

2010

ESCAPE HYBRID

MARINER HYBRID

# MODIFIERS GUIDE



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# SECTION 0

## Introduction

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## Introduction

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Ford Motor Company has assembled this Escape/Mariner Hybrid Modifier Guide to assist vehicle modifiers in producing safe and quality products. Ford believes that safety and quality come first. To achieve customer satisfaction, we want to assist modifiers in achieving the highest standards of safety and quality in their products.

This book is divided into topics pertinent to modifiers of vehicles. Reference is made to the current Escape/Mariner Hybrid Workshop Manual for appropriate service procedures, torque specifications, component separation clearances and other standard information which is common with the unmodified vehicle. Specifications which are unique to the guide are designated.

This modifier guide is not a “how-to” book, it should be used as a checklist to help make sure that certain important steps in the modification process are considered. While Ford is providing this information to assist modifiers, it does not warrant the products, methods, materials or the workmanship of the modifier. Nor does it warrant against failures that result from the modification of a vehicle.

Following the guidelines contained in this guide does not assure individual modifiers that the products they modify comply with U.S. Federal or Canadian Motor Vehicle Safety Standards in effect at the time of the modification. The guidelines set forth are based on engineering analysis of typical vehicles. If followed, the modifier's efforts in certifying vehicles to applicable standards should be aided. Compliance testing that may be required for certification of specific vehicle configurations or construction is, however, the sole responsibility of the individual modifier.

### **Genuine Ford Accessories For Your Vehicle**

A wide selection of Genuine Ford Accessories are available for your vehicle through your local authorized Ford or Ford of Canada dealer. These quality accessories have been specifically engineered to fulfill your automotive needs; they are custom designed to complement the style and aerodynamic appearance of your vehicle. In addition, each accessory is made from high quality materials and meets or exceeds Ford's rigorous engineering and safety specifications. Ford Motor Company will repair or replace any properly dealer-installed Genuine Ford Accessory found to be defective in factory-supplied materials or workmanship during the warranty period, as well as any component damaged by the defective accessory. The accessory will be warranted for whichever provides you the greatest benefit:

- 12 months or 12,000 miles (20,000 km) (whichever occurs first), or
- the remainder of your new vehicle limited warranty.



## Introduction

This means that Genuine Ford Accessories purchased along with your new vehicle and installed by the dealer are covered for the full length of your New Vehicle's Limited Warranty — 3 years or 36,000 miles (60,000 km) (whichever occurs first). Contact your dealer for details and a copy of the warranty.

### Considerations When Using or Installing Accessories

For maximum vehicle performance, keep the following information in mind when adding accessories or equipment to your vehicle:

- When adding accessories, equipment, passengers and luggage to your vehicle, do not exceed the total weight capacity of the vehicle or of the front or rear axle (GVWR or GAWR as indicated on the Safety Compliance Certification label). Consult your dealer for specific weight information.
- The Federal Communications Commission (FCC) and Canadian Radio Telecommunications Commission (CRTC) regulate the use of mobile communications systems — such as 2-way radios, telephones and theft alarms that are equipped with radio transmitters. Any such equipment installed in your vehicle should comply with FCC or CRTC regulations and should be installed only by a qualified service technician.
- Mobile communications systems may harm the operation of your vehicle, particularly if they are not properly designed for automotive use.
- To avoid interference with other vehicle functions, such as anti-lock braking systems, amateur radio users who install radios and antennas onto their vehicle should not locate the Amateur Radio Antennas in the area of the driver's side hood.
- Electrical or electronic accessories or components that are added to the vehicle by the dealer or the owner may adversely affect battery performance and durability.

# SECTION 1

## General Information

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## General Information

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## Section 1: General Information

### Important Safety Notice

**Note:** The descriptions and specifications contained in this guide were in effect at the time this manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design without notice and without incurring obligation.

Appropriate repair methods and procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This manual provides general directions and guidelines for performing modifications to the Escape/Mariner Hybrid. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools and parts for modifying vehicles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

## Section 1: General Information

### Notes, Notices and Warnings

As you read through this guide, you will come across NOTES, NOTICES and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. NOTICES are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause you personal injury. The following list contains some general warnings that you should follow when you work on a vehicle.



#### **WARNING:**

- Before carrying out any vehicle modifications, the high-voltage traction battery (HVTB) must be depowered. Failure to follow these instructions may result in severe personal injury or death.
- The nominal HVTB voltage is 330 volts DC. A buffer zone must be set up and high-voltage insulated safety gloves and a face shield must be worn when modifying the vehicle in close proximity to the high-voltage system. Failure to follow these instructions may result in severe injury or death.
- The HVTB and charging system contain high-voltage components and wiring. High-voltage cables and wiring are orange in color. High-voltage insulated safety gloves and a face shield must be worn when modifying the vehicle in close proximity to the high-voltage system. Failure to follow these instructions may result in severe personal injury or death.
- The high-voltage insulated safety rubber insulating gloves that are to be worn when modifying the vehicle in close proximity to the high-voltage system should be of the appropriate safety and protection rating for use on the high-voltage system. They must be inspected before use and must always be worn in conjunction with the leather outer gloves. Any hole in the rubber insulating glove is a potential entry point for high voltage. Failure to follow these instructions may result in severe personal injury or death.
- Exposure to high voltage may result in severe personal injury or death. High-voltage components must be serviced by a trained service technician.
- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Make sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. The gear selector should be set in PARK unless instructed otherwise for a specific operation. Place wood blocks (4 inch x 4 inch or larger) against the front and rear surfaces of the tires to help prevent the vehicle from moving.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide poisoning.

## Section 1: General Information

- Keep yourself and your clothing away from moving parts when the engine is running, especially the drive belts.
- To reduce the risk of serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tailpipe, catalytic converter and muffler.
- Do not smoke while working on a vehicle.
- To reduce the risk of injury, always remove rings, watches, loose hanging jewelry and loose clothing before beginning to work on a vehicle.
- When it is necessary to work under the hood, keep hands and other objects clear of the radiator fan blades.
- Failure to follow these instructions may result in personal injury.

### **NOTICE:**

- Do not disable the A/C system. The high voltage traction battery (HVTB) cooling system uses the cabin air to cool the HVTB.
- Before placing the vehicle in a paint booth, make sure that the high-voltage traction battery (HVTB) is not installed in the vehicle. High paint booth temperatures may damage the HVTB.
- Place the service disconnect plug into the **SERVICING SHIPPING** position while carrying out any vehicle modifications. If the service disconnect plug is left out and placed on the bench or toolbox, dirt or other contaminants may enter the HVTB, which can cause damage.

### **Making Safety Devices and Elements Inoperative**

The vehicle contains many safety features required by Federal or Canadian Motor Vehicle Safety Standards. These features, which include the key-in-ignition chime and brake lights, should never be disabled or modified.

CFR 49 Section 30122 states that “A manufacturer, distributor, dealer or motor vehicle repair business may not knowingly make inoperative any part of a device or element of design installed on or in a motor vehicle or motor vehicle equipment in compliance with an applicable motor vehicle safety standard prescribed under this chapter unless the manufacturer, distributor, dealer or repair business reasonably believes the vehicle or equipment will not be used (except for testing or a similar purpose during maintenance or repair) when the device or element is inoperative.”

### **Good Practices**

#### **Process and Quality Assurance Systems**

A formalized Process and Quality Assurance Systems check may be helpful in consistently producing high quality products. An overview of some of the key items for such a system are outlined in this section.

## Section 1: General Information

### Quality Assurance

Completed unit sign-off: All control items should be inspected with a written sign-off. All labels should be inspected and signed off, including verification that the information on the labels is correct. All appropriate systems should be checked for leaks. A road test should be performed to verify that all systems are operating correctly. All systems and functions that were provided by Ford should be checked to make sure that they function correctly after the build process.


The modifier's Process and Quality Assurance Systems should also make sure that appropriate training is provided to the employees.


### Minimum and Maximum Screw Sizes

When installing aftermarket equipment, avoid using fasteners that are too long for the application or are in an area which might damage vehicle components, including wiring, brake lines, fuel tank and lines, powertrain components, exhaust system and suspension.

### Tires and Loading

#### Tire Replacement Requirements

 **WARNING:** Only use replacement tires and wheels that are the same size and type (such as P-metric versus LT-metric or all-season versus all-terrain) as those originally provided by Ford. Use of any tire or wheel not recommended by Ford can affect the safety and performance of your vehicle, which could result in an increased risk of loss of vehicle control, vehicle rollover, personal injury and death. Additionally the use of non-recommended tires and wheels could cause steering, suspension, axle or transfer case/power transfer unit failure. If you have questions regarding tire replacement, see an authorized Ford or Lincoln Mercury dealer.

 **WARNING:** Do not install an offroad, aggressive tread or incorrectly sized tire. Any of these may cause elevated stress to the steering system. This can cause the power steering system to overheat and shut off the power assist, which can affect the safety and performance of your vehicle.

Note: The Escape/Mariner Hybrid vehicle is equipped with a reduced rolling resistance tire design. The use of a different tire can effect the fuel economy of your vehicle.

Make sure all tires and wheels on the vehicle are of the same size, type, tread design, brand, load-carrying capacity and speed rating because it can affect the safety and performance of your vehicle, which could result in an increased risk of loss of vehicle control, vehicle rollover, personal injury and death.

## Section 1: General Information

### Using Snow Tires and Traction Devices

Note: Snow tires must be the same size and grade as originally equipped on your vehicle.


The tires on your vehicle have all-weather treads to provide traction in rain and snow. However, in some climates, using snow tires or traction devices may be necessary.

Follow these guidelines when using snow tires and traction devices:

- SAE Class “S” cables should ONLY be used on the front axle tires.
- Install cables or chains securely, verifying that the cables or chains do not touch any wiring, brake lines or fuel lines.
- Drive cautiously. If you hear the cables or chains rub or bang against the vehicle, stop and retighten them. If this does not work, remove the cables or chains to prevent vehicle damage.
- Avoid overloading your vehicle.
- Remove the cables or chains when they are no longer needed.
- Do not use cables or chains on dry roads.
- Do not exceed 48 km/h (30 mph) with tire cables or chains on your vehicle.

Consult your dealer for information on other Ford approved methods of traction control.

### Vehicle Loading

 **WARNING:** The appropriate loading capacity of your vehicle can be limited either by volume capacity (how much space is available) or by payload capacity (how much weight the vehicle should carry). Once you have reached the maximum payload of your vehicle, do not add more cargo, even if there is space available. Overloading or improperly loading your vehicle can contribute to loss of vehicle control and vehicle rollover.


 **WARNING:** Exceeding the Safety Compliance Certification Label axle and/or vehicle weight rating limits could result in substandard vehicle handling or performance, engine, transmission and/or structural damage, serious damage to the vehicle, loss of control and personal injury.

Gross Vehicle Weight Rating (GVWR) — is the maximum allowable weight of the fully loaded vehicle (including all options, equipment, passengers and cargo). The GVWR is shown on the Safety Compliance Certification Label located on the B-pillar or the edge of the driver's door.



## Section 1: General Information

Gross Axle Weight Rating (GAWR) — is the maximum allowable weight that can be carried by a single axle (front or rear). These numbers are shown on the Safety Compliance Certification Label located on the B-pillar or the edge of the driver's door. The total load on each axle must never exceed its GAWR.

 **WARNING: Do not use replacement tires with lower load carrying capacities than the original tires because they may lower the vehicle's Gross Vehicle Weight Rating (GVWR) and Gross Axle Weight Rating (GAWR) limitations. Replacement tires with a higher limit than the originals do not increase the GVWR and GAWR limitations.**

Steps for determining the correct load limit:

- Locate the statement “The combined weight of occupants and cargo should never exceed XXX kg or XXX lb” on your vehicle's placard.
- Determine the combined weight of the driver and passengers that will be riding in your vehicle.
- Subtract the combined weight of the driver and passengers from XXX kg or XXX lb.
- The resulting figure equals the available amount of cargo and luggage load capacity. For example, if the “XXX” amount equals 1,400 lb and there will be five 150 lb passengers in your vehicle, the amount of available cargo and luggage load capacity is 650 lb (1400 - 750 (5 x 150) = 650 lb). In metric units (635 - 340 (5 x 68) = 295 kg).
- Determine the combined weight of luggage and cargo being loaded on the vehicle. That weight may not safely exceed the available cargo and luggage load capacity calculated in the step above.

### Vehicle Storage

#### Vehicle Storage — General

- Vehicles should be stored in a dry, ventilated place and protected from sunlight, if possible.
- If vehicles are stored outside, maintenance against rust and damage, as described below, is recommended.

**NOTICE: Keep all rubber parts free from oil and solvents.**

#### Vehicle Storage — Electrical

Note: Extended storage times which result in the discharge of the low- or high-voltage batteries may result in the setting of DTCs and/or a no start condition.

Your vehicle must be started and run for a minimum of 10 minutes once a month in order to maintain the high-voltage battery charge. This will maintain the high-voltage battery but it is not enough to maintain the low-voltage (underhood) battery and additional low-voltage (underhood) battery charging may be required after 60 days.

## Section 1: General Information

If your vehicle is to be stored for 30 days or longer, the low-voltage (underhood) battery negative terminal must be disconnected. Failure to do this could damage your vehicle's battery systems.

### Vehicle Storage — Body

- Wash vehicle thoroughly to remove dirt, grease, oil, tar or mud from exterior surfaces and underside of front fender.
- Periodically wash vehicles stored in exposed locations.
- Touch up exposed raw or primed metal to provide rust protection.
- Cover chrome and stainless steel parts with a thick coat of auto wax to prevent discoloration. Rewax as necessary when the vehicle is washed.
- Lubricate all hood, door hinges and latches with a light grade oil.
- Cover the interior soft trim to prevent fading.

### Vehicle Storage — Engine

- Start the engine every month. Run it at fast idle until it reaches normal operating temperature.
- With foot on brake pedal (and brake applied), shift the transmission into all gears while the engine is running.

### Vehicle Storage — Fuel System

- Regularly move vehicles short distances to mix fuel anti-oxidation agents.

**Note:** During extended periods of vehicle storage (60 days or more), gasoline may deteriorate due to oxidation. This can damage rubber and other polymers in the fuel system and may clog small orifices. A commercially available gasoline fuel stabilizer (Sta-Bil® or equivalent) should be added to gasoline-powered vehicles whenever actual or expected storage periods exceed 60 days. The manufacturer's instructions packaged with the product should be followed. The vehicle should then be operated at an idle speed to circulate the additive throughout the fuel system.

### Vehicle Storage — Tires

Most high performance tires are made with nylon overlay.

As such, the following steps should be taken to avoid flat spotting when the vehicles are not used for a period of time.

- Store the vehicles with 303 kPa (44 psi) in the tires. If the cars are to be driven, the air pressure should be reduced to recommended operating pressure and then increased back up to 303 kPa (44 psi) when returned to storage.
- If the vehicle is stored for periods longer than 30 days, it should be moved several feet at least once during each 30-day period, so that a different portion of the tread contacts the ground.

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# Electrical

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## Section 2: Electrical

### Electrical Basics

Inside a vehicle, electricity is supplied through “hot” wires, comparable to the pressurized supply pipes of a plumbing system. At various points along the wires are outlets in the form of lights, switches and receptacles. Turning on a light switch is somewhat like opening a faucet to let water run, an electric current flows through the hot wire to make the light glow. Once the electricity has done its work, its potential drops to zero, just as water loses pressure after flowing through a sink or laundry tub. The electrical system has “drains”, which are the ground wires that return the current to its source, just as a plumbing system has drain pipes through which water runs into the sewer mains or the ground.

The light or equipment powered by the current, technically called the load, can be compared to a water wheel that remains motionless until a stream of water causes it to turn. A load may be one of 2 kinds. The first consists of a resistance, a material that permits the passage of electric current, but only with difficulty and thereby creates heat. The tungsten filament of an incandescent bulb is resistance; so is the heating element of an electric heater or a coffee pot. A load may also be an inductance, typically a motor with windings of copper wire, in which the magnetic fields generated by the current create motion. At any moment, the demand on an electrical system depends on the number of loads in operation and their consumption of energy, just as demand on a water system depends on how many faucets are opened and how wide they are opened.

The mechanics and physical fittings of the system are simple. Current moves throughout the vehicle in wires of different sizes, according to the current a circuit may have to carry. Power is supplied directly to equipment through connectors.

### Electrical Terms

**VOLT** is the unit of electrical potential, equal to the difference of electrical potential between 2 points on a circuit.

**AMPERE** is the unit used to measure the amount of current, that is, the number of electrically charged particles called electrons, that flows past a given point on a circuit each second. It is similar to measuring the amount of water flowing through a pipe at any given point. The larger the pipe is, the more water that can flow past the point per second. Similarly, the bigger the wire is, the more current that can flow through it at any given point. Current that has lost its voltage still has amperage as it completes the circuit and returns to the battery.

**WATT** is the unit of power. It indicates that rate at which a device converts electric current to another form of energy, either heat or motion, or to put it another way, the rate at which a device consumes energy.

The relationship of volts, amperes and watts to one another is expressed in a simple equation that enables you to make any calculations you may need for proper and safe electrical modifications to the vehicle. Volts x amperes = watts. If the current is at 12 volts and a device requires 4 amperes of current, the equation will read 12 volts x 4 amperes = 48 watts.

To figure the current needed for a device rated in watts, turn the equation around: Watts/volts = amperes. For example, if you have a piece of equipment, such as a communications radio, that uses 120 watts: 120 watts/12 volts = 10 amperes.

## Section 2: Electrical

### Control Modules — Red Area

Do not install any components into the control modules or module harness. Connecting into this system may affect control module operation. As an example: connection of aftermarket electrical equipment into the brake light circuit or any other circuit which is connected to the PCM, anti-lock brake computer, air bag system or any other vehicle system will cause vehicle malfunction.

### Controller Area Network (CAN) Bus

**NOTICE:** Wiring faults in the controller area network (CAN) bus may shut down the vehicle and prevent further operation.

Do not splice or connect any equipment to the controller area network (CAN) bus wiring.

### General Electrical Considerations

#### Communication Equipment

Mobile communication systems may harm the operation of the vehicle, particularly if they are not properly designed for automotive use or are not properly installed. For example, when operated, such systems may cause the engine to stumble or stall. Citizen band (CB) transceivers, garage door openers and other transmitters whose power output is 5 watts or less will not ordinarily affect the operation of the vehicle.

#### Vehicle Speed Signal

The vehicle speed signal is sent from the PCM to other vehicle modules through the CAN bus. There is no specific wire or circuit that carries the vehicle speed signal pulses.

#### Disabling Brake Lights

Do not disable the brake light circuits for any reason.

#### Disabling the A/C System

Do not disable the A/C system. The cabin air is used to cool the high voltage traction battery (HVTB).

#### High- and Low-Voltage Systems

**NOTICE:** Do not splice the high-voltage system. Voltage in the system is in the range of 216 to 397 volts. Damage may occur to equipment added to the system.

## Section 2: Electrical

The high-voltage system has a floating ground. When the engine is operating or the vehicle is moving, the high-voltage generator begins to generate high voltage, AC electricity. High-voltage AC electricity can be consumed or generated by the motor generator, the traction motor or a combination of both motors. Excess high-voltage current is converted from high-voltage AC to high-voltage DC electrical power inside the motor generator unit and transmitted through the high-voltage cables. The high-voltage DC electrical power is converted to low-voltage DC electrical power through the DC/DC converter. This low-voltage DC electrical power is then supplied to the 12-volt battery through the low-voltage battery cables.

### 12-Volt Battery

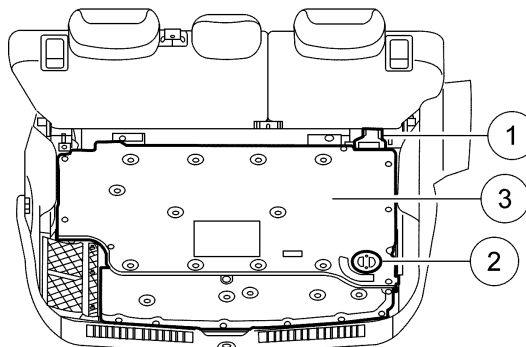
The 12-volt battery is a standard automotive battery. It is a DC source connected in a negative ground system. The battery case is sealed, with 2 vent holes to release gases. The battery has 3 major functions:

- Storage of electricity for later use
- Voltage stabilizer for the electrical system
- Temporary power source when electrical loads exceed the DC/DC converter output current

### High-Voltage Traction Battery (HVTB)

**NOTICE:** Do not splice the high-voltage wiring. Voltage in the system is in the range of 216 to 397 volts. Damage may occur to equipment added to the system.

The high-voltage traction battery (HVTB) is a 216-397 volt DC source connected in a floating ground system. The battery receives, stores and delivers high-voltage electrical power when required. It contains the traction battery control module (TBCM), which controls the higher functions of the battery. The TBCM also estimates the state of charge, estimates the power available, estimates the power it can absorb and controls the battery temperature. The TBCM controls the battery temperature by activating or deactivating the fans contained within the HVTB.



N0052770

Figure 1.



## Section 2: Electrical

1. High-voltage connector shield
2. Service disconnect
3. High-voltage battery case

### DC/DC Converter

The DC/DC converter is a liquid-cooled component that converts high-voltage (216-397 volts) DC power to low-voltage (12 volts) DC power while maintaining electrical isolation between the 2 DC power systems. The converter steps down the high voltage to 12 volts, providing power to the vehicle low-voltage battery systems. The PCM controls the operation of the DC/DC converter through an enable input from the PCM to the DC/DC converter.

### DC/AC Inverter and AC Power Point

**Note:** Do not keep electrical devices plugged in the power point whenever the device is not in use. It is not recommended to use any extension cord with the 110 VAC power point, since it will defeat the safety protection design provided by the cap and twist tab. It will also cause the power point to overload due to powering multiple devices that can reach beyond the 150 watt load limit.

The DC/AC inverter converts 12-volt DC to 110-volt AC to power a device that uses AC current with a rating of less than 150 watts. The power point will automatically shut off if the load exceeds 150 watts. This prevents damage to the inverter or load. The inverter supplies 110-volt AC power only when the key is in the ON/START position. This reduces the draw on the 12-volt system when the vehicle is not running. The DC/AC inverter outlet (AC power point) is equipped with a green LED that indicates the system integrity. The green LED illuminates continuously when the key is in the ON/START position and the system is operating normally. The green LED flashes constantly if the key is in the ON/START position and a fault is detected. Short circuits, overloads or overheating of the inverter will cause the green LED to flash and the power to be cut off to the outlet. If the LED is flashing, the problem must be corrected (that is, short circuit or excessive load). If the inverter is overheated, it must be allowed time to cool off (without the load connected).

The power outlet is not designed for the following electric appliances; they may not work properly:

- Cathode ray tube-type televisions
- Motor loads, such as vacuum cleaners, electric saws and other electric power tools, compressor-driven refrigerators
- Measuring devices, which process precise data, such as medical equipment, measuring equipment
- Other appliances requiring an extremely stable power supply: microcomputer-controlled electric blankets, touch sensor lamps

## Section 2: Electrical

### Auxiliary Power Point — 12V


**NOTICE:** Power outlets are designed for accessory plugs only. Do not insert any other object in the power outlet as this will damage the outlet and blow the fuse. Do not hang any type of accessory or accessory bracket from the plug. Improper use of the power outlet can cause damage not covered by your warranty.


Note: Do not use the power point for operating the cigarette lighter element (if equipped).

To prevent the fuse from being blown, do not use the power point(s) over the vehicle capacity of 12-VDC/180W.


To prevent the battery from being discharged, do not use the power point longer than necessary when the engine is not running.

### Buffer Zone

 **WARNING:** The nominal high-voltage traction battery (HVTB) voltage is 330 volt DC. A buffer zone must be set up and high-voltage insulated safety gloves and a face shield must be worn when modifying the vehicle in close proximity to the high-voltage system. Failure to follow these instructions may result in severe injury or death.

 **WARNING:** The high-voltage traction battery (HVTB) and charging system contains high-voltage components and wiring. High-voltage cables and wiring are orange in color. High-voltage insulated safety gloves and a face shield must be worn when carrying out any modifications on this vehicle. Failure to follow these instructions may result in severe personal injury or death.

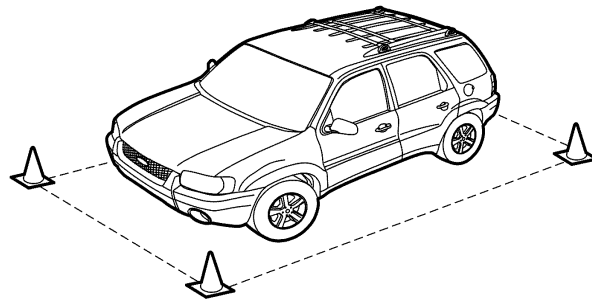
 **WARNING:** Before carrying out any vehicle modifications, the high-voltage traction battery (HVTB) must be depowered. Failure to follow these instructions may result in severe personal injury or death.

 **WARNING:** The high-voltage insulated safety rubber insulating gloves that are to be worn while working on the high-voltage system should be of the appropriate safety and protection rating for use on the high-voltage system. They must be inspected before use and must always be worn in conjunction with the leather outer gloves. Any hole in the rubber insulating glove is a potential entry point for high voltage. Failure to follow these instructions may result in severe personal injury or death.

1. Position the vehicle in the repair bay.

## Section 2: Electrical

2. Position 4 orange cones around the corners of the vehicle to mark off a 1 m (3 ft) perimeter around the vehicle.



3. Do not allow any unauthorized personnel into the buffer zone during repairs involving the high-voltage system. Only personnel trained for repair on the high-voltage system are to be permitted in the buffer zone.

### Rubber Insulating Gloves Testing


**⚠ WARNING:** The high-voltage insulated safety rubber insulating gloves that are to be worn when modifying the vehicle in close proximity to the high-voltage system, should be of the appropriate safety and protection rating for use on the high-voltage system. They must be inspected before use and must always be worn in conjunction with the leather outer gloves. Any hole in the rubber insulating glove is a potential entry point for high voltage. Failure to follow these instructions may result in severe personal injury or death.


Note: The high-voltage insulated safety gloves must be re-certified every 6 months to remain within OSHA guidelines.

1. Roll the glove up from the open end until the lower portion of the glove begins to balloon from the resulting air pressure. If the glove leaks any air, it must not be used.
2. The gloves should not be used if they show any signs of wear and tear.
3. The leather gloves must always be worn over the rubber insulating gloves in order to protect them.
4. The rubber insulating gloves must be class “00” and meet all of the American Society for Testing and Materials (ASTM) standards.


## Section 2: Electrical

### High-Voltage Traction Battery (HVTB) Systems Depowering

 **WARNING:** The nominal high-voltage traction battery (HVTB) voltage is 330 volt DC. A buffer zone must be set up and high-voltage insulated safety gloves and a face shield must be worn when modifying the vehicle in close proximity to the high-voltage system. Failure to follow these instructions may result in severe injury or death.

 **WARNING:** The high-voltage traction battery (HVTB) and charging system contains high-voltage components and wiring. High-voltage cables and wiring are orange in color. High-voltage insulated safety gloves and a face shield must be worn when modifying the vehicle in close proximity to the high-voltage system. Failure to follow these instructions may result in severe personal injury or death.

 **WARNING:** Before carrying out any vehicle modifications, the high-voltage traction battery (HVTB) must be depowered. Failure to follow these instructions may result in severe personal injury or death.

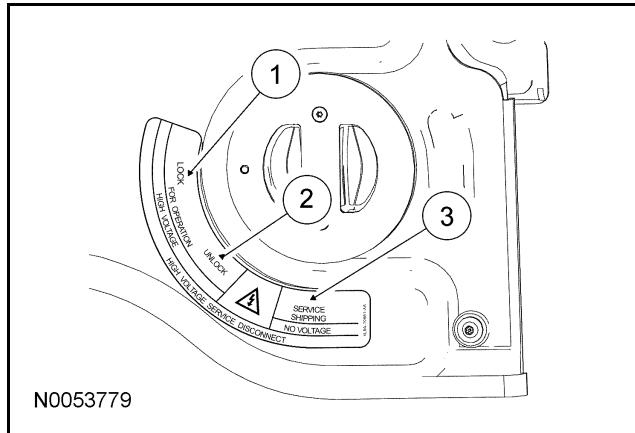
 **WARNING:** The high-voltage insulated safety rubber insulating gloves that are to be worn when modifying the vehicle in close proximity to the high-voltage system, should be of the appropriate safety and protection rating for use on the high-voltage system. They must be inspected before use and must always be worn in conjunction with the leather outer gloves. Any hole in the rubber insulating glove is a potential entry point for high voltage. Failure to follow these instructions may result in severe personal injury or death.

 **WARNING:** A buffer zone is required when modifying the vehicle in close proximity to the high voltage system. Failure to follow this instruction may result in severe personal injury or death.

1. Set up the buffer zone around the vehicle. For additional information, refer to Buffer Zone in this section.
2. Turn the ignition to the OFF position.
3. Disconnect the 12-volt battery.

## Section 2: Electrical

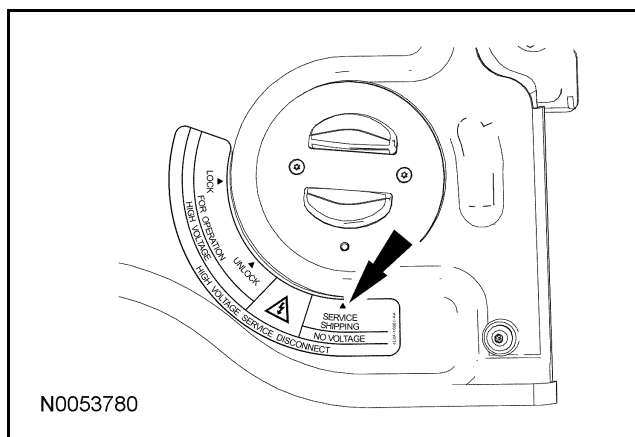
4. Remove the service disconnect plug.



- Rotate the service disconnect plug from the LOCK (1) position to the UNLOCK (2) position.
- Remove the service disconnect plug and place in the SERVICE SHIPPING (3) position.

5. **NOTICE:** Place the service disconnect plug into the **SERVICE SHIPPING** position while carrying out any vehicle modifications. If the service disconnect plug is left out and placed on the bench or toolbox, dirt or other contaminants may enter the high voltage traction battery (HVTB), which can cause damage.

Insert the service disconnect plug into the SERVICE SHIPPING position. This disconnects the HVTB.



6. To connect, reverse the disconnect procedure.

## Section 2: Electrical

### Electrical Systems Management

Care must be given in deciding what equipment should be installed into a vehicle given the power demands of the equipment and the power available from the vehicle. A power load strategy should be developed to minimize the risk of running out of power. Examine the proposed equipment for vehicle installation. Add up the current requirements. If the current requirements exceed what the vehicle can reasonably be expected to be able to provide, the battery will begin discharging to provide the power to the equipment that the generator is unable to provide. After some period of time, the vehicle will shut off as the battery voltage decreases to a level that cannot sustain vehicle operation.

There are alternatives that can be considered to minimize system electrical overload. Consider the current requirements of equipment before it is purchased and installed. Modern light bars and radios use a fraction of the current than units made as recently as 1996. As the light bar is the most power intensive unit installed on most vehicles, considerable attention should be given to its current requirements. Changes in driver habits can make a difference as well. When a vehicle is sitting and no one is in the car, the air conditioner can be turned off until the driver is ready to get back into the vehicle. The air conditioner is among the largest current user of OEM equipment. As such, it can impact available power for other uses as well.

### Generator Output

The Escape/Mariner Hybrid generator is different from that used on the standard Escape/Mariner. The Escape/Mariner Hybrid has a 110-amp generator.

### Vehicle Component Electrical Loads

Vehicle component electrical loads are shown in the table below. Not all features are powered all the time, so actual vehicle loads on the power supply system will vary.

Note: Smart junction box (SJB) fuse 1 (30A), circuit SBP04 (GN/RD) for the DC/AC power inverter is at maximum available current limit when the power inverter is installed and used. Do not splice into this fused circuit when the DC/AC power inverter is installed and used.

Note: SJB fuse 18 (20A), circuit SBP18 (YE/RD) for the heated seats is at maximum available current limit when the heated seats option is installed and used. Do not splice into this fused circuit when the heated seats option is installed and used.

Note: If the heated seat connectors are disconnected, DTCs will set in the electronic automatic temperature control (EATC) module.

Component	Amps
<b>Base</b>	
Miscellaneous Base Loads	36.1
<b>Cooling</b>	
Cooling Fan (variable speed)	24.0
<b>Climate Control</b>	

(Continued)

## Section 2: Electrical

Component	Amps
A/C Clutch	3.7
A/C Fan to Face — High Speed (recirculating air)	21.7
A/C Fan to Face — M/H Speed (recirculating air)	11.9
Heater Fan to Foot — M/H Speed (fresh air)	10.7
<b>Lighting</b>	
Exterior and IP Lamps (non-dimmable)	4.5
Headlamps — Low Beam	10.0
Fog Lamps	8.0
Brake Lights (with CHMSL)	7.5
<b>Heated Features</b>	
Heated Rear Window (includes heated mirrors)	14.0
Heated Front Seat — LH	6.5
Heated Front Seat — RH	6.5
<b>Other</b>	
Radio	1.9
DC/AC Inverter	10.7
Speed Control	1.8
<b>Typical Vehicle Load = 95-110 Amps</b>	

### Typical Police/Taxi Equipment

Loads for equipment commonly found on police vehicles are shown in the table below. Not all equipment will be operating at the same time, so actual loads on the power supply system will vary.

Component	Amps
Communications Radio	5.0-20.0
Light Bar	28.0-43.0
LED Light Bar	6.0
Siren	15.0-30.0
Headlamp Flasher	1.0-1.5
LED Deck Bars/Led Visor Lights	2.0
Radar	0.8
Taximeter	3.3
Receipt Printer	3.0
Spot Lights (each)	7.8
Alley Lights (each)	1.0
Camcorder	2.0

## Section 2: Electrical

### General Guidelines

- Provide circuit protection (fuses) for all wiring. The fuse rating should not exceed either the rated wiring current capacity or the total current requirements for all the add-on components on the circuit. Install fuses as close to the point of tapped power as possible.
- Document all revisions to the electrical system and place with the vehicle Owner's Literature. Color code and/or label all revisions or additions to wiring.
- Provide protective covering in all areas that could be damaged during normal equipment installations.
- Disconnect the negative battery cable of vehicles stored on site to reduce the possibility of draining the battery by lights or other equipment.
- Do not allow control panels attached to the instrument panel to protrude into the driver and passenger air bag deployment zones. For additional information, refer to Section 4: Reference in this guide.
- Do not install switches and gauges in the driver or passenger knee impact areas.
- Inspect all Ford gauges, lights and switches for correct operation after instrument panel work is performed.
- Properly secure all wiring relocated or removed while working behind the instrument panel to prevent chafing, squeaks and rattles.
- Provide adequate retention for wiring harnesses so that they are clear of bolts, corners or edges which could abrade the wires during normal vehicle operation.
- Anticipate misrouted wiring situations and protect all wiring from penetration by screws and raw edges.
- Weather-seal all electrical connectors exposed to the elements.
- Do not use quick splice connectors or wire nuts.
- Install the fuse panel so fuses are readily accessible.
- Make sure that connections are easily accessible for assembly and service.
- Make sure submersible connectors do not lose their seals under extreme assembly conditions such as bending wires 90 degrees immediately after the connector.
- Whenever using connectors, use a socket (female) connector on the electrical source side and a plug (male) connector on the electrical load side to reduce the possibility of a short circuit when disconnected.
- Air bag restraint systems must remain intact as received from Ford Motor Company. Before modifications are done to the vehicle, the system must be disarmed by following the instructions provided in the current Escape/Mariner Hybrid Workshop Manual.
- Adherence to the above guidelines is not to be construed as approval by Ford Motor Company of any specific revisions or additions to the vehicle's original electrical system.



## Section 2: Electrical

### Keep-Alive Memory Power

The electronic engine and transmission control modules require battery power to be supplied at all times to maintain the keep-alive memory. Keep this in mind when installing load disconnect switches or solenoids.

### Equipment Grounding Guidelines

- Do not ground the body to the transmission or transmission crossmember. Ground accessories to the chassis or the vehicle battery.
- Splicing into circuitry relating to the electronic engine and/or transmission control systems is not acceptable because of the adverse effect on the electronic system operation.
- Adequately protect electrical connections exposed to the elements.

### Wire Insulation

- Polyvinyl Chloride (PVC) rated at 90°C (194°F) is the standard wire insulation that is acceptable for inside body use but is not acceptable for underhood/underbody wiring.
- Hypalon insulation should be used on links only (Ford Specification ESB-M1L54-A).
- Cross-linked Polyethylene (XLPE or SXL) rated at 125°C (257°F) is the required insulation for underhood/underbody applications (Ford Specification ESB-M1L123-A).
- GXL can be used as an alternate wire (Ford Specification ESB-M7L85B) as long as the concentricity specifications are met. To provide a water-resistant seal in conjunction with crimp connectors, a Duraseal crimp connector is recommended since it is designed to account for outside wire diameter that is smaller than the present SXL wire.

### Terminals and Connectors

Connector Types:

- Submersible (sealed) — A connector that is capable of being immersed in water.
- Weather-resistant — A connector that will retain its sealing and connection qualities while being exposed to adverse weather conditions.
- Duraseal crimp — A supplier trade name for a sealed wiring repair or splice.

## Section 2: Electrical

When a connection is not defined (typical situation — harness-to-harness connectors), the following suggestions should be implemented:

- Determine the connector type. If it will be located in a hostile environment, use a sealed connector; if not, use an open connector. A hostile environment is defined as being exposed to water and/or salt accumulation and/or high temperatures (that is; underhood, exterior panels and footwells). Use in-line connectors with secondary locks to prevent the terminal from being pushed out.
  - Do not use single wires smaller than 14 gauge in a 2-way or larger weather-resistant connector (the very large style), since the wire may break during disengagement.
  - Use Hypalon, XLPE or Elexar insulation in submersible connectors to maintain sealing integrity. PVC is not acceptable because it cold flows and allows setting in a deformed pattern, therefore compromising the integrity of the seal.
- Determine the terminal type. Base your decision on wire gauge, current carrying capacity, connector type and insulation type.
  - Use non-detent low insertion force terminals whenever possible.
  - Do not use low insertion force female terminals in weather-resistant connectors.
  - Analyze circuit requirements (signal levels, current, voltage) to determine the proper plating material (such as gold). Use of non-plated terminals is not recommended.
  - Do not use plugs to seal holes in micropin connector grommets. It is very easy to forget to insert them during manufacturing and ruin the seal. Use a grommet with only the necessary number of holes or use dummy wires at least 600 mm (24 in) long.
  - Fully align connectors prior to terminal connection — terminal cavities should have minimum tolerance to prevent terminals from floating, bending or pin push-out during mating/engagement.
  - Make sure connectors of similar type and color are identifiable to the operator to eliminate crossed connections and minimize assembly time. Avoid using similar types and colors of connectors close together.
  - Be sure that connectors have positive locking devices that allow easy installation with a low insertion force and easy removal. The connector snap should be easily felt and heard.
  - Eliminate the use of edgeboard, tang-type and molded-over connectors. The use of blade-type weather-resistant connectors is restricted to high current applications which cannot be handled by submersible connectors.

### Circuit Protection and Electrical Load

- Modification to existing vehicle wiring should be done only with caution and careful consideration of effects on the completed vehicle's electrical system. Anticipated circuitry should be studied to determine the required circuit protection and to avoid feedback loops.
- Added circuitry must be protected either by a base vehicle fuse or circuit breaker, or by a similar device supplied by the modifier.

## Section 2: Electrical

- When adding loads to a base vehicle-protected circuit, make sure that the total electrical load through the base vehicle fuse or circuit breaker is less than the device's load rating.
- Use 80% of the fuse rating to determine maximum steady state load to reduce nuisance fuse failures.
- Use 135% of the fuse rating when sizing wiring to protect the circuit in the event of an overload. Fuses will last for one hour at 135% of their rating.
  - Total current draw is the sum of the base vehicle's circuit current requirement (measured with an ammeter) and the anticipated add-on component current requirements.
  - Never increase the rating of a factory installed fuse or circuit breaker.
  - If the total electrical load including additional electrical components, on any circuit, is less than the fuse protection rating or the capacity of some limiting component (switch, relay), the items to be added can be connected directly to that circuit. The headlamp switch circuits should never have additional lighting or electrical components directly connected.
  - Added devices that exceed the current capabilities of the factory-installed system are best controlled through the use of a relay or separate switch. The coil of the relay can be fed from the circuit in the factory harness (now acting as a signal circuit) with added wiring providing feeds to the added electrical device. The relay selection is important and depends on current requirements, number of cycles expected in the relay lifetime, whether the relay is to be operated intermittently or for long periods of time and whether the relay is exposed to weather conditions or is installed in a protected area. When the current requirements of a circuit exceed the capacity of an available relay, the load should be reduced or divided through the use of additional relays.

### Wire Protection Requirements

#### General Notes:

- Anticipate problems and design accordingly. Try to anticipate what could go wrong and modify your designs to address any adverse impact.
- Review all connector applications and electrical systems to determine the need for solder, grease, weather-resistant or sealed connectors. Make sure components and wire insulation are compatible with greased connectors (important for long-term durability).
- Make sure that drip loops or other means are provided to prevent water leakage into the vehicle through wiring assemblies that pass through the dash panel.
- Use greased or sealed connectors in floor pan troughs which are subject to moisture coming through the carpeting.
- Use XLPE insulation for uncovered runs that exceed 305 mm (12 in).

## Section 2: Electrical

### Electrical Protection

- Properly route wires away from noise-generating wires or components. However, if routing near noisy wires or plugging into noisy components is unavoidable, additional protection must be designed into the harness.
- Shielding — Electro Magnetic Interference (EMI) — Consider shielding if you must route close to high-current or noisy circuits. Use shielded wire and ground one side. Seal all splices in wire assemblies that use bare coaxial shielding (braid or tape) for EMI suppression, and insulate or tape over all shielding ends that terminate near any open connectors. This prevents splice and terminal shorts to the shielding. Minimize the length of conductors which extend beyond the shield. Failure to do this reduces the effectiveness of the shield.
- Spike suppression, in general, is accomplished by connecting a diode or resistor-diode combination across the terminals of the noisy component. The diode should be sufficiently close to the component (both electrically and physically) so that inductive spikes are clamped off. Make sure the diode is connected with the proper polarity.

Proper routing and retention will reduce the likelihood of chafing or pinching. When this ideal routing is unattainable, the following additional protection is needed:

### Mechanical/Environmental Protection

- Tape — Tape is the most basic means of protection. It contains the wires in a loose bundle and provides limited environmental protection. It does not protect against chafing and pinching.
  - Kendall Polyken Fiberglass Base Tape (Ford Specification ESB-M3G38-A) is used for engine compartment applications. This durable tape provides protection against cut-through and abrasion commonly found in underhood applications.
  - Polyken 267 is a substitute tape that may be used in lower temperature areas of the engine compartment (apron area).
- Convolute — Use convolute for all underhood/underbody applications or when increased temperature, abrasion or pinch resistance is required. Convoluted tubing comes in different diameters and materials to accommodate different temperature ranges and harness sizes.
  - Use polyethylene convolute when abrasion is the only consideration; this convolute is adequate up to 96°C (205°F) maximum. Use nylon convolute when underhood/underbody or abrasion and temperature are considerations; nylon convolute is adequate up to 177°C (350°F) maximum.
  - On all engine-mounted wiring or bend points. Use vinyl tape on the outside of the convolute to prevent wiring from looping out. This tape must be able to withstand temperatures 135°C (275°F) or higher.
  - Tape convolute junctions with abrasion-resistant tape (Polyken 267, fiberglass).
- Scroll — Similar to convolute, but without the ridges. Scroll is used where harness rigidity is required, especially for maintaining critical locator dimensions. Use scroll for short lengths only, as it is quite inflexible.

## Section 2: Electrical


Note: This is not meant to be an all-inclusive list of methods for physically protecting the wires. There are other means of protection available that are not listed.

### Grommets and Sealing Requirements

Any additional wiring routed through sheet metal must pass through a grommet that both seals the opening and locates the wire(s). Two-piece grommets (rubber with plastic inserts) are recommended to facilitate installation and retention.

- Locate grommets so they are accessible for proper seating (achieved by pulling) in sheet metal holes.
- Ramp grommets at the insertion end to facilitate installation and sealing.
- Be sure that the direction of the hole punch is in the direction of grommet seating and the hole is burr-free.
- Make sure the grommet molding compound will adhere to the harness to prevent slippage.
- Make sure the grommet will withstand the environment (temperature, splash).
- Be sure that holes are large enough to allow the installation of the harness without causing circuit damage.
- Use adhesive tape on main trunks or branches with at least a 50% overlap to prevent wicking through grommets. Be certain to diaper-wrap the takeouts.

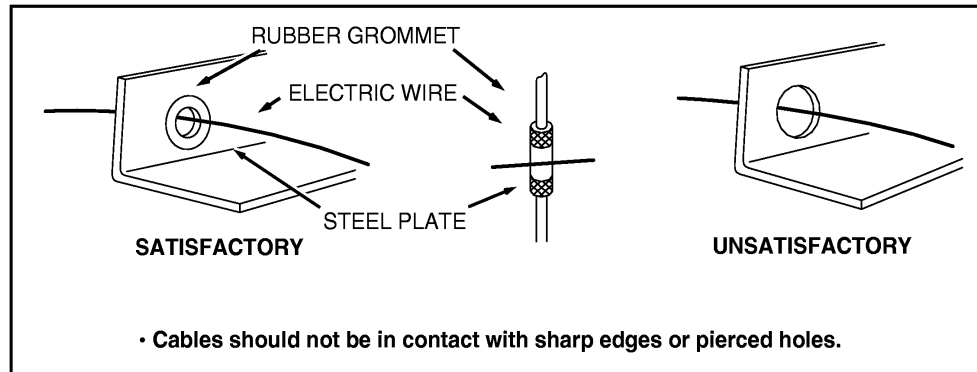
### Wire Routing

 **WARNING: Do not place electrical component attachments or ground screws adjacent to vehicle fuel tanks, fuel filler pipes, fuel lines, fuel vapor lines or carbon canisters. Failure to follow these instructions may result in personal injury in the event of a collision.**

Wire harness routing should conform to the following:

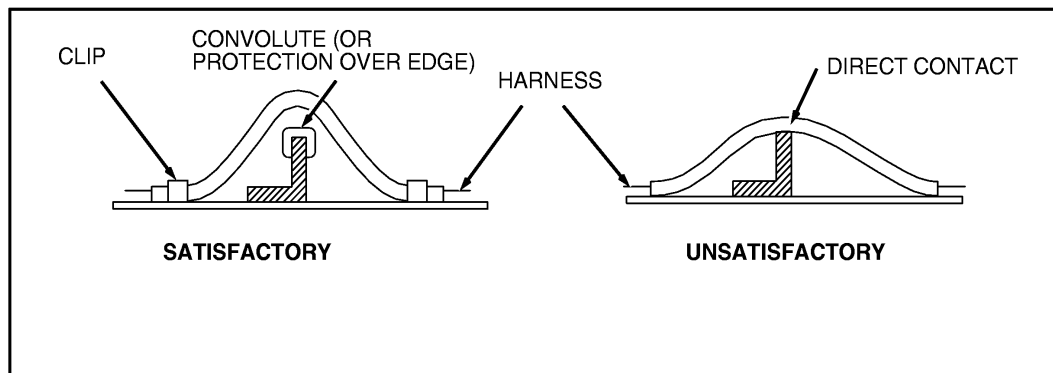
- Protect wires routed through holes in sheet metal or castings with a grommet whether or not conduit is used (see figure below).

## Section 2: Electrical



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- Route wires to avoid metal edges, screws, trim fasteners and abrasive surfaces. When such routing is not possible, use protective devices (shields, caps) to protect the wires. Cover metal edges with a protective shield and fasten the wiring within 76 mm (3 in) on each side of the edge (see figure below).



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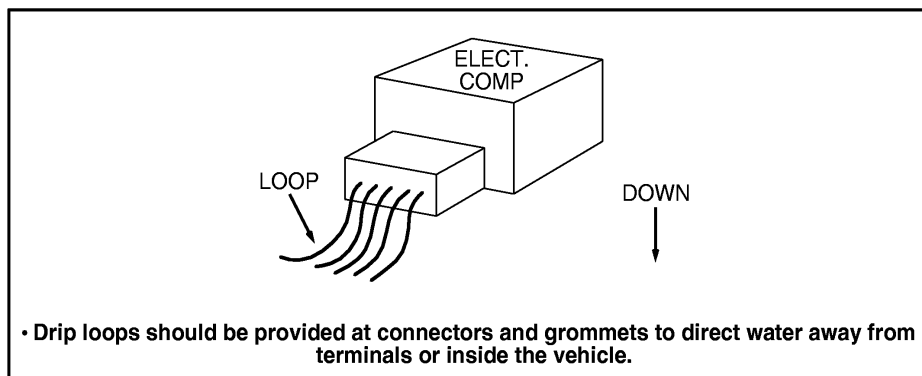
- Route wires to provide at least 76 mm (3 in) of clearance to moving parts in their extreme movement location, unless positively fastened and protected by a conduit.
- Avoid wire routing without conduit in areas where temperatures exceed 82°C (180°F). Minimum clearance of 152 mm (6 in) should be maintained from exhaust system components. Heat insulation and heat shields must be used on the wires routed in high temperature areas.
- Make certain that all underhood or underbody wiring is cross-linked polyethylene high-temperature insulation wire 135°C (275°F) (minimum rating) consistent with SAE specification J1128 Type SXL wire. Normal PVC wire must not be used in underhood or underbody applications.
- Make sure all ground locations are readily accessible for installation, service and verification.
- Do not place ground attachments in high-splash areas.
- Do not route underbody wiring over the exhaust system.
- Underhood/underbody wiring must be routed in conduit for protection. Minimum conduit rating is 177°C (350°F).

## Section 2: Electrical

### Wire Retention and Routing

Use the following criteria to determine the location of retainers:

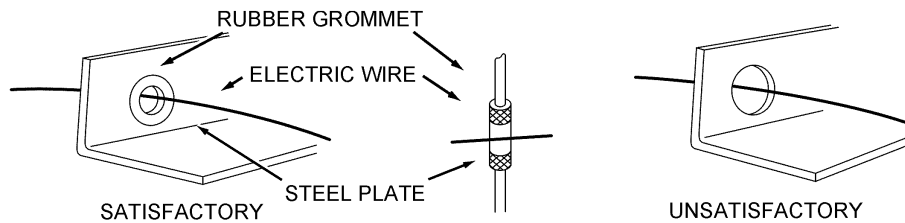
- Size and weight of wire bundle.
- Holes with poor accessibility that prevent installation of locators.
- Movement of wires that can result in abrasion, squeaks and rattles.
- When wiring is routed between 2 members where relative motion can occur, the wiring should be secured to each member with enough wire slack to allow flexing without damaging the wire.
- Wiring exposed to weather must provide a drip loop to prevent moisture from being conducted into the device through the wire connection (see figure below).



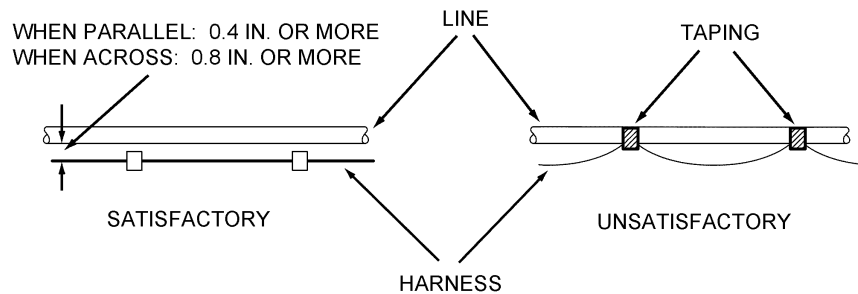
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- Avoid routing wires into areas exposed to wheel splash. When such routing cannot be avoided, adequate clipping and/or protective shields are required to protect the wires from stone and ice damage. Allow adequate slack in wiring between the engine and stationary components to compensate for engine roll.
- Avoid routing wires under the frame side members or at points lower than the bottom frame flange.
- Use plastic “zip” straps for “bundling” only (securing to other wires).
- The wire retainers and grommets installed by the assembly plant are usually designed to accommodate only the Ford-installed wires. Additional wiring or tubing should be retained by additional clips. When added wires or tubes are routed through sheet metal panels, new holes with proper wire protection and sealing must be used.

## Section 2: Electrical



- Cables should not be in contact with sharp edges or pierced holes.



- Harnesses should not be taped to fuel lines or other lines. A sufficient clearance should be maintained between harness and lines.

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For retainer screws, the following guidelines apply:

- Avoid using fasteners that are too long for the application or are in an area which might damage vehicle components, including wiring, brake lines, fuel tank and lines, powertrain components, exhaust system and suspension.
- Do not use pointed screws for attachments. Also check that screws used in the vicinity of the wiring are blunt-ended.
- To minimize the potential for wiring shorts, do not use drill point screws. Trim components (including wiring shields) should use pin-type attachments instead of screws.
- Always check areas that screws protrude into for verification that an interference condition to other components does not exist.
- Make sure that retainers used are capable of withstanding the environment over the vehicle's life expectancy.

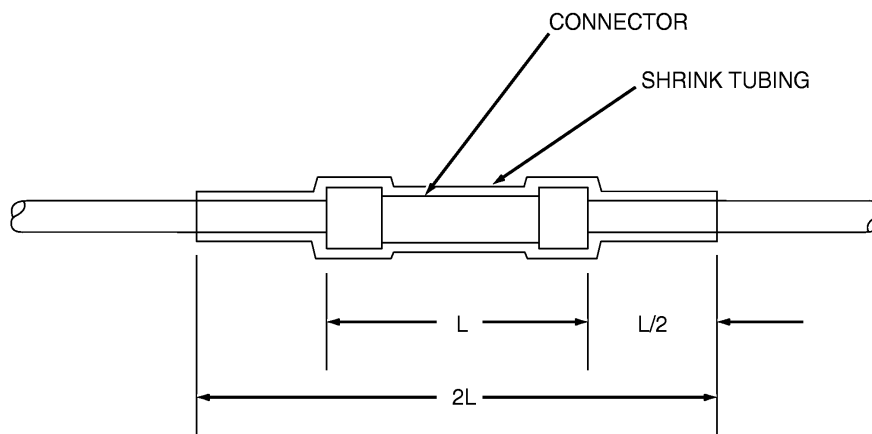


## Section 2: Electrical

### Splices and Repairs

For quality splicing and to reduce potential problems, the following guidelines are recommended:

- Stagger the splices within a harness to reduce increased harness diameter. Splice only on straight areas as installed, not on bends.
- Strip wire ends making sure that individual conductor strands are not damaged.
- When soldering, make sure an adequate mechanical joint exists before applying solder. Use only resin-core solder. Acid-core solder should not be used since it may result in corrosion.
- For crimp joints, use butt-type metal barrel fasteners and the proper tool at the appropriate setting for the wire size (such as Motorcraft Crimp Tool S-9796) specifically designed for this type of work.
- Make sure splice joints are adequately sealed and insulated. In an outside environment, use Duraseal butt connectors or equivalent. A durable substitute splice joint can be achieved by using a bare metal barrel, crimping, flow-soldering and covering with shrink tubing. Quality electrical tape can be used inside the vehicle but is not recommended for an outside environment.
- Be sure that the new wire is not a lesser gauge than its original mating wire.



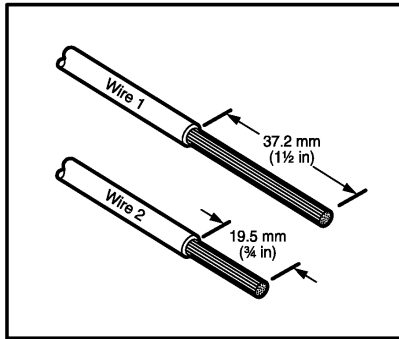
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### Recommended Splicing Method — Solder (For 16 AWG and Smaller Diameter Wire Only)

1. Disconnect the battery ground cable.

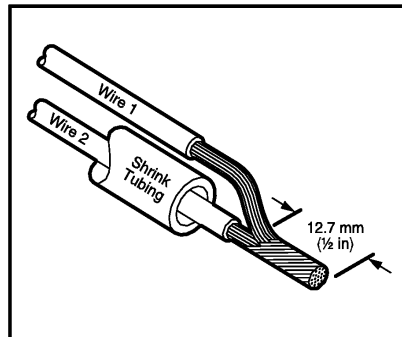
## Section 2: Electrical

- Strip wires to appropriate length.



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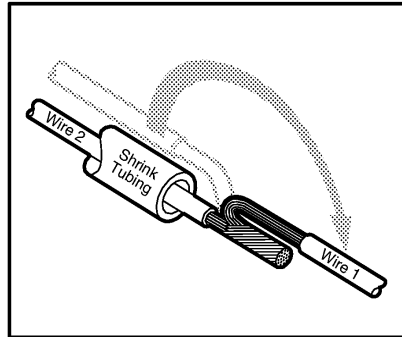
- Install heat shrink tubing.
- Twist the wires together.
- Note: Use resin-core mildly-activated (RMA) solder. Do not use acid-core solder. Solder wires together.



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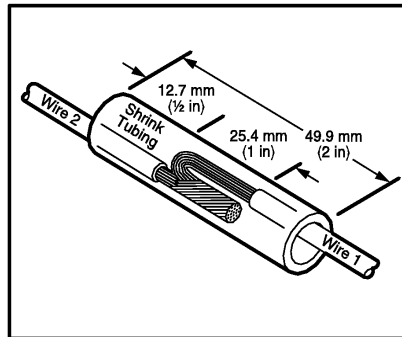
- Note: Wait for solder to cool before moving wires. Bend wire No. 1 back in a straight line.

## Section 2: Electrical



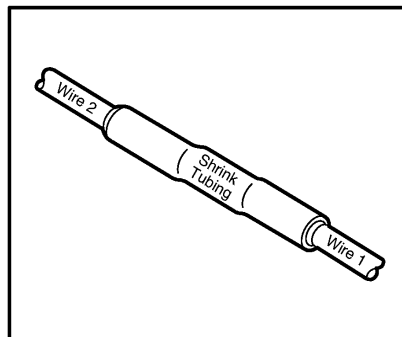
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7. Note: Overlap tubing on both wires.  
Evenly position heat shrink tubing over wire repair.



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8. Use a shielded heat gun to heat the repaired area until adhesive flows out of both ends of heat shrink tubing.



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## Section 2: Electrical

- Reconnect the battery ground cable.

### Sealed Connectors

Ford Part Number	Part Name	Class
E6FZ-14488-A	Butt Connector Gauge: 18-22, Color: Red	C
E6FZ-14488-B	Butt Connector Gauge: 14-16, Color: Blue	C
E6FZ-14488-C	Butt Connector Gauge: 10-12, Color: Yellow	C

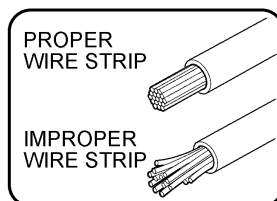
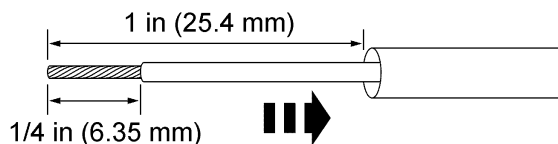
### Heat Shrinkable Tubing (Heat Shrink) (Ford Specification ESB-M99D56-A2)

Heat shrinkable tubing is available in various diameters for different splice sizes and configurations. When shrunk, it forms a small, flexible hermetic seal.

Other methods (tape, PVC mold) do not provide a hermetic seal and are not recommended. Splice balancing is critical with heat shrink insulation. If the splice is extremely unbalanced (more circuits on one side than the other), heat shrink insulation will not provide a proper seal. Evaluate the use of double terminals instead of splices where practical in these situations.

### Recommended Splicing Method — Crimp (For 10 - 22 AWG Diameter Wire to Like Wire Diameter)

- Disconnect the battery ground cable.
- Strip wires to appropriate length.
- Install heat shrink tubing.



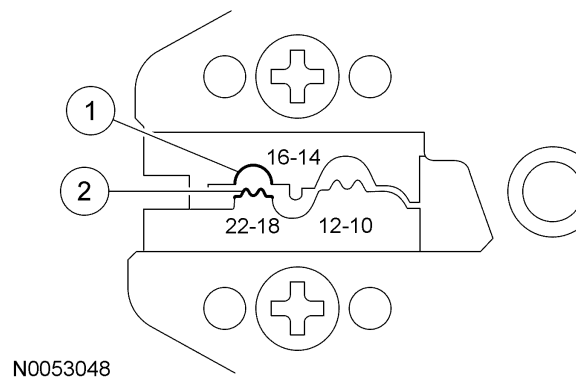
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## Section 2: Electrical

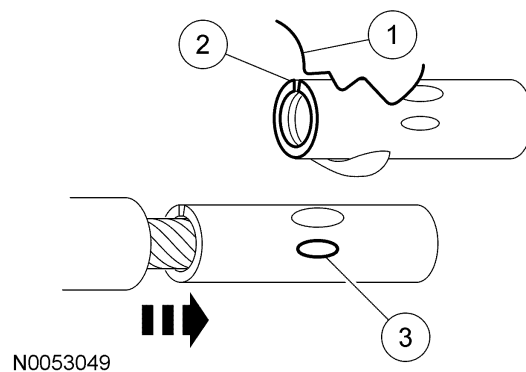
4. Select the appropriate wire splice for the wires to be spliced from Rotunda Wire Splice Kit 164-R5903.
5. Note: Rotunda 164-R5901 Pro-Crimper supplied with the wire splice kit is the only tool that can be used with these splices.

Identify the appropriate chamber on the Rotunda Pro-Crimper by matching the wire size on the dies with the wire size stamped on the butt splice.

- (1) Cavity
- (2) Indenter



6. Crimp the connector.
  - (1) Center one end of the wire splice in the appropriate crimping chamber.
  - (2) Insert stripped wire into the barrel.
  - (3) Holding the wire in place, squeeze the tool handles until ratchet releases.

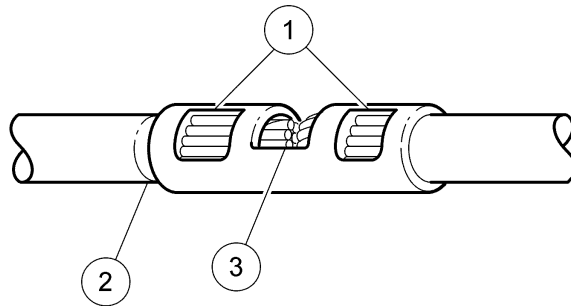


7. Repeating Step 6, crimp the other half of the splice.

## Section 2: Electrical

8. Check for acceptable crimp.

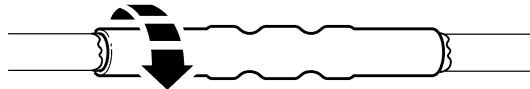
- (1) Crimp should be centered on each end of the butt splice.
- (2) Wire insulation does not enter butt splice.
- (3) Wire is visible through inspection hole of splices.



N0053050

9. Evenly position supplied heat shrink tubing over wire repair.

10. Use shielded heat gun to heat the repaired area until adhesive flows out of both ends for the heat shrink tubing.



N0070450

11. Reconnect the battery ground cable.

Heat Shrinkable Tubing (Heat Shrink) (Ford Specification ESB-M99D56-A2)

Heat shrinkable tubing is available in various diameters for different splice sizes and configurations. When shrunk, it forms a small, flexible hermetic seal.

Other methods (tape, PVC mold) do not provide a hermetic seal and are not recommended. Splice balancing is critical with heat shrink insulation. If the splice is extremely unbalanced (more circuits on one side than the other), heat shrink insulation will not provide a proper seal. Evaluate the use of double terminals instead of splices where practical in these situations.

## Section 2: Electrical

### Wiring Reference Information

#### 2009 Escape/Mariner Hybrid Wiring Diagram Excerpts

The following pages are from sections of the 2009 Escape/Mariner Hybrid Wiring Diagrams.

#### Ordering Information

To obtain information about ordering complete copies of Ford or Lincoln/Mercury publications, call 1-800-782-4356.

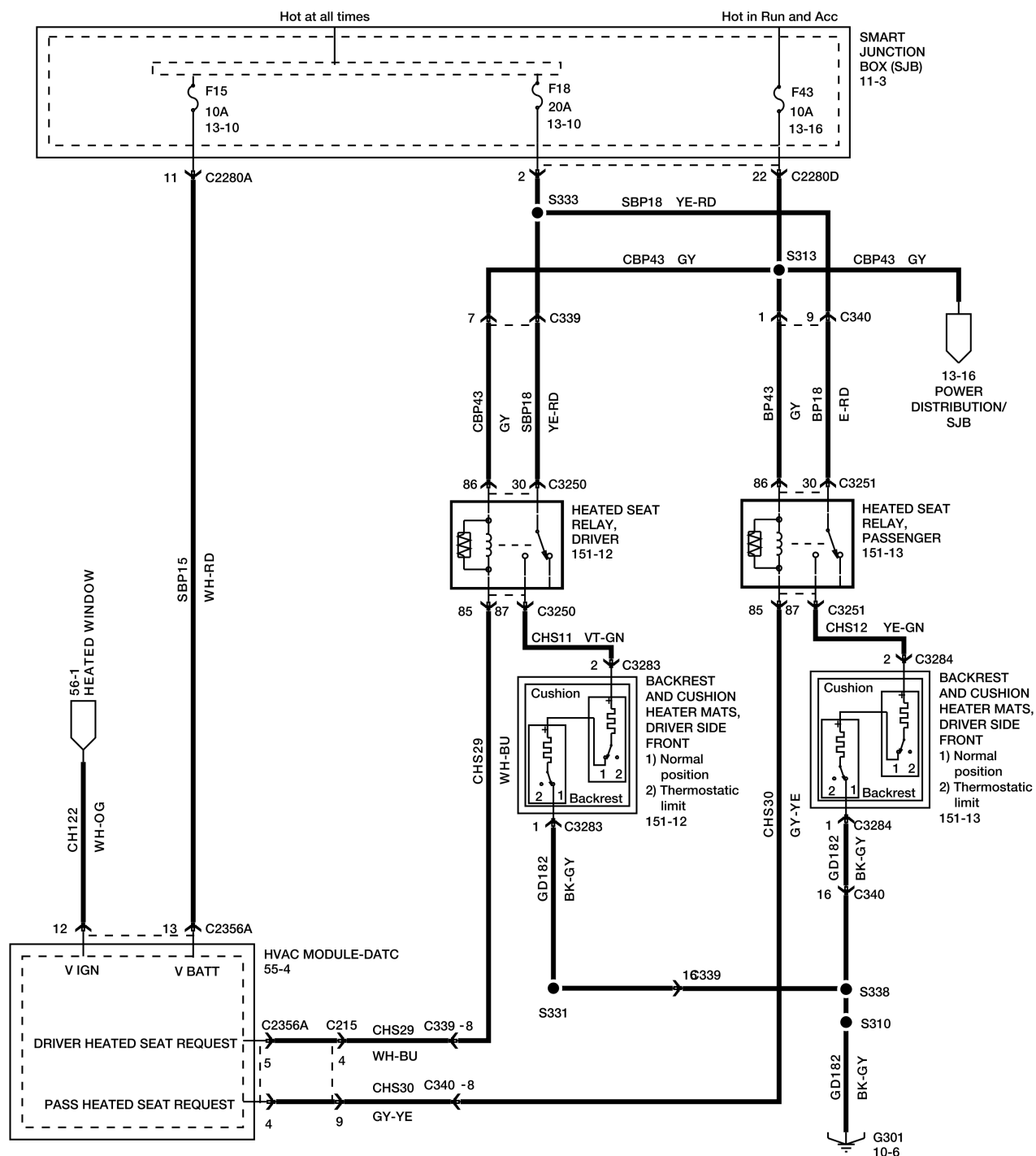
Available publications include Workshop Manuals, Wiring Diagrams, PC/ED Manuals and Owner's Literature.

In addition, a publications order form can be obtained by writing to: Ford Publications, C/O Helm Inc., PO Box 07150, Detroit, MI 48207

#### Wiring Diagrams

Note: Smart junction box (SJB) fuse 18 (20A), circuit SBP18 (YE/RD) for the heated seats is at maximum available current limit when the heated seats option is installed and used. Do not splice into this fused circuit when the heated seats option is installed and used.

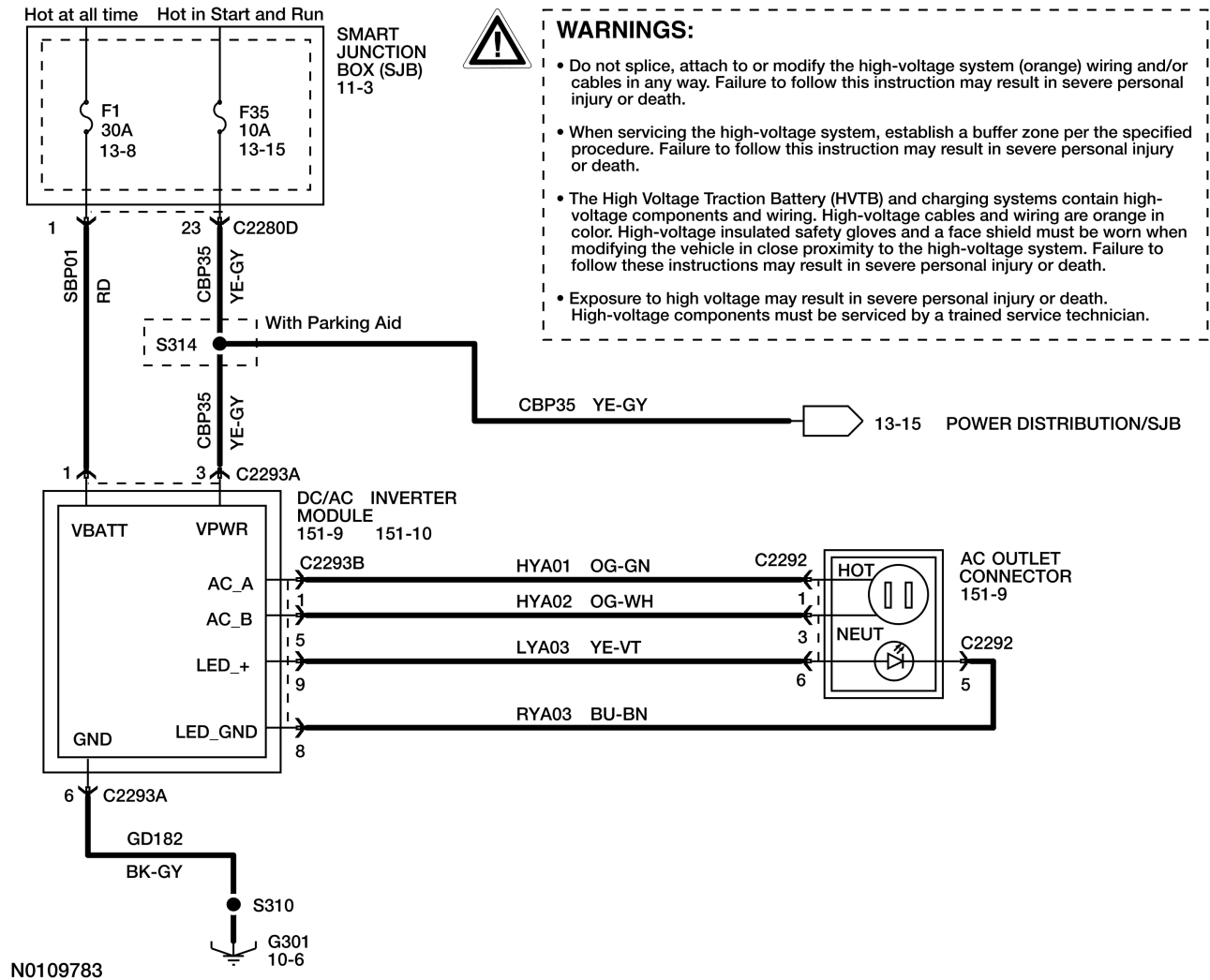
## Section 2: Electrical





## Section 2: Electrical

Note: Smart junction box (SJB) fuse 1 (30A), circuit SBP01 (RD) for the DC/AC power inverter is at maximum available current limit when the power inverter is installed and used. Do not splice into this fused circuit when the DC/AC power inverter is installed and used.



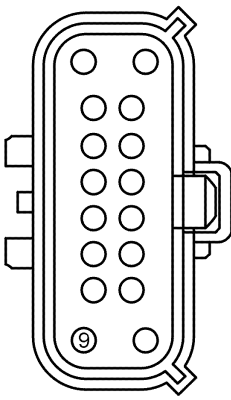
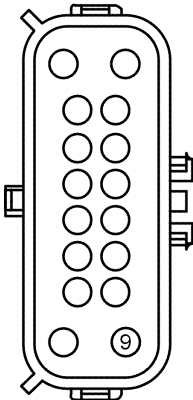
Section 2: Electrical

Connector End Views

C339  
Inline

14C719

14405



MALE

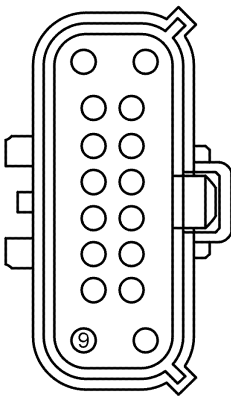
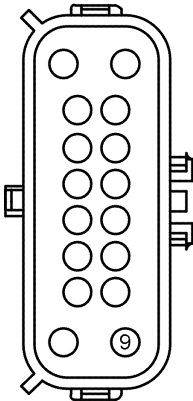
FEMALE

N0068537

C340  
Inline

14A699

14405



MALE

FEMALE

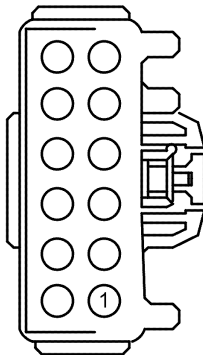
N0068536

## Section 2: Electrical

C2293A (GY)

14405

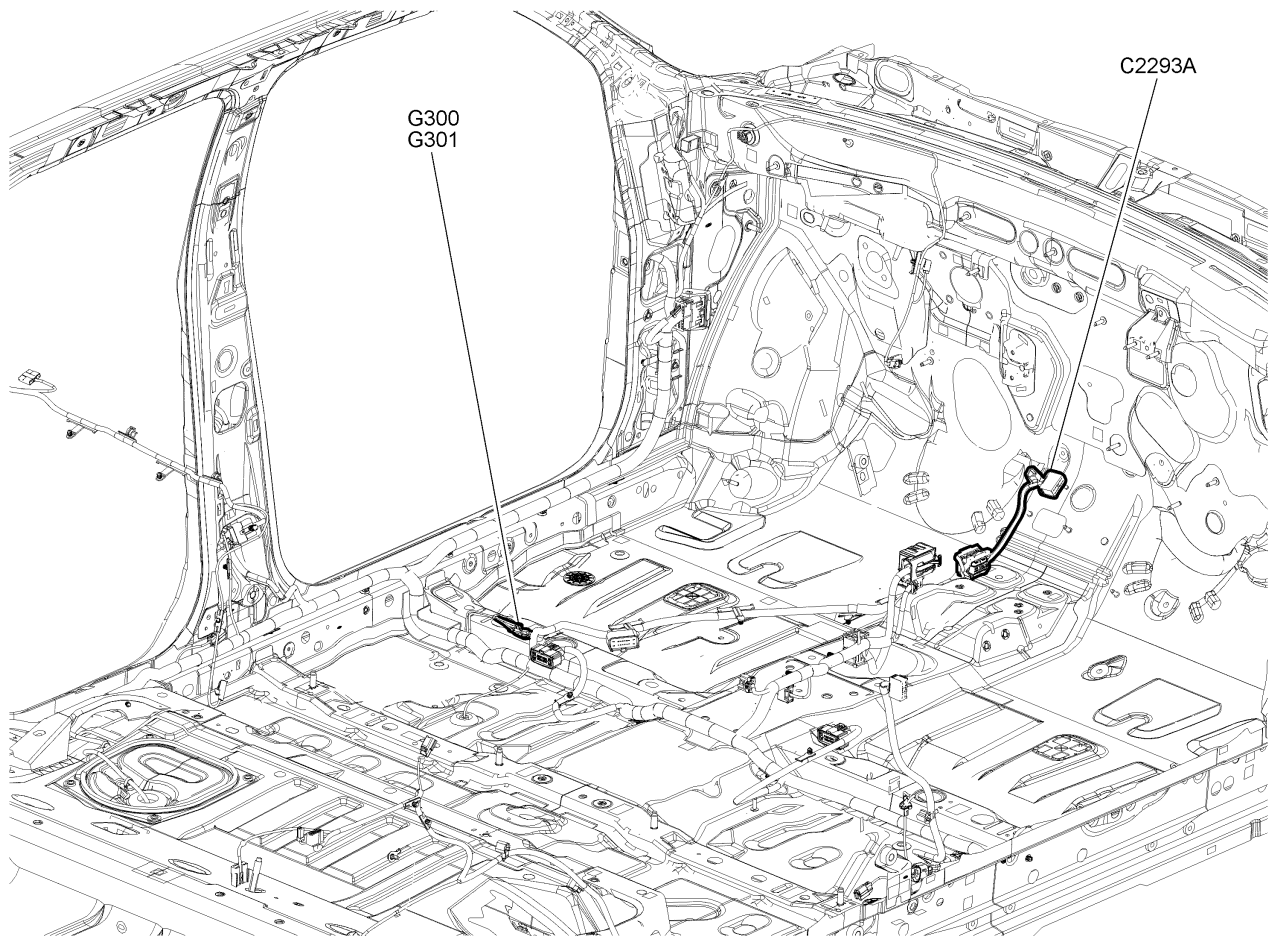
DC/AC INVERTER  
MODULE (19G317)



N0053100

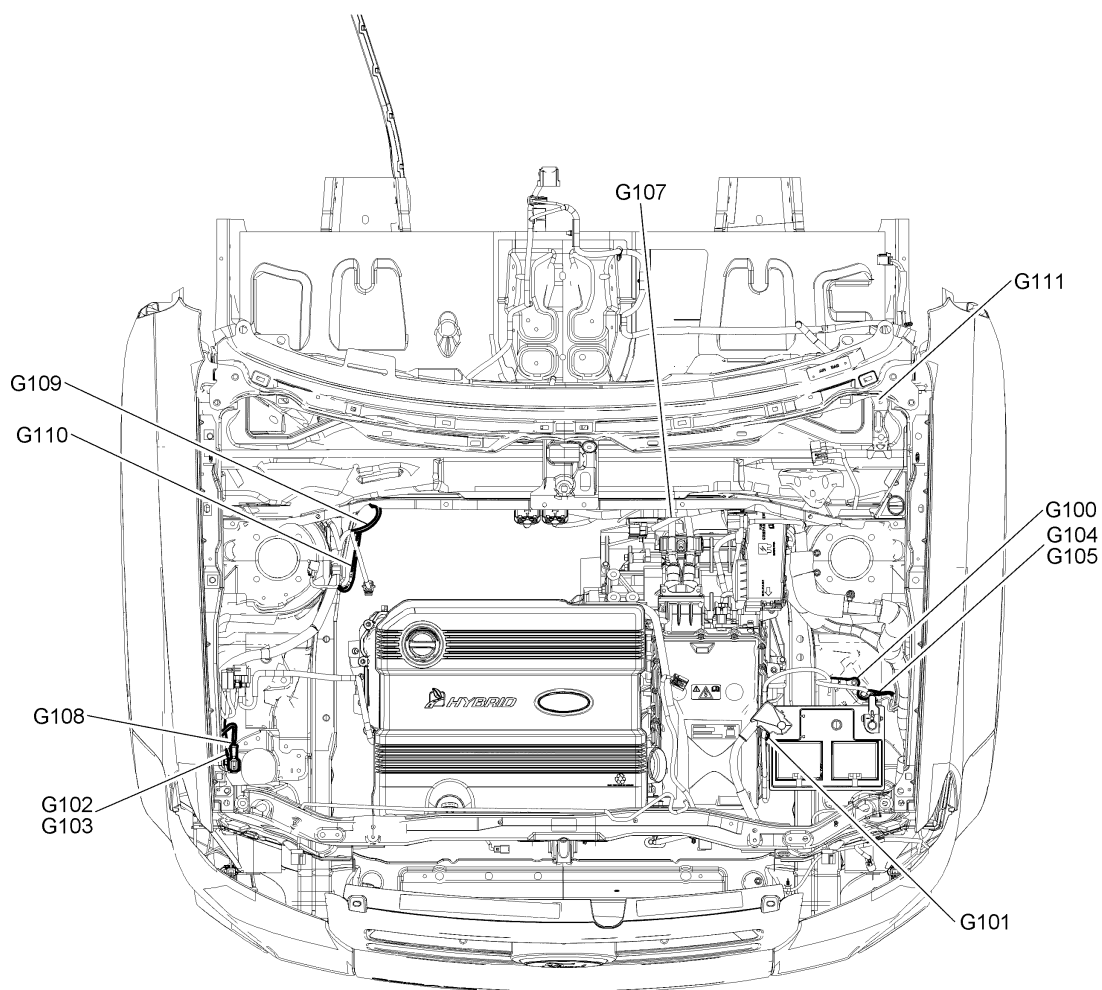
## Section 2: Electrical

### Connector and Ground Locator



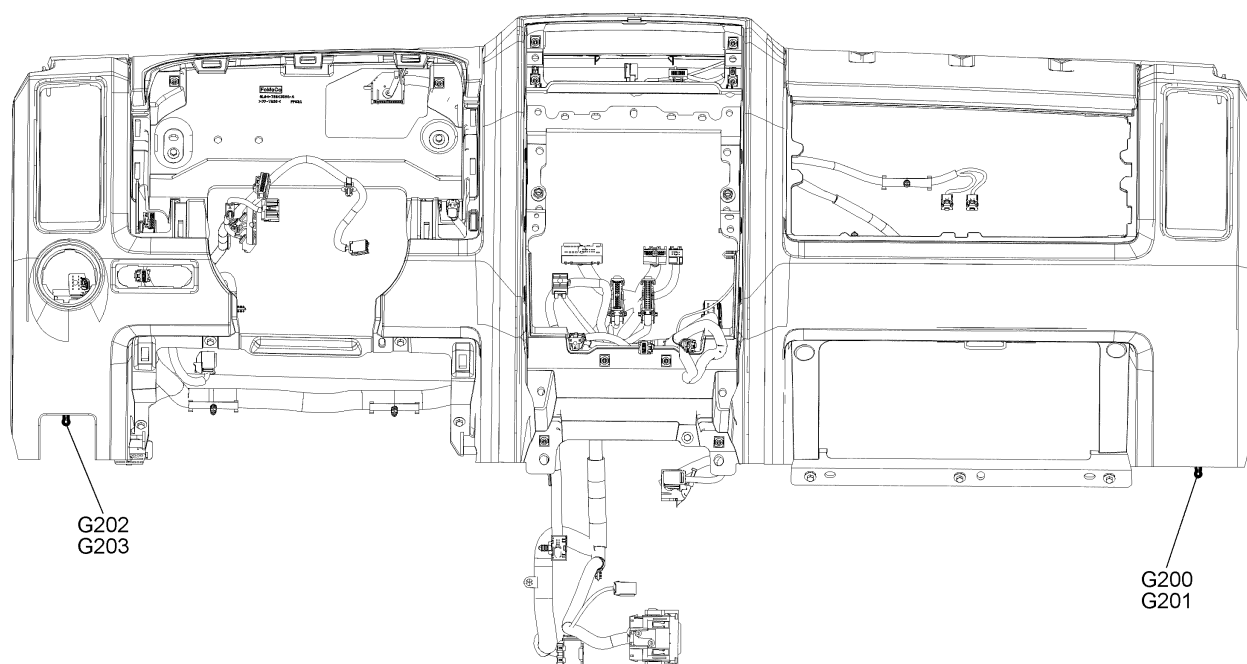
N0069473

## Section 2: Electrical



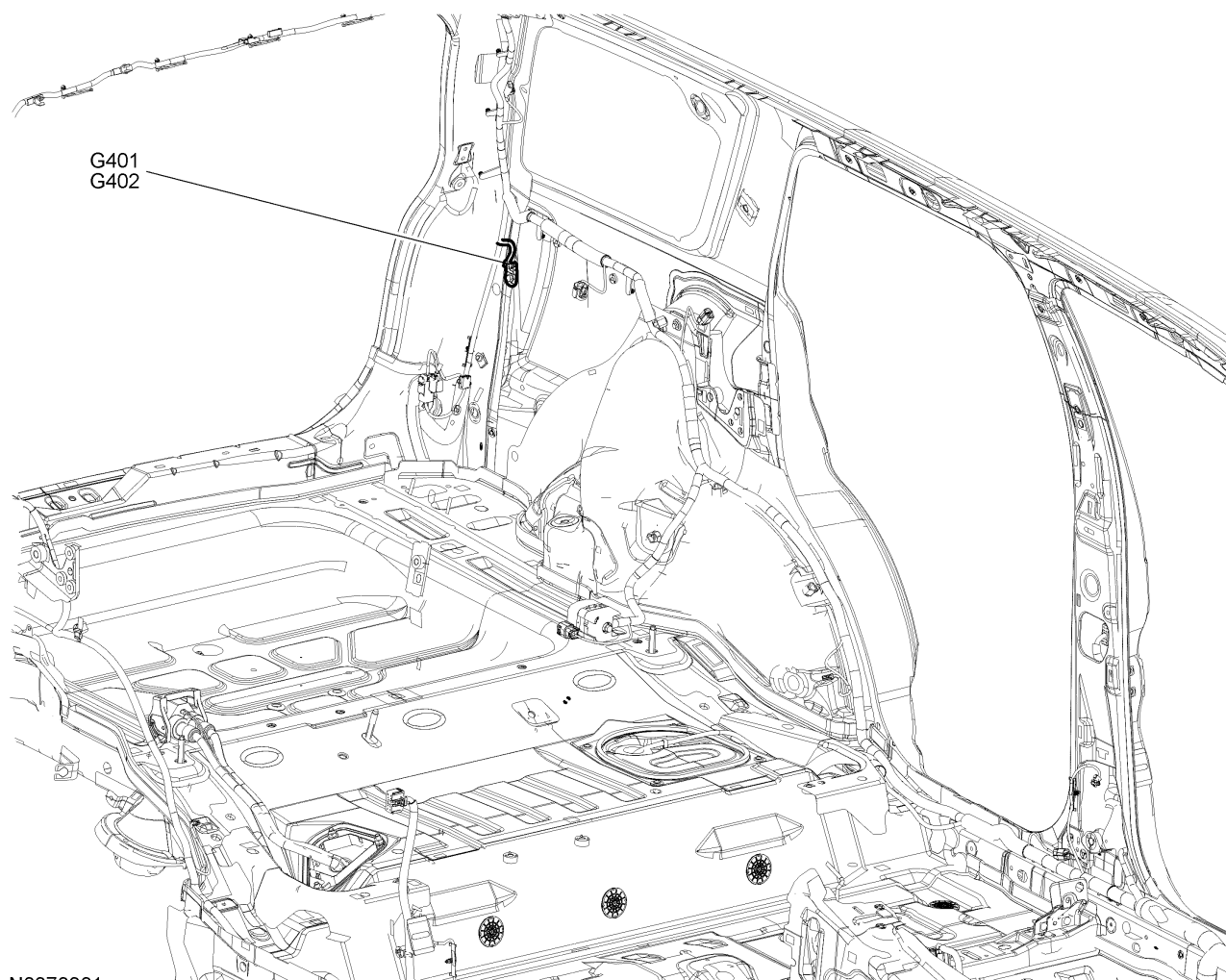
N0069476

## Section 2: Electrical



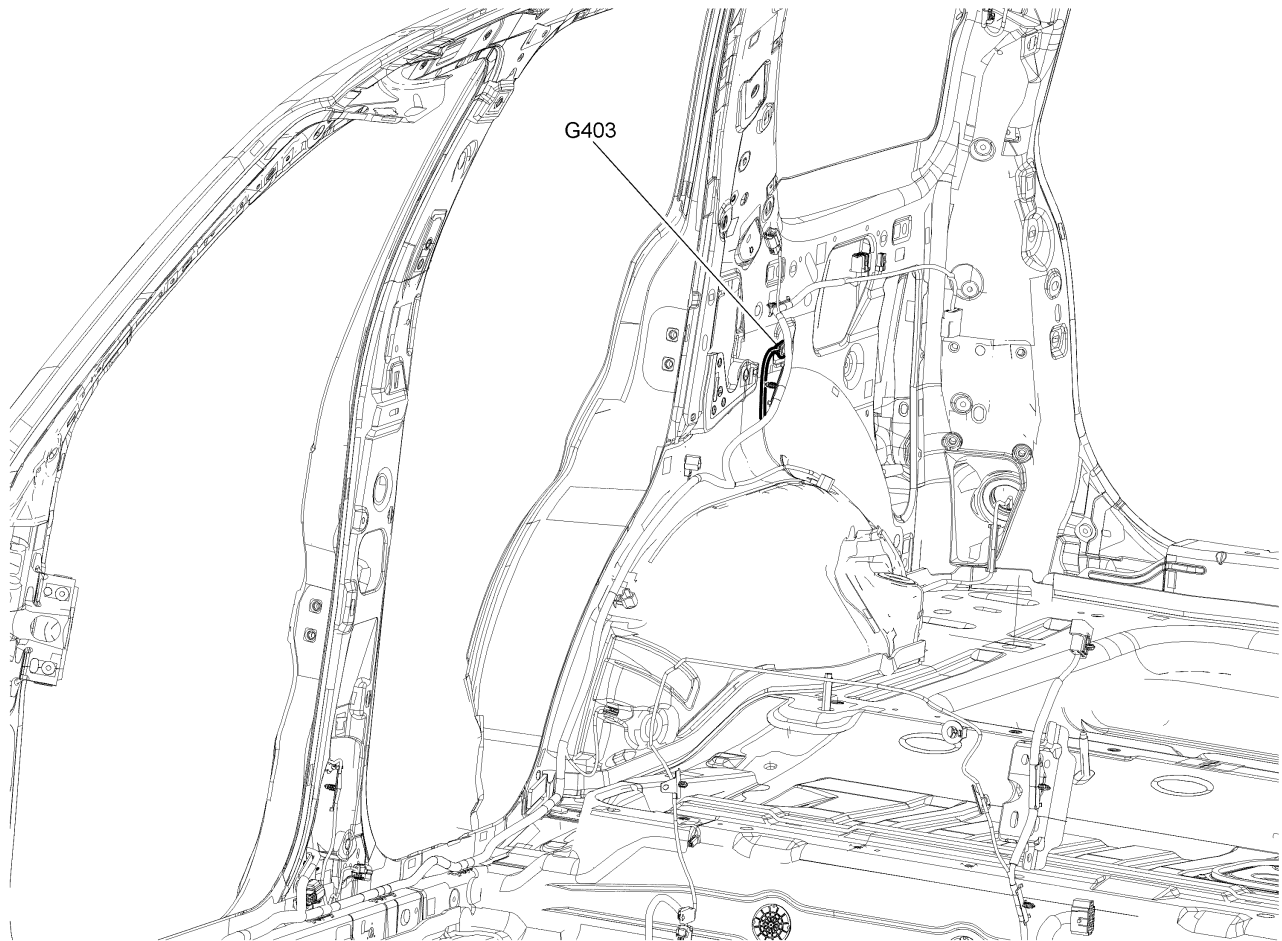
N0069472

## Section 2: Electrical



N0070301

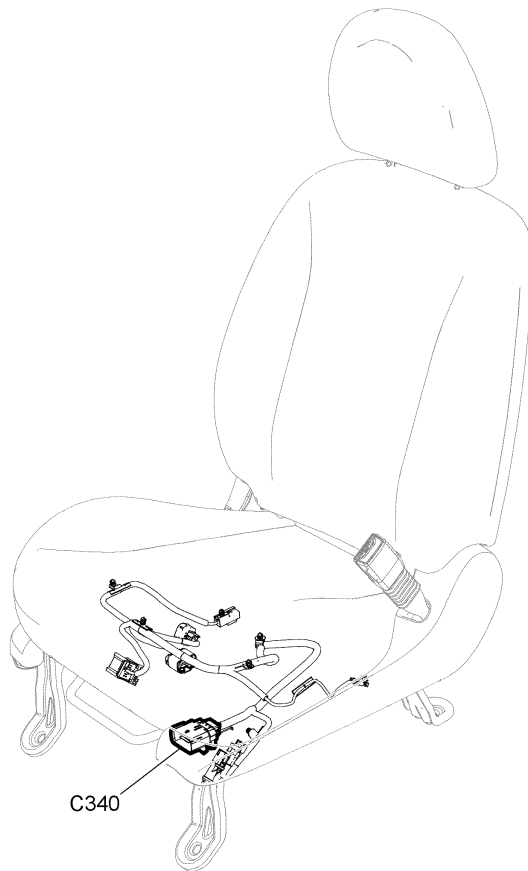
## Section 2: Electrical



N0069474

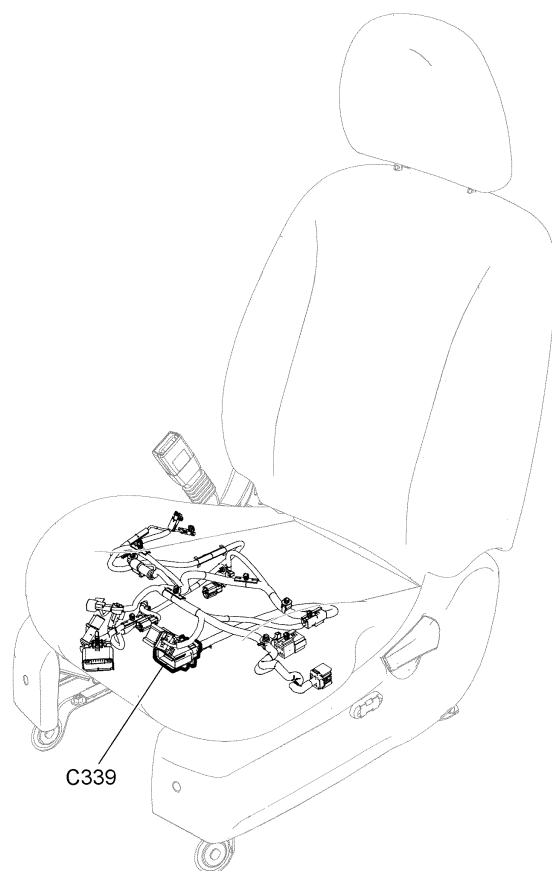


## Section 2: Electrical



N0069593

## Section 2: Electrical



C339

N0069592

# SECTION 3

# Mounting

## Contents

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  - Using the Vehicle as an Ambulance .....3-1
  - Siren and Grille Lights.....3-1
  - Mounting Equipment to the Vehicle .....3-1
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## Section 3: Mounting

### Push Bumpers

Ford Motor Company does not recommend the installation of any type of push bumper.

### Using the Vehicle for Snowplowing

Do not use the vehicle for snowplowing. The Escape/Mariner Hybrid is not equipped with a snowplowing package.

### Using the Vehicle as an Ambulance

Do not use the vehicle as an ambulance. The Escape/Mariner Hybrid is not equipped with the Ford ambulance preparation package.

### Siren and Grille Lights

The engine cooling system relies on proper airflow through the radiator to keep the engine at its proper operating temperature. When adding sirens and grille lights to a vehicle, make sure this airflow is not obstructed. Reduced airflow could put additional strain on the cooling system and shorten the operational life of related components. The cooling system also cools the electric motors and electronics. If the coolant exceeds certain temperatures, the components will attempt to protect themselves by limiting the power and torque available. During the installation process, keep the placement of components away from the grille area of the vehicle.

### Mounting Equipment to the Vehicle

**NOTICE:** Do not disable the electrical air conditioning system. The high voltage traction battery (HVTB) system uses the cabin air to cool the HVTB.

- Do not mount equipment to the cargo load floor/high-voltage traction battery (HVTB).
- Do not mount equipment on the instrument panel between the driver and passenger airbags due to deployment variability.
- Do not mount equipment obstructing the HVTB service disconnect.
- Do not mount equipment to the LH rear quarter trim panel.
- Do not cover or block the LH interior trim panel air intake or exhaust vents to the high voltage battery.
- Do not cover any vehicle or warning labels.

## Section 3: Mounting

- Do not mount equipment to the high-voltage connector shield located under the RH rear seat back and bottom.

**NOTICE:** The side impact sensor is tuned to excite based on its mass (including wiring), as well as the host sheet metal. Any alteration to these components must be avoided. Additions, such as padding, wire connectors, retainers, tape or fasteners of any kind should not be used. All fasteners in this predominantly sheet metal environment should be made of steel or a non-conductive plastic to guarantee retention and longevity. If any part of a steel fastener is exposed to a wet area, it should be plated to resist corrosion.

Note: Vehicles not equipped with safety canopy module and side air bag module only.


- Do not mount equipment to the C-pillars within 15.25 cm (6 in) of the retractors and side impact sensors.
- Do not mount equipment to the B-pillars within 30.5 cm (12 in) of the floor.

**NOTICE:** The side impact sensor is tuned to excite based on its mass (including wiring), as well as the host sheet metal. Any alteration to these components must be avoided. Additions, such as padding, wire connectors, retainers, tape or fasteners of any kind should not be used. All fasteners in this predominantly sheet metal environment should be made of steel or a non-conductive plastic to guarantee retention and longevity. If any part of a steel fastener is exposed to a wet area, it should be plated to resist corrosion.


Note: Vehicles equipped with safety canopy module and side air bag module only.


- Do not mount equipment to the A-, B- and C-pillars.
- Do not mount equipment on the headliner within 200 mm (8 in) of the side edges.
- Do not mount equipment above the beltline within 200 mm (8 in) of the side glass from the A-pillar leading edge to the rear edge of the C-pillar.
- Do not mount equipment on the headliner along the siderails.
- Do not install a partition, divider or equipment that spans the vehicle above the beltline.

### Partition Installation Guidelines — Vehicles Not Equipped With Safety Canopy Module and Side Air Bag Module Only

 **WARNING:** If the vehicle is equipped with a safety canopy module and side air bag module, do not install a partition, divider or equipment that spans the vehicle above the beltline. Failure to follow these instructions may result in personal injury.

## Section 3: Mounting

 **WARNING:** The partition and the installation hardware of the partition must not interfere with the proper operation of the safety belt, safety belt retractor, side impact sensor and the safety belt height adjusters. Failure to follow these instructions may result in personal injury.

 **WARNING:** Installation of prisoner partitions may increase the risk of injury to front seat occupants if the vehicle is impacted from a high speed rear end collision. This risk should be balanced by the law enforcement agency against the risk of injury to the officer associated with prisoner transportation. Failure to follow these instructions may result in personal injury.

**NOTICE:** The side impact sensor is tuned to excite based on its mass (including wiring), as well as the host sheet metal. Any alteration to these components must be avoided. Additions, such as padding, wire connectors, retainers, tape or fasteners of any kind should not be used. All fasteners in this predominantly sheet metal environment should be made of steel or a non-conductive plastic to guarantee retention and longevity. If any part of a steel fastener is exposed to a wet area, it should be plated to resist corrosion.

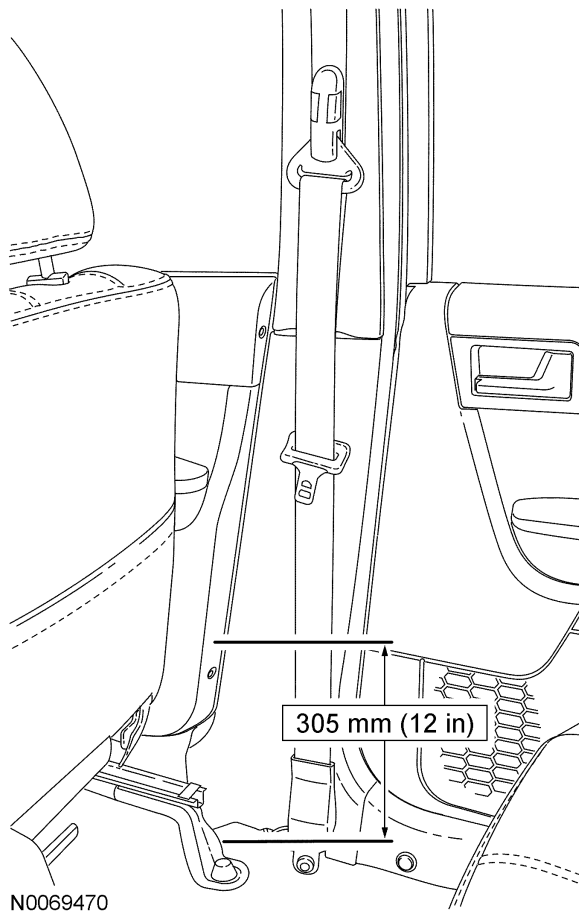
### Safety Belt Retractor

The safety belt retractors are located in the base of the B-pillars. The pretensioner located in the retractor is referred to as the “safety belt retractor pretensioner”. In the event the restraints control module (RCM) senses an impact, pretensioners provide improved occupant protection by rapidly removing slack from the safety belt. Removing slack from the safety belt helps to properly position the occupant and allows for maximum effectiveness of the safety belts and the air bags.

- Do not use the safety belt retractor bolts for mounting the partition.
- Do not mount any partition hardware on the inboard side of the B-pillar within the bottom 305 mm (12 in).
- Do not mount any partition hardware that will interfere with the proper sealing of the door.

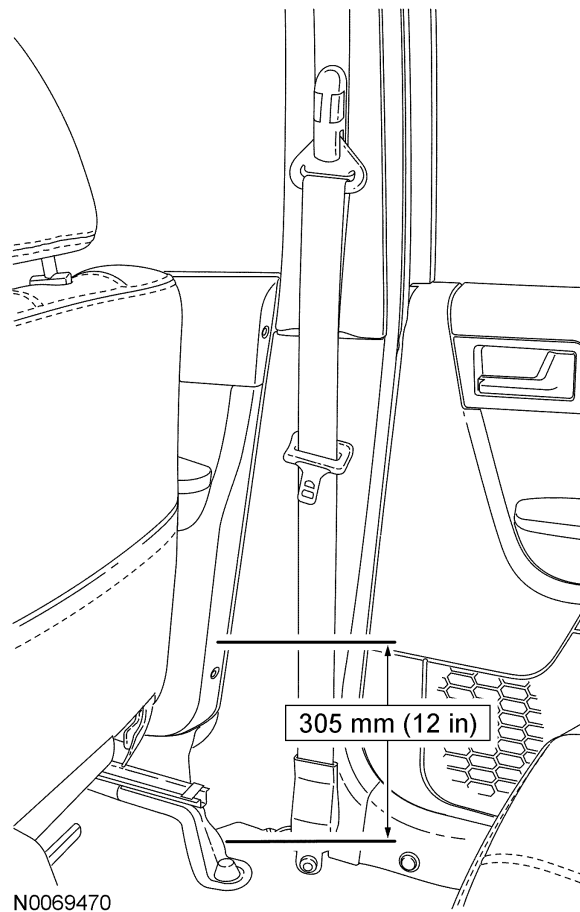
## Section 3: Mounting

Refer to the following illustration for locations that must not be used for partition mounting:



## Section 3: Mounting

### Side Impact Sensor (if equipped)



The side impact sensors are located in the base of the B-pillars. They are positioned below the safety belt retractors. The location and orientation are critical for the correct operation of all the impact sensors. Do not use the attachment bolts of the impact sensors to mount any equipment.

### Console Design and Installation


#### Restraints Control Module (RCM)


The restraints control module (RCM) is mounted on the center tunnel under the instrument panel. The RCM orientation is critical for proper operation of the restraint systems. Do not use the RCM mounting bolts for attachment purposes of any equipment.




## Section 3: Mounting


### Air Bag Deployment Interference


 **WARNING:** Do not place objects or mount equipment in front of the air bag module cover or in front seat areas that may come in contact with a deploying air bag. Dash-, tunnel- or console-mounted equipment should be placed within the specified zone. Failure to follow these instructions may result in personal injury.


 **WARNING:** Do not put anything on or over the air bag module. Placing objects on or over the air bag inflation area may cause those objects to be propelled by the air bag into your face and torso, causing serious injury.

 **WARNING:** Dash-, tunnel- or console-mounted equipment should not be placed outside of the specified zone. Failure to follow these instructions may result in personal injury.


 **WARNING:** Do not mount equipment between the side of the front seat and the door trim that would block deployment of the side air bag (if equipped). Failure to follow these instructions may result in personal injury.


 **WARNING:** Do not attempt to service, repair or modify the airbag supplemental restraint systems or its fuses. See your Ford or Lincoln Mercury dealer. Failure to follow these instructions may result in personal injury.

 **WARNING:** Modifications to the front end of the vehicle, including frame, bumper, front end body structure, tow hooks and B-pillar surrounding parts may affect the performance of the airbag sensors, increasing the risk of injury. Do not modify the front end of the vehicle.

 **WARNING:** Do not place objects or mount equipment on or near the headliner at the siderail that may come into contact with a deploying safety canopy (if equipped). Failure to follow these instructions may increase the risk of personal injury in the event of a collision.

## Section 3: Mounting

 **WARNING:** Do not attempt to service, repair or modify the safety canopy system (if equipped), its fuses, the A-, B-, or C-pillar trim, or the headliner on a vehicle containing a safety canopy. See your Ford or Lincoln Mercury dealer.

 **WARNING:** To reduce risk of injury, do not obstruct or place objects in the deployment path of the inflatable safety canopy (if equipped).

**NOTICE:** The side impact sensor is tuned to excite based on its mass (including wiring), as well as the host sheet metal. Any alteration to these components must be avoided. Additions, such as padding, wire connectors, retainers, tape or fasteners of any kind should not be used. All fasteners in this predominantly sheet metal environment should be made of steel or a non-conductive plastic to guarantee retention and longevity. If any part of a steel fastener is exposed to a wet area, it should be plated to resist corrosion.

Driver/passenger air bags affect the way equipment can be mounted in vehicles. Any surfaces that could come into contact with an air bag during deployment must not damage the air bag or alter its deployment path. Sharp edges, corners or protrusions could damage the nylon air bag material and reduce the effectiveness of the air bag. Do not mount or place any objects in the deployment path of an air bag. Air bags must be allowed to fully deploy without restriction. The deployment of air bags is not compatible with any configuration of equipment mounting that places objects in the air bag deployment path. Equipment mounted or placed in the deployment area of an air bag will reduce the effectiveness of the air bag, damage the air bag and potentially damage or dislodge the equipment.

Air bag deployment drawings are provided in Section 4. Consult the drawings before equipment is installed inside the passenger compartment to make sure that the mounted equipment does not interfere with air bag deployment.

### Seat Bolts

The vehicle safety belts and seat assemblies are factory installed in their correct location. Seat attaching bolts are not to be used as attachment points for any equipment. Any added material between the seat bolt and the seat frame could have unpredictable effects on the seat bolt torque. If the safety belts are removed for any reason, all of the appropriate attaching hardware must be hand started and then tightened to the correct torque specifications as per the workshop manual. Proper operation must be verified before returning the vehicle to service.

### Driveshaft Clearance

When installing equipment such as a console or other equipment in the console area, it is important to consider the available clearance between the underbody and the driveshaft. Never use self-tapping screws and never use screws that are longer than necessary in the console area.

# SECTION 4

# Reference

## Contents

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## Section 4: Reference


### Engineering Drawings

#### Air Bag Deployment Interference


 **WARNING:** Do not place objects or mount equipment in front of the air bag module cover or in front seat areas that may come in contact with a deploying air bag. Dash-, tunnel- or console-mounted equipment should be placed within the specified zone. Failure to follow these instructions may result in personal injury.


 **WARNING:** Do not put anything on or over the air bag module. Placing objects on or over the air bag inflation area may cause those objects to be propelled by the air bag into your face and torso, causing serious injury.

 **WARNING:** Dash-, tunnel- or console-mounted equipment should not be placed outside of the specified zone. Failure to follow these instructions may result in personal injury.


 **WARNING:** Do not mount equipment between the side of the front seat and the door trim that would block deployment of the side air bag (if equipped). Failure to follow these instructions may result in personal injury.


 **WARNING:** Do not attempt to service, repair or modify the airbag supplemental restraint systems or its fuses. See your Ford or Lincoln Mercury dealer.

 **WARNING:** Modifications to the front end of the vehicle, including frame, bumper, front end body structure, tow hooks and B-pillar surrounding parts may affect the performance of the airbag sensors, increasing the risk of injury. Do not modify the front end of the vehicle.

 **WARNING:** Do not place objects or mount equipment on or near the headliner at the siderail that may come into contact with a deploying safety canopy (if equipped). Failure to follow these instructions may increase the risk of personal injury in the event of a collision.

## Section 4: Reference

 **WARNING:** Do not attempt to service, repair or modify the safety canopy system (if equipped), its fuses, the A-, B-, or C-pillar trim, or the headliner on a vehicle containing a safety canopy. See your Ford or Lincoln Mercury dealer. Failure to follow these instructions may result in personal injury.

 **WARNING:** To reduce risk of injury, do not obstruct or place objects in the deployment path of the inflatable safety canopy.

**NOTICE:** The side impact sensor is tuned to excite based on its mass (including wiring), as well as the host sheet metal. Any alteration to these components must be avoided. Additions, such as padding, wire connectors, retainers, tape or fasteners of any kind should not be used. All fasteners in this predominantly sheet metal environment should be made of steel or a non-conductive plastic to guarantee retention and longevity. If any part of a steel fastener is exposed to a wet area, it should be plated to resist corrosion.

Driver/passenger air bags affect the way equipment can be mounted in vehicles. Any surfaces that could come into contact with an air bag during deployment, must not damage the air bag or alter its deployment path. Sharp edges, corners or protrusions could damage the nylon air bag material and reduce the effectiveness of the air bag. Do not mount or place any objects in the deployment path of an air bag. Air bags must be allowed to fully deploy without restriction. The deployment of air bags is not compatible with any configuration of equipment mounting that places objects in the air bag deployment path. Equipment mounted or placed in the deployment area of an air bag will reduce the effectiveness of the air bag, damage the air bag and potentially damage or dislodge the equipment.

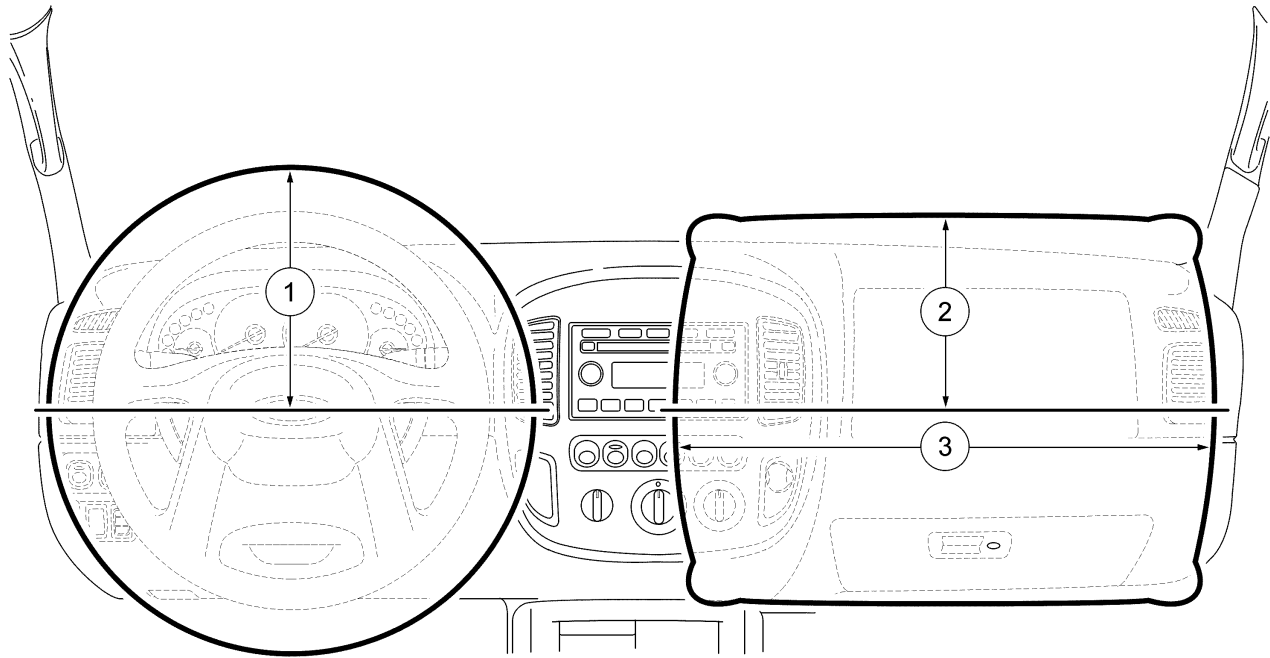
Some approximate dimensions for air bags, at full inflation, are provided below. These dimensions are somewhat flexible and represent free form deployments without the loading of occupants. The zone dimensions provided below are approximate and will vary with the loading of occupants in the seats.

All air bag and equipment mounting zone dimensions are approximate due to different air bag deployment characteristics.

Do not mount equipment between the side of the front seat and the door trim that would block deployment of the side air bag.

## Section 4: Reference

Note: Do not mount equipment on the instrument panel between the driver and passenger airbags due to deployment variability.

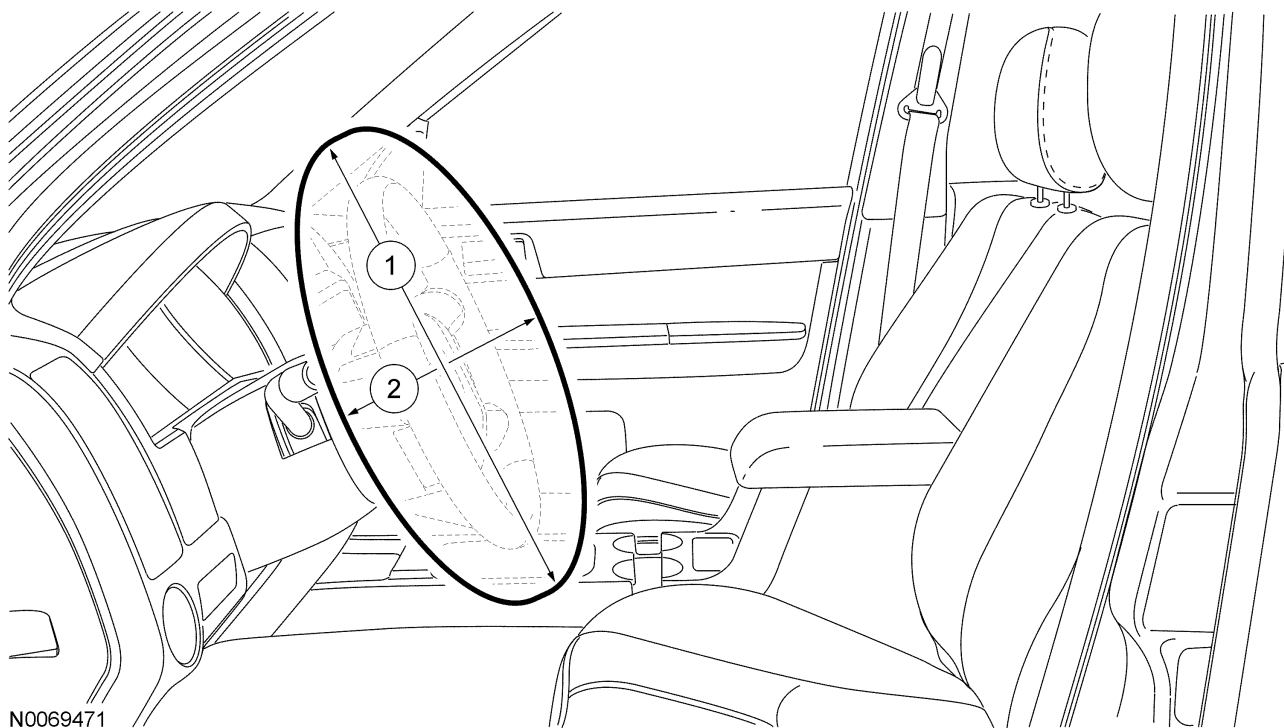


N0053065

*Figure 1.*

1. 324 mm (12.75 in) from center of air bag door
2. 450 mm (17.7 in) from center of air bag door
3. 610 mm (24 in)

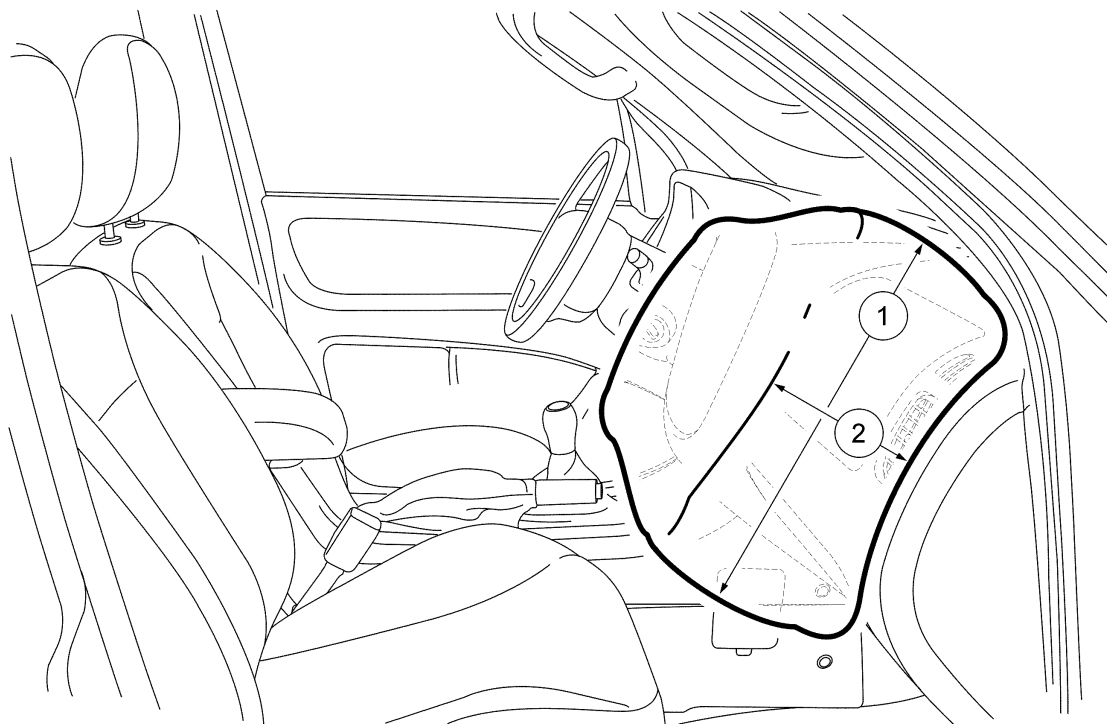
## Section 4: Reference



*Figure 2.*

1. 648 mm (25.5 in) from center of air bag door
2. 229 mm (9.0 in) from center of air bag door

## Section 4: Reference



N0053067

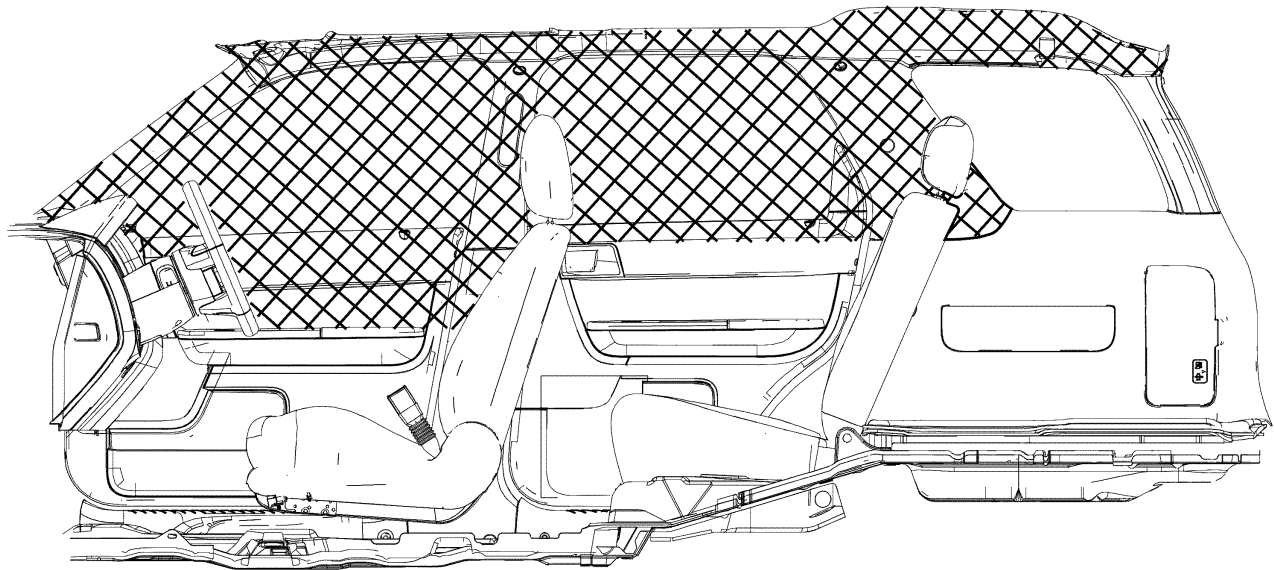
*Figure 3.*

1. 730 mm (28.7 in) from center of air bag door
2. 650 mm (25.6 in) from center of air bag door



## Section 4: Reference

Note: Vehicles equipped with safety canopy module and side air bag module only.



N0069459

Figure 4.

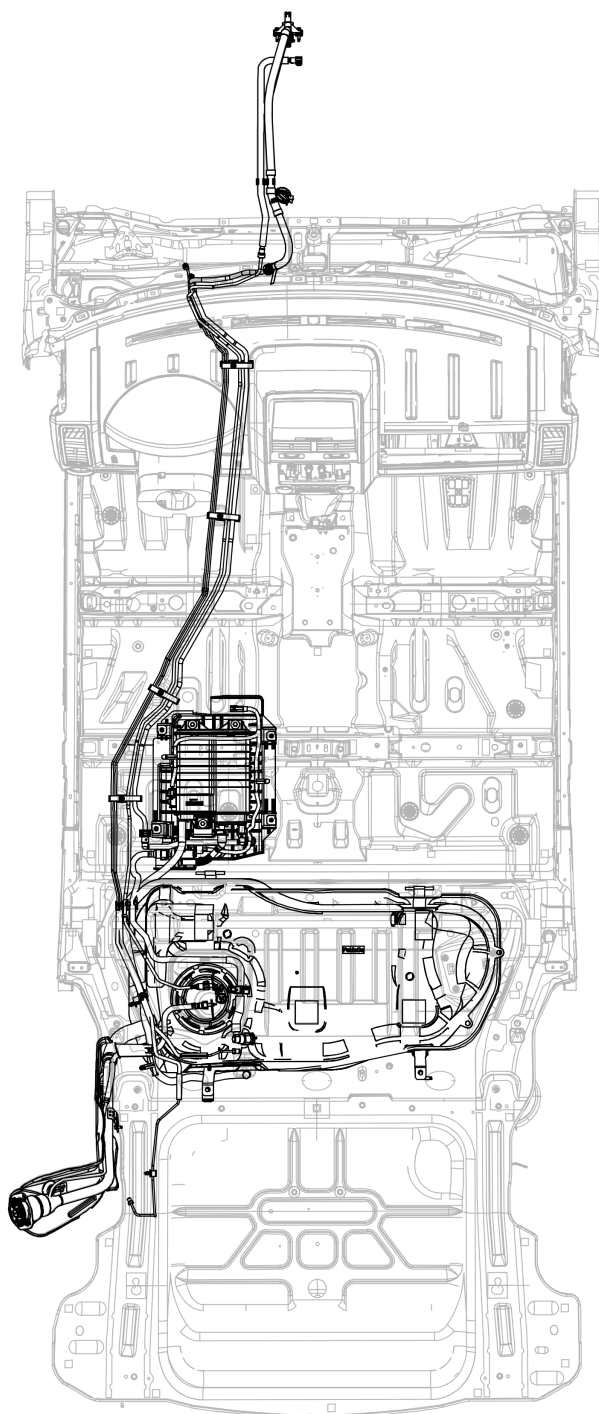
**NOTICE:** The side impact sensor is tuned to excite based on its mass (including wiring), as well as the host sheet metal. Any alteration to these components must be avoided. Additions, such as padding, wire connectors, retainers, tape or fasteners of any kind should not be used. All fasteners in this predominantly sheet metal environment should be made of steel or a non-conductive plastic to guarantee retention and longevity. If any part of a steel fastener is exposed to a wet area, it should be plated to resist corrosion.

**NOTICE:** Any surfaces that could come into contact with side air curtain (Safety Canopy®) during deployment must not damage the curtain. Sharp edges, corners or protrusions could damage the curtain and reduce the overall effectiveness of the side air curtain.

- Do not mount equipment to the A-, B- and C-pillars.
- Do not mount equipment on the headliner within 200 mm (8 in) of the side edges.
- Do not mount equipment above the beltline within 200 mm (8 in) of the side glass from the A-pillar leading edge to the rear edge of the C-pillar.
- Do not mount equipment on the headliner along the siderails.

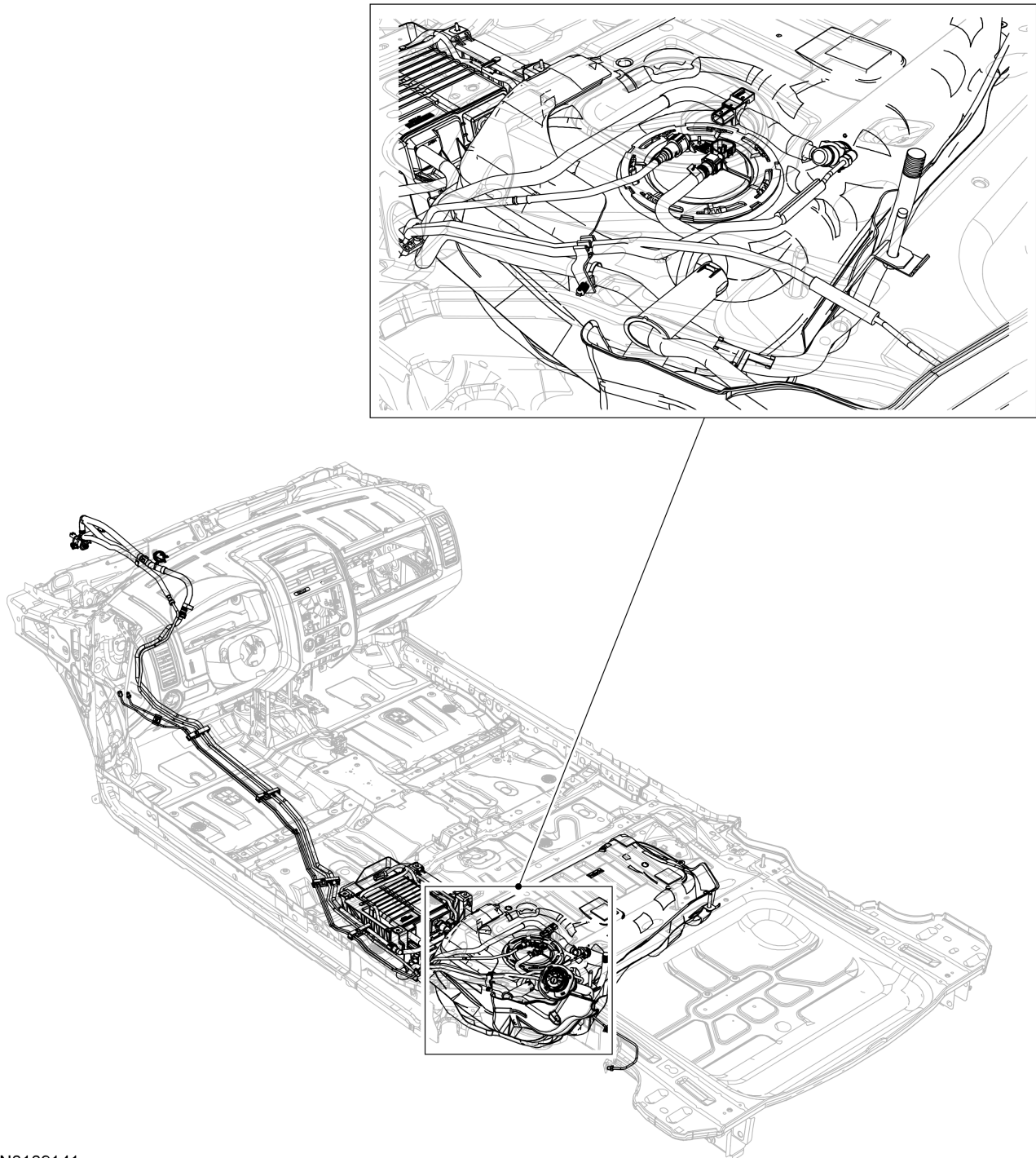
## Section 4: Reference

## Evaporative Emissions and Fuel Systems



N0109140

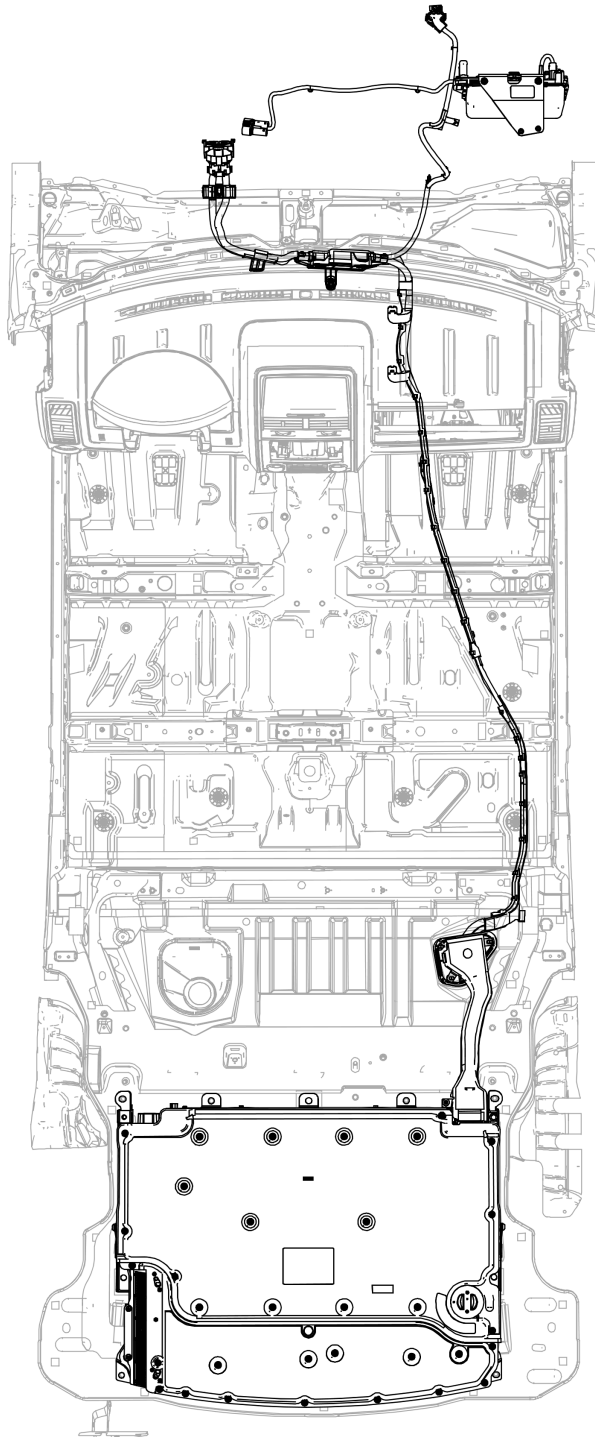
## Section 4: Reference



N0109141

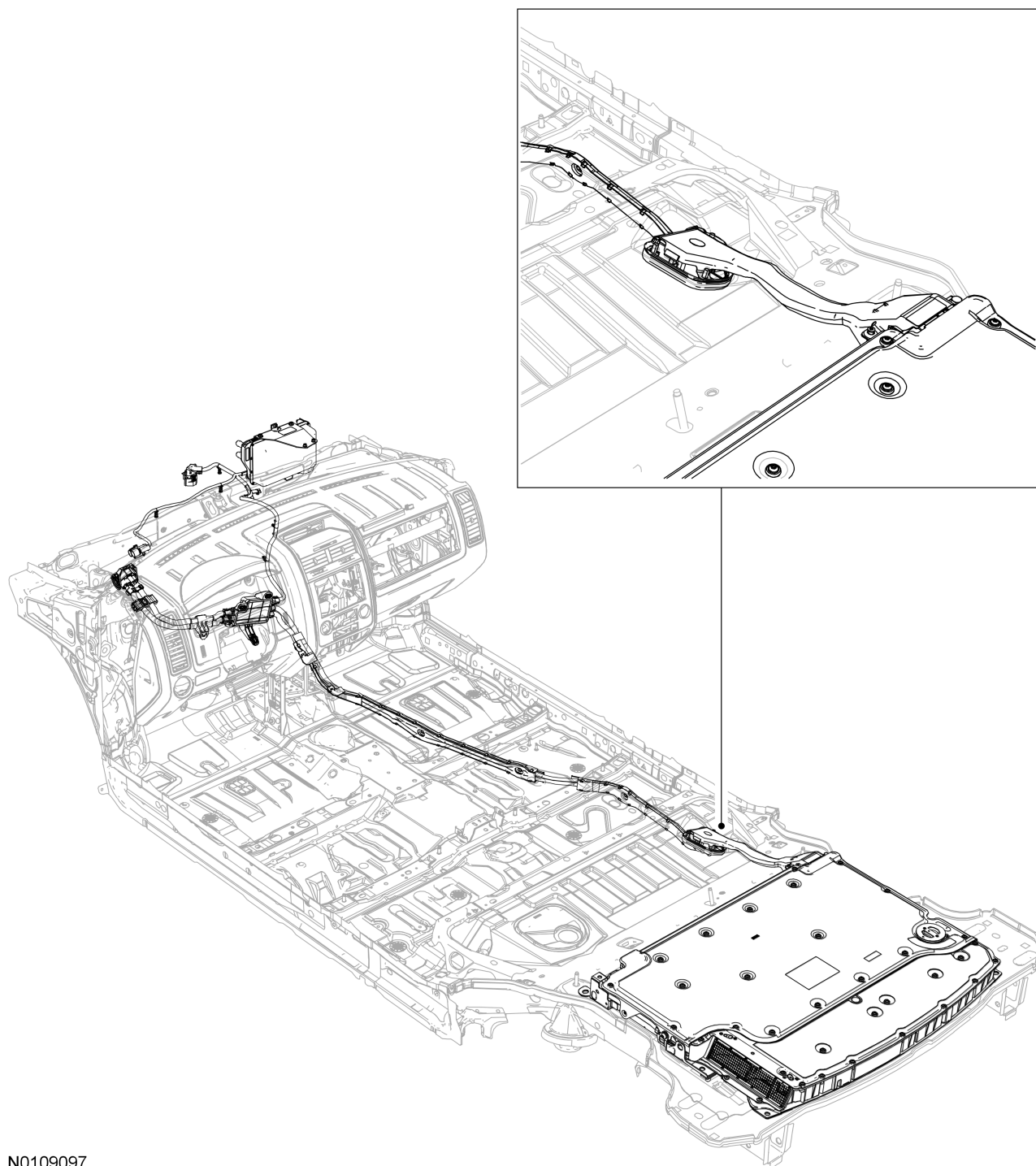
## Section 4: Reference

### High-Voltage System



N0109096

## Section 4: Reference

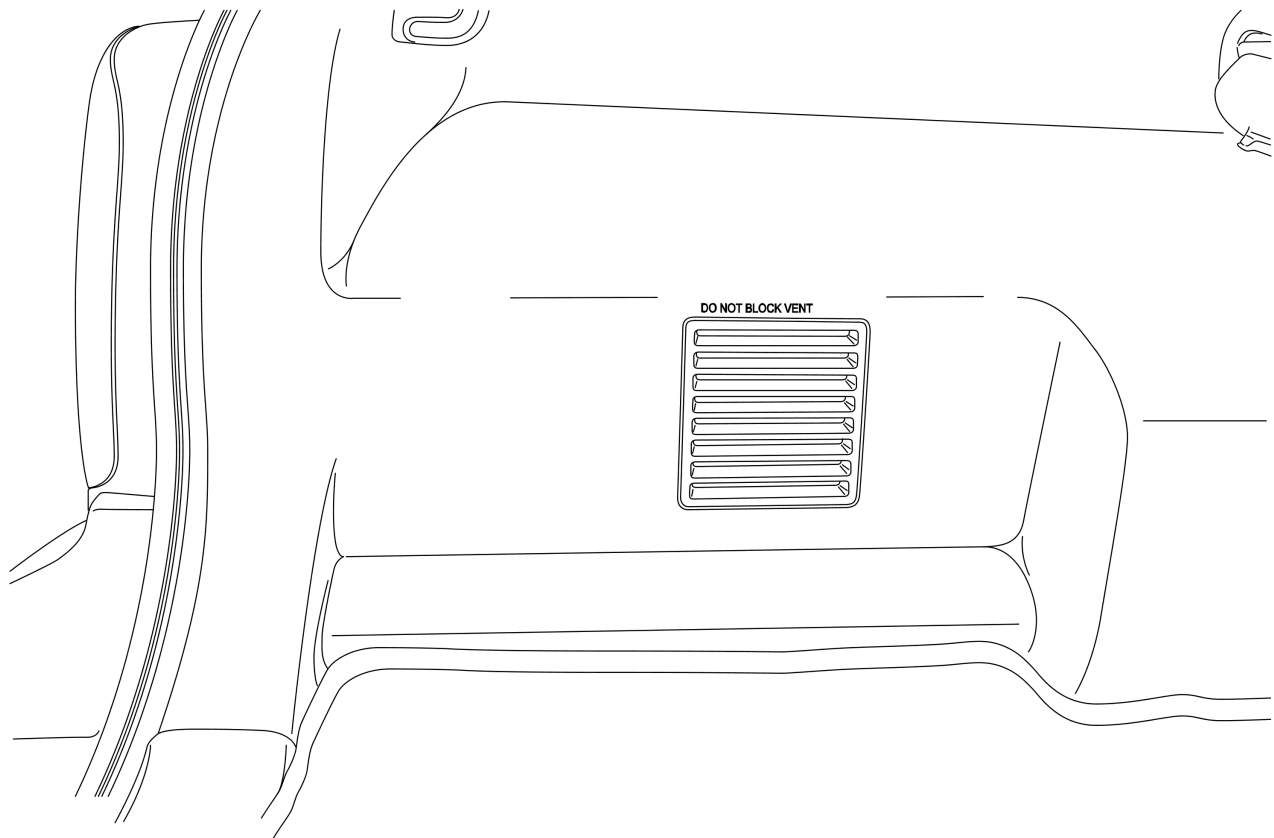


N0109097

## Section 4: Reference

### High Voltage Traction Battery (HVTB) Vent

Note: The HVTB vent is located on the left rear interior trim panel. Do not block vent or system shutdown can occur.



N0109087