

Section 1:	General Information
Section 2:	Chassis
Section 3:	Powertrain
Section 4:	Electrical
Section 5:	Body
	Pre-Delivery

Section 1 General Information

General Specifications	2
Description and Operation	3
Acids	3
Brake Fluid	3
Electric Shock	4
EV-Specific Precautions	4
Safety	4
Rubber Insulating Gloves Testing	5
Buffer Zone	5
Warning Labels	6
Vehicle Identification Number (VIN) Label	11
Certification Label	12
Jacking, Lifting and Towing	12
Jacking	12
Lifting	14
Towing/Tow Hooks	16
Battery Information	17
Battery Types	18
Battery Fill Procedure – Flooded Batteries Only	19
Battery Charging	23
Vehicle Storage - Battery	26
Battery Water Reminder Indicator Resetting (Flooded Batteries Only)	28
Battery Type Reprogramming	28
Tire Rotation	29
Maintenance Schedule	30

General Specifications

Battery Specifications		
Maintenance Free (Gel Type) Battery		
Description	Specification	
Type Number	8G31	
Voltage	12	
Cold Cranking Amps (CCA) @ 0° F	550	
Approximate Weight Lbs (Kgs)	71.7 (32.5)	
Dimensions (LxWxH) In (mm)	12 ^{15/16} x 6 ^{3/4} x 9 ^{3/8} (329x171x238)	
Flooded (Water Filled) Battery		
Description	Specification	
Type Number	31XHS	
Voltage	12	
Cold Cranking Amps (CCA) @ 0° F	550	
Approximate Weight Lbs (Kgs)	67 (30)	
Dimensions (LxWxH) In (mm)	13 x 6 ^{3/4} x 9 ^{1/2} (331x171x242)	
Lubrication Specifications		
Description	Part Number	Ford Specification
Electrical Grease	F8AZ-19G208-AA	WSB-M1C239-A
Motorcraft High Performance DOT 3 Motor Vehicle Brake Fluid	C6AZ-19542-AB	ESA-M6C25-A
80W90 Premium Rear Axle Lubricant. (Gearbox Lubricant)	XY-80W90-QL	WSP-M2C197-A
Halfshaft splines (CV joint high temp. grease)	E43Z-19590-A	ESP-M1C207-A
Lock cylinders (Penetrating and Lock Lubricant)	Motorcraft XL-1	None

Description and Operation

The TH!NK neighbor is a combination of conventional and unique Electric Vehicle (EV) components and systems. Because the EV uses an electric motor rather than a gasoline engine, there are unique warnings and cautions. The procedures outlined are designed to encourage safe repair of the vehicle and should be carefully followed. The EV uses many electronic components that can be easily damaged if the procedures are not followed.

Acids

WARNING!

LEAD-ACID BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR BATTERIES TO PROTECT AGAINST SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

The battery pack is composed of 6 12-volt lead acid batteries wired in series. These batteries are similar in design to the battery in a gasoline-powered vehicle. The batteries contain sulfuric acid which can cause severe skin or eye damage if allowed to contact these areas. Follow all safety precautions outlined in the EV-Specific Precautions prior to working on the battery pack.

WARNING!

BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY OR DEATH. DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERIES. WHEN CHARGING OR WORKING NEAR THE BATTERIES, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE ADEQUATE VENTILATION.

Brake Fluid

CAUTION:

When adding brake fluid to the brake reservoir, avoid spilling fluid onto the vehicle's plastic panels, including the instrument panel. If brake fluid is spilled on any surface, wash it immediately with soap and water to prevent cracking, discoloration, or other damage.

Electric Shock

WARNING!

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

There are two electrical systems on the EV. A 72V high voltage system used to power the motor/gearbox. Orange color or orange wrapping on the harness bundle identifies high voltage wiring contained within the bundle. Components that have larger connectors, orange coverings on the wires, or warning labels contain or carry high voltage. The second is a 12V voltage system is used to operate the standard systems such as headlamps, windshield wipers and turn signals. These components should be treated with extreme caution. Do not perform any service on them until all system warnings and cautions are read and understood.

EV-Specific Precautions

When working on the 72-volt system the following precautions must be taken.

1. A buffer zone must be placed around the vehicle.
2. Rubber insulating gloves must be worn.
3. A face shield must be worn to shield the face and protect the eyes from electric arc.

Safety

Throughout this service manual there are paragraphs that are marked with a title of **WARNING**, or **CAUTION**. These special paragraphs contain specific safety information, and must be read, understood, and heeded before continuing the procedure, or performing the step(s).

WARNING!

A WARNING INDICATES AN IMMEDIATE HAZARD, WHICH COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.

CAUTION:

A Caution indicates conditions that could result in damage to the vehicle or other property.

A third special paragraph that appears throughout this service manual is marked with the title of “Note”

A “Note” is a paragraph that describes essential service or maintenance information that relates to a particular step(s) or procedure. The “Note” must be read, understood and heeded before continuing with the procedure, or performing the step(s).

Note:

A note contains additional information to make the procedure, or step(s), more easily understood or implemented. Or it may contain essential maintenance information to assure proper operation of the vehicle.

Rubber Insulating Gloves Testing

Note:

The rubber insulating gloves that are to be worn while working on the high voltage system are rated for use on equipment of up to 1000volts. They must be inspected before each use and must always be worn in conjunction with the leather outer glove. Any hole in the rubber-insulating glove is a potential entry point for high voltage.

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 exhibit any signs of wear and tear.
3. The leather gloves must always be worn over the rubber insulating gloves in order to protect them.
4. The rubber insulating gloves must be class "O" and meet all of the American Safety Testing Materials Standards.

Buffer Zone

Note:

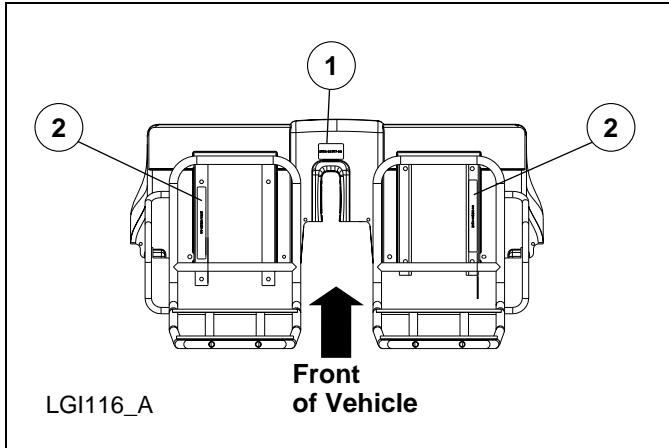
The buffer zone is required only when working on the 72-volt system.

1. Position the vehicle in the service bay.
2. Mark off a 1m (3ft) perimeter around the vehicle.
3. Do not allow any unauthorized personnel into the buffer zone during repairs involving high voltage. Only personnel trained for service on the high voltage system are to be permitted in the buffer zone.

Warning Labels

The vehicle is equipped with nine different warning labels. These labels are to assist in preventing the personal injury or death as a result of coming into contact with the high voltage current generated by, or used to operate, the component. The following illustrations show the locations of the warning labels.

Seat Stanchion Warning Labels



Item	Part Number	Description
1	00014	Parking Brake Warning Label
2	00014	High Voltage Warning Label

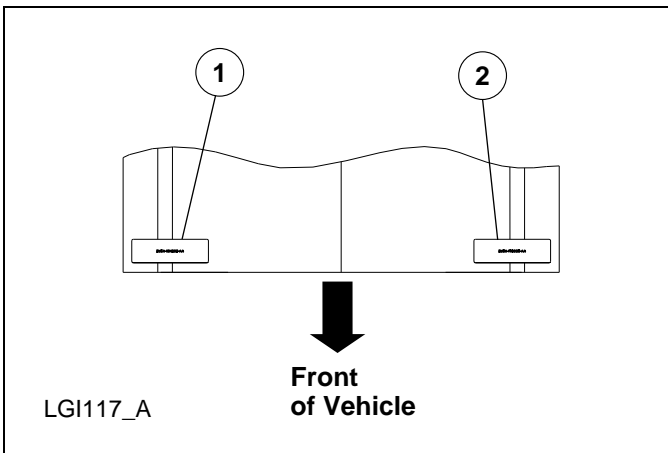
Parking Brake Warning Label



High Voltage Warning Label

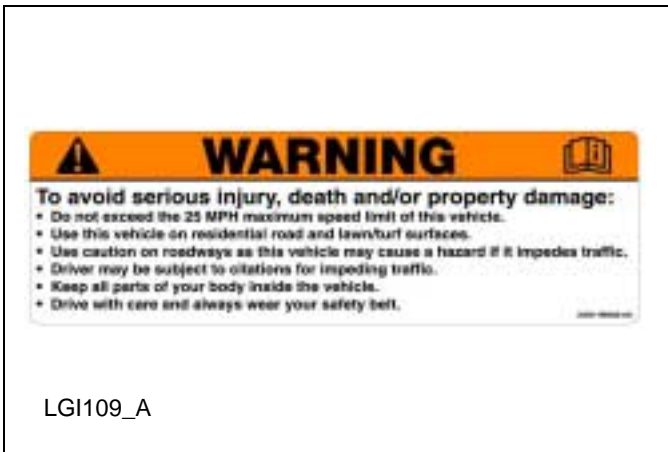


Roof Warning Labels

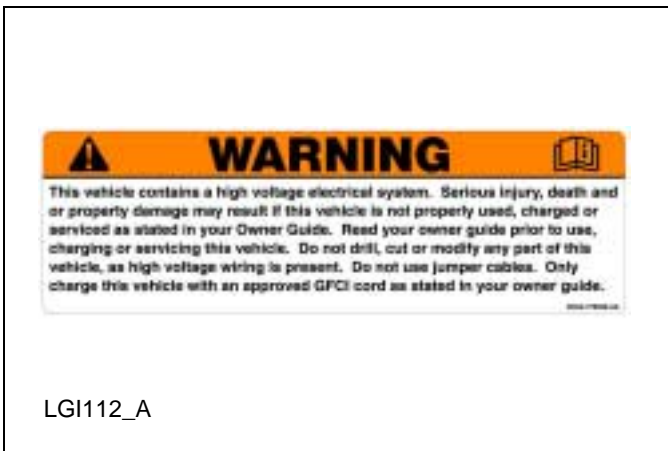


Item	Part Number	Description
1	00014	Slow Moving Vehicle Warning
2	00014	High Voltage Warning Label

Slow Moving Vehicle Warning

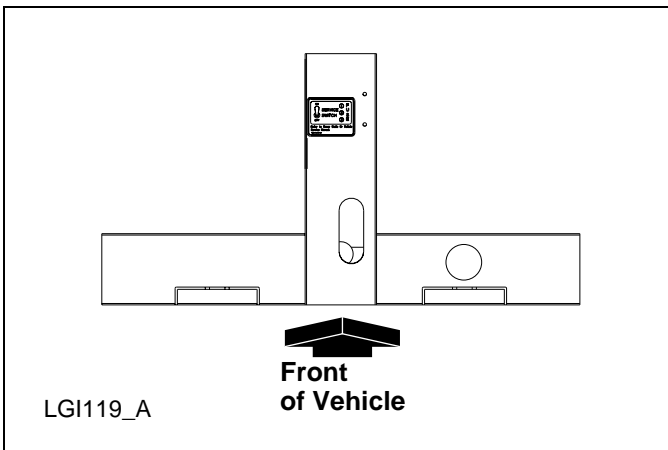


High Voltage Warning Label

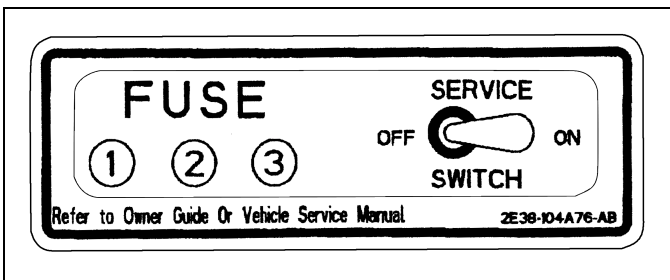
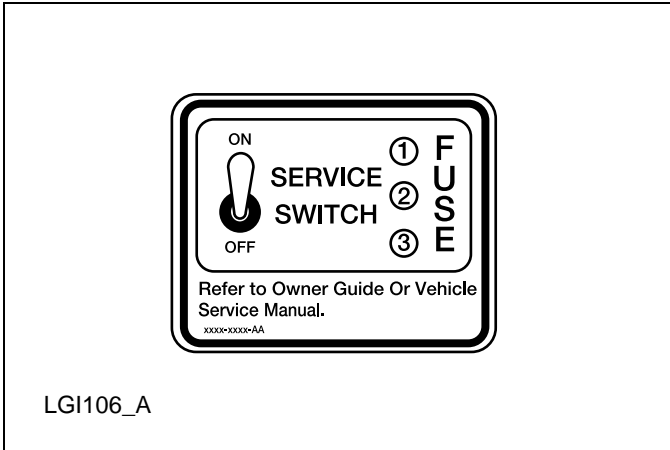


Seat Stanchion Support Warning Label

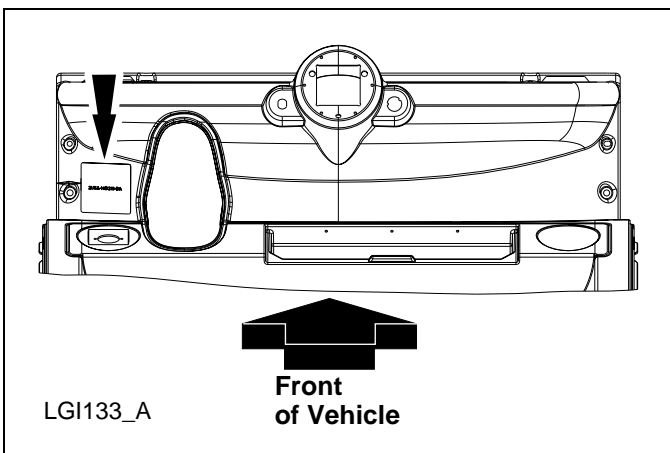
The seat stanchion support is located under the driver seat within the seat stanchion cover.



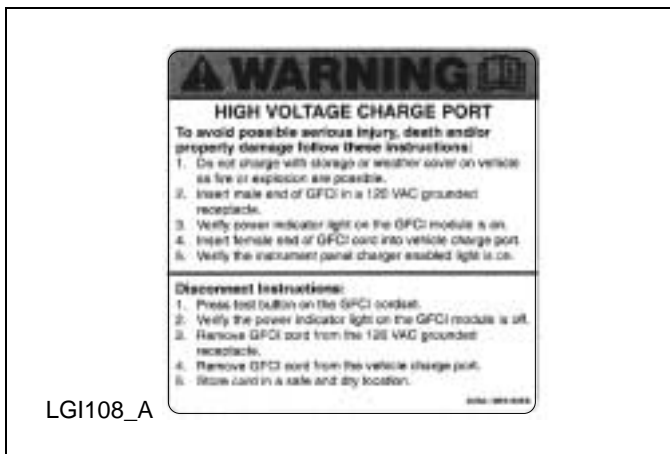
Service Disconnect Switch Labels



Instrument Panel Charge Warning Label



Charge Warning Label



Vehicle Identification Number (VIN) Label

The Vehicle Identification Number (VIN) label has seventeen digits and is located on the LH side of the instrument panel at the base of the windshield. The following is a breakdown of what each digit represents.

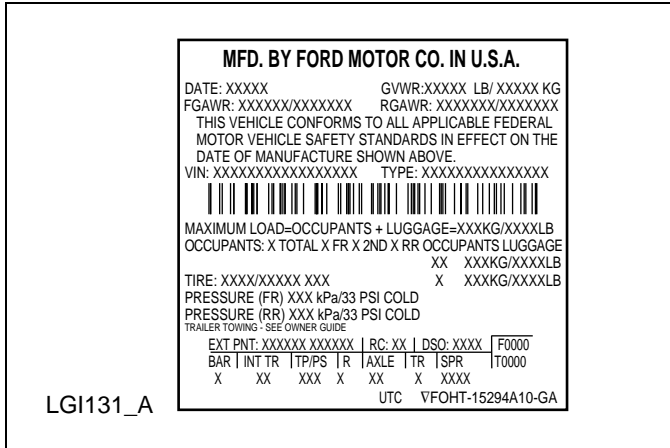


LGI115_A

Item	Position and Description	Code
1	Positions 1-3 World Manufacturer Identifier	1FA (Passenger vehicle produced in the U.S.)
2	Position 4 Restraint Code	B (Active belts only)
3	Positions 5-7 Body codes	P20 – 2 passenger, TH!NK Neighbor
		P21 – 2 passenger wagon, TH!NK Neighbor
		P22 – 4 passenger, TH!NK Neighbor
4	Position 8 Engine code	5 – 5Kw, 72V (350 amp), General Electric, Lead Acid Battery, 6hp
5	Position 9 Check Digit	0 - 9
6	Position 10 Model Year	2 – 2002MY
		3 – 2003MY
7	Position 11 Manufacture Plant	0 – Detroit Michigan (Detroit Empowerment Zone)
8	Position 12-17 Serialization	100001 – 599999

Certification Label

The certification label is located on the roof panel towards the rear of the vehicle.



Jacking, Lifting and Towing

Jacking

WARNING!

NEVER RUN THE MOTOR WITH ONE WHEEL OFF THE GROUND, SUCH AS WHEN CHANGING A TIRE. THE WHEEL STILL ON THE GROUND COULD CAUSE THE VEHICLE TO MOVE.

CAUTION:

Under no circumstances should the vehicle ever be lifted by the front control arms, rear trailing arms or halfshafts. Severe damage to the vehicle could result.

CAUTION:

Do not attempt to use a jack on the front or rear bumper. Damage to the bumpers will occur.

Front Jacking Point

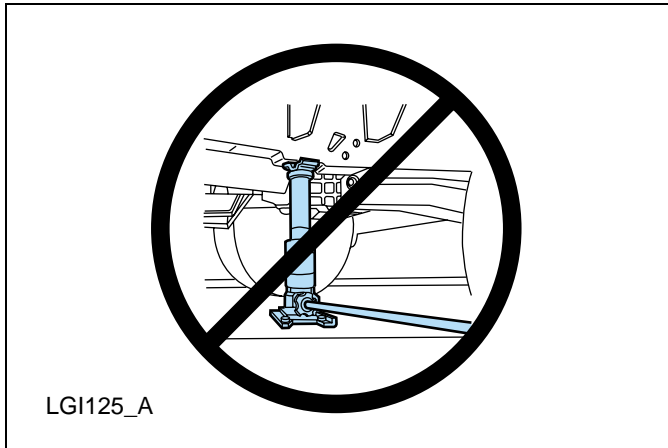


Rear Jacking Point



CAUTION:

The vehicle should not be lifted using a bottle type jack. Severe damage to the vehicle could result.

**Lifting****WARNING!**

NEVER RUN THE MOTOR WITH ONE WHEEL OFF THE GROUND, SUCH AS WHEN CHANGING A TIRE. THE WHEEL STILL ON THE GROUND COULD CAUSE THE VEHICLE TO MOVE.

CAUTION:

Under no circumstances should the vehicle ever be lifted by the front control arms, rear trailing arms or halfshafts. Severe damage to the vehicle could result.

CAUTION:

Do not attempt to use a jack on the front or rear bumper. Damage to the bumpers will occur.

Lift the vehicle using the appropriate lifting points as indicated.

Front Lifting Points

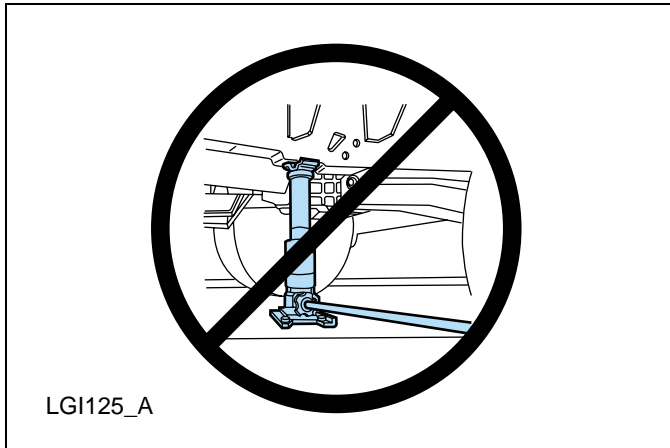


Rear Lifting Points



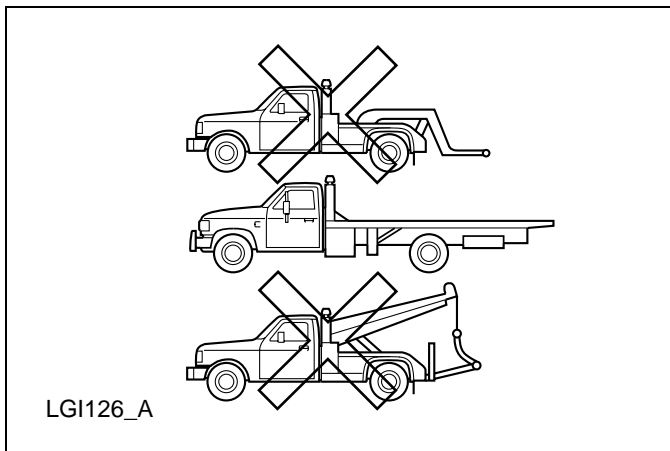
CAUTION:

The vehicle should not be lifted using a bottle type jack. Severe damage to the vehicle could result.

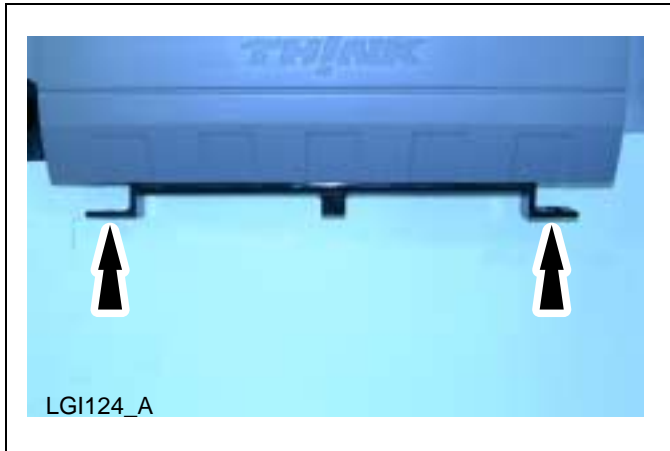
**Towing/Tow Hooks****CAUTION:**

Vehicle damage could occur if the vehicle is improperly towed or transported.

The vehicle should be towed on a flatbed tow truck. It should not be towed using a sling belt or wheel lift truck.



Each corner of your vehicle is equipped with a tow/tie down hook. Both front or both rear tow hooks must be used for towing or recovery operations. Additionally, when shipping or transporting, all 4 tow/tie down hooks must be used to prevent damage.



Battery Information

WARNING:

BATTERIES NORMALLY PRODUCE EXPLOSIVE GASSES THAT CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERIES. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WARNING:

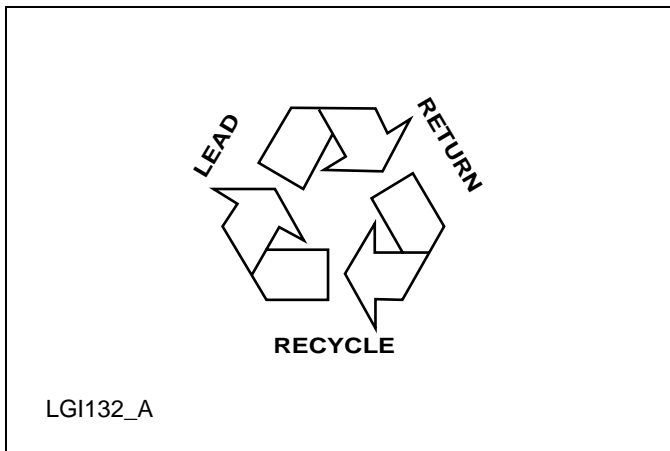
WHEN LIFTING A BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

WARNING:

KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERIES TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF 15 MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, CALL A PHYSICIAN IMMEDIATELY.

WARNING!

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.



TH!NK Mobility strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.

Battery Types

There are two types of batteries, which may be used in the neighbor:

Flooded, or wet

Maintenance free, or gel

Both utilize lead acid technology. As the name implies, maintenance-free or gel batteries do not require addition of electrolyte. Flooded, or wet, batteries require periodic addition of deionized or distilled water.

Do not mix battery types within a battery pack. Use either six flooded batteries, or six maintenance free, or gel, batteries in a battery pack.

Flooded type batteries are identified by the following:

1. Fill caps have slots in the top of them and are threaded into the battery, visible from the top.
2. Deionized or distilled water must be added periodically.
3. The case of the battery is black in color.

4. There is no carrying handle built in to aid in removal and installation.
5. Part number 10655-AA

Maintenance Free (Gel type) batteries are identified by the following:

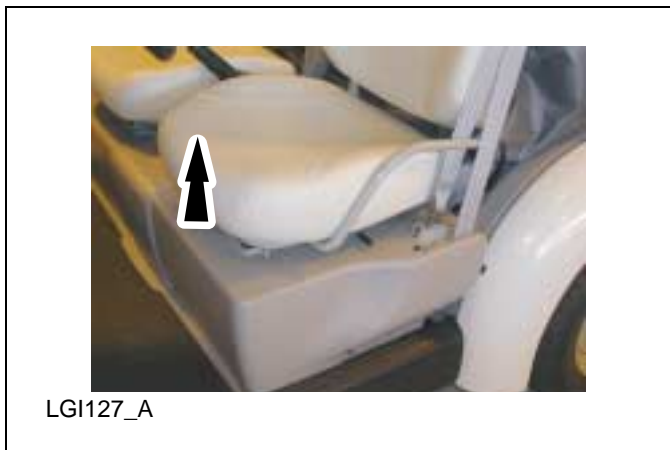
1. Fill caps are a hexagonal shape and are permanently installed. They are not intended to be removed and non-serviceable. DO NOT OPEN
2. The case of the battery is gray in color.
3. There is a handle built in to aid in removal and installation.
4. Part number 10655-BA

Battery Fill Procedure – Flooded Batteries Only

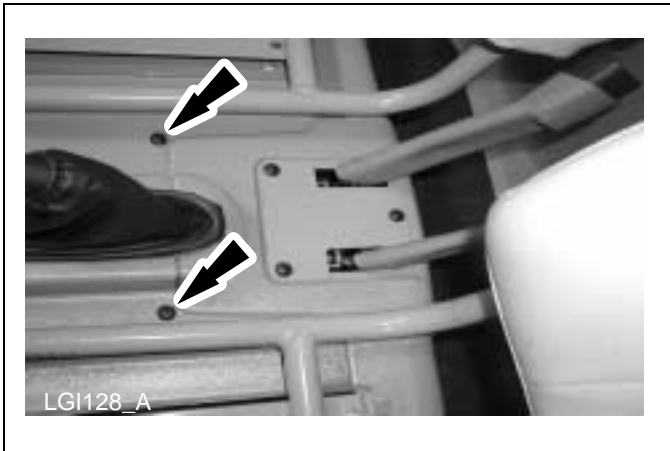
Note:

Be sure you have correctly identified the type of battery installed in the vehicle. Do not add electrolyte to maintenance-free, or gel, batteries. For additional information, refer to [Battery Types](#) in this section.

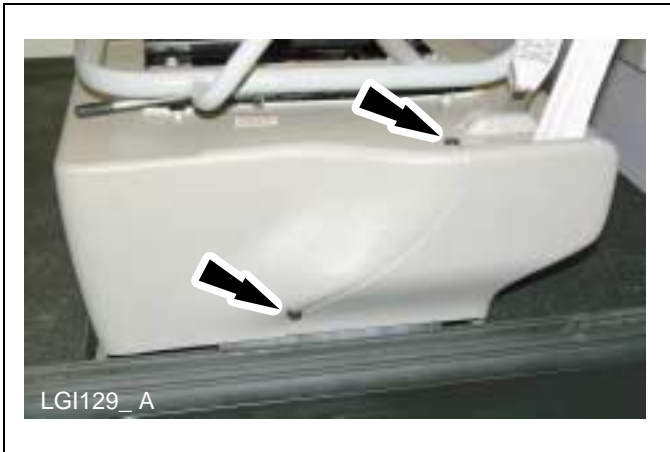
1. Pull straight up on the front seat cushions to release the clips.



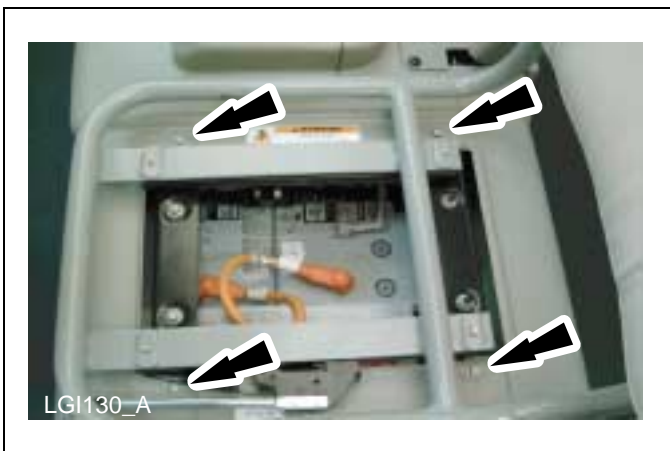
2. Remove the two center pushpins.



3. From both sides of the vehicle, remove the two pushpins.

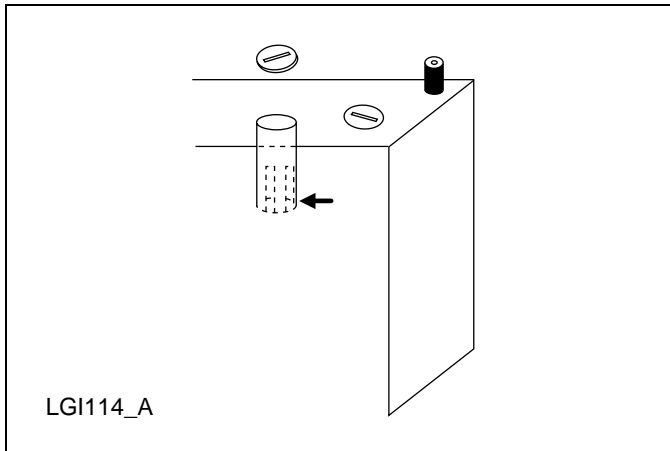


4. From both sides of the vehicle, remove the four seat stanchion cover bolts.

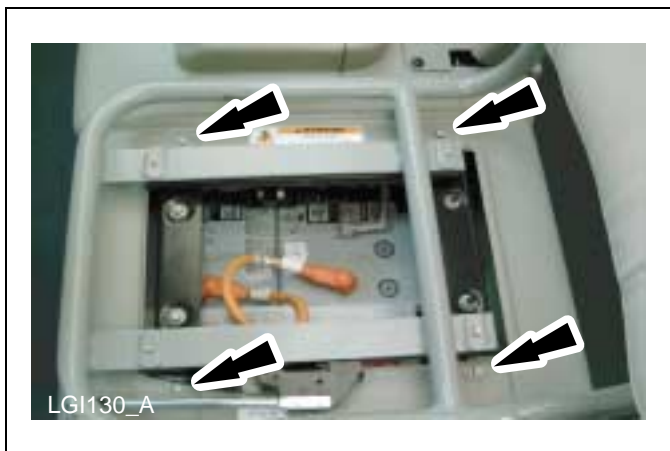


5. Carefully slide the seat stanchion cover forward and remove from the vehicle.

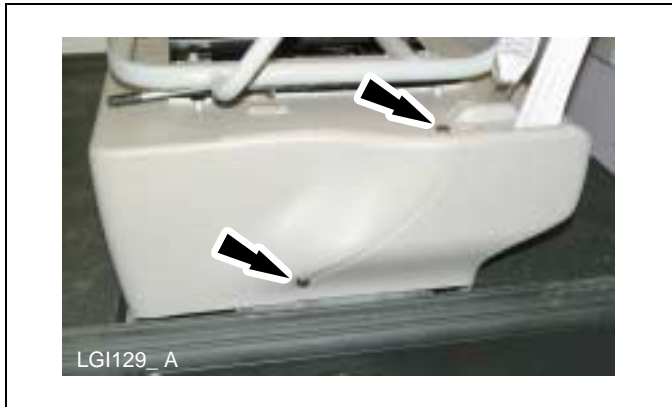
6. Remove each battery cell cap. Make sure battery fluid is visible at the bottom of the slotted cup. If fluid is not visible, fill with demineralized water or distilled water until level reaches bottom of slotted cup.



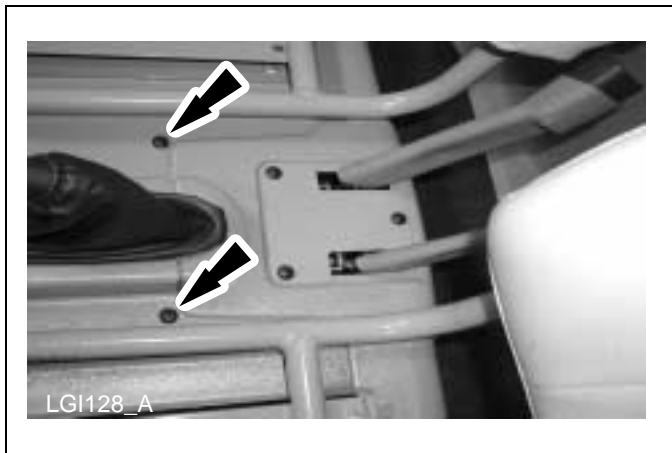
7. Install the battery cell caps.
8. Carefully slide the seat stanchion cover rearward over the batteries and stanchion support.
9. From both sides of the vehicle, install the four seat stanchion cover bolts. Tighten the seat stanchion cover bolts to 20-25N.m. (15-18 lb-ft.)



10. From both sides of the vehicle, install the two pushpins.



11. Install the two center pushpins.



12. Slide the seat cushion as far back on the seat as possible and press down firmly to lock in place.

Battery Charging

Battery charging requires 120volt AC 15A service. The GFCI (ground fault circuit interrupt) charge cord supplied with the vehicle plugs directly into the charge inlet located in the left side of the front kickup. Approximately 8-10 hours are needed to replenish a 20% (one bar showing) charged battery pack. Charge the vehicle whenever the state of charge is less than 80% (four bars showing), to maximize your travel range and prolong the battery life.

The battery charger receives 120volt AC power from an external standard grounded 3-prong 15A outlet and converts it to DC energy. The battery charger only operates when a GFCI charger cord is plugged into your vehicle. If the battery charger detects any presence of AC current (from the GFCI charger cord), the vehicle cannot be started or driven.

WARNING!

THERE ARE HYDROGEN GASES AROUND THE BATTERIES THAT CAN EXPLODE IF EXPOSED TO FLAMES, SPARKS, OR LIT CIGARETTES. THE AMOUNT OF HYDROGEN GAS IS INCREASED DURING BATTERY CHARGING. AN EXPLOSION COULD RESULT IN PERSONAL INJURY OR VEHICLE DAMAGE.

WARNING!

BATTERIES CONTAIN SULFURIC ACID, WHICH CAN BURN SKIN, EYES, AND CLOTHING, IF CONTACTED.

CAUTION:

Do not allow the vehicle to remain in a discharged state, as the batteries may be permanently damaged and vehicle range will be decreased.

To recharge the vehicle batteries:

Note:

Use only the GFCI cord supplied with the vehicle. If the GFCI cord does not fit the receptacle, have a qualified electrician install the proper outlet.

Note:

The outlet must be properly installed and grounded in accordance with all local codes and ordinances.

1. Park the vehicle within GFCI charger cord length of a 120 volt AC 15A grounded 3-prong wall outlet.
2. Place the key in the black dot (off) position, remove the key and set the parking brake.

Note:

Make sure the power point, if equipped, is not in use.

3. Plug the GFCI charger cord into the 120volt AC 15A grounded 3-prong wall outlet. Do not use any plug adapters or extension cords to make the electrical connection.
4. Open the charge inlet access door. Make sure that the inlet is clean and dry.

CAUTION:

If the vehicle is allowed to sit in conditions of -6°C (20°F) or less with a state of charge of 20% (one bar showing on gauge) or less, the batteries could freeze. Allowing the batteries to freeze may cause permanent damage to the batteries and permanently reduce their capacity. In cold conditions, place the vehicle in an area warmer than 0°C (32°F) and allow it to warm up before charging. Never charge the vehicle if the batteries may be frozen. Allow the batteries to warm above 0°C (32°F) first, then charge.

CAUTION:

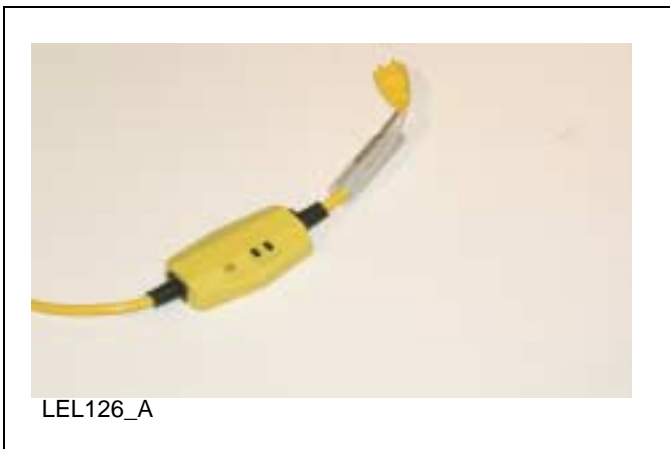
Do not park and leave the vehicle with discharged batteries. The batteries could discharge to the point where damage could occur and the battery charger will not charge.



5. Align the GFCI charger cord with the charge inlet and fully insert the plug into the outlet.



6. Verify the POWER indicator is illuminated on the GFCI charger cord. Also, the battery charge indicator on the instrument panel cluster will illuminate during the charging process.



Note:

The humming noise you will hear is the transformer on the charger, which will operate regardless of whether the vehicle is accepting the charge.

Note:

If the charge indicator fails to display make sure the service disconnect switch is in the “ON” position. If the service disconnect switch is on while charging and charge indicator fails to display, refer to the following flowchart.

To stop charging the vehicle batteries:

1. Push the TEST button on the GFCI charger cord. Verify the power indicator on the GFCI is off.

2. Disconnect the GFCI charger cord from the wall outlet.
3. Disconnect the GFCI charger cord from the charge inlet.
4. Close the charge inlet access door.
5. Store the cord in a safe and dry location.

Vehicle Storage - Battery

WARNING:

TO AVOID SERIOUS INJURY AND/OR DEATH, NEVER PERFORM ANY VEHICLE SERVICE OR MAINTENANCE WHILE THE ELECTRICAL LEAKAGE WARNING IS ILLUMINATED. REFER TO LEAKAGE DETECTION IN THE ELECTRICAL SECTION AND RESOLVE THE LEAKAGE CONDITION PRIOR TO BEGINNING OTHER REPAIRS.

The service disconnect switch (see photo below) is located either under the driver seat cushion or toward the center of the vehicle behind the parking brake lever within the seat stanchion. The front of the seat stanchion cover should be removed to access the service disconnect switch and the fuse holders on vehicles with the switch located behind the parking brake lever. It is not encouraged to blindly reach down through the opening on top of the driver's side seat stanchion cover when the cushion is removed.

The vehicle can be stored for 14 days with the service disconnect switch on. This assumes a full charge when stored. If 14 days is exceeded or the batteries were not fully charged prior to storing, the vehicle batteries may be severely discharged resulting in permanent damage. This would reduce the batteries capacity and vehicle range.

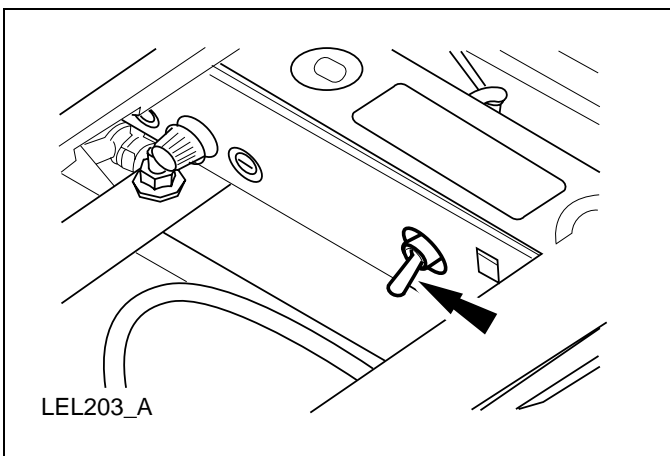
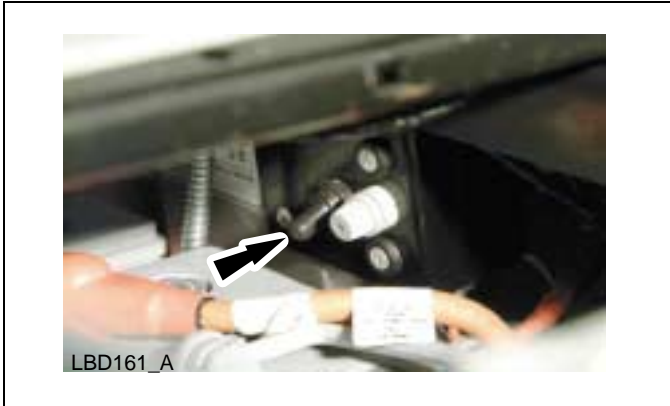
The vehicle can be stored for six months with the service disconnect switch off if starting with a full charge; however, the vehicle should be charged monthly if possible. With the service disconnect switch in the OFF position, there is a minimal draw from the vehicle components. The battery self-discharge determines the storage time. This is less than 5% per month at temperatures between 40 and 70° F (21° C). The self-discharge rate increases slightly at higher temperatures. If the batteries are nearly discharged then they may freeze at 32° and below. This will cause severe damage that may even cause battery case damage and leakage of the electrolyte.

When storing the neighbor:

1. Make sure the batteries are fully charged. Refer to [Battery Charging](#) in this section.
2. If storing the vehicle for more than 14 days, toggle the service disconnect switch to the off position.

Note:

Service disconnect switch location could be either under the driver seat or below and behind the parking brake lever.



Battery Water Reminder Indicator Resetting (Flooded Batteries Only)

Caution:

If the vehicle is equipped with flooded batteries, the instrument cluster gauge must be programmed for flooded batteries. Damage to the batteries can occur if the battery type is incorrectly programmed. Refer to [Battery Type Reprogramming](#) in this section.

Note:

The battery water reminder function of the instrument cluster gauge must be reset whenever the battery water has been checked and filled. The indicator will illuminate every 300miles (483kms). Battery electrolyte levels should be checked every 300 miles (483kms) or monthly, whichever comes first. The only time the battery water indicator can be reset is when the key is in the R (Reverse) position, the instrument cluster gauge is in the flooded battery mode and the battery water reminder indicator is on.

1. Turn the key to R (Reverse) position.
2. Press and hold the Select/Reset button for over 3 seconds.
3. Turn the key to the OFF (black dot) position.

Battery Type Reprogramming

CAUTION:

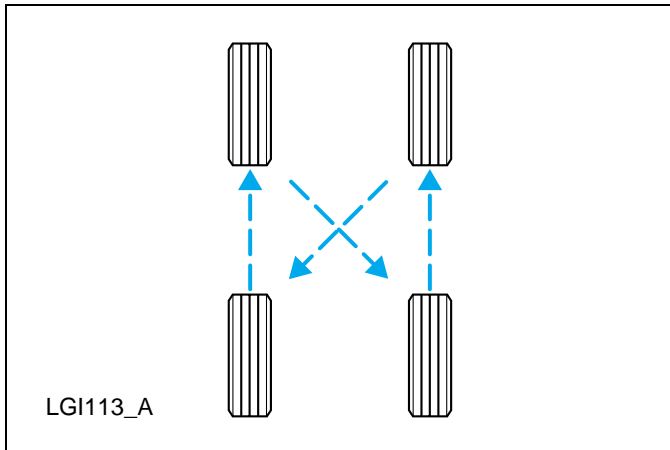
If the type of battery (flooded to gel, gel to flooded) is being changed, the instrument cluster gauge must be reprogrammed to avoid battery pack damage. The charging rate differs between type of battery and the battery water reminder indicator must be turned on for flooded type batteries.

1. With the key in the OFF (black dot) position, press and hold down the Select/Reset button.
2. Turn the key to the D (Drive) position.
3. Release the Select/Reset button.
4. Turn the key to the R (Reverse) position.
5. Press and release the Select/Reset button to alternate between the flooded and sealed battery modes.

6. Turn the key to the OFF (black dot) position. The gauge will automatically exit the reprogramming mode after 10 seconds.

Tire Rotation

The tire rotation pattern is the same as on other rear wheel drive vehicles. The front wheels move to the opposite side of the vehicle at the rear position. The rear wheels move to the same side of the vehicle at the front position.



Maintenance Schedule

WARNING:

TO AVOID SERIOUS INJURY AND/OR DEATH, NEVER PERFORM ANY VEHICLE SERVICE OR MAINTENANCE WHILE THE ELECTRICAL LEAKAGE WARNING IS ILLUMINATED. REFER TO LEAKAGE DETECTION IN THE ELECTRICAL SECTION AND RESOLVE THE LEAKAGE CONDITION PRIOR TO BEGINNING OTHER REPAIRS.

Regular Interval	Item	Service
Daily service (by owner)	Batteries	Charge batteries after each use.
Monthly service (by owner or technician)	Batteries	Flooded Only-Check electrolyte level. Add distilled or demineralized water as necessary.
		Wash battery tops and clean terminals with baking soda/water solution. Dispose of wastewater properly.
	Tires	Check air pressure and adjust as necessary.
	General Vehicle	Wash battery compartment and underside of vehicle. Dispose of the wastewater properly.
Semi-annual service by a qualified technician	Brake system	Check brake shoes.
		Lubricate brake slides.
	Brake linkage and pivots	
Front wheel alignment	Check and adjust as required.	
Annual service by a qualified technician	Batteries	Test batteries. Check for proper battery terminal tightness.
	Gearbox	Drain/fill gearbox fluid.
	Front suspension	Inspect and lubricate front wheel bearings.
	Brake system	Pushrod locknut for tightness.

Section 2 Chassis

General Specifications	2
Torque Specifications	2
Description and Operation	4
Wheel Alignment Angles.....	4
Brakes	4
Diagnosis and Testing.....	6
Ball Joint Inspection	6
Wheel Bearing Inspection.....	6
Master Cylinder	7
Compensator Port Check	7
Brake Drag Check.....	7
Bleeding Brake System.....	7
Manual Bleeding.....	7
Pressure Bleeding	9
Removal and Installation	11
Parking Brake Lever	11
Parking Brake Cables - Primary, Front Cable	12
Rear Parking Brake Cable.....	13
Brake Pedal Arm and Pad.....	15
Brake Lines	16
Master Cylinder Reservoir.....	17
Master Cylinder	19
Front/Rear Brake Drum	21
Front Brake Shoes and Hardware	22
Rear Brake Shoes and Hardware	24
Wheel Cylinder	25
Coil Over Assembly.....	26
Upper Control Arm.....	28
Lower Control Arm	30

Rear Trailing Arm.....	31
Steering Column.....	34
Steering Rack.....	36
Steering Bellows.....	37
Steering Knuckle.....	38
Tie Rod Ends.....	40
Adjustment.....	41
Brake Pushrod Adjustment.....	41

General Specifications

Description	Degrees.	Radians	
Front Toe Setting	0.0 ± 0.50	0.0 ± 0.009	
Description	2 Passenger mm (in)	2 Passenger Wagon mm (in)	4 Passenger mm (in)
Track – Street tires	1274 (50.1)	1274 (50.1)	1274 (50.1)
Track – Turf tires	1234 (48.6)	1234 (48.6)	1234 (48.6)
Overall height	1720 (67.7)	1720 (67.7)	1720 (67.7)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Accelerator Assembly Bolts	23-31	18-22	-
Master Cylinder Push Rod Jam Nut	8.5-11.5		76-101
Brake Drum Screws	1	-	8.9
Brake Fittings	13-17	10-12	
Brake Pedal Arm Pivot Bolt	10.6–14.4	7.8-10.6	-
Brake Pedal Pad Bolt	23-31	18-23	-
Ball Joint Nuts	59.5-80.5	43.8-59.3	-
Master Cylinder Reservoir Bolts	3.4-4.8	-	30.1-42.4

Description	Nm	Lb-Ft	Lb-In
Master Cylinder Reservoir Bracket/Header	9-12	-	80-106
Coil over Bolt – Lower	102-150	75-111	-
Coil over Nut – Upper	15-18 mm from top of stud.		
Front Hub Bolts	23-31	18-23	-
Front Lower Control Arm Bolts	102-150	75-111	-
Front Upper Control Arm Bolts	102-150	75-111	-
Halfshaft Nut	175-260	129-191	-
Master Cylinder Bolts	23-31	18-23	
Multifunction Switch Screw	2.5-3.7	-	22.1-32.7
Parking Brake Lever Bolts	23-31	18-23	-
Parking Brake Rear Cable Bracket Bolts	23-31	18-23	-
Parking Brake Cable Adjustment/Lever	30 mm	Exposed	Thread
Rear Hub Bolts	23-31	18-23	-
Steering Column and Bracket Bolts	23-31	18-22	-
Steering Column Shroud Screws	2.5-3.7	-	22.1-32.7
Steering Rack Bolt/Left Side	102-150	75-110	-
Steering Rack Bolt/Right Side	41-60	30-44	
Steering Shaft Pinch Bolt	20-30	15-22	-
Steering wheel bolt	40-55	30-40	
Tie down brackets	20-30	15-22	
Tie Rod Castle Nuts	16-34	11-25	-
Trailing Arm Bolts	124-128	91-94	-
Tie Rod End Jam Nut	49-54	37-40	-
Wheel Cylinder Bolts	12-14	8-10	-
Wheel Lug Nuts	100-134	74-98	-

Description and Operation

Wheel Alignment Angles

- Caster and camber correction requirements are factory-determined. Thoroughly inspect the suspension system to locate worn or damaged components that may have caused the setting to change.
- The vehicle toe setting affects tire wear and directional stability.
- Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.
- Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.
- Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or the steering correction is completed.
- Drift/pull is a tugging sensation, felt by the hands on the steering wheel that must be overcome to keep the vehicle going straight. Drift describes what a vehicle with this condition does with hands off the steering wheel. A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect. Drift/pull may be induced by conditions external to the vehicle (i.e., wind, road camber).

Brakes

The hydraulic brake system consists of:

- Master cylinder
- Brake fluid reservoir
- Wheel cylinders
- Brake lines and hoses

The hydraulic brake system is divided into two separate circuits, front and rear. It is divided to help prevent complete brake failure if one part of either circuit is damaged.

Brake Fluid

WARNING!

BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

CAUTION:

When adding brake fluid to the brake reservoir, avoid spilling fluid onto the vehicle's plastic panels, including the instrument panel. If brake fluid is spilled on any surface, wash it immediately with soap and water to prevent cracking, discoloration, or other damage.

- Clean, fresh Motorcraft High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A is the only brake fluid that should be used in motor vehicles.
- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.
- Do not mix different types of brake fluid.

Master Cylinder and Master Cylinder Reservoir

The master cylinder reservoir is equipped with a fluid level sensor to detect low brake fluid level. The fluid level sensor will provide a ground path to illuminate the brake warning icon.

Brake Tubes and Hoses

CAUTION:

Never use copper tubing, it is subject to fatigue, cracking and corrosion, which could result in brake tube failure.

All brake tube fittings must be properly flared (90° bubble flare for master cylinder and wheel cylinder, 45° double flare per SAE J533B for all other connections) to provide strong leak proof connections. When bending tubing to fit the underbody contours, be careful not to kink or crack the tube.

If a section of brake tube is damaged, the entire section must be replaced with a tube of the same type, size, shape and length.

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After replacement, bleed the brake system.

Parking Brake

The vehicle is equipped with a cable operated parking brake system. The parking brake is designed to prevent vehicle roll away if stopped on an incline and the foot operated brakes are not engaged. The parking brake system incorporates a warning signal. If the vehicle is stopped and the key switch turned off, the signal will remind the operator for ten seconds to set the parking brake.

Diagnosis and Testing

Ball Joint Inspection

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Prior to performing any inspection of the ball joints, inspect the front wheel bearings. Refer to [Wheel Bearings](#) in this section.
3. Position a safety stand beneath the front axle to be tested.
4. While an assistant pulls and pushes the bottom of the tire, observe the relative movement between the lower control arm and the steering knuckle. Any movement indicates a worn or damaged lower ball joint. Replace lower control arm Refer to [Lower Control Arm](#) in this section.
5. While an assistant pulls and pushes the top of the tire, observe the relative movement between the upper control arm and the steering knuckle. Movement at or exceeding the specification indicates a worn or damaged upper ball joint. Replace the upper control arm. Refer to [Upper Control Arm](#) in this section.

Wheel Bearing Inspection

1. Raise and support the vehicle until the tire is off the floor. Refer to [Lifting](#) in the General Information section.

Note:

Make sure the wheel rotates freely and the brake shoes are retracted sufficiently to allow movement of the tire and wheel assembly.

2. Grasp each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.
3. If the tire and wheel (hub) is loose on the steering knuckle or does not rotate freely, replace the front wheel bearing.

Master Cylinder

1. Disconnect the brake lines at the master cylinder.
2. Plug the outlet ports of the master cylinder.
3. Apply the brakes. If brake pedal height cannot be maintained, the master cylinder has an internal leak and must be rebuilt or a new one installed.

Compensator Port Check

The purpose of the compensator ports in the master cylinder is to supply any additional brake fluid required by the system due to brake pad wear, and to allow brake fluid returning from the brake lines to the master cylinder to enter the master cylinder reservoir.

The returning brake fluid will cause a slight turbulence in the master cylinder reservoir. Turbulence seen in the master cylinder reservoir upon release of the brake pedal is normal and shows that the compensating ports are not plugged.

Brake Drag Check

Vehicles built before 12/14/01 may exhibit brake drag. Verify the condition as follows:

1. Raise and support the vehicle. Refer to [Lifting](#) in the General information section.
2. Spin the wheels to verify they rotate freely. Refer to [Brake Pushrod Adjustment](#) if the wheels do not rotate freely.

Bleeding Brake System

Manual Bleeding

WARNING!

USE OF ANY BRAKE FLUID OTHER THAN APPROVED DOT 3 WILL CAUSE PERMANENT DAMAGE TO BRAKE COMPONENTS AND WILL RENDER THE BRAKES INOPERATIVE.

WARNING!

BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

CAUTION:

Do not allow the master cylinder reservoir to run dry during the bleeding operation. Keep the master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION:

Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Note:

When any part of the hydraulic system has been disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Clean all dirt from and remove the master cylinder reservoir cap and fill the master cylinder reservoir with the specified brake fluid.
2. Place a box end wrench on the right rear bleeder screw. Attach a rubber drain tube to the right rear bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.
3. Have an assistant hold firm pressure on the brake pedal.
4. Loosen the right rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the right rear bleeder screw.
5. Repeat until clear, bubble-free fluid comes out.
6. Fill the master cylinder reservoir as necessary.
7. Tighten the right rear bleeder screw.
8. Repeat steps **3, 4, 5, 6** and **7** for the left rear bleeder screw.

9. Place a box end wrench on the right front brake wheel cylinder bleeder screw. Attach a rubber drain tube to the right front brake wheel cylinder bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.
10. Have an assistant hold firm pressure on the brake pedal.
11. Loosen the right front cylinder bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the right front wheel cylinder brake wheel cylinder bleeder screw.
12. Repeat until clear, bubble-free fluid flows.
13. Fill the master cylinder reservoir as necessary.
14. Tighten the right front wheel cylinder bleeder screw.
15. Repeat steps **10**, **11**, **12**, **13** and **14** for the left front wheel cylinder brake bleeder screw.

Pressure Bleeding

WARNING!

USE OF ANY BRAKE FLUID OTHER THAN APPROVED DOT 3 WILL CAUSE PERMANENT DAMAGE TO BRAKE COMPONENTS AND WILL RENDER THE BRAKES INOPERATIVE.

WARNING!

BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

CAUTION:

Do not allow the master cylinder reservoir to run dry during the bleeding operation. Keep the master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION:

Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Note:

When any part of the hydraulic system has been disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Clean all dirt from and remove the master cylinder filler cap and fill the master cylinder reservoir with the specified brake fluid

Note:

Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

2. Install the bleeder adapter to the master cylinder reservoir, and attach the bleeder tank hose to the fitting on the adapter.

Note:

Bleed the longest line first. Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

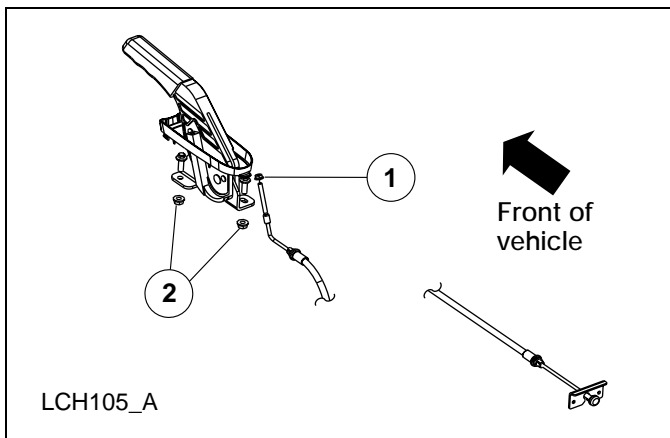
3. Place a box end wrench on the right rear bleeder screw. Attach a rubber drain tube to the right rear bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.
4. Open the valve on the bleeder tank.
5. Loosen the right rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the right rear bleeder screw and remove the rubber hose.
6. Continue bleeding the rear of the system, going in order from the left rear bleeder screw to the right front wheel cylinder brake bleeder screw, ending with the left front wheel cylinder brake bleeder screw.
7. Close the bleeder tank valve. Remove the tank hose from the adapter, and remove the adapter.

Removal and Installation

Parking Brake Lever

Removal

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
2. Remove the two parking brake lever bolts (2) and the parking brake lever.
3. Disconnect the warning lamp switch connector
4. Disconnect the primary parking brake cable (1).



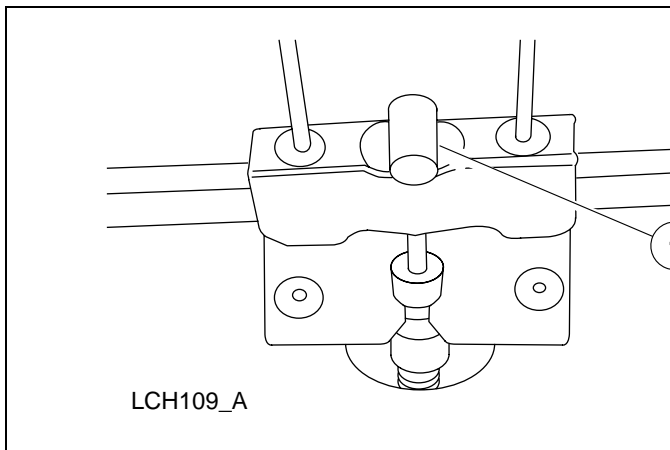
Installation

1. Reverse the removal procedure.
2. Tighten the parking brake lever bolts to 23-31N.m. (18-23lb-ft.).
3. Tighten the cable nut until the cable is fully seated in the cable housing and 30mm (1.1in) of thread is exposed.

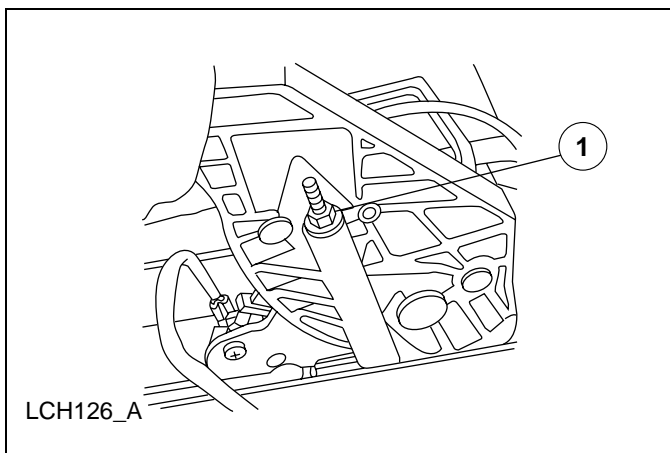
Parking Brake Cables - Primary, Front Cable

Removal

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. Disconnect the primary parking brake cable (1) from the rear cable bracket.



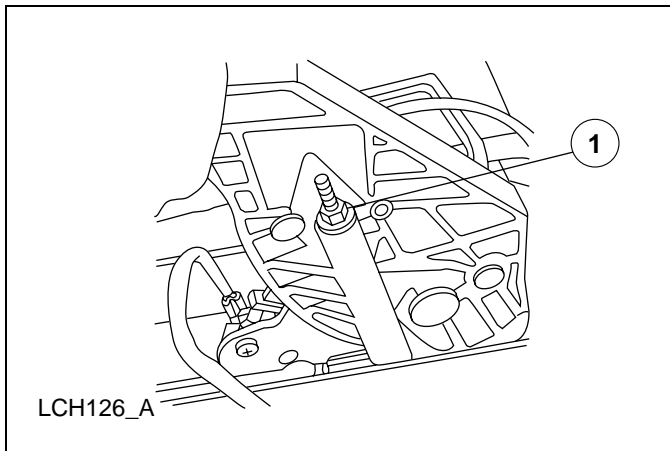
4. Remove the anchor nut from the cable end.



5. Remove the primary parking brake cable from the vehicle.

Installation

1. Install the front end of the cable through the floor, into the lever mounting bracket.
2. Connect the primary parking brake cable to the rear cable bracket.
3. Lower the vehicle.
4. Position the cable through the cable anchor nut and bracket.
5. Connect the cable to the anchor and tighten the nut until the exposed thread length is 30 mm.

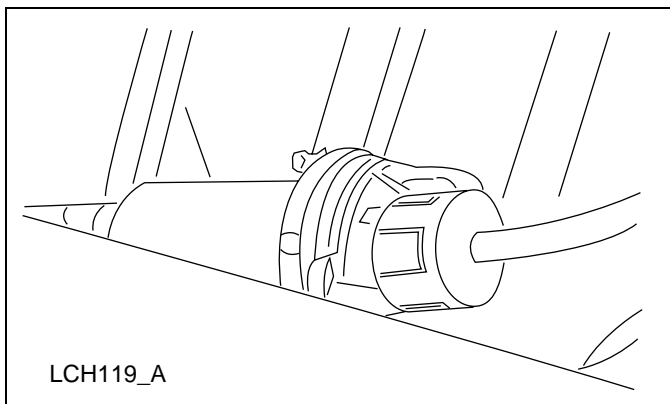


6. Install the dust boot.
7. Install the seat stanchion cover.

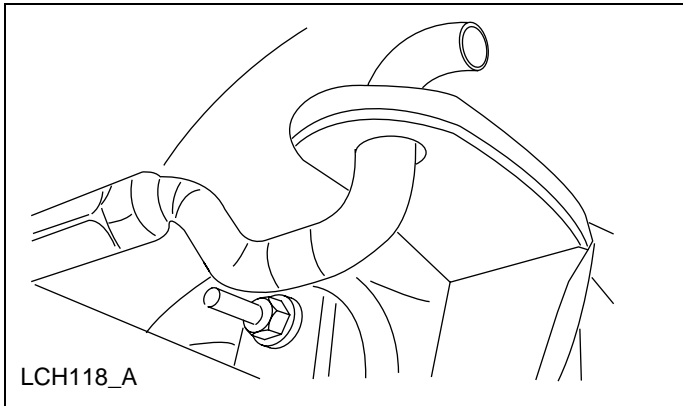
Rear Parking Brake Cable

Removal

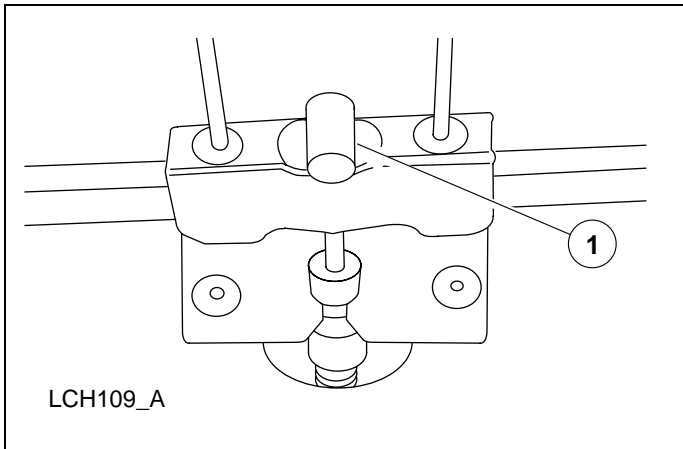
1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.



2. Loosen primary cable adjustment nut to reduce system tension.
3. Disconnect the cables from the rear brake cable bracket.



4. Remove the cable from the rear actuator on the rear wheel.



5. Disconnect the primary cable (1).
6. Remove the secondary parking brake cables from the vehicle.

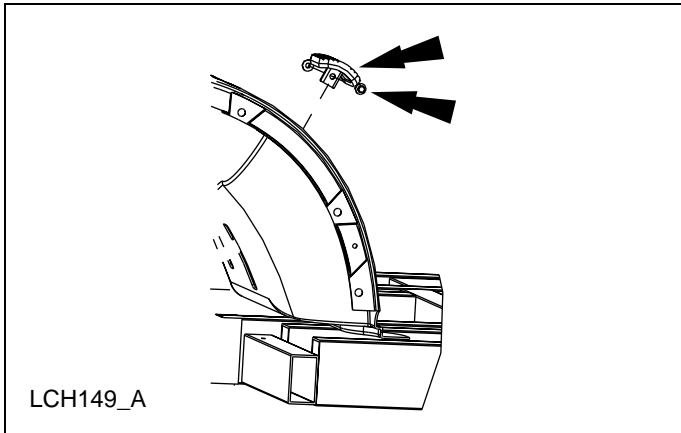
Installation

1. Reverse the removal procedure.

Brake Pedal Arm and Pad

Removal

1. Remove the pedal pad nut and bolt. Remove the pad.

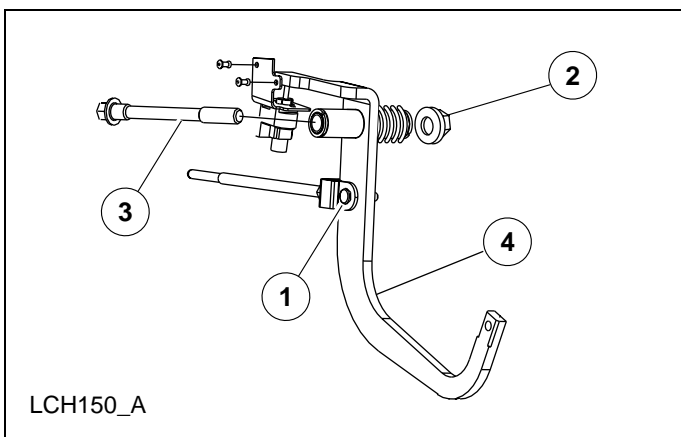


2. Raise and support the vehicle. Refer to [Lifting](#) in the General information section.

Note:

The system has a brake pedal arm return spring. The brake arm may spring up if the floor has been removed from the vehicle.

3. Remove the master cylinder push rod clevis pin and cotter pin (1).



4. Remove the brake on/off switch from the bracket.

CAUTION:

Switch will be over plunged if not removed.

5. Remove the brake pedal arm pivot bolt (2) and nut (3).

6. Remove the brake pedal arm (4).

Installation

WARNING!

Make sure the master cylinder push rod jam nut is tightened to 8.5 – 11.5N.m (76-101lb-in). The master cylinder push rod jam nut could loosen resulting in an accident or personal injury.

WARNING!

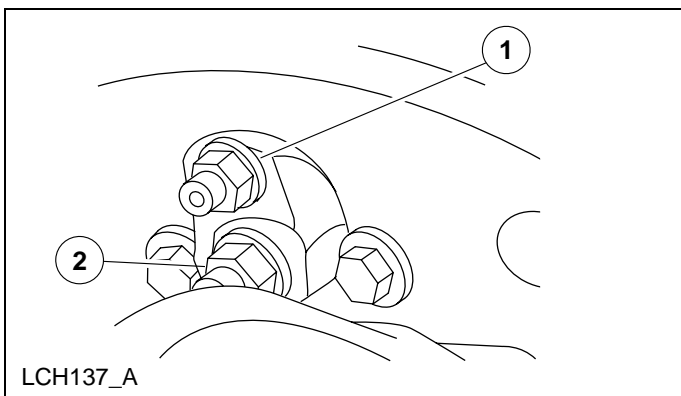
Make sure the cotter pin is properly installed through the master cylinder push rod clevis pin. If the cotter pin is not installed the clevis pin could fallout resulting in an accident or personal injury.

1. Reverse the removal procedure.
2. Tighten the brake pedal arm pivot bolt to 10.6-14.4N.m. (7.8-10.6lb-ft.).
3. Tighten the brake pedal pad bolt to 23-31N.m. (18-23lb-ft.).
4. Tighten the master cylinder push rod jam nut to 8.5 – 11.5N.m (76-101lb-in).

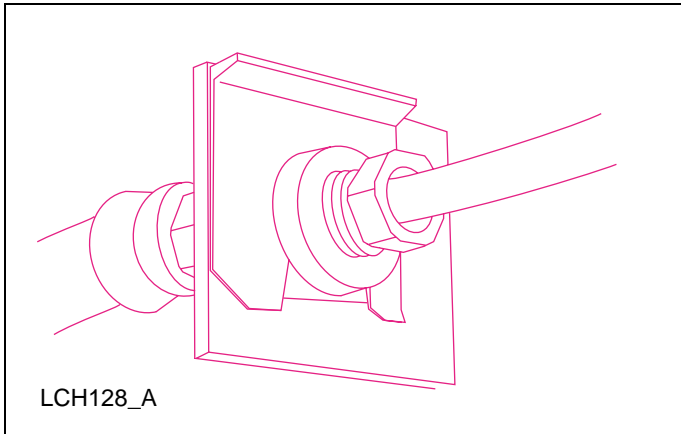
Brake Lines

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Open the brake bleeder (1) on the wheel for the brake line that is being replaced.



3. Disconnect the brake line (2) on the brake wheel cylinder.



4. Disconnect the brake line at the brake tube (3).
5. Remove the brake line retainer and the brake line.

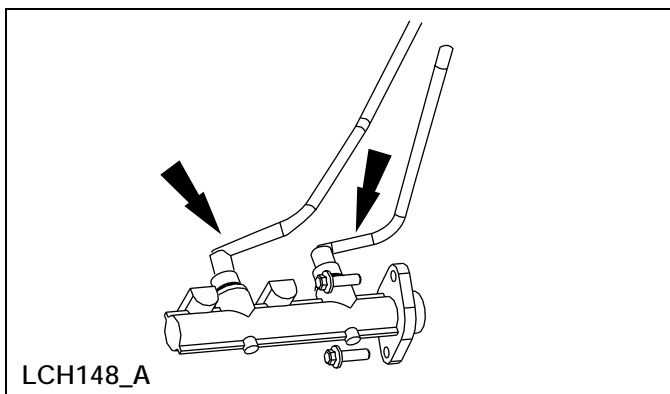
Installation

1. Reverse the removal procedure.
2. Bleed the brake system. Refer to [Bleeding Brake System](#) in this section.

Master Cylinder Reservoir

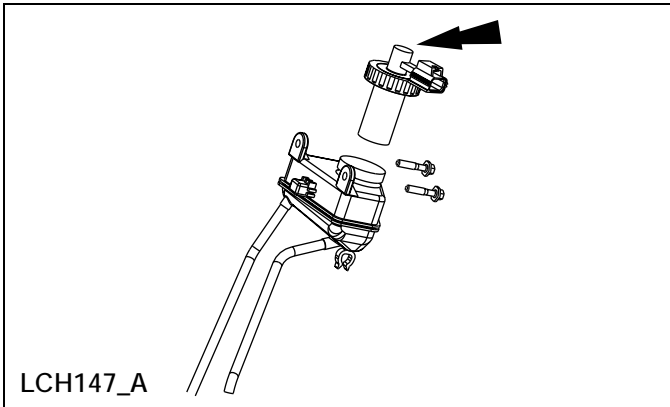
Removal

1. Position a drain pan under the vehicle.
2. Unlock and remove the hood.
3. Disconnect the two brake fluid lines from the master cylinder.

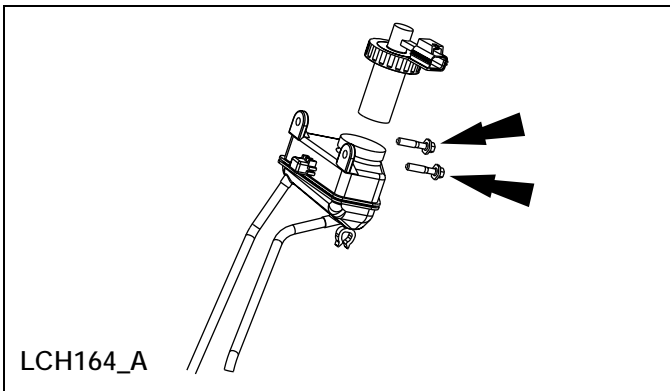


4. Remove the scrivet and the cowl tray panel.

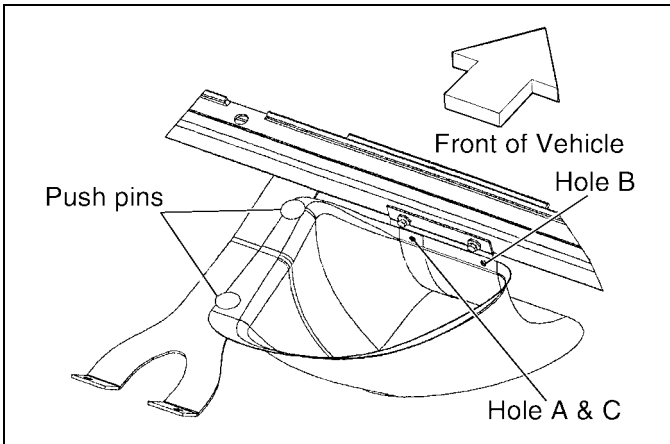
- Remove the master cylinder reservoir filler cap.



- Remove the two master cylinder brake fluid reservoir bolts, spacer and the master cylinder brake fluid reservoir.

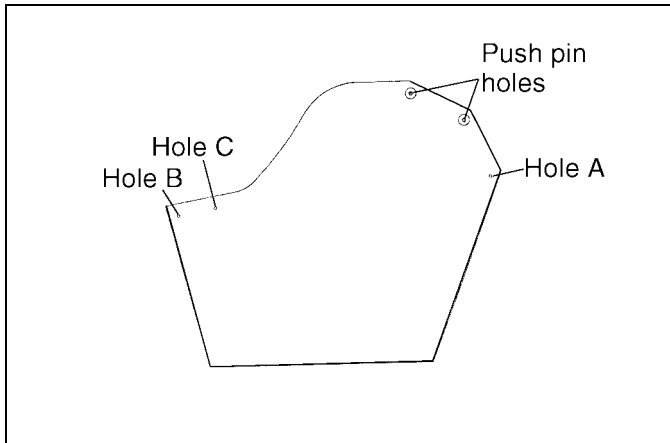


- If necessary, remove the two pushpins and the brake fluid shield.



Installation

1. Reverse the removal procedure.
2. Align holes A and C while installing the master cylinder reservoir and bolts.

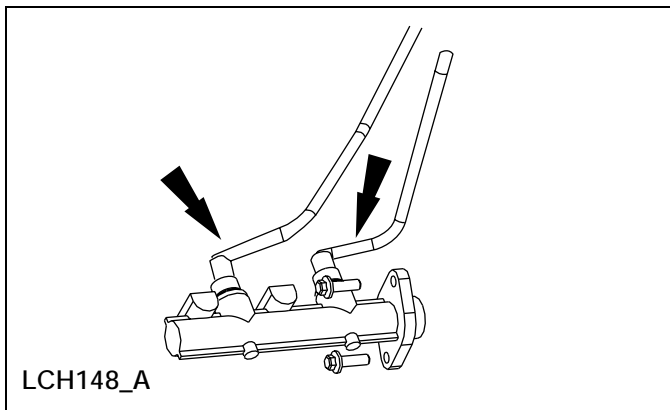


3. Tighten the master cylinder reservoir bolts to 3.4-4.8 N.m. (30.1-42.4 lb-in.).
4. Fill and bleed the master cylinder. Refer to Bleeding Brake System in this section.
5. Recheck the brake fluid level.

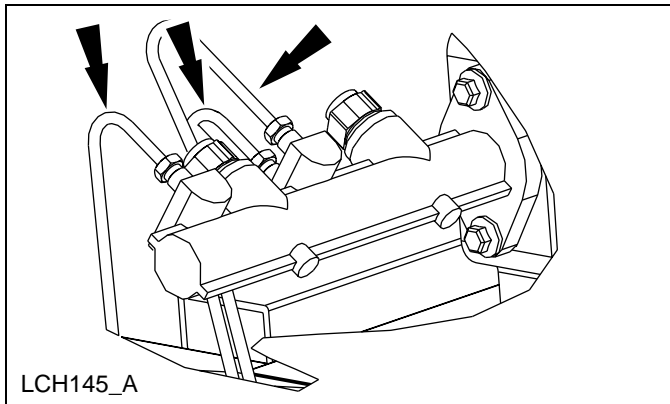
Master Cylinder

Removal

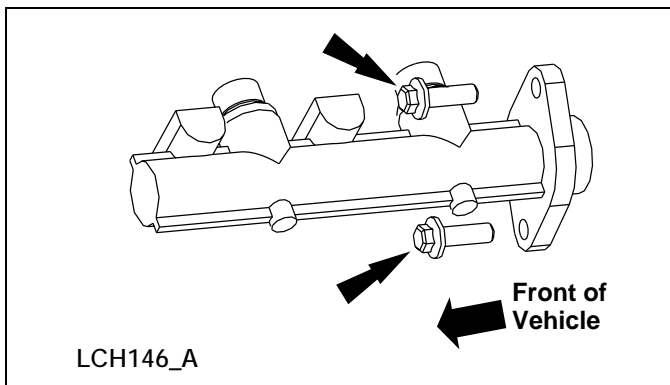
1. Position a drain pan under the vehicle.
2. Unlock and remove the hood.
3. Disconnect the two brake fluid lines from the master cylinder.



4. Disconnect the three brake lines from the master cylinder.



5. Remove the two master cylinder bolts and the master cylinder.



Installation

WARNING!

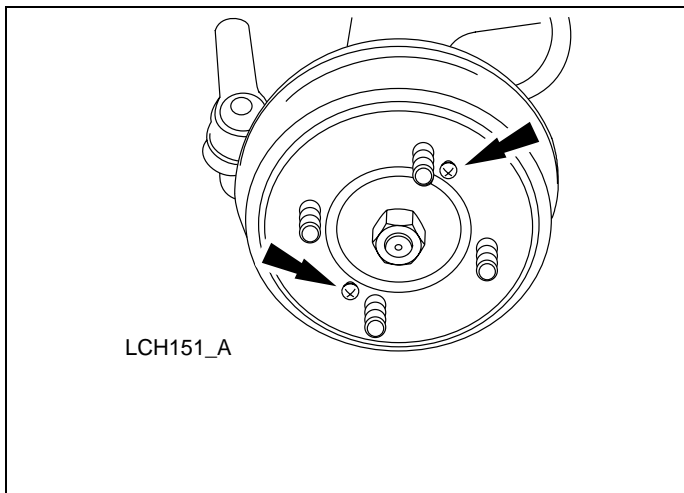
Make sure to torque the brake actuator rod jam nut to 8.5 – 11.5N.m (76-101lb-in). The brake actuator rod jam nut could loosen resulting in an accident or personal injury.

1. Reverse the removal procedure.
2. Tighten the master cylinder bolts to 23-31N.m. (18-23lb-ft.).
3. Fill the brake fluid reservoir.
4. Bleed the master cylinder. Refer to [Bleeding Brake System](#) in this section.
5. Recheck the brake fluid level.

Front/Rear Brake Drum

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Remove the brake hub screws from the brake drum.

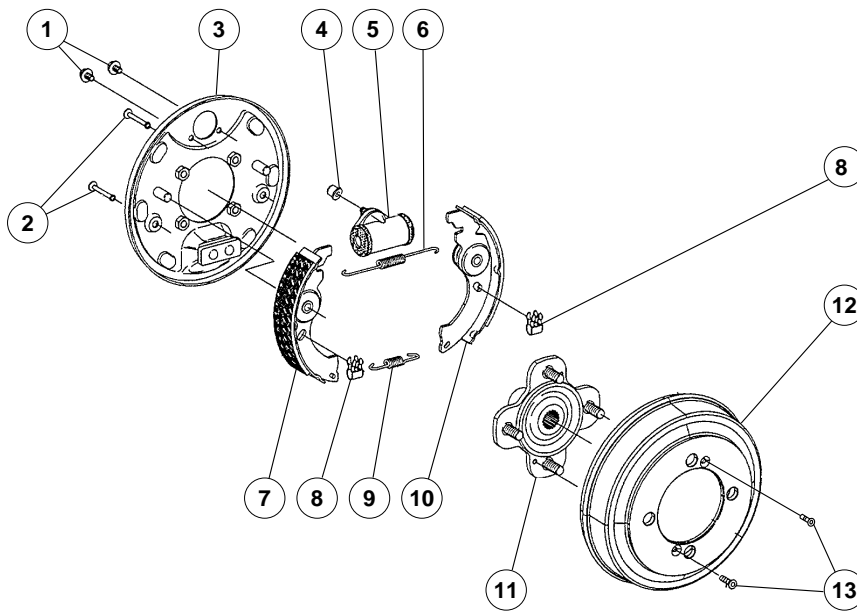


4. Remove the brake drum from the hub.

Installation

1. Reverse the removal procedure.
2. Tighten the brake hub screws to 1 N.m. (8.8lb-in.).
3. Check the brake adjustment.

Front Brake Shoes and Hardware



LCH157_A

Item	Part Number	Description
1	9922	Screw M6 X 40
2	-	Spring Pin
3	-	Shoe Holder Plate
4	-	Boot
5	2C-537	Hydraulic Cylinder
6	2A-225	Upper Return Spring
7	2007	Left Brake Shoe
8	-	Shoe Locking Spring
9	2A-225	Lower Return Spring
10	2007	Right Brake Shoe
11	-	Flange
12	1126	Front Brake Drum
13	-	Screw M5 X 12

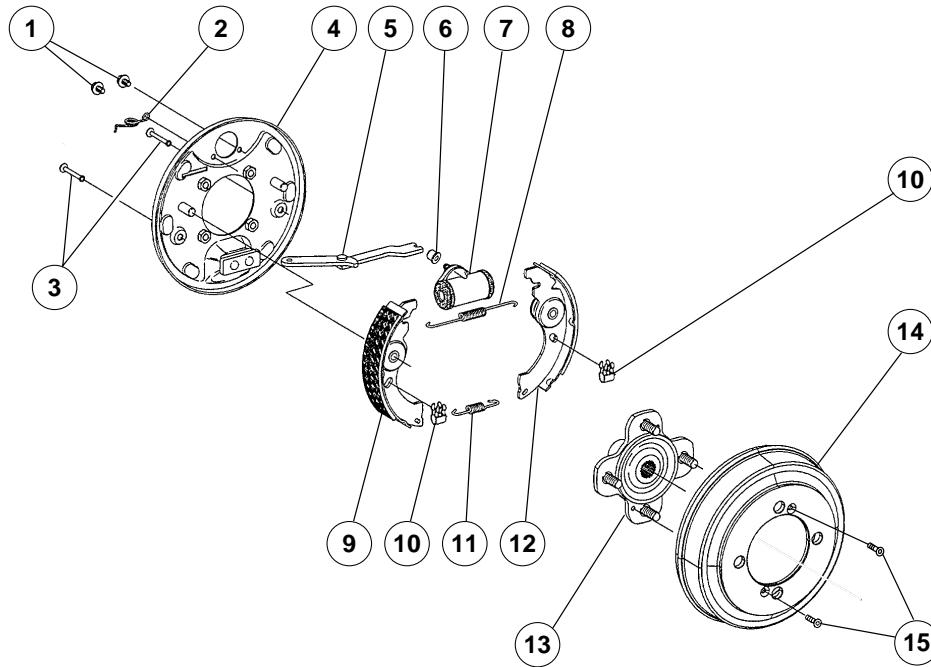
Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the front wheel and tire assembly.
3. Remove the front brake drum screws (13) and the brake drum (12).
4. Remove the upper return spring (6).
5. Remove the shoe locking springs (8).
6. Remove the spring pins (2).
7. Remove the brake shoes (7) and (10).

Installation

1. Install the spring pins (2).
2. Install the lower return spring (9) between the two brake shoes.
3. Install the brake shoes (7) and (10) on the spring pins (2).
4. Install the shoe locking springs (8).
5. Install the upper return spring (6).
6. Install the brake drum (12) and screws (13).
7. Tighten the brake drum screws to 1 N.m. (8.8lb-in.).
8. Install the wheel and tire assembly. Tighten the wheel lug nuts to 110-124N.m. (81-91lb-ft.).
9. Lower the vehicle.
10. Test the brake pedal for hardness.
11. Check and fill the master cylinder reservoir if necessary.

Rear Brake Shoes and Hardware



LCH158_A

Item	Part Number	Description
1	9922	Screw M6 X 40
2	-	Left Hand Brake Lever Spring
3	-	Spring Pin
4	-	Shoe Holder Plate
5	-	Brake Hand Lever
6	-	Boot
7	-	Hydraulic Cylinder
8	2A-225	Upper Return Spring
9	2007	Left Brake Shoe
10	-	Shoe Locking Springs
11	2A-225	Lower Return Spring
12	2007	Right Brake Shoe

13	-	Flange
14	1126	Brake Drum
15	-	Screw M5 X 12

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Remove the two brake drum screws (15) and the brake drum (14).
4. Remove the upper return spring (8).
5. Remove the rear brake lever spring (2).
6. Remove the lower return spring (11).
7. Remove the shoe locking springs (10).
8. Remove the brake shoes (9) (12).

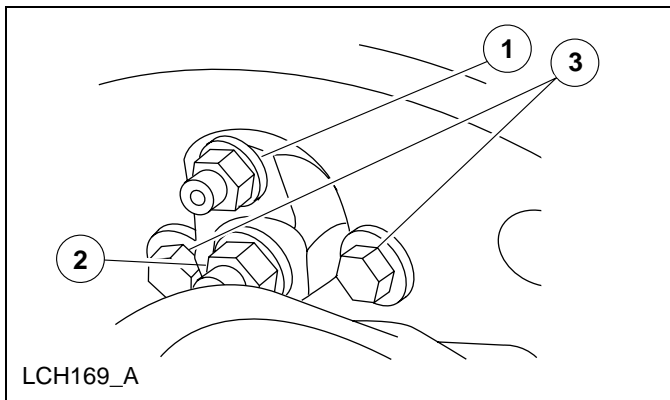
Installation

1. Reverse the removal procedure.
2. Tighten the brake drum screws to 1 N.m. (8.9lb-in.).
3. Tighten the wheel lug nuts to 100-134 N.m. (74-98lb-ft.).

Wheel Cylinder

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Loosen the bleeder screw (1) to relieve fluid pressure.



4. Remove the brake shoes. Refer to [Brake Shoes and Hardware](#) in this section.
5. Loosen the brake line flange nut and disconnect the brake line (2) from the wheel cylinder.
6. Remove the wheel cylinder bolts (3) and the wheel cylinder from the backing plate.

Installation

1. Reverse the removal procedure.
2. Tighten the wheel cylinder bolts to 12-14N.m (8-10lb-ft.).
3. Tighten the wheel lug nuts to 100-134N.m. (74-98lb-ft.).
4. Fill the master cylinder reservoir and bleed the brake system. Refer to [Bleeding Brake System](#) in this section.

Coil Over Assembly

Removal

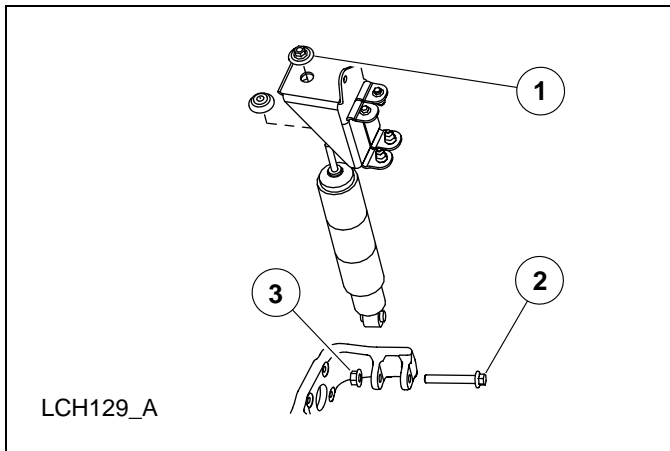
Note:

On rear coil over shock removal, the rear-trailing arm must be supported. If allowed to fall, damage to halfshaft could occur.

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Support the lower control arm spring weight on a jack stand.
3. Remove the coil over upper nut, washer and grommet (1) from the coil over assembly.



4. Remove the coil over nut (3) and bolt (2) from the coil over assembly lower mount.



5. Lower the jack stand.
6. Remove the coil over assembly.

Installation

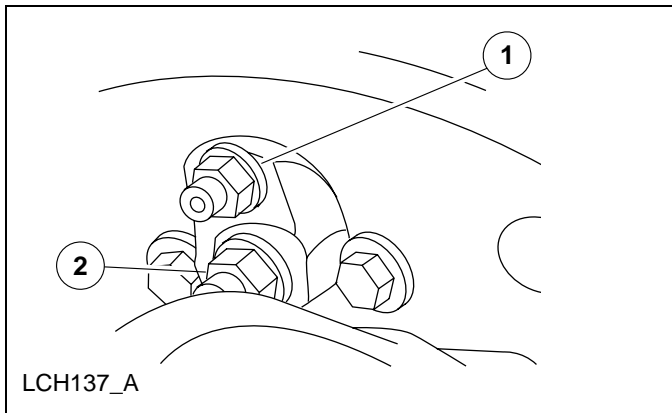
1. Reverse the removal procedure.
2. Install the coil over assembly with the painted alignment mark facing out.
3. Tighten the upper coil over nut to 15-18mm from top of stud.
4. Tighten the lower coil over bolt to 102-150N.m. (75-111lb-ft.).
5. Remove the jack stand.
6. Lower the vehicle.

Upper Control Arm

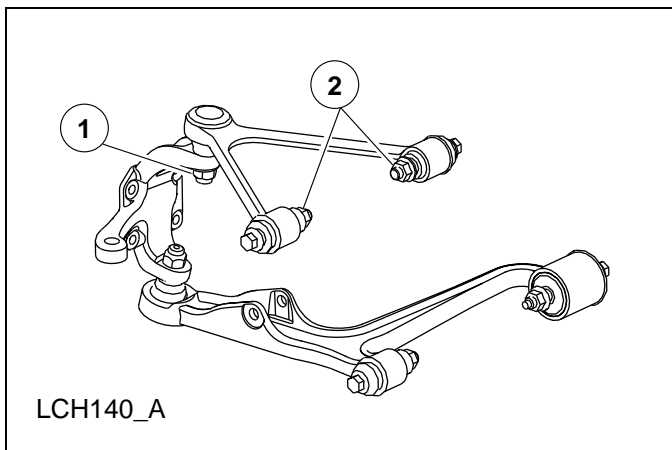
Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Drill out the four rivets and remove the inner fender shield.

4. Open the brake bleeder screw (1) to relieve fluid pressure.



5. Disconnect the wheel cylinder brake hose (2) and position it aside.
6. Support the lower control arm.
7. Separate the front steering knuckle from the upper ball joint (1).



8. Remove the upper control arm nuts and bolts (2) and remove the upper control arm.

Installation

1. Reverse the removal procedure.
2. Install the inner fender shield.

Note:

Tighten all fasteners in full rebound condition.

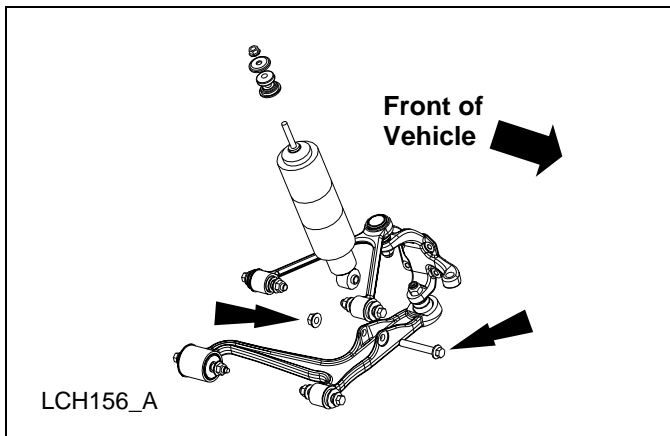
3. Tighten the ball joint nut to 59.5-80.5N.m. (43.8-59.3lb-ft.).
4. Tighten the control arm bolts to 102-150N.m. (75-111lb-ft.).

5. Tighten the wheel lug nuts to 100-134N.m. (74-98lb-ft.).
6. Adjust the toe equally for clear vision.

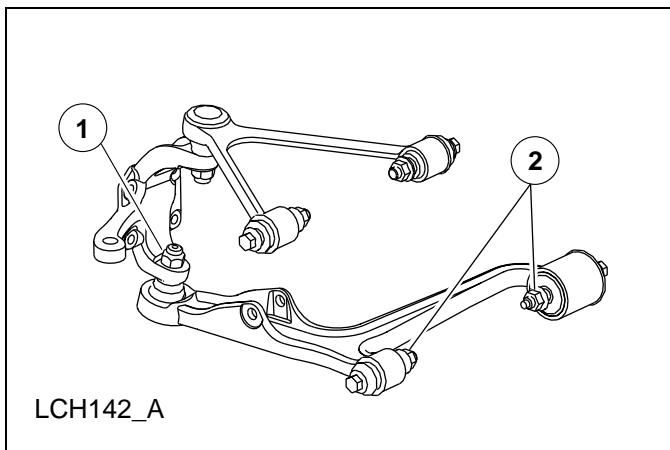
Lower Control Arm

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Support the lower control arm with a jack stand.
4. Remove the lower coil over shock bolt and nut.



5. Remove the lower ball joint nut and separate the lower ball joint (1).



6. Remove the lower control arm nuts and bolts (2) and spacers.
7. Reposition and support the upper control arm and brake drum assembly.
8. Remove the lower control arm.

Installation

1. Reverse the removal procedure.

Note:

Tighten all fasteners in full rebound condition.

2. Tighten the control arm bolts front then rear.
3. Tighten the control arm bolts to 102-150 N.m (75-111 lb.ft).
4. Tighten the lower coil over bolt to 102-150 N.m. (75-111lb-ft).
5. Tighten the ball joint nut to 59.5-80.5 N.m. (43.8-59.3lb-ft).
6. Tighten the wheel lug nuts to 100-134N.m. (74-98lb-ft.).
7. Adjust the toe equally for clear vision.

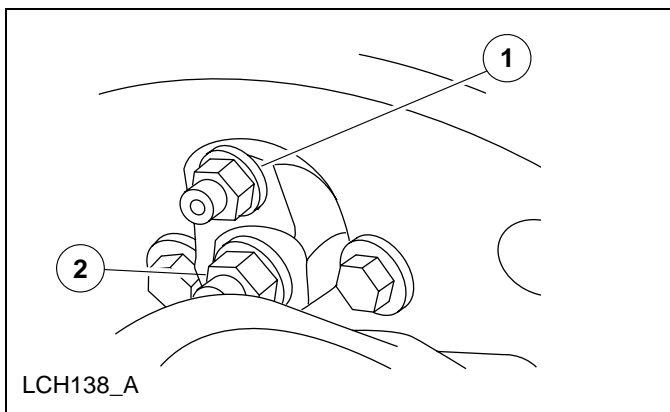
Rear Trailing Arm

Removal

Note:

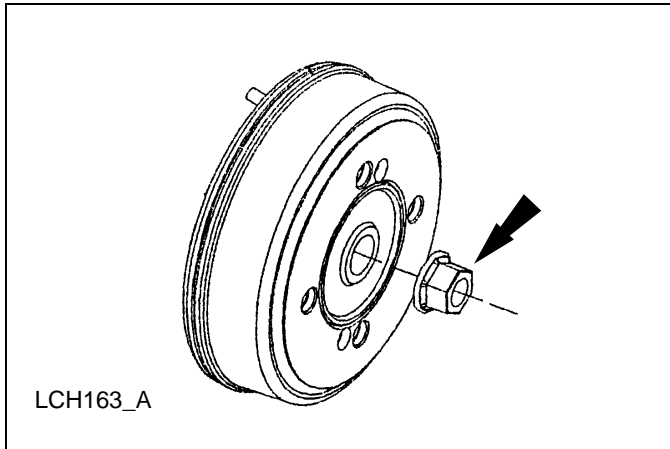
The rear-trailing arm must be supported. If allowed to fall, damage to the halfshaft could occur.

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Open the wheel cylinder bleeder screw (1) to relieve fluid pressure

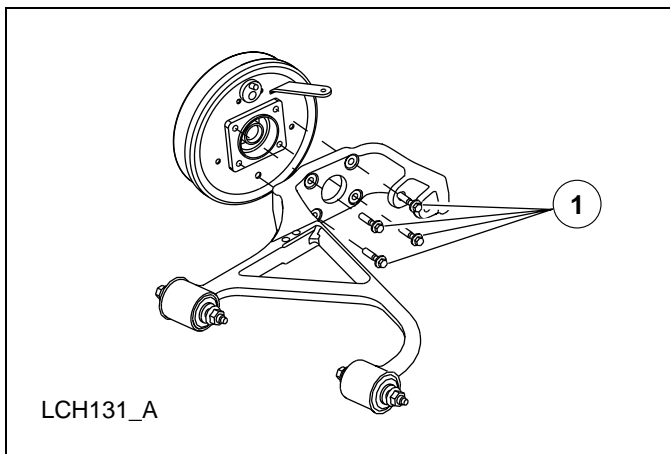


4. Disconnect the rear wheel cylinder brake line (2).

5. Remove the halfshaft nut.

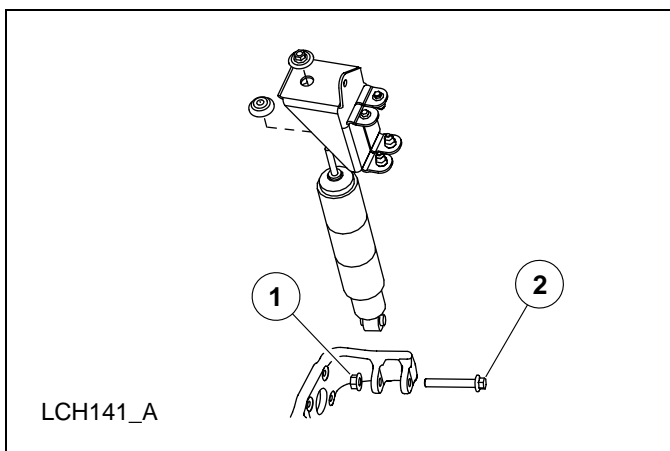


6. Remove the four rear hub bolts (1).



7. Support the hub assembly.

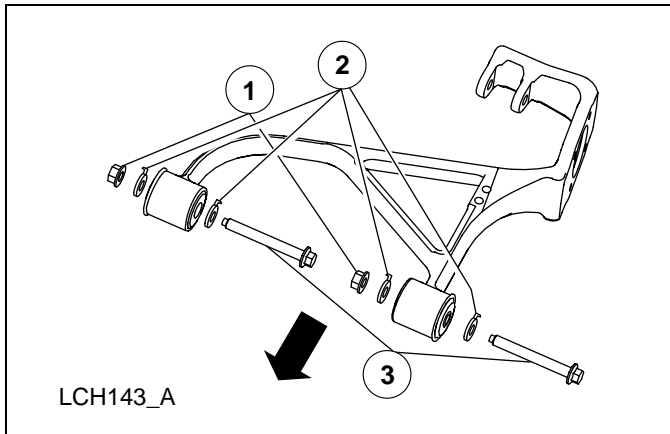
8. Remove the lower coil over shock nut (1) and bolt (2).



Note:

The rear-trailing arm must be supported. If allowed to fall, damage to the halfshaft could occur.

9. Remove the two trailing arm nuts (1), the four washers (2), and the two bolts (3).



10. Remove the rear-trailing arm off of the halfshaft and from the vehicle.

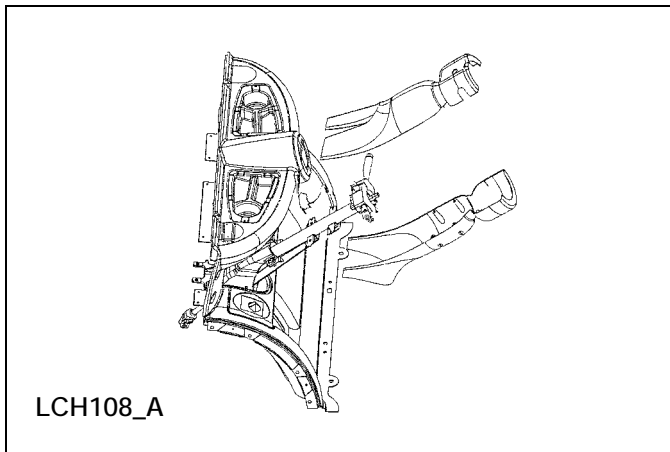
Installation

1. Reverse the removal procedure.
2. Tighten the lower coil over bolt to 102-150N.m. (75-111lb-ft.).
3. Tighten the trailing arm bolts to 124-128N.m. (91-94lb-ft.).
4. Tighten the halfshaft nut to 175-260N.m (129-191lb-ft.)
5. Tighten the wheel lug nuts to 100-134N.m. (74-98lb-ft.).
6. Bleed the brake system. Refer to [Bleeding Brake System](#) in this section.

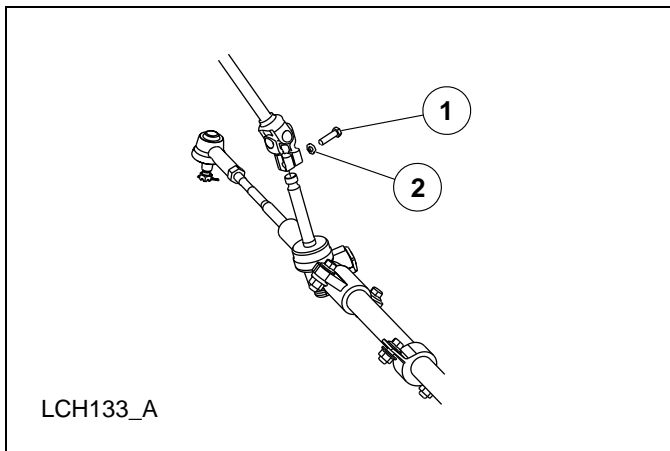
Steering Column

Removal

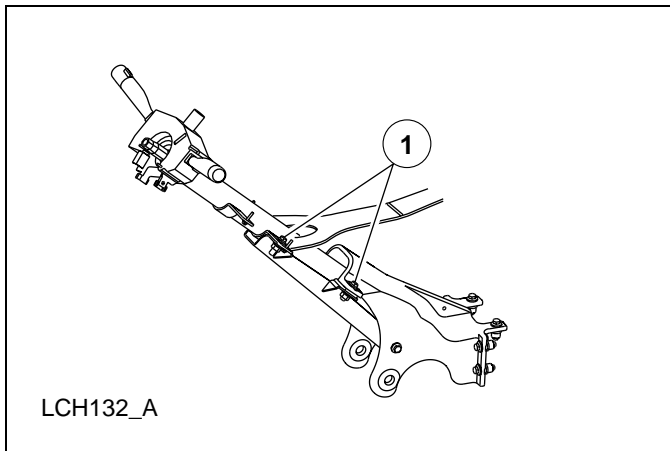
1. Remove the four steering column shroud screws, the two pushpins and the steering column shrouds.



2. Remove the steering wheel cover, steering wheel bolt and the steering wheel.
3. Disconnect the two multifunction switch connectors.
4. Remove the intermediate shaft pinch bolt (1) and washer (2) at the steering rack input shaft.



5. Remove the four steering column nuts and bolts (1). There are two on each side.



6. Remove the steering column from the vehicle.
7. Transfer the multifunction switch if necessary.

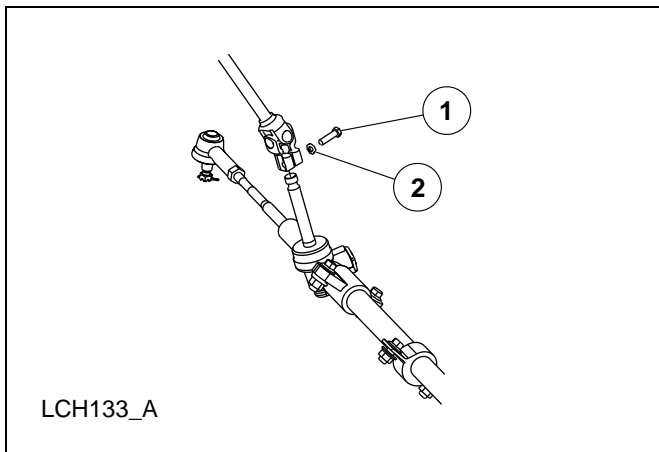
Installation

1. Reverse the removal procedure.
2. Tighten the steering column bolts to 23-31N.m. (18-22lb-ft.).
3. Tighten the intermediate shaft pinch bolt to 20-30N.m. (15-22lb-ft.).
4. Tighten the multifunction switch screw to 2.5-3.7N.m (22.1-32.7lb-in.).
5. Tighten the steering wheel bolt to 40-55Nm (30-40lb-ft.).
6. Adjust the steering wheel for clear vision.

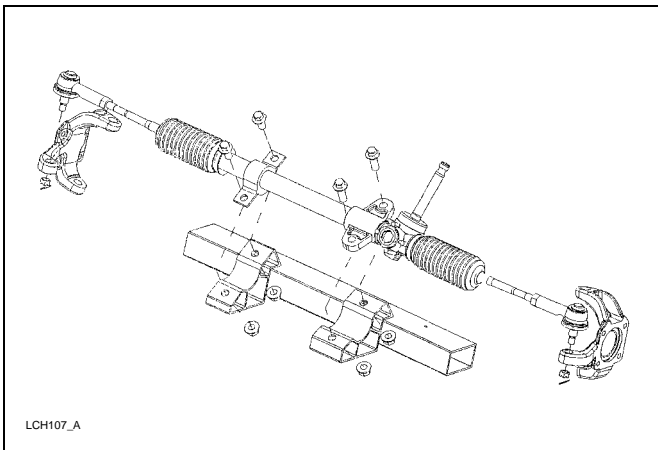
Steering Rack

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Disconnect the tie rod ends from the steering knuckle.
3. Remove the intermediate shaft pinch bolt (1) and washer (2).



4. Remove the steering rack nuts and bolts.



5. Slide the steering rack out from the driver side of the vehicle
6. If necessary, remove the tie rod ends.

Installation

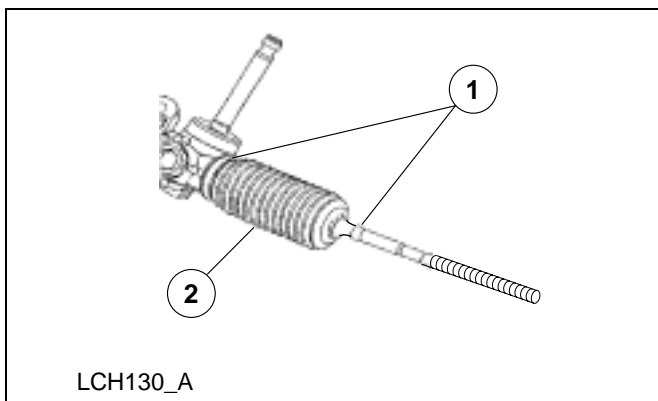
1. Reverse the removal procedure.
2. Tighten the left side steering rack bolts to 102-150N.m. (75-150 lb-ft.).

3. Tighten the right side steering rack bolts to 41-60 N.m (30-44 Lb. Ft.).
4. Tighten the intermediate shaft pinch bolt to 20-30N.m. (15-22lb-ft.).
5. Tighten the steering shroud screws to 2.5-3.7N.m (22.1-32.7 lb-in.).
6. Adjust the toe equally for clear vision.

Steering Bellows

Removal

1. Remove the tie rod end. Refer to [Tie Rod End](#) in this section
2. Remove the tie rod end jam nut.
3. Cut the inner and outer band clamps (1) on the bellows.



4. Slide the bellows (2) off the tie rod.
5. Clean dirt and debris from the tie rod.

Installation

1. Wrap the tie rod threads with tape.
2. Lubricate the new bellows ends with a light coating of petroleum jelly.
3. Slide the bellows, with clamps, onto the steering rack.
4. Use band clamp pliers and secure the band clamps in position.
5. Remove the tape.
6. Install the tie rod jam nut.
7. Do not tighten the jam nut.

8. Install the tie rod end to the steering knuckle.
9. Adjust the toe equally for clear vision.
10. Tighten the jam nuts to 49-54N.m. (37-40lb-ft.).

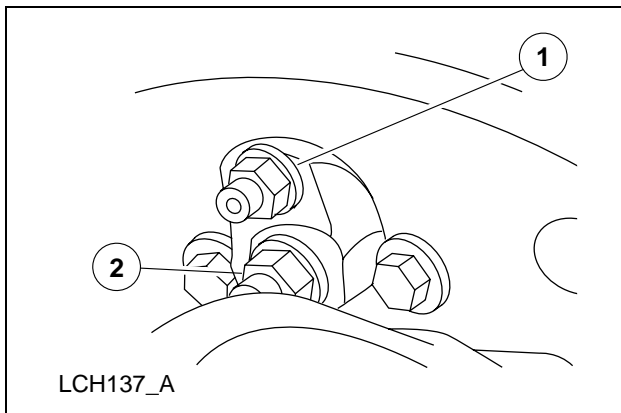
Steering Knuckle

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Remove the upper coil over coil shock nut and grommet.

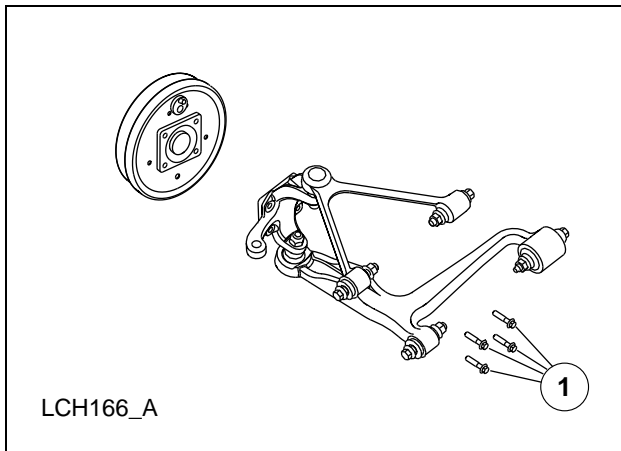


4. Open the wheel cylinder bleeder screw (1) to relieve fluid pressure.

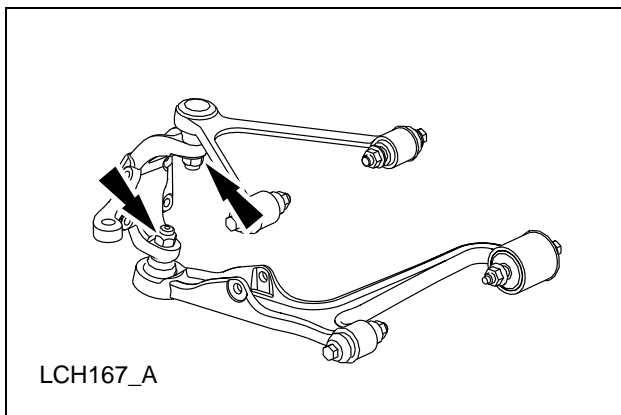


5. Disconnect the brake hose (2) from the wheel cylinder and position it aside.

6. Remove the front brake assembly bolts (1) and remove the brake assembly.



7. Separate the tie rod end from the steering knuckle.
8. Remove the upper and lower ball joint nuts and separate the upper and lower ball joints from the steering knuckle.



9. Remove the steering knuckle from the vehicle.

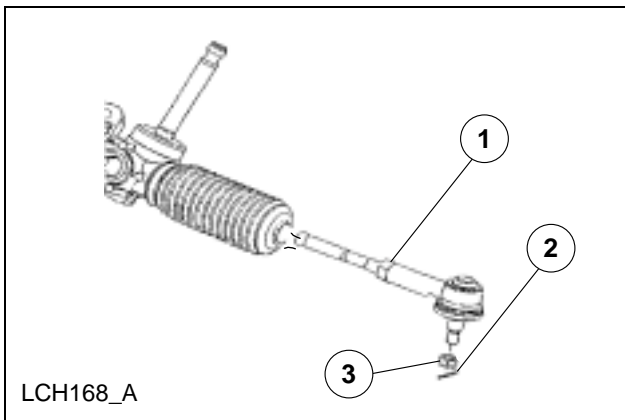
Installation

1. Reverse the removal procedure.
2. Tighten the ball joint nuts to 59.5-80.5N.m (43.8-59.3lb-ft.)
3. Tighten the tie rod castle nuts to 16-34N.m. (11-25lb- ft.).
4. Tighten the tie rod end jam nuts to 49-54N.m. (37-40lb- ft.).
5. Tighten the wheel lug nuts to 100-134N.m. (74-98lb-ft.).
6. Adjust the toe equally for clear vision.

Tie Rod Ends

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Loosen the tie rod end jam nut (1).



3. Remove the cotter pin (2) and castle nut (3) from tie rod end.
4. Separate the tie rod end from the steering knuckle.
5. Mark the tie rod threads for reference when installing the tie rod end.
6. Remove the tie rod end from the tie rod.

Installation

1. Install the new tie rod end on the tie rod.
2. Tighten, but do not torque, the jam nut.
3. Install the tie rod end into the steering knuckle.
4. Install the tie rod castle nut. Tighten the tie rod castle nut to 16-34N.m. (11-25lb-ft.).
5. Install a new cotter pin. Rotate the castle nut clockwise to align hole.
6. Adjust the toe equally for clear vision.
7. Tighten the tie rod end jam nut to 49-54N.m. (37-40lb-ft.).

Adjustment

Brake Pushrod Adjustment

Adjustment

1. Raise and support the vehicle. Refer to [Lifting](#) in the General information section.

Note:

The system has a brake pedal arm return spring. The brake arm may spring up if the floor has been removed from the vehicle.

2. Loosen the master cylinder push rod jam nut.
3. Shorten or lengthen the pushrod effective length by turning the clevis in to the pushrod. The length should be adjusted to allow for 2-3mm (0.08-0.11in) of a gap between the brake pedal and the front kickup.

WARNING!

Make sure the master cylinder push rod jam nut is tightened to 8.5 – 11.5N.m (76-101lb-in). The master cylinder push rod jam nut could come loose resulting in an accident or personal injury.

4. Tighten the master cylinder push rod jam nut to 8.5 – 11.5N.m (76-101lb-in).
5. Lower the vehicle.

Section 3 Powertrain

General Specifications	2
Torque Specifications	2
Description and Operation	3
Diagnosis and Testing.....	3
Halfshafts	3
Motor.....	3
Motor Controller	3
Potentiometer	3
Gearbox	4
Removal and Installation	5
Accelerator Pedal Pad	5
Accelerator/Potentiometer	6
Halfshafts	7
Motor.....	8
Motor Controller	10
Speed Sensor	13
Gearbox.....	15
Gearbox Drain and Fill	15

General Specifications

Description	Part Number	Specification	Capacity
80W90 Premium Rear Axle Lubricant (Gearbox Lubricant)	XY-80W90-QL	WSP-M2C197-A	0.65l (22.4 oz)

Torque Specifications

Description	Nm	Lb-ft	Lb-in.
Accelerator / Potentiometer Bolts	23-31	18-22	-
Gearbox Bolts	40-55	20-40	-
Gearbox Drain/Fill Plugs	27-34	20-25	-
Halfshaft Nut	175-260	129-191	-
Motor Bolts - Gearbox Side	9-12	-	80-106
Motor Bolts - Motor Side	21 -29	15-21	-
Motor Controller Bolts	9-12	-	80-106
Motor Cable Large End Connectors	24-31	17-23	-
Motor Cable Small End Connectors	8-10	-	71-88
Motor Controller Connections #1	27.5	20	-
Motor Controller Connections #2	27.5	20	-
Motor Controller Connections #3	6.2	-	55

Description and Operation

The Powertrain System consists of the following.

1. Accelerator/Potentiometer - The accelerator/potentiometer provides the motor controller with driver desired speed requests.
2. Motor Controller - The motor controller provides driver input to the motor from the accelerator/potentiometer and the drive mode selector switch.
3. Motor - The motor provides drive force for the gearbox and propels the vehicle gearbox and drivetrain.
4. Halfshafts - The halfshafts connect the gearbox to the wheels and provide rotational force to the driving surface of the vehicle.
5. Gearbox - The gearbox converts power from the motor and drives the halfshafts and wheels.

Diagnosis and Testing

Halfshafts

Universal Joint (U-Joint) Inspection

Place the vehicle on a frame hoist and rotate the halfshaft by hand. Check for rough operation or seized U-joints. Install a new halfshaft if it shows signs of seizure, excessive wear, or incorrect seating.

Motor

The [motor diagnosis](#) and testing is in Electrical System section.

Motor Controller

The [motor controller](#) diagnosis and testing is in Electrical System section.

Potentiometer

The [potentiometer](#) diagnosis and testing is in Electrical System section.

Gearbox

Visual Inspection

Note:

The gearbox lubricant level is can not be inspected. Fluid must be drained and filled. Refer to [Gearbox Draining and Filling](#) in this section.

Clean up the leaking area enough to identify the exact source. A gearbox leak can be caused by:

- Gearbox lubricant level is too high.
- Worn or damaged axle shaft hub seals.
- Gearbox housing or cover is cracked.
- Gearbox cover is not sealed.
- Vent is plugged, loose or missing.
- The gearbox is not a serviceable unit. Replace the gearbox if necessary.

Removal and Installation

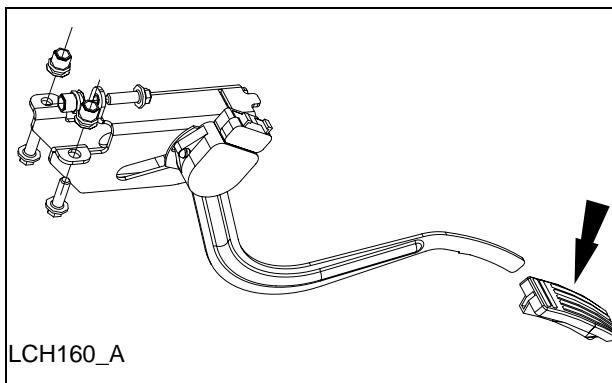
Accelerator Pedal Pad

Removal

Note:

The accelerator pedal pad must be replaced whenever it is removed from the accelerator potentiometer arm.

1. Remove the accelerator pedal pad by tapping it down off of the pedal arm.



2. Discard the accelerator pedal pad.

Installation

Note:

The vehicle may not reach 25 mph if the pedal is not fully installed.

Tap the new accelerator pedal pad onto the accelerator pedal arm until the tabs are locked.

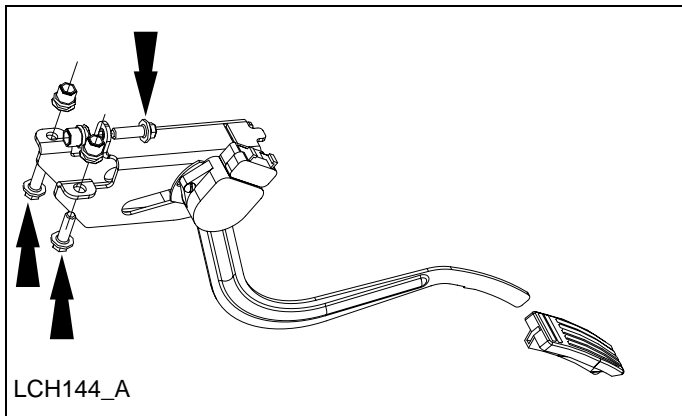
Accelerator/Potentiometer

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in the Electrical section.
2. Remove the accelerator pedal pad.
3. Remove the front fascia. Refer to [Front Fascia](#) in the Body section.
4. Disconnect the potentiometer connector at the potentiometer.
5. Remove the three accelerator/potentiometer bolts and the accelerator/potentiometer from the vehicle.



6. If necessary, drill out the rivets and remove the potentiometer

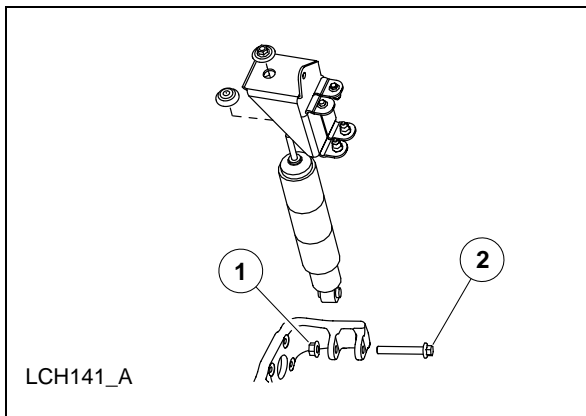
Installation

1. If replaced, position the potentiometer and install new rivets.
2. Position the accelerator potentiometer in the vehicle.
3. Install the three accelerator/potentiometer bolts. Tighten the accelerator/potentiometer bolts to 23-31N.m (18-22lb-ft.).
4. Connect the potentiometer connector.
5. Install a new accelerator pedal pad.
6. Turn the vehicle power on. Refer to [Power Shutdown Procedure](#) in the Electrical section.

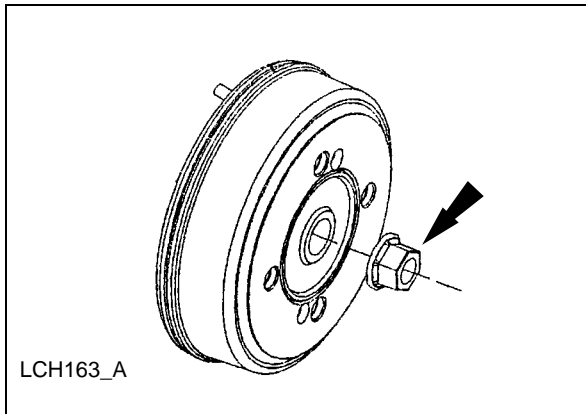
Halfshafts

Removal

1. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
2. Remove the wheel and tire assembly.
3. Remove the coil over shock assembly lower mounting nut (1) and bolt (2).



4. Remove the halfshaft nut and spacer.



5. Pry the halfshaft from the gearbox and then remove it from the hub.

Installation

1. Reverse the removal procedure.
2. Replace the tension clip on the inboard end of the halfshaft.
3. Install the halfshaft spacer and nut.
4. Tighten the halfshaft nut to 175-260N.m (129-191lb-ft.).

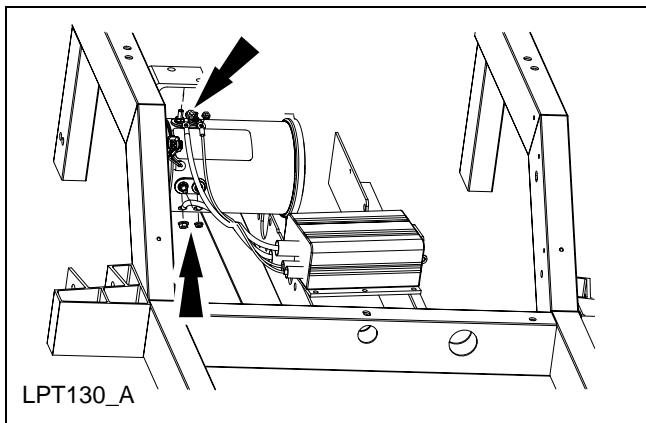
Motor

Removal

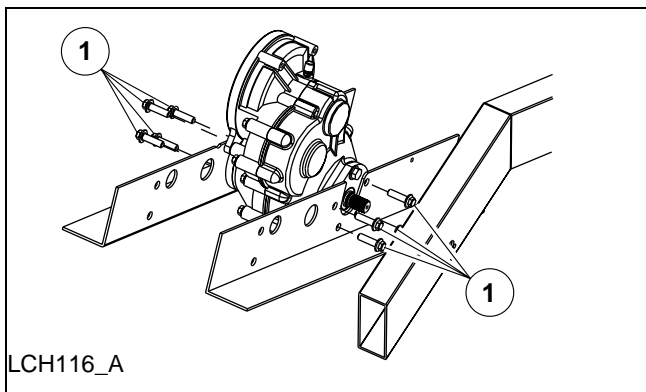
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

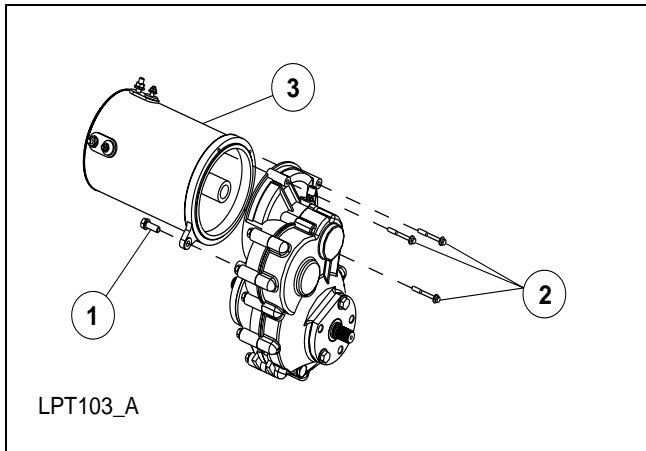
1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in the Electrical section.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. Remove the right rear wheel and tire assembly.
4. Remove the right side halfshaft. Refer to [Halfshafts](#) in this section.
5. Make note of the locations of the electrical connections and disconnect the motor electrical connections.



6. Remove the eight gearbox bolts (1) and slightly lift the gearbox to access the motor bolt on the motor side.



- Remove the motor bolt (1) on the motor side. Lower the gearbox.



- Remove the three motor bolts (2) on the gearbox side.
- Remove the motor (3) from the passenger side.

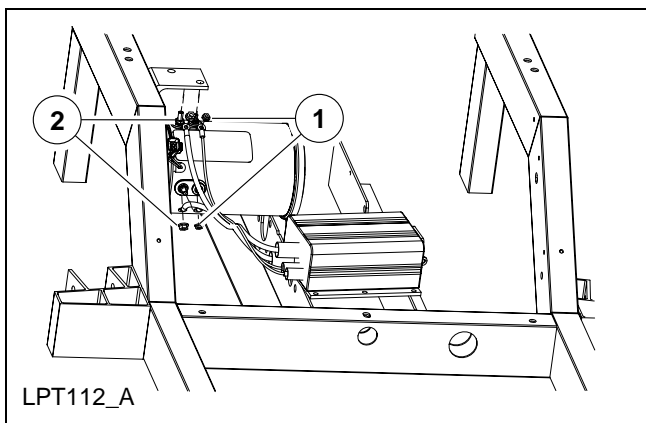
Installation

- Reverse the removal procedure.
- Tighten the three motor bolts on the gearbox side to 9-12 N.m (7-9 lb-ft.). Tighten the motor bolt on the motor side to 21-29 N.m (15-21lb-ft.).
- Tighten the eight gearbox bolts to 40-55N.m (20-40lb-ft.).

Note:

Make sure electrical connections are installed correctly or the vehicle will not operate properly. Refer to the alpha numeric references on the components and the wiring to properly mate the cables to the connectors.

- Connect the motor cable ends.



5. Tighten motor cable large end connectors (1) to 24-31 N.m. (18-23 lb-ft.).
6. Tighten motor cable small end connectors (2) to 8-10 N.m. (71-88 lb-in).
7. Turn the vehicle power on. Refer to the [Power Shutdown Procedure](#) in the Electrical section.
8. Verify proper vehicle operation.

Motor Controller

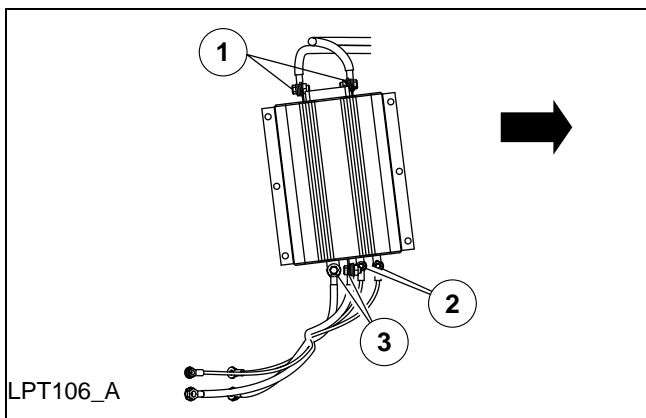
Removal

1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in the Electrical section.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.

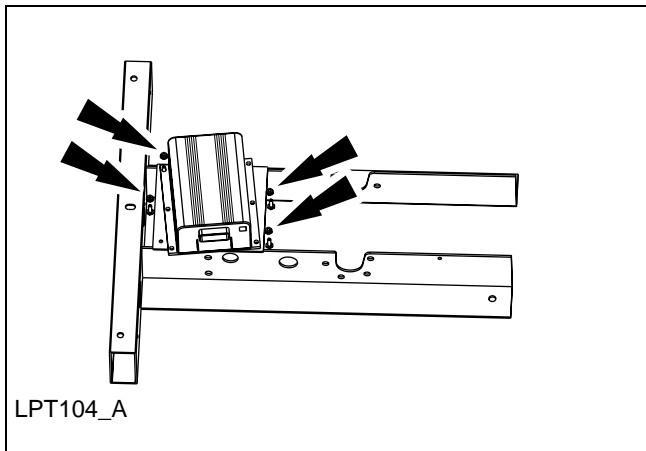
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

3. Cut away the shrink-wrap from the cable connections.
4. Remove the fasteners at (1), (2) and (3) motor controller connections.



5. Remove the four motor controller nuts and bolts.



6. Remove the motor controller from the vehicle.

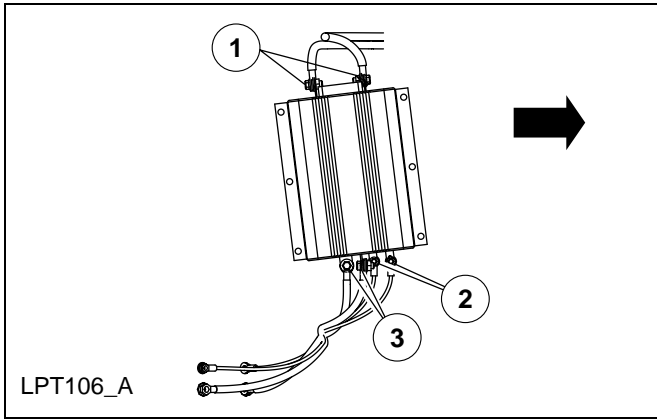
Installation

1. Position the motor controller in the vehicle.
2. Install the motor controller bolts. Tighten the motor controller bolts to 9-12 N.m (84-108lb-in.).
3. Install new shrink-wrap material. Use 1" for the large connectors and 3/4 " for the small connectors.

Note:

Make sure electrical connections are installed correctly or the vehicle will not operate properly. Refer to the alpha numeric references on the components and the wiring to properly mate the cables to the connectors.

4. Connect the wires as shown. Tighten the motor controller connections at (1) to 27.5N.m (20lb-ft.). Tighten the connection at (2) to 27.5N.m (20 lb-ft.). Tighten the motor controller connections at (3) to 6.2N.m (60lb-in.).



5. Heat the shrink-wrap until connections are tightly sealed.
6. Turn the vehicle power on. Refer to [Power Shutdown Procedure](#) in the Electrical section.
7. Verify proper vehicle operation.

Speed Sensor

Removal

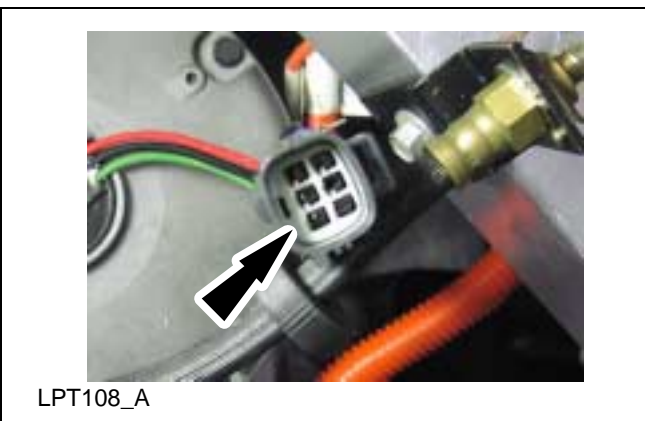
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

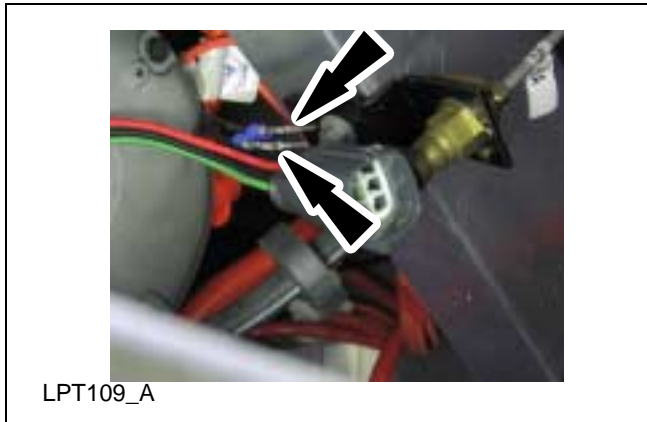
1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in the Electrical section.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. Remove the right rear tire and wheel assembly.
4. Disconnect the speed sensor connector.



5. Remove the connector wire retainer.



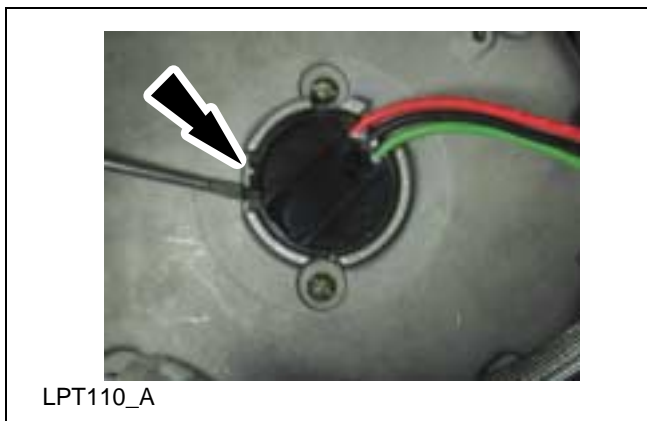
6. Remove the two black wires from the connector.



CAUTION:

Do not allow any outside items fall into the motor with the speed sensor removed or damage could occur to the motor.

7. Use a flathead screwdriver to pry around the edge of the speed sensor.



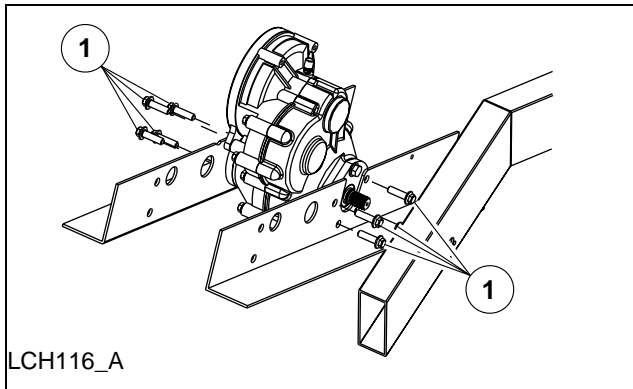
Installation

1. Reverse the removal procedure.
2. Turn the vehicle power on. Refer to the [Power Shutdown Procedure](#) in the Electrical section.
3. Check the speedometer operation.

Gearbox

Removal

1. Remove the halfshafts. Refer to [Halfshafts](#) in this section.
2. Remove the motor. Refer to [Motor](#) in this section.
3. Remove the eight gearbox bolts and washers (1).



4. Remove the gearbox from the vehicle.

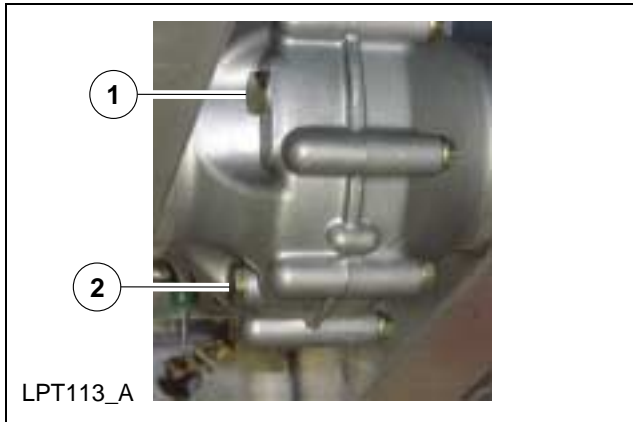
Installation

1. Reverse the removal procedure.
2. Tighten the eight gearbox bolts to 40-55N.m (20-40lb-ft.).

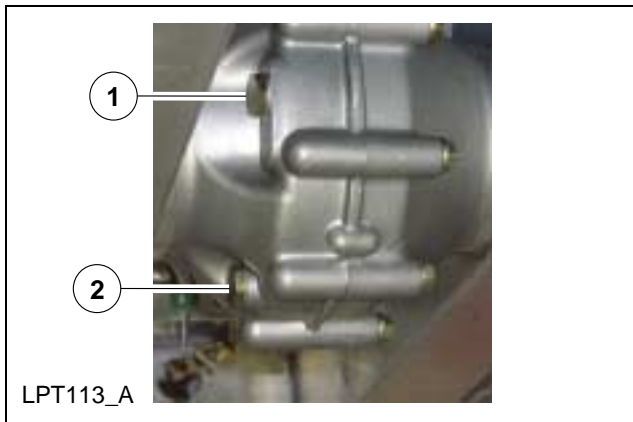
Gearbox Drain and Fill

1. Raise and support the vehicle. Refer to [Lifting](#) in General Information section.
2. Position a drain pan under the gearbox.

3. Remove the drain plug and washer (2) from the gearbox.



4. Allow the oil to drain for several minutes before installing the drain plug.
5. Clean and inspect the gearbox opening and the drain plug and washer for damage.
6. Install and tighten the drain plug (2) to 27-34N.m. (20-25lb.ft.)
7. Remove the fill plug and washer (1).



8. Fill the gearbox with 0.65 liters or (22.4 oz) of 80W90 Premium Rear Axle Fluid part number XY-80W90-QL meeting Ford specification WSP-M2C197-A.
9. Tighten the fill plug to 27-34N.m (20-25lb-ft).

Section 4 – Electrical

General Specifications	3
Torque Specifications	4
Description and Operation	5
Regenerative Braking System (RBS).....	6
Acids	7
Electric Shock	7
Key Replacement	8
Energy Tips.....	8
EV-Specific Precautions	9
Safety	9
Rubber Insulating Gloves Testing.....	9
Buffer Zone	10
Fuses/Relays.....	13
Warning Labels.....	15
Harness Routing.....	19
Battery Charging.....	21
Diagnosis and Testing.....	23
Diagnostic Trouble Code Information	23
Basic Troubleshooting Information	26
Power Distribution	39
Ground Distribution	44
Electrical Leakage Detection	47
Accelerator Potentiometer.....	55
Required Tools.....	58
Battery.....	67
Charging.....	74
Voltage Step Down.....	81
Exterior Lamps.....	86
Heater/Defogger.....	104

Horn	113
Instrument Cluster Gauge	119
Motor and Motor Controller	151
Power Point	178
Wiper/Washer	183
Connector End Views	191
Removal and Installation	210
Accelerator/Potentiometer	210
Batteries	210
Charger.....	213
Contactor.....	215
Controller, Motor	216
Converter 1, DC/DC -Standard.....	217
Converter 2, DC/DC - Optional	217
Instrument Cluster Gauge	218
Headlamp	220
Headlamp Bulb	221
Motor.....	224
Motor, Wiper.....	225
Heater/Defogger System Components.....	227
Heater/Defogger Assembly.....	229
Heater/Defogger Switch.....	230
Heater/Defogger Contactor.....	231
Heater/Defogger Duct and Hose.....	232
Power Point, 15A DC/DC.....	233
Electronic Flasher	234
Temperature Sensor	234
Switch, Drive Mode Selector	235
Switch, Horn	236
Switch, Multifunction	237
Switch, Service Disconnect.....	238
Front Turn Signal	238

Rear Turn Signal	239
Wiring Harnesses – 12V	240
Wiring Harnesses – 72V (Front of vehicle)	240
Wiring Harnesses – 72V (Mid vehicle)	241
Wiring Harnesses – 72V (Rear of vehicle)	242
General Procedures	243
Battery Charging	243
Vehicle Storage -- Battery	247
Power Shutdown Procedure	249
Battery Water Reminder Indicator Resetting (Flooded Batteries Only)	254
Battery Type Reprogramming	255
Headlamp Adjustment	255

General Specifications

Battery Specifications		
Maintenance Free (Gel Type) Battery		
Description	Specification	
Type Number	8G31	
Voltage	12	
Cold Cranking Amps (CCA) @ 0° F	550	
Approximate Weight Lbs (Kgs)	71.7 (32.5)	
Dimensions (LxWxH) In (mm)	12 ^{15/16} x 6 ^{3/4} x 9 ^{3/8} (329x171x238)	
Flooded (Water Filled) Battery		
Description	Specification	
Type Number	31XHS	
Voltage	12	
Cold Cranking Amps (CCA) @ 0° F	550	
Approximate Weight Lbs (Kgs)	67 (30)	
Dimensions (LxWxH) In (mm)	13 x 6 ^{3/4} x 9 ^{1/2} (331x171x242)	
Lubrication Specifications		
Description	Part Number	Ford Specification

Electrical Grease	F8AZ-19G208-AA	WSB-M1C239-A
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Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Accelerator pedal bracket bolts	24-31	18-22	
Battery hold-down strap bolts	24-28	18-20	
Battery hold-down strap nuts	8		70
Battery hold-down bracket	24-28	18-20	
Battery charger bolt	24-28	18-20	
Battery cable clamp nuts	12-15		107-132
Battery cable to contactor nut	8-10		71-88
Brake lamp screws	2-2.7		18-23
Bumper bolts – Rear	3.3		29
Contacto lower cable nut	8-10		71-88
Contacto upper cable nut	8-10		71-88
Chassis connector bolt	24-31	18-22	
Front turn signal bracket bolt	24-31	18-22	
Front turn signal bolts	8-10		71-88
“H” frame bolts	20-30	15-22	
Headlamp bracket bolt	24-31	18-22	
Headlamp to bracket screws	3.3-4.9		29-43
Heater/defogger contactor cable nuts	8-10		71-88
Heater/defogger switch nuts	1.75-2.25		15.4-19.9
Heater/defogger bracket bolts	23.3-31.7	17.1-23.3	
High mount stop lamp screws	3.3		29
High mount stop lamp lens screws	1.9-2.7		17-23
Horn bolts	23-31	17-22	
Instrument cluster gauge screws	0.85-1.15		7.5-10.1
Multifunction switch screw	2.5-3.7		22.1-32.7
Rear turn signal screws	1.9-2.7		17-23

Description	Nm	Lb-Ft	Lb-In
Steering column shroud screws	2.7-3.7		23.8-32.7
Washer bottle bolts	7-10		62-88
Wiper motor upper bracket bolts	24-28	18-20	
Wiper motor to lower bracket nut	5-7		45-61
Wiper motor lower bracket bolt	5-7		45-61
Wiper motor shaft nut	4-5		35-44

Description and Operation

The main functions of the electrical system are to power and move the vehicle. The main components of the electrical system are the six batteries, wiring harnesses, motor, motor controller and instrument panel gauge.

There are six 12V batteries connected in series. 72V power is supplied to the charger at all times, even when the service disconnect switch is in the OFF position. Low amperage 72V is supplied at all times to the motor, motor controller and gauge. When the drive mode selector switch is moved to the R (Reverse), D (Drive) or T (Turf) position, the instrument cluster gauge supplies the +72V power to the motor controller, which in turn closes the contactor coil. High amperage is supplied through the closed contactor contacts to the motor controller. The motor controller then supplies regulated power to the motor to move the vehicle.

The battery-charging rate is determined by type of battery selected via the instrument cluster gauge and ambient temperature. A temperature sensor located by the battery pack reads the ambient temperature around the battery pack. When the temperature sensor reads extremely high ambient temperatures [120°F (49°C) or higher] the charging rate will be limited to 8 amps until the temperature reduces in turn increasing the amount of time necessary to charge the vehicle. The type of battery selected in the instrument cluster gauge must correspond to the type of batteries installed in the vehicle. Damage to the batteries could occur if the type of battery programmed in the instrument cluster gauge is incorrect.

The motor controller monitors battery pack voltage while the vehicle is being operated. If the battery pack voltage drops below 68V while driving, the vehicle will continue to operate, but will not restart. A Diagnostic Trouble Code (DTC) will be set if the key is cycled OFF, and then to R, T or D. The motor controller is programmed not to allow the vehicle to operate if the battery pack voltage drops below 68V. If the battery pack voltage drops below 55V, current to the motor will be limited and the vehicle may cease to operate.

The motor controller monitors a variety of parameters during driving. DTCs related to motor controller faults are covered in the Diagnosis and Testing subsection of this section. The motor is connected to the motor controller by four cables: A1 and A2 (armature) and F1 and F2 (field). These cables must be properly attached in order for the vehicle to operate properly.

Battery life is determined by capacity. Battery capacity cannot be accurately measured by any equipment available in the field. Load testing and measuring cold cranking amps (CCA) will however allow an assessment as to whether a battery has a suspect cell.

To maximize battery pack life, the capacities of the individual batteries must be closely matched. Within the first 50 cycles (approximately one month in service), battery capacity remains relatively constant. After this point, however, battery capacity will begin to drop. A pack, which contains batteries of widely varying capacity, will experience premature failure. For this reason, individual batteries may only be replaced within the first month in service, and replaced as a pack after that time.

Low voltage (12V) power is supplied from the DC/DC converter for lighting, horn, turn signals and instrument cluster gauge backlighting. The horn, brake lights and hazards are powered at all times. Vehicles equipped with the optional powerpoint are equipped with a second DC/DC converter than powers only the powerpoint. The optional powerpoint is powered at all times.

When troubleshooting the electrical systems, always remain aware of the systems, which are powered under the conditions existing during testing. When performing diagnostic procedures on the vehicle when the vehicle power has not been turned off, use High Voltage Insulated Gloves 100-F036 or equivalent and Face Shield 100-F035 or equivalent for protection. When replacing a component on the 72V harness or interfaced to the 72V harness, turn the vehicle power off using the [Power Shutdown Procedure](#) in this section to avoid risk of electric shock or injury while working on the vehicle. When

Regenerative Braking System (RBS)

The vehicle is equipped Regenerative Braking System (RBS). The RBS is designed to utilize the vehicle's forward motion to generate electricity and partially recharge the batteries for a nominal increase in driving range. The RBS works when you are not applying the accelerator. Once the accelerator pedal is released, the vehicle automatically and slowly decelerates. This deceleration is caused by using the spinning motor as a generator to create electrical current. This recharges the battery pack and slows the vehicle. The RBS works only when the vehicle is traveling at 18 mph (29 km/h) or greater. When driving down hills, regenerative braking may be used to maintain speed while recovering energy similar to the way engine braking is typically used. When the battery is fully charged, regenerative braking is eliminated to prevent overcharging of the batteries. Regenerative braking does not take the place of the standard friction brakes; it only assists them.

CAUTION:

If the battery pack is fully charged, RBS will not be enabled because the battery pack cannot accept the additional current. The contactor is designed to open if the battery pack voltage exceeds 95V. Avoid driving situations where you will be driving down steep grades with a fully charged battery pack or the drive system and RBS will shut down. The standard braking system is not affected but speeds may exceed 25 mph (40 kp/h). If this should occur, apply the brakes to reduce and maintain speeds below 25 mph (40 kp/h).

Acids

WARNING!

LEAD-ACID BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR BATTERIES TO PROTECT AGAINST SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

The battery pack is composed of 6 12-volt lead acid batteries wired in series. These batteries are similar in design to the battery in a gasoline-powered vehicle. The batteries contain sulfuric acid, which can cause severe skin or eye damage if allowed to contact these areas. Follow all safety precautions outlined in the EV-Specific Precautions prior to working on the battery pack.

WARNING!

BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY OR DEATH. DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERIES. WHEN CHARGING OR WORKING NEAR THE BATTERIES, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE ADEQUATE VENTILATION.

Electric Shock

WARNING!

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

There are two electrical systems on the EV. A 72V high voltage system is used to power the motor/gearbox. Orange color or orange wrapping on the harness bundle identifies high voltage wiring contained within the bundle. Components that have larger connectors, orange coverings on the wires, or warning labels contain or carry high voltage. A 12V system is used to operate the standard systems such as headlamps, windshield wipers and turn signals. These components should be treated with extreme caution. Do not perform any service on them until all system warnings and cautions are read and understood.

Key Replacement

The keys for the TH!NK neighbor require special adapter kits to cut new keys on existing key cutting machines. When using Rotunda Exacta Key Machine 011-00215, or equivalent the Rotunda TH!NK Neighbor AE Exacta Accessory Kit 011-00270 should be used. When using Rotunda 029A Key Machine Code & Duplicator 011-00263, or equivalent the Rotunda TH!NK Neighbor 029A Accessory Kit 011-00271 should be used.

Energy Tips

The range the vehicle can travel is affected by:

- The use of vehicle accessories.
- Driving habits
- Type of tire (Turf tires reduce vehicle range)
- Weather conditions.
- Age of battery pack.
- Climbing steep terrain.
- Driving off-road.

To maximize the vehicle's range, follow these steps:

- Keep the tires properly inflated.
- Keep payloads as light as possible.
- Avoid frequent full throttle usage.
- Maintain a steady speed while driving.
- Cruise at moderate speeds.
- Select routes that minimize the number of starts and stops encountered.
- Charge the vehicle after every use.

EV-Specific Precautions

When working on the 72-volt system the following precautions must be taken.

1. A buffer zone must be placed around the vehicle.
2. Rubber insulating gloves must be worn.
3. A face shield must be worn to shield the face and protect the eyes from electric arc.

Safety

Throughout this service manual there are paragraphs that are marked with a title of **WARNING**, or **CAUTION**. These special paragraphs contain specific safety information, and must be read, understood, and heeded before continuing the procedure, or performing the step(s).

WARNING!

A WARNING INDICATES AN IMMEDIATE HAZARD, WHICH COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.

CAUTION:

A Caution indicates conditions that could result in damage to the vehicle or other property.

A third special paragraph that appears throughout this service manual is marked with the title of “Note”

A “Note” is a paragraph that describes essential service or maintenance information that relates to a particular step(s) or procedure. The “Note” must be read, understood and heeded before continuing with the procedure, or performing the step(s).

Note:

A note contains additional information to make the procedure, or step(s), more easily understood or implemented. Or it may contain essential maintenance information to assure proper operation of the vehicle.

Rubber Insulating Gloves Testing

Note:

The rubber insulating gloves that are to be worn while working on the high voltage system are rated for use on equipment of up to 1000 volts. They must be inspected before each use and must always be worn in conjunction with the leather outer glove. Any hole in the rubber-insulating glove is a potential entry point for high voltage.

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 exhibit any signs of wear and tear.
3. The leather gloves must always be worn over the rubber insulating gloves in order to protect them.
4. The rubber insulating gloves must be class "O" and meet all of the American Safety Testing Materials Standards.

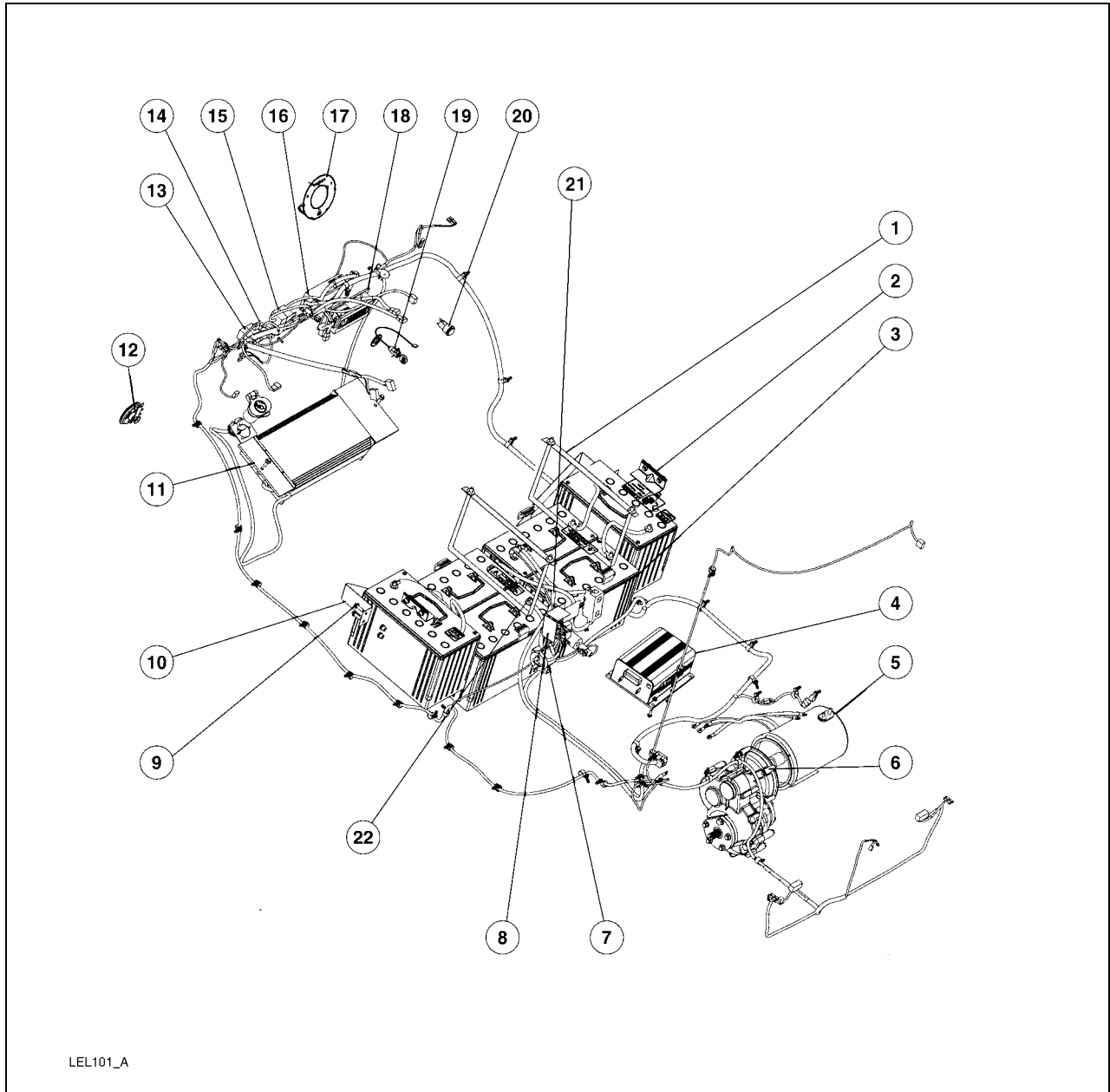
Buffer Zone

Note:

The buffer zone is required only when working on the 72-volt system.

1. Position the vehicle in the service bay.
2. Position four orange cones around the corners of the vehicle to mark off a 1m (3ft) perimeter around the vehicle.
3. Do not allow any unauthorized personnel into the buffer zone during repairs involving high voltage. Only personnel trained for service on the high voltage system are to be permitted in the buffer zone.

The service disconnect switch location was modified mid year. Refer to the following.

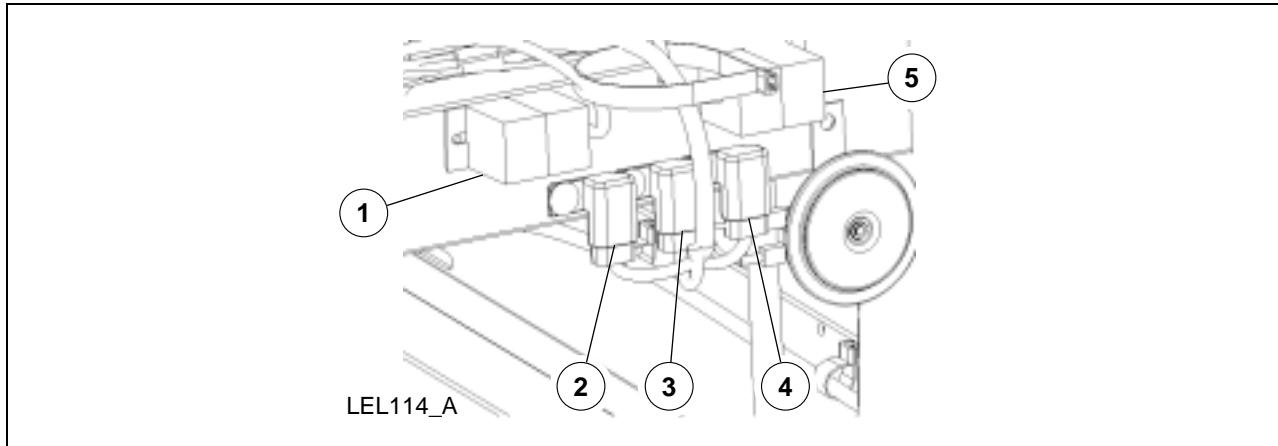


Item	Part Number	Description
1	10718	Battery Mounting Strap
2	10755	Battery Mounting Bracket
3	10655	Battery (one of six)
4	14B298	Motor Controller
5	14B280	Motor

Item	Part Number	Description
6	7002	Gearbox
7	14B267	Contactactor
8	Part of 14401	Service Disconnect Switch
9	--	Battery Mounting Strap Bolt
10	10753	Battery Mounting Strap
11	10B689	Battery Charger
12	13832	Horn
13	--	Relay - Horn
14	--	Fuses
15	--	Relay – DC/DC
16	14B227	DC/DC Converter 1 (standard)
17	045D27	Instrument Cluster Gauge Face Plate
18	14B227	DC/DC Converter 2 (optional)
19	Part of 22050	Drive Mode Selector Switch
20	19N236	Power Point – Optional
21	--	Battery Pack Negative
22	--	Battery Pack Positive

Fuses/Relays

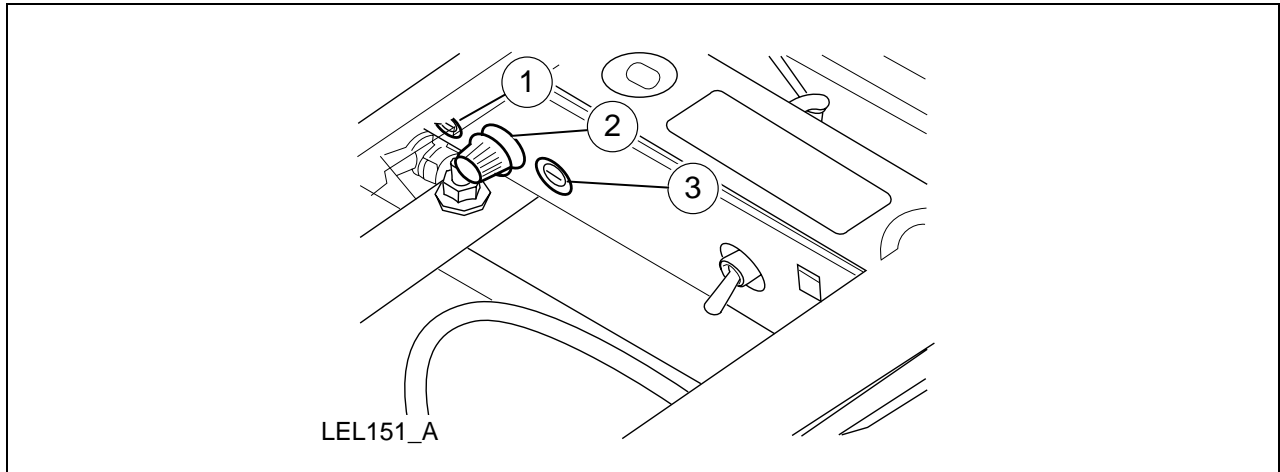
The fuses and relays shown are located at the front of the vehicle. Remove the hood to access them.



Item	Fuse Amp Rating	Description
1	--	Relay – DC/DC
2	20A	Brake, Flasher, Horn
3	20A	Lights
4	10A	Wiper, Washer
5	--	Horn Relay

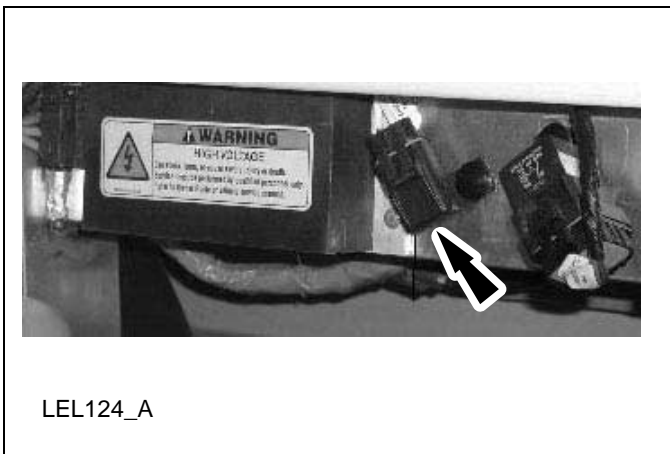
The 400A megafuse located under the seat stanchion cover is not serviced separately. When servicing the 400A megafuse, you must replace the 400A megafuse and the attached harness as an assembly.

Switch shown in “ON” position.



Item	Fuse Amp Rating	Description
1	30A	DC/DC
2	30A	Charger
3	10A	Control (motor controller/gauge)

The optional power point's fuse is located at the front of the vehicle. Remove the hood to access it.

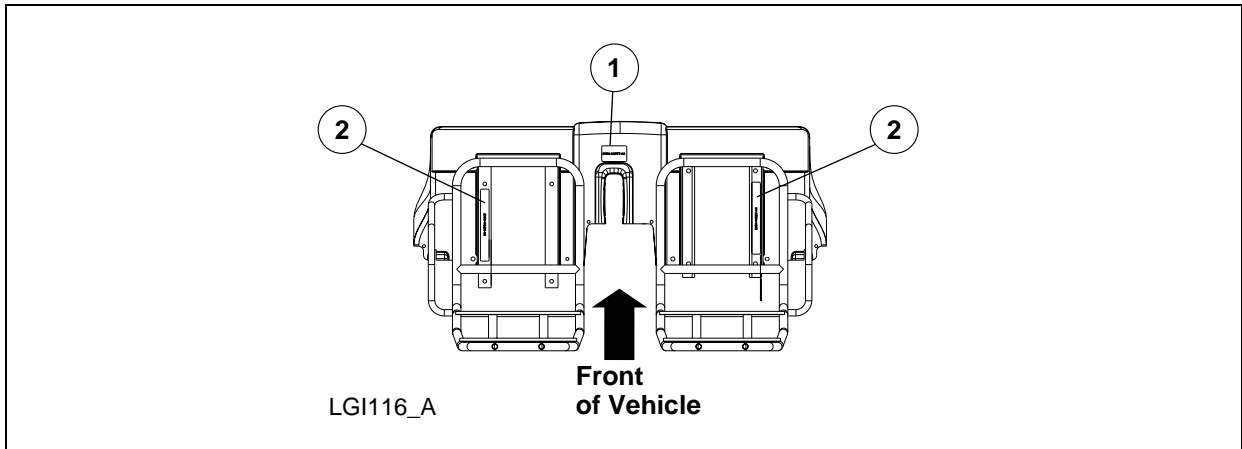


Flasher relay is located on the bottom of the multi-function switch within the steering column shroud.

Warning Labels

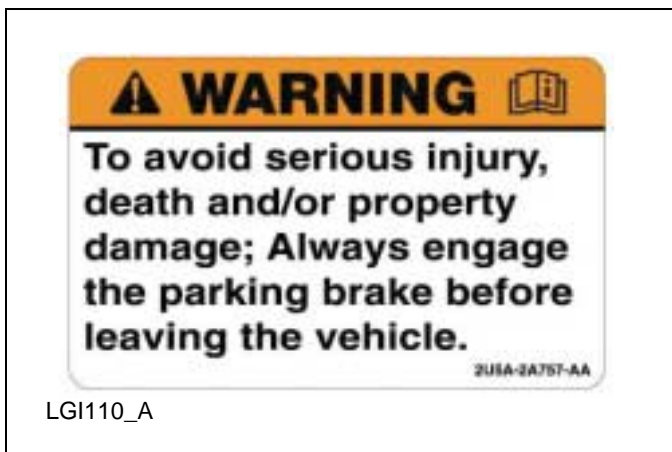
The vehicle is equipped with nine different warning labels. These labels are to assist in preventing damage to property or the personal injury or death. The following art illustrates the locations of the warning labels along with their verbiage.

Seat Stanchion Warning Labels



Item	Part Number	Description
1	00014	Parking Brake Warning Label
2	00014	High Voltage Warning Label

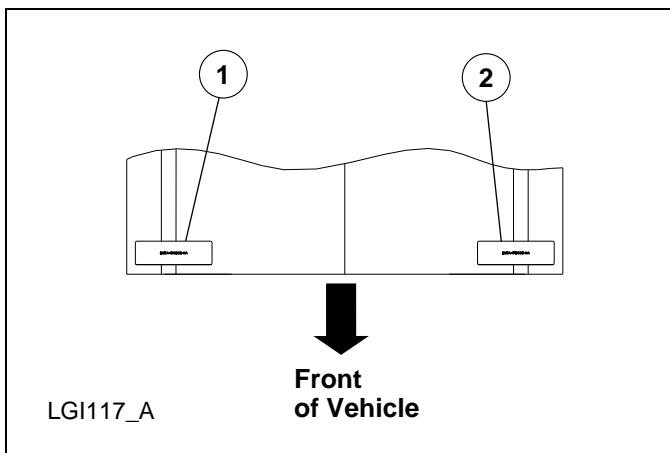
Parking Brake Warning Label



High Voltage Warning Label

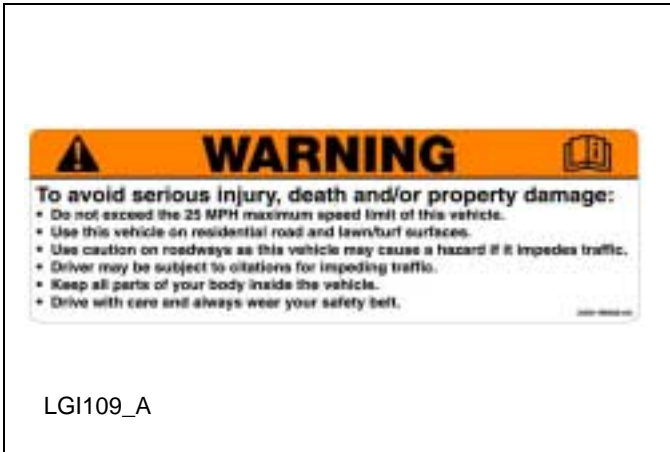


Roof Warning Labels

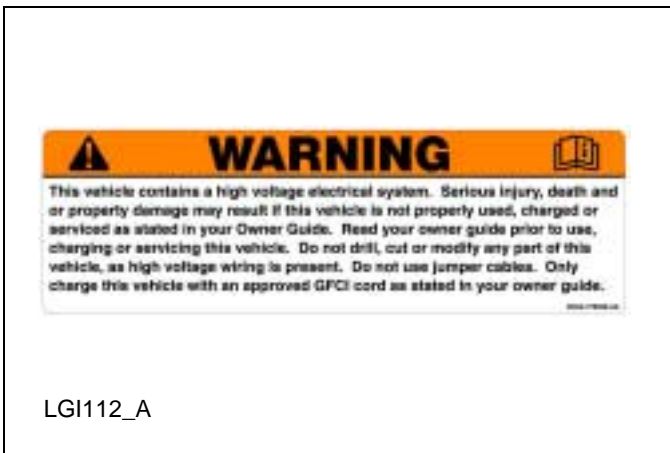


Item	Part Number	Description
1	00014	Slow Moving Vehicle Warning
2	00014	High Voltage Warning Label

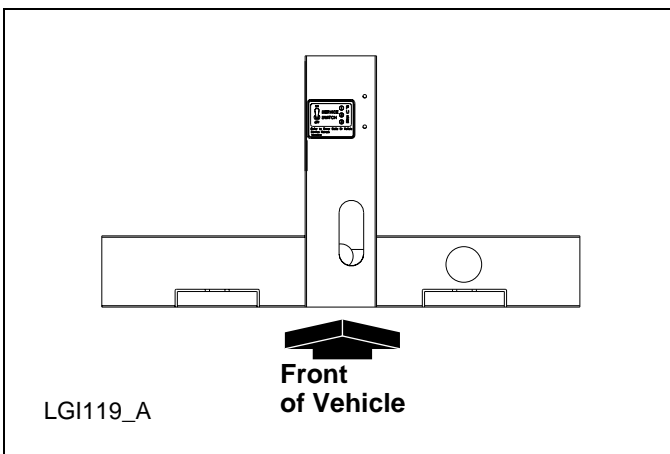
Slow Moving Vehicle Warning



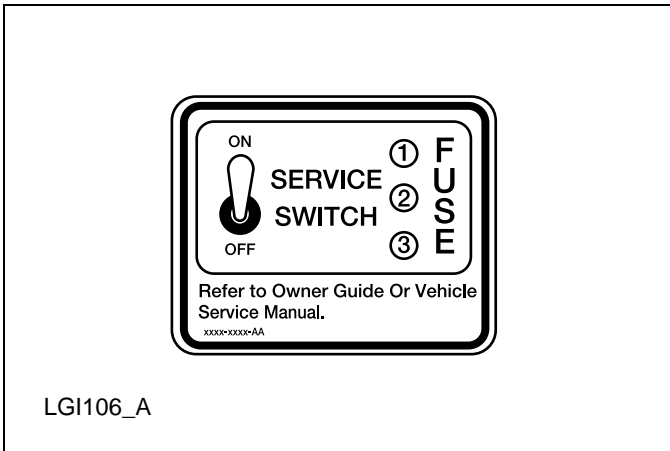
High Voltage Warning Label



Seat Stanchion Support Warning Label

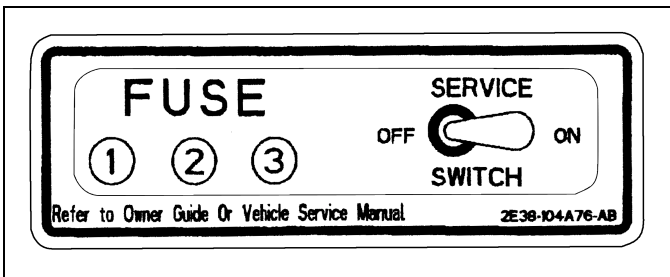


Service Disconnect Switch Label

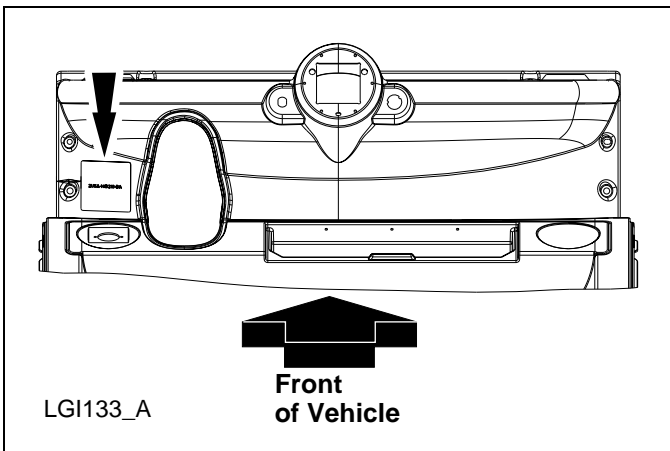


Service Disconnect Switch Label

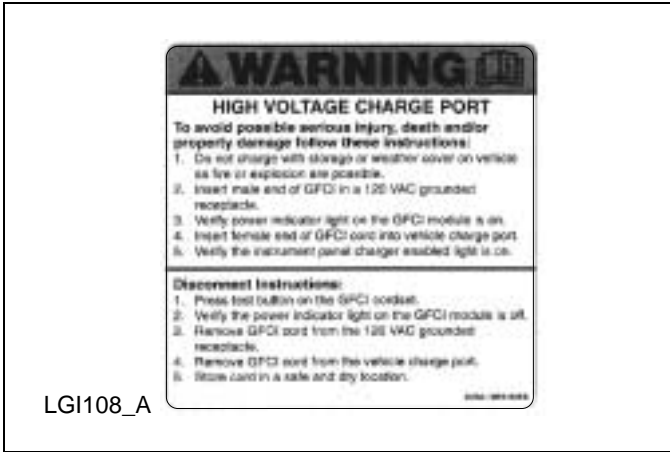
The service disconnect switch label is located directly under the driver seat on the seat stanchion H-support.



Instrument Panel Charge Warning Label

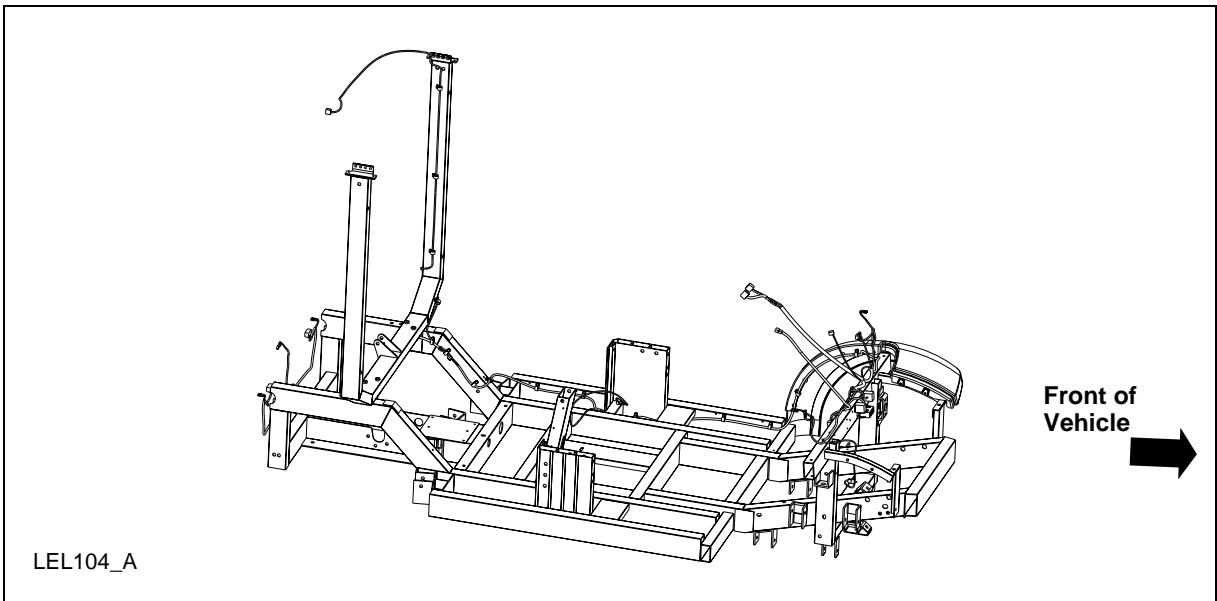


Charge Warning Label



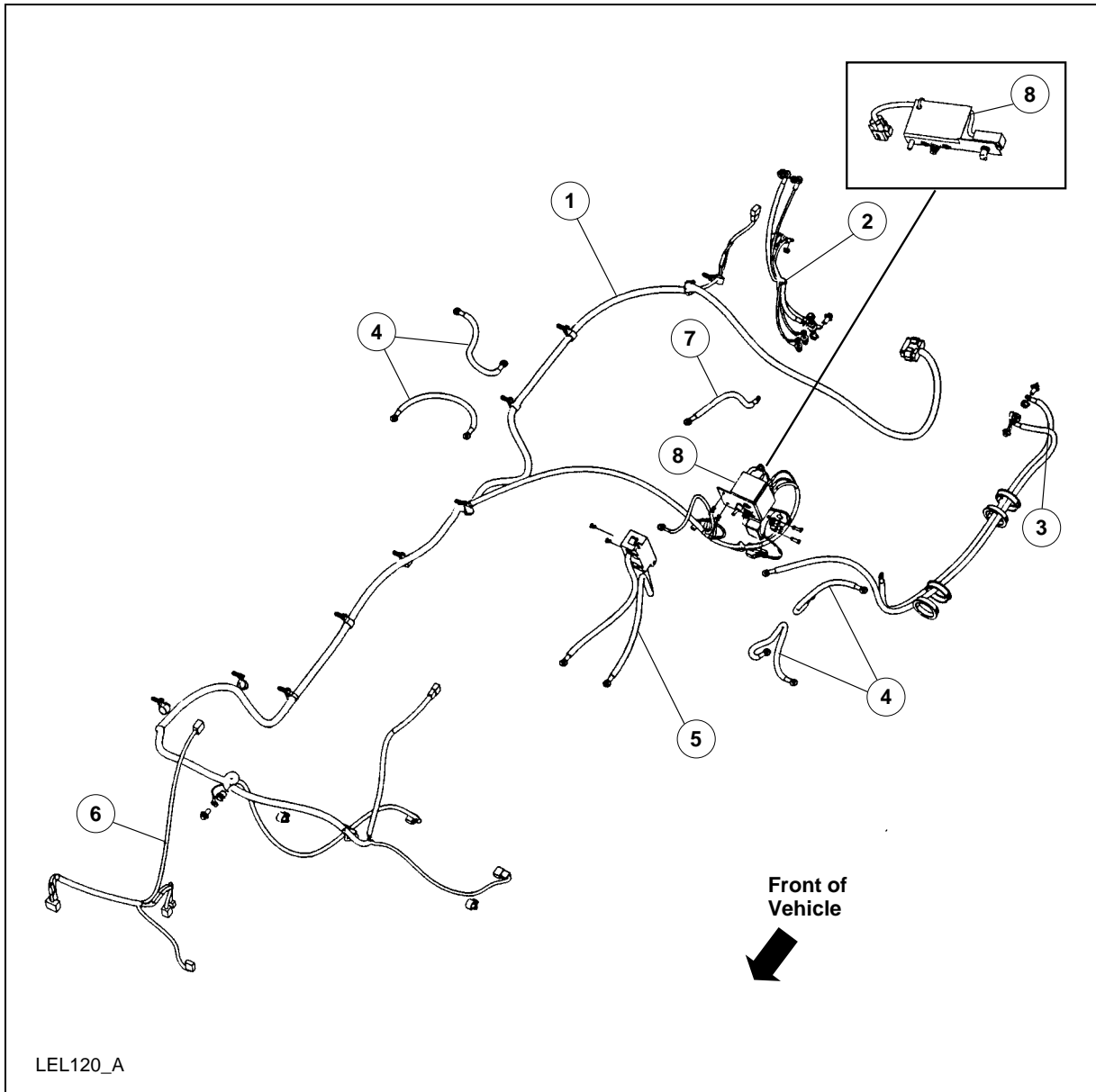
Harness Routing

Low Voltage Wiring Harness



High Voltage Wiring Harnesses

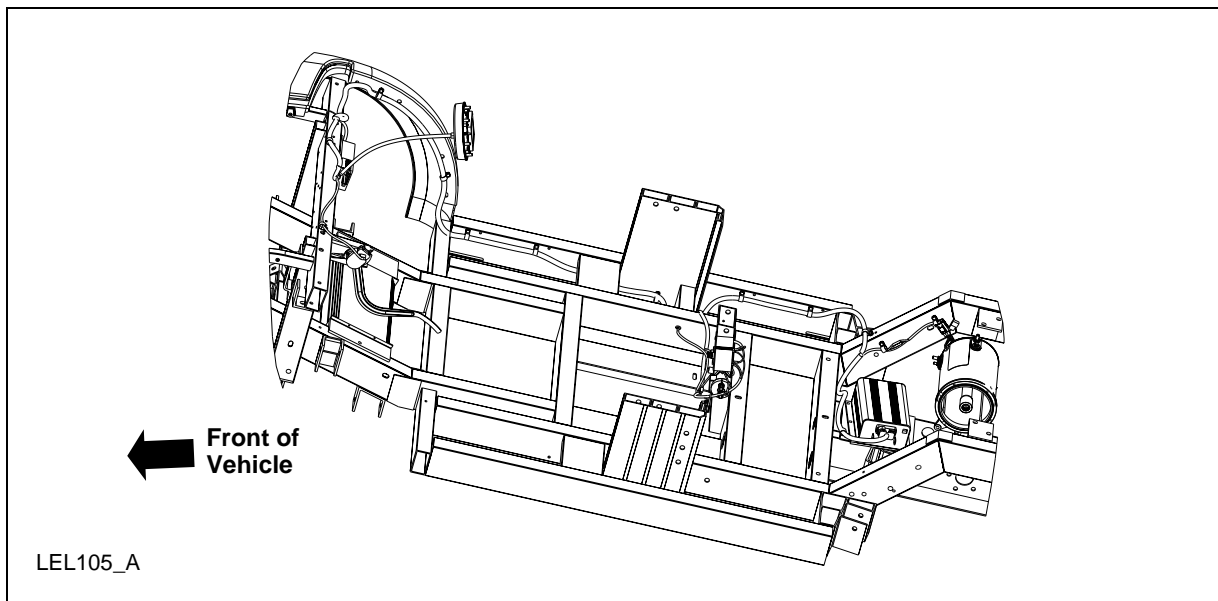
The service disconnect switch location was modified mid year. Refer to the following.



LEL120_A

Item	Part Number	Description
1	14401	Low current high voltage wiring harness
2	14401	Motor controller harness
3	14401	High current high voltage wiring harness
4	14401	Battery interconnect harnesses

Item	Part Number	Description
5	14401	Mega-fuse and wiring harness assembly
6	14401	Power point wiring – Optional
7	14401	72V harness
8	--	Service disconnect switch



Battery Charging

Battery charging uses 120 volt AC 15A service. The GFCI (ground fault circuit interrupt) charge cord supplied with the vehicle plugs directly into the charge inlet located to the left of the steering column on the front kick-up. Approximately 8-10 hours are needed to replenish a 20% (one bar showing) charged battery pack. Charge the vehicle whenever the state of charge is less than 80% (four bars showing), to maximize the travel range and prolong the battery life.

The battery charger receives 120 volt AC power from an external standard grounded 3-prong 15A outlet and converts it to DC energy. The battery charger only operates when a GFCI charger cord is plugged into your vehicle. If the battery charger detects AC current (from the GFCI charger cord), the vehicle cannot be started or driven.

WARNING!

THERE ARE GASES AROUND THE BATTERIES THAT CAN EXPLODE IF EXPOSED TO FLAMES, SPARKS, OR LIT CIGARETTES. THE AMOUNT OF GAS IS

INCREASED DURING BATTERY CHARGING. AN EXPLOSION COULD RESULT IN PERSONAL INJURY OR VEHICLE DAMAGE.

WARNING!

BATTERIES CONTAIN SULFURIC ACID, WHICH CAN BURN SKIN, EYES, AND CLOTHING, IF CONTACTED.

WARNING!

DO NOT CHARGE THE BATTERIES WITH THE WEATHER ENCLOSURE CLOSED OR THE VEHICLE COVER IN PLACE. A BUILD UP OF HYDROGEN GAS CAN RESULT WHICH CAN EXPLODE. THE CHARGING AREA SHOULD BE WELL VENTILATED.

CAUTION:

If the vehicle is allowed to sit in conditions of -6°C (20°F) or less with a state of charge of 20% (one bar showing on gauge) or less, the batteries could freeze. Allowing the batteries to freeze may cause permanent damage to the batteries and permanently reduce their capacity. In cold conditions, place the vehicle in an area greater than 0°C (32°F) and allow it to warm up before charging. Never charge the vehicle if the batteries may be frozen. Allow the batteries to warm above 0°C (32°F) first, then charge.

CAUTION:

Do not park and leave the vehicle with discharged batteries. The batteries could discharge to the point where damage could occur and the battery charger will not charge.

CAUTION:

If the battery pack is fully charged, the Regenerative Braking System (RBS) will not be enabled because the battery pack cannot accept the additional current. The contactor is designed to open if the battery pack voltage exceeds 80V. Avoid driving situations where you will be driving down steep grades with a fully charged battery pack or the drive system and RBS will shut down. The standard braking system is not affected but speeds may exceed 25 mph (40 km/h). If this should occur, apply brakes to reduce and maintain speeds below 25 mph (40 km/h).

Diagnosis and Testing

Diagnostic Trouble Code Information

Description and Operation

The instrument cluster gauge has the ability to detect and display diagnostic trouble codes (DTCs). The DTCs are of great value to the service technician in finding and repairing vehicle concerns. The instrument cluster gauge stores the 20 most recent DTCs in memory. A complete list of DTCs is provided below.

When retrieving DTCs, record each of the DTCs displayed. Upon completion of the diagnosis and repair required for each DTC, clear the DTCs from the instrument cluster gauge. Refer to

[Retrieving and Clearing DTCs](#). Once the DTCs are cleared, operate the system and recheck for DTCs to verify the repair.

Retrieving and Clearing DTCs

To retrieve DTCs, set the park brake and perform the following:

1. While pressing the Select/Reset button, place the drive mode selector switch in the Drive position.
2. Release the Select/Reset button within 5 seconds. The battery state of charge indicator and the most recent DTC will be displayed.
3. Press and release the Select/Reset button to scroll through the DTCs. The most recent DTC is displayed first followed by the next most recent DTCs.
4. To clear DTCs, press and hold the Select/Reset button for more than 3 seconds.
5. To exit Retrieving and Clearing DTCs, place the drive mode selector switch in the OFF position and either press the Select/Reset button or wait 10 seconds.

The DTC(s) and the odometer reading at which each DTC was set, along with the service required (wrench) indicator, are the only items displayed when the instrument cluster gauge is in Retrieving and Clearing DTCs mode.

Diagnostic Trouble Code (DTC) Chart

DTC	Description	Reference
05	Accelerator potentiometer switch fails to close.	REFER to Accelerator Potentiometer .
06	Accelerator potentiometer pedal is pressed with no direction signal given to motor controller.	REFER to Accelerator Potentiometer .
08	Accelerator potentiometer input voltage to the motor controller is greater than 1.25V on power-up after initial drive mode selector switch closure.	REFER to Accelerator Potentiometer .
09	Both the forward and reverse direction switches are closed at the same time.	REFER to Instrument Cluster Gauge .
11	Accelerator potentiometer switch closed on power up after initial drive mode selector switch closure.	REFER to Accelerator Potentiometer .

DTC	Description	Reference
15	Battery voltage is less than 68.3 volts at initial drive mode selector switch closure.	REFER to Battery .
16	Battery voltage is greater than 86 volts at initial drive mode selector switch closure.	REFER to Battery .
21	Accelerator voltage is too high.	REFER to Motor and Motor Controller .
23	Motor field current is high on start-up in the reverse direction.	REFER to Motor and Motor Controller .
24	Motor field current is high on start-up in the forward direction.	REFER to Motor and Motor Controller .
27	12V bus is too low.	REFER to Motor and Motor Controller .
41	Open thermal protector (TP) or transistor over-temperature.	REFER to Motor and Motor Controller .
42	Motor armature offset voltage too high.	REFER to Motor and Motor Controller .
43	Motor armature offset voltage too low.	REFER to Motor and Motor Controller .
44	Armature transistor did not turn off properly.	REFER to Motor and Motor Controller .
45	Armature transistor did not turn on properly.	REFER to Motor and Motor Controller .
46	“Look Ahead” test for A2 voltage less than 12% of battery voltage.	REFER to Motor and Motor Controller .
49	Motor field current is too low during the Run mode.	REFER to Motor and Motor Controller .
51	Capacitor voltage is low before the line contactor closes.	REFER to Motor and Motor Controller .
57	Controller “motor current sensor” input too low while running.	REFER to Motor and Motor Controller .

DTC	Description	Reference
66	The field current exceeds the current limit of the field transistor.	REFER to Motor and Motor Controller .
76	Capacitor 1C voltage too high during regenerative braking.	REFER to Motor and Motor Controller .
77	Capacitor 1C voltage too high during motoring.	REFER to Motor and Motor Controller .
90	Motor thermostat is open during control operation.	REFER to Motor and Motor Controller .

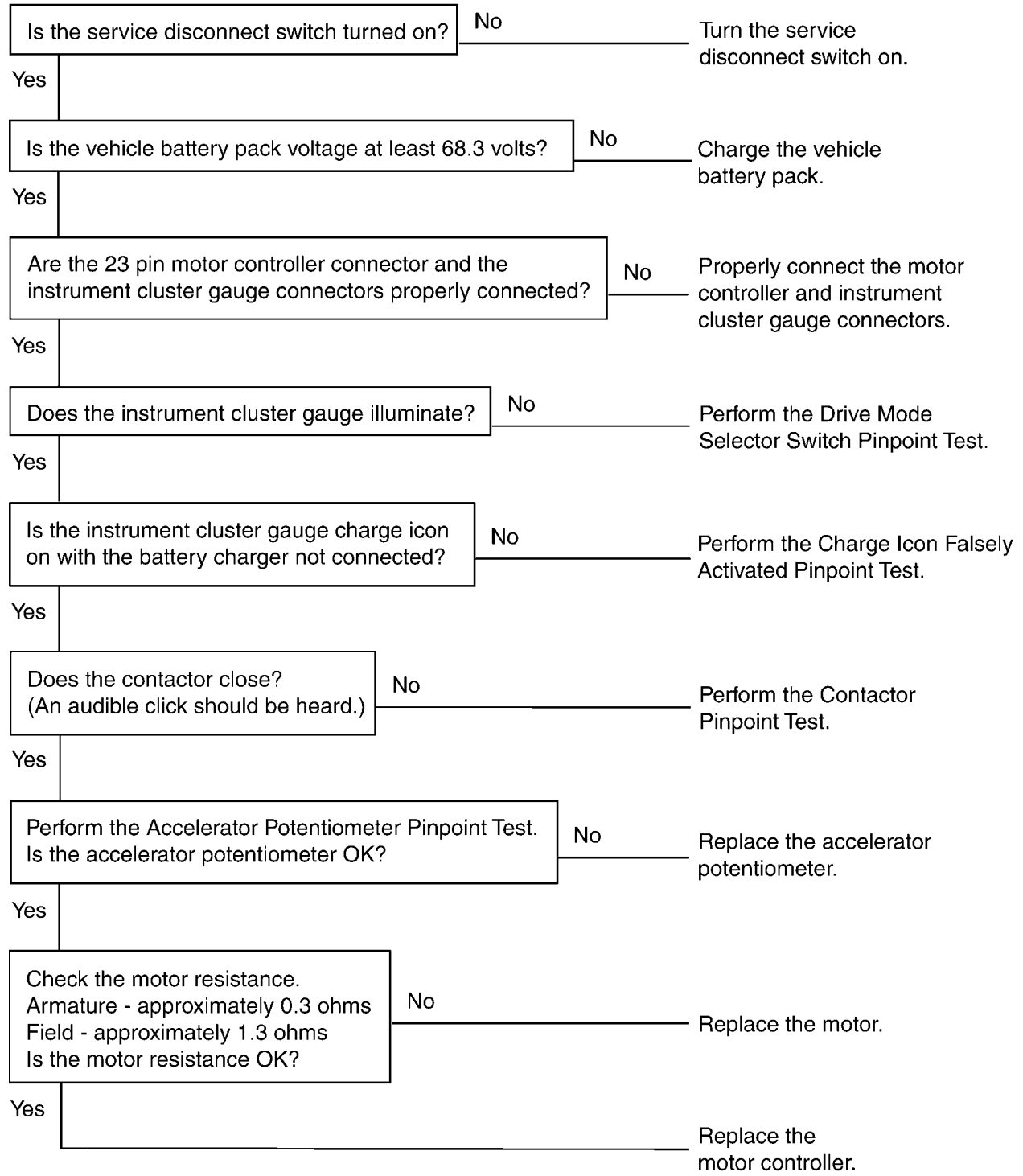
Basic Troubleshooting Information

Description and Operation

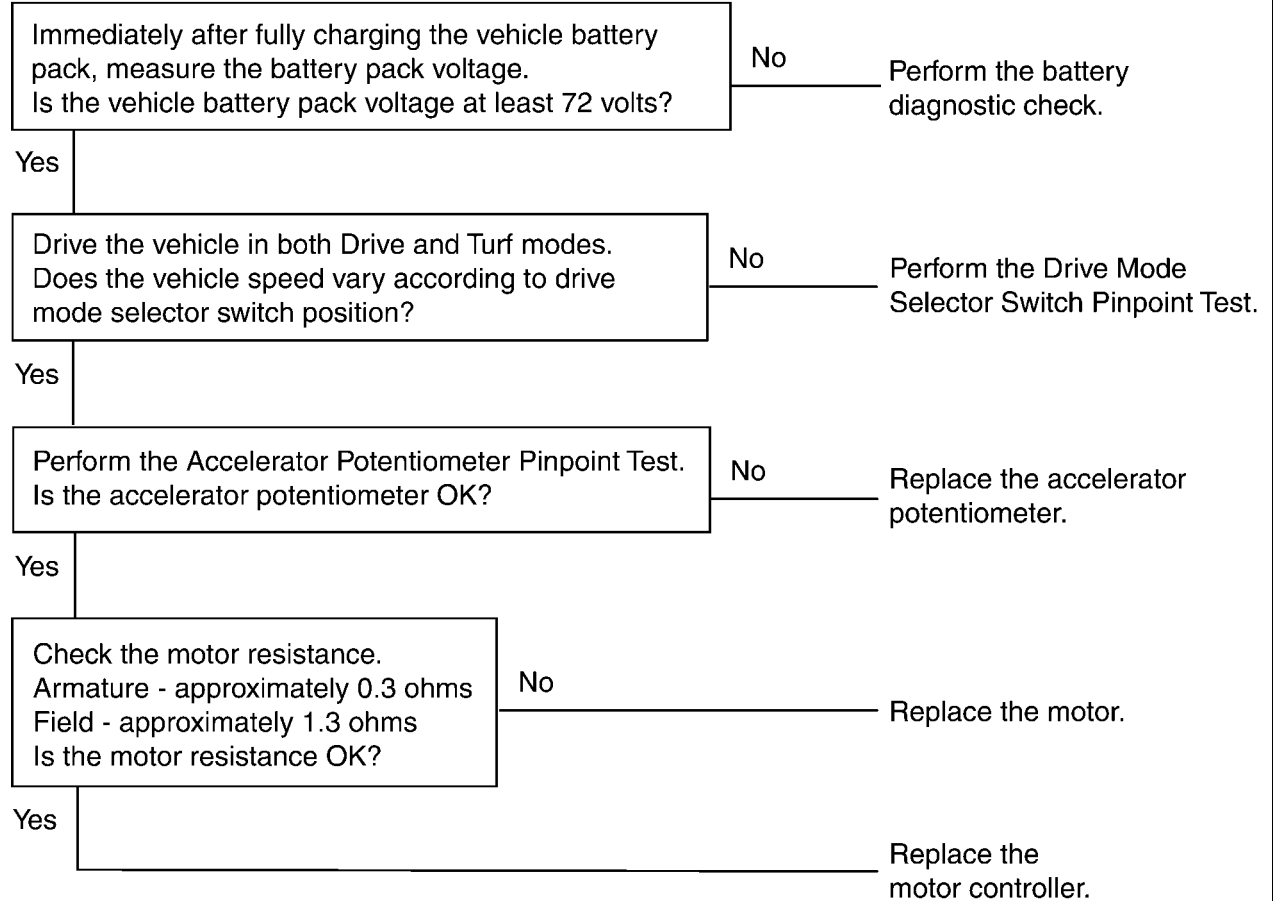
Basic Troubleshooting Information is a series of troubleshooting flowcharts and pinpoint tests that may be useful in diagnosing certain vehicle or system concerns. To diagnose any of the following symptoms, refer to the corresponding troubleshooting flowchart and follow the diagnostic steps provided.

Troubleshooting Flowcharts

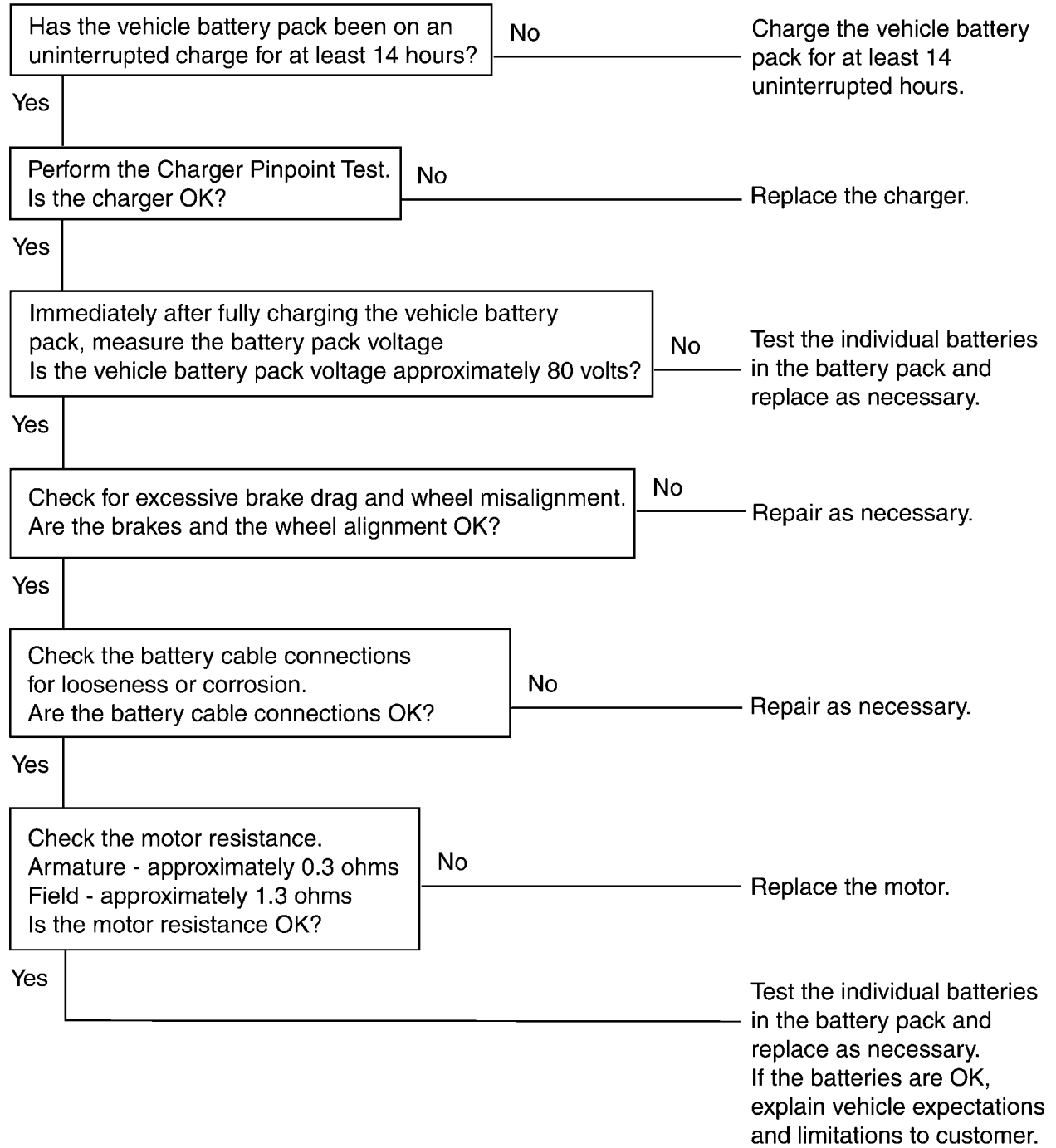
Vehicle No Enable Troubleshooting



Lack of Speed Troubleshooting



Low Range Troubleshooting



Drive Mode Selector Switch Pinpoint Test

WARNING:

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

WARNING:

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1.	1. Disconnect the drive mode selector switch harness connector. 2. Connect a DVOM between the drive mode selector switch harness connector terminal 2 and the vehicle chassis. Does the DVOM display approximately 12 volts? Yes – GO to Step 2. No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.	Drive Mode Selector Switch – J5
2.	Connect a fused jumper wire between the drive mode selector switch harness connector J5 terminal 1 and terminal 2 (on the component side). Does the instrument cluster gauge backlighting illuminate? Yes – GO to Step 3. No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.	Drive Mode Selector Switch – J5
3.	Connect a fused jumper wire between the drive mode selector switch harness connector J5 terminal 1 and terminal 3 (on the component side). Does the instrument cluster gauge backlighting illuminate?	Drive Mode Selector Switch – J5

Step	Action	Connector End View
	<p>Yes – GO to Step 4.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	
4.	<p>Connect a fused jumper wire between the drive mode selector switch harness connector J5 terminal 1 and terminal 4 (on the component side).</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – INSTALL a new drive mode selector switch. REFER to Drive Mode Selector Switch in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	Drive Mode Selector Switch – J5

Charge Icon Falsely Activated Pinpoint Test

Step	Action	Connector End View
1.	<p>1. Make sure the GFCI charger cord is not connected to the vehicle.</p> <p>2. Check the 30A charger fuse.</p> <p>Is the fuse OK?</p> <p>Yes – GO to Step 2.</p> <p>No – INSTALL a new fuse. OPERATE the system to verify the repair.</p>	
2.	<p>Check the fuse cap.</p> <p>Is the fuse cap OK?</p> <p>Yes – GO to Step 3.</p> <p>No – INSTALL a new fuse cap. OPERATE the system to verify the repair.</p>	
3.	<p>Check charger harness connector and instrument cluster gauge harness connectors for partially seated terminals, connectors</p>	

Step	Action	Connector End View
	<p>not mating properly and for dirt, moisture or corrosion.</p> <p>Are the charger and instrument cluster gauge harness connectors OK?</p> <p>Yes – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR the harness connector(s) as necessary. OPERATE the system to verify the repair.</p>	

Contactor Pinpoint Test

Step	Action	Connector End View
1.	<p>Check the battery pack voltage</p> <p>Is the battery pack voltage at least 68.3 volts?</p> <p>Yes – GO to Step 2.</p> <p>No – CHARGE the vehicle battery pack and retest. If the voltage is still below 68.3 volts, REFER to Battery in this section for further diagnosis.</p>	
2.	<ol style="list-style-type: none"> 1. Turn the drive mode selector switch to the Reverse, Turf or Drive position. 2. Check the instrument cluster gauge. <p>Is the instrument cluster gauge charge icon activated?</p> <p>Yes – REFER to the Charge Icon Falsely Activated Pinpoint Test.</p> <p>No – GO to Step 3.</p>	
3.	<ol style="list-style-type: none"> 1. Turn the drive mode selector switch to the off position. 2. Disconnect the motor controller harness connector. 3. Turn the drive mode selector switch to the Reverse, Turf or Drive position. 4. Connect a DVOM between motor controller harness 	Motor Controller

Step	Action	Connector End View
	connector terminal 11 and the vehicle chassis. Does the DVOM display approximately 72 volts? Yes – GO to Step 4. No – GO to Step 6.	
4.	Connect a fused jumper wire between motor controller connector terminal 11 and the vehicle chassis. Does the contactor close? Yes – GO to Step 5. No – INSTALL a new contactor. OPERATE the system to verify the repair.	Motor Controller
5.	Connect a DVOM between motor controller connector terminal 1 and the vehicle chassis. Does the DVOM display approximately 72 volts? Yes – GO to Step 7. No – GO to Step 8.	Motor Controller
6.	Connect a DVOM between contactor terminal 2 and the vehicle chassis. Does the DVOM display approximately 72 volts? Yes – INSTALL a new contactor. OPERATE the system to verify the repair. No – REPAIR circuit 41 (OR/VT). OPERATE the system to verify the repair.	Contactor
7.	Connect a DVOM between motor controller connector terminal 2 and the vehicle chassis. Does the DVOM display approximately 72 volts? Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.	Motor Controller

Step	Action	Connector End View
	No – GO to Step 9.	
8.	<p>1. Disconnect the instrument cluster gauge connector J7A.</p> <p>2. Connect a DVOM between the contactor connector terminal 2 and the instrument cluster gauge connector J7A terminal 7.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 41 (OG/VT) between the contactor and the instrument cluster gauge. OPERATE the system to verify the repair.</p>	<p>Instrument Cluster Gauge—J7A</p> <p>Contactor</p>

Accelerator Potentiometer Pinpoint Test

WARNING:

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WARNING:

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Step	Action	Connector End View
1.	<p>1. Place the drive mode selector switch in the OFF position.</p> <p>2. Disconnect the motor controller harness connector.</p> <p>3. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p>	<p>Motor Controller Accelerator Potentiometer</p>

Step	Action	Connector End View
	<p>4. Connect a DVOM between the motor controller harness connector terminal 3 and the vehicle chassis.</p> <p>Does the DVOM display greater than 10 volts with the accelerator pedal pressed and approximately 0 volts with the accelerator pedal released?</p> <p>Yes - GO to Step 2.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	
2.	<ol style="list-style-type: none"> 1. Disconnect the motor controller harness connector and the accelerator potentiometer harness connector. 2. Connect a DVOM between the motor controller harness connector terminal 7 and the accelerator potentiometer harness connector terminal A. 3. Connect a DVOM between the motor controller harness connector terminal 8 and the accelerator potentiometer harness connector terminal E. 4. Connect a DVOM between the motor controller harness connector terminal 9 and the accelerator potentiometer harness connector terminal G. 5. Connect a DVOM between the motor controller harness connector terminal 13 and the accelerator potentiometer harness connector terminal J <p>Does continuity exist?</p> <p>Yes – GO to Step 3.</p> <p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	<p>Motor Controller Accelerator Potentiometer</p>
3.	<ol style="list-style-type: none"> 1. Reconnect the accelerator potentiometer harness connector. 2. Connect a DVOM between the motor controller harness connector terminal 7 and terminal 8. <p>Does the DVOM display between 1.9k and 3.9k ohms with the accelerator potentiometer pedal raised and between 3.7k and 5.7k ohms with the accelerator potentiometer pedal pressed?</p> <p>Yes – GO to Step 4.</p> <p>No – INSTALL a new accelerator potentiometer. REFER</p>	<p>Motor Controller Accelerator Potentiometer</p>

Step	Action	Connector End View
	to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.	
4.	<p>Connect a DVOM between the motor controller harness connector terminal 8 and terminal 13.</p> <p>Does the DVOM display between 3.7k and 5.7k ohms with the accelerator potentiometer pedal raised and between 1.9k and 3.9k ohms with the accelerator potentiometer pedal pressed?</p> <p>Yes – GO to Step 5.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	Motor Controller
5.	<p>Connect a DVOM between the motor controller harness connector terminal 8 and terminal 9.</p> <p>Does the DVOM display less than 5k ohms?</p> <p>Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	Motor Controller

Charger Pinpoint Test

WARNING:

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WARNING:

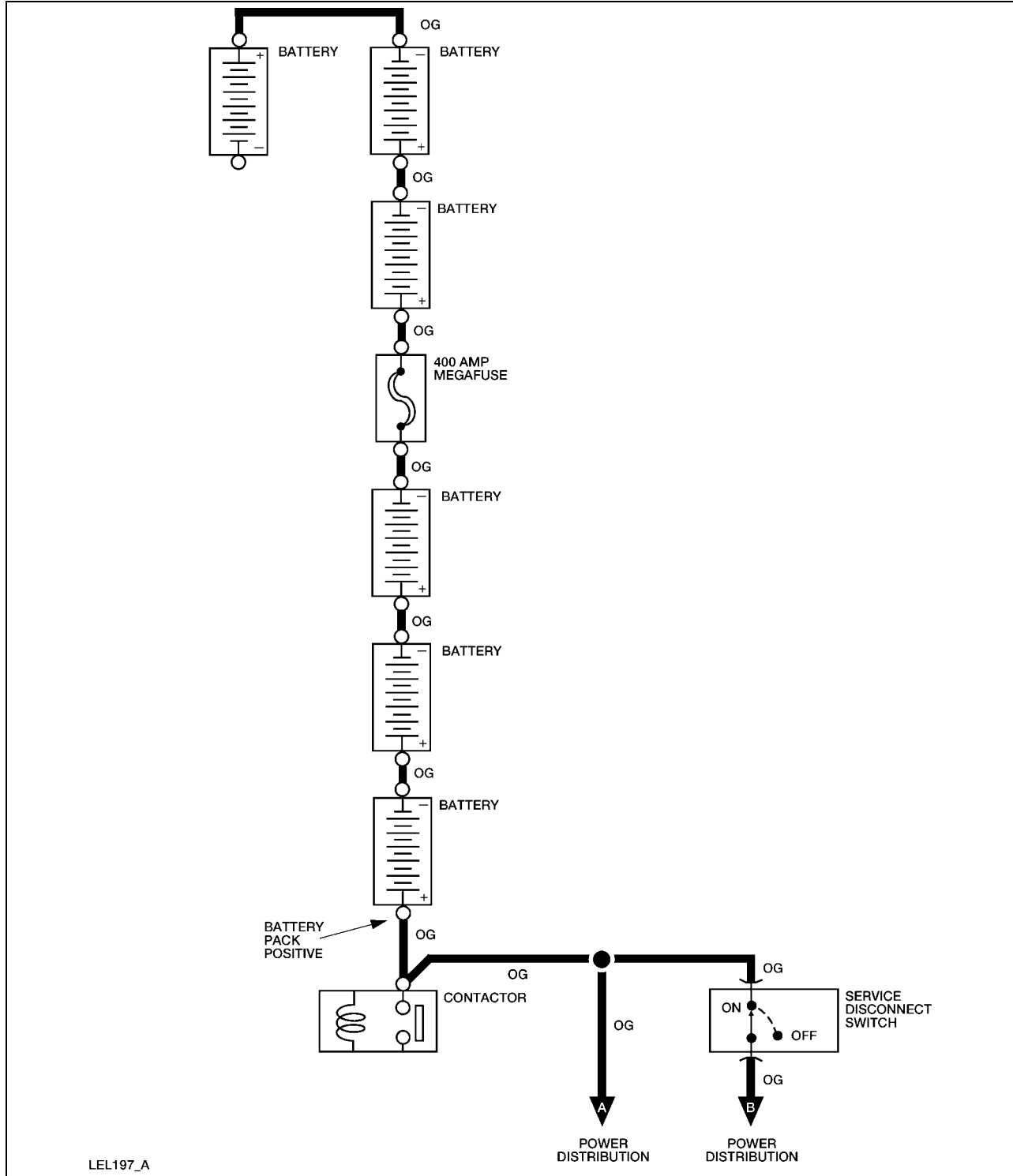
THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

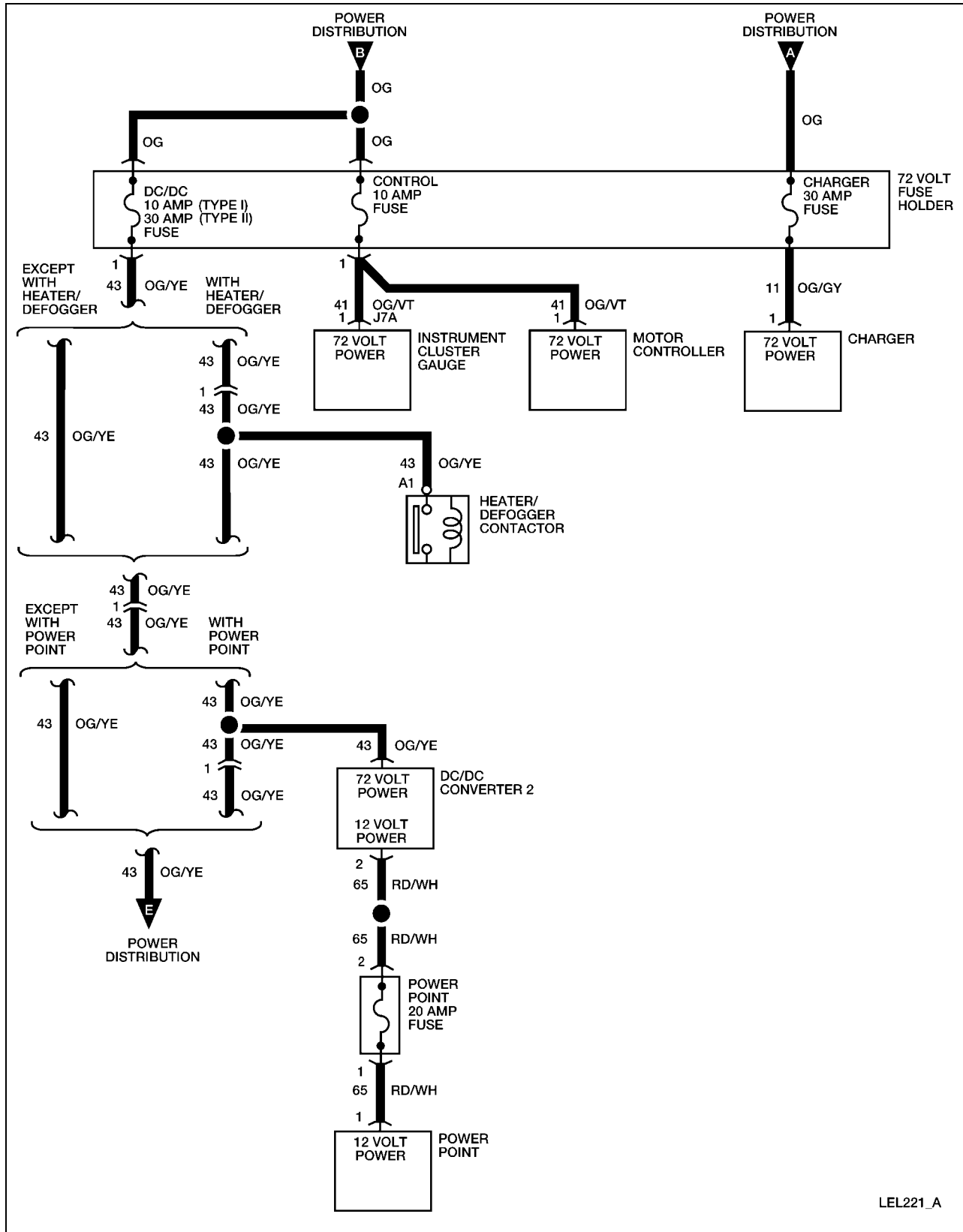
Step	Action	Connector End View
1.	1. Disconnect the charger harness connector. 2. Connect a DVOM between the charger harness connector terminal 1 and terminal 2. Does the DVOM display approximately 72 volts? Yes – GO to Step 2. No – GO to Step 4.	Charger
2.	1. Reconnect the charger connector. 2. Connect the GFCI charger cord to the charger. 3. Verify charger operation by listening for a buzz noise and feeling for a slight vibration from the charger. Does the charger operate? Yes – GO to Step 3. No – GO to Step 7.	
3.	With the GFCI cord connected to the charger, connect a DVOM between the battery pack positive and battery pack negative. Does the voltage increase after two minutes? Yes – The system is OK. No – TEST the batteries. REFER to Battery Test in this section. If all batteries are OK, INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.	
4.	Connect a DVOM between the battery pack positive and battery pack negative. Does the DVOM display approximately 72 volts? Yes – GO to Step 5. No – TEST the batteries. REFER to Battery Test in this section.	
5.	Connect a DVOM between the charger harness connector terminal 2 and the battery pack negative. Does continuity exist? Yes – GO to Step 6.	Charger

Step	Action	Connector End View
	<p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	
6.	<p>1. Perform the Power Shutdown Procedure. Refer to Power Shutdown Procedure in this section.</p> <p>2. Connect a DVOM between the charger harness connector terminal 1 and the battery pack positive.</p> <p>Does continuity exist?</p> <p>Yes – The system is OK.</p> <p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	Charger
7.	<p>1. Connect a known good GFCI cord to the charger.</p> <p>2. Verify charger operation by listening for a buzz noise and feeling for a slight vibration from the charger.</p> <p>Does the charger operate?</p> <p>Yes – INSTALL a new GFCI cord. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p>	

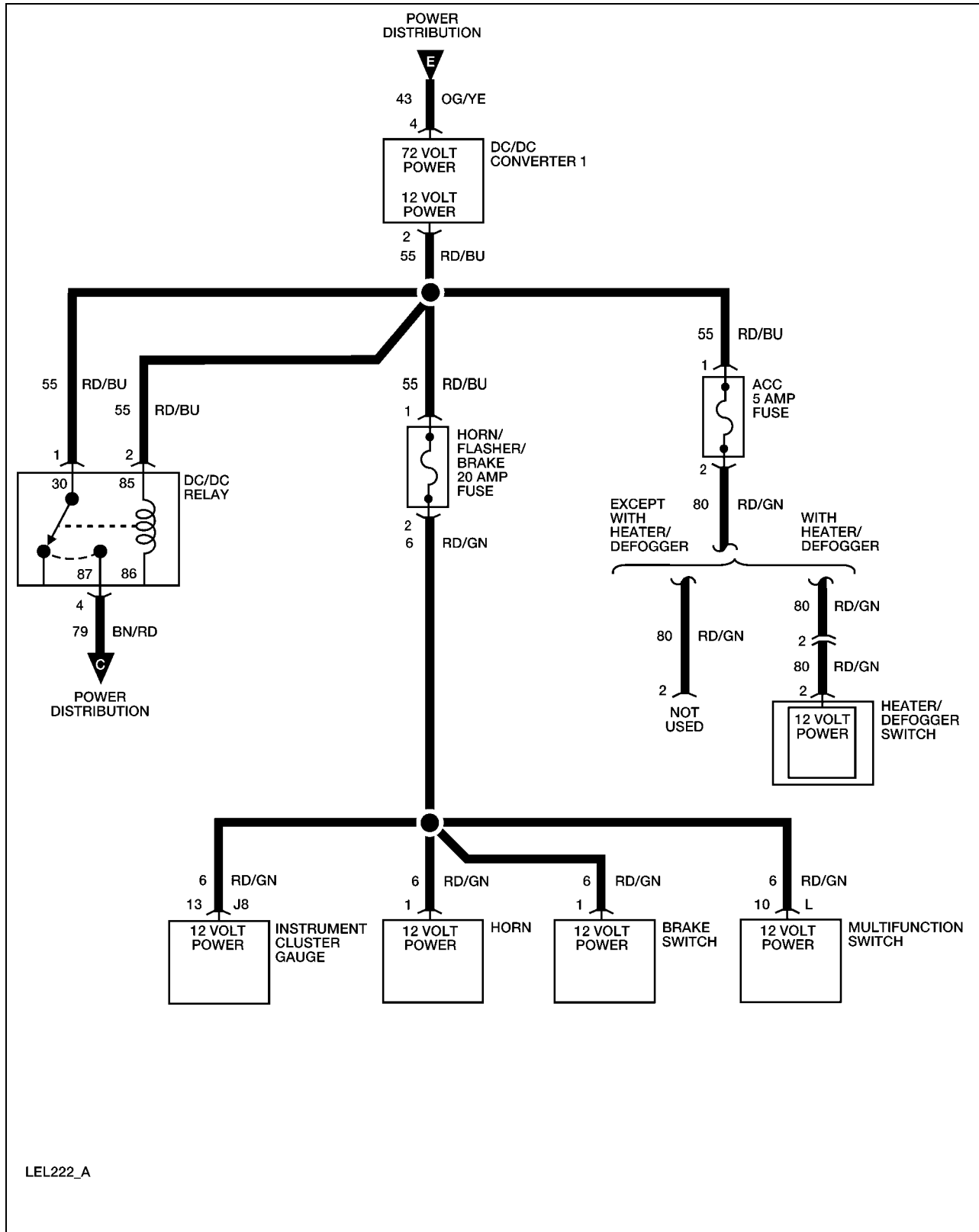
Power Distribution

Circuit Schematic

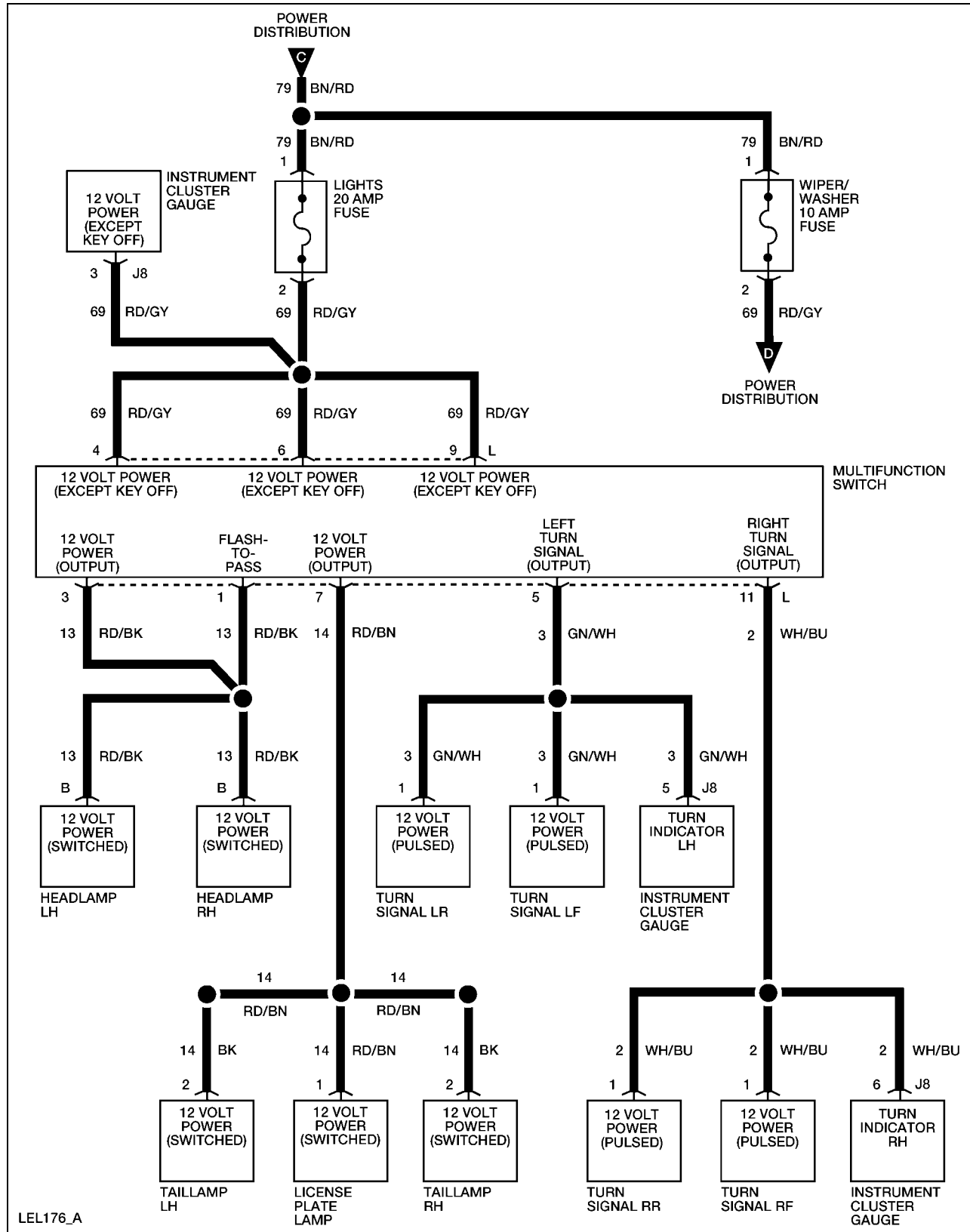


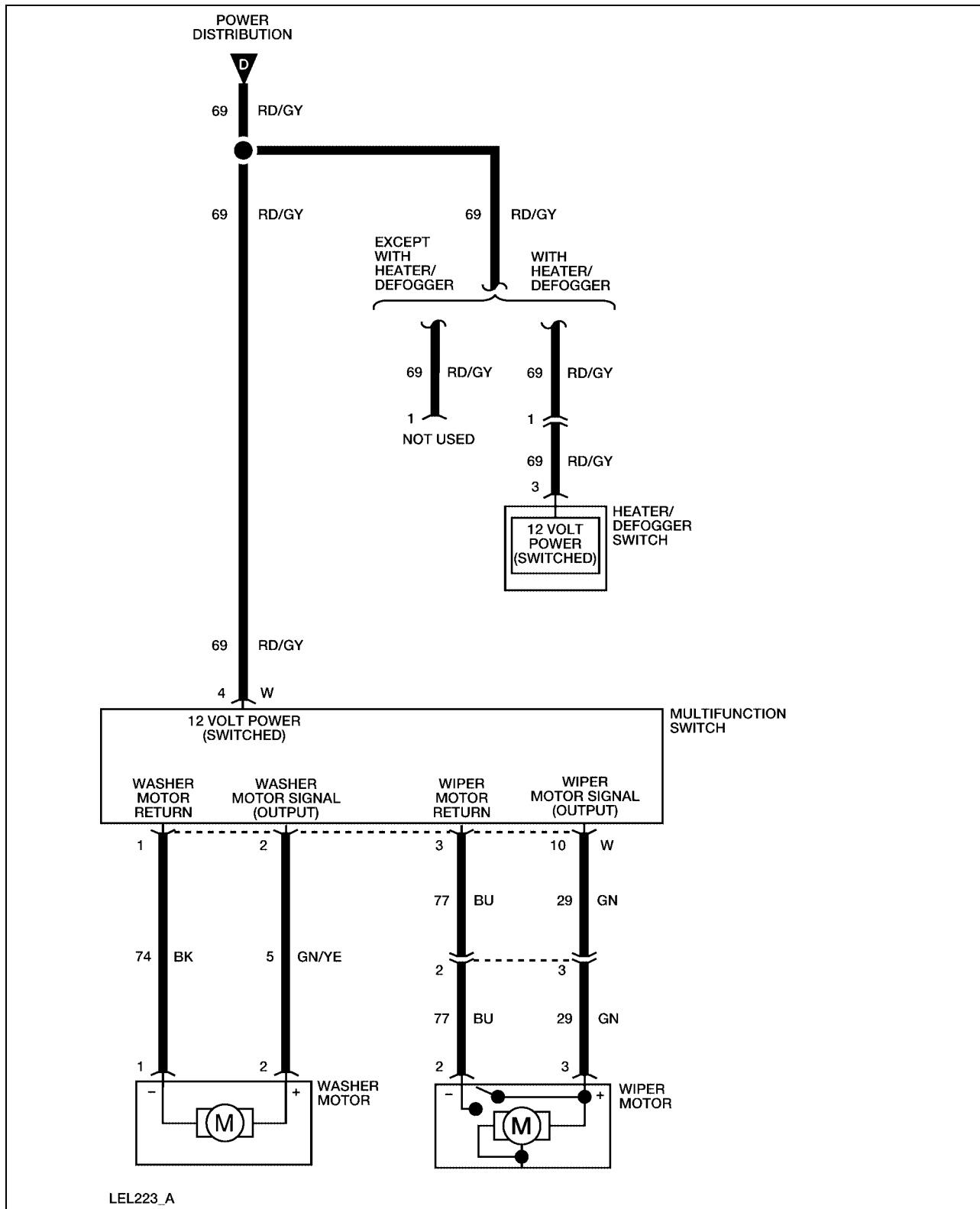


LEL221_A

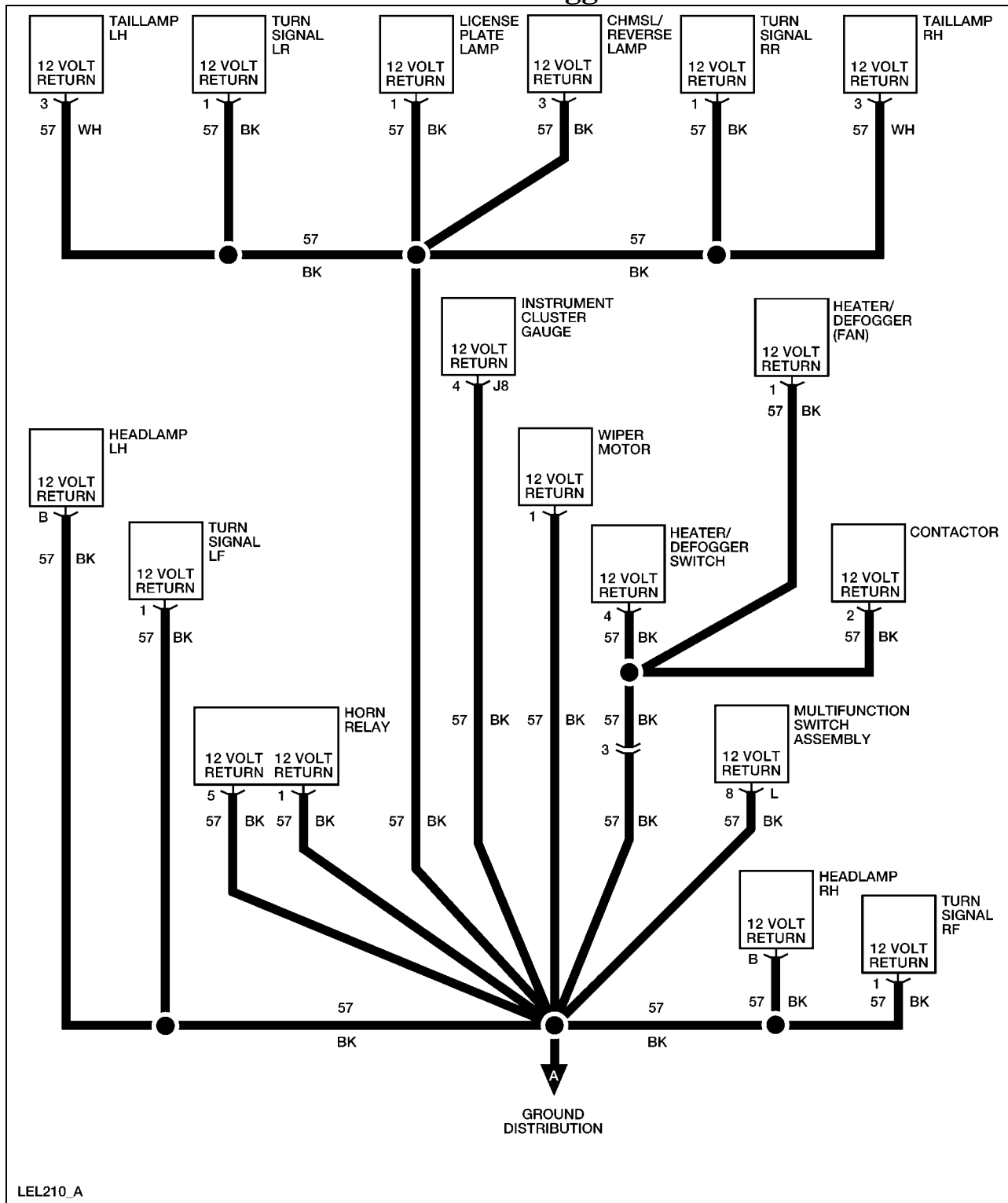


LEL222_A

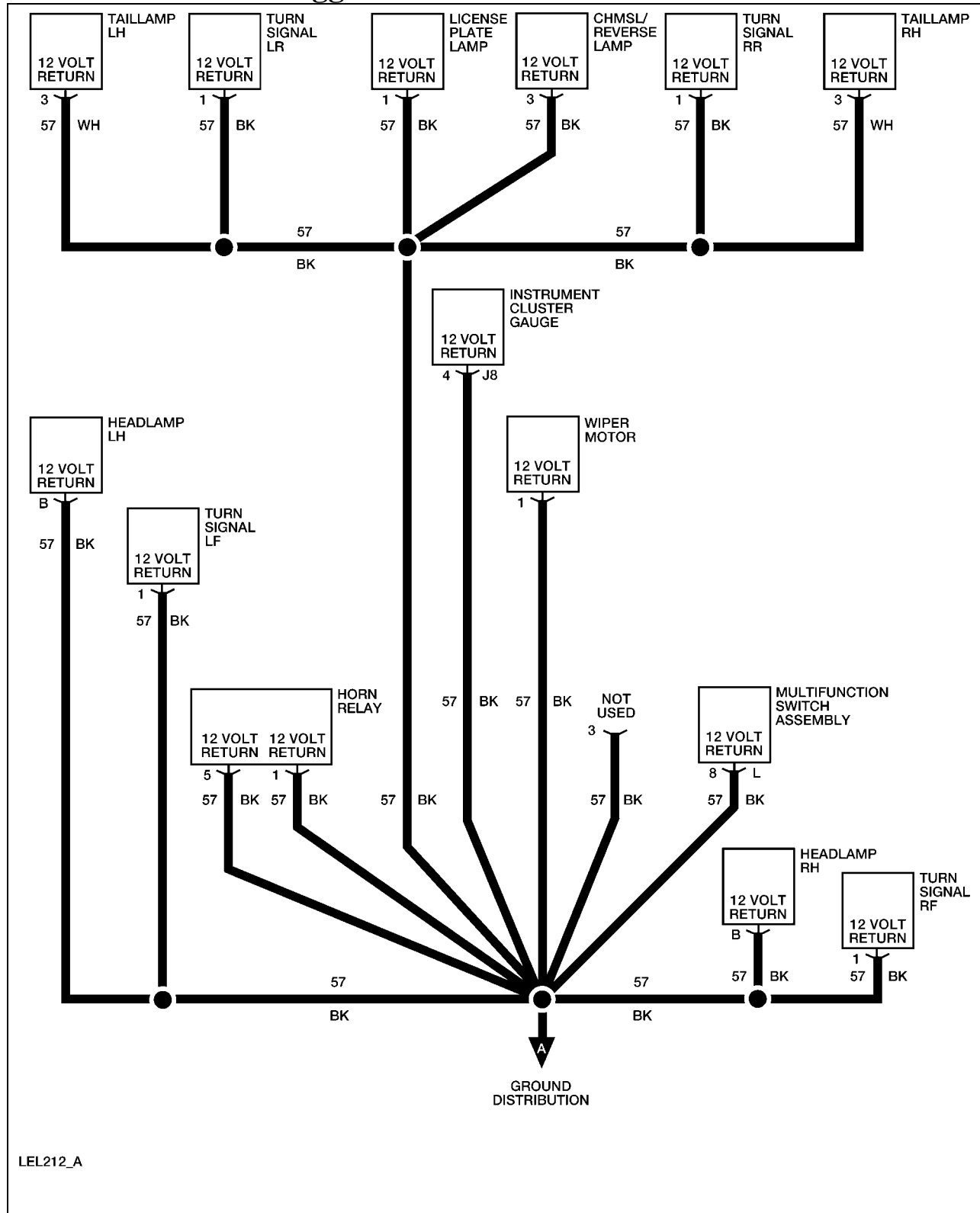


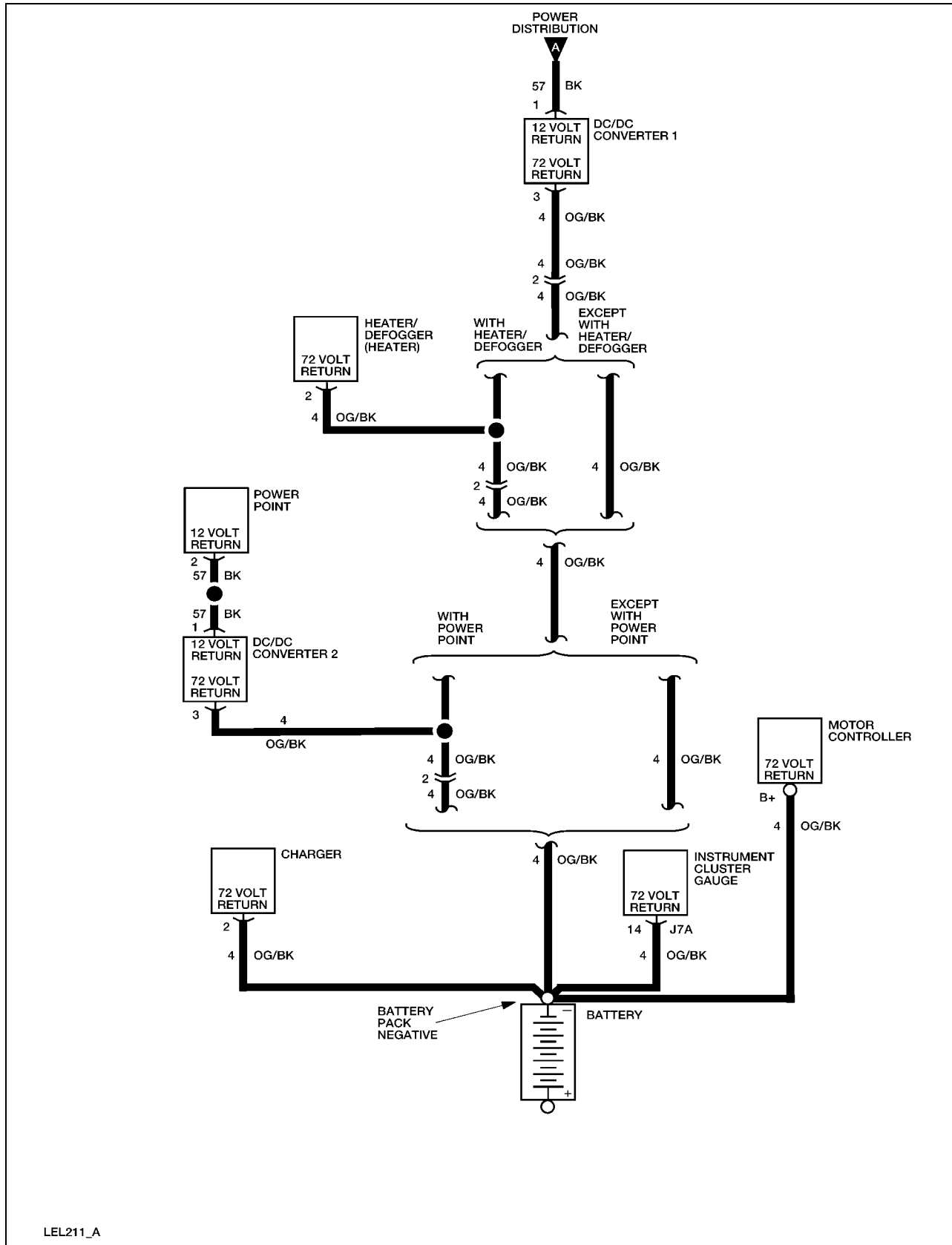


Ground Distribution Circuit Schematic – With Heater/Defogger



Without Heater/Defogger





LEL211_A

Electrical Leakage Detection

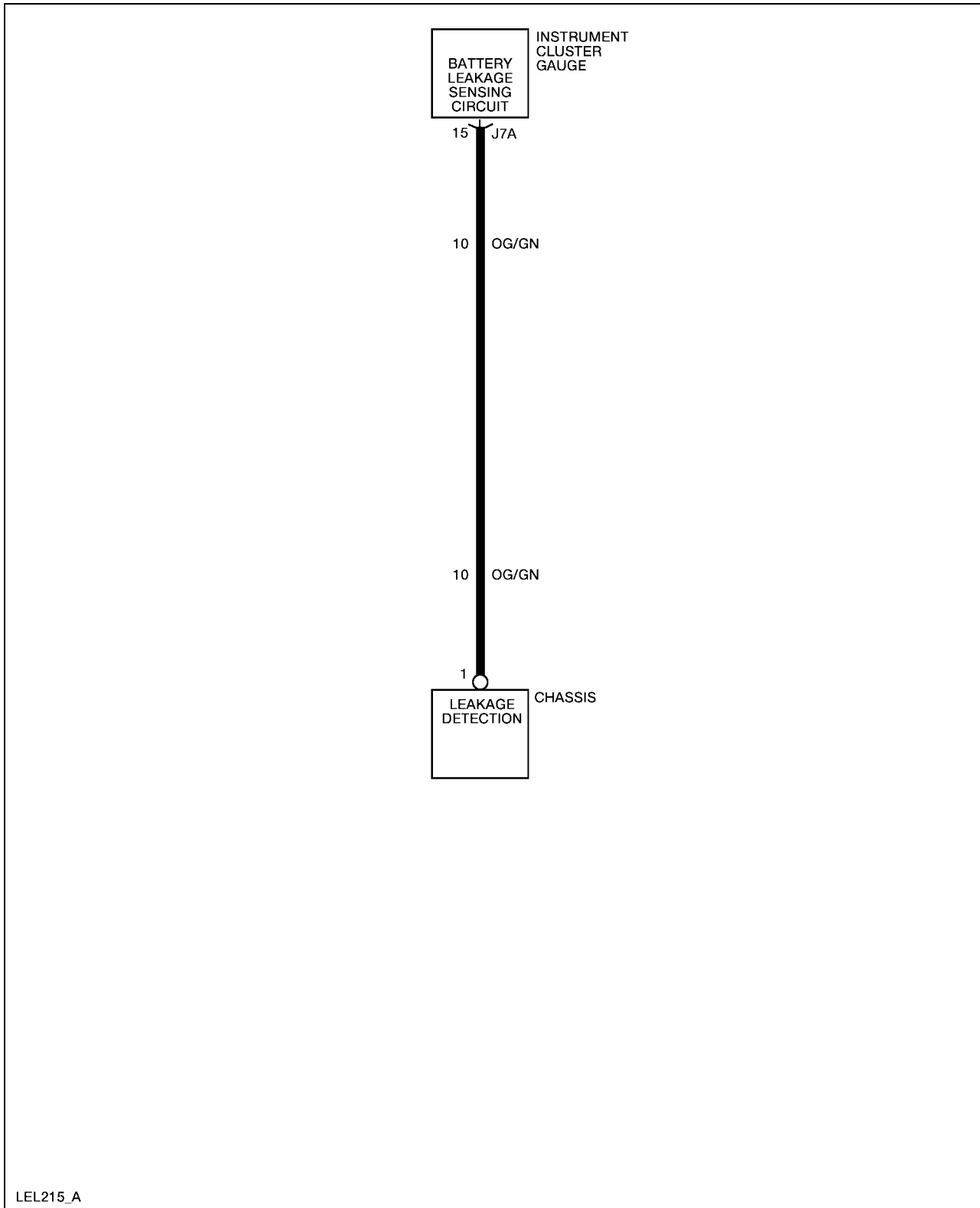
Circuit Description and Operation

The electrical leakage detection circuit measures current flow from the battery pack to the vehicle frame. The battery pack is electrically isolated from the vehicle frame. There are four system components that ground to the frame: headlamps, chassis connector, wiper motor and the park brake switch. The chassis connector circuit is between the instrument cluster gauge and an eyelet that is connected to the frame on the opposite side of the DC/DC converter 1 (standard). An OP AMP inside the instrument cluster gauge converts voltage to amperage from any place where leakage is detected. Any current above 0.1mA will set the electrical leakage indicator. Any part of the 72 volt harness has the potential for leakage detection. The 12 volt harness has the potential for leakage detection at the accelerator potentiometer and the motor tachometer/speed sensor. Vehicles equipped with the optional power point will have a DC/DC converter 2 (optional). The DC/DC converter 2 (optional) also has the potential for leakage detection.

The following components and harnesses are to be checked for electrical leakage in this procedure:

- Contactor coil
- Instrument cluster gauge
- Motor controller
- DC/DC converter 1 (standard)
- DC/DC converter 2 (optional)
- Motor
- Motor tachometer/speed sensor
- Accelerator potentiometer
- Charger
- 72 volt harness
- Batteries

Circuit Schematic



LEL215_A

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

Guidelines to diagnose electrical leakage:

1. Service disconnect switch must be in the ON position to observe the electrical leakage indicator located on the face of the instrument cluster gauge.
2. Before disconnecting any component, you must first place the service disconnect switch in the OFF position.
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material. Wait at least 2 minutes after all debris has been cleared so that the instrument cluster gauge has enough time to detect leakage.
4. Make sure the vehicle is thoroughly dry before attempting electrical leakage diagnosis. Electrical leakage may be detected if certain electrical connectors are exposed to moisture due to rain or washing of the vehicle. This will cause the electrical leakage indicator in the instrument cluster gauge to be set.

Electrical Leakage Diagnosis

WARNING:

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WARNING:

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Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Disconnect the chassis connector. 3. Place the service disconnect switch in the ON position. 4. Set the park brake. 5. Place the drive mode selector switch in the Reverse, Turf or Drive mode and wait 10 seconds. 6. Observe the instrument cluster gauge. <p>Does the electrical leakage indicator display?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – RECONNECT the chassis connector. GO to Step 3.</p>	
3	<p>Drive the vehicle while observing the instrument cluster gauge.</p> <p>Does the electrical leakage indicator display only after heavy acceleration or high motor load?</p> <p>Yes – INSTALL a new motor. REFER to Motor in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No – GO to Step 4.</p>	
4	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Disconnect the motor harness connectors. 3. Place the service disconnect switch in the ON position. 4. Set the park brake. 	

Step	Action	Connector End View
	<p>5. Place the drive mode selector switch in the Reverse, Turf or Drive mode and wait 10 seconds.</p> <p>6. Observe the instrument cluster gauge.</p> <p>Does the electrical leakage indicator display?</p> <p>Yes – GO to Step 5.</p> <p>No – INSTALL a new motor. REFER to Motor in the Powertrain section. OPERATE the system to verify the repair.</p>	
5	<p>1. Place the service disconnect switch in the OFF position.</p> <p>2. Reconnect the motor harness connectors.</p> <p>3. Disconnect the motor controller harness connector.</p> <p>4. Place the service disconnect switch in the ON position.</p> <p>5. Set the park brake.</p> <p>6. Place the drive mode selector switch in the Reverse, Turf or Drive mode and wait 10 seconds.</p> <p>7. Observe the instrument cluster gauge.</p> <p>Does the electrical leakage indicator display?</p> <p>Yes – GO to Step 6.</p> <p>No – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p>	
6	<p>1. Place the service disconnect switch in the OFF position.</p> <p>2. Reconnect the motor controller harness connector.</p> <p>3. Disconnect the DC/DC converter 1 (standard).</p> <p>4. Place the service disconnect switch in the ON position.</p> <p>5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds.</p> <p>6. Observe the instrument cluster gauge.</p> <p>Is the electrical leakage indicator displayed?</p>	

Step	Action	Connector End View
	<p>Yes – If vehicle is equipped with DC/DC converter 2 (optional), GO to Step 7.</p> <p>If the vehicle is not equipped with DC/DC converter 2 (optional), GO to Step 8.</p> <p>No – INSTALL a new DC/DC converter 1 (standard). REFER to DC/DC Converter 1 (Standard) in this section. OPERATE the system to verify the repair.</p>	
7	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Reconnect the DC/DC converter 1 (standard) harness connector. 3. Disconnect the DC/DC converter 2 (optional). 4. Place the service disconnect switch in the ON position. 5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds. 6. Observe the instrument cluster gauge. <p>Is the electrical leakage indicator displayed?</p> <p>Yes - GO to Step 8.</p> <p>No - INSTALL a new DC/DC converter 2 (optional). REFER to DC/DC Converter (Optional) in this section. OPERATE the system to verify the repair.</p>	
8	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Reconnect the DC/DC converter 2 (optional) (if equipped) and the DC/DC converter 1 (standard) harness connectors. 3. Disconnect the charger harness connector. 4. Place the service disconnect switch in the ON position. 5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds. 	

Step	Action	Connector End View
	<p>6. Observe the instrument cluster gauge. Is the electrical leakage indicator displayed? Yes - GO to Step 9. No - INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p>	
9	<p>1. Place the service disconnect switch in the OFF position. 2. Reconnect the charger harness connector. 3. Disconnect the accelerator potentiometer harness connector. 4. Place the service disconnect switch in the ON position. 5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds. 6. Observe the instrument cluster gauge. Is the electrical leakage indicator displayed? Yes – GO to Step 10. No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	
10	<p>1. Place the service disconnect switch in the OFF position. 2. Reconnect the accelerator potentiometer harness connector. 3. Disconnect the motor tachometer/speed sensor harness connector. 4. Place the service disconnect switch in the ON position. 5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds. 6. Observe the instrument cluster gauge. Is the electrical leakage indicator displayed? Yes - GO to Step 11.</p>	

Step	Action	Connector End View
	<p>No - INSTALL a new motor tachometer/speed sensor. REFER to Motor Tachometer/Speed Sensor in the Powertrain section. OPERATE the system to verify the repair.</p>	
11	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Reconnect the motor tachometer/speed sensor harness connector. 3. Disconnect the contactor coil harness connectors. 4. Place the service disconnect switch in the ON position. 5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds. 6. Observe the instrument cluster gauge. <p>Is the electrical leakage indicator displayed?</p> <p>Yes – GO to Step 12.</p> <p>No - INSTALL a new contactor coil. REFER to Contactor in this section. OPERATE the system to verify the repair.</p>	
12	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Reconnect the motor tachometer/speed sensor harness connector. 3. Clean battery cases and battery compartment to make sure there is no dirt, moisture or corrosion buildup that could create an electrical leak path. 4. Place the service disconnect switch in the ON position. 5. Place the drive mode selector switch in the Reverse, Turf or Drive position and wait 10 seconds. 6. Observe the instrument cluster gauge. <p>Is the electrical leakage indicator displayed?</p> <p>Yes – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify</p>	

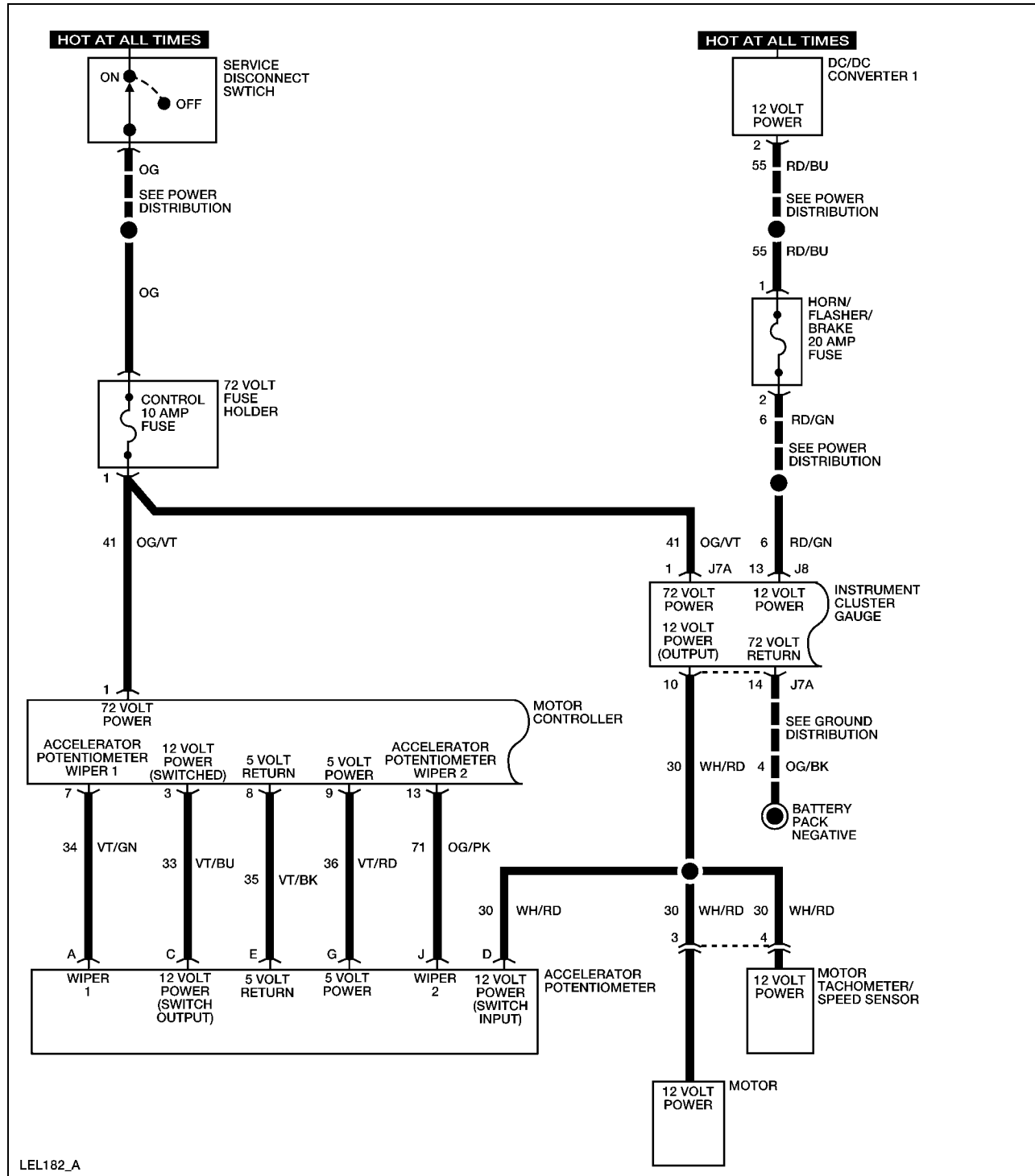
Step	Action	Connector End View
	the repair. No – GO to Step 13.	
13	<p>Connect the positive lead of a DVOM to the positive terminal of the first battery (from the negative end of the battery pack). Connect the negative lead of the DVOM to the vehicle chassis.</p> <p>Does the DVOM display negative voltage?</p> <p>Yes – REMOVE and CLEAN the battery with a baking soda solution. REINSTALL the battery and RETEST to verify the repair.</p> <p>No – MOVE the positive lead of the DVOM to the positive terminal of the next battery of the battery pack. CHECK each battery until a negative voltage is displayed on the DVOM. REMOVE and CLEAN the battery that displays a negative voltage. RETEST to verify the repair.</p>	

Accelerator Potentiometer

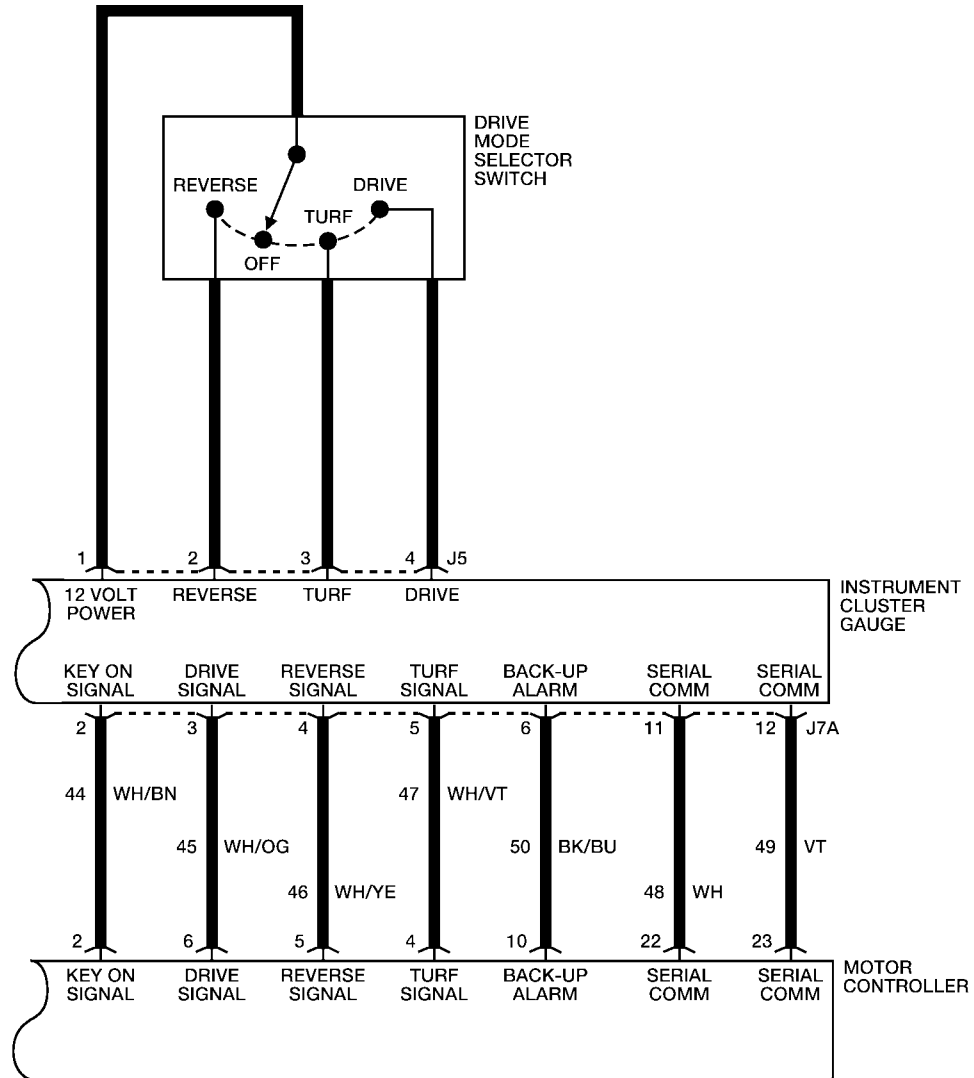
Circuit Description and Operation

When the contactor is turned on, the accelerator potentiometer receives 12 volts from the instrument cluster gauge. When the accelerator potentiometer pedal is pressed, a 12 volt signal is sent from the accelerator potentiometer to the motor controller. Two additional voltage signals are also sent from the accelerator potentiometer to the motor controller. These additional signals will vary depending on accelerator potentiometer pedal position. The motor controller uses these signals to control motor speed.

Circuit Schematic



LEL182_A



LEL219_A

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the accelerator potentiometer system are:

- Service disconnect switch
- Control fuse
- Motor controller
- Instrument cluster gauge
- Accelerator potentiometer
- Motor tachometer/speed sensor

Guidelines to diagnose the accelerator potentiometer system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Verify service disconnect switch is in ON position.
5. Check for any diagnostic trouble codes. Refer to [Retrieving and Clearing DTCs](#).

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
Vehicle speed does not change when accelerator potentiometer position changes.	<ul style="list-style-type: none"> Accelerator potentiometer Connectors and related wiring 	GO to Accelerator Potentiometer Inoperative.

Accelerator Potentiometer Inoperative

WARNING:

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WARNING:

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Step	Action	Connector End View
1.	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation in this section.	
2.	<ol style="list-style-type: none"> Disconnect the motor controller harness connector and the accelerator potentiometer harness connector. Connect a DVOM between the motor controller harness connector terminal 7 and the accelerator potentiometer harness connector terminal A. Connect a DVOM between the motor controller harness connector terminal 8 and the accelerator potentiometer harness connector terminal E. Connect a DVOM between the motor controller harness connector terminal 9 and the accelerator potentiometer harness connector terminal G. Connect a DVOM between the motor controller harness 	Motor Controller Accelerator Potentiometer

Step	Action	Connector End View
	<p>connector terminal 13 and the accelerator potentiometer harness connector terminal J</p> <p>Does continuity exist?</p> <p>Yes – GO to Step 3.</p> <p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	
3.	<ol style="list-style-type: none"> 1. Reconnect the accelerator potentiometer harness connector. 2. Connect a DVOM between the motor controller harness connector terminal 7 and terminal 8. <p>Does the DVOM display between 1.9k and 3.9k ohms with the accelerator potentiometer pedal raised and between 3.7k and 5.7k ohms with the accelerator potentiometer pedal pressed?</p> <p>Yes – GO to Step 4.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	Motor Controller Accelerator Potentiometer
4.	<p>Connect a DVOM between the motor controller harness connector terminal 8 and terminal 13.</p> <p>Does the DVOM display between 3.7k and 5.7k ohms with the accelerator potentiometer pedal raised and between 1.9k and 3.9k ohms with the accelerator potentiometer pedal pressed?</p> <p>Yes – GO to Step 5.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	Motor Controller
5.	<p>Connect a DVOM between the motor controller harness connector terminal 8 and terminal 9.</p> <p>Does the DVOM display less than 5k ohms?</p> <p>Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	Motor Controller

DTC 05

Description:

Accelerator potentiometer switch fails to close.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Accelerator potentiometer
- Connectors and related wiring

WARNING:

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WARNING:

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Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the motor controller harness connector. 2. Set the park brake. 3. Place the drive mode selector switch in the Reverse, Turf or Drive position. 4. Connect a DVOM between the motor controller harness connector terminal 3 and the vehicle chassis. <p>Does the DVOM display approximately 12 volts with the</p>	Motor Controller

Step	Action	Connector End View
	<p>accelerator potentiometer pedal pressed?</p> <p>Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No – GO to Step 3.</p>	
3	<ol style="list-style-type: none"> 1. Disconnect the accelerator potentiometer harness connector. 2. Connect a DVOM between the accelerator potentiometer harness connector terminal C and terminal D. <p>Does the DVOM display approximately 3.3k ohms with the accelerator potentiometer pedal pressed?</p> <p>Yes – GO to Step 4.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	Accelerator Potentiometer
4	<p>Connect a DVOM between the accelerator potentiometer harness connector terminal D and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p> <p>No – GO to Step 5.</p>	Accelerator Potentiometer
5	<p>Connect a DVOM between the instrument cluster gauge harness connector J7A (back probe) terminal 10 and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A

DTC 06**Description:**

Accelerator potentiometer pedal is pressed with no direction signal given to the controller.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Accelerator potentiometer
- Connectors and related wiring
- Instrument cluster gauge

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check in this section.	
2	1. Set the park brake. 2. Place the drive mode selector switch in the Reverse position. 3. Disconnect the motor controller harness connector. 4. Connect a DVOM between the motor controller harness connector terminal 5 and the vehicle chassis.	Motor Controller

Step	Action	Connector End View
	<p>Does the DVOM display approximately 12 volts? Yes - GO to Step 3. No - GO to Step 4.</p>	
3	<p>1. Place the drive mode selector switch in the Drive position.</p> <p>2. Connect a DVOM between the motor controller harness connector terminal 6 and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE system to verify the repair. No - GO to Step 5.</p>	Motor Controller
4	<p>1. Disconnect the instrument cluster gauge harness connector J7A.</p> <p>2. Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 4 and the motor controller harness connector terminal 5.</p> <p>Does continuity exist? Yes - INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No - INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A Motor Controller
5	<p>Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 3 and the motor controller harness connector terminal 6.</p> <p>Does continuity exist? Yes - INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No - INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A Motor Controller

DTC 08

Description:

Accelerator potentiometer input voltage to the motor controller is greater than 1.25 volts on power-up after initial drive mode selector switch closure.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Accelerator potentiometer
- Connectors and related wiring
- Motor controller

Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - GO to Step 3. No - REFER to Diagnostic System Check in this section.	
2	1. Disconnect the motor controller harness connector. 2. Disconnect the accelerator potentiometer harness connector. 3. Connect a DVOM between the motor controller harness connector terminal 7 and each of the other terminals of the motor controller harness connector. Does continuity exist between circuit 34 and any other circuit in the motor controller harness connector? Yes - INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair. No – GO to Step 3.	Motor Controller Accelerator Potentiometer
3	Connect a DVOM between the motor controller terminal 7 and the vehicle chassis. Does the DVOM display greater than approximately 1.25	Motor Controller

Step	Action	Connector End View
	volts? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.	

DTC 11

Description:

Accelerator potentiometer switch closed on power-up after initial drive mode selector switch closure.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Accelerator potentiometer
- Connectors and related wiring
- Motor controller

Note: Check all vehicle fuses before performing this diagnostic procedure.

WARNING:

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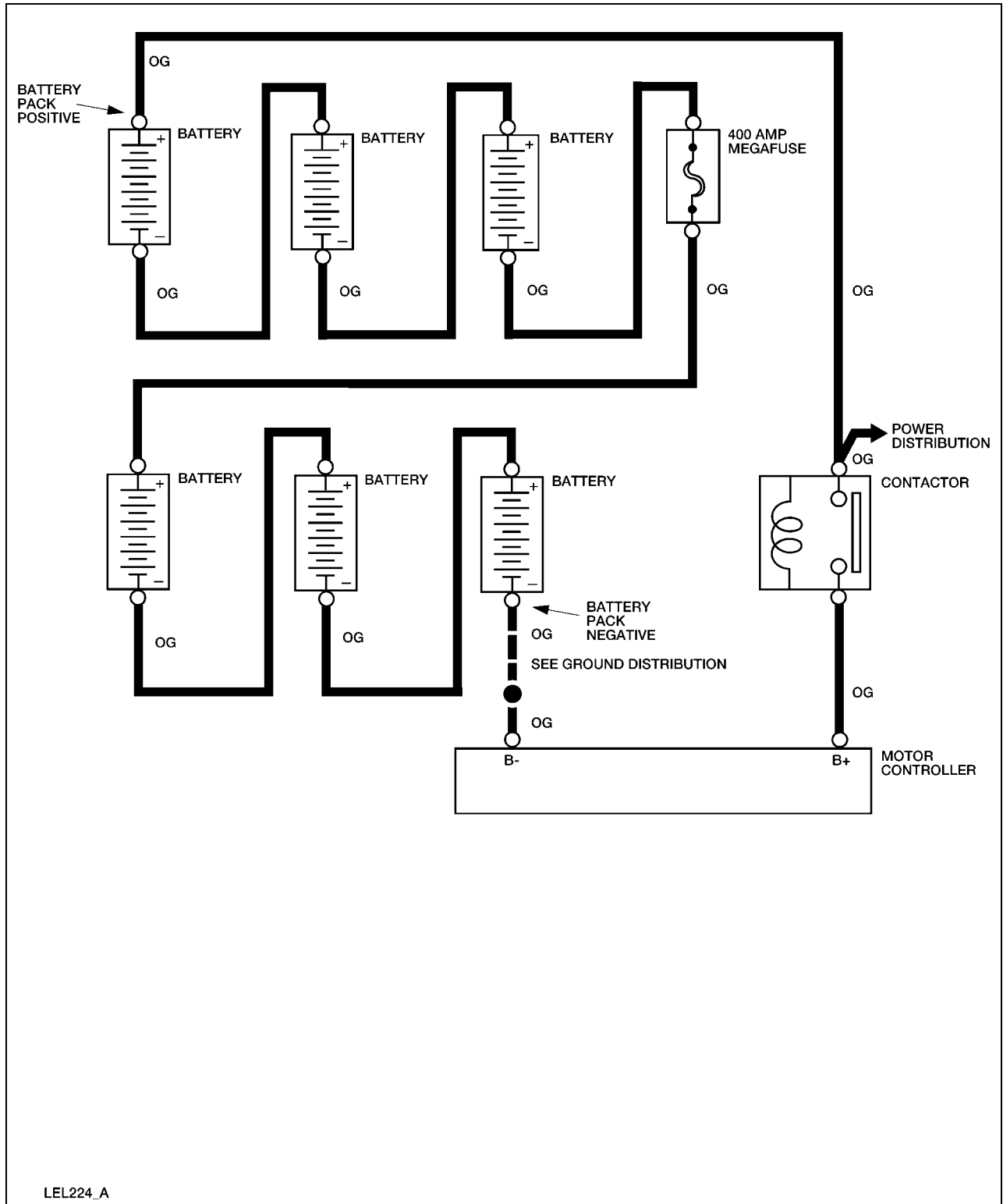
Step	Action	Connector End View
1	<p>Did you perform the Diagnostic System Check?</p> <p>Yes - GO to Step 2.</p> <p>No - Refer to Diagnostic System Check in this section.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the motor controller harness connector. 2. Disconnect the accelerator potentiometer harness connector. 3. Connect a DVOM between the motor controller harness connector terminal 7 and each of the other terminals of the motor controller harness connector. <p>Does continuity exist between circuit 33 and any other circuit in the motor controller harness connector?</p> <p>Yes - INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p> <p>No - GO to Step 3.</p>	<p>Motor Controller</p> <p>Accelerator Potentiometer</p>
3	<p>Connect a DVOM between the motor controller harness connector terminal 3 and the vehicle chassis.</p> <p>Does the DVOM display greater than approximately 7.2 volts?</p> <p>Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No - INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	<p>Motor Controller</p>

Battery

Circuit Description and Operation

72 volt power is supplied a pack by six 12 volt batteries connected in series. The battery pack is divided into two banks of three batteries, which are connected by a 400 amp megafuse.

Circuit Schematic



LEL224_A

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the battery system are:

- Batteries
- 400 amp megafuse
- Contactor coil

Guidelines to diagnose the battery system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Check for any diagnostic trouble codes. Refer to [Retrieving and Clearing DTCs](#) in this section.

If the concern still exists, refer to the following table.

Symptom Chart

Symptom	Possible Causes	Action
The vehicle does not operate — no power	<ul style="list-style-type: none"> • Battery • 400 amp megafuse 	GO to Battery Test .

Selecting Battery Type

When the maintenance-free battery mode is selected, the battery water reminder indicator will not be displayed on the instrument cluster gauge. If the flooded battery mode is selected, the battery water reminder will be displayed under either of the following conditions:

- When the drive mode selector switch is turned to the Reverse, Turf or Drive position and the instrument cluster gauge performs an indicator test.

- When the vehicle has been driven at least 300 miles (483 km) since the last reset or activation of the battery water reminder.

To toggle the battery type between flooded battery mode and maintenance-free battery mode, perform the following:

1. While pressing the Select/Reset button, place the drive mode selector switch in the Drive position.
2. Release the Select/Reset button within 5 seconds.
3. Place the drive mode selector switch in the Reverse position.
4. Press and release the Select/Reset button to toggle between the flooded battery mode and the maintenance-free battery mode.
5. To exit Selecting Battery Type, place the drive mode selector switch in the OFF position and either press the Select/Reset button or wait 10 seconds.

The battery water reminder indicator is the only indicator displayed when the instrument cluster gauge is in Selecting Battery Type mode.

Battery Test

WARNING:

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The battery test is done by measuring individual battery voltages with a calibrated voltmeter. This test determines the general state of charge and battery condition quickly. Use the Rotunda Alternator, Regulator Battery and Starter Tester (ARBST) 010-00725 or equivalent. Apply a 50 amp load to each of the batteries for no more than 10 seconds. Read the voltage before removing the load. A well-charged battery should maintain at least 12 volts. If the meter reads less than approximately 11.5 volts, the battery is not charged adequately, or it may be defective. Charge the battery using a battery charger and perform the test again. When charging the individual batteries, make sure the battery charger leads are clamped to the bases of the battery posts and

not the threaded studs. If battery voltage is not within specification, replace the battery. Refer to [Batteries](#) in this section. Charge the new battery using a 12 volt battery charger and perform the test again.

DTC 15

Description:

Battery voltage is less than 68.3 volts at initial drive mode selector switch closure.

Symptom:

Motor controller will not operate.

Possible cause(s):

Discharged or inoperative battery or batteries.

Note:

Check all vehicle fuses before performing this diagnostic procedure.

WARNING:

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WARNING:

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes – GO to Step 2. No - REFER to Diagnostic System Check in this section.	
2	Connect a DVOM between the battery pack positive and the battery pack negative. Is the voltage less than 68.3 volts?	

Step	Action	Connector End View
	<p>Yes – If the vehicle is equipped with flooded batteries, GO to Step 3. If the vehicle is equipped with maintenance-free batteries, GO to Step 4.</p> <p>No – The system is OK.</p>	
3	<p>Inspect the batteries for the proper water level. Refer to Battery Fill Procedure in the General Information section.</p> <p>Is the water level OK?</p> <p>Yes - GO to Step 4.</p> <p>No - Fill the batteries to the correct level with de-ionized or distilled water. GO to Step 4.</p>	
4	<ol style="list-style-type: none"> 1. Fully charge each individual battery using a battery charger. 2. Connect a DVOM between the battery pack positive and the battery pack negative. <p>Is the voltage less than 68.3 volts?</p> <p>Yes – REFER to Battery Test in this section.</p> <p>No – The system is OK.</p>	

DTC 16

Description:

Battery voltage is greater than 86 volts at initial drive mode selector switch closure.

Symptom:

Motor controller will not operate.

Possible cause(s):

- GFCI charger cord is connected to the charger.
- Battery voltage too high.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check in this section.	
2	Connect a DVOM between the battery pack positive and the battery pack negative. Is the voltage greater than 86 volts? Yes – REFER to Battery Test , in this section, to check the individual batteries for overcharge. No – The system is OK.	

Charging

Circuit Description and Operation

The battery charger receives 120-volt AC power from an external standard grounded 3-prong outlet and converts it to DC power as required to charge the vehicle battery pack. After properly connecting the vehicle to the receptacle, the charger will initiate a four stage charging process. In the first stage, the battery pack is tested. If the battery pack passes, the charger determines the appropriate charging rate, depending upon the voltage of the battery pack, and charges the battery pack. In the second and third stages, the voltage is regulated, and charging is completed. The battery pack is maintained at the full state of charge in the fourth stage. If the vehicle is left connected to the charger, the charger will automatically reinitiate a new charge cycle every 28 days. The rate at which the battery pack charges will vary, depending on the type of batteries installed. To ensure a fully charged battery pack, the vehicle should be charged continuously and uninterrupted for 14 hours. The instrument cluster gauge must be set for the type of batteries that are installed in the vehicle to prevent excessive charge time or damage to the batteries. Refer to [Battery Type Reprogramming](#) in this section. The battery charger should only be operated with the supplied GFCI charger cord. If the battery charger detects current from the GFCI charger cord, it will send a signal to the instrument cluster gauge. The instrument cluster gauge will then display the charging indicator and prevent the vehicle from being driven.

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the charging system are:

- GFCI cord
- Charger
- Service disconnect switch
- Battery temperature sensor
- Charger fuse
- Fuse cap
- Related wiring

Guidelines to diagnose the charging system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Service disconnect switch must be in the ON position to charge batteries.
5. Make sure the instrument cluster gauge is set for the type of batteries that are installed in the vehicle. Refer to [Battery Type Reprogramming](#) in this section.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The batteries do not charge	<ul style="list-style-type: none"> • GFCI power cord • Charger fuse • Fuse cap • Charger • Battery (or batteries) • Connectors or related wiring 	GO to Charger Inoperative.
The batteries charge slowly (take too long to fully charge)	<ul style="list-style-type: none"> • Charger • Battery temperature sensor • Connectors or related wiring 	GO to Batteries Charge Slowly.
The 120VAC indicator will not display	<ul style="list-style-type: none"> • Instrument cluster gauge • Connectors or related wiring 	GO to 120VAC Energized Indicator Inoperative.

Charger Inoperative

WARNING:

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

WARNING:

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1.	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No – REFER to Circuit Description and Operation in this section.	

Step	Action	Connector End View
2.	1. Disconnect the charger harness connector. 2. Connect a DVOM between the charger harness connector terminal 1 and terminal 2. Does the DVOM display approximately 72 volts? Yes – GO to Step 3. No – GO to Step 5.	Charger
3.	1. Reconnect the charger connector. 2. Connect the GFCI charger cord to the charger. 3. Verify charger operation by listening for a buzz noise and feeling for a slight vibration from the charger. Does the charger operate? Yes – GO to Step 4. No – GO to Step 8.	
4.	With the GFCI cord connected to the charger, connect a DVOM between the battery pack positive and battery pack negative. Does the voltage increase after two minutes? Yes – The system is OK. No – TEST the batteries. REFER to Battery Test in this section. If all batteries are OK, INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.	
5.	Connect a DVOM between the battery pack positive and battery pack negative. Does the DVOM display approximately 72 volts? Yes – GO to Step 6. No – TEST the batteries. REFER to Battery Test in this section.	
6.	Connect a DVOM between the charger harness connector terminal 2 and the battery pack negative. Does continuity exist? Yes – GO to Step 7.	Charger

Step	Action	Connector End View
	<p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	
7.	<p>1. Perform the Power Shutdown Procedure. Refer to Power Shutdown Procedure in this section.</p> <p>2. Connect a DVOM between the charger harness connector terminal 1 and the battery pack positive.</p> <p>Does continuity exist?</p> <p>Yes – The system is OK.</p> <p>No – INSPECT the fuse cap and INSTALL a new fuse cap if necessary. If the fuse cap is OK, INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	Charger
8.	<p>1. Connect a known good GFCI cord to the charger.</p> <p>2. Verify charger operation by listening for a buzz noise and feeling for a slight vibration from the charger.</p> <p>Does the charger operate?</p> <p>Yes – INSTALL a new GFCI cord. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p>	

Batteries Charge Slowly

WARNING:

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

WARNING:

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation in this section.</p>	
2	<ol style="list-style-type: none"> 1. Perform the Power Shutdown Procedure. Refer to Power Shutdown Procedure in this section. 2. Disconnect the charger harness connector. 3. Connect a DVOM between the charger harness connector terminal 4 and terminal 5. <p>Does the DVOM display between 8k and 12k ohms at approximately 25 degrees C?</p> <p>Yes – GO to Step 3.</p> <p>No – GO to Step 4.</p>	Charger
3	<p>Measure the time required to bring batteries to a full state of charge.</p> <p>Do the batteries charge fully in 8-10 hours?</p> <p>Yes – The system is OK.</p> <p>No – TEST the batteries. REFER to Battery Test in this section. If all batteries are OK, INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p>	
4	<ol style="list-style-type: none"> 1. Disconnect the battery temperature sensor harness connector. 2. Connect a DVOM between the battery temperature sensor harness connector terminal 1 and terminal 2. <p>Does the DVOM display between 8k and 12k ohms at approximately 25 degrees C?</p> <p>Yes – GO to Step 5.</p> <p>No – INSTALL a new battery temperature sensor. OPERATE the system to verify the repair.</p>	Battery Temperature Sensor
5	<p>Connect a DVOM between the battery temperature sensor harness connector terminal 1 and the charger harness connector terminal 4.</p>	Battery Temperature Sensor Charger

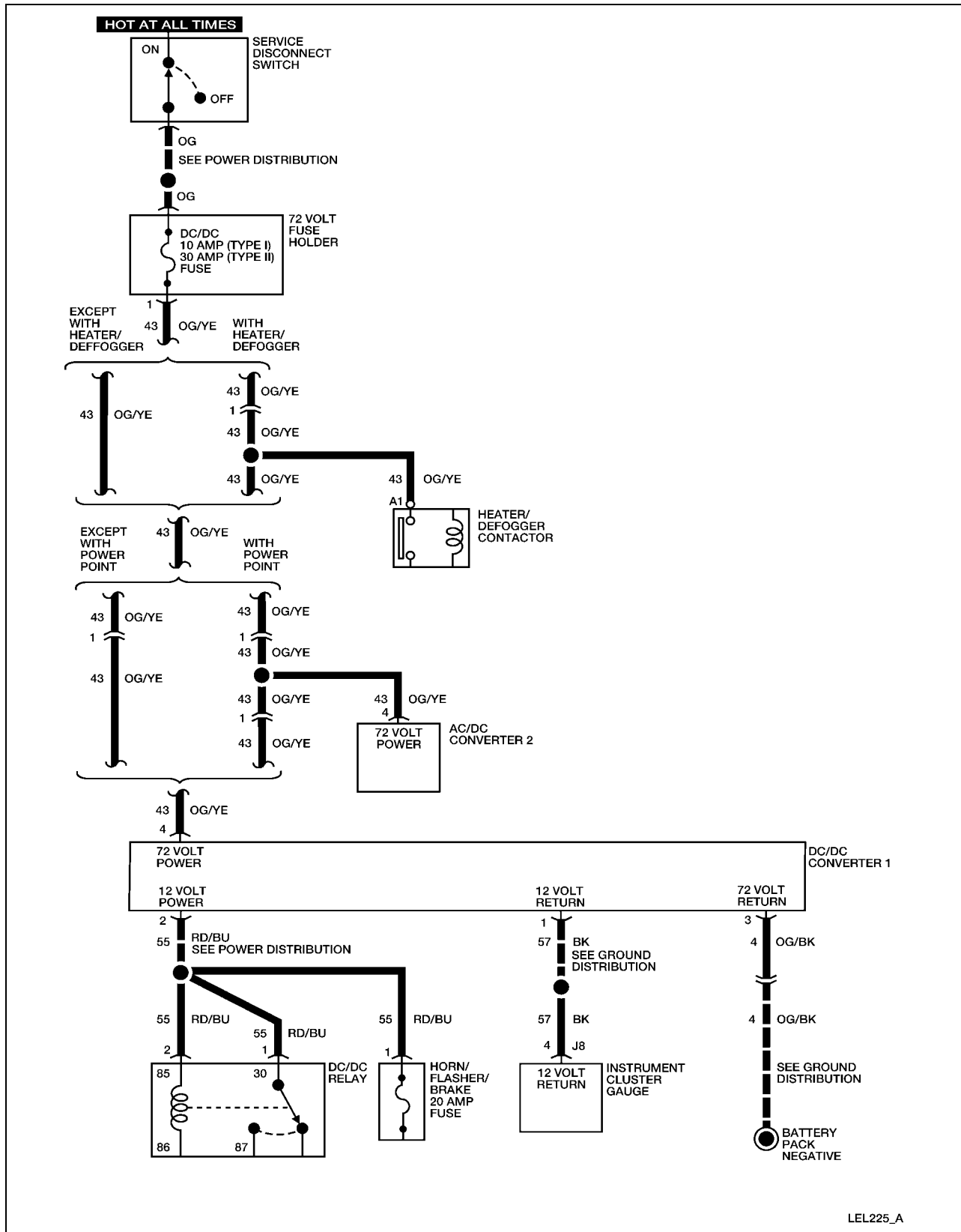
Step	Action	Connector End View
	<p>Does continuity exist?</p> <p>Yes – GO to Step 6.</p> <p>No – REPAIR circuit 16. OPERATE the system to verify the repair.</p>	
6	<p>Connect a DVOM between the battery temperature sensor harness connector terminal 2 and the charger harness connector terminal 5.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 17. OPERATE the system to verify the repair.</p>	<p>Battery Temperature Sensor</p> <p>Charger</p>

Voltage Step Down

Circuit Description and Operation

The DC/DC converter 1 (standard) and DC/DC converter 2 (optional) receive 72 volt power through the DC/DC fuse when the service disconnect switch is in the ON position. The DC/DC converter 1 (standard) and the DC/DC converter 2 (optional) step down the voltage from 72 volts to 12 volts for vehicle systems that require 12 volt power, such as exterior lamps, wiper/washer, horn, etc. For diagnosis of the DC/DC converter 2 (optional) or the power point system, refer to [Power Point](#) in this section.

Circuit Schematic



LEL225_A

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the voltage step down system are:

- DC/DC converter 1 (standard)
- DC/DC fuse
- Service disconnect switch
- Related wiring

Guidelines to diagnose the voltage step down system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Verify that the battery pack is fully charged. REFER to [Battery](#) in this section.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
All 12 volt systems except power point are inoperative	<ul style="list-style-type: none"> • DC/DC fuse • DC/DC converter 1 (standard) • Connectors or related wiring 	GO to DC/DC Converter 1 (Standard) Inoperative.

DC/DC Converter 1 (Standard) Inoperative

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WARNING:

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1.	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation in this section.	
2.	Connect a DVOM between the DC/DC converter 1 (standard) harness connector terminal 1 and terminal 2. Does the DVOM display approximately 12 volts? Yes – The DC/DC converter (standard) is operating correctly. CHECK operation of each 12 volt system to determine symptom. No - GO to Step 3.	DC/DC Converter 1 (Standard)
3.	1. Disconnect the DC/DC relay. 2. Remove the Horn/flasher/brake fuse. 3. Connect a DVOM between the DC/DC converter 1 (standard) harness connector terminal 1 and terminal 2. Does the DVOM display approximately 12 volts? Yes – INSTALL a new DC/DC relay. OPERATE the system to verify the repair.	DC/DC Converter 1 (Standard)

Step	Action	Connector End View
	No - GO to Step 4.	
4.	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Disconnect DC/DC converter 1 (standard) harness connector. 3. Connect a DVOM between the DC/DC converter 1 (standard) harness connector terminal 2 and the vehicle chassis. <p>Does continuity exist?</p> <p>Yes – REPAIR circuit 55 (RD/BU). OPERATE the system to verify the repair.</p> <p>No – GO to Step 5.</p>	DC/DC Converter 1 (Standard)
5.	<ol style="list-style-type: none"> 1. Connect a DVOM between the DC/DC converter 1 (standard) harness connector terminal 3 and terminal 4. 2. Place the service disconnect switch in the ON position. <p>Does the DVOM display approximately 72 volts?</p> <p>Yes – INSTALL a new DC/DC converter 1 (standard). REFER to DC/DC Converter 1 (Standard) in this section. OPERATE the system to verify the repair.</p> <p>No – GO to Step 6.</p>	DC/DC Converter 1 (Standard)
6.	<p>Check continuity between the DC/DC converter 1 (standard) harness connector terminal 3 and battery pack negative.</p> <p>Does continuity exist?</p> <p>Yes - REPAIR circuit 43. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 4. OPERATE the system to verify the repair.</p>	DC/DC Converter 1 (Standard)

Exterior Lamps

Circuit Description and Operation

The headlamps operate only when the drive mode selector switch is in the Reverse, Turf or Drive position. There are no high beam headlamps on this vehicle. The DC/DC converter 1 (standard) supplies 12 volt power through the DC/DC relay and the lights fuse to the multifunction switch connector-L. When the headlamp switch is turned to the ON (2nd) position, 12 volt power is supplied to the headlamps. The DC/DC converter 1 (standard) supplies 12 volt return for the headlamps to complete the circuit. The flash-to-pass function only operates when the headlamp switch is in the OFF or TAIL (1st) position.

The turn signals operate only when the drive mode selector switch is in the Reverse, Turf or Drive position. When the multifunction switch is in the LH or RH turn signal position, 12 volt power is supplied to the turn signal lamps and to the instrument cluster gauge turn signal indicators. The lamps flash ON and OFF as the electronic flasher internal relay toggles. The DC/DC converter 1 (standard) supplies 12 volt return for the lamps and the instrument cluster gauge to complete the circuit.

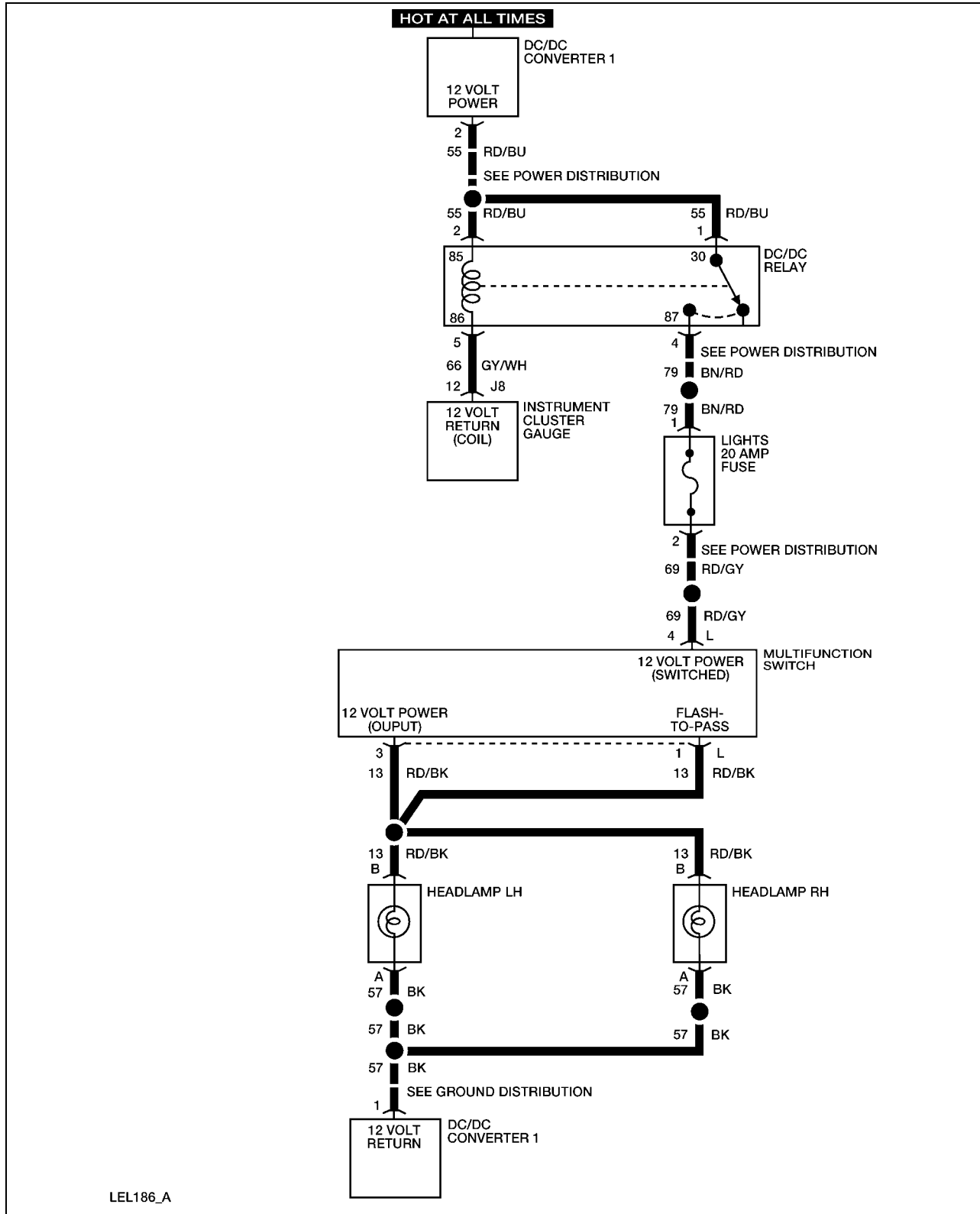
The hazard lamps operate with the drive mode selector switch in any position. The DC/DC converter 1 (standard) supplies 12 volt power through the horn/flasher/brake fuse to the multifunction switch connector-L. When the hazard switch (part of multifunction switch) is in the ON position, 12 volt power is supplied to the turn signal lamps and to the instrument cluster gauge turn signal indicators. The lamps and hazard switch will flash ON and OFF continuously until the hazard switch is placed in the OFF position. The DC/DC converter 1 (standard) supplies the 12 volt return for the lamps and the instrument cluster gauge to complete the circuit.

The brake lamps operate with the drive mode selector switch in any position. The center high-mounted stop lamp (CHMSL) is mounted on the rear of the vehicle roof. The CHMSL and the brake lamps illuminate when the brake pedal is depressed. 12 volt power is supplied at all times by the DC/DC converter 1 (standard) to the brake switch through the horn/flasher/brake fuse. The DC/DC converter 1 (standard) supplies 12 volt return for the CHMSL and the brake lamps. When the brake pedal is pressed, the brake switch closes and the brake lamps and CHMSL illuminate.

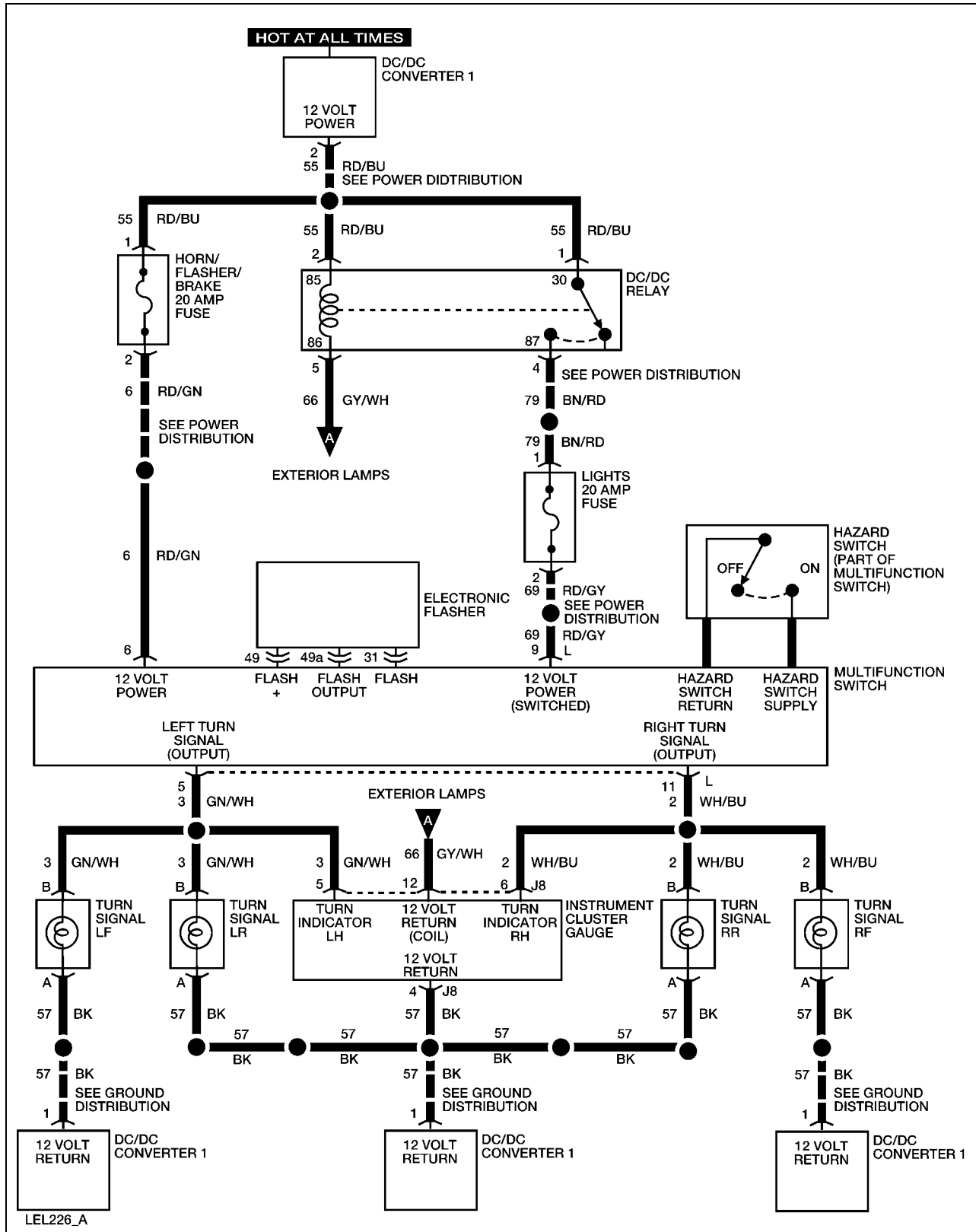
The reverse lamp illuminates when the drive mode selector switch is turned to the Reverse position. The DC/DC converter 1 (standard) supplies 12 volt return for the reverse lamp. When the drive mode selector switch is turned to the Reverse position, 12 volt power is supplied to the reverse lamp by the instrument cluster gauge and the reverse lamp illuminates.

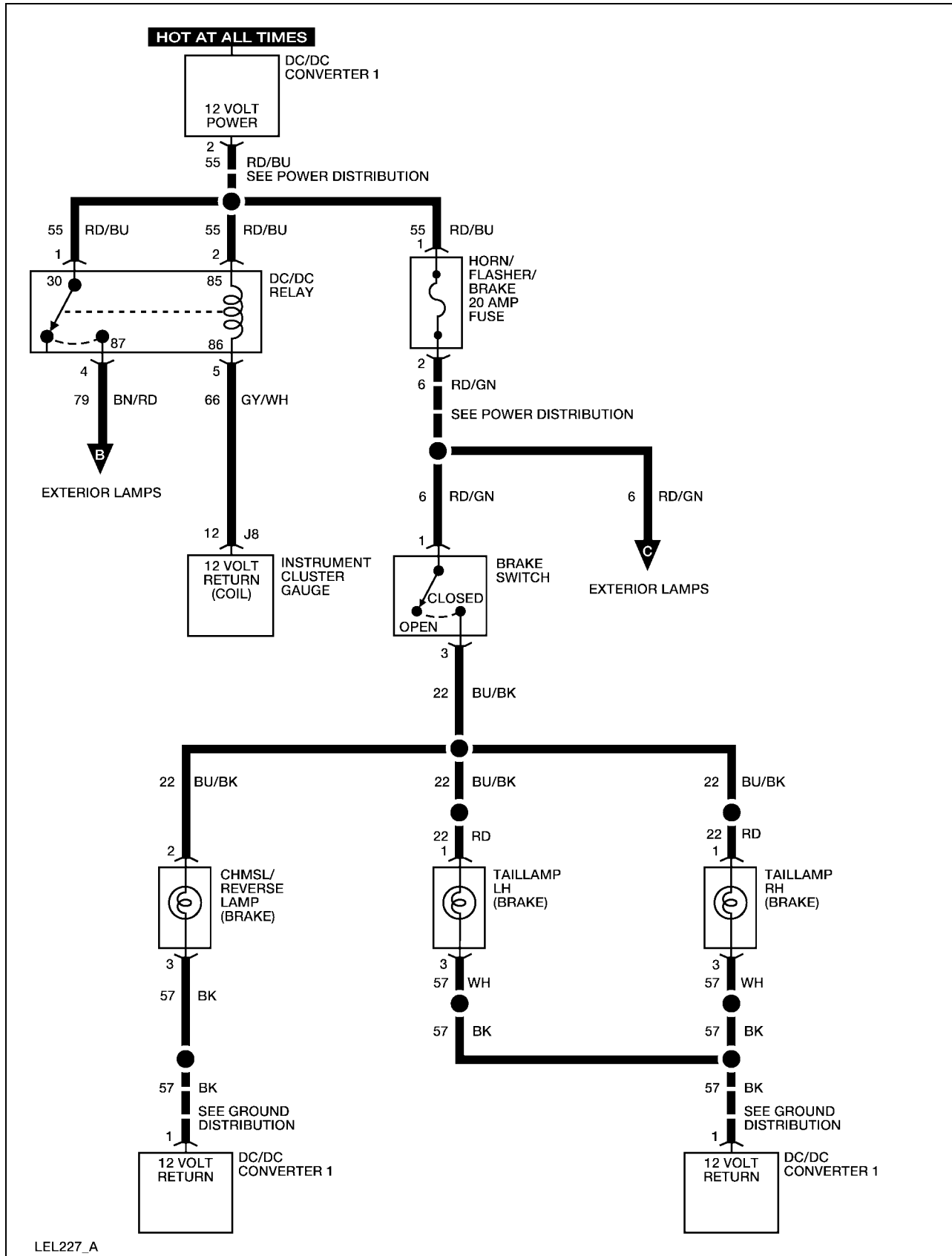
The taillamps and the license plate lamp illuminate when the drive mode selector switch is turned to the Reverse, Turf or Drive position and the headlamp switch is turned to the TAIL (1st) or ON (2nd) position. When the headlamp switch is turned to the TAIL (1st) or ON (2nd) position, 12 volt power is supplied to the taillamps and the license plate lamp. The DC/DC converter 1 (standard) supplies 12 volt return for the taillamps and the license plate lamp.

Circuit Schematic

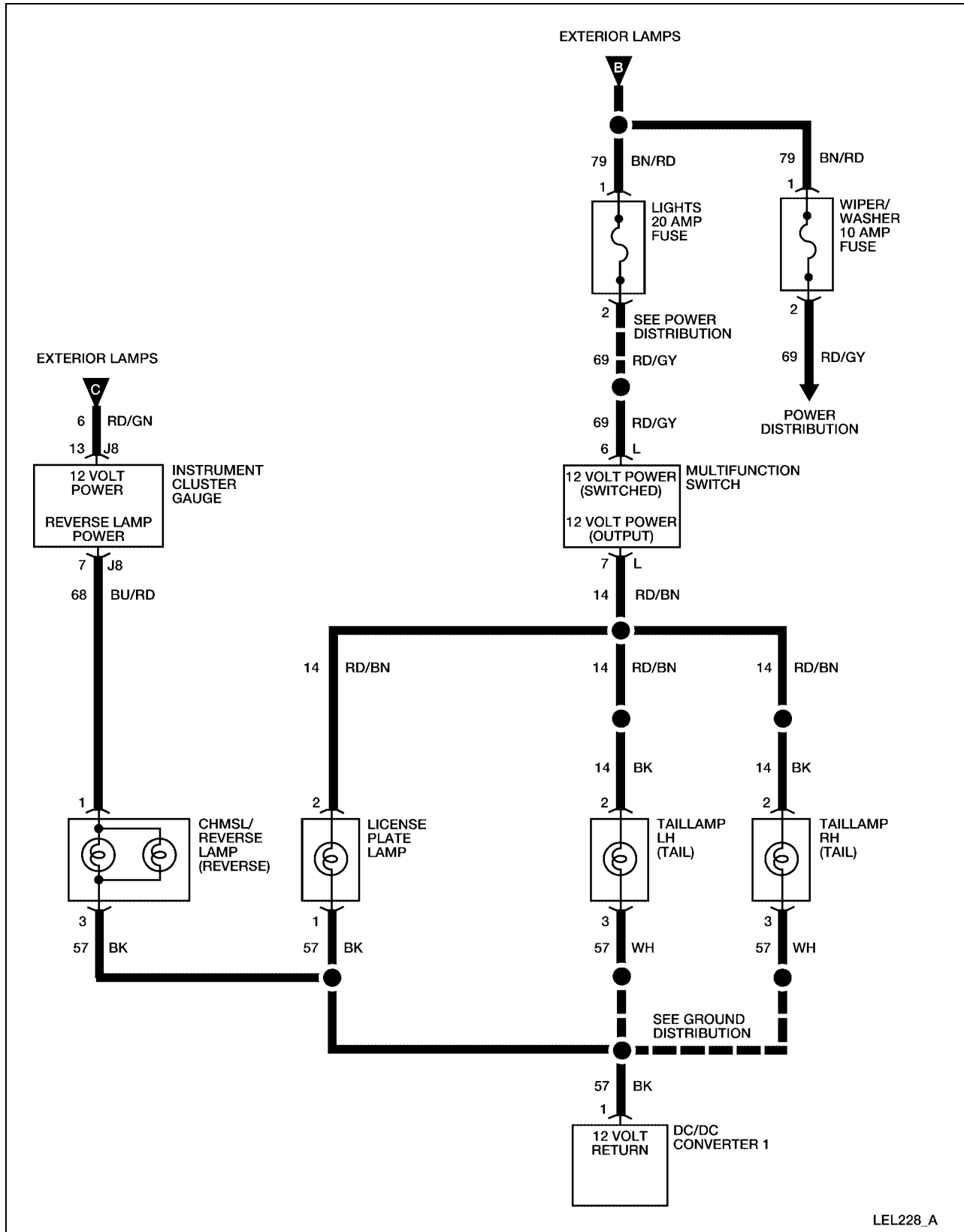


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System Check

Functional components in the exterior lamps system are:

- Lights fuse
- Horn/flasher/brake fuse
- Multifunction switch
- Headlamps
- CHMSL/reverse lamp
- Taillamps
- License plate lamp
- Electronic flasher
- Hazard switch (part of multifunction switch)
- Brake switch
- Turn signal lamps
- Instrument cluster gauge
- Related wiring

Guidelines to diagnose the exterior lamps system:

1. Verify the concern.
2. Check fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. If a single lamp is inoperative, check and replace the bulb (if necessary) before performing further diagnosis.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The headlamps are inoperative	<ul style="list-style-type: none"> • Lights fuse • Bulbs • Multifunction switch • Connectors or related wiring 	GO to Headlamps Inoperative.
One headlamp is inoperative	<ul style="list-style-type: none"> • Bulb • Connectors or related wiring 	GO to Headlamps Inoperative — One Lamp.
The headlamps are always on	<ul style="list-style-type: none"> • Multifunction switch • Connectors or related wiring 	GO to Headlamp(s) Always ON.
The turn signal lamps are inoperative	<ul style="list-style-type: none"> • Lights fuse • Horn/flasher/brake fuse • Bulbs • Multifunction switch • Connectors or related wiring 	GO to Turn Signal Lamps Inoperative.
One turn signal lamp is inoperative	<ul style="list-style-type: none"> • Bulb • Connectors or related wiring 	GO to Turn Signal Lamps Inoperative — Left or Right Side.
The turn signal lamps are inoperative — left or right side	<ul style="list-style-type: none"> • Bulbs • Connectors or related wiring 	GO to Turn Signal Lamps Inoperative — Left or Right Side.
The turn signal indicator is inoperative — left or right side	<ul style="list-style-type: none"> • Instrument cluster gauge • Connectors or related wiring 	GO to Turn Signal Indicator Inoperative — Left or Right Side

Symptom	Possible Causes	Action
The hazard flasher is inoperative (turn signals operate correctly)	<ul style="list-style-type: none"> • Multifunction switch 	INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.
The hazard flasher switch illumination is inoperative	<ul style="list-style-type: none"> • Bulb 	INSTALL a new hazard flasher switch bulb. OPERATE the system to verify the repair.
The hazard flasher is always on	<ul style="list-style-type: none"> • Multifunction switch 	INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.
The brake lamps are inoperative	<ul style="list-style-type: none"> • Horn/flasher/brake fuse • Brake switch • Connectors or related wiring 	GO to Brake Lamps Inoperative.
One brake lamp is inoperative — left or right side	<ul style="list-style-type: none"> • Bulb • Connectors or related wiring 	GO to One Brake Lamp Inoperative — Left or Right Side.
The CHMSL is inoperative	<ul style="list-style-type: none"> • Bulb • Connectors or related wiring 	GO to CHMSL Inoperative.
The brake lamps/CHMSL is always on	<ul style="list-style-type: none"> • Brake switch • Connectors or related wiring 	GO to Brake Lamps/CHMSL Always ON.
The reverse lamps are inoperative	<ul style="list-style-type: none"> • Instrument cluster gauge • Connectors or related wiring 	GO to Reverse Lamps Inoperative.
The reverse lamps are always on	<ul style="list-style-type: none"> • Instrument cluster gauge • Connectors or related wiring 	GO to Reverse Lamps Always ON.

Symptom	Possible Causes	Action
The taillamps/license plate lamps are inoperative	<ul style="list-style-type: none"> • Lights fuse • Multifunction switch • Connectors or related wiring 	GO to Tail/License Plate Lamps Inoperative.
One taillamp is inoperative	<ul style="list-style-type: none"> • Bulb • Connectors or related wiring 	GO to One Tail/License Lamp Inoperative.
The license plate lamp is inoperative	<ul style="list-style-type: none"> • Bulb • Connectors or related wiring 	GO to One Tail/License Lamp Inoperative.
The taillamps/license plate lamps are always on	<ul style="list-style-type: none"> • Multifunction switch • Connectors or related wiring 	GO to Tail/License Plate Lamps Always On.

Headlamps Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. 3. Operate the flash-to-pass switch. <p>Do the headlamps illuminate?</p> <p>Yes – GO to Step 3.</p> <p>No – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p>	
3	<ol style="list-style-type: none"> 1. Connect a DVOM between multifunction switch connector-L terminal 3 and the vehicle chassis. 2. Place the headlamp switch in the ON (2nd) position. 	Multifunction Switch-L

Step	Action	Connector End View
	<p>Does the DVOM display approximately 12 volts?</p> <p>Yes – REPAIR circuit 13. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p>	

Headlamps Inoperative — One Lamp

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the inoperative headlamp. 2. Set the park brake. 3. Place the drive mode selector switch in the Reverse, Turf or Drive position. 4. Place the headlamp switch in the ON (2nd) position. 5. Connect a DVOM between the inoperative headlamp connector terminal A and terminal B. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new headlamp bulb. REFER to Headlamp Bulb. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 13. OPERATE the system to verify the repair.</p>	<p>Headlamp LH</p> <p>Headlamp RH</p>

Headlamp(s) Always ON

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes – GO to Step 2. No – REFER to Circuit Description and Operation .	
2	Disconnect the multifunction switch connector-L. Do the headlamps illuminate? Yes – REPAIR circuit 13 between the multifunction switch harness connector-L terminal 1 or terminal 3 and the headlamps. OPERATE the system to verify the repair. No – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.	Multifunction Switch-L

Turn Signal Lamps Inoperative

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No – REFER to Circuit Description and Operation .	
2	Place the hazard switch in the ON position. Do the hazard lamps operate correctly? Yes - INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair. No - GO to Step 3.	
3	1. Disconnect the electronic flasher. 2. Connect a fused jumper wire between the electronic flasher connector terminal 49a and terminal 49. 3. Turn on the left turn signals. Do all left turn signals illuminate? Yes – INSTALL a new electronic flasher. REFER to Electronic	

Step	Action	Connector End View
	<p>Flasher in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p>	

Turn Signal Lamps Inoperative — Left or Right Side

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect an inoperative turn signal lamp. 2. Set the park brake. 3. Place the drive mode selector switch in the Reverse, Turf or Drive position. 4. Place the turn signal switch in the ON position (inoperative side). 5. Connect a DVOM between the inoperative turn signal lamp connector terminal A and terminal B. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new bulb. OPERATE the system to verify the repair.</p> <p>No – GO to Step 3.</p>	<p>Turn Signal LF</p> <p>Turn Signal RF</p> <p>Turn Signal LR</p> <p>Turn Signal RR</p>
3	<p>Connect a DVOM between multifunction switch terminal 5 (LH side) or terminal 11 (RH side) and inoperative turn signal lamps.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p> <p>No - REPAIR circuit 2 (RH side) or circuit 3 (LH side). OPERATE the system to verify the repair.</p>	<p>Multifunction Switch-L</p>

Turn Signal Indicator Inoperative — Left or Right Side

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect instrument cluster gauge connector J8. 2. Set the park brake. 3. Place the drive mode selector switch in the Reverse, Turf or Drive position. 4. Place the turn signal switch in the ON position (inoperative side). 5. Connect a DVOM between instrument cluster connector J8 terminal 5 (LH side) or terminal 6 (RH side) and terminal 4. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No - REPAIR circuit 5 (LH side) or circuit 6 (RH side). OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J8

Brake Lamps Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the brake switch harness connector. 2. Connect a fused jumper wire between the brake switch connector terminal 1 and terminal 3. <p>Do the brake lamps illuminate?</p> <p>Yes - INSTALL a new brake switch. OPERATE the system to verify the repair.</p> <p>No - REPAIR circuit 22. OPERATE the system to verify the repair.</p>	Brake Switch

One Brake Lamp Inoperative — Left or Right Side

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the harness connector of the inoperative brake lamp. 2. Connect a DVOM between terminal 1 (taillamp LH or RH harness connector) or terminal 2 (CHMSL/reverse lamp harness connector) and terminal 3 of the inoperative brake lamp. 3. Press the brake pedal. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new bulb. OPERATE the system to verify the repair.</p> <p>No - REPAIR circuit 22. OPERATE the system to verify the repair.</p>	<p>Taillamp LH</p> <p>Taillamp RH</p> <p>CHMSL/Reverse Lamp</p>

CHMSL Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the CHMSL/reverse lamp harness connector. 2. Connect a DVOM between CHMSL/reverse lamp harness connector terminal 2 and terminal 3. 3. Press the brake pedal. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new bulb. OPERATE the system to verify the repair.</p> <p>No - REPAIR circuit 22. OPERATE the system to verify the repair.</p>	<p>CHMSL/Reverse Lamp</p>

Brake Lamps/CHMSL Always ON

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation .	
2	Disconnect the brake switch harness connector. Do the brake lamps and CHMSL remain illuminated? Yes - REPAIR circuit 22. OPERATE the system to verify the repair. No - INSTALL a new brake switch. OPERATE the system to verify the repair.	Brake Switch

Reverse Lamps Inoperative

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation .	
2	1. Disconnect the CHMSL/reverse lamp harness connector. 2. Connect a DVOM between CHMSL/reverse lamp harness connector terminal 1 and terminal 3. 3. Set the park brake. 4. Place the drive mode selector switch in the Reverse position. Does the DVOM display approximately 12 volts? Yes - INSTALL new bulbs. OPERATE the system to verify the repair. No - GO to Step 3.	CHMSL/Reverse Lamp
3	Connect a DVOM between instrument cluster gauge connector J8 terminal 7 and the CHMSL/reverse lamp connector terminal 1. Does continuity exist? Yes - INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the	

Step	Action	Connector End View
	<p>system to verify the repair.</p> <p>No – REPAIR circuit 68. OPERATE the system to verify the repair.</p>	

Reverse Lamps Always ON

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<p>1. Disconnect instrument cluster gauge harness connector J8.</p> <p>2. Set the park brake.</p> <p>3. Place the drive mode selector switch in the Drive position.</p> <p>Do the reverse lamps remain illuminated?</p> <p>Yes - REPAIR circuit 68. OPERATE the system to verify the REPAIR.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	

Tail/License Plate Lamps Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<p>Press the brake pedal.</p> <p>Do the brake lamps illuminate?</p> <p>Yes – GO to Step 3.</p> <p>No – REFER to Brake Lamps Inoperative.</p>	
3	<p>1. Connect a DVOM between multifunction switch harness connector-L terminal 6 and terminal 7.</p>	Multifunction Switch-L

Step	Action	Connector End View
	<p>2. Set the park brake.</p> <p>3. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>4. Place the headlamp switch in the TAIL (1st) position.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – REPAIR circuit 14. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p>	

One Tail/License Lamp Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation.</p>	
2	<p>1. Disconnect the inoperative taillamp harness connector.</p> <p>2. Set the park brake.</p> <p>3. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>4. Place the headlamp switch in the TAIL (1st) position.</p> <p>5. Connect a DVOM between the inoperative taillamp harness connector terminal 2 and terminal 3 (LH or RH taillamp) or terminal 1 (license plate lamp).</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new bulb. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 14. OPERATE the system to verify the repair.</p>	<p>Taillamp LH</p> <p>Taillamp RH</p> <p>License Plate Lamp</p>

Tail/License Plate Lamps Always On

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation .	
2	Disconnect the multifunction switch harness connector-L. Are the taillamps and license plate lamp illuminated? Yes - REPAIR circuit 14. OPERATE the system to verify the repair. No - INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.	Multifunction Switch – L

Heater/Defogger

Circuit Description and Operation

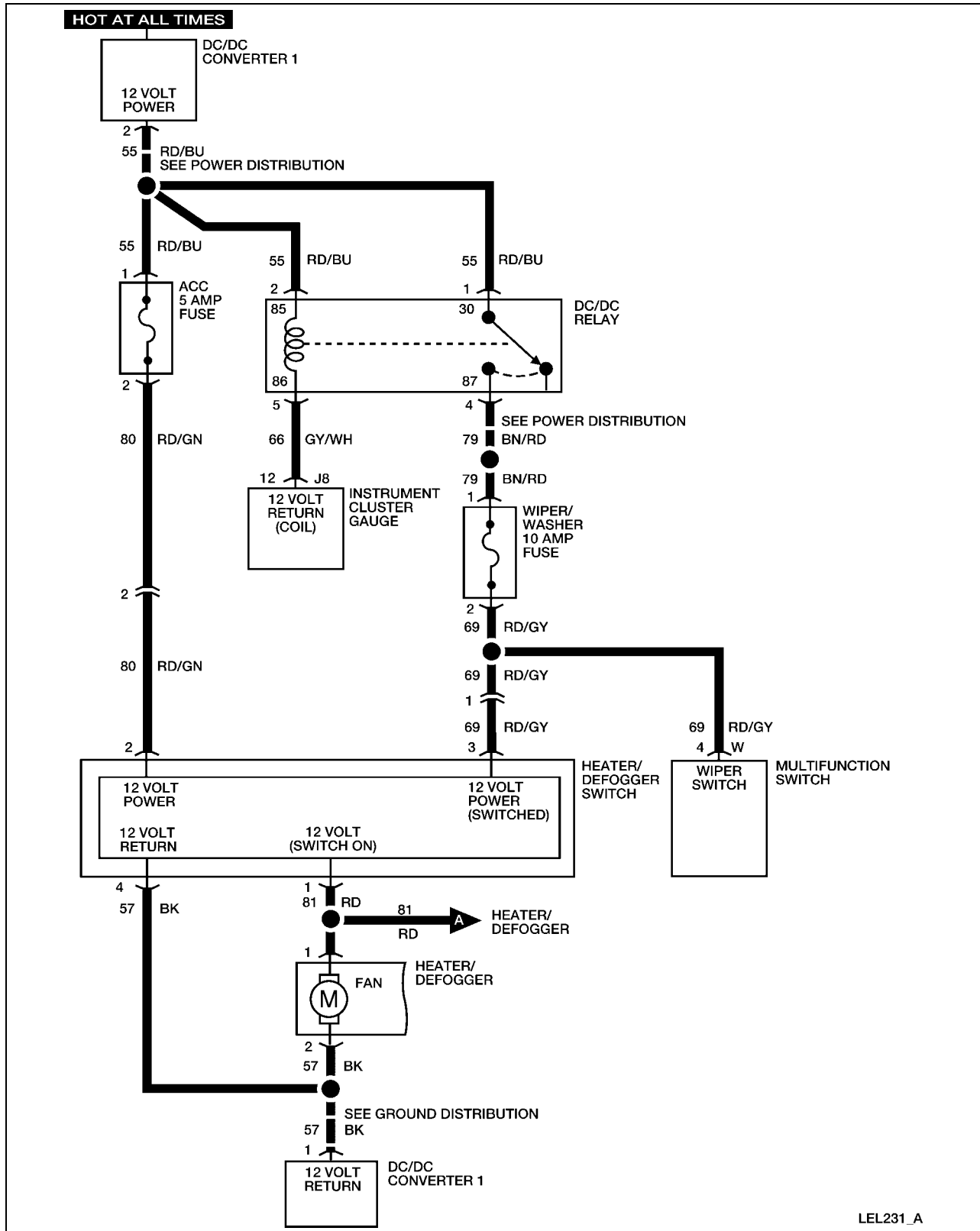
The heater/defogger system consists of an electromechanical switch mounted on the cowl, heater element, fan, and contactor that are mounted on a bracket under the cowl, and two jumper harnesses which connect to the main harness and deliver power to the system. Two air vent hoses route warm air from the heater box to air ducts mounted on the right and left sides of the cowl.

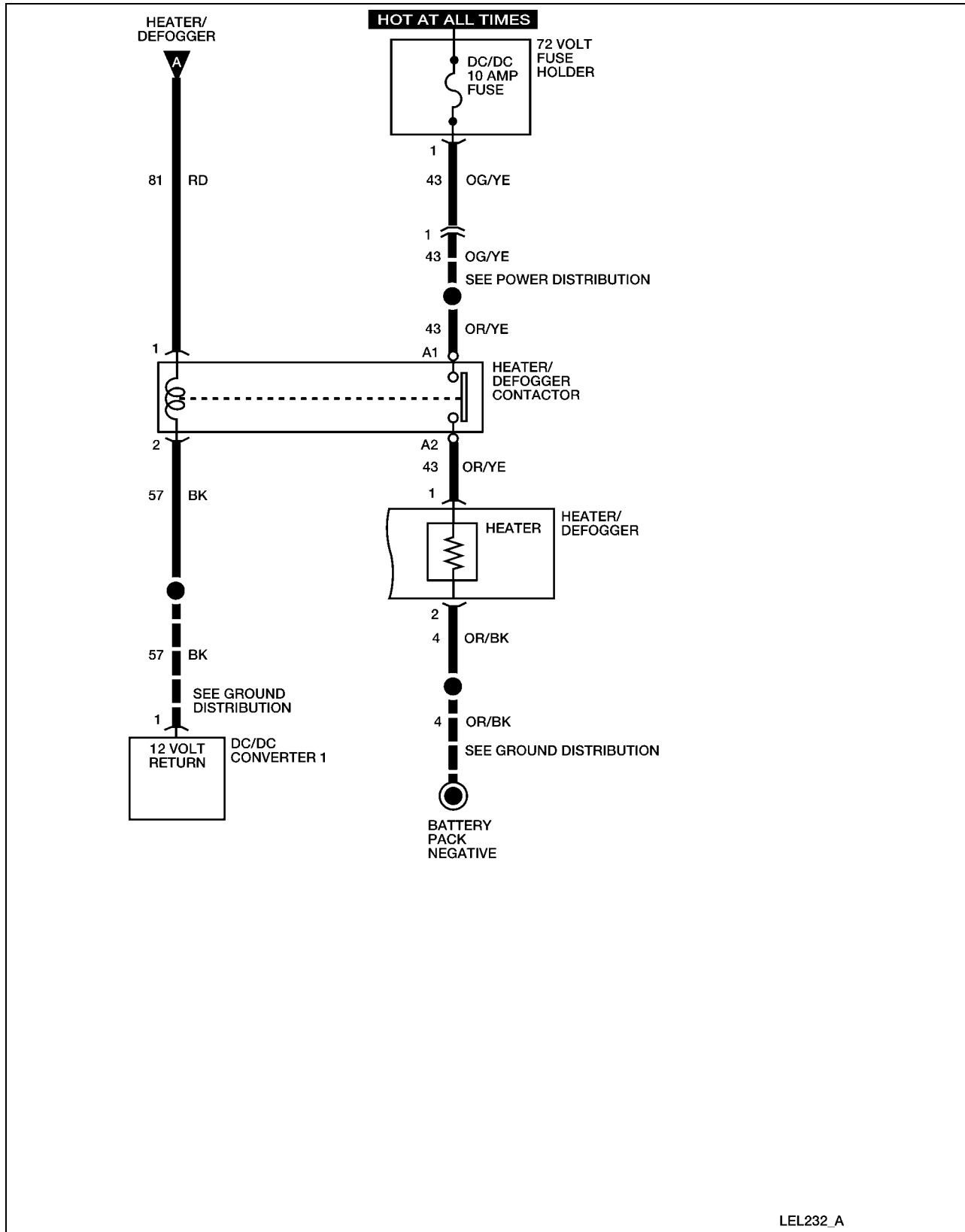
The system cannot be operated unless the vehicle is powered on (charging cord is disconnected, service disconnect switch is ON, and drive mode selector switch is in reverse, turf, or drive). When the heater switch is turned on, a microprocessor in the switch closes a relay in the contactor to turn the system on. The switch has a built-in timer that will turn the system off after 10 minutes. The switch may also be turned off any time during the 10-minute run cycle.

There are two jumper harnesses used on the heater/defogger. The 18A654 jumper harness delivers 72V from the main harness through the contactor mounted on the heater box to the heater element, then continuing through the DC/DC converter. The 18A586 jumper harness delivers 12V, when the vehicle is powered on and the drive mode selector switch is on, to close the contactor and power the heater fan. The connector that connects the DC/DC converter to this jumper harness is included on every vehicle. On vehicles without heater/defogger, this connector may be used to provide power to aftermarket accessories such as lights, radio, etc. at the discretion of the customer.

Using the heater/defogger for the full 10-minute cycle will consume approximately 25% of the capacity of a completely charged battery pack.

Circuit Schematic





LEL232_A

System Check

Functional components in the heater/defogger system are:

- Lamps fuse
- ACC fuse
- Heater/defogger switch
- DC/DC relay
- Heater blower control relay
- Heater
- Fan
- Vent hose
- Nylon clamps
- Related wiring

Guidelines to diagnose the heater/defogger system:

1. Verify the concern.
2. Check fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The fan is inoperative	<ul style="list-style-type: none"> • Lamps fuse • DC/DC relay • Heater/defogger switch • Fan • Connectors or related wiring 	GO to Fan Inoperative .
The fan is always on	<ul style="list-style-type: none"> • Heater/defogger switch • Connectors or related wiring 	GO to Fan Always ON .
The fan runs but blows cool air	<ul style="list-style-type: none"> • Heater blower control relay • Heater • Heater/defogger contactor • Connectors or related wiring 	GO to Heater Inoperative .
The fan runs but no air is directed to the windshield	<ul style="list-style-type: none"> • Heater/defogger ducts • Nylon clamps • Vent hose 	INSPECT vent hoses for damage, incorrect routing or for loose connection to ducts. INSPECT nylon clamps for incorrect installation. REPAIR as necessary.
The fan runs but air is directed to only one side of the windshield	<ul style="list-style-type: none"> • Heater/defogger ducts • Nylon clamps • Vent hose 	INSPECT vent hoses for damage, incorrect routing or for loose connection to ducts. INSPECT nylon clamps for incorrect installation. REPAIR as necessary.
The fan runs but air volume is low	<ul style="list-style-type: none"> • Heater/defogger ducts • Nylon clamps • Vent hose 	INSPECT vent hoses for damage, incorrect routing or for loose connection to ducts. INSPECT nylon clamps for incorrect installation. REPAIR as necessary.

Fan Inoperative

Step	Action	Connector End View
1.	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2.	<p>1. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>2. Press the heater/defogger switch to turn the system on.</p> <p>Does the heater/defogger switch illuminate?</p> <p>Yes – GO to Step 3.</p> <p>No – GO to Step 6.</p>	
3.	<p>1. Disconnect the fan connector.</p> <p>2. Connect a DVOM between fan connector terminal 1 and the vehicle chassis.</p> <p>Press the heater/defogger switch to turn the system on.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 4.</p> <p>No – GO to Step 5.</p>	Heater/defogger Fan
4.	<p>Connect a DVOM between fan connector terminal 2 and the vehicle chassis.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new fan. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 57 (BK). OPERATE the system to verify the repair.</p>	Heater/defogger Fan

5.	<p>1. Disconnect heater/defogger switch connector.</p> <p>2. Connect a DVOM between fan connector terminal 1 and heater/defogger switch connector terminal 1.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new heater/defogger switch. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 81 (RD). OPERATE the system to verify the repair.</p>	<p>Heater/defogger Fan</p> <p>Heater/defogger Switch</p>
6.	<p>1. Disconnect the heater/defogger switch connector.</p> <p>2. Connect a DVOM between heater/defogger switch terminal 2 and the vehicle chassis, and between heater/defogger switch terminal 3 and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – REPAIR circuit 57 (BK). OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 80 (RD/GN) or circuit 69 (RD/GY). OPERATE the system to verify the repair.</p>	<p>Heater/defogger Switch</p>

Fan Always ON

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	

Step	Action	Connector End View
2	1. Disconnect the heater/defogger switch. 2. Place the drive mode selector switch in the reverse, turf or drive position. 3. Check operation of the fan. Does the fan still run? Yes – REPAIR circuit 81 (RD). OPERATE the system to verify the repair. No – INSTALL a new heater/defogger switch. OPERATE the system to verify the repair.	

Heater Inoperative

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes – GO to Step 2. No – REFER to Circuit Description and Operation .	
2	1. Place the drive mode selector switch in the Reverse, Turf or Drive position. 2. Press the heater/defogger switch to turn the system on while listening for noise from the heater/defogger contactor. Does the heater/defogger contactor click when the system is turned on? Yes – GO to Step 3. No – GO to Step 7.	
3	1. Disconnect the heater/defogger contactor. 2. Connect a DVOM between heater/defogger contactor terminal A1 and the vehicle chassis. Does the DVOM display approximately 72 volts?	Heater/defogger Contactor

Step	Action	Connector End View
	<p>Yes – GO to Step 4.</p> <p>No – REPAIR circuit 43 (OR/YE) between the 72 volt fuse holder and the heater/defogger contactor. OPERATE the system to verify the repair.</p>	
4	<p>Connect a DVOM between heater/defogger contactor terminal A2 and the vehicle chassis.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new heater/defogger contactor. REFER to Heater/Defogger System in this section. OPERATE the system to verify the repair.</p> <p>No – GO to Step 5.</p>	<p>Heater/defogger Contactor</p>
5	<ol style="list-style-type: none"> 1. Disconnect the heater/defogger. 2. Connect a DVOM between heater/defogger contactor terminal A2 and heater/defogger terminal 1. <p>Does continuity exist?</p> <p>Yes – GO to Step 6.</p> <p>No – REPAIR circuit 43 (OR/YE) between the heater/defogger contactor and the heater/defogger. OPERATE the system to verify the repair.</p>	<p>Heater/defogger Contactor</p> <p>Heater/defogger</p>
6	<p>Connect a DVOM between heater/defogger terminal 2 and the vehicle chassis.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new heater/defogger. REFER to Heater/Defogger Assembly in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 4 (OR/BK). OPERATE the system to verify the repair.</p>	<p>Heater/defogger</p>
7	<ol style="list-style-type: none"> 1. Disconnect the heater/defogger contactor. 2. Connect a DVOM between heater/defogger contactor terminal 1 and the vehicle chassis. 	<p>Heater/defogger Contactor</p>

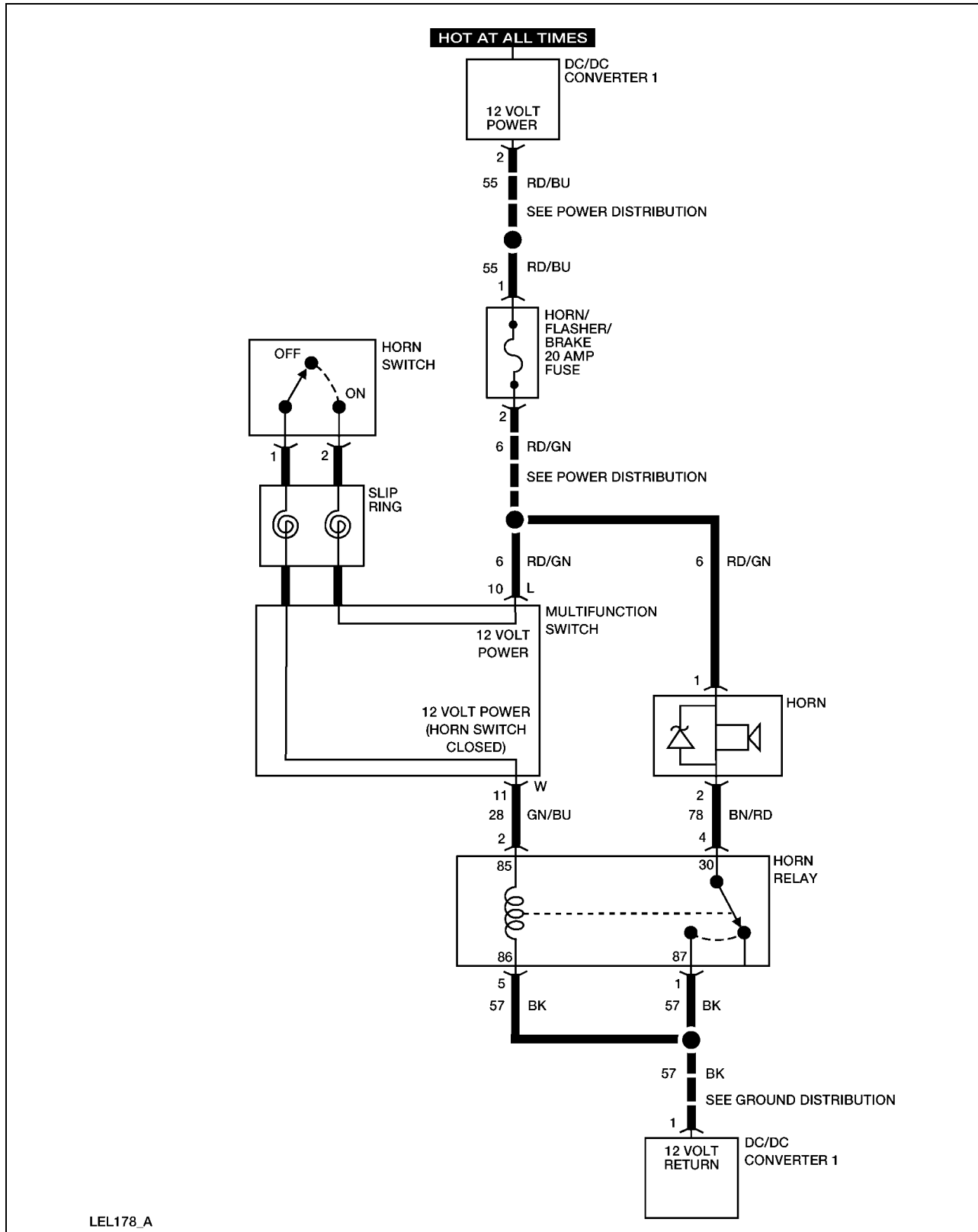
Step	Action	Connector End View
	<p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 8.</p> <p>No – REPAIR circuit 81 (RD). OPERATE the system to verify the repair.</p>	
8	<p>Connect a DVOM between heater/defogger terminal 2 and the vehicle chassis.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new heater/defogger contactor. REFER to Heater/Defogger System in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 57 (RD). OPERATE the system to verify the repair.</p>	Heater/defogger

Horn

Circuit Description and Operation

The horn will sound any time the horn switch is pressed. The DC/DC converter 1 (standard) supplies 12 volt power through the horn/flasher/brake fuse to the multifunction switch and the horn. When the horn switch is pressed, 12 volt power is supplied to the horn relay coil, which closes the horn relay switch, providing a 12 volt return for the horn. This completes the circuit and the horn will sound.

Circuit Schematic



LEL178_A

System Check

Functional components in the horn system are:

- Horn/flasher/brake fuse
- Horn switch
- Multifunction switch
- Horn
- Horn relay
- Related wiring

Guidelines to diagnose the horn system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The horn is inoperative	<ul style="list-style-type: none"> • Horn/flasher/brake fuse • Horn Relay • Horn • Horn switch • Multifunction switch • Connectors or related wiring 	GO to Horn Inoperative.
The horn is always on	<ul style="list-style-type: none"> • Horn relay • Multifunction switch • Horn switch 	GO to Horn Always On.

Symptom	Possible Causes	Action
	<ul style="list-style-type: none"> Connectors or related wiring 	

Horn Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2	<p>Place the hazard switch in the ON position.</p> <p>Do the hazard lamps operate properly?</p> <p>Yes – GO to Step 3.</p> <p>No – REFER to DC/DC Converter 1 (Standard) Inoperative.</p>	
3	<ol style="list-style-type: none"> Disconnect the horn relay harness connector. Connect a DVOM between the horn relay harness connector terminal 2 and the vehicle chassis. Press the horn switch. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 4.</p> <p>No – GO to Step 8.</p>	Horn Relay
4	<p>Connect a DVOM between the horn relay harness connector terminal 4 and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 5.</p> <p>No – GO to Step 6.</p>	Horn Relay
5	<ol style="list-style-type: none"> Check continuity between the horn relay harness connector terminal 1 and the vehicle chassis. Check continuity between the horn relay harness connector terminal 5 and the vehicle chassis. <p>Does continuity exist?</p> <p>Yes – INSTALL a new horn relay. OPERATE the system to verify the repair.</p>	Horn Relay

Step	Action	Connector End View
	No – REPAIR circuit 57. OPERATE the system to verify the repair.	
6	1. Disconnect the horn harness connector. 2. Connect a DVOM between the horn harness connector terminal 1 and the vehicle chassis. Does the DVOM display approximately 12 volts? Yes – GO to Step 7. No – REPAIR circuit 6. OPERATE the system to verify the repair.	Horn
7	Check continuity between the horn harness connector terminal 2 and the horn relay harness connector terminal 4. Does continuity exist? Yes – INSTALL a new horn. OPERATE the system to verify the repair. No – REPAIR circuit 78. OPERATE the system to verify the repair.	Horn Horn Relay
8	1. Disconnect the multifunction switch harness connectors. 2. Connect a DVOM between the multifunction switch harness connector L terminal 10 and the vehicle chassis. Does the DVOM display approximately 12 volts? Yes – GO to Step 9. No - REPAIR circuit 6. OPERATE the system to verify the repair.	Multifunction Switch - L
9	Check continuity between the multifunction switch harness connector W terminal 11 and the horn relay harness connector terminal 2. Does continuity exist? Yes – GO to Step 10. No – REPAIR circuit 28. OPERATE the system to verify the repair.	Multifunction Switch - W Horn Relay

Step	Action	Connector End View
10	1. Disconnect the horn switch harness connector. 2. Check continuity between the horn switch harness connector terminal 1 and the multifunction switch harness connector W terminal 11. 3. Check continuity between the horn switch harness connector terminal 2 and the multifunction switch harness connector L terminal 10. Does continuity exist? Yes – INSTALL a new horn switch. REFER to Horn Switch in this section. OPERATE the system to verify the repair. No – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.	Horn Switch Multifunction Switch-W Multifunction Switch-L

Horn Always On

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes – GO to Step 2. No – REFER to Circuit Description and Operation .	
2	Disconnect the horn relay harness connector. Does the horn stop sounding? Yes – GO to Step 3. No – REPAIR circuit 78. OPERATE the system to verify the repair.	
3	Connect a DVOM between the horn relay harness connector terminal 2 and the vehicle chassis. Does the DVOM display approximately 12 volts? Yes – GO to Step 4. No – INSTALL a new horn relay. OPERATE the system to verify the repair.	Horn Relay
4	1. Disconnect the multifunction switch harness connector W. 2. Connect a DVOM between the horn relay harness connector terminal 2 and the vehicle chassis.	Horn Relay

Step	Action	Connector End View
	<p>Does the DVOM display approximately 12 volts?</p> <p>Yes – REPAIR circuit 28. OPERATE the system to verify the repair.</p> <p>No – RECONNECT multifunction switch connector W. GO to Step 5.</p>	
5	<p>1. Disconnect the horn switch harness connector.</p> <p>2. Connect a DVOM between the horn relay harness connector terminal 2 and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new horn switch. REFER to Horn Switch in this section. OPERATE the system to verify the repair.</p>	<p>Horn Switch</p> <p>Horn Relay</p>

Instrument Cluster Gauge

Circuit Description and Operation

The instrument cluster gauge is the main component of the electrical system. The four connectors on the back of the instrument cluster gauge are for the drive mode selector switch, the 12 volt harness, the 72 volt harness and the gauge overlay (for the Select/Reset Button). The instrument cluster gauge backlighting illuminates when the drive mode selector switch is placed in the Reverse, Turf or Drive position.

The brake indicator will display when either the park brake is engaged or the brake fluid level is low. The park brake switch closes when the park brake is set. The 12 volt return is supplied through the instrument cluster gauge from the DC/DC converter 1 to complete the circuit. When the brake fluid in the master cylinder is low, the brake fluid level switch closes. The 12 volt return is supplied through the instrument cluster gauge from the DC/DC converter 1 to complete the circuit. The instrument cluster gauge will display the park brake/fluid warning/rollaway reminder indicator when these conditions are met.

The warning chime is built into the instrument cluster gauge and provides audible warning when the drive mode selector switch is in the Reverse position. The audible warning also sounds for 10 seconds (as a rollaway reminder) when the drive mode selector switch is placed in the OFF position from any other position unless the park brake is engaged.

When the GFCI cord is connected to the charger, a signal is sent to the instrument cluster gauge. This signal activates the 120VAC energized indicator. This signal also inhibits the vehicle from activating any of the drive modes.

The battery water reminder indicator (flooded batteries only) will display every 300 miles (483 km) on vehicles equipped with flooded batteries. To reset the battery water reminder indicator, refer to [Resetting the Battery Water Reminder](#) in this section. The instrument cluster gauge must be set for the type of batteries that are installed in the vehicle to prevent excessive charge time or damage to the batteries. Refer to [Selecting Battery Type](#) in this section.

The drive system over-temp indicator will display when the drive system overheats. A fault code from the motor controller will activate the over-temp indicator. The indicator will remain on until the fault code from the motor controller disappears.

The electrical leakage indicator will display when electrical current is detected between the 72 volt harness or components and the vehicle chassis. The indicator will display regardless of the drive mode selector switch position. Although this condition may not affect the drive or accessory system functionality, the display of the electrical leakage indicator indicates a need for service. Make sure the vehicle is thoroughly dry before attempting electrical leakage diagnosis. Electrical leakage may be detected if certain electrical connectors are exposed to moisture due to rain or washing of the vehicle.

The odometer has five LCD positions that display total vehicle miles/kilometers. These positions are shared with the trip odometer. All digits will be displayed when in the odometer mode (trailing zeros will all be displayed). Refer to [Selecting Odometer or Trip Odometer Mode](#) in this section. The trip odometer starts with one digit and one decimal place (e.g. 0.0). More digits will be displayed as trip odometer counts up. Mileage is stored in non-volatile memory. In the event of unexpected power loss, software flash or placing the drive mode selector switch in the OFF position, mileage data will be maintained.

The seatbelt warning indicator will display for 30 seconds when the drive mode selector switch is placed in the Drive position. Switching to the Turf or Reverse position during the 30 second period will not affect the timer for the indicator. Placing the drive mode selector switch in the OFF position is the only way to clear the indicator before the 30 seconds has elapsed.

The service required (wrench) indicator will be displayed anytime a diagnostic trouble code sets due to a system malfunction.

The speedometer has two LCD positions that will display the vehicle speed in MPH or KPH, depending on the selected display mode. Refer to [Selecting Speed and Distance Units](#) in this section. The speedometer will function when the vehicle is in the Reverse, Turf or Drive positions.

The state of charge indicator displays the charge level of the battery pack. The number of lines/bars displayed indicates the state of charge. The motor controller outputs this information to the instrument cluster gauge through the serial communication lines. The State of Charge

Indicator Chart shows the battery pack voltage and corresponding instrument cluster gauge display.

The left and right turn signal indicators are green LEDs that flash with their respective turn signals.

State of Charge Indicator Chart

Battery Pack Voltage (Approximate)	State of Charge Indicator Bars Displayed	State of Charge Indicator Battery Outline Display	Additional Information
0 - 20 V	0 (or 5) bars	Flashing fast	Charger hums but does not charge. Vehicle will not drive.
20 - 63 V	0 (or 5) bars	Flashing fast	Charger charges at 2 amp rate. Vehicle will not drive.
63 - 68 V	0 (or 5) bars	Flashing fast	Charger charges at 10 amp rate. Vehicle will not drive.
68.3 – 69.8 V	0 (or 5) bars	Flashing fast	Charger charges at 10 amp rate. Vehicle will drive.
69.8 – 70.6 V	1 bar	Flashing slow	Charger charges at 10 amp rate. Vehicle will drive.
70.6 – 72 V	2 bars	Solid	Charger charges at 10 amp rate. Vehicle will drive.
72 – 73.4 V	3 bars	Solid	Charger charges at 10 amp rate. Vehicle will drive.
73.4 – 74.9 V	4 bars	Solid	Charger charges at 10 amp rate. Vehicle will drive.
74.9 – 80 V	5 bars	Solid	Charger charges at 10 amp rate. Vehicle will drive.

Selecting Speed and Distance Units

To change the speed and distance units between miles per hour (MPH) and kilometers per hour (KPH), set the park brake and perform the following:

1. While pressing the Select/Reset button, place the drive mode selector switch in the Drive position.
2. Release the Select/Reset button within 5 seconds.

3. Place the drive mode selector switch in the Turf position.
4. Press and release the Select/Reset button to alternate between MPH and KPH display.
5. Place the drive mode selector switch in the OFF position and either press the Select/Reset button or wait 10 seconds to exit.

The MPH and KPH indicators are the only items displayed when the instrument cluster gauge is in Selecting Speed and Distance Units mode.

Selecting Odometer or Trip Odometer Mode

To change the instrument cluster gauge display between the Odometer and the Trip Odometer mode, set the park brake and perform the following:

1. Place the drive mode selector switch in the Drive or Turf position.
2. Press and release the Select/Reset button within three seconds.

Resetting the Trip Odometer

To reset the trip odometer, set the park brake and perform the following:

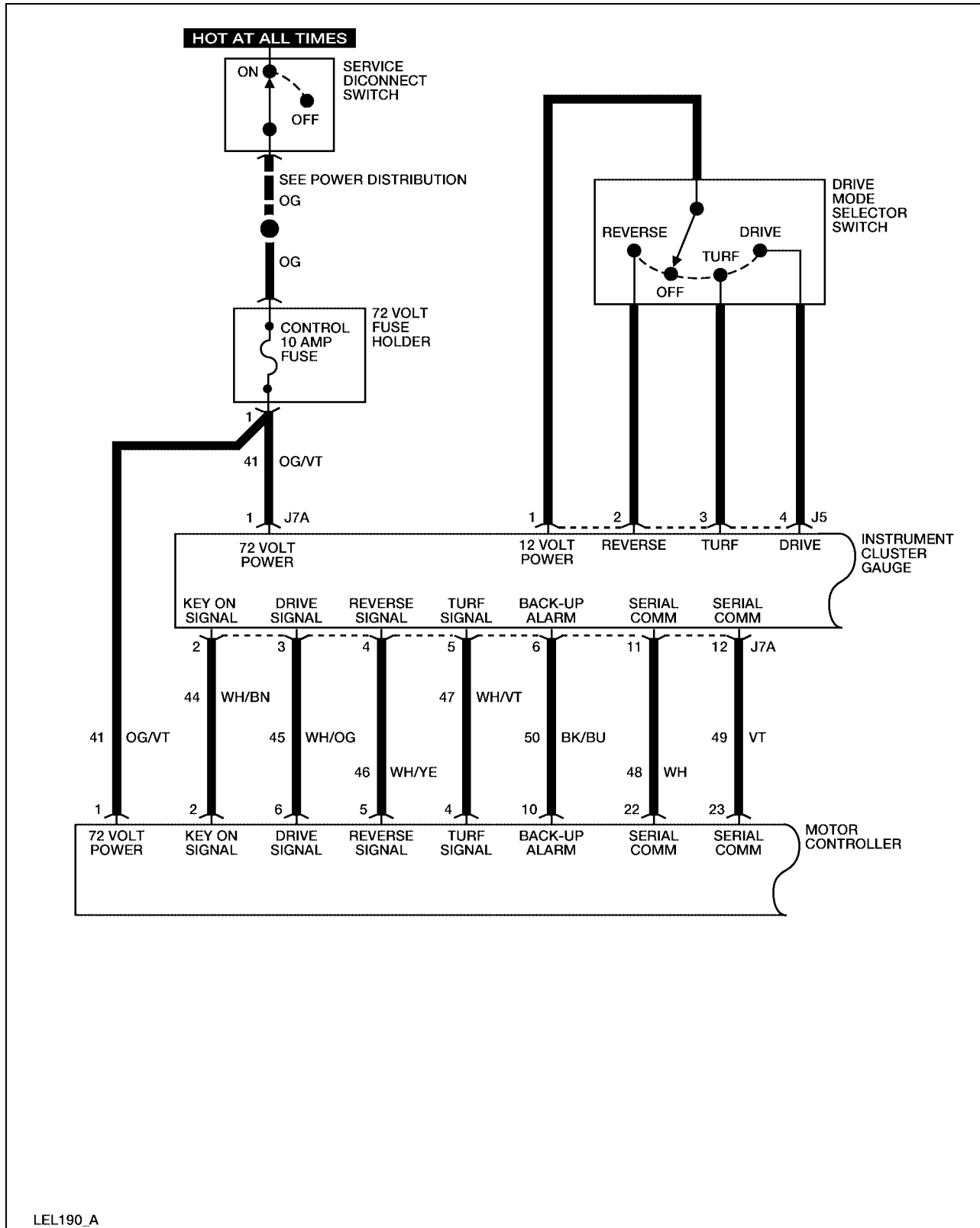
1. Place the drive mode selector switch in the Drive or Turf position.
2. Set the odometer to the Trip mode. Refer to [Selecting Odometer or Trip Odometer Mode](#) in this section.
3. Press and hold the Select/Reset button for longer than three seconds.

Resetting the Battery Water Reminder

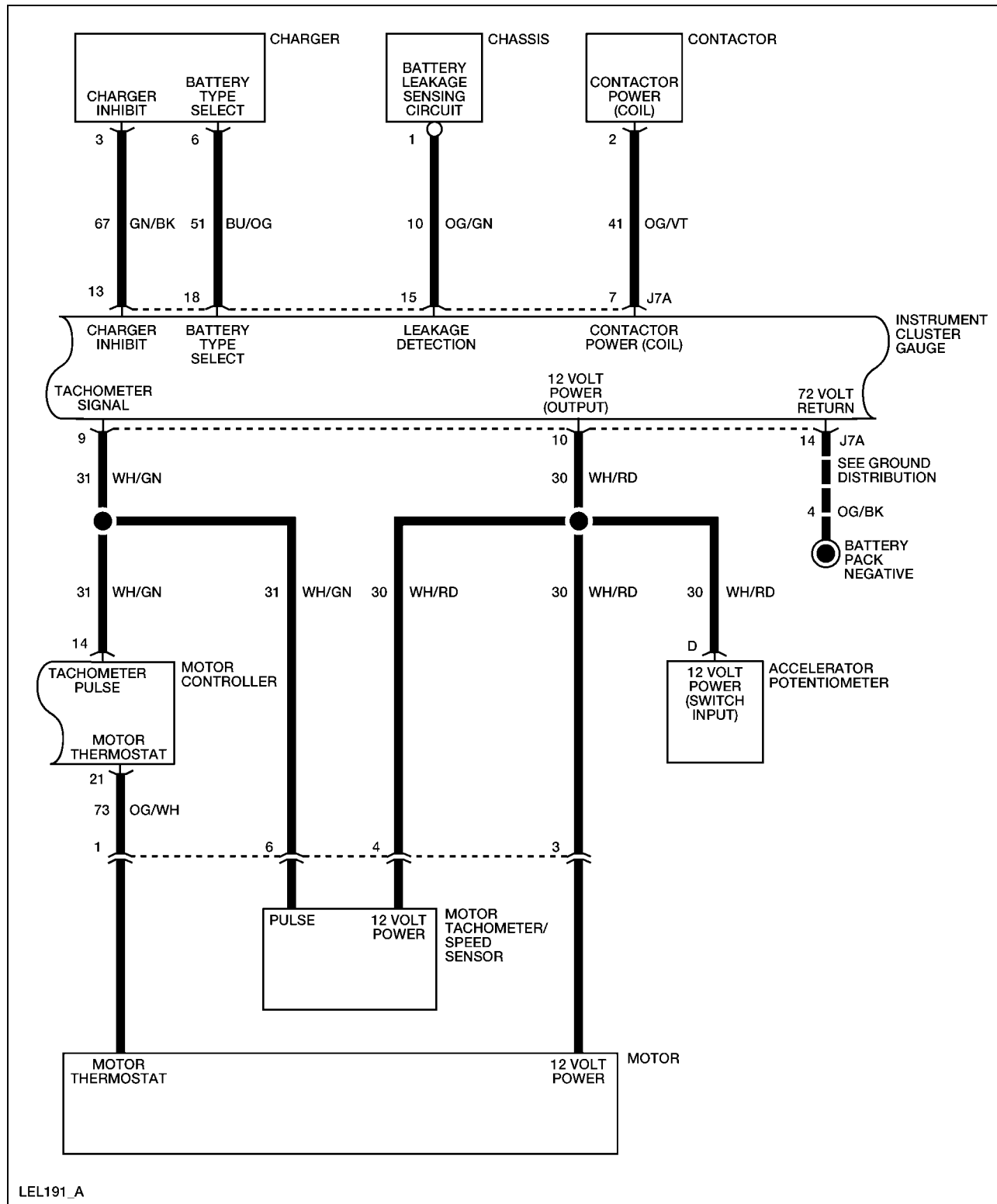
To reset the battery water reminder, set the park brake and perform the following:

1. Place the drive mode selector switch in the Reverse position.
2. Press and hold the Select/Reset button for longer than three seconds.

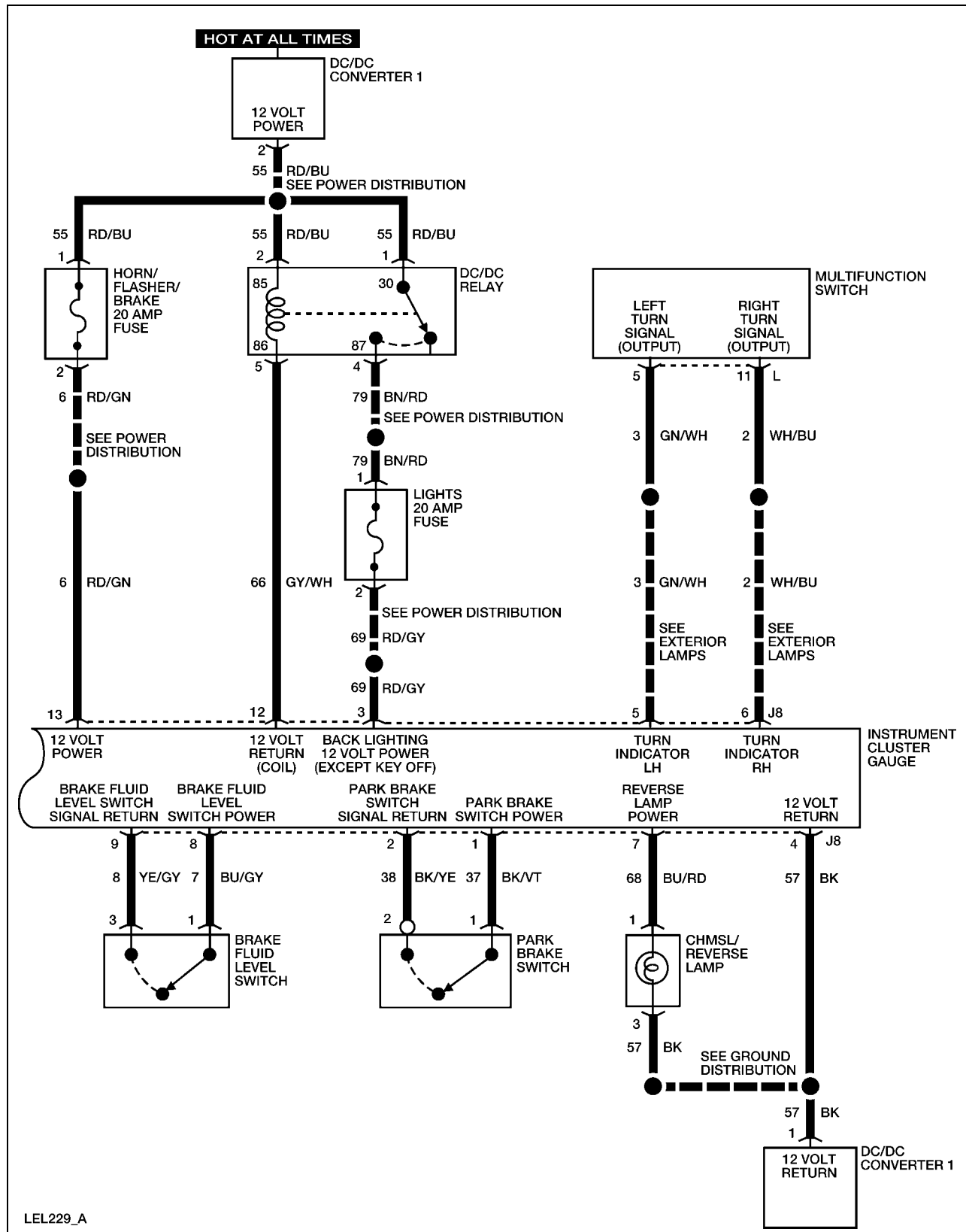
Circuit Diagram



LEL190_A



LEL191_A



Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the instrument cluster gauge system are:

- Service disconnect switch
- Instrument cluster gauge
- Control fuse
- Horn/flasher/brake fuse
- Lights fuse
- Motor controller
- Motor tachometer/speed sensor
- Accelerator potentiometer
- Charger
- Chassis
- Drive mode selector switch
- DC/DC converter 1 (standard)
- DC/DC relay
- Multifunction switch
- Brake fluid level switch
- Park brake switch
- CHMSL/reverse lamp
- Related wiring

Guidelines to diagnose the instrument cluster gauge system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Make sure the service disconnect switch is in the ON position.
5. Fill the brake fluid reservoir as necessary.
6. Check for any diagnostic trouble codes. Refer to [Retrieving and Clearing DTCs](#).

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The instrument cluster gauge does not illuminate with the drive mode selector switch in the Reverse, Turf or Drive position	<ul style="list-style-type: none"> • Drive mode selector switch • Instrument cluster gauge • Connectors or related wiring 	GO to Instrument Cluster Gauge .
The state of charge indicator is inoperative	<ul style="list-style-type: none"> • Instrument cluster gauge • Motor controller • Connectors or related wiring 	GO to State of Charge Indicator Inoperative .
The speedometer indicator is inoperative	<ul style="list-style-type: none"> • Instrument cluster gauge • Motor tachometer/speed sensor • Connectors or related wiring 	GO to Instrument Cluster Gauge Does Not Display Correct Vehicle Speed .
The odometer/trip odometer is inoperative	<ul style="list-style-type: none"> • Instrument cluster gauge • Connectors or related wiring 	GO to Odometer/Trip Odometer Inoperative .
The park brake/rollaway reminder chime is always on	<ul style="list-style-type: none"> • Instrument cluster gauge 	INSTALL a new instrument cluster gauge. REFER to

Symptom	Possible Causes	Action
		Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.
The reverse chime is always on	<ul style="list-style-type: none"> Instrument cluster gauge 	INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.
The reverse chime is always on	<ul style="list-style-type: none"> Instrument cluster gauge 	INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.
The park brake/rollaway reminder chime is inoperative	<ul style="list-style-type: none"> Instrument cluster gauge Park brake switch Connectors or related wiring 	GO to Park Brake/ Rollaway Reminder Chime Inoperative.
The seatbelt warning indicator is always on	<ul style="list-style-type: none"> Instrument cluster gauge Connectors or related wiring 	GO to Seatbelt Warning Indicator Always On.
The seatbelt warning indicator is inoperative	<ul style="list-style-type: none"> Instrument cluster gauge 	INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.
The battery water reminder indicator is always on	<ul style="list-style-type: none"> Instrument cluster gauge Connectors or related wiring 	GO to Battery Water Reminder Indicator Always On.
The battery water reminder indicator is inoperative	<ul style="list-style-type: none"> Instrument cluster gauge Incorrect battery type selected 	GO to Battery Water Reminder Indicator Inoperative.
The electrical leakage indicator is always on	<ul style="list-style-type: none"> Instrument cluster gauge Connectors or related wiring 	GO to Electrical Leakage Indicator Always On.
When the GFCI charger cord is connected to the charger,	<ul style="list-style-type: none"> Instrument cluster gauge 	GO to 120VAC Energized

Symptom	Possible Causes	Action
the 120VAC energized indicator does not display	<ul style="list-style-type: none"> Connectors or related wiring 	Indicator Inoperative.
The 120VAC energized indicator is always on	<ul style="list-style-type: none"> Instrument cluster gauge Connectors or related wiring 	GO to 120VAC Energized Indicator Always On.
The service required (wrench) indicator is always on	<ul style="list-style-type: none"> Instrument cluster gauge Connectors or related wiring 	GO to Service Required Indicator Always On.
The drive system over-temp indicator is always on but vehicle has normal performance	<ul style="list-style-type: none"> Instrument cluster gauge 	INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. TEST the system to verify the repair.
The drive system over-temp indicator is always on and vehicle has sluggish performance	<ul style="list-style-type: none"> Instrument cluster gauge Connectors or related wiring 	GO to Drive System Over-Temp Indicator Always On.
The park brake indicator does not turn on when the park brake is applied	<ul style="list-style-type: none"> Parking brake switch Connectors or related wiring 	GO to Park Brake/Fluid Warning/Rollaway Reminder Indicator Inoperative.
The brake warning indicator is always on	<ul style="list-style-type: none"> Brake fluid switch Parking brake switch Connectors or related wiring 	GO to Park Brake/Fluid Warning/Rollaway Reminder Indicator Always On.

Diagnostic System Check

Note: Before performing the diagnostic system check, perform the following:

1. Set the park brake.
2. Cycle the service disconnect switch OFF and then ON.
3. Place the drive mode selector switch in the Drive position, then to the OFF position.
4. Check all vehicle fuses.

The Diagnostic System Check helps identify and diagnose the instrument cluster gauge and related vehicle system failures. Use the chart below as a starting point for all instrument cluster gauge diagnosis.

Step	Action	Connector End View
1	<p>Attempt to enter Selecting Battery Type mode. Refer to Selecting Battery Type in this section.</p> <p>Does the instrument cluster gauge enter Selecting Battery Type mode?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Instrument Cluster Gauge in this section.</p>	
2	<p>Attempt to enter Selecting Speed and Distance Units mode. Refer to Selecting Speed and Distance Units.</p> <p>Does the instrument cluster gauge enter Selecting Speed and Distance Units mode?</p> <p>Yes - GO to Step 3.</p> <p>No - REFER to Instrument Cluster Gauge in this section.</p>	
3	<p>Attempt to enter Retrieving and Clearing DTCs mode. Refer to Retrieving and Clearing DTCs.</p> <p>Does the instrument cluster gauge enter Retrieving and Clearing DTCs mode?</p> <p>Yes - GO to Step 4.</p> <p>No - REFER to Instrument Cluster Gauge Inoperative in this section.</p>	
4	<p>Does the instrument cluster gauge display any DTCs?</p> <p>Yes - REFER to Diagnostic Trouble Code (DTC) Chart.</p> <p>No - REFER to Symptom Chart in this section.</p>	

DC/DC Relay Test

Step	Action	Connector End View
1	<ol style="list-style-type: none"> 1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. <p>Does the horn sound? Yes - GO to Step 2. No - REFER to Horn Inoperative in this section.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the DC/DC relay harness connector. 2. Connect a DVOM between the DC/DC relay harness connector terminal 1 and the vehicle chassis. 3. Connect a DVOM between the DC/DC relay harness connector terminal 2 and the vehicle chassis. <p>Does the display approximately 12 volts? Yes – GO to Step 3. No – REPAIR circuit 55. OPERATE the system to verify the repair.</p>	DC/DC Relay
3	<p>Connect a DVOM between the DC/DC relay harness connector terminal 1 and terminal 5.</p> <p>Does the display approximately 12 volts? Yes – GO to Step 5. No – GO to Step 4.</p>	DC/DC Relay
4	<ol style="list-style-type: none"> 1. Disconnect the instrument cluster gauge harness connector J8. 2. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 12 and the DC/DC relay harness connector terminal 5. <p>Does continuity exist? Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No – REPAIR circuit 66. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J8 DC/DC Relay
5	<ol style="list-style-type: none"> 1. Remove the lights fuse. 2. Remove the wiper/washer fuse. 3. Connect a DVOM between the DC/DC relay harness connector terminal 4 and the lights fuse terminal 1. 	DC/DC Relay

Step	Action	Connector End View
	<p>4. Connect a DVOM between the DC/DC relay harness connector terminal 4 and the wiper/washer fuse terminal 1.</p> <p>Does continuity exist?</p> <p>Yes – GO to Step 6.</p> <p>No – REPAIR circuit 79. OPERATE the system to verify the repair.</p>	
6	<ol style="list-style-type: none"> 1. Remove the lights fuse from the 72 volt fuse holder. 2. Disconnect the multifunction switch harness connector – L. 3. Connect a DVOM between the lights fuse terminal 2 and the multifunction switch harness connector – L terminal 9. 4. Connect a DVOM between the lights fuse terminal 2 and the multifunction switch harness connector – L terminal 6. 5. Connect a DVOM between the lights fuse terminal 2 and the multifunction switch harness connector – L terminal 4. 6. Connect a DVOM between the lights fuse terminal 2 and the instrument cluster gauge harness connector J8 terminal 3. <p>Does continuity exist?</p> <p>Yes – INSTALL a new DC/DC relay. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 69. OPERATE the system to verify the repair.</p>	<p>Multifunction Switch – L</p> <p>Instrument Cluster Gauge – J8</p>

DTC 09

Description:

Both the forward and reverse direction switches are closed at the same time.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Drive mode selector switch.
- Instrument cluster gauge.

Step	Action	Connector End View
1	<p>Did you perform the Diagnostic System Check?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Diagnostic System Check.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the drive mode selector switch connector J5. 2. Place the drive mode selector switch in the Drive position. 3. Connect a DVOM between the drive mode selector switch terminal 1 and terminal 2. 4. Connect a DVOM between the drive mode selector switch terminal 1 and terminal 3. <p>Does continuity exist for either test?</p> <p>Yes - INSTALL a new drive mode selector switch. REFER to Drive Mode Selector Switch. OPERATE the system to verify the repair.</p> <p>No - GO to Step 3.</p>	Drive Mode Selector Switch
3	<ol style="list-style-type: none"> 1. Place the drive mode selector switch in the Turf position. 2. Connect a DVOM between drive mode selector switch terminal 1 and terminal 2. 3. Connect a DVOM between the drive mode selector switch terminal 1 and terminal 4. <p>Does continuity exist for either test?</p> <p>Yes - INSTALL a new drive mode selector switch. REFER to Drive Mode Selector Switch in this section. OPERATE the system to verify the repair.</p> <p>No - GO to Step 4.</p>	Drive Mode Selector Switch
4	<ol style="list-style-type: none"> 1. Place the drive mode selector switch in the Reverse position. 2. Connect a DVOM between drive mode selector switch 	Drive Mode Selector Switch

Step	Action	Connector End View
	<p>terminal 1 and terminal 3.</p> <p>3. Connect a DVOM between the drive mode selector switch terminal 1 and terminal 4.</p> <p>Does continuity exist for either test?</p> <p>Yes - INSTALL a new drive mode selector switch. REFER to Drive Mode Selector Switch. OPERATE the system to verify the repair.</p> <p>No – GO to Step 5.</p>	
5	<p>1. Disconnect the instrument cluster gauge harness connector J7A and the motor controller harness connector.</p> <p>2. Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 4 and terminal 3.</p> <p>3. Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 4 and terminal 5.</p> <p>Does continuity exist?</p> <p>Yes – REPAIR circuit 45, 46 or 47. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	

Instrument Cluster Gauge Inoperative

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WARNING:

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Step	Action	Connector End View
1.	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2.	<p>1. Set the park brake.</p> <p>2. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>Does the instrument cluster gauge function properly and back lighting illuminate?</p> <p>Yes – The system is OK.</p> <p>No - GO to Step 3.</p>	
3.	<p>Connect a DVOM between the instrument cluster gauge connector J8 terminal 3 and the vehicle chassis.</p> <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 4.</p> <p>No – REFER to DC/DC Relay Test.</p>	Instrument Cluster Gauge – J8
4.	<p>Connect a DVOM between the instrument cluster gauge connector J7A terminal 1 and the battery pack negative.</p> <p>Does the DVOM display approximately 72 volts?</p> <p>Yes – GO to Step 5.</p> <p>No – INSTALL a new 72 volt harness. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A
5.	<p>1. Disconnect the instrument cluster gauge harness connector J8.</p> <p>2. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 4 and the vehicle chassis.</p> <p>Does continuity exist?</p> <p>Yes - GO to Step 6.</p> <p>No – REPAIR circuit 57. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J8

Step	Action	Connector End View
6.	<p>Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 14 and the battery pack negative.</p> <p>Does continuity exist?</p> <p>Yes - GO to Step 7.</p> <p>No – INSTALL a new 72 volt harness. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A
7.	<ol style="list-style-type: none"> 1. Reconnect the instrument cluster gauge harness connector J8. 2. Disconnect the drive mode selector switch harness connector. 3. Connect a DVOM between the drive mode selector switch harness connector terminal 2 and the vehicle chassis. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 8.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	Drive Mode Selector Switch – J5
8.	<p>Connect a fused jumper wire between the drive mode selector switch harness connector J5 terminal 1 and terminal 2 (on the component side).</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – GO to Step 9.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	Drive Mode Selector Switch – J5
9.	<p>Connect a fused jumper wire between the drive mode selector switch harness connector J5 terminal 1 and terminal 3 (on the component side).</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – GO to Step 10.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the</p>	Drive Mode Selector Switch – J5

Step	Action	Connector End View
	system to verify the repair.	
10.	<p>Connect a fused jumper wire between the drive mode selector switch harness connector J5 terminal 1 and terminal 4 (on the component side).</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – INSTALL a new drive mode selector switch. REFER to Drive Mode Selector Switch in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	Drive Mode Selector Switch – J5

State of Charge Indicator Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake.</p> <p>2. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – GO to Step 3.</p> <p>No - REFER to Instrument Cluster Gauge in this section.</p>	
3	<p>Connect a DVOM between the battery pack positive and the battery pack negative.</p> <p>Does the state of charge indicator display correspond to the voltage displayed on the DVOM?</p> <p>Yes – The system is OK.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	

Seatbelt Warning Indicator Always On

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake.</p> <p>2. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>Does the seatbelt indicator display for 30 seconds and then go out?</p> <p>Yes – The system is OK.</p> <p>No - INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	

Odometer/Trip Odometer Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake.</p> <p>2. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes - GO to Step 3.</p> <p>No - REFER to Instrument Cluster Gauge Inoperative.</p>	
3	<p>Press and hold the Select/Reset button for three seconds and then release it.</p> <p>Does the odometer/trip odometer display reset to 0?</p> <p>Yes – The system is OK.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	

Battery Water Reminder Indicator Always On

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. Does the instrument cluster gauge backlighting illuminate? Yes - GO to Step 3. No – REFER to Instrument Cluster Gauge Inoperative in this section.</p>	
3	<p>1. Set the park brake. 2. Place the drive mode selector switch in the Reverse position. 3. Press and hold the Select/Reset button for three seconds and then release it. Does the battery water reminder indicator remain on? Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No – The system is OK.</p>	

Battery Water Reminder Indicator Inoperative

Step	Action	Connector End View
1	<p>Did you read the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check in this section.</p>	
2	<p>1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. Does the instrument cluster gauge backlighting illuminate? Yes - GO to Step 3. No – REFER to Instrument Cluster Gauge Inoperative in this section.</p>	

Step	Action	Connector End View
3	<ol style="list-style-type: none"> 1. Place the drive mode selector switch in the OFF position. 2. Place the drive mode selector switch in the Reverse position. 3. Press and hold the Select/Reset button for three seconds and then release it. <p>Does the battery water reminder indicator display when the drive mode selector switch is initially placed in the Reverse, Turf or Drive position?</p> <p>Yes – The system is OK. No – GO to Step 4.</p>	
4	<p>Verify that the correct battery type is set in the instrument cluster gauge. Refer to Selecting Battery Type in this section.</p> <p>Does the battery water reminder indicator display when flooded battery mode is selected?</p> <p>Yes – The system is OK. No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	

Electrical Leakage Indicator Always On

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WARNING:

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Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation in this section.	
2	Disconnect the chassis connector and wait for 30 seconds. Does the electrical leakage indicator remain on? Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No – REFER to Electrical Leakage Detection in this section.	

120VAC Energized Indicator Inoperative

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation in this section.	
2	1. Place the drive mode selector switch in the OFF position and remove the key. 2. Connect the GFCI cord to the charger. Does the 120VAC energized indicator display on the instrument cluster gauge? Yes – GO to Step 3. No – GO to Step 4.	
3	Disconnect the GFCI cord from the charger. Does the 120VAC energized indicator remain on? Yes – REFER to 120VAC Energized Indicator Always On in this section. No – The system is OK.	
4	1. Disconnect the charger harness connector. 2. Disconnect the instrument cluster gauge harness connector J7A. 3. Connect a DVOM between the charger harness	Charger Instrument Cluster Gauge – J7A

Step	Action	Connector End View
	<p>connector terminal 3 and the instrument cluster gauge harness connector J7A terminal 13.</p> <p>Does continuity exist?</p> <p>Yes – GO to Step 5.</p> <p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	
5	<ol style="list-style-type: none"> 1. Reconnect the charger harness connector. 2. Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 13 and the battery pack positive. <p>Does the DVOM display approximately 72 volts?</p> <p>Yes – GO to Step 6.</p> <p>No – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A
6	<ol style="list-style-type: none"> 1. Connect the GFCI cord to the charger. 2. Connect a DVOM between the instrument cluster gauge connector J7A terminal 13 and the battery pack positive. <p>Does the DVOM display approximately 0 volts?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A

120VAC Energized Indicator Always On

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<ol style="list-style-type: none"> 1. Make sure the GFCI cord is not connected to the charger. 2. Disconnect the instrument cluster gauge harness 	Instrument Cluster Gauge – J7A

Step	Action	Connector End View
	<p>connector J7A.</p> <p>3. Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 13 and the battery pack positive.</p> <p>Does the DVOM display approximately 72 volts?</p> <p>Yes – GO to Step 3.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	
3	<p>1. Disconnect the charger harness connector.</p> <p>2. Connect a DVOM between the charger harness connector terminal 3 and the battery pack positive.</p> <p>Does the DVOM display approximately 72 volts?</p> <p>Yes – INSTALL a new charger. REFER to Charger in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.</p>	Charger

Service Required Indicator Always On

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes - GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake.</p> <p>2. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – GO to Step 3.</p> <p>No - REFER to Instrument Cluster Gauge Inoperative.</p>	
3	<p>Check for DTCs. Refer to Retrieving and Clearing DTCs.</p> <p>Are any DTCs displayed?</p> <p>Yes – REFER to Diagnostic Trouble Code (DTC) Chart.</p>	

Step	Action	Connector End View
	No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.	

Drive System Over-Temp Indicator Always On

Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation in this section.	
2	1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. Does the instrument cluster gauge backlighting illuminate? Yes - GO to Step 3. No – REFER to Instrument Cluster Gauge Inoperative in this section.	
3	Check the motor tachometer/speed sensor connector for loose connection or damage. Is the motor tachometer/speed sensor connector OK? Yes – GO to Step 4. No – REPAIR the motor tachometer/speed sensor connection. OPERATE the system to verify the repair.	Motor Tachometer/Speed Sensor
4	1. Park the vehicle and allow the motor to cool. 2. Disconnect the motor tachometer/speed sensor connector. 3. Connect a DVOM between the motor tachometer/speed sensor harness connector terminal 1 and terminal 3. Does continuity exist? Yes – GO to Step 5. No – INSTALL a new motor. REFER to Motor in the Powertrain section. OPERATE the system to verify the repair.	Instrument Cluster Gauge – J7A Motor Controller
5	1. Disconnect the motor controller harness connector. 2. Connect a DVOM between the motor tachometer/speed	Motor Tachometer/Speed

Step	Action	Connector End View
	sensor harness connector terminal 1 and the motor controller harness connector terminal 21. Does continuity exist? Yes – GO to Step 6. No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.	Sensor
6	1. Disconnect the instrument cluster gauge connector J7A. 2. Connect a DVOM between the motor tachometer/speed sensor harness connector terminal 3 and the instrument cluster gauge harness connector terminal 10. Does continuity exist? Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.	Motor Tachometer/Speed Sensor Instrument Cluster Gauge – J7A

Park Brake/Fluid Warning/Rollaway Reminder Indicator Inoperative

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Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation? Yes - GO to Step 3. No - REFER to Circuit Description and Operation in this section..</p>	
2	<p>1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. Does the instrument cluster gauge backlighting illuminate? Yes – GO to Step 3. No – REFER to Instrument Cluster Gauge Inoperative in this section..</p>	
3	<p>Make sure the park brake is set. Does the instrument cluster gauge display the park brake/fluid warning/rollaway reminder indicator? Yes – GO to Step 4. No - GO to Step 5.</p>	
4	<p>With the park brake switch connected, remove the cap from the brake fluid reservoir. Does the instrument cluster gauge display the park brake/fluid warning/rollaway reminder indicator? Yes – The system is OK. No - GO to Step 5.</p>	
5	<p>1. Disconnect the instrument cluster gauge harness connector J8. 2. Disconnect the park brake switch harness connector. 3. Connect a DVOM between the instrument cluster gauge connector J8 terminal 1 and connector J8 terminal 2 and the park brake switch harness connector terminal 1. Does continuity exist? Yes – GO to Step 6. No - REPAIR circuit 37. OPERATE the system to verify the repair.</p>	<p>Instrument Cluster Gauge – J8 Park Brake Switch</p>
6	<p>Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 2 and the park brake switch harness connector terminal 2.</p>	<p>Instrument Cluster Gauge – J8 Park Brake Switch</p>

Step	Action	Connector End View
	<p>Does continuity exist? Yes – GO to Step 7. No – REPAIR circuit 38. OPERATE the system to verify the repair.</p>	
7	<p>1. Disconnect the brake fluid level switch harness connector. 2. Connect a DVOM between the instrument cluster gauge connector J8 terminal 8 and the brake fluid level switch harness connector terminal 1. Does continuity exist? Yes – GO to Step 8. No – REPAIR circuit 7. OPERATE the system to verify the repair.</p>	<p>Instrument Cluster Gauge – J8 Brake Fluid Level Switch</p>
8	<p>Connect a DVOM between the instrument cluster gauge connector J8 terminal 9 and the brake fluid level switch harness connector terminal 2. Does continuity exist? Yes – GO to Step 9. No – REPAIR circuit 8. OPERATE the system to verify the repair.</p>	<p>Instrument Cluster Gauge – J8 Brake Fluid Level Switch</p>
9	<p>1. Reconnect the instrument cluster gauge harness connector J8. 2. Connect a DVOM between the brake fluid level switch harness connector terminal 1 and terminal 3. Does the DVOM display approximately 6 volts? Yes – INSTALL a new brake fluid level switch. OPERATE the system to verify the repair. No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	<p>Brake Fluid Level Switch</p>

Park Brake/Fluid Warning/Rollaway Reminder Indicator Always On

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WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

WARNING:

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Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation? Yes – GO to Step 3. No - REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake. 2. Place the drive mode selector switch in the Reverse, Turf or Drive position. Does the instrument cluster gauge backlighting illuminate? Yes – GO to Step 3. No – REFER to Instrument Cluster Gauge Inoperative in this section.</p>	
3	<p>Disconnect the brake fluid level switch harness connector. Does the park brake/fluid warning/rollaway reminder indicator remain on? Yes – GO to Step 4. No – INSTALL a new brake fluid level switch. OPERATE the system to verify the repair.</p>	Brake Fluid Level Switch
4	<p>Disconnect the park brake switch. Does the park brake/fluid warning/rollaway reminder indicator remain on? Yes – GO to Step 5. No – INSTALL a new park brake switch. OPERATE the system to verify the repair.</p>	
5	<p>Connect a DVOM between the brake fluid level switch</p>	Brake Fluid Level

Step	Action	Connector End View
	harness connector terminal 1 and terminal 3. Does the DVOM display approximately 6 volts? Yes – GO to Step 7. No – GO to Step 6.	Switch
6	<ol style="list-style-type: none"> 1. Disconnect the instrument cluster gauge harness connector J8. 2. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 8 and the brake fluid level switch harness connector terminal 1. 3. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 9 and the brake fluid level switch harness connector terminal 3. Does continuity exist? Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No – REPAIR circuit 7 or circuit 8. OPERATE the system to verify the repair.	Instrument Cluster Gauge – J8 Brake Fluid Level Switch
7	<ol style="list-style-type: none"> 1. Reconnect the instrument cluster gauge harness connector J8. 2. Connect a DVOM between the park brake switch harness connector terminal 1 and terminal 2. Does the DVOM display approximately 3 volts? Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair. No – GO to Step 8.	Park Brake Switch
8	<ol style="list-style-type: none"> 1. Disconnect the instrument cluster gauge harness connector J8. 2. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 1 and the park brake switch harness connector terminal 1. 3. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 2 and the park brake switch harness connector terminal 2. 	Instrument Cluster Gauge – J8 Park Brake Switch

Step	Action	Connector End View
	<p>Does continuity exist?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 37 or circuit 38. OPERATE the system to verify the repair.</p>	

Park Brake/ Rollaway Reminder Chime Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No - REFER to Circuit Description and Operation in this section.</p>	
2	<p>1. Set the park brake.</p> <p>2. Place the drive mode selector switch in the Reverse, Turf or Drive position.</p> <p>Does the instrument cluster gauge backlighting illuminate?</p> <p>Yes – GO to Step 3.</p> <p>No – REFER to Instrument Cluster Gauge Inoperative in this section.</p>	
3	<p>Place the drive mode selector switch in the Reverse position.</p> <p>Does the park brake/rollaway reminder chime sound?</p> <p>Yes – GO to Step 4.</p> <p>No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p>	
4	<p>1. Disengage the park brake.</p> <p>2. Hold the service brake and place the drive mode selector switch in the OFF position.</p> <p>Does the park brake/rollaway reminder chime sound for</p>	

Step	Action	Connector End View
	10 seconds and then stop? Yes – The system is OK. No – GO to Step 5.	
5	1. Disconnect the instrument cluster gauge harness connector J8. 2. Disconnect the park brake switch harness connector. 3. Connect a DVOM between the instrument cluster gauge harness connector J8 terminal 1 and the park brake switch harness connector terminal 2. Does continuity exist? Yes – REPAIR circuit 37 or 38. OPERATE the system to verify the repair. No – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.	

Motor and Motor Controller

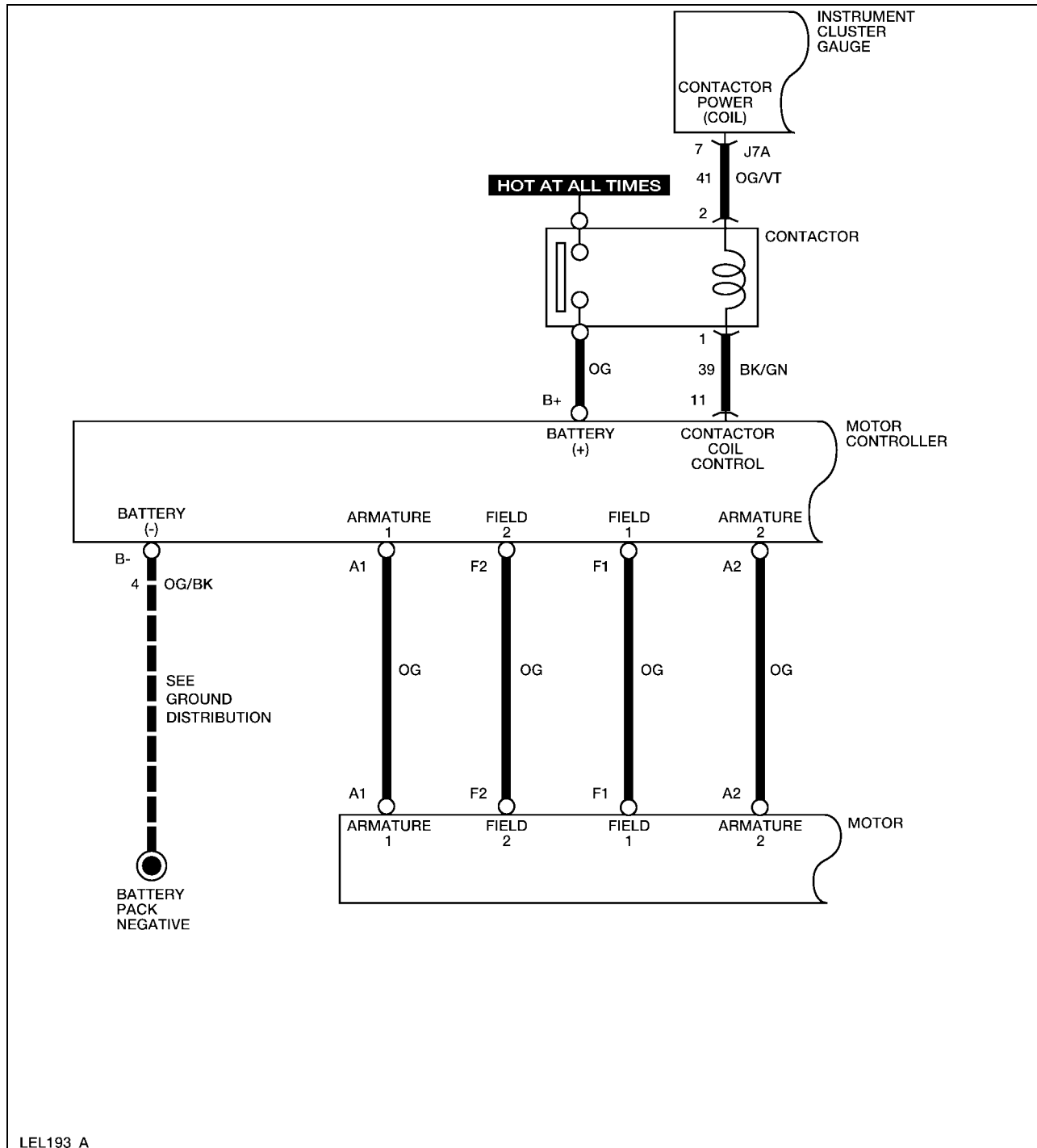
Circuit Description and Operation

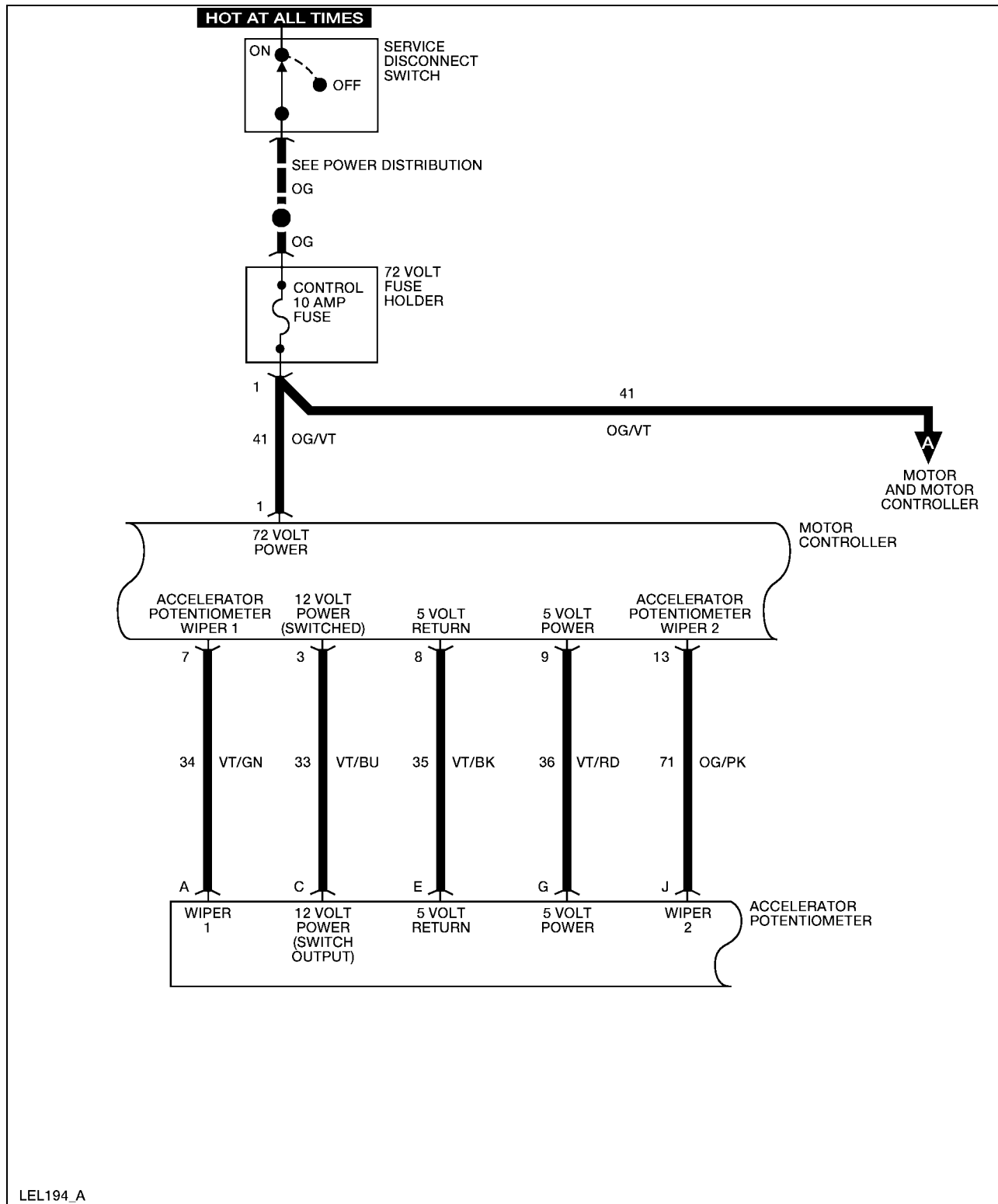
With the drive mode selector switch in the Reverse, Turf or Drive position, the motor controller uses inputs from the instrument cluster gauge and the accelerator potentiometer to control motor function. The motor controller varies current flow (direction and intensity) in response to these inputs to allow forward vehicle movement with the drive mode selector switch in the Turf or Drive position, and reverse vehicle movement with the drive mode selector switch in the Reverse position. The motor tachometer/speed sensor sends a signal to the instrument cluster gauge, which displays the vehicle speed.

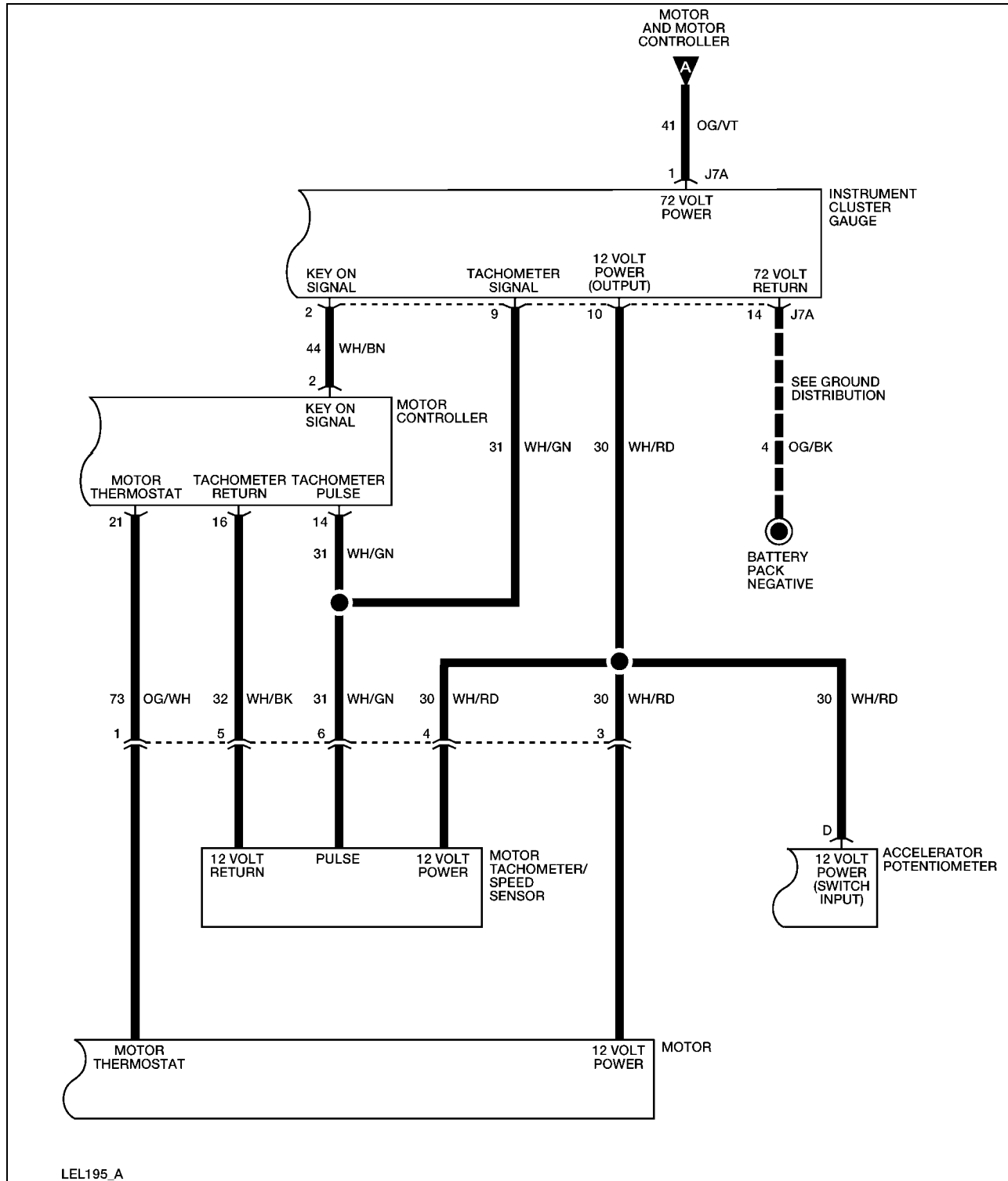
The following safety features may affect the motor and motor controller operation:

- If the motor temperature exceeds 302 degrees F (150 degrees C), the motor controller will limit current to the motor (armature current) and vehicle performance may seem sluggish.
- If the GFCI cord is connected to the charger, the motor and motor controller will be inoperative.

Circuit Schematic







LEL195_A

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the motor and motor controller system are:

- Service disconnect switch
- Contactor coil
- Control fuse
- Motor
- Motor controller
- Motor tachometer/speed sensor
- Instrument cluster gauge
- Accelerator potentiometer

Guidelines to diagnose the motor and motor controller system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Check for any diagnostic trouble codes. Refer to [Retrieving and Clearing DTCs](#).

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
Incorrect vehicle speed is displayed on the instrument cluster gauge	<ul style="list-style-type: none"> • Motor tachometer/speed sensor • Instrument cluster gauge • Connectors and related wiring 	GO to Instrument Cluster Gauge Does Not Display Correct Vehicle Speed.

Instrument Cluster Gauge Does Not Display Correct Vehicle Speed

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WARNING:

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Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation.	
2	<ol style="list-style-type: none"> 1. Raise the vehicle on a hoist. 2. Disconnect the motor controller harness connector. 3. Connect a fused jumper wire between the motor controller harness connector terminal 16 and the battery pack negative. 4. Connect a DVOM between the motor controller harness connector terminal 16 and terminal 14. 5. Place the drive mode selector switch in the Drive position. 6. Slowly rotate both rear vehicle wheels in the same direction. 	Motor Controller

Step	Action	Connector End View
	<p>(This will cause the motor to rotate.)</p> <p>Does the voltage alternate between approximately 1 volt and 10 volts?</p> <p>Yes – GO to Step 3.</p> <p>No – GO to Step 5.</p>	
3	<p>Observe the instrument cluster gauge while rotating both rear vehicle wheels in the same direction.</p> <p>Does the speed indication on the instrument cluster gauge change?</p> <p>Yes – The system is OK.</p> <p>No – GO to Step 4.</p>	
4	<ol style="list-style-type: none"> 1. Disconnect the instrument cluster gauge harness connector J7A. 2. Disconnect the motor tachometer/speed sensor harness connector. 3. Connect a DVOM between the instrument cluster connector J7A terminal 9 and motor tachometer/speed sensor connector terminal 6. <p>Does continuity exist?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 31. OPERATE the system to verify the repair.</p>	<p>Instrument Cluster Gauge – J7A</p> <p>Motor Tachometer/Speed Sensor</p>
5	<ol style="list-style-type: none"> 1. Disconnect the motor tachometer/speed sensor harness connector. 2. Connect a DVOM between the motor tachometer/speed sensor harness connector terminal 4 and the battery pack negative. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 6.</p> <p>No – GO to Step 7.</p>	<p>Motor Tachometer/Speed Sensor</p>
6	<ol style="list-style-type: none"> 1. Connect a DVOM between the motor controller harness connector terminal 16 and the motor tachometer/speed sensor harness connector terminal 5. 	<p>Motor Controller</p> <p>Motor Tachometer/Speed</p>

Step	Action	Connector End View
	<p>2. Connect a DVOM between the motor controller harness connector terminal 14 and the motor tachometer/speed sensor harness connector terminal 6.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new motor tachometer/speed sensor. REFER to Motor Tachometer/Speed Sensor in the powertrain section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 31 or circuit 32. OPERATE the system to verify the repair.</p>	Sensor
7	<p>1. Disconnect the instrument cluster gauge harness connector J7A.</p> <p>2. Connect a DVOM between the instrument cluster harness connector J7A terminal 10 and the motor tachometer/speed sensor harness connector terminal 4.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 30. OPERATE the system to verify the repair.</p>	Instrument Cluster Gauge – J7A Motor Tachometer/Speed Sensor

DTC 21

Description:

Accelerator voltage is too high.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Accelerator potentiometer
- Connectors and related wiring
- Motor controller

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Step	Action	Connector End View
1.	Did you perform the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check in this section.	
2.	<ol style="list-style-type: none"> 1. Disconnect the motor controller harness connector and the accelerator potentiometer harness connector. 2. Connect a DVOM between the motor controller harness connector terminal 7 and the accelerator potentiometer harness connector terminal A. 3. Connect a DVOM between the motor controller harness connector terminal 8 and the accelerator potentiometer harness connector terminal E. 4. Connect a DVOM between the motor controller harness connector terminal 9 and the accelerator potentiometer harness connector terminal G. 5. Connect a DVOM between the motor controller harness connector terminal 13 and the accelerator potentiometer harness connector terminal J. Does continuity exist? Yes - GO to Step 3. No – INSTALL a new 72 volt harness. REFER to Wiring Harnesses in this section. OPERATE the system to verify the repair.	Motor Controller Accelerator Potentiometer
3.	Connect a DVOM between the motor controller terminal 7	Motor Controller

Step	Action	Connector End View
	<p>and the vehicle chassis.</p> <p>Does the DVOM display greater than approximately 1.25 volts?</p> <p>Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new accelerator potentiometer. REFER to Accelerator Potentiometer in the Powertrain section. OPERATE the system to verify the repair.</p>	

DTC 23

Description:

Motor field current is high at start up in the reverse direction.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	<p>Did you perform the Diagnostic System Check?</p> <p>Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No - REFER to Diagnostic System Check.</p>	

DTC 24

Description:

Motor field current is high at start up in the forward direction.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	<p>Did you perform the Diagnostic System Check?</p> <p>Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section.</p>	

Step	Action	Connector End View
	No – REFER to Diagnostic System Check .	

DTC 27

Description:

12 volt bus is too low.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	<p>Did you perform the Diagnostic System Check?</p> <p>Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No - REFER to Diagnostic System Check.</p>	

DTC 41

Description:

Open thermal protector (TP) or transistor over-temperature.

Symptom:

Reduced or no power to traction motor.

Possible cause(s):

- Motor controller is in thermal cutback due to high temperature.
- Motor controller.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check .	
2	1. Allow the motor to cool to ambient temperature. 2. Clear the DTC. Refer to Retrieving and Clearing DTCs. 3. Drive the vehicle. 4. Check for DTCs. Refer to Retrieving and Clearing DTCs. Does DTC 41 set again? Yes - INSTALL a new motor controller. REFER to Motor	

Step	Action	Connector End View
	<p>Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No – The system is OK.</p>	

DTC 42

Description:

Motor armature offset voltage is too high.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	<p>Did you perform the Diagnostic System Check?</p> <p>Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p> <p>No - REFER to Diagnostic System Check.</p>	

DTC 43

Description:

Motor armature offset voltage is too low.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to Diagnostic System Check .	

DTC 44

Description:

Armature transistor did not turn off properly.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to Diagnostic System Check .	

DTC 45

Description:

Armature transistor did not turn on properly.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to Diagnostic System Check .	

DTC 46

Description:

“Look Ahead” test for A2 voltage is less than 12% of battery voltage.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to Diagnostic System Check .	

DTC 49

Description:

Motor field current is too low during the run mode.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor.
- Motor controller.

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check .	
2	1. Disconnect the motor field connections at the motor. 2. Connect a DVOM between the motor field terminals. Does continuity exist? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - INSTALL a new motor. REFER to Motor in the	

Step	Action	Connector End View
	Powertrain section. OPERATE the system to verify the repair.	

DTC 51

Description:

Capacitor voltage is low before the line contactor closes.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

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THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to Diagnostic System Check .	

DTC 57

Description:

Controller “motor current sensor” input too low while running.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

WARNING:

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

WARNING:

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to the Diagnostic System Check .	

DTC 66

Description:

The field current exceeds the current limit of the field transistor.

Symptom:

Control will not operate or is sluggish on start up. Line contactor opens.

Possible cause(s):

- Motor field circuits shorted.
- Binding line contactor.
- Motor over-temperature condition.
- Motor thermal fuse.
- Motor controller.

WARNING:

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Step	Action	Connector End View
1.	Did you perform the Diagnostic System Check? Yes – GO to Step 2. No - REFER to the Diagnostic System Check .	
2.	1. Disconnect the motor field connections at the motor. 2. Connect a DVOM between the motor field terminals. Does the DVOM display approximately 1.3 ohms?	Motor

Step	Action	Connector End View
	<p>Yes – GO to Step 3.</p> <p>No – INSTALL a new motor. REFER to Motor in the Powertrain section. OPERATE the system to verify the repair.</p>	
3.	<ol style="list-style-type: none"> 1. Disconnect the motor field connections at the motor controller. 2. Connect a DVOM between motor F1 and motor controller F1. 3. Connect a DVOM between motor F2 and motor controller F2. <p>Does continuity exist?</p> <p>Yes – GO to Step 4.</p> <p>No – REPAIR open in field cable. OPERATE the system to verify the repair.</p>	
4.	<ol style="list-style-type: none"> 1. Connect a DVOM between motor F1 and the vehicle chassis. 2. Connect a DVOM between motor F2 and the vehicle chassis. <p>Does continuity exist?</p> <p>Yes – REPAIR field cable short to ground. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair.</p>	

DTC 76

Description:

Capacitor 1C voltage too high during regenerative braking.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

WARNING:

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WARNING:

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Step	Action	Connector End View
1.	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to the Diagnostic System Check .	

DTC 77

Description:

Capacitor 1C voltage too high during motoring.

Symptom:

Motor controller will not operate.

Possible cause(s):

- Motor controller.

WARNING:

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WARNING:

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Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No - REFER to the Diagnostic System Check .	

DTC 90

Description:

Motor thermostat is open during control operation.

Symptom:

- Over-temp condition has occurred.
- Motor armature current is limited to 100 amps. Vehicle performance is sluggish.

Possible cause(s):

- Motor controller.
- 72 volt harness open.
- Motor over-temperature condition.
- Motor thermal fuse (internal to the motor).
- Instrument cluster gauge.

WARNING:

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WARNING:

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Step	Action	Connector End View
1	Did you perform the Diagnostic System Check? Yes - GO to Step 2. No - REFER to Diagnostic System Check .	
2	1. Allow the motor to cool to ambient temperature.	

Step	Action	Connector End View
	2. Clear the DTC. Refer to Retrieving and Clearing DTCs . 3. Drive the vehicle. 4. Check for DTCs. Refer to Retrieving and Clearing DTCs . Does DTC 90 display again? Yes - GO to Step 3. No – The system is OK.	
3	1. Disconnect the motor tachometer/speed sensor harness connector. 2. Connect a DVOM between the motor tachometer/speed sensor harness connector terminal 1 and terminal 3. Does continuity exist? Yes – GO to Step 4. No – INSTALL a new motor. REFER to Motor in the Powertrain section. OPERATE the system to verify the repair.	Motor Tachometer/Speed Sensor
4	1. Set the park brake. 2. Place the drive mode selector switch in the Drive position. 3. Connect a DVOM between the motor tachometer/speed sensor harness connector terminal 3 and the battery pack negative. Does the DVOM display approximately 12 volts? Yes – GO to Step 5. No – GO to Step 6.	Motor Tachometer/Speed Sensor
5	1. Disconnect the motor controller harness connector. 2. Connect a DVOM between the motor controller harness connector terminal 21 and the motor tachometer/speed sensor connector terminal 1. Does continuity exist? Yes – INSTALL a new motor controller. REFER to Motor Controller in the Powertrain section. OPERATE the system to verify the repair. No – REPAIR circuit 73. OPERATE the system to verify the repair.	Motor Controller Motor Tachometer/Speed Sensor
6	1. Place the drive mode selector switch in the OFF position.	Instrument Cluster Gauge – J7A

Step	Action	Connector End View
	<p>2. Disconnect the instrument cluster gauge harness connector J7A.</p> <p>3. Connect a DVOM between the instrument cluster gauge harness connector J7A terminal 10 and the motor tachometer/speed sensor harness connector terminal 3.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new instrument cluster gauge. REFER to Instrument Cluster Gauge in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 30. OPERATE the system to verify the repair.</p>	<p>Motor Tachometer/Speed Sensor</p>

Power Point

Circuit Description and Operation

72 volt power is applied through the DC/DC fuse to DC/DC converter 2 (optional), then through the power point fuse to the power point. The 12 volt return for the power point is also provided through the DC/DC converter 2 (optional). When an accessory is inserted into the power point, the circuit is complete and power is applied to the accessory.

Required Tools

High Voltage Insulated Gloves	100-F036 or equivalent
Face Shield	100-F035 or equivalent

System Check

Functional components in the power point system are:

- DC/DC fuse
- DC/DC converter 2 (optional)
- Power point fuse
- Power point
- Related wiring

Guidelines to diagnose the power point system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The power point is inoperative	<ul style="list-style-type: none"> • DC/DC fuse • Power point fuse • Power point • DC/DC converter 2 (optional) • Connectors or related wiring 	GO to Power Point Inoperative.

Power Point Inoperative

WARNING:

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WARNING:

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Step	Action	Connector End View
1	Did you read the Circuit Description and Operation? Yes - GO to Step 2. No - REFER to Circuit Description and Operation .	
2	Connect a DVOM between the DC/DC converter 2 (optional) harness connector terminal 1 and terminal 2. Does the DVOM display approximately 12 volts? Yes – GO to Step 3. No - GO to Step 5.	DC/DC Converter 2 (optional)
3	1. Disconnect the power point harness connector. 2. Connect a DVOM between the power point harness connector terminal 1 and terminal 2. Does the DVOM display approximately 12 volts? Yes – INSTALL a new power point. OPERATE the system to verify the repair. No - GO to Step 4.	DC/DC Converter 2 (optional)
4	Connect a DVOM between the DC/DC converter 2 (optional) harness connector terminal 1 and the power point harness connector terminal 2.	DC/DC Converter 2 (optional) Power Point

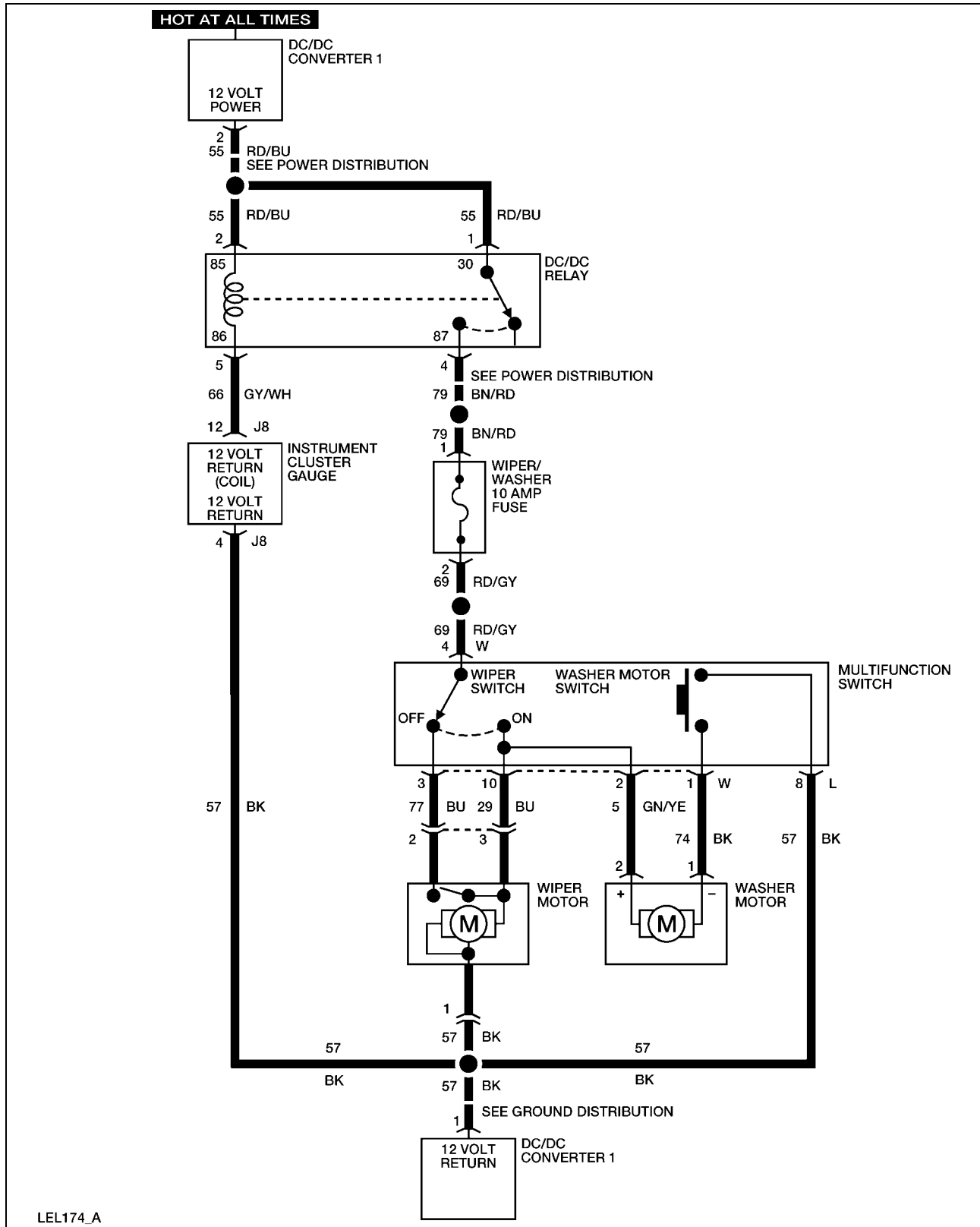
Step	Action	Connector End View
	<p>Does continuity exist?</p> <p>Yes – REPAIR circuit 65. OPERATE the system to verify the repair.</p> <p>No - REPAIR circuit 57. OPERATE the system to verify the repair.</p>	
5	<ol style="list-style-type: none"> 1. Place the service disconnect switch in the OFF position. 2. Disconnect the DC/DC converter 2 (optional) harness connector. 3. Connect a DVOM between the DC/DC converter 2 (optional) harness connector terminal 3 and terminal 4. 4. Place the service disconnect switch in the ON position. <p>Does the DVOM display approximately 72 volts?</p> <p>Yes – INSTALL a new DC/DC converter 2 (optional). REFER to DC/DC Converter 2 (Optional) in this section. OPERATE the system to verify the repair.</p> <p>No – GO to Step 6.</p>	DC/DC Converter 2 (optional)
6	<p>Check continuity between the DC/DC converter 2 (optional) harness connector terminal 3 and the battery pack negative.</p> <p>Does continuity exist?</p> <p>Yes - REPAIR circuit 43. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 4. OPERATE the system to verify the repair.</p>	DC/DC Converter 2 (optional)

Wiper/Washer

Circuit Description and Operation

This is a conventional single speed wiper system. When the drive mode selector switch is in the Reverse, Turf or Drive position, 12 volt power is supplied from the DC/DC converter 1 (standard) through the DC/DC relay to the wiper/washer fuse. The 12 volt return for the wiper motor is provided through DC/DC converter 1 (standard). When the wiper switch is turned ON, 12 volt power is supplied through the multifunction switch to the wiper motor. When the wiper switch is turned OFF, the wiper motor returns the wiper to the park position. When the washer switch is held in the ON position, the washer pump operates. The wiper switch must be in the ON position for the washer to operate.

Circuit Schematic



LEL174_A

System Check

Functional components in the wiper/washer system are:

- Wiper/washer fuse
- Multifunction switch
- Instrument cluster gauge
- Washer motor
- Wiper motor
- Related wiring

Guidelines to diagnose the wiper/washer system:

1. Verify the concern.
2. Check the fuse(s).
3. Check all connectors and related wiring for partially seated terminals, connectors not mating properly and for dirt, moisture or corrosion. For proper contact, terminal(s) must be free of all foreign material.
4. Fill washer fluid as necessary.
5. Check washer hoses/nozzles for obstruction.

If the concern still exists, refer to the following table:

Symptom Chart

Symptom	Possible Causes	Action
The washer is inoperative	<ul style="list-style-type: none"> • Wiper/washer fuse • Washer motor • Multifunction switch • Connectors or related wiring 	GO to Washer Inoperative.
The wiper is inoperative	<ul style="list-style-type: none"> • Wiper/washer fuse • Wiper motor • Connectors or related wiring 	GO to Wiper Inoperative.
The wiper is always on	<ul style="list-style-type: none"> • Multifunction switch • Wiper motor • Connectors or related wiring 	GO to Wiper Always On.
The wiper does not stop in the park position	<ul style="list-style-type: none"> • Wiper motor 	INSTALL a new wiper motor. REFER to Wiper Motor in this section. OPERATE the system to verify the repair.

Washer Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the washer motor harness connector. 2. Set the park brake. 3. Place the drive mode selector switch in the Reverse, Turf or Drive position. 4. Connect a DVOM between the washer motor harness connector terminal 1 and terminal 2. 5. Place the wiper switch in the ON position. 6. Press the washer motor switch. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – INSTALL a new washer motor. OPERATE the system to verify the repair.</p> <p>No – GO to Step 3.</p>	Washer Motor
3	<ol style="list-style-type: none"> 1. Disconnect the multifunction switch harness connector W. 2. Connect a DVOM between the multifunction switch harness connector W terminal 4 and the vehicle chassis. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 4.</p> <p>No – REPAIR circuit 69. OPERATE the system to verify the repair.</p>	Multifunction Switch-W
4	<ol style="list-style-type: none"> 1. Check continuity between the washer motor harness connector terminal 1 and the multifunction switch harness connector W terminal 1. 2. Check continuity between the washer motor harness connector terminal 2 and the multifunction switch harness connector W terminal 2. <p>Does continuity exist?</p> <p>Yes – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the</p>	Washer Motor Multifunction Switch-W

Step	Action	Connector End View
	<p>system to verify the repair.</p> <p>No – REPAIR circuit 5 or circuit 74. OPERATE the system to verify the repair.</p>	

Wiper Inoperative

Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the wiper motor harness connector. 2. Set the park brake. 3. Place the drive mode selector switch in the Reverse, Turf or Drive position. 4. Connect a DVOM between the wiper motor harness connector terminal 3 and the vehicle chassis. 5. Place the wiper switch in the ON position. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 3.</p> <p>No – GO to Step 4.</p>	Wiper Motor
3	<p>Check continuity between the wiper motor harness connector terminal 1 and the vehicle chassis.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new wiper motor. REFER to Wiper Motor in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 57. OPERATE the system to verify the repair.</p>	Wiper Motor
4	<ol style="list-style-type: none"> 1. Disconnect the multifunction switch harness connector W. 2. Connect a DVOM between the multifunction switch harness connector W terminal 4 and the vehicle chassis. <p>Does the DVOM display approximately 12 volts?</p> <p>Yes – GO to Step 5.</p>	Multifunction Switch-W

Step	Action	Connector End View
	No – GO to Step 6.	
5	<p>Check continuity between the multifunction switch harness connector W terminal 10 and the wiper motor harness connector terminal 3.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new wiper motor. REFER to Wiper Motor in this section. OPERATE the system to verify the repair.</p> <p>No – REPAIR circuit 29. OPERATE the system to verify the repair.</p>	Multifunction Switch-W Wiper Motor
6	<ol style="list-style-type: none"> 1. Remove the wiper/washer fuse from the fuse holder. 2. Connect a DVOM between the multifunction switch harness connector W terminal 4 and the wiper/washer fuse holder terminal 2. <p>Does continuity exist?</p> <p>Yes – REFER to DC/DC Relay Test.</p> <p>No – REPAIR circuit 69. OPERATE the system to verify the repair.</p>	Multifunction Switch-W

Wiper Always On

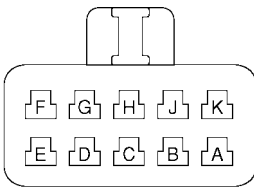
Step	Action	Connector End View
1	<p>Did you read the Circuit Description and Operation?</p> <p>Yes – GO to Step 2.</p> <p>No – REFER to Circuit Description and Operation.</p>	
2	<ol style="list-style-type: none"> 1. Disconnect the multifunction switch harness connector W. 2. Check operation of the wiper motor. <p>Does the wiper motor continue to operate?</p> <p>Yes – REPAIR circuit 29 between the multifunction switch and the wiper motor. OPERATE the system to verify the repair.</p> <p>No – GO to Step 3.</p>	
3	<p>Check continuity between the multifunction switch harness connector W terminal 4 and the multifunction switch harness</p>	Multifunction Switch-W

Step	Action	Connector End View
	<p>connector W terminal 10 with the wiper switch in the OFF position.</p> <p>Does continuity exist?</p> <p>Yes – INSTALL a new multifunction switch. REFER to Multifunction Switch in this section. OPERATE the system to verify the repair.</p> <p>No – INSTALL a new wiper motor. REFER to Wiper Motor in this section. OPERATE the system to verify the repair.</p>	

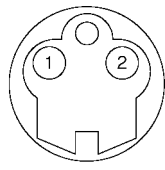
Connector End Views

- Accelerator Potentiometer
- Brake Fluid Level Switch
- Charger
- Contactor Coil
- DC/DC Converter 2 (Optional)
- Electronic Flasher
- Fuse, Lights
- Fuse, Wiper/Washer
- Headlamp RH
- Heater/Defogger (Fan)
- Heater/Defogger Inline
- Horn Relay
- Instrument Cluster Gauge – J8
- Motor Controller
- Multifunction Switch – L
- Power Point
- Taillamp RH
- Turn Signal LR
- Turn Signal RR
- Wiper Motor
- Battery Temperature Sensor
- Brake Switch
- CHMSL/Reverse Lamp
- DC/DC Converter 1 (Standard)
- DC/DC Relay
- Fuse, Horn/Flasher/Brake
- Fuse, Power Point
- Headlamp LH
- Heater/Defogger Contactor
- Heater/Defogger (Heater)
- Heater/Defogger Switch
- Instrument Cluster Gauge – J7A
- Key Switch
- Motor Tachometer/Speed Sensor
- Multifunction Switch – W
- Taillamp LH
- Turn Signal LF
- Turn Signal RF
- Washer Motor
- 72 Volt Inline

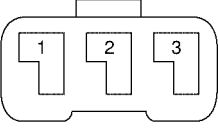
Accelerator Potentiometer

 <p>LEL156_A</p>			
Pin	Wire Color	Circuit	Function
A	VT/GN	34	Wiper 1
B	-	-	-
C	VT/BU	33	12 Volt Power (Switch Output)
D	WH/RD	30	12 Volt Power (Switch Input)
E	VT/BK	35	5 Volt Return
F	-	-	-
G	VT/RD	36	5 Volt Power
H	-	-	-
J	OG/PK	71	Wiper 2
K	-	-	-

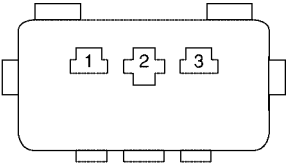
Battery Temperature Sensor

 <p>LEL162_A</p>			
Pin	Wire Color	Circuit	Function
1	GY/BU	16	Battery Temperature Sensor Power
2	GY/GN	17	Battery Temperature Sensor Signal Return

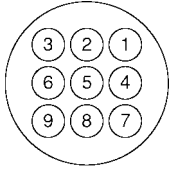
Brake Fluid Level Switch

 <p>LEL170_A</p>			
Pin	Wire Color	Circuit	Function
1	BU/GY	7	Brake Fluid Level Switch Power
2	-	-	-
3	YE/GY	8	Brake Fluid Level Switch Signal Return

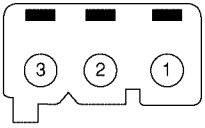
Brake Switch

 <p>LEL166_A</p>			
Pin	Wire Color	Circuit	Function
1	RD/ GN	6	12 Volt Power
2	-	-	-
3	BU/BK	22	Brake Switch Signal Return

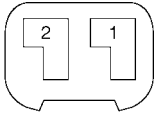
Charger

 <p>LEL167_A</p>			
Pin	Wire Color	Circuit	Function
1	OG/GY	11	72 Volt Power
2	OG/BK	4	72 Volt Return
3	GN/BK	67	Charger Inhibit
4	GY/BU	16	Battery Temperature Sensor Power
5	GY/GN	17	Battery Temperature Sensor Signal Return
6	BU/OG	51	Battery Type Select
7	-	-	-
8	-	-	-
9	-	-	-

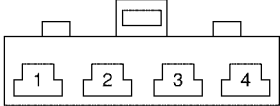
CHMSL/Reverse Lamp

 <p>LEL164_A</p>			
Pin	Wire Color	Circuit	Function
1	BU/RD	68	Reverse Lamp Power
2	BU/BK	22	Brake Lamp Power
3	BK	57	CHMSL/Reverse Lamp Return

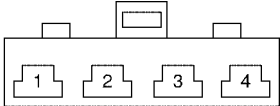
Contactor

 <p>LEL163_A</p>			
Pin	Wire Color	Circuit	Function
1	BK/GN	39	Contactor Return (Coil)
2	OG/VT	41	Contactor Power (Coil)

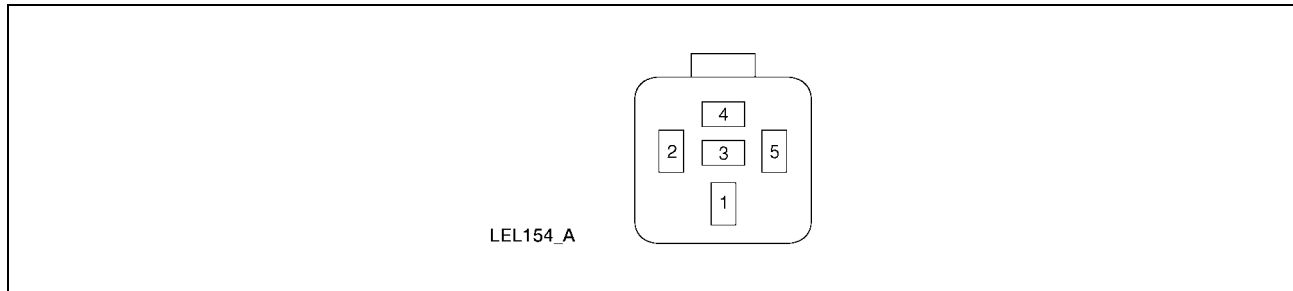
DC/DC Converter 1 (Standard)

 <p>LEL153_A</p>			
Pin	Wire Color	Circuit	Function
1	BK	57	12 Volt Return
2	RD/BU	55	12 Volt Power
3	OG/BK	4	72 Volt Return
4	OG/YE	43	72 Volt Power

DC/DC Converter 2 (Optional)

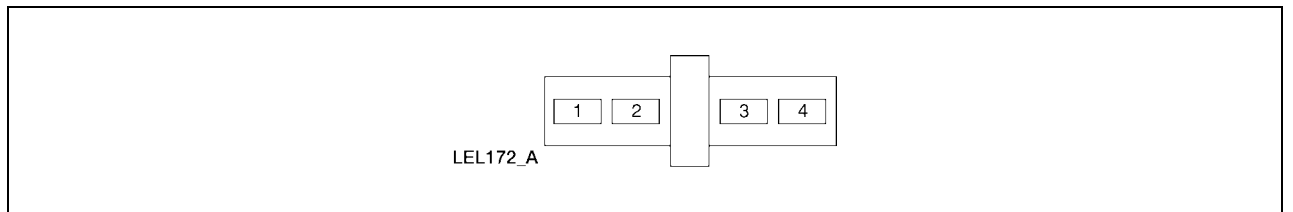
 <p>LEL153_A</p>			
Pin	Wire Color	Circuit	Function
1	BK	57	12 Volt Return
2	RD/BU	55	12 Volt Power
3	OG/BK	4	72 Volt Return
4	OG/YE	43	72 Volt Power

DC/DC Relay



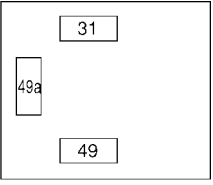
Pin	Wire Color	Circuit	Function
1	RD/BU	55	12 Volt Power (Switch)
2	RD/BU	55	12 Volt Power (Coil)
3	-	-	-
4	BN/RD	79	12 Volt Power (Switched)
5	GY/WH	66	12 Volt Return (Coil)

Drive Mode Selector Switch – J5

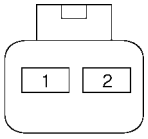


Pin	Wire Color	Circuit	Function
1	-	-	12 Volt Power
2	-	-	Reverse
3	-	-	Turf
4	-	-	Drive

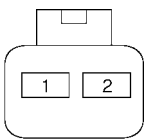
Electronic Flasher

 <p style="margin: 0;">LEL189_A</p>			
Pin	Wire Color	Circuit	Function
31	-	-	Return
49	-	-	Power
49a	-	-	Flash Output

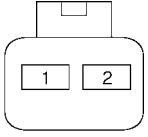
Fuse, ACC

 <p style="margin: 0;">LEL152_A</p>			
Pin	Wire Color	Circuit	Function
1	RD/BU	55	12 Volt Power
2	RD/GN	80	12 Volt Power (Protected)

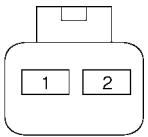
Fuse, Horn/Flasher/Brake

 <p style="margin: 0;">LEL152_A</p>			
Pin	Wire Color	Circuit	Function
1	RD/BU	55	12 Volt Power
2	RD/GN	6	12 Volt Power (Protected)

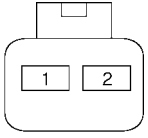
Fuse, Lights

 <p>LEL152_A</p>			
Pin	Wire Color	Circuit	Function
1	BN/RD	79	12 Volt Power
2	RD/GY	69	12 Volt Power (Protected)

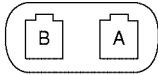
Fuse, Power Point

 <p>LEL152_A</p>			
Pin	Wire Color	Circuit	Function
1	RD/WH	65	12 Volt Power (Protected)
2	RD/WH	65	12 Volt Power

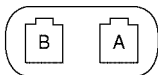
Fuse, Wiper/Washer

 <p>LEL152_A</p>			
Pin	Wire Color	Circuit	Function
1	BN/RD	79	12 Volt Power
2	RD/GY	69	12 Volt Power (Protected)

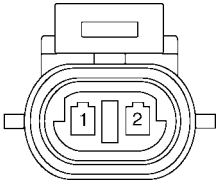
Headlamp LH

 LEL158_A			
Pin	Wire Color	Circuit	Function
A	BK	57	12 Volt Return
B	RD/BK	13	12 Volt Power (Switched)

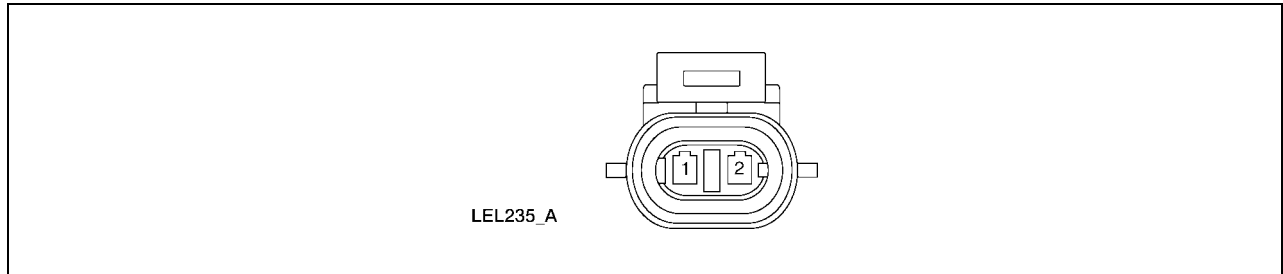
Headlamp RH

 LEL158_A			
Pin	Wire Color	Circuit	Function
A	BK	57	12 Volt Return
B	RD/BK	13	12 Volt Power (Switched)

Heater/Defogger Contactor

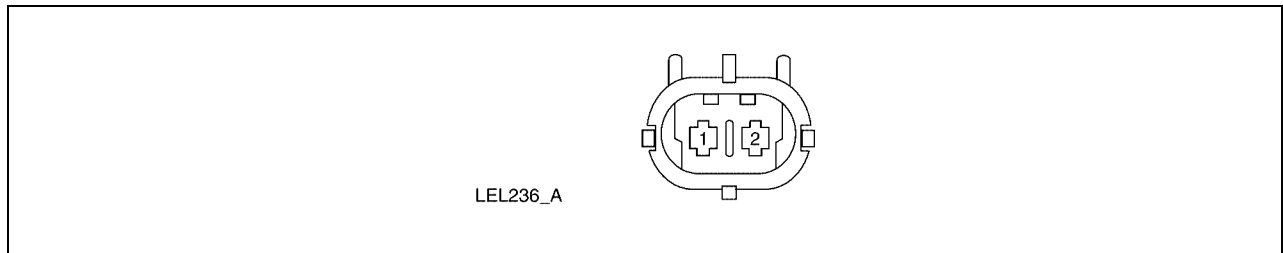
 LEL233_A			
Pin	Wire Color	Circuit	Function
1	RD	81	12 Volt Power
2	BK	57	12 Volt Return

Heater/Defogger (Fan)



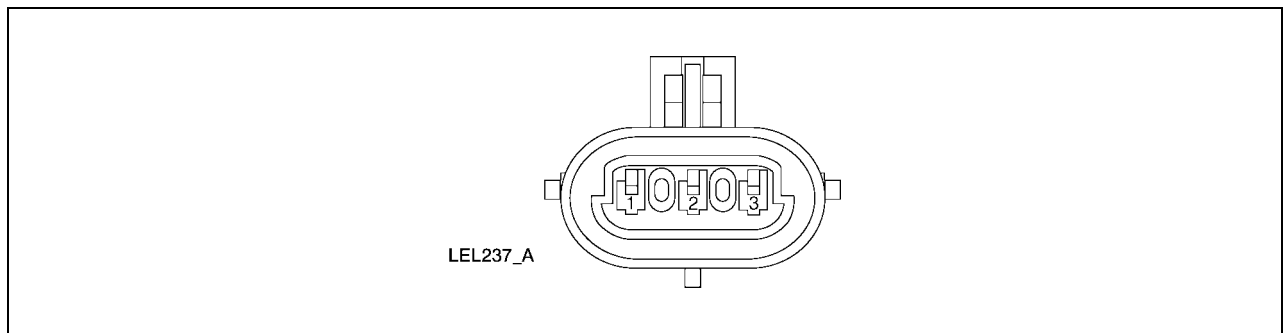
Pin	Wire Color	Circuit	Function
1	RD	81	12 Volt Power
2	BK	57	12 Volt Return

Heater/Defogger (Heater)



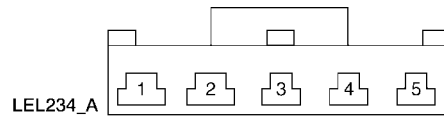
Pin	Wire Color	Circuit	Function
1	OR/BK	4	72 Volt Return
2	OG/YE	43	72 Volt Power

Heater/Defogger Inline



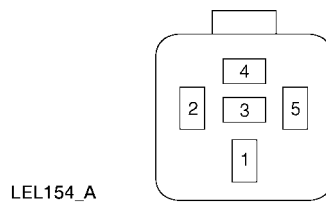
Pin	Wire Color	Circuit	Function
1	RD/GY	69	12 Volt Power (Except Key Off)
2	RD/GN	80	12 Volt Power
3	BK	57	12 Volt Return

Heater/Defogger Switch



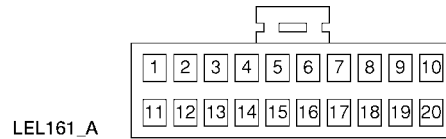
Pin	Wire Color	Circuit	Function
1	RD	81	12 Volt Power (Heater/Defogger ON)
2	RD/GN	80	12 Volt Power
3	RD/GY	69	12 volt Power (Switched)
4	BK	57	12 Volt Return
5	-	-	-

Horn Relay



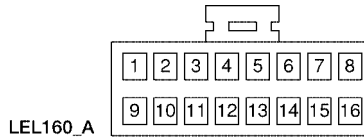
Pin	Wire Color	Circuit	Function
1	BK	57	12 Volt Return (Switch)
2	GN/BU	28	12 Volt Power (Horn Switch Closed) (Coil)
3	-	-	-
4	BN/RD	78	Horn Control
5	BK	57	12 Volt Return (Coil)

Instrument Cluster Gauge – J7A



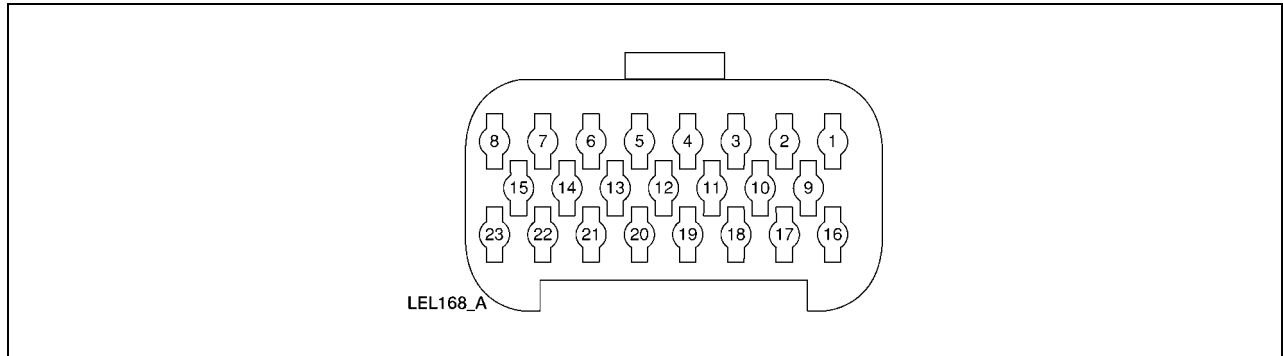
Pin	Wire Color	Circuit	Function
1	OG/VT	41	72 Volt Power
2	WH/BN	44	Key On Signal
3	WH/OG	45	Drive Signal
4	WH/YE	46	Reverse Signal
5	WH/VT	47	Turf Signal
6	BK/BU	50	Back Up Alarm
7	OG/VT	41	Contactor Power (Coil)
8	-	-	-
9	WH/GN	31	Tachometer Signal
10	WH/RD	30	12 Volt Power (Output) (Except Key Off)
11	WH	48	Serial Communication
12	VT	49	Serial Communication
13	GN/BK	67	Charger Inhibit
14	OG/BK	4	72 Volt Return
15	OG/GN	10	Leakage Detection
16	-	-	-
17	-	-	-
18	BU/OG	51	Battery Type Select
19	-	-	-
20	-	-	-

Instrument Cluster Gauge – J8



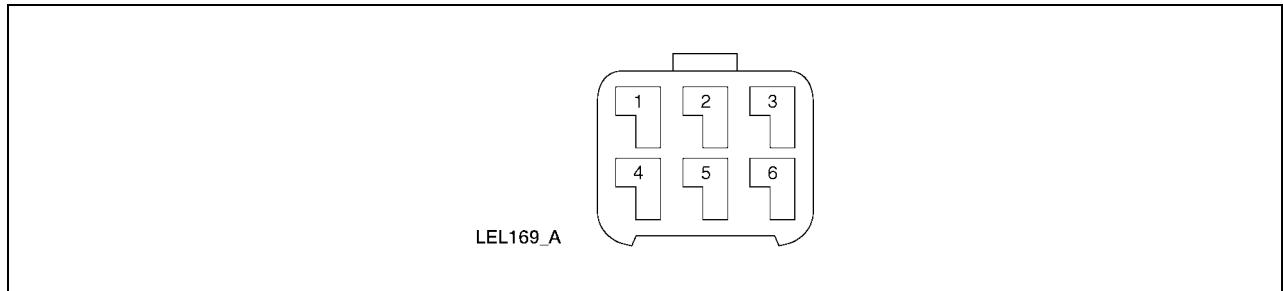
Pin	Wire Color	Circuit	Function
1	BK/VT	37	Park Brake Switch Power
2	BK/YE	38	Park Brake Switch Signal Return
3	RD/GY	69	12 Volt Power (Except Key Off)
4	BK	57	12 Volt Return
5	GN/WH	3	Turn Indicator LH
6	WH/BU	2	Turn Indicator RH
7	BU/RD	68	Reverse Lamp Power
8	BU/GY	7	Brake Fluid Level Switch Power
9	YE/GY	8	Brake Fluid Level Switch Signal Return
10	-	-	-
11	-	-	-
12	GY/WH	66	12 Volt Return (Coil)
13	RD/GN	6	12 Volt Power
14	-	-	-
15	-	-	-
16	-	-	-

Motor Controller



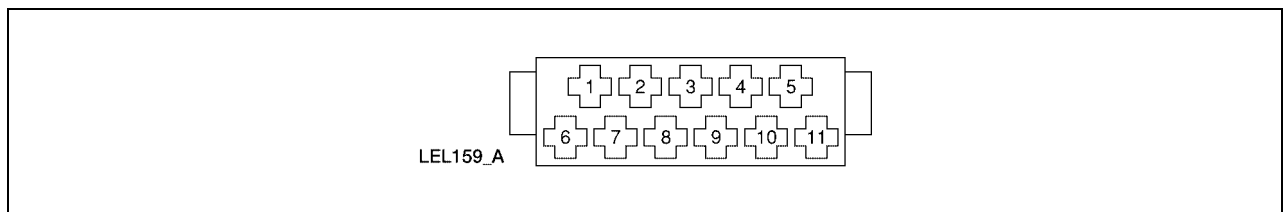
Pin	Wire Color	Circuit	Function
1	OG/VT	41	72 Volt Power
2	WH/BN	44	Key On Signal
3	VT/BU	33	12 Volt Power (Switched)
4	WH/VT	47	Turf Signal
5	WH/YE	46	Reverse Signal
6	WH/OG	45	Drive Signal
7	VT/GN	34	Accelerator Potentiometer Wiper 1
8	VT/BK	35	5 Volt Return
9	VT/RD	36	5 Volt Power
10	BK/BU	50	Back Up Alarm
11	BK/GN	39	Contactora Coil Control
12	-	-	-
13	OG/PK	71	Accelerator Potentiometer Wiper 2
14	WH/GN	31	Tachometer Pulse
15	-	-	-
16	WH/BK	32	Tachometer Return
17	-	-	-
18	-	-	-
19	-	-	-
20	-	-	-
21	OG/WH	73	Motor Thermostat
22	WH	48	Serial Communication
23	VT	49	Serial Communication

Motor Tachometer/Speed Sensor



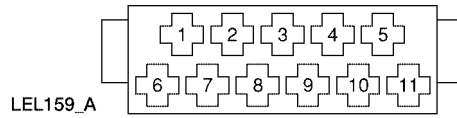
Pin	Wire Color	Circuit	Function
1	OG/WH	73	Motor Thermostat
2	-	-	-
3	WH/RD	30	12 Volt Power
4	WH/RD	30	12 Volt Power
5	WH/BK	32	12 Volt Return
6	WH/GN	31	Pulse

Multifunction Switch - L



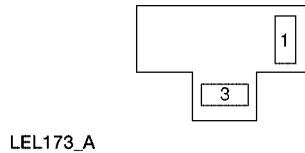
Pin	Wire Color	Circuit	Function
1	RD/BK	13	Flash-To-Pass
2	-	-	-
3	RD/BK	13	12 Volt Power (Output)
4	RD/GY	69	12 Volt Power (Switched)
5	GN/WH	3	Left Turn Signal (Output)
6	RD/GY	69	12 Volt Power (Switched)
7	RD/BN	14	12 Volt Power (Output)
8	BK	57	12 Volt Return
9	RD/GY	69	12 Volt Power (Switched)
10	RD/GN	6	12 Volt Power
11	WH/BU	2	Right Turn Signal (Output)

Multifunction Switch - W



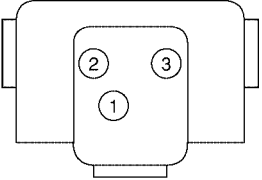
Pin	Wire Color	Circuit	Function
1	BK	74	Washer Motor Return
2	GN/YE	5	Washer Motor Signal (Output)
3	BU	77	Wiper Motor Return
4	RD/GY	69	12 Volt Power (Switched)
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	-
9	-	-	-
10	GN	29	Wiper Motor Signal (Output)
11	GN/BU	28	12 Volt Power (Horn Switch Closed)

Power Point

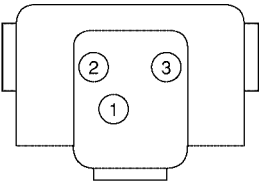


Pin	Wire Color	Circuit	Function
1	RD/WH	65	12 Volt Power
2	BK	57	12 Volt Return

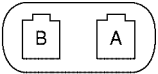
Taillamp LH

 <p>LEL165_A</p>			
Pin	Wire Color	Circuit	Function
1	RD	22	12 Volt Power (Switched)
2	BK	14	12 Volt Power (Switched)
3	WH	57	12 Volt Return

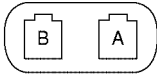
Taillamp RH

 <p>LEL165_A</p>			
Pin	Wire Color	Circuit	Function
1	RD	22	12 Volt Power (Switched)
2	BK	14	12 Volt Power (Switched)
3	WH	57	12 Volt Return

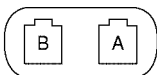
Turn Signal LF

 <p>LEL158_A</p>			
Pin	Wire Color	Circuit	Function
A	BK	57	12 Volt Return
B	GN/WH	3	12 Volt Power (Pulsed)

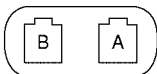
Turn Signal LR

			
Pin	Wire Color	Circuit	Function
A	BK	57	12 Volt Return
B	GN/WH	3	12 Volt Power (Pulsed)

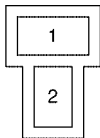
Turn Signal RF

			
Pin	Wire Color	Circuit	Function
A	BK	57	12 Volt Power Return
B	WH/BU	2	12 Volt Power (Pulsed)

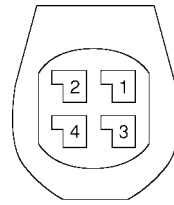
Turn Signal RR

			
Pin	Wire Color	Circuit	Function
A	BK	57	12 Volt Return
B	WH/BU	2	12 Volt Power (Pulsed)

Washer Motor

			
Pin	Wire Color	Circuit	Function
1	GN/YE	5	Washer Motor Power
2	BK	74	Washer Motor Return

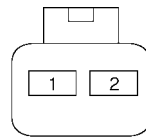
Wiper Motor



LEL157_A

Pin	Wire Color	Circuit	Function
1	BK	57	Wiper Motor Return
2	BU	77	Wiper Motor Signal Return
3	GN	29	Wiper Motor Power
4	-	-	-

72 Volt Inline



LEL152_A

Pin	Wire Color	Circuit	Function
1	OG/YE	43	72 Volt Power
2	OG/BK	4	72 Volt Return

Removal and Installation

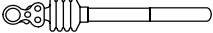

Accelerator/Potentiometer

Removal and Installation

Refer to [Accelerator/Potentiometer](#) in the Powertrain section.

Batteries

Required Tools

High Voltage Insulated Gloves, 100-F036 or Equivalent		Battery Post Torque Wrench, 307-026 or Equivalent	
Battery Terminal Cap Opener, 418-F215		Face Shield, 100-F035 or Equivalent	

Removal

LEAD-ACID BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR BATTERIES TO PROTECT AGAINST SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

WARNING!

BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY OR DEATH. DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERIES. WHEN CHARGING OR WORKING NEAR THE BATTERIES, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE ADEQUATE VENTILATION.

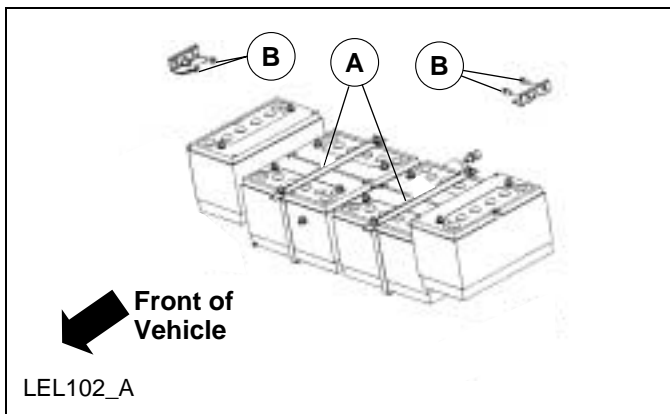
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

CAUTION:

If the type of battery (flooded to gel, gel to flooded) is being changed the instrument cluster gauge must be reprogrammed to avoid battery pack damage. The charging rate differs between type of battery and the battery water reminder indicator must be turned on for flooded type batteries. Refer to [Battery Type Reprogramming](#) procedure in this section.

1. Remove the driver and passenger seat. Refer to [Seat Back and Frame – Driver Seat](#) and [Seat Back and Frame – Passenger Seat](#) in the Body section.
2. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section
3. Turn the vehicle power off. Refer to [Power Shutdown Procedure](#) in this section.
4. Remove the “H” frame bolts and the “H” frame.
5. Remove the tie strap from the battery cable.
6. Remove the battery hold-down strap nuts (A) and battery hold-down bracket bolts (B).



7. Remove the parking brake lever. Refer to [Parking Brake Lever](#) in the Chassis section.
8. Use Battery Terminal Cap Opener to open the battery terminal covers.
9. Disconnect the battery cables. Make note of their locations before removing.

WARNING!

WHEN LIFTING A BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO LEAK OUT THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY, DAMAGE TO THE VEHICLE OR BATTERY. LIFT WITH BATTERY CARRIER.

CAUTION:

Do not use a battery carrier that lifts by the battery posts. Internal battery damage could occur.

10. Use a side clamping battery carrier, and carefully remove the batteries.

Installation**WARNING!**

WHEN LIFTING A BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO LEAK OUT THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY, DAMAGE TO THE VEHICLE OR BATTERY. LIFT WITH BATTERY CARRIER.

CAUTION:

Do not use a battery carrier that lifts by the battery posts. Internal battery damage could occur.

CAUTION:

When replacing a battery or batteries, all of the batteries in the battery pack including the new battery (batteries) should be fully charged over night to prevent an uneven charge condition that will cause premature failure and could reduce the life of the battery pack.

CAUTION:

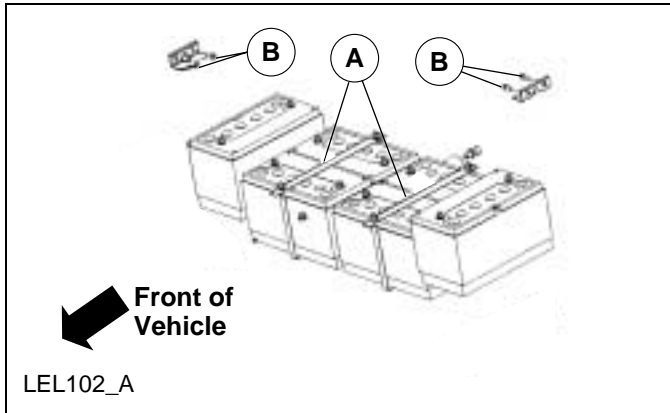
Do not mix flooded and gel type batteries. Damage to the battery pack will occur.

Note:

To ensure full battery life and vehicle range if the battery pack has been in service for more than one month the complete battery pack must be replaced.

1. Use a side clamping battery carrier, and carefully install the batteries.

2. Install the battery hold-down straps and brackets. Tighten the battery hold-down strap nuts (A) to 8N.m. (70lb-in.) Tighten the battery hold-down bracket bolts (B) to 24-28N.m. (18-20lb-ft.)



3. Install a new tie strap to hold the battery cable in place.
4. Install the parking brake lever. Refer to [Parking Brake Lever](#) in the Chassis section.
5. Apply Electrical Grease F8AZ-19G208-AA or equivalent meeting Ford specification WSB-M1C239-A to the battery posts.
6. Refer to the mounting notes during removal and connect the battery cables. Use Battery Post Torque Wrench to tighten the battery cable clamp nuts to 12-15N.m. (107-132lb-in.).
7. Install the “H” frame. Tighten the “H” frame bolts to 20-30N.m. (15-22lb-ft.).
8. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section
9. Turn the vehicle power on. Refer to [Power Shutdown Procedure](#) in this section.

Charger

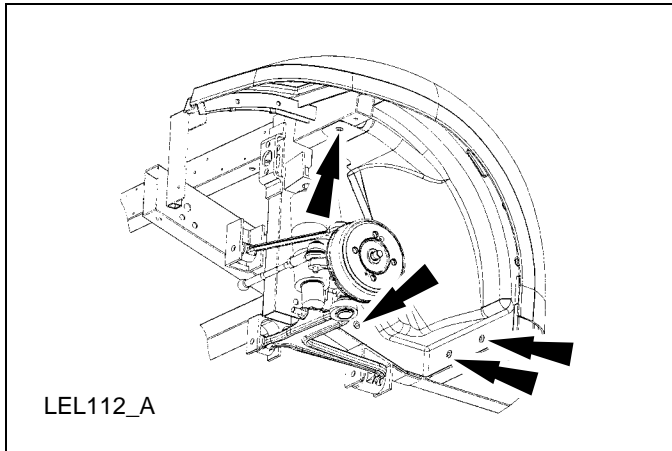
Removal

WARNING!

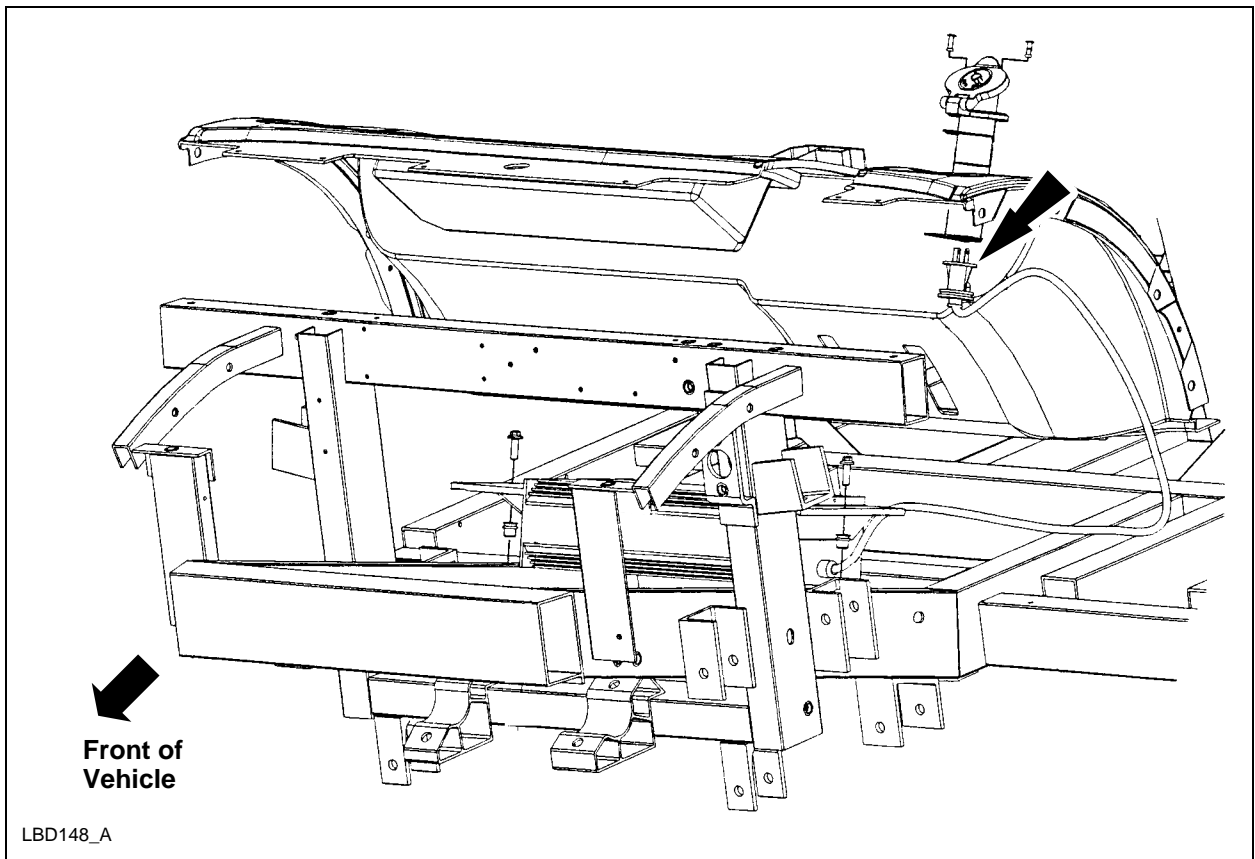
MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section
2. Turn the vehicle power off. Refer to [Power Shutdown Procedure](#) in this section.
3. Unlock and remove the hood.

4. Raise and support the vehicle.
5. Drill out the four rivets and remove the LH fender shield.

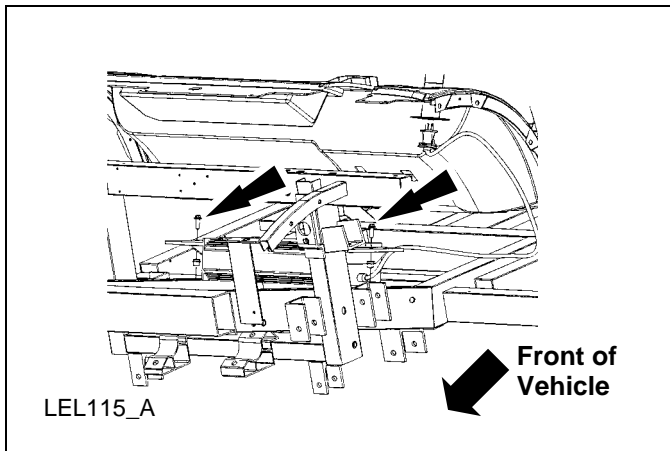


6. Press in the retaining button on the battery charger inlet plug and remove the battery charger inlet plug from the front floor kick-up.



7. Lower the vehicle.

8. Disconnect the two electrical connectors and remove the two charger bolts.



Installation

1. Reverse the removal procedure.
2. Tighten the two charger bolts to 24-28N.m. (18-20lb-ft.)

Contactor

Removal

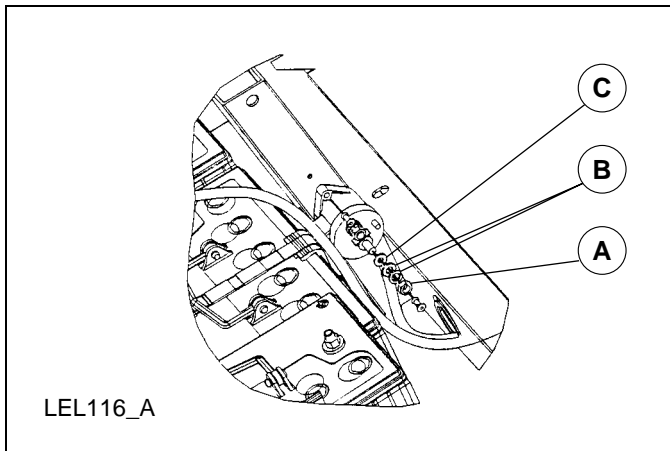
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

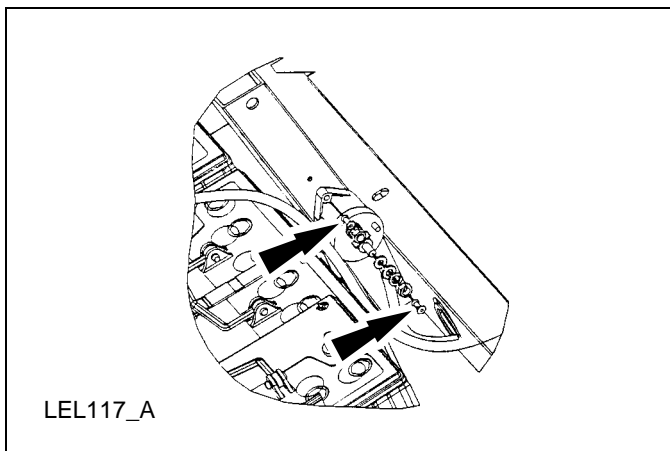
1. Turn the vehicle power off. Refer to [Power Shutdown Procedure](#) in this section.
2. Remove the upper nut (A) attaching the cable to the service disconnect switch and remove the washers (B) and disconnect the cables (C).



3. Remove the lower nut (A) attaching the cable to the motor controller, remove the washers (B) and disconnect the cable (C).



4. Remove the two plastic rivets and the contactor.



Installation

1. Reverse the removal procedure.
2. Tighten the contactor cable nuts to 8-10N.m. (71-88lb-in.)

Controller, Motor

Removal and Installation

Refer to [Motor Controller](#) in the Powertrain section.

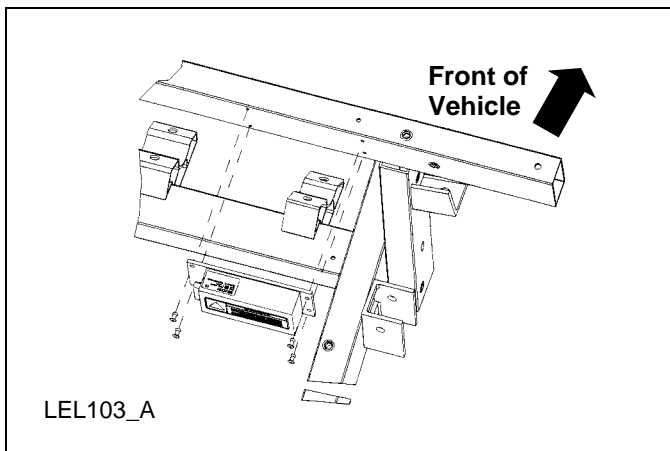
Converter 1, DC/DC -Standard

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
2. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
3. Remove the front floor kick-up. Refer to [Front Floor Kick-up](#) in the Body section.
4. Disconnect the DC/DC converter 1 (standard) electrical connector.
5. Drill out the four rivets and remove the DC/DC converter 1 (standard).



Installation

Reverse the removal procedure.

Converter 2, DC/DC - Optional

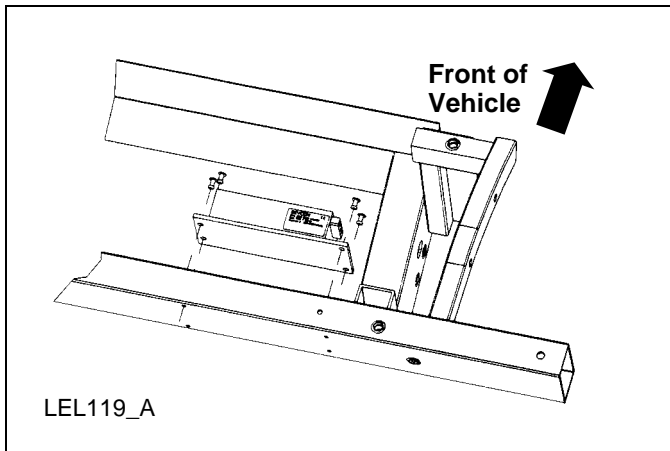
Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
2. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.

3. Unlock and remove the hood.
4. Disconnect the DC/DC converter 2 (optional) electrical connector.
5. Drill out the four rivets and remove the DC/DC converter 2 (optional).



Installation

Reverse the removal procedure.

Instrument Cluster Gauge

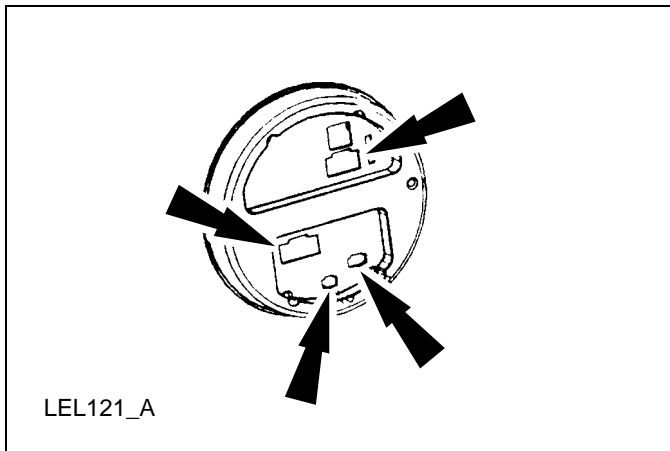
Removal

WARNING!

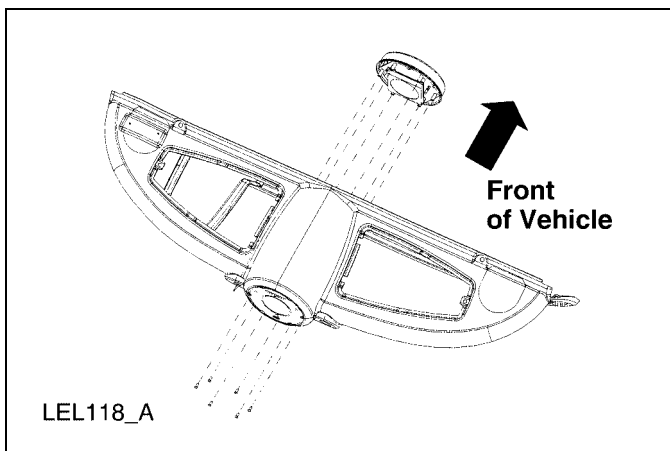
MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. If replacing the instrument cluster gauge, turn the drive mode selector switch to D and make a note of the odometer reading. Make sure the odometer is not in TRIP mode.
2. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
3. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
4. Remove the RH cowl tray scrivet and the RH cowl tray.

5. Disconnect the four electrical connectors from the instrument cluster gauge.



6. While supporting the instrument cluster gauge from behind the instrument panel remove the six instrument cluster gauge screws.



7. Remove the instrument cluster gauge through the cowl tray opening.

Installation

Note:

Federal law requires that the odometer in any replacement speedometer must register the same mileage as that registered in the removed speedometer. Since the mileage cannot be reset on this unit, affix an odometer sticker to the inner area of the A-pillar at the front LH side of the vehicle and record the original mileage.

1. Reverse the removal procedure.
2. Tighten the instrument cluster gauge screws to 0.85-1.15N.m. (7.5-10.1lb-in.)

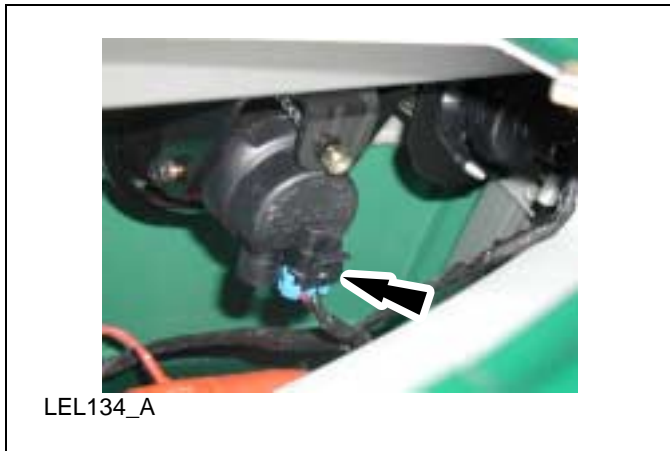
Headlamp

Removal

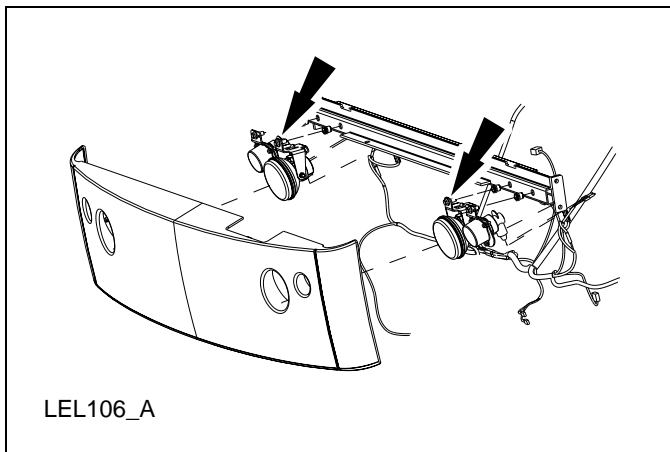
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the front fascia. Refer to [Fascia – Front](#) in the Body section.
2. Disconnect the headlamp electrical connector.



Remove the headlamp bracket bolt and the headlamp assembly.



Installation

1. Reverse the removal procedure.
2. Tighten the headlamp bracket bolt to 24-31N.m. (18-22lb-ft.)

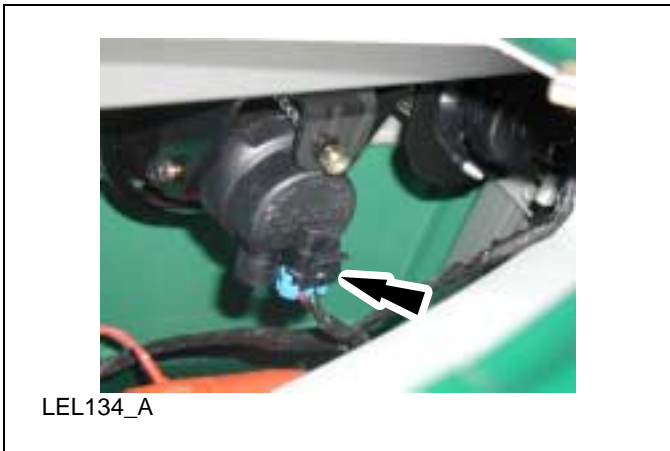
Headlamp Bulb

Removal

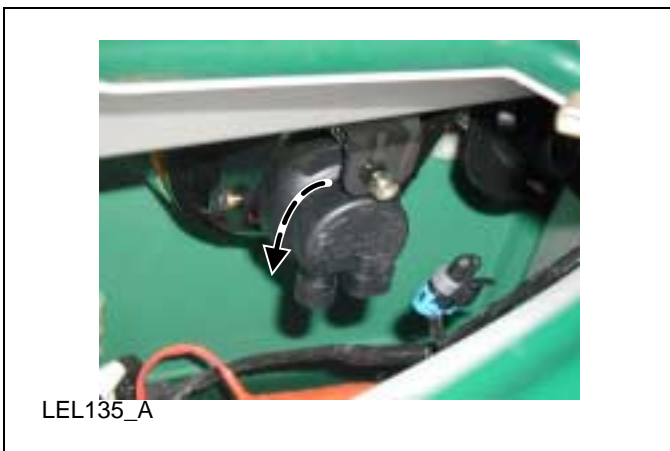
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

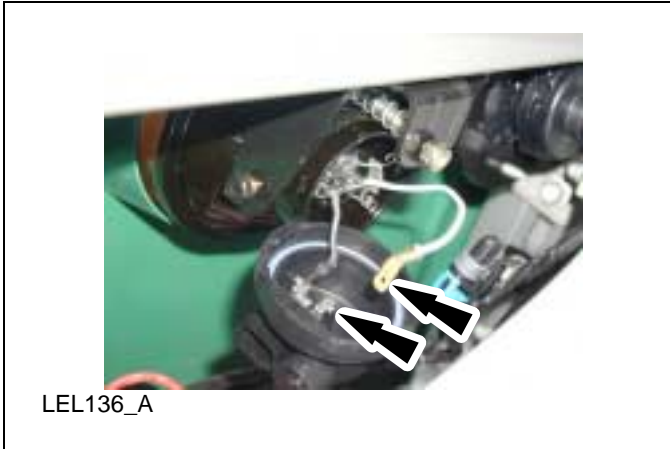
1. Remove the scrivet and the cowl tray panel.
2. Disconnect the headlamp electrical connector.



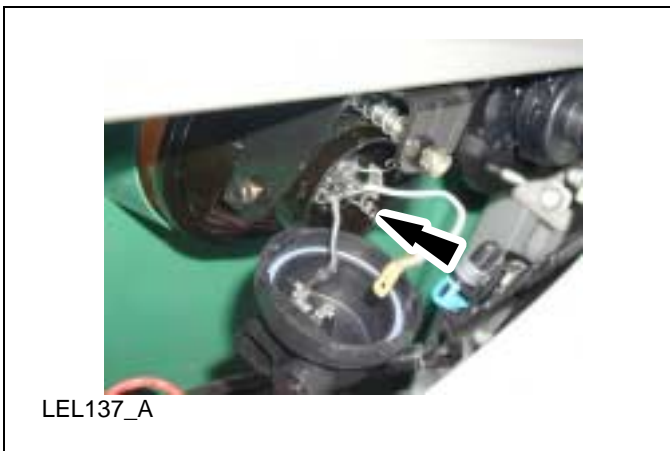
3. Rotate the headlamp bulb shield counterclockwise and flip down to access the bulb connectors.



4. Pull the flat connector attached to the white wire from the headlamp bulb shield.



5. Push and squeeze the two bulb retainer wires to disengage them from the headlamp housing. Remove the headlamp bulb.

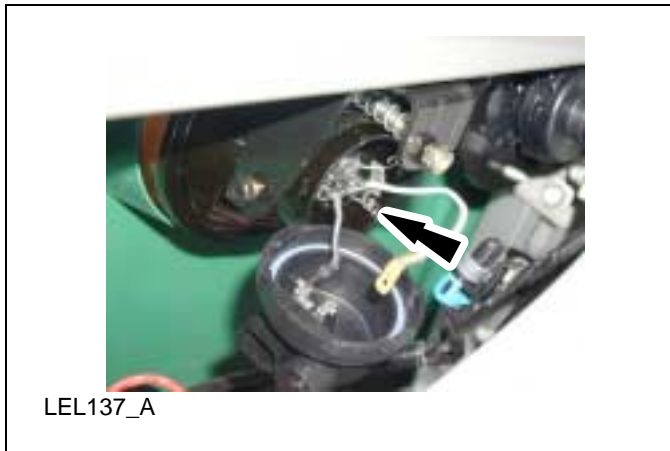


Installation

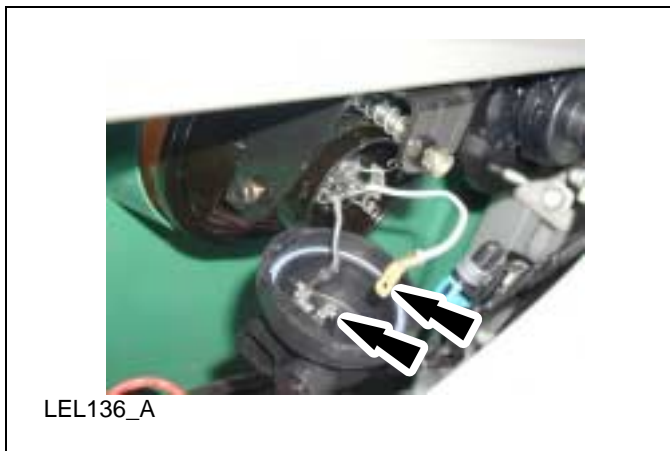
WARNING!

HANDLE A HALOGEN HEADLAMP BULB CAREFULLY AND KEEP OUT OF CHILDREN'S REACH. GRASP THE BULB ONLY BY ITS METAL BASE AND DO NOT TOUCH THE GLASS. THE OIL FROM YOUR HAND COULD CAUSE THE BULB TO BREAK THE NEXT TIME THE HEADLAMPS ARE OPERATED.

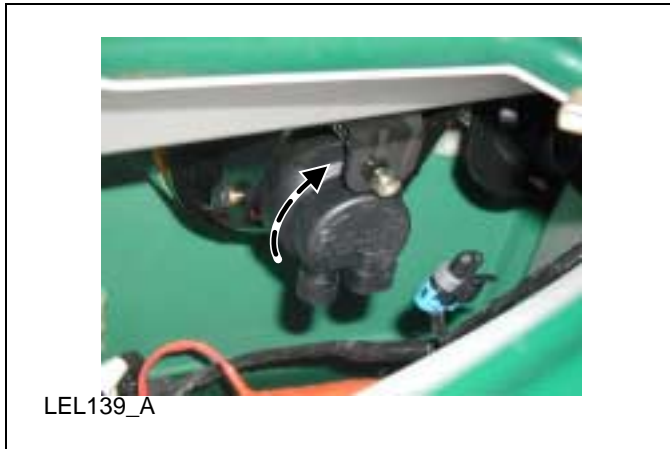
1. Install the headlamp bulb. Squeeze and push the two bulb retainer wires to engage them to the headlamp housing.



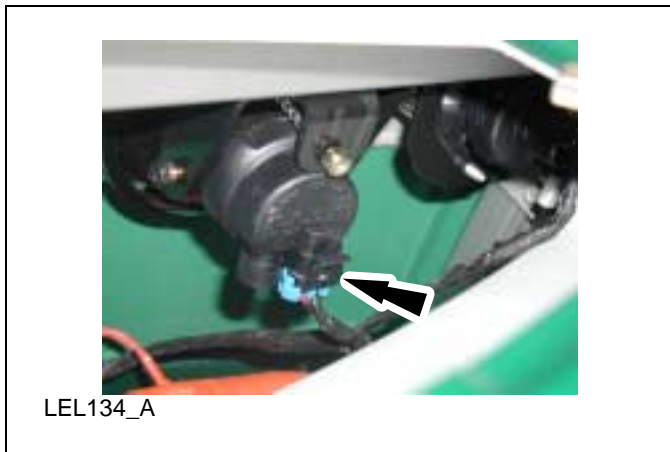
2. Push the flat connector attached to the white wire into the headlamp bulb shield.



3. Install and rotate the headlamp bulb shield clockwise.



4. Connect the headlamp electrical connector.



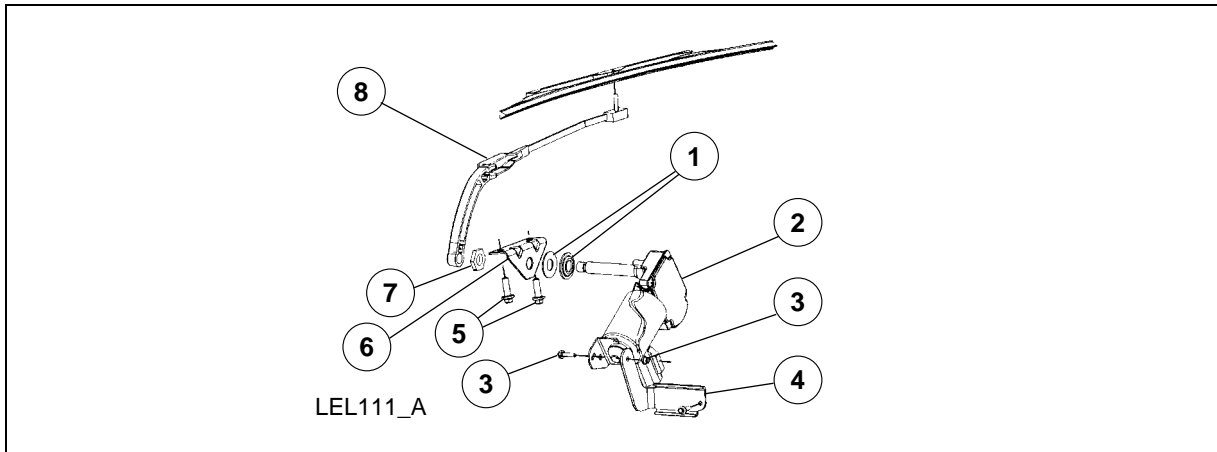
5. Install the cowl tray panel and the scrivet.

Motor

Removal and Installation

Refer to [Motor](#) in the Powertrain section.

Motor, Wiper



Item	Part Number	Description
1	--	Wiper Motor Shaft Washers
2	17508	Wiper Motor
3	--	Wiper Motor to Lower Bracket Nut and Bolt
4	17496	Wiper Motor Lower Bracket
5	--	Wiper Motor Upper Bracket Bolts
6	17496	Wiper Motor Upper Bracket
7	--	Wiper Motor Shaft Nut
8	17526/17528	Wiper Arm And Blade

Removal

WARNING!

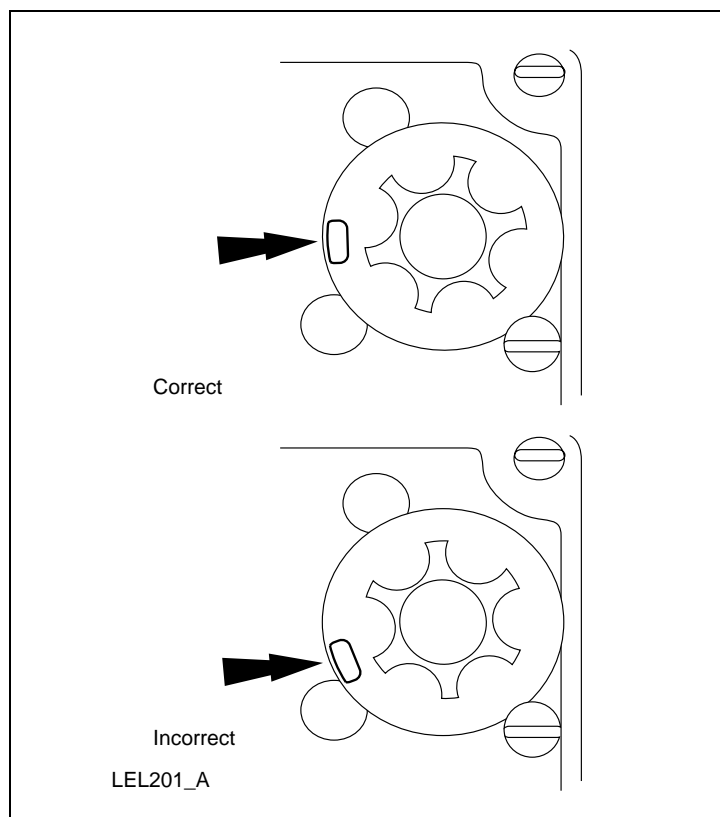
MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the front fascia. Refer to [Fascia – Front](#) in the Body Section.
2. Remove the windshield wiper arm by pressing the release lever and firmly pulling the arm straight off the shaft.
3. Remove the wiper motor shaft nut.

4. Disconnect the wiper motor electrical connector.
5. Remove the wiper motor to lower bracket nut and bolt and remove the wiper motor.

Installation

1. Reverse the removal procedure.
2. Tighten the wiper motor to lower bracket nut to 5-7N.m. (45-61lb.in.).
3. If the wiper motor was replaced adjust the wiper park as follows:
 - a. Turn the vehicle power on but leave the wiper switch OFF.



- b. Loosen the setscrew and rotate the disc clockwise until the wiper activates then rotate the disc counterclockwise until the wiper stops working.

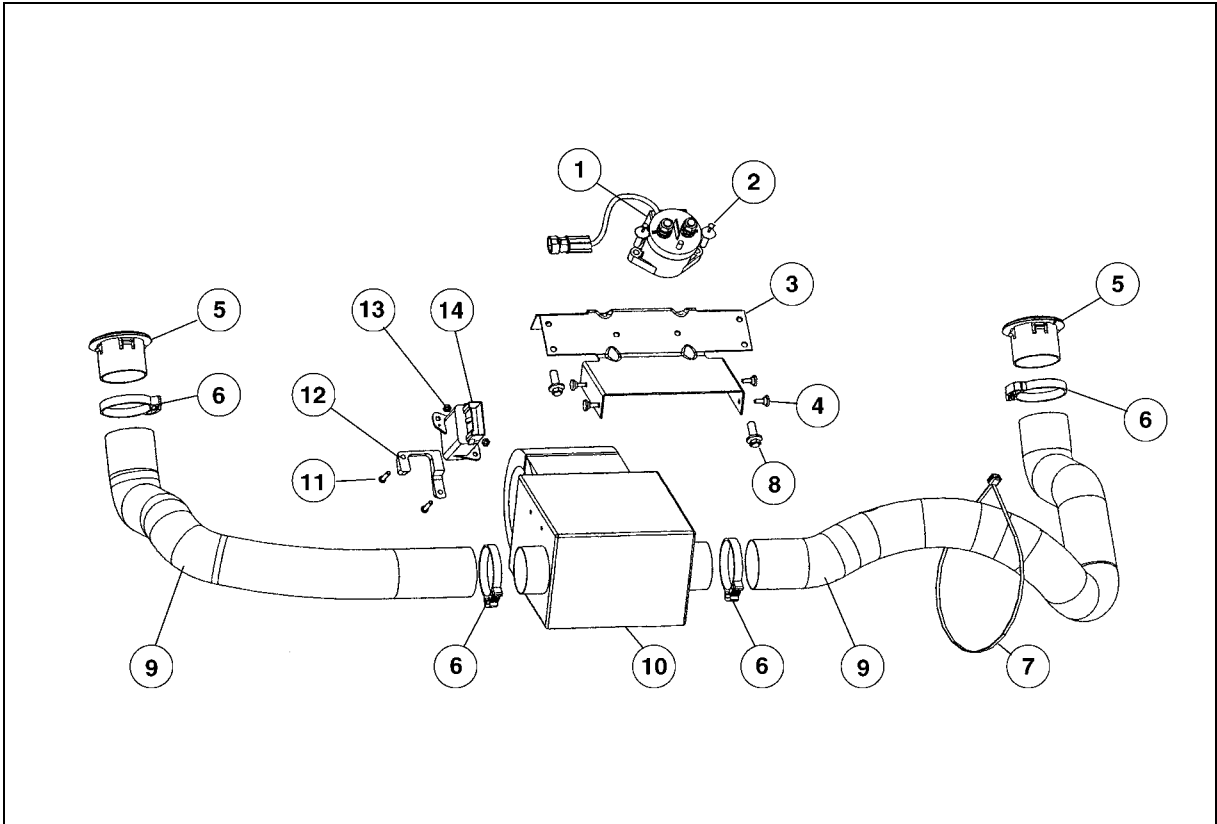
Note:

Make sure the windshield is wet prior to cycling the wipers on.

- c. Tighten the setscrew and then cycle and park the wiper on wet glass a few times.
 - d. Repeat as necessary to ensure wiper blade park position is parallel and 4" from the top of the black border on the windshield.

Heater/Defogger System Components

As viewed from the front of the vehicle.

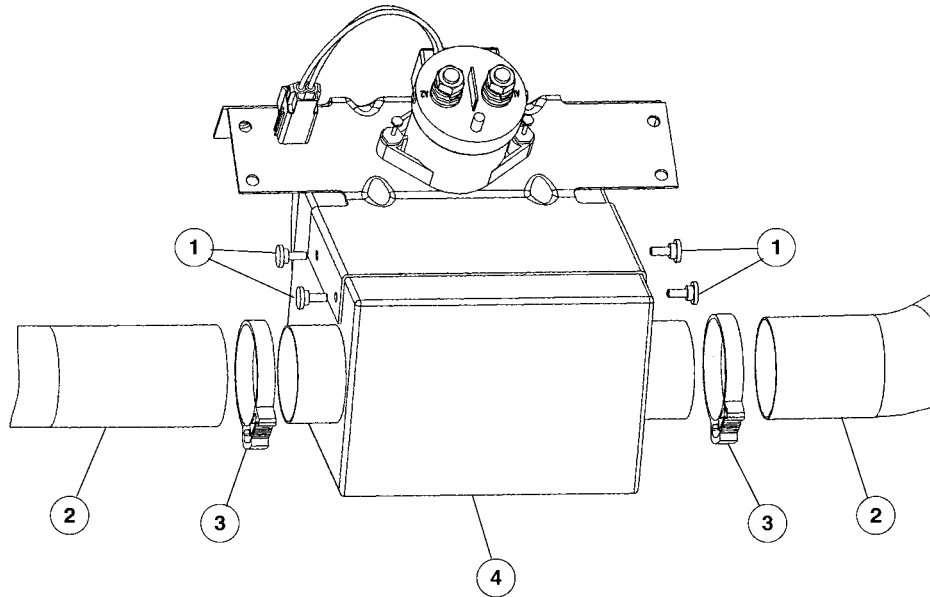


LEL206-A

Item	Part Number	Description
1	--	Heater/defogger contactor
2	--	Rivet
3	--	Heater/defogger bracket
4	--	Heater/defogger screws
5	--	Heater/defogger duct
6	--	Nylon clamps
7	--	Tie strap
8	--	Heater/defogger bracket bolt

Item	Part Number	Description
9	--	Vent hose
10	--	Heater/defogger assembly
11	--	Heater/defogger switch screws
12	--	Heater/defogger switch spacer
13	--	Heater/defogger switch nut
14	--	Heater/defogger switch

Heater/Defogger Assembly



LEL204-A

Item	Part Number	Description
1	--	Heater/defogger screws
2	--	Vent hoses
3	--	Nylon clamps
4	--	Heater/defogger assembly

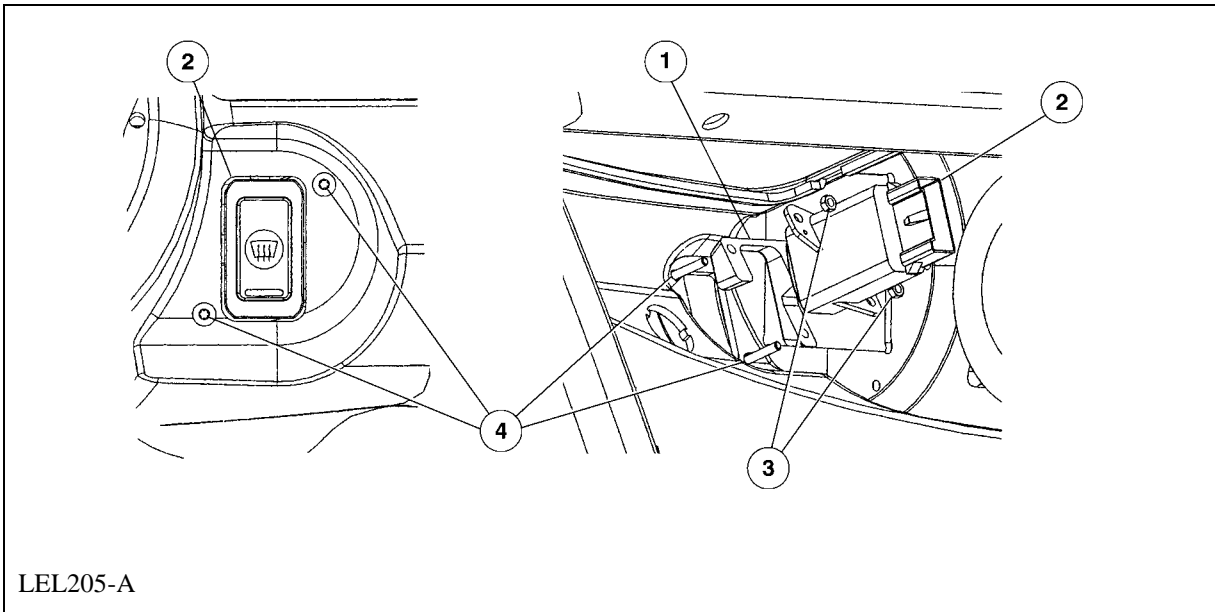
Removal

1. Remove the front fascia. Refer to [Fascia – Front](#) in the Body section.
2. Loosen the two nylon clamps and slide the vent hoses off of the heater/defogger housing.
3. Disconnect the heater/defogger electrical connector.
4. Support the heater/defogger assembly and remove the four heater/defogger screws.

Installation

Reverse the removal procedure.

Heater/Defogger Switch



Item	Part Number	Description
1	--	Heater/defogger switch spacer
2	--	Heater/defogger switch
3	--	Heater/defogger switch nuts
4	--	Heater/defogger switch screws

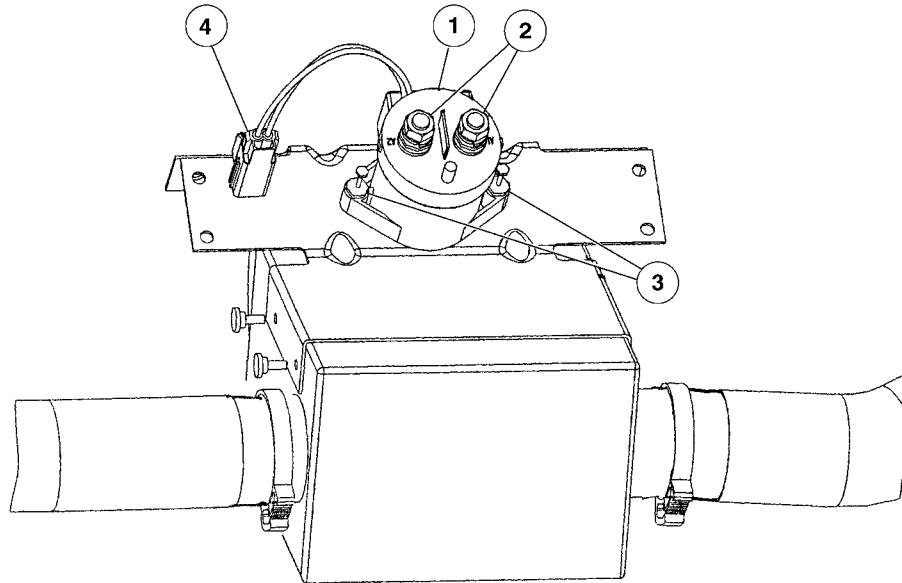
Removal

1. Remove the scrivet and the RH cowl tray panel.
2. Disconnect the heater/defogger switch electrical connector
3. Remove the heater/defogger switch nuts.
4. Remove the heater/defogger switch screws, heater/defogger switch and spacer.

Installation

1. Reverse the removal procedure.
2. Tighten the heater/defogger switch nuts to 1.75-2.25N.m (15.4-19.9lb-in.).

Heater/Defogger Contactor



LEL207-a

Item	Part Number	Description
1	--	Heater/defogger contactor
2	--	Heater/defogger contactor cable nuts
3	--	Rivets
4	--	Heater/defogger contactor electrical connector

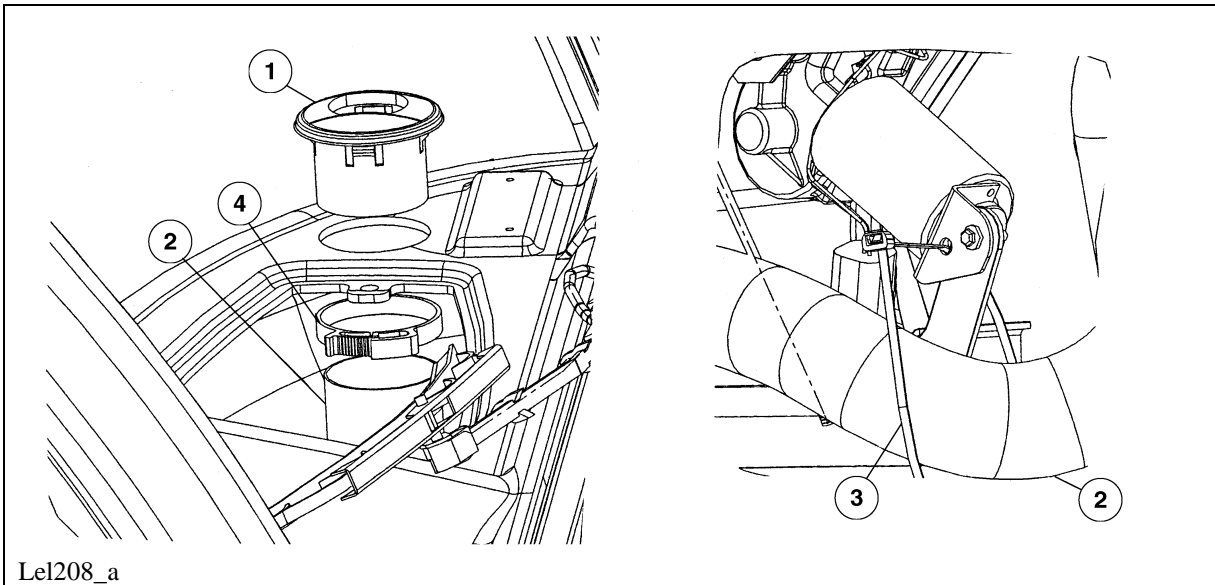
Removal

1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
2. Remove the front fascia. Refer to [Fascia – Front](#) in the Body section.
3. Disconnect the heater/defogger contactor electrical connector.
4. Note the wire locations and remove the heater/defogger contactor cable nuts.
5. Drill out the rivets and remove the heater/defogger contactor.

Installation

1. Reverse the removal procedure.
2. Tighten the heater/defogger contactor cable nuts to 8-10N.m. (71-88lb-in.).

Heater/Defogger Duct and Hose



Item	Part Number	Description
1	--	Heater/defogger duct
2	--	Vent hose
3	--	Tie strap
4	--	Nylon clamp

Removal

1. If removing the LH duct and/or hose, remove the front fascia. Refer to [Fascia – Front](#) in the Body section.
2. If removing the RH duct and/or hose, remove the scrivet and the cowl tray panel.
3. Remove the nylon clamp and slide the vent hose off of the heater/defogger duct.
4. If necessary, remove the heater/defogger duct.

5. Remove the nylon clamp and slide the vent hose off of the heater/defogger housing.
6. If removing the LH vent hose, cut and remove the tie strap.
7. Remove the vent hose.

Installation

Reverse the removal procedure.

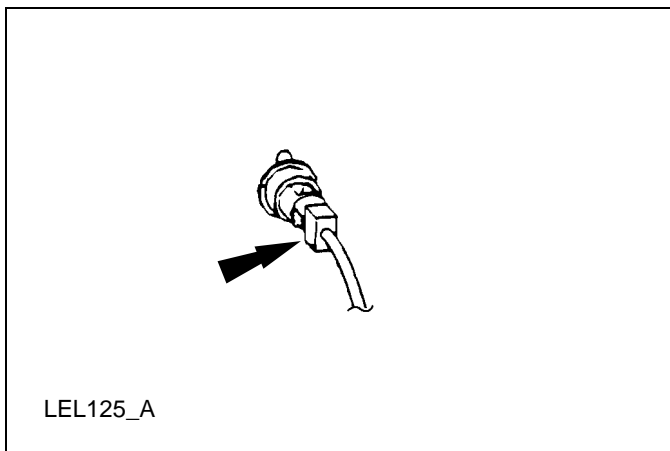
Power Point, 15A DC/DC

Removal

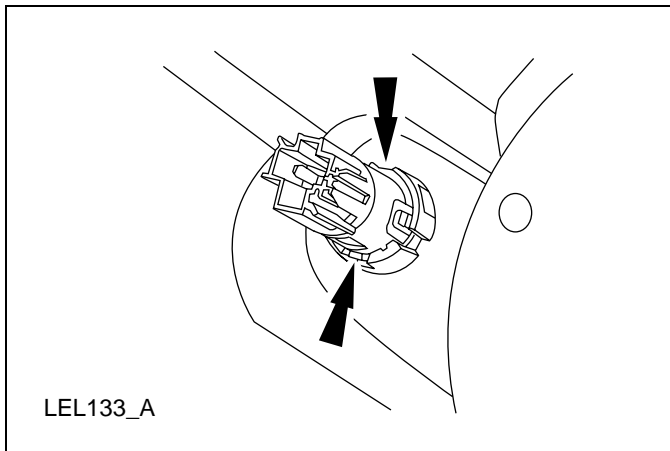
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
2. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
3. Remove the scrivet and the RH cowl tray.
4. Disconnect the power point electrical connector.



- Squeeze the two tabs and remove the power point socket.



Installation

Reverse the removal procedure.

Electronic Flasher

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

- Remove the four steering column shroud screws and two pushpins and the lower steering column shroud.
- Remove the electronic flasher.

Installation

- Reverse the removal procedure
- Tighten the steering column shroud screws to 2.7-3.7N.m. (23.8-32.7lb-in.)

Temperature Sensor

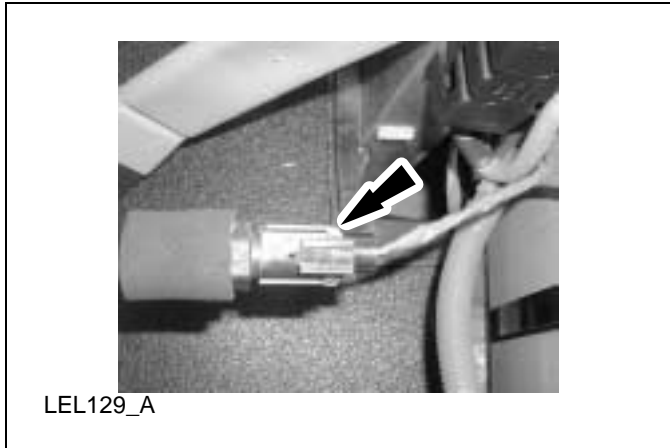
Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

- Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.

2. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
3. Remove the temperature sensor and disconnect the temperature sensor electrical connector.



4. Carefully remove the insulator from the switch. If damaged, replace the insulator.

Installation

Reverse the removal procedure.

Switch, Drive Mode Selector

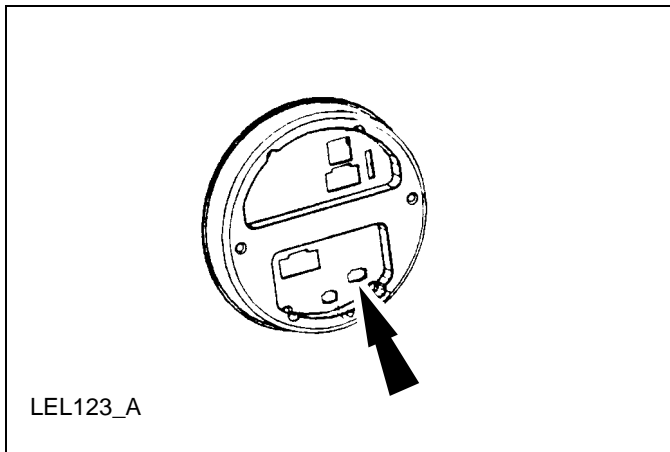
Removal

WARNING!

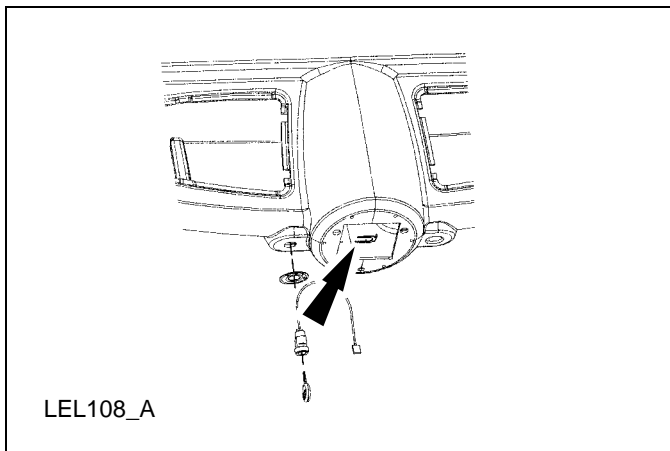
MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
2. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
3. Remove the scrivet and the LH or RH cowl tray.

4. Disconnect the drive mode selector switch electrical connector from the back of the instrument cluster gauge.



5. Remove the spring clip retainer and the drive mode selector switch.



Installation

Reverse the removal procedure.

All locks should be replaced when replacing drive mode selector switch.

Switch, Horn

Removal and Installation

The horn switches are not serviced separate from the steering wheel.

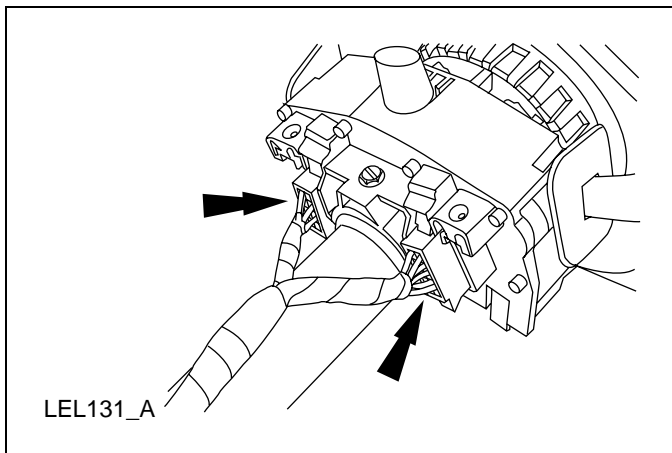
Switch, Multifunction

Removal

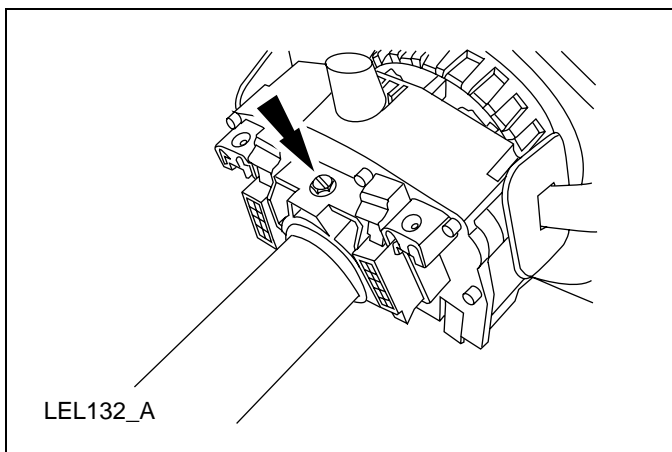
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.
3. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
4. Remove the four steering column shroud screws and the steering column shroud.
5. Disconnect the two multifunction switch electrical connectors.



6. Remove the multifunction switch screw.



Installation

1. Reverse the removal procedure.

2. Tighten the multifunction switch screw to 2.5-3.7N.m (22.1-32.7lb-in.).
3. Tighten the four steering column shroud screws to 2.7-3.7N.m (23.8-32.7lb-in.).

Switch, Service Disconnect

Removal and Installation

The service disconnect switch can only be replaced with the newer style including the connector. If the vehicle is equipped with the hard wired service disconnect switch the harness will have to be replaced. Refer to [Wiring Harness](#) in this section for the locations of the wiring harnesses and service disconnect switch.

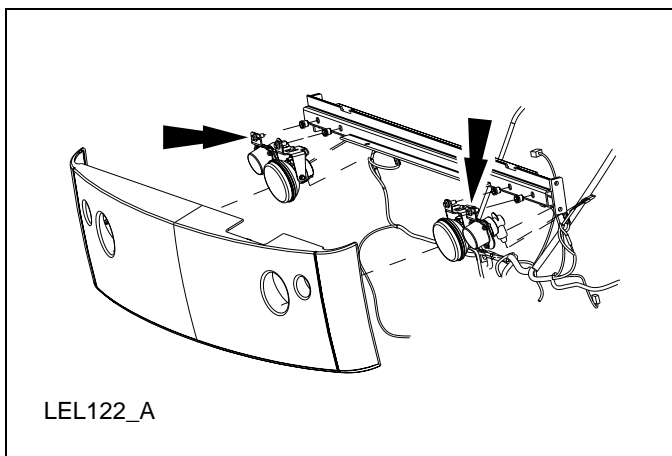
Front Turn Signal

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Remove the front fascia. Refer to [Fascia – Front](#) in the Body section.
2. Disconnect the front turn signal electrical connector.
3. Remove the front turn signal bracket bolt and the front turn signal assembly.



Installation

1. Reverse the removal procedure.
2. Tighten the front turn signal bracket bolt to 24-31N.m. (18-22lb-ft.)

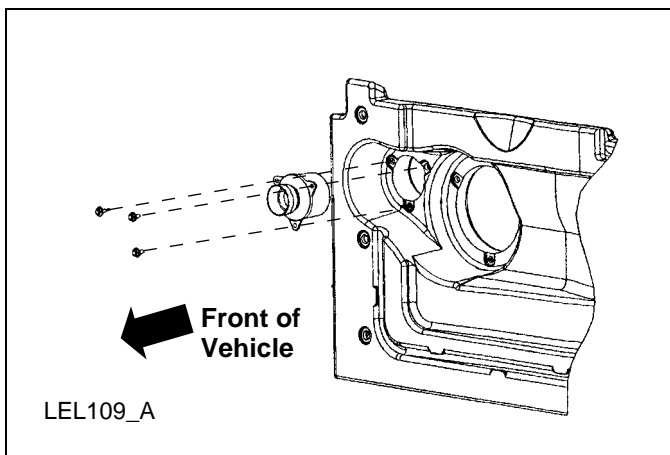
Rear Turn Signal

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

1. Unlock and remove the decklid.
2. Remove the six rear bumper bolts and support the rear bumper.
3. Disconnect the rear turn signal electrical connector.
4. Remove the three rear turn signal screws and the front turn signal assembly.



Installation

1. Reverse the removal procedure.
2. Tighten the three rear turn signal screws to 1.9-2.7N.m. (17-23lb-in.)
3. Tighten the six rear bumper bolts to 3.3N.m. (29lb-in.)

Wiring Harnesses – 12V

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

Note:

When replacing a wiring harness, contact Hotline for assistance with special steps for modifying the floor panels for additional clearance.

To service the wiring harnesses refer to [Harness Routing](#) in this section for locations of harnesses.

1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
2. Remove any necessary components to access the wiring harnesses, electrical connectors and wiring harness fasteners.
3. Remove the applicable wiring harness.

Installation

Reverse the removal procedure.

Wiring Harnesses – 72V (Front of vehicle)

Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

Refer to [Harness Routing](#) in this section for assistance in locating of harnesses.

1. Unlock and remove the hood.
2. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
3. Remove the instrument panel. Refer to [Instrument Panel](#) in this section.
4. Disconnect the accelerator potentiometer electrical connector.
5. Remove the tape from the ferrate beads and then from the beads themselves.

6. Remove the leakage sensor lead (10 mm bolt & eyelet) from the front of the vehicle.
7. Disconnect the DC/DC converter from the high voltage wire harness.
8. Disconnect the charger electrical connector.
9. Remove the two rivets from the front passenger side of the vehicle that attach the dash to the frame. This is where the harness is going to be pulled through, so this needs to be done so that the connectors can be feed through.
10. Remove the front passenger side tire.
11. Remove the four rivets and the front passenger wheel well by removing the 4 rivets.
12. Pull the harness between the under body panel and the frame rail in the front passenger wheel well area

Installation

Reverse the removal procedure.

Wiring Harnesses – 72V (Mid vehicle)

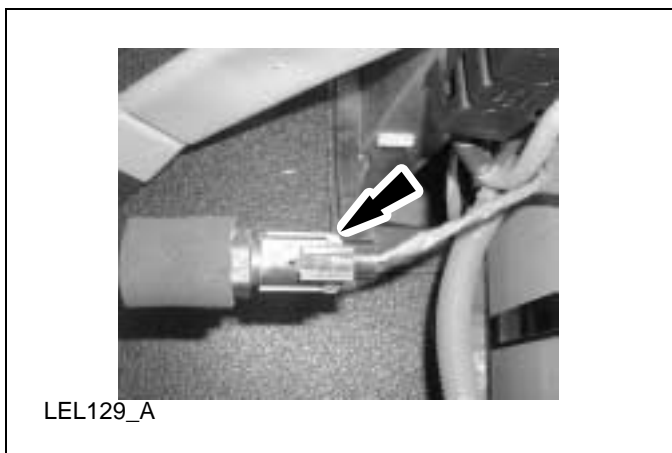
Removal

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

Refer to [Harness Routing](#) in this section for assistance in locating of harnesses.

1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
2. Disconnect the temperature sensor electrical connector.



3. Disconnect the contactor electrical connector.
4. Disconnect the battery negative connection from the harness to battery negative 1.
5. Remove the cluster spade from the service disconnect switch fuse box.
6. Remove the DC/DC spade from the service disconnect switch fuse box.
7. Cut the charger connection lead to the service disconnect switch fuse box.
8. Remove the service disconnect switch box.
9. Cut out floor pan where the harness will go through, cut enough out so that the connectors can be feed through.
10. Remove the harness through the floor.

Installation

Reverse the removal procedure.

Wiring Harnesses – 72V (Rear of vehicle)

Removal

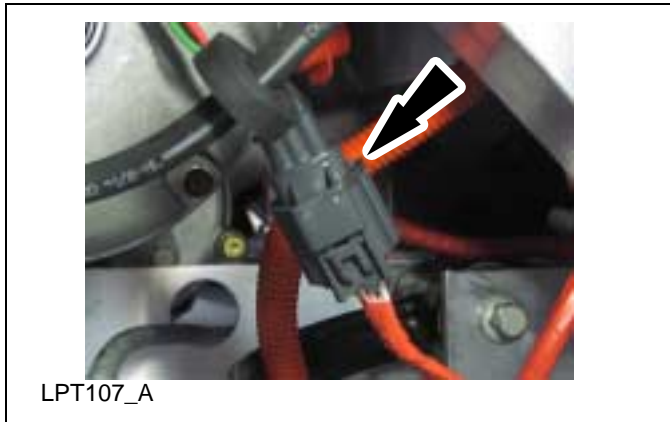
WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.

Refer to [Harness Routing](#) in this section for assistance in locating of harnesses.

1. Turn the vehicle power off. Refer to the [Power Shutdown Procedure](#) in this section.
2. Remove the rear passenger side tire.

3. Disconnect the motor tachometer/speed sensor electrical connector.



4. Disconnect the 23 pin motor controller electrical connector.
5. Remove the harness through the wheel well.

General Procedures

Battery Charging

WARNING!

THERE ARE GASES AROUND THE BATTERIES THAT CAN EXPLODE IF EXPOSED TO FLAMES, SPARKS, OR LIT CIGARETTES. THE AMOUNT OF GAS IS INCREASED DURING BATTERY CHARGING. AN EXPLOSION COULD RESULT IN PERSONAL INJURY OR VEHICLE DAMAGE.

WARNING!

BATTERIES CONTAIN SULFURIC ACID, WHICH CAN BURN SKIN, EYES, AND CLOTHING, IF CONTACTED.

WARNING!

DO NOT CHARGE THE BATTERIES WITH THE WEATHER ENCLOSURE CLOSED OR THE VEHICLE COVER IN PLACE. A BUILD UP OF HYDROGEN GAS CAN RESULT WHICH CAN EXPLODE. THE CHARGING AREA SHOULD BE WELL VENTILATED.

CAUTION:

If the vehicle is allowed to sit in conditions of -6°C (20°F) or less with a state of charge of 20% (one bar showing on gauge) or less, the batteries could freeze. Allowing the batteries to freeze may cause permanent damage to the batteries and permanently reduce their

capacity. In cold conditions, place the vehicle in an area greater than 0°C (32°F) and allow it to warm up before charging. Never charge the vehicle if the batteries may be frozen. Allow the batteries to warm above 0°C (32°F) first, then charge.

CAUTION:

Do not park and leave the vehicle with discharged batteries. The batteries could discharge to the point where damage could occur and the battery charger will not charge.

Note:

Make sure the service disconnect switch is on the ON position when charging.

To recharge the vehicle batteries:

Use only the GFCI cord supplied with the vehicle. If the GFCI cord does not fit the receptacle, have a qualified electrician install the proper outlet.

Note:

The outlet must be properly installed and grounded in accordance with all local codes and ordinances.

1. Park the vehicle within GFCI charger cord length of a 120 volt AC 15A grounded 3-prong wall outlet.
2. Place the key in the black dot (off) position, remove the key and set the parking brake.

Note:

Make sure the power point, if equipped, is not in use and the hazard lamps are not in use.

3. Plug the GFCI charger cord into the 120volt AC 15A grounded 3-prong wall outlet. Do not use any plug adapters or extension cords to make the electrical connection.

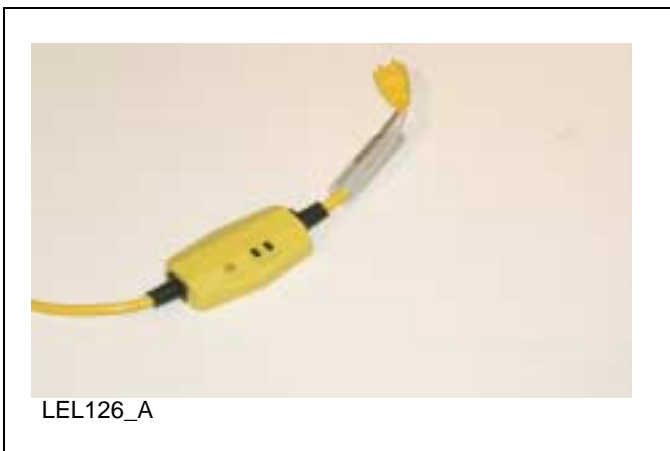
4. Open the charge inlet access door. Make sure that the inlet is clean and dry.



5. Align the GFCI charger cord with the charge inlet and fully insert the plug into the outlet.



6. Verify the POWER indicator is illuminated on the GFCI charger cord. Also, the battery charge indicator on the instrument panel cluster will illuminate during the charging process.



Note:

The humming noise you will hear is the transformer on the charger, which will operate regardless of whether the vehicle is accepting the charge.

Note:

If the charge indicator fails to display make sure the service disconnect switch is in the “ON” position.

To stop charging the vehicle batteries:

1. Push the TEST button on the GFCI charger cord. Verify the power indicator on the GFCI is off.
2. Disconnect the GFCI charger cord from the wall outlet.
3. Disconnect the GFCI charger cord from the charge inlet.
4. Close the charge inlet access door.
5. Store the cord in a safe and dry location.

Vehicle Storage -- Battery

WARNING!

TO AVOID SERIOUS INJURY OR DEATH NEVER PERFORM ANY VEHICLE SERVICE OR MAINTENANCE WHILE THE ELECTRICAL LEAKAGE WARNING IS ILLUMINATED REFER TO ELECTRICAL LEAKAGE DETECTION IN THIS SECTION AND RESOLVE THE LEAKAGE CONDITION PRIOR TO BEGINNING OTHER REPAIRS.

The service disconnect switch (see below) is located either under the driver seat cushion or toward the center of the vehicle behind the parking brake lever within the seat stanchion. The front of the seat stanchion cover should be removed to access the service disconnect switch and the fuse holders on vehicles with the switch located behind the parking brake lever. It is not encouraged to blindly reach down through the opening on top of the driver's side seat stanchion cover when the cushion is removed.

The vehicle can be stored for 14 days with the service disconnect switch on. This assumes a full charge when stored. If 14 days is exceeded or the batteries were not fully charged prior to storing the vehicle the batteries may be severely discharged resulting in permanent damage. This would reduce the batteries capacity and vehicle range.

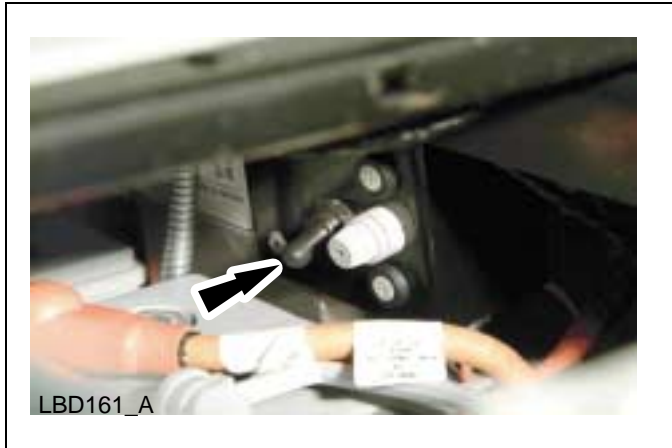
The vehicle can be stored with the service disconnect switch off for six months if starting with a full charge; however, the vehicle should be charged monthly if possible. With the service disconnect switch in the off position, there is a minimal draw from the vehicle components. The battery self discharge determines the storage time. This is less than 5% per month at temperatures between 4 and 21°C (40° and 70° F). The self-discharge rate increases slightly at higher temperatures. If the batteries are nearly discharged then they may freeze at 0°C (32°F) and below. This will cause severe damage that may even cause battery case damage and leakage of the electrolyte and the inability to operate the vehicle.

When storing the neighbor:

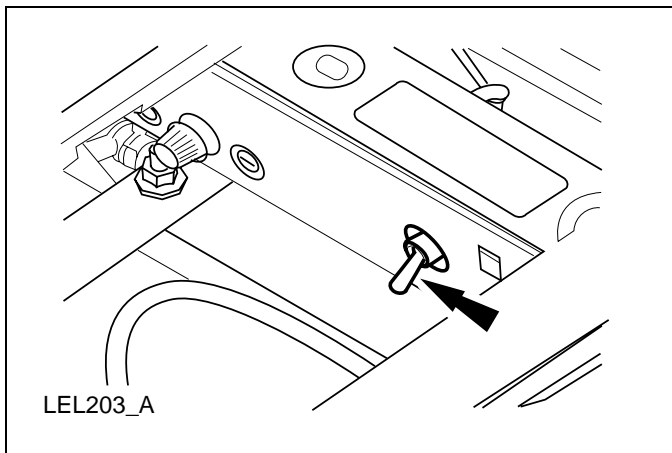
1. Make sure the batteries are fully charged. Refer to [Battery Charging](#) in this section.

2. If storing the vehicle for more than 14 days toggle the service disconnect switch to the OFF position.

Switch shown in the “OFF” position

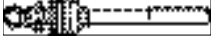

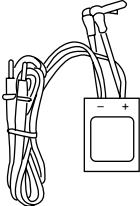


Switch shown in the “ON” position



Power Shutdown Procedure

Required Tools

High Voltage Insulated Gloves 100-F036 or Equivalent		Battery Post Torque Wrench 307-026 or Equivalent	
Battery Terminal Cap Opener 418-F215		Face Shield 100-F035 or Equivalent	
Capacitor Discharge Tool 418-F213		73 Digital Multimeter (DVOM) 105-R0051 or Equivalent	

Note:

This procedure is designed to lower the voltage present on the vehicle and reduce the risk of shock or hazard. At the end of this procedure, you will have split the battery pack into three 24V sub-units.

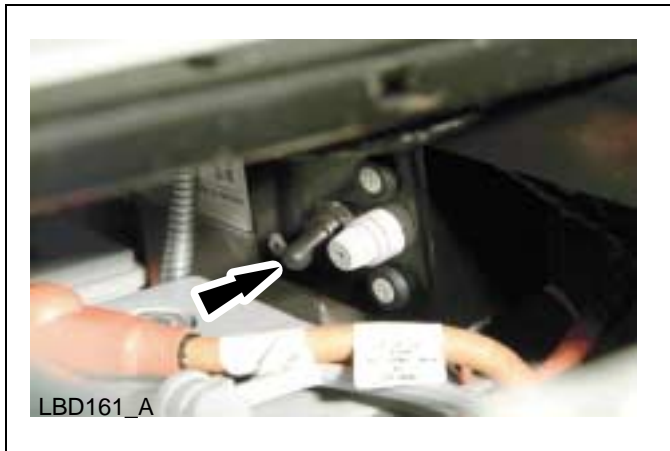
Note:

Continue to use all appropriate high voltage safety procedures when working on a vehicle.

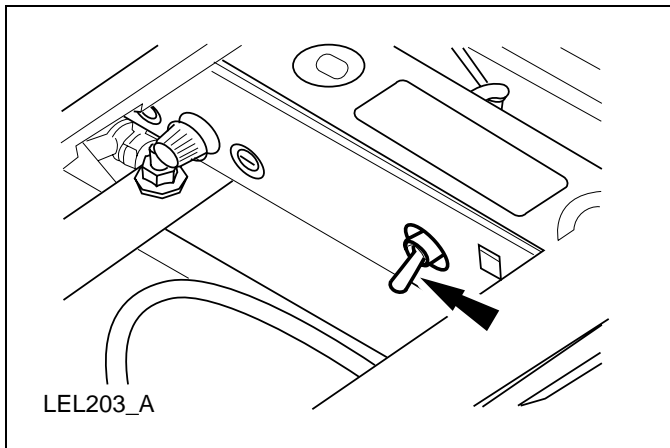
1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in the Body section.

2. Toggle the service disconnect switch to the OFF position and wait one minute. Refer to schematic item number 5.

Switch shown in the “OFF” position



Switch shown in the “ON” position



3. Connect the Capacitor Discharge Tool to the DVM. Set the DVOM for DC volts.

WARNING!

THE BATTERY PACK CONTAINS HIGH-VOLTAGE COMPONENTS AND WIRING. HIGH-VOLTAGE INSULATED SAFETY GLOVES AND FACE SHIELD MUST BE WORN WHEN PERFORMING THE FOLLOWING STEPS. FAILURE TO FOLLOW THIS WARNING MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

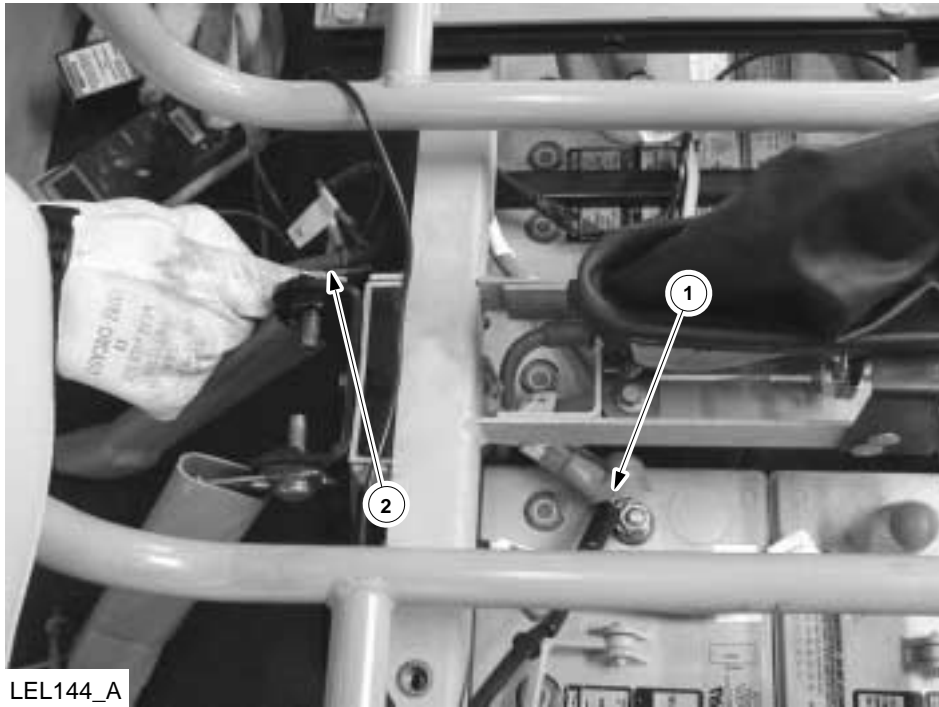
WARNING!

THE BATTERY PACK ASSEMBLY CAN DELIVER IN EXCESS OF 72 VOLTS OF DC POWER. IMPROPER HANDLING OF THE BATTERY PACK CAN RESULT IN INJURY OR FATALITY. ONLY AUTHORIZED PERSONNEL TRAINED TO WORK

WITH BATTERY PACK COMPONENTS ARE PERMITTED TO HANDLE THE BATTERIES.

WARNING!

MAKE SURE THE VEHICLE IS NOT BEING CHARGED.



Item	Description
1	Negative Probe of DVOM to B- (battery negative, labeled “BATT 1 NEG”).
2	Positive Probe of DVOM to Load Side of 10-Amp Controller Circuit Fuse.

To discharge the motor controller:

4. Touch the negative probe of the DVOM to the B- (battery negative, which is labeled “BATT 1 NEG”).
5. Touch the positive probe of the DVOM to the load side of the 10-amp fuse for the motor controller circuit. This will be the spade connector closest to the front of the fuse holder and it is labeled “GAUGE/MTR-CNTR”.
6. The DVOM will display any voltage present. Repeat steps 4 and 5 if DVOM reads more than 0 volts.

To discharge the DC/DC converter 1 (standard) or DC/DC converter 2 (optional):

7. Touch the negative probe of the DVOM to the B- (battery negative, which is labeled “BATT 1 NEG”).
8. Touch the positive probe of the DVOM to the load side of the 10-amp fuse for the DC/DC circuit. This will be the spade connector closest to the front of the fuse holder and it is labeled “DC/DC”.
9. The DVOM will display any voltage present. Repeat steps 7 and 8 if DVOM reads more than 0 volts.
10. Disconnect the battery cables at locations (3) and (4) and wrap the terminals on the cables with electrical tape.

4	Battery Pack Negative Cable
5	Service Disconnect Switch
6	DC/DC Converter 1 (standard)
7	Charger
8	Motor Controller
9	Motor
10	Motor Controller 23-Pin Connector
11	Contactors

Battery Water Reminder Indicator Resetting (Flooded Batteries Only)

Caution:

If the vehicle is equipped with flooded batteries, the instrument cluster gauge must be programmed for flooded batteries. Damage to the batteries can occur if the battery type is incorrectly programmed. Refer to [Battery Type Reprogramming](#) in this section.

Note:

The battery water reminder function of the instrument cluster gauge must be reset whenever the battery water has been checked and filled. The indicator will illuminate every 300miles (483kms). Battery electrolyte levels should be checked every 300 miles (483kms) or monthly, whichever comes first. The only time the battery water indicator can be reset is when the key is in the R (Reverse) position, the instrument cluster gauge is in the flooded battery mode and the battery water reminder indicator is on.

1. Turn the key to R (Reverse) position.
2. Press and hold the Select/Reset button for over 3 seconds.
3. Turn the key to the OFF (black dot) position.

Battery Type Reprogramming

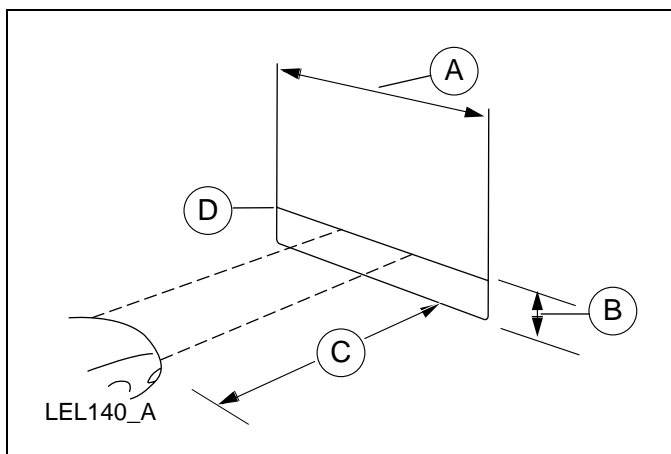
CAUTION:

If the type of battery (flooded to gel, gel to flooded) is being changed the instrument cluster gauge must be reprogrammed to avoid battery pack damage. The charging rate differs between type of battery and the battery water reminder indicator must be turned on for flooded type batteries.

1. With the key in the OFF (black dot) position, press and hold down the Select/Reset button.
2. Turn the key to the D (Drive) position.
3. Release the Select/Reset button.
4. Turn the key to the R (Reverse) position.
5. Press and release the Select/Reset button to alternate between the flooded and sealed battery modes.
6. Turn the key to the OFF (black dot) position. The gauge will automatically exit the reprogramming mode after 10 seconds or exit immediately by pressing the Select/Reset button.

Headlamp Adjustment

1. Park the vehicle on a level surface approximately 7.6m (25ft.) from a vertical wall or screen directly in front of it.



- A. Eight feet.
- B. Height of top of lamp beam to ground.

- C. Twenty five feet
 - D. Horizontal reference line.
2. Turn on the headlamps to illuminate the wall or screen.
 3. The top of the headlamp beam area should be between 2' – 2' 3" above the ground.
Adjust the headlamp adjustment nut until the beam is within this specification.



LEL138_A

Section 5 Body

Torque Specifications	3
Description and Operation	6
Exterior Body Components	6
Rivet Locations and Types	7
Floor and Kick-up Rivet Locations	8
Interior Body Components.....	9
Frame Components.....	11
Golf Rack.....	12
Seat Belts	13
Ball and Club Washer.....	14
2-Passenger Wagon Panels	15
Tailgate	17
Removal and Installation	18
Bag Bay.....	18
Box, Wagon	19
Expanded Trunk.....	20
Floor – Front & Rear, Scuff Panels, Rockers	21
Floor Kick-up – Front.....	29
Floor Kick-up – Rear	33
Fascia - Front	36
Fender - Front	36
Fender - Rear	37
Instrument Panel	38
Roof Rail – Rear	40
Roof Rail – Side.....	42
Roof Panel.....	45
Seat Back and Frame – Rear Seat.....	52
Seat Back and Frame – Driver Seat	54
Seat Back and Frame – Passenger Seat	55
Seat Back Cushion Cover	55

Seat Belt Buckle - Front.....	56
Seat Belt Buckle - Rear.....	57
Seat Belt Retractor - Front	58
Seat Belt Retractor - Rear	59
Seat Cushion	59
Seat Cushion Cover	59
Seat Stanchion Cover.....	60
Steering Wheel.....	63
Sun Roof/Roof Vent	64
Weather Enclosure	65
Windshield.....	73
Body Repair and Cleaning	77
Light Scuff Repair	77
Scratch Repair.....	78
Deep Gouge Repair for White Body Panels	79
Deep Gouge Repair for Non-White Body Panels.....	80
Wagon Box Cleaning.....	81
Frame Repair.....	81
Aluminum Alloys, Notes for Manual Welding	81
Manual Welding Equipment.....	81
Manual Welding Techniques	82
Cleaning	83
Additional Tools	83
Butt Welding.....	84
Burn-Through Weld Repair	87
Crack Inspection	87
Acceptability Criteria.....	88
Crack Repair	90
Frame Straightening.....	91
Frame Service Parts	91
Rear Frame to Side Frame Extensions.....	92
Frame Center Support.....	95

Seat Stanchion Center Support	97
Two-Passenger Wagon Frame Extenders and Mounts	102
Two-Passenger Frame Hole Locator Art – Top View	103
Two-Passenger Frame Hole Locator Art – Side View	104
Four-Passenger Frame Hole Locator Art – Top View	105
Four-Passenger Frame Hole Locator Art – Side View	106

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
B-pillar bolts	102-150	76-110	
B-pillar trim screws	20-30	15-22	
Ball club washer bracket bolts	23-33	17-24	
Ball club washer screws	0.8-1.2		7-10
Brake pedal pad bolt	24-31	18-22	
Expanded trunk bolts	23-33	17-24	
Fender bolts – front	8		70
Fender bolts – rear	8		70
Floor mat scrivets	9-13		80-115
Frame extender bolts	24-31	18-22	
Frame front upper crossmember bolt	24-31	18-22	
Front fascia bolts	3.3		29
Golf rack bolts	23-33	17-24	
Grab handle bolts	20-30	15-22	
High mount stop lamp screws	9-12		80-106
Hinge Bolt	41-60		
Hinge Bracket Screws	12-16		107-141
Instrument cluster gauge screws	2.7-3.7		24-32
Instrument panel bolts	10		88
Instrument panel bracket bolts	23-33	17-24	88
Lower windshield roof rail bolts	24-31	18-22	

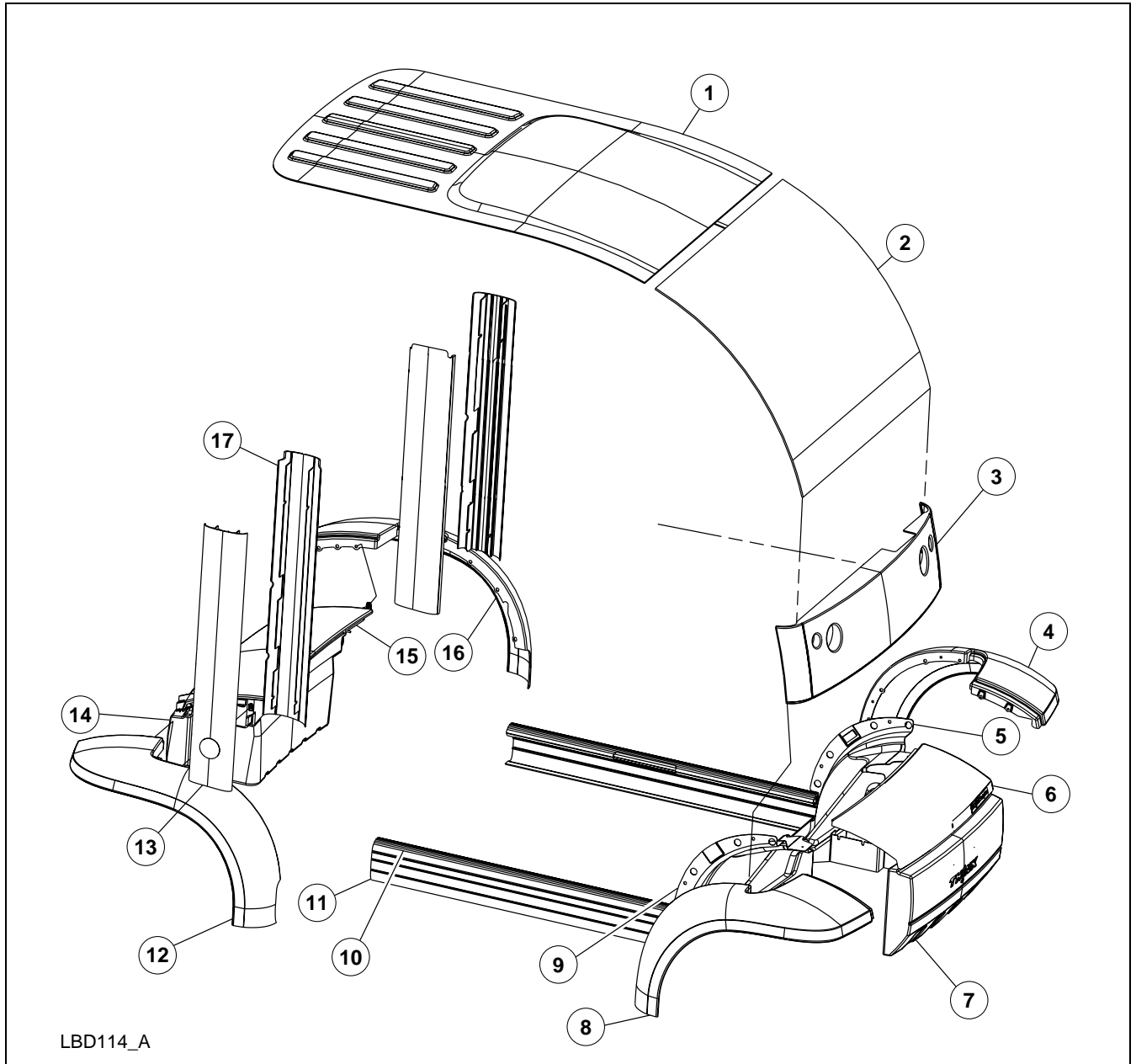
Description	Nm	Lb-Ft	Lb-In
Rear bumper bolts	3.3		29
Roof rail to cowl bracket bolts	24-31	18-22	
Roof rail reinforcement to B-pillar inner bolts	24-31	18-22	
Roof rail reinforcement to B-pillar lower bolts	11-13		98-115
Seat back cover screws – Rear	10		88
Seat back frame bolts – Rear	20-30	15-22	
Seat belt hanger bolt	26-34	19-25	
Seat belt retractor bolt – Front	26-34	19-25	
Seat belt retractor bolt – Rear	26-34	19-25	
Seat belt bolt	26-34	19-25	
Seat belt retractor bracket bolt	20-25	15-18	
Seat belt hanger bracket bolt – lower	9-12		80-106
Seat belt hanger bracket bolt – side	20-25	15-18	
Seat belt buckle bolts	26-34	19-25	
Seat frame slider bolts	12-14		107-123
Seat stanchion bolts	20-25	15-18	
Seat stanchion cover bolts	8		70
Seat stanchion H-support bolts	20-30	15-22	
Side Panel Bolts	6.8-9.2		60.2-81.4
Side view mirror	20-30	15-22	
Steering column shroud screws	2.7-3.7		23.9-32.7
Steering wheel bolt	47	34	
Stop lamp screws	0.8-1.2		7.1-10.6
Sun roof/roof vent screws	3		26
Sweater basket nut and bolt	23-33	17-24	
Tailgate Latch Receiver Screws	12-16		107-141
Tailgate Support Screws	12-16		107-141
Tow hook bolts	20-30	15-22	
Tow hook bracket bolts	20-30	15-22	

Description	Nm	Lb-Ft	Lb-In
Upper Trim Panel Screws	3.2-4.8		28.3-42.4
Upper windshield roof rail bolts	24-31	18-22	
Wagon box bolts – Lower	24-31	18-22	
Wagon box bolts – Side	24-31	18-22	
Wagon box bracket bolts	24-31	18-22	

* Should be tightened in alphabetic order shown in [2 Passenger Wagon Panels](#).

Description and Operation

Exterior Body Components



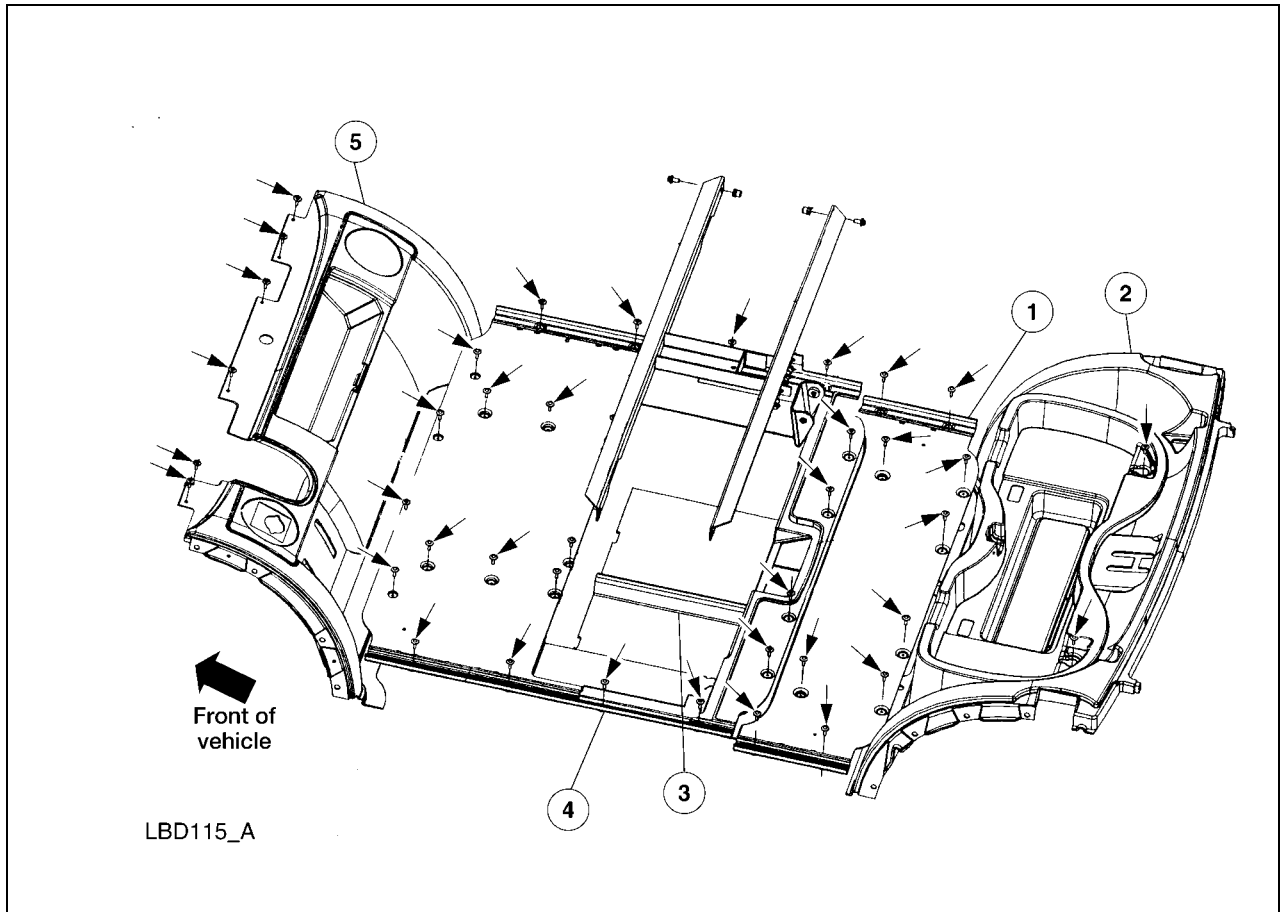
Item	Part Number	Description
1	50202	Roof Panel
2	03100	Windshield
3	02010	Front Fascia

Item	Part Number	Description
4	16006	LH Front Fender
5	16103	LH Front Fender Shield
6	16612	Hood
7	17D957	Front Bumper
8	16005	RH Front Fender
9	16102	RH Fender Shield
10	13208	Scuff Panel
11	10176	Rocker
12	16005	RH Rear Fender
13	243A52	Outer B-pillar Trim Panel
14	19B423	Bag Bay
15	40110	Decklid
16	16006	LH Rear Fender
17	24356	Inner B-pillar Trim Panel

Rivet Locations and Types

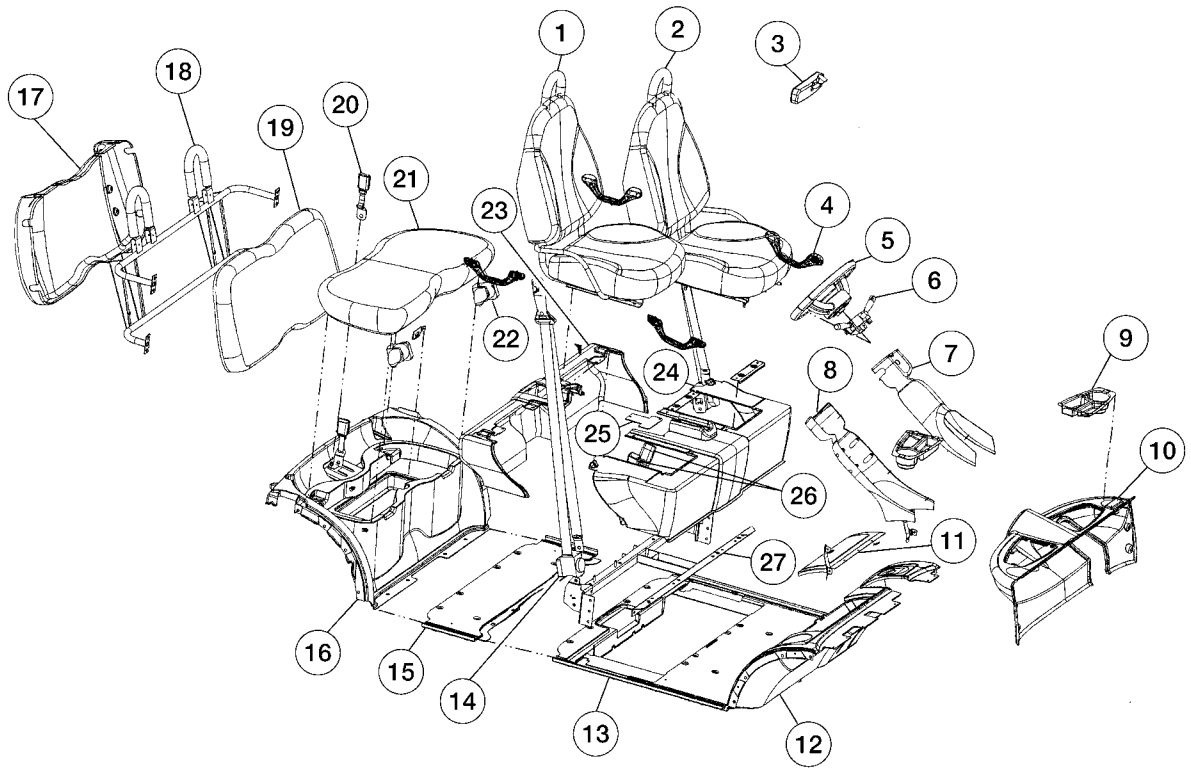
Description	Part Number
Bag Bay Rivets	E647558
Cup Holder Rivets	E647558
DC/DC Converter Rivets	W525158-S417
Fender Shield Rivets	E647558
Floor Rivets	E647558
Front Kick-up Rivets	E647558
Rear Kick-up Rivets	E647558
Rocker Rivets	E647558
Windshield Washer Bottle Bracket Rivets	E647558

Floor and Kick-up Rivet Locations



Item	Part Number	Description
1	11160	Rear Floor
2	11215	Rear Floor Kick-up
3	10755	Battery Tray
4	11160	Front Floor
5	11135	Front Floor Kick-up

Interior Body Components

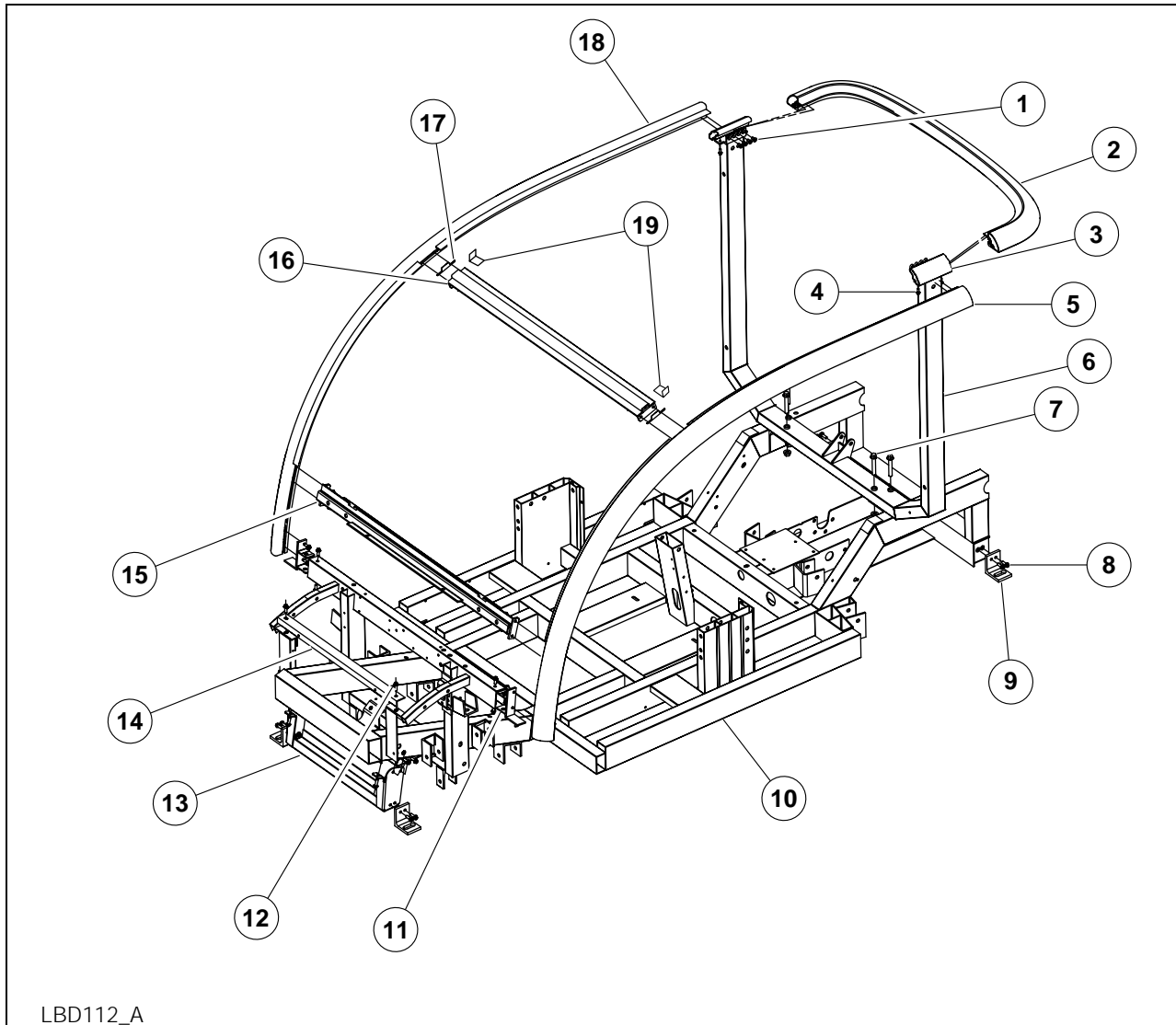


LBD113_A

Item	Part Number	Description
1	60004	Passenger Seat
2	60005	Driver Seat
3	17000/17700	Rearview Mirror
4	31406	Grab Handle
5	3600	Steering Wheel

Item	Part Number	Description
6	13341	Multi-function Switch
7	3530	Steering Column Shroud – Upper
8	3530	Steering Column Shroud – Lower
9	06202	Cowl Tray
10	02010	Instrument Panel
11	06024	Glovebox Door
12	11135	Front Floor Kick-up
13	11160	Front Floor
14	15611B08/61216	Front Seat Belt Retractor/Retractor Bracket
15	11160	Rear Floor (Four-Passenger Vehicle Only)
16	11215	Rear Floor Kick-up
17	668C92	Rear Seat Back Cover
18	613A38	Rear Seat Back Frame
19	66892	Rear Seat Back
20	1660044	Rear Seat Belt Buckle
21	60080	Rear Seat Cushion
22	16611B68	Rear Seat Belt Retractor
23	62284	Seat Stanchion Cover – Rear
24	62284	Seat Stanchion Cover – Front
25	62284	Access Cover
26	61202	Front Seat Belt Buckle
27	605A38	Seat Stanchion H-Support

Frame Components



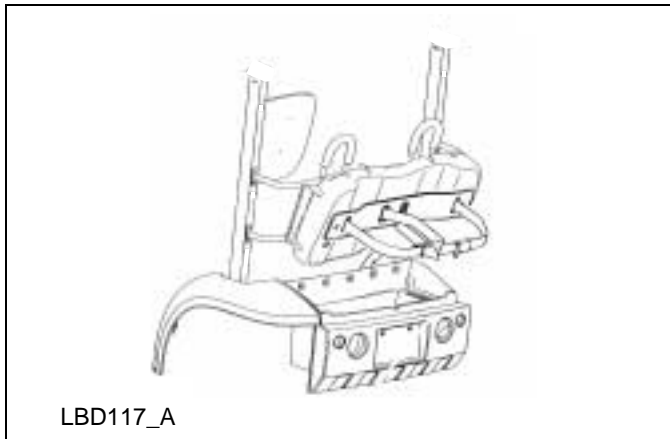
LBD112_A

Item	Part Number	Description
1	W505741-S426	Rear Roof Rail Reinforcement to B-pillar Inner Bolts
2	403A10	Rear Roof Rail
3	51248	Rear Roof Rail Reinforcement
4	--	Rear Roof Rail Reinforcement to B-pillar Lower Bolts
5	51181	LH Roof Rail
6	28160	B-pillar
7	W500546-S426	B-pillar Bolts

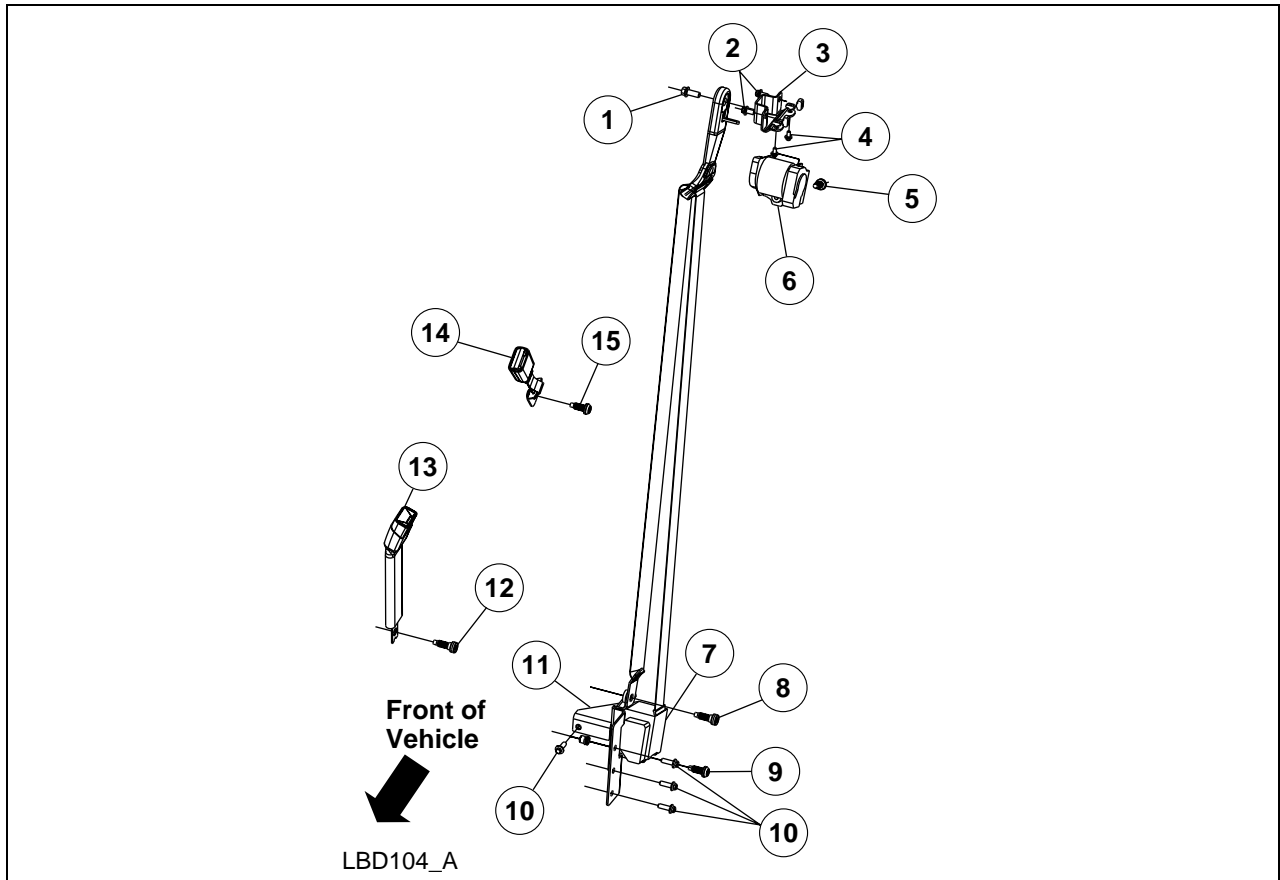
Item	Part Number	Description
8	--	Rear Tow Hook Bolts
9	17T787	Rear Tow Hook
10	5005	Frame Assembly
11	02892	Roof Rail to Cowl Bracket
12	41201	Frame Front Upper Crossmember Rivet
13	17B787	Tow Hook Bracket
14	5D066	Frame Front Upper Crossmember
15	03408	Lower Windshield Roof Rail
16	03408	Upper Windshield Roof Rail
17	034S08	Upper Header Rail Seal
18	51180	RH Roof Rail
19	3M PUL 0612	Adhesive Urethane Film (Ford specification ESB-M99J291-A-A4)

Golf Rack

Four-Passenger Shown, Two-Passenger Similar



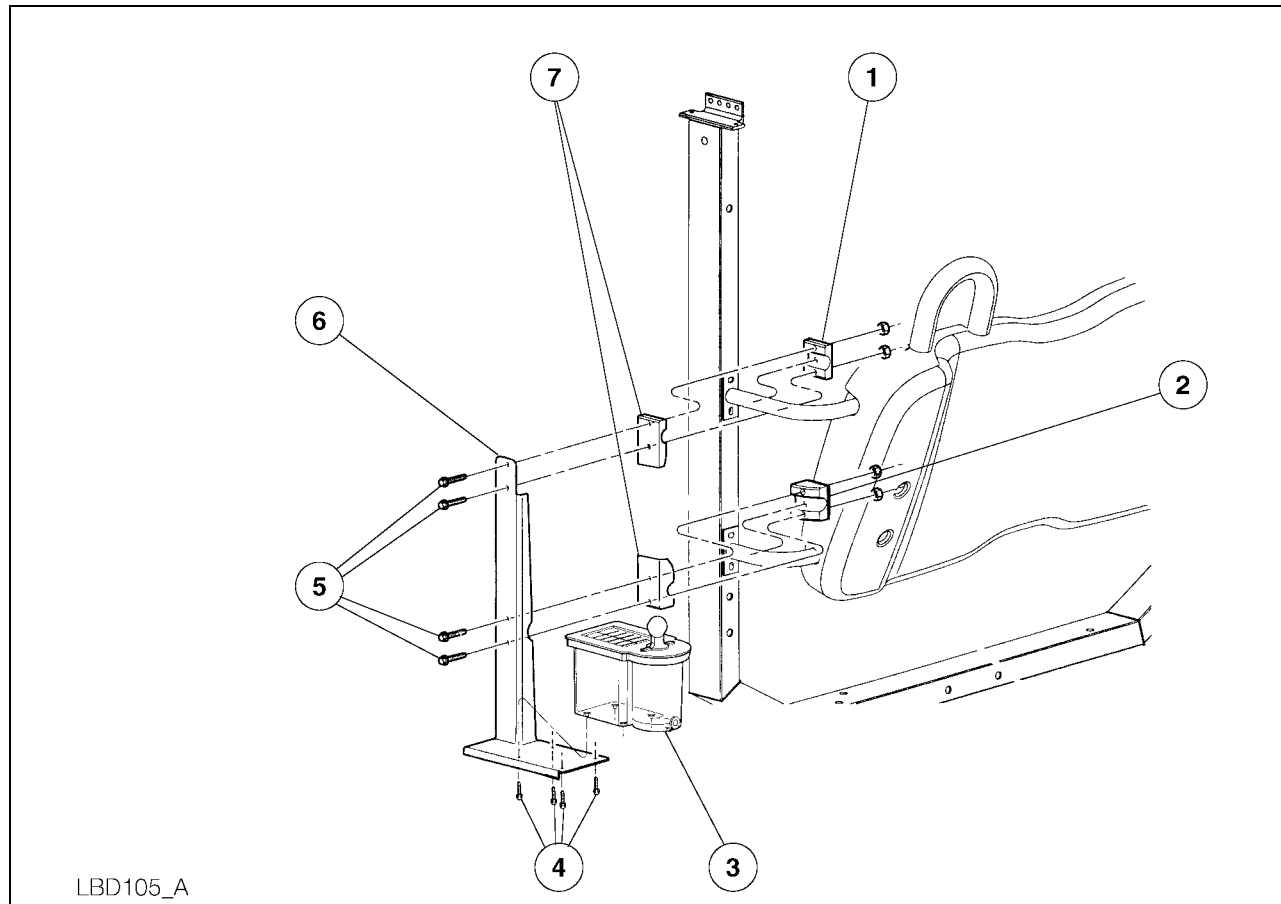
Seat Belts



Item	Part Number	Description
1	5861212	Seat Belt Hanger Bolt
2	W500022-S426	Seat Belt Hanger Bracket Bolts – Side
3	611C70	Seat Belt Hanger Bracket
4	W500011-S426	Seat Belt Hanger Bracket Bolts – Lower
5	W700883-S409M	Rear Seat Belt Retractor Bolt
6	16611B68	Rear Seat Belt Retractor
7	611B09	Front Seat Belt Retractor
8	W707957-S409M	Seat Belt to Bracket Bolt
9	W707957-S409M	Front Seat Belt Retractor Bolt
10	W500023-S426	Front Seat Belt Retractor Bracket Bolts
11	61217	Front Seat Belt Retractor Bracket
12	W500023-S426	Seat Belt Buckle Bolt – Front

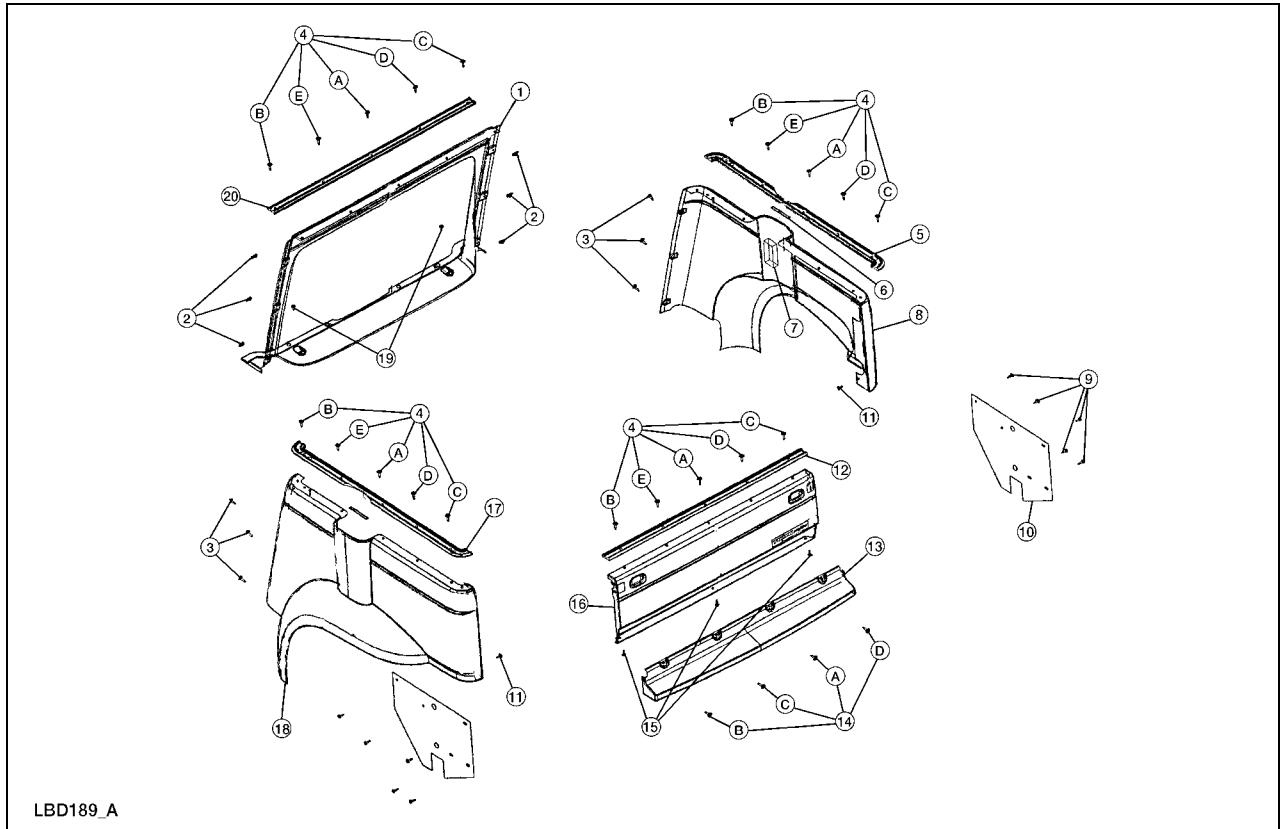
Item	Part Number	Description
13	61202	Seat Belt Buckle – Front
14	1660044	Seat Belt Buckle – Rear
15	W700883-S409M	Seat Belt Buckle Bolt – Rear

Ball and Club Washer



Item	Part Number	Description
1	19B431	Ball and Club Washer Upper Support
2	19B431	Ball and Club Washer Lower Support
3	19G431	Ball and Club Washer
4	--	Ball and Club Washer Screws
5	--	Ball and Club Washer Bracket Bolts
6	19B431	Ball and Club Washer Bracket
7	19B431	Ball and Club Washer Bracket Insulators

2-Passenger Wagon Panels



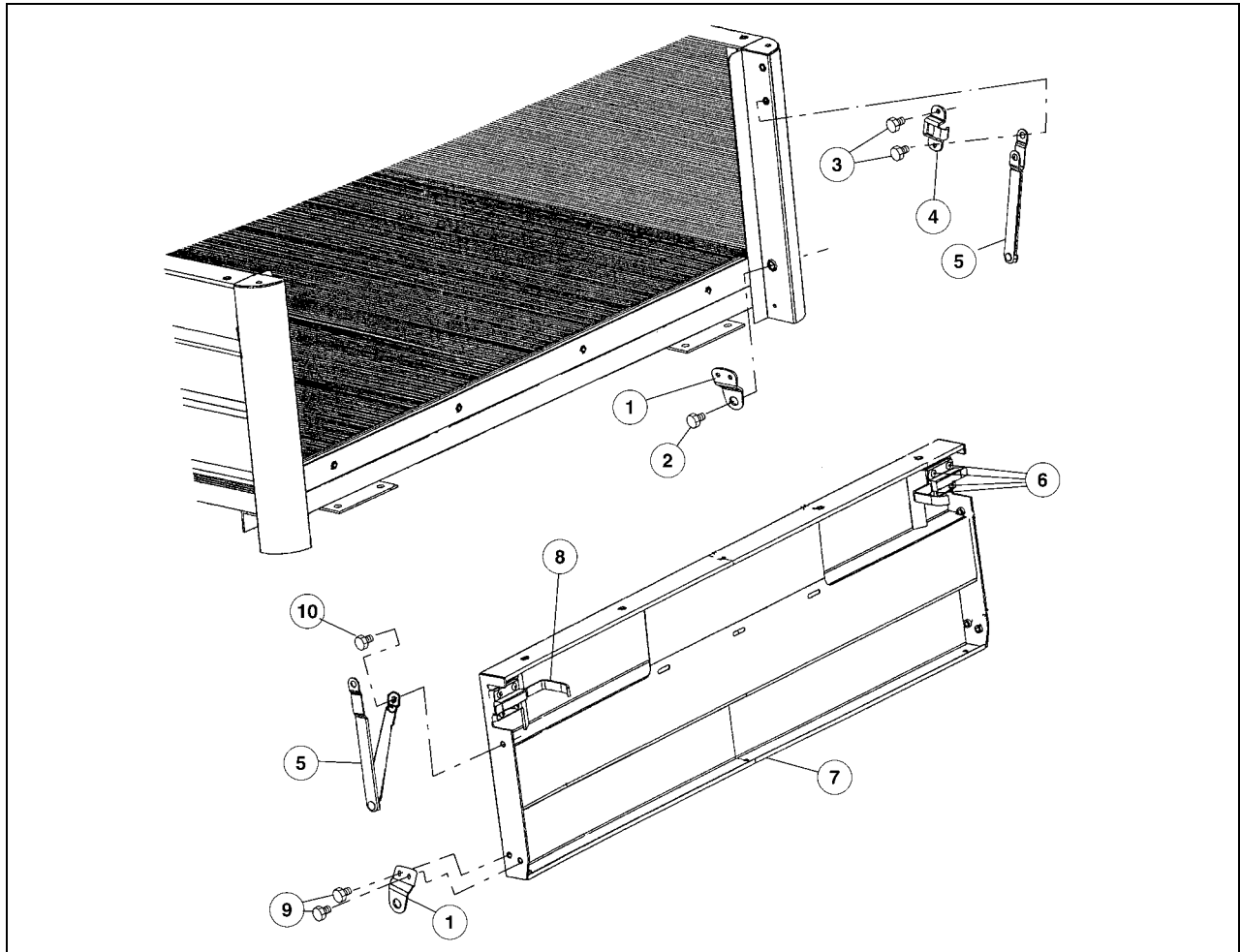
LBD189_A

Item	Part Number	Description
1	--	Rear Panel
2	--	Nut
3	--	Side Panel Bolt
4	--	Upper Trim Panel Screw *
5	--	Upper Trim Panel – RH
6	--	Spacer
7	--	Spacer
8	--	Wagon Panel – RH
9	--	Finish Panel Rivets
10	--	Finish Panel – RH
11	--	Side Panel Front Lower Rivet
12	--	Upper Trim Panel – Tailgate

Item	Part Number	Description
13	--	Tailgate Finish Panel
14	--	Tailgate Finish Panel Bolts *
15	--	Tailgate Panel Rivets
16	--	Tailgate Panel
17	--	Upper Trim Panel – LH
18	--	Wagon Panel – LH
19	--	Rear Panel Rivets
20	--	Upper Trim Panel – Rear Panel

* Should be tightened in alphabetic order shown.

Tailgate



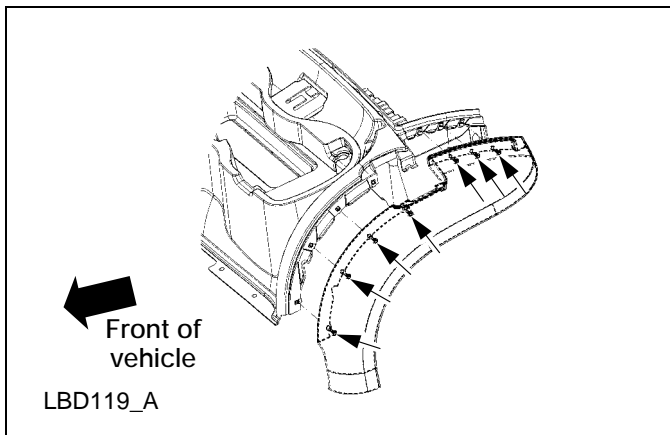
Item	Part Number	Description
1	--	Hinge Bracket
2	--	Hinge Bolt
3	--	Tailgate Latch Receiver Screws
4	--	Tailgate Latch Receiver RH/LH
5	--	Tailgate Support
6	--	Tailgate Latch Rivets
7	--	Tailgate
8	--	Tailgate Latch
9	--	Hinge Bracket Screws
10	--	Tailgate Support Screws

Removal and Installation

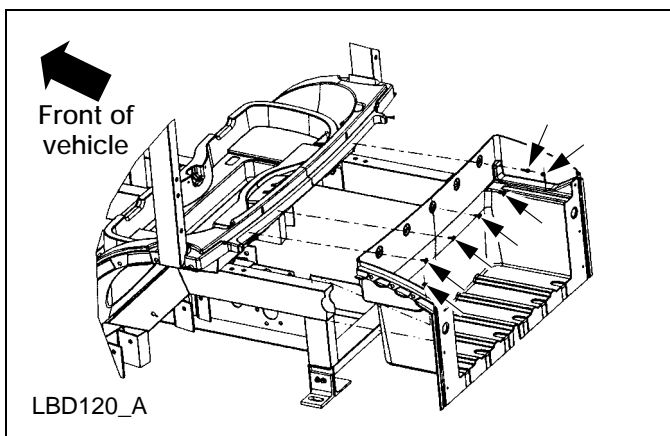
Bag Bay

Removal

1. Unlock and remove the decklid.
2. Remove the six rear bumper bolts and disconnect the electrical connectors. Remove the rear bumper.
3. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
4. Remove the seven rear fender bolts and the fender. Repeat on the other side of the vehicle.



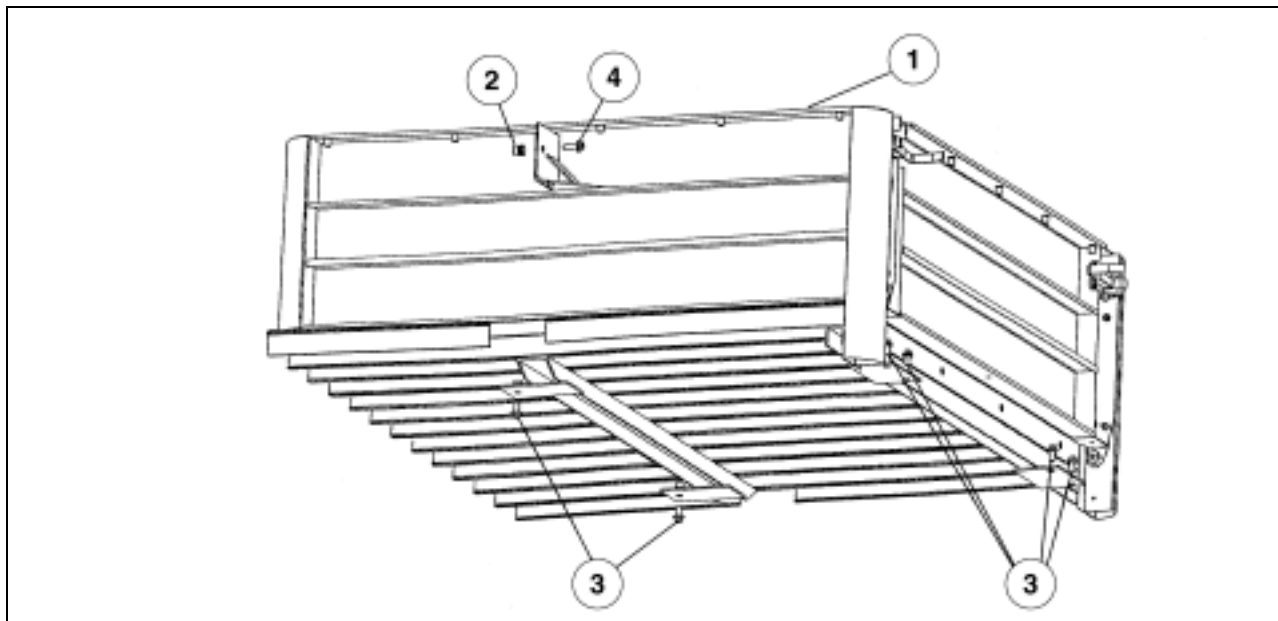
5. Drill out the seven rivets and remove the bag bay.



Installation

1. Reverse the removal procedure.
2. Tighten the rear fender bolts to 8N.m. (70lb-in.).
3. Tighten the rear bumper bolts to 3N.m (29lb-in.).

Box, Wagon



Item	Part Number	Description
1	--	Wagon Box
2	--	Rivnut Nut
3	--	Lower Wagon Box Bolts
4	--	Side Wagon Box Bolts

Removal

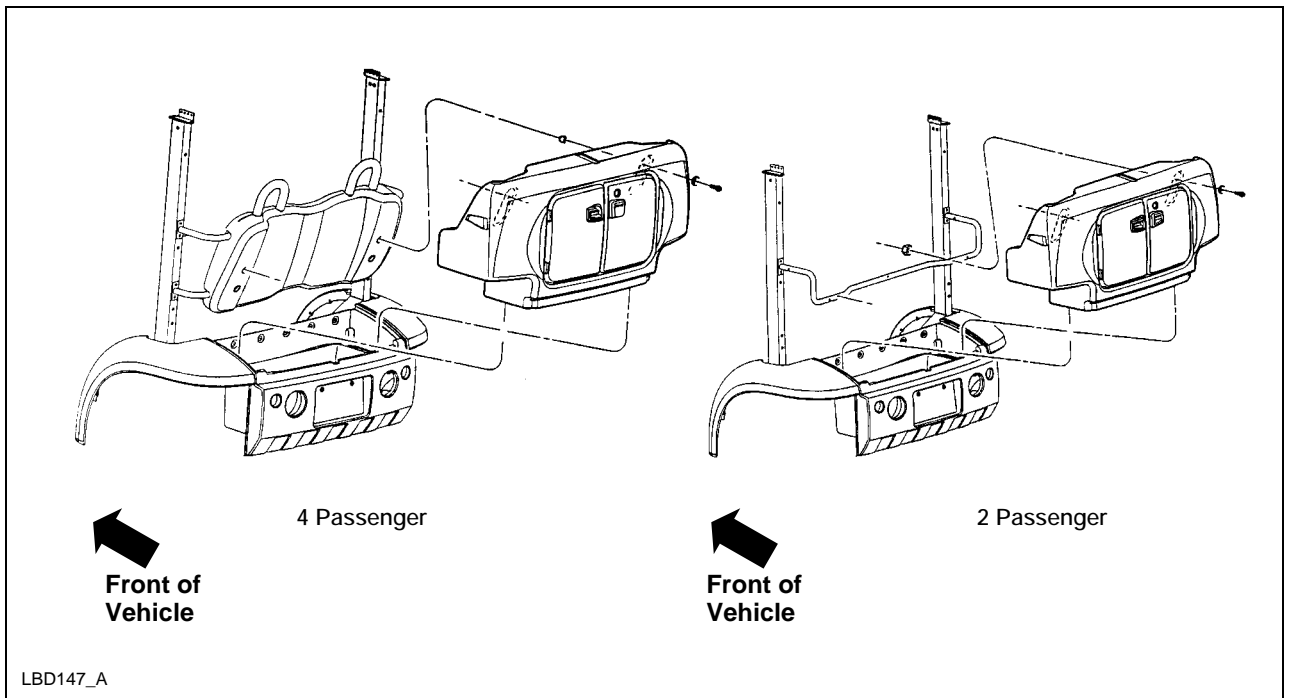
1. If necessary, remove the tailgate. Refer to [Tailgate](#) in this section.
2. Remove the wagon panels. Refer to [2-Passenger Wagon Panels](#) for fastener and panel locations.
3. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
4. Remove the two lower wagon box bolts.

5. Lower the vehicle.
6. Remove the four lower wagon box bolts.
7. Remove the two side wagon box bolts.

Installation

1. Reverse the removal procedure.
2. Tighten the lower wagon box bolts to 24–31N.m. (18–22lb-ft.).
3. Tighten the side wagon box bolts to 24–31N.m. (18–22lb-ft.).

Expanded Trunk



Removal

1. Unlock and open the expanded trunk doors.
2. Remove the two expanded trunk bolts and washers.
3. Tilt the top of the expanded trunk forward and carefully remove the expanded trunk.

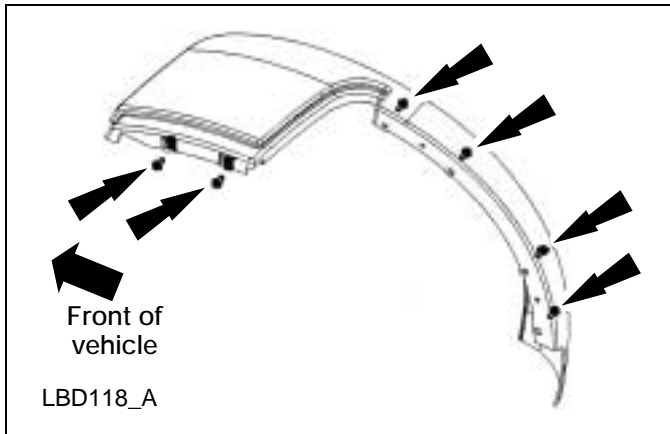
Installation

1. Reverse the removal procedure.
2. Tighten the expanded trunk bolts to 23-33N.m (17-24lb.ft.).

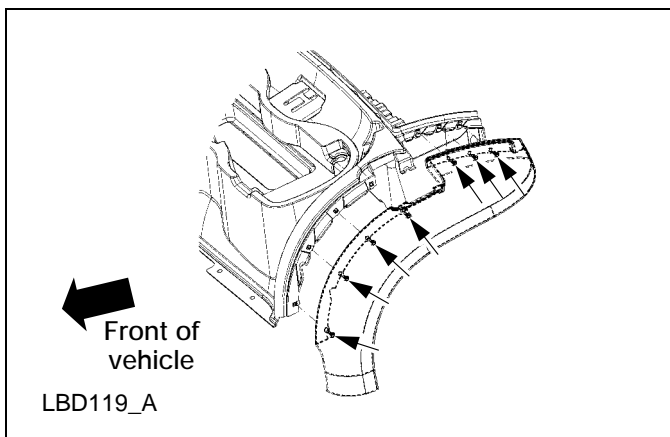
Floor – Front & Rear, Scuff Panels, Rockers

Removal

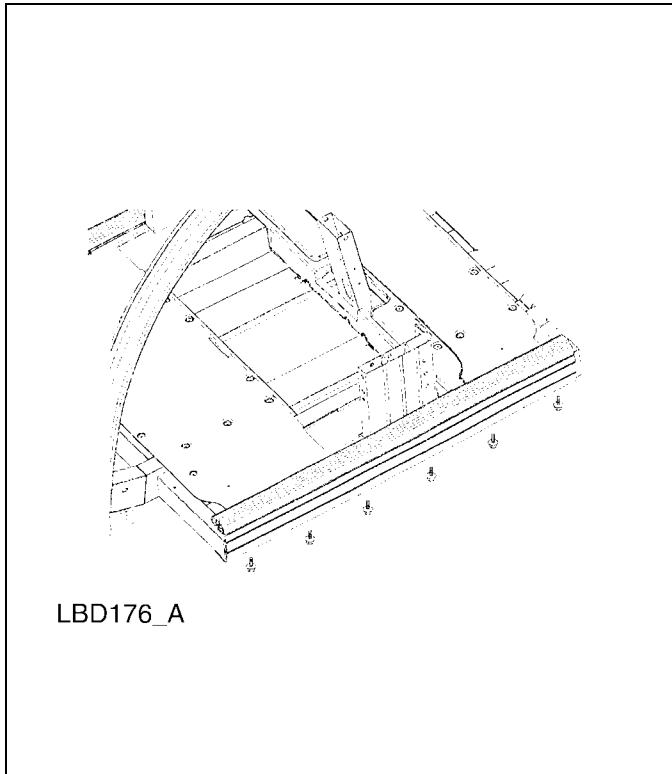
1. Unlock and remove the hood and decklid.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. Remove the six fender bolts and the fender. Repeat on the other side of the vehicle.



4. Remove the seven rear fender bolts and the rear fender. Repeat on the other side of the vehicle.

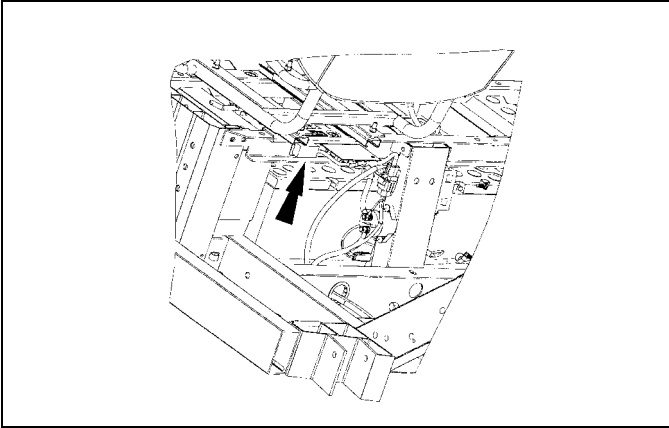


5. Drill out the six rocker rivets. Repeat on the other side of the vehicle.

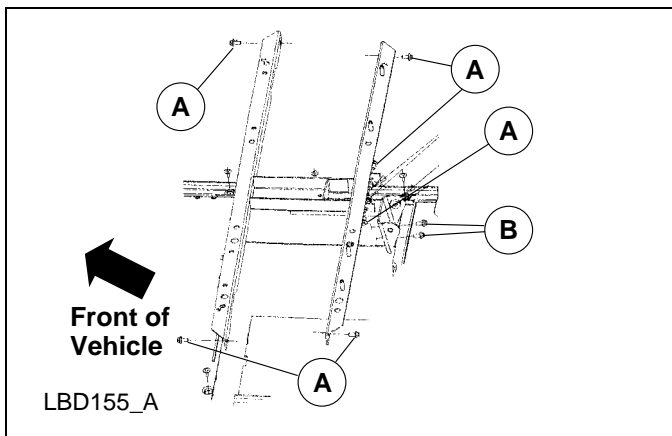


6. Lower the vehicle.
7. Remove the front floor kick-up. Refer to [Floor Kick-up – Front](#) in this section.
8. Remove the rear floor kick-up. Refer to [Floor Kick-up – Rear](#) in this section.
9. Remove the driver and passenger seat. Refer to [Seat Back and Frame – Driver Seat](#) and [Seat Back and Frame – Passenger Seat](#) in this section.
10. Remove the parking brake lever. Refer to [Parking Brake Lever](#) in the Chassis section.
11. Turn the vehicle power off. Refer to [Power Shutdown Procedure](#) in the Electrical section.

12. If mounted to the seat stanchion H-support, disconnect the service disconnect switch electrical connector.

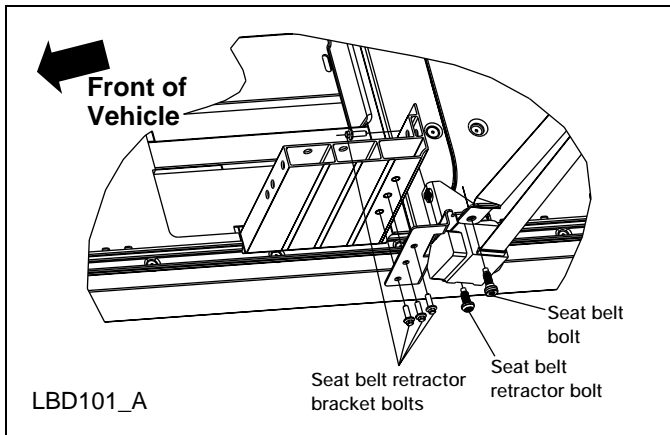


13. Remove the seat stanchion H-support.
- Remove the six seat stanchion H-support bolts (A).
 - Remove the two front seat belt buckle bracket bolts (B).



14. Remove the six batteries. Refer to [Batteries](#) in the Electrical section.
15. Remove the battery tray.

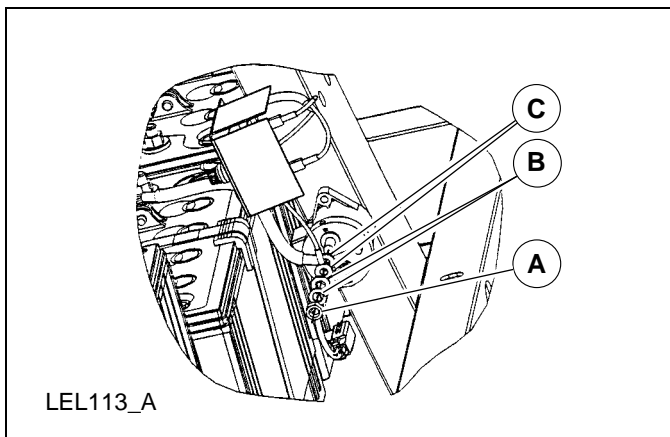
16. Remove the four seat belt retractor bracket bolts and move the bracket and retractor aside. Repeat on the other side of the vehicle.



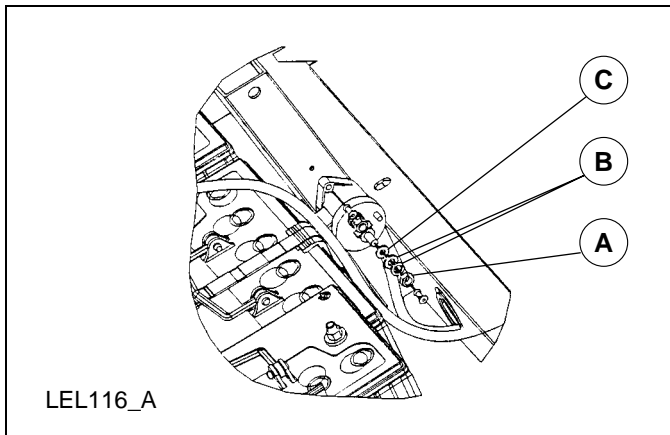
17. Remove the temperature sensor from the seat stanchion support.



18. Remove the upper nut (A) attaching the cable to the service disconnect switch and remove the washers (B) and disconnect the cables (C).



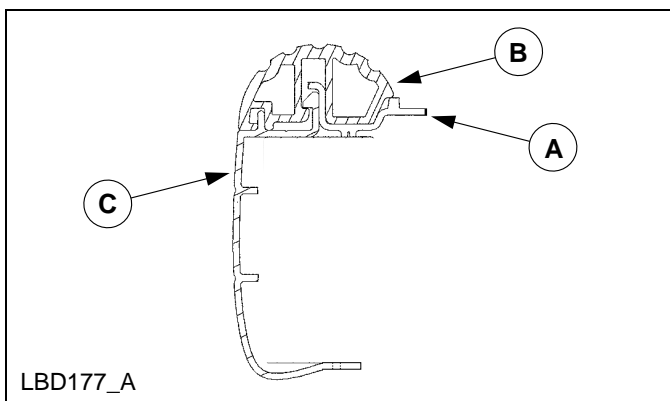
19. Remove the lower nut (A) attaching the cable to the motor controller, remove the washers (B) and disconnect the cable (C).



20. Drill out the two service disconnect switch rivets.
21. Drill out the floor rivets. Refer to [Floor and Kick-up Rivet Locations](#) in this section.
22. Pull outward on the rockers to clear the frame.
23. While lifting the floor assembly push the battery strap rearward to clear the corner of the battery floor. Lift the floor, rocker and scuff panel as an assembly over the seat stanchion support and out of the vehicle.
24. Slide the scuff panel off of the joint between the rocker and the floor.

Installation

1. Assemble the floor (A) scuff panel (B) and rocker (C) by aligning the rocker to the floor and sliding the scuff panel onto the joint between the rocker and the floor.

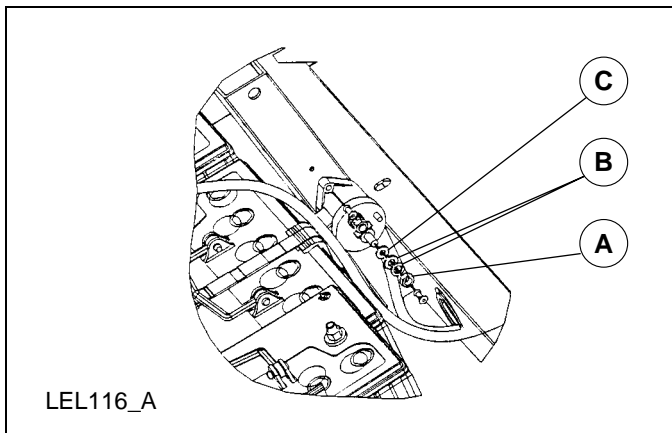


2. Position the front floor over the seat stanchion support. While lowering the floor assembly push the battery strap rearward to clear the corner of the battery floor and lower the floor assembly into position.

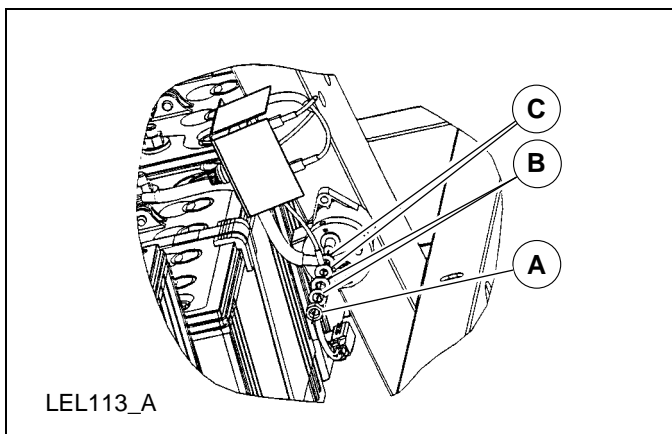
3. Pull outward on the rockers to clear the frame.
4. Install the new floor rivets. Refer to [Floor and Kick-up Rivet Locations](#) in this section.
5. Install the temperature sensor onto the seat stanchion support.



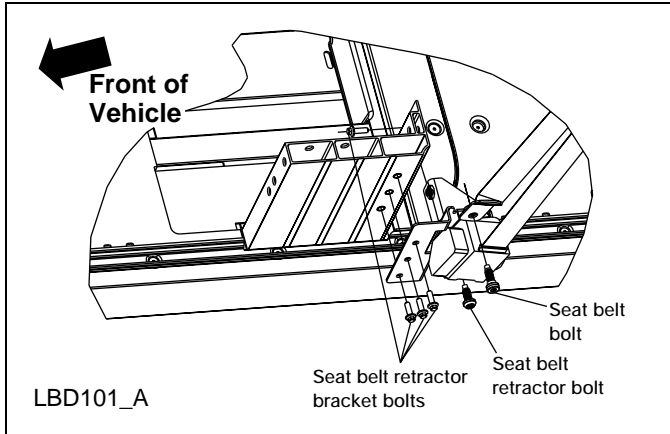
6. Install the cables (C), washers (B) and the lower nut (A). Tighten the contactor lower cable nut to 8-10N.m. (71-88lb-in.).



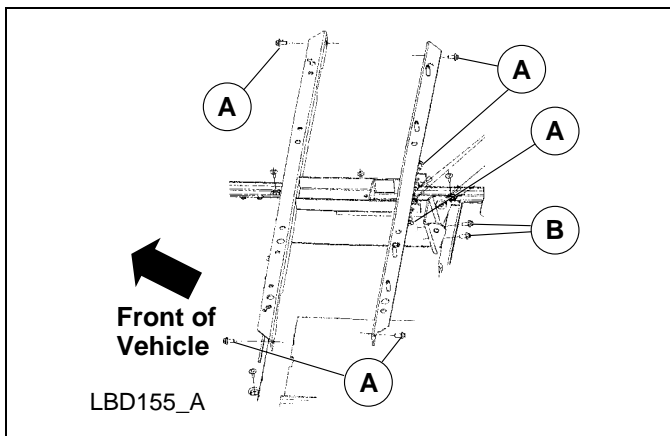
7. Install the cable, washers and the upper nut. Tighten the contactor upper cable nut to 8-10N.m. (71-88lb-in.)



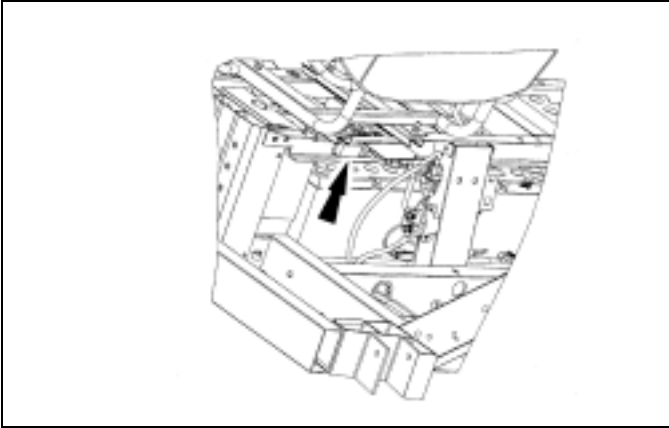
8. Position the service disconnect switch and install two new rivets.
9. Install the seat belt retractor and front seat belt retractor bolt. Tighten the front seat belt retractor bolt to 26-34N.m (19-25 lb-ft.).



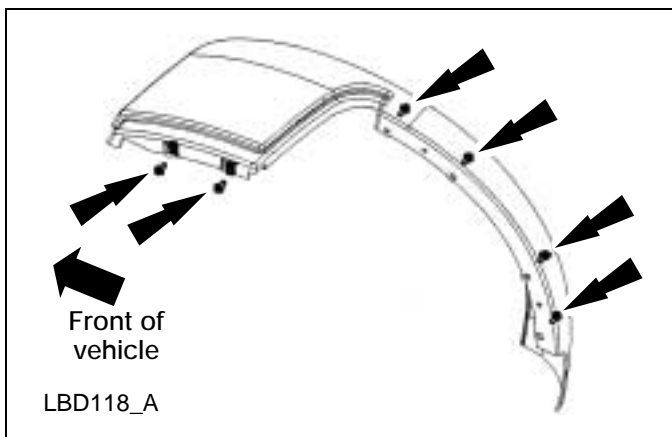
10. Install the battery tray.
11. Install the six batteries. Refer to [Batteries](#) in the Electrical section.
12. Install the seat stanchion H-support
13. Install the six seat stanchion H-support bolts (A). Tighten the six seat stanchion H-support bolts (A) to 20-30N.m (15-22lb-ft.).
14. Install the two front seat belt buckle bracket bolts (B). Tighten the two front seat belt buckle bracket bolts (B) to 20-30N.m (15-22lb-ft.).



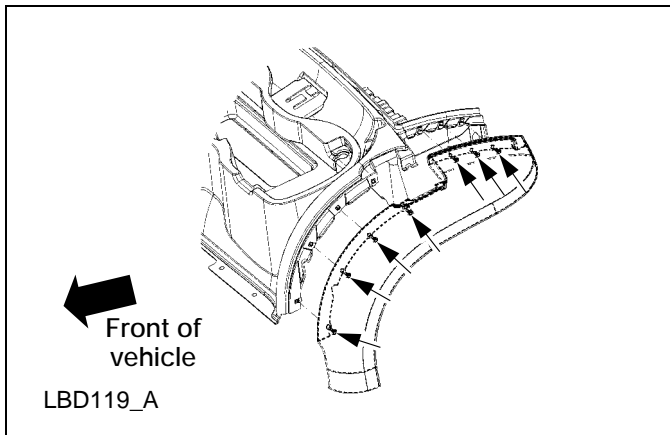
15. If mounted to the seat stanchion H-support, connect the service disconnect switch electrical connector.



16. Turn the vehicle power off. Refer to [Power Shutdown Procedure](#) in the Electrical section.
17. Install the front floor kick-up. Refer to [Floor Kick-up – Front](#) in this section.
18. Install the rear floor kick-up. Refer to [Floor Kick-up – Rear](#) in this section.
19. Install the parking brake lever. Refer to [Parking Brake Lever](#) in the Chassis section.
20. Install the driver and passenger seat. Refer to [Seat back and Frame – Driver Seat](#) and [Seat back and Frame – Passenger Seat](#) in this section.
21. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
22. Install the six new rocker rivets. Repeat on the other side of the vehicle.
23. Install the front fender and the six fender bolts. Tighten the front fender bolts to 8N.m (70lb-in.). Repeat on the other side of the vehicle.



24. Install the rear fender and the seven rear fender bolts. Tighten the rear fender bolts to 8N.m (70lb-in.). Repeat on the other side of the vehicle.

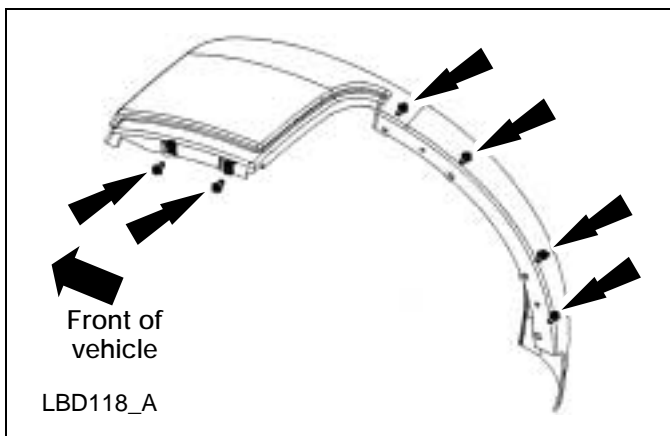


25. Lower the vehicle.
26. Install and lock the hood and decklid.

Floor Kick-up – Front

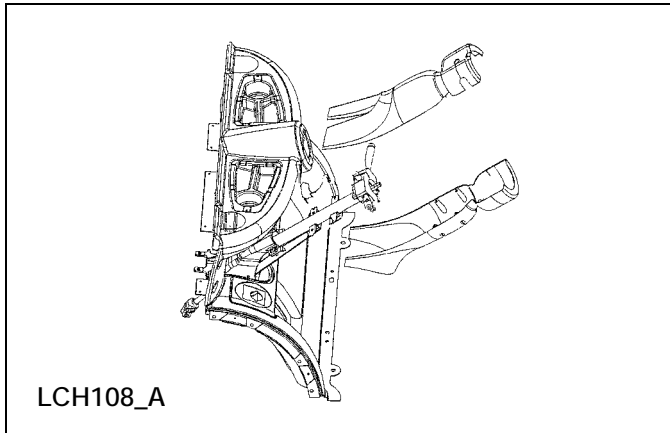
Removal

1. Unlock and remove the hood.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. Remove the six fender bolts and the fender. Repeat on the other side of the vehicle.

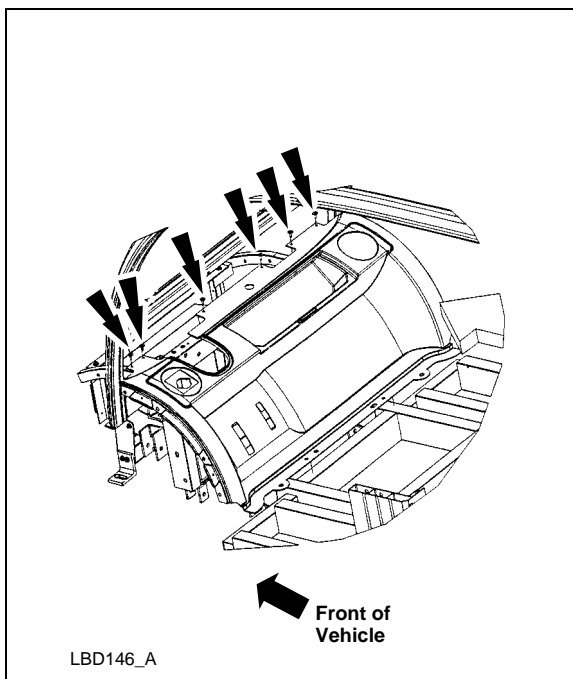


4. Lower the vehicle.

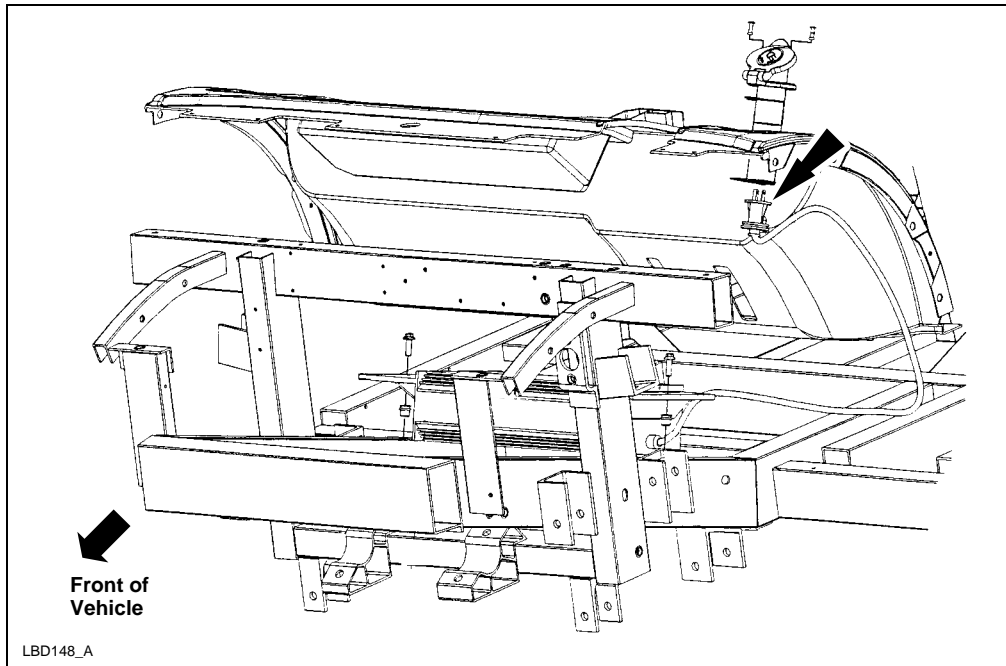
5. Remove the four steering column shroud screws.
6. Remove the two pushpins on the front of the steering column shroud assembly. Separate and remove the steering column shroud.



7. Remove the instrument panel. Refer to [Instrument Panel](#) in this section.
8. Remove and discard the accelerator pedal pad.
9. Remove the brake pedal pad nut and bolt and remove the brake pedal pad.
10. Drill out the four floor rivets nearest to the front floor kick-up. Refer to [Floor and Kick-up Rivet Locations](#) in this section.
11. Drill out the six front floor kick-up rivets.



12. Carefully tilt the top of the front floor kick-up rearward. Press in the retaining button on the battery charger inlet plug and remove the battery charger inlet plug from the front floor kick-up.

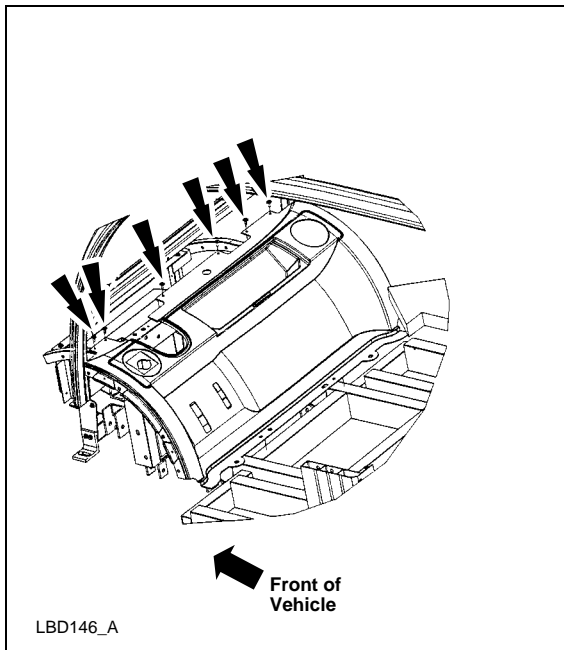


13. Remove the front floor kick-up.
14. If necessary, remove the glove box door rivets and the glove box door.

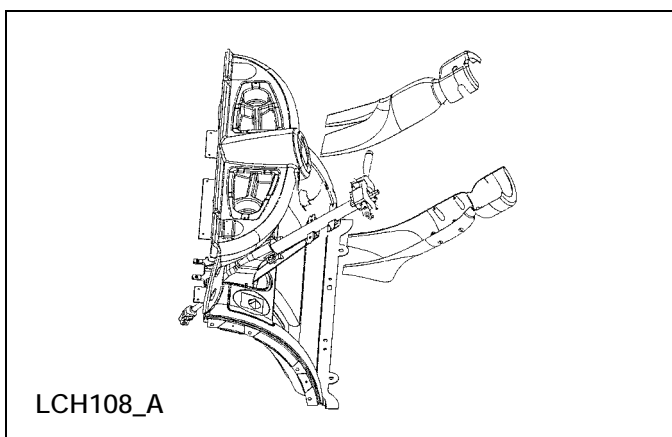
Installation

1. If necessary, position the glove box door and install the glove box door rivets.
2. Carefully tilt the top of the front floor kick-up rearward and slide the front floor kick-up under the front floor.
3. Connect the battery charger inlet plug.

4. Align the holes in the front floor kick-up with the holes in the crossmember and install the six new front floor kick-up rivets.

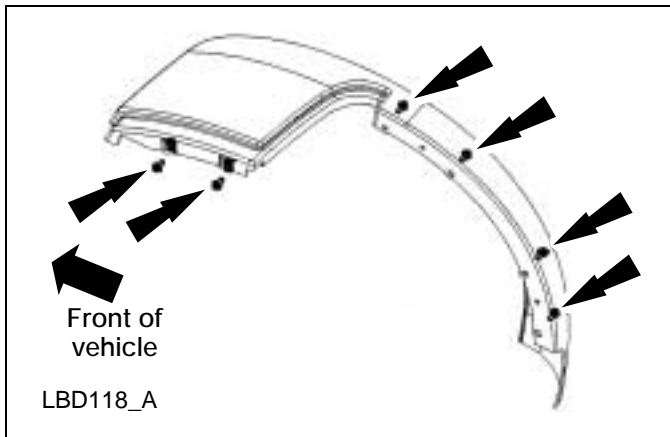


5. Align the holes in the front floor kick-up with the holes in the front floor and install the four new floor rivets nearest to the front floor kick-up. Refer to [Floor and Kick-up Rivet Locations](#) in this section.
6. Install the brake pedal pad and the brake pedal pad nut and bolt. Tighten the brake pedal pad bolt to 24-31N.m (18-22lb-ft.).
7. Position the steering column shroud halves and install the four steering column shroud screws and two pushpins. Tighten the steering column shroud screws to 2.7-3.7N.m. (23.9-32.7lb-in.).



8. Install a new accelerator pedal pad.

9. Install the instrument panel. Refer to [Instrument Panel](#) in this section.
10. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
11. Install the fender and the six fender bolts. Tighten the fender bolts to 8N.m (70lb-in.). Repeat on the other side of the vehicle.

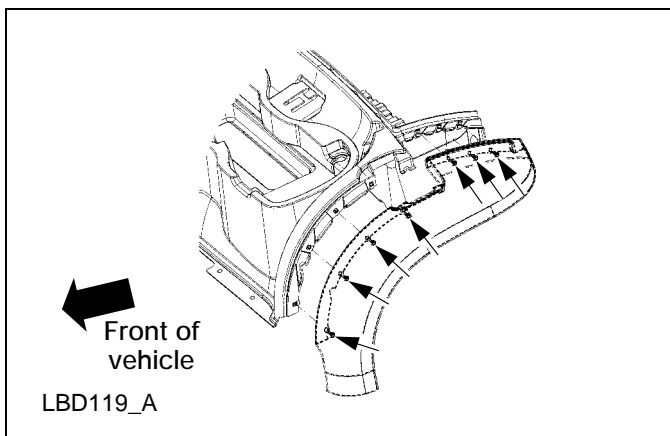


12. Lower the vehicle and check the fit.
13. Install and lock the hood.

Floor Kick-up – Rear

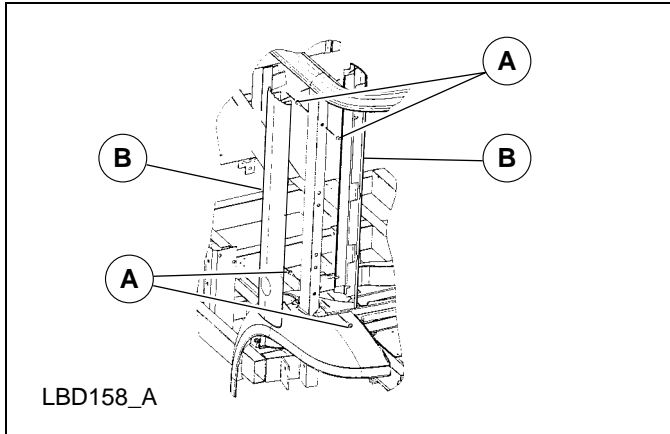
Removal

1. Unlock and remove the decklid.
2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. Remove the seven rear fender bolts and the fender. Repeat on the other side of the vehicle.

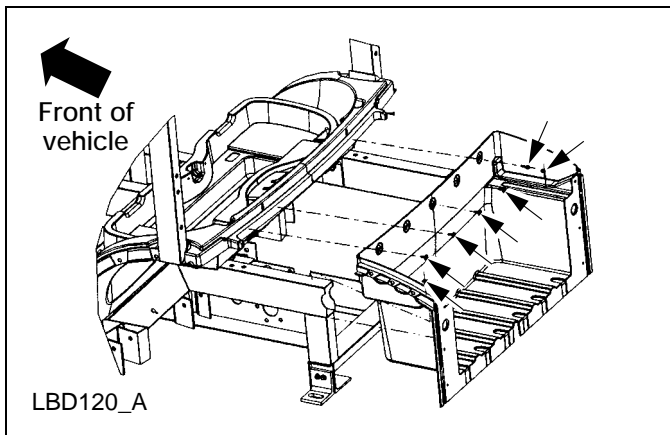


4. Lower the vehicle.

5. Remove the B-pillar seal.
6. Loosen the four B-pillar trim screws (A) and remove the B-pillar trim (B). Repeat on the other side of the vehicle.

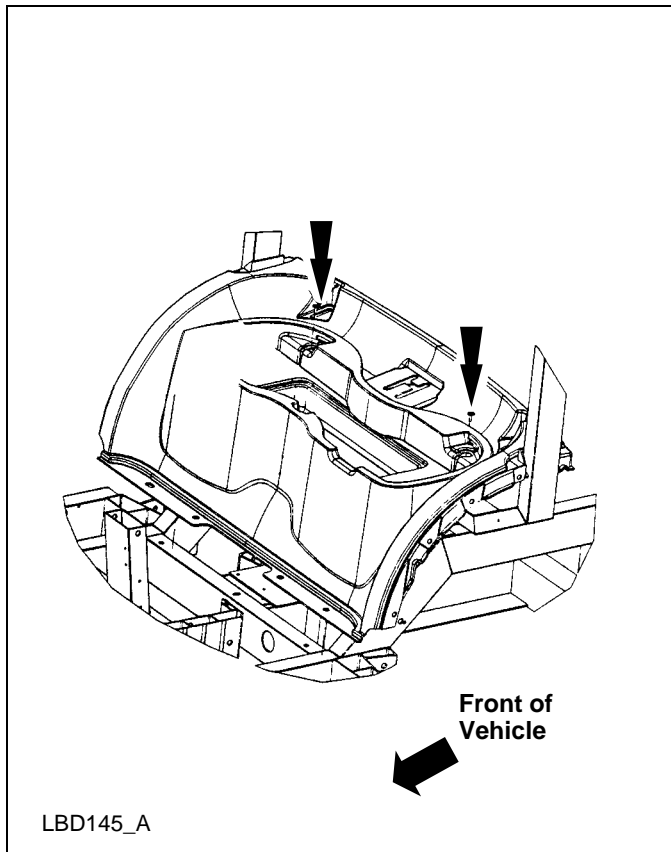


7. Drill out the rear five rivets from the bag bay.



8. If equipped, remove the rear seat cushion.
9. If equipped, remove the two rear seat belt buckle bolts and the two rear seat belt buckles.
10. Drill out the four floor rivets nearest to the rear floor kick-up. Refer to [Floor and Kick-up Rivet Locations](#) in this section.

11. Drill out the two rivets at the top of the rear floor kick-up.



12. Carefully tilt the top of the rear floor kick-up forward and remove the rear floor kick-up.

Installation

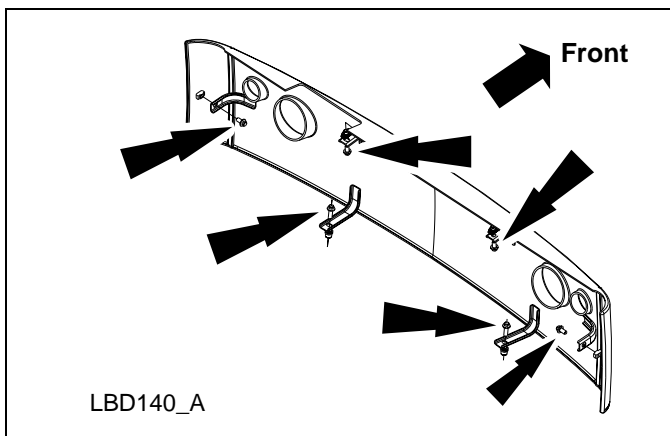
1. Carefully tilt the top of the rear floor kick-up forward and slide the rear floor kick-up into place.
2. Install the two new rivets at the top of the rear floor kick-up.
3. Install the four new floor rivets nearest to the rear floor kick-up. Refer to [Floor and Kick-up Rivet Locations](#) in this section.
4. If equipped, install the two rear seat belt buckles and the two rear seat belt buckle bolts. Tighten the two rear seat belt buckle bolts to 26-34N.m (19-25lb-ft.).
5. If equipped, install the rear seat cushion.
6. Install the new rear five rivets onto the bag bay.
7. Install the B-pillar trim (B) and tighten the four B-pillar trim screws (A) to 20-30N.m (15-22lb-ft.). Repeat on the other side of the vehicle.

8. Install the B-pillar seal.
9. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
10. Install the rear fenders and the seven rear fender bolts. Tighten the rear fender bolts to 8N.m (70lb-in.).
11. Lower the vehicle.
12. Install and lock the decklid.

Fascia - Front

Removal

1. Unlock and remove the hood.
2. Remove the instrument panel. Refer to [Instrument Panel](#) in this section.
3. Remove the front fascia bolts.



4. Carefully remove the front fascia, being careful not to scratch the front fascia.

Installation

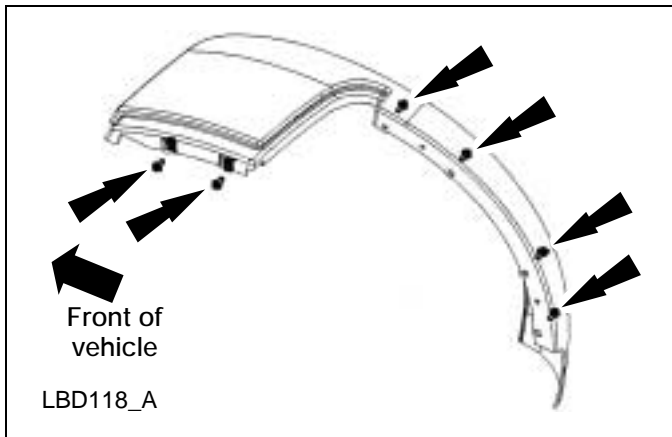
1. Reverse the removal procedure.
2. Tighten the front fascia bolts to 3.3N.m (29lb-in.).

Fender - Front

Removal

1. Unlock and remove the hood.

2. Raise and support the vehicle. Refer to [Lifting](#) in the General Information section.
3. If removing the RH fender, drill out the four fender shield rivets and remove the fender shield.
4. If removing the RH fender, separate the wire retainers from the fender.
5. Remove the six fender bolts and the fender.



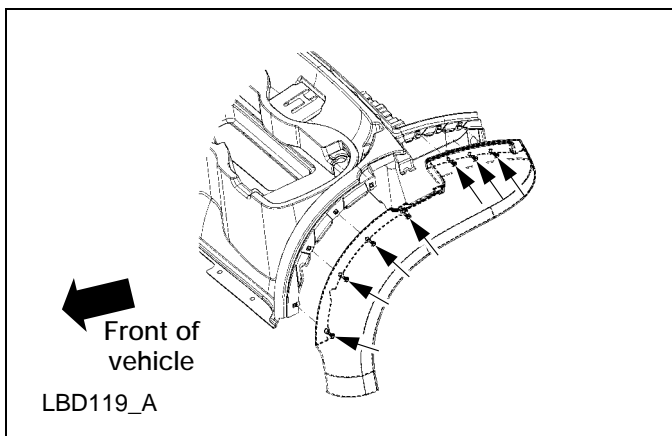
Installation

1. Reverse the removal procedure.
2. Tighten the fender bolts to 8N.m (70lb-in.).

Fender - Rear

Removal

1. Unlock and remove the decklid.
2. Remove the seven rear fender bolts and the rear fender.



Installation

1. Reverse the removal procedure.
2. Tighten the rear fender bolts to 8N.m (70lb-in.).

Instrument Panel

Removal

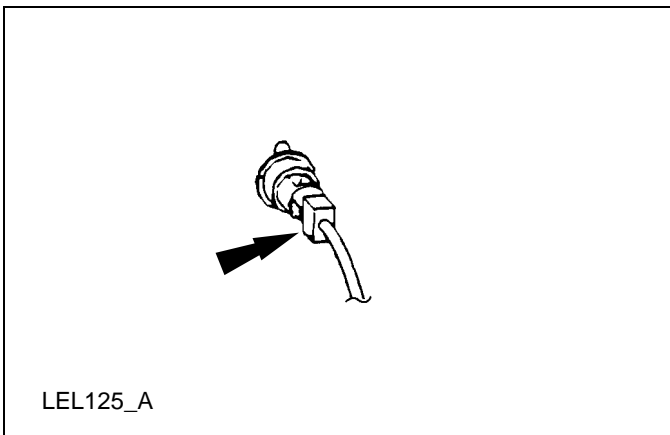
Note:

When replacing the instrument panel a new gauge overlay for the instrument cluster gauge will have to be ordered.

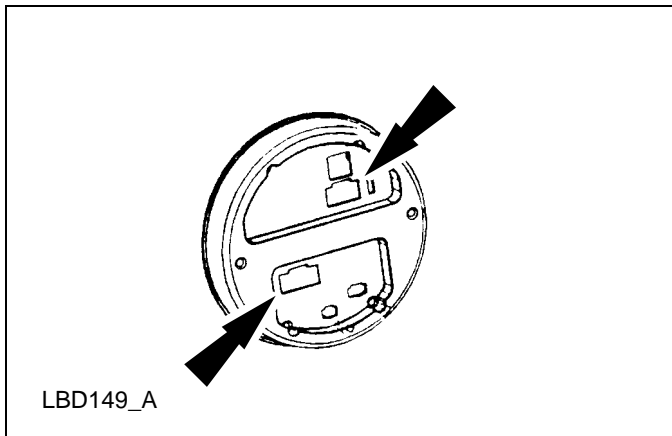
Note:

The VIN plate on the instrument panel may need to be replaced when replacing an instrument panel. Contact the field representative for assistance with the process for ordering a new VIN, if the VIN plate must be replaced.

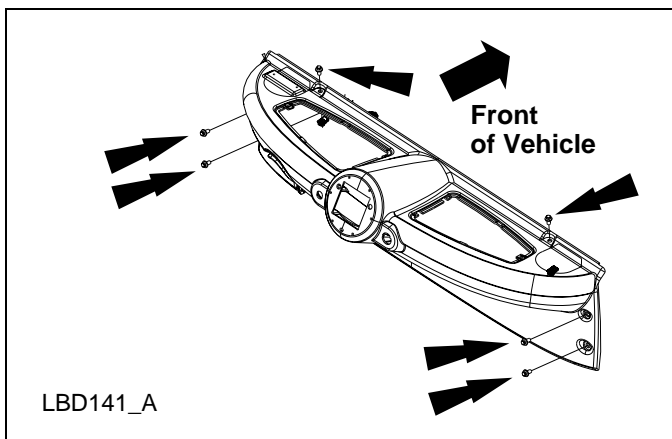
1. Turn the vehicle power off. Refer to [Power Shutdown Procedure](#) in the Electrical section.
2. Remove the two cowl tray scrivenets and the cowl trays.
3. If equipped, disconnect the power point electrical connector.



4. Disconnect the two instrument cluster gauge electrical connectors.



5. Remove the six instrument panel bolts and carefully remove the instrument panel.



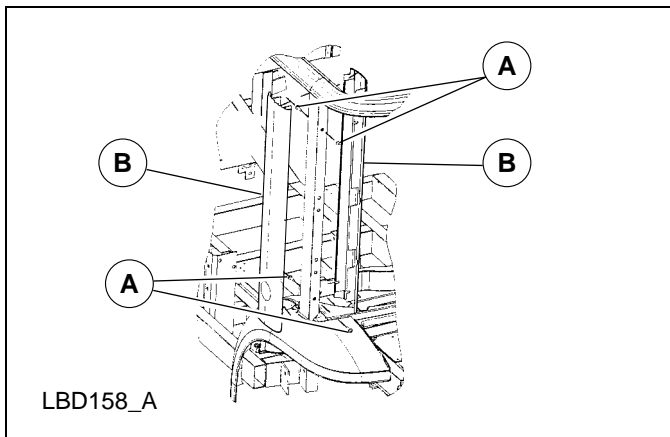
Installation

1. Carefully install the instrument panel and the six instrument panel bolts. Tighten the six instrument panel bolts to 10N.m (88lb.-in.).
2. Connect the two instrument panel gauge electrical connectors.
3. If equipped, connect the power point electrical connector.
4. Install the two cowl trays and the cowl tray scrivenets.
5. Turn the vehicle power on. Refer to [Power Shutdown Procedure](#) in the Electrical section.

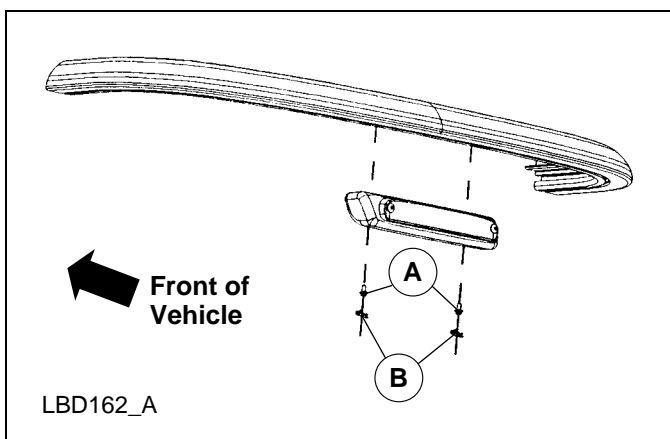
Roof Rail – Rear

Removal

1. If necessary, remove the rear storage compartment. Refer to applicable procedure in this section.
2. Remove the roof panel. Refer to [Roof Panel](#) in this section.
3. Remove the B-pillar seal.
4. Loosen the four B-pillar trim screws (A) and remove the B-pillar trim (B). Repeat on the other side of the vehicle.



5. Remove the seal from the rear roof rail.
6. Remove the two screw covers (B) and two high-mount stop lamp screws (A). Remove the high-mount stop lamp and carefully pull the wiring harness out of the channel.



7. Loosen the roof rail reinforcement to B-pillar inner bolts from both sides of the vehicle.
8. Loosen the roof rail reinforcement to B-pillar lower bolts from both sides of the vehicle.

9. Slide the rear roof rail rearward off the vehicle.
10. Remove the rear roof rail reinforcement if left in the vehicle.

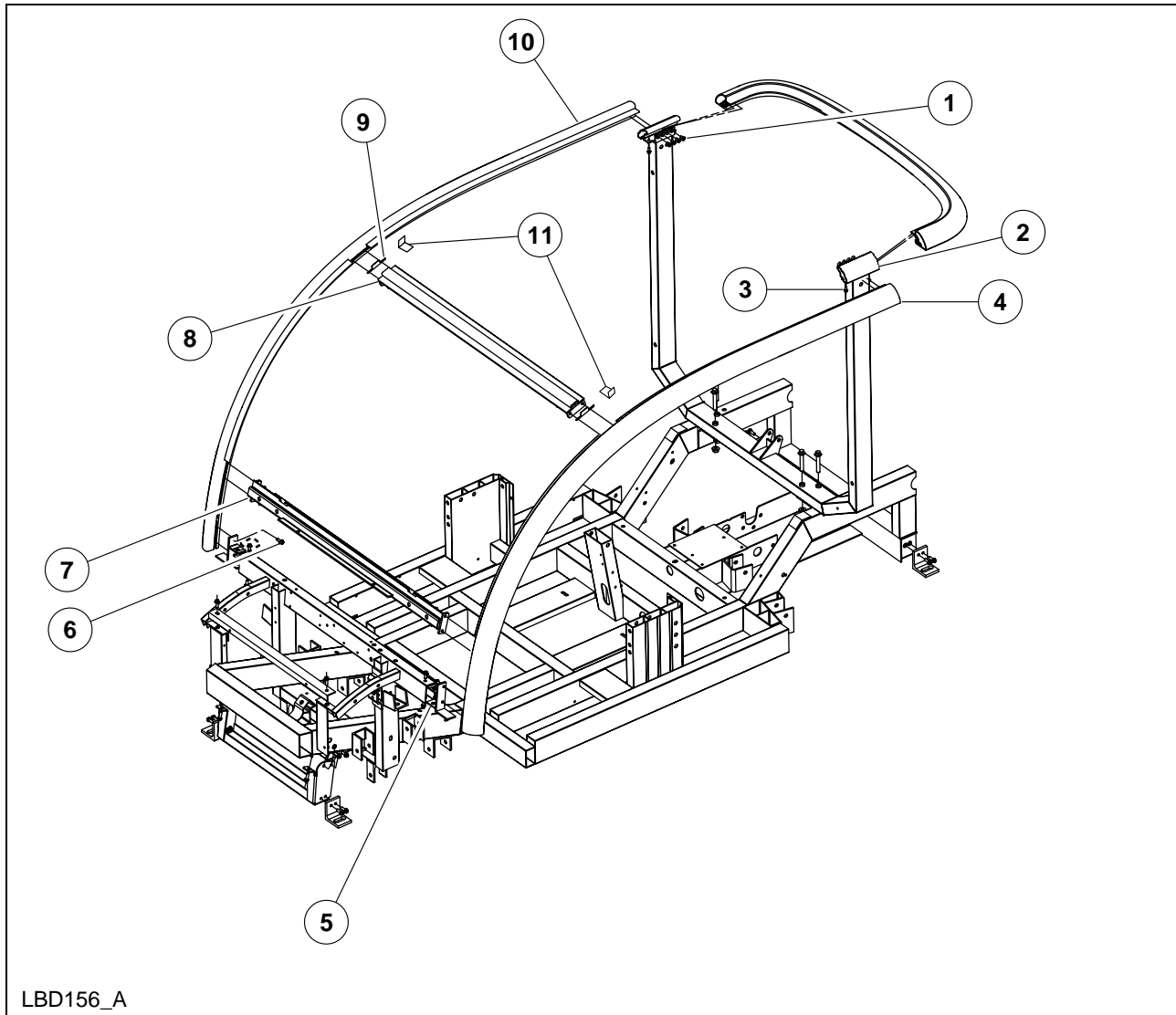
Installation

Note:

The rear roof rail reinforcement must be installed in the rear roof rail prior to installing the rear roof rail to ensure proper installation and alignment of the rear roof rail reinforcement.

1. Install the rear roof rail reinforcement into the rear roof rail.
2. Slide the rear roof rail forward onto the vehicle.
3. Tighten the roof rail reinforcement to B-pillar lower bolts on both sides of the vehicle to 11-13N.m (98-115lb-in.).
4. Tighten the roof rail reinforcement to B-pillar inner bolts from both sides of the vehicle to 24-31N.m (18-22lb-ft.).
5. Install the high-mount stop lamp and two high-mount stop lamp screws. Tighten the two high mount stop lamp screws to 9-12N.m (80-106lb-in.). Install the two screw covers.
6. Press the wiring harness into the channel and install the seal.
7. Install the B-pillar trim and tighten the four B-pillar trim screws to 20-30N.m (15-22lb-ft.). Repeat on the other side of the vehicle.
8. Install the B-pillar seal.
9. Install the roof panel. Refer to [Roof Panel](#) in this section.
10. If necessary, install the rear storage compartment. Refer to applicable procedure in this section.

Roof Rail – Side



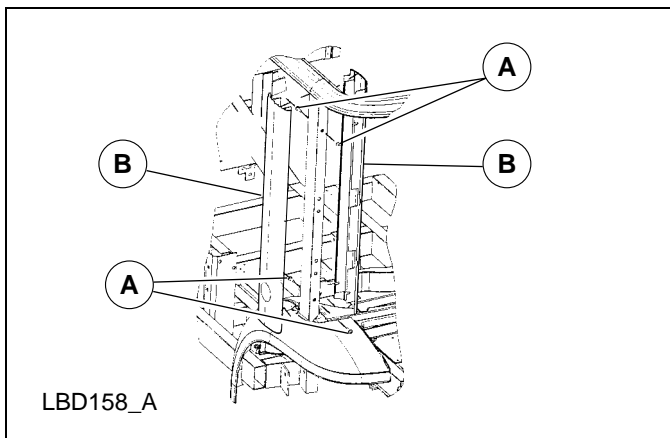
LBD156_A

Item	Part Number	Description
1	W505741-S426	Roof Rail Reinforcement to B-pillar Inner Bolts
2	51248	Roof Rail Reinforcement
3		Roof Rail Reinforcement to B-pillar Lower Bolts
4	51181	LH Roof Rail
5	02892	Roof Rail to Cowl Bracket
6		Roof Rail to Cowl Bracket Bolt
7	03408	Lower Windshield Roof Rail
8	03408	Upper Windshield Roof Rail

Item	Part Number	Description
9	034S08	Upper Header Rail Seal
10	51180	RH Roof Rail
11	3M PUL 0612	Adhesive Urethane Film (Ford specification ESB-M99J291-A-A4)

Removal

1. Remove the grab handles.
2. Remove the two lower and two side seat belt hanger bracket bolts. Set the seat belt hanger aside.
3. If equipped, remove the side view mirror.
4. Remove the B-pillar seal.
5. Loosen the four B-pillar trim screws and remove the B-pillar trim.



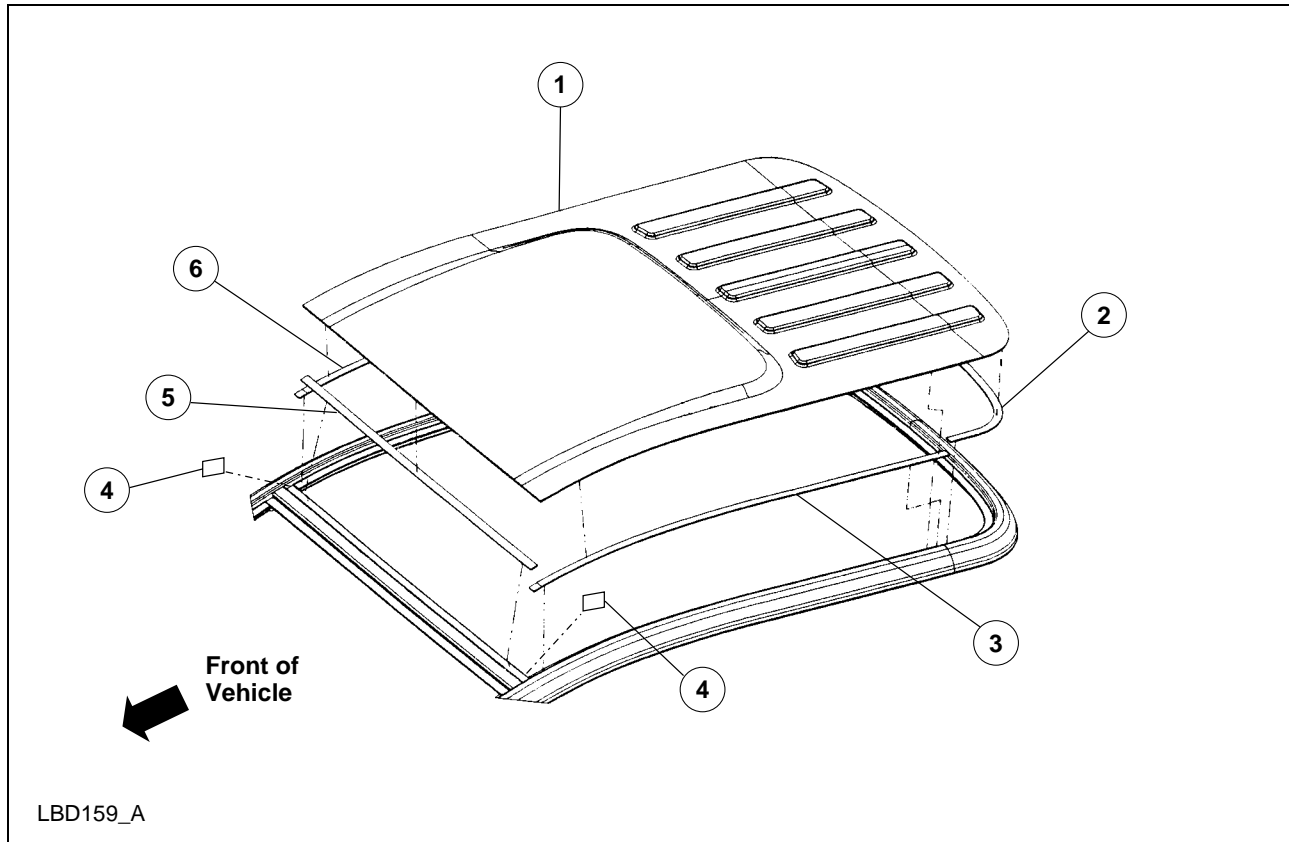
6. Remove the instrument panel. Refer to [Instrument Panel](#) in this section.
7. Remove the front fascia. Refer to [Front Fascia](#) in this section.
8. Remove the windshield. Refer to [Windshield](#) in this section.
9. Remove the roof panel. Refer to [Roof Panel](#) in this section.
10. Remove the four upper windshield roof rail bolts, upper windshield roof rail and upper header rail seal.
11. Remove the two lower windshield roof rail bolts and support the lower windshield roof
12. Loosen the roof rail reinforcement to B-pillar inner bolts.

13. Loosen the roof rail reinforcement to B-pillar lower bolts.
14. Remove the roof rail to cowl bracket bolt and slide the side roof rail forward off the vehicle.

Installation

1. Slide the side roof rail rearward onto the roof rail reinforcement to B-pillar and install the roof rail to cowl bracket bolt. Tighten the roof rail to cowl bracket bolt to 24-31N.m (18-22lb-ft.).
2. Tighten the roof rail reinforcement to B-pillar inner bolts to 24-31N.m (18-22lb-ft.).
3. Tighten the roof rail reinforcement to B-pillar lower bolt to 11-13N.m (98-115lb-in.).
4. Install the two lower windshield roof rail bolts. Tighten the two lower windshield roof rail bolts to 24-31N.m (18-22lb-ft.).
5. Install the upper windshield roof rail and the four upper windshield roof rail bolts. Tighten the four upper windshield roof rail bolts to 24-31N.m (18-22lb-ft.).
6. Install the roof panel. Refer to [Roof Panel](#) in this section.
7. Install the windshield. Refer to [Windshield](#) in this section.
8. Install the front fascia. Refer to [Front Fascia](#) in this section.
9. Install the instrument panel. Refer to [Instrument Panel](#) in this section.
10. Install the B-pillar trim and tighten the four B-pillar trim screws to 20-30N.m (15-22lb-ft.).
11. Install the B-pillar seal.
12. If equipped, install the side view mirror. Tighten the side view mirror screws to 20-30N.m (15-22lb-ft.).
13. Position the seat belt hanger bracket and install the two lower and two side seat belt hanger bracket bolts. Tighten the two side seat belt hanger bracket bolts to 20-25N.m (15-18lb-ft.). Tighten the two lower seat belt hanger bracket bolts to 9-12N.m (80-106lb-ft.).
14. Install the grab handles. Tighten the grab handle bolts to 20-30N.m (15-22lb-ft.).

Roof Panel



Item	Part Number	Description
1	50202	Roof Panel
2	502S02	Roof Panel Rear Adhesive Strip
3	502S02	Roof Panel LH Adhesive Strip
4		Rail Seal
5	502S02	Roof Panel Front Adhesive Strip
6	3M PUL 0612 (Ford specification ESB-M99J291-A-A4)	Adhesive Urethane Film

Removal

1. Sharply push on the roof panel near the roof rail, from the inside of the vehicle. Continue pressure and gradually peel the roof away from the rail.

Installation

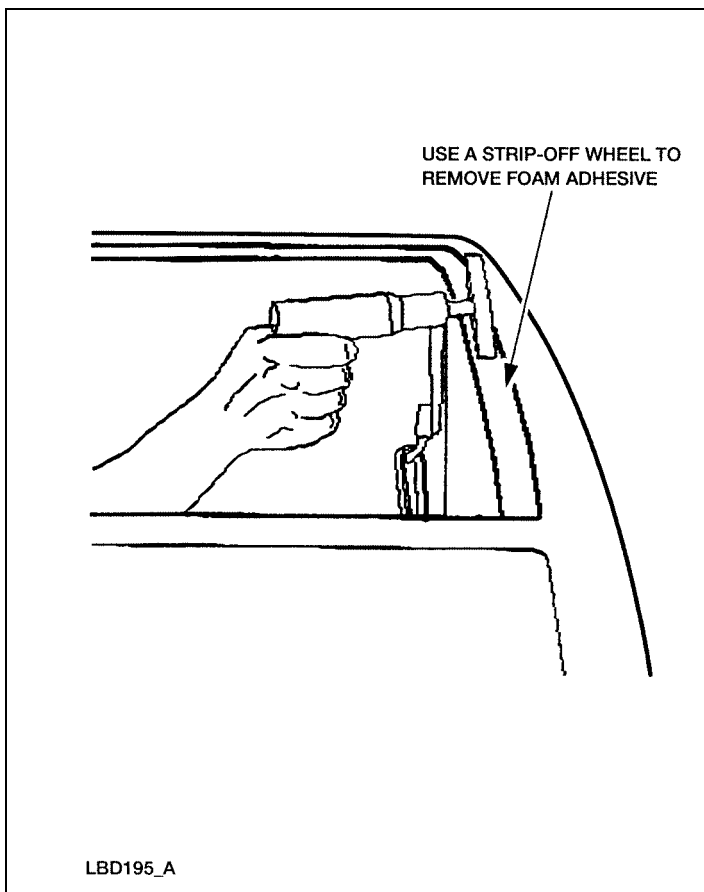
Note:

The roof is attached to the roof rails with double-sided adhesive coated tape. Some vehicles will also be sealed with silicone adhesive, and/or have hot melt sealant in the corners. All of these materials need to be removed and the surface cleaned.

Note:

If the adhesive tape is difficult to remove, gently apply heat to the tape using a heat gun.

1. Remove the foam tape and silicone adhesive from the roof panel, rails, and header.
2. Use rubber stripe removal wheel such as #M 07498 on an air drill (tool optimal speed is 1500-2000 rpm) to remove remaining foam adhesive. The surface should be relatively clean, recognizing that it may not be possible to remove all traces of the silicone adhesive.



CAUTION:

Do not use metal to scrape the roof rails or the roof panel. The roof rails are anodized and the metal will corrode if scratched through the anodized layer. The roof is ABS plastic and metal objects may gouge the surface.

3. Use compressed air and blow away any debris from the rubber stripe removal wheel.
4. Wipe the roof rail, upper windshield roof rail and roof panel bonding area using a clean rag and wax and grease remover or alcohol.

Note:

The bonding surfaces must be clean to achieve a watertight bond.

5. Apply 1” masking tape to the top, outer edge of the roof panel.

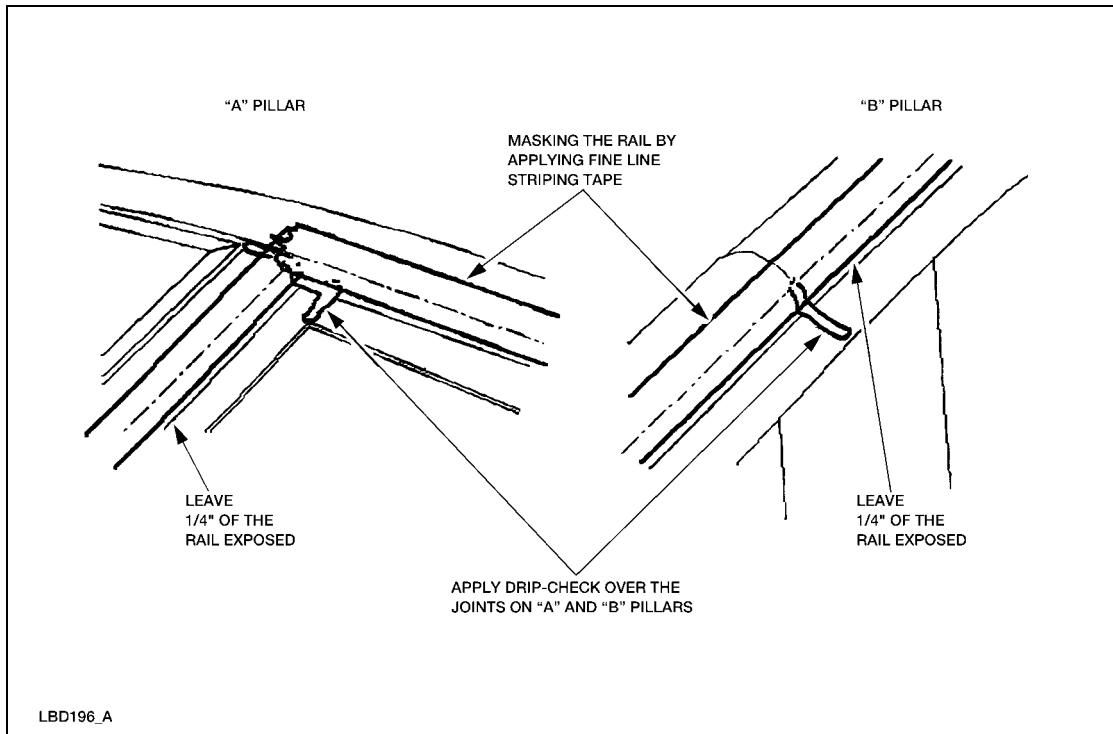
Note:

Drip-check will shrink considerably as it cures. If the Drip-Check is not cured before the foam tape is applied, the bonding ability of the foam tape will be compromised and leaks may result.

Note:

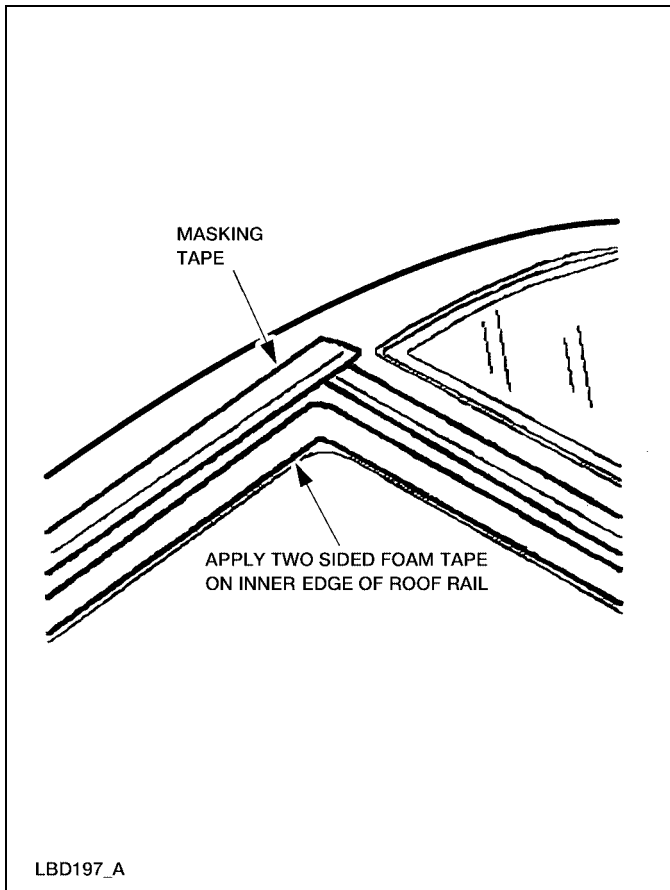
If the gap at the A-pillar is greater than 2mm (0.078in) place a piece of masking tape under the joint (from inside the vehicle) to support the Drip-Check as it cures and fills the gap.

6. Apply a 5-7mm (0.20-0.27in) bead of 3M Drip-Check 08531 over the joints at the A- and B-pillars. Make sure the joint will be filled when the material dries. Allow the Drip-Check to cure 3-4 hours before proceeding.

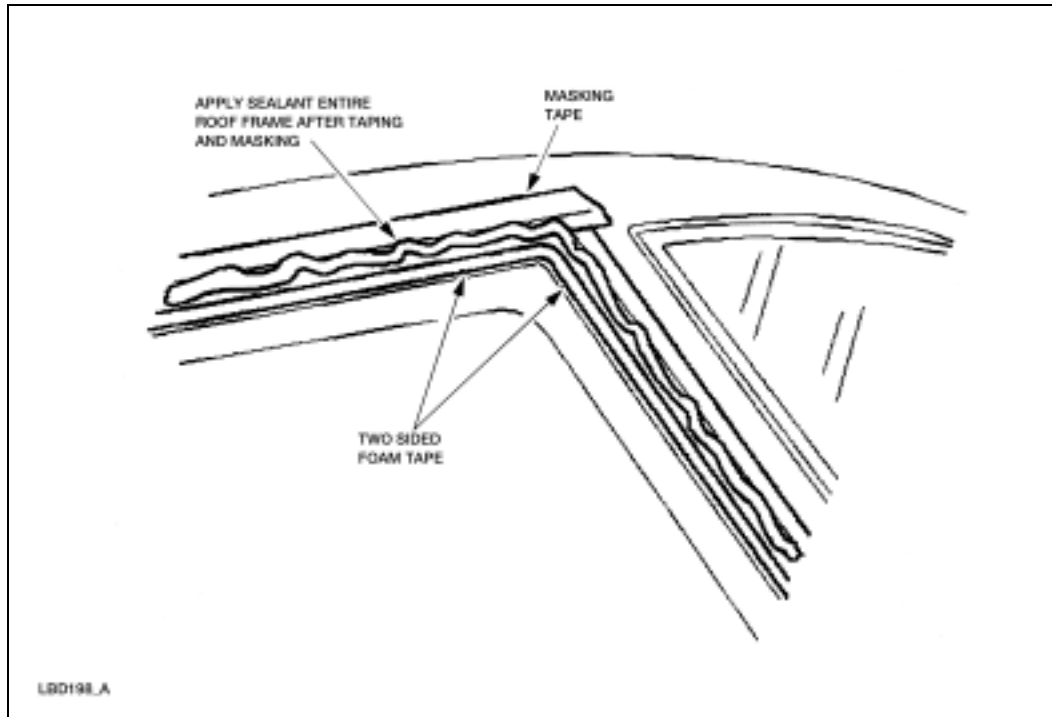


7. Mask the rail by applying fine line striping tape such as 3M 06314 on the vertical surface of the roof rail and upper windshield roof rail, and then peeling the lower 1/4" of the tape away. You may also apply 1/4" fine line striping tape such as 3M 06301 on the lower vertical surface of the rail then 1" masking tape directly above the fine line tape, and finally removing the fine line tape to expose the lower 1/4" of the rails vertical surface.

8. Apply 12.7mm x 1.14mm (.5 x .045in) double-sided foam tape such as 3M 06380 around the roof rail perimeter, beginning at the middle rear of the vehicle. Use a continuous piece, and ease the tape by pulling a little around the corners. Do not use thicker tape, as this is difficult to ease around the corners. Remove the backing, and apply a second layer of tape at this time. This will serve as a dam for the urethane adhesive. Press down on the tape, all the way around the perimeter, to ensure the tape has completely bonded to the roof rail.



9. Apply a 5-6mm(0.197-0.236in) bead of 3M 08360 Ultra-Pro White Urethane Seam Sealer on the roof rails and upper windshield roof rail beginning on the outside by the masking tape, and then apply a second bead next to the foam tape. Do not get urethane adhesive on the foam tape. Be sure to apply sufficient material in the A-pillar area. This material requires a special applicator gun, 3M 08398. Use only white urethane.



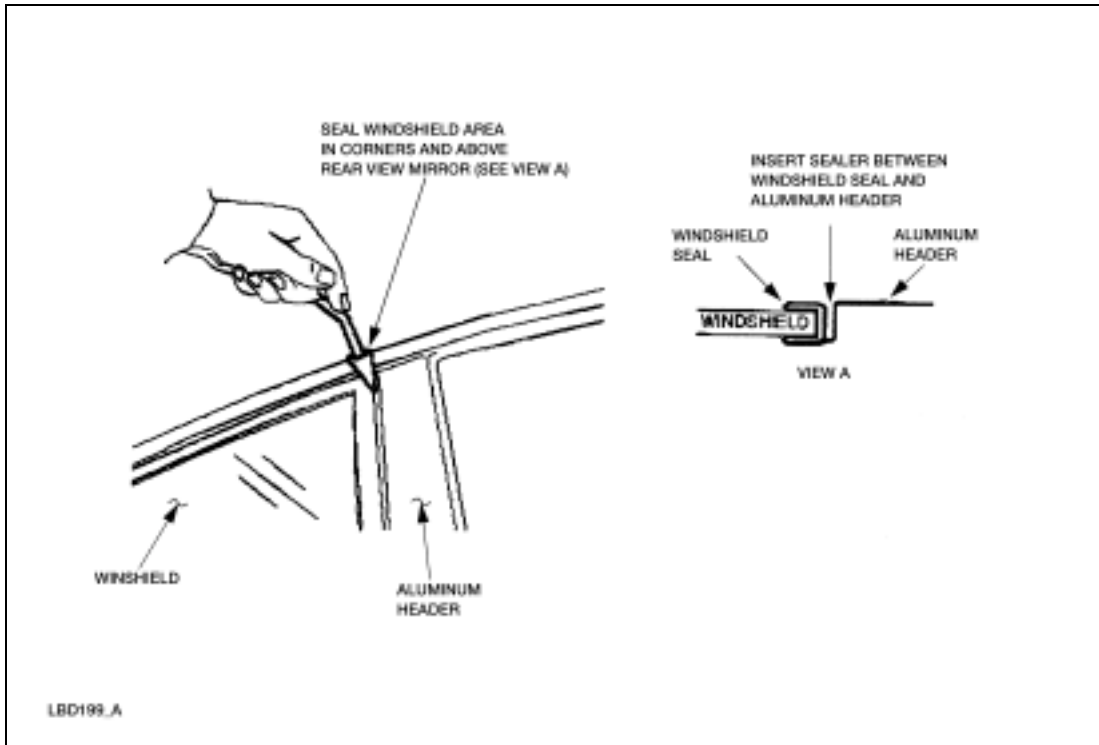
10. Remove the backing on the foam tape. Set the roof panel into the opening carefully, lining the leading edge of the roof panel up with the upper windshield roof rail and then setting the rear of the roof panel into place. Press the roof firmly, and visually inspect all areas of the bond from the inside of the vehicle, and you should see the urethane spilling into the trench between the roof panel and the roof rail.

Note:

Lightly spraying adhesive cleaner such as 3M 08987 on the glove and urethane will make it easier to spread and smooth the adhesive.

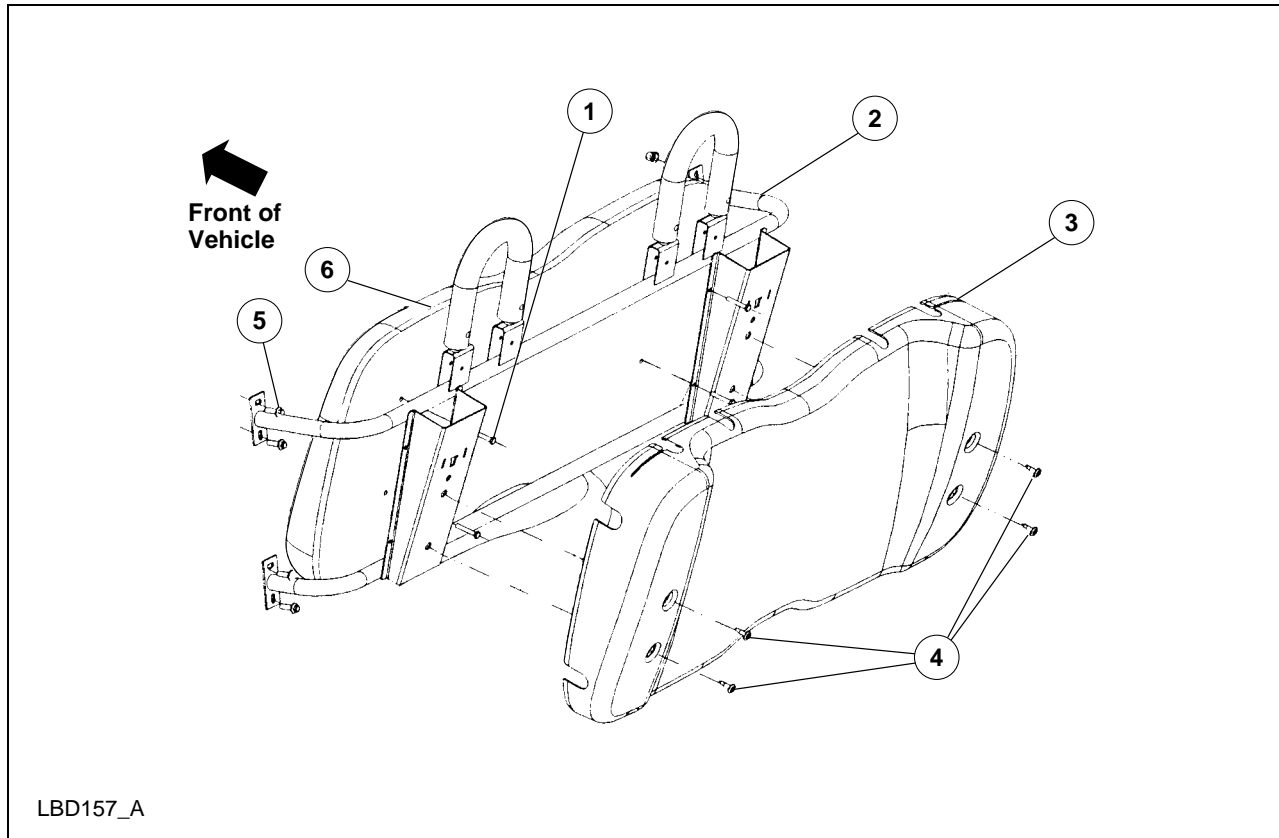
11. Wearing latex gloves, smooth the urethane adhesive in the ditch area between the roof panel and the roof rails. You may wish to fill additional urethane adhesive into the ditch for cosmetic purposes.
12. Clean any misapplied urethane adhesive using adhesive cleaner such as 3M 08987 before it has cured.
13. Carefully remove the masking tape from the roof panel and the roof rails.

14. Seal the upper edge of the windshield, and above the rear view mirror, using 3M 08994 Windo-weld flow grade resealant. Inject the resealant between the rubber windshield seal and the upper windshield roof rail.



15. Allow curing for 2-4 hours.
16. Water test the vehicle to verify the repair.

Seat Back and Frame – Rear Seat

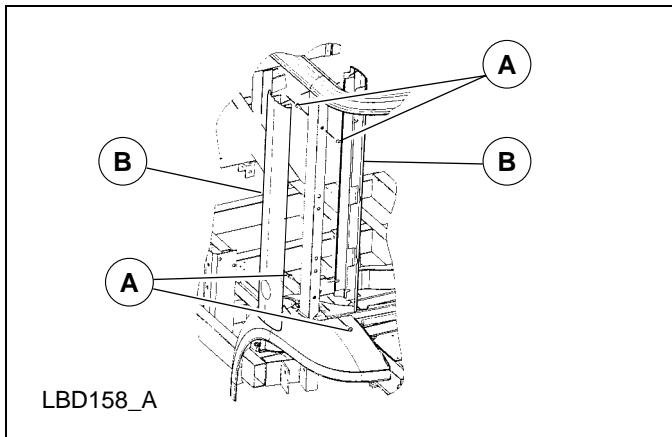


Item	Part Number	Description
1	60108	Rear Seat Back Bolt
2	613A38	Rear Seat Back Frame
3	668C92	Rear Seat Back Cover
4	W505545-S306	Rear Seat Back Cover Screws
5	W500023-S426	Rear Seat Back Frame Bolts
6	66892	Rear Seat Seat Back

Removal

1. Remove the four rear seat back cover screws and the rear seat back cover.
2. Remove the four rear seat back bolts and the rear seat seat back.
3. Remove the B-pillar seal.

4. Loosen the four B-pillar screws (A) and remove the B-pillar trim (B). Repeat on the other side of the vehicle.



5. Remove the eight rear seat back frame bolts and the rear seat back frame.

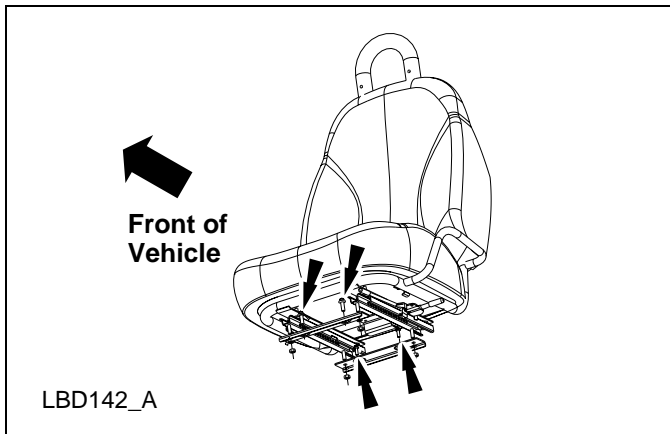
Installation

1. Install the rear seat back frame and the eight rear seat back frame bolts. Tighten the eight rear seat back frame bolts to 20-30N.m (15-22lb-ft.).
2. Install the B-pillar trim and tighten the four B-pillar screws to 20-30N.m (15-22lb-ft.). Repeat on the other side of the vehicle.
3. Install the B-pillar seal.
4. Install the rear seat seat back and the four rear seat back bolts. Tighten the four rear seat back bolts to 9-12N.m (80-106lb-in.)
5. Install the rear seat back cover and the four rear seat back cover screws. Tighten the rear seat back cover screws to 10N.m (88lb-in.).

Seat Back and Frame – Driver Seat

Removal

1. Pull up and remove the front seat cushion.
2. Remove the four seat back and frame bolts.



3. Carefully lift the seat assembly off the seat stanchion.
4. If necessary, remove the four seat frame slider bolts and remove the seat frame slider.

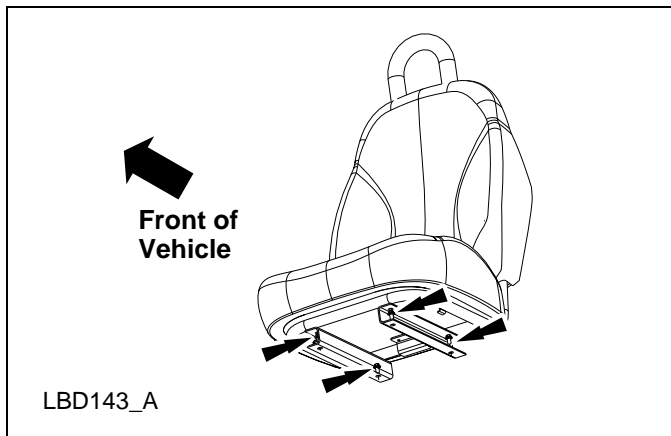
Installation

1. If necessary, install the four seat frame slider and the seat frame slider bolts. Tighten the seat frame slider bolts to 12-14N.m (107-123lb-in.).
2. Carefully lower the seat assembly onto the seat stanchion.
3. Install the four seat back and frame bolts. Tighten the four seat back and frame bolts to 20-30N.m (15-22lb-ft.).
4. Firmly press down on the front seat cushion to lock it in place.

Seat Back and Frame – Passenger Seat

Removal

1. Remove the four seat back and frame bolts.



2. Carefully lift the seat assembly off the seat stanchion.

Installation

1. Reverse the removal procedure.
2. Tighten the four seat back and frame bolts to 20-30N.m (15-22lb-ft.).

Seat Back Cushion Cover

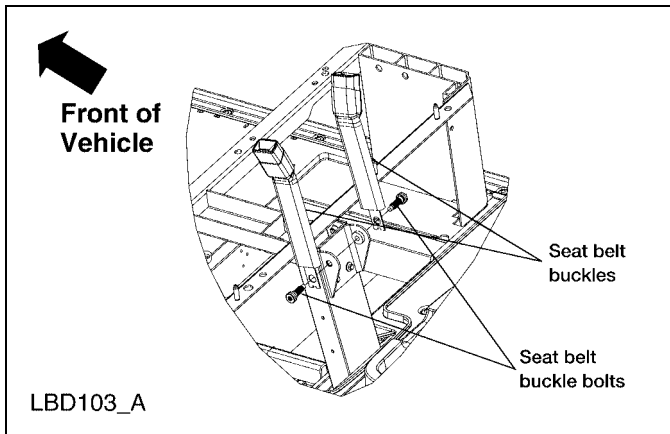
Removal and Installation

Seat back cushion covers are not serviceable separate from the seat back. Refer to [Seat Back and Frame- Driver Seat](#) and [Seat Back and Frame- Passenger Seat](#) in this section.

Seat Belt Buckle - Front

Removal

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in this section.
2. Remove the seat belt buckle bolt and the seat belt buckle.



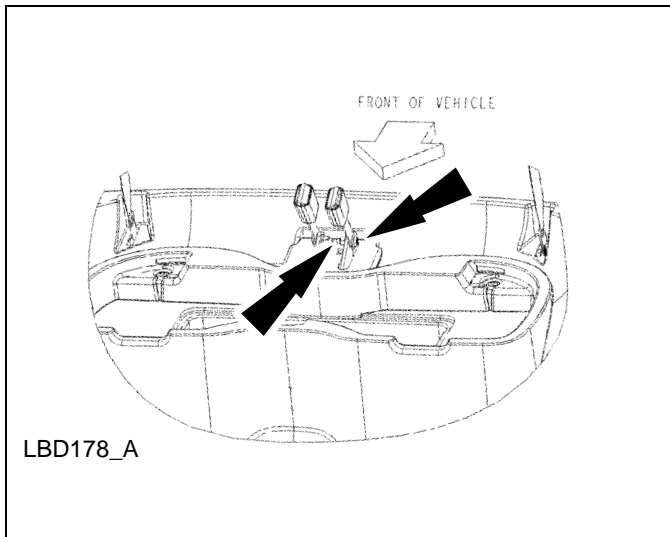
Installation

1. Reverse the removal procedure.
2. Tighten the seat belt buckle bolt to 26-34N.m (19-25 lb-ft.).

Seat Belt Buckle - Rear

Removal

1. Pull up and remove the rear seat cushion.
2. Remove the rear seat belt buckle bolt and the rear seat belt buckle.



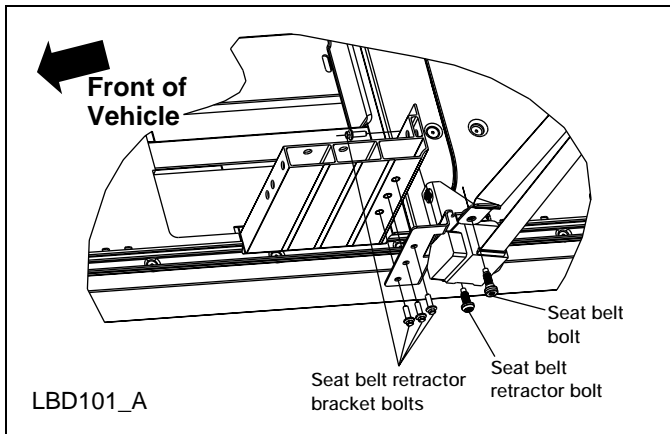
Installation

1. Reverse the removal procedure.
2. Tighten the seat belt buckle bolt to 26-34N.m (19-25 lb-ft.).

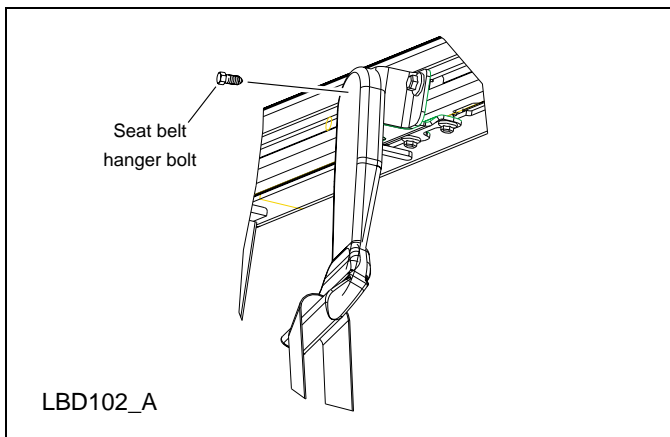
Seat Belt Retractor - Front

Removal

1. Remove the seat stanchion cover. Refer to [Seat Stanchion Cover](#) in this section.
2. Remove the seat belt bolt and seat belt retractor bolt.



3. Pry down the rubber hanger cover. Remove the seat belt hanger bolt and the retractor and belt assembly.



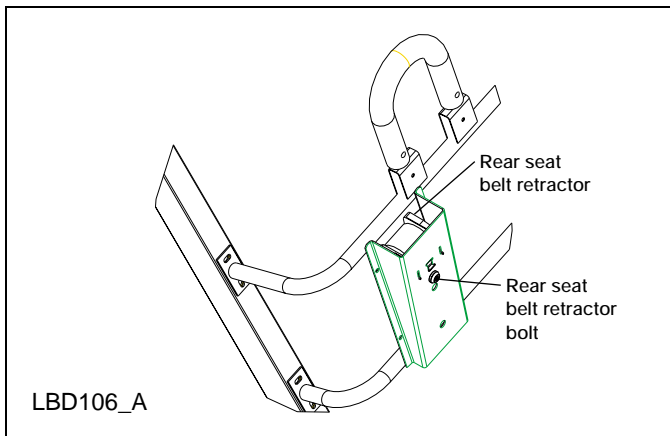
Installation

1. Reverse the removal procedure.
2. Tighten the seat belt hanger bolt to 26-34N.m (19-25 lb-ft.).
3. Tighten the front seat belt retractor bolt to 26-34N.m (19-25 lb-ft.).
4. Tighten the seat belt bolt to 26-34N.m (19-25lb-ft.).

Seat Belt Retractor - Rear

Removal

1. If equipped, remove the golf rack. Refer to [Golf Rack](#) in this section.
2. Remove the four rear seat back cover screws and the rear seat back cover.
3. Remove the rear seat belt retractor bolt and the retractor.



Installation

1. Reverse the removal procedure.
2. Tighten the seat belt retractor bolts to 26-34N.m (19-25lb-ft.).
3. Tighten the four rear seat back covers to 10N.m (88lb-in.).

Seat Cushion

Removal

Remove the seat cushion by lifting up on the cushion to disengage the seat clips.

Installation

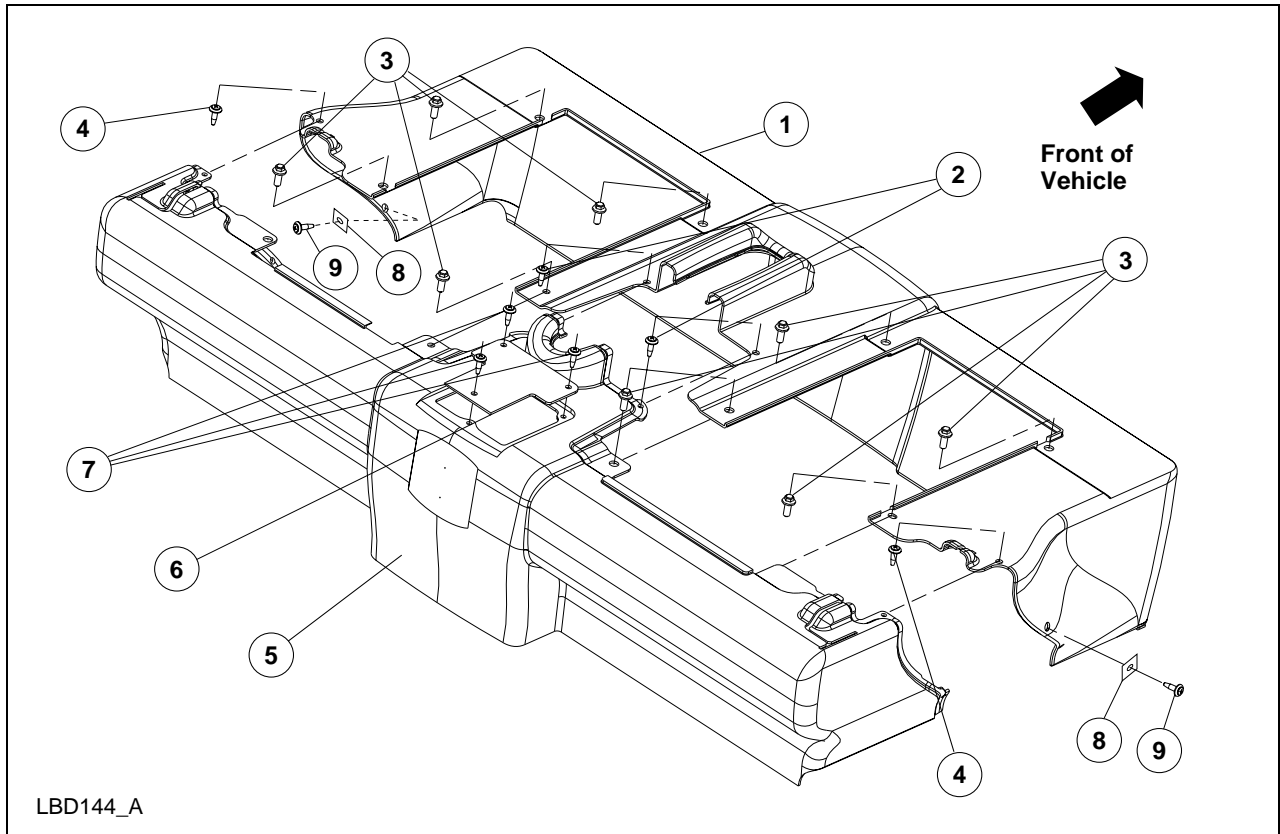
Set the seat cushion in place and firmly push down to engage the clips.

Seat Cushion Cover

Removal and Installation

Seat cushion covers are not serviceable separate from the seat cushion. Refer to [Seat Cushion](#) in this section.

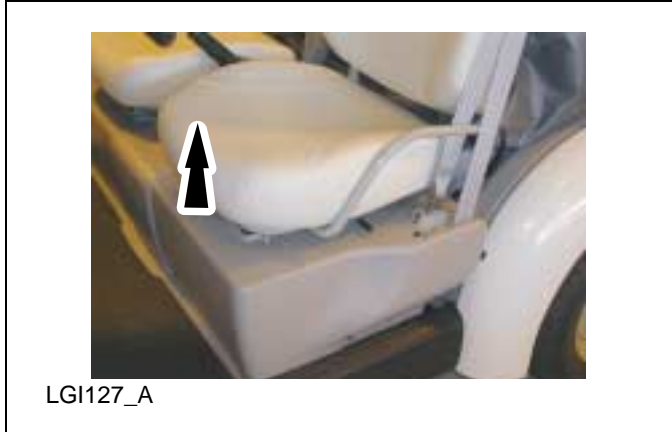
Seat Stanchion Cover



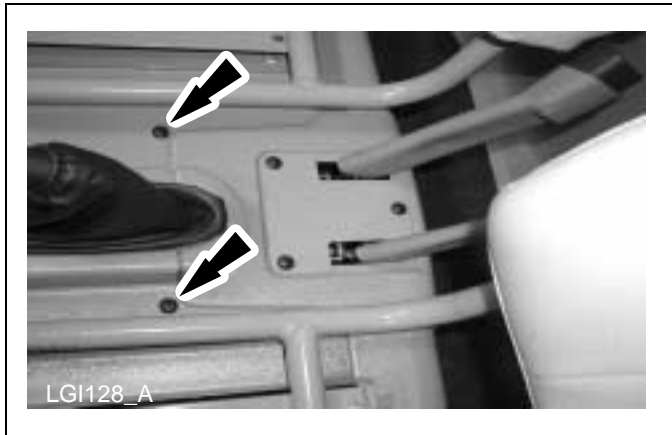
Item	Part Number	Description
1	62284	Seat Stanchion Cover – Front
2	--	Seat Stanchion Cover Pushpin – Center
3	--	Seat Stanchion Cover Bolts
4	--	Seat Stanchion Cover Pushpin – Side
5	62284	Seat Stanchion Cover – Rear
6	62284	Access Cover
7	--	Cover Panel Pushpins
8	--	Insert Nut
9	--	Seat Stanchion Cover Screw – Side

Removal

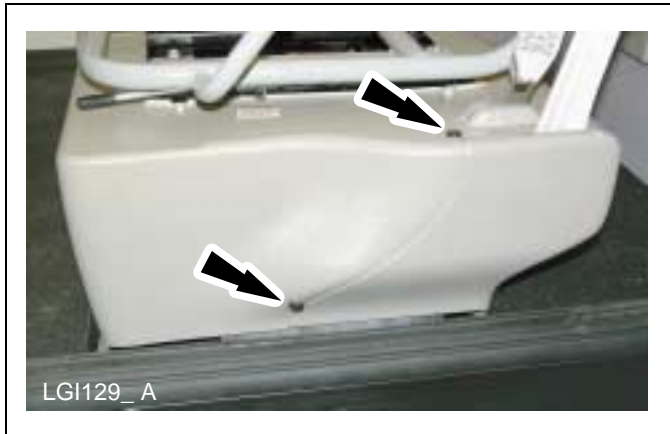
1. Pull straight up on the front seat cushions to release the clips.



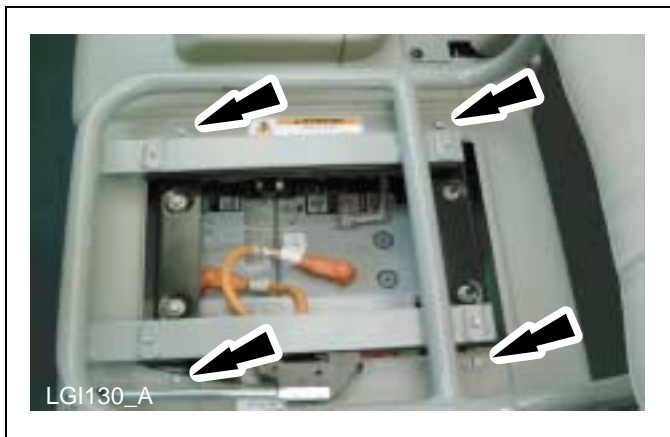
2. On two-passenger vehicles, remove the front seats. Refer to [Seat Back and Frame – Driver Seat](#) and [Seat Back and Frame - Passenger Seat](#) in this section.
3. Remove the two center pushpins.



4. Remove the side pushpin and screw. Repeat on the other side of the vehicle.



5. Remove the eight seat stanchion cover bolts.



6. Carefully slide the front seat stanchion cover forward and out of the vehicle.
7. Carefully slide the rear seat stanchion cover rearward and lift out of vehicle.

Installation

1. Reverse the removal procedure.
2. Tighten the seat stanchion cover bolts to 8N.m (70lb-in.).

Steering Wheel

Removal

1. Carefully pull on the edges of the steering wheel cover and remove from the steering wheel.
2. Remove the steering wheel bolt and pull the steering wheel straight off the steering column.



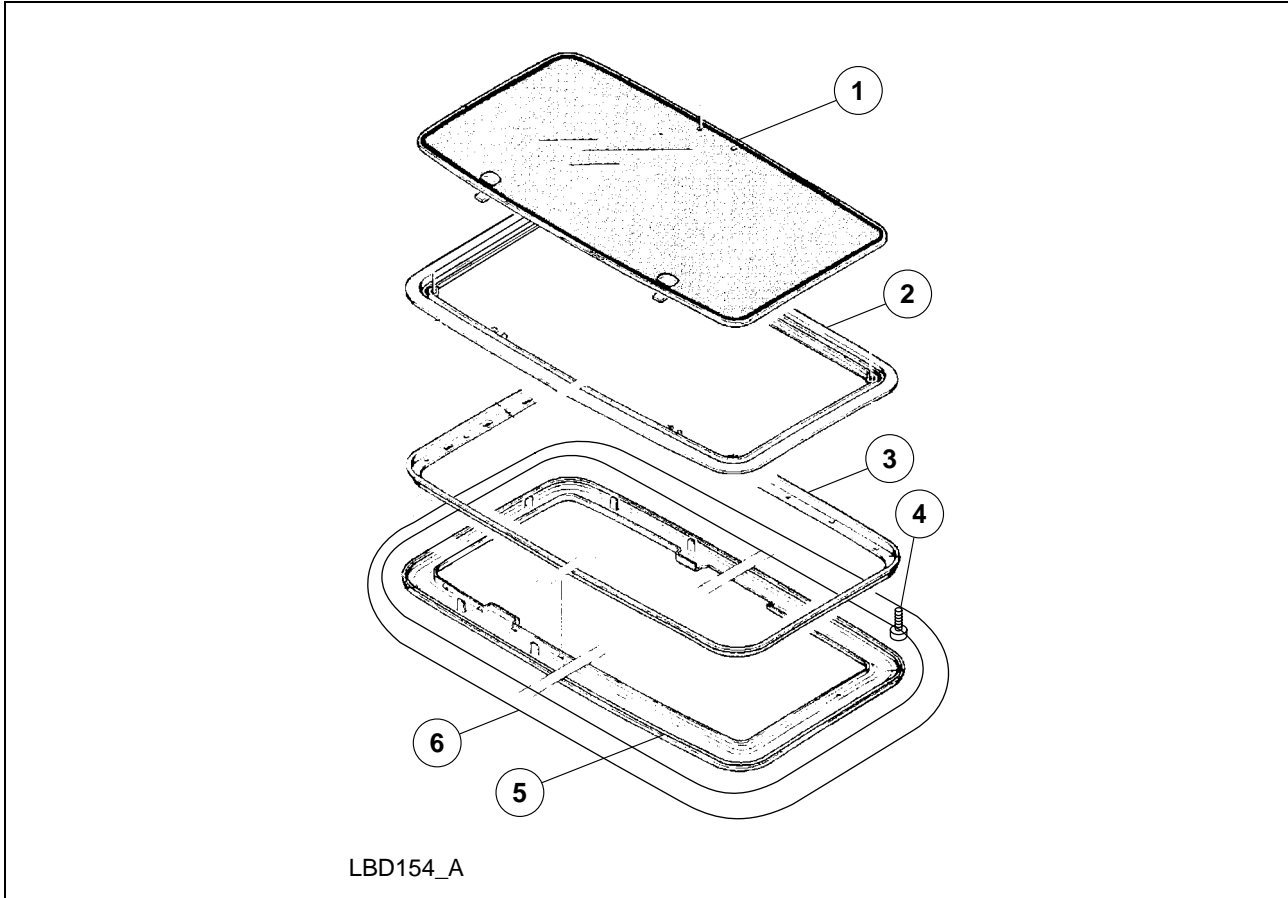
Installation

Note:

If necessary, adjust the toe equally to ensure clear vision.

1. Reverse the removal procedure.
2. Tighten the steering wheel bolt to 47N.m (34lb-ft.).

Sun Roof/Roof Vent



LBD154_A

Item	Part Number	Description
1	Part of 502A82	Sun Roof/Roof Vent Glass (includes handle and hinges)
2	Part of 502A82	Sun Roof/Roof Vent Glass Frame
3	Part of 502A82	Sun Roof/Roof Vent Retainer
4	Part of 502A82	Sun Roof/Roof Vent Screws
5	Part of 502A82	Sun Roof/Roof Vent Trim
6	034S08	Sun Roof/Roof Vent Trim Seal

Removal

1. Carefully pull down on the sun roof/roof vent trim and remove.
2. Remove the 24 sun roof/roof vent screws and the sun roof/roof vent retainer.
3. Carefully lift the sun roof/roof vent glass and frame off the vehicle.

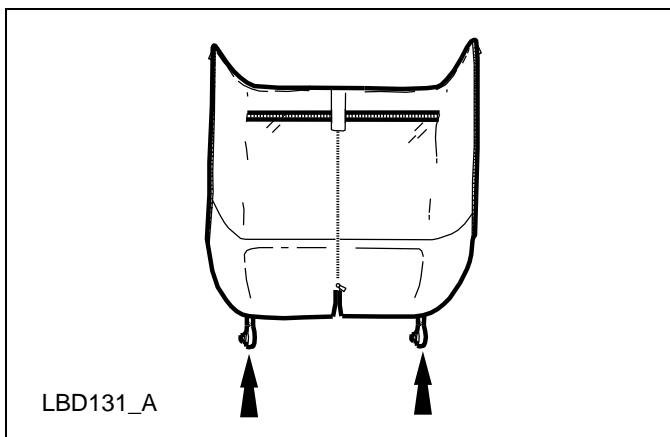
Installation

1. Clean an area 12mm (0.47in) from the edge around the sun roof/roof vent opening with Multi-Purpose Cleaner Concentrate B8A-19523-AA meeting Ford specification ESR-M14P4-A (diluted to proper concentration) or equivalent.
2. Carefully lower the sun roof/roof vent glass and frame onto the vehicle.
3. Install the sun roof/roof vent retainer and the 24 sun roof/roof vent screws. Tighten the sun roof/roof vent screws to 3N.m (26lb-in.).
4. Press the sun roof/roof vent trim into place.

Weather Enclosure

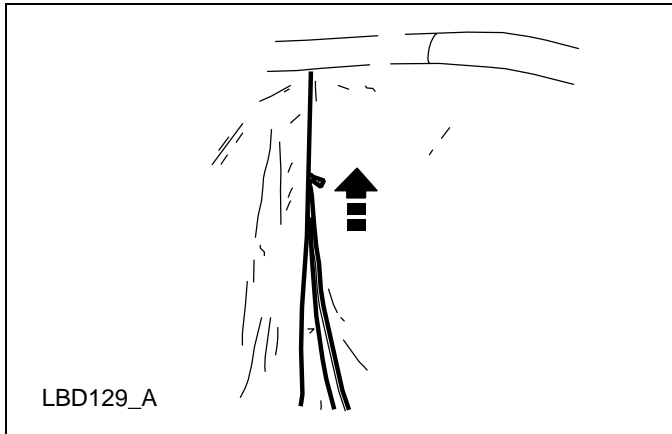
Removal

1. On 2-passenger and 4-passenger vehicles, unfasten the two rear mounting hooks from the rear fenders.

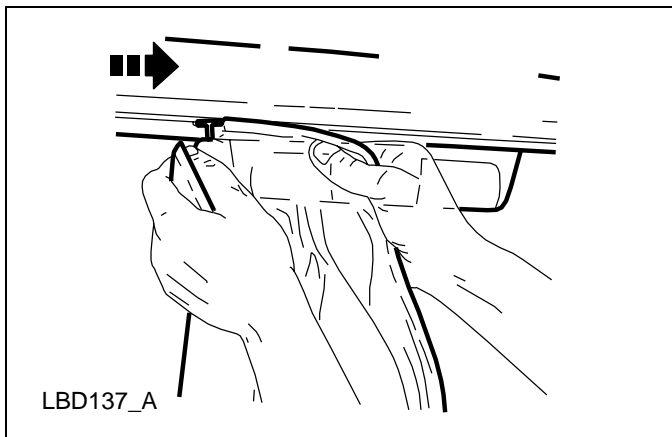


2. On 2-passenger wagons, unfasten the two rear mounting hooks from the rear bumper.

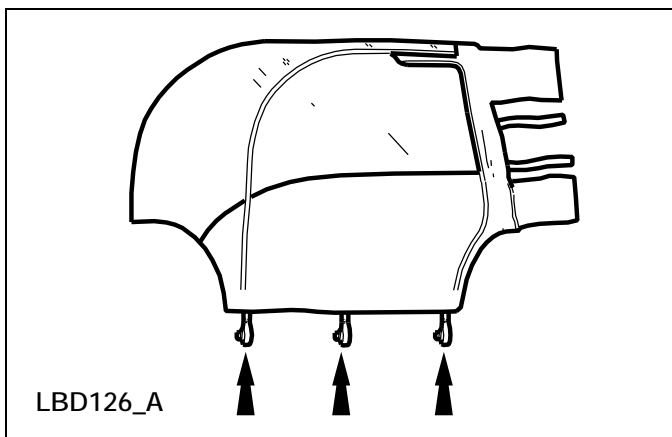
3. Unzip the two rear weather enclosure to side weather enclosure zippers.



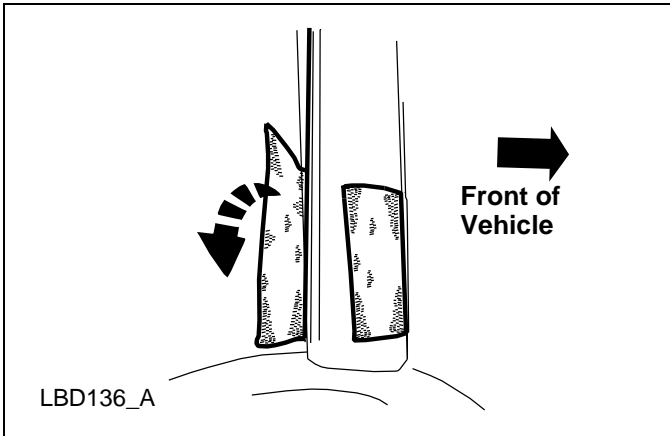
4. Remove the rear weather enclosure hangers from the slots near the high-mount stop lamp.



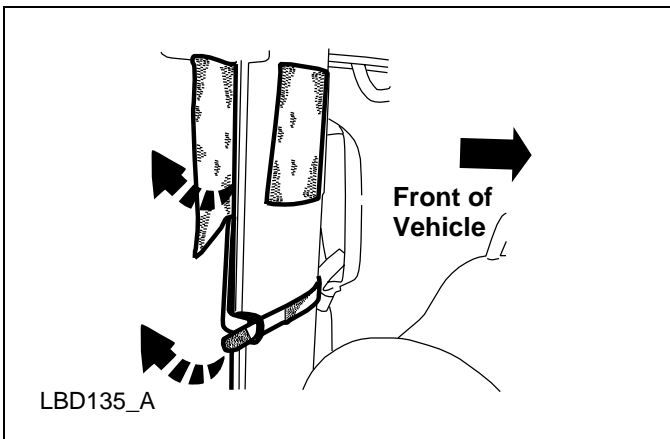
5. Unfasten the three side weather enclosure mounting hooks from the openings in the frame rail.



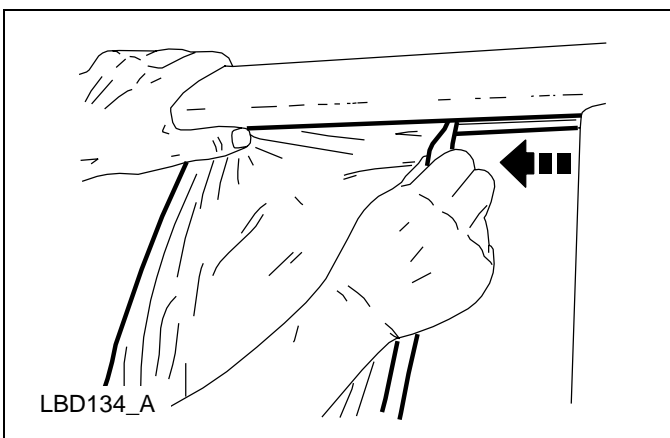
6. Pull apart the large lower attaching strap.



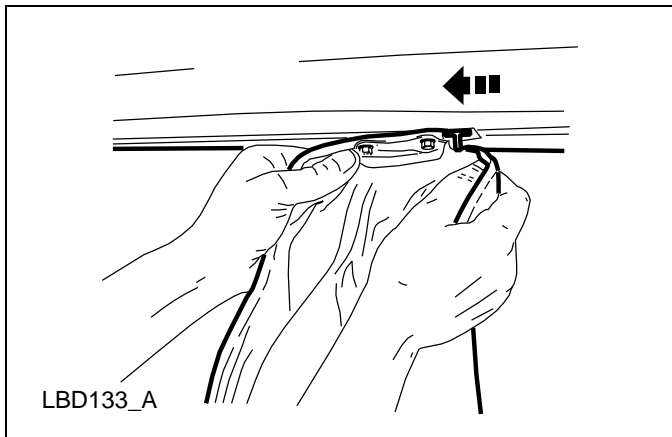
7. Pull apart the large upper attaching strap and the thin attaching strap.



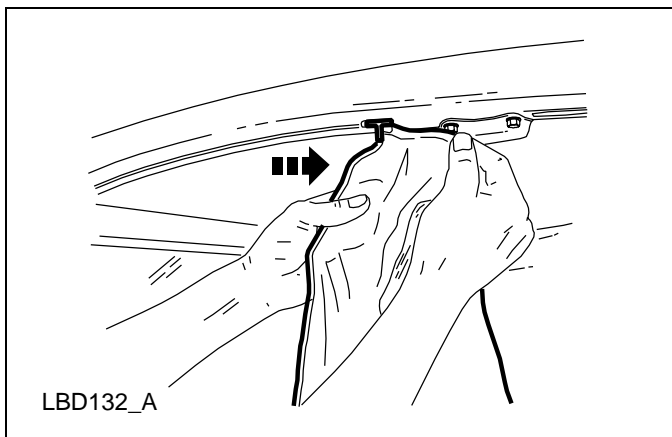
8. Slide the hanger forward, away from the B-pillar.



9. Remove the side weather enclosure rear hanger from the slot on the underside of the roof rail by the seat belt hanger bracket.



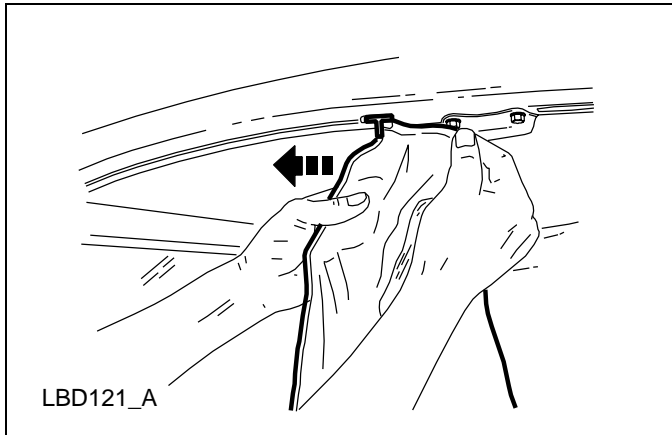
10. Slide the hanger away from the front fender.



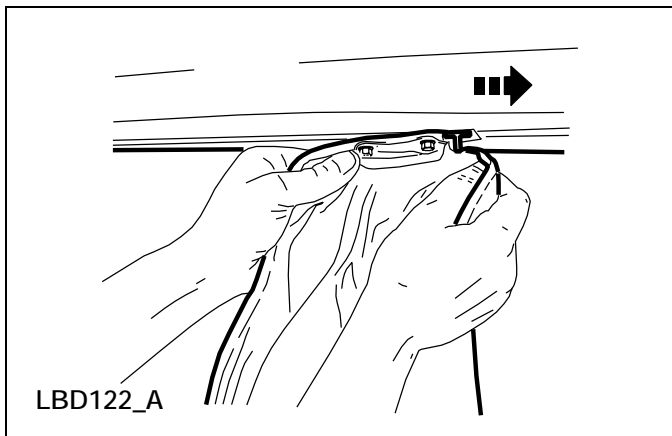
11. Remove the side weather enclosure front hanger from the slot on the underside of the roof rail by the seat belt hanger bracket.
12. Repeat steps 5 - 11 for the opposite side of the vehicle.

Installation

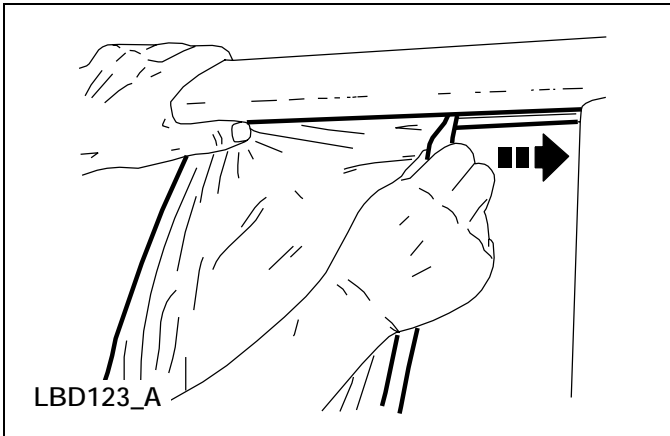
1. Insert the side weather enclosure front hanger into the slot on the underside of the roof rail by the seat belt hanger bracket.
2. Slide the hanger forward until it reaches the front fender.



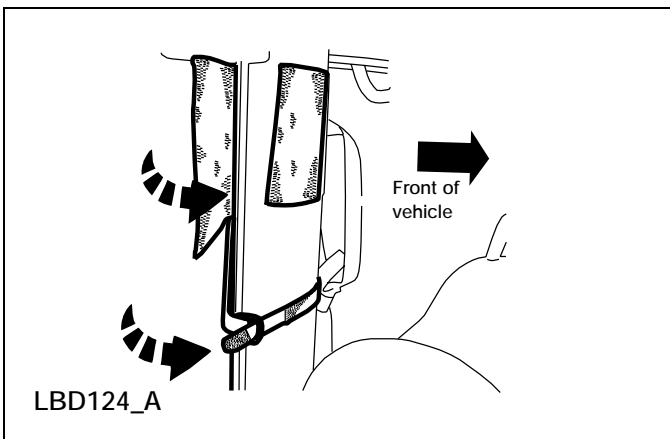
3. Insert the side weather enclosure rear hanger into the slot on the underside of the roof rail by the seat belt hanger bracket.



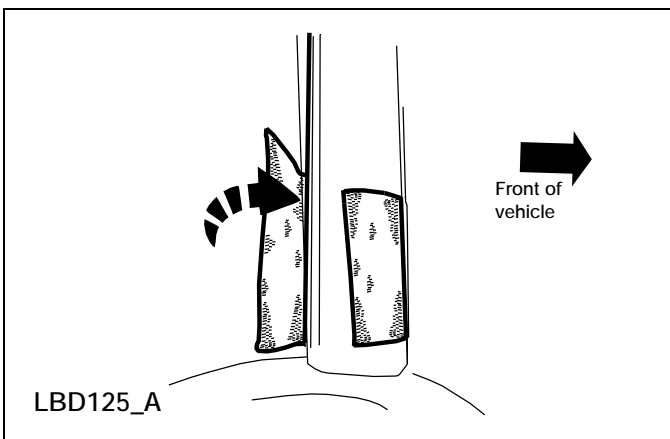
- Slide the hanger rearward until it reaches the B-pillar.



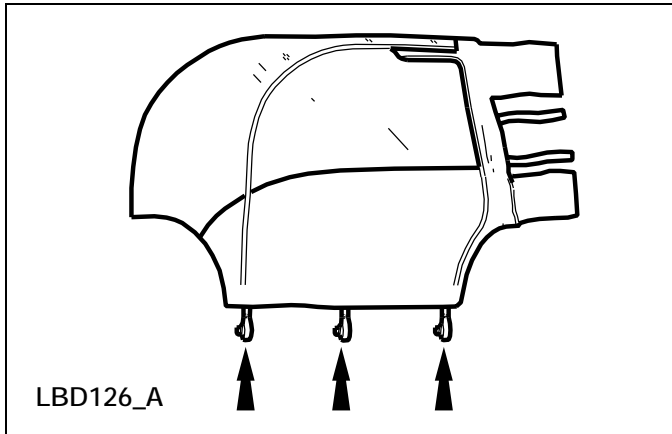
- Wrap and fasten the large upper attaching strap. Insert the thin attaching strap through the D-ring and fasten securely.



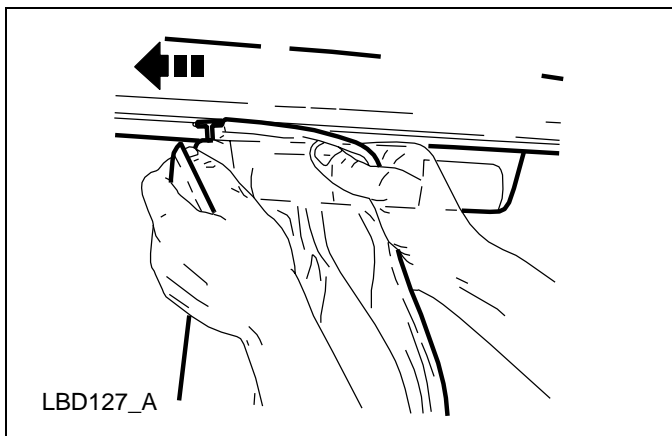
- Wrap and fasten the large lower attaching strap.



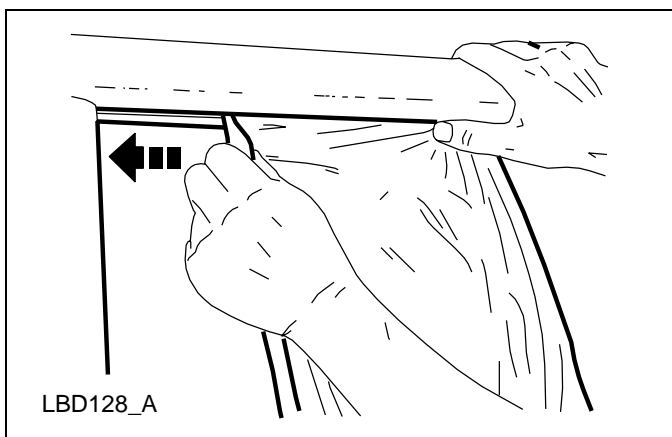
7. Attach the three mounting hooks to the openings in the frame rail.



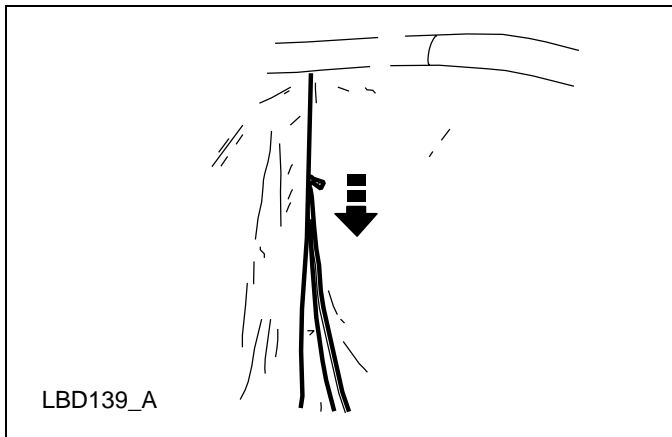
8. Repeat steps 1 - 7 for the opposite side of the vehicle.
9. Insert the rear weather enclosure hanger into the slot near the high-mount stop lamp.



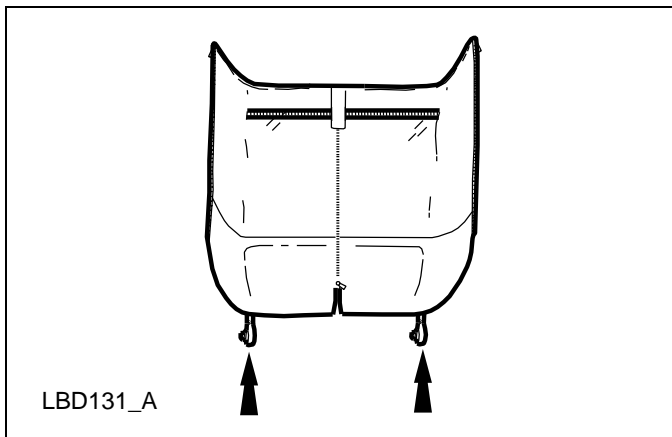
10. Slide the hanger towards the B-pillar.



11. Zip the weather enclosure to side weather enclosure zipper. Repeat on the other side of the vehicle.




12. On 2-passenger and 4-passenger vehicles, attach the two rear mounting hooks to the rear fenders.



13. On 2-passenger wagons, attach the two rear mounting hooks to the rear bumper.

Windshield

Required Tools

Knife, Windshield Glass Sealant T70P-42006-A or Equivalent	 LBD193_A
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Removal

1. Remove the windshield wiper arms.
2. Remove the rearview mirror.
3. Lubricate the urethane sealant with a soap and water solution to aid the Windshield Glass Sealant Knife when cutting the urethane sealant.

WARNING!

TO PREVENT GLASS SPLINTERS FROM ENTERING THE EYES OR CUTTING THE HANDS, WEAR SAFETY GLASSES AND HEAVY GLOVES WHEN CUTTING THE GLASS FROM THE VEHICLE.

4. Insert the Windshield Glass Sealant Knife into the urethane sealant at the upper center of the vehicle interior, and work toward the bottom corners.

Note:

Support the windshield, to prevent the glass from dropping, before cutting the bottom edge of the urethane sealant.

5. Insert the Windshield Glass Sealant Knife into the bottom center of the urethane sealant on the vehicle exterior, and work toward the corners.

CAUTION:

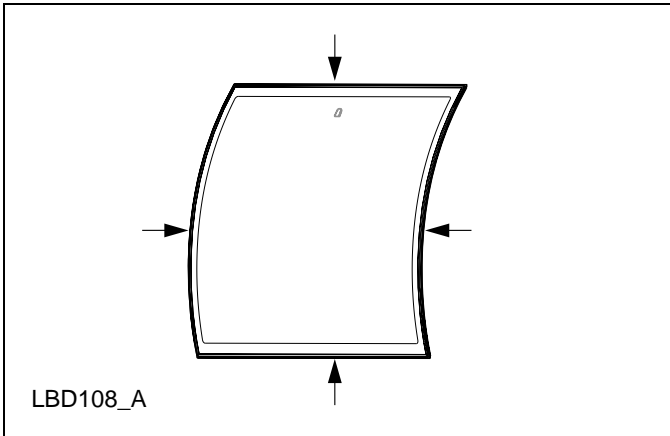
Removing the glass requires more than one technician.

6. Carefully remove the windshield glass from the vehicle.
7. Trim the remaining urethane. The old urethane must be smooth and free of cuts and contamination.
8. Remove the inner seal from the windshield mounting flange.

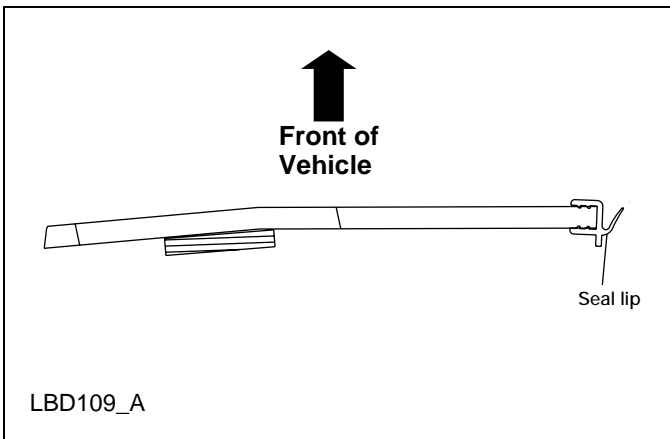
Installation

1. Check the windshield mounting area for damage, or foreign material that could cause glass damage.
2. Clean the mounting flange inside the vehicle where the inner seal is mounted using Extra Strength Tar and Road Oil Remover B7A-19520-AA or equivalent meeting Ford specification ESR-M5B106-A.
3. Apply Essex Betaseal 43532 (Body Primer) or equivalent meeting Ford specification WSB-M2G234-C to any exposed metal on the windshield mounting surface using either a clean rag or clean sponge applicator.
 - Do not apply the primer to the existing urethane bead.
 - Let the primer dry for a minimum of 6-10 minutes before proceeding.
4. Properly align the windshield glass to the body, mark the body-mounting surface, and remove the windshield glass from the vehicle.
 - Place the windshield glass in the opening, and center it from top to bottom and side to side with about equal clearance on all sides.
 - Make alignment marks on each of the four sides of the windshield glass.
 - Remove the windshield glass from the vehicle, and place it inside up.
5. If re-installing the same windshield glass, remove all remaining traces of urethane sealant.
6. Clean the inside of the windshield glass using isopropyl alcohol wipes or Ultra-Clear Spray Glass Cleaner E4AZ-19C507-AA or equivalent meeting Ford specification ESR-M14P5-A.
7. Apply Essex Betaseal 43519 (Glass Primer) or equivalent meeting Ford specification WSB-M5B280-B to the entire inside perimeter of the windshield glass. Wipe off immediately after each application.
8. Apply Essex Betaseal 43520A (Glass Primer) or equivalent meeting Ford specification WSB-M2G314-B to the entire inside perimeter of the windshield glass. Allow a minimum of 5 minutes drying time.

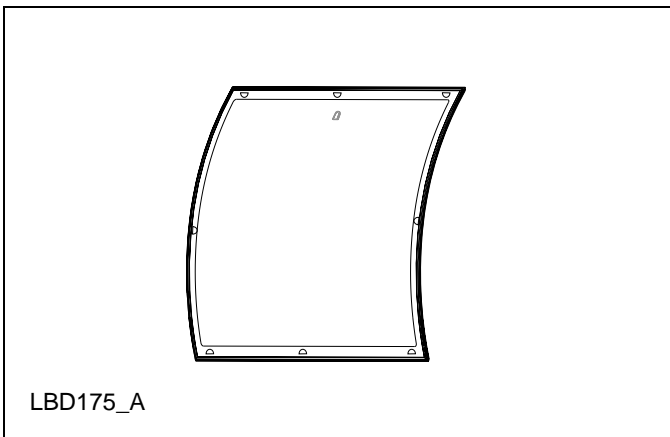
9. Install the windshield seal (4G4631) on the windshield.



10. Make sure the seal lip faces outward of the vehicle.



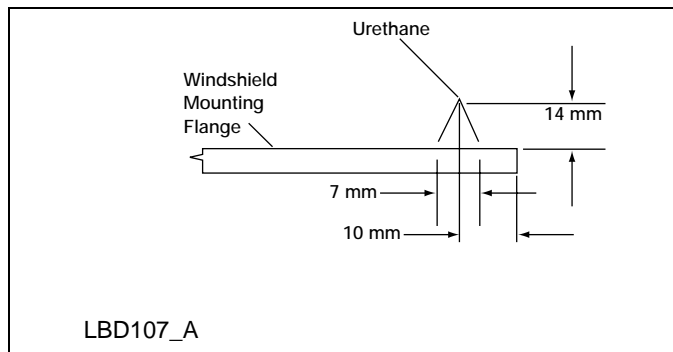
11. Cut four spacers (V030T12) in half to be half moon shaped. Install the spacers on the windshield glass with the flat edge against the windshield seal.



Note:

The windshield glass must be positioned within 10 minutes of applying the urethane sealant.

12. Apply a 7mm (0.28inch) wide bead of Essex Betaseal 57302 (Urethane) or equivalent meeting Ford specification WSB-M2G316-B to the entire primed area of the windshield glass.



CAUTION:

After replacing the urethane-installed glass, the vehicle must not be driven until the urethane has cured. The curing time at temperatures above 13°C (55°F) and relative humidity above 50% is 12-24 hours (decreasing at higher temperatures and lower humidity). Inadequate curing of the urethane can adversely affect the strength of the urethane sealant bond.

13. Position the windshield glass on the vehicle, aligning it with the marks.
14. Wipe off any excess urethane sealant.
15. Install the rearview mirror.
16. Install the windshield wiper arm.

Body Repair and Cleaning

Note:

If the surface of any of the body panels, including the instrument panel, has been scratched to the point where it has gone through the top gel coat, the panel cannot be repaired and will have to be replaced to ensure proper color and shine. Only minor surface scratches can be polished out.

Light Scuff Repair

Required Tools

1,000 rpm buffing tool

1. Clean the entire area of the repair. Clean water is fine for this purpose; do not use solvent, as this will damage the plastic surface.
2. Install the cutting pad #7006 on the buffer. (Maroon pad.)
3. Spread the compound on the area of repair. Use about as much as it takes to cover a half-dollar coin; this is a good starting point.
4. Set the buffing tool to the lowest possible speed on the dial. Do not buff at a high speed as this will heat and warp the material.
5. Buff the damaged area until the surface scuff disappears. A second and third application of the compound may be required. Keep the buffer moving over the surface, this will help keep the surface cool. Clean the compound residue off the surface after each buffing operation. Do not continue to buff the compound until dry, or buff the surface of the plastic when dry. When all of the scuff marks have been buffed out, the surface may still appear a little dull; if so, proceed to step #6.
6. Install the polishing pad #9006 on the buffer. (Tan pad.)
7. Spread the #8232 polish on the surface as in step #3.
8. Polish to a high luster, or as required to match the surrounding material.
9. Wipe clean with a soft clean cloth; any dirt on the cloth will mar the surface.

Scratch Repair

Required Tools

1,000 rpm buffing tool

1. Clean the entire area of the repair. Clean water is fine for this purpose, do not use solvent, as this will damage the plastic surface.
2. Install the interface-sanding pad onto the finishing sander. Attach the sanding film to the interface pad. (Take care in centering the sanding pad and film on the sander.)
3. Sand the surface using about 45 psi. air pressure at the tool inlet; do not sand at a high pad speed because the speed causes the sanding film to load with dust and heats the surface of the plastic. Proper sander pad speed is based on cut and travel speed of the pad, and the downward pressure applied by the operator. To clean the sanding pad surface, run the sander face at 90 degrees on the edge of a piece of cardboard. This cleaning operation will help keep the sanding film clean and run cooler. Continue to sand the surface until the original scratch damage is no longer visible. Wipe the surface with a cloth, and then inspect to be sure the entire original scratch has been fully sanded away.
4. Install the cutting pad #7006 on the buffer. (Maroon pad.)
5. Spread the compound #8432 on the area to be repaired. Use about as much as it takes to cover a half-dollar coin; this is a good starting point.
6. Set the buffing tool to the lowest possible speed on the dial; do not buff at a high speed as this will heat and warp the material.
7. Buff the sanded area until the sanding marks disappear.
8. A second and third application of the compound may be required. Keep the buffer moving over the surface; this will help keep the surface cool. Clean the compound residue off of the surface after each buffing operation. Do not continue to buff the compound until dry, or buff the surface of the plastic when dry.
9. When all of the scuff marks have been buffed out, the surface may still appear a little dull. If so, proceed to step 10.
10. Install the polishing pad #W-9006 on the buffer. (Tan pad.)
11. Spread the #8232 polish on the surface as in step 5
12. Polish to a high luster, or as required to match the surrounding material.
13. Wipe clean with a soft clean cloth; any dirt on the cloth will mar the surface.

Deep Gouge Repair for White Body Panels

Required Tools

1,000 rpm buffing tool

1. Clean the entire area of the repair. Clean water is fine for this purpose; do not use solvent, as this will damage the plastic surface.
2. Install the interface-sanding pad onto the finishing sander. Attach 500 grit sanding film to the interface pad. (Take care in centering the sanding pad and film on the sander.)
3. Sand the surface using about 45 psi air pressure at the tool inlet; do not sand at a high pad speed because the speed causes the sanding film to load with dust and heats the surface of the plastic. Proper sander pad speed is based on cut and travel speed of the pad, and the downward pressure applied by the operator. To clean the sanding pad surface, run the sander face at 90 degrees onto the edge of a piece of cardboard. This cleaning operation will help keep the sanding film clean and run cooler. Continue to sand the surface until the original gouge damage is no longer visible. Wipe the surface with a cloth, and then inspect to be sure the entire original gouge has been fully sanded away (very important).
4. Attach 800 grit sanding film to the sander and sand the surface so as to remove all of the 500 grit sand scratches.
5. Pay close attention to the edges surrounding the gouge. Any 500 grit scratches left behind will be very hard to remove with the buffing operation.
6. Install the cutting pad #W-7006 on the buffer. (Maroon pad.) Spread the compound on the area to be repaired. Use about as much as it takes to cover a half-dollar coin; this is a good starting point.
7. Set the buffing tool to the lowest possible speed on the dial; do not buff at a high speed as this will heat and warp the material.
8. Buff the sanded area until the sanding marks disappear. A second and third application of the compound may be required. Keep the buffer moving over the surface; this will help keep the surface cool. Clean the compound residue off of the surface after each buffing operation. Do not continue to buff the compound until dry, or buff the surface of the plastic when dry.
9. When all of the scuff marks have been buffed out the surface may still appear a little dull; if so, proceed to step 10.
10. Install the polishing pad #W-9006 on the buffer. (Tan pad.)
11. Spread the #8232 polish on the surface as in step 6.

12. Polish to a high luster, or as required to match the surrounding material
13. Wipe clean with a soft clean cloth; any dirt on the cloth will mar the surface.

Deep Gouge Repair for Non-White Body Panels

Required Tools

1,000 rpm buffing tool

1. Clean the entire area of the repair. Clean water is fine for this purpose; do not use solvent, as this will damage the plastic surface.
2. Install the interface-sanding pad onto the finishing sander. Attach 500 grit sanding film to the interface pad. (Take care in centering the sanding pad and film on the sander.)
3. Sand the surface using about 45 psi air pressure at the tool inlet; do not sand at a high pad speed because the speed causes the sanding film to load with dust and heats the surface of the plastic. Proper sander pad speed is based on cut and travel speed of the pad, and the downward pressure applied by the operator. To clean the sanding pad surface, run the sander face at 90 degrees onto the edge of a piece of cardboard. This cleaning operation will help keep the sanding film clean and run cooler. Continue to sand the surface until the original gouge damage is no longer visible. Wipe the surface with a cloth, and then inspect to be sure the entire original gouge has been fully sanded away (very important).
4. Fill damaged area with Evercoat body filler (2-part system) and allow to completely dry.
5. Sand down high spots with 500-grit paper. If recesses are still visible due to filler shrinkage, apply second skim coat and again allow to dry completely, then sand surface flush with surrounding area.
6. Apply DuPont Full-Thane Primer 421-15 over body filler.
7. Once primer is completely dry, clean surface with DuPont 3939 cleaner, and again allow surface to dry completely.
8. Apply 42470 Sealer over body filler.
9. Apply color-matched paint system with HVLP paint sprayer according to supplier's recommendations to meet WeatherPro G's surface finish, i.e. DuPont's two part Base/clear coat system.

Wagon Box Cleaning

The wagon box is an all aluminum unit that can be cleaned using commercially available wheel cleaners. A very mild abrasive household cleaner can be used to clean mild blemishes but may change the appearance of the box and should be done with the grain of the panel and may have to be done on the entire panel to ensure a consistent appearance.

If the box has minor scratches they can be removed using “Scotch-Brite” pads. The appearance of the box may be affected and should be done with the grain of the panel and may have to be done on the entire panel to ensure a consistent appearance.

If the above procedures do not work cleaning and polishing the box may be necessary. An aluminum wheel cleaner & polish can be used but will change the appearance of the box and should be done to the entire visible surface of the box to ensure a consistent appearance.

Frame Repair

Aluminum Alloys, Notes for Manual Welding

- Aluminum alloys melt without changing color when heated. Temperature crayons should be used to monitor temperature.
- Aluminum is more susceptible to heat distortion than steel.
- Approximate melting temperatures for 6061 and 6063 aluminum alloys are 582-654°C (1080-1210° F).
- Make sure to check all measurements prior to welding.
- Non Silicon grinding equipment only. Silicon residue may cause subsequent weld failure.

Manual Welding Equipment

- MIG welder with output current of approximately 200A and maximum output at 30% duty cycle.
- Protective hat, gloves, eyewear, eye shield, dust proof mask, apron, welding gloves and safety shoes.
- Only welding wire 4043 should be used while welding the aluminum on this frame.
- Welding wire diameter should be 0.9-1.2mm (0.035-0.047in.).
- Do not use welding gas other than 100% argon gas.

- The argon gas flow rate should be set per manufacturers recommendation, typically: to a rate of 35-50 cubic feet/hour. Normally the higher the flow rate within specification the better quality weld.
- MIG welding is the only approved method.

Manual Welding Techniques

Individuals trained and experienced with aluminum welding should only perform welding.

When welding is performed anywhere on the vehicle, precautionary measures should be taken to prevent damage to electrical system wiring or components. Prior to welding, any parts that could be damaged by excessive temperatures should be removed or adequately shielded. Also prior to welding, remove the batteries and then disconnect the instrument cluster gauge, motor controller, DC/DC converter(s) and battery charger. Computer processors should be removed if welding is to be done within their close proximity. Welding cables should never be allowed to lie on, near, or across any electrical wiring or electronic component during welding. After welding, when parts are cool, carefully inspect wiring and electrical components for shorts or other damage which could draw excessive currents and possibly cause an electrical system short when the battery is reconnected.

- The welding ground clamp should be positioned as close to the weld area as possible.
- Aluminum alloys are welded at a higher gun feed speed than steel plates.
- Using the forehand welding sequence for the gun advance direction may help minimize the formation of black soot.
- Prior to servicing the frame, practice welds should be performed on the damaged area removed from the frame to establish welding parameters.
- Emphasis should be placed upon weld application techniques to avoid stress risers that may adversely affect frame-operating stresses.
- When welding multiple layers of a thick material, brush the surface of the welded area thoroughly using a stainless steel wire brush after each pass.
- If possible, back fill welds to protect against cracks propagating from “fisheye”.

Cleaning

Note:

The use of compressed air is not recommended due to contaminants in the airline. If compressed air is required, re-clean the surface afterwards using an oil/grease remover and a clean dry cloth.

Note:

Whatever oil/grease remover is used must evaporate completely and CANNOT leave a film or residue on the surface.

1. Use a wax and grease remover to clean any dirt, oil or grease prior to welding.
2. If the aluminum alloy surface is coated with a paint film or other coatings, use a disc sander and #80 sanding disc to remove the paint or coatings from the weld lines to a width of approximately 40mm (1.57inch) from the top and 20mm (0.78inch) from the bottom. If sanding a large area, sand in phases allowing sufficient time for the part to cool between phases.
3. Use a stainless steel wire brush to brush the surface of the aluminum alloy.
4. Do this on both the top and the bottom surfaces to remove thick oxide layer.
5. Use a wax and grease remover to completely clean away any loose oxide from the surface.

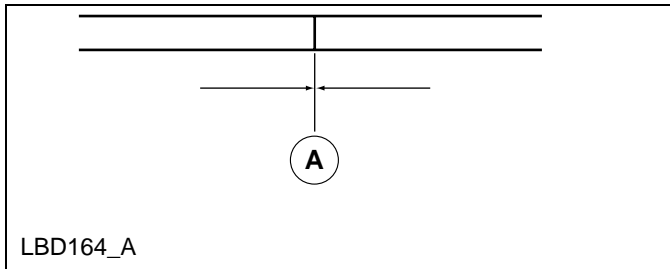
Additional Tools

- Tools for welding, grinding, sanding, filing and/or cleaning must be used exclusively for aluminum or steel repair work. Never use the same tools for both aluminum and steel welding.
- Use a stainless steel wire brush; do not use an iron wire brush.
- Sanding discs are very useful for large quantities of material removal. However, they should be used with caution not to decrease the original part gauge (only to remove protrusion or excess surface material).
- Do not operate the sanding tool continuously as this heats the surface of the metal. If sanding a large area, sand in phases allowing sufficient time for the part to cool between phases.
- Do not use clogged sanding tools or sandpaper.

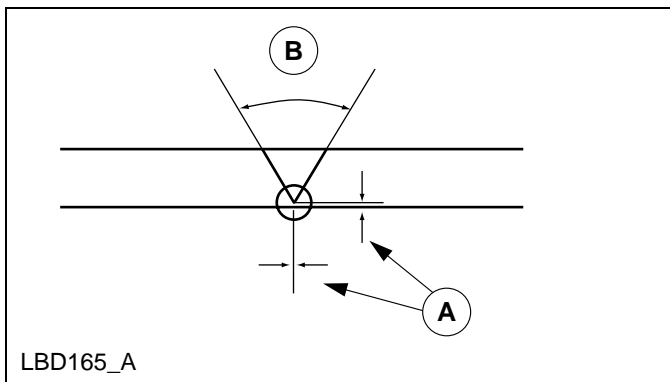
Butt Welding

Preparation

- Use a smooth-cut file to prepare the edge to a smooth finish.
- With plates less than 3mm (0.11inch) thick reduce the clearance between plates to 0-0.5mm (0-.01inch) (A) maximum.



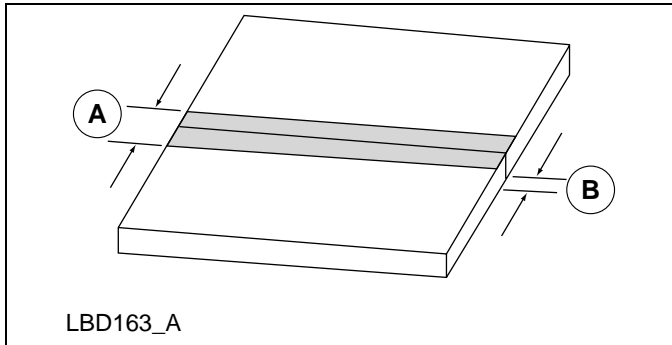
- With plates more than 3mm thick reduce the clearance between plates to 0-.5mm maximum.
- Edge preparation should be performed as follows:
 1. Use a disc grinder or file (rough cut or vixen) to initial prep edges.
 2. Use a disc sander with #80 sanding disc and a file (smooth-cut) to finish preparation of edges.
 3. Edges need to be filed and sanded to the specifications indicated.



- Reverse side beads occur because of edge preparation indicated.

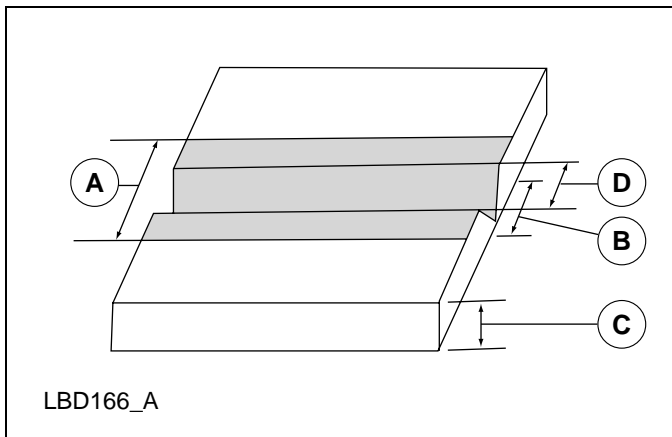
Square Edge Sanding

- Sand the top to a width of approximately 40mm (1.57inch) (A) and the bottom width of approximately 20mm (0.78inch) (B).



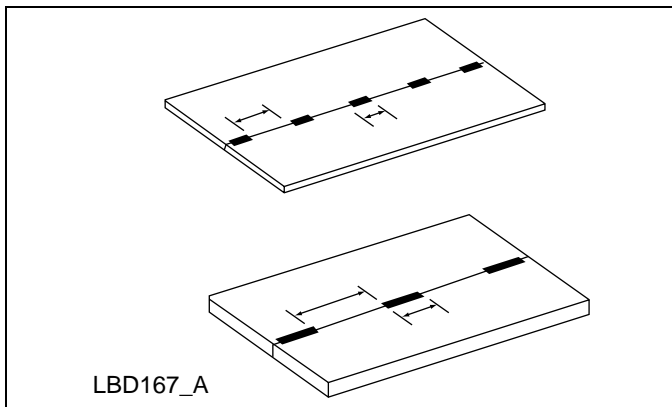
V-Edge Sanding

- Sand the top (A) to a width of approximately three times the width of the edge and the bottom width (B) approximately the same as the edge (C).
- Sand the edge preparation area (D).



Tack Welding

- Prior to finish welding, tack weld the areas to prevent strain and enhance joint precision. Weld the plates at several points with short beads.
- The thinner the sheet or plate, the shorter the tack welding pitch and bead.
- Avoid tack welding the ends and corners of the base metal.
- Since the beads left are not ground down afterward, this process should be done as carefully as finish welding.



Note:

Use a stainless steel wire brush to clean the tack weld zones prior finish welding.

Finish Welding

Note:

Use a stainless steel wire brush to clean the tack weld zones prior finish welding.

- Stand in a stable position so that the gun does not move around and is firmly held.
- The weld zone must be visible.
- Maintain the proper distance and gun angle between the gun contact tip and the base metal.
- Adjust the gun feed speed while observing the penetration.
- The gun angle should split the angle of the weld joint cross section. For example, if the parts being welded are at a 90° angle the gun should be held at a $45^\circ \pm 15^\circ$ angle with a push of $5-15^\circ$.

Burn-Through Weld Repair

- Grind off excess weld from the top surface, using a disc having a maximum coarseness of 60 grit.
- Bevel the edges of the hole using either a thin grinding wheel or tapered drill bit
- Clean the weld with an oil/grease remover - wipe the surface dry with a clean cloth.
- Stainless steel wire brush the weld / mating surfaces
- Blow any contaminates out of the weld with compressed shop air.
- Clean the weld with an oil/grease remover - wipe the surface dry with a clean cloth.
- Apply back-up tape to the underside of the melt through hole / slot.
- Re-weld along the same weld line, until the burn-through condition is completely filled.
- Inspect the weld for any other defects and take corrective actions.

Crack Inspection

After welding aluminum alloy, welds must be inspected for cracks.

A penetrating solution containing coloring enables the tester to find minute cracks.

Note:

Perform in a well-ventilated area and follow the manufacturer's instructions.

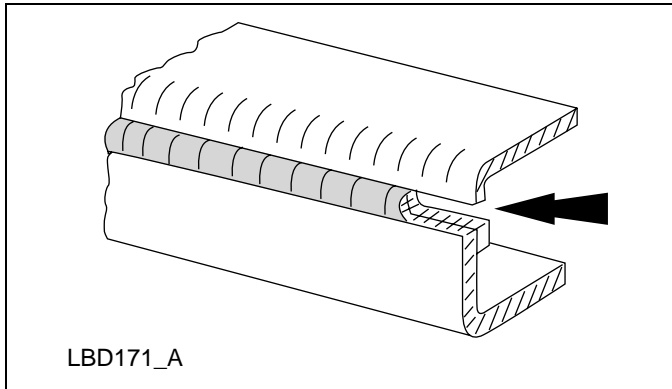
Application method:

1. Wash the inspection surface with the washer.
2. Apply the penetrant solution to the surface and allow ample time to soak in.
3. Wash off any excess penetrant solution remaining on the surface.
4. Apply the developing solution and inspect for cracks

Acceptability Criteria

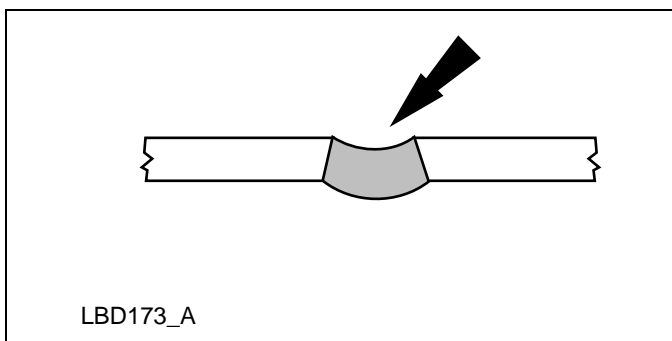
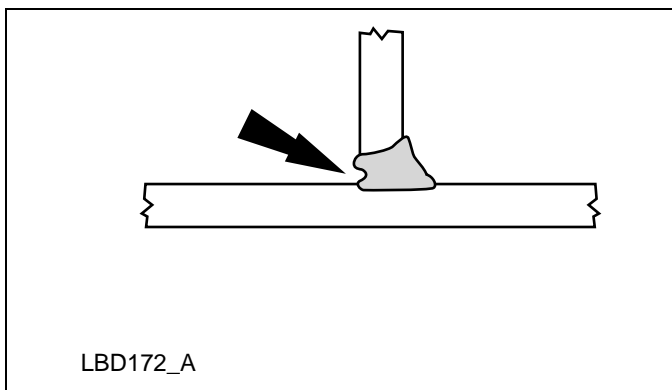
Definitions

Notching - Gouging of the base metal at the ends or edge of the welded joint.

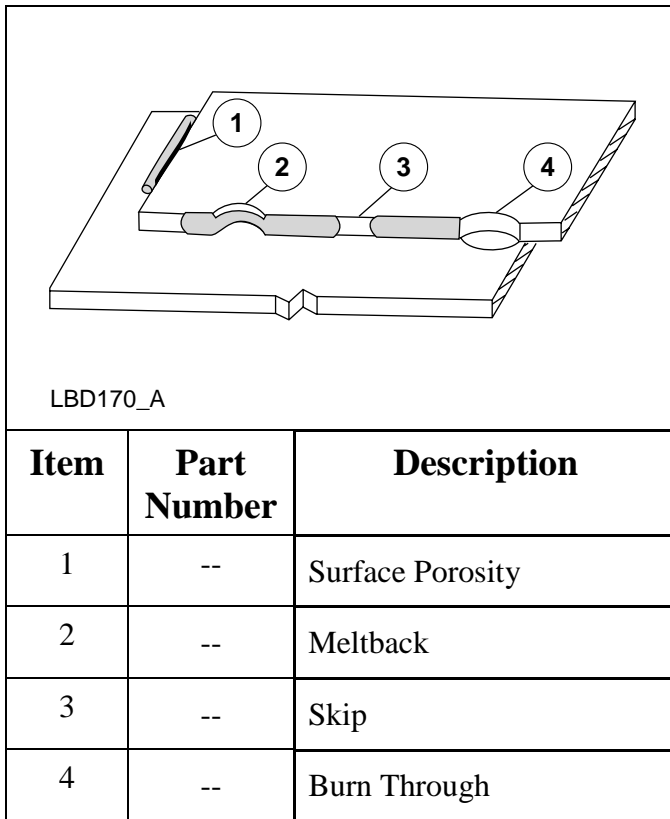


Skip - An unwelded portion of a designated weld.

Suck-back - A concave surface on the side of the base metal opposite the point of weld metal application. It is caused by the solidification shrinkage (6% by volume) when penetrating a high percentage of the base metal without complete penetration through the opposite side. This is illustrated in Figure 4. It also occurs in the overhead position when the weld volume is such that the gravitational force exceeds the surface tension.



Surface Porosity. Individual pinholes, separated by at least their own diameter, and other scattered surface porosity should be permitted. The extension of a single pore must be $\leq 0.4t$ (where t is the gage), max 2 pores / 10mm weld length, and a maximum 10% of the total welding area is allowed to be filled with pores



Blow-hole - A void within the weld, in which there is an absence of filler material and is common to butt joints with internal nodes (aka square groove).

Discrepant weld - A weld that differs from the requirements of this standard. Even though this weld differs, it still may have useful engineering properties.

Gap - The distance or air space between two base components (see Figure 1). Note, that for butt weld joints this distance can be referred to as the root opening.

Melt back - This occurs where the base metal melts back from an edge, but does not become part of the weld. This condition, also referred to as button hooks, leaves a void between the weld deposit and the base metal.

Joint Gap

Maximum allowable joint gap for specific joints is determined by the structural performance required in service and the ability to accommodate the gap during welding. The maximum allowable weld joint gap between adjacent members less than 4.0mm (0.16in.) in thickness should be one-quarter the thickness of the thinner member or 1.5mm (0.059in.). In the case of welding heavier gauges above 4mm (0.16 in.), the gap should not exceed 1.5 mm (0.06 in.). The gap values listed above are the maximum recommended because tighter restrictions may be needed depending on the welding process and joint configuration used. Larger gaps than specified can adversely affect weld geometry, quality, and structural performance, i.e., fatigue life, strength.

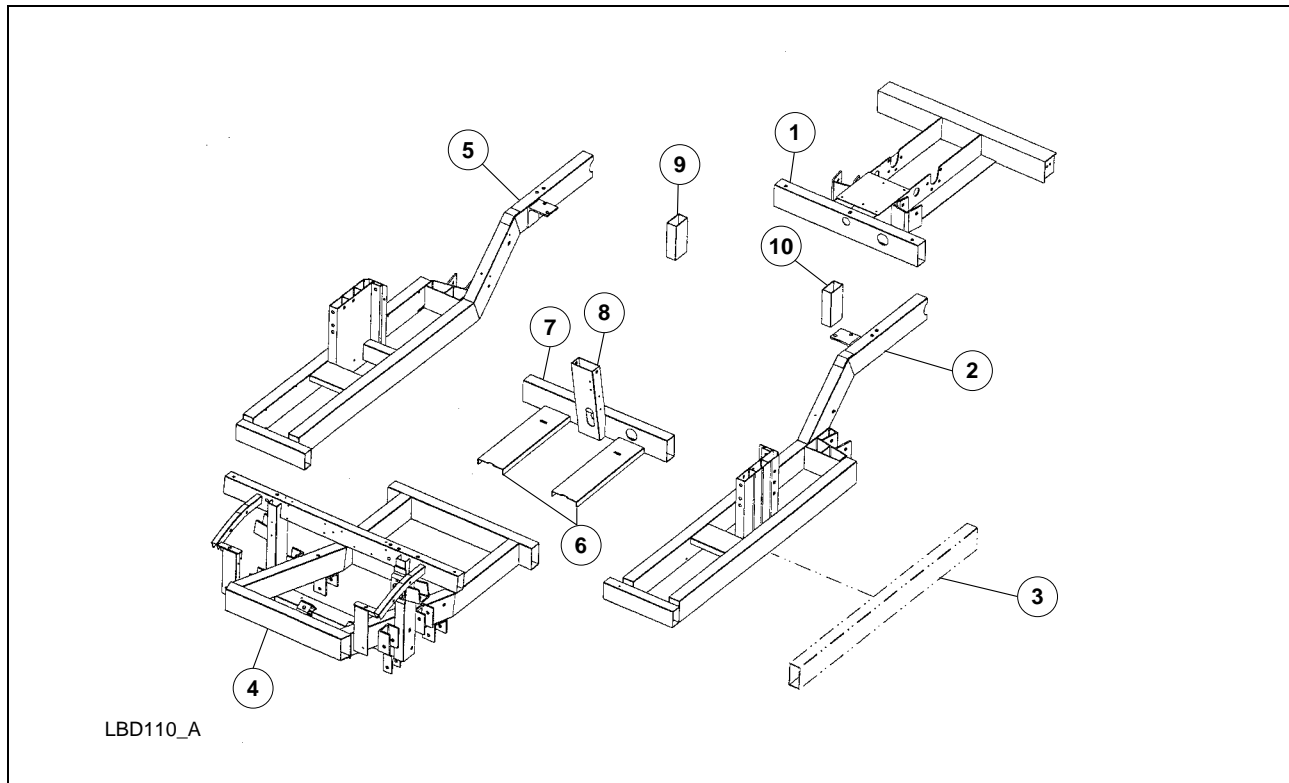
Crack Repair

1. File or grind down a length twice as long as the crack.
2. Thoroughly clean the area. If necessary, refer to [Cleaning](#) in this section.
3. Reweld the area.

Frame Straightening

Since the frame consists of extrude honed frame rails, the frame should not be straightened if bent.

Frame Service Parts

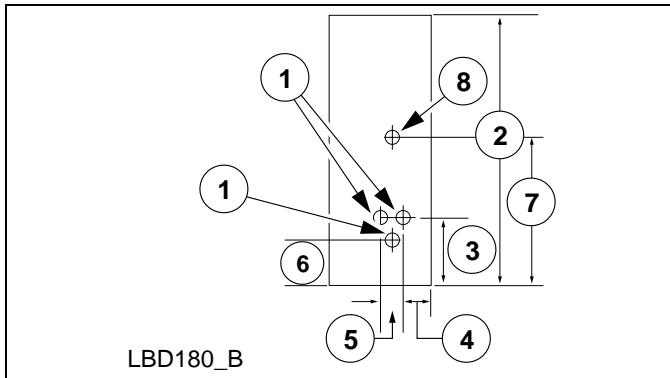


Item	Part Number	Description
1	5005	Rear Frame Assembly
2	5005	LH Frame Assembly
3	5B010	Frame Extension Sidemember
4	5005	Front Frame Assembly
5	5005	RH Frame Assembly
6	Use flat stock to service	Battery Tray Supports
7	Use 5B010 and cut to specification	Frame Center Support
8	Use 5B010 and cut to specification	Seat Stanchion Center Support
9	Use 5B010 and cut to specification	Rear Frame to Side Frame Extensions - RH
10	Use 5B010 and cut to specification	Rear Frame to Side Frame Extensions - LH

Rear Frame to Side Frame Extensions

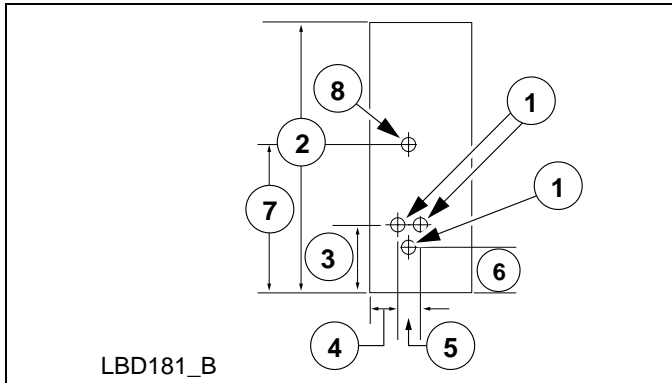
To service the rear frame to side frame extensions, the frame extension sidemember must be used and cut and drilled to the dimensions provided below. The holes should only be drilled on one side of the support.

Left Rear Frame to Side Frame Extension



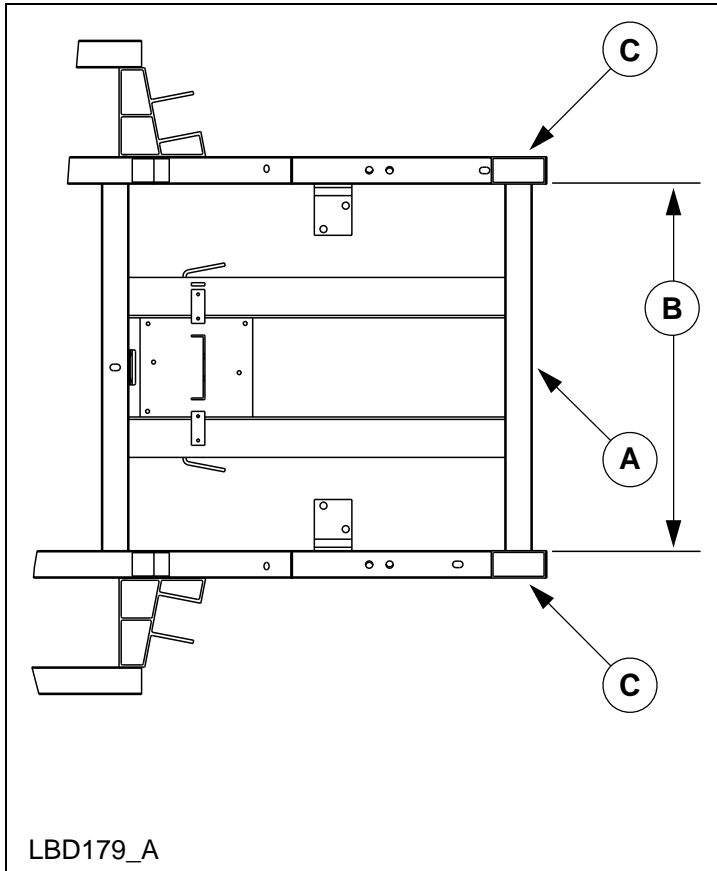
Item	Specification
1	13.65mm (0.537in)
2	264mm (10.393in)
3	61.1mm (2.405in)
4	28.1mm (1.106in)
5	20mm (0.787in)
6	39.1mm (1.539in)
7	140.4mm (5.527in)
8	13.5mm (0.531in)

Right Rear Frame to Side Frame Extension



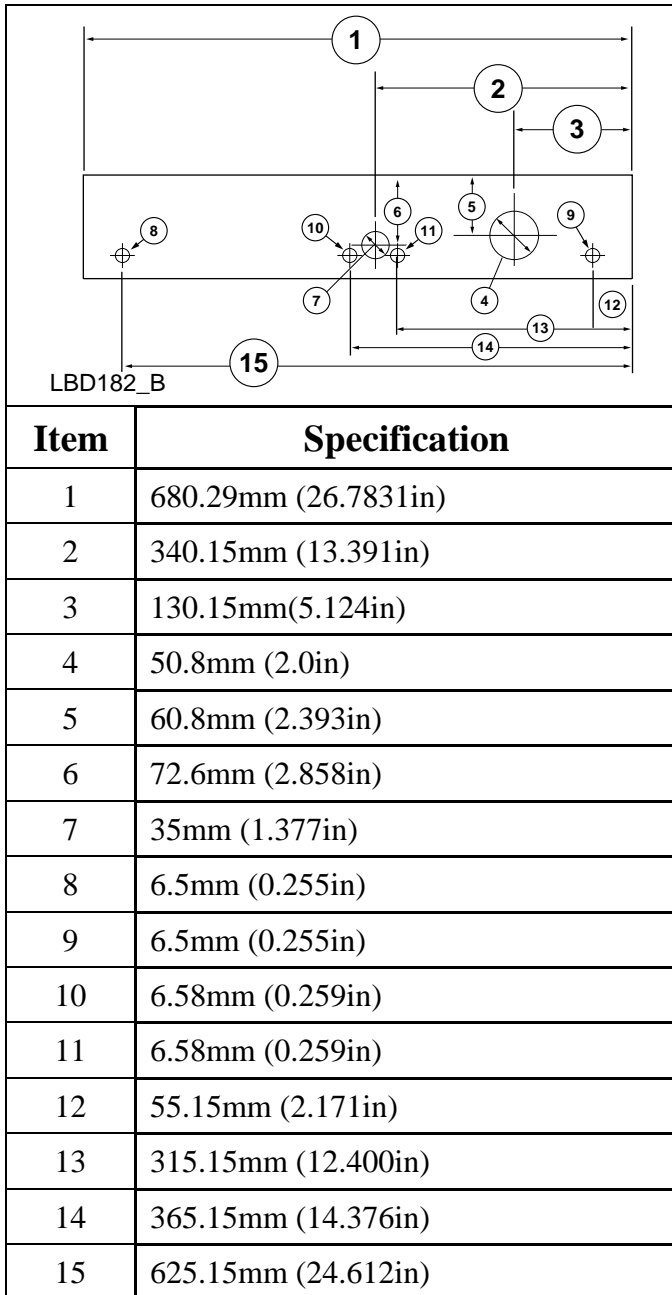
Item	Specification
1	13.65-13.50mm (0.537-0.531in)
2	264mm (10.393in)
3	61.1mm (2.405in)
4	53.5mm (2.106in)
5	20mm (0.787in)
6	39.1mm (1.539in)
7	140.4mm (5.527in)
8	13.5mm (0.531in)

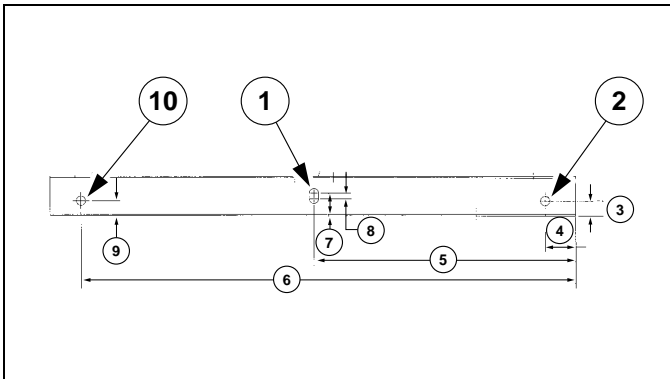
The center section of the rear frame assembly (A) must be cut down to (B) 680.29mm (26.783in.) to properly install the new rear frame to side frame extensions (B). This is necessary to ensure a clean solid weld and proper alignment of the new rear frame to side frame extensions (C).



Frame Center Support

To service the frame center support, the frame extension sidemember must be used. Cut and insert holes as indicated in the dimensions provided below. Holes 4 and 7 should be drilled through both sides of the support. Holes 8 – 11 should be drilled through one side of the support.





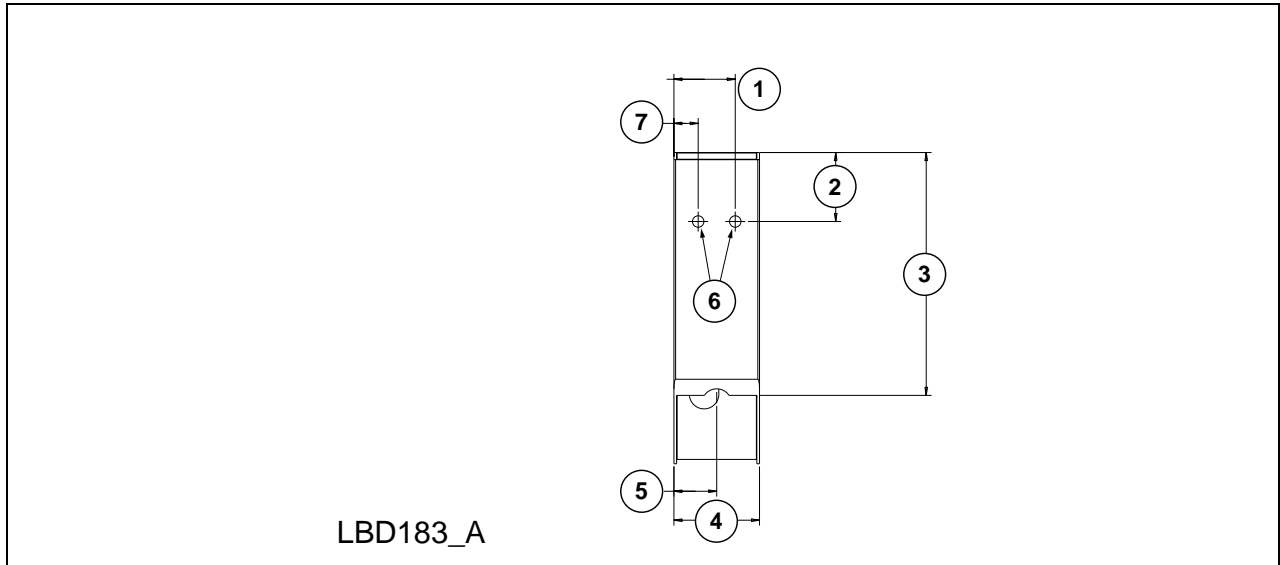
LBD194_A

Item	Specification
1	12mm (0.472in)
2	12mm (0.472in)
3	19.2mm(0.755in)
4	40.15mm (1.580in)
5	340.15mm (13.391in)
6	640.15mm (25.202in)
7	28.9mm (1.378in)
8	7mm (0.275in)
9	19.2mm (0.755in)
10	12mm (0.472in)

Seat Stanchion Center Support

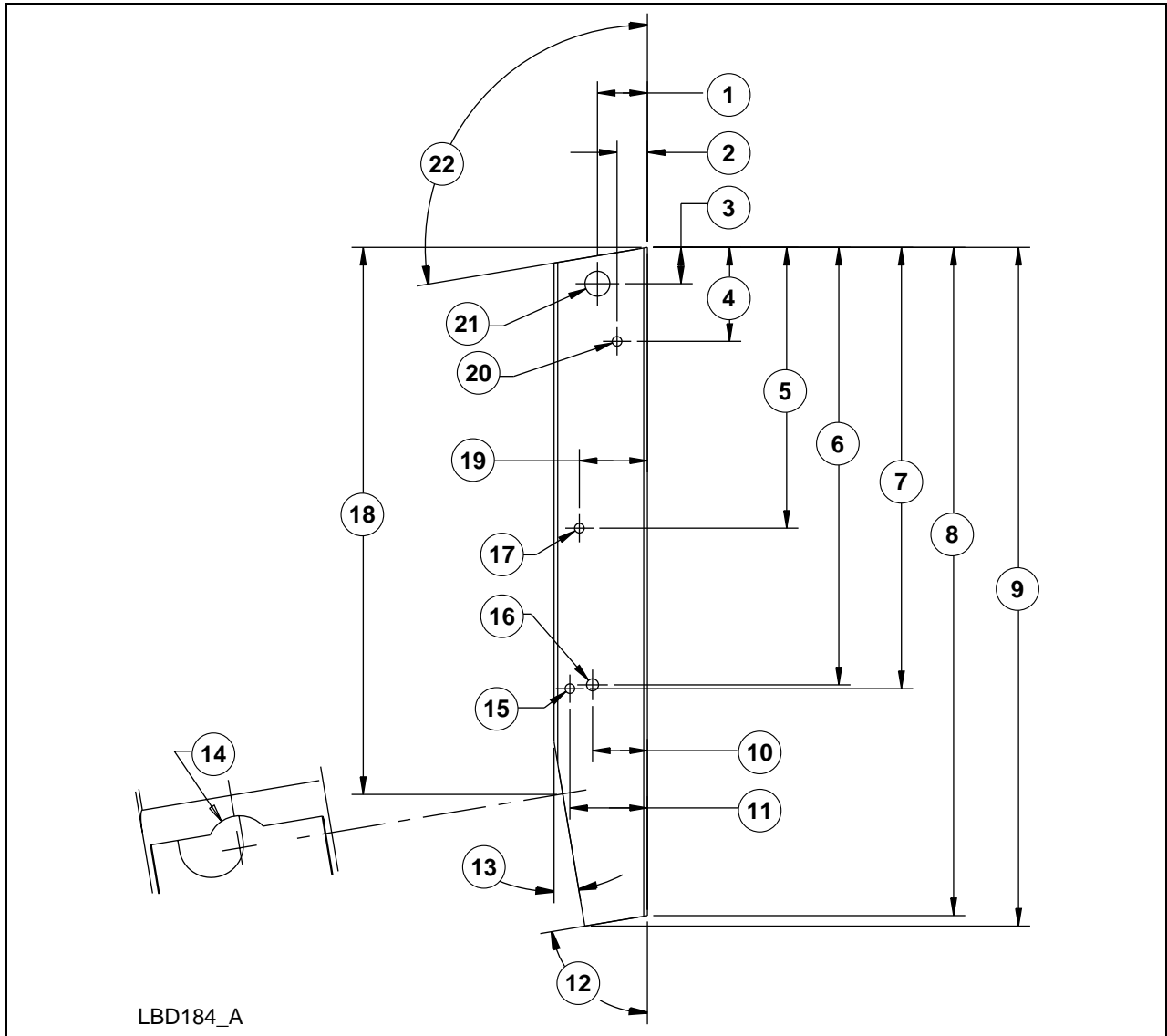
To service the seat stanchion center support, the frame extension sidemember must be used. Cut and insert holes as indicated in the dimensions provided below.

Front View



Item	Specification
1	72.8mm (2.866in)
2	81.8mm (3.220in)
3	287.99mm (11.388in)
4	101.6mm (4.000in)
5	50.8mm (2.000in)
6	13.58mm (0.534in)
7	28.8mm (1.133in)

Right View

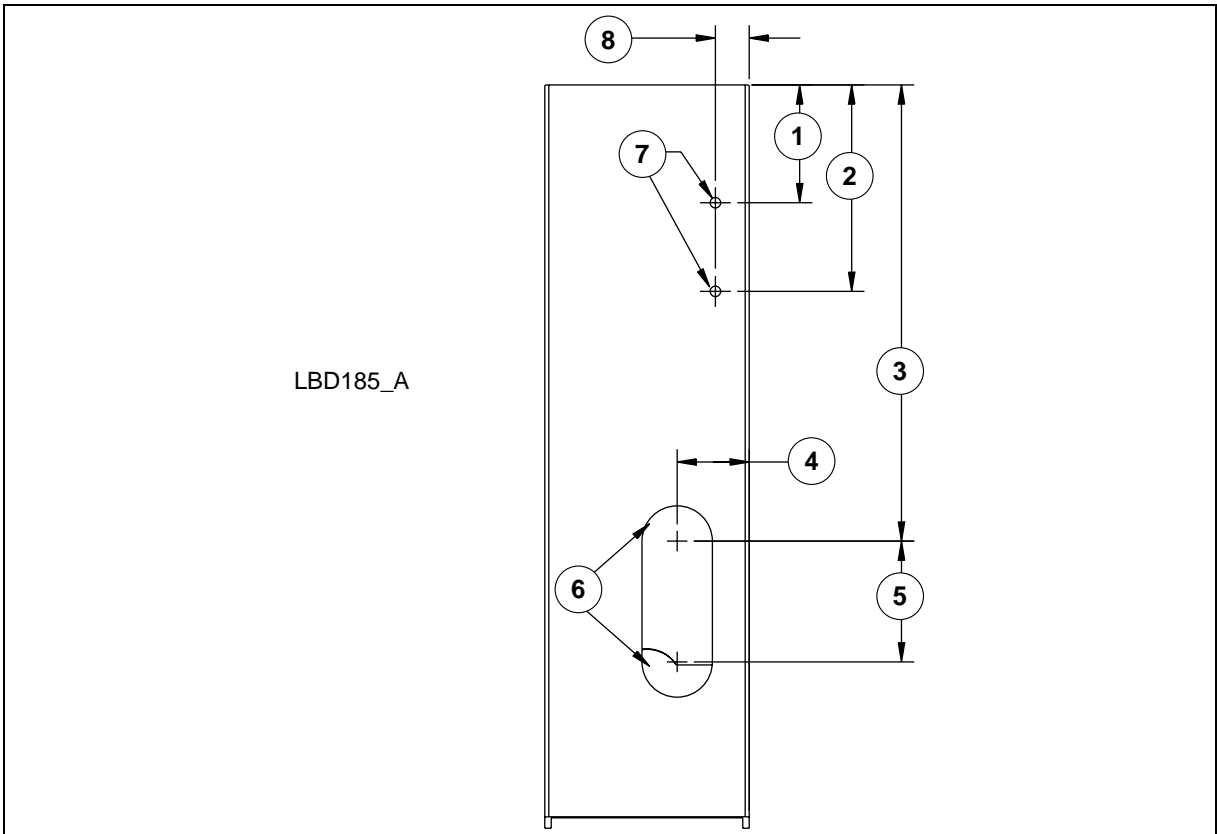


LBD184_A

Item	Specification
1	27.19mm (1.070in)
2	16.5mm (0.649in)
3	19.76mm (0.777in)
4	51.1mm (2.011in)
5	152.7mm (6.011in)
6	237.9mm (9.366in)
7	239.96mm (9.447in)

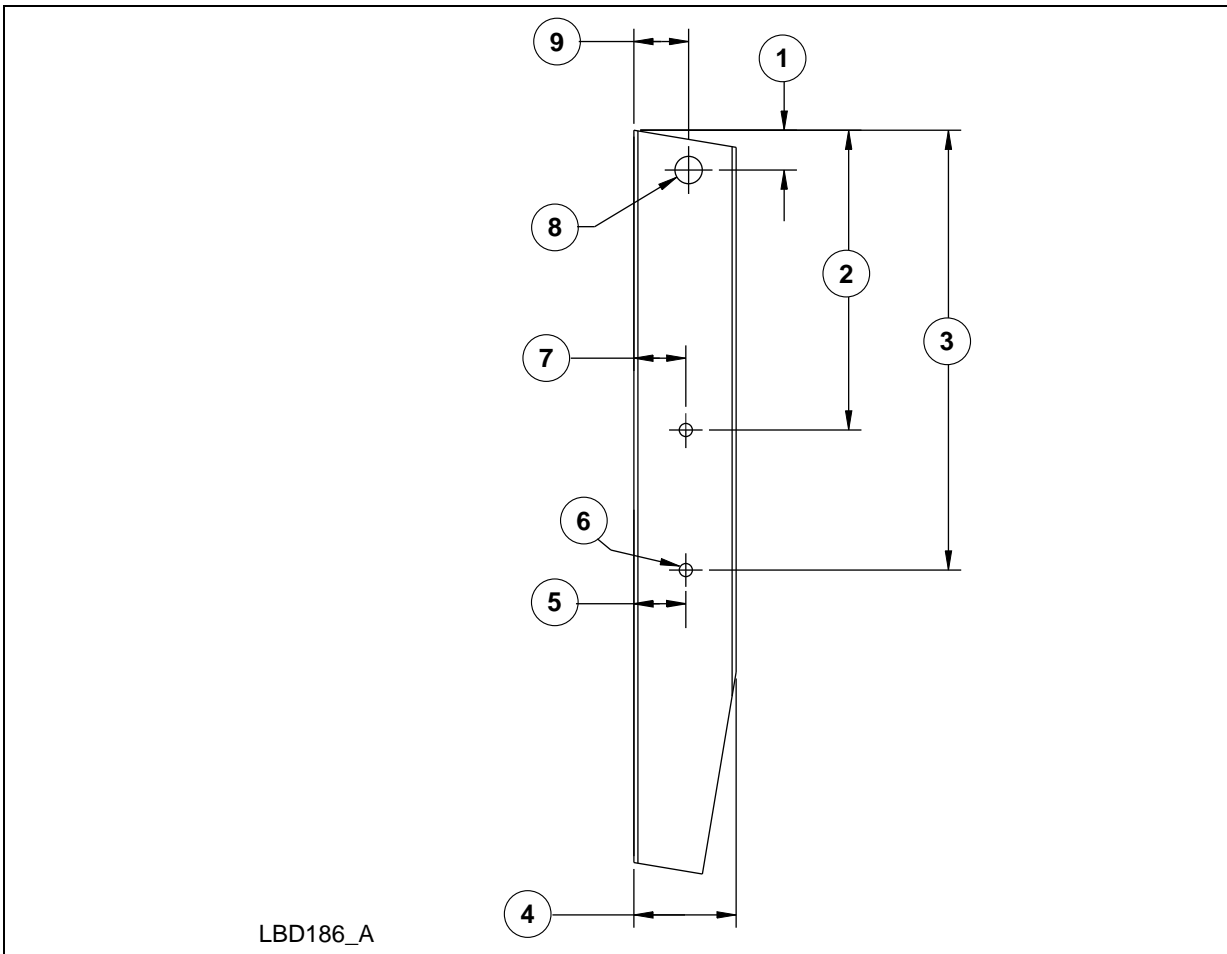
Item	Specification
8	363.38mm (14.306in)
9	369.08mm (14.530in)
10	29.84mm (1.174in)
11	42.17mm (1.660in)
12	80.5°
13	9.5°
14	17.5mm (0.688in) radius
15	5.2mm (0.204in)
16	6.5mm (0.255in)
17	5.2mm (0.204in)
18	297.47mm (11.711in)
19	37mm (1.456in)
20	5.2mm (0.204in)
21	13.58mm (0.534in)
22	99.5°

Left View



Item	Specification
1	58.5mm (2.303in)
2	102.5mm (4.035in)
3	226.51mm (8.917in)
4	35.8mm (1.409in)
5	60mm (2.362in)
6	35mm (1.377in)
7	5.2mm (0.204in)
8	16.8mm (0.661in)

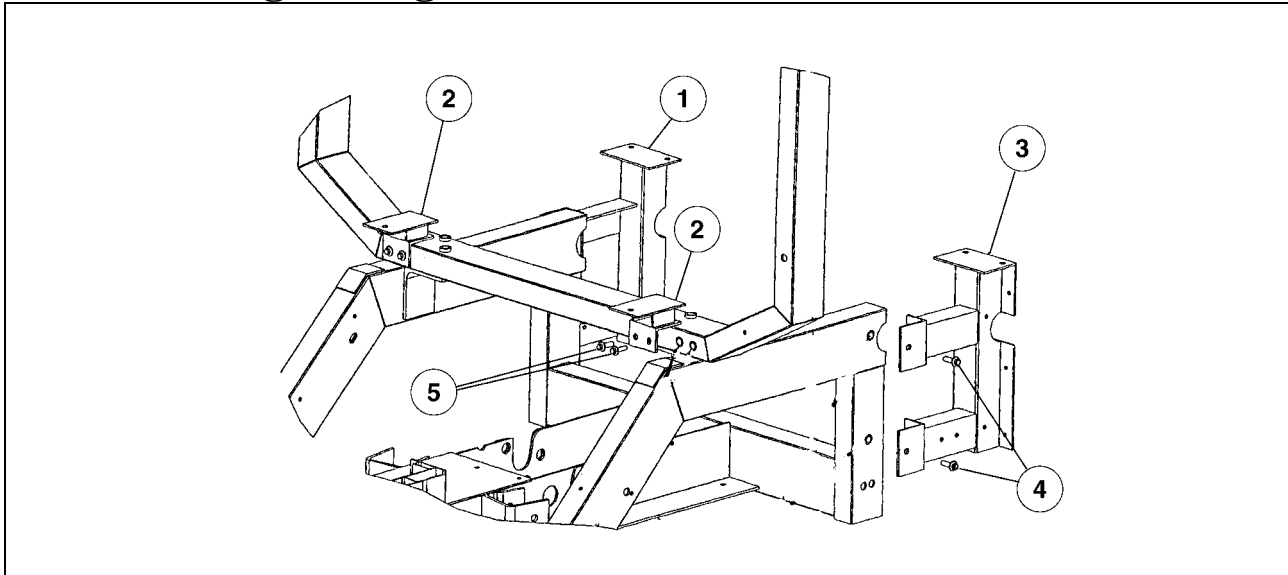
Rear View



LBD186_A

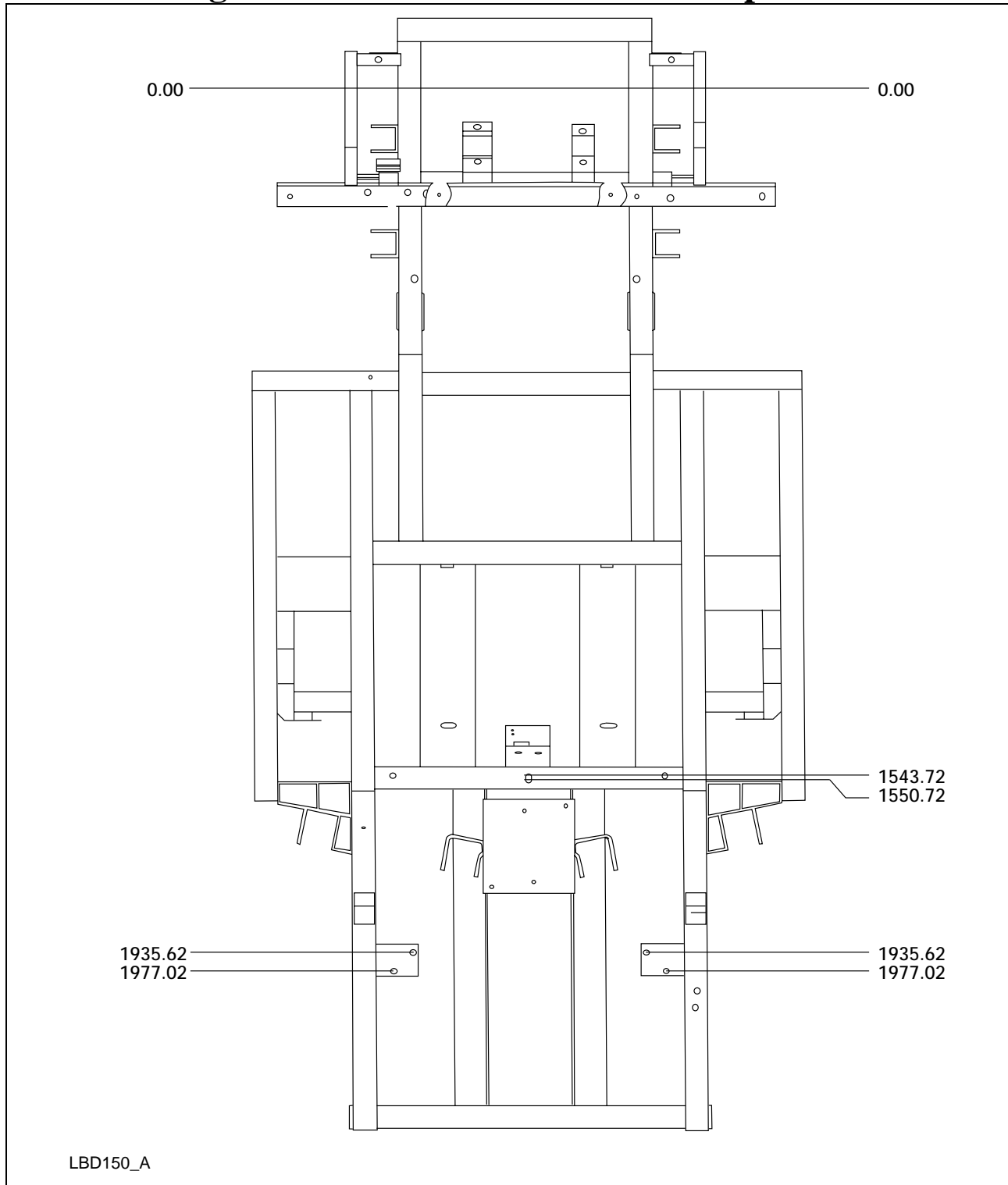
Item	Specification
1	19.76mm (0.777in)
2	148.75mm (5.856in)
3	218.25mm (8.592in)
4	50.8mm (2.000in)
5	25.8mm (1.015in)
6	6.5mm (0.255in)
7	25.8mm (1.015in)
8	13.58mm (0.534in)
9	27.19mm (1.070in)

Two-Passenger Wagon Frame Extenders and Mounts

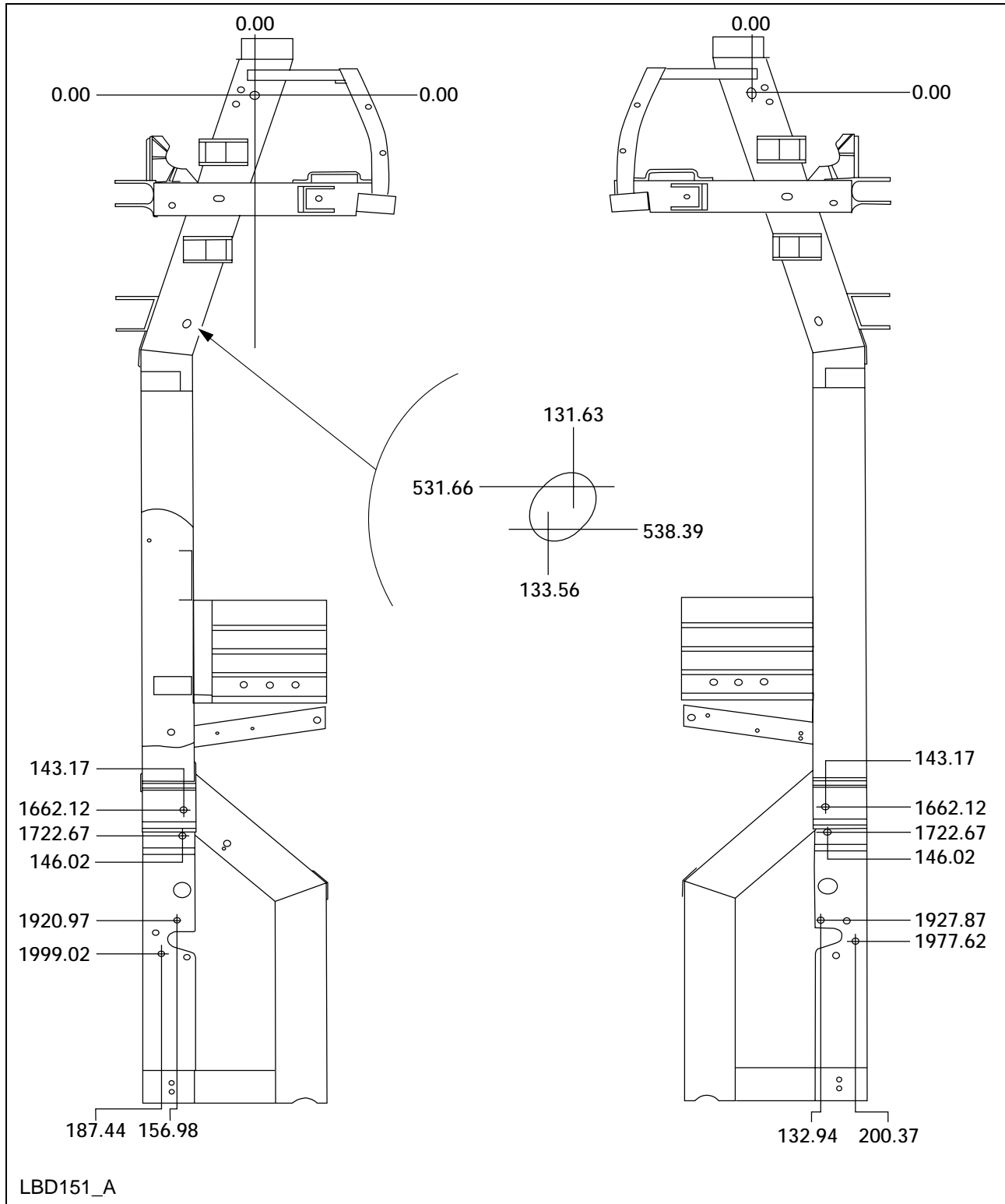


Item	Part Number	Description
1	--	RH Frame Extender
2	--	Wagon Box Brackets
3	--	LH Frame Extender
4	--	Frame Extender Bolts
5	--	Wagon Box Brackets Bolts

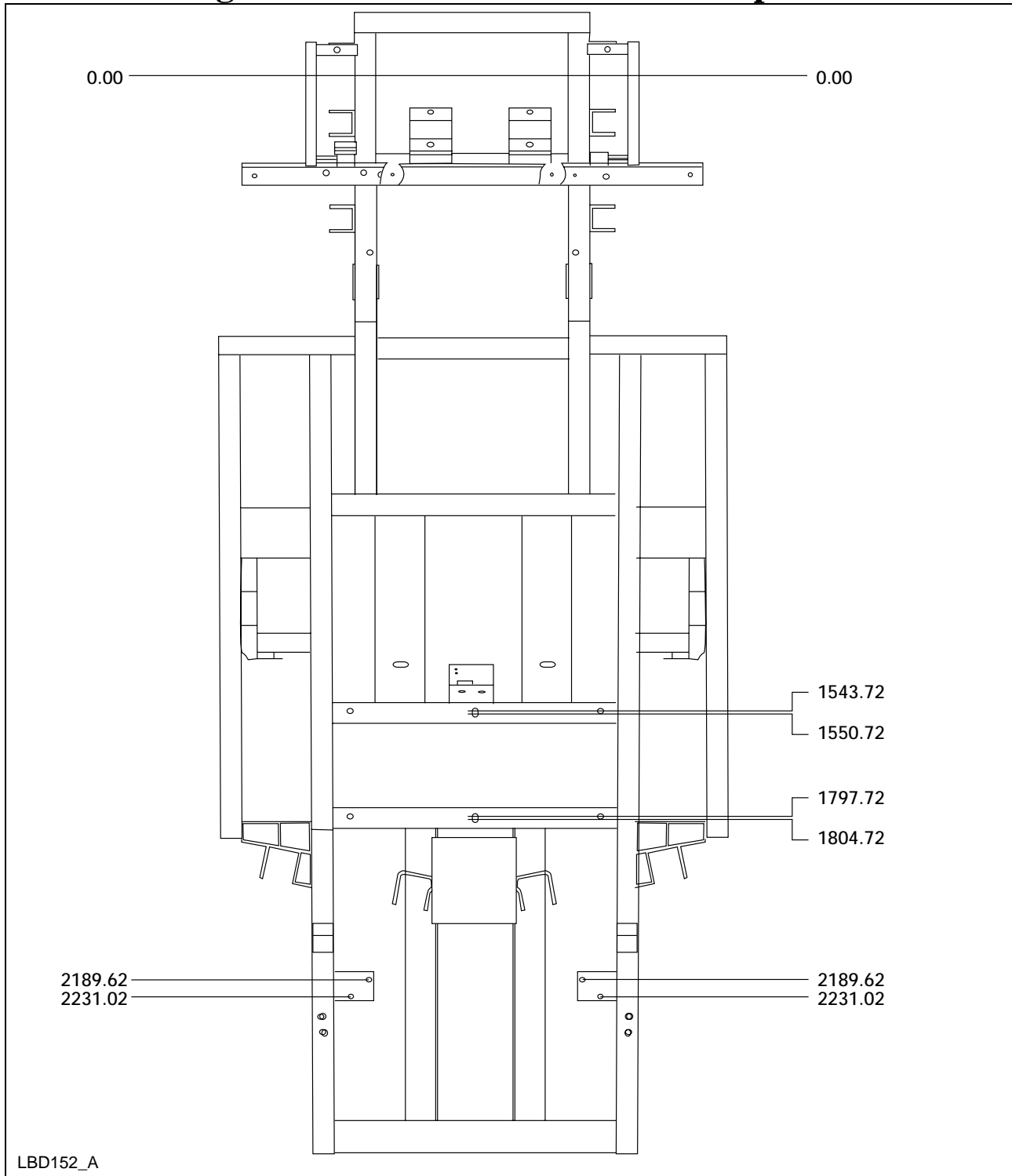
Two-Passenger Frame Hole Locator Art – Top View



Two-Passenger Frame Hole Locator Art – Side View



Four-Passenger Frame Hole Locator Art – Top View



Four-Passenger Frame Hole Locator Art – Side View

