

2010

FUSION HYBRID

MILAN HYBRID

MODIFIERS GUIDE



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Introduction

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Introduction

Ford Motor Company has assembled this 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 Fusion, Milan 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 US 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 the guidelines are 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 that meet or exceed Ford’s rigorous engineering and safety specifications. Ford Motor Company will repair or replace any properly 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 20,000 km (12,000 mi) (whichever occurs first), or
- the remainder of your new vehicle limited warranty.

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 60,000 km (36,000 mi) (whichever occurs first). Contact your dealer for details and a copy of the warranty.

Introduction

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 gross vehicle weight rating (GVWR) or gross axle weight rating (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 the anti-lock brake system (ABS), 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 guide 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 guide provides general directions and guidelines for performing modifications to the Fusion Hybrid and Milan Hybrid, which will help assure reliability.

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

Section 1: General Information

Warnings, Notices and Notes

As you read through this guide, you will come across WARNINGS, NOTICES and NOTES. Each one is there for a specific purpose. WARNINGS remind you to be especially careful in those areas where carelessness can cause you personal injury. NOTICES are given to prevent you from making an error that could damage the vehicle or the vehicle components. NOTES give you added information that will help you to complete a particular procedure. The following list contains some generalized 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 this instruction may result in severe personal injury or death.
- The nominal HVTB voltage is 275 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 personal injury or death.
- The HVTB and charging systems 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 each 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.
- Do not cut, weld or screw into the high-voltage battery case or penetrate the case in any way.
- Do not mount equipment to the high-voltage (orange) wiring/cables, the high-voltage cover or the HVTB cooling plenum.
- 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 in x 4 in

Section 1: General Information

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.
- Keep yourself and your clothing away from moving parts, especially the accessory drive belt, when the engine is running.
- To reduce the risk of serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, 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 cooling fan blades.
- Failure to follow these instructions may result in severe personal injury or death.

NOTICE:

- Do not disable the air conditioning (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.
- Remove the service disconnect while carrying out any vehicle modifications.

Making Safety Devices and Elements Inoperative

The vehicle contains many safety features required by US 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.”

Section 1: General Information

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.

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 the low-voltage wiring, the high-voltage system including the high-voltage traction battery (HVTB) and the (orange) high-voltage wiring/cables, 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 or suspension failure. If you have questions regarding tire replacement, see an authorized Ford or Lincoln-Mercury dealer.

NOTICE: Do not install an off road, 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.

Section 1: General Information

Note: The Fusion Hybrid and Milan Hybrid vehicles are equipped with a reduced rolling resistance tire design. The use of a different tire can affect 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.

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.

Section 1: General Information

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 door.

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 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.

Section 1: General Information

Vehicle Storage — Electrical

NOTICE: 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 battery.

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.

Vehicle Storage — Body

- Wash vehicle thoroughly to remove any contaminants from the exterior surfaces and underside of the vehicle.
- 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 your foot on the brake pedal (and brake applied), shift the transmission into all gears while the engine is idling.

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.

Section 1: General Information

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 vehicle is 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, the vehicle 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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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 backprobe or splice into the high-voltage system. Voltage in the system is 275 volts DC. 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 (orange) 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:

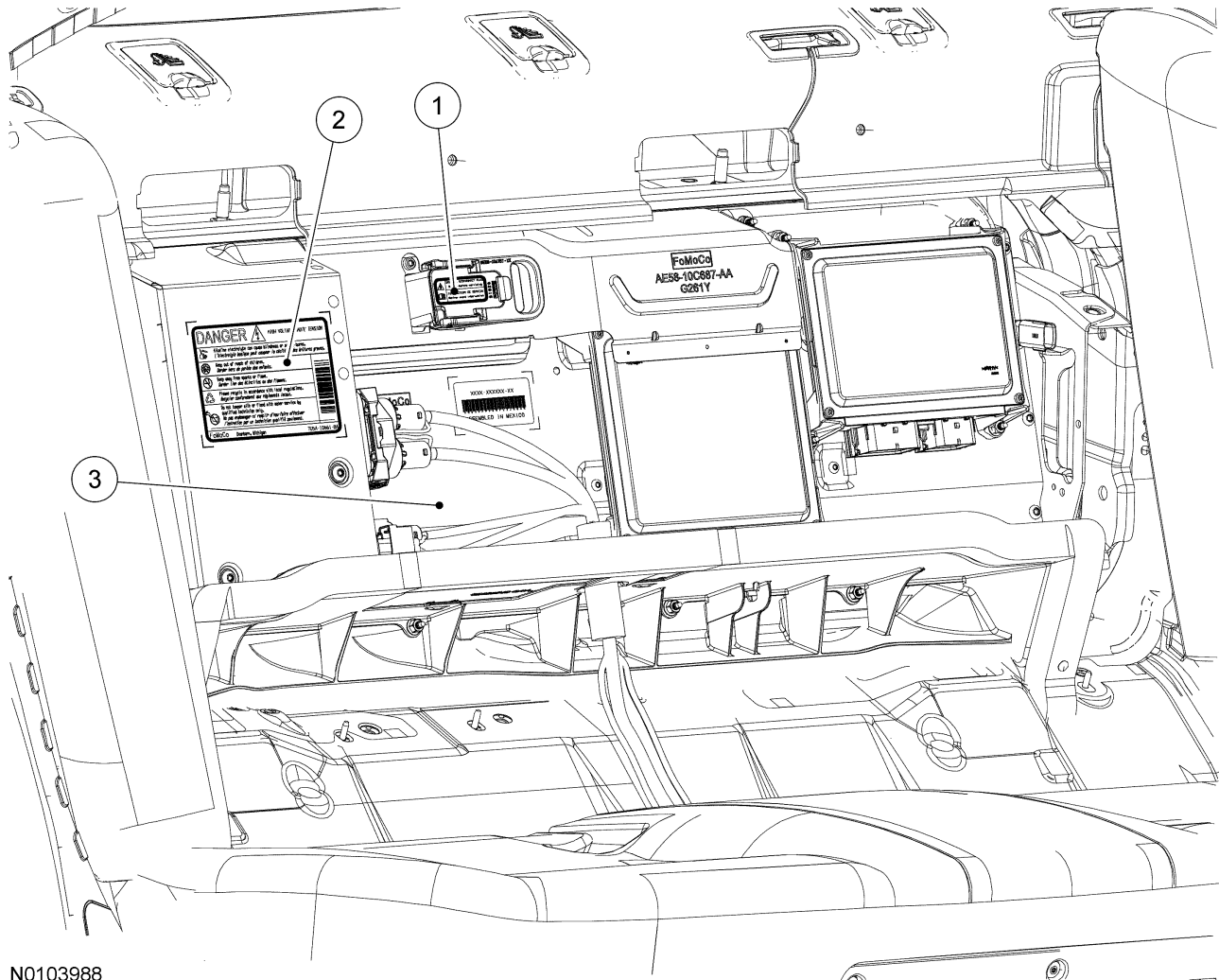
- Storage of electricity for later use
- Voltage stabilizer for the electrical system
- Temporary power source when electrical loads exceed the DC/DC converter output current

High-Voltage Traction Battery (HVTB)

NOTICE: Do not backprobe, splice or repair the high-voltage (orange) wiring. Voltage in the system is 275 volts DC. Damage may occur to equipment added to the system.

The high-voltage traction battery (HVTB) is a 275 volt DC source connected in a floating ground system. The battery receives, stores and delivers high-voltage electrical power when required by the vehicle control strategy. On the HVTB there are 2 controllers: a battery energy control module (BECM) and a battery pack sensing module (BPSM). **None** of the BECM or the BPSM wiring should be tapped or spliced to check for battery voltage (power), ground or signals. There is also the bussed electrical center (BEC) which houses the contactors, current sensor and the associated components. The service disconnect is mounted between the BEC and the BPSM and is used to disconnect the high-voltage from the vehicle system.

Section 2: Electrical



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Figure 1.

1. High-voltage service disconnect
2. High-voltage cover
3. High-voltage traction battery (HVTB)

DC/DC Converter

The DC/DC converter is a liquid-cooled component that converts high-voltage DC to low-voltage DC power. It maintains an electrical isolation between the 2 DC power systems. This system converts the high voltage (275 volts) to low voltage (12 volts) that provides power to the vehicle low-voltage battery systems. The PCM controls the operation of the DC/DC converter through an enabled input from the PCM to the DC/DC converter.

Section 2: Electrical

DC/AC Inverter and AC Power Point

Note: Do not keep electrical devices plugged in the power point when the device is not in use. It is not recommended to use any extension cord with the 110V AC 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 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

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 12V DC/180W.

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


Section 2: Electrical

Buffer Zone

 **WARNING:** The high-voltage traction battery (HVTB) voltage is 275 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 systems 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 carrying out any modifications on this vehicle. Failure to follow these instructions may result in severe personal injury or death.

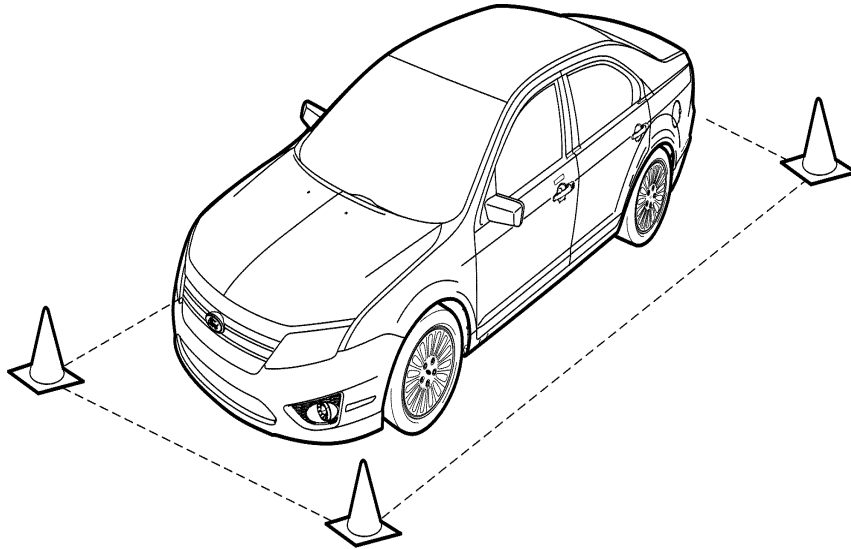
 **WARNING:** Before carrying out any vehicle modifications, the high-voltage traction battery (HVTB) must be depowered. Failure to follow this instruction may result in severe personal injury or death.

 **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.



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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 each 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 the insulating gloves.


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4. The rubber insulating gloves must be able to handle up to 500V AC and meet all of the American Society for Testing and Materials (ASTM) standards.

High-Voltage Traction Battery (HVTB) Systems Depowering

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

 **WARNING:** The high-voltage traction battery (HVTB) voltage is 275 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.

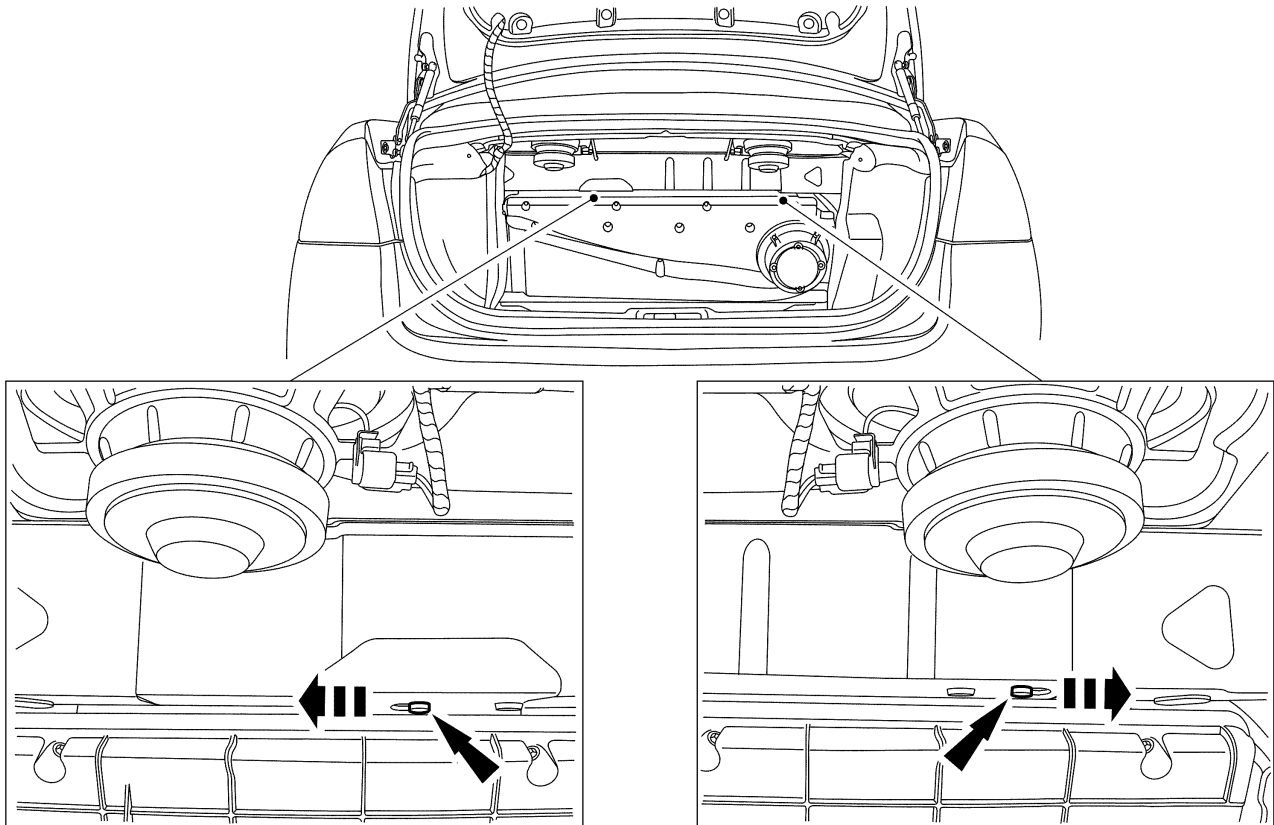
 **WARNING:** The high-voltage traction battery (HVTB) and charging systems contain high-voltage components and wiring. High-voltage cables and wiring are orange in color. High-voltage insulated safety gloves and a face shield must be worn when modifying the vehicle in close proximity to the high-voltage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

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. Note: If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise the backrest upward to release the safety belt retractor and the belt webbing.

Fold the LH backrest down.

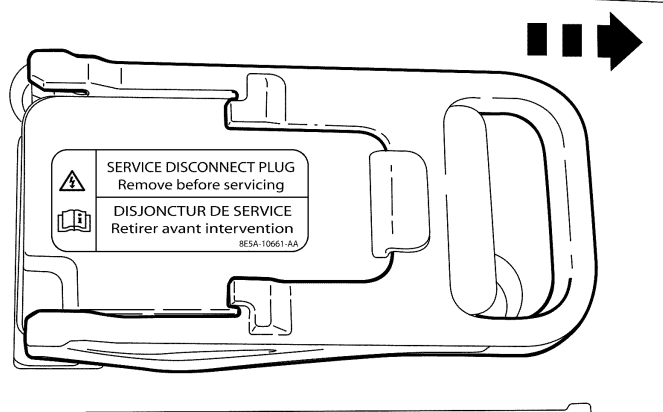
- Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
- Push the release lever toward the outboard side of the vehicle and fold the backrest down.

Section 2: Electrical



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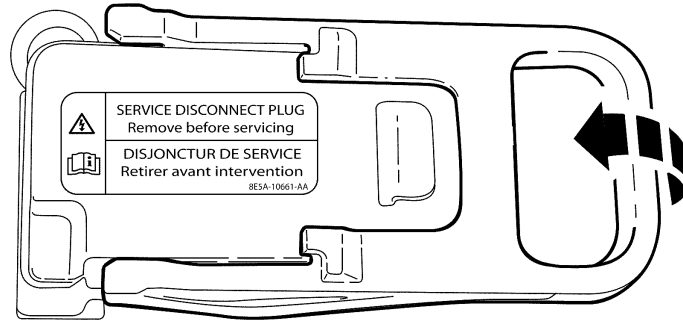
4. Locate and slide the handle of the service disconnect toward the LH side of the vehicle.



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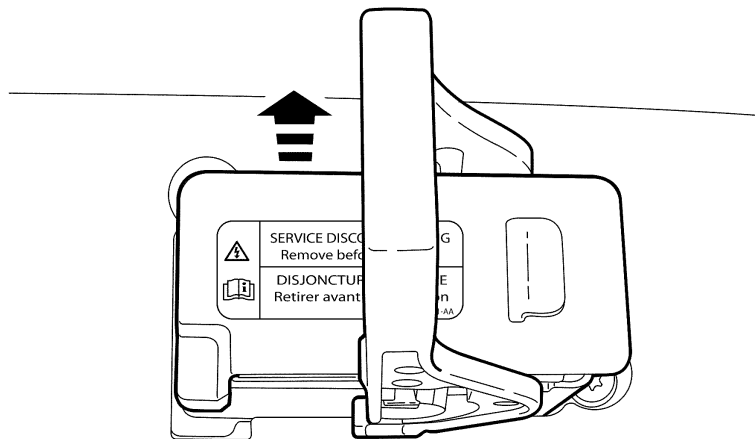
Section 2: Electrical

5. Rotate the handle upward.



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6. Pull the service disconnect out and away from the HVTB. Make sure to store the service disconnect in a place where it cannot be accidentally re-installed while the vehicle is being serviced.



N0103503

7. Wait 5 minutes after the service disconnect has been removed before continuing service. This allows any residual voltage in the high-voltage system to dissipate.
8. To repower the system, reverse the depowering procedure.

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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. As an example, modern light bars and radios use a fraction of the current than units made as recently as 1996. 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 in the electrical system load and will impact available power as well. When a vehicle is sitting and no one is in the car, certain electrical equipment can be turned off until the driver is ready to get back into the vehicle.

Generator Output

The Fusion Hybrid and Milan Hybrid generators are different from those used on the standard Fusion/Milan. The Fusion Hybrid and Milan Hybrid have 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) F4 (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.

Component	Amps
Base	
Miscellaneous base loads	36.1
Cooling	
Cooling fan (variable speed)	24.0
Climate Control	
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

(Continued)

Section 2: Electrical

Component	Amps
Heater fan to foot — M/H speed (fresh air)	10.7
Lighting	
Exterior and IP lamps (non-dimmable)	4.5
Headlamps — low beam	10.0
Fog lamps	8.0
Brake lights (with CHMSL)	7.5
Heated Features	
Heated rear window (includes heated mirrors)	14.0
Heated front seat — LH	6.5
Heated front seat — RH	6.5
Other	
Radio	1.9
DC/AC inverter	10.7
Speed control	1.8
Typical Vehicle Load = 95-110 Amps	

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

- Do not backprobe, splice or repair the high-voltage system (orange) wiring/cables.
- Do not mount to or modify the high-voltage system (orange) wiring/cables in any way.
- Do not cut, weld or screw into the HVTB case or penetrate the batteries in any way.
- Air bag restraint systems must remain intact as received from Ford Motor Company. Before modifications are done to the vehicle, the system must be depowered by following the instructions provided in the current Fusion, Milan Workshop Manual.
- 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.
- Provide protective covering in all areas that could be damaged during normal equipment installations.
- 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.
- 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.
- Properly secure all wiring relocated or removed while working behind the instrument panel to prevent chafing, squeaks and rattles.
- 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.
- Inspect all Ford gauges, lights and switches for correct operation after instrument panel work is performed.
- 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.
- 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

- 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.
- Disconnect the negative battery cable of vehicles stored on site to reduce the possibility of draining the battery by lights or other equipment.

Keep-Alive Memory (KAM) Power

The electronic engine and/or transmission control modules and the HVTB BECM require low battery voltage (12 volt) to be supplied at all times to maintain the keep-alive memory (KAM). Keep this in mind when installing load disconnect switches or solenoids.

Equipment Grounding Guidelines

NOTICE: Do not use/modify any of the high-voltage system grounds or damage to the high-voltage components may occur.

- 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 (XPLPE 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.

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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 its properties allow it to set 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 the vehicle's existing low-voltage (12 volt) 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.

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- 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.
- Electro magnetic interference (EMI) shielding — 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

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.

- 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).

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- 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.

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.

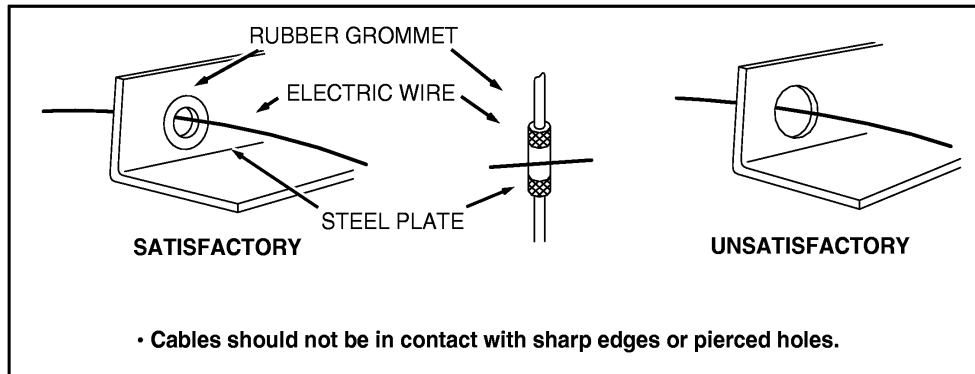
Wire Routing

 **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 severe personal injury in the event of a collision.**

Wire harness routing should conform to the following:

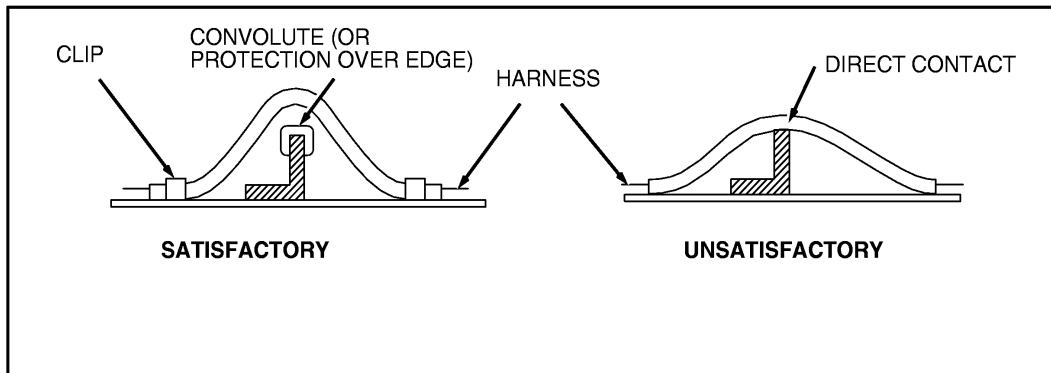
- Protect wires routed through holes in sheet metal or castings with a grommet whether or not conduit is used (see figure below).

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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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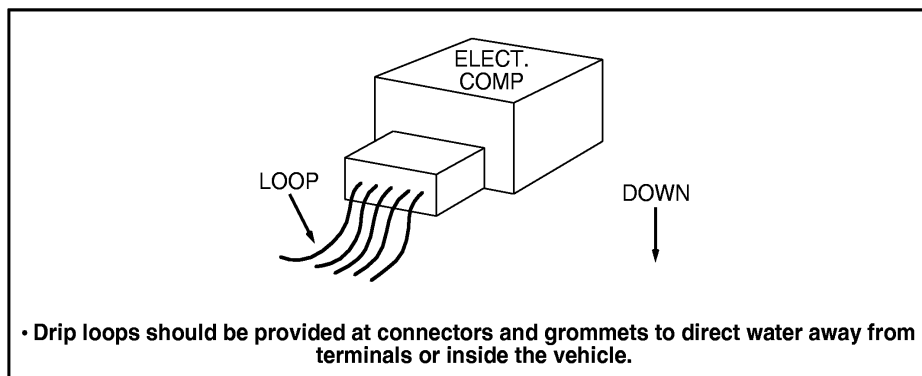
- Route wires to provide at least 76 mm (3 in) of clearance to moving parts in their extreme movement location, unless positively fastened and protected by conduit.
- Avoid wire routing without conduit in areas where temperatures exceed 82°C (180°F). Minimum clearance of 152 mm (6 in) should be maintained 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).

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Wire Retention and Routing

Use the following criteria to determine the location of retainers:

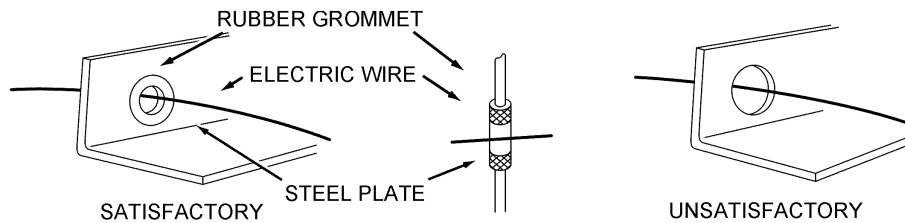
- Size and weight of wire bundle.
- Holes with poor accessibility that prevent installation of locators.
- Movement of wires that can result in abrasion, squeaks and rattles.
- When wiring is routed between 2 members where relative motion can occur, the wiring should be secured to each member with enough 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).



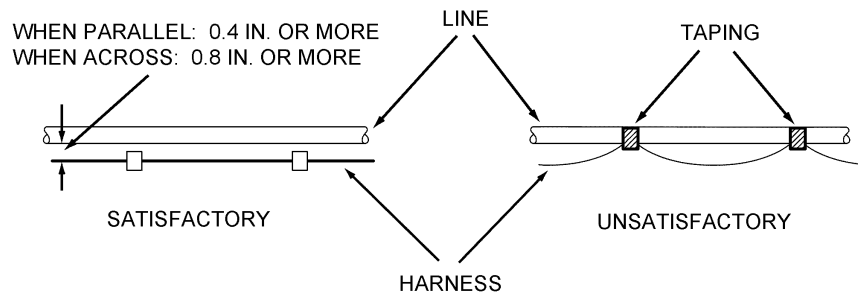
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- Avoid routing wires into areas exposed to wheel splash. When such routing cannot be avoided, adequate clipping and/or protective shields are required to protect the wires from stone and ice damage. Allow adequate slack in wiring between the engine 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:

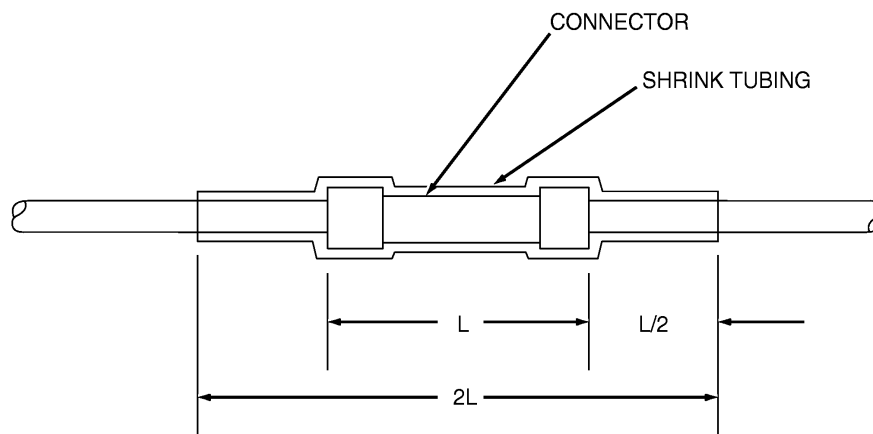
- Avoid using fasteners that are too long for the application or are in an area which might damage vehicle components, including wiring, brake lines, fuel tank and lines, powertrain components, exhaust system and suspension.
- Do not use pointed screws for attachments. Also check that screws used in 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

⚠ WARNING: Do NOT splice into or repair high-voltage (orange) wiring/cables. The high voltage in this system is 275 volts DC. Failure to follow these instructions may result in severe personal injury or death.

- 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.



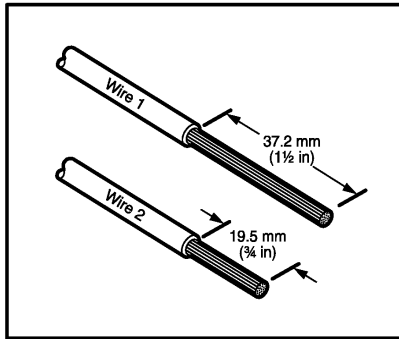
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Recommended Splicing Method — Solder (For 16 AWG and Smaller Diameter Wire Only)

1. Disconnect the battery ground cable.

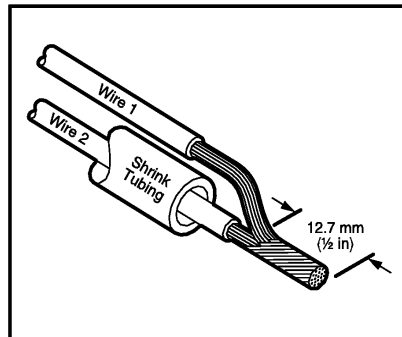
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- Strip wires to appropriate length.



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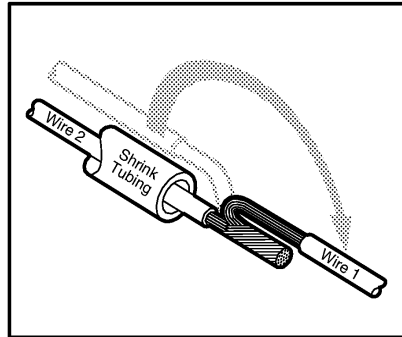
- Install heat shrink tubing.
- Twist the wires together.
- Note: Use resin-core mildly-activated (RMA) solder. Do not use acid-core solder. Solder wires together.



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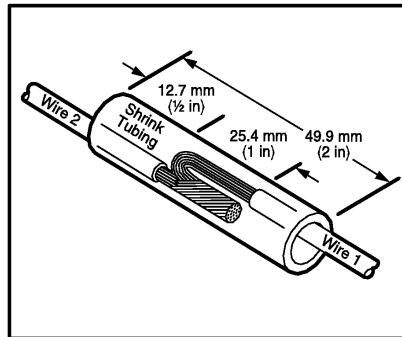
- Note: Wait for solder to cool before moving wires. Bend wire No. 1 back in a straight line.

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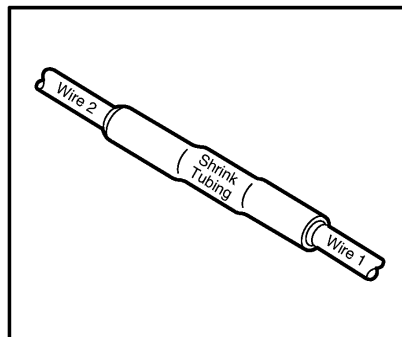
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7. Note: Overlap tubing on both wires.
Evenly position heat shrink tubing over wire repair.



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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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- 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

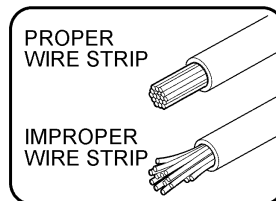
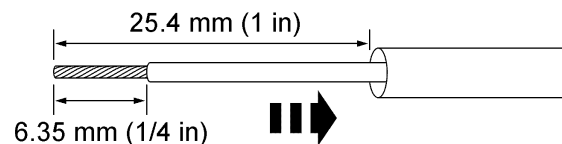
Heat Shrinkable Tubing (Heat Shrink) (Ford Specification ESB-M99D56-A2)

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.



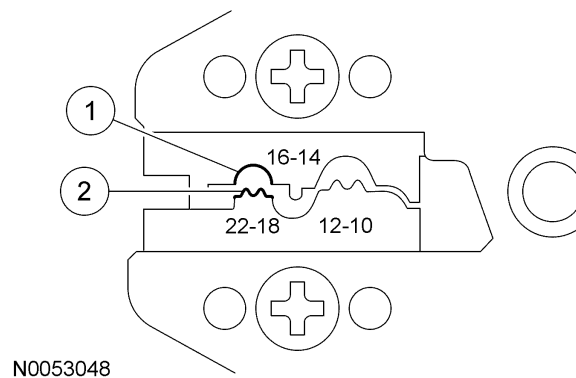
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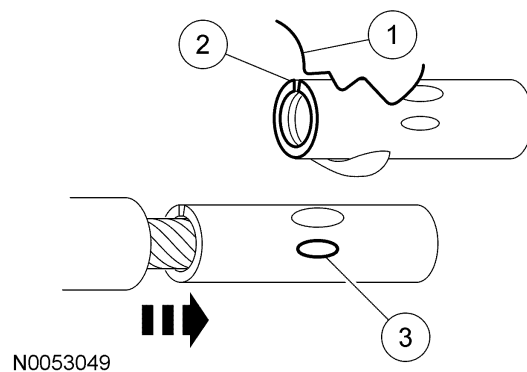
4. Select the appropriate wire splice for the wires to be spliced from Rotunda Wire Splice Kit 164-R5903.
5. Note: Rotunda Pro-Crimper 164-R5901 supplied with the wire splice kit is the only tool that can be used with these splices.

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.

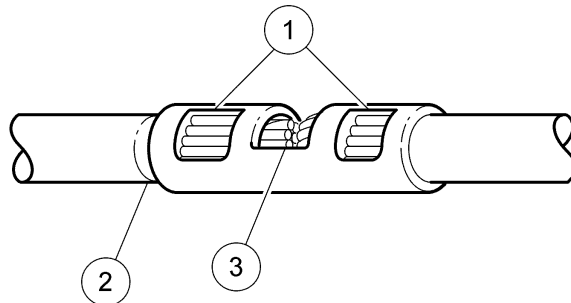


7. Repeating Step 6, crimp the other half of the splice.

Section 2: Electrical

8. Check for acceptable crimp.

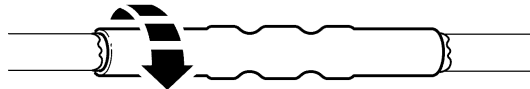
- (1) Crimp should be centered on each end of the butt splice.
- (2) Wire insulation does not enter butt splice.
- (3) Wire is visible through inspection hole of splices.



N0053050

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

10. Use a 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

2010 Fusion, Milan Wiring Diagram Excerpts

The following pages are from sections of the 2010 Fusion, Milan Wiring Diagrams manual.


Ordering Information

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

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

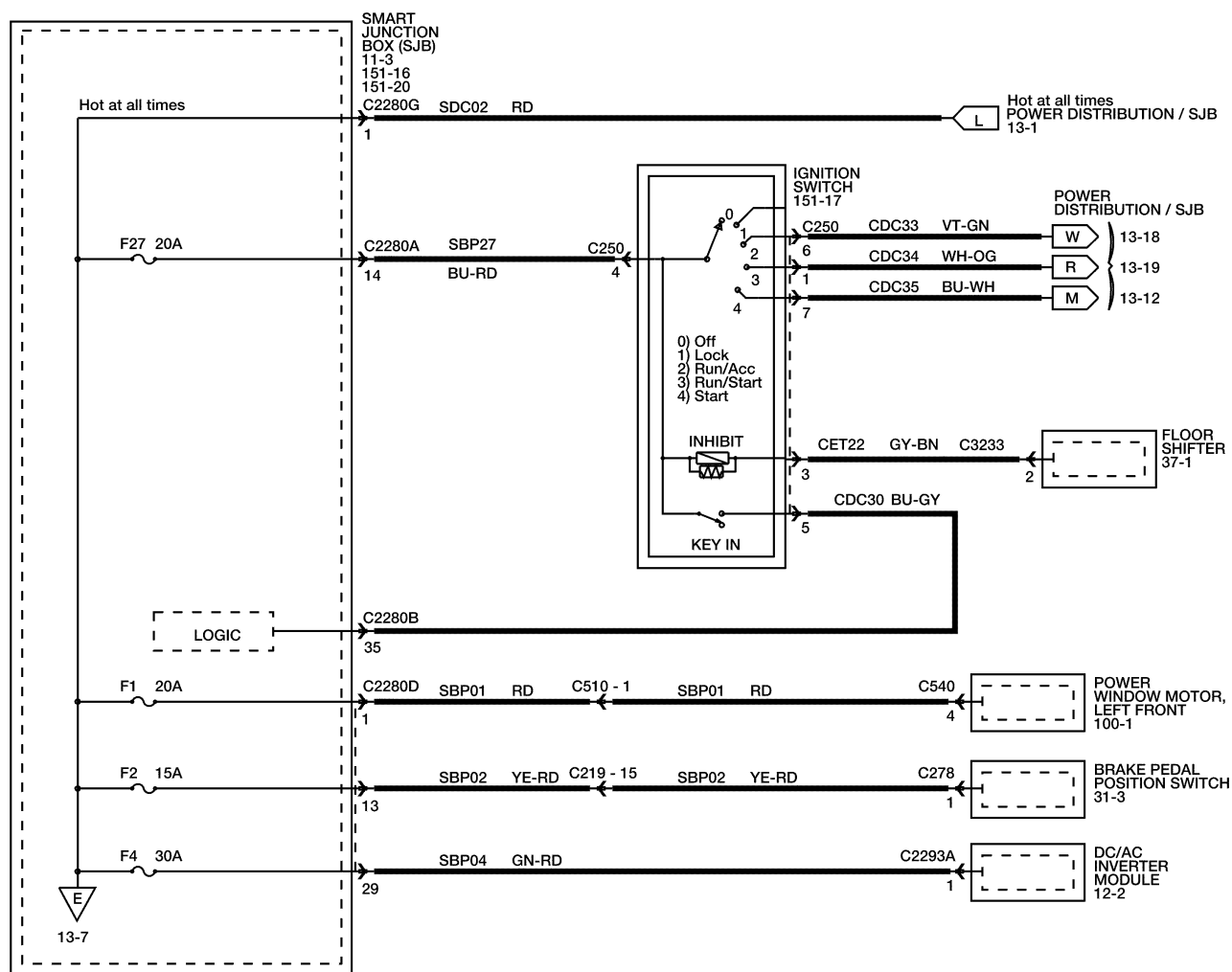
Available publications include Workshop Manuals, Wiring Diagrams manual, PC/ED Manuals and Owner's Literature.

Wiring Diagrams

 **WARNING: The following wiring diagrams contain high-voltage circuits. Do not backprobe, splice, modify or repair in any way. The system voltage is 275V DC. Failure to follow this instruction may result in severe injury or death.**

Note: Smart junction box (SJB) F4 (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.

Section 2: Electrical

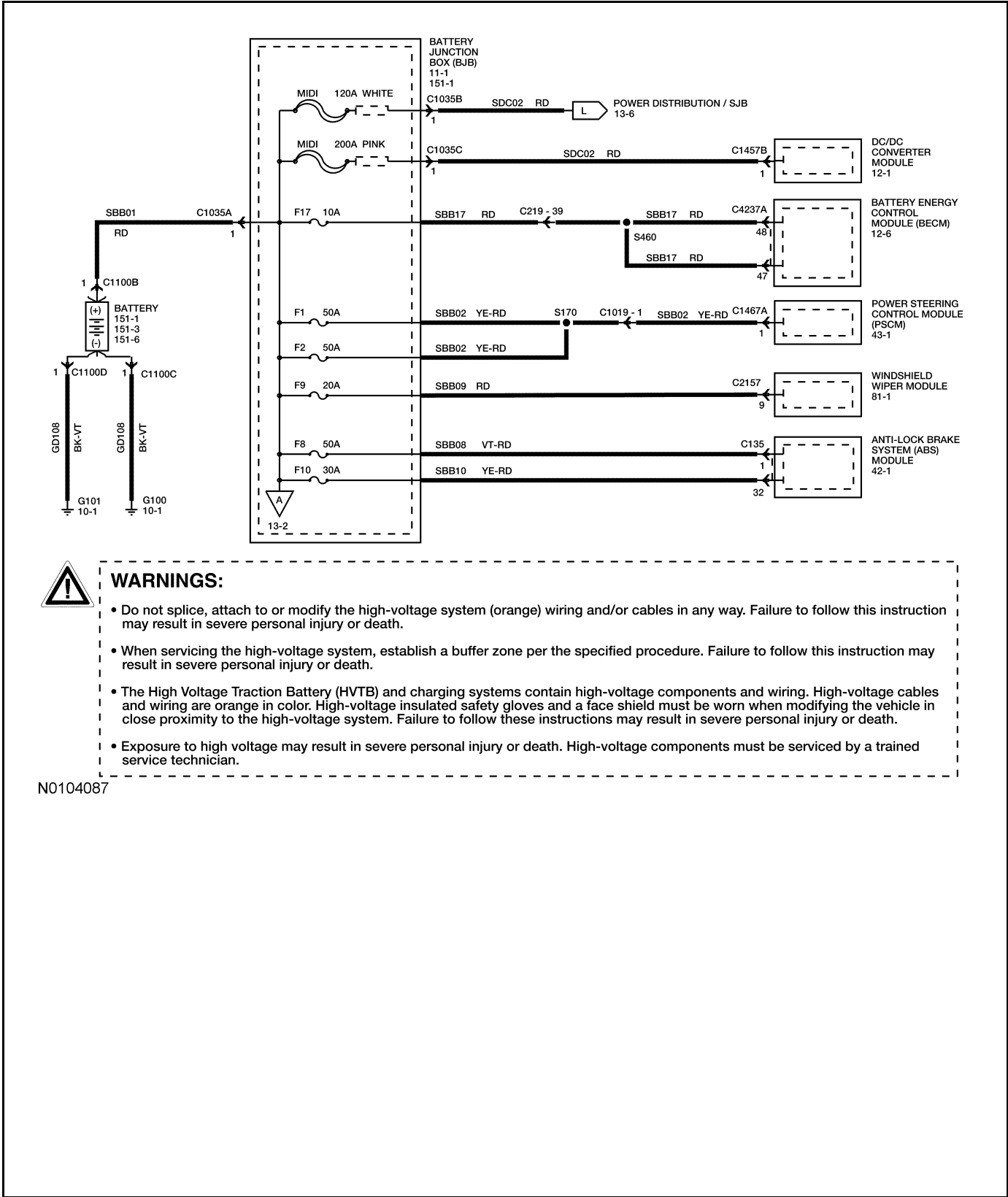


WARNINGS:

- Do not splice, attach to or modify the high-voltage system (orange) wiring and/or cables in any way. Failure to follow this instruction may result in severe personal injury or death.
- When servicing the high-voltage system, establish a buffer zone per the specified procedure. Failure to follow this instruction may result in severe personal injury or death.
- The High Voltage Traction Battery (HVTB) and charging systems 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.
- Exposure to high voltage may result in severe personal injury or death. High-voltage components must be serviced by a trained service technician.

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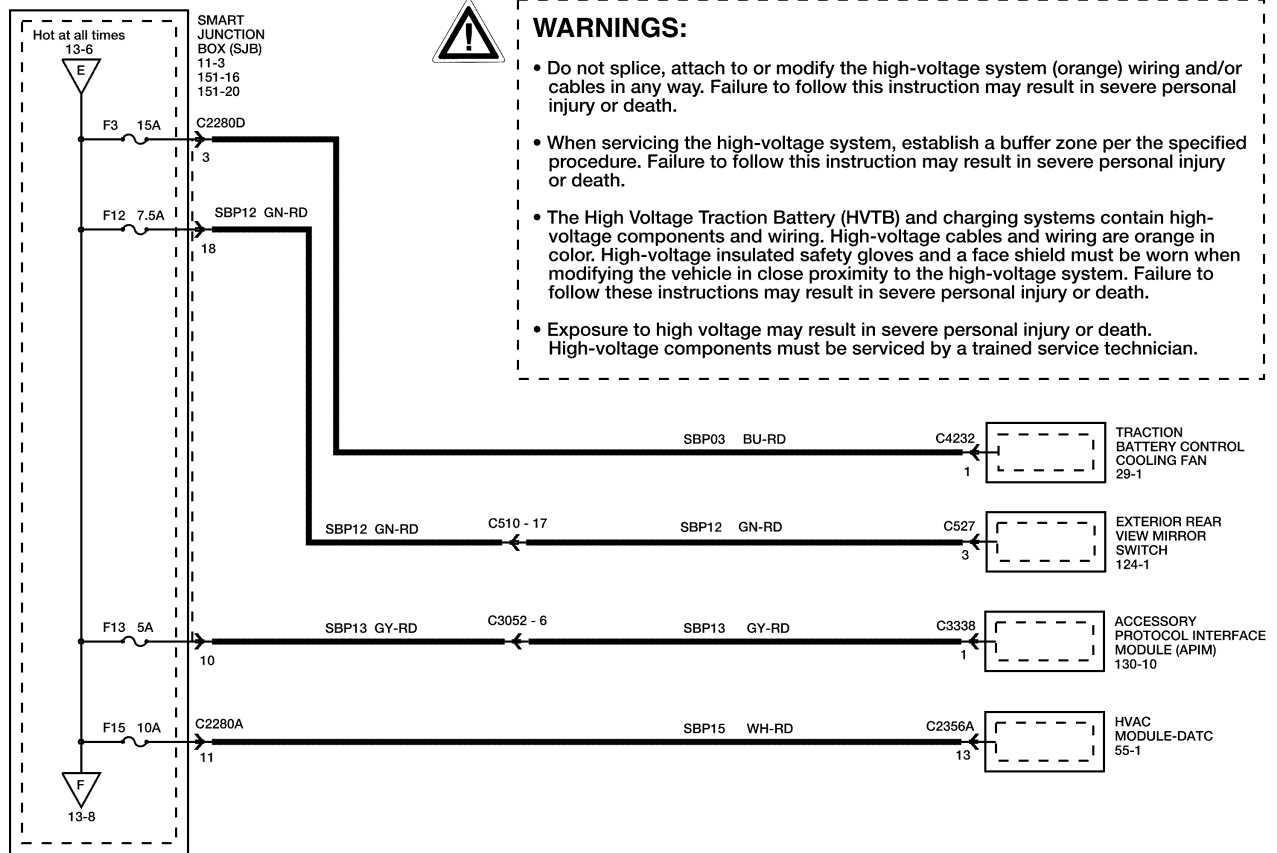
Section 2: Electrical



- Do not splice, attach to or modify the high-voltage system (orange) wiring and/or cables in any way. Failure to follow this instruction may result in severe personal injury or death.
- When servicing the high-voltage system, establish a buffer zone per the specified procedure. Failure to follow this instruction may result in severe personal injury or death.
- The High Voltage Traction Battery (HVTB) and charging systems 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.
- Exposure to high voltage may result in severe personal injury or death. High-voltage components must be serviced by a trained service technician.

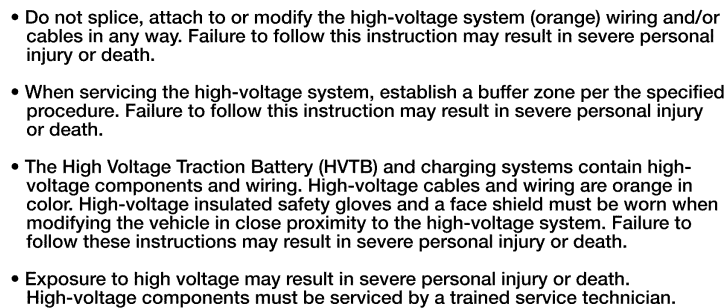
2010 Fusion Hybrid, Milan Hybrid Modifiers Guide, 07/2009

Section 2: Electrical



N0104088

Section 2: Electrical



2010 Fusion Hybrid, Milan Hybrid Modifiers Guide, 07/2009

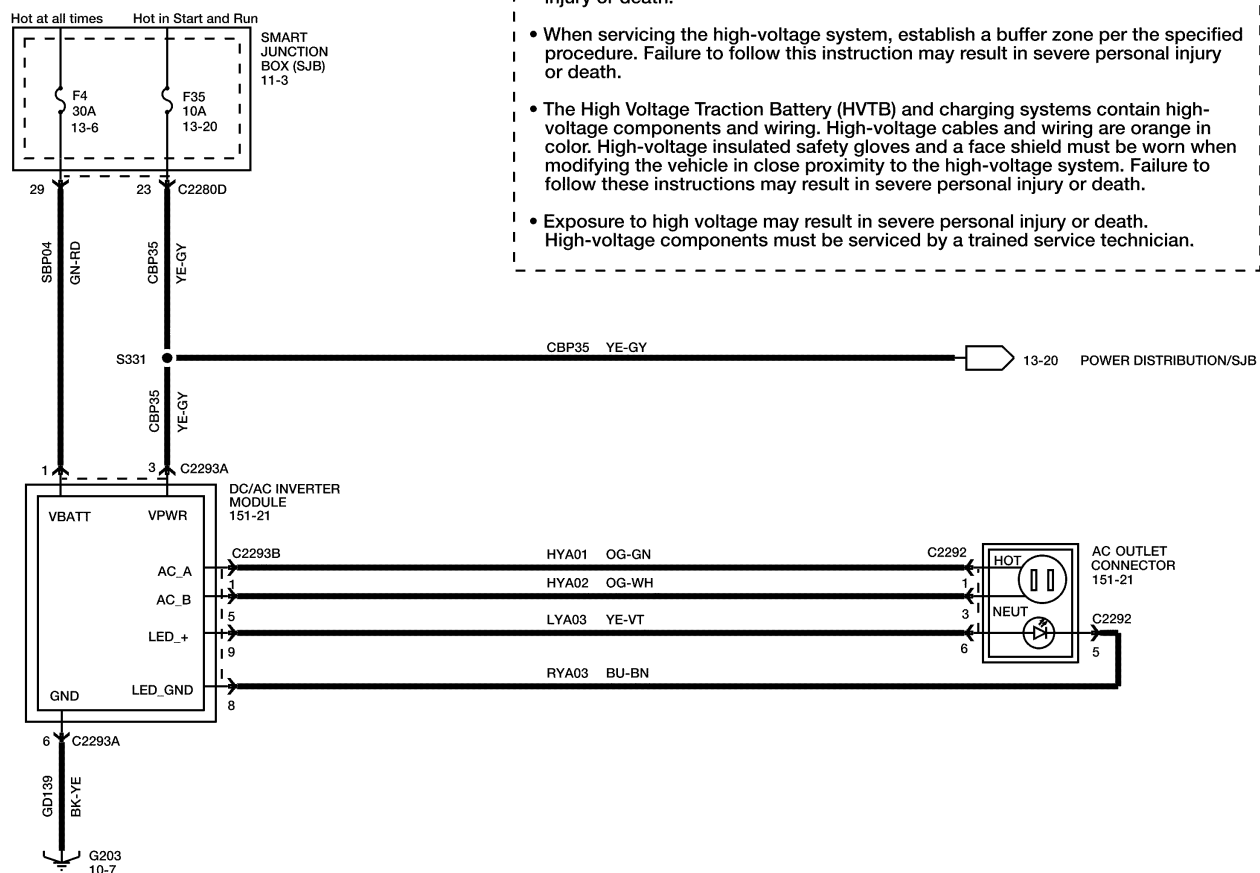
Section 2: Electrical

Charging System



WARNINGS:

- Do not splice, attach to or modify the high-voltage system (orange) wiring and/or cables in any way. Failure to follow this instruction may result in severe personal injury or death.
- When servicing the high-voltage system, establish a buffer zone per the specified procedure. Failure to follow this instruction may result in severe personal injury or death.
- The High Voltage Traction Battery (HVTB) and charging systems 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.
- Exposure to high voltage may result in severe personal injury or death. High-voltage components must be serviced by a trained service technician.



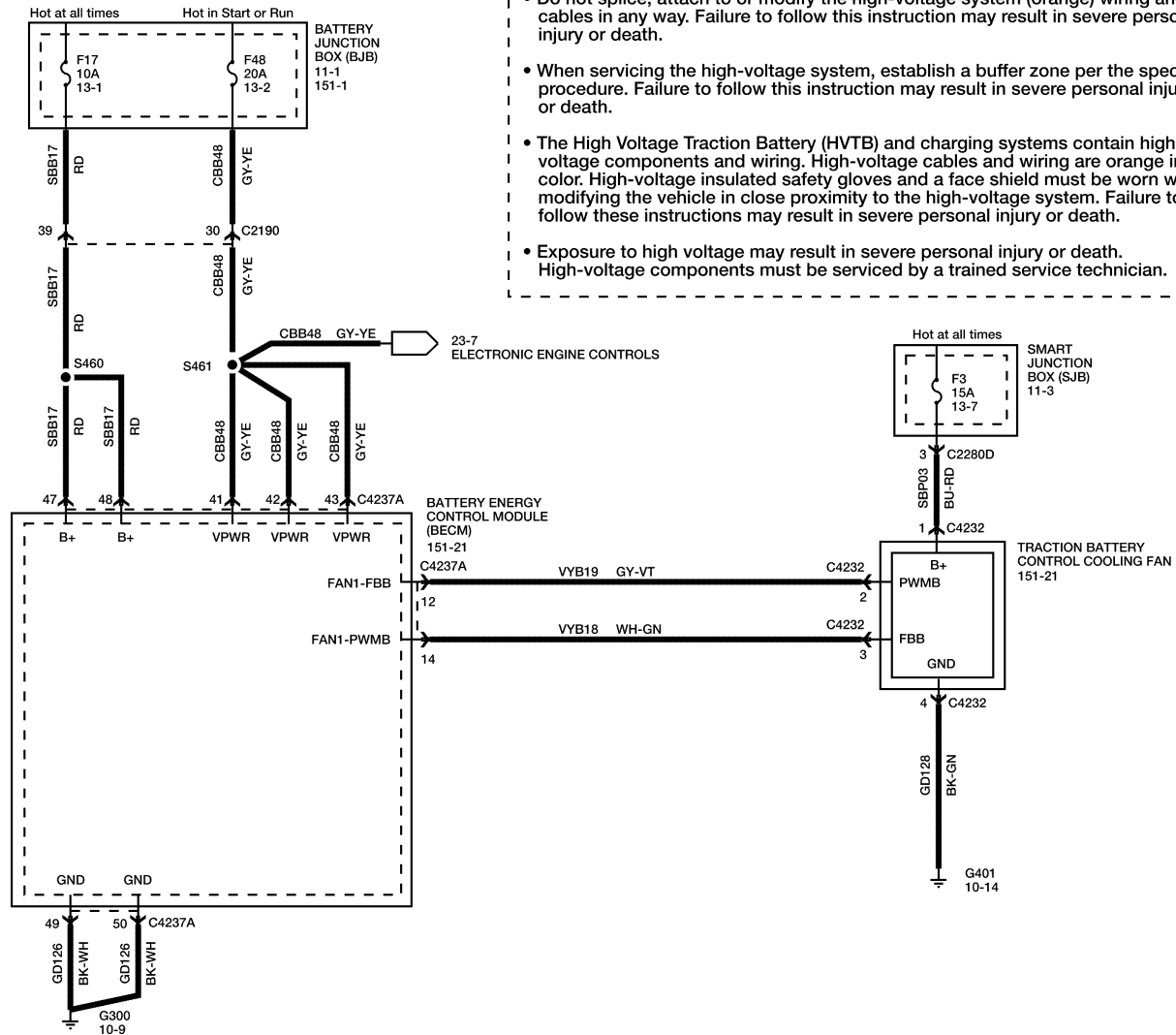
N0104090

Section 2: Electrical



WARNINGS:

- Do not splice, attach to or modify the high-voltage system (orange) wiring and/or cables in any way. Failure to follow this instruction may result in severe personal injury or death.
- When servicing the high-voltage system, establish a buffer zone per the specified procedure. Failure to follow this instruction may result in severe personal injury or death.
- The High Voltage Traction Battery (HVTB) and charging systems 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.
- Exposure to high voltage may result in severe personal injury or death. High-voltage components must be serviced by a trained service technician.



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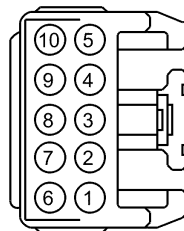
Section 2: Electrical

Connector End Views

C2293B (GY)

14B322

DC/AC INVERTER MODULE (19G317)

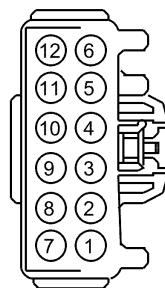


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C2293A

14A005

DC/AC INVERTER MODULE (PART# NA)

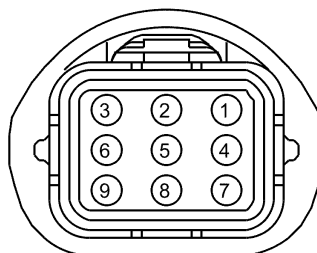


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14290

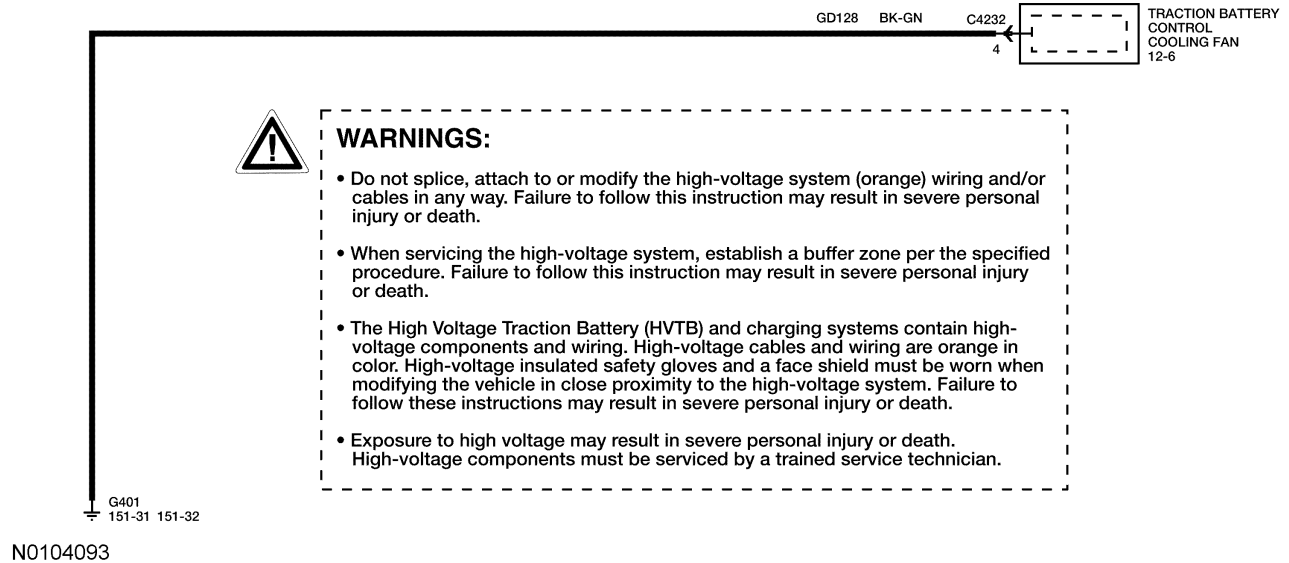
DC/DC CONVERTER MODULE (PART# NA)



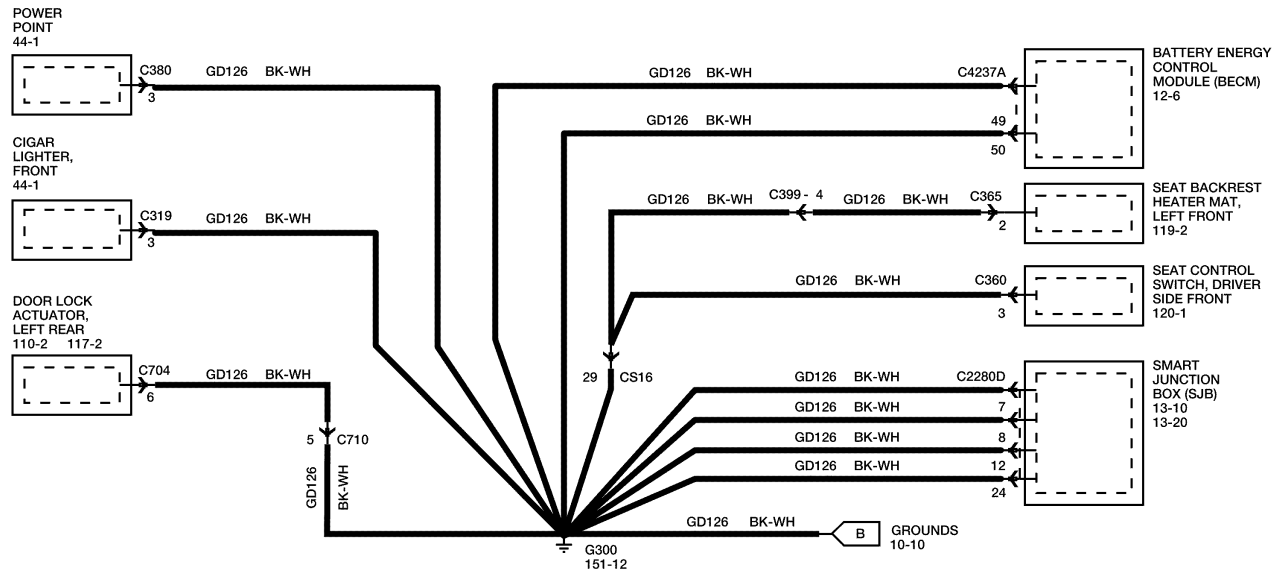
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Section 2: Electrical

Connector and Ground Locator



Section 2: Electrical

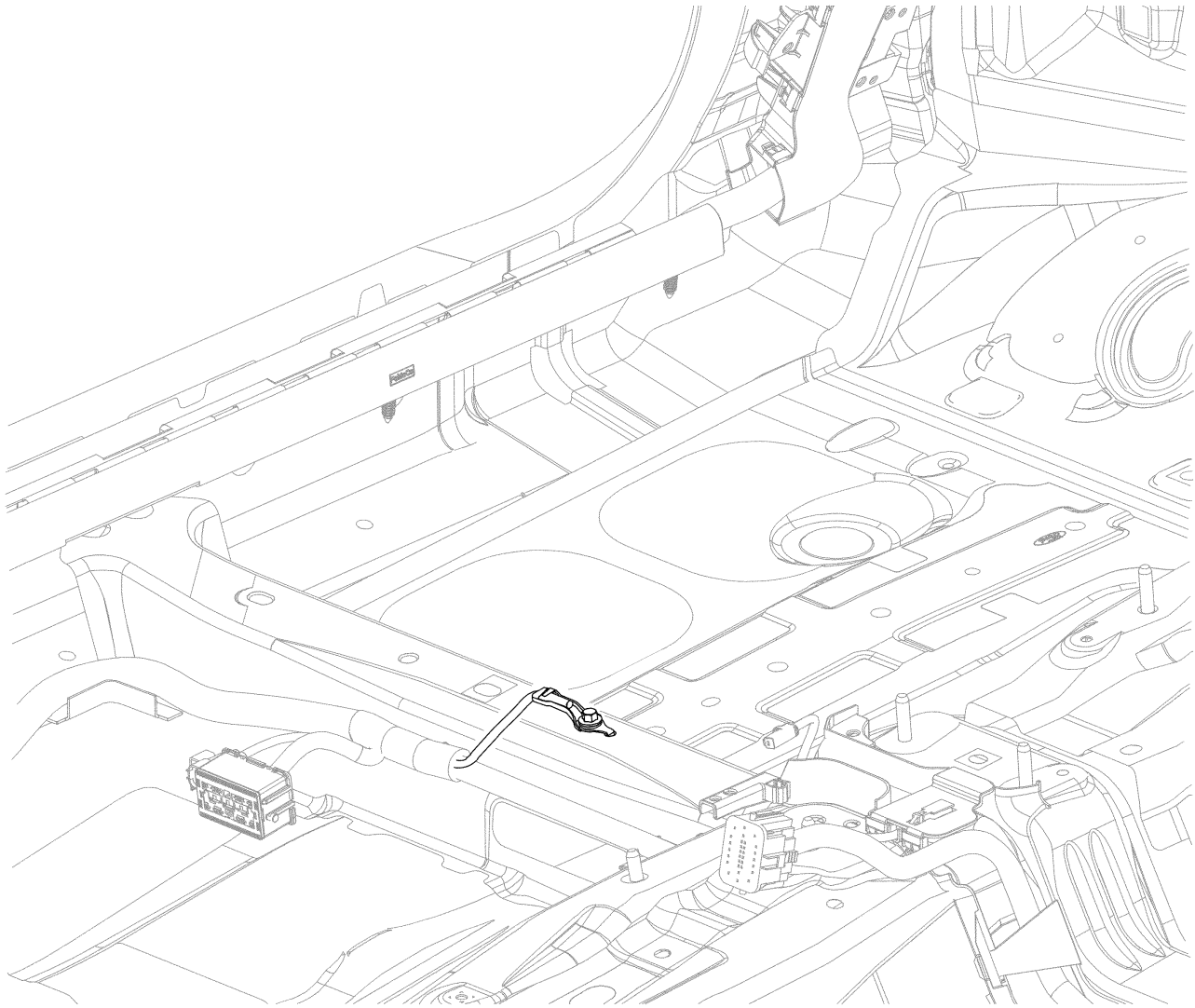


WARNINGS:

- Do not splice, attach to or modify the high-voltage system (orange) wiring and/or cables in any way. Failure to follow this instruction may result in severe personal injury or death.
- When servicing the high-voltage system, establish a buffer zone per the specified procedure. Failure to follow this instruction may result in severe personal injury or death.
- The High Voltage Traction Battery (HVTB) and charging systems 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.
- Exposure to high voltage may result in severe personal injury or death. High-voltage components must be serviced by a trained service technician.

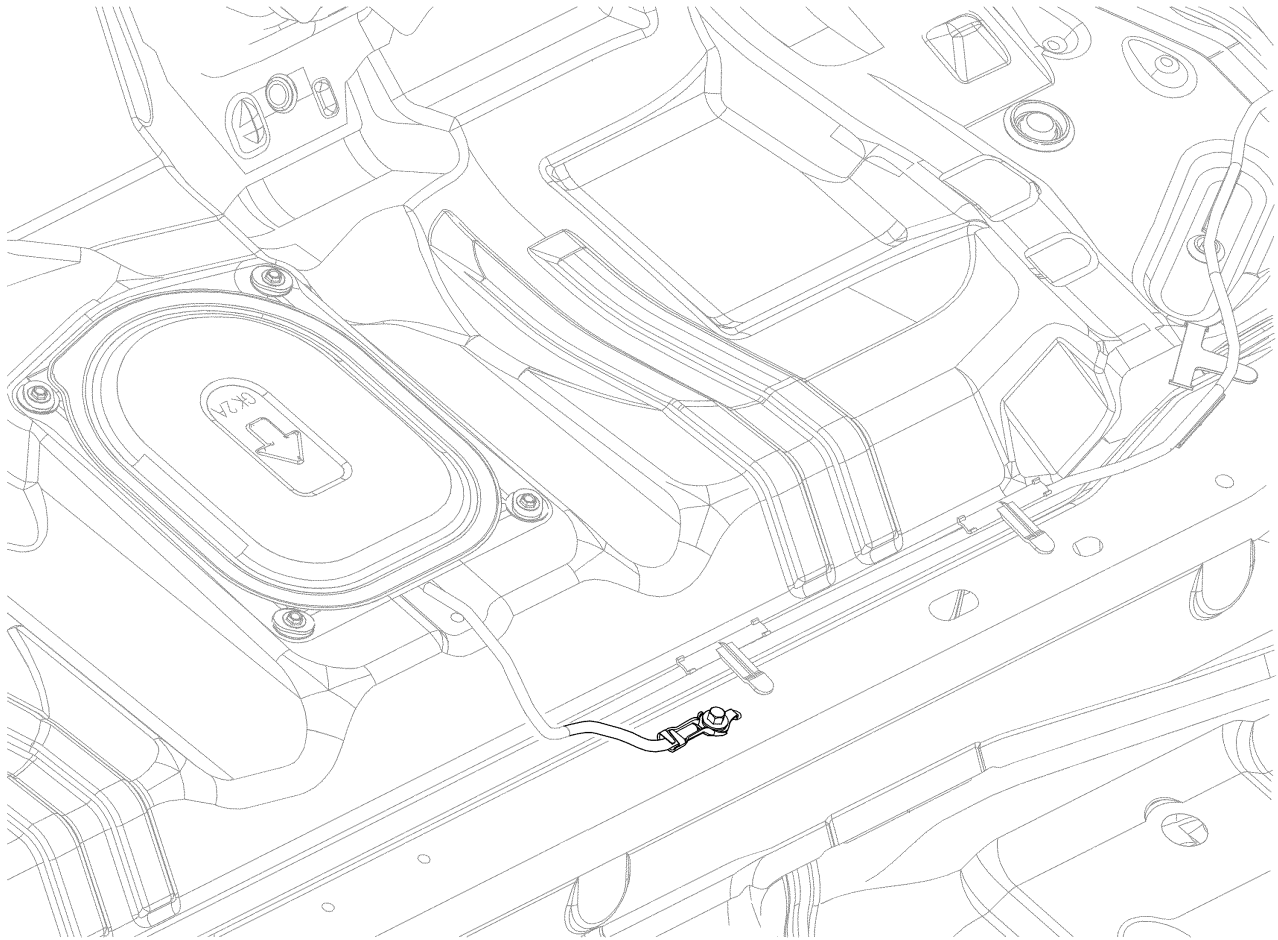
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Section 2: Electrical



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Section 2: Electrical



N0105242

SECTION 3

Mounting

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Section 3: Mounting

Push Bumpers

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

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 A/C system or damage to the high-voltage traction battery (HVTB) system may occur. The HVTB cooling system uses the cabin air to cool the HVTB.

- Do not mount equipment to the high-voltage (orange) wiring/cables, the high-voltage cover or the HVTB cooling plenum.
- Do not mount equipment on the instrument panel between the driver and passenger air bags due to deployment variability.
- Do not mount equipment on the instrument panel between the driver and the pedals, between the door and the console area due to knee air bag deployment variability.
- Do not mount equipment obstructing the HVTB service disconnect located behind the rear seat back.
- Do not remove or block the HVTB cooling plenum or ducts. These components are necessary for the proper cooling of the HVTB.
- Do not cover any vehicle or warning labels.

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.

- 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.

Section 3: Mounting

- 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.

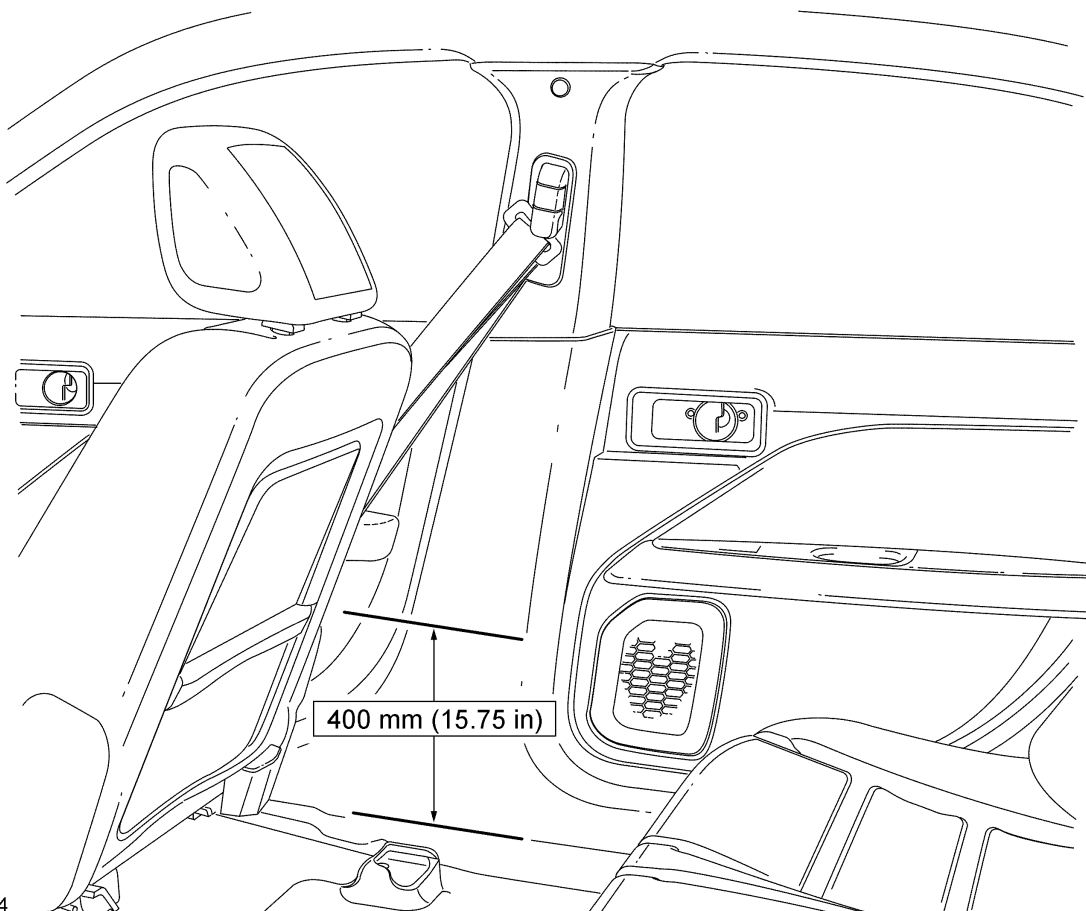
Safety Belt Retractor

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

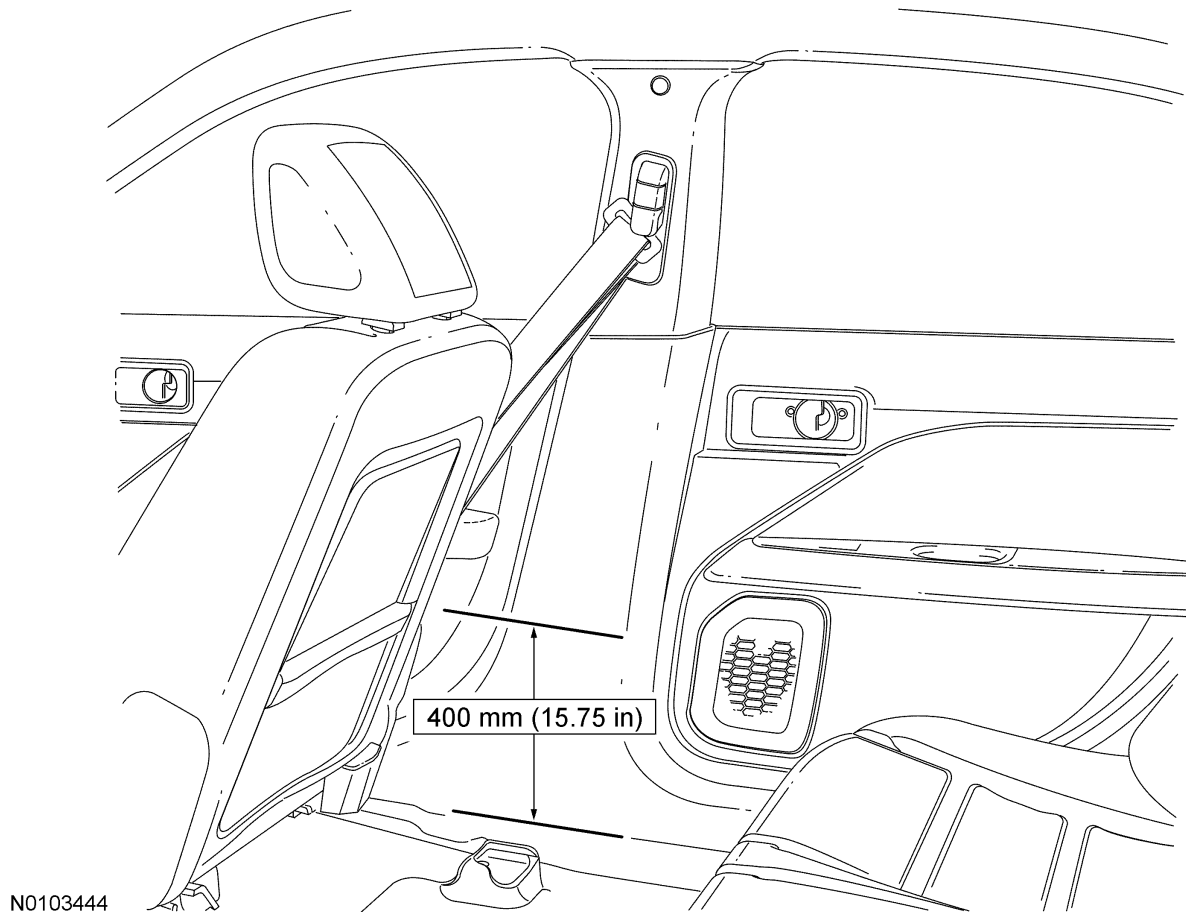
Refer to the following illustration for locations that must not be used for partition mounting:



N0103444

Section 3: Mounting

Side Impact Sensor




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.

Restraints Control Module (RCM)


The restraints control module (RCM) is mounted under the front of the center console. 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. Placing objects on or over the air bag inflation area may cause those objects to be propelled by the air bag. Failure to follow these instructions may result in personal injury.


 **WARNING:** Dash-, tunnel- or console-mounted equipment should be placed only within their specified zone. Failure to follow this instruction 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. Failure to follow this instruction may result in personal injury.

 **WARNING:** Do not mount equipment on the instrument panel between the driver and the pedal area, between the door and the console that may come in contact with or block a deploying knee air bag. Failure to follow this instruction may result in personal injury.

 **WARNING:** Do not attempt to service, repair or modify the air bag supplemental restraint systems (SRS) or its fuses. See your Ford or Lincoln-Mercury dealer. Failure to follow this instruction 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 air bag 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® System. Failure to follow this instruction may increase the risk of personal injury in the event of a collision.

 **WARNING:** Do not attempt to service, repair or modify the Safety Canopy® System, its fuses, the A-, B-, or C-pillar trim, or the headliner on a vehicle containing a Safety Canopy® System. See your Ford or Lincoln-Mercury dealer.

Section 3: Mounting

 **WARNING:** To reduce risk of injury, do not obstruct or place objects in the deployment path of the inflatable Safety Canopy® System.

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.

SECTION 4

Reference


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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. Placing objects on or over the air bag inflation area may cause those objects to be propelled by the air bag. Failure to follow these instructions may result in severe personal injury or death.

 **WARNING:** Dash-, tunnel- or console-mounted equipment should be placed only within their specified zone. Failure to follow this instruction may result in severe personal injury or death.

 **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. Failure to follow this instruction may result in personal injury.

 **WARNING:** Do not attempt to service, repair or modify the air bag supplemental restraint systems (SRS) in any way. Failure to follow this instruction may result in severe personal injury. 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 air bag sensors, increasing the risk of injury. Do not modify the front end of the vehicle. Failure to follow these instructions may result in severe personal injury or death.

 **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. Failure to follow this instruction may increase the risk of personal injury in the event of a collision.

 **WARNING:** Do not attempt to service, repair or modify the Safety Canopy® System, its fuses, the A-, B- or C-pillar trim, or the headliner on a vehicle containing a Safety Canopy® System. See your Ford or Lincoln-Mercury dealer. Failure to follow these instructions may result in personal injury.

Section 4: Reference

Note: 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.

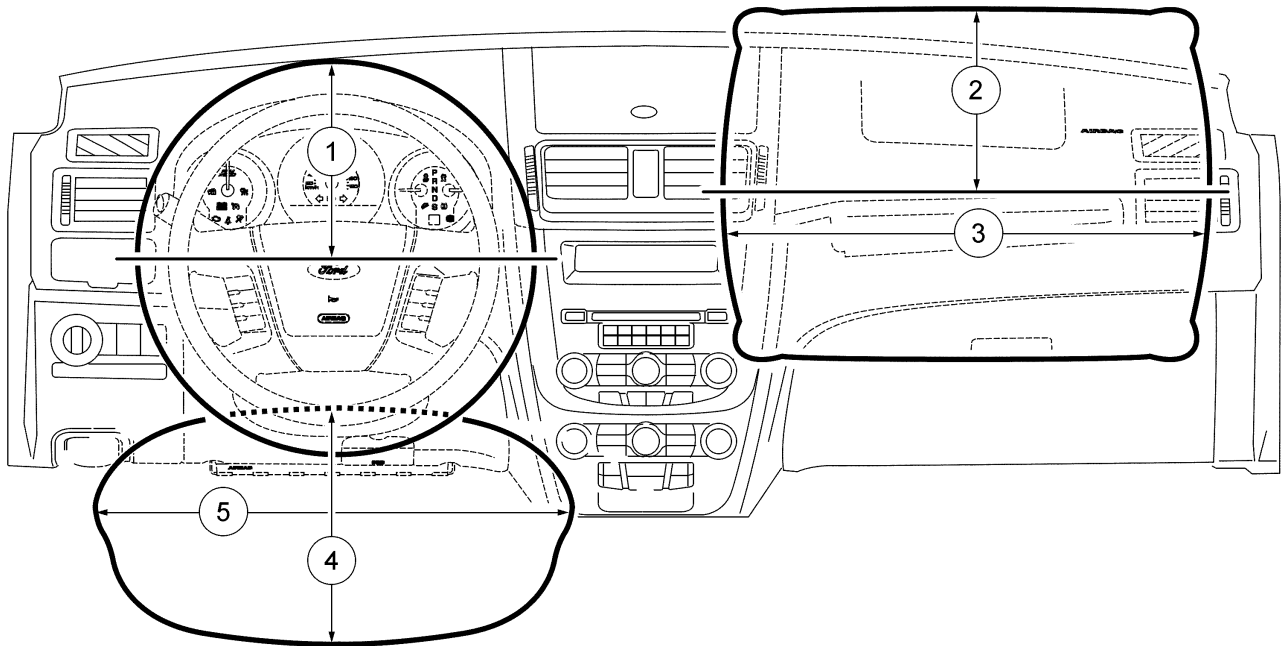
Some approximate dimensions for air bags, at full inflation, are provided. These dimensions are somewhat flexible and represent free-form deployments without the loading of occupants. The zone dimensions provided are approximate and will vary with the loading of occupants in the seats.

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 air bags due to deployment variability.



N0103482

Figure 1.

1. 318 mm (12.5 in) from center of air bag door
2. 450 mm (17.7 in) from center of air bag door
3. 610 mm (24 in)
4. 80 mm (3.15 in)
5. 500 mm (19.7 in)

Section 4: Reference

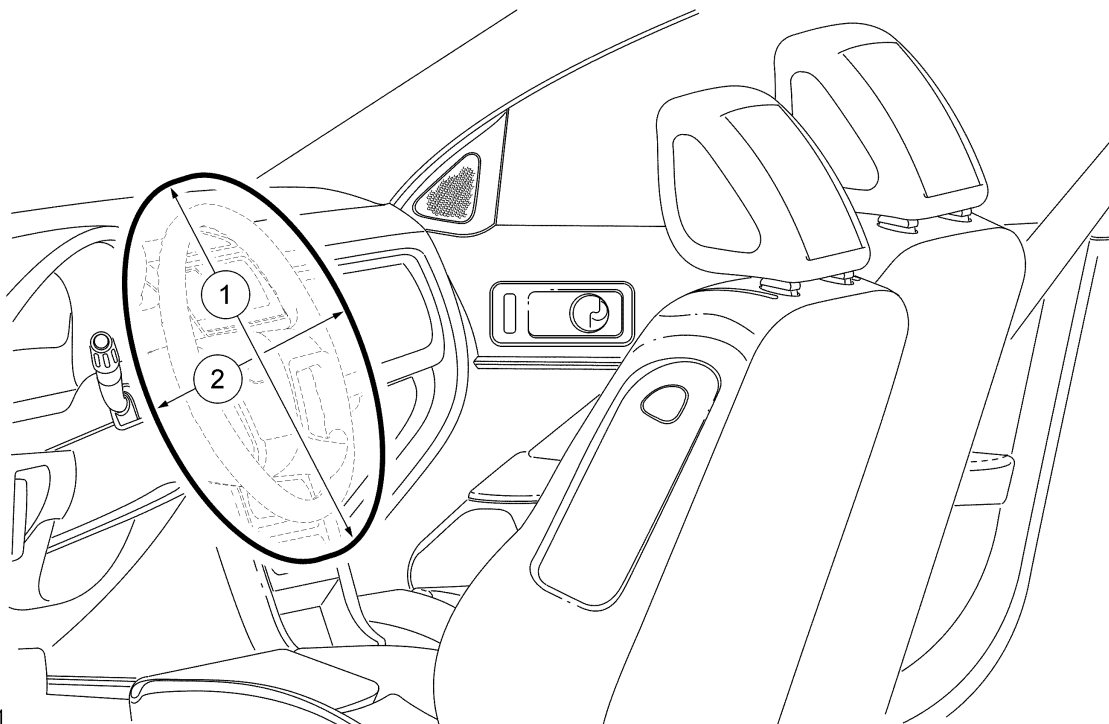
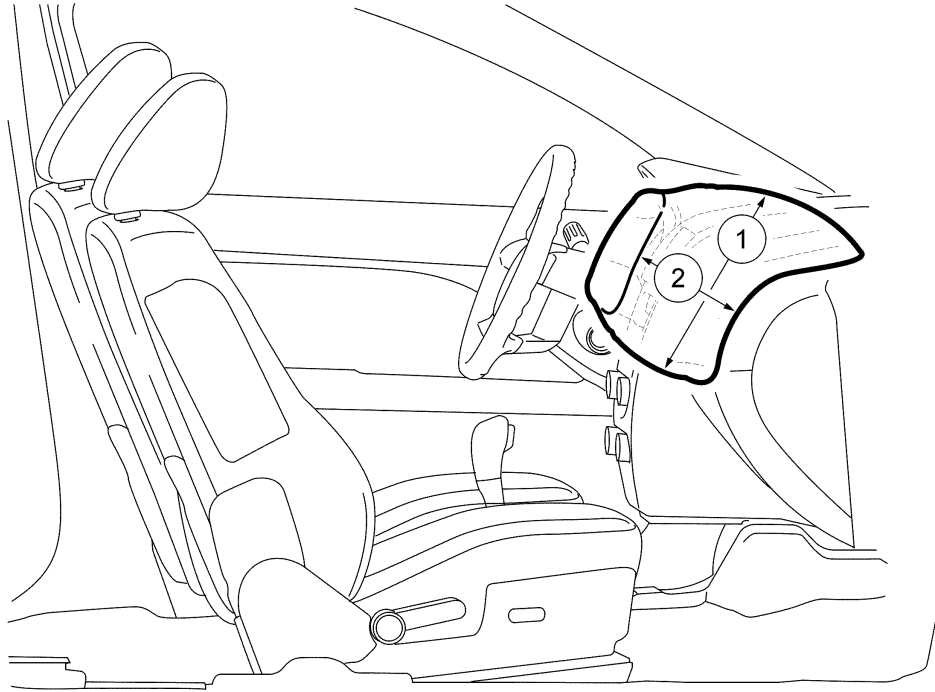


Figure 2.

1. 635 mm (25 in) from center of air bag door
2. 203 mm (8.0 in) from center of air bag door

Section 4: Reference

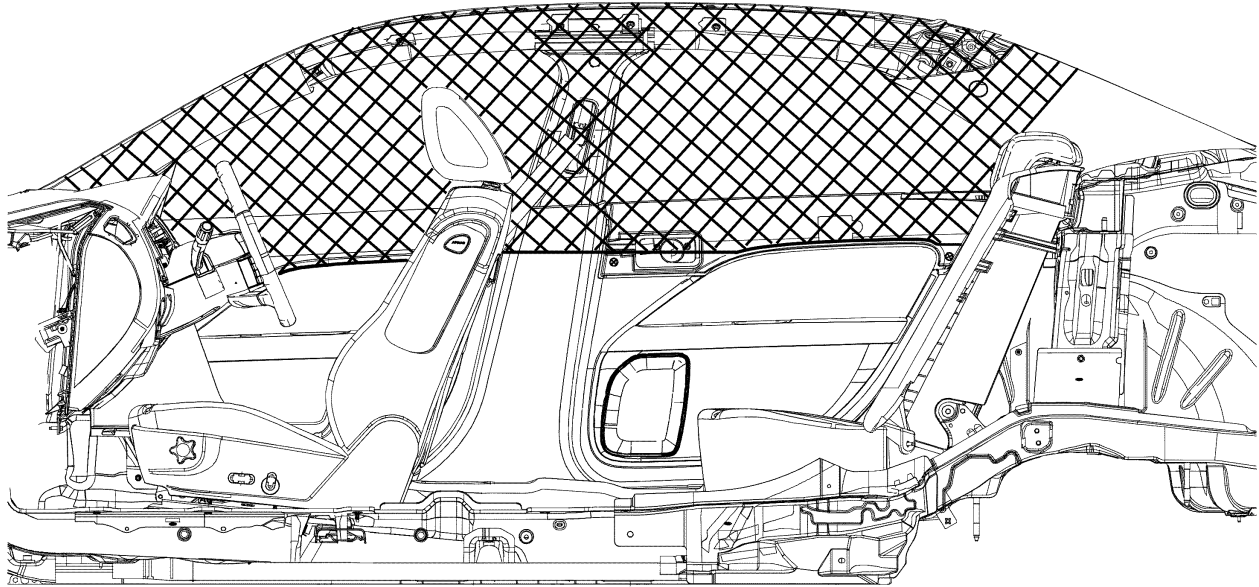


N0103443

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



N0103442

Figure 4.

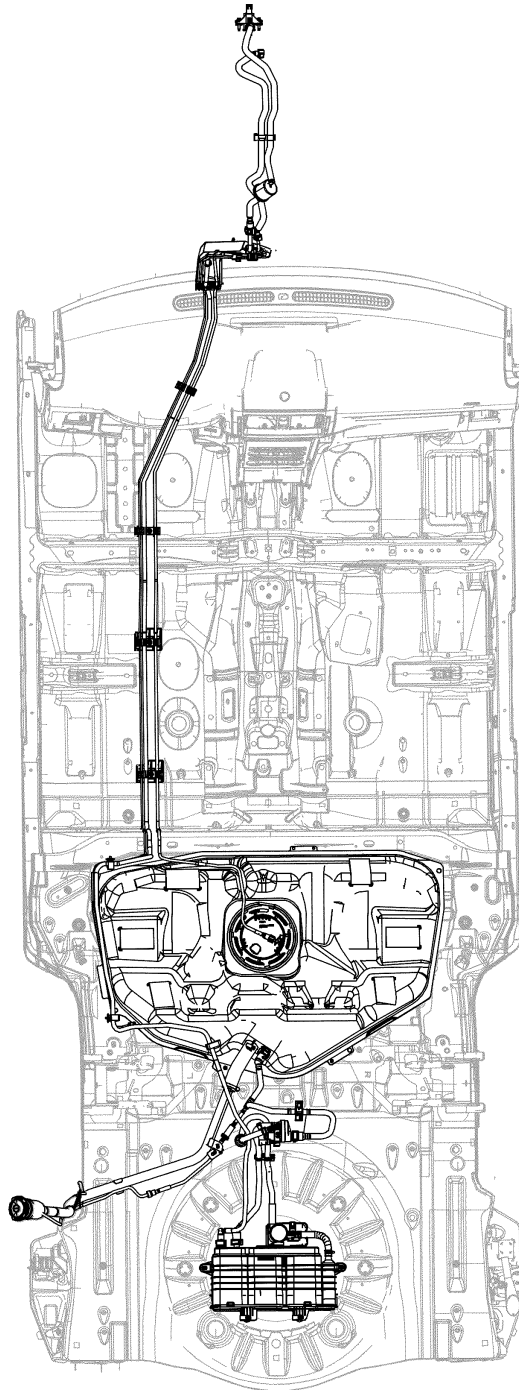
NOTICE: Any surfaces that could come into contact with side air curtain (Safety Canopy® System) during deployment must not damage the curtain. Sharp edges, corners or protrusions could damage the curtain and reduce the overall effectiveness of the side air curtain.

Note: 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.

- 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.

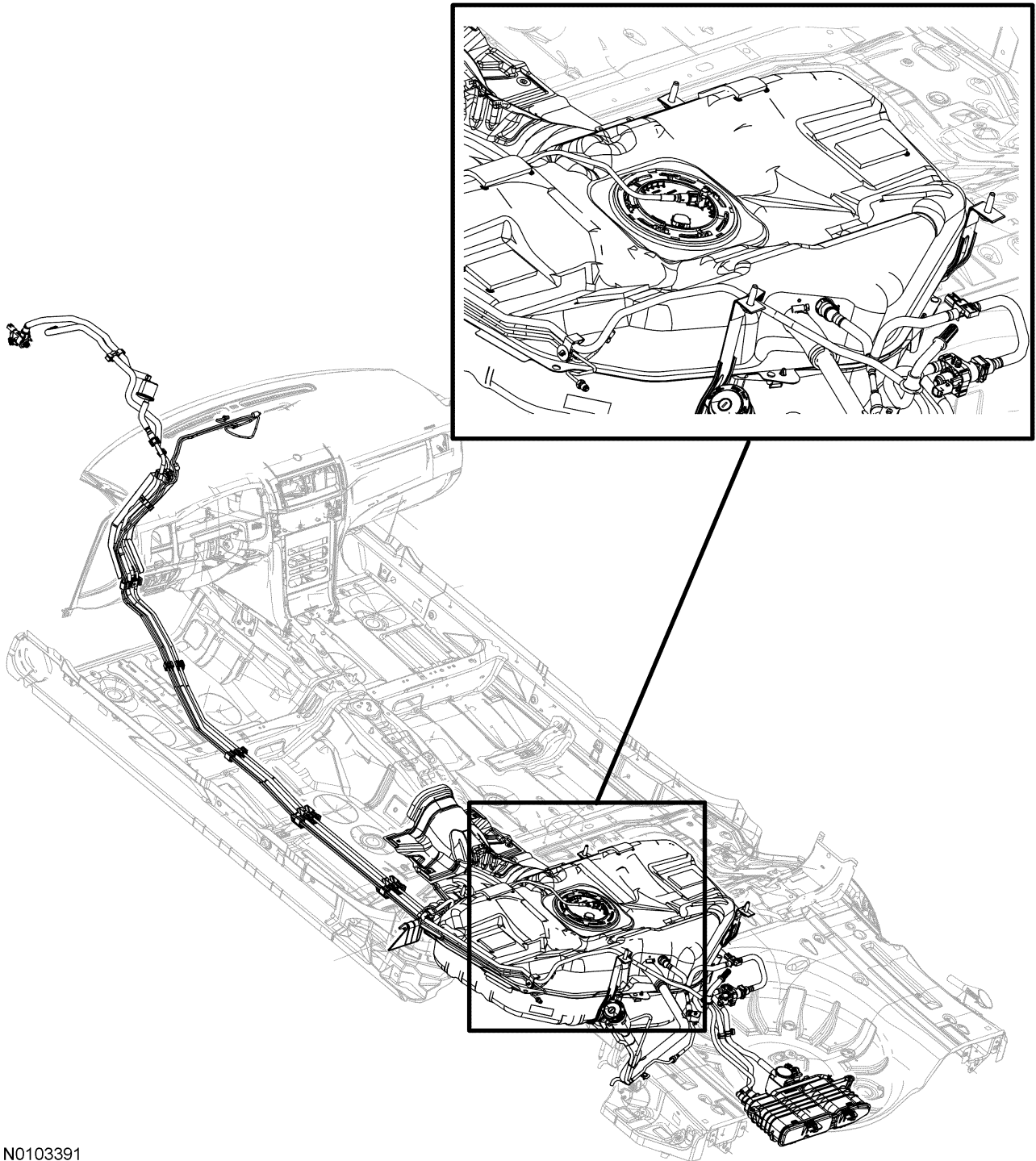
Section 4: Reference

Evaporative Emissions and Fuel Systems



N0103364

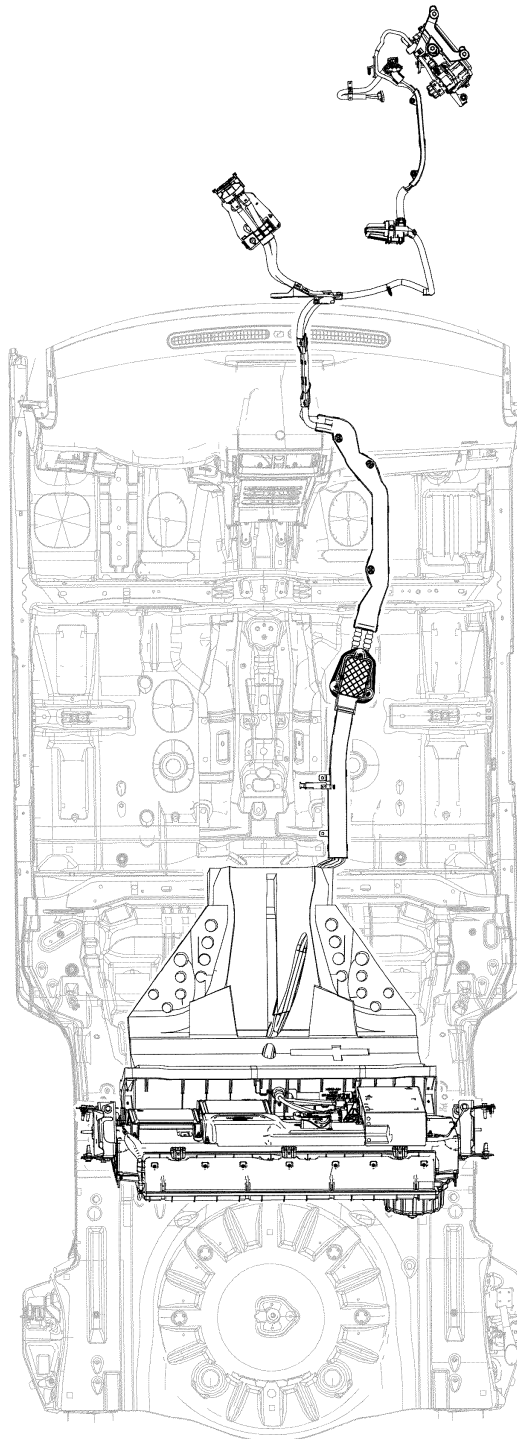
Section 4: Reference



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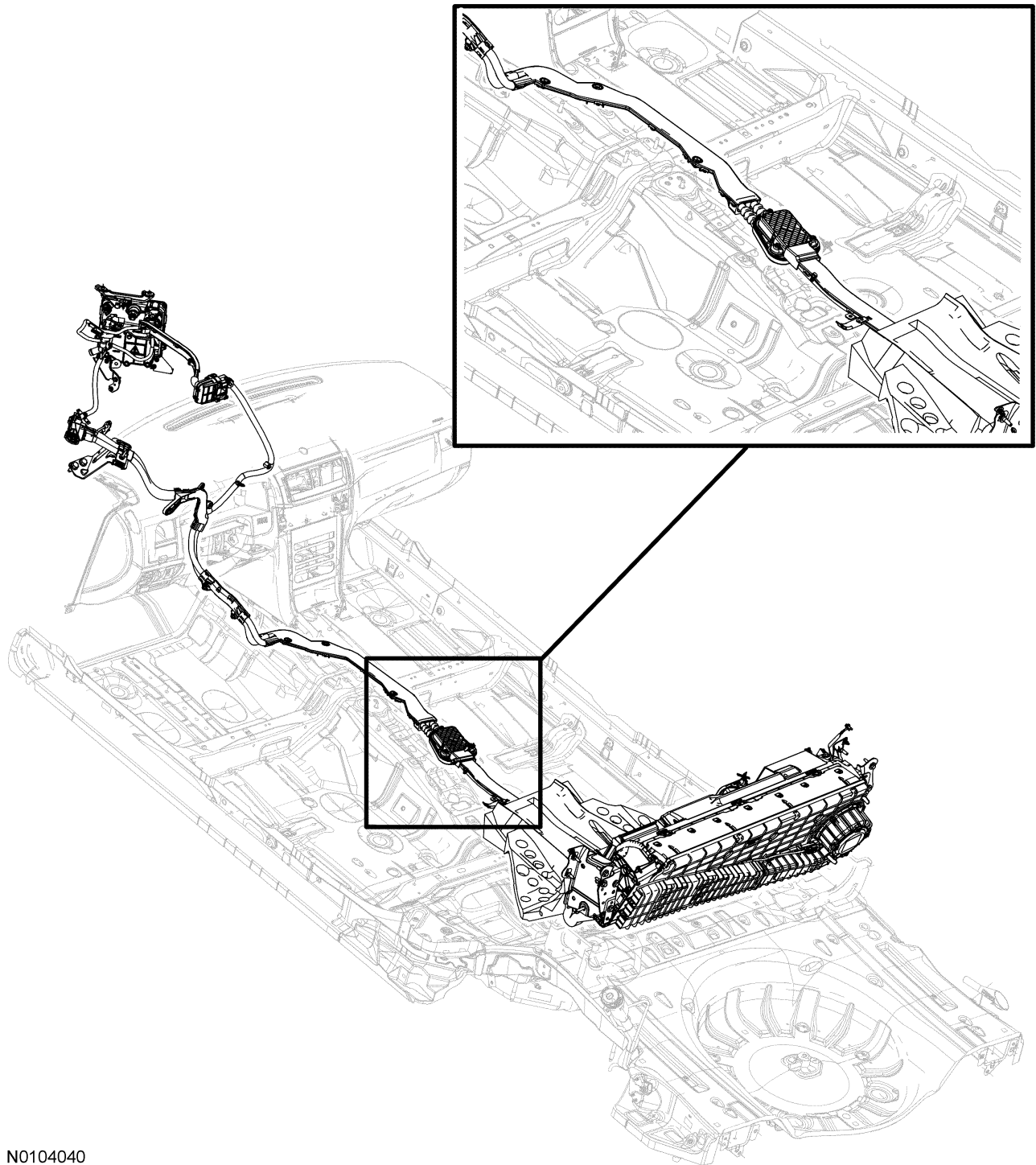
Section 4: Reference

High-Voltage System



N0104041

Section 4: Reference



N0104040