manufacturer's instructions when connecting accessories and equipment to the vehicle.**
-  **Do not fit a non-Ford approved bull bar to your vehicle as this may interfere with the operation of the restraint system, including the air bag deployment, and could result in injury to yourself and others. Fitment of a bull bar may also void the vehicle's compliance with Australian Design Rules.**
-  **Do not modify the front of your vehicle in any way. This could adversely affect deployment of the airbags. Failure to adhere to this warning could result in serious personal injury or death.**
-  **After bullbar installation, contact your authorised Ford Dealer to correctly calibrate the Adaptive Cruise Control Radar Module (if equipped). This is required to ensure correct operation of the advanced safety features this vehicle offers.**

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

Bull Bar Accessory Mounting Positions



E210762

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

Antenna Cables Routing

WARNINGS:

-  **Ensure that the antenna cables have sufficient clearance from hot and moving parts.**
-  **Do not fasten the antenna cables to original vehicle wiring, fuel pipes and brake pipes.**
-  **Keep the 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.

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

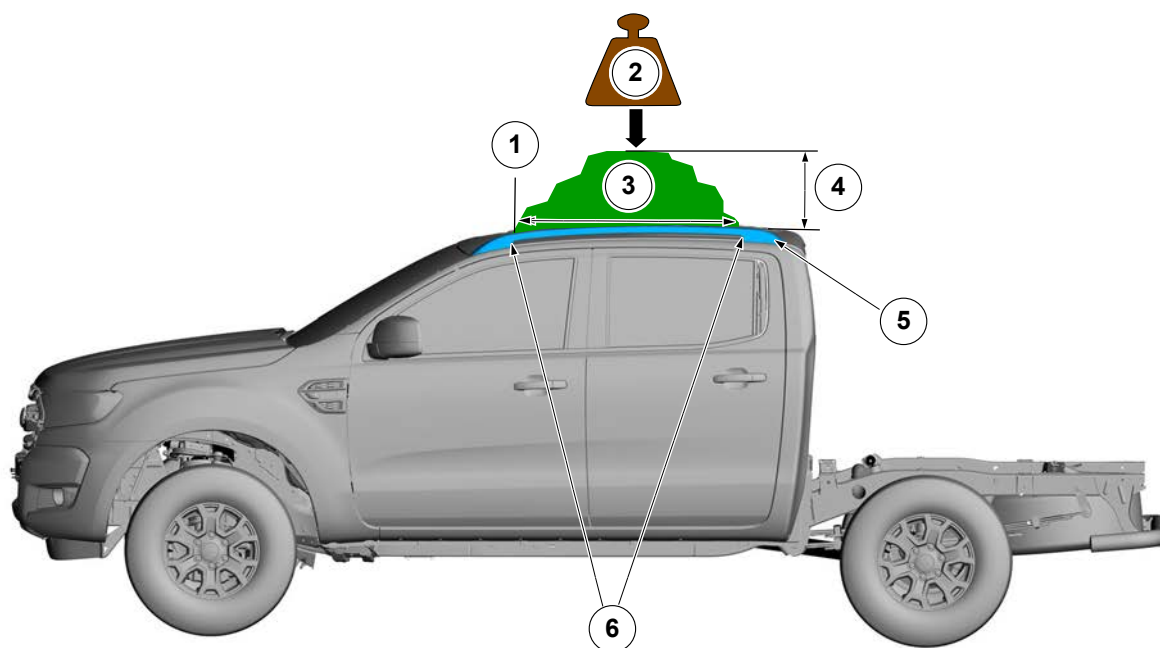
- Roof racks may be fitted to all variants as illustrated in figure, providing the following is satisfied:
- The carried load does not exceed 80kg (Body Builder to ensure owner’s hand book identifies this limitation).
 - The carried load does not exceed 300mm load height (converter to ensure owner’s 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 / Super 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 super cab applications, in particular steering, braking and front axle ratings 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 Centre of Gravity condition. For details please consult the Ford dealer.

Roof Rack Vehicle Converter Special Fit



E278320

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:

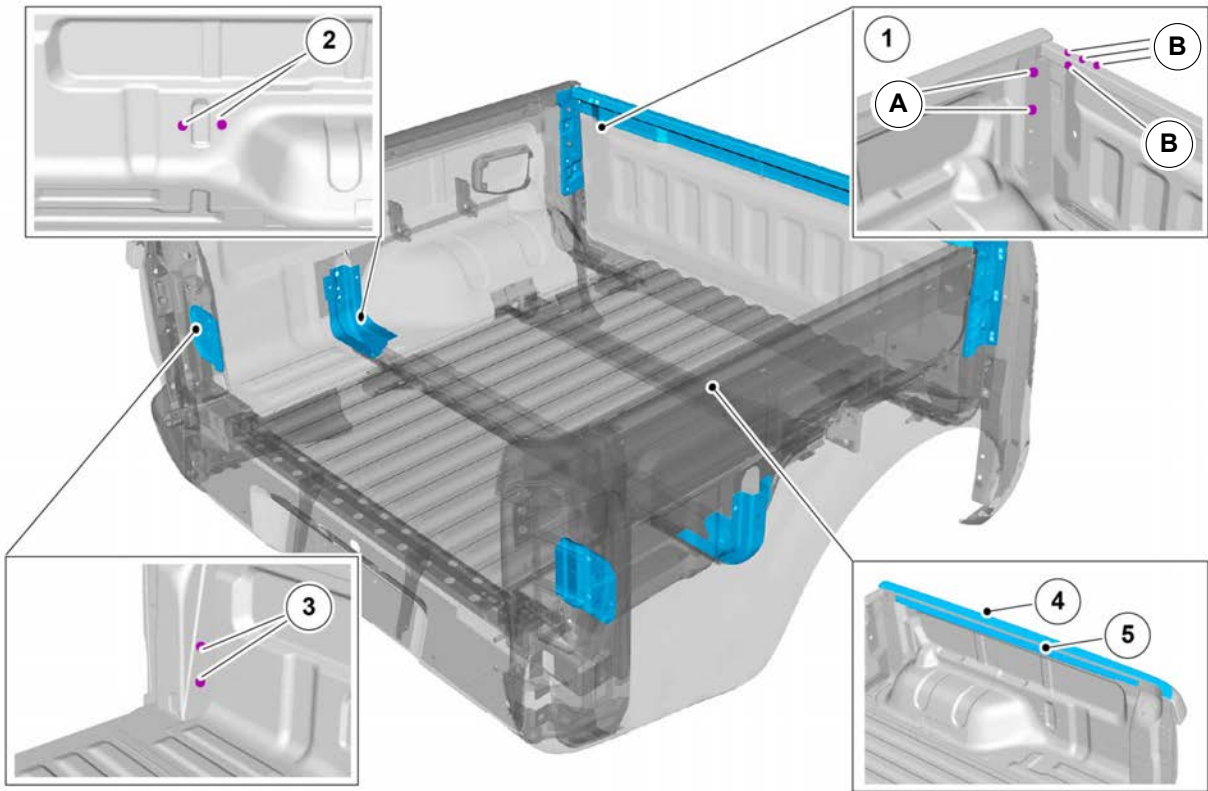
-  **Only use the recommended attachment points for the canopy fitment, otherwise damage may occur to the load box.**
-  **The return flange on the load box sides should never be cut away, be drilled into, or be used otherwise for bolting of the canopy.**

-  **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

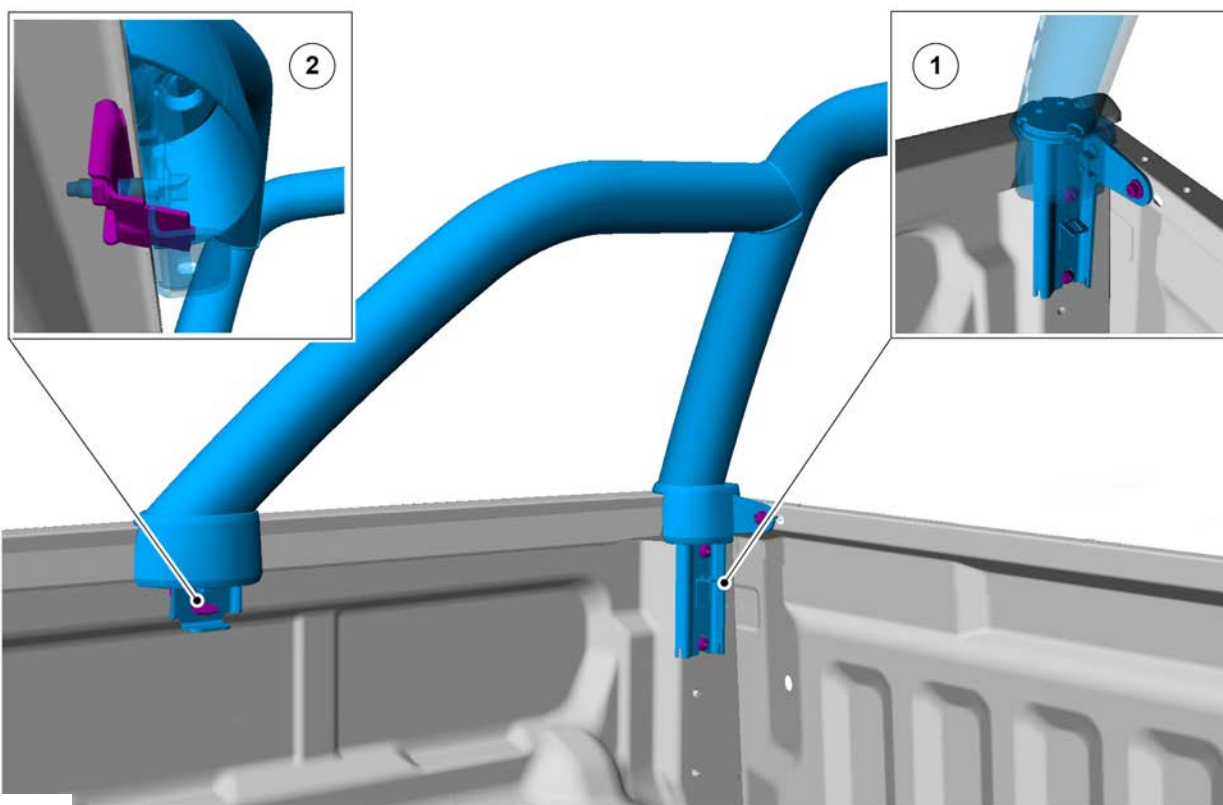


E170921

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 - (Low Level Vehicles)

Front Seats

Side airbags are not compatible with swivelling front seats.

Do not specify the base vehicle with side airbags when planning to retrofit a swivelling 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.

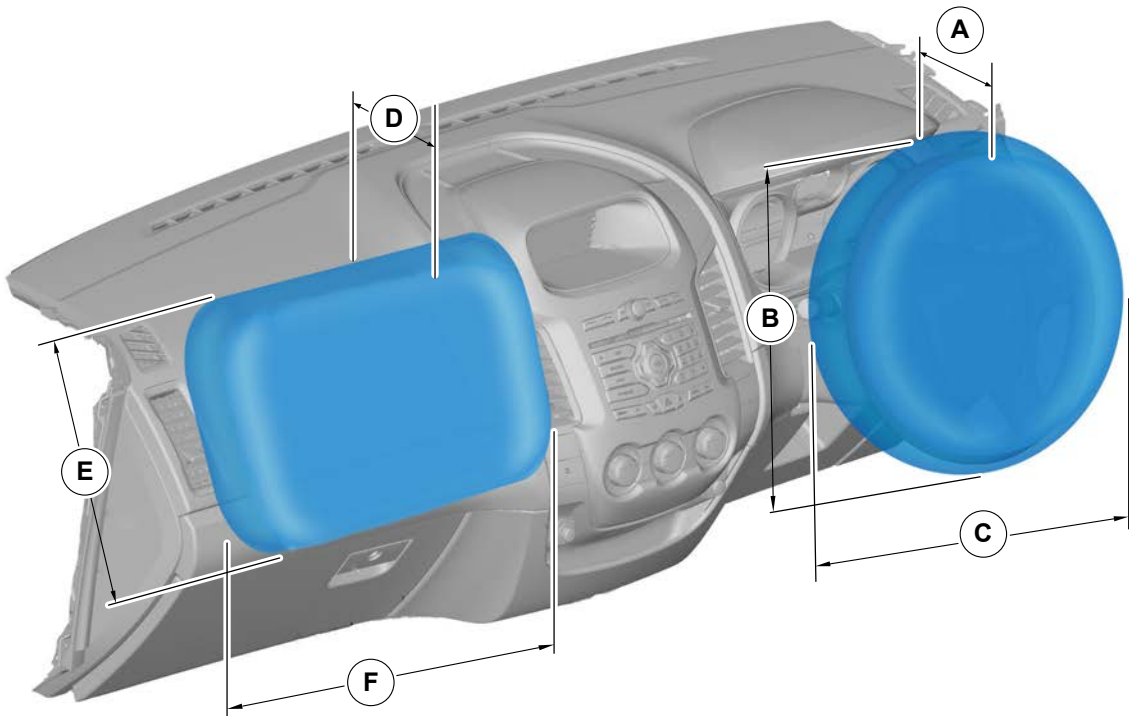
The acceleration based airbag sensors for side airbags are located nearby the bottom of the C-pillar inner for Super Cab and Double Cab vehicles. The pressure based airbag sensors for side airbags are located near the centre of the front doors' inner door sheet metal for all Cab styles.

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.

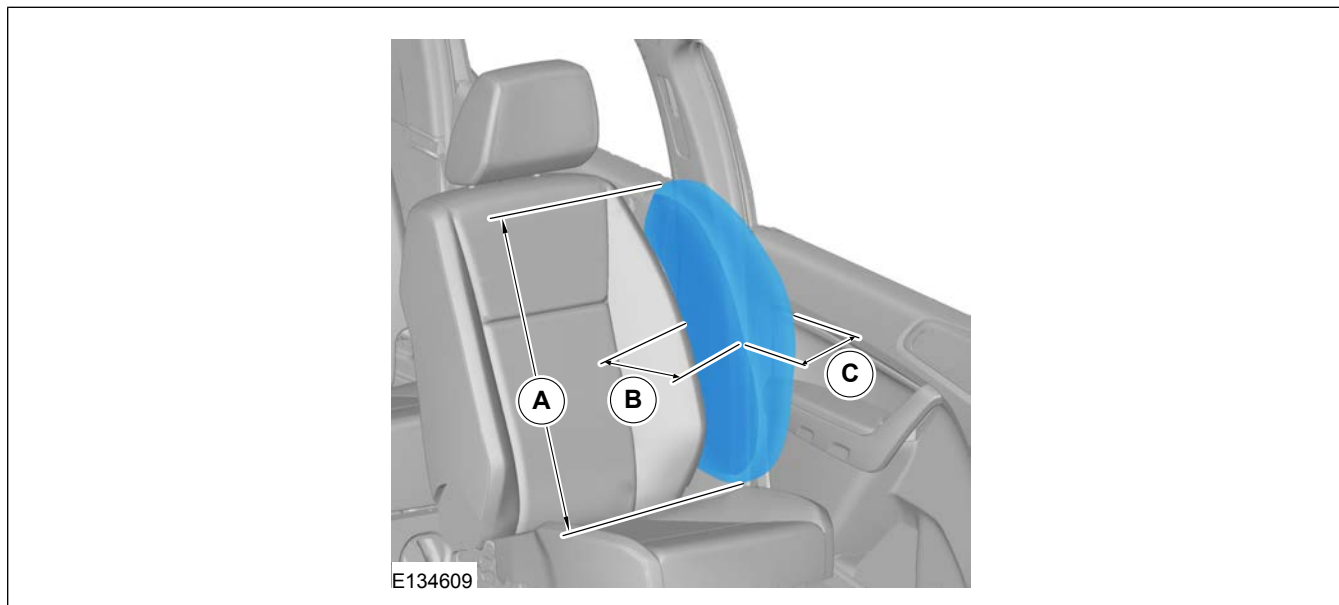
Driver and Passenger Front Airbag Deployment Zones



E134101

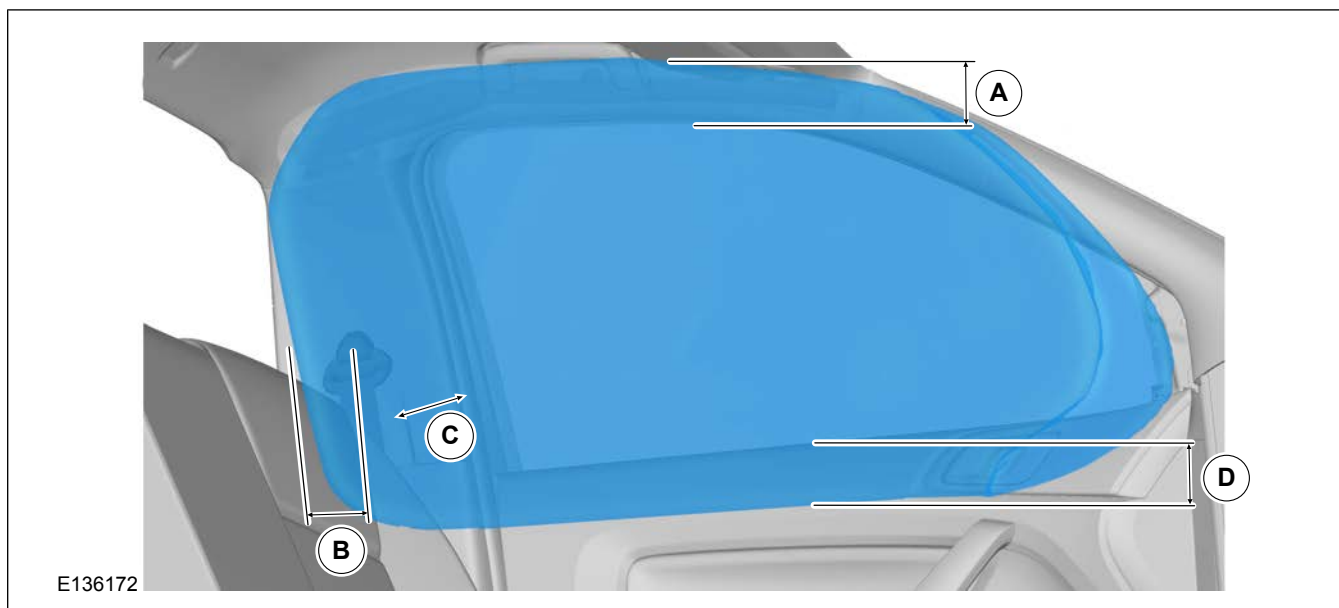
Dimensions (mm)			
A	400	D	660
B	700	E	630
C	700	F	700

Side Airbag



Dimensions (mm)			
A	550	C	250
B	350		

Curtain Airbag - Single cab



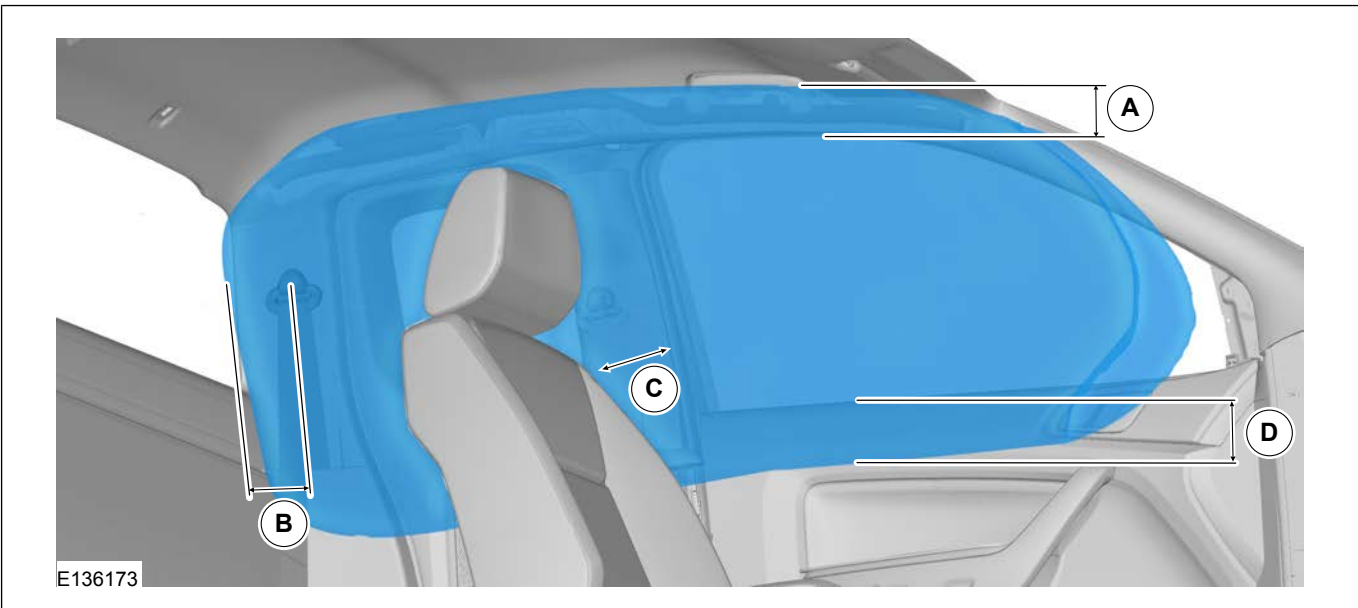
Dimensions (mm)			
A	140	C	250
B	40	D	100

Curtain Airbag - Double cab



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

Curtain Airbag - Super cab



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

5.2.2 Air Bags - (High Level Vehicles)

Front Seats

Side airbags are not compatible with swivelling front seats.

Do not specify the base vehicle with side airbags when planning to retrofit a swivelling 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 Super Cab and Double 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.

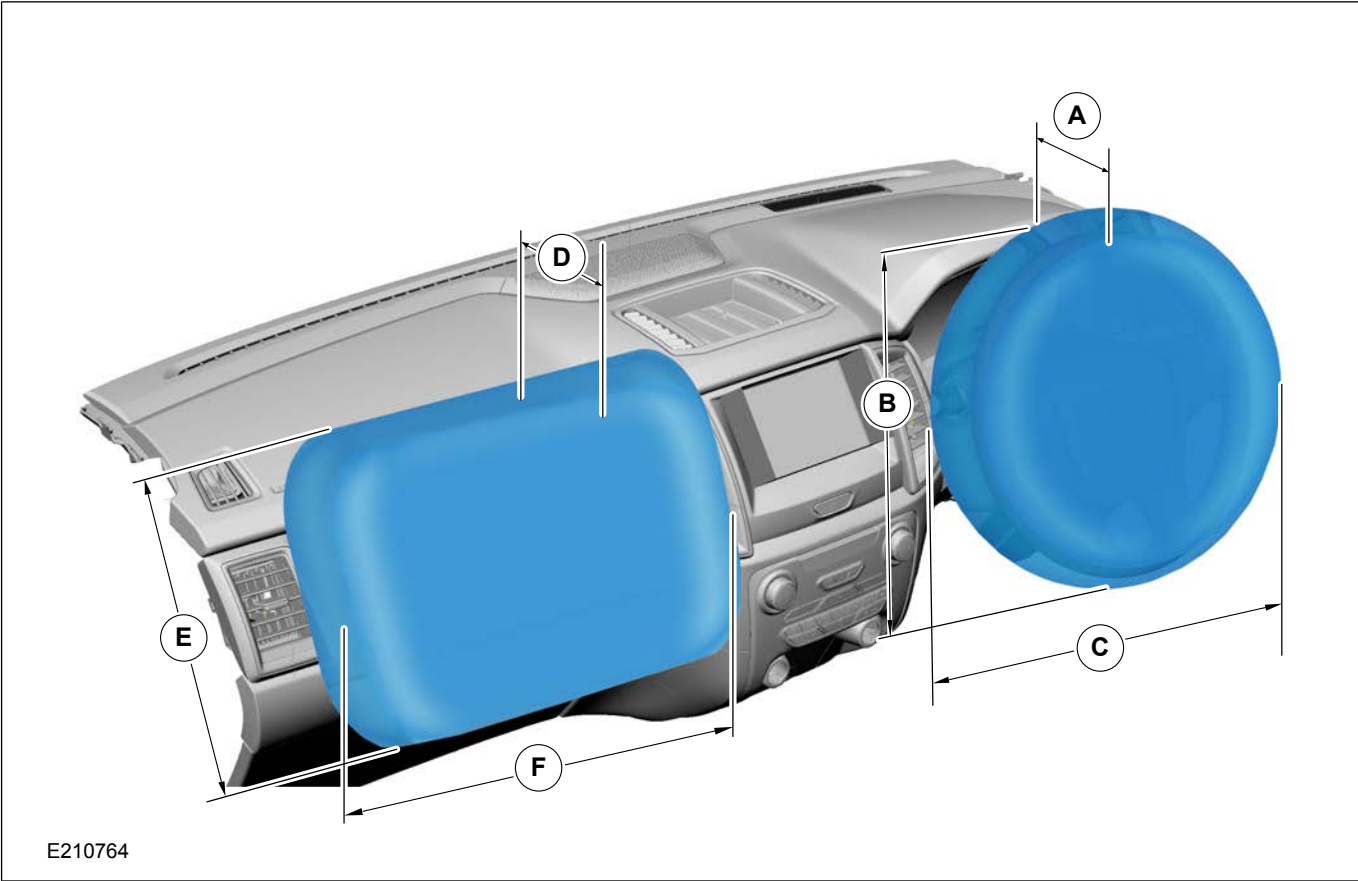


WARNING: Modifications or reinforcements in the area of the sensors may affect the side airbag fire timing and result in uncontrolled side air bag deployment.

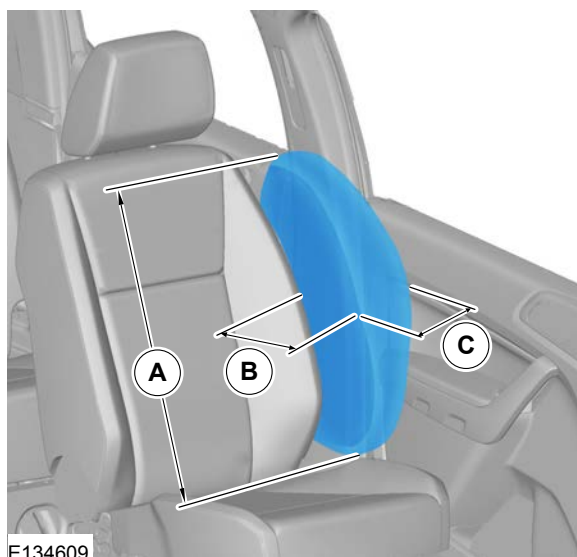
Please note that vehicles not equipped with side airbags but equipped with front airbags only are not affected.

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

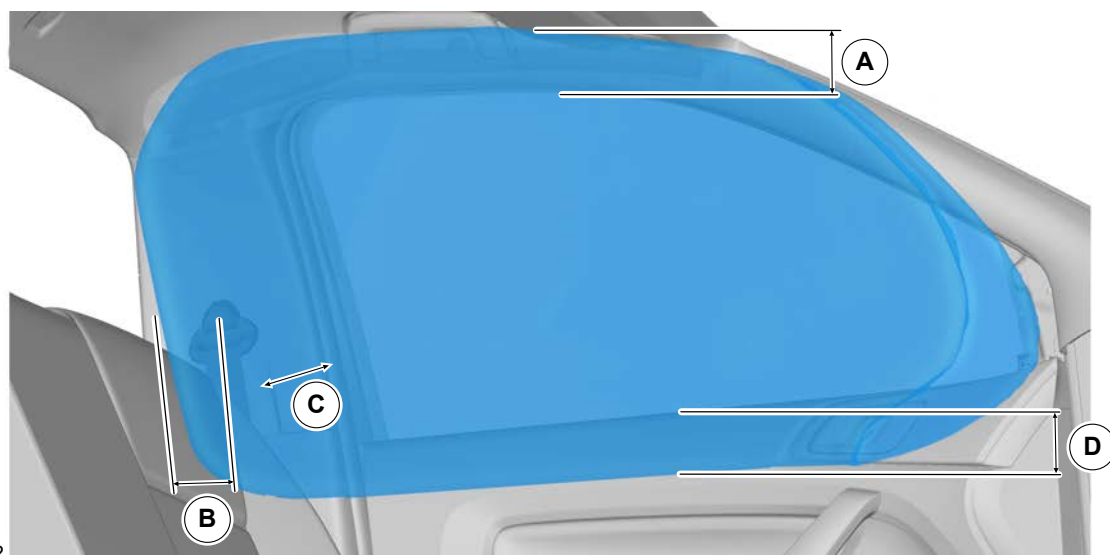
Driver and Passenger Front Airbag Deployment Zones



Dimensions (mm)			
A	260	D	392
B	470	E	520
C	470	F	544

Side Airbag**Dimensions (mm)**

A	550		
B	350		
C	250		

Curtain Airbag - Single cab**Dimensions (mm)**

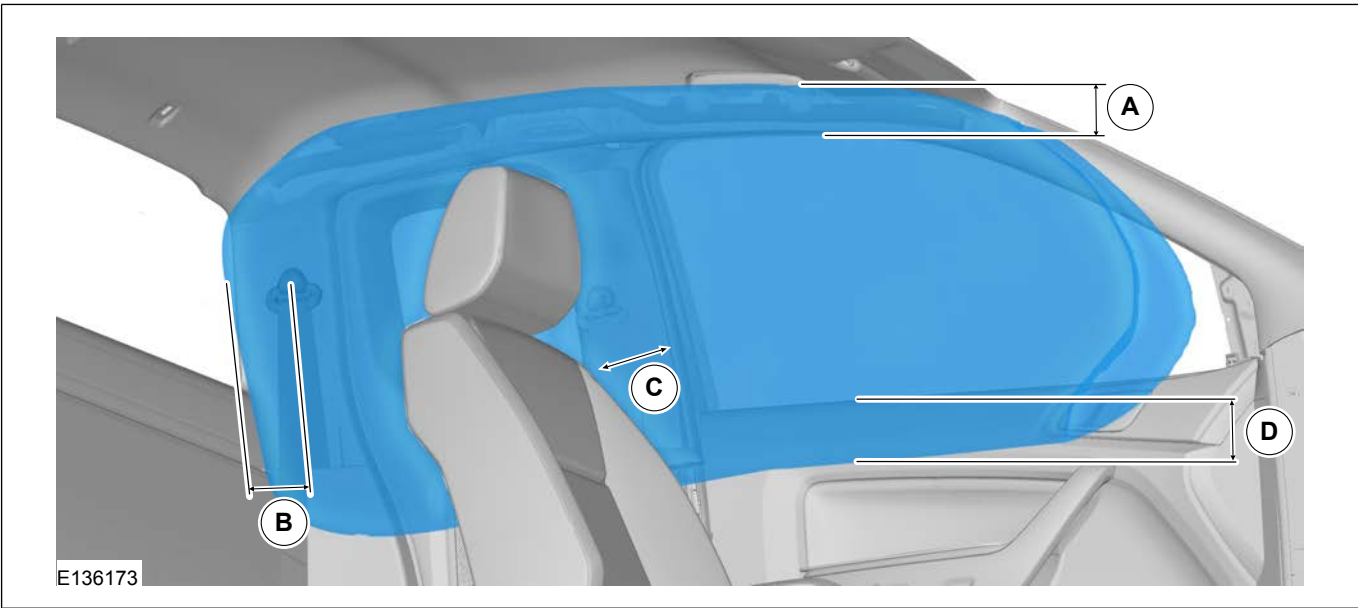
A	140	C	250
B	40	D	100

Curtain Airbag - Double cab



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

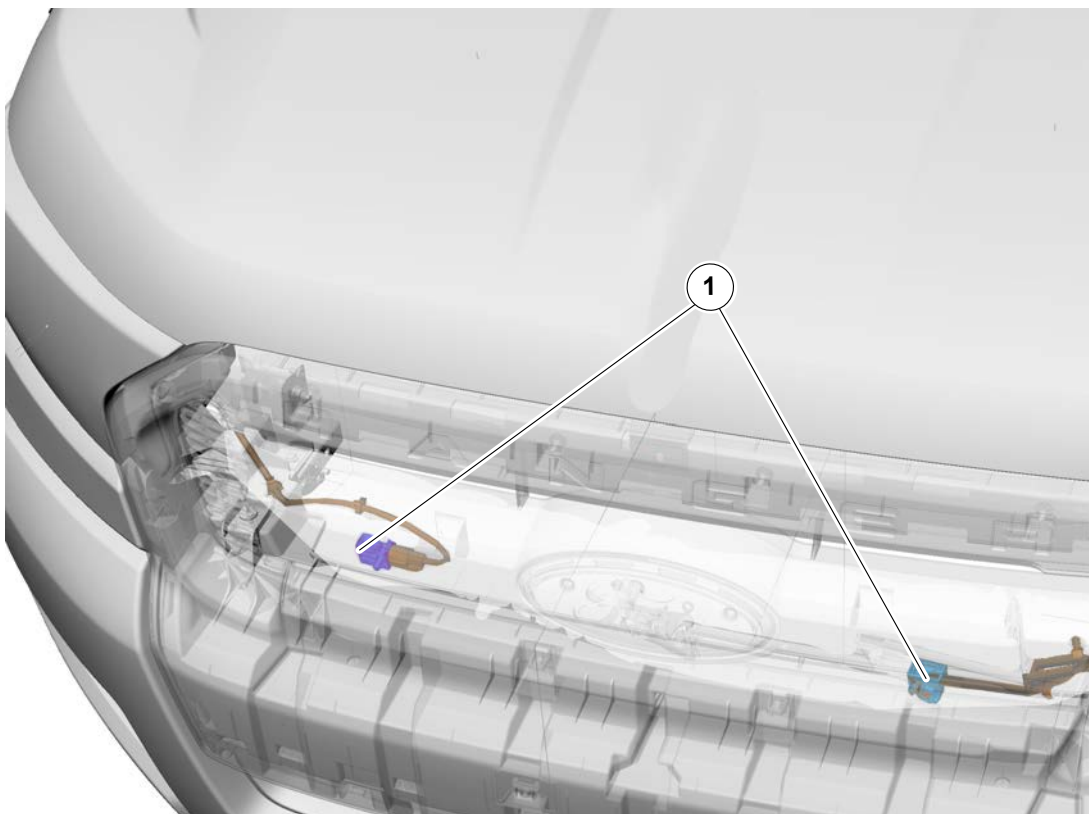
Curtain Airbag - Super cab



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

5.2.3 Supplementary Restraint Sensors (Front)

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



E210765

Item	Description
1	Front SRS Impact Sensors

5.3 Seatbelt Systems — Australia

 **WARNING: Follow the Ford approved removal and installation procedures for the seatbelt system to ensure correct function of the restraints system.**

The removal and reinstallation of the seatbelt, restrainer or any component of the seatbelt 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 seatbelt system as described in the workshop manual. Please consult your local National Sales Company representative for further information.

When removing the seatbelt system, a seatbelt 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

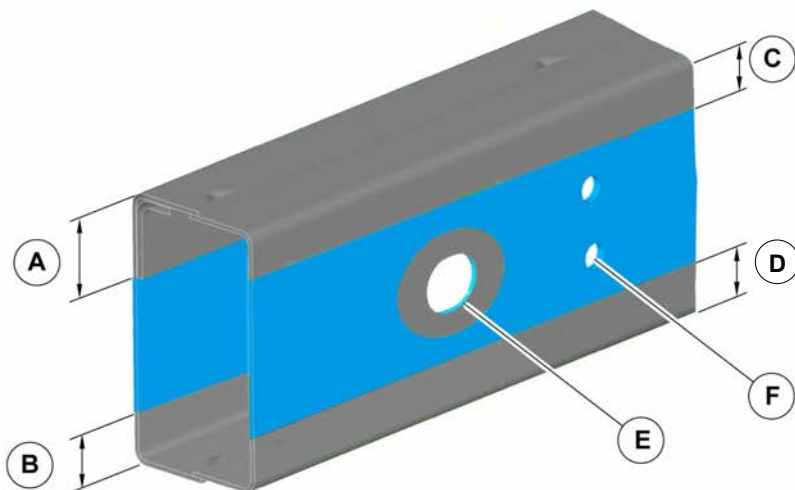
5.5.1 Mounting Points and Tubing

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 93).

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.

1. No Welding is allowed to the Vehicle Structure.

2. To make holes in frames do not use a gas flame. Drill holes using sharp drills.

3. Use cold riveting only when attaching brackets with rivets.

4. 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.

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.
6. Holes must NOT be drilled near side member profile changes.

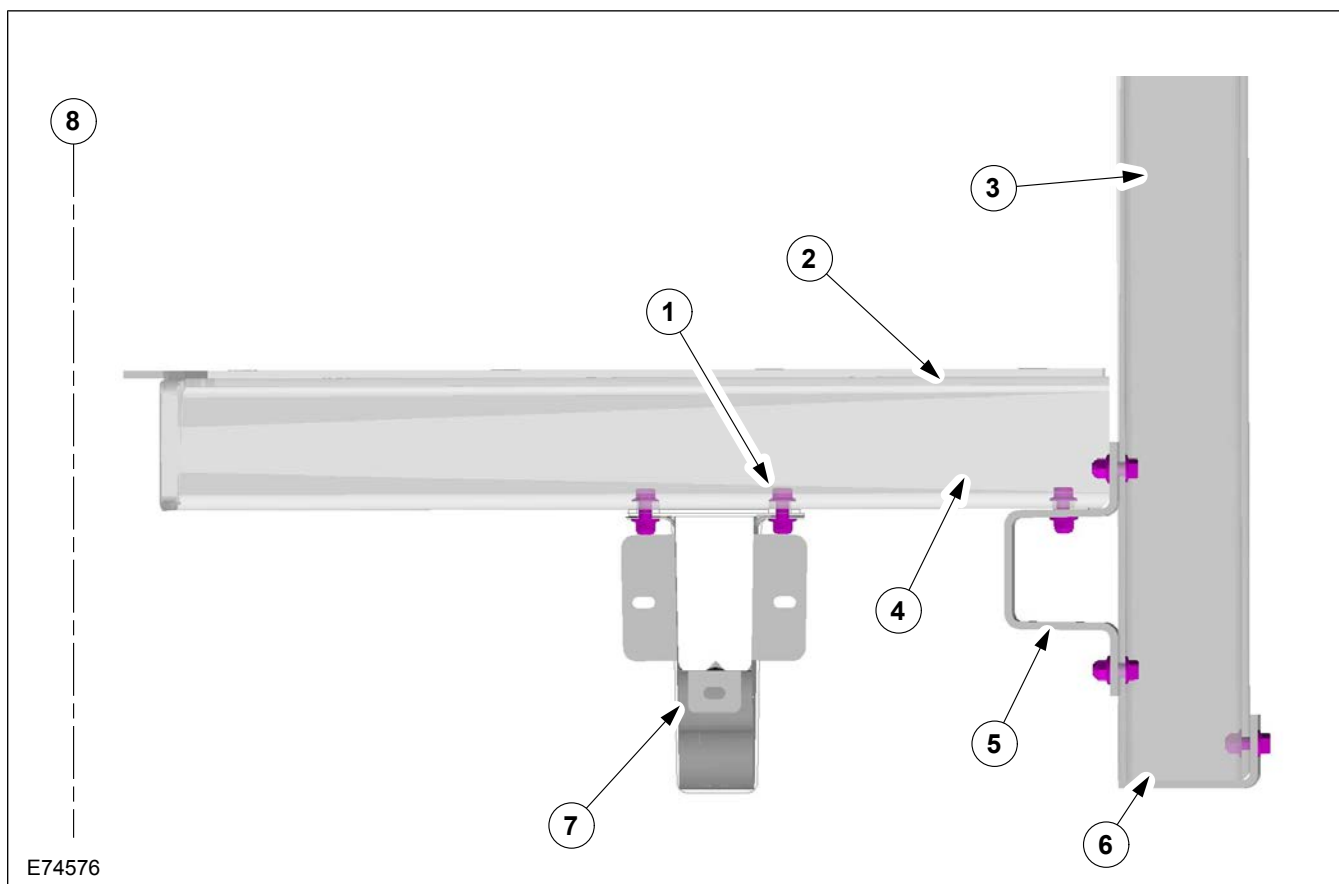
7. Existing holes in top and bottom flanges must NOT be bored out.

8. No more than two holes are to be drilled in a vertical line down from the frame web.

9. Corrosion protection is to be applied post drilling operations to the vehicle. Corrosion protection & protective coatings for all modifications should conform to all local regulatory standards.

10. Reinforcements should be added to the vehicle structure where appropriate, to avoid excessive load concentrations.

Typical Design Principle of a Self-Supporting Body Structure



E74576

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: Body \(page ?\).](#)

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 \(page 94\).](#)
- 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 \(page 93\).](#)

- 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 \(page 93\).](#)

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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