ISUZU

ISUZU COMMERCIAL TRUCK

FSR, FTR, FVR
Equipped with 6 HK1 engine

SERVICE MANUAL (1998)

BOOK 1 OF 3

CAUTION

In order to reduce the chance of personal injury and/or property damage, carefully observe the instructions that follow:

The service manuals of Isuzu Motors America Inc. are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others. This could also damage the vehicle, or cause the vehicle to operate improperly.

Proper vehicle service and repair are important to the safety of the service technician and to the safe, reliable operation of all motor vehicles. If you need to replace a part, use the same part number or an equivalent part. Do not use a replacement part of lesser quality.

The service procedures we recommend and describe in this service manual are effective methods of performing service and repair. Some of the procedures require the use of tools that are designed for specific purposes.

Accordingly, any person who intends to use a replacement part, a service procedure, or a tool that is not recommended by Isuzu, must first establish that there is no jeopardy to personal safety or the safe operation of the vehicle.

This manual contains various *CAUTIONS* and *NOTICES* that you must observe carefully in order to reduce the risk of personal injury during service or repair. Improper service or repair may damage the vehicle or render the vehicle unsafe. These *CAUTIONS* and *NOTICES* are not exhaustive. Isuzu can not possibly warn of all the potentially hazardous consequences of your failure to follow these instructions.

This manual covers service procedures to vehicles that are equipped with a Supplemental Inflatable Restraint (SIR). Refer to the *CAUTIONS* in Cautions and Notices and in Restraints. Refer to SIR component and wiring location views in Restraints before performing a service on or around SIR components or wiring. Failure to follow these *CAUTIONS* could cause air bag deployment, personal injury, or otherwise unneeded SIR repairs.

In order to help avoid accidental air bag deployment and personal injury, whenever you service a vehicle that requires repair of the SIR and another vehicle system, we recommend that you first repair the SIR, then go on to the other system.

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New Style Service Manual Structure

This new style service manual is constructed with the following 10 sections:

0. General Information
1. Heating, Ventilation, and Air Conditioning (HVAC)
2. Steering
3. Suspension
4. Driveline and Axle
5. Brakes
6. Engine
7. Transmission
8. Body and Accessories
9. Restraints

The following table gives the previous service manual sub-sections with the name of the new section and sub-section. Almost all of the diagnosis that was in section 8A is now located in its applicable sub-section.

Truck Service Manual Sub-Section to Section and Sub-Section Conversion Table

Old Sub-Section	Old Sub-Section	New Section	Section Name	Sub-Section Name
0A	General Information	0	General Information	General Information
0B	Maintenance and Lubrication	0	General Information	Maintenance and Lubrication
0C	Vibration Diagnosis	0	General Information	Vibration Diagnosis
1A	Heating and Ventilation	1	HVAC	Heating and Ventilation (Non A/C)
1B	Heating, Ventilation, and Air Conditioning	1	HVAC	HVAC systems with Air Conditioning
1D	A/C Compressors	1	HVAC	HVAC systems with Air Conditioning
2A	Frame and Bumpers	8	Body and Accessories	Frame and Underbody, and Bumpers
3A	Front Wheel Alignment	3	Suspension	Wheel Alignment
3B, 3B1A, 3B1B	Power Steering Gear and Pump	2	Steering	Power Steering System
3B3	Steering Linkage	2	Steering	Steering Linkage
3C	Front Suspension	3	Suspension	Front Suspension
3D	Rear Suspension	3	Suspension	Rear Suspension
3E	Tires and Wheels	3	Suspension	Tires and Wheels
3F	Steering Columns	2	Steering	Steering Wheel and Column
4A	Propeller Shaft	4	Driveline/Axle	Propeller Shaft
4B	Rear Axle and Differential	4	Driveline/Axle	Rear Drive Axle
4C	Front Drive Axles and Differential	4	Driveline/Axle	Front Wheel Drive Shafts and Front Drive Axle
5	Hydraulic Brakes	5	Brakes	Hydraulic Brakes
5A	Master Cylinder	5	Brakes	Hydraulic Brakes
5B	Front Disc Brakes	5	Brakes	Disc Brakes
5C	Drum Brakes	5	Brakes	Drum Brakes
5D	Hydraulic or Vacuum Booster	5	Brakes	Hydraulic Brakes
5E	Antilock Brakes	5	Brakes	Antilock Brakes
5F	Parking Brake	5	Brakes	Parking Brake
6, 6A	Engine Mechanical	6	Engine	Engine Mechanical
6B	Engine Cooling and Radiator	6	Engine	Engine Cooling
6C	Engine Fuel	6	Engine	Engine Controls
6D	Engine Electrical	6	Engine	Engine Electrical
—	Driveability and Emissions	6	—	Engine Controls
6F	Exhaust System	6	—	Exhaust System
6H	Vacuum Pump	6	Engine	Vacuum Pump
6J	Turbocharger	6	Engine	Turbocharger
7A	Automatic Transmission	7	Transmission/Transaxle	Automatic Transmission and Transmission/Transfer Case Unit Repair Manual

Truck Service Manual Sub-Section to Section and Sub-Section Conversion Table (cont'd)

Old Sub-Section	Old Sub-Section	New Section	Section Name	Sub-Section Name
7B	Manual Transmission	7	Transmission/Transaxle	Manual Transmission and Transmission/Transfer Case Unit Repair Manual
7C	Clutch	7	Transmission/Transaxle	Clutch
7D	Transfer Case	4	Driveline/Axle	Transfer Case and Transmission/Transfer Case Unit Repair Manual
8B	Lighting Systems	8	Body and Accessories	Lighting Systems
8C	Instrument Panel and Gages	8	Body and Accessories	Instrument Panel, Gages and Console
8D	Chassis Electrical	8	—	Refer to the Index at the end of the manual
8E	Wipers and Washers	8	Body and Accessories	Wiper/Washer Systems
9A	Audio Systems	8	Body and Accessories	Entertainment
9B	Cruise Control	8	Body and Accessories	Cruise Control
9E	Engine Coolant Heater	6	Engine	Engine Cooling
9F	Luggage Carrier	8	Body and Accessories	Roof
9J	Supplemental Inflatable Restraint	9	Restraints	Supplemental Inflatable Restraints
9K	Remote Keyless Entry	8	Body and Accessories	Keyless Entry
10A1	Doors	8	Body and Accessories	Doors
10A2	Seats	8	Body and Accessories	Seats
		9	Restraints	Seat Belts
10A3	Stationary Windows	8	Body and Accessories	Stationary Glass
10A4	Interior Trim	8	Body and Accessories	Exterior/Interior Trim
10A5	Endgate	8	Body and Accessories	Body Rear End
10B	Cab and Body Maintenance	—	—	Refer to the Index at the end of the manual

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1998 Medium Duty Truck
FSR, FTR, FVR
Service Manual

Volume 1

This manual provides information on the diagnosis, the service procedures, the adjustments, and the specifications for the 1998 Isuzu Medium Duty Truck.

The technicians who understand the material in this manual and in the appropriate Dealer Service Bulletins better service the vehicle owners.

When this manual refers to a brand name, a part number, or a specific tool, you may use an equivalent product in place of the recommended item. All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication approval. Isuzu reserves the right to make changes at any time without notice.

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Cautions and Notices

Definition of Caution, Notice, and Important

The diagnosis and repair procedures in the Isuzu Service Manual contain both general and specific Cautions, Notices, and Importants. Isuzu is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for the proper operation of the vehicle, however, certain procedures may present a hazard to the technician if they are not followed in the recommended manner. Cautions, Notices, and Importants are elements designed to prevent these hazards, however, not all hazards can be foreseen. This information is placed at strategic locations within the service manual. This information is designed to prevent the following from occurring:

- Serious bodily injury to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper repair or replacement of vehicle components. Any caution or notice that appears in general information is referenced from the individual service categories.

CAUTION Defined
When encountering a CAUTION, you will be asked to take a necessary action or not to take a prohibited action. If a CAUTION is not heeded, the following consequences may occur:

- Serious bodily injury to the technician
- Serious bodily injury to other technicians in the workplace area
- Serious bodily injury to the driver and/or passenger(s) of the vehicle, if the vehicle has been improperly repaired

NOTICE Defined
Notices call special attention to a necessary action or to a prohibited action. If a NOTICE is not heeded, the following consequences may occur:

- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper operation or performance of the system or component under repair
- Damage to any systems or components which are dependent upon the proper operation of the system or component under repair
- Improper operation or performance of any systems or components which are dependent upon the proper operation or performance of the system or component under repair
- Damage to fasteners, basic tools, or special tools
- The leakage of coolant, lubricant, or other vital fluids

IMPORTANT Defined
IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. IMPORTANT statements are designed to do the following:

- Clarify a procedure
- Present additional information for accomplishing a procedure
- Give insight into the reason or reasons for performing a procedure in the manner recommended
- Present information that will help to accomplish a procedure in a more effective manner
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease

ABS Handling Caution

Caution: Certain components in the Antilock Brake System (ABS) are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those component with approved removal and installation procedures should be serviced.

Battery Disconnect Caution

Caution: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

Brake Dust Caution

Caution: Avoid taking the following actions when you service wheel brake parts:

- ***Do not grind brake linings.***
- ***Do not sand brake linings.***
- ***Do not clean wheel brake parts with a dry brush or with compressed air.***

Some models or aftermarket brake parts may contain asbestos fibers which can become airborne in dust. Breathing dust with asbestos fibers may cause serious bodily harm. Use a water-dampened cloth in order to remove any dust on brake parts. Equipment is available commercially in order to perform this washing function. These wet methods prevent fibers from becoming airborne.

Brake Fluid Caution

Caution: Brake fluid may be irritating to the skin or eyes. In case of contact, take the following actions:

- *Eye contact—rinse eyes thoroughly with water.*
- *Skin contact—wash skin with soap and water.*

Clutch Dust Caution

Caution: When servicing clutch parts, do not create dust by grinding or sanding the clutch disc or by cleaning parts with a dry brush or with compressed air. A water-dampened cloth—NOT SOAKED—should be used. The clutch disc contains asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

Fuel and EVAP Pipe Caution

Caution: In order to Reduce the Risk of Fire and Personal Injury observe the following items:

- *Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, Do Not attempt to repair the sections of the nylon fuel pipes*
- *Do Not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.*
- *Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.*
- *Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)*

Fuel Gauge Leak Caution

Caution: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

Fuel Pipe Fitting Caution

Caution: Always apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings in order to reduce the risk of fire and personal injury.

This will ensure proper reconnection and prevent a possible fuel leak.

During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

Fuel Storage Caution

Caution: Do not drain the fuel into an open container. Never store the fuel in an open container due to the possibility of a fire or an explosion.

Gasoline/Gasoline Vapors Caution

Caution: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

Moving Parts and Hot Surfaces Caution

Caution: While working around a running engine, avoid contact with moving parts and hot surfaces to prevent possible bodily injury.

Road Test Caution

Caution: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury.

Safety Glasses and Compressed Air Caution

Caution: Wear safety glasses when using compressed air in order to prevent eye injury.

Safety Goggles and Fuel Caution

Caution: Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

Vehicle Lifting Caution

Caution: To help avoid personal injury, when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which you are removing components. The additional support will reduce the possibility of the vehicle falling off the hoist. When you are removing major components from the vehicle while the vehicle is on a hoist, chain the vehicle frame to the hoist pads at the same end from which you are removing the major components to prevent tip-off. If you fail to follow these precautionary measures, vehicle damage, serious personal injury, or death may result.

Window Removal Caution

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

Work Stall Test Caution

Caution: One or more of the following guidelines may apply when performing specific required tests in the work stall:

- ***When a test requires spinning the drive wheels with the vehicle jacked up, adhere to the following precautions:***
  - ***Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual vehicle speed under these conditions. Personal injury may result from excessive wheel spinning.***
  - ***If all of the drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive wheel spinning.***
  - ***All persons should stay clear of the rotating components and the balance weight areas in order to avoid possible personal injury.***
  - ***When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and the transmission.***
- ***When a test requires jacking up the vehicle and running with the wheels and brake rotors removed, adhere to the following precautions:***
  - ***Do not apply the brake with the brake rotors removed.***
  - ***Do not place the transmission in PARK with the drive wheels still spinning.***
  - ***Turn Off the ignition in order to stop the powertrain components from spinning.***

Defective Scan Tool Notice

Notice: Do not use a scan tool that displays faulty data. Report the scan tool problem to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Fastener Notice

Notice: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Fuel Pressure Notice

Notice: Do not allow the fuel pressure to exceed the specified value because damage to the fuel pressure regulator or the fuel pressure gauge may result.

Handling ESD Sensitive Parts Notice

Notice: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.

Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.

Do not allow tools to contact exposed terminals when servicing connectors.

Do not remove components from their protective packaging until required to do so.

Avoid the following actions unless required by the diagnostic procedure:

Jumpering or grounding of the components or connectors.

Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.

Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

Ignition OFF When Disconnecting Battery Notice

Notice: Always turn the ignition OFF when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the Powertrain Control Module (PCM) or other electronic components.

Nylon Fuel Lines Notice

Notice: Do not attempt to straighten the kinked nylon fuel lines. Replace any kinked nylon fuel feed or return pipes in order to prevent damage to the vehicle.

PCM and ESD Notice

Notice: Do not touch the connector pins or soldered components on the circuit board in order to prevent possible electrostatic discharge (ESD) damage to the PCM.

Single Cylinder Flooding Notice

Notice: In order to prevent flooding of a single cylinder and possible engine damage, relieve the fuel pressure before performing the fuel injector coil test procedure.

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General Information

In order to convert English units to metric units, multiply the English units by the conversion factor shown in the conversion table.

In order to convert metric units to English units, divide the metric units by the conversion factor shown in the conversion table.

Conversion - English/Metric

English	Multiply/ Divide by	Metric
LENGTH		
in	25.4	mm
ft	0.3048	m
yd	0.9144	
mi	1.609	km
AREA		
sq in	645.2	sq mm
	6.45	sq cm
sq ft	0.0929	sq m
sq yd	0.8361	
VOLUME		
cu in	16,387.0	cu mm
	16.397	cu cm
	0.0164	L
qt	0.9464	
gal	3.7854	
cu yd	0.7646	cu m
MASS		
lb	0.4536	kg
ton	907.18	
	0.907	tonne (t)
FORCE		
kg	9.807	newtons (N)
oz	0.2780	
lb	4.448	
ACCELERATION		
ft/s^2	0.3048	m/s^2
in/s^2	0.0254	
TORQUE		
lb in	0.11298	N.m
lb ft	1.3558	
POWER		
hp	0.746	kW

Conversion - English/Metric (cont'd)

English	Multiply/ Divide by	Metric
PRESSURE (STRESS)		
inches of Mercury	3.377	kPa
inches of H2O	0.2491	kPa
lb/sq in	6.895	
LIGHT		
Foot Candle	10.764	lm/m^2
VELOCITY		
mph	1.6093	km/h
TEMPERATURE		
°F	5/9(°F-32)	°C
°C	9/5(°C+32)	°F
FUEL PERFORMANCE		
mpg	2.3527	L/km

Refer to the following table for equivalent of fractions to decimals in English (inches), to metric (millimeters).

Equivalents - Decimal and Metric

Fraction (in)	Decimal (in)	Metric (mm)
1/64	0.015625	0.39688
1/32	0.03125	0.79375
3/64	0.046875	1.19062
1/16	0.0625	1.5875
5/64	0.078125	1.98437
3/32	0.09375	2.38125
7/64	0.109375	2.77812
1/8	0.125	3.175
9/64	0.140625	3.57187
5/32	0.15625	3.96875
11/64	0.171875	4.36562
3/16	0.1875	4.7625
13/64	0.203125	5.15937
7/32	0.21875	5.55625
15/64	0.234375	5.95312
1/4	0.25	6.35
17/64	0.265625	6.74687
9/32	0.28125	7.14375
19/64	0.296875	7.54062
5/16	0.3125	7.9375
21/64	0.328125	8.33437

Equivalents - Decimal and Metric (cont'd)

Fraction (in)	Decimal (in)	Metric (mm)
11/32	0.34375	8.73125
23/64	0.359375	9.12812
3/8	0.375	9.525
25/64	0.390625	9.92187
13/32	0.40625	10.31875
27/64	0.421875	10.71562
7/16	0.4375	11.1125
29/64	0.453125	11.50937
15/32	0.46875	11.90625
31/64	0.484375	12.30312
1/2	0.5	12.7
33/64	0.515625	13.09687
17/32	0.53125	13.49375
35/64	0.546875	13.89062
9/16	0.5625	14.2875
37/64	0.578125	14.68437
19/32	0.59375	15.08125
39/64	0.609375	15.47812
5/8	0.625	15.875
41/64	0.640625	16.27187
21/32	0.65625	16.66875
43/64	0.671875	17.06562
11/16	0.6875	17.4625
45/64	0.703125	17.85937
23/32	0.71875	18.25625
47/64	0.734375	18.65312
3/4	0.75	19.05
49/64	0.765625	19.44687
25/32	0.78125	19.84375
51/64	0.796875	20.24062
13/16	0.8125	20.6375
53/64	0.828125	21.03437
27/32	0.84375	21.43125
55/64	0.859375	21.82812
7/8	0.875	22.225
57/64	0.890625	22.62187
29/32	0.90625	23.01875
59/64	0.921875	23.41562
15/16	0.9375	23.8125
61/64	0.953125	24.20937
31/32	0.96875	24.60625
63/64	0.984375	25.00312
1	1.0	25.4

Paper Version of the Service Manual - How to Use

Construction

This service manual is constructed with the following 10 major sections:

Major Section Number	Major Section Name
0	General Information
1	Heating, Ventilation, and Air Conditioning (HVAC)
2	Steering
3	Suspension
4	Driveline/Axle
5	Brakes
6	Engine
7	Transmission/Transaxle
8	Chassis/Body Electrical
9	Accessories
10	Body

Information Flow

Each major section will be structured as follows:

1. A single table of contents for the entire major section; including all contents of the subsections within the major section.
2. Subsections

The service information located within each subsection will be ordered as follows:

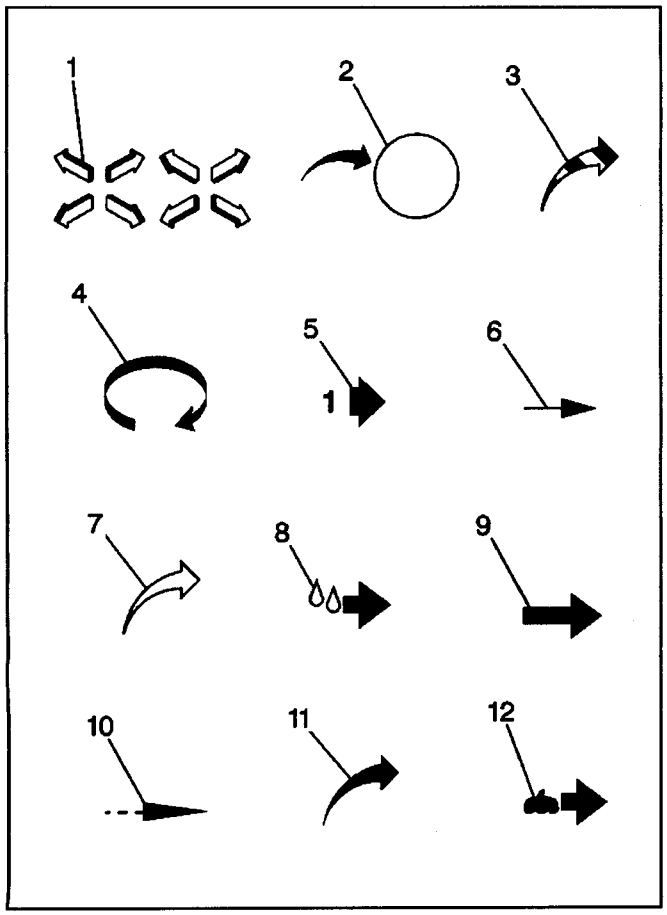
1. Specifications
2. Diagnosis
3. Repair procedures
4. General description and system operation
5. Special tools

Improvements Made

This service manual provides many more illustrations than in earlier manuals. Illustrations serve as the primary source for repair procedures. These illustrations will be supplemented with text descriptions. In the previous service manuals, text was the primary source of information for repair procedures and illustrations provided support.

Repair procedures, illustrations, and the descriptive text have been arranged so that they will correspond with the way you work. This manual provides disassembled views, wherever possible, so that it will be easy to look up parts, names, and order of assembly. The text descriptions have been rewritten into simple, complete sentences.

Arrows and Symbols



196216

Legend

(1) Front of Vehicle
(2) View Detail
(3) Ambient Air Mixed With Another Gas, Can Indicate Temperature Change
(4) Motion or Direction
(5) View Angle
(6) Dimension (1:2)
(7) Ambient/Clean Air Flow, Cool Air Flow
(8) Lubrication Point—Oil or Fluid*
(9) Task Related
(10) Sectioning (1:3)
(11) Gas Other Than Ambient Air, Hot Air Flow
(12) Lubrication Point—Grease or Jelly*

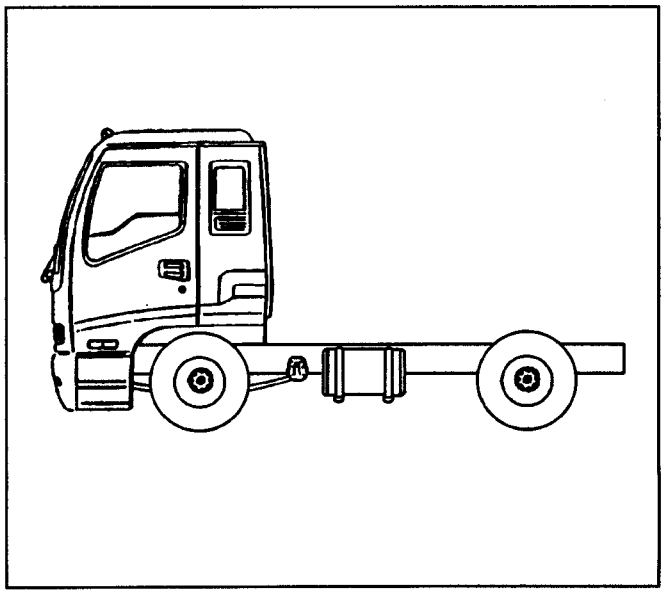
Special Tools Ordering Information

Special Tools

The special service tools shown in this service manual have tool product numbers beginning with J or BT. Special tools are distributed worldwide by Kent-Moore:
Kent-Moore
SPX Corporation
29784 Little Mack
Roseville, MI 48066-2298
1-800-328-6657
Mon.–Fri. 8:00 a.m. to 7:00 p.m. EST
Telex: 244040 KMTR UR
Fax: 1-800-578-7375

Purchase scan tools and accessories from Kent-Moore at the address above.

Vehicle Identification



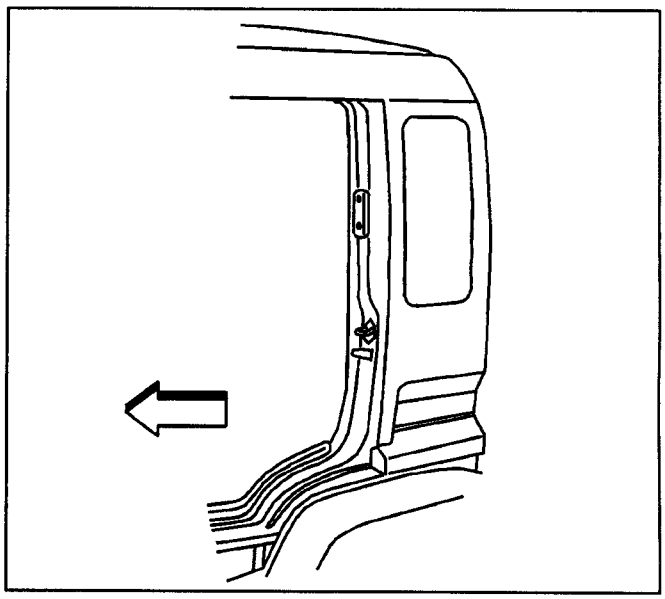
205884

The Isuzu Commercial Truck is available in the above body style.

VIN Derivative

The Vehicle Identification Number (VIN) is the legal identifier of the vehicle. The VIN contains the following information:

- The manufacturer
- The model
- The chassis type
- The engine type
- The Gross Vehicle Weight (GVW) range
- The model year
- The plant code
- The sequential number



205886

The VIN plate is attached to the driver's door opening.

Vehicle Identification Number (VIN) System

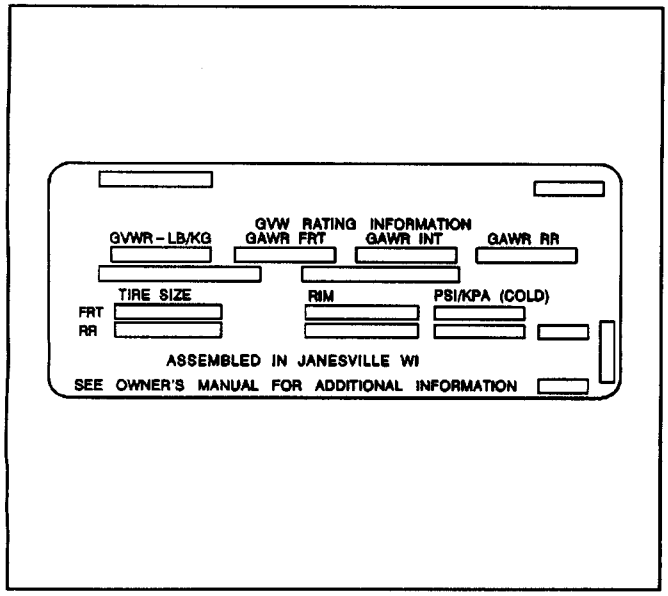
Position	Definition	Character	Description
1	Country of Origin	4	United States
2	Manufacturer	G	Isuzu
3	Model	T	Isuzu Incomplete Vehicle
4	GVWR/Brake System	A	9001–10000 Hydraulic
		B	10001–14000 Hydraulic
		C	14001–16000 Hydraulic
		D	14001–16000 Air
		E	16001–19500 Hydraulic
		F	16001–19500 Air
		G	19501–23500 Hydraulic
		H	19501–23500 Air
		J	23501–26000 Hydraulic
		K	23501–26000 Air
		L	26001–33000 Hydraulic
		M	26001–33000 Air
		N	33001–40500 Hydraulic
		P	33001–40500 Air
		R	40501–48500 Hydraulic
		S	40501–48500 Air
		T	48501–58000 Air
		V	58001–69500 Air
		W	69501–over Air
5	Series	6	6000
		7	7000
6	Cab Type	C	Medium Tilt, Steel, 226 cm (89") BBC
7	Chassis Type	1	4 x 2, 2 Axles, 1 Driving
8	Engine Type	2	Isuzu 6 Cylinder Turbo Diesel (7.8L)

Vehicle Identification Number (VIN) System (cont'd)

Position	Definition	Character	Description
9	Check Digit	1	—
10	Model Year	—	1998
11	Plant Location	J	Janesville
12–17	Plant Sequence Number	—	6-Digit Sequential Numbers

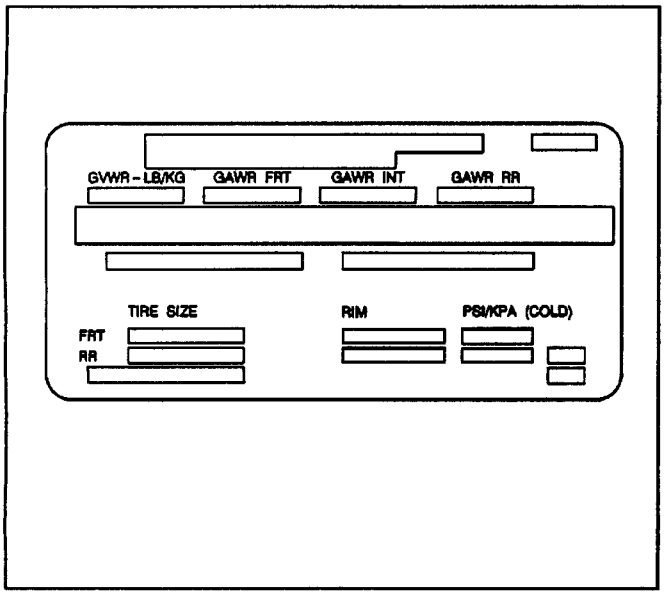
Label - Vehicle Certification

Complete Vehicle Certification Label



291017

Incomplete Vehicle Certification Label



291007

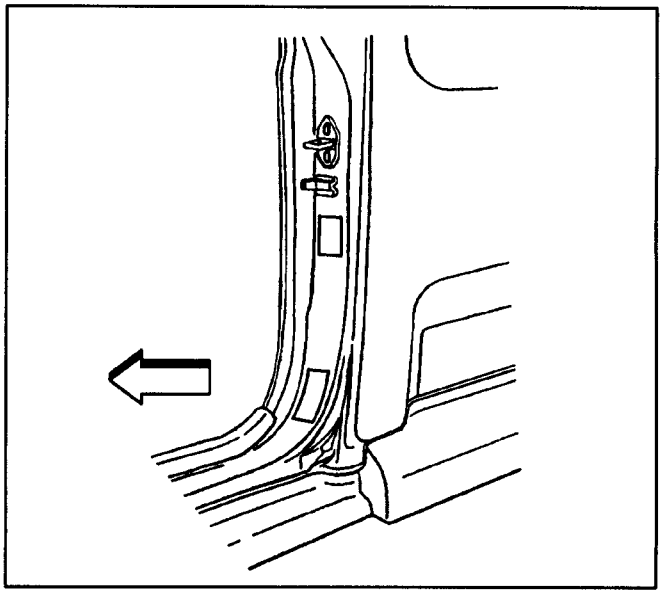
The Vehicle Certification Label indicates the following ratings for the vehicle:

- The Gross Vehicle Weight Rating (GVWR)
- The front and rear Gross Axle Weight Rating (GAWR)
- The payload rating

The Gross Vehicle Weight (GVW) is the weight of the stock vehicle and all the options added to the vehicle after leaving the factory. The GVW includes, but not limted to, the weight of the following items:

- The body
- Winches
- Booms
- The driver
- All occupants
- The load that the vehicle is carrying

Ensure that the Gross Vehicle Weight (GVW) does not exceed the Gross Vehicle Weight Rating (GVWR). Ensure that the front and the rear Gross Axle Weights (GAW) do not exceed the front and the rear Gross Axle Weight Rating (GAWR).



205890

The payload rating shown on the label is the maximum allowable cargo load (including the weight of the driver and all occupants) that the vehicle may carry based on the stock equipment. The payload rating lowers if any accessories or other equipment are added to the vehicle after the final date of manufacture. Determine the weight of any added accessories and deduct the amount from the payload rating.

The vehicle may also have a Gross Combination Weight Rating (GCWR). The GCWR is the total weight of the loaded tow vehicle (including passengers) and a loaded trailer.

Ensure that the tires on the vehicle are the proper size and at the proper inflation pressure for the load that the vehicle is carrying. The vehicle certification label shows the stock tire size and recommended inflation pressures.

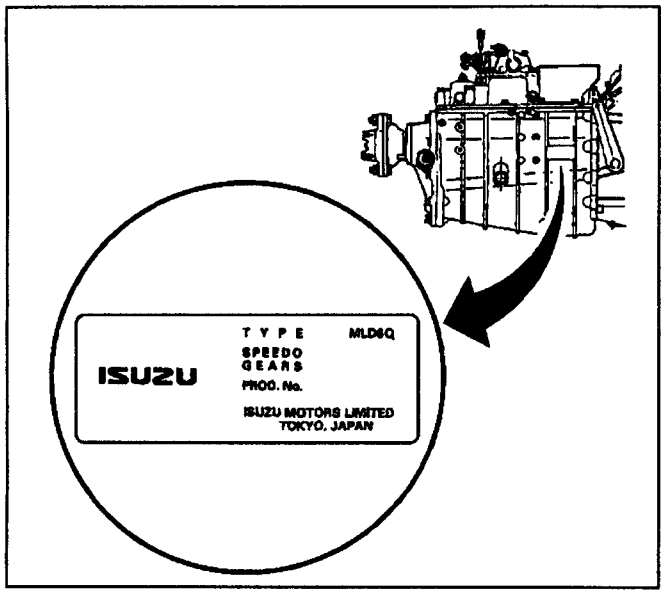
Engine Identification

Diesel Engine

The engine serial number is located on the front right side corner of the engine block.

Transmission Identification

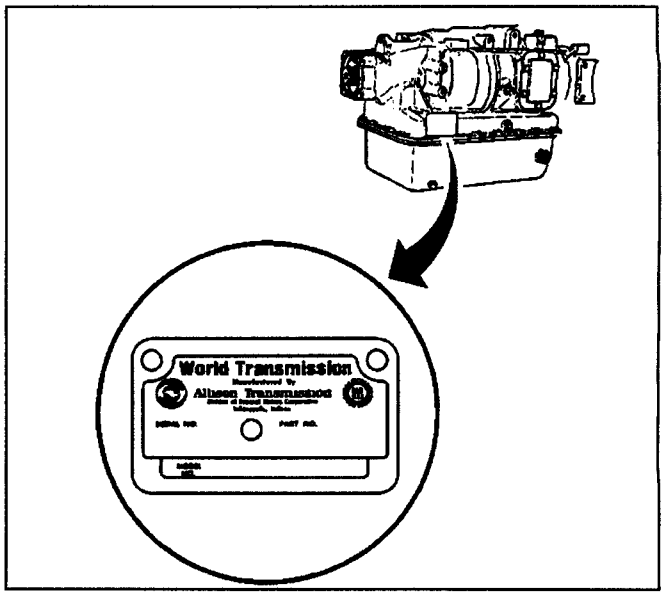
Isuzu



208509

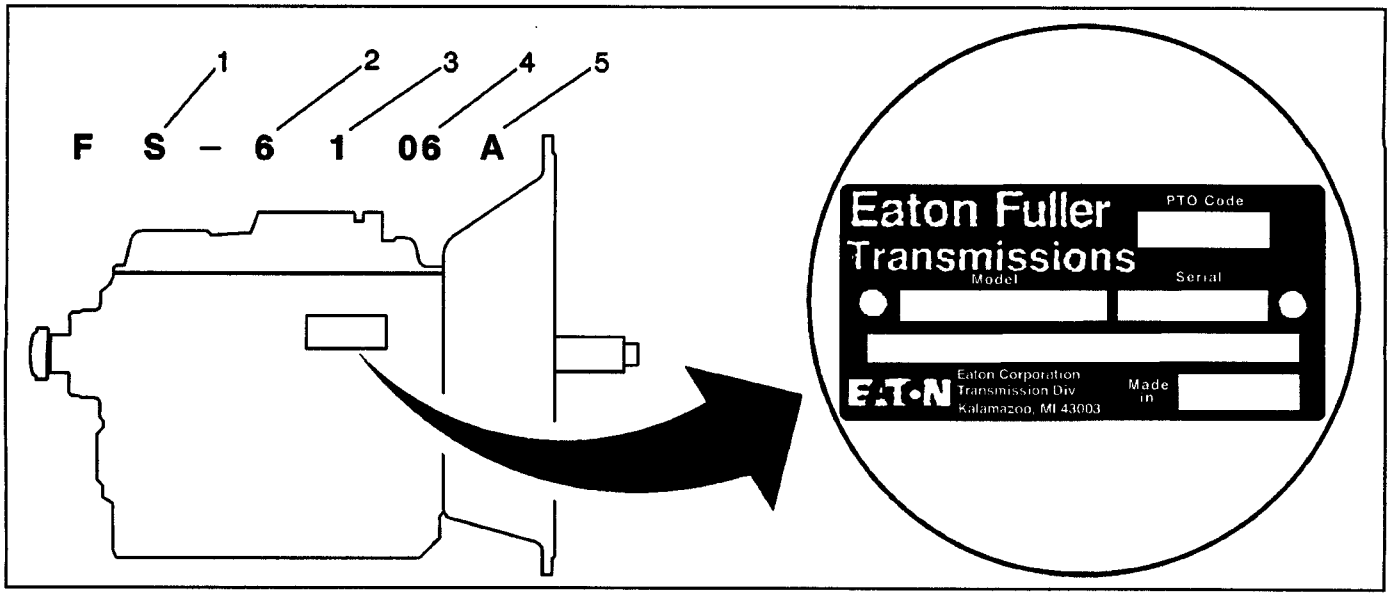
The Isuzu transmission identification plate is located on the left upper side of the housing.

Allison



208521

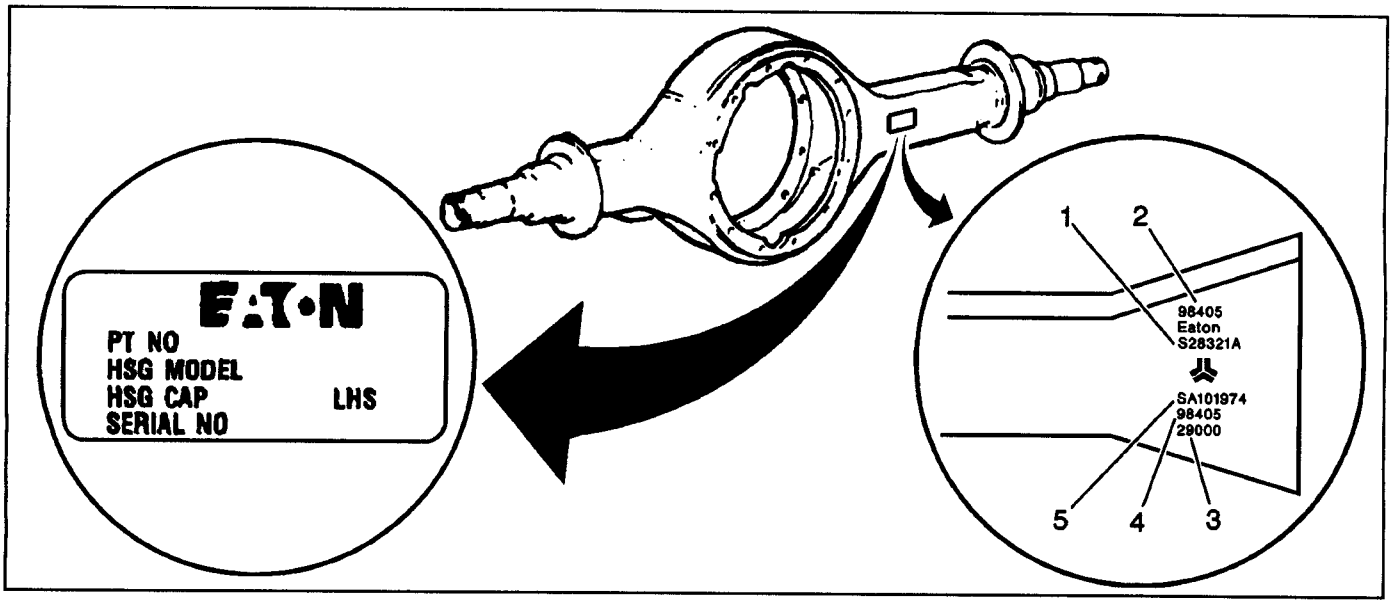
The Allison® transmission identification plate is located on the rear left side of the housing, just above the oil pan.



200589

Rear Axle Identification

Eaton® Rear Axle ID



200579

Legend

(1) Axle Specification Number
(2) Casting Number
(3) Rough Number
(4) Capacity
(5) Housing Subassembly Number (Including Tubes)

All axle housings have identification tags or identification information stamped on the side of the differential carrier.

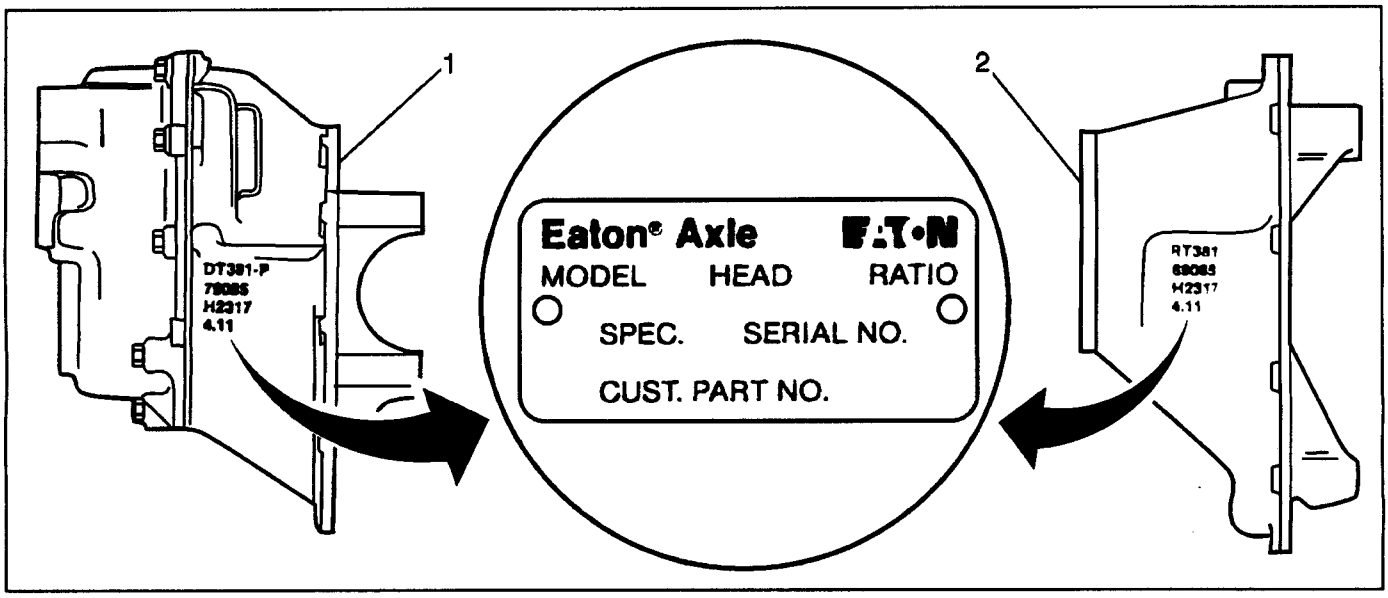
Differential Carrier

The carrier tag may contain the following information:

- The axle model
- The ratio
- The carrier assembly number
- The carrier serial number
- The date of assembly

Use all the information on the carrier tag in order to identify the axle assembly.

Eaton® Differential Carrier ID

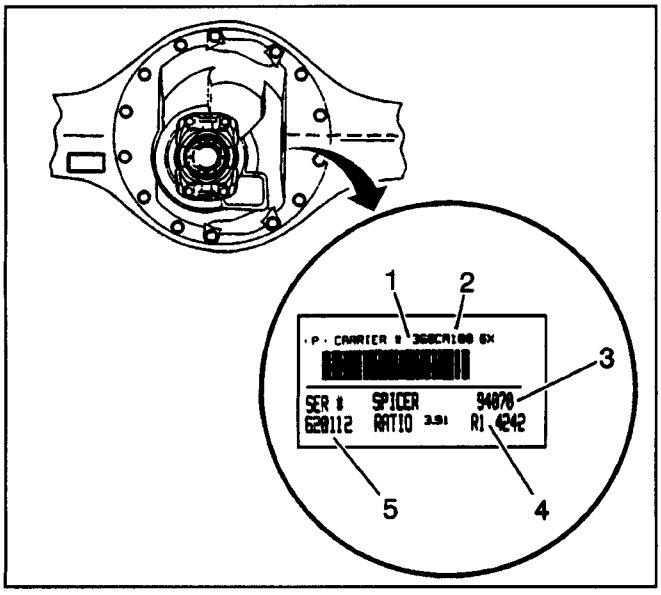


200584

Legend

(1) Side View
(2) Top View

Dana/Spicer® Rear Axle Differential Carrier ID



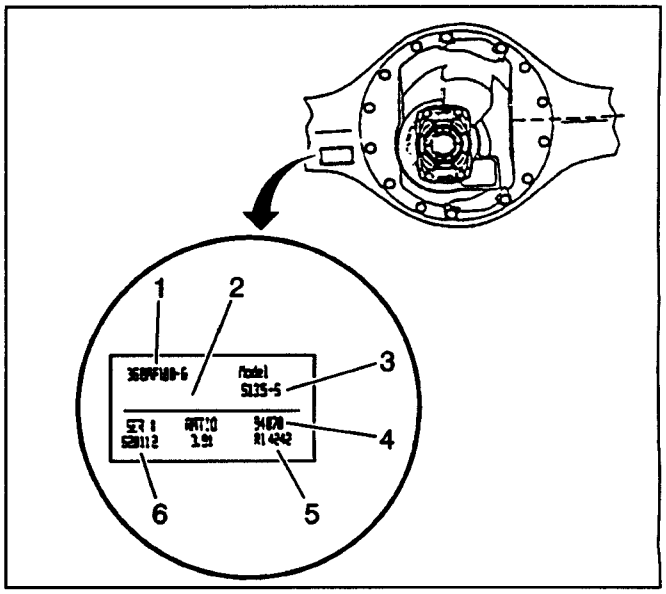
200587

Legend

(1) Dana® Part Number
(2) Customer Part Number (Optional)
(3) Julian Date Code
(4) Line Set Number (Optional)
(5) Last Six Digits of Vehicle Serial Number (Optional)

Axle Housing

Dana/Spicer® Rear Axle ID



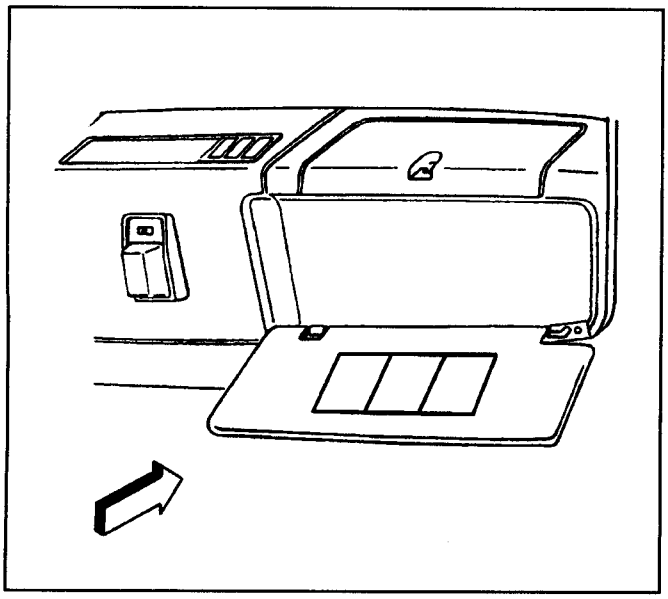
200582

Legend

(1) Dana® Part Number
(2) Customer Part Number (Optional)
(3) Model
(4) Julian Date Code
(5) Line Set Number (Optional)
(6) Last Six Digits of Vehicle Serial Number (Optional)

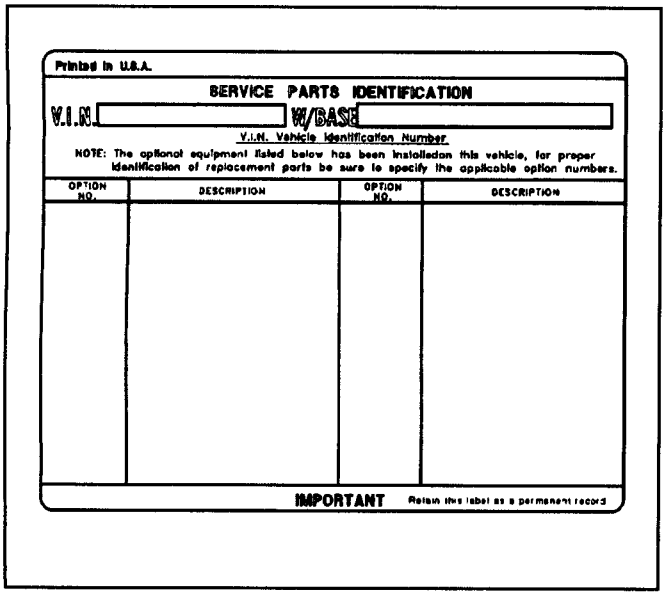
The housing tag is the same type of tag used for the Differential Carrier.

Label - Service Parts ID



205849

The Service Parts Identification Label is on the passenger's side sun visor.



200611

Always refer to the Service Parts Identification Label when ordering parts. The label lists the following items:

- The Vehicle Identification Number (VIN)
- The wheelbase
- The paint information
- All production options
- All factory-installed special equipment

RPO Code List

RPO	Description
ASA	Seat: Front Bucket, Driver High Back, Self Contained Air Suspension
AV8	Seat: Center Front Bucket, Auxiliary, Folding
BAG	Parts Package Export
BPU	First Position Prop Hanger, NON-BOC, Height A
BPV	First Position Prop Hanger, NON-BOC, Height B
BPW	First Position Prop Hanger, NON-BOC, Height C
BUB	First Position Prop Hanger, NON-BOC, Height D
BUC	First Position Prop Hanger, NON-BOC, Height E
CKD	Vehicle Completely Knocked Down
CV3	Country Mexico
C60	HVAC System Air Conditioner, Front Manual Controls
DFO	Mirror: Outside, LH and RH, 17.8 cm x 40.6 cm (7 in x 16 in), SST
DNN	Mirror: Outside, Dual Velvac Heated, 15.2 cm x 40.6 cm (6 in x 16 in), Stainless Steel
DTE	Mirror: Auxiliary Outside 20 cm (8 in) Spot, Dual Retrac, SST
EG5	401 cm (158 in) Wheelbase
EH8	432 cm (170 in) Wheelbase
EK8	478 cm (188 in) Wheelbase
EM2	508 cm (200 in) Wheelbase
EQ8	592 cm (233 in) Wheelbase
ERA	Second Position Prop Hanger, Height A
ERB	Second Position Prop Hanger, Height B
ERC	Second Position Prop Hanger, Height C
ERD	Second Position Prop Hanger, Height D
ERE	Second Position Prop Hanger, Height E
ES5	630 cm (248 in) Wheelbase
EV9	Suspension: Attach Bolted
EXP	Export I.E.S.
EY1	Yoke: Propeller Shaft, Driveline, Dana®
FD0	Frame: Rail, Full Depth, 612 cm x 15 cm (241 in x 6 in), 22 680 kg (50,000 lb)
FD5	Frame: Rail, Full Depth, 622 cm x 20 cm (245 in x 8 in), 36 288 kg (80,000 lb)
FF1	Hub: Front, Oil Filled

RPO Code List (cont'd)

RPO	Description
FK9	Suspension: Front, Multileaf, 4 090 kg (9,017 lb)
FL1	Axle: Front, 3 674 kg (8,100 lb)
FL2	Axle: Front, 4 990 kg (11,000 lb)
FL3	Axle: Front, 6 623 kg (14,600 lb)
FM0	Suspension: Front, Multileaf, 6 610 kg (14,600 lb)
FM4	Suspension: Front, Multileaf, 6 350 kg (14,000 lb)
FPL	554 cm (218 in) Wheelbase
FQT	356 cm (140 in) Wheelbase
FS7	Axle: Front, 5 443 kg (12,000 lb) HD
F03	Frame: Rail, Full Depth, 232 cm x 25 cm (249 in x 10 in), 49,896 kg (110,000 lb)
F08	Reinforcement: Frame, Outside, Inverted L Type, 36,288 kg (80,000 lb)
F12	Suspension: Front, Tapered Leaf, 3 175 kg (7,000 lb)
F14	Suspension: Front, Tapered Leaf, 3 674 kg (8,100 lb)
F15	Suspension: Front, Tapered Leaf, 4 082 kg (9,000 lb)
F26	Suspension: Front, Tapered Leaf, 5 443 kg (12,000 lb)
F59	Stabilizer Shaft: Front
GG0	Suspension: Rear, Multileaf, 6 804 kg (15,000 lb)
GG7	Suspension: Rear, Tapered Leaf 7 666 kg (16,900 lb)
GN0	Suspension: Rear, Tapered Leaf, 8 620 kg (19,000 lb)
GN1	Stabilizer Shaft: RR (Dup with F61)
GN2	Suspension: Rear, Multileaf, 8 620 kg (19,000 lb)
GN8	Suspension: Rear, Multileaf, 9 525 kg (21,000 lb)
GPG	Vehicle: Low Profile Package
GP0	Suspension: Rear, Tapered Leaf, 10 430 kg (23,000 lb)
GP1	Suspension: Rear, Multileaf, 10 660 kg (23,500 lb)
GQB	Third Position Prop Hanger, Height A
GQC	Third Position Prop Hanger, Height B
GQD	Third Position Prop Hanger, Height C
GQE	Third Position Prop Hanger, Height D
GQF	Third Position Prop Hanger, Height E
GQ0	Suspension: Rear, Tapered Leaf, 8 600 kg (15,000 lb)

RPO Code List (cont'd)

RPO	Description
GR9	Suspension: Rear, Tapered Leaf, 9 525 kg (21,000 lb)
GZI	GVW Rating: 11 771 kg (25,950 lb)
GZT	Provisions for Taperleaf/Multileaf Rear Springs
G40	Suspension: Rear Air, 8 618 kg (19,000 lb)
G60	Spring: Rear, Auxiliary
G68	Shock Absorbers: Rear, Heavy Duty
G86	Axle: Limited Slip
G98	Seal: Rear Axle Oil, Stemco
HNA	Axle: Rear, Eaton® 23105S, Single Speed, 10 433 kg (23,000 lb)
HPG	Axle: Rear, Eaton® 22060S, Single Speed, 9 979 kg (22,000 lb)
HPH	Axle: Rear, Eaton® 22060T, Two Speed, 9 979 kg (22,000 lb)
HPK	Axle: Rear, Eaton® 19060S, Single Speed, 8 618 kg (19,000 lb)
HPM	Axle: Rear, Eaton® 19060T, Two Speed, 8 618 kg (19,000 lb)
HPP	Axle: Rear, Eaton® 21060S, Single Speed, 9 526 kg (21,000 lb)
HPQ	Axle: Rear, Eaton® 23080S, Two Speed, 10 433 kg (23,000 lb)
HPZ	Control: Rear Axle Shift, Two Speed, Electric
HWY	Axle: Rear, Eaton® 19050S, Single Speed, 7 666 kg (16,900 lb)
HZT	Axle: Rear, Eaton® 19050T, Two Speed, 8 097 kg (17,850 lb)
HZW	Axle: Rear, Eaton® 19050S, Single Speed, 8 097 kg (17,850 lb)
H08	Axle: Rear, Dana® S150-S, Single Speed, 6 804 kg (15,000 lb)
H10	Axle: Rear, Eaton® 15040S, Single Speed, 6 804 kg (15,000 lb)
H11	Axle: Rear, Eaton® 19050S, Single Speed, 8 618 kg (19,000 lb)
H15	Axle: Rear, Eaton® 21060T, Two Speed, 9 526 kg (21,000 lb)
H20	Axle: Rear, Eaton® 23080T, Two Speed, 10 433 kg (23,000 lb)
JE3	Brake: Hydraulic
JE4	Brake: Air
JE5	Braking System, Power, Antilock, Front and Wheel
JPV	Brake Rating: Rear, Air Carlisle, NAB9ML, Non-Abestos Lining, 14 cm (5.5 in) Slack, 42 cm x 178 cm (16.5 in x 7 in) Fab Shoe, 16 Hole Mounting

RPO Code List (cont'd)

RPO	Description
JPZ	Valve: Air Suspension, Air Release
JQB	Universal Joint: Main, 1480/148N Series
JQF	Adjuster: Rear Slack, Automatic, Rockwell
JQM	Universal Joint: Main, 1710/17N Series
JQP	Universal Joint: Main, 1550/155N Series
JQQ	Universal Joint: Main, 1710/17N Series, HD Tube
JQR	Universal Joint: Main, 1610/161N Series
JRA	Universal Joint: Inter Axle, 1610/161N Series
JRD	Brake Rating: Front, Air Carlisle, E145A Non-Abestos Lining, 14 cm (5.5 in) Slack, 4 or 8 Hole Mounting
JRF	Shield: Rear Brakes, Dust
JRL	Brake Rating: Rear, Air Carlisle, E145A Non-Abestos Lining, 14 cm (5.5 in) Slack, 42 cm 18 cm (16.5 in x 7 in) Fab Shoe, 10 Hole Mounting
JRN	Brake Rating: Rear, Air Carlisle, E145A Non-Abestos Lining, 15 cm (6 in) Slack, 42 cm x 18 cm (16.5 in x 7 in) Fab Shoe, 9 Hole Mounting
JTJ	Brake Adjuster, RR Slack, Eaton® Automatic
JTK	Brake Adjuster, Front Slack, Eaton® Automatic
JTT	Air Dryer B/W Model, AD9 Heated, Brake Air Tank
JUE	Brake Adjuster: Front Slack, Rockwell® Automatic
JUZ	Equipment RR Brake Chamber Brand, MGM E-Series
JVA	Provisions Antilock Brake Delete
JVQ	Brake Rating: Front, Air Carlisle, E145A Non-Abestos Lining, 14 cm (5.5 in) Slack, 42 cm x 13 cm (16.5 in x 5 in) Fab Brake Shoe, 8 Hole Mounting
JWB	Brake Rating: Rear, Air Carlisle, E145A Non-Abestos Lining, 14 cm (5.5 in) Slack, 42 cm x 18 cm (16.5 in x 7 in) Fab Brake Shoe, 16 Hole Mounting
JWF	Brake Rating: Rear, Air Carlisle, E145A Non-Abestos Lining, 15 cm (6 in) Slack, 42 cm x 18 cm (16.5 in x 7 in) Fab Shoe, 16 Hole Mounting
JXD	Universal Joint: Main, 1750/176N Series, HD Tube
JXG	Valve: Air Brake Moisture Ejector, B/W DV2, Heated, Front

RPO Code List (cont'd)

RPO	Description
JYV	Brake Provisions: Full Trailer
JZC	Chamber: Front Brake, Type 16
JZD	Chamber: Front Brake, Type 20
JZE	Chamber: Front Brake, Type 24
JZF	Chamber: Rear Brake, Type 30
JZG	Chamber: Rear Brake, Type 24
J71	Parking Brake: Power Operated
J78	Valve: Moisture Ejector Air Brake
J91	Brake Provisions: Trailer
KG8	Generator: 130 AMP
KRW	Hose: Radiator, Silicone
KVB	Hose: Water, Silicone, Except Radiator
KYC	Air Compressor: Zexel, 185L/MN, Water Cooled
K40	Engine Brake: Exhaust
K60	Generator: 100 AMP
LG4	Engine: Diesel, 6 Cylinder, 7.8L, Turbo
LQB	Engine: Diesel, 6 Cylinder, 7.8L, 149 kW (200 Gross hr), 2400 RPM
LQC	Engine: Diesel, 6 Cylinder, 7.8L, 172 kW (230 Gross hp), 2400 RPM
MF1	Transmission: Allison® AT545, Automatic
MPU	Transmission Manual 5-speed Fuller FS5005A
MRK	Clutch: 350 mm, (13.8 in) Single Plate, Push Type, Dana-Spicer®
MWE	Pilot Shaft: Automatic Transmission, No Spline
MWF	Pilot Shaft: Automatic Electric Transmission, No Spline
MWM	Clutch Spicer 14-1 Cerametallix, Pull Type, Greasable Bearing
MWW	Pilot Shaft: Transmission, 44.45 mm (1.75 in) Spline
MWX	Pilot Shaft: Transmission, 38.1 mm (1.5 in) Spline
M54	Transmission: Manual, 6 Speed, ISUZU, 136 mm (5.35 in), 6.72 1st, Over Drive
NB5	Exhaust System: Single
NL0	Fuel Tank: 189L, (50 gal), LH, Rectagular, Steel
NL5	Fuel Tank: 189L, (50 gal), Dual, Rectangular, Steel
NXN	Fuel: 57L (15 gal) Additional
NXY	Steering: Power, ZF
PNB	Wheel: Polished Aluminum, Both Sides, Rear

RPO Code List (cont'd)

RPO	Description
PNL	Secondary Color: Exterior, Penske
PNQ	Angle: Rear Axle Pinion, Nominal 3°
PNR	Angle: Rear Axle Pinion, Nominal 4°
PNS	Angle: Rear Axle Pinion, Nominal 5°
PNU	Primary Color: Interior, Penske
PNX	Angle: Rear Axle Pinion, Nominal 6°
PNY	Angle: Rear Axle Pinion, Nominal 7°
PQR	Wheel: Front Generic, 8 Hole, 275 mm (10.8 in), BC, FN
PQS	Wheel: Rear Generic, 8 Hole Disc, 275 mm (10.8 in), BC, FN
PQU	Wheel: Front, Generic Steel, 10 Hole, 285.75 mm (11.25 in), BC, Disc Piloted, Disc
PQV	Wheel: Rear, Generic Steel, 10 Hole, 285.75 mm (11.25 in), BC, Disc Piloted, Disc
PQY	Wheel: Front, Generic Steel, 10 Hole, 287.75 mm (11.25 in), BC, Piloted
PQZ	Wheel: Rear, Generic Steel, 10 Hole, 287.75 mm (11.25 in), BC, Piloted
PRS	Identification Pro-Spec
PTA	Provisions Low Profile Front Tires
PVG	Wheel: Front, Generic 8 Hole, 275 mm (10.8 in), BC
PVH	Wheel: Rear, Generic 8 Hole, 275 mm (10.8 in), BC
P2C	Pricing Wheels, Class A
P53	Tire Tread, Spare Tread and Brand, Front Match
P54	Tire Tread, Spare Tread and Brand, Rear Match
QE5	Odometer Rear Axle Hub
QH3	Wheel: Front, 22.5 x 7.50, 10 Hole, 287.75 mm (11.25 in) BC, FN, Hub Piloted
QH4	Wheel: Rear, 22.5 x 7.50, 10 Hole, 287.75 mm (11.25 in) BC, FN, Hub Piloted
Q82	Wheel: Front, 19.5 x 6.0, 8 Hole, 275 mm (10.8 in), BC, FN
Q83	Wheel: Rear, 19.5 x 6.0, 8 Hole, 275 mm (10.8 in), BC, FN
RNE	Wheel: Front, 22.5 x 8.25, 10 Hole, 285.75 mm (11.25 in), BC, Piloted Hub
RNF	Wheel: Rear, 22.5 x 8.25, 10 Hole, 285.75 mm (11.25 in), BC, Piloted Hub
RPM	Wheel: Front, 19.5 x 6.75, 8 Hole, 275 mm (10.8 in), BC, FN, Piloted Hub
RPQ	Wheel: Front, 22.5 x 8.25, 10 Hole, 285.75 mm (11.25 in), BC, Piloted Hub

RPO Code List (cont'd)

RPO	Description
RPR	Wheel: Rear, 22.5 x 8.25, 10 Hole, 285.75 mm (11.25 in), BC, Piloted Hub
RPW	Wheel: Rear, 19.5 x 6.75, 8 Hole, 275 mm (10.8 in), BC, FN, Piloted Hub
RQ2	Vehicle Application: Truck Service
R3B	Front Tire: Extra Strength Highway Tread
R3C	Front Tire: Premium Highway Tread
R3M	Front Tire: All Season Tread
R3N	Front Tire: Premium Highway Improved Steering Control Tread
R4A	Front Tire Brand: Goodyear
R4H	Front Tire Brand: General
R4L	Front Tire Brand: Michelin
R4N	Front Tire Brand: Bridgestone
R4R	Front Tire Brand: Select, Brand Plant
R4T	Front Tire Brand: Yokohama
R6B	Control Sales Item No. 02
R6G	Control Sales Item No. 07
R6P	Control Sales Item No. 15
R9U	Control Sales Item No. 95
SGB	Form Advanced Broadcast Document
SMA	Spacer Pack: Right Spring Cab Leveling, +10 mm (+.374 in)
SMB	Spacer Pack: Right Spring Cab Leveling, +0 mm (+0 in)
SMC	Spacer Pack: Right Spring Cab Leveling, -10 mm (-.374 in)
SMD	Spacer Pack: Right Spring Cab Leveling, -20 mm (-.787 in)
SNF	Wheel: Front, Spare
SNR	Wheel: Rear, Spare
S3B	Tire Tread: Rear, Extra Strength Highway
S3C	Tire Tread: Rear, Premium Highway
S3D	Tire Tread: Rear, Highway Premium
S3E	Tire Tread: Rear, On/Off Road Highway
S3F	Tire Tread: Rear, Off Road Rolling
S3H	Tire Tread: Rear, Highway
S3J	Tire Tread: Rear, Highway Traction
S3K	Tire Tread: Rear, On/Off Road Rib
S3L	Tire Tread: Rear, Off Road Traction
S3M	Tire Tread: Rear, All Season
S3N	Tires: Tread, Rear, Premium Highway, Improved Steering Control
S4A	Rear Tire Brand: Goodyear
S4C	Rear Tire Brand: Dunlop

RPO Code List (cont'd)

RPO	Description
S4H	Rear Tire Brand: General
S4L	Rear Tire Brand: Michelin
S4N	Rear Tire Brand: Bridgestone
S4R	Rear Tire: Select, Brand Plant
S4T	Rear Tire Brand: Yokohama
TM0	Battery: 900 CCA, Dual
TNL	Battery: Twin, 12V (1110)
TNN	Battery: Twin, Delco® 1150, 12V
TRF	Tires: Front, Radial Identifier
TRG	Tire Selection, Customer Brand
TRH	Tire Selection, Customer Brand
TRR	Tires: Rear, Radial Identifier
TRZ	Equipment Air Shift Transmission
T62	Lighting: Daytime Running
UEA	Taillamp Delete
UET	Indicator, Electronic Transmission, Oil Level
UM6	Radio: AM/FM Stereo, Seek & Scan, Auto Reverse Cassette, Clock, ETR
UM7	Radio: AM/FM Stereo, Seek & Scan, Clock, ETR
UZF	Alarm B/U Electrical, 97 Decibles
U08	Horn: Dual Electric
U86	Wiring Harness: Full Trailer, 7-Wire
VCO	Vehicle Label, Noise Control Information
VC5	Label, Shipping, Except US, or Japan
VC6	Label, Shipping, Hawaii, US Territories, and Puerto Rico
VH4	Mud Flaps
VPG	Cable: Trailer Jumper Cable, 7-Wire, 12-foot, Synflex Coiled
VPH	Vehicle Preparation Overseas Delivery
VWN	Hook: Tow, Rear, Bolt On
VXT	Vehicle Incomplete
V01	Radiator: Heavy Duty
V48	Coolant: Maximum Protection Engine
V76	Hook: Tow
V78	Vehicle Statement: Delete
V98	Vehicle Statement: Delete
WDB	Control Engineering Edit
XQT	Tire: Front, 8.00R19.5/E, 10PR, BL TL Radial
XRL	Tire: Front, 235/80R22.5/G, 14PR, BL TL Radial
XRN	Tire: Front, 295/75R22.5/G, 14PR, BL TL Radial

RPO Code List (cont'd)

RPO	Description
XSB	Tire: Front, 255/80R22.5/G, 14PR, BL TL Radial
XSH	Tire: Front, 275/80R24.5/G, 14PR, BL TL Radial
XTB	Tire: Front 255/70R22.5/H, 16PR, BL TL Radial
XTI	Tire: Front, 245/70R19.5/F, 12PR, BL TL Radial
XTN	Tire: Front, 225/70R19.5/F, BW, R/ST TL HWY
XTQ	Tire: Front, 245/75R22.5/G, BL TL Radial
XTU	Tire: Front, 265/75R22.5/G, BL TL Radial
XTX	Tire: Front, 8.00R19.5/F, 12 PR, BL TL Radial
XTY	Tire: Front, 245/70R19.5/G, 14PR, BL TL Radial
XWJ	Tire: Front, 10.00R22.5/F, 12PR, BL TL Radial
XWK	Tire: Front, 10.00R22.5/G, 14PR, BL TL Radial
XWL	Tire: Front, 11.00R22.5/G, 14PR, BL TL Radial
XWM	Tire: Front, 11.00R22.5/H, 16PR, BL TL Radial
X80	Plate GVW Rating
YA6	Sales Package Body Override, California
YE8	Vehicle Test, Engineering
YF5	Certification Emission, California
YF6	Sales Processing Option Geographic Control, California
YQT	Tire: Rear, 8.00R19.5/E, 10PR, BL TL Radial
YRL	Tire: Rear, 235/80R22.5/G, 14PR, BL TL Radial
YRN	Tire: Rear, 295/75R22.5/G, 14PR, BL TL Radial
YSB	Tire: Rear, 255/80R22.5/G, 14PR, BL TL Radial
YSH	Tire: Rear, 275/80R24.5/G, 14PR, BL TL Radial
YTB	Tire: Rear, 255/70R22.5/H, 16PR, BL TL Radial
YTI	Tire: Rear, 245/70R19.5/F, 12PR, BL TL Radial
YTN	Tire: Rear, 225/70R19.5/F, BW, R/ST ST TL HWY
YTQ	Tire: Rear, 245/75R22.5/G, BL TL Radial

RPO Code List (cont'd)

RPO	Description
YTU	Tire: Rear, 265/75R22.5/G, BL TL Radial
YTX	Tire: Rear, 8.00R19.5/F, 12PR, BL TL Radial
YTY	Tire: Rear, 245/70R19.5/G, 14PR, BL TL Radial
YU8	Wheel: Single, Polished Aluminum, One Side, Front
YWJ	Tire: Rear, 10.00R22.5/F, 12PR, BL TL Radial
YWK	Tire: Rear, 10.00R22.5/G, 14PR, BL TL Radial
YWL	Tire: Rear, 11.00R22.5/G, 14PR, BL TL Radial
YWM	Tire: Rear, 11.00R22.5/H, 16PR, BL TL Radial
YX6	Attachment Main Driveline One-Shaft System
YX7	Attachment Main Driveline Two-Shaft System
YX8	Attachment Main Driveline Three-Shaft System
YX9	Attachment Main Driveline Four-Shaft System
YY7	Paint Process Chassis
YY9	Paint Process Wheel
ZQT	Tire: Spare, 8.00R19.5/E, 10 PR, BL TL Radial
ZRL	Tire: Spare, 235/80R22.5/G, 14PR, BL TL Radial
ZRN	Tire: Spare, 295/75R22.5/G, 14PR, BL TL Radial
ZSB	Tire: Spare, 255/80R22.5/G, 14PR, BL TL Radial
ZSH	Tire: Spare 275/80R22.5/G, 14PR, BL TL Radial
ZTB	Tire: Spare, 255/70R22.5/H, 16PR BL TL Radial
ZTI	Tire: Spare, 245/70R19.5/F, 12PR BL TL Radial
ZTN	Tire: Spare, 225/70R19.5/F, BW, R/ST ST TL HWY
ZTQ	Tire: Spare, 245/75R22.5/F, BL TL Radial
ZTU	Tire: Spare, 265/75R22.5/G, BL TL Radial
ZTX	Tire: Spare, 8.00/19.5/F, 12PR, BL TL Radial
ZTY	Tire: Spare, 245/70R19.5/G, 14PR BL TL Radial
ZV1	Statement of Origin Manufacture

RPO Code List (cont'd)

RPO	Description
ZWJ	Tire: Spare, 10.00R22.5/F, 12PR, BL TT Radial
ZWK	Tire: Spare, 10.00R22.5/G, 14PR, BL TT Radial
ZWL	Tire: Spare, 11.00R22.5/G, 14PR, BL TT Radial
ZWM	Tire: Spare, 11.00R22.5/H, 16PR, BL TL Radial
ZY1	Color Combination: Solid
ZY2	Color Combination: Two-Tone
Z49	Export Canadian Modified Mandatory Base Equipment
Z89	Conversion Name Plate ISUZU
001	3.70 Ratio Code
002	4.11 Ratio Code
003	4.33 Ratio Code
005	4.56 Ratio Code
006	4.63 Ratio Code
008	4.88 Ratio Code
009	5.29 Ratio Code
01L	Secondary Color: Exterior, Special
01U	Primary Color: Exterior, Special
010	5.43 Ratio Code
011	5.57 Ratio Code
012	5.83 Ratio Code
014	6.14 Ratio Code
015	6.17 Ratio Code
016	5.25 Ratio Code
017	6.50 Ratio Code
018	6.65 Ratio Code
019	6.67 Ratio Code
020	5.63 Ratio Code
022	7.17 Ratio Code
032	6.29 Ratio Code
038	6.57 Ratio Code
039	3.55 Ratio Code
057	3.36 Ratio Code
066	4.10 Ratio Code
069	3.90 Ratio Code
070	5.38 Ratio Code
092	4.30 Ratio Code
16L	Primary Color: Exterior, White Kodiak, Frost
16U	Color: Primary Exterior, White Kodiak, Frost
23L	Secondary Color: Exterior, Ocean Blue
23U	Primary Color: Exterior, Ocean Blue

RPO Code List (cont'd)

RPO	Description
24L	Secondary Color: Exterior, Medium Blue Metallic
40P	Wheel Color: White
41P	Wheel Color: Black
46L	Secondary Color: Exterior, Dark Green
46U	Primary Color: Exterior, Dark Green
5DO	Paint Process Bumper, Light Gray
61L	Secondary Color: Exterior, Tan
61U	Primary Color: Exterior, Tan
70L	Secondary Color: Exterior, Dark Maple
71L	Secondary Color: Exterior, Red Orange
71U	Primary Color: Exterior, Red Orange
72U	Primary Color: Exterior, Standard Red
86L	Secondary Color: Exterior, Wheatland Yellow
86U	Primary Color: Exterior, Wheatland Yellow
88L	Secondary Color: Exterior, Tangier Orange
88U	Primary Color: Exterior, Tangier Orange

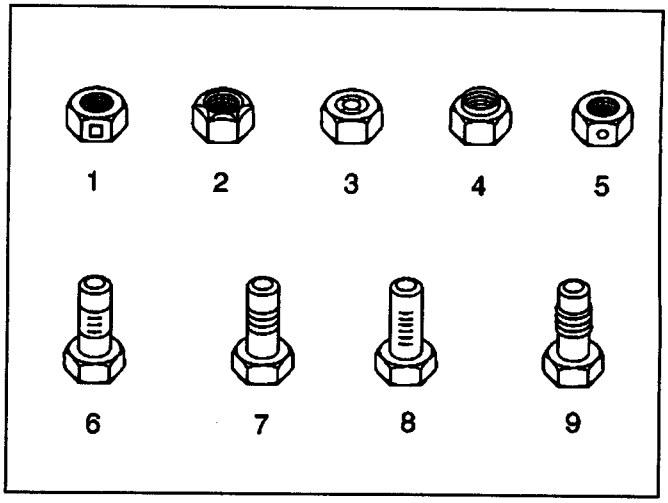
Labels - How to Obtain Replacement

Order the following replacement labels through Isuzu Service Parts:

- The Vehicle Emission Control Information (Exhaust Emission Tune-Up)
- The Spare Wheel Caution
- The Jacking
- The Spare Tire Storage
- The Belt Routing
- The Engine Fan Caution

The Standard Parts Catalog lists the above labels and other labels. The Vehicle Certification Label, the Tire Pressure Placard, and the Service Parts Identification Label are NOT available as service parts.

Fasteners (Prevailing Torque Fasteners)



171892

Engineers design prevailing torque nuts in order to develop an interference between the nut and bolt threads. Usually the interference is caused by distorting the top of a metal nut (1,2) or by a nylon patch on the threads in the middle of the hex flat (3). A nylon insert between the nut and bolt threads also may cause the interference (4,5).

Engineers design prevailing torque bolts in order to develop an interference between the bolt and nut threads, or the threads of a tapped hole. The interference is caused by distorting some of the threads using one of the following methods:

- A nylon patch (8)
- Adhesive (6)
- A deformed thread profile (7)
- An out of round thread area (9)

Recommendations for Reuse

Perform the following steps in order to reuse clean, non-rusted, prevailing torque nuts:

1. Clean dirt and other foreign material off of the nuts and bolts.
2. Inspect the nuts or bolts for the following conditions. If any of the following conditions exist, use a new prevailing torque fastener:
   - Cracks
   - Rust
   - Damage
   - Elongation
   - Signs of abuse
   - Signs of overtightening
3. Assemble the parts.
4. Hand start the nuts or bolts.
5. Ensure that the fastener develops proper torque before the fastener seats. Refer to the Torque Table. If the proper torque does not develop, use a new prevailing torque fastener.
6. Tighten the fastener to the torque specified in the appropriate fastener tightening specification.

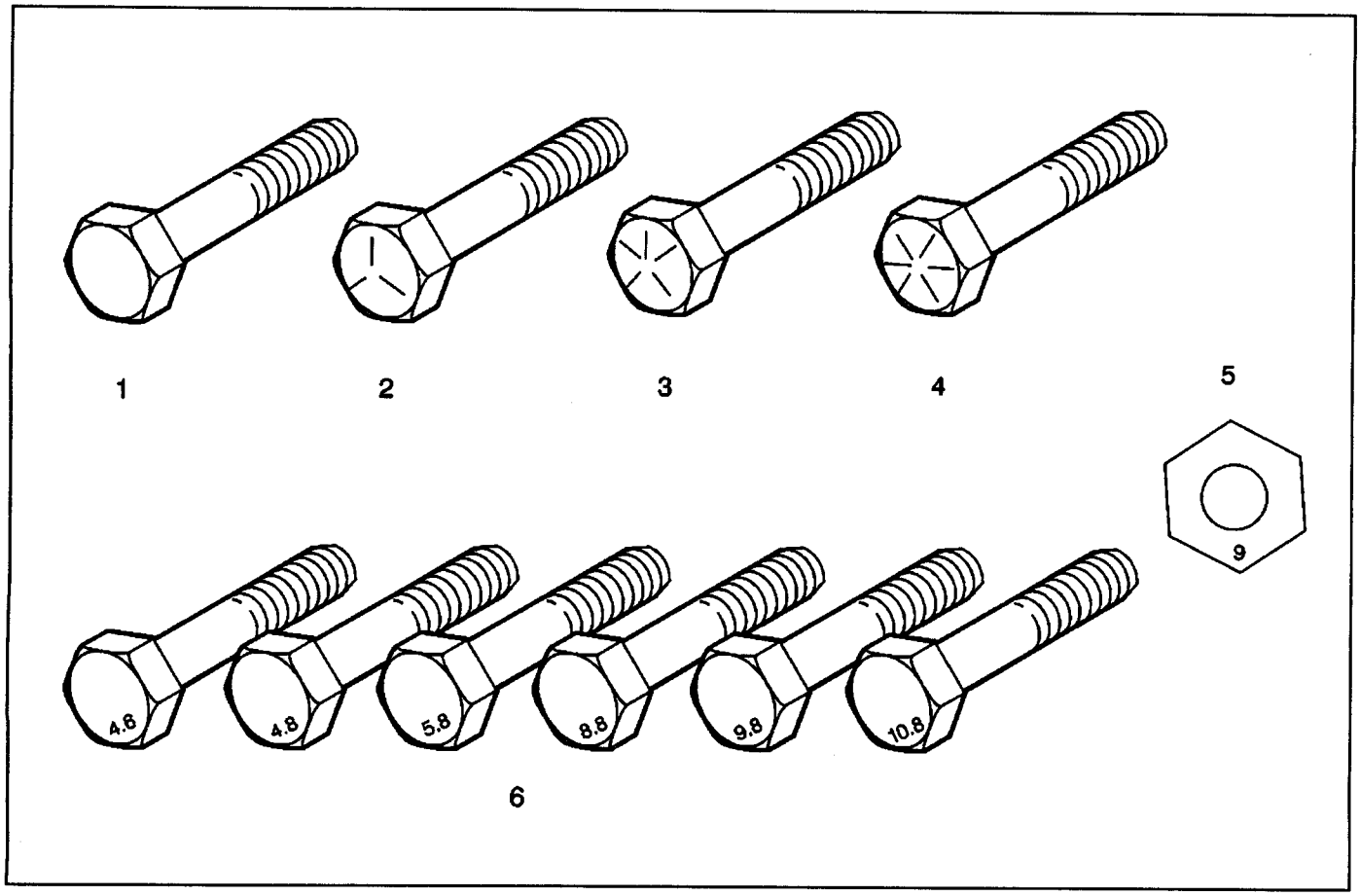
Metric Fasteners (Prevailing Torque)

Fastener Type	Specification	
	Metric	English
Nuts/Metal Bolts		
6	0.4 N·m	4 lb in
6.3	0.4 N·m	4 lb in
8	0.8 N·m	7 lb in
10	1.4 N·m	12 lb in
12	2.2 N·m	19 lb in
14	3.0 N·m	27 lb in
16	4.2 N·m	37 lb in
Adhesive or Nylon Coated Bolts		
6	0.4 N·m	4 lb in
6.3	0.4 N·m	4 lb in
8	0.6 N·m	5 lb in
10	1.2 N·m	11 lb in
12	1.6 N·m	14 lb in
14	2.4 N·m	21 lb in
16	3.4 N·m	30 lb in

English Fasteners (Prevailing Torque)

Fastener Type/Torque Units	Specification	
	Metric	English
Nuts/Metal Bolts		
0.250	0.4 N·m	4 lb in
0.312	0.6 N·m	5 lb in
0.375	1.4 N·m	12 lb in
0.437	1.8 N·m	16 lb in
0.500	2.4 N·m	21 lb in
0.562	3.2 N·m	28 lb in
0.625	4.2 N·m	37 lb in
Adhesive or Nylon Coated Bolts		
0.250	0.4 N·m	4 lb in
0.312	0.6 N·m	5 lb in
0.375	1.0 N·m	9 lb in
0.437	1.4 N·m	12 lb in
0.500	1.8 N·m	16 lb in
0.562	2.6 N·m	23 lb in
0.625	3.4 N·m	30 lb in

Fasteners (Strength Identification)



171891

Legend

(1) English Bolt, Grade 2 (Strength Class)
(2) English Bolt, Grade 5 (Strength Class)
(3) English Bolt, Grade 7 (Strength Class)
(4) English Bolt, Grade 8 (Strength Class)
(5) Metric Nut, Strength Class 9
(6) Metric Bolts, Strength Class Increases as Numbers Increase

Notice: The designation of the standard fasteners used on this vehicle are of coarse screw thread up to M8 and fine screw thread beyond M10. The designation to pitch relations are somewhat different between coarse screw thread and fine screw thread. Therefore, when replacing fasteners, the pitch should be confirmed carefully even if the replacement fastener is the same metric fastener.

The most common metric fastener strength property classes are 9.8 and 10.9. The class identification number is embossed on the head of each bolt (6). Some metric nuts are marked with single digit strength identification numbers on the nut face.

English strength classes range from 2 (low strength) to 8 (high strength). A grade-2 bolt has no lines embossed on the bolt head (1). One radial line is embossed on the bolt head for each strength grade above 2. That is, a bolt with one embossed line indicates grade-3. Two embossed lines indicate grade-4. Six embossed lines signify grade-8, the highest-grade bolt (4).

Correct replacement bolts and nuts are available through American Isuzu Parts Distributor Network (AIPDN). Many metric fasteners available in the after-market parts channels are designed to foreign metric standards, and may have a different thread pitch. Isuzu products use metric fasteners designed to new, international standards. Some non-domestic bolt and nut suppliers may not yet use the international standards.

Fasteners (Strength Identification)

Metric Coarse Screw Threads				Metric Fine Screw Threads			
Thread	Pitch	Thread	Pitch	Thread	Pitch	Thread	Pitch
M39	4	M8	1.25	M39x3	3	M20x1.5	1.5
M36	4	M7	1	M36x3	3	M18.1.5	1.5
M33	3.5	M6	1	M33x2	2	M16x1.5	1.5
M30	3.5	M5x0.8	0.8	M30x2	2	M14x1.5	1.5
M27	3	M4x0.7	0.75	M27x2	2	M12x1.25	1.25
M24	3	M4x0.7	0.7	M24x2	2	M10x1.25	1.25
M22	2.5	M3.5	0.6	M22x1.5	1.5	M8x1	1
M20	2.5	M3x0.5	0.5	—	—	—	—
M18	2.5	M2.5	0.45	—	—	—	—
M16	2	M2.2	0.45	—	—	—	—
M14	2	M2	0.4	—	—	—	—
M12	1.75	M1.6	0.35	—	—	—	—
M10	1.5	—	—	—	—	—	—

Fasteners (Metric Fasteners)

Current model Isuzu vehicles are dimensioned primarily in the metric system. Many fasteners are metric and are very close in dimension to fasteners in the inch system. Replace the fasteners using the following identical specifications:

- The nominal diameter
- The thread pitch
- The strength

Most stock metric fasteners have numbers indicating the strength of the material in the fastener. "Beauty" bolts, such as exposed bumper bolts have no strength indicator. Identify metric cross-recess screws by a Posidriv® or Type 1A marking. Use a Type 1A cross-recess screwdriver in order to fasten or unfasten metric cross-recess screws. If a Type 1A cross-recess screwdriver is not available, use a Phillips head screwdriver.

Isuzu Engineering Standards and other North American industries use a portion of the standard metric fastener sizes defined by the International Standards Organization (ISO). Now the total number of fastener sizes in use is lower, and the overall strength quality of each thread size is higher.

For example, the metric M6.0 x 1 screw replaces the English 1/4-20 and 1/4-28 screws, which have nearly the same diameter. The thread pitch, 25.4 threads per inch, is between coarse and fine thread pitches in English. Metric and English thread notations differ slightly. The thread major diameter of a 1/4-20 bolt is 1/4-inch, and the bolt has 20 threads per inch. The thread major diameter of a 6.0 x 1 bolt is 6.0 mm, and the distance between threads is 1 mm.

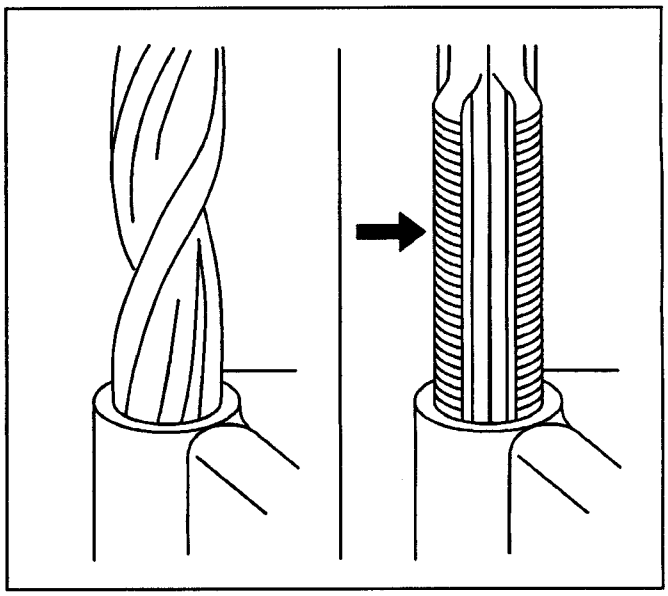
Thread Inserts

Repair Procedure

Tools Required

General purpose thread repair kits. These kits are available commercially.

Caution: Wear safety glasses in order to avoid eye damage.



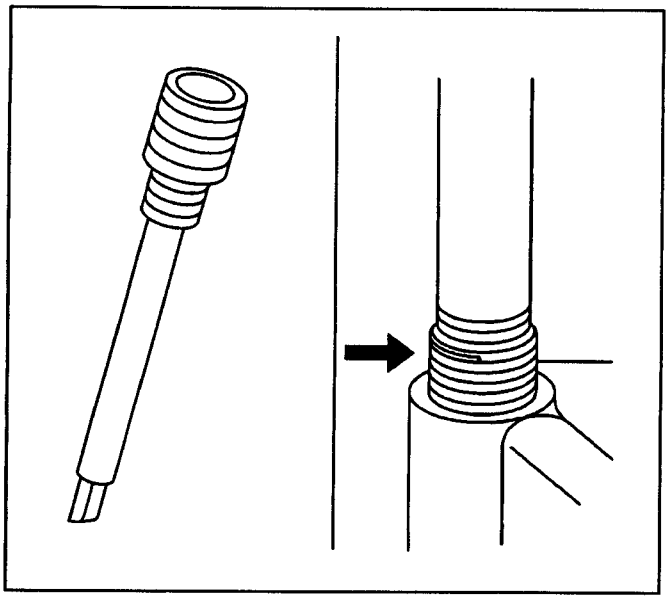
4962

Important: Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and tap to use.

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.

2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.



4963

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

   Important: The insert should be flush to one turn below the surface.
5. Lubricate the insert with light engine oil (except when installing in aluminum) and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

Torque Wrenches

Torque Defined

Torque is defined as the measurement of resistance to turning or rotating. Torque, often called torsional or twisting movement, tends to twist a body about an axis of rotation. A typical application is the tightening of a screw.

Torque applied in tightening a common bolt, nut, or screw is expended in three areas:

- The head
- Bearing surface
- Clamp load

Clamp Load

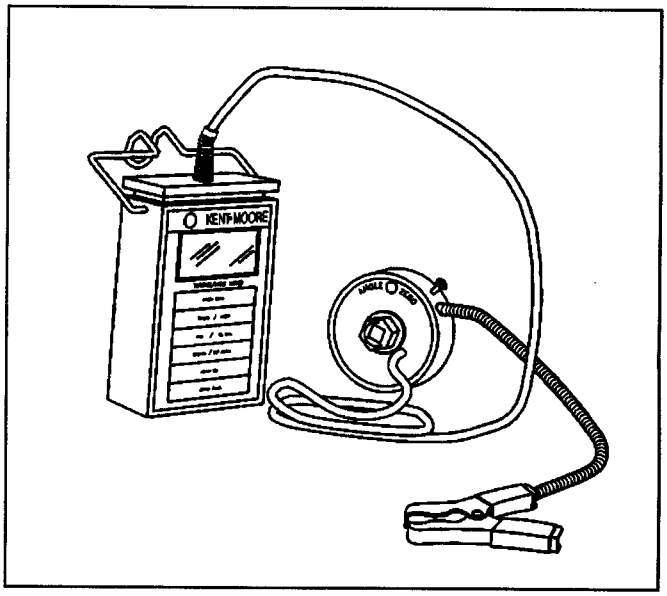
About 50 percent of applied torque is used in overcoming bearing friction. This is the friction between the bearing surface of the bolt head, screw head or nut face, and the base material or washer (the surface the fastener is rotating on). Approximately 40 percent of the applied torque is used in overcoming thread friction. This leaves only about 10 percent of the applied torque to develop useful clamp load. Clamp load is the force that holds a joint together. Friction can account for as much as 90 percent of the applied torque on a fastener.

Torque Techniques

The frictional characteristics of each fastener or threaded hole can vary under a variety of circumstances. For example, consider a joint that has 10 bolts. If all 10 fasteners were torqued to 20 N.m and the clamp load is measured, all 10 bolts would most likely have different clamp load readings. Even though all 10 bolts are torqued at 20 N.m, it is not guaranteed that they have all reached the same clamp load. A rule of thumb is that the clamp load can vary ± 25 percent using torque control for joint assembly.

At times, critical applications such as cylinder head bolts require very tight tolerances for clamp load distribution. If torque is not considered to be accurate enough for these critical joints, an alternative method of tightening called TORQUE ANGLE may be used.

Torque Angle Method



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Torque angle is required for critical joints because it can help eliminate frictional variations in the joint. The following are the general steps used for the torque angle method:

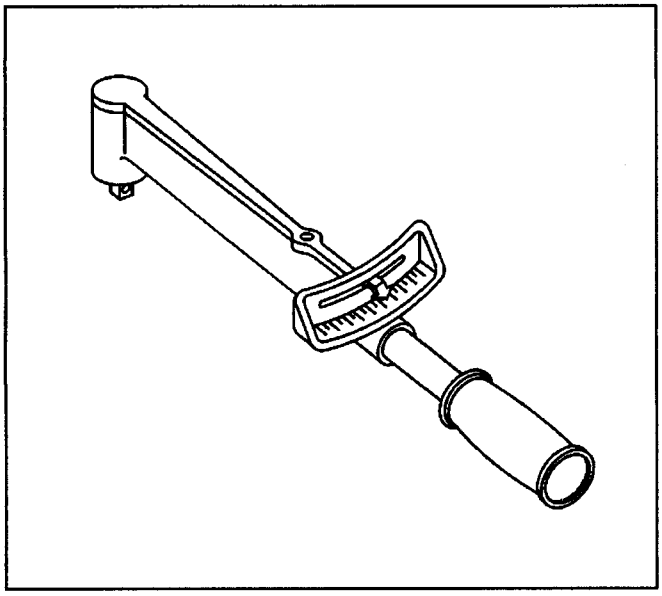
1. Tighten to a predetermined seating torque to remove any compliance out of the joint.
2. Turn the fastener to a specified angle of rotation. Use the Torque Angle Meter *J 36660.*

This is the only acceptable general method for measuring this angle of rotation. Follow the specific procedure where it is provided.

Torque Wrenches and Techniques

The term TORQUE WRENCH is commonly used to describe a type of measuring tool. The tool is set or calibrated in such a way as to make possible the measurements of the resistance to turning (torque). The torque wrench measures this resistance to turning and, therefore, is the method used to obtain objective tightening data used in the assembly of fasteners. A torque wrench is a gage tool that can be compared with micrometers, dial indicators, vernier calipers, levels, and other measuring devices.

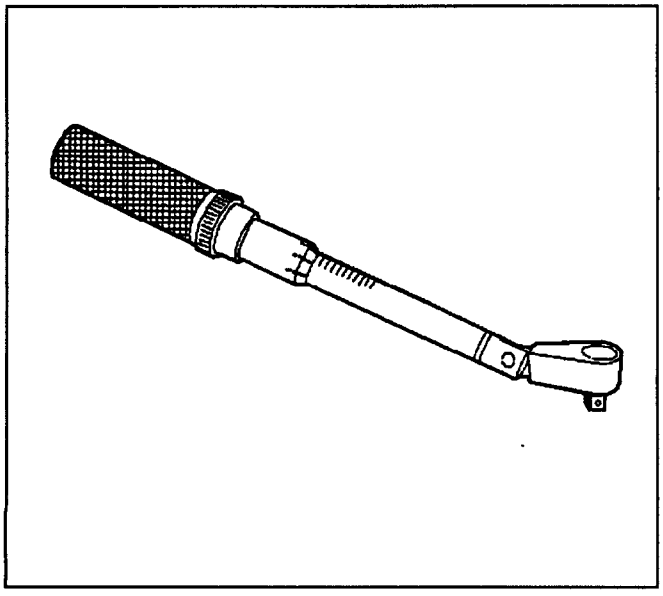
Tapered Beam Model Torque Wrench



65520

Of the many different types of torque wrenches available, the most popular in the service field is the tapered beam model. This model uses a pointer attached to the head that runs the length of the flexible beam (shaft) to a scale located near the handle. As the wrench is pulled, the beam bends and the pointer indicates the torque on the scale.

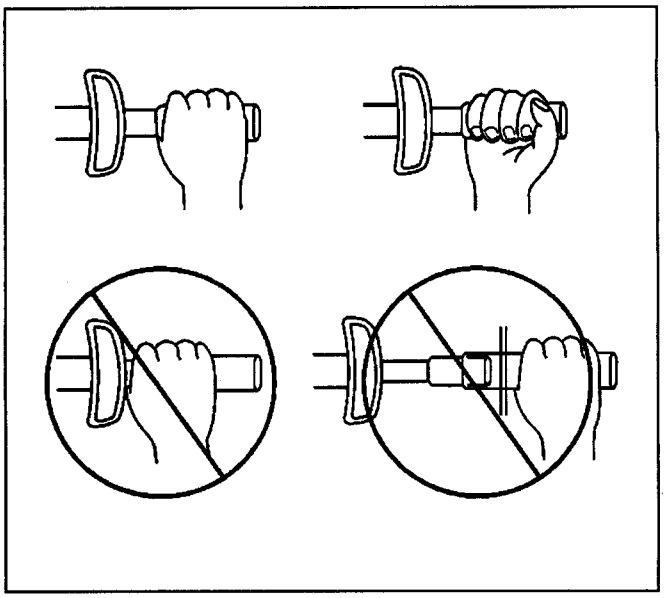
Click-type Torque Wrench



6484

Another type of torque wrench is the CLICK type which is adjusted to a predetermined torque. Once the designated torque has been reached, the wrench has a reflex signalling feature that causes a momentary breakaway of the body of the torque wrench. This feature has the effect of sending a strong impulse to the technician's hand. Although once quite popular, these wrenches are not the preferred method for torque applications.

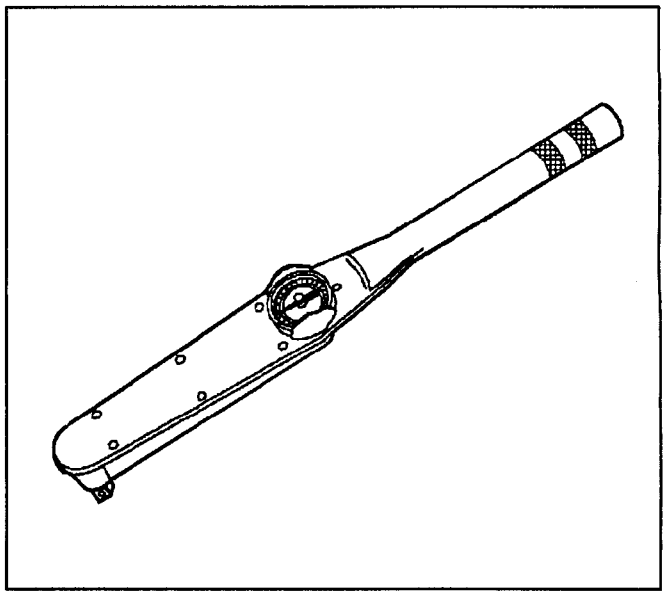
Pivoted Handle Torque Wrench



289952

Some types of torque wrenches are equipped with a pivoted handle. If used properly, this handle permits the accurate and correct use of the torque wrench. In order to hold a pivoted type handle, it should be floated on the pivot point. This concentrates your pulling force. If the pivoting handle comes in contact with the yoke extension during the process of pulling, there is a very good chance the torque readings will be inaccurate because this could alter the wrench loading point. The design of the handle, however, makes it inconvenient to deliberately use the floating principle improperly.

Direct Reading Torque Wrench



6486

Some of the newer model wrenches, such as the Snap-on® Direct Reading Torqometer wrench (Model TES or equivalent) can be held at any position on the wrench without affecting accuracy. These wrenches are preferred over the flexible beam types because of their greater degree of accuracy, compact design, and scales that are easily readable.

Torque Wrench Accuracy

Selecting the proper size and range of a torque wrench is important in obtaining accurate results. The best quality torque wrenches (the Snap-on® Direct Reading Torqometer models or equivalent) are accurate within 2 percent of the indicated reading from 20 percent of full scale to full scale. For example, a 200 N.m (148 lb ft) full scale torque wrench is guaranteed to be accurate from 40 N.m to 200 N.m (30–148 lb ft) (20–100 percent of full scale). Using this wrench below 40 N.m (30 lb ft) (its guaranteed operating range) could result in inaccurate torque readings and possible joint failure due to either an overtorque or undertorque condition.

Torque Wrench Selection

Since it is not possible to purchase one wrench to fit the widest range of torque specifications in the service environment, the following guidelines should be used for torque wrench selection:

- 0–20 N.m Full Scale (177 lb in). Accurate from 4–20 N.m (35–177 lb in).
- 0–75 N.m Full Scale (55 lb ft). Accurate from 15–75 N.m (11–55 lb ft).
- 0–250 N.m Full Scale (185 lb ft). Accurate from 50–250 N.m (37–185 lb ft).

Torque Wrench Calibration

This is a general guideline and is published to facilitate the selection of a range or torque wrenches that would cover most applications and would remain in the guaranteed accuracy ranges of the wrenches. Once a wrench is put into service, nothing guarantees that the wrench will remain calibrated within its accuracy range. It is recommended, therefore, that torque wrenches be calibrated a minimum of twice annually. Once again, the torque wrench is a precision measuring device. The torque wrench is exposed to rugged working conditions. Precautions must be taken in order to protect against inaccurate measurements.

Continuous Pull Method

Once a torque wrench is selected, use a technique called the CONTINUOUS PULL METHOD in order to increase accuracy during torquing. Pull the torque wrench in one continuous, smooth action until the specified torque is reached. There is no jerking or ratcheting during this final tightening effort. The continuous pull method is an excellent way to develop consistency.

Abbreviations and Their Meanings

The following abbreviations may appear in this manual.

Abbreviations Table

Abbreviation	Meaning
A	
A/C	Air Conditioning
AC	Alternating Current
ACL	Air Cleaner
ADJ	Adjust
A/F	Air/Fuel (Ratio)
AIR	Secondary Air Injection
Alt	Altitude
AMP	Ampere(s)
AM/FM	AM/FM Stereo
Ant	Antenna
AP	Accelerator Pedal
ASM	Assembly
AT	Automatic Transmission
ATDC	After Top Dead Center
Auth	Authority
Auto	Automatic
B	
B+	Battery Positive Voltage
BARO	Barometric (pressure)
Bat	Battery
BP	Back Pressure
BTDC	Before Top Dead Center
C	
°C	Degrees Celsius
CAC	Charge Air Cooler
Calif	California
CCOT	Cycling Clutch Orifice Tube
CD	Compact Disc
CFI	Continuous Fuel Injection
CFM	Cubic Feet Per Minute
CID	Cubic Inch Displacement
CKP	Crankshaft Position
CL	Closed Loop
cm	Centimeters
CMP	Camshaft Position
CO	Carbon Monoxide
Coax	Coaxial
Conn	Connector
Conv	Converter
CPP	Clutch Pedal Position
CPS	Central Power Supply
Crank	Crankshaft
CTP	Closed Throttle Position
CV	Constant Velocity

Abbreviations Table (cont'd)

Abbreviation	Meaning
Cyl	Cylinder(s)
D	
DC	Direct Current
DFI	Direct Fuel Injection
Diff	Differential
DI	Distributor Ignition
Dist	Distributor
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
DTM	Diagnostic Test Mode
DVM	Digital Voltmeter
E	
EAC	Electric Air Control
EAS	Electric Air Switching
ECL	Engine Coolant Level
ECM	Engine Control Module
ECT	Engine Coolant Temperature
ECU	Engine Calibration Unit (PROM)
EEPROM	Electronically Erasable Programmable Read Only Memory
EFE	Early Fuel Evaporation
EGR	Exhaust Gas Recirculation
EGR TVV	Exhaust Gas Recirculation Thermal Vacuum Valve
EI	Electronic Ignition
EM	Engine Modification
EPROM	Erasable Programmable Read Only Memory
ESC	Electronic Spark Control
ESD	Electrostatic Discharge
ETR	Electronically Tuned Receiver
EVAP	Evaporative Emission
Exh	Exhaust
F	
°F	Degrees Fahrenheit
FC	Fan Control
FED	Federal (all the United States except California)
G	
gal	Gallon
GAW	Gross Axle Weight
GAWR	Gross Axle Weight Rating
GCWR	Gross Combination Weight Rating
Gen	Generator
Gov	Governor
g	gram

Abbreviations Table (cont'd)

Abbreviation	Meaning
gnd	Ground
GVW	Gross Vehicle Weight
GVWR	Gross Vehicle Weight Rating
H	
Harn	Harness
HC	Hydrocarbons
HD	Heavy Duty
Hg	Mercury
Hi Alt	High Altitude
HO2S	Heated Oxygen Sensor
hp	Horse Power
I	
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Ignition Control
ICM	Ignition Control Module
ID	Identification or Inside Diameter
IFI	Indirect Fuel Injection
ign	Ignition
ILC	Idle Load Compensator
INJ	Injection
INT	Intake
I/P	Instrument Panel
IPC	Instrument Panel Cluster
ISC	Idle Speed Control
K	
kg	Kilogram
km	Kilometer
km/h	Kilometers per hour
kPa	Kilopascals
KS	Knock Sensor
kV	Kilovolts
L	
lb	Pound(s)
lb ft	Pound feet (torque)
lb in	Pound inch (torque)
L	Liter (engine displacement)
LF	Left Front
LH	Left Hand
LR	Left Rear
LS	Left Side
M	
MAF	Mass Air Flow
Man	Manual
MAP	Manifold Absolute Pressure

Abbreviations Table (cont'd)

Abbreviation	Meaning
MAT	Manifold Air Temperature
Max	Maximum
MC	Mixture Control
MDP	Manifold Differential Pressure
MFI	Multi-Port Fuel Injection
mi	Mile(s)
MIL	Malfunction Indicator Lamp
Min	Minimum
ml	Milliliter
mm	Millimeter
mpg	Miles per Gallon
mph	Miles per Hour
MST	Manifold Surface Temperature
mV	MilliVolt
N	
NC	Normally Closed
N·m	Newton-meter (torque)
NO	Normally Open
NOx	Oxides of Nitrogen
NVRAM	Non-Volatile Random Access Memory
O	
OBD	On-Board Diagnostics
OC	Oxidation Converter (Catalytic)
OD	Outside Diameter
OL	Open Loop
O2	Oxygen
O2S	Oxygen Sensor
oz	Ounce(s)
P	
PAIR	Pulsed Secondary Air Injection
P/B	Power Brakes
PCM	Powertrain Control Module
PCV	Positive Crankcase Ventilation
PNP	Park/Neutral Position
PRESS	Pressure
PROM	Programmable Read Only Memory
PS	Power Steering
psi	Pounds per Square Inch
pt	Pint
PTO	Power Take Off
PWM	Pulse Width Modulated
Q	
qt	Quart(s)

Abbreviations Table (cont'd)

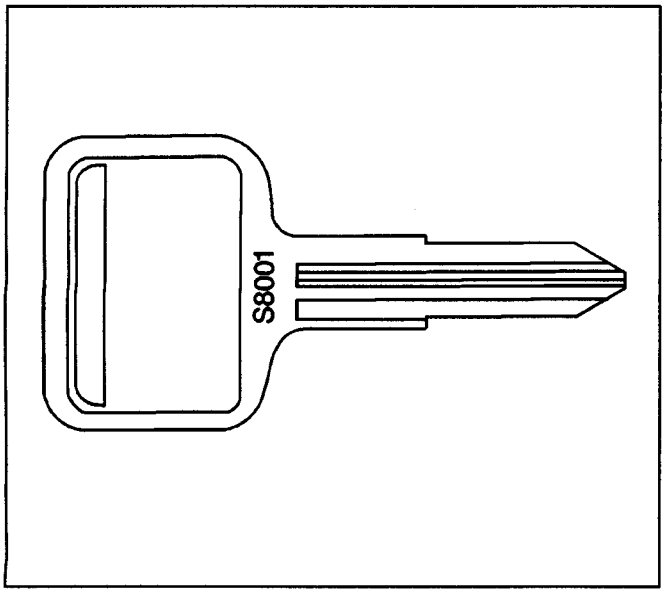
Abbreviation	Meaning
R	
RAM	Random Access Memory
Ref	Reference
RF	Right Front
RFI	Radio Frequency Interference
RH	Right Hand
ROM	Read Only Memory
RPM	Engine Speed (Revolutions Per Minute)
RPO	Regular Production Option
RR	Right Rear
RS	Right Side
RTV	Room Temperature Vulcanizing (sealer)
RVB	Rear Vacuum Brake
RVR	Response Vacuum Reducer
S	
SAE	Society of Automotive Engineers
Sec	Secondary
SI	System International
sol	Solenoid
SPEC	Specification
Speedo	Speedometer
SPL	Smoke Puff Limiter
SRI	Service Reminder Indicator
SRT	Service Readiness Test
ST	Scan Tool
syn	Synchronize
T	
TAC	Throttle Actuator Control
Tach	Tachometer
TCC	Torque Converter Clutch
TCM	Transmission Control Module
TEMP	Temperature
TDC	Top Dead Center
Term	Terminal
Thermo	Thermostatic Air Cleaner
TP	Throttle Position
TRANS	Transmission
TV	Throttle Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Converter (Catalytic)
TWC+OC	Three Way + Oxidation Converter (Catalytic)

Abbreviations Table (cont'd)

Abbreviation	Meaning
U	
U-Bolt	Universal Bolt
U-Joint	Universal Joint
V	
V6	Six Cylinder Engine, V-Type
V8	Eight Cylinder Engine, V-Type
V	Volt(s)
V-ref	ECM Reference Group
Vac	Vacuum
VAF	Volume Air Flow
VDOT	Variable Displacement Orifice Tube
VIN	Vehicle Identification Number
VR	Vacuum Regulator
VRV	Vacuum Reducer Valve
VSS	Vehicle Speed Sensor
W	
W/	With
W/B	Wheel Base
W/O	Without
WOT	Wide Open Throttle
WU-OC	Warm Up Oxidation Converter (Catalytic)
WU-TWC	Warm Up Three Way Converter (Catalytic)

Key and Lock Cylinder Coding

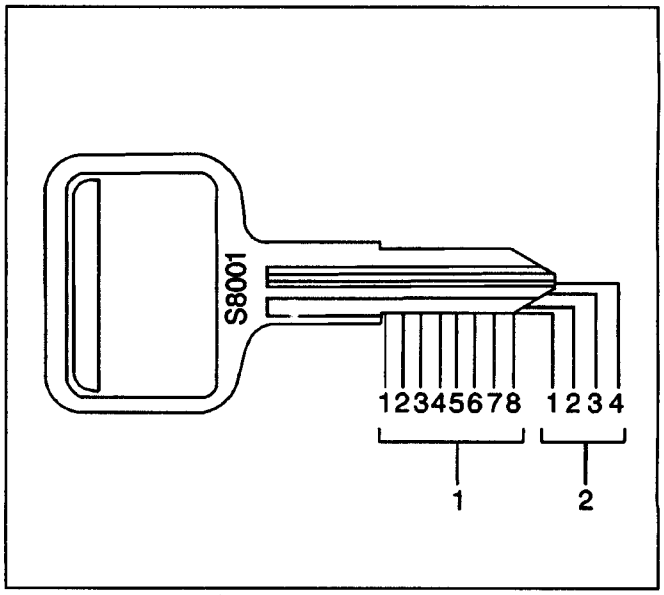
Medium Duty Trucks use a one-key locking system. A single, two-sided key operates the ignition and both doors. The key is reversible, and inserts with either side facing up.



205853

Identify keys by the five-character key code stamped onto the key. Use the code numbers and a code list in order to determine the lock combination of the vehicle. The owners of key cutting equipment receive the code list from equipment suppliers. If the code number is not available from records or from the five-character key code number, a key code number label is on the inside of the bottom glass on the passenger's side door.

Key Code Diagram



205851

Legend

(1) Position
(2) Level

Cutting Keys

1. Determine the code from the code list or the key code diagram.
2. Cut a blank key to the proper level for each of the eight tumbler positions.
3. Ensure that the key locks and unlocks the lock cylinder.

Replacement Lock Cylinders

The service parts warehouses offer lock cylinders as a complete assembly, including the key. Do not service or code the lock cylinders. If a lock cylinder is faulty, replace the cylinder. Order lock cylinders from the service parts warehouses.

Lifting and Jacking the Vehicle

Caution: To help avoid a personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle falling off the hoist.

Notice: When jacking or lifting a vehicle at prescribed lift points, be certain that lift pads do not contact the exhaust system, brake pipes, cables, fuel lines or under body. Such contact may result in damage or unsatisfactory vehicle performance.

Any time you lift a vehicle on one end, chock the wheels at the opposite end. Use jack stands in order to provide support. When supporting the vehicle using jack stands, place the jack stands under the side rails or the axle.

Park the vehicle on a clean, hard, level surface before lifting the vehicle. Ensure that the lifting equipment meets weight requirements. Ensure that the lifting equipment is in good working order. Before lifting the vehicle, ensure that the vehicle loads are secure and equally distributed. In some cases only the frame side rails are able to support the vehicle. Do not put excessive stress on the frame side rails. You may lift and support the front of the vehicle at the front axle near the wheel assemblies.

In order to remove the front axle, support the vehicle near the rear front spring support brackets using suitable jack stands and/or other lifting equipment. The lifting points for the front frame are just behind the rear front spring support brackets.

You may lift and support the rear of the vehicle at the rear axle near the wheel assemblies. Do not support the vehicle at the differential assembly.

In order to remove the rear axle, support the vehicle at the frame side rails and the rear crossmember, just in front of the rear spring brackets.

When you are removing the vehicle's major components while the vehicle is on a hoist, chain the vehicle frame to the hoist pads nearest the component to be removed. Chaining the vehicle to the hoist pads will prevent tip-off.

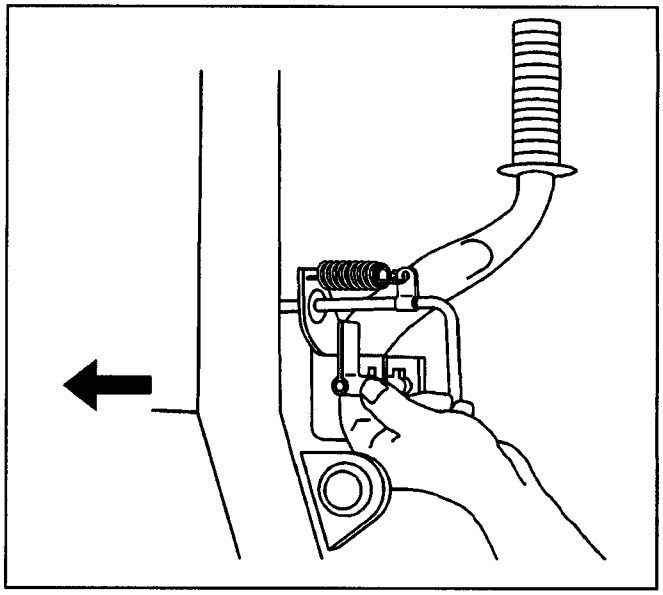
Cab Tilting

In order to gain access to the components under the cab, complete the following procedure:

Before Tilting the Cab

1. Park the vehicle in a level place.
2. Secure all loose articles in the cab.
3. Close the cab doors.
4. Inspect the area for sufficient clearance in front of and above the cab.
5. In order to prevent the vehicle from moving, take the following steps:
   - Apply the parking brake.
   - Place an automatic transmission in PARK (P).
   - Place a manual transmission in NEUTRAL (N).
   - Turn the engine OFF.
   - Block both the front and the rear wheels.

Tilting the Cab

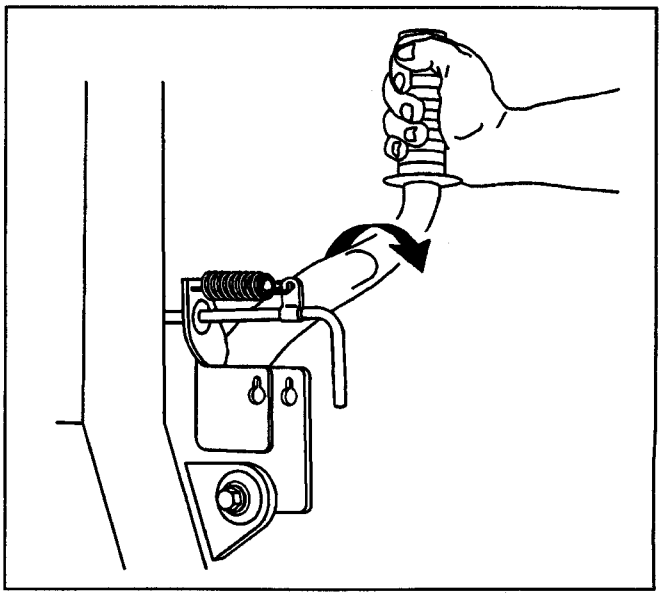


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Caution: A tilt cab not properly locked in the tilted position could fall, causing serious injury. To insure that the cab is securely locked in position and won't move, the safety lockpin must always be inserted into the cab support when the cab is in the tilted position.

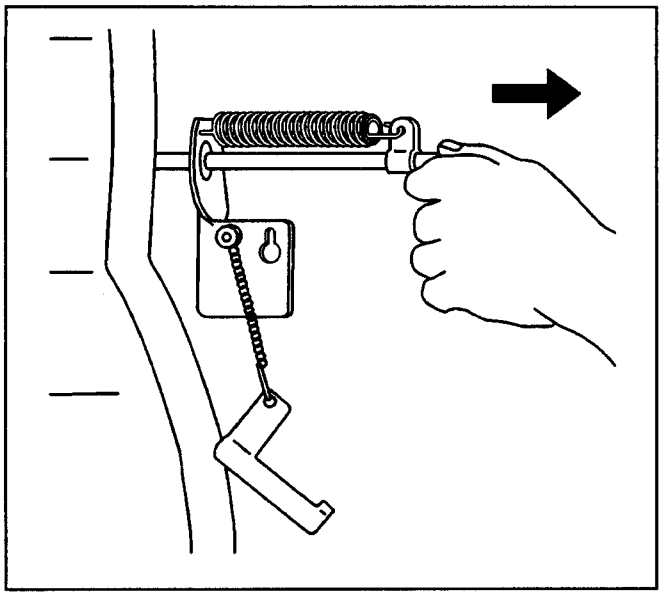
Caution: Things that burn can get on hot engine parts and start a fire. These include liquids like gasoline or diesel fuel, oil, brake fluid, windshield washer and other fluids and plastic or rubber. Be careful not to drop or spill things that will burn onto a hot engine.

1. Remove the leverpin. Turn the pin in order to align the tab with the slot.



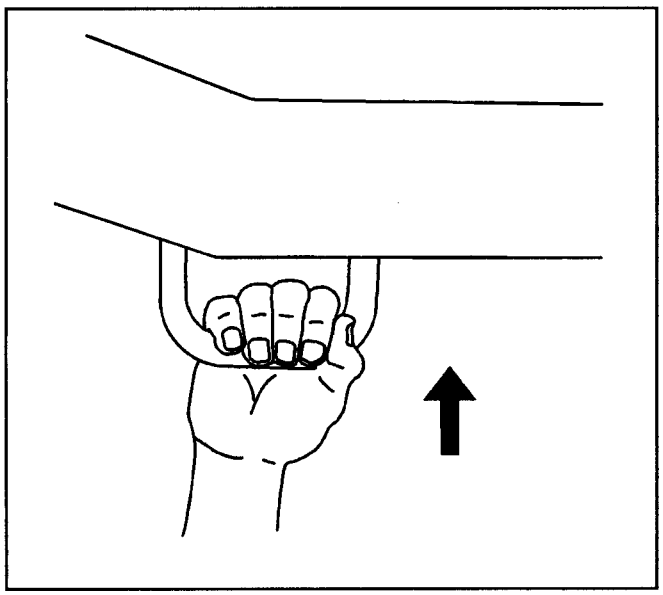
205879

2. Move the primary tilt lever all the way downward.



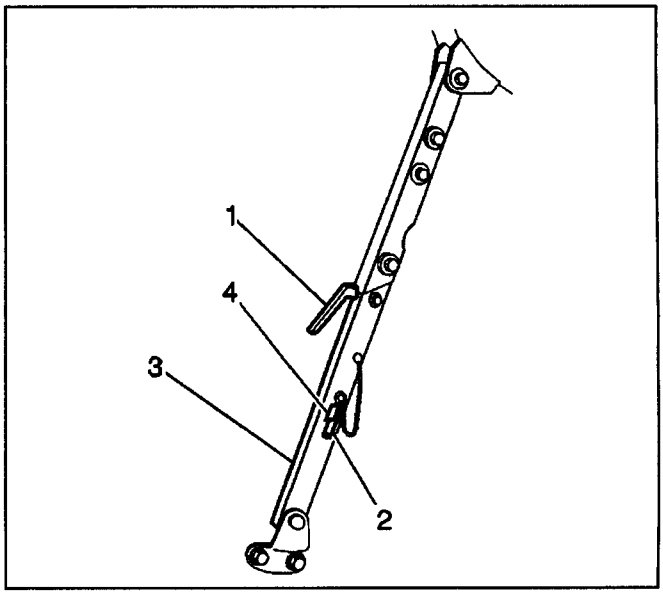
205872

3. Pull the secondary latch lever in order to release the hook from the catch at the back of the cab. Now the cab is able to tilt.



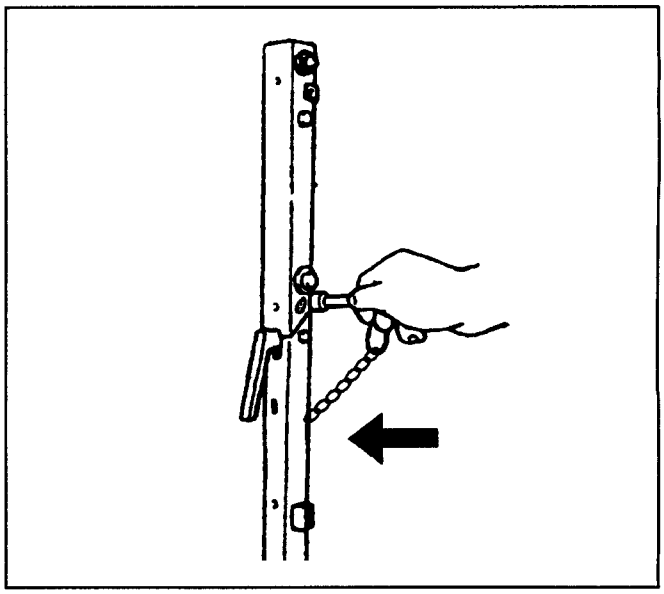
205877

4. Use the handle located at the bottom of the cab at the back in order to rotate the cab forward. Torsion bars located under the cab assist the tilting.



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5. Tilt the cab all the way forward until the cab support(3) under the cab is fully locked.



205876

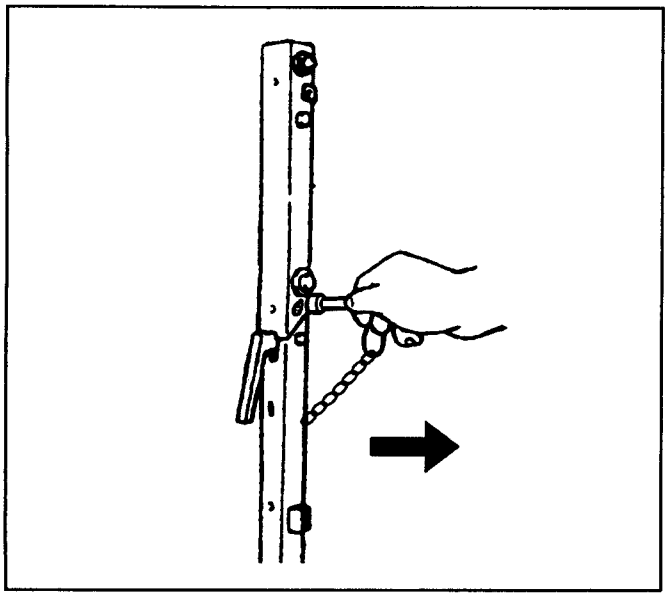
6. Remove the lockpin(2) from the retainer(4) on the cab support(3).
7. Insert the lockpin(2) into the hole in the cab support.

Caution: A tilt cab not properly locked in the tilted position could fall, causing serious injury. To insure that the cab is securely locked in position and won't move, the safety lockpin must always be inserted into the cab support when the cab is in the tilted position.

Caution: Things that burn can get on hot engine parts and start a fire. These include liquids like gasoline or diesel fuel, oil, brake fluid, windshield washer and other fluids and plastic or rubber. Be careful not to drop or spill things that will burn onto a hot engine.

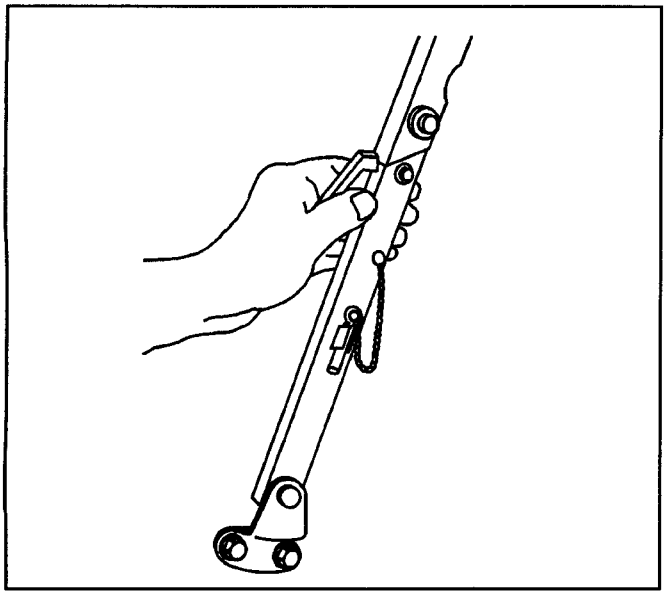
When you are ready to lower the cab, complete the following procedure:

Lowering the Cab



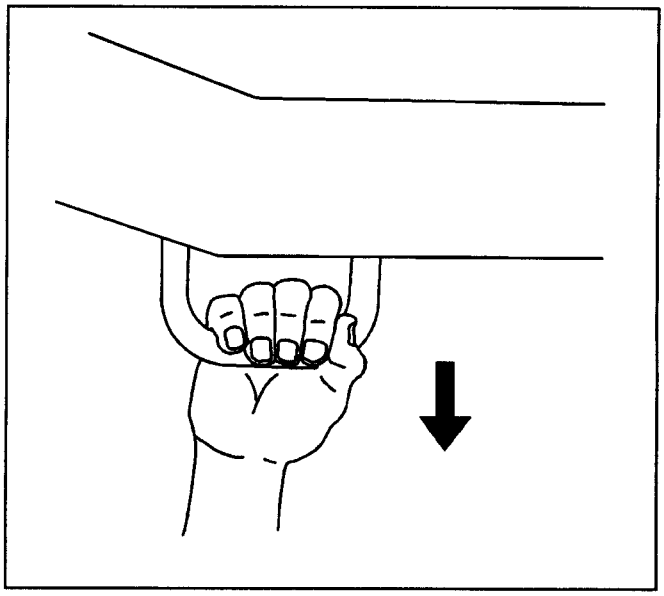
205858

1. Rotate and pull on the lockpin(2) in order to remove the lockpin(2) from the cab support(3).
2. Insert the lockpin(2) into the retainer(4) on the cab support(3).



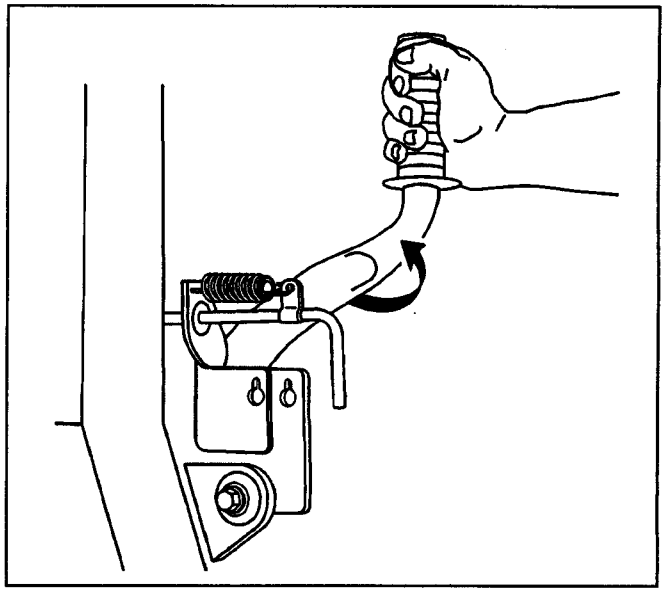
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3. Squeeze the lock lever(1) on the cab support in order to release the detent.



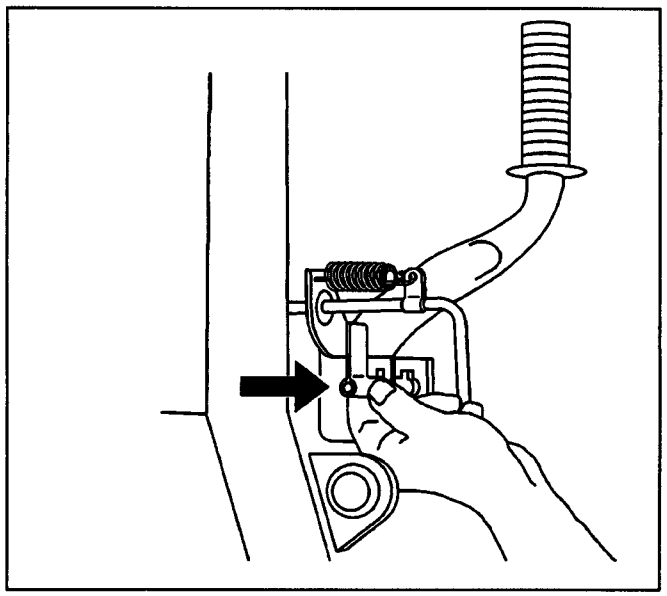
205869

4. Use the handle located at the bottom of the cab toward the back in order to lower the cab until the hook catches and holds the cab down.



205861

5. Push the primary tilt lever upward fully in order to lock the cab to the chassis.



205855

6. Replace the lever pin. Insert and turn the pin in order to align the tab with the slot.

Towing a Disabled Vehicle

When towing a Medium Duty Truck, take the following precautions in order to prevent damage to the vehicle:

- Use an Isuzu dealer or a professional towing service in order to tow a disabled Commercial Truck.
- Use proper equipment.
- Turn on the hazard warning flashers (if they are not damaged).
- Connect the towing components to the main structural parts of the vehicle.
- Do not attach towing components to the following parts:
  - Bumpers
  - Tow hooks
  - Brackets
- Only use equipment designed for towing.
- Follow the instructions given by the tow truck manufacturer.
- Use a safety chain system.

Front End Towing (Front Wheels off the Ground)

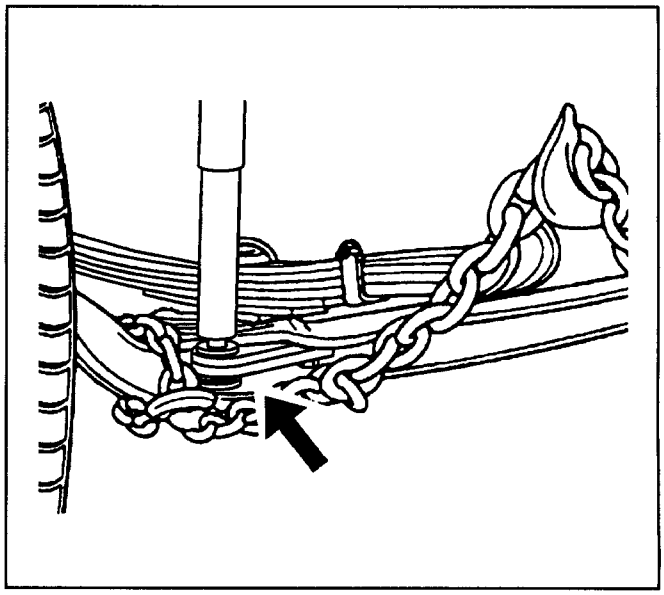
Before Towing

Block the rear wheels of the disabled vehicle. On vehicles with air brakes, release the parking brake system by compressing the brake chamber springs. Refer to Air Brakes. Releasing the parking brake system prevents the parking brake from engaging while the vehicle is in tow.

On vehicles with hydraulic brakes, release the parking brake fully by moving the lever handle to the fully released position.

Vehicle Towing with the Front Bumper Removed

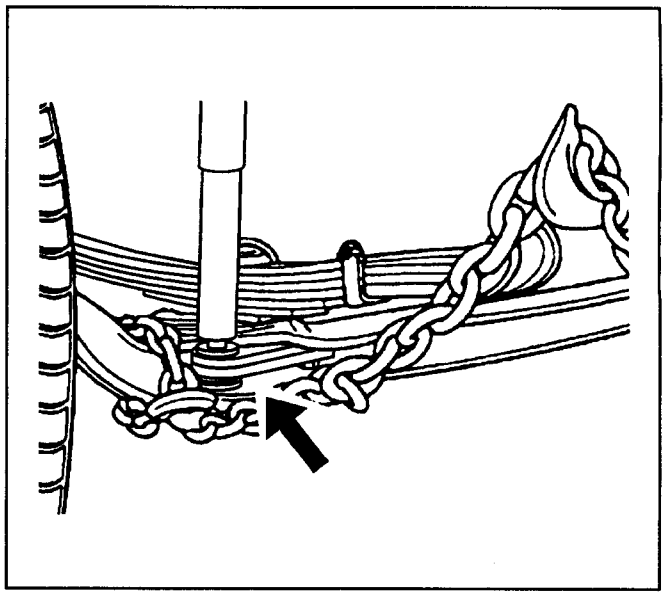
1. Remove the front bumper.



205857

2. Connect and lock the lift chains to the front axle, outside of the spring anchor plates.
3. Place a hardwood beam underneath and slightly behind the front spring shackle brackets.
4. Connect the lift chains to the tow bar.
5. Raise the tow bar until the lift chain cinches up and the hardwood beam seats fully against the spring shackle brackets.
6. Raise the vehicle to the required height.

To Tow a Vehicle with the Front Bumper Installed



205857

1. Remove the front bumper.
2. Connect and lock the lift chains to the front axle, outside of the spring anchor plates.
3. Place a hardwood beam underneath and slightly behind the front spring shackle brackets.
4. Connect the lift chains to the tow bar.

5. Take up the slack in the chains until the tow bar is within four inches of the front bumper facing.
6. Remove the remaining slack in the lift chains.
7. Raise the vehicle to the required height.
8. Prepare the axles. Refer to Preparing the Axles Before Towing the Vehicle in this section.

Preparing the Axles Before Towing the Vehicle

Single Drive Rear Axle

1. Remove the rear axle shafts. Refer to Axle Shaft Replacement in Driveline/Axle.
2. Cover the hub openings in order to prevent loss of the lubricant or lubricant contamination.

After Towing

1. Block the rear wheels and install the axle shafts. Refer to Axle Shaft Replacement in Driveline/Axle.
2. Install the propeller shafts, and inspect the universal joints for proper phasing. Refer to one of the following procedures in Driveline/Axle:
   - One-Piece Propeller Shaft Replacement
   - Two- Piece Propeller Shaft Replacement
   - Three- Piece Propeller Shaft Replacement
3. Apply the parking brake before disconnecting theTruck from the towing vehicle.
4. Inspect the fluid level in the rear axle. Fill the rear axles with oil as required.

Front End Towing (All Wheels on the Ground)

You may tow the vehicle on all wheels, provided that the steering is operable. The power brakes and power steering will not have power assist. Vehicles with air brakes will not have braking capability. Ensure that there is a tow bar between the towing vehicle and the disabled vehicle.

Before Towing

- Block the wheels of the disabled vehicle.
- On vehicles with air brakes, release the parking brake system by compressing the brake chamber springs. Refer to Air Brakes. Releasing the parking brake will prevent the parking brake from engaging while the vehicle is in tow.
- Disconnect the propeller shaft at the rear axle (forward unit on tandem axles). Refer to one of the following procedures in Driveline/Axle:
  - One-Piece Propeller Shaft Replacement
  - Two-Piece Propeller Shaft Replacement
  - Three-Piece Propeller Shaft Replacement
- Secure the propeller shaft to the frame or the crossmember.
- If there is damage or suspected damage to the rear axle, remove the axle shafts. Refer to Axle Shaft Replacement in Driveline/Axle.
- Cover the hub openings in order to prevent loss of lubricant or lubricant contamination.

After Towing

- Block the rear wheels and install the axle shafts. Refer to Axle Shaft Replacement in Driveline/Axle.
- Install the propeller shafts and inspect for proper phasing of the universal joints. Refer to one of the following procedures in Driveline/Axle:
  - One-Piece Propeller Shaft Replacement
  - Two or Three Piece Propeller Shaft Replacement
- Apply the parking brake before disconnecting the Truck from the towing vehicle.

Rear End Towing (Rear Wheels Off the Ground)

Before Towing

- Secure the steering wheel in order to maintain a straight-ahead position.
- Ensure that the front axle is not loaded above the front axle Gross Axle Weight Rating (GAWR).
- The GAWR is located on the Vehicle Certification Label.

After Towing

- Block the rear wheels.
- Release the steering.
- Apply the parking brake before disconnecting from the towing vehicle.
- Inspect the fluid level in the rear axle.
- Fill the rear axle with oil as necessary.

Special Towing Instructions

- Call a local Isuzu dealer or a professional towing service.
- Follow all the state and local laws regarding towing:
  - Warning signals
  - Night illumination
  - Speed
- Do not tow any vehicle over 90 km/h (55 mph).
- If a vehicle is damaged, secure any loose or protruding parts prior to towing.
- Use a safety chain system that is completely independent of the primary lifting and towing attachment.
- Do not go underneath a raised vehicle unless the vehicle is supported by safety stands.
- Do not perform any towing operation that may risk the safety of the tow truck operator, bystanders or other motorists.

Strategy Based Diagnosis

Strategy based diagnostics is a uniform approach to repair all electrical/electronics systems. The diagnostic flow can always be used to resolve an E/E system problem and is the place to start when repairs are necessary. Refer to the following chart for proper strategy based diagnostics.

1. Verify the complaint: In order to verify the complaint the technician should know the normal operation of the system.
2. Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code information in order to achieve an effective repair.
3. Perform Published Diagnostic System Checks: One or more DTCs may not support a system. System checks verify the proper operation of the system. This will lead the technician in an organized approach to diagnostics.
4. Check Bulletins and Other Service Information: Also checks the videos, the newsletters, etc.
5. Check for any stored DTCs: Follow the designated DTC steps exactly in order to make an effective repair.
   - 5.1. Symptom No DTC: Select the symptom. Follow the diagnostic steps or suggestions in order to complete the repair, or refer to the applicable component/system check.
   - 5.2. No Published Diagnostics: Analyze the complaint. Develop a plan for the diagnostics. Utilize the wiring diagrams and theory of operation.
   - 5.3. Intermittents: Conditions that are not always present are intermittent. In order to resolve intermittents, perform the following. Observe the history for similar cases where repair history may be available. Combine the technician knowledge with efficient use of the available service information. Evaluate the symptoms and conditions described by the customer. Use a check sheet or other method in order to identify the circuit or electrical system component. Follow the suggestions for intermittent diagnosis found in the service documentation. The Tech 1, Tech 2 and Fluke 87 scan tools have data capturing capabilities that can assist in detection of intermittents.
   - 5.4. Vehicle Operates as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.
6. Re-examine the Concern: If a technician cannot successfully find or isolate the complaint, a reevaluation is necessary. Re-verify the complaint. The complaint could be an intermittent or normal.
7. Repair and Verify Fix: After isolating the cause, make the repairs. Then validate for proper operation. Verify that the symptom has been corrected. Verification may involve road testing the vehicle.

Maintenance and Lubrication

Specifications

Approximate Fluid Capacities

Application	Specification	
	Metric	English
Automatic Transmission AT545		
Shallow Pan	8.5 liters	18.0 pints
Deep Pan	15.0 liters	32.0 pints
Shallow Pan (Overhaul only)	14.0 liters	30.0 pints
Deep Pan (Overhaul only)	21.0 liters	44.0 pints
Cooling System		
7.8L (W/Automatic Transmission)	30.3 liters	32.0 quarts
Dana Rear Axle Single-Speed Model (See Note A)		
S150S (RPO-H08)	13.0 liters	13.8 quarts
Eaton® Rear Axle Single-Speed Models (See Note A)		
15040S (RPO-H10)	10.1 liters	10.7 quarts
15050S (RPO-HWY)	12.8 liters	13.5 quarts
15050S (RPO-HZW)	12.8 liters	13.5 quarts
15050S (RPO-H11)	12.8 liters	13.5 quarts
15060S (RPO-HPK)	14.6 liters	15.5 quarts
21060S (RPO-HPP)	14.6 liters	15.5 quarts
22060S (RPO-HPG)	14.6 liters	15.5 quarts
23080S (RPO-HPQ)	20.3 liters	21.5 quarts
23105S (RPO-HNA)	24.1 liters	25.5 quarts
Eaton® Rear Axle Two Speed Models (See Note A)		
19050T (RPO-HZT)	16.8 liters	17.8 quarts
19060T (RPO-HPM)	18.0 liters	19.0 quarts
21060T (RPO-H15)	17.5 liters	18.5 quarts
22060T (RPO-HPH)	17.5 liters	18.5 quarts
23080T (RPO-H20)	21.0 liters	22.0 quarts
Engine Crankcase		
7.8L Engine	14.0 liters	14.79 quarts
Fuel Tanks		
Standard Fuel Tanks (RPO NLO)	189.0 liters	50.0 gallons
Optional Fuel Tanks (RPO NL5)	378.0 liters	100.0 gallons
Manual Transmission		
5-Speed Fuller FS5005A	5.0 liters	10.5 pints
6-Speed with PTO	7.2 liters	15.22 pints
6-Speed without PTO	6.5 liters	13.74 pints
These quantities include 1.5 liters (3.2 pints) in order to fill the hub cavities.		

Fluid and Lubricant Recommendations

Air Brake System Alcohol Evaporator	Commercial grade of methyl alcohol
Brake Caliper Housing, the Caliper Support Spring, and the Caliper Support Key	Aeroshell #5 grease
Cab-Door Hinges and Latches	Engine oil
Chassis Lubricant	Chassis lubricant that meets the requirements of NLGI Brake 2, Category LB or GC-LB
Clutch Bearing Lubricant	High-temperature grease of NLGI #3 consistency
Engine Coolant	50/50 mixture of clean drinkable water and DEX-COOL™ or Havoline® DEX-COOL™ antifreeze (orange-colored, silicate-free).
Engine Oil	Engine oil with the letters CG-4 is best for your vehicle. If CG-4 is not available, you may use CF-4/SH oil (see Note A). In order to determine the preferred viscosity for your vehicle's diesel engine, refer to Engine Oil in the ISUZU Owner's Manual.
Exhaust Brake Ball Joint Cap Lubricant	High-temperature grease of NLGI #3 consistency

Fluid and Lubricant Recommendations (cont'd)

Front Wheel Bearings with Oil Filled Hubs	SAE 75W-90 synthetic axle lubricant.
Hydraulic Brake System	DOT-3 brake fluid.Hydraulic Brake System
Power Steering System	Power steering fluid.
Propshafts and Splines	Wheel bearing lubricant that meets the requirements of NLGI Grade 2, Category GC or GC-LB.
Rear Axle	SAE 75W-90 synthetic gear lubricant.
Rear Axle Shift Motor	Refrigerant Oil
Spring Parking Brake Hydraulic Pump	DEXRON®-III automatic transmission fluid.
Steering Shaft and Clutch Shift Block	NLGI Category GC-LB #2 multi-purpose type grease.
Manual Transmission Fluid	Multi-purpose gear oil SAE 90 GL5 (SAE 80 W -90 GL5 in Canada).
Automatic Transmission Fluid	DEXRON®-III automatic transmission fluid or Type C-4.
Water Pump	NLGI Category GC-LB #2 or #3 multi-purpose type grease.
Weatherstrip Conditioning	Dielectric silicone grease
Wheel Bearing Grease	Wheel bearing lubricant that meets the requirements of NGLI Grade 2, Category GC or GC-LB

Maintenance Items

Item	Part Identification
Fuel Filter (Primary)	Raycor (NWB) B32002
Fuel Filter (Secondary Engine Mounted)	1-13240-074-0
Oil Filter	1-13200-487-2

Maintenance

Maintenance Schedule

Perform the services in this schedule up to 161 000 km (100 000 mi) and after 161 000 km (100 000 mi) at the same intervals.

Refer to *Explanation of Scheduled Services* for further explanations of maintenance services and footnotes.

160 km (100 mi)
Perform the wheel stud nut service. (45)

800 km (500 mi)
Perform the wheel stud nut service. (45)

1 600 km (1,000 mi)
Perform the wheel stud nut service. (45,46)

5 200 km (3,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Inspect the clutch pedal for free travel. (10)
- Inspect and clean the air conditioner filter (or every month, whichever occurs first).
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Service the rear axle air shift motor. (11)

10 400 km (6,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and the rollers using engine oil.
- Replace the automatic transmission fluid and the filter (or every 12 months, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Verify the curb idle speed (or every 12 months, whichever occurs first). (20)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first).
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)

15 700 km (9,750 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.

20 800 km (13,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the steering system inspection. (13)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the throttle linkage service. (19)
- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service(or every month, whichever occurs first). (4, 5, 21)
- Verify the operation of the air brake relay valve and inspect for leaks (or every month or every 300 hours, whichever occurs first).

26 000 km (16,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean air conditioner filter (or every month, whichever occurs first).
- Lubricate the clutch shift block (or every month, whichever occurs first).

31 400 km (19,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Inspect door hinge pins and bushings and replace as necessary.
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the steering system inspection. (13)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Perform the hydraulic brake caliper system service (or every 6 months, whichever occurs first). (22)
- Perform the air brake service (or every 6 months, whichever occurs first). (39)
- Clean the air brake application valve (or every 3 months, or every 300 hours, whichever occurs first). Lubricate the linkage.

36 400 km (22,750 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean air conditioner filter (or every month, whichever occurs first).
- Lubricate the clutch shift block (or every month, whichever occurs first).

41 600 km (26,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Inspect door hinge pins and bushings and replace as necessary.
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the steering system inspection. (13)
- Replace the automatic transmission fluid and the filter (or every 12 months, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Inspect the fuel injection fuel lines (or every 12 months, whichever occurs first). (26)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheel bearing service (or every 24 months, whichever occurs first and whenever the hubs are removed). (23)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Perform the engine drive belts service (or every 12 months, whichever occurs first). (18)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the throttle linkage service. (19)
- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)

- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Inspect the air intake system (or every 24 months, whichever occurs first). (4, 5, 24)
- Air brake automatic slack adjuster service (or every 500 hours, whichever occurs first). (40)
- Replace the fuel filter (or every 24 months, whichever occurs first. (3)
- Replace the air cleaner filter (or every 24 months, whichever occurs first. (3, 4, 27)
- Pereform the rear axle air shift motor service. (11)
- Perform the air brake service (or every 6 months, whichever comes first). (39)
- Verify the operation of the air brake relay valve and inspect for leaks (or every month or every 300 hours, whichever occurs first).
- Inspect the operation of the air brake chamber (or every 2 months, whichever occurs first). (41)
- Perform the trailer brake hand control valve service (or every 3 months, or 900 hours, whichever occurs first). (42)
- Inspect the starter brushes for wear (or every 12 months, whichever occurs first). Replace the brushes as necessary.
- Inspect the generator brushes for wear (or every 12 months, whichever occurs first). Replace the brushes as necessary.

46 800 km (29,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean air conditioner filter (or every month, whichever occurs first). Refer to HVAC Air Filter Replacement in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

52 000 km (32,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and rollers using engine oil.
- Perform the cooling system service (or every 12 months, whichever occurs first). (3, 35)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)

57 200 km (35,750 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

62 400 km (39,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Inspect door hinge pins and bushings and replace as necessary.
- Lubricate the door hinge pins and rollers using engine oil.
- Perform the steering system inspection. (13)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Replace the manual transmission fluid (or every 12 months, whichever occurs first). (2)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the throttle linkage service. (19)

- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Perform the hydraulic brake capliper system service (or every 6 months, whichever occurs first). (22)
- Perform the air brake service(or every 6 months, whichever occurs first). (39)
- Verify the operation of the air brake relay valve and inspect for leaks (or every month or every 300 hours, whichever occurs first).
- Clean the air brake application valve (or every 3 months, or every 300 hours, whichever occurs first). Lubricate the linkage.

67 600 km (42,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

72 800 km (45,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and rollers using engine oil.
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)

78 000 km (48,750 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

83 200 km (52,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter. Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the steering system inspection. (13)
- Replace the automatic transmission fluid and the filter (or every 12 months, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Verify the curb idle speed (or every 12 months, whichever occurs first). (20)
- Perform the injector service (or every 12 months, whichever occurs first). (25)
- Inspect fuel injection fuel lines (or every 12 months, whichever occurs first). (26)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheel bearing service (or every 24 months, whichever occurs first and whenever the hubs are removed). (23)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Perform the engine drive belts service (or every 6 months, whichever occurs first). (18)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform throttle linkage service. (19)

- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Inspect the air intake system (or every 24 months, whichever occurs first). (4, 5, 24)
- Replace the fuel filter (or every 6 months, whichever occurs first. (3, 4, 27)
- Replace the air cleaner filter (or every 24 months, whichever occurs first). (3)
- Adjust the valve lash (or every 12 months, whichever occurs first). (28)
- Retighten the manifold mounting and the injector bracket nuts to specifications (or every 6 months, whichever occurs first).
- Perform the rear axle air shift motor service. (11)
- Perform the air brake service (or every 6 months, whichever comes first). (39)
- Verify the operation of the air brake relay valve operation and inspect for leaks (or every month or every 300 hours, whichever occurs first).
- Inspect the operation of the air brake chamber (or every 2 months, whichever occurs first). (41)
- Perform the trailer brake hand control valve service (or every 3 months, or 900 hours, whichever occurs first). (42)
- Air brake automatic slack adjuster service (or every 500 hours, whichever occurs first). (40)
- Inspect the starter brushes for wear (or every 12 months, whichever occurs first). Replace the brushes as necessary.
- Inspect the generator brushes for wear (or every 12 months, whichever occurs first). Replace the brushes as necessary.

88 400 km (55,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

93 600 km (58,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter. Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Inspect the door hinge pins and rollers.
- Lubricate the door hinge pins and the rollers using engine oil.
- Replace the air conditioning filter dryer (or every 18 months, whichever occurs first, and whenever the refrigerant charge is lost for any reason).
- Replace the automatic transmission fluid and the filter (or every 12 months, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Perform the hydraulic brake caliper service (or every 6 months, whichever occurs first). (22)
- Clean the air brake application valve (or every 3 months, or every 300 hours, whichever occurs first). Lubricate the linkage.

98 800 km (61,750 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

104 000 km (65,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and the rollers using engine oil.

- Service the cooling system (or every 12 months since the last service, whichever occurs first). (3, 35)
- Perform the steering system inspection. (13)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the throttle linkage service. (19)
- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Perform the air brake service (or every 6 months, whichever occurs first). (39)
- Verify the operation of the air brake relay valve operation and inspect for leaks (or every month or every 300 hours, whichever occurs first).

109 200 km (68,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

114 400 km (71,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and rollers using engine oil.
- Perform the steering system inspection. (13)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)

119 600 km (74,750 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

124 800 km (78,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Inspect door hinge pins and bushings and replace as necessary.
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the steering system inspection. (13)
- Replace the automatic transmission fluid and the filter (or every 12 months, whichever occurs first). (1)
- Replace the manual transmission fluid (or every 12 months, whichever occurs first). (2)
- Perform the injector service (or every 12 months, whichever occurs first). (25)

- Perform the front and rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheel bearing service (or every 24 months, whichever occurs first and whenever the hubs are removed). (23)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Perform the engine drive belts service(or every 12 months, whichever occurs first). (18)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the throttle linkage service. (19)
- Inspect the exhaust system (or every month, whichever occurs first). (3, 4, 17)
- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Inspect the air intake system (or every 24 months, whichever occurs first). (4, 5, 24)
- Replace the fuel filter (or every 6 months, whichever occurs first. (3)
- Perform the fuel tank, the fuel cap, and the fuel lines service(or every 72 months, whichever occurs first). (3, 30)
- Replace the air cleaner filter (or every 24 months, whichever occurs first). (3, 4, 27)
- Perform the rear axle air shift motor service. (11)
- Perform the hydraulic brake service (or every 6 months, whichever occurs first). (22)
- Perform the air brake service (or every 6 months, whichever comes first). (39)
- Verify the operation of the air brake relay valve operation and inspect for leaks (or every month or every 300 hours, whichever occurs first).
- Clean the air brake application valve (or every 3 months, or every 300 hours, whichever occurs first). Lubricate the linkage.
- Inspect the operation of the air brake chamber (or every 2 months, whichever occurs first). (41)
- Perform the trailer brake hand control valve service (or every 3 months, or 900 hours, whichever occurs first). (42)
- Air brake automatic slack adjuster service (or every 500 hours, whichever occurs first). (40)
- Inspect the starter brushes for wear (or every 12 months, whichever occurs first). Replace the brushes as necessary.
- Inspect the generator brushes for wear (or every 12 months, whichever occurs first). Replace the brushes as necessary.

130 000 km (81,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the air brake automatic slack adjuster service (or every 500 hours, whichever occurs first). (40)

135 200 km (84,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and rollers using engine oil.
- Inspect the automatic transmission fluid level (or every 12 months, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the shields and underhood insulation service (or every month, whichever occurs first). (4, 5, 21)

140 400 km (87,750 mi)

- Perform the wheel bearing service – Eaton® Axle (oil filled) (or every 36 months, whichever occurs first). (23)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

145 600 km (91,000 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the steering system inspection. (13)
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the front andthe rear suspension service. (14)
- Perform the spring-to-axle U-bolts and the shackle bolts service. (16)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the throttle linkage service. (19)
- Perform the thermostatically controlled engine cooling fan service. (4, 20)
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Verify the operation of the air brake relay valve and inspect for leaks (or every month or every 300 hours, whichever occurs first).

150 800 km (94,250 mi)

- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the clutch shift block (or every month, whichever occurs first).

156 000 km (97,500 mi)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). (3, 9)
- Inspect the fluid levels (or every 3 months, whichever occurs first). (3, 6)
- Perform the chassis lubrication service (or every 6 months, whichever occurs first). (12)
- Clean the air conditioner filter (or every month, whichever occurs first). Refer to *Passenger Compartment Air Filter Replacement* in HVAC.
- Lubricate the water pump (or every 3 months, whichever occurs first).
- Lubricate the steering column shaft (or every 3 months, whichever occurs first).
- Inspect the door hinge pins and bushings and replace as necessary.
- Lubricate the door hinge pins and the rollers using engine oil.
- Perform the cooling system service (or every 12 months since the last service, whichever occurs first). (3, 35)
- Replace the air conditioning filter dryer (or every 18 months, whichever occurs first, and whenever the refrigerant charge is lost for any reason).
- Inspect the automatic transmission fluid level (or every month, whichever occurs first). (1)
- Inspect the manual transmission fluid level (or every 3 months, whichever occurs first). (2)
- Perform the wheels and tires service. (15)
- Perform the brake service (or every 6 months, whichever occurs first). (7)
- Perform the hydraulic parking brake service (or every 6 months, whichever occurs first). (8)
- Inspect the clutch pedal for free travel. (10)
- Lubricate the clutch shift block (or every month, whichever occurs first).
- Perform the shields and the underhood insulation service (or every month, whichever occurs first). (4, 5, 21)
- Inspect the oil level gauge rubber hose for cracks, damage, or other abnormal conditions (or every 12 months, whichever occurs first).
- Perform the hydraulic brake system service (or every 6 months, whichever occurs first). (22)
- Clean the air brake application valve (or every 3 months, or every 300 hours, whichever occurs first). Lubricate the linkage.

166 000 km (100,000 mi)

- Change the power steering fluid (or every 36 months, whichever occurs first). (13)
- Perform the front axle service (or every 36 months, whichever occurs first). (38)
- Perform the exhaust brake service (if equipped). Inspect for excessive spindle free play and smooth operation. Lubricate the ball joint cap.
- Replace the accelerator control cable (or every 36 months, whichever occurs first). (19)
- Perform the air brake valves service (or every 6 months, or 1800 hours, whichever occurs first). (44)
- Perform rear axle service Eaton® Axle (or every 12 months, whichever occurs first). (37)

240 300 km (150,000 mi)
Perform the cooling system service (or every 60 months since the last service, whichever occurs first). (3, 35)

320 000 km (200,000 mi)
Remove, disassemble, clean, and inspect the air brake trailer supply valve (or every 2 years or 7,200 hours, whichever occurs first).

400 000 km (250,000 mi)

- Perform the wheel bearing service – Eaton® Axle (oil filled) (or every 36 months, whichever occurs first). (23)
- Service the rear axle – Eaton® Axles service (or every 36 months, whichever occurs first). (37)

480 000 km (300,000 mi)
Remove, disassemble, clean, and inspect the air brake dryer (or every 3 years or 10,800 hours, whichever occurs first). Replace the desiccant on Bendix® Westing House.

Maintenance Schedule - Short Trip/City

Notice: One of the reasons you should follow the Short Trip/City schedule, if you operate your vehicle under any of these conditions, is that these conditions cause engine oil to break down sooner.

Follow this schedule if any one of the following conditions is true for your vehicle:

- Most trips are less than 8–16 km (5–10 mi). This is particularly important when outside temperatures are below freezing.
- Most trips include extensive idling and/or low speed operation (such as door-to-door delivery and frequent driving in stop-and-go traffic).
- Most trips are through dusty areas.
- The vehicle frequently tows a trailer.
- The vehicle operates at or near the maximum Gross Vehicle Weight (GVW) ratings.
- The vehicle operates in hilly or mountainous terrain.

Maintenance Schedule - Long Trip/Highway

Notice: Driving a vehicle with a fully warmed engine under highway conditions causes engine oil to break down slower.

Follow this schedule only if none of the conditions from the Short Trip/City Maintenance Schedule is true.

Owner Checks and Services (General)

Perform the owner checks and services that are listed below at the intervals specified in order to ensure the safety, dependability and emission control performance of your vehicle.

For your safety and the safety of others, inspect any of the safety related components that may have been damaged in an accident. Perform any necessary repairs before operating the vehicle.

At the minimum, perform these routine inspections every 6 months or 10 000 km (6,000 mi), whichever occurs first. Complete any necessary repairs before operating the vehicle.

At Each Fuel Fill

Important: Perform these underhood inspections at each fuel fill.

Engine Oil Level Inspection
Inspect the engine oil level. Add the proper oil if necessary. Refer to *Fluid and Lubricant Recommendations.*

Engine Coolant Level Inspection
Inspect the engine coolant level. Add the proper coolant mix if necessary. Refer to *Fluid and Lubricant Recommendations.*

Windshield Washer Fluid Level Inspection
Inspect the windshield washer fluid level in the windshield washer tank. Add the proper fluid if necessary. Refer to *Fluid and Lubricant Recommendations.*

Tire Inflation Inspection
Inspect the tire inflation. Ensure that the tires are inflated to the pressures specified on the Certification/Tire label.

At Least Twice a Year

Restraint System Inspection
Ensure that the following components are functioning properly:

- The belts
- The buckles
- The latch plates
- The retractors
- The anchorages
- The reminder systems

Inspect for any other loose or damaged safety belt system parts.

Repair any components in a condition that might prevent a safety belt system from functioning properly.

Replace any torn or frayed safety belts.

Body Lubrication Service

Notice: Recommended Fluids and Lubricants tells you what to use. More frequent lubrication may be required when exposed to a corrosive environment.

Lubricate all of the following exposed surfaces:

- The door checks
- The door lock bolts
- The lock strike Plates
- The door hinge bushings
- The dovetail bumper wedges

Use a dripless oil where oil holes are provided.

Also lubricate the following components:

- The seat adjusters
- The seat track
- The door weatherstrips
- The rubber hood bumpers

Parking Brake Inspection
Park on a fairly steep hill. Hold the vehicle with the parking brake only. This procedure determines the holding ability of the parking brake.

Starter Switch Inspection

Caution: When you are doing this check, the vehicle could move suddenly. If it does, you or others could be injured. Follow the steps below.

Follow this procedure for the starter switch inspection:

1. Ensure that there is enough room around the vehicle.
2. Firmly apply the parking brake (refer to Parking Brake in your Isuzu Owner's Manual if necessary) and the regular brakes.

   Notice: Do not use the accelerator pedal, and be ready to turn off the engine immediately if it starts.
3. On automatic transmission vehicles, attempt to start the engine in each gear. The starter should function only in NEUTRAL (N) or PARK (P). If the starter functions in any other position, perform the service of the vehicle.

   On manual transmission vehicles, place the shift lever in NEUTRAL (N). Push the clutch down halfway and attempt to start the engine. The starter should function only when the clutch is pushed down all the way to the floor. If the starter functions when the clutch is NOT pushed all the way down, perform the service of the vehicle.

Automatic Transmission Shift Indicator Inspection
Verify that the indicator points to the gear chosen.

Steering Inspection
Be alert for any of the following conditions:

- Changes in steering action
- Abnormal front tire wear
- Changes in steering wheel position

An inspection or service is needed when the following conditions occur:

- The steering wheel is harder to turn.
- The steering wheel has too much free play.
- Strange sounds can be heard during turning or parking.

Brake System Inspection
Be alert for any of the following conditions:

- Illumination of the low air warning lamp
- The tone alarm
- Changes in braking action
  - Repeated pulling to one side
  - Unusual sounds during braking
  - Increased brake pedal travel

Ensure that the air brake system reservoirs are drained daily with full system air pressure. Inspect the system for leaks.

Any of these conditions may indicate the need for brake system inspection or service.

Engine Cooling System Service
Inspect the hoses and have them replaced if they are cracked, swollen or deteriorated. Inspect all pipes, fittings and clamps; replace as needed. Clean the outside of the radiator and air conditioning condenser. To help ensure proper operation, a pressure test of the cooling system and pressure cap is recommended at least once a year.

Exhaust System Inspection
Be alert for any changes in the sound of the exhaust system or any smell of fumes. These conditions indicate that the system may be leaking. Inspect or repair the exhaust system immediately, if needed. Refer to Engine Exhaust and Running Your Engine While You're Parked cautions in the Owner's manual.

Windshield Wipers and Washers Inspection
Inspect the following:

- Inspect the operation and the conditions of the wiper blades.
- Inspect the for wear or cracking.
- Replace blade inserts that appear worn or damaged or that streak or miss areas of the windshield.

Defroster Inspection
Move the control to the defrost symbol and the fan to HI or the high symbol. Inspect the airflow from the ducts at the inside base of the windshield.

Mirrors and Sun Visors Inspection
Verify that the friction joints hold the mirrors and the sun visor in place.

Seat Adjuster Inspection
When adjusting a manual seat, ensure that the seat adjuster latches by attempting to move the seat after latching.

Lamps Inspection
Inspect the following lamps on the inside:

- The panel lighting
- The warning lights
- The indicator lights
- The interior lamps

Inspect the following lamps on the outside:

- The license plate lamps
- The sidemarker lamps
- The reflectors or lights on the outside mirrors
- The headlamps
- The parking lamps
- The identification lamps and the clearance lamps
- The taillamps
- The brake lamps
- The turn signals
- The backup lamps
- The hazard warning flashers

Inspect the headlamp aim if the beams seem to be inappropriately aimed.

Glass, Mirrors, Lamps and/or Reflectors Condition Inspection
Inspect all glass, mirrors, lamps, or reflectors for the following conditions:

- Breaks
- Scratches
- Dirt
- Damage

Any of the above conditions may reduce the view or visibility or cause injury. Replace, clean, or repair promptly if necessary.

Door Latches Inspection
Verify that the doors perform the following functions:

- Close
- Latch
- Lock tightly

Inspect for broken, damaged, or missing parts that might prevent tight latching.

Cab Latches Inspection
Verify that the cab closes firmly.

Inspect for broken, damaged, loose, or missing parts that might prevent tight latching.

Fluid Leaks Inspection
Inspect for fluid leaks of the following substances by looking at the surface beneath the vehicle after it has been parked for a while:

- Fuel
- Coolant
- Oil

Underbody Inspection
Corrosive materials used for ice and snow removal and dust control may collect on the underbody. If these materials are not removed, accelerated corrosion (rust) may occur on the following underbody parts:

- The fuel lines
- The frame
- The floor pan
- The exhaust system

At least every spring, flush these materials from the underbody using plain water. Thoroughly clean any areas where mud and other debris may collect. Loosen the sediment packed in closed areas of the frame before flushing.

Engine Cover Inspection
Verify that the cab's engine cover and seal (if equipped) are not torn or damaged.

Verify that the cover is bolted down firmly to the floor.

At Least Once a Year

Key Lock Cylinders Service
Lubricate the key lock cylinders with the correct lubricant. Refer to *Fluid and Lubricant Recommendations.*

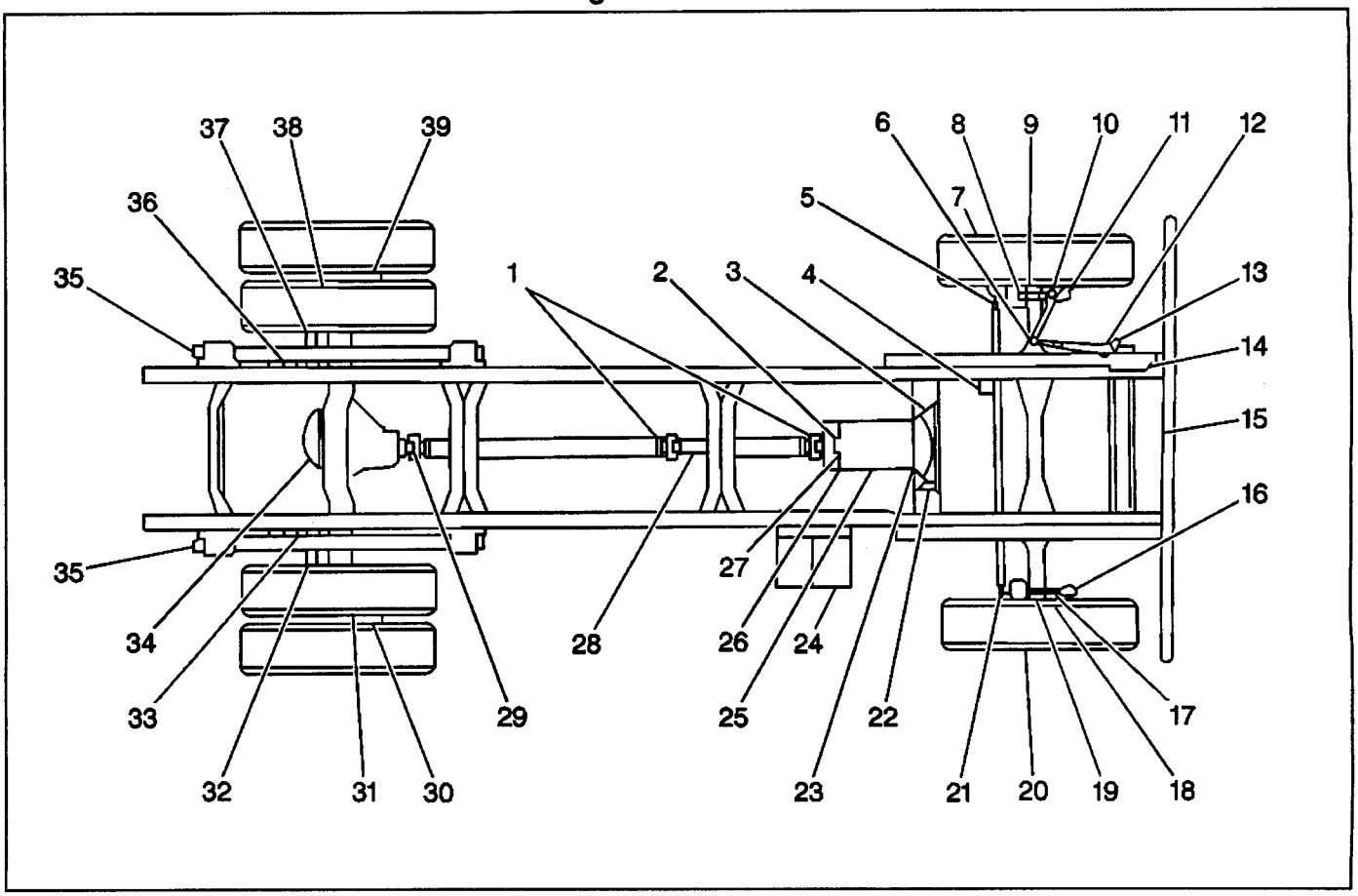
Underbody Flushing Service
At least every spring, use plain water to flush any corrosive materials from the underbody. Take care to clean thoroughly any areas where mud and other debris can collect.

Tractor Protection (Breakway) Valve Check
On air brake models, remove, disassemble, clean and inspect the tractor protection (breakaway) valve.

Towing Vehicle Protection Valve
On air brake models, remove, disassemble, clean, and inspect the towing vehicle protection valve.

Owner Checks and Services (Single Axle)

Single Axle Models



290696

Legend

(1) Propshaft Slip Joint
(2) Parking Brake Clevis Pin (If equipped with hydraulic brakes only)
(3) Clutch Release Cross Shaft (If equipped)
(4) Master Cylinder (If equipped with hydraulic brakes only)
(5) Steering Tie Rod Ends (If equipped)
(6) Steering Column U-Joints
(7) Front Wheel Bearings
(8) Front Steering Knuckles
(9) Brake Cam Roller Pins at interface of pin and shoe (Air Brakes Only)
(10) Slack Adjuster (Air Brakes Only)
(11) Brake Camshaft Brake Caliper Rails (If equipped)
(12) Steering Column Slip Joint (If equipped)
(13) Steering Drag Link Ends
(14) Pivot Points and Hinges
(15) Pivot Points and Hinges
(16) Brake Camshaft Brake Caliper Rails (If equipped)
(17) Slack Adjuster (Air Brakes Only)
(18) Brake Cam Roller Pins at interface of pin and shoe (Air Brakes Only)
(19) Front Steering Knuckles
(20) Front Wheel Bearings
(21) Steering Tie Rod Ends (If equipped)
(22) Clutch Release Cross Shaft (If equipped)
(23) Clutch Release Bearing (If equipped)
(24) Battery Terminal (Except "ST" type)
(25) Transmission
(26) Parking Brake Bell Crank (If equipped with hydralic brakes only)
(27) Parking brake Lever Pivot (If equipped with hydralic brakes only)
(28) Propshaft Slip Joint
(29) Propshaft Slip Joint
(30) Rear Wheel Bearing
(31) Brake Cam Roller Pins at interface of pin and shoe (Air Brakes Only)

(32) Brake Camsaft Brake Caliper Rails (If equipped)
(33) Slack Adjuster (Air Brakes Only)
(34) Rear Axle
(35) Spring Slip Pads (If equipped with Multi-leaf)
(36) Slack Adjuster (Air Brakes Only)
(37) Brake Camshaft Brake Caliper Rails (If equipped)
(38) Brake Cam Roller Pins at interface of pin and shoe (Air Brakes Only)
(39) Rear Wheel Bearing

Explanation of Scheduled Services

1. Replace the automatic transmission fluid and the filter at 10 400 km (6,500 mi), 41 600 km (26,000 mi) and then every 41 600 km (26,000 mi) thereafter.

   Inspect the automatic transmission fluid level at each 10 400 km (6,500 mi) interval that does not call for a fluid change (or every month, whichever occurs first).
2. Replace the manual transmission fluid every 62 400 km (39,000 mi).

   Inspect the manual transmission fluid level at each 10 400 km (6,500 mi) interval that does not call for a fluid change (or every 3 months, whichever occurs first).
3. This is an emission control service.
4. This is a noise emission control device.
5. This service applies only to vehicles sold in the United States.
6. Inspect the fluid level in the following components:
   - The brake master cylinder. A low fluid level in the brake master cylinder may indicate worn brake linings and should be inspected.
   - The clutch master cylinder (if equipped)
   - The power steering pump
   - The axle
   - The transmission
   - The hydraulic spring parking brake pump (if equipped)
7. Inspect the following brake components:
   - The brake lines and the hoses. Inspect the lines and the hoses for the following conditions:
     - Proper hookup
     - Binding
     - Leaks
     - Cracks
     - Chafing
   - The disc brake pads for wear
   - The rotors for surface condition
   - The drum brake linings for wear or cracks
   - The drums
   - The wheel cylinders
   - The piston heat shields and the boots
   - Other brake parts
   - The brake pedal for excessive free play or travel (or every 6 months, whichever occurs first). Perform the service, if necessary.
   - Inspect the brakes more often if driving habits and conditions result in frequent braking.

   Important: The spring brake section of the actuator is NOT serviceable.
8. Inspect the hydraulic parking brake drum and the linings for wear or cracks. Inspect the linkage and the adjustment. Inspect the spring brake actuator and the pump for leaks.
9. Change the main oil filter and the partial oil filter element.
10. Inspect the clutch pedal for free travel. Use the following procedure:
    - Press the pedal using your hand until resistance is felt.
    - Maintain free travel at 38–51 mm (1.5–2.0 in) measured at the clutch pedal pad.
    - Inspect the clutch pedal for free travel at 5 200 km (3,250 mi) and 10 400 km (6,500 mi) and then every 10 400 km (6,500 mi) thereafter.
11. Inspect the rear axle air shift motor for fluid leaks. Use the following procedure:
    - Remove the plug in order to inspect the fluid level.
    - Inspect the air lines and the hoses for the following conditions:
      - Proper hookup
      - Binding
      - Leaks
    - Inspect the rear axle air shift motor at 5 200 km (3,250 mi) and 16 00 km (24,000 mi) and then every 40 000 km (24,000 mi) thereafter.
12. Lubricate all the grease fittings in the front suspension, the front axle, and the steering linkage.

    Lubricate the suspension, the axle and the steering linkage more often when operating under dusty or muddy conditions and in excessive off-road use.

    DO NOT lubricate the kingpin bushings with air pressure equipment. Use a hand-held grease gun in order to ensure complete purge and eliminate sealer cap distortion.

Lubricate the following components:

- The transmission and the shift linkage
- The hood latches and the hinges
- The parking brake lever pivot
- The clevis pins and the linkage
- The disc brake caliper rails
- The clutch linkage and the release bearing (if equipped)
- The propeller shaft slip joint
- The universal joint
- The brake camshaft bracket
- The slack adjusters
- The pedal shaft
- The clutch cross shaft
- The clutch pedal springs

13. Inspect the steering the system for damaged, loose or missing parts. Inspect for parts showing signs of wear or lack of lubrication. Replace the parts as needed.

    Inspect the following components:

    - The steering gear mounting bolts. Tighten if necessary.
    - The pitman arm nut. Tighten if necessary.
    - The gear housing upper cover and the side cover attaching bolts. Tighten if necessary.
    - The steering column mounting bolts. Tighten if necessary.
    - The cardan joint clamp bolts. Tighten if necessary.
    - The power steering hoses, the tubes and the fittings for leaks. Ensure that the hoses and the lines are not twisted, kinked, or tightly bent.
    - The clips, the clamps, the supporting tubes, and the hoses for proper location and secureness.
    - The steering gear for leakage around the pitman shaft and the housing. If leakage is evident (lubrication oozing out, not just an oily film), repair the leak immediately.

14. Inspect the front and rear suspension for damaged, loose or missing parts, or parts showing signs of wear or lack of lubrication. Replace the parts as needed.
15. Adjust the tire pressure as indicated in the Isuzu Owner's Manual for optimum tire life.

    Inspect the tires for excessive or abnormal wear or damage. Inspect the wheels for damage. Replace the wheels and/or tires as needed.

16. Inspect the spring-to-axle U-bolts and the shackle bolts for the proper torque.

    When the vehicle is new or when you have replaced the parts, inspect and adjust the torque more often during the first 10 000 km (6,000 mi). Inspect the torque at 800 km (500 mi) and 3 000 km (2,000 mi) after the parts are first used.

17. In order to maintain the exhaust system integrity, replace the exhaust pipes whenever a new muffler is installed.

    Inspect the complete exhaust system for the following conditions. Perform any needed repairs immediately.

    - Broken parts
    - Damaged parts
    - Missing parts
    - Out of position parts
    - Open seams
    - Holes
    - Loose connections
    - Other conditions which may permit exhaust fumes to seep into the driver compartment.

18. Inspect all of the engine drive belts for cracks, fraying, wear, and proper tension. Adjust or replace the belts as needed. Replace the belts at 83 200 km (52,000 mi) and every 83 200 km (52,000 mi) thereafter.
19. Do not lubricate the accelerator and cruise control cables.

    Inspect the throttle linkage for the following conditions. Perform any needed repairs immediately.

    - Damaged parts (including throttle return springs)
    - Missing parts (including throttle return springs)
    - Interference
    - Binding

20. With the engine OFF and below normal operating temperature, verify that the thermostatically controlled engine cooling fan may be rotated by hand on viscous-operated drives. Replace the components as needed.
21. Inspect the shields and the underhood insulation for damage or looseness. Adjust or replace the components as needed.
22. Lubricate the following components:

    - The brake caliper V-ways
    - The brake caliper retainer
    - The brake caliper retainer spring

23. Perform the following wheel bearing service:
    - Grease type: Clean, inspect and lubricate using the proper wheel bearing grease at designated intervals or whenever the hubs are removed. Refer to *Fluid and Lubricant Recommendations*.
    - Oil-filled type: Some wheel bearings require a rear axle lubricant. If you have the oil-filled hubs, use a lubricant identical to that used in the rear axle. Lubricant change intervals are the same for both the front and the rear axles. Maintain the oil level at the OIL LEVEL mark between the change intervals. Refer to *Fluid and Lubricant Recommendations*.
24. Inspect the air intake system installation in order to ensure that the gaskets are seated properly and all of the hose connections, fasteners, and other components are tight.

    For gasoline engines, ensure that the air cleaner housing is properly seated, that the cover fits tightly and that the wing nut is tight.

    Tighten the connections and the fasteners or replace the parts as needed.
25. Incorrect injection timing may result in increased exhaust emission or reduced engine output. Inspect the tip of the injector needle valve and the injector ofifices for accumulation of carbon.

    Remove any contamination with an injector cleaning tool by thoroughly cleaning the inside and outside of the injector end.
26. Inspect all of the fuel lines connections on the fuel injection pump and the injector.
27. Replace the air cleaner filter (or every 24 months, whichever occurs first). Replace the filter more often when driving in dusty conditions. Ask your dealer for the proper replacement intervals for your driving conditions.
28. Adjust the valve lash. Incorrect valve clearance will result in increased engine noise and reduced engine output. Retorque the rocker shaft bracket nuts before inspecting and adjusting the valve clearance. The intake and exhaust valve clearance is 0.4 mm (0.016 in) for cold adjustment.
29. Verify curb idle speed at 10 400 km (6,500 mi), 83 200 km (52,000 mi) and then every 83 200 km (52,000 mi) thereafter. If necessary, perform the adjustment by turning the injection pump governor low idle adjusting screw.
30. Perform the following inspections, replacing the parts as needed:
    - Inspect the following components for damage which may cause leakage:
      - The fuel tank
      - The fuel cap
      - The fuel lines
    - Inspect the fuel cap for proper sealing ability and damage.
    - Inspect the fuel cap gasket for an even filter neck imprint.
31. Drain, flush, and refill the cooling system. Refer to *Fluid and Lubricant Recommendations*.

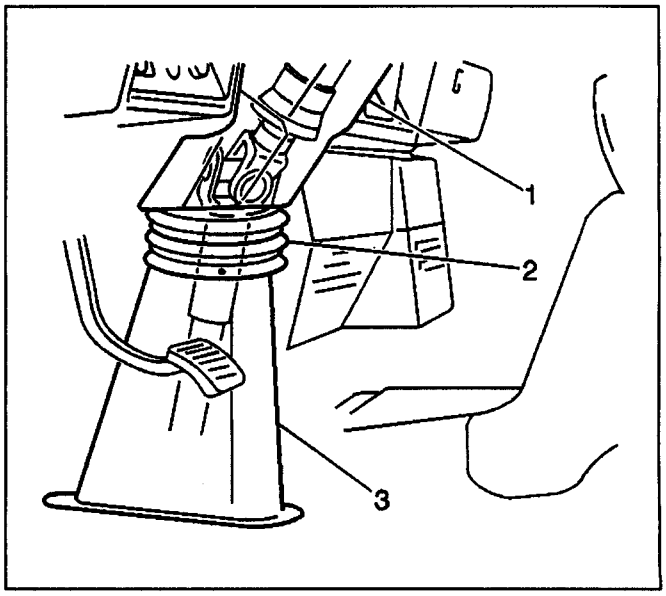
    Inspect the hoses. Clean the radiator, the condenser, the pressure cap, and the neck. Perform the cooling system pressure test and the pressure cap test.
32. Tighten the wheel stud nuts to the torque values indicated in the Isuzu Owner's Manual at 160 km (100 mi), 800 km (500 mi) and 1 600 km (1,000 mi), then every 1 600 km (1,000 mi) thereafter.
33. Change the lubricant. Refer to *Fluid and Lubricant Recommendations*.
34. Repack the upper kingpin roller bearing.

    Notice: The spring brake section of the rear brake diaphragms are non-serviceable.
35. Perform the following air brake service:
    - Test the air lines for leaks.
    - Tighten the air line connections as necessary.
    - Replace the compressor filter.
    - Inspect the air parking brake chamber for leaks and damage.
    - Inspect the lines and the hoses for leaks, cracks, chafing, etc.
    - Inspect all attachments for tightness, wear, or damage.
36. Clean and lubricate the air brake automatic slack adjuster. Inspect the pushrod travel and the auto adjustment operation. Perform the air brake automatic slack adjuster service, if necessary.
37. Inspect the operation of the air brake chamber and the following components. Inspect for leaks.
    - The mounting
    - The clamps
    - The air lines

38. Inspect the operation of the trailer brake hand control valve. Lubricate the cam and the follower.
39. Remove, disassemble, clean, and inspect the following air brake components. Replace any parts showing wear. Replace any rubber parts:
    - The safety valve
    - The standard brake chamber
    - The quick release valve
    - The quick release/double check valve combination
    - The parking brake control valve
    - The double check valve
    - The spring brake control valve
40. For Stud Wheels Only: Tighten the wheel stud nuts to the specified torque values at 100 miles (160 km), 500 miles (800 km) and 1,000 miles (1,600 km) and thereafter.
41. For Hub Piloted Wheels Only: Tighten the wheel stud nuts to the specified torque values at 1,000 miles (1,600 km). Thereafter, tighten them 1,000 miles (1,600 km) after each time the wheel is removed.

Inspections and Other Services

The steering shaft is provided with a lubrication fitting. The lubricant type and service intervals are outlined in *Fluid and Lubricant Recommendations.* In order to reach the top lower steering shaft lubrication fitting, use the following procedure:



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1. Push down the boot (2) in order to expose the lubrication fitting.
2. Turn the steering wheel until the lubrication fitting can be reached.
3. Turn the steering wheel in order to rotate the lubrication fitting location.

Vibration Diagnosis and Correction

Specifications

Wheel Specifications

Application	Metric	English
All Wheels (Except Dual Wheel Applications)		
Lateral	1.143 mm	0.045 in
Radial	1.015 mm	0.040 in
Dual Wheel Applications	2.3 mm	0.0938 in
On-Vehicle Hub Check	1.52 mm	0.06 in

One - Piece Propeller Shaft Runout

Application	Metric	English
Front	1.016 mm	0.040 in
Center	1.27 mm	0.050 in
Rear	1.40 mm	0.055 in

Two - Piece Propeller Shaft Runout

Application	Metric	English
Front	0.762 mm	0.030 in
Center	0.762 mm	0.030 in
Rear	0.889 mm	0.035 in

Three - Piece Propeller Shaft Runout

Application	Metric	English
Front	1.016 mm	0.040 in
Center	1.27 mm	0.050 in
Rear	1.40 mm	0.055 in

Propeller Shaft Balancing Weight Amounts

Correction, Total Weight	Clamp Spread, Degrees
0.0	180
0.1	174
0.2	169
0.3	163
0.4	157
0.5	151
0.6	145
0.7	139
0.8	133
0.9	127
1.0	120
1.1	113
1.2	106
1.3	99
1.4	91
1.5	83
1.6	74
1.7	64
1.8	52
1.9	36
2.0	0

Diagnostic Information and Procedures

Systematic Approach

During the last 10 to 15 years, vehicle design and engineering have dramatically changed because of increased fuel costs, decreased fuel supplies, Corporate Average Fuel Economy requirements, clean air legislation, foreign competition, crashworthiness, and rising customer expectations. Vehicle designs have evolved from full-frame construction, utilizing multiple noise/vibration isolating body mounts, to lighter unibody designs that transfer noise and vibration much more readily.

General Motors has greatly reduced the use of heavier and smoother running V8 engines, replacing them with lighter, more fuel-efficient engines. During this same period, options such as air conditioning, power steering, and have become more and more popular. These types of options increase engine load. They can also generate unwanted noise and vibration.

Customer perception of quality can be directly linked to the presence or absence of unwanted noise and vibration. A technician's ability to quickly diagnose and repair a noise or vibration directly affects that customer's loyalty to the dealership. Technicians who are capable of satisfying this need will be highly regarded and in great demand.

The intent of this section of the service manual is to provide a systematic approach to vehicle vibration diagnosis and correction. By using Strategy Based Diagnosis and troubleshooting philosophies covered in this section, technicians will be able to provide effective and timely repairs.

Vibration Diagnosis

Engine Firing Frequencies

Condition	Engine Speed (RPM)	Any Engine First Order (Hz)	6-Cylinder Third Order (Hz)	8-Cylinder Fourth Order (Hz)
Shake	500	8.3	24.9	33.2
	750	12.5	37.5	50
	1000	16.6	49.8	66.4
	1500	25	75	100
Roughness	2000	33.3	99.9	133.2
	2500	41.6	124.8	166.4
Buzz	3000	50	150	200
	3500	58.3	174.9	233.2
	4000	66.6	199.8	266.4

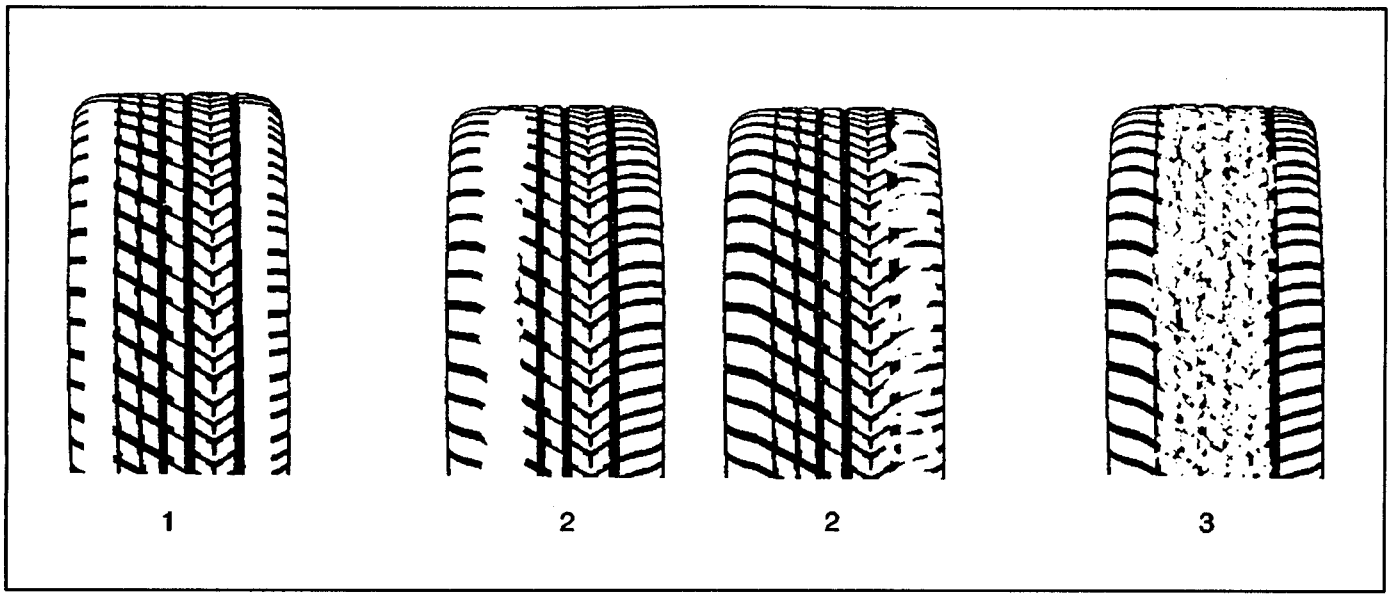
Engine Order Vibration

Engine Order	L6	V8 90°
1/2 Order Torque Sensitive	Single Cylinder Misfire	Single Cylinder Misfire
1st Order Imbalance	Abnormal	Abnormal
1.5 Order Torque Sensitive	-	-
2nd Order	Abnormal	Abnormal
2nd Order Torque Sensitive	-	Bank-to-Bank EGR/Fuel Variance
3rd Order Torque Sensitive	Normal	-
4th Order Torque Sensitive	-	Normal

Road Test

Tire and Wheel Inspection

The tires on all new Medium Duty models have a tire rating molded on the sidewall. A replacement tire should have the same rating.



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Legend

(1) Hard Cornering, Under Inflation
(2) Excessive Toe on Non–Drive Axle
(3) Heavy Acceleration on Drive Axle, Excessive Toe on Drive Axle, Over Inflation

This test should be performed for ALL vibration complaints unless the disturbance occurs only with the vehicle at a standstill.

Inspect the tire and wheel assemblies for the following conditions:

- Unusual wear such as cupping, flat spots, and heel-and-toe wear

  (These conditions can cause tire growl, howl, slapping noises, and vibrations throughout the vehicle.)
- Proper inflation
- Bulges in the sidewalls

  (Not to be confused with normal ply splices, commonly seen as indentations in the sidewall.)
- Bent rim flanges

Inspecting these characteristics of the tire and wheel assemblies may lead to the cause of the vibration. At the very least, the inspection will provide assurance that the vehicle is safe for road testing.

Slow Acceleration Test

This test will identify the engine-speed or vehicle-speed related conditions. Additional tests may be necessary in order to determine in which category the vibration belongs.

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. On a smooth, level road, slowly accelerate up to highway speed.
3. Look for disturbances that match the customer's description.
4. Note the following readings where the disturbance occurs:
   - The vehicle speed, km/h (mph)
   - The engine speed (RPM)
   - The frequency (if possible)

Following this test, perform the Neutral Coast-Down Test and the Downshift Test.

Neutral Coast-Down Test

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. On a smooth level road, accelerate to a speed slightly higher than the speed at which the vibration occurs.
3. Shift the vehicle into NEUTRAL and coast down through the vibration range.

   Note if the vibration is present in NEUTRAL.

If the vibration still occurs in NEUTRAL, then the vibration is definitely vehicle-speed sensitive. At this point, the engine, the clutch disc (manual transmission), the propeller shaft (located inside the driveline support assembly), the transmission flex plate (automatic transmission) and the torque converter have been eliminated as a cause. Depending on the symptoms or frequency, the repair will concentrate on the tire and wheel assemblies, the transmission output shaft, the rear axle differential pinion, or the rear drive axle shafts.

Downshift Test

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. On a smooth, level road, accelerate to the speed at which the complaint vibration occurs. Note the engine RPM.
3. Decelerate and safely downshift to the next lower gear (from OVERDRIVE to DRIVE, or from DRIVE to SECOND, etc.)
4. Operate the vehicle at the previous engine RPM.

If the vibration returns at the same engine RPM, the engine, the clutch disc (manual transmission), the propeller shaft (located inside the driveline support assembly), the transmission flex plate (automatic transmission), or the torque converter are the most probable causes. You may repeat this test is still smaller gears, and in NEUTRAL, in order to confirm the results.

In some cases, a vibration may be sensitive to torque or engine load, as well as being related to a specific engine (RPM) or vehicle (km/h / mph) speed. These vibrations can be most difficult to diagnose, and require additional testing. Still, following a systematic approach usually leads to pinpointing the problem.

Neutral Run-Up Test

This test is designed to identify engine-speed related vibrations. Use this test when the customer complains of vibration at idle, or as a follow-up to the downshift test. This test more than likely doesn't apply when the complaint is vehicle-speed related only (appearing at the same vehicle speed regardless of the engine speed).

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. Slowly increase the engine speed while looking for disturbances that match the customer's complaint.
3. Note at which engine speed (rpm) and frequency (if possible) that the vibration occurs.

Brake Torque Test

This test is designed to identify engine-related vibrations that were not uncovered with the Neutral Run-Up Test. This test also works for vibrations that are sensitive to the engine load or to the torque. This test will more than likely not apply to vehicle-speed related only vibrations.

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. Apply the parking brake.
3. Block the front wheels.
4. Step firmly on the brake pedal.
5. Place the vehicle in Drive.
6. Slowly increase the engine speed while looking for vibrations that match the customer's description.
7. Note the engine speed (rpm) and frequency (if possible) at which the disturbance occurs.
8. Repeat steps 4, 6, and 7 in Reverse, if necessary.

Additional Tests

You can perform one or more of the following tests for unique vibration complaints such as those that are torque/load sensitive, in addition to vehicle-speed or engine-speed sensitive:

- Steering Input Test
- Standing Start Acceleration Test

Steering Input Test

This test is intended to determine how much the wheel bearings and other suspension components contribute to the vibration, especially those relating to noises such as growl, grinding, and roaring.

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. Drive through slow sweeping turns with the vehicle at the vibration speed (mph) in one direction, then in the other.
3. If the vibration gets worse or goes away, inspect the following components as possible causes of the vibration:
   - The wheel bearings
   - The hubs
   - The tire tread

Standing Start Acceleration (Launch Shudder) Test

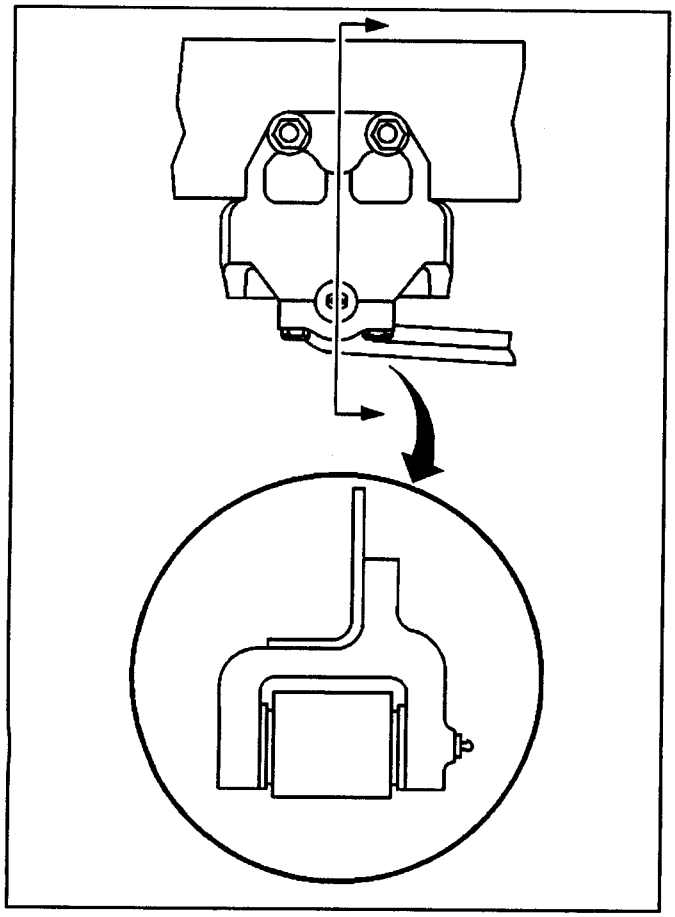
The purpose of this test is to duplicate a vibration called launch shudder. In some cases, a powertrain mount or an exhaust ground-out may also be suspected, depending on the symptoms.

1. Observe the necessary safety precautions. Refer to *Road Test Caution* in Cautions and Notices.
2. With the vehicle at a complete stop and in gear, remove your foot from the brake pedal.
3. Accelerate to 48–64 km/h (30–40 mph) while looking for vibrations that match the customer's description.

Other possible causes of launch shudder include the following conditions:

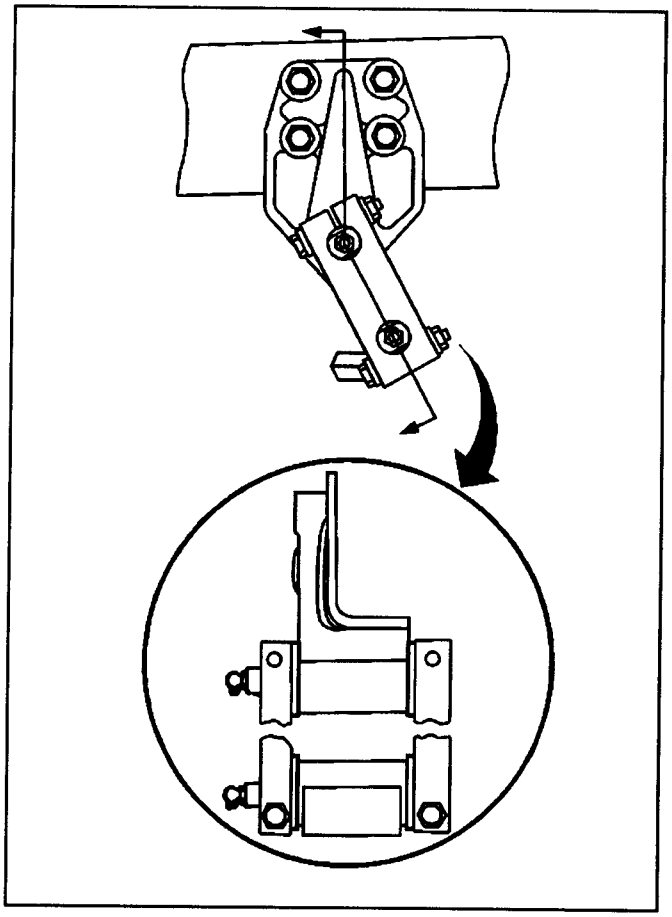
- Incorrect trim height. Refer to the vehicle Body Builder.
- A damaged propeller shaft.
- Worn universal joins.
- A ground-out engine/transmission mount.
- Faulty exhaust hangers and mounts.

Front Spring Shackle Inspection Test



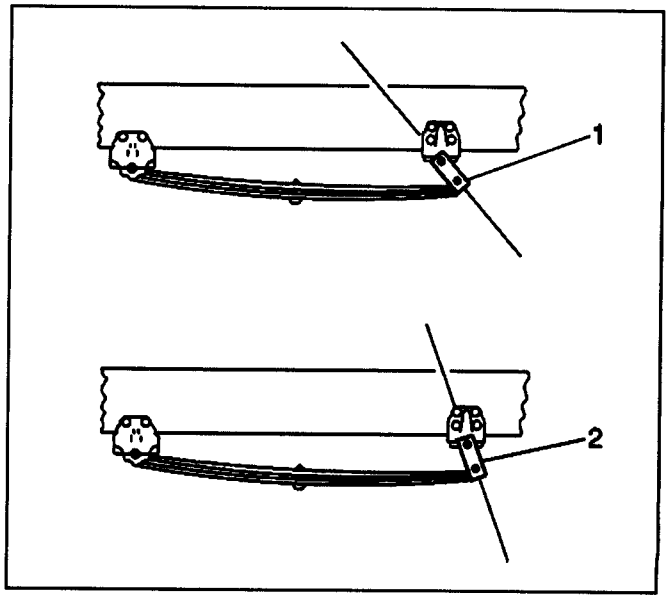
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The lateral gap between the front spring eyes and or shackle and the frame mounted spring hanger brackets should be measured with a feeler gauge and not exceed 1.016 mm (0.040 in). Thrust washers should be used to bring the lateral gap within tolerances.



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Exceeding this clearance may result in wander, shake, or shimmy and a slapping noise.



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If a vehicle rides well on a smooth road surface and a jolt or severe "slap-in-the back" occurs when passing over highway irregularities, the shackle pins, shock absorbers, cab mounts and fifth wheel should be inspected and corrected as required.

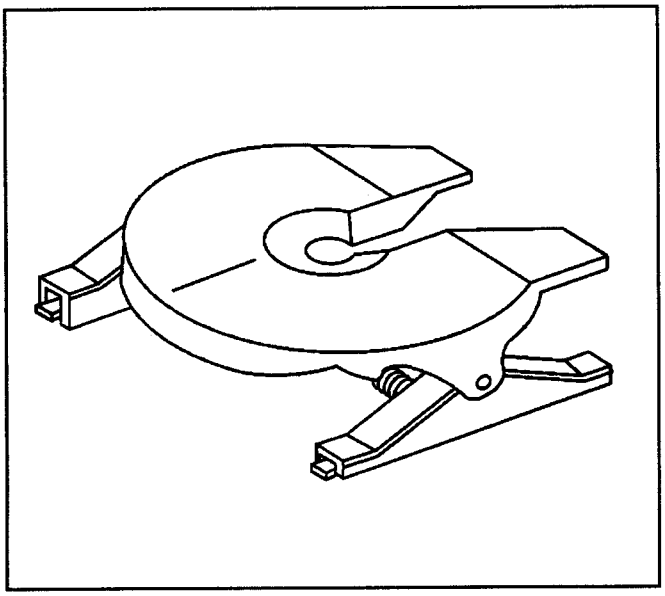
Shackle Pin Inspection Test

Apply grease to the front spring pin and shackle pin lubrication fittings (if equipped). As grease is applied, it should come out evenly at each end of the pins. If the assemblies accept grease readily and grease comes out each end of the assemblies, it is a good indicator they are actuating properly and not seized.

Another method of inspecting the front spring pins to ensure that they are not seized requires placing jacks under the frame rail at the front of the vehicle and lifting the vehicle. If the spring pivots around the front spring pin, and the shackle link position changes in relation to the spring leaves on the bottom and mounting bracket on the top, the assemblies are activating properly.

If the shackle link position does not change, replace the front spring pin and shackle pins as required.

Fifth Wheel Inspection Test



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Rock the fifth wheel mounting plate manually up and down to ensure that it pivots freely in the fifth wheel support bracket. If the fifth wheel mounting plate is seized or the pivot bushings are worn, service as required.

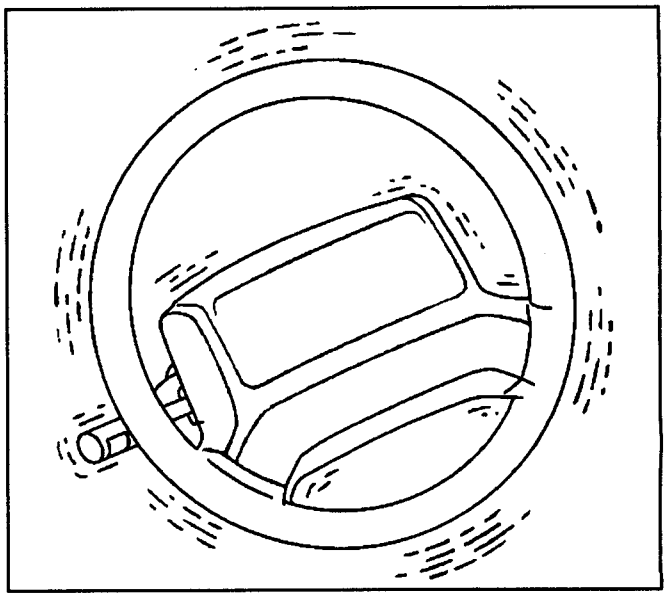
Classifying the Vibration

The next step after road testing the vehicle is to identify the frequency of the duplicated and abnormal vibration. Use the EVA in order to measure the frequency. If the EVA is not available, the frequency can be categorized into groups according to how the vibration feels or sounds. The majority of vibrations will fit into one of the following categories.

- Vibrations that can be felt:
  - Shake
  - Roughness
  - Buzz
  - Tingling
- Vibrations that make noise:
  - Boom
  - Moan and groan
  - Howl
  - Whine

Vibrations That Can Be Felt

Shake



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The shake is a low frequency vibration, typically 5–20 Hz. The shake is sometimes seen in the steering wheel, the seat, or the console. The best description is the feeling from an out-of-round or unbalanced tire. Customers may refer to shake in one of the following terms:

- Shimmy
- Wobble
- Shudder
- Waddle
- Hop

In most cases, damage to or wear of the following components is to blame for the shake:

- The tires
- The wheels
- The brake rotors (vehicle-speed sensitive)
- The steering tie rod ends
- The suspension ball joints
- The engine (engine-speed sensitive)

Roughness

Roughness is a vibration with a slightly higher frequency than the shake, usually 20–50 Hz. Roughness is similar to the feeling you get from holding a jigsaw.

Buzz
Buzz is slightly higher in frequency: 50–100 Hz. A buzz is similar to the feel of an electric razor. You may feel it in your hands through the steering wheel, in the feet through the floor, or in the seat. Inspect the following components for a possible cause:

- The exhaust system
- The A/C compressor
- The engine

Tingling
This is the highest frequency that can still be felt. Tingling may sometimes produce a PINS AND NEEDLES sensation. Customers may say the vibration puts their hands or feet TO SLEEP.

Vibrations That Make Noise

Boom
Boom is a low frequency interior noise of 20–60 Hz. Sometimes the customer complains of a pressure in their ears. Examples of similar noises include a bowling ball rolling down an alley, deep thunder, or a bass drum.

A customer may use the following words to describe boom:

- Droning
- Growling
- Moaning
- Roaring
- Rumbling
- Humming

Boom may not be accompanied by a perceptible vibration (roughness).

Moan or Drone
Moan or drone is a sustained tone at a low frequency of 60–120 Hz, somewhat higher than boom.

Examples of similar noises include a bumble bee, or blowing air across the top of a soda bottle. Examples of words to describe moan or drone are humming, buzzing, resonance. Moan or drone may be accompanied by a perceptible buzzing vibration. Inspect the following systems:

- The powertrain mounts
- The exhaust system.

Howl
Howl is a noise at mid-range frequency of 120–300 Hz. This sounds like the wind howling.

Whine
Whine is a prolonged, high-pitched sound in the 300–500 Hz range, and is usually related to the meshing gears or gear noise. Similar sounds include mosquitoes, turbine engines, and vacuum cleaners.

Matching Frequency to Component Speed

At this point in the diagnosis, the vibration has been duplicated, designated as abnormal, identified as being related to engine speed or vehicle speed, and assigned a frequency from the EVA or categorized into a symptom group based on how it feels or sounds.

Automotive vibrations are usually related to the rotating speed of a component. The speed of these components will be calculated using either an engine speed or vehicle speed method. The engine rpm readings taken during the road test will be used in diagnosing vibrations that are engine speed sensitive. If the vibration is vehicle speed sensitive, the rotational speed of the tires needs to be determined. As long as the vehicle is operated at a constant speed, the tires will operate at a constant speed. These speed is measured in rotations or cycles per second. The reading is then compared to the frequency of the vibration, which is also measured in cycles per second.

Calculating Tire Rotation

TIRE/WHEEL AND PROPSHAFT ROTATION

Vehicle Information

Complaint Speed: _____ km/h (mph)
Year: _____ Model: _____
Symptom: _____ VIN: _____
Frequency: _____ Engine: _____ Trans: _____
Engine Speed: _____ rpm Tire Size: _____ Axle Ratio: _____
Gear: _____ TPC Spec: _____

Tire/Wheel Speed

Vibration Occurs at:		km/h ÷ 8(km/h) mph ÷ 5(mph)			=	Increments of 8 km/h (5mph)
8 km/h (5mph) increments		x		tire RPS* at 8 km/h (5mph) (from chart)	=	Tire/Wheel Speed, RPS (Hz) 1st order
1st order		x 2			=	2nd order
1st order		x 3			=	3rd order

Propeller Shaft Speed

						Propeller Shaft Speed
1st order tire		x		(axle ratio)	=	1st order
1st order propshaft		x 2			=	2nd order

*RPS = revolutions per second; equates to cycles per second (Hz).

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Determine the rotational speed of the tires in revolutions per second, or Hertz (Hz), based on the vehicle speed at which the vibration occurs. In order to determine the rotational speed, follow this procedure:

1. Determine the complaint speed — the vehicle speed at which the vibration occurs.
2. Determine the number of 8 km/h (5 mph) increments:
   - Divide the complaint speed by 8 when using km/h.
   - Divide the complaint speed by 5 when using mph.
3. Measure the tires rolling circumference.
4. Divide the tires rolling circumference by 88.
5. Multiply the Hertz value by the number of 8 km/h (5 mph) increments.
6. The result is the rotational speed of the tires in Hertz at the complaint speed. If this figure matches the vibration frequency, a first-order vibration is present in the tire and wheel assembly.

Sometimes, the tire/wheel vibration may be of a higher-order. In order to compute possible higher-order vibrations, multiply the rotational speed of the tires in Hertz at the complaint speed by the order number. If any of these matches the vibration frequency, then a vibration of that particular order is present in one of the tire and wheel assemblies.

Steering and Suspension Assembly Vibrations

Steering and suspension assembly vibrations are the first level of testing for low-frequency vibrations that are vehicle-speed sensitive. The symptoms if a steering/suspension first-order vibration are shimmy or shake, usually felt in the steering wheel or in the seat. Inspect the following components for wear or damage:

- The steering tie rod ends.
- The suspension ball joints.

Tire and Wheel Vibration

Problem	Possible Cause	Correction
Wheel Hop, Vehicle Vibration, and Rough Steering	Rocks and debris wedged between dual disc wheels	Remove the rocks and debris.
	An out-of-balance tire and/or hub and drum/rotor assembly	Determine the out-of-balance component. Balance the component or replace the component.
	Loose or worn driveline or suspension components	Identify the location of the vibration. Vibration may be transmitted through the frame, so that a rear end vibration gives the impression of coming from the front. Repair or replace the loose or worn components.
Wobble, Vehicle Vibration, and Rough Steering	A bent or distorted disc from overloading or improper handling	Replace the wheel.
	• Loose mountings • Damaged studs or wheel nuts • Enlarged stud holes • A worn or a broken hub face • Foreign material on the mounting surfaces	Replace the worn or damaged components.
	Improper alignment	Align the wheels. Refer to *Wheel Alignment Specifications* in Wheel Alignment.
	Loose, worn, or broken suspension components	Repair the components or replace the components.

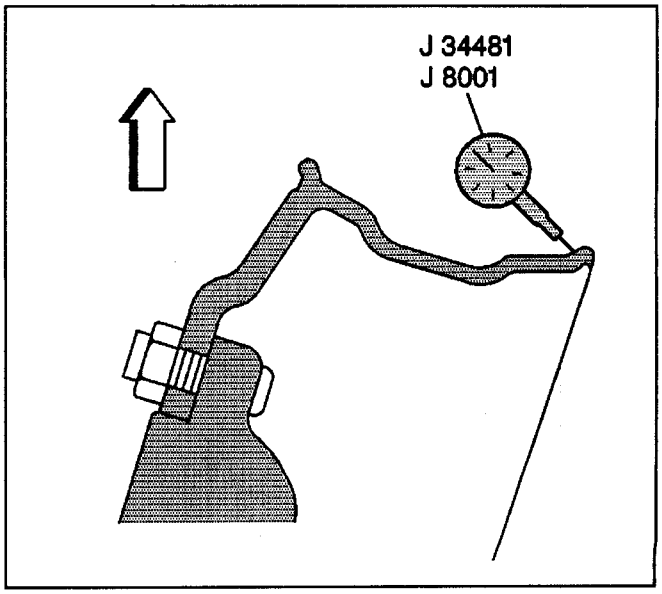
Tire and Wheel Runout Measurement

Aluminum Disc-type Wheels

Tools Required

- *J 8001* Dial Indicator Set
- *J 34481* Universal Flexible Magnetic Dial Indicator Stand

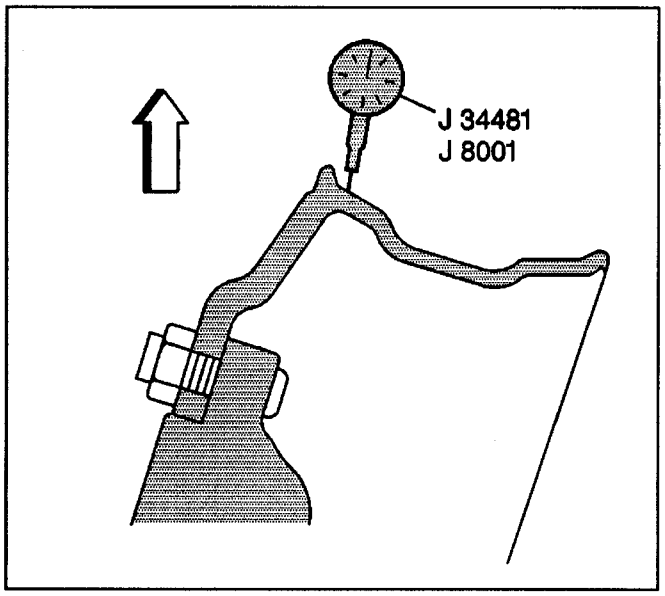
1. Inspect the torque of the wheel nuts.
2. Inspect the rim-to-drum or the rim-to-hub mating surfaces. Verify that the surfaces are clean and free of distortions and corrosion.
3. Remove the tire-wheel assembly. Refer to *Wheel Removal (Front)* or *Wheel Removal (Dual/Rear)* in Tires and Wheels.
4. Remove the tire from the wheel. Refer to *Tire Mounting and Dismounting* in Tires and Wheels.
5. Clean the rim-to-hub or the rim-to-drum mating surface and install the rim. Refer to *Wheel Installation (Front)* or *Wheel Installation (Dual/Rear)* in Tires and Wheels.



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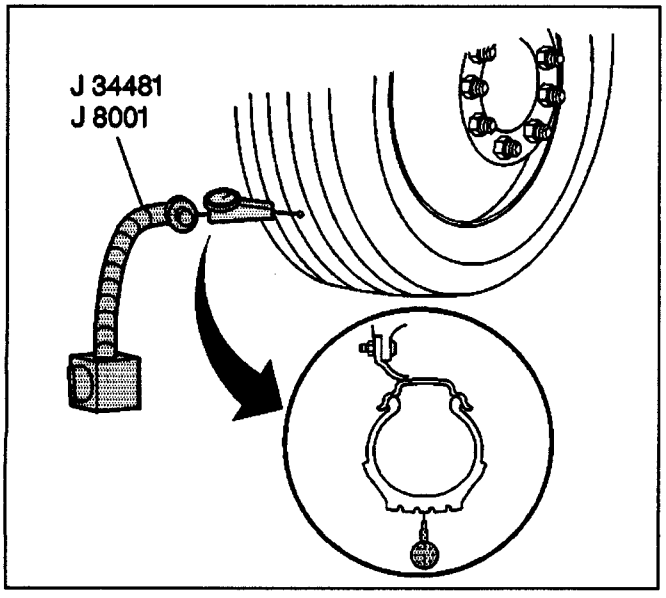
6. Position *J 34481* so that *J 8001* contacts the rim surface.

7. Measure the wheel lateral runout using *J 8001* while gently turning the rim.
   Reading
   The lateral runout at the rim should not exceed 3.1 mm (0.125 in). If the rim exceeds this measurement, replace the rim.



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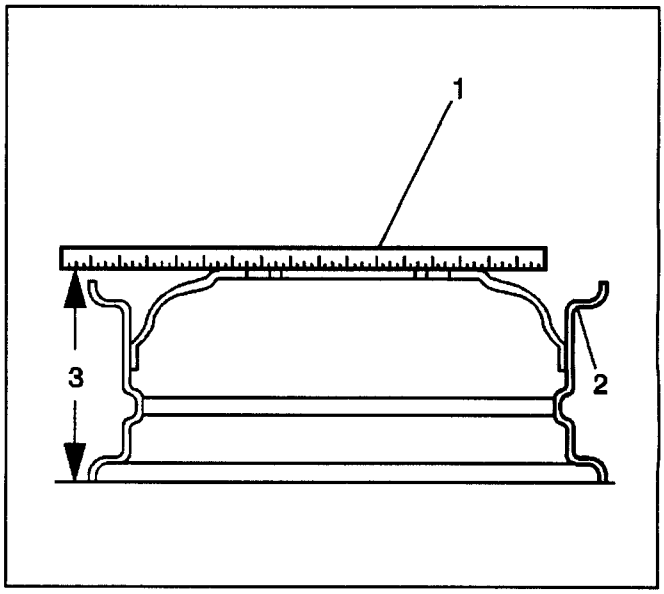
8. Position *J 34481* so that *J 8001* contacts the rim surface.
9. Measure the wheel radial runout using *J 8001* while gently turning the rim.
   Reading
   The radial runout at the rim should not exceed 3.1 mm (0.125 in). If the rim exceeds this measurement, replace the rim.



209840

10. Mount the tire to the wheel. Refer to *Tire Mounting and Dismounting* in Tires and Wheels.
11. Install the tire-wheel assembly. Refer to *Wheel Installation (Front)* or *Wheel Installation (Dual/Rear)* in Tires and Wheels.
12. Position *J 34481* so that *J 8001* contacts the tire surface.
13. Measure the total radial runout using *J 8001* while gently turning the wheel.
    Reading
    The radial runout at the rim should not exceed 3.1 mm (0.125 in).
14. If the wheel exceeds this measurement, demount the wheel. Clean the rim-to-tire mating surfaces and mount the wheel to the rim. Refer to *Tire Mounting and Dismounting* in Tires and Wheels. Return to the previous step and recheck the runout.

Off-Vehicle Hub and Wheel Check



209843

1. Place a straightedge on the face or the hub of the wheel.
2. Measure the distance from the straightedge (1) to the edge of the rim (2) at four equally spaced locations. If the distance (3) is the same at all positions, then the wheel is not distorted.
   You may also check a dismounted wheel for radial and lateral runout. Temporarily mount the wheel to a hub on the vehicle. Follow the procedure for the On-Vehicle Check.

On-Vehicle Hub Check

If you are not certain whether the wheel or the hub is distorted, check the hub using the following procedure:

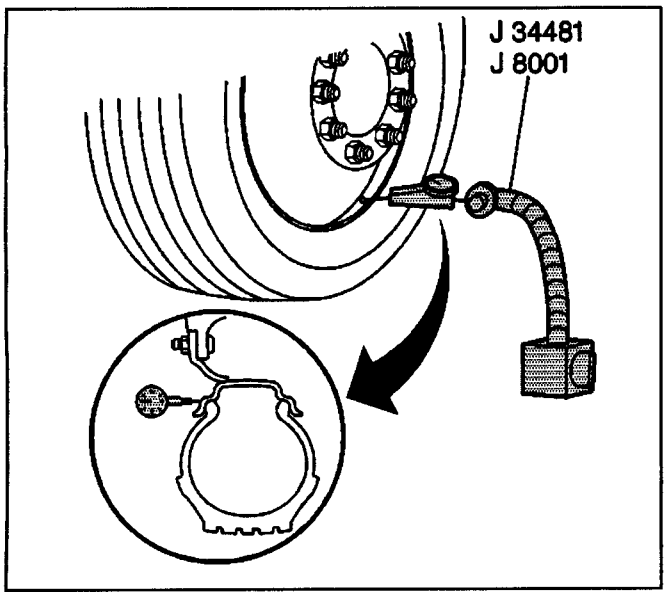
1. Replace the existing wheel with a wheel known to be good.
2. Turn the wheel and perform the same measurements shown in the previous procedure.
3. If the measurements are within the limits of 2.3 mm (0.0938 in) laterally and radially, then the wheel is good, but the hub is sprung.

Steel Disc-type Wheels

Tools Required

- *J 8001* Dial Indicator Set
- *J 34481* Universal Flexible Magnetic Dial Indicator Stand

1. Inspect the torque of the wheel nuts.
2. Inspect the rim-to-drum or the rim-to-hub mating surfaces. Verify that the surfaces are clean and free of distortions and corrosion.
3. Raise and support the axle on the side that you are preparing to inspect.

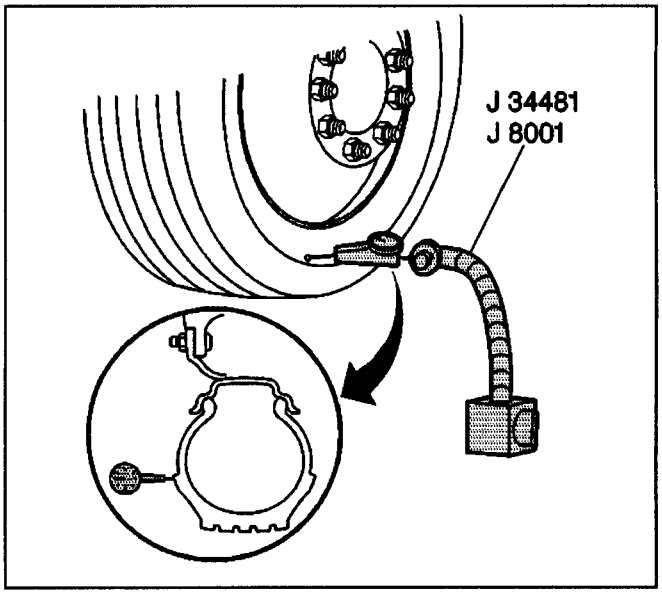


209835

4. Position *J 34481* so that *J 8001* contacts the rim surface.
5. Measure the wheel lateral runout using *J 8001* while gently turning the rim.

   Reading

   - The lateral runout at the rim should not exceed 3.1 mm (0.125 in) for single wheels.
   - The lateral runout at the rim should not exceed 4.7 mm (0.187 in) for dual wheels.
6. If the rim exceeds this measurement, replace the rim.

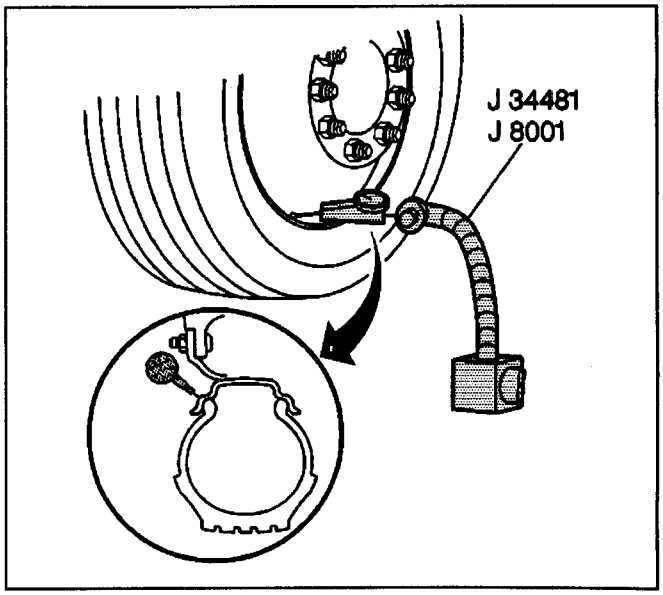


209838

7. Position *J 34481* so that *J 8001* contacts the tire surface.
8. Measure the total lateral runout using *J 8001* while gently turning the wheel.

   Reading

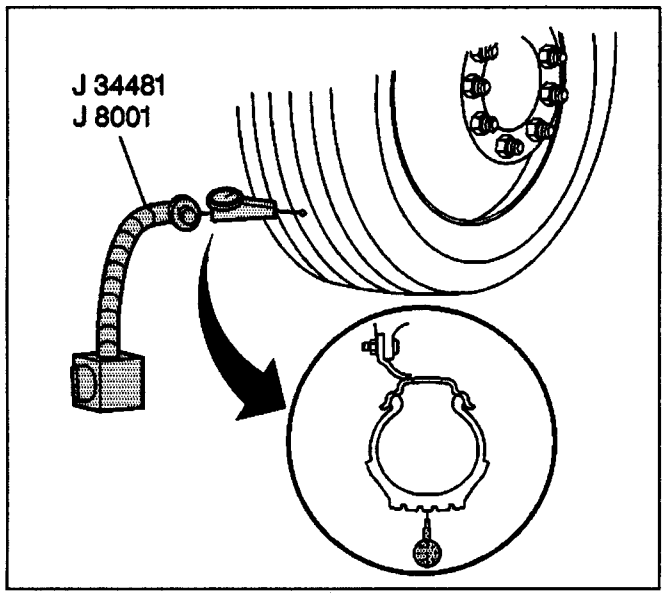
   - The lateral runout at the rim should not exceed 3.1 mm (0.125 in) for single wheels.
   - The lateral runout at the rim should not exceed 4.7 mm (0.187 in) for dual wheels.
9. If the wheel exceeds this measurement, demount the wheel. Clean the rim-to-tire mating surfaces and mount the wheel to the rim. Refer to *Tire Mounting and Dismounting* in Tires and Wheels. Return to the previous step and recheck the runout.



209839

10. Position *J 34481* so that *J 8001* contacts the rim surface.

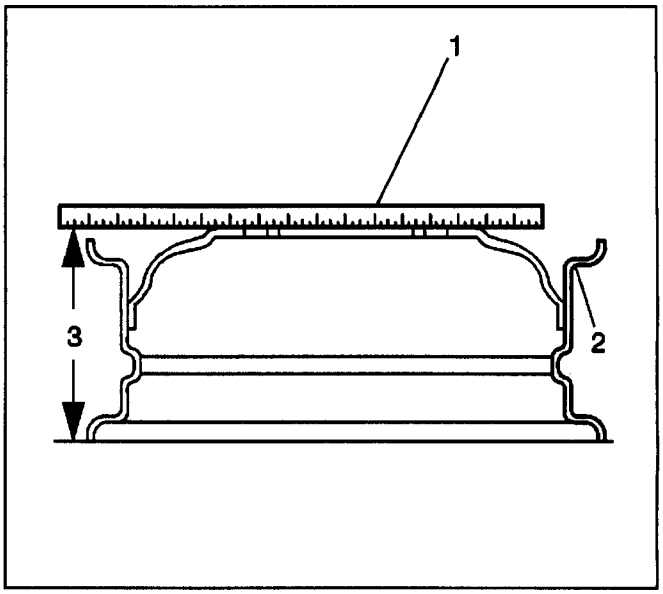
11. Measure the wheel radial runout using *J 8001* while gently turning the wheel.
    Reading
    The radial runout at the rim should not exceed 3.1 mm (0.125 in). If the rim exceeds this measurement, replace the rim.



209840

12. Position *J 34481* so that *J 8001* contacts the tire surface.
13. Measure the total radial runout using *J 8001* while gently turning the wheel.
    Reading
    The radial runout at the rim should not exceed 3.1 mm (0.125 in).
14. If the wheel exceeds this measurement, demount the wheel. Clean the rim-to-tire mating surfaces and mount the wheel to the rim. Refer to *Tire Mounting and Dismounting* in Tires and Wheels. Return to the previous step and recheck the runout. if runout is excessive, replace the rim.

Off-Vehicle Hub and Wheel Check



209843

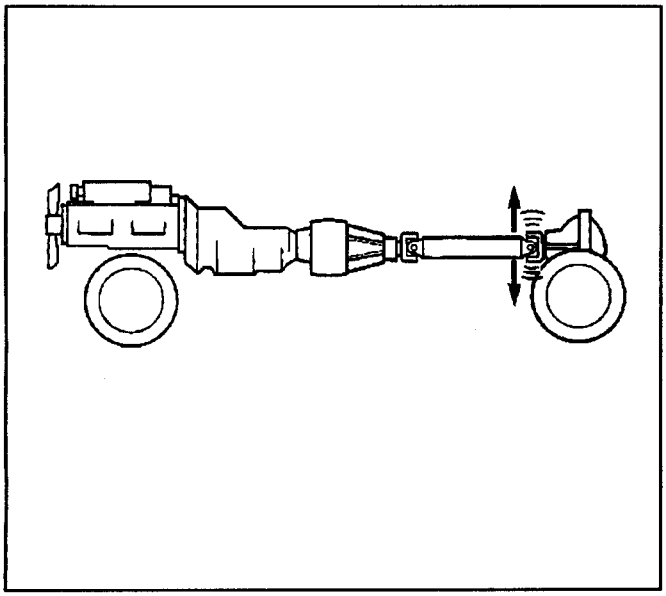
1. Place a straightedge on the face or the hub of the wheel.
2. Measure the distance from the straightedge (1) to the edge of the rim (2) at four equally spaced locations. If the distance (3) is the same at all positions, then the wheel is not distorted. You may also check a dismounted wheel for radial and lateral runout. Temporarily mount the wheel to a hub on the vehicle. Follow the procedure for the On-Vehicle Check

On-Vehicle Hub Check

If you are not certain whether the wheel or the hub is distorted, check the hub using the following procedure:

1. Replace the existing wheel with a wheel known to be good.
2. Turn the wheel and perform the same measurements shown in the previous procedure.
3. If the measurements are within the limits of 2.3 mm (0.0938 in) laterally and radially, then the wheel is good, but the hub is sprung.

Driveline Vibration Analysis with EVA



301903

The following components are possible sources of driveline vibration:

- The transmission output shaft
- The propeller shaft/s (driveshaft/s)
- The union flange
- The pinion gear

The above components are either bolted or splined together. Therefore, all of the components rotate at the same speed, vibrate at the same frequency and have the same symptoms.

Driveline vibrations may relate either to the first or to the second order of driveline rotation. Driveline vibrations are always related to the speed of the vehicle. The vibration is often related to torque. If the vibration is worse or only noticeable when accelerating, decelerating, or crowding the throttle, then the vibration is related to the torque. The vibration will always occur at the same speed. If a vibration is both torque and speed sensitive, the driveline is the probable cause. Tire/wheel vibrations are speed sensitive, but not torque sensitive.

First-Order Driveline Vibration Symptoms

The following symptoms may indicate first-order driveline vibration:

- The vibration is related to vehicle speed.
- The vibration is torque sensitive.
- A "boom" or "moan" noise is present.
- The vibration occurs commonly above 72 km/h (45 mph), but possibly as low as 48 km/h (30 mph).
- The "roughness" or "buzz" vibration is felt in the seat, floor or steering wheel.
- The corresponding frequency on the EVA equals first-order driveline rotation (25-60 Hz), depending on the speed of the vehicle and the ratio of the axle. Refer to the worksheet in order to obtain the rotation speed of the propeller shaft.

Driveline Vibration Analysis

Once you identify a vibration that is related to the driveline, continue testing in this service area. The following components are possible sources of first-order driveline vibration:

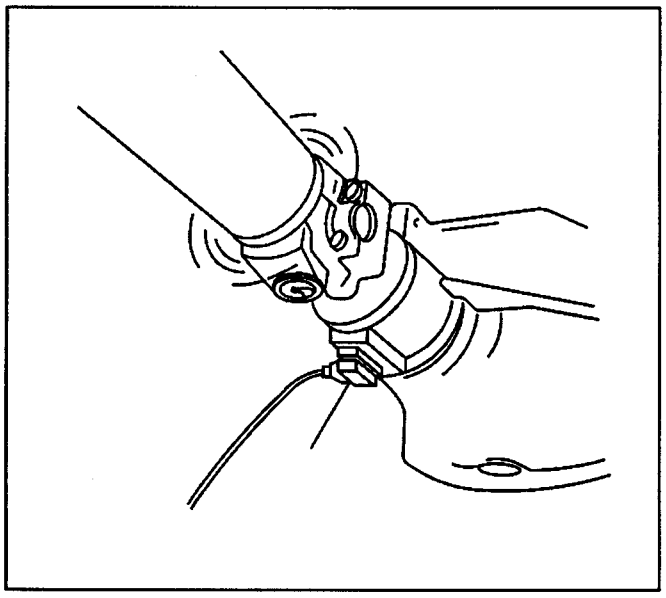
- The propeller shafts
- The transmission output shaft
- The pinion flange
- The pinion gear

Locate the Source of Driveline Vibration with the EVA

Caution: Never run the vehicle faster than 112 km/h (70 mph) when performing propeller shaft vibration or checking for balance. Stay clear of rotating components and balance weights to avoid personal injury. Do not run the vehicle on the hoist for extended periods of time to avoid engine or transmission overheating. Do not step on the brake pedal with the brake drums removed.

In order to pinpoint the source of vibration, reproduce the vibration with the vehicle in the service stall. Then determine which component is vibrating the most using the EVA and the following procedure:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Front)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Shoe Replacement* in Air Drums.
4. Ensure that the propeller shaft is free of undercoating.
5. Inspect the propeller shaft and U-joints for dents or damage.
6. Start the engine.
7. Place the transmission in gear.
8. Run the vehicle at the speed which the vibration occurs.



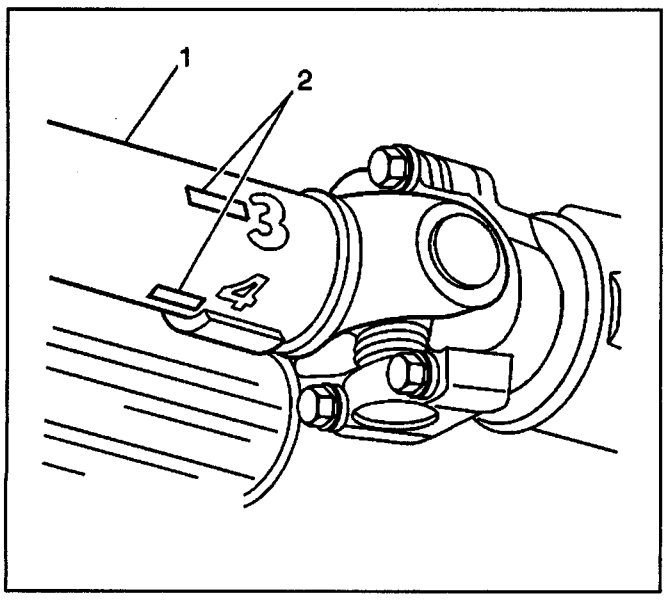
176032

Hold the EVA sensor against the pinion nose and the transmission tailshaft assembly in order to determine which end of the propeller shaft has the most vibration. The end that has the most vibration will have a higher amplitude on the EVA.

If the vehicle has a two-piece propeller shaft, inspect the center support bearing.

If the transmission tailshaft vibrates, inspect the transmission crossmember under the transmission mount. If the mount is secured properly, there should be no vibration at the crossmember.

Runout and Balance Testing with the EVA



182137

Ensure that the runout of the various driveline components are within specifications. If the runouts are within specifications, strobe balance the driveline.

The EVA is able to simplify the balancing process. Use the following procedure:

1. Use the EVA in order to determine which end of the propeller shaft has the most vibration.
2. Mark the end of the propeller shaft (1) that has the most vibration at four points (2), 90 degrees apart. Number the marks 1 through 4.
3. Mount the EVA sensor onto the bottom of the following components:
   - The differential housing
   - The center bearing support (for two-part propeller shafts)
   - The transmission tailshaft assembly
4. Position the sensor as close to the propeller shaft as possible. Ensure that the UP side of the sensor faces up. Ensure that the sensor is horizontal.

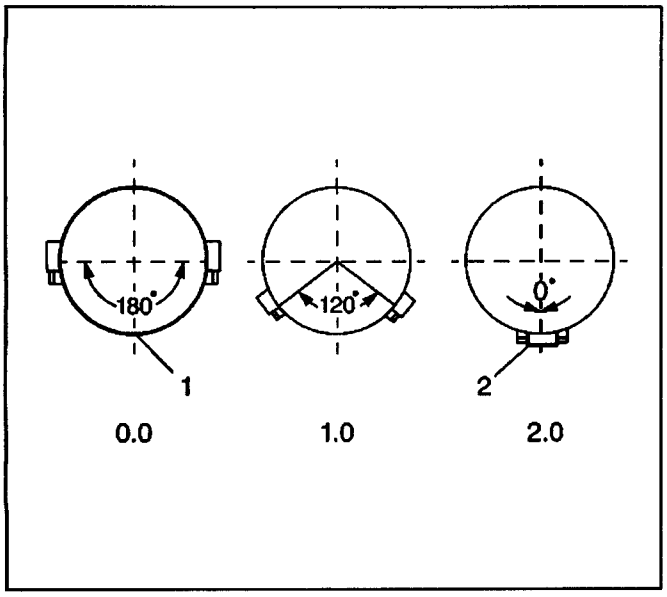
   Notice: Do not use cruise control to maintain vehicle speed.
5. Start the engine.
6. Turn off all engine accessories.
7. Place the transmission in gear.
8. Run the vehicle at the speed which causes the most vibration in the propeller shaft.
9. Hook the timing light clip to the trigger wire.
10. Plug the vibration sensor into Input A of the EVA. Input B does not have strobe light capability.
11. Verify that the predominant frequency on the EVA display matches the frequency of the original vibration. Use the strobe light only if the rotation speed of the propeller shaft is the predominant frequency.
12. The EVA displays a series of questions in order to select the correct filter. Press YES in order to select the desired filter. Ensure that the frequency is in the middle of the filter range. Use the full range only as a last resort.
13. The EVA displays the test frequency, the amplitude and the filter range. The driveline is balanced when the amplitude is near two. In some cases a slightly higher amplitude will provide adequate balance.
14. Point the timing light at the propeller shaft. The strobe effect will appear to freeze the propeller shaft. Note which of the numbered marks is at the bottom of the propeller shaft (the 6 o'clock position). This position is the light spot.
15. Turn the engine off.
16. Install a weight directly on the light spot.
17. Start the engine.
18. Run the vehicle at peak vibration speed.
19. Strobe the propeller shaft again.

The propeller shaft is balanced if the strobe image is erratic and the amplitude is near two.

The propeller shaft is not balanced if one of the following conditions exist:

- The weight and the original light spot are at the 6 o'clock position — This condition means that there is not enough weight on the propeller shaft.

  In order to correct the balance, add a second weight next to the first weight. Inspect the balance again using the strobe light.



182176

  If the weights are now between 90 and 180 degrees off (between the 9 and the 3 o'clock positions) there is too much weight. In order to correct the balance, split the two weights equally on either side of the original light spot. Splitting the weight will produce a total weight between one and two weights.

  Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and original light spot are 90 to 180 degrees off (between the 9 and the 3 o'clock positions) — This condition means that one weight is too much.

  In order to correct the balance, split the two weights equally on either side of the original light spot. in order to produce a total weight less than one (between 120 and 180 degrees apart).

  Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and the original light spot are within 180 degrees of the 6 o'clock position.

  Move weight towards the 6 o'clock position. Inspect the balance again using the strobe light. Adjust the weight as necessary. Refer to the previous two conditions.

If the shaft will not balance using two weights, then place a third weight on the light spot. Split the first two weights in order to produce a total weight between two and three weights.

If three weights fail to balance the driveline, replace the propeller shaft.

When the propeller shaft balances, road test the vehicle in order to verify that the vibration is eliminated.

First-Order Driveline Vibration Analysis (Torque Sensitive)

If the vehicle has a vibration that is equal to first-order driveline rotation, and the vibration is not present when testing the vehicle in the stall, then internal rear axle components are the probable cause of the vibration.

Internal rear axle components are also the probable cause of the vibration if you were able to correct the vibration in the stall, but the vibration returned during the road test. Internal rear axle vibrations may be aggravated by the load of the vehicle working against the ring and pinion gear seat.

Since the propeller shaft and the pinion gear are bolted together through the pinion flange, the propeller shaft and the pinion gear operate at the same speed. Vibration in the pinion gear will therefore have the same frequency and symptoms as the propeller shaft.

In order to isolate the vibration to the pinion gear, use the following procedure:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire/wheel assemblies. Refer to *Wheel Removal (Front)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Shoe Replacement* in Air Drums.
4. Touch the pinion nose, or hold the EVA vibration sensor up to the pinion nose.
5. Use another technician in order to accelerate and decelerate the vehicle through the speed range at which the vibration was noticed during the road test.

   Example

   - If the vibration was originally noticed at 88 km/h (55 mph), accelerate from 72 km/h (45 mph) to 107 km/h (65 mph). Then decelerate from 107 km/h (65 mph) back to 72 km/h (45 mph).
   - Repeat the above step and note whether or not the pinion nose vibrates under load during acceleration and/or deceleration.

If the vibration does not occur during the above procedure, install the brake drums and the tire/wheel assemblies. The brake drums and tire/wheel assemblies will add additional load on the system. Then repeat the above test.

Ensure that both axle shafts rotate at the same speed. The differential may mask a vibration when one tire is spinning faster than the other tire. Adjust the brakes in order to correct unequal tire rotation speed.

If you are unable to reproduce the vibration in the stall, apply the brake lightly in order to load the system further. Maintain the vehicle speed at which the vibration was noticed. Do not overheat the brakes.

If the pinion nose vibrates under acceleration and/or deceleration, and the other driveline components are eliminated as the cause of the vibration, then one of the following conditions may cause the vibration:

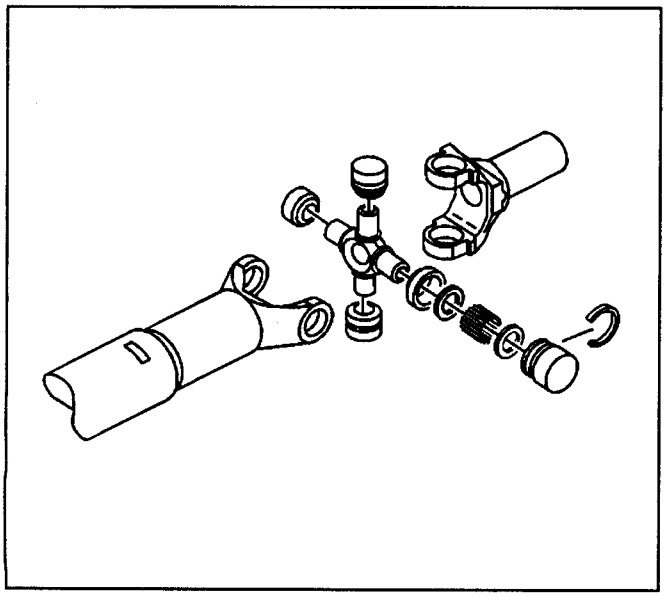
- A high spot on the pinion gear
- A bent pinion stem
- A cocked pinion bearing
- An improper axle housing bore

Anything that effects the pinion gear and how the pinion gear contacts the rotating ring gear may contribute to a first-order, torque-sensitive driveline vibration. The only way to correct the condition is to replace the faulty components. In most cases, the ring and pinion gear set and the related bearings must be replaced. In some case, however, the axle housing must be replaced. Complete a close-up visual inspection for damage or unusual wear in order to measure or identify the specific faulty component.

It is possible to isolate an internal axle vibration. Install a "known good" axle assembly from a stock unit. Verify that the "known good" axle assembly does not have a vibration problem.

Once you correct the internal axle problem, road test the vehicle. Inspect the vehicle for vibration. Balance the driveline as necessary in order to eliminate any remaining vibration.

Second-Order Driveline Vibration Theory



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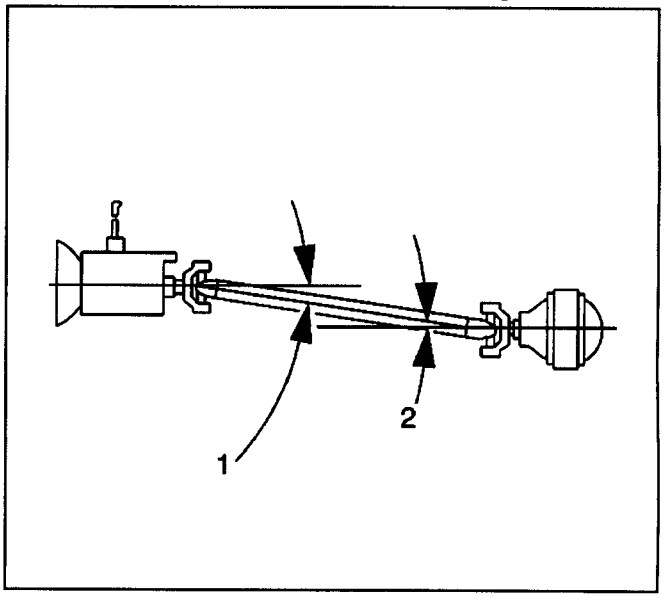
A faulty universal joint (U-joint) may cause a vibration that occurs twice for each rotation of the propeller shaft. This type of vibration is called a second-order vibration.

Second-order driveline vibrations are independent of runout or balance of a driveline component.

The following description of basic U-joint theory will help you to understand where second-order driveline vibrations originate and why they occur.

- As the propeller shaft rotates, the U-joints speed up and slow down twice for each rotation of the propeller shaft.
- The acceleration and deceleration of the U-joints is not visible. If there is vibration in the U-joints, the acceleration and deceleration will be audible and tactile.
- Compare the U-joint in a vehicle to a universal-type socket. When a universal-type socket is used to tighten a bolt, the socket will "bind and release" as the socket turns toward 90 degrees. The "bind and release" occurs twice for each revolution of the socket.
- The U-joint in a vehicle works in the same way as the universal-type socket. The "bind and release" effect is directly proportional to the angle that the U-joint operates: the greater the angle, the greater the effect.
- Because the transmission output speed is constant, the binding and releasing of the U-joints is better described as an acceleration and deceleration which occurs twice for each revolution of the propeller shaft.
- If the propeller shaft is running slowly, the accelerating and decelerating effect is visible. The acceleration and deceleration may create a vibration due to the fluctuations in force that are generated at high speeds.

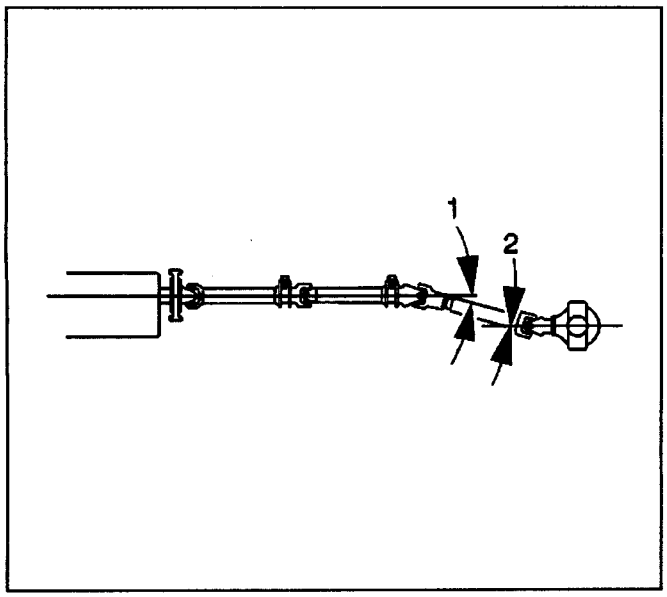
Canceled Out Driveline Angles



182180

Legend

(1) Front Working Angle
(2) Rear Working Angle



301902

Engineers design drivelines in order to compensate for the accelerations and decelerations in order to produce a smooth, constant flow of power, as listed below:

- The transmission drives the front yoke of the propeller shaft at a smooth and constant speed.
- The first U-joint causes the power to fluctuate twice for each revolution of the propeller shaft.
- The second U-joint, oriented 90 degrees from the first U-joint, causes the power to fluctuate opposite that of the first U-joint.
- As the first joint slows down, the second joint speeds up.

This design causes one U-joint to cancel out the effect of the other U-joint. The cancelled effects result in a smooth, constant power flow from the output yoke of the propeller shaft.

Second-order driveline vibrations occur when the cancellation become unequal between the front and rear U-joints.

Second-Order Driveline Vibration Symptoms

Second-Order driveline vibration has the following signs and symptoms:

- The vibration is always related to vehicle speed.
- The vibration is usually torque-sensitive.
- The vibration is worse under a torque load.

Launch shudder is the most common complaint of a second-order driveline vibration.

Launch shudder occurs during acceleration from 0-40 km/h (0-25 mph). Launch shudder appears as a low frequency shake, wobble, or shudder. The driver may feel the vibrations in the seat or steering wheel at low speeds 0-24 km/h (0-15 mph). The vibrations will increase in frequency as the vehicle speed increases. Launch shudder feels more like driveline roughness at higher speeds 24-40 km/h (15-25 mph). At speeds greater than 40 km/h (25 mph) the vibration usually disappears.

Launch shudder vibration is equal to a second-order vibration of the driveline. The EVA will not perceive frequency information due to the transitory nature of launch shudder.

Engine Related Vibration

Engine vibration is usually due to one or more of the following conditions:

- First-order engine imbalance
- Inherent engine firing sequence
- Inherent shaking engine forces
- Engine-driven accessories

Because these vibrations are engine-speed related, they are also normally torque sensitive. These vibrations may appear and disappear at different vehicle or road speeds, but will always appear at the same engine speed.

For example, if a customer states that a vibration is present at 40 km/h (25 mph), 64 km/h (40 mph), and again at 104 km/h (65 mph), and that the symptoms of the vibration are similar at all of these speeds, the vibration is probably engine-speed related. Any disturbance or vibration that is present during the following road tests would be considered engine-speed related:

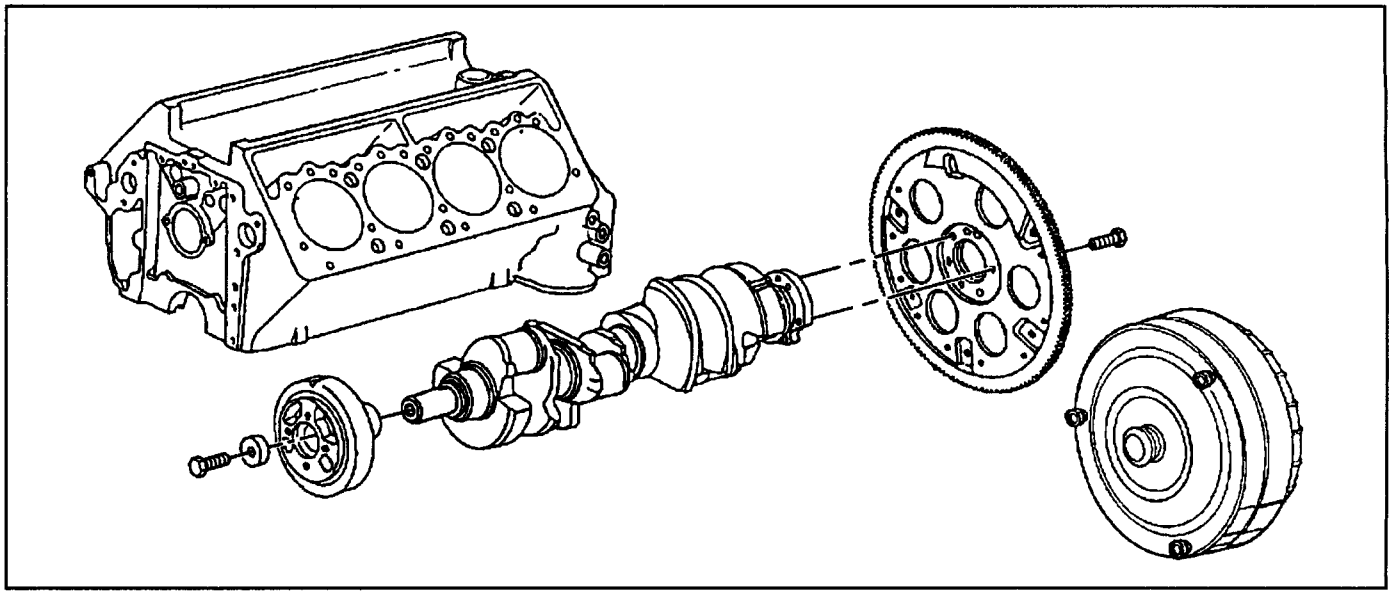
- The Neutral run-up test
- The downshift test
- The brake torque test

Any vibration that is present during the Neutral Coast-Down test is not engine-speed related. The engine-related vibrations covered in this diagnosis are engine-speed sensitive only.

Notice: Do not accelerate against the brakes for longer than 10 seconds. Do not overheat the engine or the transmission. Depending on the vehicle design, the engine will only accelerate to a certain point under these conditions. Also, care should be taken during diagnosis as some disturbances may be created during brake torque that normally do not exist.

Notice: Proper flywheel installation requires carefully WALKING the flywheel onto the crankshaft and stagger-tightening the bolts. Proper torque converter to flywheel installation then requires gradually WALKING the torque converter to be flush with the flywheel, prior to installing the bolts. Do not draw the torque converter to the flywheel with the bolts. If these precautions are not followed, warping or bending of the flywheel and/or damage to the transmission torque converter may result.

First-Order Engine Imbalance



95610

Engine imbalance is a condition that exists when a component that rotates at crankshaft speed is either unbalanced or has excessive runout. In rare cases, the crankshaft may be unbalanced. In any case, balancing the component or correcting the runout may bring the disturbance to an acceptable level.

Symptoms

The following list contains symptoms that are typically exhibited from a first-order engine imbalance.

- Vehicle shake at low engine speeds of 500–1200 RPM, or 8–20 Hz
- Roughness and BOOM at higher speeds of 1200–3000 RPM, or 20–50 Hz
- Vibration detected during the Neutral run-up test

Isolating the Components

Inspect the following:

1. Inspect for any exhaust system binding or exhaust-to-vehicle contact. Repair as necessary. Refer to *Vibration or Rattling* in Engine Exhaust.
2. Inspect all engine and transmission mounts. Repair or replace as needed.
3. Refer to Engine Mount Inspection in Engine Mechanical — 7.8L.
4. Perform the Neutral run-up test noting the severity and the RPM at which the vibration is the worst. Refer to *Road Test* in Vibration Diagnosis and Correction
5. Matchmark the torque converter and the flywheel.
6. Disconnect the torque converter from the flywheel. Move and secure the torque converter away from the flywheel.
7. Perform the Neutral run-up test again. Refer to *Road Test* in Vibration Diagnosis and Correction. If the flywheel shows any wobble or lateral runout, replace the flywheel. Refer to
8. Refer to Engine Flywheel Replacement in Engine Mechanical — 7.8L.
9. Rotate and secure the torque converter to the flywheel 120 degrees from its originally marked position and perform the Neutral run-up test.
10. Repeat Step 7 with the torque converter in all three positions until the vibration is minimized.
11. If the vibration still exists, replace the torque converter.
12. If the vibration still exists after replacing the torque converter, replacing the harmonic balancer MAY reduce the vibration.
13. If the vibration still exists after replacing the crankshaft balancer, the problem is related to residual engine imbalance.

Correcting Residual Engine Imbalance

1. Install washers on the harmonic balancer pulley bolts.
2. Replace bolts with longer bolts of equal hardness as needed.
3. Manual Transmission Only: Inspect the flywheel and the pressure plate for the following conditions:
   - Correct factory indexing.
   - Warping
   - Balance

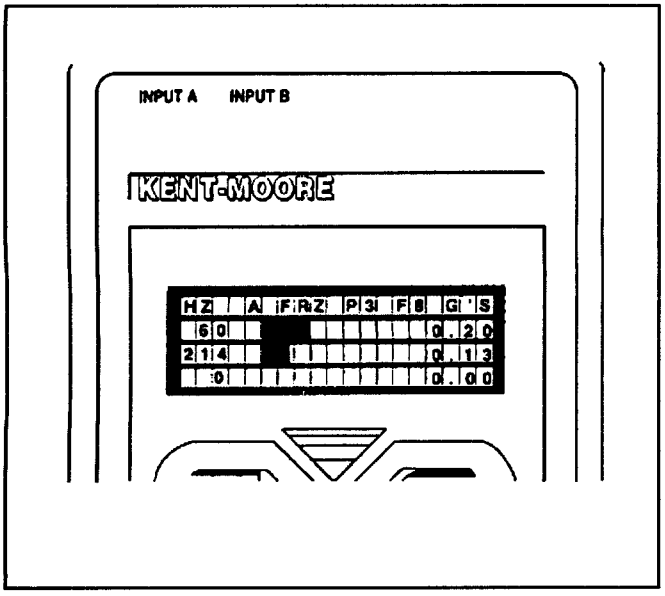
Excessive Inherent Engine Firing Frequency
Firing frequency is a term used to describe the pulses created as the engine fires each cylinder. All engines have a firing frequency. However, the object is to keep these disturbances from entering the passenger compartment. Perform the following steps:

- Ensure that the engine and the exhaust system are mounted in a relaxed position.
- Ensure that all of the engine mounts, transmission mounts and exhaust hangers are in good condition and correct for the application.
- Ensure that no hoses or lines are contacting the frame or the body.

The frequency of these disturbances will depend on the number of cylinders. The engine order will always be equal to one-half the number of cylinders. This is because a four-stroke engine requires two complete revolutions of the crankshaft in order to fire all of the cylinders.

For example, a V6 engine will fire cylinders 1, 3 and 5 on the first revolution. Cylinders 2, 4 and 6 will fire on the second revolution. This results in three firing pulses per revolution of the crankshaft, or third order. A V8 engine will fire cylinders 1, 3, 5, and 7 on the first revolution. Cylinders 2, 4, 6, and 8 will fire on the second revolution. This results in four firing pulses per revolution of the crankshaft, or fourth order.

Engine Vibration Diagnosis with the EVA



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1. Place the EVA vibration sensor on the seat track rail with the UP label facing upward.
2. Plug the EVA into a 12-volt power supply.
3. Prepare the EVA for data recording:
   3.1. Press RECORD.
   3.2. Select a snapshot tag number.
   3.3. Press ENTER in order to begin recording.
4. Slowly accelerate until the vibration occurs.
5. Note the vehicle and engine speed (RPM) where the disturbance occurs.
6. Press ENTER on the EVA in order to record the vibration data.
7. Perform the road test diagnoses in order to determine engine-speed or vehicle-speed sensitivity. Refer to *Road Test* in Vibration Diagnosis and Correction.

Engine Firing Frequency Symptoms

- The vibration may be torque sensitive.
- The vibration is engine-speed related.
- The vibration is heard as a boom or a moan.
- The vibration is felt as shake, roughness, or buzz (depending on the number of cylinders).
- The vibration excites the resonance of a system or a component, causing the system or the component to have a narrow engine speed (RPM) range.

Correct these types of complaints by isolating the vibration from the passenger compartment or the body.

Diagnosis and Repair of Engine Firing Frequency-Related Vibrations

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Take the necessary safety precautions. Refer to *Work Stall Test Caution* in Cautions and Notices.
3. Attempt to duplicate the vibration.
4. While the vibration is present, find the area(s) of the vehicle excited by the vibration.
5. Inspect for witness marks due to a rubbing component.
6. Isolate the component and re-evaluate the vibration.
7. Inspect for proper torque on the excited component(s). Tighten the component fasteners as needed.
8. If the vibration still exists, proceed to the following diagnostic information.

Engine Firing Frequency-Related Vibration Causing Components

Important: Some residual vibrations may be normal. Compare the complaint vibration with a similar vehicle to validate that the vibration is abnormal, preferably with the customer present. Also, refer to bulletins for updates on the use of mass damper weights for specific applications.

1. Inspect and replace any collapsed engine mounts.
2. Refer to Engine Mount Inspection in Engine Mechanical — 7.8L.

3. Inspect the exhaust system and hangers. Remember that exhaust systems can expand one to two inches in length when they are hot.
   - Remove the exhaust system hangers one at a time.
   - Adjust or replace any faulty exhaust system hangers as needed.
4. Lubricate the exhaust manifold flexible coupling.
5. Inspect the air conditioning and power steering lines.
   - Isolate the hoses from the body.
   - Install the retainers.
6. Inspect the drive belts for whipping.
7. Inspect the accessory unit fasteners for damage or looseness. Tighten or replace as necessary.
8. Inspect the body panels for missing or loose welds.
9. Remove any aftermarket equipment that may complete a vibration transfer path into the passenger compartment.
10. Inspect the exhaust system and powertrain mounts. Re-bed the engine and align the exhaust system as follows if needed:
    - Loosen the exhaust system and powertrain mounts and hangers.
    - Tighten all fasteners with the powertrain in the relaxed position.

Inherent Engine Shaking Forces

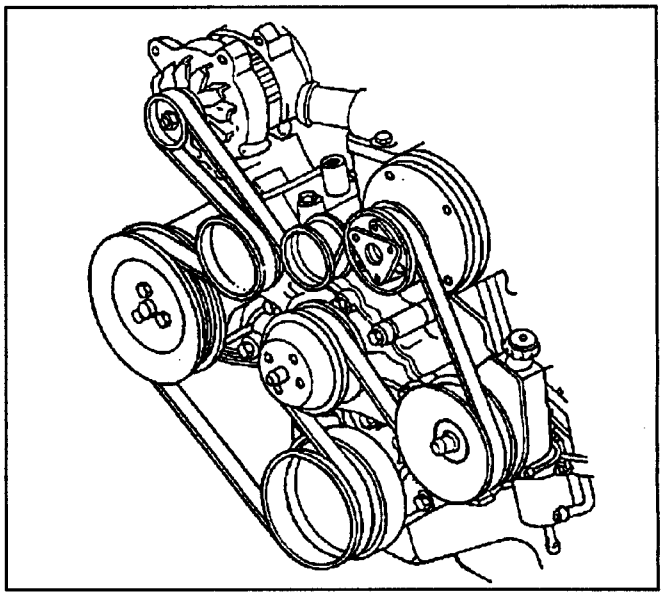
Just like firing frequency, some engine disturbances are the result of normal operation. Some engines can have additional inherent vibration due to the cylinder arrangement, the design, and the firing order.

The key to resolve an inherent engine disturbance is to isolate the vibration from the passenger compartment. Follow the same procedures as described in Diagnosis and Repair of Engine Firing Frequency-Related Vibrations.

Engine Order Vibration Table

Engine Order	V6 60° and V6 90°
1/2 Order Torque Sensitive	Single Cylinder Misfire or Bank-to-Bank EGR/Fuel Variation
1st Order Imbalance	Abnormal
1.5 Order Torque Sensitive	Bank-to-Bank EGR/Fuel Variation
2nd Order	Normal
2nd Order Torque Sensitive	—
3rd Order Torque Sensitive	Normal
4th Order Torque Sensitive	—

Engine-Driven Accessories



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Important: Some vibrations may be normal. Compare the complaint vibration with a similar vehicle that is operating normally to validate that the vibration is abnormal, preferably with the customer present.

Diagnosing engine driven accessories that exhibit vibration pose some special challenges. For example, most engine accessory drive belts can no longer be removed one at a time in order to isolate the condition. If removing the belt eliminates the vibration, reinstall the belt and operate each accessory one at a time in order to see which has the most effect on the vibration. However, one component may affect another because the drive belt drives all of the accessories.

Verify that the accessory load is not exciting the engine firing frequency.

Diagnosis

1. Remove the drive belts.
2. If the vibration stops, perform the following steps:
   2.1. Install the drive belts.

   Important: The drive belts drive all of the engine accessories. Therefore, one component may affect another.

   2.2. Operate each accessory one at a time in order to see which has the most effect on the vibration.
3. Inspect for accessory load affecting the engine firing frequency.
4. Inspect the pulleys for misalignment or bends. Repair or replace as needed.
5. Inspect the A/C system for an overcharge condition. Evacuate and recharge the system as needed.

Repair Instructions

General Service Precautions

Caution: One or more of the following guidelines may apply when performing specific required tests in the work stall:

1. ***When a test requires spinning the drive wheels with the vehicle jacked up:***
   - ***On vehicles equipped with a limited-slip differential, do not attempt to spin one drive wheel with the other wheel on the ground. The vehicle may drive through this wheel and cause the vehicle to move unexpectedly, or drive off the safety stands. This may result in personal injury or damage.***
   - ***Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual wheel speed under these conditions. If all drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive speed wheel spinning. All persons should stay clear of rotating components and balance weight areas to avoid possible personal injury.***
   - ***When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and transmission.***
2. ***When a test requires jacking up the vehicle and running with the wheels and brake drum removed:***
   - ***Do not apply the brake with the brake drums removed.***
   - ***Do not place the transmission in Park with the propeller shaft still spinning.***
   - ***Turn off the ignition to stop the powertrain components from spinning.***

Correcting Tire and Wheel Vibration

A first order tire and wheel vibration is usually the result of one of the following five conditions:

- Excessive radial runout
- Excessive lateral runout
- Excessive imbalance
- Excessive radial force variation
- Excessive lateral force variation

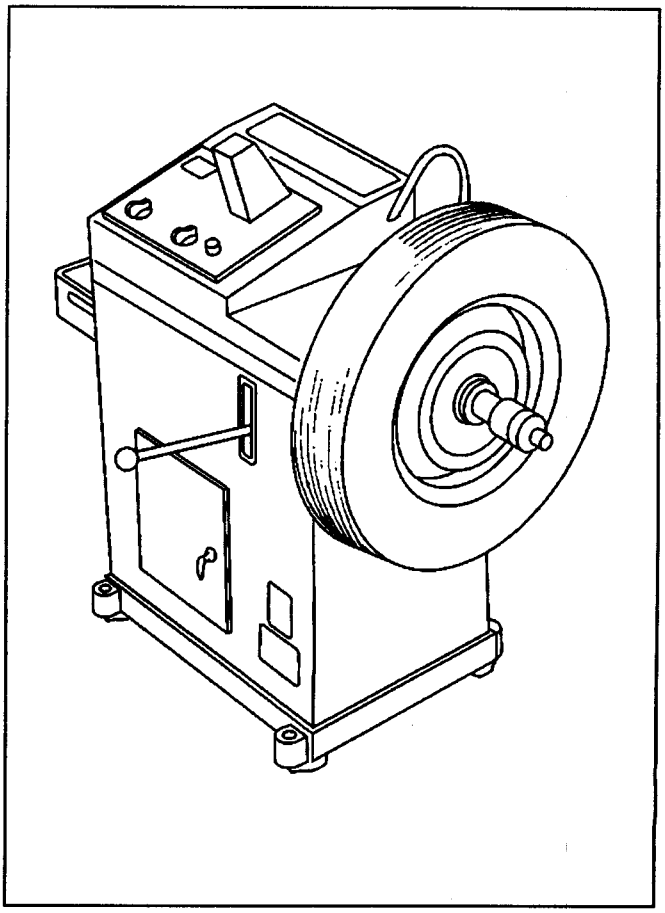
These conditions must be eliminated one at a time in order to attain a set of tires that are free from vibration causing elements. Substitute a set of tires from another vehicle only as a last resort, and only after the tires have been tested on a similar vehicle under the same conditions. Correcting the existing tire and wheel assemblies is the most accurate and least time consuming approach. This is due to vehicle-to-vehicle sensitivities and the differences between the hubs of any two vehicles.

Balancing Tires and Wheels

Caution: Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:

1. ***Clean away any dirt or deposits from the inside of the wheels.***
2. ***Remove any stones from the tread.***
3. ***Wear eye protection.***
4. ***Use coated weights on aluminum wheels.***

Important: The tires can be balanced either on-vehicle or off-vehicle, but the off-vehicle balancing procedures are recommended. Off-vehicle methods are better because tire rotation will not affect the balancing. The off-vehicle balancers are also more accurate than the on-vehicle balancers. Off-vehicle balancers can perform dynamic balancing as well as static balancing.



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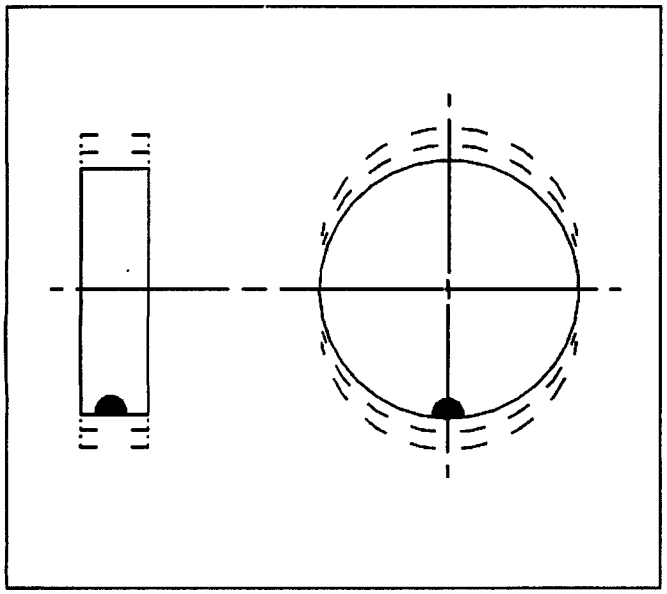
Tire and wheel balancers can drift out of calibration without warning, or can become inaccurate as a result of abuse. The balancer calibration should be inspected every two weeks, and whenever the readings are questionable.

Tire Balancer Calibration Test

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.
   Specification
   0.00–0.25 oz
3. Balance a tire and wheel assembly that is within radial and lateral tolerances to ZERO.
4. Add a 3 ounce test weight to the wheel at any location.
5. Spin the tire and wheel assembly again, noting the readings.
   - In the static and dynamic modes, the balancer should call for 3 ounces of weight, 180 degrees opposite the test weight.
   - In the dynamic mode only, the weight should be called for on the flange of the wheel opposite the last weight.
6. With the assembly unbalanced to 3 ounces, cycle the balancer 5 times.
7. Take the balancer readings:
   Specification
   Variation: 0.25 oz or less
8. Index the tire and wheel assembly at four separate locations on the balancer shaft, 90 degrees apart.
9. Cycle the balancer with the assembly at each location.
10. Take the balancer readings:
    Specification
    Variation: 0.25 oz or less

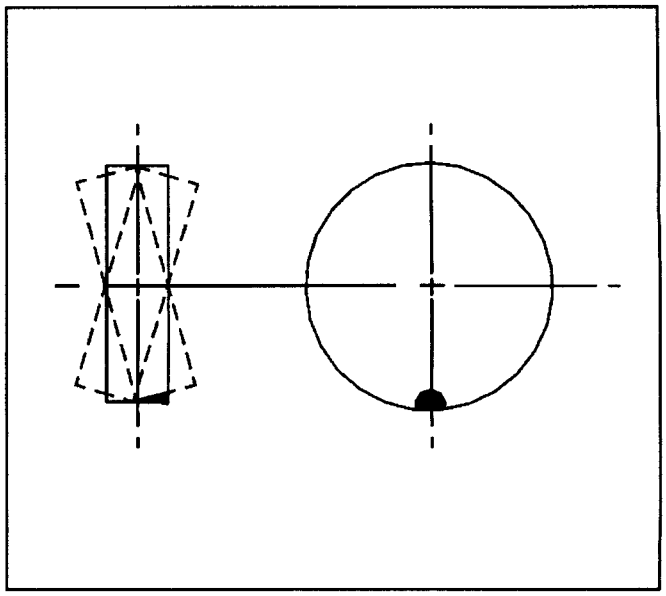
Tire Balancing Guidelines

Static and dynamic balance are two kinds of tire/wheel balance:



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- Static balance, also called single plane balance, affects the distribution of weights around the wheel circumference.



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- Dynamic balance, or two-plane balance, affects the distribution of weight on each side of the tire/wheel centerline.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance, with as little as 0.50–0.75 oz capable of inducing a vibration in some vehicles. Vibration induced by static imbalance will cause a vertical or BOUNCING motion of the tire.

Dynamic imbalance results in a side-to-side motion of the tire. This motion is referred to as SHIMMY.

- Balance all four tires as close to ZERO as possible.
- Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.
- Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting problems.
- Use the correct coated weights on aluminum wheels.
- Recheck the tire and wheel assemblies for excessive runout after they have been corrected and installed.
- Evaluate the vehicle at the complaint speed and note if the vibration has been corrected.
- If the vibration is still present, or is reduced but still unacceptable, you may find one of two possibilities:
  - On-vehicle imbalance
  - Radial or lateral force variation

Correcting On-Vehicle Imbalance

On-vehicle imbalance may result from components other than the tire and wheel assemblies having imbalance. An on-vehicle high-speed balance or replacement of suspected components may be necessary in order to correct the condition.

Rotors do not have a set tolerance. However, rotors with more than 0.75 ounce imbalance have the potential to cause vibration. The rotors can be inspected for imbalance using either the on-vehicle or the off-vehicle method as described below:

Checking Rotor Imbalance (On-Vehicle)

1. Support the vehicle rear axle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire and wheel assemblies. Refer to *Wheel Removal (Dual/Rear)* in Tires and Wheels.
3. Reinstall the wheel nuts in order to retain the rotors.
4. Take the necessary precautions. Refer to *Work Stall Test Caution* in Cautions and Notices.
5. Run the vehicle at the complaint speed while inspecting for vibration.
6. If the vibration still exists, perform the following steps:
   6.1. Remove the rotors.
   6.2. Run the vehicle back to speed.
7. If the vibration is eliminated, perform the following steps:
   7.1. Remove the rotors one at a time.
   7.2. Perform the vibration test for each rotor.
   7.3. Replace the rotor causing the imbalance.
   7.4. Inspect the balance of the new rotor.

Checking Rotor Imbalance (Off-Vehicle)

1. Measure the diameter and the width of the rotor.
2. Mount the rotor on a balancer in the same manner as a wheel.

   Important: The rotors can only be inspected for static imbalance. Ignore the dynamic imbalance reading.
3. Inspect for static imbalance.

On-Vehicle Balancing Procedure

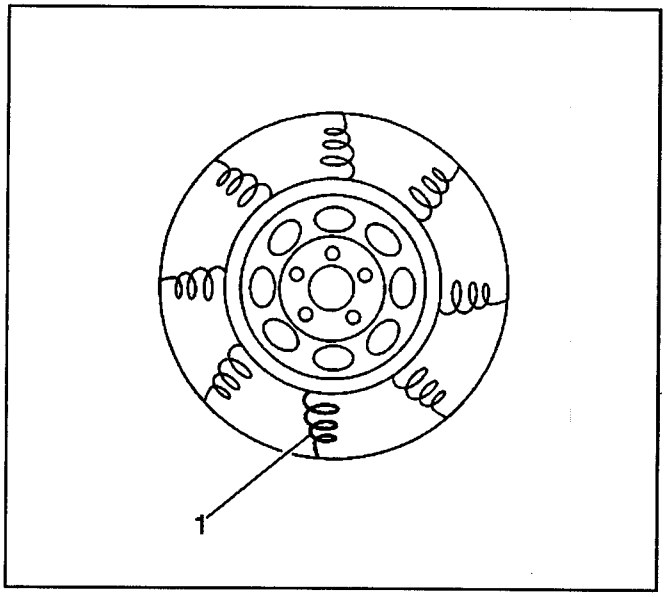
The vibration problem may not be correctable with the components removed from the vehicle. An on-vehicle high-speed balancer may be required in order to balance the tire and wheel assemblies while still mounted on the vehicle. On-vehicle balancing will balance the hubs and the rotors simultaneously, and will compensate for any residual runout encountered as a result of mounting the tire and wheel assemblies on the vehicle as opposed to off-vehicle balancing.

Follow the on-vehicle balancer manufacturer operator's manual for specific instructions while keeping the following tips in mind:

Balancing Tips

- Do not remove the off-vehicle balancing weights. The purpose of on-vehicle balance is to FINE TUNE the assembly balance already achieved, not to start over again.
- If the on-vehicle balance calls for more than 1 ounce of additional weight, split the weight between the inboard and outboard flanges of the wheel, so as not to upset the dynamic balance of the assembly that was achieved in the off-vehicle balance.
- An EVA vibration sensor placed on the fender of the vehicle during the on-vehicle balance is an excellent indicator of the amplitude of the vibration, and the effect that the balance has on the vibration.
- Evaluate the vibration after the on-vehicle balance in order to determine if the vibration condition has been resolved.

Radial Force Variation



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Radial force variation is the difference in the stiffness of a tire as the tire rotates and contacts the road. The tire and wheel assemblies have some variation due to splices in the tire plies. These splices do not cause a problem unless the force variation is excessive. These STIFF SPOTS in the tire (1) can deflect the tire and wheel assembly upward as the assembly contacts the road.

If the tire has only one stiff spot, the spot will deflect the spindle once per each revolution of the tire and wheel assembly, thus causing a first-order tire/wheel vibration. If the tire has two stiff spots, the spots cause a second-order vibration. First- and second-order tire/wheel vibrations are the most common to occur as a result of radial force variation. Third-, fourth-, or higher orders are possible but rarely occur.

The most effective way to minimize the possibility of force variation as a factor in tire and wheel assembly vibrations is to ensure that the tire and wheel assembly runout is at an absolute minimum. However, some tire and wheel assemblies exhibit vibration-causing force variation even though they are within runout and balance tolerances. These instances are becoming rare due to tighter tolerances and higher standards in manufacturing.

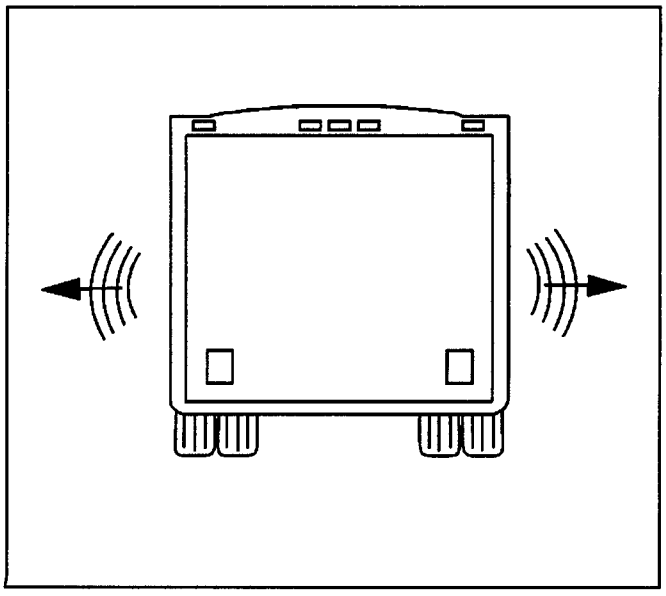
The following two alternatives are available if force variation is suspected as a factor in tire and wheel assembly vibration complaints:

- Buff the tires.
- Substitute one or more known good tire and wheel assemblies.

The tires may be buffed on a tire matching machine that is designed to remove small amounts of rubber from the outer rows of the tread blocks at the location of the stiff spots under load. This eliminates the spindle deflection. This type of equipment is not currently in widespread use. Do not use a TRUER or any tool that is designed to make the tire perfectly round. These tools will not correct the condition.

You may substitute one or more known good tire and wheel assemblies when a tire manufacturer is not available locally.

Lateral Force Variation



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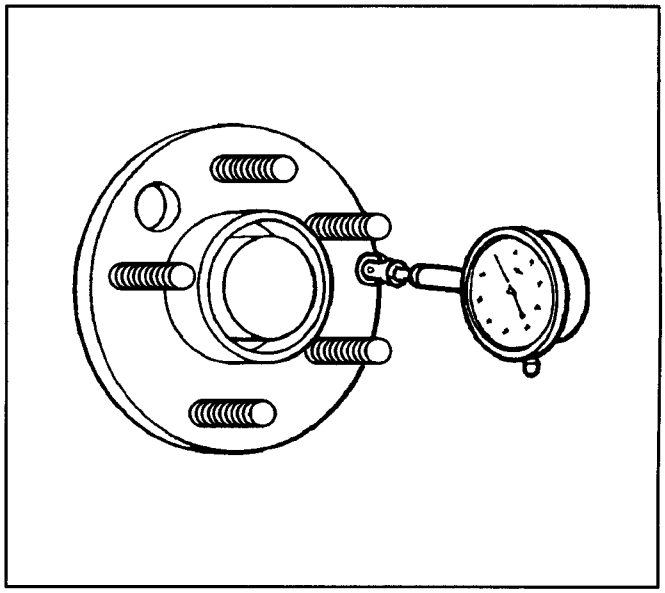
Lateral force variation tends to deflect the vehicle sideway, or laterally. Lateral force variation is based on the same concept as radial force variation. A SNAKY belt inside the tire may be the cause of lateral force. The tire substitution method may have to be used before tire replacement.

A lateral force variation condition is rare. The best way to eliminate lateral force variation as a factor in tire and wheel vibration conditions is to ensure that the lateral runout of the tire and wheel assemblies is at an absolute minimum.

The vehicle will "wobble" or "waddle" at slow speeds of 8–40 km/h (5–25 mph) when lateral force variation is excessive. This condition is usually related to the first-order of tire and wheel rotation.

Wheel Hub/Axle Flange Runout

Inspect the wheel hub/axle flange runout when lateral runout occurs during on-vehicle testing but not during off-vehicle testing. The tolerances provided are only guidelines. Perform corrections only if the on-vehicle runout cannot be brought to within tolerance.



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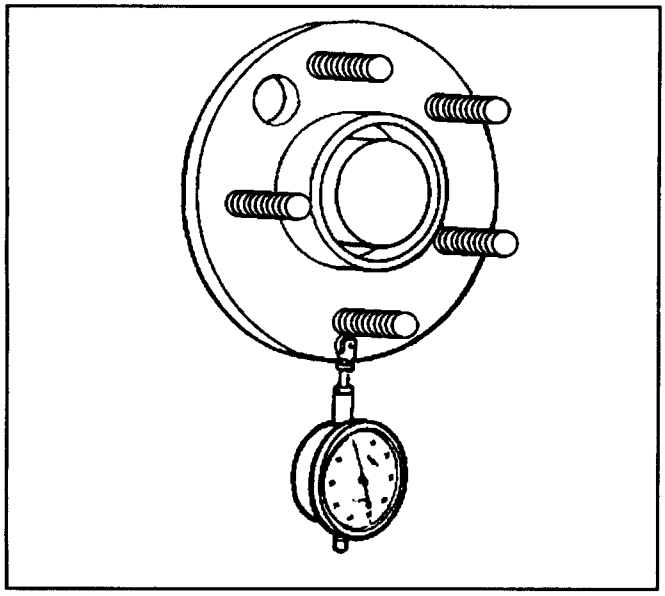
1. Position the dial indicator on the machined surface of the hub, the axle flange, or the rotor, outside of the wheel studs.
2. Rotate the hub in order to find the low spot.
3. Set the dial indicator to zero at the low spot.
4. Rotate the hub again and check the total amount of runout.

   Specification (Guideline)

   Runout tolerance: 0.130 mm (0.0050 in)

Wheel Stud (Stud Circle) Runout

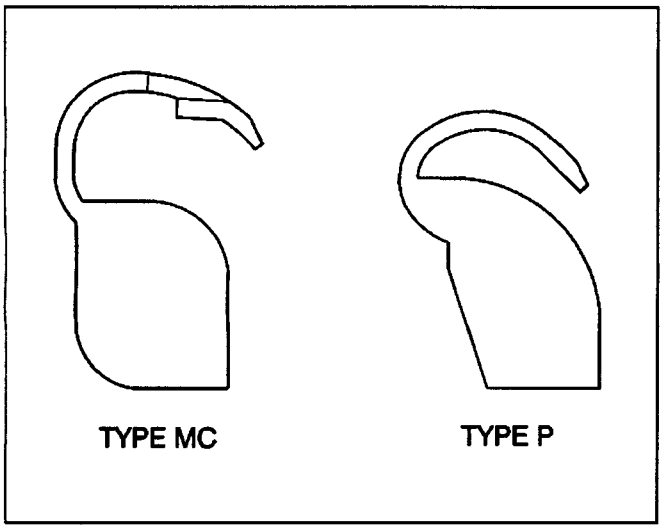
Use the following procedure whenever the off-vehicle radial runout and the on-vehicle radial runout are significantly different, and earlier attempts to correct the tire and wheel vibration condition have not been successful.



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1. Position the dial indicator in order to contact the wheel mounting studs.
   Measure the stud runout as close to the flange as possible.
2. Turn the hub to register on each of the studs.
3. Zero the dial indicator on the lowest stud.
4. Rotate the hub again and check the total amount of runout.
   Specification (Guideline)
   Runout tolerance: 0.80 mm (0.030 in)

Wheel Weight Usage



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Locate the wheel weights on the inboard rim flange. If during static balancing more than 28 grams (1 ounce) is needed, split the weights as equally as possible between the inboard and outboard flanges.

Special polyester-coated clip-on wheel weights are to be used to balance factory aluminum wheels. These weights are designated MC or P, and must be used on aluminum wheels having a wide, 7.6 mm (19/64 inch) flange. A plastic tipped hammer should be used to prevent damage to the weight's coating during installation.

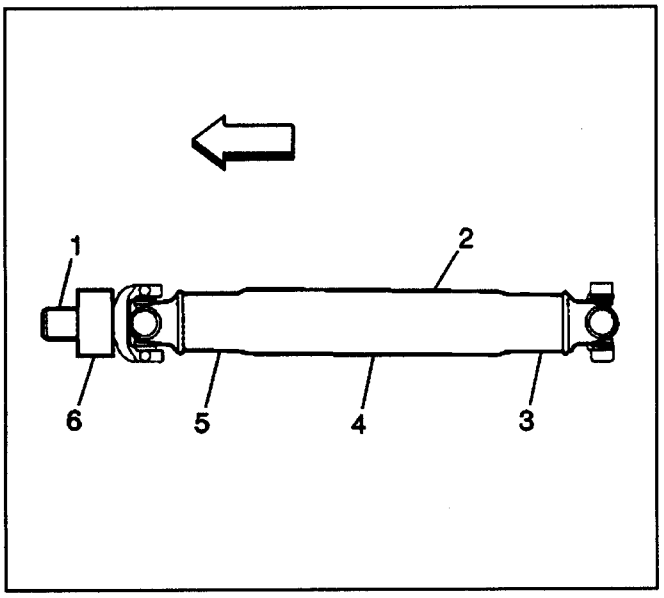
Adhesive wheel weights are also available. Use the following procedure to install adhesive wheel weights.

1. Determine where the wheel weight is to be located on the inboard side of the wheel and clean that area by sanding it to bare aluminum. Do not sand the outboard side of the wheel as this will damage the clear coat finish.
2. Wipe the sanded area with a mixture of half ispopropyl alcohol and half water. Use a clean cloth or paper towel.
3. Dry the area with hot air until the wheel surface is warm to the touch.
4. Warm the adhesive backing on the wheel balance weight to room temperature.
5. Remove the tape from the back of the weight. Do not touch the adhesive tape.
6. Apply the wheel weight and press on with hand pressure.
7. Secure the wheel weight with a 70 to 110 N.m (16 to 25 lb ft) force applied with a roller.

Correcting Non-Uniform Tires

Use the following two methods to correct tires which cause a vibration, although the tires are balanced properly:

1. This method uses an automatic machine that loads the tire and buffs small amounts of rubber from high spots on the outer two tread rows.
   - Using this method in order to correct the tires is usually permanent. This method does not significantly affect the appearance or the tire tread life.
   - Do not true the tires with a blade-type machine. This reduces the tread life substantially, and this often does not permanently correct the problem.
2. The second method is to dismount the tire and rotate it 180 degrees on the rim. It is important that this is be done on the tire and wheel assemblies which are known to be causing a vibration, as it is just as likely to cause good assemblies to vibrate.



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Correcting Driveline Vibration - RWD and 4WD

Diagnosis will be much easier once you have identified a vibration as first-order of driveline rotation during the road test. Then identify the exact area that the vibration is coming from and take proper action.

In most cases, vibration may be reproduced in the stall. In the stall the vibration may be better or worse than that experienced during the road test.

The objective is to reduce the vibration to the lowest point possible in the stall, than evaluate the results on a road test. Many times, a vibration you were able to reduce drastically in the stall will be completely eliminated on the road.

The cause of first-order drive line vibration is usually excessive runout or an imbalanced component.

The following procedure offers a systematic process of elimination in order to determine which component is at fault:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or heavy stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Dual/Rear)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Drum Replacement* in Air Drums.
4. Inspect the propeller shaft. The propeller shaft should be free of undercoating before continuing this diagnosis.
5. Inspect the propeller shaft or U-joints for any obvious dents or damage. Dents or damage will contribute to first-order driveline vibrations.
6. Start the engine.
7. Place the transmission in gear.
8. Run the vehicle up to the speed at which the vibration was most severe. Do not step on the brake while the brake drums are removed.
9. Note the vibration present, and at what speed.
10. If the vibration is not present, refer to First-Order Driving Vibration Testing (Torque Sensitive) in the Road Testing Diagnosis.
11. If the vibration is present, determine which end of the driveshaft is vibrating the most. Hold your hand against the pinion nose and the transmission tailshaft, or hold an EVA vibration sensor up to each component.
12. If the vehicle is equipped with a two-piece propeller shaft, inspect the center support bearing for vibration.
13. If the transmission tail is vibrating, touch the transmission crossmember under the transmission mount. If there is no vibration on the crossmember, then the transmission mount is working properly.
14. Note which end of the driveshaft is the worst, and how severe the vibration is. The inspection will be a reference by which to judge future progress.

Helpful Hints

Do not fill the propeller shaft with foam, oil, or any other substance in order to correct a vibration. Filling the propeller shaft is only effective in reducing an unrelated condition called Torsional Rattle. Filling the propeller shaft should only be done in strict adherence to the procedure outlined in corporate bulletins that address Torsional Rattle. Failure to follow the correct procedure will induce a vibration and/or affect the structural integrity of the propeller shaft. The propeller shaft will then have to be replaced.

Propeller Shaft Runout

A propeller shaft or pinion (companion) flange with excessive runout causes first-order driveline vibrations. Use the following procedure in order to measure runout of the propeller shaft (2). The tolerances are critical for smooth operation of the driveline.

- Remove excess corrosion of the propeller shaft surface before checking runout. Also inspect for damage and dents. Replace dented propeller shafts. Remove any undercoating from the propeller shaft before proceeding.
- The measurement procedure that follows applies to all one-piece and two-piece propeller shaft assemblies.

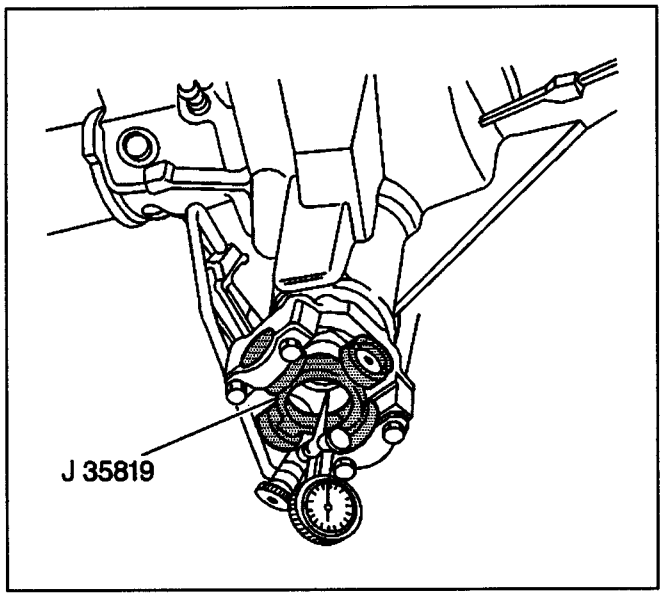
  The splined end (1) of a propeller shaft is critical to the smooth operation of a two-piece propeller shaft. When checking stub-shaft runout, ensure that the dial indicator readings are accurate.

Measuring Propeller Shaft Runout

Tools Required

- *J 8001* Dial Indicator
- *J 7872* Magnetic Base Dial Indicator Set

1. Raise the vehicle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Allow the wheels to spin freely.
3. Attach *J 8001* and *J 7872*



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4. Place the transmission in Neutral. Rotate the pinion flange or transmission yoke by hand while taking the measurements for runout. The propeller shaft will turn easier in one direction than in the other. Removing the wheels and drums will also help.
5. For one piece propeller shafts, if the runout exceeds the tolerances at one or more points:
   5.1. Rotate the propeller shaft 180 degrees in the pinion flange. Reinstall the propeller shaft and recheck the measurement.
   5.2. If the runout still exceeds the tolerance, double-check the pinion flange runout before replacing the propeller shaft.
   5.3. Do not include fluctuations on the dial indicator due to welds or surface irregularities.
6. For two-piece propeller shafts, if the runout exceeds the tolerances at one or more points:
   6.1. Measure the rear propeller shaft.
   6.2. Mark the position of the rear shaft in the pinion flange, then remove the rear shaft.
   6.3. Measure the front propeller shaft runout on the tube and the stub shaft.
   6.4. Replace the propeller shaft if either measurement is out of tolerance.

Refer to *Specifications* in Vibration Diagnosis and Correction.

Important: When you replace a propeller shaft, check the new shaft for runout. Double-check the pinion flange runout if the replacement shaft runout is also out of tolerance.

Measuring Pinion Flange Runout

Tools Required

- *J 8001* Dial Indicator Set
- *J 23409* Dial Indicator Extension
- *J 35819* Pinion Flange Runout Gauge

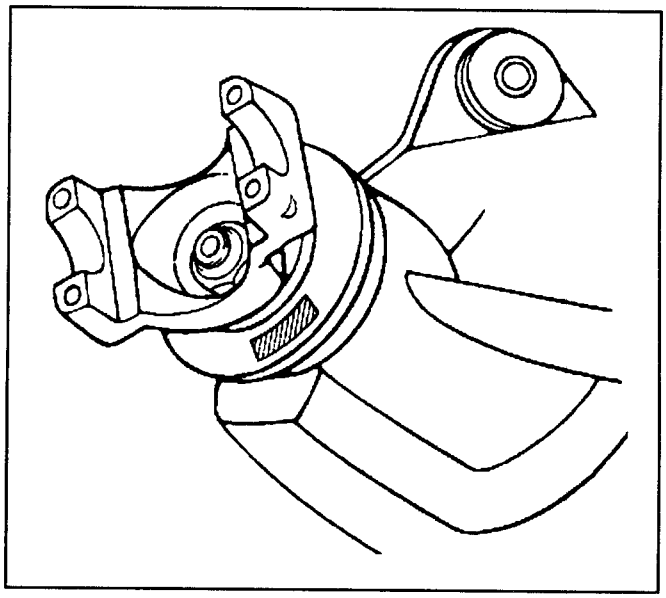
1. Place the vehicle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information. Allow the wheels to rotate freely.
2. Remove the propeller shaft from the pinion flange.
3. Install the *J 35819* Pinion Flange Runout Gauge

   Important: The dial indicator will have inverted readings. You are measuring the inside diameter of the flange, and not the outside diameter. The highest reading on the dial indicator is the low spot. The lowest reading is the high spot.
4. Rotate the pinion shaft 360 degrees and zero the dial indicator on the low spot.
5. Rotate the pinion flange again and record the total runout.
6. If the pinion flange runout is 0.15 mm (0.006 in) or less, remove the pinion flange balance weight.

7. If the pinion flange runout is over 0.15 mm (0.006 in) but no less than 0.28 mm (0.011 in), and the runout compensation weight is at or near the low spot, then no further action is necessary. Remove the weight if the runout compensation weight is not at or near the low spot.
8. If the pinion flange runout is more than 0.28 mm (0.011 in) but no greater than 0.38 mm (0.015 in), and the balance weight is at or near the low point, then no further action is necessary. Remove the weight and re-index the pinion flange until the runout is 0.25 mm (0.010 in) or less if the runout compensation weight is not at or near the low spot.
9. Replace the pinion shaft when the runout is 0.25 mm (0.010 in) or less. Then, recheck the runout. Service replacement flanges do not have balance weights.

Helpful Hints

- If necessary, add compensation weights on the face of the pinion flange dust slinger. These weights are tack-welded onto the slinger. You may remove the weights with a die-grinder.
- Carefully remove the spot weld at either end of the weight.
- Do not remove the weight unless you have inspected the pinion flange runout and the procedure calls for weight removal.
- Do not remove any weights on the outboard edge of the dust slinger. These weights are present in order to internal axle components. The weights are not related to the pinion flange runout.

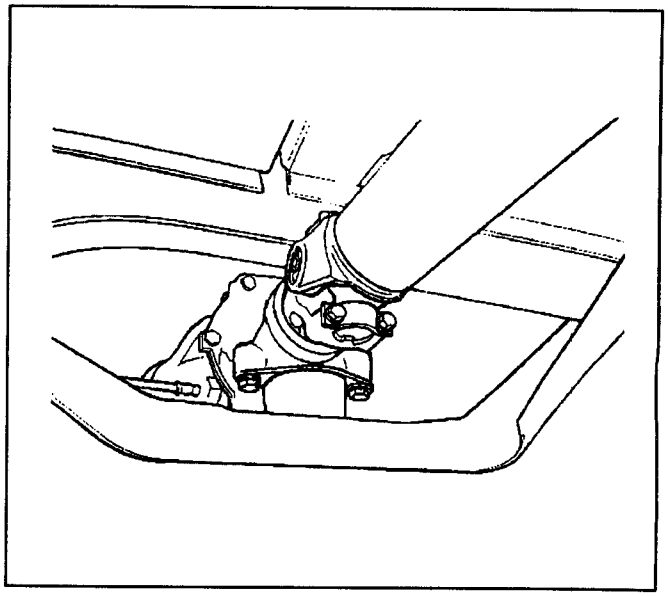


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Correcting Vibration at the Pinion Nose

Most first-order driveline vibrations originate at the pinion nose end of the driveshaft. Ensure that the vibrations are at a minimum at this location in order to achieve acceptable results. Reduce the runout of the components to a minimum. Balance the driveline as a system when necessary.

1. Measure the runout of the propeller shaft and check the tolerance.
2. If the tolerance is excessive, mark the position of the shaft for future reference and rotate the shaft 180 degrees.
3. Reinstall the shaft and recheck the runout. Inspect the level of vibration in order to determine if the vibration is lower or corrected.



182281

4. If the runout is still excessive, or if the vibration is still present, refer to Measuring Pinion Flange Runout. Replace the pinion flange or re-index the flange 180 degrees if the pinion flange runout exceeds the tolerance.

   Remove and reinstall the pinion flange only once on axles utilizing a "crush" type sleeve. Replace the sleeve with a new sleeve if the sleeve is "crushed". Removing the sleeve requires removal of the ring and pinion set. Therefore, replace flanges with excessive runout. Regardless of the method used, measure the pinion flange runout in order to ensure that the flange is within tolerance.

5. Recheck the propeller shaft runout if the vibration is present after the pinion flange runout is corrected. If the propeller shaft runout is still excessive, correct the runout before doing a driveline system balance. Either replace the shaft with a shaft that is within tolerance or sublet the shaft to a reputable independent for straightening and re-balance. Ensure that the new or rebuilt shaft is within runout tolerance before you continue.

6. Once the propeller shaft and pinion flange are within runout tolerances, check if the vibration is gone. If the level of the vibration is still unacceptable, perform a driveline system balance procedure.

Correcting Vibration at the Transmission Tailshaft

First-order driveline vibrations that originate at the transmission end of the propeller shaft are rare. If the tailshaft of the transmission is vibrating, inspect the tailshaft housing bushing for wear or damage. A leaky transmission tailshaft oil seal indicates bushing problems.

Feel for vibration at the crossmember underneath the transmission mount. If there is no vibration, the transmission mount is doing its job of isolating the vibration from the structure of the vehicle. The transmission mount is therefore probably not cause of vibration.

Use the following procedure if you can feel vibration on the crossmember and the tailshaft bushing, and if transmission output is normal:

1. Measure the propeller shaft runout. If the runout is excessive, replace the shaft with one that has acceptable runout. Alternatively, sublet the shaft to a reputable independent service shop in order to have the shaft rebalanced and the runout corrected.

2. Test drive the vehicle. If the vibration is still unacceptable, balance the shaft on the vehicle. Refer to *Roughness or Vibration (Propeller Shaft Runout)* in Propeller Shaft.

Correcting Vibration at the Center Support Bearing

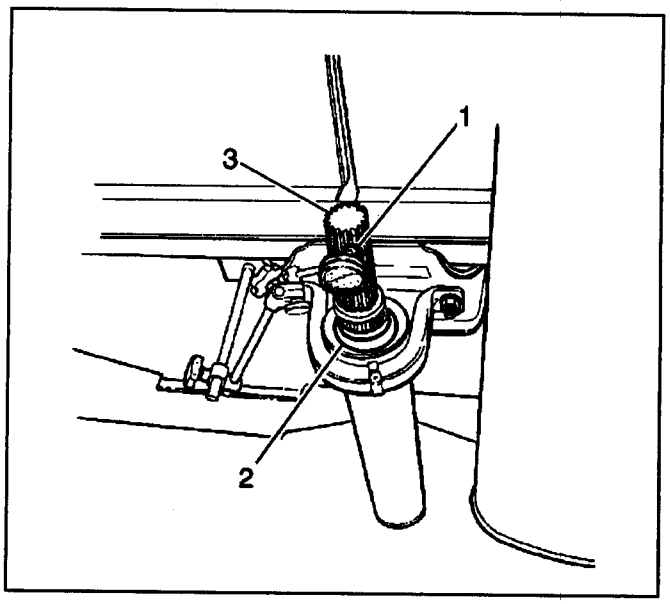
These guidelines apply to the two-piece propeller or three-piece shafts only. First-order driveline vibrations that occur mainly at the center support bearing (2) are usually the result of excessive runout at the stub (splined) shaft (3).

Unlike other first-order driveline vibrations, these vibrations can appear at unusually low speeds of 40 km/h (25 mph) and up.

Follow the following procedure to correct this type of vibration:

1. Mark the position of the rear propeller shaft at both ends for proper reassembly. Remove the rear propeller shaft form the vehicle.
2. Measure the runout of the splines about 12.7 mm (0.5 in) from the end (1).
3. Replace the shaft if the runout exceeds the tolerances.

   Stub shaft/spline runout 0.076 mm (0.003 in)



182285

Troubleshooting Hints

Vibration is eliminated with the correction of the propeller shaft runout. If some vibration is still present, perform a vehicle road test. Then, determine if an on-vehicle system balance is necessary.

Driveline System Balance with Electronic Vibration Analyzer (EVA)

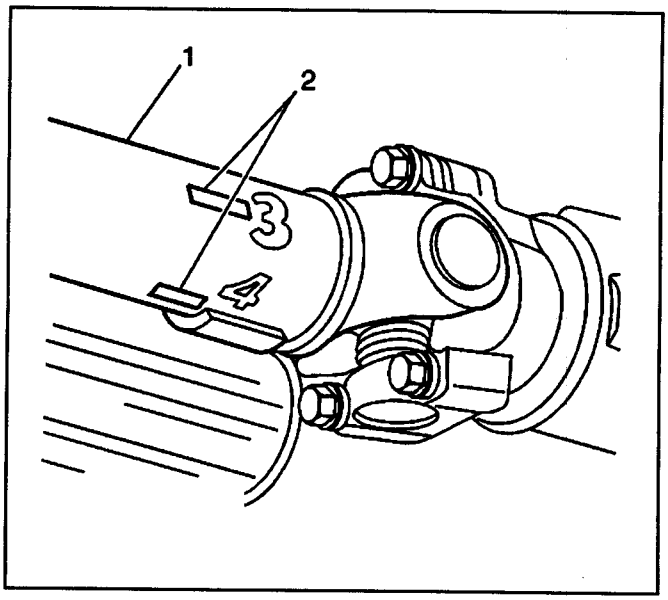
To pinpoint the source, you must reproduce the vibration in the service stall and then determine which component is vibrating the most using the EVA:

1. Support the vehicle on a suitable hoist or on safety stands. Ensure that the rear of the rear axle is at curb height. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Dual/Rear)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Drum Replacement* in Air Drums.
4. Ensure that the propeller shaft is free of undercoating. Check for dents or damage to the propeller shaft or U-joints.
5. Start the engine. Place the transmission in gear and run at the vehicle speed at which the vibration occurs at.

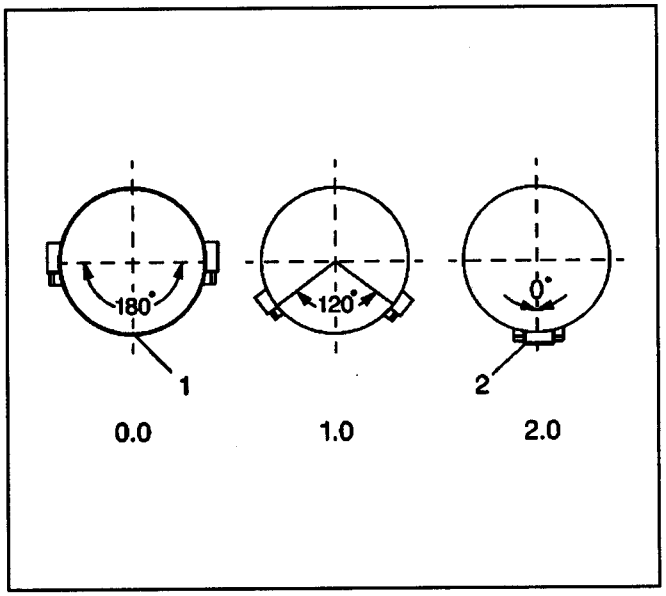
Determine which end of the propeller shaft is vibrating the most. Hold the EVA's sensor against the pinion nose and the transmission tailshaft assembly. The higher the amplitude reading, the greater the vibration.

If the vehicle has a two-piece propeller shaft, check the center support bearing.

If the transmission tailshaft vibrates, check the transmission crossmember under the transmission mount. The vibration should not be present if the mount is doing its job.



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Runout and Balance Testing with the Electronic Vibration Analyzer (EVA)

Ensure that the runout of the various driveline components are within specifications. If the runouts are within specifications, strobe balance the driveline. The EVA is able to simplify the balancing process, using the following procedure:

1. Use the EVA in order to determine which end of the propeller shaft has the most vibration.
2. Mark the end of the propeller shaft (1) that has the most vibration at four points, 90 degrees apart. Number the marks 1 through 4 (2).
3. Mount the EVA sensor onto the bottom of the following components:
   - The differential housing
   - The center bearing support (for two-piece or three-piece propeller shafts)
   - The transmission tailshaft assembly
4. Position the sensor as close to the propeller shaft as possible. Ensure that the UP side of the sensor faces up. Ensure that the sensor is horizontal.
5. Start the engine.
6. Turn off all engine accessories.
7. Place the transmission in gear.
8. Run the vehicle at the speed which causes the most vibration in the propeller shaft.
9. Hook the timing light clip to the trigger wire.
10. Plug the vibration sensor into Input A of the EVA. Input B does not have strobe light capability.
11. Verify that the predominant frequency on the EVA display matches the frequency of the original vibration. Use the strobe light only if the rotation speed of the propeller shaft is the predominant frequency.
12. The EVA displays a series of questions in order to select the correct filter. Press YES in order to select the desired filter. Ensure that the frequency is in the middle of the filter range. Use the full range only as a last resort.
13. The display shows the test frequency, the amplitude and the filter range. The driveline is balanced when the amplitude is near two. In some cases a slightly higher amplitude will provide adequate balance.
14. Point the timing light at the propeller shaft. The strobe effect will appear to freeze the propeller shaft. Note which of the numbered marks is at the bottom of the propeller shaft, or the 6 o'clock position. This position is the light spot.
15. Turn the engine off.
16. Install a weight directly on the light spot.
17. Start the engine.
18. Run the vehicle at peak vibration speed.
19. Strobe the propeller shaft again.

The propeller shaft is balanced if the strobe image is erratic and the amplitude is near two.

The propeller shaft is not balanced if one of the following conditions exist:

- The weight and the original light spot are at the 6 o'clock position.

  The above condition means that there is not enough weight on the propeller shaft. In order to correct the balance, add a second weight next to the first weight. Inspect the balance again using the strobe light.

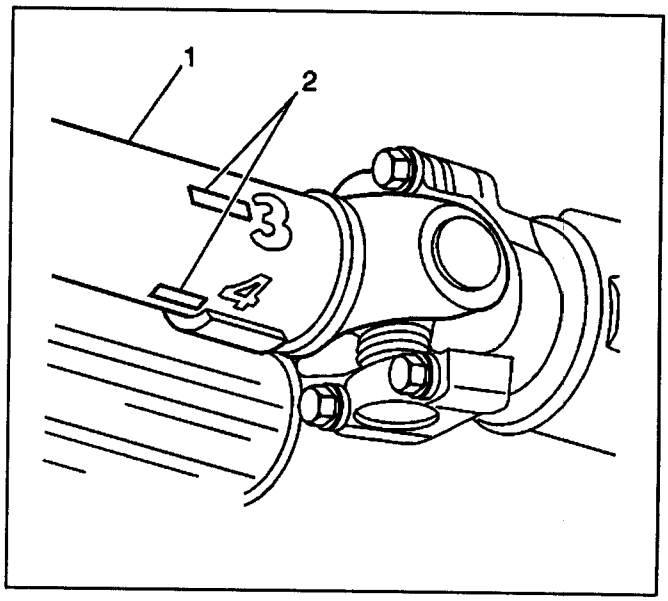
  If the weights are now between 90 and 180 degrees off (between the 9 and the 3 o'clock positions) too much weight exists. In order to correct the balance, split the two weights equally on either side of the original light spot in order to produce a total weight between one and two weights (between 0 and 120 degrees apart). Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and original light spot are 90 to 180 degrees off (between the 9 and the 3 o'clock positions).

  The above condition means that one weight is too much. In order to correct the balance, split the two weights equally on either side of the original light spot in order to produce a total weight less than one (between 120 and 180 degrees apart). Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and the original light spot are within 180 degrees of the 6 o'clock position.

  Move weight towards the 6 o'clock position. Inspect the balance again using the strobe light. Adjust the weight as necessary. Refer to the previous two conditions.



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If the shaft will not balance using two weights, then place a third weight on the light spot. Split the first two weights in order to produce a total weight between two and three weights.

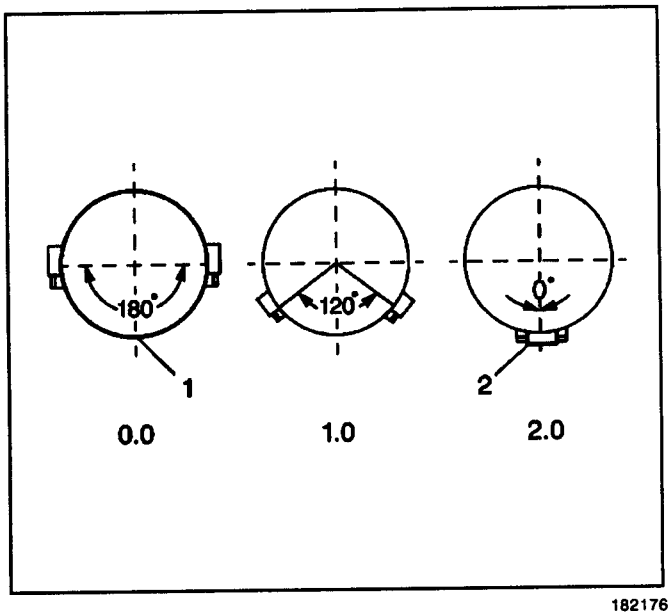
If three weights fail to balance the driveline, then replace the propeller shaft.

When the propeller shaft balances, road test the vehicle in order to verify that the vibration is eliminated.

Driveline System Balance without the Electronic Vibration Analyzer

The following procedure is designed to fine-tune the balance of the propeller shaft while it is mounted in the vehicle. The procedure also is able correct residual imbalance of the remaining driveline components.

Prior to balancing the driveline system, verify that the propeller shaft and the pinion flange runout are within specification.



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Do not overheat the engine when performing this procedure.

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Dual/Rear)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Drum Replacement* in Air Drums.
4. Determine which end of the propeller shaft has the most vibration in order to identify where to begin installing the hose clamps.
5. Mark the end of the propeller shaft (1) which has the most vibration at four points, 90 degrees apart. Number the marks 1 through 4 (2).

Troubleshooting Hints

The following procedure uses a trial and error method of determining where to place the hose clamps on the shaft. Use the following tips in order to help locate the clamps:

1. Because the imbalance may be related to propeller shaft runout, begin installing the clamps at the low point of the propeller shaft runout.
2. When the plant workers balance the propeller shaft, they use weights in graduated increments: 1/16 oz, 1/8 oz, etc. If the stock weight is too light or too heavy, place the hose clamp either directly in line with or opposite to the stock weight.

The last method involves road testing the vehicle at a speed which the vibration is felt.

1. Carefully hold a piece of chalk up to the very end of the propeller shaft. Barely touch the chalk to the shaft.
2. Shut the engine off in order to stop the propeller shaft from rotating. Do not step on the brake pedal. Do not put the transmission in Park.
3. Inspect the chalk mark.

If you performed the above procedure correctly, the chalk mark will indicate the heavy spot on the shaft. The heavy spot deflected downward and touched the chalk. If the chalk mark circle the entire shaft, touch the chalk more gently to the shaft. Ensure that the chalk touches only the heavy spot. Once the heavy spot is located, place the hose clamp 180 degrees opposite to the chalk mark. Then perform the following steps:

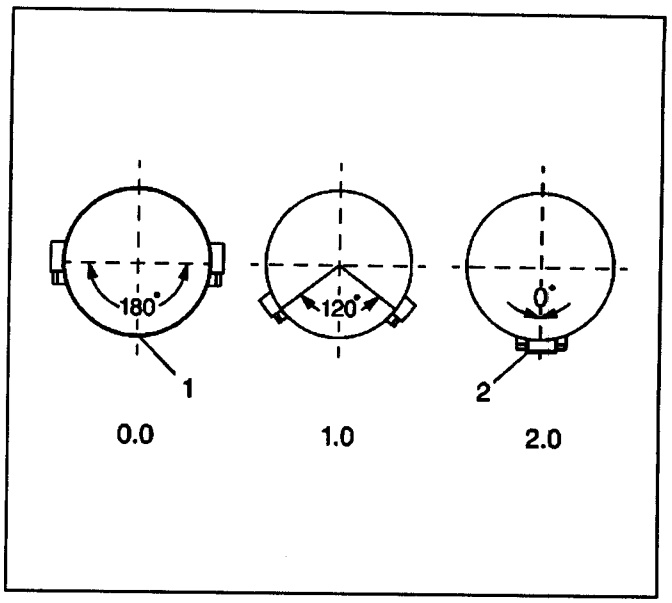
1. Place the hose clamp at the light spot, or at any of the four points marked previously.
2. Test drive the vehicle at the speed at which the vibration occurred. Record any changes in the vibration.
3. Move the clamp to the other positions.
4. Test drive the vehicle each time the clamp is moved. Record any changes in vibration. Note which position gives the best balance.

If the vibration does not change at all, or gets worse, then one clamp is too light or too heavy.

- If the vibration did not change at all, then repeat the procedure using two clamps together.
- If the vibration got worse, repeat the procedure using two clamps separated. Separate the clamps to reduce the spinning weight.

Continue the trial and error procedure using different weights in different locations until you achieve the best balance. If more that three clamps aligned in the same position are required, then replace the propeller shaft.

If you are able to reduce the vibration in the stall, but are unable to eliminate the vibration completely, perform a road test on the vehicle. A slight vibration noticeable in the stall may not be noticeable on the road.



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Propeller Shaft Balance Weights

When using clamps in order to balance a propeller shaft with the total wight method, the correction weight required will often be a fraction or a multiple of one hose clamp. Use the following phasing procedure with two hose clamp in order to accurately place any required amount between zero weights (0.0 total weight) to two weights (2.0 total weight).

Ensure that the clamps are located with even spaces on either side of the light spot, or 180 degrees opposite the heavy spot.

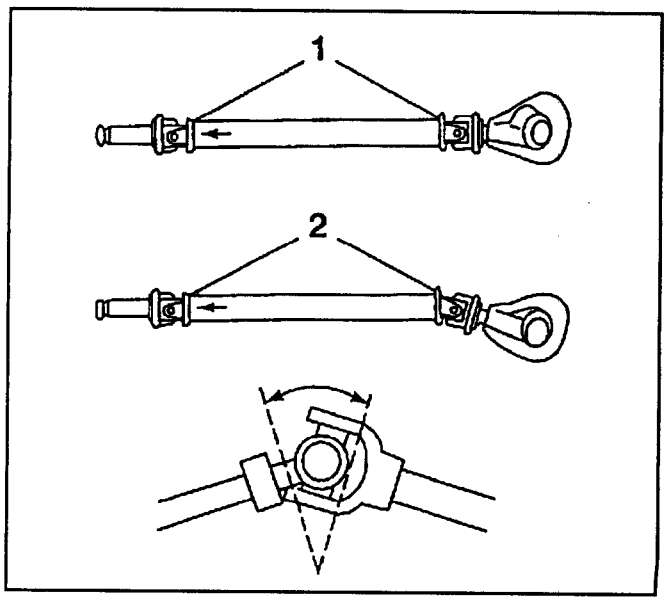
The following table contains the weight amounts in terms of the total weight and the included angle (spread) between the clamps.

The main objective of this section is to correct the conditions that interfere with the proper cancellation effect of the U-joints (1). The most common condition, especially where the where launch shudder is concerned, is incorrect driveline working angles. However, other factors may aggravate the condition.

Address these factors before you attempt to measure or correct driveline working angles:

- Worn, failed, damaged, or improperly installed U-joints (2).
- Worn, collapsed, or improper powertrain mounts
- Incorrect vehicle trim height adjustment for the front suspension. This condition aggravates launch shudder.
- Incorrect trim height adjustment for the rear suspension.
- Trim height inspection includes trim heights that are too low or too high. Vehicles equipped with aftermarket lift kits, vehicles that are constantly loaded with cargo, and custom conversion vans all fit in this category. On rear drive vehicles, the pinion nose tilts upward as the rear trim height is lowered.

If a second-order driveline vibration exists after these conditions are corrected, measure and correct the driveline angles.



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If the complaint is present only with cargo in the vehicle, perform the measurements with the vehicle fully loaded. Once a second-order driveline vibration has been corrected with the vehicle loaded, the vibration may reappear with the vehicle unloaded. The reverse of this is also true. You may have to reach a compromise with the customer in this case.

Driveline Working Angles

Tools Required

- *J38460* Digital Inclinometer
- *J 23498-A* Driveshaft Inclinometer
- *J 23498-20* Driveshaft Inclinometer Adapter

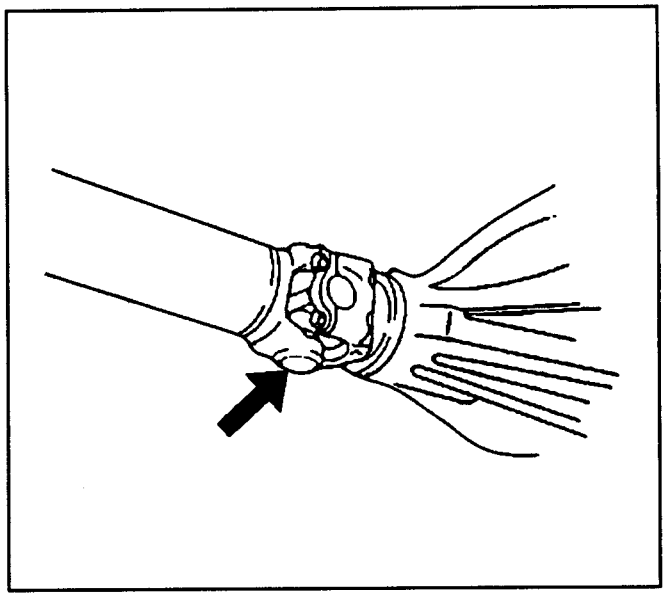
Driveline working angle does not refer to the angle of any one shaft, but to the angle that is formed by the intersection of two shafts, as shown.

The procedure for measuring and correcting driveline working angles depends on whether the vehicle is equipped with a one or two-piece propeller shaft.

You need a *J38460* Digital Inclinometer

- The *J 23498-A* Driveshaft Inclinometer
- The *J38460* Digital Inclinometer
- Use *J 23498-20* Driveshaft Inclinometer Adapter

To verify the accuracy of the adapter, check the angle of an angle of an accessible joint with the inclinometer prior to assign it on an inaccessible joint.



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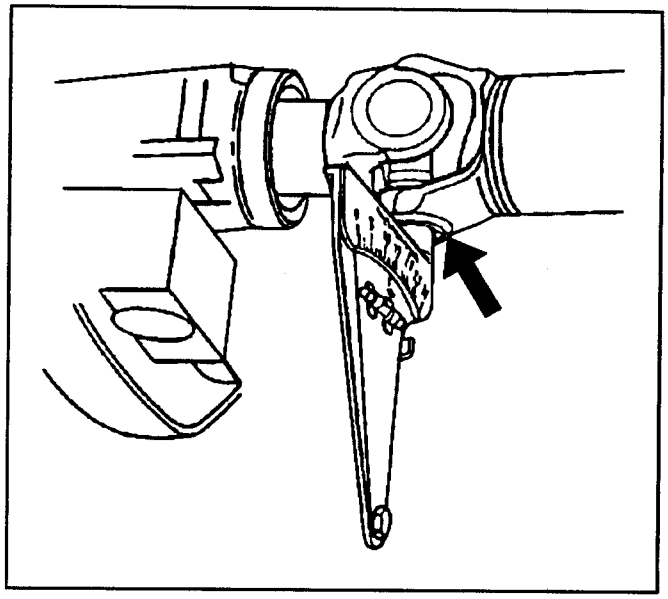
Preliminary Checks

Raise the vehicle on a suitable hoist or on safety stands. Ensure that the rear axle is supported at curb height and that the wheels are free to spin. Refer to *Lifting and Jacking the Vehicle* in General Information. Place the transmission in Neutral. Make sure the vehicle has a full tank of fuel or the equivalent amount of weight in the rear to simulate a full tank. 3.8 liters of gasoline (one gallon) weighs approximately 2.8 kg (6.2 lb).

Checking Phasing of U-joints

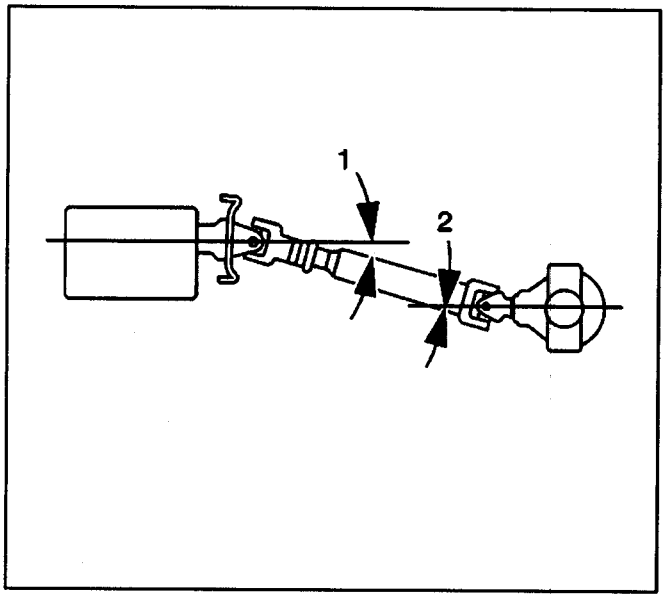
Inspect the propeller shaft for correct phasing. This means that the front and rear U-joints are directly in line or parallel with each other so that proper cancellation takes place.

1. Rotate the propeller shaft so that the propeller shaft rear U-joint bearing cap (1) is vertical as shown.
2. Ensure that the front bearing cap (1) is also vertical.
3. Place the inclinometer on the propeller shaft rear U-joint bearing cap in order to ensure that both U-joints are vertical.
4. Set the indicator line above the sight glass on 15 (the horizontal reference) and rotate the propeller shaft until the bubble centers in the sight glass. This brings the rear U-joint to vertical.
5. Remove the inclinometer without disturbing the setting. Leave the setting on 15 and install the inclinometer on the front U-joint. The bubble should remain centered plus or minus 3 degrees if the shaft is properly phased.



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The out of phasing of the single-piece propeller shaft is very unusual. If the shaft is visibly out of place, the end yokes are welded on in the wrong position, or the shaft is damaged due to twisting. In either case, replace the propeller shaft before continuing with this procedure.



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Measuring the Working Angles

The working angle of a U-joint is the difference between the angles formed when two shafts intersect. One piece propeller shaft systems have two working angles, the front and the rear.

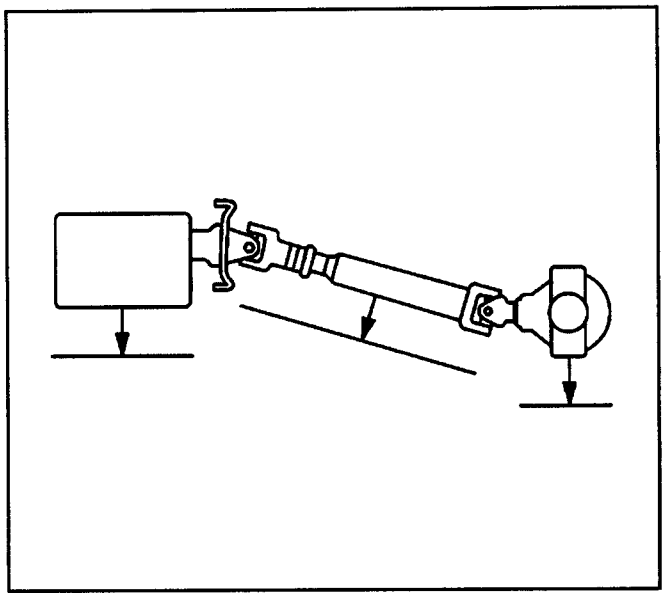
- The two working angles should be equal within 1/2 of a degree.
- The working angles themselves should not exceed 4 degrees.
- The working angles themselves should not be equal to zero because a zero working angle will cause premature U-joint wear due to lack of rotation of the U-joints.

The angle of the propeller shaft and the rear axle pinion form the rear working angle (2). The angle of the propeller shaft and the transmission output shaft form the front working angle (1).

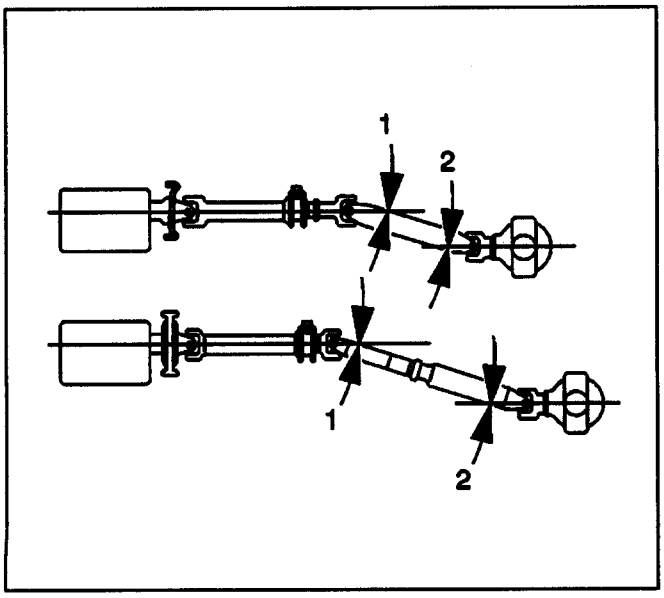
The angles of these components are most accurately measured from the U-joint bearing caps. The bearing caps should be free of corrosion or foreign material to ensure accurate readings. Remove any snap rings that may interfere wit the correct placement of the inclinometer. Do not forget to reinstall them after you take the measurements.

Take the measurements from the same side of the propeller shaft to maintain consistent angle measurements (either driver or passenger side).

It is extremely helpful to record the readings on a diagram like the one shown as you proceed through the measurements.



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Evaluation

The two working angles in a one-piece propeller shaft system should be equal to within 1/2 of a degree for effective cancellation.

Measuring Two-Piece Propeller Shaft System Working Angles

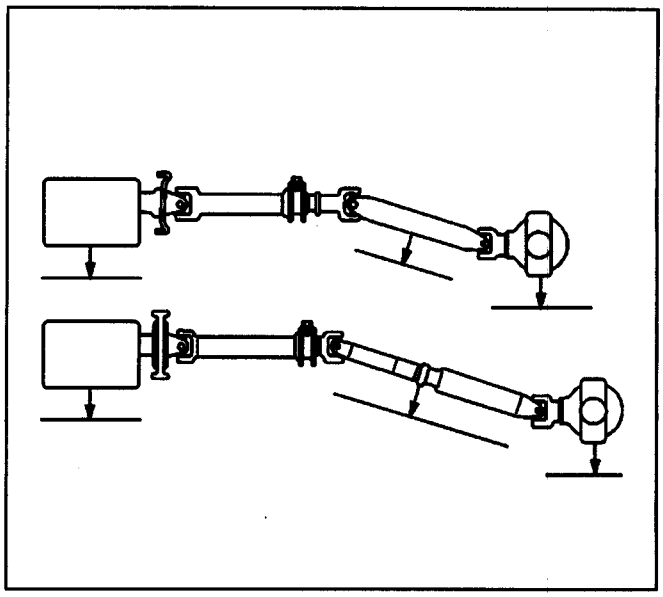
Two-piece propeller shaft systems have three working angles instead of two as in one-piece systems.

- The first angle (1) is the front working angle. It is formed by the angle of the output shaft of the transmission and the angle of the front propeller shaft.
- The second angle (2) is the middle working angle. It is formed by the angle of the front propeller shaft and the angle of the rear propeller shaft.
- The third angle is the rear working angle. It is formed by the angle of the rear propeller shaft and the angle of the pinion yoke of the rear axle.

This system has an odd joint that does not have another joint to provide cancellation. Therefore, the rear working angle and the middle working angle act as a pair of joints to cancel each other out, like in one-piece propeller shaft systems.

The front angle is considered the odd joint because it does not have another joint to provide cancellation. Because of this, the working angle of the odd joint must be kept at or under 1/2 or a degree.

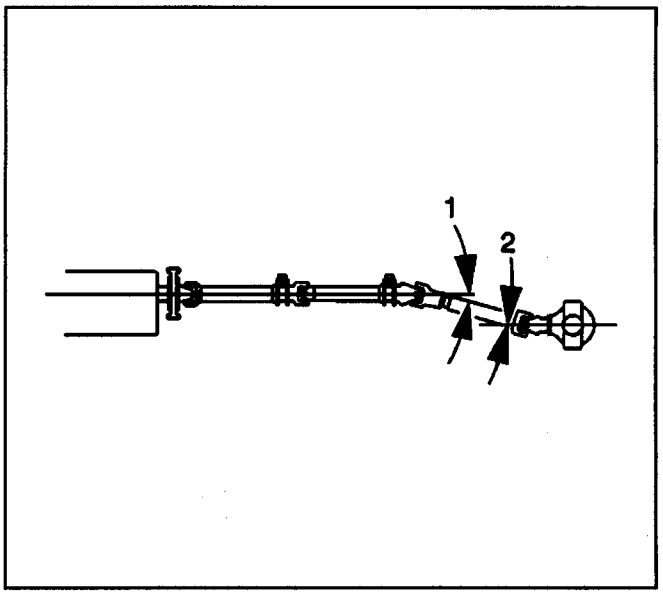
Keep the working angle of this odd joint to a minimum so that there are not any great fluctuations in speed that need to be canceled out. The front joint is used as the odd joint because the front joint angle does not change with suspension bounce, rebound, or axle windup. For this reason, think of the front propeller shaft of a two piece system as an extension of the transmission output shaft.



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Measuring Three-Piece Propeller Shaft System Working Angles

Three-piece propeller shaft systems have four working angles instead of two as in one-piece systems.

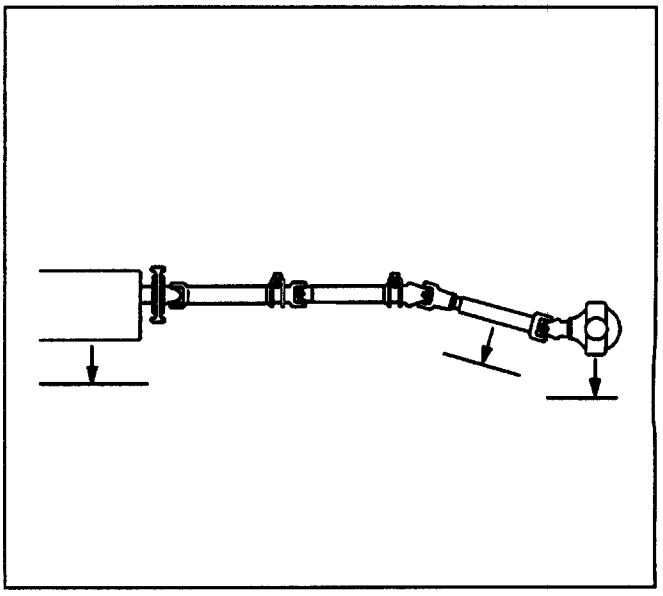


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- The first angle is the front working angle. It is formed by the angle of the output shaft of the transmission and the angle of the front propeller shaft.
- The second angle is the middle working angle. It is formed by the angle of the front propeller shaft and the angle of the rear propeller shaft.
- The third angle is the rear working angle. It is formed by the angle of the rear propeller shaft and the angle of the pinion yoke of the rear axle.

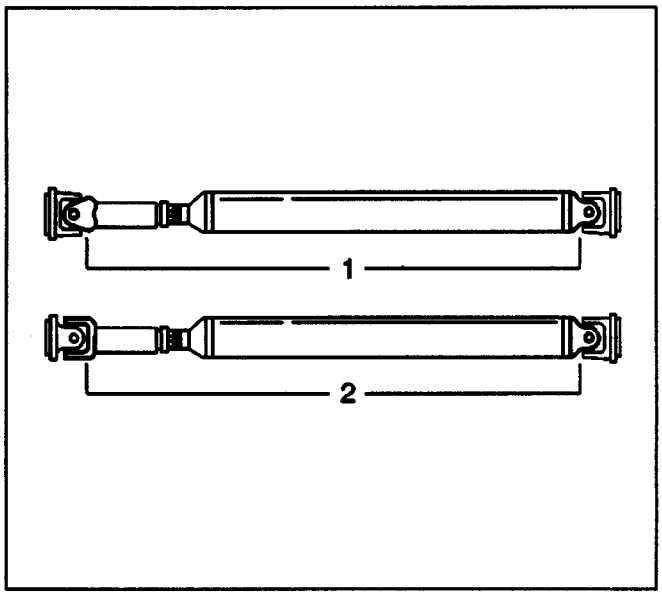
This system has an odd joint that does not have another joint to provide cancellation. Therefore, the rear working angle and the middle working angle act as a pair of joints to cancel each other out, like in one-piece propeller shaft systems.

The front angle is considered the odd joint because it does not have another joint to provide cancellation. Because of this, the working angle of the odd joint must be kept at or under 1/2 or a degree.



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Keep the working angle of this odd joint to a minimum so that there are not any great fluctuations in speed that need to be canceled out. The front joint is used as the odd joint because the front joint angle does not change with suspension bounce, rebound, or axle windup. For this reason, think of the front propeller shaft of a two piece system as an extension of the transmission output shaft.

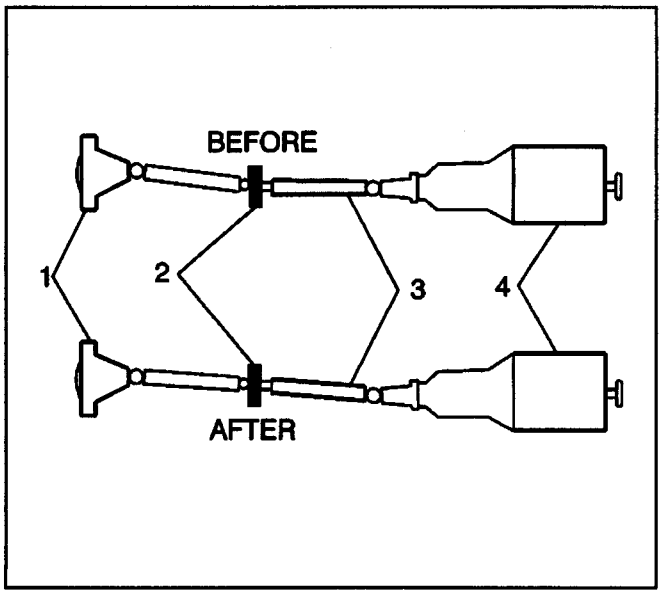


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Propeller Shaft Phasing

The setup and measurement techniques are identical to that of all propeller shaft systems. First, check for proper phasing:

1. Turn the rear shaft so the rear U-joint is straight up and down. Ensure that the front U-joint of the (1) propeller shaft is also straight up and down.
2. Rotate the shafts 90 degrees so that the front propeller shaft front U-joint is straight up and down. Ensure that the propeller shaft is also straight up and down (actually part of the slip yoke on the shaft) (1).



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If the two U-joints of the propeller shaft are not in this phase (2), the two halves of the propeller shaft may have been assembled incorrectly.

Propeller Shaft(s) Lateral Alignment

The procedure for lateral alignment of a propeller shaft(s) is used for launch shudder or any second-order, driveline vibrations. Adjust the lateral alignment before you measure and adjust the driveline angles.

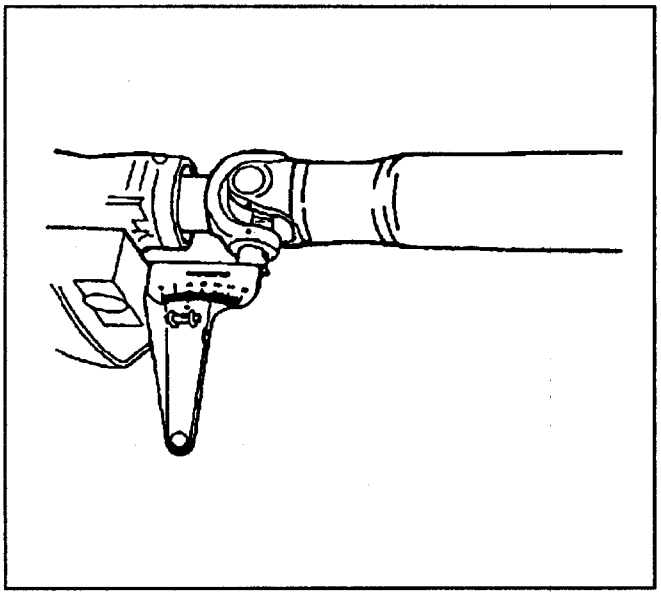
1. Raise and suitably support the vehicle on a hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Look down the front of the propeller shaft.
3. If the propeller shaft is not straight, or if the center bearing support, if equipped, is off to one side, relocate center support bearing, if equipped, to make the propeller shaft assembly as straight as possible. Ensure that you do not create a ground-out condition against the exhaust or another component.

If launch shudder or second-order driveline vibration is still present, measure and correct the driveline angles.

Measuring Propeller Shaft Working Angles

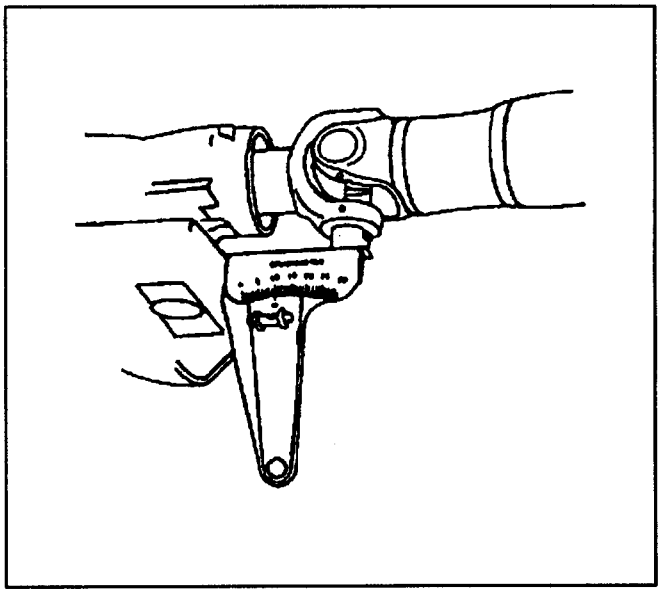
This procedure is essentially the same, for all propeller shaft(s). You must, however, take into account the third angle if you have more than one propeller shaft.

1. Place the inclinometer on the propeller shaft bearing cap (1).

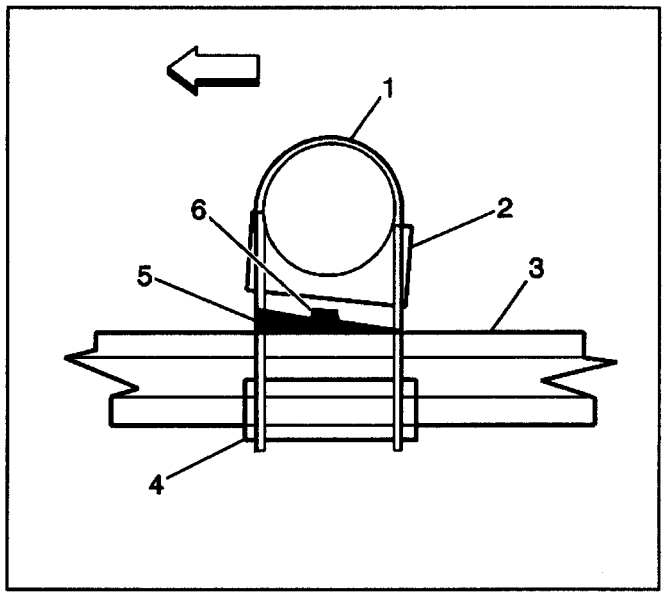


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2. Center the bubble in the sight glass and record the measurement. The bearing cap must be straight up and down to obtain accurate measurement. Enter the measurements on your diagram.
3. Rotate the propeller shaft 90 degrees and place the inclinometer on the transmission output yoke bearing cap. Again, the bearing cap must be straight up and down to obtain an accurate measurement.
4. Center the bubble in the sight glass and record the measurement.
5. Subtract the smaller reading from the larger reading to obtain the front U-joint working angle.



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Evaluation

The working angle is within tolerance, following the rule that the working angle of an odd joint in a two-piece joint system is 1/2 degree or less. Notice that in each of the good examples that the front working angle (FWA) is 1/2 degree or less and is treated as a separate joint. The middle working angle (MWA) and rear working angle (RWA) are subtracted and the difference (DIFF) is 1/2 degree or less. The middle and rear joints may cancel each other.

Correcting Working Angles

In order to change the working angles, shim the components up or down. Look closely at the existing angles. Use the existing angles and the shims in order to achieve the correct working angles.

Compared to horizontal or true level, the components located at the rear of the vehicle are usually lower than the components located at the front of the vehicle. This condition is called "down in the rear". If a component with a down in the rear angle is shimmed up at the rear, then the shim will bring the component closer to the horizontal (zero). Alternately, if a component with a down in the rear angle is shimmed down, then the component will move farther from the horizontal (zero).

Rear Axle Wind-Up

Rear axle wind-up may cause launch shudder even when all of the working angles are within specifications. Rear axle wind-up occurs when heavy torque during acceleration causes the pinion nose to point upward. In order to compensate for axle wind-up, tip the pinion nose downward. Install the axle shims incrementally, performing a road test after each shim. Add shims until the road test indicates that the shudder is eliminated.

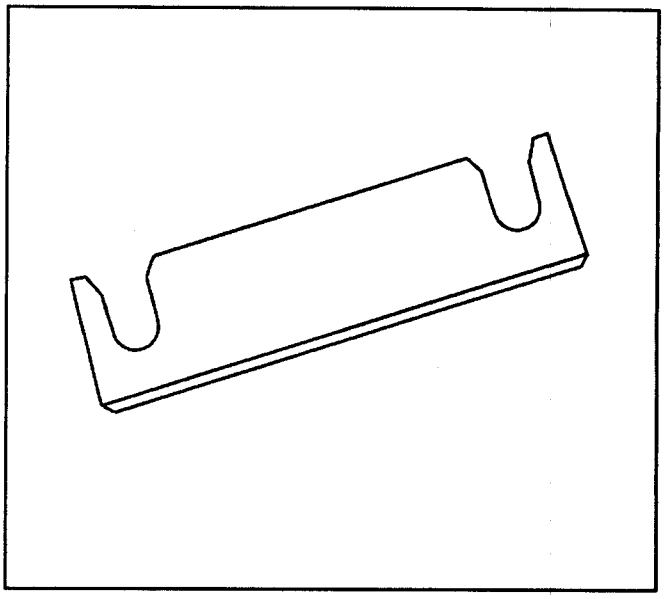
Rear Axle Shims

Wedge shims of different sizes are available through GMSPO and independent suppliers for the purpose of shimming the rear axle angle. GM shims are available in two, three and four degrees.

Caution: Never attempt to shim a rear axle using anything except shims that are designed for this purpose. Failure to do so will result in the shims falling out and a loss of vehicle control and that could cause personal injury.

Install the shims (5) in order to increase or decrease the angle of the rear axle pinion. Install the shims between the leaf spring (3) and the spring seat. Depending on the design of the suspension (leaf spring on top or underneath the axle), and the direction of the desired change, install the shims with either the thick side toward the front of the vehicle or toward the rear of the vehicle.

Important: After installing the shims, ensure that the U-bolt has two or three threads above the nut. Ensure also that the center bolt, located in the spring seat, is long enough to seat in the locator hole. If these two conditions do not exist, use longer U-bolts and center bolts. Longer U-bolts and center bolts are available through local spring shops.



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Transmission Shims

If a transmission requires shims, order the shims.

Installing most shims will change the transmission angle approximately 1/2 degree.

When shimming transmissions, use a shim made from steel stock at the necessary thickness. Ensure that the shim contacts the full width of the area to be shimmed. Do not use washers.

Description and Operation

General Description

Vibration Theory

The vehicle designs and the engineering requirements have undergone drastic changes in this decade. The following factors drive many of these requirements:

- Increased fuel costs
- Decreased fuel supplies
- Corporate Average Fuel Economy (CAFE)
- Clean air legislation
- Foreign competition
- Crashworthiness
- Rising customer expectations

The vehicle designs have evolved from the full frame construction, where multiple isolating body mounts were used, to the lighter unibody designs of today. The unibody designs transfer any noise or vibration faster.

The use of heavier V8 engines has been reduced, being replaced with lighter, more fuel-efficient four and six-cylinder engines. During this same period, options such as A/C and PS have become more popular. These types of options increase the engine load, resulting in more unwanted noise and vibration.

The presence/absence of unwanted noise and vibration is linked to the customer's perception of the overall vehicle quality.

Vibration is the repetitive motion of an object, back and forth, or up and down. The following conditions cause most vehicle vibrations:

- A rotating component
- The engine combustion process firing impulses

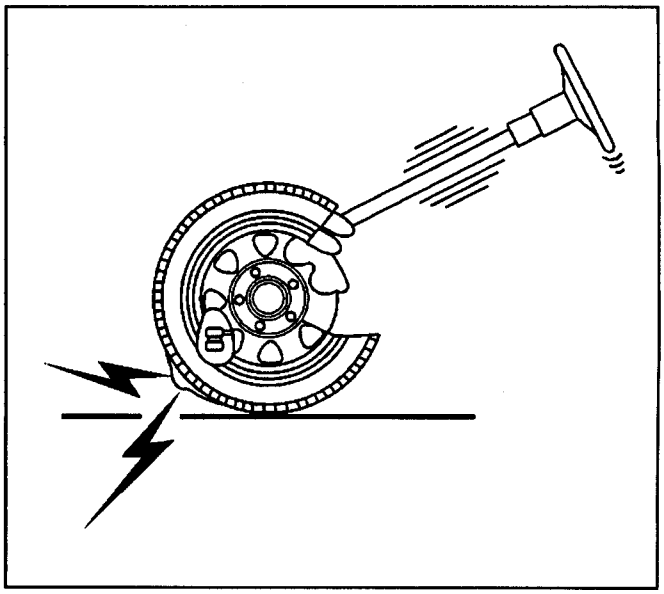
Rotating components will vibrate with excessive imbalance or runout. During vibration diagnosis, the amount of allowable imbalance or runout should be considered a TOLERANCE and not a SPECIFICATION. In other words, the less imbalance or runout the better.

A vibration concern will occur when the firing impulses of the engine are not properly isolated from the passenger compartment.

A vibrating component operates at a consistent rate (km/h, mph, or rpm). Measure the rate of vibration in question. When the rate/speed is determined, relate the vibration to a component that operates at an equal rate/speed in order to pinpoint the source. Vibrations also tend to transmit through the body structure to other components. Therefore, just because the seat vibrates doesn't mean the source of vibration is in the seat.

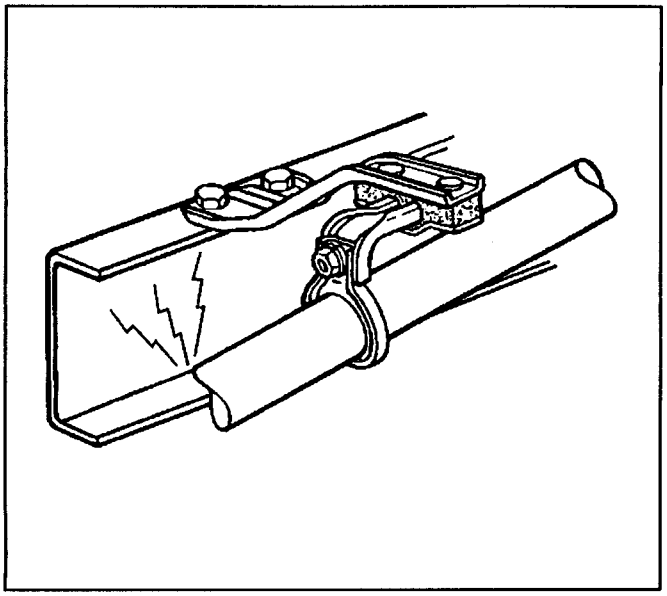
Vibrations consist of the following three elements:

- The source — the cause of the vibration
- The transfer path — the path the vibration travels through the vehicle
- The responder — the component where the vibration is felt



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In the preceding picture, the source is the unbalanced tire. The transfer path is the route the vibrations travels through the vehicle's suspension system into the steering column. The responder is the steering wheel, which the customer reports as vibrating. Eliminating any one of these three elements will usually correct the condition. Decide, from the gathered information, which element makes the most sense to repair. Adding a brace to the steering column may keep the steering wheel from vibrating, but adding a brace is not a practical solution. The most direct and effective repair would be to properly balance the tire.



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Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe GROUNDED to the frame. The source of the vibration is the engine firing impulses traveling through the exhaust. The transfer path is a grounded or bound-up exhaust hanger. The responder is the frame. The floor panel vibrates, acting as a large speaker, which produces noise. The best repair would be to eliminate the transfer path. Aligning the exhaust system and correcting the grounded condition at the frame would eliminate the transfer path.

Basic Vibration Terminology

The following are the two primary components of vibration diagnosis:

- The physical properties of objects
- The object's properties of conducting mechanical energy

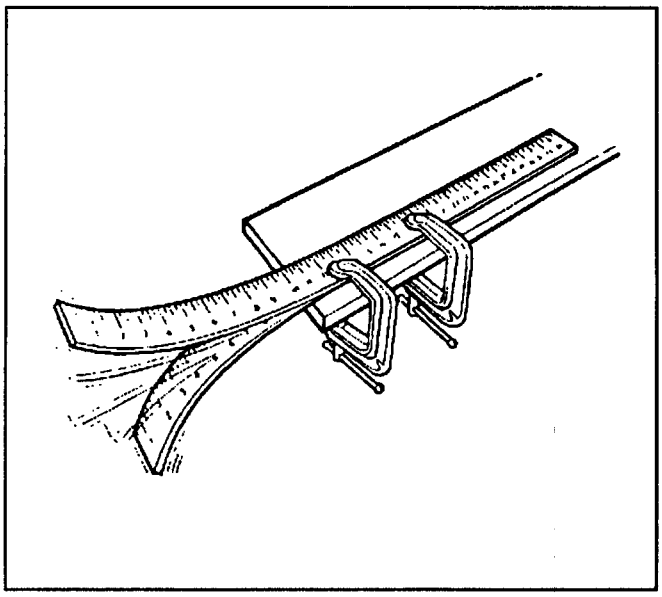
The repetitive up and down or back and forth movement of a component cause most customer vibration complaints. The following are the common components that vibrate:

- The steering wheel
- The seat cushion
- The frame
- The I/P

Vibration diagnosis involves the following simple stepwise outline:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency back on terms of the rotational speed of a component that is operating at the same rate or speed.
3. Inspect and test the components for conditions that cause vibration.

For example, performing the following steps will help demonstrate the vibration theory:



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1. Clamp a yardstick to the edge of a table, leaving about 50 cm (20 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The motion of the stick occurs in repetitive cycles. The cycle begins at midpoint, continues through the lowest extreme of travel, then back past the midpoint, through the upper extreme of travel, and back to the midpoint where the cycle begins again.

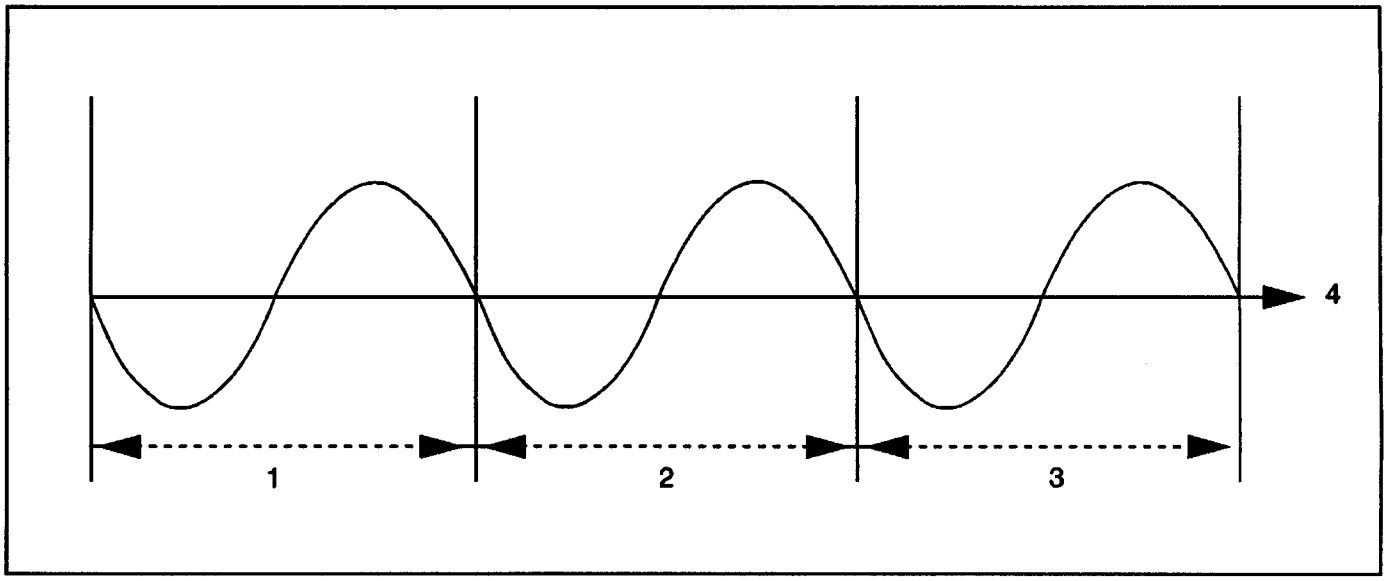
The cycle occurs over and over again at the same rate, or frequency. In this case, about 10 cycles in one minute. If we measure the frequency to reflect the number of complete cycles that the yardstick made in one minute, the measure would be 10 cycles x 60 seconds = 600 cycles per minute (cpm).

We have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top to the very bottom. Redo the experiment as follows:

1. Reclamp the yardstick to the edge of a table, leaving about 25 cm (10 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The stick vibrates at a much faster frequency: 30 cycles per second (1800 cycles per minute).

Cycle

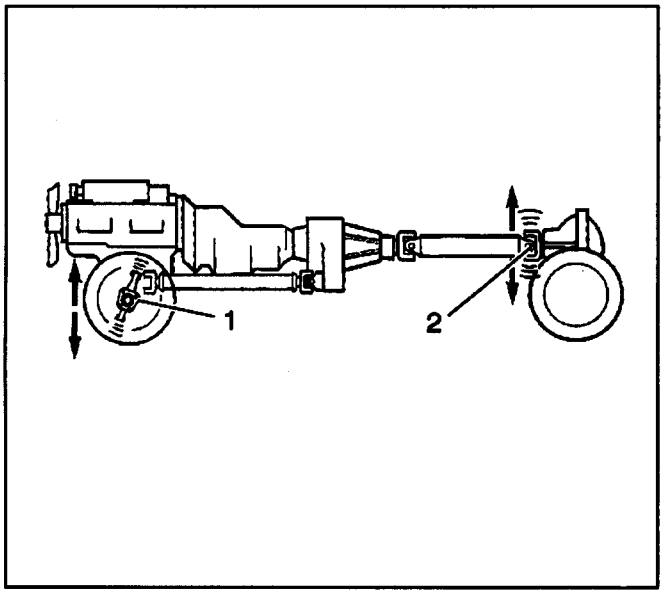


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Legend

(1) 1st Cycle
(2) 2nd Cycle
(3) 3rd Cycle
(4) Time

Vibration Cycles in Powertrain Components



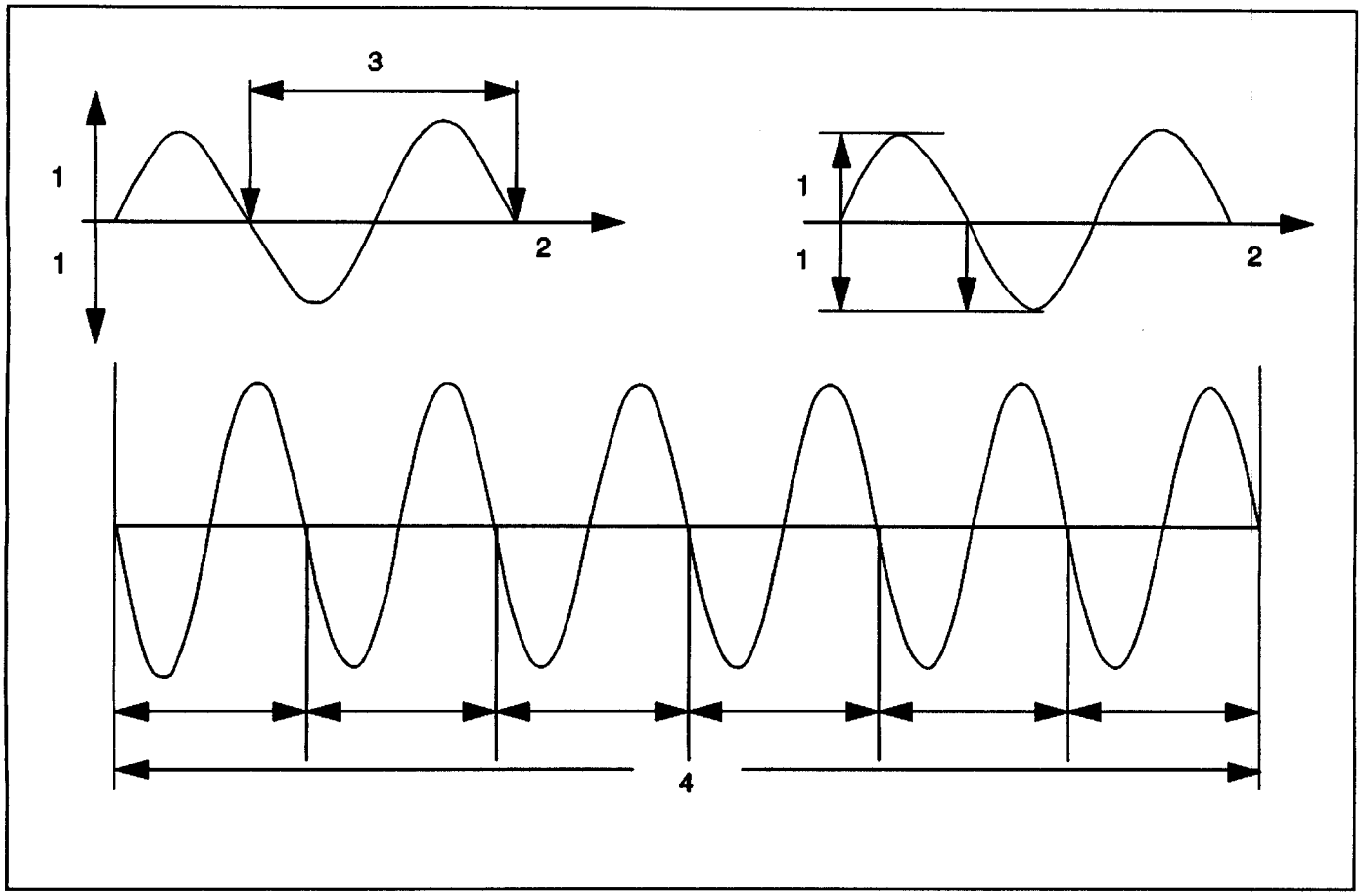
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Legend

(1) Spindle
(2) Pinion Nose

The word CYCLE comes from the same root as the word CIRCLE. A circle begins and ends at the same point, as thus, so does a cycle. All vibrations consist of repetitive cycles.

Frequency



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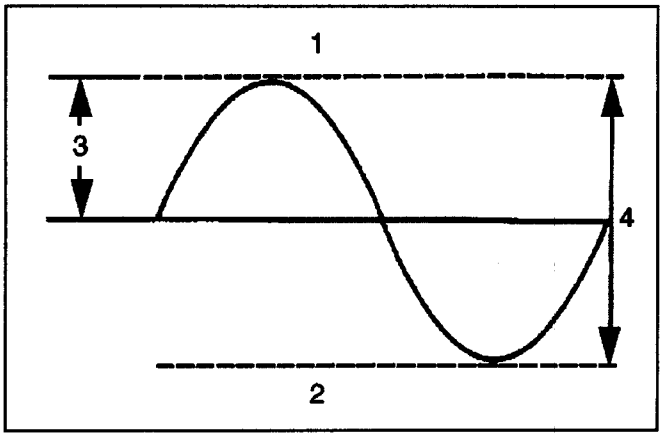
Legend

(1) Amplitude
(2) Reference
(3) Time in Seconds
(4) 1 Second

Frequency is defined as the rate at which an event occurs during a given period of time. With a vibration, the event is a cycle, and the period of time is one second. Thus, frequency is expressed in cycles per second.

The proper term for cycles per seconds is Hertz (Hz). This is the most common way to measure frequency. Multiply the Hertz by 60 to get the cycles or revolutions per minute (RPM).

Amplitude



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Legend

(1) Maximum
(2) Minimum
(3) Zero-to-Peak Amplitude
(4) Peak-to-Peak Amplitude

Amplitude is the maximum value of a periodically varying quantity. Used in vibration diagnostics, we are referring it to the magnitude of the disturbance. A severe disturbance would have a high amplitude; a minor disturbance would have a low amplitude.

Amplitude is measured by the amount of actual movement, or the displacement. For example, consider the vibration caused by an out-of-balance wheel at 80 km/h (50 mph) as opposed to 40 km/h (25 mph). As the speed increases, the amplitude increases.

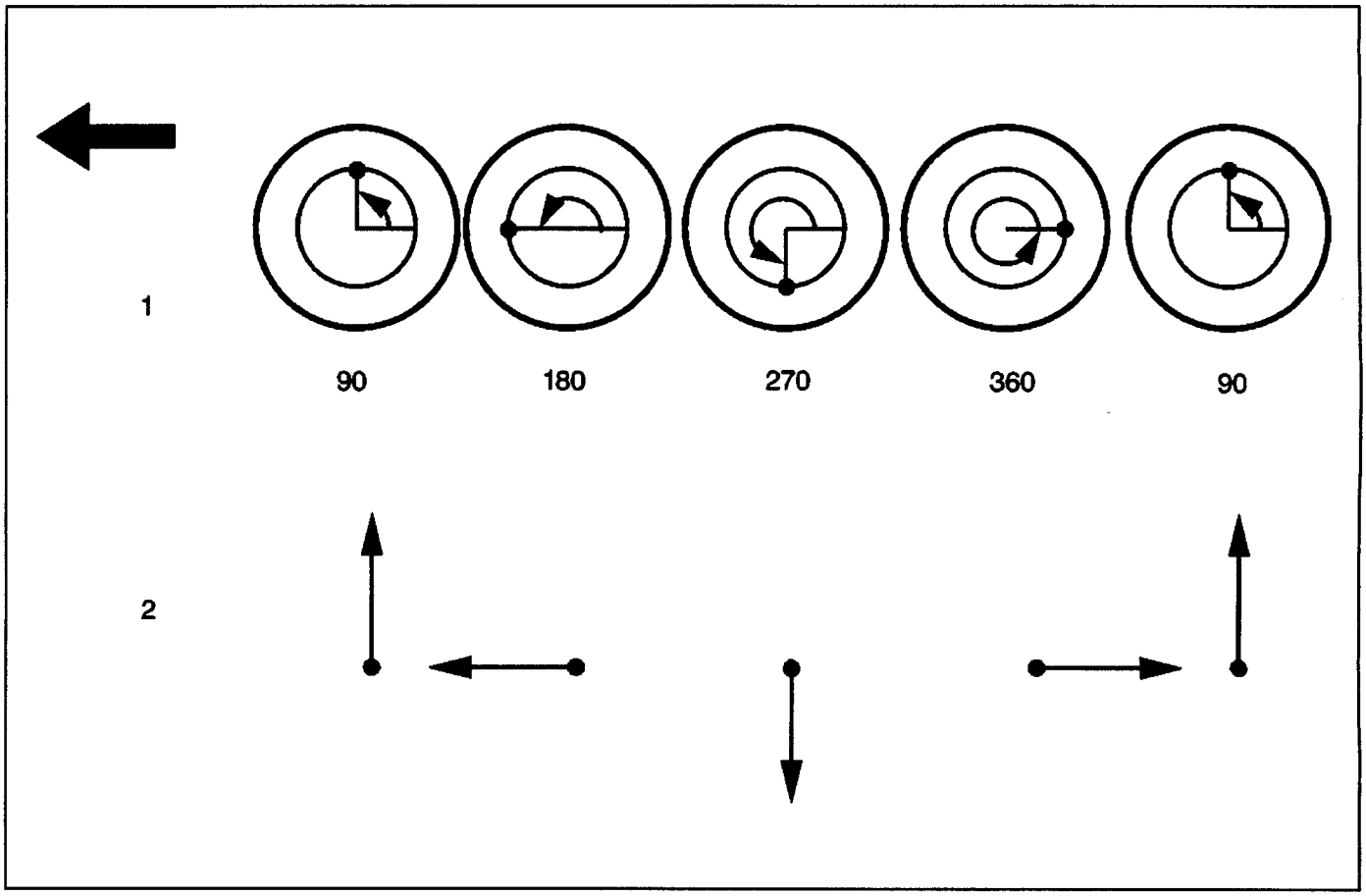
Free Vibration

Free vibration is the continued vibration in the absence of any outside force. In the yardstick example, the yardstick continued to vibrate even after the end was released.

Forced Vibration

Forced vibration is when an object is vibrating continuously as a result of an outside force.

Centrifugal Force Due to an Imbalance



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Legend

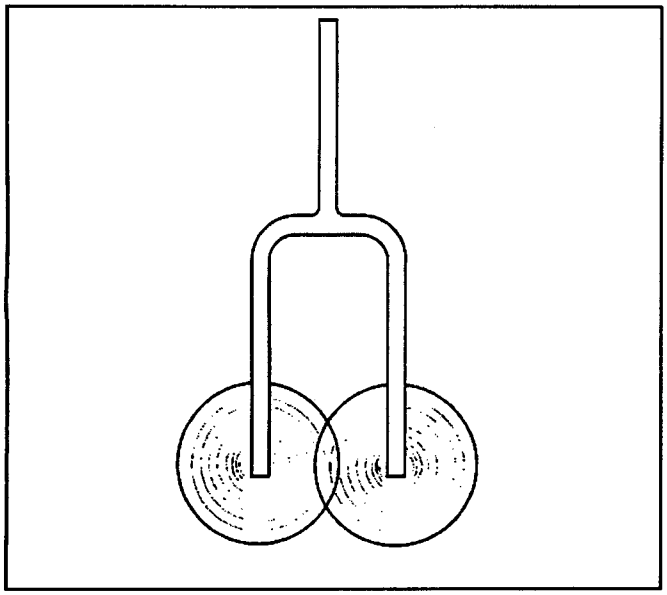
(1) Location of Imbalance (Degrees)
(2) Centrifugal Force Acting on Spindle

A spinning object with an imbalance generates a centrifugal force. Performing the following steps will help to demonstrate centrifugal force:

1. Tie a nut to a string.
2. Hold the string. The nut hangs vertically due to gravity.
3. Spin the string. The nut will spin in a circle.

Centrifugal force is trying to make the nut fly outward, causing the pull you feel on your hand. An unbalanced tire follows the same example. The nut is the imbalance in the tire. The string is the tire, wheel, and suspension assembly. As the vehicle speed increases, the disturbing force of the unbalanced tire can be felt in the steering wheel, the seat, and the floor. This disturbance will be repetitive (Hz) and the amplitude will increase. At higher speeds, both the frequency and the amplitude will increase. As the tire revolves, the imbalance, or the centrifugal force, will alternately lift the tire up and force the tire downward, along with the spindle, once for each revolution of the tire.

Natural or Resonant Frequency



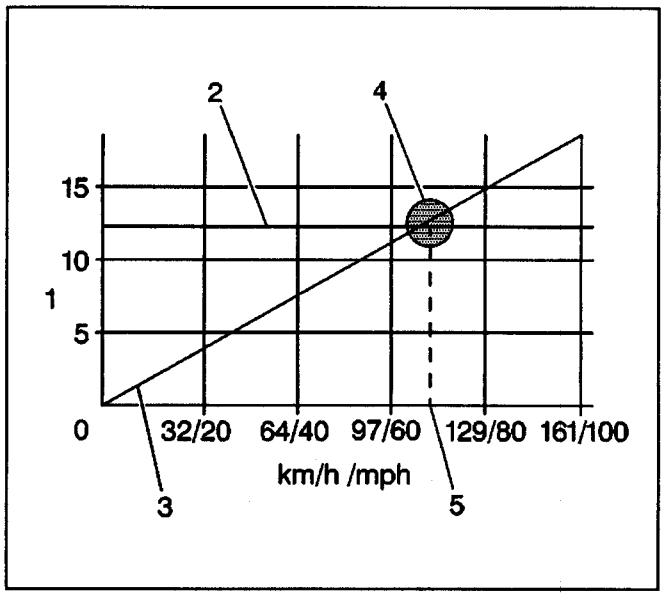
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The natural frequency is the frequency at which an object tends to vibrate. Bells, guitar strings, and tuning forks are all examples of objects that tend to vibrate at specific frequencies when excited by an external force.

Suspension systems, and even engines within their mounts, have a tendency to vibrate at certain frequencies. This is why some vibration complaints occur only at specific vehicle speeds or engine rpm.

The stiffness and the natural frequency of a material have a relationship. Generally, the stiffer the material, the higher the natural frequency. The opposite is also true. The softer a material, the lower its natural frequency. Conversely, the greater the mass, the higher the natural frequency.

Resonance



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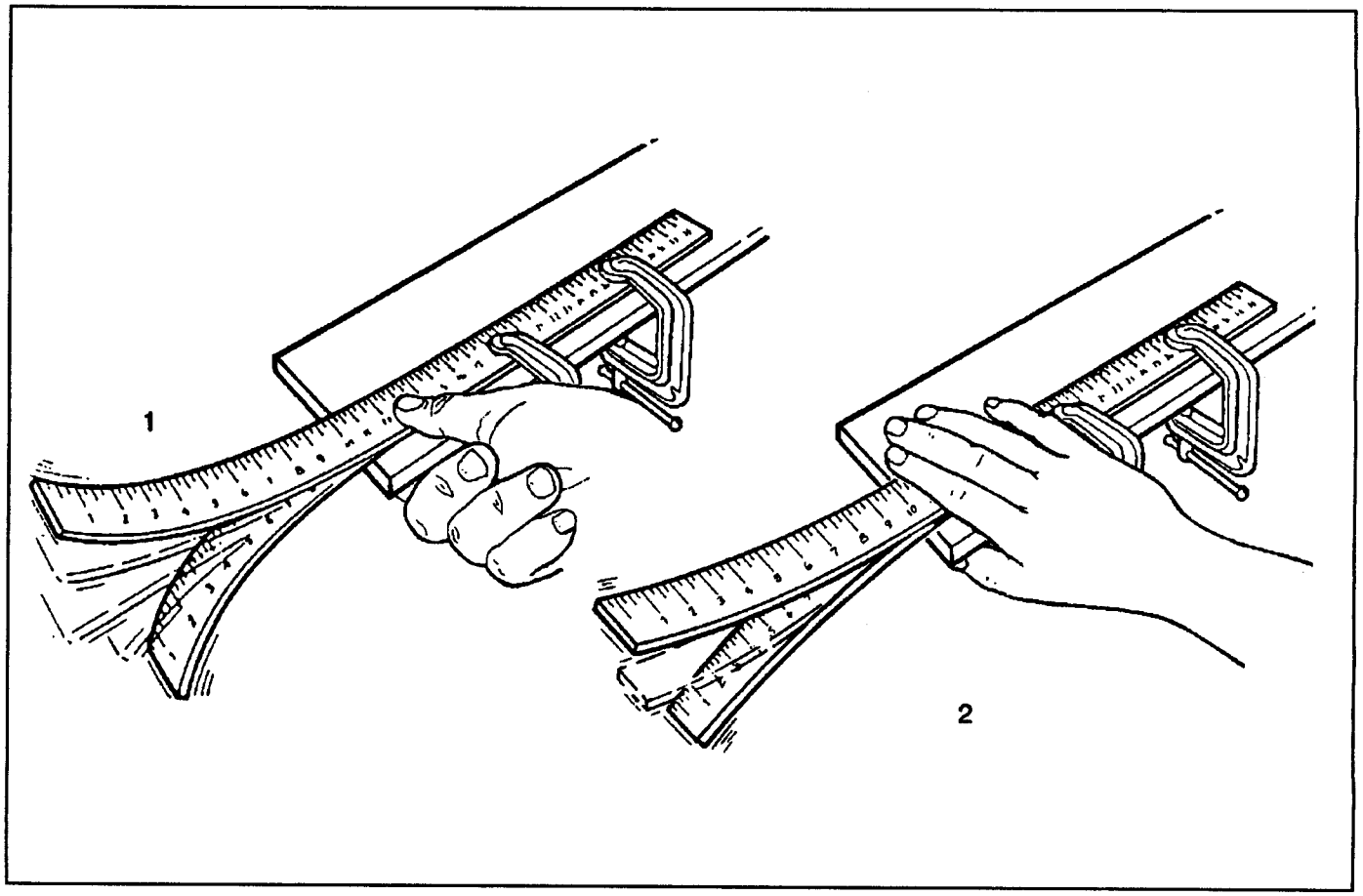
Legend

(1) Frequency – cps
(2) Suspension Frequency
(3) Unbalanced Excitation
(4) Point of Resonance
(5) Problem Speed

All objects have natural frequencies. The natural frequency of a typical automotive front suspension is in the 10–15Hz range. This natural frequency is the result of the suspension design. The suspension's natural frequency is the same at all vehicle speeds. As the tire speed increases along with the vehicle speed, the disturbance created by the tire increases in frequency. Eventually, the frequency of the unbalanced tire will intersect with the natural frequency of the suspension. This causes the suspension to vibrate. The intersecting point is called the resonance.

The amplitude off a vibration will be greatest at the point of resonance. While the vibration may be felt above and below the problem speed, the vibration may be felt the most a the point of resonance.

Damping



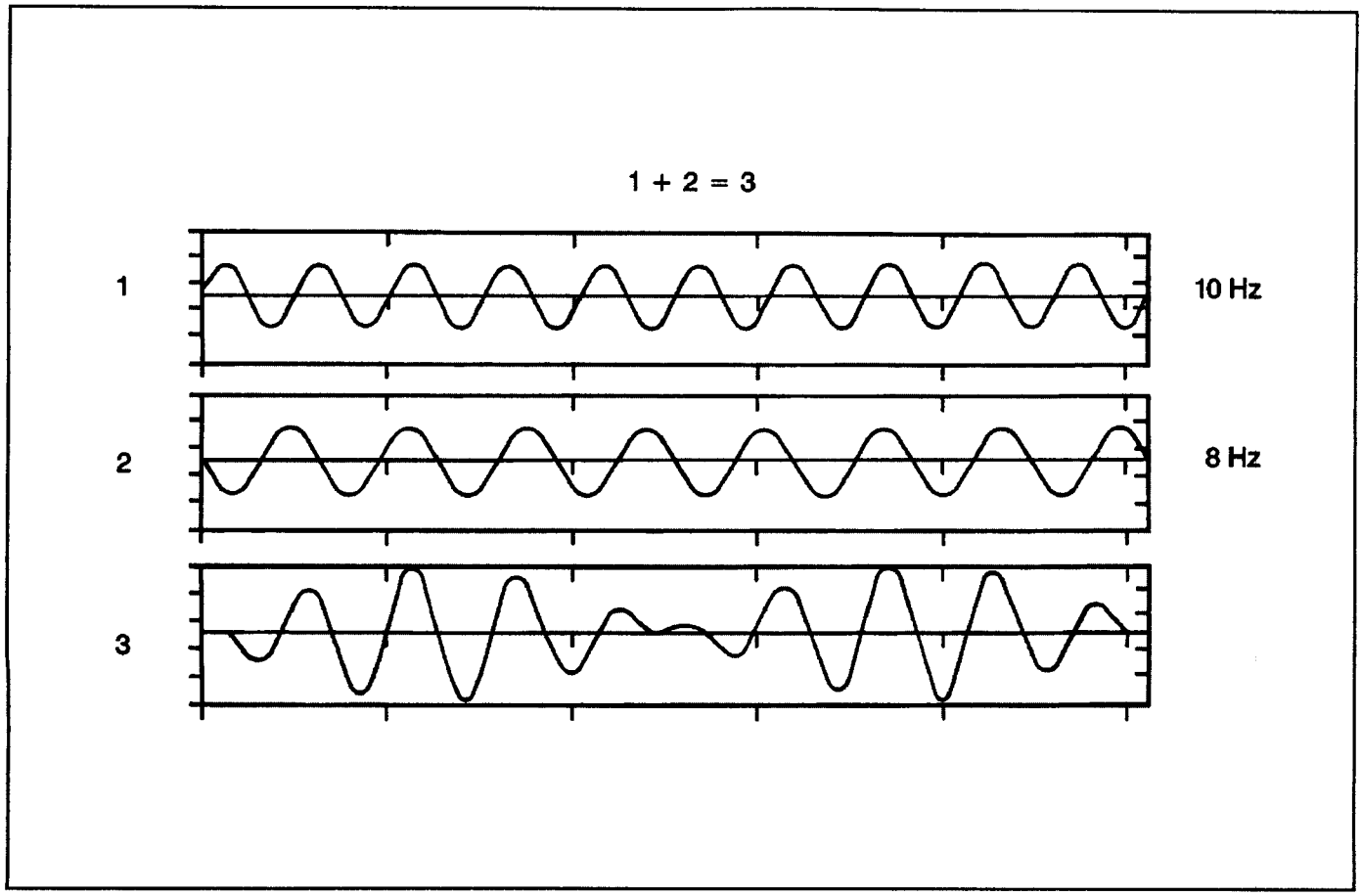
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Legend

(1) Low Damping
(2) High Damping

Damping is the ability of an object or material to dissipate or absorb vibration. The automotive shock absorber is a good example. The function of the shock absorber is to absorb or dampen the oscillations of the suspension system.

Beating (Phasing)



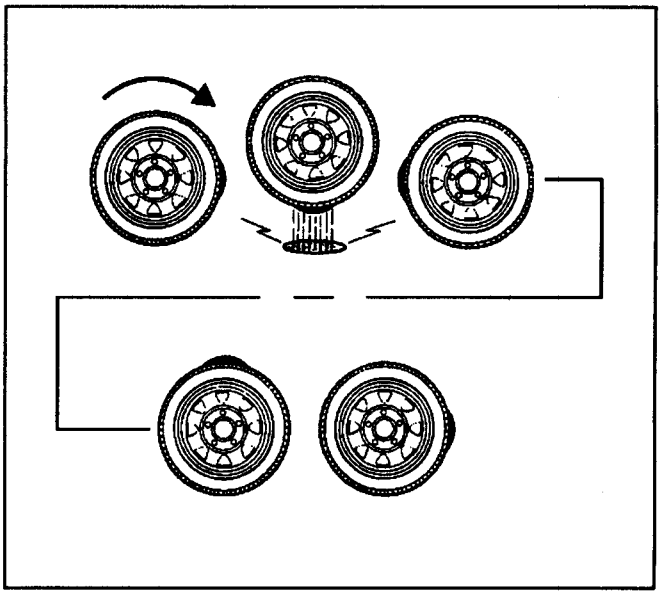
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Two separate disturbances that are relatively close together in frequency will lead to a condition called beating, or phasing. A beating vibration condition will increase in intensity or amplitude in a repetitive fashion as the vehicle travels at a steady speed. This beating vibration can produce the familiar droning noise heard in some vehicles.

Beating occurs when two vibrating forces are adding to each other's amplitude. However, two vibrating forces can also subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is called beating. In many cases, eliminating either one of the disturbances can correct the condition.

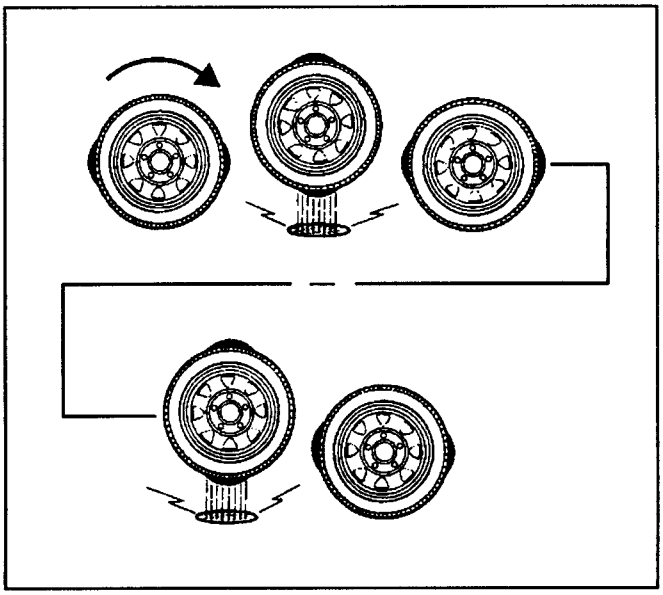
Order

Order refers to how many times an event occurs during one revolution of a rotating component.



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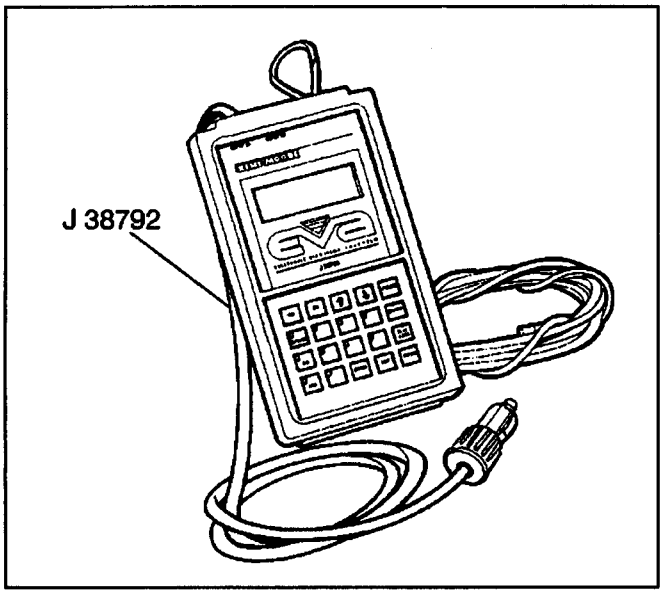
For example, a tire with one high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.



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An oval-shaped tire with two high spots would create a disturbance twice for every revolution. This is called second-order vibration. Three high spots would be third-order, and so forth. Two first-order vibrations may add or subtract from the overall amplitude of the disturbance, but that is all. Two first-order vibrations do not equal a second-order. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

Electronic Vibration Analyzer (EVA)



95602

The *J 38792* Electronic Vibration Analyzer (EVA) is specifically designed to diagnose vibrations. This hand-held device is similar to a scan tool. A standard 12-volt power feed supplies the power. The vibration sensor, or the accelerometer, is at the end of a 6 m (20 ft) cord. The vibration sensor can be mounted virtually anywhere on the vehicle where a vibration is felt.

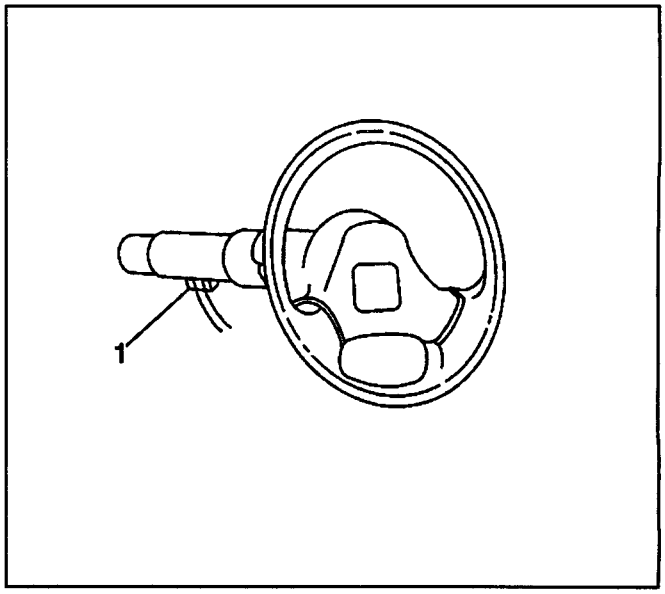
EVA Basic Hookup

1. Inspect that the software cartridge is correctly inserted at the bottom of the unit. (The cartridge usually remains there at all times.)
2. Connect the vibration sensor cord into either input A or B.
3. Line up the connector so that the release button is at the bottom.

   Important: Do not twist the connector. The sensor should remain plugged into the unit at all times.
4. Push the connector into the input until the connector clicks and locks in place.
5. Plug the power cord into a 12-volt power feed in order to turn the EVA on. (There is no ON-OFF switch.)

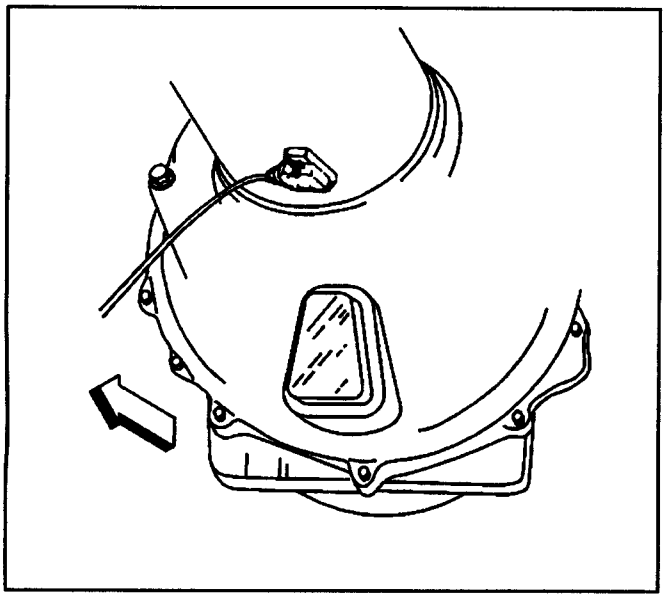
To Disconnect the sensor, press the release button and gently pull the connector straight out.

EVA Sensor Placement



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Proper EVA sensor placement is critical in order to take proper vibration readings. The sensor can be placed anywhere on the vehicle where vibrations are felt. Use putty or a hook and loop fastener in order to hold the sensor in place on non-ferrous surfaces, such as the surface of the steering column.

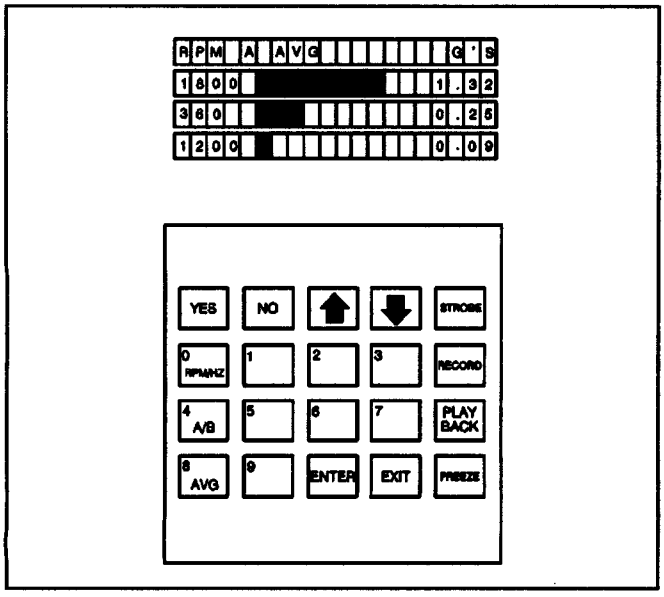


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A magnet is supplied in order to hold the sensor to ferrous surfaces.

Vibrations are typically felt in an up-and-down direction. The sensor is directionally sensitive. Therefore, place the sensor as flat as possible with the side marked UP facing upward. Place the UP side of the sensor in the exact position every time for consistent results when repeating the tests or making a comparison.

EVA Display



95605

The EVA offers the following main display features, all of which are described below:

- Freeze
- Record/Playback
- Averaging/Non-averaging modes
- Strobe Balancing

Freeze

Pressing the FREEZE button on the keypad activates the freeze function, which locks the display of data. The display shows FRZ at the top. The freeze function is useful when conducting an acceleration/deceleration test in which the significant amount of vibration registers only for a very short time. Pressing EXIT or the FREEZE button again deactivates the freeze function.

Record/Playback

The displayed vibration information can be recorded for later playback. The EVA retains stored data for about 70 hours after the unit has been unplugged from a power source. Data is recorded as SNAPSHOTS of vibration information. Each snapshot consists of 10 different frames. Up to 10 of these snapshots can be recorded.

Press RECORD in order to record a snapshot. The screen will display R? in order to request a tag number between 0 and 9. These tag numbers are the individual frames of the snapshot recording. New data will replace the existing data when a number is chosen that has already been used in order to tag a snapshot.

Pressing PLAYBACK plays back the recorded data. The screen shows P? in order to request the tag number for the wanted snapshot. Once the number is entered, the snapshot data is displayed: P and the tag number will appear. Then, an F and a 0–9 will be displayed in order to indicate which frame of the snapshot is being displayed.

The freeze function can be used in order to freeze the display at any point in the sequence during playback. Individual frames can be viewed in a forward or backward sequence using the up and down arrow keys.

The display returns to the active screen when the recording or playback of a snapshot is finished, or when EXIT is pressed.

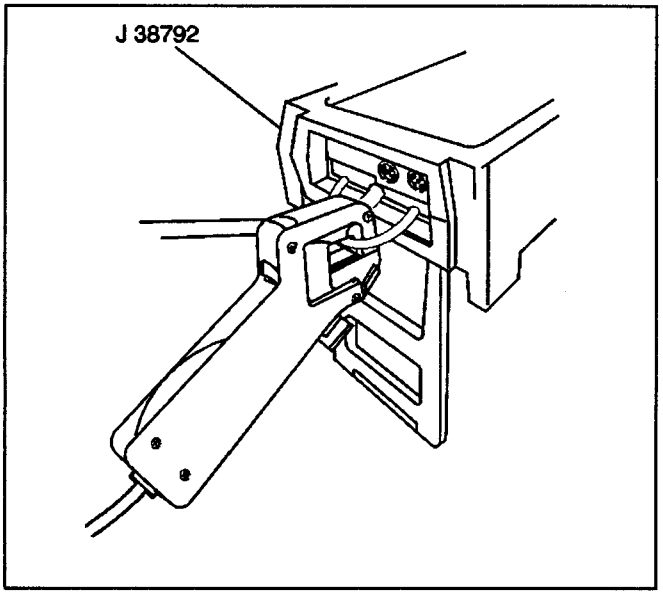
Averaging/Non-Averaging Modes

The EVA normally operates in an averaging mode that averages multiple vibration samples over a period of time. The averaging mode minimizes the effects of sudden vibration that are not related to the problem (such as form potholes or uneven road surfaces). Most tests use the averaging mode.

The EVA is more sensitive to vibrations in the non-averaging mode. The display is more instantaneous and not averaged over a period of time. The non-averaging mode is used when measuring a vibration that exists for only a short period of time, and during acceleration/deceleration tests.

Pressing the AVG button switches between the averaging and non-averaging modes. The screen will display AVG.

Strobe Balancing



95606

The EVA can strobe balance a rotating component. A trigger wire is located on the top of the EVA, which is used in conjunction with an inductive pick-up light strobe. The EVA triggers the strobe light at the same frequency as the vibration. The timing light clips on to the trigger wire. The vibration sensor must be attached to input A. Input B does not provide the strobe function.

Pressing STROBE starts the strobe balancing function. The EVA will ask a series of questions in order to determine the correct filter range: full, low, or high.

The low and high ranges prevent other vibrations from interfering with the operation of the strobe light. Use the full range as a last resort only. Press YES in order to select a range. Press NO in order to go on to the next range. The vibration/strobe frequency must fall within the selected range.

The EVA will display the strobe frequency, amplitude, and filter range. The EVA is now ready to begin the strobe balance procedure.

EVA Calibration

The EVA features the following two built in calibration procedures:

- Sensor Calibration
- Phase Shift Calibration

A replaced or added sensor must be calibrated in order to function properly with the EVA unit. The phase shift calibration is performed at the factory and should not be repeated under normal use.

Sensor Calibration

1. Lay the sensor on a flat stationary surface with the UP side facing upward.
2. Plug the sensor into either input A or B.
3. Plug the EVA into a 12-volt power supply.
4. After the display initializes, select the proper input.
5. Press the up arrow key.
6. Press the number 2 three times on the keypad. The message BURNING will appear, followed by a request to turn the sensor over.
7. Turn the sensor over.
8. Press any key in order to commence calibration:
   - Calibration will take about 20 seconds.
   - The display will return to the active mode when calibration is complete.

Phase Shift Calibration

1. Plug the EVA into a 12-volt power supply.
2. Press the down arrow key on the EVA keypad.
3. Press the number 2 three times in order to begin calibration:
   - Do not press any key until the message ANY KEY TO CONTINUE appears. Pressing a key will cancel the calibration process.
   - The display will flash numbers for 5–6 minutes. (If the numbers flash for more than 10 minutes, the EVA is defective.)
   - The message BURNING PHASE SHIFT CONSTANTS will appear for one minute.
   - The BURNING CENTER FREQUENCIES LOW=39 HIGH=48 message will appear.
   - The ANY KEY TO CONTINUE message should appear.
4. Press any key in order to return to the active mode.

Special Tools and Equipment

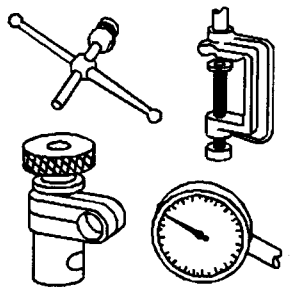
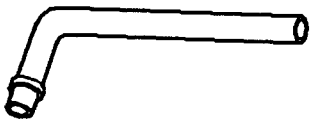
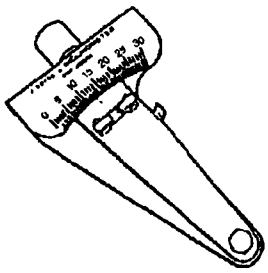
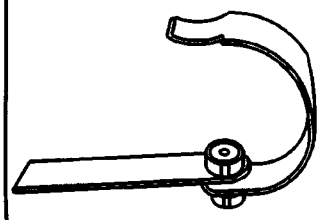
Illustration	Tool Number/ Description
 2014	J 8001 Dial Indicator Set
 1517	J 23409 Dial Indicator Extension
 8224	J 23498-A Driveshaft Inclinometer
 180348	J 23498-20 Driveshaft Inclinometer Adapter

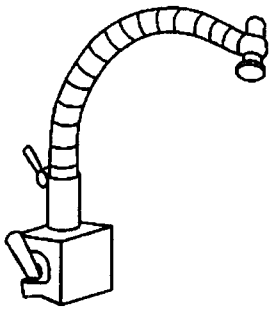
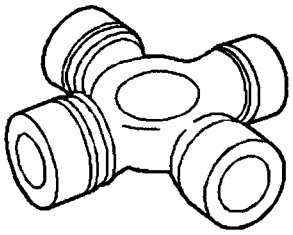
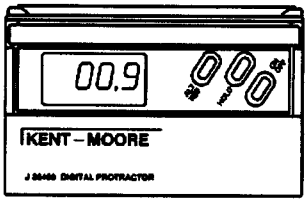
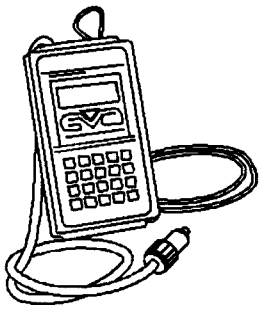
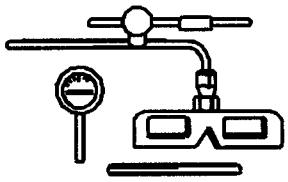
Illustration	Tool Number/ Description
 210346	J 34481 Universl Flexable Magnetic Dial Indicator Stand
 1512	J 35819 Flange Runout Gauge
 198883	J 38460 Digital Inclinometer
 6826	J 38792 Electronic Vibration Analyzer (EVA)

Illustration	Tool Number/ Description
 35463	J 7872 Magnetic Base Dial Indicator Set

Section 1
HVAC

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Heating and Ventilation (Non-A/C)

Specifications

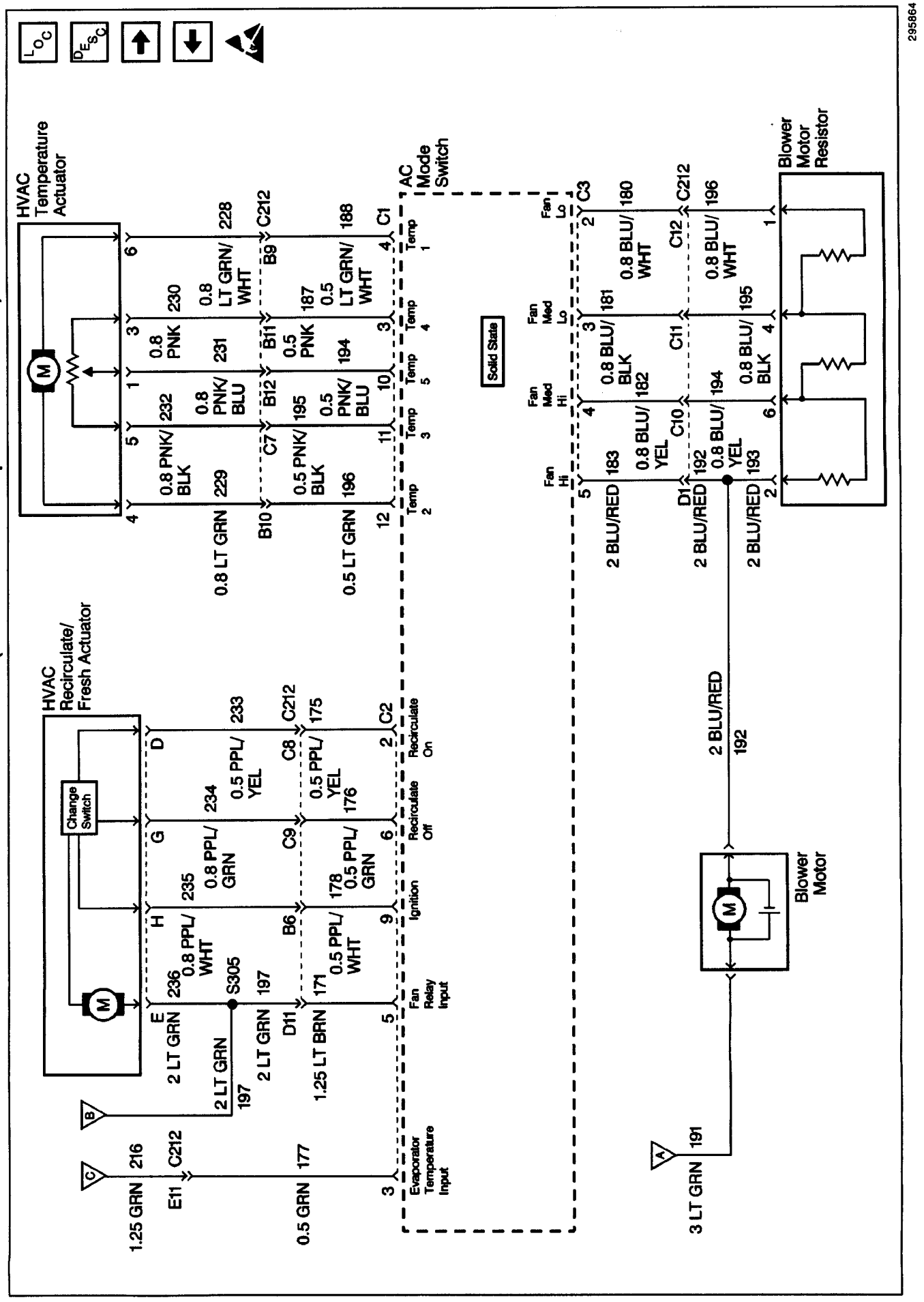
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Quick Connect Heater Inlet Connector	35 N.m	26 lb ft

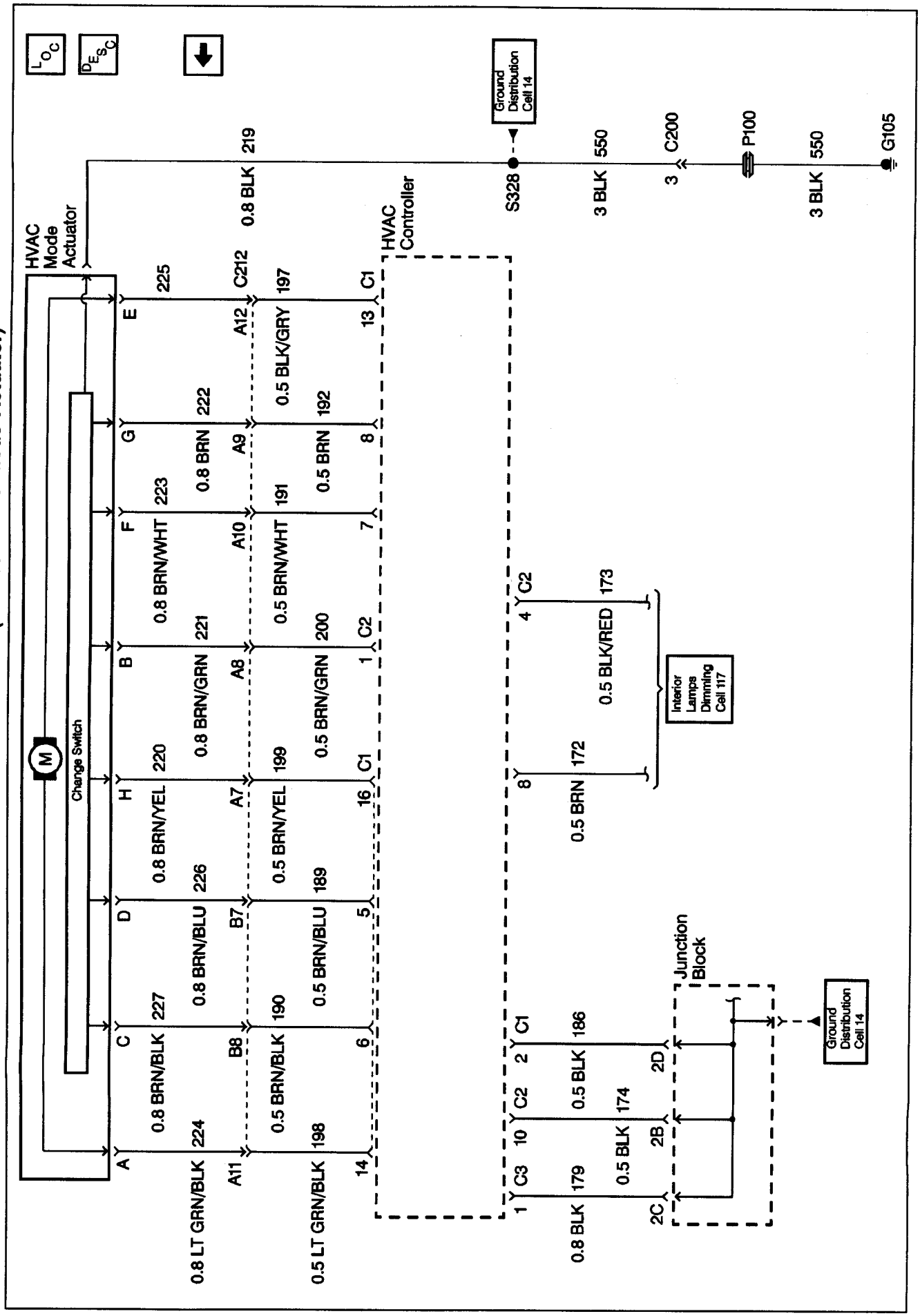
Schematic and Routing Diagrams

Heater Blower Controls Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Interior Lamps Dimming Cell 117	8—Lighting Systems


Heater Blower Controls Schematics (Cell 60: HVAC Temperature Actuator)
295864
HVAC Temperature Actuator
AC Mode Switch
HVAC Recirculate/ Fresh Actuator
Change Switch
Solid State
Blower Motor Resistor
Blower Motor
Evaporator Temperature Input
Fan Relay Input
Ignition
Recirculate Off
Recirculate On
Fan Hi
Fan Med Hi
Fan Med Lo
Fan Lo
Temp 1
Temp 2
Temp 3
Temp 4
Temp 5
1.25 GRN
216
C212
E11
2 LT GRN
236
0.8 PPL/ WHT
S305
197
2 LT GRN
0.5 GRN
177
1.25 LT BRN
171
0.5 PPL/ WHT
D11
B6
9
0.5 PPL/ GRN
178
C9
6
0.8 PPL/ GRN
235
H
G
234
0.5 PPL/ YEL
C8
C212
233
D
175
0.5 PPL/ YEL
176
C2
2
3
5
0.8 PNK/ BLK
232
0.8 PNK/ BLU
C7
B12
195
0.5 PNK/ BLU
0.8 LT GRN
229
B10
0.5 PNK/ BLK
196
0.8 LT GRN
0.5 LT GRN
12
11
10
1
0.8 PNK
231
B11
0.5 PNK
194
0.8 LT GRN/ WHT
230
B9
C212
228
0.5 LT GRN/ WHT
187
C1
188
4
6
3
2 BLU/RED
183
0.8 BLU/ YEL
C10
192
D1
0.8 BLU/ BLK
182
C11
181
0.8 BLU/ WHT
C12
C212
180
0.8 BLU/ WHT
C3
0.8 BLU/ YEL
193
0.8 BLU/ BLK
194
0.8 BLU/ WHT
195
0.8 BLU/ WHT
196
2 BLU/RED
192
2 BLU/RED
3 LT GRN
191
A
C
B
E
D
M

Heater Blower Controls Schematics (Cell 60: HVAC Mode Actuator)



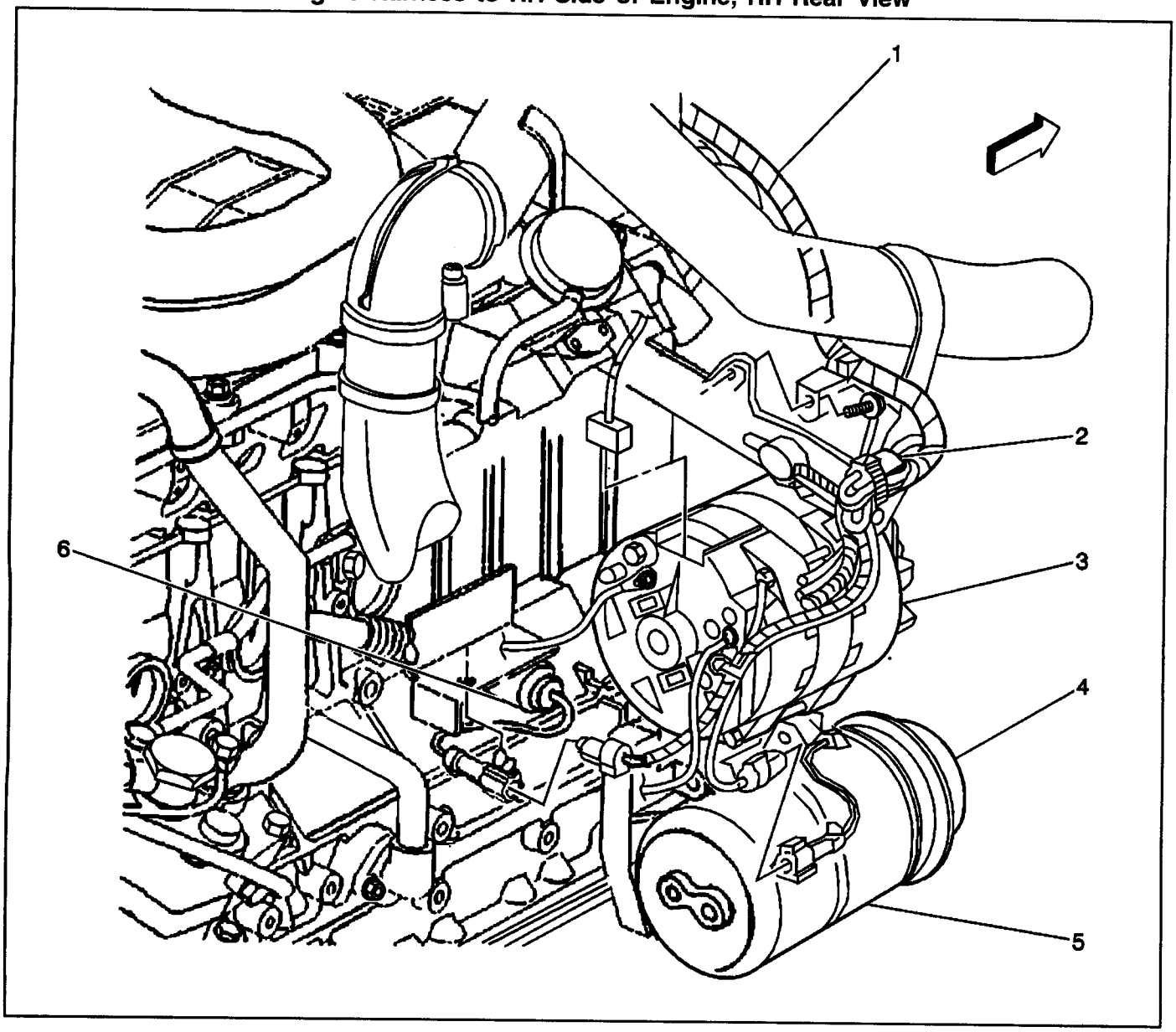
Component Locator

Heater Blower Controls Components

Name	Location	Locator View	Connector End View
A/C Compressor Clutch Connector Plug (w/o A/C)	In the engine harness, on the lower right front of the engine, on the A/C compressor clutch harness	*Heater Blower Controls Component Views*	—
A/C Mode Switch (w/o A/C)	In the center of the IP, part of the HVAC controller	*Heater Blower Controls Component Views*	—
Blower Motor (w/o A/C)	Behind the lower right side of the IP	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
Blower Motor Resistor (w/o A/C)	In the lower right side of the IP, part of the blower motor assembly	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
Blower Relay (w/o A/C)	In the center of the lower IP, behind the panel, in relay center 2	*Heater Blower Controls Component Views*	—
Blower Switch (w/o A/C)	In the center of the IP, part of the HVAC controller	*Heater Blower Controls Component Views*	—
HVAC Air Temperature Actuator (w/o A/C)	Behind the lower right side of the IP, near the blower motor assembly	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
HVAC Controller (w/o A/C)	In the upper IP harness to the HVAC controller	*Heater Blower Controls Component Views*	—
HVAC Controller (w/o A/C) C1 (16 cavities)	In the upper IP harness to the HVAC controller	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
HVAC Controller (w/o A/C) C2 (12 cavities)	In the upper IP harness to the HVAC controller	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
HVAC Controller (w/o A/C) C3 (6 cavities)	In the upper IP harness to the HVAC controller	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
HVAC Mode Door Actuator (w/o A/C)	Behind the lower right side of the IP, near the blower motor assembly	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*
HVAC Recirculating/Fresh Air Actuator (w/o A/C)	Behind the lower right side of the IP, near the blower motor assembly	*Heater Blower Controls Component Views*	*Heater Blower Controls Connector End Views*

Heater Blower Controls Component Views

Engine Harness to RH Side of Engine, RH Rear View

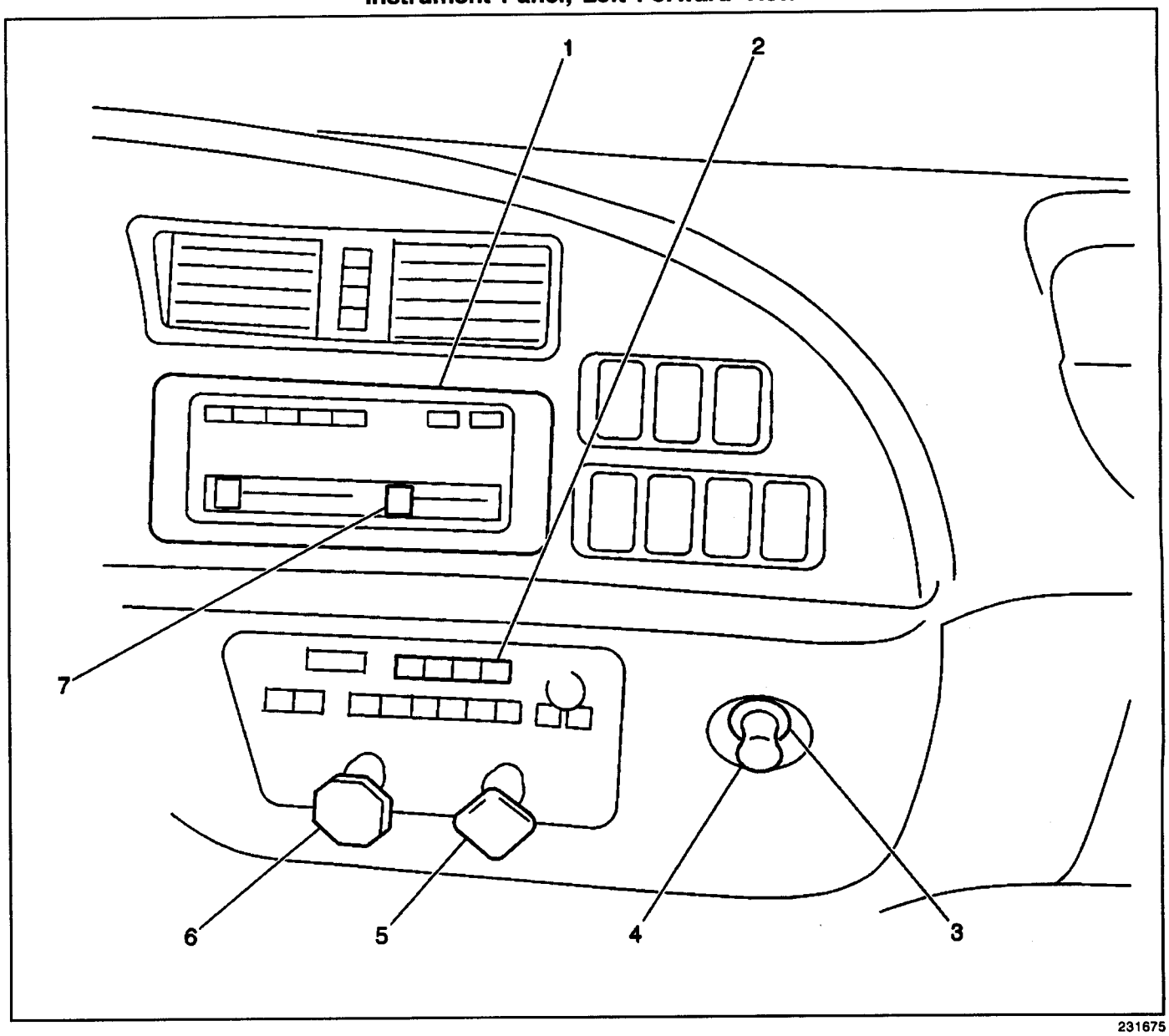


228805

Legend

(1) Engine Harness
(2) Generator Fuse
(3) Generator
(4) A/C Compressor Clutch
(5) A/C Compressor
(6) Engine Oil Pressure Gauge Sensor

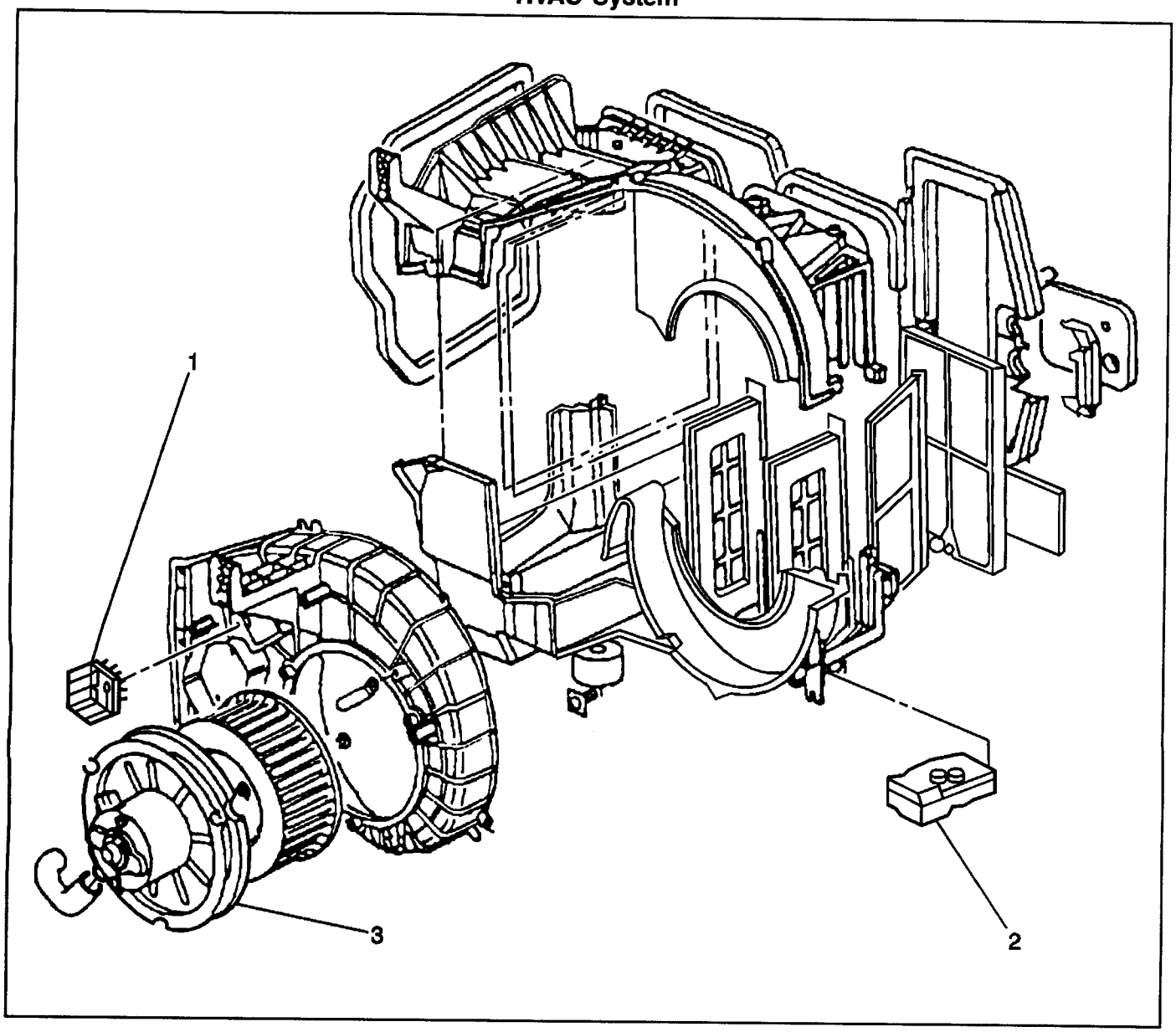
Instrument Panel, Left Forward View



Legend

(1) HVAC Controller
(2) Radio
(3) Cigar Lighter Lamp
(4) Cigar Lighter
(5) Park Brake Switch (ABS-Air)
(6) Trailer Stoplamps Switch (ABS-Air)
(7) Blower Switch (Part of HVAC Controller)

HVAC System

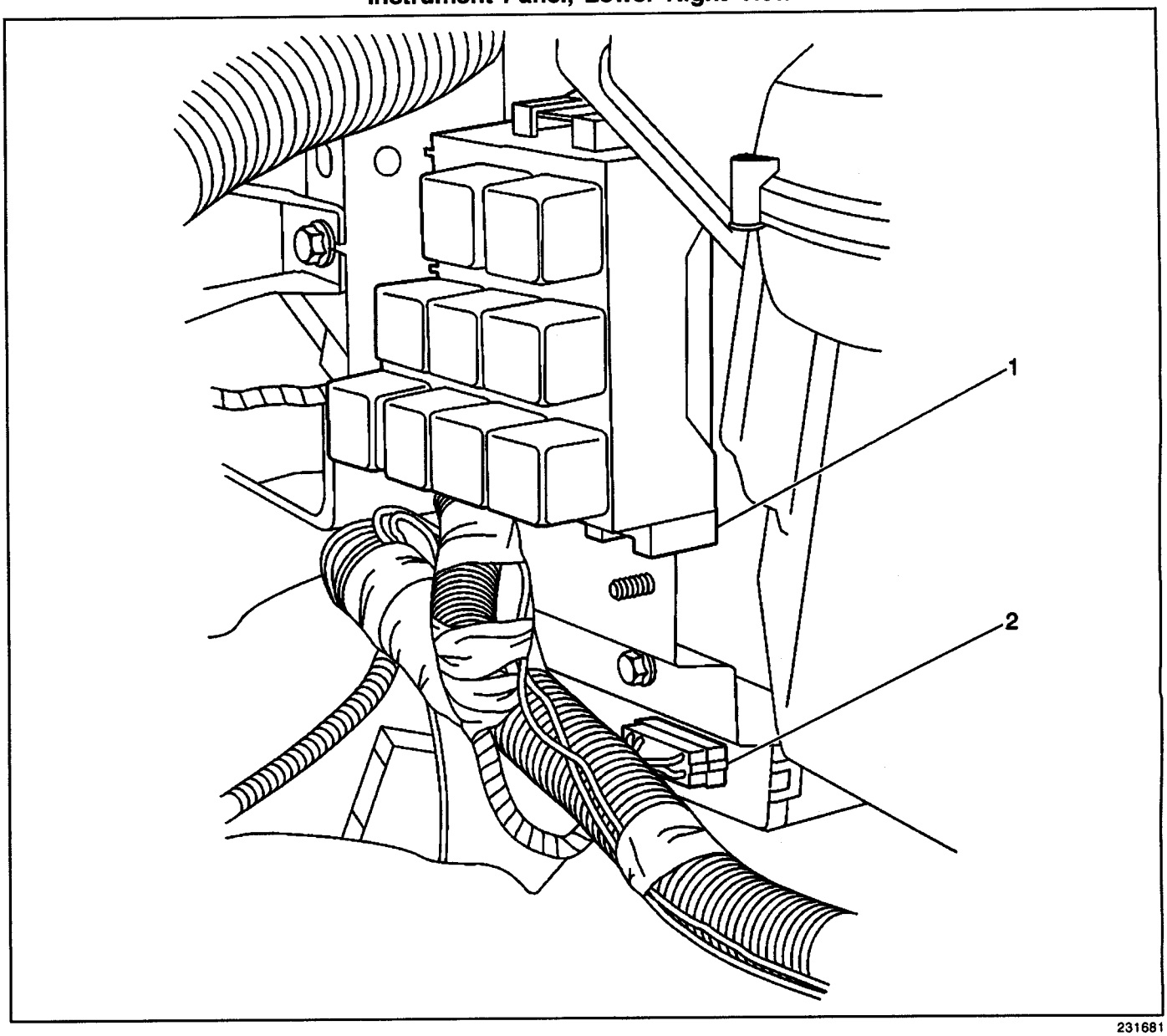


231683

Legend

(1) Blower Motor Resistor
(2) HVAC Recirculating/Fresh Air Actuator
(3) Blower Motor

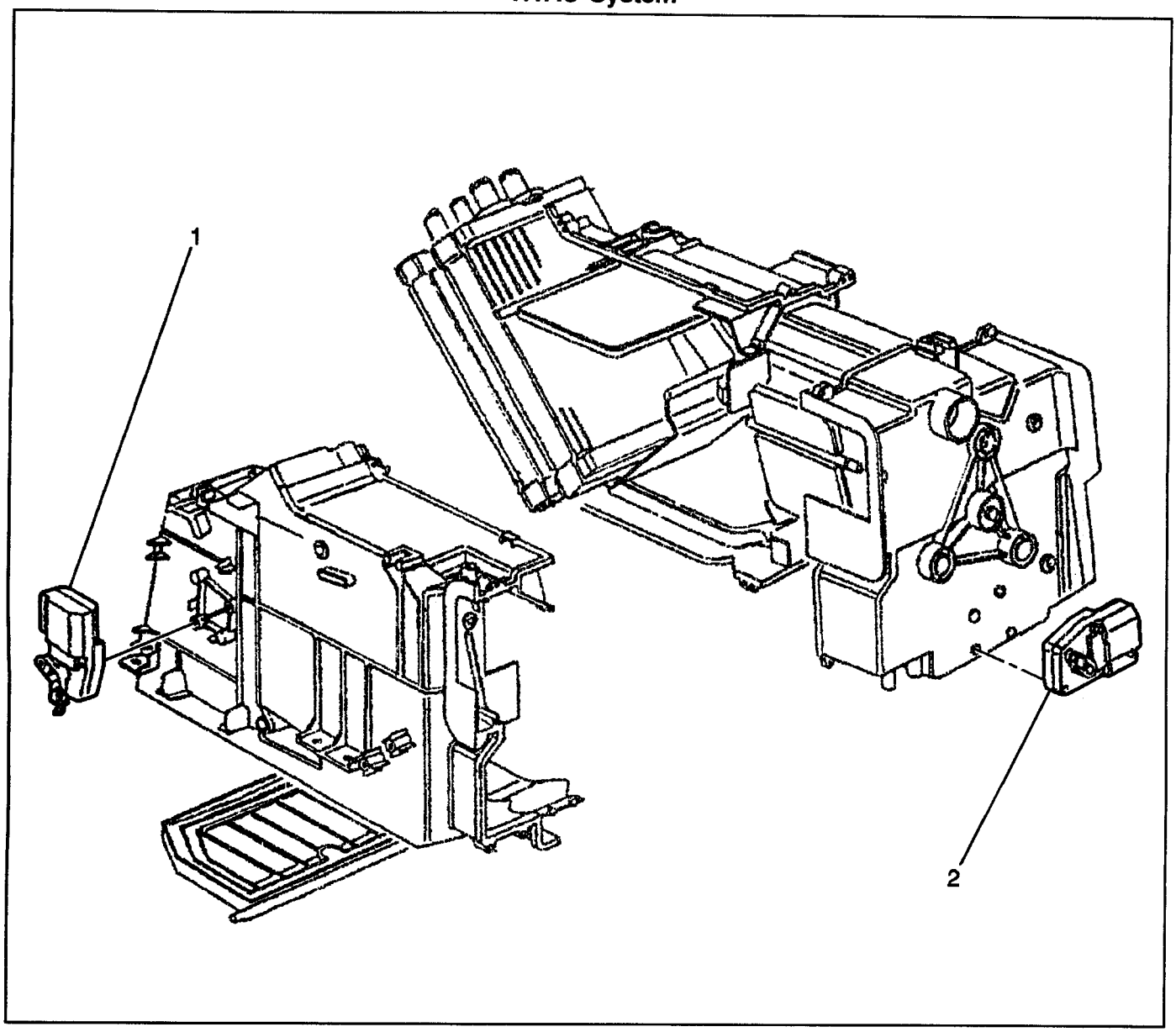
Instrument Panel, Lower Right View



Legend

(1) Relay Center 2
(2) Turn/Hazard Flasher Module

HVAC System



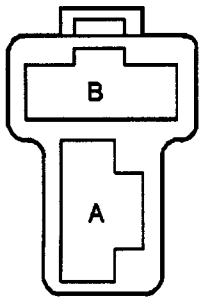
231686

Legend

(1) HVAC Mode Door Actuator
(2) HVAC Air Temperature Actuator

Heater Blower Controls Connector End Views

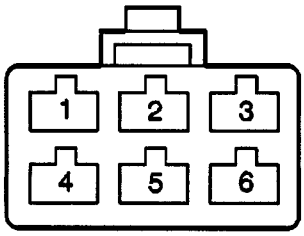
Blower Motor (w/o A/C)



239986

Connector Part Information		• 3 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN	191	Blower Motor
B	BLU/RED	192	Blower Motor Resistor

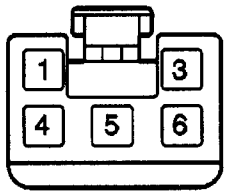
Blower Motor Resistor (w/o A/C)



240173

Connector Part Information		• 3 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BLU/ WHT	196	Fan Low Resistor
2	BLU/RED	192	Blower Motor
3	—	—	Not Used
4	BLU/BLK	195	Fan Medium Low Resistor
5	—	—	Not Used
6	BLU/YEL	194	Fan Medium High Resistor

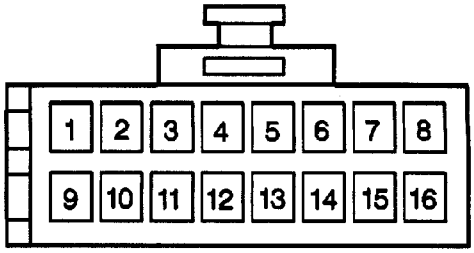
HVAC Air Temperature Actuator (w/o A/C)



240174

Connector Part Information		• 5 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	PNK/BLU	231	Temperature Actuator, Temperature 5
2	—	—	Not Used
3	PNK	230	Temperature Actuator, Temperature 4
4	LT GRN	229	Temperature Actuator, Temperature 2
5	PNK/BLK	232	Temperature Actuator, Temperature 3
6	LT GRN/WHT	228	Temperature Actuator, Temperature 1

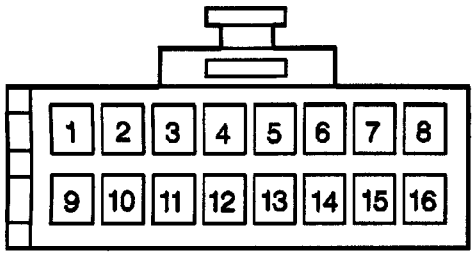
HVAC Controller C1 (w/o A/C)



240175

Connector Part Information		• 16 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	—	—	Not Used
2	BLK	186	Ground
3	PNK	187	Temp 4
4	LT GRN/WHT	188	Temp 1

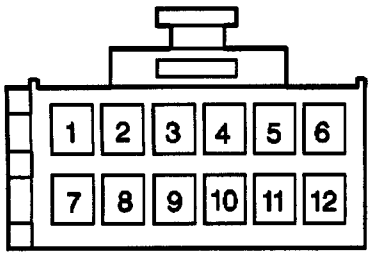
HVAC Controller C1 (w/o A/C) (cont'd)



240175

Connector Part Information		• 16 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
5	BRN/BLU	189	Mode 1
6	BRN/BLK	190	Mode 2
7	BRN/ WHT	191	Mode 3
8	BRN	192	Mode 4
9	—	—	Not Used
10	PNK/BLU	194	Temp 5
11	PNK/BLK	195	Temp 3
12	LT GRN	196	Temp 2
13	LT GRN/YEL	197	Mode 7
14	LT GRN/BLK	198	Mode 8
15	—	—	Not Used
16	BRN/YEL	199	Mode 6

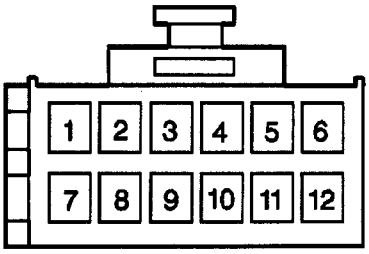
HVAC Controller C2 (w/o A/C)



240177

Connector Part Information		• 12 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN/ GRN	200	Mode 5
2	PPL/YEL	175	Recirculate ON
3	GRN	177	Condenser Fan Control

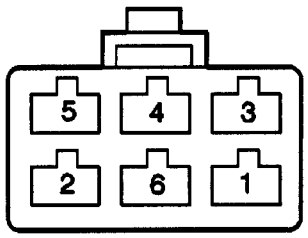
HVAC Controller C2 (w/o A/C) (cont'd)



240177

Connector Part Information		• 12 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
4	BLK/RED	173	Rheostat
5	LT GRN	171	Ignition
6	PPL/GRN	176	Recirculate OFF
7	RED/BLU	184	Ground
8	BRN	172	Illumination
9	PPL/ WHT	178	Not Used
10	BLK	174	Ground
11–12	—	—	Not Used

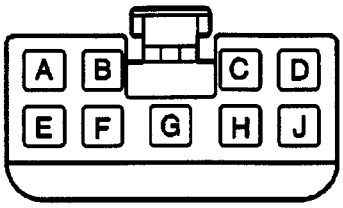
HVAC Controller C3 (w/o A/C)



240180

Connector Part Information		• 6 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BLK	179	Ground
2	BLU/ WHT	180	Fan Lo
3	BLU/BLK	181	Fan Med Lo
4	BLK	182	Fan Med Hi
5	BLU/RED	183	Fan Hi
6	RED/BLU	184	Ground

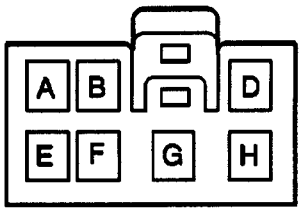
HVAC Mode Door Actuator (w/o A/C)



240182

Connector Part Information		• 9 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN/BLK	224	Mode Actuator Mode 8
B	BRN/ GRN	221	Mode Actuator Mode 5
C	BRN/BLK	227	Mode Actuator Mode 2
D	BRN/BLU	226	Mode Actuator Mode 1
E	LT GRN/YEL	225	Mode Actuator Mode 7
F	BRN/ WHT	223	Mode Actuator Mode 3
G	BRN	222	Mode Actuator Mode 4
H	BRN/YEL	220	Mode Actuator Mode 6
J	BLK	219	Mode Actuator

HVAC Recirculating/Fresh Air Actuator (w/o A/C)



240183

Connector Part Information		• 7 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
A–C	—	—	Not Used
D	PPL/YEL	233	Recirculate/Fresh Actuator ON
E	LT GRN	236	Not Used
F	—	—	Not Used
G	PPL/GRN	234	Recirculate/Fresh Actuator OFF
H	PPL/ WHT	235	Not Used

Diagnostic Information and Procedures

Blower Motor Inoperative at Any Speed

Problem	Action
A faulty fuse.	• Determine and correct cause of the malfunction. • Refer to *HVAC Blower Controls System Check.*
A faulty blower motor resistor.	• Determine and correct cause of the malfunction. • Refer to *HVAC Blower Controls System Check.*
A faulty fan controller switch.	• Determine and correct cause of the malfunction. • Refer to *HVAC Blower Controls System Check.*
A faulty blower motor and/or wiring.	• Determine and correct cause of the malfunction. • Refer to *HVAC Blower Controls System Check.*

Blower Motor Inoperative at High Speed Only

Step	Action	Value(s)	Yes	No
1	Place the blower speed switch in the failing speed position. Is HIGH speed the failing speed?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the open in CKT 192 (BLU/RED) between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 3*
3	1. Disconnect the connector at the blower motor resistor. 2. Place the ignition switch in the RUN position. 3. Place the blower speed switch in the HIGH speed position. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal for the failing position and the wire and chassis ground. The following are the failing positions: • LOW-1 • MED LOW-4 • MED-HI-6 Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 5*
5	Disconnect the HVAC mode switch connector C 3 terminal 2 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Locate and repair the open in the wire between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 7*
7	Replace the HVAC mode switch. Is the repair complete?	—	System OK	—

Blower Motor Inoperative at Medium Speed

Step	Action	Value(s)	Yes	No
1	Place the blower speed switch in the failing speed position. Is MED speed the failing speed?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the open in CKT 192 (BLU/RED) between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 3*
3	1. Disconnect the connector at the blower motor resistor. 2. Place the ignition switch in the RUN position. 3. Place the blower speed switch in the MED speed position. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal for the failing position and the wire and chassis ground. The following are the failing positions: • LOW-1 • MED LOW-4 • MED-HI-6 Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 5*
5	Disconnect the HVAC mode switch connector C 3 terminal 2 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Locate and repair the open in the wire between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 7*
7	Replace the HVAC mode switch. Is the repair complete?	—	System OK	—

Blower Motor Inoperative at Low Speed Only

Step	Action	Value(s)	Yes	No
1	Place the blower speed switch in the failing speed position. Is LOW speed the failing speed?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the open in CKT 192 (BLU/RED) between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 3*
3	1. Disconnect the connector at the blower motor resistor. 2. Place the ignition switch in the RUN position. 3. Place the blower speed switch in the LOW speed position. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal for the failing position and the wire and chassis ground. The following are the failing positions: • LOW-1 • MED LOW-4 • MED-HI-6 Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 5*
5	1. Disconnect the HVAC mode switch connector C 3. 2. Connect a test lamp between the connector C 3 terminal 2 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Locate and repair the open in the wire between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 7*
7	Replace the HVAC mode switch. Is the repair complete?	—	System OK	—

Heating Insufficient

Poor Defrosting

Problem	Action
• The door(s) which control airflow are not functioning correctly. • The blower motor is not working. • There is blockage in the defroster outlets. • A restricted heater core and/or hoses. • A faulty thermostat and/or radiator cap. • There is blockage in front of the air conditioning filter. • There is blockage in the path of the door.	• Determine and correct the cause of the malfunction. • Determine and correct the cause of the malfunction. Refer to. *Blower Motor Inoperative at Any Speed* • Remove the blockage. • Flush the cooling system. Refer to.*Flushing* • Determine and correct the cause of the malfunction. Refer to *Thermostat Diagnosis.* • Clean the air conditioning filter. Refer to *Passenger Compartment Air Filter Replacement.* • Remove the blockage.

No Heat (Blower Motor Working)

Problem	Action
• There is low engine coolant level. • A faulty thermostat and/or radiator cap. • A restricted heater core and/or hoses. • A faulty actuator. • The pivot shaft of door(s) is not seated correctly. • There is blockage in front of the air conditioning filter. • There is blockage in the path of the door.	1. Check the engine coolant level. Refer to. *Draining and Filling Cooling System (Cooling System)* in Engine Cooling. 2. Determine and correct the cause of the malfunction. Refer to. *Thermostat Replacement* in Engine Cooling. 3. Flush the cooling system. Refer to. *Flushing* 4. Check the actuator function and replace as necessary. 5. Seat the pivot shaft of the door(s) correctly. 6. Clean the air conditioning filter. Refer to *Passenger Compartment Air Filter Replacement.* 7. Remove the blockage.

Heater Gurgling Sound

Problem	Action
• There is low engine coolant. • A restricted heater core and/or hoses.	• Check the engine coolant level. Refer to *Draining and Filling Cooling System (Cooling System).* • Flush the cooling system. Refer to *Flushing* in Engine Cooling.

Poor Ventilation

Problem	Action
• A blockage in the heater module. • A blockage in the recirculating/fresh air duct. • A binding or sticking of the recirculating/fresh air door. • The recirculating/fresh air door is not operating. • A faulty recirculating/fresh air actuator. • The pivot shaft of the door is not seated correctly.	• Remove the blockage in the heater module. • Remove the blockage in the recirculating/fresh air duct. • Remove the blockage, repair and replace as necessary. • Repair and replace the door as necessary. • Seat the pivot shaft of the door. • Seat the pivot shaft of the door(s).

Heat Excessive

Problem	Action
• The temperature door and/or actuator are faulty. • The engine is overheating.	• Determine and correct the cause of the malfunction. • Determine and correct the cause of the malfunction. Refer to *Engine Overheating.*

Repair Instructions

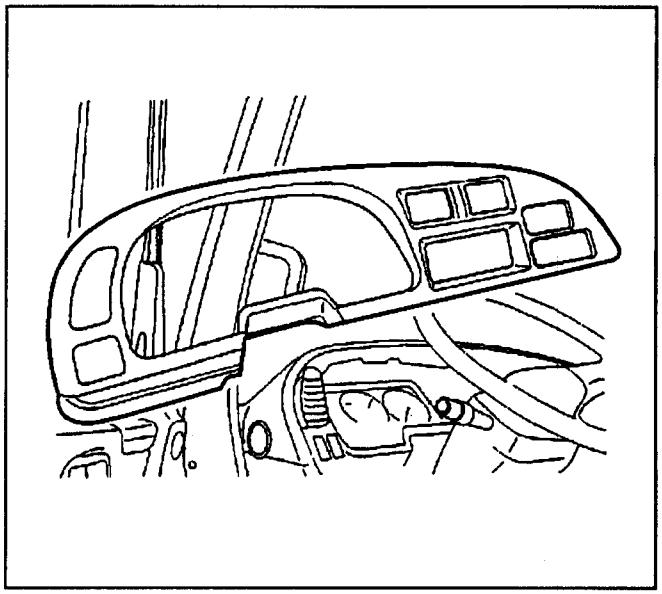
Control Assembly Replacement

Removal Procedure

A control assembly is available from the service parts warehouses. They are offered as a complete assembly. This item cannot be serviced. Service is by replacement only.

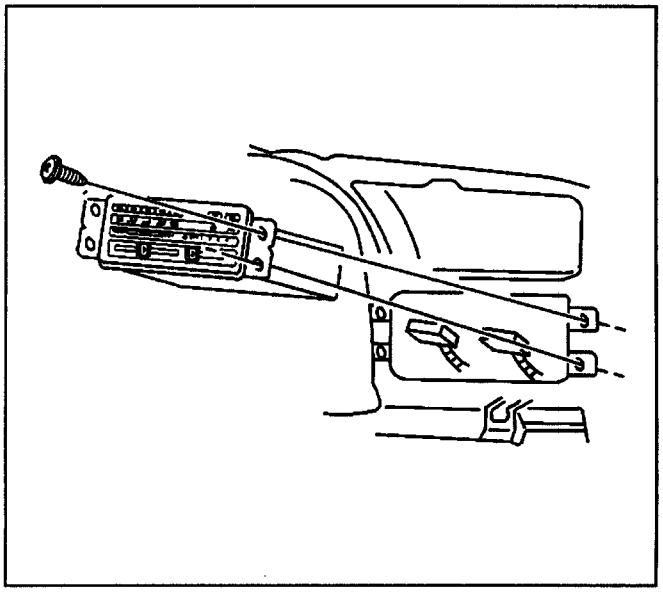
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electical.
2. Remove the cluster trim.



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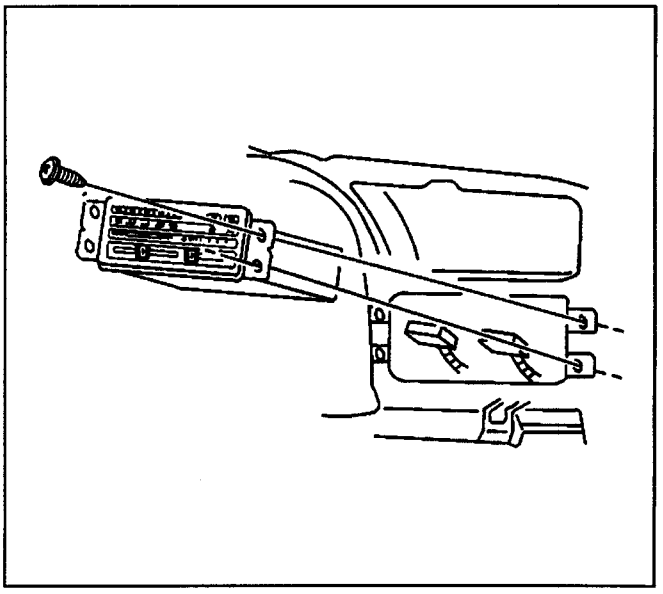
3. Remove the control assembly screws.
4. Remove the control assembly.
5. Disconnect the electrical connectors.



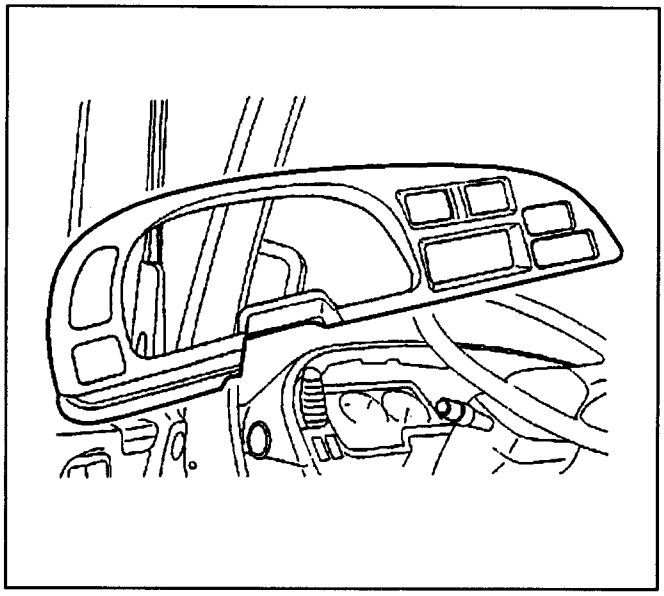
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Installation Procedure

1. Connect the electrical connectors.
2. Install the control assembly.
3. Install the control assembly screws.

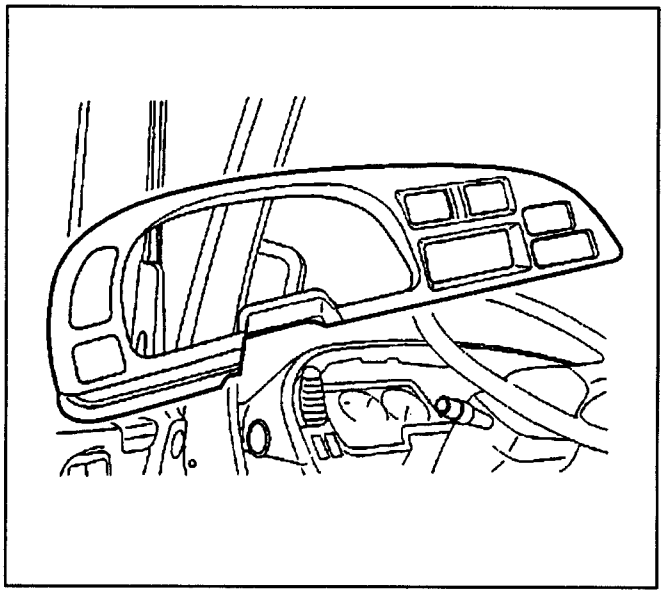


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4. Install the cluster trim.
5. Connect the negative battery cable.



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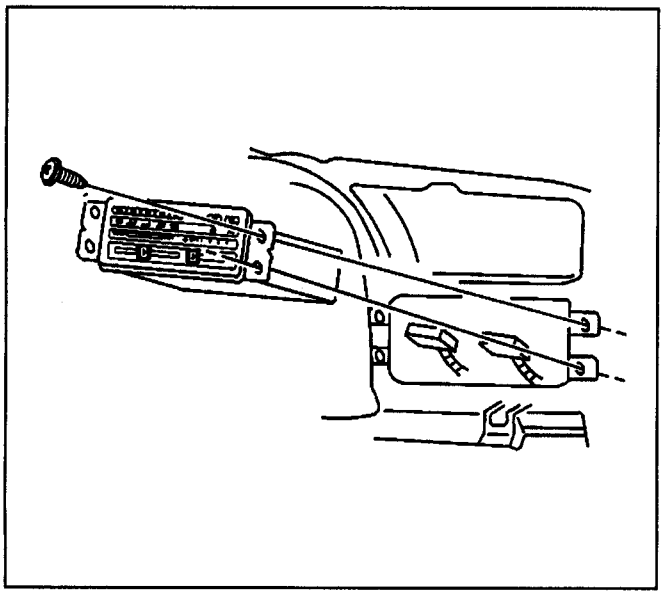
Blower Switch Replacement

Removal Procedure

A control assembly is available from the service parts warehouses. They are offered as a complete assembly. This item cannot be serviced. Service is by replacement only.

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electical.
2. Remove the cluster trim.

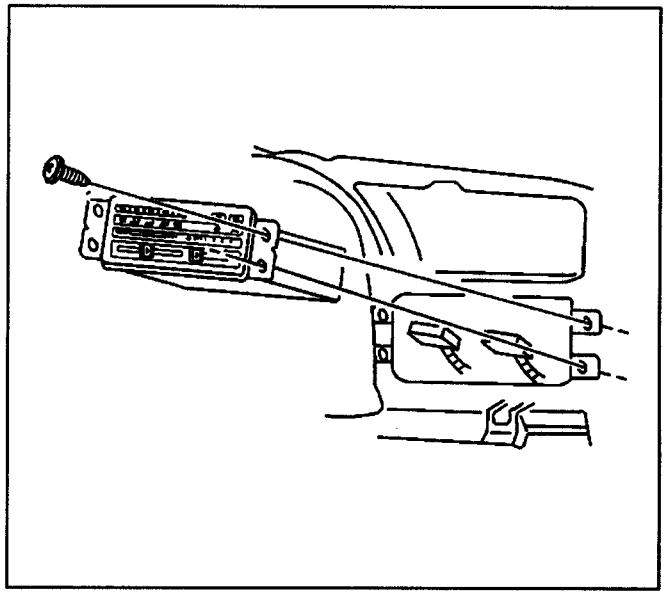


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3. Remove the control assembly screws.
4. Remove the control assembly.
5. Disconnect the electrical connectors.

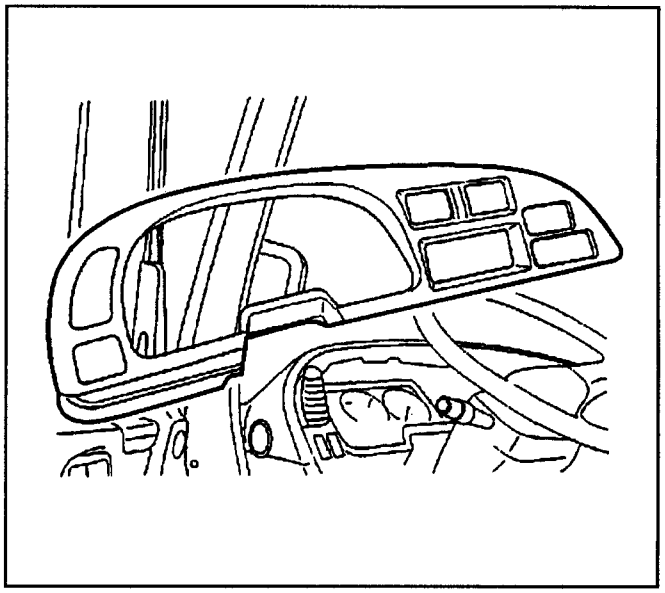
Installation Procedure

1. Connect the electrical connectors.
2. Install the control assembly.
3. Install the control assembly screws.



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4. Install the cluster trim.
5. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



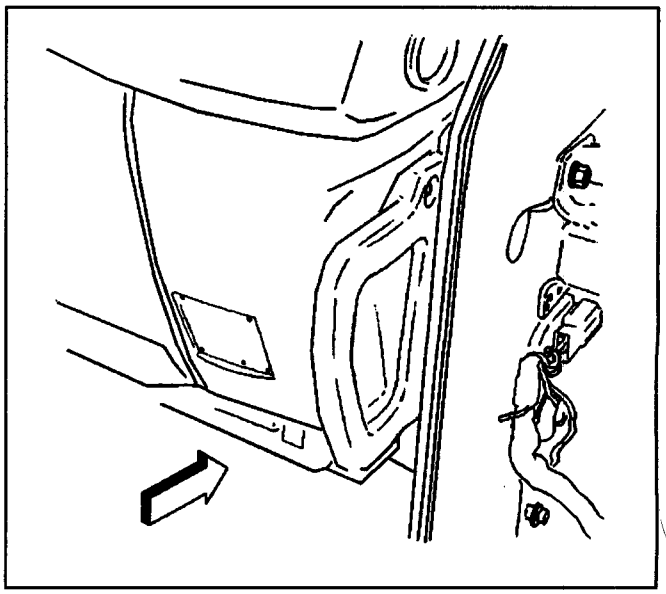
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Blower Motor Resistor Replacement

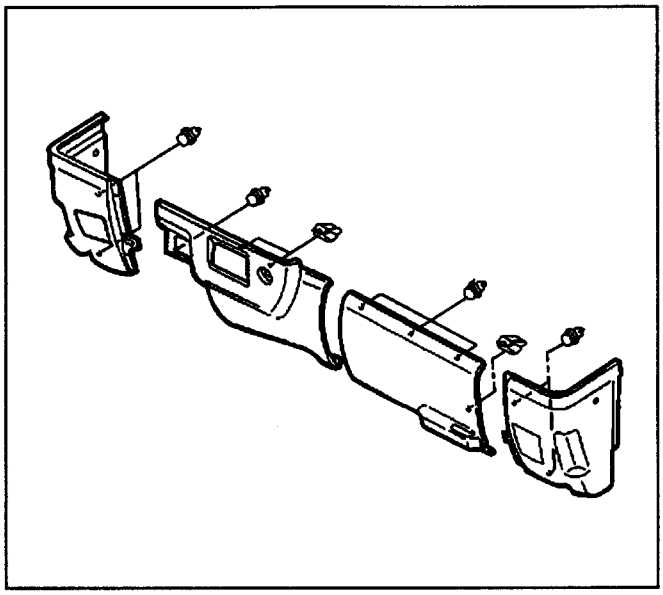
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electical.
2. Remove the assist handle bolts.
3. Remove the assist handle.

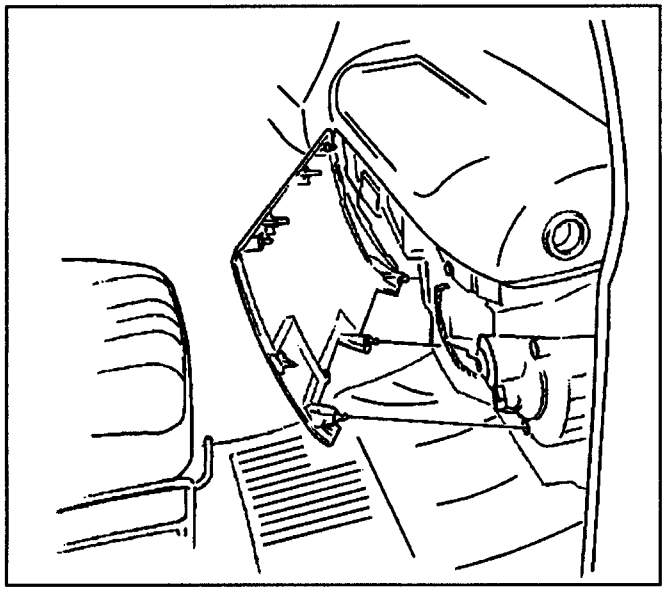


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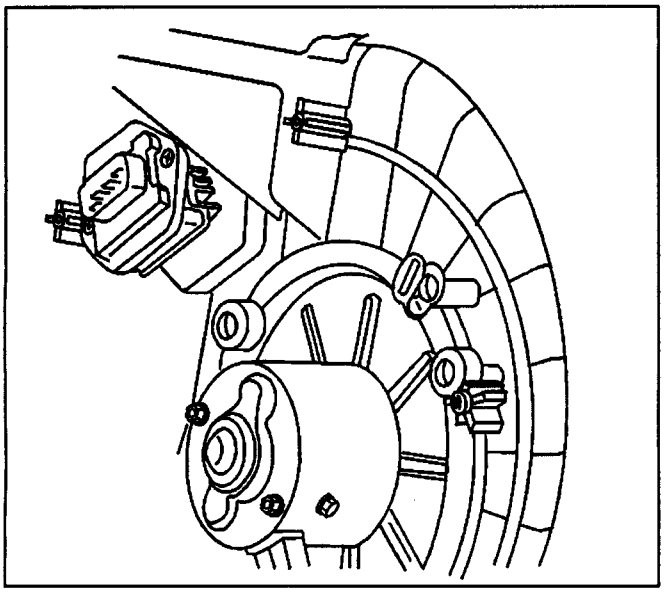
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4. Remove the instrument panel right lower trim.



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5. Disconnect the electrical connectors.

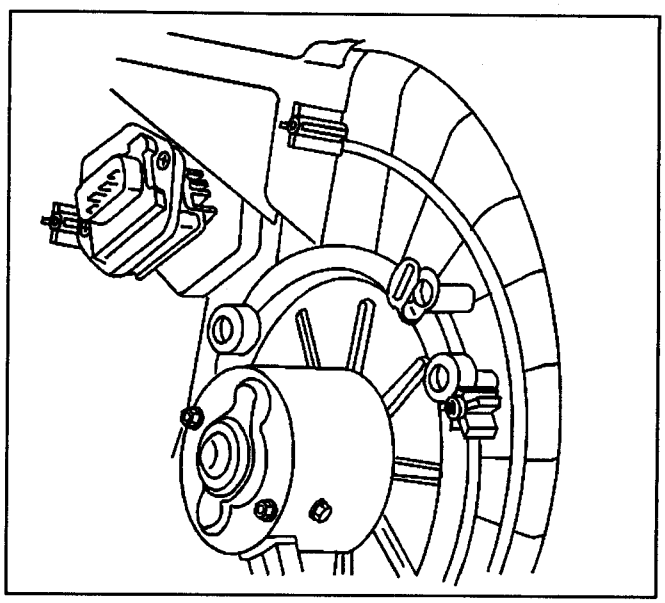


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6. Remove the blower resistor screws.
7. Remove the blower motor resistor.

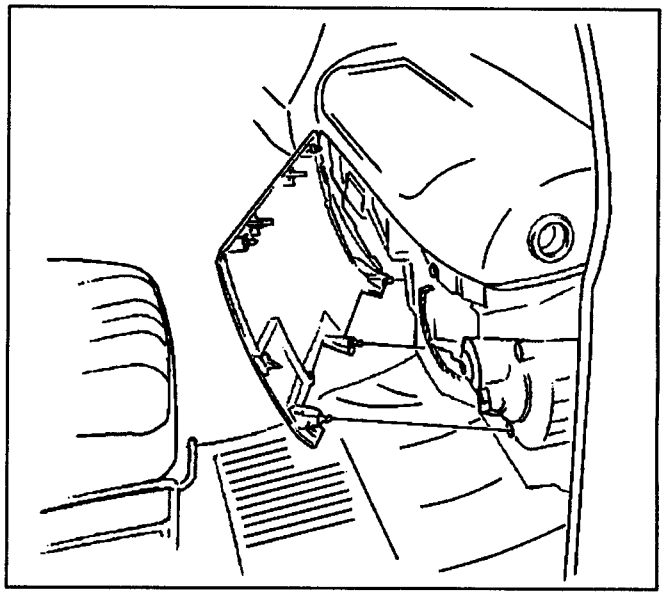
Installation Procedure

1. Install the blower motor resistor.



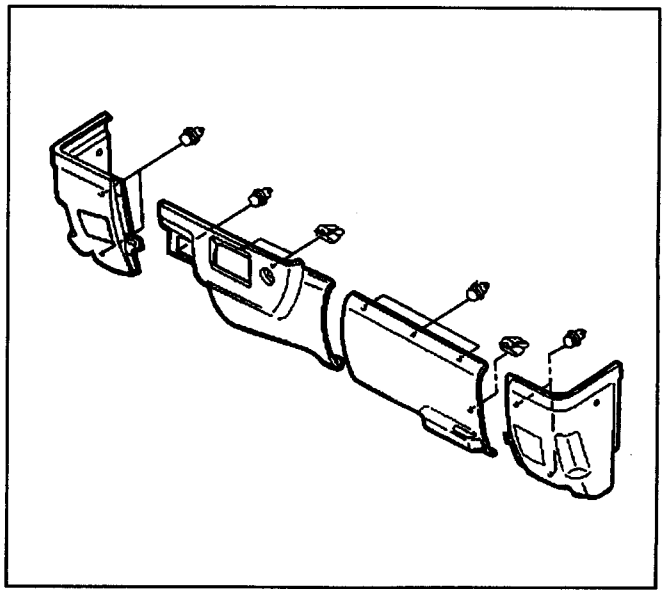
229930

2. Install the blower motor resistor screws.
3. Connect the electrical connectors.

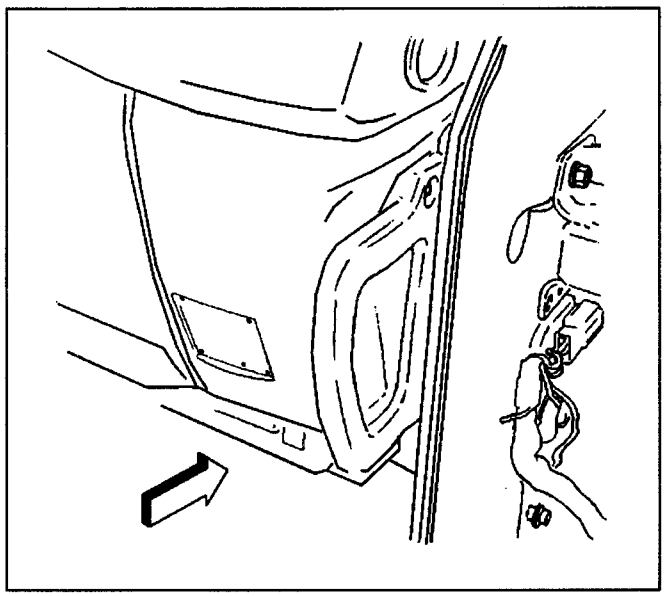


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4. Install the instrument panel right lower trim.

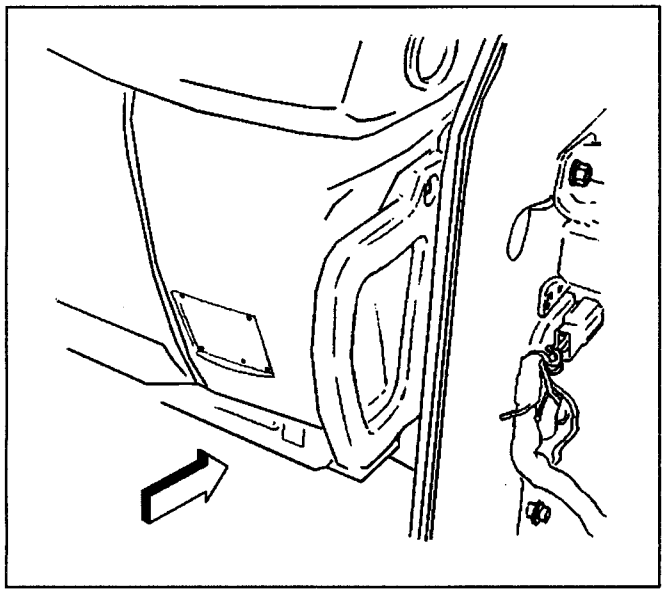


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5. Install the assist handle.
6. Install the assist handle bolts.
7. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



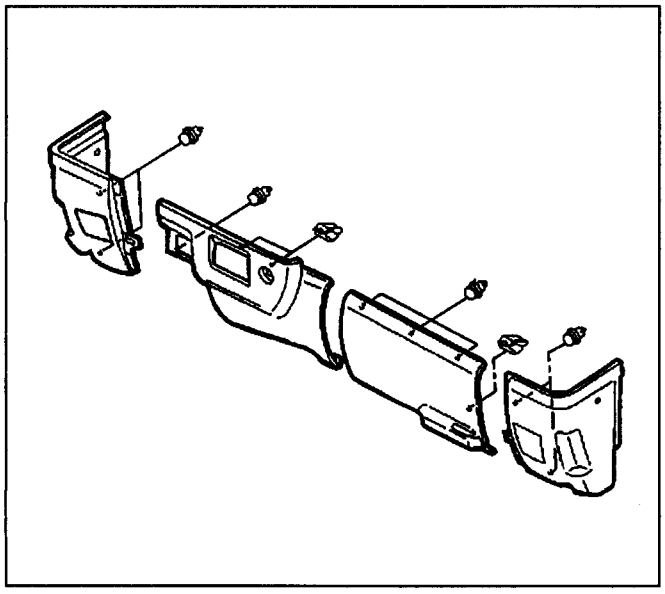
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Blower Motor and Fan Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Caution and Notices.

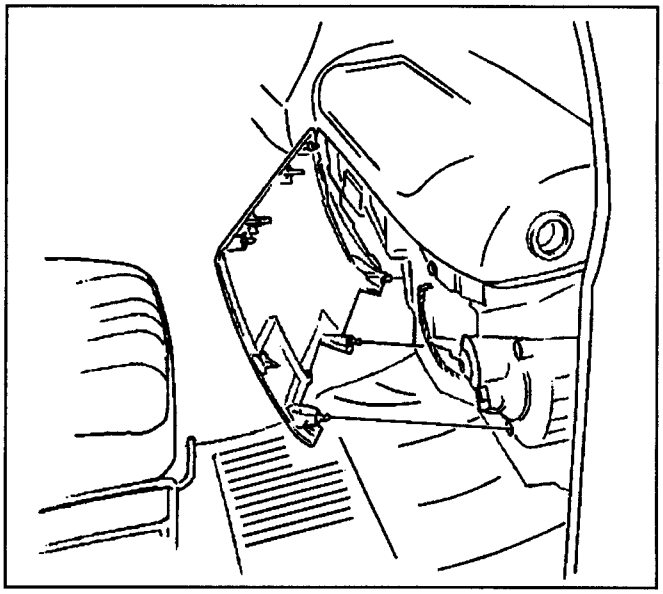
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.



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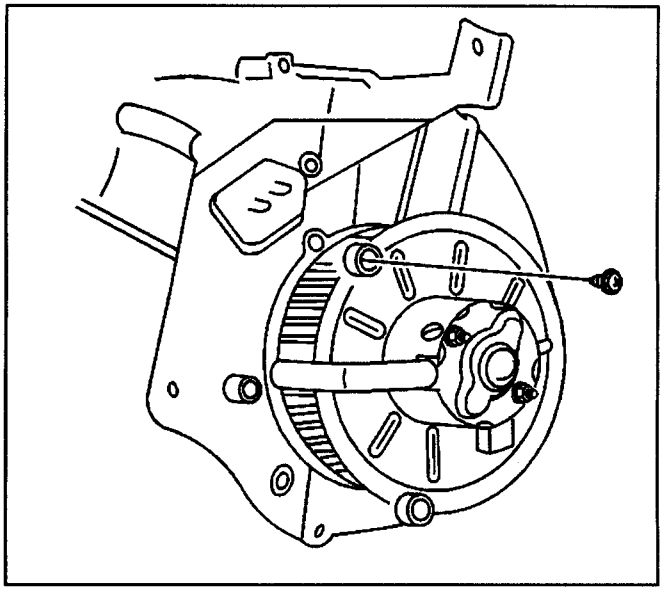
4. Remove the instrument panel right lower trim.

5. Disconnect the electrical connectors.
6. Remove the blower motor cooling tube.
7. Remove the blower motor screws.



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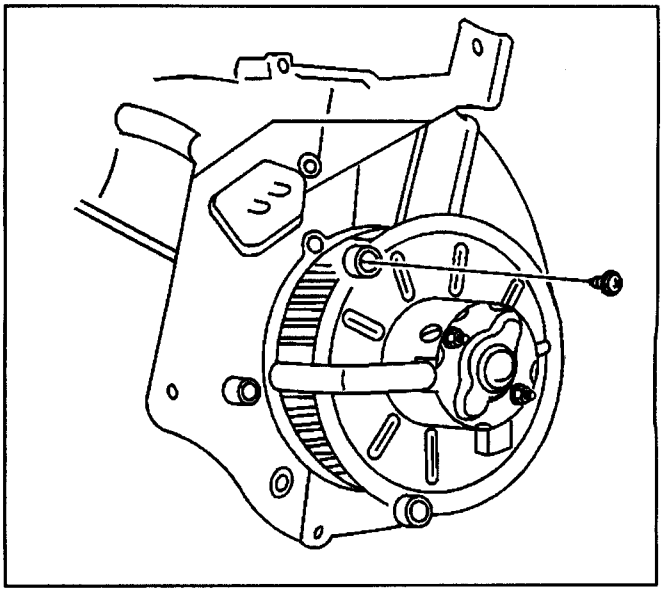
8. Remove the blower motor and fan.



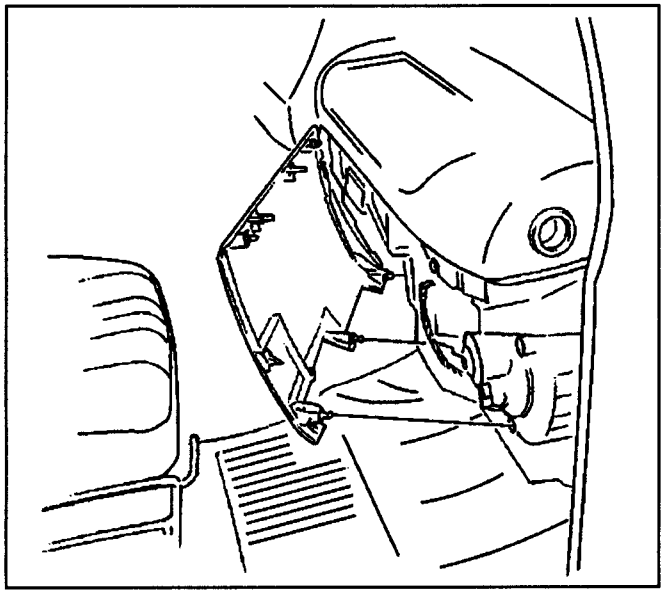
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Installation Procedure

1. Install the blower motor and fan.

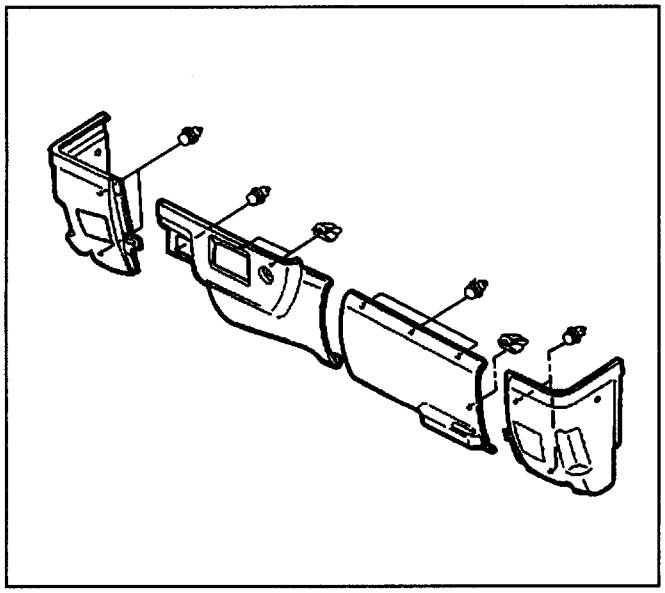


229931



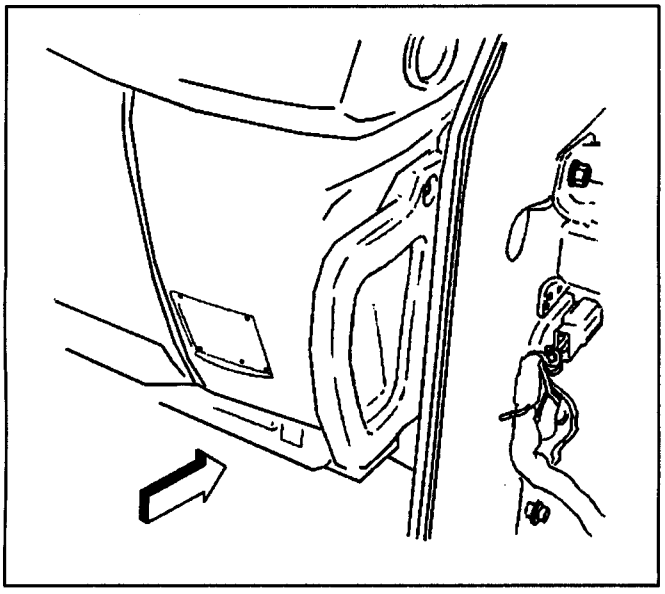
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2. Install the blower motor screws.
3. Install the blower motor cooling tube.
4. Connect the electrical connectors.



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5. Install the instrument panel right lower trim.



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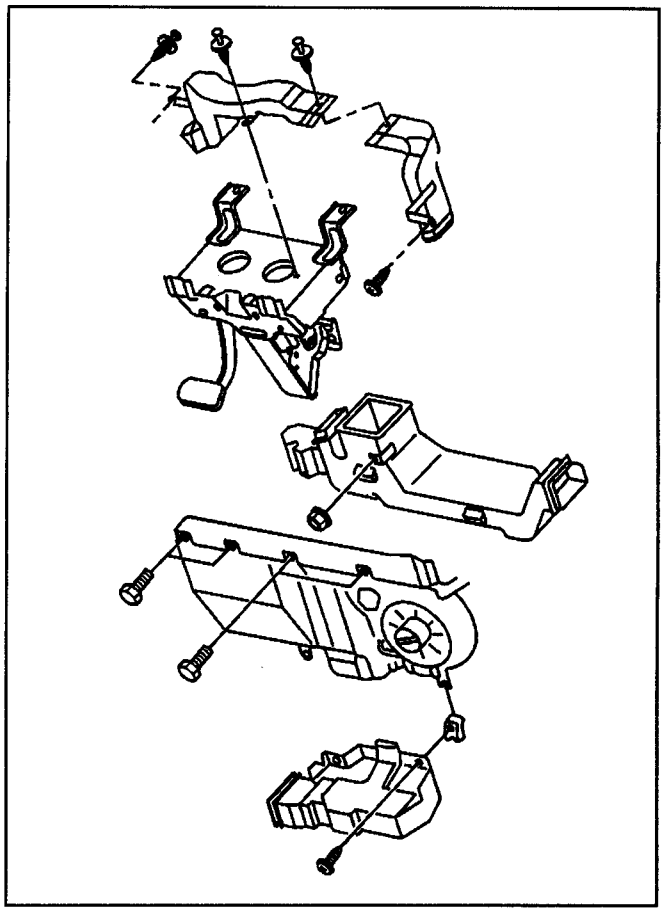
6. Install the assist handle.
7. Install the assist handle bolts.
8. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.

Air Distributor Duct Replacement (Lower)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

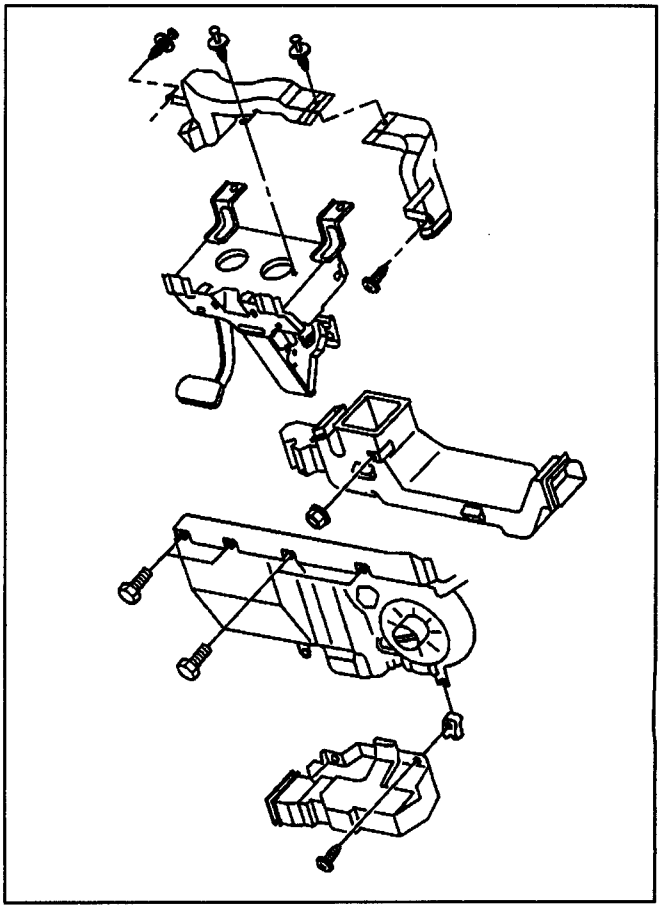
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the instrument panel. Refer to *IP Carrier Replacement* Instrument Panel and Gauges.
3. Remove the air distributor duct lower screws.
4. Remove the air distributor duct lower bolt.
5. Remove the air distributor lower duct.



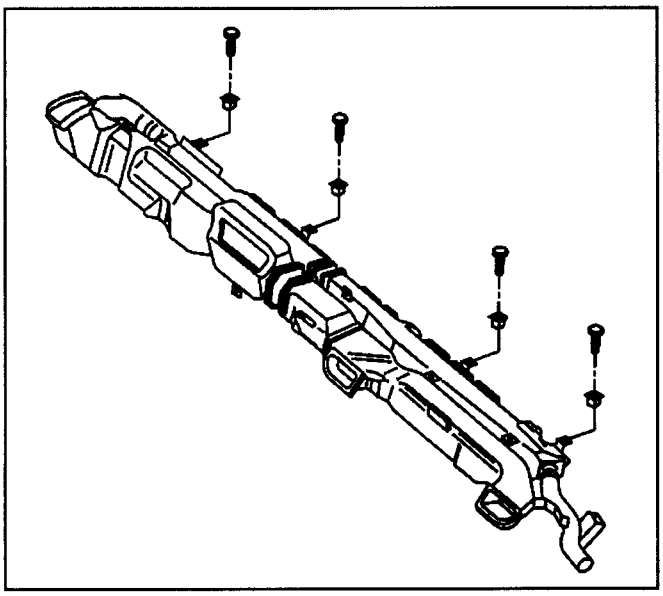
229904

Installation Procedure

1. Install the air distributor lower duct.
2. Install the air distributor lower duct bolt.
3. Install the air distributor lower duct screws.
4. Install the instrument panel. Refer to *IP Carrier Replacement* Instrument Panel and Gauges
5. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electical.



229904



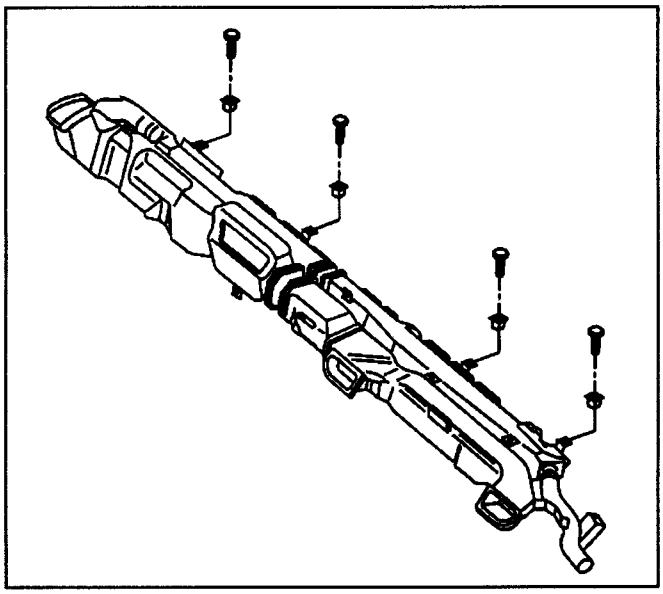
229918

Air Distributor Duct Replacement (Upper)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

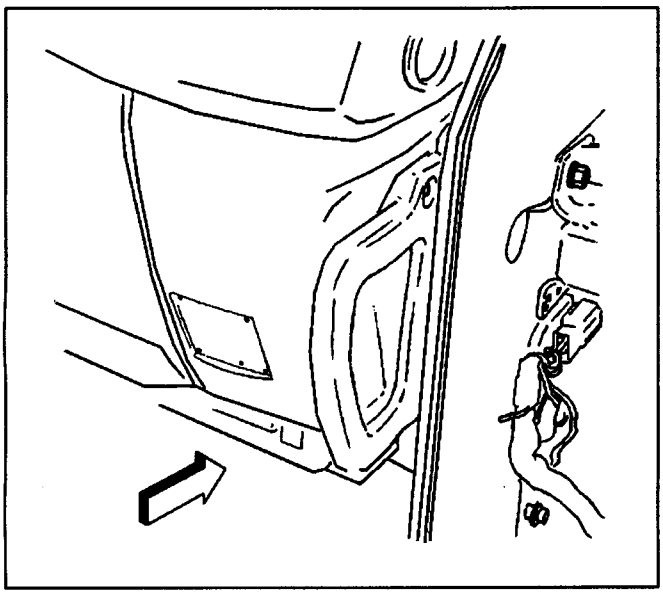
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
3. Remove the air distributor upper duct screws.
4. Remove the air distributor upper duct.



229918

Installation Procedure

1. Install the air distributor upper duct.
2. Install the air distributor upper duct screws.
3. Install the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
4. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



229889

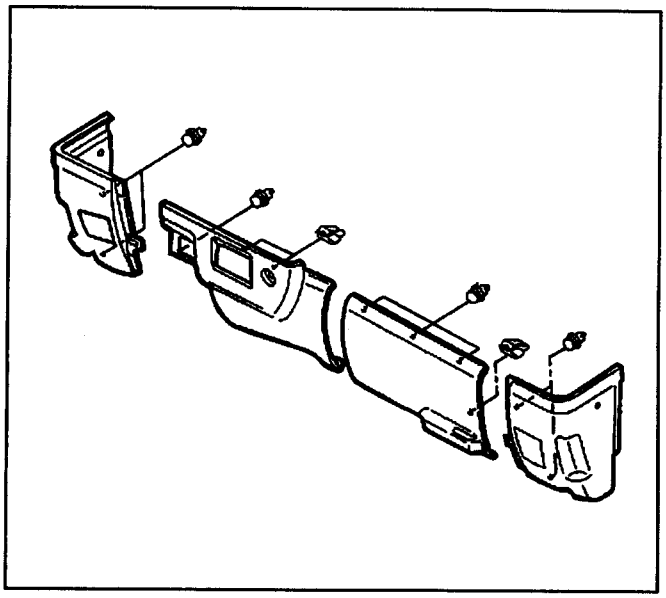
Air Inlet Actuator Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

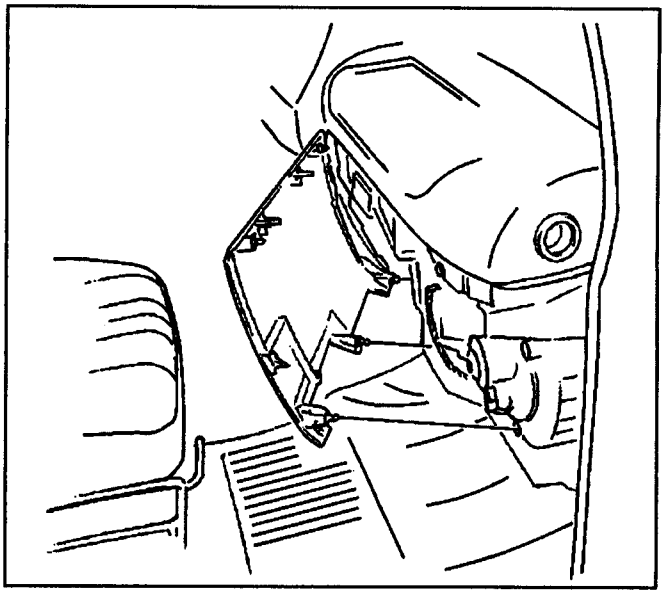
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.

4. Remove the instrument panel right lower trim.

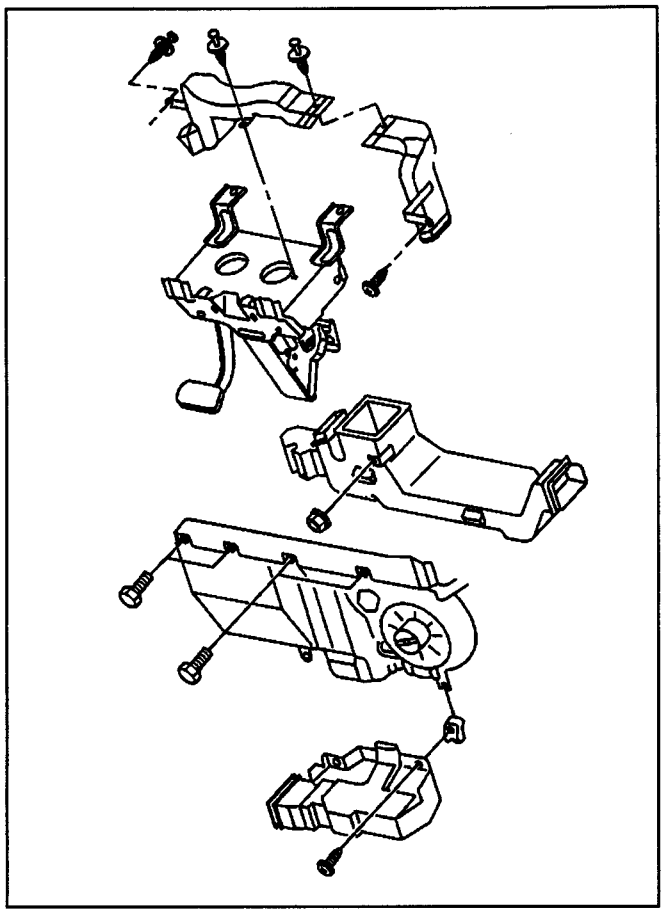


214669

5. Remove the air distributor lower duct.

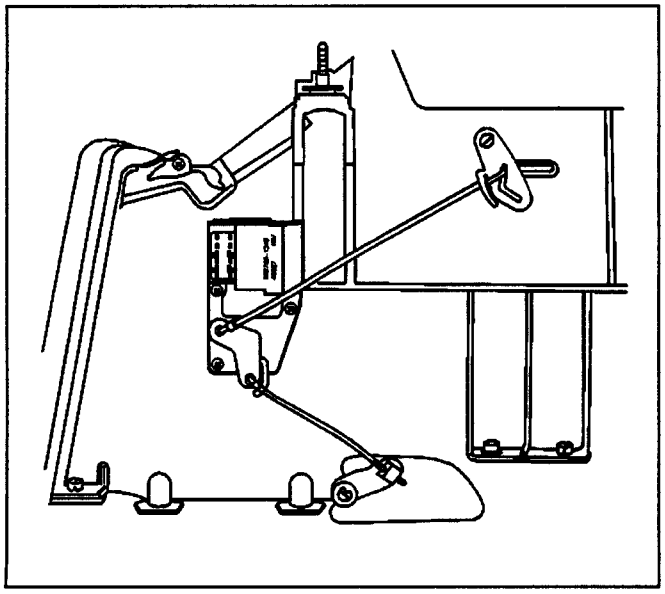


229897



229904

6. Disconnect the electrical connectors.

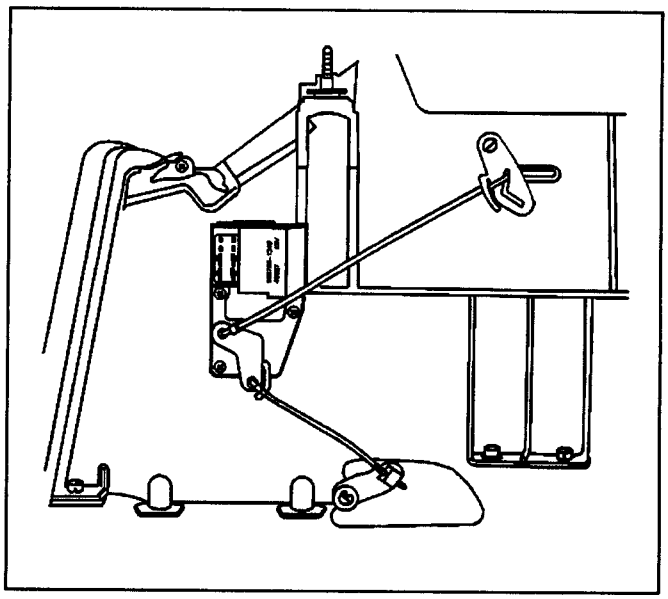


229948

7. Remove the air inlet actuator.

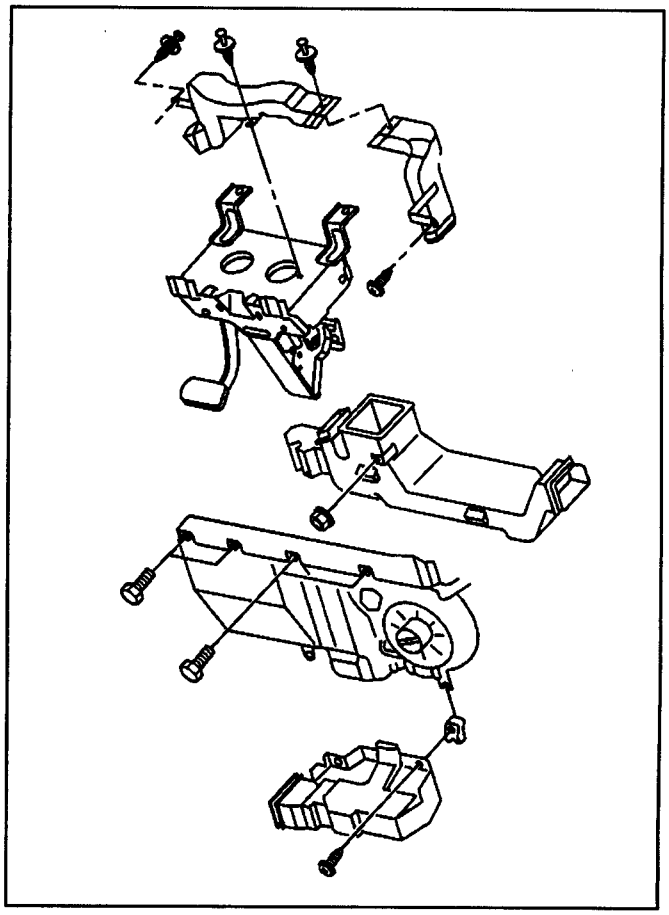
Installation Procedure

1. Install the air inlet actuator.

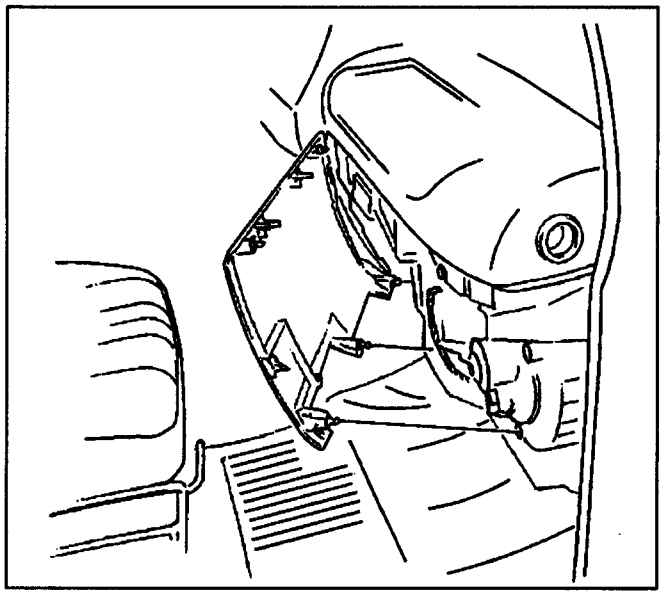


229948

2. Connect the electrical connectors.

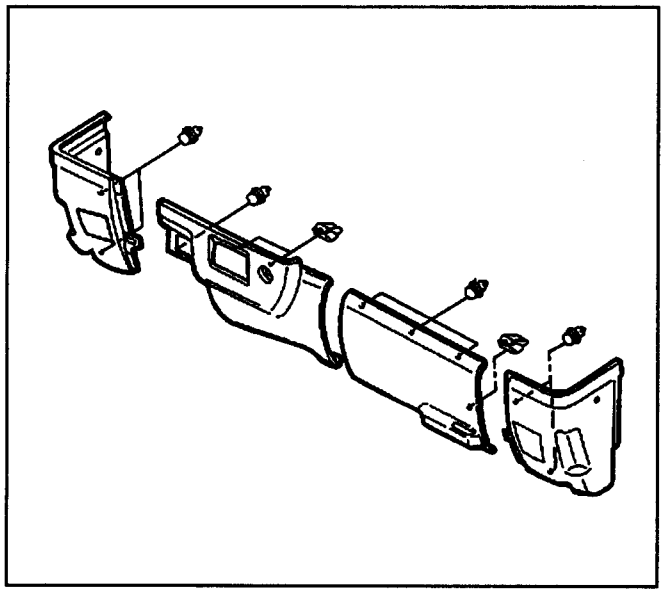


229904



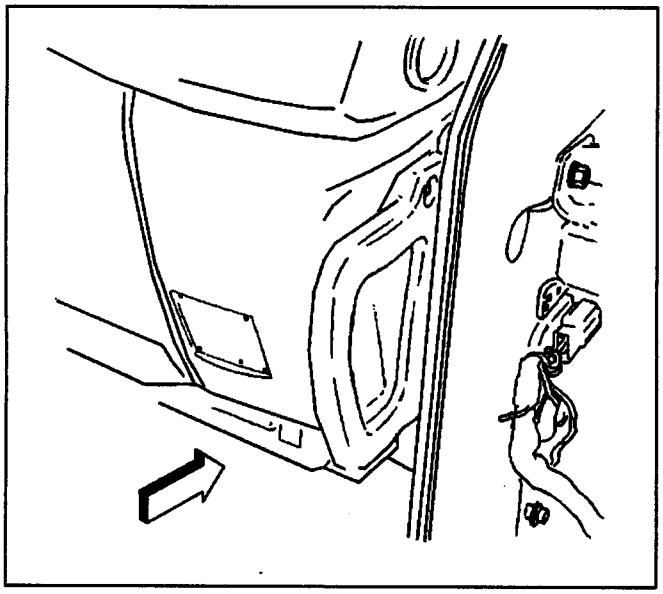
229897

3. Install the air distributor lower duct.



214669

4. Install the instrument panel right lower trim.



229889

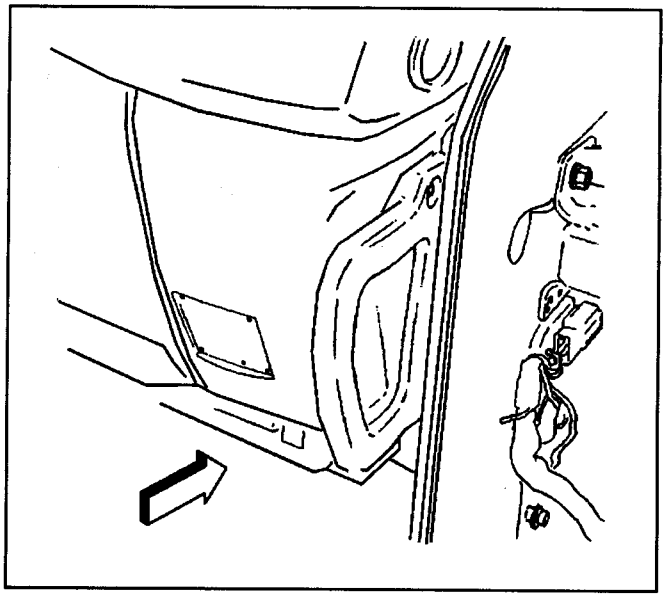
5. Install the assist handle.
6. Install the assist handle bolts.
7. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.

Temperature Actuator Replacement

Removal Procedure

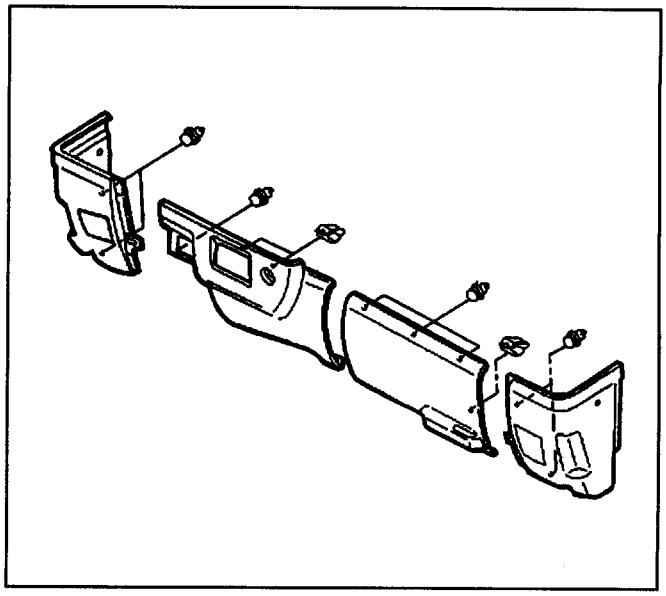
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.



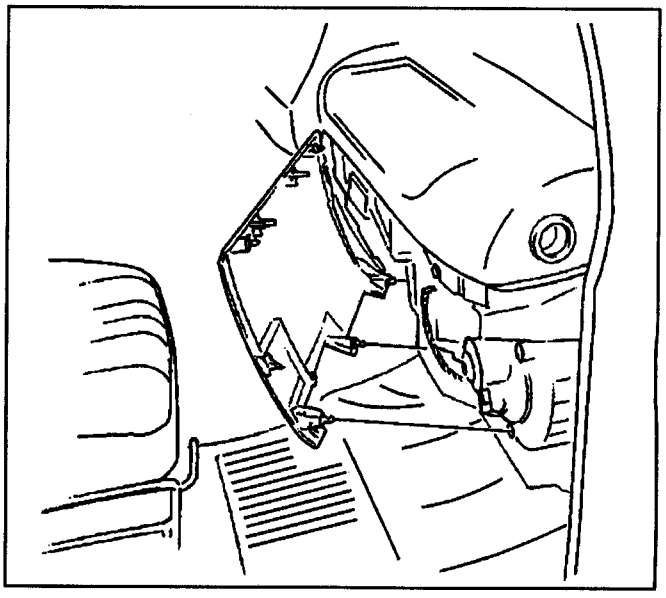
229889

4. Remove the instrument panel right lower trim.

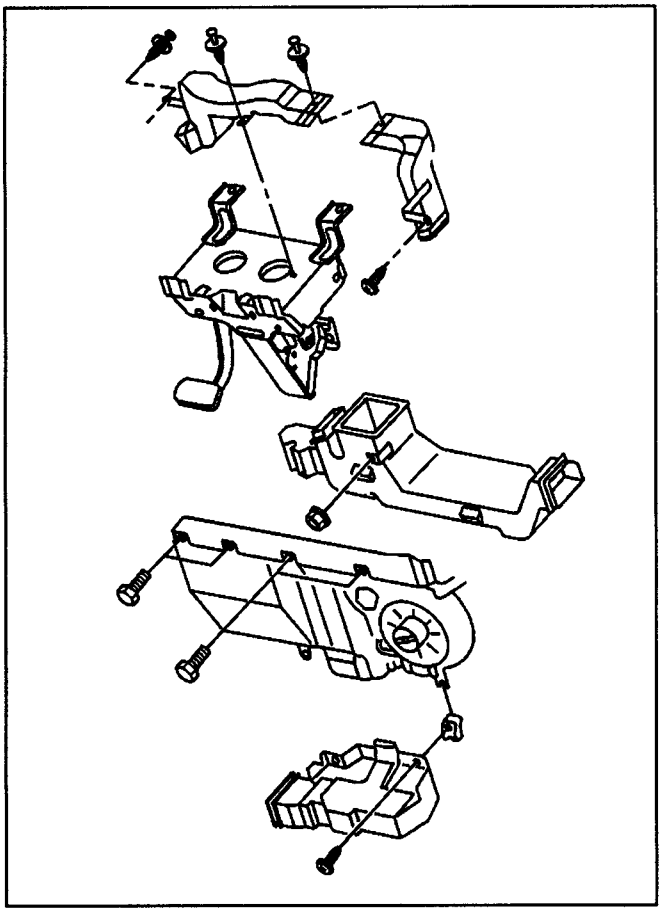


214669

5. Remove the air distributor lower duct.

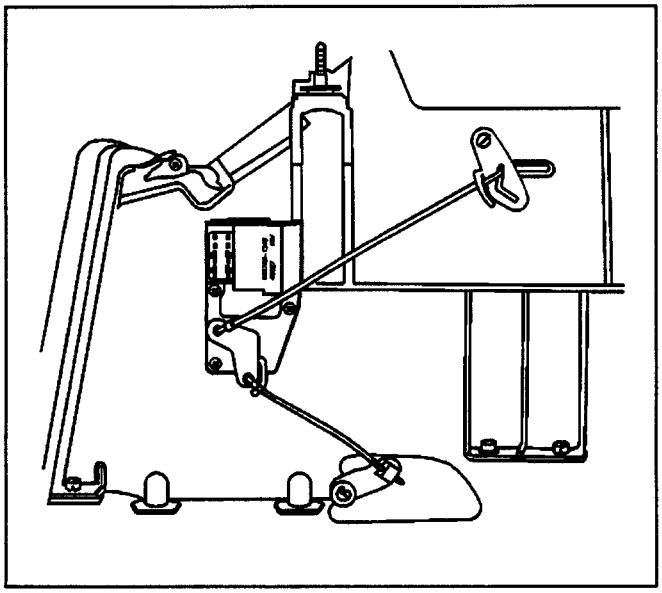


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229904

6. Disconnect the electrical connectors.

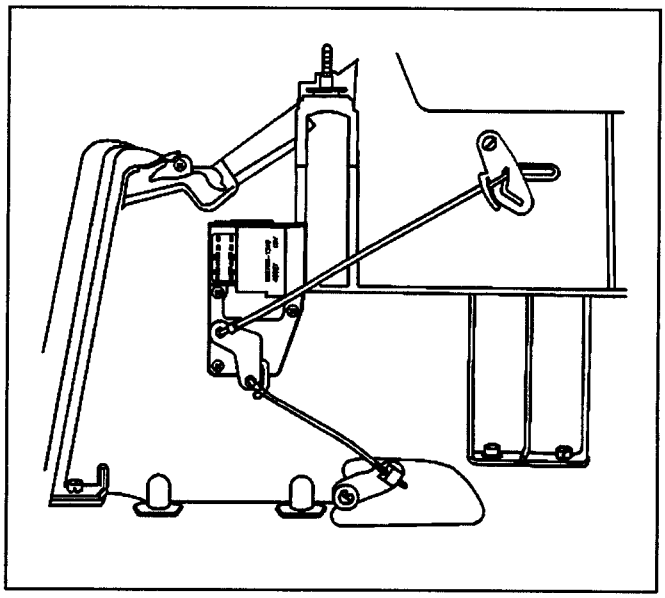


229948

7. Remove the temperature actuator.

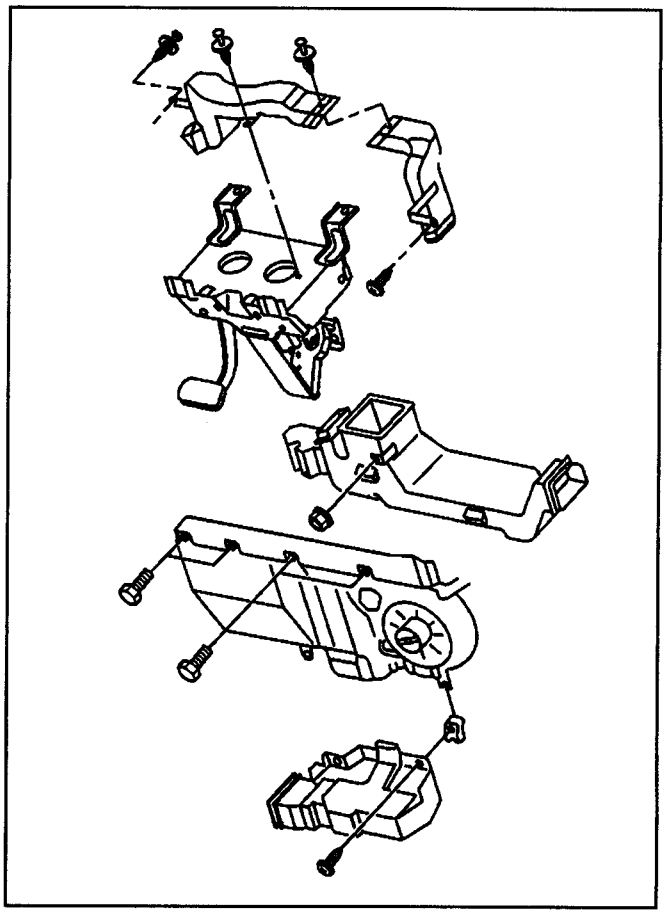
Installation Procedure

1. Install the temperature actuator.

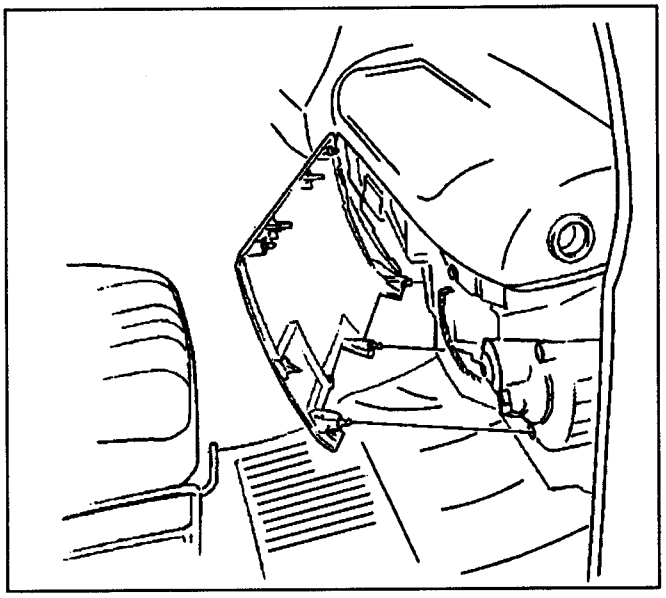


229948

2. Connect the electrical connectors.

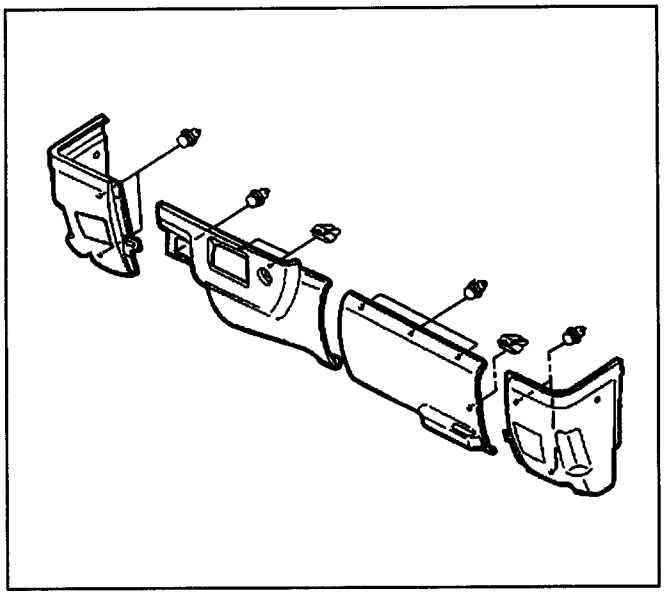


229904



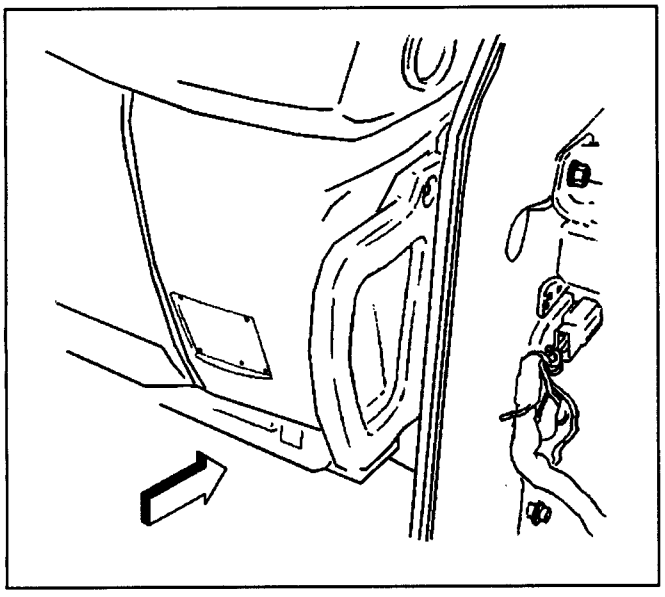
229897

3. Install the air distributor lower duct.



214669

4. Install the instrument panel right lower trim.



229889

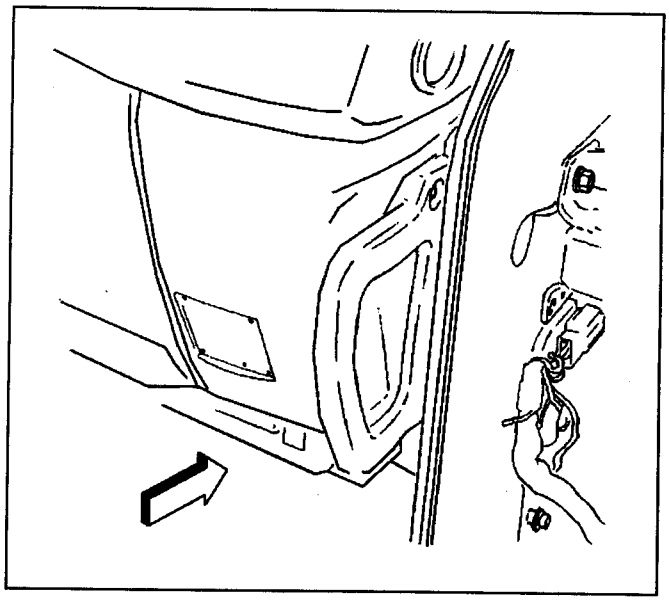
5. Install the assist handle.
6. Install the assist handle bolts.
7. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.

Mode Actuator Replacement

Removal Procedure

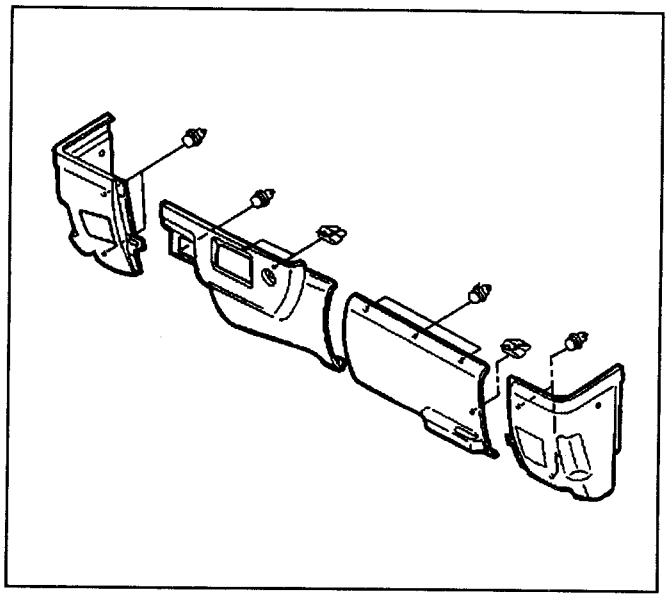
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle.



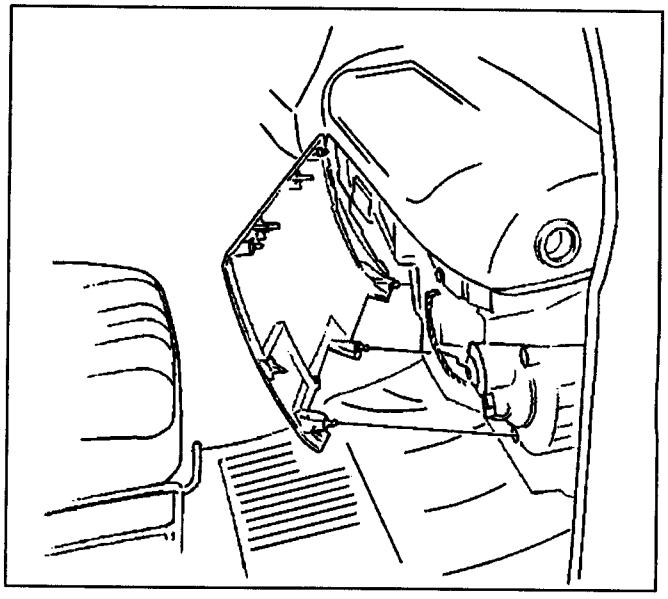
229889

3. Remove the assist handle bolts.
4. Remove the instrument panel lower trim.

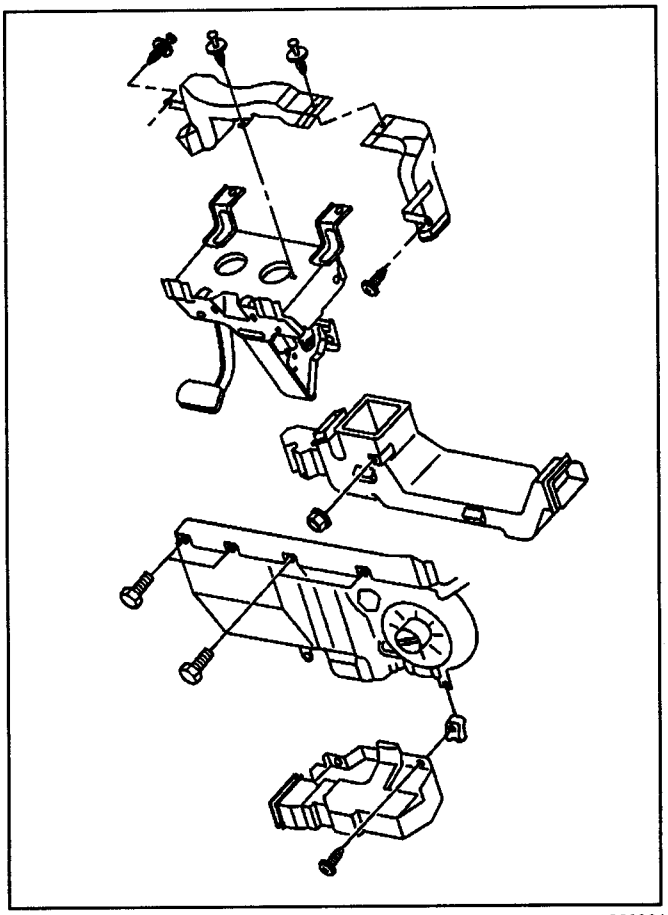


214669

5. Disconnect the audio system. Refer to *Radio Replacement* in Entertainment.

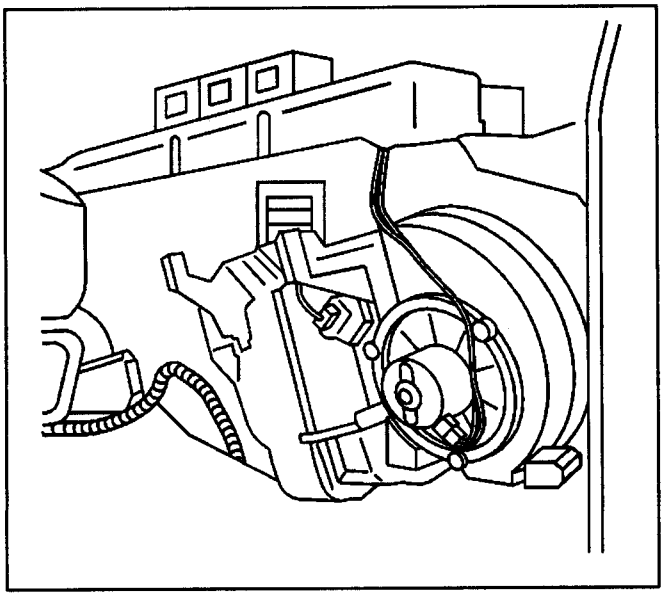


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229904

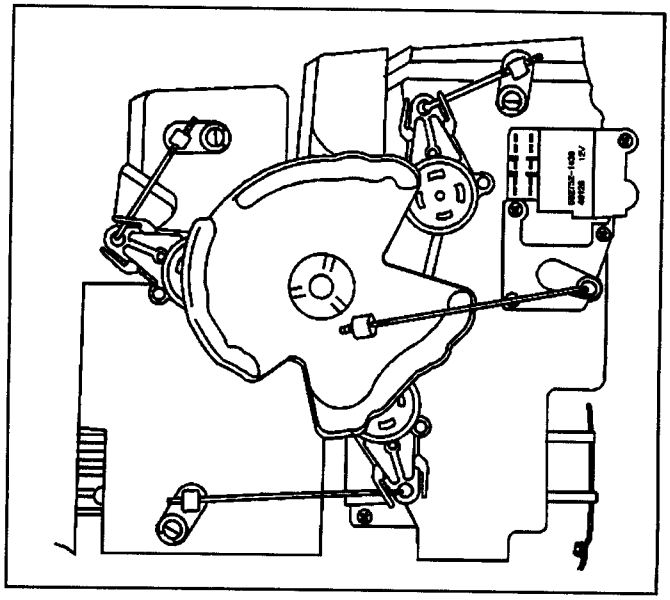
6. Disconnect the electrical connectors.



229927

7. Remove the heater module (right side).

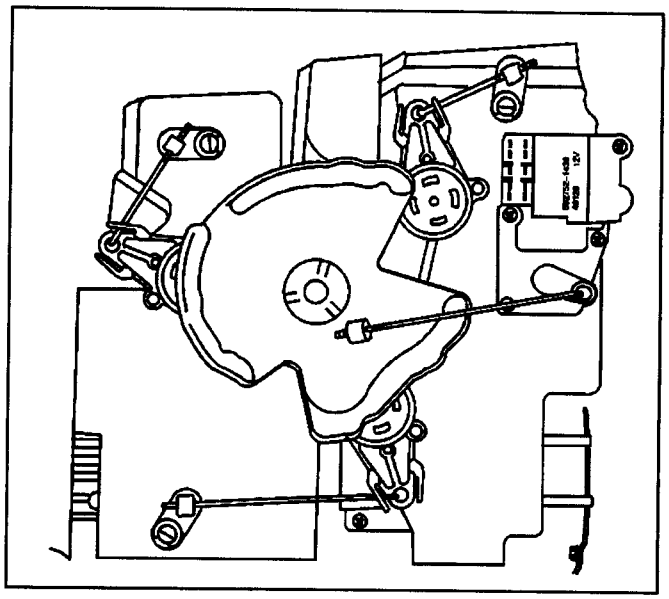
8. Remove the mode actuator.



229907

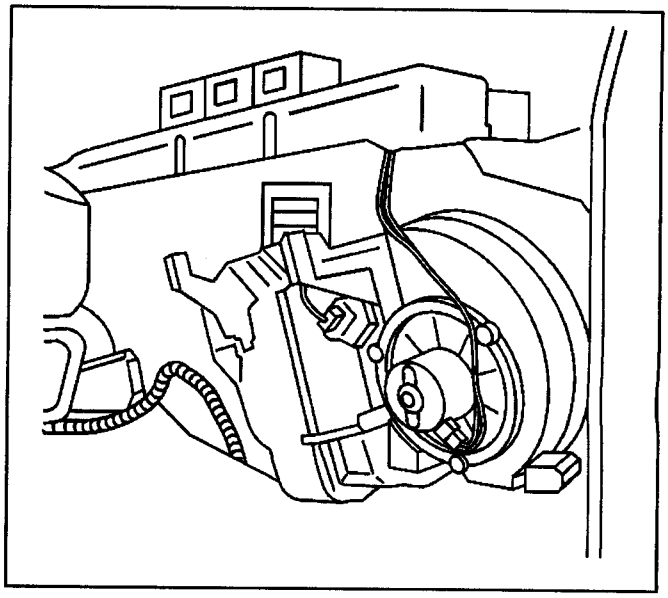
Installation Procedure

1. Install the mode actuator.

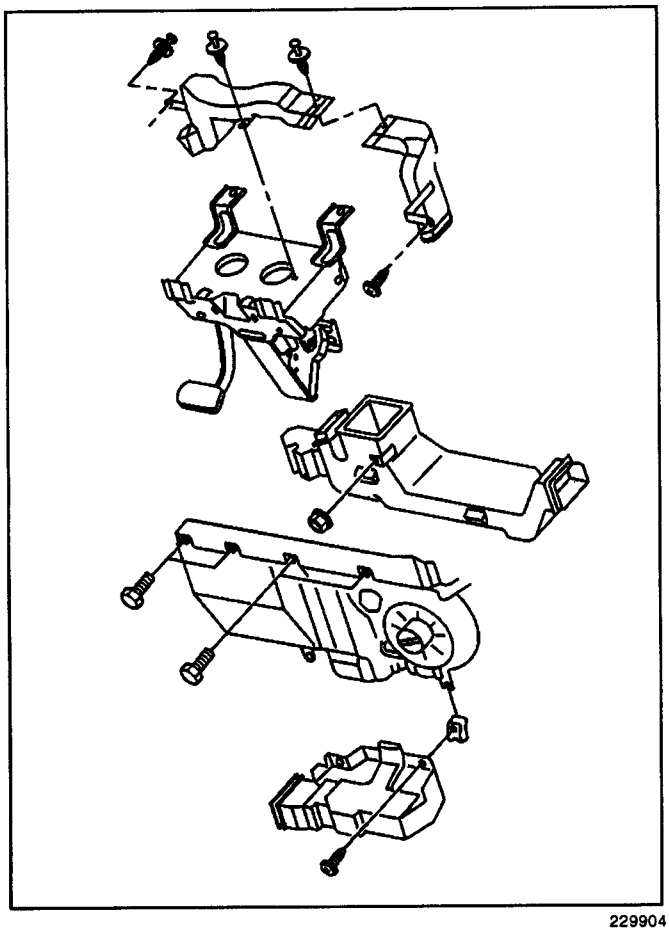


229907

2. Install the heater module (right side).

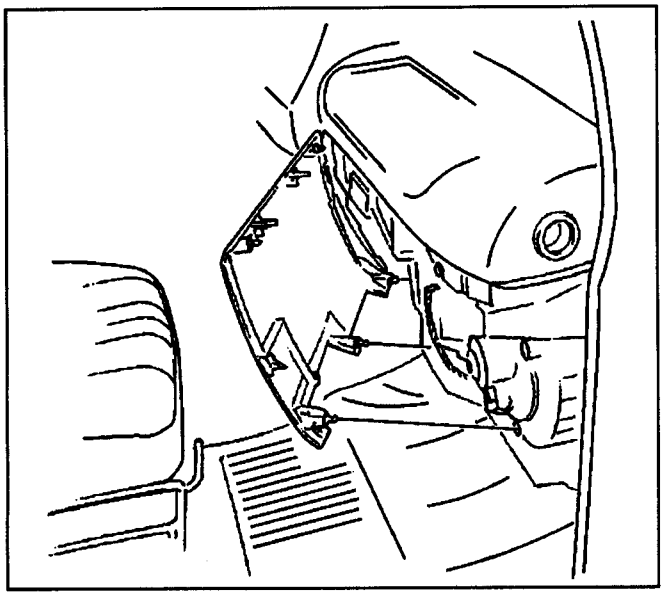


229927



229904

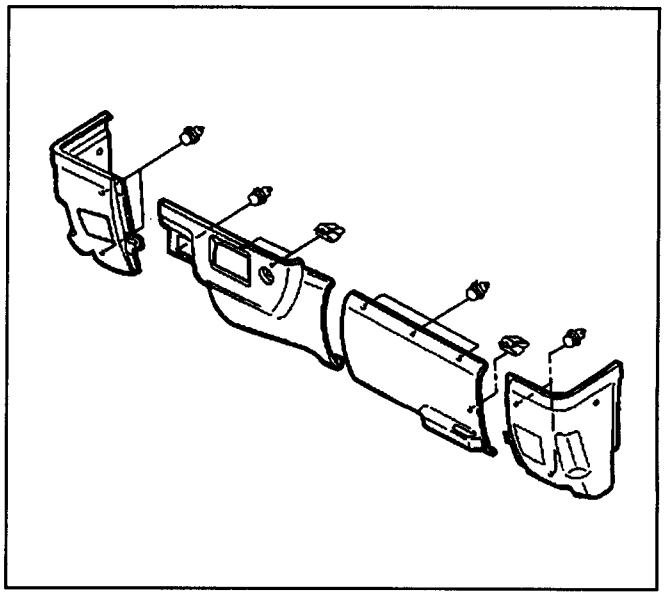
3. Connect the electrical connectors.



229897

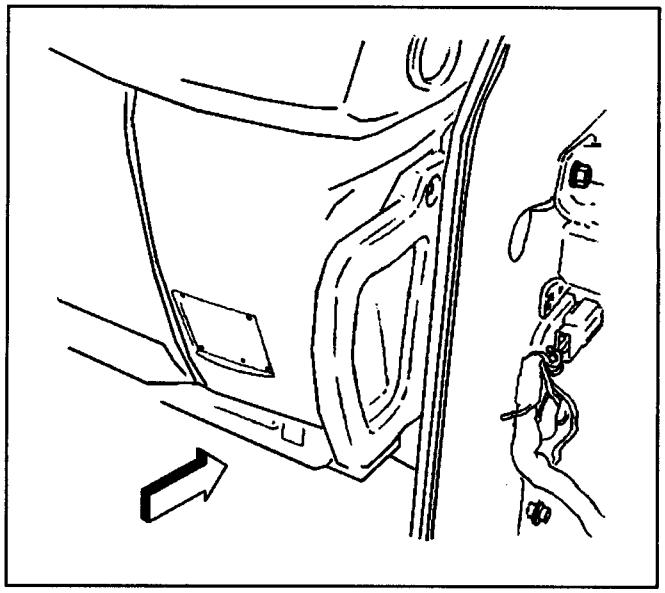
4. Connect the audio system. Refer to *Radio Replacement* in Entertainment.

5. Install the instrument panel lower trim.
6. Install the assist handle bolts.



214669

7. Install the assist handle.
8. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.

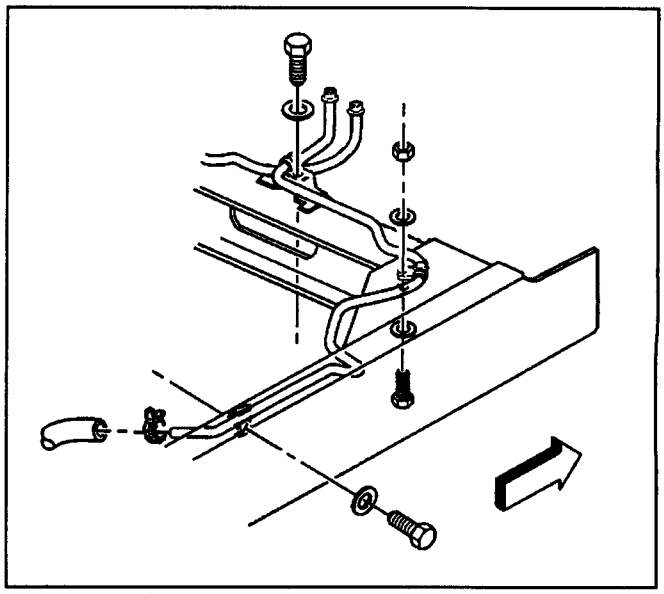


229889

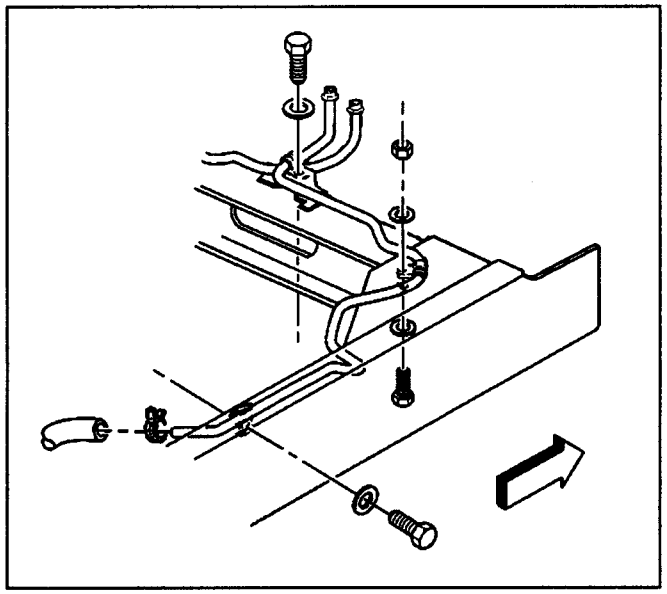
Heater Pipes Replacement (Inlet)

Removal Procedure

1. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
2. Remove the inlet hose clamp to the engine pipe.
3. Remove the hose clamps from the heater core.
4. Remove the inlet pipe mounting bolts, washers and nuts.

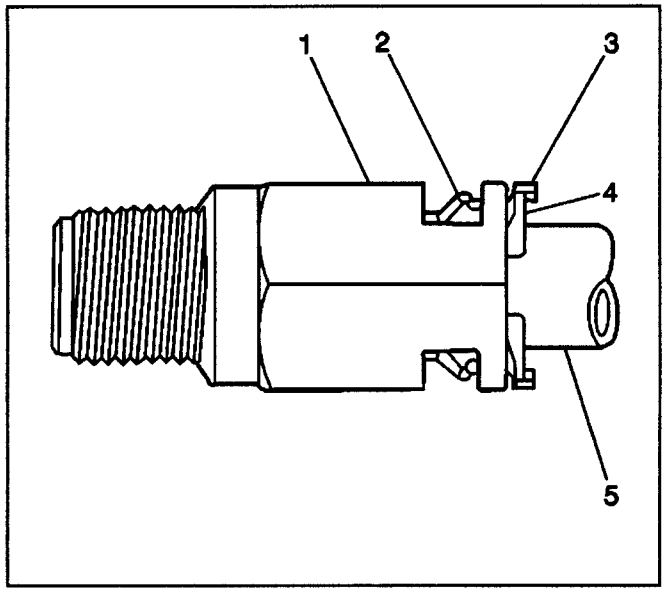


290969



290969

5. Remove the inlet pipe clamp on the frame.

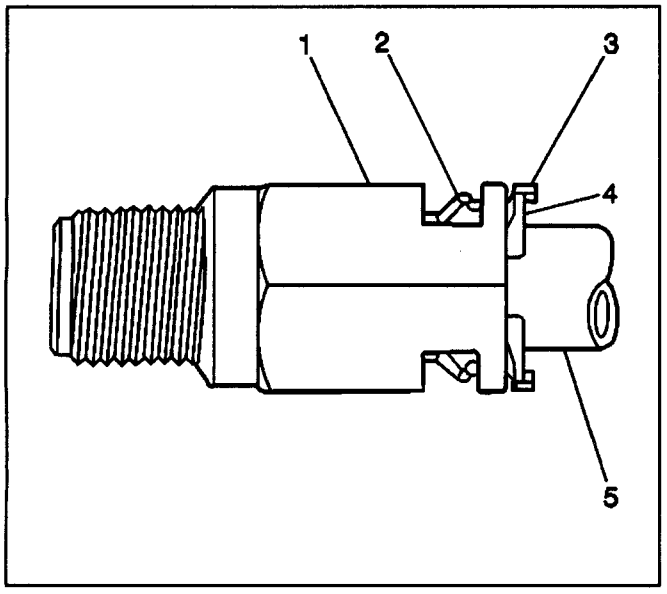


220038

Important:

- If replacing the heater inlet connector (1), it is located on the engine, remove the retainer (4) from the hose and discard. The new connector is equipped with a retainer. (4)
- If replacing the heater inlet hose, (5) remove the retainer (4) from the heater inlet hose and reinsert in the connector. (1)
- If reusing the hose (5) and connector, (1) the retainer (4) can remain in heater inlet place on the hose.

6. Remove the inlet pipe.



220038

Installation Procedure

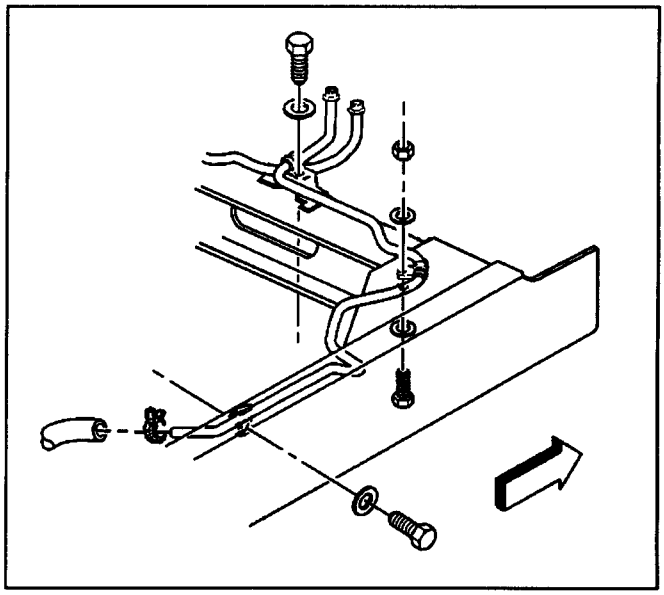
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Push the pipe into the heater inlet hose connnector (1) until the retainer locking tabs lock (2, 3). Pull back on the hose to check for proper engagement.

   Tighten

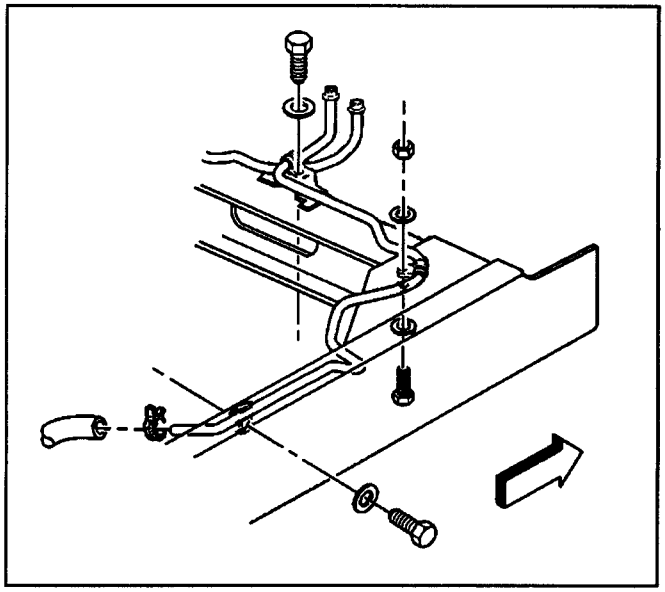
   Quick connect heater inlet connector to 35 N.m (26 lb ft).

2. Install the inlet pipe.



290969

3. Install the pipe clamps on the frame.
4. Install the inlet pipe mounting bolts, washers and nuts.
5. Install the inlet hose clamp from the heater core.
6. Install the inlet hose clamp to the engine pipe.
7. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
8. Inspect the system for leaks.

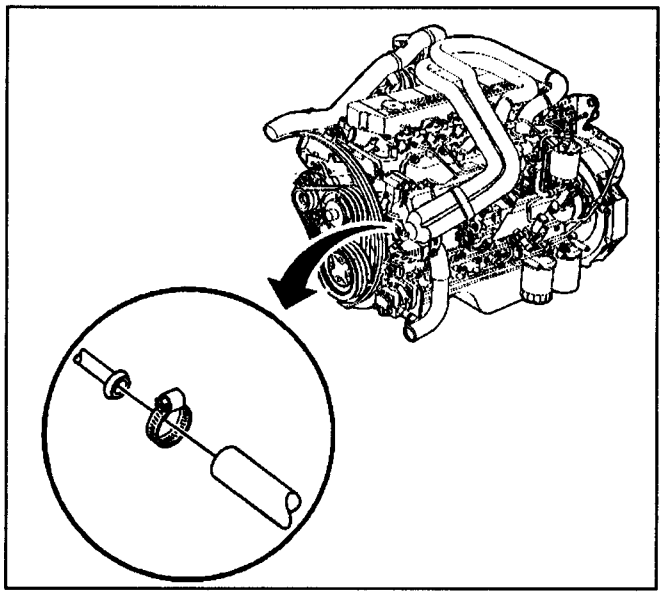


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Heater Pipes Replacement (Outlet)

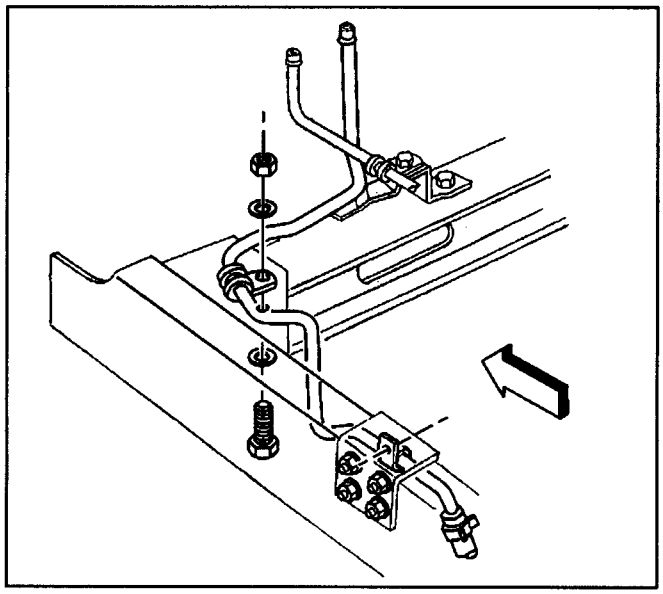
Removal Procedure

1. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
2. Remove the hose clamp from the heater core.
3. Remove the hose clamp from the radiator hose.
4. Remove the mounting bolt.



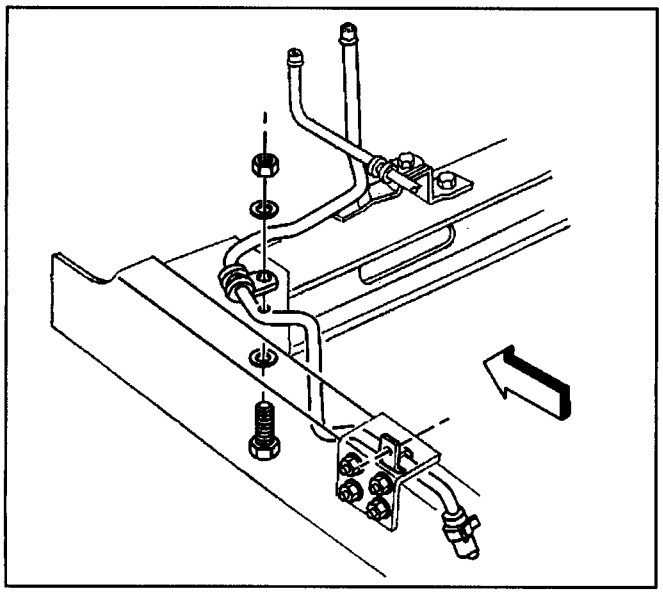
291029

5. Remove the pipe clamp on the frame.



290964

6. Remove the outlet pipe.

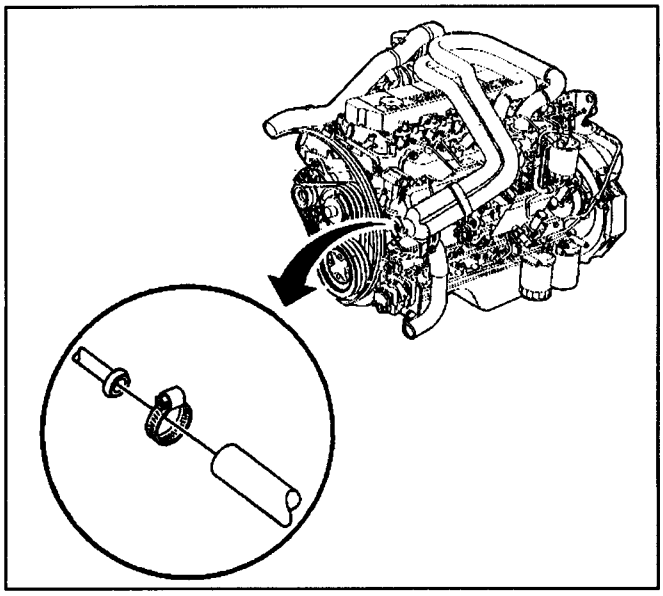


290964

Installation procedure

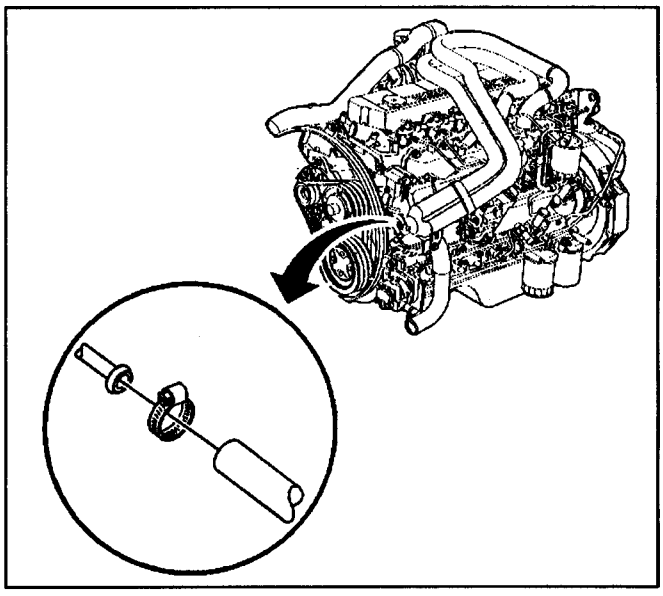
1. Install the outlet pipe.

2. Install the clamp on the frame.



291029

3. Install the mounting bolt.
4. Install the hose clamp from the radiator hose.
5. Install the hose clamp from the heater core.
6. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
7. Inspect the system for leaks.

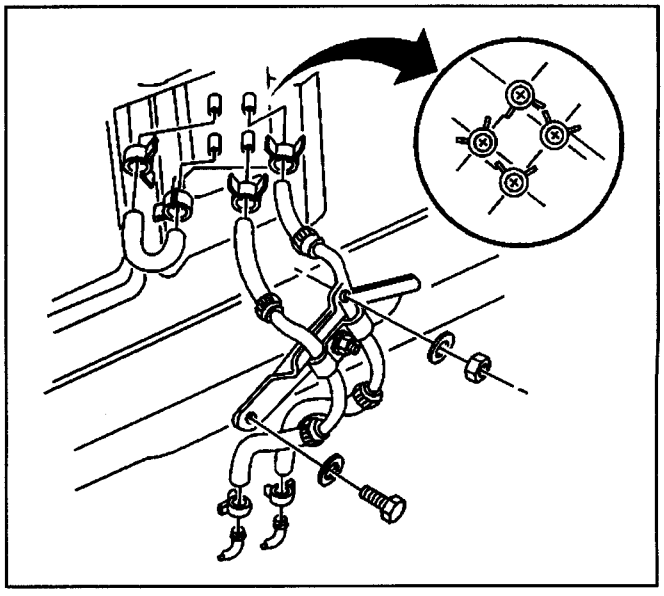


291029

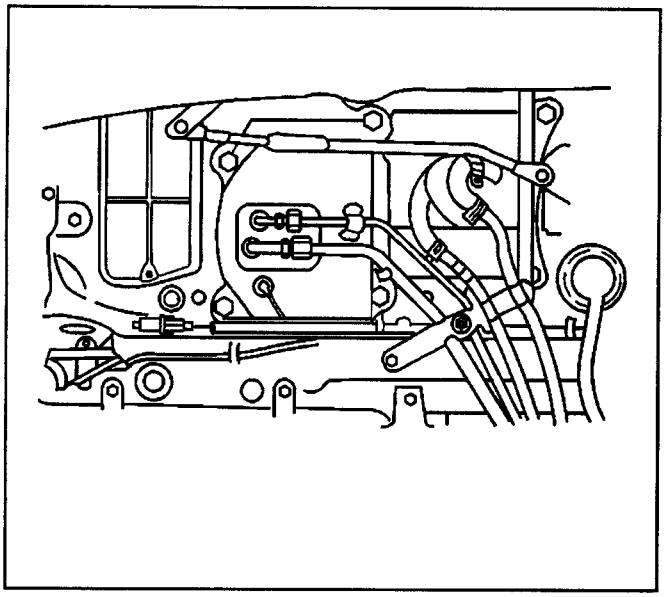
Heater Core Replacement (Right)

Removal Procedure

1. Raise the hood and support.
2. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
3. Remove the windshield wiper right link.
4. Remove the heater hose clamps.
5. Remove the heater hoses.

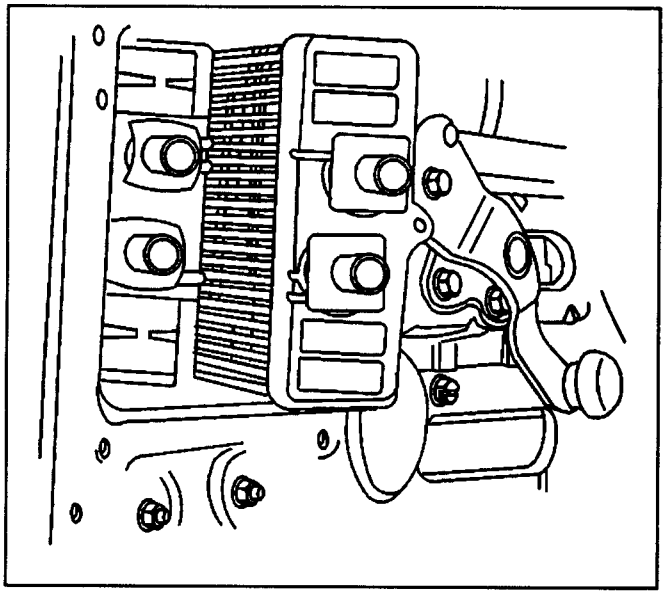


229937



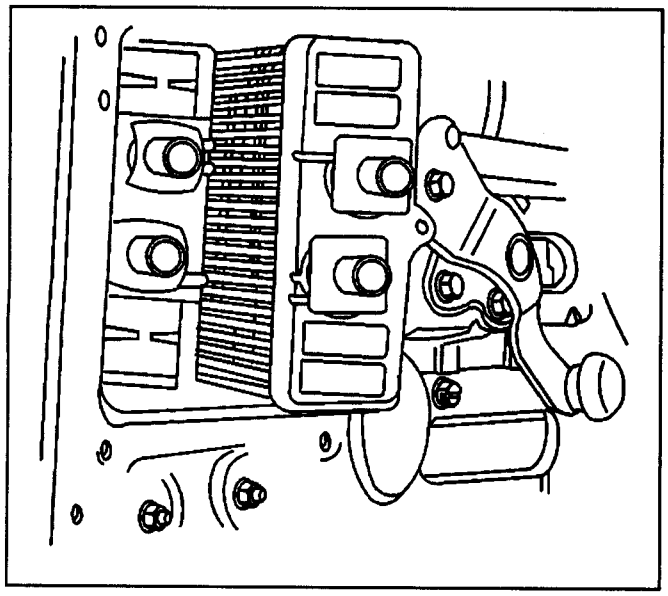
229939

6. Remove the heater core cover plate screws.
7. Remove the heater core cover plate.
8. Remove the heater core screw.



229941

9. Remove the right heater core.

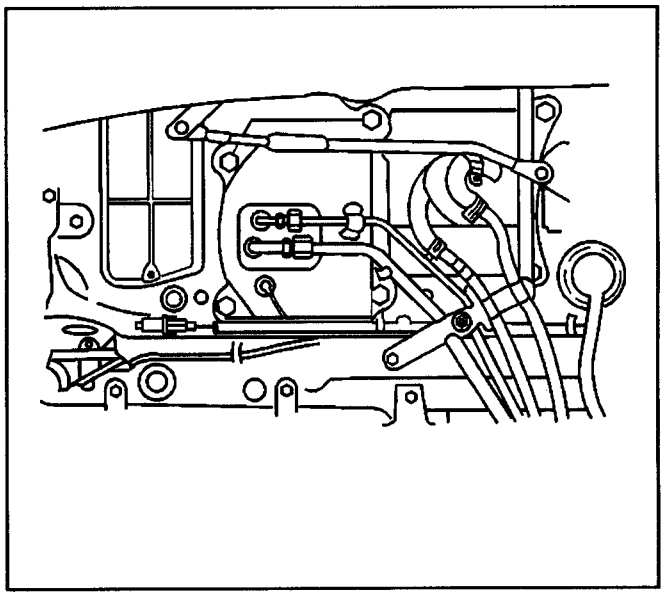


229941

Installation Procedure

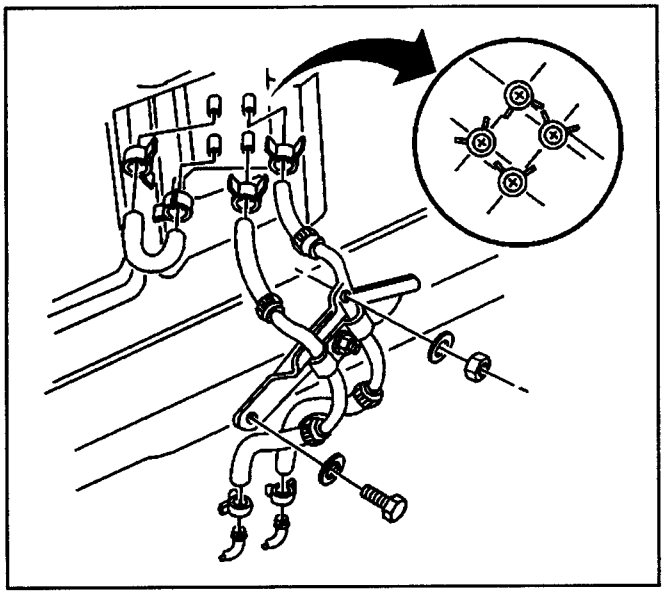
1. Install the right heater core.
2. Install the heater core screw.
3. Install the heater core cover plate.

4. Install the heater core cover plate screws.



229939

5. Install the heater hoses.
6. Install the heater hose clamps.
7. Install the windshield wiper right link.
8. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
9. Inspect the system for leaks.
10. Close the hood.

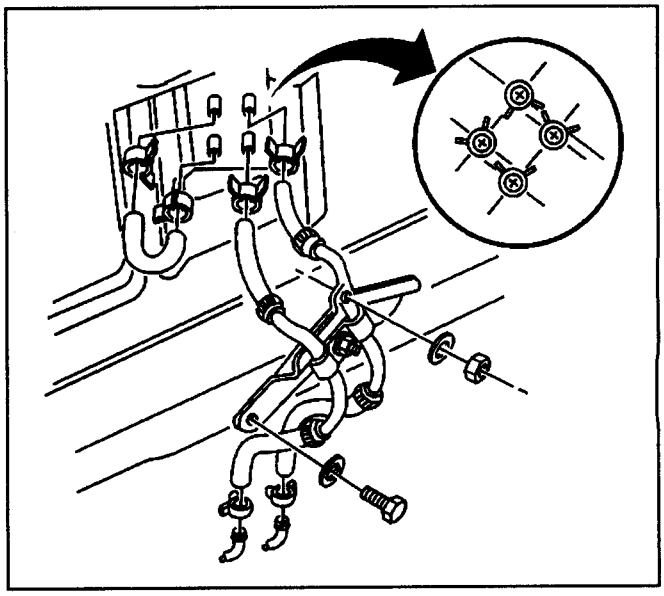


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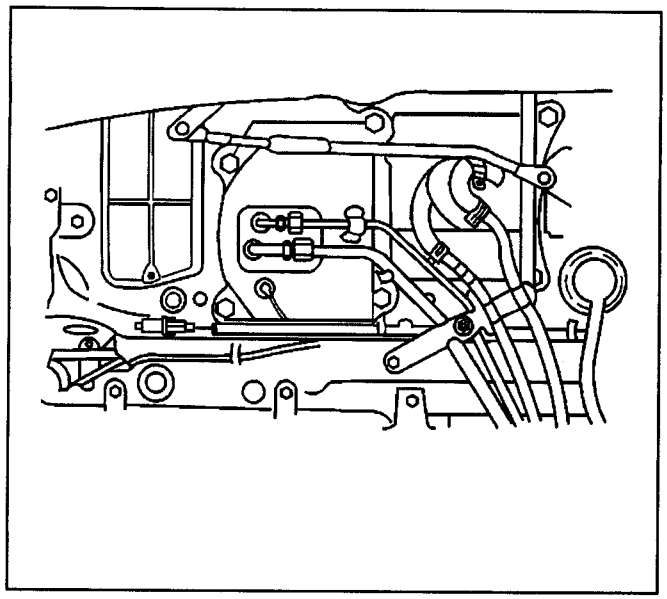
Heater Core Replacement (Left)

Removal Procedure

1. Raise the hood and support.
2. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
3. Remove the windshield wiper right link.
4. Remove the heater hose clamps.
5. Remove the heater hoses.

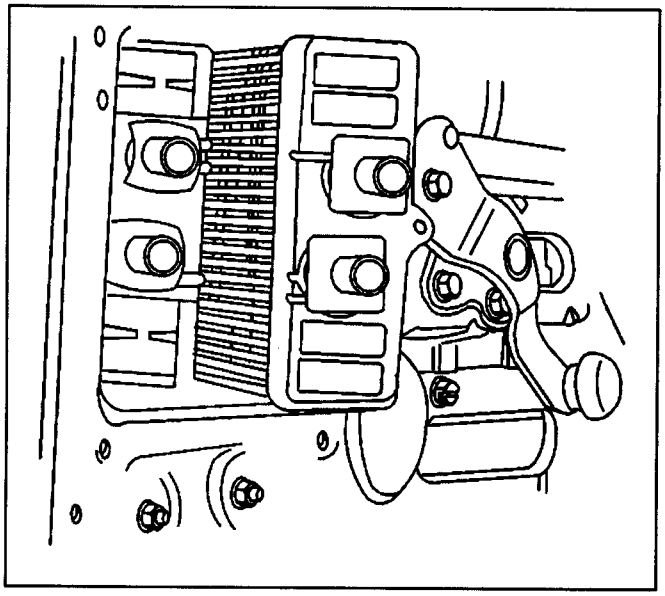


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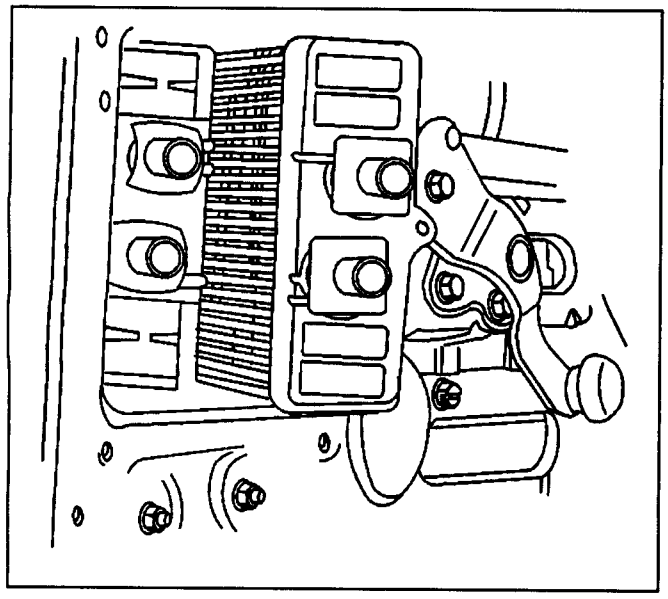
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6. Remove the heater core cover plate screws.
7. Remove the heater core cover plate.
8. Remove the heater core screw.



229941

9. Remove the left heater core.

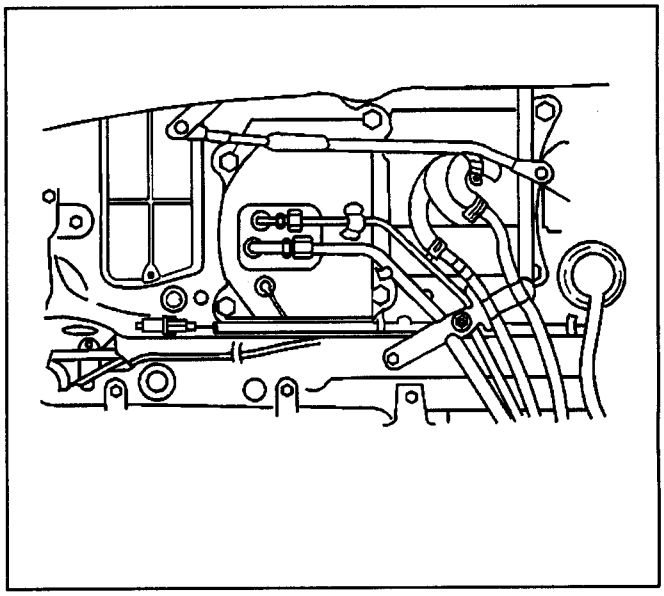


229941

Installation Procedure

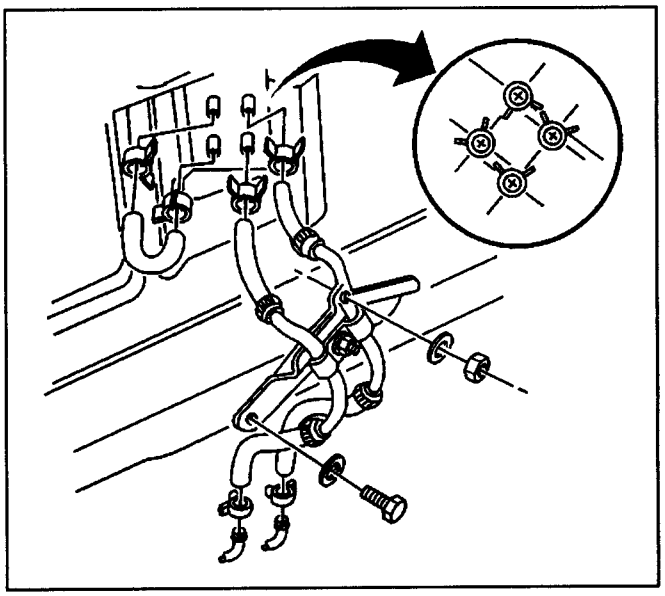
1. Install the left heater core.
2. Install the heater core screw.
3. Install the heater core cover plate.

4. Install the heater core cover plate screws.

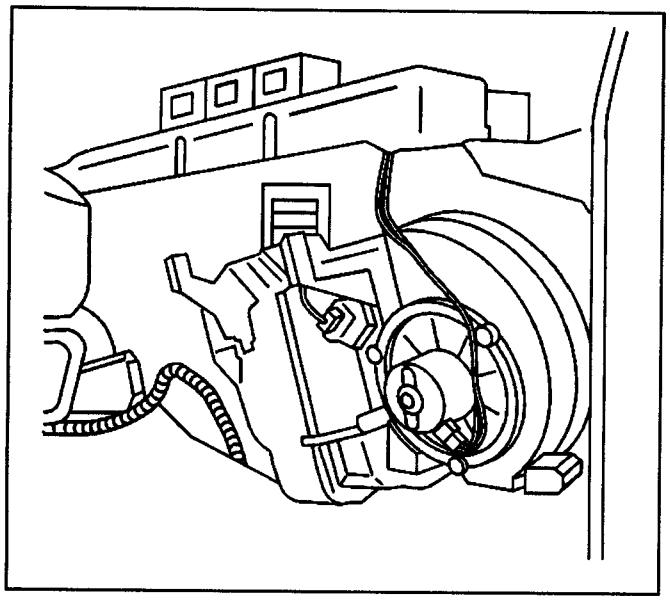


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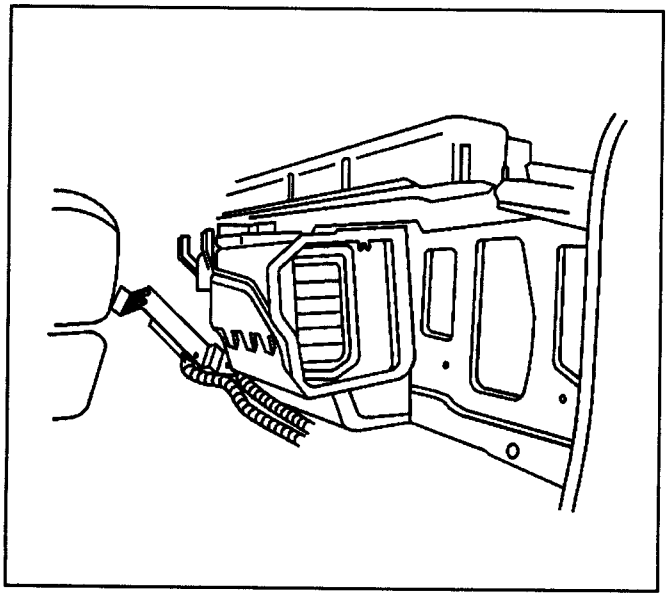
5. Install the heater hoses.
6. Install the heater hose clamps.
7. Install the windshield wiper right link.
8. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
9. Inspect the system for leaks.
10. Close the hood.



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229929

Heater/Vent Module Replacement

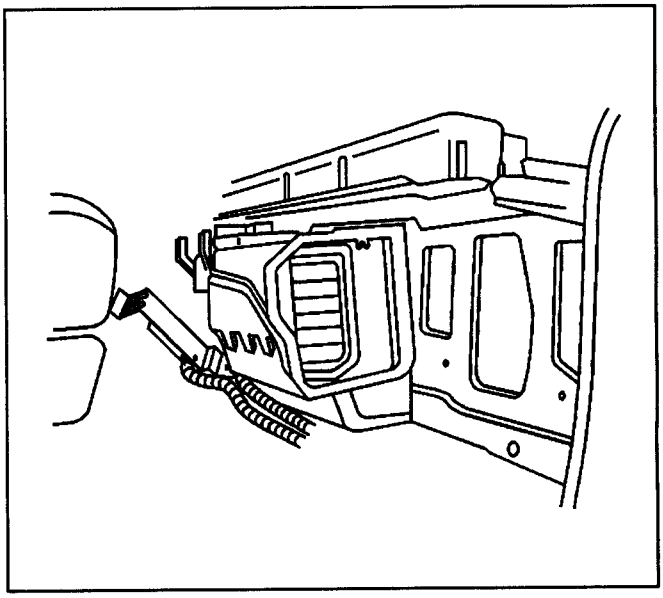
Removal Procedure

Caution: Refer to Battery Disconnect Caution In Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
3. Remove the right heater core. Refer to *Heater Core Replacement (Right).*
4. Remove the A/C Tempature Sensor connectors screw.
5. Remove the left heater core. Refer to *Heater Core Replacement (Left).*
6. Disconnect the A/C Tempature Sensor connectors electrical connectors.
7. Remove the A/C Tempature Sensor connectors.
8. Remove the air conditioning evaporator. Refer to *Evaporator Core Replacement.*
9. Disconnect the blower motor resistor electrical connectors.
10. Disconnect the blower motor electrical connectors.
11. Remove the heater vent module nuts.
12. Remove the right heater vent module.
13. Remove the left heater vent module.

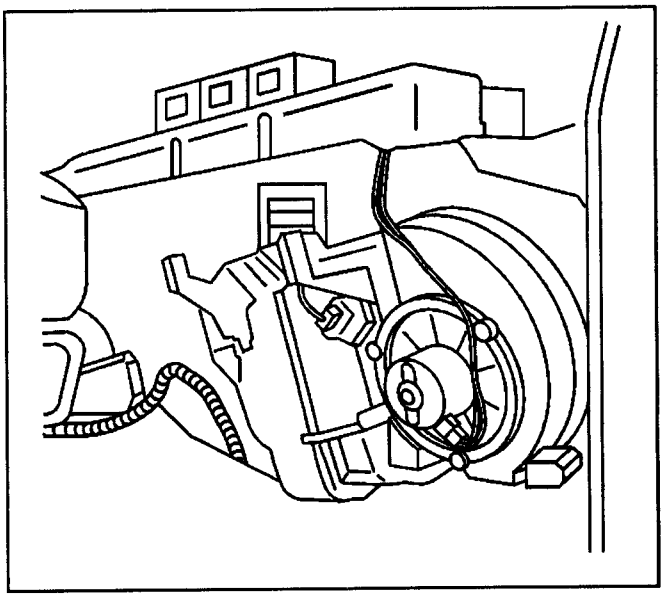
Installation Procedure

1. Install the left heater vent module.



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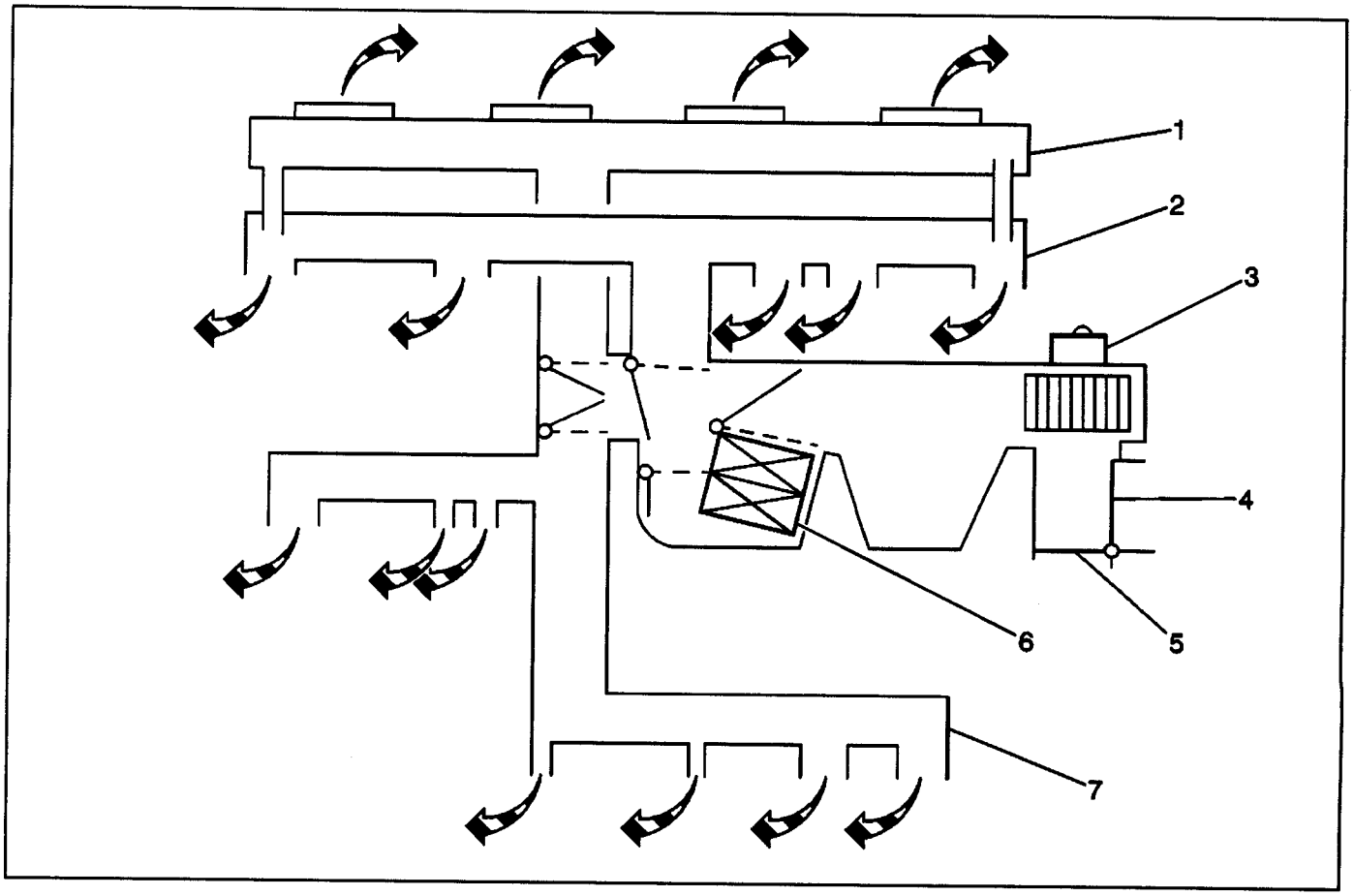
2. Install the right heater vent module.
3. Install the heater vent module nuts.
4. Install the blower motor electrical connectors.
5. Install the blower motor resistor electrical connectors.
6. Install the air conditioning evaporator. Refer to *Evaporator Core Replacement.*
7. Install the A/C Tempature Sensor connectors.
8. Connect the A/C Tempature Sensor connectors electrical connectors.
9. Install the A/C Tempature Sensor connectors screw.
10. Install the heater cores. Refer to *Heater Core Replacement (Right).*
11. Install the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
12. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



229927

Description and Operation

Heater System Description



229842

Hot coolant comes from the engine and is directed through the heater cores (6) and returned to the cooling system when the engine is running (under normal operating conditions).

The heater vent module contains components that heat the air flowing through. The heater vent module directes air to the proper ducts and outlets such as the distributor duct (upper) (1), the insturment panel outlets (2), and the floor vents (7).

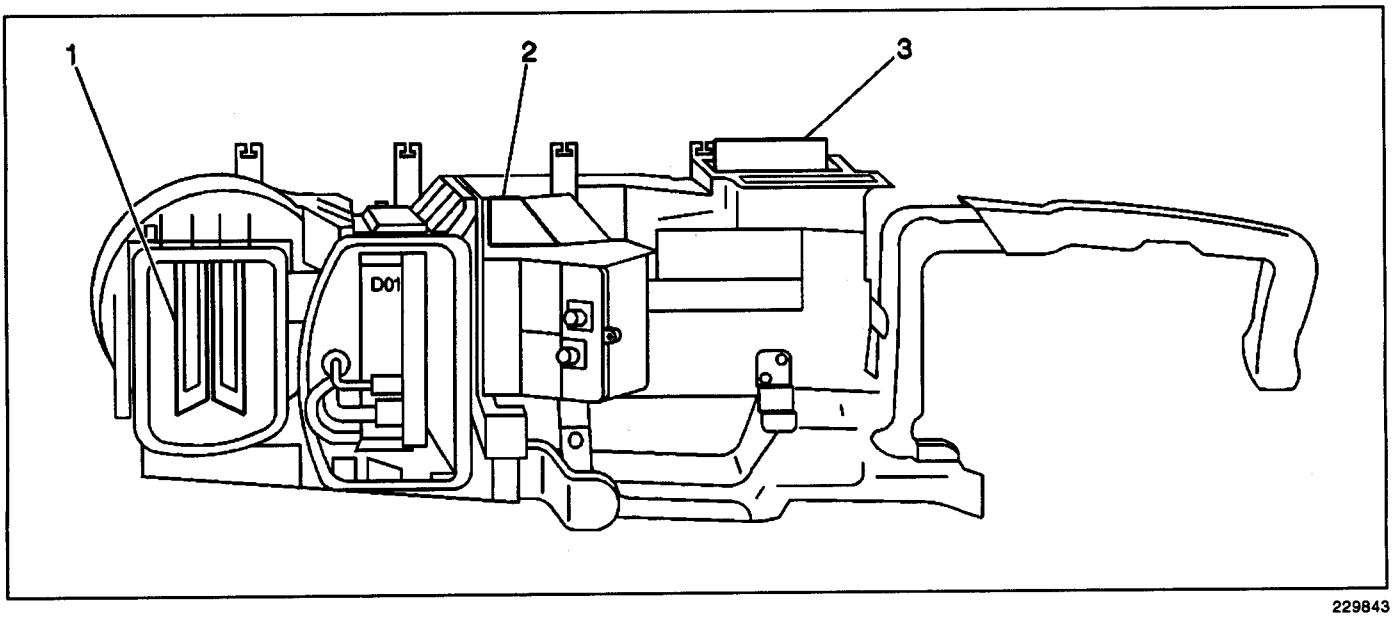
The heater system provides the following features:

- Heated ram air
- Power ventilation
- Windshield defrosting

Outside air is drawn from the plenum into the heater vent module by the blower motor fan (3). Additional outside air (called ram air) is forced into the heater vent module by the forward movement of the vehicle and goes to the outside air inlet (5). Within the heater vent module, the air is heated as required, then routes through ducts to the proper outlets for discharge into the passenger compartment. A control assembly in the instrument panel allows the operator to control the following conditions:

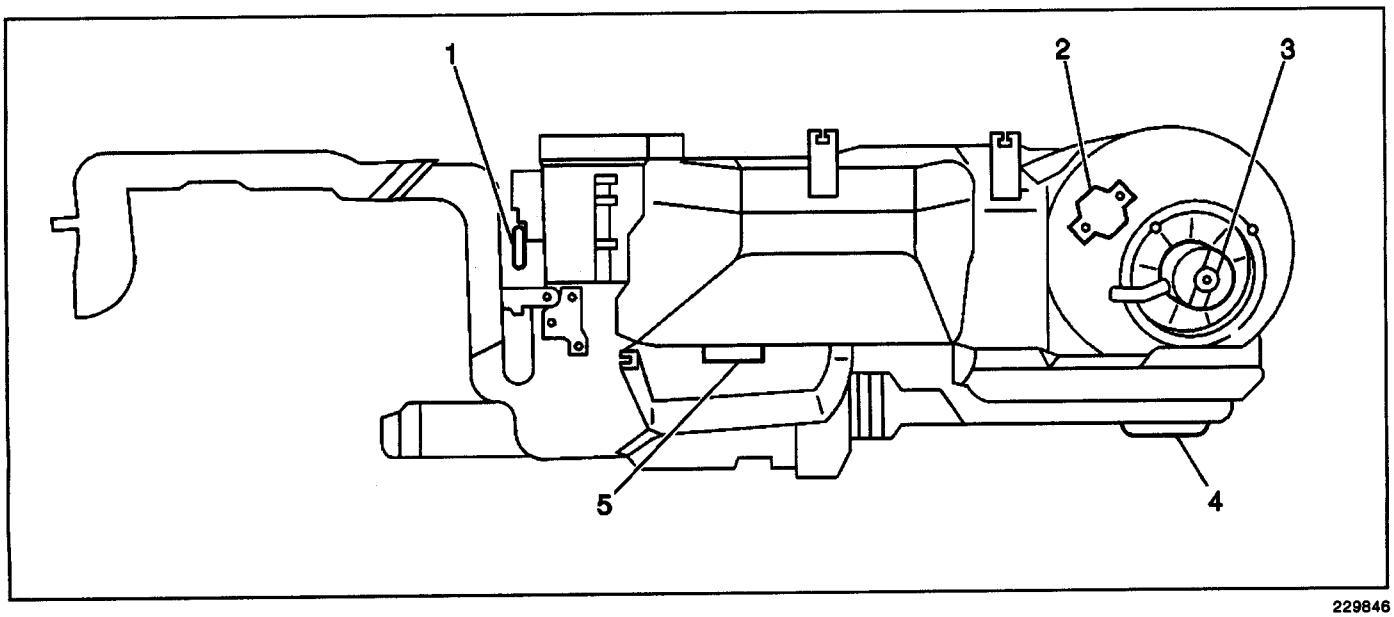
- Blower speed
- Mode of operation
- Temperature of the air coming from the heater system

Air Distribution System Description



229843

Within the heater vent module is a series of air doors the inlet air door (1), the temperature actuator door (2), and the mode actuator door (3). These air doors are hinged parts that direct the airflow through the various sections of the heater vent module in order to provide the proper airflow for the selected operating mode.



229846

Each air door is controlled by an actuator either the mode actuator (1), the inlet air actuator (4) or the temperature actuator door (5).

Heater Blower Controls Circuit Description

Blower Motor

The blower motor controls operate by supplying ground to the motor through the blower speed switch contacts through the blower resistor. Battery voltage is available to the blower relay coil from Circuit Breaker #6 when the ignition switch is in the RUN position through the BRN (198) wire. Relay contact power is provided by Circuit Breaker #24 for the operation of the blower motor any time the ignition is in the RUN position. Motor speed is controlled by routing the blower motor ground through dropping resistors. The blower motor speed switch supplies ground through one of the resistors for all speeds but HIGH.

With the blower motor switch in the LO position, voltage is applied from the switch contacts through the BLU/WHT (180,196) wire to the blower motor resistor. The blower motor current flows through all three resistors in this switch position. The grounding is provided through the switch common terminal through the HVAC controller module. Current flow is established at which point the blower motor operates. Voltage drop through the three resistors in the blower motor resistor limits motor operation to its lowest speed.

With the blower motor switch in the MED LO position, voltage is applied to the blower motor resistor through the BLU/BLK (181, 195) wire. Current flows through only two resistors to get to the motor. The motor operates at a faster speed than through all three resistors.

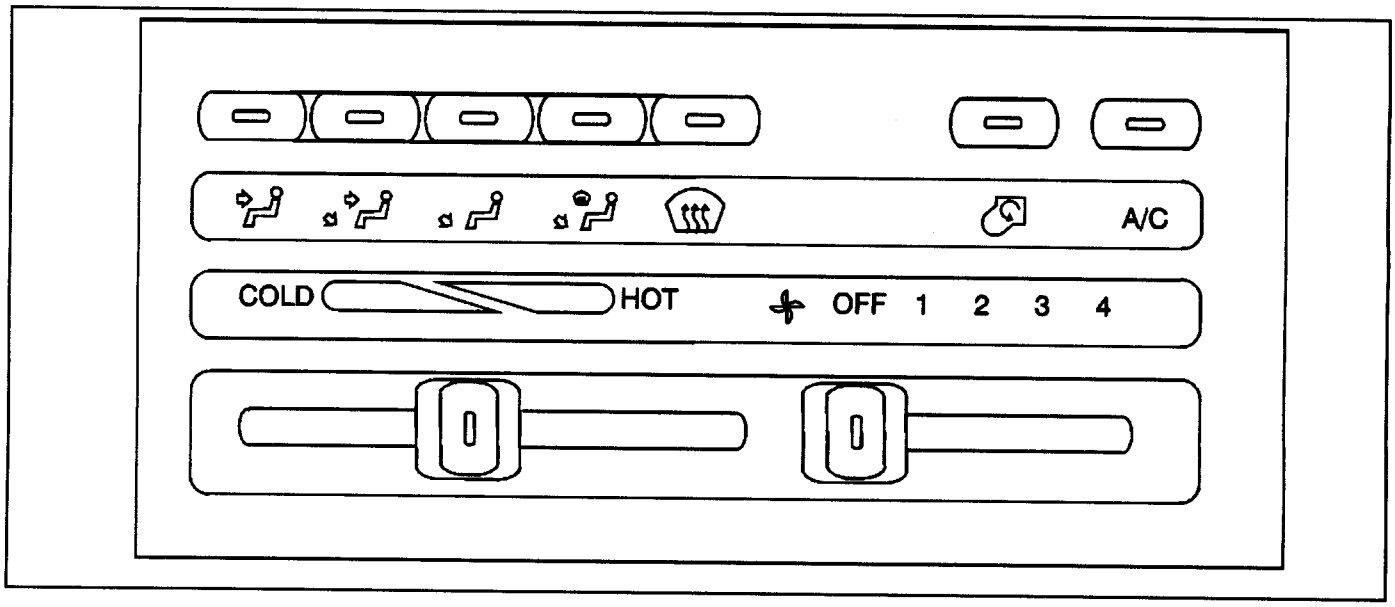
With the blower motor switch in the MED HI position, voltage is applied to the blower motor resistor through the BLU/YEL (182/194) wire. Current flows through only one resister to get to the motor. With the increased voltage at the motor, the motor operates at a still faster speed.

With the blower motor switch in the HI position, voltage is applied directly to the blower motor through the BLU/RED (183/192) wire. Current flows directly to the motor. With the maximum voltage at the motor, the motor operates at the fastest speed.

HVAC Temperature Actuator

The HVAC temperature actuator controls the amount of engine coolant available to the heater core. The operator heat selection lever position is translated into an electric signal. The temperature actuator controls a motor operated valve in the engine coolant line. The valve is driven open in order to provide more heat energy (or closed for less heat) in response to the operator temperature selection.

Modes Description



229857

The control assembly in the instrument panel contains the following components:

- A blower switch
- Mode switches
- A temperature lever

The controls are lit when the headlamps are on. Electrical power is provided by the control panel lighting circuit from the control panel harness.

The mode control switches allow the driver to control the direction and quantity of air through different outlets.

Brightness of the illumination is controlled by the instrument panel dimmer switch. The control assembly bulbs are in parallel with the radio bulb and the instrument cluster illumination bulbs.

Fan Control Switch

Air quantity is controlled by the four-position blower fan (4) control switch. The blower fan control switch provides a choice of various blower motor speeds.

Temperature Lever

When the temperature lever (5) is in the COLD or extreme left end of the slot, all of the air delivered by the heater system is unheated. The temperature actuator and the temperature control door are positioned to stop all of the airflow through the heater cores so only unheated air is sent up in the heater module.

When the temperature lever is in the HOT or extreme right end of the slot, almost all of the air delivered by the system is heated. The temperature actuator and the temperature control door is positioned to open so that all of the airflow through the heater cores is sent up in the heater vent module.

Intermediate positions of the temperature lever result in a mixture of heated and unheated air to provide more moderate air temperatures. This lever operates the temperature actuator. As a result, this lever moves the temperature control door.

Vent Mode

With the vent switch (6) in the ON position, the inlet air actuator is activated. This causes the recirculating/fresh air door to open completely and air is discharged from the upper air outlets. As a result, the air coming from the upper air outlets should be nearly the same temperature as the outside air.

Bi-Level Mode

With the Bi-Level switch (7) in the ON position, the mode actuator is activated. This causes the mode control door to open halfway. The airflow is divided between the upper air outlets and the floor air outlets.

Floor Mode

With the Floor switch (8) in the ON position, the mode actuator is activated. This causes the mode control door to open completely. The majority of airflow is routed to the floor while the remaining airflow is routed to the windshield outlets.

Floor/Defrost Mode

With the Floor / Defrost switch (9) in the ON position, the mode actuator is activated. This causes the mode control door to open halfway. Half of the airflow is delivered to the floor while the other half is delivered to the windshield outlets.

Defrost Mode

With the Defrost switch (1) in the ON position, the mode actuator is activated. This causes the mode control door to open completely. The majority of the airflow is routed to the windshield outlets while the remaining airflow is routed to the floor.

Max/Rec/Rc Mode

With the Max /Rec/ Rc switch (2) in the ON position, the air inlet actuator is activated. This causes the air inlet door to close completely, causing very little outside air (that is needed for the outside air system) from coming in. The majority of airflow is not outside air. The air is recirculated throughout the cab.

A/C Mode

With the A/C switch (3) in the ON Position, the air conditioning will work.

BLANK

HVAC Systems with A/C - Manual

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Compressor Hose Block Fitting Bolt	35 N.m	26 lb ft
Compressor Mounting Bracket Bolt	39 N.m	29 lb ft
Condenser Brace Lower Nut	70 N.m	51 lb ft
Condenser Insulator Bracket Nut	24 N.m	18 lb ft
Condenser Insulator Nut	35 N.m	26 lb ft
Condenser Tube to Receiver/Dryer or Dehydrator Fitting	15 N.m	11 lb ft
Evaporator High Pressure Hose Fitting at Condenser	18 N.m	14 lb ft
Evaporator Hose Bracket Nut	30 N.m	22 lb ft
Evaporator Hose Clamp Nut	30 N.m	22 lb ft
Evaporator Low Pressure Hose Fitting at Evaporator	32 N.m	24 lb ft
Expansion Valve Fitting	20 N.m	15 lb ft
Expansion Valve Low Pressure Fitting	15 N.m	11 lb ft
Fan Drive Support Assembly Nut	45 N.m	33 lb ft
Refrigerant Hose Clamp Nut	30 N.m	22 lb ft
Refrigerant Hose Fitting at Condenser	23 N.m	17 lb ft
Refrigerant Hose Fitting at Evaporator	32 N.m	24 lb ft
Armature Bolt	13 N.m	113 lb in
Field Coil Screw	5 N.m	44 lb in

Compressor Specifications

Compressor Information	Data
Armature Clearance	0.3 – 0.6 mm (0.01 – 0.02 in)
Compressor Model	7 Zexel DKS-17CH
Cylinder Type	6 Cylinder Axial
Rotation	Clockwise
Oil	R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil

System Capacities

Application	Specification	
	Metric	English
Refrigerant-134a	0.9072 kg	2.0 lb

Refrigerant Oil Distribution Specifications

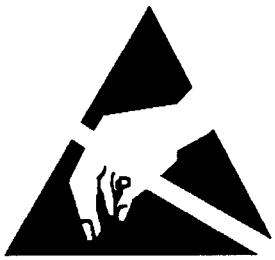
Application	Specification	
	Metric	English
R134-a Swash Plate P/N AIPDN 2-90188-300-0 Refrigerant Oil		
Zexel DKS-17CH Compressor	196 ml	6.6 fl oz
Evaporator	50.2 ml	1.7 fl oz
Condenser	29.6 ml	1.0 fl oz
Receiver/Dryer Dehydrator	8.9 ml	0.3 fl oz
Refrigerant Hose	8.9 ml	0.3 fl oz

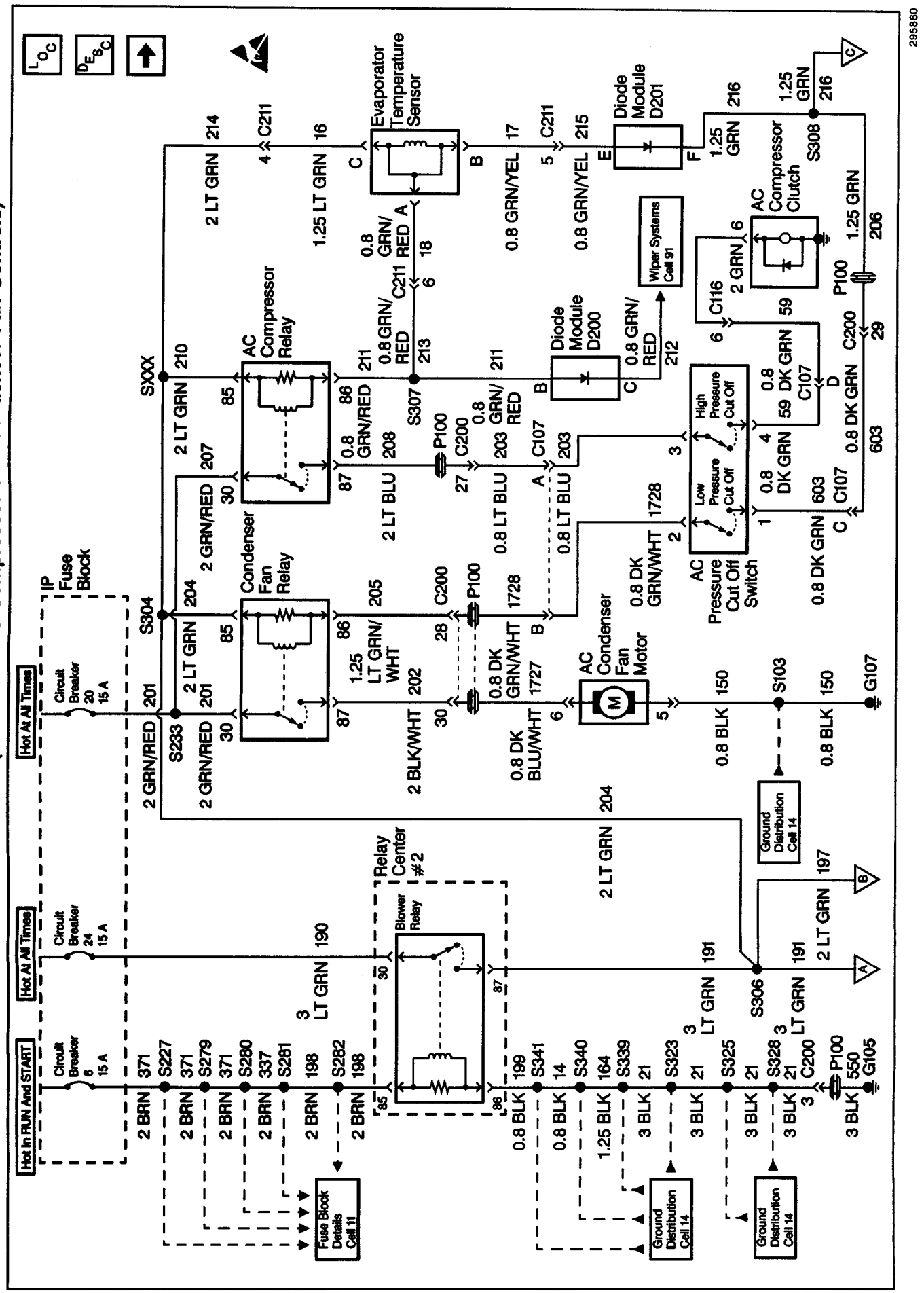
Schematic and Routing Diagrams

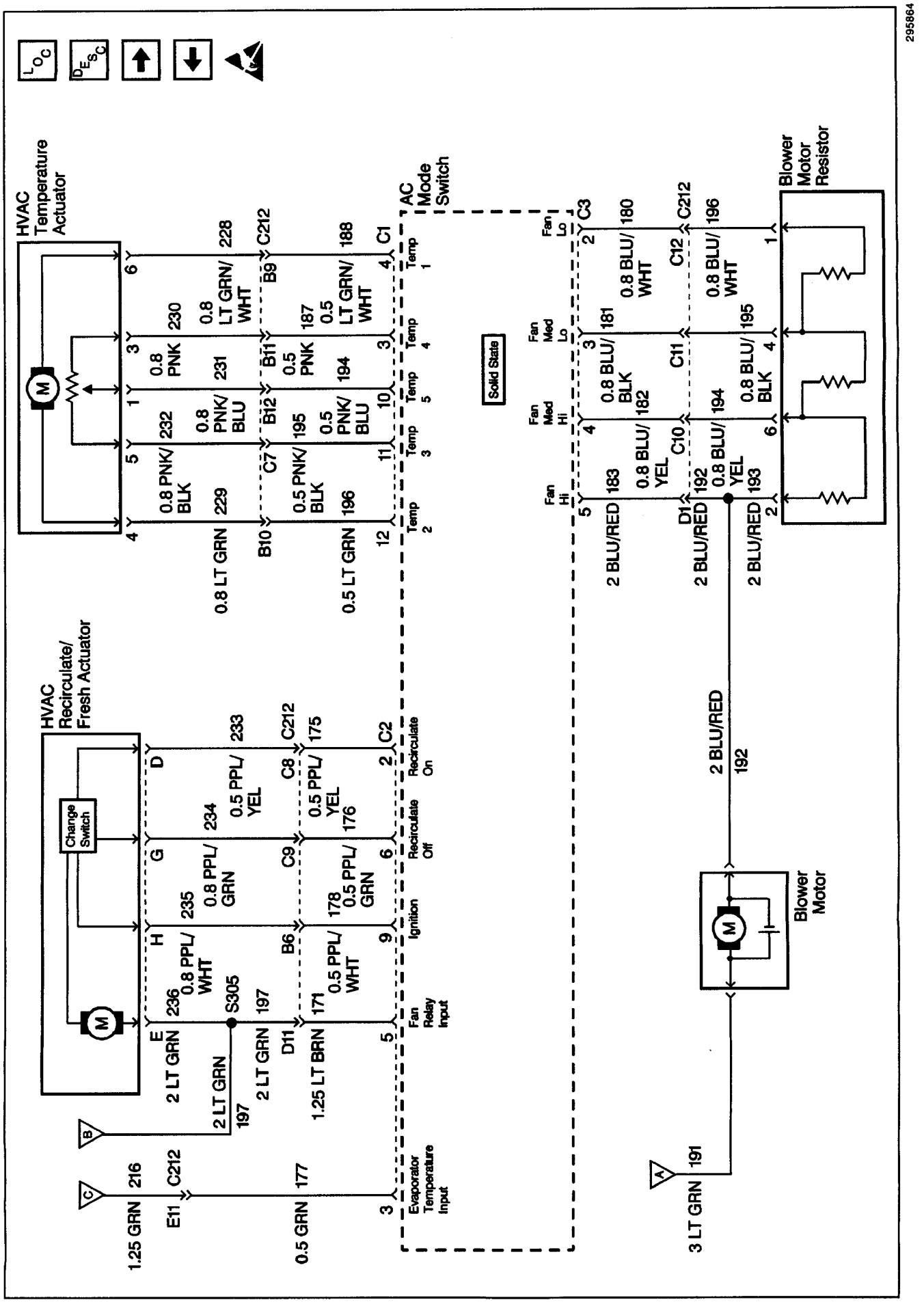
HVAC Schematic References

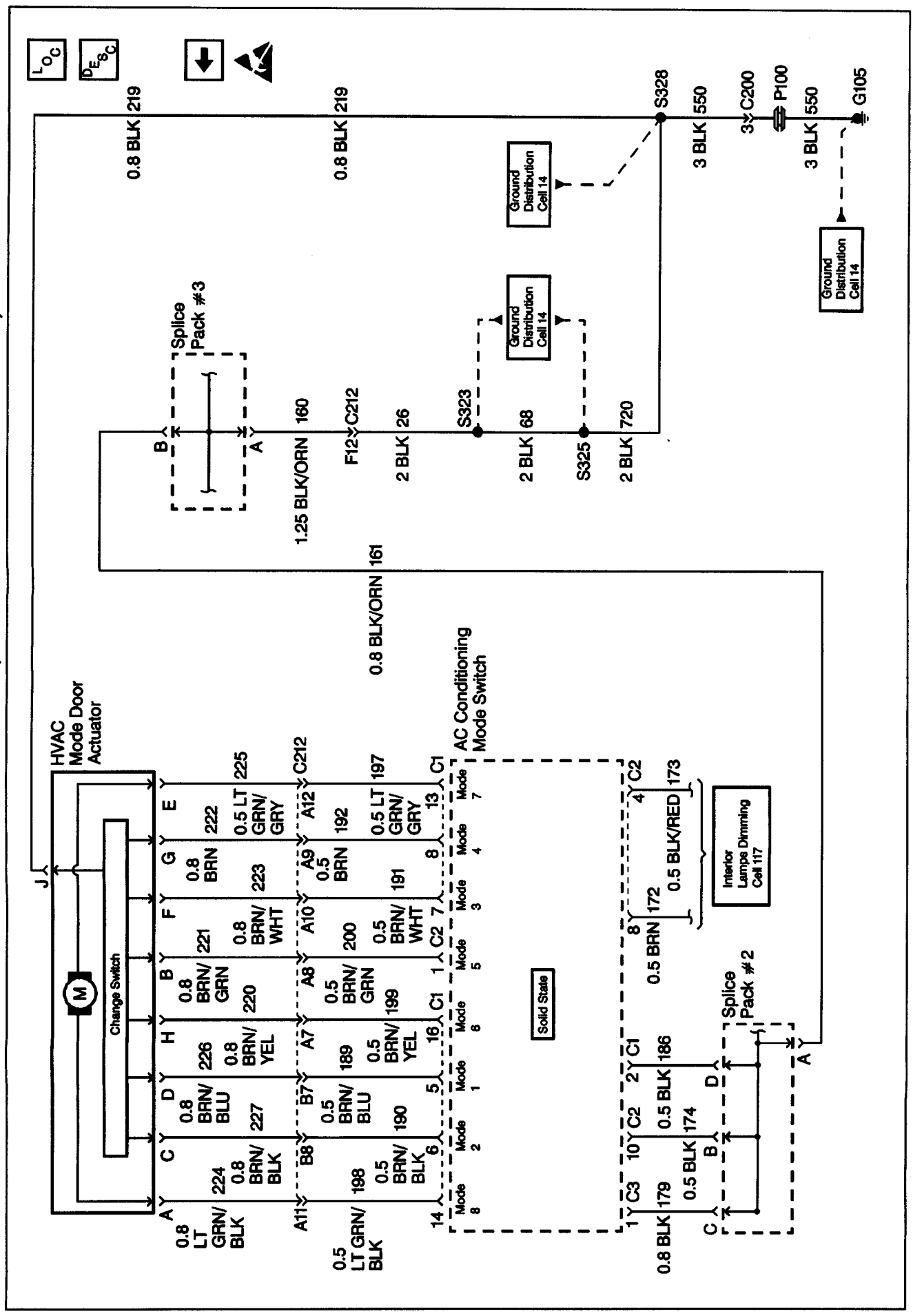
Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Interior Lamps Dimming Cell 117	8—Lighting Systems
Wiper/Washer: Pulse Cell 91	8—Wiper/Washer Systems

HVAC Schematic Icons

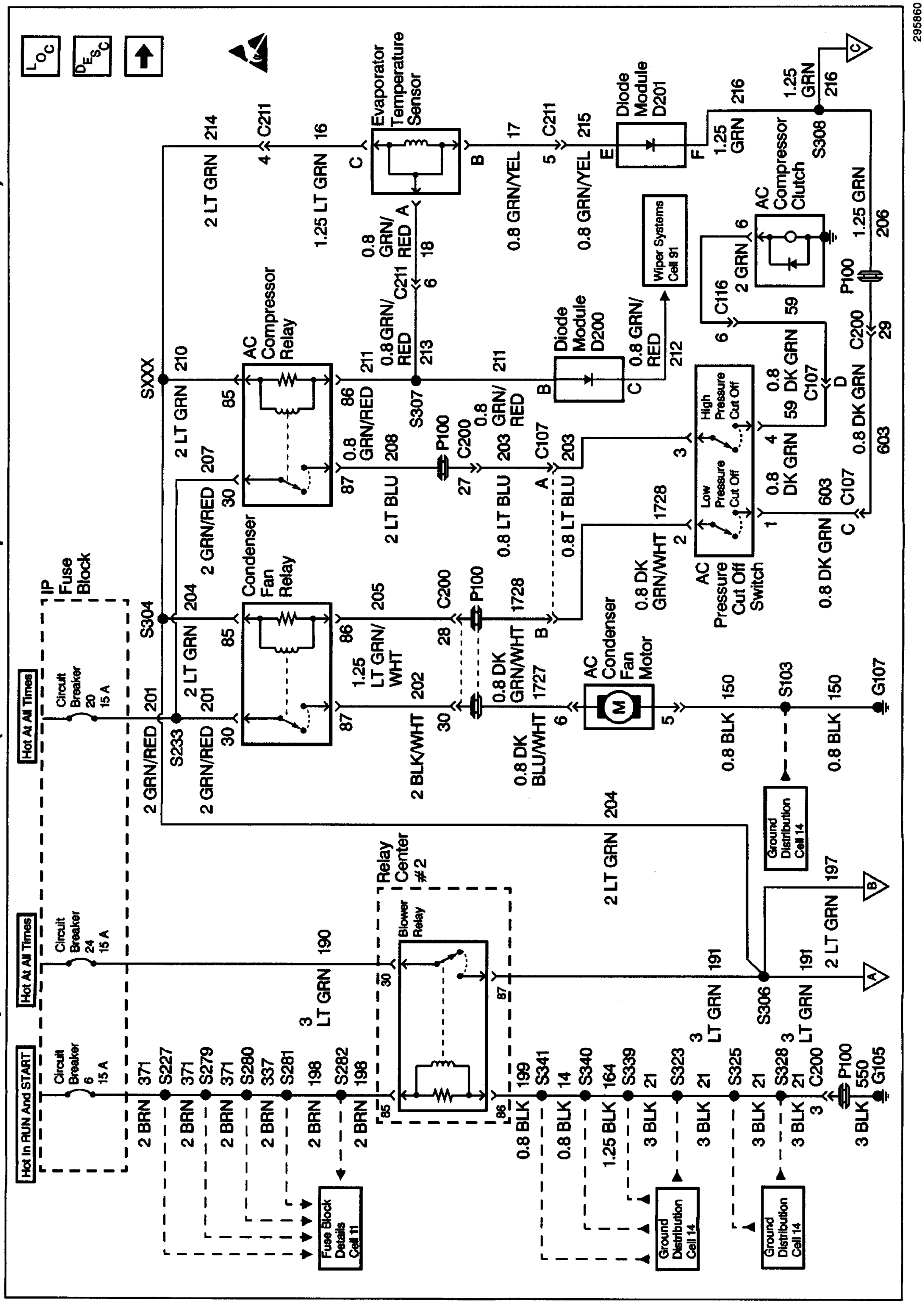
Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.

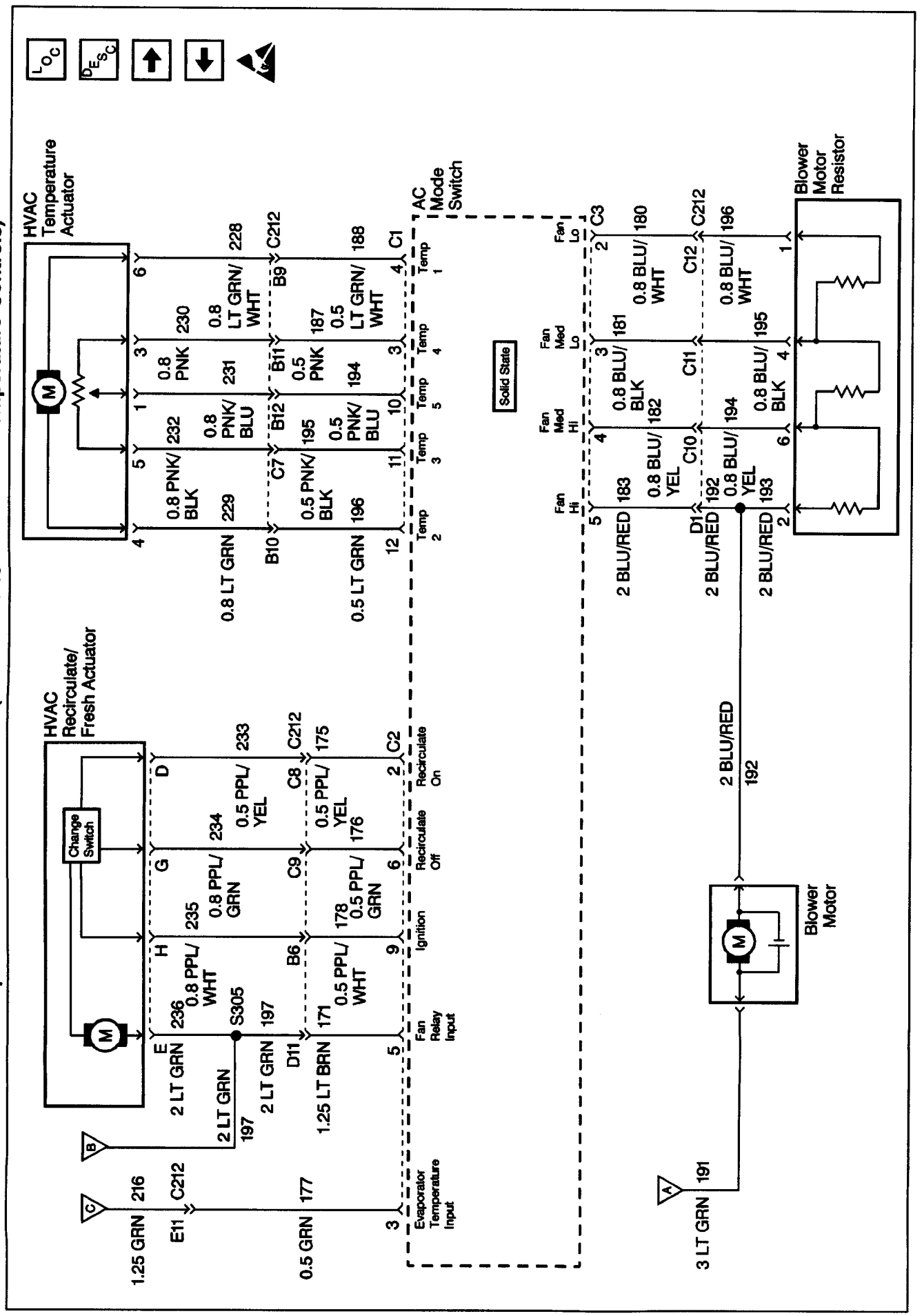

HVAC Blower Control Schematics (Cell 63: HVAC Compressor and Condenser Fan Controls)
295860
Hot In RUN And START
Hot At All Times
Circuit Breaker 6 15 A
Circuit Breaker 24 15 A
Circuit Breaker 20 15 A
IP Fuse Block
Relay Center #2
Blower Relay
Condenser Fan Relay
AC Compressor Relay
Evaporator Temperature Sensor
Diode Module D200
Diode Module D201
AC Condenser Fan Motor
AC Pressure Cut Off Switch
Low Pressure Cut Off
High Pressure Cut Off
AC Compressor Clutch
Wiper Systems Cell 91
Fuse Block Details Cell 11
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
2 BRN 371 S227
2 BRN 371 S279
2 BRN 371 S280
2 BRN 337 S281
2 BRN 198 S282
3 LT GRN 190
2 BRN 198
0.8 BLK 199 S341
0.8 BLK 14 S340
1.25 BLK 164 S339
3 BLK 21 S323
3 LT GRN 191
3 BLK 21 S325
3 BLK 21 S328
3 LT GRN 191 S306
3 BLK 21 C200
3 LT GRN 191
3 BLK P100 550 G105
2 LT GRN 197
2 LT GRN 204
2 GRN/RED 201 S233
2 GRN/RED 30
2 LT GRN 201
2 GRN/RED 204
2 LT GRN 207
2 LT GRN 214
4 C211 16
1.25 LT GRN
C Evaporator Temperature Sensor B
0.8 GRN/YEL 17
5 C211 215
E Diode Module D201 F
1.25 GRN 216
1.25 GRN 216 S308
C
SXXX 210
2 LT GRN
85 AC Compressor Relay 86
211 0.8 GRN/RED
87 0.8 GRN/RED 208
2 LT BLU
S307 213
0.8 GRN/RED
6 C211 A 18
0.8 GRN/RED
211
B Diode Module D200 C
0.8 GRN/RED 212
Wiper Systems Cell 91
6 C116 2 GRN 6
AC Compressor Clutch
1.25 GRN 206
P100 1.25 GRN
C200 29
59 0.8 DK GRN C107 D
0.8 DK GRN 603
C C107 0.8 DK GRN 603
S304
85 Condenser Fan Relay 86
205 1.25 LT GRN/WHT
87 1.25 LT GRN/WHT 202
2 BLK/WHT
C200 28
P100 30
0.8 DK GRN/WHT 1727
0.8 LT BLU 1728
B
0.8 DK BLU/WHT
6 AC Condenser Fan Motor M 5
0.8 BLK 150
S103
0.8 BLK 150
G107
C200 27
P100 30
0.8 GRN/RED 203
C107 A
0.8 LT BLU 203
0.8 LT BLU
0.8 DK GRN/WHT 1728
2 AC Pressure Cut Off Switch 1
3 High Pressure Cut Off
Low Pressure Cut Off
4 0.8 DK GRN 59
1 0.8 DK GRN 603
C C107 0.8 DK GRN 603

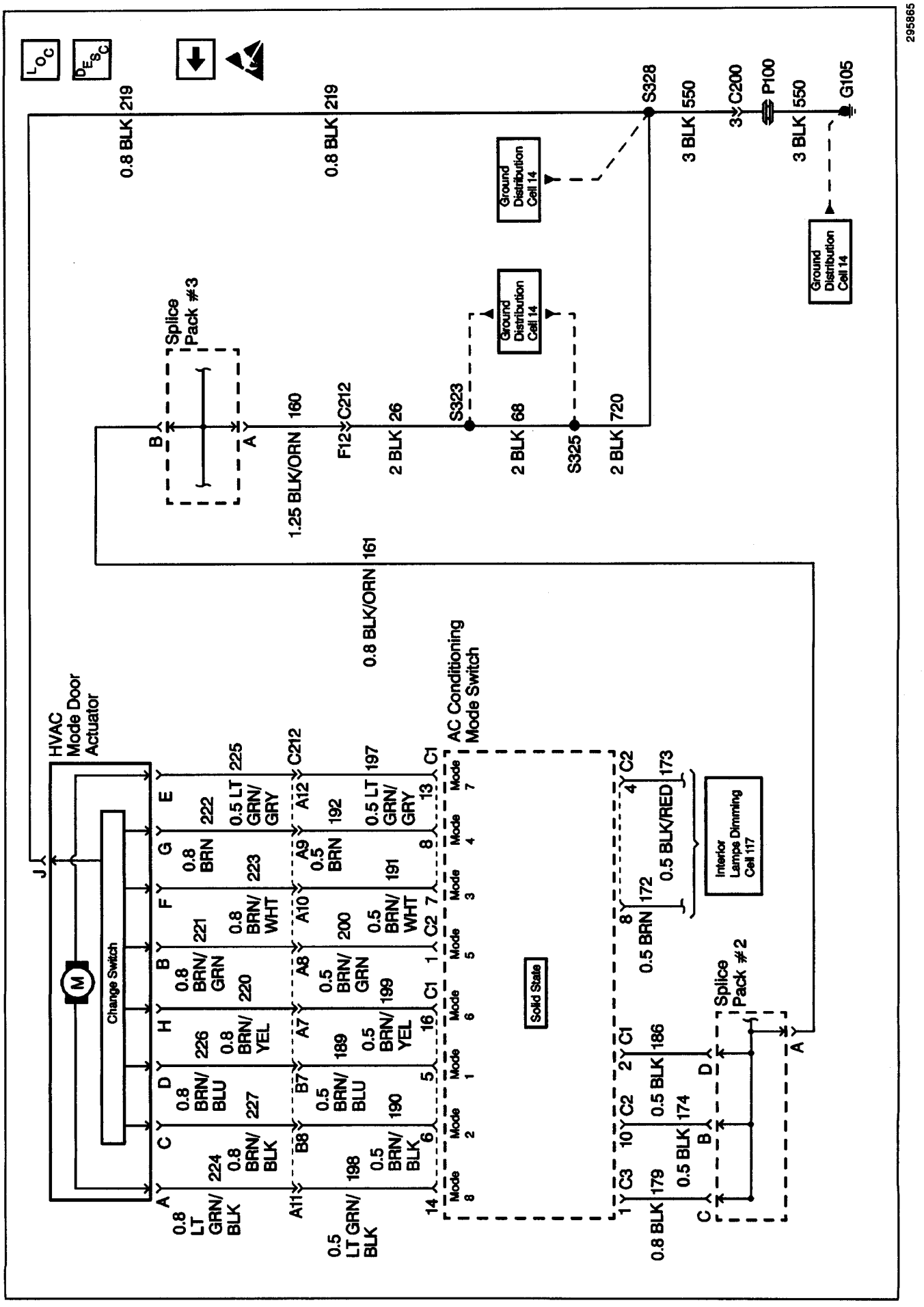

HVAC Blower Control Schematics (Cell 63: HVAC Blower and Temperature Controls)
295864
HVAC Temperature Actuator
HVAC Recirculate/ Fresh Actuator
Change Switch
AC Mode Switch
Solid State
Blower Motor Resistor
Blower Motor
Evaporator Temperature Input
Fan Relay Input
Ignition
Recirculate Off
Recirculate On
Fan Hi
Fan Med Hi
Fan Med Lo
Fan Lo
Temp 1
Temp 2
Temp 3
Temp 4
Temp 5
1.25 GRN 216 C212 E11
0.5 GRN 177
3 LT GRN 191 A
2 LT GRN 197
2 LT GRN 236 E
1.25 LT BRN 171 D11
0.8 PPL/ WHT 235 H
0.5 PPL/ WHT 178 9
0.8 PPL/ GRN 234 G
0.5 PPL/ GRN 6
0.5 PPL/ YEL 233 D
0.5 PPL/ YEL 176
C212 C8 C9 B6 S305 C2 2 5
0.8 LT GRN B10
0.5 LT GRN 12
0.8 PNK/ BLK 229 4
0.5 PNK/ BLK 196
0.8 PNK/ BLU 232 5
0.5 PNK/ BLU 195
0.8 PNK 231 1
0.5 PNK 194
0.8 LT GRN/ WHT 230 3
0.5 LT GRN/ WHT 187
C7 B12 B11 10 11
B9 C212 228 6
C1 188 4 3
2 BLU/RED 183 5
0.8 BLU/ BLK 182 4
0.8 BLU/ YEL 181 3
0.8 BLU/ WHT 180 2
C3
C10 C11 C12 C212
D1 2 BLU/RED 192
0.8 BLU/ YEL 194 6
0.8 BLU/ BLK 195 4
0.8 BLU/ WHT 196 1
2 BLU/RED 193 2
2 BLU/RED 192


HVAC Blower Control Schematics (Cell 64: HVAC Mode Door Actuator)
295865
HVAC Mode Door Actuator
Change Switch
AC Conditioning Mode Switch
Solid State
Interior Lamps Dimming Cell 117
Splice Pack #3
Splice Pack #2
Ground Distribution Cell 14
0.8 BLK 219
0.8 BLK/ORN 161
1.25 BLK/ORN 160
2 BLK 26
2 BLK 68
2 BLK 720
3 BLK 550
0.8 LT GRN/BLK
0.5 LT GRN/BLK
0.8 BRN/BLU
0.8 BRN/BLK
0.8 BRN/YEL
0.8 BRN/GRN
0.8 BRN/WHT
0.8 BRN
0.5 LT GRN/GRY
0.5 BRN/BLU
0.5 BRN/BLK
0.5 BRN/YEL
0.5 BRN/GRN
0.5 BRN/WHT
0.5 BRN
0.5 BLK/RED
0.5 BLK
S328
S323
S325
C200
P100
G105
C212
C1
C2
C3

HVAC Compressor Control Schematics (Cell 63: HVAC Compressor and Condenser Fan Controls)




HVAC Compressor Control Schematics (Cell 63: HVAC Blower and Temperature Controls)
295864
HVAC Temperature Actuator
HVAC Recirculate/ Fresh Actuator
Change Switch
AC Mode Switch
Solid State
Blower Motor
Blower Motor Resistor
Evaporator Temperature Input
Fan Relay Input
Ignition
Recirculate Off
Recirculate On
Temp 1
Temp 2
Temp 3
Temp 4
Temp 5
Fan Hi
Fan Med Hi
Fan Med Lo
Fan Lo
1.25 GRN
216
C212
E11
0.5 GRN
177
3 LT GRN
191
2 LT GRN
197
1.25 LT BRN
171
0.8 LT GRN
229
0.5 LT GRN
196
2 BLU/RED
192
2 BLU/RED
183
0.8 LT GRN/ WHT
228
0.5 LT GRN/ WHT
188
0.8 PNK/ BLK
0.8 PNK/ BLU
0.5 PNK/ BLK
0.5 PNK/ BLU
0.8 PPL/ WHT
0.5 PPL/ WHT
0.8 PPL/ GRN
0.5 PPL/ GRN
0.5 PPL/ YEL
0.8 BLU/ BLK
0.8 BLU/ YEL
0.8 BLU/ WHT
S305
B10
B12
B11
B9
C7
C8
C9
C10
C11
C12
C212
C1
C2
C3
D1
D11
B6


HVAC Compressor Control Schematics (Cell 64: HVAC Mode Door Actuator)
295865
HVAC Mode Door Actuator
Change Switch
AC Conditioning Mode Switch
Solid State
Interior Lamps Dimming Cell 117
Splice Pack #3
Splice Pack #2
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
0.8 BLK 219
0.8 BLK 219
3 BLK 550
3 BLK 550
S328
C200
P100
G105
1.25 BLK/ORN 160
2 BLK 26
2 BLK 68
2 BLK 720
F12
C212
S323
S325
0.8 BLK/ORN 161
0.8 LT GRN/BLK 224
0.8 BRN/BLK 198
0.8 BRN/BLU 227
0.5 BRN/BLU 190
0.8 BRN/YEL 226
0.5 BRN/YEL 189
0.8 BRN/GRN 220
0.5 BRN/GRN 199
0.8 BRN/WHT 221
0.5 BRN/WHT 200
0.8 BRN 223
0.5 BRN 191
0.8 BRN 222
0.5 LT GRN/GRY 192
0.5 LT GRN/GRY 197
0.5 BLK/RED 173
0.5 BRN 172
0.5 BLK 186
0.5 BLK 174
0.5 BLK 179
0.8 BLK 179
0.5 LT GRN/BLK
A11
B8
B7
A7
A8
A10
A9
A12
C1
C2
C3
J
M
Mode 1
Mode 2
Mode 3
Mode 4
Mode 5
Mode 6
Mode 7
Mode 8

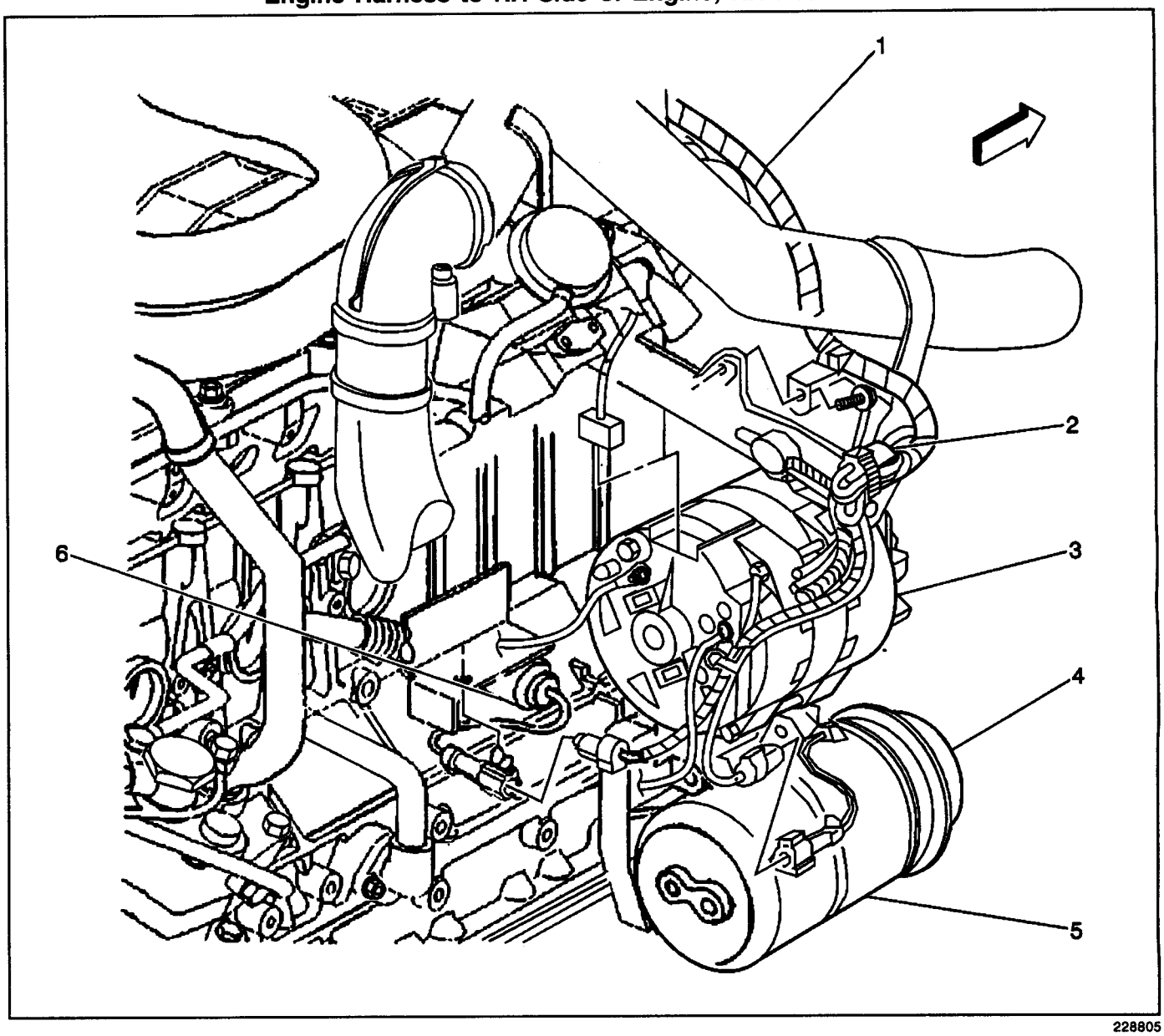
Component Locator

HVAC Components

Name	Location	Locator View	Connector End View
A/C Compressor	On the lower right front of the engine	*HVAC Component Views*	—
A/C Compressor Clutch	On the lower right front of the engine, on the front of the A/C compressor, behind the pulley, part of the A/C compressor	*HVAC Component Views*	*HVAC Connector End Views*
A/C Compressor Relay	In the center of the lower IP, behind the panel, in relay center 2	*HVAC Component Views*	—
A/C Condenser Fan Capacitor	On the upper left rear of the A/C condenser fan shroud, in the lower right front of the vehicle	*HVAC Component Views*	—
A/C Condenser Fan Motor	Behind the A/C condenser, in the lower right front of the vehicle	*HVAC Component Views*	*HVAC Connector End Views*
A/C Condenser Fan Relay	In the center of the lower IP, behind the panel, in relay center 1	*HVAC Component Views*	—
A/C Mode Switch (w/ A/C)	In the center of the IP, part of the HVAC controller	*HVAC Component Views*	—
A/C Pressure Cutoff Switch	In the right front of the vehicle, behind the front bumper, on the top of the A/C condenser receiver/dryer	*HVAC Component Views*	*HVAC Connector End Views*
A/C Temperature Sensor	In the A/C evaporator housing	*HVAC Component Views*	*HVAC Connector End Views*
A/C Temperature Switch	In the A/C evaporator housing	*HVAC Component Views*	*HVAC Connector End Views*
Blower Motor (w/ A/C)	Behind the lower right side of the IP	*HVAC Component Views*	*HVAC Connector End Views*
Blower Motor Resistor (w/ A/C)	In the lower right side of the IP, part of the blower motor assembly	*HVAC Component Views*	*HVAC Connector End Views*
Blower Relay (w/ A/C)	In the center of the lower IP, behind the panel, in relay center 2	*HVAC Component Views*	—
Blower Switch (w/ A/C)	In the center of the IP, part of the HVAC controller	*HVAC Component Views*	—
HVAC Air Temperature Actuator (w/ A/C)	Behind the lower right side of the IP, near the blower motor assembly	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Controller (w/ A/C)	In the center of the IP, above the radio	*HVAC Component Views*	—
HVAC Controller (w/ A/C) C1 (16 cavities)	In the upper IP harness to the HVAC controller	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Controller (w/ A/C) C2 (12 cavities)	In the upper IP harness to the HVAC controller	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Controller (w/ A/C) C3 (6 cavities)	In the upper IP harness to the HVAC controller	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Mode Door Actuator (w/ A/C)	Behind the lower right side of the IP, near the blower motor assembly	*HVAC Component Views*	*HVAC Connector End Views*
HVAC Recirculating/Fresh Air Actuator (w/ A/C)	Behind the lower right side of the IP, near the blower motor assembly	*HVAC Component Views*	*HVAC Connector End Views*

HVAC Component Views

Engine Harness to RH Side of Engine, RH Rear View

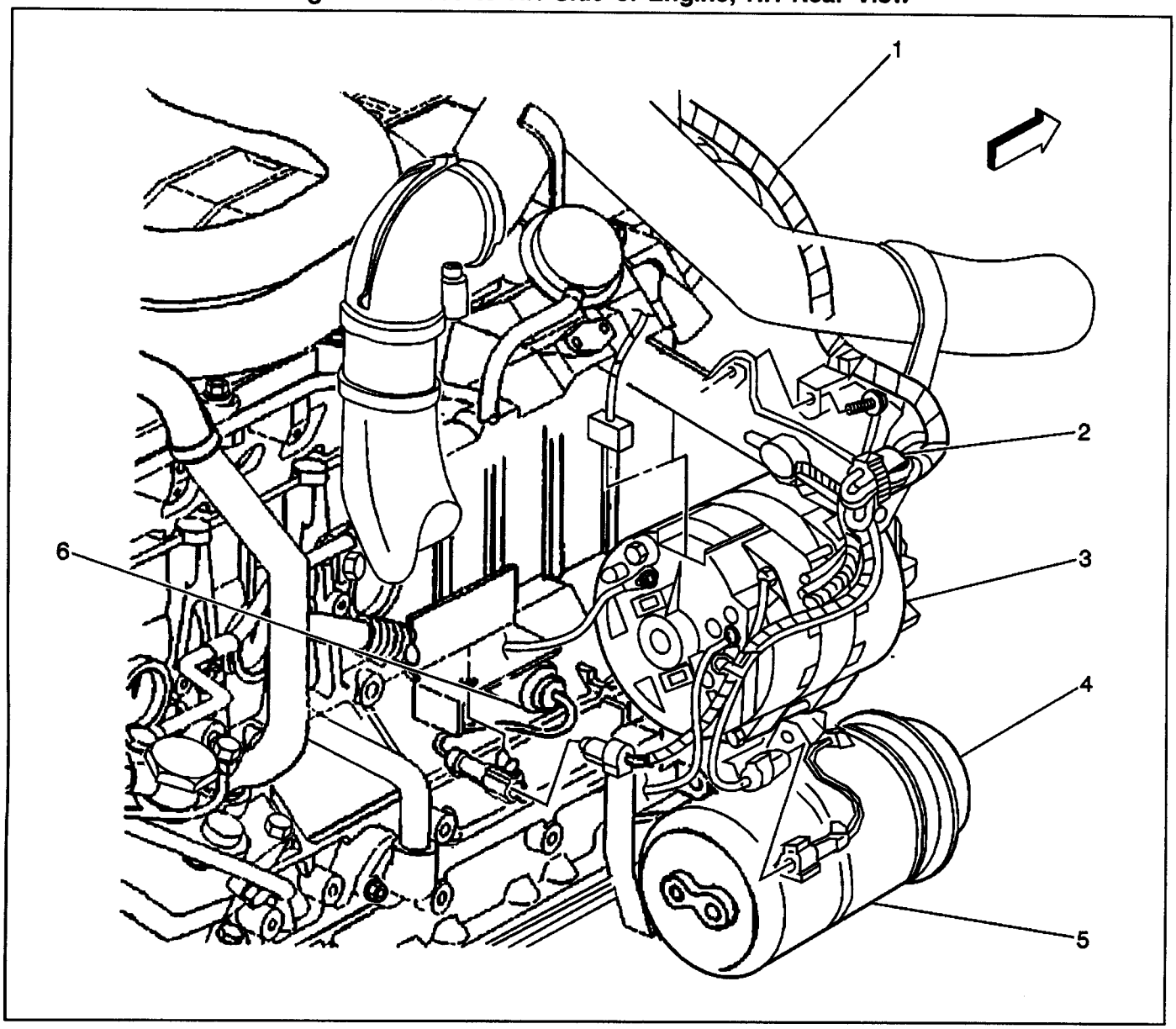


228805

Legend

(1) Engine Harness
(2) Generator Fuse
(3) Generator
(4) A/C Compressor Clutch
(5) A/C Compressor
(6) Engine Oil Pressure Gauge Sensor

Engine Harness to RH Side of Engine, RH Rear View

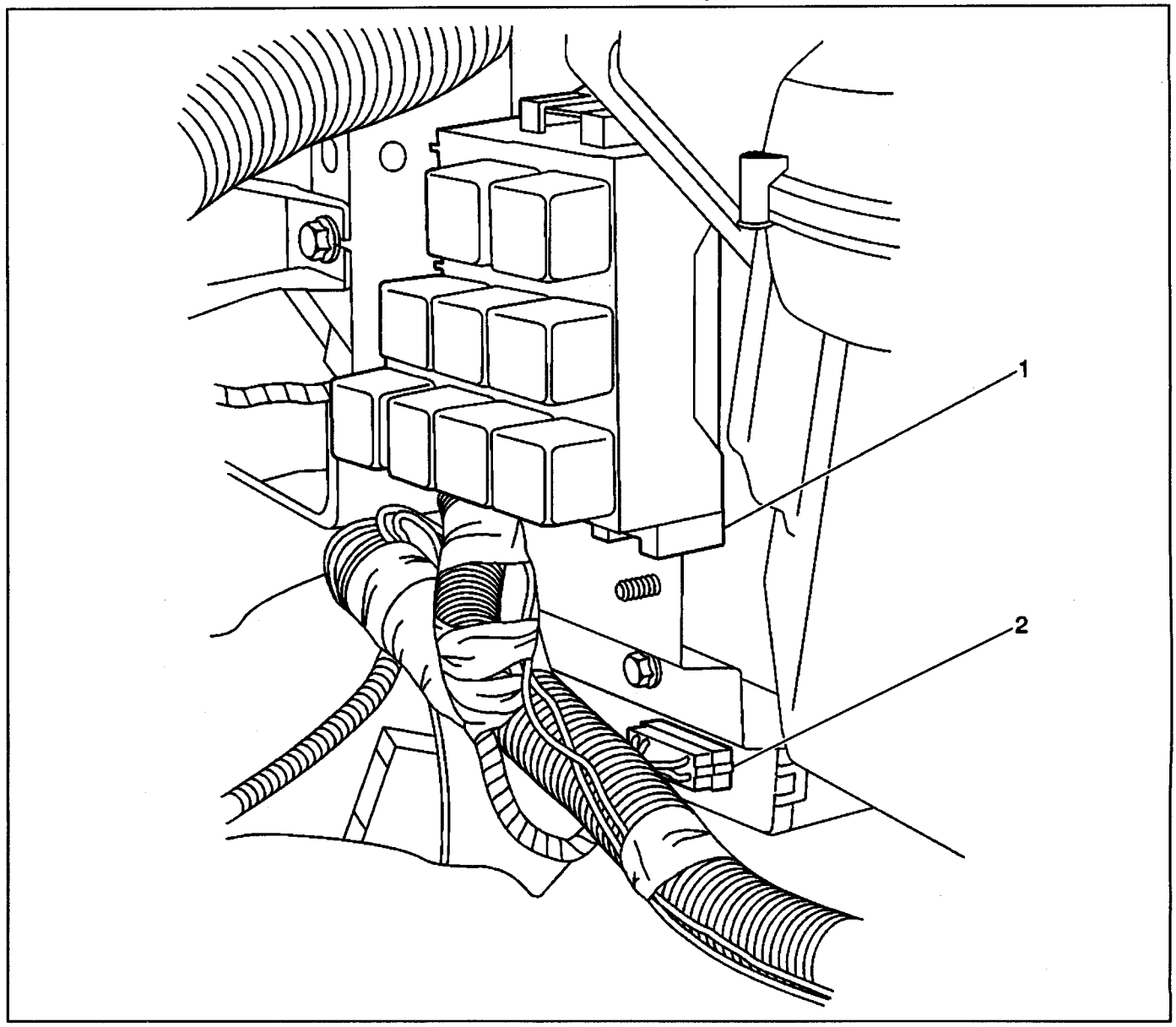


228805

Legend

(1) Engine Harness
(2) Generator Fuse
(3) Generator
(4) A/C Compressor Clutch
(5) A/C Compressor
(6) Engine Oil Pressure Gauge Sensor

Instrument Panel, Lower Right View

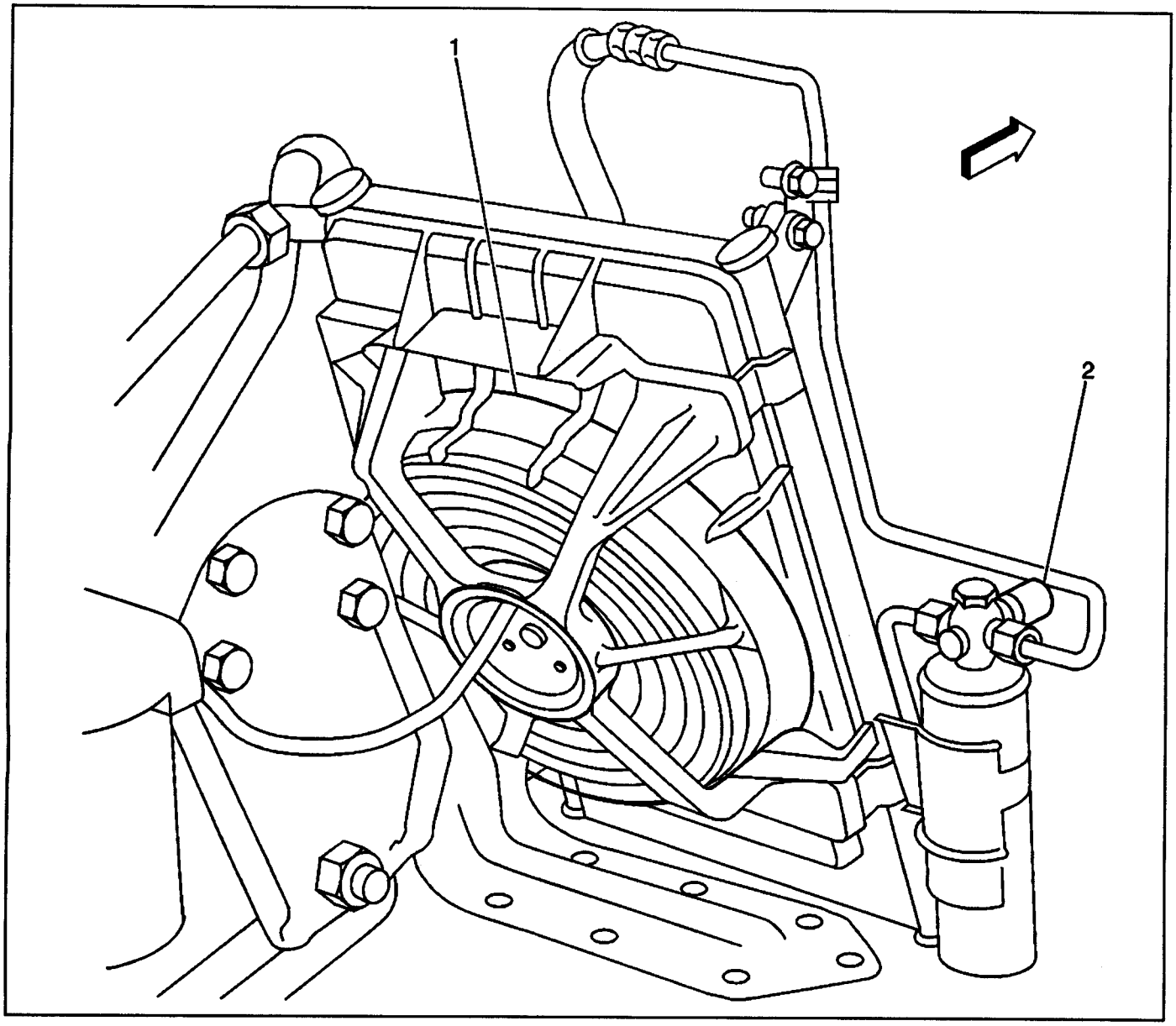


231681

Legend

(1) Relay Center 2
(2) Turn/Hazard Flasher Module

A/C Condenser

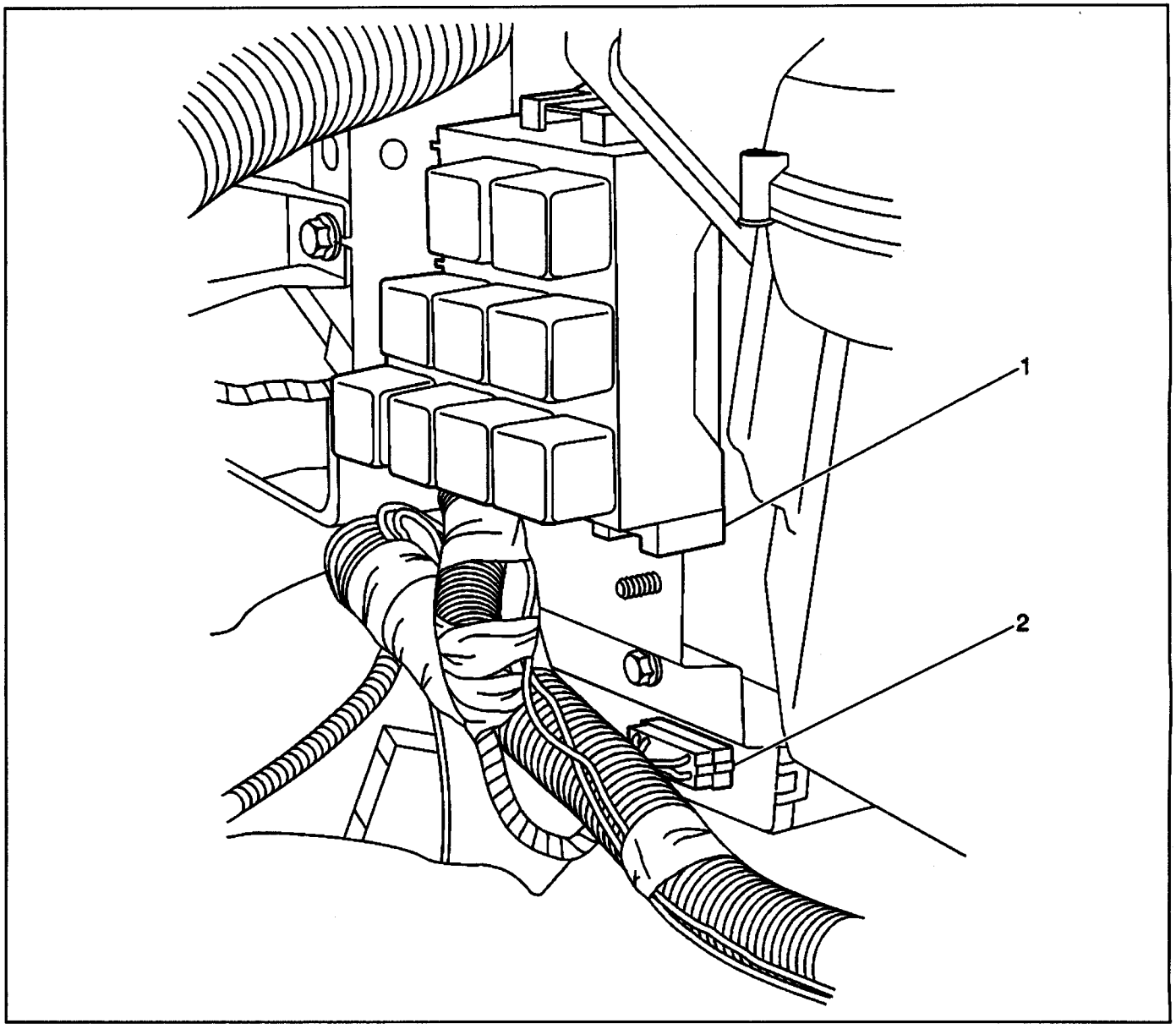


231530

Legend

(1) A/C Condenser Fan Motor
(2) A/C Pressure Cutoff Switch

Instrument Panel, Lower Right View

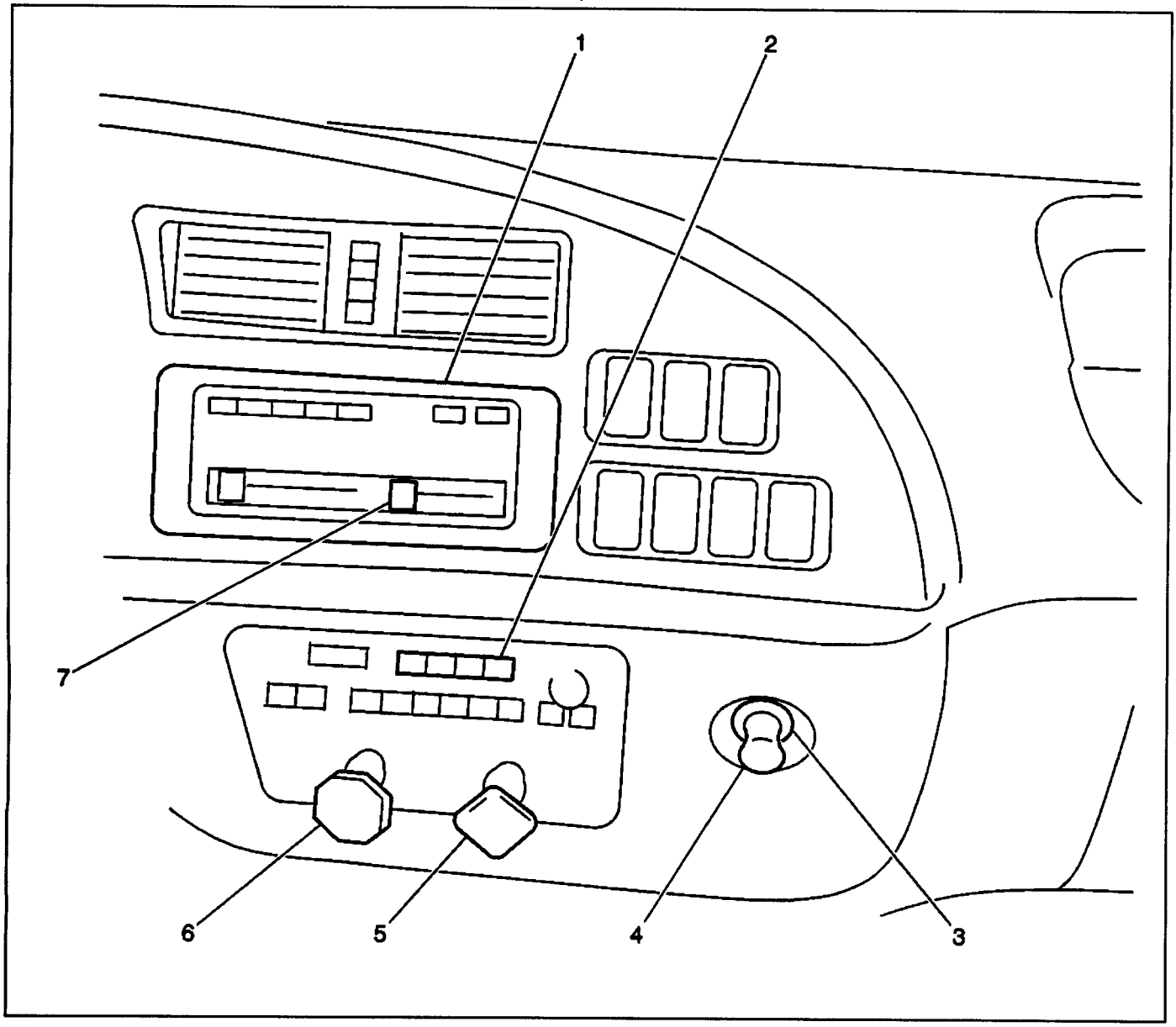


231681

Legend

(1) Relay Center 2
(2) Turn/Hazard Flasher Module

Instrument Panel, Left Forward View

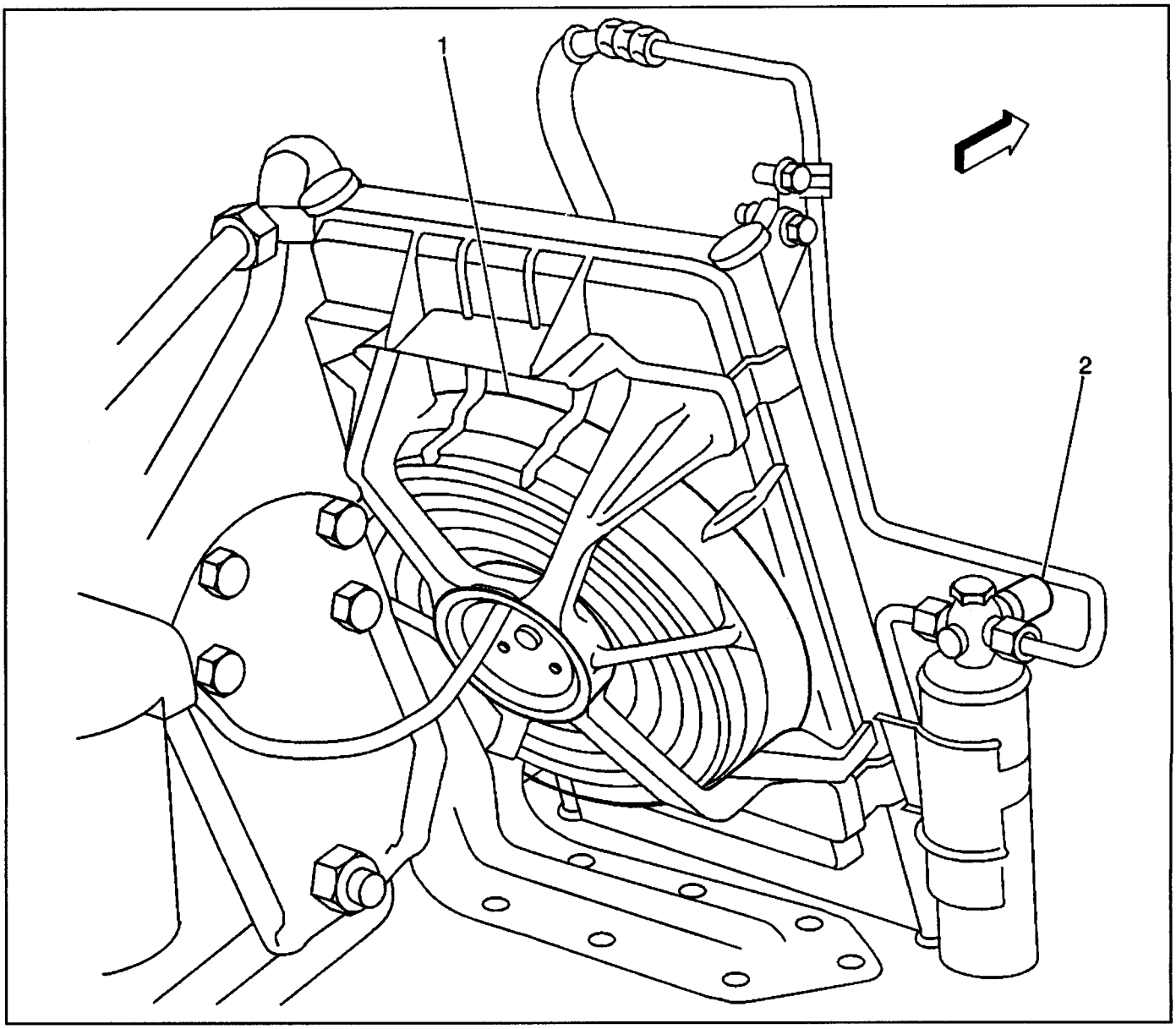


231675

Legend

(1) HVAC Controller
(2) Radio
(3) Cigar Lighter Lamp
(4) Cigar Lighter
(5) Park Brake Switch (ABS-Air)
(6) Trailer Stoplamps Switch (ABS-Air)
(7) Blower Switch (Part of HVAC Controller)

A/C Condenser

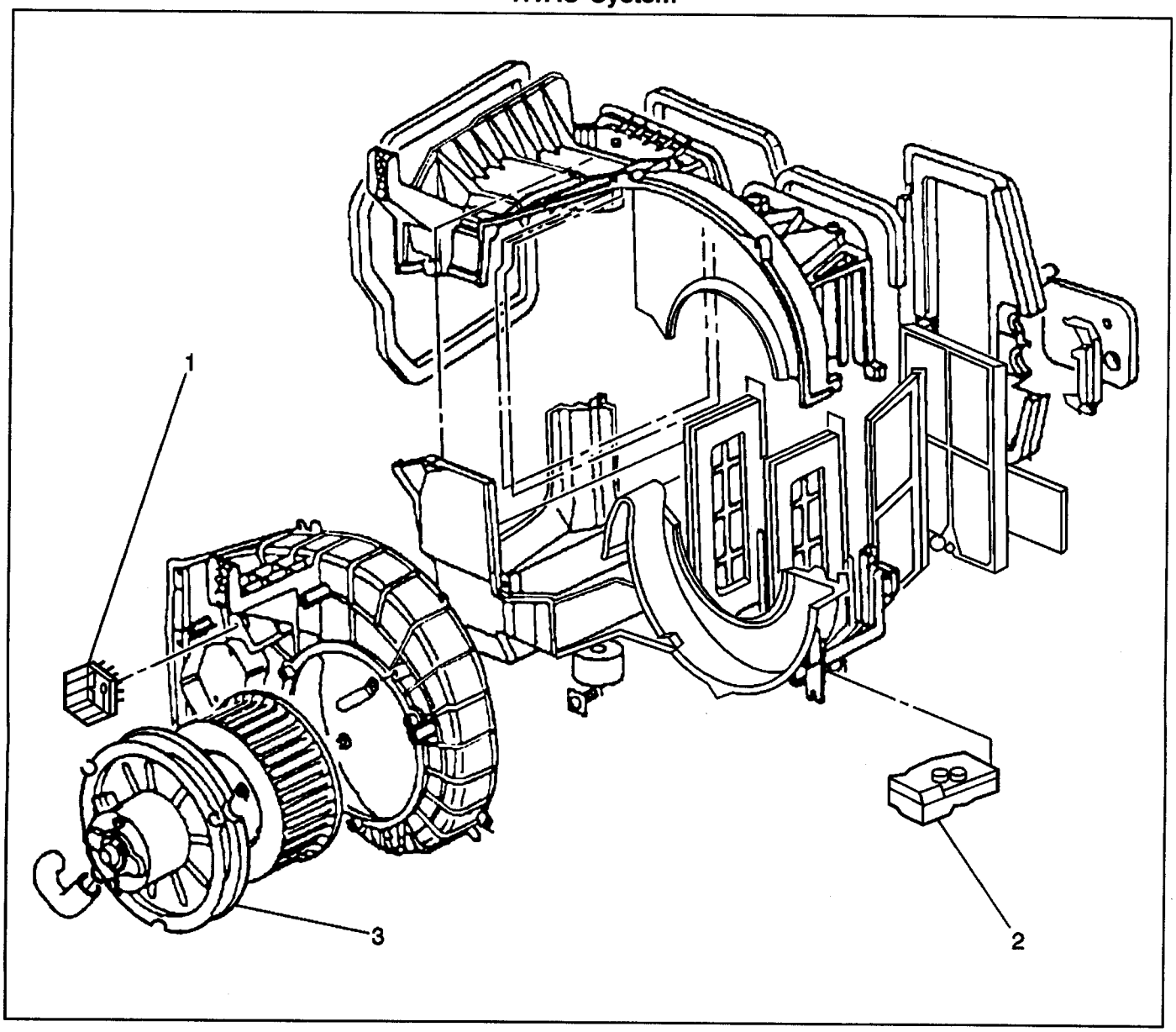


231530

Legend

(1) A/C Condenser Fan Motor
(2) A/C Pressure Cutoff Switch

HVAC System

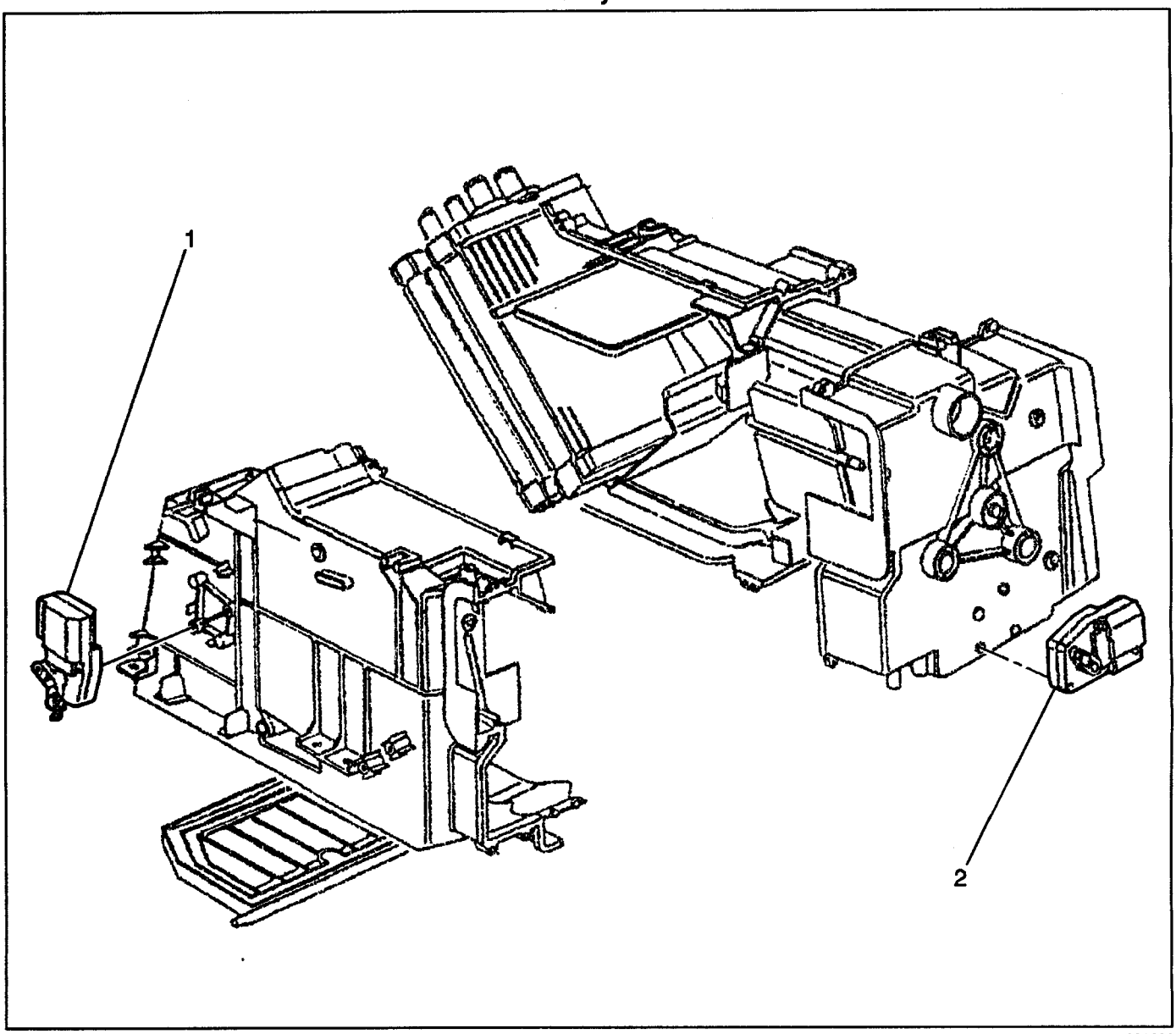


231683

Legend

(1) Blower Motor Resistor
(2) HVAC Recirculating/Fresh Air Actuator
(3) Blower Motor

HVAC System



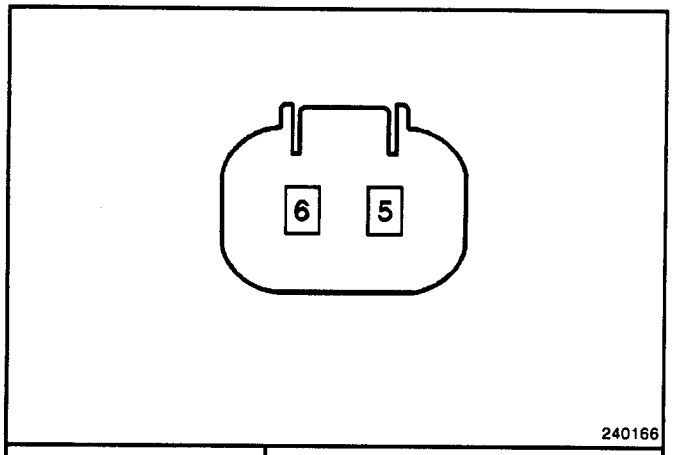
231686

Legend

(1) HVAC Mode Door Actuator
(2) HVAC Air Temperature Actuator

HVAC Connector End Views

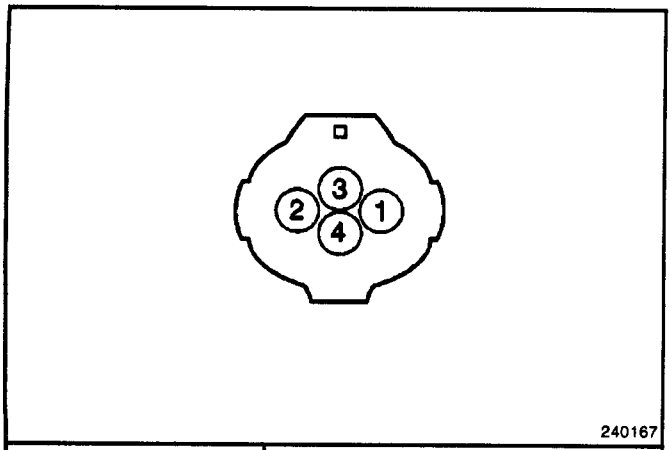
A/C Condensor Fan Motor



240166

Connector Part Information	• 12162890 • ASM 2F (Black)		
Pin	**Wire Color**	**Circuit No.**	**Function**
5	DK GRN	59	Air Conditioning Compressor Clutch Solenoid Feed
6	BLK	150	Ground

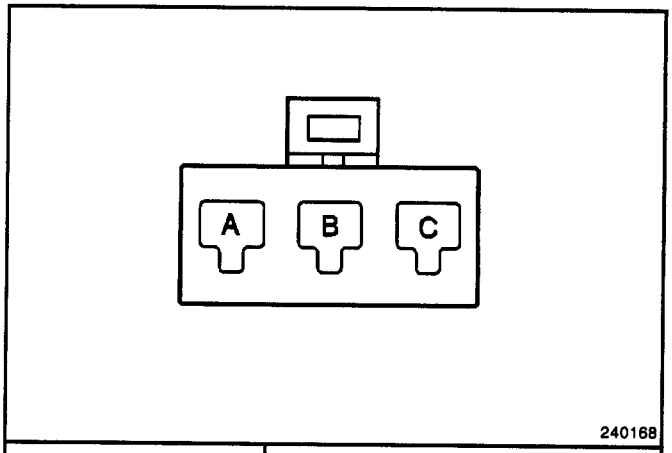
A/C Refridgerant Pressure Switch



240167

Connector Part Information	• 12162929 • ASM 4F 090 SLD (Natural)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	DK GRN	603	Air Conditioning Refrigerant Low Pressure Cut Out Switch Output
2	DK GRN/WHT	1728	Air Conditioning Condenser Relay Output Coil
3	LT BLU	203	Air Conditioning Refrigerant High Pressure Cut Out Switch Feed
4	LT GRN/BLK	59	Air Conditioning Compressor Clutch Solenoid Feed

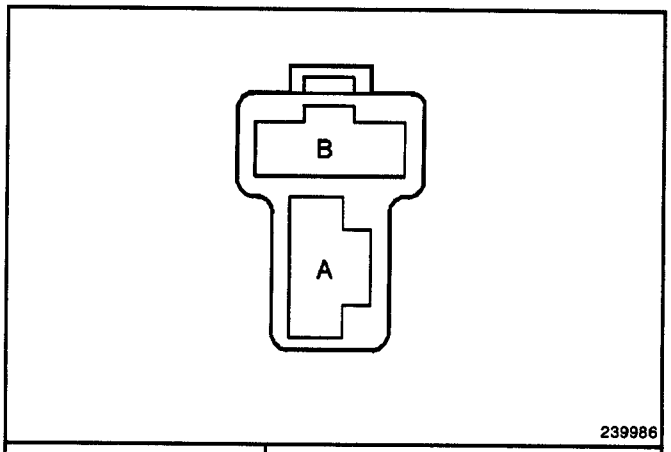
A/C Temperature Switch



240168

Connector Part Information	• 3 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRN/ RED	18	Thermo Switch
B	GRN/ YEL	17	Thermo Switch
C	LT GRN	16	Thermo Switch

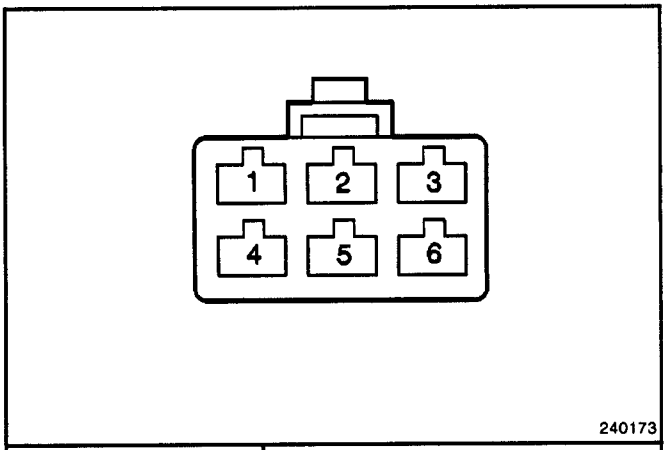
Blower Motor (w/ A/C)



239986

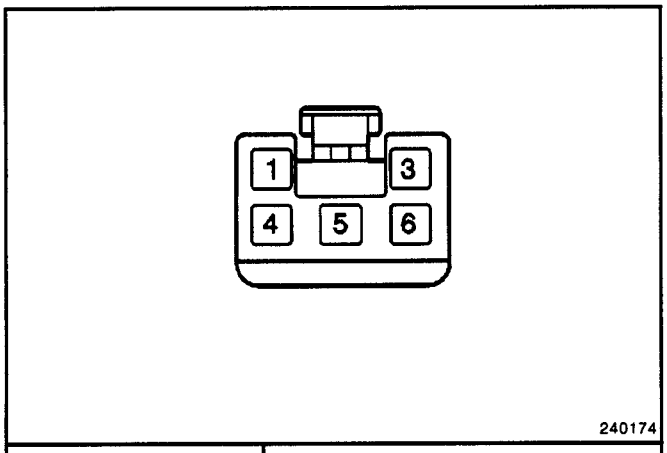
Connector Part Information	• 3 Way • Male		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN	191	Blower Motor
B	BLU/RED	192	Blower Motor Resistor

Blower Motor Resistor (w/ A/C)



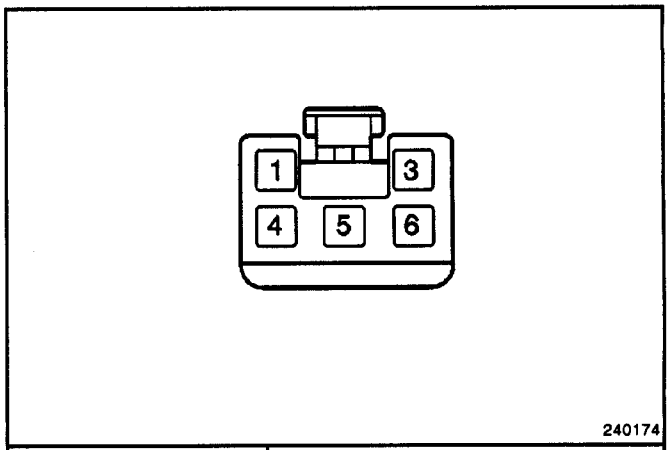
Connector Part Information		• 6 Way • Male	
Pin	Wire Color	Circuit No.	Function
1	BLU/ WHT	196	Fan Low Resistor
2	BLU/RED	192	Blower Motor
3	—	—	Not Used
4	BLU/BLK	195	Fan Middle Low Resistor
5	—	—	Not Used
6	BLU/YEL	194	Fan Middle High Resistor

HVAC Air Temperature Actuator (w/ A/C)



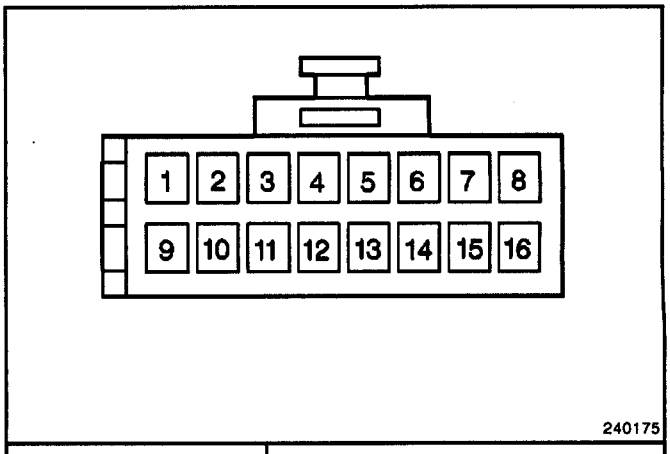
Connector Part Information		• 6 Way • Male	
Pin	Wire Color	Circuit No.	Function
1	PNK/BLU	231	Temperature Actuator, Temperature 5
2	—	—	Not Used
3	PNK	230	Temperature Actuator, Temperature 4

HVAC Air Temperature Actuator (w/ A/C) (cont'd)



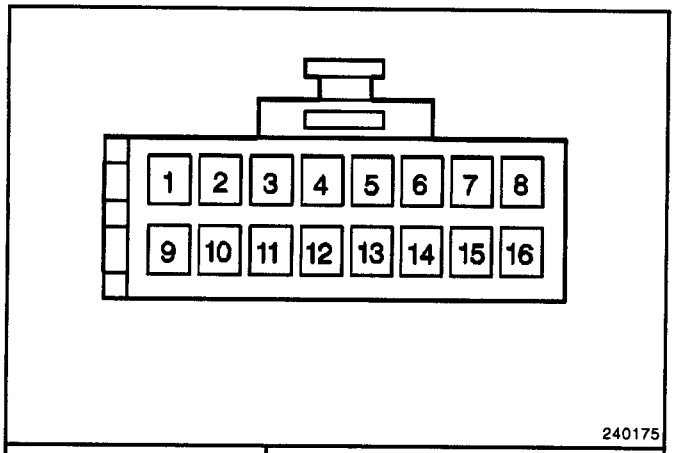
Connector Part Information		• 6 Way • Male	
Pin	Wire Color	Circuit No.	Function
4	LT GRN	229	Temperature Actuator, Temperature 2
5	PNK/BLK	232	Temperature Actuator, Temperature 3
6	LT GRN/WHT	228	Temperature Actuator, Temperature 1

HVAC Controller C1 (w/ A/C)



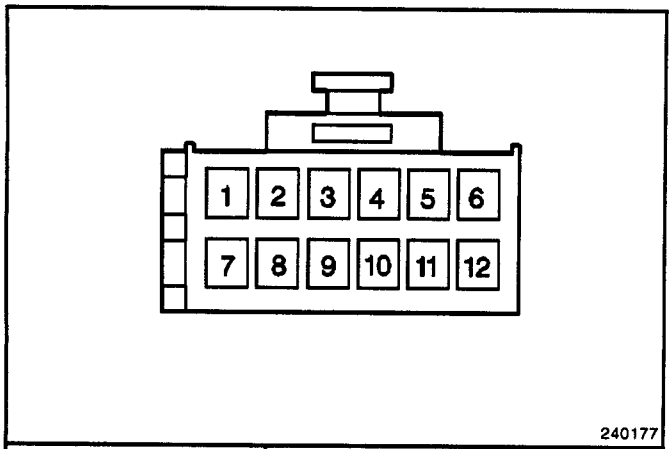
Connector Part Information		• 16 Way • Male	
Pin	Wire Color	Circuit No.	Function
1	—	—	Not Used
2	BLK	186	Ground
3	PNK	187	Temp 4
4	LT GRN/WHT	188	Temp 1

HVAC Controller C1 (w/ A/C) (cont'd)



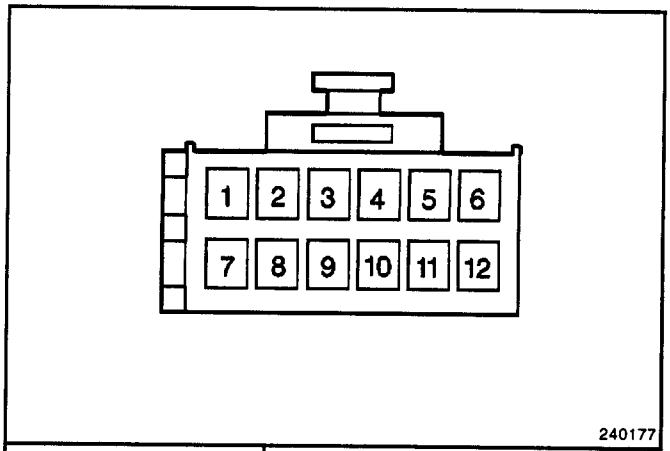
Connector Part Information		• 16 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
5	BRN/BLU	189	Mode 1
6	BRN/BLK	190	Mode 2
7	BRN/ WHT	191	Mode 3
8	BRN	192	Mode 4
9	—	—	Not Used
10	PNK/BLU	194	Temp 5
11	PNK/BLK	195	Temp 3
12	LT GRN	196	Temp 2
13	LT GRN/YEL	197	Mode 7
14	LT GRN/BLK	198	Mode 8
15	—	—	Not Used
16	BRN/YEL	199	Mode 6

HVAC Controller C2 (w/ A/C)



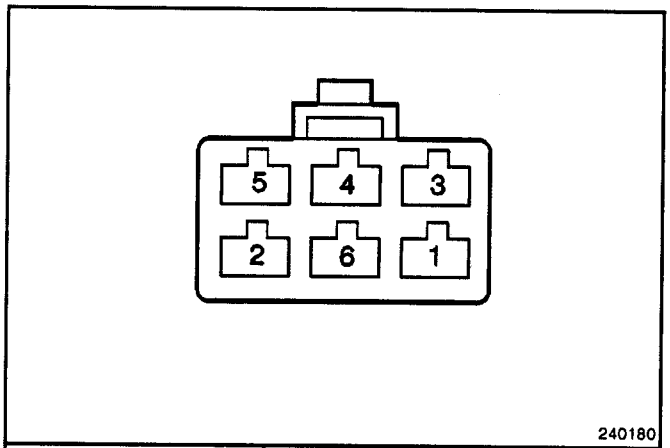
Connector Part Information		• 12 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN/ GRN	200	Mode 5
2	PPL/YEL	175	Recirculate ON
3	GRN	177	Condenser Fan Control

HVAC Controller C2 (w/ A/C) (cont'd)



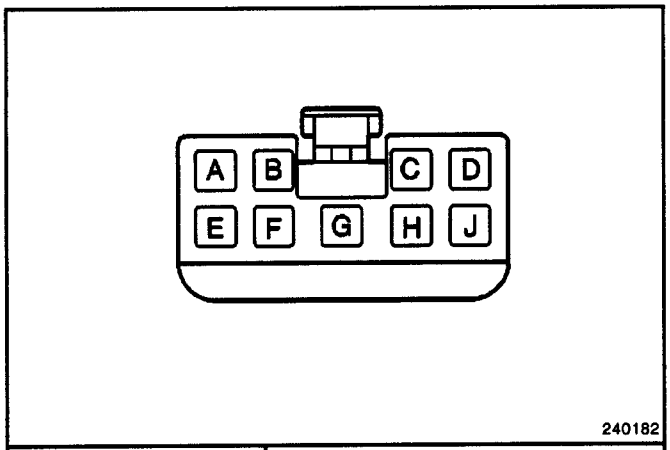
Connector Part Information		• 12 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
4	BLK/RED	173	Rheostat
5	LT GRN	171	Ignition
6	PPL/GRN	176	Recirculate OFF
7	RED/BLU	184	Ground
8	BRN	172	Illumination
9	PPL/ WHT	178	Not Used
10	BLK	174	Ground
11–12	—	—	Not Used

HVAC Connector C3 (w/ A/C)



Connector Part Information		• 6 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BLK	179	Ground
2	BLU/ WHT	180	Fan Lo
3	BLU/BLK	181	Fan Med Lo
4	BLK	182	Fan Med Hi
5	BLU/RED	183	Fan Hi
6	RED/BLU	184	Ground

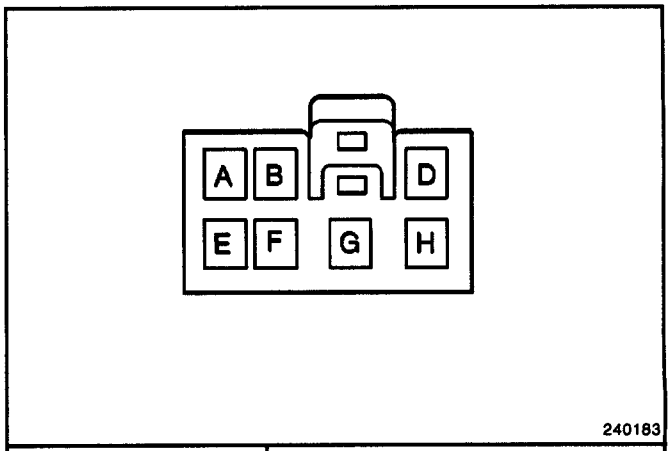
HVAC Mode Door Actuator (w/ A/C)



240182

Connector Part Information		• 9 Way • Male	
Pin	Wire Color	Circuit No.	Function
A	LT GRN/BLK	224	Mode Actuator Mod 8
B	BRN/ GRN	221	Mode Actuator Mode 5
C	BRN/BLK	227	Mode Actuator Mode 2
D	BRN/BLU	226	Mode Actuator Mode 1
E	LT GRN/YEL	225	Mode Actuator Mode 7
F	BRN/ WHT	223	Mode Actuator Mode 3
G	BRN	222	Mode Actuator Mode 4
H	BRN/YEL	220	Mode Actuator Mode 6
J	BLK	219	Mode Actuator

HVAC Recirculating/Fresh Air Actuator (w/ A/C)



240183

Connector Part Information		• 7 Way • Male	
Pin	Wire Color	Circuit No.	Function
A–C	—	—	Not Used
D	PPL/YEL	233	Recirculate/Fresh Actuator ON
E	LT GRN	236	Blower motor
F	—	—	Not Used
G	PPL/GRN	234	Recirculate/Fresh Actuator OFF
H	PPL/ WHT	235	HVAC Controller C2

Diagnostic Information and Procedures

Functional Check

The following conditions indicate that the electrical circuits are functioning properly:

- The air conditioning operates at all speeds in any position except for OFF.
- The compressor clutch engages.

The system is charged properly if the hand-felt temperatures of the following components are the same:

- The evaporator inlet pipe
- The receiver/dryer or dehydrator surface of an opening system

The air conditioning control head is operating correctly when the air conditioning control head distributes air from the designed outlets.

HVAC Blower Controls System Check

A constant air rush noise is typical of high-speed blower operation. Some systems and modes may be noisier than others.

Perform the following steps on a similar vehicle in order to determine whether the noise is typical or excessive:

1. Close the doors and the windows of the vehicle.
2. Sit in the vehicle.
3. Turn the ignition to the ON position. Do not start the engine.
4. Set the temperature for maximum cooling.
5. Run the blower on the 4 speed.
6. Cycle through all of the blower speeds, the modes and the temperature settings.

7. Determine if the noise is one of the following types of noise:
   - The noise is constant but decreases with blower speed reduction. The following noises are typical:
     - A whine
     - A tick/click
     - A flutter
     - A scrape
   - The noise occurs only at startup or is intermittent.

     This noise may occur at cold ambients and low blower speeds.

     Typical noises are a squeal or a screech.
   - The noise is constant at high blower speeds in certain modes, but can be eliminated at lower blower speeds in other modes.

     Typical noises are a flutter or a rumble.
8. Complete the following steps if the noise persists:
   - Remove the blower assembly.
   - Inspect for obstructions or foreign material that may cause noise.
   - Remove any obstructions from the blower assembly.
   - If no obstructions are found, replace the blower assembly.

HVAC Compressor Clutch Does Not Engage

Step	Action	Value(s)	Yes	No
1	1. Locate the vehicle in an area with ambient air temperature greater than 10°C (50°F). 2. Start the engine and maintain at 1000 rpms. 3. Place the A/C mode switch in the ON position. 4. Place the fan control switch in position 1. 5. With the blower motor operating, place the fan control in position 4. 6. Place the temperature control lever, on the A/C mode switch, in the full left COLD position. 7. Ensure the A/C compressor clutch engages during a 5 minute observation period and cold air is produced. Does the A/C compressor clutch engage?	—	Go to *System Performance Chart*	*Go to Step 2*
2	1. Place the fan control switch in position 1. 2. Remove the A/C compressor clutch relay from the relay socket. 3. Connect a fused jumper wire between terminal 30 and terminal 87 in the A/C compressor clutch relay socket. Does the A/C compressor clutch engage?	—	*Go to Step 3*	*Go to Step 11*
3	1. Connect a self-powered test lamp between terminal 86 in the compressor relay socket and chassis ground. 2. Set the window washer switch to the ON position. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Connect a test lamp between the A/C compressor relay socket terminal 85 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Repair the open CKT 211 (GRN/RED) between S 307 and terminal 86 in the compressor relay socket. Is the repair complete?	—	System OK	*Go to Step 4*
6	1. Install the compressor relay into the relay socket. 2. Place the window washer switch in the ON position. Does the compressor clutch engage?	—	*Go to Step 8*	*Go to Step 9*
7	Locate and repair the open in the CKT 210 (LTGRN) wire betweeen terminal 87 in the blower relay and terminal 85 in the A/C compressor relay. Is the repair complete?	—	System OK	*Go to Step 6*

HVAC Compressor Clutch Does Not Engage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Disconnect the harness connector from the thermo switch. 2. Connect a fused jumper between terminal A and terminal B in the thermo switch harness connector. Does the A/C compressor clutch engage?	—	*Go to Step 10*	*Go to Step 11*
9	Replace the compresor relay. Is the repair complete?	—	System OK	*Go to Step 8*
10	1. Make sure the evaporator icing condition does not exist. 2. Replace the thermo switch. Is the repair complete?	—	System OK	*Go to Step 11*
11	Connect a fused jumper between terminal A in the thermo switch harness connector and chassis ground. Does the A/C compressor clutch engage?	—	*Go to Step 12*	*Go to Step 13*
12	1. Connect a jumper between terminal B in the thermo switch harness connector and chassis ground. 2. Remove the D201 diode module. 3. Connect a self-powered test lamp between terminal 1E in the D201 diode module harness connector and chassis ground. Does the test lamp light?	—	*Go to Step 14*	*Go to Step 15*
13	Locate and repair open in CKT 18/213 (GRN/RED) between S 307 and terminal A in the thermo switch. Is the repair complete?	—	System OK	*Go to Step 12*
14	1. Disconnect the harness connector C2 from the A/C mode switch. 2. Connect a jumper between terminal 3 in the A/C mode switch harness connector C2 and chassis ground. 3. Connect a self-powered test lamp between terminal 1F in the D201 diode module harness connector and chassis ground. Does the test lamp light?	—	*Go to Step 16*	*Go to Step 17*
15	Locate and repair open in CKT 17/215 (GRN/YEL) between terminal 1E in the D201 diode module harness connector and terminal B in the thermo switch harness connector. Is the repair complete?	—	System OK	*Go to Step 16*
16	Inspect diode D201. Is diode D201 in good condition?	—	*Go to Step 18*	*Go to Step 19*
17	Locate and repair open in CKT 177/216 (GRN) between terminal 1F in the D201 diode module harness connector and terminal 3 in the A/C mode switch harness connector. Is the repair complete?	—	System OK	*Go to Step 16*
18	Replace the A/C mode switch. Is the repair complete?	—	System OK	*Go to Step 19*
19	Replace the diode module. Is the repair complete?	—	System OK	*Go to Step 20*
20	Connect a test lamp between the A/C compressor clutch relay socket terminal 87 and chassis ground. Does the test lamp light?	—	*Go to Step 21*	*Go to Step 22*

HVAC Compressor Clutch Does Not Engage (cont'd)

Step	Action	Value(s)	Yes	No
21	Connect a self-powered test lamp between the A/C compressor clutch relay socket terminal 87 and chassis ground. Does the test lamp light?	—	*Go to Step 23*	*Go to Step 24*
22	Locate and repair open in CKT 201/207 (GRN/RED) between circuit breaker 20 and terminal 30 in the A/C compressor relay socket. Is the repair complete?	—	System OK	*Go to Step 21*
23	Replace the compressor clutch relay. Is the repair complete?	—	System OK	*Go to Step 24*
24	1. Disconnect harness connector from the A/C pressure cut-off switch. 2. Connect a self-powered test lamp between terminal 87 in the A/C compressor relay socket and terminal 3 in the A/C refrigerant pressure switch connector. Does the test lamp light?	—	*Go to Step 25*	*Go to Step 26*
25	Connect a self-powered test lamp between terminal 4 in the A/C refrigerant pressure switch harness connector and chassis ground. Does the test lamp light?	—	*Go to Step 27*	*Go to Step 28*
26	Locate and repair the open in CKT 203/208 between terminal 87 in the A/C compressor relay and terminal 3 in the A/C refrigerant pressure switch. Is the repair complete?	—	System OK	*Go to Step 25*
27	1. Charge the A/C system with freon. Refer to *Refrigerant Recovery and Recharging*. 2. Replace the A/C pressure cutoff switch. Is the replacement complete?	—	System OK	*Go to Step 28*
28	1. Disconnect the harness connector from the A/C compressor clutch. 2. Connect a self-powered test lamp between the A/C compressor clutch terminal and chassis ground. Does the test lamp light?	—	*Go to Step 29*	*Go to Step 30*
29	Locate and repair open in CKT 6/59 (DK GRN) between terminal 4 in the A/C refrigerant pressure switch harness connector and the A/C compressor clutch harness connector terminal. Is the repair complete?	—	System OK	*Go to Step 30*
30	Repair or replace the A/C compressor clutch. Is the repair complete?	—	System OK	—

HVAC Compressor Clutch Does Not Disengage

Step	Action	Value(s)	Yes	No
1	Verify the symptom. Does the A/C compressor clutch remain continuously engaged with the A/C switch in the OFF position?	—	*Go to Step 2*	—
2	1. Disconnect the A/C compressor clutch harness connector from the A/C compressor. 2. Place the A/C on/off switch on the A/C mode switch to the OFF position. 3. Place the fan control switch in the OFF position. 4. Start the engine and maintain at approximately 1000 rpms. Does the A/C compressor clutch disengage?	—	*Go to Step 4*	*Go to Step 5*
4	1. Turn the engine OFF. 2. Place the ignition switch in the RUN position. 3. Remove the harness connector from the A/C pressure cutoff switch. 4. Connect a self-powered test lamp between terminal 4 in the A/C pressure cutoff switch harness connector and chassis. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Replace the A/C compressor clutch. Is the repair complete?	—	System OK	*Go to Step 4*
6	Locate and repair short to B positive in CKT 59 (DK GRN) between terminal 4 in the A/C pressure cutoff switch harness connector and the A/C compressor clutch harness connector. Is the repair complete?	—	System OK	*Go to Step 7*
7	Repair or replace the A/C pressure cutoff switch. Is the repair complete?	—	System OK	—

Blower Motor Inoperative at Any Speed

Step	Action	Value(s)	Yes	No
1	1. Place the ignition switch in the RUN position. 2. Place the blower speed switch in the HI position. 3. Connect a test lamp between blower relay terminal 30 and the chassis ground. Does the test lamp light?	—	*Go to Step 3*	*Go to Step 2*
2	Locate and repair the open in CKT 190 (RED) wire between the I/P fuse block and the blower relay. Is the repair complete?	—	System OK	*Go to Step 3*
3	Connect a test lamp between blower relay terminal 85 and the chassis ground. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 4*
4	Locate and repair the open in CKT 198 (BRN) wire between the I/P fuse block and the blower relay. Is the repair complete?	—	System OK	*Go to Step 5*

Blower Motor Inoperative at Any Speed (cont'd)

Step	Action	Value(s)	Yes	No
5	Connect a test lamp across blower motor terminal A and the chassis ground. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 6*
6	Locate and repair the open in CKT 191 (GRN) wire between the blower motor and the blower relay. Is the repair complete?	—	System OK	*Go to Step 7*
7	Connect a self-powered test lamp across blower motor terminal B and ground. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
8	Replace the blower motor. Is the repair complete?	—	System OK	*Go to Step 9*
9	Connect a self-powered test lamp across A/C mode switch connector C3 terminal 5 and the chassis ground. Does the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
10	Locate and repair the open circuit between the blower motor and A/C mode switch. Is the repair complete?	—	System OK	*Go to Step 11*
11	Connect a self-powered test lamp between A/C mode switch connector C3 terminal 1 and ground. Does the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
12	Replace the A/C mode switch. Is the repair complete?	—	System OK	*Go to Step 13*
13	Locate and repair the open in CKT 179 (BLK) wire between A/C mode switch connector C3 and ground. Is the repair complete?	—	System OK	—

Blower Motor Low Speed Inoperative

Step	Action	Value(s)	Yes	No
1	Place the blower speed switch in the failing speed position. Is LOW speed the failing speed?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the open in CKT 192 (BLU/RED) between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 3*
3	1. Disconnect the connector at the blower motor resistor. 2. Place the ignition switch in the RUN position. 3. Place the blower speed switch in the failing speed position. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal for the failing position and the wire and chassis ground. The following are the failing positions: • LOW-1 • MED LOW-4 • MED-HI-6 Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*

Blower Motor Low Speed Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
4	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 5*
5	Disconnect the A/C mode switch connector C 3 terminal 2 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Locate and repair the open in the wire between the blower resistor and the A/C mode switch. Is the repair complete?	—	System OK	*Go to Step 7*
7	Replace the A/C mode switch. Is the repair complete?	—	System OK	—

Blower Motor Medium Speed Inoperative

Step	Action	Value(s)	Yes	No
1	Place the blower speed switch in the failing speed position. Is MED speed the failing speed?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the open in CKT 192 (BLU/RED) between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 3*
3	1. Disconnect the connector at the blower motor resistor. 2. Place the ignition switch in the RUN position. 3. Place the blower speed switch in the failing speed position. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal for the failing position and the wire and chassis ground. The following are the failing positions: • LOW-1 • MED LOW-4 • MED-HI-6 Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 5*
5	Disconnect the A/C mode switch connector C 3 terminal 2 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Locate and repair the open in the wire between the blower resistor and the A/C mode switch. Is the repair complete?	—	System OK	*Go to Step 7*
7	Replace the A/C mode switch. Is the repair complete?	—	System OK	—

Blower Motor Low and Medium Speeds Inoperative

Step	Action	Value(s)	Yes	No
1	1. Place the ignition switch in the RUN position. 2. Place the temperature selector in the LOW blower speed. 3. Disconnect the connector at the blower motor resistor. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal 1 for the CKT 196 (BLU/WHT) wire and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 3*
3	Connect a self-powered test lamp between the A/C mode switch connector C3 terminal 2 and the chassis ground. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Locate and repair the open in CKT 180/196 (BLU/WHT) wire between the A/C mode switch and the blower motor resistor. Does the test lamp light?	—	Ststem OK	*Go to Step 5*
5	Replace the A/C mode switch. Is the repair complete?	—	System OK	—

Blower Motor High Speed Inoperative

Step	Action	Value(s)	Yes	No
1	Place the blower speed switch in the failing speed position. Is HIGH speed the failing speed?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the open in CKT 192 (BLU/RED) between the blower resistor and the HVAC mode switch. Is the repair complete?	—	System OK	*Go to Step 3*
3	1. Disconnect the connector at the blower motor resistor. 2. Place the ignition switch in the RUN position. 3. Place the blower speed switch in the failing speed position. 4. Connect a self-powered test lamp between the blower motor resistor connector terminal for the failing position and the wire and chassis ground. The following are the failing positions: • LOW-1 • MED LOW-4 • MED-HI-6 Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Replace the blower motor resistor. Is the repair complete?	—	System OK	*Go to Step 5*
5	Disconnect the A/C mode switch connector C 3 terminal 2 and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Locate and repair the open in the wire between the blower resistor and the A/C mode switch. Is the repair complete?	—	System OK	*Go to Step 7*
7	Replace the A/C mode switch. Is the repair complete?	—	System OK	—

Condenser Fan Inoperative

Step	Action	Value(s)	Yes	No
1	1. Backprobe relay center 2 with a test lamp from blower relay terminal 85 to ground. 2. Place ignition switch in RUN. Did the test lamp light?	—	Go to Step	Go to Step
2	Locate and repair open CKT196, CKT337, or CKT371 (BRN) between IP fuse block and relay center 2. Is the repair complete?	—	System OK	—
3	Backprobe relay center 2 with a test lamp from blower relay terminal 30 to ground. Did the test lamp light?	—	Go to Step	Go to Step
4	Locate and repair open CKT190 (LT GRN) between IP fuse block and relay center 2. Is the repair complete?	—	System OK	—
5	Backprobe relay center 2 with a test lamp from blower relay terminal 86 to B+. Did the test lamp light?	—	Go to Step	Go to Step
6	Locate and repair open CKT199 (BLK) between relay center 2 and G105. Is the repair complete?	—	System OK	—
7	Backprobe relay center 2 with a test lamp from blower relay terminal 87 to ground. Did the test lamp light?	—	Go to Step	Go to Step
8	Replace the blower relay. Is the repair complete?	—	System OK	—
9	Backprobe relay center 2 with a test lamp from A/C condensor fan relay terminal 85 to ground. Did the test lamp light?	—	Go to Step	Go to Step
10	Locate and repair open in CKT204 (LT GRN) between blower relay and A/C condensor fan relay. Is the repair complete?	—	System OK	—
11	Backprobe relay center 2 with a test lamp from A/C condensor fan relay terminal 30 to ground. Did the test lamp light?	—	Go to Step	Go to Step
12	Locate and repair open CKT201 (GRN/RED) between I/P fuse block and relay center 2. Is the repair complete?	—	System OK	—
13	Backprobe relay center 2 with a test lamp from A/C condensor fan relay terminal 86 to B+. Did the test lamp light?	—	Go to Step	Go to Step
14	Backprobe control assembly with a test lamp from connector C2 terminal 3 to B+. Did the test lamp light?	—	Go to Step	Go to Step
15	Replace the control assembly. Refer to, *Control Assembly Replacement.* Is the repair complete?		System OK	—
16	Backprobe A/C temperature sensor with a test lamp from connector C2 terminal 3to B+. Did the test lamp light?	—	Go to Step	Go to Step

Condenser Fan Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
17	Locate and repair open CKT603, CKT206, CKT216 or CKT177 (GRN) between A/C temperature sensor and control assembly. Is the repair complete?	—	System OK	—
18	Backprobe A/C temperature sensor with a test lamp from cavity 2C2 2 to B+. Did the test lamp light?	—	Go to Step	Go to Step
19	Replace the A/C temperature sensor. Refer to *A/C Temperature Sensor Replacement* Is the repair complete?	—	System OK	—
20	Backprobe relay center 2 with a test lamp from A/C condensor fan relay cavity 87 to ground. Did the test lamp light?	—	Go to Step	Go to Step
21	Replace the A/C condensor fan relay. Is the repair complete?	—	System OK	—
22	Backprobe A/C condensor fan motor with a test lamp from cavity 6 to ground. Did the test lamp light?	—	Go to Step	Go to Step
23	Locate and repair open CKT202, CKT206 and 1727 (DK BLU/WHT) between relay center 2 and A/C condensor fan motor. Is the repair complete?	—	System OK	—
24	Backprobe A/C condensor fan motor with a test lamp from cavity 5 to B+. Did the test lamp light?	—	Go to Step	Go to Step
25	Replace the A/C condensor fan motor. Is the repair complete?	—	System OK	—
26	Locate and repair open CKT150 (BLK) between A/C condensor fan motor and G107. Is the repair complete?	—	System OK	—

Condenser Fan On at All Times

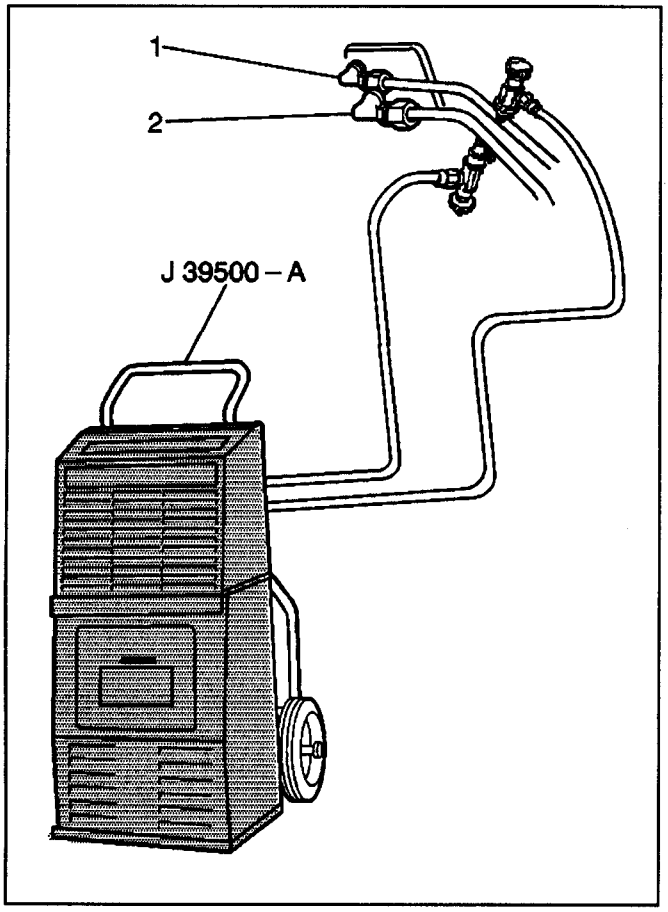
Step	Action	Value(s)	Yes	No
1	Place ignition switch in run. Remove A/C condensor fan relay. Does the A/C condensor fan turn off?	—	Go to Step	Go to Step
2	Replace the A/C condensor fan relay. Is the repair complete?	—	System OK	—
3	Locate and repair short to voltage in CKT202, CKT1727 (DK BLU/WHT) between relay center 2 and A/C condensor fan motor. Is repair complete?	—	System OK	—

System Performance Chart

Tools Required

J 39500

1. Park the vehicle inside a building or in a shaded area.
2. Place the transmission in PARK or NEUTRAL.
3. Open the hood.
4. Secure the hood.
5. Remove the low pressure hose cap.
6. Remove the high pressure hose cap.



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7. Connect the low pressure hose (1).
8. Connect the high pressure hose (2).
9. Start the engine.
10. Stabilize the engine to a normal idling condition.
11. Press the button in the ON position.
12. Press the MAX/REC/RC button in the ON position.
13. Adjust the blower speed to HI.
14. Adjust the temperature control to full COLD.
15. Carefully follow the manufacturer's instructions.

The normal temperature guideline for pressures readings is approximately 25—30°C (77—86°F).

The normal pressure guideline at ambient for the low pressure side is approximately 127—265 kPA (18.5—38.4 psi).

The normal pressure guideline at ambient for the high pressure side is approximately 1,373—1,765 kPA (199—255.9 psi).

System Performance Chart

Pressure		Temperature	
(kPa)	(psi)	(°C)	(°F)
36	5.3	-20	-4.4
67	9.7	-15	5
104	15	-10	14
147	21	-5	23
196	28	0	32
255	37	5	41
314	45	10	50
392	57	15	59

System Performance Chart (cont'd)

Pressure		Temperature	
471	68	20	68
569	82	25	77
677	98	30	86
785	114	35	95
912	132	40	104
1059	154	45	113
1216	176	50	122

Refrigerant System Checks

High Pressure Abnormally Low

Problem	Action
The system contains insufficient refrigerant.	Check the refrigerant system for leaks. Refer to *Leak Testing.*
The expansion valve is clogged or defective, with a low pressure indicating vacuum.	Replace the expansion valve. Refer to *Thermal Expansion Valve Replacement.*
Frost or dew exists on the refrigerant line before and after the receiver/dryer or the dehydrator or the expansion valve and low pressure indicate vacuum. This may be due to restriction caused by debris or moisture in the receiver/dryer or dehydrator.	Replace the receiver/dryer or dehydrator. Refer to *Receiver Dehydrator Replacement.*
The high and low pressure balanced quickly with the engine shut off. This may be caused by a defective compressor seal or poor compressor operation.	Replace the compressor. Refer to *Compressor Replacement.*

Low Pressure is Abnormally High

Problem	Action
The low pressure drops after the condenser is cooled by water. This may be caused by excessive refrigerant in the system.	1. Discharge the refrigerant. 2. Recover the refrigerant. 3. Recharge the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
The low pressure hose temperature around the compressor refrigerant line connector is lower than around the evaporator. This may be caused by improper expansion valve operation.	Replace the expansion valve. Refer to *Thermal Expansion Valve Replacement.*
The high or low pressure balanced quickly with the engine off. This may be caused by improper compressor operation.	Replace the compressor. Refer to *Compressor Replacement.*

Low Pressure is Abnormally Low

Problem	Action
The system contains insufficient refrigerant.	Check the refrigerant system for leaks. Refer to *Leak Testing.*
Frost on the expansion valve. This may be caused by a plugged expansion valve.	Replace the expansion valve. Refer to *Thermal Expansion Valve Replacement.*
A distinct temperature difference exists between the receiver/dryer or the dehydrator inlet and the outlet refrigerant lines. This may be caused by a clogged receiver/dryer or dehydrator.	Replace the receiver/dryer or dehydrator. Refer to *Receiver Dehydrator Replacement.*
The low pressure indicates that the vacuum and the expansion valve outlet refrigerant line is not cold. This may indicate that the expansion valve temperature sensor is defective.	Replace the expansion valve. Refer to *Thermal Expansion Valve Replacement.*
The low pressure reading decreases or shows a vacuum. This may be caused by a clogged or blocked refrigerant line.	Replace the refrigerant line.
The evaporator core is frozen. This may be caused by a defective A/C Temperature Sensor.	Replace the A/C Temperature Sensor. Refer to A/C Temperature Sensor in *Heater/Vent Module Replacement.*

Low and High Pressures are Abnormally High

Problem	Action
DEFINITION: The low and high pressure readings are abnormally high.	
The system contains excessive refrigerant.	1. Discharge the refrigerant. 2. Recover the refrigerant. 3. Recharge the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
The condenser is clogged or dirty.	Clean the condenser fins.
The system contains excessive air. This is indicated if the suction (low pressure) hose is not cold.	1. Discharge the refrigerant. 2. Recover the refrigerant. 3. Recharge the refrigerant. Refer to *Refrigerant Recovery and Recharging.*

Low and High Pressures are Abnormally Low

Problem	Action
The system contains excessive refrigerant.	1. Discharge the refrigerant. 2. Recover the refrigerant. 3. Recharge the refrigerant. Refer to *Refrigerant Recovery and Recharging.*

Leak Testing

Caution: Avoid breathing A/C Refrigerant 134a (R-134a) and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (R-134a recycling equipment). If accidental discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Caution: Take care to prevent personal injury which could occur due to touching a hot engine when testing. Tests should be done with the engine "Off" and as cool as possible. Do not operate the detector in a combustible atmosphere since its sensor operates at high temperature.

Perform a refrigerant leak test on the system when the following conditions exist:

- A leak is suspected.
- A service operation disturbs the components, lines or connections.

Electronic Leak Detector

Tools Required

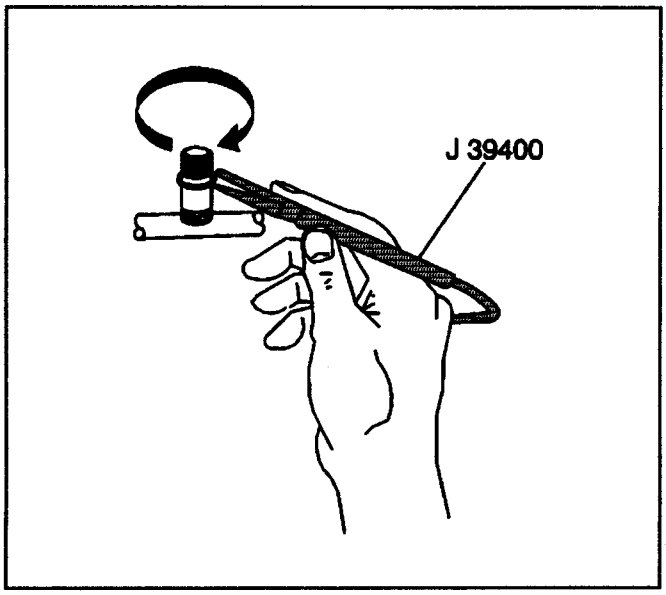
J 39400 Electronic Leak Detector

The *J 39400* is a small unit which operates on 12V DC.

The detector provides an audible signal. The signal increases in frequency as R-134a is detected.

Use the included instructions in order to ensure that the instrument is properly calibrated. Ensure that the detector is used in the proper setting for the type of refrigerant being tested.

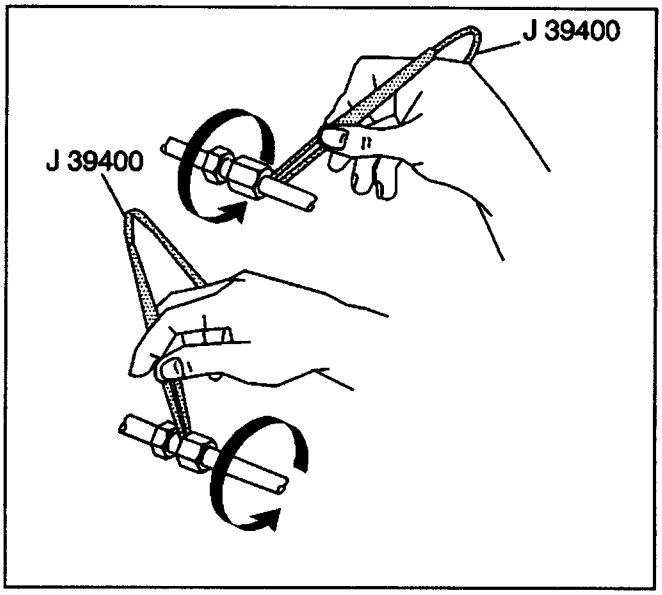
Place the detector GAS switch in the R-134a setting prior to use.



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Inspect the refrigerant fittings and the connections for leaks. The following conditions may cause leaks:

- Improper torque
- Damaged O-ring seals
- Lack of lubricant on the O-ring seals
- Dirt or debris across the O-ring seals
- Small pieces of lint from cotton gloves or shop cloths



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When using the electronic leak detector, ensure that the following conditions exist:

- Each joint is completely circled.
- The scan rate is 25-51 mm (1.2 in) per second.
- The tip of the probe is as close to the surface as possible but no more than 6 mm (0.25 in) away.
- The air intake is not blocked.

Important: Halogen leak detectors are sensitive to the following compounds:

1. Windshield washing solutions
2. Solvents and cleaners
3. Adhesives

In order to prevent a false warning, ensure that all of the surfaces are clean. Ensure that all of the surfaces are dry. The ingestion of liquids will damage the detector.

A leak is indicated when the audible tone changes from a steady 1-2 clicks per second to a solid alarm. Adjust the balance knob frequently in order to maintain the 1-2 clicks per second rate.

Important: Always follow the refrigerant system around in a continuous path so that no areas of potential leaks are missed. Always test all of the following areas in order to ensure that the entire system is leak free, even when one leak is already found.

Use this procedure in order to test the following areas:

- The A/C evaporator inlet and outlet
- The A/C accumulator inlet and outlet
- The A/C condenser inlet and outlet
- All brazed and welding areas
- All areas that exhibit signs of damage
- The hose couplings
- The A/C compressor rear head
- The housing joints

Service Ports/Access Valves

The sealing gap is the primary seal for the service ports. This cap contains a specially designed O-ring seal or gasket which provides a leak-free seal.

The following conditions will result in the loss of refrigerant charge:

- A loose cap
- A missing cap
- The use of a wrong cap

A/C Evaporator Core

Leaks in the A/C evaporator core may be difficult to detect. Use the following procedure in order to test the core:

1. Turn the blower fan on HIGH for 15 or more seconds.
2. Turn off the blower fan.
3. Wait for 10 minutes.
4. Remove the blower mower resistor. Refer to *Blower Motor Resistor Replacement.*
5. Insert the leak detector probe. Be sure to insert the leak detector as close to the A/C evaporator as possible.
6. Listen to the detector. If the detector sounds a solid alarm, a leak has been found.
7. Visually inspect the core face with a flashlight for evidence of refrigerant oil.

A/C Compressor Block Fitting and Shaft Seal

1. Blow shop air behind and in front of the A/C compressor armature/pulley for 15 seconds or more.
2. Wait for 1—2 minutes.
3. Probe the area in front of the pulley.
4. Listen to the detector. If the detector sounds a solid alarm, a leak has been found.

Leak Inspection

Before disassembling any A/C compressor components, inspect for leaks. Replace the A/C compressor if a leak is found in any of the following areas:

- The valve plate
- The oil plug

Heating Insufficient

Poor Defrosting

Problem	Action
1. The door(s) which control airflow are not functioning correctly. 2. The blower motor is not working. 3. There is blockage in the defroster outlets. 4. A restricted heater core and/or hoses. 5. A faulty thermostat and/or radiator cap. 6. There is blockage in front of the air conditioning filter. 7. There is blockage in the path of the door.	1. Determine and correct the cause of the malfunction. 2. Determine and correct the cause of the malfunction. Refer to *Blower Motor Inoperative at Any Speed.* 3. Remove the blockage. 4. Flush the cooling system. Refer to *Flushing.* 5. Determine and correct the cause of the malfunction. Refer to *Thermostat Diagnosis.* 6. Clean the air conditioning filter. Refer to *Passenger Compartment Air Filter Replacement.* 7. Remove the blockage.

No Heat (Blower Motor Working)

Problem	Action
1. There is low engine coolant level. 2. A faulty thermostat and/or radiator cap. 3. A restricted heater core and/or hoses. 4. A faulty actuator. 5. The pivot shaft of door(s) is not seated correctly. 6. There is blockage in front of the air conditioning filter. 7. There is blockage in the path of the door.	1. Check the engine coolant level. Refer to *Draining and Filling Cooling System (Cooling System).* 2. Determine and correct the cause of the malfunction. Refer to *Thermostat Replacement.* 3. Flush the cooling system. Refer to *Flushing.* 4. Check the actuator function and replace as necessary. 5. Seat the pivot shaft of the door(s) correctly. 6. Clean the air conditioning filter. Refer to *Passenger Compartment Air Filter Replacement.* 7. Remove the blockage.

Heater Gurgling Sound

Problem	Action
1. There is low engine coolant. 2. A restricted heater core and/or hoses.	1. Check the engine coolant level. Refer to *Draining and Filling Cooling System (Cooling System).* 2. Flush the cooling system. Refer to *Flushing.*

Poor Ventilation

Problem	Action
1. A blockage in the heater module. 2. A blockage in the recirculating/fresh air duct. 3. A binding or sticking of the recirculating/fresh air door. 4. The recirculating/fresh air door is not operating. 5. A faulty recirculating/fresh air actuator. 6. The pivot shaft of the door is not seated correctly.	1. Remove the blockage in the heater module. 2. Remove the blockage in the recirculating/fresh air duct. 3. Remove the blockage, repair and replace as necessary. 4. Repair and replace the door as necessary. 5. Seat the pivot shaft of the door. 6. Seat the pivot shaft of the door(s).

Heat Excessive

Problem	Action
1. The temperature door and/or actuator are faulty. 2. The engine is overheating.	1. Determine and correct the cause of the malfunction. 2. Determine and correct the cause of the malfunction. Refer to *Engine Overheating.*

Cooling Insufficient - A/C Inoperative

High Pressure is Abnormally High

Problem	Action
The A/C condensor is clogged or dirty.	Clean the A/C condensor fins.
The cooling fan is not operating properly.	Check system for malfunction.

A/C Component Checks

Problem	Action
The A/C compressor belt is loose or broken.	Adjust or replace the drive belt. Refer to Engine Mechanical.
The armature friction face is glazed.	Clean or replace the magnetic armature face.
The clearance between the magnetic drive plate and the pulley is incorrect.	Adjust the clearance. Refer to *Compressor Magnetic Clutch (Disassembly).*
The A/C compressor is seized.	Replace the A/C compressor. Refer to *Compressor Replacement.*
The refrigerant is insufficiently charged or excessively charged.	1. Discharge the refrigerant. Refer to *Refrigerant Recovery and Recharging.* 2. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging.* 3. Recharge the refrigerant. Refer to *Refrigerant Recovery and Recharging.*
Leaks are present in the refrigerant system.	Inspect the refrigerant system for leaks. Refer to *Leak Testing.*
The A/C condenser is clogged. The radiation in the A/C condenser is not sufficient.	Clean or replace the A/C condenser, as necessary. Refer to *Condenser Replacement.*
The A/C expansion valve is operating incorrectly due to a foreign substance.	Replace the A/C expansion valve. Refer to *Thermal Expansion Valve Replacement.*

Air Delivery Improper

Musty Smell of Coolant Smell

- Check for water leaks. Seal the body as necessary.
- Check the evaporator drain for blockage. Remove blockage.
- Check the coolant level. If it is low inspect the heater core or heater pipes/hoses.

Under certain climate and operating conditions, a musty odor develops from mold growth in the evaporator core face. This odor is generally temporary. As climate conditions change, the condition will repair on its own. However, if the odor persists, remove the evaporator core and clean the face with an appropriate cleaner.

Odors may be emitted from the air conditioning system primarily at startup in hot, humid climates. This odor may be the result of debris in the heater/A/C evaporator case or growth of mold on the Evaporator core.

Repair Instructions

Odor Correction

Musty Smell

Problem	Action
Water Leaks (Body)	Seal the body.
Evaporator Drain	Clean the drain.
Mold/Mildew	Clean the evaporator.

Coolant Smell

Problem	Action
Anti-freeze	• Heater core • Heater pipe/hoses

Refrigerant Leak

Problem	Action
Refrigerant Oil	Evaporator Core

Under certain climate and operating conditions, a musty odor develops from mold growth in the evaporator core face. This odor is generally temporary. As climate conditions change, the condition will repair on its own. However, if the odor persists, remove the evaporator core and clean the face with an appropriate cleaner.

If diagnosis indicates that a component of the A/C systems needs to be cleaned, use the following procedure:

Cleaning Procedure

Tools Required

- *J 36645* Evaporator Cleaning Gun
- Disinfectant Kit

Caution: Procedure should only be performed on a cold vehicle to prevent the disinfectant from coming in contact with hot engine components. Disinfectant can cause substantial but temporary eye injury. Do not get in eyes or clothing. Wash thoroughly with soap and water after handling.

Important: Complete the following steps if disinfectant gets into your eyes:

1. Hold your eyelids open
2. Flush your eyes with a steady, gentle stream of water for 15 minutes.
3. Obtain medical attention if the irritation persists.

1. Put on rubber gloves and safety goggles.
2. Pour the small bottle of the two-part Air Conditioning System Disinfectant Kit into the large bottle.
3. Seal the container.
4. Invert the large container 1-2 times in order to mix the contents.
5. Inspect underneath the vehicle in order to verify that the drain outlet is not plugged.
6. Connect the battery charger in order to avoid draining the battery during the cleaning procedure.

   Notice: Do not allow the metal coils of the blower resistor to become grounded to any metal surface as this may result in internal circuitry damage.
7. Remove the blower resistor. Be sure to leave the wiring connectors attached. Refer to *Blower Motor Resistor Replacement.*
8. Inspect the heater/A/C evaporator case for debris.
   - Remove any debris that is present through the blower resistor opening.
   - If the debris is imbedded into the A/C evaporator core face and cannot be removed, remove and clean the core.
   - If a large amount of debris is present in the heater/A/C evaporator case, seal the air inlet screen around the air intake in the cowl area.
9. Turn the ignition to the ON position. Do not start the vehicle.
10. Set the mode selector to Max/Rec/Rc.
11. Set the blower speed to 1.
12. Set the temperature to full COLD.
13. Open all of the windows and the doors.
14. Exit the vehicle.
15. Place a drain pan with at least a 2-quart capacity below the heater/A/C evaporator drain hole.

    Position the drain pan so that it will collect the disinfectant and the rinse water runoff.

    If necessary, install an additional hose onto the drain so that all of the fluid goes into the drain pan.
16. Turn the pedestal fan to 4 in order to provide cross ventilation during the cleaning procedure.

    Important: Do not allow disinfectant to come into contact with hot engine components such as the exhaust manifold.
17. Insert the nozzle of the *J 36645*
18. Spray the disinfectant directly toward the A/C evaporator face.
    - Saturate the core completely.
    - Use the entire container of solution.
    - Be sure to cover the corners and the edges.
19. Turn the ignition to the OFF position.
20. Allow the core to soak for 5 minutes.
21. Inspect underneath the vehicle.

    Verify that the drain is operating properly. If necessary, use a razor blade or sharp knife in order to unclog and increase the drain plug slits.
22. Turn the ignition to the ON position. Do not start the vehicle.
23. Use the spray gun in order to thoroughly rinse the A/C evaporator core with clean water.

    Be sure to remove all of the disinfectant residue.

    Use at least 1–2 liters of rinse water.
24. Turn the ignition to the OFF position.
25. Reinstall the blower resistor. Refer to *Blower Motor Resistor Replacement.*
26. Discard the disinfectant and the rinse water that was collected in the drained pan. Be sure to discard the liquid in an approved manner.

Refrigerant Recovery and Recharging

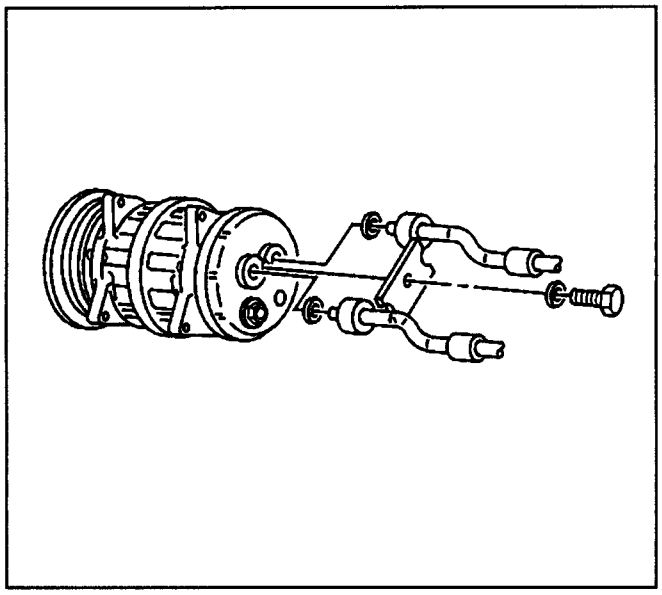
The air conditioning refrigerant (R-134a) recovery, recycling and recharging system (J 39500-A) completes the following actions with one hookup:

- Removes Refrigerant-134a from the vehicle A/C system
- Recycles
- Recharges

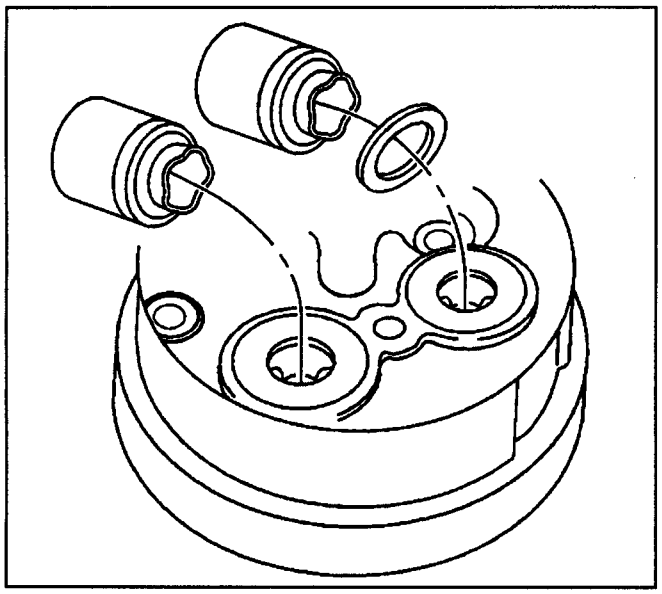
The following actions ensure a constant supply of clean/dry refrigerant for A/C system charging:

- Single-pass filtering during the recovery cycle
- Automatic multiple-pass filtering during the evacuation cycle

Important: R-12 and R-134a require separate and non-interchangeable sets of recovery, recycle and recharge equipment. The refrigerants and lubricants are not compatible and cannot be mixed.



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Do not attempt to use one set of equipment for both R-12 and R-134a, as all equipment contains residual amounts of refrigerant and/or lubricant. This would contaminate and damage the recover/recycle equipment.

Do not use adapters in order to convert one size fitting to the other. Refrigerant/lubricant contamination will occur and system failure may result.

Compressor Replacement

Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.

   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
3. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
4. Remove the drive belt. Refer to Engine Mechanical.
5. Remove the electrical connector from the A/C compressor, as necessary.
6. Remove the A/C compressor block fitting bolt.

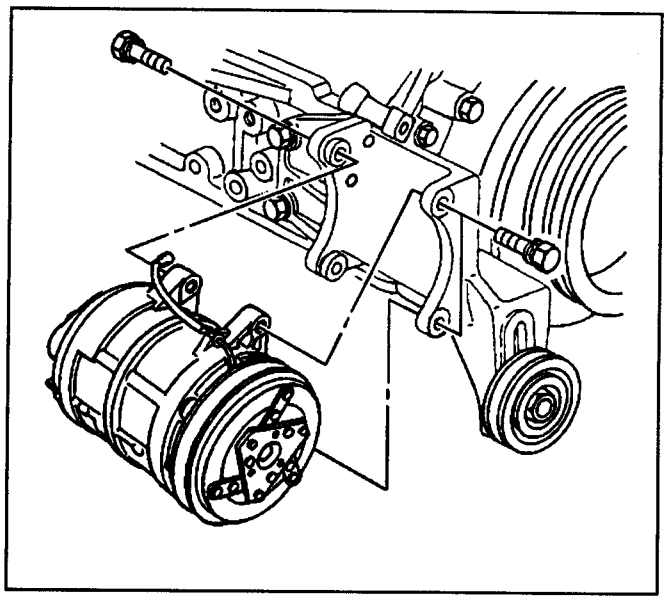
Important: When removing sealing washers, keep dirt and foreign material from getting on the following sealing surfaces:

- The washers
- The block fitting
- The A/C compressor ports

Clean all of the sealing surfaces with a lint-free rag.

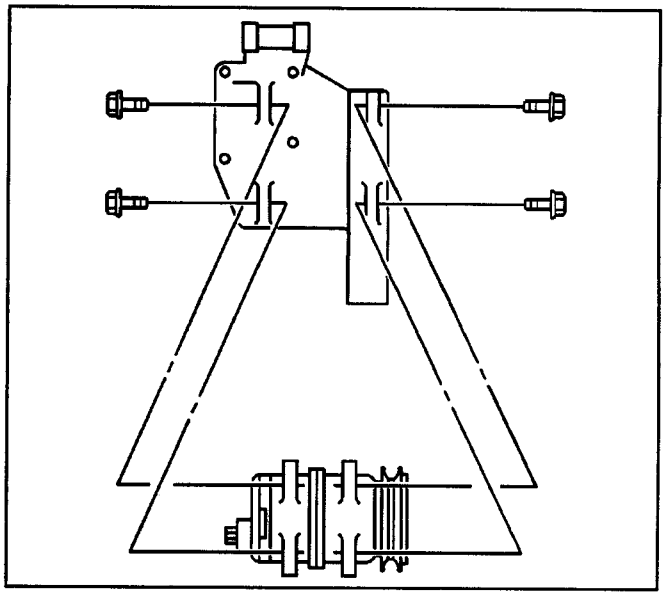
7. Remove the A/C compressor sealing washers. Discard the A/C compressor sealing washers.
8. Remove the refrigerant hoses.

9. Remove the idler pulley adjusting bolt.



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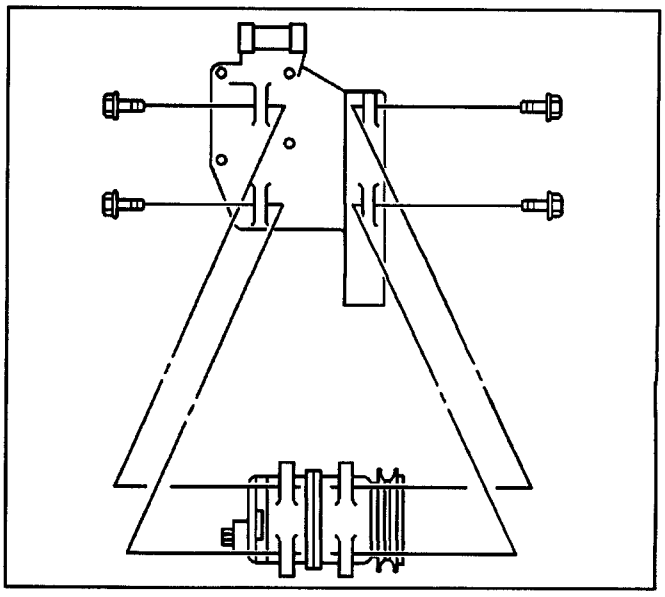
10. Remove the bolts from the mounting bracket.



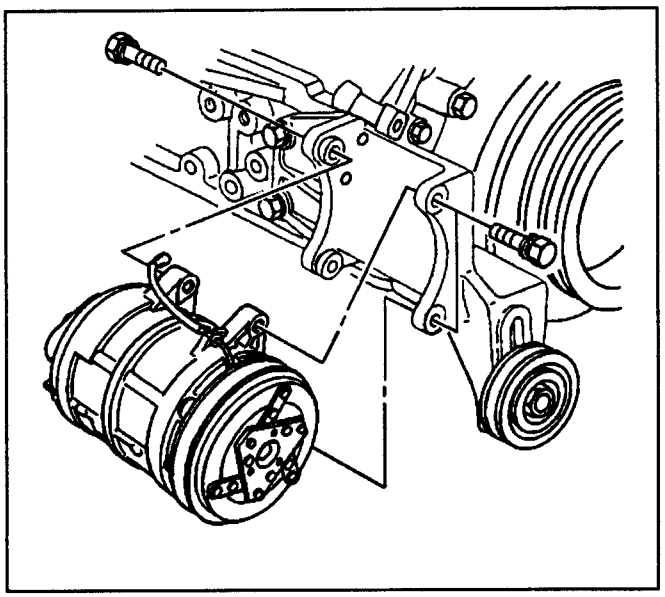
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Installation Procedure

1. Fill the A/C compressor. Refer to *Refrigerant Oil Distribution Specifications.*
2. Position the A/C compressor on the mounting bracket.

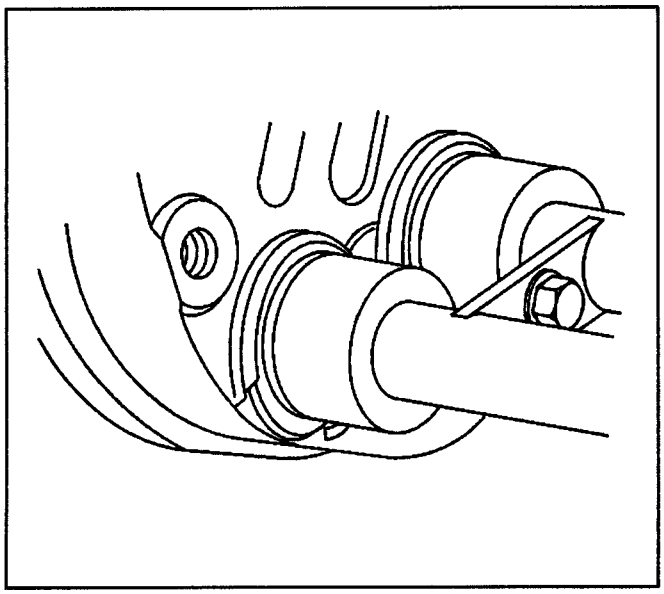


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3. Install the bolts on the mounting bracket. Do not tighten at this time.



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Important: When installing the sealing washers, keep dirt and foreign material from getting on the following sealing surfaces:

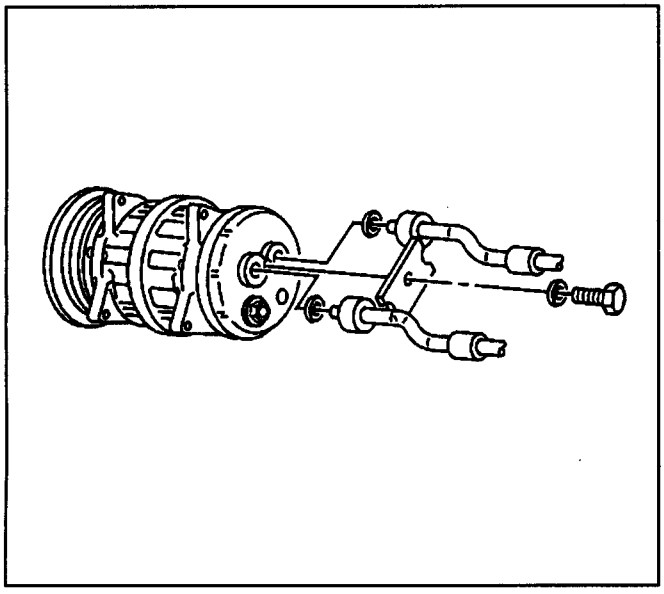
- The washers
- The block fitting
- The A/C compressor ports

Clean all of the sealing surfaces with a lint-free rag.

Do not reuse the sealing washers.

Do not oil the sealing washers prior to assembly.

4. Install new sealing washers onto the pilots of the block fitting. Ensure that the washers bottom against the surface of the block fitting.



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5. Install the refrigerant hoses on the A/C compressor hose block fitting bolt.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Hold the block in place. Hand tighten the A/C compressor hose block fitting bolt.

   Tighten

   Tighten the A/C compressor hose block fitting bolt to 35 N·m (26 lb ft).

7. Install the A/C electrical connector to the A/C compressor.
8. Install the drive belt and idler pulley adjusting bolt.

   Tighten

   Tighten the mounting bracket bolts to 39 N·m (29 lb ft).

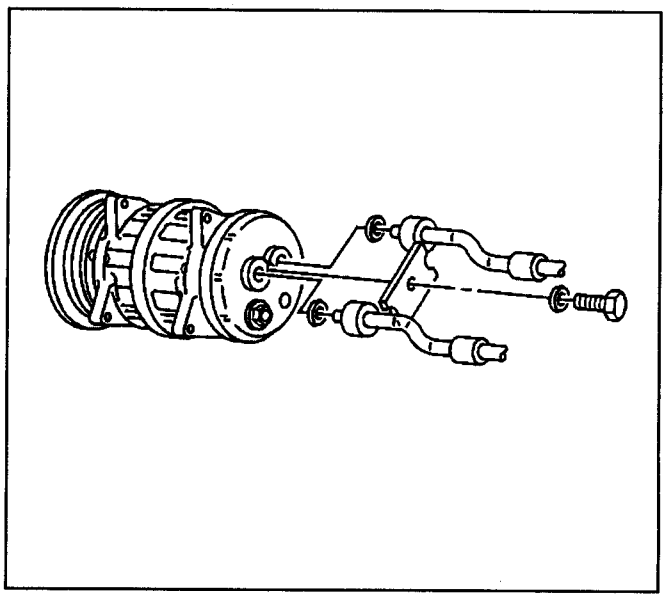
9. Install the electrical connector to the A/C compressor.

10. Install the drive belt and the idler pulley adjusting bolt.
    Tighten
    Tighten the mounting bracket bolts to 39 N.m (29 lb ft).
11. Install the negative battery cables.
12. Install the refrigerant to the system. Refer to *Refrigerant Recovery and Recharging.*
13. Inspect the system for leaks. Refer to *Leak Testing.*
14. Lower the cab.

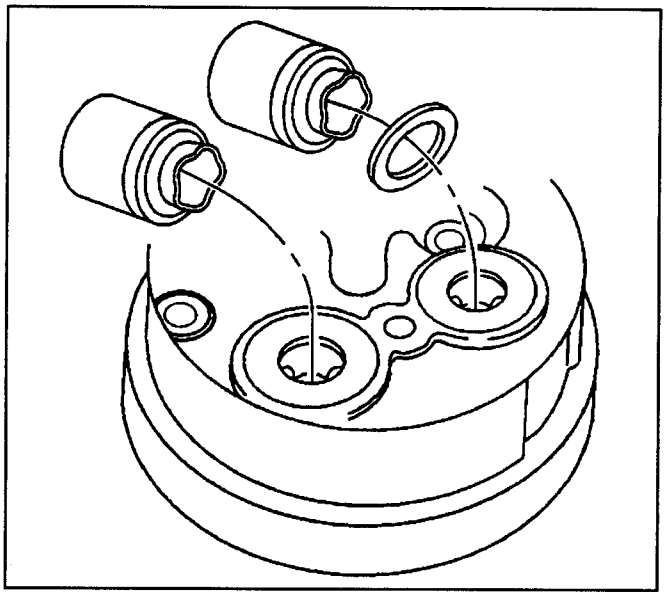
Compressor Sealing Washers Replacement

Removal Procedure

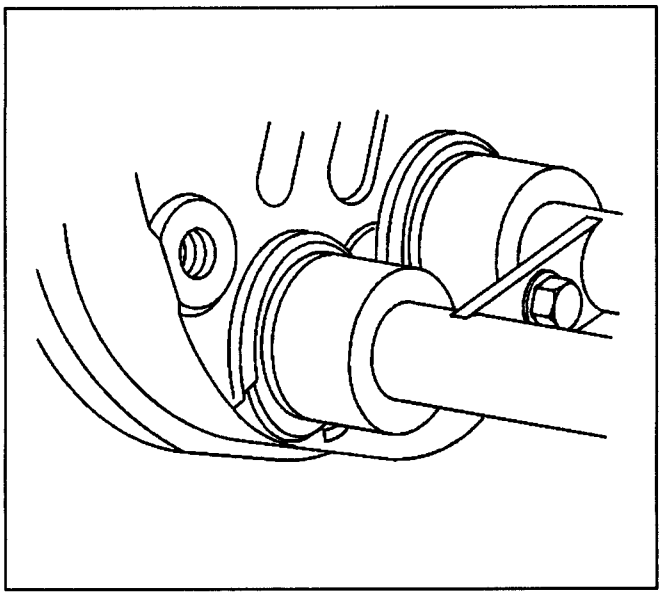
1. Tilt the cab. Refer to *Cab Tilting* in General Information.
   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Remove the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
3. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
   Important: When removing the sealing washers, prevent dirt and foreign material from getting on the sealing surfaces of the washers, block fitting or A/C compressor ports. Clean all of the sealing surfaces with a lint-free cloth.
4. Remove the compressor hose block fitting bolt from the A/C compressor.
5. Remove the sealing washers.
   Discard the A/C compressor sealing washers.



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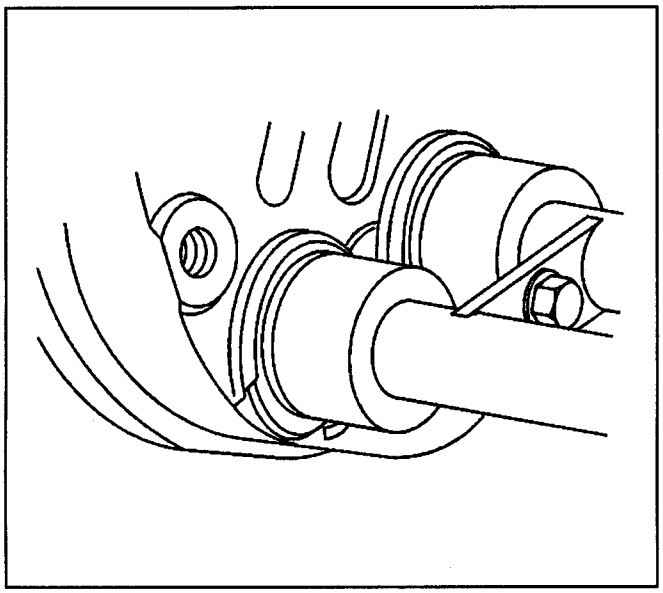


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6. Remove the A/C compressor hoses.



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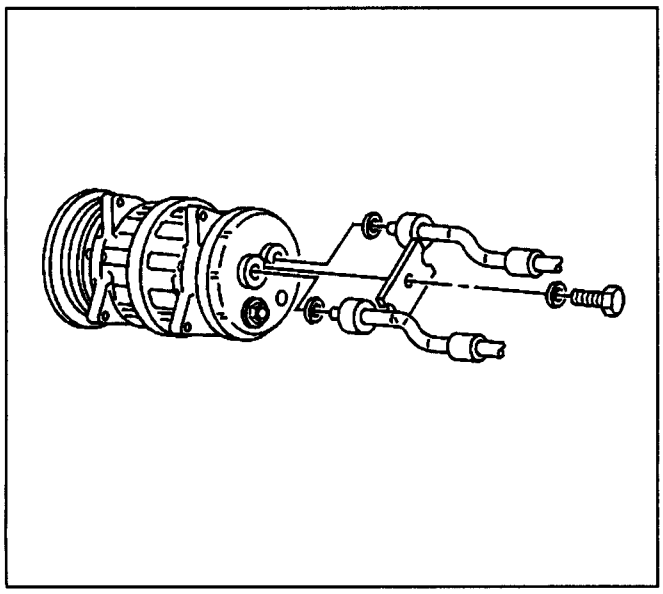
Installation Procedure

Important: When installing the sealing washers, prevent dirt and foreign material from getting on the sealing surfaces of the washers, block fitting or A/C compressor ports. Clean all of the sealing surfaces with a lint-free cloth.

Do not reuse the sealing washers.

Do not oil the sealing washers prior to assembly.

1. Install new sealing washers onto the pilots of the block fitting. Ensure that the washers bottom against the surface of the block fitting.



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2. Install the A/C compressor hoses onto the A/C compressor. Secure the hoses with the A/C compressor hose block fitting washer and the bolt.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Hold the block in place. Hand tighten the A/C compressor block fitting bolt.

   Tighten

   Tighten the A/C compressor hose block fitting bolt to 35 N·m (26 lb ft).

4. Connect the negative battery cables.
5. Add refrigerant to the system. Refer to *Refrigerant Recovery and Recharging.*
6. Inspect the system for leaks. Refer to *Leak Testing.*
7. Lower the cab.

O-Ring Replacement

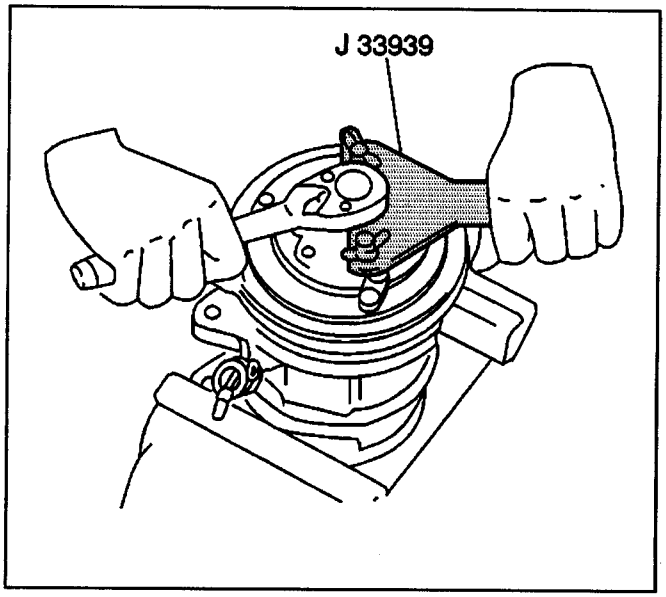
- Before attempting any service that will expose the refrigerant lines or the components to the atmosphere, refer to Handling Refrigerant R-134a., *Handling of Refrigerant Lines and Fittings* and *Maintaining Chemical Stability.*
- Follow the instructions in Refrigerant Recovery for the unit that is being serviced.
- Install new replacement air conditioning O-ring seals whenever a joint or a fitting is installed. If the O-ring seals are included with new replacement components, use these included O-ring seals. Excessive leakage of Refrigerant-134a may occur if the service replacement O-ring seals do not bear the specified part numbers. Refer to the part number for identification.
- Coat the air conditioning O-ring seals with 525 viscosity refrigerant oil just before installation. Slip the air conditioning O-ring seals onto the flange tube in order to ensure proper locating and sealing. Do not soak the O-ring seals in refrigerant oil. Soaking the O-rings may cause swelling and reduced sealing effectiveness.
- Examine the O-ring seals and the fitting before installation. Ensure that the parts are not nicked or deformed. Replace nicked or deformed parts in order to prevent leakage.

Compressor Magnetic Clutch (Disassembly)

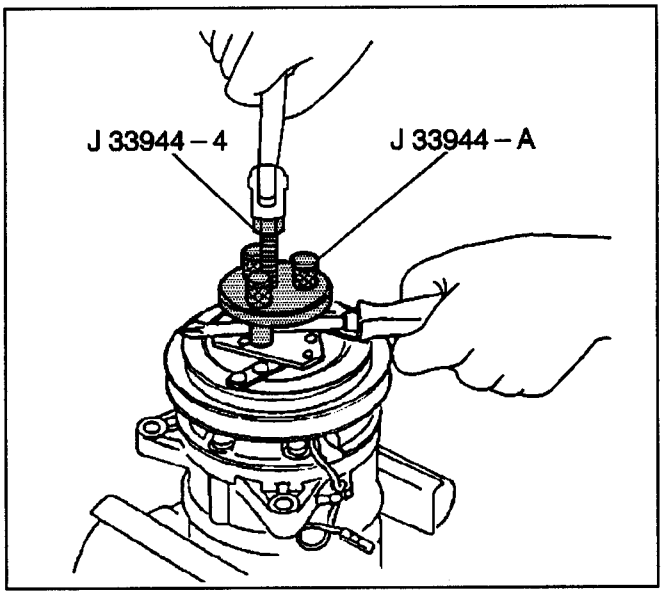
Tools Required

- *J 33939* Armature Holder
- *J 33944-A* Armature Plate Remover
- *J 33944-4* Puller Forcing Screw

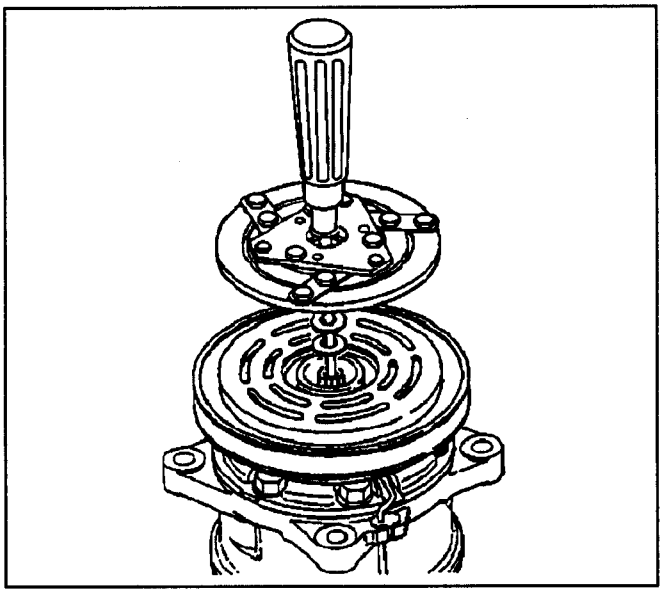
1. Remove the armature bolt from the A/C compressor shaft by inserting the two pins of the *J 33939* into any two threaded holes of the armature.
2. Remove the armature. Replace the driver plate and pulley if the surface shows signs of damage due to excessive heat.



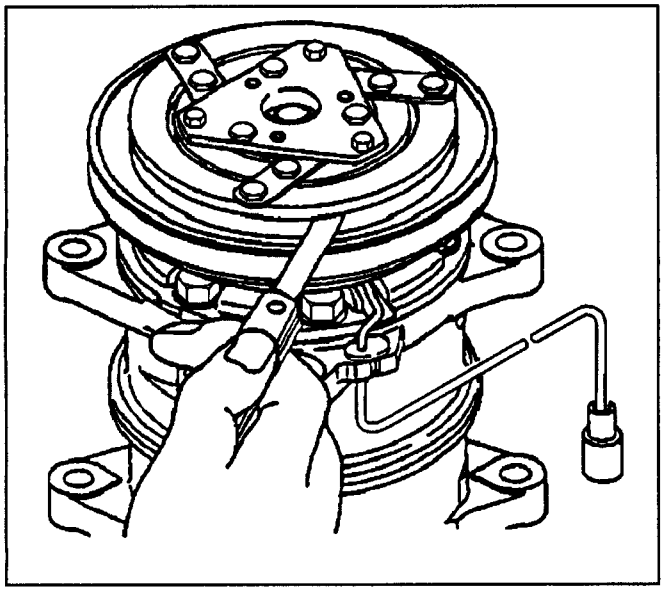
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3. Remove the shim(s) from the front housing.

Compressor Magnetic Clutch (Assembly)

Tools Required

- *J 33939* Armature Holder
- *J 33940-A* Puller Installer
- *J 8092* Driver Handle
- *J 4245* External Snap Ring Pliers

1. Install the shim on the A/C compressor shaft.
2. Clean the armature with suitable cleaning solvent.
3. Install the armature onto the A/C compressor shaft by inserting the two pins of the *J 33939* into any two threaded holes of the armature.
4. Use the *J 37872* in order to hold the plate.

   Notice: Refer to *Fastener Notice* in Cautions and Notices
5. Install the armature bolt on the A/C compressor shaft.

   Tighten

   Tighten the armature bolt to 13 N·m (113 lb in).
6. Inspect the armature clearance. Ensure that the armature clearance is between 0.3 – 0.6 mm (0.01–0.02 in).

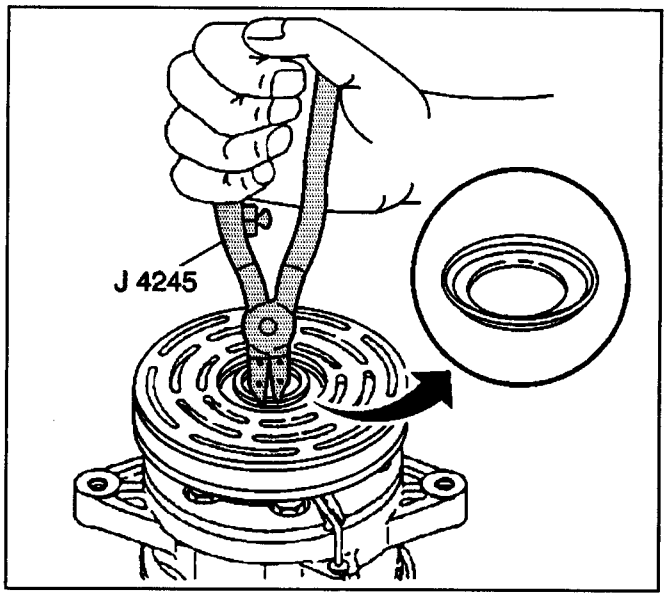
Compressor Magnetic Clutch (Pulley)

Removal Procedure

Tools Required

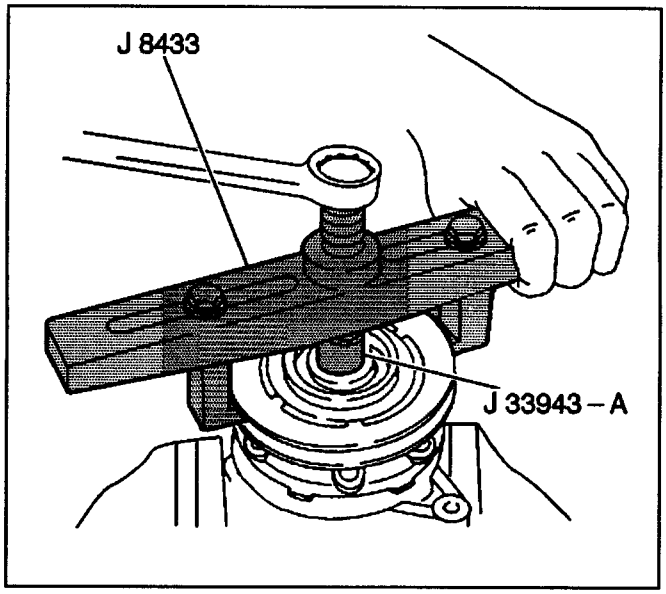
- *J 33943-A* Pulley Puller Pilot
- *J 4245* External Snap Ring Pliers
- *J 8433* Compressor Pulley Puller

1. Remove the armature from the A/C compressor. Refer to *Compressor Magnetic Clutch (Disassembly)*.
2. Use the *J 4245* in order to remove the front housing snap ring.
3. Remove the front housing snap ring cover, if equipped.



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4. Remove the pulley.
   - 4.1. Align the *J 33943-A* to the center bolt of the A/C compressor shaft.
   - 4.2. Turn the puller center bolt to the right until the pulley is free.



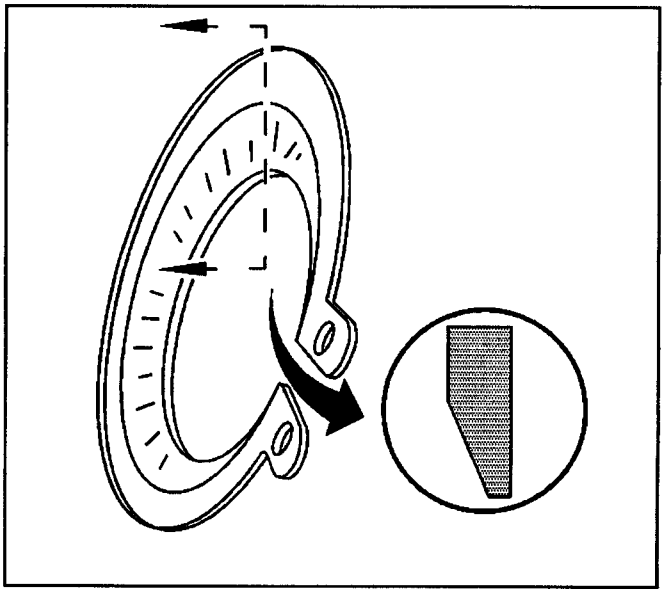
230299

Installation Procedure

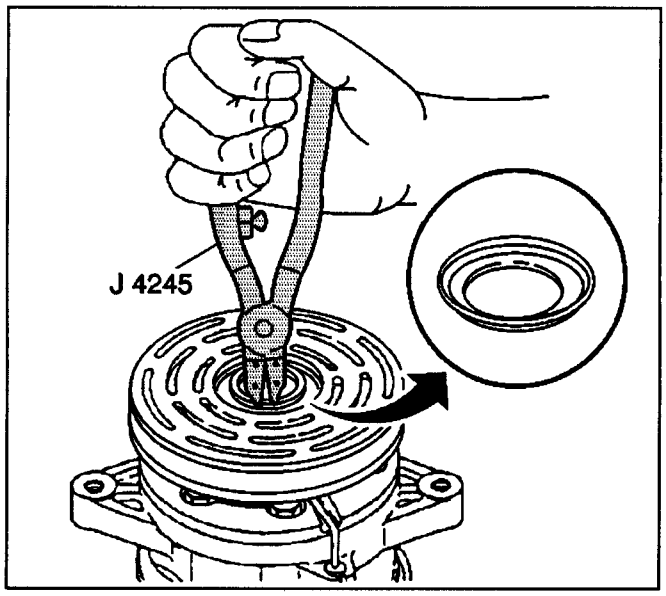
Tools Required

- *J 33939* Armature Holder
- *J 33940-A* Puller Installer
- *J 8092* Driver Handle
- *J 4245* External Snap Ring Pliers

1. Install the front housing snap ring cover, if equipped.

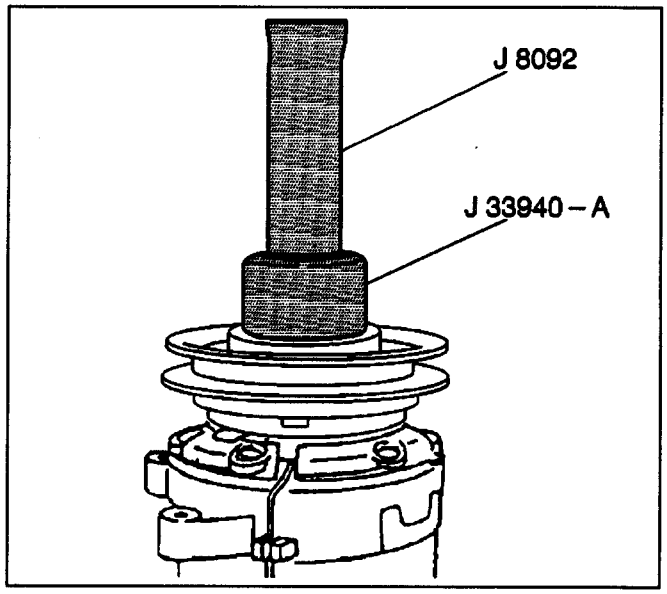


230309



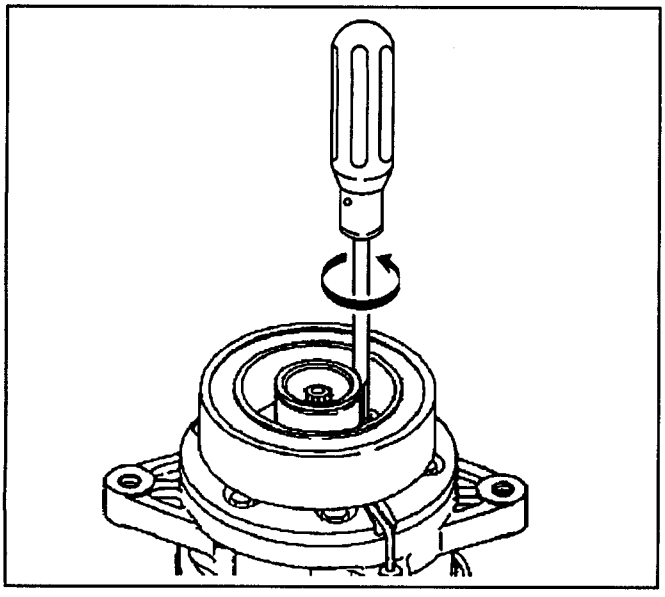
230287

2. Install the front housing snap ring with the *J 4245* External Snap Ring Pliers.



230305

3. Install the pulley.
   3.1. Place the *J 33940-A* on the A/C compressor shaft.
   3.2. Place the *J 8092* on the A/C compressor shaft.
   3.3. Tap the end of the *J 8092* in order to guide the rotor pulley on the A/C compressor shaft until it bottoms out against the A/C compressor front housing hub. A distinct change of sound will indicate that the pulley has bottomed out.
4. Install the armature on the A/C compressor. Refer to *Compressor Magnetic Clutch (Assembly)*.



230317

Compressor Magnetic Clutch (Field Coil)

Removal Procedure

1. Remove the armature from the A/C compressor. Refer to *Compressor Magnetic Clutch (Disassembly)*.
2. Remove the pulley from the A/C compressor. Refer to *Compressor Magnetic Clutch (Pulley)*.
3. Remove the field coil lead wire from the clip on top of the A/C compressor front housing.
4. Remove the field coil screw and field coil from the A/C compressor.

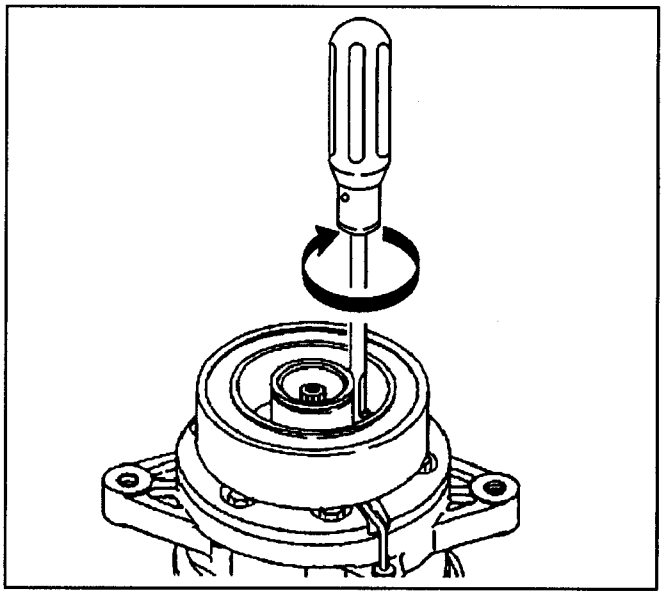
Installation Procedure

1. Install the field coil on the A/C compressor with the field coil screw.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the field coil lead wire on the clip on top of the A/C compressor front housing.

   Tighten

   Tighten the field coil screw to 5 N·m(44 lb in).
3. Install the pulley on the A/C compressor.
4. Install the armature on the A/C compressor. Refer to *Compressor Magnetic Clutch (Assembly).*



230319

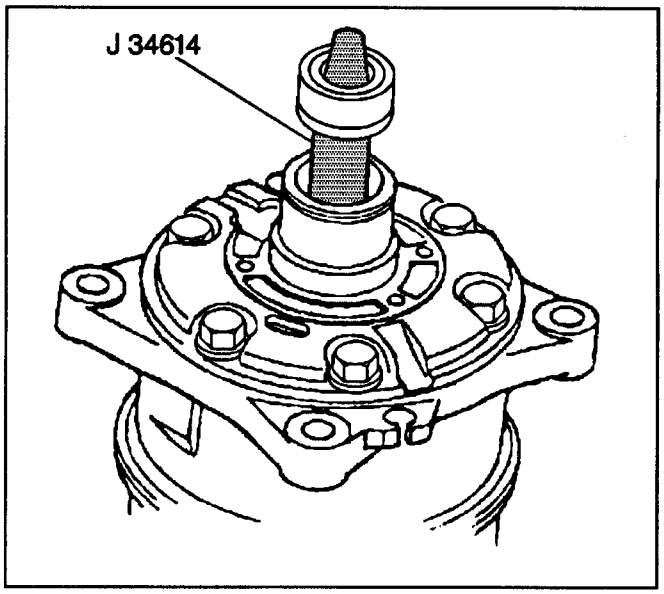
Compressor Magnetic Clutch (A/C Compressor Seal)

Removal Procedure

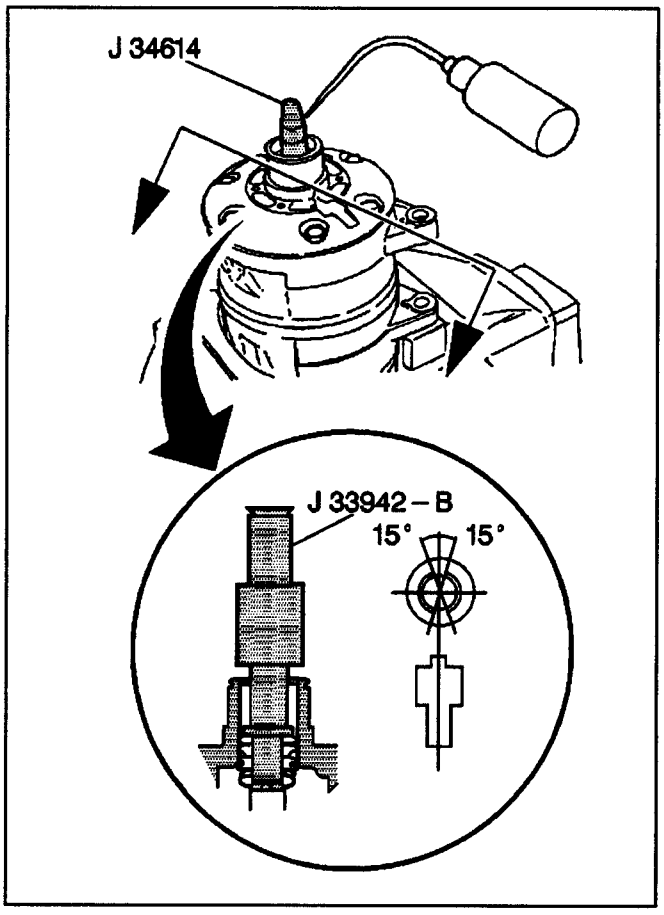
Tools Required

- *J 4245* External Snap Ring Pliers
- *J 33942-B* Seal Seat Remover/Installer

1. Remove the armature from the A/C compressor. Refer to *Compressor Magnetic Clutch (Disassembly).*
2. Remove the pulley from the A/C compressor. Refer to *Compressor Magnetic Clutch (Pulley).*
3. Remove the field coil from the A/C compressor. Refer to *Compressor Magnetic Clutch (Field Coil).*
4. Remove the felt from the compressor shaft. if equipped.
5. Use the *J 33942-B* in order to remove the seal shaft cover (if equipped) from the compressor shaft.
6. Engage the hook with the shaft seal cover grove.
7. Remove the shaft seal cover off the compressor shaft.
8. Use the *J 4245* in order to remove the snap ring from the compressor shaft.
9. Use the *J 33942-B* in order to remove the shaft seal from the compressor shaft.
10. Engage the hook with the shaft seal grove and slowly remove the shaft seal off the compressor shaft.
11. Discard the shaft seal.



230337



230356

Installation Procedure

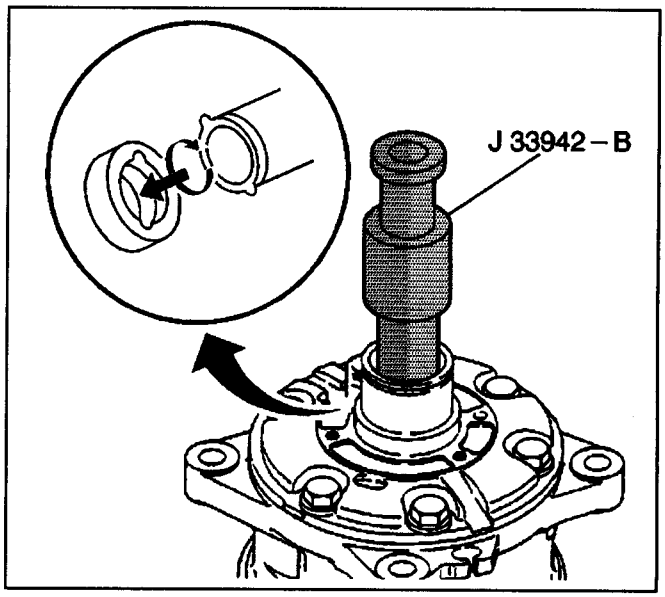
Tools Required

- *J 34614* Shaft Seal Protector
- *J 4245* External Snap Ring Pliers
- *J 33942-B* Seal Seat Remover/Installer

Important: Keep the new shaft seal free from oil, grease and all contaminates.

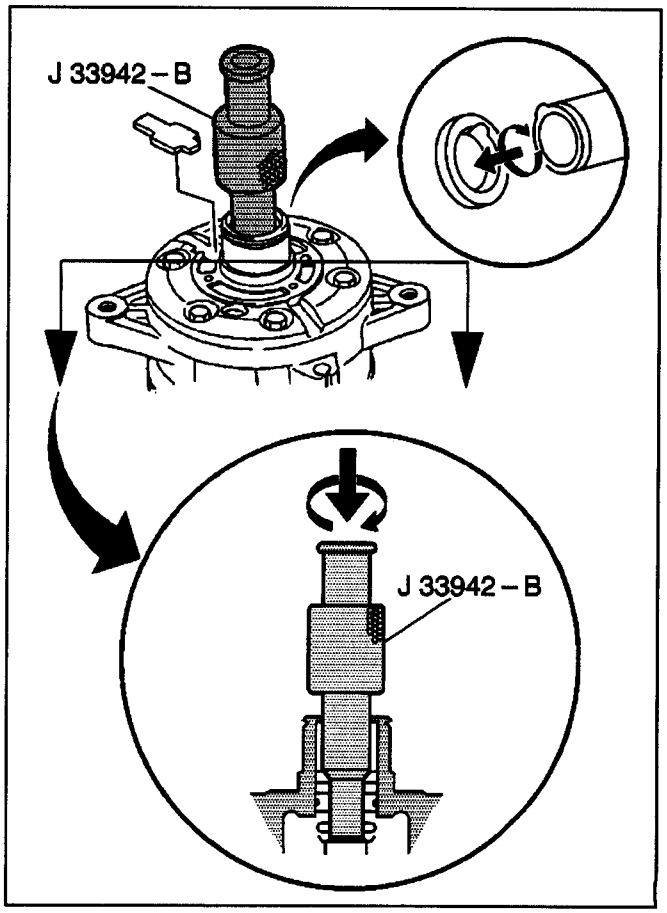
1. Clean the shaft seal sealing portions of the compressor housing and the compressor shaft.
2. Coat the new shaft seal and the *J 34614* Shaft Seal Protector with new compressor oil.
3. Position the *J 34614* Shaft Seal Protector over the compressor shaft.
4. Position the new shaft seal on the compressor shaft.

5. Use the *J 33942-B* in order to install the new shaft seal on the compressor shaft.



230347

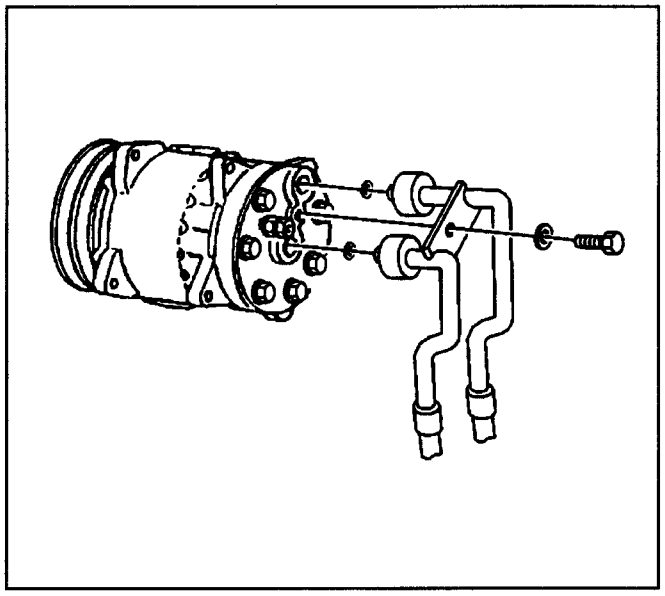
6. Use the *J 33942-B* in order to install the shaft seal cover on the compressor shaft.
7. Install the field coil.
8. Install the pulley on the A/C compressor.
9. Install the armature on the A/C compressor. Refer to *Compressor Magnetic Clutch (Assembly)*.



230355

Compressor Overhaul

The operations described here are based on bench repair with the A/C compressor removed from the vehicle.



229691

Compressor Hose Assembly Replacement

Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.

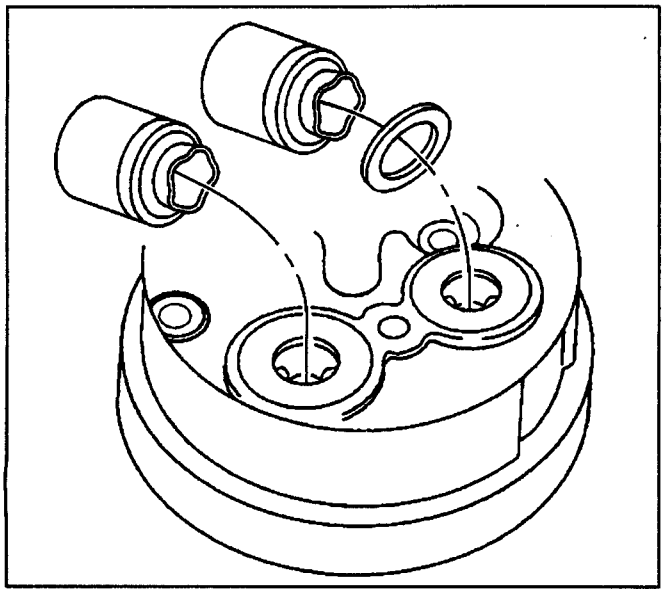
   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

2. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
3. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*

   Important: When removing the sealing washers, prevent dirt or foreign materials from getting on the surfaces of the following components:

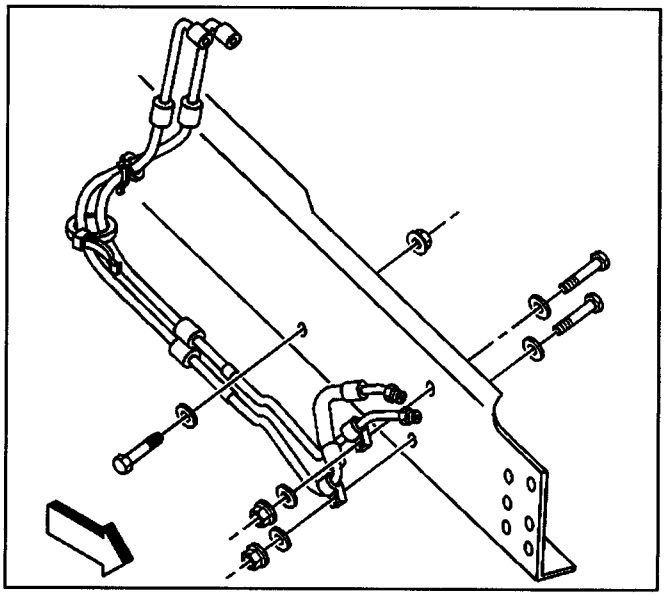
   - The washers
   - The block fitting
   - The A/C compressor ports

   Clean all of the sealing surfaces with a lint-free rag.
4. Remove the A/C compressor hose block fitting bolt.
5. Remove the A/C compressor sealing washers. Discard the A/C compressor sealing washers.



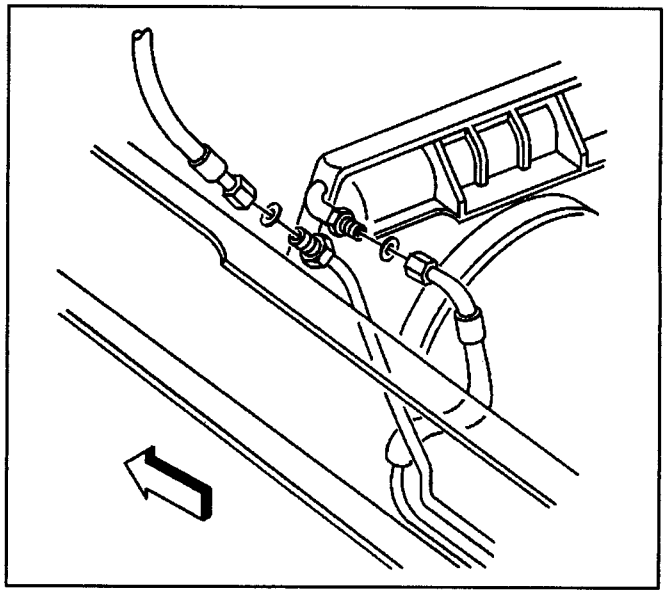
334243

6. Remove the refrigerant hoses from the A/C compressor.



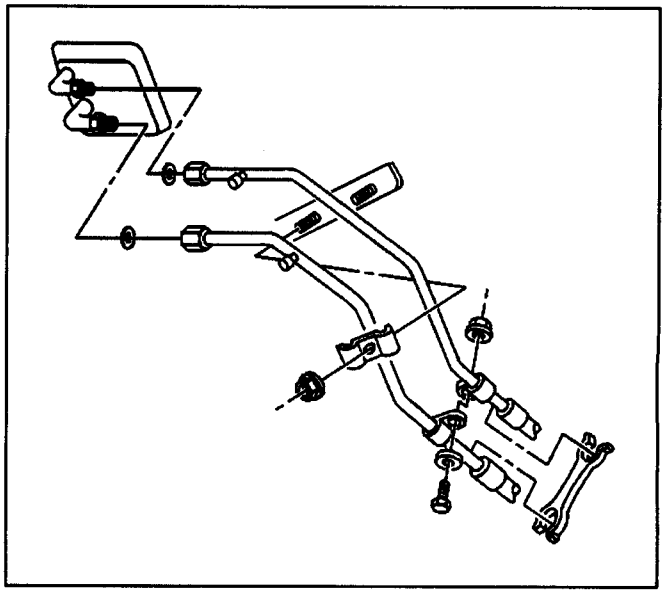
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7. Remove the refrigerant hose from the A/C condenser.
8. Remove the O-ring seal.
   Discard the O-ring seal.

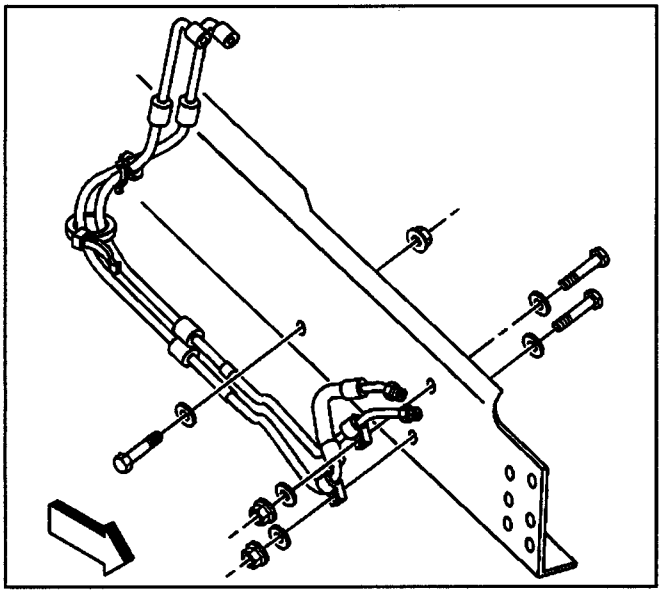


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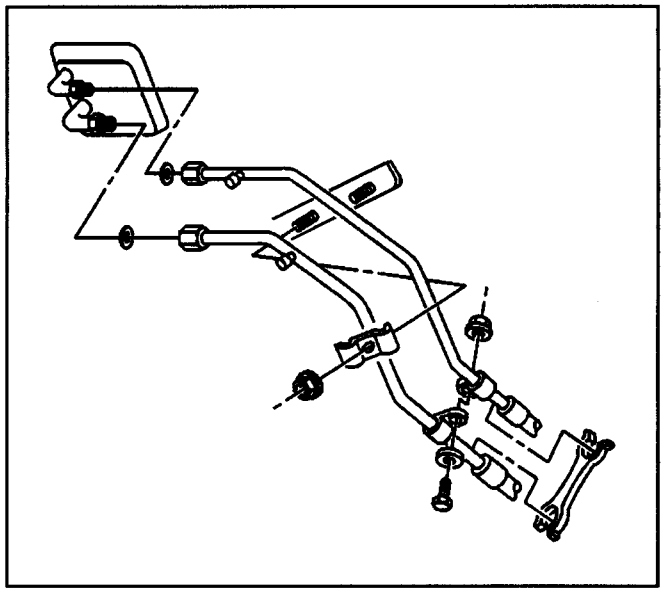
9. Remove the refrigerant hose from the A/C evaporator.
10. Remove the O-ring seal.
    Discard the O-ring seal.
11. Remove the following components from the frame rail and the refrigerant hoses:
    - The hose clamp nuts
    - The washers
    - The bolts
    - The hose clamps



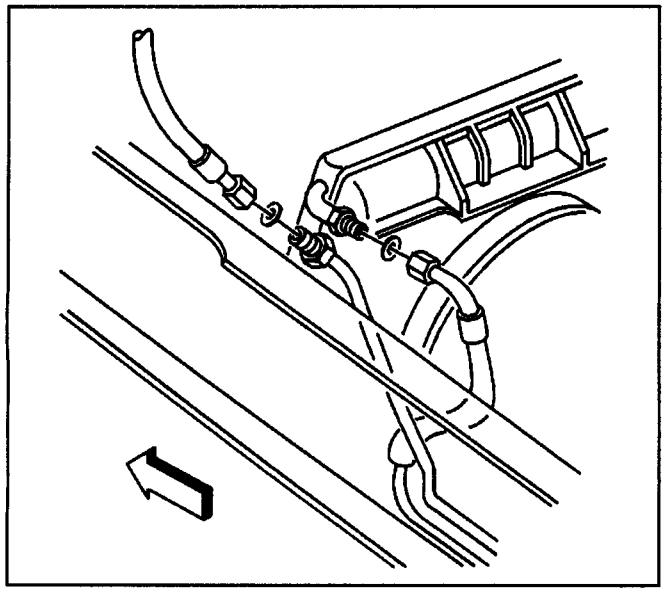
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Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the hose clamps to the refrigerant hoses and frame rail. Secure the hose clamps with bolts washers and nuts.
   Tighten
   Tighten the refrigerant hose clamp nuts to 30 N.m (22 lb ft).
2. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
3. Install the new O-ring seal into the A/C evaporator end of the refrigerant hose.
4. Connect the refrigerant hose to the A/C evaporator.
   Tighten
   Tighten the refrigerant hose fitting at the A/C evaporator to 32 N.m (24 lb ft).
5. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
6. Install the new O-ring seal in the A/C condenser end of the refrigerant.
7. Connect the refrigerant hose to the A/C condenser.
   Tighten
   Tighten the refrigerant hose fitting at the A/C condenser to 23 N.m (17 lb ft).
8. Fill the refrigerant hoses. Refer to *Refrigerant Oil Distribution Specifications.*

Important: When installing the sealing washers, prevent dirt or foreign materials from getting on the surfaces of the following components:

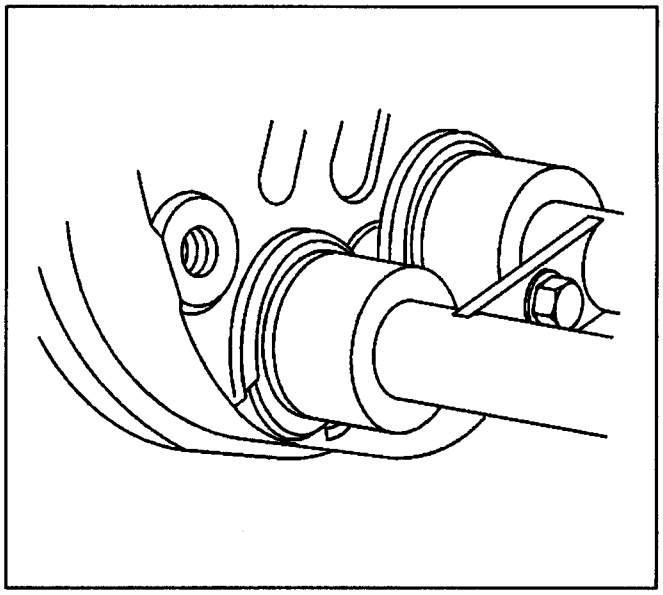
- The washers
- The block fitting
- The A/C compressor ports

Clean all of the sealing surfaces with a lint-free rag.

Do not reuse the sealing washers.

Do not oil the sealing washers prior to assembly.

9. Install the new sealing washers onto the pilots of the block fitting. Ensure that the washers bottom against the surface of the block fitting.

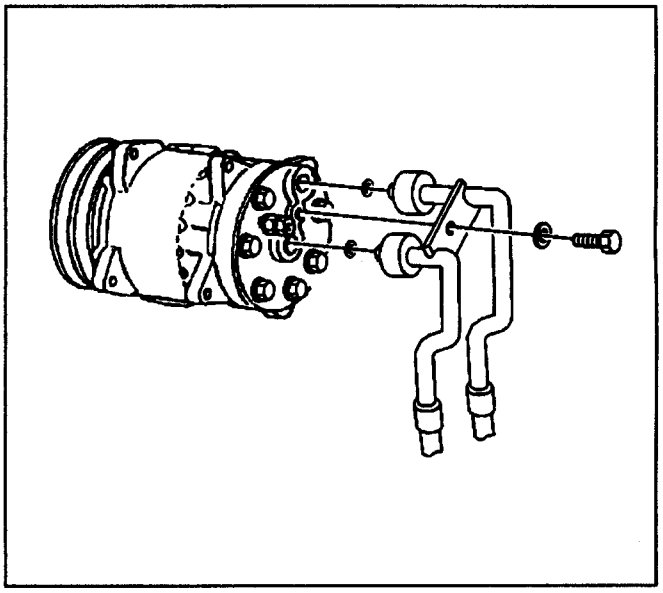


334249

10. Install the refrigerant hoses on the A/C compressor. Secure the compressor with the A/C compressor hose block fitting bolt.
11. Hold the block in place. Hand tighten the A/C compressor block fitting bolt.

    Tighten

    Tighten the A/C compressor hose block fitting bolt to 35 N·m (26 lb ft).
12. Connect the negative battery cables.
13. Add the refrigerant to the system. Refer to *Refrigerant Recovery and Recharging.*
14. Inspect the system for leaks. Refer to *Leak Testing.*
15. Lower the cab.



229691

Evaporator Hose Assembly Replacement

Removal Procedure

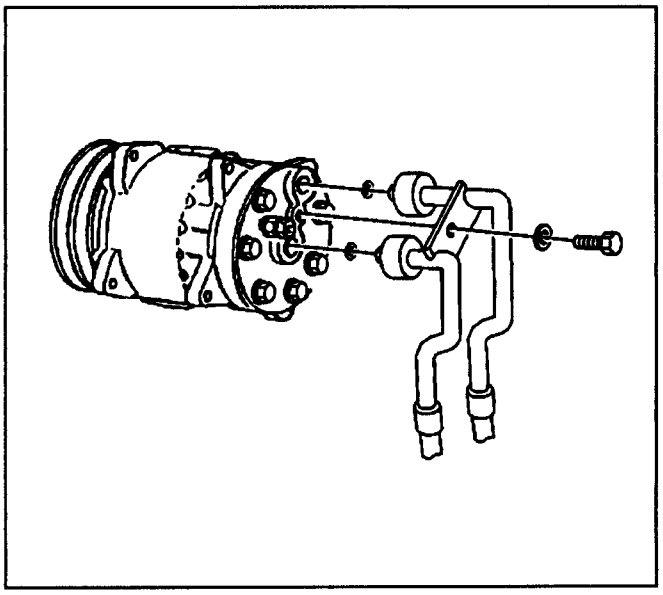
1. Tilt the cab. Refer to *Cab Tilting* in General Information.

   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Disconnect the negative battery cables.
3. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*

   Important: When removing the sealing washers, prevent dirt or foreign materials from getting on the surfaces of the following components:

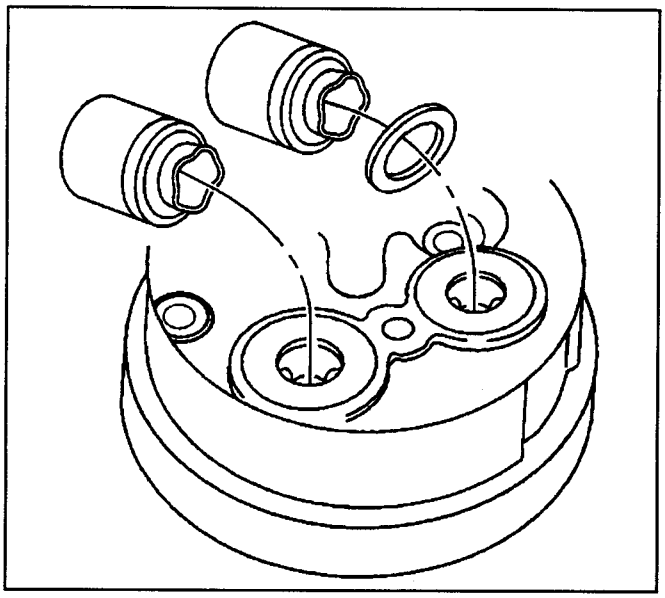
   - The washers
   - The block fitting
   - The A/C compressor ports

   Clean all of the sealing surfaces with a lint-free rag.

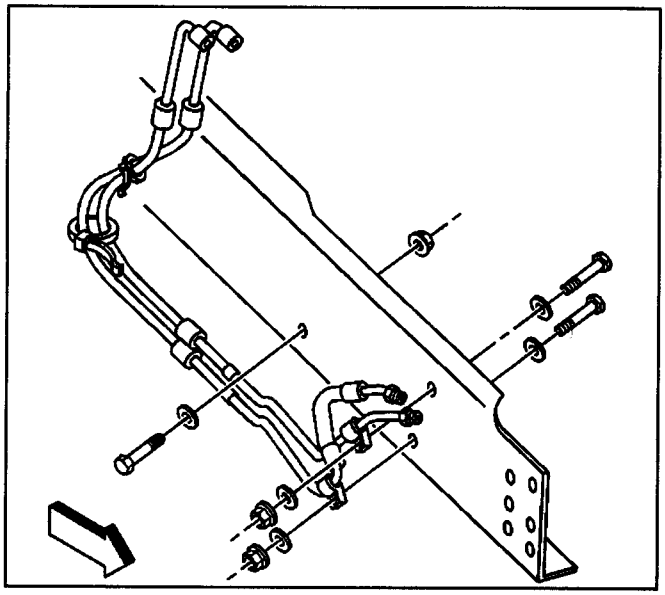


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4. Remove the A/C compressor hose block fitting bolt.
5. Remove the A/C compressor sealing washers. Discard the A/C compressor sealing washers.



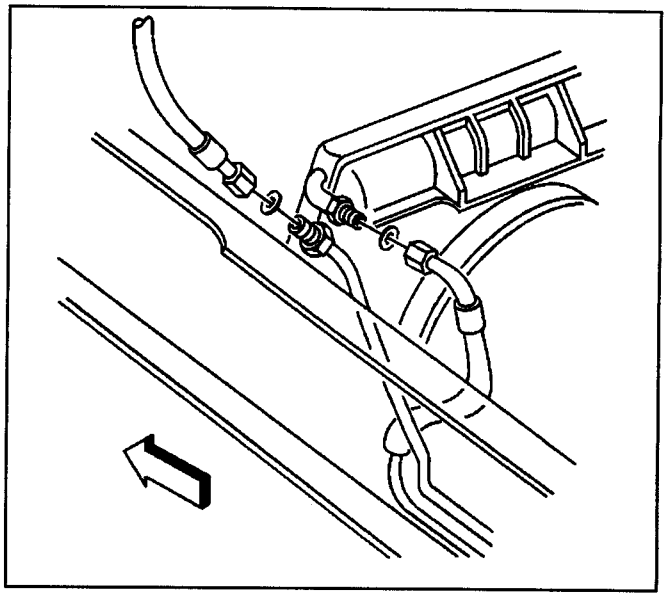
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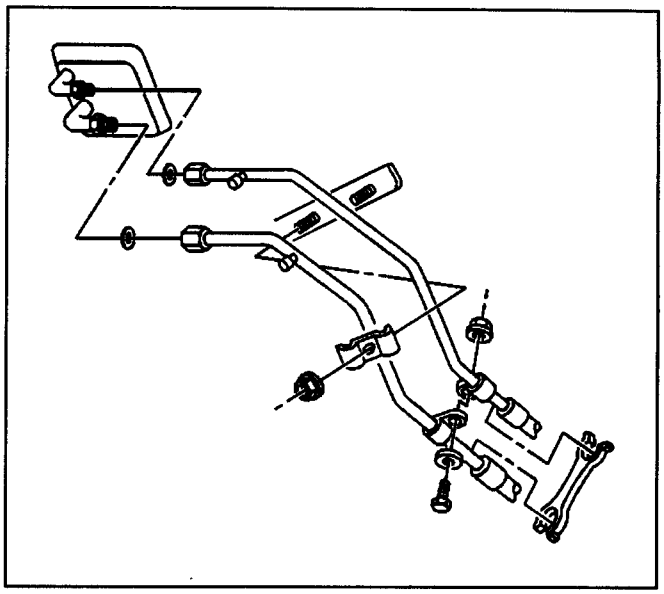
6. Remove the refrigerant hoses from the A/C compressor.

7. Remove the refrigerant hose from the A/C condenser.
8. Remove the O-ring seal.
   Discard the O-ring seal.



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9. Remove the refrigerant hose from the A/C evaporator.
10. Remove the O-ring seal.
    Discard the O-ring seal.
11. Remove the following components from the frame rail and the refrigerant hoses:
    - The hose clamp nuts
    - The washers
    - The bolts
    - The hose clamps

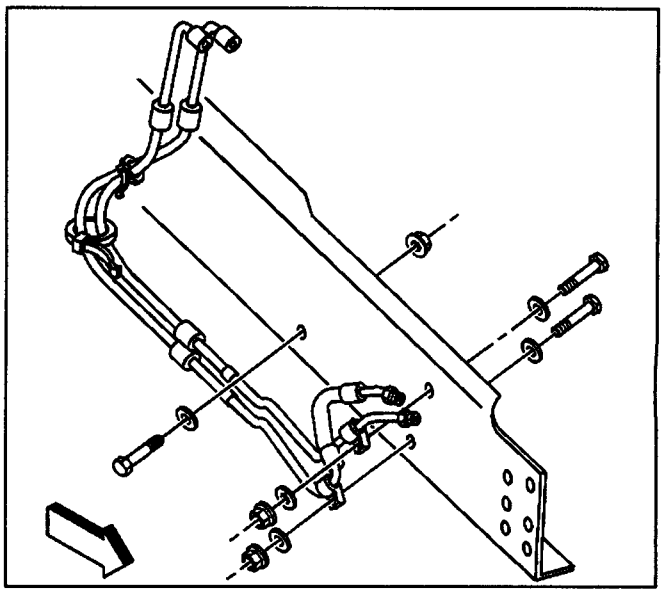


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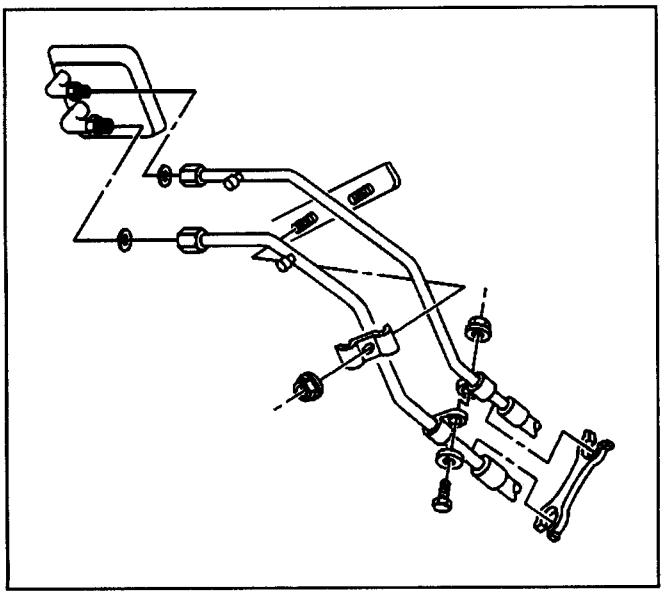
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the hose clamps to the refrigerant hoses and the frame rail. Secure the hose clamps with the bolts, the washers and the nuts.
   Tighten
   Tighten the refrigerant hose clamp nuts to 30 N·m (22 lb ft).
2. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
3. Install the new O-ring seal in the A/C evaporator end of the refrigerant hose.

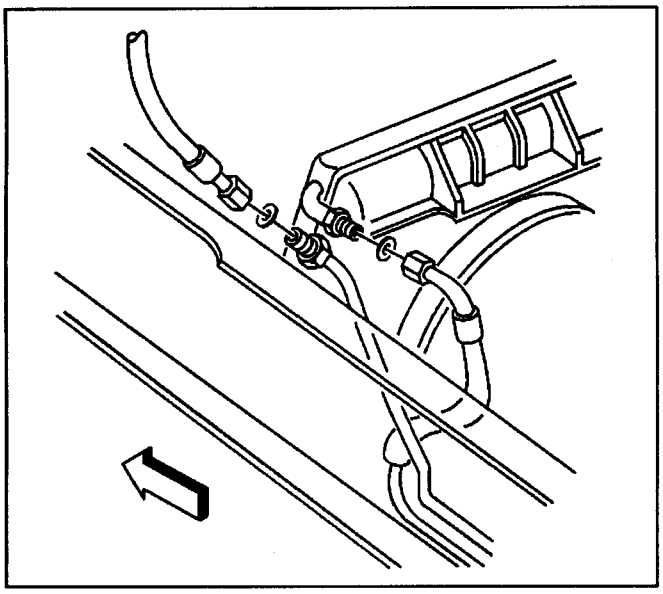


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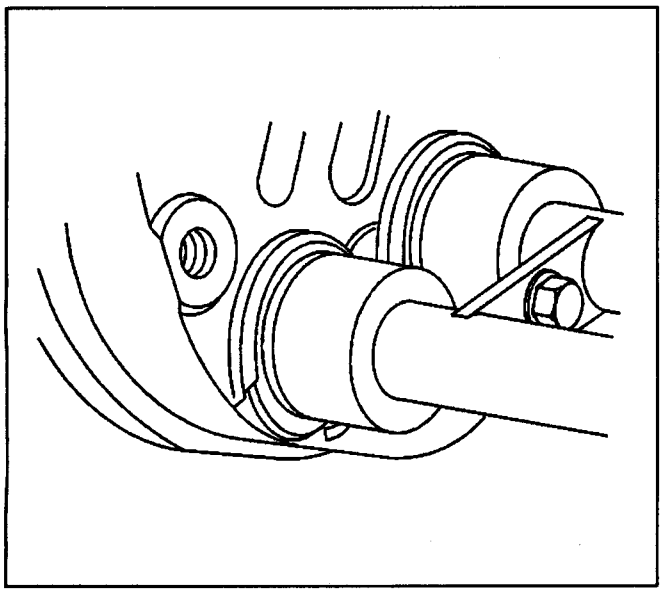
229714

4. Connect the refrigerant hose to the A/C evaporator.
   Tighten
   Tighten the refrigerant hose fitting at the A/C evaporator to 32 N·m (24 lb ft).
5. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.



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6. Install the new O-ring seal in the A/C condenser end of the refrigerant.
7. Connect the refrigerant hose to the A/C condenser.
   Tighten
   Tighten the refrigerant hose fitting at the A/C condenser to 23 N·m (17 lb ft).
8. Fill the refrigerant hoses. Refer to *Refrigerant Oil Distribution Specifications*.



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Important: When installing the sealing washers, prevent dirt or foreign materials from getting on the surfaces of the following components:

- The washers
- The block fitting
- The A/C compressor ports

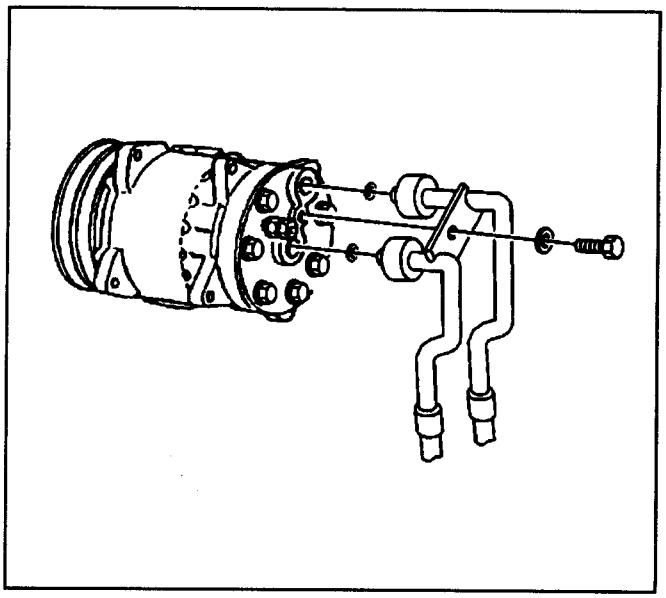
Clean all of the sealing surfaces with a lint-free rag.

Do not reuse the sealing washers.

Do not oil the sealing washers prior to assembly.

9. Install the new sealing washers onto the pilots of the block fitting. Ensure that the washers bottom against the surface of the block fitting.

10. Install the refrigerant hoses to the A/C compressor. Secure the refrigerant hoses with the A/C compressor hose block fitting bolt.
11. Hold the block in place. Hand tighten the A/C compressor block fitting bolt.
    Tighten
    Tighten the A/C compressor hose block fitting bolt to 35 N·m (26 lb ft).
12. Connect the negative battery cables.
13. Add the refrigerant to the system. Refer to *Refrigerant Recovery and Recharging.*
14. Inspect the system for leaks. Refer to *Leak Testing.*
15. Lower the cab.



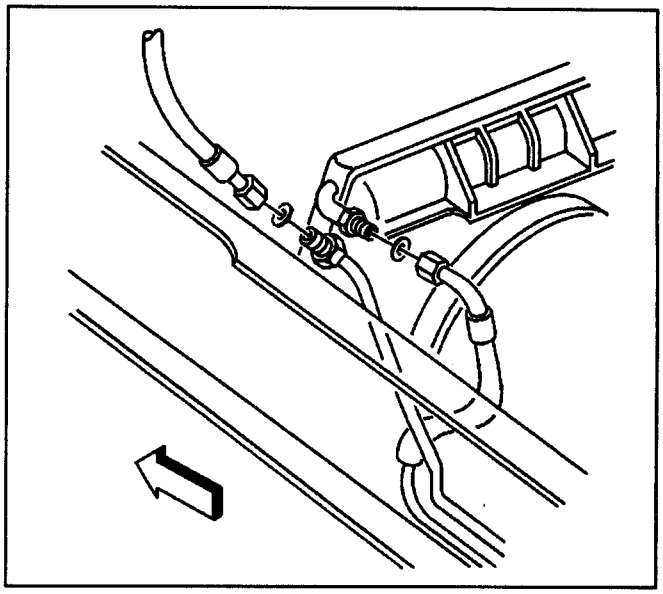
229691

Receiver Dehydrator and Evaporator Hose Assembly

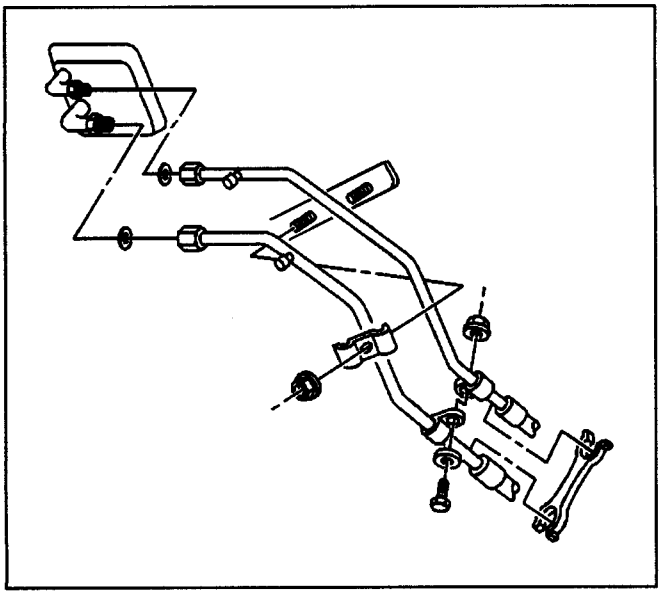
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
2. Open the hood.
3. Secure the hood.
4. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
5. Remove the low pressure hose at the A/C evaporator.
6. Remove the O-ring seal.
   Discard the O-ring seal.
7. Remove the high pressure hose at the A/C evaporator.
8. Remove the O-ring seal.
   Discard the O-ring seal.
9. Remove the following components from the bracket stud:
   - The A/C evaporator bracket nut
   - The A/C evaporator hose bracket

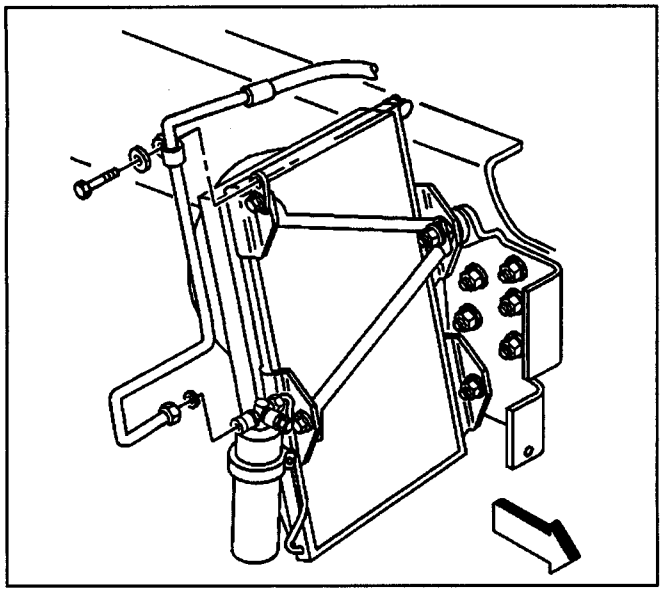


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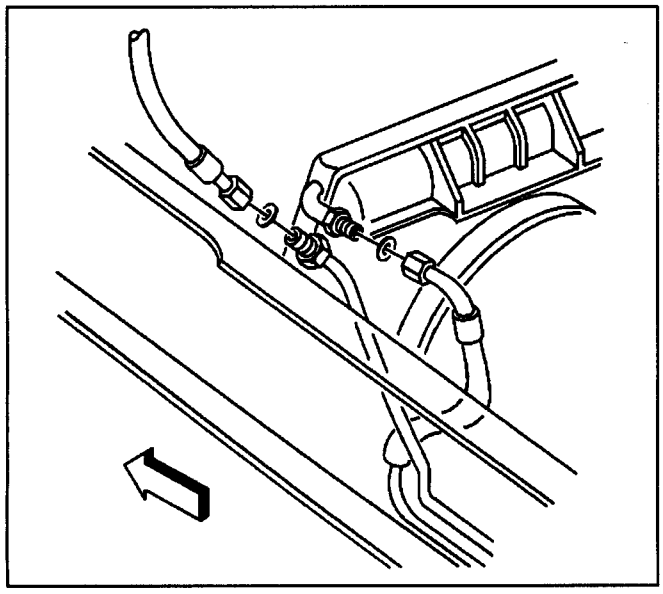
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10. Remove the following components from the A/C evaporator hoses:
    - The hose clamp nut
    - The washer
    - The bolt
    - The A/C evaporator hose clamp



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11. Remove the low pressure hose at the A/C receiver/dryer or dehydrator.
12. Remove the O-ring seal.
    Discard the O-ring seal.
13. Remove the high pressure hose at the A/C condenser.
14. Remove the O-ring seal.
    Discard the O-ring seal.



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Installation Procedure

1. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
2. Install the new O-ring seal into A/C condenser end of the evaporator hose.
3. Fill the refrigerant hoses. Refer to *Refrigerant Oil Distribution Specifications.*

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
4. Install the high pressure hose to the A/C condenser.

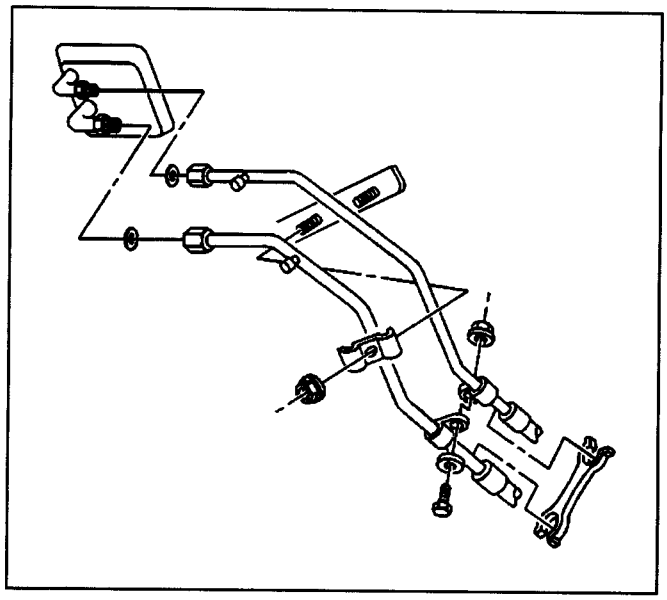
   Tighten

   Tighten the A/C evaporator high pressure hose fitting at the condenser to 18 N.m (14 lb ft).

5. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
6. Install the new O-ring seal into the A/C evaporator end of the A/C evaporator hose.
7. Connect the low pressure hose to the A/C evaporator.

   Tighten

   Tighten the A/C evaporator low pressure hose fitting at the A/C evaporator to 32 N.m (24 lb ft).
8. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.



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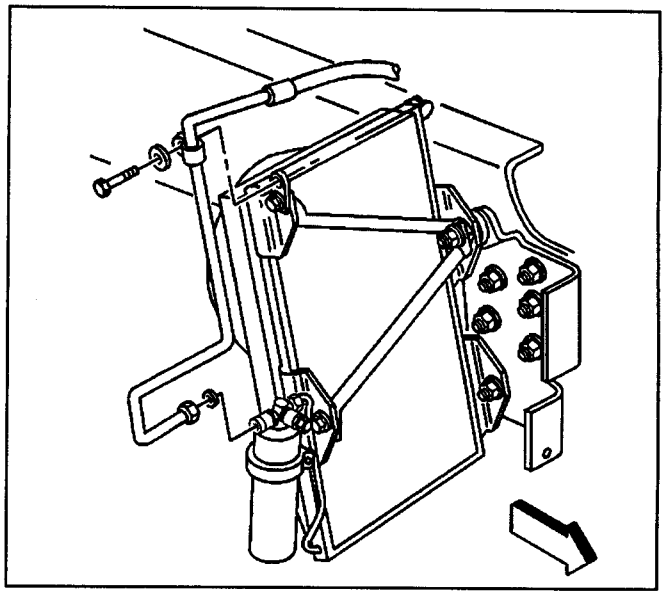
9. Install the new O-ring seal into the A/C evaporator end of the A/C evaporator hose.
10. Install the high pressure hose to the A/C evaporator.
11. Install the A/C evaporator hose clamps to the A/C evaporator. Secure the clamps with the washer, the bolt and the nut.

    Tighten

    Tighten the A/C evaporator hose clamp nut to 30 N.m (22 lb ft).
12. Install the A/C evaporator hose bracket to the A/C evaporator hose bracket stud. Secure the hose bracket with the nut.

    Tighten

    Tighten the A/C evaporator hose bracket nut to 30 N.m (22 lb ft).
13. Connect the negative battery cables.
14. Close the hood.



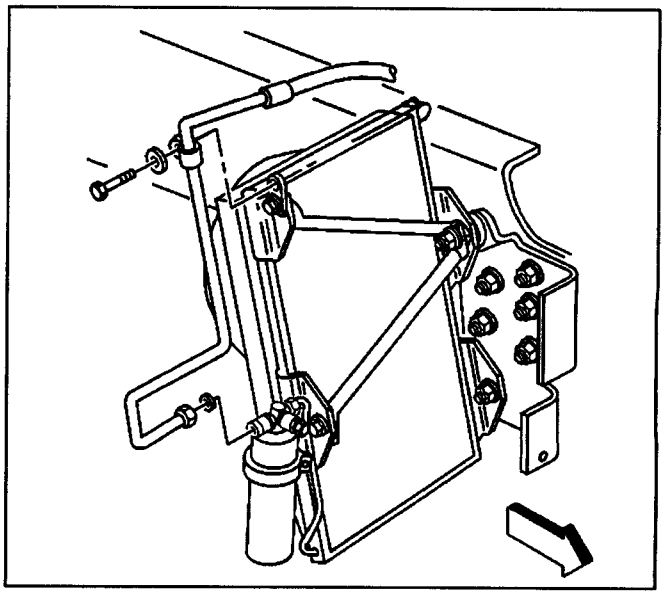
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Receiver Dehydrator Replacement

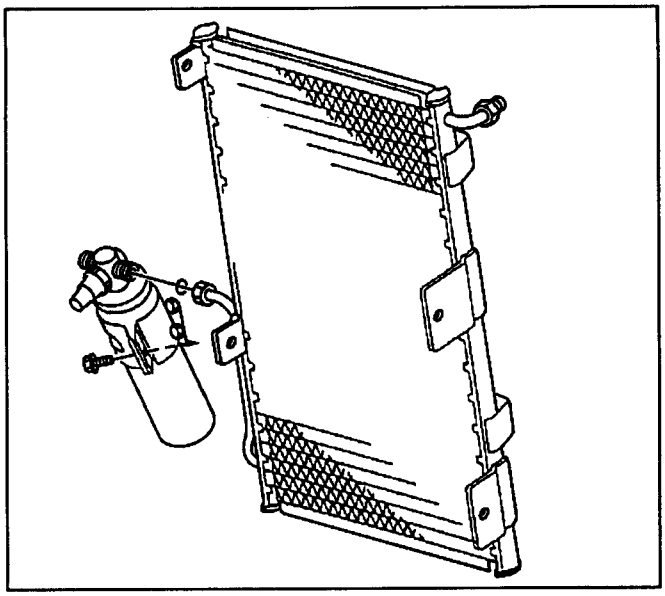
Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.

   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
3. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
4. Remove the A/C receiver/dryer or dehydrator electrical connector from the A/C receiver/dryer or dehydrator pressure switch.

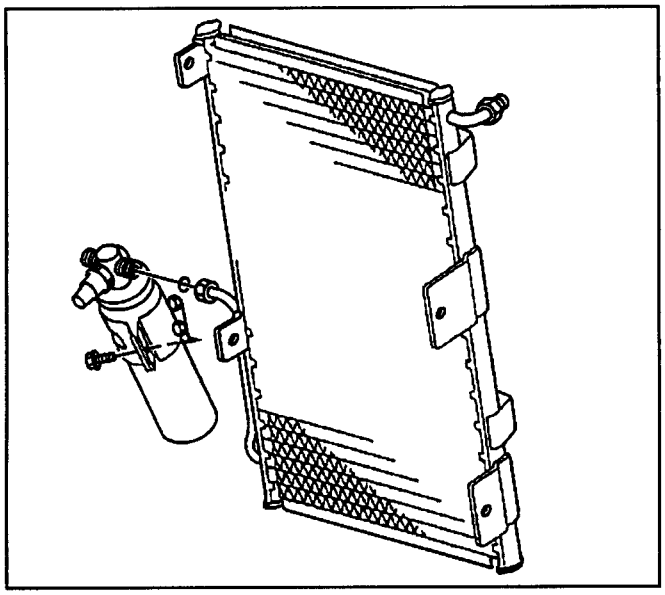


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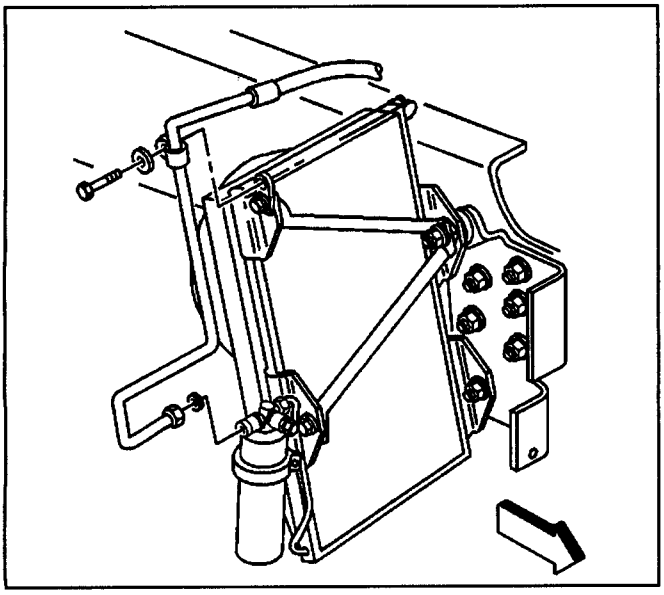
5. Remove the A/C condenser tube.
6. Remove the O-ring seal.
   Discard the O-ring seal.
7. Remove the A/C evaporator hose.
8. Remove the O-ring seal from the A/C condenser.
   Discard the O-ring seal.
9. Remove the A/C receiver/dryer or dehydrator clamp bolt.
10. Remove the A/C receiver/dryer or dehydrator from the A/C receiver/dryer or dehydrator clamp.



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Installation Procedure

1. Install the A/C receiver/dryer or the dehydrator into the A/C receiver/dryer or dehydrator clamp.
2. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
3. Install the new O-ring seal.



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Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Connect the A/C condenser tube to the A/C receiver/dryer or dehydrator.
   Tighten
   Tighten the condenser tube to receiver/dryer or dehydrator fitting to 15 N.m (11 lb ft).
5. Coat the new O-ring seal with R-134a Swash Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
6. Install the new O-ring seal.
7. Install the A/C receiver/dryer and dehydrator clamp bolt.
8. Install the A/C receiver/dryer or dehydrator electrical connector to the A/C receiver/dryer or dehydrator pressure switch.
9. Connect the negative battery cables.
10. Add the refrigerant to the system. Refer to *Refrigerant Recovery and Recharging.*

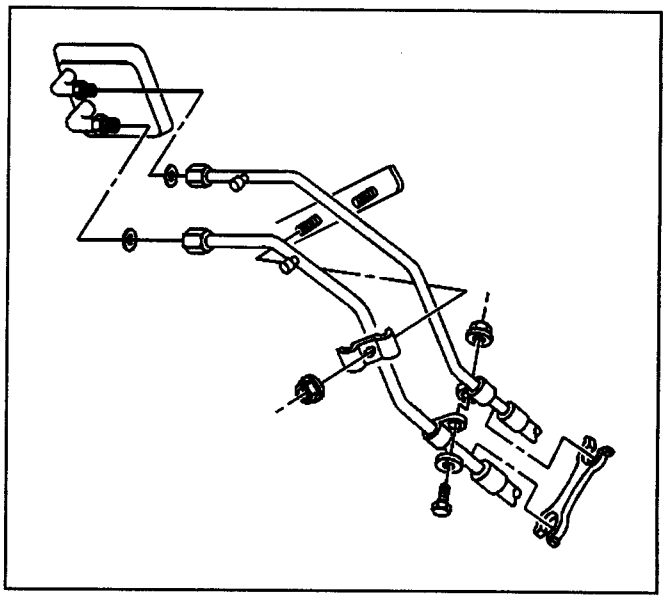
11. Inspect the system for leaks. Refer to *Leak Testing.*
12. Lower the cab.

Thermal Expansion Valve Replacement

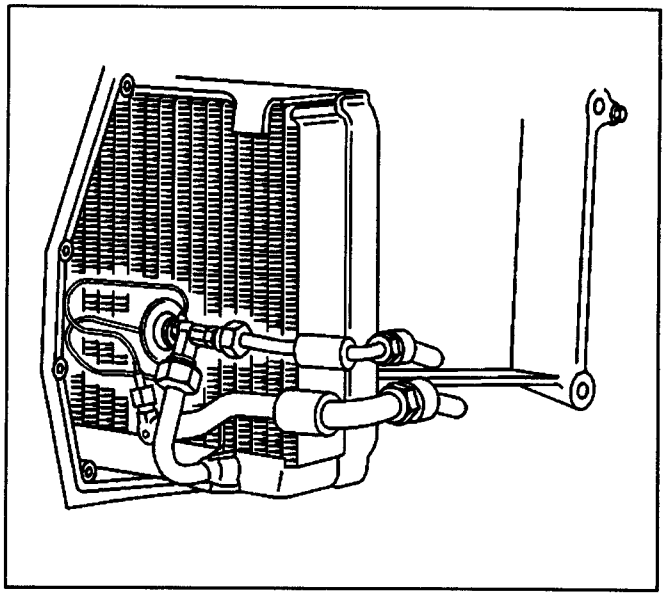
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

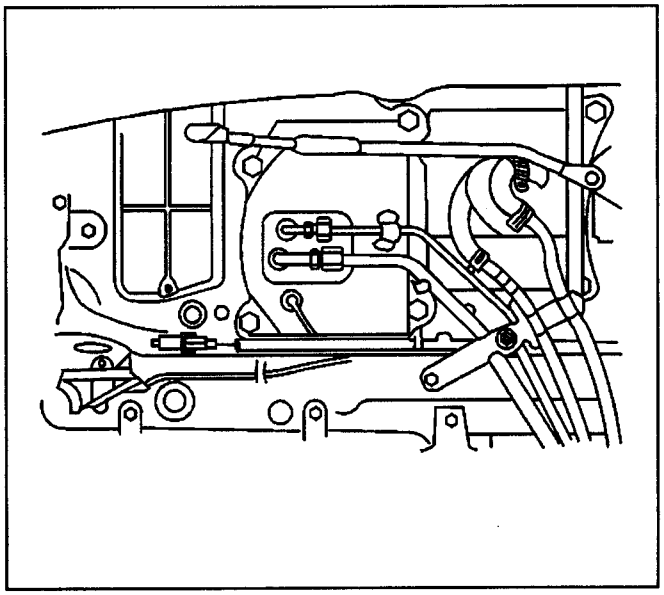
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Open the hood.
3. Secure the hood.
4. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
5. Remove the right wiper arm linkage from the wiper arm pivot.
6. Remove the low pressure hose from the A/C evaporator.
7. Remove the low pressure hose.
8. Remove the O-ring seal.
   Discard the O-ring seal.
9. Remove the high pressure hose.
10. Remove the high pressure hose O-ring seal from the A/C evaporator. Discard the O-ring seal.
11. Remove the A/C evaporator core cover screws.



229714

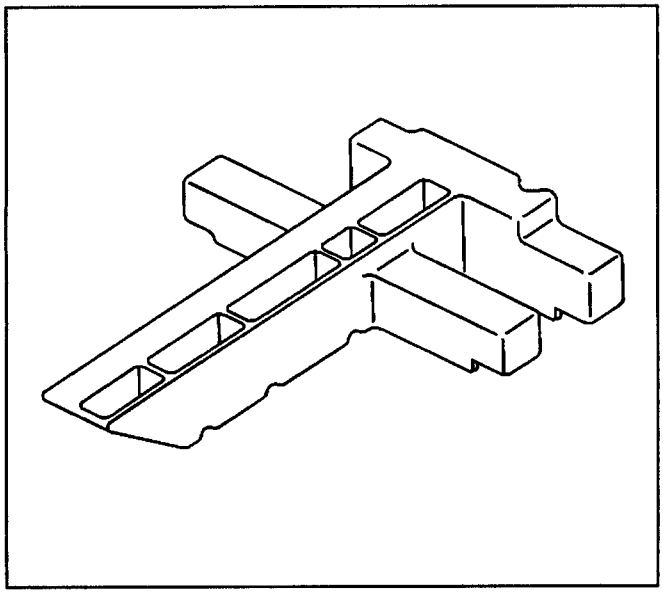


229734



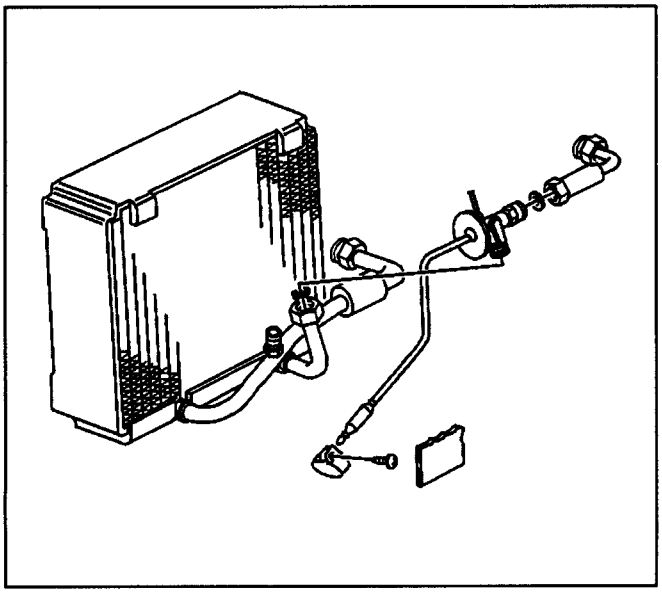
229728

12. Remove the A/C evaporator core cover.



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13. Remove the A/C spacer.
14. Remove the A/C evaporator.
15. Remove the screw and the clamp.



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16. Remove the A/C expansion valve from the low pressure fitting.
17. Remove the A/C expansion valve O-ring seal from the low pressure fitting.
18. Discard the O-ring seal.
19. Remove the A/C expansion valve from the A/C evaporator core.
20. Remove the A/C expansion valve O-ring seal from the A/C evaporator core.
21. Discard the O-ring seal.

Installation Procedure

1. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0 refrigerant oil.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the new O-ring seal and the expansion valve to the A/C evaporator core.

   Tighten

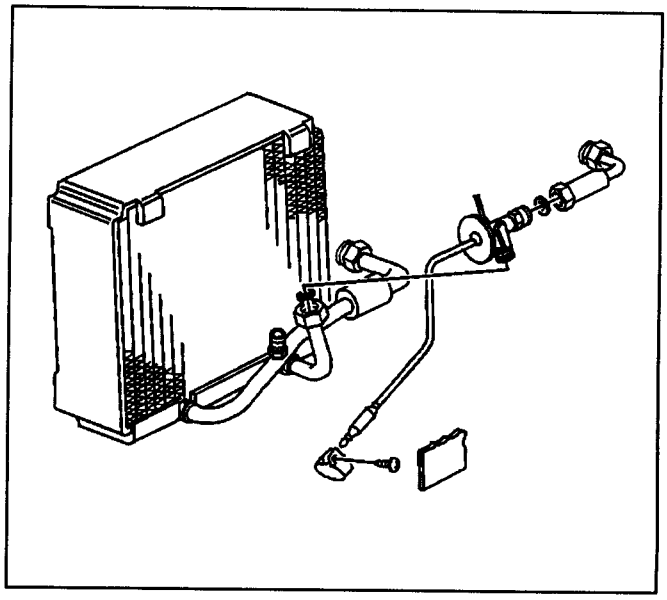
   Tighten the A/C expansion valve fitting to 20 N.m (15 lb in).

3. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
4. Install the new O-ring and A/C expansion valve to the low pressure hose fitting.

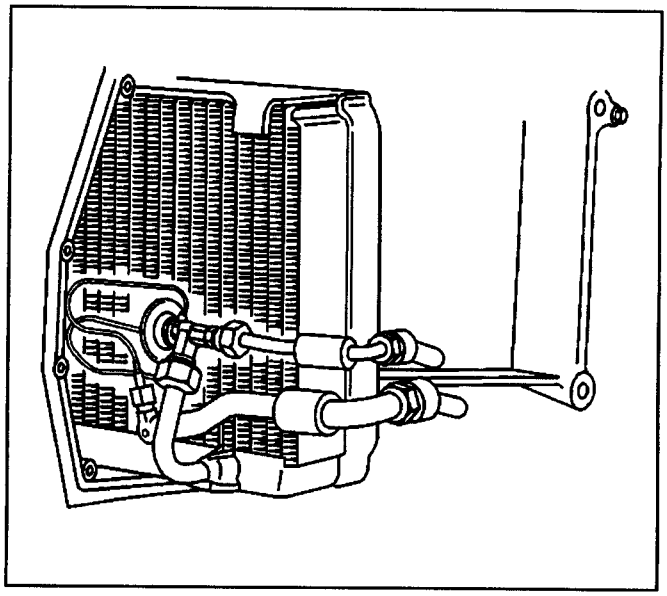
   Tighten

   Tighten the A/C expansion valve low pressure fitting to 15 N.m (11 lb in).

5. Install the screw and the clamp.
6. Fill the A/C evaporator core. Refer to *Refrigerant Oil Distribution Specifications.*

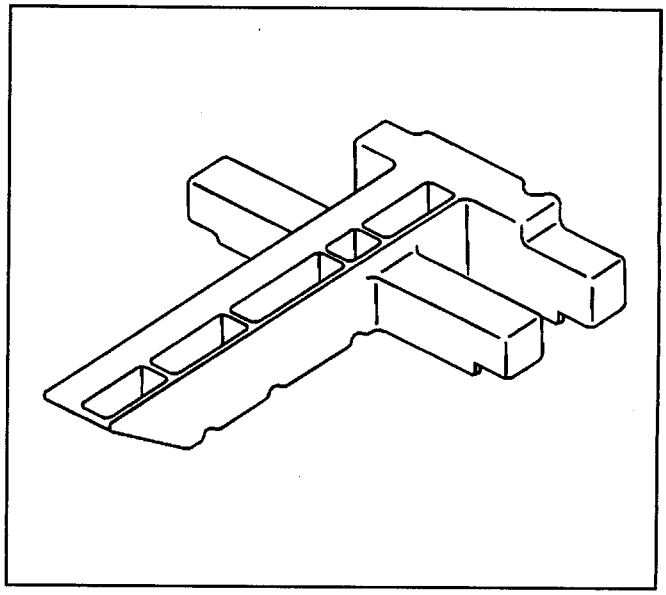


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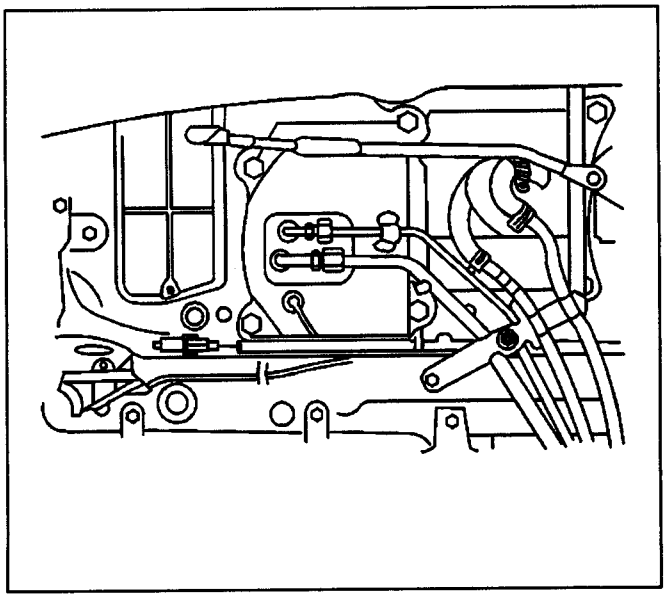


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7. Install the A/C evaporator spacer.

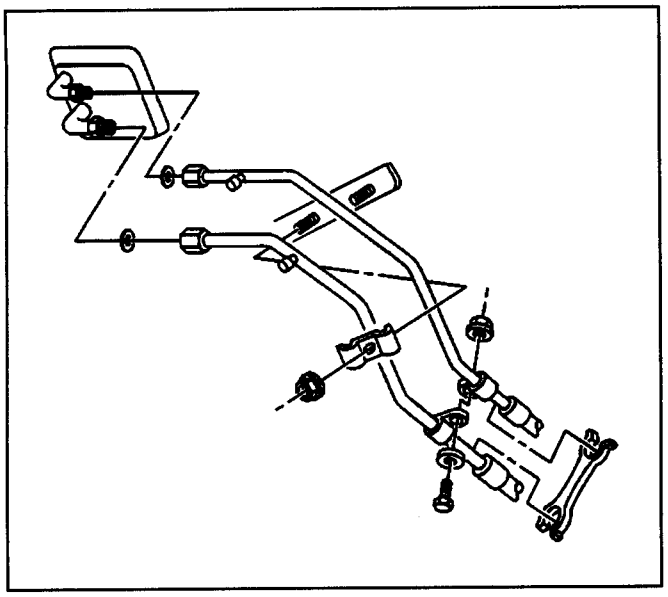


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8. Install the A/C evaporator core cover.
9. Install the A/C evaporator core cover screws.
10. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0 refrigerant oil.

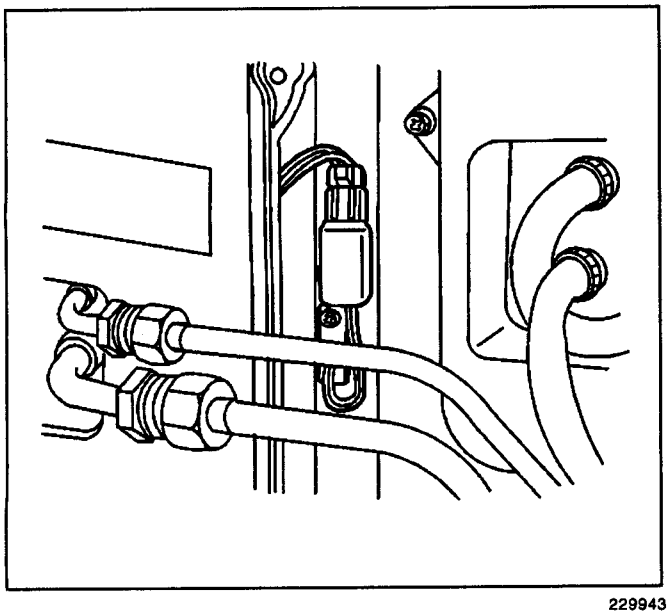


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11. Install the new O-ring and the high pressure hose to the A/C evaporator.
12. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
13. Install the new O-ring and the low pressure hose to the A/C evaporator.

    Tighten

    - Tighten the high pressure hose fitting at the A/C evaporator to 18 N·m (13 lb in).
    - Tighten the low pressure hose fitting at the A/C evaporator to 32 N·m (24 lb in).
14. Push carefully on the right wiper arm linkage.
15. Close the hood.
16. Secure the hood.
17. Connect the negative battery cables.
18. Inspect the system for leaks. Refer to *Leak Testing*.



229943

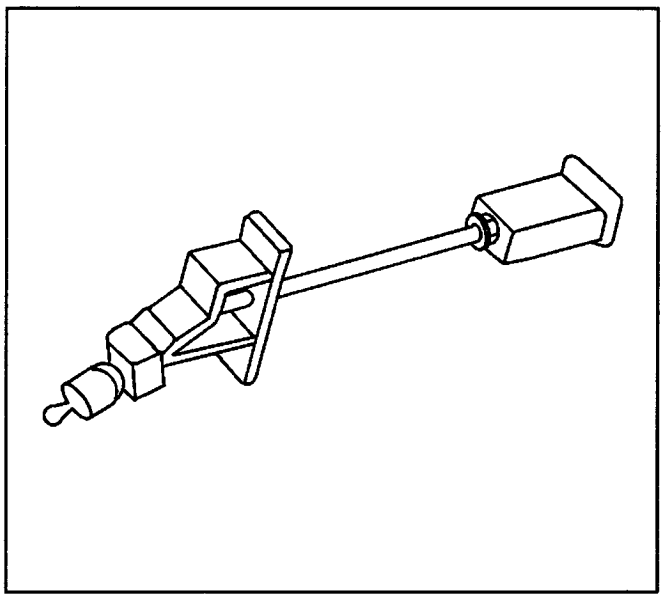
A/C Temperature Sensor Replacement

Removal Procedure

1. Raise the hood. Support the hood.

   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
3. Disconnect the electrical connections.
4. Remove the screw.

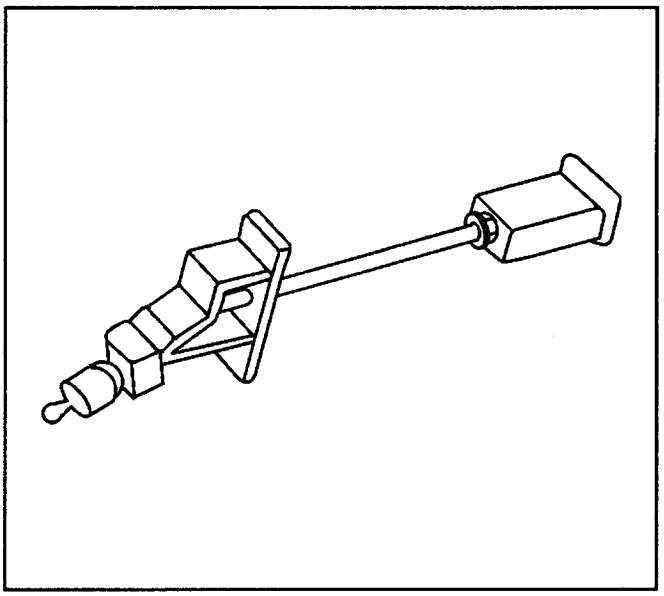
5. Remove the thermostat.



229944

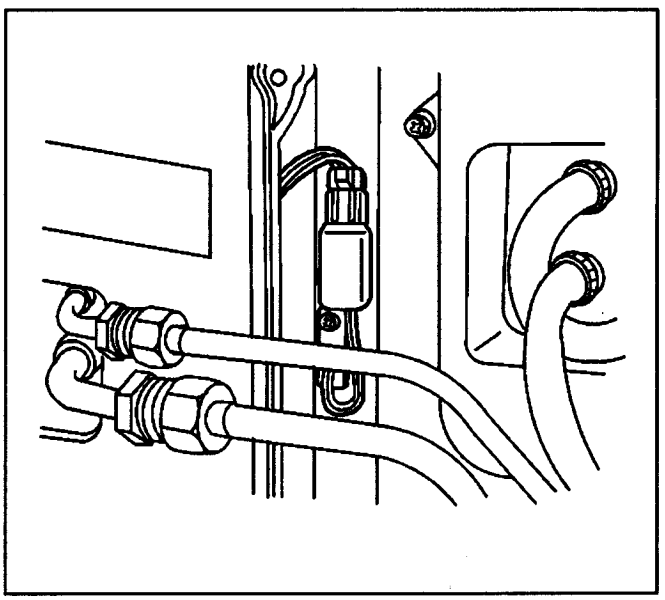
Installation Procedure

1. Install the thermostat.
2. Install the screw.

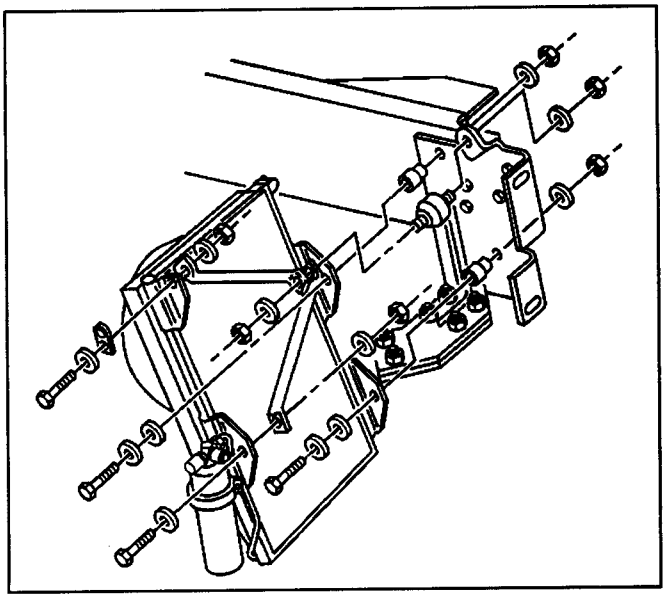


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3. Connect the electrical connections.
4. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
5. Close the hood.



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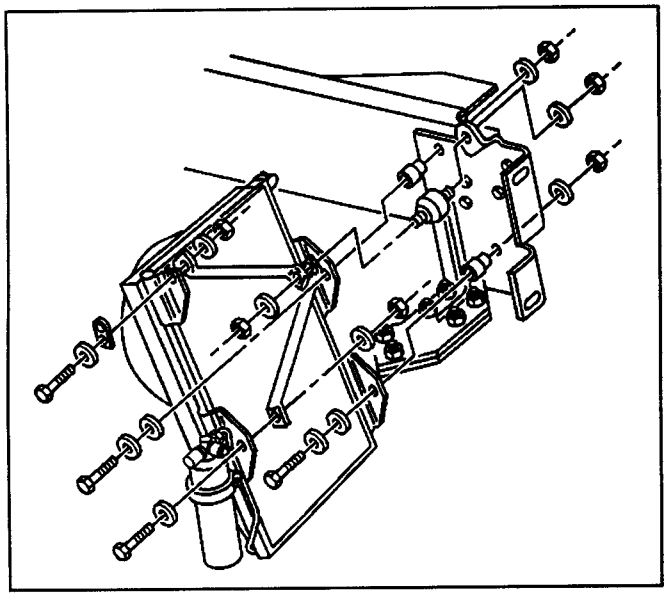
229722

Condenser Fan Replacement

Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.

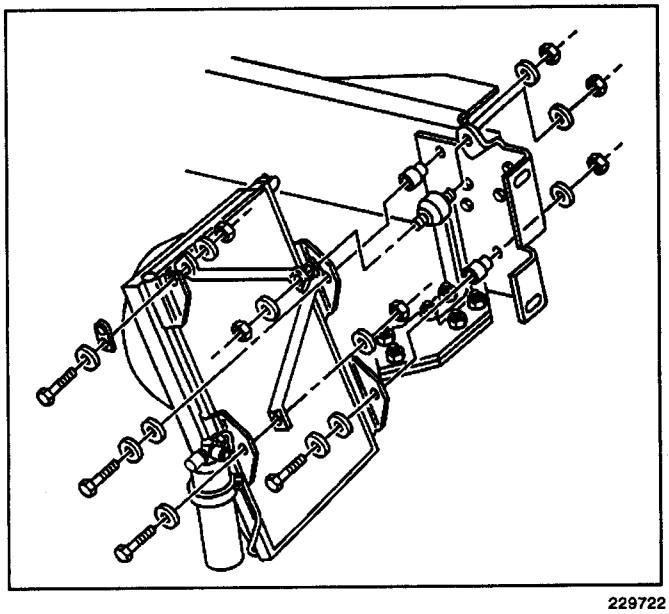
   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
3. Remove the A/C condenser fan electrical connector from the A/C condenser fan.
4. Remove the following components from the A/C condenser:
   4.1. The four bolts
   4.2. The A/C condenser fan



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Installation Procedure

1. Install the A/C condenser fan to the A/C condenser.
2. Secure the A/C condenser fan with the four bolts.
3. Install the A/C condenser fan electrical connector to the A/C condenser fan.
4. Connect the negative battery cables.
5. Lower the cab.



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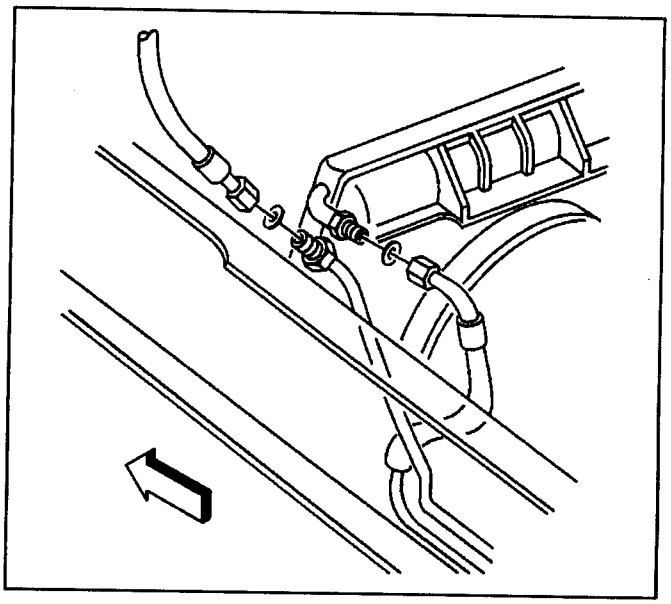
Condenser Replacement

Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.

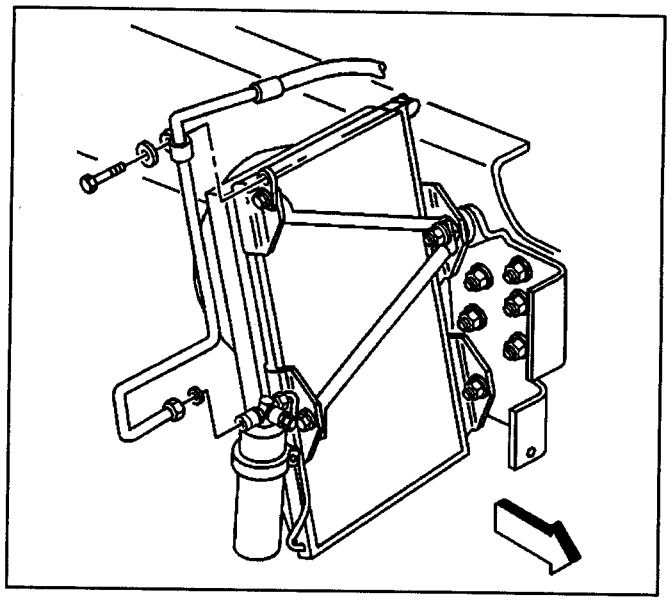
   Caution: Refer to Battery Disconnect Caution in Cautions and Notices.
2. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
3. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
4. Remove the A/C condenser fan from the A/C condenser. Refer to *Condenser Fan Replacement.*
5. Remove the A/C condenser hose from the A/C condenser.

6. Remove the A/C evaporator hose.
7. Remove the O-ring seal from the A/C condenser. Discard the O-ring seal.



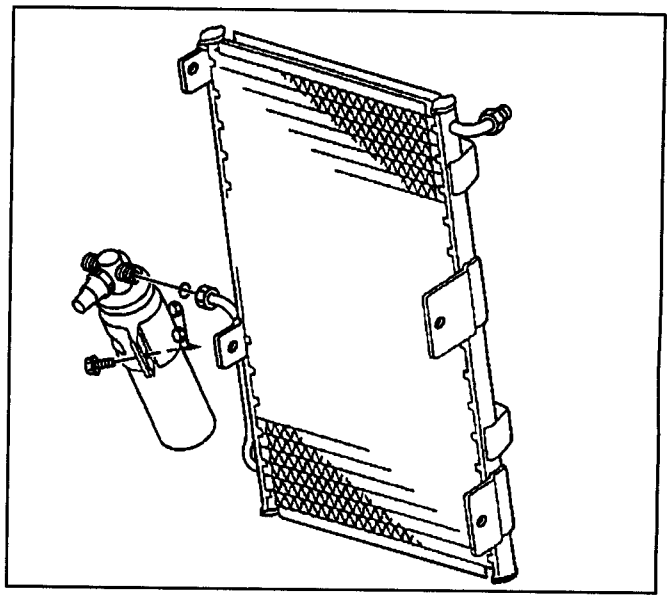
229705

8. Remove the A/C condenser tube.
9. Remove the O-ring seal from the A/C receiver/dryer or the dehydrator. Discard the O-ring seal.



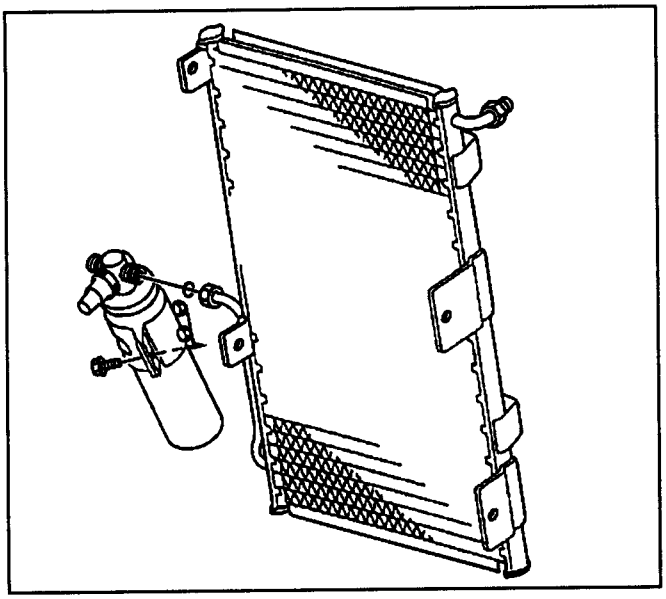
229717

10. Remove the A/C receiver/dryer or dehydrator electrical connector from the A/C receiver/dryer or dehydrator pressure switch.
11. Remove the A/C receiver/dryer or dehydrator clamp bolt.
12. Remove the A/C receiver/dryer or dehydrator from the A/C receiver/dryer or dehydrator clamp.
13. Remove the A/C condenser brace insulator nut and the washer.
14. Remove the following components from the frame rail:
    - 14.1. The nuts from the two A/C condenser mounting brackets
    - 14.2. The bolts
    - 14.3. The insulators
    - 14.4. Six washers
    - 14.5. The A/C condenser



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15. Remove the following components from the A/C condenser braces:
    15.1. The nut
    15.2. The washer
    15.3. The A/C condenser insulator
16. Remove the following components from the A/C condenser:
    16.1. The nut
    16.2. The bolt
    16.3. The washers
    16.4. The bracket
    16.5. The upper A/C condenser brace
17. Remove the following components from the A/C condenser:
    17.1. The nut
    17.2. The bolt
    17.3. The washers
    17.4. The bracket
    17.5. The lower A/C condenser brace
18. Remove the following components from the A/C condenser:
    18.1. Two screws
    18.2. The A/C receiver/dryer or dehydrator clamp



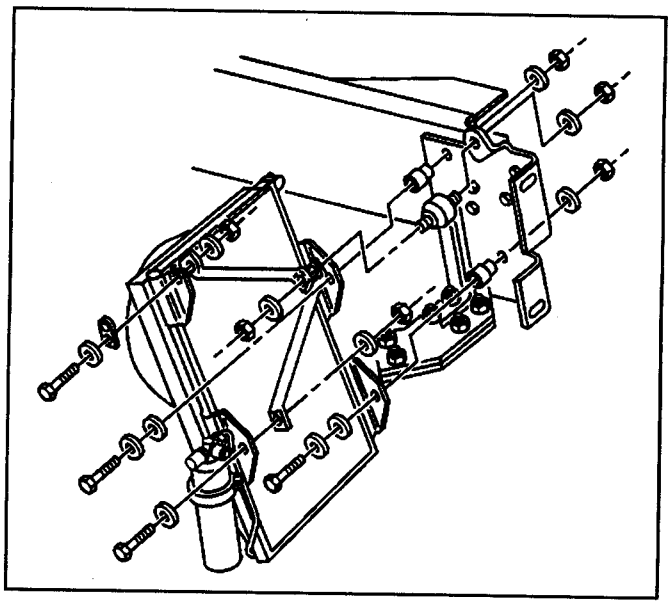
229725

Installation Procedure

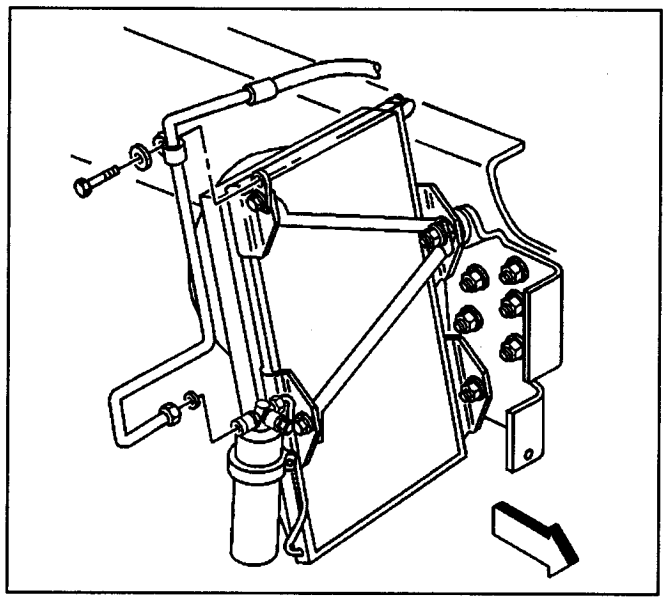
1. Install the A/C receiver/dryer or dehydrator clamp to the A/C condenser. Secure the clamp with two screws.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lower A/C condenser brace to the A/C condenser. Secure the brace with the following components:
   2.1. The bolt
   2.2. The washers
   2.3. The bracket
   2.4. The nut
   Tighten
   Tighten the lower A/C condenser brace nut to 70 N.m (51 ft lb).
3. Install the upper A/C condenser brace to the A/C condenser. Secure the brace with the following components:
   3.1. The bolt
   3.2. The washers
   3.3. The bracket
   3.4. The nut
   Tighten
   Tighten the upper A/C condenser brace nut to 70 N.m (51 ft lb).
4. Install the A/C condenser insulator to the A/C condenser braces. Secure the insulator with a washer and a nut.
   Tighten
   Tighten the A/C condenser insulator nut to 35 N.m (26 ft lb).
5. Install the A/C condenser to the frame rail. Secure the condenser with the following components:
   5.1. Two A/C condenser mounting bracket insulators
   5.2. Six washers
   5.3. Two bolts
   5.4. The nuts
   Tighten
   Tighten the A/C condenser insulator bracket nuts to 24 N.m (18 ft lb).
6. Install the A/C condenser brace insulator washer and the nut.
   Tighten
   Tighten the A/C condenser insulator nut to 35 N.m (26 ft lb).

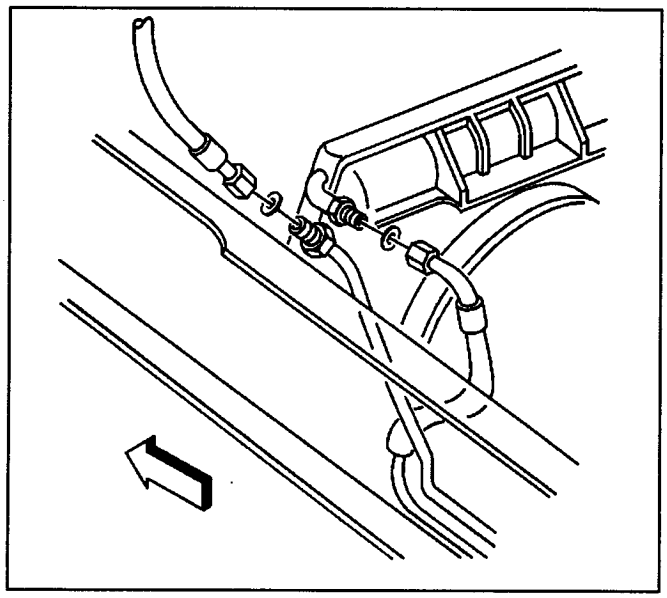


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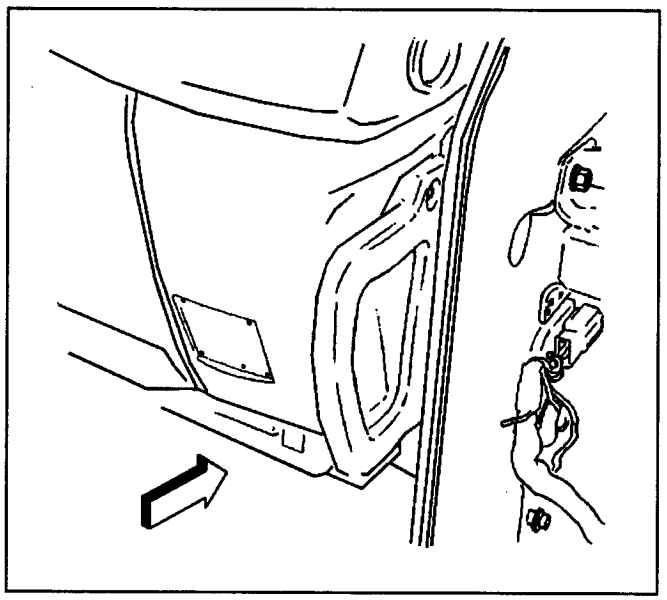
229717

7. Install the A/C receiver/dryer or the dehydrator into the A/C receiver/dryer or dehydrator clamp.
8. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0.
9. Install the new O-ring seal.
10. Connect the A/C condenser tube to the A/C receiver/dryer or the dehydrator.
11. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0.
12. Install the new O-ring seal.



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13. Connect the A/C evaporator hose to the A/C condenser.
14. Install the A/C receiver/dryer or dehydrator clamp bolt.
15. Install the A/C receiver/dryer or dehydrator electrical connector to the A/C receiver/dryer or dehydrator pressure switch.
16. Install the A/C condenser hose to the A/C condenser.
17. Install the A/C condenser fan.
18. Connect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
19. Add the refrigerant to the system. Refer to *Refrigerant Recovery and Recharging.*
20. Inspect the system for leaks. Refer to *Leak Testing.*
21. Lower the cab. Refer to *Cab Tilting* in General Information.



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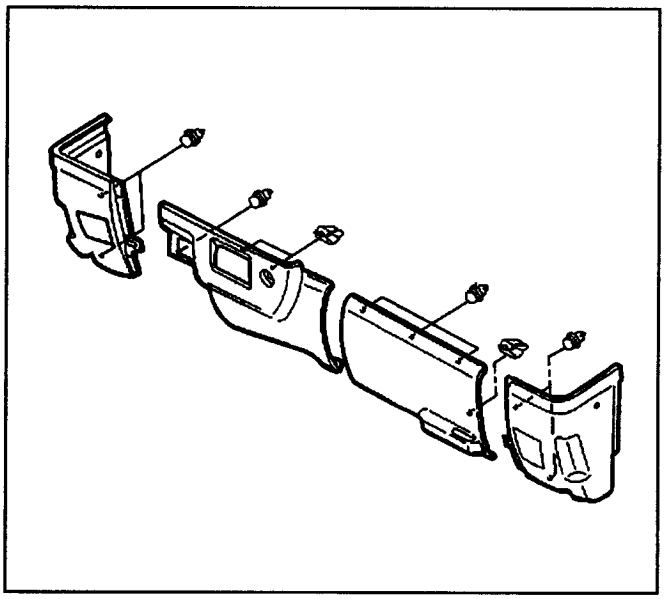
Blower Motor Resistor Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

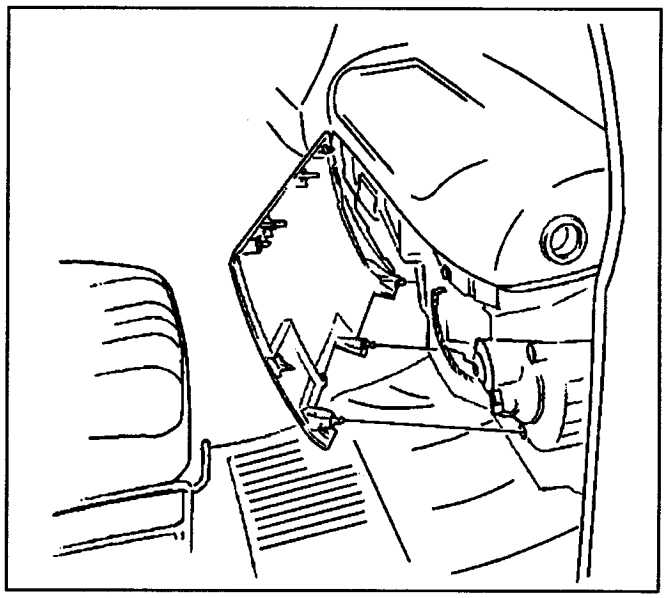
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.

4. Remove the instrument panel right lower trim.



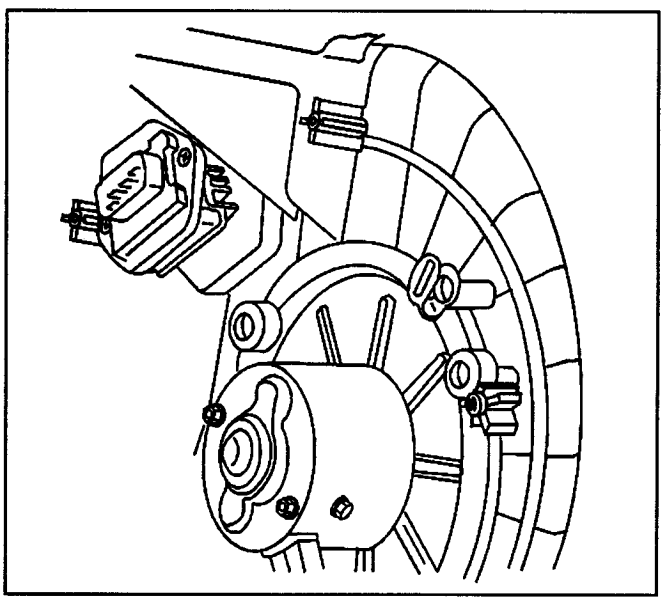
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5. Disconnect the electrical connectors.

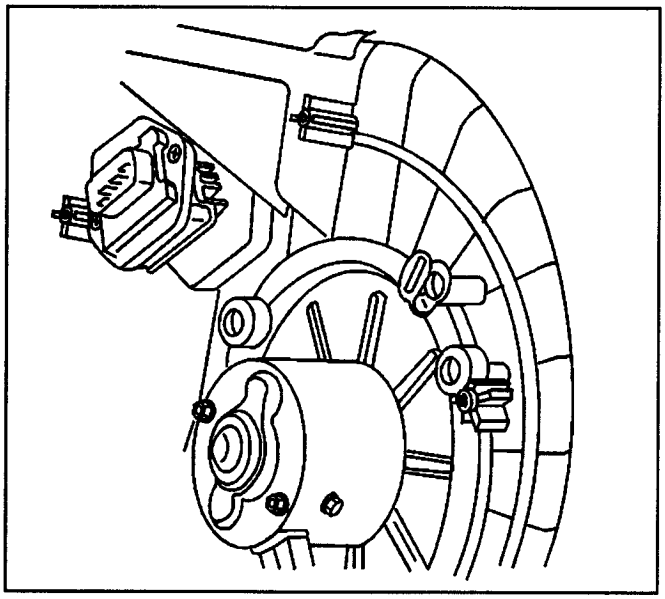


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6. Remove the blower resistor screws.
7. Remove the blower motor resistor.



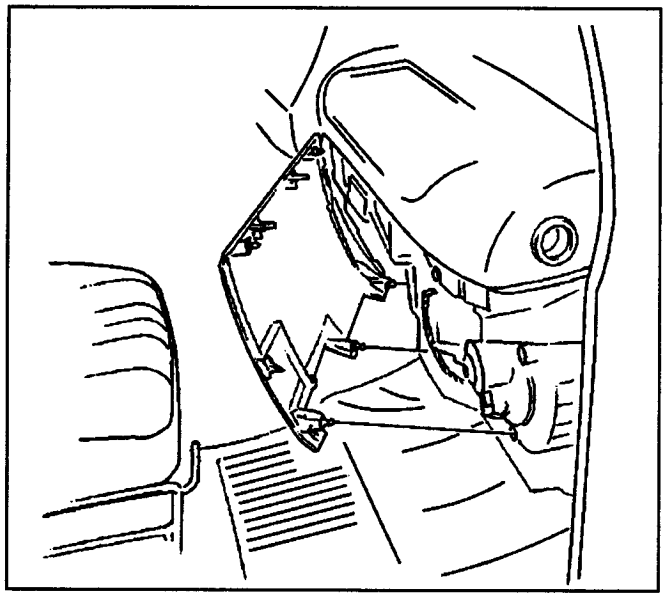
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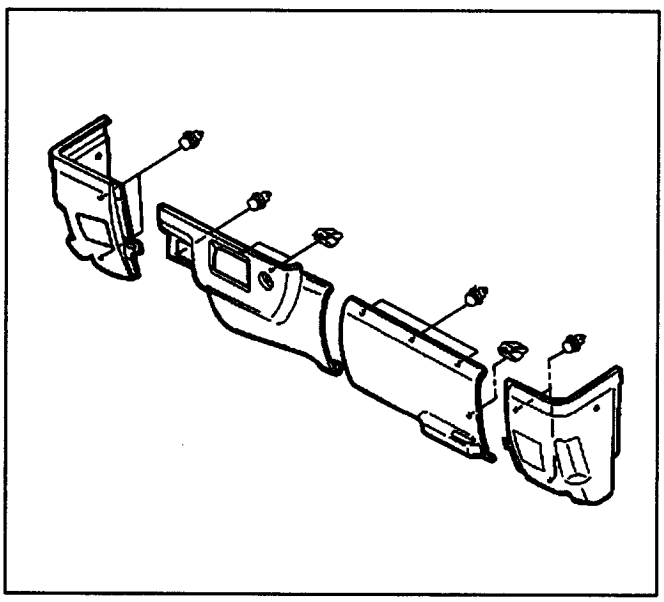
Installation Procedure

1. Install the blower motor resistor.



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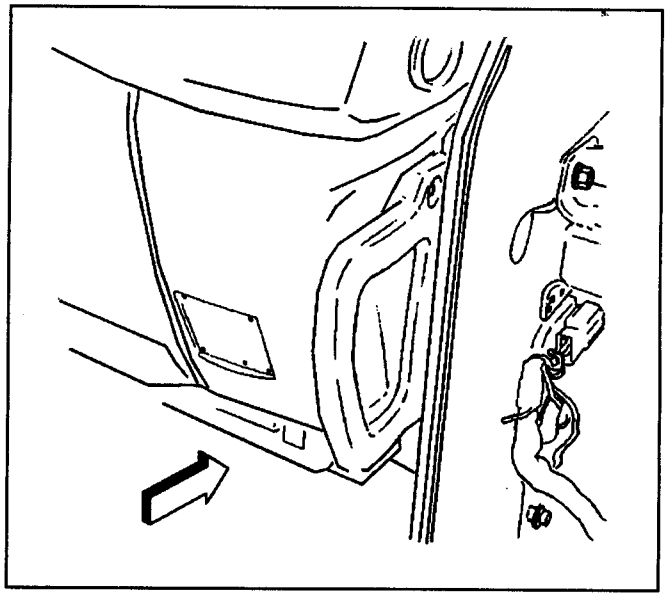
2. Install the blower motor resistor screws.
3. Connect the electrical connectors.



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4. Install the instrument panel right lower trim.

5. Install the assist handle.
6. Install the assist handle bolts.
7. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



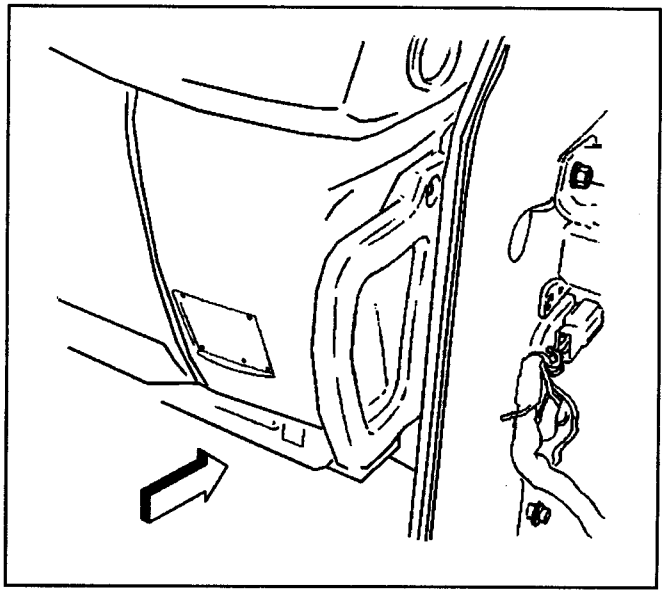
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Blower Motor and Fan Replacement

Removal Procedure

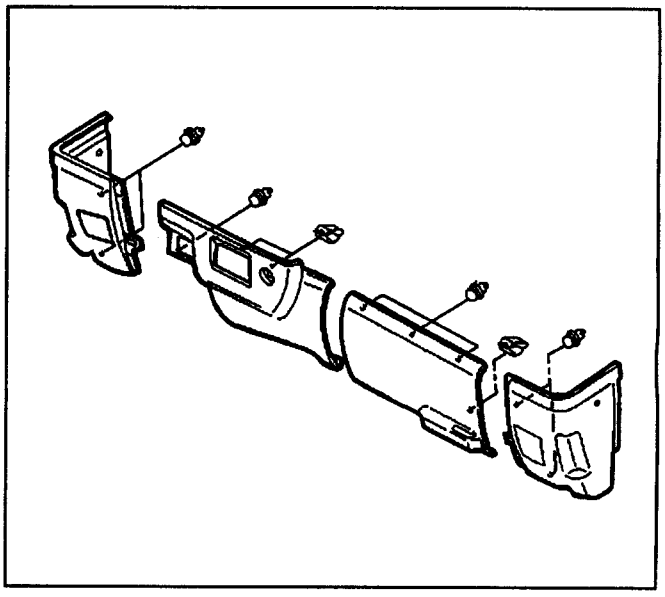
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.

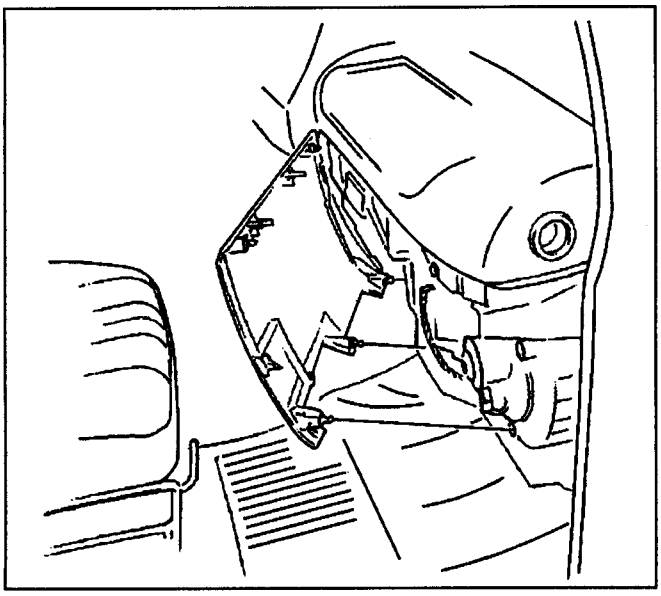


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4. Remove the instrument panel right lower trim.

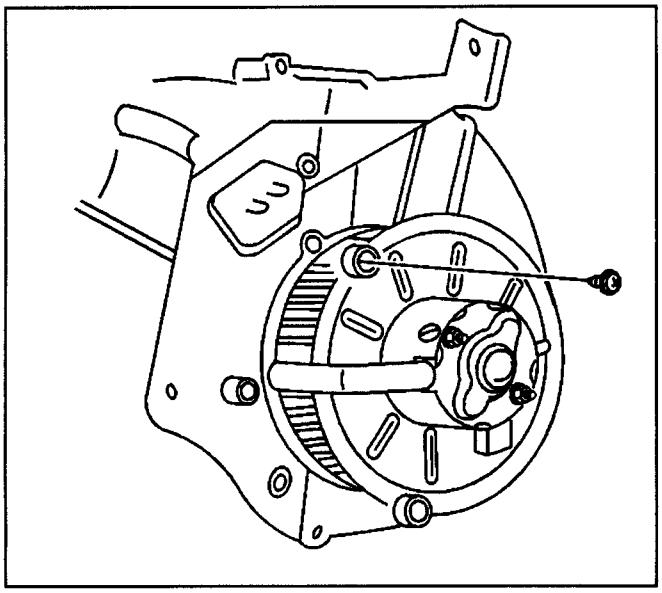


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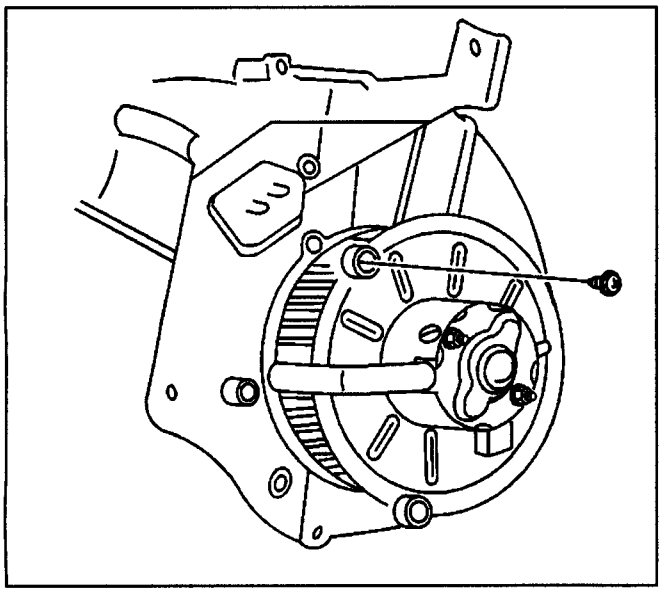
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5. Disconnect the electrical connectors.
6. Remove the blower motor cooling tube.
7. Remove the blower motor screws.



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8. Remove the blower motor and fan.

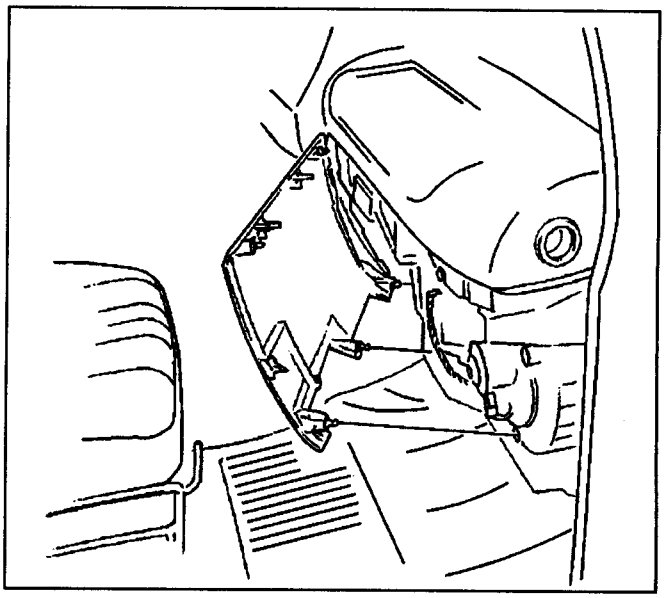


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Installation Procedure

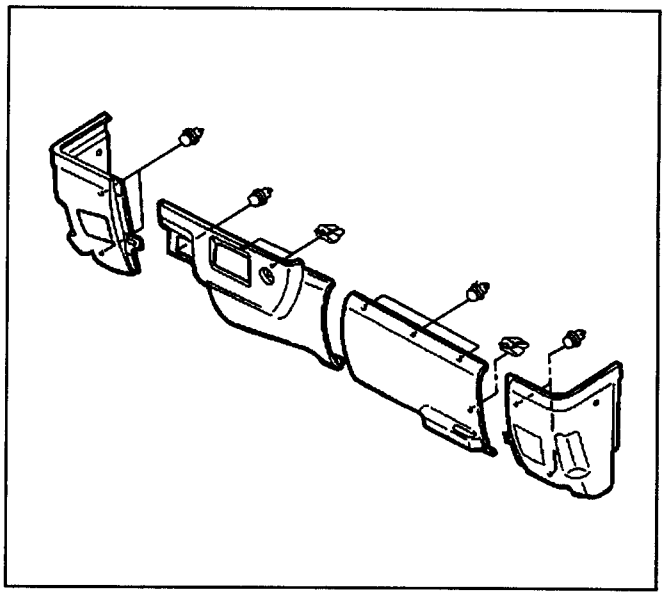
1. Install the blower motor and fan.

2. Install the blower motor screws.
3. Install the blower motor cooling tube.
4. Connect the electrical connectors.



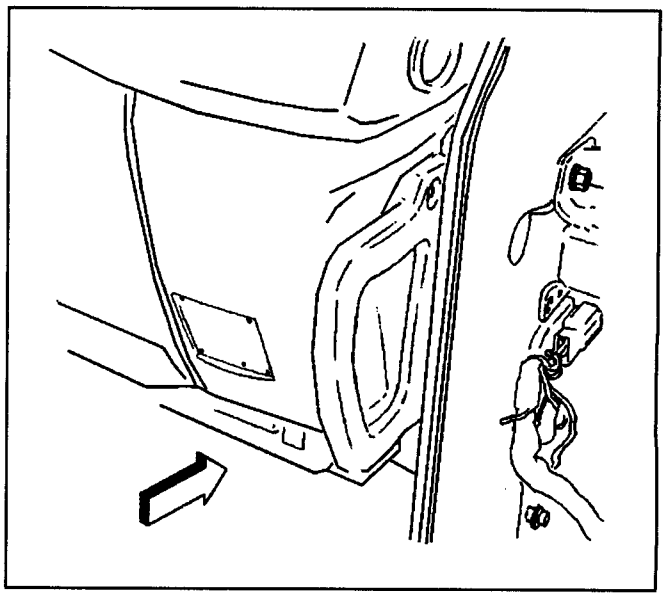
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5. Install the instrument panel right lower trim.

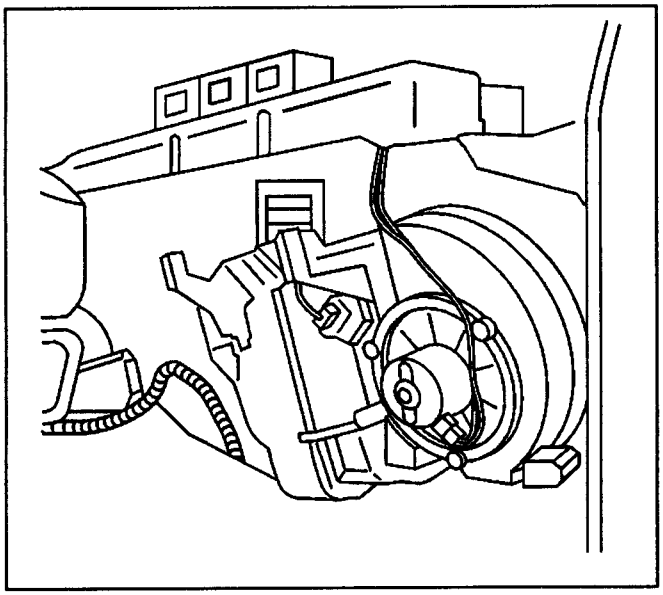


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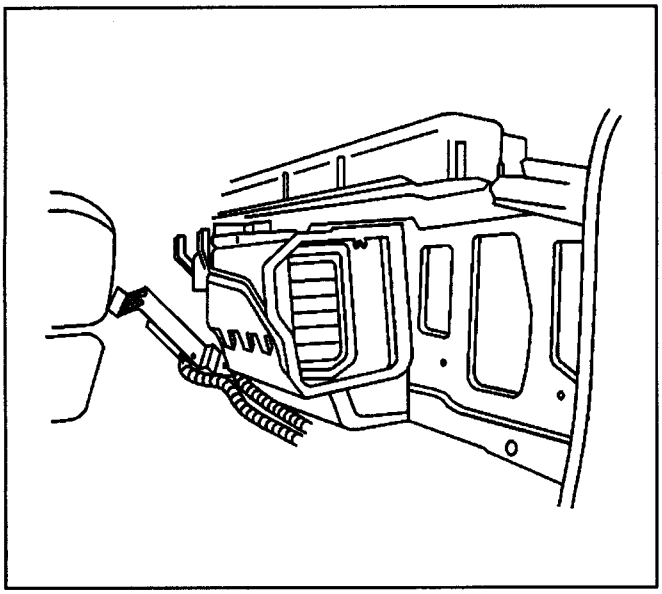
6. Install the assist handle.
7. Install the assist handle bolts.
8. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



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HVAC Module Assembly Replacement

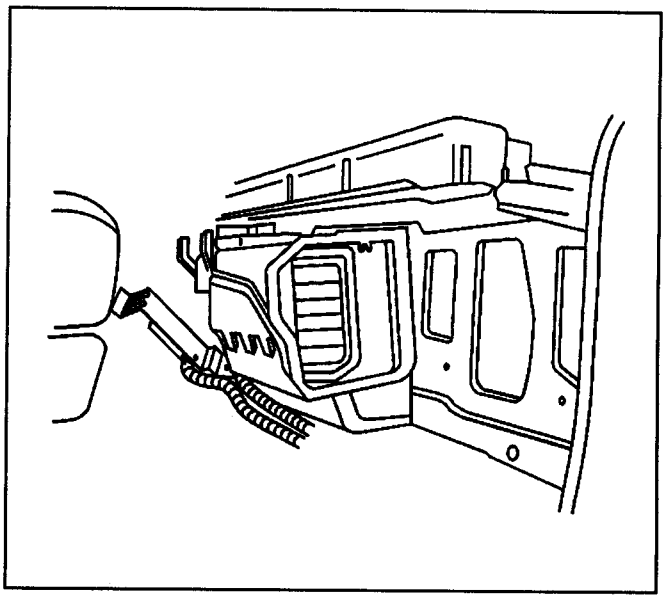
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
3. Remove the right heater core. Refer to *Heater Core Replacement (Right).*
4. Remove the A/C Temperature Sensor connectors screw.
5. Remove the left heater core. Refer to *Heater Core Replacement (Left).*
6. Disconnect the A/C Temperature Sensor connectors electrical connectors.
7. Remove the A/C Temperature Sensor connectors.
8. Remove the air conditioning evaporator. Refer to *Evaporator Core Replacement.*
9. Disconnect the blower motor resistor electrical connectors.
10. Disconnect the blower motor electrical connectors.
11. Remove the heater vent module nuts.
12. Remove the right heater vent module.
13. Remove the left heater vent module.

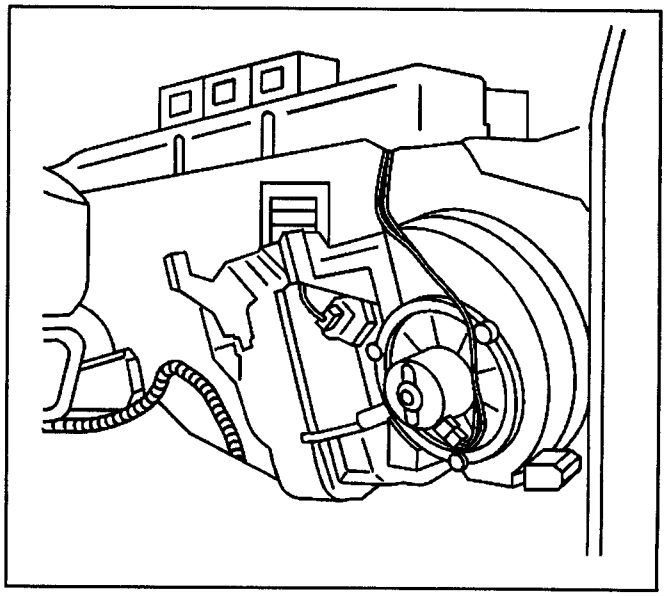
Installation Procedure

1. Install the left heater vent module.



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2. Install the right heater vent module.
3. Install the heater vent module nuts.
4. Install the blower motor electrical connectors.
5. Install the blower motor resistor electrical connectors.
6. Install the air conditioning evaporator. Refer to *Evaporator Core Replacement.*
7. Install the A/C Temperature Sensor connectors.
8. Connect the A/C Temperature Sensor connectors electrical connectors.
9. Install the A/C Temperature Sensor connectors screw.
10. Install the heater cores. Refer to *Heater Core Replacement (Right).*
11. Install the instrument panel. Refer to *IP Carrier Replacement.*
12. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



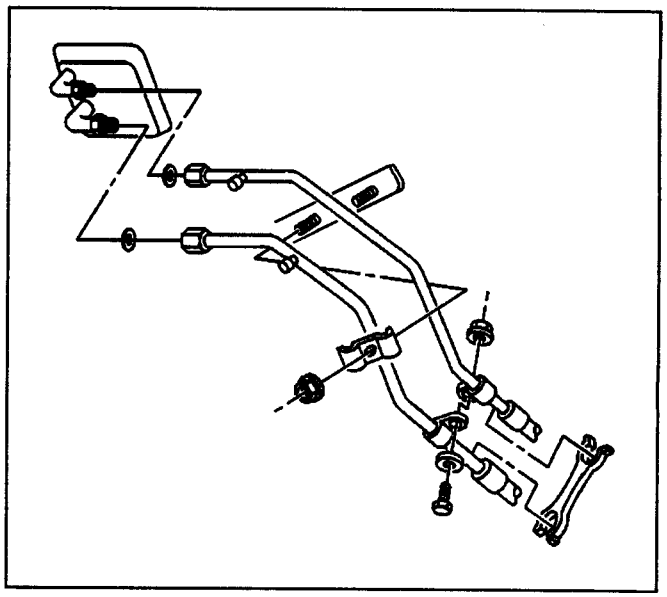
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Evaporator Core Replacement

Removal Procedure

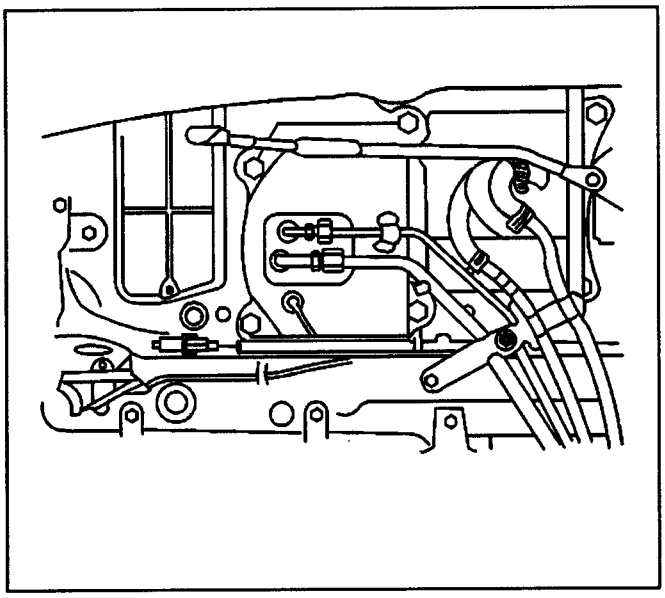
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cables. Refer to *Battery Replacement* in Engine Electrical.
2. Open the hood.
3. Secure the hood.
4. Discharge and recover the refrigerant from the system. Refer to *Refrigerant Recovery and Recharging.*
5. Remove the right wiper arm linkage from the wiper arm pivot.
6. Remove the low pressure hose from the A/C evaporator.
7. Remove the low pressure hose O-ring seal from the A/C evaporator.
8. Discard the O-ring seal.



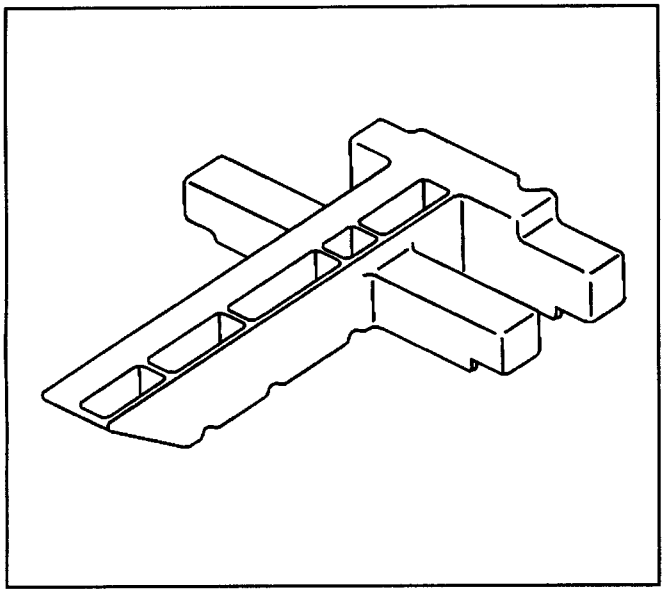
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9. Remove the high pressure hose.
10. Remove the high pressure hose O-ring seal from the A/C evaporator.
11. Discard the O-ring seal.
12. Remove the A/C evaporator core cover screws.
13. Remove the A/C evaporator core cover.



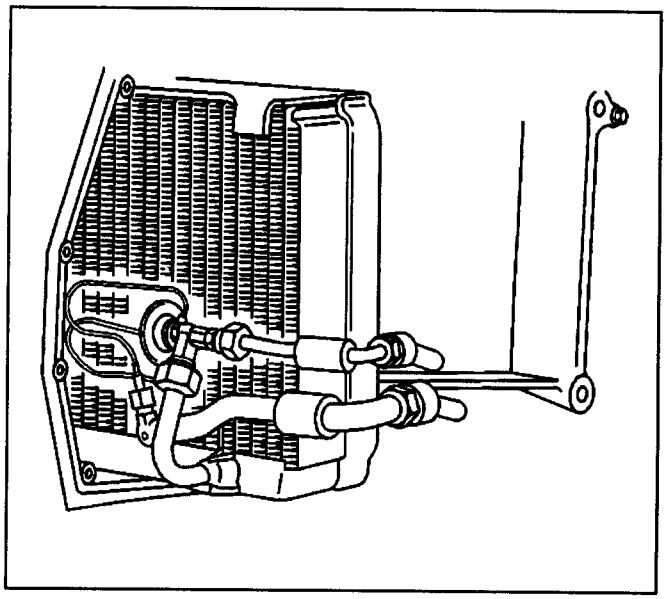
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14. Remove the A/C evaporator spacer.



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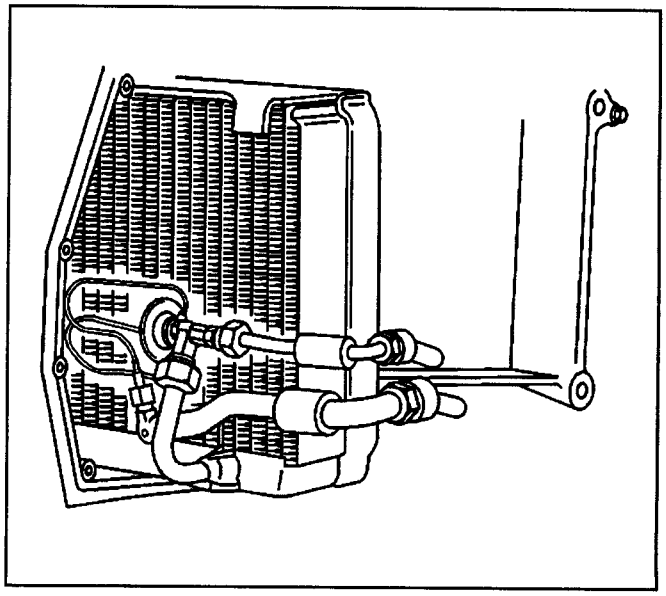
15. Remove the A/C evaporator.



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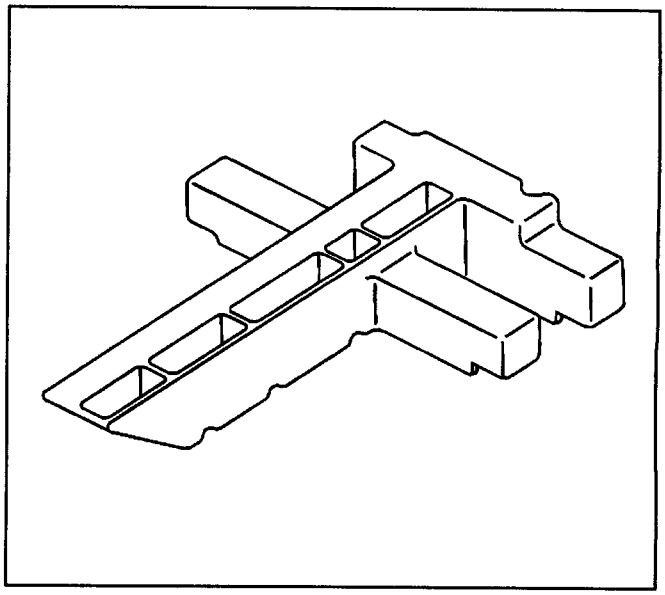
Installation Procedure

1. Fill the A/C evaporator. Refer to *Refrigerant Oil Distribution Specifications.*

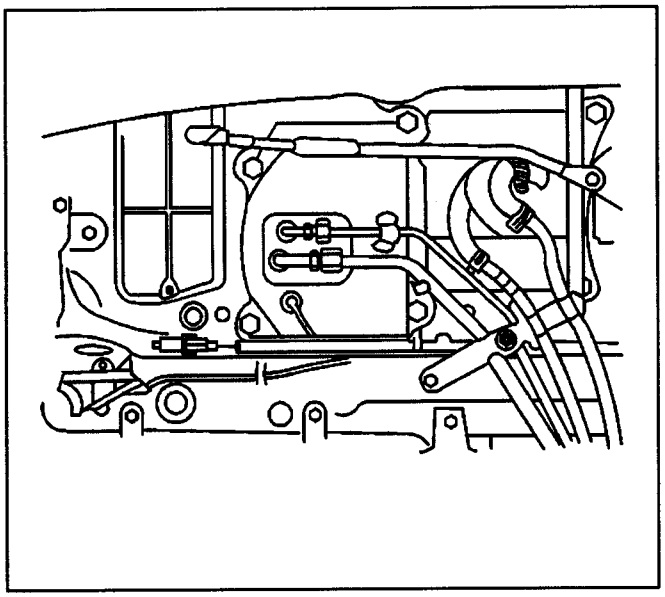


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2. Install the A/C evaporator spacer.

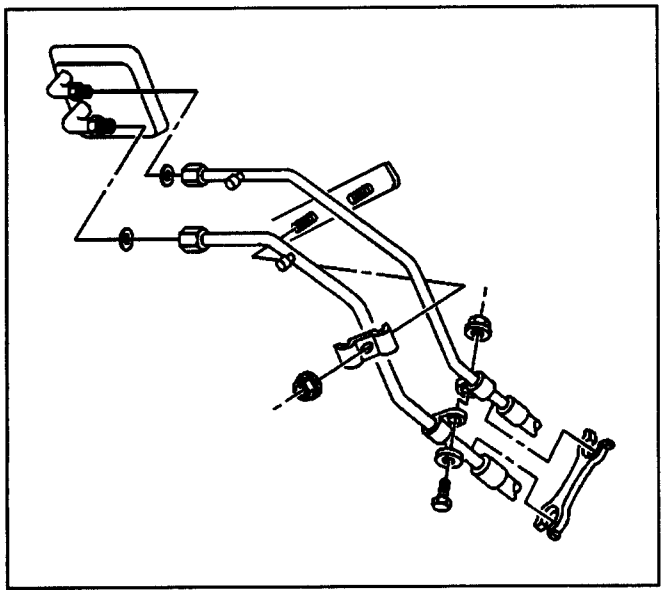


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3. Install the A/C evaporator core cover.
4. Install the A/C evaporator core cover screws.
5. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
6. Install the new O-ring seal.



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7. Install the high pressure hose to the A/C evaporator.
8. Coat the new O-ring seal with R-134a Swish Plate P/N AIPDN 2-90188-300-0 refrigerant oil.
9. Install the new O-ring seal.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
10. Install the low pressure hose to the A/C evaporator.

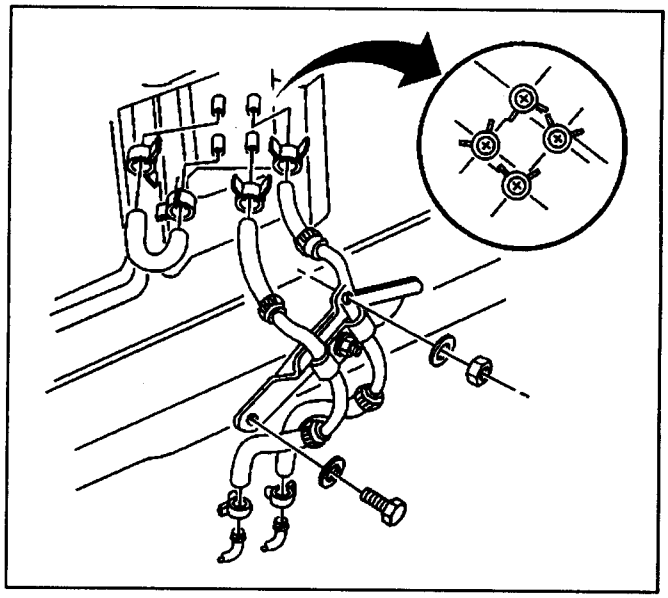
    Tighten

    - Tighten the high pressure hose fitting at the A/C evaporator to 18 N·m (13 lb in).
    - Tighten the low pressure hose fitting at the A/C evaporator to 32 N·m (24 lb in).
11. Push carefully on the right wiper arm linkage.
12. Close the hood.
13. Secure the hood.
14. Connect the negative battery cables.
15. Inspect the system for leaks. Refer to *Leak Testing*.

Heater Core Replacement (Right)

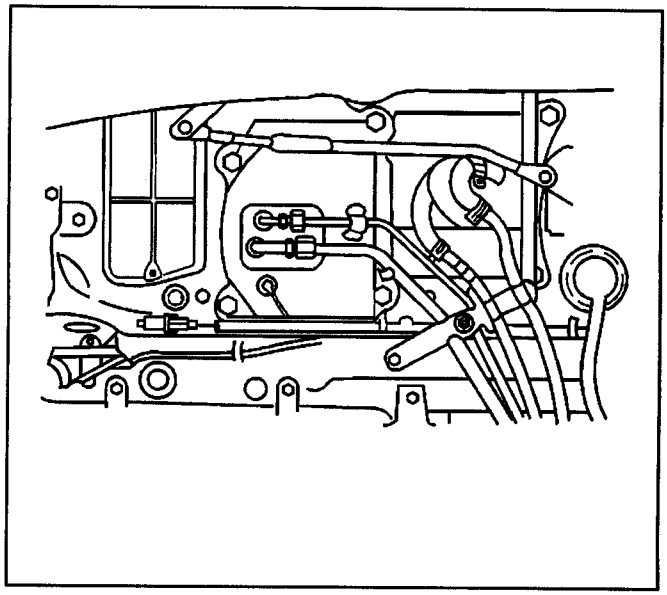
Removal Procedure

1. Raise the hood and support.
2. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
3. Remove the windshield wiper right link.
4. Remove the heater hose clamps.
5. Remove the heater hoses.



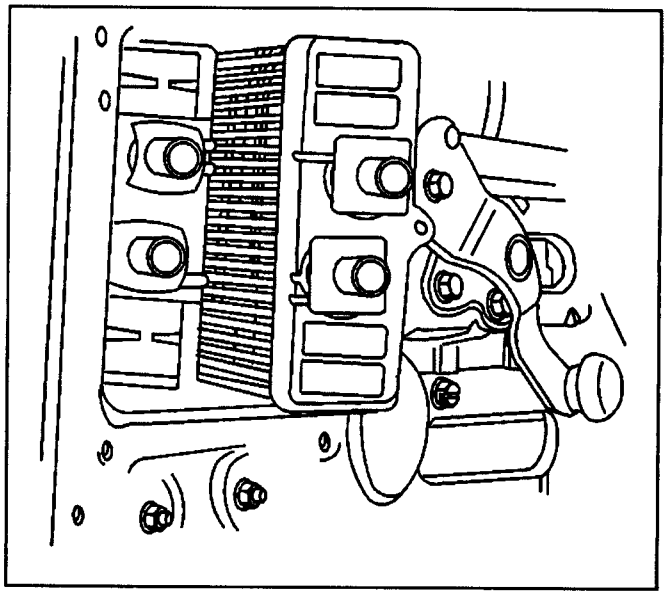
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6. Remove the heater core cover plate screws.
7. Remove the heater core cover plate.
8. Remove the heater core screw.

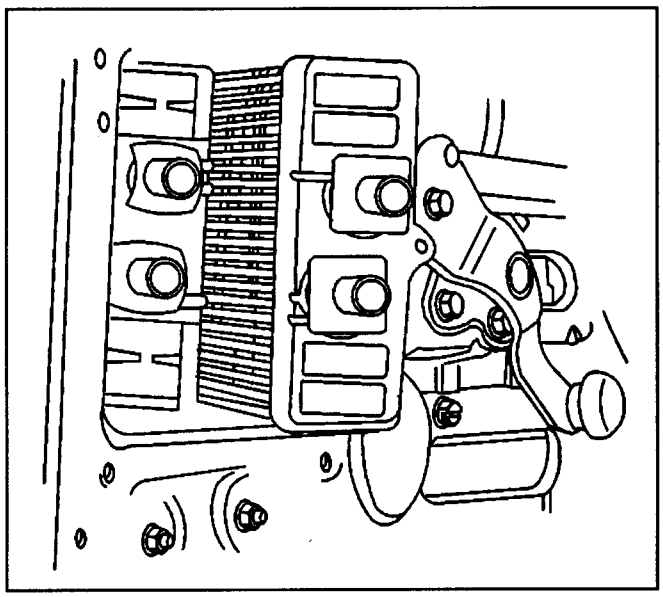


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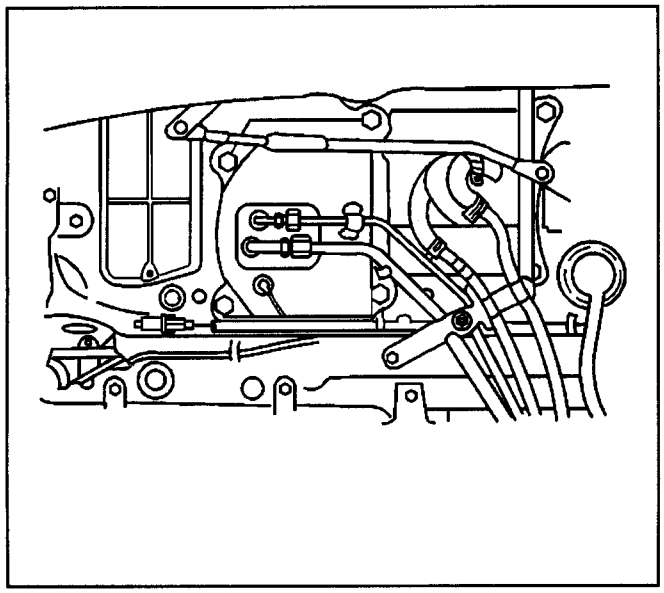
9. Remove the right heater core.



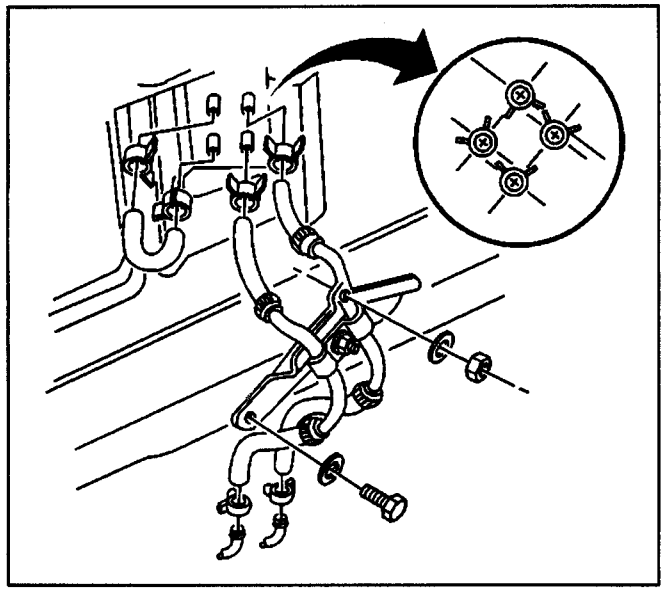
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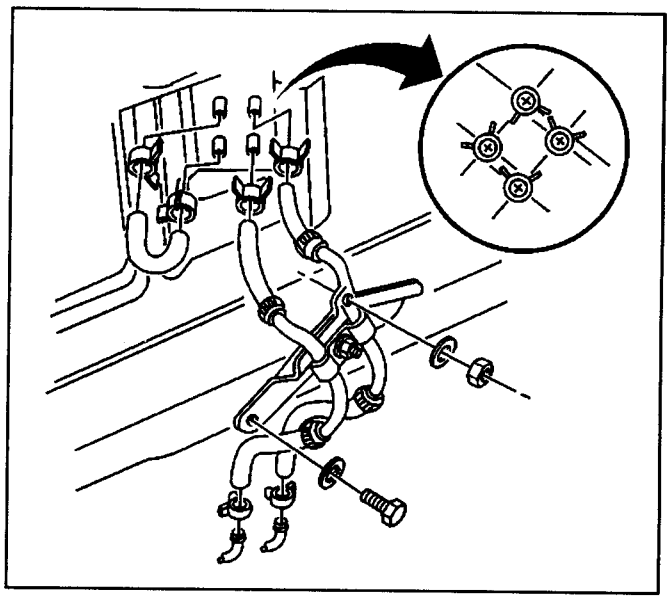
Installation Procedure

1. Install the right heater core.
2. Install the heater core screw.
3. Install the heater core cover plate.
4. Install the heater core cover plate screws.
5. Install the heater hoses.
6. Install the heater hose clamps.
7. Install the windshield wiper right link.
8. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
9. Inspect the system for leaks.
10. Close the hood.

Heater Core Replacement (Left)

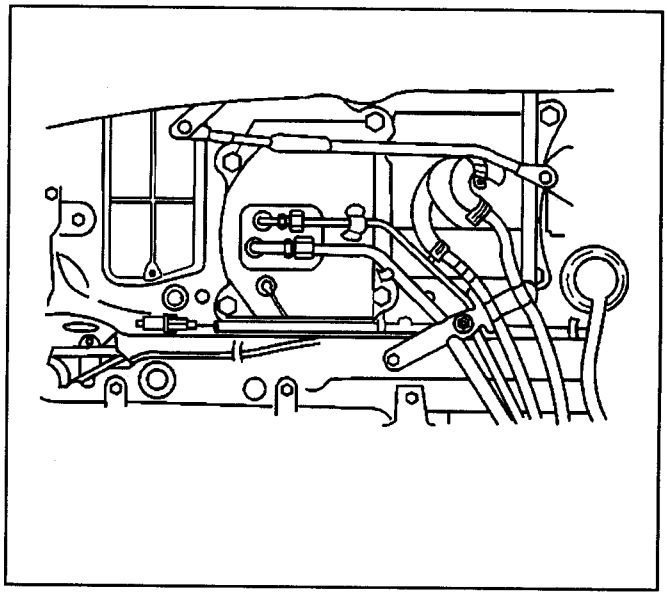
Removal Procedure

1. Raise the hood and support.
2. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
3. Remove the windshield wiper right link.
4. Remove the heater hose clamps.
5. Remove the heater hoses.



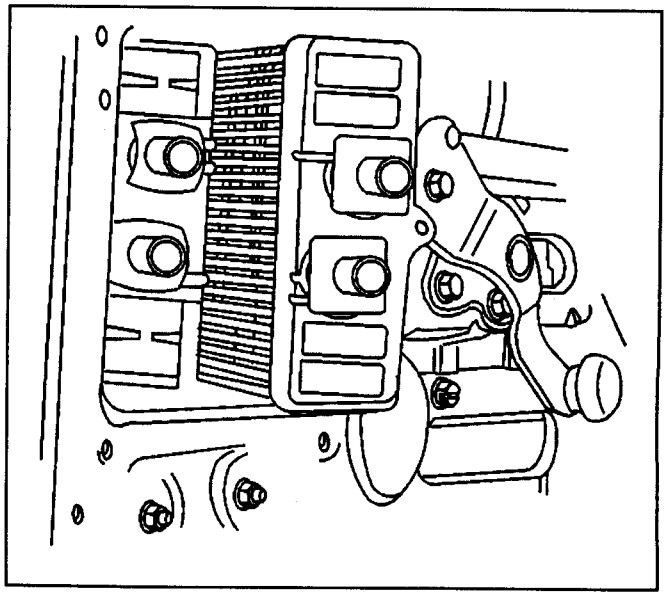
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6. Remove the heater core cover plate screws.
7. Remove the heater core cover plate.
8. Remove the heater core screw.

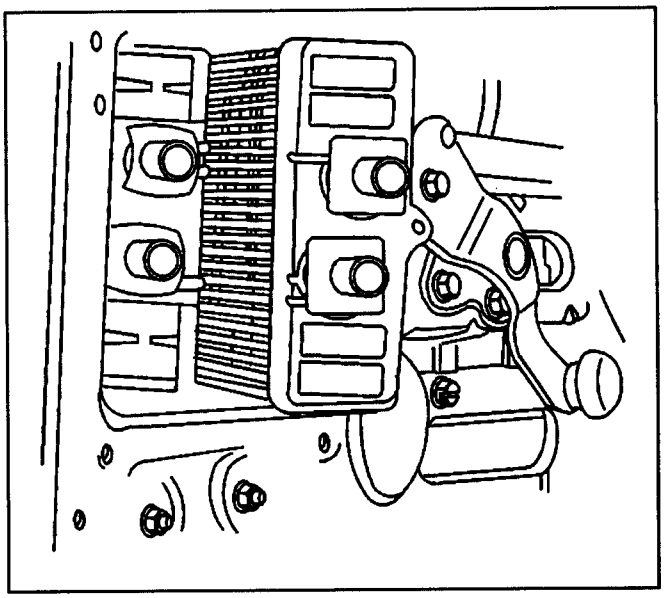


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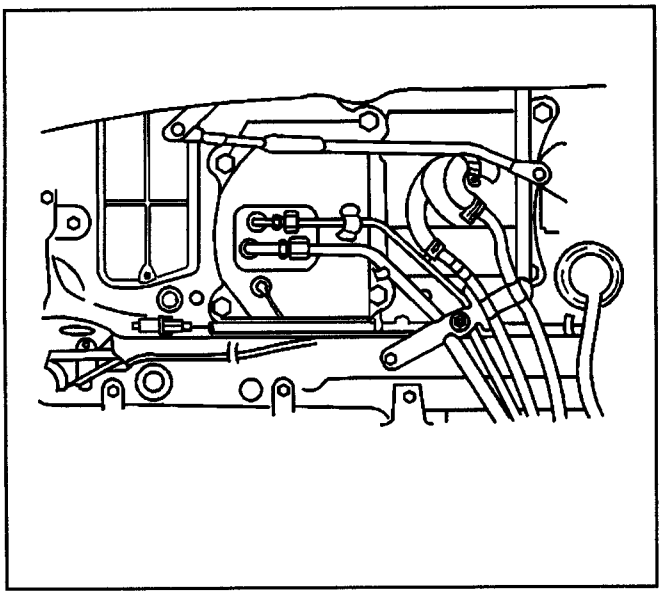
9. Remove the left heater core.



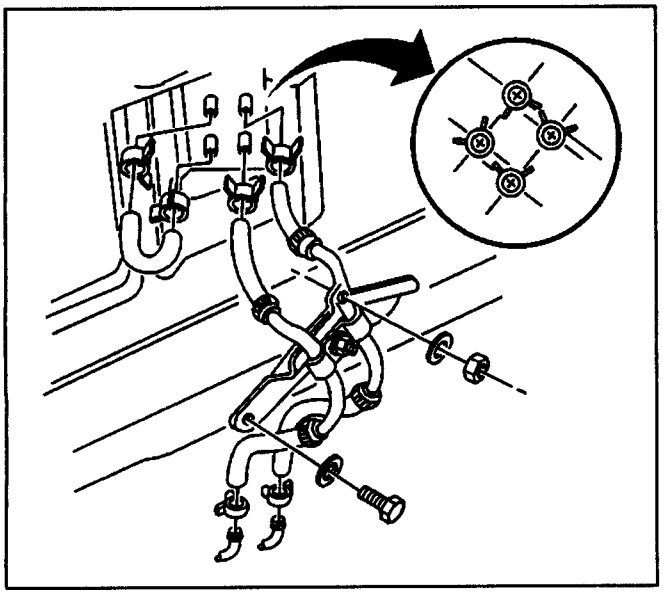
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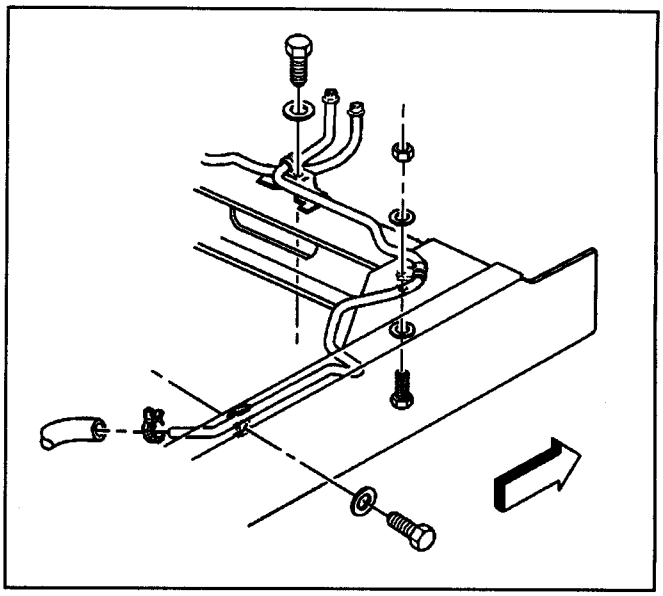
Installation Procedure

1. Install the left heater core.
2. Install the heater core screw.
3. Install the heater core cover plate.
4. Install the heater core cover plate screws.
5. Install the heater hoses.
6. Install the heater hose clamps.
7. Install the windshield wiper right link.
8. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
9. Inspect the system for leaks.
10. Close the hood.

Heater Pipes Replacement (Inlet)

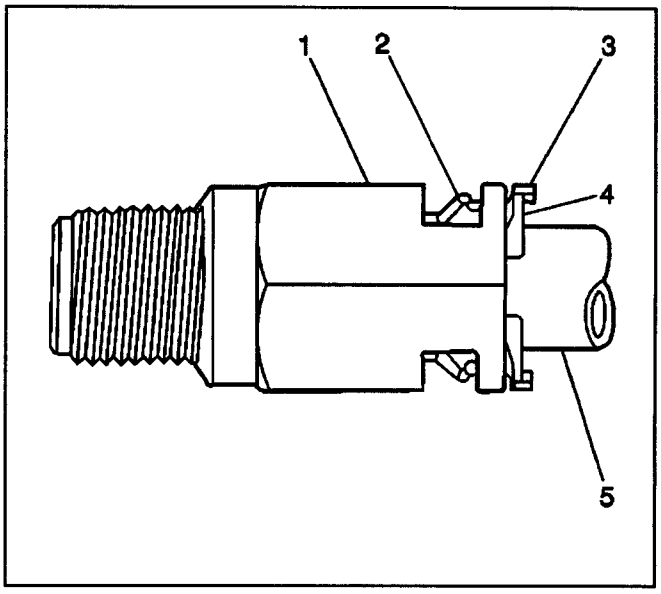
Removal Procedure

1. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
2. Remove the inlet hose clamp to the engine pipe.
3. Remove the hose clamps from the heater core.
4. Remove the inlet pipe mounting bolts, washers and nuts.
5. Remove the inlet pipe clamp on the frame.



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6. Remove the inlet pipe.



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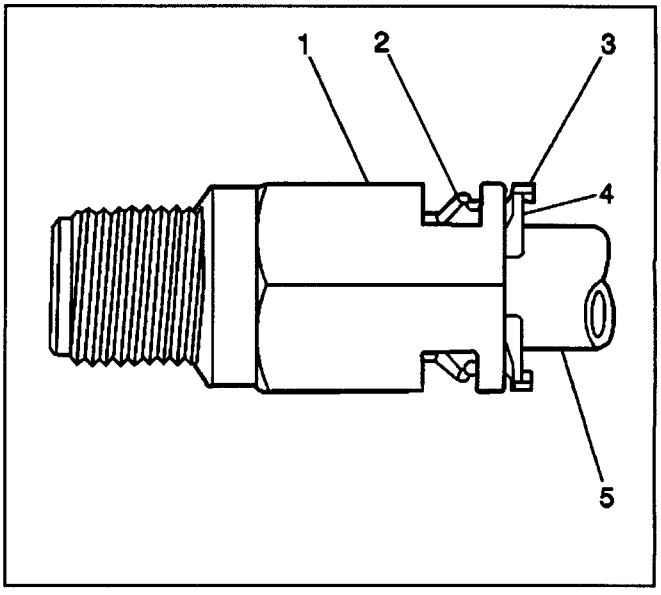
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

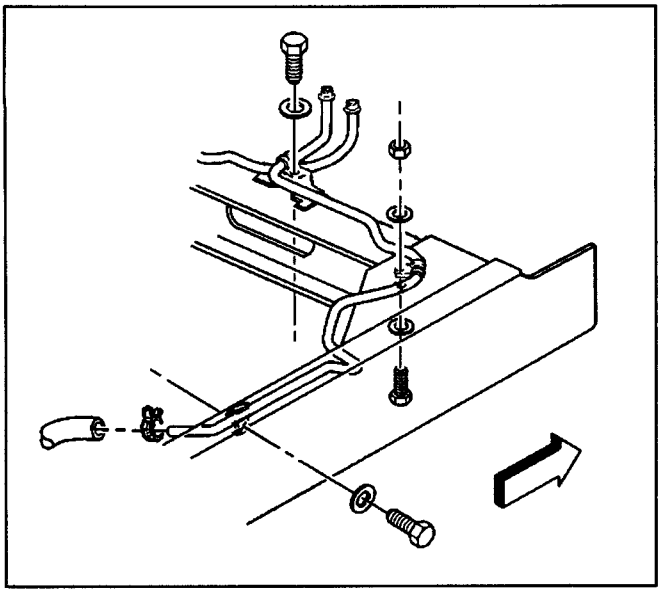
1. Push the pipe into the heater inlet hose connector (1) until the retainer locking tabs lock. (2,3) Pull back on the hose to check for proper engagement.

   Tighten

   Quick Connect Heater Inlet Connector to 35 N.m (26 lb ft).

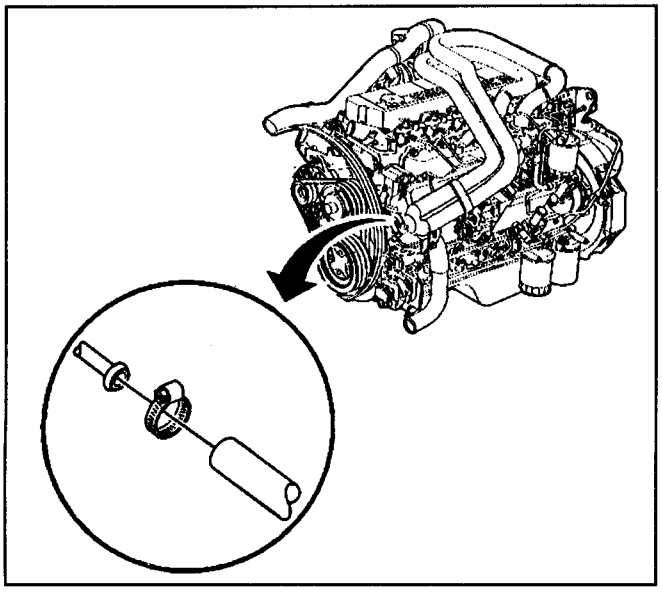


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290969

2. Install the inlet pipe.
3. Install the pipe clamps on the frame.
4. Install the inlet pipe mounting bolts, washers and nuts.
5. Install the inlet hose clamp from the heater core.
6. Install the inlet hose clamp to the engine pipe.
7. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
8. Inspect the system for leaks.

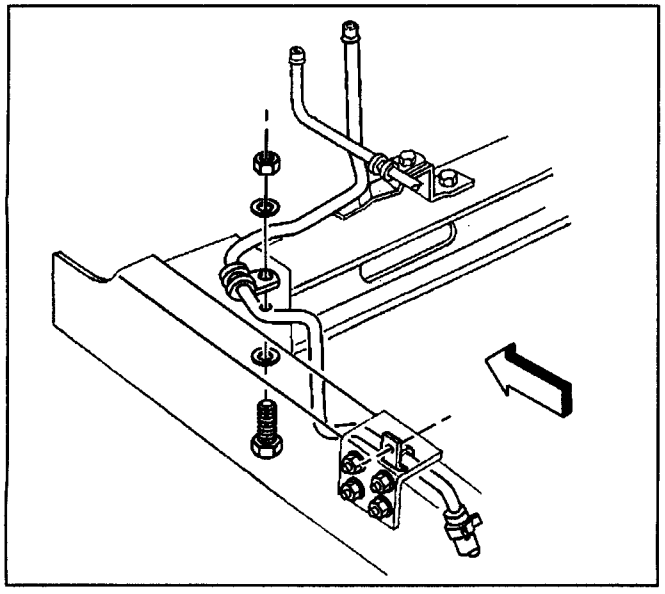


291029

Heater Pipes Replacement (Outlet)

Removal Procedure

1. Drain the engine coolant. Refer to *Draining and Filling Cooling System (Draining)* in Engine Cooling.
2. Remove the hose clamp from the heater core.
3. Remove the hose clamp from the radiator hose.
4. Remove the mounting bolt.
5. Remove the pipe clamp on the frame.

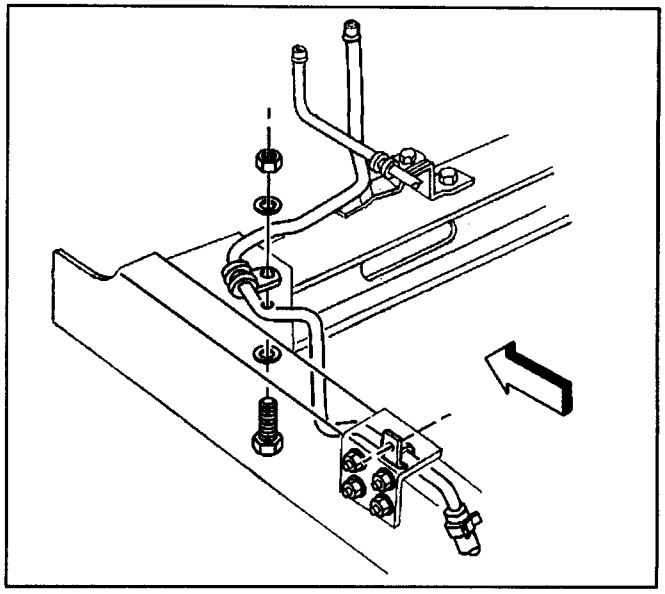


290964

6. Remove the outlet pipe.

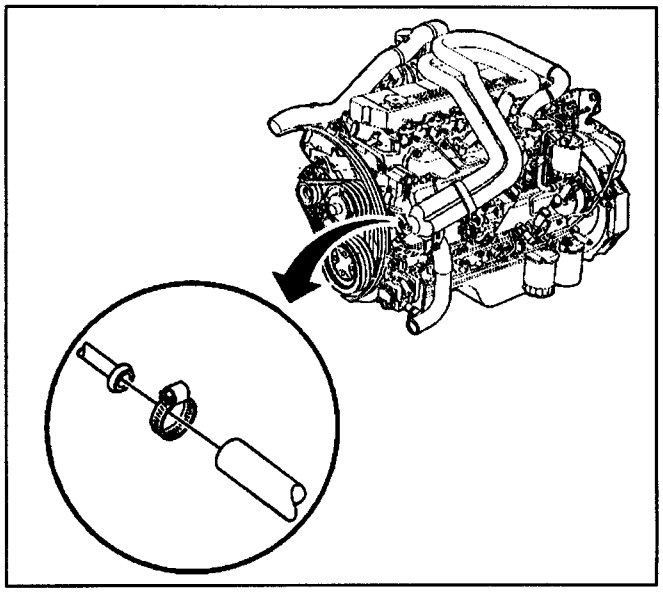
Installation procedure

1. Install the outlet pipe.
2. Install the clamp on the frame.



290964

3. Install the mounting bolt.
4. Install the hose clamp from the radiator hose.
5. Install the hose clamp from the heater core.
6. Fill with engine coolant. Refer to *Draining and Filling Cooling System (Filling)* in Engine Cooling.
7. Inspect the system for leaks.

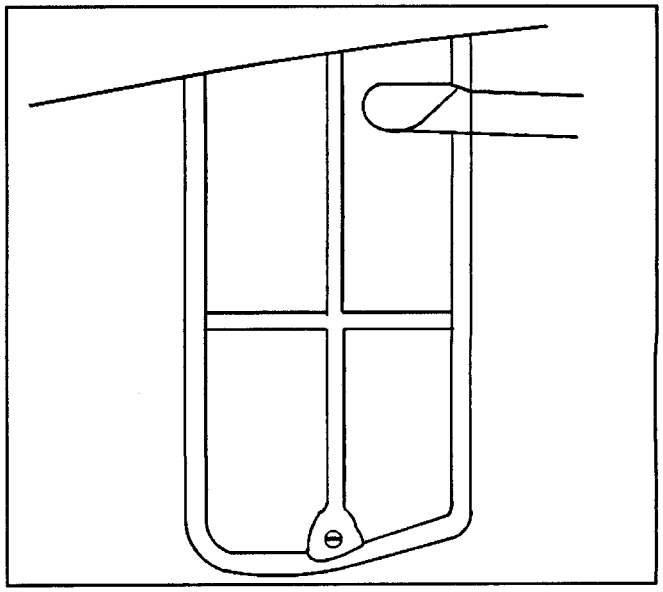


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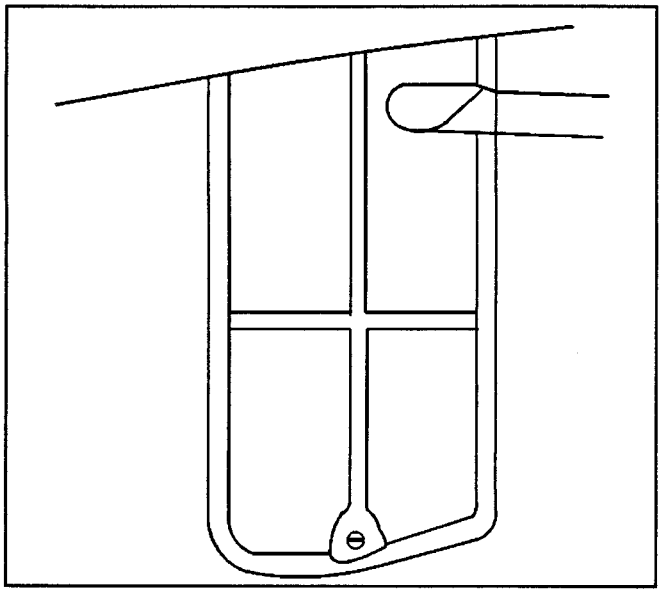
Passenger Compartment Air Filter Replacement

Removal Procedure

1. Open the hood.
2. Secure the hood.
3. Hold the tap located at the bottom of the filter. Pull the tap carefully.
4. Rinse the filter with clean water on both sides.



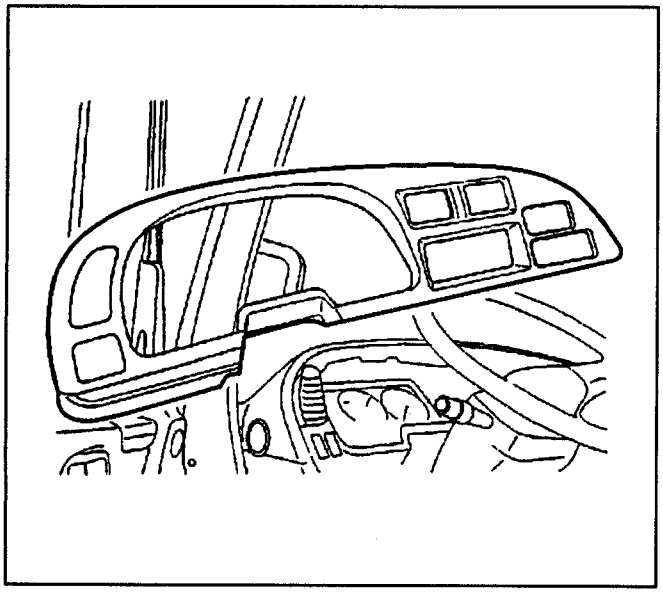
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Installation Procedure

1. Push carefully on the filter. Install the filter in the heater module.
2. Close the hood.



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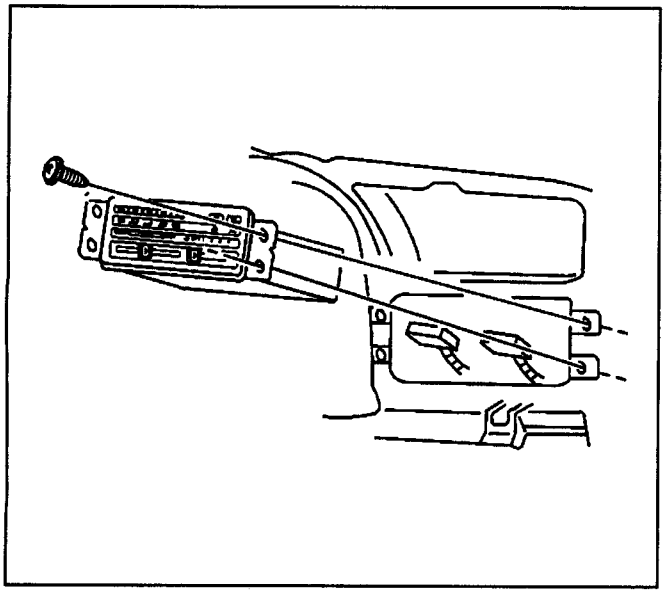
Control Assembly Replacement

A control assembly is available from the service parts warehouses. They are offered as a complete assembly. This item cannot be serviced. Service is by replacement only.

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the cluster trim.

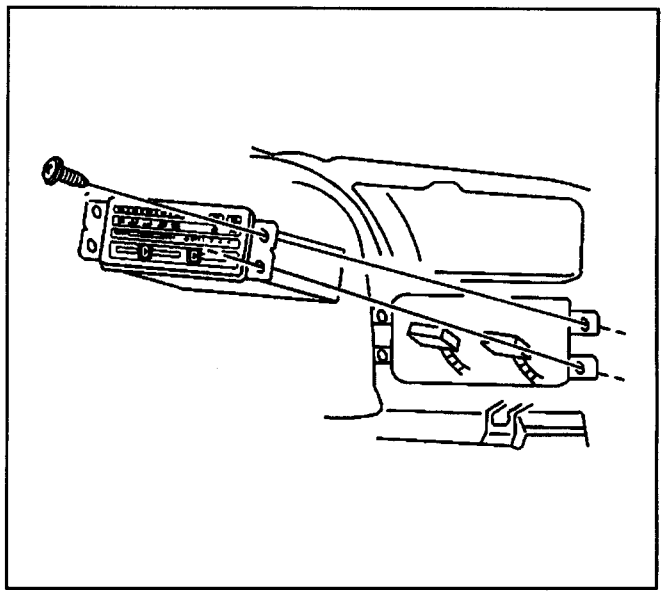


229887

3. Remove the control assembly screws.
4. Remove the control assembly.
5. Disconnect the electrical connectors.

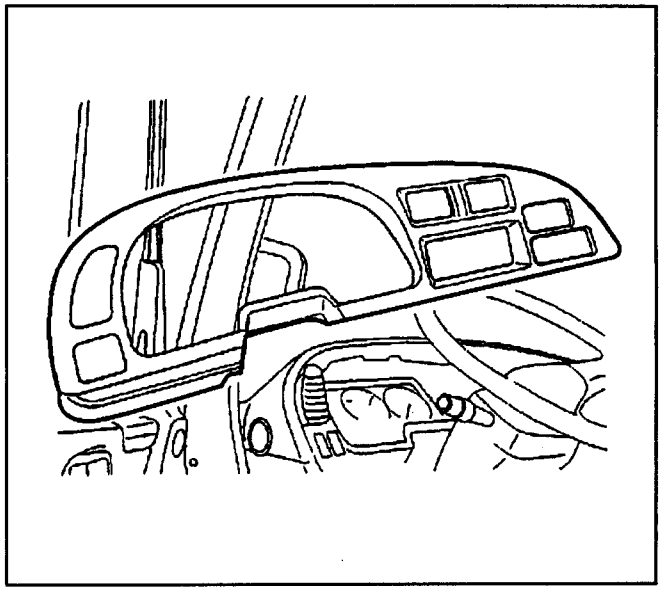
Installation Procedure

1. Connect the electrical connectors.
2. Install the control assembly.
3. Install the control assembly screws.



229887

4. Install the cluster trim.
5. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



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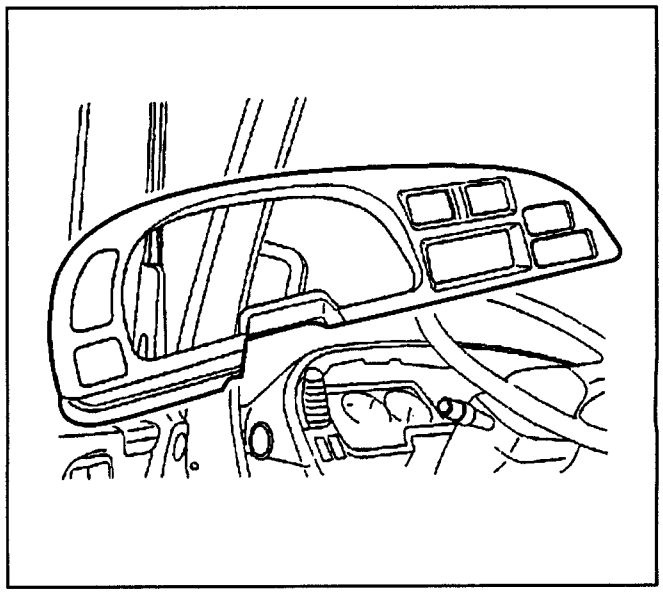
Blower Switch Replacement

A control assembly is available from the service parts warehouses. They are offered as a complete assembly. This item cannot be serviced. Service is by replacement only.

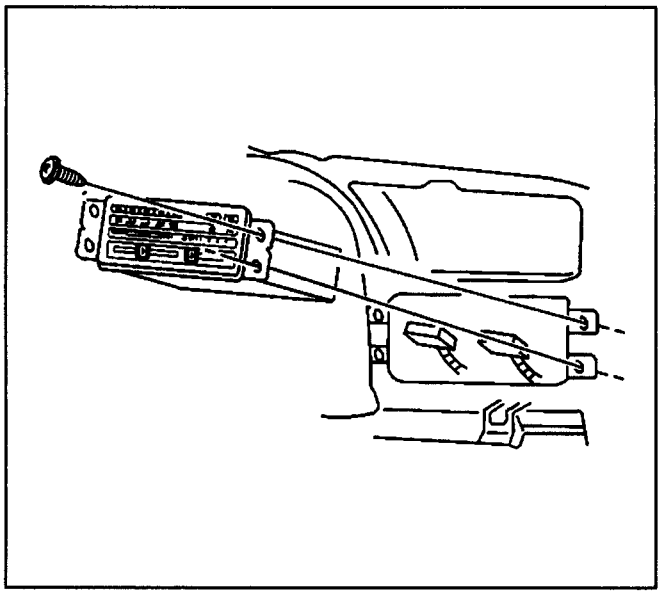
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the cluster trim.

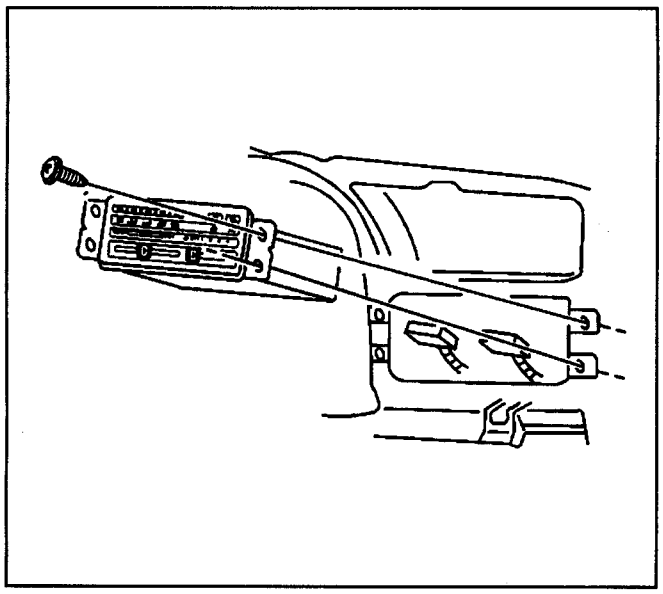


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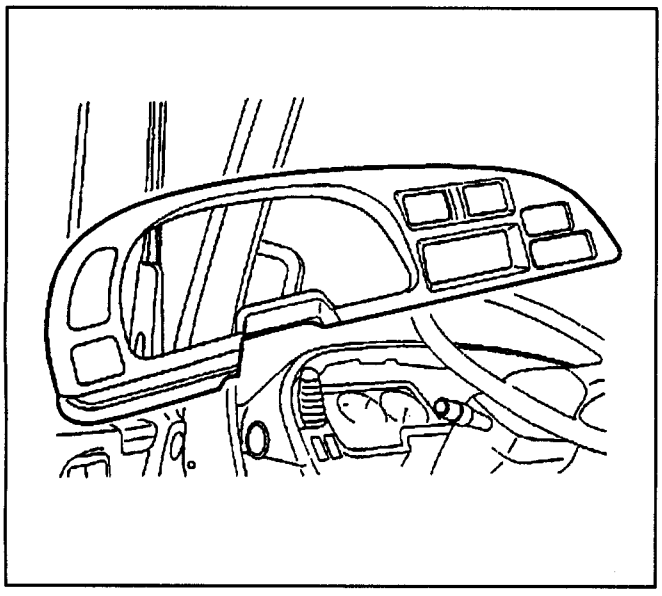
3. Remove the control assembly screws.
4. Remove the control assembly.
5. Disconnect the electrical connectors.



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Installation Procedure

1. Connect the electrical connectors.
2. Install the control assembly.
3. Install the control assembly screws.



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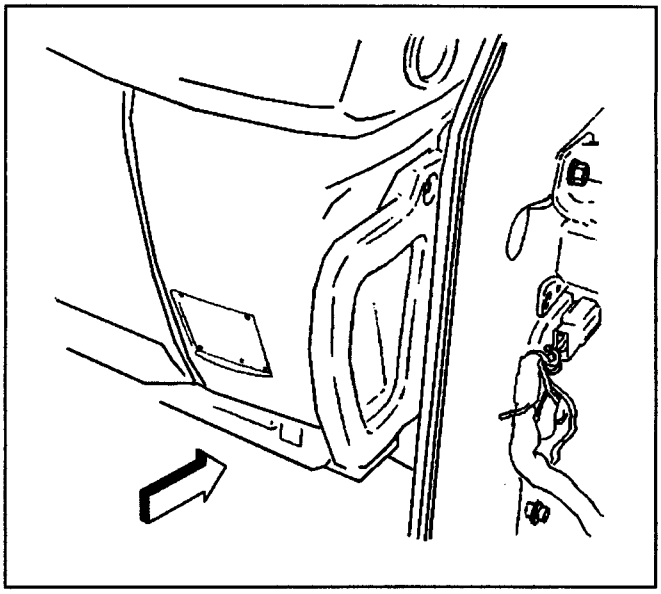
4. Install the cluster trim.
5. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.

Mode Actuator Replacement

Removal Procedure

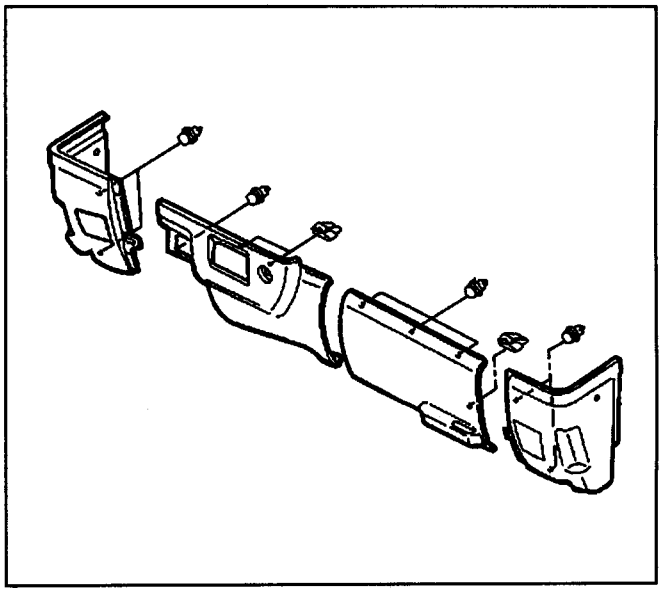
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle.



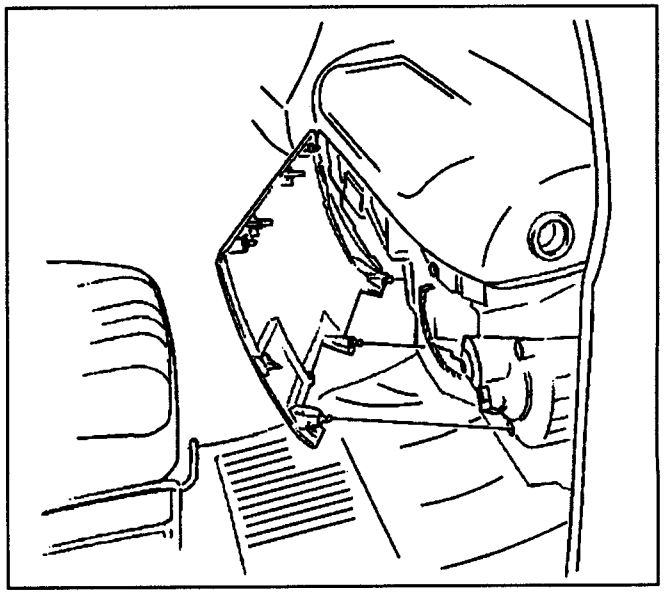
229889

3. Remove the assist handle bolts.
4. Remove the instrument panel lower trim.

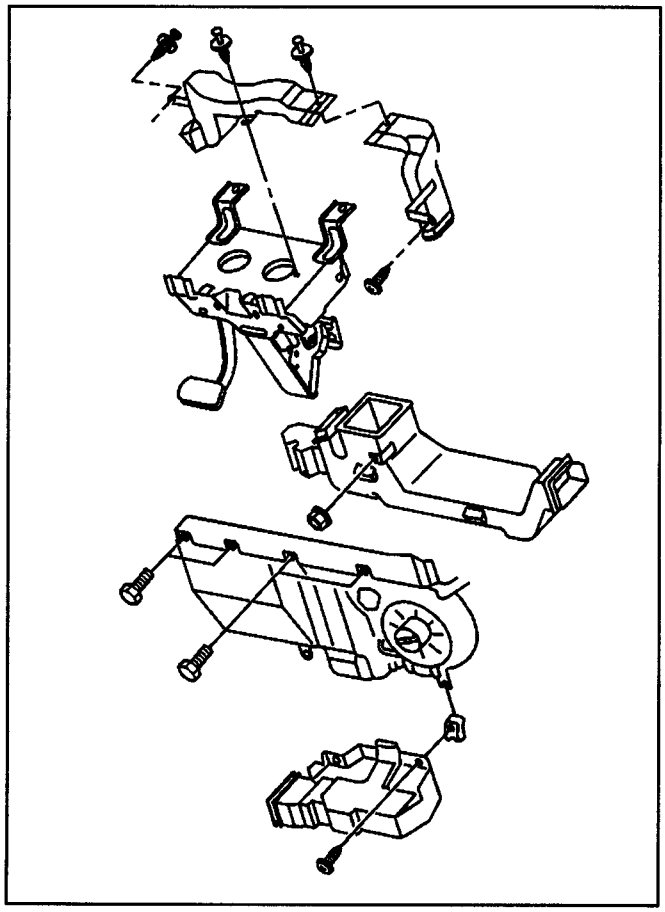


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5. Disconnect the audio system. Refer to *Radio Replacement* in Entertainment.

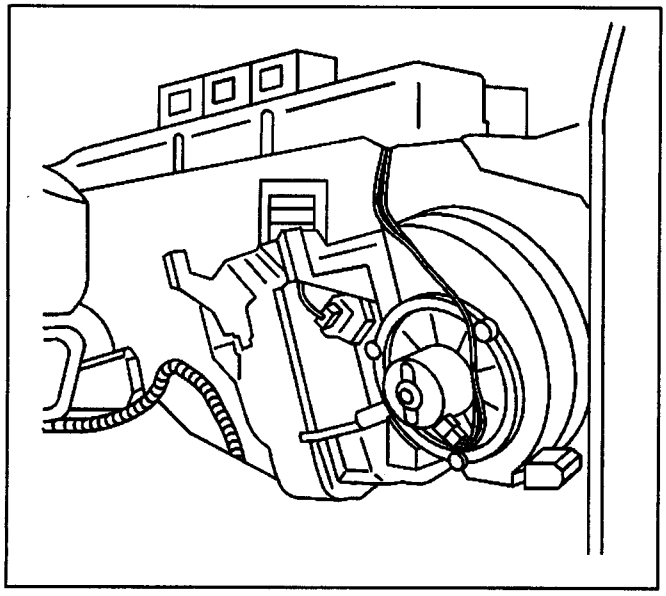


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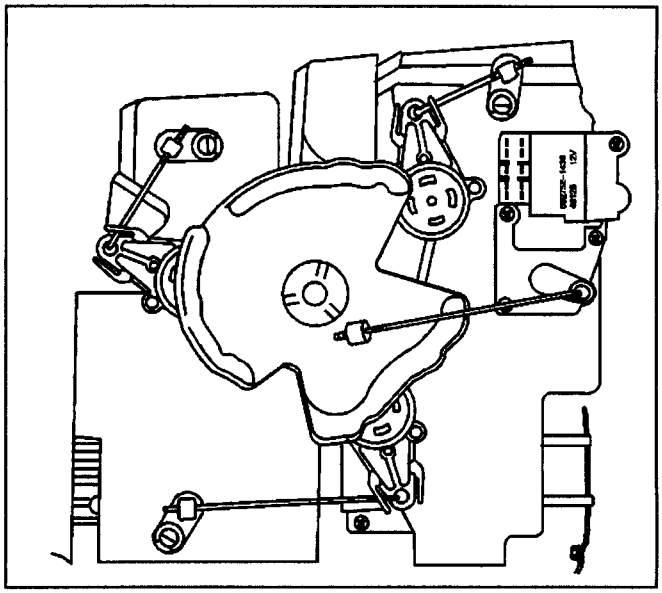
6. Disconnect the electrical connectors.



229927

7. Remove the heater module (right side).

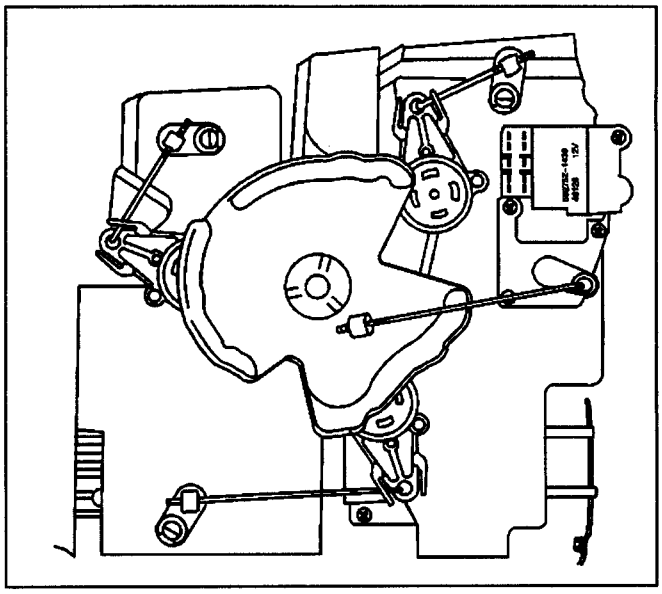
8. Remove the mode actuator.



229907

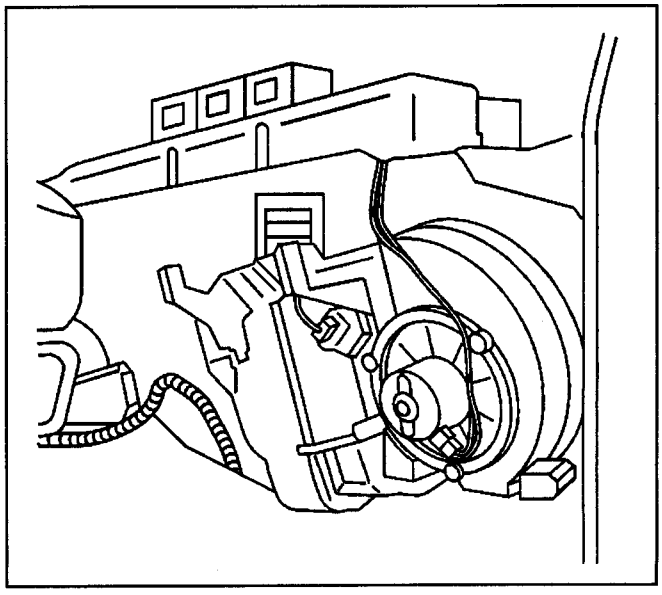
Installation Procedure

1. Install the mode actuator.

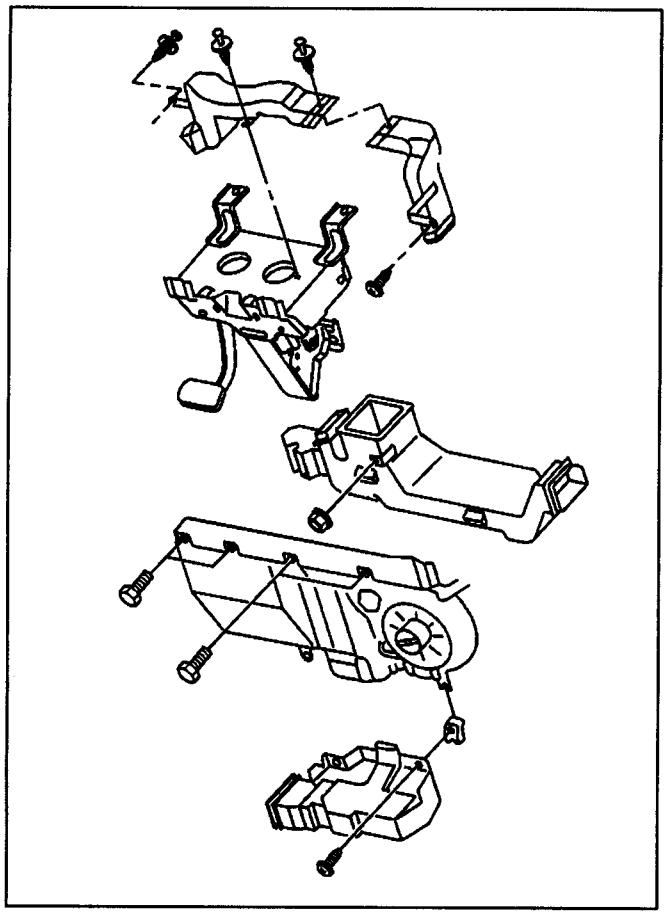


229907

2. Install the heater module (right side).

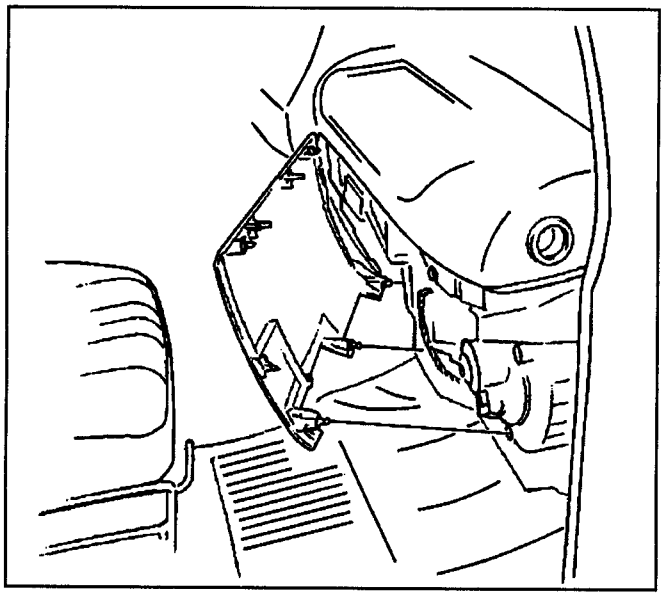


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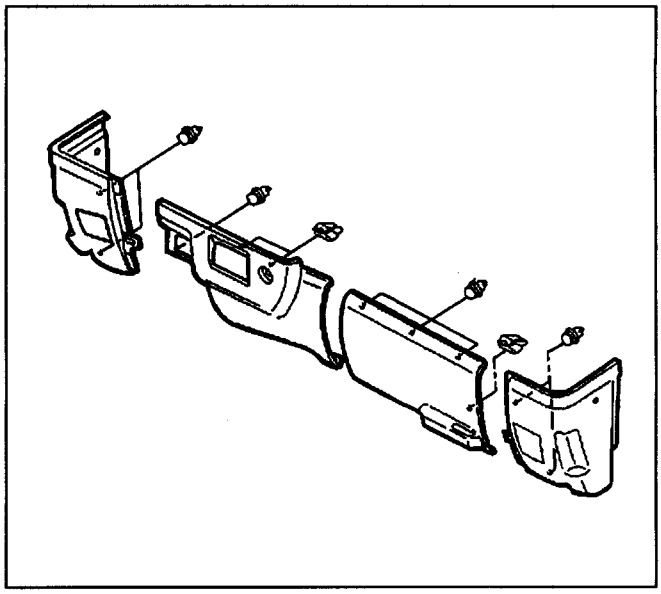
3. Connect the electrical connectors.



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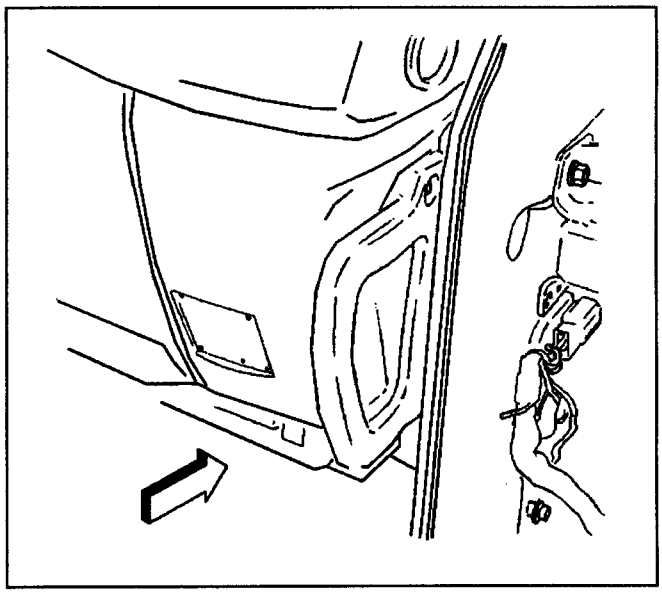
4. Connect the audio system. Refer to *Radio Replacement* in Entertainment.

5. Install the instrument panel lower trim.
6. Install the assist handle bolts.



214669

7. Install the assist handle.
8. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



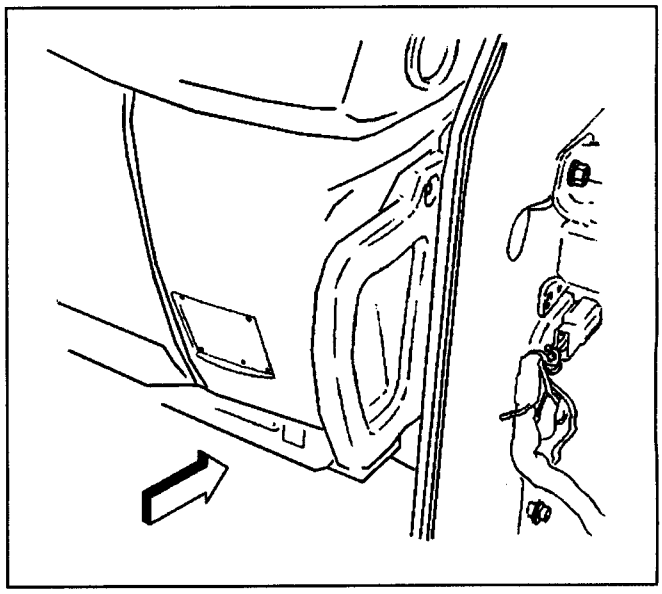
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Air Inlet Actuator Replacement

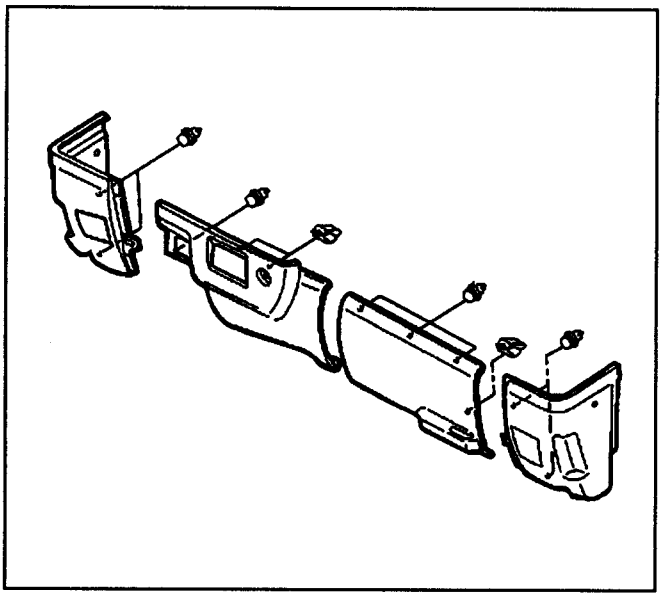
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.

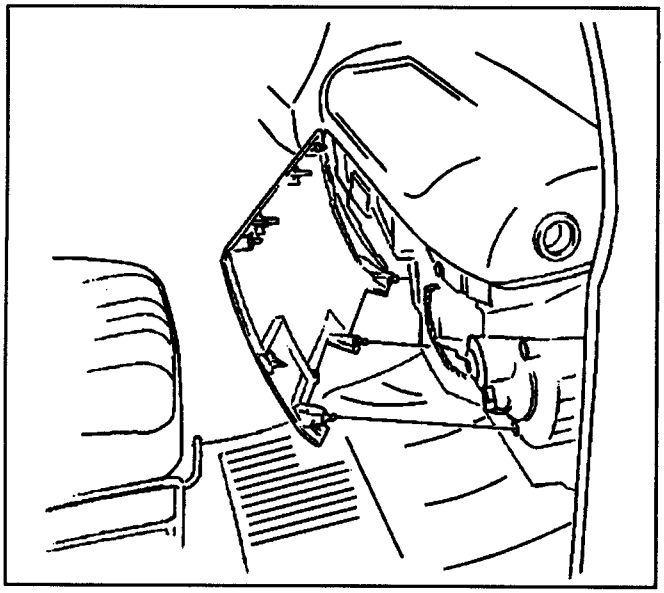


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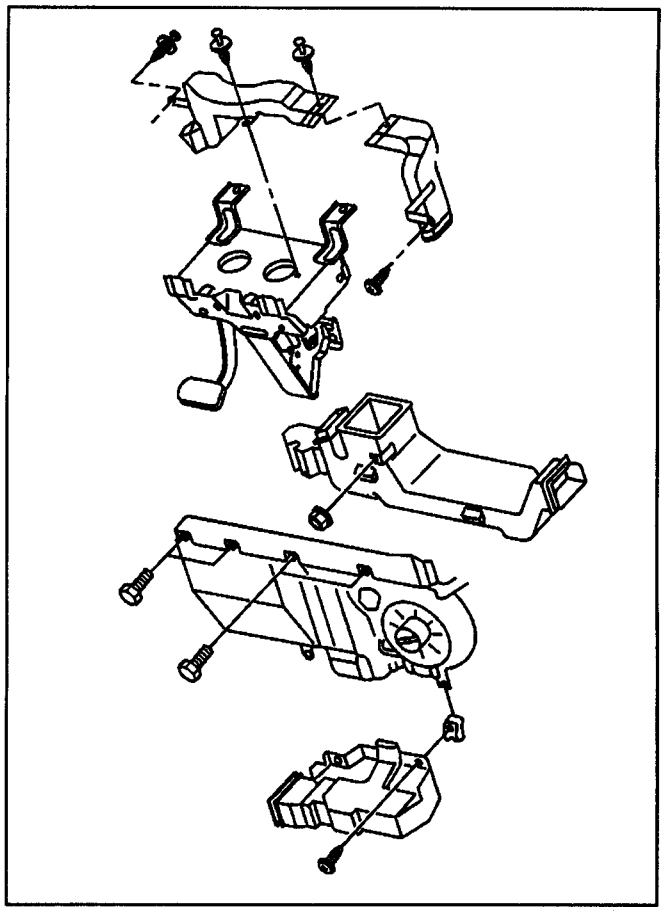
4. Remove the instrument panel right lower trim.



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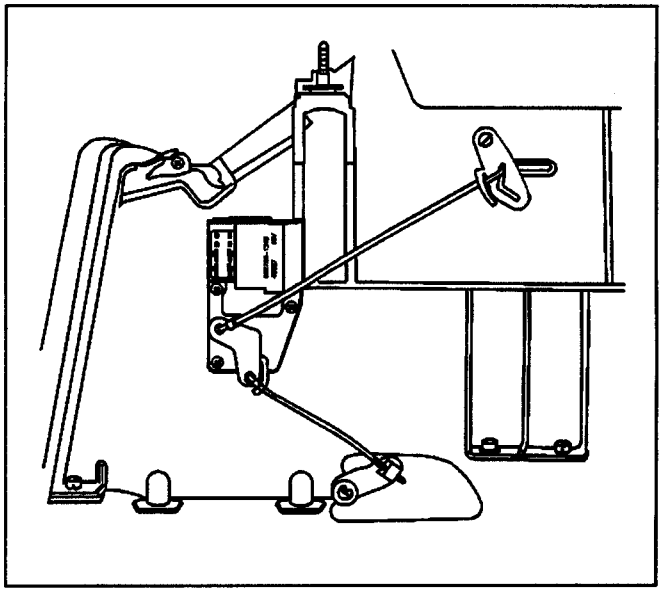
5. Remove the air distributor lower duct.

6. Disconnect the electrical connectors.

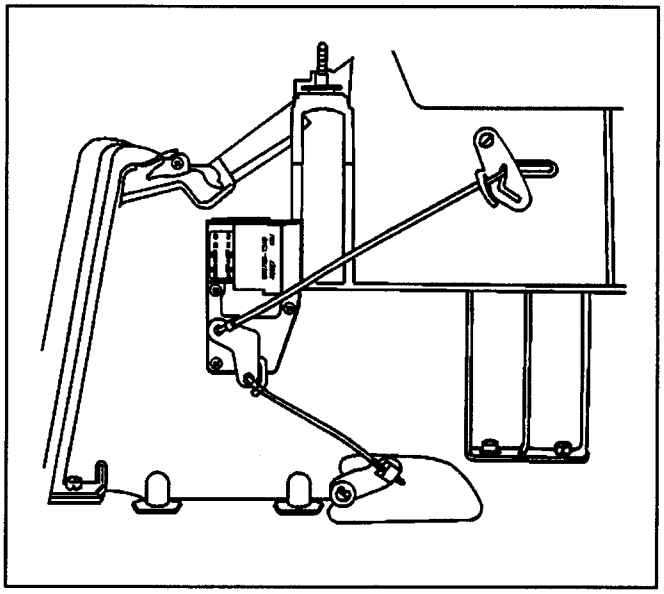


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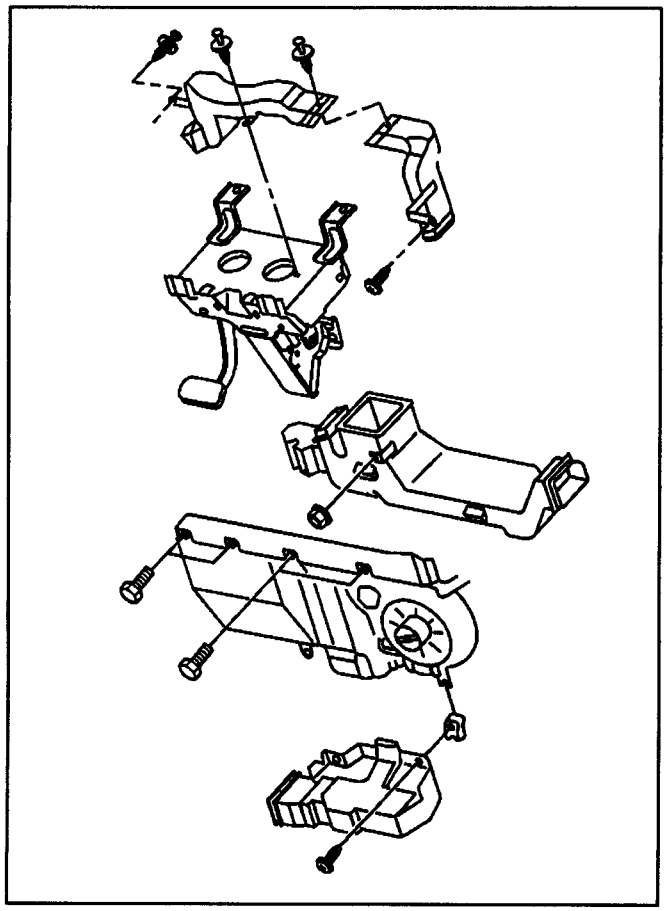
7. Remove the air inlet actuator.



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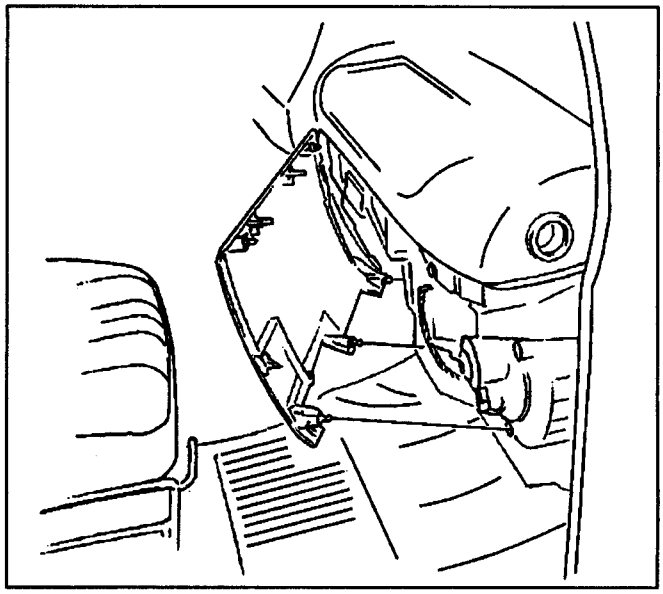


229904

Installation Procedure

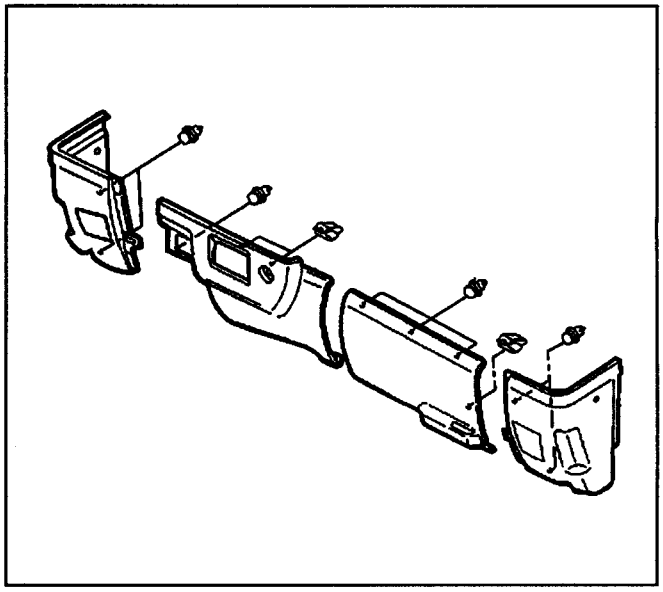
1. Install the air inlet actuator.
2. Connect the electrical connectors.

3. Install the air distributor lower duct.



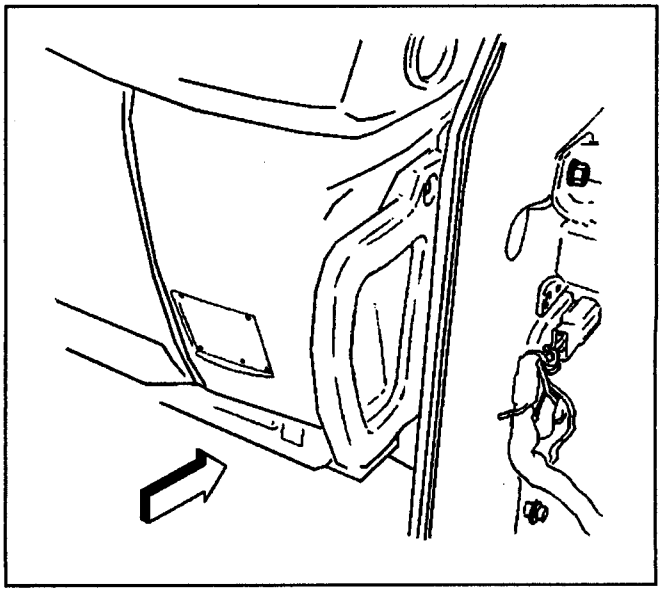
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4. Install the instrument panel right lower trim.

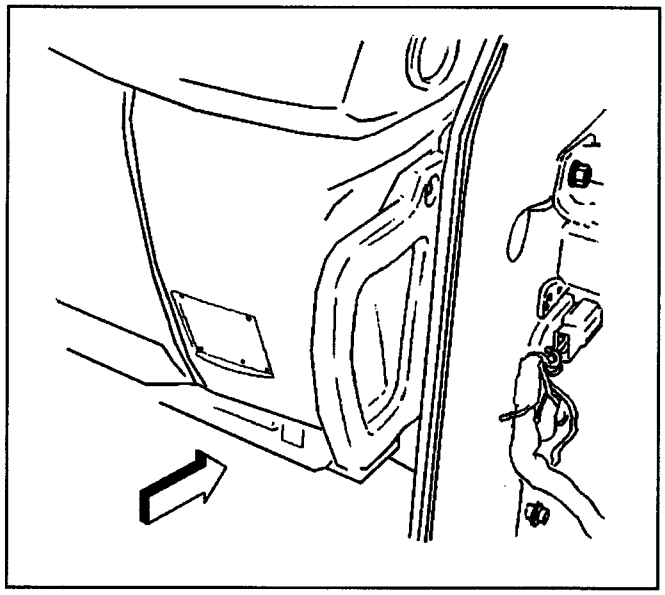


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5. Install the assist handle.
6. Install the assist handle bolts.
7. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



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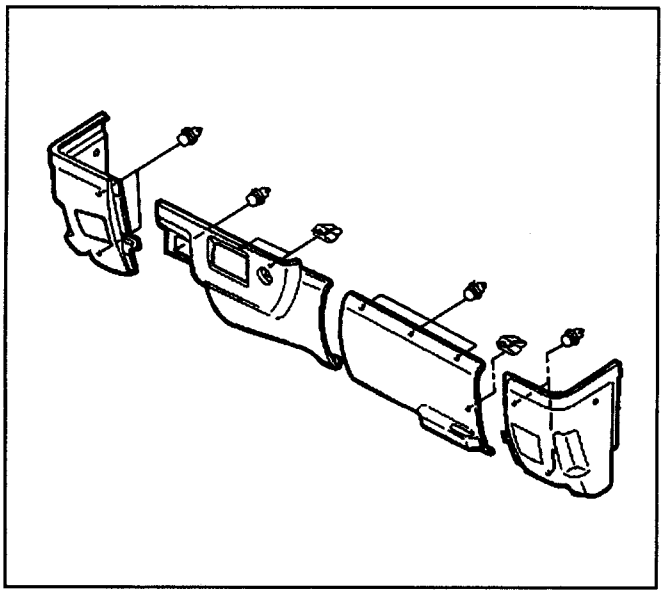
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Temperature Actuator Replacement

Removal Procedure

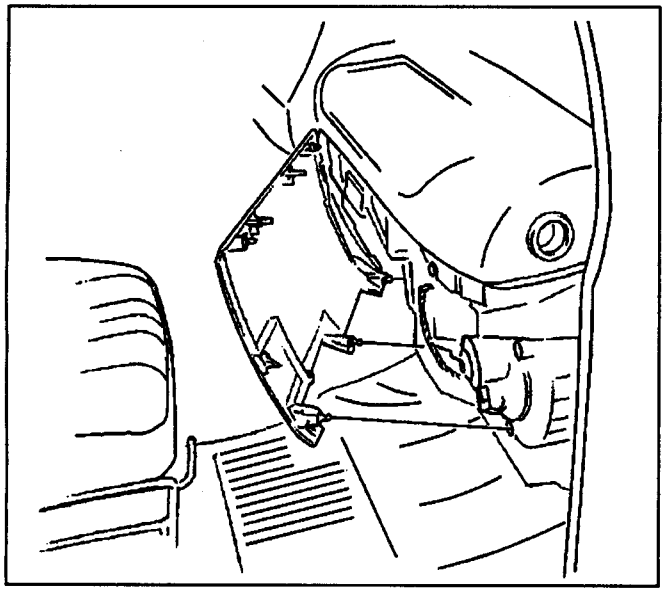
Caution: Refer to Battery Disconnect Caution in Cautions and Notices

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the assist handle bolts.
3. Remove the assist handle.



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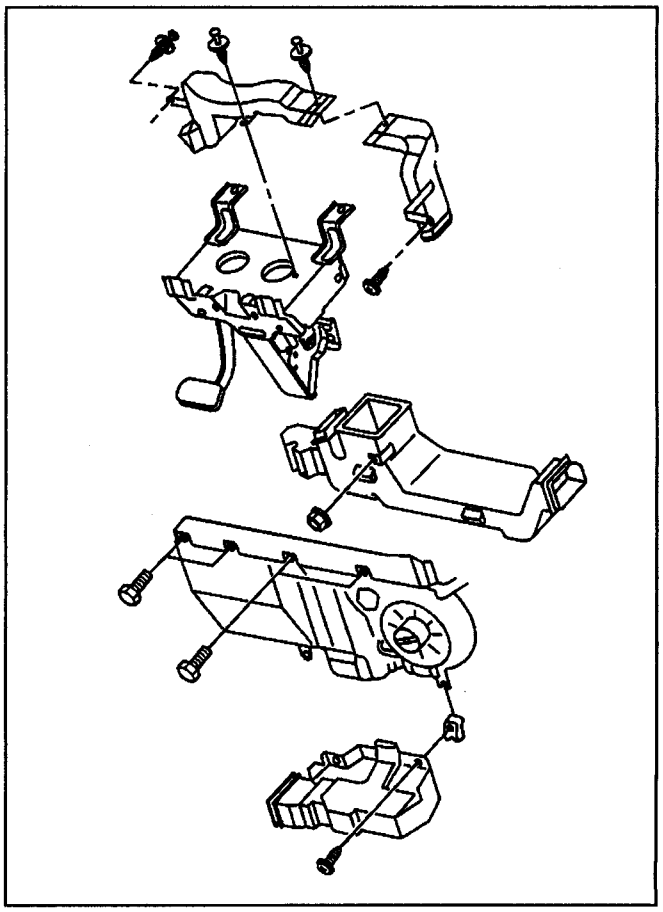
4. Remove the instrument panel right lower trim.



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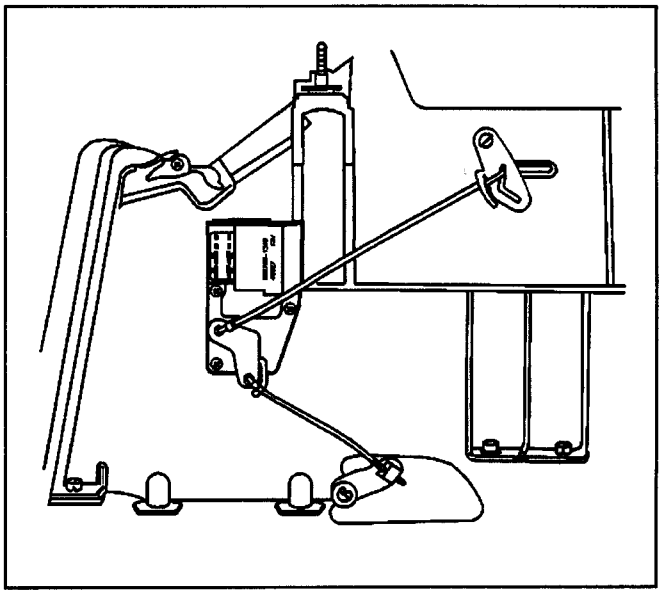
5. Remove the air distributor lower duct.

6. Disconnect the electrical connectors.

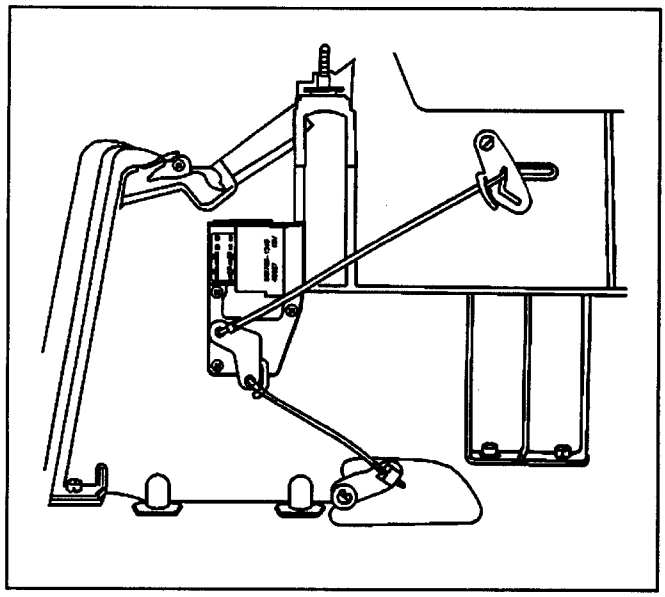


229904

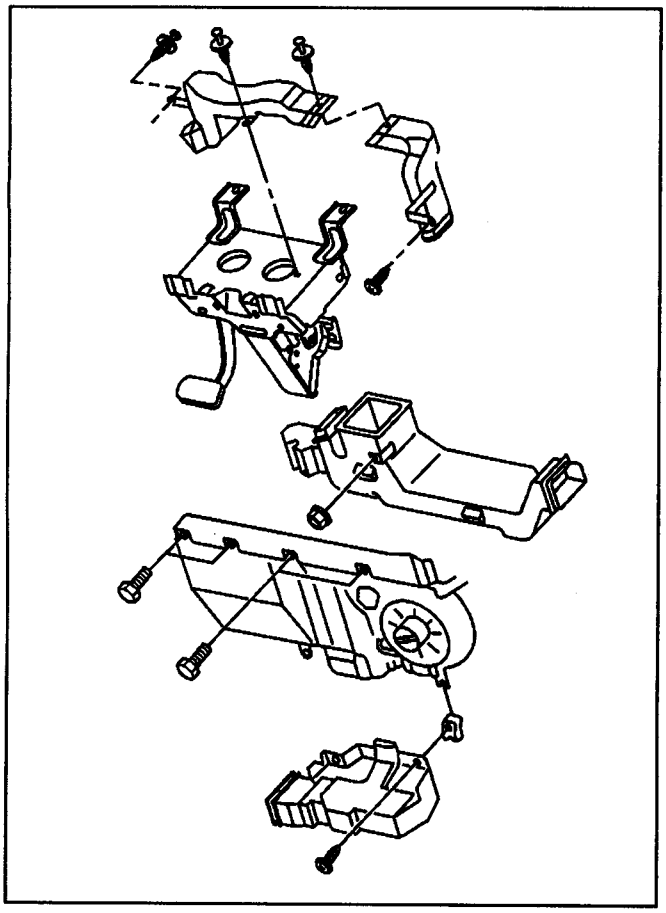
7. Remove the temperature actuator.



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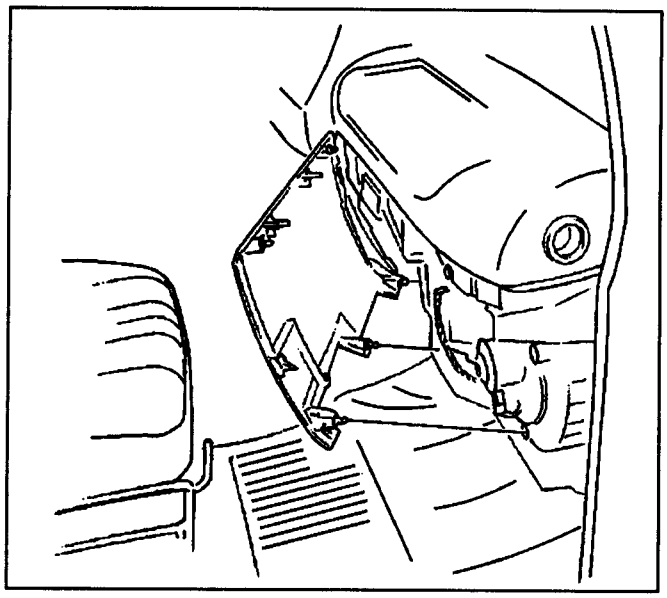


229904

Installation Procedure

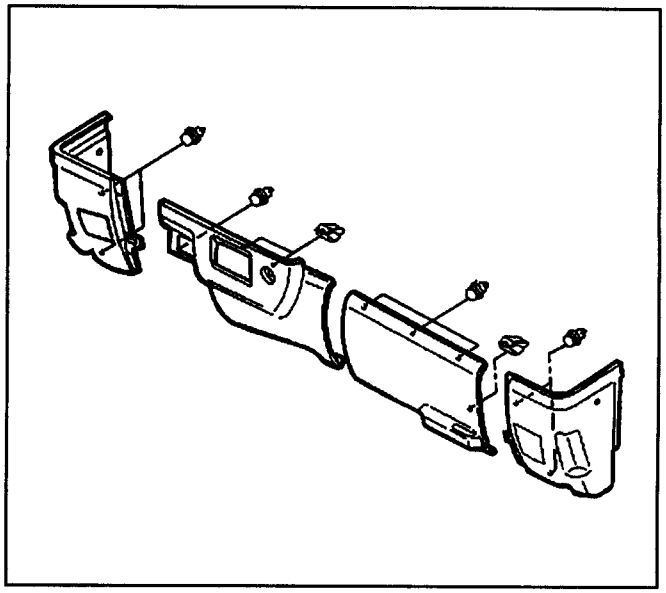
1. Install the temperature actuator.
2. Connect the electrical connectors.

3. Install the air distributor lower duct.



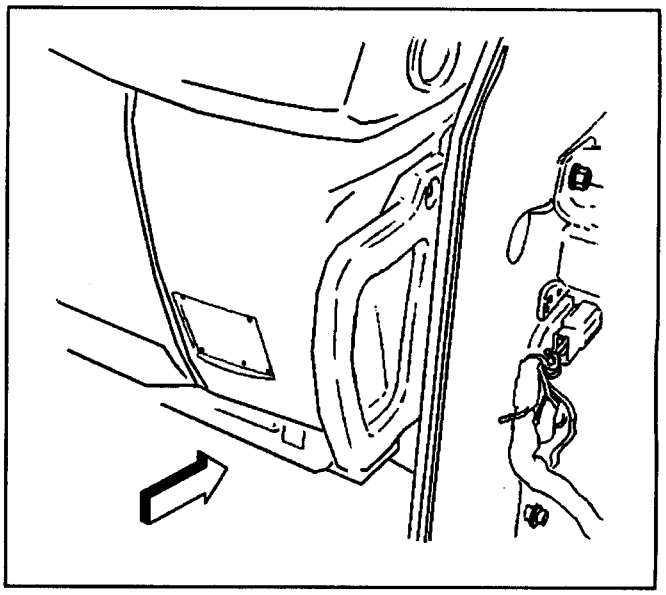
229897

4. Install the instrument panel right lower trim.

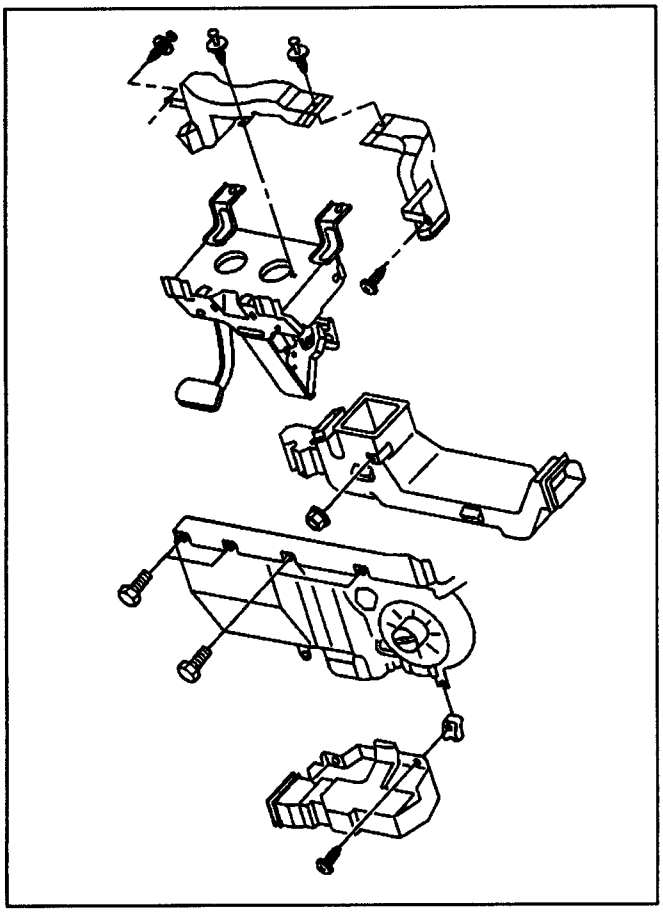


214669

5. Install the assist handle.
6. Install the assist handle bolts.
7. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



229889



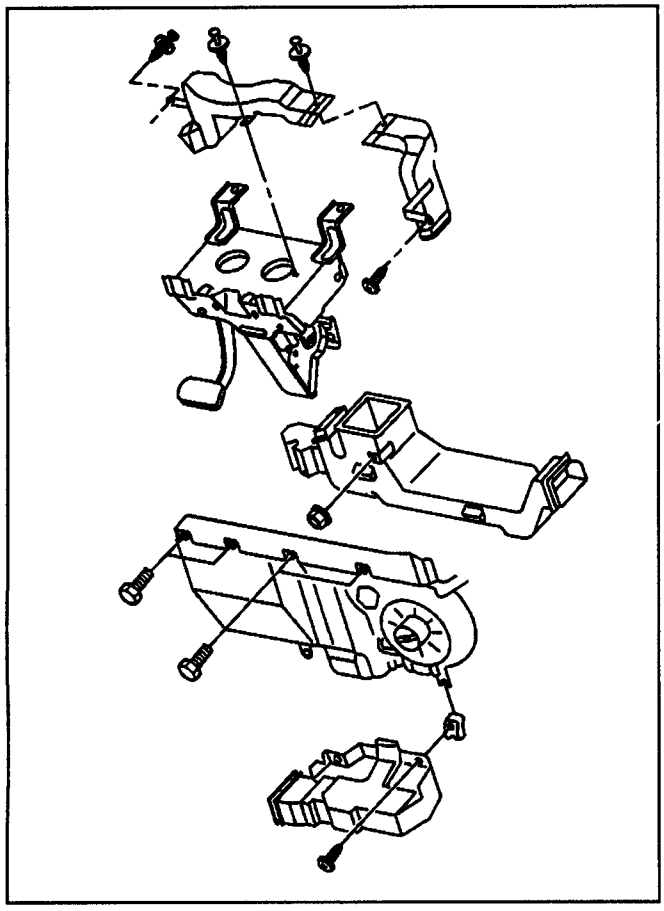
229904

Air Distributor Duct Replacement (Lower)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
3. Remove the air distributor duct lower screws.
4. Remove the air distributor duct lower bolt.
5. Remove the air distributor lower duct.



229904

Installation Procedure

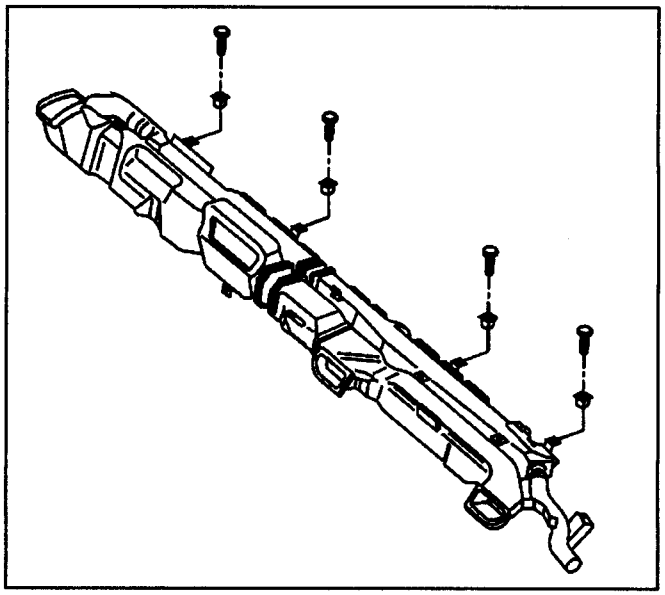
1. Install the air distributor lower duct.
2. Install the air distributor lower duct bolt.
3. Install the air distributor lower duct screws.
4. Install the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
5. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.

Air Distributor Duct Replacement (Upper)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices

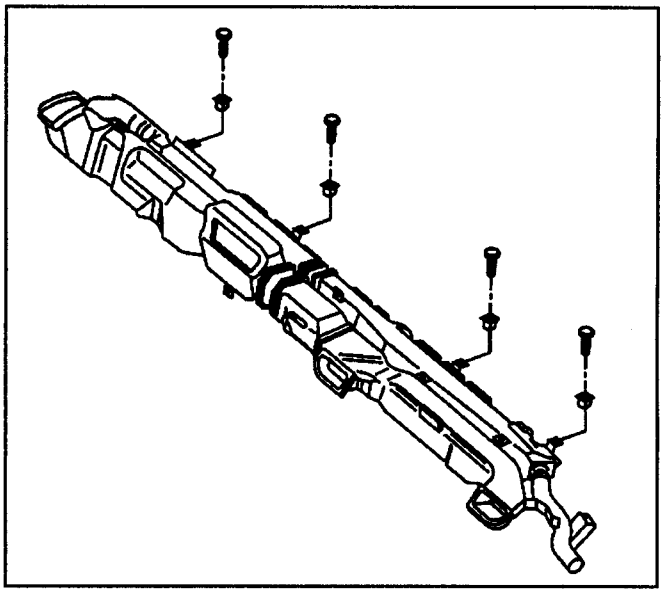
1. Disconnect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
3. Remove the air distributor upper duct screws.
4. Remove the air distributor upper duct.



229918

Installation Procedure

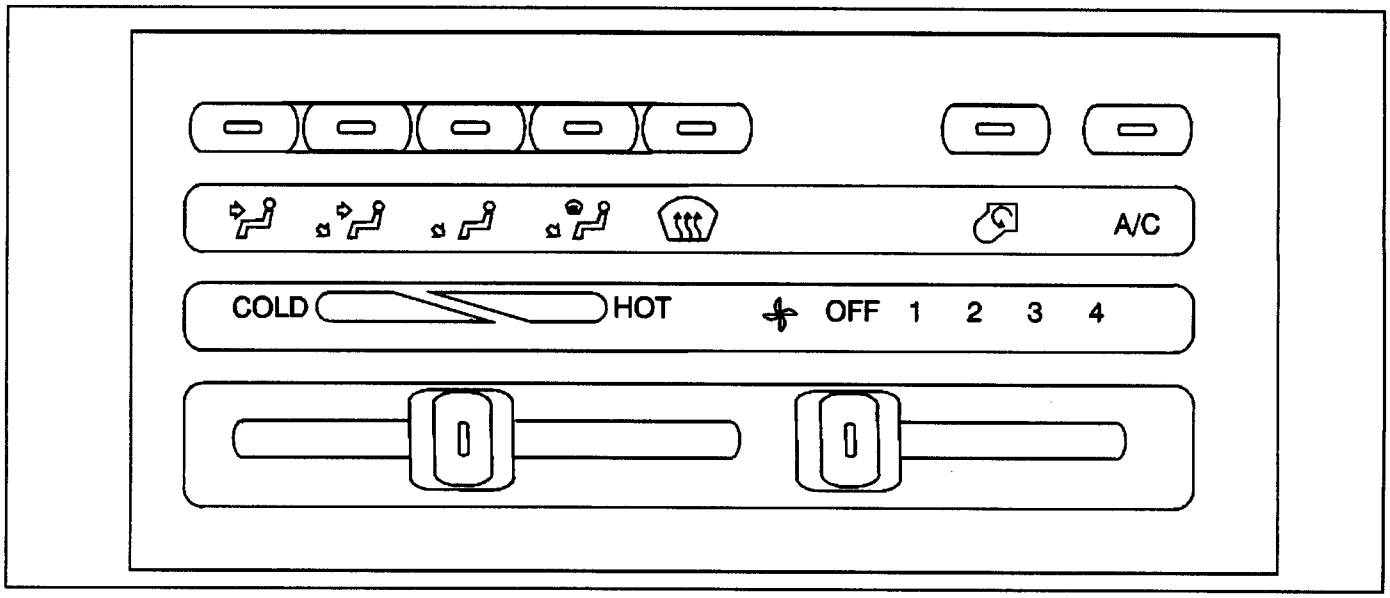
1. Install the air distributor upper duct.
2. Install the air distributor upper duct screws.
3. Install the instrument panel. Refer to *IP Carrier Replacement* in Instrument Panel and Gauges.
4. Connect the negative battery cable. Refer to *Battery Replacement* in Engine Electrical.



229918

Description and Operation

Operating Modes



229857

The control assembly in the instrument panel contains the following components:

- A blower switch
- Mode switches
- A temperature lever

The controls are lit when the headlamps are on. Electrical power is provided by the control panel lighting circuit from the control panel harness.

The mode control switches allow the driver to control the direction and quantity of air through different outlets.

Brightness of the illumination is controlled by the instrument panel dimmer switch. The control assembly bulbs are in parallel with the radio bulb and the instrument cluster illumination bulbs.

Fan Control Switch

Air quantity is controlled by the four-position blower fan control switch. The blower fan control switch provides a choice of various blower motor speeds.

Temperature Lever

When the temperature lever is in the COLD or extreme left end of the slot, all of the air delivered by the heater system is unheated. The temperature actuator and the temperature control door are positioned to stop all of the airflow through the heater cores so only unheated air is sent up in the heater module.

When the temperature lever is in the HOT or extreme right end of the slot, almost all of the air delivered by the system is heated. The temperature actuator and the temperature control door is positioned to open so that all of the airflow through the heater cores is sent up in the heater vent module.

Intermediate positions of the temperature lever result in a mixture of heated and unheated air to provide more moderate air temperatures. This lever operates the temperature actuator. As a result, this lever moves the temperature control door.

Vent Mode

With the vent switch in the ON position, the inlet air actuator is activated. This causes the recirculating/fresh air door to open completely and air is discharged from the upper air outlets. As a result, the air coming from the upper air outlets should be nearly the same temperature as the outside air.

Bi-Level Mode

With the Bi-Level switch in the ON position, the mode actuator is activated. This causes the mode control door to open halfway. The airflow is divided between the upper air outlets and the floor air outlets.

Floor Mode

With the Floor switch) in the ON position, the mode actuator is activated. This causes the mode control door to open completely. The majority of airflow is routed to the floor while the remaining airflow is routed to the windshield outlets.

Floor/Defrost Mode

With the Floor / Defrost switch in the ON position, the mode actuator is activated. This causes the mode control door to open halfway. Half of the airflow is delivered to the floor while the other half is delivered to the windshield outlets.

Defrost Mode

With the Defrost switch in the ON position, the mode actuator is activated. This causes the mode control door to open completely. The majority of the airflow is routed to the windshield outlets while the remaining airflow is routed to the floor.

Max/Rec/Rc Mode

With the Max /Rec/ Rc switch (2) in the ON position, theair inlet actuator is activated. This causes the air inlet door to close completely, causing very little outside air (that is needed for the outside air system) from coming in. The majority of airflow is not outside air. The air is recirculated throughout the cab.

A/C Mode

With the A/C switch (3) in the ON Position, the air conditiioning will work.

Air Distribution System Description

The HVAC module contains a series of air doors. These doors are hinged parts that direct the airflow through various sections of the HVAC module. This action provides the proper airflow for the selected operating mode. Each air door is controlled by an actuator.

Ducts and Outlets

A system of ducts and outlets directs air to the passenger compartment.

If the air output is poor, inspect the following areas for obstruction:

- The defroster
- The heater
- The air conditioning
- The vent ducts

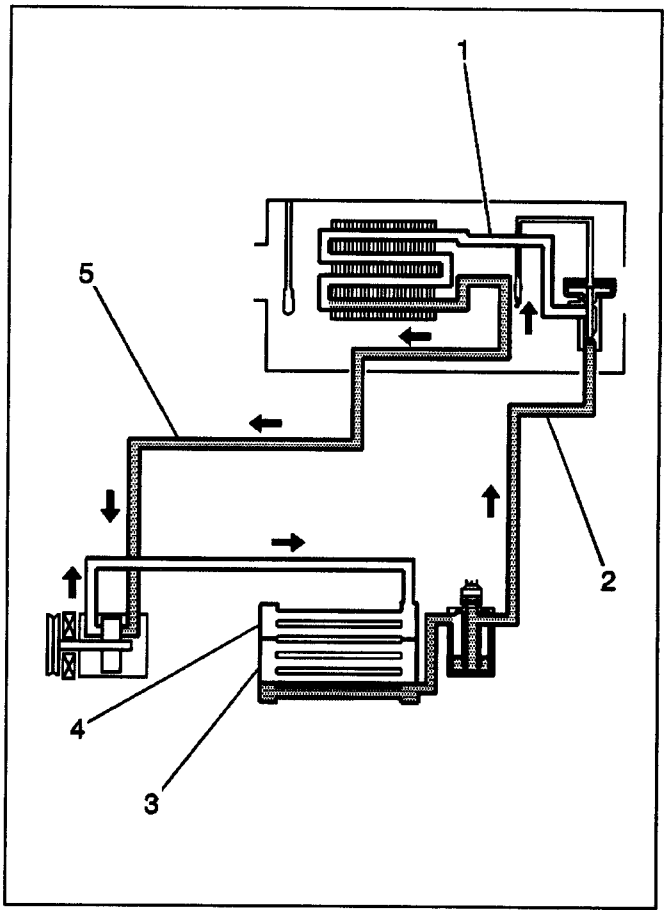
Refrigeration System Description (With A/C)

The system contains a refrigerant. The refrigerant is either a gas or a liquid, depending on the temperature and the pressure. The refrigerant is a heat exchange medium.

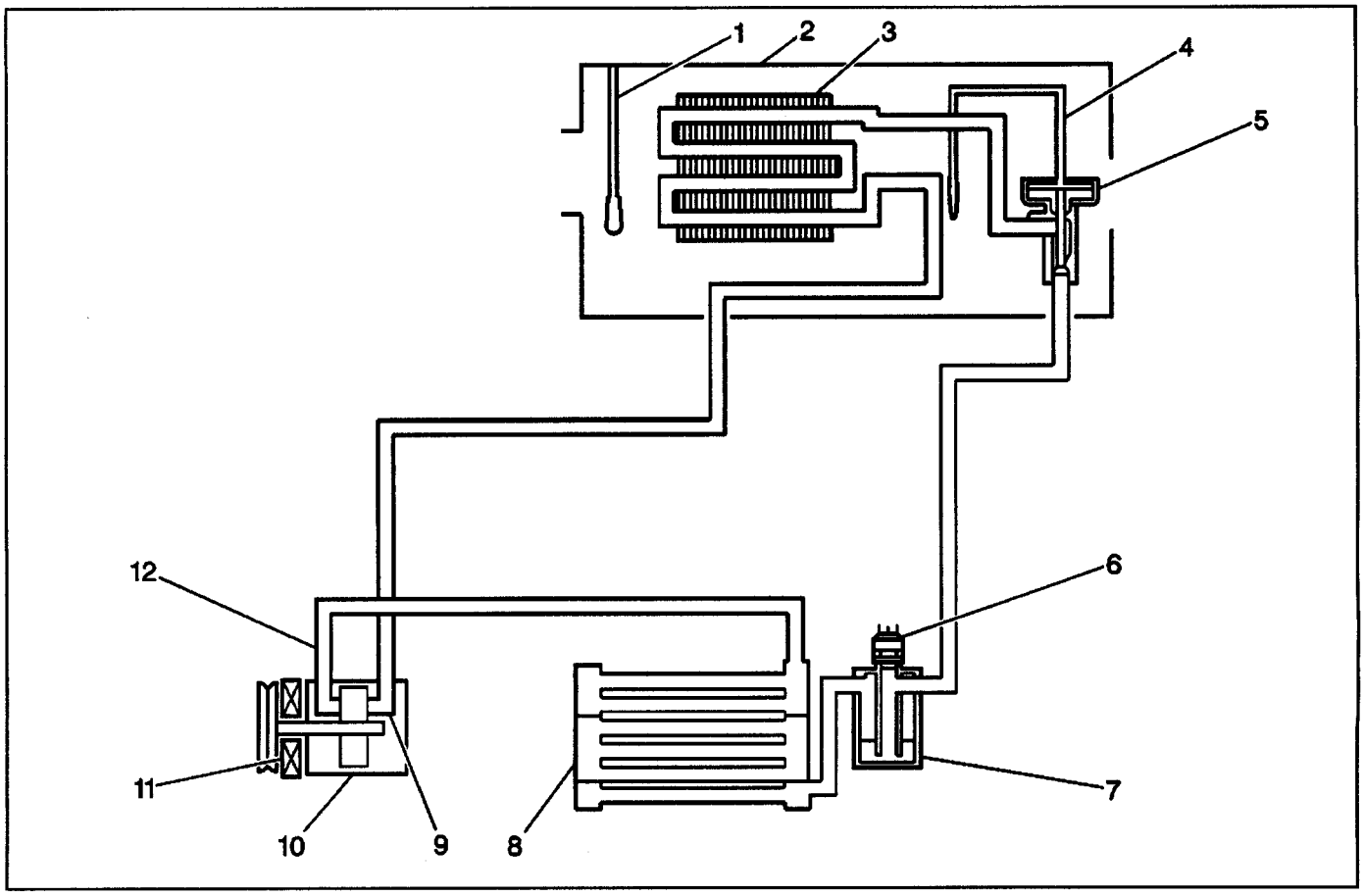
Heat is required to change the liquid refrigerant (134a) into a gas or vapor.

When the R-134a refrigerant changes from a liquid to a gas in the A/C evaporator, the vehicle cab cools.

The air that passes through the A/C evaporator transfers heat to the R-134a refrigerant. The R-134a refrigerant absorbs the heat and changes into a gas. The blower motor circulates the air in the cab.



229659

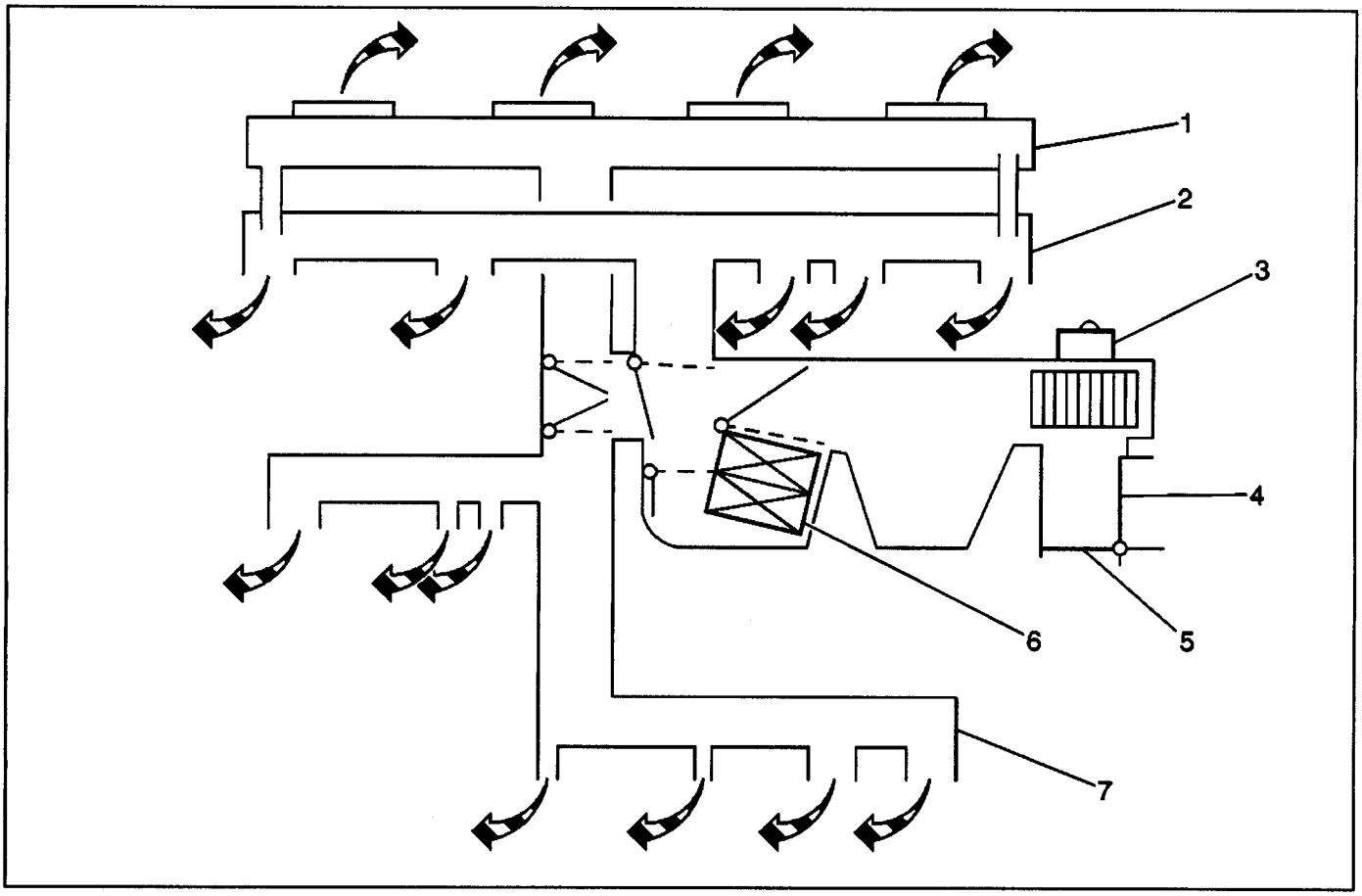


229652

The following steps occur in the refrigerant cycle:

1. The refrigerant cycle starts at the A/C compressor (10).
   The refrigerant is a low pressure, low temperature vapor when it enters the compressor.
2. The refrigerant is compressed to a high pressure, high temperature vapor.
3. The vapor flows through the A/C condenser tube.
4. The vapor transfers heat to the cooler air that is passing through the A/C condenser cooling fins (8).
5. The high pressure, high temperature vapor changes into a high pressure, high temperature liquid.
6. The high pressure liquid passes through the A/C receiver/dryer or dehydrator.
   The following actions occur in the A/C receiver/dryer or dehydrator (7):
   6.1. A screen filters the refrigerant.
   6.2. A desiccant removes moisture from the refrigerant.
   6.3. The A/C receiver/dryer or dehydrator also stores the refrigerant.
7. The liquid refrigerant flows through the A/C expansion valve (5).
8. The refrigerant changes to a low pressure, low temperature liquid in the A/C evaporator (2).
9. Warm inside air flows through the cooler A/C evaporator core or fins (3).
   The warm air transfers heat to the low pressure, low temperature liquid in the A/C evaporator.
10. The low pressure vapor returns to the A/C compressor.
11. The cycle begins again.

Refrigeration System Description (Without A/C)



229842

Hot coolant comes from the engine and is directed through the heater cores and returned to the cooling system when the engine is running (under normal operating conditions).

The heater vent module contains components that heat the air flowing through. The air is directed to the proper ducts and outlets.

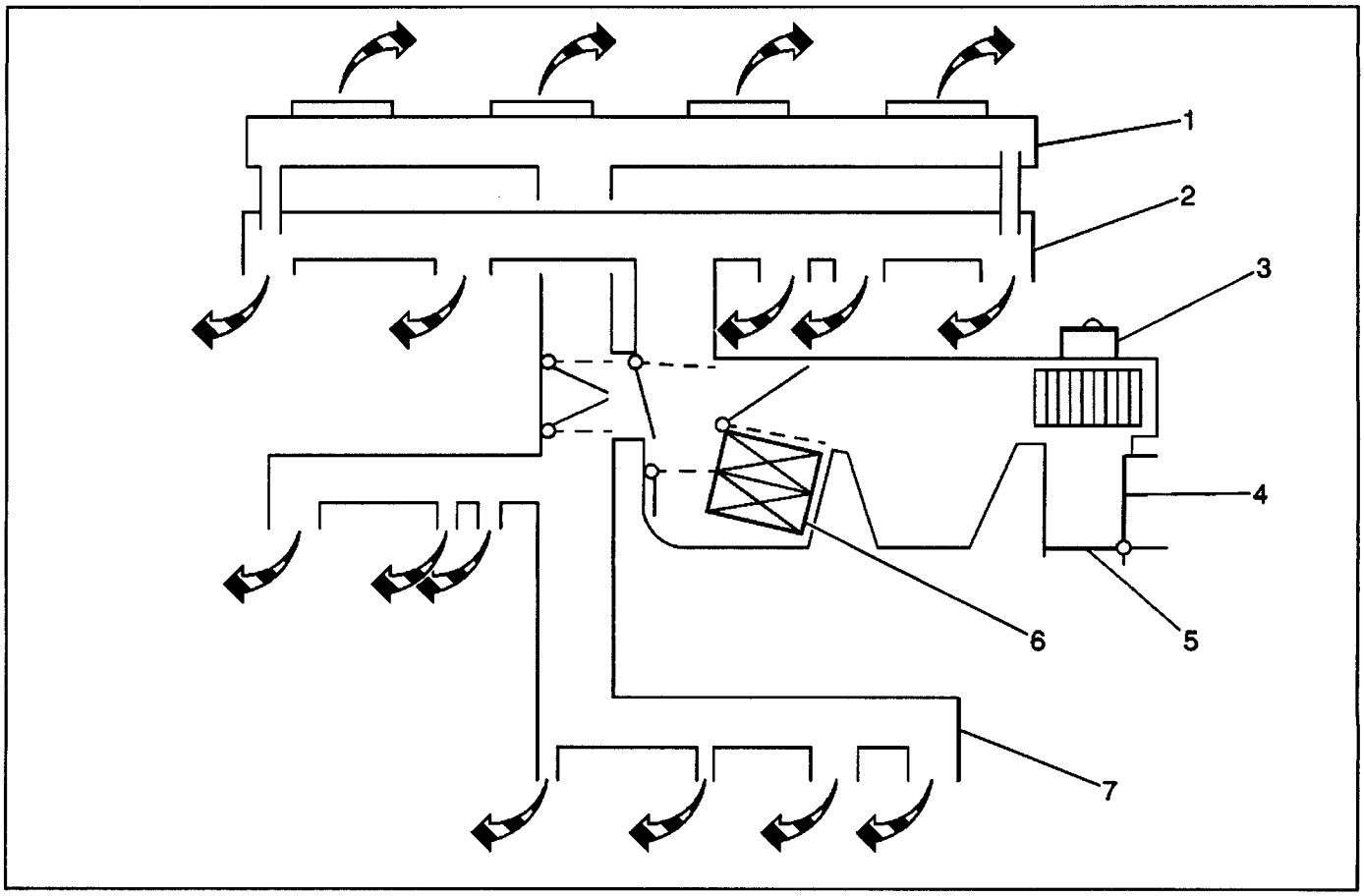
The heater system provides the following features:

- Heated ram air
- Power ventilation
- Windshield defrosting

Outside air is drawn from the plenum into the heater vent module by the blower motor fan. Additional outside air (called ram air) is forced into the heater vent module by the forward movement of the vehicle. Within the heater vent module, the air is heated as required, then routes through ducts to the proper outlets for discharge into the passenger compartment. A control assembly in the instrument panel allows the operator to control the following conditions:

- Blower speed
- Mode of operation
- Temperature of the air coming from the heater system

Heater System Description



229842

Hot coolant comes from the engine and is directed through the heater cores and returned to the cooling system when the engine is running (under normal operating conditions).

The heater vent module contains components that heat the air flowing through. The air is directed to the proper ducts and outlets.

The heater system provides the following features:

- Heated ram air
- Power ventilation
- Windshield defrosting

Outside air is drawn from the plenum into the heater vent module by the blower motor fan. Additional outside air (called ram air) is forced into the heater vent module by the forward movement of the vehicle. Within the heater vent module, the air is heated as required, then routes through ducts to the proper outlets for discharge into the passenger compartment. A control assembly in the instrument panel allows the operator to control the following conditions:

- Blower speed
- Mode of operation
- Temperature of the air coming from the heater system

Refrigerant R-134a

Caution: Avoid breathing A/C Refrigerant-134a and lubricant vapor and mist. Exposure may irritate eyes, nose and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (R-134a recycling equipment). If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Refrigerant performs the following functions in the air conditioning system:

- Absorbs heat
- Carries heat
- Releases heat

These vehicles use Refrigerant-134a (R-134a). Refrigerant-134a is a nontoxic, nonflammable, clear, colorless liquefied gas.

Handling Refrigerant R-134a

Caution: Avoid breathing A/C Refrigerant-134a and lubricant vapor and mist. Exposure may irritate eyes, nose and throat. To remove R-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (R-134a recycling equipment). If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Important:

- Use only the approved lubricant for the R-134a system and the R-134a components. If lubricants other than those specified are used, compressor failure may occur. Coat all of the fittings and the O-ring seals with a clean approved refrigerant oil. This action will provide a leak-proof seal and to aid in assembly and disassembly.
- Do not store or heat the refrigerant containers above 125°F (52°C).
- Do not heat a refrigerant container with an open flame. If the container must be warmed, place the bottom of the container in a pail of warm water.
- Do not drop, puncture, or incinerate the refrigerant containers.
- Refrigerant will displace oxygen. Work in well-ventilated areas in order to prevent suffocation.
- Do not introduce compressed air to any refrigerant container or refrigerant component. The action may cause the contamination of the refrigerant.
- If it is necessary to carry a container of Dot CFR Refrigerant-134a in a vehicle, do not carry it in the passenger compartment.

Handling of Refrigerant Lines and Fittings

Important: Before opening the refrigeration system, ensure that the work area is well-ventilated. Do not conduct welding or steam-cleaning operations on or near the following areas:

- The refrigeration system lines
- Other air conditioning components
- Ensure that all of the metal tubing lines are free of dents or kinks that may cause line restriction. Line restriction may cause the loss of system capacity.
- Do not bend the flexible hose lines to a radius of less than 4 times the diameter of the hose.
- Do not allow the flexible hose lines to come within 6.5 mm (2.5 in) of the exhaust manifold.
- Regularly inspect the flexible hose lines for leaks or brittleness. Replace the lines with new lines if deterioration or leaking is found.
- When disconnecting any fitting in the refrigerant system, recover the system of all Refrigerant 134a.

Use the following steps in order to recover the system of all Refrigerant 134a:

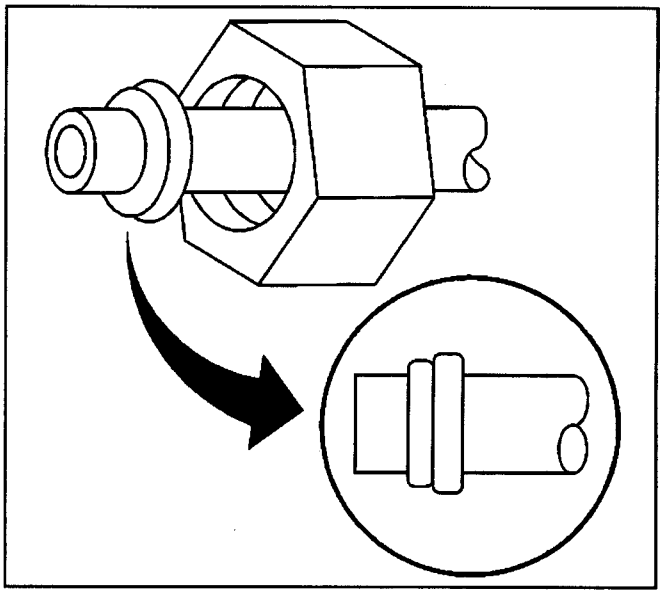
1. Proceed very cautiously regardless of the gage readings.
2. Open the fitting very slowly.
3. Keep the hands and the face away from the fitting in order to prevent injury.
4. If pressure is noticed when a fitting is loosened, allow the pressure to bleed off slowly.

Notice: Never use alcohol to remove moisture from the refrigeration system. Damage to the system components could occur.

- Immediately cap any refrigerant lines that are opened to the atmosphere. This action prevents the entrance of moisture and dirt.

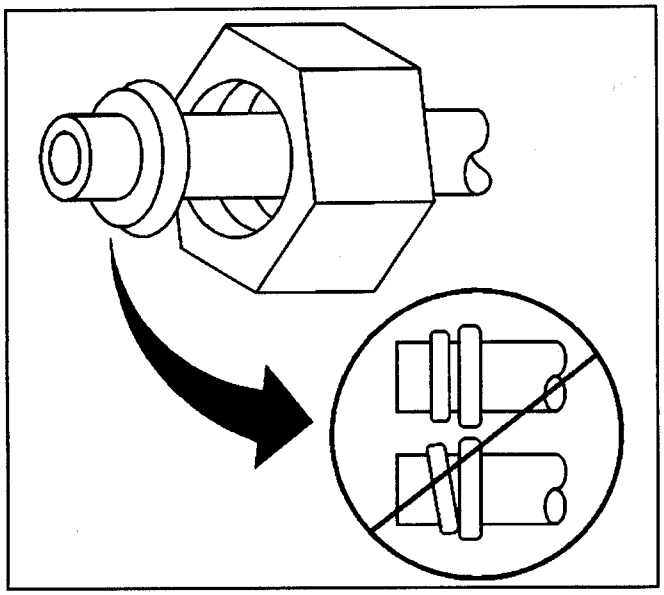
  Dirt and moisture may cause internal A/C compressor wear or plugged lines in the following areas:
  - The A/C condenser
  - The A/C evaporator core
  - The A/C expansion (orifice) tubes
  - The A/C compressor inlet screens
- Remove the sealing caps from the subassemblies just before making the connections for final assembly.

  Apply a small amount of clean 525 viscosity refrigerant oil on all of the tube and hose joints.



221228

Use new O-ring seals dipped in 525 viscosity oil when assembling joints. The oil aids in assembly and helps provide a leakproof joint. Ensure that the O-ring seals and the seats are in perfect condition. A burr or a piece of dirt on the O-ring seal may cause a refrigerant leak.



221226

Important: Use the proper wrenches in order to make connections on the O-ring seal fittings.

Using improper wrenches may damage the connection.

- Use a wrench in order to back up the opposing fitting. This action will prevent distortion of the connecting lines or the components.
- Use three different wrenches in order to simultaneously hold the following components when connecting the flexible hose connections:
  - The swaged fitting
  - The flare nut
  - The coupling that is attached to the flare nut

  This action prevents turning in the fitting and damage to the seat.
- Tighten tubing connections to the specified torque. Refer to *Fastener Tightening Specifications.*

Maintaining Chemical Stability

The life and efficient operation of the air conditioning system depends upon the chemical stability of the refrigerant system.

The following conditions may result if foreign material contaminates the refrigeration system:

- A change in the stability of Refrigerant-134a and Polyalkaline Gylcol (PAG) refrigerant oil
- A change in the pressure-temperature relationship
- Reduced efficiency of the system
- Internal corrosion
- Abnormal wear of moving parts

Use the following general practices in order to ensure chemical stability in the system:

- Whenever a hose connection is disconnected, wipe away any dirt or oil at or near the connection. This action prevents dirt from entering the system.
- Cap, plug or tape both sides of the connection as soon as possible in order to prevent the entrance of dirt and moisture. (Remember that air contains moisture. Air that enters any part of the refrigeration system will carry moisture with it. The exposed surface will collect the moisture quickly.)
- Ensure that the following components remain clean and dry:
  - All of the tools, including the Manifold Gage Set
  - All of the replacement parts
- When adding Polyalkaline Glycol (PAG) refrigerant oil, ensure that the container/transfer tube through which the oil will flow is clean and dry. Refrigerant oil must be as moisture-free as possible.
- Gather all of the necessary tools and components before opening an air conditioning system. This action will ensure that a minimum amount of time is used to perform the operation. Do not leave the air conditioning system open to the atmosphere any longer than necessary.
- Whenever the air conditioning system is opened, properly evacuate the air conditioning system before recharging the system.

Evaporator Description

The A/C evaporator cools, drys and cleans the air that enters the passenger compartment. The A/C evaporator case is insulated in order to prevent sweating.

The following series of actions occurs in the A/C evaporator:

1. Refrigerant enters the A/C evaporator as a low pressure liquid.
2. The liquid boils (vaporizes) at this low pressure.
3. The liquid absorbs heat.

   The heat comes from the warmer outside air that passes through the A/C evaporator fins.
4. The air that will be directed into the passenger compartment is cooled.
5. As the heat is transferred to the A/C evaporator, moisture from the air condenses the surface of the evaporator.
6. The moisture drains off.

   The moisture carries dust and pollen as it drains.

   A water drain port is located in the bottom of the housing.

The temperature of the A/C evaporator must be high enough so that the water collecting on the surface will not freeze. Frozen water on the surface may restrict the passage of air.

The following components control the temperature along with the A/C evaporator:

- The A/C expansion valve
- The thermostat

The A/C evaporator is located in the heater module, underneath and behind the instrument panel.

Condenser Description

The A/C condenser includes the following components:

- The coils
- The cooling fins

The coils carry the refrigerant.

The cooling fins provide a rapid transfer of heat.

The air passing through the A/C condenser cools the high-pressure refrigerant vapor. This action causes the air to condense into a liquid.

Accumulator Description

The sealed A/C accumulator assembly is connected to the A/C evaporator outlet pipe. The A/C accumulator assembly functions as a liquid/vapor separator.

The A/C accumulator assembly receives the following items from the A/C evaporator:

- The refrigerant vapor
- Some liquid
- The refrigerant from the A/C evaporator

It only allows refrigerant vapor and oil to continue on to the A/C compressor.

A desiccant may be present at the bottom of the A/C accumulator. The desiccant acts as a drying agent. An oil bleed hole is also located near the bottom of the A/C accumulator outlet pipe. The oil bleed hole provides an oil return path to the A/C compressor.

Compressor Description

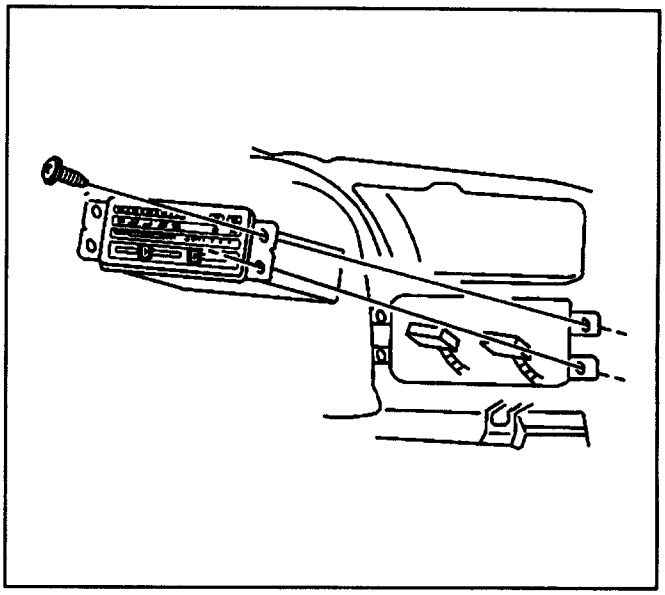
The air conditioning compressor is a belt-driven six cylinder swash plate type. There are three double end positions that form six pumping chambers.

Refrigerant-134a flow is controlled by a reed valve and internal passages.

Front and rear cylinder heads hold the valve and plates to the main body and are secured by six bolts.

Compressor oil mixed with refrigerant lubricates the A/C compressor. Compressor cycling is determined by an electrically actuated armature and other controls.

Control Assembly Description



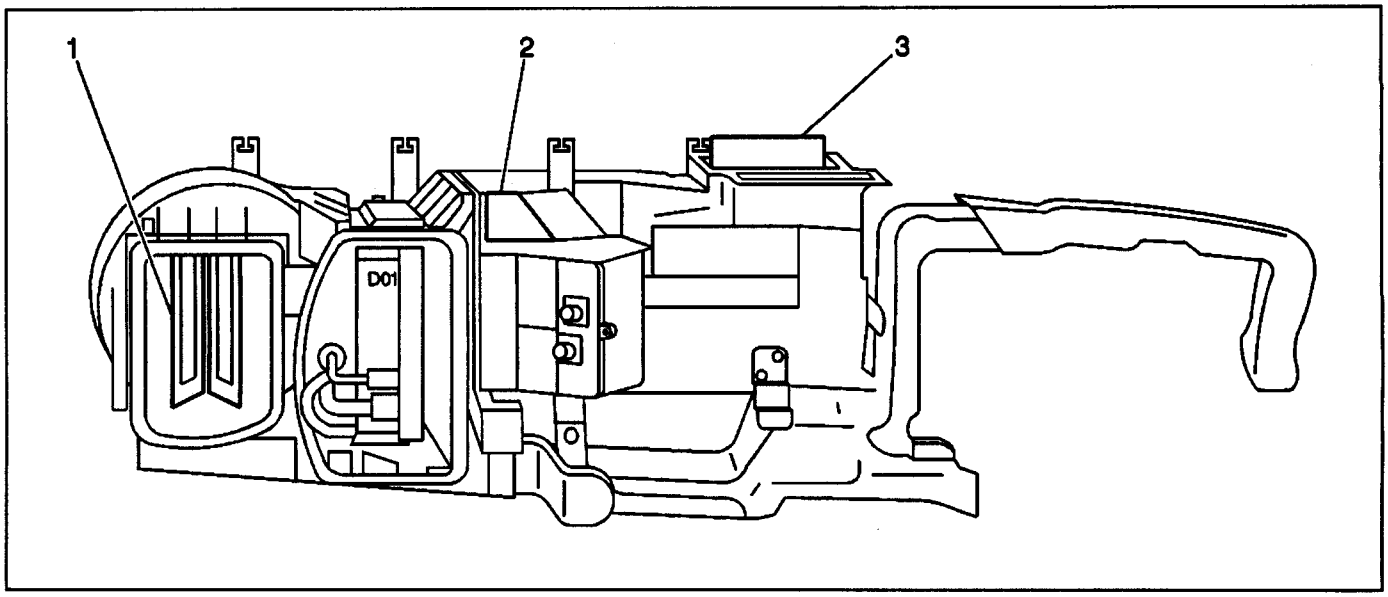
229887

The air conditioning operates only when the A/C button on the control assembly is ON.

The following controls on the controller maintain the temperature of the passenger compartment:

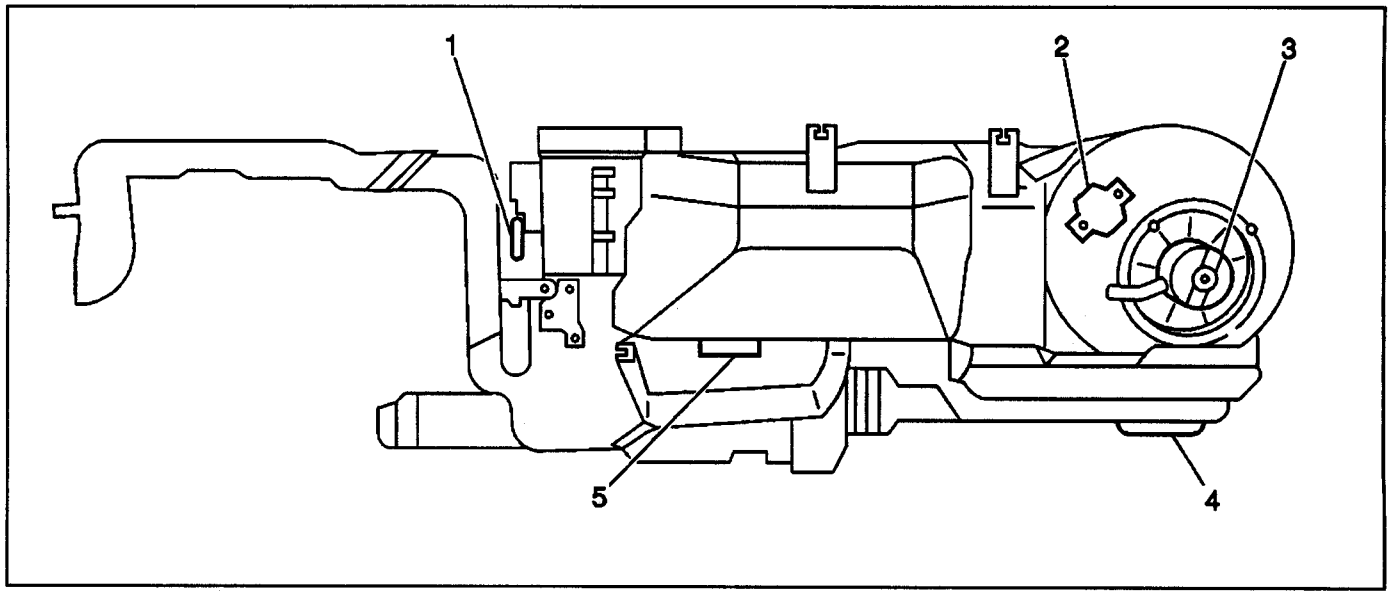
- The temperature selector
- The fan control switch

Ventilation Description



229843

Within the heater vent module is a series of air doors. These air doors are hinged parts that direct the airflow through the various sections of the heater vent module in order to provide the proper airflow for the selected operating mode.



229846

Each air door is controlled by an actuator.

Relays and Sensors Description

Electronic Thermostat

The thermostat consists of the following components:

- The thermosensor
- The thermostat unit

These components electrically reduce the noise caused by system operation.

The electronic thermosensor is mounted at the The electronic thermosensor senses the temperature of the cool air from the A/C evaporator. The temperature signals are input to the thermostat unit. This information is compared by the thermounit. The results in output are used in order to complete the following actions:

- Operate the A/C compressor relay.
- Turn the A/C compressor clutch on and off.

These actions prevent A/C evaporator freeze up.

A/C Dual Pressure Switch

An A/C dual pressure switch is located on the A/C receiver/dryer or dehydrator.

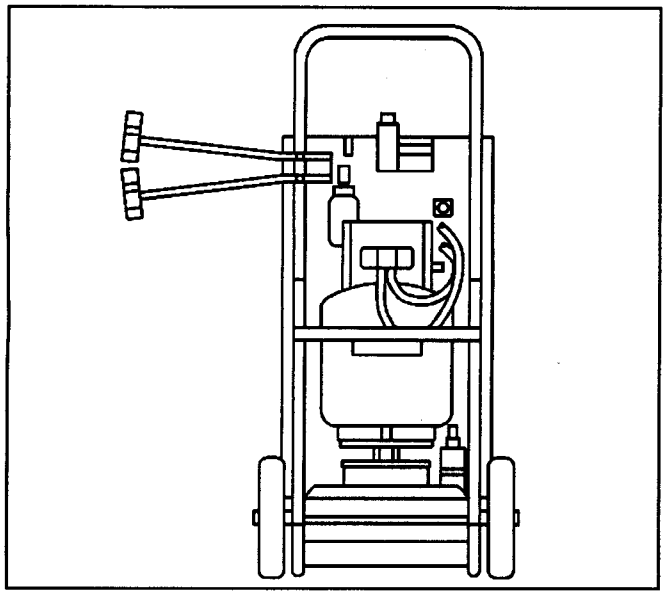
The switch is normally closed. The switch will open the circuit to the A/C compressor clutch coil if the refrigerant pressure becomes too high or too low.

ACR4 Procedures

Initial Setup

Refer to the manufacturer's instructions for all initial setup procedures.

Operational Setup



277008

Caution: Always wear goggles and gloves when doing work that involves opening the refrigerant system. If liquid refrigerant comes into contact with the skin or eyes, injury may result.

Caution: Use only authorized 23-kg (50-lb.) refillable tanks (J 39500-50). Use of other tanks could cause personal injury and void the warranty.

Notice: Refrigerant-134a systems have special fittings (per SAE specifications) to avoid cross-contamination with Refrigerant-12 systems. Do not attempt to adapt this unit to Refrigerant-12 systems as severe system failure will result.

- Connect the following hoses to the ACR4 unit:
  - The high side (Red) hose
  - The low side (Blue) hose
- Route the hoses through the hose reel bracket grommets.

HVAC Blower Controls Circuit Description

Blower Motor

The Blower Motor controls supply ground to the motor through the following components:

1. The Blower Speed Switch contacts
2. The Blower Resistor

Circuit Breaker #6 can supply battery voltage to the Blower Relay Coil when the ignition switch is in the RUN position through the BRN (198) wire.

Circuit Breaker #24 provides relay contact power for the operation of the Blower Motor. The relay contact power is provided when the ignition is in the RUN position.

Motor speed is controlled by routing the blower motor ground through dropping resistors.

The Blower Motor Speed Switch supplies ground through one of the resistors for all of the speeds but HIGH.

The following conditions exist when the Blower Motor Switch is the LO position:

- Voltage is applied from the switch contacts through the BLU/WHT (180,196) wire to the Blower Motor Resistor.
- The Blower Motor current flows through all three resistors.
- Grounding is provided through the following components:
  - The switch common terminal
  - The HVAC controller module
- Current flow is established.
- The Blower Motor operates.
- The voltage drops through the three resistors in the Blower Motor Resistor.

  The drop in voltage limits motor operation to the lowest possible speed.

The following conditions exist when the Blower Motor Switch is in the MED LO position:

- Voltage is applied to the Blower Motor Resistor through the BLU/BLK (181, 195) wire.
- Current flows through two resistors in order to get to the motor.
- The motor operates at a faster speed than through all three resistors.

The following conditions occur when the Blower Motor Switch is in the MED HI position:

- Voltage is applied to the Blower Motor Resistor through the BLU/YEL (182/194) wire.
- Current flows through only one resistor in order to get to the motor.
- The increased voltage causes the motor to operate at a faster rate.

The following conditions exist when the Blower Motor Switch is in the HI position:

- Voltage is applied directly to the Blower Motor through the BLU/RED (183/192) wire.
- Current flows directly to the motor.
- Maximum voltage is applied to the motor. The motor operates at the fastest possible speed.

HVAC Temperature Actuator

The HVAC Temperature Actuator controls the amount of engine coolant that is available to the heater core. The operator heat selection lever position is translated into an electrical signal.

The Temperature Actuator controls a motor operated valve in the engine coolant line. The position of the valve is changed in response to the operator temperature selection. The valve is driven open in order to provide more heat energy. The valve is driven closed for less heat.

HVAC Compressor Controls Circuit Description

A/C Compressor Clutch

The A/C Compressor is belt driven. The pulley of the compressor rotates whenever the engine is operating. The compressor only operates when the compressor clutch has been energized. The clutch is engaged when the Compressor Relay passes current to the Compressor Clutch Coil.

Compressor Relay

The Compressor Relay receives two sources of voltage:

- Circuit Breaker #20 provides voltage at all times to Compressor Relay terminal 30 through the GRN/RED (207) wire.
- When the Ignition Switch is in the RUN position, Circuit Breaker #6 provides power to the Compressor Relay coil from the Blower Relay contacts, through the LT GRN (210) wire.

The Compressor Relay contacts are normally open. When the Compressor Relay is energized, the contacts close. The contacts apply voltage through the LT BLU (203,208) wire to the A/C Compressor Clutch Coil. Because the A/C Compressor Clutch Coil is grounded internally through its case, the coil is energized when voltage is applied.

The Compressor Relay is energized when a ground path is provided for the relay coil through the GRN/RED (213) wire. The Air Conditioning Mode Switch provides this ground path through the Thermo Switch.

The Thermo Switch performs the following functions:

- Senses the temperature of the interior vehicle air
- Cycles to ground when the temperature goes above the set value

  This action energizes the Compressor Relay coil.

The A/C Pressure Cutoff Switch cycles the compressor off when the following conditions exist:

- The compressor is otherwise enabled.
- The freon in the system reaches a set pressure.

A/C Pressure Cutoff Switch

The A/C Pressure Cutoff Switch performs the following two functions:

- The high pressure cutout section of the switch is normally closed during the operation of the A/C Compressor.

  The switch opens if the pressure in the A/C refrigerant lines is too high.

  This action interrupts the power to the A/C compressor relay.
- The low pressure cutout section of this switch cycles on and off in response to evaporator temperature.

  The switch opens just above the freezing point. This action prevents the system from freezing.

  The temperature switch closes as the evaporator temperature rises. This action allows the compressor to run and to maintain system cooling.

Thermo Switch

The Thermo Switch provides additional protection from icing conditions in the evaporator core by performing the following actions:

- Sensing the evaporator core temperature.
- Removing ground from the compressor relay coil when the temperature falls below a set value.

HVAC Air Delivery Circuit Description

HVAC Mode Actuator

The HVAC Mode Actuator operates with the HVAC Mode Switch.

The following modes are the HVAC modes:

- VENT
- BI-LEVEL
- FLOOR
- FLOOR/DEFROST
- DEFROST

The HVAC Mode Actuator Motor operates when an HVAC mode change is selected.

The HVAC Mode Actuator Motor drives the dampers open or closed in the HVAC ductwork segments.

This action provides the correct air handling mode path.

Vent Mode

The recirculating/fresh air actuator is activated when the switch is in the ON position.

The following actions occur when the recirculating/fresh air actuator is activated:

- The recirculating/fresh air door opens completely.
- Air is discharged from the upper air outlets.

As a result, the temperature of the air that is released from the upper air outlets is close to the temperature of the outside air.

Bi-Level Mode

The mode actuator is activated when the switch is in the ON position.

This action causes the mode control door to open halfway.

Airflow is divided between the upper air outlets and the floor air outlets.

Floor Mode

The mode actuator is activated when the switch is in the ON position.

This action causes the mode control door to open completely.

Most of the airflow is routed to the floor. The rest of the air is routed to the windshield outlets.

Floor/Defrost Mode

The mode actuator is activated when the switch is in the ON position.

This action causes the mode control door to open halfway.

Half of the airflow is routed to the floor. The other half of the airflow is delivered to the windshield outlets.

Defrost Mode

The mode actuator is activated when the switch is in the ON position.

This action causes the mode control door to open completely.

Most of the airflow is routed to the windshield outlets. The rest of the airflow is routed to the floor.

HVAC Recirculating Fresh Air Actuator

The HVAC Recirculating Fresh Air Actuator controls the amount of fresh air that enters the vehicle during the various HVAC modes.

- The VENT mode provides 100 percent fresh air from outside of the vehicle.
- The MAX A/C and the MAX HEAT modes provide a minimum of fresh air to the vehicle.

  These modes recirculate most of the vehicle inside air in order to quickly cool or warm the interior.

HVAC Temperature Actuator

The HVAC Temperature Actuator controls the amount of air from the Blower Motor that will be routed through either or both of the following components:

- The A/C Evaporator Core
- The Heater Core

The position of the operator temperature selection lever is translated into an electrical signal.

The temperature actuator controls a series of motor operated valves. The valves are driven into different positions. The positions provide more heating or cooling in response to the temperature selection.

HVAC Compressor/Condenser Fan Circuit Description

A/C Condenser Fan

When the Ignition Switch is in the RUN position voltage is applied to the coil of the blower Relay 3 through Circuit Breaker #6. Since the coil of Blower Relay is grounded at all times through G105, the Relay will energized, close the relay contacts. Voltage is now applied at all times from Circuit Breaker #24 through the now closed contacts of Blower Relay to the coil of A/C Condenser Fan Relay. The coil is then grounded through the A/C Refrigerant Pressure Cutoff Switch through the Control Assembly, which is case grounded. The A/C Pressure Cutoff Switch will close when the A/C system pressure is within specifications. When this switch closes, a ground path is provided for the A/C Condenser Fan Relay, and the relay contacts will close. Voltage is now applied from the Circuit Breaker #20 through the closed contacts of A/C Condenser Fan Relay to the A/C Condenser Fan Motor. Since the A/C Condenser Fan Motor is permanently grounded at G107, the fan will run.

A/C Compressor Clutch

The A/C Compressor is belt driven and the compressor's pulley rotates whenever the engine is operating. The compressor only operates when the compressor clutch has been engaged when the Compressor Relay passes current to the Compressor Clutch Coil.

Compressor Relay

The Compressor Relay receives two sources of voltage. Circuit Breaker #20 provides voltage at all times to the Compressor Relay terminal 30 through the CKT207 (GRN/RED) wire. When the Ignition Switch is in the RUN position, Circuit Breaker #6 provides power to the Compressor Relay coil from the Blower Relay Contacts, through the CKT210 (LT GRN) wire. When the Compressor Relay is energized, the normally-open contacts close to apply voltage through the CKT203, 208 (LT BLU wire to the A/c Compressor Clutch Coil. Since the A/C Compressor Clutch Coil is grounded internally through its case, the coil is energized when voltage is applied.

The Compressor Relay is energized when a ground path is provided for the relay coil through the CKT213 (GRN/RED) wire. The Air Conditioning Mode Switch provides the ground path through the Evaporator Temperature Sensor. The Evaporator Temperature Sensor senses temperature and cycles to ground, which energizes the Compressor Relay Coil, when the temperature goes above the set value. The A/C High Pressure Cutoff Switch will cycle the compressor off while otherwise enabled, when the freon in the system reaches a set pressure.

A/C Pressure Cutoff Switch

The A/C Pressure Cutoff Switch provides two functions:

- The high pressure cutout section of this switch is normally closed during operation of the A/C compressor. If pressure in the A/C refrigerant lines goes too high, this switch will open, interrupting power to the A/C Compressor Relay.
- The low pressure cutout section of this switch cycles on and off in response to refrigerant pressure. The switch opens just above the freezing point, providing system freeze protection. The temperature switch closes as the evaporator temperature rises, allowing the Condenser Fan to run, maintaining system cooling.

Evaporator Temperature Sensor

The Evaporator Temperature Sensor provides additional protection from icing conditions in the evaporator core by sensing the evaporator core temperature and removing ground from the compressor relay coil when the temperature falls below a set value.

Special Tools and Equipment

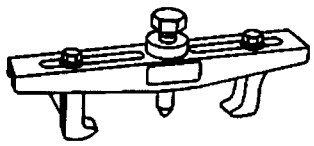
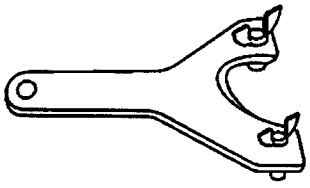
Illustration	Tool Number/ Description
 671	J 4245 External Snap Ring Pliers
 216164	J 8433 Compressor Pulley Puller
 2015	J 8092 Driver Handle
 247673	J 33939 Armature Holder

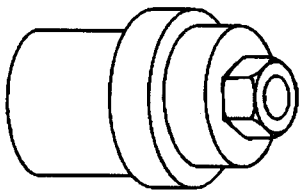
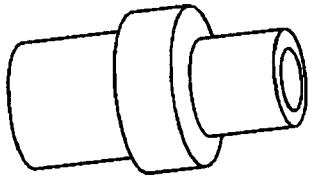
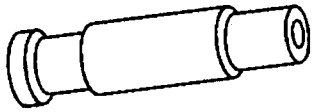
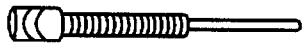
Illustration	Tool Number/ Description
 247636	J 33940-A Puller Installer
 247641	J 33943-A Pulley Puller Pilot
 247668	J 33942-B Seal Seat Removal/Installer
 247669	J 33944-4 Puller Forcing Screw

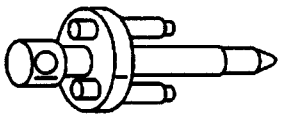
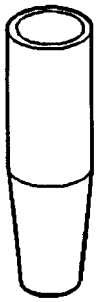
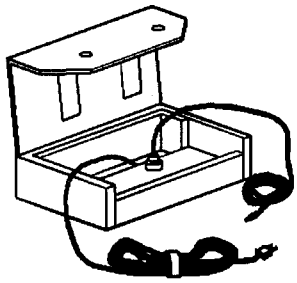
Illustration	Tool Number/ Description
 247670	J 33994-A Armature Plate Remover
 6206	J 34614 Shaft Seal Protector
 3550	J 36645 Evaporator Cleaning Gun

Illustration	Tool Number/ Description
 3547	J 39400 Electronic Leak Detector
 82133	J 39500-A Refrigerant, Recovery, Recycling and Recharging Station

BLANK

Section 8

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Lighting Systems

Specifications

Fastener Tightening Specifications

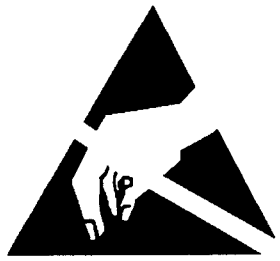
Application	Specification	
	Metric	English
Headlamp Bezel Screws	1.9 N·m	17 lb in
Park/Turn Signal Lamp Retaining Nut	8 N·m	71 lb in
Tail Lamp Retaining Bolts	35 N·m	26 lb ft

Schematic and Routing Diagrams

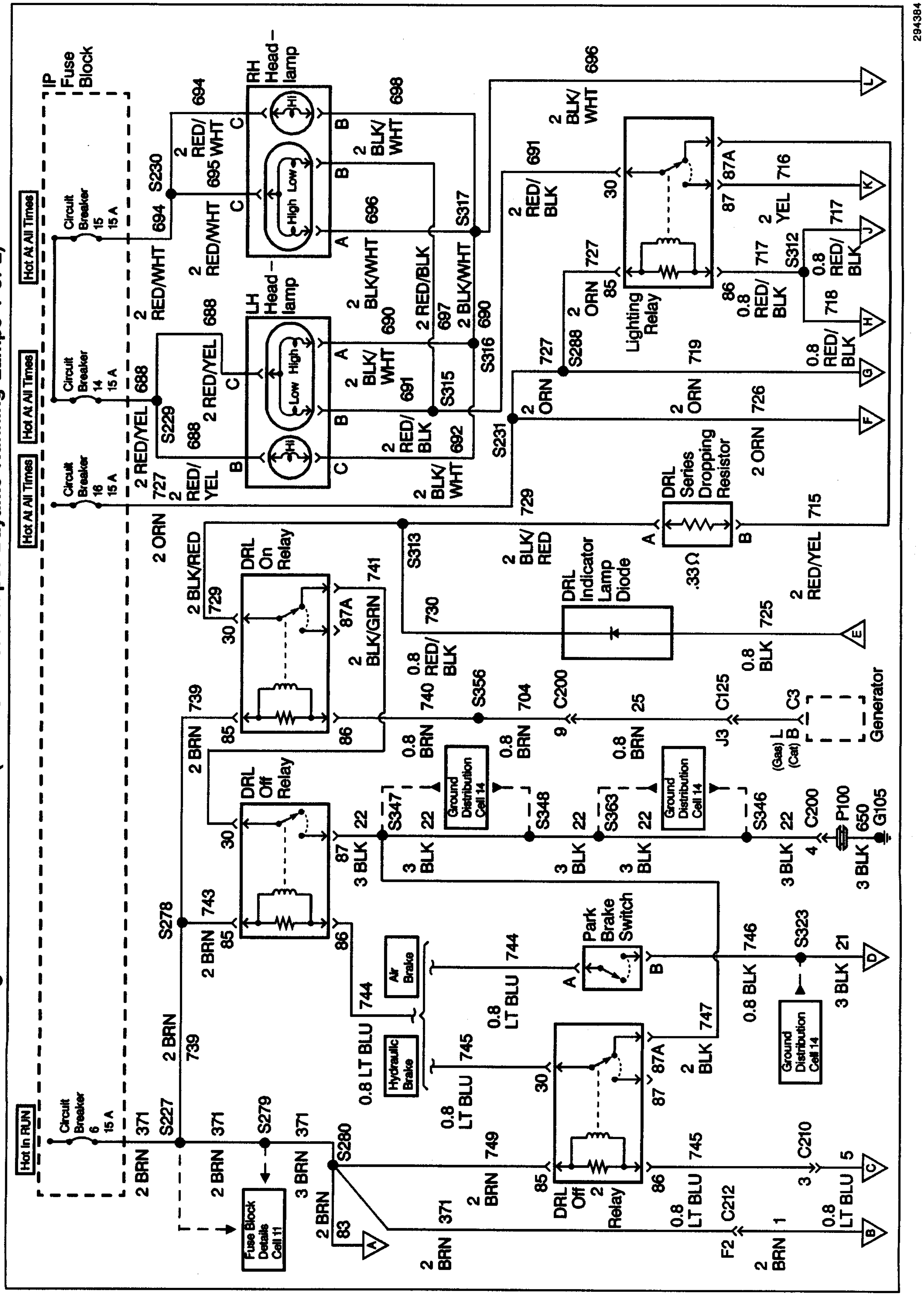
Lighting Systems Schematic References

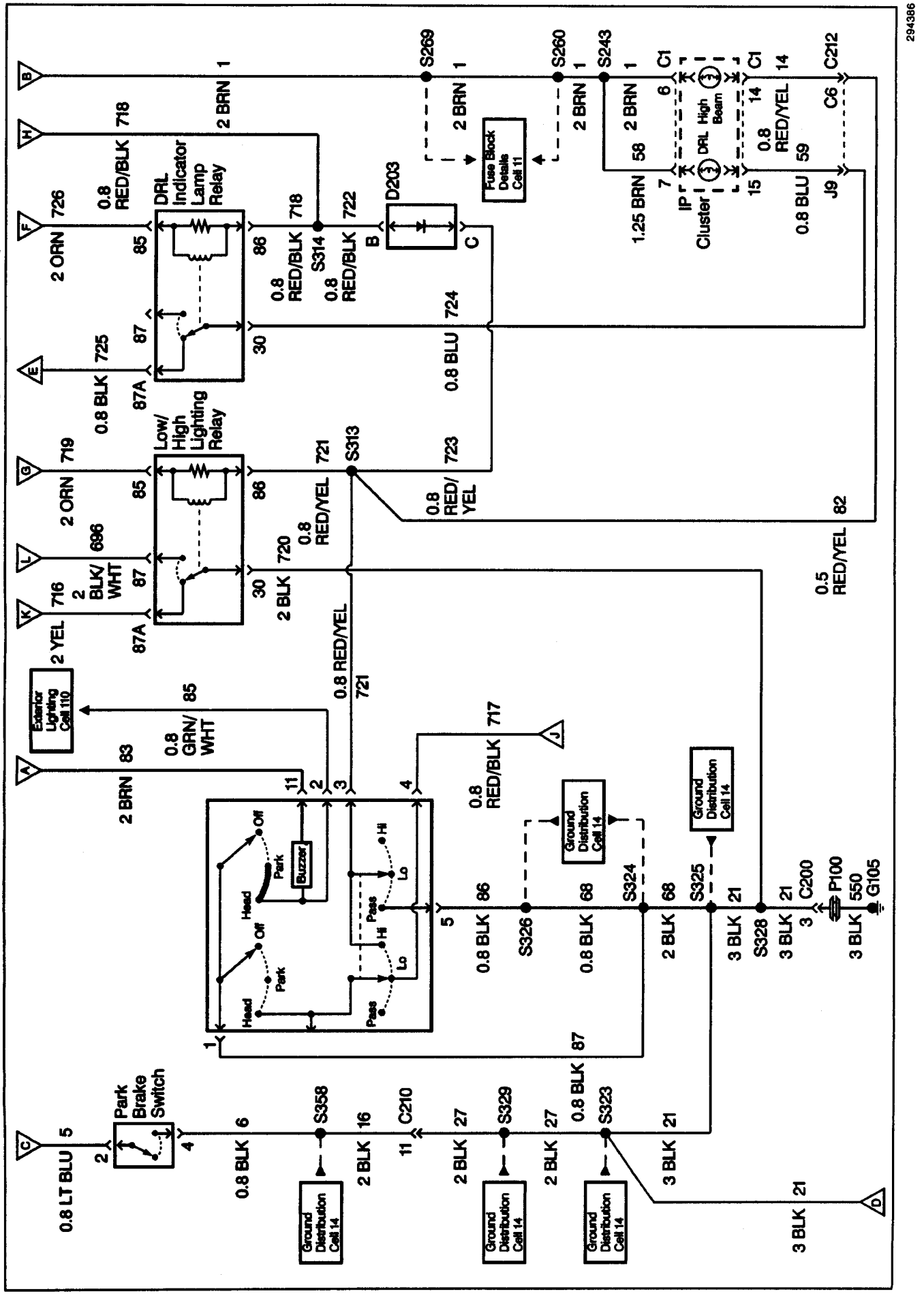
Reference on Schematic	Section Number - Subsection Name
Audible Warnings Cell 76	8—Instrument Panel, Gauges and Console
Exterior Lamps Cell 110	8—Lighting Systems
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Heated Mirrors Cell 61	8—Doors
Horns Cell 40	8—Horns
Interior Lamps: Dimming Cell 117	8—Lighting Systems
Park Lamp Relay Cell 110	8—Lighting Systems
Power Distribution Cell 10	8—Wiring Systems

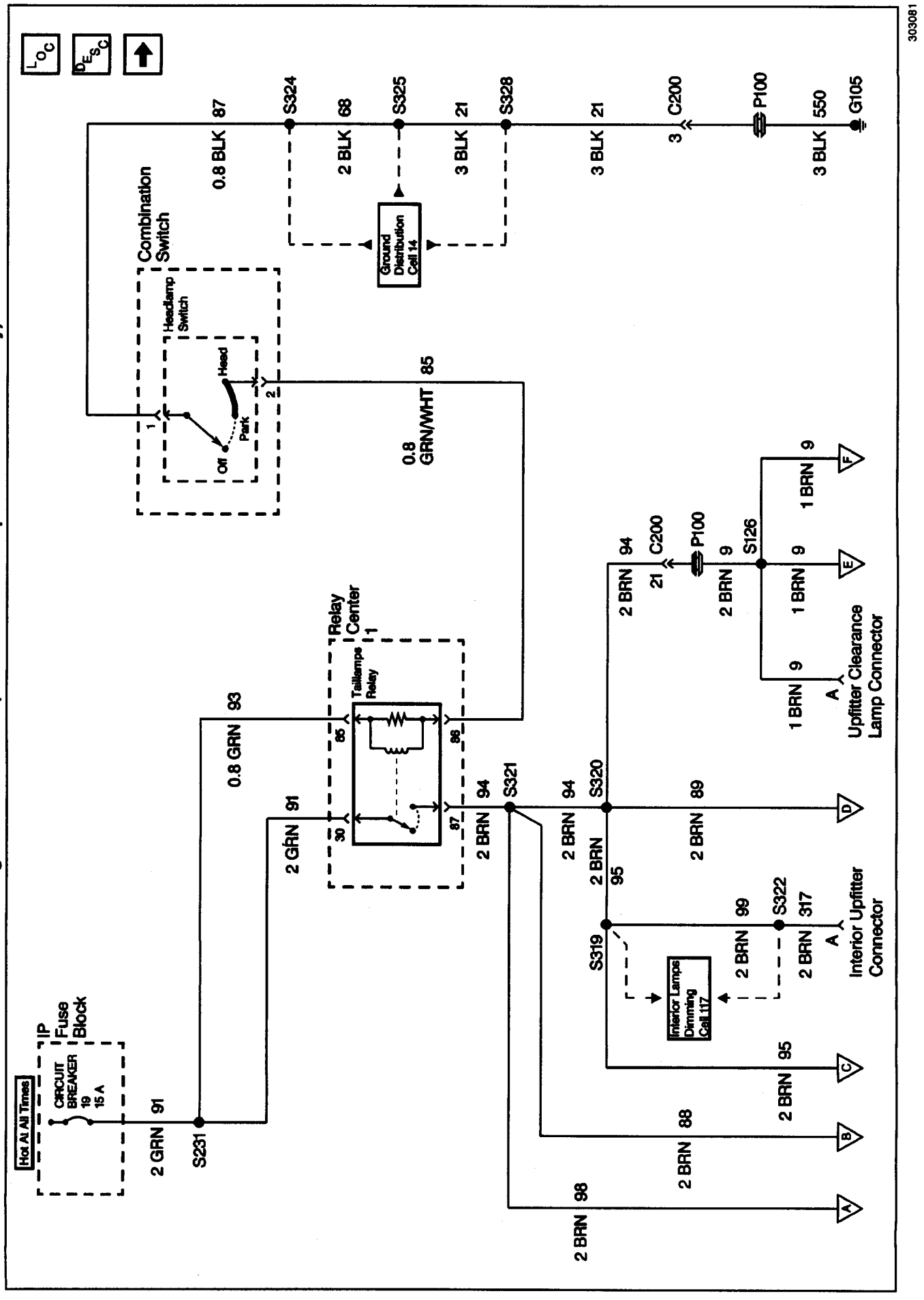
Lighting Systems Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.

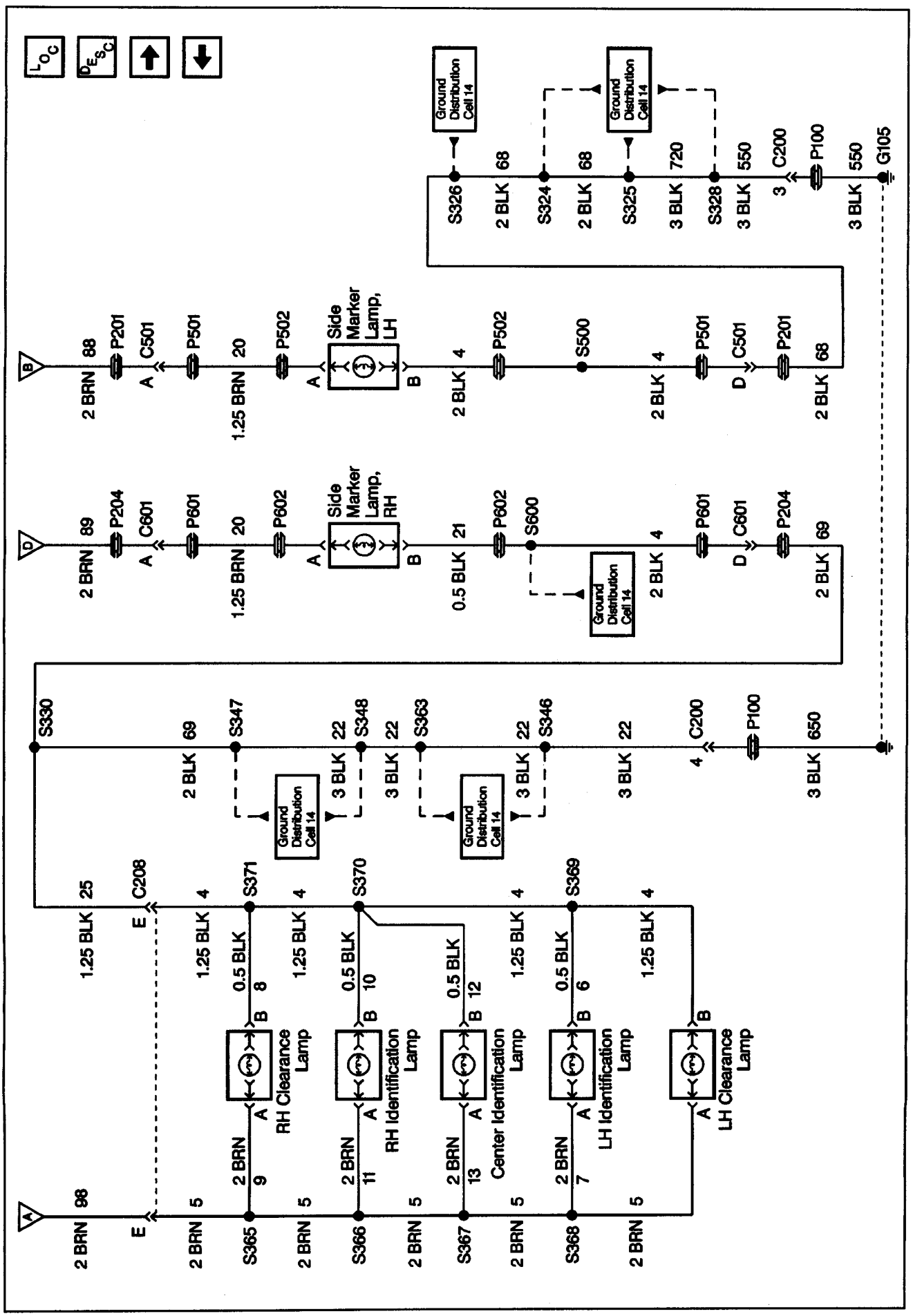
Headlights DRL Schematics (Cell 102: Headlamps: Daytime Running Lamps 1 of 2)



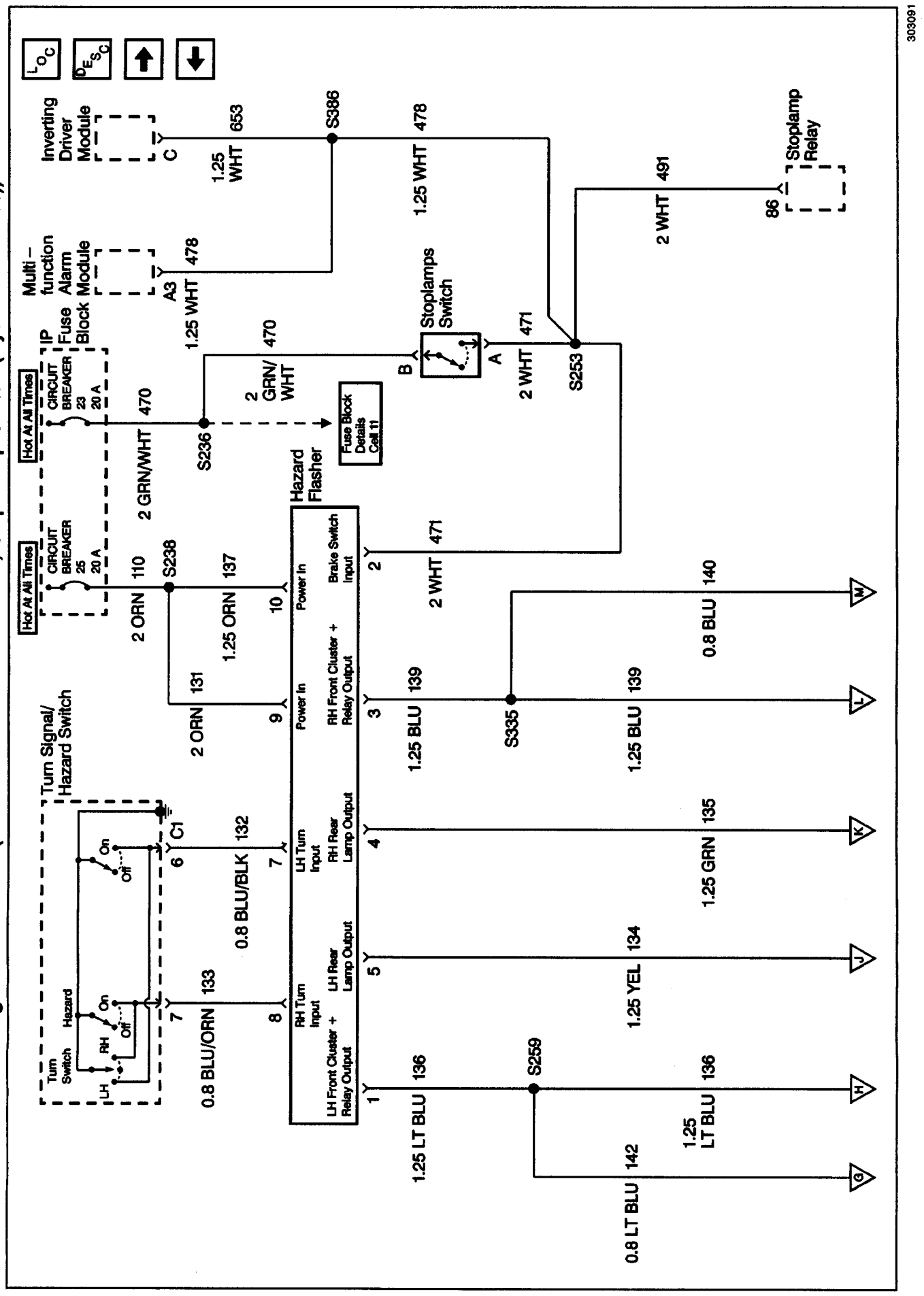

Headlights DRL Schematics (Cell 102: Headlamps: Daytime Running Lamps 2 of 2)
294386
DRL Indicator Lamp Relay
Low/ High Lighting Relay
Fuse Block Details Cell 11
Exterior Lighting Cell 110
Park Brake Switch
Ground Distribution Cell 14
Off
Park
Head
Buzzer
Hi
Lo
Pass
S269
S260
S243
S314
S313
S358
S329
S323
S324
S325
S326
S328
D203
C1
C6
C212
C210
C200
P100
G105
J9
IP Cluster
DRL
High Beam
2 BRN
0.8 RED/BLK
2 ORN
0.8 BLK
0.8 BLU
0.8 RED/YEL
0.5 RED/YEL
0.8 RED/ YEL
2 BLK/ WHT
2 YEL
0.8 GRN/ WHT
0.8 LT BLU
1.25 BRN
0.8 BLK
2 BLK
3 BLK

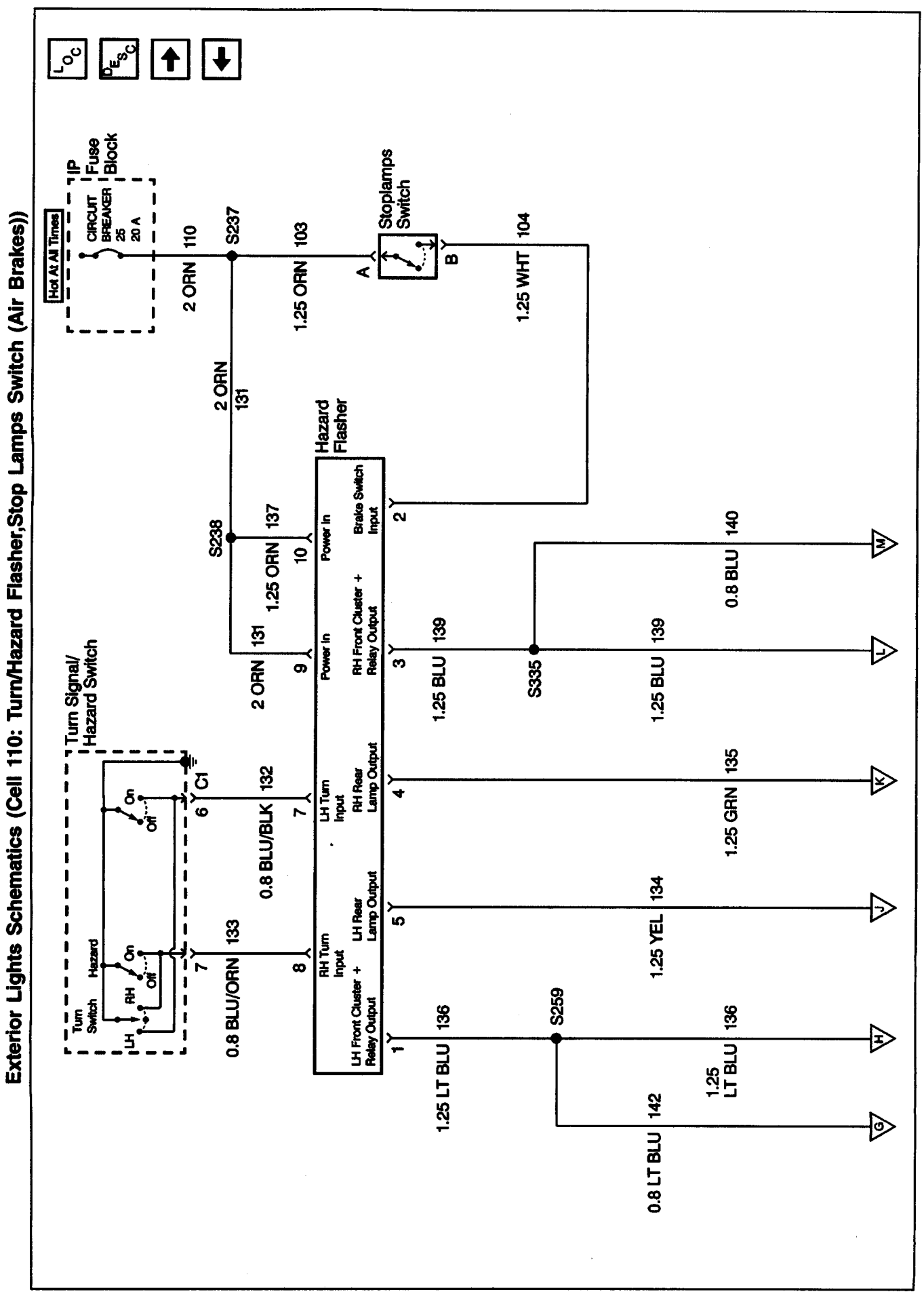

Exterior Lights Schematics (Cell 110: Tail Lamps Switch and Relay)
303081
LOC
DESC
Hot At All Times
IP Fuse Block
CIRCUIT BREAKER 19 15 A
2 GRN 91
S231
0.8 GRN 93
2 GRN 91
Relay Center 1
Taillamp Relay
85
86
30
87
2 BRN 94
S321
Combination Switch
Headlamp Switch
Off
Park
Head
1
2
0.8 GRN/WHT 85
0.8 BLK 87
S324
2 BLK 68
S325
3 BLK 21
S328
Ground Distribution Cell 14
3 BLK 21
C200 3
P100
3 BLK 550
G105
2 BRN 94
S320
2 BRN 95
S319
2 BRN 89
2 BRN 99
S322
2 BRN 317
A
Interior Upfitter Connector
Interior Lamps Dimming Cell 117
2 BRN 88
2 BRN 98
2 BRN 94
C200 21
P100
2 BRN 9
S126
1 BRN 9
1 BRN 9
1 BRN 9
A
Upfitter Clearance Lamp Connector
A
B
C
D
E
F

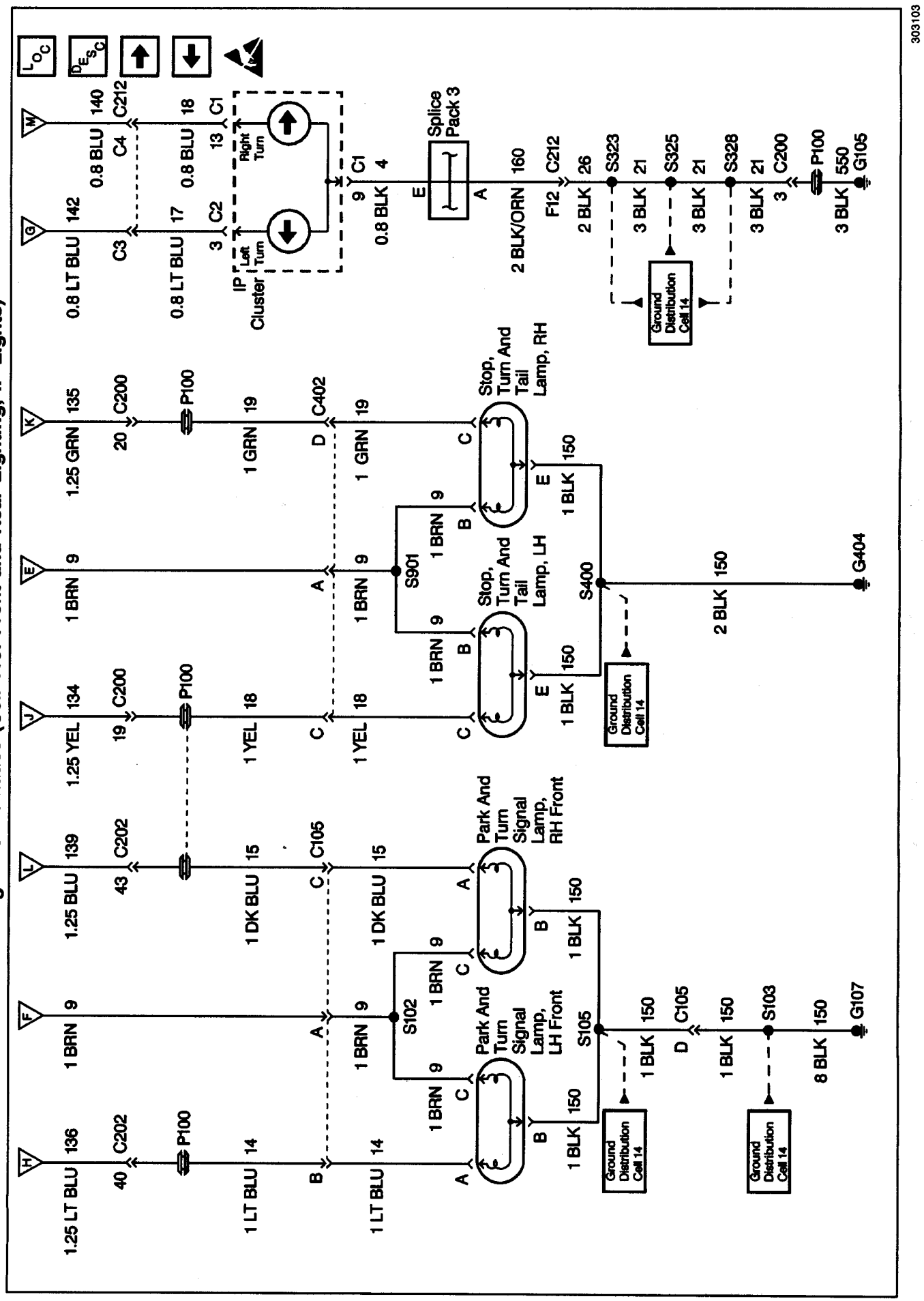
Exterior Lights Schematics (Cell 110: Clearance and Marker Lamps)

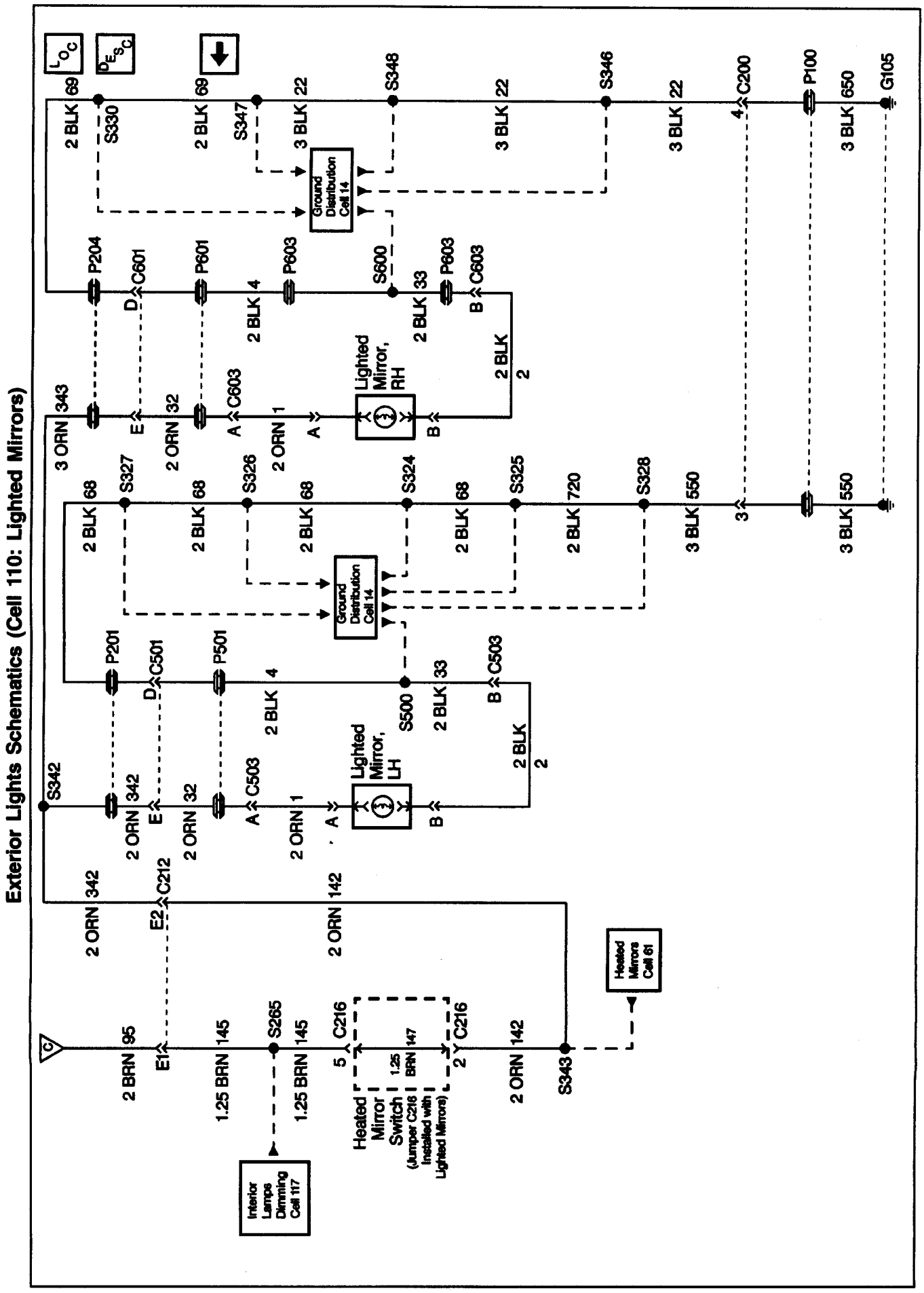


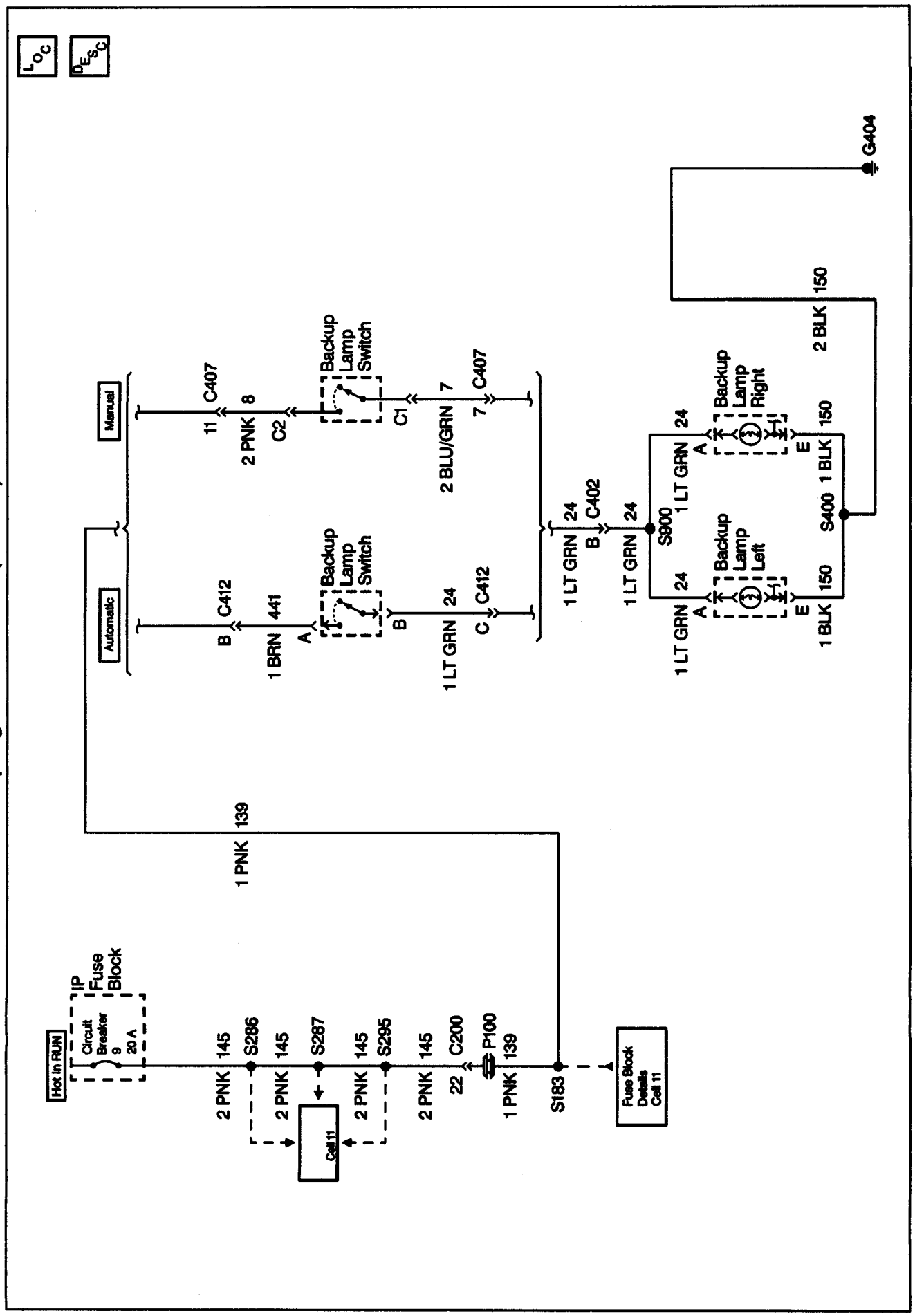
Exterior Lights Schematics (Cell 110: Turn/Hazard Flasher, Stop Lamp Switch (Hydraulic Brakes))

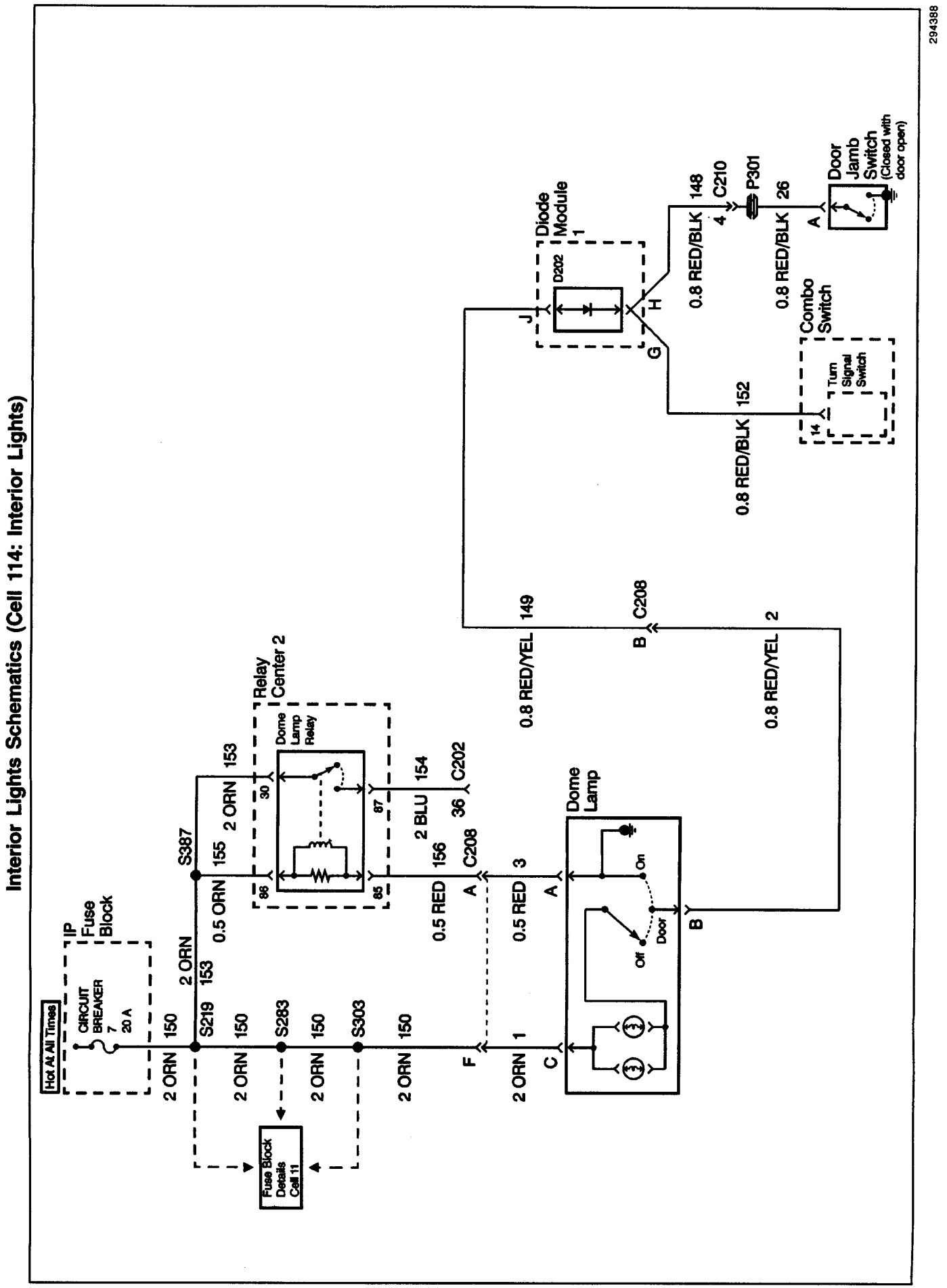


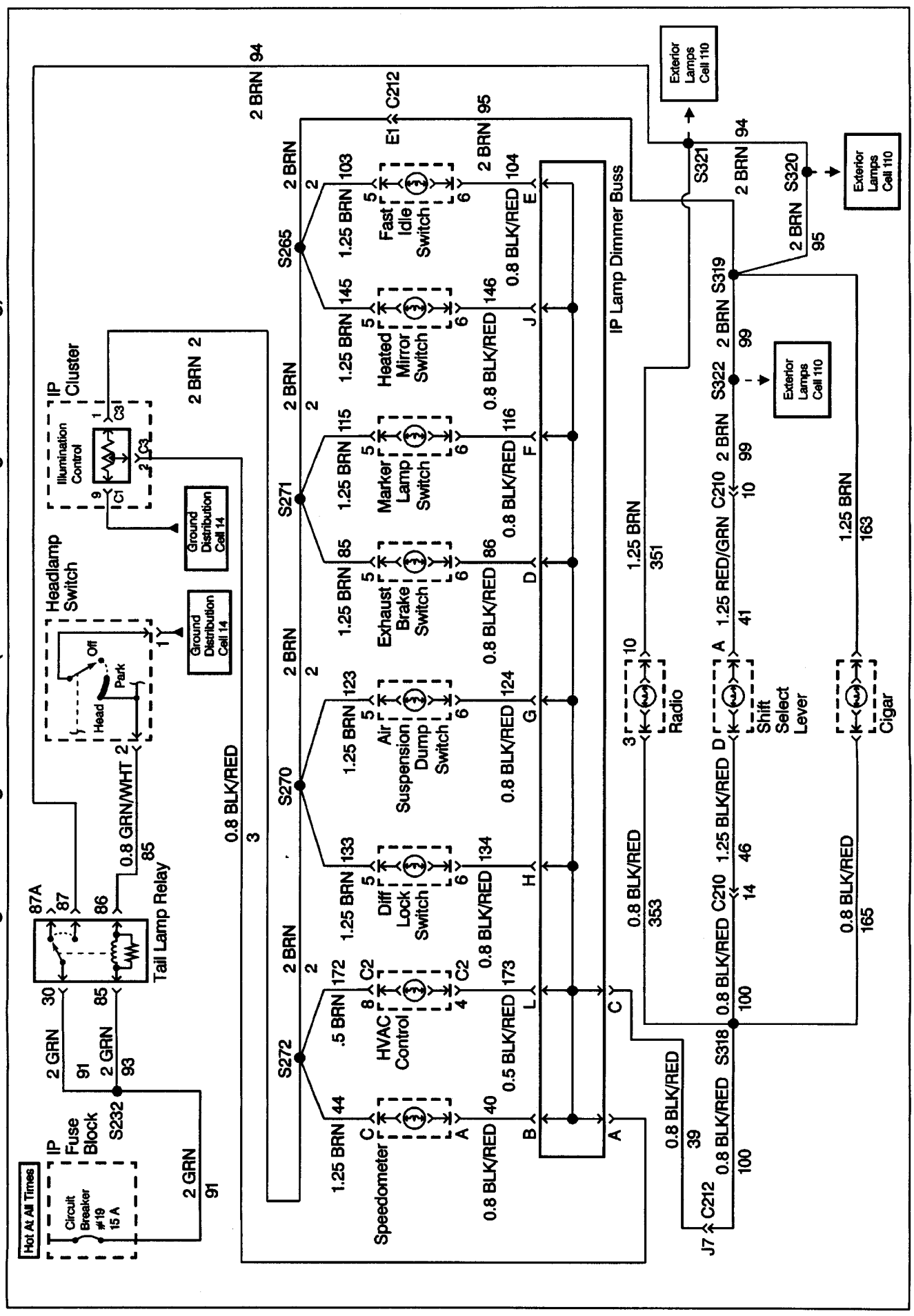

Exterior Lights Schematics (Cell 110: Turn/Hazard Flasher,Stop Lamps Switch (Air Brakes))
303097
Hot At All Times
IP Fuse Block
CIRCUIT BREAKER 25 20 A
110
2 ORN
S237
103
1.25 ORN
Stoplamps Switch
A
B
104
1.25 WHT
2 ORN
131
S238
137
1.25 ORN
10
9
Hazard Flasher
Power In
Brake Switch Input
2
Turn Signal/ Hazard Switch
Turn Switch
Hazard
LH
RH
On
Off
C1
6
7
0.8 BLU/BLK
132
LH Turn Input
RH Rear Lamp Output
4
RH Front Cluster + Relay Output
3
1.25 BLU
139
S335
1.25 BLU
139
0.8 BLU
140
M
L
K
135
1.25 GRN
7
8
0.8 BLU/ORN
133
RH Turn Input
LH Rear Lamp Output
5
1.25 YEL
134
J
LH Front Cluster + Relay Output
1
1.25 LT BLU
136
S259
136
1.25 LT BLU
H
0.8 LT BLU
142
G


Exterior Lights Schematics (Cell 110: Front and Rear Lighting, IP Lights)
303103
LOC
DESC
W
G
K
E
J
L
F
H
1.25 LT BLU 136
1.25 BLU 139
1.25 YEL 134
1.25 GRN 135
0.8 LT BLU 142
0.8 BLU 140
C202
C212
C4
C3
C200
P100
C105
C402
S102
S901
S400
S105
S103
S323
S325
S328
C1
C2
Splice Pack 3
IP Cluster
Left Turn
Right Turn
Park And Turn Signal Lamp, LH Front
Park And Turn Signal Lamp, RH Front
Stop, Turn And Tail Lamp, LH
Stop, Turn And Tail Lamp, RH
Ground Distribution Cell 14
G404
G105
G107
P100
C200
2 BLK/ORN 160
1 BRN
1 DK BLU
1 YEL
1 GRN
1 LT BLU
0.8 BLU
0.8 LT BLU
1 BLK
2 BLK
3 BLK
8 BLK
0.8 BLK
1998 - MD-Isuzu


Exterior Lights Schematics (Cell 110: Lighted Mirrors)
303107
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
Lighted Mirror, RH
Lighted Mirror, LH
Heated Mirrors Cell 61
Interior Lamps Dimming Cell 117
Heated Mirror Switch (Jumper C216 Installed with Lighted Mirrors)
S330
S347
S348
S346
P204
C601
P601
P603
S600
C603
S343
S327
S326
S324
S325
S328
P201
C501
P501
S500
C503
S342
C212
S265
C216
P100
G105
C200
2 BLK 69
2 BLK 22
3 BLK 650
3 BLK 550
2 BLK 4
2 BLK 33
2 BLK 2
3 ORN 343
2 ORN 342
2 ORN 32
2 ORN 1
2 BLK 68
2 BLK 720
3 BLK 22
2 ORN 142
2 BRN 95
1.25 BRN 145
1.25 BRN 147
4
3
5
2


Backup Lights Schematics (Cell 112)
243948
Hot in RUN
IP Fuse Block
Circuit Breaker 9 20 A
1 PNK 139
2 PNK 145
S286
2 PNK 145
S287
2 PNK 145
S295
2 PNK 145
C200
22
P100
1 PNK 139
S183
Fuse Block Details Cell 11
Cell 11
Automatic
Manual
C407
11
2 PNK 8
C2
Backup Lamp Switch
C1
2 BLU/GRN 7
C407
7
C412
B
1 BRN 441
A
Backup Lamp Switch
B
1 LT GRN 24
C
C412
1 LT GRN 24
B
C402
1 LT GRN 24
S900
1 LT GRN 24
A
Backup Lamp Left
E
1 BLK 150
S400
1 BLK 150
E
Backup Lamp Right
2 BLK 150
G404


Interior Lights Schematics (Cell 114: Interior Lights)
294388
Hot At All Times
IP Fuse Block
CIRCUIT BREAKER 7 20 A
2 ORN 150
2 ORN 153
S219
0.5 ORN 155
S387
2 ORN 153
Relay Center 2
Dome Lamp Relay
30
86
85
87
2 BLU 154
C202
36
0.5 RED 156
C208
A
F
2 ORN 150
S283
2 ORN 150
S303
2 ORN 150
0.5 RED 3
A
0.5 RED 1
C
Dome Lamp
On
Off
Door
B
0.8 RED/YEL 149
J
Diode Module 1
D202
G
H
0.8 RED/BLK 148
C210
4
P301
26
A
Door Jamb Switch (Closed with door open)
0.8 RED/BLK
Combo Switch
Turn Signal Switch
14
0.8 RED/BLK 152
B
C208
2
0.8 RED/YEL
Fuse Block Details Cell 11


Interior Lights Dimming Schematics (Cell 117: Interior Lights — Dimming)
294389
Hot At All Times
IP Fuse Block
Circuit Breaker #19 15 A
S232
2 GRN 91
2 GRN 93
2 GRN 91
2 GRN 30
87A
87
86
85
Tail Lamp Relay
0.8 GRN/WHT 85
Headlamp Switch
Off
Park
Head
2
1
IP Cluster
Illumination Control
C1
C3
C3I
2 BRN 2
Ground Distribution Cell 14
Ground Distribution Cell 14
0.8 BLK/RED 3
2 BRN 94
S270
S271
S272
S265
2 BRN
1.25 BRN 44
.5 BRN 172
1.25 BRN 133
1.25 BRN 123
1.25 BRN 85
1.25 BRN 115
1.25 BRN 145
1.25 BRN 103
Speedometer
HVAC Control
Diff Lock Switch
Suspension Air Dump Switch
Exhaust Brake Switch
Marker Lamp Switch
Heated Mirror Switch
Fast Idle Switch
C2
E1 C212
0.8 BLK/RED 40
0.5 BLK/RED 173
0.8 BLK/RED 134
0.8 BLK/RED 124
0.8 BLK/RED 86
0.8 BLK/RED 116
0.8 BLK/RED 146
0.8 BLK/RED 104
A B C D E F G H J L
2 BRN 95
IP Lamp Dimmer Buss
Exterior Lamps Cell 110
S321
2 BRN 94
S320
Exterior Lamps Cell 110
2 BRN S319
2 BRN 99
S322
Exterior Lamps Cell 110
2 BRN 99
C210 10
1.25 RED/GRN 41
A
1.25 BRN 351
1.25 BRN 163
0.8 BLK/RED 353
0.8 BLK/RED 165
3
10
Radio
D
Shift Select Lever
Cigar
0.8 BLK/RED 39
J7 C212
0.8 BLK/RED 100
0.8 BLK/RED S318
0.8 BLK/RED C210 14
1.25 BLK/RED 46
0.8 BLK/RED 100

Component Locator

Lighting Systems Components

Component	Location	Locator View	Connector End View
Automatic Transmission (AT) Neutral Signal Driver Module (Cat® Diesel)	Under the right seat	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Automatic Transmission (AT) Selector Control	In the center console	—	*Lighting Systems Connector End Views*
Automatic Transmission (AT) Shift Indicator Lamp (Console Mounted)	In the center console, a part of the automatic transmission (AT) selector control	—	*Lighting Systems Connector End Views*
Backup, Lamp Left Side	On the rear of the left frame rail (part of the tail, stop and turn signal lamp)	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Backup Lamp, Right Side	On the rear of the right frame rail (part of the tail, stop and turn signal lamp)	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Backup Lamps Switch (Automatic Transmission)	On the lower right side of the transmission	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Backup Lamps Switch (Cat® Diesel and 5 or 6 Speed Manual Transmission)	On the upper right side of the transmission	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Backup Lamps Switch (Cat® Diesel and 9 or 10 Speed Manual Transmission)	On the upper right side of the transmission	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Cigar Lighter Lamp	In the center of the IP, at the right of the radio (part of the cigar lighter)	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Clearance Lamp, Left Side	At the top of the roof, on the forward left outboard side of the cab	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Clearance Lamp, Right Side	On the top of the roof, on the forward right exterior side of the cab, outboard	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Clearance Lamps Relay	In the right top of the IP, under the access panel, in relay center 1	*Lighting Systems Component Views*	—
Clearance Lamps Switch	In the center of the IP	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Daytime Running Lamps (DRL) "Off" Relay	On the right side of the lower IP, in front of the blower motor, behind the panel, in the relay center 3	—	*Lighting Systems Connector End Views*
Daytime Running Lamps (DRL) "On" Relay	On the right side of the lower IP, in front of the blower motor, behind the panel, in the relay center 3	—	*Lighting Systems Connector End Views*
Daytime Running Lamps (DRL) Resistor	At the main branch of the data link connector (DLC) breakout	—	*Lighting Systems Connector End Views*
Dome and Reading Lamp	At the center front of the cab at the top	*Lighting Systems Component Views*	—
Dome and Reading Lamp Switch	In the center front top of the cab (part of the dome and reading lamp)	*Lighting Systems Component Views*	—
Door Jamb Switch, Left Side	On the left front door frame, at the rear of the opening	*Lighting Systems Component Views*	—
Headlamp, Left High Beam	In the left front of the exterior cab body	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Headlamp, Left High/ Low Beam	In the left front of the exterior cab body	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*

Lighting Systems Components (cont'd)

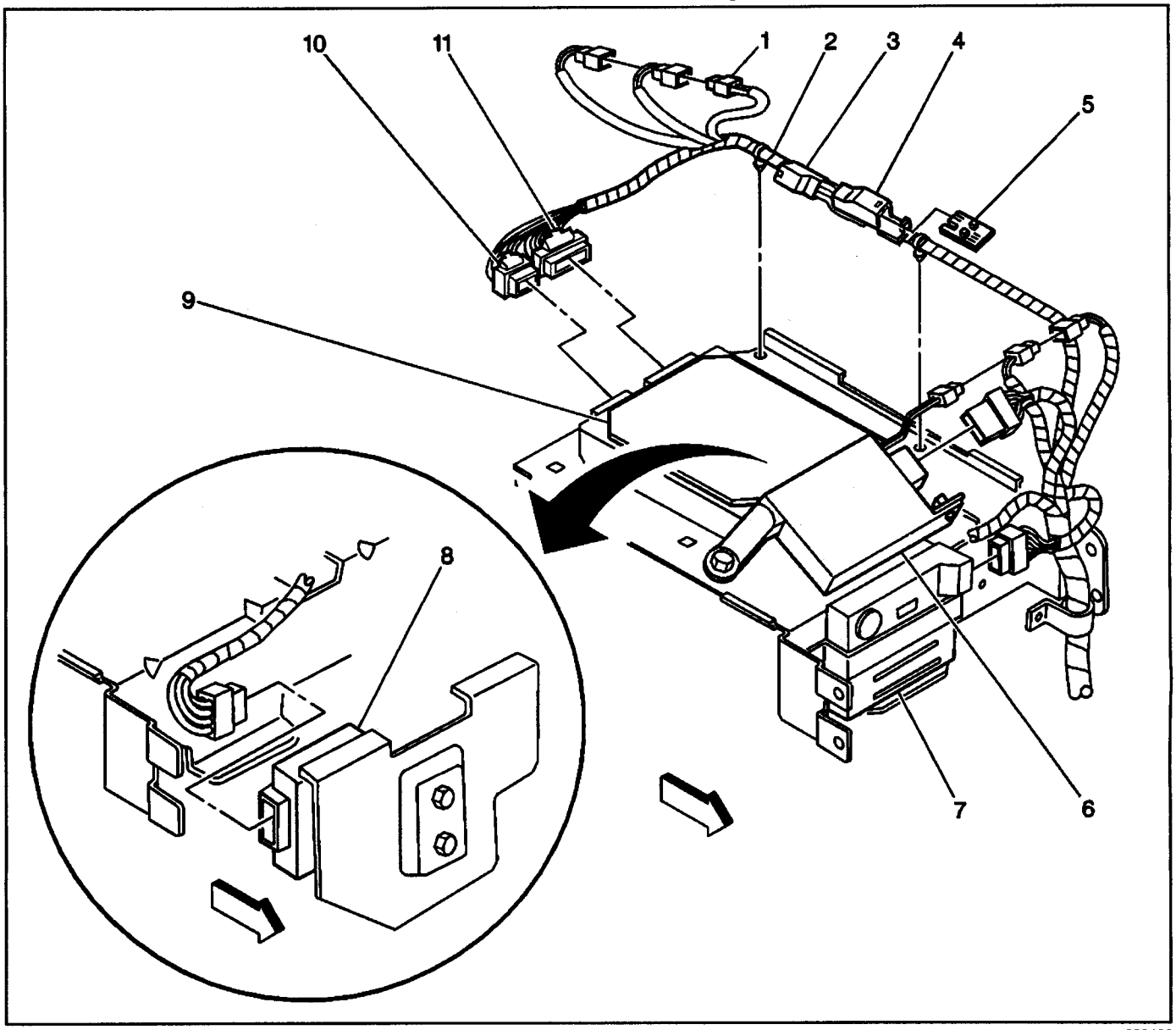
Component	Location	Locator View	Connector End View
Headlamp, Right High Beam	In the right front of the exterior cab body	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Headlamp, Right High/Low Beam	In the right front of the exterior cab body	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Headlamps Dimmer Relay	In the right top of the IP, under the access panel, in relay center 1	*Lighting Systems Component Views*	—
Headlamps Dimmer Switch	On the left side of the lower steering column	*Lighting Systems Component Views*	—
Headlamps Switch	On the left side of the steering column (part of the multifunction switch)	*Lighting Systems Component Views*	—
ID Lamp, Center	On the top of the roof, in the center of the cab	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
ID Lamp, Left Side	On the top of the roof, in the forward left inboard side of the cab	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
ID Lamp, Right Side	On the top of the roof, in the forward right inboard side of the cab	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Interior Lamps Dimming Buss	In the upper IP harness, under the crash pad, at the top of the IP, joint connector 1, row 1 (terminals 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1J and 1L)	—	—
Inverting Driver Module (ABS-Hydraulic)	Under the right seat	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
IP Lamps Dimmer Control	In the IP, on the lower right side of the speedometer, part of the instrument panel cluster (IPC)	*Lighting Systems Component Views*	—
License Lamp	At the rear of the right frame rail, part of the right taillamp	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Lighted Mirror Connector Jumper	In connector C216 (6 cavities), in the upper IP harness	—	*Lighting Systems Connector End Views*
Lighted Outside Left Rearview Mirror	On the exterior of the left door	*Lighting Systems Component Views*	—
Lighted Outside Right Rearview Mirror	On the exterior of the right door	*Lighting Systems Component Views*	—
Lighting Relay	In the top of the IP, under the access panel, in relay center 1	*Lighting Systems Component Views*	—
Marker Lamps Relay	In the top of the IP, under the access panel, in relay center 1	*Lighting Systems Component Views*	—
Marker Lamps Switch	In the center of the IP	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Neutral and Backup Lamps Switch (Push-Button Shift Control)	Internal to the automatic electronic transmission	—	—
Park Brake Switch (Hydraulic Brakes)	On the park brake lever bracket	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Park/Turn Signal Lamp, Left Front	On the left front of the front bumper	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Park/Turn Signal Lamp, Right Front	On the right front of the front bumper	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
PRNDL Lamp (Console-Mounted Selector)	In the center console, part of the automatic transmission (AT) selector control	—	*Lighting Systems Connector End Views*

Lighting Systems Components (cont'd)

Component	Location	Locator View	Connector End View
Sidemarker Lamp, Left Front	In the left forward bottom of the door	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Sidemarker Lamp, Right Front	In the right forward bottom of the door	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Stoplamps Relay (ABS-Hydraulic)	In the center of the lower IP, behind the panel, in relay center 2	*Lighting Systems Component Views*	—
Stoplamps Switch (ABS-Air)	On the left side of the exterior bulkhead, under the brake pedal, on the air brake application valve	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Stoplamps Switch (ABS-Hydraulic)	On the Brake Pedal Support	—	—
Stoplamps Switch 1 (ABS-Air)	On the left side of the exterior bulkhead, under the brake pedal, on the air brake application valve	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Stoplamps Switch 2 (ABS-Air)	On the left side of the exterior bulkhead, under the brake pedal, on the air brake application valve	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Tail and Stop/Turn Signal Lamp, Left Side	On the rear of the left frame rail	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Tail and Stop/Turn Signal Lamp, Right Side	On the rear of the right frame rail	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Taillamps Relay	In the top of the IP, under the access panel, in the relay center 1	*Lighting Systems Component Views*	—
Tractor Receptacle	In the side of the cab bridge, on the bracket near the power steering reservoir	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Trailer Receptacle	Behind the cab, on the cab bridge bracket at the left frame rail	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Trailer Stop Relay (Cat® Diesel and ABS-Air)	In the left side of the cab bridge, on the relay bracket on the front of the electronic brake control module (EBCM)	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Trailer Stop Relay (Cat® Diesel and ABS-Hydraulic)	In the left side of the cab bridge, on the relay bracket on the power steering reservoir mounting bracket	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Trailer Stop Relay (Gasoline and ABS-Hydraulic)	In the left side of the cab bridge, on the relay bracket on the power steering reservoir mounting bracket	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Trailer Stoplamps Switch (ABS-Air)	In the center of the IP, below the radio	*Lighting Systems Component Views*	—
Turn Signal Switch	On the left side of the steering column (part of the multifunction switch)	*Lighting Systems Component Views*	—
Turn/Hazard Flasher Module	Under the center of the IP, at the floor level	*Lighting Systems Component Views*	*Lighting Systems Connector End Views*
Turn/Trailer Relay, Left Side	In the right top of the IP, under the access panel, in relay center 1	*Lighting Systems Component Views*	—
Turn/Trailer Relay, Right Side	In the right top of the IP, under the access panel, in relay center 1	*Lighting Systems Component Views*	—

Lighting Systems Component Views

Instrument Panel Harness to Right Seat

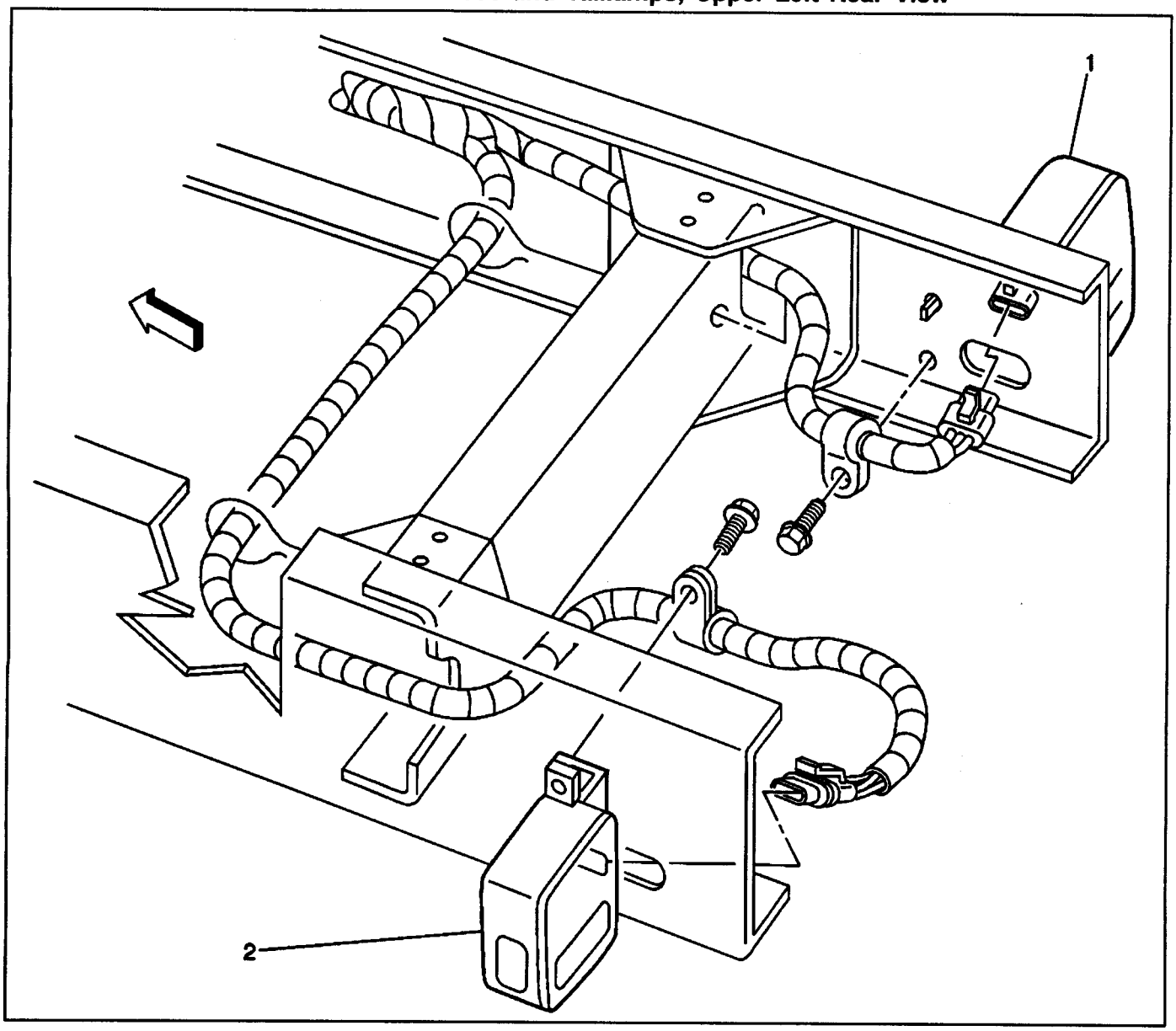


228430

Legend

(1) C215 (2 Cavities)
(2) Lower IP Harness
(3) Automatic Transmission Neutral Signal Driver Module (Cat® Diesel)
(4) Inverting Driver Module Connector
(5) Inverting Driver Module (ABS-Hydraulic)
(6) Multifunction Alarm Module
(7) Park Brake Control Module
(8) Vehicle Speed Sensor (VSS) Buffer
(9) Powertrain Control Module (PCM) (Gasoline)
(10) PCM Connector C2 (24 Cavities)
(11) PCM Connector C1 (32 Cavities)

Rear Chassis Harness and Taillamps, Upper Left Rear View



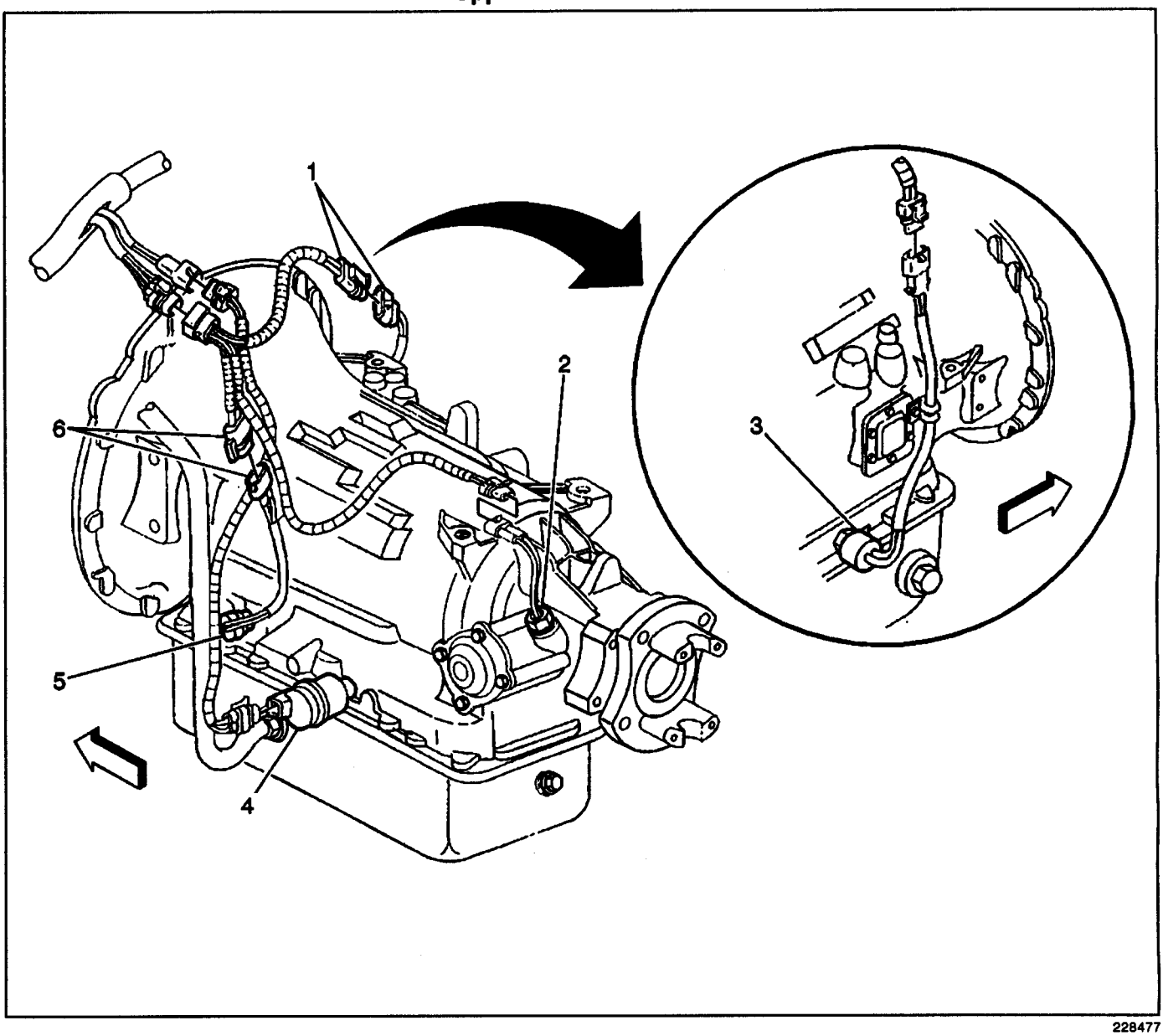
231737

Legend

(1) Right Tail, Stop and Turn Signal Lamp with Backup Lamp

(2) Left Tail, Stop and Turn Signal Lamp with Backup Lamp

Automatic Transmission Harness (Cat® Diesel and Automatic Transmission)
Upper Left Rear View

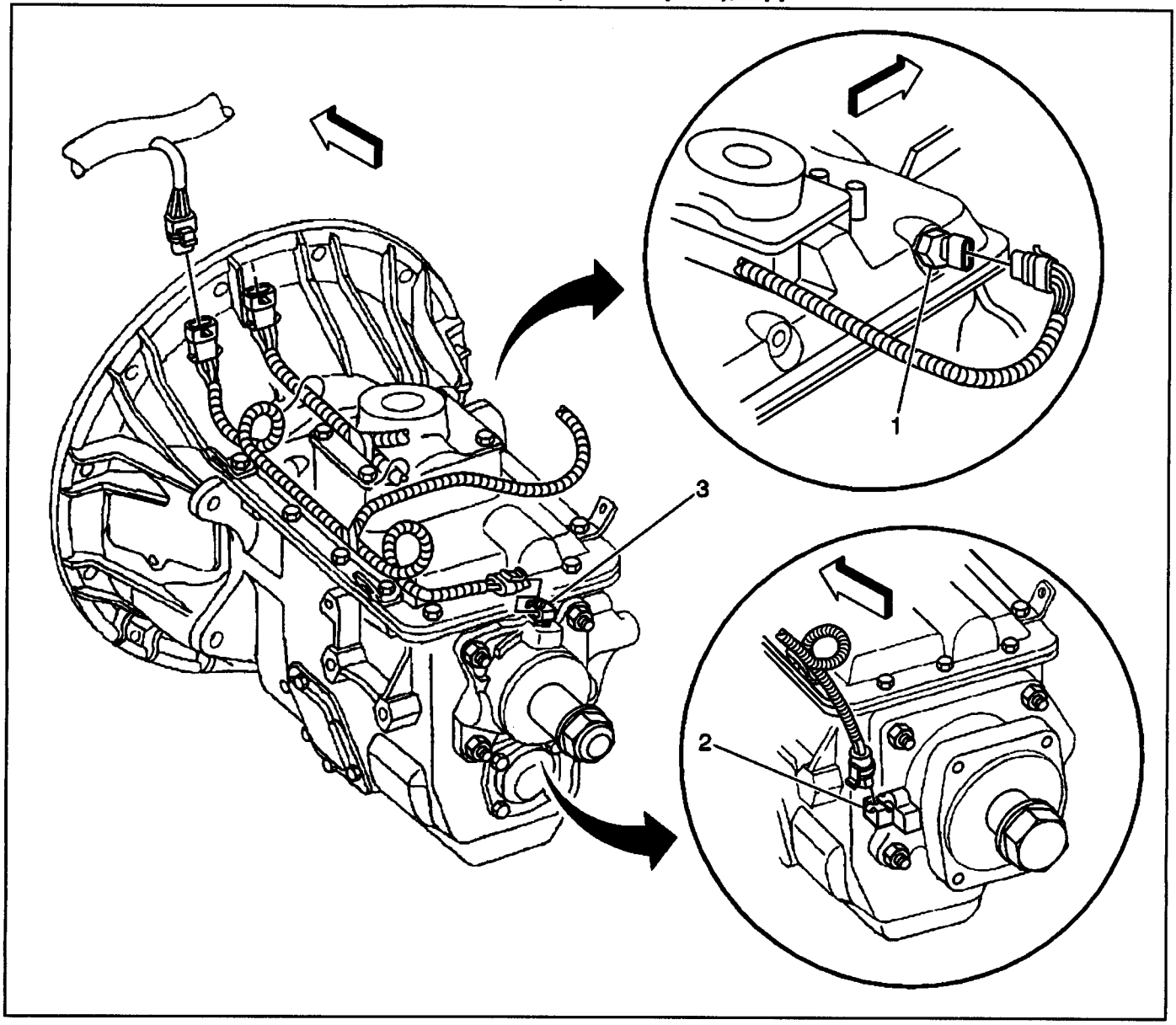


228477

Legend

(1) Backup Lamps Switch Connector
(2) Vehicle Speed Sensor (VSS)
(3) Backup Lamps Switch
(4) Automatic Transmission Modulator
(5) Neutral Switch
(6) Neutral Switch Connector

Manual Transmission Harness (5 or 6–Speed), Upper Left Rear View

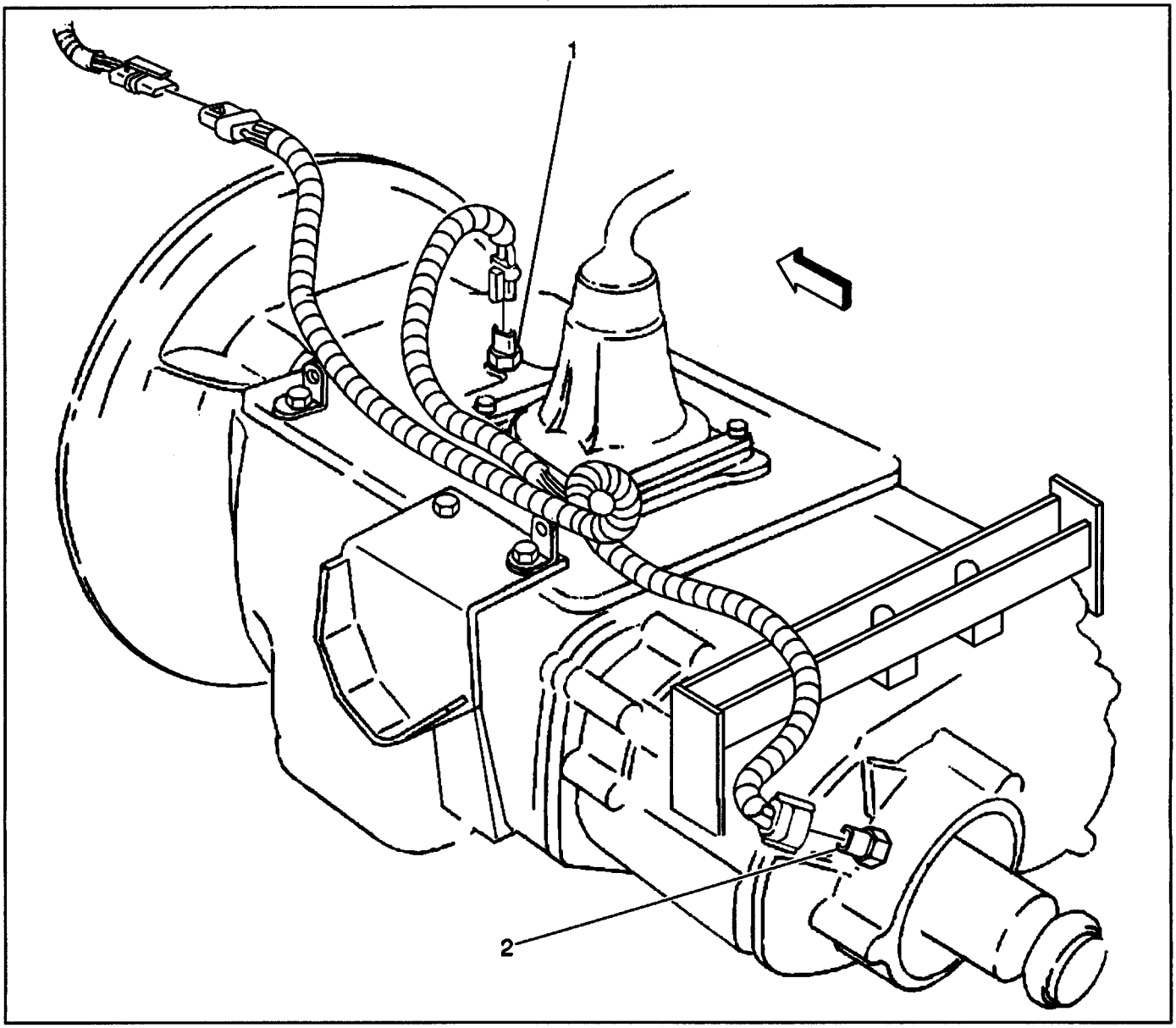


231718

Legend

(1) Backup Lamps Switch
(2) Vehicle Speed Sensor (VSS) (Hydraulic Brakes)
(3) VSS (ABS-Air)

Manual Transmission Harness (9 or 10–Speed), Upper Left Rear View



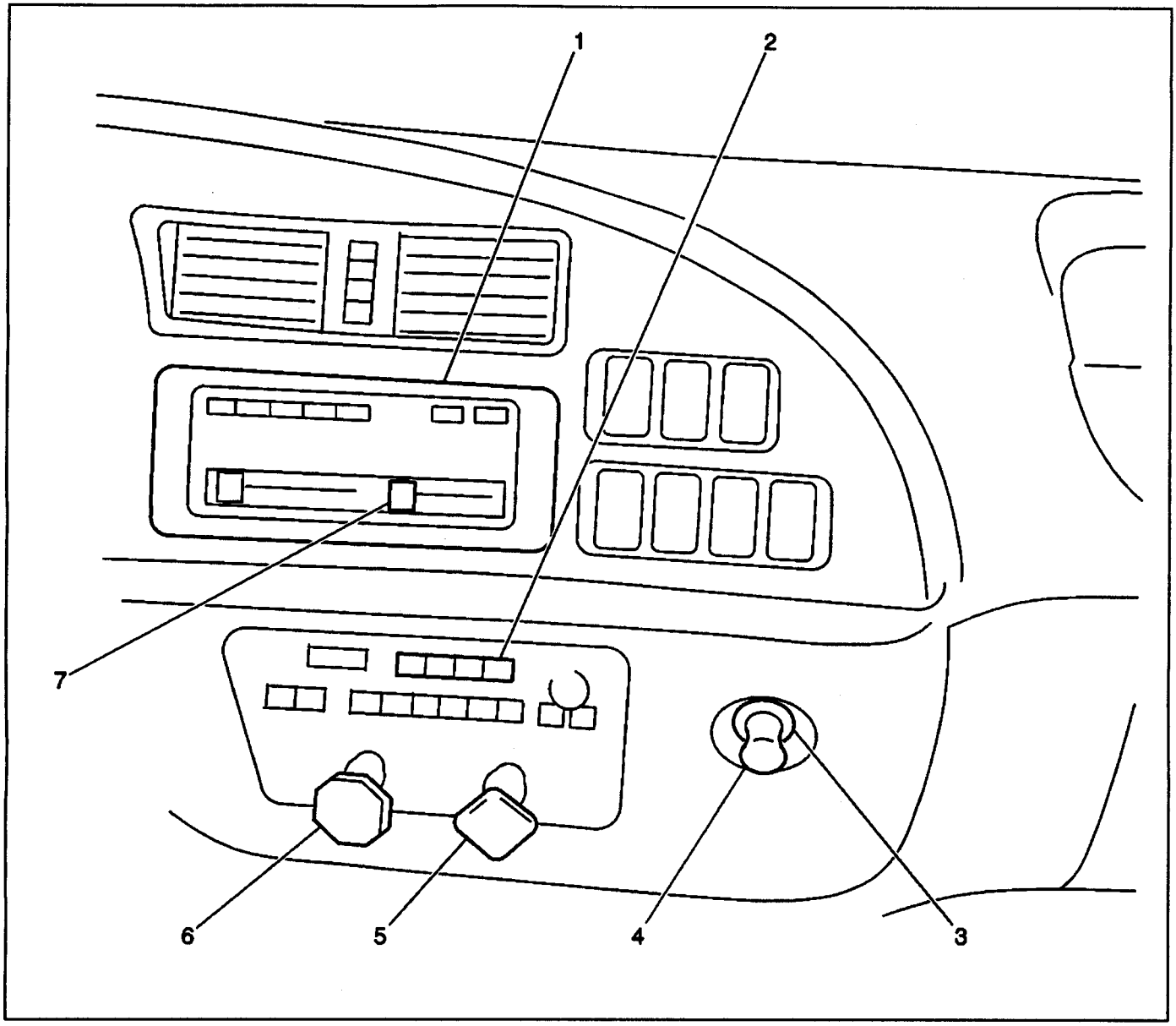
231666

Legend

(1) Backup Lamps Switch

(2) Vehicle Speed Sensor (VSS)

Instrument Panel, Left Forward View

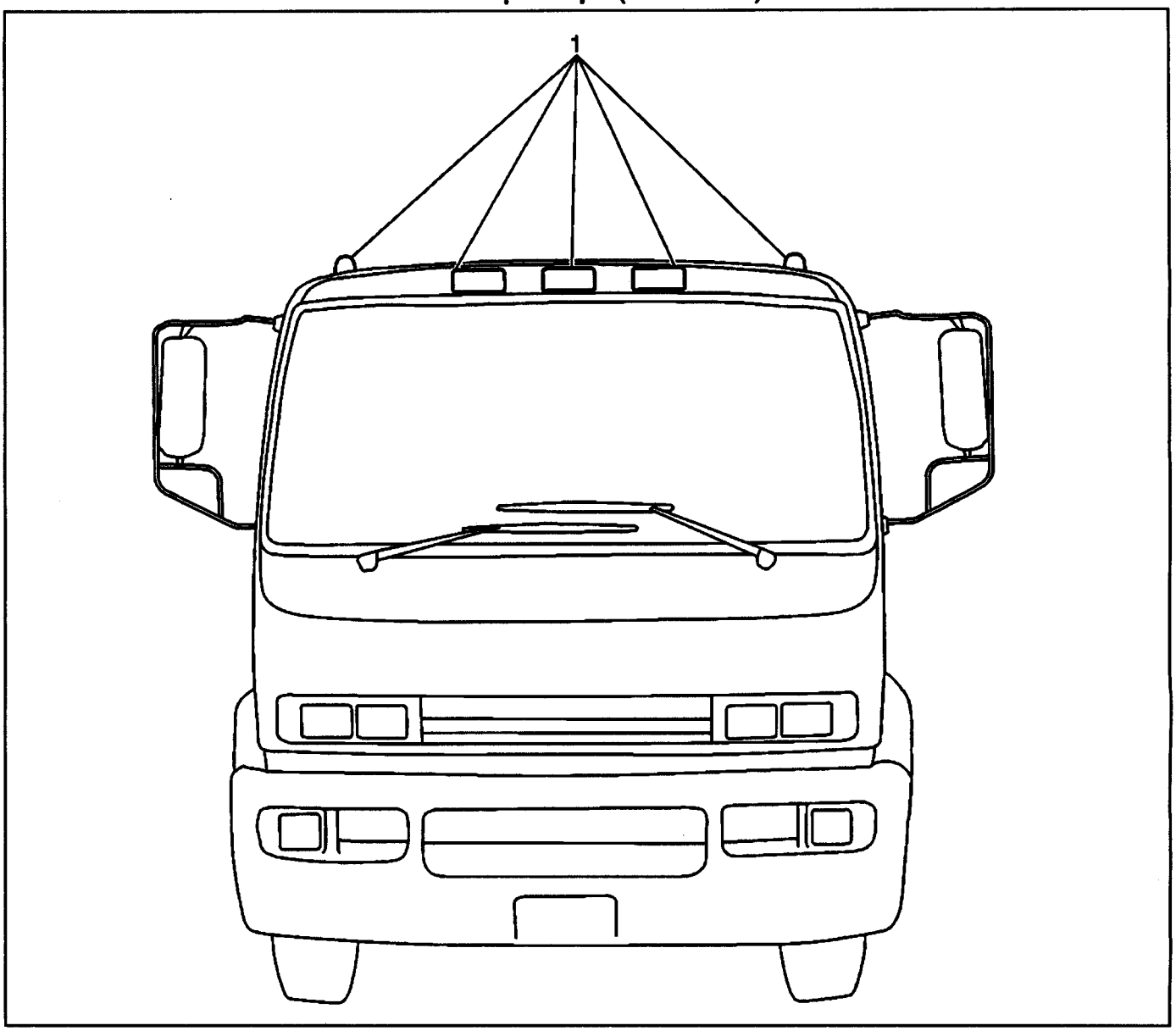


231675

Legend

(1) HVAC Controller
(2) Radio
(3) Cigar Lighter Lamp
(4) Cigar Lighter
(5) Park Brake Switch (ABS-Air)
(6) Trailer Stoplamps Switch (ABS-Air)
(7) Blower Switch (Part of HVAC Controller)

Roof-Top Lamps (Front View)

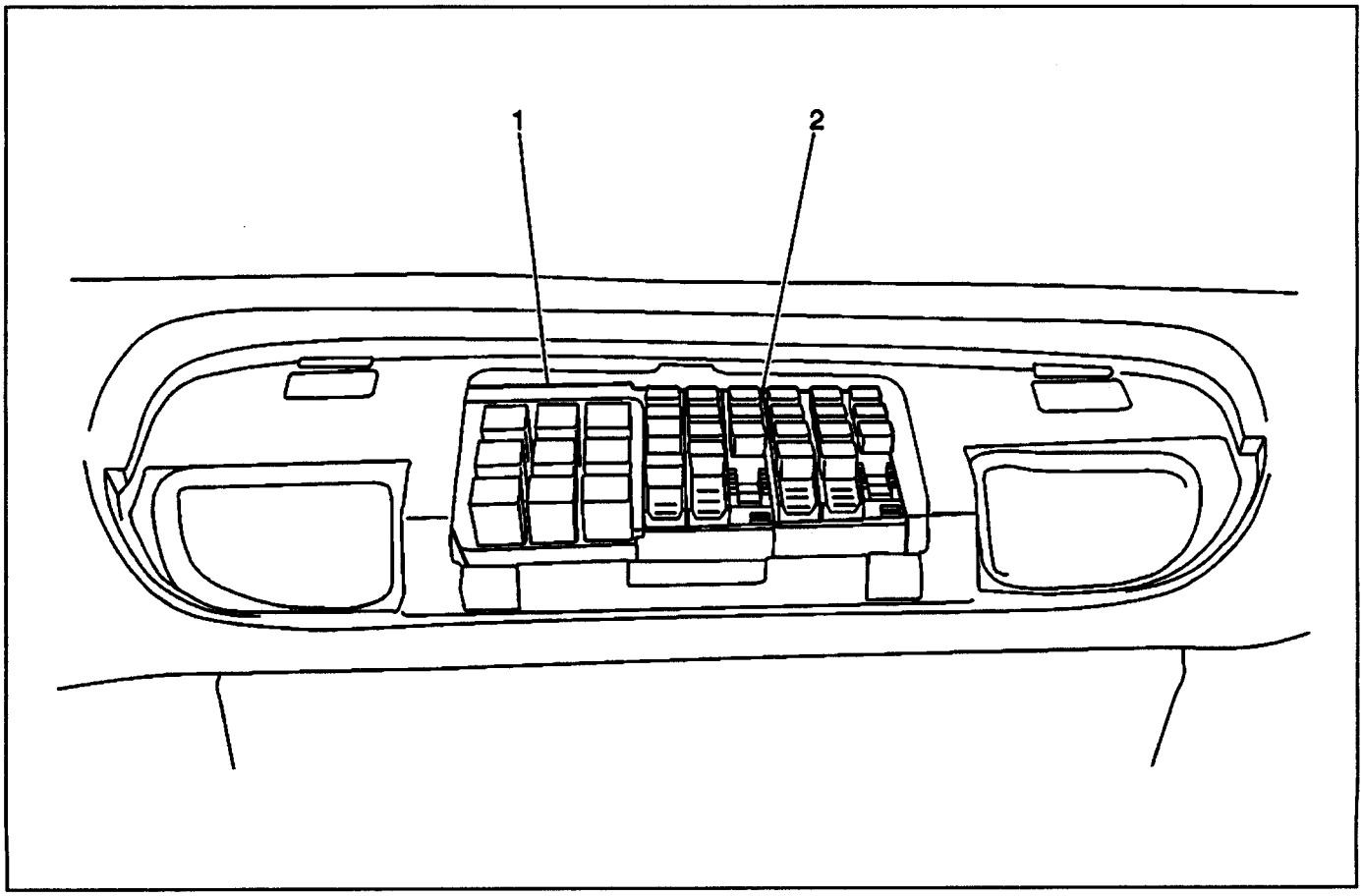


231439

Legend

(1) Left and Right Clearance Lamps and ID Lamps

Instrument Panel, Right Side Forward View

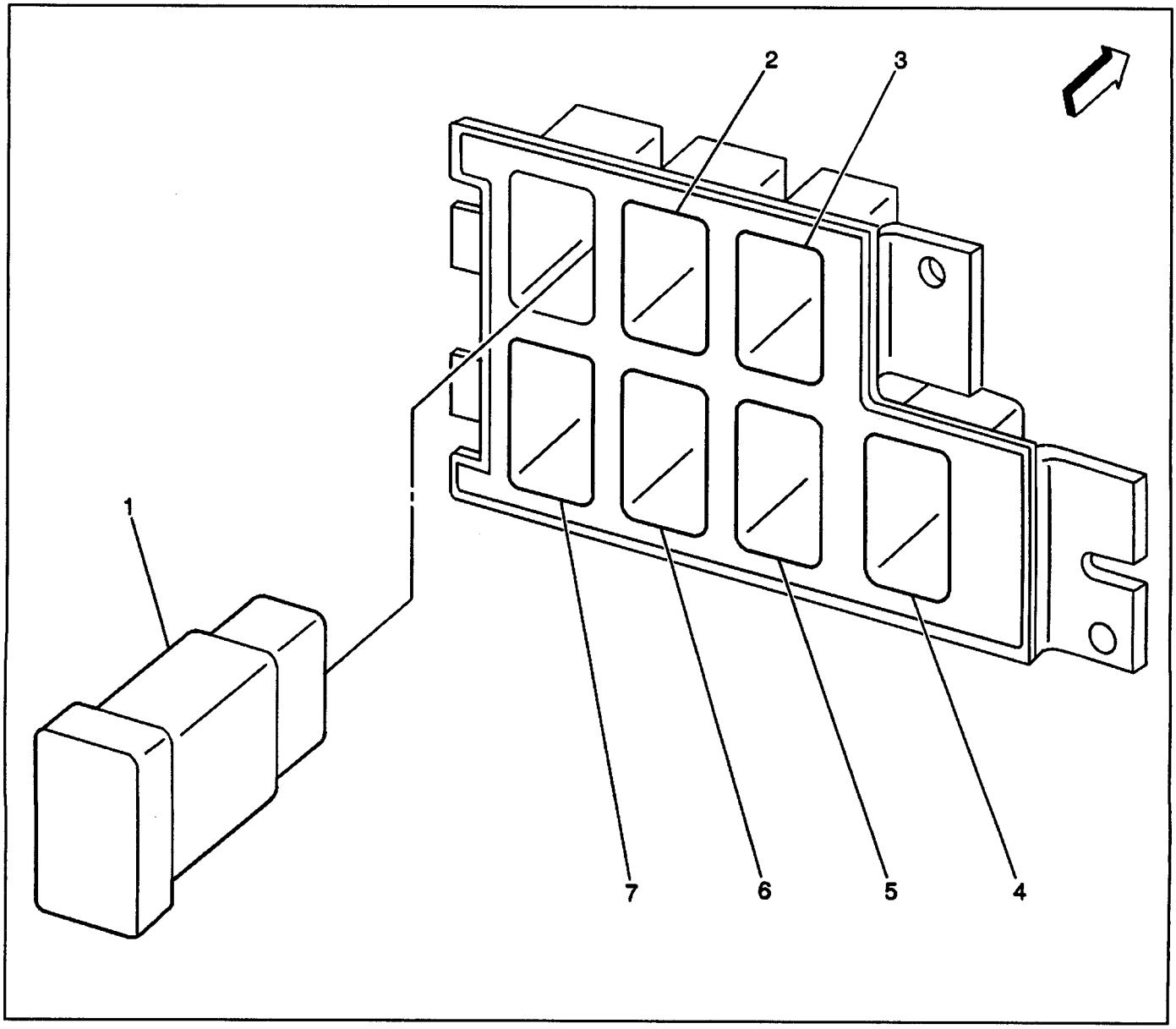


228475

Legend

(1) Relay Center 1
(2) IP Fuse Block

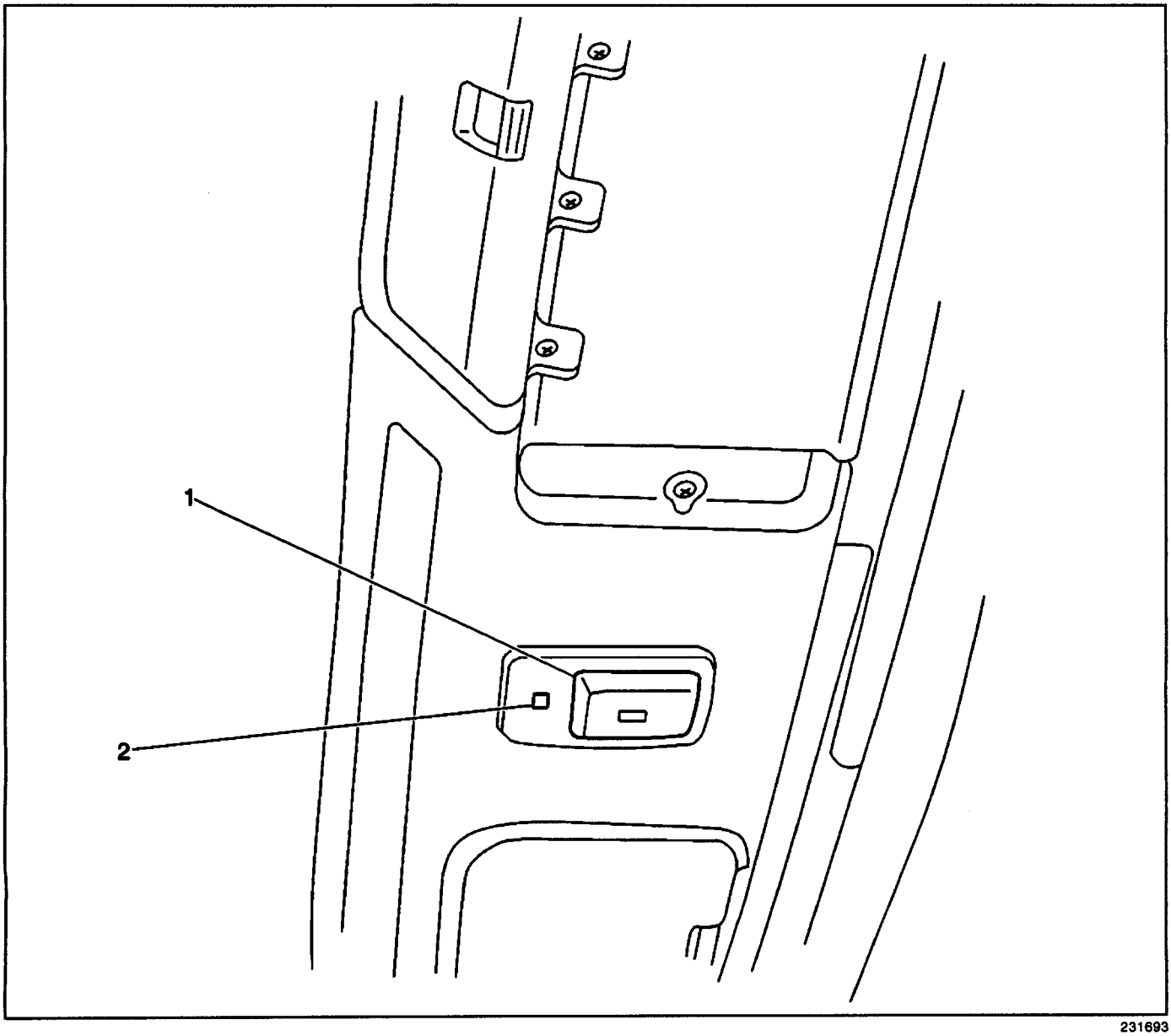
Instrument Panel Switches, Center Forward View



Legend

(1) Exhaust Brake Switch
(2) Fast Idle Switch
(3) Heated Mirror Switch
(4) Two Speed Rear Axle Shift Switch (Automatic Transmission)
(5) Air Suspension Dump Switch
(6) Differential Lock Switch
(7) Clearance Lamps Switch

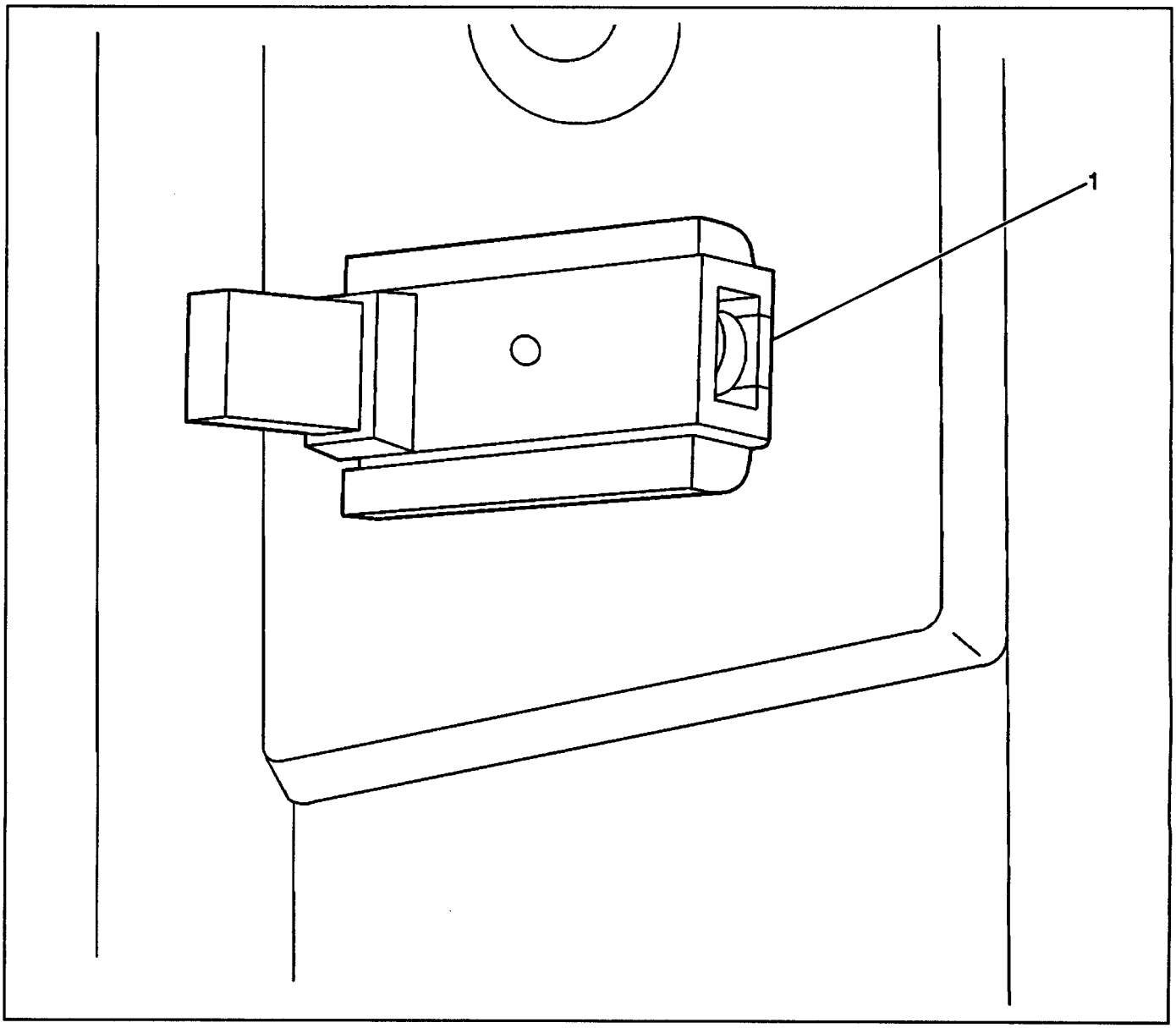
Interior Roof, Right Upper View



Legend

(1) Dome and Reading Lamp
(2) Dome and Reading Lamp Switch

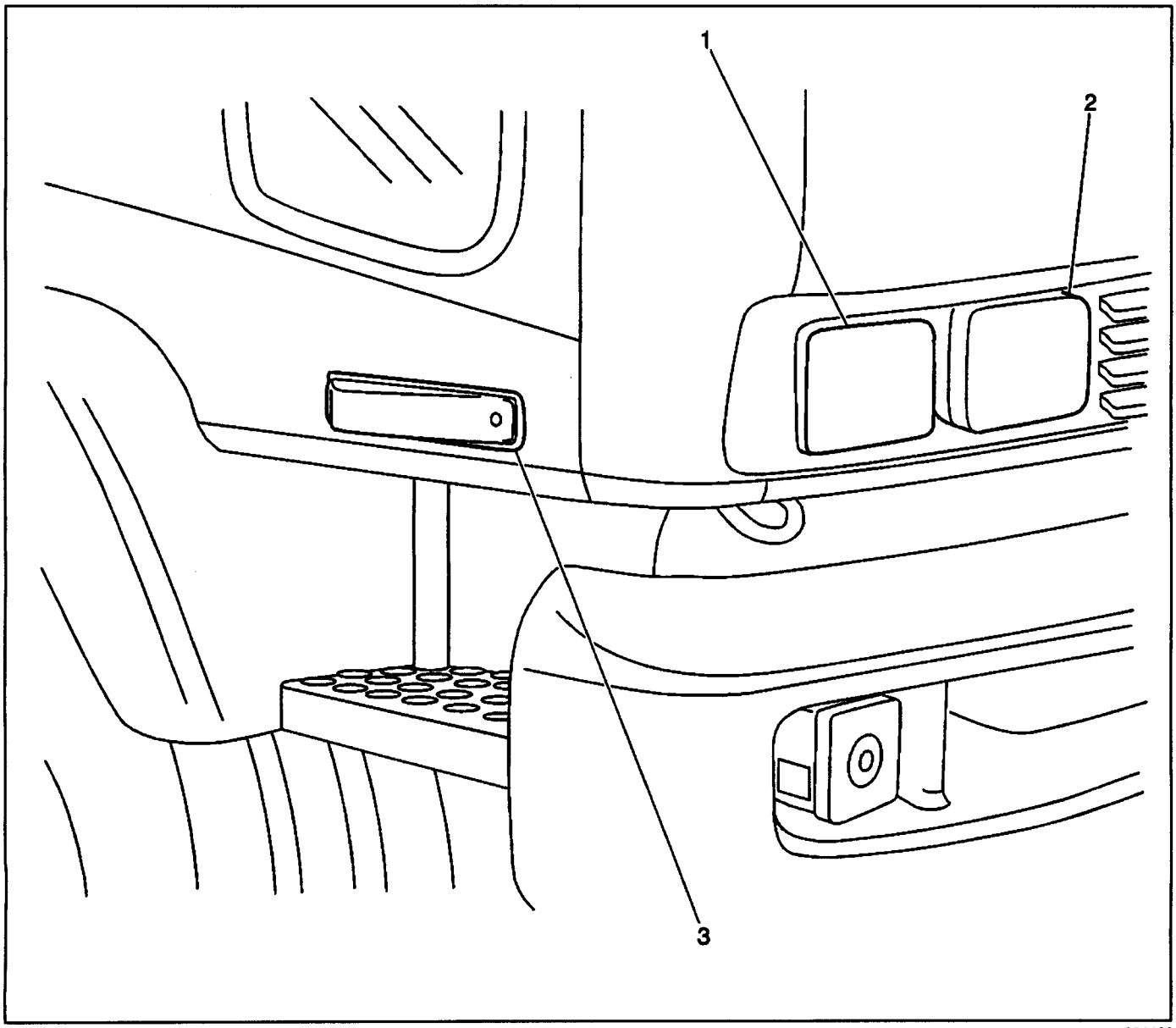
Door Jamb, Left Rear View



Legend

(1) Left Door Jamb Switch

Forward Lamps, Right Front View

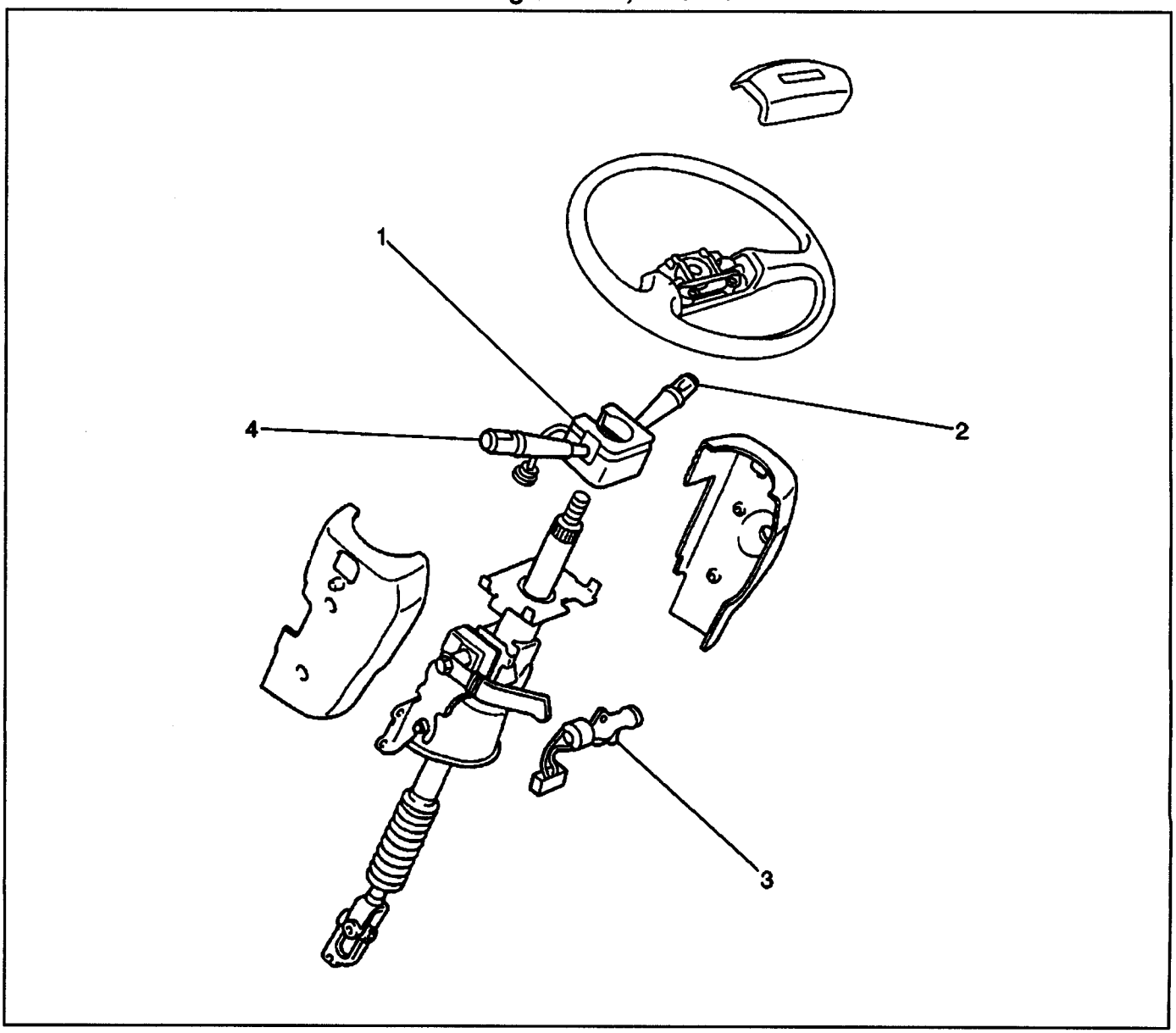


231423

Legend

(1) Right High/Low Beam Headlamp (Left Similar)
(2) Right High Beam Headlamp (Left Similar)
(3) Right Front Side Marker Lamp (Left Similar)

Steering Column, Left View

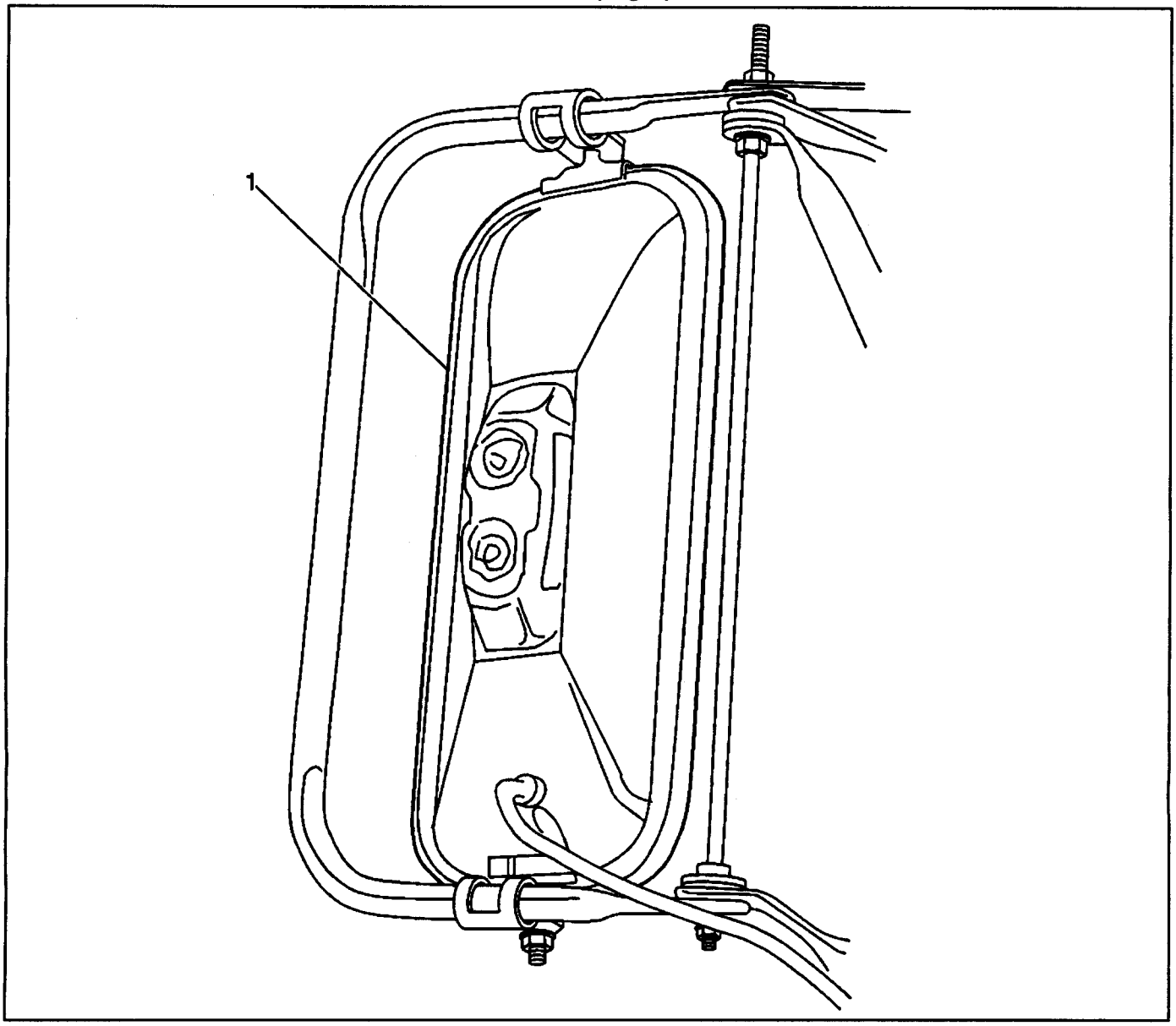


228426

Legend

(1) Multifunction Switch
(2) Right Multifunction Lever
(3) Ignition Switch
(4) Left Multifunction Lever

Mirror (Right)

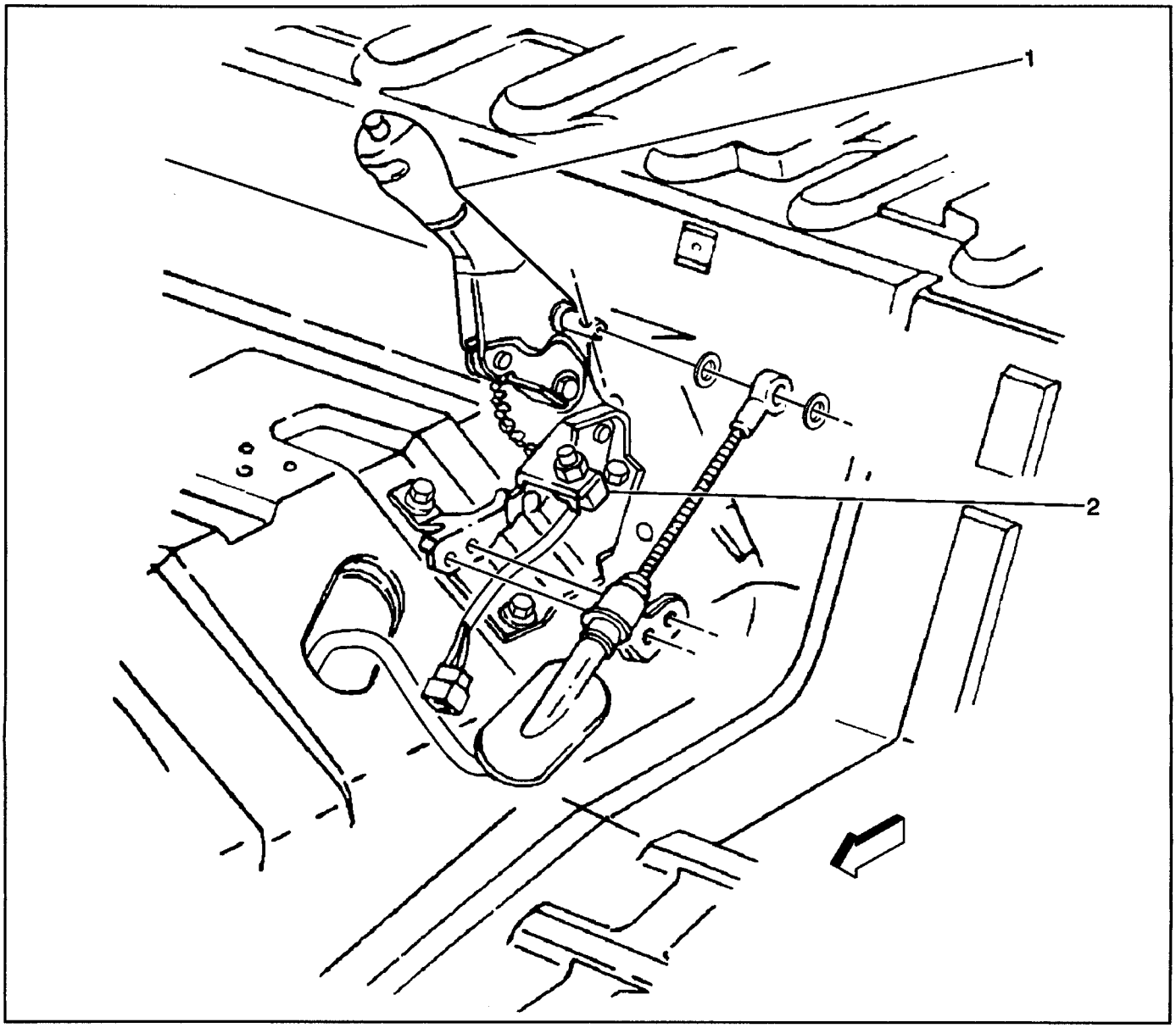


231453

Legend

(1) Right Lighted Mirror (Heated Mirror similar)

Park Brake



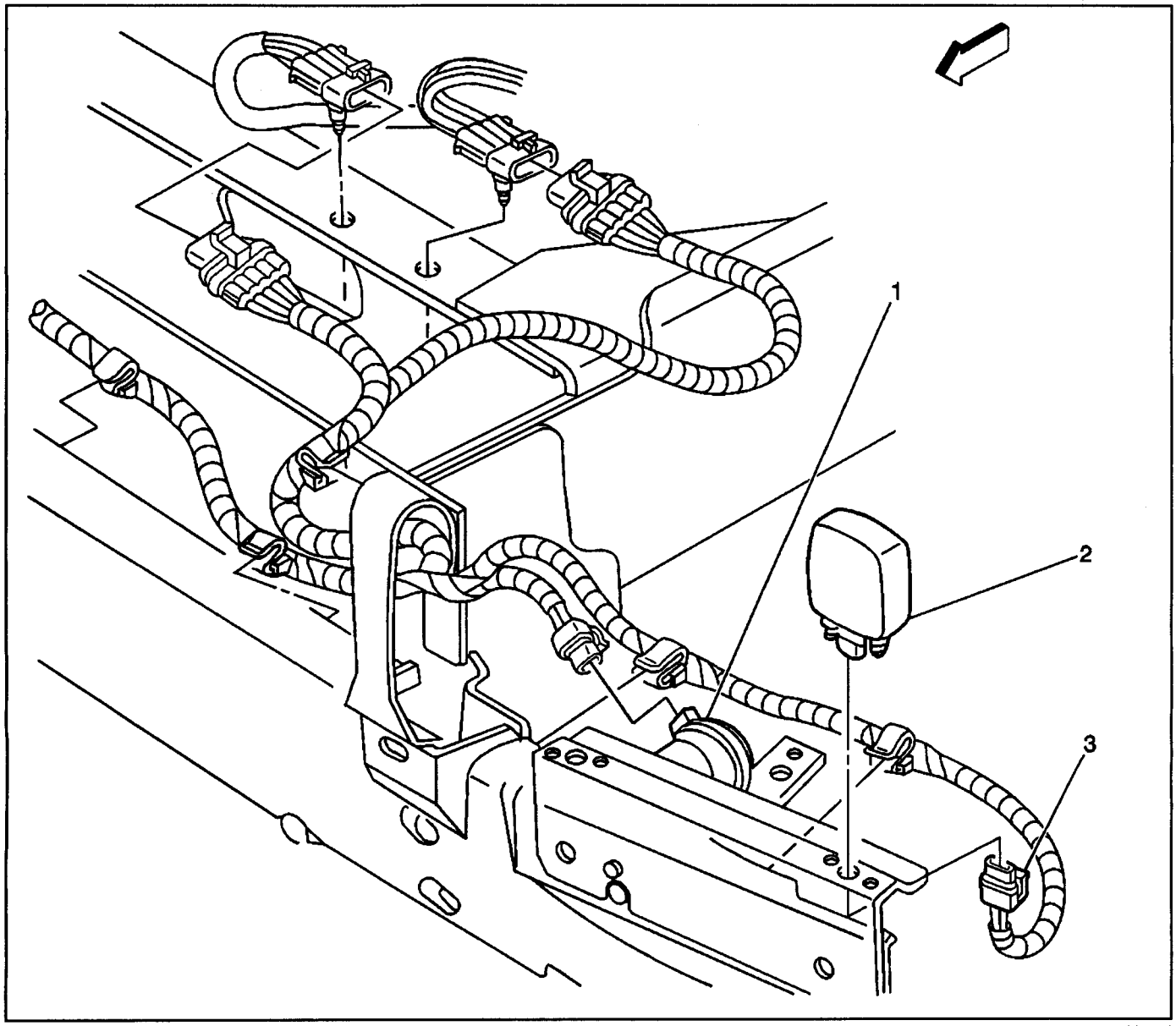
231691

Legend

(1) Park Brake Lever

(2) Park Brake Switch (Hydraulic Brakes)

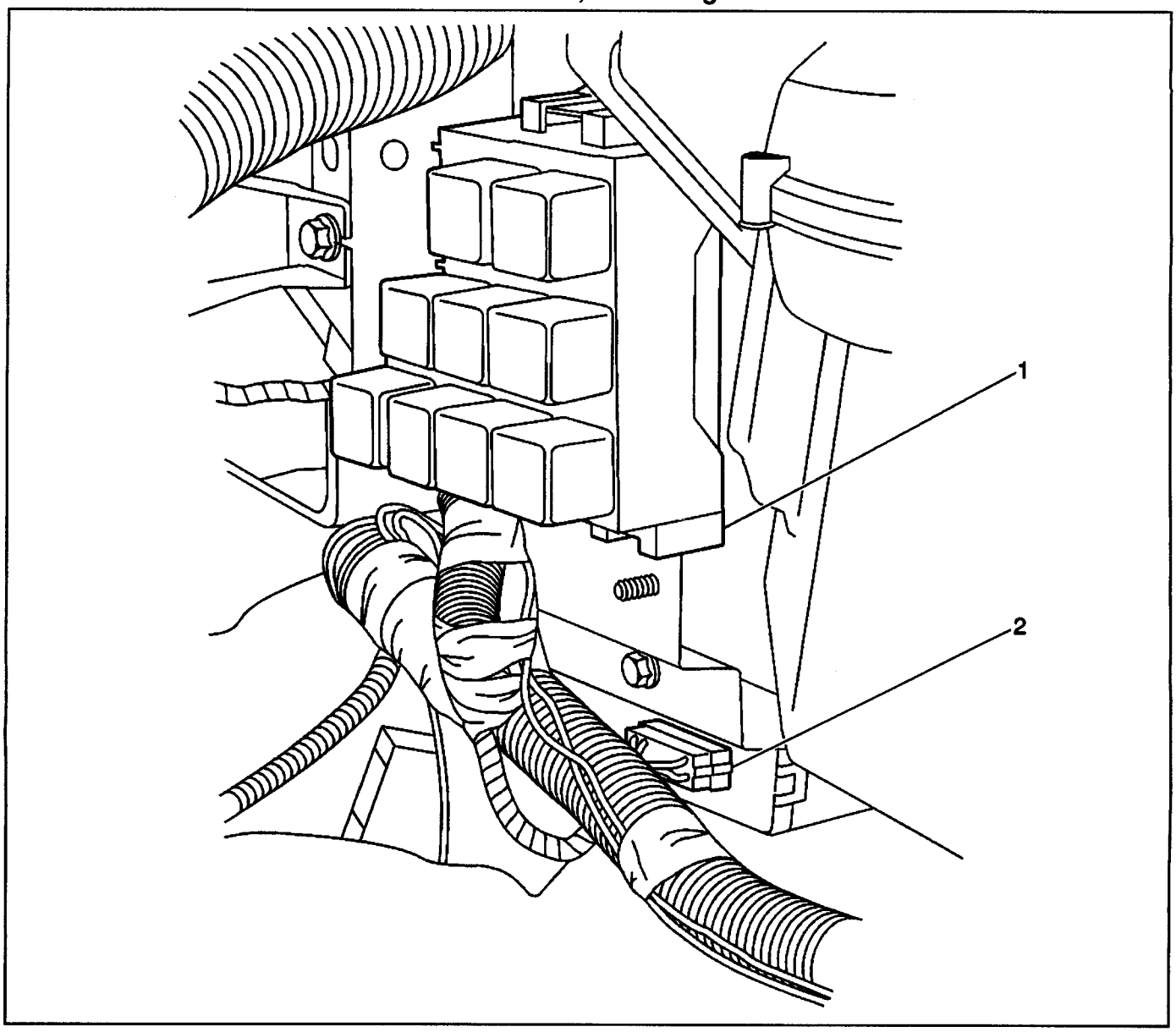
Turn Signal Harness (Left Front View)



Legend

(1) High A-Note Horn (Single Electric Horn)
(2) Left Front Park and Turn Signal Lamp
(3) Left Front Park and Turn Signal Lamp Connector

Instrument Panel, Lower Right View

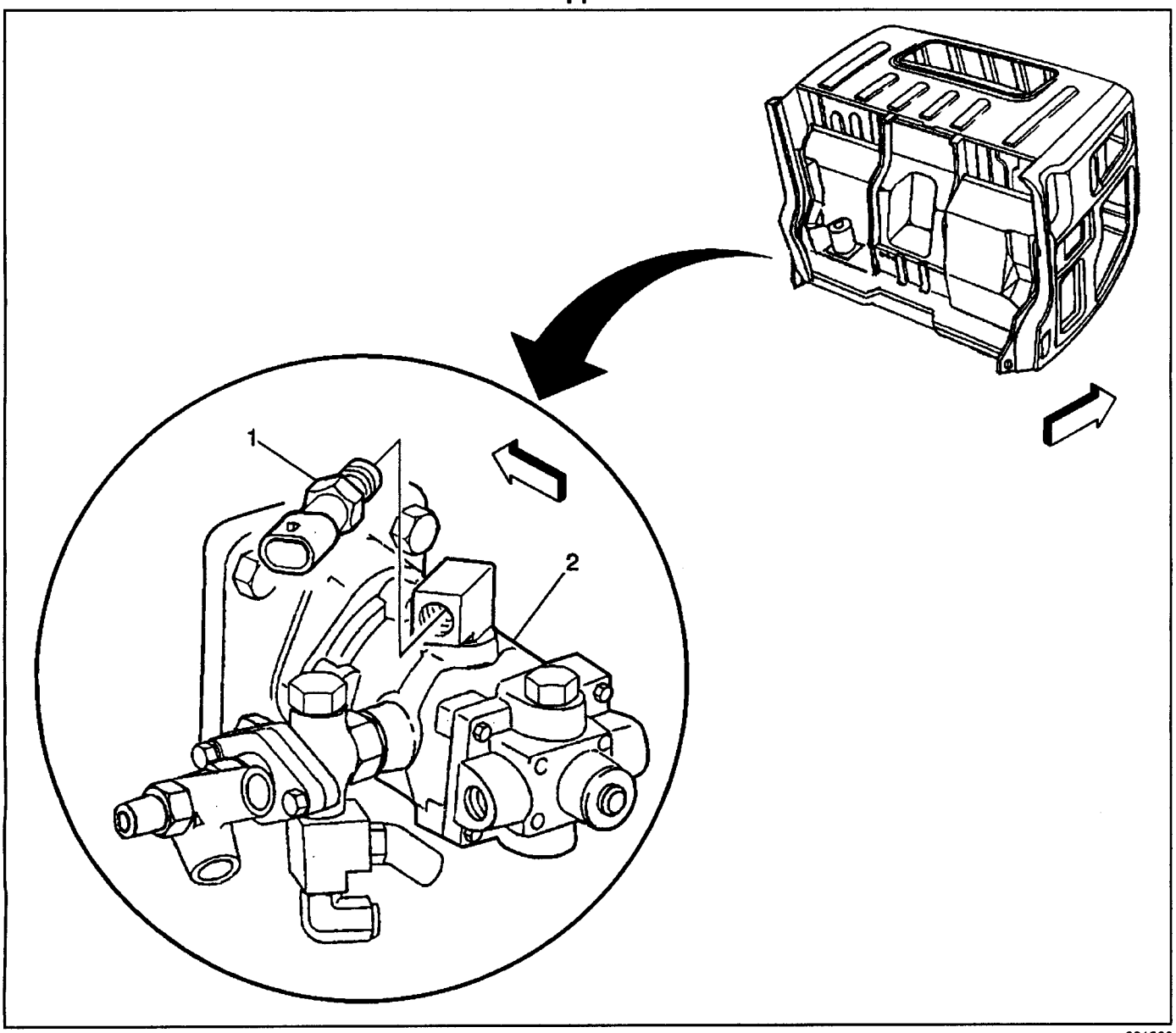


Legend

(1) Relay Center 2

(2) Turn/Hazard Flasher Module

Air Brake Application Valve

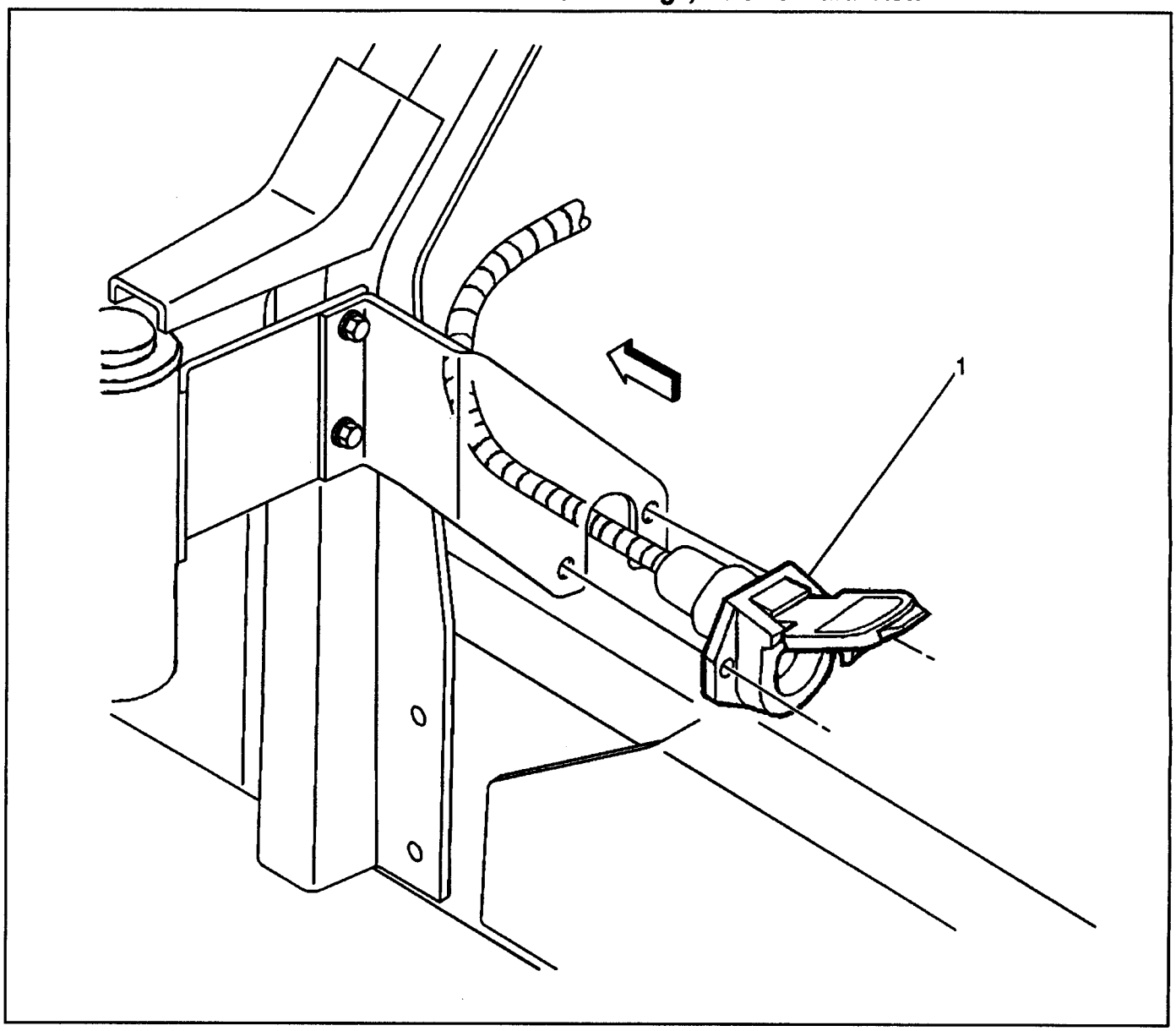


231533

Legend

(1) Stoplamps Switch
(2) Air Brake Application Valve

Trailer Front Harness to Cab Bridge, Left Forward View

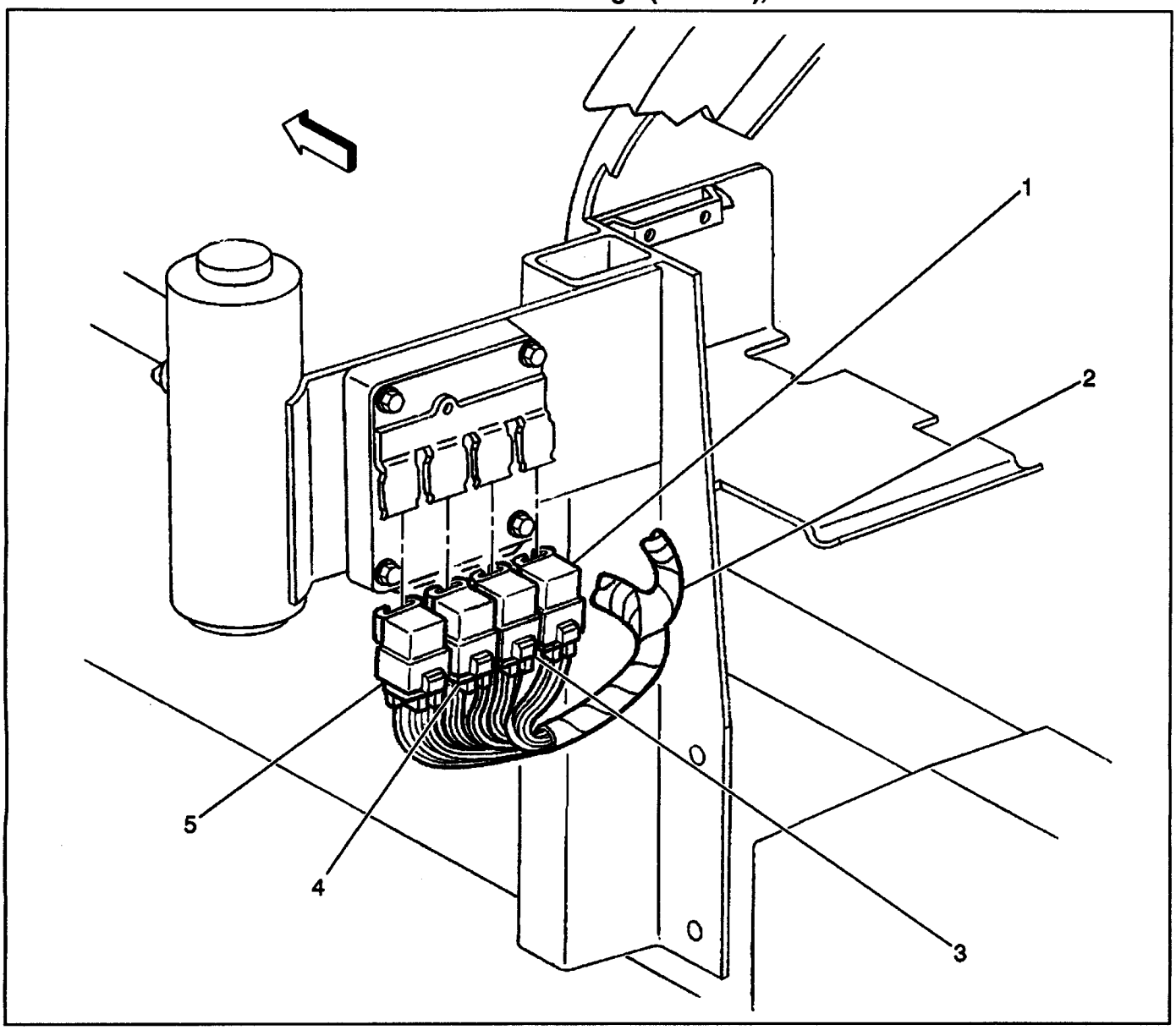


231704

Legend

(1) Trailer Receptacle

Front Chassis Harness to Cab Bridge (ABS-Air), Left Forward View

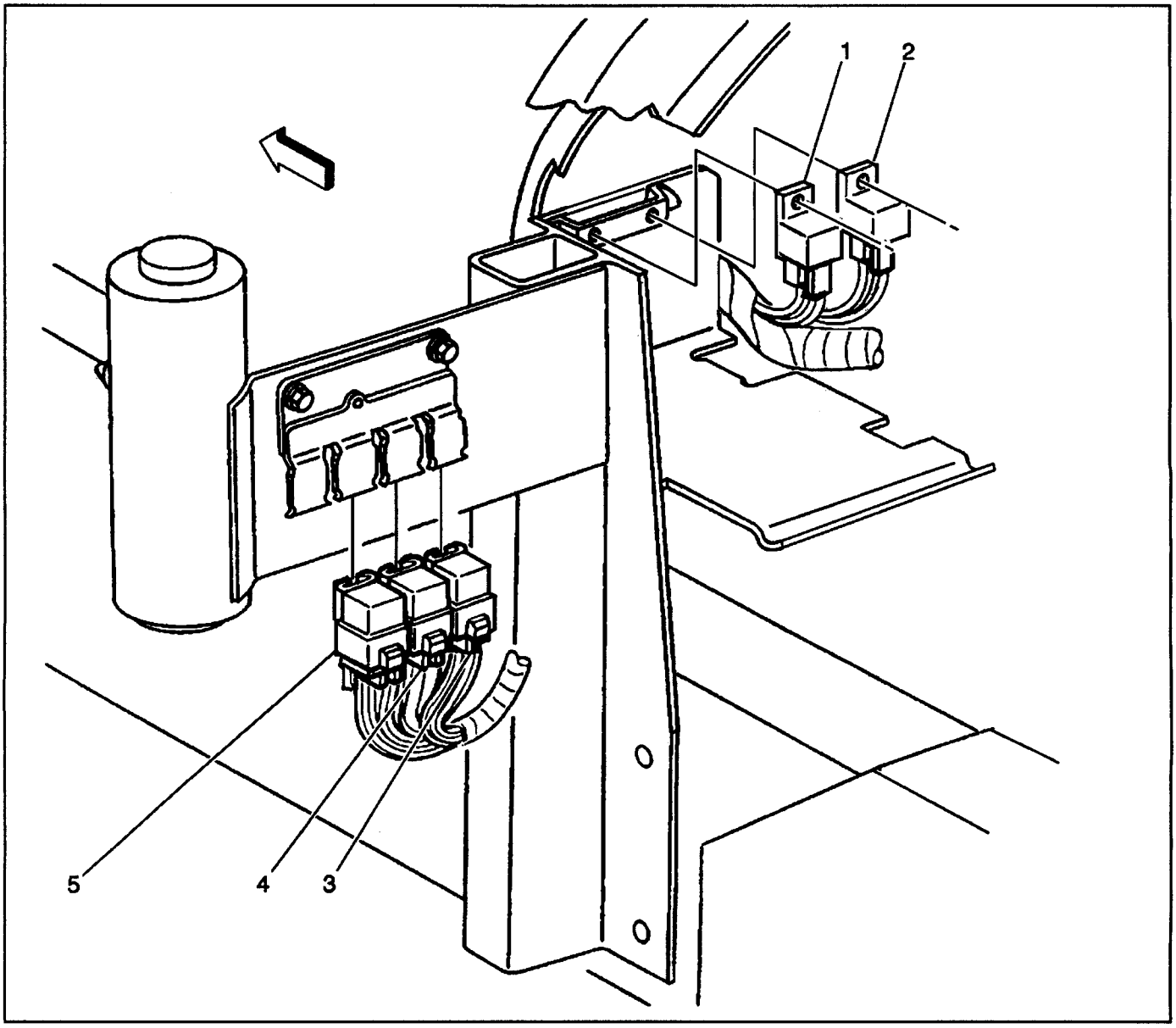


228373

Legend

(1) ABS Relay (ABS-Air)
(2) Front Chassis Harness
(3) Starter Relay (Cat® Diesel and ABS-Air)
(4) Trailer Stop Relay (Cat® Diesel and ABS-Air)
(5) Automatic Transmission Modulator Shift Relay (Cat® Diesel)

Front Chassis Harness to Cab Bridge (ABS-Hydraulic) Left Forward View



228382

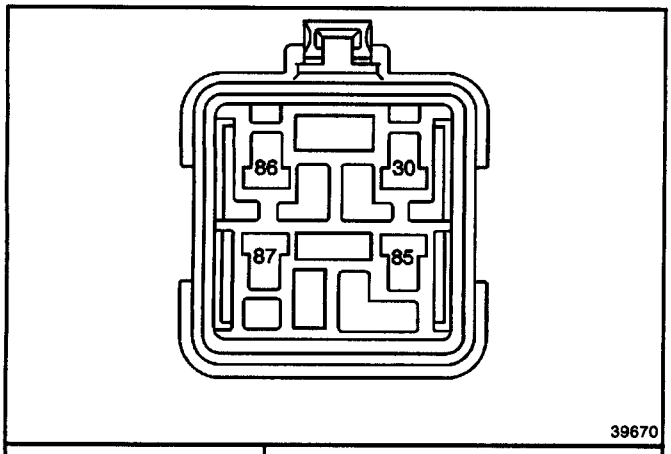
Legend

(1) Park Brake Pump Motor Relay
(2) Power Brake Booster Pump Motor Relay
(3) Starter Relay (Cat® Diesel and ABS-Hydraulic)
(4) Starter relay (Gasoline) or Trailer Stop Relay (Cat® Diesel and ABS-Hydraulic)
(5) Automatic Transmission Modulator Shift Relay (Cat® Diesel)

Visual Identification

Lighting Systems Connector End Views

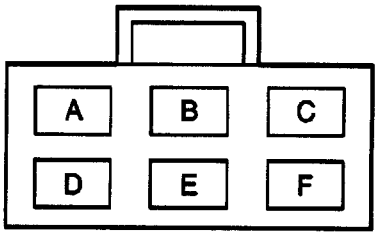
ABS Trailer Stop Relay (Air Brakes)



39670

Connector Part Information	• 12129716 • ASM 4F M/P 280 FLX LK SLD (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
30	RED	142	Fuse Output Battery
85	WHT	17	Stoplamp Switch Output
86	BLK	150	Ground
87	LT BLU	20	Stoplamp Feed

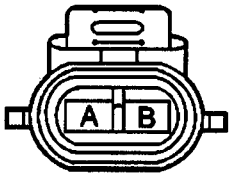
Automatic Transmission Selector Control (AT Trans.)



237082

Connector Part Information	• 6 Way F • (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED/GRN	41	Illumination
B	RED	37	Fuse Output Ignition
C	BLK/WHT	40	Transmission Park/Neutral Signal
D	BLK/RED	46	Interior Lamp Dimming Buss
E	RED/BLU	38	Select Lever Back Lamp
F	BLK/RED	39	Neutral Signal

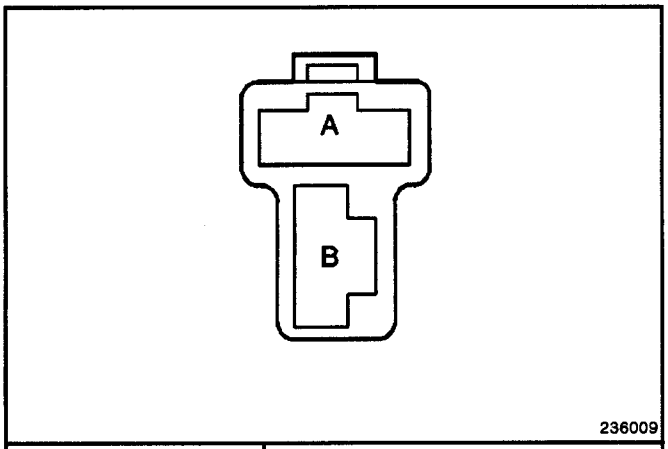
Backup Lamp Switch



236598

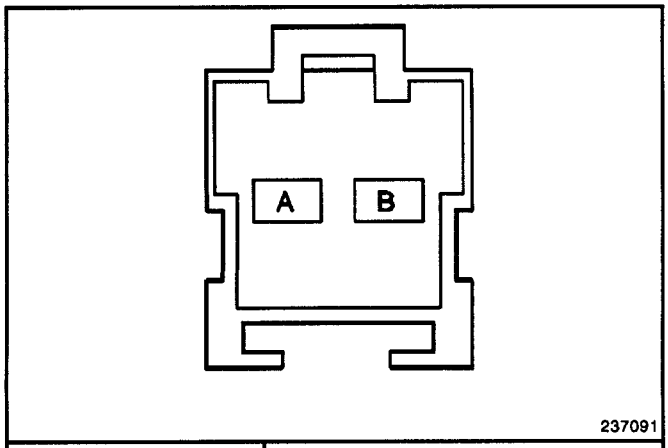
Connector Part Information	• 12052641 • ASM 2F M/P 150 (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	441	Fuse Output Ignition
B	LT GRN	24	Back Up Lamp Feed

Cigar Lighter



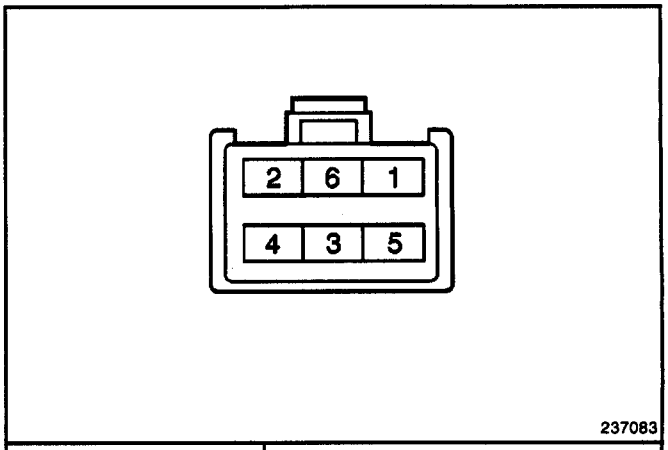
Connector Part Information		• 2 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK/RED	165	Interior Lamp Dimming Buss
B	BRN	163	Illumination

Clearance Lamp (Typical)



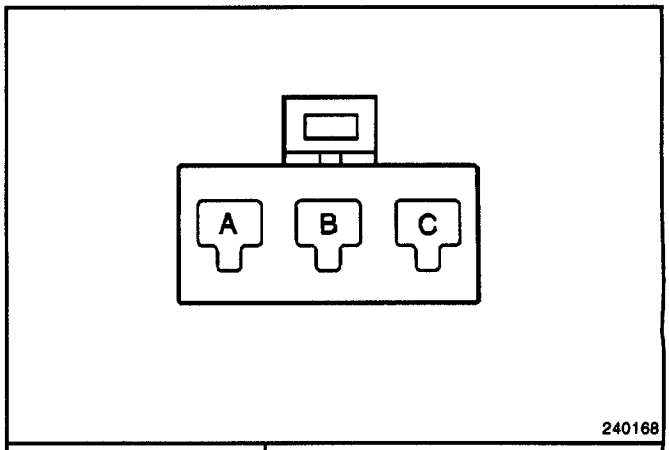
Connector Part Information		• 2 Way M • (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLk	8	Ground
B	BRN	9	Lamp Feed

Clearance Lamps Switch



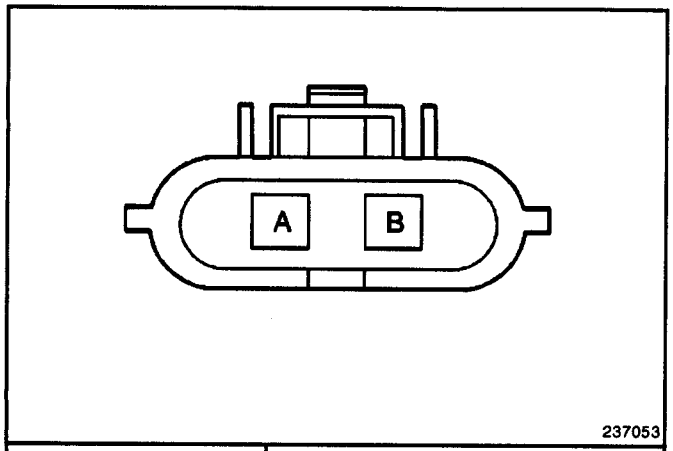
Connector Part Information		• 6 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	GRN	111	Fuse Output Battery
2	ORN	112	Switch Output
3	ORN	113	Switch Telltale Feed
4	BLK	114	Ground
5	BRN	115	Illumination
6	BLK/RED	116	Interior Lamps Dimming Buss

Dome Lamp



Connector Part Information		• 3 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	3	Dome Lamp
B	RED/YEL	2	Dome Lamp
C	ORN	1	Dome Lamp

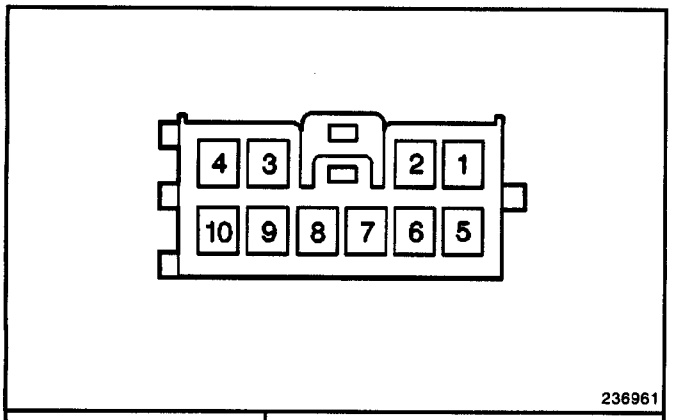
DRL Resistor



237053

Connector Part Information	• 2 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED/YEL	715	Lighting Relay
B	RED/BLK	729	Daytime Running Lamp ON Relay

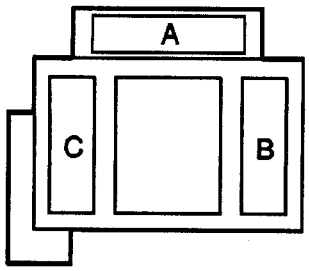
Hazard Flasher



236961

Connector Part Information	• 10 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	LT BLU	136	Front Combination Lamp (Left)
2	WHT	105	Stoplamp Switch (Air)
2	WHT	471	Stoplamp Switch (Hydraulic)
3	BLU	139	Front Combination Lamp, Right
4	GRN	135	Stop and Turn, Right
5	YEL	134	Stop and Turn, Left
6	—	—	Not Used
7	BLU/BLK	132	Turn Signal Input, Left
8	BLU/ORN	133	Turn Signal Input, Right
9	ORN	131	Fuse Output Battery
10	ORN	137	Fuse Output Battery

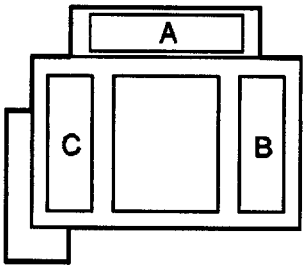
Headlamp, High Beam (Left)



236963

Connector Part Information	• 3 Way M • (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	—	—	Not Used
B	RED/YEL	688	Headlamp
C	BLK/WHT	692	Headlamp High Beam

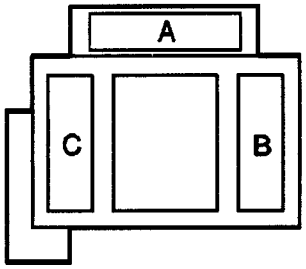
Headlamp (Left)



236963

Connector Part Information	• 3 Way M • (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK/WHT	690	High Beam
B	RED/BLK	691	Lighting Relay Output, Low
C	RED/YEL	689	Headlamp

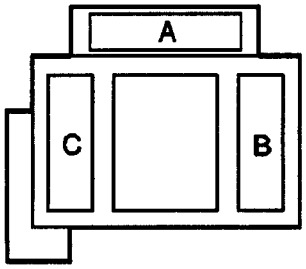
Headlamp, High Beam (Right)



236963

Connector Part Information		• 3 Way M • (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	—	—	Not Used
B	BLK/WHT	698	High Beam
C	RED/WHT	694	Headlamp

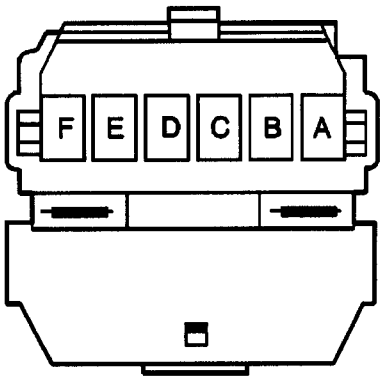
Headlamp (Right)



236963

Connector Part Information		• 3 Way M • (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK/WHT	696	Lighting (High/Low)
B	RED/BLK	697	Low Beam
C	RED/WHT	695	Headlamp

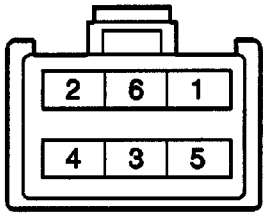
Inverting Driver Module



237093

Connector Part Information		• 12010488 • 6 Way Connector Assembly P/C Edgeboard Standard (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	651	Electronic Control Module Pin-14
B	PNK	654	Fuse Output-Battery
C	WHT	653	Electronic Control Module Pin-23
D	BLK	652	Ground
E–F	—	—	Not Used

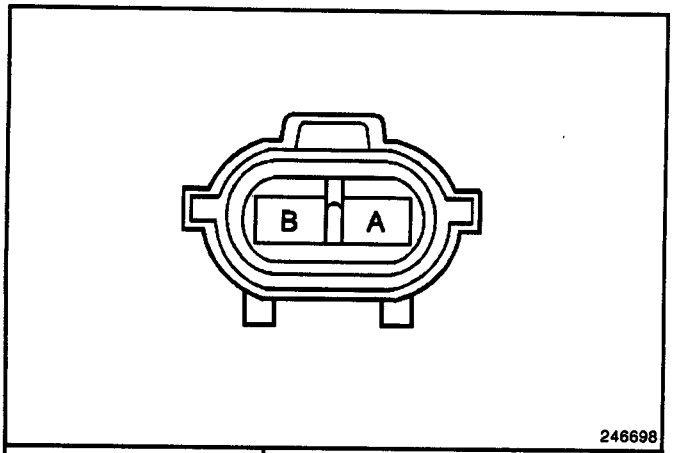
Lighted Mirror Connector Jumper C216



236079

Connector Part Information		• 6 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN	147	Illumination
2-4	—	—	Not Used
5	BRN	147	Illumination
6	—	—	Not Used

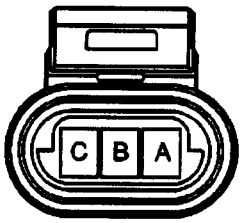
Park Brake Switch, Daytime Running Lamps (Air Brakes)



246698

Connector Part Information	• 2 Way M • (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	744	Daytime Running Lamps (DRL) Off Relay Air Brake
B	BLK	746	Park Brake Switch Air Brake

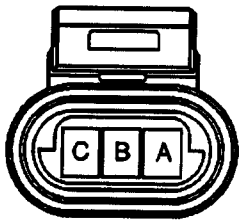
Park/Turn Lamp, Left



73223

Connector Part Information	• 12162182 • ASM 3F M/P 150.2 Series Pull To Seat (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	14	Turn Signal Lamp Feed, Left Front
B	BLK	150	Ground
C	BRN	9	Park Lamp Feed

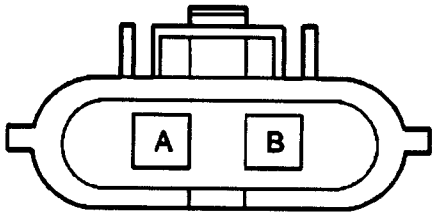
Park/Turn Lamp, Right



73223

Connector Part Information	• 12162182 • ASM 3F M/P 150.2 Series Pull To Seat (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK BLU	15	Turn Signal Lamp Feed, Right Front
B	BLK	150	Ground
C	BRN	9	Park Lamp Feed

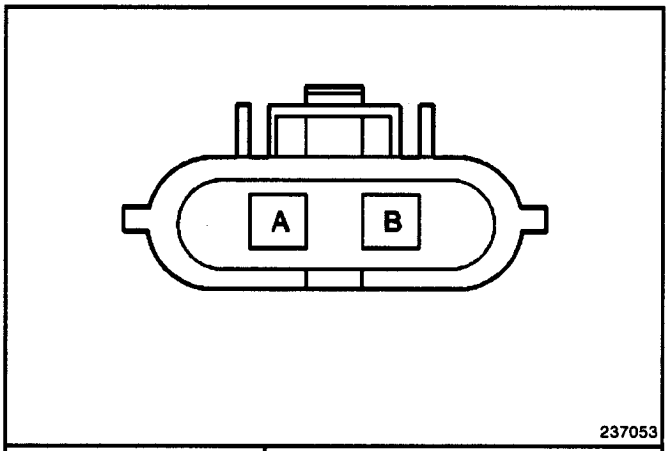
Side Marker Lamp (Typical)



237053

Connector Part Information	• 2 Way F • (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	20	Park Lamp Feed
B	BLK	4	Ground

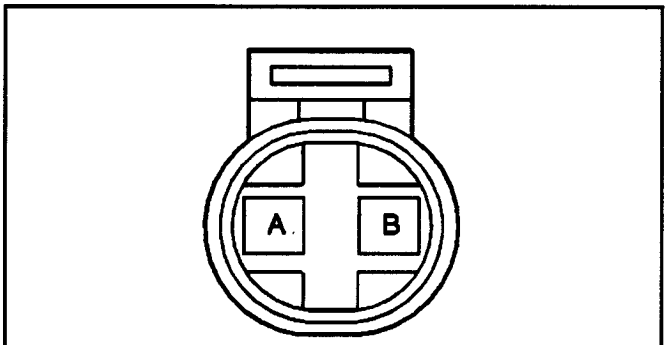
Stoplamp Switch (Air Brakes)



237053

Connector Part Information	• 12065402 • ASM 2F M/P 150 SLD (BRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	103	Stop Lamp Switch
B	WHT	104	Stop Lamp Switch

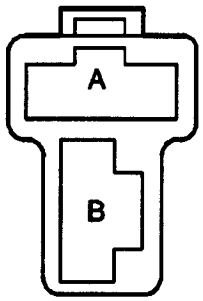
Stoplamp Switch (Air Brakes)



237232

Connector Part Information	• 12065402 • ASM 2F M/P 150 SLD (BRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	106	Stop Lamp Switch
B	WHT	107	Stop Lamp Switch

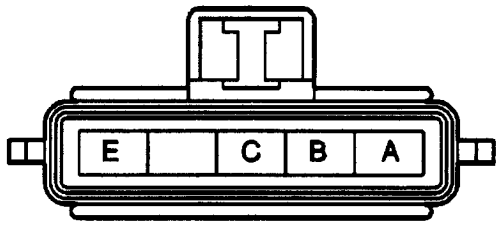
Stop Lamp Switch (Hydraulic)



236009

Connector Part Information	• 2 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WHT	471	Stop Lamp Switch
B	GRN/WHT	470	Stop Lamp Switch

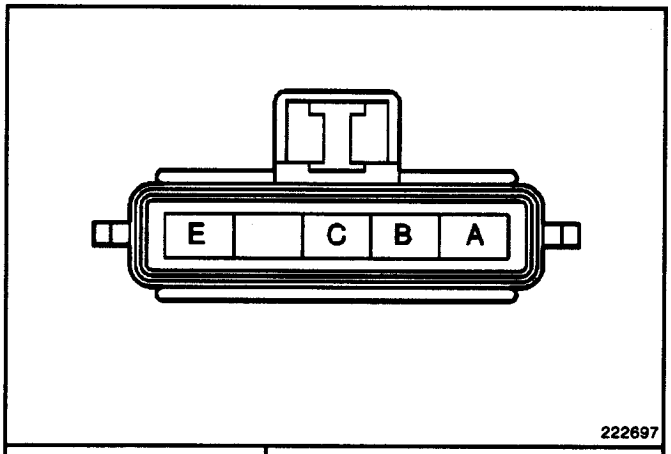
Tail, Stop and Turn Signal Lamp, Left



222697

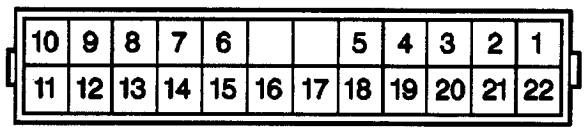
Connector Part Information	• 12065862 • ASM 4F M/P 280 (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN	24	Back Up Lamp Feed
B	BRN	9	Park Lamp Feed
C	YEL	19	Back Up Lamp Feed
D	—	—	Not Used-Sealed
E	BLK	150	Ground

Tail, Stop and Turn Signal Lamp, Right



Connector Part Information		• 12065862 • ASM 4F M/P 280 (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN	24	Back Up Lamp Feed
B	BRN	9	Park Lamp Feed
C	DK GRN	18	Stop/Turn Lamp Feed, Right Rear
D	—	—	Not Used-Sealed
E	BLK	150	Ground

Turn Signal Switch C1



Connector Part Information		• 22 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BLK	87	Ground
2	GRN/WHT	85	Taillamps Relay (Relay Center 1)
3	RED/YEL	721	Lighting (Hi.Low) Relay (Relay Center 1)
4	RED/BLK	717	Lighting Relay (Relay Center 1)
5	BLK	86	Ground
6	BLU/BLK	132	Hazard Flasher Pin–7
7	BLU/ORN	133	Hazard Flasher Pin–8
8–9	—	—	Not Used
10	GRN/RED	170	Horn Relay (Relay Center 2)
11	BRN	83	IP Cluster C1 (Battery)
12	BLU/ORN	453	Washer Pump
13	ORN	84	Fuse Output-Battery
14	RED/BLK	152	Diode (Dome Lamp)
15–22	—	—	Not Used

Diagnostic Information and Procedures

DRL System Check

1. Inspect Circuit Breakers number 6, 14, 15, and 16. If the Circuit Breaker is Open, Locate and Repair the cause of the circuit overload and Replace the Circuit Breaker.
2. Inspect G 105 to make certain that it is clean and tight.
3. Inspect the inoperative lamp for an open or shorted filament. Replace the lamp if it is defective.
4. Inspect the DRL OFF Relay, the DRL ON Relay, the Lighting Relay, Low/High Lighting Relay and the Panel Lamp/DRL Relay, to make certain that they are all tightly connected.
5. Inspect for a broken (or partially broken) conductor inside the insulation which could cause a malfunction but prove GOOD in a system test for continuity or voltage These circuits may be intermittent or resistive, when loaded, and if possible, should be monitored for a voltage drop when the system is placed under load.
6. Inspect for proper installation of aftermarket electronic equipment which might affect the operation of other equipment.

Exterior Lights System Check

1. Inspect the IGNITION MaxiFuse®, Circuit Breakers number 11, 19, 23 (with Hydraulic Brakes) and 25 to determine if any one of them is Open. Locate and Repair the cause of the circuit overload and Replace the MaxiFuse® or Circuit Breaker(s).
2. Inspect grounds G 105, G 107, G 404, G 405 to make certain that they are Clean and Tight.
3. Inspect the exterior lamps to make certain that the filaments are not Open or Shorted. Replace any defective lamps.
4. Inspect the Instrument Cluster Left and Right turn signal lamps to make certain that the filaments are not Open.
5. Inspect for a broken (or partially broken) conductor inside the insulation which could cause a malfunction but prove GOOD in a system test for continuity or voltage These circuits may be intermittent or resistive, when loaded, and if possible, should be monitored for a voltage drop when the system is placed under load.
6. Inspect for proper installation of aftermarket electronic equipment which might affect the operation of other equipment.

Backup Lights System Check

Troubleshooting Hints

1. Inspect the Circuit Breaker and determine the condition. If the Circuit Breaker is Open, Locate and Repair the cause of the overload and Replace the Circuit Breaker.
2. Inspect G 404 to make certain that it is Clean and Tight.
3. If a single lamp does not illuminate, inspect the lamp for an open filament. Replace the lamp if required. Also inspect the lamp socket for corrosion. Clean the socket if required.
4. Adjust or replace the Backup lamp switch if the lamps do not turn off. Refer to Backup Lamp Switch replacement as appropriate.
5. Inspect for a broken (or partially broken) conductor inside the insulation which could cause a malfunction but prove GOOD in a system test for continuity or voltage These circuits may be intermittent or resistive, when loaded, and if possible, should be monitored for a voltage drop when the system is placed under load.
6. Inspect for proper installation of aftermarket electronic equipment which might affect the operation of other equipment.

Interior Lights System Check

Troubleshooting Hints

1. Inspect the Circuit Breaker to determine if it is Open. If the Circuit Breaker is Open, Locate and Repair the cause of the circuit overload and Replace the Circuit Breaker.
2. Inspect the Dome lamp Switch ground to make certain that it is clean and tight.
3. Inspect the lamp filaments to make certain that they are not Open or Shorted. Replace the lamp if required.
4. Inspect for a broken (or partially broken) conductor inside the insulation which could cause a malfunction but prove GOOD in a system test for continuity or voltage These circuits may be intermittent or resistive, when loaded, and if possible, should be monitored for a voltage drop when the system is placed under load.
5. Inspect for proper installation of aftermarket electronic equipment which might affect the operation of other equipment.

Interior Lights Dimming System Check

Troubleshooting Hints

1. Inspect the Circuit Breaker to determine if it is Open. Locate and Repair the cause of the circuit overload if it is open and then Replace the Circuit Breaker.
2. Inspect ground and make certain that it is clean and tight.

3. Inspect the lamp filaments to make certain that they are not Open. Replace the lamp if any is found to be defective.
4. Inspect for a broken (or partially broken) conductor inside the insulation which could cause a malfunction but prove GOOD in a system test for continuity or voltage These circuits may be intermittent or resistive, when loaded, and if possible, should be monitored for a voltage drop when the system is placed under load.
5. Inspect for proper installation of aftermarket electronic equipment which might affect the operation of other equipment.

Backup Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	1. Place the ignition switch in RUN (Engine OFF). 2. Place the transmission gear select lever in REVERSE. Are both backup lamps inoperative?	—	Go to *Step 5*	Go to *Step 2*
2	1. Remove the lens cover from the inoperative lamp. 2. Connect a test lamp from the center terminal of the backup lamp socket to ground. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the open in CKT 150 (BLK) between the inoperative backup lamp and ground. Is the repair complete?	—	System OK	Go to *Step 5*
4	Repair the open in CKT 24 (LT GRN) between Splice S900 and the inoperative backup lamp? Is the repair complete?	—	System OK	Go to *Step 5*
5	1. Remove the lens cover from an inoperative lamp. 2. Connect the test lamp from the center terminal of the backup lamp socket to ground. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 7*
6	Repair the open in CKT 150 (BLK) between the inoperative backup lamp and ground Is the repair complete?	—	System OK	Go to *Step 7*
7	Connect the test lamp from terminal C at connector C402 to ground. Did the test lamp light?	—	Go to *Step 8*	Go to *Step 9*
8	Repair the open in CKT 24 (LT GRN) between C402 and the backup lamps. Is the repair complete?	—	System OK	Go to *Step 9*
9	1. Disconnect the backup lamp switch connector at the transmission. 2. Connect the test lamp from terminal B (Automatic) or terminal C1 (Manual) to chassis ground. Did the test lamp light?	—	Go to *Step 10*	Go to *Step 11*
10	Repair the open in CKT 24 (LT GRN) between the backup lamp switch C402. Is the repair complete?	—	System OK	Go to *Step 11*
11	Connect the test lamp from the backup lamp switch terminal A (Automatic) or terminal C2 (Manual) to chassis ground. Did the test lamp light?	—	Go to *Step 12*	Go to *Step 13*

Backup Lamps Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the backup lamp switch? Is the repair complete?	—	System OK	Go to *Step 13*
13	Connect the test lamp from connector C200 (terminal 22) to ground. Did the test lamp light?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open in CKT 8 or CKT 139 (PNK), or CKT 441 (BRN) between C200 and the backup lamp switch. Is the repair complete?	—	System OK	—
15	Repair the open in CKT 145 (PNK) between the IP fuse block and C200. Is the repair complete?	—	System OK	—

Clearance Lamps Inoperative

Important: If some but not all of the clearance/ID lamps are out and the bulbs have been checked, use the schematics and DVM or the test light in order to check suspect power circuits and ground circuits for opens or poor connections.

Clearance Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the harness connector C208. 2. Connect a test lamp between terminal E and ground in the lower IP harness connector C208. 3. Set the headlamp switch to the PARK position. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminals E and D in the lower IP harness connector C208. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 98 (BRN) between S364 and terminal E in the lower IP harness connector C208. Is the repair complete?	—	System OK	—
4	Repair the open in the roof harness in CKT 5 (BRN) between S365 and terminal E in the roof harness connector, or in CKT 4 (BLK) between S371 and terminal D in the C208 roof harness connector. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 25, CKT 22, CKT 69 or CKT 650 (BLK) between G105 and terminal D in the lower IP harness connector C208. Is the repair complete?	—	System OK	—

Courtesy or Dome Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	1. Remove the dome lamp connector. 2. Connect a test lamp between the dome lamp connector terminal 1 and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the dome lamp assembly. Is the repair complete?	—	System OK	—
3	Locate and repair the open in CKT 1 (ORN) between the dome lamp connector and the circuit breaker #7. Is the repair complete?	—	System OK	—

DRL Headlamps Always On

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to the RUN position. 2. Backprobe the DRL On relay with a test lamp from terminal 86 to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Check for a short to ground in CKT 740 (BRN) between the DRL On relay and the joint connector 2. Is there a short to ground in the circuit?	—	*Go to Step 4*	*Go to Step 5*
3	Replace the DRL On relay. Is the repair complete?	—	System OK	—
4	Repair the short to ground in CKT 740 (BRN) between the DRL On relay and joint connector 2. Is the repair complete?	—	System OK	—
5	Refer to Engine Electrical. Is the repair complete?	—	System OK	—

DRL Indicator Inoperative

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to the RUN position. 2. Move the headlamp switch to the OFF and LO positions. 3. Backprobe the instrument cluster with a test lamp from terminal A7 to ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Backprobe the instrument cluster with a test lamp from terminal A15 to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 1, CKT 58 or CKT 371 between the IP fuse block and the instrument cluster. Does the DRL indicator light?	—	System OK	—
4	Repair or replace the instrument cluster. Does the DRL indicator light?	—	System OK	—
5	Backprobe the panel lamp/DRL relay with a test lamp from terminal 87A to B+. Did the test lamp light?	—	*Go to Step 6*	*Go to Step 7*

DRL Indicator Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
6	Backprobe the panel lamp/DRL relay with a test lamp from terminal 85 to ground. Did the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the open in CKT 22 (BLK) between the panel lamp/DRL relay and G105. Does the DRL indicator light?	—	System OK	—
8	Backprobe the panel lamp/DRL relay with a test lamp from terminal 36 to B+. Did the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
9	Repair the open in CKT 726 (ORN) between the IP fuse block and the panel lamp/DRL relay. Does the DRL indicator light?	—	System OK	—
10	Replace the panel lamp/DRL relay. Does the DRL indicator light?	—	System OK	—
11	Backprobe diode module 2 with a test lamp from terminal 2B to B+. Did the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
12	Repair the open in CKT 718 or CKT 722 (RED/BLK) between the panel lamp/DRL relay and diode module 2. Does the DRL indicator light?	—	System OK	—
13	Is there an open in CKT 723 (RED/YEL) between diode module 2 and S313?	—	*Go to Step 14*	*Go to Step 15*
14	Repair the open in CKT 723 (RED/YEL) between diode module 2 and S313. Is the repair complete?	—	System OK	—
15	Replace diode module 2. Does the DRL indicator light?	—	System OK	—

Dome Lamps Inoperative with LF Door Open

Step	Action	Value(s)	Yes	No
1	1. Disconnect the dome lamp harness connector. 2. Connect a test lamp between terminal 1 and terminal 2 in the dome lamp connector. Does the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Replace the dome lamp assembly. Does the dome lamp operate when the door is open?	—	System OK	Go to *Step 3*
3	1. Do not disconnect the test lamp. Remove diode module D202 from joint connector 1 (upper). 2. Connect a jumper between terminal 1J and terminal 1H in the joint connector socket. Does the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
4	Replace diode module D202. Does the dome lamp operate when the door is open?	—	System OK	Go to *Step 5*
5	1. Do not disconnect the test lamp or the jumper. Disconnect the harness connector from the door switch. 2. Connect a jumper between the door switch connector and chassis ground. Does the test lamp light?	—	Go to *Step 6*	Go to *Step 7*

Dome Lamps Inoperative with LF Door Open (cont'd)

Step	Action	Value(s)	Yes	No
6	Replace the door switch. Does the dome lamp operate when the door is open?	—	System OK	—
7	Locate and repair the open in one or more of the following circuits between the dome lamp switch and the door switch: • CKT 2 (RED/YEL) • CKT 149 (RED/YEL) • CKT 26 (RED/BLK) • CKT 148 (RED/BLK) Does the dome lamp operate when the door is open?	—	System OK	—

Hazard Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	1. Turn the hazard switch to the ON position. 2. Disconnect the harness connector from the turn/hazard flasher. 3. Connect a self powered test lamp between terminal 8 and ground. 4. Connect a self powered test lamp between terminal 7 and ground. Does the test lamp light for both checks?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the turn/hazard flasher. Is the repair complete?	—	System OK	—
3	Replace the turn signal/hazard switch. Is the repair complete?	—	System OK	—

Headlamps Inoperative - Left Low Beam

Step	Action	Value(s)	Yes	No
1	Backprobe the left headlamp with a fused jumper from terminal B to ground. Does the headlamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Repair the open in CKT 691 (RED/BLK) between the left headlamp and S315. Does the headlamp light?	—	System OK	—
3	Replace the left headlamp. Does the headlamp light?	—	System OK	—

Headlamps Inoperative - Right Low Beam

Step	Action	Value(s)	Yes	No
1	Backprobe the right headlamp with a fused jumper from terminal B to ground. Does the headlamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Repair the open in CKT 697 (RED/BLK) between the right headlamp and S315. Does the right headlamp light?	—	System OK	—
3	Replace the right headlamp. Does the right headlamp light?	—	System OK	—

Headlamps Inoperative - Low Beams (DRL Off)

Step	Action	Value(s)	Yes	No
1	1. Place the headlamp switch in the HEAD and LO positions. 2. Backprobe the headlamp switch with a test lamp from terminal 1 to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Backprobe the headlamp switch with a test lamp from terminal 4 to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 87 (BLK) between the headlamp switch and G105. Do the headlamps light?	—	System OK	—
4	Backprobe the lighting relay with a test lamp from terminal 86 to B+. Did the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Replace the headlamp switch. Do the headlamps light?	—	System OK	—
6	Backprobe the lighting relay with a test lamp from terminal 85 to ground. Did the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the open in CKT 717 (RED/BLK) between the lighting relay and the headlamp switch. Do the headlamps light?	—	System OK	—
8	Backprobe the lighting relay with a test lamp from terminal 87 to B+. Did the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
9	Repair the open in CKT 727 (ORN) between the IP fuse block and the lighting relay. Do the headlamps light?	—	System OK	—
10	Backprobe the lighting relay with a test lamp from terminal 30 to B+. Did the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
11	Backprobe the low/high lighting relay with a test lamp from terminal 30 to B+. Did the test lamp light?	—	*Go to Step 14*	*Go to Step 15*
12	Repair the open in CKT 691 (RED/BLK) between S315 and the lighting relay. Do the headlamps light?	—	System OK	—
13	Replace the lighting relay. Do the headlamps light?	—	System OK	—
14	Backprobe the low/high lighting relay with a test lamp from terminal 86 to B+. Did the test lamp light?	—	*Go to Step 16*	*Go to Step 17*
15	Repair the open in CKT 720 (BLK) between the low/high lighting relay and G105. Do the headlamps light?	—	System OK	—
16	Repair the short to ground in CKT 721 (RED/YEL) between the low/high lighting relay, diode module 2, the instrument cluster, and the headlamp switch. Do the headlamps light?	—	System OK	—

Headlamps Inoperative - Low Beams (DRL Off) (cont'd)

Step	Action	Value(s)	Yes	No
17	Backprobe the low/high lighting relay with a test lamp from terminal 87A to B+. Did the test lamp light?	—	*Go to Step 18*	*Go to Step 19*
18	Repair the open in CKT 716 (YEL) between the lighting relay and the low/high lighting relay. Do the headlamps light?	—	System OK	—
19	Replace the low/high lighting relay. Do the headlamps light?	—	System OK	—

Headlamps Inoperative - Low Beams (During DRL Operation)

Step	Action	Value(s)	Yes	No
1	Is the vehicle equipped with hydraulic brakes instead of air brakes?	—	Go to *Step 2*	Go to*Step 8*
2	Backprobe the park brake switch with a test lamp from terminal 4 to B+. Does the test lamp light?	—	Go to *Step 4*	Go to *Step 3*
3	Locate and repair the open in CKT 6 and CKT 27 (BLK) between the park brake switch and G105. Do the low beam filaments light during DRL operation?	—	System OK	Go to *Step 4*
4	1. Backprobe the park brake switch with a test lamp from terminal 2 to B+. 2. Disengage the park brake. Does the test lamp light?	—	Go to *Step 6*	Go to *Step 5*
5	Replace the park brake switch. Do the low beam filaments light during DRL operation?	—	System OK	Go to *Step 6*
6	Backprobe the DRL OFF relay with a test lamp from terminal 86 to B+. Does the test lamp light?	—	Go to *Step 14*	Go to*Step 7*
7	Locate and repair the open in CKT 5 and CKT 745 (BLU) between the DRL OFF relay and the park brake switch. Do the low beam filaments light during DRL operation?	—	System OK	Go to *Step 14*
8	Backprobe the park brake switch with a test lamp from terminal B to B+. Does the test lamp light?	—	Go to *Step 10*	Go to *Step 9*
9	Locate and repair the open in CKT 746 (BLK) between the park brake switch and G105. Do the low beam filaments light during DRL operation?	—	System OK	—
10	1. Backprobe the park brake switch with a test lamp from terminal A to B+. 2. Disengage the park brake. Does the test lamp light?	—	Go to *Step 12*	Go to *Step 11*
11	Replace the park brake switch. Do the low beam filaments light during DRL operation?	—	System OK	—
12	Backprobe the DRL OFF relay with a test lamp from terminal 86 to B+. Does the test lamp light?	—	Go to *Step 14*	Go to *Step 13*
13	Locate and repair the open in CKT 744 (LT BLU) between the DRL OFF relay and the park brake switch. Do the low beam filaments light during DRL operation?	—	System OK	—

Headlamps Inoperative - Low Beams (During DRL Operation) (cont'd)

Step	Action	Value(s)	Yes	No
14	1. Turn the ignition switch to the RUN position. 2. Backprobe the DRL OFF relay with a test lamp from terminal 85 to chassis ground. Does the test lamp light?	—	Go to *Step 16*	Go to *Step 15*
15	Locate and repair the open in CKT 743 (BRN) between the IP fuse block and the DRL OFF relay. Do the low beam filaments light during DRL operation?	—	System OK	—
16	Backprobe the DRL OFF relay with a test lamp from terminal 87 to B+. Does the test lamp light?	—	Go to *Step 18*	Go to *Step 17*
17	Locate and repair the open in CKT 742 (BLK) between the DRL OFF relay and G105. Do the low beam filaments light during DRL operation?	—	System OK	—
18	Backprobe the DRL OFF relay with a test lamp from terminal 30 to B+. Does the test lamp light?	—	Go to *Step 20*	Go to *Step 19*
19	Replace the DRL OFF relay. Do the low beam filaments light during DRL operation?	—	System OK	—
20	Backprobe the DRL ON relay with a test lamp from terminal 87A to B+. Does the test lamp light?	—	Go to *Step 22*	Go to *Step 21*
21	Repair the open in CKT 744 (DK GRN) between the DRL ON relay and the DRL OFF relay. Do the low beam filaments light during DRL operation?	—	System OK	—
22	1. Start the engine. 2. Backprobe the DRL ON relay with a test lamp from terminal 86 to B+. Does the test lamp light?	—	Go to *Step 23*	Go to *Step 26*
23	Inspect for a short to ground in CKT 740 (BRN) between the DRL ON relay and joint connector 2. Is the circuit in need of repair?	—	Go to *Step 24*	Go to *Step 25*
24	Repair the short to ground in CKT 740 (BRN) between the DRL ON relay and joint connector 2. Do the low beam filaments light during DRL operation?	—	System OK	—
25	Refer to Engine Electrical in order to diagnose the charging/generator system. Perform repairs as necessary. Do the low beam filaments light during DRL operation?	—	System OK	—
26	1. Stop the engine. 2. Turn the ignition switch to the RUN position. 3. Backprobe the DRL ON relay with a test lamp from terminal 85 to chassis ground. Does the test lamp light?	—	Go to*Step 28*	Go to *Step 27*
27	Locate and repair the open in CKT 739 (BRN) between the IP fuse block and the DRL ON relay. Do the low beam filaments light during DRL operation?	—	System OK	—
28	Backprobe the DRL ON relay with a test lamp from terminal 30 to B+. Does the test lamp light?	—	Go to *Step 30*	Go to *Step 29*
29	Replace the DRL ON relay. Do the low beam filaments light during DRL operation?	—	System OK	—

Headlamps Inoperative - Low Beams (During DRL Operation) (cont'd)

Step	Action	Value(s)	Yes	No
30	Backprobe the DRL series dropping resistor with a test lamp from terminal A to B+. Does the test lamp light?	—	Go to *Step 32*	Go to *Step 31*
31	Locate and repair the open in CKT 729 (RED/BLK) between the DRL series dropping resistor and the DRL ON relay. Do the low beam filaments light during DRL operation?	—	System OK	—
32	1. Disconnect the DRL series dropping resistor. 2. Connect a fused jumper from the DRL series dropping resistor connector terminal A to B. Do the low beam filaments light?	—	Go to *Step 33*	Go to *Step 34*
33	Replace the DRL series dropping resistor. Do the low beam filaments light during DRL operation?	—	System OK	—
34	Do not disconnect the jumper. Backprobe the lighting relay with a test lamp from terminal 87A to B+. Does the test lamp light?	—	Go to *Step 36*	Go to*Step 35*
35	Locate and repair the open in CKT 715 (RED/YEL) between the lighting relay and the DRL series dropping resistor. Do the low beam filaments light during DRL operation?	—	System OK	—
36	Replace the lighting relay. Do the low beam filaments light during DRL operation?	—	System OK	—

Headlamps - Low Beams On with Headlamp Switch Off (DRL Off)

Step	Action	Value(s)	Yes	No
1	Disconnect the headlamp switch. Did the headlamps turn off?	—	*Go to Step 3*	*Go to Step 2*
2	Backprobe the lighting relay with a test lamp from terminal 86 to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Replace the headlamp switch. Is the repair complete?	—	System OK	—
4	Repair the short to ground in CKT 717 or CKT 718 (RED/BLK) between the headlamp switch, diode module 2, and the lighting relay. Did the headlamps turn off?	—	System OK	—
5	Disconnect the lighting relay. Did the headlamps turn off?	—	*Go to Step 6*	*Go to Step 7*
6	Connect a test lamp from lighting relay connector terminal 87A to B+. Did the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the short to ground in CKT 691 or CKT 697 (RED/BLK) between the left headlamp, the right headlamp, and the lighting relay. Did the headlamps turn off?	—	System OK	—
8	Disconnect the DRL Off relay. Did the headlamps turn off?	—	*Go to Step 10*	*Go to Step 11*
9	Replace the lighting relay. Did the headlamps turn off?	—	System OK	—

Headlamps - Low Beams On with Headlamp Switch Off (DRL Off) (cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the DRL Off relay. Did the headlamps turn off?	—	System OK	—
11	Disconnect the DRL On relay. Did the headlamps turn off?	—	*Go to Step 12*	*Go to Step 13*
12	Repair the short to ground in CKT 744 (DK GRN) between the DRL Off relay and the DRL On relay. Did the headlamps turn off?	—	System OK	—
13	Disconnect the DRL series dropping resistor. Did the headlamps turn off?	—	*Go to Step 14*	*Go to Step 15*
14	Inspect for a short to ground in CKT 729 (RED/BLK) between the DRL series dropping register and the DRL on relay. Is the connection OK?	—	*Go to Step 16*	*Go to Step 17*
15	Repair the short to ground in CKT 715 (RED/YEL) between the lighting relay and the DRL series dropping resister. Did the headlamps turn off?	—	System OK	—
16	Replace the DRL series dropping resistor. Did the headlamps turn off?	—	System OK	—
17	Repair the connection. Is the repair complete?		System OK	—

Headlamps - Low Beams On with Headlamp Switch Off (During DRL Operation)

Step	Action	Value(s)	Yes	No
1	1. Disconnect the lighting relay. 2. Backprobe the headlamp switch with a test lamp from terminal 4 to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Inspect for a short to ground in CKT 717 (RED/BLK) between the lighting relay and the headlamp switch. Does a short to ground exist?	—	*Go to Step 4*	*Go to Step 5*
3	1. Connect the lighting relay. 2. Disconnect the DRL series dropping register. 3. Start the engine. 4. Disengage the park brake. Are the headlamps lit?	—	*Go to Step 6*	*Go to Step 7*
4	Repair the short to ground in CKT 717 (RED/BLK) between the lighting relay and the headlamp switch. Is the repair complete?	—	System OK	—
5	Replace the headlamp switch. Is the repair complete?	—	System OK	—
6	Inspect for a short to ground in CKT 715 (RED/YEL) between the lighting relay and the DRL series dropping register. Does a short to ground exist?	—	*Go to Step 8*	*Go to Step 9*
7	Replace the DRL series dropping resistor. Is the repair complete?	—	System OK	—

Headlamps - Low Beams On with Headlamp Switch Off (During DRL Operation) (cont'd)

Step	Action	Value(s)	Yes	No
8	Repair the short to ground in CKT 715 (RED/YEL) between the lighting relay and the DRL series dropping register. Is the repair complete?	—	System OK	—
9	Replace the lighting relay. Is the repair complete?	—	System OK	—

Headlamps Inoperative - Left High Beam (Filament)

Step	Action	Value(s)	Yes	No
1	Backprobe the left headlamp with a test lamp from terminal A to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the left headlamp. Did the headlamp light?	—	System OK	—
3	Repair the open in CKT 690 or CKT 696 (BLK/WHT) between the left headlamp and S317. Did the headlamp light?	—	System OK	—

Headlamps Inoperative - Left High Beam (Headlamp)

Step	Action	Value(s)	Yes	No
1	Backprobe the left HI beam headlamp with a test lamp from terminal B to ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Backprobe the left HI beam headlamp with a test lamp from terminal C to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 688 (RED/YEL) between S229 and the left HI beam headlamp. Did the headlamp light?	—	System OK	—
4	Replace the HI beam headlamp. Did the headlamp light?	—	System OK	—
5	Repair the open in CKT 692 or CKT 696 (BLK/WHT) between the left HI beam headlamp and S317. Did the headlamp light?	—	System OK	—

Headlamps Inoperative - Right High Beam (Filament)

Step	Action	Value(s)	Yes	No
1	Backprobe the right headlamp with a test lamp from terminal A to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the right headlamp. Did the headlamp light?	—	System OK	—
3	Repair the open in the CKT 696 (BLK/WHT) between the right headlamp and S317. Did the headlamp light?	—	System OK	—

Headlamps Inoperative - Right High Beam (Headlamp)

Step	Action	Value(s)	Yes	No
1	Backprobe the right HI beam headlamp with a test lamp from terminal C to ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Backprobe the right HI beam headlamp from terminal B to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 695 (BLK/WHT) between S230 and the right HI beam headlamp. Did the headlamp light?	—	System OK	—
4	Replace the right HI beam headlamp. Did the headlamp light?	—	System OK	—
5	Repair the open in the CKT 698 (BLK/WHT) between the right HI beam headlamp and S317. Did the headlamp light?	—	System OK	—

Headlamps Inoperative - High Beams

Step	Action	Value(s)	Yes	No
1	Backprobe the headlamp switch with a test lamp from terminal 1 to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Backprobe the headlamp switch with a test lamp from terminal 3 to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 87 (BLK) between the headlamp switch and G105. Do the headlamps light?	—	System OK	—
4	Backprobe the low/high lighting relay with a test lamp from terminal 36 to B+. Did the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Replace the headlamp switch. Do the headlamps light?	—	System OK	—
6	Backprobe the low/high lighting relay with a test lamp from terminal 85 to ground. Did the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the open in CKT 721 (RED/YEL) between the low/high lighting relay and the headlamp switch. Do the headlamps light?	—	System OK	—
8	Backbrobe the low/high lighting relay with a test lamp from terminal 30 to B+. Did the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
9	Repair the open in CKT 719 (ORN) between the IP fuse block and the low/high lighting relay. Do the headlamps work?	—	System OK	—
10	Backprobe the low/high lighting relay with a test lamp from terminal 87 to B+. Did the test lamp light?	—	*Go to Step 12*	*Go to Step 13*

Headlamps Inoperative - High Beams (cont'd)

Step	Action	Value(s)	Yes	No
11	Repair the open in CKT 720 (BLK) between low/high lighting relay and G105. Do the headlamps light?	—	System OK	—
12	Repair the open in CKT 696 (BLK/WHT) between S317 and the low/high lighting relay. Do the headlamps light?	—	System OK	—
13	Replace the low/high lighting relay. Do the headlamps light?	—	System OK	—

Headlamps Inoperative - Flash to Pass

Step	Action	Value(s)	Yes	No
1	Backprobe the headlamp switch with a test lamp from terminal 5 to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the headlamp switch. Is the repair complete?	—	System OK	—
3	Repair the open in CKT 86 (BLK) between the headlamp switch and G105. Is the repair complete?	—	System OK	—

Headlamps Inoperative - One Lamp (Left)

Step	Action	Value(s)	Yes	No
1	Backprobe the left headlamp with a test lamp from terminal C to ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the left headlamp. Do the headlamps light?	—	System OK	—
3	Repair the open in CKT 689 or CKT 688 (RED/WHT) between the IP fuse block and the left headlamp. Do the headlamps light?	—	System OK	—

Headlamps Inoperative - One Lamp (Right)

Step	Action	Value(s)	Yes	No
1	Backprobe the right headlamp with a test lamp from terminal C to ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the right headlamp. Do the headlamps light?	—	System OK	—
3	Repair the open in CKT 694 or CKT 695 (RED/WHT) between the IP fuse block and the left headlamp. Do the headlamps light?	—	System OK	—

Headlamps, DRL On with Engine Not Running

Step	Action	Value(s)	Yes	No
Definition: DRL Does Not Disengage When Engine is Not Running.				
1	1. Place the ignition switch in the RUN position. 2. Backprobe the DRL ON relay with a test lamp from terminal 86 to B+. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Repair the short to ground in CKT 740 (BRN) between the DRL ON relay and the generator? Is the repair complete?	—	System OK	—
3	Replace the DRL ON relay. Does the DRL disengage when the engine is not runing?	—	System OK	—

High Beam Indicator Inoperative

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to the RUN position. 2. Place the headlamp switch in the HI position. 3. Backprobe the instrument cluster with a test lamp from terminal A6 to ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Backprobe the instrument cluster with a test lamp from terminal A14 to B+. Did the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 1 or CKT 371 (BRN) between the IP fuse block and the instrument cluster. Does the HI beam indicator light?	—	System OK	—
4	Repair or replace the instrument cluster. Does the HI beam indicator light?	—	System OK	—
5	Backprobe the headlamp switch with a test lamp from terminal 3 to B+. Did the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Repair the open in CKT 14 or CKT 82 (RED/YEL) between the instrument cluster and the headlamp switch. Does the HI beam indicator light?	—	System OK	—
7	Backprobe the headlamp switch with a test lamp from terminal 5 to B+. Did the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
8	Backprobe the headlamp switch with a test lamp from terminal 1 to B+. Did the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
9	Repair the open in CKT 86 (BLK) between the headlamp switch and G105. Does the HI beam indicator light?	—	System OK	—
10	Replace the headlamp switch. Does the HI beam indicator light?	—	System OK	—
11	Repair the open in CKT 87 (BLK) between the headlamp switch and G105. Does the HI beam indicator light?	—	System OK	—

Instrument Panel Lamps Inoperative (Dimming Lamps Inoperative)

Step	Action	Value(s)	Yes	No
1	Place the headlamp switch in the PARK position. Are the tail lamps ON?	—	Go to *Step 11*	Go to *Step 2*
2	1. Remove the taillamp relay from the socket. 2. Connect a DVM between socket terminal 85 and ground. Does the DVM indicate voltage?	—	Go to *Step 4*	Go to *Step 3*
3	Locate and repair the open in CKT 93 (ORN) to the tail lamp relay. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 4*	System OK
4	Connect an ohmmeter between socket terminal 86 and chassis ground. Did the ohmmeter indicate continuity?	—	Go to *Step 5*	Go to *Step 6*
5	Replace the tail lamp relay. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 6*	System OK
6	Connect an ohmmeter between headlamp switch terminal 2 and chassis ground. Did the ohmmeter indicate continuity?	—	Go to *Step 7*	Go to *Step 8*
7	Locate and repair the open in CKT 85 (GRN/WHT). Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 8*	System OK
8	Connect an ohmmeter between headlamp switch terminal 1 and chassis ground. Did the ohmmeter indicate continuity?	—	Go to *Step 10*	Go to *Step 9*
9	Locate and repair the open in the ground wire 4 (BLK) between G105 and terminal 1 in the headlamp switch. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 11*	System OK
10	Replace the headlamp switch. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 11*	System OK
11	1. Turn the headlamp illumination control counter clockwise to the dimmest position. 2. Remove the buss connector from joint connector 3 (upper). 3. Connect a test lamp between terminal A and chassis ground. Does the test lamp light?	—	Go to *Step 12*	Go to *Step 13*
12	Replace joint connector 3 (upper) buss connector. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 13*	System OK
13	1. Connect a jumper between terminal A in the joint connector 3 (upper) connector. 2. Disconnect the 17-way harness connector from the IP cluster. 3. Connect a self-powered test lamp between terminal C2 in the 17-way IP cluster harness connector and chassis ground. Does the test lamp light?	—	Go to *Step 15*	Go to *Step 14*
14	Repair the open in CKT 3 (BLK/RED) between terminal A in the joint connector 3 (upper) connector and terminal C2 in the 17-way IP cluster harness connector. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 15*	System OK
15	Connect a test lamp between terminal C1 in the 17-way IP cluster harness connector and chassis ground. Does the test lamp light?	—	Go to *Step 17*	Go to *Step 16*

Instrument Panel Lamps Inoperative (Dimming Lamps Inoperative) (cont'd)

Step	Action	Value(s)	Yes	No
16	Repair the open in CKT 2 (BRN) between S272 and terminal C1 in the 17-way IP cluster harness connector. Are the instrument panel dimming lamps still inoperative?	—	Go to *Step 17*	System OK
17	1. Disconnect the 15-way IP cluster harness connector. 2. Connect a test lamp between terminal A9 in the 15-way IP cluster harness connector and terminal C1 in the 17-way IP cluster harness connector. Does the test lamp light?	—	Go to *Step 18*	Go to *Step 19*
18	Replace the IP cluster. Are the instrument panel dimming lamps still inoperative?	—	—	System OK
19	Locate and repair the open in the ground wire 4 (BLK) between G105 and terminal A9 in the 15-way IP cluster harness connector. Are the instrument panel dimming lamps still inoperative?	—	—	System OK

Instrument Panel Lamps Inoperative (Always at Full Brightness)

Step	Action	Value(s)	Yes	No
1	1. Set the headlamp switch to the OFF position. 2. Disconnect the 17-way IP cluster harness connector. 3. Remove the buss connector from joint connector 3 (upper). 4. Using a self-powered test lamp connected to chassis ground, probe each terminal inside joint connector 3 (upper). Does the test lamp light in any probed joint connector terminal?	—	Go to *Step 2*	Go to *Step 3*
2	Locate and repair the short to ground in the affected circuit. Does the illumination control dim the instrument panel lamps?	—	System OK	—
3	Replace the IP Cluster. Does the illumination control dim the instrument panel lamps?	—	System OK	—

License and Tail Lamps Inoperative (License and Tail Lamps)

Step	Action	Value(s)	Yes	No
1	1. Disconnect the harness connector from the right tail stop/turn lamp assembly. 2. Set the headlamp switch to the PARK position. 3. Connect a test lamp between terminal B on the right tail stop/turn lamp harness connector and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminals B and E on the right tail stop/turn lamp harness connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*

License and Tail Lamps Inoperative (License and Tail Lamps) (cont'd)

Step	Action	Value(s)	Yes	No
3	Repair the open CKT 9 (BRN) between S901 and terminal B in the right tail stop/turn lamp harness connector. Is the repair complete?	—	System OK	—
4	Repair the open in the right park/turn lamp assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 150 (BLK) between S400 and terminal E in the right tail stop/turn lamp harness connector. Is the repair complete?	—	System OK	—

License and Tail Lamps Inoperative (Left Rear Taillamp Inoperative)

Step	Action	Value(s)	Yes	No
Definition: Left Rear Taillamp Is Inoperative.				
1	1. Disconnect the harness connector from the Left Rear Stop and Turn Lamp assembly. 2. Set the Headlamp Switch to the PARK position. 3. Connect a test lamp between terminal B on the Left Rear Stop and Turn Lamp harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminals B and terminal E on the Left Rear Stop and Turn Lamp harness connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 9 (BRN) between S 901 and terminal B in the Left Rear Stop and turn Lamp Harness Connector. Is the repair complete?	—	System OK	—
4	Repair the open in the Left Rear Park and Turn Lamp assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 150 (BLK) between S 400 and terminal E in the Left Rear Stop and Turn Lamp Harness Connector. Is the repair complete?	—	System OK	—

License and Tail Lamps Inoperative (Both Taillamps Inoperative)

Step	Action	Value(s)	Yes	No
Definition: Both Rear Taillamps are Inoperative.				
1	1. Disconnect the harness connector C 402. 2. Set the Headlamp Switch to the PARK position. 3. Connect a test lamp between terminal A in the C 402 Front Chassis Harness Connector and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	1. Disconnect the harness connector from the Right Rear Stop and Turn Lamp assembly. 2. Connect a self powered test lamp between terminal B in the Right Tail Stop and Turn Lamp Harness Connector and terminal A in C 402, the Rear Chassis Harness Connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 9 (BRN) between S 126 and terminal A in C 402, the Front Chassis Harness Connector. Is the repair complete?	—	System OK	—
4	Repair the open in CKT 150 (BLK) between S 400 and G 404. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 9 (BRN) between S 901 and terminal A in C 402, the Rear Chassis Harness Connector. Is the repair complete?	—	System OK	—

Park Lamps Inoperative - Front

Step	Action	Value(s)	Yes	No
1	1. Disconnect the harness connector C105. 2. Set the headlamp switch to the PARK position. 3. Connect a test lamp between terminal A in the C105 front chassis harness connector and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminals A and D on the C105 front chassis harness connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 9 (BRN) between S126 and terminal A in the C105 front chassis harness connector. Is the repair complete?	—	System OK	—
4	1. Disconnect the harness connector from the right front park/turn lamp assembly. 2. Connect a self powered test lamp between terminal B in the right front park/turn lamp harness connector and terminal D in the C105 front turn signal harness connector. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Repair the open in CKT 150 (BLK) between G107 and terminal D in the front chassis harness connector C105. Is the repair complete?	—	System OK	—

Park Lamps Inoperative - Front (cont'd)

Step	Action	Value(s)	Yes	No
6	Repair the open in CKT 150 (BLK) between S105 and terminal D in the front turn signal harness connector C105. Is the repair complete?	—	System OK	—
7	Repair the open in CKT 9 (BRN) between S102 and terminal A in the front turn signal harness connector. Is the repair complete?	—	System OK	—

Park Lamp Inoperative - LF

Step	Action	Value(s)	Yes	No
Definition: Left Front Park Lamp Inoperative.				
1	1. Disconnect the harness connector from the Left park and turn lamp assembly. 2. Set the Headlamp Switch to PARK. 3. Connect a test lamp between terminal C on the Left park and turn lamp harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminal C and terminal B on the Left park and turn lamp harness connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open CKT 9 (BRN) between S 102 and terminal C in the Left park and turn lamp harness connector. Is the repair complete?	—	System OK	—
4	Repair the open in Left park and turn lamp assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 150 (BLK) between S 105 and terminal B in the left park and turn lamp harness connector. Is the repair complete?	—	System OK	—

Park Lamp Inoperative - RF

Step	Action	Value(s)	Yes	No
Definition: Right Front Park Lamp Inoperative.				
1	1. Disconnect the harness connector from the right park and turn lamp assembly. 2. Set the Headlamp Switch to PARK. 3. Connect a test lamp between terminal C on the right park and turn lamp harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminal C and terminal B on the right park and turn Lamp harness connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 9 (BRN) (9) between S 102 and terminal C in the right park and turn lamp harness connector. Is the repair complete?	—	System OK	—

Park Lamp Inoperative - RF (cont'd)

Step	Action	Value(s)	Yes	No
4	Repair the open in Right park and turn Lamp assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 150(BLK) between S 105 and terminal B in the right park and turn lamp harness connector. Is the repair complete?	—	System OK	—

Park, Side, and Front Marker Lamps Inoperative

Step	Action	Value(s)	Yes	No
Definition: All Park Lamps, Side and Front Marker Lamps Are Inoperative (Tractor)				
1	1. Remove the taillamp relay. 2. Connect a test lamp between terminal 85 in the taillamp relay socket and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Repair the open in CKT 91 (GRN) between S289 and S232. Is the repair complete?	—	System OK	—
3	Repair the open in CKT 91 (GRN) between S232 and Circuit Breaker #19. Is the repair complete?	—	System OK	—

Park, Side Marker, and Clearance Lamps Always On

Step	Action	Value(s)	Yes	No
Definition: Park, Side Marker and Clearance Lamps Are always On (Trailer Only)				
1	1. Place the Headlamp switch in the OFF position. 2. Remove the Taillamp Relay from the relay socket. Do the side marker and clearance lamps remain ON?	—	*Go to Step 2*	*Go to Step 3*
2	Locate and repair the short to voltage in CKT 94 (BRN) connected to terminal 87 in the Taillamp relay socket. Is the repair complete?	—	System OK	—
3	Connect a test lamp between terminal 86 and terminal 85 in the Taillamp relay socket. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	1. Keep the test lamp connected. 2. Disconnect the harness connector from the Headlamp Switch Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Replace the Taillamp Relay. Is the repair complete?	—	System OK	—
6	Repair the short to ground in the CKT 85 (GRN/WHT) between terminal 2 in the headlamp switch harness connector and terminal 86 in the Taillamp Relay socket. Is the repair complete?	—	System OK	—
7	Replace the headlamp Switch. Is the repair complete?	—	System OK	—

Park, Side Marker, and Clearance Lamps Inoperative

Step	Action	Value(s)	Yes	No
Definition: All Park, Side Marker and Clearance Lamps Are Inoperative (Trailers).				
1	1. Place the headlamp switch in the PARK position. 2. Remove the taillamp relay. 3. Connect a test lamp between terminal 85 and terminal 86 in the taillamp relay socket. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminal 30 and terminal 86 in the taillamp relay socket. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Connect a test lamp between the taillamp relay socket terminal 85 and the chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
4	Connect a test lamp between terminal 30 and terminal 87 in the taillamp relay socket. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
5	Repair the open CKT 91 (ORN) between terminal 30 in the taillamp relay socket and S232. Is the repair complete?	—	System OK	—
6	1. Keep the headlamp switch in PARK. 2. Connect a self powered test lamp between terminal 86 in the taillamp relay socket and the chassis ground. Does the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
7	Repair the open in CKT 91 or CKT 93 (ORN) between Circuit Breaker #19 and the taillamp relay socket terminal 85. Is the repair complete?	—	System OK	—
8	Replace the taillamp relay. Is the repair complete?	—	System OK	—
9	Repair the open in CKT 94 (BRN) between S321 and the taillamp relay socket terminal 87. Is the repair complete?	—	System OK	—
10	Replace the Taillamp Relay. Is the repair complete?	—	System OK	—
11	1. Disconnect the headlamp switch harness connector. 2. Connect a self powered test lamp between terminal 2 on the headlamp switch connector and terminal 86 in the taillamp relay socket. Does the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
12	Replace the Headlamp Switch. Is the repair complete?	—	System OK	—
13	Repair the open CKT 85 (GRN/WHT) between terminal 2 in the Headlamp Switch and terminal 86 in the taillamp relay socket. Is the repair complete?	—	System OK	—

Rearview Mirror Lamps Inoperative - Outside (Both Mirrors)

Step	Action	Value(s)	Yes	No
1	1. Set the headlamp switch to the PARK position. 2. Connect a test light between terminal A in the interior body builder connector and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	1. Disconnect the harness connector C212. 2. Connect a self powered test light between terminals E1 and E2 in the upper IP harness connector C212. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 95 (BRN) between S319 and S320. Is the repair complete?	—	System OK	—
4	Repair the open in CKT 342 (ORN) between S342 and terminal E2 in the upper IP harness connector C212. Is the repair complete?	—	System OK	—
5	1. Disconnect the lighted mirror jumper C216. 2. Connect a self powered test lamp between terminals 2 and 5 in the lighted mirror jumper C216. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
6	Connect a self powered test lamp between terminal 2 in the upper IP lighted mirror jumper socket C216 and terminal E2 in the upper IP harness connector C212. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the open in CKT 147 (BRN) in the lighted mirror jumper C216. Is the repair complete?	—	System OK	—
8	Repair the open in CKT 2 or CKT 145 (BRN) between terminal 5 in the lighted mirror jumper socket C216 and terminal E1 in the upper IP harness connector C212. Is the repair complete?	—	System OK	—
9	Repair the open in CKT 142 (ORN) between terminal 2 in the lighted mirror jumper socket C216 and terminal E2 in the upper IP harness connector C212. Is the repair complete?	—	System OK	—

Rearview Mirror Lamps Inoperative - Outside (Right Mirror)

Step	Action	Value(s)	Yes	No
1	1. Set the headlamp switch to the PARK position. 2. Connect a test light between terminal A in the lighted mirror right door connector and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test light between terminals A and B in the lighted mirror right door connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 1, CKT 32 or CKT 342 (ORN) between S342 and terminal A in the lighted mirror right door harness connector. Is the repair complete?	—	System OK	—

Rearview Mirror Lamps Inoperative - Outside (Right Mirror) (cont'd)

Step	Action	Value(s)	Yes	No
4	Repair the open in right lighted mirror assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 2, CKT 4, CKT 33, CKT 68, CKT 550 or CKT 720 (BLK) between G105 and terminal B in the lighted mirror right door harness connector. Is the repair complete?	—	System OK	—

Rearview Mirror Lamps Inoperative - Outside (Left Mirror)

Step	Action	Value(s)	Yes	No
1	1. Set the headlamp switch to the PARK position. 2. Connect a test light between terminal A in the lighted mirror left door connector and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test light between terminals A and B in the lighted mirror left door connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 1, CKT 32 or CKT 343 (ORN) between S342 and terminal A in the lighted mirror left door harness connector. Is the repair complete?	—	System OK	—
4	Repair the open in left lighted mirror assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 2, CKT 4, CKT 22, CKT 33, CKT 69 or CKT 650 (BLK) between G105 and terminal B in the lighted mirror left door harness connector. Is the repair complete?	—	System OK	—

Side Marker Lamp Inoperative - One Lamp (Left)

Step	Action	Value(s)	Yes	No
1	1. Set the headlamp switch to the PARK position. 2. Disconnect the left door harness side marker lamp connector in the left door outer trim panel. 3. Connect a test lamp between terminals A and B in the left door harness side marker lamp connector. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Repair the open in left door side marker lamp assembly. Is the repair complete?	—	System OK	—
3	Connect a test lamp between terminal A and ground on the left door harness side marker lamp connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	1. Disconnect the harness connector C501. 2. Connect a test lamp between terminals A and D on the lower IP harness connector C501. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Repair the open in CKT 88 (BRN) between S364 and terminal A in the lower IP harness connector C501. Is the repair complete?	—	System OK	—

Side Marker Lamp Inoperative - One Lamp (Left) (cont'd)

Step	Action	Value(s)	Yes	No
6	Repair the open in CKT 4 (BLK) between terminal D on the left door harness connector C501 and the left door harness side marker lamp connector. Is the repair complete?	—	System OK	—
7	Locate and repair the open in CKT 68 or CKT 550 (BLK) between G105 and terminal D in the lower IP harness connector C501. Is the repair complete?	—	System OK	—

Side Marker Lamp Inoperative - One Lamp (Right)

Step	Action	Value(s)	Yes	No
1	1. Set the headlamp switch to the PARK position. 2. Disconnect the right door side marker lamp connector in the right door outer trim panel. 3. Connect a test lamp between terminals A and B in the right door side marker lamp connector. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Repair the open in right door side marker lamp assembly. Is the repair complete?	—	System OK	—
3	Connect a test lamp between terminal A and ground on the right door harness side marker lamp connector. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	1. Disconnect the harness connector C601. 2. Connect a test lamp between terminals A and D on the lower IP harness connector C601. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Repair the open in CKT 89 (BRN) between S320 and terminal A in the lower IP harness connector C601. Is the repair complete?	—	System OK	—
6	Repair the open in CKT 4 or CKT 21 (BLK) between terminal D on the right door harness connector C601 and the right door harness side marker lamp connector. Is the repair complete?	—	System OK	—
7	Locate and repair the open in CKT 69 or CKT 650 (BLK) between G105 and terminal D in the lower IP harness connector C601. Is the repair complete?	—	System OK	—

Side Marker Lamps Inoperative

Step	Action	Value(s)	Yes	No
DEFINITION: The tractor marker lamps are inoperative.				
1	1. Set the headlamp switch to PARK. 2. Remove the marker lamp relay. 3. Connect a test lamp between terminal 30 in the taillamp relay socket and the chassis ground. Is the test lamp lit?	—	*Go to Step 2*	*Go to Step 3*
2	1. Disconnect the harness connector C 212. 2. Connect a test lamp between terminal D 1 in C 212 the lower IP harness connector and the chassis ground. Is the test lamp lit?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 178 (GRN) between S289 and terminal 30 in the marker lamp relay socket. Is the repair complete?	—	System OK	—
4	1. Set the marker lamp switch to the ON position. 2. Connect a self powered test lamp between terminals D 1 and D 2 in C 212 the upper IP harness connector. Is the test lamp lit?	—	*Go to Step 6*	*Go to Step 19*
5	Repair the open in CKT 175 (GRN) between S289 and terminal D 1 in C212 the lower IP harness connector. Is the repair complete?	—	System OK	—
6	1. Reconnect C212 the upper IP harness connector. 2. Connect a test lamp between terminal 85 in the marker lamp relay socket and the chassis ground. Is the test lamp lit?	—	*Go to Step 7*	*Go to Step 8*
7	Connect a test lamp between terminal 85 and terminal 86 in the marker lamp relay socket. Is the test lamp lit?	—	*Go to Step 9*	*Go to Step 10*
8	Repair the open in CKT 176 (ORN) between terminal 85 in the marker lamp relay socket and terminal D 2 in C 212 the lower IP harness connector. Is the repair complete?	—	System OK	—
9	1. Disconnect C208 the harness connector. 2. Connect a test lamp between terminal D and terminal E in the C 208 lower IP harness connector. 3. Connect a jumper between terminal 30 and terminal 87 in the marker lamp relay socket. Is the test lamp lit?	—	*Go to Step 11*	*Go to Step 12*
10	Repair the open CKT 22,CKT 179 or CKT 650 (BLK) between G 105 and terminal 86 in the marker lamp relay socket. Is the repair complete?	—	System OK	—
11	1. Remove the bulb from the right front ID lamp. 2. Connect a jumper between terminal A and terminal B in the right front ID lamp bulb socket. 3. Connect a self powered test lamp between terminal D and terminal E in the C 208 lower IP harness connector. Is the test lamp lit?	—	*Go to Step 13*	*Go to Step 14*

Side Marker Lamps Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
12	1. Keeep the jumper connected. 2. Connect a test light between terminal E in the C208 of the lower IP harness connector and the chassis ground. Is the test lamp lit?	—	*Go to Step 15*	*Go to Step 16*
13	Replace the marker lamp relay. Is the repair complete?	—	System OK	—
14	Repair the open in Roof Harness CKT 5 (BRN) between the S 365 and C 208 terminal E, or the CKT 4 (BLK) between the S 371 and C 208 terminal D. Is the repair complete?	—	System OK	—
15	Repair the open in CKT 22, CKT 25, CKT 69 or CKT 650 (BLK) between G 105 and terminal D in the C 208 of the lower IP harness connector. Is the repair complete?	—	System OK	—
16	1. Keep the jumper connected. 2. Connect a test light between terminal 2 in the trailer connector and the chassis ground. Is the test lamp lit?	—	*Go to Step 17*	*Go to Step 18*
17	Repair the open in CKT 177 (BRN) between S 378 and terminal E in the C 208 of the lower IP harness connector. Is the repair complete?	—	System OK	—
18	Repair the open in CKT 177 (BRN) between S 378 and terminal 87 in the marker relay socket. Is the repair complete?	—	System OK	—
19	1. Keep the self powered test lamp connected. 2. Disconnect the harness connector from the marker lamp switch. 3. Connect a jumper between terminal 1 and terminal 2 in the upper IP harness marker lamp switch connector. Is the test lamp lit?	—	*Go to Step 20*	*Go to Step 21*
20	Replace the marker lamp switch. Is the repair complete?	—	System OK	—
21	Connect a self powered test lamp between terminal D 1 in C 212 the upper IP harness connector and terminal 1 in the marker lamp switch connector. Is the test lamp lit?	—	*Go to Step 22*	*Go to Step 23*
22	Repair the open in CKT 112 (ORN) between terminal D 2 in C 212 the upper IP harness connector and terminal 2 in the marker lamp switch connector. Is the repair complete?	—	System OK	—
23	Repair the open in CKT 111 (GRN) between terminal D 1 in C 212 the Upper IP Harness connector and terminal 1 in the marker lamp switch connector. Is the repair complete?	—	System OK	—

Stop Lamps Always On (Air Brakes)

Step	Action	Value(s)	Yes	No
1	Disconnect the harness connectors from the stoplamp switches on the application valve. Are the rear stoplamps ON?	—	Go to *Step 4*	Go to *Step 2*
2	Test both stoplamp switches for a short across terminal A and terminal B. Do either of the stoplamp switches have a short?	—	Go to *Step 3*	Go to *Step 4*
3	Replace the shorted stoplamp switch. Do the stoplamps remain ON with the brake pedal released?	—	Go to *Step 4*	System OK
4	1. Disconnect the harness connector from the turn/hazard flasher. 2. Connect a test lamp between the turn/hazard flasher harness connector terminal 2 and chassis ground. Does the test lamp light?	—	Go to *Step 5*	Go to*Step 6*
5	Locate and repair the short to voltage on one or more of the following circuits between the stoplamp switch and terminal 2 in the turn/hazard flasher harness connector: • CKT 104 (WHT) • CKT 105 (WHT) • CKT 107 (WHT) Do the stoplamps remain ON with the brake pedal released?	—	—	System OK
6	Replace the turn/hazard flasher. Do the stoplamps remain ON with the brake pedal released?	—	—	System OK

Stop Lamps Always On (Hydraulic Brakes)

Step	Action	Value(s)	Yes	No
1	Inspect the stoplamp switch for proper adjustment. Ensure that the stoplamp switch plunger is pressed in when the brakes are not applied. Is the stoplamp switch properly adjusted?	—	Go to *Step 3*	Go to *Step 2*
2	Adjust the stoplamp switch. Refer to Hydraulic Brakes. Do the stoplamps remain ON with the brake pedal released?	—	Go to *Step 3*	System OK
3	Disconnect the harness connector from the stoplamp switch. Are the rear stoplamps ON?	—	Go to *Step 5*	Go to *Step 4*
4	Replace the shorted stoplamp switch. Do the stoplamps remain ON with the brake pedal released?	—	Go to *Step 5*	System OK
5	1. Disconnect the harness connector from the turn/hazard flasher. 2. Connect a test lamp between the turn/hazard flasher harness connector terminal 2 and chassis ground. Does the test lamp light?	—	Go to *Step 6*	Go to *Step 7*

Stop Lamps Always On (Hydraulic Brakes) (cont'd)

Step	Action	Value(s)	Yes	No
6	Locate and repair the short to voltage on CKT 471 (WHT) between the stoplamp switch and terminal 2 in the turn/hazard flasher harness connector. Do the stoplamps remain ON with the brake pedal released?	—	—	System OK
7	Replace the turn/hazard flasher. Do the stoplamps remain ON with the brake pedal released?	—	—	System OK

Stop Lamps Inoperative - All (Air Brakes)

Step	Action	Value(s)	Yes	No
DEFINITION: When applying the air brakes the stop lamps do not operate.				
1	Test the operation of the turn signal lamps. Do the turn signal lamps operate?	—	*Go to Step 2*	*Go to Step 3*
2	Turn the head lamp switch to the park position. Are the rear park lamps ON?	—	*Go to Step 4*	*Go to Step 5*
3	1. Disconnect the harness connector from the turn/hazard flasher. 2. Connect a test lamp between terminal 9 of the turn/hazard flasher harness connector and chassis ground. Is the test lamp lit?	—	*Go to Step 6*	*Go to Step 7*
4	1. Disconnect the harness connector from the turn/hazard flasher. 2. Connect a test lamp betrween terminal 2 on the harness connector and ground. 3. Press the brake pedal. Is the test lamp lit?	—	*Go to Step 8*	*Go to Step 9*
5	Repair the open in CKT 150 (BLK) between G404 and S400. Is the repair complete?	—	System OK	—
6	Replace the turn/hazard flasher. Is the replacement complete?	—	System OK	—
7	Repair the open in CKT 110 or CKT 131 (ORN) between ciruit breaker #25 and the turn/hazard flasher harness connector. Is the repair complete?	—	System OK	—
8	Replace the turn/hazard flasher. Is the repair complete?	—	System OK	—
9	1. Keep the test lamp connected. 2. Disconnect the harness connectors from the stoplamp switch. 3. Connect a jumper between terminals A and B on both connectors. Is the test lamp lit?	—	*Go to Step 10*	*Go to Step 11*

Stop Lamps Inoperative - All (Air Brakes) (cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the stoplamp switch. Is the replacement complete?	—	System OK	—
11	Connect a test lamp between ground and terminal A on either stoplamp switch connector. Is the testlamp lit?	—	*Go to Step 12*	*Go to Step 13*
12	Repair the open in CKT 104 or CKT 105 (WHT) between the turn/hazard flasher harness connector and S374. Is the repair complete?	—	System OK	—
13	Repair the open in CKT 110 or CKT 103 (ORN) between S237 and S311. Is the repair complete?	—	System OK	—

Stop Lamps Inoperative - All (Hydraulic Brakes)

Step	Action	Value(s)	Yes	No
DEFINITION: When applying the hydraulic brakes the stoplamps do not operate.				
1	Test the operation of the turn signal lamps. Do the signal lamps function?	—	*Go to Step 2*	*Go to Step 3*
2	Turn the headlamp switch to the park position. Are the rear park lamps ON?	—	*Go to Step 4*	*Go to Step 5*
3	1. Disconnect the harness connector from the turn/hazard flasher. 2. Connect a test lamp between terminal 9 of the turn/hazard flasher harness connector and chassis ground. Is the test lamp lit?	—	*Go to Step 6*	*Go to Step 7*
4	1. Disconnect the harness connector from the turn/hazard flasher. 2. Connect a test lamp between terminal 2 on the harness connector and ground. 3. Press the brake pedal. Is the test lamp lit?	—	*Go to Step 8*	*Go to Step 9*
5	Repair the open in CKT 150 (BLK) between G404 and S400. Is the repair complete?	—	System OK	—
6	Replace the turn/hazard flasher. Is the replacement complete?	—	System OK	—
7	Repair the open in CKT 110 or CKT 131 (ORN) circuit breaker #25 and the turn/hazard flasher harness connector. Is the repair complete?	—	System OK	—
8	Replace the turn/hazard flasher. Is the replacement complete?	—	System OK	—
9	1. Keep the test lamp still connected. 2. Disconnect the harness connector from the stoplamp switch. 3. Connect jumper between terminals A and B on the stoplamp switch harness connector. Is the test lamp lit?	—	*Go to Step 10*	*Go to Step 11*

Stop Lamps Inoperative - All (Hydraulic Brakes) (cont'd)

Step	Action	Value(s)	Yes	No
10	Replace the stoplamp switch. Is the replacement complete?	—	System OK	—
11	Connect a test lamp between ground and terminal B on the stoplamp switch connector. Is the test lamp lit?	—	*Go to Step 12*	*Go to Step 13*
12	Repair the open in CKT 471 (WHT) between terminal A in the stoplamp switch connector and terminal 2 in the turn/hazard flasher harness connector. Is the repair complete?	—	System OK	—
13	Repair the open in CKT 470 (GRN/WHT) between S236 and terminal B in the stoplamp switch. Is the repair complete?	—	System OK	—

Stop Lamps Inoperative - One (Left Rear)

Step	Action	Value(s)	Yes	No
DEFINITION: The left rear stoplamp is inoperative.				
1	1. Remove the bulb from the left rear taillamp socket. 2. Connect a self powered test lamp between the WHT wire attached to the bulb socket and chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	1. Disconnect the harness connector from the left rear taillamp assembly. 2. Connect a test lamp between terminal C of the harness connector and chassis ground. 3. Operate the brake pedal. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	1. Disconnect the taillamp assembly harness connector. 2. Connect a self powered test lamp between terminal E in the Taillamp assembly harness connector and chassis ground. Does the test light?	—	*Go to Step 6*	*Go to Step 7*
4	Repair the open in the RED wire inside the taillamp assembly. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 18 (YEL) between the Turn and Hazard flasher and terminal C in the taillamp assembly harness connector. Is the repair complete?	—	System OK	—
6	Repair the open in CKT 150 (BLK) between S 400 and terminal E in the taillamp assembly harness connector. Is the repair complete?	—	System OK	—
7	Repair the open in the wire (WHT) inside the taillamp assembly. Is the repair complete?	—	System OK	—

Stop Lamps Inoperative - One (Right Rear)

Step	Action	Value(s)	Yes	No
DEFINITION: The right rear stoplamp is inoperative.				
1	1. Remove the bulb from the right rear taillamp socket. 2. Connect a self powered test lamp between the WHT wire attached to the bulb socket and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	1. Disconnect the harness connector from the right rear taillamp assembly. 2. Connect a test lamp between terminal C of the harness connector and chassis ground. 3. Operate the brake pedal. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	1. Disconnect the taillamp assembly harness connector. 2. Connect a self powered test lamp between terminal C in the taillamp assembly harness connector and chassis ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
4	Repair the open in the RED wire inside the taillamp assembly. Is the repair complete?	—	System OK	—
5	Repair the open in the CKT 19 or CKT circuit between the turn/hazard flasher and terminal C in the taillamp assembly harness connector. Is the repair complete?	—	System OK	—
6	Repair the open in the CKT 150 (BLK) between S 400 and terminal E in the taillamp assembly harness connector. Is the repair complete?	—	System OK	—
7	Repair the open in the white wire inside the taillamp assembly. Is the repair complete?	—	System OK	—

Turn Signal Lamps Inoperative - Front

Step	Action	Value(s)	Yes	No
Definition: Both Front Turn Lamps Are Inoperative.				
1	1. Disconnect the harness connector from the Turn and Hazard Flasher. 2. Place the Turn Signal Switch in the Left turn position. 3. Connect a self powered test lamp between terminal 7 and the chassis ground Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—
3	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—

Turn Signal Lamp Inoperative - LF

Step	Action	Value(s)	Yes	No
Definition: Left Front Turn Lamp Inoperative.				
1	1. Set the turn signal switch to the Left turn position. 2. Observe the operation of the Left Turn Signal Indicator on the instrument Cluster. Does the Left Turn Signal Indicator flash?	—	*Go to Step 2*	*Go to Step 9*
2	1. Keep the turn signal switch in the Left turn position. 2. Disconnect the harness connector from the left front turn lamp assembly. 3. Connect a test lamp between terminal A and terminal B on the left front turn lamp harness connector. Does the test lamp flash?	—	*Go to Step 3*	*Go to Step 4*
3	Repair the open in left front turn and park lamp assembly. Is the repair complete?	—	System OK	—
4	Connect a test lamp between terminal A and the chassis ground on the left front turn lamp connector. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
5	Repair the open in CKT 150 (BLK) between S 105 and terminal B in the left front turn lamp harness connector. Is the repair complete?	—	System OK	—
6	1. Disconnect the Front Chassis Harness Connector C 105. 2. Connect a test lamp between terminal B and terminal D in the Front Chassis Harness Connector C 105. Does the test lamp flash?	—	*Go to Step 7*	*Go to Step 8*
7	Repair the open in CKT 14 (LT BLU) between terminal B in the front turn signal harness connector C 105 and terminal A in the left front turn and park lamp harness connector. Is the repair complete?	—	System OK	—
8	Repair the open in CKT 14 or CKT 139 (LT BLU) between S259 and terminal B in the front chassis harness connector C 105. Is the repair complete?	—	System OK	—
9	1. Disconnect the harness connector from the Turn and Hazard Flasher. 2. Remove the left trailer turn relay from the socket. 3. Connect a self powered test light between terminal 86 in the left trailer turn relay socket and terminal 1 in the turn and hazard flasher harness connector. Does the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
10	1. Keep the turn signal switch in the Left turn position. 2. Connect a self powered test lamp between terminal 7in the turn and hazard flasher harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
11	Repair the open CKT 136 (LT BLU) between S 259 and terminal 1 in the Turn and Hazard Flasher harness connector. Is the repair complete?	—	System OK	—

Turn Signal Lamp Inoperative - LF (cont'd)

Step	Action	Value(s)	Yes	No
12	Replace the Turn/Hazard Flasher. Is the repair complete?	—	System OK	—
13	1. Keep a self powered test lamp connected. 2. Disconnect the harness connector C 1 from the Turn Signal and Hazard Switch. 3. Remove the chassis ground connection from the self powered test lamp and connect the test lamp to terminal 6 in the Turn Signal and Hazard Switch harness connector. Does the test lamp light?	—	*Go to Step 14*	*Go to Step 15*
14	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—
15	Repair the open in CKT 132 (BLU/BLK) between the Turn Signal and Hazard Switch and the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—

Turn Signal Lamp Inoperative - RF

Step	Action	Value(s)	Yes	No
Definition: Right Front Turn Lamp Inoperative.				
1	1. Set the turn signal switch to the Right turn position. 2. Observe the operation of the Right Turn Signal Indicator on the instrument cluster. Does the Right Turn Signal Indicator flash?	—	*Go to Step 2*	*Go to Step 9*
2	1. Keep the turn signal switch in the Right turn position. 2. Disconnect the Harness Connector from the right front turn lamp assembly. 3. Connect a test lamp between terminal A and terminal B on the Right Front Turn Lamp Harness Connector. Does the test lamp flash?	—	*Go to Step 3*	*Go to Step 4*
3	Repair the open in Right Front Turn and Park Lamp assembly. Is the repair complete?	—	System OK	—
4	Connect a test lamp between terminal A and the chassis ground on the right front turn lamp connector. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
5	Repair the open in CKT 150 (BLK) between S 105 and terminal B in the right front turn lamp harness connector. Is the repair complete?	—	System OK	—

Turn Signal Lamp Inoperative - RF (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Disconnect the front chassis harness connector C 105. 2. Connect a test lamp between terminal C and terminal D in the Front Chassis Harness Connector C 105. Does the test lamp flash?	—	*Go to Step 7*	*Go to Step 8*
7	Repair the open in CKT 15 (DK BLU) between terminal C in the front turn signal harness connector C 105 and terminal A in the right front turn and park lamp harness connector. Is the repair complete?	—	System OK	—
8	Repair the open in CKT 15 (DK BLU) between S 335 and terminal C in the front chassis harness connector C 105. Is the repair complete?	—	System OK	—
9	1. Disconnect the harness connector from the Turn and Hazard Flasher. 2. Remove the right trailer turn relay from the socket. 3. Connect a self powered test light between terminal 86 in the right trailer turn relay socket and terminal 3 in the turn and hazard flasher harness connector. Does the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
10	1. Keep the turn signal switch in the Right turn position. 2. Connect a self powered test lamp between terminal 8 in the turn and hazard flasher harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
11	Repair the open Ckt 139 (DK BLU) between S 335 and terminal 1 in the turn and hazard flasher harness connector. Is the repair complete?	—	System OK	—
12	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—
13	1. Keep the self powered test lamp connected. 2. Disconnect the harness connector C 1 from the turn signal and hazard switch. 3. Remove the chassis ground connection from the self powered test lamp. 4. Connect the test lamp to terminal 7 in the turn signal and hazard switch harness connector. Does the test lamp light?	—	*Go to Step 14*	*Go to Step 15*
14	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—
15	Repair the open in CKT 133 (BLU/ORN) between the Turn Signal and Hazard Switch and the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—

Turn Signal Lamps and Indicators Inop - Front

Step	Action	Value(s)	Yes	No
Definition: All Front Turn Signal Lamps and Indicators Are Inoperative.				
1	1. Turn the Hazard Switch to the ON position. 2. Disconnect the harness connector from the Turn and Hazard Flasher. 3. Connect a self powered test lamp between terminal 8 and the chassis ground. 4. Connect a self powered test lamp between terminal 7 and the chassis ground. Does the test lamp light for both tests?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—
3	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—

Turn Signal Lamps Inoperative - Rear

Step	Action	Value(s)	Yes	No
Definition: Both Rear Turn Lamps are Inoperative.				
1	Test the operation of the Stoplamps. Do the Stoplamps operate?	—	*Go to Step 5*	*Go to Step 2*
2	1. Disconnect the harness connector from the right rear stop and turn lamp assembly. 2. Connect a self powered test lamp between terminal E in the right rear stop and turn lamp connector and the chassis ground. Does the test lamp light?	—	*Go to Step 3*	*Go to Step 4*
3	1. Disconnect the harness connector from the Turn and Hazard flasher. 2. Connect a test lamp between terminal 9 of the turn and hazard flasher harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
4	Repair the open in CKT 150 (BLK) the ground circuit between G404 and S400. Is the repair complete?	—	System OK	—
5	1. Set the turn signal switch to the Left turn position. 2. Disconnect the harness connector from the Turn Signal and Hazard Switch. 3. Connect a self powered test lamp between terminal 6 on the Turn Signal and Hazard Switch and the chassis ground. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 8*
6	Repair the open in CKT 110 or CKT 131 (ORN) between Circuit Breaker #25 and the turn and hazard flasher harness connector. Is the repair complete?	—	System OK	—
7	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—
8	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—

Turn Signal Lamps Inoperative - LR

Step	Action	Value(s)	Yes	No
Definition: Left Rear Turn Lamp is Inoperative.				
1	Press the Brake Pedal. Do the Stoplamps light?	—	*Go to Step 2*	*Go to Step 3*
2	Set the turn signal switch to the Left turn position. Does the left front turn lamp flash?	—	*Go to Step 5*	*Go to Step 4*
3	Refer to Left Rear Stoplamp is Inoperative. Is the repair complete?	—	System OK	—
4	1. Keep the turn signal switch in the Left turn position. 2. Disconnect the harness connector from the Turn and Hazard Flasher. 3. Connect a self powered test lamp between terminal 7 in the turn and hazard flasher harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—
6	1. Keep the self powered test lamp connected. 2. Disconnect the harness connector C 1 from the Turn Signal and Hazard Switch. 3. Remove the chassis ground connection from the self powered test lamp. 4. Connect the chassis ground connection to terminal 6 in the Turn Signal and Hazard Switch harness connector. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 8*
7	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—
8	Repair the open in CKT 132 (BLU/BLK) between the Turn Signal and Hazard Switch and the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—

Turn Signal Lamp Inoperative - RR

Step	Action	Value(s)	Yes	No
Definition: Right Rear Turn Lamp is Inoperative.				
1	Press the Brake Pedal. Do the Stoplamps light?	—	*Go to Step 2*	*Go to Step 3*
2	Set the turn signal switch to the Right turn position. Does the right front turn lamp flash?	—	*Go to Step 5*	*Go to Step 4*
3	Refer to Right Rear Stoplamp is Inoperative. Is the repair complete?	—	System OK	—

Turn Signal Lamp Inoperative - RR (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Keep the turn signal switch in the Right turn position. 2. Disconnect the harness connector from the Turn and Hazard Flasher. 3. Connect a self powered test lamp between terminal 8 in the turn and hazard flasher harness connector and the chassis ground. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—
6	1. Keep the self powered test lamp connected. 2. Disconnect the harness connector C 1 from the turn signal and hazard switch. 3. Remove the chassis ground connection from the self powered test lamp and connect the chassis ground connection to terminal 7 in the turn signal and hazard switch harness connector. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 8*
7	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—
8	Repair the open in CKT 133 (BLU/ORN) between the Turn Signal and Hazard Switch and the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—

Turn Signal Indicators Inoperative

Step	Action	Value(s)	Yes	No
Definition: Both IP Turn Signal Indicators Are Inoperative.				
1	1. Disconnect the harness connector from the Turn and Hazard Flasher. 2. With the Turn Signal Switch in the Left turn position, connect a self powered test lamp between terminal 7 and the chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	1. Keep the Turn Signal Switch in the Left turn position. 2. Disconnect the 9-way Instrument Panel Harness connector. 3. Connect a test lamp between terminal B 3 and the chassis ground. Does the test lamp flash?	—	*Go to Step 4*	*Go to Step 5*
3	Replace the Turn Signal and Hazard Switch. Is the repair complete?	—	System OK	—
4	Replace the Instrument Panel Cluster. Is the repair complete?	—	System OK	—
5	Replace the Turn and Hazard Flasher. Is the repair complete?	—	System OK	—

Turn Signal Indicators Inoperative - Left

Step	Action	Value(s)	Yes	No
Definition: Left IP Turn Indicator Inoperative.				
1	1. Place the turn signal switch in the Left turn position. 2. Disconnect the 9-way Instrument Cluster harness connector. 3. Connect a test lamp between terminal B3 and the chassis ground. Does the test lamp flash?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the Instrument Cluster. Is the repair complete?	—	System OK	—
3	1. Keep the turn signal switch in the Left turn position. 2. Disconnect the harness connector C212. 3. Connect a test lamp between terminal C 3 in the lower IP harness connector C 212 and the chassis ground. Does the test lamp flash?	—	*Go to Step 4*	*Go to Step 5*
4	Repair the open in CKT 17 (LT BL) between terminal C 3 in the upper IP harness connector and terminal B 3 in the upper IP 9-way harness connector. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 142 (LT BLU) between S 259 and terminal C 3 in the lower IP harness connector. Is the repair complete?	—	System OK	—

Turn Signal Indicators Inoperative - Right

Step	Action	Value(s)	Yes	No
Definition: Right IP Turn Indicator Inoperative.				
1	1. Place the turn signal switch in the Right turn position. 2. Disconnect the 15-way Instrument Cluster harness connector. 3. Connect a test lamp between terminal A9 and terminal A13. Does the test lamp flash?	—	*Go to Step 2*	*Go to Step 3*
2	Replace the Instrument Cluster. Is the repair complete?	—	System OK	—
3	1. Keep the turn signal switch in the Right turn position. 2. Disconnect the harness connector C 212. 3. Connect a test lamp between terminal C4 in the lower IP harness connector C 212 and the chassis ground. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
4	Repair the open in CKT 18 (BLU) between terminal C 4 in the upper IP harness connector and terminal A13 in the upper IP 15-way harness connector. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 140 (BLU) between S 335 and terminal C 4 in the lower IP harness connector. Is the repair complete?	—	System OK	—

Turn Signal Lamps Inop - LH Output at Trailer Conn

Step	Action	Value(s)	Yes	No
Definition: No Left Turn Indicator Output at Trailer Connector.				
1	1. Place the turn signal switch in the Left turn position. 2. Remove the Left Trailer Turn Relay from the socket in Relay Center #1. 3. Connect a test lamp between terminal 86 in the Left trailer turn relay socket and the chassis ground. Does the test lamp flash?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminal 85 and terminal 86 in the Left trailer turn relay socket. Does the test lamp flash?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open in CKT 118 (LT BLU) between S 259 and terminal 86 in the Left trailer turn relay socket. Is the repair complete?	—	System OK	—
4	Connect a test lamp between terminal 85 and terminal 30 in the Left trailer turn relay socket. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Repair the open in CKT 22, CKT 117 or CKT 650 (BLK) between G 105 and terminal 85 in the Left trailer turn relay socket. Is the repair complete?	—	System OK	—
6	1. Connect a jumper between terminal 30 and terminal 87 in the Left trailer turn relay socket. 2. Connect a test lamp between terminal 1 and terminal 3 in the trailer connector socket. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the open in CKT 115 (ORN) between circuit breaker #11 and terminal 30 in the Left trailer turn relay socket. Is the repair complete?	—	System OK	—
8	Replace the Left trailer turn relay. Is the repair complete?	—	System OK	—
9	Repair the open in CKT 116 or CKT 318 (YEL) between the trailer connector socket and terminal 87 in the Left trailer turn relay socket. Is the repair complete?	—	System OK	—

Turn Signal Lamps Inop - RH Output at Trailer Conn

Step	Action	Value(s)	Yes	No
Definition: No Right Turn Indicator Output at Trailer Connector.				
1	1. Place the turn signal switch in the Right turn position. Remove the Right trailer turn relay from the socket in Relay Center #1. 2. Connect a test lamp between terminal 86 in the Right trailer turn relay socket and the chassis ground. Does the test lamp flash?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a test lamp between terminal 85 and terminal 86 in the Right trailer turn relay socket. Does the test lamp flash?	—	*Go to Step 4*	*Go to Step 5*
3	Repair the open CKT 113 (BLU) between S 335 and terminal 86 in the Right trailer turn relay socket. Is the repair complete?	—	System OK	—
4	Connect a test lamp between terminal 85 and terminal 30 in the Right trailer turn relay socket. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Repair the open in CKT 22, CKT 117 or CKT 650 (BLK) between G 105 and terminal 85 in the Right trailer turn relay socket. Is the repair complete?	—	System OK	—
6	1. Connect a jumper between terminal 30 and terminal 87 in the Right trailer turn relay socket. 2. Connect a test lamp between terminal 1 and terminal 5 in the trailer connector socket. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Repair the open in CKT 110 (ORN) between circuit breaker #25 and terminal 30 in the Right trailer turn relay socket. Is the repair complete?	—	System OK	—
8	Replace the Right trailer turn relay. Is the repair complete?	—	System OK	—
9	Repair the open in CKT 111 or CKT 319 (YEL) between the trailer connector socket and terminal 87 in the Right trailer turn relay socket. Is the repair complete?	—	System OK	—

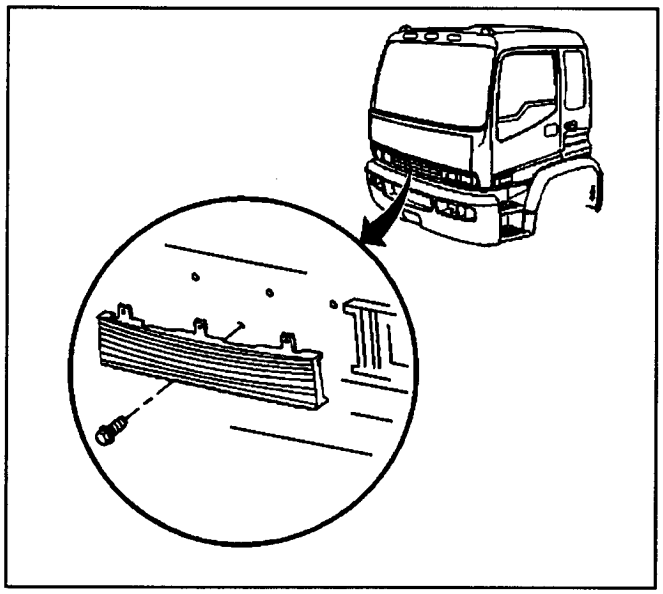
Repair Instructions

Headlamp Replacement

Removal Procedure

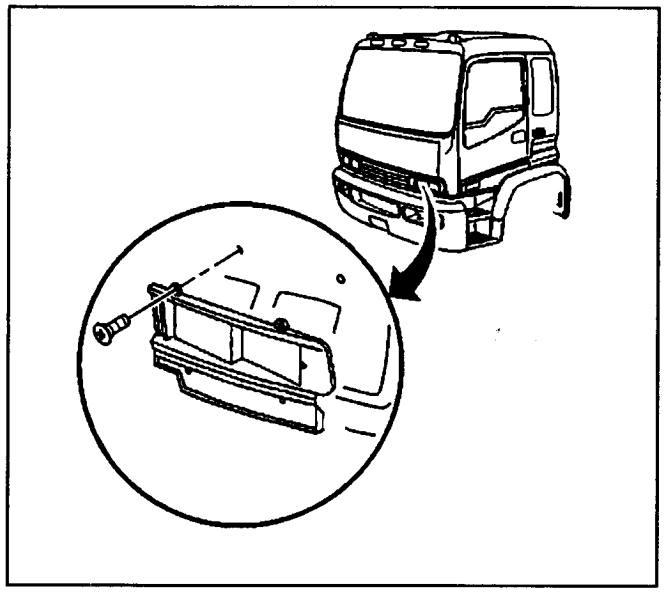
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Remove the screws holding the front grille in place.



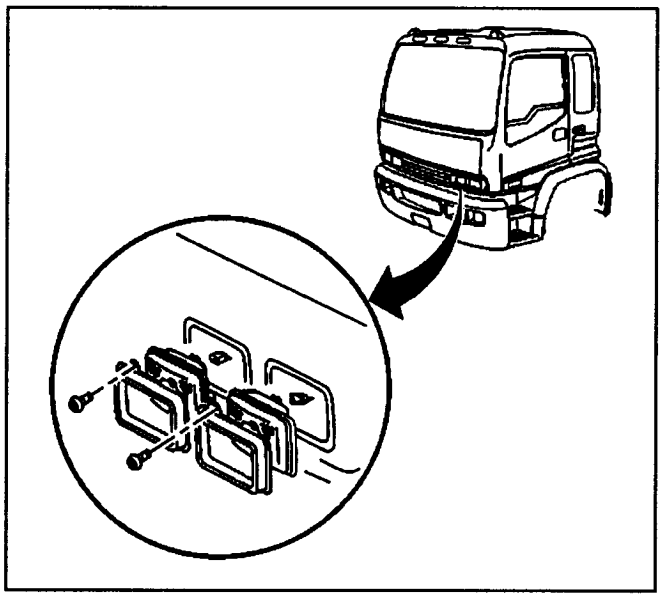
214296

4. Remove the four headlamp bezel screws.

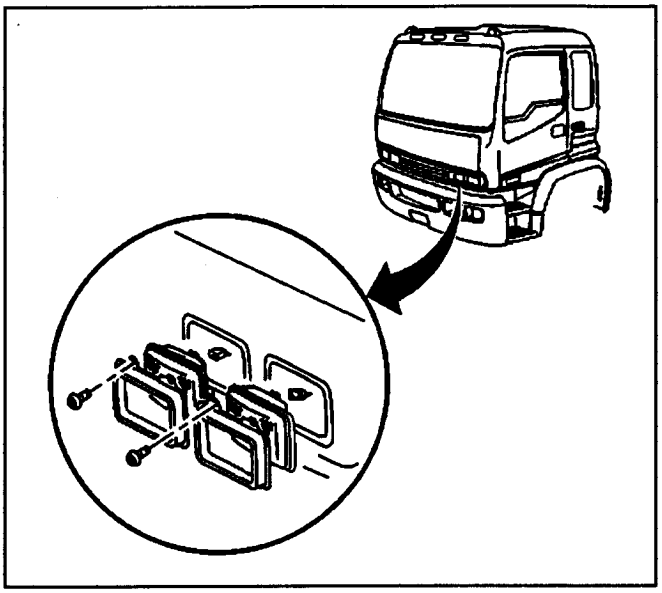


214297

5. Remove the four headlamp retaining ring screws.
6. Disconnect the headlamp electrical connector.
7. Remove the headlamp from the mounting ring.



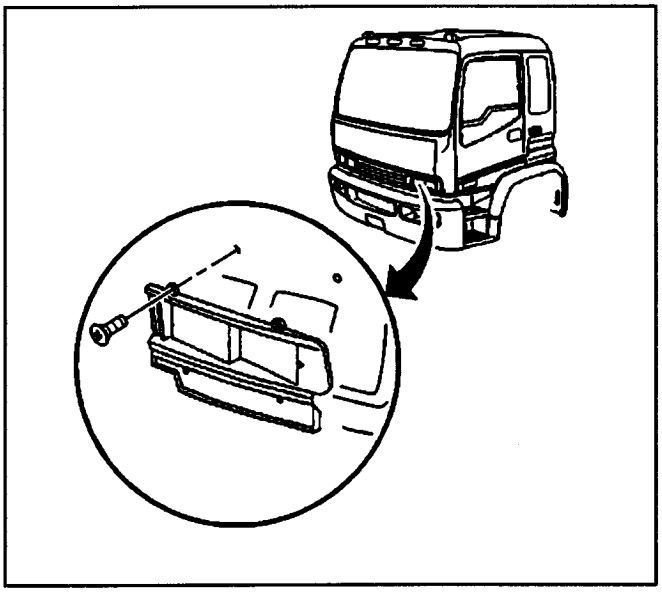
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214302

Installation Procedure

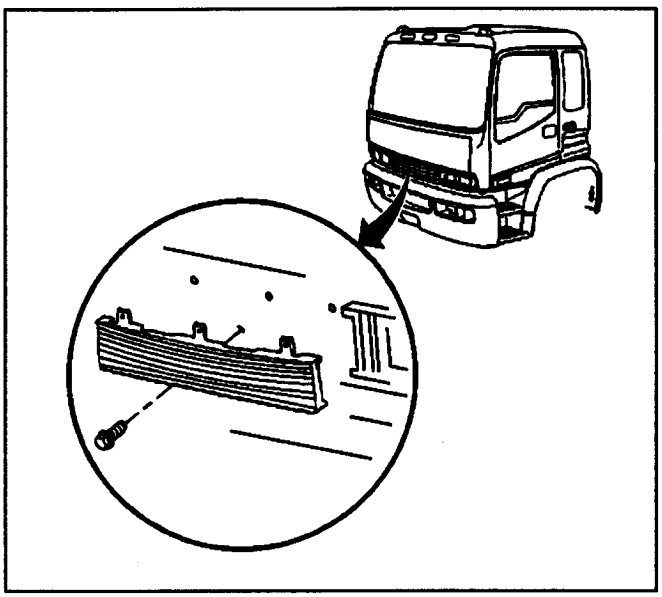
1. Connect the headlamp electrical connector.
2. Install the headlamp into the headlamp mounting ring.
3. Install the headlamp retaining ring with the four headlamp retaining ring screws.



214297

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the headlamp bezel.
   Tighten
   Tighten the four headlamp bezel screws to 1.9 N.m (17 lb in).



214296

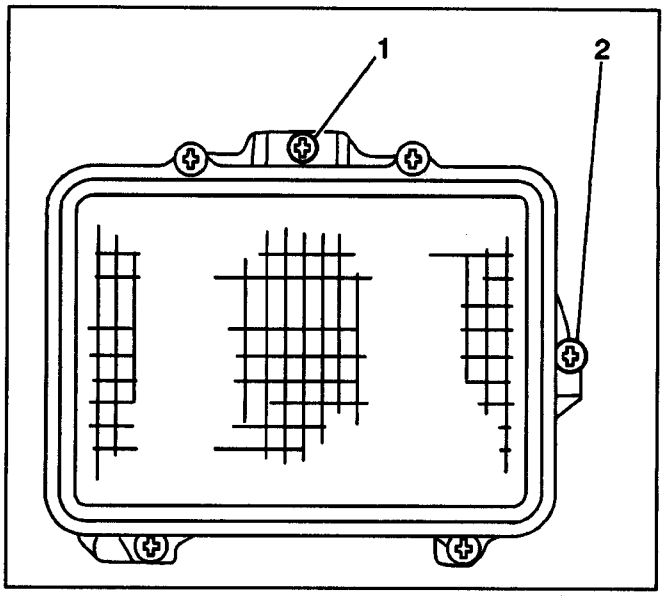
5. Install the front grill.

Headlamp Aiming

Tools Required
J 25300-E Headlight Aimer

The headlamps are aimed vertically and horizontally by adjusting the two screws that move the mounting bracket against the tension of the coil spring. The adjusting screws (1, 2) are located in the headlamp bezel area. One screw is above the headlamp and the other screw is on the right side of the headlamp. The screw (1) directly above the headlamp adjusts the vertical position. The screw (2) to the right of the headlamp adjusts the horizontal position.

Using the *J 25300-E*, adjust the headlamps to the specifications required by the state and/or local authorities. Follow the manufacturer's instructions for tool use.



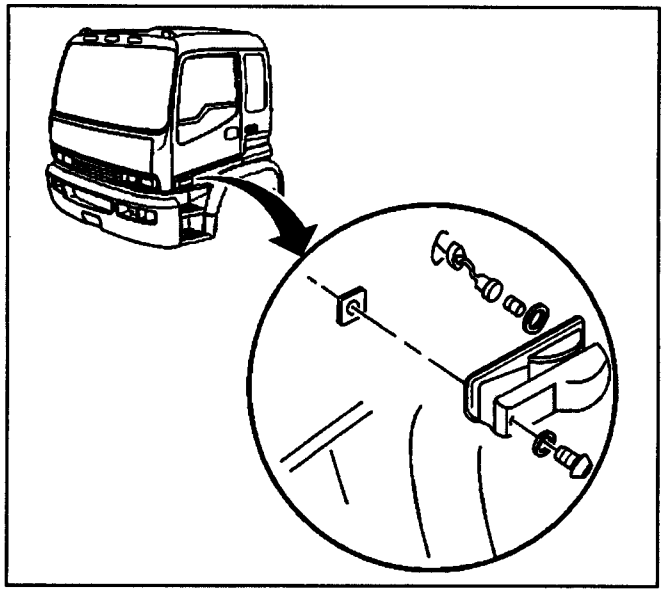
200966

Marker Lamp Replacement - Side (Housing)

Removal Procedure

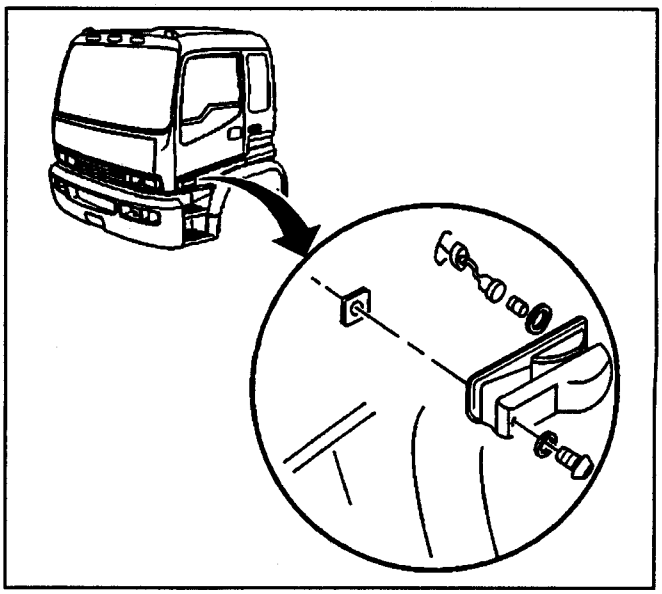
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

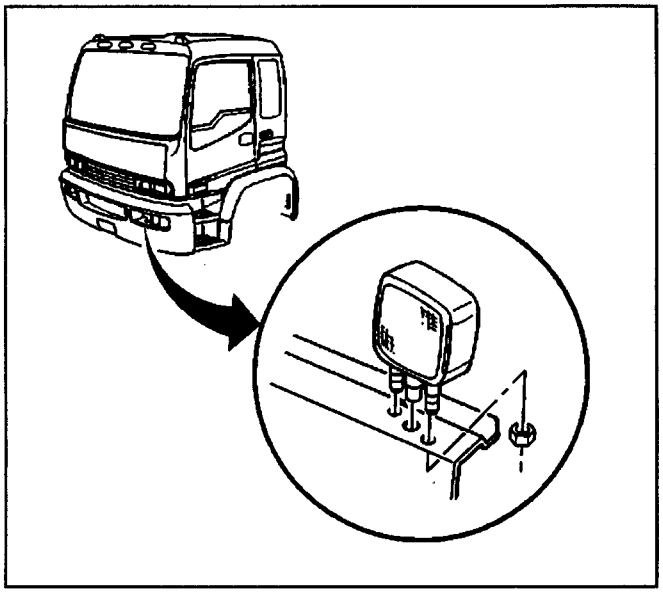
1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Remove the side marker lamp lens hold-down screw.
4. Remove the lens.
5. Remove the side marker lamp insulator by pulling the socket and the harness assembly through the insulator.
6. Disconnect the side marker lamp electrical connector.
7. Remove the lamp housing.


214293

Installation Procedure

1. Connect the side marker lamp electrical connector.
2. Install the side marker lamp insulator and the housing as follows:
   2.1. Push the socket and the harness assembly into the insulator.
   2.2. Align the housing with the holes in the cab.
3. Install the side marker lamp lens.
4. Install the lens hold-down screw.
5. Connect the negative battery cables.


214293



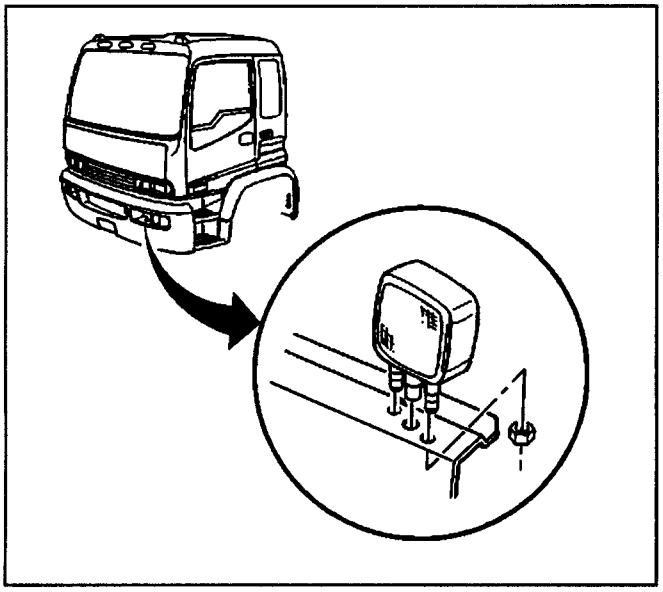
214289

Park/Turn Signal Lamp Replacement (Housing)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Disconnect the front directional signal lamp housing electrical connector.
4. Remove the two lamp housing retaining nuts.
5. Remove the backing plate.
6. Remove the lamp housing.



214289

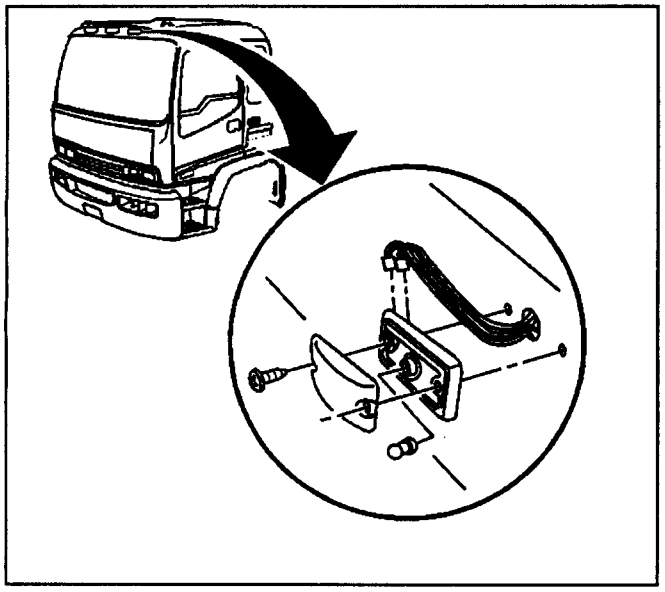
Installation Procedure

1. Install the front directional signal lamp housing.
2. Install the lamp housing backing plate.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
3. Install the two retaining nuts.

   Tighten

   Tighten the two retaining nuts to 8 N·m (71 lb in).
4. Connect the lamp housing electrical connector.
5. Connect the negative battery cables.



214280

Clearance Lamp Replacement (Lamp Housing)

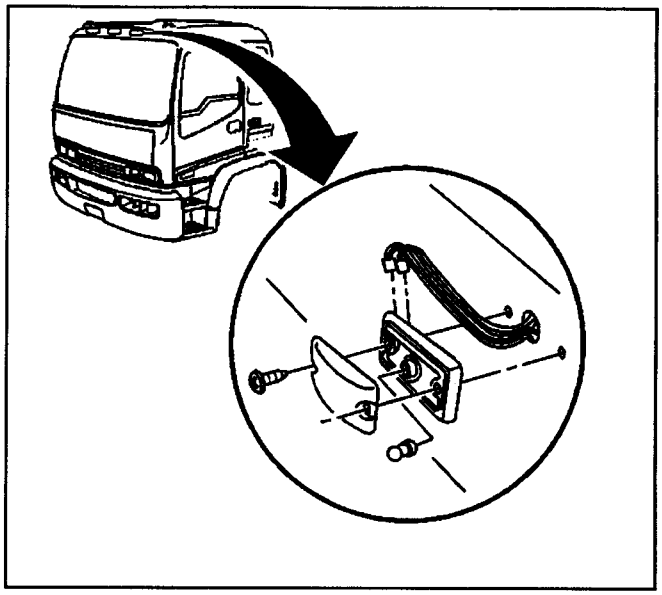
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Remove the clearance lamp lens hold-down screws.
4. Remove the clearance lamp lens.
5. Remove the insulator by pulling the socket and harness assembly through the insulator.
6. Disconnect the clearance lamp electrical connector.
7. Remove the lamp housing.

Installation Procedure

1. Connect the clearance lamp electrical connector.
2. Install the lamp insulator and the housing.
   2.1. Push the socket and the harness assembly into the insulator.
   2.2. Align the housing with the holes in the cab.
3. Install the clearance lamp lens.
4. Install the lens hold-down screws.
5. Connect the negative battery cables.



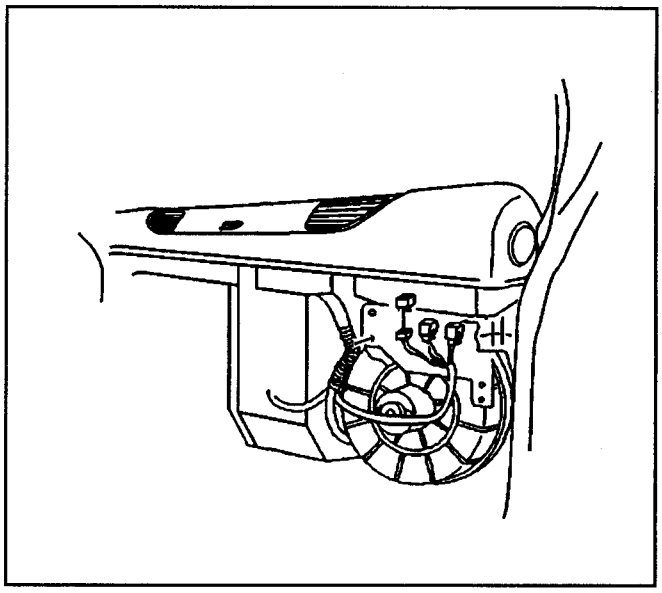
214280

DRL Relay Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

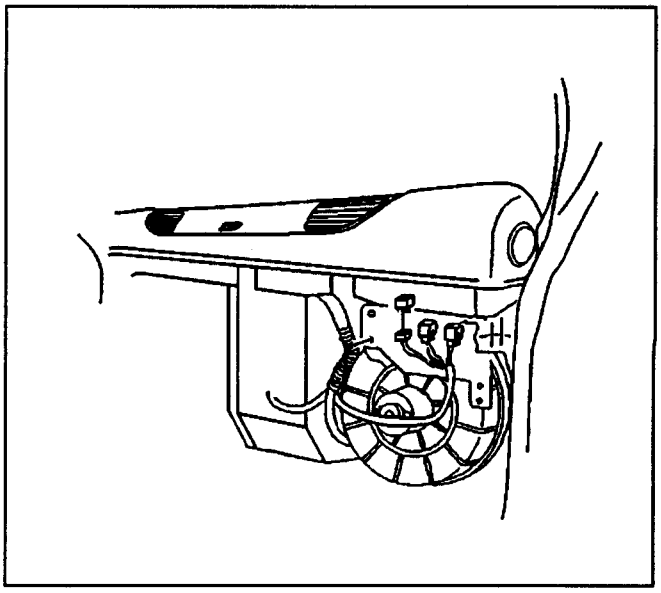
1. Turn the headlamps and the engine OFF.
2. Disconnect the negative battery cables.
3. Remove the instrument panel lower trim. Refer to *IP Cluster Replacement (Instrument Cluster)* and *IP Cluster Replacement (Speedometer)* in Instrument Panel and Gauges.
4. Disconnect the daytime running lamp relay from the relay harness.



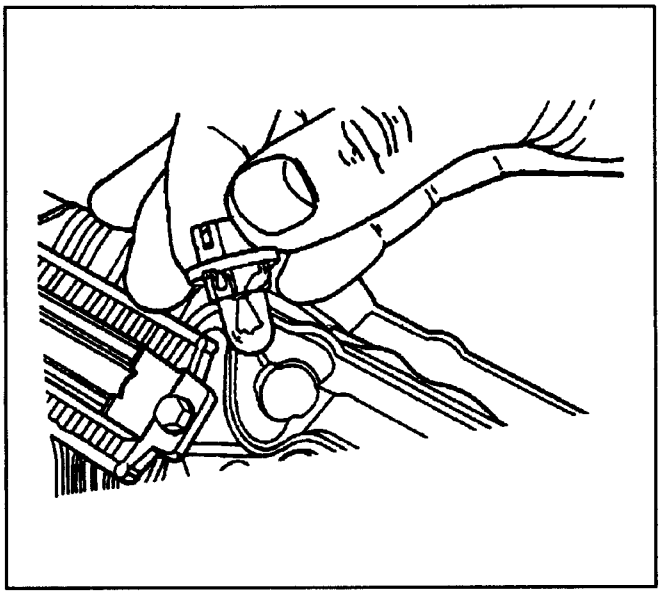
214306

Installation Procedure

1. Connect the DRL relay into the relay harness.
2. Install the instrument panel lower trim. Refer to *IP Cluster Replacement (Instrument Cluster)* and *IP Cluster Replacement (Speedometer)* in Instrument Panel and Gauges.
3. Connect the negative battery cables.



214306

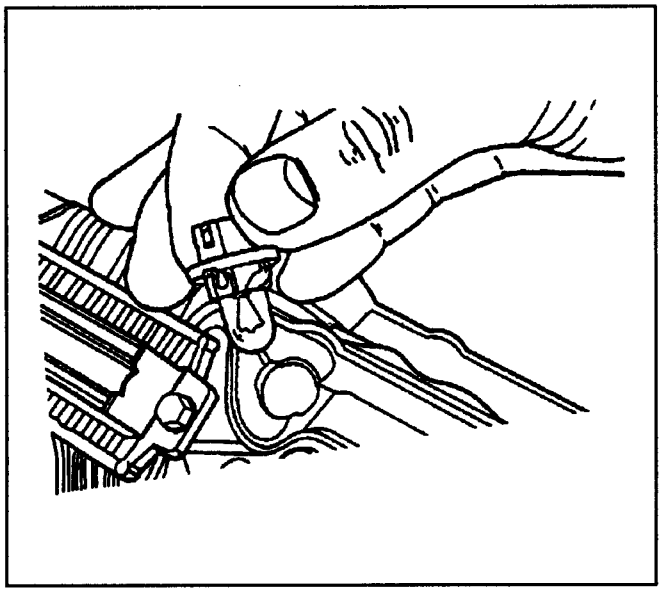


201013

IP Lamp Replacement

Removal Procedure

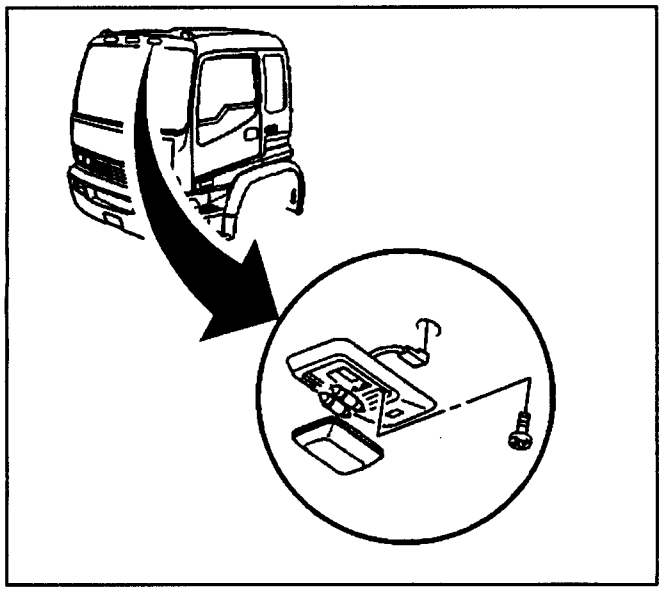
1. Remove the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster)* and *IP Cluster Replacement (Speedometer)* in Instrument Panel, Gauges and Console.
2. Remove the instrument cluster bulb assembly from the instrument cluster by turning the bulb assembly to the left.



201013

Installation Procedure

1. Install the instrument cluster bulb assembly to the instrument cluster.
2. Turn the bulb assembly to the right to secure the bulb to the instrument cluster.
3. Install the instrument cluster. Refer to *IP Cluster Replacement (Speedometer)* and *IP Cluster Replacement (Instrument Cluster)* in Instrument Panel, Gauges and Console.



214308

Dome Lamp Replacement (Housing)

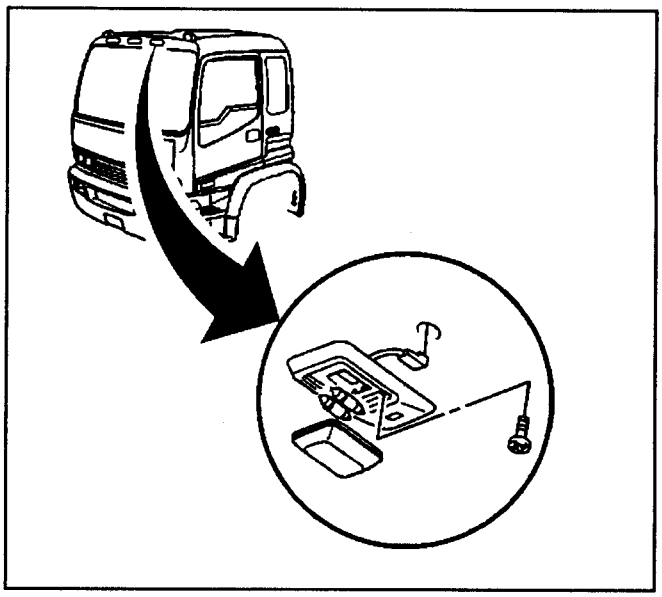
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cables.
2. Remove the dome lamp lens.
3. Remove the dome lamp bulb.
   3.1. Grasp the bulb in the center.
   3.2. Pull the bulb straight out.
4. Remove the two retaining screws from the lamp housing.
5. Remove the dome lamp housing.

Installation Procedure

1. Install the dome lamp housing to the roof with the two retaining screws.
2. Install the dome lamp bulb by pushing the bulb straight into the lamp housing until the bulb is fully seated.
3. Install the dome lamp lens.
4. Connect the negative battery cables.



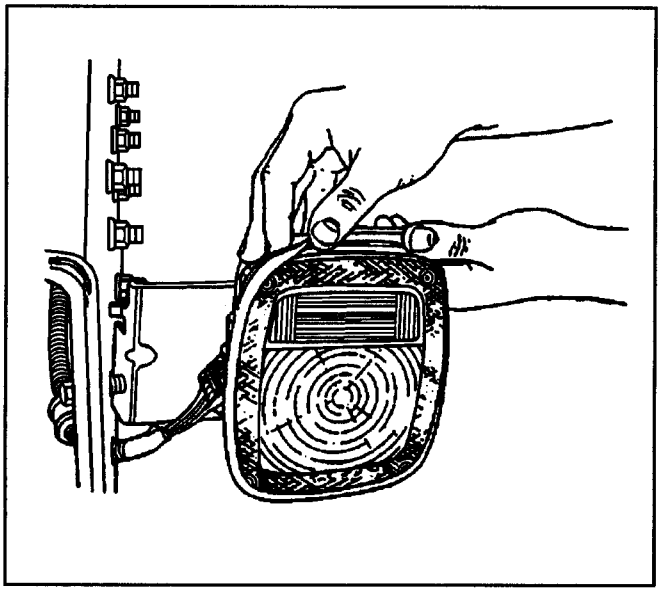
214308

Tail Lamp Replacement (Bulb)

Removal Procedure

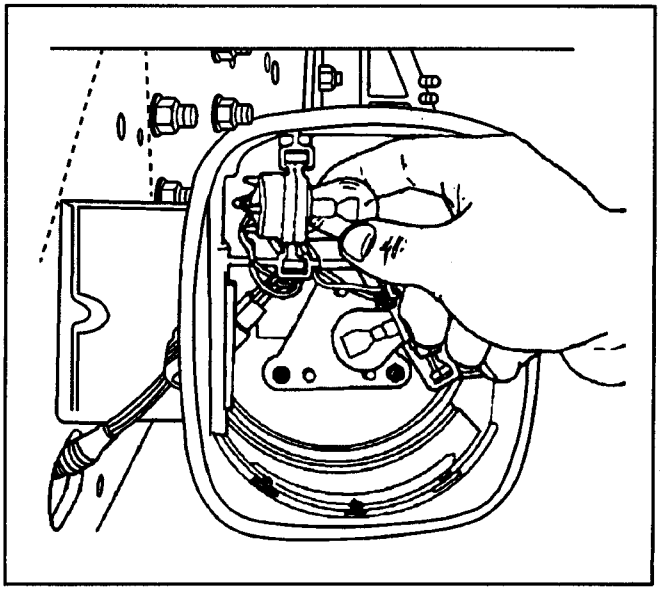
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Remove the taillamp lens from the lens housing.
   - 3.1. Roll back the rubber housing boot.
   - 3.2. Pull the lens from the lamp housing.

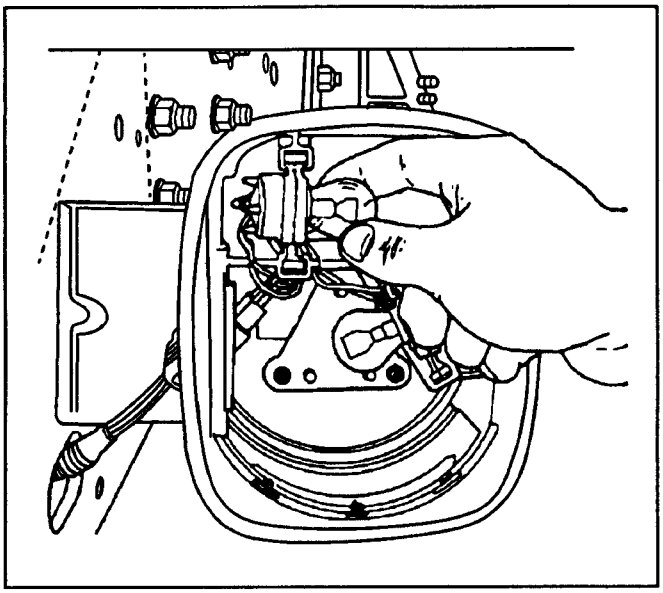


200974

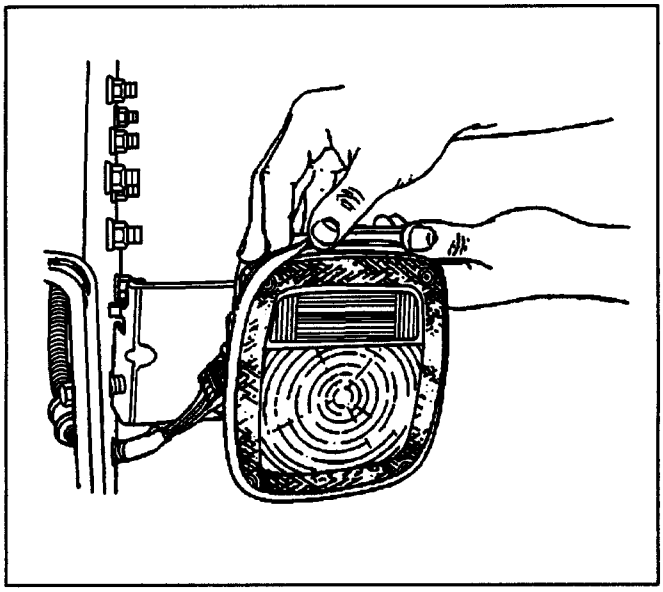
4. Remove the taillamp bulb.
   - 4.1. Press the bulb into the socket.
   - 4.2. Turn the bulb to the left.
   - 4.3. Pull the bulb out.



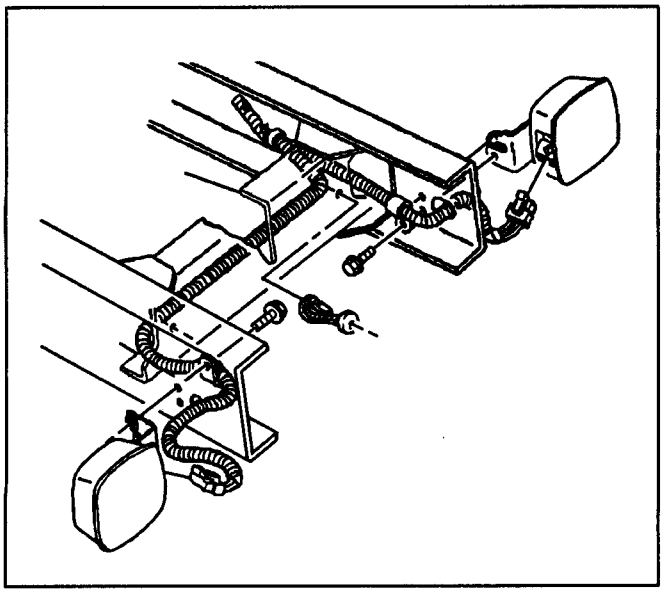
200976



200976



200974



200980

Installation Procedure

1. Install the taillamp bulb.
   1.1. Press the bulb into the socket.
   1.2. Turn the bulb to the right.
2. Install the taillamp lens into the rubber housing boot.
   Make sure that the lens is fully seated.

Tail Lamp Replacement (Housing)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Disconnect the taillamp switch electrical connector.
4. Remove the taillamp assembly.
5. Remove the taillamp.

Installation Procedure

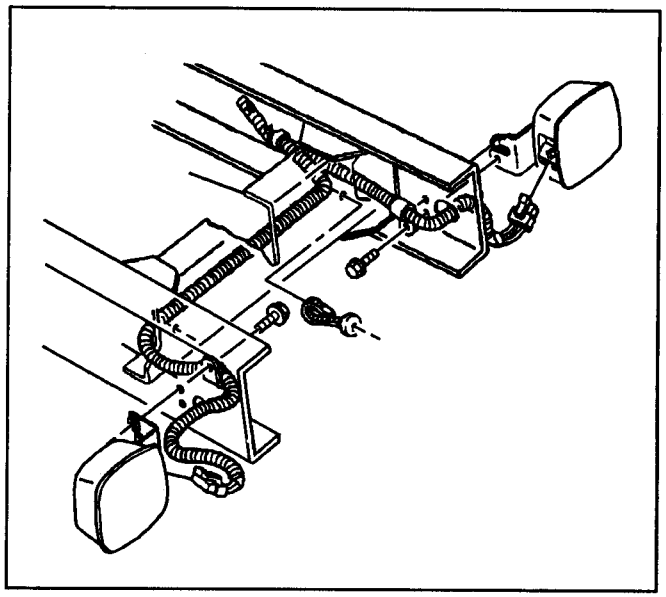
1. Install the taillamp by aligning the locator with the hole in the frame rail.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.

   Important: Make sure that the taillamp harness retaining clip is secured by the retaining bolt.
2. Install the retaining bolt into the taillamp assembly.

   Tighten

   Tighten the retaining bolt to 35 N·m (26 lb ft).
3. Connect the taillamp electrical connector.
4. Connect the negative battery cables.



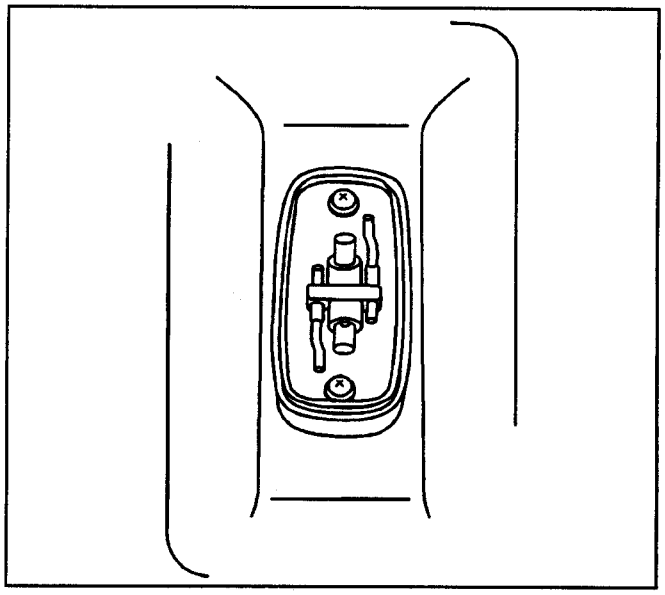
200980

Clearance Lamp Replacement - Outside Mirror (Housing)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

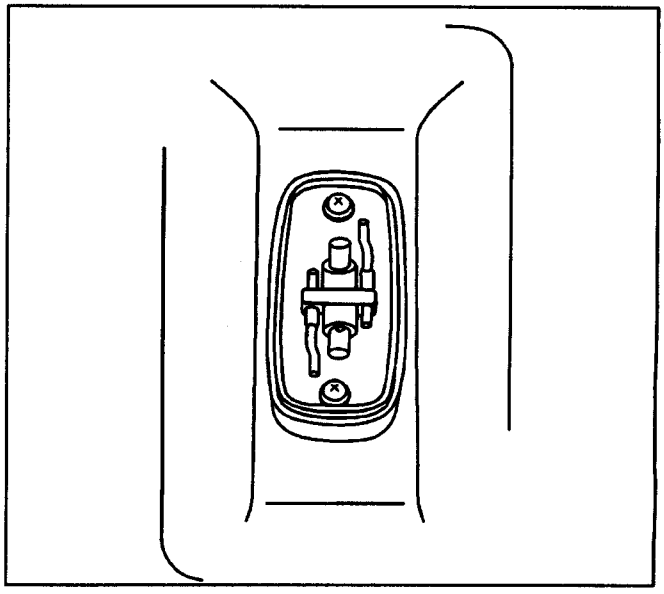
1. Turn OFF the headlamp switch.
2. Disconnect the negative battery cables.
3. Remove the illuminated mirror clearance lamp lens by unsnapping the lens from the lens housing.
4. Remove the two lamp housing retaining screws.
5. Disconnect the lamp electrical connectors.
6. Remove the lamp housing.



200969

Installation Procedure

1. Install the illuminated mirror clearance lamp housing.
2. Connect the clearance lamp electrical connectors.
3. Install the two lamp housing retaining screws.
4. Install the lens by snapping the lens onto the lens housing.
5. Connect the negative battery cables.



200969

Description and Operation

Lighting System Description

License Plate Lamp Replacement

The taillamp bulb also functions as the license plate lamp bulb. When the taillamps are turned on, the taillamp bulb shines through a clear lens at the bottom of the taillamp housing.

DRL Circuit Description

Circuit breaker #14 applies voltage to all of the filaments of the left headlamp at all times through CKT 688 or CKT 689 (RED/YEL). Circuit breaker #15 applies voltage to all of the filaments of the right headlamp at all times through CKT 694 or CKT 695 (RED/WHT). The headlamp switch is grounded at all times through CKT 87 and CKT 86 (BLK) to G105.

Low Beam Operation

When you place the headlamp switch in the HEAD and LO positions, the internal contacts of the switch close. This provides a path to ground the coil of the lighting relay through CKT 717 (RED/BLK). Circuit breaker #16 applies voltage at all times to the other side of the lighting relay coil. When ground is provided, the relay energizes, switching the relay contacts. A ground path is now provided to the low beam filaments through CKT 691 or CKT 697 (RED/BLK), through the now closed contacts of the relay, through CKT 716 (YEL) to the closed contacts of the low/high lighting relay to G105. With ground provided, the low beam filaments illuminate.

High Beam Operation

When the headlamp switch is in the HI or PASS position, a ground path to the low/high lighting relay is provided through CKT 721 (RED/YEL). Voltage is applied at all times through circuit breaker #16 and CKT 719 (ORN) to the coil of the low/high lighting relay, causing the relay to energize. With the relay contacts switched, a ground path is provided to the high beam filaments through CKT 690, CKT 692, CKT 696 or CKT 697 (BLK/WHT) through the now closed contacts of the low/high lighting relay to G105. With ground provided, the high beam filaments illuminate.

DRL Operation

In DRL operation, ground is provided to the low beam filaments through a different circuit through the normally closed contacts of the lighting relay. The park brake switch is grounded at all times at G105. When the parking brake is disengaged, ground is provided to one of the contacts of the DRL Off relay. The DRL Off relay is permanently grounded at G105. When the ignition switch is in the RUN position, voltage is supplied to the other side of the DRL Off relay, causing the relay to energize. The ground path is now provided through the now closed contacts of the DRL Off relay through the CKT 744 (DK GRN) to the normally closed contacts of the DRL On relay. The DRL On relay will energize and open up its contacts when the ignition switch is in the RUN position and the engine is not running. The ground path is now provided through CKT 729 (RED/BLK), through the DRL series dropping resistor, and through CKT 715 (RED/YEL) to the normally closed contacts of the lighting relay. The low beam filaments now light at 90 percent intensity because of the additional voltage drop across the DRL series dropping resistor.

Exterior Lights Circuit Description (Stop Lamp Circuit Operation)

Stoplamps

When the brake pedal is depressed, the Stoplamp Switch contacts close. The Stoplamp Switch has voltage available at all times from Circuit Breaker 25 (Circuit Breaker 23 on vehicles with Hydraulic Brakes) through the Ckt 103 or Ckt 110 (ORN) [CKT 470 (GRN/WHT) on vehicles with Hydraulic Brakes]. When the brake pedal is depressed and the switch contacts close, this voltage energizes Ckt 104 or CKT 105 (WHT) [CKT 471 (WHT) on vehicles with Hydraulic brakes] to the Turn/Hazard Flasher. The Turn/Hazard Flasher is a solid state logic device which controls the operation of the Stop, Turn and Hazard lamp functions. the Turn/Hazard Flasher distributes the voltage to the Stoplamp bulbs and to the Right and Left Trailer Turn Relays, which provide dedicated stop lamp signals to the Trailer Wiring Provision Connector.

These circuits are used with a dual filament, single bulb turn/stoplamp system. The Turn/Hazard Flasher logic enables one filament in a dual filament bulb to operate as a turn signal lamp even though the brake pedal is depressed. Both the Left and Right Tail Lamps contain dual filament bulbs as well as single filament back-up lamp bulbs. Both bulbs in the Left and Right Tail Lamps are grounded by CKT 150 (BLK) to Ground G 404.

Park and Side Marker Lamps

The Park, Side Marker and Clearance Lamps are energized whenever the Headlamp Switch is in the PARK or HEAD position. This causes a ground to be passed through the Headlamp Switch, which energizes the Taillamp Relay. When the Taillamp Relay is energized, voltage is distributed on CKT 94 (BRN) to the Front and Rear Park Lamps, the Right and Left Side Marker Lamps, the Right and Left Side Mirror Lamps, the Interior Body Builder Connector, and the Trailer Connector.

Grounding for the Front Park Lamps is through CKT 150 (BLK) to ground G 107. The Clearance Lamps, the Left and Right Front Side Marker Lamps, and the Lighted Mirror Lamps are grounded through CKT 550 or CKT 650 (BLK) to Ground G 105. The Right and Left Taillamps are grounded through CKT 150 (BLK) to G 404.

Marker Lamps (Tractor only)

The Marker Lamps are located on the top front portion of the cab. The Marker Lamps are controlled by the IP mounted Marker Lamp Switch. When the switch is pressed, current is passed through the switch on CKT 112 (ORN) to the Marker Lamp Relay. The Marker Lamp Relay switches power from CKT 178 (GRN) to CKT 177 (BRN) when it is energized by the Marker Lamp Switch. Power that is passed into CKT 177 (BRN) is also supplied to the Trailer Connector on CKT 53 (BLU) and through connector C 208 to the Roof Harness, where it supplies the front ID Lamps and the Clearance lamps.

Turn Signal and Hazard Lamps

The Turn Signal Lamps and Hazard Lamps operate from the same lamps. When operating as turn signal lamps, ground is provided from the Turn Signal Switch through either CKT 132 (BLU/BLK) or CKT 133 (BLU/ORN) to the Turn/Hazard Flasher. This causes the Turn/Hazard Flasher to operate only the front and rear bulbs on the selected side of the vehicle. When operated as Hazard Lamps, ground is provided to the Turn/Hazard Flasher by the Turn Signal Switch on both the Left CKT 132 (BLU/BLK) and the Right CKT 133 (BLU/ORN) at the same time and all four bulbs are flashed together.

Backup Lights Circuit Description

When the ignition switch is in the RUN position, voltage is available at the backup lamp switch from circuit breaker #9 through CKT 139 (PNK). The backup lamp switch is located on the transmission. When the transmission is placed into Reverse, the backup lamp switch contacts close. This applies voltage through CKT 24 (LT GRN) to both backup lamp assemblies. Voltage is also available to the backup alarm, if equipped. The backup lamps ground is provided through CKT 150 (BLK) to ground G404. When voltage is applied while the transmission is in Reverse, the lamps illuminate. Shifting to another gear or turning the ignition switch OFF causes the lamps to turn off.

Interior Lights Circuit Description

Dome Lamps

The dome lamp is located within the cab in the front center part of the headliner. The dome lamp receives power through CKT 150 or CKT 1 (ORN) from circuit breaker #7.

The lamp is operated by completing the ground circuit. The ground circuit is completed by operating the dome lamp switch (part of the dome lamp assembly) in one of two positions. With the switch in the DOOR position, ground is supplied to the dome lamp by the door switch, through CKT 26 or CKT 148 (RED/BLK), the diode module D 202 and CKT 2 or CKT 149 (RED/YEL). With the switch in the ON position, ground is supplied through an internal chassis ground screw connection, which doubles as a fastener for the dome lamp to the cab sheet metal.

Interior Lights Dimming Circuit Description

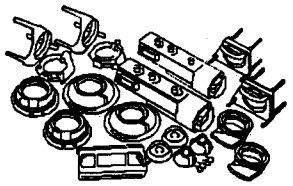
Circuit Operation

The instrument panel dimming system operates to provide a variable level of illumination at the speedometer and control switches. By adjusting the position of the dimmer control on the IP Cluster, a variable voltage is supplied to the system lamps and components.

Voltage is available at all times at circuit breaker 19. This voltage is supplied to the taillamp relay coil through CKT 93 (ORN). When the headlamp switch is positioned in either the PARK or ON positions, this switch supplies a ground to the taillamp relay coil. The taillamp relay then closes the normally open (87) contact, supplying power to the panel lamps and the IP dimmer switch. Ground is supplied through a variable resistance in the dimmer control. The resistance depends upon the position of the dimmer control.

The variable resistance ground is fed to the lamps from CKT 3 (BLK/RED) through joint connector #3. The joint connector is like a large splice pack. The joint connector distributes the variable resistance ground to the system lamps by CKT 40, CKT 173, CKT 134, CKT 124, CKT 86, CKT 116, CKT 146, CKT 104, CKT 39, CKT 100, CKT 353, CKT 46 or CKT 165 (BLK/RED).

Special Tools and Equipment

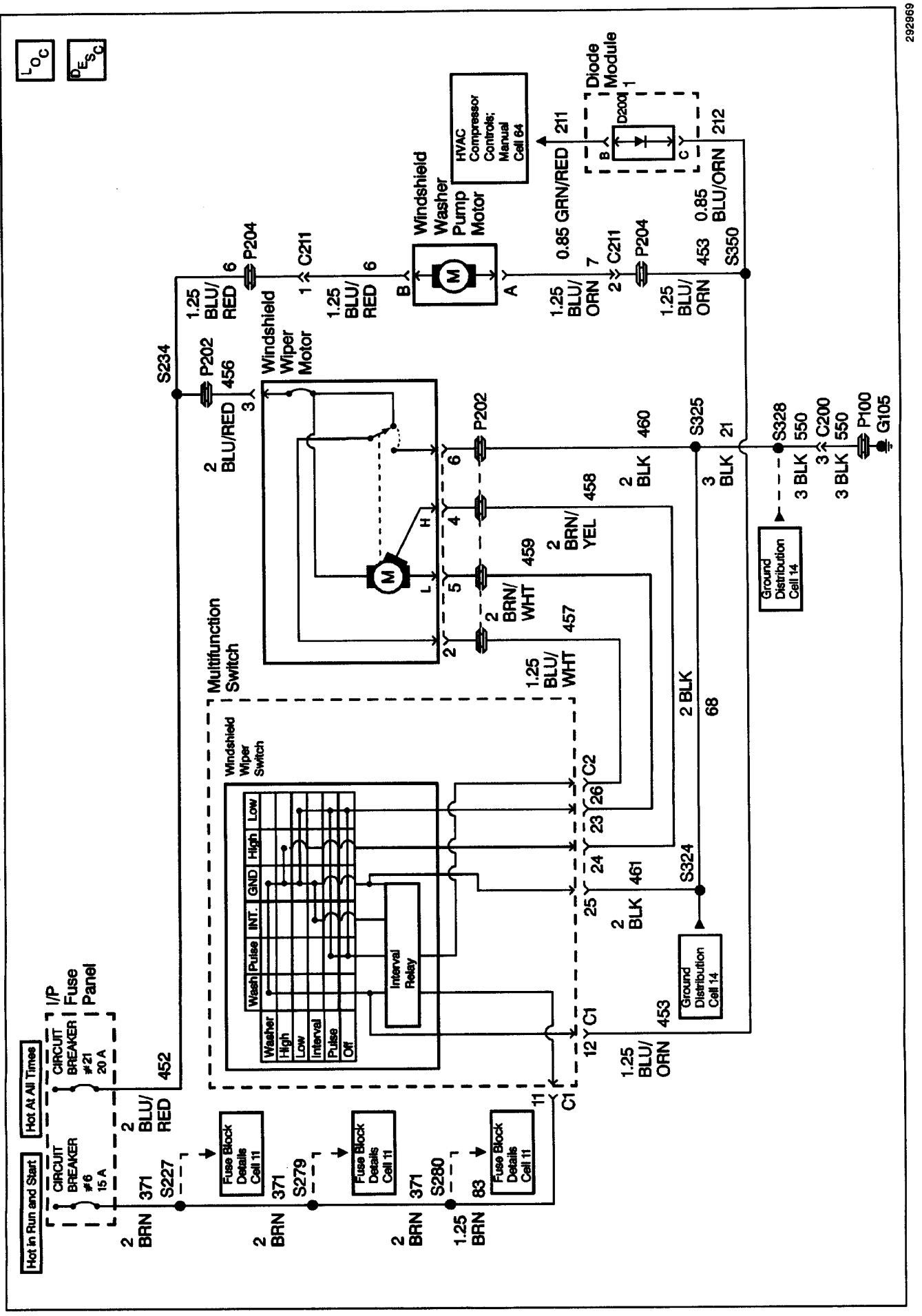
Illustration	Tool Number/ Description
 6302	J25300-E Headlamp Aimer

Wipers/Washer Systems

Schematic and Routing Diagrams

Wiper/Washer System Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
HVAC Compressor Controls Manual Cell 64	1—HVAC


Wiper/Washer System (Pulse) Schematics (Cell 91: Wiper Washer with Pulse)
292969
LOC
DESC
Hot In Run and Start
Hot At All Times
CIRCUIT BREAKER #6 15 A
CIRCUIT BREAKER #21 20 A
I/P Fuse Panel
2 BRN 371 S227
2 BRN 371 S279
2 BRN 371 S280
1.25 BRN 83
2 BLU/RED 452
Fuse Block Details Cell 11
Windshield Wiper Switch
Wash
Pulse
INT.
GND
High
Low
Washer
High
Low
Interval
Pulse
Off
Interval Relay
Multifunction Switch
S234
P202 456
2 BLU/RED 3
Windshield Wiper Motor
H
L
M
P202 6
2 BLU/RED 6
P204
C211 1
1.25 BLU/RED 6
B
A
Windshield Washer Pump Motor
HVAC Compressor Controls; Manual Cell 64
0.85 GRN/RED 211
Diode Module
D200
1.25 BLU/ORN 7
C211 2
P204
1.25 BLU/ORN 453
0.85 BLU/ORN 212
S350
2 BRN/YEL 458
2 BRN/WHT 459
2 BRN/WHT 457
1.25 BLU/WHT
2 BLK 460
S325 21
3 BLK
S328
3 BLK 550
C200 3
3 BLK 550
P100
G105
Ground Distribution Cell 14
2 BLK 68
C2 26
23
24
25
2 BLK 461
S324
C1 12
11
1.25 BLU/ORN 453
Ground Distribution Cell 14

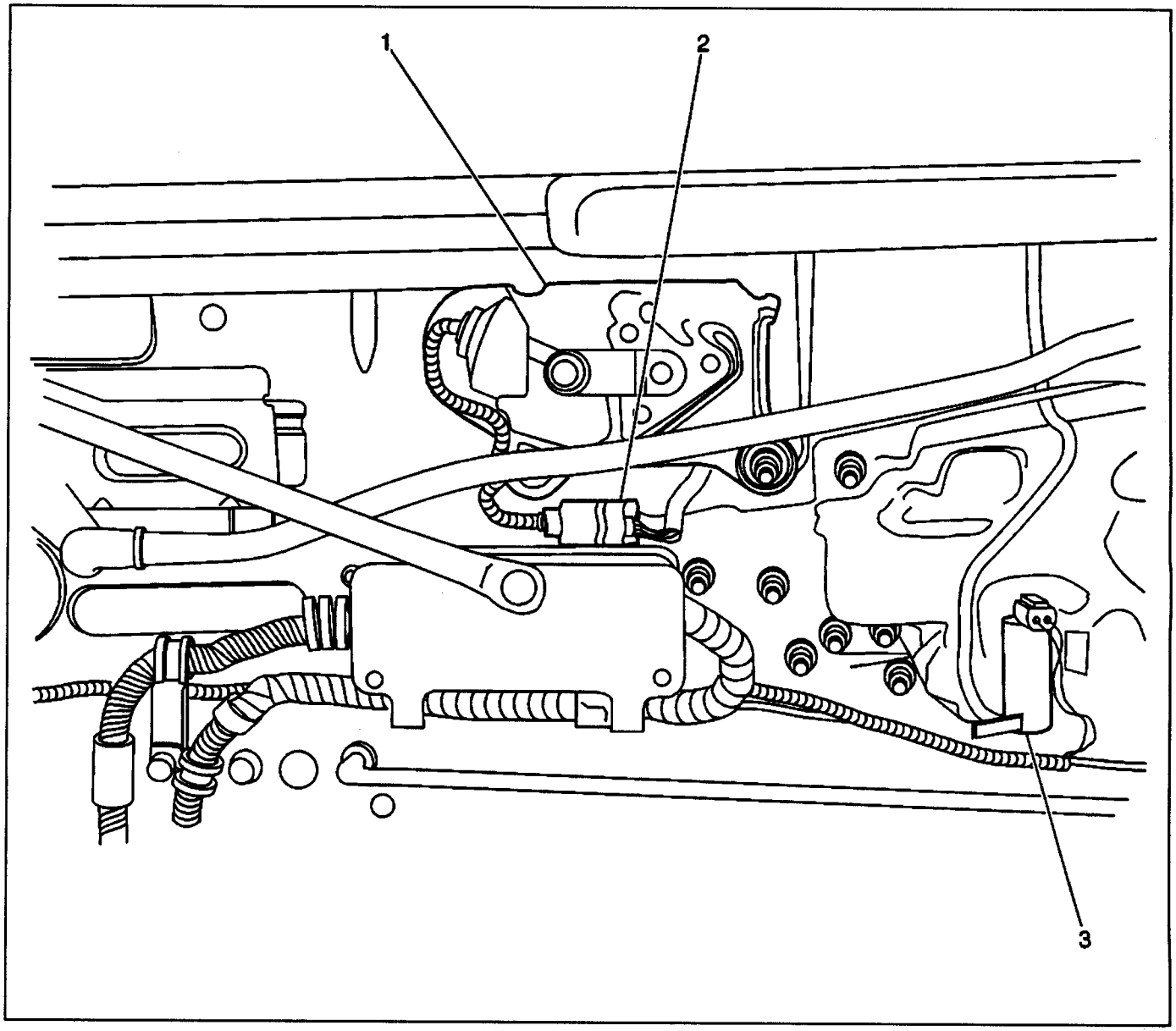
Component Locator

Wiper/Washer System Components

Name	Location	Locator View	Connector End View
Windshield Washer Pump Motor	On the center of the cab, under the hood, in the windshield washer reservoir	*Wiper/Washer System Component Views*	*Wiper/Washer System Connector End Views*
Windshield Washer Switch	On the right side of the steering column (part of the windshield wiper switch and multifunction switch)	*Wiper/Washer System Component Views*	—
Windshield Wiper Motor	On the center of the cab, under the hood	*Wiper/Washer System Component Views*	*Wiper/Washer System Connector End Views*
Windshield Wiper Switch	On the right side of the steering column (part of the multifunction switch)	*Wiper/Washer System Component Views*	—
D200	In the lower IP harness, part of the diode module 1, plugged into splice pack 1, terminals A, B and C	—	—

Wiper/Washer System Component Views

Underhood View

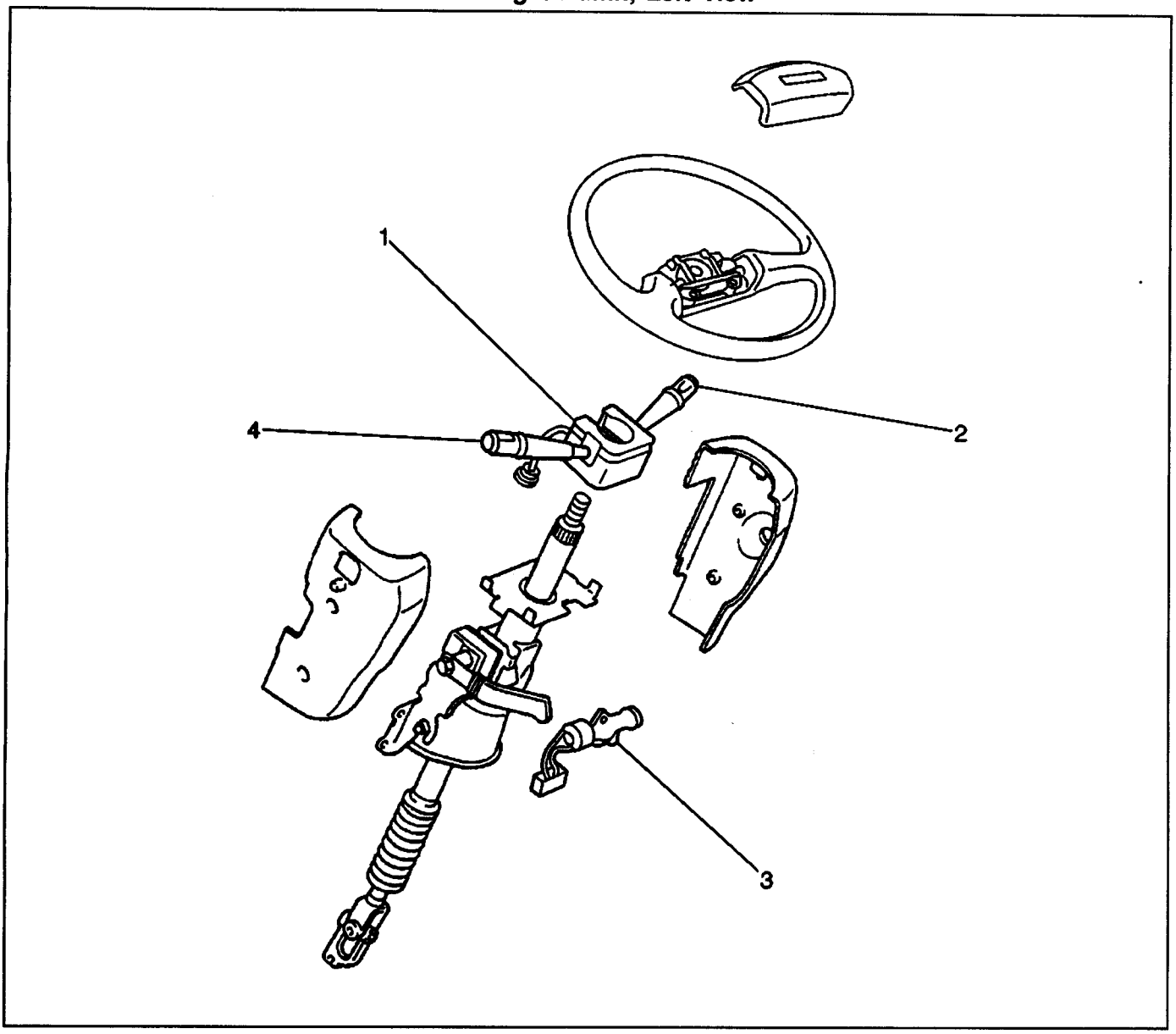


231456

Legend

(1) Windshield Wiper Motor
(2) Windshield Wiper Motor Connector
(3) Windshield Washer Pump Motor

Steering Column, Left View



228426

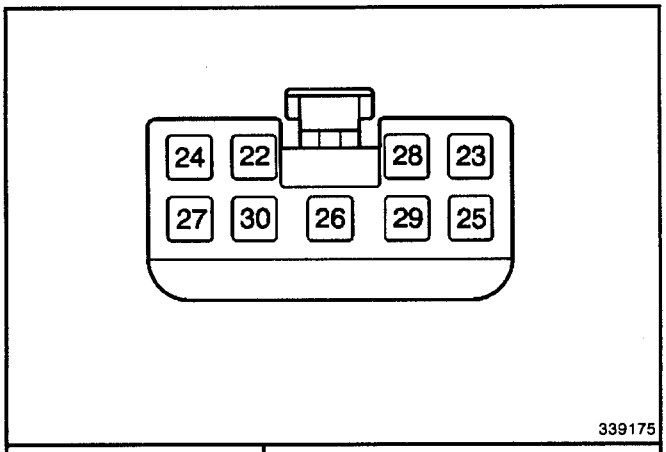
Legend

(1) Multifunction Switch
(2) Right Multifunction Lever
(3) Ignition Switch
(4) Left Multifunction Lever

Visual Identification

Wiper/Washer System Connector End Views

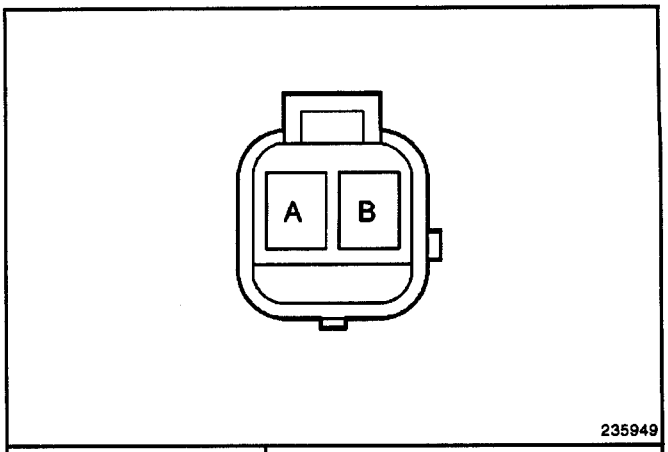
Windshield Wiper/Washer Switch C2



339175

Connector Part Information	• 9 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
22	—	—	Not Used
23	BRN/WHT	459	Windshield Wiper Motor Pin-5
24	BRN/YEL	458	Windshield Wiper Motor Pin-4
25	BLK	461	Ground
26	BLU/WHT	457	Windshield Wiper Motor Pin-2
27–30	—	—	Not Used

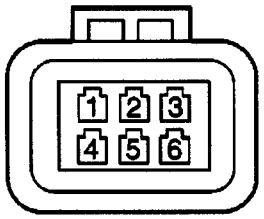
Windshield Washer Pump Motor



235949

Connector Part Information	• 2 Way F • (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLU/ORN	7	Switch Input Washer Pump
B	BLU/RED	6	Fuse Output Battery

Windshield Wiper Motor



238402

Connector Part Information	• 6 Way F • (GRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	—	—	Not Used
2	BLU/WHT	457	Intermittent
3	BLU/RED	456	Ignition
4	BRN/YEL	458	High
5	BRN/WHT	459	Low
6	BLK	460	Ground

Diagnostic Information and Procedures

Wiper/Washer Diagnostic System Check

Step	Action	Normal Result(s)	Abnormal Result(s)*
1	Turn the ignition switch to the ACCY or the RUN position. Hold the washer switch in the ON position for 1 to 2 seconds.	The washer sprays the windshield until the switch is released. The wipers run at a low speed and continue to run for approximately six seconds after the washer cycle is completed. Then the wipers return to the park position.	The washer does not spray the windshield or complete the washer cycle.
2	Turn the wiper switch to the INT position. Activate the intermittent wiper function through the entire range.	The wipers make one complete sweep, then pause for 0 to 25 seconds before making the next sweep.	The wipers do not make one complete sweep, then pause for 0 to 25 seconds before making the next sweep.
3	Turn the wiper switch to the INT position. Push the washer switch to the ON position for 1 to 2 seconds.	The washer sprays as long as the washer switch is held in the ON position. The wipers run at a low speed during the spray period and continue for approximately six seconds after the spray cycle. The wipers return to pulse mode.	The washer does not spray when the washer switch is held in the ON position. The wipers will not run at all. Refer to *Wipers All Modes and Washer Inoperative.*
4	Turn the wiper switch to the LOW position.	The wipers run continuously at a low speed.	The wipers do not run. Refer to *Wipers All Modes and Washer Inoperative.*
5	Turn the wiper switch to the HI position.	The wipers run at a faster speed.	The wipers do not run. Refer to *Wipers All Modes and Washer Inoperative.*
6	Turn the wiper switch to the OFF position.	The wipers return to the park position at a low speed.	The wipers do not run. Refer to *Wipers All Modes and Washer Inoperative.*
* Refer to the appropriate symptom diagnostic table for the applicable abnormal result.			

Wipers All Modes and Washer Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the windshield wiper motor connector. 2. Place the ignition switch in the RUN position. 3. Connect a test lamp between CKT 456 (BLU/RED) terminal 3 of the windshield wiper harness connector to ground. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 2*
2	Repair the open in CKT 452 (BLU/RED) between the IP fuse block and S234. Is the repair complete?	—	System OK	Go to *Step 3*
3	1. Disconnect the multifunction switch connector. 2. Connect a test lamp from CKT 83 (BRN) terminal 11 of the multifunction switch connector to ground. Did the test lamp light?	—	Go to *Step 5*	Go to *Step 4*
4	Repair the open in CKT 83 (BRN) or CKT 371 (BRN) between the IP fuse block and the multifunction switch. Is the repair complete?	—	System OK	Go to *Step 5*

Wipers All Modes and Washer Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
5	Connect a self-powered test lamp from windshield wiper motor connector CKT 460 (BLK) terminal 6 to ground. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 7*
6	Replace the multifunction switch. Is the repair complete?	—	System OK	—
7	Locate and repair the open in CKT 460 (BLK) or CKT 720 (BLK) or CKT 550 (BLK) between S325 and G105. Is the repair complete?	—	System OK	—

Wipers All Modes Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the windshield wiper motor connector. 2. Place the ignition switch in the RUN position. 3. Connect a test lamp from CKT 456 (BLU/RED) terminal 3 of the windshield wiper connector to ground. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 2*
2	Repair the open in CKT 456 (BLU/RED) between S234 and the windshield wiper motor connector. Is the repair complete?	—	System OK	Go to *Step 3*
3	Connect a self-powered test lamp from windshield wiper motor connector CKT 460 (BLK) terminal 6 to ground. Did the test lamp light?	—	Go to *Step 5*	Go to *Step 4*
4	Repair the open in CKT 460 (BLK) between the windshield wiper motor connector terminal 6 and S325. Is the repair complete?	—	System OK	Go to *Step 5*
5	1. Connect a test lamp from the windshield wiper motor connector CKT 459 (BRN/WHT) terminal 5 to ground. 2. Place the windshield wiper switch in the low speed position. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 7*
6	Replace the windshield wiper motor. Is the repair complete?	—	System OK	Go to *Step 7*
7	Keep the windshield wiper switch in the low speed position. Backprobe the multifunction switch connector CKT 459 (BRN/WHT) terminal 23 with a test lamp to ground. Did the test lamp light?	—	Go to *Step 8*	Go to *Step 9*
8	Locate and repair the open in CKT 459 (BRN/WHT) between the multifunction switch and the windshield wiper motor connector. Is the repair complete?	—	System OK	—
9	Replace the multifunction switch. Is the repair complete?	—	System OK	—

Wipers High Mode Inoperative, Low Mode Operates

Step	Action	Value(s)	Yes	No
1	1. Disconnect the connector at the windshield wiper motor. 2. Place the ignition switch in the RUN position. 3. Connect a test lamp from windshield wiper motor connector CKT 458 (BRN/YEL) terminal 4 to ground. 4. Place the windshield wiper switch in the high speed position. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Replace the windshield wiper motor. Is the repair complete?	—	System OK	Go to *Step 3*
3	Keep the windshield wiper switch in the high speed position. Backprobe with a test lamp from multifunction switch connector CKT 458 (BRN/YEL) terminal 24 to ground. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the open in CKT 458 (BRN/YEL) between the multifunction switch and the windshield wiper motor connector. Is the repair complete?	—	System OK	—
5	Replace the multifunction switch. Is the repair complete?	—	System OK	—

Wipers Low Mode Inoperative, High Mode Operates

Step	Action	Value(s)	Yes	No
1	1. Disconnect the connector at the windshield wiper motor. 2. Place the ignition switch in the RUN position. 3. Connect a test lamp from windshield wiper motor connector CKT 459 (BRN/WHT) terminal 5 to ground. 4. Place the windshield wiper switch in the low speed position. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Replace the windshield wiper switch. Is the repair complete?	—	System OK	Go to *Step 3*
3	Keep the windshield wiper switch in the low speed position. Backprobe with a test lamp from multifunction switch connector CKT 459 (BRN/WHT) terminal 23 to ground. Is the repair complete?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the open in CKT 459 (BRN/WHT) between the multifunction switch and the windshield wiper motor connector. Is the repair complete?	—	System OK	—
5	Replace the multifunction switch. Is the repair complete?	—	System OK	—

Wipers Always On

Step	Action	Value(s)	Yes	No
1	1. Place the windshield wiper switch in the OFF position. 2. Place the ignition switch in the RUN position. 3. Disconnect the connector at the windshield wiper motor. 4. Connect a test lamp from the windshield wiper motor connector CKT 459 (BRN/WHT) terminal 5 to ground. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 5*
2	1. Keep the test lamp connected. 2. Disconnect the multifunction switch connector. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the short to voltage on CKT 459 (BRN/WHT) between the multifunction switch and the windshield wiper motor. Is the repair complete?	—	System OK	Go to *Step 5*
4	Replace the multifunction switch. Is the repair complete?	—	System OK	Go to *Step 5*
5	Connect a test lamp from the windshield wiper motor connector CKT 458 (BRN/YEL) terminal 4 to ground. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 9*
6	1. Keep the test lamp connected. 2. Disconnect the multifunction switch connector. Did the test lamp light?	—	Go to *Step 7*	Go to *Step 8*
7	Repair the short to voltage on CKT 458 (BRN/YEL) between the multifunction switch and the windshield wiper motor. Is the repair complete?	—	System OK	Go to *Step 9*
8	Replace the multifunction switch. Is the repair complete?	—	System OK	Go to *Step 9*
9	Connect a test lamp from the windshield wiper motor connector CKT 457 (BLU/WHT) terminal 2 to ground. Did the test lamp light?	—	Go to *Step 11*	Go to *Step 10*
10	Replace the windshield wiper motor. Is the repair complete?	—	—	Go to *Step 11*
11	1. Keep the test lamp connected. 2. Disconnect the multifunction switch connector. Did the test lamp light?	—	Go to *Step 12*	Go to *Step 13*
12	Locate and repair the short to voltage on CKT 457 (BLU/WHT) between the multifunction switch and the windshield wiper motor. Is the repair complete?	—	System OK	—
13	Replace the multifunction switch. Is the repair complete?	—	System OK	—

Washers Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the connector at the windshield washer pump motor. 2. Connect a test lamp from the windshield washer pump motor connector CKT 6 (BLU/RED) terminal 1 to ground. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 2*
2	Repair the open in CKT 6 (BLU/RED) between S234 and the windshield washer pump motor connector. Is the repair complete?	—	System OK	Go to *Step 3*
3	1. Connect a self-powered test lamp from the windshield washer pump motor connector CKT 7 (BLU/ORN) terminal 2 to ground. 2. Press and hold the WASH switch. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
4	Replace the windshield washer pump motor. Is the repair complete?	—	System OK	Go to *Step 5*
5	1. Backprobe from the multifunction switch connector terminal 12 to chassis ground with a self-powered test lamp. 2. Press and hold the WASH switch. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 7*
6	Repair the open in CKT 453 (BLU/ORN) between the multifunction switch and the windshield washer pump motor connector. Is the repair complete?	—	System OK	—
7	Replace the multifunction switch. Is the repair complete?	—	System OK	—

Washers Always On

Step	Action	Value(s)	Yes	No
1	1. Disconnect the connector at the windshield washer pump motor. 2. Connect a self-powered test lamp from the windshield washer pump motor connector CKT 7 (BLU/ORN) terminal 2 to ground. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 2*
2	Replace the windshield washer pump motor. Is the repair complete?	—	System OK	Go to *Step 3*
3	Keep the self-powered test lamp connected. Disconnect the multifunction switch. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the short to ground in CKT 453 (BLU/ORN) between the multifunction switch and the windshield washer pump motor connector. Is the repair complete?	—	System OK	—
5	Replace the multifunction switch. Is the repair complete?	—	System OK	—

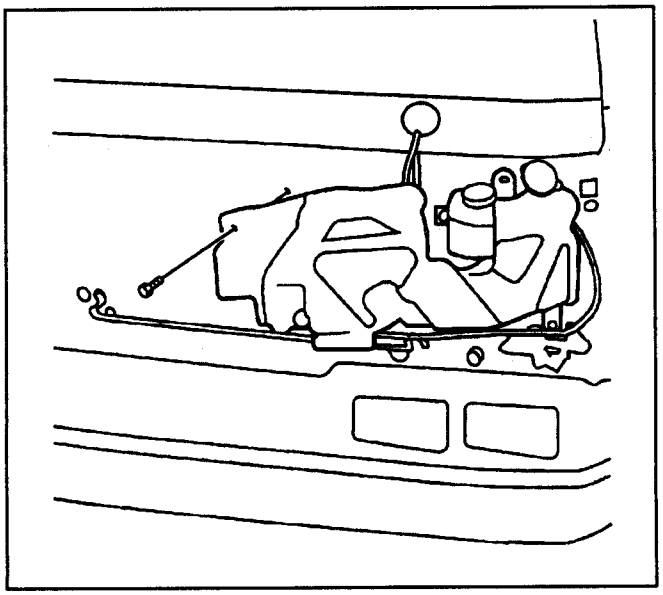
Wiper Arm Tip Pressure Check, Blade Element Check

If the wipers miss or shudder when wiping the windshield and the windshield wipers and wiper inserts are clean, check the wiper arm pressure. If the wiper arms are not within specifications, replace the wiper arms. Refer to *Wiper Arm Replacement.* Complete the following steps in order to check the wiper arm pressure:

1. Position the wiper arm in the center of the windshield.
2. Attach a tension scale at the end of the wiper arm.
3. While pulling on the scale, lift the wiper arm approximately 13 mm (0.5 in) above of the windshield.
4. Measure the wiper arm pressure. Ensure that the wiper arm pressure is between 7.8-9.5 N (28-34 oz).

Blade Insert Set Check

Remove the wiper blade assemblies from the wiper arms. Look down the length of the blade insert. The rubber insert that contacts the glass must be on the center line of the blade or no more than 15 degrees. Replace the insert if necessary.



215294

Repair Instructions

Washer Pump/Reservoir Replacement

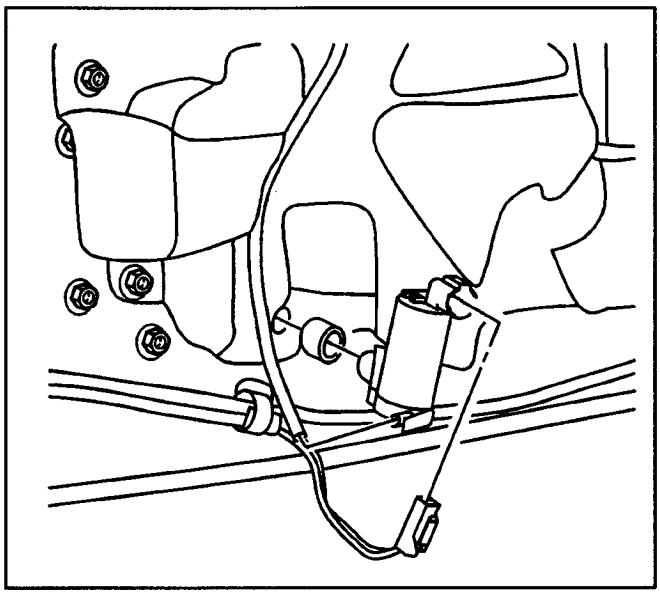
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Raise and support the hood.
3. Remove the electrical connector from the washer pump motor.

   Important: Prior to removing the hoses from the solvent container or the pump, position an adequate container in order to catch the fluid.
4. Remove the hoses from the washer pump motor and the solvent container.
5. Remove the bolts and solvent container from the vehicle.

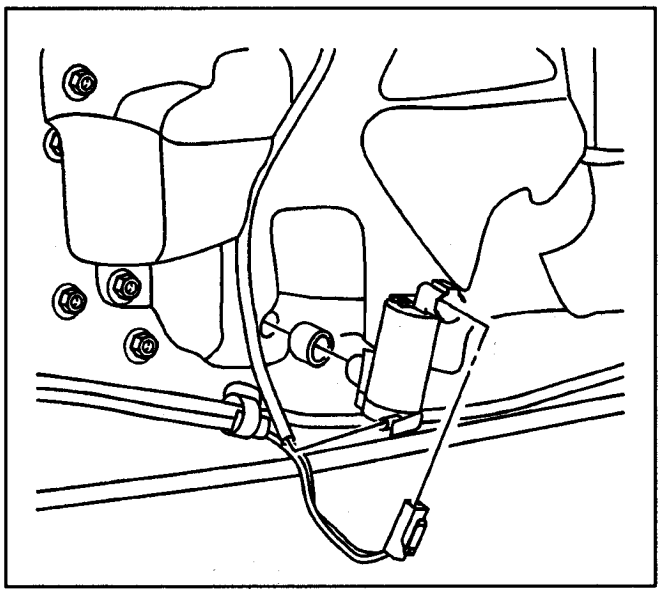
6. Remove the washer pump motor from the solvent container.
7. Remove the washer pump motor grommet from the solvent container.



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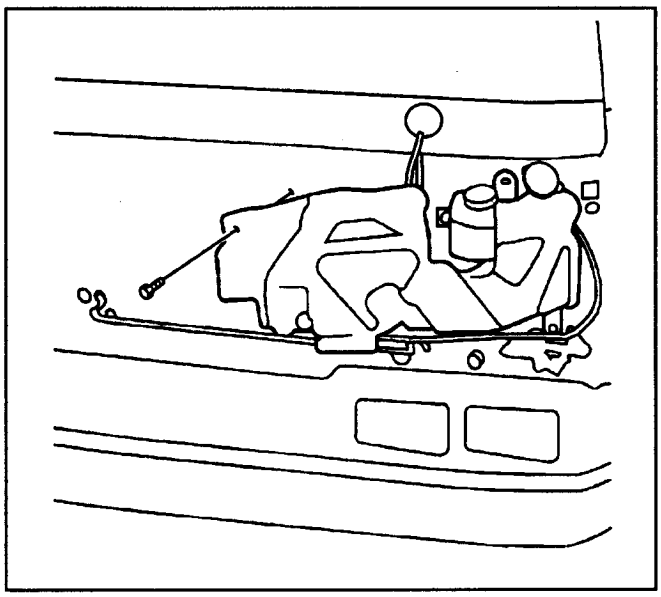
Installation Procedure

1. Install the washer pump motor grommet to the solvent container.
2. Install the washer pump motor to the solvent container.
3. Install the solvent container bolts.
4. Connect the hoses to the washer pump motor solvent container.

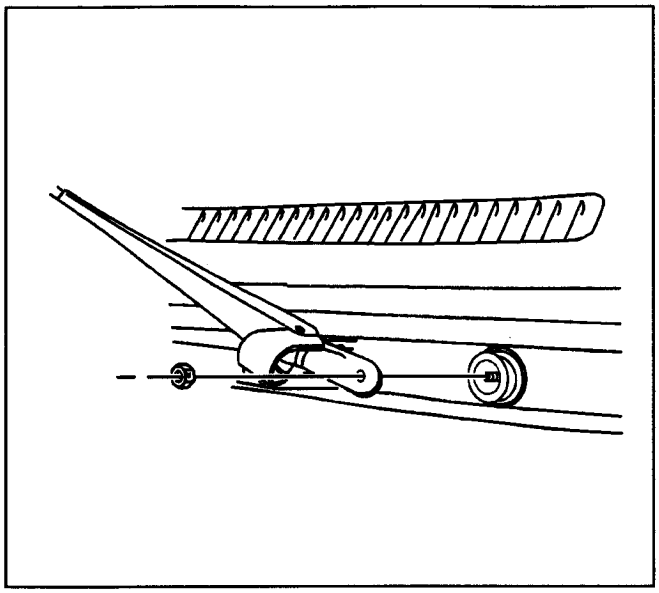


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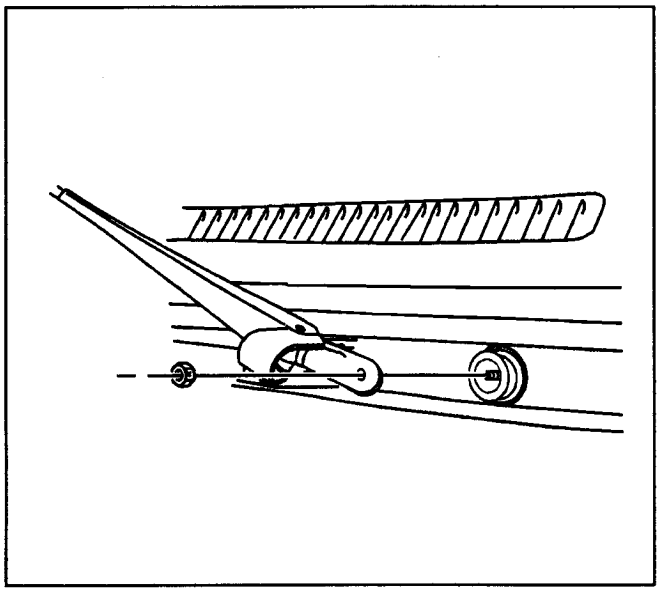
5. Install the electrical connector to the washer pump motor.
6. Fill the solvent container.
7. Close the hood.
8. Connect the negative battery cable.



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Wiper Arm Replacement

Removal Procedure

Important: Before removing one or both arm and blade assemblies, mark the windshield in order to indicate proper park position and to aid in reinstallation.

1. Remove the washer hose.
2. Lift the wiper arm nut cover.
3. Remove the wiper arm nut and wiper arm from the wiper transmission.

Installation Procedure

1. Position the wiper arm on the transmission drive shaft so that the wiper blade aligns with the mark made during removal.
2. Install the wiper arm nut.
3. Install the lower wiper arm nut cover.
4. Install the washer hose.

Wiper Arm Blade Replacement

Removal Procedure

1. Complete the following steps in order to remove the wiper blade from the wiper arm:
   1.1. Insert a narrow-bladed screwdriver into the slot over the retainer spring.
   1.2. Pivot the screwdriver so that the blade tip presses downward on the retainer spring.
   1.3. Release the blade from the pin of the wiper arm.

   Important: The insert must be replaced if it is removed.
2. Squeeze the locking tabs together in order to remove the insert from the blade.

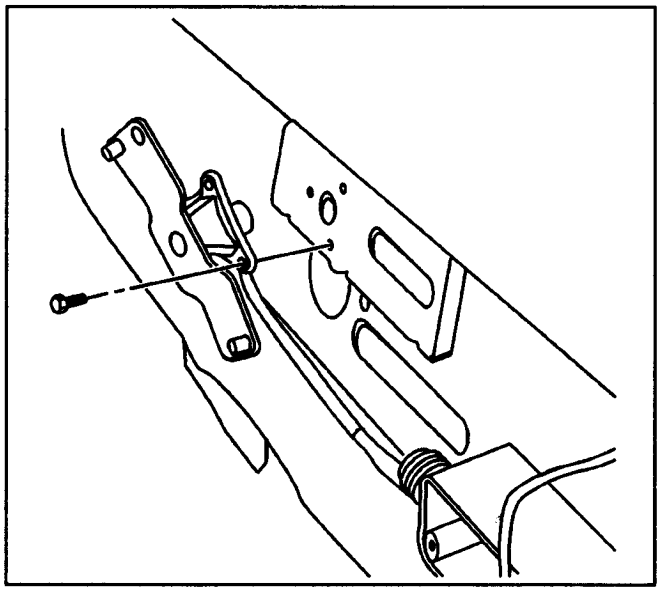
Installation Procedure

1. Complete the following steps in order to install the wiper arm:
   1.1. Position the retainer at the bottom end of the blade.
   1.2. Guide the insert through the blade.
   Ensure that you engage the claw sets along the entire length of the blade.
   The insert is fully seated when both locking tabs engage the claw set.
2. Install the blade to the wiper by snapping the blade into place.

Wiper Center Pivot Replacement

Removal Procedure

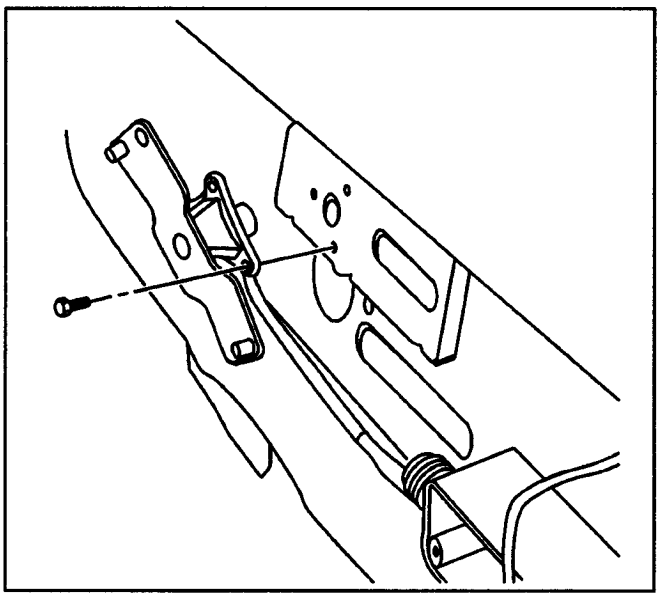
1. Raise and support the hood.
2. Align the wiper motor with the alignment marks.
3. Remove the wiper arm links from the center pivot.
4. Remove the wiper center pivot bolts.
5. Remove the wiper center pivot from the vehicle.



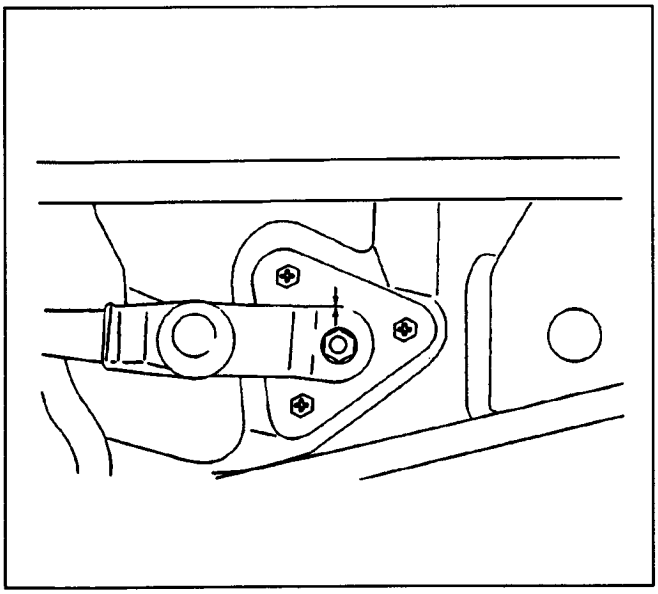
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Installation Procedure

1. Install the wiper center pivot to the vehicle using the wiper center pivot bolts.
2. Install the wiper arm links to the wiper center pivot.
3. Close the hood.



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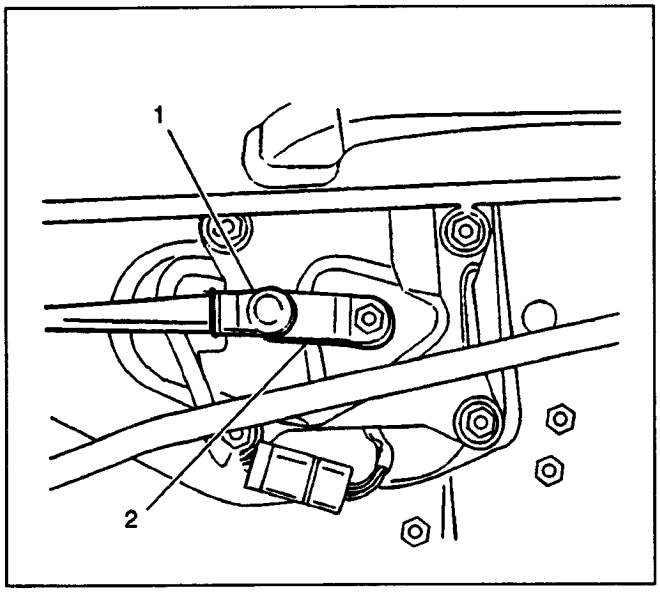
215289

Wiper Motor Replacement

Removal Procedure

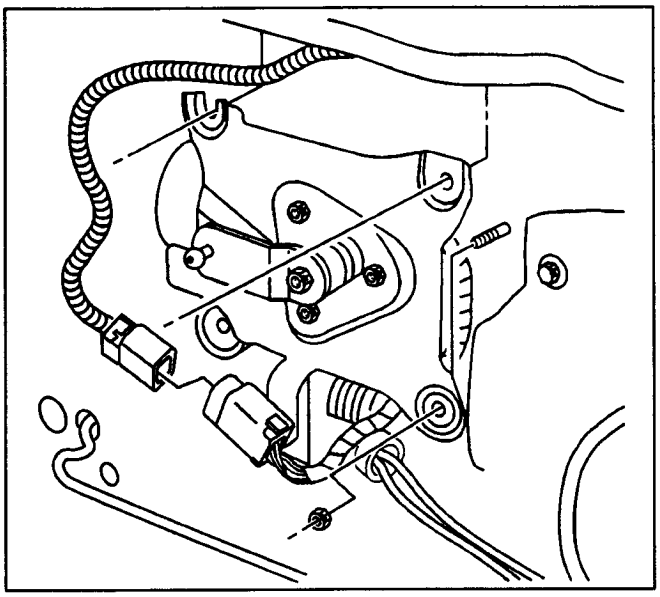
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable. Refer to *Battery Cable Replacement* in Engine Electrical.
2. Raise and support the hood.
3. Align the wiper motor with the alignment marks.



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4. Disconnect the wiper arm links (1) from the left wiper transmission at the wiper motor crank (2).
5. Remove the electrical connector from the wiper motor.
6. Loosen the wiper motor mounting nuts enough to access the wiper wiring harness retaining clip on the back side of the wiper motor.
7. Remove the wiper wiring harness from the wiper motor bracket.

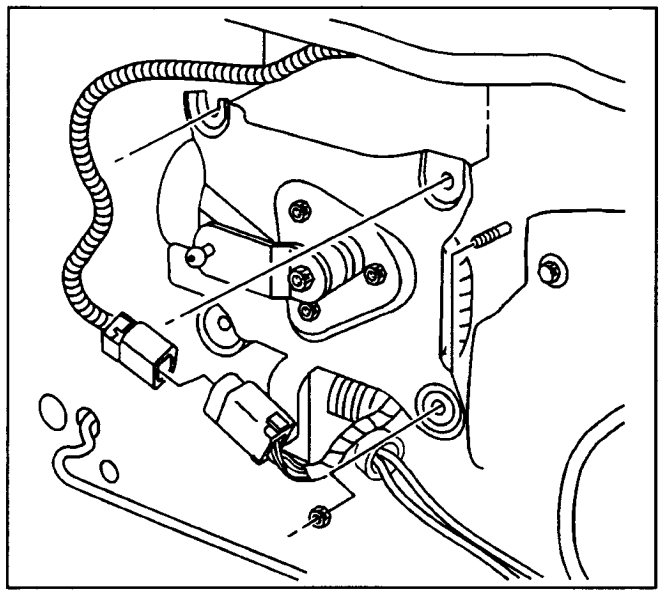


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8. Remove the wiper motor from the vehicle.

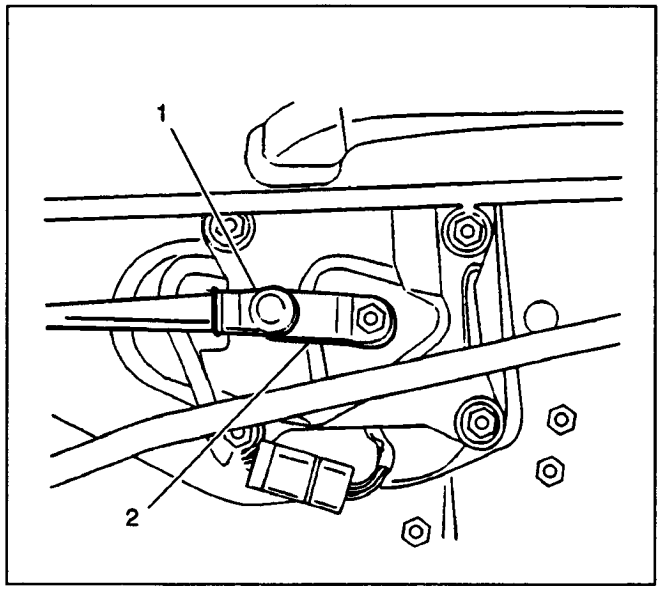
Installation Procedure

1. Install the wiper motor to the vehicle.
2. Install the wiper wiring harness clip to the wiper motor bracket.
3. Install the wiper motor to the vehicle using the mounting nuts.
4. Install the electrical connector to the wiper motor.



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5. Connect the wiper arm links (1) to the wiper motor crank (2) and to the left wiper transmission.
6. Close the hood.
7. Connect the negative battery cable.

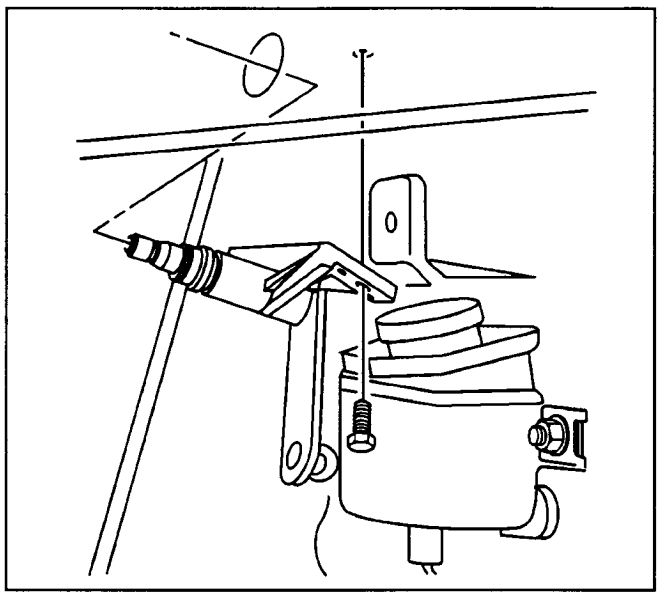


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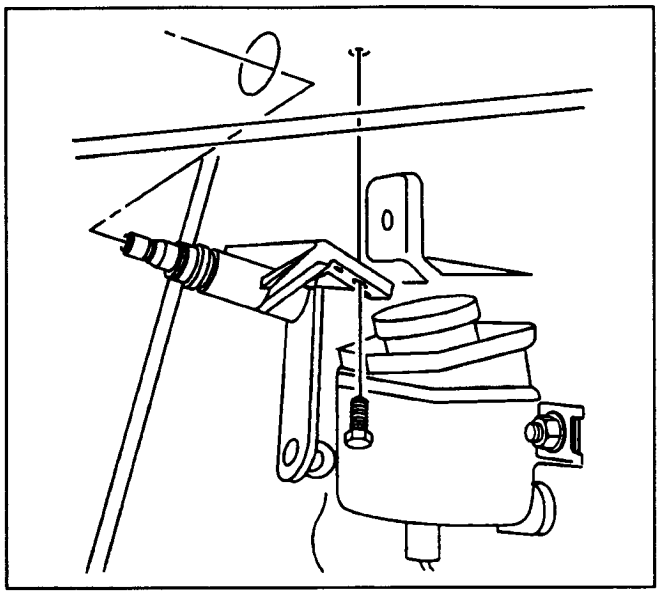
Wiper Transmission Replacement

Removal Procedure

1. Remove the wiper arm. Refer to *Wiper Arm Replacement.*
2. Raise and support the hood.
3. Remove the link arm from the wiper transmission.
4. Remove the two bolts and the wiper transmission from the windshield cowl.



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Installation Procedure

1. Install the wiper transmission to the windshield cowl using the two bolts.
2. Install the link arm to the wiper transmission.
3. Close the hood.
4. Install the wiper arm.

Wiper Chatter Repair

If the wipers chatter or shudder when wiping the windshield, clean the windshield and/or the inserts. Use a non-abrasive cleaner such as Bon Ami® in order to clean the windshield. Continue cleaning until the water sheets off the windshield. Use undiluted windshield washer solvent and a clean, lint free cloth in order to clean the wiper inserts.

Caution: Avoid prolonged skin contact with washer solvent in order to avoid damage to your skin. Overexposure may cause central nervous system effects.

Use only a water-soluble marker in order to mark the windshield. Other types of markers may damage the wiper inserts. The chemicals that are used to remove other types of markings may damage the paint, the glass, the inserts, or leave a residue on the glass that could lead to chatter.

Wiper arms must not be subjected to temperatures above 70°C (160°F). Remove the wiper arms before any painting operations that include the use of an oven in order to cure the paint.

Wipers/Washer Switch Replacement

The wiper/washer switch assembly is part of the combination switch located inside the steering column. Refer to Steering Column in Steering Wheel and Column for replacement procedures.

Description and Operation

Windshield Wipers/Washer System Description

The windshield wiper/washer system consists of the following components:

- The permanent magnet
- The positive-park wiper motor
- The center pivot
- Two wiper transmissions
- The arm links
- The wiper arm and blade assemblies
- The washer pump motor mounted on the side of the washer solvent container
- The turn signal-type wiper/washer switch assembly

The turn signal-type wiper/washer switch assembly is an integral component of the combination switch located on the steering column.

The wiper motor drives an arm link attached to the center pivot. The arm links connect to individual transmissions for both the right and left sides. The wiper transmissions are mounted below the windshield in the windshield cowl. The transmission transfers rotary motion from the wiper motor into reciprocating motion at the transmission drive shafts.

The wiper motor is sealed. No service parts are available. Replace the motor if the motor requires service.

Wiper/Washer System Operation

When you push the wash button for more than one second, washer solvent sprays onto the windshield as long as you hold the button. Wiper activity will continue for about 6 seconds after the button is released.

Rotating the wiper switch to the LO or HI speed position closes the respective brush circuit and the wiper motor runs at the corresponding speed.

Rotating the wiper switch to the INT mode operates the wiper motor intermittently. The delay varies by rotating the INT TIME switch sleeve back and forth.

Washer hose routing begins at two nozzles that mount to the wiper arms. The hose clips in various places to the wiper arm and the cowl, then attaches to the washer pump.

Wiper/Washer System Circuit Description

Circuit Operation

The pulse-type windshield wiper is powered by a two-speed windshield wiper motor. The windshield wiper switch on the multifunction switch controls the motor. In the HIGH mode, the windshield wiper motor operates at high speed without any delay after the end of a wipe cycle. When the multifunction switch is in any other mode, the motor operates at low speed. However, a variable delay time between wipe cycles reduces the wipe frequency. The solid state logic of the windshield wiper switch determines the variable delay. The solid state logic also contains logic which will return the wipers to the parked position after the windshield washer switch moves to the OFF position.

Circuit Breaker 21 supplies voltage at all times to the windshield wiper motor and the windshield washer pump motor through CKT 452 (BLU/RED). Circuit Breaker 6 supplies voltage to the windshield wiper switch whenever the ignition switch is in the RUN or the START position through CKT 371 (BRN).

Washer Operation

When the windshield wiper switch is pressed, the windshield washer pump motor is grounded through the closed contacts of the windshield wiper switch to G105. The windshield washer pump operates as long as the washer switch is pressed. Depressing the washer switch will also initiate operation of the wipers. When the washer switch is depressed, voltage is switched through the internal circuitry of the windshield wiper switch from the LOW side of the windshield wiper motor to G105. The wipers will operate until the washer switch is released. As the motor turns, the windshield wiper motor pawl and switch engages and turns along with the motor. The pawl and switch remains closed for one wipe cycle. If the switch is closed, battery voltage is applied to the interval relay at the windshield wiper switch.

Low Operation

If the windshield wiper switch is in the LO position, battery voltage is applied through circuit breaker 21 to the LOW winding of the windshield wiper motor and then to the LOW side of the windshield wiper switch. The internal circuitry of the windshield wiper switch then switches the voltage to G105. Since the windshield wiper motor grounds permanently at G105, the motor operates at low speed as long as the switch remains in the LO position.

High Operation

If the windshield wiper switch is in the HI position, battery voltage is applied through circuit breaker 21 to the HIGH winding of the windshield wiper motor and then to the HIGH side of the windshield wiper switch. The internal circuitry of the windshield wiper switch then switches the voltage to G105. Since the windshield wiper motor grounds permanently at G105, the motor operates at high speed as long as the switch remains in the HIGH position.

Intermittent Operation

Intermittent operation is similar to LOW operation. If the windshield wiper switch is in the INT position, battery voltage is applied to the LOW side of the windshield wiper motor. The ground is pulsed through the closed contacts of the windshield wiper switch. Turning the INT TIME control on the windshield wiper switch adjusts the timed pulses sent to the windshield wiper motor.

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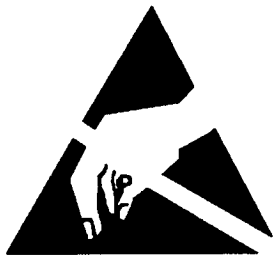
Entertainment

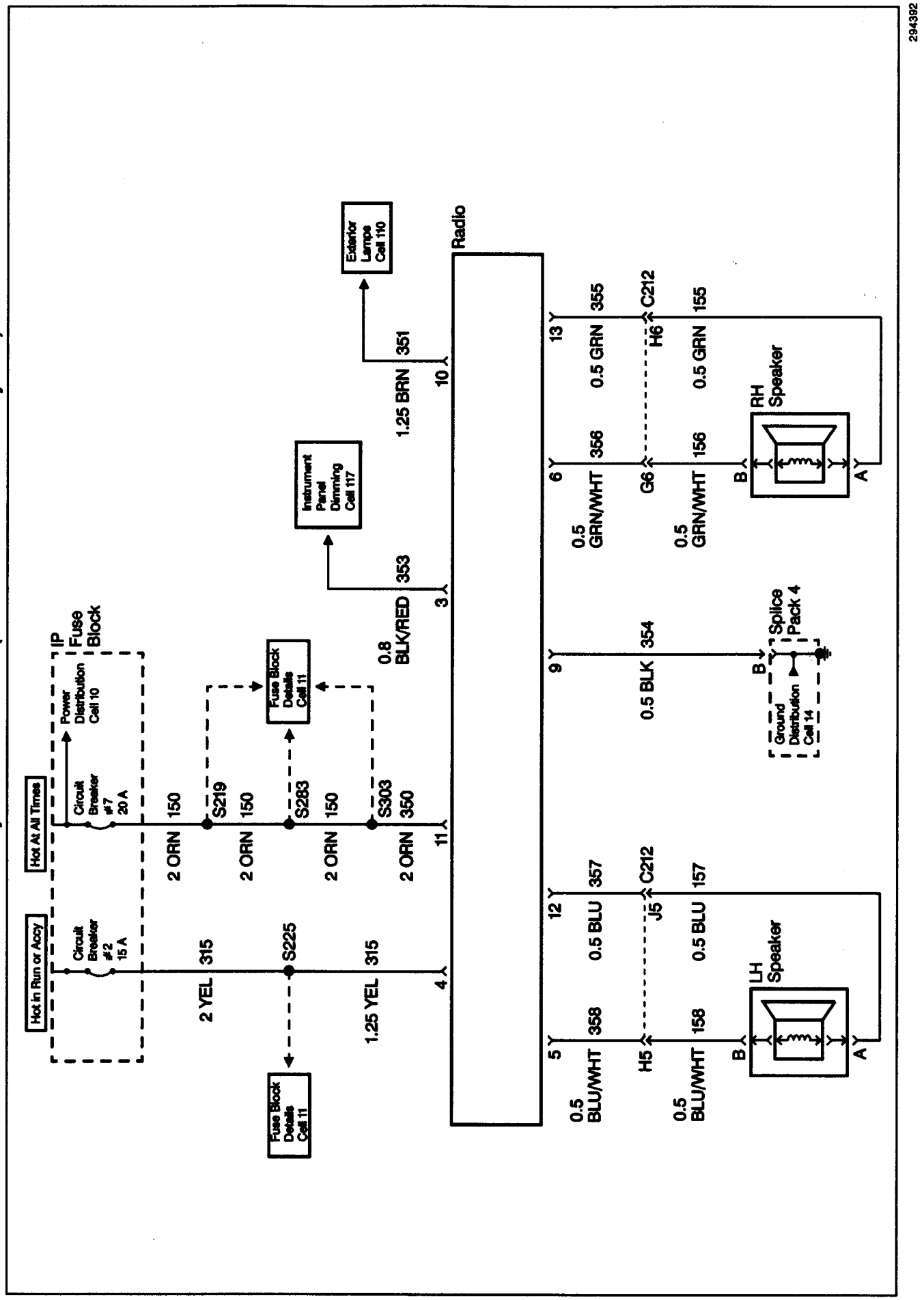
Schematic and Routing Diagrams

Entertainment Schematic References

Reference on Schematic	Section Number - Subsection Name
Exterior Lamps Cell 110	8—Lighting Systems
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Instrument Panel Dimming Cell 117	8—Lighting Systems

Entertainment Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.


Radio/Audio System Schematics (Cell 150: Entertainment System)
294392
Hot in Run or Accy
Hot At All Times
Circuit Breaker #2 15 A
Circuit Breaker #7 20 A
IP Fuse Block
Power Distribution Cell 10
Fuse Block Details Cell 11
Fuse Block Details Cell 11
Instrument Panel Dimming Cell 117
Exterior Lamps Cell 110
Radio
Splice Pack 4
Ground Distribution Cell 14
LH Speaker
RH Speaker
2 YEL 315 S225 1.25 YEL 315
2 ORN 150 S219
2 ORN 150 S283
2 ORN 350 S303
0.8 BLK/RED 353
1.25 BRN 351
0.5 BLU 357 C212 J5 0.5 BLU 157
0.5 BLU/WHT 358 H5 0.5 BLU/WHT 158
0.5 GRN/WHT 356 G6 0.5 GRN/WHT 156
0.5 GRN 355 C212 H6 0.5 GRN 155
0.5 BLK 354
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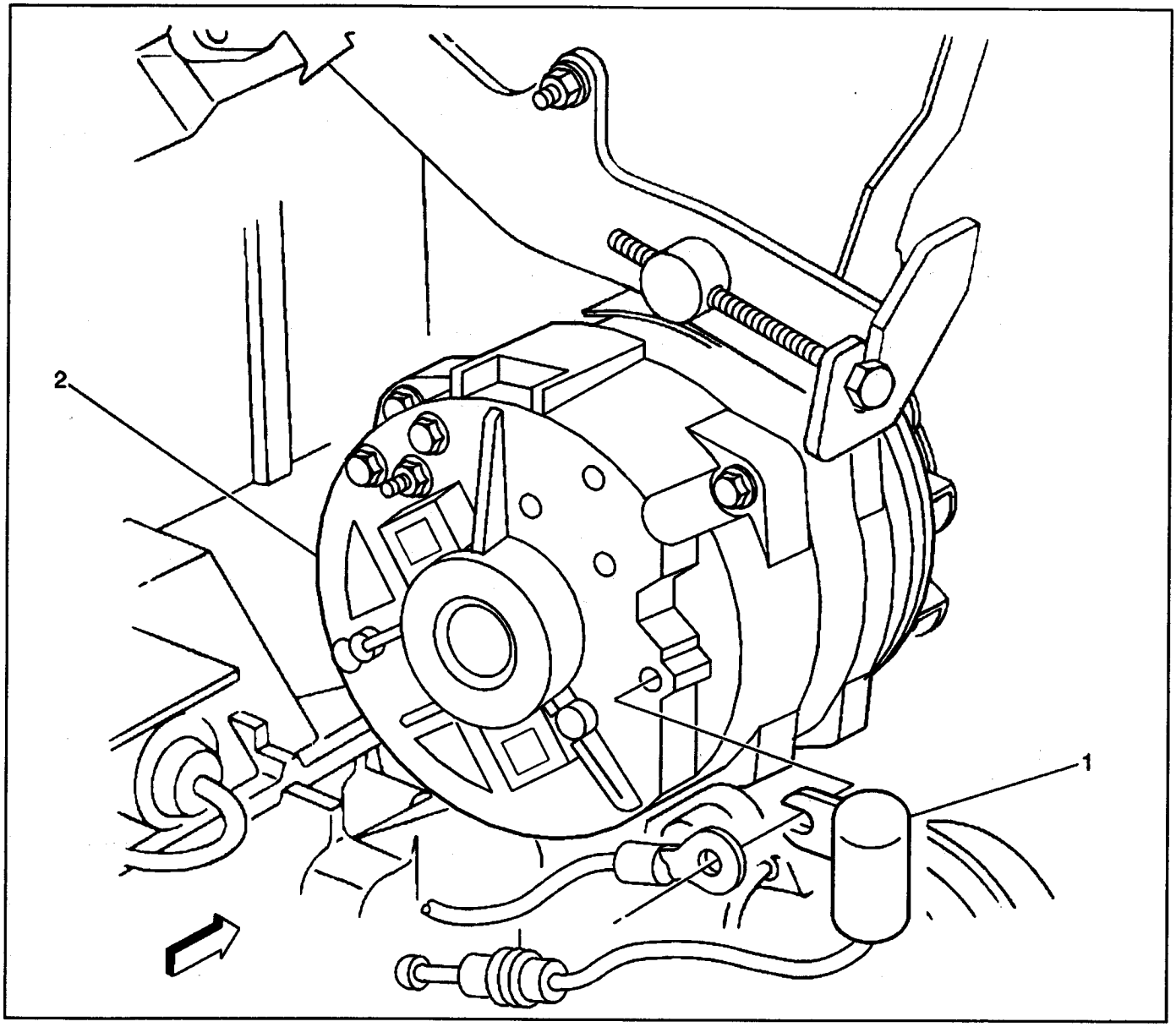
Component Locator

Entertainment Components

Name	Location	Locator View	Connector End View
Antenna	In the windshield glass	—	—
Generator Capacitor	Right side of the engine, on the side of the generator	*Entertainment Component Views* in Entertainment	—
Radio	Center of the IP, below the HVAC controller	*Entertainment Component Views* in Entertainment	*Entertainment Connector End Views* in Entertainment
Radio Speaker, Left	Upper left front of the IP	—	*Entertainment Connector End Views* in Entertainment
Radio Speaker, Right	Upper right front of the IP	—	*Entertainment Connector End Views* in Entertainment

Entertainment Component Views

Generator, Rear View

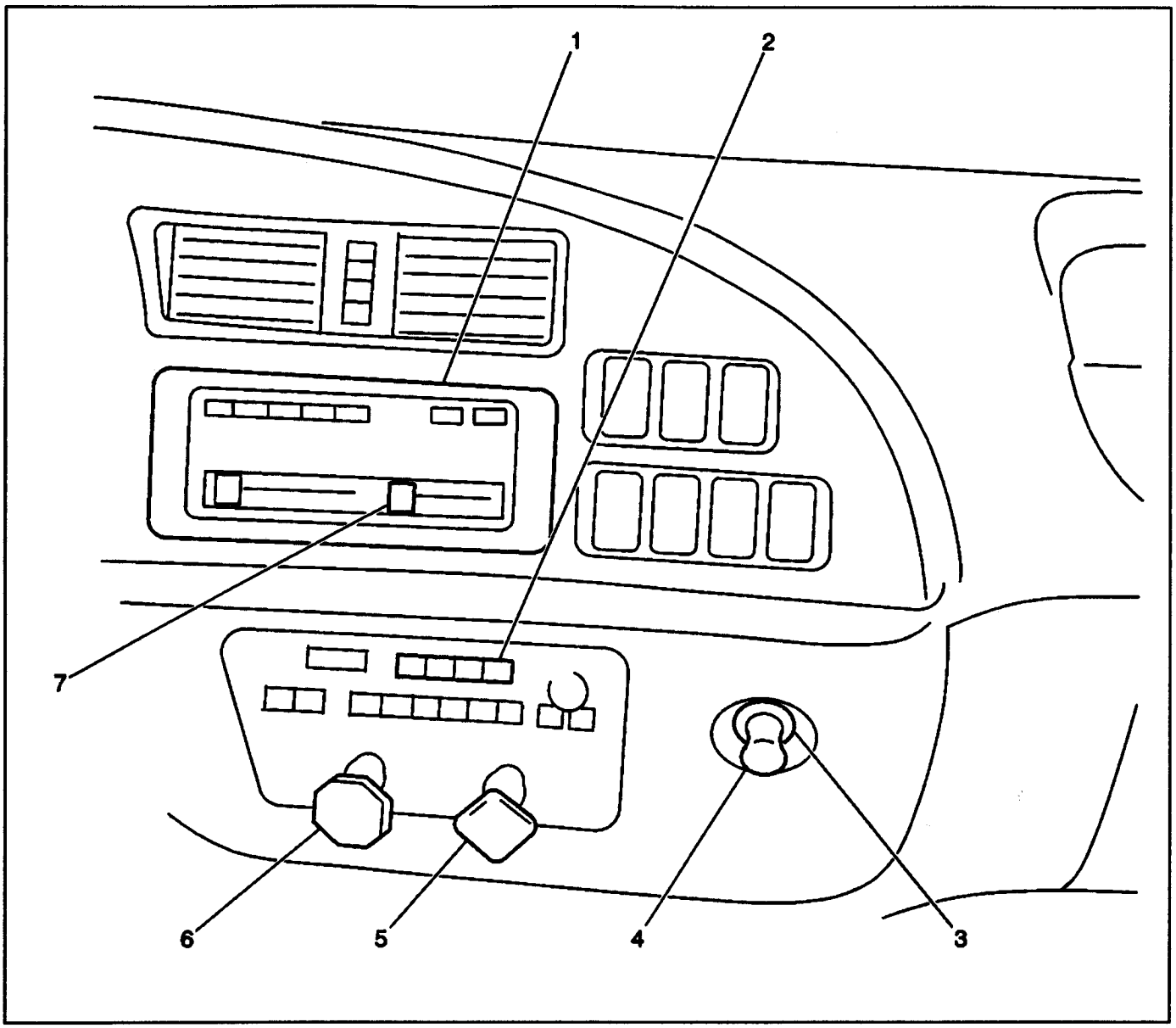


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Legend

(1) Generator Capacitor
(2) Generator

Instrument Panel, Left Forward View



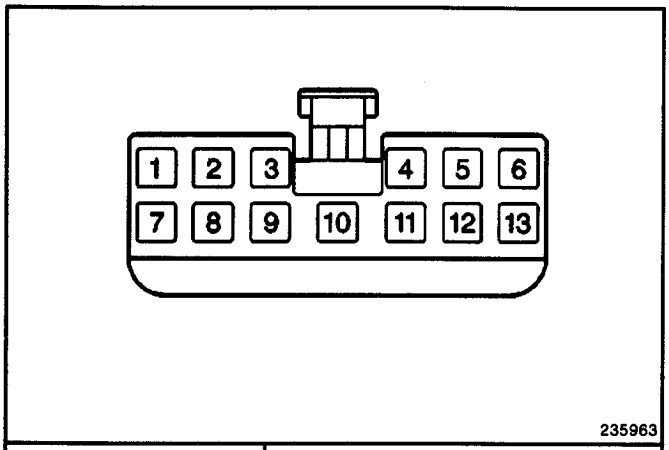
231675

Legend

(1) HVAC Controller
(2) Radio
(3) Cigar Lighter Lamp
(4) Cigar Lighter
(5) Park Brake Switch (ABS-Air)
(6) Trailer Stoplamps Switch (ABS-Air)
(7) Blower Switch (Part of HVAC Controller)

Entertainment Connector End Views

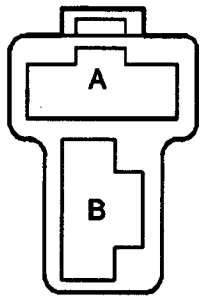
Radio



235963

Connector Part Information		• 13 Way M • (GRN)	
Pin	**Wire Color**	**Circuit No.**	**Function**
1–2	—	—	Not Used
3	BLK/RED	353	Interior Lamp Dimming Buss
4	YEL	352	Fuse Input Ignition
5	BLU/WHT	358	Radio Left Speaker
6	GRN/WHT	356	Radio /Right Speaker
7–8	—	—	Not Used
9	BLK	354	Ground
10	BRN	351	Illumination
11	ORN	350	Fuse Input Battery
12	BLU	357	Radio Left Speaker
13	GRN	355	Radio Right Speaker

Speaker, Left Side (Typical)



236009

Connector Part Information		• 2 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLU	157	Speaker
B	BLU/WHT	158	Speaker

Diagnostic Information and Procedures

Radio Always On

Step	Action	Value(s)	Yes	No
1	Check all the radio controls for any obstructions or foreign matter. Were any obstructions or foreign matter found?	—	*Go to Step 2*	*Go to Step 3*
2	Clear the obstructions or foreign matter from the radio controls. Is the repair complete?	—	System OK	—
3	Remove the radio for repair. Is the repair complete?	—	System OK	—

Radio Memory Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the radio connector. 2. Connect an unpowered test lamp between radio connector terminal 11 for CKT 350 (ORN) and ground. Does the test lamp light?	—	*Go to Step 3*	*Go to Step 2*
2	Locate and repair the open in CKT 350 (ORN) between the IP fuse block and the radio. Is the malfunction still present?	—	*Go to Step 3*	System OK
3	1. Connect an unpowered test lamp between radio connector terminal 4 for CKT 352 (YEL) and ground. 2. Place the ignition switch in the RUN position. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 4*
4	Locate and repair the open in CKT 352 (YEL) between the IP fuse block and the radio. Is the malfunction still present?	—	*Go to Step 5*	System OK
5	Remove the radio and send the radio in for repair. Is the repair complete?	—	System OK	—

Radio Display Inoperative, No Sound from Speakers

Step	Action	Value(s)	Yes	No
1	1. Disconnect the radio connector. 2. Turn the ignition switch to the ACC or RUN position. 3. Connect a digital multimeter (DMM) from the radio connector terminal 4 to ground. 4. Measure the voltage. Is the voltage more than the specified value?	10 V	*Go to Step 2*	*Go to Step 4*
2	1. Connect a DMM between the radio connector cavities 4 and 9. 2. Measure the voltage. Is the voltage more than the specified value?	10 V	*Go to Step 3*	*Go to Step 5*
3	1. Connect a DMM between the radio connector cavities 11 and 9. 2. Measure the voltage. Is the voltage more than the specified value?	10 V	*Go to Step 6*	*Go to Step 7*

Radio Display Inoperative, No Sound from Speakers (cont'd)

Step	Action	Value(s)	Yes	No
4	Repair the open in CKT 352 (YEL) between the instrument panel (IP) fuse block and the radio. Is the repair complete?	—	System OK	—
5	Repair the open in CKT 354 (BLK) between the radio and the splice pack 2. Is the repair complete?	—	System OK	—
6	1. Check for shorts in the cavities of the radio connector. 2. Repair any shorts in the radio connector. 3. If no shorts were found, remove the radio for repair. Is the repair complete?	—	System OK	—
7	Repair the open in CKT 350 (ORN) and CKT 150 (ORN) between the radio and the IP fuse block. Is the repair complete?	—	System OK	—

Tape Player Inoperative

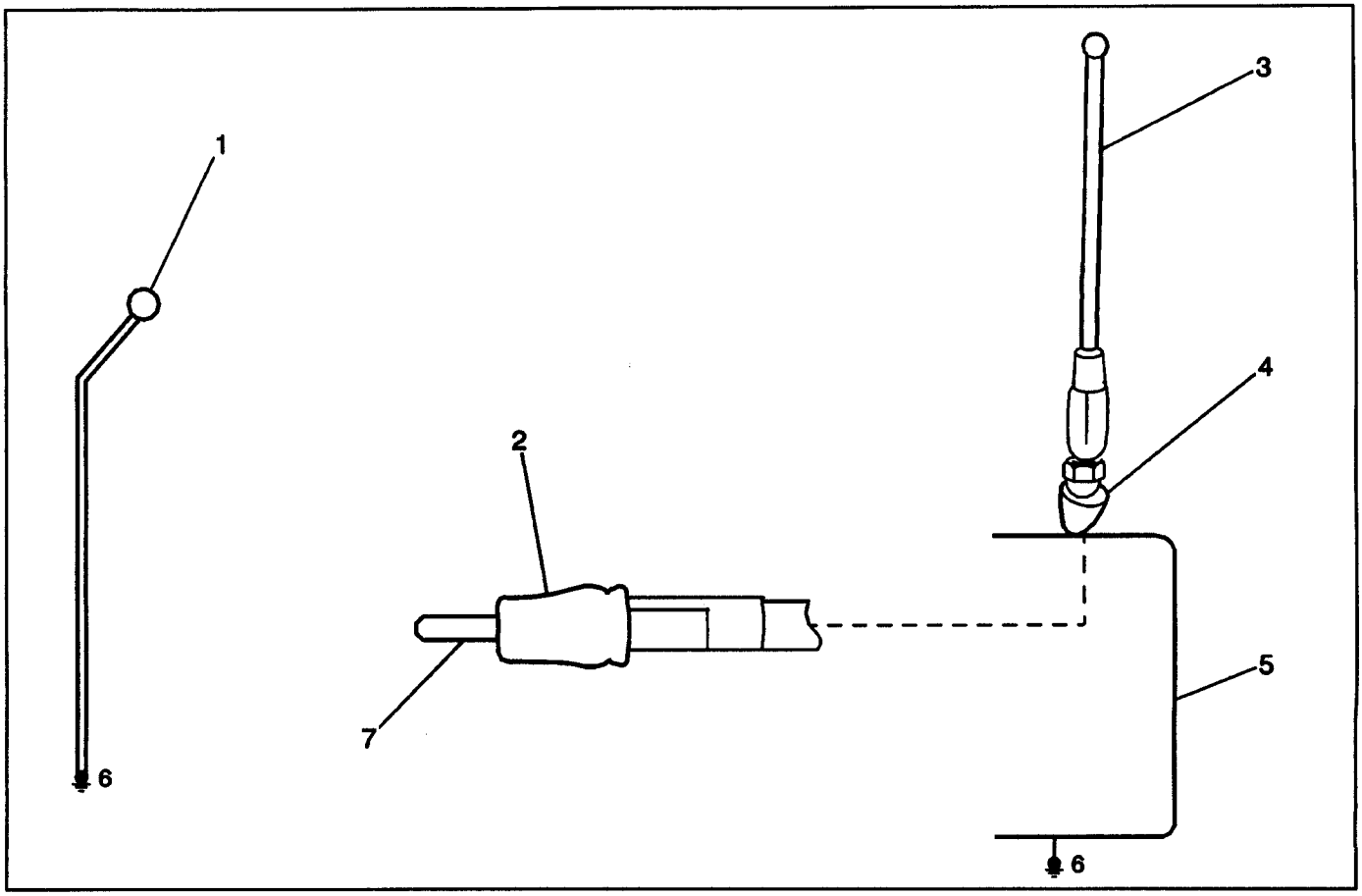
Step	Action	Value(s)	Yes	No
1	Check through the tape door for an obstruction in the tape player. Is an obstruction found?	—	*Go to Step 2*	*Go to Step 3*
2	***Notice:*** Improper removal may damage tape player. 1. Remove the obstruction. 2. Inspect and clean the moving parts and the tape head, or use a cleaning cassette. Refer to *Cleaning Tape Head and Capstan, Cassette Cleaning.* 3. Insert a diagnostic tape. Does the test tape operate?	—	System OK	*Go to Step 3*
3	Remove the radio for repair. Is the repair complete?	—	System OK	—

Speaker Noise - General

Step	Action	Value(s)	Yes	No
1	1. Place the ignition switch in the RUN position. 2. Play the radio. 3. Compare the radio's reception of a weak station to a known good radio's reception of the same weak station. Ensure that both of the vehicles are positioned equivalently in order to equalize the possible differences in noise or reception levels. 4. Turn the radios off. Is the radio's reception equivalent to the known good raido's reception with no significant difference in noise levels?	—	System OK	*Go to Step 2*
2	Verify the difference between the reception of the two radios. Is the reception of the radio weaker than the reception of the known good radio and any difference in noise level is probably caused by the weaker reception?	—	*Go to Step 3*	Go to Noise Diagnosis

Speaker Noise - General (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Disconnect the radio antenna lead-in wire at the radio. 2. Connect a pre-zeroed ohmmeter between the coax (outer) conductor of the radio antenna lead in wire and ground. 3. Measure the resistance. Does the resistance measure less than the specified value?	0.15 Ω	*Go to Step 5*	*Go to Step 4*
4	Locate and repair the open or high resistance condition in the antenna ground circuit. Is the reception condition resolved?	—	System OK	–
5	Wiggle the antenna mast and the lead-in wire while monitoring the ohmmeter for intermittent opens. Does the power antenna resistance to ground remain less than the specified value?	0.15 Ω	*Go to Step 7*	*Go to Step 6*
6	Locate and repair the intermittent open or high resistance condition in the antenna ground circuit. Is the reception condition resolved?	—	System OK	*Go to Step 7*
7	Connect a pre-zeroed ohmmeter between the signal (inner) conductor of the radio antenna lead-in wire and the antenna mast. Does the antenna lead-in wire signal resistance measure less than the specified value?	2 Ω (RG-58 or RG-59) or 3.5 Ω (RG-62 or RG-62M)	*Go to Step 9*	*Go to Step 8*
8	Locate and repair the open or high resistance condition in the antenna lead-in wire. Is the reception condition resolved?	—	System OK	–
9	Wiggle the antenna mast and the lead-in wire while monitoring the ohmmeter for intermittent opens. Does the antenna lead-in wire signal resistance remain less than the specified value?	2 Ω (RG-58 or RG-59) or 3.5 Ω (RG-62 or RG-62M)	*Go to Step 11*	*Go to Step 10*
10	Locate and repair the intermittent open or high resistance condition in the antenna lead-in wire. Is the reception condition resolved?	—	System OK	*Go to Step 11*
11	1. Reconnect the antenna lead-in wire to the radio. 2. Place the ignition switch in the RUN position. 3. Play the radio. Is the reception condition resolved?	—	System OK	Go to Use and Construction of a Noise Sniffer in *Antenna Diagnostic Check*



209119

Legend

(1) Negative Battery Cable
(2) Coaxial Radio Connector Outer Conductor
(3) Antenna Mast
(4) Antenna Base
(5) Body
(6) Chassis Ground
(7) Coaxial Radio Connector Inner Conductor

Lead-in Cable Resistance Values

DMM Probes At Coaxial Radio Conductor Inner Connector And The Following Points:	Resistance Measured
Antenna Mast	Less Than 1.0 Ω
Coaxial Radio Connector Outer Connector	Infinite
Chassis Ground	Infinite

Antenna System Resistance Values

Ohmeter Probes At The Following Pair of Points:		Resistance Measured
Negative Battery Cable	Coax Outer Conductor	Less Than 0.15 Ω
Negative Battery Cable	Antenna Base	Less Than 0.15 Ω
Coax Outer Conductor	Antenna Base	Less Than 0.15 Ω
Negative Battery Cable	Coax Inner Conductor	Infinite
Coax Outer Conductor	Coax Inner Conductor	Infinite
Coax Outer Conductor	Antenna Mast	Infinite
Negative Battery Cable	Antenna Mast	Infinite

Symptom Diagnostic Test Procedure

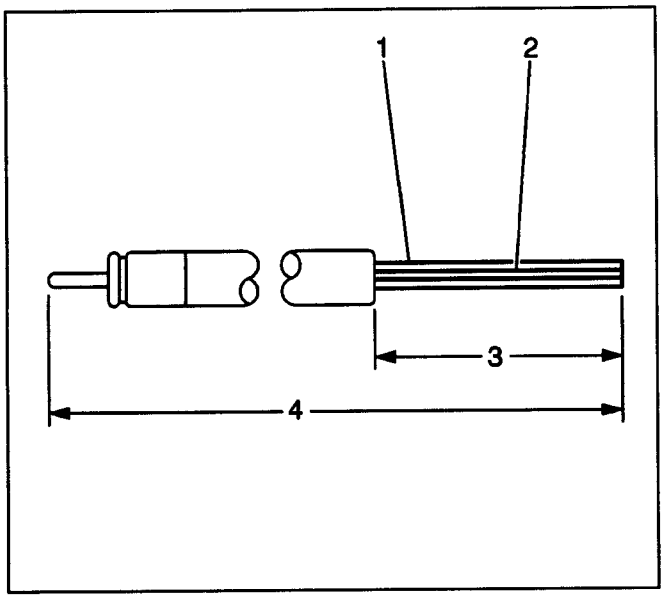
Antenna Diagnostic Check

Step	Action	Value(s)	Yes	No
1	***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.*** 1. Disconnect the negative battery cable. 2. Disconnect the antenna lead-in connector at the radio receiver. ***Notice:*** Before measuring the resistance of the antenna, remove the negative (-) battery cable and "zero" the meter before taking measurements. When checking resistance, cautiously wiggle the lead-in tip and cable. The readings below should always be obtained. If not, some portions of the lead-in is intermittent and the lead-in should be replaced. 3. Using a DMM, measure the resistance between the coax radio connector outer conductor and the negative battery cable. Is the resistance within the specified range?	Less than 0.15 Ω	Go to *Step 2*	Go to *Step 5*
2	1. Grasp the antenna mast. 2. While observing the DMM, wiggle the antenna. Does the DMM indicate intermittent continuity?	—	Go to *Step 5*	Go to *Step 3*
3	***Notice:*** Before measuring the resistance of the antenna, remove the negative (-) battery cable and "zero" the meter before taking measurements. When checking resistance, cautiously wiggle the lead-in tip and cable. The readings below should always be obtained. If not, some portions of the lead-in is intermittent and the lead-in should be replaced. Use a DMM and measure the resistance between the radio coaxial lead-in connector inner conductor and antenna mast. Is the resistance within the specified range?	Less than 0.15 Ω	Go to *Step 4*	Go to *Step 6*
4	While observing the DMM, wiggle the coaxial wire. Does the DMM indicate intermittent continuity?	—	Go to *Step 6*	Go to *Speaker Noise - General* General Radio Noise
5	1. Check the base of the antenna for a good connection to the body ground. 2. Check the coaxial cable interconnects for a poor connection or corrosion. 3. Check the ground connection from the negative battery cable to the body. 4. Repair the antenna ground circuit as necessary. Is the repair complete?	—	System OK	Go to *Speaker Noise - General* General Radio Noise
6	1. Check the coax cable interconnects for a poor connection or corrosion. 2. Repair or replace the antenna coaxial circuit as necessary. 3. Perform the General Radio Noise diagnostic procedure. Is the repair complete?	—	System OK	—

Use And Construction Of A Noise "Sniffer"

Use the noise sniffer along with the radio in the vehicle in order to locate "hot spots" that generate radio noise interference. Find these "hot spots" in the harnesses, the upper part of the instrument panel, and between the hood and the windshield.

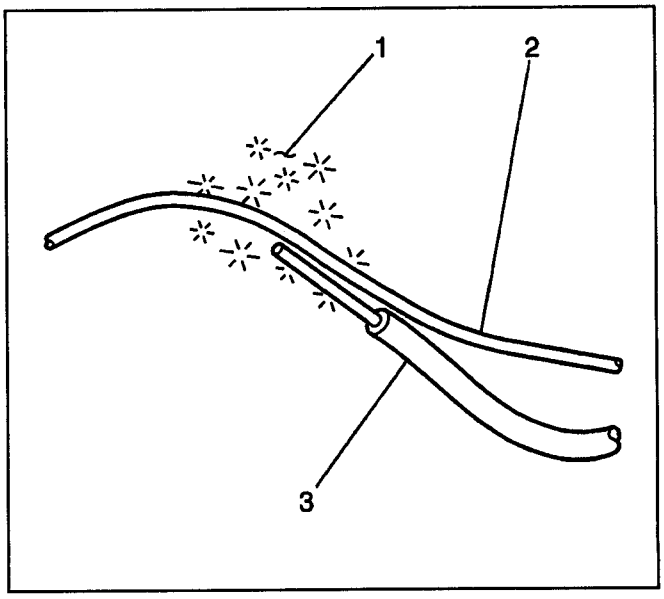
Construct the sniffer by doing the following steps:



209123

1. Find an old, long piece of antenna lead-in (4) from a mast or power antenna.
2. Strip 25 mm (2 in) of the insulation (1) from the center conductor wire (2).
3. Plug the sniffer into the radio antenna socket.

   Important: Do not touch the probe portion bare conductor of the wire (3).
4. Use the section of probe portion of the wire (3) in order to search for hot spots while listening to the complaint noise on the radio.
5. Turn the radio to a higher volume.



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6. Check for noise (1) on a wire (2) by placing the sniffer (3) parallel to the wire.

Speakers Inoperative - One or More (Left Front Speaker)

Step	Action	Value(s)	Yes	No
1	1. Disconnect the connector at the left front radio speaker. 2. Connect an ohmmeter between left front radio speaker terminal A and terminal B. 3. Measure the resistance. Does the resistance measure within the specified range?	4–15 Ω	*Go to Step 2*	Go to left front speaker Replacement in *Speaker Replacement.*
2	1. Ensure that the speaker and connector terminals are not damaged or corroded. 2. Reconnect the connector at the left front radio speaker. 3. Place the ignition switch in the ACCY position. 4. Turn the radio on. Does the speaker operate properly with clear sound?	—	*Go to Step 3*	*Go to Step 4*

Speakers Inoperative - One or More (Left Front Speaker) (cont'd)

Step	Action	Value(s)	Yes	No
3	Repair the left front radio speaker connector as necessary. Is the speaker malfunction resolved?	—	System OK	*Go to Step 4*
4	1. Disconnect the connector at the left front radio speaker. 2. Disconnect the connector at the radio. 3. Verify that no voltage is present on CKT 357 (BLU). 4. Connect a self-powered test lamp between radio connector terminal 12 for CKT 357 (BLU) and ground. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
5	1. Locate and repair the short to ground on CKT 357 (BLU) between the radio and the left front radio speaker. 2. Test the speaker performance. Has the short circuit damaged the radio speaker's output?	—	Go to *Radio Replacement*	*Go to Step 6*
6	1. Ensure that no voltage is present on CKT 358 (BLU/WHT). 2. Connect a self-powered test lamp between radio connector terminal 5 for CKT 358 (BLU/WHT) and ground. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 8*
7	1. Locate and repair the short to ground on CKT 358 (BLU/WHT) between the radio and the left front radio speaker. 2. Test the speaker performance. Has the short circuit damaged the radio speaker's output?	—	Go to *Radio Replacement*	*Go to Step 8*
8	1. Reconnect the connector at the left front radio speaker. 2. Connect an ohmmeter between radio connector terminal 5 for CKT 358 (BLU/WHT) and terminal 12 for CKT 357 (BLU). 3. Measure the resistance. Does the resistance measure within the specified range?	4–15 Ω	Go to *Radio Replacement*	*Go to Step 9*
9	Locate and repair the following conditions in CKT 357 (BLU) or CKT 358 (BLU/WHT) between the radio and the left front radio speaker: 1. The open circuit 2. The pinched lead wire 3. The high contact resistance Is the speaker malfunction resolved?	—	System OK	—

Speakers Inoperative - One or More (Right Front Speaker)

Step	Action	Value(s)	Yes	No
1	1. Disconnect the connector at the right front radio speaker. 2. Connect an ohmmeter between right front radio speaker terminal A and terminal B. 3. Measure the resistance. Does the resistance measure within the specified range?	4–15 Ω	*Go to Step 2*	Go to right front speaker Replacement in *Speaker Replacement*
2	1. Ensure that the speaker and connector terminals are not damaged or corroded. 2. Reconnect the connector at the right front radio speaker. 3. Place the ignition switch in the ACCY position. 4. Turn the radio on. Does the speaker operate properly with clear sound?	—	*Go to Step 3*	*Go to Step 4*
3	Repair the right front radio speaker connector as necessary. Is the speaker malfunction resolved?	—	System OK	*Go to Step 4*
4	1. Disconnect the connector at the right front radio speaker. 2. Disconnect the connector at the radio. 3. Verify that no voltage is present on CKT 155 (GRN) and CKT 355 (GRN). 4. Connect a self-powered test lamp between radio connector terminal 13 for CKT 355 (GRN) and ground. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 6*
5	1. Locate and repair the short to ground on CKT 155 (GRN) and CKT 355 (GRN) between the radio and the right front radio speaker. 2. Test the speaker performance. Has the short circuit damaged the radio speaker's output?	—	Go to *Radio Replacement*	*Go to Step 6*
6	1. Ensure that no voltage is present on CKT 156 (GRN/WHT) and CKT 356 (GRN/WHT). 2. Connect a self-powered test lamp between radio connector terminal 6 for CKT 156 (GRN/WHT) and CKT 356 (GRN/WHT) and ground. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 8*
7	1. Locate and repair the short to ground on CKT 156 (GRN/WHT) and CKT 356 (GRN/WHT) between the radio and the right front radio speaker. 2. Test the speaker performance. Has the short circuit damaged the radio speaker's output?	—	Go to *Radio Replacement*	*Go to Step 8*

Speakers Inoperative - One or More (Right Front Speaker) (cont'd)

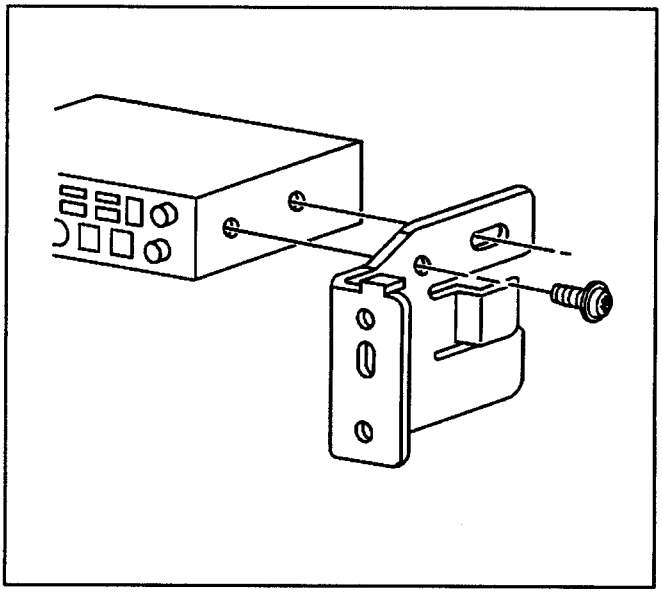
Step	Action	Value(s)	Yes	No
8	1. Reconnect the connector at the right front radio speaker. 2. Connect an ohmmeter between radio connector terminal 13 for CKT 355 (GRN/WHT) and terminal 6 for CKT 356 (GRN). 3. Measure the resistance. Does the resistance measure within the specified range?	4–15 Ω	Go to *Radio Replacement*	*Go to Step 9*
9	Locate and repair the following conditions in CKT 355 (GRN) or CKT 356 (GRN/WHT) between the radio and the right front radio speaker: 1. The open circuit 2. The pinched lead wire 3. The high contact resistance Is the speaker malfunction resolved?	—	System OK	—

Repair Instructions

Radio Replacement

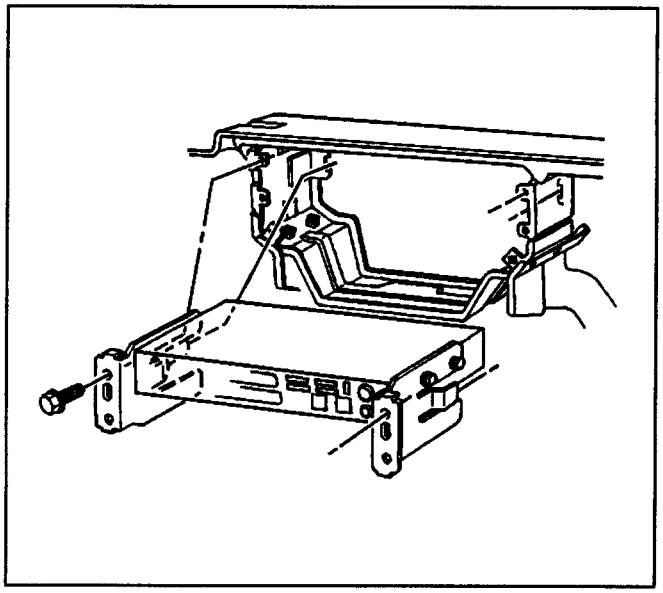
Removal Procedure

1. Remove the lower instrument panel trim.
2. Remove the radio retaining screws.
3. Remove the antenna cable.
4. Remove the electrical connectors.
5. Remove the radio brackets.

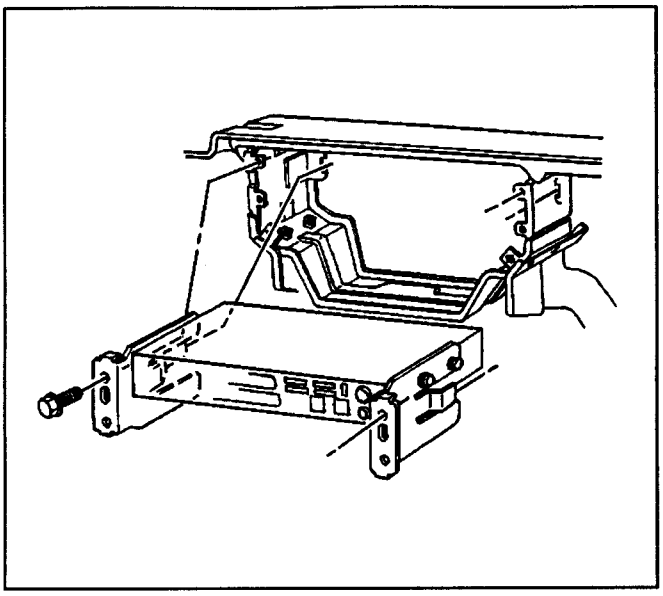


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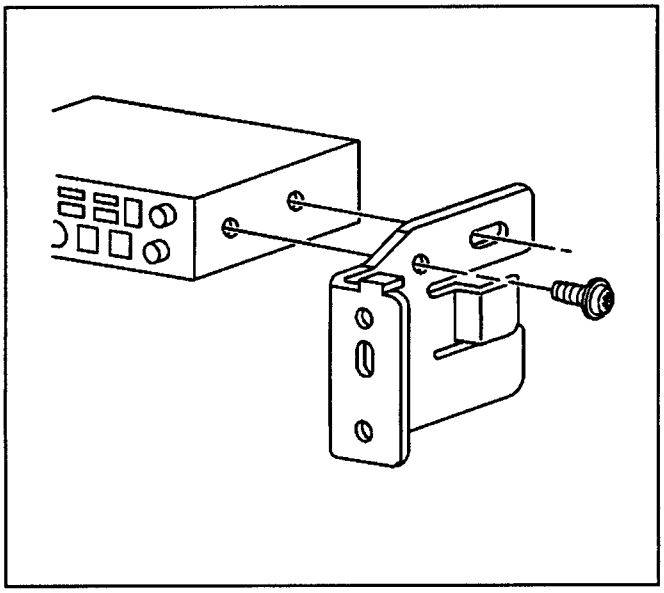
6. Remove the radio.



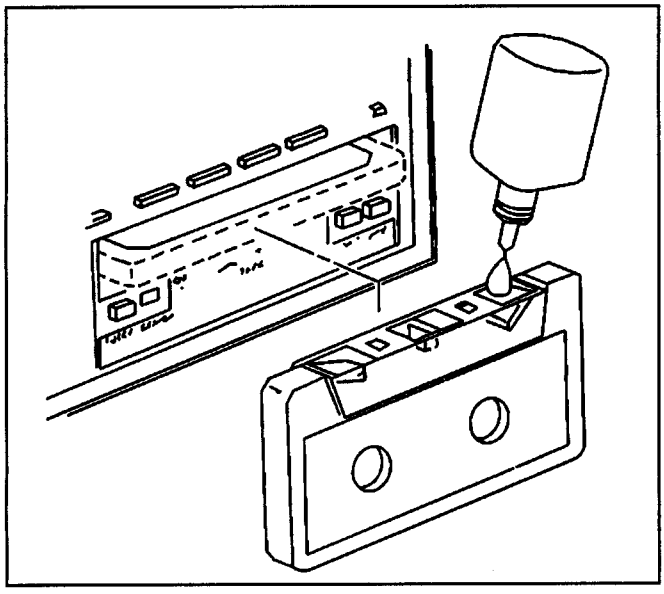
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Installation Procedure

1. Install the radio.
2. Install the radio brackets.
3. Install the electrical connectors.
4. Install the antenna cable.
5. Install the radio retaining screws.
6. Install the lower instrument panel trim.

Cleaning Tape Head and Capstan, Cassette Cleaning

Tape Player and Cassette Care

For the best operation of the cassette tape player, do not use cassette tapes that are longer than 90 minutes in playback time (45 minutes or longer per side). Cassette tapes longer than 90 minutes may cause the tape to slip or jam.

Tape Head and Capstan Cleaning

There are two parts that are cleaned on a tape player: the head and the capstan. Since they can be reached through the tape door, leave the tape player in the vehicle. This service should be performed every 50 hours of operation.

In order to clean the head and capstan, use a cotton swab dipped in ordinary rubbing alcohol, or use a cleaning cassette.

As an alternate way to clean the head and capstan, a cleaning cassette may be purchased. Follow the instructions included with the kit to clean the tape player.

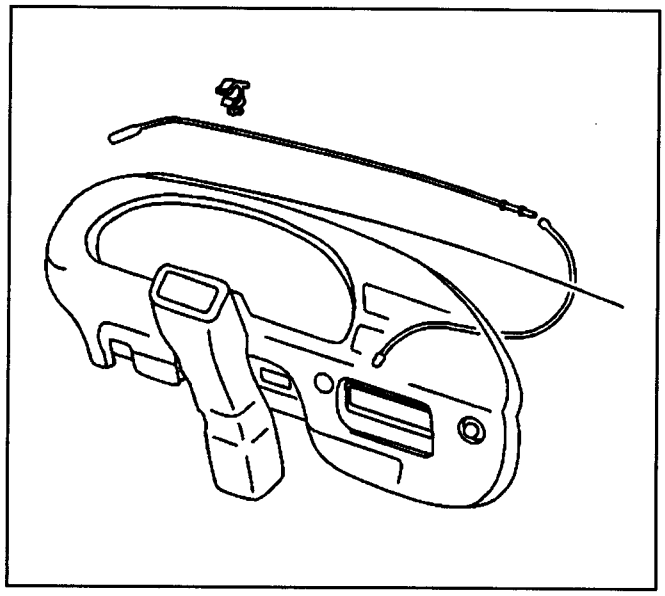
Do not contact the tape head with magnetized tools. If the head becomes magnetized, every cassette played in the player will be degraded.

No service is performed on the tapes. Warranty of these tapes is handled by the cassette manufacturer, not by the dealer. Any test tape used by the dealer should be stored in the test tape container in order to keep the tape clean. Store cassettes away from extreme heat or direct sunlight.

Fixed Antenna Mast Replacement

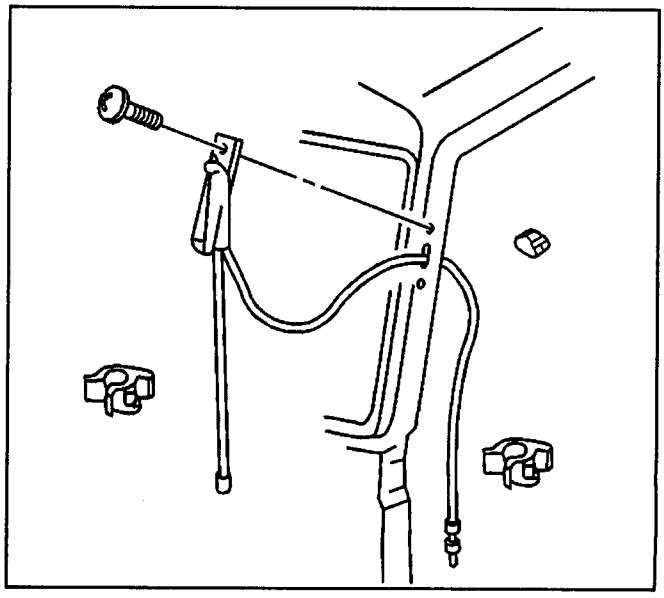
Removal Procedure

1. Remove the cluster trim.
2. Remove the upper instrument panel pad.
3. Remove the radio.
4. Remove the cable from the back of the radio.
5. Remove the retaining clips.
6. Remove the two screws from the antenna base on the cab.

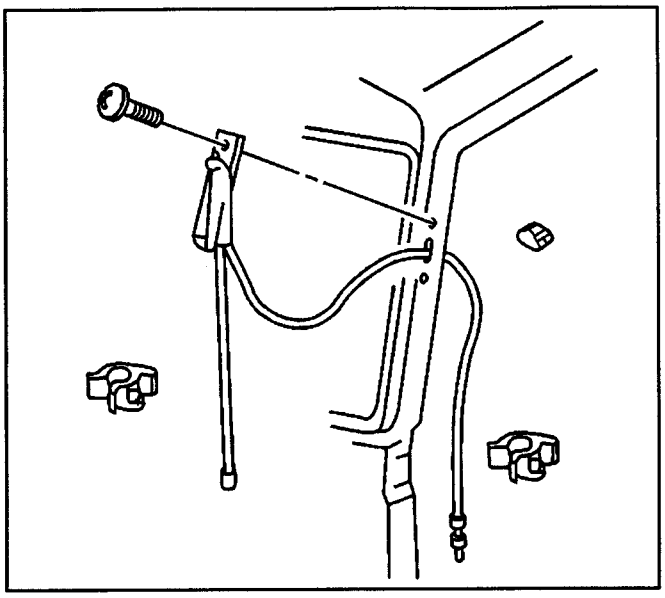


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7. Remove the antenna from the cab.



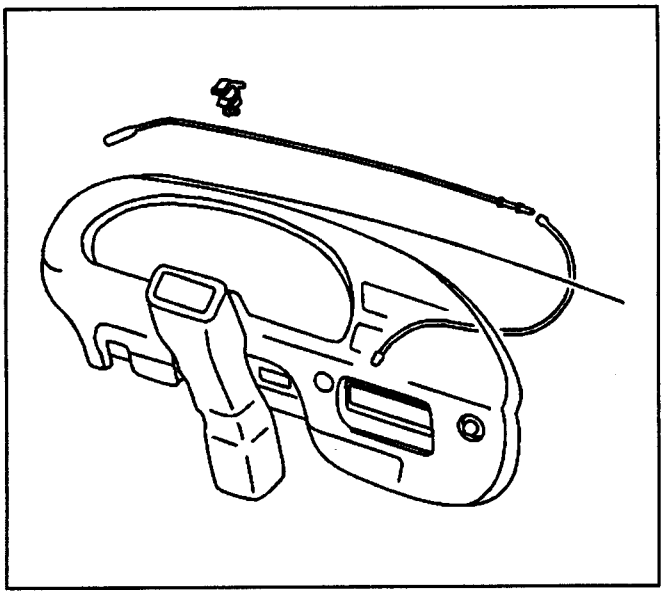
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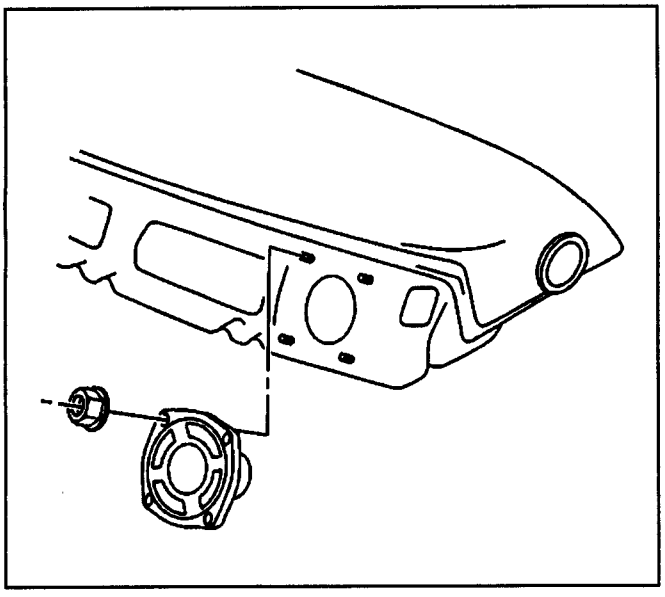
Installation Procedure

1. Install the antenna to the cab.
2. Install the antenna base screws.



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3. Install the cable to the back of the radio.
4. Install the retaining clips.
5. Install the radio.
6. Install the upper instrument panel pad.
7. Install the cluster trim.



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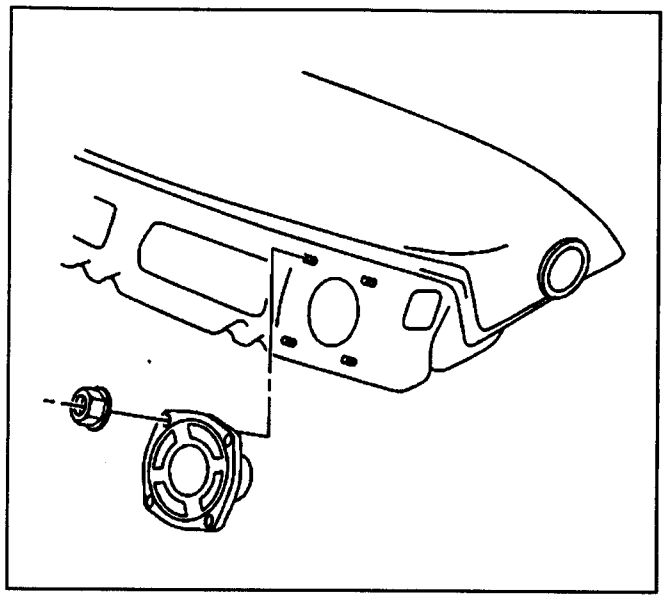
Speaker Replacement

Removal Procedure

1. Remove the speaker grille.
2. Remove the nuts.
3. Remove the speaker.
4. Remove the electrical connectors, as necessary.

Installation Procedure

1. Install the electrical connectors, as necessary.
2. Install the speaker.
3. Install the nuts.
4. Install the speaker grille.



214690

Description and Operation

Radio/Audio System Description

The radio is mounted under the climate controls on the instrument panel. The available radio systems are as follows:

1. UM7– AM/FM stereo, seek and scan, clock
2. UM6– AM/FM stereo, seek and scan, auto-reverse cassette, clock

Radio/Audio System Operation

AM/FM Stereo Radio (UM7 or UM6)

On/Volume/Balance Knob

Press the on/volume/balance knob in order to turn the radio on and off. Turn the knob clockwise in order to increase the volume and counter clockwise in order to decrease the volume. The ignition lock cylinder must be in the ACCESSORY or the RUN position for the radio to operate.

Finding a Station

Band: In order to tune the radio, push the DISP button and select the band. Pressing this button alternately selects either the AM or FM band. The selected band will be on the display.

Tuning the Buttons: Press the button with the upward arrow in order to increase the frequency. Press the button with the downward arrow in order to decrease the frequency.

In order to use automatic tuning, push one of the tuning buttons for a half a second or longer.

The frequency display will stop automatically when a live frequency is detected.

In order to tune stations manually, push one of the buttons for less than half a second.

Scan: Press this button in order to listen to the next radio station for a few seconds. The radio will scan stations until the scan button is pressed during the five seconds that a station is being reviewed.

Preset Buttons: The six numbered preset buttons let you return to your favorite stations. You can set up to 12 stations (6 AM, 6FM). Complete the following steps to preset a station:

Tune in the desired station.

Press one of the preset buttons for two seconds or longer.

Whenever you press that numbered button for less than two seconds, the station you set will return.

DISP Button: With each press of this button, the display alternates between the time, alarm status, and radio frequency. The display automatically returns to the clock mode after a few seconds when the radio is on.

Setting the Tone: Turn the tone knob clockwise in order to emphasize the treble. Turn the tone knob counterclockwise in order to emphasize the bass.

Adjusting the Speakers: Pull out the power/volume/balance knob. Turn the knob to the right or left, depending on which speakers you want the sound to come through.

Using the Timer: The timer in your radio can be used to set a time from 15 minutes to three hours. An alarm sounds when the time expires.

In order to set the timer, press the timer button. The timer symbol and 0:00 will be lighted on the display. With each press of the button, the time increases.

When the time expires, an alarm will sound for two minutes. When the timer is set back to 0:00, the timer symbol will disappear from the display.

Using the Alarm: The alarm in the radio can be used to activate an alarm at a desired time.

In order to set the timer, press the DISP button to switch the display to ALARM. Press the alarm button while the alarm symbol is flashing. An A will illuminate in the display.

After setting an alarm time the same way as setting a clock, wait until the current time is indicated. Then, press the alarm button. The alarm symbol will appear in the display. Once set, the alarm will sound at the same time each day.

In order to make sure of the alarm time, press the display button. In order to disconnect the alarm, press the alarm button again.

Setting the Wake-up Timer: The wake up timer is used to turn the radio on at a specific time without the key in the ignition.

Press the DISP button. While the alarm symbol flashes, press the alarm button so that the display shows U.

Set the desired time the same way as you set the clock.

When the set time comes, the radio is switched on and remains on for one hour.

The wake up feature is activated only once and the alarm set status will be returned automatically when one hour is over.

To cancel wake-up when it is activated, press the alarm button.

Setting the Tone: Turn the tone knob clockwise in order to emphasize the treble and counterclockwise to emphasize the bass.

Setting the Clock: Press and hold down the AM/FM button. Press the downward arrow button in order to advance the hours. Press upward arrow button in order to advance the minutes.

Playing a Cassette Tape

The tape player is built to work best with tapes that are 30 to 45 minutes long on each side. Tapes longer than that are so thin they may not work well in this player.

Once the tape is playing, use the knobs for volume, tone and balance, just as you do for radio operation.

FF/Rew Buttons: Press the button with the arrows in the same direction of tape play (as indicated on the display) in order to rapidly advance the tape.

Press the other button in order to rewind the tape.

In order to stop fast forwarding or rewinding, press the other button lightly.

Press both fast forward buttons at the same time in order to switch the tape sides. An arrow will light on the display in order to indicate the tape playing direction.

Eject Button: Press this button in order to remove the tape or stop the tape and play the radio.

Radio/Audio System Circuit Description

Radio

Circuit breaker #7 makes voltage available at all times to the radio through CKT 350 (ORN). This voltage provides power to the radio memory storage for time and station presets. Operating power is available to the radio from circuit breaker #2 through CKT 352 (YEL) when the ignition switch is in the RUN position or the ACCY position. CKT 354 (BLK) grounds the radio at joint connector 1, (lower).

Wiring Systems

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Horn Mounting Bolt	9 N.m	80 lb in
Electric Horn Mounting Nut	17 N.m	13 lb ft
Lanyard to Roof Panel Bolt	2 N.m	18 lb in

Diagnostic Information and Procedures

Where to Find Electrical Schematics

Because more than one electrical system is located in each subsection, each electrical system's schematics are further broken down into operating systems, or cells. Each set of electrical system schematics will have a cell number that remains common across all vehicle platforms. Cells are organized by subsystems with most containing a circuit schematic and the associated text. For example, the cruise control schematic will be located in the cruise control subsection and the schematic title will begin with cell 34.

Some subsections may have more than one circuit schematic such as Power Distribution, Interior Lights and Air Conditioning.

Electrical Schematic Locations

Cell No.	System Name	Section	Subsection
10	Power Distribution Schematics	Body and Accessories	Wiring Systems
14	Ground Distribution Schematics	Body and Accessories	Wiring Systems
15	Retained Accessory Power Schematics	Body and Accessories	Retained Accessory Power
17	Auxiliary Battery Schematics	Body and Accessories	Wiring Systems
18	Upfitter Provision Schematics	Body and Accessories	Wiring systems
19	Cigar Lighter/Auxiliary Outlet Schematics	Body and Accessories	Wiring Systems
20	Engine Controls Schematics	Engine	Engine Controls
30	Starting and Charging Schematics	Engine	Engine Electrical
31	Cooling fan Schematics	Engine	Engine Cooling
32	Radiator Shutter Schematics	Engine	Engine Cooling
33	Engine Exhaust Brake Schematics	Brakes	Engine Exhaust
34	Cruise Control Schematics	Body and Accessories	Cruise Control
35	Manual Transmission Schematics	Transmission Transaxle	Manual Transmission
36	Inter-Axle Differential Lock Schematics	Driveline/Axle	Rear Axle Controls
37	Two Speed Rear Axle Schematics	Driveline/Axle	Rear Axle Controls
38	Transfer Case Control Schematics	Driveline/Axle	Transfer Case
39	Automatic Transmission Controls Schematics	Transmission/Transaxle	Automatic Transmission or Automatic Transaxle
40	Horn Schematics	Body and Accessories	Horns

Electrical Schematic Locations (cont'd)

Cell No.	System Name	Section	Subsection
41	Brake Warning System Schematics	Brakes	Hydraulic Brakes or Air Brakes
42	ALC Suspension Schematics	Suspension	Automatic Level Control
43	Suspension Controls Schematics	Suspension	Road Sensing Suspension - RSS Real Time Dampening - RTD Air Suspension
44	ABS Schematics ABS/TCS Schematics	Brakes	ABS Traction Control
45	Steering Control Schematics	Steering	Variable Effort Steering
46	Park Brake System Schematics	Brakes	Park Brakes
47	SIR Schematics SRS Schematics	Restraints	SIR
48	Tire Pressure Monitor System	Suspension	Tire Pressure Monitor
49	Tilt/Telescoping Steering Column Schematics	Steering	Steering Wheel and Column Tilt
50	Data Link Connector (DLC) Schematics	Body and Accessories	Wiring Systems
51	Body Control Module Schematics	Body and Accessories	Body Control System
55	Door Control Module Schematics	Body and Accessories	Doors
57	Brake Booster Pump Schematics	Brakes	Hydraulic Brakes
58	Air Brake System Schematics	Brakes	Air Brakes
60	Heater Blower Controls Schematics	HVAC	Heater and Ventilation (Non-A/C)
61	Defogger Schematics	Body and Accessories	Stationary Windows
62	Heated Windshield Schematics	Body and Accessories	Stationary Windows
63	HVAC Blower Controls Schematics	HVAC	HVAC Systems with A/C Manual
64	HVAC Compressor Controls Schematics HVAC Compressor/Condensor Fan Controls Schematics	HVAC	HVAC Systems with A/C Manual
65	HVAC Air Delivery Controls Schematics	HVAC	HVAC Systems with A/C Manual
66	HVAC Blower Controls Schematics	HVAC	HVAC Systems with A/C-Automatic (Includes Electronic and Dual Zone)
67	HVAC Compressor Controls Schematics HVAC Compressor/Condensor Fan Controls Schematics	HVAC	HVAC Systems with A/C Automatic (Includes Electronic and Dual Zone)
68	HVAC Air Delivery Controls Schematics	HVAC	HVAC Systems with A/C-Automatic (Includes Electronic and Dual Zone)
70	Collision Avoidance Schematic	Body and Accessories	Collision Avoidance
76	Audible Warnings Schematics	Body and Accessories	Instrument Panel, Gauges and Console

Electrical Schematic Locations (cont'd)

Cell No.	System Name	Section	Subsection
79	Backup Alarm System Schematics	Body and Accessories	Backup Alarm
81	Instrument Cluster: Analog Schematics	Body and Accessories	Instrument Panel, Gauges and Console
82	Instrument Cluster: Digital Schematics	Body and Accessories	Instrument Panel, Gauges and Console
83	Head Up Display Schematics	Body and Accessories	Instrument Panel, Gauges and Console
85	Navigation System Schematic	Body and Accessories	Instrument Panel, Gauges and Console
86	Driver Information System Schematics	Body and Accessories	Instrument Panel, Gauges and Console
90	Wiper/Washer System (Standard) Schematics	Body and Accessories	Wiper/Washer Systems
91	Wiper/Washer System (Pulse) Schematics	Body and Accesspories	Wiper/Washer Systems
92	Wiper/Washer System (Rear) Schematics	Body and Accessories	Wiper/Washer Systems
93	Headlamp Washer Schematics	Body and Accessories	Wiper/Washer Systems
100	Headlights Schematics	Body and Accessories	Wiper/Washer Systems
101	Headlights Twilight Sentinel/DRL Schematics	Body and Accessories	Lighting Systems
102	Headlights DRL Schematics	Body and Accessories	Lighting Systems
103	Fog Lights Schematics	Body and Accessories	Lighting Systems
104	Headlight Doors Schematics	Body and Accessories	Lighting Systems
105	Headlight Leveling Schematrics	Body and Accessories	Lighting Systems
110	Exterior Lights Schematics	Body and Accessories	Lighting Systems
112	Backup Lights Schematics	Body and Accessories	Lighting Systems
114	Interior Lights Schematics	Body and Accessories	Lighting Systems
117	Interior Lights Dimming Schematics	Body and Accessories	Lighting Systems
120	Power Windows Schematics	Body and Accessories	Doors
121	Power Folding Top Schematics	Body and Accessories	Roof
122	Power Sunroof Schematics	Body and Accessories	Roof
130	Door Locks Schematics	Body and Accessories	Door Locks
132	Keyless Entry Schematics	Body and Accessories	Keyless Entry
133	Theft Deterrent System Schematics	Body and Accessories	Theft Deterrent
134	Release System Schematics	Body and Accessories	Body Rear End
135	Pulldown Systems Schematics	Body and Accessories	Body Rear End
136	Garage Door Opeener Schematics	Body and Accessories	Garage Door Opener
137	Power Sliding Door (PSD) Schematics	Body and Accessories	Doors
138	BTSI Schematics	Steering	Steering Wheel and Column Standard Steering Wheel and Column Tilt

Electrical Schematic Locations (cont'd)

Cell No.	System Name	Section	Subsection
139	Column/Ignition	Steering	Steering Wheel and Column Standard Steering Wheel and Column Tilt
140	Power Seat Schematics	Body and Accessories	Seats
141	Memory Seats Schematics	Body and Accessories	seats
142	Lumbar Support Schematics	Body and Accessories	Seats
143	Heated Seats Schematics	Body and Accessories	Seats
146	Power Seat Schematics	Restraints	Seat Belts
147	Outside Mirrors Schematics	Body and Accessories	Doors
148	Automatic Day-Night Mirror	Body and Accessories	Stationary Windows
150	Radio/Audio Systems Schematics	Body and Accessories	Entertainment
151	Power Antenna Schematics	Body and Accessories	Entertainment
152	Steering Wheel Controls Schematics	Body and Accessories	Entertainment
153	Cellular Telephone Schematics	Body and Accessories	Cellular Communications
154	On Star Schematics	Body and Accessories	Cellular Communications

How to Use Electrical Diagnosis

Electrical Diagnosis contains the following types of diagnostic information. Using these elements together makes the electrical diagnosis of the various vehicle systems faster and easier:

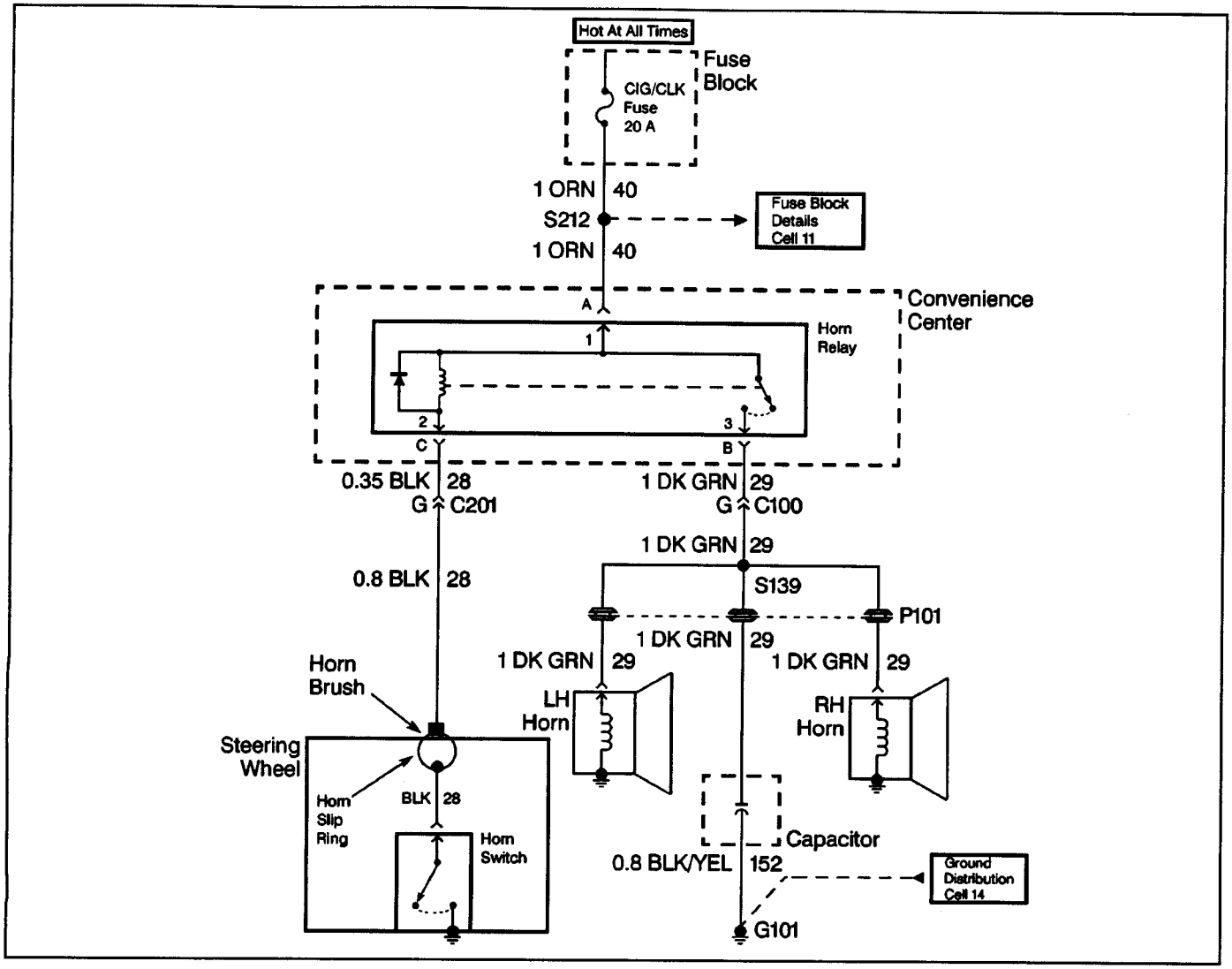
- Schematic Reference Table, refer to *How to Use Schematic Reference Tables*
- Schematic Icon Table, refer to *How to Use Schematic Icon Tables*
- Electrical Schematics, refer to *Where to Find Electrical Schematics*
- Component Location Table, refer to *How to Use Component Location Tables*
- Component Location Views, refer to *How to Use Connector End Views*
- Connector End Views, refer to *How to Use Connector End Views*
- System Check(s), refer to *How to Use Diagnostic System Checks*
- Diagnostic Tables, refer to *How to Use Diagnostic Tables*
- Circuit Description, refer to *How to Use Circuit Descriptions*

How to Use Electrical Schematics

The wiring schematic is the cornerstone of electrical diagnosis. Schematics break the entire electrical system into individual circuits, showing the electrical current paths when a circuit is operating properly. Wiring which is not part of the circuit of interest is referenced to another page where the circuit is shown complete. Schematics use a top (power) to bottom (ground) sequence to present electrical information.

Important: The schematic does not represent the components and wiring as they physically appear on the vehicle. For example, a 4-foot length of wire is treated no differently in a schematic from one which is only a few inches long.

When diagnosing a horn problem use the service information located in the Horns (cell 40) service category. The following schematic is a typical example of a schematic with its supporting text.



61199

How to Use Schematic Reference Tables

The schematic reference table is used when a circuit continues into another electrical system's schematic. The schematic reference table matches all references made on schematics to the appropriate service category type number and service category where the schematic's continuation is shown.

How to Use Schematic Icon Tables

The schematic icon table shows all icons on schematic with their definition or references.

How to Use Component Location Tables

The component location table shows a list of all the electrical components within a systems electrical schematics. The table consists of the following information within a system's electrical schematic:

- All components
- Grounds
- Pass-through grommets
- Splices

The table consists of 4 columns which describe the following information:

- The component name
- The component location
- The reference to the component view
- The reference to the connector end view (if applicable)

Name

The name cells provide the name of the components that are used on the schematic(s). If a connector is listed the number of cavities are also provided. This represents the total number of cavities in the connector regardless of how many connectors are actually used.

Location

The location cell provides a written location of where the component is in the vehicle with respect to vehicle landmarks. Nearly all of the following information shown on a schematic can be pinpointed visually using the component location view illustrations:

- Components
- Connectors
- Grounds
- Splices

Locator View

This column contains the reference to the appropriate component view. The reference contains the location within the subsection and the section. Refer to *How to Use Component Location Views.*

Connector End View

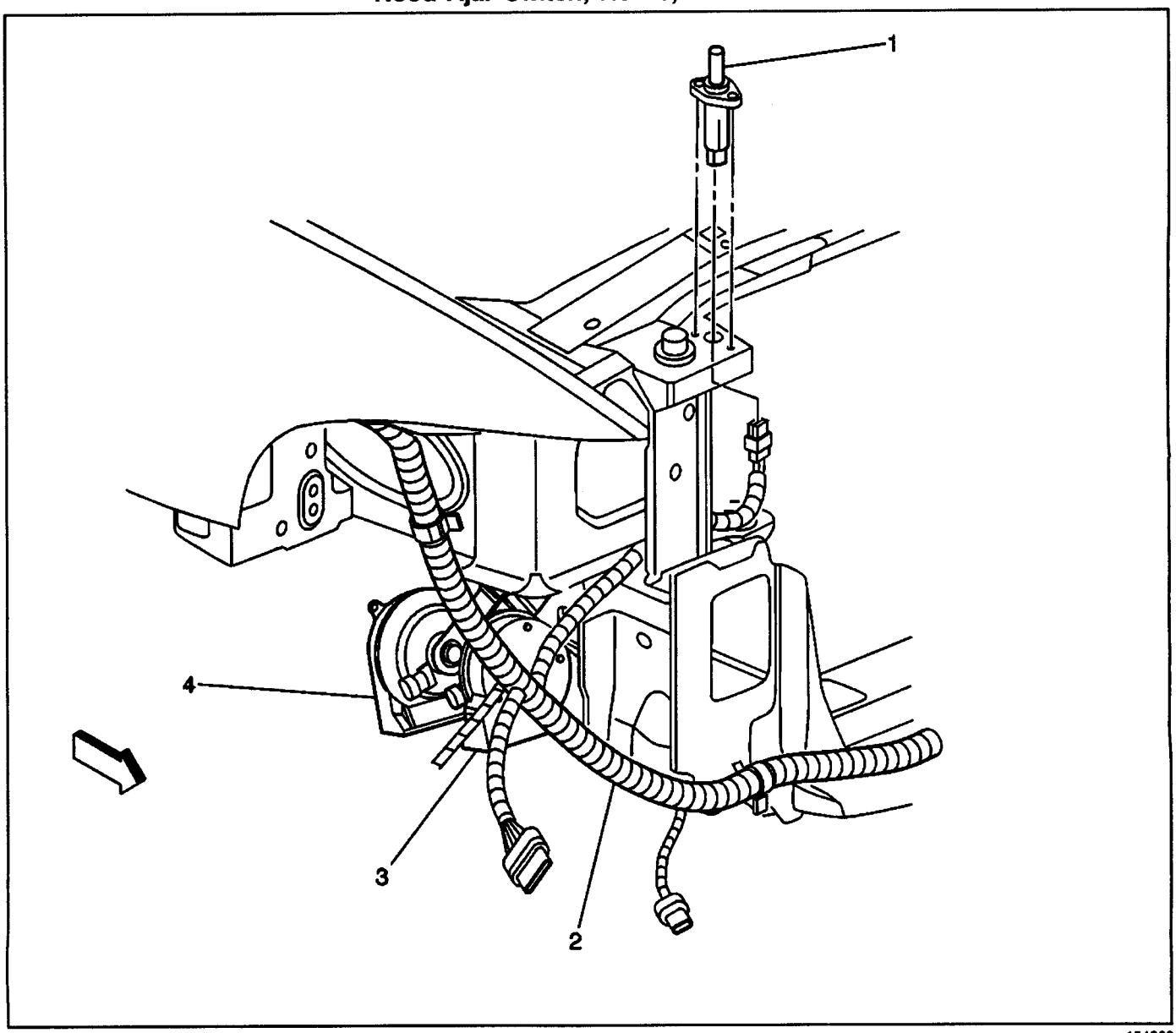
This column contains the reference to the appropriate connector end view. The reference contains the location within the subsection and the section. Refer to *How to Use Connector End Views.*

How to Use Component Location Views

Component location views are line illustrations that indicate all of the vehicle's electrical components within each electrical system.

Below is an example of a typical component view.

Hood Ajar Switch, Horns, and S114



154362

Legend

(1) Hood Ajar Switch (Export)
(2) S114
(3) RH Horn A Note
(4) RH Horn F Note

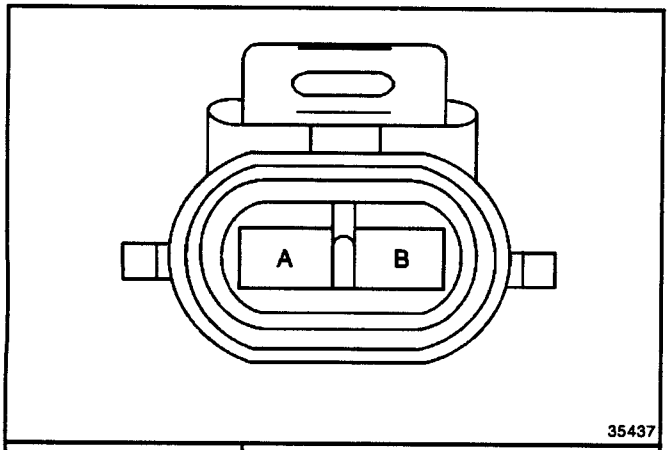
How to Use Connector End Views

Connector end views show the cavity or terminal locations for all the related 2—pin or larger connectors shown in the system schematic(s). The drawings show the connector's face as seen after the harness connector has been disconnected from a component or mating connector. Unused cavities are left blank in the table.

In addition, the color and part number of the connector body is provided along with the family/series name.

Below is an example of a typical connector end view.

RH Horn A Note



Connector Part Information		• 12052644 • 2 Way F Metri-Pack 150 Series Sealed (GRY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	250	Ground
B	DK GRN	29	Horn Feed

How to Use Diagnostic System Checks

The system check gives a summary of how the system operates and what actions occur. This is especially important when working on a new system. The system check will help identify symptoms, lead to diagnosis and confirm normal operation of the system after repair.

Horn System Check

Step	Action	Normal Result(s)	Abnormal Result(s)*
1	Press horn switch.	All Horns sound with good horn tone.	• Horns Inoperative • One Horn Inoperative • Poor Horn Tone
2	Release horn switch.	Horns do not sound.	Horns Always On
* Refer to the appropriate symptom diagnostic table for the applicable abnormal result.			

How to Use Diagnostic Tables

Diagnostic tables provide a procedure that will help you locate the condition in a circuit that is causing a malfunction. All diagnostic procedures are symptom based, to assist you in locating the condition as fast as possible. Diagnostic tables should exist for all possible (realistic) symptoms and diagnostic trouble codes (DTCs).

Horns Inoperative

Step	Action	Value(s)	Yes	No
DEFINITION: Horns will not sound when horn button is pressed.				
1	Was the Diagnostic System Check performed?	—	*Go to Step 2*	Go to Horns System Check
2	1. Turn ignition switch to OFF. 2. Remove the horn relay. 3. Connect a fused jumper across the horn relay terminals 30 and 87. Do the horns sound?	—	*Go to Step 3*	*Go to Step 6*
3	Connect a test lamp between the horn relay terminals 85 and ground. Does the test lamp light?	—	*Go to Step 4*	Go to Power Distribution
4	1. Connect a test lamp between the horn relay terminal 86 and battery (B+). 2. Press and hold the horn switch. Does the test lamp light?	—	*Go to Step 5*	*Go to Step 11*
5	Replace the horn relay. Is the repair completed?	—	Go to Horns System Check	—
6	Connect a test lamp between the underhood junction block terminal A12 or B12 (CKT 29) and ground. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 7*
7	Replace the underhood junction block, refer to underhood junction block replacement. Is repair completed?	—	Go to Horns System Check	—
8	Connect a test lamp between the Ground Splice Pack G104 (CKT 250) and battery (B+). Does the test lamp light?	—	*Go to Step 9*	*Go to Step 10*
9	Replace horns. Is repair completed?	—	Go to Horns System Check	—
10	Inspect G104 ground, if OK replace Ground Splice Pack G104. Is repair completed?	—	Go to Horns System Check	—
11	1. Disconnect the underhood junction block connector C2. 2. Connect a test lamp between the underhood junction block terminal D1 and battery (B+). 3. Press and hold the horn switch. Does the test lamp light?	—	*Go to Step 7*	*Go to Step 12*
12	1. Disconnect the Dash Integration Module (DIM). 2. Connect a test lamp between the underhood junction block terminal D1 and battery (B+). 3. Press and hold the horn switch. Does the test lamp light?	—	*Go to Step 13*	*Go to Step 14*
13	Replace the Dash Integration Module (DIM), refer to DIM replacement. Is the repair completed?	—	Go to Horns System Check	—

Horns Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
14	1. Disconnect C202. 2. Connect a test lamp between connector C202 terminal B12 of the steering column side and battery (B+). 3. Press and hold the horn switch. Does the test lamp light?	—	*Go to Step 15*	*Go to Step 16*
15	Repair short to ground in CKT 28 (BLK). Is repair completed?	—	Go to Horns System Check	—
16	Repair open in CKT 28 in the steering column. Is the repair completed?	—	Go to Horns System Check	—

How to Use Circuit Descriptions

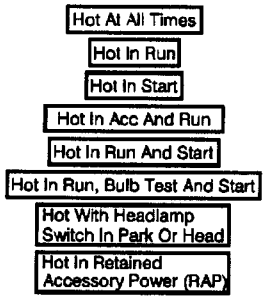
The circuit description describes how the system works electrically. It details how power, ground, inputs, and outputs are supplied to the system's related components. The circuit description also explains the communication and interaction of all components that affect the operation of the system.

Battery positive voltage is applied at all times to the horn relay terminals 85 and 30. Pressing the horn switch grounds the horn relay coil on CKT 28 (BLK). The relay coil can also be grounded on CKT 28 (BLK) by the Dash Integration Module (DIM). The horn relay applies battery positive voltage to the horns on CKT 29 (DK GRN) when energized. The horns sound until the horn switch is released or the DIM signal is gone.

Electrical Symbols

Symbol	Description
 106629	Electrostatic Sensitive Discharge (ESD) Icon. This icon is used to alert the technician that the system contains ESD sensitive components that require certain precautions before servicing. Refer to *Handling ESD Sensitive Parts Notice* in Cautions and Notices.
 106630	Supplemental Inflatable Restraint (SIR) or Supplemental Restraint System (SRS) Icon. This icon is used to alert the technician that the system contains SIR/SRS components that require certain precautions before servicing. Refer to *SIR Handling Caution* in General Information.

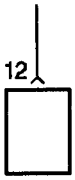
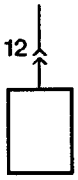
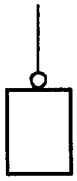
Electrical Symbols (cont'd)

Symbol	Description
 106632	On-Board Diagnostic (OBD II) Icon. This icon is used to alert the technician that the circuit is essential for proper OBD II emission controls circuit operation. Any circuit which, if it fails, causes the malfunction indicator lamp (MIL) to turn on, is identified as an OBD II circuit.
 106633	Important Icon This icon is used to.alert the technician that there is additional information that will aid in servicing a system.
 106635	Voltage Indicator Boxes. These boxes are used on schematics to indicate when voltage is present at a fuse.

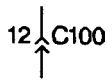
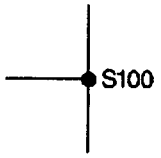
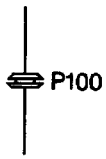
Electrical Symbols (cont'd)

Symbol	Description
 106637	Partial Component. When a component is represented in a dashed box, the component or it's wiring is not shown in it's entirety.
 106641	Entire Component. When a component is represented in a solid box the component or it's wiring is shown in it's entirety.
 106643	Fuse
 106642	Circuit Breaker

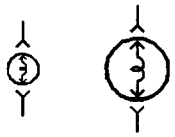
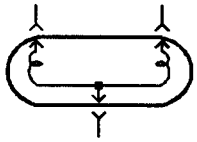
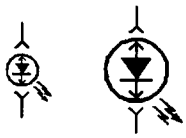
Electrical Symbols (cont'd)

Symbol	Description
 106644	Fusible Link
 106645	Connector Attached to Component
 106646	Pigtail Connector
 106647	Bolt On or Screw On Eyelet Terminal

Electrical Symbols (cont'd)

Symbol	Description
 106648	Inline Harness Connector
 106649	Splice
 106650	Pass Through The Grommet
 106651	Chassis Ground

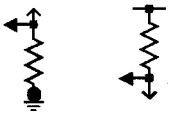
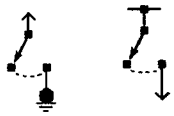
Electrical Symbols (cont'd)

Symbol	Description
 106652	Case Ground
 106653	Single Filaments Light Bulb
 106654	Double Filament Light Bulb
 106655	Light Emitting Diodes

Electrical Symbols (cont'd)

Symbol	Description
 106656	Capacitor
 106657	Battery
 106660	Variable Battery
 106658	Resistor

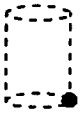
Electrical Symbols (cont'd)

Symbol	Description
 106659	Variable Resistor
 106661	Position Sensor
 106662	I/O Resistors
 106663	I/O Switches

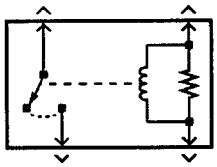
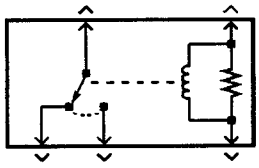
Electrical Symbols (cont'd)

Symbol	Description
 106664	Diode
 106665	Crystal
 106666	Heating Elements
 106667	Motor

Electrical Symbols (cont'd)

Symbol	Description
 106668	Solenoid
106669	Coil
 106670	Antenna
 106671	Shield

Electrical Symbols (cont'd)

Symbol	Description
 106672	Switches
 106673	Single Pole Single Throw Relay
 106674	Single Pole Double Throw Relay

General Electrical Diagnosis Procedures

Basic Knowledge Required

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures contained in this section. You should understand the basic theory of electricity and know the meaning of voltage (volts), current (amps) and resistance (ohms). You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram.

The following four-step troubleshooting procedure is recommended:

Check the Problem
Perform a System Check to determine a symptom. Don't waste time fixing part of the problem! Do not begin disassembly or testing until you have narrowed down the possible causes.

Read the Electrical Schematic
Study the schematic and read the Circuit Description text to gain an understanding of how the circuit should work. Check circuits that share wiring with the problem circuit. (Shared circuits are shown on Power Distribution, Ground Distribution, Fuse Block Detail pages.) Try to operate the shared circuits. If the shared circuits work, then the shared wiring is OK. The cause must be within the wiring used only by the problem circuit. If several circuits fail at the same time, chances are the power (fuse) or ground circuit is faulty.

Find the fault and repair
Narrow down the possible causes.

Use the Troubleshooting Hints.

Make the necessary measurements or checks as given in the System Diagnosis.

Before replacing a component, check power, signal and ground wires at the component harness connector. If the checks and connections are OK, the most probable cause is component failure.

Test the Repair
Repeat the System Check to verify that the fault has been corrected and that no other faults were induced during the repair.

Troubleshooting Tools

Electrical troubleshooting requires the use of common electrical test equipment.

Test Light
A test light is a simple quick way to check a circuit for voltage. The J 34142-B test light is made up of a 12 volt light bulb with a pair of leads attached. After grounding one lead, touch the other lead to various points along the circuit where voltage should be present. When the bulb goes on, there is voltage at the point being tested. A J 21008-A self-powered test light can be used to check for continuity. This tool is made up of a light bulb, Battery and two leads. If the leads are touched together, the bulb will go on.

A self-powered test light is used only on an unpowered circuit. First remove the fuse which feeds the circuit you're working on. Select two specific points along the circuit through which there should be continuity. Connect one lead of the self-powered test light to each point. If there is continuity, the test light circuit will be completed and the bulb will go on. Never use a self-powered test light on circuits that contain solid state components, since damage to these components may result.

Digital Multimeter (DMM)
A DMM can be used instead of a test light to check for voltage. While a test light shows whether or not voltage is present, a DMM indicates how much voltage is present.

An increasing number of circuits include solid state control modules. One example is the Powertrain Control Module (PCM). Voltages in these circuits should be tested only with a 10-megohm or higher impedance J 39200 Digital Multimeter (DMM). Unless directed to within the diagnostics, never use a test light on circuits that contain solid state components, since damage to these components may result.

When testing for voltage or continuity at the connection, it is not necessary to separate the two halves of the connector. Unless testing a Weather Pack® or a Metri Pack® connector 150 series and below, always probe the connector from the back. Always check both sides of the connector. An accumulation of dirt and corrosion between contact surfaces is sometimes a cause of electrical problems. A terminal contact checking procedure can be found later in this section.

A Digital Multimeter can also be used instead of a self-powered test light to check for circuit continuity. The ohmmeter function on a DMM shows how much resistance there is between two points along a circuit. Low resistance means good continuity.

Circuits which include any solid state control modules, such as the PCM, should be tested only with a 10-megohm or higher impedance J 39200 digital Multimeter.

When measuring resistance with a DMM, the vehicle's Battery should be disconnected. This will prevent incorrect readings. DMMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.

Diodes and solid state components in a circuit can cause an Digital Multimeter to give a false reading. To find out if a component is affecting a measurement, take a reading once, reverse the leads and take a second reading. If the readings differ, the solid state component is affecting the measurement.

Connector Test Adapters
Connector Test Adapter Kit is available for making tests and measurements at separated connectors. This kit contains an assortment of probes which mate with many of the types of terminals you will see. Avoid using paper clips and other substitutes since they can damage terminals and cause incorrect measurements.

Fused Jumper Wire
The J 36169 fused jumper is available with small clamp connectors providing adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 A fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

Short Finder
The J 8681-A short finder is available to locate hidden shorts to ground. The short finder creates a pulsing magnetic field in the shorted circuit and shows you the location of the short through body trim or sheet metal.

Notice: A fused jumper may not protect solid state components from being damaged.

Troubleshooting Tests

Aftermarket Accessories
Do not connect aftermarket accessories into SIR circuits. All such circuits are indicated on circuit diagrams with the SIR symbol.

Do not connect aftermarket accessories into OBD II circuits. All such circuits are indicated on circuit diagrams with the OBD II symbol.

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Some possible causes of vehicle problems related to aftermarket accessories include:

- Power feeds connected to points other than the battery.
- Antenna location.
- Transceiver wiring located too close to vehicle electronic modules or wiring.
- Poor shielding or poor connectors on antenna feed line.
- Check for recent service bulletins detailing installation guidelines for aftermarket accessories.

Probing
After probing, when reconnecting connectors or replacing terminals, always be sure to reinstall Connector Position Assurance (CPA) and Terminal Position Assurance (TPA).

Frontprobe
When frontprobing of connectors is required, always use a mating terminal adapter from the (J 35616-A) Connector Test Adapter Kit. The use of proper adapters will ensure that proper terminal contact integrity is maintained. A terminal contact checking procedure is located later in this section.

Backprobe
Only backprobe connector terminals when specifically called for in diagnostic procedures. Since backprobing can be a source of damage to connector terminals, extra care must be taken to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large a test probe.

After backprobing any connector, always check for terminal damage. If terminal damage is suspected, check for proper terminal contact (refer to Checking Terminal Contact, later in this section).

Testing for Voltage
Connect one lead of a test light to a known good ground. When using a DMM, be sure the voltmeter's negative lead is connected to ground.

Connect the other lead of the test light or voltmeter to a selected test point (connector or terminal).

If the test light illuminates, there is voltage present. When using a DMM, note the voltage reading.

Testing for Continuity
Remove the fuse to the circuit involved.

Connect one lead of a self-powered test light or ohmmeter to one end of the part of the circuit you wish to test.

Connect the other lead to the other end of the circuit.

If the self-powered test light glows, there is continuity. When using an ohmmeter, low or no resistance means good continuity.

Testing for Voltage Drop
This test checks for voltage being lost along a wire, or through a connection or switch.

Connect the positive lead of a DMM to the end of the wire (or to one side of the connection or switch) which is closer to the Battery.

Connect the negative lead to the other end of the wire (or the other side of the connection or switch).

Operate the circuit.

The DMM will show the difference in voltage between the two points.

Testing for Short to Ground
With a Test Light or DMM:

1. Remove the blown fuse and disconnect the load.
2. Connect a test light or voltmeter across the fuse terminals (be sure that the fuse is powered).
3. Beginning near the Fuse Block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test light or DMM.
4. When the test light glows, or the DMM registers, there is a short to ground in the wiring near that point.

With a Self-Powered Test Light or Ohmmeter:

1. Remove the blown fuse and disconnect the battery and load.
2. Connect one lead of a self-powered test light or ohmmeter to the fuse terminal on the load side.
3. Connect the other lead to a known good ground.
4. Beginning near the Fuse Block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the self-powered test light or ohmmeter.
5. When the self-powered test light glows, or the ohmmeter registers, there is a short to ground in the wiring near that point.

Fuses Powering Several Loads:

1. Find the schematic in Fuse Block Details, for the fuse that has blown.
2. Open the first connector or switch leading from the fuse to each load.
3. Replace the fuse.
   - If the fuse blows, the short is in the wiring leading to the first connector or switch. Use a test light or DMM as described on previous page.
   - If fuse does not blow, refer to next step.

Close each connector or switch until the fuse blows in order to find which circuit has the short. Connect test light or DMM at the connector to the suspect circuit (disconnected) rather than at the fuse terminals.

Intermittent and Poor Connections

Most intermittents are caused by faulty electrical connections or wiring, although occasionally a sticking relay or solenoid can be a problem. Some items to check are:

- Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).
- Dirt or corrosion on the terminals. The terminals must be clean and free of any foreign material which could impede proper terminal contact.
- Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orientation with the component or mating connector.
- Improperly formed or damaged terminals. All connector terminals in problem circuits should be checked carefully to ensure good contact tension. Use a corresponding mating terminal to check for proper tension. Refer to Checking Terminal Contact in this section for the specific procedure.
- The J 35616-A Connector Test Adapter Kit must be used whenever a diagnostic procedure requests checking or probing a terminal. Using the adapter will ensure that no damage to the terminal will occur, as well as giving an idea of whether contact tension is sufficient. If contact tension seems incorrect, refer to Checking Terminal Contact in this section for specifics.
- Poor terminal to wire connection. Some conditions which fall under this description are poor crimps, poor solder joints, crimping over wire insulation rather than the wire itself, corrosion in the wire to terminal contact area, etc.
- Wire insulation which is rubbed through, causing an intermittent short as the bare area touches other wiring or parts of the vehicle.
- Wiring broken inside the insulation. This condition could cause a continuity check to show a good circuit, but if only one or two strands of a multi-strand type wire are intact, resistance could be far too high.

To avoid any of the above problems when making wiring or terminal repairs, always follow the instructions for wiring and terminal repair detailed in Wiring Repairs and Connector Repairs.

Checking Terminal Contact

When diagnosing an electrical system that utilizes Metri-Pack 150/280/480/630 series terminals (refer to the J 38125-A Terminal Repair Kit or the J 38125-4 Instruction Manual for terminal identification), it is important to check terminal contact between a connector and component, or between in-line connectors, before replacing a suspect component.

Frequently, a diagnostic chart leads to a step that reads: Check for poor connection. Mating terminals must be inspected to assure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination is caused by the connector halves being improperly connected, a missing or damaged connector seal, or damage to the connector itself, exposing the terminals to moisture and dirt. Contamination, usually in underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter, improperly joining the connector halves or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact, causing an open or intermittently open circuit.

Follow the procedure below to check terminal contact.

1. Separate the connector halves. Refer to the J 38125-A Terminal Repair Kit or the J 38125-4 instruction manual.
2. Inspect the connector halves for contamination. Contamination will result in a white or green build- up within the connector body or between terminals, causing high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal from the J 38125-A Terminal Repair Kit, check the retention force of the female terminal in question by inserting and removing the male terminal to the female terminal in the connector body. Good terminal contact will require a certain amount of force to separate the terminals.
4. Using an equivalent female terminal from the J 38125-A Terminal Repair Kit, compare the retention force of this terminal to the female terminal in question by joining and separating the male terminal to the good female terminal, and then joining and separating the male terminal to the female terminal in question. If the retention force is significantly different between the two female terminals, replace the female terminal in question (refer to the J 38125- A Terminal Repair Kit).

If a visual (physical) check does not reveal the cause of the problem, the vehicle may be able to be driven with a DMM connected to the suspected circuit. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit.

Detecting Electrical Intermittents

Use the following procedure to detect intermittent terminal contact or a broken wire with an intermittent connection inside the insulation.

The J 39200 Digital Multimeter (DMM) has the ability to monitor current, resistance, or voltage while recording the minimum (MIN) and maximum (MAX) values measured. The DMM can also be set to display the average (AVG) value measured.

When diagnosing circuits that have voltage applied, use the voltage setting to monitor a connector (or length of a circuit) which is suspected of having an intermittent connection but is currently operating normally.

1. Connect the J 39200 Digital Multimeter to both sides of a suspect connector (still connected) or from one end of a suspect circuit to the other. This will continuously monitor the terminal contacts or length of wire being checked. Refer to Meter Connections for examples of the various methods for connecting the DMM to the circuit.
2. Set the DMM for voltage. Since the MIN MAX mode does not use auto ranging, manually select the voltage range necessary before proceeding.
3. Press the MIN MAX button. The DMM should read 100 ms RECORD (100 millisecond record) and emit a 1/4 second beep. The DMM is now ready to record and will generate an audible tone for any change in voltage. At this point, you may wish to press the PEAK MIN MAX button, which will record any voltage variations that occur for at least 1 millisecond.
4. Try to simulate the condition that is potentially causing an intermittent connection, either by wiggling connections or wiring, test driving or performing other operations. If an open or resistance is created, a voltage will be present and the DMM will emit a tone for as long as the open or resistance exists. Any change in voltage will cause the DMM to emit a tone for no less than 1/4 second. (Listening for a tone while manipulating wiring is very helpful for narrowing down an intermittent connection.)

Use the MIN and MAX values when the DMM is out of sight or sound range, in noisy areas or for test driving when it may not be possible to monitor the DMM.

To check the MIN and MAX recorded voltages press MIN MAX once for MAX and twice for MIN. A variation between MIN and MAX recorded voltages (unless nearly 0 volts) suggests an intermittent open or that resistance exists and should be repaired as necessary.

Important: The 100 ms RECORD (100 millisecond record) mode is NOT the amount of time allowed to perform a specific procedure. It is the amount of time used to record each snapshot of information used for calculating AVG when in the MIN MAX mode.

Digital Multimeter (DMM) Connections

The previous diagnostic procedure was written to detect intermittents using the DMM set to voltage. Whether using the current, voltage, or resistance setting to detect intermittents, it is necessary to connect the DMM to the circuit.

Following are examples of the various methods of connecting the DMM to the circuit to be checked:

- Backprobe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while performing other operations or test driving. (Do not backprobe Weather Pack® type connectors.)
- Disconnect the harness at both ends of the suspect circuit where it connects either to a component or to other harnesses.
- Use the J 35616-A Connector Test Adapter Kit to connect the DMM to the circuit.
- If the system being diagnosed has a specified pinout or breakout box, it may be used to simplify connecting the DMM to the circuit or for checking multiple circuits quickly.

Additional Information

Notice: Do not touch the electrical connections and pins. Do not allow the pins or connections to contact brake fluid. This will damage the EBCM.

Continuity tests that work well for detecting intermittent shorts to ground can be performed by setting the DMM to ohms, then pressing the PEAK MIN MAX button. An audible tone will be heard whenever the DMM detects continuity for at least 1 millisecond.

The J 39200 Instruction Manual is a good source of information and should be read thoroughly upon receipt of the DMM as well as kept on hand for reference during new procedures.

Notice: Turn off power to the test circuit before attempting in-circuit resistance measurements to prevent false readings or damage to the DMM. Do not use the DMM to measure resistance through a solid state module.

Strategy Based Diagnostic Flow

Important: An understanding of the following ideas and theories is required before performing any diagnostic procedures.

- Basic theory of electricity, understand the meaning of voltage (volts), current (amps) and resistance (ohms).
- Understand the affects an open or a shorted wire can have on a circuit.
- Able to read and understand a wiring schematic.

Troubleshooting Procedure

Use the following seven step procedure when diagnosing an electrical system concern. Refer to Strategy Based Diagnostic Flow in General Information for a visual diagram of the following procedure.

Verify Customer Concern, Check the Problem, #1
Verify the correct normal operating behavior of the system also verify that the customer complaint is a valid failure of the system. Use any of the following resources to validate the complaint.

- Vehicle road test.
- Review the system operation in the owners manual.
- Check an identical vehicle.
- Review the circuit descriptions in the service manual.

These questions should be asked: When and where does problem occur? Do all related systems operate properly? How does the problem occur? How often does the problem occur? How long has the condition existed / did it ever work?

Preliminary Checks, #2
The goal of this step is to establish if the complaint is visually obvious and accumulate enough data to properly search for a bulletin. The initial checks may vary due to the complexity of the system and may include:

- Identify parts of the system that work properly, review the system's schematic.
- Checking for open fuses, visual inspection for unplugged connectors and checking terminals for damage and tightness.
- Investigating the vehicle's service history.

When performing the preliminary checks observe the unusual such as noise, vibration/feel, smell.

This step will save time and labor. REMEMBER, it is essential to understand how a circuit should work before trying to figure out why it doesn't. After understanding how a circuit should operate, read the schematic again, this time keeping in mind what has been learned by operating the circuit.

Perform Published Diagnostic System Checks, #3
System checks exist for all electrical systems and consist of two types.

- Diagnostic System Check, this table is used for checking various vehicle control modules for any DTC's stored by the vehicle's control modules.
- System Check, this table is used to operate the system and determine if a abnormal condition is present.

Performing a system check will provide a systematic approach to narrowing down the possible cause of a system fault.

Check for Bulletins, #4
Checking the Technical Service Bulletins and utilizing the Techline equipment for any bulletin information.

Stored DTC(s), #5.1
After performing the diagnostic system check follow the DTC diagnostic tables in the service manual.

Symptoms, No DTCs, #5.2
After performing the system check follow the symptom diagnostic tables in the service manual.

No Published Diagnostics, #5.3
Analyze the complaint and utilize the wiring schematics and circuit description to develop a plan for the diagnosing the complaint.

Intermittent, #5.4
Utilize the electrical intermittent information in the service manual.

Operating as Designed, #5.5
If the complaint can not be verified, ensure that the vehicle is tested and is operating as designed. To ensure that customer satisfaction is maintained, verify the complaint under the conditions described by the customer before releasing the vehicle.

Isolate the Root Cause, #6
A properly performed diagnostic check should isolate the root cause of the complaint.

Repair and Verify Completeness of Repair, #7
Once proper diagnosis has been performed and documented, a thorough repair procedure is performed to fix the complaint. To confirm that the repair has addressed the complaint, perform the appropriate system check. If the complaint is still present, re-examine the complaint, review the first four steps of your strategy based diagnostics carefully.

Important: Also verify the complaint under the conditions described by the customer before releasing the vehicle. The verification of the repair in the form of a working test is the only way the repair process can be considered complete, this test should either be a road test or performance test in the service bay.

Symptom Diagnostic Example

The following is an example of a symptom and the correct course of action taken by the technician.

Important: It can not be stressed enough that proper preparation of: checking for possible bulletins, DTC's, checking vehicles service history and a thorough screening with the customer of the problem is detrimental to a complete repair of the vehicle and therefore the customers complete satisfaction.

Verify the customer concern, Check the problem

Customer complaint is the headlamps are inoperative. Verifying the normal operating procedure of the circuit and the components that share that circuit. Refer to *Strategy Based Diagnostic Flow.*

Review the Headlamps Electrical Schematic (Preliminary Checks)

Review the schematic, it is essential to understand how a circuit should work before trying to figure out why it doesn't. After understanding how a circuit should operate, read the schematic again, this time keeping in mind what has been learned by operating the circuit. Since both the low beam headlamps operate, ensure that the following components are operating properly.

- The headlamp Switch.
- The YEL wire.
- Low contacts of the Headlamp Dimmer Switch.
- C100 terminal 1E.
- The TAN wires.
- Grounds G105 and G109.

Refer to *Strategy Based Diagnostic Flow.*

Perform the System Check

The system check indicates that the low beam headlamps operate when the high beam switch is in high. Also, the high beam indicator illuminates but neither high beam headlamp operates. Refer to *Strategy Based Diagnostic Flow.*

Check for Bulletins

Utilizing a combination of Techline tools and the information accumulated from the Preliminary Checks, check for bulletins.

Isolate the Root Cause

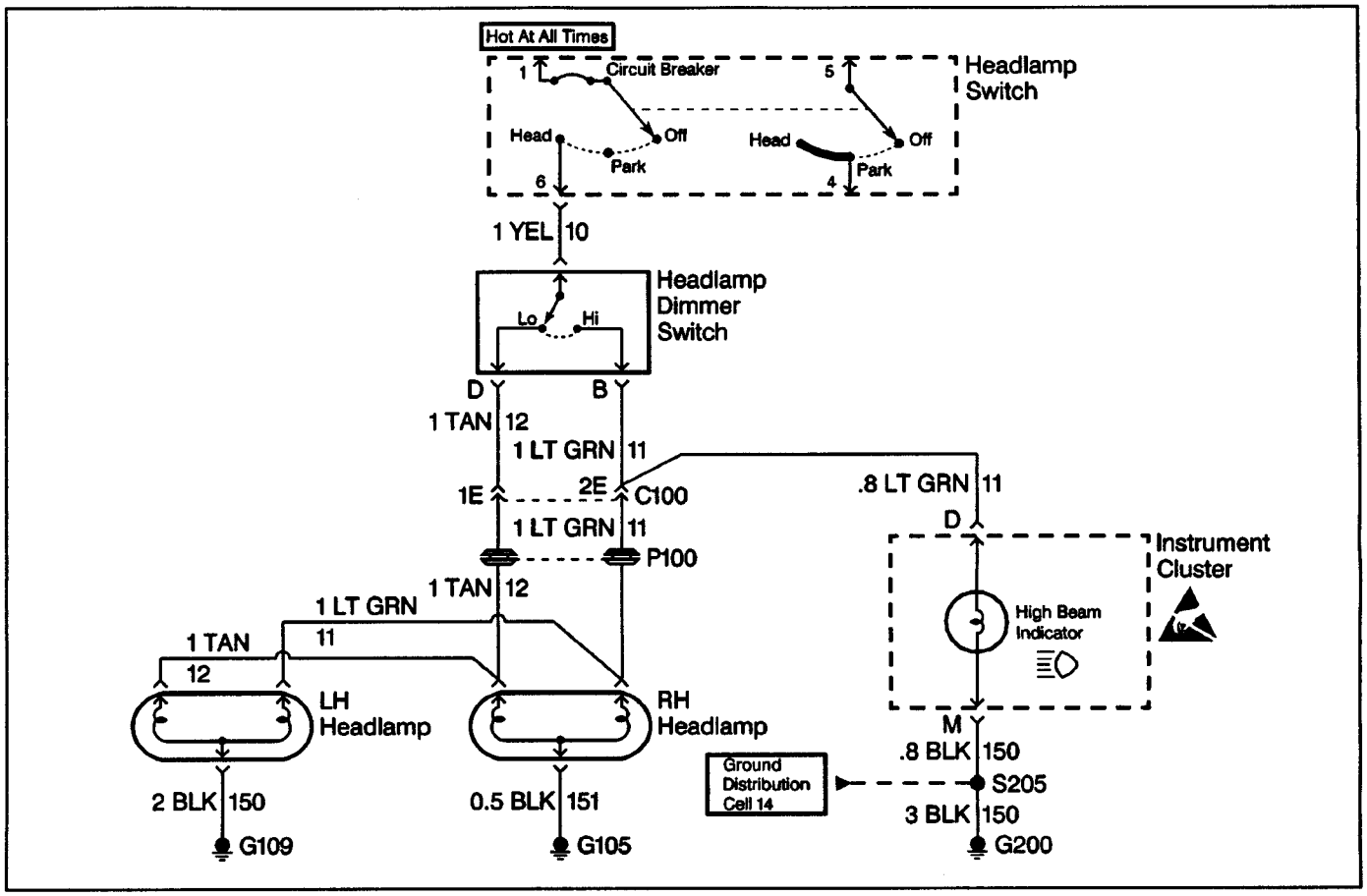
At this point analyze and (diagnose the problem), and develop text. Since the high beam indicator illuminated when the headlamp dimmer switch was in the high position, the high contacts of the headlamp dimmer switch and the LT GRN wire between the headlamp dimmer switch and C100 are good.

At this point, it is extremely unlikely that the high beam filaments in the RH headlamp are both open or that both headlamp connections are bad. The cause must be a bad connection at C100 or an open in the LT GRN wire between C100 and the RH headlamp.

Repair and Verify Fix

From isolating the root cause, basically the problem has been diagnosed. Using the Component Location Table and the corresponding figure, quickly find C100 and the LT GRN wire, locate the exact trouble point and make the repair.

Check the thoroughness of the repair by performing a final system check on the headlamp circuit. This of course means making sure that both high beams, both low beams, and the high beam indicator are working.



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Checking Aftermarket Accessories

Important: Do not connect aftermarket accessories into the following circuits:

- SIR circuits, all such circuits are indicated on circuit diagrams with the SIR symbol. Refer to *SIR Service Precautions Caution* in Cautions and Notices.
- OBDII circuits, all such circuits are indicated on circuit diagrams with the OBDII symbol.

  Refer to *OBD II Symbol Description Notice* in Cautions and Notices.

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Possible causes of vehicle problems related to aftermarket accessories include:

- Power feeds connected to points other than the battery.
- Antenna location.
- Transceiver wiring located too close to vehicle electronic modules or wiring.
- Poor shielding or poor connectors on antenna feed line.
- Check for recent service bulletins detailing installation guidelines for aftermarket accessories.

Troubleshooting with a Test Light

A test light can simply and quickly check a circuit for voltage. The following two types of test lights the J 34142-B test light and J 21008–A self-powered test light can be used in diagnosing vehicle symptoms. Review the following text before using either tool.

J 34142-B test light is comprised of a 12 volt light bulb with an attached pair of leads. To properly operate this tool use the following procedure.

1. Attach one lead to ground.
2. Touch the other lead to various points along the circuit where voltage should be present.
3. When the bulb illuminates, there is voltage at the point being tested.

Notice: Do not use a self-powered test light in circuits that contain solid state components, as damage to these components may result.

J 21008-A self-powered test light is comprised of a light bulb, battery, and two leads. If the leads are touched together the bulb illuminates. A self-powered test light is used only on an unpowered circuit and can check for continuity of a circuit. To properly operate this tool use the following procedure.

1. Remove the fuse which feeds the circuit.
2. Select two specific points along the circuit through which there should be continuity.
3. Connect one lead of the self-powered test light to each point. If there is continuity the test light circuit will be completed and the bulb illuminates.

Troubleshooting with a Digital Multimeter

Digital Multimeter (DMM)

Notice: Do not insert a DMM test probe into any connector or fuse block terminal. The diameter of the DMM test probe will deform most terminals. A deformed terminal can cause a poor connection between the device, which can result in system failures. Always use the Connect Test Adapter Kit when using a DMM in order to probe terminals.

Important: Circuits which include any solid state control modules, such as the PCM, should be tested only with a 10 megohm or higher impedance *J 39200* digital multimeter.

The *J 39200* Instruction Manual is a good source of information and should be read thoroughly upon receipt of the DMM as well as kept on hand for reference during new procedures.

A DMM should be used instead of a test light to check for voltage. While a test light shows whether voltage is present, a DMM indicates how much voltage is present.

When testing for voltage or continuity at the connection, it is not necessary to separate the two halves of the connector. Unless testing a Weather Pack® or a Metri Pack® connector 150 series and below, always probe the connector from the back. Always check both sides of the connector. An accumulation of dirt and corrosion between contact surfaces is sometimes a cause of electrical problems.

A DMM should be used instead of a self-powered test light to check for circuit continuity. The ohmmeter function on a DMM shows how much resistance exists between two points along a circuit. Low resistance in a circuit means good continuity.

Important: Disconnect the battery when measuring resistance with a DMM. This prevents incorrect readings.

DMMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.

Diodes and solid state components in a circuit can cause a DMM to display a false reading. To find out if a component is affecting a measurement take a reading once, then reverse the leads and take a second reading. If the readings differ the solid state component is affecting the measurement. Following are examples of the various methods of connecting the DMM to the circuit to be checked:

- Backprobe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while you perform other operations or test driving.
- Disconnect the harness at both ends of the suspected circuit where it connects either to a component or to other harnesses.

  Use the *J 35616* Connector Test Adapter Kit in order to connect the DMM to the circuit.
- If the system that is being diagnosed has a specified pinout or breakout box, it may be used in order to simplify connecting the DMM to the circuit or for checking multiple circuits quickly.

Troubleshooting with a Short Finder

The J 8681-A short finder can locate hidden shorts to ground. The short finder creates a pulsing magnetic field in the shorted circuit and shows the location of the short through the body trim or sheet metal.

Using Connector Test Adapters

Notice: Do not use paper clips or other substitutes as they can damage terminals and cause incorrect measurements.

The *J 35616* Connect Test Adapter Kit contains various terminal pigtails for probing terminals.

Connector test adapter kit allows the DMM to conduct tests and measurements at separated connectors, fuse, or relay terminals.

Using Fused Jumper Wires

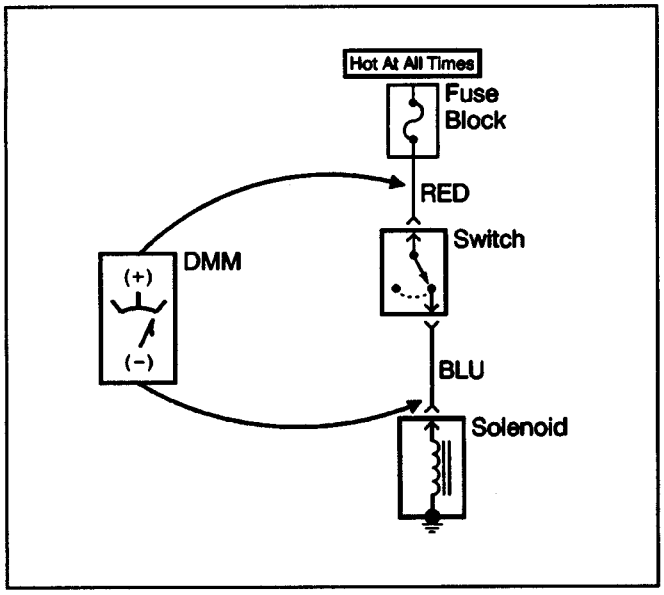
Important: A fused jumper may not protect solid state components from being damaged.

The J 36169 fused jumper includes small clamp connectors that provide adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 A fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

Testing for Voltage

Notice: Do not insert a DMM test probe into any connector or fuse block terminal. The diameter of the DMM test probe will deform most terminals. A deformed terminal can cause a poor connection between the device, which can result in system failures. Always use the Connect Test Adapter Kit when using a DMM in order to probe terminals.

This test checks for voltage along a wire through a connection or switch.



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1. Apply power to the circuit.
2. Place meter leads in the COM (black) and Vohm inputs.
3. Place the rotary switch (meter) in the V (AC) or V (DC) position.
4. Connect the positive lead of a DMM to the end of the wire, (or to one side of the connection or switch) which is closer to the battery.
5. Connect the negative lead to the other end of the wire (or the other side of the connection or switch).
6. Operate the circuit.

Testing for Continuity

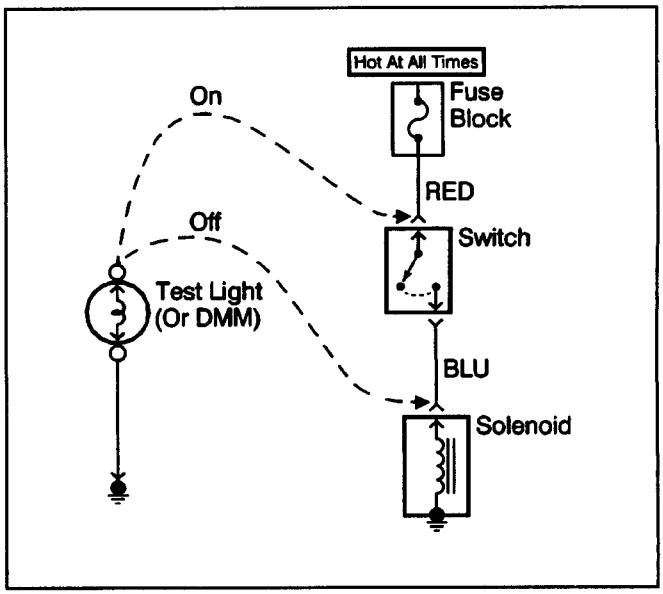
With a DMM

Continuity tests work well for detecting intermittent shorts to ground and can be performed by setting the DMM to ohms, then pressing the PEAK MIN MAX button. An audible tone is heard whenever the DMM detects continuity for at least 1 millisecond.

This test checks for continuity along a wire, through a connection or switch.

Notice: Do not insert a DMM test probe into any connector or fuse block terminal. The diameter of the DMM test probe will deform most terminals. A deformed terminal can cause a poor connection between the device, which can result in system failures. Always use the Connect Test Adapter Kit when using a DMM in order to probe terminals.

1. Remove the negative battery cable.
2. Place the leads of the DMM in COM (black) and V/ohms (red) inputs.
3. Set the rotary dial of the DMM to ohms.
4. Press the PEAK MIN MAX button.
5. Connect one lead of the DMM to one end of the circuit to test.
6. Connect the other lead to the other end of the circuit.
7. If the DMM displays low or no resistance and a tone is heard the circuit being tested has good continuity.



61700

With a Test Light

This test checks for continuity along a wire, through a connection or switch.

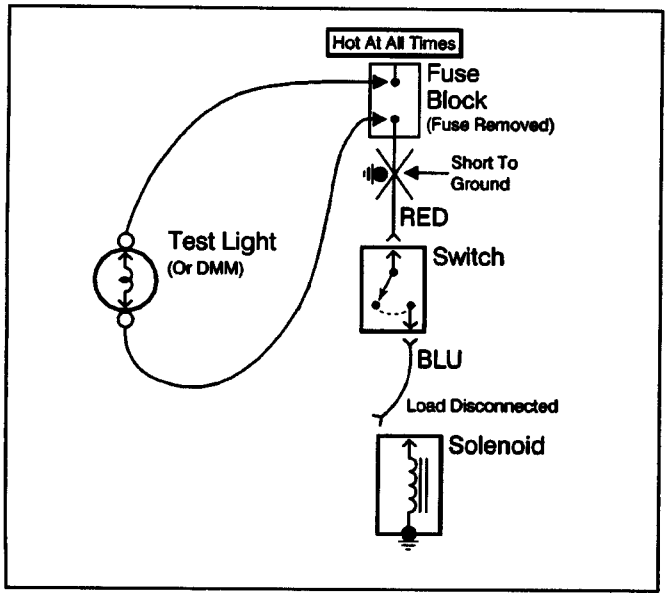
Notice: Do not insert a DMM test probe into any connector or fuse block terminal. The diameter of the DMM test probe will deform most terminals. A deformed terminal can cause a poor connection between the device, which can result in system failures. Always use the Connect Test Adapter Kit when using a DMM in order to probe terminals.

1. Remove the fuse from the suspect circuit.
2. Connect one lead of the test light to one end of the circuit to test.
3. Connect one end of the circuit to be tested to ground.
4. If the test light is not self-powered connect the other lead to a battery positive voltage source.
5. If the test light illuminates (full intensity) then the circuit being tested has good continuity.

Testing for Short to Ground

Notice: Do not use a self-powered test light in circuits that contain solid state components, as damage to these components may result.

This test checks a short to ground along a wire or through a connection, or switch.



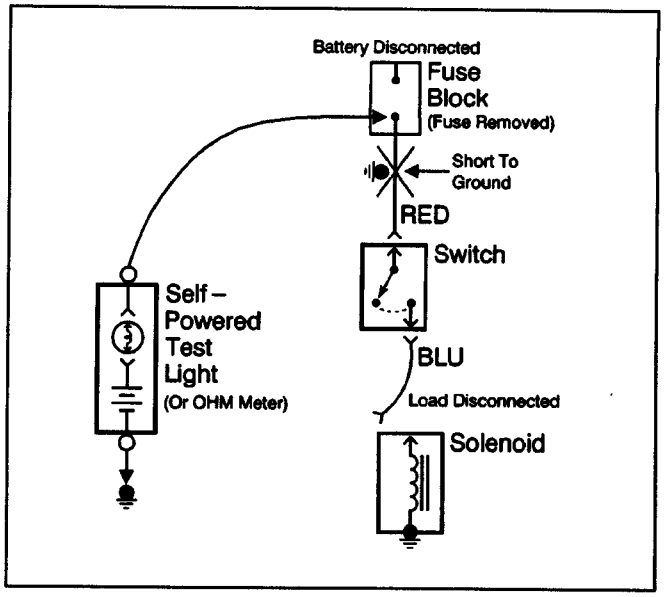
61705

With a DMM Set to Ohmmeter Function

1. Remove the open fuse.
2. Disconnect the battery.
3. Disconnect the load.
4. Connect one lead of the DMM to the fuse terminal on the load side.
5. Connect the other lead to a known good ground.
6. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the DMM.
7. When the DMM displays low or no resistance, there is a short to ground in the wiring near that point.

With a DMM Set to Voltage Function

1. Remove the open fuse.
2. Disconnect the load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
4. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the DMM.
5. When the DMM displays voltage, there is a short to ground in the wiring near that point.



61706

With a Test Light

1. Remove the open fuse.
2. Disconnect the load.
3. Connect a test light across the fuse terminals (be sure that the fuse is powered).
4. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test light.
5. When the test light glows there is a short to ground in the wiring near that point.

With a Self-Powered Test Light

1. Remove the open fuse and disconnect the battery and load.
2. Disconnect the battery.
3. Disconnect the load.
4. Connect one lead of a self-powered test light to the fuse terminal on the load side.
5. Connect the other lead to a known good ground.
6. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the self-powered test light.
7. When the self-powered test light glows, there is a short to ground in the wiring near that point.

Fuse Powering Several Loads

1. Review the system schematic and locate the fuse that is open.
2. Open the first connector or switch leading from the fuse to each load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
   - When the DMM displays voltage the short is in the wiring leading to the first connector or switch.
   - If the DMM does not display voltage refer to the next step.
4. Close each connector or switch until the DMM displays voltage in order to find which circuit has the short.

Testing for Electrical Intermittents

Use the following procedure to detect an intermittent circuit that is currently operating normally.

Important: The J 39200 Digital Multimeter (DMM) must be used to perform the following procedure since the DMM can monitor current, resistance or voltage while recording the minimum (MIN), and maximum (MAX) values measured.

1. Connect the J 39200 Digital Multimeter (DMM) to both sides of a suspected connector, (still connected) or from one end of a suspected circuit to the other.

Important: Refer to *Troubleshooting with a Digital Multimeter*

2. Select the appropriate voltage mode on the DMM.
3. Press the Range button to select the desired voltage range.
4. Press the MIN MAX button. The DMM displays 100 ms RECORD and emits an audible tone (beep).

Important: The DMM is now ready to record and generates an audible tone for any change in voltage.

The 100 ms RECORD mode is the amount of time used to record each snapshot of information used for calculating the AVG voltage.

5. Simulate the condition that is potentially causing an intermittent connection, either by wiggling the connections or the wiring, also by test driving or performing other operations. If an open or a high resistance condition is created voltage is present and the DMM emits a tone for as long as the condition exists.
6. Press the MIN MAX button once to display the MAX value and note the value.
7. Press the MIN MAX button twice for the MIN value and note the value.
8. Determine the difference between the MIN and MAX values.
   - If the variation between the recorded MIN and MAX voltage values is one volt or greater an intermittent open or high resistance condition exists. Repair condition as necessary.
   - If the variation between the recorded MIN and MAX voltage values is less than one volt an intermittent open or high resistance condition does not exist.

Testing for Poor Connections

Most intermittents are caused by faulty electrical connections or wiring. Occasionally a sticking relay or solenoid can also cause an intermittent failure. Some items to check are:

- Poor mating of connector halves or terminals not fully seated in the connector body (backed out).
- Dirt or corrosion on the terminals.
- The terminals must be clean and free of any foreign material which could impede proper terminal contact.
- Damaged connector body.
- Exposure of terminals to moisture and dirt causing improper terminal orientation with the component or mating connector.
- Improperly formed or damaged terminals.
- Check all connector terminals in problem circuits in order to ensure good contact tension. Use a corresponding mating terminal to check for proper tension. Refer to *Connector Repairs* for the specific procedure.
- Poor terminal to wire connection. Some conditions which fall under this description are poor crimps, poor solder joints, crimping over wire insulation rather than the wire itself and corrosion in the wire to terminal contact area, etc.
- Wire insulation which is rubbed through. This causes an intermittent short as the bare area touches other wiring or parts of the vehicle.
- Wiring broken inside the insulation. This condition could cause a continuity check to show a good circuit but if only one or two strands of a multi-strand type wire are intact, resistance could be far too high.

In order to avoid any of the above problems when making wiring or terminal repairs always follow the instructions for wiring and terminal repair detailed in *Wiring Repairs* and *Connector Repairs.*

Checking Terminal Contact

When diagnosing an electrical system that utilizes Metri-Pack 150/280/480/630 series terminals (refer to the J 38125-A Terminal Repair Kit or the J 38125-4 Instruction Manual for terminal identification), it is important to check terminal contact between a connector and component, or between in-line connectors, before replacing a suspected component.

Frequently, a diagnostic leads to a step that reads: Check for poor connection. Mating terminals must be inspected to assure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination is caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself or exposing the terminals to moisture and dirt, can cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter, improperly joining the connector halves or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Follow the procedure below to check terminal contact.

1. Separate the connector halves. Refer to the J 38125-A Terminal Repair Kit or the J 38125-4 instruction manual.
2. Inspect the connector halves for contamination. Contamination will result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal from the J 38125-A Terminal Repair Kit, check that the retention force is significantly different between the two female terminals. Replace the female terminal in question (refer to the J 38125-A Terminal Repair Kit.)

If a visual physical check does not reveal the cause of the problem, connect a DMM to the suspected circuit. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit.

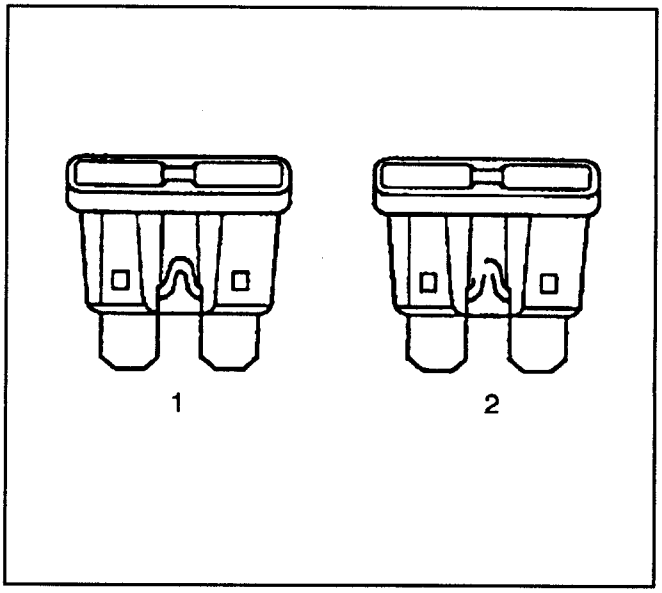
Wiring Repairs

Circuit Protection

Important: After you make any electrical repair, always test the circuit by operating the devices in the circuit. This confirms not only that the repair is correct, but also that the cause of the complaint was correctly identified.

All electrical circuits are protected against excessive loads which might occur because of shorts or overloads in the wiring system. A fuse or circuit breaker provides such protection. A short may cause a fuse to blow or a circuit breaker to open.

Fuses



8786

The fuse is the most common method of automotive wiring circuit protection. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit. Fuses are a "one time" protection device and must be replaced each time the circuit is overloaded. To determine if a fuse is blown, remove the suspect fuse and examine the element in the fuse for a break. If the element is broken, replace the fuse with one of equal current rating.

Fuse Types

Current Rating Amperes	Color
Auto Fuses, Mini Fuses	
2	Gray
3	Violet
5	Tan
7.5	Brown
10	Red
15	Blue
20	Yellow
25	White
30	Green
Maxi Fuses	
20	Yellow
30	Light Green
40	Orange
60	Blue

Circuit Breakers

A circuit breaker is a protective device that is designed to open the circuit when a current load is in excess of the rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. Two types of circuit breakers are used. The first is a circuit breaker. This type will open when excessive current passes through it for a period of time. It will close again after a few seconds. If the cause of the high current is still present, it will open again. It will continue to cycle open and closed until the condition causing the high current is removed. The second type of circuit breaker is a positive temperature coefficient (PTC) circuit breaker. This type greatly increases its resistance when excessive current passes through it. The excessive current heats the PTC device. As the device heats, its resistance increases. Eventually the resistance gets so high that the circuit is effectively open. Unlike the ordinary circuit breaker, the PTC unit will not reset until the circuit is opened, removing the voltage from its terminals. Once the voltage is removed, the circuit breaker will re-close within a second or two.

Typical Electrical Repairs

An open circuit is an incomplete circuit. Power cannot reach the load or the ground. If a circuit is open, active components do not energize. A short circuit is an unwanted connection between one part of the circuit and either the ground or another part of the circuit. A short circuit causes a fuse to blow or a circuit breaker to open.

Short Circuits Caused by Damaged Wire Insulation

If the damage is minor, locate the problem and tape over the wire. If the damage is more extensive, replace the faulty segment of the wire. Follow the instructions below in order to repair copper and shielded cables.

Wire Size Conversion Table

Metric Wire Sizes (mm[^{2}])	AWG Sizes
0.22	24
0.35	22
0.5	20
0.8	18
1.0	16
2.0	14
3.0	12
5.0	10
8.0	8
13.0	6
19.0	4
32.0	2
50.0	1/0

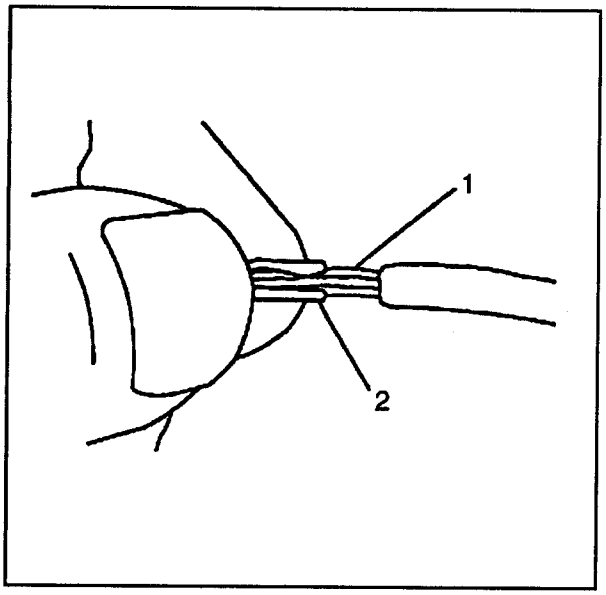
Splicing Copper Wire Using Splice Clips

Tools Required

J 38125 Terminal Repair Kit

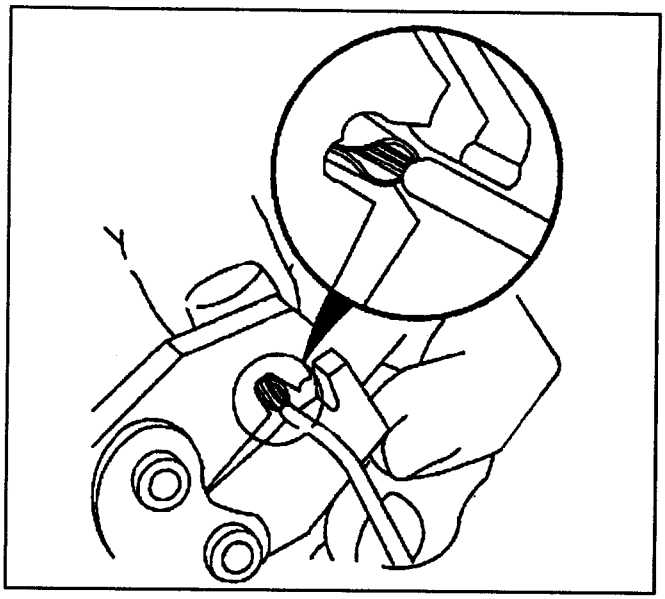
1. Open the harness.
   - If the harness is taped, remove the tape.
   - To avoid wiring insulation damage, use a sewing ripper in order to cut open the harness.
   - If the harness has a black plastic conduit, pull out the desired wire.
2. Cut the wire.
   - Cut as little wire off the harness as possible.
   - Ensure that each splice is at least 40 mm (1.5 in) away from other splices, harness branches, and connectors. This will help prevent moisture from bridging adjacent splices and causing damage.

3. Strip the insulation.
   - Use wire of equal or greater size than the original. The wire's insulation must have the same or higher temperature rating.
   - You may use general purpose insulation for areas that are not subject to high temperatures.
   - Use a cross-linked polyethylene insulated wire for areas where high temperatures are expected.
     - Cross-linked polyethylene wire may be used to replace PVC, but you may not replace cross-linked polyethylene with PVC.
     - Cross-linked polyethylene wire is not fuel resistant and should not be used to replace wire where there is the possibility of fuel contact.
   - Select the correct size opening in the wire stripper or work down from the largest size.



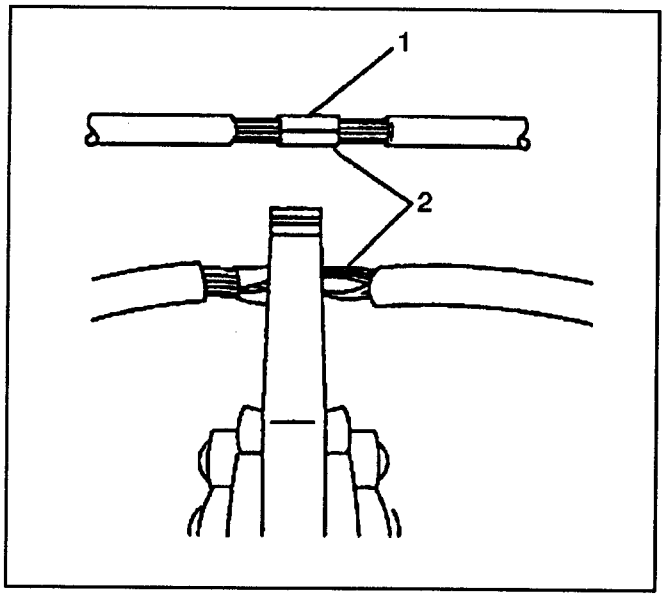
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4. Crimp the wires.
   - Select the proper clip to secure the splice. Follow the instructions in the J 38125 Kit in order to determine the proper clip size crimp tool and anvil.
   - Overlap the two stripped wire ends and hold them between your thumb and forefinger.
   - Center the splice clip under the stripped wires and hold it in place.



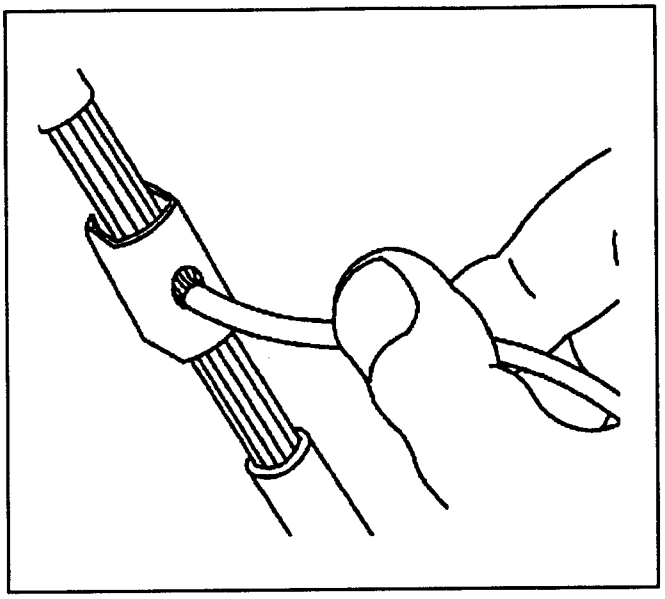
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5. Apply steady pressure until the crimp tool closes.
   - Ensure that the wires extend beyond the clip in each direction.
   - Ensure that no strands of wire are cut loose.
   - Ensure that no insulation is caught under the clip.



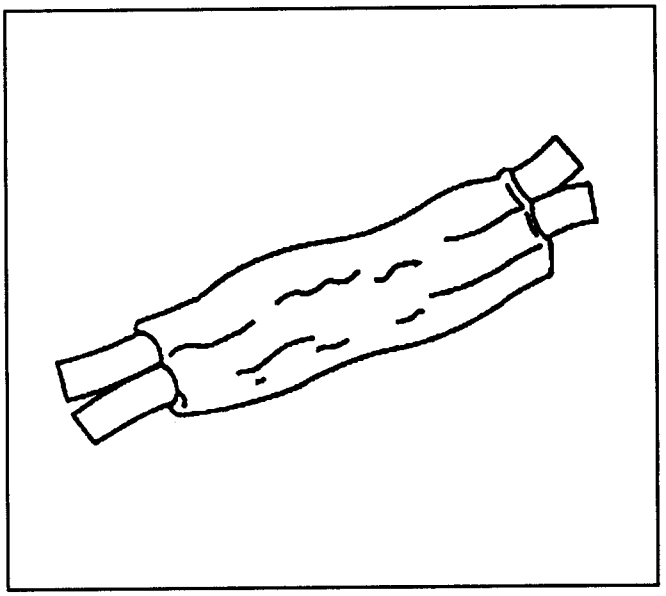
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6. Crimp the splice on each end.



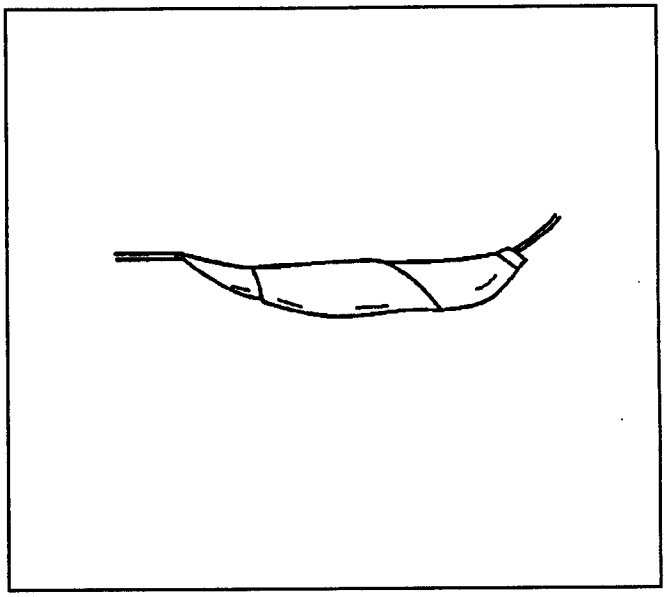
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7. Apply 60/40 rosin core solder to the opening in the back of the clip. Follow the manufacturer's instructions for the solder equipment.



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8. Tape the splice. Roll on enough tape in order to duplicate the thickness of the insulation on the existing wires.



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9. You may tape the wire again if the wire does not belong in a conduit or another harness covering. Use a winding motion in order to cover the first piece of tape.

Splicing Copper Wire Using Crimp and Seal Splice Sleeves

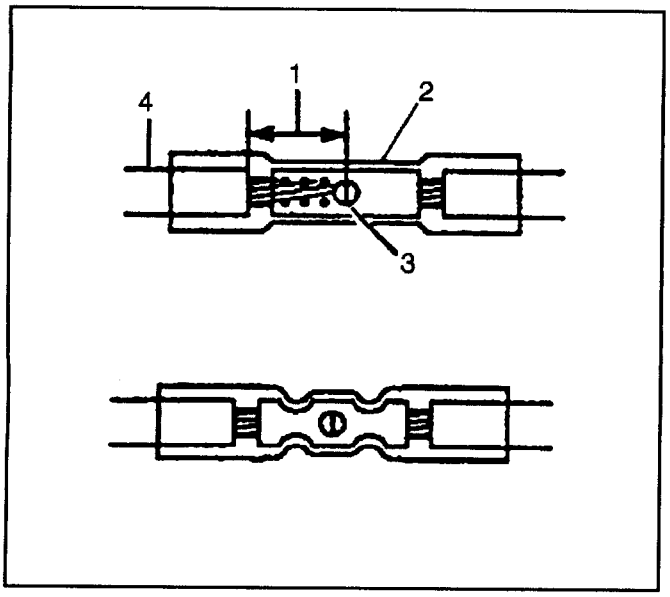
Crimp and seal splice sleeves may be used on all types of insulation except tefzel and coaxial to form a one-to-one splice. They are to be used where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using crimp and seal splice sleeves.

Crimp And Seal Splice Chart

Color Splice Sleeve	Crimp Tool Nest Color	Wire Gage AWG/ (Metric)
Salmon	Red	20, 18,/ (0.5, 0.8)
Blue	Blue	16, 14 /(1.0, 2.0)
Yellow	Yellow	12, 10/(3.0, 5.0)

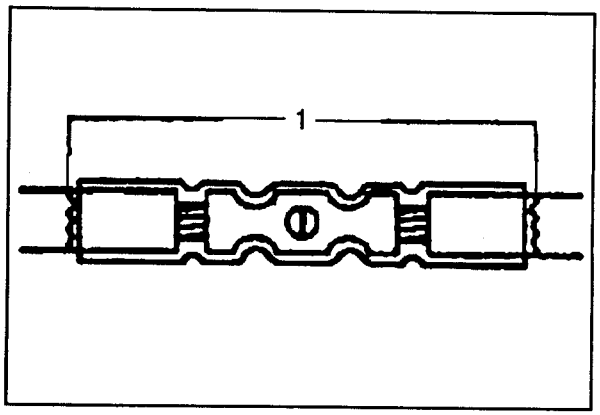
1. Open the harness.
   - If the harness is taped, remove the tape.
   - To avoid wiring insulation damage, use a sewing ripper in order to cut open the harness.
   - If the harness has a black plastic conduit, pull out the desired wire.

2. Cut the wire.
   - Cut as little wire off the harness as possible.
   - Ensure that each splice is at least 40 mm (1.5 in) away from other splices, harness branches, and connectors. This will help prevent moisture from bridging adjacent splices and causing damage.
3. Strip the insulation.
   - Find the correct wire size.
   - Select the correct size opening in the wire stripper or work down from the largest size.
   - Strip approximately 7.5 mm (5/16 in) of insulation from each wire to be spliced.
4. Select the proper splice sleeve according to the wire size.



8796

5. Insert the wires into the splice sleeve and crimp.
   - Place the splice tool in the nest so that the crimp falls at point 1 on the splice. The sleeve has a stop in the middle of the barrel in order to prevent the wire from going farther.
   - Close the hand crimper handles slightly in order to hold the splice sleeve firmly in the proper nest.
   - Insert the wire into the splice until it hits the barrel stop.
   - Close the handles of the J 38125 until the crimper handles open when released. The crimper handles will not reopen until the proper amount of pressure is applied to the splice sleeve.

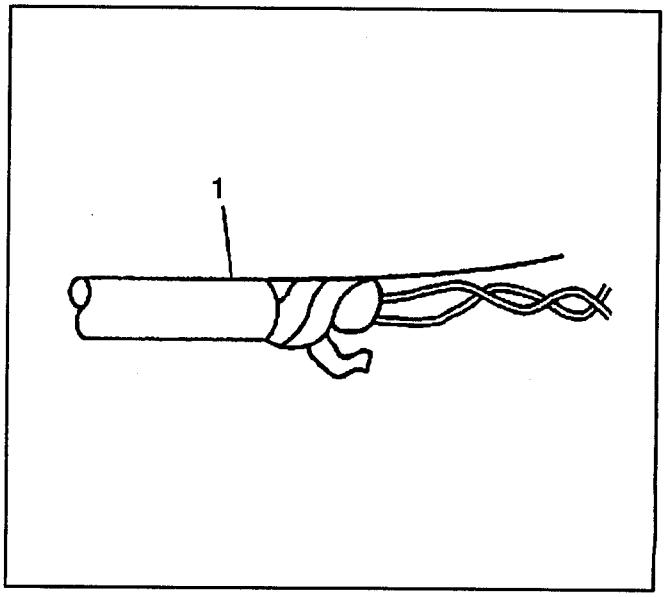


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6. Shrink the insulation around the splice.
   - Use a torch in order to apply heat where the barrel is crimped.
   - Gradually move the heat barrel to the open end of the tubing, shrinking the tubing as the heat is moved along the insulation. A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

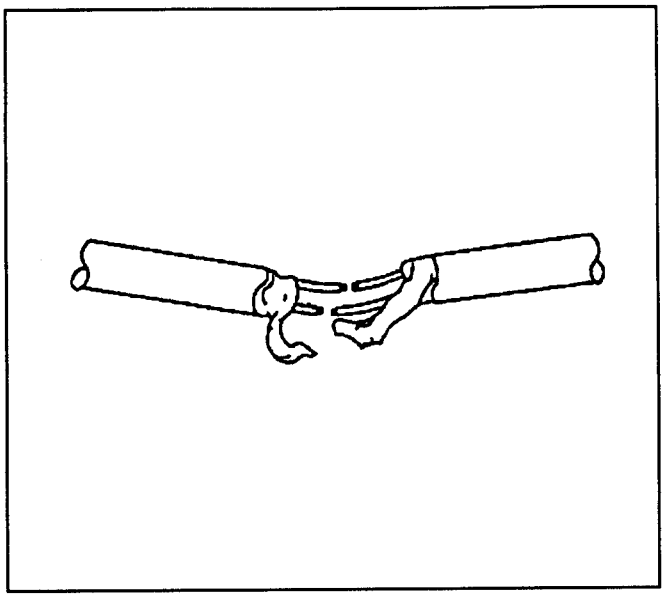
Splicing Twisted/Shielded Cable

Twisted/shielded cable is used in order to protect wiring from electrical noise. Two-conductor cable of this construction is used between the radio and the Delco-Bose® speaker/amplifier units and other applications where low level, sensitive signals must be carried. Follow the instructions below in order to repair the twisted/shielded cable.



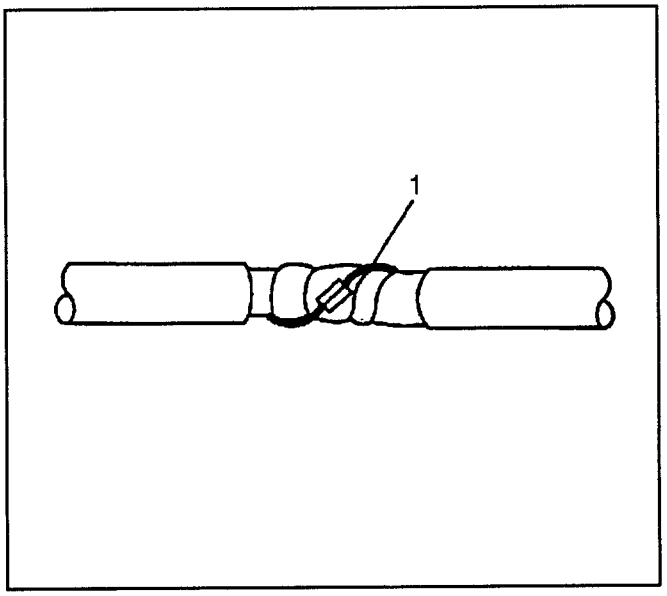
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1. Remove the outer jacket. Use care not to cut into the drain wire of the mylar tape.
2. Unwrap the tape. Do not remove the tape. The tape will be used in order to rewrap the twisted conductors after you have made the splice.



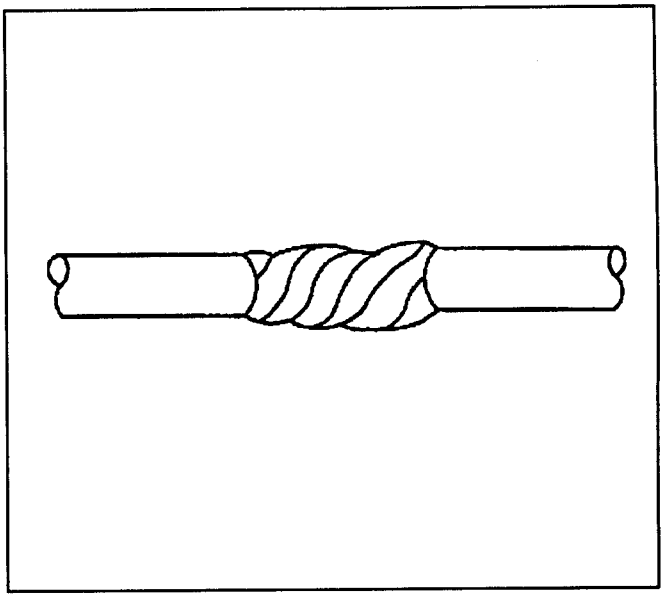
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3. Prepare the splice. Untwist the connectors and follow the splicing instructions for copper wire.



8800

4. Re-assemble the cable.
   - Rewrap the conductors with the mylar tape.
   - Use caution not to wrap the drain wire in the tape.
   - Follow the splicing instructions for copper wire and splice the drain wire.
   - Wrap the drain wire around the conductors and tape with mylar tape.



8801

5. Tape over the entire cable. Use a winding motion when you apply the tape.

Splicing Inline Harness Diodes

Many vehicle electrical systems use a diode to isolate circuits and protect the components from voltage spikes. When installing a new diode use the following procedure.

1. Open the harness.
   - If the harness is taped, remove the tape.
   - To avoid wiring insulation damage, use a sewing ripper in order to cut open the harness.
   - If the harness has a black plastic conduit, pull out the diode.
2. If the diode is taped to the harness, remove all of the tape.
3. Check and record the current flow direction and orientation of diode.
4. Remove the inoperative diode from the harness with a suitable soldering tool.

Important: If the diode is located next to a connector terminal remove the terminal(s) from the connector to prevent damage from the soldering tool.

5. Carefully strip away a section of insulation next to the old soldered portion of the wire(s). Do not remove any more than is needed to attach the new diode.
6. Check current flow direction of the new diode, being sure to install the diode with correct bias. Reference the appropriate service manual wiring schematic to obtain the correct diode installation position.
7. Attach the new diode to the wire(s) using 60/40 rosin core solder. Before soldering attach some heat sinks (aluminum alligator clips) across the diode wire ends to protect the diode from excessive heat. Follow the manufacturer's instruction for the soldering equipment.

8. Reinstall terminal(s) into the connector body if previously removed.
9. Tape the diode to the harness or connector using electrical tape.

Important: To prevent shorts to ground and water intrusion, completely cover all exposed wire and diode attachment points with tape.

HO2S Wiring Repairs

Notice: Do not solder repairs under any circumstances as this could result in the air reference being obstructed.

If the heated oxygen sensor pigtail wiring, connector, or terminal is damaged the entire oxygen sensor assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly it must have a clean air reference. This clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors or terminals could result in the obstruction of the air reference and degrade oxygen sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor, causing poor performance. Also, the sensor pigtail and harness wires must not be damaged in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.
- Neither the sensor nor vehicle lead wires should be bent sharply or kinked. Sharp bends, kinks, etc., could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire (where applicable). Vehicles that utilize the ground wire sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will also cause poor engine performance.
- To prevent damage due to water intrusion, be sure that the peripheral seal remains intact on the vehicle harness connector.

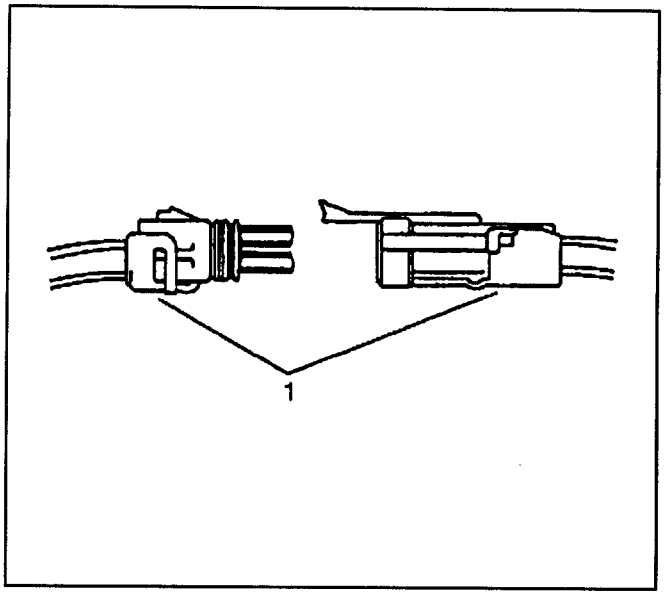
The engine harness may be repaired using the J 38125-A Crimp and Splice Seals Terminal Repair Kit.

Connector Repairs

Push-to-Seat Connector

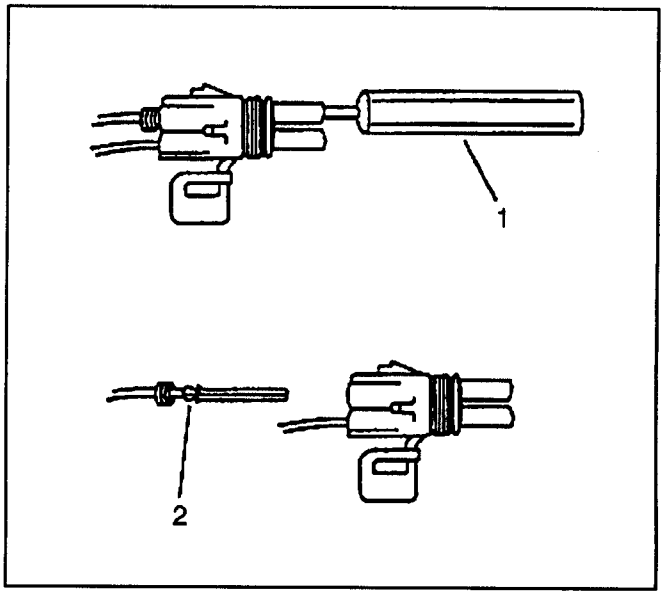
Follow the steps below in order to repair push-to-seat connectors.

1. Remove the terminal position assurance (TPA) device, the connector position assurance (CPA) device, and/or the secondary lock.



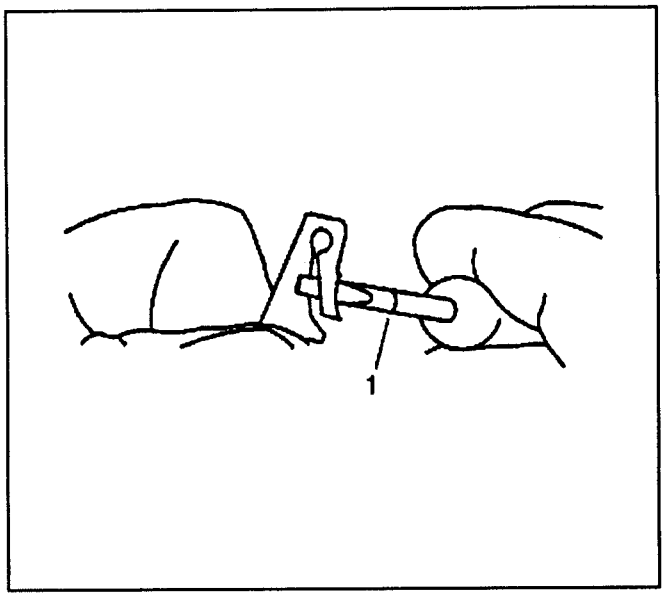
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2. Separate the connector halves.



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3. Use the proper pick or removal tool (1) in order to release the terminal.
4. Gently pull the cable and the terminal (2) out of the back of the connector.



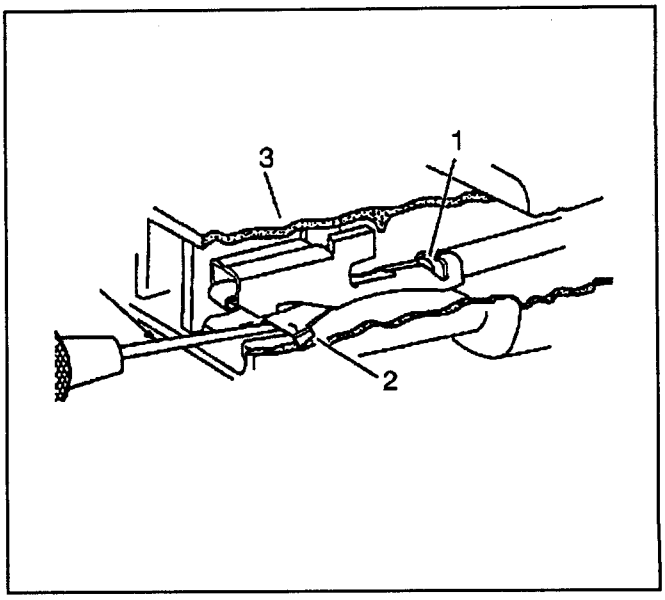
8804

5. Re-form the locking device if the you are going to reuse the connector.
6. Make the repair.
   - Slip the cable seal away from the terminal.
   - Cut the wire as close to the terminal as possible.
   - Slip a new cable seal onto the wire.
   - Strip 5 mm (3/16 in) of insulation from the wire.
   - Crimp a new terminal to the wire.
   - Solder the crimp with rosin core solder.
   - Slide the cable seal toward the terminal.
   - Crimp the cable seal and the insulation.
   - If the connector is outside of the passenger compartment, apply grease to the connector.
     - In order to reuse a terminal or lead assembly, see the splicing copper wire. Refer to *Wiring Repairs* Wiring Repairs.
     - Ensure that the cable seal is kept on the terminal side of the splice.
     - Insert the lead from the back until it catches.
   - Install the TPA, CPA and/or the secondary locks.

Pull-to-Seat Connector

Follow the steps below in order to repair pull-to-seat type connectors.

1. Separate the connector halves.



8805

2. Use the proper pick or removal tool in order to remove the terminal.
   - Gently pull the lead.
   - Insert the pick from the front of the connector into the canal.
   - Pry up on the tab.
   - Push on the lead in order to remove the lead.
3. If the terminal is to be reused, re-form the locking tang.
4. Make the repair.
   - Pull the terminal wire out of the connector body.
   - Cut the wire as close to the terminal as possible.
   - Strip 5 mm (3/26 in) of insulation from the wire.
   - Crimp the new terminal to the wire.
   - Solder the crimp with rosin core solder.
   - Carefully pull on the wire in order to draw the terminal into the connector body until it locks.

Connector Position Assurance Locks

The Connector Position Assurance (CPA) is a small plastic insert that fits through the locking tabs of all the SIR system electrical connectors. The CPA ensures that the connector halves cannot vibrate apart. You must have the CPA in place in order to ensure good contact between the SIR mating terminals.

Terminal Position Assurance Locks

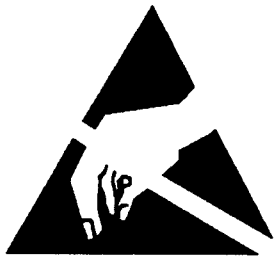
The Terminal Position Assurance (TPA) insert resembles the plastic combs used in the control module connectors. The TPA keeps the terminal securely seated in the connector body. Do not remove the TPA from the connector body unless you remove a terminal for replacement.

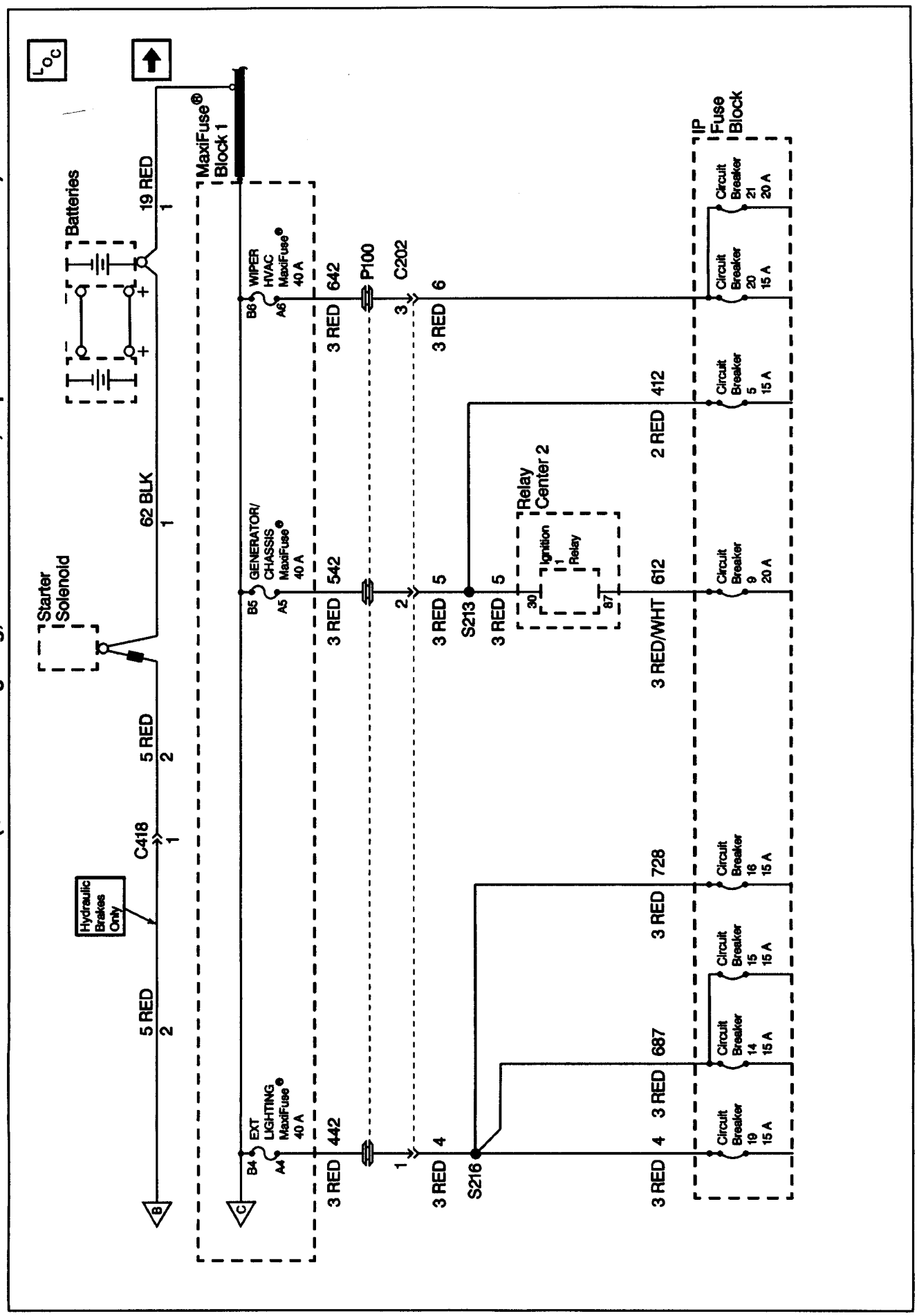
Schematic and Routing Diagrams

Power and Grounding Schematic References

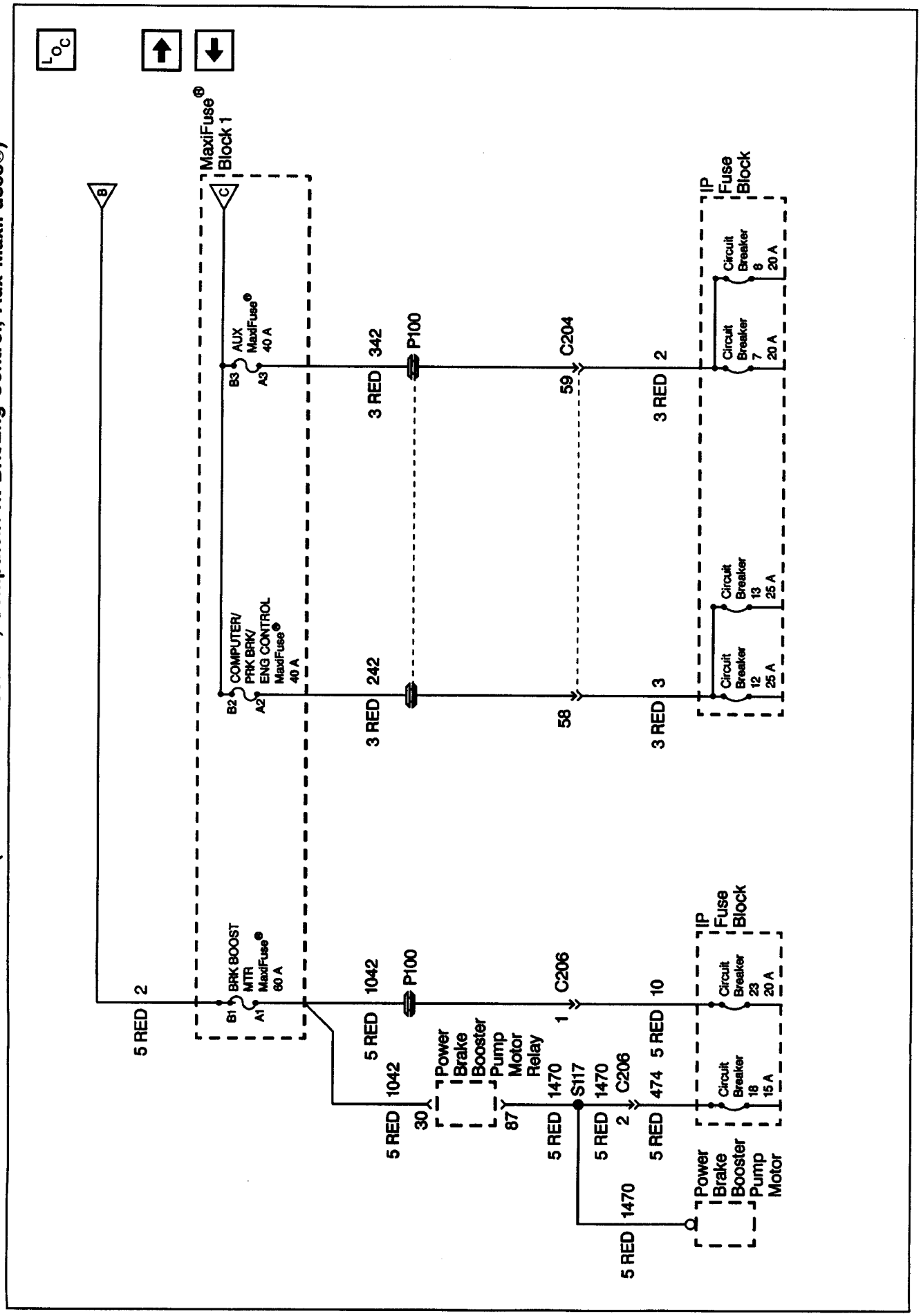
Reference on Schematic	Section Number - Subsection Name
Headlights: Daytime Running Lights (DRL) Cell 102	8—Lighting Systems
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Exterior Lamps Cell 110	8—Lighting Systems

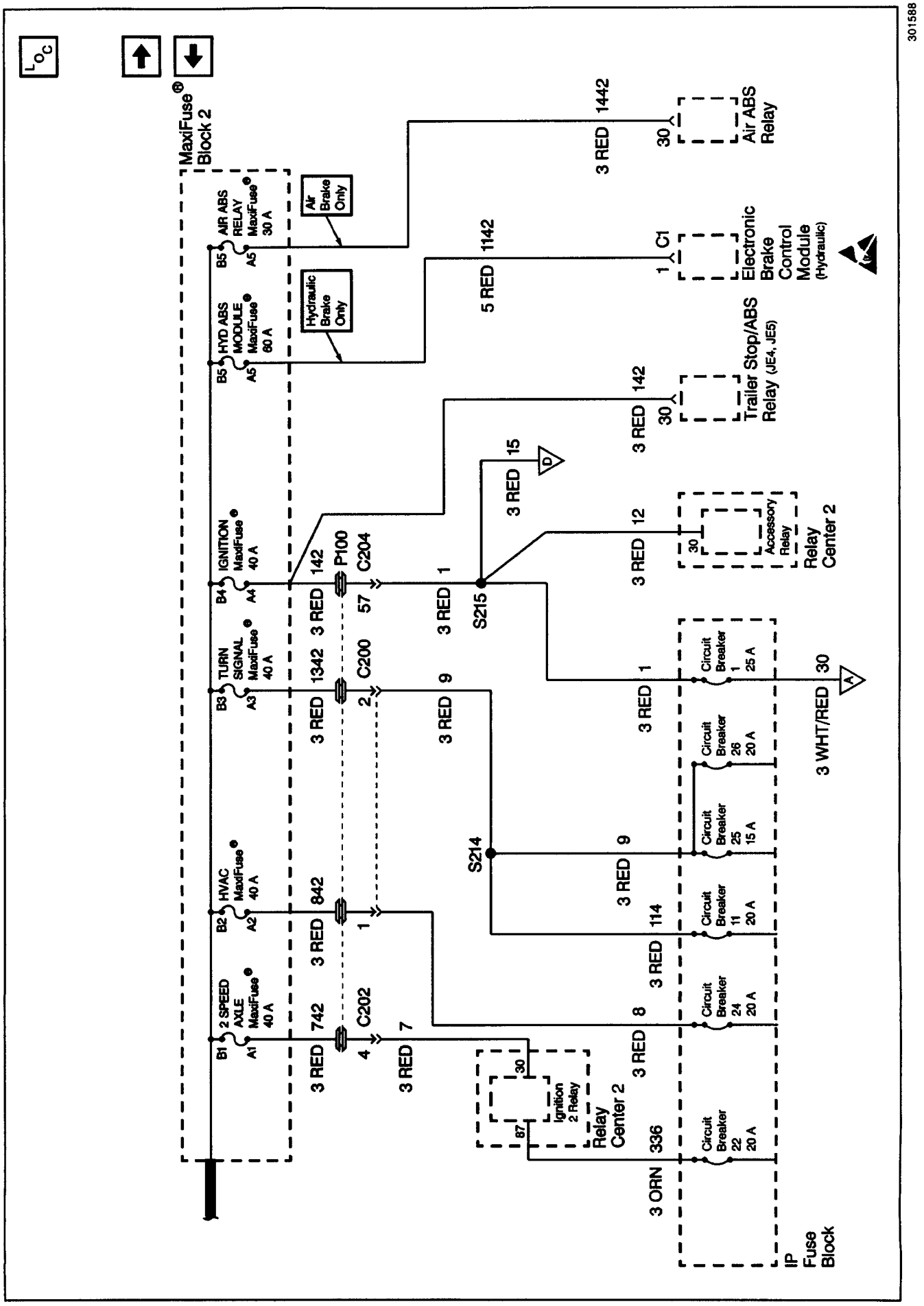
Power and Grounding Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.

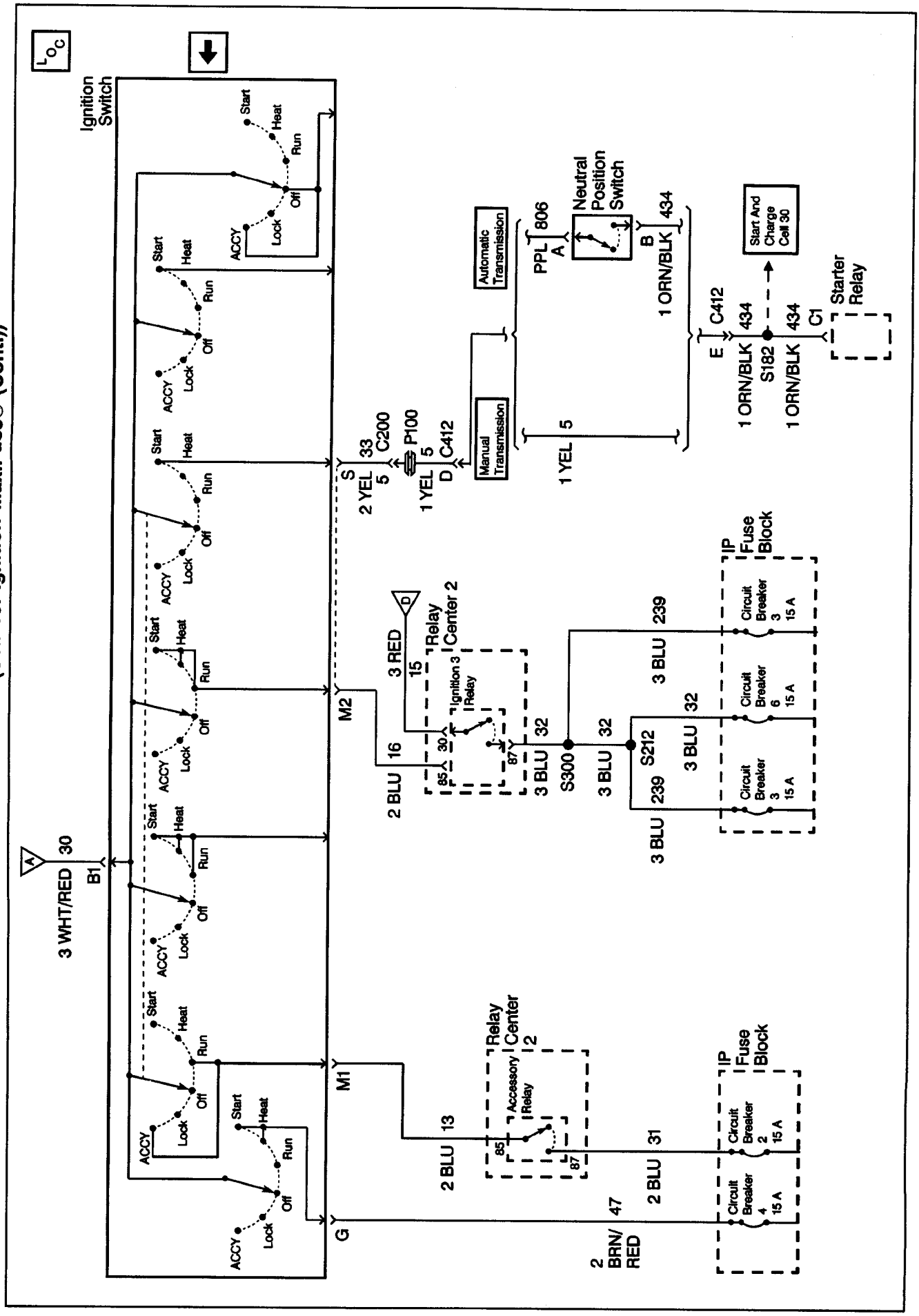

Power Distribution Schematics (Cell 10: Ext Lighting, Generator/Chassis, Wiper HVAC MaxiFuses®)
301585
Batteries
Starter Solenoid
MaxiFuse® Block 1
19 RED
62 BLK
5 RED
C418
Hydraulic Brakes Only
GENERATOR/ CHASSIS MaxiFuse® 40 A
WIPER HVAC MaxiFuse® 40 A
EXT LIGHTING MaxiFuse® 40 A
P100
C202
S213
S216
Relay Center 2
Ignition Relay
IP Fuse Block
Circuit Breaker 19 15 A
Circuit Breaker 14 15 A
Circuit Breaker 15 15 A
Circuit Breaker 16 15 A
Circuit Breaker 9 20 A
Circuit Breaker 5 15 A
Circuit Breaker 20 15 A
Circuit Breaker 21 20 A
3 RED
5 RED
2 RED
3 RED/WHT
442
542
642
412
612
687
728

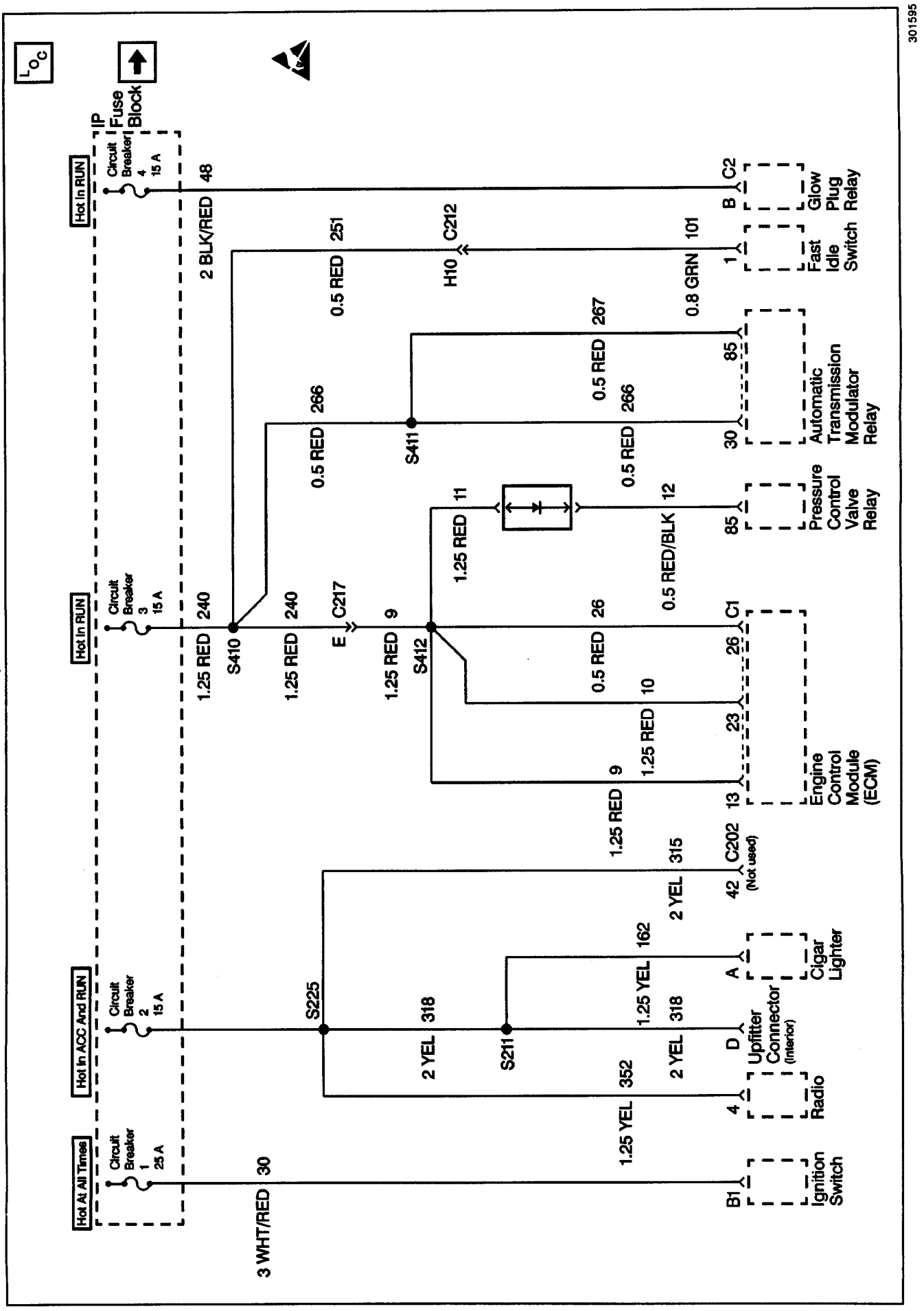
Power Distribution Schematics (Cell 10: Brk Boost Mtr, Computer/Prk Brk/Eng Control, Aux MaxiFuses®)



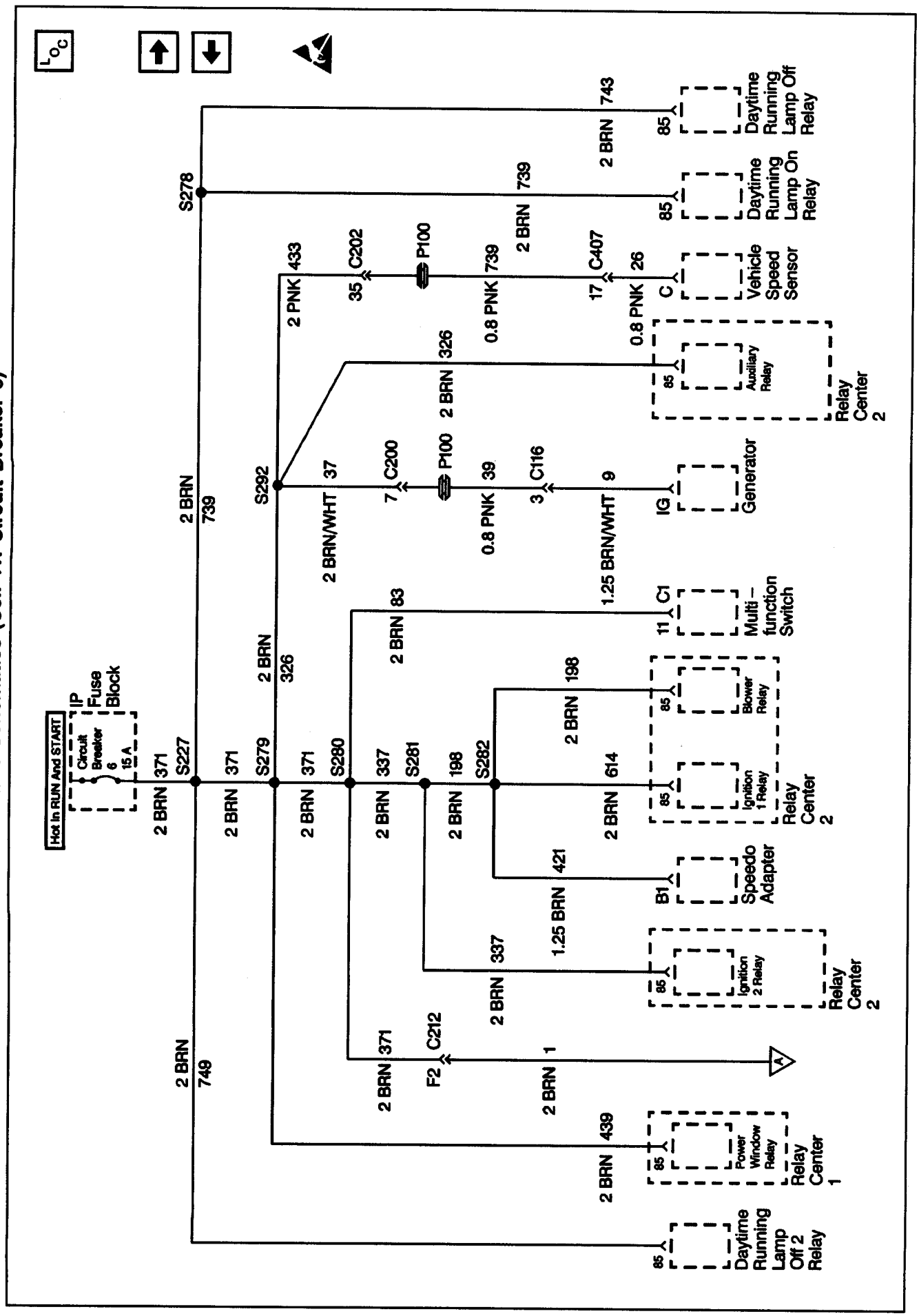

Power Distribution Schematics (Cell 10: 2 Speed Axle, HVAC, Turn Signal, Ignition MaxiFuses®)
MaxiFuse® Block 2
2 SPEED AXLE MaxiFuse® 40 A
HVAC MaxiFuse® 40 A
TURN SIGNAL MaxiFuse® 40 A
IGNITION MaxiFuse® 40 A
HYD ABS MODULE MaxiFuse® 60 A
AIR ABS RELAY MaxiFuse® 30 A
Air Brake Only
Hydraulic Brake Only
Ignition 2 Relay
Relay Center 2
Accessory Relay
Relay Center 2
Trailer Stop/ABS Relay (JE4, JE5)
Air ABS Relay
Electronic Brake Control Module (Hydraulic)
IP Fuse Block
Circuit Breaker 22 20 A
Circuit Breaker 24 20 A
Circuit Breaker 11 20 A
Circuit Breaker 25 15 A
Circuit Breaker 26 20 A
Circuit Breaker 1 25 A
3 ORN 336
3 RED 742
3 RED 842
3 RED 1342
3 RED 142
3 RED 1142
3 RED 1442
3 WHT/RED 30
C202
C200
C204
P100
S214
S215
C1
301588

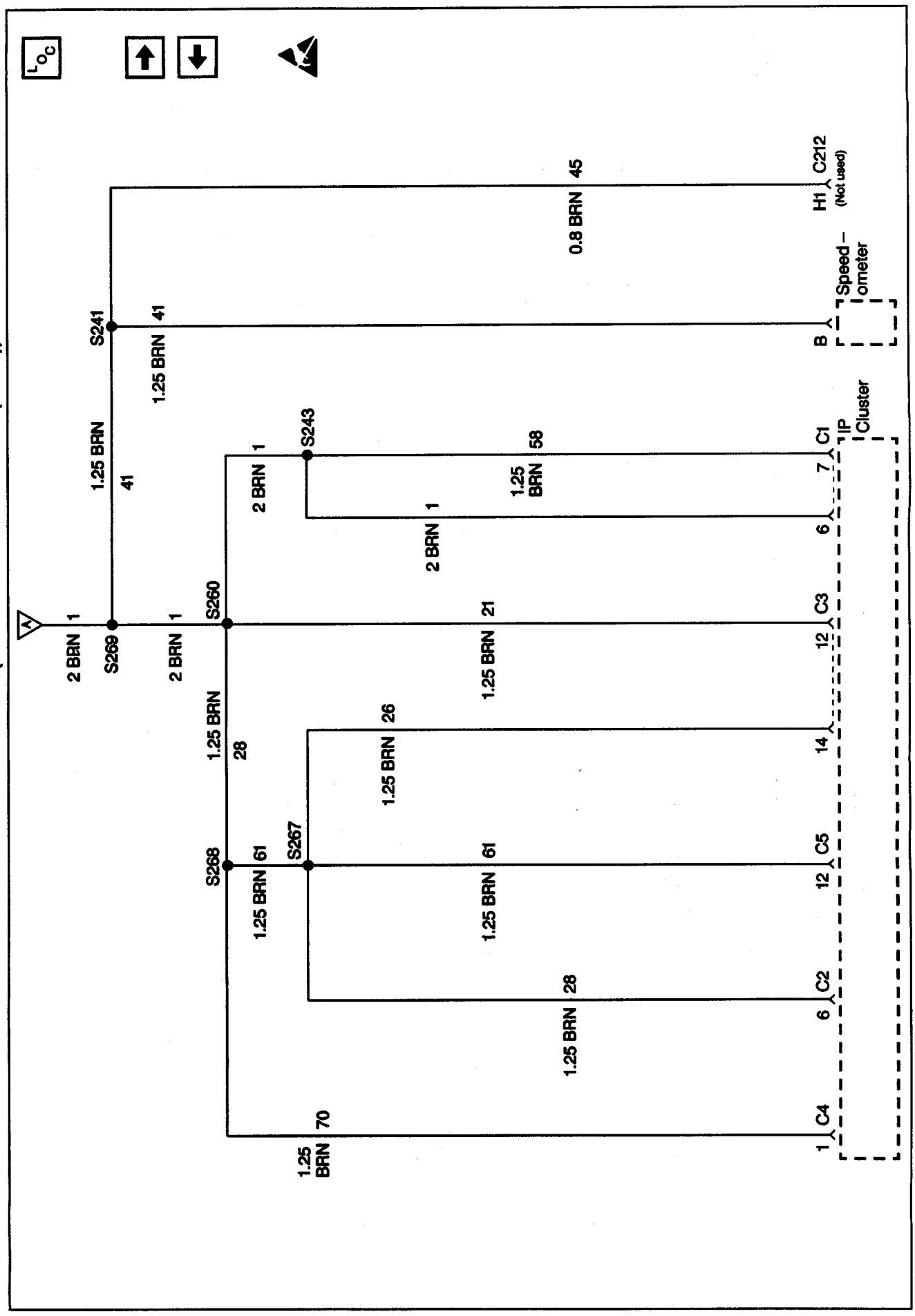
Power Distribution Schematics (Cell 10: Ignition MaxiFuse® (Cont.))



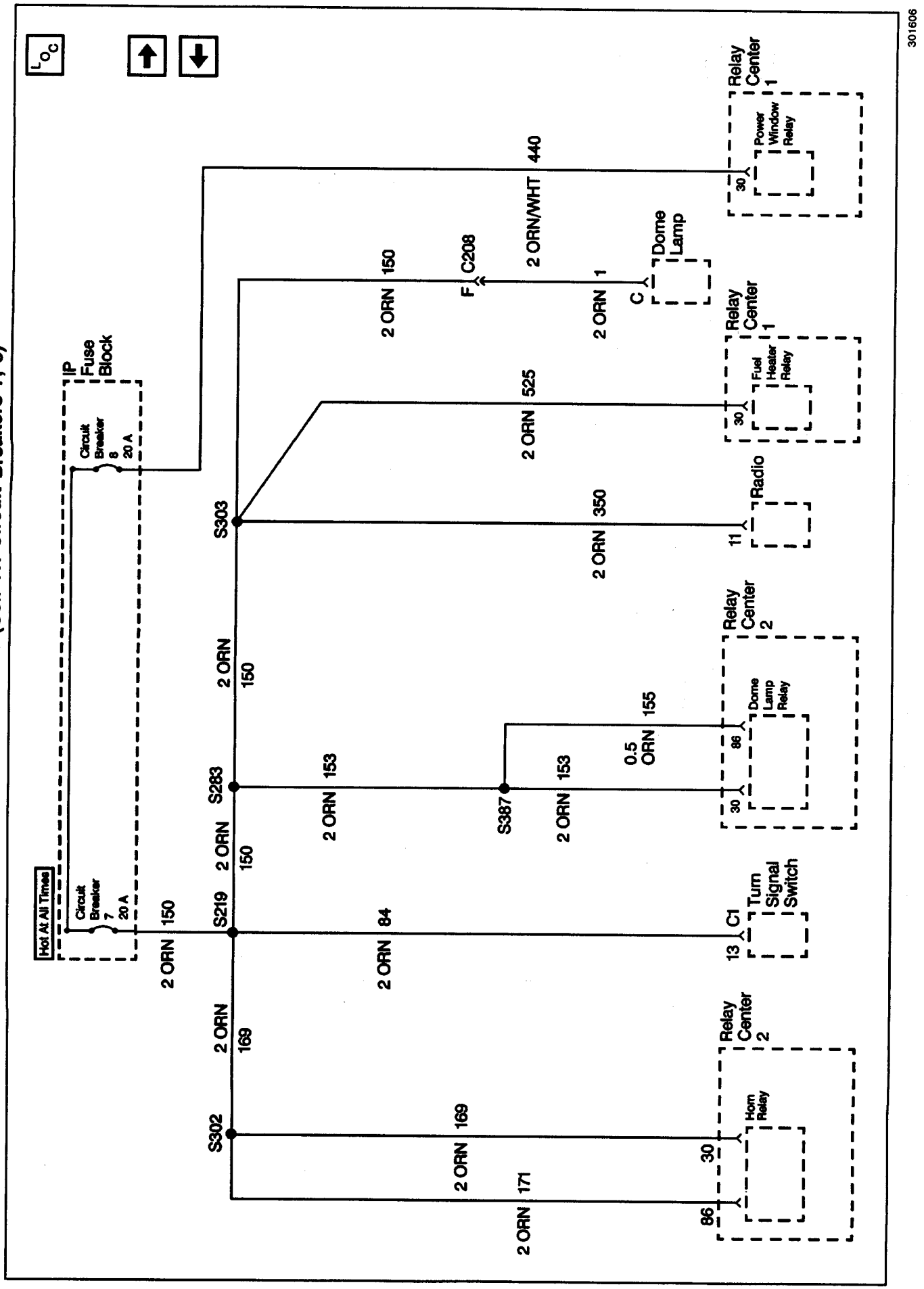

Fuse Block Details Schematics (Cell 11: Circuit Breakers 1, 2, 3, 4)
301595
Hot At All Times
Hot In ACC And RUN
Hot In RUN
Hot In RUN
IP Fuse Block
Circuit Breaker 1 25 A
Circuit Breaker 2 15 A
Circuit Breaker 3 15 A
Circuit Breaker 4 15 A
3 WHT/RED 30
1.25 YEL 352
2 YEL 318
1.25 YEL 318
1.25 YEL 162
2 YEL 315
1.25 RED 9
1.25 RED 240
1.25 RED 240
1.25 RED 9
1.25 RED 11
0.5 RED 10
0.5 RED 26
0.5 RED 266
0.5 RED 266
0.5 RED 267
0.5 RED 251
0.5 RED/BLK 12
2 BLK/RED 48
0.8 GRN 101
S225
S211
S410
S412
S411
E C217
H10 C212
B1
4
D
A
42 C202 (Not used)
13
23
26
C1
30
85
85
1
B C2
Ignition Switch
Radio
Upfitter Connector (Interior)
Cigar Lighter
Engine Control Module (ECM)
Pressure Control Valve Relay
Automatic Transmission Modulator Relay
Fast Idle Switch
Glow Plug Relay

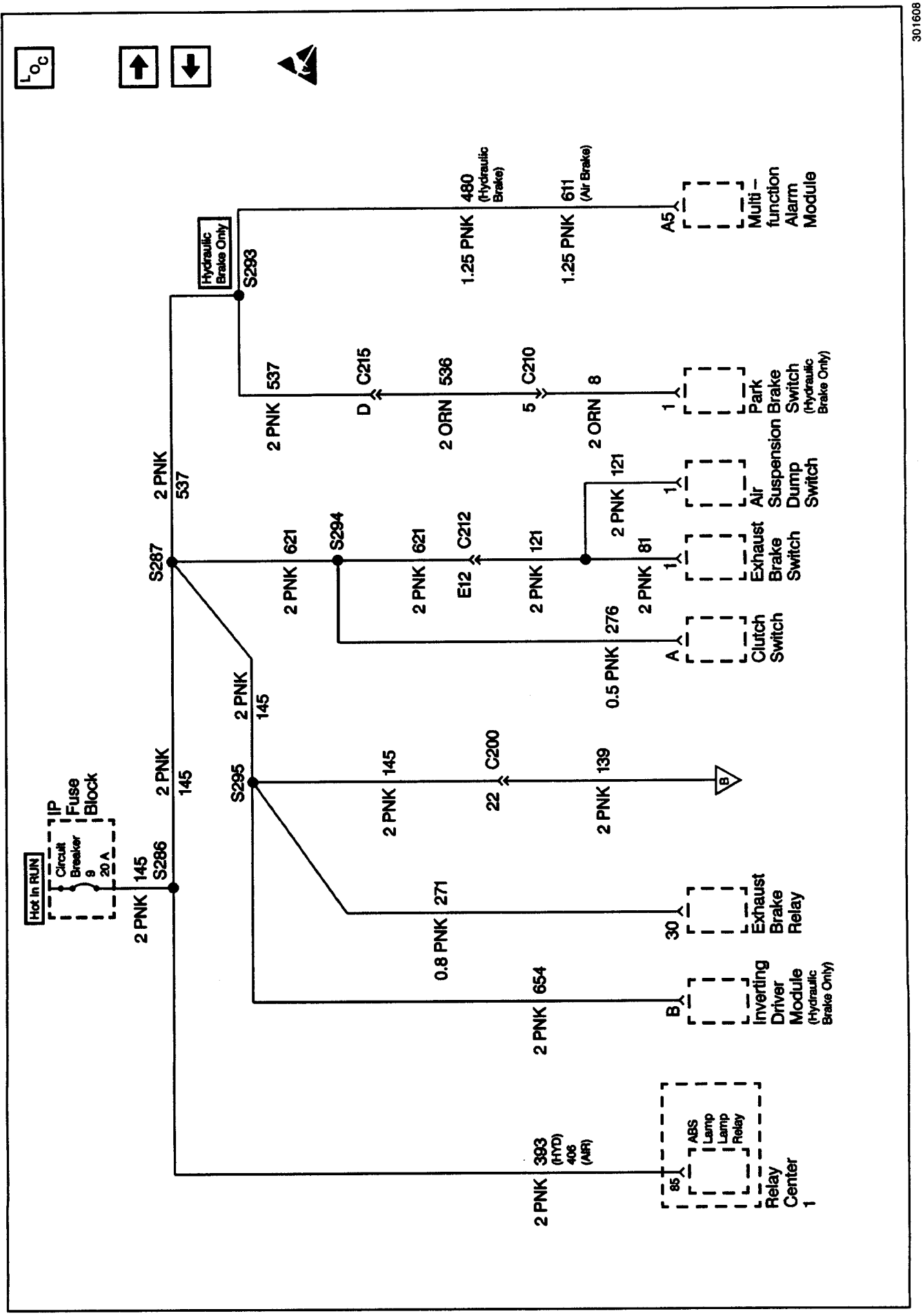
Fuse Block Details Schematics (Cell 11: Circuit Breaker 6)

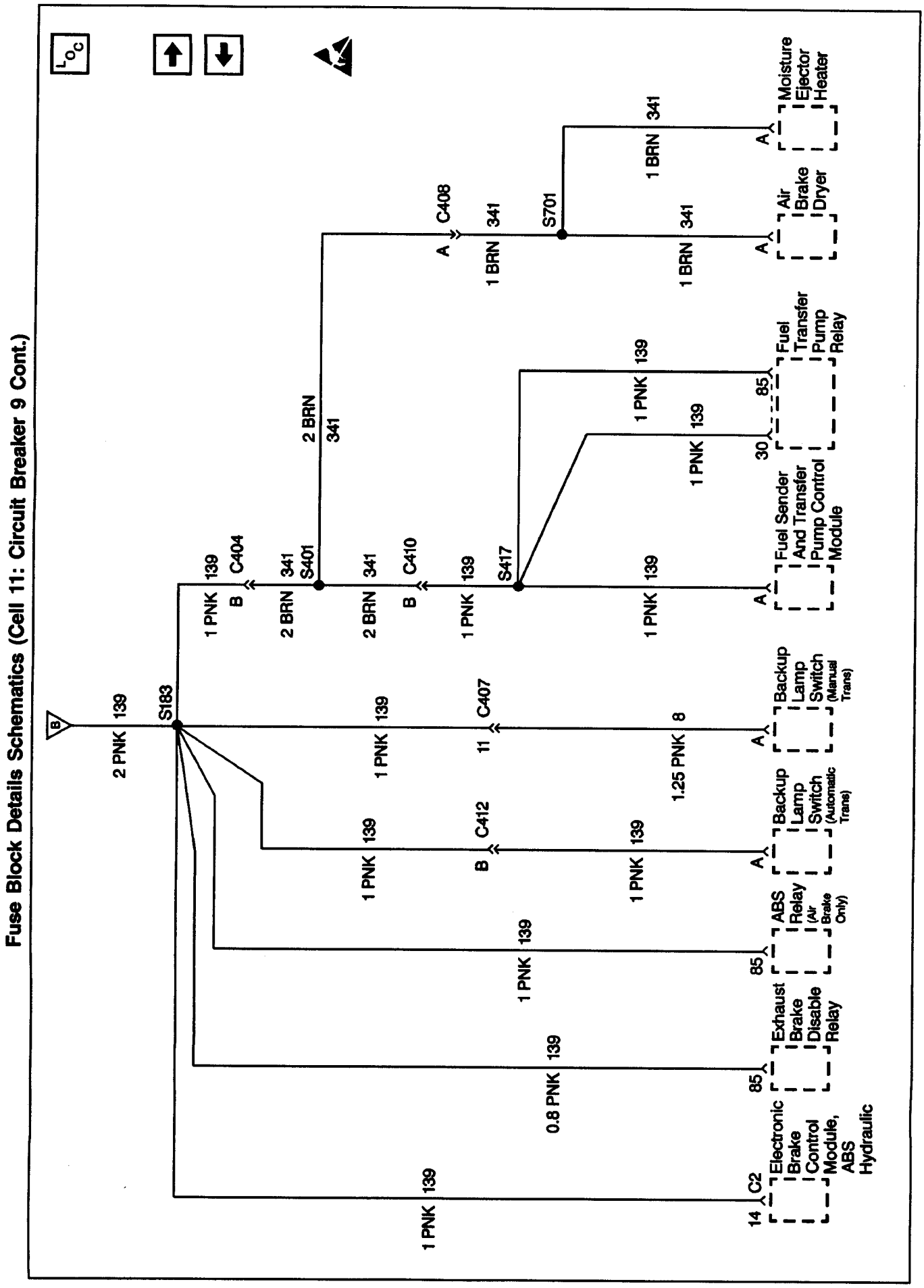



Fuse Block Details Schematics (Cell 11: Circuit Breaker 6 (Cont.))
301605
2 BRN
1
S269
2 BRN
1
S260
1.25 BRN
41
S241
1.25 BRN
41
1.25 BRN
28
S268
1.25 BRN
61
S267
1.25 BRN
70
2 BRN
1
S243
2 BRN
1
1.25 BRN
26
1.25 BRN
61
1.25 BRN
28
0.8 BRN
45
1.25 BRN
58
1.25 BRN
21
1.25 BRN
61
1.25 BRN
28
H1
C212
(Not used)
B
Speed-ometer
C1
7
IP Cluster
6
C3
12
14
C5
12
C2
6
C4
1

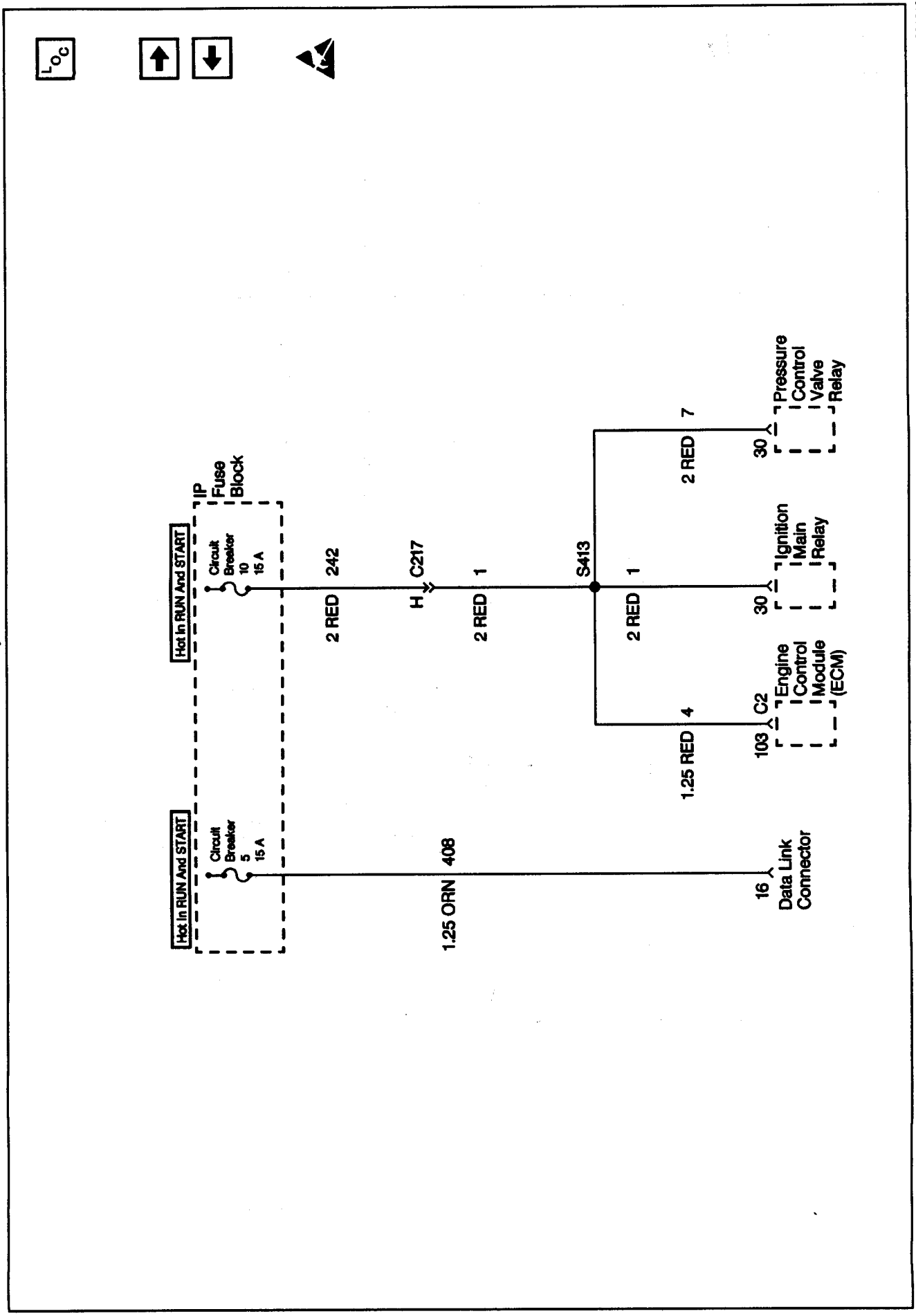
Fuse Block Details Schematics (Cell 11: Circuit Breakers 7, 8)

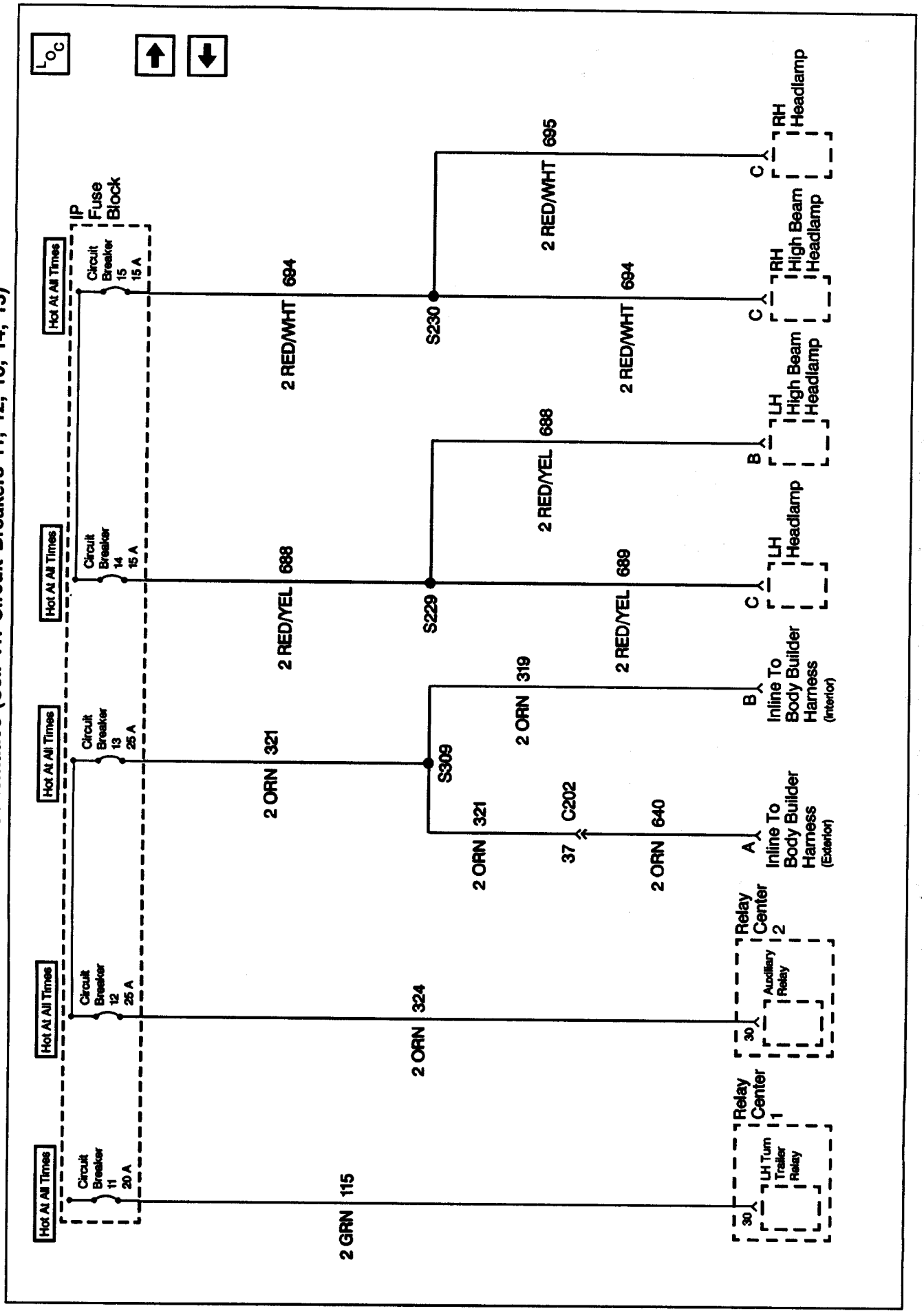



Fuse Block Details Schematics (Cell 11: Circuit Breaker 9)
301608
Hot In RUN
IP Fuse Block
Circuit Breaker 9 20 A
2 PNK 145 S286
2 PNK 145
S287
2 PNK 537
Hydraulic Brake Only
S293
2 PNK 537 D C215 2 ORN 536 5 C210 2 ORN 8 1 Park Brake Switch (Hydraulic Brake Only)
1.25 PNK 480 (Hydraulic Brake) A5 Multi-function Alarm Module
1.25 PNK 611 (Air Brake)
2 PNK 621 S294 2 PNK 621 E12 C212 2 PNK 121 2 PNK 81 1 Exhaust Brake Switch
2 PNK 121 1 Air Suspension Dump Switch
0.5 PNK 276 A Clutch Switch
2 PNK 145 S295 2 PNK 145
2 PNK 145 C200 22 2 PNK 139 B
0.8 PNK 271 30 Exhaust Brake Relay
2 PNK 654 B Inverting Driver Module (Hydraulic Brake Only)
2 PNK 393 (HYD) 406 (AIR) 85 ABS Lamp Lamp Relay
Relay Center 1

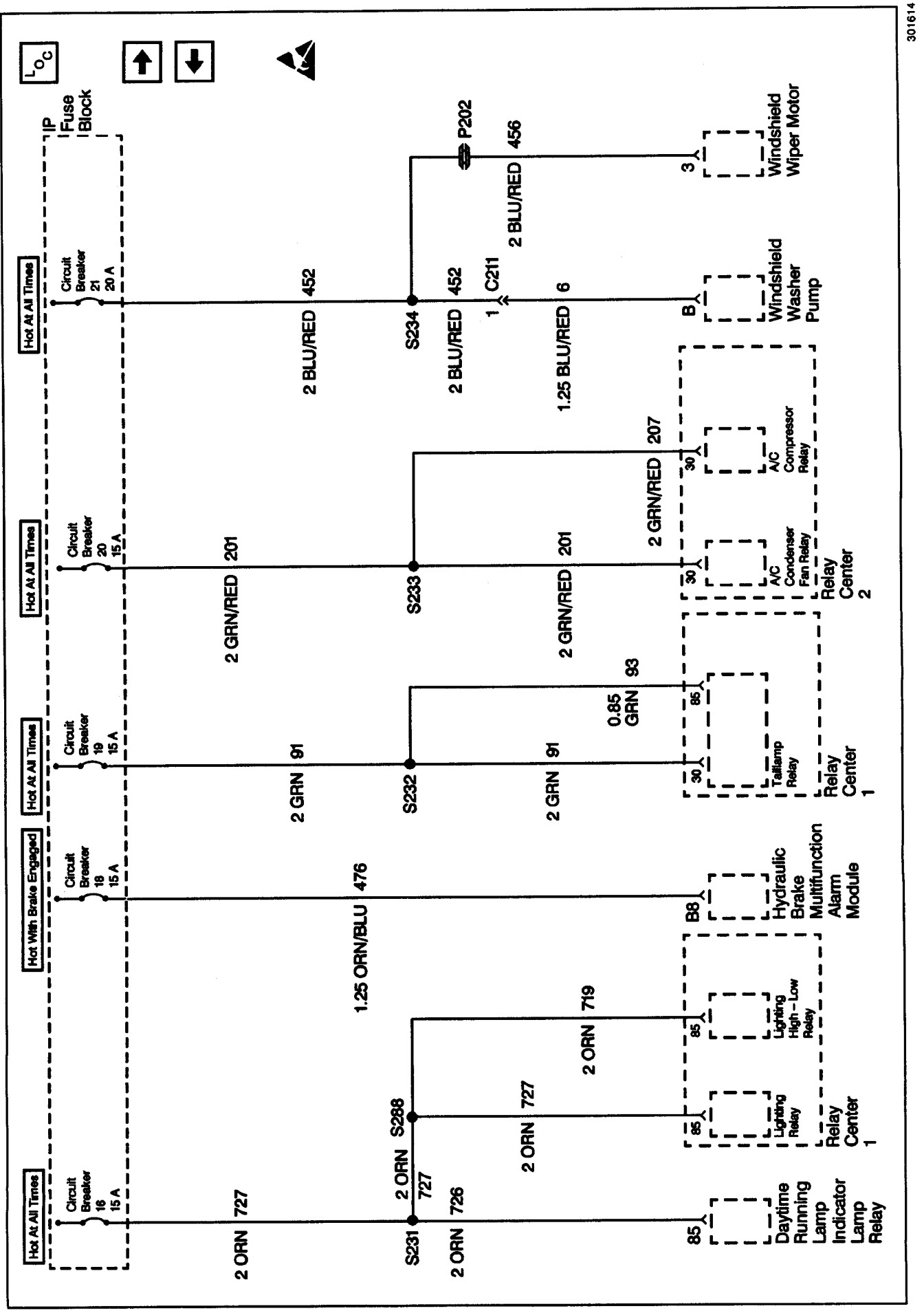

Fuse Block Details Schematics (Cell 11: Circuit Breaker 9 Cont.)
301610
LOC
B
2 PNK 139
S183
1 PNK 139
B
C404
2 BRN 341
S401
2 BRN 341
C408
A
1 BRN 341
S701
1 BRN 341
A
Moisture Ejector Heater
A
Air Brake Dryer
2 BRN 341
B
C410
1 PNK 139
S417
1 PNK 139
1 PNK 139
85
Fuel Transfer Pump Relay
1 PNK 139
30
Fuel Sender And Transfer Pump Control Module
A
1 PNK 139
C407
11
1.25 PNK 8
A
Backup Lamp Switch (Manual Trans)
1 PNK 139
B
C412
1 PNK 139
A
Backup Lamp Switch (Automatic Trans)
1 PNK 139
85
ABS Relay (Air Brake Only)
0.8 PNK 139
85
Exhaust Brake Disable Relay
1 PNK 139
14
C2
Electronic Brake Control Module, ABS Hydraulic

Fuse Block Details Schematics (Cell 11: Circuit Breaker 5,10)

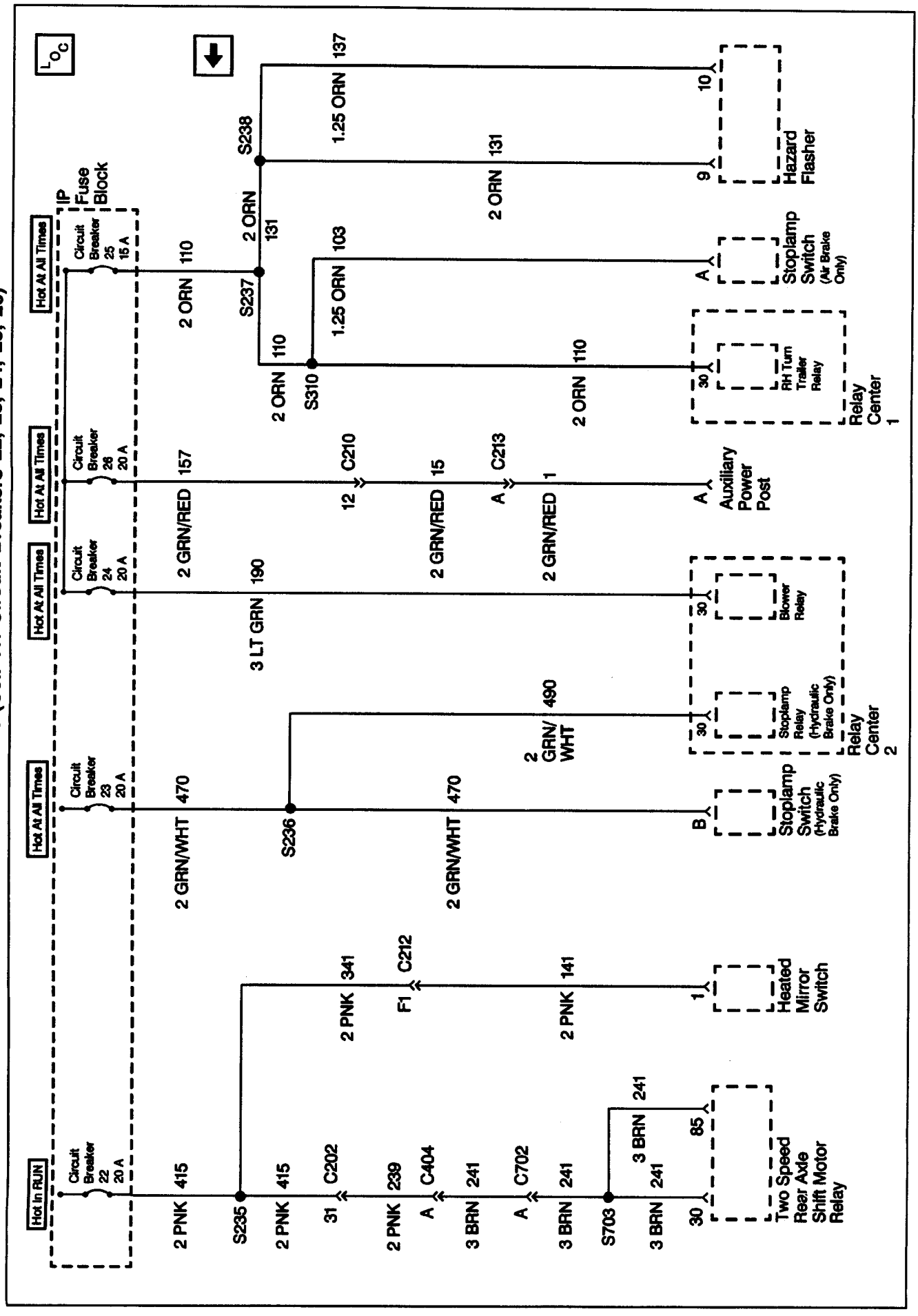



Fuse Block Details Schematics (Cell 11: Circuit Breakers 11, 12, 13, 14, 15)
301613
IP Fuse Block
Hot At All Times
Circuit Breaker 11 20 A
Circuit Breaker 12 25 A
Circuit Breaker 13 25 A
Circuit Breaker 14 15 A
Circuit Breaker 15 15 A
2 GRN 115
2 ORN 324
2 ORN 321
2 RED/YEL 688
2 RED/WHT 694
2 RED/WHT 695
2 ORN 319
2 RED/YEL 689
2 RED/MHT 694
2 RED/YEL 688
S309
S229
S230
C202
37
2 ORN 321
2 ORN 640
Relay Center 1
Relay Center 2
LH Turn Trailer Relay
Auxiliary Relay
Inline To Body Builder Harness (Exterior)
Inline To Body Builder Harness (Interior)
LH Headlamp
LH High Beam Headlamp
RH High Beam Headlamp
RH Headlamp

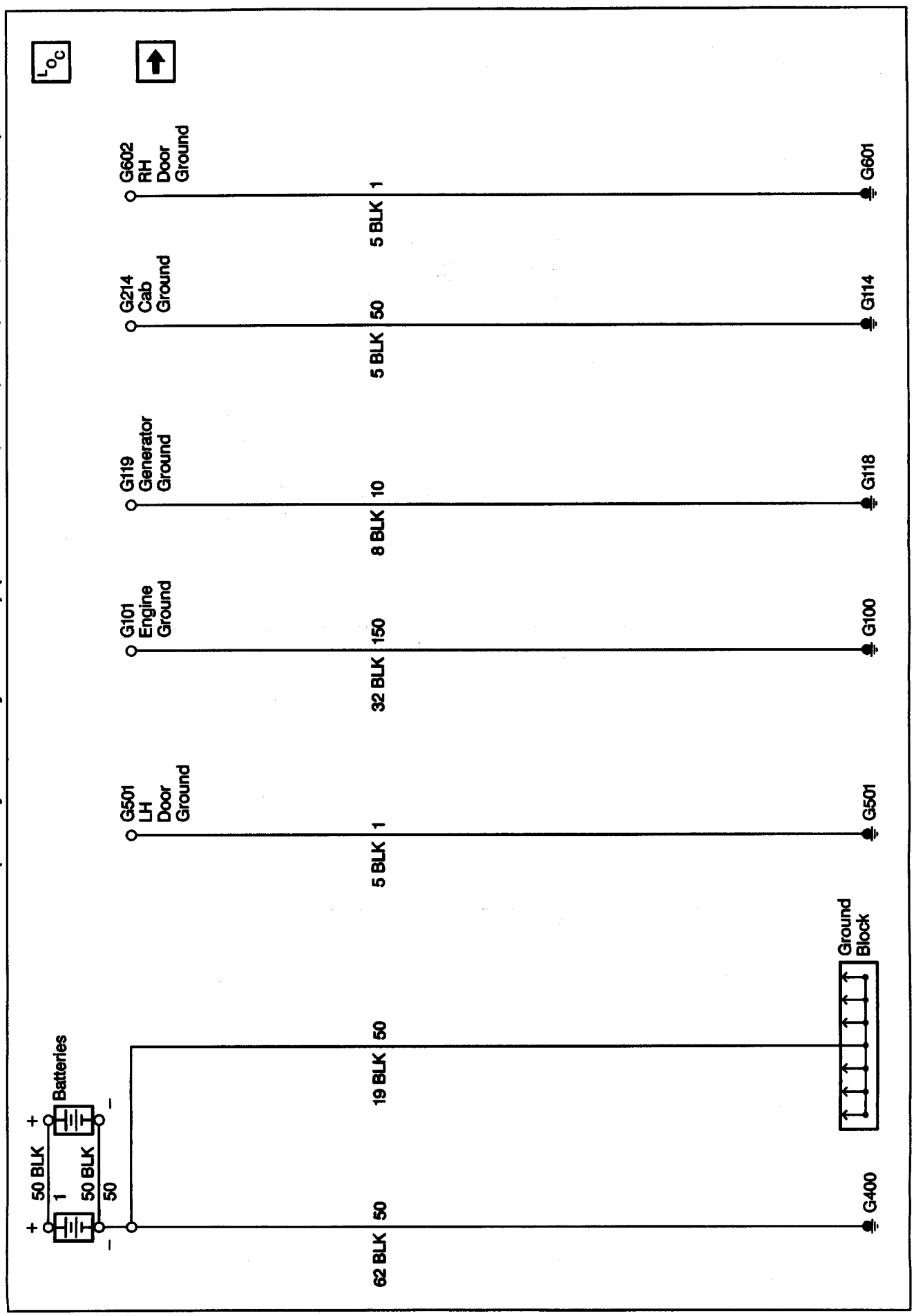
Fuse Block Details Schematics (Cell 11: Circuit Breakers 16, 18, 19, 20, 21)

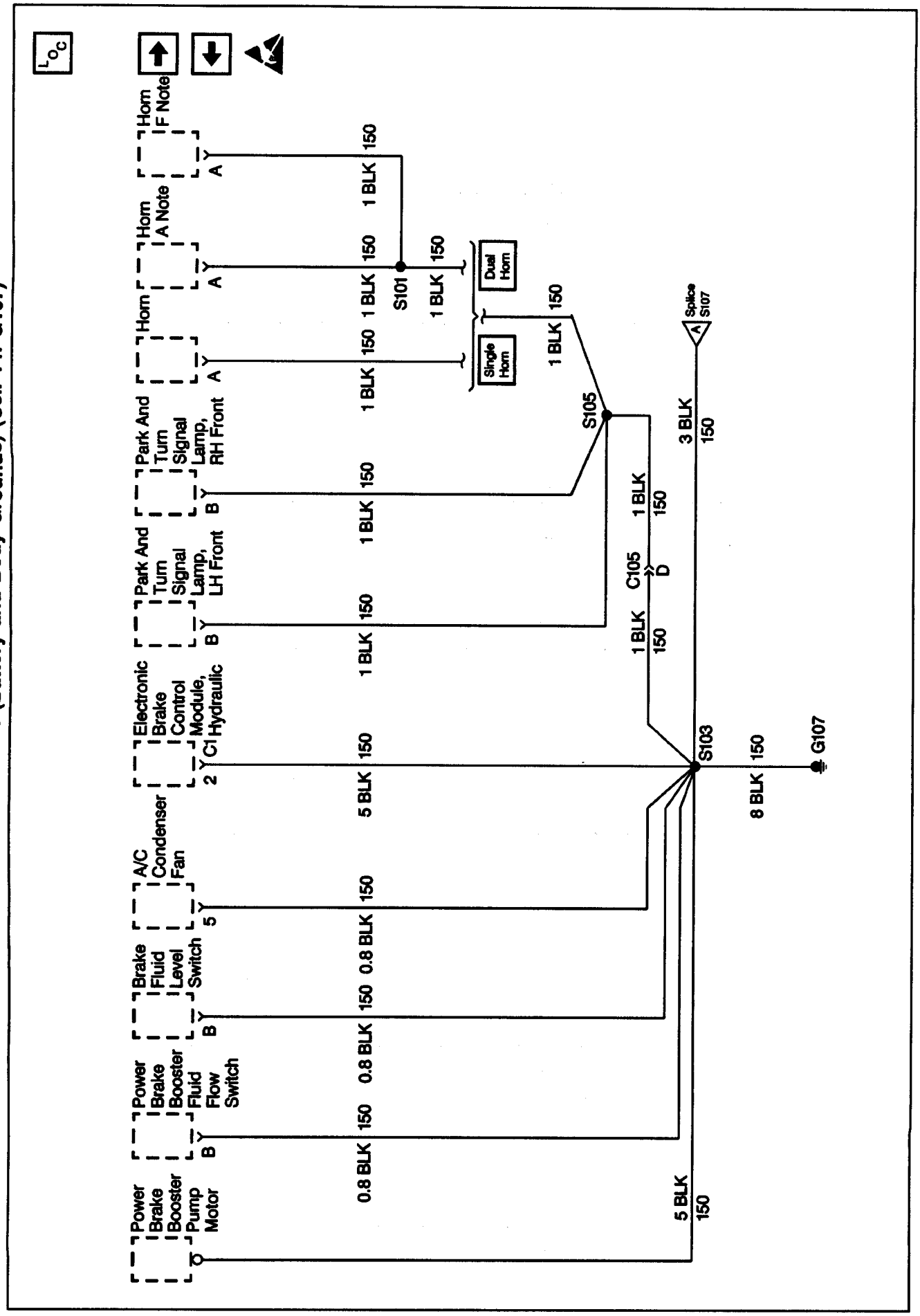


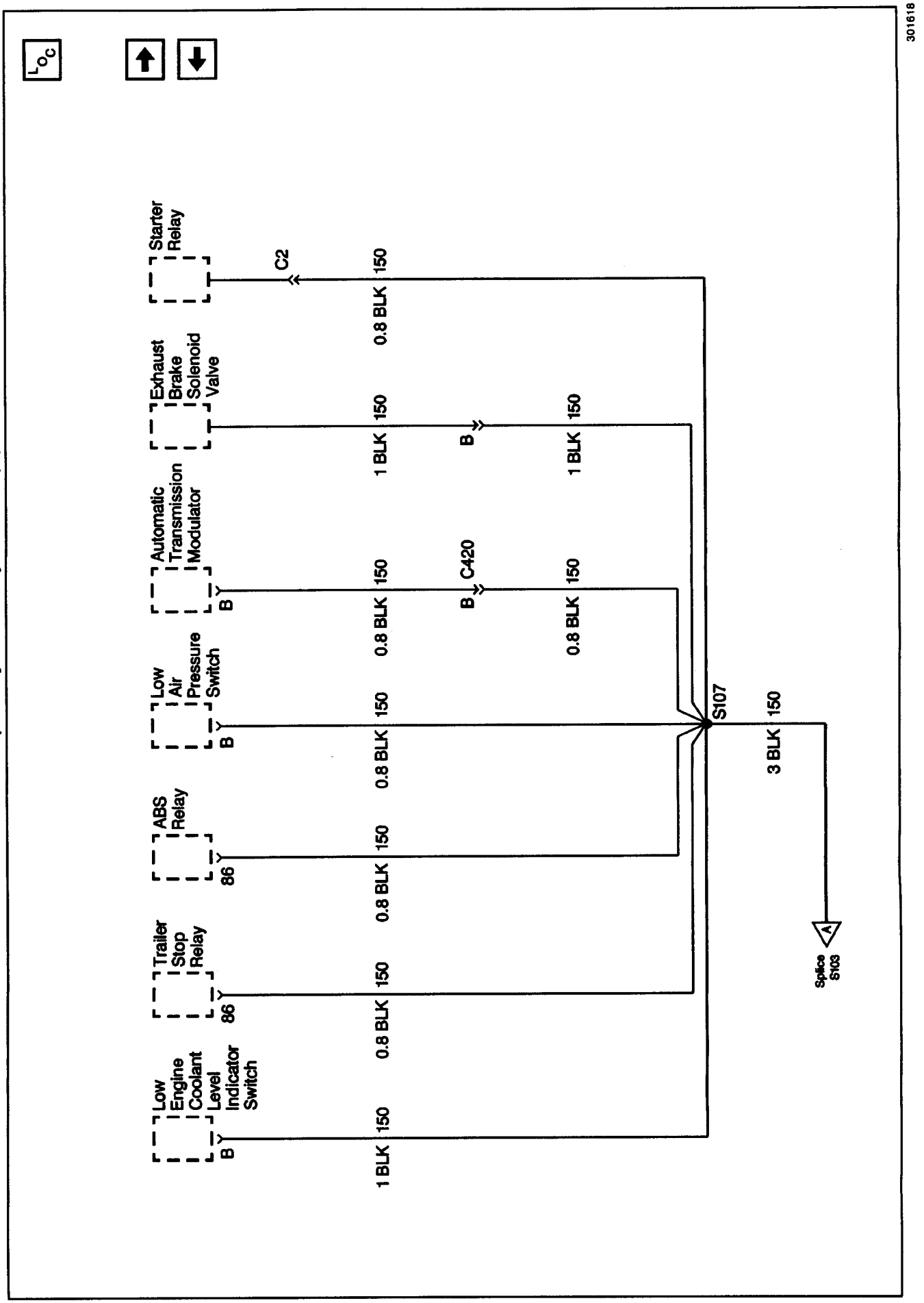
Fuse Block Details Schematics (Cell 11: Circuit Breakers 22, 23, 24, 25, 26)

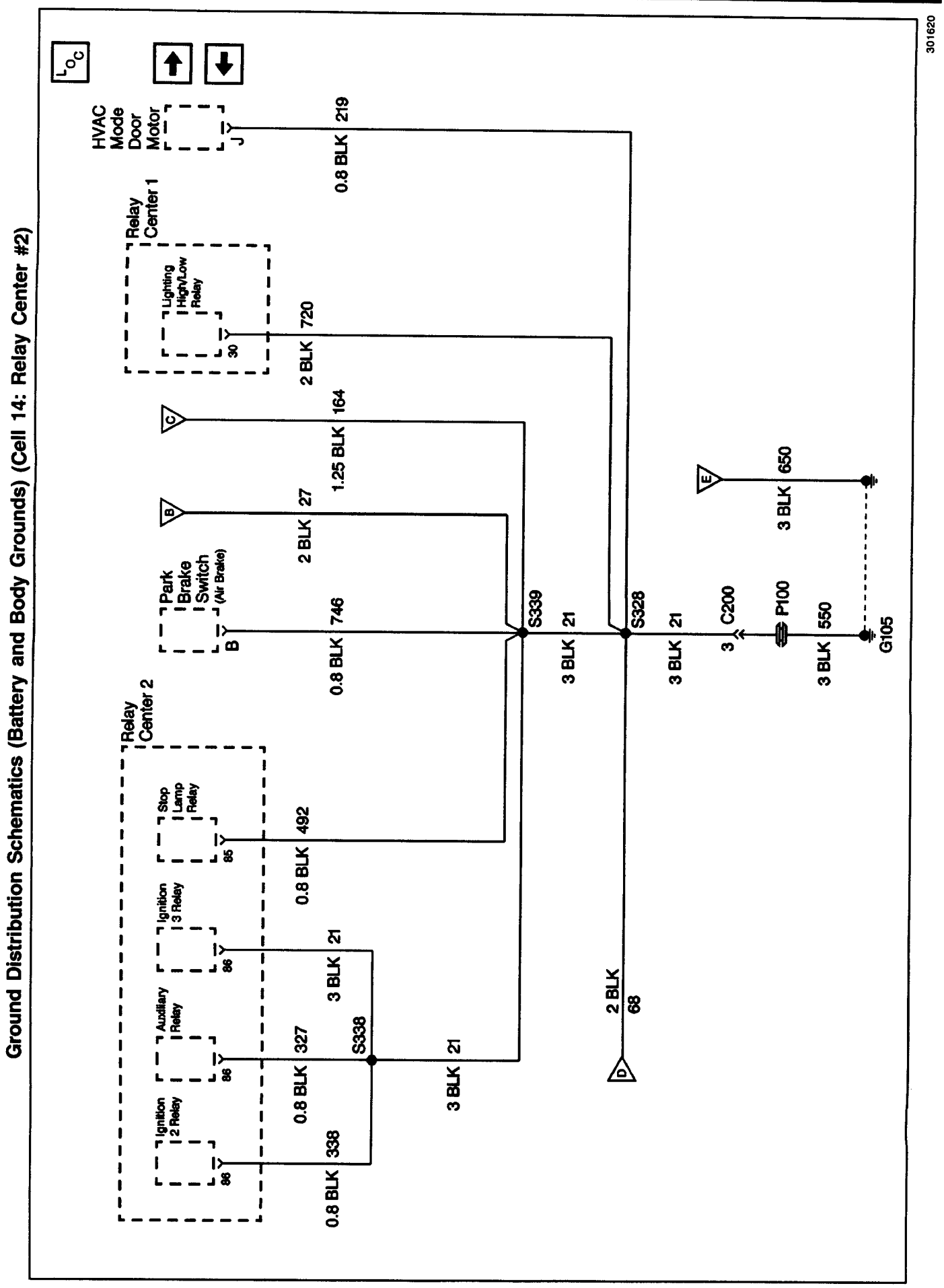


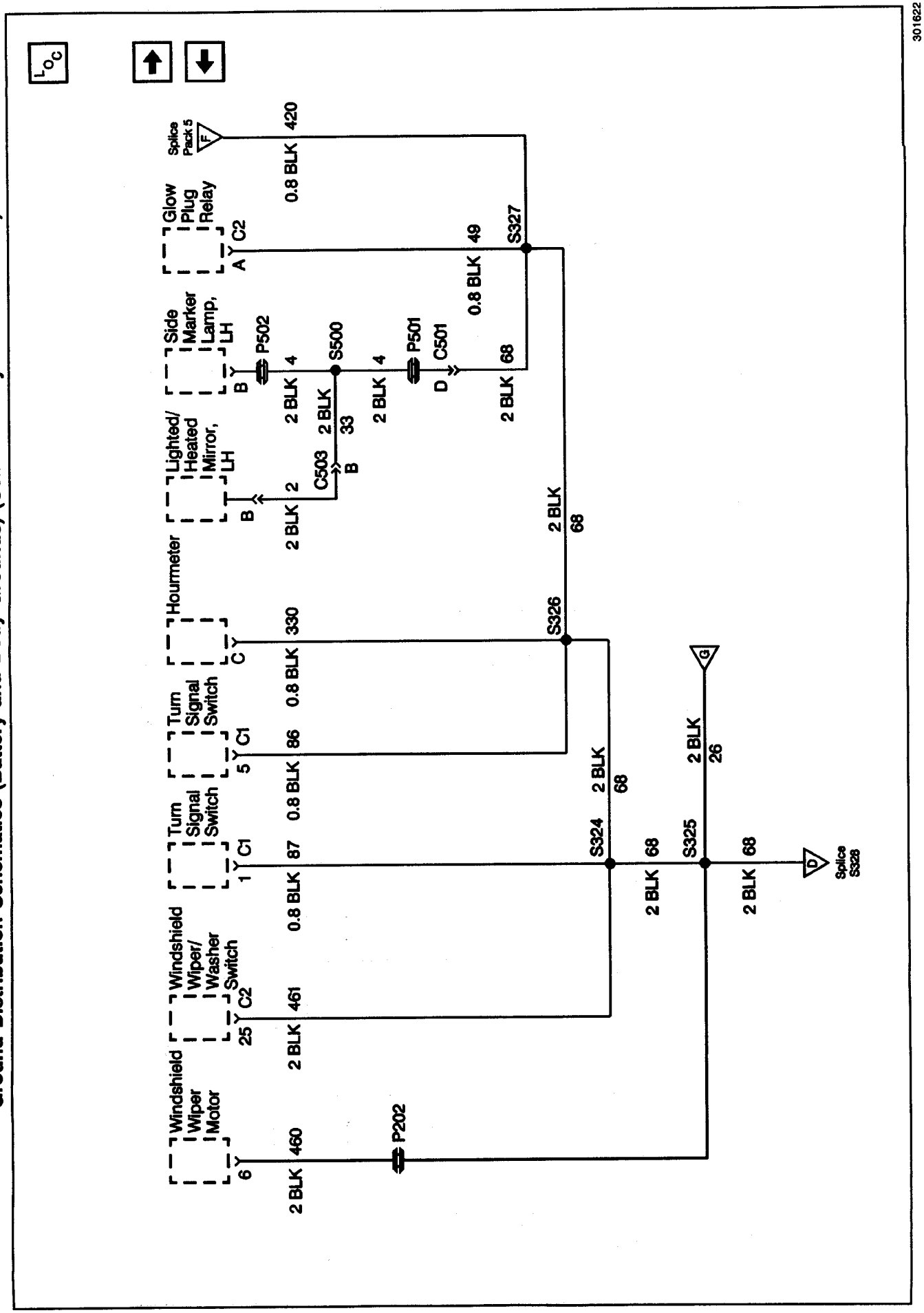
Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: G400, G501, G100, G118, G114, G601)



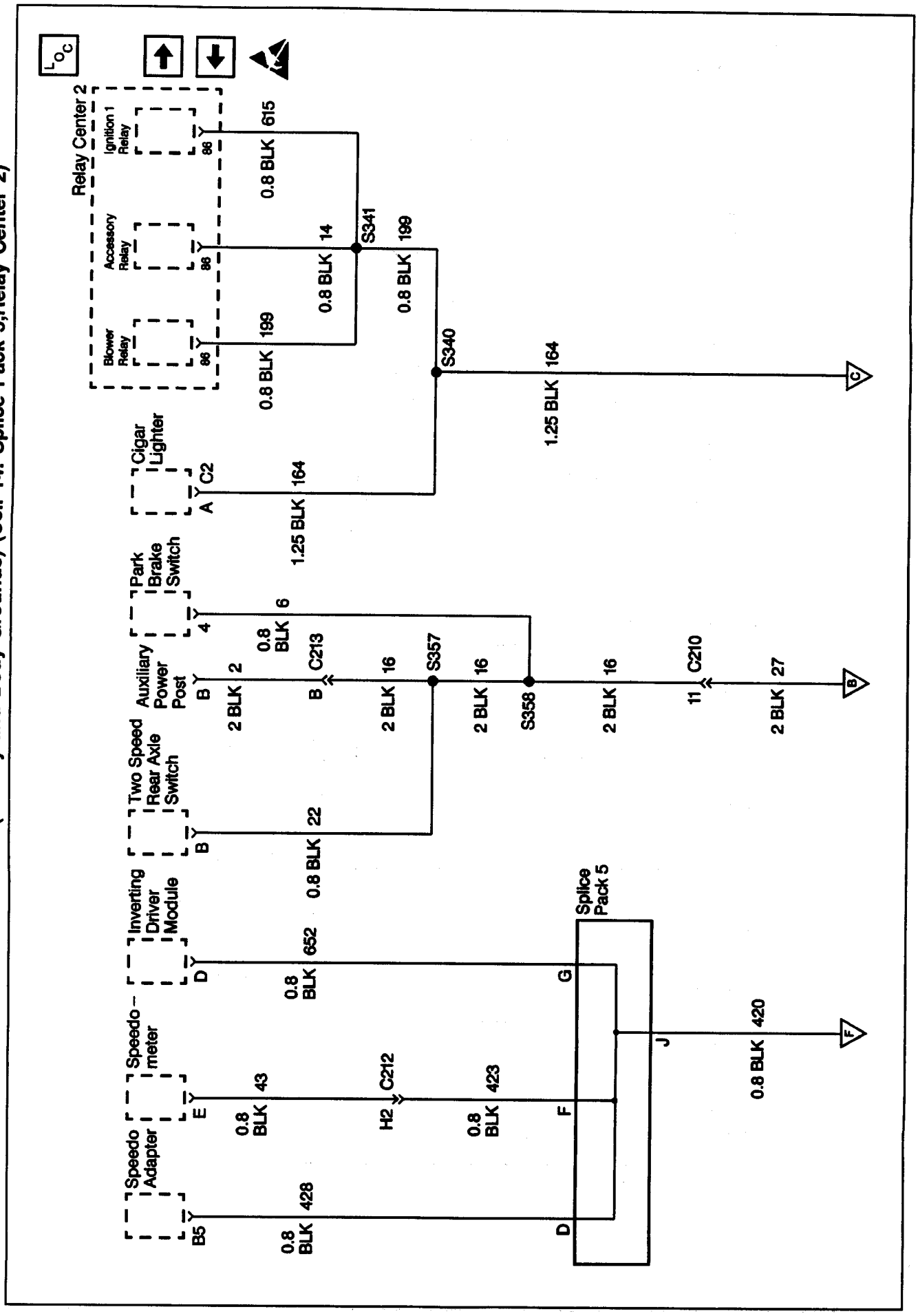

Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: G107)
301616
LOC
Power Brake Booster Pump Motor
Power Brake Booster Fluid Flow Switch
Brake Fluid Level Switch
A/C Condenser Fan
Electronic Brake Control Module, Hydraulic
Park And Turn Signal Lamp, LH Front
Park And Turn Signal Lamp, RH Front
Horn
Horn A Note
Horn F Note
Single Horn
Dual Horn
S101
S103
S105
C105
Splice S107
G107
0.8 BLK
5 BLK
1 BLK
8 BLK
3 BLK
150

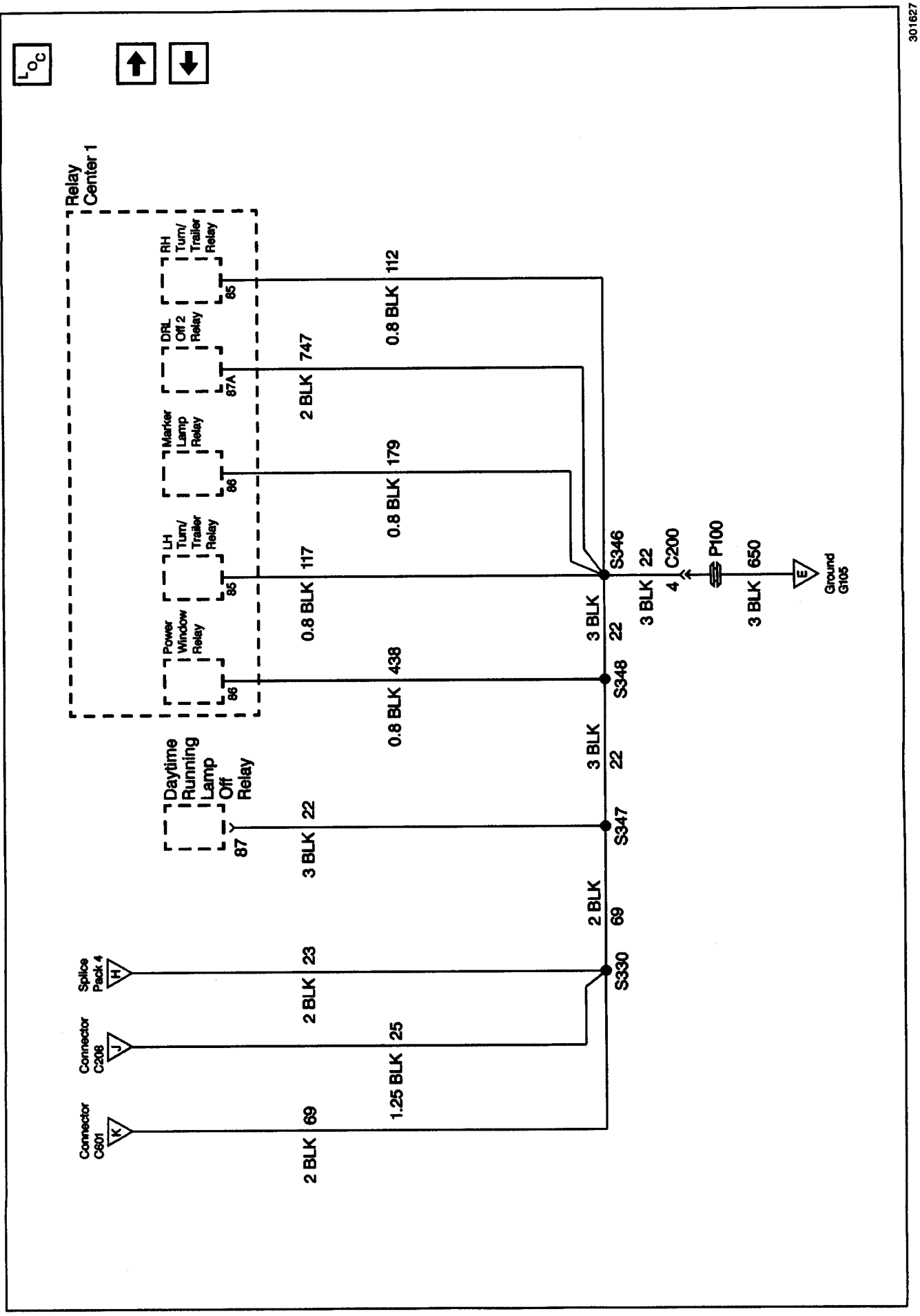

Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: G107 Cont.)
301618
Starter Relay
C2
150
0.8 BLK
Exhaust Brake Solenoid Valve
150
1 BLK
B
150
1 BLK
Automatic Transmission Modulator
B
150
0.8 BLK
B
C420
150
0.8 BLK
Low Air Pressure Switch
B
150
0.8 BLK
ABS Relay
86
150
0.8 BLK
Trailer Stop Relay
86
150
0.8 BLK
Low Engine Coolant Level Indicator Switch
B
150
1 BLK
S107
150
3 BLK
A
Splice S103


Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Relay Center #2)
301620
LOC
HVAC Mode Door Motor
J
219
0.8 BLK
Relay Center 1
Lighting High/Low Relay
30
720
2 BLK
C
164
1.25 BLK
B
27
2 BLK
Park Brake Switch (Air Brake)
B
746
0.8 BLK
S339
21
3 BLK
S328
21
3 BLK
E
650
3 BLK
C200
3
P100
550
3 BLK
G105
Relay Center 2
Stop Lamp Relay
85
492
0.8 BLK
Ignition 3 Relay
86
21
3 BLK
Auxiliary Relay
86
327
0.8 BLK
S338
21
3 BLK
Ignition 2 Relay
86
338
0.8 BLK
2 BLK
D
68

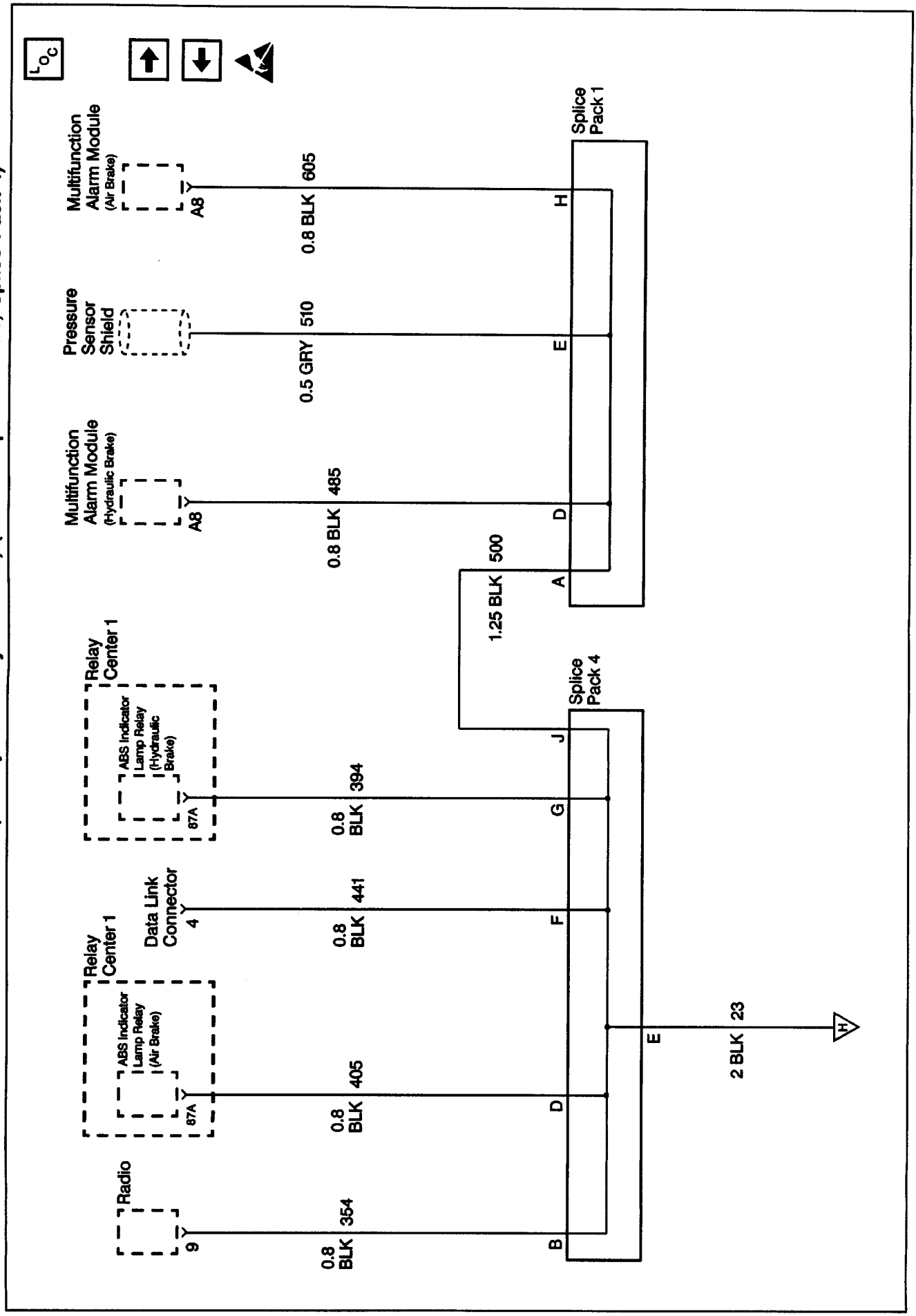

Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Relay Center 2 Cont.)
LOC
301622
Windshield Wiper Motor
Windshield Wiper/ Washer Switch
Turn Signal Switch
Turn Signal Switch
Hourmeter
Lighted/ Heated Mirror, LH
Side Marker Lamp, LH
Glow Plug Relay
Splice Pack 5
P202
C2
C1
C1
C1
C2
C503
P502
S500
P501
C501
S324
S325
S326
S327
Splice S328
2 BLK 460
2 BLK 461
0.8 BLK 87
0.8 BLK 86
0.8 BLK 330
2 BLK 2
2 BLK 4
2 BLK 33
2 BLK 4
2 BLK 68
0.8 BLK 49
0.8 BLK 420
2 BLK 68
2 BLK 68
2 BLK 68
2 BLK 26
2 BLK 68

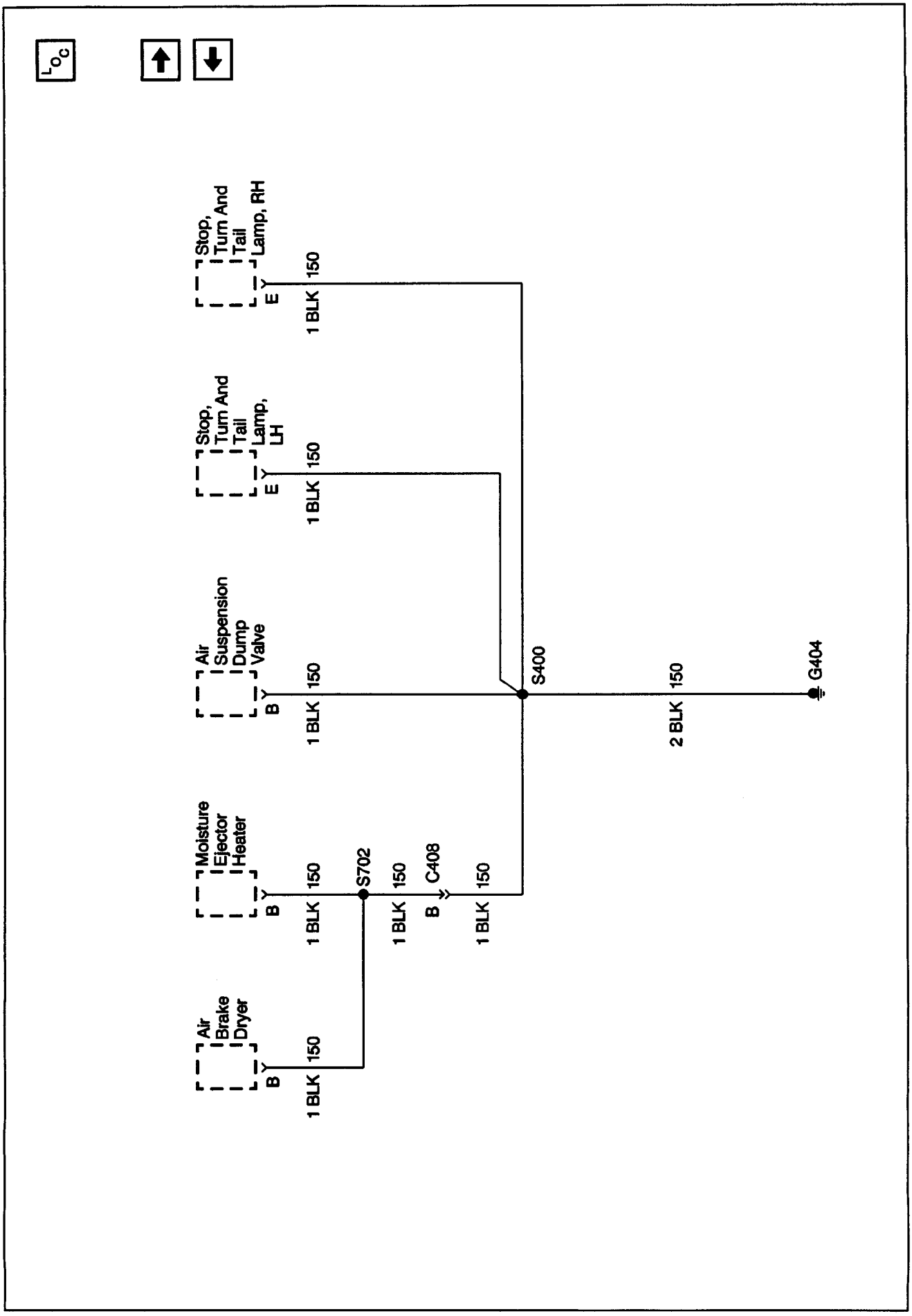
Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Splice Pack 5,Relay Center 2)



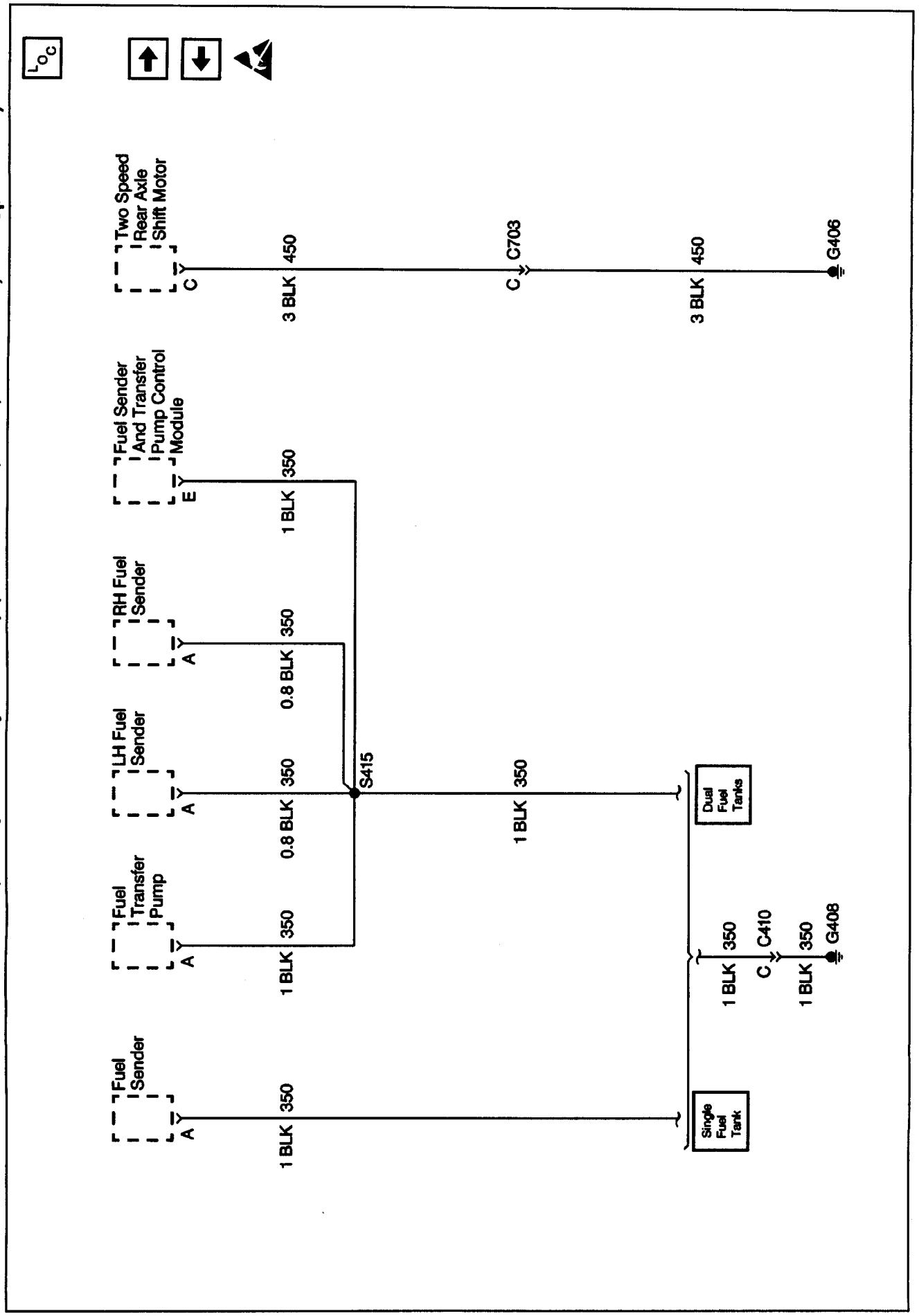

Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Relay Center 1)
301627
Relay Center 1
RH Turn/ Trailer Relay
DRL Off 2 Relay
Marker Lamp Relay
LH Turn/ Trailer Relay
Power Window Relay
Daytime Running Lamp Off Relay
85
87A
86
87
112
747
179
117
438
22
0.8 BLK
2 BLK
3 BLK
S346
S348
S347
S330
C200
P100
Ground G105
Splice Pack 4
Connector C208
Connector C601
23
25
69
1.25 BLK

Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Splice Pack 1, Splice Pack 4)

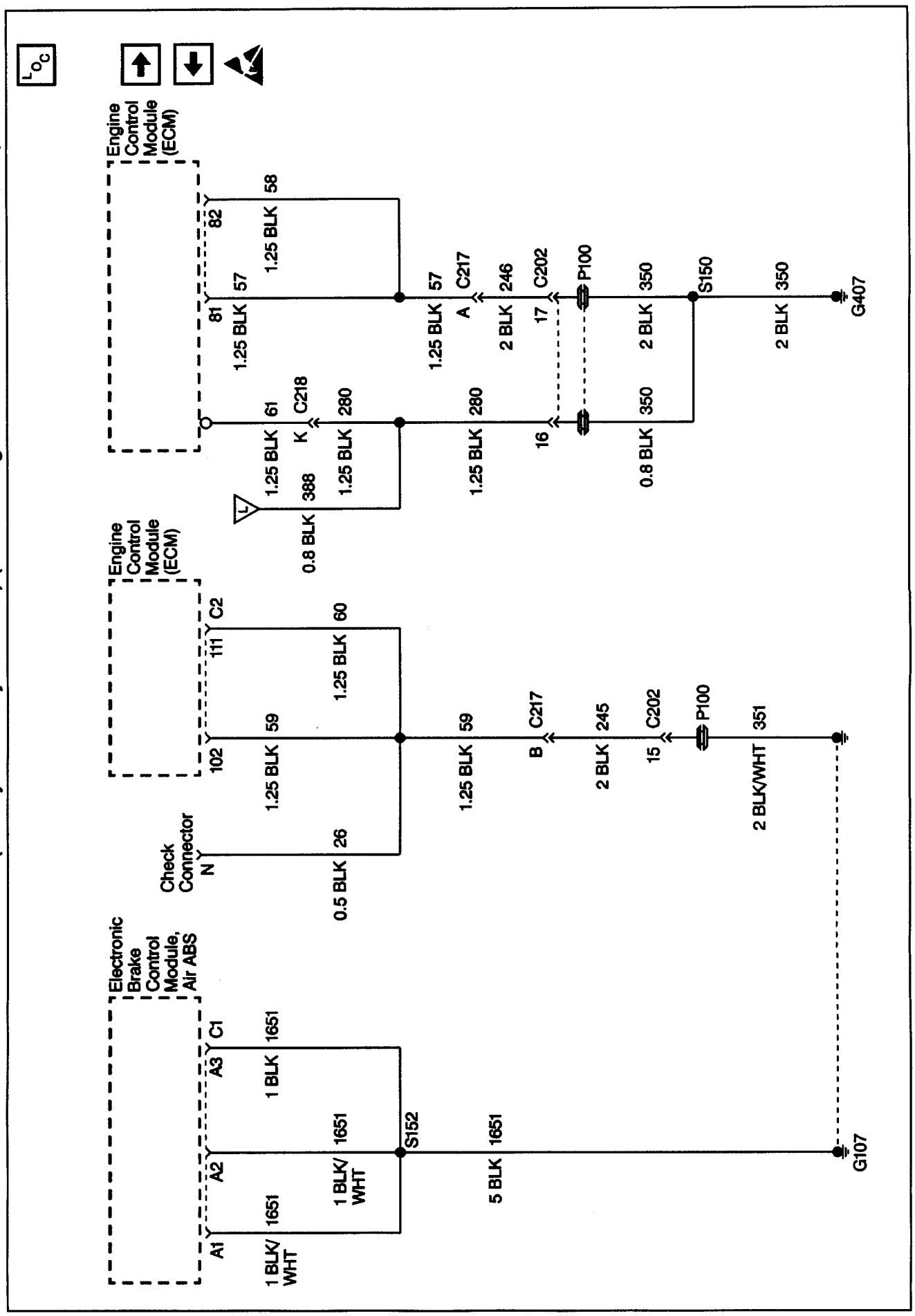



Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: G404)
301629
Air Brake Dryer
B
1 BLK 150
Moisture Ejector Heater
B
1 BLK 150
S702
1 BLK 150
C408
B
1 BLK 150
Air Suspension Dump Valve
B
1 BLK 150
S400
2 BLK 150
G404
Stop, Turn And Tail Lamp, LH
E
1 BLK 150
Stop, Turn And Tail Lamp, RH
E
1 BLK 150

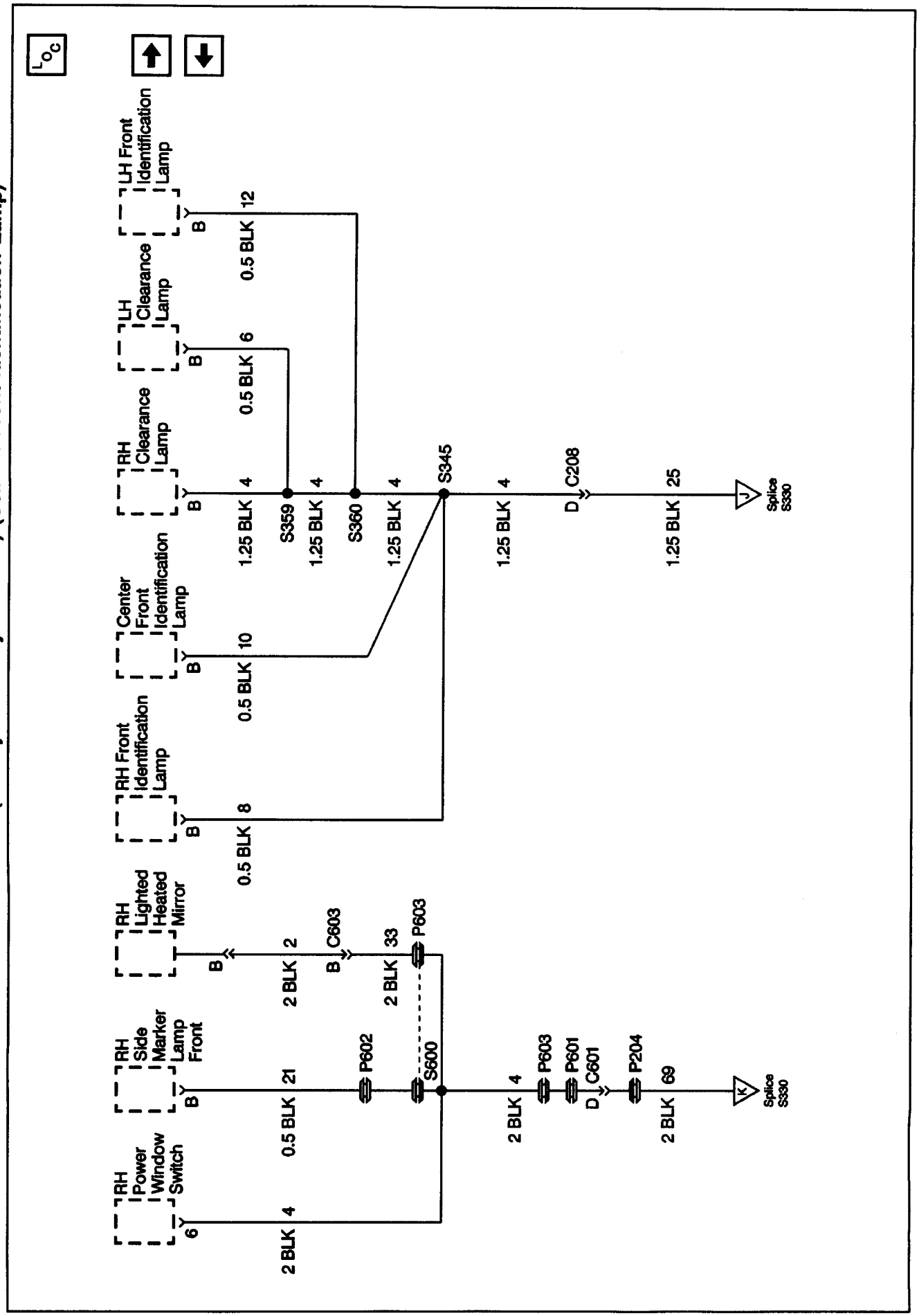
Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: G406, G408, Fuel Tanks, Two Speed Axle)



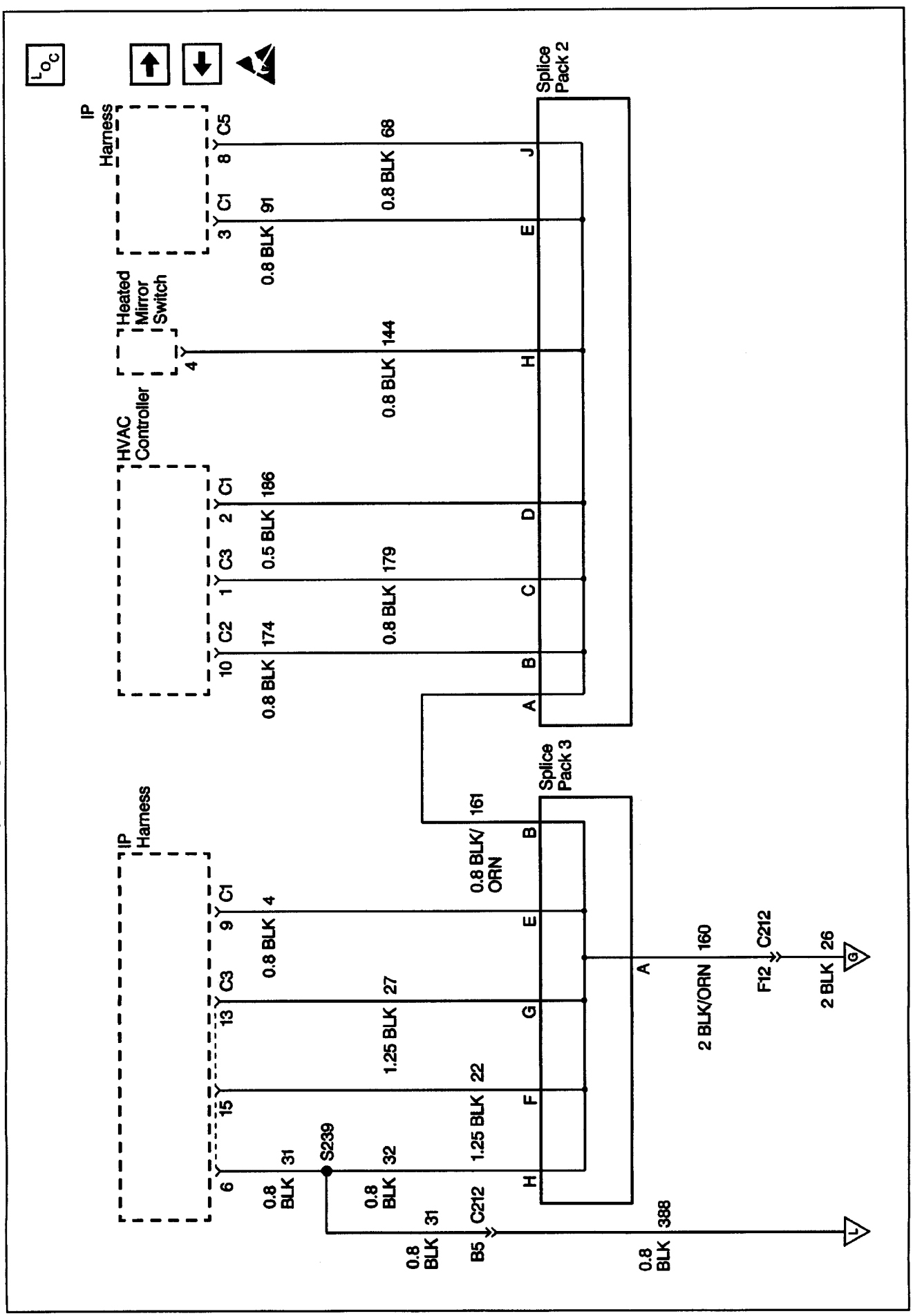
Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Engine Control Module, EBCM, Air)

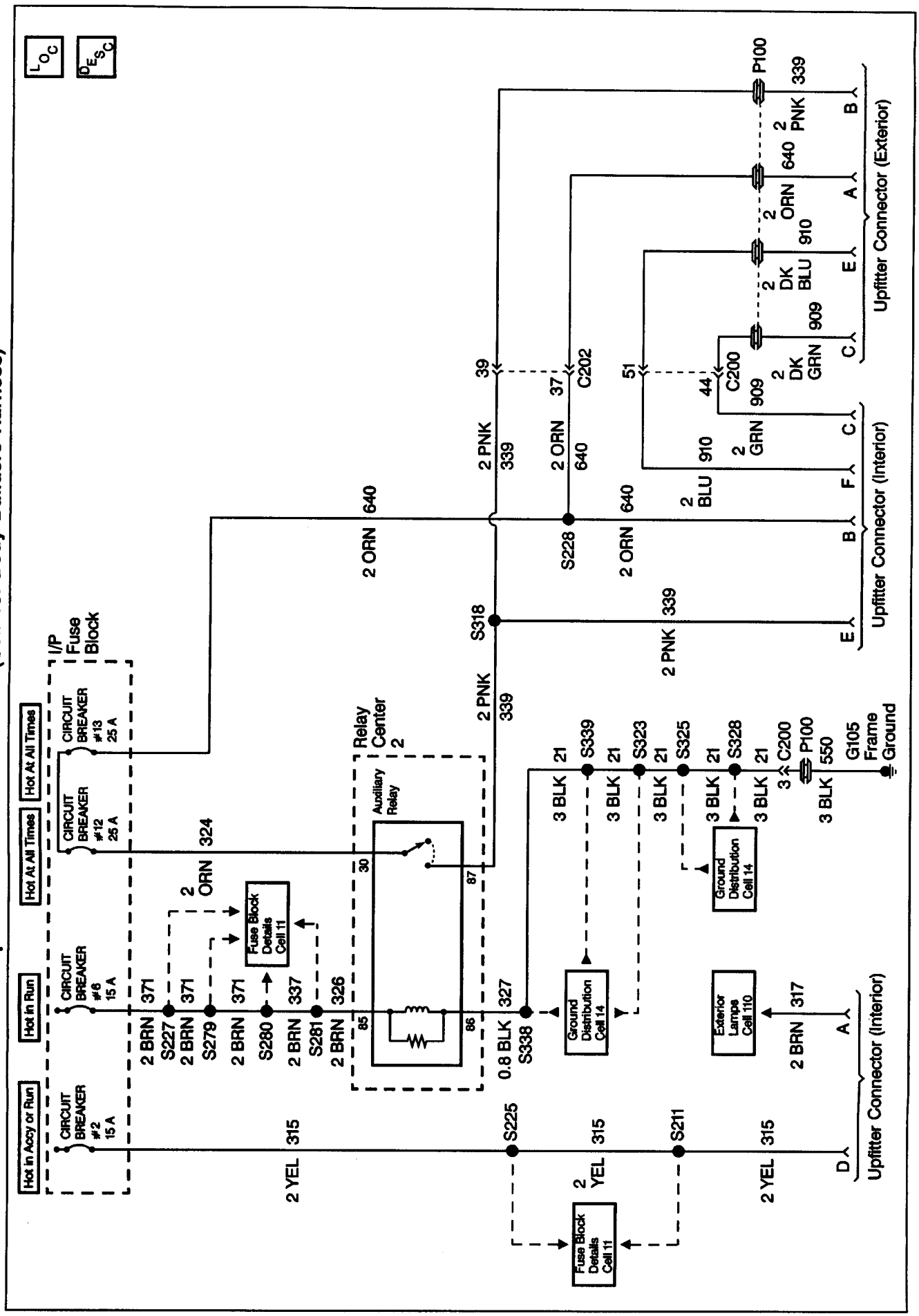


Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Front Identification Lamp)



Ground Distribution Schematics (Battery and Body Grounds) (Cell 14: Splice Pack 2, Splice Pack 3)




Upfitter Provision Schematics (Cell 18: Body Builders Harness)
292674
Hot in Accy or Run
Hot in Run
Hot At All Times
Hot At All Times
CIRCUIT BREAKER #2 15 A
CIRCUIT BREAKER #6 15 A
CIRCUIT BREAKER #12 25 A
CIRCUIT BREAKER #13 25 A
I/P Fuse Block
Relay Center 2
Auxiliary Relay
Fuse Block Details Cell 11
Ground Distribution Cell 14
Exterior Lamps Cell 110
Upfitter Connector (Interior)
Upfitter Connector (Exterior)
Frame Ground
G105
C200
C202
P100
S225
S211
S227
S279
S280
S281
S338
S318
S228
S339
S323
S325
S328
2 YEL 315
2 BRN 371
2 ORN 324
2 BRN 326
0.8 BLK 327
2 ORN 640
2 PNK 339
3 BLK 21
3 BLK 550
2 BRN 317
2 BLU 910
2 GRN 909
2 DK GRN 909
2 DK BLU 910
2 ORN 640
2 PNK 339

Component Locator

Power and Grounding Components

Name	Location	Locator View	Connector End View
Accessory Relay	In the center of the lower IP, behind the panel, in relay center 2	*Power and Grounding Component Views*	—
Auxiliary Power Posts	In the center of the console	—	—
Auxiliary Relay	In the center of the lower IP, behind the panel, in relay center 2	*Power and Grounding Component Views*	—
Battery, Inboard	On the outboard side of the right frame rail	*Power and Grounding Component Views*	—
Battery, Outboard	On the outboard side of the right frame rail	*Power and Grounding Component Views*	—
Cab Ground Cable	From the right front of the cab to the right front of the frame rail	*Power and Grounding Component Views*	—
Cab Interface Connector Housing	Under the hood, in the center of the bulkhead	*Power and Grounding Component Views*	—
Cigar Lighter	In the center of the IP, to the right of the radio	*Power and Grounding Component Views*	*Power and Grounding Connector End Views*
Cigar Lighter *C1	In the IP harness to the cigar lighter	*Power and Grounding Component Views*	*Power and Grounding Connector End Views*
Cigar Lighter *C2	In the IP harness to the cigar lighter	*Power and Grounding Component Views*	*Power and Grounding Connector End Views*
Diagnostic Connector (1 cavity)	Under the left side of the IP	—	*Power and Grounding Connector End Views*
Diagnostic Connector (20 cavities)	Under the left side of the IP	—	*Power and Grounding Connector End Views*
Diode Module 1	Below the left side of the IP to the right of the steering column, in joint connector 1, row 1, terminals 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1J and 1K	—	—
Diode Module 2	Below the left side of the IP to the right of the steering column, in joint connector 2, row 1, terminals 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1J and 1K	—	—
Engine Controls Connector Housing	Behind the left side of the front bumper	*Power and Grounding Component Views*	—
Fusible Link	In the engine harness to starter solenoid C2	—	—
Ground Block (6 cavities)	On the right frame, inboard, part of the negative battery cable	*Power and Grounding Component Views*	—
Ground Buss 1	Below the left side of the IP to the right of the steering column, joint connector 1, row 2, terminals 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2J and 2L	—	—
Ground Buss 2	Below the left side of the IP to the right of the steering column, joint connector 1, row 3, terminals 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3J and 3L	—	—
Ground Buss 3	Below the left side of the IP to the right of the steering column, joint connector 2, row 2, terminals 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2J and 2L	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
Ground Buss 4	In the upper IP harness, under the crash pad, in the top of the IP, row 2, terminals 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2J and 2L	—	—
Ground Buss 5	Under the crash pad, in the top of the IP, joint connector 1, row 3, terminals 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3J and 3L	—	—
Ignition Relay 1	In the center of the lower IP, behind the panel, in relay center 2	*Power and Grounding Component Views*	—
Ignition Relay 2	In the center of the lower IP, behind the panel, in relay center 2	*Power and Grounding Component Views*	—
Ignition Relay 3	In the center of the lower IP, behind the panel, in relay center 2	*Power and Grounding Component Views*	—
Ignition Switch	On the right side of the steering column	*Power and Grounding Component Views*	*Power and Grounding Connector End Views*
IP Fuse Block	In the right top of the IP, under the access panel	*Power and Grounding Component Views*	—
MaxiFuse® Block 1	On the left rear of the cab, below the cab bridge	*Power and Grounding Component Views*	—
MaxiFuse® Block 2	On the left rear of the cab, below the cab bridge	*Power and Grounding Component Views*	—
Memory Clear Connector (1 cavity)	Under the left side of the IP	—	*Power and Grounding Connector End Views*
Negative Battery Cable	From the outboard battery NEG terminal to the outside right frame rail with a feed to the ground block on the inside of the right frame rail	*Power and Grounding Component Views*	—
Negative Battery to Battery Cable	From the outboard battery NEG terminal to the inboard battery NEG terminal	*Power and Grounding Component Views*	—
Positive Battery Cable	From the positive battery cable POS terminal to the starter solenoid, at the starter motor	*Power and Grounding Component Views*	—
Positive Battery Cable (Dual Batteries)	From the outboard battery POS terminal to the starter solenoid	*Power and Grounding Component Views*	—
Positive Battery to Battery/Feed Cable	From the outboard battery POS terminal to the inboard battery POS terminal with a feed to the MaxiFuse® block	*Power and Grounding Component Views*	—
Relay Center 1	In the right top of the IP, under the access panel	*Power and Grounding Component Views*	—
Relay Center 2	In the center of the lower IP, behind the panel	*Power and Grounding Component Views*	—
Relay Center 3	In the right side of the lower IP, in front of the blower motor, behind the panel	—	—
Starter Motor Ground Cable	On the lower right side of the engine from the starter to the right frame rail	*Power and Grounding Component Views*	—
Transmission Connector Jumper (C412) (Manual Transmission)	Behind the engine at the left top of the bell housing, in connector C412, in the front chassis harness	*Power and Grounding Component Views*	—
Upfitter Connector (1 cavity)	The in-line connector in the front chassis harness, by the right frame rail, inboard of the batteries	*Power and Grounding Component Views*	—
Upfitter Connector (4 cavities)	The in-line connector in the front chassis harness, by the right frame rail, inboard of the batteries	*Power and Grounding Component Views*	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
Upfitter Connector, Interior (6 cavities)	The in-line connector in the lower IP harness, below the IP, to the left of the center of the cab	—	*Power and Grounding Connector End Views*
C101 (2 cavities) (Dual Electric Horns)	In the front turn signal harness to the dual electric horn harness, behind the left side of the front bumper impact bar	*Power and Grounding Component Views*	—
C105 (5 cavities)	In the front turn signal harness, to the front chassis harness, on the left top of the #1 crossmember	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C107 (4 cavities)	In the front turn signal harness, to the front chassis harness, on the left top of the #1 crossmember	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C111 (3 cavities)	In the timing and injection rate control system (TICS) harness from the engine, behind the lower left front of the front bumper, in the engine controls connector housing	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C112 (6 cavities)	In the timing and injection rate control system (TICS) harness from the engine, behind the lower left front of the front bumper, in the engine controls connector housing	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C113 (4 cavities)	In the timing and injection rate control system (TICS) harness from the engine, behind the lower left front of the front bumper, in the engine controls connector housing	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C114 (2 cavities)	In the timing and injection rate control system (TICS) harness from the engine, behind the lower left front of the front bumper, in the engine controls connector housing	*Power and Grounding Component Views*	—
C116 (8 cavities)	In the engine harness, to the front chassis harness, at the right front of the engine	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C118 (2 cavities)	In the front chassis harness, to the engine harness, at the right front of the engine	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C120 (1 cavity)	In the starter harness, to the WHT fusible link, starter solenoid C2	*Power and Grounding Component Views*	—
C121 (2 cavities)	In the starter harness, to the BLU and the BLK fusible links, starter solenoid C3	*Power and Grounding Component Views*	—
C200 (56 cavities)	In the lower IP harness, to the front chassis harness, in the left center of the cab, in the cab interface connector	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C202 (56 cavities)	In the lower IP harness, to the front chassis harness, in the left center of the cab, in the cab interface connector	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C204 (3 cavities)	In the lower IP harness, to the front chassis harness, in the left center of the cab, in the cab interface connector	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C205 (1 cavity)	In the lower IP harness, to the front chassis harness, in the left center of the cab, in the cab interface connector	*Power and Grounding Component Views*	—
C206 (2 cavities)	In the lower IP harness, to the front chassis harness, in the left center of the cab, in the cab interface connector	*Power and Grounding Component Views*	*Inline Harness Connector End Views*

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
C207 (1 cavity)	In the lower IP harness, to the front chassis harness, in the left center of the cab, in the cab interface connector	*Power and Grounding Component Views*	—
C208 (5 cavities)	In the lower IP harness, to the roof harness	—	*Inline Harness Connector End Views*
C210 (16 cavities)	In the lower IP harness, to the floor harness	—	*Inline Harness Connector End Views*
C211 (6 cavities)	In the lower IP harness, to the dash harness, under the hood, on the right side	—	*Inline Harness Connector End Views*
C212 (84 cavities)	In the lower IP harness, to the upper IP harness, in the left center of the IP at the floor	—	*Inline Harness Connector End Views*
C213 (2 cavities)	In the auxiliary power harness, to the floor harness	—	*Inline Harness Connector End Views*
C214 (2 cavities)	In the lower IP harness, to the park brake jumper, under the right seat	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C215 (2 cavities)	In the lower IP harness jumper, under the right seat	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C216 (6 cavities) (Lighted Mirror)	In the upper IP harness	—	*Inline Harness Connector End Views*
C400 (15 cavities) (ABS-Air)	In the front chassis harness, to the ABS-air brake harness, on the inboard side of the left frame rail, to the left of the transmission	—	*Inline Harness Connector End Views*
C402 (8 cavities)	In the front chassis harness, to the rear chassis and taillamps harness, on the inboard side of the right frame rail, inboard of the batteries	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C404 (3 cavities)	In the front chassis harness, to the rear chassis and taillamps harness, on the inboard side of the right frame rail, inboard of the batteries	*Power and Grounding Component Views*	—
C406 (5 cavities)	On the inboard side of the right frame rail, inboard of the batteries	*Power and Grounding Component Views*	—
C407 (14 cavities) (Automatic Transmission)	In the front chassis harness, to the starter harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C407 (14 cavities) (Manual Transmission)	In the front chassis harness, capped, on the bell housing mounting bracket	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C407 Connector Cover (Automatic Transmission)	In the front chassis harness, the sealed connector, on the bell housing mounting bracket	*Power and Grounding Component Views*	—
C408 (2 cavities) (Long Wheelbase)	In the rear chassis and taillamps harness, to the air brake moisture ejector valve, approximately 15 cm (5.9 in) from the ground connectors breakout	*Power and Grounding Component Views*	—
C410 (6 cavities)	In the rear chassis and taillamps harness, to the fuel tank/s harness, at the right frame rail forward of the back of the cab crossmember	*Power and Grounding Component Views*	—
C412 (8 cavities) (Automatic Transmission)	In the front chassis harness, to the transmission harness or connector C412 jumper, behind the engine, at the top of the bell housing	*Power and Grounding Component Views*	*Inline Harness Connector End Views*

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
C413 (4 cavities)	In the front chassis harness, to the transmission harness, on inboard side of the left frame rail, to the left of the transmission	—	—
C417 (2 cavities) (Automatic Transmission)	In the front chassis harness, to the starter harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C417 (2 cavities) (Manual Transmission)	In the starter harness, to the front chassis harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	*Inline Harness Connector End Views*
C418 (1 cavity) (Automatic Transmission)	In the starter harness, to the front chassis harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	—
C418 (1 cavity) (Cover-Air Brakes)	In the front chassis harness, to the starter harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	—
C418 (1 cavity) (Manual Transmission)	In the front chassis harness, to the starter harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	—
C419 (1 cavity) (Automatic Transmission)	In the starter harness, to the front chassis harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	—
C419 (1 cavity) (Manual Transmission)	In the starter harness, to the front chassis harness, on the bell housing mounting bracket	*Power and Grounding Component Views*	—
C501 (8 cavities)	In the left door harness, in the left door	—	*Inline Harness Connector End Views*
C503 (2 cavities)	In the left mirror connector harness, to the heated or lighted outside rearview mirror	—	*Inline Harness Connector End Views*
C601 (8 cavities)	In the right door harness, to the right heated or lighted outside rearview mirror	—	*Inline Harness Connector End Views*
C603 (2 cavities)	In the right mirror connector harness, to the heated or lighted outside rearview mirror	—	*Inline Harness Connector End Views*
C702 (3 cavities)	On the right frame rail, forward of the rear axle	*Power and Grounding Component Views*	—
D202	In the lower IP harness, part of diode module 1, plugged into joint connector 1, terminals G1, H1, J1 and K1	—	—
D203	In the lower IP harness, part of diode module 2, plugged into joint connector 2, terminals A1, B1 and C1	—	—
D204	In the lower IP harness, part of diode module 2, plugged into joint connector 2, terminals D1, E1 and F1	—	—
D205	In the lower IP harness, part of diode module 2, plugged into joint connector 2, terminals G1, H1, J1 and K1	—	—
D206	In the lower IP harness, plugged into the diode connector breakout	—	—
G103	On the left front of the #1 crossmember	*Power and Grounding Component Views*	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
G104 (ABS-Air)	The front chassis harness ground, on the left side of the cab bridge, on the power steering reservoir mounting bracket with the EBCM	*Power and Grounding Component Views*	—
G105	On the left front of the #1 crossmember	*Power and Grounding Component Views*	—
G107	From the front chassis harness, on the left frame rail, approximately 25 cm (9.8 in) to the rear of the front shock absorber	*Power and Grounding Component Views*	—
G108 (Hydraulic Brakes)	From the engine harness, to the power brake booster pump housing, to the left of the brake master cylinder	*Power and Grounding Component Views*	—
G111	On the left frame rail, on the front of the belly band	*Power and Grounding Component Views*	—
G114	The ground wire, on the front of the right frame rail to the right front of the cab	*Power and Grounding Component Views*	—
G118	From the engine harness, on the left frame rail to the generator	*Power and Grounding Component Views*	—
G119	From the engine harness, on the generator to the left frame rail	*Power and Grounding Component Views*	—
G120	The ground cable, at the right frame rail to the lower right side of the engine, near the starter	*Power and Grounding Component Views*	—
G121	The ground cable, at the right side of the engine, near the starter motor, to the right frame rail	*Power and Grounding Component Views*	—
G208	From the lower IP harness, to the upper right side of the IP	—	—
G209	From the lower IP harness, to the upper right side of the IP	—	—
G210	From the lower IP harness, to the right side of the body	—	—
G214	From the right front of the cab to the front of the right frame rail	*Power and Grounding Component Views*	—
G400	The negative battery cable to the right frame rail	*Power and Grounding Component Views*	—
G404	From the rear chassis and taillamps harness, to the inboard side of the right frame rail, in the ground block, part of the negative battery cable	*Power and Grounding Component Views*	—
G405	From the trailer harness, to the inboard side of the right frame rail, in the ground block, part of the negative battery cable	*Power and Grounding Component Views*	—
G406 (Two-Speed Rear Axle and Air Brake Dryer)	From the rear chassis and taillamps harness, to the inboard side of the right frame rail, in the ground block, part of the negative battery cable	*Power and Grounding Component Views*	—
G407	From the front chassis and taillamps harness, to the inboard side of the right frame rail, in the ground block, part of the negative battery cable	*Power and Grounding Component Views*	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
G408	From the rear chassis and taillamps harness, to the inboard side of the right frame rail, in the ground block, part of the negative battery cable	*Power and Grounding Component Views*	—
G501	From the left door harness	—	—
G502	From the left door harness	—	—
G601	From the right door harness	—	—
G602	From the right door harness	—	—
P100	On the front chassis harness, under the hood, in the center of the bulkhead, in the cab interface connector housing	*Power and Grounding Component Views*	—
P101	On the front chassis harness, under the hood, in the center of the bulkhead, in the cab interface connector housing	*Power and Grounding Component Views*	—
P102	On the dash harness, to the A/C temperature sensor/switch	—	—
P103	On the engine controls harness, under the hood, in the center of the bulkhead, to the right of the cab interface connector housing	*Power and Grounding Component Views*	—
P201	On the IP harness, under the hood, in the left side of the bulkhead	—	—
P202	On the IP harness, under the hood, in the center of the bulkhead	—	—
P203	On the IP harness, under the hood, in the right side of the bulkhead	—	—
P204	On the IP harness, under the hood, in the right side of the bulkhead	—	—
P300	On the left floor harness, to the door jamb switch	—	—
P400	On the positive battery feed cable, to MaxiFuse® block 1	*Power and Grounding Component Views*	—
P401	On the front chassis harness, to MaxiFuse® block 1	*Power and Grounding Component Views*	—
P501	On the left door harness, to the lower IP harness	—	—
P502	On the left door harness, in the left door	—	—
P503	On the left door harness, in the left door	—	—
P601	On the right door harness, to the lower IP harness	—	—
P602	On the right door harness, in the right door	—	—
P603	On the right door harness, in the right door	—	—
S100 (Dual Electric Horns)	In the dual electric horn harness, behind the left side of the front bumper impact bar, approximately 17 cm (6.7 in) from the rear horn connector	—	—
S101 (Dual Electric Horns)	In the dual electric horn harness, behind the left side of the front bumper impact bar, approximately 21 cm (8.3 in) from the rear horn connector	—	—
S102	In the front turn signal harness, in the main branch, approximately 34 cm (13.4 in) from the left turn signal breakout	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S103	In the front chassis harness, approximately 7 cm (2.8 in) to the rear of the main harness breakout	—	—
S104	In the front chassis harness, approximately 13 cm (5.1 in) from the main harness breakout	—	—
S105	In the front turn signal harness, in the main branch, approximately 40 cm (15.7 in) from the left turn signal breakout	—	—
S107	In the front chassis harness, approximately 4 cm (1.6 in) to the ABS harness breakout	—	—
S108	In the front chassis harness, approximately 11 cm (4.3 in) to the ABS harness breakout	—	—
S110	In the front chassis harness, approximately 7 cm (2.8 in) from the brake harness breakout toward the front turn signal harness	—	—
S111	In the front chassis harness, approximately 4 cm (1.6 in) in the power brake booster motor breakout	—	—
S117	In the front chassis harness, approximately 7 cm (2.8 in) toward P100 from the power brake booster pump motor breakout	—	—
S126	In the front chassis harness, approximately 30 cm (11.8 in) to the rear of the starter harness	—	—
S130	In the front chassis harness, approximately 17 cm (6.7 in) to the left of the starter harness breakout	—	—
S131	In the front chassis harness, approximately 11 cm (4.3 in) from the brake harness breakout, away from the forward lamps breakout	—	—
S132	In the front chassis harness, approximately 11 cm (4.3 in) from the brake harness breakout, toward the forward lamps breakout	—	—
S150	In the front chassis harness, approximately 31 cm (12.2 in) from the brake harness breakout	—	—
S152	In the front chassis harness, approximately 5 cm (2.0 in) from the rear of the engine oil pressure switch breakout	—	—
S181	In the front chassis harness	—	—
S182	In the front chassis harness, approximately 13 cm (5.1 in) to the rear of the engine oil pressure switch breakout	—	—
S183	In the front chassis harness, approximately 3 cm (1.2 in) forward of the engine oil pressure switch breakout	—	—
S207	In the upper IP harness	—	—
S211	In the lower IP harness, behind the center of the IP, approximately 16 cm (6.3 in) above the relay center 2 breakout	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S212	In the lower IP harness	—	—
S213	In the lower IP harness	—	—
S214	In the lower IP harness, relay center 1 breakout	—	—
S215	In the lower IP harness	—	—
S216	In the lower IP harness	—	—
S217	In the lower IP harness, in the main branch, to the right of relay center 1	—	—
S218	In the upper IP harness	—	—
S219	In the upper IP harness, to the right of the fuse block harness breakout	—	—
S220	In the upper IP harness	—	—
S221	In the upper IP harness	—	—
S222	In the upper IP harness	—	—
S223	In the lower IP harness	—	—
S224	In the lower IP harness	—	—
S225	In the lower IP harness, in the front chassis harness breakout, approximately 29 cm (11.4 in) from connector C202 (56 cavities)	—	—
S226	In the upper IP harness, approximately 32 cm (12.6 in) from the data link connector (DLC)	—	—
S227	In the upper IP harness, under the IP, approximately 6 cm (2.4 in) to the left of the fuse block breakout	—	—
S228	In the lower IP harness, inside of the cab, approximately 20 cm (7.9 in) from C202 (56 cavities)	—	—
S229	In the lower IP harness, under the left side of the IP at P203	—	—
S230	In the lower IP harness, under the right side of the IP, approximately 12 cm (4.7 in) from P203	—	—
S231	In the lower IP harness, in main harness at fuse center breakout	—	—
S232	In the lower IP harness, in main harness at fuse center breakout	—	—
S233	In the lower IP harness, approximately 16 cm (6.3 in) to the left of relay center 2	—	—
S234	In the lower IP harness, approximately 7 cm (2.8 in) to the right of the fuse block harness breakout	—	—
S235	In the lower IP harness, in the main harness at the HVAC and turn/hazard flasher module harness	—	—
S236	In the lower IP harness, in the IP extension breakout, approximately 20 cm (7.9 in) from the main branch	—	—
S237	In the lower IP harness, in the main harness at the HVAC and turn/hazard flasher module harness breakout	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S238	In the lower IP harness, approximately 12 cm (4.7 in) to the right of the relay center 1 harness breakout	—	—
S239	In the lower IP harness	—	—
S240	In the lower IP harness	—	—
S241	In the upper IP harness, approximately 4 cm (1.6 in) to the left of the main harness breakout, toward the speedometer breakout	—	—
S242	In the lower IP harness	—	—
S243	In the upper IP harness, approximately 13 cm (5.1 in) from the IP connector toward the main harness	—	—
S244	In the lower IP harness	—	—
S245	In the lower IP harness	—	—
S246	In the lower IP harness	—	—
S247	In the lower IP harness	—	—
S248	In the lower IP harness	—	—
S249	In the lower IP harness	—	—
S250	In the lower IP harness	—	—
S251	In the lower IP harness	—	—
S252	In the lower IP harness	—	—
S253	In the lower IP harness	—	—
S254	In the lower IP harness	—	—
S255	In the lower IP harness	—	—
S256	In the lower IP harness	—	—
S257	In the upper IP harness	—	—
S258	In the lower IP harness	—	—
S259	In the upper IP harness	—	—
S260	In the upper IP harness, in the main harness at the speedometer breakout	—	—
S261	In the upper IP harness	—	—
S262	In the upper IP harness	—	—
S263	In the lower IP harness	—	—
S264	In the upper IP harness	—	—
S265	In the upper IP harness, in the main harness, approximately 21 cm (8.3 in) from the upper IP connector C212 (84 cavities)	—	—
S266	In the upper IP harness	—	—
S267	In the upper IP harness, approximately 15 cm (5.9 in) to the left of the speedometer harness breakout	—	—
S268	In the upper IP harness, at the speedometer harness breakout	—	—
S269	In the upper IP harness, in the main harness, approximately 21 cm (8.3 in) from the upper IP connector C212 (84 cavities)	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S270	In the upper IP harness, in the main harness, approximately 4 cm (1.6 in) to the right of the speedometer	—	—
S271	In the upper IP harness, in the main harness, approximately 19 cm (7.5 in) from the upper IP connector C212 (84 cavities)	—	—
S272	In the upper IP harness, in the main harness, at the joint connector breakout	—	—
S273	In the upper IP harness, approximately 20 cm (7.9 in) from the differential lock switch connector	—	—
S274	In the upper IP harness, approximately 35 cm (13.8 in) from the air suspension dump switch	—	—
S275	In the upper IP harness, approximately 21 cm (8.3 in) from the heated mirror switch connector	—	—
S276	In the upper IP harness, approximately 37 cm (14.6 in) from the differential lock switch connector	—	—
S277	In the upper IP harness, in the main harness, approximately 8 cm (3.1 in) to the right of the joint connector breakout	—	—
S278	In the lower IP harness, below the IP, at the fuse block harness breakout	—	—
S279	In the lower IP harness, below the IP, approximately 5 cm (2.0 in) to the right of the relay center 1 harness breakout	—	—
S280	In the lower IP harness, in the main harness, at the frame harness breakout	—	—
S281	In the lower IP harness, approximately 5 cm (2.0 in) toward relay center 2 from the upper IP harness breakout	—	—
S282	In the lower IP harness, approximately 5 cm (2.0 in) toward relay center 2 from the upper IP harness breakout	—	—
S283	In the lower IP harness, in the right side of the IP, at the IP ground breakout	—	—
S284	In the lower IP harness, in the right side of the IP, approximately 8 cm (3.1 in) to the right of the joint connector 1 breakout	—	—
S285	In the lower IP harness	—	—
S286	In the lower IP harness, in the main harness, at the fuse block harness breakout	—	—
S287	In the lower IP harness, in the main harness, approximately 22 cm (8.7 in) to the right of the fuse block harness breakout	—	—
S288	In the lower IP harness, in the main harness, approximately 13 cm (5.1 in) to the right of the relay center 1 harness breakout	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S289	In the lower IP harness, in the main harness, approximately 6 cm (2.4 in) to the right of the relay center 1 harness breakout	—	—
S290	In the lower IP harness, approximately 24 cm (9.4 in) from the turn/hazard flasher module connector	—	—
S291	In the lower IP harness, inside of the cab, at the left headlamp (P201)	—	—
S292	In the lower IP harness, in the main harness, at the frame harness breakout	—	—
S293	In the lower IP harness, in the main branch, under the right seat, approximately 15 cm (5.9 in) from the park brake module breakout	—	—
S294	In the lower IP harness, in the main branch, at the C200 (56 cavities) and C202 (56 cavities) breakout	—	—
S295	In the lower IP harness, in the main branch, at the C200 (56 cavities) and C202 (56 cavities) breakout	—	—
S296	In the lower IP harness, in the main branch, approximately 20 cm (7.9 in) from relay center 2	—	—
S297	In the lower IP harness, in the main branch, approximately 20 cm (7.9 in) from relay center 2	—	—
S298	In the lower IP harness, in the main branch, approximately 16 cm (6.3 in) from the floor harness	—	—
S299	In the lower IP harness, in the main branch, approximately 20 cm (7.9 in) from the floor harness	—	—
S300	In the lower IP harness	—	—
S301	In the lower IP harness	—	—
S302	In the lower IP harness	—	—
S303	In the lower IP harness	—	—
S304	In the lower IP harness	—	—
S305	In the lower IP harness	—	—
S306	In the lower IP harness	—	—
S307	In the lower IP harness	—	—
S308	In the lower IP harness	—	—
S309	In the lower IP harness	—	—
S310	In the lower IP harness	—	—
S311	In the lower IP harness	—	—
S312	In the lower IP harness	—	—
S313	In the lower IP harness	—	—
S314	In the lower IP harness	—	—
S315	In the lower IP harness	—	—
S316	In the lower IP harness	—	—
S317	In the lower IP harness	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S318	In the lower IP harness	—	—
S319	In the lower IP harness	—	—
S320	In the lower IP harness	—	—
S321	In the lower IP harness	—	—
S322	In the lower IP harness	—	—
S323	In the lower IP harness	—	—
S324	In the lower IP harness	—	—
S325	In the lower IP harness	—	—
S326	In the lower IP harness	—	—
S327	In the lower IP harness	—	—
S328	In the lower IP harness	—	—
S329	In the lower IP harness	—	—
S330	In the lower IP harness	—	—
S331	In the lower IP harness	—	—
S332	In the lower IP harness	—	—
S333	In the lower IP harness	—	—
S334	In the lower IP harness	—	—
S335	In the lower IP harness	—	—
S336	In the lower IP harness	—	—
S337	In the lower IP harness	—	—
S338	In the lower IP harness	—	—
S339	In the lower IP harness	—	—
S340	In the lower IP harness	—	—
S341	In the lower IP harness	—	—
S342	In the lower IP harness, approximately 36 cm (14.2 in) from upper IP connector C212 (84 cavities)	—	—
S343	In the upper IP harness, approximately 24 cm (9.4 in) from heated mirror switch connector C216 (6 cavities) with the lighted mirror	—	—
S344	In the upper IP harness	—	—
S345	In the roof harness	—	—
S346	In the lower IP harness	—	—
S347	In the lower IP harness	—	—
S348	In the lower IP harness	—	—
S349	In the lower IP harness	—	—
S350	In the lower IP harness	—	—
S351	In the lower IP harness	—	—
S352	In the lower IP harness	—	—
S353	In the lower IP harness	—	—
S354	In the lower IP harness	—	—
S355	In the lower IP harness	—	—
S356	In the lower IP harness	—	—
S357	In the floor harness	—	—
S358	In the floor harness	—	—

Power and Grounding Components (cont'd)

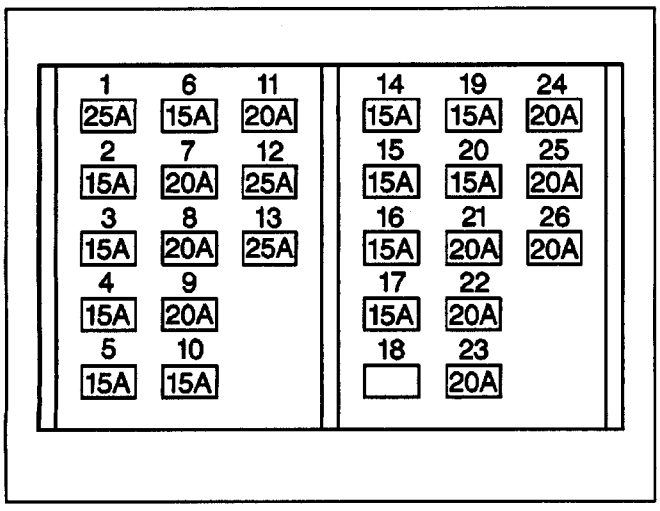
Name	Location	Locator View	Connector End View
S359	In the roof harness	—	—
S360	In the roof harness	—	—
S361	In the upper IP harness	—	—
S362	In the lower IP harness	—	—
S363	In the lower IP harness	—	—
S364	In the lower IP harness	—	—
S365	In the roof harness	—	—
S366	In the roof harness	—	—
S367	In the roof harness	—	—
S368	In the roof harness	—	—
S369	In the roof harness	—	—
S370	In the roof harness	—	—
S371	In the roof harness	—	—
S372	In the lower IP harness	—	—
S373 (ABS-Air)	In the lower IP harness	—	—
S374	In the lower IP harness	—	—
S376	In the lower IP harness	—	—
S377	In the lower IP harness	—	—
S378	In the lower IP harness	—	—
S386	In the lower IP harness	—	—
S400	In the rear chassis and taillamps harness, approximately 30 cm (11.8 in) from the engine harness connectors	—	—
S400 (Long Wheelbase)	In the rear chassis and taillamps harness, at the main branch, approximately 10 cm (3.9 in) from the ground connectors breakout	—	—
S400 (Low Profile)	In the rear chassis and taillamps harness, at the main branch, approximately 10 cm (3.9 in) from the ground connectors breakout	—	—
S401	In the rear chassis and taillamps harness, approximately 20 cm (7.9 in) from the engine harness connectors	—	—
S401 (Long Wheelbase)	In the rear chassis and taillamps harness, at the main branch, approximately 5 cm (2.0 in) from C410	—	—
S405	In the full trailer harness, approximately 100 cm (39.4 in) from the trailer receptacle	—	—
S406	In the front chassis harness, approximately 7 cm (2.8 in) to the ABS harness breakout	—	—
S408	In the front chassis harness, approximately 7 cm (2.8 in) to the rear of the ABS relay breakout	—	—
S410	In the front chassis harness, approximately 17 cm (6.7 in) from the ABS module	—	—
S411	In the front chassis harness, approximately 4 cm (1.6 in) to the left of the starter motor relay breakout	—	—

Power and Grounding Components (cont'd)

Name	Location	Locator View	Connector End View
S415 (Dual Fuel Tanks)	In the dual fuel tank harness, on the main branch, approximately 11 cm (4.3 in) from the fuel sender and the balance pump control module breakout	—	—
S417 (Dual Fuel Tanks)	In the dual fuel tank harness, on the main branch, approximately 4 cm (1.6 in) from the fuel sender and the balance pump control module breakout	—	—
S500	In the left door harness, approximately 15 cm (5.9 in) from P501, toward the sidemarker lamp breakout	—	—
S600	In the right door harness, approximately 31 cm (12.2 in) from the power window switch	—	—
S701	In the moisture ejector and air dryer harness, approximately 10 cm (3.9 in) back from the air brake dryer breakout	—	—
S702	In the moisture ejector and air dryer harness, approximately 30 cm (11.8 in) back from the air brake dryer breakout	—	—
S703	In the two-speed axle control harness, approximately 5 cm (2.0 in) in front of the relay breakout	—	—
S900	In the rear chassis and taillamps harness, approximately 14 cm (5.5 in) in front of the tail, stop and turn signal lamps breakout	—	—
S900 (Long Wheelbase)	In the rear chassis and taillamps harness, at the main branch, approximately 5 cm (2.0 in) from the right taillamp breakout	—	—
S901	In the rear chassis and taillamps harness, approximately 5 cm (2.0 in) in front of the tail, stop and turn signal lamps breakout	—	—
S901 (Long Wheelbase)	In the rear chassis and taillamps harness, at the main branch, approximately 10 cm (3.9 in) from the right taillamp breakout	—	—

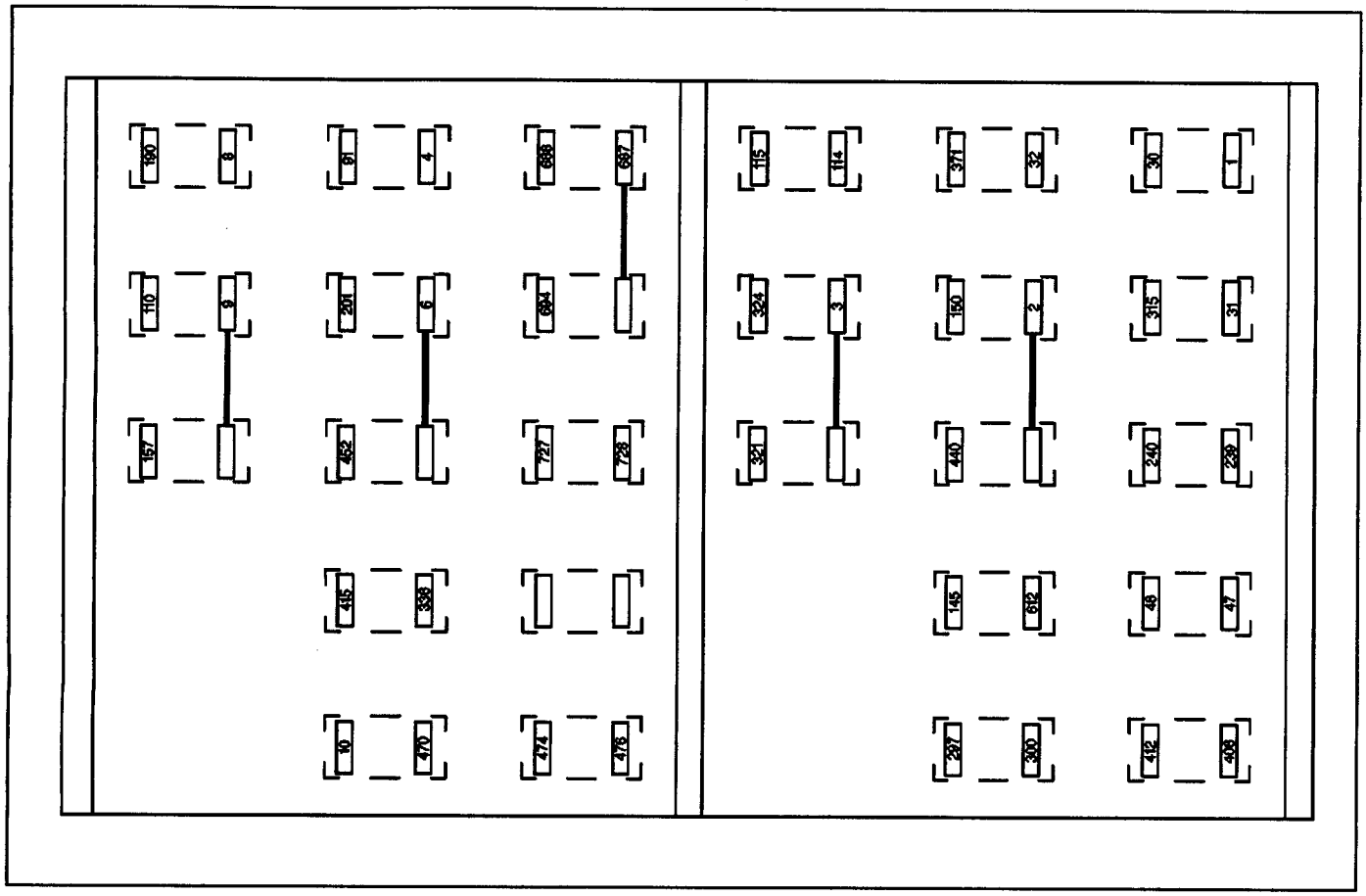
Power and Grounding Component Views

Cell 11: Fuse Block, Front View



244535

Cell 11: Fuse Block, Rear View



244479

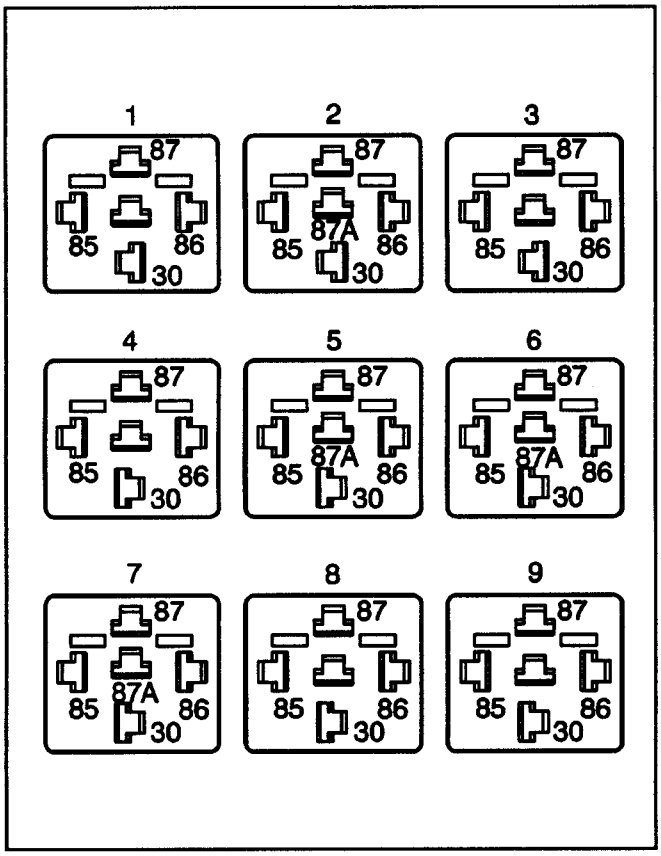
Power and Grounding Component Views

Fuse/Circuit Breaker	Rating	Description
1	25A	Ignition Switch
2	15A	Radio, Cigar Lighter, Body Builder Connector
3	15A	Timing and Injection Rate Control System (TICS)
4	15A	Glow Plug Relay
5	15A	Data Link Connector (DLC), Serial Signal Connector
6	15A	Relay Centers, VSS Buffer, I/P, Turn Signal Switch, DRL Relays
7	20A	Horn Relay, Turn Signal Switch, Radio, Engine Shutdown Module, Dome Lamp
8	20A	Power Window Relay
9	20A	Multifunction Alarm Module, Relay Center 1, Fuel Injection Pump Control Valve, Check Connector, Exhaust Brake Switch, Fuel Tanks, Air ABS Relay, Electronic Brake Control Module (Hydraulic)
10	15A	Timing and Injection Rate Control System (TICS), Serial Signal Connector, Check Connector
11	20A	LH Turn/Stop Relay
12	25A	Auxiliary Relay (Switched)
13	25A	Body Builder Connector (Battery Direct)
14	15A	LH Headlamps
15	15A	RH Headlamps
16	15A	Lighting Relays
17	—	Not Used
18	15A	Multifunction Alarm Module (MFAM)

Power and Grounding Component Views (cont'd)

Fuse/Circuit Breaker	Rating	Description
19	15A	Taillamp Relay
20	20A	A/C Compressor, A/C Condensor Fan
21	20A	Windshield Wiper Motor, Windshield Washer Pump
22	20A	Heated Mirror Switch, Two-Speed Axle Motor Relay
23	20A	Stoplamp Relay, Stoplamp Switch
24	20A	Blower Motor Relay
25	20A	Hazard Flasher, Stoplamp Switch (Air Brake), RH Turn/Stop Relay, Park Brake Switch
26	20A	Auxiliary Power Post

Relay Center 1

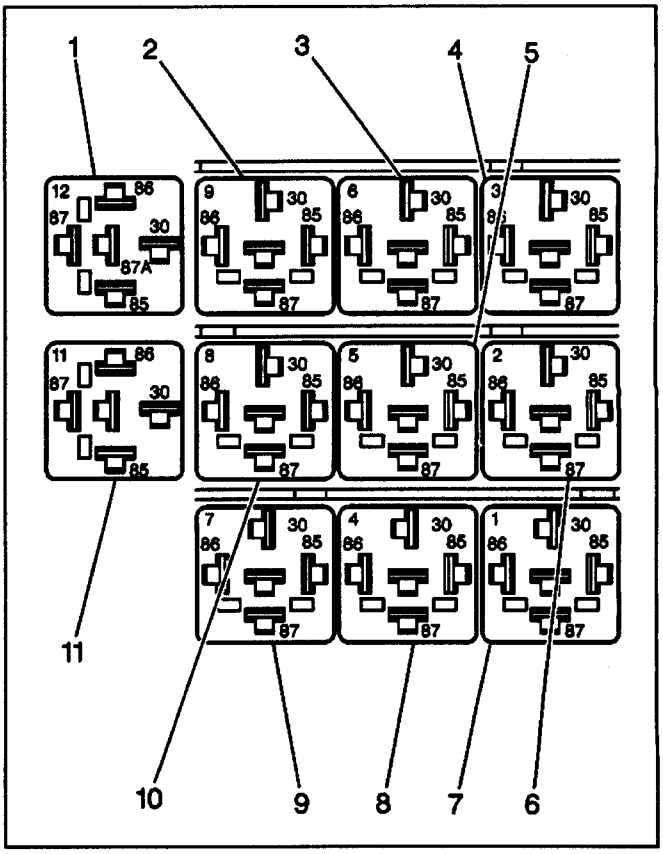


215317

Legend

(1) Power Window Relay
(2) Lighting Relay
(3) Taillamp Relay
(4) Fuel Pump Relay (Gas), Fuel Heater Relay (Diesel)
(5) Lighting Relay
(6) Park Brake Relay (w/J71 Park Brake), Marker Lamps Relay (Tractor)
(7) ABS Telltale Relay
(8) Left Turn/Trailer Relay
(9) Right Turn/Trailer Relay

Relay Center 2



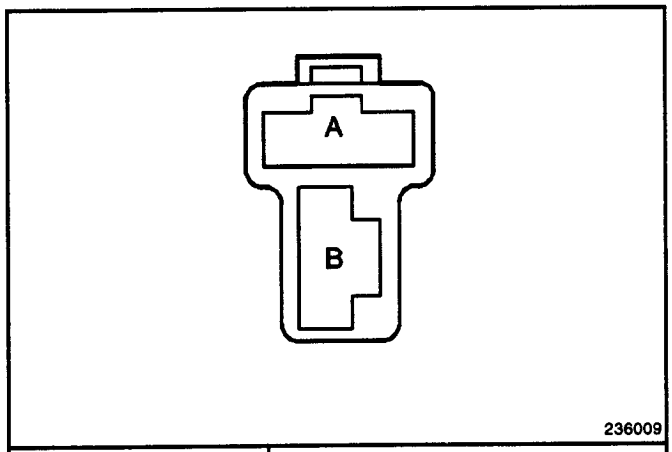
244518

Legend

(1) Engine Stop Relay
(2) Ignition #3 Relay
(3) Ignition #2 Relay
(4) Blower Relay
(5) Ignition #1 Relay
(6) Compressor Relay
(7) Condenser Fan Relay
(8) Accessory Relay
(9) Auxiliary Relay
(10) Horn Relay
(11) Stoplamp Relay

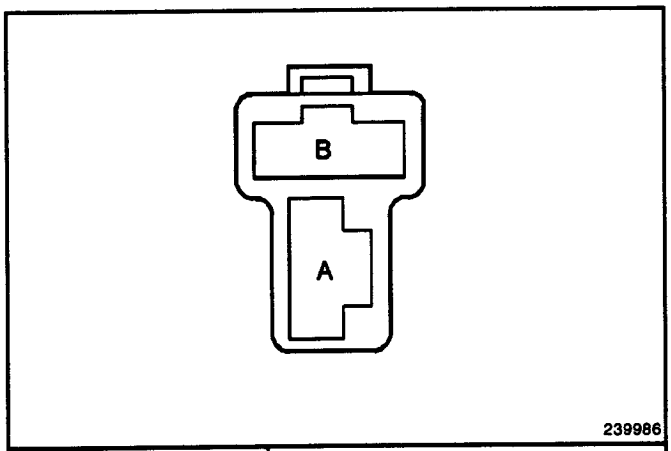
Power and Grounding Connector End Views

Cigar Lighter



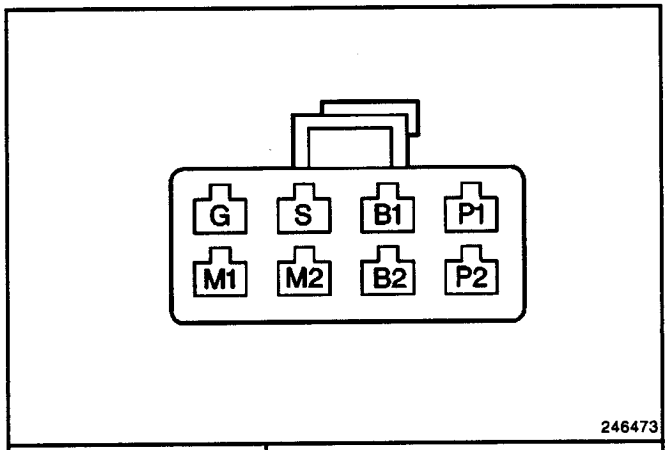
Connector Part Information		• 2 Way • Male	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK/RED	165	Interior Lamp Dimming Buss
B	BRN	163	Illumination

Consent



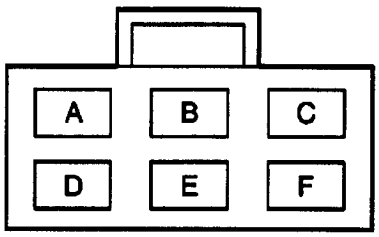
Connector Part Information		• 2 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRN/RED	15	Consent
B	BLK	16	Ground

Ignition Switch



Connector Part Information		• 8 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
G	BRN/RED	47	Ignition Switch Output (Hot in Start and Heat Positions)
S	YEL	33	Ignition Switch Output (Hot in Start Position)
B1	WHT/RED	30	Main Feed to Ignition Switch From IP Fuseblock (Circuit Breaker 1 25amp)
B2	—	—	Not Used
M1	BLU	13	Ignition Switch Output (Hot in Run and ACCY Positions) to Accessory Relay
M2	BLU	16	Ignition Switch Output (Hot in Start, Heat, and Run Positions) to Ignition 3 Relay
P1–P2	—	—	Not Used

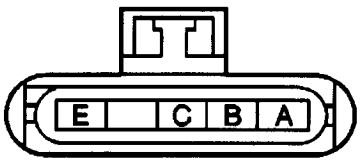
Interior Upfitter Connector



237082

Connector Part Information		• 6 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	317	Exterior Lamps
B	ORN	319	Fuse Output-Battery
C	GRN	322	Upfitter Connector (Exterior) Pin-C
D	YEL	318	Fuse Output-Ignition
E	PNK	320	Auxiliary Relay Contact (Relay Center 2)
F	BLU	323	Upfitter Connector (Exterior) Pin-E

Exterior Upfitter Connector



236398

Connector Part Information		• 12065862 • 4 Way Metri-Pack 280 Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	ORN	640	Fuse Output-Battery
B	PNK	339	Fuse Output-Ignition
C	DK GRN	909	Interior Upfitter Connector
D	—	—	Not Used-Sealed
E	DK BLU	910	Interior Upfitter Connector

Diagnostic Information and Procedures

Upfitter Provision System Check

Diagnosis Body Builder Harness

1. Inspect Circuit Breakers #2, #6, #12 and #13 to determine if any circuit breaker is open. If an open condition exists, Locate and Repair the overload condition and Replace the circuit breaker.
2. Inspect ground G 105 to assure that it is clean and tight.
3. Inspect for broken (or partially broken) wire inside the insulation. This condition could cause system malfunction but prove to test good in a continuity or voltage test with the system disconnected. These circuits may be intermittent or resistive when in operation. If possible test for a voltage drop when the system is operational.
4. Inspect for proper installation of aftermarket electronic equipment which may affect the integrity of other systems.

Cigar Lighter/Auxiliary Outlets System Check

Diagnosis Cigar Lighter

1. Inspect the CIG/AUX Circuit Breaker to determine if the circuit breaker is open. If an open condition exists, Locate and Repair the overload condition and Replace the circuit breaker.
2. Test for B+ at the AUX Power Outlet (if equipped)). This outlet shares the same power supply as the lighter.
3. Inspect for broken (or partially broken) wire inside the insulation. This condition could cause system malfunction but prove to test good in a continuity or voltage test with the system disconnected. These circuits may be intermittent or resistive when in operation. If possible test for a voltage drop when the system is operational.
4. Inspect for proper installation of aftermarket electronic equipment which may affect the integrity of other systems.

Cigar Lighter Inoperative

Step	Action	Value(s)	Yes	No
1	Connect a test lamp from CKT 240 (ORN) at the Cigar Lighter harness to chassis ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a self powered test lamp from CKT 250 (BLK) at the Cigar Lighter connector harness to chassis ground. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Locate and repair the open in CKT 240 (ORN) between the Cigar Lighter and the IP Fuse Block. Is the repair complete?	—	System OK	—
4	Replace the Cigar Lighter. Is the repair complete?	—	System OK	—
5	Locate and repair the open in CKT 250 (BLK) between the Cigar Lighter and chassis ground. Is the repair complete?	—	System OK	—

Upfitter Provision Relay Inoperative

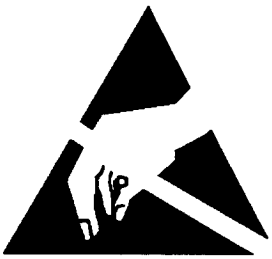
Step	Action	Value(s)	Yes	No
Definition: Auxiliary Relay Does Not Energize.				
1	1. Connect a test lamp from CKT 326 (BRN) at the Auxiliary Relay terminal 85 to ground. 2. Place the ignition switch in RUN. Does the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Connect a test lamp from CKT 326 (BRN) at the Auxiliary Relay terminal 85 to CKT 327 (BLK) at the Auxiliary Relay terminal 86. Does the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
3	Locate and repair open in CKT 37, CKT 326 or CKT 371 (BRN) between the IP Fuse Block and the Auxiliary Relay. Is the repair complete?	—	System OK	—
4	Connect a test lamp from CKT 324 (ORN) at the Auxiliary Relay terminal 30 to ground. Does the test lamp light?	—	Go to *Step 6*	Go to *Step 7*
5	Locate and repair open in CKT 21, CKT 327 or CKT 550 (BLK) between the Auxiliary Relay and ground G 105. Is the repair complete?	—	System OK	—
6	Connect a self-powered test lamp between CKT 325 (PNK) at the Auxiliary Relay and CKT 320 (PNK) or CKT 339 (PNK) at the Body Builder Connector. Does the test lamp light?	—	Go to *Step 8*	Go to *Step 9*
7	Locate and repair open in CKT 324 (ORN) between the IP Fuse Block and the Auxiliary Relay. Is the repair complete?	—	System OK	—
8	Replace the Auxiliary relay. Is the repair complete?	—	System OK	—
9	Locate and repair the open in CKT 320, CKT 325 or CKT 339 (PNK) between Auxiliary Relay and Body Builder Connectors. Is the repair complete?	—	System OK	—

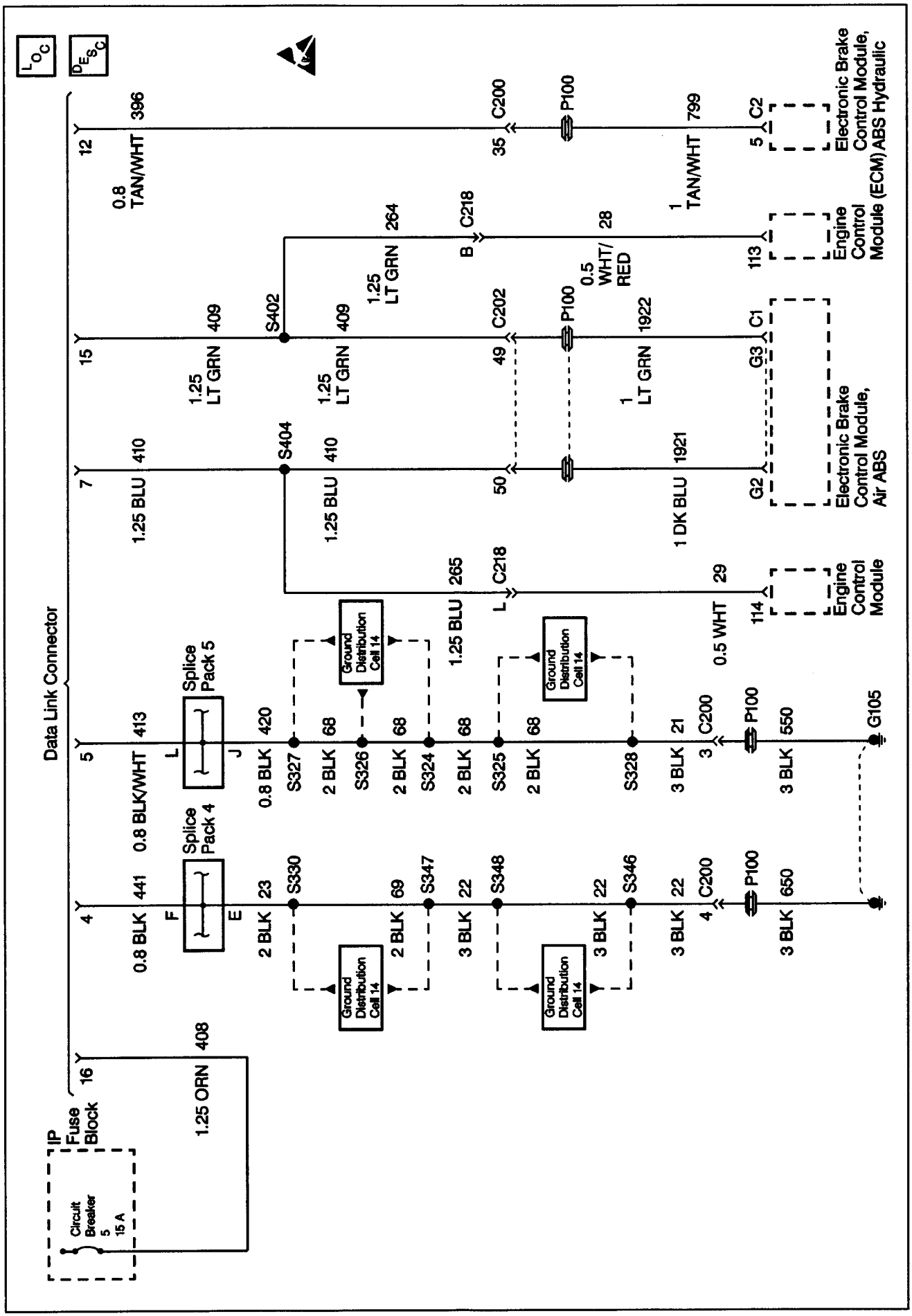
Schematic and Routing Diagrams

Data Link Connector Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems

Data Link Connector Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.


Data Link Connector Schematics (Cell 50: Data Link Connector)
303078
Data Link Connector
Fuse Block
IP
Circuit Breaker 5 15 A
1.25 ORN
408
16
0.8 BLK
441
4
F
E
Splice Pack 4
2 BLK
23
S330
Ground Distribution Cell 14
0.8 BLK/WHT
413
5
L
J
Splice Pack 5
0.8 BLK
420
S327
2 BLK
68
S326
2 BLK
68
S324
2 BLK
68
S325
2 BLK
68
S328
3 BLK
21
C200
3
0.5 WHT
P100
114
Engine Control Module
3 BLK
550
G105
3 BLK
650
P100
4
C200
3 BLK
22
S346
3 BLK
22
S348
3 BLK
22
S347
2 BLK
69
S330
1.25 BLU
265
C218
L
1.25 BLU
410
S404
1.25 BLU
410
50
C202
49
1.25 LT GRN
409
S402
1.25 LT GRN
409
15
1.25 LT GRN
409
C202
49
P100
0.5 WHT/RED
1922
C1
G3
1 LT GRN
1921
1 DK BLU
G2
Electronic Brake Control Module, Air ABS
1.25 BLU
410
7
1.25 BLU
410
50
C218
L
1 DK BLU
1921
29
Engine Control Module
114
P100
0.5 WHT
C200
3
21
3 BLK
S328
3 BLK
22
S346
3 BLK
22
S348
3 BLK
22
S347
2 BLK
69
S330
2 BLK
23
0.8 BLK
441
4
F
E
Splice Pack 4
0.8 BLK/WHT
413
5
L
J
Splice Pack 5
0.8 BLK
420
S327
2 BLK
68
S326
2 BLK
68
S324
2 BLK
68
S325
2 BLK
68
S328
3 BLK
21
C200
3
0.5 WHT
P100
114
Engine Control Module
3 BLK
550
G105
3 BLK
650
P100
4
C200
3 BLK
22
S346
3 BLK
22
S348
3 BLK
22
S347
2 BLK
69
S330
2 BLK
23
1.25 ORN
408
16
Fuse Block
IP
Circuit Breaker 5 15 A
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
Data Link Connector
0.8 TAN/WHT
396
12
C200
35
P100
1 TAN/WHT
799
C2
5
Electronic Brake Control Module, ABS Hydraulic
1.25 LT GRN
264
B
C218
0.5 WHT/RED
28
C1
G3
113
Engine Control Module (ECM)
1 LT GRN
1922
1 DK BLU
1921
G2
Electronic Brake Control Module, Air ABS

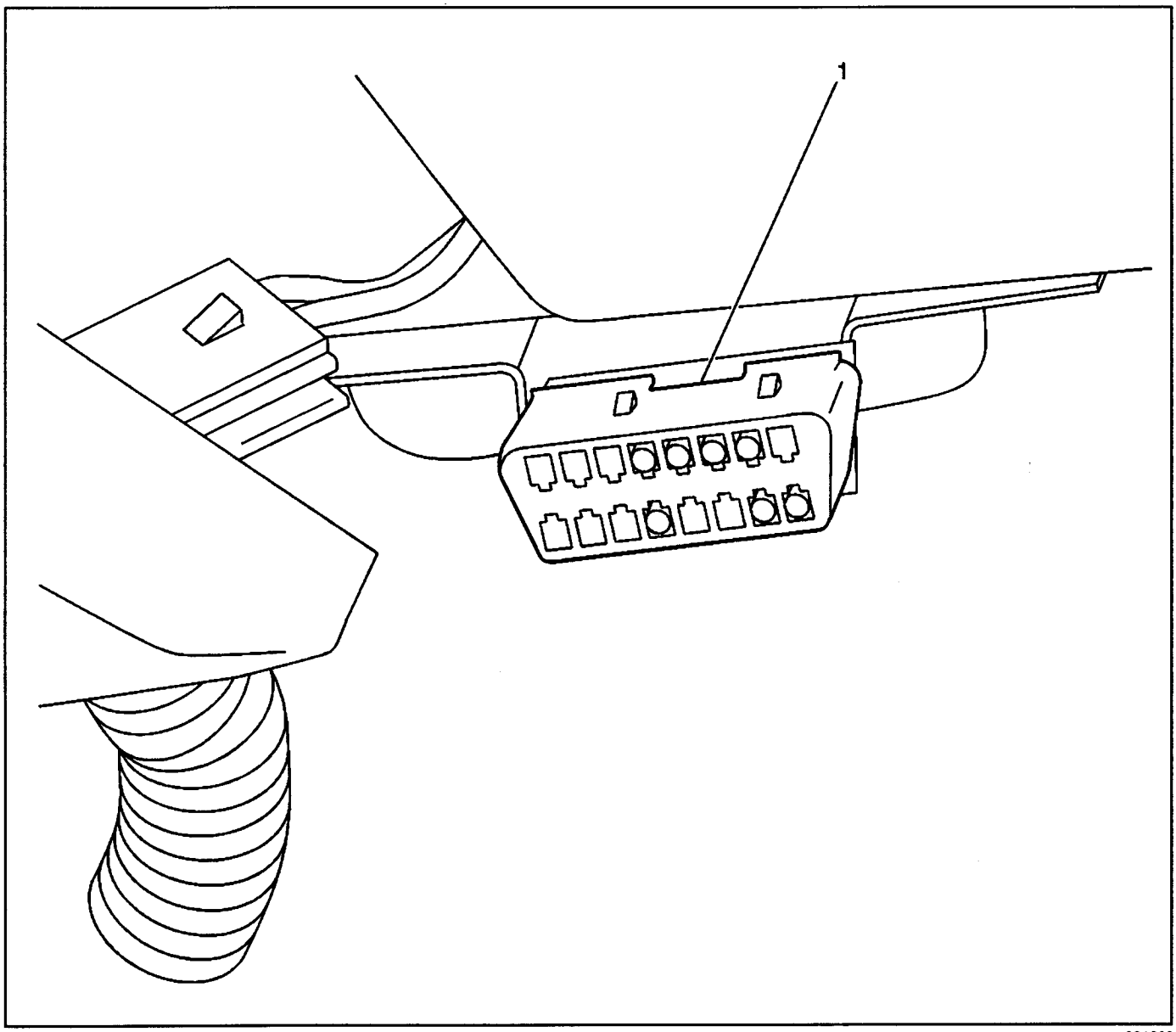
Component Locator

Data Link Connector Components

Name	Location	Locator View	Connector End View
Data Link Connector (DLC)	Under the left side of the lower IP	*Data Link Connector Component Views*	*Data Link Connector End Views*
Serial Data Connector (10 cavities)	Under the left side of the IP	—	*Data Link Connector End Views*

Data Link Connector Component Views

Lower Instrument Panel, Left Forward View



231692

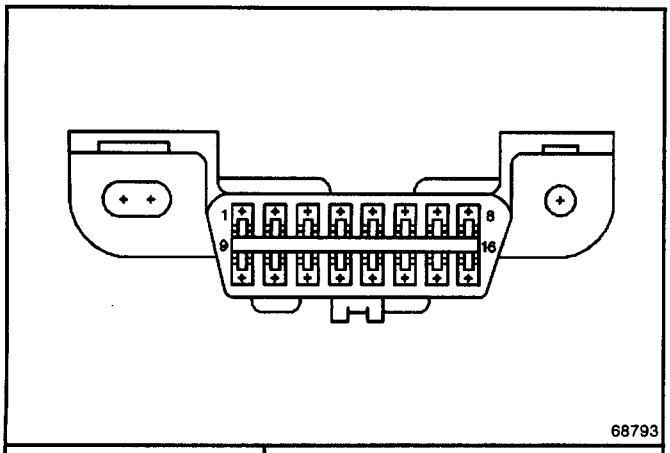
Legend

(1) Data Link Connector (DLC)

Visual Identification

Data Link Connector End Views

Data Link Connector (DLC)



68793

Connector Part Information	• 12110250 • ASM 16F Metri Pack 150 TNGLS (Black)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1–3	—	—	Not Used
4	BLK	411	Ground
5–6	—	—	Not Used
7	BLU	410	Serial Data Link
8–11	—	—	Not Used
12	BRN/WHT	396	ABS Diagnostic
13–14	—	—	Not Used
15	LT GRN	409	Serial Data Link
16	ORN	408	Fuse Output Battery

Diagnostic Information and Procedures

Data Link Connector System Check

Troubleshooting Hints

1. Test the Scan Tool operation on a known good vehicle to make certain that the tool is operating properly.
2. Inspect the Horn Circuit Breaker to determine if it is open. If an open condition exists, Locate and Repair the cause of the overload and then Replace the circuit breaker.
3. Inspect grounds G111, G113, G210 or G403 to make certain that they are clean and tight.
4. Inspect for broken (or partially broken) wire inside the insulation. This condition could cause system malfunction but prove to test good in a continuity or voltage test with the system disconnected. These circuits may be intermittent or resistive when in operation. If possible test for a voltage drop when the system is operational.
5. Inspect for proper installation of aftermarket electronic equipment which may affect the integrity of other systems.

Scan Tool Does Not Communicate with Components (EBCM (Hydraulic))

Step	Action	Value(s)	Yes	No
1	1. Disconnect the scan tool from the vehicle. 2. Connect the scan tool to a vehicle with the same system. 3. Attempt to establish communications. Were communications established?	—	Go to *Step 2*	Refer to the scan tool instruction manual
2	Backprobe the DLC using a test lamp from terminal 16 to ground. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 3*
3	Repair the open in CKT 408 (ORN) between the IP fuse block and the DLC. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 4*
4	Backprobe the DLC using a test lamp from terminal 16 to terminal 4. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 5*
5	Repair the open in CKT 411 (BLK) between the DLC and joint connector 1. Will the Scan Tool communicate with the EBCM?	—	System OK	Go to *Step 6*

Scan Tool Does Not Communicate with Components (EBCM (Hydraulic)) (cont'd)

Step	Action	Value(s)	Yes	No
6	Using a self-powered test lamp, backprobe the DLC from terminal 12 to the EBCM terminal 5. Did the test lamp light?	—	Go to *Step 8*	Go to *Step 7*
7	Repair the open in CKT 396 (BRN/WHT) or CKT 799 (TAN/WHT) between the DLC and the EBCM. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 8*
8	Using a self powered test lamp, backprobe the DLC from terminal 12 to terminal 4. Did the test lamp light?	—	Go to *Step 9*	Refer to Antilock Brakes
9	Repair the short to ground in CKT 396 (BRN/WHT) or CKT 799 (TAN/WHT) between the DLC and the EBCM. Will the scan tool communicate with the EBCM?	—	System OK	—

Scan Tool Does Not Communicate with Components (EBCM (Air))

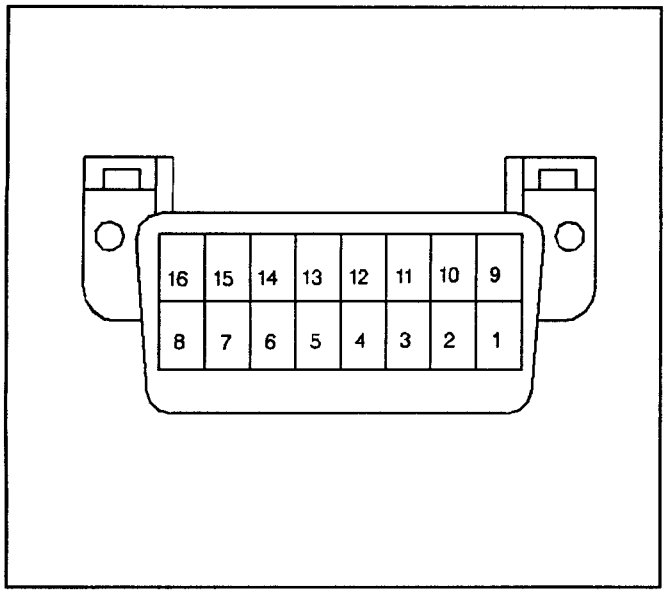
Step	Action	Value(s)	Yes	No
1	1. Disconnect the scan tool from the vehicle. 2. Connect the scan tool to a different vehicle with the same system. 3. Attempt to establish communications. Were communications established?	—	Go to *Step 2*	Refer to the scan tool instruction manual
2	1. Using a *J 39200* DMM, backprobe the DLC from terminal 16 to ground. 2. Measure the voltage. Was the voltage less than the specified value?	10.0 V	Go to *Step 3*	Go to *Step 4*
3	Repair the open in CKT 408 (ORN) between the IP fuse block and the DLC. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 4*
4	1. Using a *J 39200*, backprobe the DLC from terminal 16 to terminal 4. 2. Measure the voltage. Was the voltage less than the specified value?	10.0 V	Go to *Step 5*	Go to *Step 6*
5	Repair the open in CKT 411 (BLK) between the DLC and joint connector 1. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 6*
6	1. Using a *J 39200*, backprobe the DLC from terminal 7 to the EBCM terminal A3. 2. Measure the resistance. Was the resistance more than the specified value?	5.0 Ω	Go to *Step 7*	Go to *Step 8*
7	Repair the open in CKT 410 (BLU) or CKT 1921 (DK BLU) between the DLC and the EBCM. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 8*
8	1. Using a *J 39200*, backprobe the DLC from terminal 7 to terminal 4. 2. Measure the resistance. Was the resistance less than the specified value?	10M Ω	Go to *Step 9*	Go to *Step 10*
9	Repair the short to ground in CKT 410 (BLU) or CKT 1921 (DK BLU) between the DLC and the EBCM. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 10*

Scan Tool Does Not Communicate with Components (EBCM (Air)) (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Using a *J 39200*, backprobe the DLC from terminal 15 to the EBCM terminal B3. 2. Measure the resistance. Was the resistance more than the specified value?	5.0 Ω	Go to *Step 11*	Go to *Step 12*
11	Repair the open in CKT 409 and CKT 1922 (LT GRN) between the DLC and the EBCM. Will the scan tool communicate with the EBCM?	—	System OK	Go to *Step 12*
12	1. Using a *J 39200*, backprobe the DLC from terminal 15 to terminal 4. 2. Measure the resistance. Was the resistance more than the specified value?	10M Ω	Go to *Step 13*	Refer to Antilock Brakes
13	Repair the short to ground in CKT 409 and CKT 1922 (LT GRN) between the DLC and the EBCM. Will the scan tool communicate with the EBCM?	—	System OK	—

Description and Operation

Data Link Connector Description



432

The provision for communicating is the Data Link Connector (DLC). It is usually located under the instrument panel and is sometimes covered by a plastic cover labeled DIAGNOSTIC CONNECTOR. It is used in the assembly plant to receive information in checking that the engine is operating properly before it leaves the plant. The connector is also used by the service technician to identify stored trouble codes and to read control module data using a hand held scan tool.

Data Link Connector Operation

On Diesel Engine equipped vehicles, the Powertrain Control Module (PCM), the Transmission Control Module (TCM),if equipped, and the Electronic Brake Control Module (EBCM) are accessed by the Scan Tool through CKT 410 (DK/BLU) or CKT 1921 (DK/BLU) and CKT 409 (LT/GRN) or CKT 1922 (LT/GRN). The scan tool also accesses the PCM through CKT 448 (WHT) or CKT 679 (WHT/BLK).

On gasoline powered vehicles, the PCM is accessed through CKT 547 (ORN/WHT) and CKT 549 (WHT/BLK). The scan tool accesses the EBCM (hydraulic) through CKT 396 (BRN/WHT) on these vehicles and on CKT 799 (TAN/WHT) on diesel powered vehicles.

These communication lines are used to monitor the modules for diagnostic purposes and to check for Diagnostic Trouble Codes (DTCs). Voltage is applied at all times to the DLC through the Circuit Breaker 5. The DLC is permanently grounded through G 105 and G 113.

Data Link Connector Circuit Description

In hydraulic brake models, the scan tool accesses the electronic brake control module (EBCM) through CKT 396 (BRN/WHT) or CKT 799 (TAN/WHT).

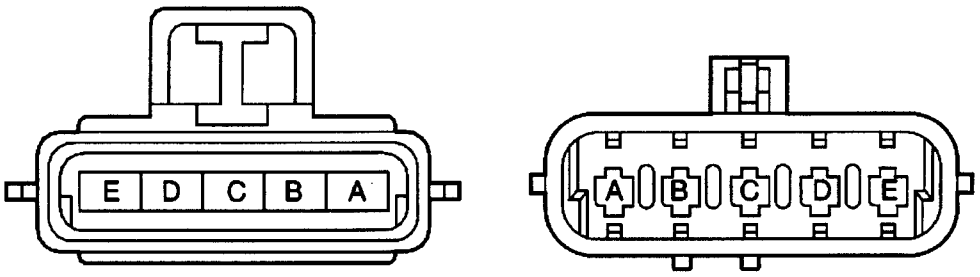
In air brake models, the scan tool accesses the EBCM through the following circuits:

- CKT 410 (BLU) or CKT 1921 (DK BLU)
- CKT 396 (BRN/WHT) or CKT 799 (TAN/WHT)

These communication lines monitor the modules for diagnostic purposes and inspect for diagnostic trouble codes (DTCs). Circuit breaker 5 applies voltage at all times to the data link connector (DLC). Joint connector 1 permanently grounds the DLC.

Inline Harness Connector End Views

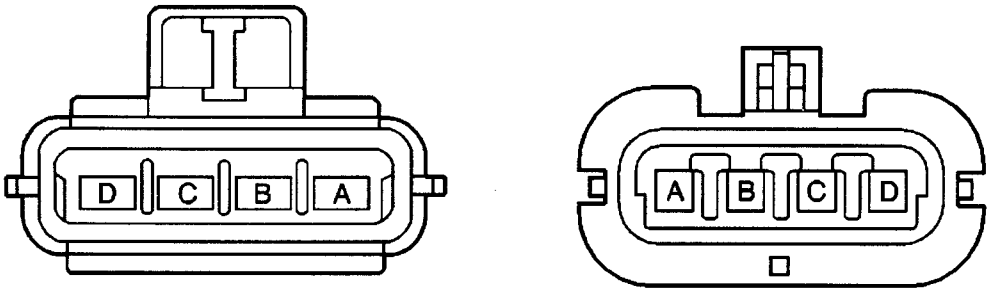
Inline Connector C105



222657

Connector Part Information		• 12084891 • ASM 5F Metri-Pack 280 SLD (Gray)		Connector Part Information		• 12186013 • ASM 5M Metri Pack 280 SLD (Gray)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	BRN	9	Park Lamp Feed	A	BRN	9	Park Lamp Feed
B	LT BLU	14	Turn Signal Lamp Feed, Left Front	B	LT BLU	14	Turn Signal Lamp Feed, Left Front
C	DK BLU	15	Turn Signal Lamp Feed, Right Front	C	DK BLU	15	Turn Signal Lamp Feed, Right Front
D	BLK	150	Ground	D	BLK	150	Ground
E	DK GRN	29	Horn Feed	E	DK GRN	29	Horn Feed

Inline Connector C107



246476

Connector Part Information		• 12129600 • Conn 4F Metri-Pack 280 SLD (Gray)		Connector Part Information		• 12129600 • Conn 4M Metri-Pack 280 SLD (Gray)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	203	Air Conditioning Refrigerant High Pressure Cut Out Switch Feed	A	LT BLU	203	Air Conditioning Refrigerant High Pressure Cut Out Switch Feed
B	DK GRN/WHT	1728	Air Conditioning Condenser Relay Output Coil	B	DK GRN/ WHT	1728	Air Conditioning Condenser Relay Output Coil
C	DK GRN	603	Air Conditioning Refrigerant Low Pressure Cut Out Switch Output	C	DK GRN	603	Air Conditioning Refrigerant Low Pressure Cut Out Switch Output
D	LT GRN/BLK	59	Air Conditioning Compressor Clutch Solenoid Feed	D	LT GRN/BLK	59	Air Conditioning Compressor Clutch Solenoid Feed

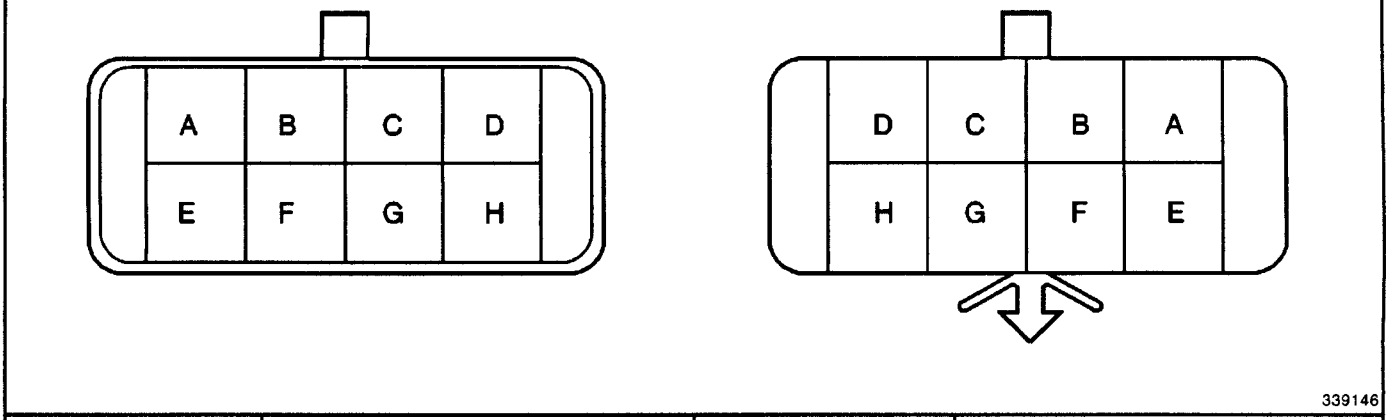
Inline Connector C111



95864

Connector Part Information		• 3 Way F • (GRN)		Connector Part Information		• 3 Way M • (GRN)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	BLK	242	Ground	A	BLK	242	Ground
B	WHT	241	Signal	B	WHT	241	Signal
C	GRY	284	Shield	C	GRY	284	Shield

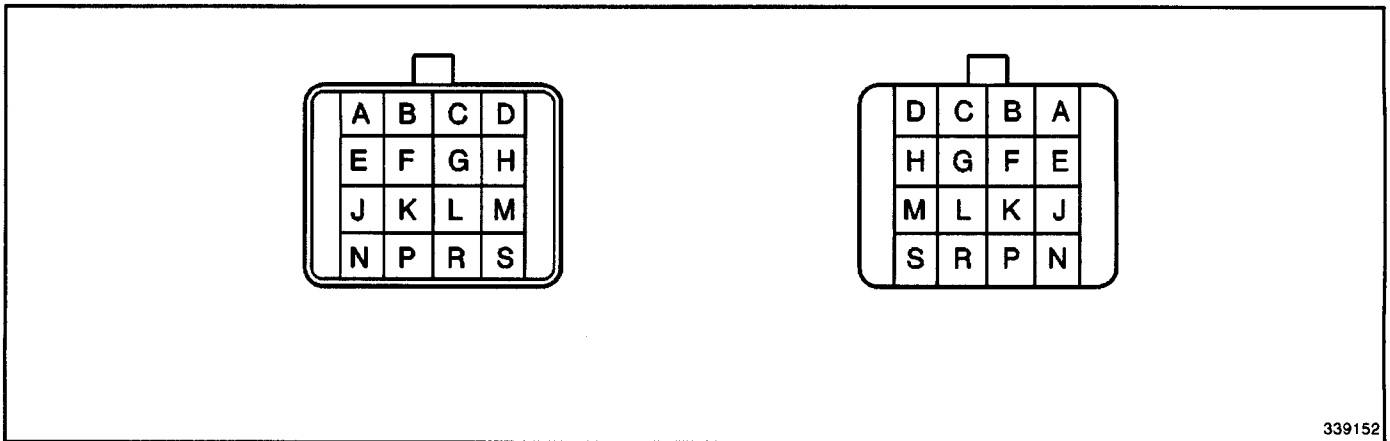
C112



339146

Connector Part Information		• 8 Way M • (GRY)		Connector Part Information		• 8 Way F • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BLU/BLK	98	Fuel Temperature Sensor	A	BLU/BLK	39	Fuel Temperature Sensor
B	GRA	75	Shield	B	GRA	42	Shield
C	WHT	73	Engine Speed Sensor	C	WHT	15	Engine Speed Sensor
D	BLK	72	Engine Speed Sensor	D	BLK	14	Engine Speed Sensor
E	BLU/RED	97	Fuel Temperature Sensor	E	BLU/RED	38	Fuel Temperature Sensor
F	BLU/BLK	95	Engine Coolant Temperature Sensor	F	BLU/BLK	36	Engine Coolant Temperature Sensor
G	YEL/BLK	94	Engine Coolant Temperature Sensor	G	YEL/BLK	35	Engine Coolant Temperature Sensor
H	GRN	96	Engine Coolant Temperature Sensor	H	GRN	37	Engine Coolant Temperature Sensor

C114



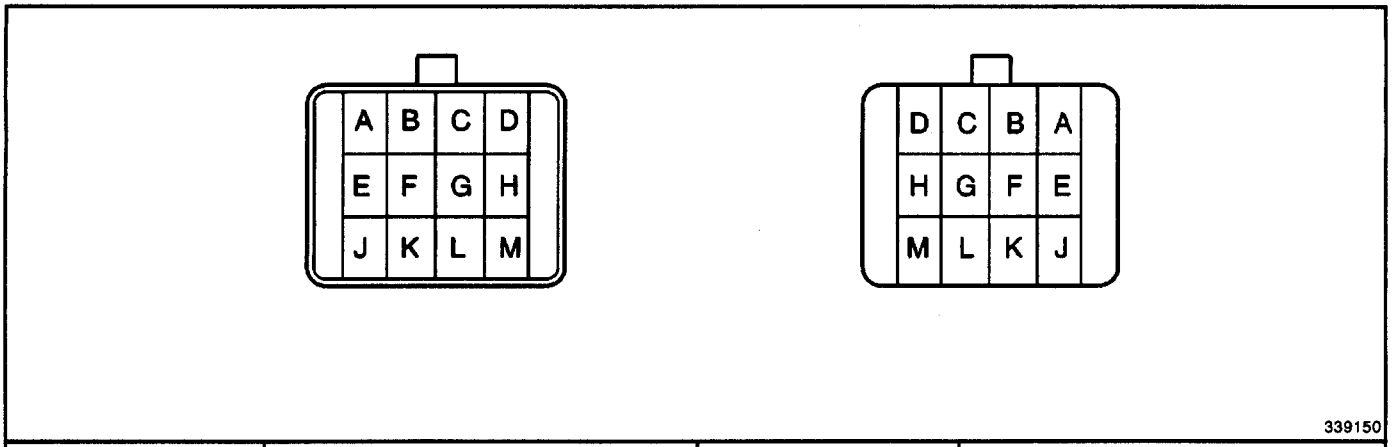
339152

Connector Part Information		• 16 Way F • (GRY)		Connector Part Information		• 16 Way F • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	GRN	78	Cylinder 1 Injector	A	GRN	20	Cylinder 1 Injector
B	GRN	77	Cylinder 1 Injector	B	GRN	19	Cylinder 1 Injector
C	BLU	86	Cylinder 6 Injector	C	BLU	29	Cylinder 6 Injector
D	BLU	85	Cylinder 6 Injector	D	BLU	28	Cylinder 6 Injector
E	GRN/WHT	80	Cylinder 5 Injector	E	GRN/WHT	22	Cylinder 5 Injector

C114 (cont'd)

Connector Part Information		• 16 Way F • (GRY)		Connector Part Information		• 16 Way F • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
F	GRN/WHT	79	Cylinder 5 Injector	F	GRN/WHT	21	Cylinder 5 Injector
G	BLU/WHT	88	Cylinder 2 Injector	G	BLU/WHT	31	Cylinder 2 Injector
H	BLU/WHT	87	Cylinder 2 Injector	H	BLU/WHT	30	Cylinder 2 Injector
J	GRN/RED	83	Cylinder 3 Injector	J	GRN/RED	25	Cylinder 3 Injector
K	GRN/RED	82	Cylinder 3 Injector	K	GRN/RED	24	Cylinder 3 Injector
L	BLU/RED	91	Cylinder 4 Injector	L	BLU/RED	34	Cylinder 4 Injector
M	BLU/RED	90	Cylinder 4 Injector	M	BLU/RED	33	Cylinder 4 Injector
N	RED/BLU	89	Cylinder 4 Injector	N	RED/BLU	32	Cylinder 4 Injector
P	RED/BLU	84	Cylinder 6 Injector	P	RED/BLU	27	Cylinder 6 Injector
R	RED/YEL	81	Cylinder 3 Injector	R	RED/YEL	23	Cylinder 3 Injector
S	RED/YEL	76	Cylinder 1 Injector	S	RED/YEL	17	Cylinder 1 Injector

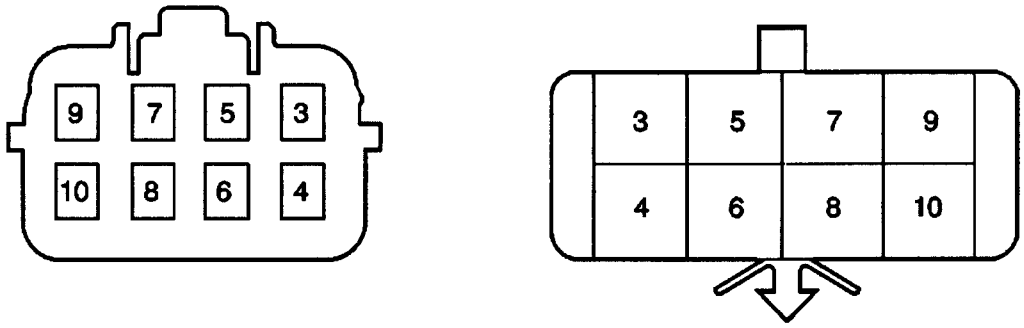
Inline Connector C113



339150

Connector Part Information		• 12 Way F • (GRY)		Connector Part Information		• 12 Way M • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	GRN	68	Injection Pump Speed Sensor	A	GRN	11	Injection Pump Speed Sensor
B	WHT	63	Fuel Pressure Sensor	B	WHT	8	Fuel Pressure Sensor
C	BRN/BLK	55	Pressure Control Valve 2	C	BRN/BLK	5	Pressure Control Valve 2
D	GRN	8	Pressure Control Valve 1	D	GRN	1	Pressure Control Valve 1
E	RED	69	Injection Pump Speed Sensor	E	RED	12	Injection Pump Speed Sensor
F	RED	64	Fuel Pressure Sensor	F	RED	9	Fuel Pressure Sensor
G	BRN/BLK	56	Pressure Control Valve 2	G	BRN/BLK	6	Pressure Control Valve 2
H	BRN	53	Pressure Control Valve 1	H	BRN	3	Pressure Control Valve 1
J	GRA	71	Shield	J	GRA	41	Shield
K	GRA	67	Shield	K	GRA	40	Shield
L	BLK	62	Fuel Pressure Sensor	L	BLK	7	Fuel Pressure Sensor
M	BRN	54	Pressure Control Valve 1	M	BRN	4	Pressure Control Valve 1

Inline Connector C116



339145

Connector Part Information		• 12186024 • ASM 8F SWP SLD (Gray)		Connector Part Information		• 7322748440 • 8 Way M (Gray)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
3	PNK	39	Fuse Output-Ignition	3	BRN/WHT	9	Fuse Output-Ignition
4	DK GRN	135	Coolant Temperature Sensor Signal	4	—	—	Not Used
5	BRN	25	Charge Indicator Lamp Output	5	BRN	5	Charge Indicator Lamp Output
6	DK GRN	59	Air Conditioning Compressor Clutch Solenoid Feed	6	GRN	6	Air Conditioning Compressor Clutch Solenoid Feed
7	TAN/WHT	331	Oil Pressure Sensor Signal	7	BRN/WHT	7	Oil Pressure Sensor Signal
8	RED	225	Alternator Output Regulator Reference Voltage	8	RED	8	Alternator Output Regulator Reference Voltage
9	GRY	535	Coolant Temperature Switch Output	9	GRY	11	Coolant Temperature Switch Output
10	—	—	Not Used	10	—	—	Not Used

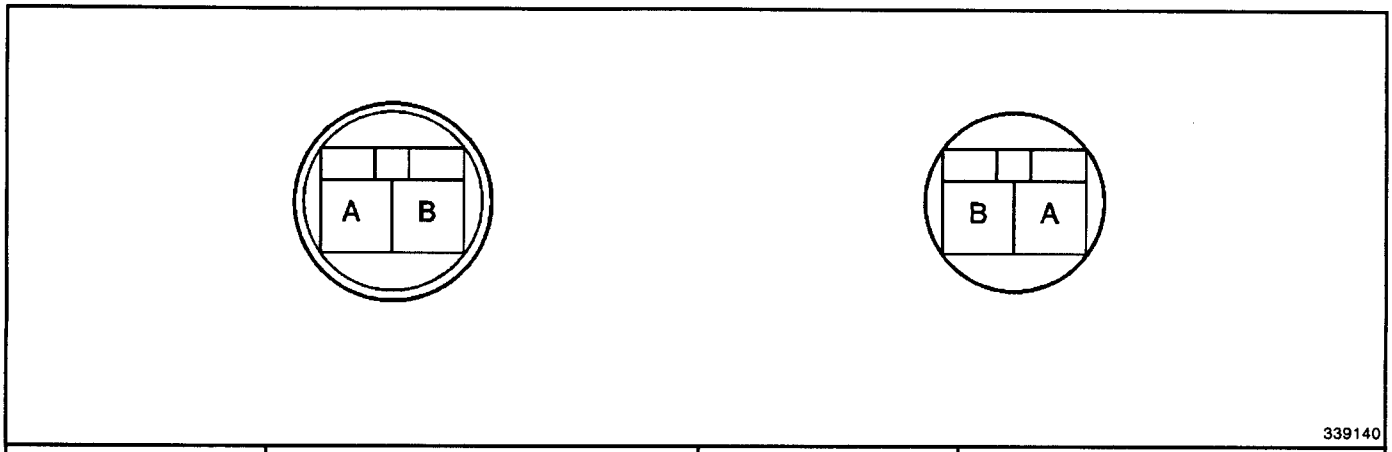
C118



229954

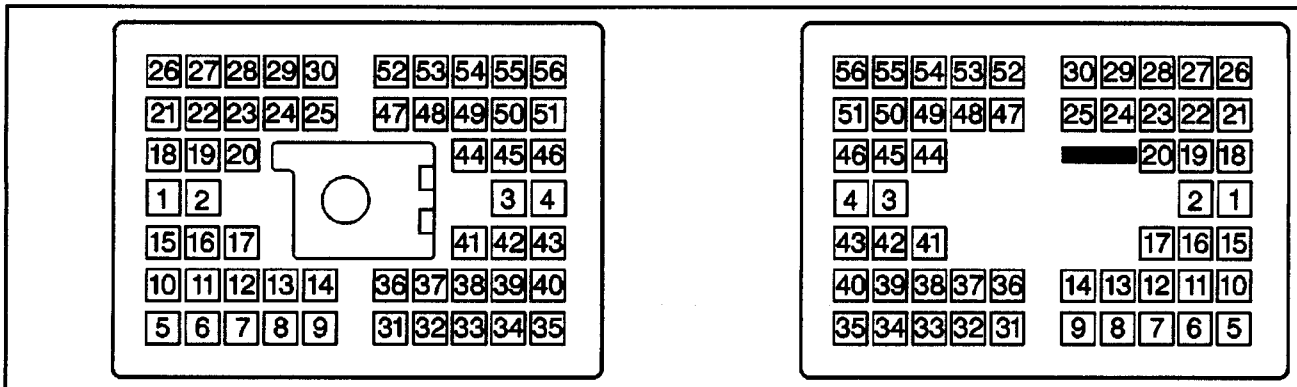
Connector Part Information		• 12162918 • 2 Way F (GRY)		Connector Part Information		• 2 Way M • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
1	RED	503	Glow Plug	1	RED	2	Glow Plug
2	—	—	Not Used	2	—	—	Not Used

C121



Connector Part Information		• 2 Way • Female		Connector Part Information		• 2 Way • Male	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BLU	31	Starter	A	RED	1	Starter
B	BLU	32	Starter	B	RED	3	Starter

Inline Connector C200



Connector Part Information		• 56 Way • Female		Connector Part Information		• 12162883 • ASM CONN 56M (WHT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
1	RED	8	Battery Output Unfused	1	RED	842	Battery Output Unfused
2	RED	9	Fuse Output Battery	2	RED	1342	Fuse Output Battery
3	BLK	21	Ground	3	BLK	550	Ground
4	BLK	22	Ground	4	BLK	650	Ground
5	YEL	33	Ignition Switch Output Crank	5	YEL	5	Ignition Switch Output Crank
6	ORN/BLK	487	Transmission Mounted Neutral Safety Switch Signal	6	ORN/BLK	434	Transmission Mounted Neutral Safety Switch Signal
7	BRN/WHT	35	Generator Indicator Lamp Output	7	PNK	39	Fuse Output-Ignition
8	YEL	37	Fuse Output Generator Tachometer Pulse	8	YEL	53	Fuse Output Generator Tachometer Pulse

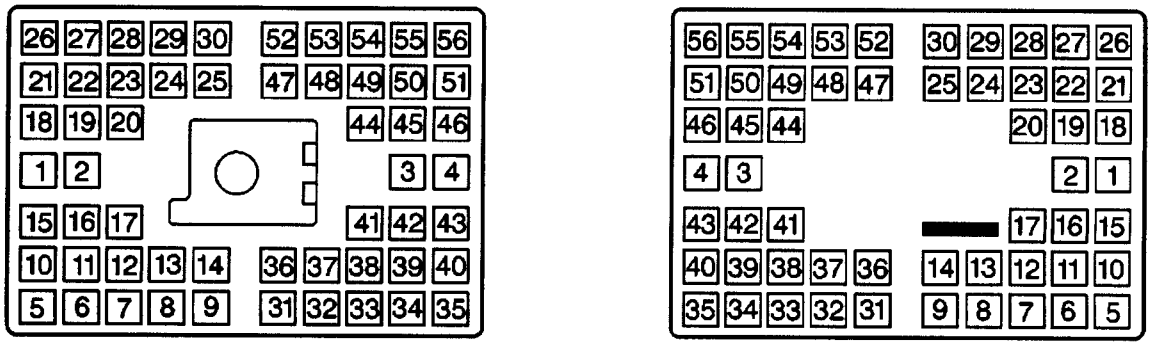
Inline Connector C200 (cont'd)

Connector Part Information		• 56 Way • Female		Connector Part Information		• 12162883 • ASM CONN 56M (WHT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
9	BRN	38	Generator Indicator Lamp Output	9	BRN	25	Generator Indicator L-amp Output
10	WHT	702	Generator Indicator Lamp Output	10	—	—	Not Used
11–14	—	—	Not Used	11–14	—	—	Not Used
15	GRY	65	Coolant Temperature Switch Output	15	GRY	535	Coolant Temperature Switch Output
16–17	—	—	Not Used	16–17	—	—	Not Used
18	GRN	172	Horn Feed	18	GRN	29	Horn Feed
19	YEL	134	Stop/Turn Lamp Feed, Left Rear	19	YEL	18	Stop/Turn Lamp Feed, Left Rear
20	GRN	135	Stop/Turn Lamp Feed, Right Rear	20	GRN	19	Stop/Turn Lamp Feed, Right Rear
21	BRN	24	Park Lamp Feed	21	BRN	9	Park Lamp Feed
22	PNK	145	Fuse Output Ignition	22	PNK	139	Fuse Output Ignition
23	—	269	Shift Solenoid Feed	23	BRN	323	Shift Solenoid Feed
24	BLK/WHT	272	Engine Brake Enable Signal	24	PPL	1146	Engine Brake Enable Signal
25	BLU	622	Suspension Dump Valve Solenoid Feed	25	BLU	1944	Suspension Dump Valve Solenoid Feed
26	—	—	Not Used	26	—	—	Not Used
27	LT BLU	208	Air Conditioning Refrigerant High Pressure Cut Out Switch Feed	27	LT BLU	203	Air Conditioning Refrigerant High Pressure Cut Out Switch Feed
28	GRN/WHT	205	Air Conditioning Condenser Relay Output Coil	28	GRN/WHT	1728	Air Conditioning Condenser Relay Output Coil
29	GRN	206	Air Conditioning Refrigerant Low Pressure Cut Out Switch Output	29	GRN	603	Air Conditioning Refrigerant Low Pressure Cut Out Switch Output
30	BLU/WHT	202	Air Conditioning Condenser Fan Motor Feed	30	BLU/WHT	1727	Air Conditioning Condenser Fan Motor Feed
31	BLU	407	Dash Lamp Relay Output Coil	31	BLU	1899	Dash Lamp Relay Output Coil
32	—	—	Not Used	32	—	—	Not Used
33	LT GRN	391	ABS Failure Indicator Lamp Output	33	LT GRN	867	ABS Failure Indicator Lamp Output
34	BLU	395	Dash Lamp Relay Output Coil	34	BLU	1899	Dash Lamp Relay Output Coil
35	BRN/WHT	396	Diagnostic Signal ABS5208V	35	BRN/WHT	799	Diagnostic Signal ABS5208V
36	BRN/WHT	602	Brake Warning Indicator Lamp Output	36	BRN/WHT	33	Brake Warning Indicator Lamp Output
37	—	—	Not Used	37	—	—	Not Used
38	LT GRN	481	Low Coolant Sensor Signal	38	LT GRN	1478	Low Coolant Sensor Signal
39	—	—	Not Used	39	—	—	Not Used
40	BRN/WHT	495	Brake Warning Indicator Lamp Output	40	BRN/WHT	33	Brake Warning Indicator Lamp Output

Inline Connector C200 (cont'd)

Connector Part Information		• 56 Way • Female		Connector Part Information		• 12162883 • ASM CONN 56M (WHT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
41	LT BLU	475	Brake Booster Fluid Flow Switch Feed	41	LT BLU	1928	Brake Booster Fluid Flow Switch Feed
42	GRY/BLK	489	Brake Pedal Switch Output Extended Travel	42	GRY/BLK	847	Brake Pedal Switch Output Extended Travel
43	WHT	493	Brake Pedal Switch Output Extended Travel	43	GRY	847	Brake Pedal Switch Output Extended Travel
44	GRN	322	Body Builder Connector	44	GRN	909	Body Builder Connector
45–50	—	—	Not Used	45–50	—	—	Not Used
51	BLU	323	Body Builder Connector	51	BLU	910	Body Builder Connector
52	GRN	385	Coolant Temperature Sensor Signal	52	GRN	135	Coolant Temperature Sensor Signal
53	PPL	386	Fuel Gauge Sensor Signal	53	PPL	30	Fuel Gauge Sensor Signal
54	BRN/WHT	383	Oil Pressure Sensor Signal	54	BRN/WHT	331	Oil Pressure Sensor Signal
55	BRN	382	Oil Pressure Indicator Lamp Output	55	BRN	31	Oil Pressure Indicator Lamp Output
56	—	—	Not Used	56	—	—	Not Used

Inline Connector C202



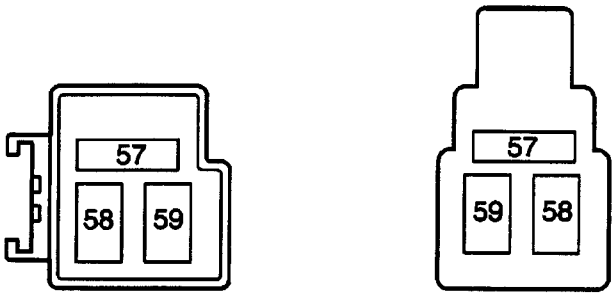
240000

Connector Part Information		• 56 Way • Female		Connector Part Information		• 12162881 • ASM CONN 56M (Gray)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
1	RED	4	Fuse Output Battery	1	RED	442	Fuse Output Battery
2	RED	5	Fuse Output Battery	2	RED	542	Fuse Output Battery
3	RED	6	Fuse Output Battery	3	RED	642	Fuse Output Battery
4	RED	7	Fuse Output Battery	4	RED	742	Fuse Output Battery
5	BRN	651	Brake Pedal Switch Signal ABS	5	BRN	848	Brake Pedal Switch Signal ABS
6–14	—	—	Not Used	6–14	—	—	Not Used
15	BLK	245	Ground-Clean	15	BLK/WHT	351	Ground-Clean
16	BLK	280	Ground	16	BLK	350	Ground
17	BLK	246	Ground	17	BLK	350	Ground
18	—	—	Not Used	18	—	—	Not Used

Inline Connector C202 (cont'd)

Connector Part Information		• 56 Way • Female		Connector Part Information		• 12162881 • ASM CONN 56M (Gray)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
19	WHT	258	Turbo Charger Boost Pressure Signal	19	WHT	900	Turbo Charger Boost Pressure Signal
20	RED	259	Reference Voltage Feed-5 Volt Reference	20	GRA	596	Reference Voltage Feed-5 Volt Reference
21	WHT/BLK	679	Fuse Output Accessory	21	WHT/BLK	448	Fuse Output Accessory
21	—	—	Not Used	21	—	—	Not Used
22	BLK	260	Sensor Return	22	BLK	808	Sensor Return
23	GRA	263	Drain Wire Return	23	BARE	1782	Drain Wire Return
24–30	—	—	Not Used	24–30	—	—	Not Used
31	PNK	415	Fuse Output Ignition	31	PNK	239	Fuse Output Ignition
32	GRY/BLK	416	Two Speed Rear Axle Shift Motor Relay Output Coil	32	GRY/BLK	1467	Two Speed Rear Axle Shift Motor Relay Output Coil
33	LT GRN/BLK	426	Vehicle Speed Sensor Return	33	LT GRN/BLK	822	Vehicle Speed Sensor Return
33	LT GRN/BLK	431	Vehicle Speed Sensor Return	33	LT GRN/BLK	822	Vehicle Speed Sensor Return
34	PPL/WHT	425	Vehicle Speed Sensor Return	34	PPL/WHT	821	Vehicle Speed Sensor Return
34	PPL/WHT	432	Vehicle Speed Sensor Return	34	PPL/WHT	821	Vehicle Speed Sensor Return
35	PNK	433	Fuse Output Ignition	35	PNK	739	Fuse Output Ignition
36	—	—	Not Used	36	—	—	Not Used
37	ORN	321	Fuse Output Battery	37	ORN	640	Fuse Output Battery
38	—	—	Not Used	38	—	—	Not Used
39	PNK	325	Fuse Output Ignition	39	PNK	339	Fuse Output Ignition
40	LT BLU	136	Turn Signal Lamp Feed, Left Front	40	LT BLU	14	Turn Signal Lamp Feed, Left Front
41	WHT	105	Stop Lamp Switch Output	41	WHT	17	Stop Lamp Switch Output
42	—	—	Not Used	42	—	—	Not Used
43	DK BLU	139	Turn Signal Lamp Feed, Right Front	43	DK BLU	15	Turn Signal Lamp Feed, Right Front
44	YEL	116	Trailer Relay Output (N.O.) Contact, Left Rear Stop/Turn Lamp	44	YEL	318	Trailer Relay Output (N.O.) Contact, Left Rear Stop/Turn Lamp
45	GRN	111	Trailer Relay Output (N.O.) Contact, Right Rear Stop/Turn Lamp	45	GRN	319	Trailer Relay Output (N.O.) Contact, Right Rear Stop/Turn Lamp
46–48	—	—	Not Used	46–48	—	—	Not Used
49	LT GRN	409	Serial Data Link B SAE 1708	49	LT GRN	1922	Serial Data Link B SAE 1708
50	BLU	410	Serial Data Link A SAE 1708	50	BLU	1921	Serial Data Link A SAE 1708
51–56	—	—	Not Used	51–56	—	—	Not Used

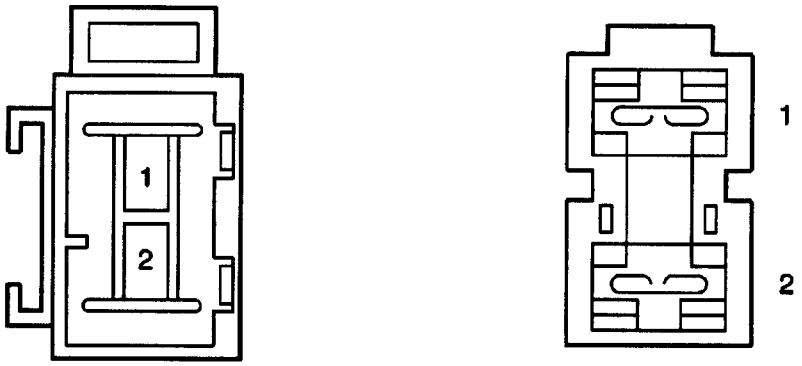
Inline Connector C204



229956

Connector Part Information		• 12162885 • ASM 3F (Natural)		Connector Part Information		• 7147586530 • ASM 3M (NAT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
57	RED	142	Fuse Output Battery	57	RED	1	Fuse Output Battery
58	RED	242	Fuse Output Battery	58	RED	3	Fuse Output Battery
59	RED	342	Fuse Output Battery	59	RED	2	Fuse Output Battery

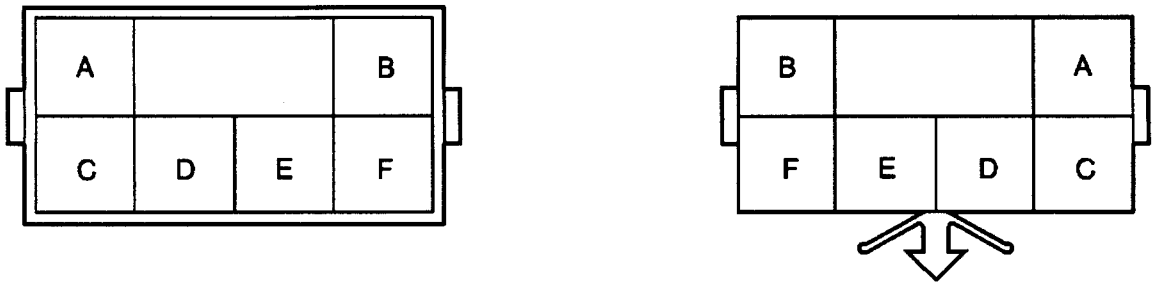
Inline Connector C206



239989

Connector Part Information		• 12162873 • ASM 2F (BLU)		Connector Part Information		• 2 Way M • (BLU)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
1	RED	1042	Fuse Output Battery	1	RED	10	Fuse Output Battery
2	RED	1470	Power Brake Booster Pump Motor Feed	2	RED	474	Power Brake Booster Pump Motor Feed

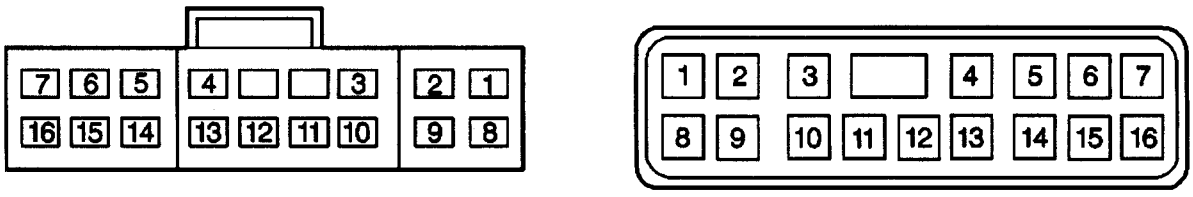
Inline Connector C208



339126

Connector Part Information		• 6 Way F • (BLK)		Connector Part Information		• 6 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	RED	156	Dome Lamp	A	RED	3	Dome Lamp
B	RED/YEL	149	Dome Lamp	B	RED/YEL	2	Dome Lamp
C	BRN	98	ID Clearance Lamp	C	BRN	5	ID Clearance Lamp
D	—	—	Not Used	D	—	—	Not Used
E	BLK	25	RH Clearance Lamp	E	BLK	4	RH Clearance Lamp
F	ORN	150	Dome Lamp	F	ORN	1	Dome Lamp

Inline Connector C210



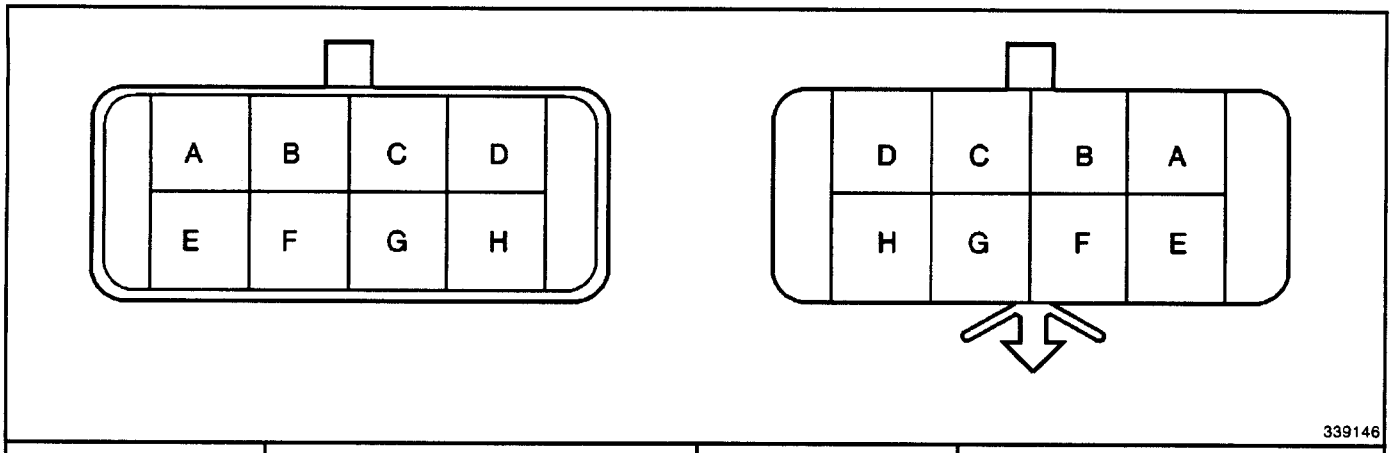
238853

Connector Part Information		• 16 Way F • (BLK)		Connector Part Information		• 16 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
1-2	—	—	Not Used	1-2	—	—	Not Used
3	GRA	65	Automatic Transmission Selector Control (Manual Only)	3	LT BLU	745	Automatic Transmission Selector Control (Manual Only)
4	RED/BLK	26	Door Jamb Switch	4	RED/BLK	148	Door Jamb Switch
5	ORN	8	Trailer Stop Lamp Switch	5	ORN	108	Trailer Stop Lamp Switch
5	ORN	8	Trailer Stop Lamp Switch	5	ORN	536	Trailer Stop Lamp Switch
6	—	—	Not Used	6	—	—	Not Used
7	WHT	9	Trailer Stop Lamp Switch Output	7	WHT	109	Trailer Stop Lamp Switch Output

Inline Connector C210 (cont'd)

Connector Part Information		• 16 Way F • (BLK)		Connector Part Information		• 16 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
7	WHT	9	Trailer Stop Lamp Switch Output	7	YEL/BLK	523	Trailer Stop Lamp Switch Output
8-9	—	—	Not Used	8-9	—	—	Not Used
10	BRN	76	Shift Selector	10	BRN	99	Shift Selector
11	BLK	16	Consent(C213)	11	BLK	27	Consent(C213)
12	GRN/RED	15	Consent(C213)	12	GRN/RED	157	Consent(C213)
13	—	—	Not Used	13	—	—	Not Used
14	BRN/RED	73	Automatic Transmission Selector Control (Manual Only)	14	BLK/RED	100	Automatic Transmission Selector Control (Manual Only)
15-16	—	—	Not Used	15-16	—	—	Not Used

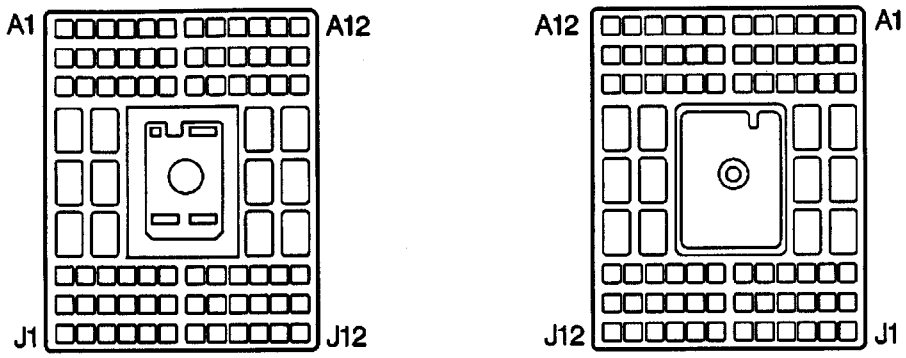
Inline Connector C211



339146

Connector Part Information		• 8 Way F • (GRY)		Connector Part Information		• 8 Way F • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BLU/RED	452	Washer Pump	A	BLU/RED	6	Washer Pump
B	BLU/ORN	453	Washer Pump	B	BLU/ORN	7	Washer Pump
C	—	—	Not used	C	—	—	Not Used
D	BLU/WHT	255	ATM Temperature Sensor	D	BLU/WHT	20	ATM Temperature Sensor
E	LT GRN	214	Switch, Thermal	E	LT GRN	16	Switch, Thermal
F	GRN/YEL	215	Switch, Thermal	F	GRN/YEL	17	Switch, Thermal
G	GRN/RED	213	Switch, Thermal	G	GRN/RED	18	Switch, Thermal
H	BLU/BLK	214	ATM Temperature Sensor	H	BLU/BLK	21	ATM Temperature Sensor

Inline Connector C212



229957

Connector Part Information		• 73221474 • 84 Way F (WHT)		Connector Part Information		• 73231567 • 84 Way M (WHT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A1	GRY	635	Do Not Shift Indicator Lamp	A1	GRY	7	Do Not Shift Indicator Lamp
A2	BRN	382	Do Not Shift Indicator Lamp	A2	BRN	8	Oil Indicator Lamp
A3	BRN/WHT	383	Oil Pressure Gauge	A3	BRN/WHT	211	Oil Pressure Gauge
A4–A5	—	—	Not Used	A4–A5	—	—	Not Used
A6	BRN/WHT	248	Service Engine Soon Indicator Lamp	A6	BRN/WHT	36	Service Engine Soon Indicator Lamp
A7	BRN/YEL	220	A/C Mode 6	A7	BRN/YEL	199	Mode 6
A8	BRN/GRN	221	A/C Mode 5	A8	BRN/GRN	200	Mode 5
A9	BRN	222	A/C Mode 4	A9	BRN	192	Mode 4
A10	BRN/WHT	223	A/C Mode 3	A10	BRN/WHT	191	Mode 3
A11	LT GRN/BLK	224	A/C Mode 8	A11	LT GRN/BLK	198	Mode 8
A12	LT GRN/YEL	225	A/C Mode 7	A12	LT GRN/YEL	197	Mode 7
B1	—	—	Not used	B1	—	—	Not Used
B2	GRN	257	Water Temp Gauge	B2	GRN	23	Water Temperature Gauge
B3	PPL	386	Fuel Gauge	B3	PPL	24	Fuel Gauge
B4	WHT	250	Tachometer Signal	B4	WHT	30	Tachometer Pulse
B5	BLK	388	Tachometer Ground	B5	BLK	31	Tachometer Ground
B6	PPL/WHT	235	R/F Actuator ON	B6	PPL/WHT	178	R/F Actuator ON
B7	BRN/BLU	226	A/C Mode 1	B7	BRN/BLU	189	Mode 1
B8	BRN/BLK	227	A/C Mode 8	B8	BRN/BLK	190	Mode 2
B9	LT GRN/WHT	229	A/C Temp 2	B9	LT GRN	188	Temp 2
B10	LT GRN	229	A/C Temp 2	B10	LT GRN	196	Temp 2
B11	PNK	230	A/C Temp 4	B11	PNK	187	Temp 5
B12	PNK/BLU	231	A/C Temp 5	B12	PNK/BLU	194	Temp 5
C1	—	417	—	C1	—	151	—
C2	LT GRN	404	ABS Indicator Lamp	C2	LT GRN	38	ABS Indicator Lamp
C2	LT GRN	392	ABS Indicator Lamp	C2	LT GRN	38	ABS Indicator Lamp
C3	LT BLU	142	Left Turn Signal Indicator Lamp	C3	LT BLU	17	Left Turn Signal Indicator Lamp
C4	BLU	140	Right Turn Signal Indicator Lamp	C4	BLU	18	Right Turn Signal Indicator Lamp

Inline Connector C212 (cont'd)

Connector Part Information		• 73221474 • 84 Way F (WHT)		Connector Part Information		• 73231567 • 84 Way M (WHT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
C5	—	—	Not Used	C5	—	—	Not Used
C6	RED/YEL	82	High Beam Indicator Lamp	C6	RED/YEL	14	High Beam Indicator Lamp
C7	PNK/BLU	232	A/C Temp 3	C7	PNK/BLK	195	A/C Temp 3
C8	PPL/YEL	233	A/C Recirculate ON	C8	PPL/YEL	175	A/C Recirculate ON
C9	PPL/GRN	234	A/C Recirculate OFF	C9	PPL/GRN	176	A/C Recirculate OFF
C10	BLU/YEL	194	HVAC Fan Medium/High Resistor	C10	BLU/YEL	182	HVAC Fan Medium/High Resistor
C11	BLU/BLK	195	HVAC Fan Medium/Low Resistor	C11	BLU/BLK	181	HVAC Fan Medium/Low Resistor
C12	BLU/WHT	196	HVAC Fan Low	C12	BLU/WHT	180	HVAC Fan Low Resistor
D1	GRN	175	Side Marker Lamp	D1	GRN	111	Marker Lamp Switch
D2	ORN	176	Side Marker Lamp	D2	ORN	112	Marker Lamp Switch
D11	LT GRN	197	Ignition	D11	LT GRN	171	Ignition
D12	BLU/RED	192	HVAC Fan High	D12	BLU/RED	183	HVAC Fan High
E1	BRN	95	Illumination (+)	E1	BRN	2	Tail
E2	ORN	342	Heated Mirror Switch	E2	ORN	142	Heated Mirror
E11	GRN	216	A/C Condenser Fan Control	E11	GRN	177	A/C Condenser Fan Control
E12	PNK	621	Air Suspension Dump Switch	E12	PNK	121	Air Suspension Dump Switch
F1	PNK	341	Heated Mirror Switch	F1	PNK	141	Heated Mirror
F2	BRN	371	Fuse Output Ignition	F2	BRN	1	Fuse Output Ignition
F11	—	—	Not Used	F11	—	—	Not Used
F12	BLK/ORN	26	Ground	F12	BLK/ORN	160	Ground Bus
G1	—	—	Not Used	G1	—	—	Not Used
G2	BLK/WHT	278	Exhaust Brake Indicator Lamp	G2	BLK/WHT	90	Exhaust Brake Indicator Lamp
G3	—	—	Not Used	G3	—	—	Not Used
G4	BLU/YEL	273	Exhaust Brake Switch	G4	BLU/YEL	82	Exhaust Brake Switch
G5	WHT	669	Exhaust Brake Switch	G5	WHT	83	Exhaust Brake Switch
G6	GRN/WHT	356	Speaker, Right	G6	GRN/WHT	156	Speaker, Right
G7	—	254	Not Used	G7	—	—	Not Used
G8	BLK/WHT	511	Service Park Brake Indicator Lamp	G8	BLK/WHT	13	Service Park Brake Indicator Lamp
G9	LT GRN	512	Apply Park Brake Indicator Lamp	G9	LT GRN	11	Apply Park Brake Indicator Lamp
G10	BLU	513	Apply Park Brake Indicator Lamp	G10	BLU	12	Apply Park Brake Indicator Lamp
G11	—	253	Not Used	G11	—	—	Not Used
G12	BRN/WHT	494	Primary Brake Indicator Lamp	G12	BRN/WHT	9	Primary Brake Indicator Lamp
G12	BRN/WHT	606	Primary Brake Indicator Lamp	G12	BRN/WHT	9	Primary Brake Indicator Lamp
H1	BRN	—	Speedometer (+)	H1	—	45	Not Used
H2	BLK	423	Ground	H2	BLK	43	Ground

Inline Connector C212 (cont'd)

Connector Part Information		• 73221474 • 84 Way F (WHT)		Connector Part Information		• 73231567 • 84 Way M (WHT)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
H3	WHT	422	Vehicle Speed Sensor Signal (B8)	H3	WHT	42	Vehicle Speed Sensor Signal (B8)
H4	—	—	Not Used	H4	—	—	Not Used
H5	BLU/WHT	358	Speaker, Left	H5	BLU/WHT	158	Speaker, Left
H6	GRN	355	Speaker, Right	H6	GRN	155	Speaker, Right
H7	BRN	465	Coolant Temperature Switch	H7	BRN	33	Check Gauge Logic (6H)
H7	BRN	609	Coolant Temperature Switch	H7	BRN	33	Check Gauge Logic (6H)
H8	BRN/BLK	466	Low Oil Pressure Switch	H8	BRN/BLK	34	Check Gauge Logic (6H)
H8	BRN/BLK	610	Low Oil Pressure Switch	H8	BRN/BLK	34	Check Gauge Logic (6H)
H9	BLK	672	Fast Idle Switch	H9	BLK	102	ECU (29)
H10	RED	251	Fast Idle Switch	H10	GRN	101	Fast Idle Switch
H11	BLU	622	Air Suspension Dump Switch	H11	BLU	122	Air Suspension Dump Switch
H12	PPL	542	Differential Lock Switch	H12	PPL	132	Differential Lock Switch
J1	RED	—	Service Trans Filter Indicator Lamp	J1	RED	—	Service Trans Filter Indicator Lamp
J2	BRN/YEL	578	Engine Overspeed Indicator Lamp	J2	BRN/YEL	71	Engine Overspeed Indicator Lamp
J3	—	—	Not Used	J3	—	—	Not Used
J4	LT BLU	712	Intake Heater panel Lamp	J4	LT BLU	66	Intake Heater Panel Lamp
J5	BLU	357	Speaker, Left	J5	BLU	157	Speaker, Left
J6	RED	670	Fast Idle Indicator Lamp	J6	RED	64	Fast Idle Indicator Lamp
J7	BLK/RED	100	Interior Lamps Dimming Buss	J7	BLK/RED	39	Interior Lamp Dimming Buss
J8	BRN	38	Generator Indicator Lamp	J8	WHT	6	Generator Indicator Lamp
J9	BLU	724	Daytime Running Lights Indicator Lamp	J9	BLU	59	Daytime Running Lights Indicator Lamp
J10	YEL/RED	483	Low Coolant Indicator Lamp	J10	YEL/RED	15	Low Coolant Indicator Lamp
J10	YEL/RED	603	Low Coolant Indicator Lamp	J10	YEL/RED	15	Low Coolant Indicator Lamp
J11	YEL/BLK	484	Aux Brake Indicator Lamp	J11	YEL/BLK	10	Aux Brake Indicator Lamp
J12	BLU/YEL	607	Check Gauges Indicator Lamp	J12	BLU/YEL	19	Check Gauges Indicator Lamp
J12	BLU/YEL	488	Check Gauges Indicator Lamp	J12	BLU/YEL	19	Check Gauges Indicator Lamp

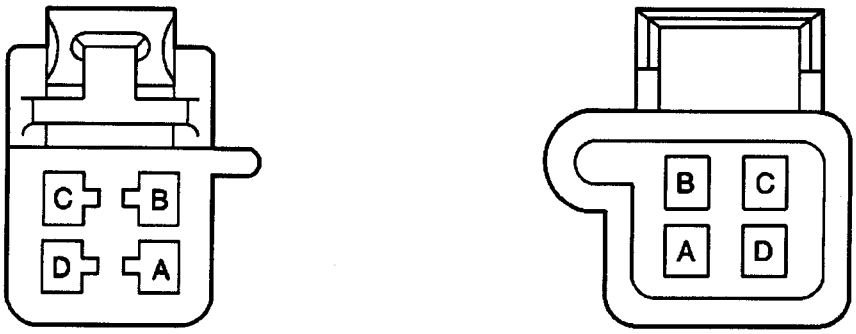
Inline Connector C213



339143

Connector Part Information		• 2 Way F • (NAT)		Connector Part Information		• 2 Way M • (NAT)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	GRN	15	Auxiliary Power Post Feed	A	GRN	1	Auxiliary Power Post Feed
B	BLK	16	Auxiliary Power Post Ground	B	BLK	2	Auxiliary Power Post Ground

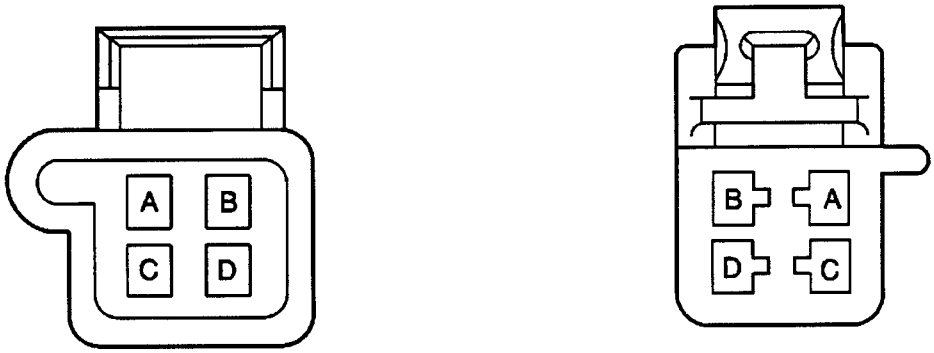
Inline Connector C214



62458

Connector Part Information		• 12064760 • ASM 4F Metri Pack 150 (Black)		Connector Part Information		• 12064761 • ASM 4M Metri-Pack 150 (Black)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	252	Multi-Function Alarm Module (Engine Shutdown)	A	LT BLU	66	Multi-Function Alarm Module (Engine Shutdown)
B–C	—	—	Not Used	B–C	—	—	Not Used
D	GRY	65	Engine Coolant Temperature Signal	D	—	—	Not Used

Inline Connector C215 (With/Without Electric Park Brake)



339125

Connector Part Information		• 4 Way F • (BLK)		Connector Part Information		• 4 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	—	—	Not Used	A	BLK	535	Park Brake Switch
A	BLK	521	Park Brake Conn. (Mech.)	A	BLK	535	Park Brake Switch
B	ORN	516	Park Brake Conn. (Elec.)	B	ORN	533	Park Brake Switch
B	BLU	520	Park Brake Conn. (Mech.)	B	ORN	533	Park Brake Switch
C	YEL/BLK	517	Park Brake Conn. (Elec.)	C	YEL/BLK	534	Park Brake Switch
C	—	—	Not Used	C	YEL/BLK	534	Park Brake Switch
D	ORN	522	Park Brake Conn. (Elec.)	D	ORN	536	Park Brake Switch
D	PNK	537	Park Brake Conn. (Mech.)	D	ORN	536	Park Brake Switch

C217



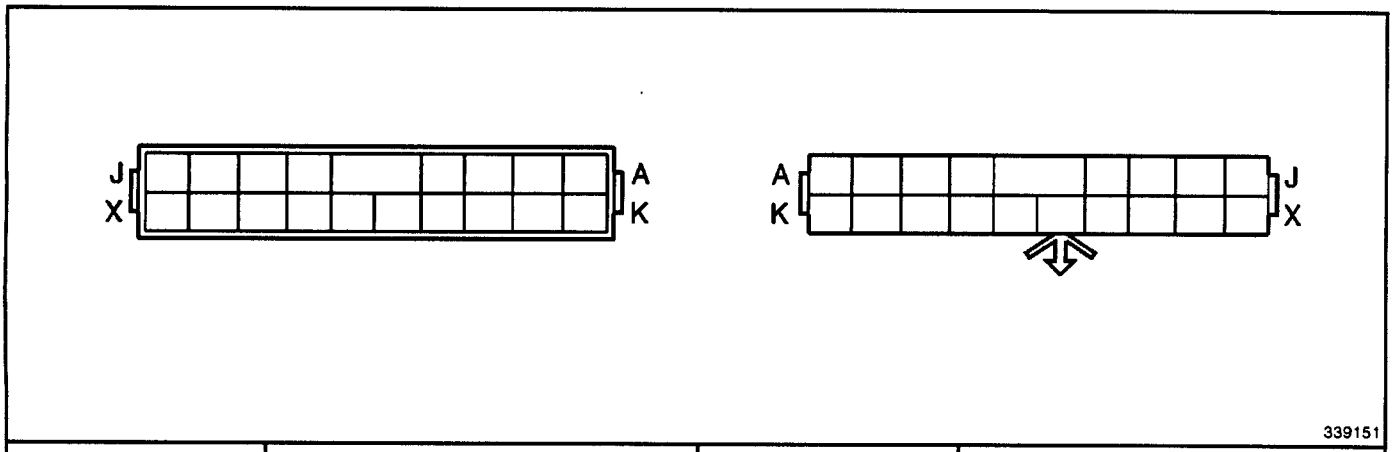
339155

Connector Part Information		• 16 Way F • (BLK)		Connector Part Information		• 16 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BLK	57	Ground	A	BLK	246	Ground
B	BLK	59	Ground	B	BLK	245	Ground
C	BLU/BLK	93	ATM Temperature Sensor	C	BLU/BLK	256	ATM Temperature Sensor
D	BLU/YEL	42	Clutch Switch	D	BLU/YEL	277	Clutch Switch
E	RED	9	Fuse Output-Ignition	E	RED	240	Fuse Output-Ignition
F	BLU/WHT	92	ATM Temperature Sensor	F	BLU/WHT	255	ATM Temperature Sensor

C217 (cont'd)

Connector Part Information		• 16 Way F • (BLK)		Connector Part Information		• 16 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
G	BRN/WHT	16	IP Cluster (Service Engine Soon)	G	BRN/WHT	248	IP Cluster (Service Engine Soon)
H	RED	1	Ignition Main Relay	H	RED	242	Ignition Main Relay
J	BLK	101	Fuel Pressure Sensor	J	BLK	260	Fuel Pressure Sensor
K	GRA	103	Shield	K	GRA	262	Shield
L	YEL	49	Ignition Switch	L	YEL	243	Ignition Switch
M	PNK/BLK	35	ECM Pin 29 (Fast Idle Switch Down)	M	PNK/BLK	253	Plugged at C212 (Upper Facia)
N	PNK/GRN	34	ECM Pin 10 (Fast Idle Switch Up)	N	PNK/GRN	254	Plugged at C212 (Upper Facia)
P	RED	100	Turbo Boost Pressure Sensor	P	RED	259	Turbo Boost Pressure Sensor
R	WHT	99	Turbo Boost Pressure Sensor	R	WHT	258	Turbo Boost Pressure Sensor
S	—	—	Not Used	S	—	—	Not Used

C218



339151

Connector Part Information		• 20 Way F • (BLK)		Connector Part Information		• 20 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	—	—	Not Used	A	—	—	Not Used
B	LT GRN	28	Data Link Connector	B	LT GRN	264	Data Link Connector
C	—	—	Not Used	C	—	—	Not Used
D	RED/BLK	50	Automatic Transmission Modulator Relay	D	RED/BLK	268	Automatic Transmission Modulator Relay
E	—	—	Not Used	E	—	—	Not Used
F	GRA	113	Accelerator Pedal Sensor	F	GRA	285	Accelerator Pedal Sensor
G	BLK	38	Accelerator Pedal Sensor	G	BLK	283	Accelerator Pedal Sensor
H	WHT	36	Accelerator Pedal Sensor	H	WHT	281	Accelerator Pedal Sensor
J	RED	37	Accelerator Pedal Sensor	J	RED	282	Accelerator Pedal Sensor
K	BLK	61	Ground	K	BLK	280	Ground
L	BLU	29	Data Link Connector	L	BLU	265	Data Link Connector

C218 (cont'd)

Connector Part Information		• 20 Way F • (BLK)		Connector Part Information		• 20 Way M • (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
M	LT BLU	20	Multifunction Alarm Module C2 w/ Auto Engine Shutdown	M	LT BLU	252	Multifunction Alarm Module C2 w/ Auto Engine Shutdown
N	WHT	19	IP Cluster(Tach.)	N	WHT	250	IP Cluster(Tach.)
P	GRN	96	Engine Coolant Temperature Sensor	P	GRN	257	Engine Coolant Temperature Sensor
R	BLU/YEL	52	Exhaust Brake Relay	R	BLU/YEL	275	Exhaust Brake Relay
S	—	—	Not Used	S	—	—	Not Used
T	GRA	116	Accelerator Pedal Sensor	T	GRA	291	Accelerator Pedal Sensor
U	BLU	41	Accelerator Pedal Sensor	U	BLU	289	Accelerator Pedal Sensor
W	GRN	39	Accelerator Pedal Sensor	W	GRN	287	Accelerator Pedal Sensor
X	YEL	40	Accelerator Pedal Sensor	X	YEL	288	Accelerator Pedal Sensor

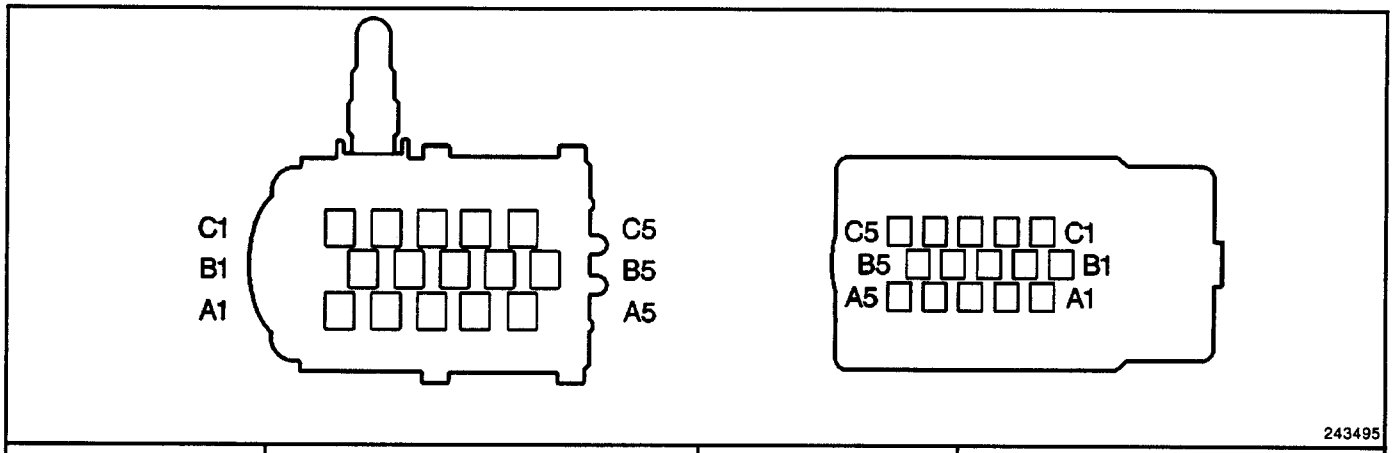
C219



246493

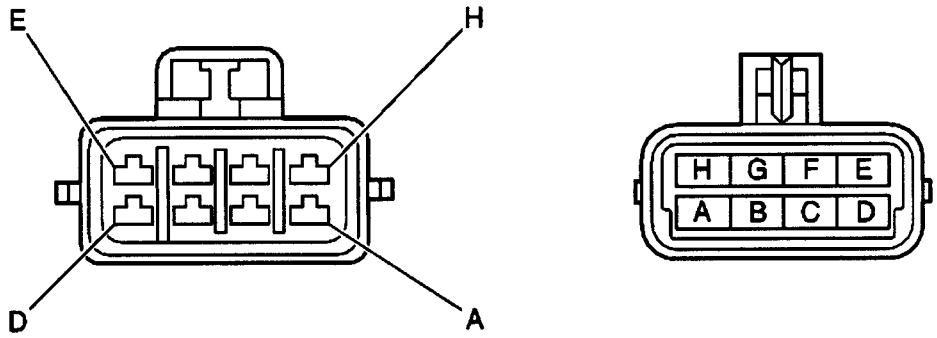
Connector Part Information		• 2 Way • Female		Connector Part Information		• 2 Way • Male	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	GRA/BLK	21	Two Speed Rear Axle Switch	A	GRA/BLK	416	Two Speed Rear Axle Switch
B	GRN	68	Automatic Transmission Selector Control (MD Trans Only)	B	GRN	642	Automatic Transmission Selector Control (MD Trans Only)

Inline Connector C400



Connector Part Information		• 12161186 • ASM 15F Metri-Pack 280 SLD (Black)		Connector Part Information		• 12161187 • ASM 15M Metri-Pack 280 SLD (Black)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A1	DK BLU/WHT	1911	ABS Wheel Speed Sensor Signal Left Rear	A1	DK BLU/WHT	1911	ABS Wheel Speed Sensor Signal Left Rear
A2	DK GRN/WHT	1912	ABS Wheel Speed Sensor Return Left Rear	A2	DK GRN/WHT	1912	ABS Wheel Speed Sensor Return Left Rear
A3	GRY	1913	ABS Modulator Output Exhaust Left Rear	A3	GRY	1913	ABS Modulator Output Exhaust Left Rear
A4	LT BLU/BLK	1914	ABS Modulator Output Hold Left Rear	A4	LT BLU/BLK	1914	ABS Modulator Output Hold Left Rear
A5	ORN	1915	ABS Modulator Feed Left Rear	A5	ORN	1915	ABS Modulator Feed Left Rear
B1	LT GRN/BLk	1916	ABS Wheel Speed Sensor Signal Right Rear	B1	LT GRN/BLk	1916	ABS Wheel Speed Sensor Signal Right Rear
B2	LT BLU/WHT	1917	ABS Wheel Speed Sensor Return Right Rear	B2	LT BLU/WHT	1917	ABS Wheel Speed Sensor Signal Right Rear
B3	LT GRN	1918	ABS Modulator Exhaust Right Rear	B3	LT GRN	1918	ABS Modulator Exhaust Right Rear
B4	PNK/BLU	1919	ABS Modulator Output Hold Right Rear	B4	PNK/BLU	1919	ABS Modulator Output Hold Right Rear
B5	PPL	1920	ABS Modulator Feed Right Rear	B5	PPL	1920	ABS Modulator Feed Right Rear
C1–C5	—	—	Not Used	C1–C5	—	—	Not Used

Inline Connector C402



229958

Connector Part Information		• 12047937 • 8 Way F Metri-Pack 150 Series, Sealed (BLK)		Connector Part Information		• 12047931 • 8 Way M Metri-Pack 150 Series, Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	BRN	9	Park Lamp Feed	A	BRN	9	Park Lamp Feed
B	LT GRN	24	Back Up Lamp Feed	B	LT GRN	24	Back Up Lamp Feed
C	YEL	18	Stop/Turn lamp Feed, Left Rear	C	YEL	18	Stop/Turn Lamp Feed, Left Rear
D	DK GRN	19	Stop/Turn Lamp Feed, Right Rear	D	DK GRN	19	Stop/Turn Lamp Feed, Right Rear
E	—	—	Not Used	E	GRA	120	Fuel Pump Motor Feed
F	PPL	30	Fuel Gauge Sensor Signal	F	PPL	30	Fuel Gauge Sensor Signal
G	GRY/BLK	1467	Two Speed Rear Axle Shift Motor Relay Output Coil	G	GRY/BLk	1467	Two Speed Rear Axle Shift Motor Relay Output Coil
H	DK BLU	1944	Suspension Dump Valve Solenoid Feed	H	DK BLU	1944	Suspension Dump Valve Solenoid Feed

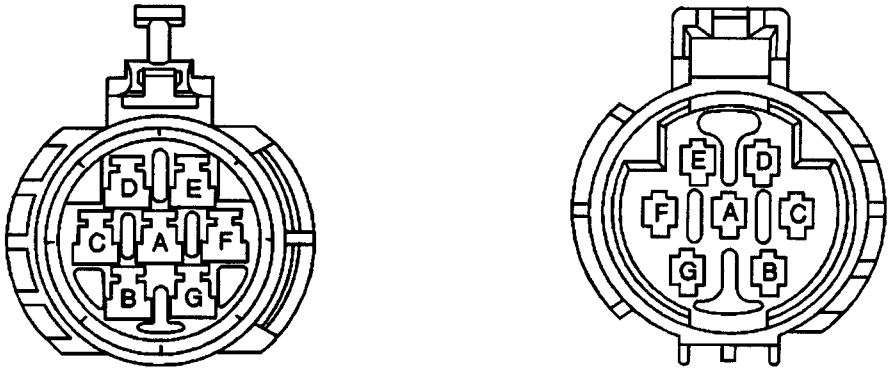
C404



95864

Connector Part Information		• 12040977 • 3 Way F Metri-Pack 280 Series, Sealed (BLK)		Connector Part Information		• 15300003 • 3 Way M Metri-Pack 280 Series, Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	PNK	239	Fuse Output-Ignition	A	BRN	241	Fuse Output-Ignition
B	PNK	139	Fuse Output-Ignition	B	BRN	341	Fuse Output-Ignition
C	—	—	Not Used	C	—	—	Not Used

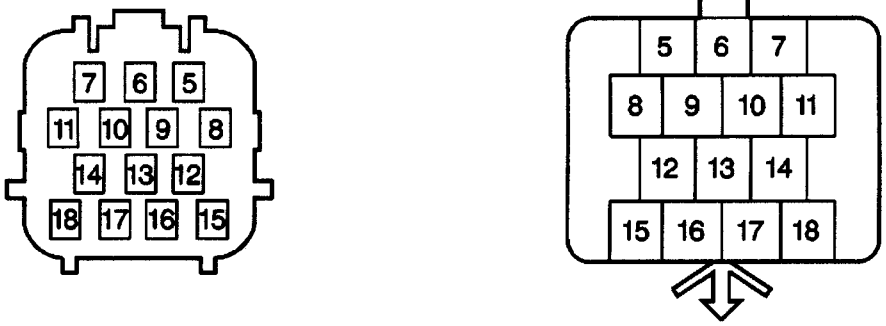
C406



39743

Connector Part Information		• 12110751 • 7 Way F Metri-Pack 280 Series, Flexlock, Sealed (BLK)		Connector Part Information		• 12110753 • 7 Way M Metri-Pack 280 Series, Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A–B	—	—	Not Used	A–B	—	—	Not Used
C	YEL	318	Trailer Relay Output-N.O. Contact-Left Rear Stop/ Turn Lamp	C	YEL	318	Trailer Relay Output-N.O. Contact-Left Rear Stop/ Turn Lamp
D	RED	950	Trailer Stop Lamp Relay-N.O. Contact	D	RED	1411	Trailer Stop Lamp Relay-N.O. Contact
E	DK GRN	319	Trailer Relay Output-N.O. Contact-Right Rear Stop/Turn Lamp	E	DK GRN	319	Trailer Relay Output-N.O. Contact-Right Rear Stop/Turn Lamp
F	BRN	9	Park Lamp Feed	F	BRN	9	Park Lamp Feed
G	—	—	Not Used	G	—	—	Not Used

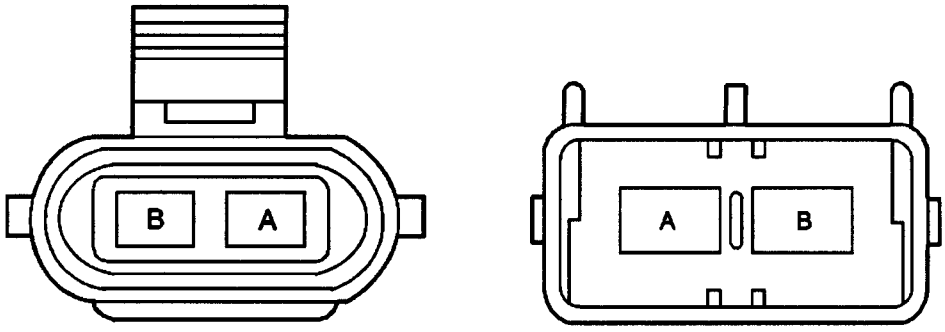
Inline Connector C407



339158

Connector Part Information		• 12162871 • ASM 14F SLD (GRY)		Connector Part Information		• 14 Way M • (GRY)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
5–6	—	—	Not Used	5–6	—	—	Not Used
7	ORN	24	Back Up Lamp Feed	7	ORN	7	Back Up Lamp Feed
8–10	—	—	Not Used	8–10	—	—	Not Used
11	PNK	139	Fuse Output Ignition	11	PNK	8	Fuse Output Ignition
12–14	—	—	Not Used	12–14	—	—	Not Used
15	LT GRN/BLK	822	Vehicle Speed Sensor Return	15	LT GRN/BLK	24	Vehicle Speed Sensor Return
16	PPL/WHT	821	Vehicle Speed Sensor Signal	16	PPL/WHT	25	Vehicle Speed Sensor Signal
17	PNK	739	Fuse Output Ignition	17	PNK	26	Fuse Output Ignition
18	—	—	Not Used	18	—	—	Not Used

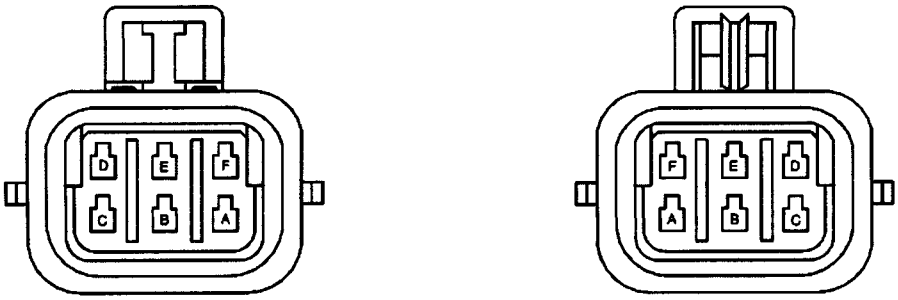
C408



277418

Connector Part Information		• 15300027 • 2 Way F Metri-Pack 280 Series, Sealed(BLK)		Connector Part Information		• 15300002 • 2 Way M Metri-Pack 280 Series, Sealed(BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	BRN	341	Fuse Output-Ignition	A	BRN	341	Fuse Output-Ignition
B	BLK	150	Ground	B	BLK	150	Ground

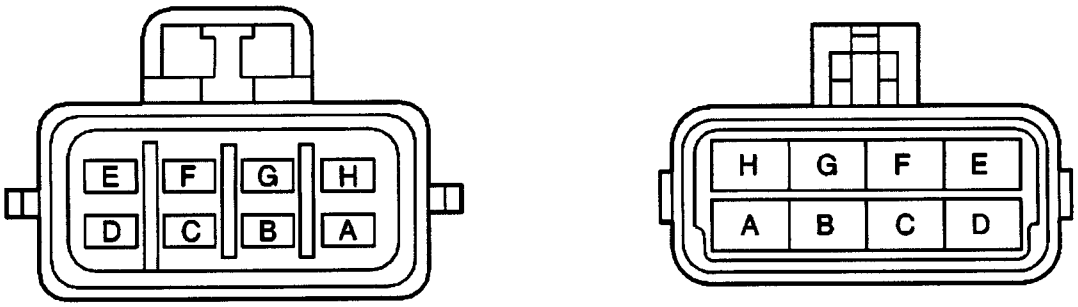
C410



62447

Connector Part Information		• 12052848 • 6 Way F Metri-Pack 150 Series, Sealed (BLK)		Connector Part Information		• 12124107 • 6 Way M Metri-Pack 150 Series, Sealed, Self-locking (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	PPL	30	Fuel Gauge Sensor Signal	A	PPL	30	Fuel Gauge Sensor Signal
B	BRN	341	Fuse Output-Ignition	B	BRN	139	Fuse Output-Ignition
C	BLK	350	Ground	C	BLK	350	Ground
D	—	—	Not Used	D	—	—	Not Used
E	GRA	120	Fuel Pump Motor Feed	E	—	—	Not Used
F	—	—	Not Used	F	—	—	Not Used

Inline Connector C412



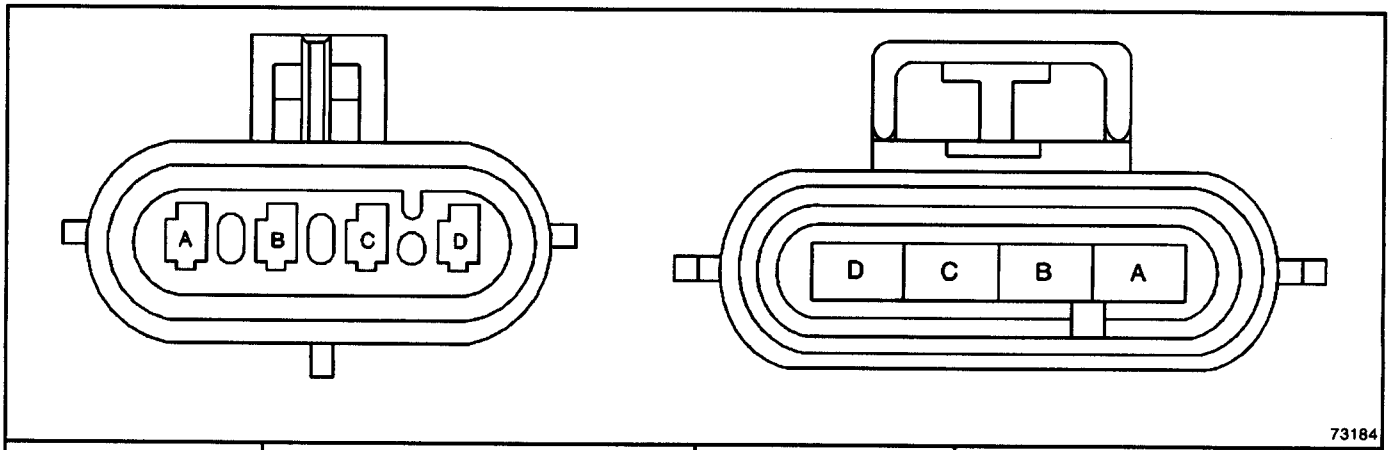
222652

Connector Part Information		• 12047937 • ASM 8F Metri-Pack 150 (Black)		Connector Part Information		• 12047931 • ASM 8M Metri-Pack 150 Series (Black)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	—	—	Not Used	A	—	—	Not Used
B	PNK	139	Fuse Output Ignition	B	BRN	441	Fuse Output Ignition
C	LT GRN	24	Back Up Lamp Feed	C	LT GRN	24	Back Up Lamp Feed
D	YEL	5	Ignition Switch Output Crank	D	PPL	806	Fuse Output Crank

Inline Connector C412 (cont'd)

Connector Part Information		• 12047937 • ASM 8F Metri-Pack 150 (Black)		Connector Part Information		• 12047931 • ASM 8M Metri-Pack 150 Series (Black)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
E	ORN/BLK	434	Transmission Mounted Neutral Safety Switch Signal	E	ORN/BLK	434	Transmission Mounted Neutral Safety Switch Signal
F	LT GRN/BLK	822	Vehicle Speed Sensor Return	F	LT GRN/BLK	822	Vehicle Speed Sensor Signal
G	PPL/WHT	821	Vehicle Speed Sensor Signal	G	PPL/WHT	821	Vehicle Speed Sensor Signal
H	—	—	Not Used	H	—	—	Not Used

C413



Connector Part Information		• 12162144 • 4 Way F Metri-Pack 150 Series, Sealed (BLK)		Connector Part Information		• 12162102 • 4 Way M Metri-Pack 150 Series, Sealed, Self-Locking (BLK)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BRN	882	Wheel Speed Sensor Signal-Right Rear	A	BRN	882	Wheel Speed Sensor Signal-Right Rear
B	WHT	883	Wheel Speed Sensor Return-Right Rear	B	WHT	883	Wheel Speed Sensor Return-Right Rear
C	BLK	884	Wheel Speed Sensor Signal-Left Rear	C	BLK	884	Wheel Speed Sensor Signal-Left Rear
D	RED	885	Wheel Speed Sensor Return-Left Rear	D	RED	885	Wheel Speed Sensor Return-Left Rear

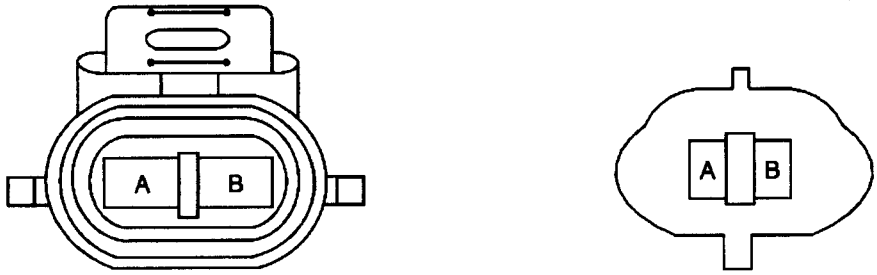
Inline Connector C417



229954

Connector Part Information		• 12162918 • 2 Way F (GRY)		Connector Part Information		• 2 Way M • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
1	RED	6	Starter Solenoid Feed	1	RED	2	Starter Solenoid Feed
2	RED	2	Fuse Output Battery	2	RED	1	Starter Solenoid Feed

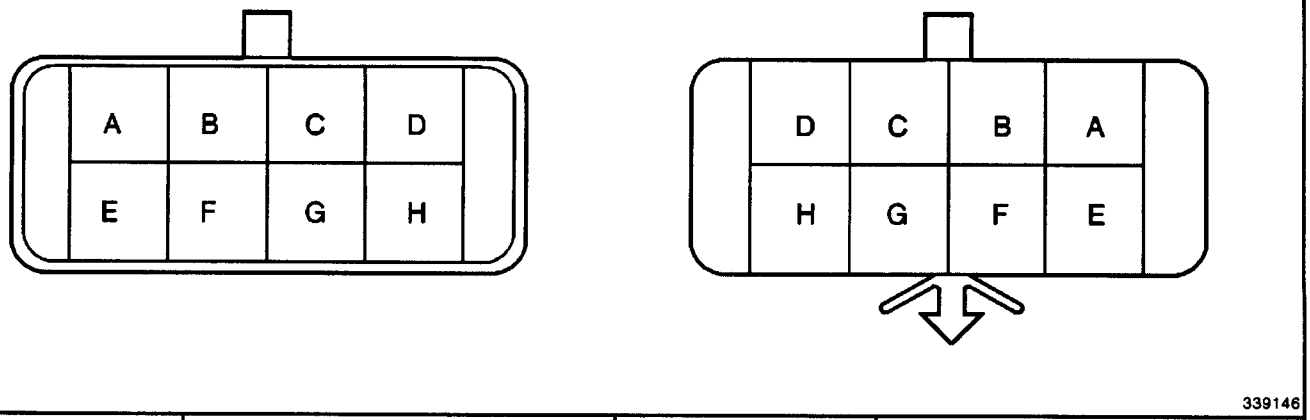
C420



40381

Connector Part Information		• 12052644 • 2 Way F Metri-Pack 150 Series, Sealed (LT GRA)		Connector Part Information		• 12162343 • 2 Way M Metri-Pack 150 Series, Sealed (LT GRA)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BRN	323	Shift Solenoid Feed	A	BRN	323	Shift Solenoid Feed
B	BLK	150	Ground	B	BLK	150	Ground

Inline Connector C501



339146

Connector Part Information		• 8 Way F • (GRY)		Connector Part Information		• 8 Way M • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BRN	88	Side Marker Lamp	A	BRN	20	Side Marker Lamp
B	—	—	Not Used	B	—	—	Not Used
C	ORN	443	Power Window Relay Output	C	ORN	7	Power Window Relay Output
D	BLK	68	Ground	D	BLK	4	Ground
E	ORN	342	Heated Mirror	E	ORN	32	Heated Mirror
F	LT GRN/WHT	445	Power Window Lock	F	LT GRN/WHT	8	Power Window Lock
G	LT GRN/RED	446	Power Window Up	G	LT GRN/RED	9	Power Window Up
H	LT GRN/BLK	447	Power Window Down	H	LT GRN/BLK	10	Power Window Down

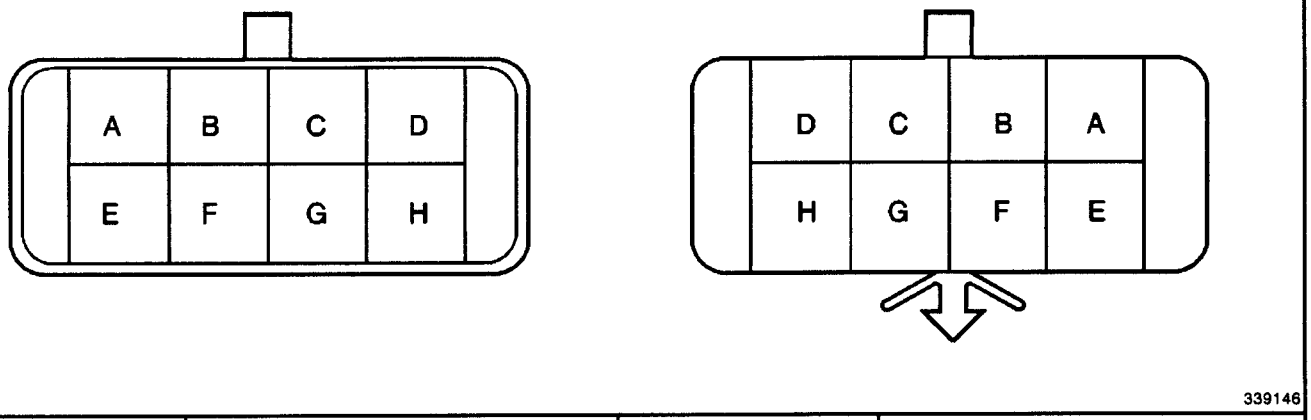
Inline Connector C503



339136

Connector Part Information		• 2 Way F • (GRY)		Connector Part Information		• 2 Way M • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	ORN	1	Mirror Lamp Feed	A	ORN	32	Mirror Lamp Feed
B	BLK	2	Mirror Lamp Ground	B	BLK	33	Mirror Lamp Ground

Inline Connector C601



339146

Connector Part Information		• 8 Way F • (BRN)		Connector Part Information		• 8 Way M • (BRN)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	BRN	89	Side Marker Lamp	A	BRN	20	Side Marker Lamp
B	—	—	Not Used	B	—	—	Not Used
C	ORN	441	Power Window Relay Output	C	ORN	3	Power Window Relay Output
D	BLK	69	Side Marker Lamp	D	BLK	4	Side Marker Lamp
E	ORN	343	Heated Mirror	E	ORN	32	Heated Mirror
F	LT GRN/WHT	445	Power Window Lock	F	LT GRN/WHT	8	Power Window Lock
G	LT GRN/RED	446	Power Window Up	G	LT GRN/RED	9	Power Window Up
H	LT GRN/BLK	447	Power Window Down	H	LT GRN/BLK	10	Power Window Down

Inline Connector C603



339136

Connector Part Information		• 2 Way F • (GRY)		Connector Part Information		• 2 Way M • (GRY)	
Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	ORN	1	Mirror Lamp Feed	A	ORN	32	Mirror Lamp Feed
B	BLK	2	Mirror Lamp Ground	B	BLK	33	Mirror Lamp Ground

C703

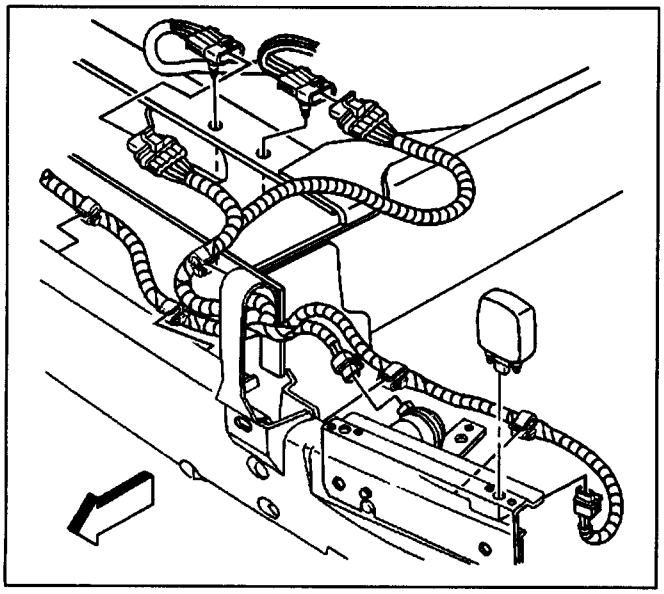


95864

Connector Part Information		• 12040977 • 3 Way F Metri-Pack 280 Series,Sealed (BLK)		Connector Part Information		• 15300003 • 3 Way M Metri-Pack 280 Series,Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**	**Pin**	**Wire Color**	**Circuit No.**	**Function**
A	BRN	241	Fuse Output-Ignition	A	BRN	241	Fuse Output-Ignition
B	GRA/BLK	1467	Two Speed Rear Axle Shift Motor Relay Output-Coil	B	GRA/BLK	1467	Two Speed Rear Axle Shift Motor Relay Output-Coil
C	BLK	450	Ground	C	BLK	450	Ground

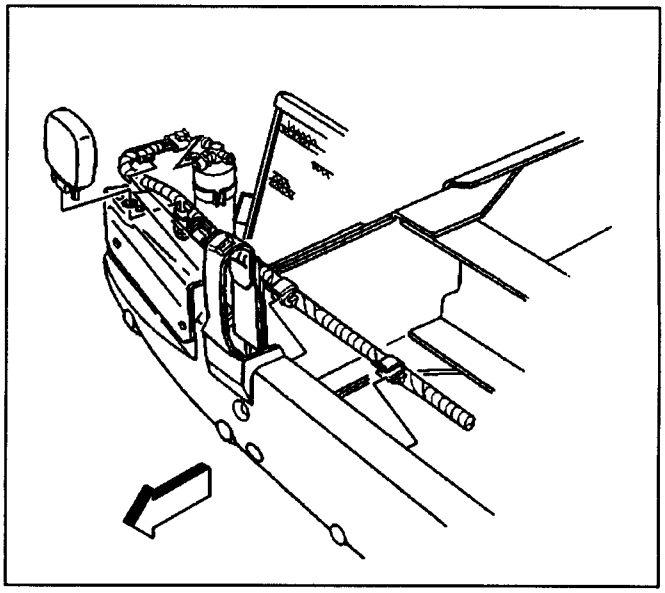
Harness Routing Views

Turn Signal Harness, Left Side



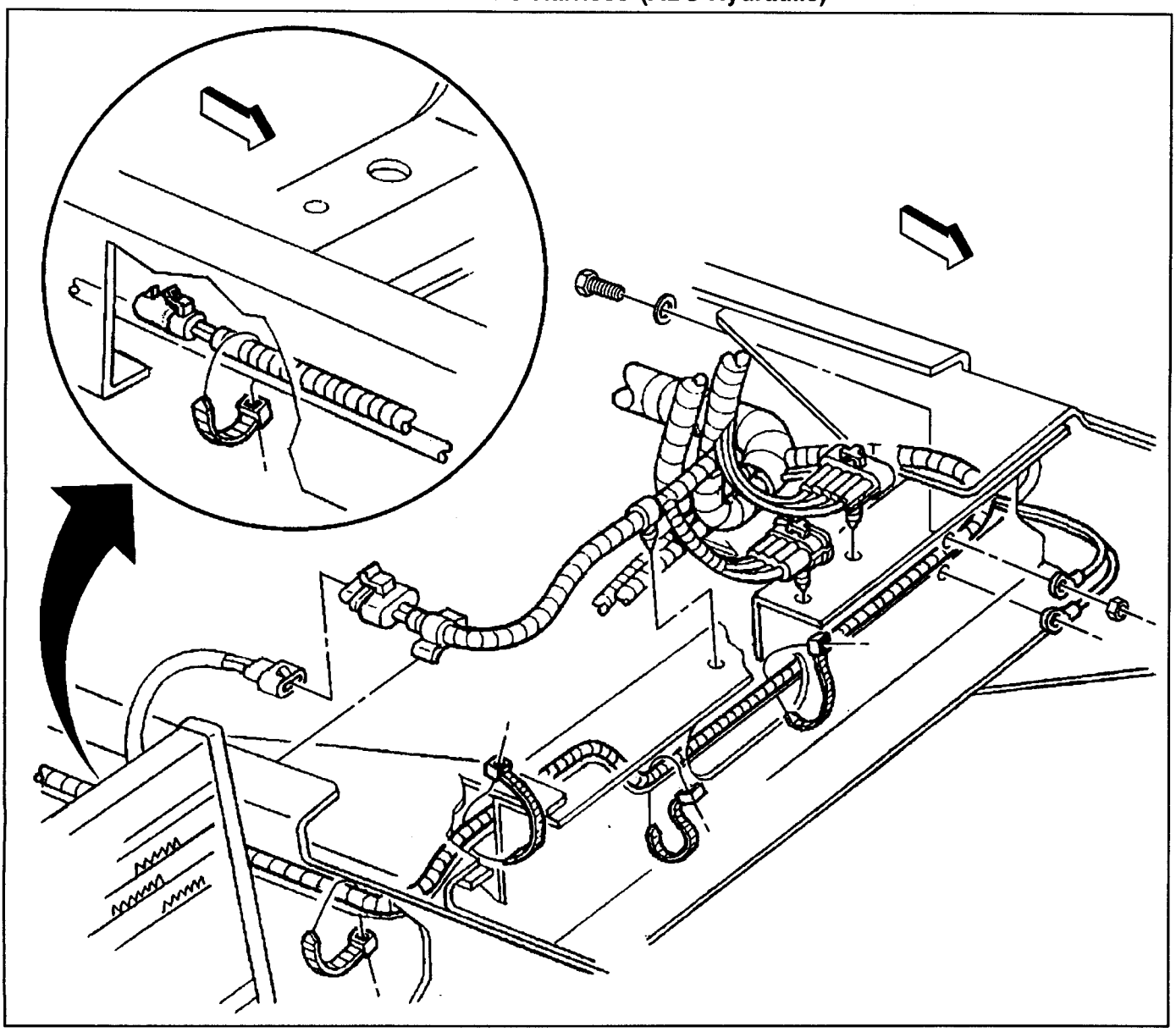
216301

Turn Signal Harness, Right Side



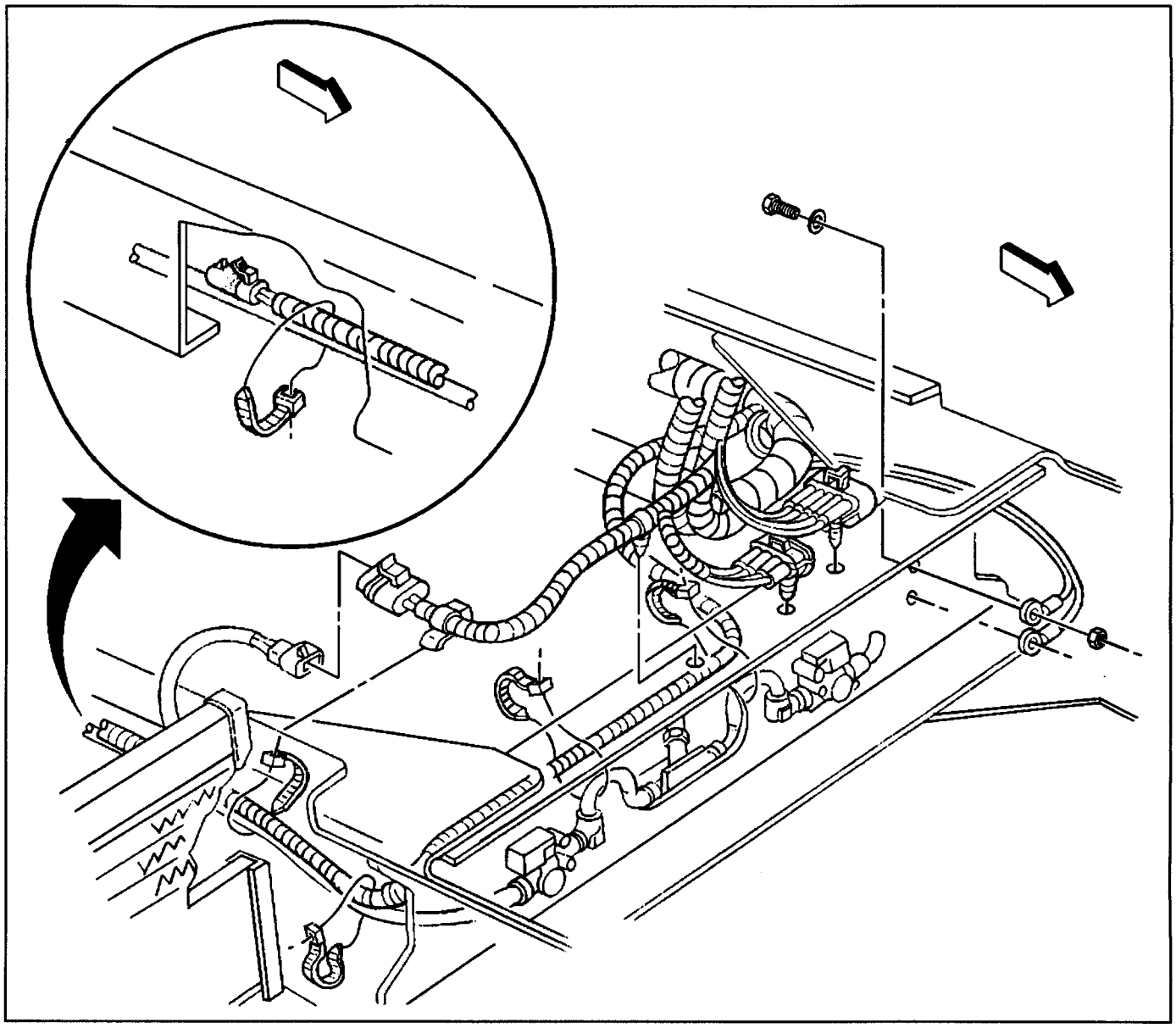
216305

Front Chassis Harness (ABS-Hydraulic)



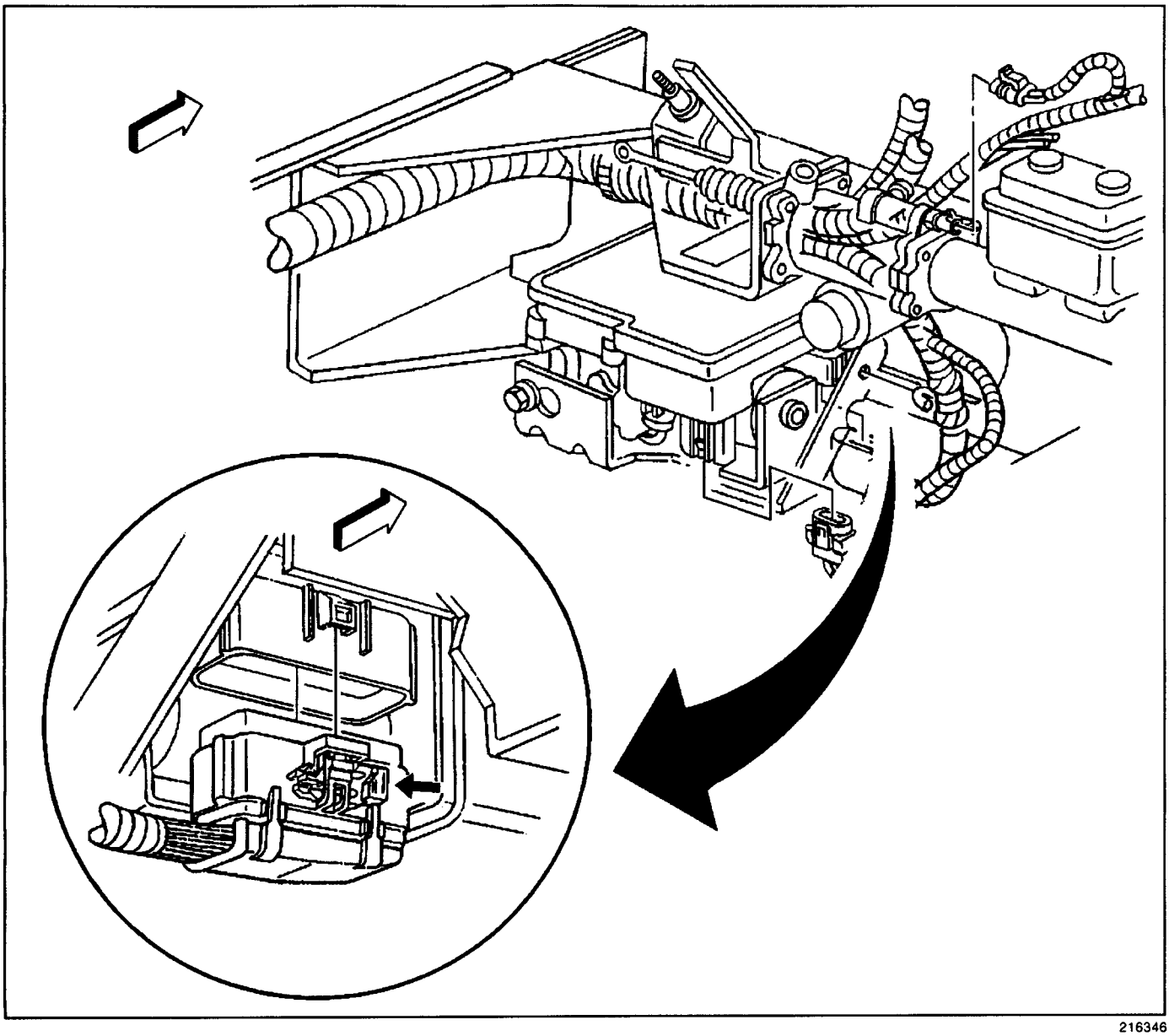
216309

Front Chassis Harness RPO-JE4



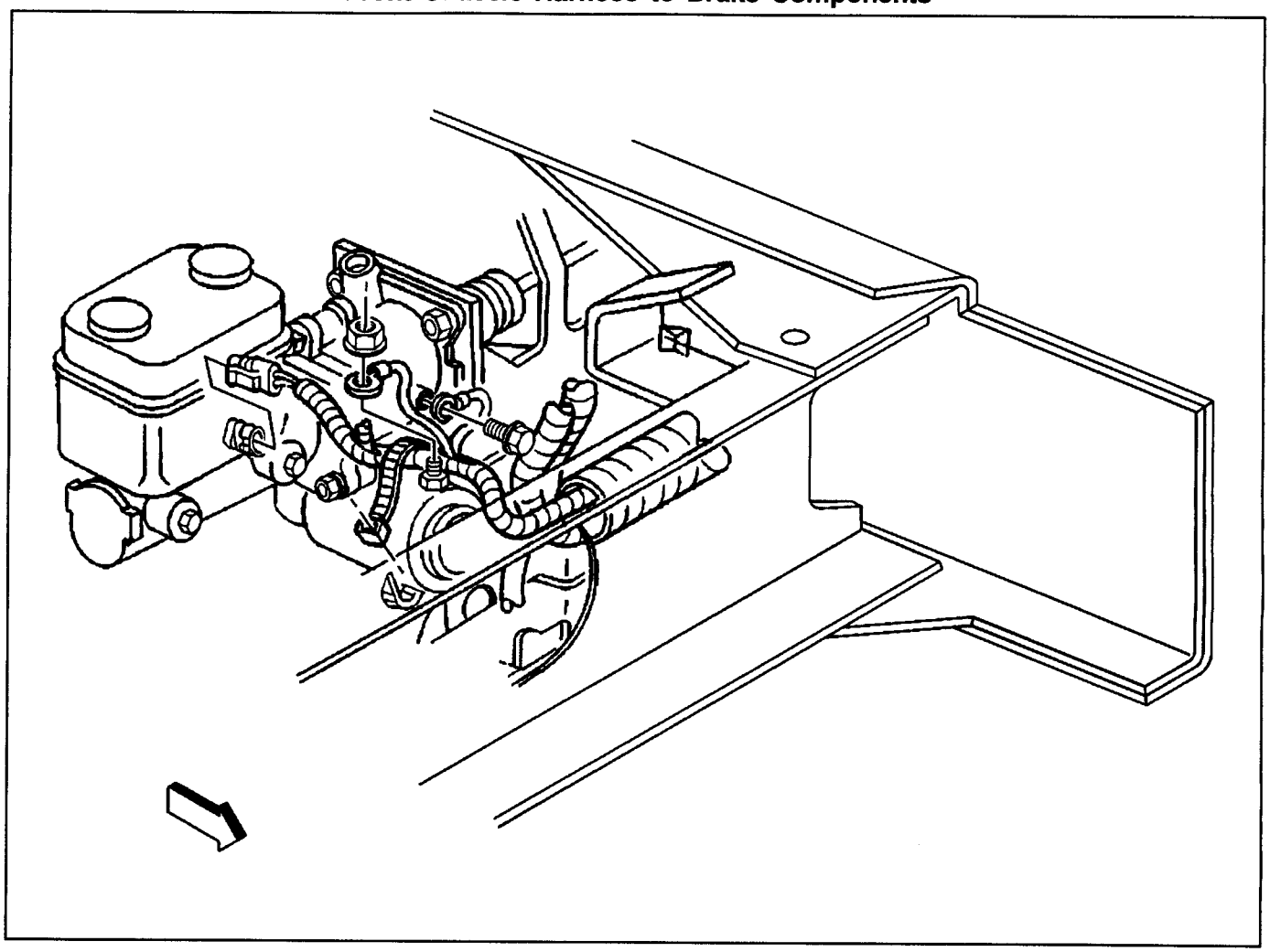
216343

Front Chassis Harness to Brake Components (ABS-Hydraulic)



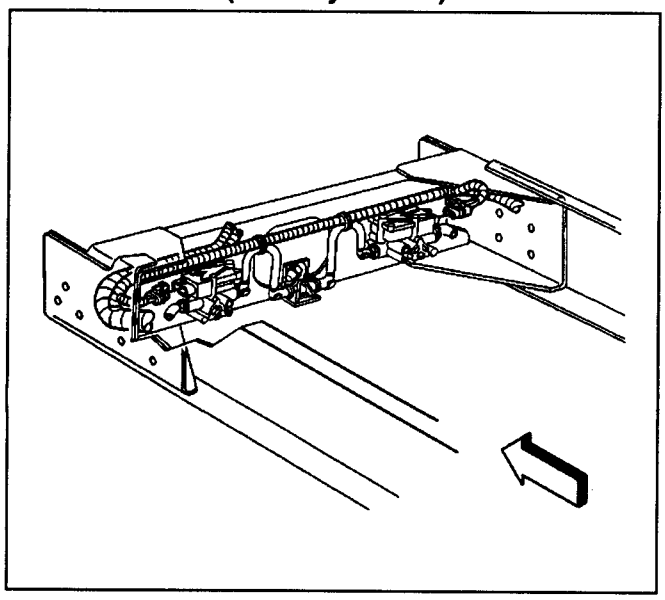
216346

Front Chassis Harness to Brake Components



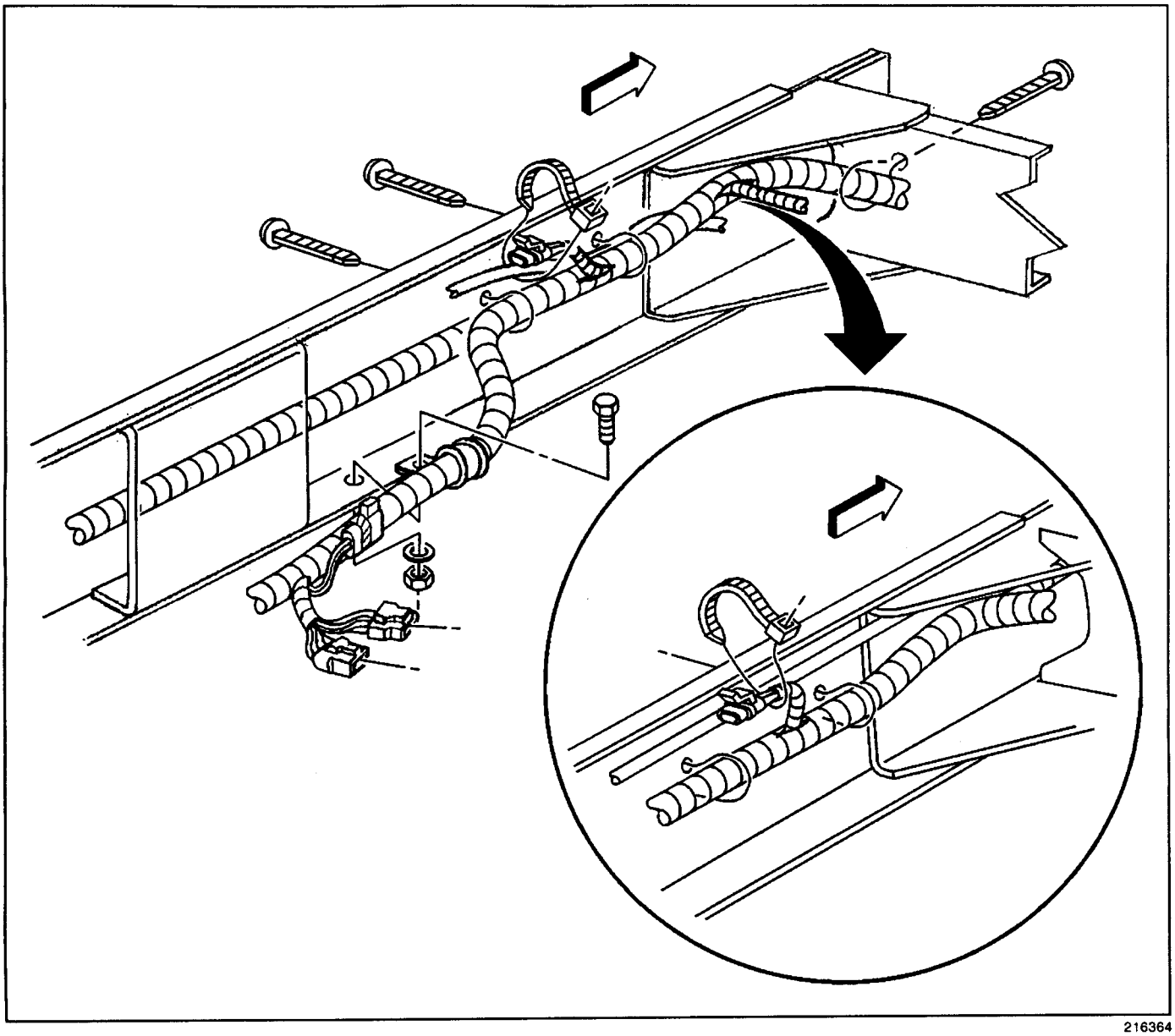
216350

Front Chassis Harness to Brake Components (ABS-Hydraulic)



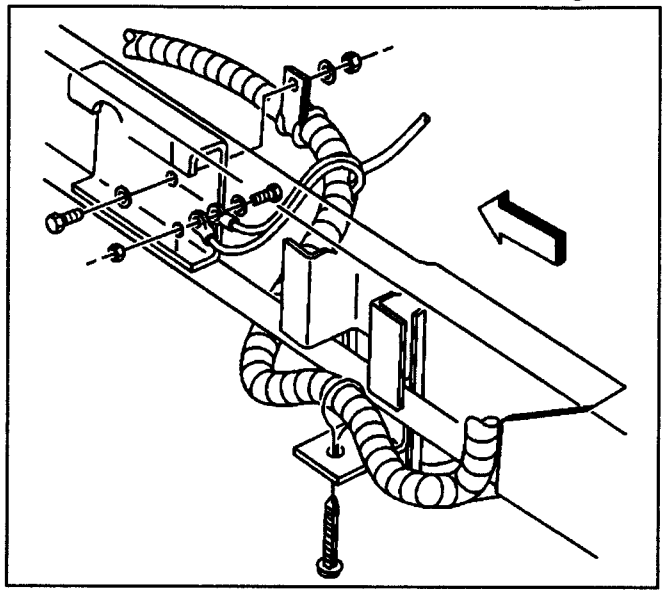
216352

Front Chassis Harness, Center



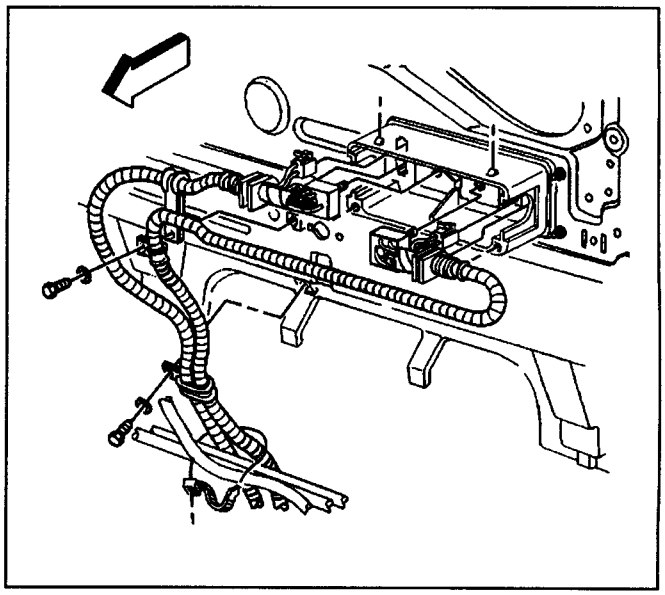
216364

Front Chassis Harness at Rear of Engine



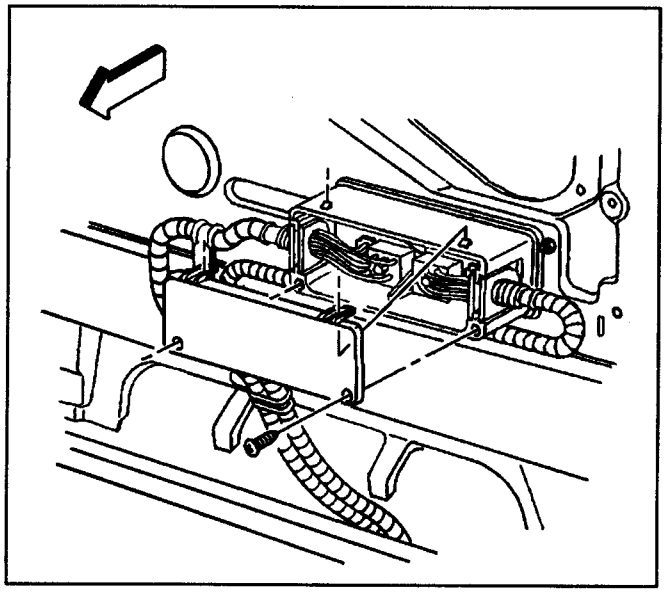
216371

Front Chassis Harness to Cab



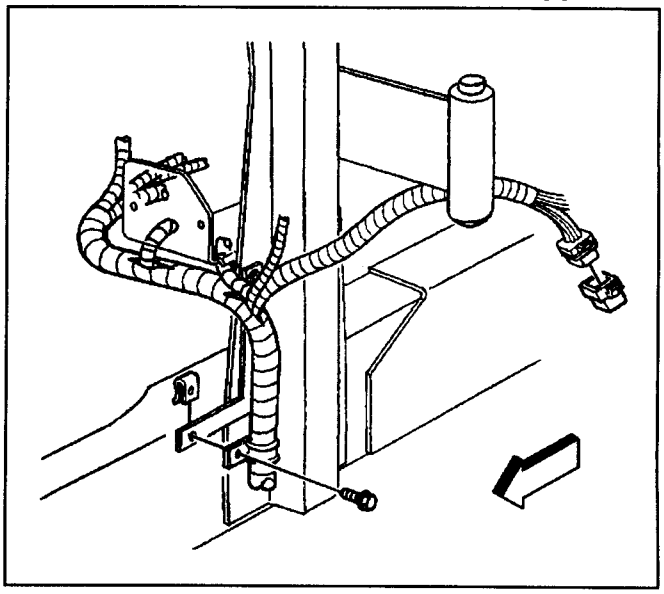
216374

Cover to Cab Interface Removal



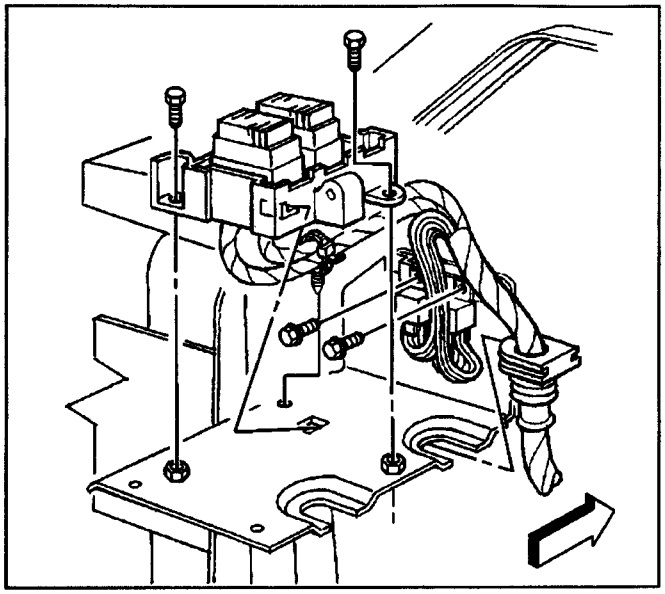
216373

Front Chassis to Harness Rear Support



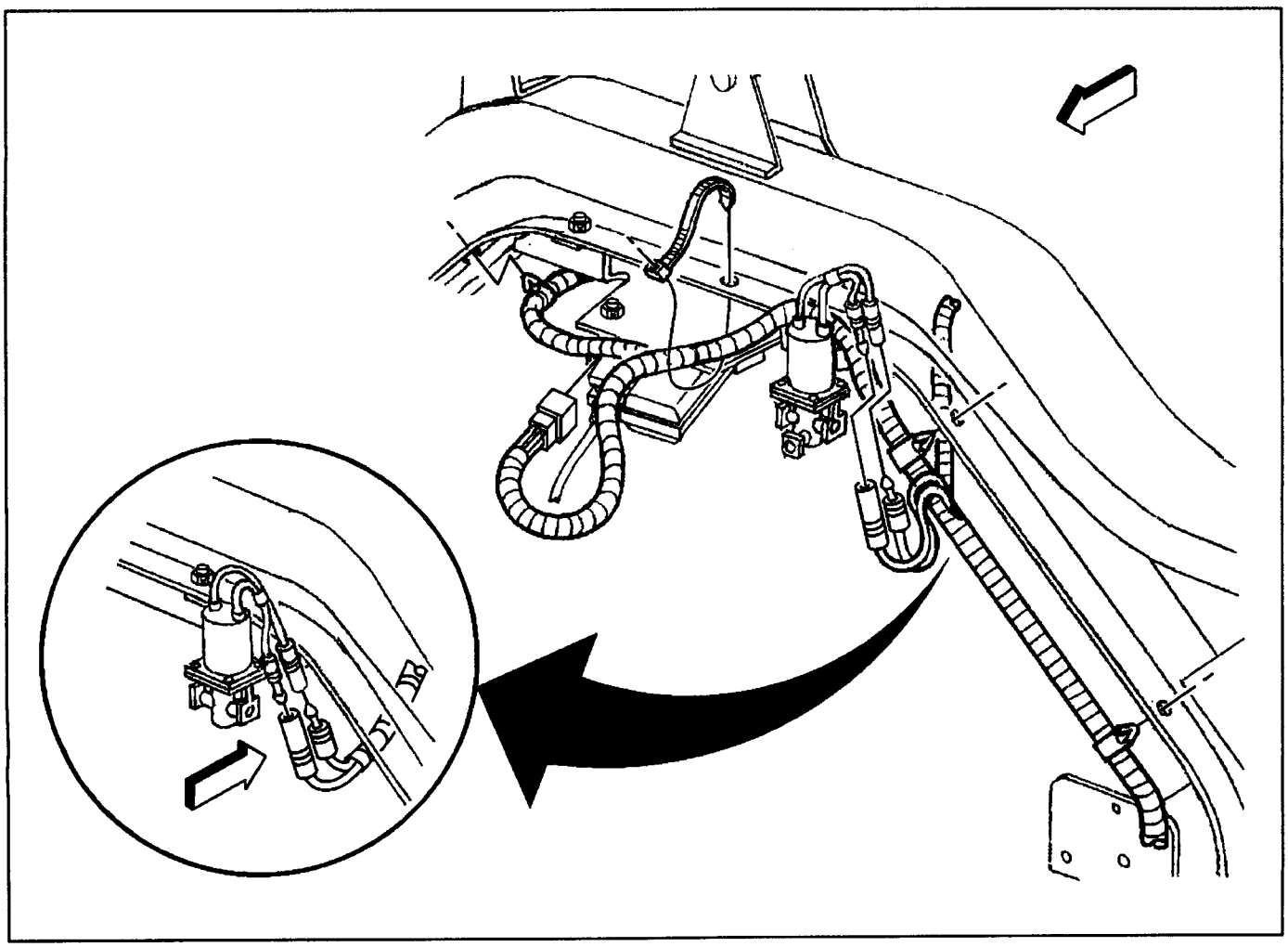
216375

Front Chassis Harness, Maxi-Fuse® Block



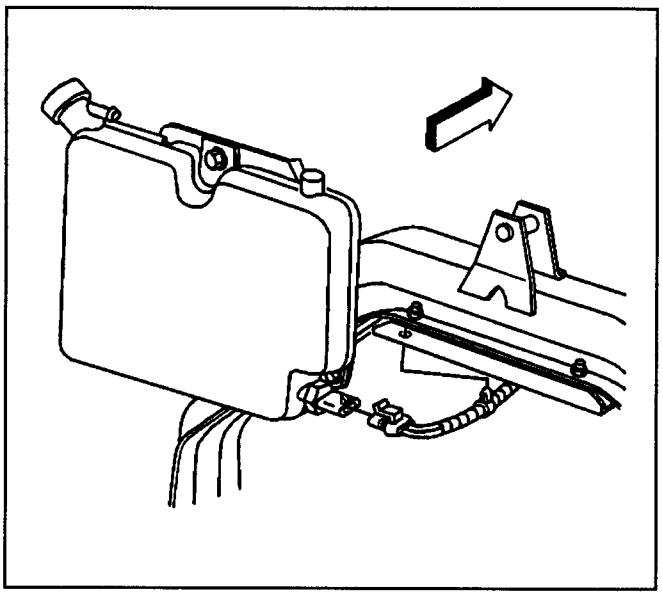
216377

Front Chassis Harness to Control Valves



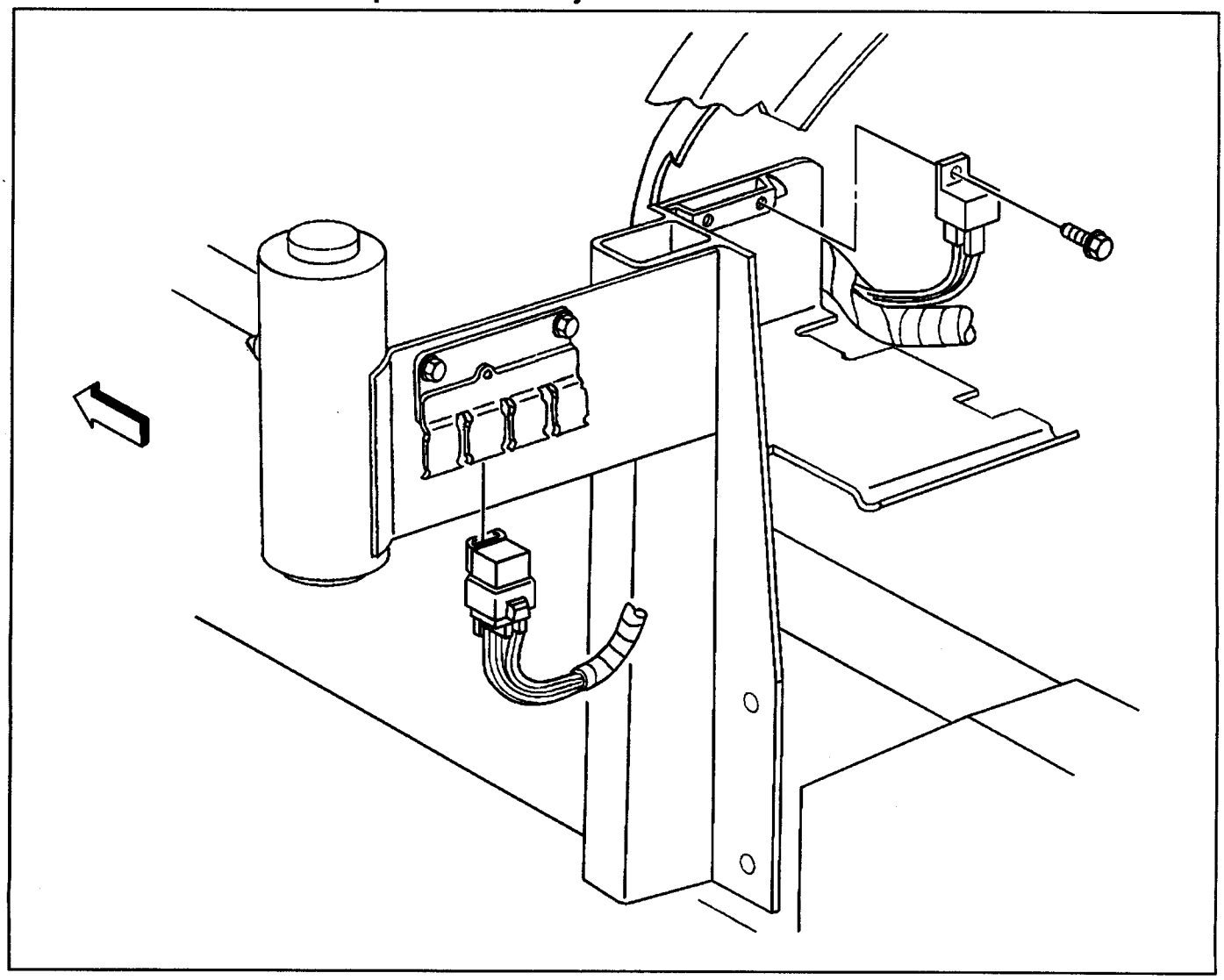
223179

Front Chassis Harness to Coolant Level Switch RPO-LXO



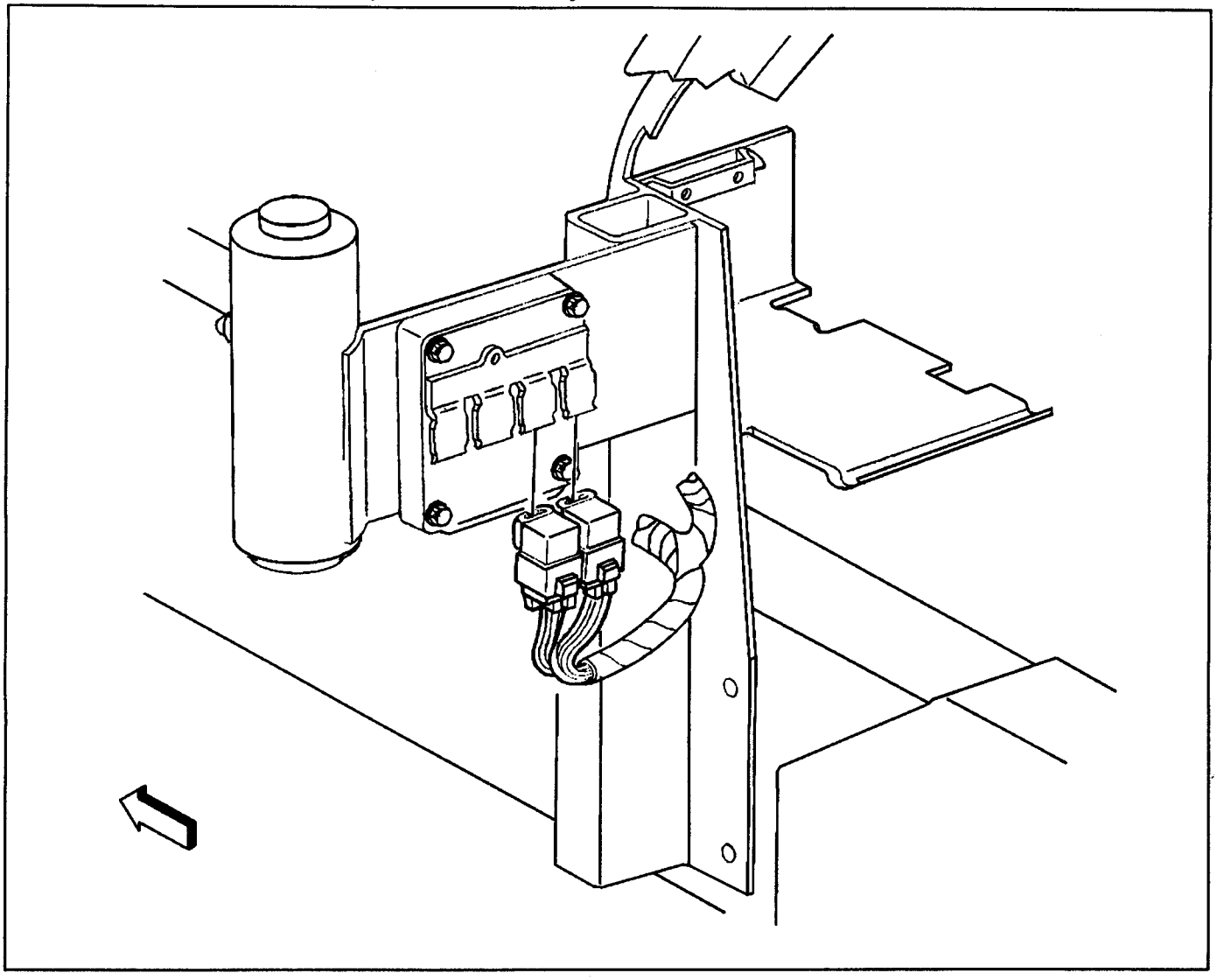
216381

Trailer Stop and ABS Relay Installation to Bracket RPO-JE3



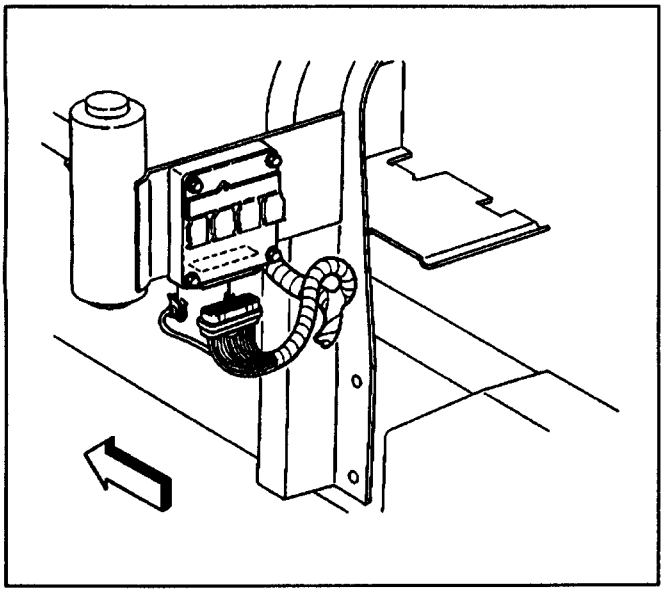
223279

Trailer Stop and ABS Relay Installation to Bracket RPO-JE4



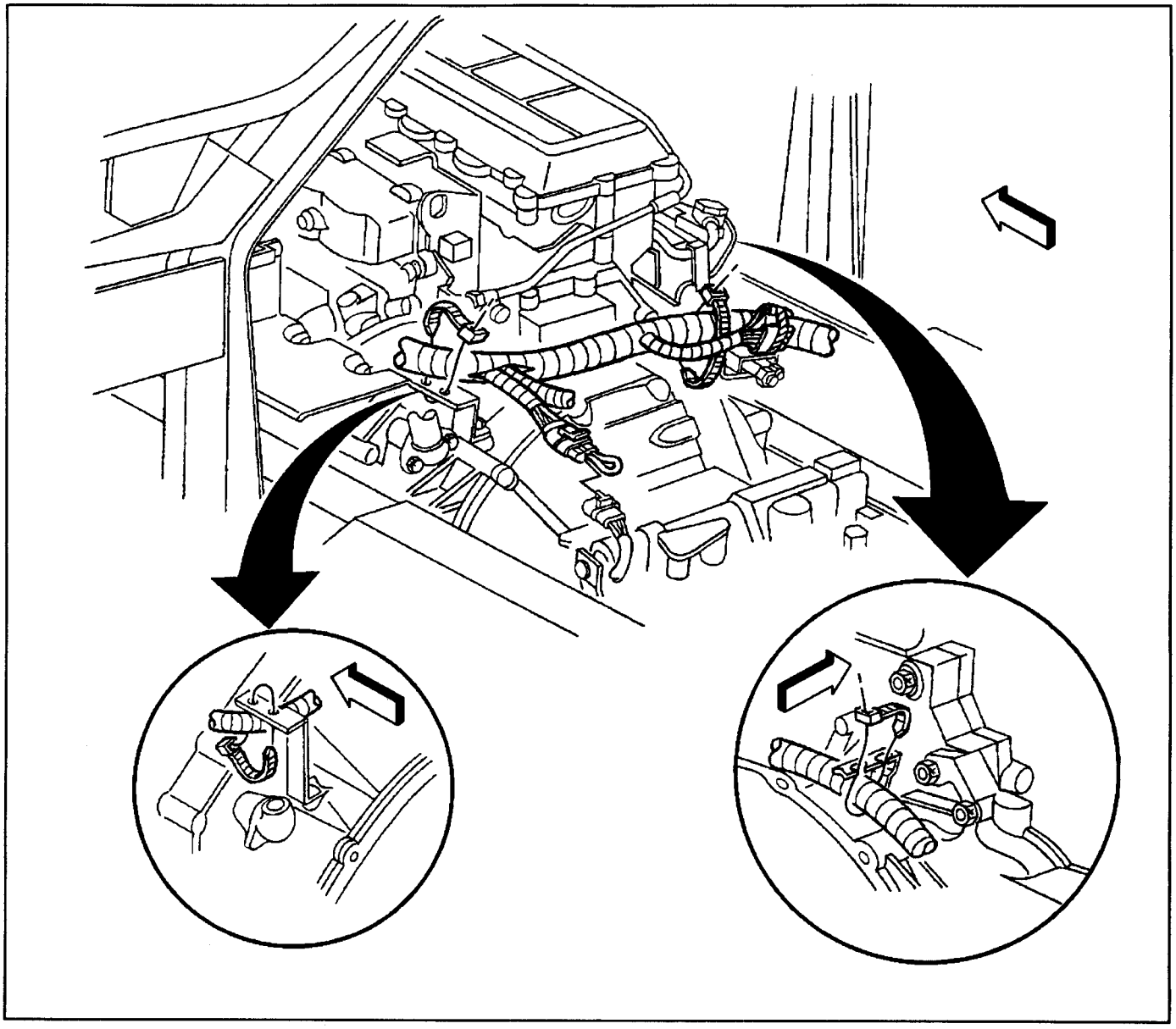
223187

Front Chassis Harness to ABS Control Unit RPO-JE4 and JE5



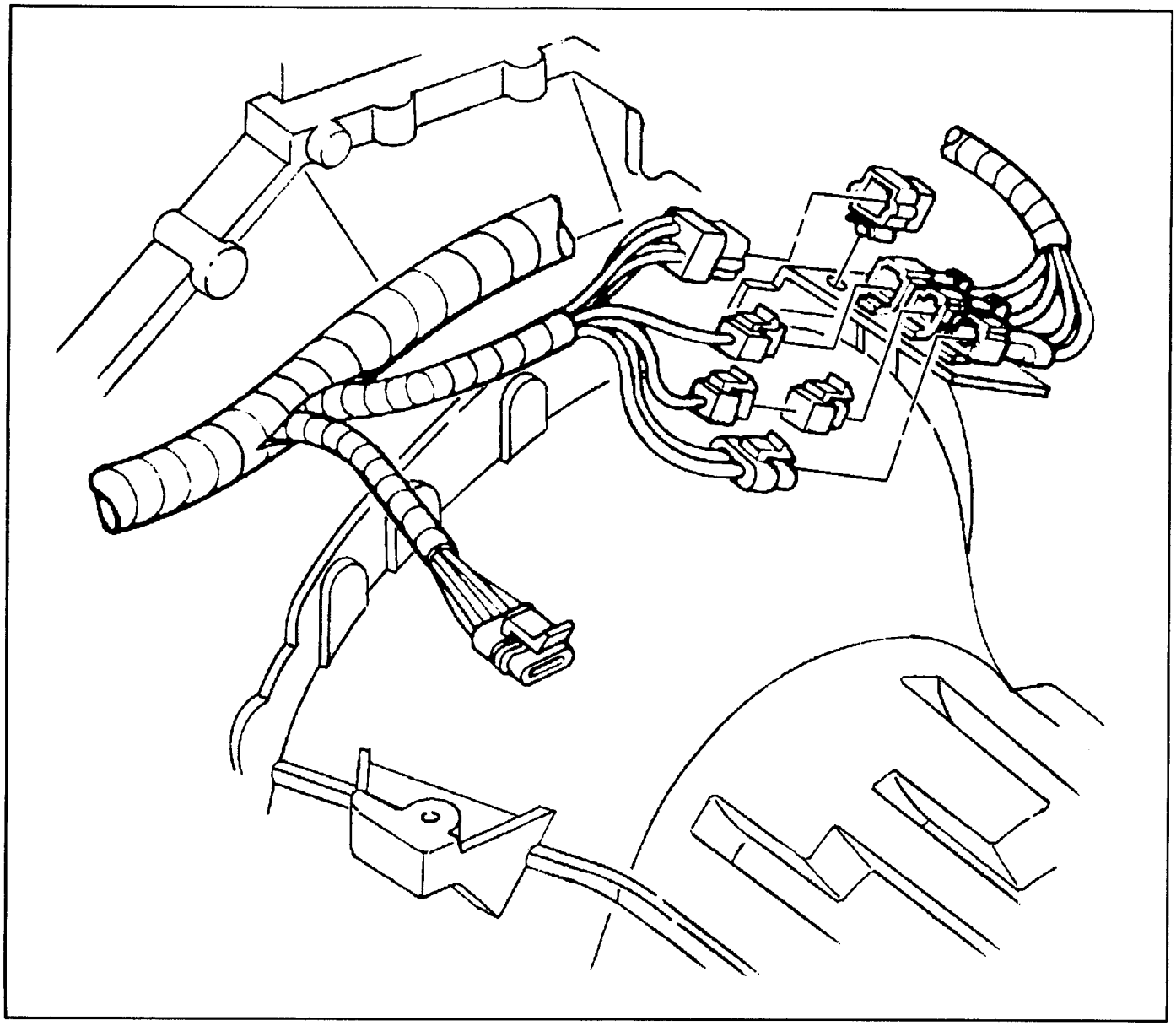
216384

Front Chassis Harness to Engine



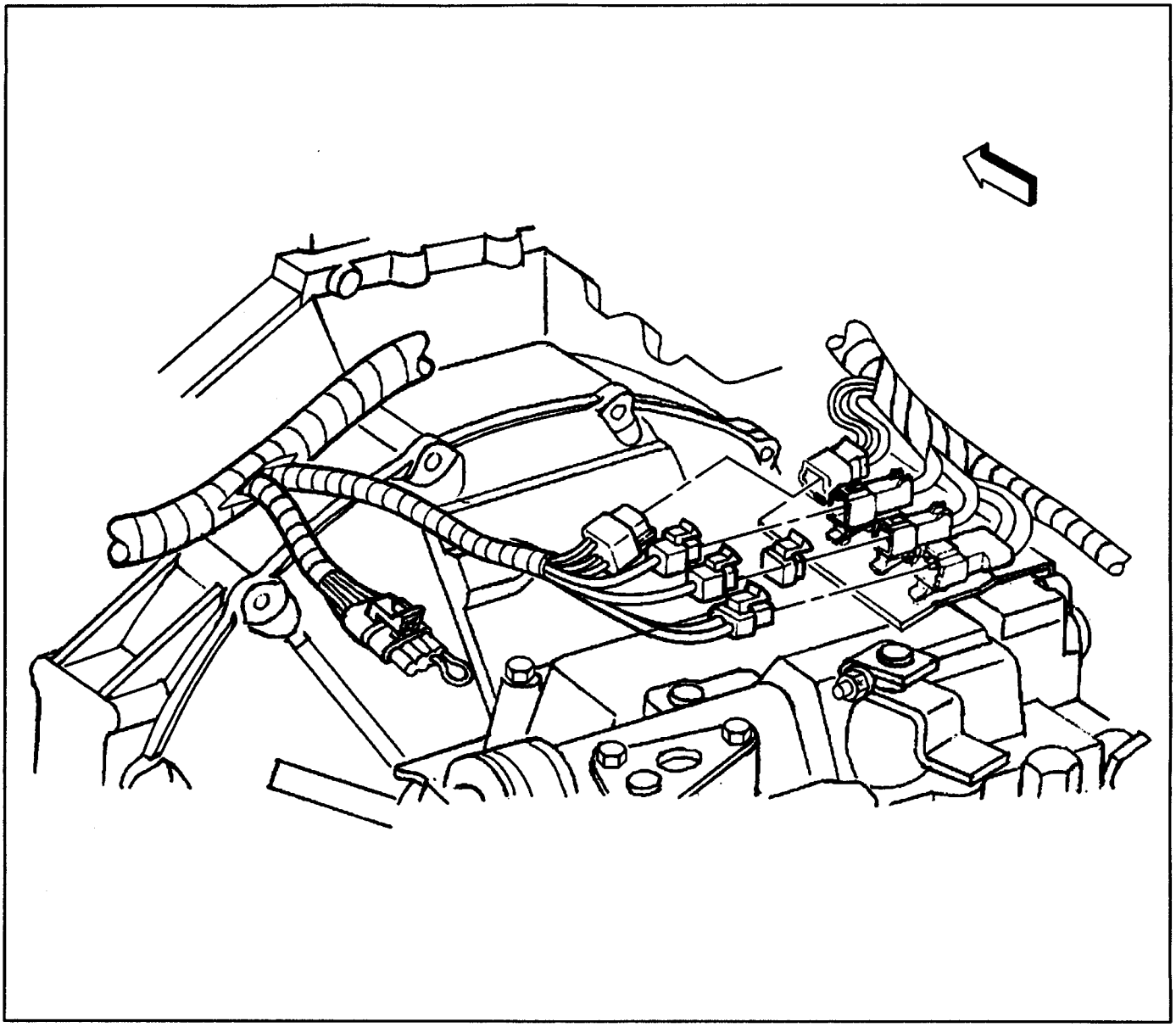
223194

Front Chassis Harness to Starter Harness



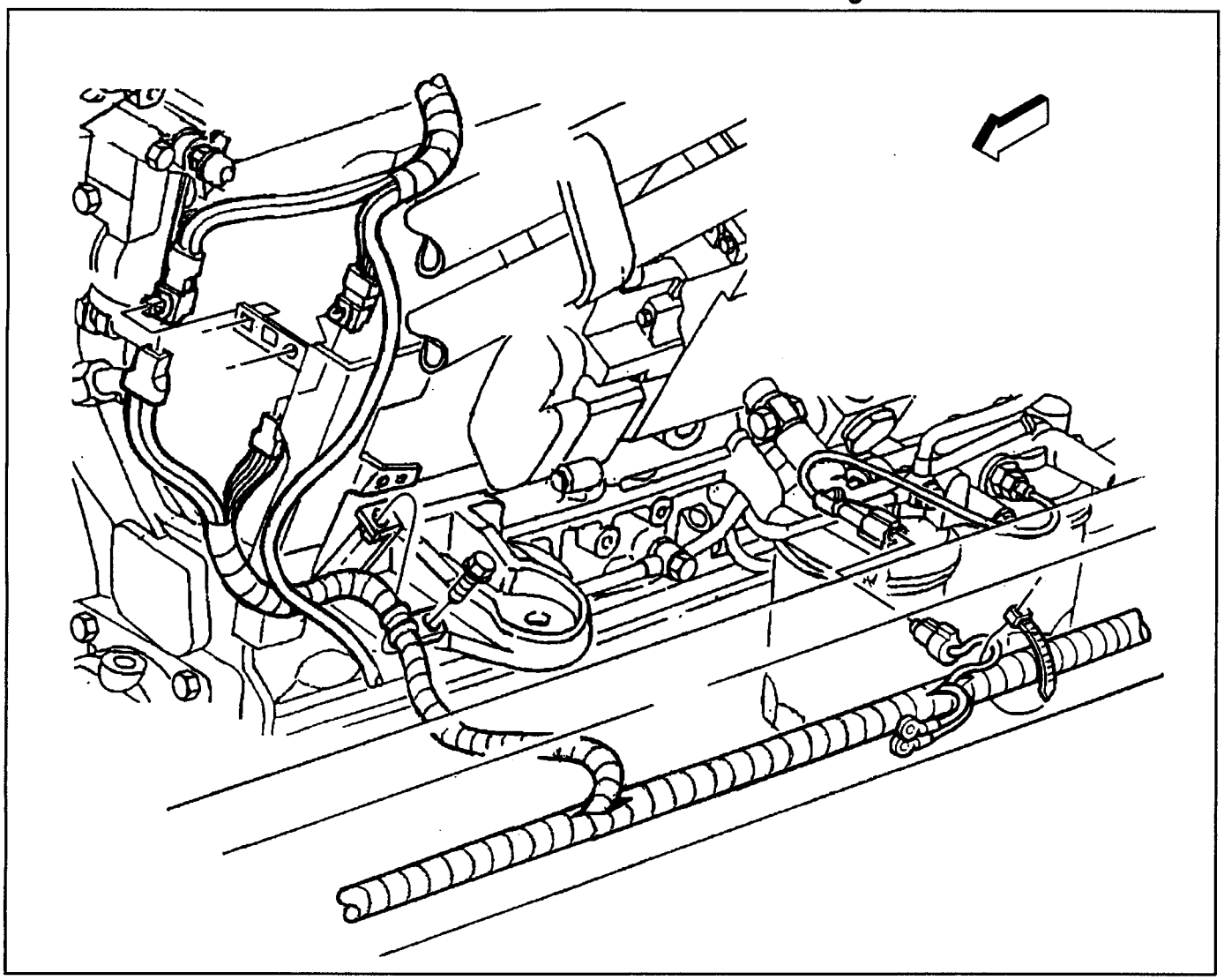
223206

Front Chassis Harness to Starter Harness RPO-M54 and JE3



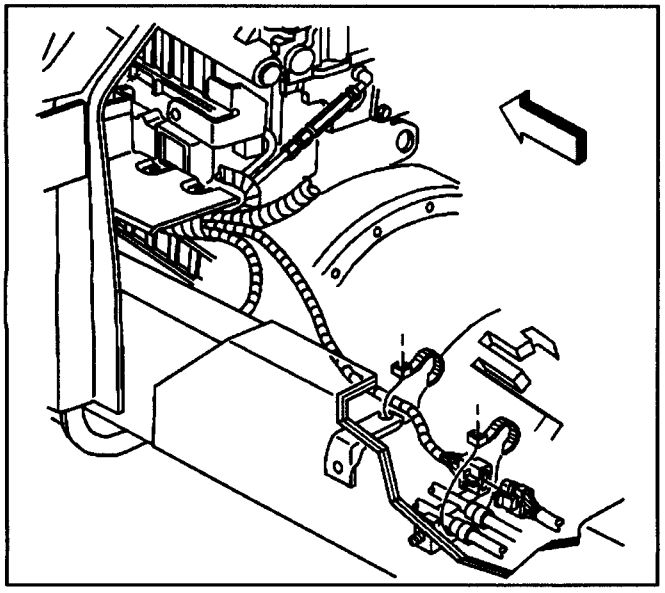
223210

Front Chassis Harness to Left Side of Engine



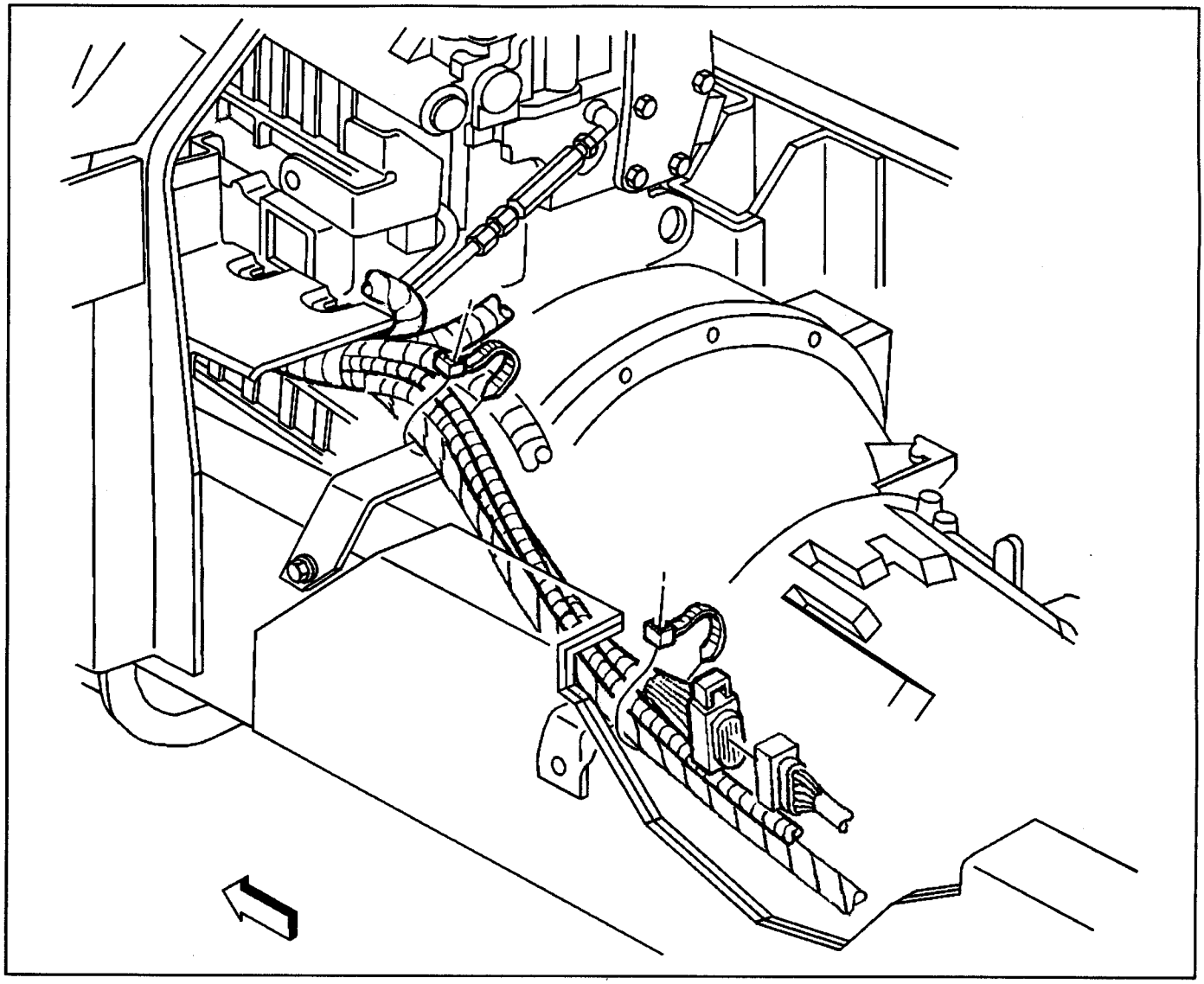
223214

Front Chassis Harness to Left Rear of Frame RPO-JE3



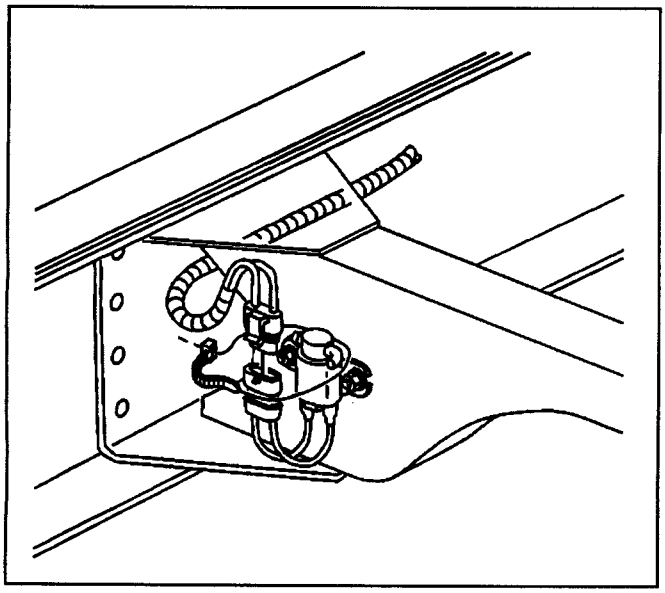
216389

Front Chassis Harness to Left Rear of Frame RPO-JE4 and JE5



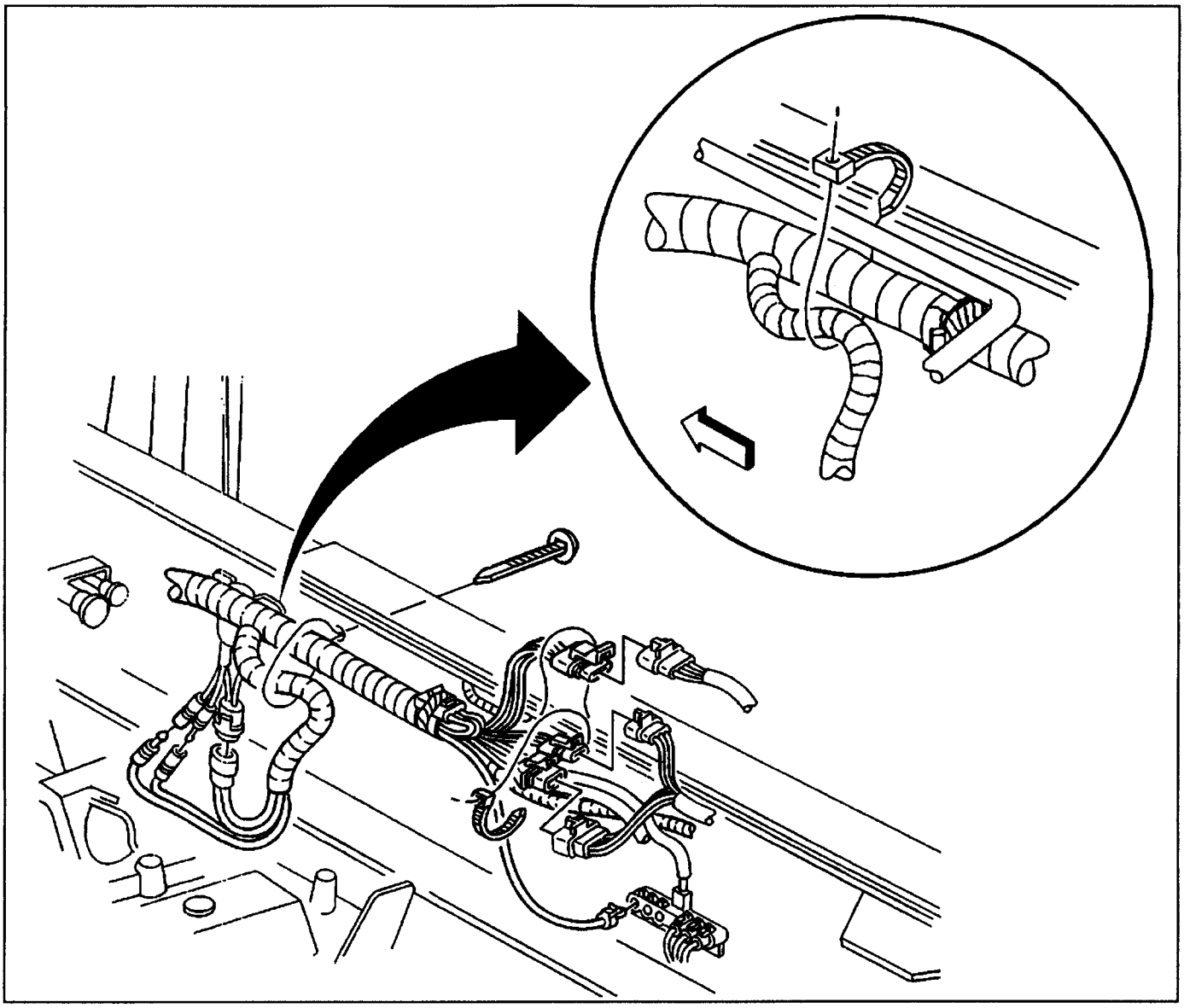
223217

Front Chassis Harness to Exhaust Brake



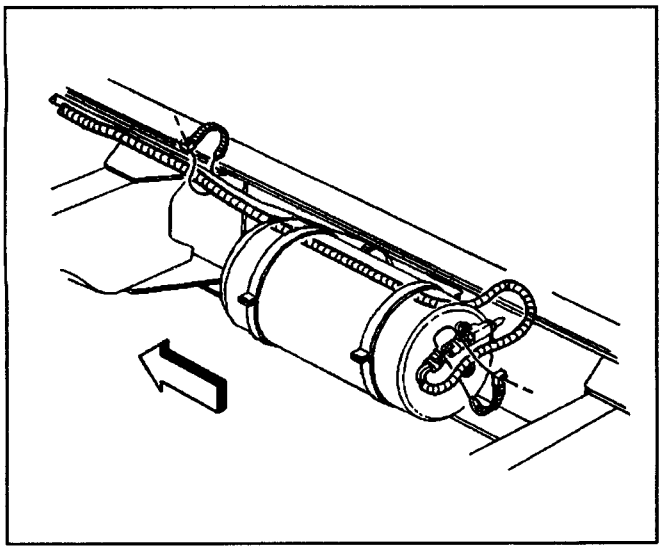
216401

Front Chassis Harness to Right Rear of Frame



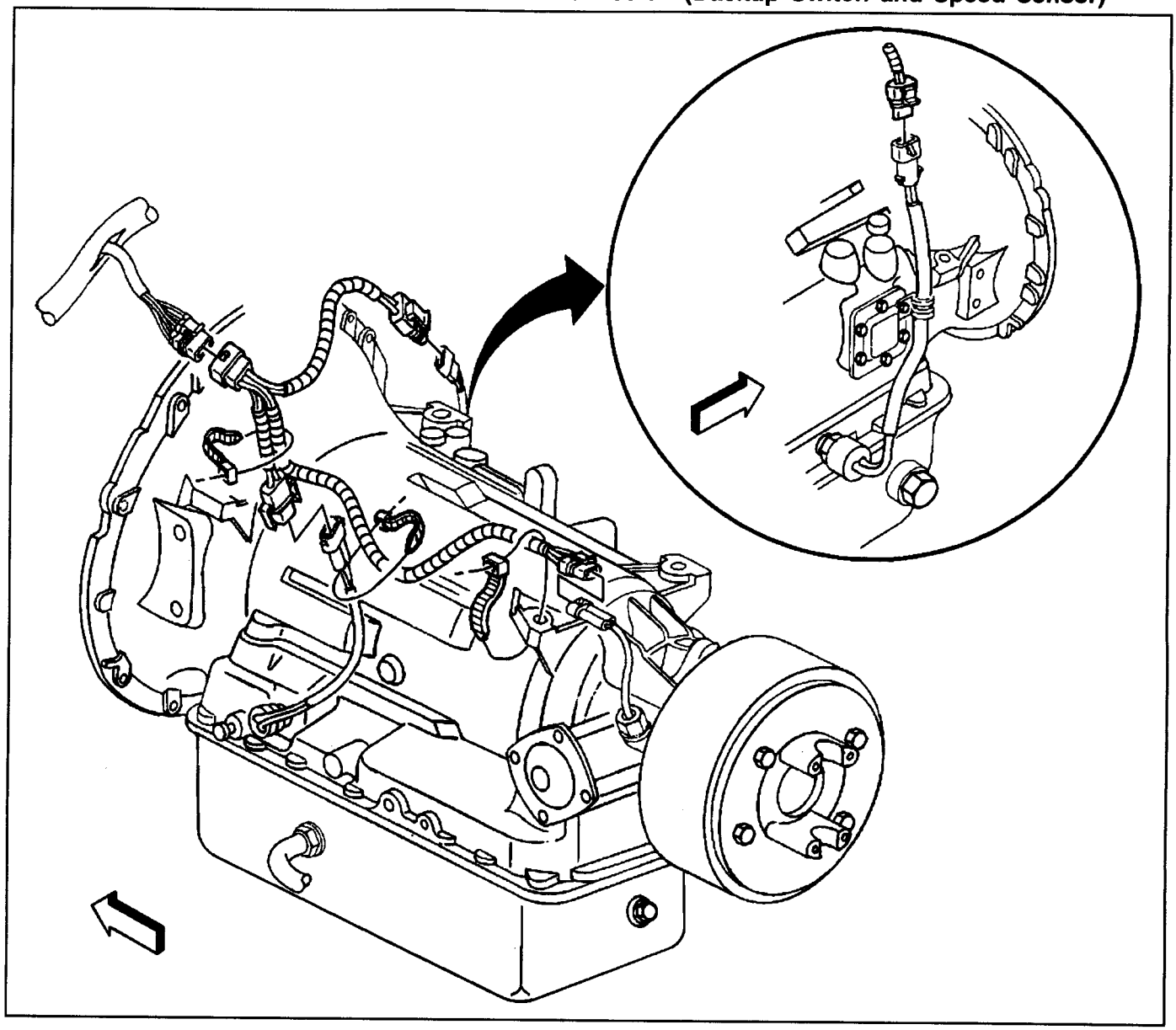
223222

Front Chassis Harness to Low Air Pressure Switch



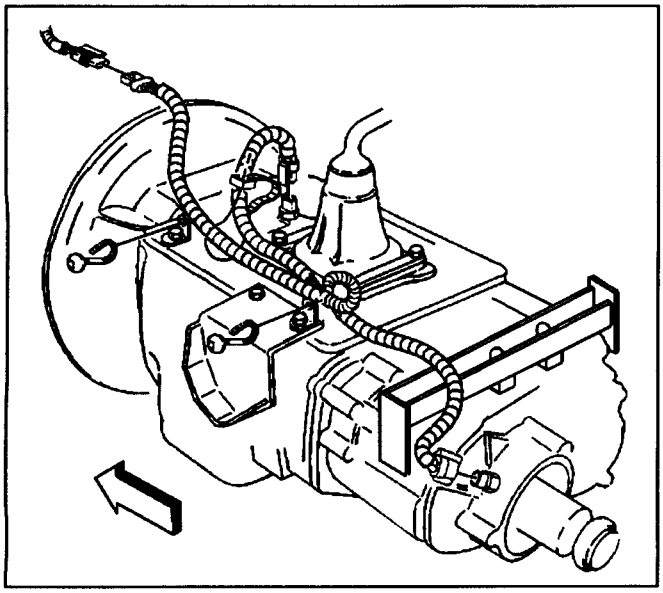
216402

Transmission Harness to Automatic Transmission (Backup Switch and Speed Sensor)



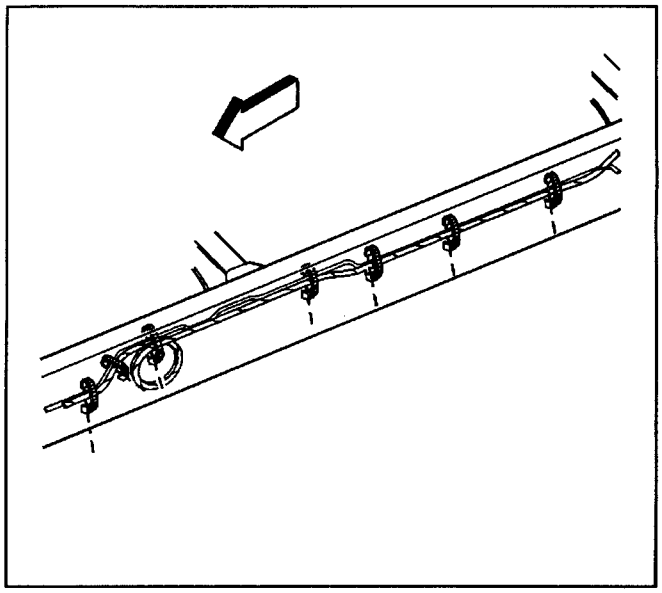
216412

Transmission Harness to Manual Transmission RPO-MTH/MUT/MWK (Backup Switch and Speed Sensor)



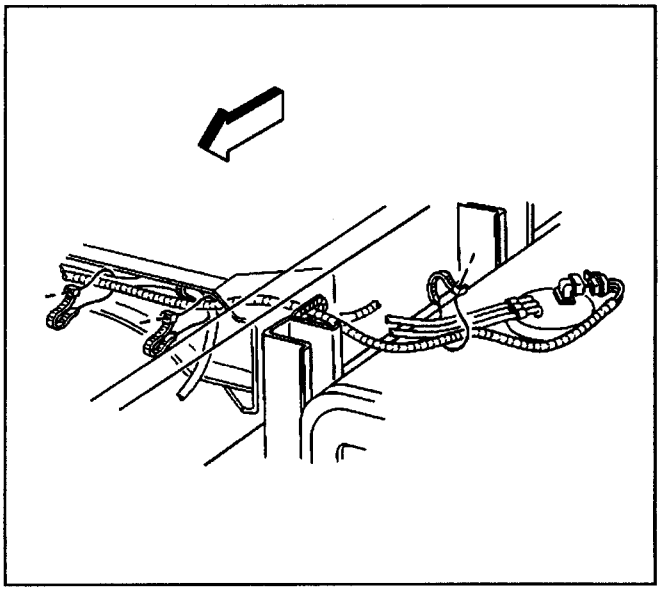
216421

Electric Brake Control Harness, Center



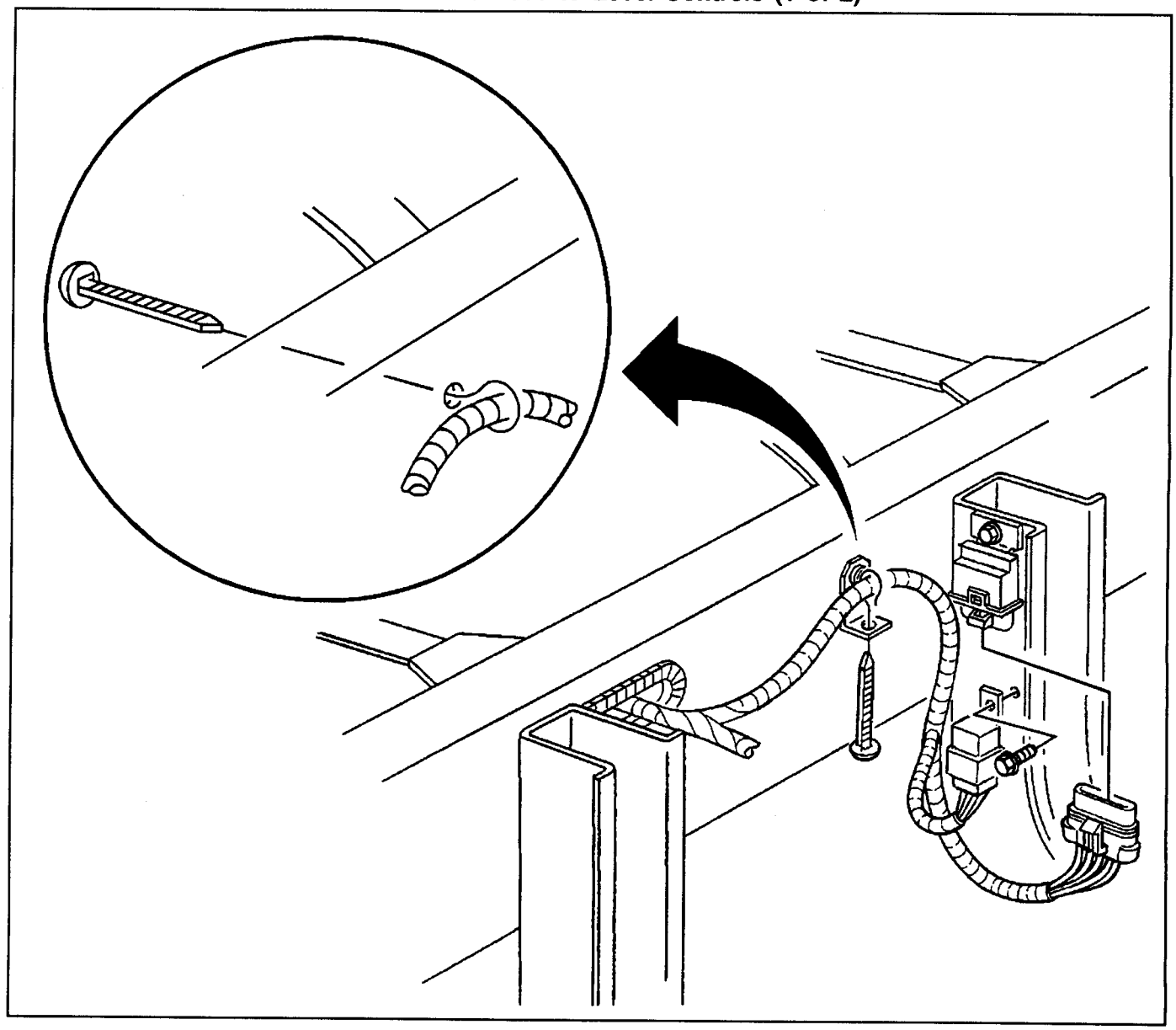
216426

Fuel Tank Harness, Left Side



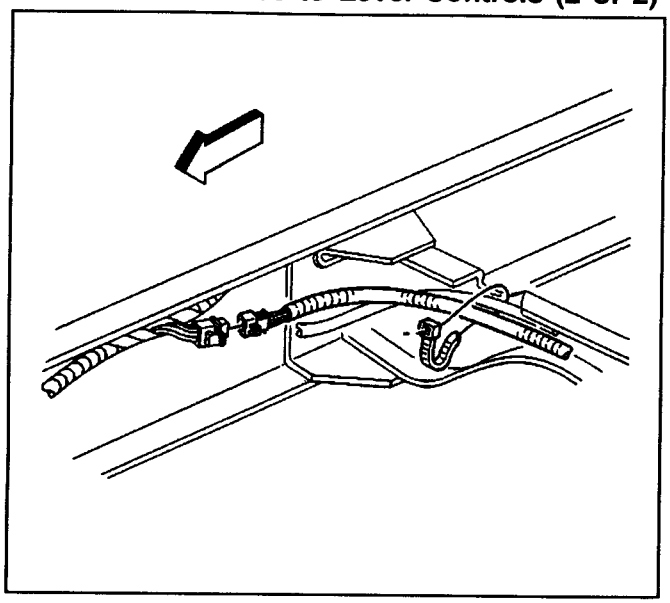
216429

Fuel Tank Harness to Level Controls (1 of 2)



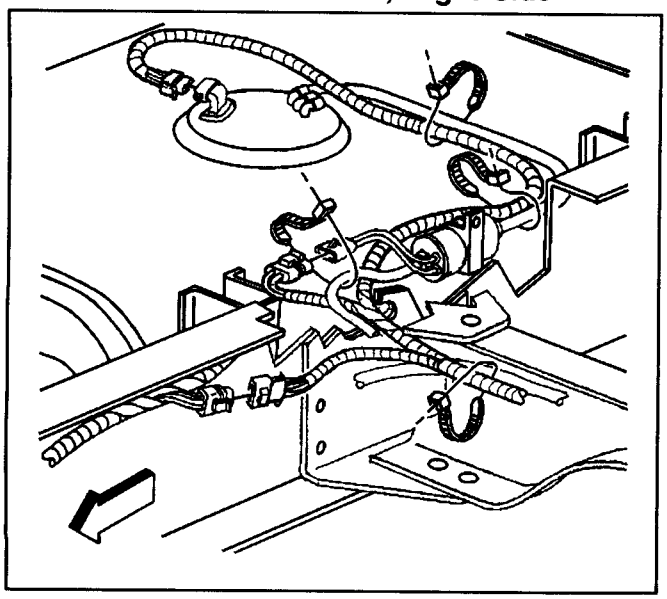
216454

Fuel Tank Harness to Level Controls (2 of 2)



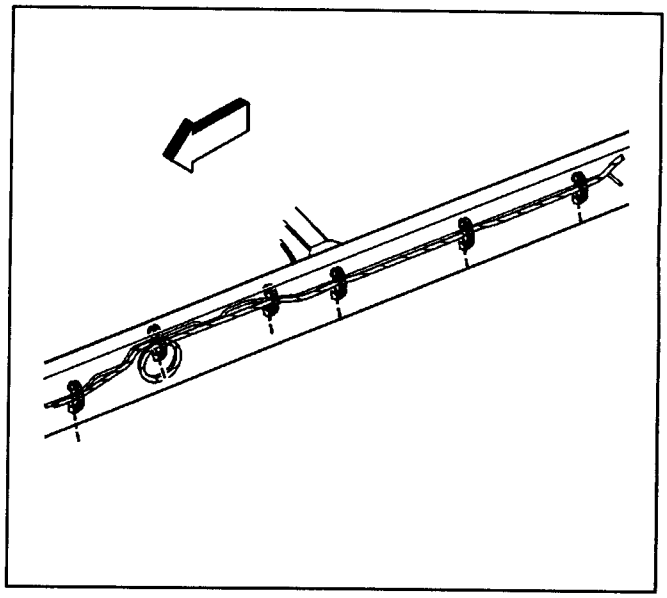
216463

Fuel Tank Harness, Right Side



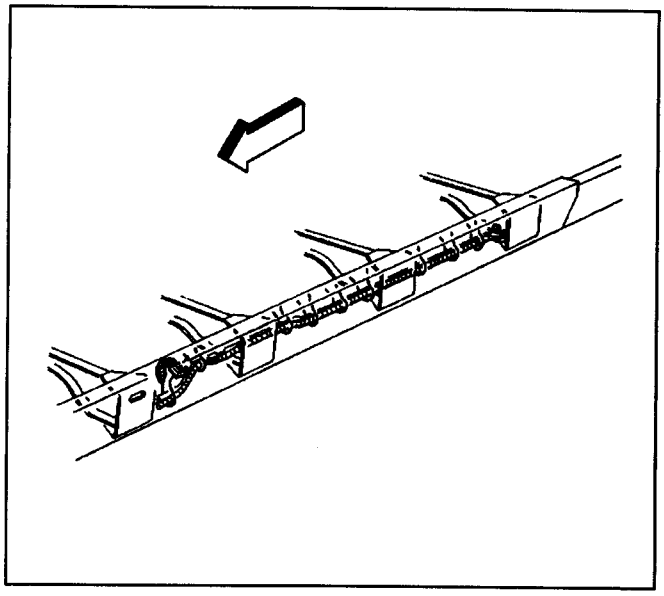
216465

Electric Brake Control Harness, Center RPO-JE3 and EM2



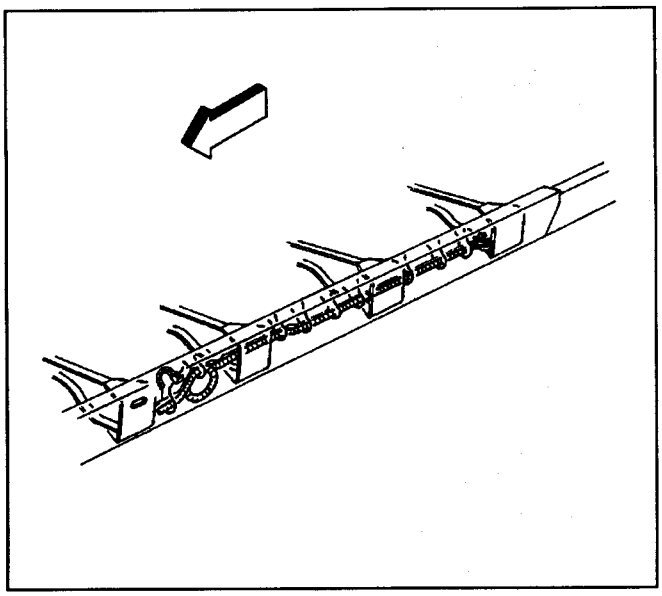
216483

Electric Brake Control Harness, Center RPO-JE3 and FPL



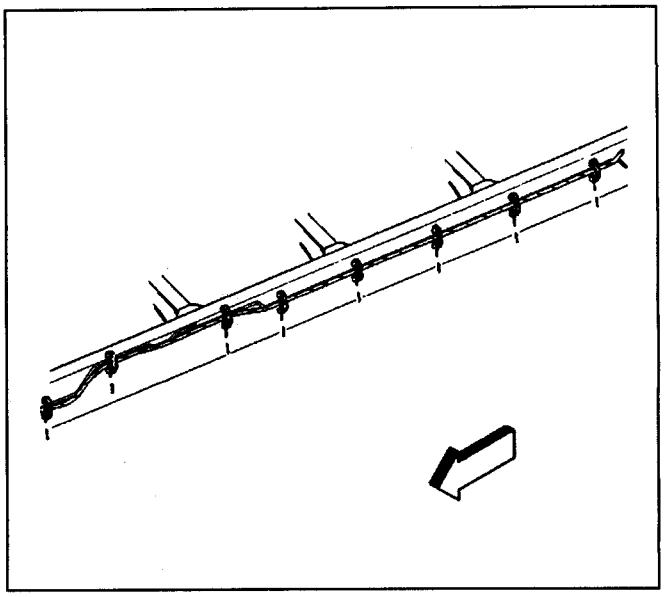
216486

Electric Brake Control Harness, Center RPO-JE3 and EQ8



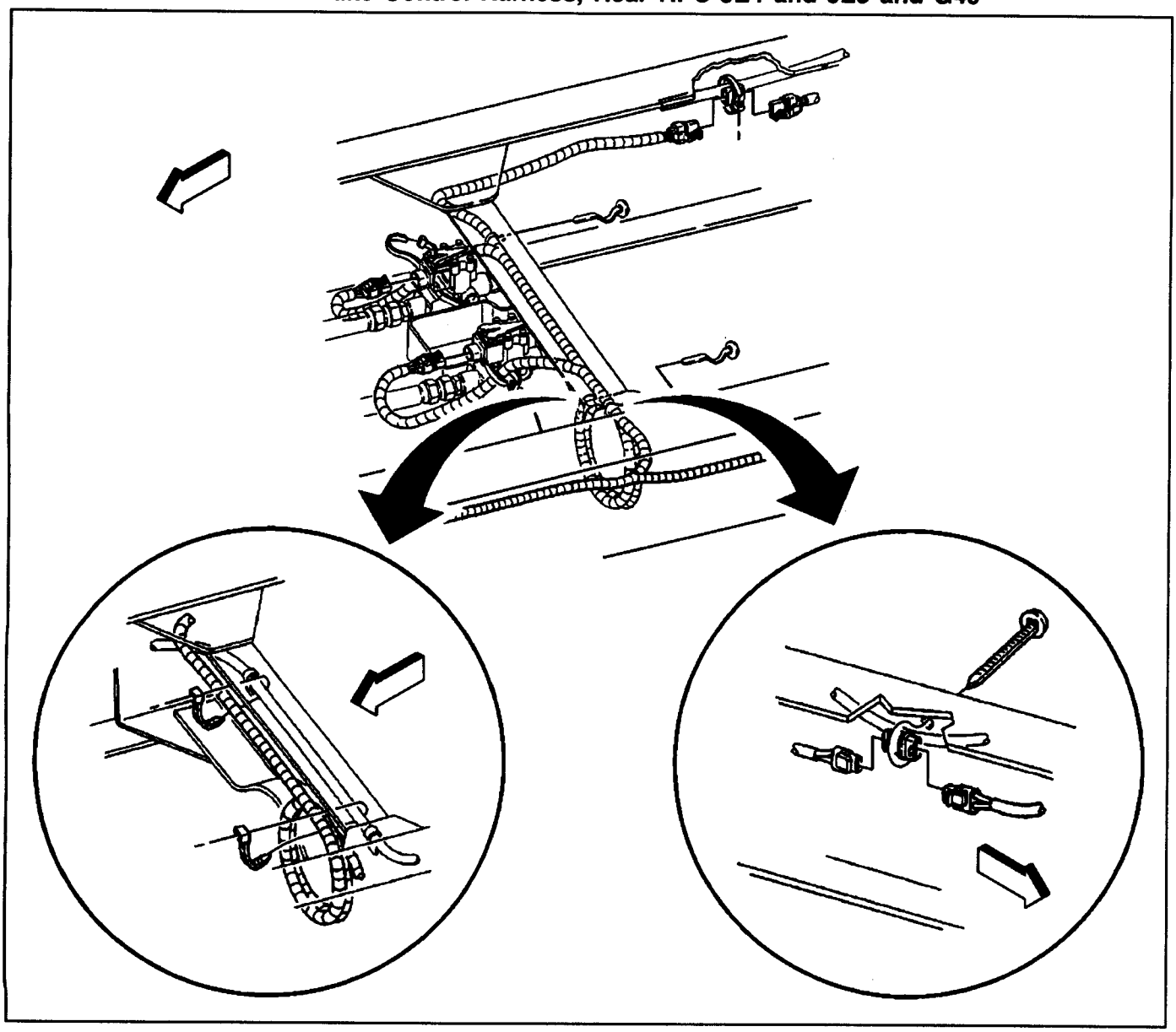
216491

Electric Brake Control Harness, Center RPO-JE3 and ES5



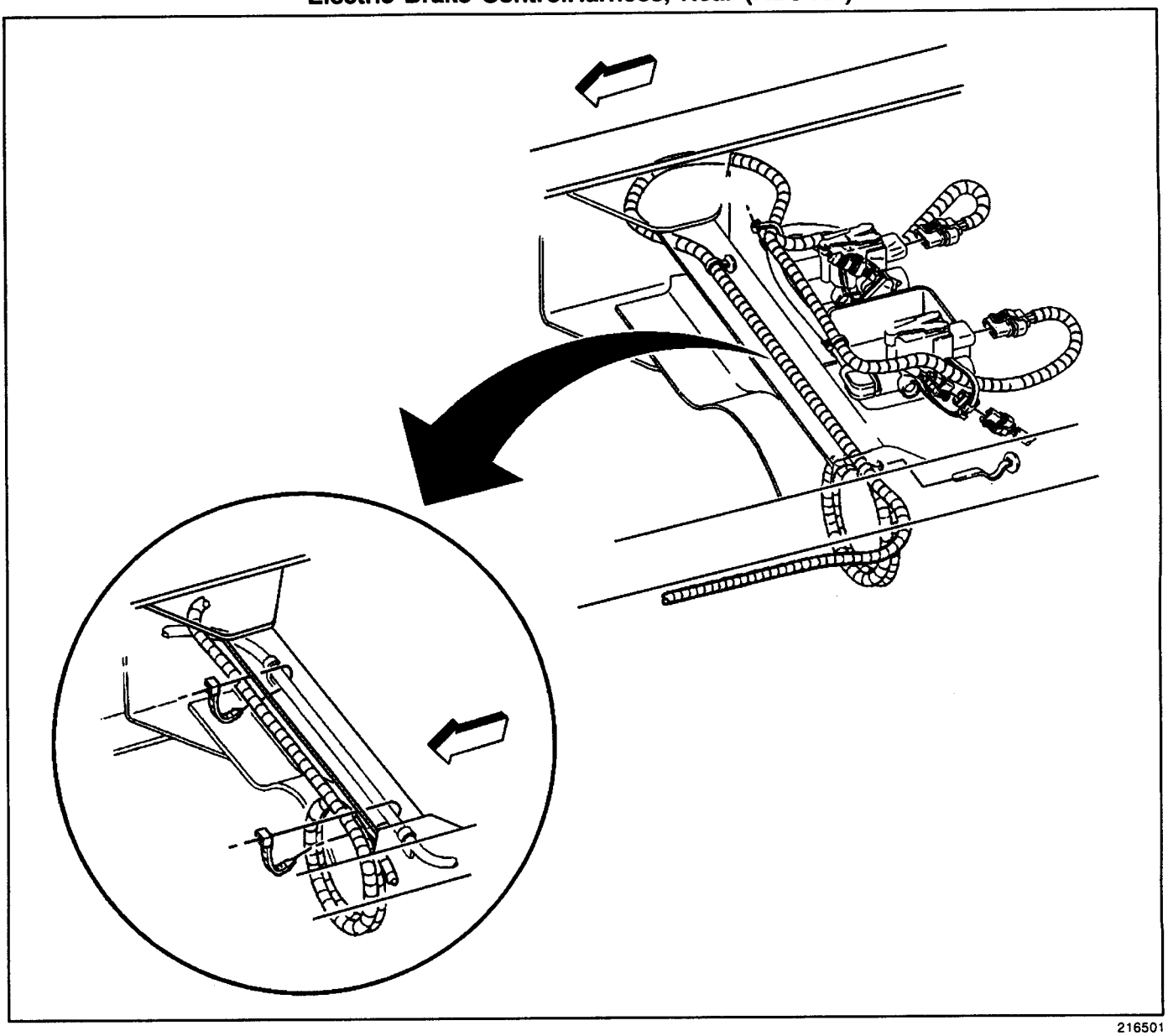
216494

Electric Brake Control Harness, Rear RPO-JE4 and JE5 and G40



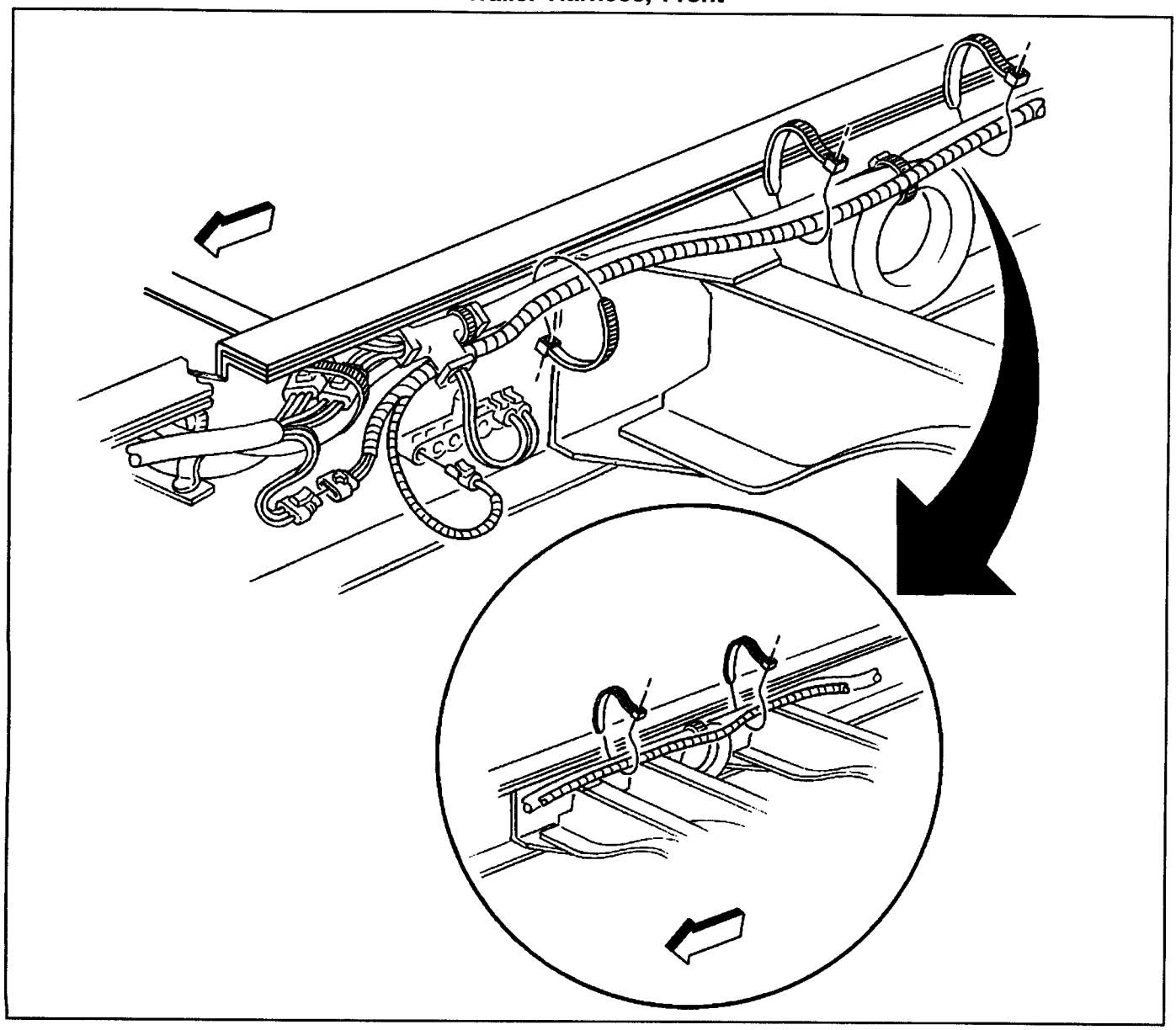
216499

Electric Brake ControlHarness, Rear (ABS-Air)



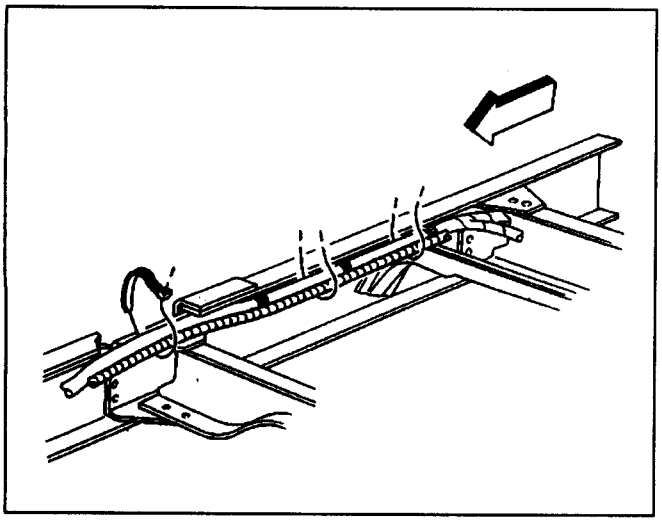
216501

Trailer Harness, Front



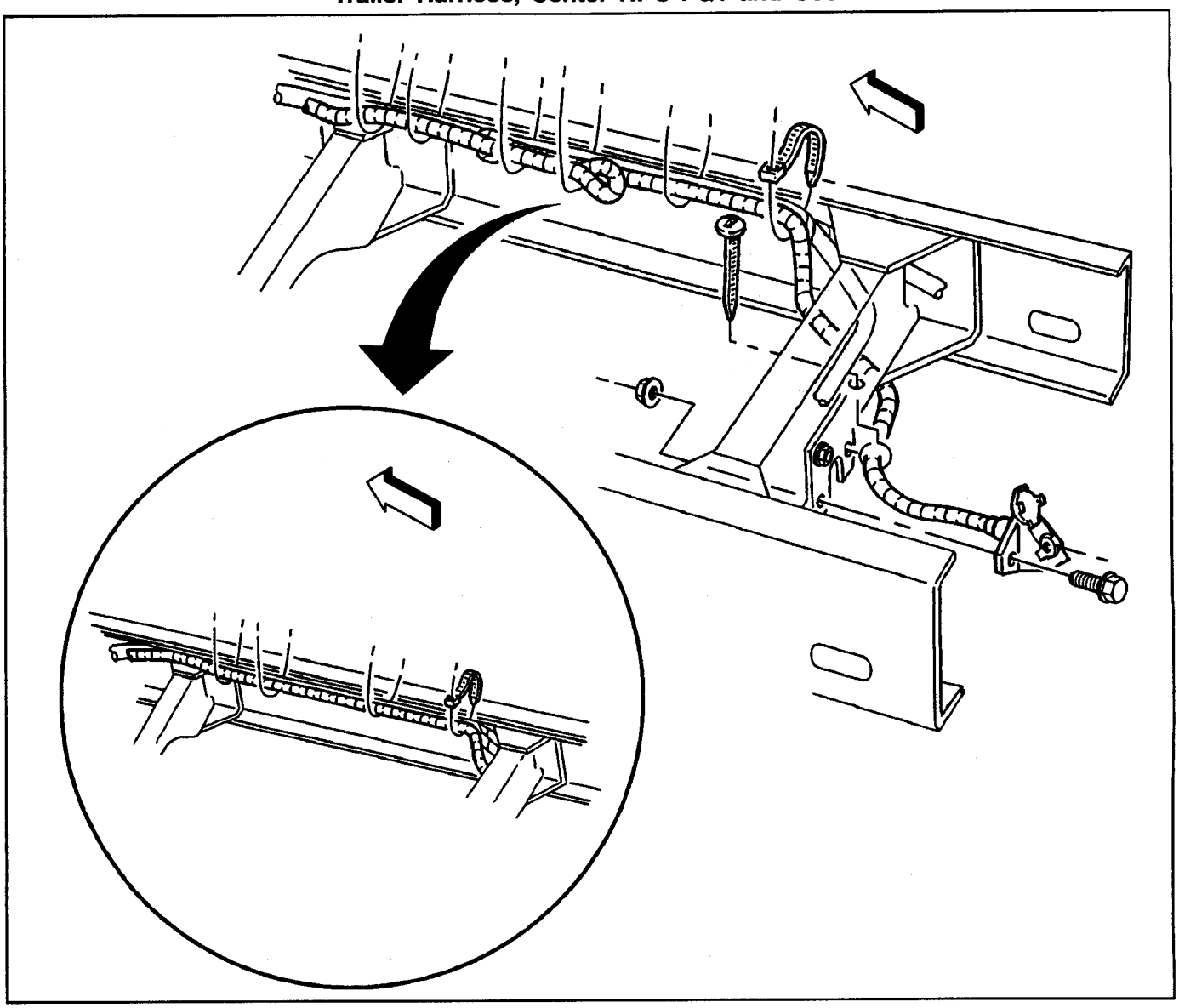
216502

Trailer Harness, Center



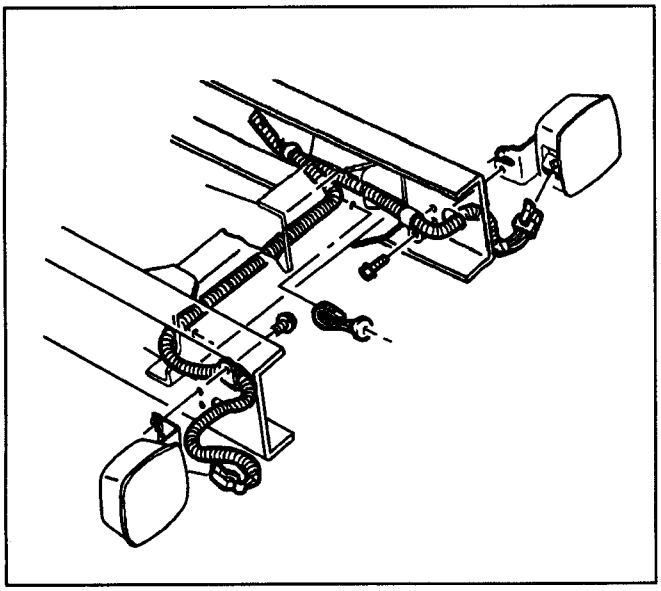
216503

Trailer Harness, Center RPO-FQT and U86



216093

Tail Light Harness



202612

Instrument Panel, Gauges and Console

Specifications

Fastener Tightening Specifications

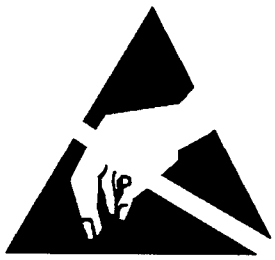
Application	Specification	
	Metric	English
Multifunctional Alarm Module Mounting Bolt	3 N·m	27 lb in

Schematic and Routing Diagrams

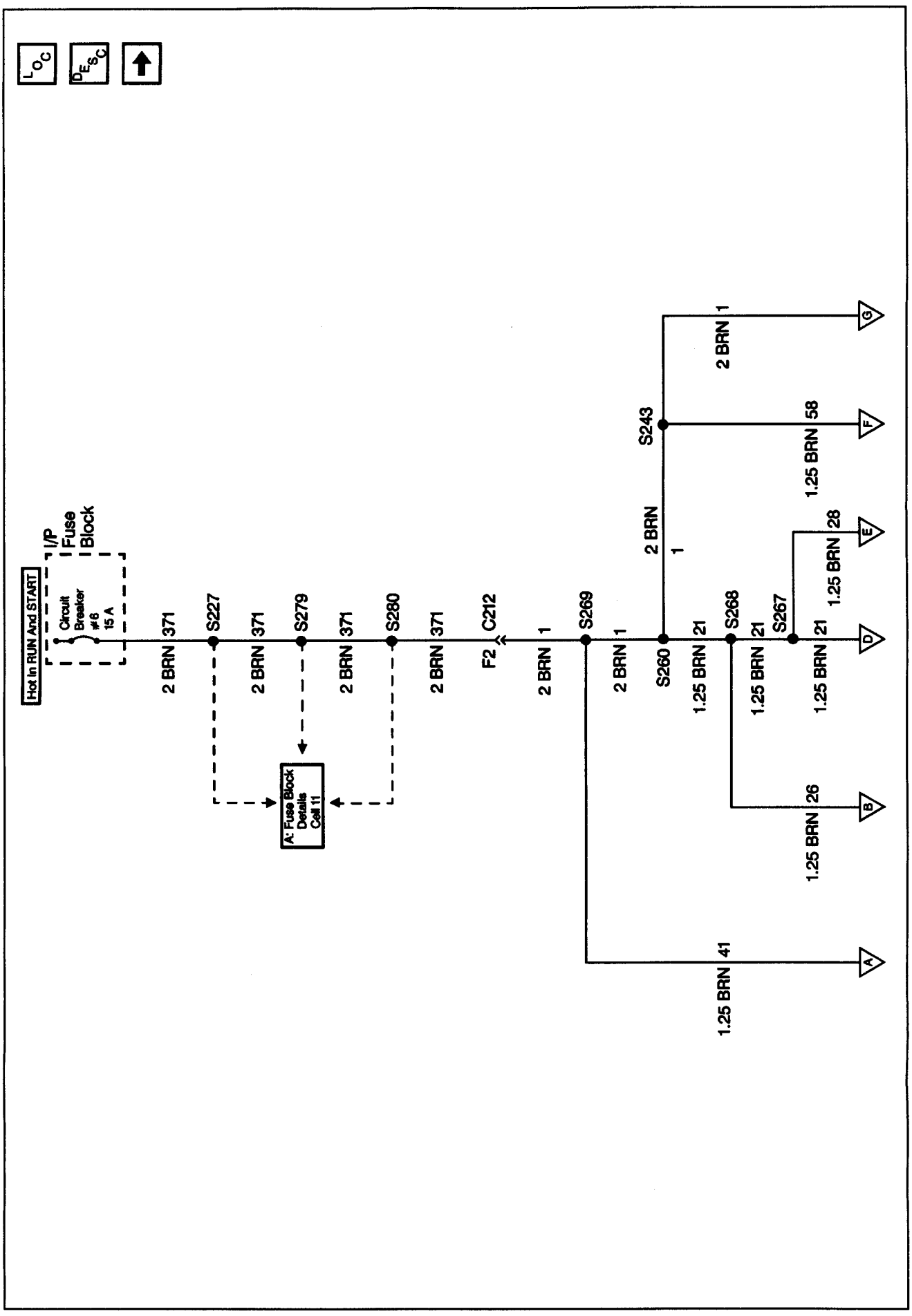
Instrument Cluster Schematic References

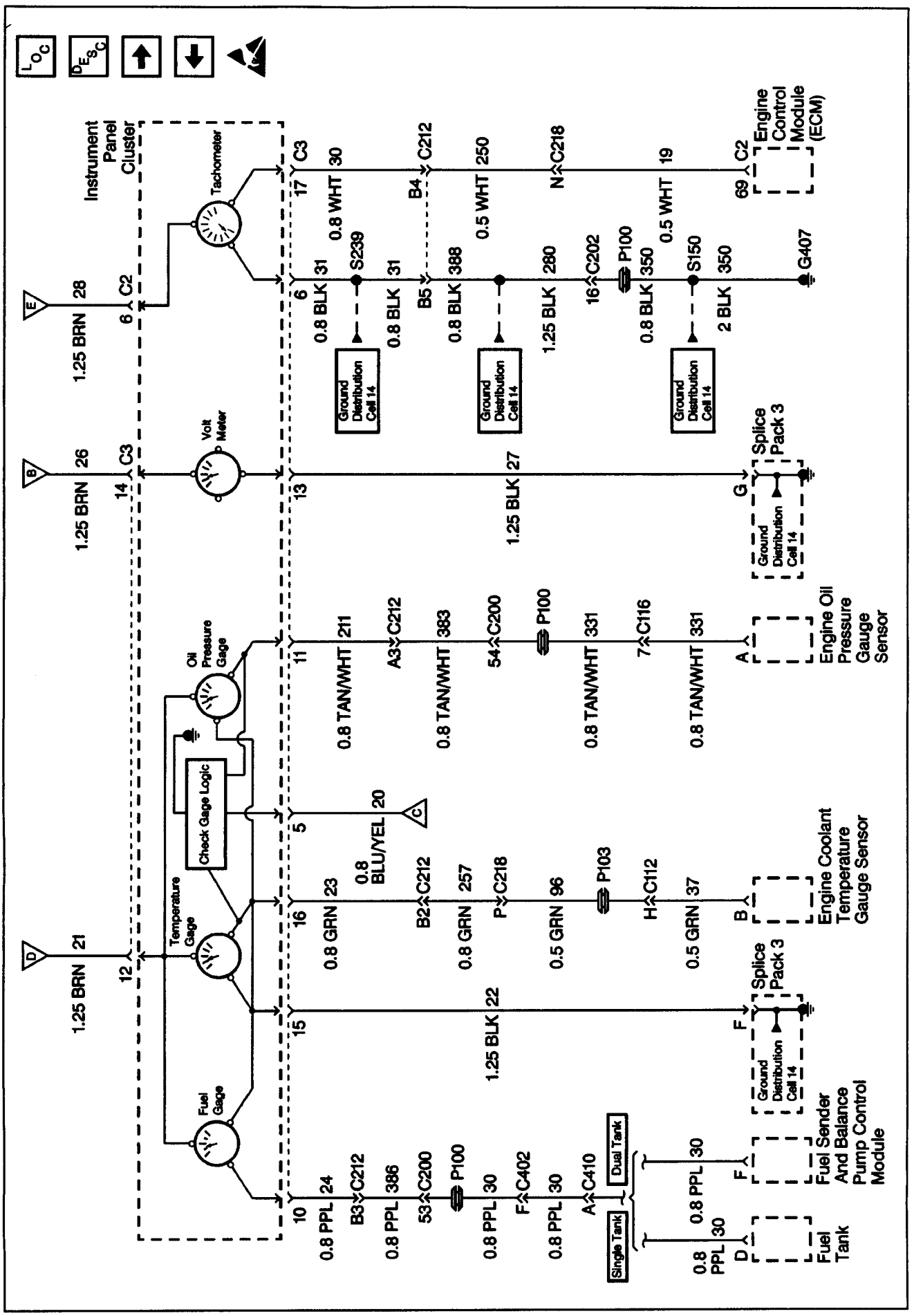
Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Instrument Panel Dimming Cell 117	8—Lighting Systems

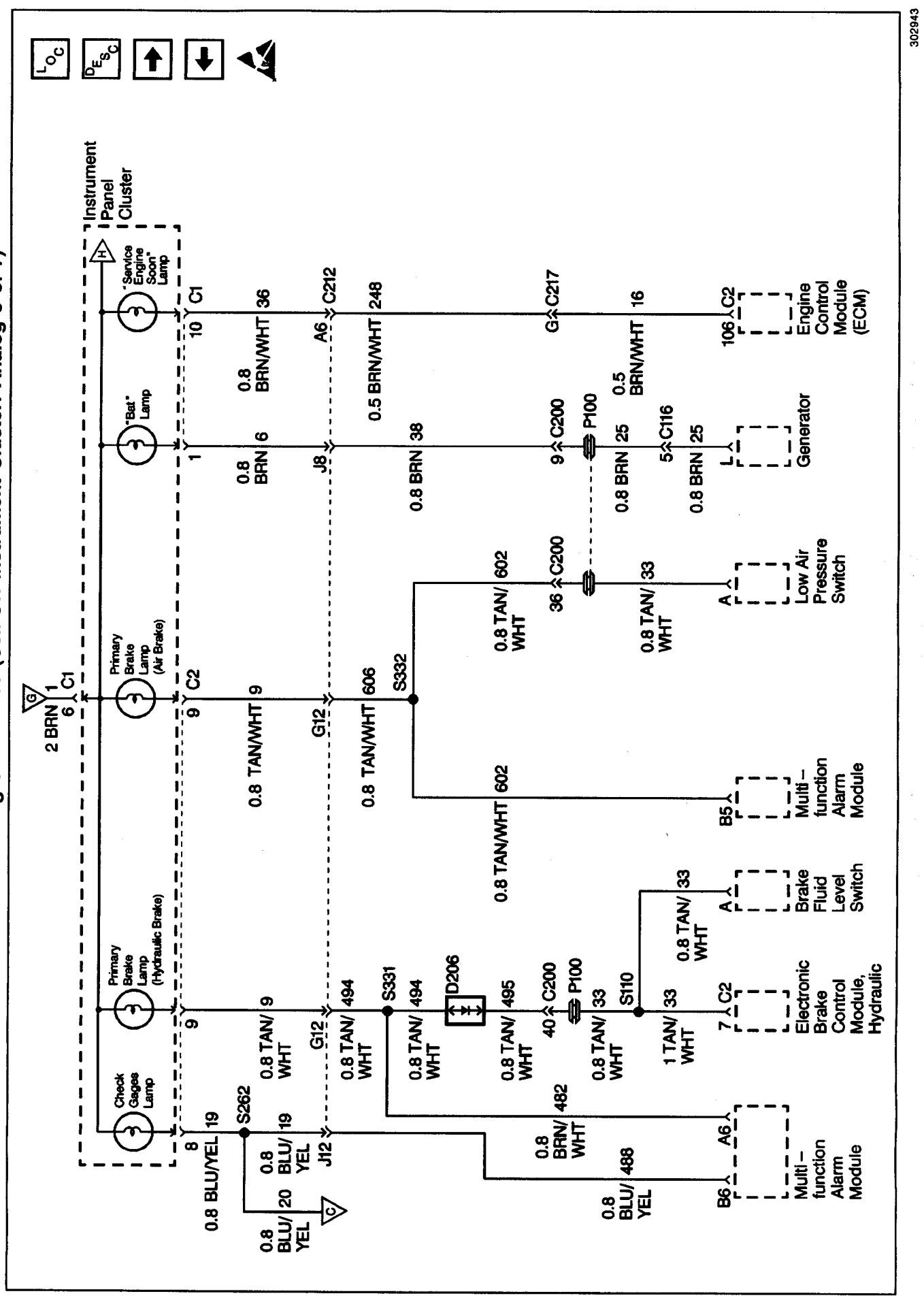
Instrument Cluster Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices.

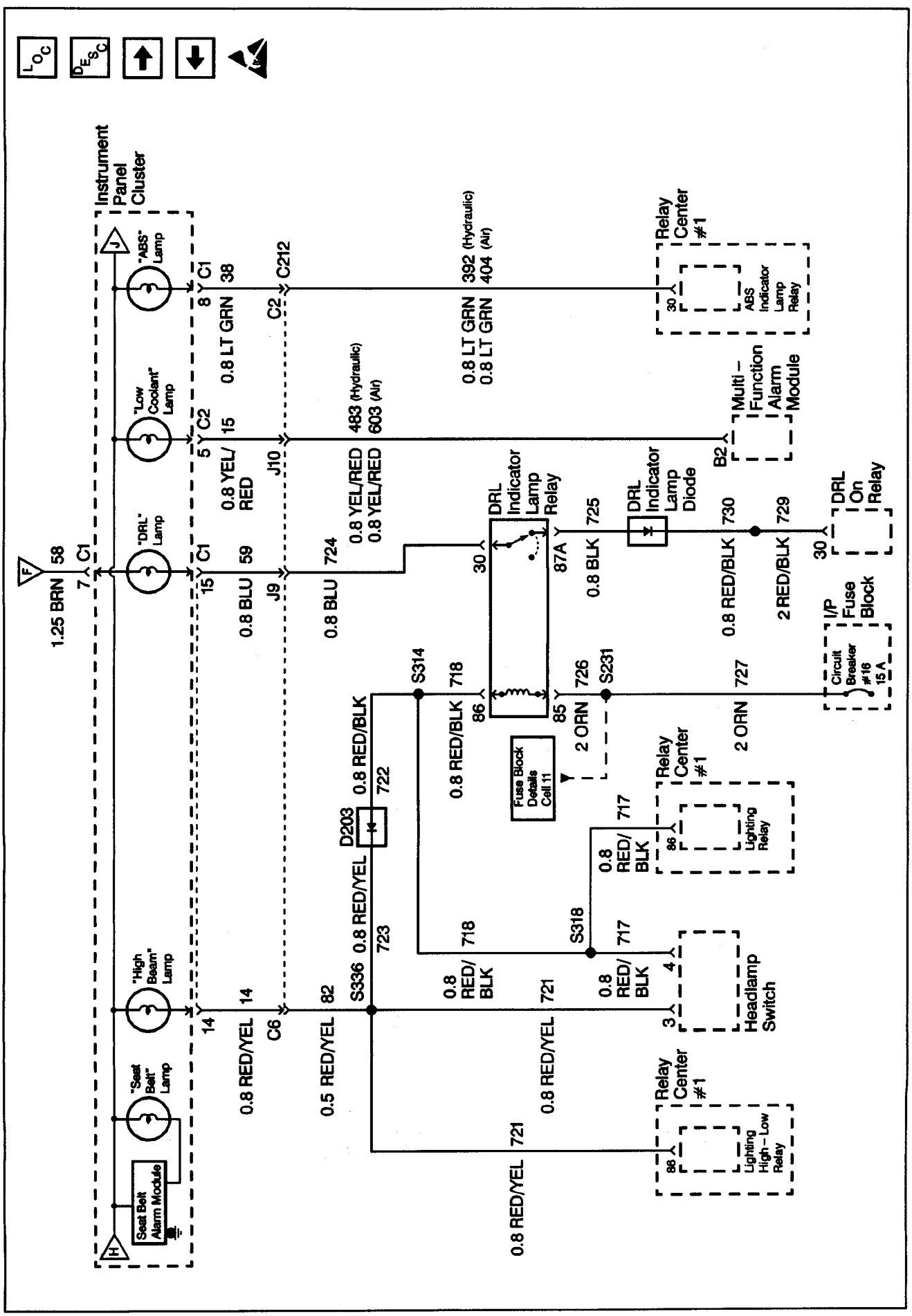
Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 1 of 7)

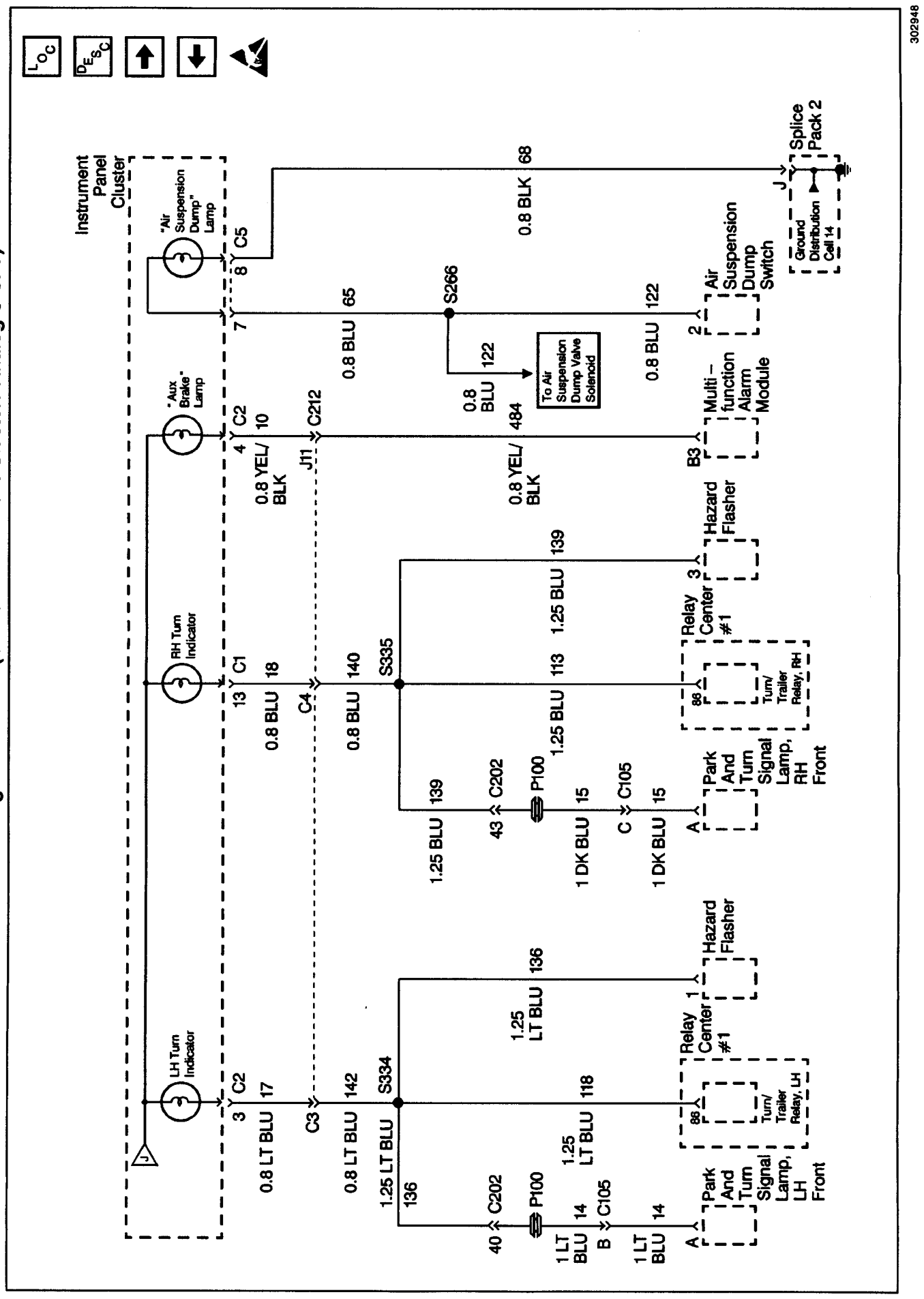


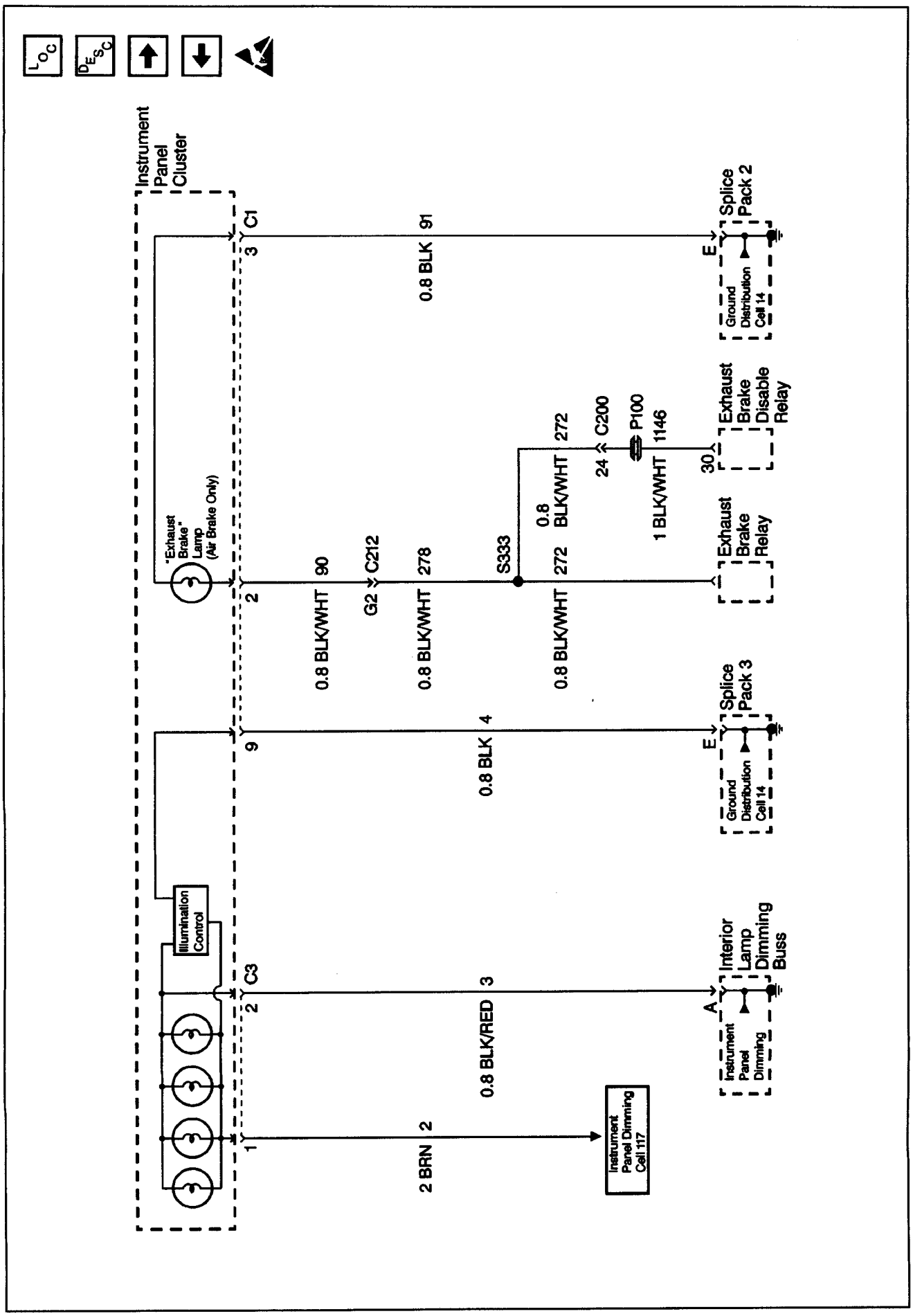

Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 2 of 7)
302941
Instrument Panel Cluster
Tachometer
Volt Meter
Oil Pressure Gage
Temperature Gage
Fuel Gage
Check Gage Logic
Engine Control Module (ECM)
Engine Oil Pressure Gauge Sensor
Engine Coolant Temperature Gauge Sensor
Fuel Sender And Balance Pump Control Module
Fuel Tank
Single Tank
Dual Tank
Splice Pack 3
Ground Distribution Cell 14
1.25 BRN
0.8 WHT
0.5 WHT
0.8 BLK
1.25 BLK
2 BLK
0.8 TAN/WHT
0.8 GRN
0.8 BLU/YEL
0.5 GRN
0.8 PPL
S239
S150
G407
P100
P103
C116
C112
C218
C200
C212
C202
C410
C402
C2
C3
C218
C212

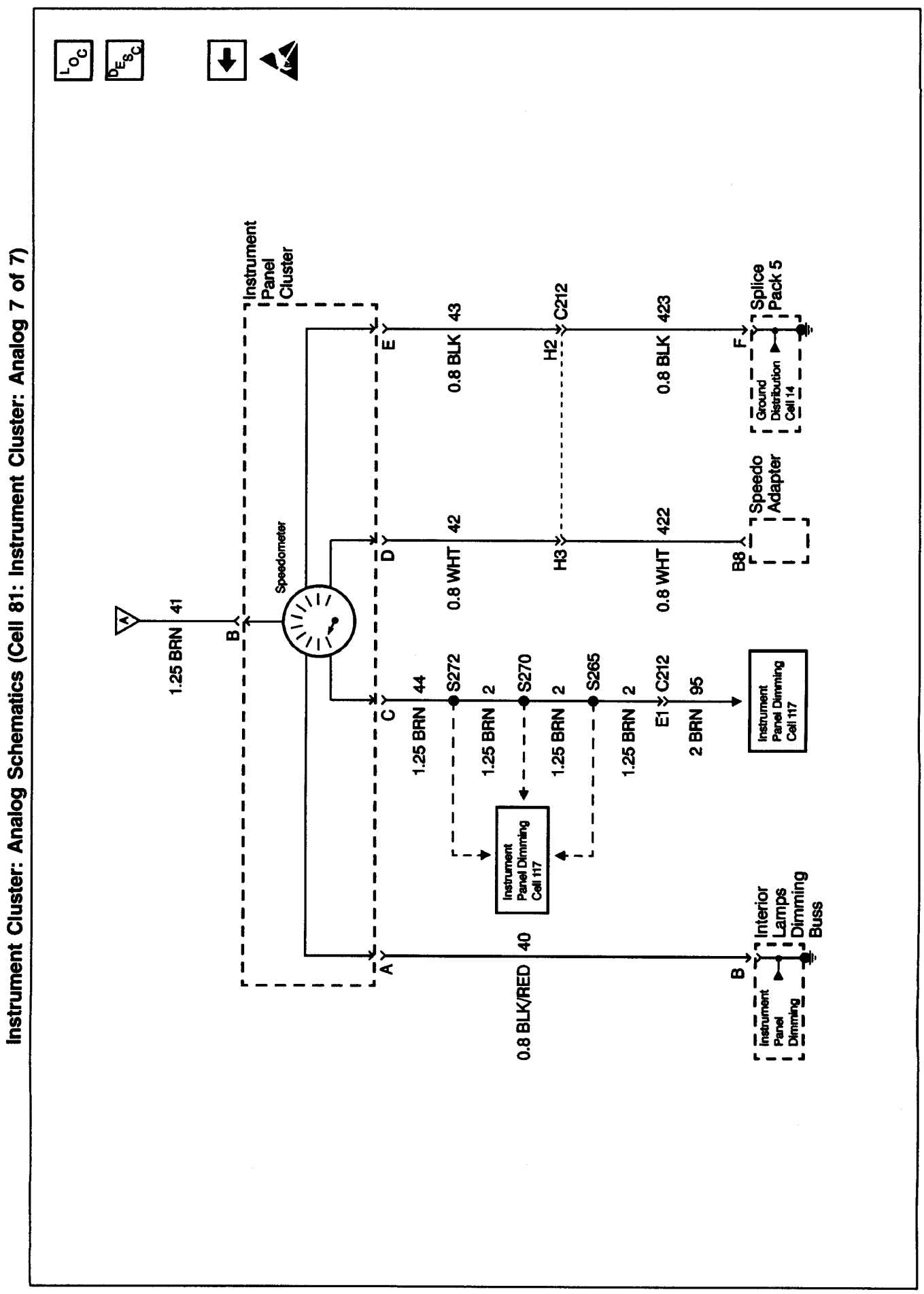

Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 3 of 7)
302943
Instrument Panel Cluster
"Service Engine Soon" Lamp
"Bat" Lamp
Primary Brake Lamp (Air Brake)
Primary Brake Lamp (Hydraulic Brake)
Check Gages Lamp
Engine Control Module (ECM)
Generator
Low Air Pressure Switch
Multi-function Alarm Module
Brake Fluid Level Switch
Electronic Brake Control Module, Hydraulic
Multi-function Alarm Module
2 BRN
0.8 BLU/YEL
0.8 BLU/YEL
0.8 BLU/YEL
0.8 BRN/WHT
0.8 BRN
0.5 BRN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 TAN/WHT
0.8 BRN/WHT
0.8 BLU/YEL
1 TAN/WHT
0.8 BRN
0.5 BRN/WHT
0.8 BRN
0.8 BRN
S262
S331
S332
S110
D206
P100
C200
C212
C217
C116
C1
C2
A6
B6
B5
J8
J12
G12
606
602
482
488
494
495
33
38
248
16
25
106
10
9
6
1
36
40
7
A
L
G
H
C

Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 4 of 7)




Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 5 of 7)
302948
Instrument Panel Cluster
"Air Suspension Dump" Lamp
"Aux Brake" Lamp
RH Turn Indicator
LH Turn Indicator
Air Suspension Dump Switch
Multi – function Alarm Module
Hazard Flasher
Relay Center #1
Turn/ Trailer Relay, RH
Turn/ Trailer Relay, LH
Park And Turn Signal Lamp, RH Front
Park And Turn Signal Lamp, LH Front
To Air Suspension Dump Valve Solenoid
Splice Pack 2
Ground Distribution Cell 14
C1
C2
C3
C4
C5
C202
C105
C212
J1
P100
S266
S334
S335
0.8 BLK
0.8 BLU
0.8 YEL/ BLK
0.8 LT BLU
1.25 BLU
1.25 LT BLU
1.25 LT BLU
1 DK BLU
1 LT BLU


Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 6 of 7)
302950
Instrument Panel Cluster
"Exhaust Brake" Lamp (Air Brake Only)
Illumination Control
C1
C3
C212
C200
P100
S333
Splice Pack 2
Splice Pack 3
Ground Distribution Cell 14
Exhaust Brake Disable Relay
Exhaust Brake Relay
Interior Lamp Dimming Buss
Instrument Panel Dimming
Instrument Panel Dimming Cell 117
0.8 BLK/WHT 90
0.8 BLK/WHT 278
0.8 BLK/WHT 272
0.8 BLK/WHT 272
1 BLK/WHT 1146
0.8 BLK 91
0.8 BLK 4
0.8 BLK/RED 3
2 BRN 2


Instrument Cluster: Analog Schematics (Cell 81: Instrument Cluster: Analog 7 of 7)
LOC
DESC
302953
Instrument Panel Cluster
Speedometer
1.25 BRN 41
B
A
0.8 BLK/RED 40
C
1.25 BRN 44
S272
2
1.25 BRN
S270
2
1.25 BRN
S265
2
1.25 BRN
E1
C212
95
2 BRN
Instrument Panel Dimming Cell 117
Instrument Panel Dimming Cell 117
D
0.8 WHT 42
H3
C212
422
0.8 WHT
B8
Speedo Adapter
E
0.8 BLK 43
H2
C212
423
0.8 BLK
F
Splice Pack 5
Ground Distribution Cell 14
B
Interior Lamps Dimming Buss
Instrument Panel Dimming

Component Locator

Instrument Cluster Components

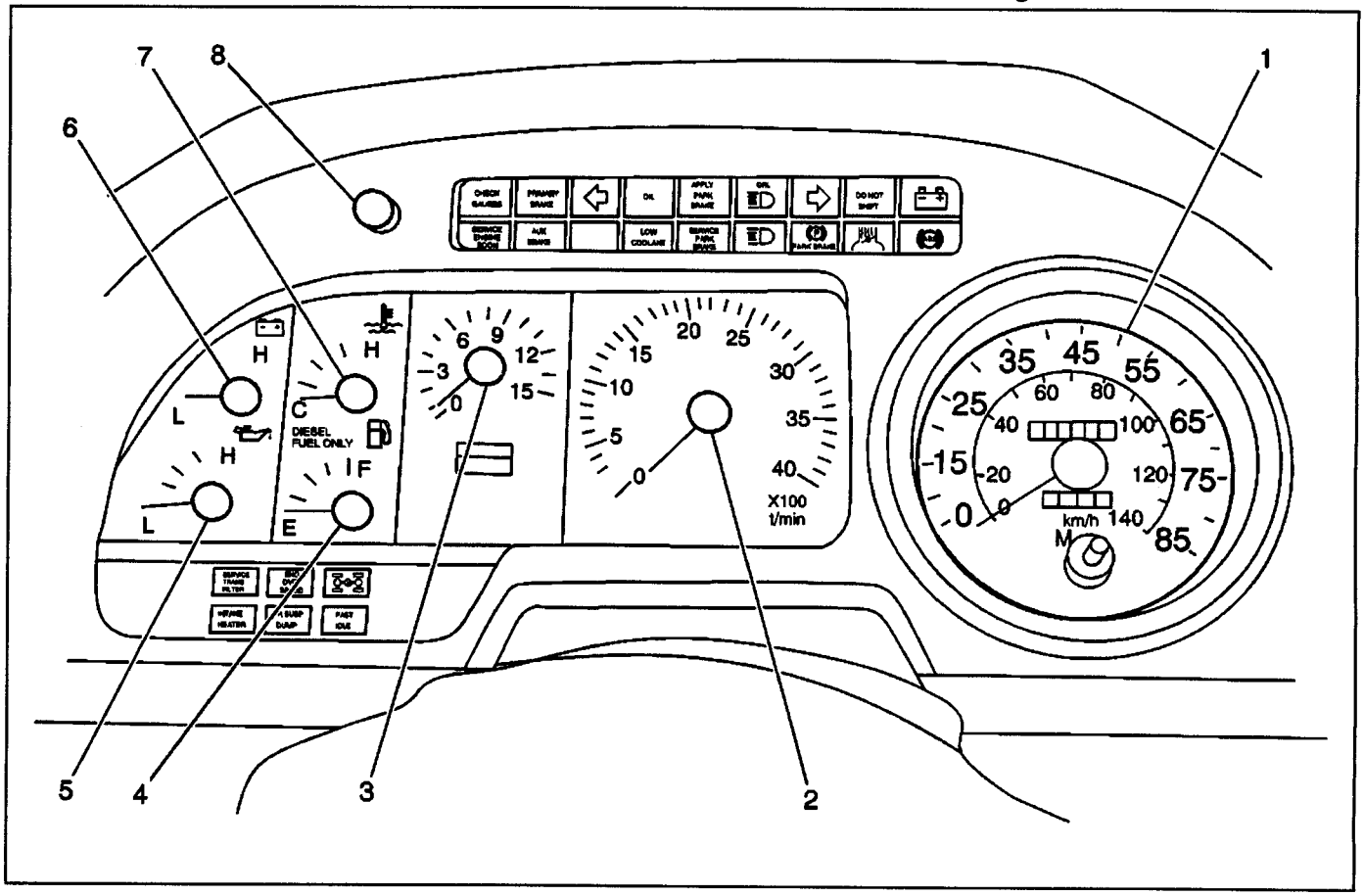
Name	Location	Locator View	Connector End View
Engine Coolant Temperature (ECT) Gauge	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Engine Coolant Temperature (ECT) Gauge Sensor	On the upper left side of the engine	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Engine Oil Pressure (EOP) Gauge	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Engine Oil Pressure (EOP) Gauge Sensor	On the right side of the engine block	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Engine Oil Pressure (EOP) Indicator Switch	On the inside left frame rail, in the front of the oil filter	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Fuel Gauge	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Fuel Sender, Left Side Tank	On the outboard of the left frame rail in the fuel tank	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Fuel Sender, Right Side Tank	On the outboard of the right frame rail in the fuel tank	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Hourmeter	Under the left side of the IP, near the data link connector (DLC)	—	—
Indicator Lamps Check Switch	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Instrument Panel Cluster (IPC)	On the left side of the IP	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Instrument Panel Cluster (IPC) C1 (15 Cavities)	On the upper IP harness to the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Instrument Panel Cluster (IPC) C2 (9 Cavities)	On the upper IP harness to the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Instrument Panel Cluster (IPC) C3 (17 Cavities)	On the upper IP harness to the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Instrument Panel Cluster (IPC) C4 (7 Cavities)	On the upper IP harness to the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Low Engine Coolant Level Indicator Lamp Diode (D200)	On the lower IP harness, part of diode module 1, plugged into joint connector 1, terminals A1, B1 and C1	—	—
Low Engine Coolant Level Indicator Switch	On the left cab bridge, on the bottom of the radiator surge tank	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Park Brake Switch (ABS Air)	In the center of the IP, below the radio	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Park Brake Switch (Hydraulic Brakes)	On the park brake lever bracket	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Speedo Adapter (Vehicle Speed Sensor [VSS] Buffer) (Diesel)	Under the right seat	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Speedometer	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Tachometer	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*

Instrument Cluster Components (cont'd)

Name	Location	Locator View	Connector End View
Vehicle Speed Sensor (VSS) (Automatic Transmission)	On the transmission rear tailshaft housing	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Vehicle Speed Sensor (VSS) (Manual Transmission)	On the transmission rear tailshaft housing	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Vehicle Speed Sensor (VSS) Buffer	Under the right seat	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*
Voltmeter	On the left side of the IP, part of the instrument panel cluster (IPC)	*Instrument Cluster Component Views*	*Instrument Cluster Connector End Views*

Instrument Cluster Component Views

Instrument Panel and Instrument Cluster With Gauges

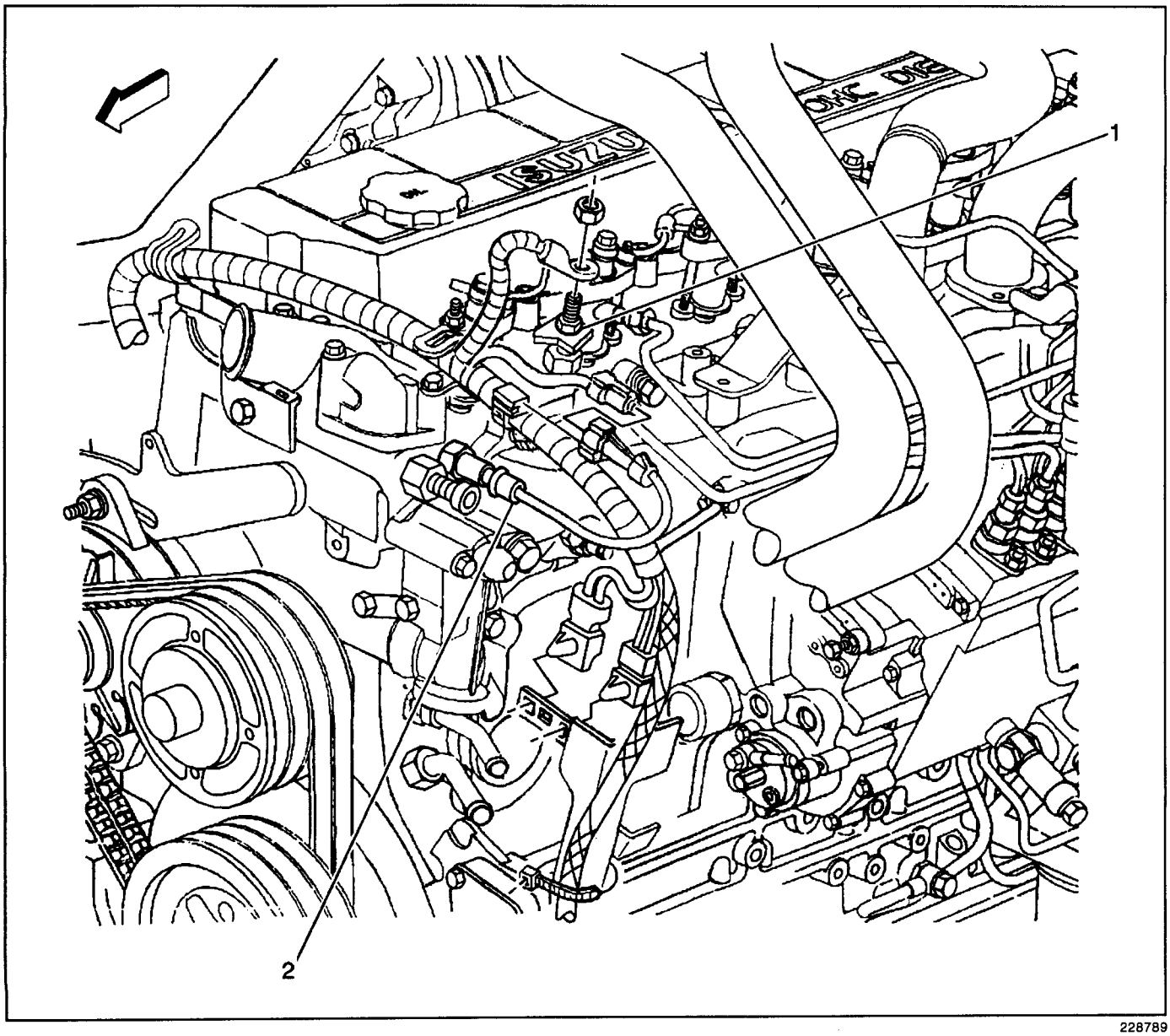


228466

Legend

(1) Speedometer
(2) Tachometer
(3) Air Pressure Gauge
(4) Fuel Gauge
(5) Engine Oil Pressure Gauge
(6) Voltmeter
(7) Engine Coolant Temperature (ECT) Gauge
(8) Indicator Lamps Check Switch

Engine Harness to Engine, Upper LH Front View



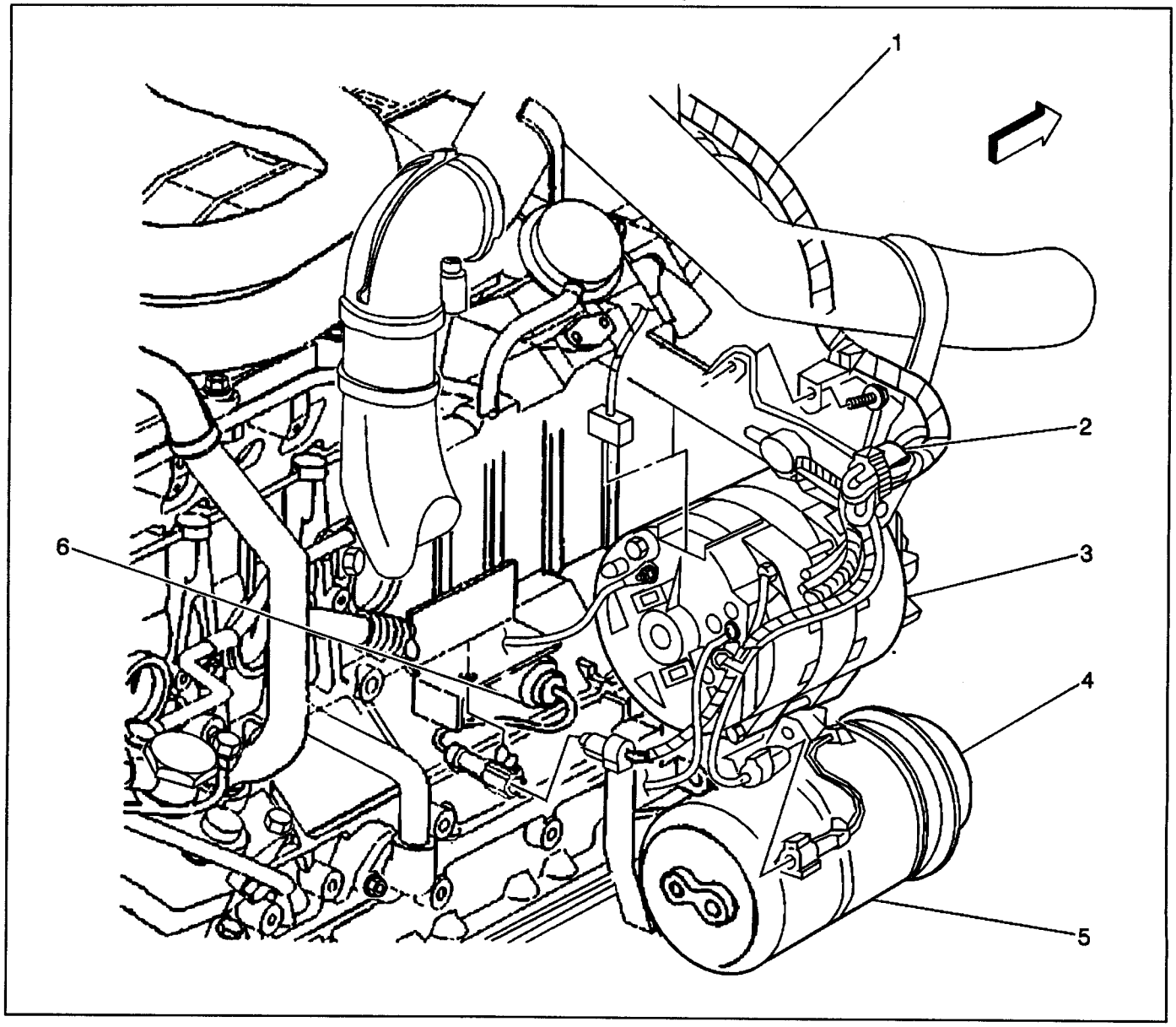
228789

Legend

(1) Glow Plug

(2) Engine Harness to Front Chassis Connector C118 (2 cavities)

Engine Harness to RH Side of Engine, RH Rear View

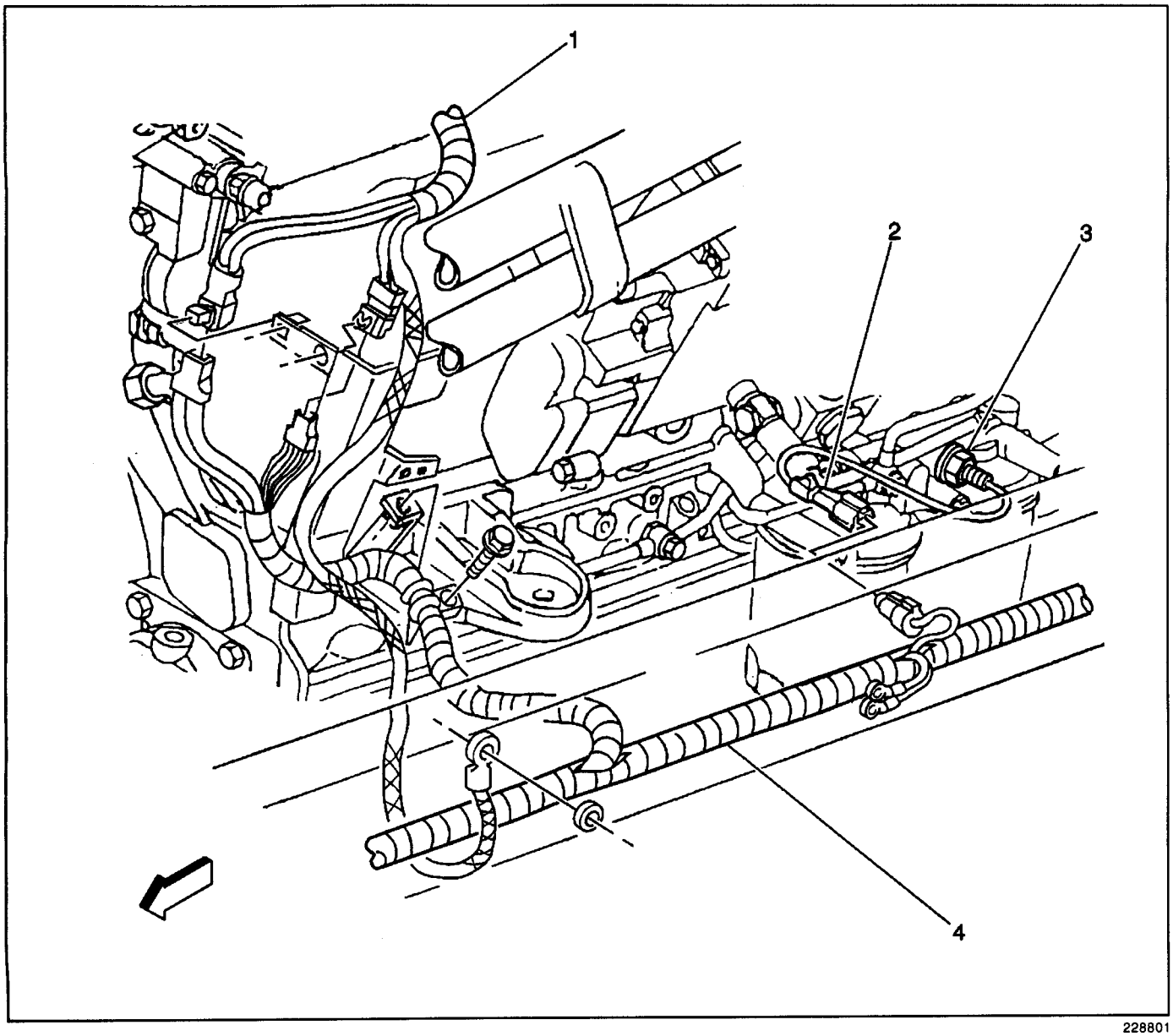


228805

Legend

(1) Engine Harness
(2) Generator Fuse
(3) Generator
(4) A/C Compressor Clutch
(5) A/C Compressor
(6) Engine Oil Pressure Gauge Sensor

Front Chassis Harness to Engine, LH Front View

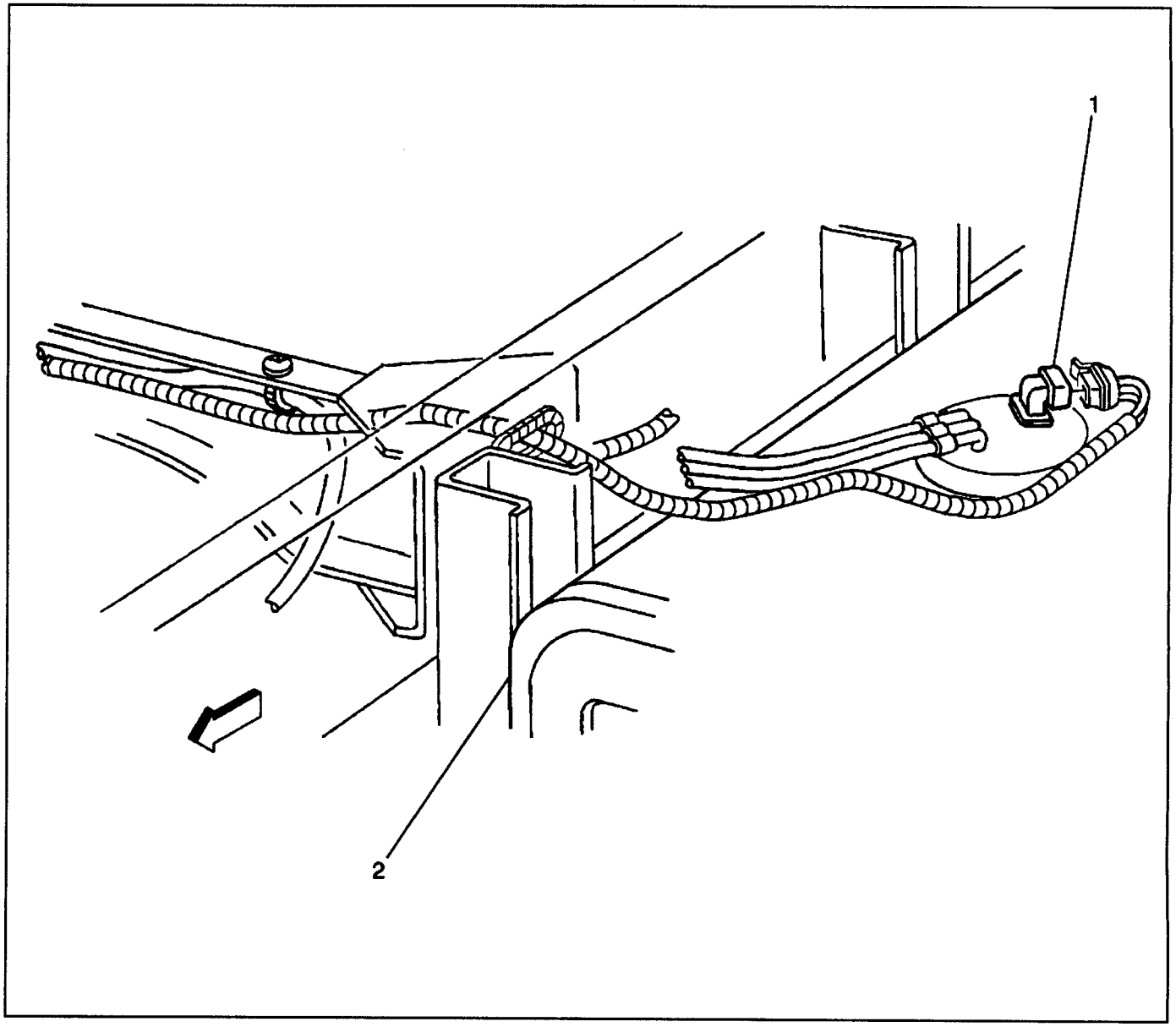


228801

Legend

(1) Engine Harness
(2) Engine Oil Pressure Indicator Switch Connector
(3) Engine Oil Pressure Indicator Switch
(4) Front Chassis Harness

Fuel Tank Harness, LH Side

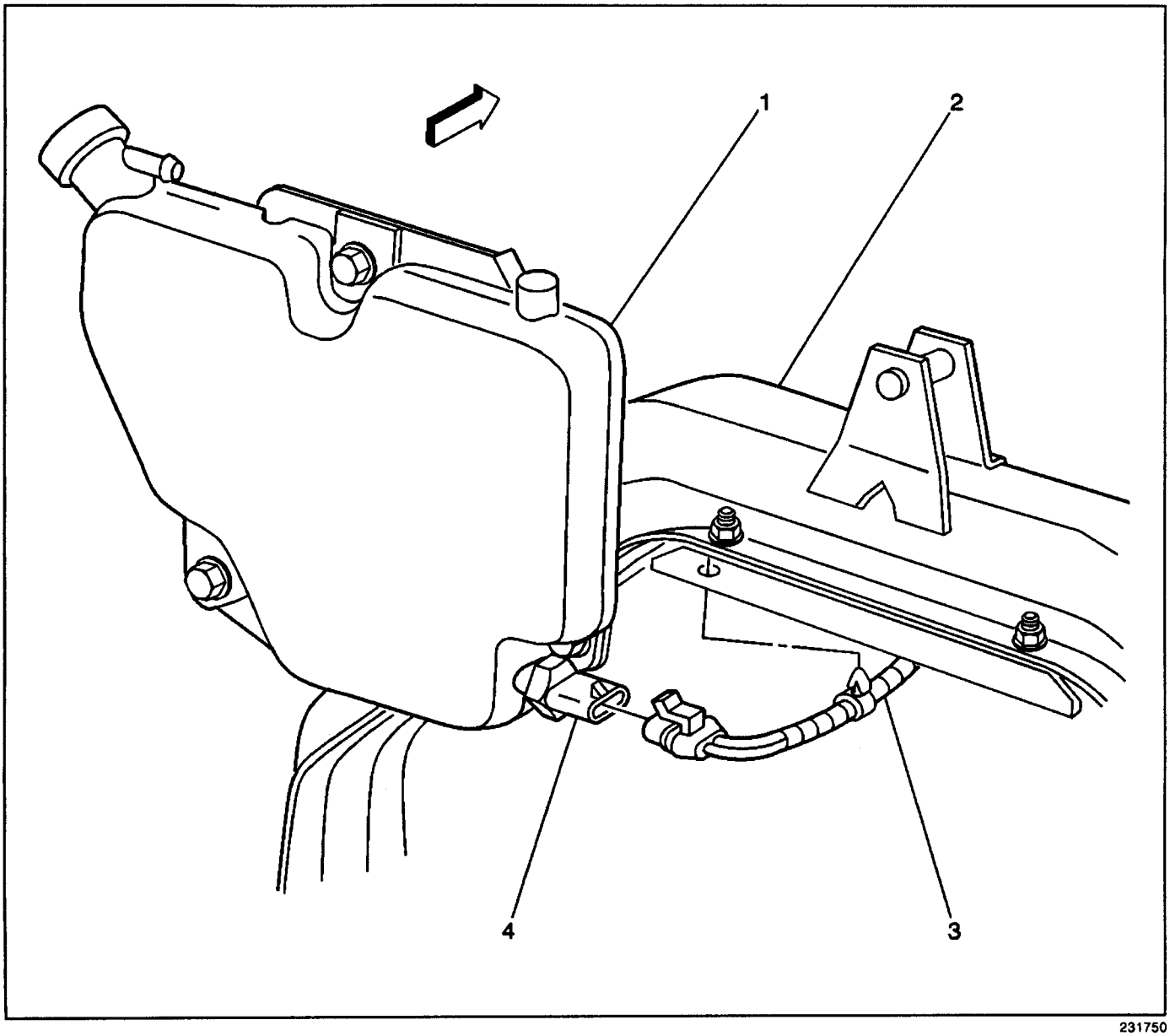


231729

Legend

(1) Fuel Sender
(2) Fuel Tank

Front Chassis Harness to Radiator Surge Tank, Forward View

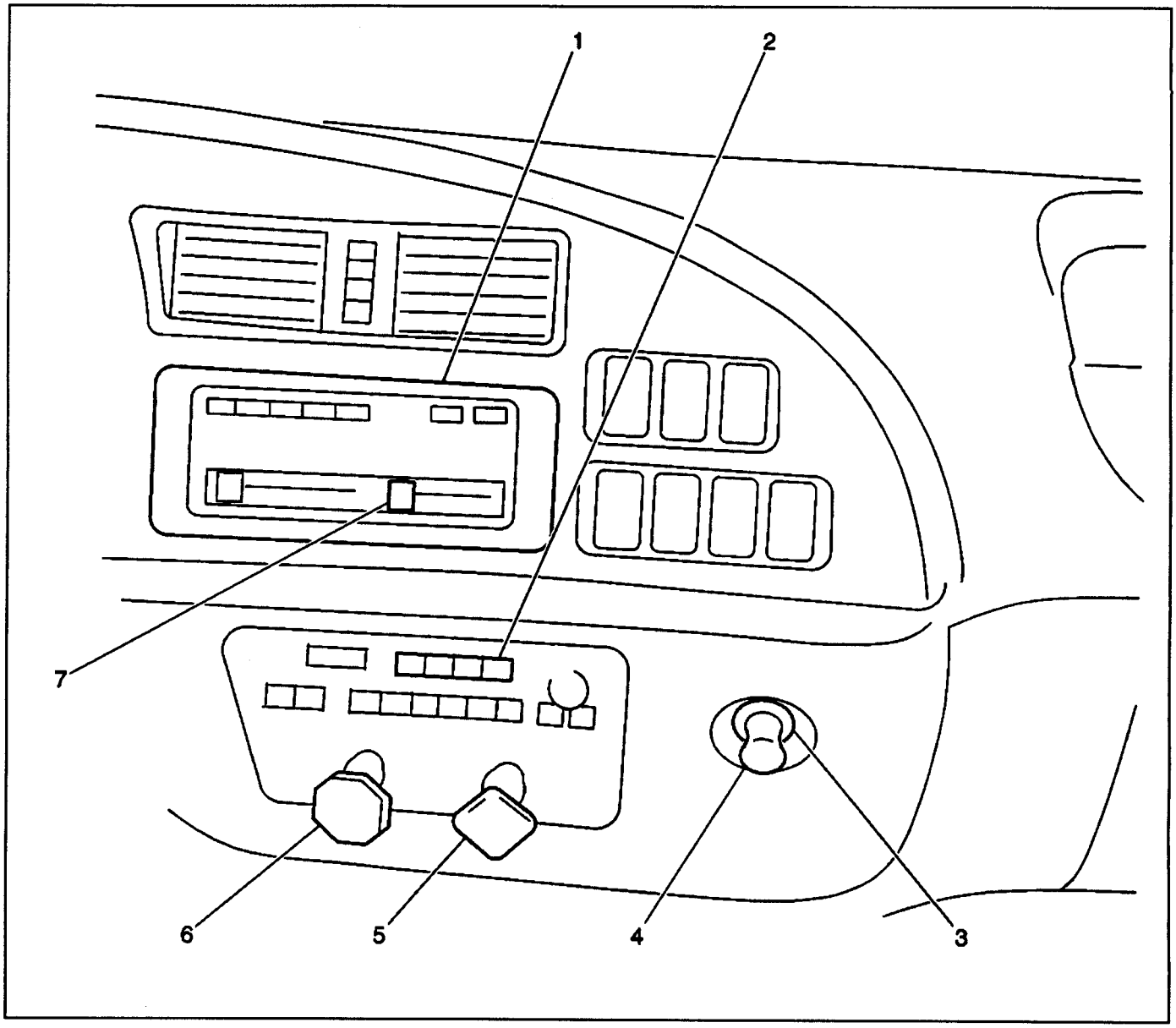


231750

Legend

(1) Radiator Surge Tank
(2) Cab Bridge
(3) Front Chassis Harness
(4) Low Engine Coolant Level Indicator Switch

Instrument Panel, Left Forward View

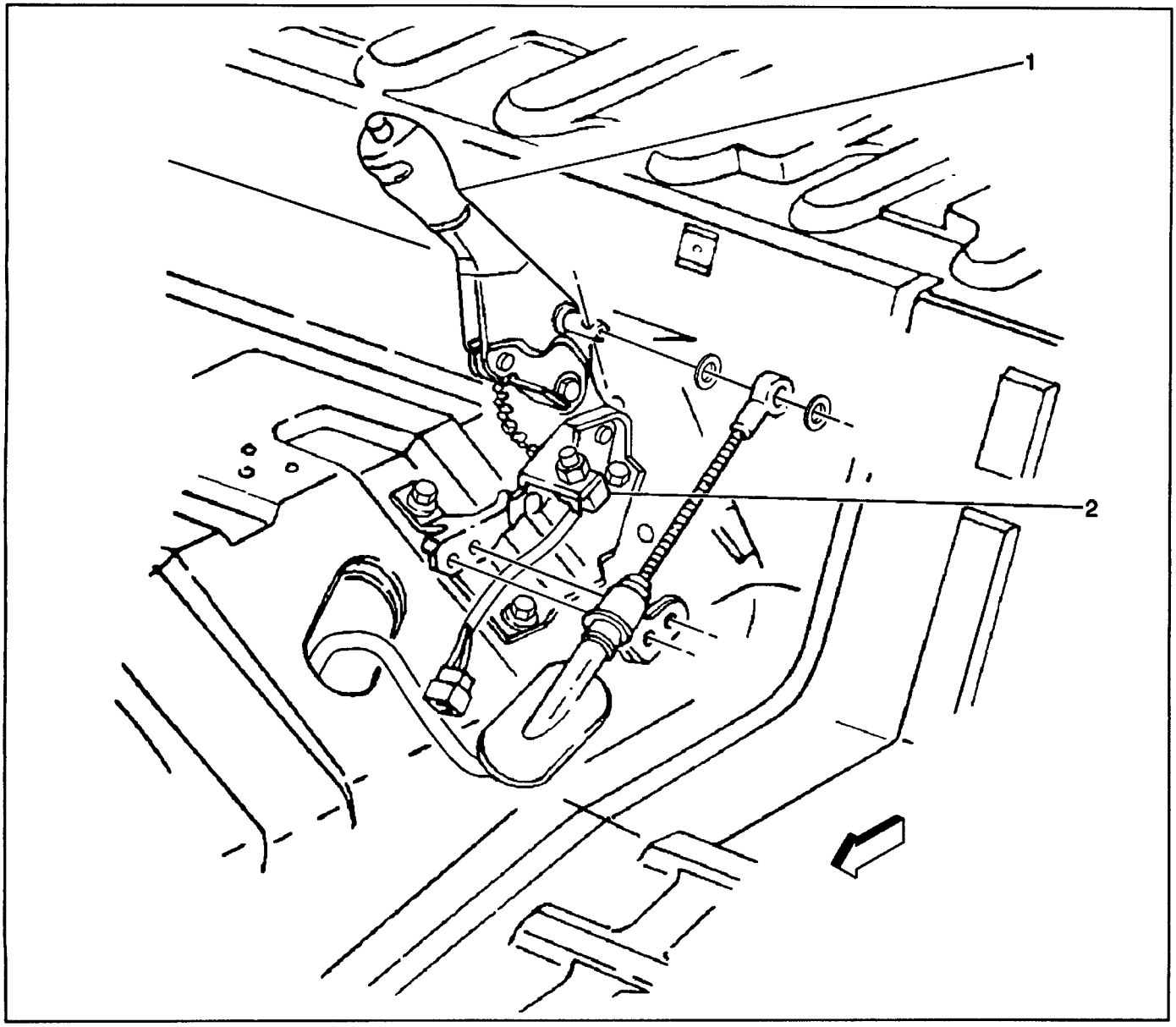


231675

Legend

(1) HVAC Controller
(2) Radio
(3) Cigar Lighter Lamp
(4) Cigar Lighter
(5) Park Brake Switch (ABS-Air)
(6) Trailer Stoplamps Switch (ABS-Air)
(7) Blower Switch (Part of HVAC Controller)

Park Brake



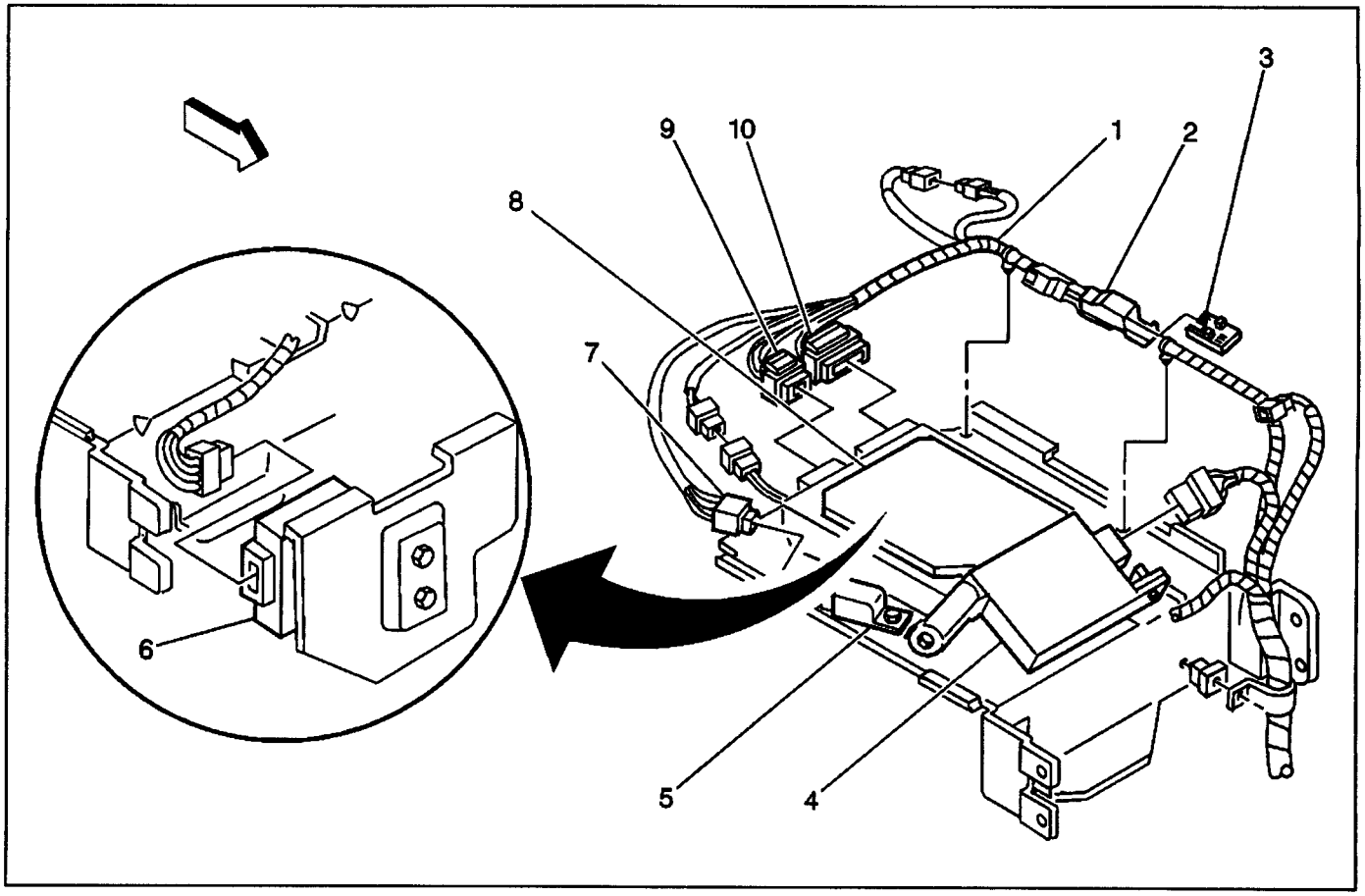
231691

Legend

(1) Park Brake Lever

(2) Park Brake Switch (Hydraulic Brakes)

Instrument Panel Harness to Right Seat

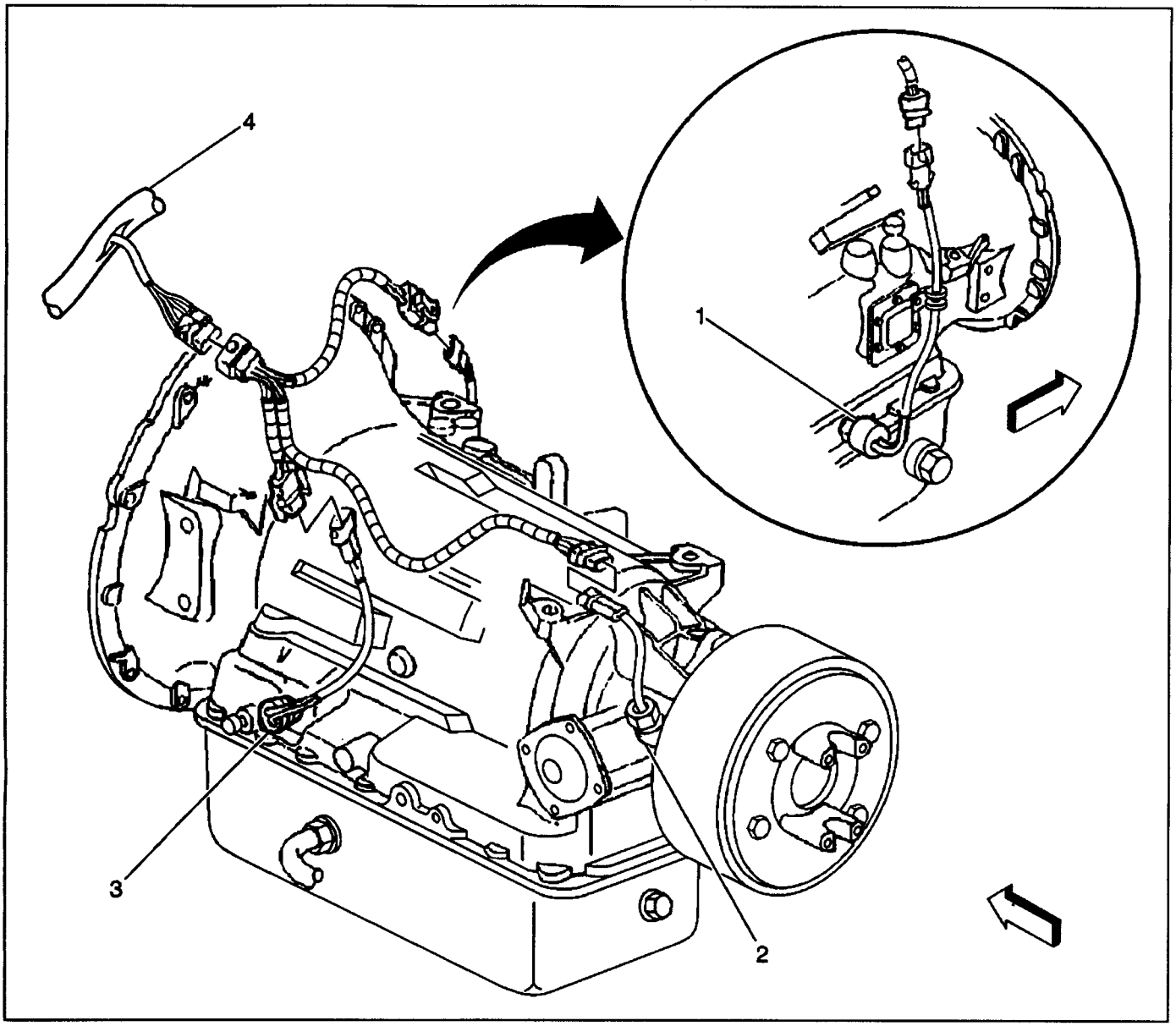


228786

Legend

(1) Lower IP Harness
(2) Inverting Driver Module Connector (ABS-Hydraulic)
(3) Inverting Driver Module (ABS-Hydraulic)
(4) Multifunction Alarm Module
(5) Ignition Main Relay
(6) Speedo Adapter (Vehicle Speed Sensor (VSS) Buffer)
(7) Pre Stroke Power Cut Relay Fusible Link, 30 A
(8) Engine Control Module
(9) Engine Control Module Connector C2 (80 cavities)
(10) Engine Control Module Connector C1 (40 cavities)

Automatic Transmission Harness, Upper Left Rear View

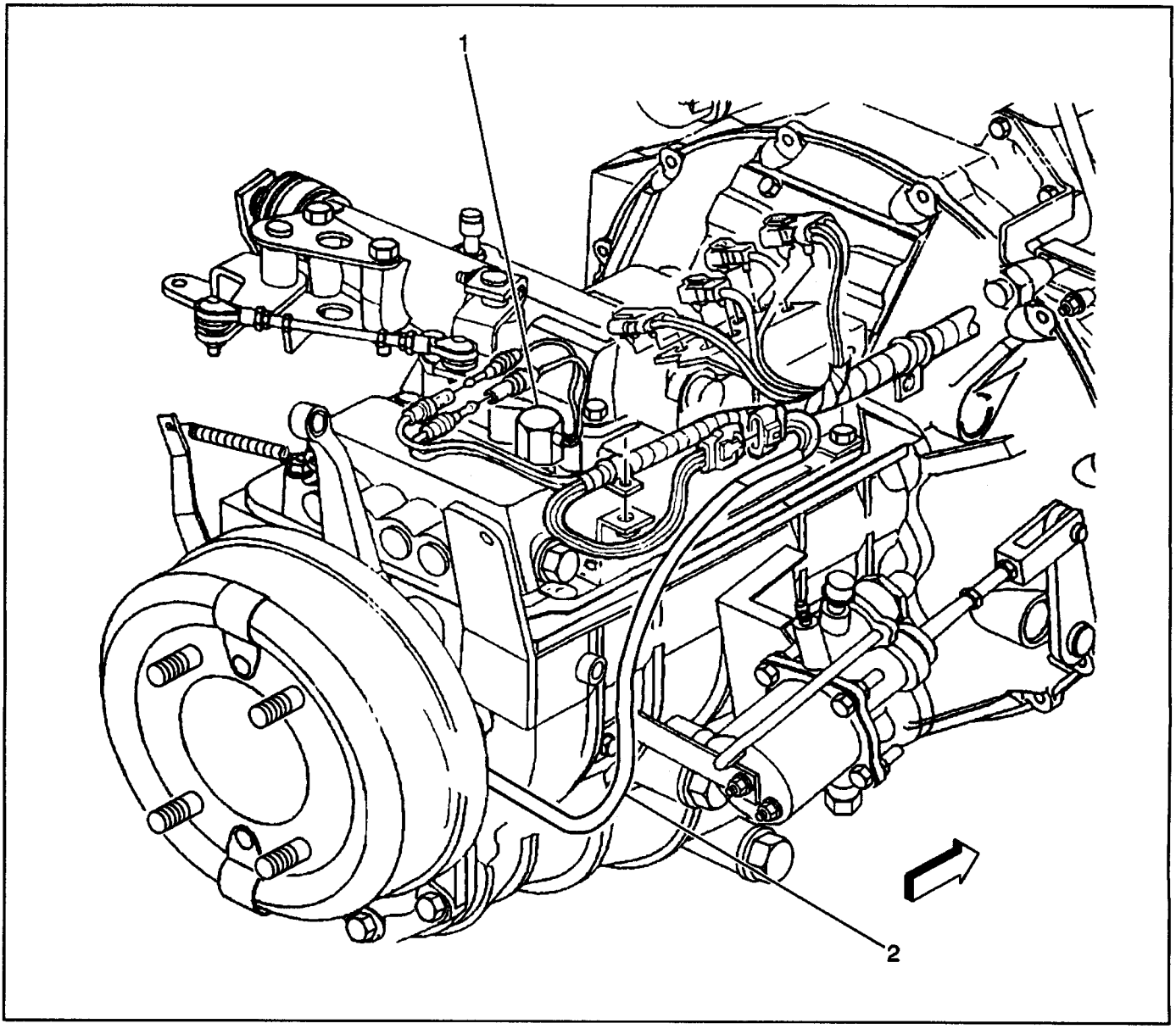


228797

Legend

(1) Backup Lamps Switch
(2) Vehicle Speed Sensor (VSS)
(3) Neutral Switch
(4) Front Chassis Harness

Starter Harness to Manual Transmission, Upper Right Forward View



228793

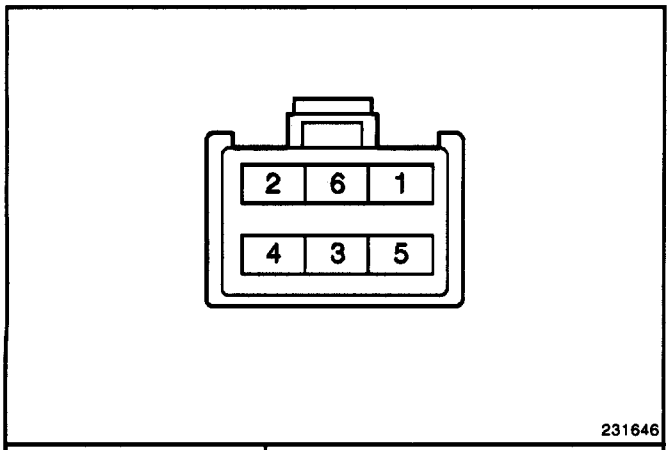
Legend

(1) Backup Lamps Switch
(2) Vehicle Speed Sensor

Visual Identification

Instrument Cluster Connector End Views

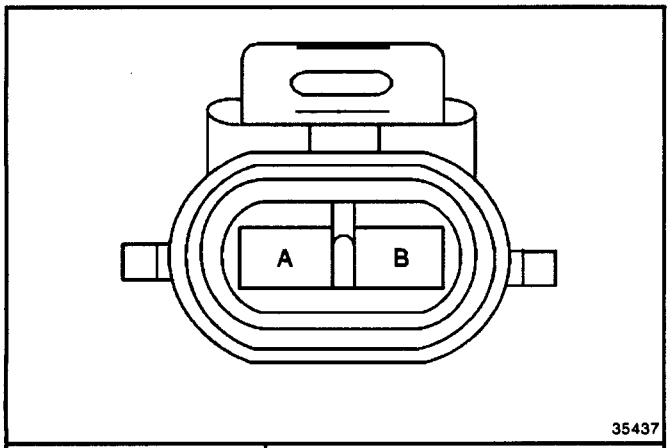
Air Suspension Dump Switch



231646

Connector Part Information	• 6 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	PNK	121	Fuse Output-Ignition
2	BLU	122	Air Suspension Dump Valve Solenoid Feed
3-4	—	—	Not Used
5	BRN	123	Illumination
6	BLK/RED	124	Interior lamp Dimming Buss

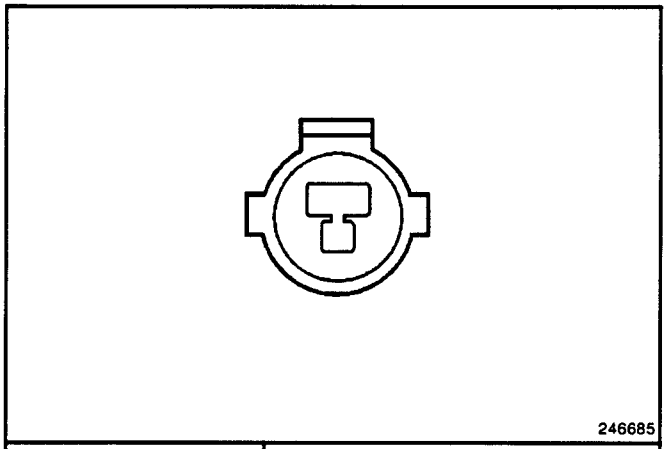
Engine Coolant Temperature Gauge Sensor



35437

Connector Part Information	• 12052644 • 2 Way F Metri-Pack 150 Series (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRN	11	Multifunction Alarm Module-Water Temp. (Engine Shutdown)
B	—	—	Not Used

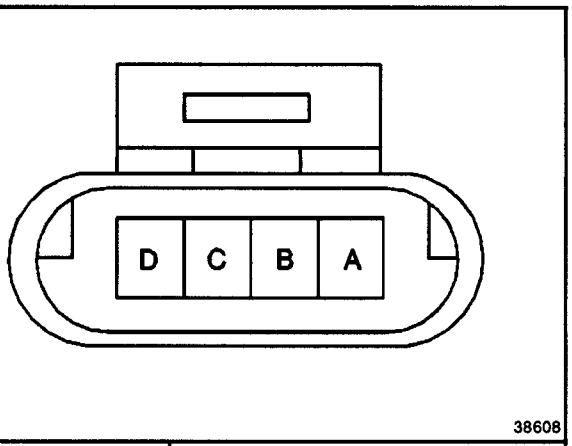
Engine Oil Pressure Gauge Sender (Isuzu)



246685

Connector Part Information	• 1 Way • Female		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN/WHT	7	Oil Pressure Switch Signal

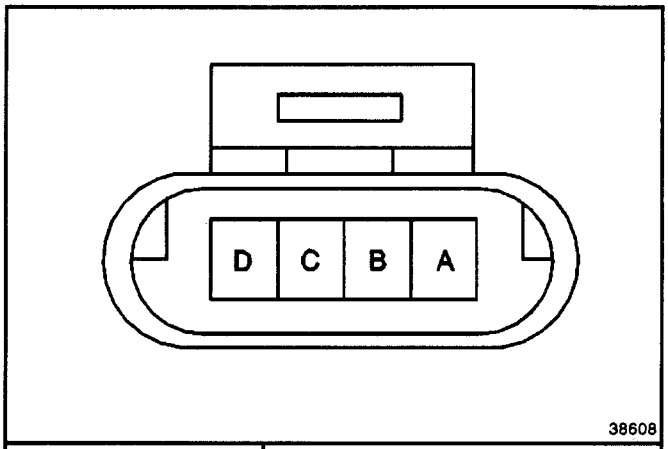
Fuel Sender (Single Fuel Tank)



38608

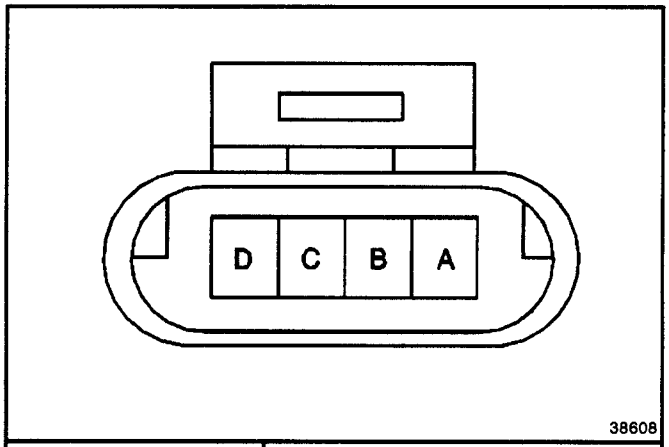
Connector Part Information	• 12162189 • 4 Way F Metri-Pack 150.2 Series Pull To Seat, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	350	Ground
B–C	—	—	Not Used
D	PPL	30	Fuel Gauge Sensor Signal

Fuel Sender (Dual Fuel Tank-Left Hand)



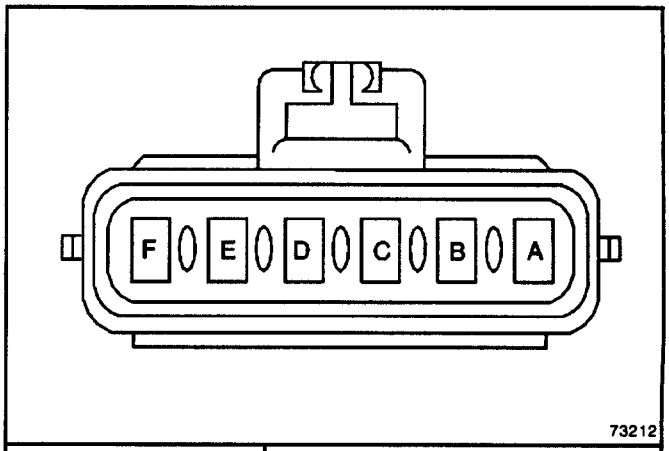
Connector Part Information	• 12162189 • 4 Way F Metri-Pack 150.2 Series Pull To Seat, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	350	Ground
B–C	—	—	Not Used
D	DK BLU	1936	Fuel Gauge Sensor Signal-Left

Fuel Sender (Dual Fuel Tank-Right Hand)



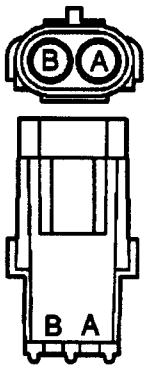
Connector Part Information	• 12162189 • 4 Way F Metri-Pack 150.2 Series Pull To Seat, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	350	Ground
B–C	—	—	Not Used
D	DK BLU	1937	Fuel Gauge Sensor Signal-Right

Fuel Sender and Transfer Pump Control Module



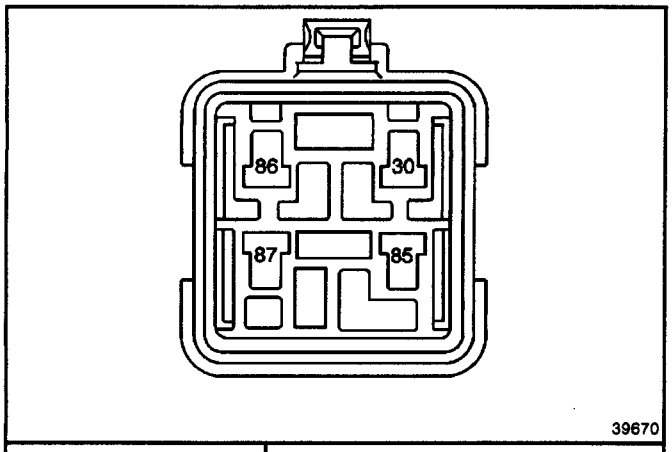
Connector Part Information	• 12059573 • 6 Way F Metri-Pack 280 Series, Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	139	Fuse Output-Ignition
B	LT BLU	1937	Fuel Gauge Sensor Signal-Right
C	DK BLU	1936	Fuel Gauge Sensor Signal-Left
D	LT GRN	497	Fuel Pump Relay Output-Coil-Secondary
E	BLK	350	Ground
F	PPL	30	Fuel Gauge Sensor Signal

Fuel Transfer Pump



Connector Part Information	• 12010973 • 2 Way M Weather Pack (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	350	Ground
B	GRA	120	Fuel Pump,Motor Feed

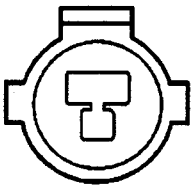
Fuel Transfer Pump Relay



39670

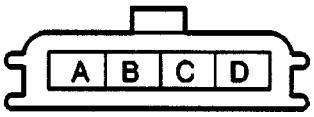
Connector Part Information		• 12129716 • 4 Way F Metri-Pack 280 Series, Flexlock, Sealed (GRY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
30	PNK	139	Fuse Output-Ignition
85	PNK	139	Fuse Output-Ignition
86	LT GRN	497	Fuel Pump Relay Output-Coil-Secondary
87	GRA	120	Fuel Pump Motor Feed

Engine Coolant Temperature Gauge Connector (Isuzu)


246685

Connector Part Information		• 1 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	GRN	4	Engine Coolant Temperature Gauge Sender

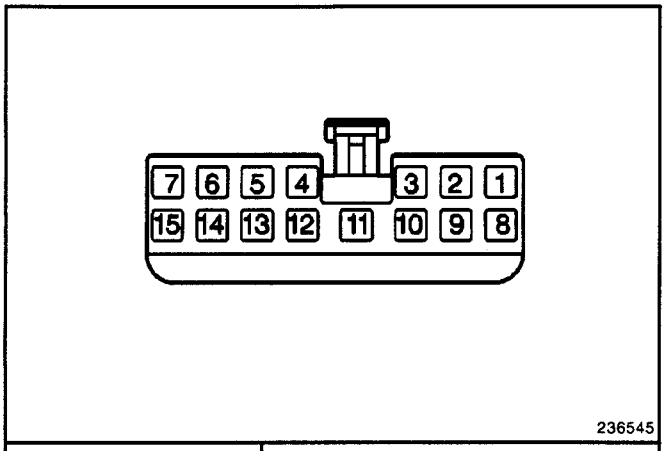
Hourmeter



222755

Connector Part Information		• 12045813 • ASM 4F M/P 150 (NAT)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL	37	Generator
B	—	—	Not Used
C	BLK	330	Ground
D	—	—	Not Used

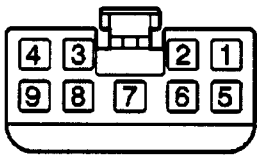
IP Harness Connector C1 (15 Way)



236545

Connector Part Information		• 15 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN	6	Generator Indicator Lamp
2	BLK/WHT	90	Exhaust Brake Indicator Lamp
3	BLK	91	Exhaust Brake Indicator Lamp
4	GRY	7	Do Not Shift Indicator Lamp
5	BLU	12	Park Brake Indicator Lamp
6	BRN	1	Fused Output Ignition
7	BRN	58	Daytime Running Lights Indicator Lamp
8	LT GRN	38	ABS Indicator Lamp
9	BLK	4	Ground
10	BRN/WHT	36	Service Engine Soon Indicator Lamp
11	BLK/WHT	13	Service Parking Brake Indicator Lamp
12	LT GRN	11	Apply Parking Brake Indicator Lamp
13	BLU	18	Left Turn Signal Indicator Lamp
14	RED/YEL	14	High Beam Indicator Lamp
15	BLU	59	Daytime Running Lights Indicator Lamp

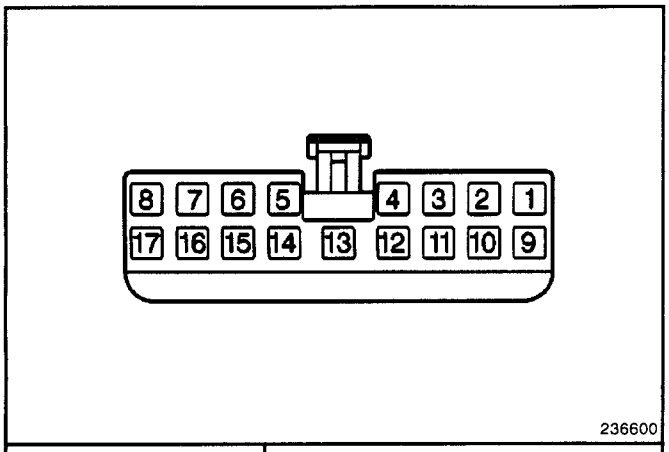
IP Harness Connector C2 (9 Way)



236605

Connector Part Information		• 9 Way F • (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN	8	Charge Indicator Lamp
2	—	—	Not Used
3	LT BLU	17	Right Turn Signal Indicator Lamp
4	YEL/BLK	10	Aux Brake Indicator Lamp
5	YEL/RED	15	Low Coolant Indicator Lamp
6	BRN	28	Tachometer Ignition
7	—	—	Not Used
8	BLU/YEL	19	Check Gauges Indicator Lamp
9	BRN/WHT	9	Primary Brake Indicator Lamp

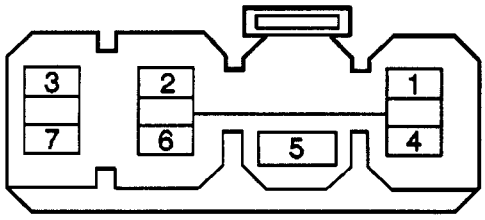
IP Connector C3 (17 Way)



236600

Connector Part Information		• 17 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN	2	Illumination
2	BLK/RED	3	Rheostat
3	BRN	33	Check Gauge Logic (6H)
4	BRN/BLK	34	Check Gauge Logic (6H)
5	BLU/YEL	20	Check Gauge Logic (Gas)
6	BLK	31	Tachometer (Ground)
7–9	—	—	Not Used
10	PPL	24	Fuel Gauge Input
11	BRN/WHT	211	Oil Pressure Gauge
12	BRN	21	Fused Input Ignition
13	BLK	27	Voltmeter (-)
14	BRN	26	Voltmeter (+)
15	BLK	22	Meter Ground
16	GRN	23	Water Temperature
17	WHT	30	Tachometer Signal

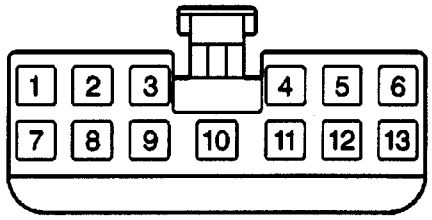
IP Harness Connector C4 (7 Way)



236724

Connector Part Information		• 7 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BRN	70	Fused Output Ignition
2	PPL	63	Differential Lock Panel Lamp
3	BLK	69	Ground Bus
4–7	—	—	Not Used

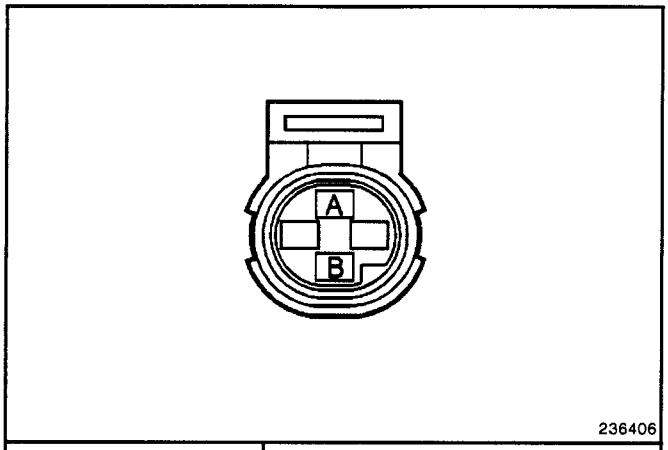
IP Harness Connector C5 (13 Way)



235963

Connector Part Information		• 13 Way F • (GRN)	
Pin	**Wire Color**	**Circuit No.**	**Function**
1-6	—	—	Not Used
7	BLU	65	Air Suspension Dump Switch
8	BLK	68	Air Suspension Dump Switch
9-13	—	—	Not Used

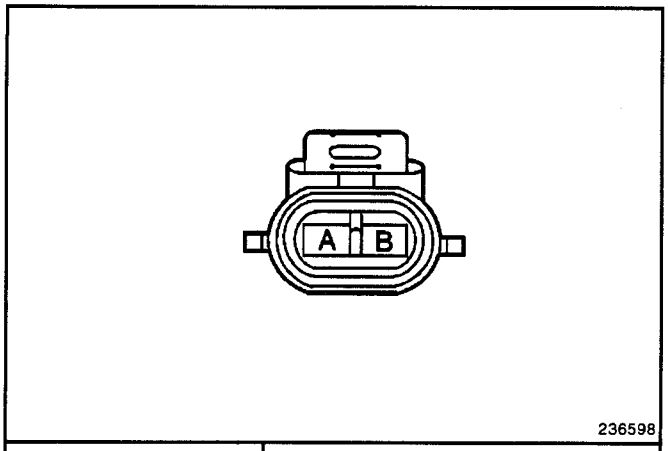
Low Air Pressure Switch



236406

Connector Part Information	• 12065400 • 2 Way F Metri-Pack 150 Series, Sealed (GRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TAN/WHT	33	Brake Warning Indicator Lamp Output
B	BLK	150	Ground

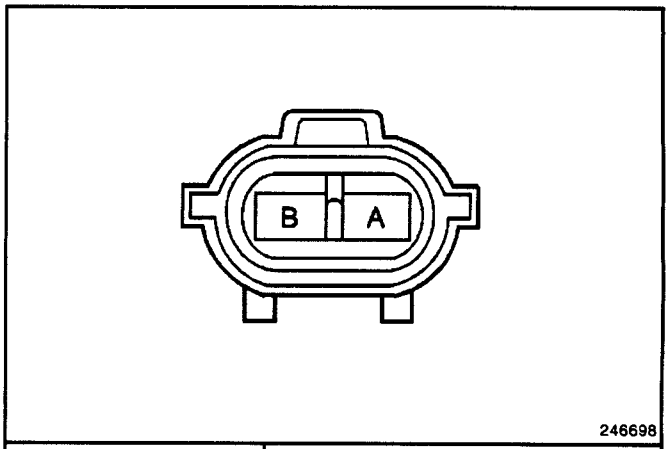
Low Coolant Level Indicator Switch



236598

Connector Part Information	• 12052641 • ASM 2F M/P 150 (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN	1478	Low Coolant Sensor Signal
B	BLK	150	Ground

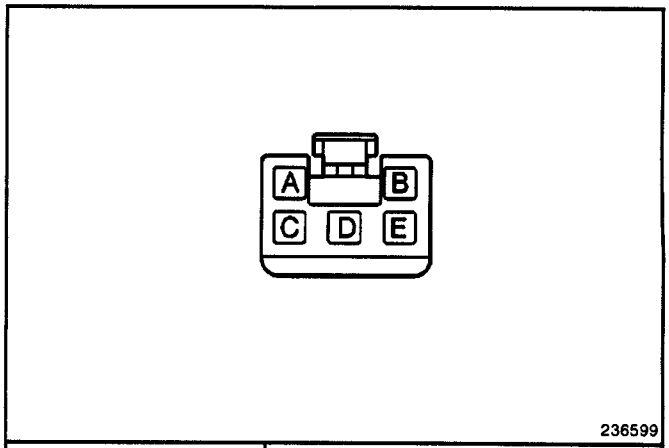
Park Brake Switch, Daytime Running Lamps (Air Brakes)



246698

Connector Part Information	• 2 Way M • (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	744	Daytime Running Lamps (DRL) Off Relay Air Brake
B	BLK	746	Park Brake Switch Air Brake

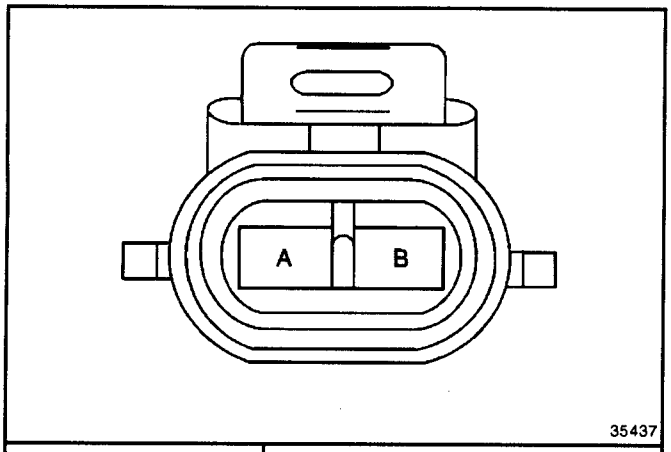
Speedometer



236599

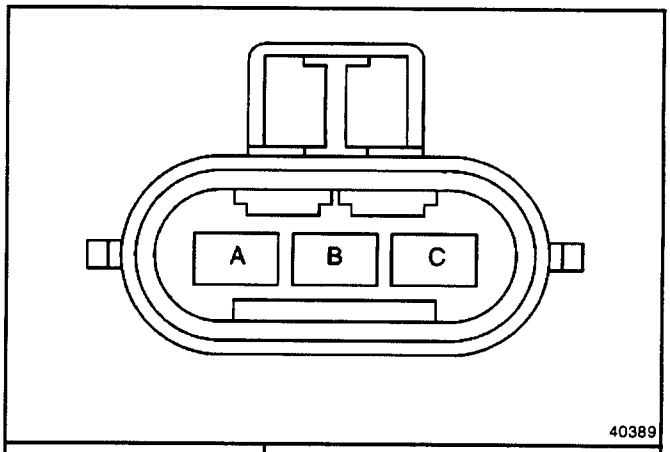
Connector Part Information	• 5 Way • Male		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK/RED	40	Interior Lamp Dimming Buss
B	BRN	41	Ignition
C	BRN	44	Illumination
D	WHT	42	Speed Signal
E	BLK	43	Ground

Vehicle Speed Sensor (Automatic Transmission)



Connector Part Information	• 12052644 • ASM 2F M/P 150 (LT GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL/WHT	821	Vehicle Speed Sensor Signal
B	LT GRN/BLK	822	Vehicle Speed Sensor Return

Vehicle Speed Sensor (Manual)



Connector Part Information	• 3 Way F • (GRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT GRN/BLK	24	Vehicle Speed Sensor Signal
B	PPL/WHT	25	Vehicle Speed Sensor Return
C	PNK	26	Fuse Output-Ignition

Diagnostic Information and Procedures

Gauge - Engine Coolant Temp Always Cold

Step	Action	Value(s)	Yes	No
1	Operate the engine and compare the actual engine coolant temperature with the temperature indicated by the instrument cluster temperature gauge. Is the deviation between the actual engine coolant temperature and the indicated coolant temperature within the specified value?	-1°C (30°F)	Go to *Step 2*	Go to *Step 3*
2	This indicates that the temperature gauge is functioning properly. Check the engine cooling system operation if appropriate. Has the condition been resolved?	—	System OK	—
3	1. Disconnect the connector at the engine coolant temperature sensor. 2. Place the ignition switch in the RUN position. 3. Connect a fused jumper wire between terminal A (Diesel) or C (Gas) of the engine coolant temperature sensor connector and ground. Does the temperature gauge indicate hot?	—	Go to *Step 6*	Go to *Step 4*

Gauge - Engine Coolant Temp Always Cold (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Disconnect the connector at the instrument cluster. 2. Connect a self-powered test lamp between terminal C16 of the instrument cluster connector and terminal A (Diesel) or C (Gas) of the engine coolant temperature sensor connector for CKT 4 or CKT 135 (DK GRN), CKT 385 or CKT 23 (GRN). Did the test lamp light?	—	Go to *Step 7*	Go to *Step 5*
5	Repair the open in CKT 4 or CKT 135 (DK GRN), CKT 385 or CKT 23 (GRN) between the engine coolant temperature gauge sensor and the instrument cluster. Is the repair complete?	—	System OK	—
6	Replace the engine coolant temperature sensor. Refer to *Engine Coolant Temperature Sensor Replacement.* Is the repair complete?	—	System OK	—
7	Replace the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—

Gauge - Eng Coolant Temp Inaccurate or Inoperative

Step	Action	Value(s)	Yes	No
1	Operate the engine and compare the actual engine coolant temperature with the temperature indicated by the instrument cluster temperature gauge. Is the deviation between the engine coolant temperature and the indicated coolant temperature within the specified value?	-1°C (30°F)	*Go to Step 2*	*Go to Step 3*
2	Check the operation of the cooling system. Is the cooling system operating properly?	—	System OK	—
3	1. Disconnect the connector at the engine coolant temperature gauge sensor. 2. Connect one red lead of a *J 33431-B* at engine coolant temperature gauge sensor connector terminal A for CKT 4 and CKT 135 (DK GRN), and CKT 385 and CKT 23 (GRN). 3. Connect the other lead to ground. 4. Adjust the tester to 1,305 ohms and observe the temperature gauge reading. 5. Adjust the tester to 49.5 ohms and observe the temperature gauge reading. 6. The temperature gauge should indicate approximately 38°C(100°F), then approximately 100°C(260°F). Does the temperature gauge indicate the specified cold and then hot values?	38°C (100°F) 126°C (260°F)	Go to *Engine Coolant Temperature Sensor Replacement.*	*Go to Step 4*
4	Check the temperature gauge. Did the temperature gauge indicate a value significantly below the specified value for hot at 49.5 Ω?	126°C (260°F)	*Go to Step 5*	Go to *IP Cluster Replacement (Instrument Cluster).*

Gauge - Eng Coolant Temp Inaccurate or Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the 17 way IP harness connector at the instrument cluster. 2. Connect an ohmmeter between instrument cluster connector terminal C16 and terminal A (Diesel) or C (Gas) of the engine coolant temperature gauge sensor connector terminal A for CKT 4 and CKT 135 (DK GRN), and CKT 385 and CKT 23 (GRN). Are the wire resistances of CKT 4 and CKT 135 (DK GRN), and CKT 385 and CKT 23 (GRN) above the specified value?	20 Ω	*Go to Step 6*	Go to *IP Cluster Replacement (Instrument Cluster).*
6	1. Locate the high resistance in CKT 4 and CKT 135 (DK GRN), and CKT 385 and CKT 23 (GRN) between the instrument cluster and the engine coolant temperature gauge sensor. 2. Repair the high resistance. Is the repair complete?	—	System OK	—

Gauge - Engine Oil Pressure Always High

Step	Action	Value(s)	Yes	No
1	1. Check the actual engine oil pressure with the engine running. 2. Compare this value to the indicated value. 3. The oil pressure gauge should indicate approximately the same as the actual pressure, within the specified range. Does the oil pressure gauge indicate a reading close to the specified value?	69 kPa (10 psi)	Go to *Step 2*	Go to *Step 3*
2	Inspect the engine for operating problems. Is the engine operating properly?	—	System OK	—
3	1. Disconnect the connector at the engine oil pressure indicator sender. 2. Connect a fused jumper wire between the oil pressure indicator sender connector terminal A for CKT 7 (BRN/WHT) and ground. 3. The oil pressure gauge should indicate 0 kPa (0 psi) or less. Does the oil pressure indicate low pressure?	—	Go to *Step 4*	Go to *Step 5*
4	Replace the engine oil pressure sender. Is the repair complete?	—	System OK	—
5	1. Disconnect the 17 way IP harness connector at the instrument cluster. 2. Connect a self-powered test lamp from the instrument cluster connector C11 to the engine oil pressure indicator sender terminal A. Does the test lamp light?	—	Go to *Step 6*	Go to *Step 7*

Gauge - Engine Oil Pressure Always High (cont'd)

Step	Action	Value(s)	Yes	No
6	Replace the instrument cluster. Is the repair complete?	—	System OK	—
7	Locate and repair the open in one or more of the following circuits between the instrument cluster and the engine oil pressure indicator sender: 1. CKT 7 (BRN/WHT) 2. CKT 383 (BRN/WHT) 3. CKT 211 (BRN) 4. CKT 331 (TAN/WHT) Is the repair complete?	—	System OK	—

Gauge - Engine Oil Pressure Always Low

Step	Action	Value(s)	Yes	No
1	1. Check the actual engine oil pressure while the engine is running. 2. Compare the actual engine oil pressure to the indicated value. Is the oil pressure indicated by the gauge approximately equal to the actual oil pressure within the specified range?	69 kPa (10 psi)	*Go to Step 2*	*Go to Step 3*
2	Inspect the engine for operating problems. Is the engine operating properly?	—	System OK	—
3	1. Disconnect the connector at the engine oil pressure indicator sender. 2. Place the ignition switch in the RUN position. 3. Connect one red lead of a *J 33431-B* at terminal A of the engine oil pressure sensor connector for CKT 211 (BRN), CKT 7 or CKT 383 (BRN/WHT) or CKT 331 (TAN/WHT). 4. Connect the other lead to ground. 5. Adjust the tester to 88 ohms. Is the test oil pressure gauge reading higher than the specified value?	550 kPa (80 psi)	Go to *Step 6*	*Go to Step 4*
4	1. Disconnect the 17 way IP harness connector. 2. Connect a self-powered test lamp between the instrument cluster connector terminal C12 and the engine oil pressure indicator sender connector terminal A for CKT 211 or CKT 383 (BRN) or CKT 331 (TAN/WHT). Does the test lamp light?	—	*Go to Step 5*	Go to *IP Cluster Replacement (Instrument Cluster).*
5	Locate and repair the short to ground in for CKT 211 (BRN), CKT 383 or CKT 7 (BRN/WHT), or CKT 331 (TAN/WHT) between the instrument cluster and the engine oil pressure indicator sender. Is the repair complete?	—	System OK	—
6	Replace the engine oil pressure indicator sender. Is the repair complete?		System OK	—

Gauge - Eng Oil Pressure Inaccurate or Inoperative

Step	Action	Value(s)	Yes	No
1	1. Check the actual engine oil pressure while the engine is running. 2. Compare this value to the indicated value. Does the oil pressure gauge reading meet the specified value?	70 kPa (10 psi)	*Go to Step 2*	*Go to Step 3*
2	Inspect the engine for operating problems. Is the engine operating properly?	—	System OK	—
3	1. Disconnect the connector at the engine oil pressure indicator switch. 2. Place the ignition switch in the RUN position. 3. Connect one red lead of a *J 33431-B* at terminal A of the engine oil pressure switch connector. 4. Connect the other lead to ground. 5. Adjust the tester to 0 ohm. The test oil pressure gauge should indicate 0 kPa (0 psi). 6. Adjust the tester to 88 Ω. The test oil pressure gauge should indicate 550 kPa (80 psi). Does the test oil pressure gauge indicate the correct values?	0 kPa (0 psi) 88 kPa (550 psi)	Go to *Engine Oil Pressure Switch Replacement*	*Go to Step 4*
4	1. Disconnect the 17 way IP harness connector at the instrument cluster. 2. Connect a fused jumper wire between the B+ and terminal C12 of the instrument cluster connector. 3. Connect a fused jumper wire between terminal C15 of the instrument cluster connector for CKT 22 (BLK) and ground. 4. Connect one red lead of a *J 33431-B* at terminal C11 of the instrument cluster connector. 5. Connect the other lead to ground. 6. Adjust the tester to 0 ohm. The oil pressure gauge should indicate 0 kPa (0 psi). 7. Adjust the tester to 88 ohms. Does the oil pressure meet the specified value?	0 kPa (0 psi) 88 kPa (550 psi)	*Go to Step 5*	Go to *IP Cluster Replacement (Instrument Cluster)*
5	1. Locate the high resistance in CKT 7, CKT 211 or CKT 383 (BRN/WHT) or CKT 331 (TAN/WHT). 2. Repair the high resistance. Is the repair complete?	—	System OK	—

Gauge - Fuel Always Indicates Empty (Single Tank)

Step	Action	Value(s)	Yes	No
1	Check condition of ignition switch circuit breaker. Is circuit breaker OPEN?	—	Go to step 2.	Go to step 3.
2	Locate and repair cause of the overload. Is the repair complete?	—	Go to step 6.	—
3	1. Disconnect fuel sender or fuel sender and fuel pump connector. 2. Place ignition switch in RUN. Does the fuel gauge indicate full?	—	Go to step 4.	Go to step 5.

Gauge - Fuel Always Indicates Empty (Single Tank) (cont'd)

Step	Action	Value(s)	Yes	No
4	Replace the fuel sender or fuel sender and fuel pump. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—
5	Locate and repair short to ground in CKT 30 (PPL) wire between IP cluster and fuel sender or fuel sender and fuel pump. Is the repair complete?	—	System OK	Go to step 7.
6	Replace the circuit breaker. Is the repair complete?	—	System OK	—
7	Replace the fuel gauge. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—

Gauge - Fuel Always Indicates Empty (Dual Tanks)

Step	Action	Value(s)	Yes	No
DEFINITION: Fuel gauge indicates empty when there is fuel in tank (Dual tanks).				
1	1. Remove connector at fuel sender and balance pump control module. 2. Place the ignition switch in RUN. Does the fuel gauge indicate FULL?	—	Go to step 5.	Go to step 2.
2	Check for a short to ground in CKT30 (PPL) between the fuel sender and balance pump control module connector and the IP cluster harness connector. Was a short to ground found?	—	Go to step 3.	Go to step 4.
3	Repair the short to ground in CKT30 (PPL) between the fuel sender and balance pump control module and the IP harness connector. Is the repair complete?	—	System OK	—
4	Replace the fuel gauge. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—
5	1. Connect a jumper between terminal C and terminal F at the fuel sender and balance pump control module harness connector. 2. Visually inspect the fuel level in the LH fuel tank. 3. Check the fuel gauge. Does the fuel gauge indicate the approximate fuel level of the LH fuel tank?	—	Go to step 9.	Go to step 6.
6	Check for a short to ground in CKT1936 (DK BLU) between the fuel sender and balance pump control module harness connector and the LH fuel tank harness connector. Was a short found?	—	Go to step 7.	Go to step 8.
7	Repair the short in CKT1936 (DK BLU) between the fuel sender and balance pump control module and the LH fuel tank. Is the repair complete?	—	System OK	—
8	Replace the fuel sender and fuel pump assembly. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—

Gauge - Fuel Always Indicates Empty (Dual Tanks) (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Connect a jumper wire between terminal B and terminal F at the fuel sender and balance pump control module. 2. Visually inspect the fuelfuel sender and flevel in the RH fuel tank. 3. Check the fuel gauge. Does the fuel gauge indicate the approximate fuel level of the RH fuel tank?	—	Go to step 10.	Go to step 11.
10	Replace the fuel sender and balance pump control module. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—
11	Check CKT1937 (LT BLU) for an open condition between the fuel sender and balance pump control module harness connector and the RH fuel tank harness connector. Was an open condition found?	—	Go to step 12.	Go to step 13.
12	Repair the open in CKT1937 (LT BLU) beetween the fuel sender and balance pump control module harness connector and the RH fuel tank harness connector. Is the repair complete?	—	System OK	—
13	Replace the fuel sender and fuel pump assembly. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—

Gauge - Fuel Always Indicates Full (Single Tank)

Step	Action	Value(s)	Yes	No
1	1. Disconnect fuel sender or fuel sender and fuel pump harness connector at the fuel tank. 2. Connect a fused jumper from CKT30 (PPL) at the fuel tank connector to chassis ground. 3. Place the ignition switch in RUN. Does the fuel gauge indicate FULL?	—	Go to Step 2	Go to Step 5
2	Check for open in CKT30 (PPL) between the fuel sender and the IP harness connector. Was an open wire found?	—	Go to Step 3	Go to Step 4
3	Repair the open in CKT30 (PPL) between the fuel sender and the IP harness connector. Is the repair complete?	—	System OK	—
4	Replace the fuel gauge. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—
5	Connect a fused jumper between the CKT30 (PPL) and the CKT350 (BLK) at the fuel sender or fuel sender and fuel pump connector. Does the fuel gauge indicate FULL?	—	Go to Step 6	Go to Step 7
6	Locate and repair the open in CKT350 (BLK) between the fuel sender or fuel sender and fuel pump harness connector and ground. Is the repair complete?	—	System OK	—
7	Replace the fuel gauge sender. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—

Gauge - Fuel Always Indicates Full (Dual Tanks)

Step	Action	Value(s)	Yes	No
1	1. Disconnect harness connector at fuel sender and balance pump control module 2. Connect a fused jumper from CKT 30 (PPL) wire at harness connector to chassis ground. 3. Place ignition switch in RUN. Does fuel gauge indicate FULL?	—	Go to Step 2	Go to Step 4
2	Locate and repair open in CKT 30 (PPL) wire from the fuel sender and balance pump control module harness connector to instrument cluster harness connector. Is repair complete?	—	System OK	Go to step 3
3	Replace the fuel gauge. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—
4	Connect a fused jumper from CKT 30 (PPL) wire to CKT 350 (BLK) wire at fuel sender and balance pump control module harness connector. Does fuel gauge indicate FULL?	—	Go to Step 5	Go to Step 6
5	Locate and repair open in CKT 350 (BLK) wire from the fuel sender and balance pump control module harness connector to splice S413. Is repair complete?	—	System OK	—
6	1. Connect a jumper from CKT 1936 (DK BLU) wire to CKT 30 (PPL) wire at fuel sender and balance pump control module harness connector. 2. Disconnect connector at left hand fuel tank. 3. Connect a fused jumper from CKT 1936 (DK BLU) wire at left hand fuel tank harness connector to chassis ground. Does fuel gauge indicate FULL?	—	Go to Step 7	Go to Step 8
7	Locate and repair open in CKT 1936 (DK BLU) wire between the fuel sender and balance pump control module harness connector and the left hand fuel tank harness connector. Is repair complete?	—	System OK	—
8	1. Connect a fused jumper from CKT1936 (DK BLU) to CKT 350 (BLK) wire at the left hand fuel tank connector. 2. Connect a jumper from CKT 1936 (DK BLU) to CKT 30 (PPL) wire at fuel sender and balance pump control module harness connector. Does fuel gauge indicate FULL?	—	Go to Step 9	Go to Step 10
9	Locate and repair open in CKT 350 (BLK) wire between the fuel sender and balance pump control module harness connector and splice S413. Is repair complete?	—	System OK	—
10	1. Connect a jumper from CKT 1937 (LT BLU) to CKT 30 (PPL) wire at fuel sender and balance pump control module harness connector. 2. Disconnect connector at right hand fuel tank. 3. Connect a fused jumper from CKT 1937 (LT BLU) wire at harness connector to chassis ground. Does fuel gauge indicate FULL?	—	Go to Step 11	Go to Step 12

Gauge - Fuel Always Indicates Full (Dual Tanks) (cont'd)

Step	Action	Value(s)	Yes	No
11	Locate and repair open in CKT 1937 (LT BLU) wire between the fuel sender and balance pump control module harness connector and right hand fuel tank harness connector. Is repair complete?	—	System OK	—
12	1. Connect a fused jumper from CKT 1937 (LT BLU) to CKT 350 (BLK) wire at the right hand fuel tank connector. 2. Connect a jumper from to CKT 1937 (LT BLU) wire to CKT 30 (PPL) wire at fuel sender and balance pump control module harness connector. Does fuel gauge indicate FULL?	—	Go to Step 13	Go to Step 14
13	Locate and repair open in CKT 350 (BLK) wire from the fuel sender and balance pump control module harness connector to G404. Is repair complete?	—	System OK	—
14	1. Visually determine approximate fuel level in right hand and left hand fuel tanks. 2. Use ohmmeter to check resistance between CKT 350 (BLK) and CKT 1937 (LT BLU) or CKT 1936 (DK BLU) wires on the fuel senders on each fuel tank. • An empty tank would indicate low resistance (approximately one ohm). • A full tank would indicate high resistance (approximately 88 ohms). • A partially full tank would indicate somewhere between those values. Is sender resistance good?	—	Go to Step 15	Go to Step 16
15	Replace fuel sender and balance pump control module. Is the repair complete?	—	System OK	—
16	Replace the applicable sender unit. Refer to *Fuel Pump Replacement* Is the repair complete?	—	System OK	—

Gauge - Fuel Inaccurate or Inoperative (Single Tank)

Step	Action	Value(s)	Yes	No
DEFINITION: The fuel reading on the gauge does not corrospond with the fuel level in the tank.				
1	1. Disconnect the fuel sender or fuel sender and fuel pump harness connector. 2. Connect the red lead of the fuel pump tester J33431-B to CKT30 (Ppl) and the other lead to ground. 3. Place the ignition switch in RUN. 4. Set the resistance dial to 0Ω and then to 90Ω. Fuel gauge shiuld indicate empty and then full. (Allow time for gauge to reach FULL due to anti -slosh device. Does the gauge respond correctly?	—	Go to Step 2	Go to Step 5
2	Check CKT350 (Blk) from fuel sender or fuel sender and fuel pump to ground for high resistance. Is resistance high?	—	Go to Step 3	Go to Step 4

Gauge - Fuel Inaccurate or Inoperative (Single Tank) (cont'd)

Step	Action	Value(s)	Yes	No
3	Repair or replace CKT350 (Blk) between the fuel tank and ground. Is the repair complete?	—	System OK	—
4	Replace the fuel sender. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—
5	Check CKT30 (Ppl) for high resistance between the fuel sender and the IP cluster connector. Is the resistance high?	—	Go to Step 6	Go to Step 7
6	Repair or replace CKT30 (Ppl) between the fuel tank and the IP cluster. Is the repair complete?	—	System OK	—
7	Replace the fuel gauge. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—

Gauge - Fuel Inaccurate or Inoperative (Dual Tanks)

Step	Action	Value(s)	Yes	No
1	1. Remove the connector from the fuel sender and balance pump control module. 2. Connect a fused jumper between the terminal C and terminal F at the fuel sender and balance pump control module harness connector. 3. Place ignition switch in RUN. Note: Allow time for the gauge to reach its final position due to the anti-slosh device. Did the gauge indicate approximately the capicity of the LH fuel tank?	—	Go to Step 9	Go to Step 2
2	1. Remove the connector from the LH fuel sender and fuel pump. 2. Connect one lead of tester J-33431-B to the CKT 1936 (DK BLU) and the other end to chassis ground. 3. Set the resistance to 0Ω and then to 90Ω. Fuel gauge should indicate EMPTY and then FULL. Note: Allow time for the gauge to reach FULL due to the anti-slosh device. Did the gauge respond correctly?	—	Go to Step 3	Go to Step 6
3	Check CKT350 (BLK) for high resistance between the LH tank connector and chassis ground. Was there high resistance in CKT350?	—	Go to Step 5	Go to Step 4
4	Replace the fuel gauge sender. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—
5	Repair or replace CKT350 (BLK) between thr LH fuel tank connector and chassis ground. Is the repair complete?	—	System OK	—

Gauge - Fuel Inaccurate or Inoperative (Dual Tanks) (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Check for high resistance in CKT30 (PPL) between the fuel sender and balance pump control module harness connector and the IP. 2. Check for high resistance in CKT1936 (DK BLU) between the fuel sender and balance pump control module harness connector and the LH fuel tank. Did either circuit show high resistance?	—	Go to Step 7	Go to Step 8
7	Repair or replace CKT30 (PPL) or CKT1936 (DK BLU). Is the repair complete?	—	System OK	—
8	Replace the fuel gauge. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—
9	1. Remove the jumper wire. 2. Install the jumper between terminal B amd terminal F at the fuel sender and balance pump control module harness connector. 3. Place the ignition switch in RUN. Note: Allow time for the gauge to reach final position due to anti-sloshing device. Does the gauge indicate the approximate capacity of the RH fuel tank?	—	Go to Step 10	Go to Step 11
10	Replace the fuel sender and balance pump control module. Is the repair complete?	—	System OK	—
11	1. Remove the RH fuel sender and fuel pump connector. 2. Connect one lead of J-33431-B to CKT1937 (LT BLU) and the other to chassis ground. 3. Set the resistance to 0Ω and then to 90Ω. Fuel gauge should indicate EMPTY and then FULL. Note: Allow time for gauge to reach final position due to anti-slosh device. Did the gauge respond correctly?	—	Go to Step 12	Go to Step 15
12	Check CKT 350 (BLK) for high resistance between the LH tank connector and ground. Is there high resistance in CKT350?	—	Go to Step 13	Go to Step 14
13	Repair or replace CKT350 between the LH tank connector and ground. Is the repair complete?	—	System OK	—
14	Replace the fuel sender and fuel pump assembly. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—
15	Locate and repair the open in CKT1937 (LT BLU) between the fuel sender and balance pump control module harness connector and th RH fuel tank harness connector. Is the repair complete?	—	System OK	—

Gauge - Fuel Inaccurate or Inoperative (Vehicle Runs Out at Half Tank)

Step	Action	Value(s)	Yes	No
1	1. Remove connector at the fuel sender and fuel pump, RH. 2. Connect a fused jumper between the fuel sender and fuel pump terminal A on the tank, and chassis ground. 3. Connect a fused jumper from B+ to terminal C at the fuel sender and fuel pump connector at the fuel tank. Does the fuel pump run?	—	Go to Step 3	Go to Step 2
2	Replace the fuel sender and fuel pump assembly. Refer to *Fuel Pump Replacement.* Is the repair complete?	—	System OK	—
3	Connect a self powered test lamp between the fuel sender and fuel pump harness connector terminal A, and chassis ground. Did the test lamp light?	—	Go to Step 5	Go to Step 4
4	Locate and repair the open in CKT350 (BLK) between the fuel sender and fuel pump harness connector and G404. Is the repair complete?	—	System OK	—
5	1. Remove the fuel transfer pump relay from its socket. 2. Connect a self powered test lamp between fuel transfer pump relay socket terminal 87 and fuel sender and fuel pump connector terminal C. Did the test lamp light?	—	Go to Step 7	Go to Step 6
6	Locate and repair CKT458 (YEL) between the fuel sender and fuel pump, and the fuel transfer pump relay. Is the repair complete?	—	System OK	—
7	1. Connect a test lamp between the fuel transfer pump relay socket terminal 30 and chassis ground. 2. Place the ignition switch in RUN. Did the test lamp light?	—	Go to Step 9	Go to Step 8
8	Locate and repair the open in CKT341 (BRN) between the IP fuse block and the fuel transfer pump relay. Is the repair complete?	—	System OK	—
9	1. Remove the fuel pump relay from the socket in the relay center. 2. Connect a self powered test lamp between the fuel pump relay terminal N1 and fuel transfer pump relay terminal 85. Did the test lamp light?	—	Go to Step 11	Go to Step 10
10	Locate and repair the open in CKT120 (GRY) between S406 and the fuel transfer pump relay. Is the repair complete?	—	System OK	—
11	1. Remove the connector at the fuel sender and balance pump control module. 2. Connect a self powered test lamp between the fuel transfer pump relay socket terminal 86 and the fuel sender and balance pump control module terminal D. Did the test lamp light?	—	Go to Step 13	Go to Step 12

Gauge - Fuel Inaccurate or Inoperative (Vehicle Runs Out at Half Tank) (cont'd)

Step	Action	Value(s)	Yes	No
12	Locate and repair the open in CKT497 (LT GRN) between the fuel sender and balance pump control module and the fuel transfer pump relay. Is the repair complete?	—	System OK	—
13	1. Replace the fuel transfer pump relay in its socket. 2. Connect a fused jumper between the fuel sender and balance pump control module connector terminal D and chassis ground. 3. Connect a test lamp between the fuel sender and fuel pump connector terminal C and ground. 4. Place the ignition switch in RUN. Note: the circuit will be energized for approximately 2 seconds. Did the test lamp light?	—	Go to Step 15	Go to Step 14
14	Replace the fuel transfer pump relay. Is the repair complete?	—	System OK	—
15	Connect a test lamp between the fuel sender and balance pump control module connector terminal A and chassis ground. Did the test lamp light?	—	Go to Step 17	Go to Step 16
16	Locate and repair the open in CKT341 (BRN) between S415 and the fuel sender and balance pump control module. Is the repair complete?	—	System OK	—
17	Connect a self powered test lamp between the fuel sender and balance pump control module connector terminal E and chassis groung. Did the test lamp light?	—	Go to Step 18	Go to Step 19
18	Replace the fuel sender and balance pump control module. Is the repair complete?	—	System OK	—
19	Locate and repair the open in CKT350 (BLK) between S413 and the fuel sender and balance pump control module. Is the repair complete?	—	System OK	—

Gauges Inoperative - All

Step	Action	Value(s)	Yes	No
1	1. Disconnect the 17-terminal IP cluster connector at the instrument cluster. 2. Place the ignition switch in the RUN position. 3. Connect a test lamp between CKT 21 (BRN) at the instrument cluster harness connector terminal C12 to chassis ground. Did the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	Connect a self-powered test lamp between CKT 22 (BLK) at the instrument cluster connector terminal C15 and ground. Did the test lamp light?	—	Go to *Step 5*	*Go to Step 4*
3	Locate and repair the open in CKT 21 (BRN) between the IP fuse block circuit breaker #6 and the instrument cluster connector. Is the repair complete?	—	System OK	—

Gauges Inoperative - All (cont'd)

Step	Action	Value(s)	Yes	No
4	Locate and repair the open in CKT 22 (BLK) between the instrument cluster and joint connector 1, terminal 3F. Is the repair complete?	—	System OK	—
5	Replace the instrument cluster. Is the repair complete?	—	System OK	—

Gauge - Voltmeter Inaccurate or Inoperative

Step	Action	Value(s)	Yes	No
1	1. Place the ignition switch in the RUN position. 2. Check the battery voltage with a voltmeter. 3. Compare the instrument cluster voltmeter indication to the tested voltage. Are the voltmeter indications approximately the same within the specified value?	12 V	System OK	Go to *Step 2*
2	Replace the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?		System OK	—

Indicator - Check Gauge Always On (Cell 81)

Step	Action	Value(s)	Yes	No
1	1. Place the ignition switch in the RUN position. 2. Observe the temperature gauge indicator. Does the temperature gauge indicator indicate a temperature beyond the specified value?	120°C (245°F)	Go to *Gauge - Engine Oil Pressure Always High*	*Go to Step 2*
2	1. Start the engine. 2. Observe the oil pressure gauge indicator. Does the oil pressure gauge indicate the pressure is below the specified value?	34 kPa (5 psi)	Go to *Gauge - Engine Oil Pressure Always Low*	*Go to Step 3*
3	1. Disconnect the multifunction alarm module. 2. Observe the CHECK GAUGES indicator lamp. Is the CHECK GAUGES indicator lamp off?	—	Go to *Multifunction Alarm Module Replacement.*	*Go to Step 4*
4	1. Disconnect the instrument cluster connector. 2. Connect an ohmmeter across instrument cluster harness connector terminal B8 and ground. Does the ohmmeter indicate a short to ground?	—	*Go to Step 5*	*Go to Step 6*
5	1. Locate the short in the wire between the multifunction alarm module and the instrument cluster. 2. Repair the short. Is the repair complete?	—	System OK	—
6	Replace the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—

Indicator - Check Gauge Always On (Cell 41)

Step	Action	Value(s)	Yes	No
1	Disconnect the engine coolant temperature switch. Does the lamp turn off?	—	Go to *Step 2*	Go to *Step 3*
2	Replace the engine coolant temperature switch. Is the repair complete?	—	System OK	—
3	Disconnect the oil pressure switch. Does the lamp turn off?	—	Go to *Step 4*	Go to *Step 5*
4	Replace the oil pressure switch. Is the repair complete?	—	System OK	—
5	Disconnect the multifunction alarm module. Does the lamp remain on?	—	Go to *Step 6*	Go to *Step 7*
6	Locate and repair the short to ground in CKT 19 or CKT 607 (BLU/YEL) between the instrument cluster and the multifunction alarm module. Is the repair complete?	—	System OK	—
7	Connect a test lamp from the oil pressure switch connector to B+. Does the test lamp light?	—	Go to *Step 8*	Go to *Step 9*
8	Locate and repair the short to ground in CKT 231 (TAN/BLK) or CKT 608 (BRN/BLK) between the oil pressure switch and the multifunction alarm module. Is the repair complete?	—	System OK	—
9	Connect a test lamp from the engine coolant temperature switch connector to B+. Does the test lamp light?	—	Go to *Step 10*	Go to *Step 11*
10	Locate and repair the short to ground in CKT 1675 (BRN) between the engine coolant temperature switch and the multifunction alarm module. Is the repair complete?	—	System OK	—
11	Replace the multifunction alarm module. Is the repair complete?	—	System OK	—

Indicator - Check Gauge Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the engine coolant temperature switch. 2. Connect a fused jumper from the engine coolant temperature switch connector to chassis ground. 3. Place the ignition switch in the RUN position. Does the lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Replace the engine coolant temperature switch. Is the repair complete?	—	System OK	—
3	1. Leave the jumper connected. 2. Backprobe the multifunction alarm module with a DVM from terminal B7 to B+. Is the voltage less than the specified value?	10.0 V	Go to *Step 4*	Go to *Step 5*

Indicator - Check Gauge Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
4	Locate and repair the open in CKT 1675 (BRN) between the multifunction alarm module and the engine coolant temperature switch. Is the repair complete?	—	System OK	—
5	1. Place the ignition switch in the LOCK position. 2. Disconnect the fused jumper. 3. Disconnect the oil pressure switch. 4. Connect a fused jumper from the oil pressure switch connector to chassis ground. 5. Place the ignition switch in the RUN position. Does the lamp light?	—	Go to *Step 6*	Go to *Step 7*
6	Replace the oil pressure switch. Is the repair complete?	—	System OK	—
7	1. Leave the jumper connected. 2. Backprobe the multifunction alarm module with a DVM from terminal A7 to B+. Is the voltage less than the specified range?	10.0 V	Go to *Step 8*	Go to *Step 9*
8	Locate and repair the open in CKT 231 (TAN/BLK) or CKT 469 (BRN/BLK) between the multifunction alarm module and the oil pressure switch. Is the repair complete?	—	System OK	—
9	1. Place the ignition switch in the LOCK position. 2. Disconnect the jumper. 3. Disconnect the multifunction alarm module. 4. Connect a fused jumper from the multifunction alarm module connector terminal B6 to chassis ground. 5. Place the ignition switch in the RUN position. Does the lamp light?	—	Go to *Step 10*	Go to *Step 11*
10	Locate and repair the open in CKT 19 or CKT 607 (BLU/YEL) between the instrument cluster and the multifunction alarm module. Is the repair complete?	—	System OK	—
11	Replace the multifunction alarm module. Is the repair complete?	—	System OK	—

Indicator - Fasten Safety Belt Always On

Replace the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster)*. This is an ignition switch-initiated, timed indicator that reminds the driver to fasten the seat belts.

Indicator - Fasten Safety Belt Inoperative

Replace the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster)*. This is an ignition switch-initiated, timed indicator that reminds the driver to fasten the seat belts.

Indicator - Low Engine Coolant Always On

Step	Action	Value(s)	Yes	No
1	1. Disconnect the low coolant probe. 2. Place the ignition switch in the RUN position. Does the lamp remain lit or light up?	—	Go to *Step 3*	Go to *Step 2*
2	Replace the low coolant probe. Is the repair complete?	—	System OK	—
3	Backprobe the multifunction alarm module with a DVM from terminal B1 to B+. Is the voltage more than the specified range?	1.0 V	Go to *Step 4*	Go to *Step 5*
4	Locate and repair the short to ground in CKT 601 or CKT 1478 (LT GRN) between the low coolant probe and the multifunction alarm module. Is the repair complete?	—	System OK	—
5	1. Place the ignition switch in the LOCK position. 2. Disconnect the multifunction alarm module. Does the lamp remain lit?	—	Go to *Step 6*	Go to *Step 7*
6	Locate and repair the short to voltage in CKT 15 or CKT 603 (YEL/RED) between the instrument cluster and the multifunction alarm module. Is the repair complete?	—	System OK	—
7	Replace the multifunction alarm module. Is the repair complete?	—	System OK	—

Indicator - Low Engine Coolant Inoperative (Cell 41)

Step	Action	Value(s)	Yes	No
1	Backprobe the low coolant probe connector with a DVM from terminal B to B+. Is the voltage less than the specified value?	10.0 V	Go to *Step 2*	Go to *Step 3*
2	Locate and repair the open in CKT 150 (BLK) between the low coolant probe and G107. Is the repair complete?	—	System OK	—
3	1. Disconnect the low coolant probe. 2. Connect a fused jumper from the low coolant probe connector terminal B to A. 3. Place the ignition switch in the RUN position. Does the lamp turn on?	—	Go to *Step 4*	Go to *Step 5*
4	Replace the low coolant probe. Is the repair complete?	—	System OK	—
5	1. Leave the jumper connected. 2. Backprobe the multifunction alarm module with a DVM from terminal B to B+. 3. Measure the voltage. Is the voltage less than the specified value?	10.0 V	Go to *Step 6*	Go to *Step 7*

Indicator - Low Engine Coolant Inoperative (Cell 41) (cont'd)

Step	Action	Value(s)	Yes	No
6	Locate and repair the open in CKT 601 or CKT 1478 (LT GRN) between the low coolant probe and the multifunction alarm module. Is the repair complete?	—	System OK	—
7	1. Place the ignition switch in the LOCK position. 2. Disconnect the multifunction alarm module. 3. Disconnect the fused jumper. 4. Connect a fused jumper from the multifunction alarm module connector terminal B2 to B+. Does the test lamp light?	—	Go to *Step 8*	Go to *Step 9*
8	Locate and repair the open in CKT 15 or CKT 603 (YEL/RED) between the instrument cluster and the multifunction alarm module. Is the repair complete?	—	System OK	—
9	Replace the multifunction alarm module. Is the repair complete?	—	System OK	—

Indicator - Low Engine Coolant Inoperative (Cell 81)

Step	Action	Value(s)	Yes	No
1	1. Disconnect the instrument cluster connector. 2. Connect a voltmeter between the harness connector terminal B5 for CKT 483 or CKT 15 (YEL/RED) and ground. Does the voltmeter indicate battery voltage?	—	Go to *Step 2*	Go to *Step 4*
2	1. Disconnect the multifunction alarm module connector. 2. Connect a voltmeter across the multifunction alarm module harness terminal B2 and ground. Does the voltmeter indicate battery voltage?	—	Go to *Step 3*	Go to *Step 5*
3	Repair the short to the battery in CKT 483 or CKT 15 between the instrument cluster and the multifunction alarm module terminal B2. Is the repair complete?	—	System OK	—
4	Replace the instrument cluster. Refer to *IP Cluster Replacement (Instrument Cluster).* Is the repair complete?	—	System OK	—
5	Replace the multifunction alarm module. Refer to *Multifunction Alarm Module Replacement.* Is the repair complete?	—	System OK	—

Speedometer Inaccurate (J 38522 Unavailable)

Step	Action	Value(s)	Yes	No
1	Check that the speedo adapter is correctly calibrated for the axle ratio and the tire size. Is the condition resolved?	—	System OK	*Go to Step 2*
2	1. Connect a scan tool in order to monitor the vehicle speed. 2. Drive the vehicle over a known distance: • Maintain a distance of 8 km (5 mi) or more. • Maintain a speed of 80–110 km/h (50–65 mph), if practical. 3. Using a scan tool, compare the indicated speed to the speedometer indication. 4. Record the following specifications: • The initial odometer reading • The final odometer reading • The actual distance driven While at the specified speed, are the scan tool and the speedometer readings within 6 km/h (4 mph) of each other?	—	*Go to Step 3*	Go to *IP Cluster Replacement (Instrument Cluster).*
3	Divide the actual distance driven by the distance driven as indicated by the odometer. Is the indicated ratio within the specified range?	0.96–1.04	System OK	Go to *IP Cluster Replacement (Instrument Cluster).*

Speedometer and/or Odometer Inoperative

Step	Action	Value(s)	Yes	No
1	Perform diagnostic testing per BRAKES and ENGINE CONTROLS. This testing will identify problems with the vehicle speed sensor or the speedo adapter. Is the problem resolved?	—	Go to *Step 2*	Go to *Step 3*
2	System is operating properly. Is the repair complete?	—	System OK	—
3	1. Disconnect the connector at the instrument cluster. 2. Disconnect the connector at the speedo adapter. 3. Connect a self-powered test lamp between the instrument cluster connector terminal D for CKT 42 (WHT) and CKT 422 (WHT) and ground. Does the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
4	Locate and repair the short to ground on CKT 42 (WHT) and CKT 422 (WHT) between the speedo adapter and the instrument cluster. Is the repair complete?	—	System OK	—
5	Connect a self-powered test lamp between the instrument cluster connector terminal D and the speedo adapter connector terminal B8 for CKT 42 (WHT) and CKT 422 (WHT). Does the test lamp light?	—	Go to *Step 6*	Go to *Step 7*

Speedometer and/or Odometer Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
6	Replace the instrument cluster. Is the repair complete?	—	System OK	—
7	Locate and repair the open in the CKT 42 (WHT) and CKT 422 (WHT) between the speedo adapter and the instrument cluster. Is the repair complete?	—	System OK	—

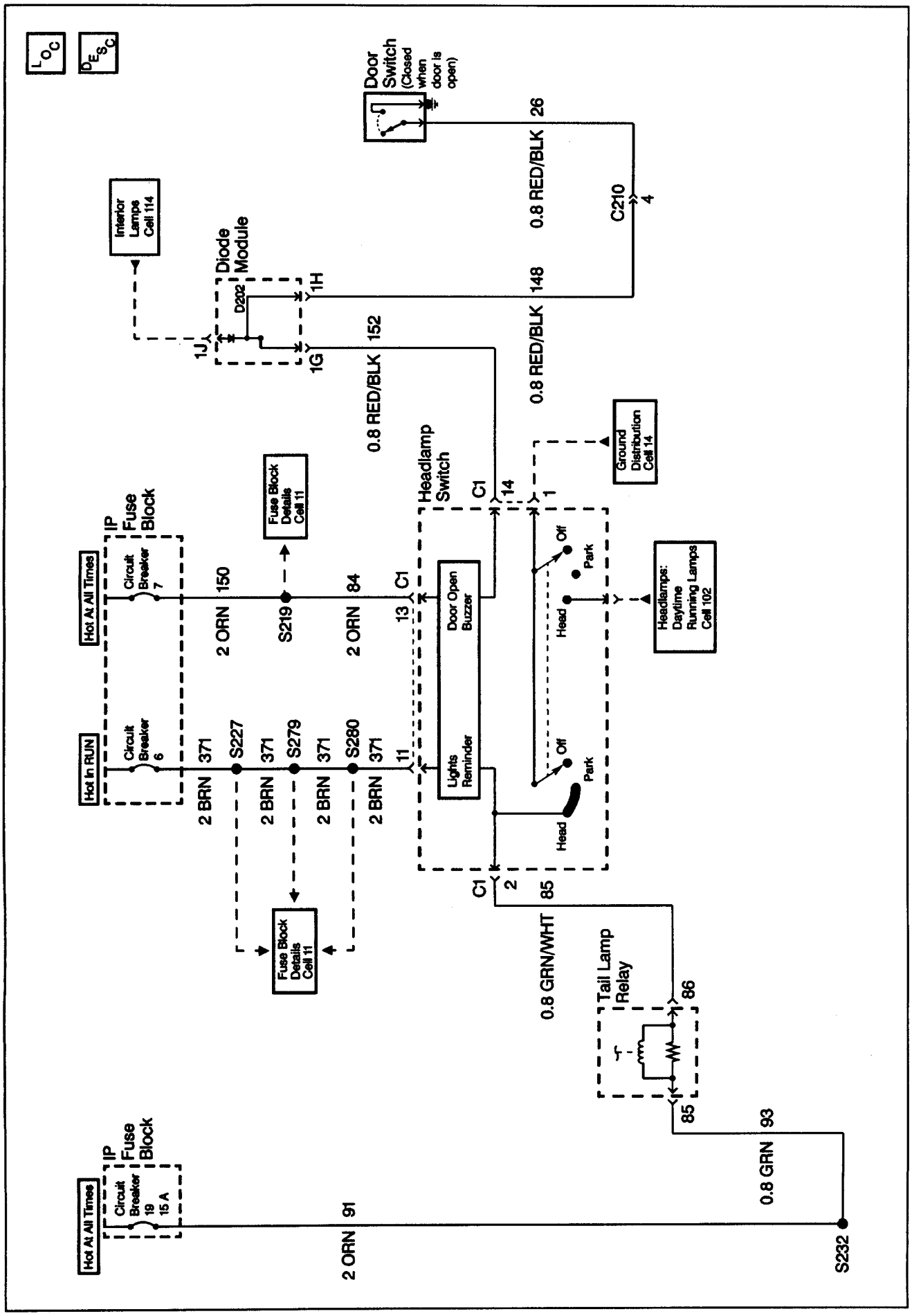
Tachometer Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the 17 way IP harness connector (C3) at the instrument cluster. 2. Connect a voltmeter across the harness connector terminal 17 and ground. Does the voltmeter indicate DC voltage?	—	Go to *Step 2*	Go to *Step 3*
2	Replace the instrument cluster. Is the repair complete?	—	System OK	—
3	1. Disconnect the engine control module connector. 2. Connect an ohmmeter across the instrument cluster harness connector 17 and ground. Does the ohmmeter indicate a short to ground?	—	Go to *Step 4*	Go to *Step 5*
4	Locate and repair the short in CKT 211 and CKT 19 (WHT) between the instrument cluster and the engine control module. Is the repair complete?	—	System OK	—
5	Connect an ohmmeter across the instrument cluster harness connector 17 and the engine control module harness connector terminal 69. Does the ohmmeter indicate a short?	—	Go to *Step 6*	Go to *Step 7*
6	Replace the engine control module. Is the repair complete?	—	System OK	—
7	Locate and repair the open in CKT 121 and CKT 19 (WHT) between the instrument cluster and the engine control module. Is the repair complete?	—	System OK	—

Schematic and Routing Diagrams

Audible Warnings Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Headlamps: Daytime Running Lamps Cell 102	8—Lighting Systems
Interior Lamps Cell 114	8—Lighting Systems


Audible Warnings Schematics (Cell 76)
LOC
DESC
240854
Door Switch (Closed when door is open)
Interior Lamps Cell 114
Diode Module
D202
1J
1H
1G
26
148
152
0.8 RED/BLK
C210
4
IP Fuse Block
Hot At All Times
Circuit Breaker 7
Hot In RUN
Circuit Breaker 6
Fuse Block Details Cell 11
Headlamp Switch
C1
14
1
Ground Distribution Cell 14
150
84
13
11
2 ORN
2 BRN
371
S219
S227
S279
S280
Door Open Buzzer
Lights Reminder
Off
Park
Head
Headlamps: Daytime Running Lamps Cell 102
2
85
0.8 GRN/WHT
Tail Lamp Relay
86
93
0.8 GRN
Circuit Breaker 19 15 A
91
S232

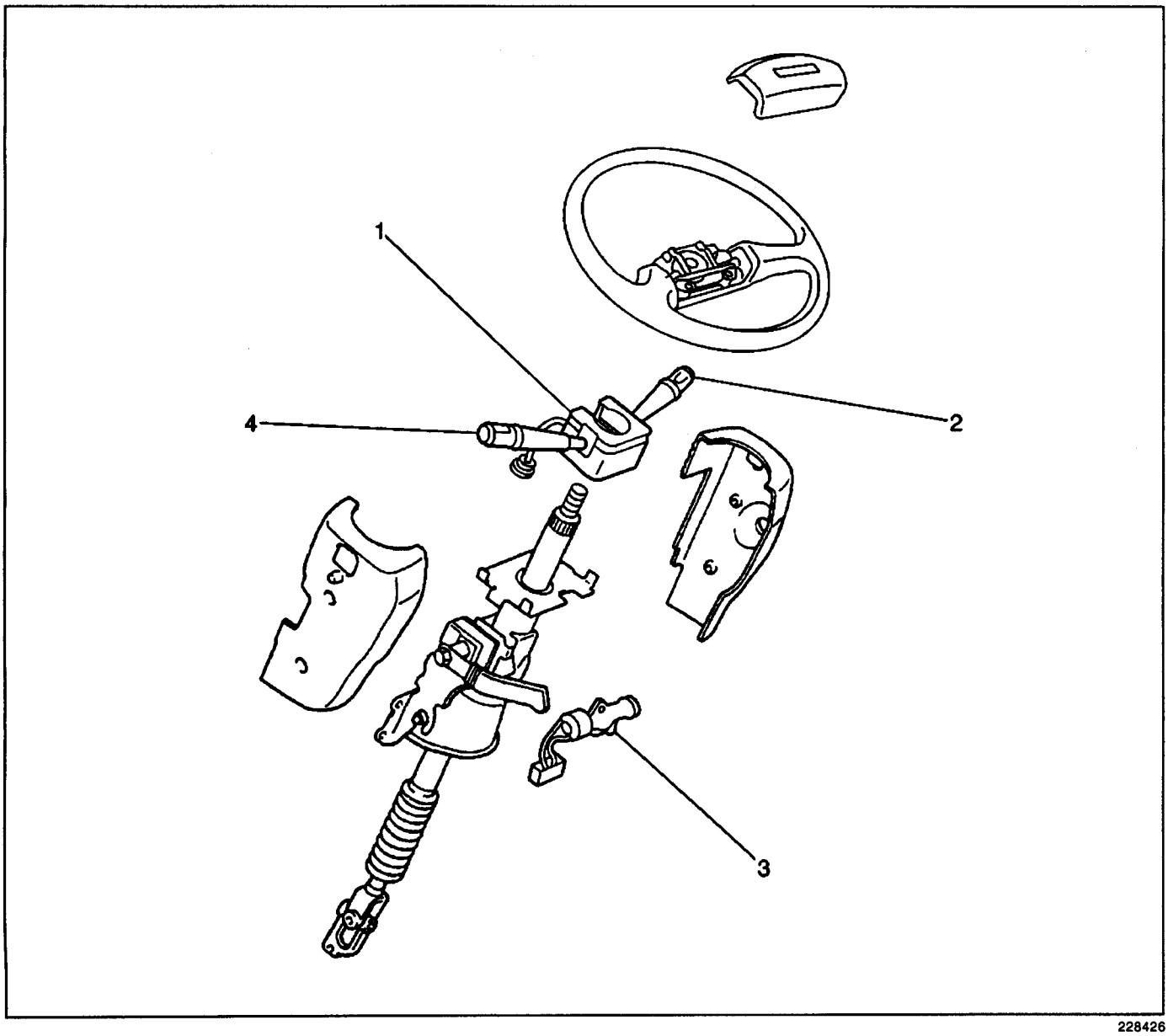
Diagnostic Information and Procedures

Audible Warnings Components

Name	Location	Locator View	Connector End View
Door Open Reminder Alarm	On the steering Column (part of the multifunction switch)	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*
Lights On Reminder Alarm	On the steering Column (part of the multifunction switch)	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*
Multifunction Alarm Module (MFAM) (Air Brakes)	Under the right seat	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*
Multifunction Alarm Module (MFAM) (Hydraulic Brakes)	Under the right seat	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*
Multifunction Alarm Module (MFAM) C1 (16 cavities) (Air Brakes)	On the lower IP harness to the MFAM	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*
Multifunction Alarm Module (MFAM) C1 (16 cavities) (Hydraulic Brakes)	On the lower IP harness to the MFAM	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*
Multifunction Alarm Module (MFAM) C2 (2 cavities) (with Automatic Engine Shutdown)	On the lower IP harness to the MFAM	*Audible Warnings Component Views*	*Audible Warnings Connector End Views*

Audible Warnings Component Views

Steering Column, Left View

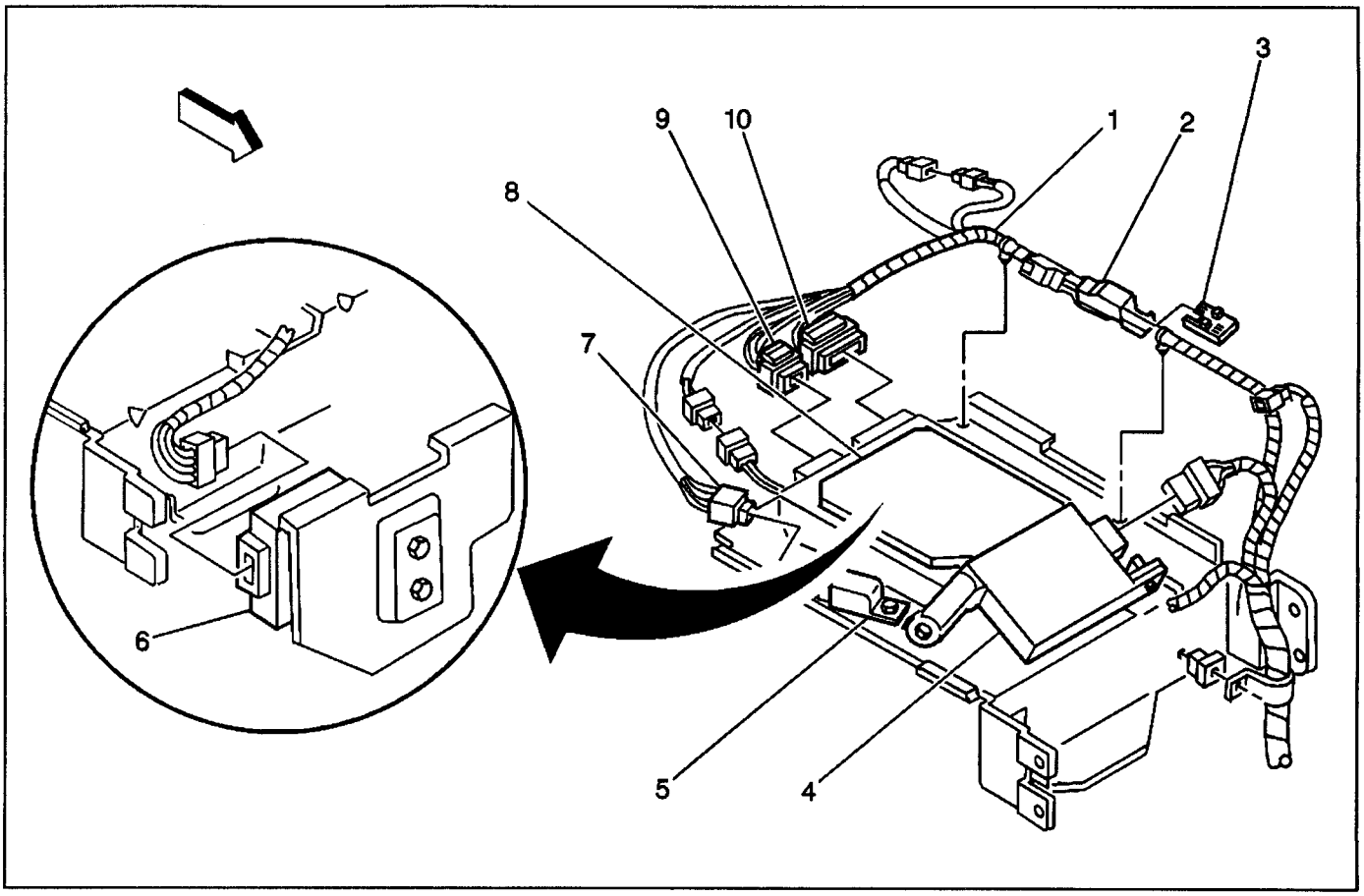


228426

Legend

(1) Multifunction Switch
(2) Right Multifunction Lever
(3) Ignition Switch
(4) Left Multifunction Lever

Instrument Panel Harness to Right Seat



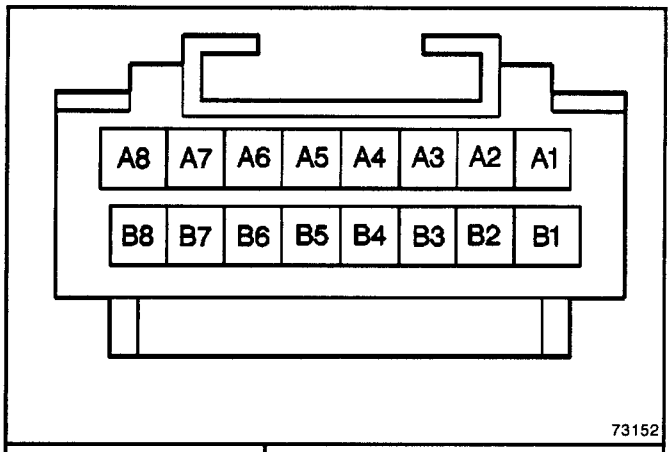
228786

Legend

(1) Lower IP Harness
(2) Inverting Driver Module Connector (ABS-Hydraulic)
(3) Inverting Driver Module (ABS-Hydraulic)
(4) Multifunction Alarm Module
(5) Ignition Main Relay
(6) Speedo Adapter (Vehicle Speed Sensor (VSS) Buffer)
(7) Pre Stroke Power Cut Relay Fusible Link, 30 A
(8) Engine Control Module
(9) Engine Control Module Connector C2 (80 cavities)
(10) Engine Control Module Connector C1 (40 cavities)

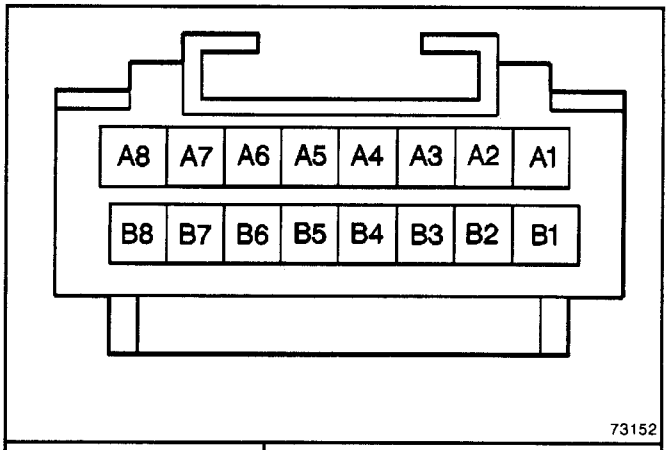
Audible Warnings Connector End Views

Multifunction Alarm Module (MFAM) (Air Brakes)



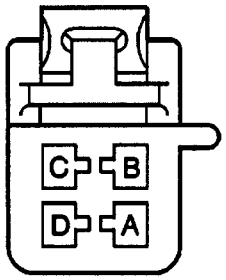
Connector Part Information		• 12084944 • ASM 16F MIC/P 100 (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A1–A4	—	—	Not Used
A5	PNK	611	Fused Output Ignition
A6	—	—	Not Used
A7	BRN/BLK	610	Low Oil Pressure Switch
A8	BLK	605	Ground
B1	LT GRN	601	Low Coolant Probe
B2	YEL/RED	603	Low Coolant Indicator Lamp
B3–B4	—	—	Not used
B5	BRN/WHT	602	Low Air Switch
B6	BLU/YEL	607	Check Gauges Indicator Lamp
B7	BRN	609	Coolant Temperature Switch
B8	—	—	Not Used

Multifunction Alarm Module (MFAM) (Hydraulic)



Connector Part Information		• 12084944 • ASM 16F MIC/P 100 (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A1	LT BLU	475	Brake (Hydraulic)
A2	YEL	468	M.F.A.M. Pin-A2
A3	WHT	478	Stoplamp Switch Input
A4	ORN/BLK	487	Starter Input
A5	PNK	480	Fused Output Ignition
A6	BRN/WHT	482	Primary Brake Indicator Lamp Output
A7	BRN/BLK	466	Low Oil Pressure Switch
A8	BLK	485	Ground Buss
B1	LT GRN	481	Low Coolant Probe
B2	YEL/RED	483	Low Coolant Indicator Lamp
B3	YEL/BLK	484	Auxiliary Brake Indicator Lamp
B4	WHT	477	Stoplamp Switch Input
B5	—	—	Not Used
B6	BLU/YEL	488	Check Gauges Indicator Lamp
B7	BRN	465	Coolant Temperature Switch
B8	ORN/BLUL	476	Fuse Output Battery

Multifunction Alarm Module (MFAM) C2 w/ Auto Engine Shutdown



280782

Connector Part Information		• 12064760 • 4 Way F Metri-Pack 150 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	252	Engine Stop
B–C	—	—	Not Used
D	GRN	65	Engine Coolant Temperature Switch (Engine Shutdown)

Audible Warnings Diagnostic System Check

1. Check the condition of circuit breakers #6, #7, and #19. If any circuit breaker is open, locate and repair cause of overload. Replace the circuit breaker if necessary.
2. Check that G105 is clean and tight.
3. Check that the LH door jamb switch operates freely.
4. Check that the tail lamps are working properly. Refer to Cell 110 (Exterior Lighting) for diagnostics of the tail lamps circuit.
5. Check for a broken, or partially broken wire inside the insulation which could cause system malfunction but prove good in a continuity/voltage check with the system disconnected. These circuits may be intermittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
6. Check for the proper installation of aftermarket electronic equipment which may affect the integrity of other systems. Refer to *Checking Aftermarket Accessories.*

Chime Always On

Step	Action	Value(s)	Yes	No
1	Remove the door jamb switch connector. Does the audible warning remain ON?	—	Go to Step 3	Go to Step 2
2	Replace the door jamb switch. Is the repair completed?	—	System OK	—
3	1. Remove the combination switch connector C1. 2. Connect a self powered test lamp from CKT 152 (RED/BLK) at combination switch to ground. Did the test lamp light?	—	Go to Step 5	Go to Step 4
4	Replace the combination switch. Is the repair complete?	—	System OK	—
5	Locate and repair the short to ground in CKT 152, CKT 148, and CKT 26 (RED/BLK) between the combinaton switch and the door jamb switch. Is the repair complete?	—	System OK	—

Chime Inoperative

Step	Action	Value(s)	Yes	No
1	1. Remove the connector at the combination switch. 2. Connect a test lamp between the combination switch (terminal 13) and ground. Does the test lamp light?	—	*Go to Step 2*	*Go to Step 3*
2	1. Connect a test lamp from CKT 83 (BRN) at the combination switch connector C1 (terminal 11) to ground. 2. Turn the ignition switch to the ON position. Does the test lamp light?	—	*Go to Step 4*	*Go to Step 5*
3	Locate and repair the open in CKT 84 and CKT 150 (ORN) between the IP Fuse Block and the combination switch. Is the repair complete?	—	System OK	—
4	Connect a self powered test lamp from CKT 87 (BLK) at the combination switch connector C1 (terminal 1) to ground. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 7*
5	Locate and repair the open in CKT 83 and CKT 371 (BRN) between the IP fuse block and the combination switch. Is the repair complete?	—	System OK	—
6	1. Connect a self powered test lamp from CKT 152 (RED/BLK) at the combination switch connector C1 (terminal 14) to ground. 2. Open the driver's door. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 9*
7	Locate and repair the open in CKT 87, CKT 68, CKT 21 or CKT 550 (BLK) between the combination switch and ground G105. Is the repair complete?	—	System OK	—
8	Replace the combination switch assembly. Is the repair complete?	—	System OK	—
9	Connect a self powered test lamp from the combination switch (terminal 14) to the left door jamb switch connector. Does the test lamp light?	—	*Go to Step 10*	*Go to Step 11*
10	Replace the door jamb switch. Is the repair complete?	—	System OK	—
11	Connect a self powered test lamp from the combination switch connector C1 (terminal 14) to the connector C210 (Terminal 4). Does the test lamp light?	—	*Go to Step 12*	*Go to Step 13*
12	Locate and repair the open in CKT 26 (RED/BLK) between the connector C210 and the door jamb switch. Is the repair complete?	—	System OK	—
13	Connect a self powered test lamp from the combination switch connector C1 (terminal 14) to the diode module (terminal 1H). Does the test lamp light?	—	*Go to Step 14*	*Go to Step 15*
14	Locate and repair the open in CKT 148 (RED/BLK) between the diode module and the connector C210. Is the repair complete?	—	System OK	—

Chime Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
15	Connect a self powered test lamp from the combination switch connector (terminal 14) to the diode module (terminal 1G). Does the test lamp light?	—	*Go to Step 16*	*Go to Step 17*
16	Replace the diode module. Is the repair complete?		System OK	—
17	Locate and repair the open in CKT 152 (RED/BLK) between the combination switch and the diode module. Is the repair complete?		System OK	—

Fasten Safety Belt Chime Always On

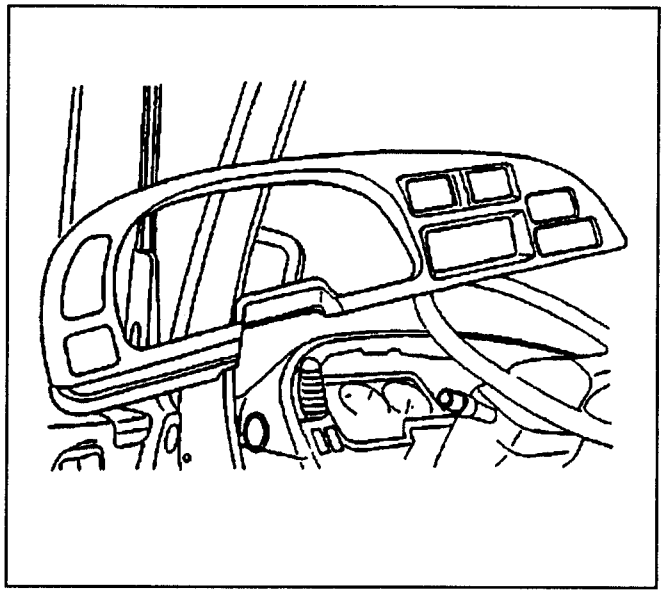
Step	Action	Value(s)	Yes	No
1	Remove the door jamb switch connector. Does the audible warning remain on?	—	Go to *Step 2*	Go to *Step 3*
2	1. Remove the combination switch connector C1. 2. Connect a self powered test lamp from CKT 152 (RED/BLK) at the combination switch to ground. Does the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
3	Replace the door jamb switch. Is the repair complete?	—	System OK	—
4	Locate and repair the short to ground in CKT 152, CKT 148 or CKT 26 (RED/BLK) between the combination switch and the door jamb switch. Is the repair complete?	—	System OK	—
5	Replace the combination switch. Is the repair complete?	—	System OK	—

Repair Instructions

IP Cluster Replacement (Instrument Cluster)

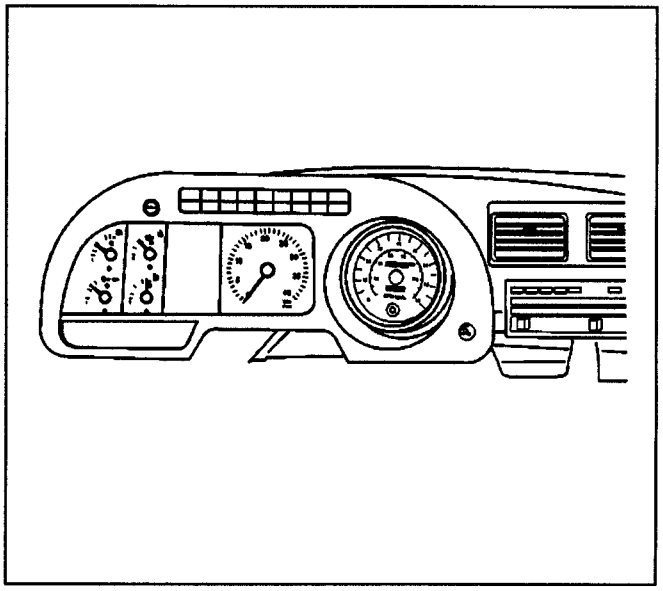
Removal Procedure

1. Remove the cluster trim.



215548

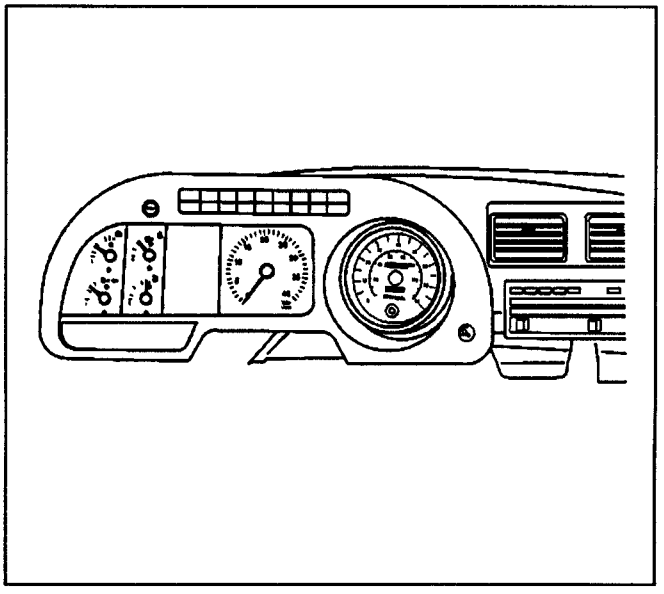
2. Remove the cluster screws.
3. Disconnect the electrical connector.



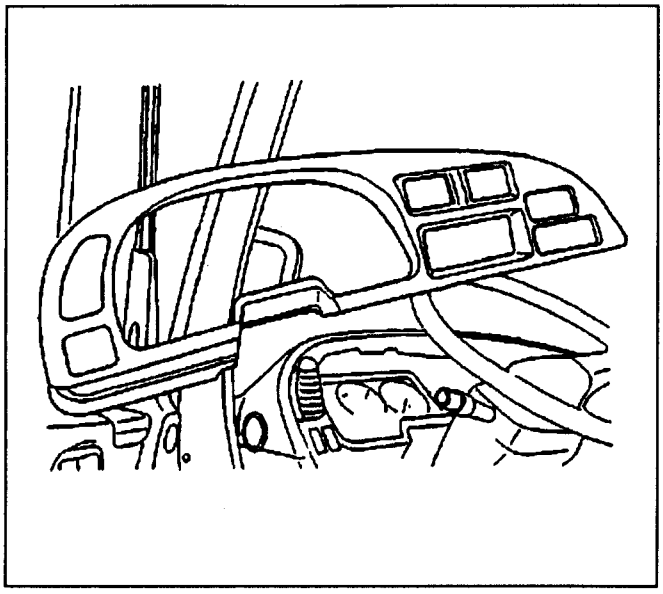
215553

Installation Procedure

1. Connect the electrical connector.
2. Install the cluster screws

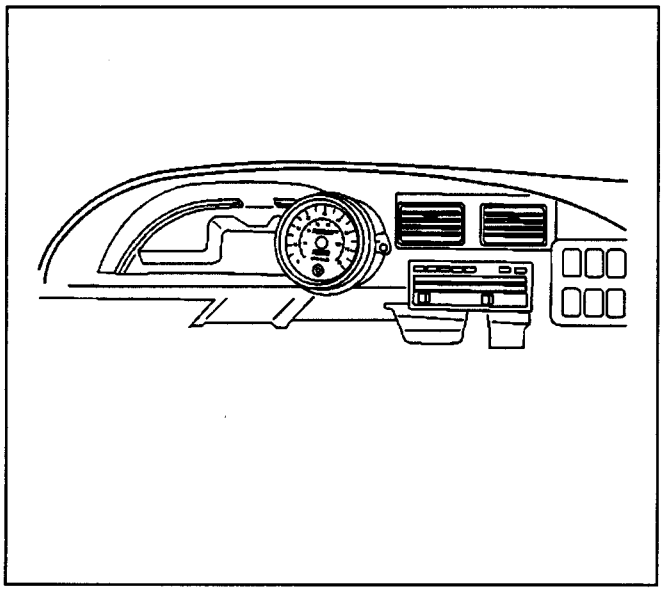


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3. Install the cluster trim.

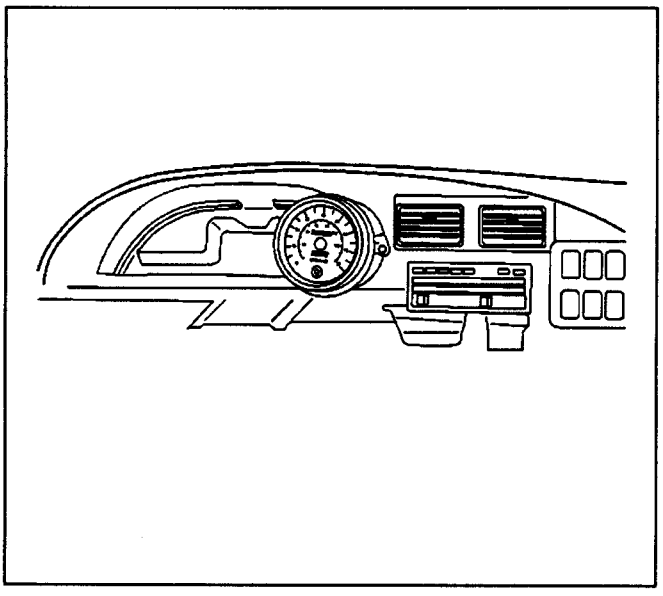


215557

IP Cluster Replacement (Speedometer)

Removal Procedure

1. Remove the cluster trim.
2. Remove the cluster.
3. Remove the speedometer screws.
4. Disconnect the electrical connector.



215557

Installation Procedure

1. Connect the electrical connector.
2. Install the speedometer screws.
3. Install the cluster.
4. Install the cluster trim.

Cigar Lighter Replacement

Removal Procedure

1. Remove the lower instrument panel trim.
2. Disconnect the electrical connector.
3. Remove the lighter housing.

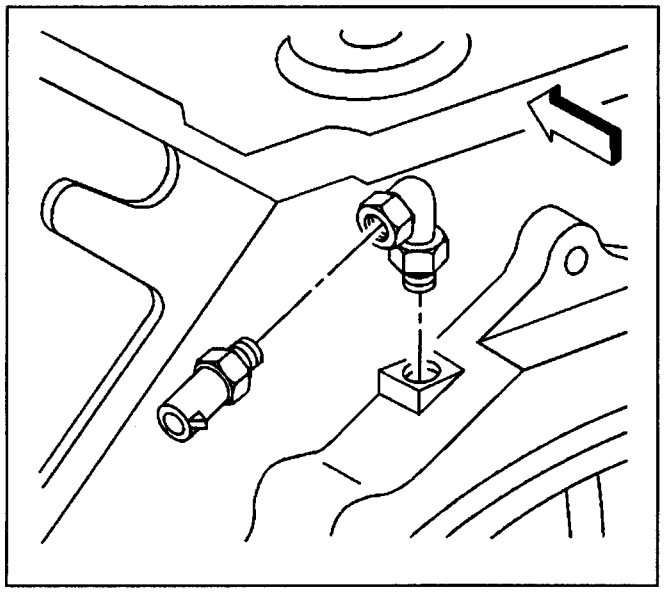
Installation Procedure

1. Install the lighter housing.
2. Connect the electrical connector.
3. Install the lower instrument panel trim.

Engine Oil Pressure Switch Replacement

Removal Procedure

1. Disconnect the electrical connector from the sender.
2. Remove the oil pressure sender from the engine block.



215560

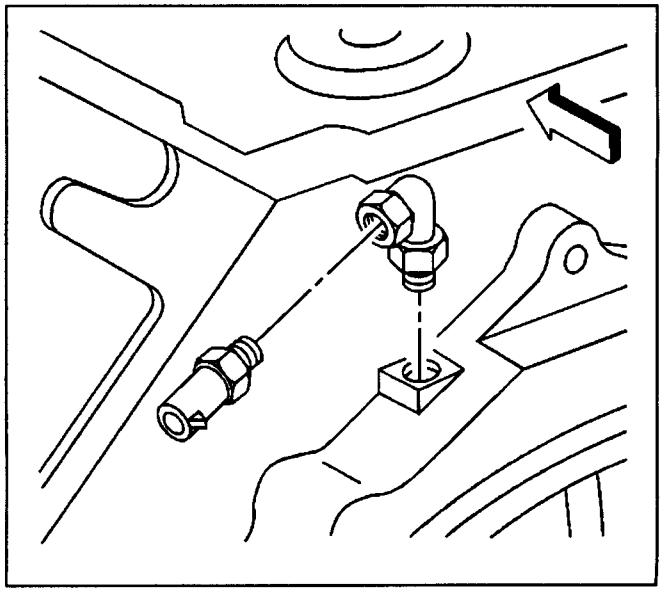
Installation Procedure

1. Install the oil pressure sender to the engine block.

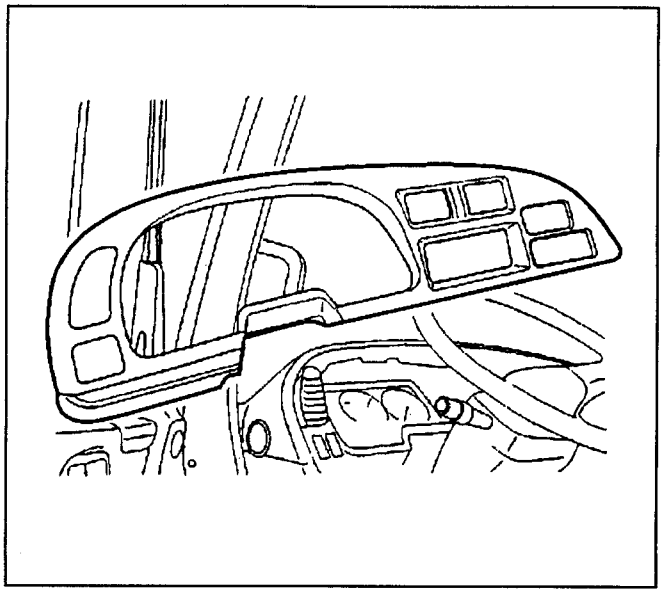
   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Connect the electrical connector to the sender.

   Tighten

   Tighten the oil pressure sender to 13 N·m (115 lb in).



215560



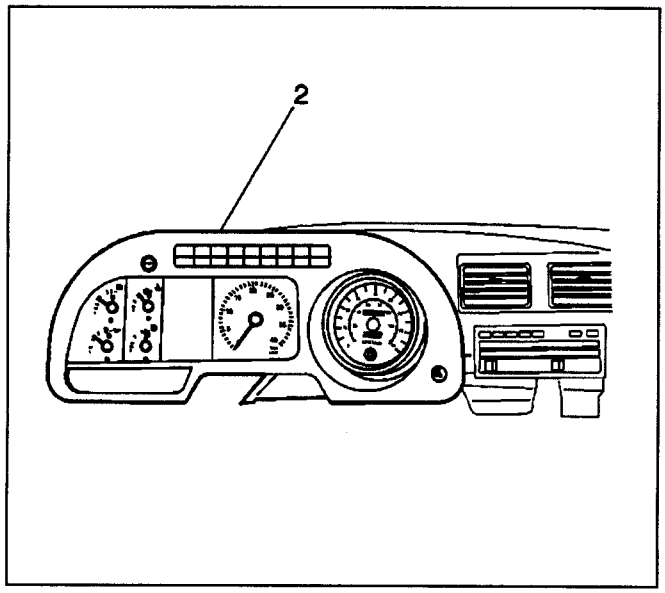
214649

IP Carrier Replacement

Removal Procedure

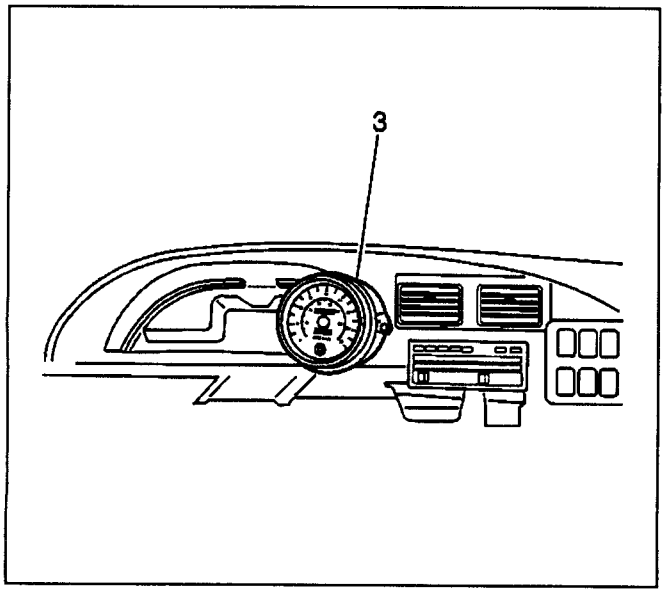
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the instrument cluster trim.



214655

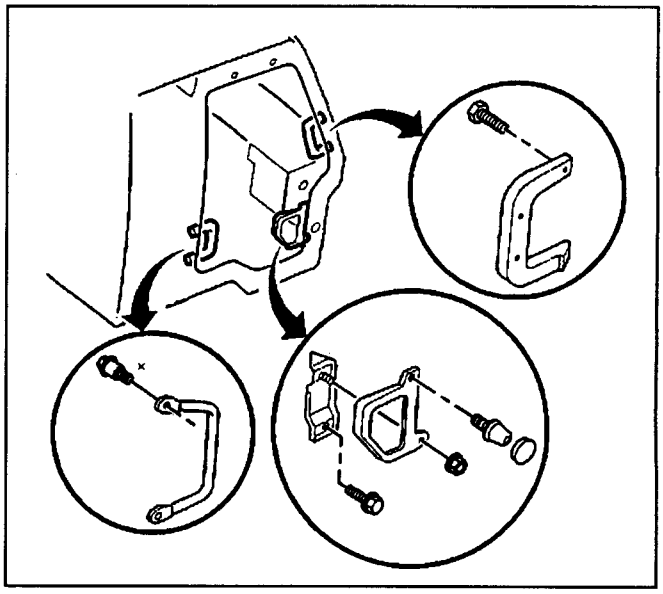
3. Remove the instrument cluster (2).
4. Disconnect the instrument cluster electrical connector.



214657

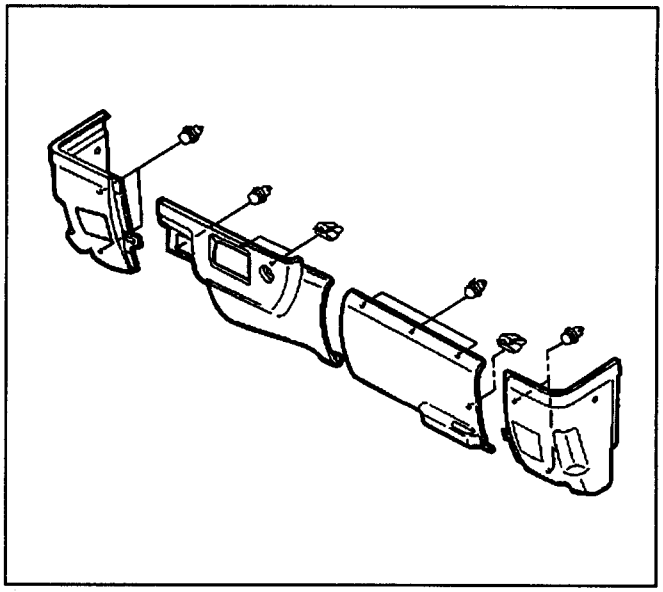
5. Remove the speedometer (3).
6. Disconnect the speedometer electrical connector.
7. Remove the trim surrounding the radio and the climate control assembly.

8. Remove the right and left lower assist handles and the lower assist handle trim.



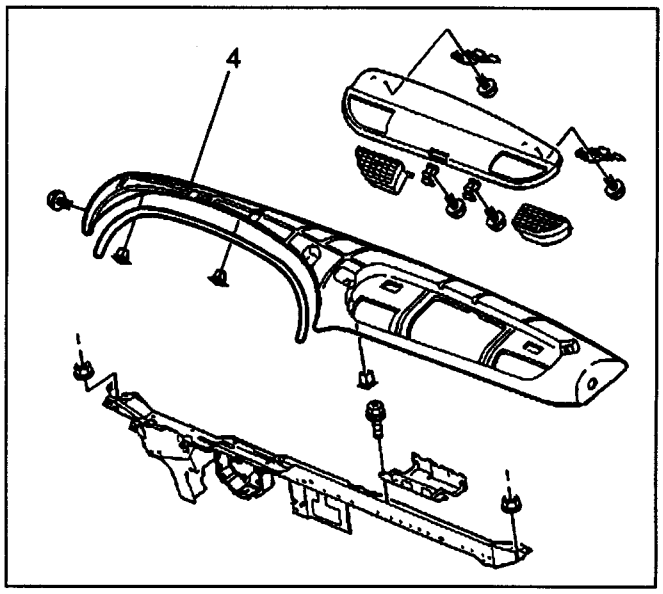
214665

9. Remove the right side lower instrument panel trim.
10. Carefully pry up the defroster grilles and remove them.

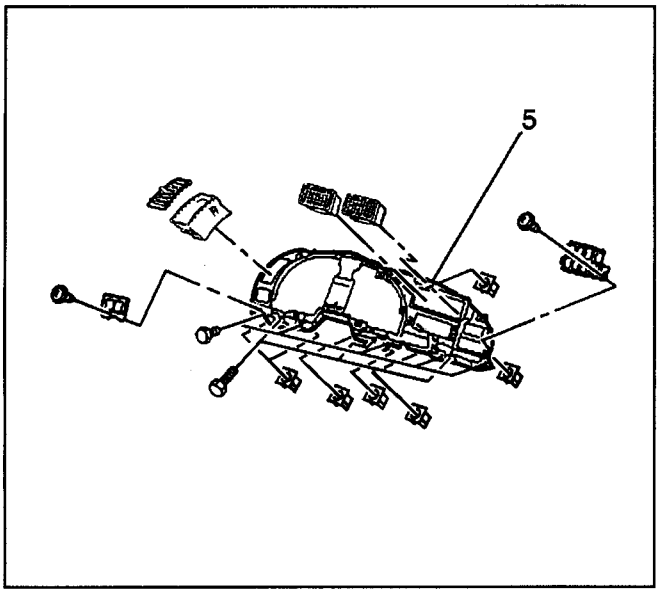


214669

11. Remove the upper instrument panel retaining bolts.
12. Remove the instrument panel upper trim (4).

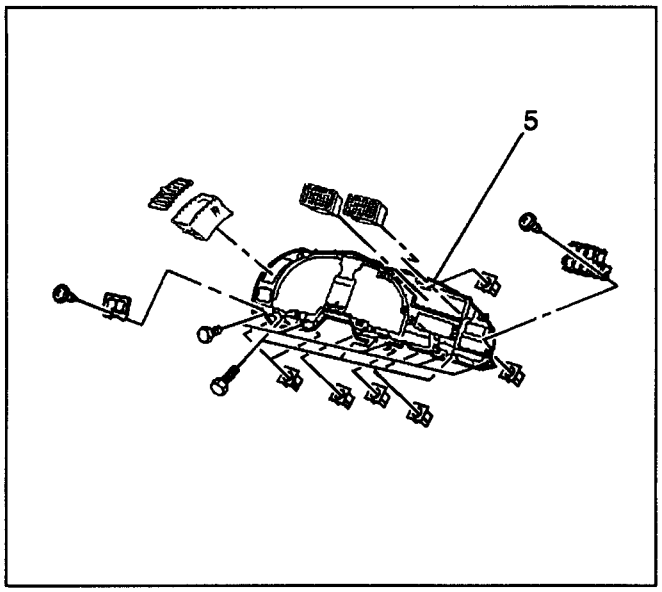


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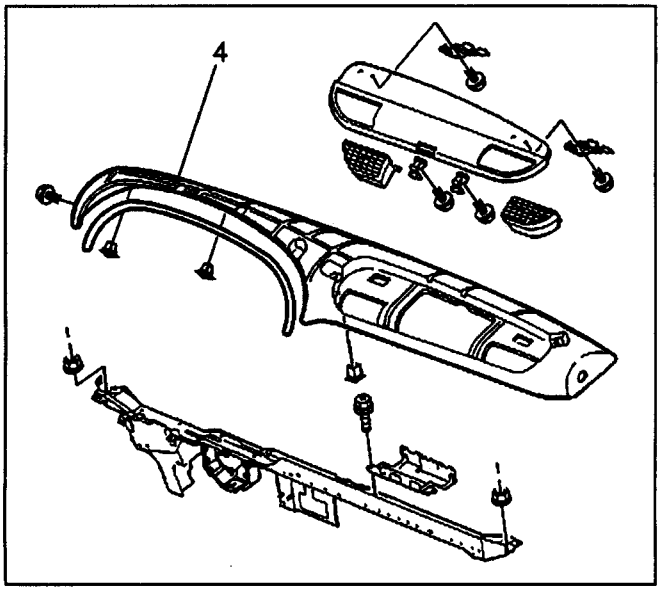
13. Remove the center relay housing (5).
14. Remove the hood release cable handle.
15. Disconnect the instrument panel wiring harness.
16. Remove the instrument panel support.



214662

Installation Procedure

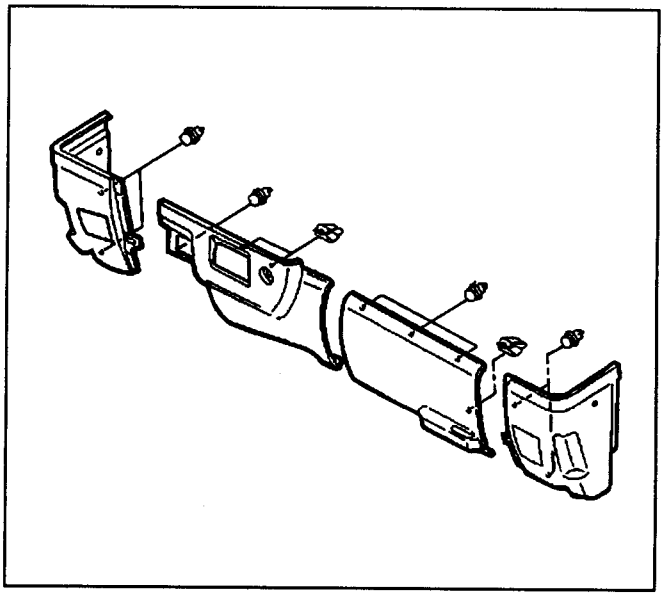
1. Install the instrument panel support.
2. Connect the instrument panel wiring harness.
3. Install the hood release cable handle.
4. Install the center relay housing (5).



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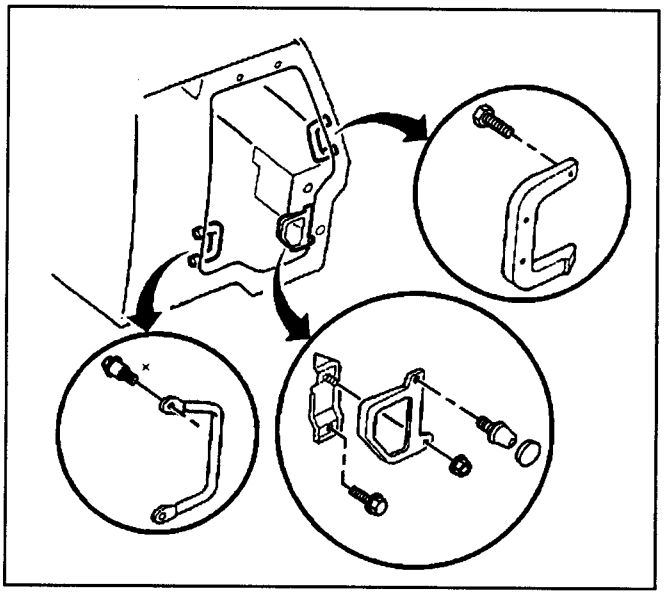
5. Install the instrument panel upper trim (4).
6. Install the upper instrument panel retaining bolts.
7. Install the defroster grilles.

8. Install the right side lower instrument panel trim.



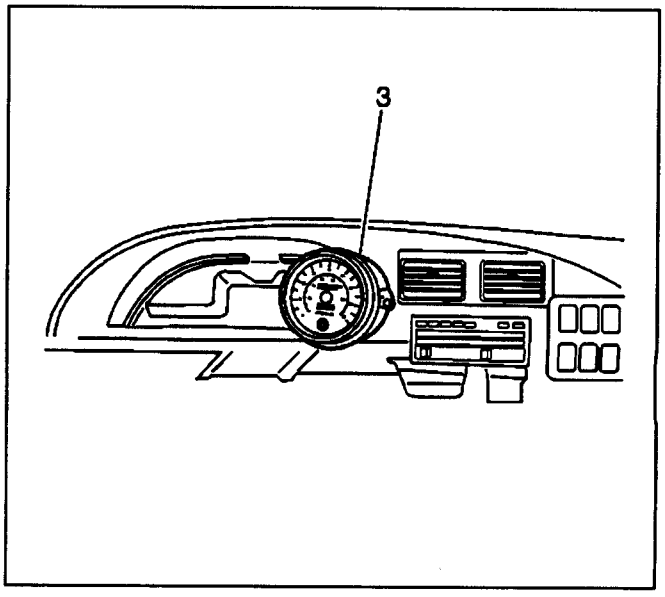
214669

9. Install the right and left lower assist handles and the lower assist handle trim.
10. Connect the radio and climate control assembly electrical connector.
11. Install the radio and climate control assembly.
12. Install the trim surrounding the radio and climate controls.
13. Connect the speedometer electrical connector.

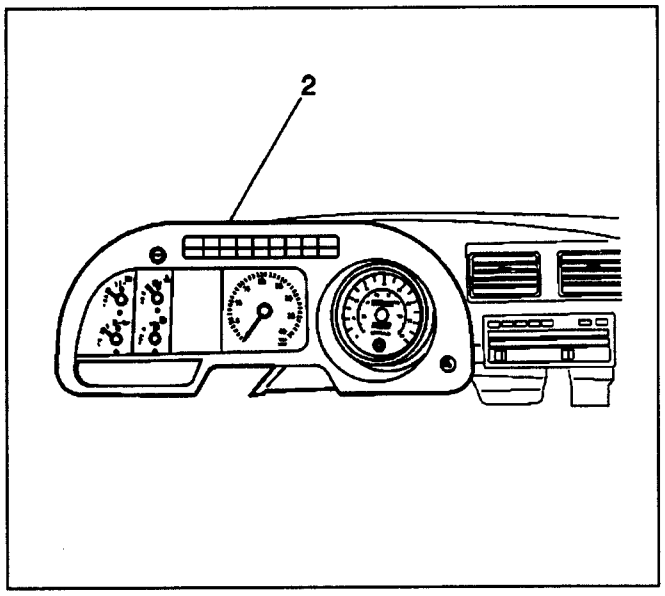


214665

14. Install the speedometer (3).

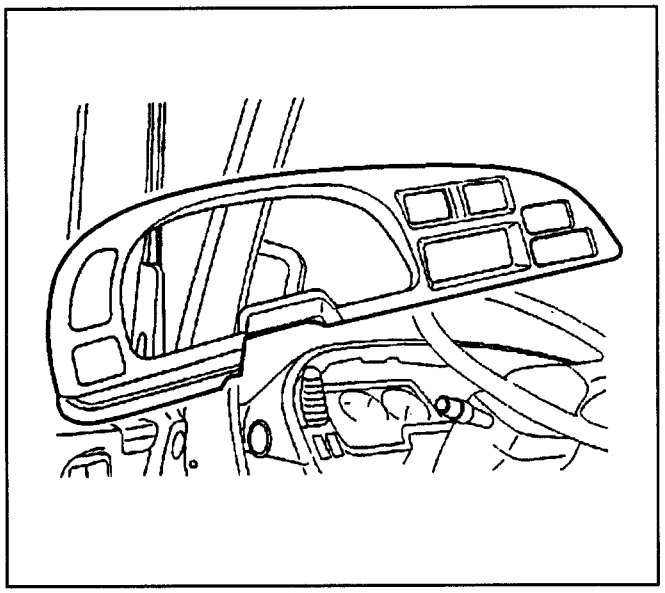


214657



214655

15. Connect the instrument cluster electrical connector.
16. Install the instrument cluster.



214649

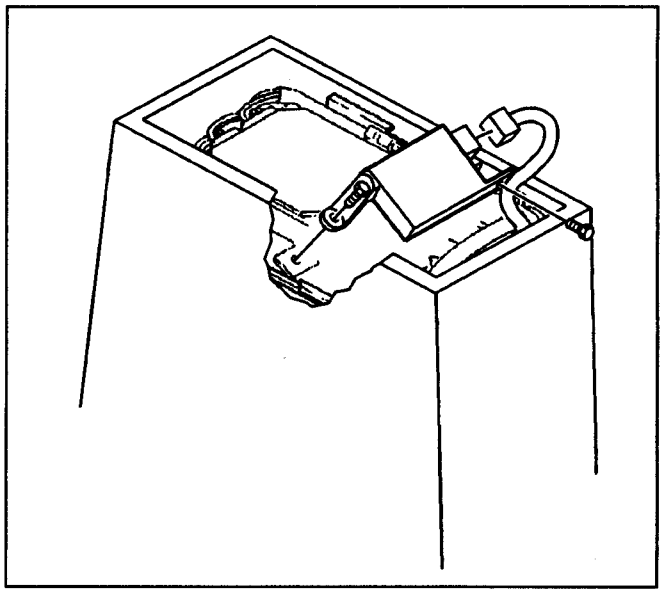
17. Install the instrument cluster trim.
18. Connect the negative battery cable.

Multifunction Alarm Module Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Raise the passenger seat.
3. Disconnect the electrical connector from the multifunctional alarm module.
4. Remove the three bolts and the multifunctional alarm module from the seat frame.

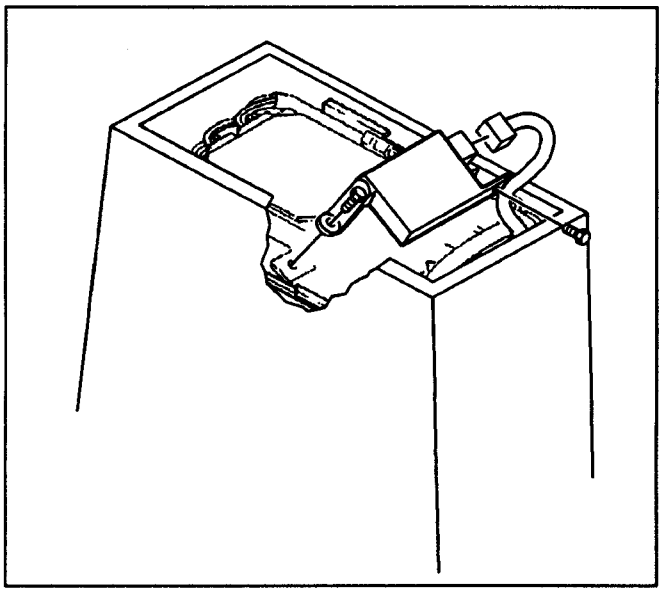


216127

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Connect the multifunctional alarm module to the seat frame with three mounting bolts.
   Tighten
   Tighten the bolts to 3 N·m (27 lb in).
2. Install the multifunctional alarm module electrical connector.
3. Lower the passenger seat.
4. Connect the negative battery cable.



216127

Description and Operation

Instrument Cluster Circuit Description

Check Gauges Indicator Lamp

The CHECK GAUGES indicator lamp lights when either the engine oil pressure is at or below approximately 34 kPa (5 psi) or whenever the engine coolant temperature is at or over approximately 118°C (245°F), as sent from the malfunction alarm module. The ignition switch must be in the RUN position in order to power the CHECK GAUGES lamp driver. Circuit Breaker #6 in the IP fuse block provides power to the lamp. The lamp driver is grounded by the multifunction alarm module. The CHECK GAUGES indicator lamp remains lit after the engine is started until the engine oil pressure exceeds the low oil pressure setpoint.

Oil Pressure Gauge

Battery voltage, from circuit breaker #6 in the IP fuse block, powers the oil pressure gauge when the ignition switch is in the RUN position. If the current through the oil pressure gauge and the oil pressure sensing element is high, the pointer moves toward the 0 kPa (0 psi) indication. If the current through the gauge and the sensor decreases, the gauge moves toward the 550 kPa (80 psi) indication.

The current that passes through the oil pressure gauge passes through two magnetic coils. The vertical coil connects directly to ground. The horizontal coil ground path passes through the oil pressure sensing element. Some of the current always passes through the vertical coil. The percentage of total current passing through the horizontal coil depends on the resistance of the oil pressure sensing element. The oil pressure sensing element produces a resistance of approximately 0 ohms when the oil pressure is zero. The oil pressure sensing element produces a resistance of approximately 88 ohms when the oil pressure is at 550 kPa (80 psi). With a lower resistance, a greater percentage of the total current passes through the horizontal coil and the pointer moves to 0 kPa (0 psi). When the oil pressure is high, a smaller percentage of the current flows through the oil pressure gauge horizontal coil and the pointer moves toward 550 kPa (80 psi).

When the multifunction alarm module senses a high temperature, (low oil pressure) condition, the multifunction alarm module grounds the CHECK GAUGES cluster indicator lamp input terminal, B8. The oil pressure setpoint is at approximately 34 kPa (5 psi).

The accuracy of the oil pressure gauge is adequate for normal operator usage because the oil pressure gauge provides a reasonably accurate indication of the engine oil pressure from which sudden or long term changes may be identified. The response of the sensing element is essentially linear over the operating range. The gauge accuracy is for 3.5 degrees (angular) at 0 kPa (80 psi) and for 7 degrees at 550 kPa (80 psi). Changes in the battery voltage do not affect the gauge accuracy.

Speedometer/Odometer

The speedometer and the odometer operate through solid state circuity inside the instrument cluster. The IP fuse block circuit breaker #6 powers the instrument cluster through CKT 41 (BRN). The instrument cluster receives a square wave, 4,000 pulses per mile signal from the vehicle speed sensor (VSS) buffer through CKT 42 and CKT 422 (WHT). The solid state electronics position the speedometer pointer in response to the pulse rate. The electronics also drive the odometer indication in response to the pulse rate over time.

The speedometer's rated accuracy at 65 mph is plus or minus 2 mph (63 to 67 mph). At 20 mph, the rated accuracy is plus or minus 4 mph (16 to 24 mph). Variations in voltage and inaccuracies in the other circuit components may increase the error.

Tachometer

The timing and injection rate control system (TICS) module drives the tachometer. The TICS module receives the input from the engine speed sensor and generates the tachometer output signal which is sent to the cluster mounted tachometer.

Temperature Gauge

The magnetic fields of the two coils, the 38°C (100°F) coil and the 126°C (260°F) coil, moves the pointer of the temperature gauge. The two coils are oriented at right angles so that the magnetic fields interfere with each other. When the ignition switch is in the RUN position, circuit breaker #6 makes battery voltage available to the instrument cluster through CKT 21, CKT 28, CKT 1 or CKT 371 (BRN). If little current flows through the 126°C (260°F) coil, then current flows through the 38°C (100°F) coil which places the pointer at 38°C (100°F), low temperature. If the current through the 126°C (260°F) coil is high, then the pointer moves toward the 126°C (260°F), high temperature, indication.

The current that passes through the 126°C (260°F) coil has two paths to ground. Some of the current can pass through the fixed resistance of the 38°C (100°F) coil and to G101 through CKT 451 (BLK/WHT). The remainder of the current passes to ground through the variable resistance of the temperature sensor. The engine coolant temperature gauge sensor produces a resistance of approximately 1,305 ohms when the temperature is 38°C (100°F). With this high resistance, more current flows through the 38°C (100°F) coil and the pointer moves toward 38°C (100°F). The resistance of the sensor is approximately 61.9 ohms at 118°C (245°F). With this low resistance, more current passes through the temperature sensor and not the 38°C (100°F) coil. The pointer moves toward 126°C (260°F).

When the multifunction alarm module senses a high temperature (low oil pressure) condition the MFAM grounds the CHECK GAUGES indicator lamp input terminal, B8. The temperature setpoint is at approximately 61.9 Ohms or 245°F (118°C).

The accuracy of the temperature gauge is adequate for the normal operator usage because the temperature gauge provides a reasonably accurate indication of the engine coolant temperature from which sudden or long term changes may be identified. The response of the sensing element is non-linear over the operating range. This condition limits accuracy. The gauge accuracy specification is for 3.5 degrees (angular) at 126°C (260°F) and for 7 degrees at 38°C (100°F). Changes in the battery voltage do not affect the gauge accuracy.

Voltmeter

The voltmeter indicates battery voltage when the ignition switch is in the RUN position. The voltmeter measures generator voltage when the engine is running. The normal generator voltage is 14 volts. The battery voltage without the engine running depends upon the ambient temperature. The battery voltage may be as low as 9.6 volts. Circuit breaker #6 supplies voltage to the voltmeter through CKT 26), CKT 1 or CKT 371 (BRN). Ground for the single coil indicator passes through CKT 27 (BLK) to joint connector #1 (upper).

Audible Warnings Operation

Alarm Systems General Description

Each vehicle has at least one, or possibly several, alarm systems that alert the driver to system malfunctions. At start-up, all of the warning indicators will turn on as a bulb check. An alarm module controls the alarm systems on any vehicle. Refer to the following alarm and module information.

Hydraulic Brake Control and Low Coolant Alarm Module

The brake fluid level switch turns on the PRIMARY BRAKE warning lamp on the instrument panel if the fluid in the brake master cylinder is low. If the flow of fluid from the power steering pump is low, the module turns on the PRIMARY BRAKE lamp and sounds a continuous alarm.

If the module detects a malfunction in the auxiliary electric pump system, the module turns on the AUX BRAKE warning lamp and sounds a continuous alarm.

If the coolant level becomes very low, the module also turns on the LOW COOLANT warning lamp and sounds an alarm at five beats per second.

Low Air (Air Brakes) and Low Coolant Alarm Module

The low air pressure switch turns on the PRIMARY BRAKE warning lamp when the engine starts, and the lamp remains on until the system reaches normal pressure.

If the system air pressure drops below 503 kPa (73 psi), when the ignition is on, the low air pressure switch turns on the warning lamp and the module sounds a constant tone alarm.

If the coolant level becomes very low, the module also turns on the LOW COOLANT warning lamp and sounds an alarm at five beats per second.

Low Air, Low Coolant, and Engine Shutdown Module

This module applies to vehicles with the optional CHECK GAUGES warning lamp and the engine shutdown feature.

This alarm module monitors the following information:

- Air brake system pressure
- Oil pressure
- Engine coolant temperature
- Coolant level

The module may also shut down the engine under the following conditions:

- The engine coolant gets too hot.
- The oil pressure drops below a safe level.
- The coolant level drops below the level of the coolant probe.

If the air brake pressure drops below 503 kPa (73 psi) when the engine is running, the air pressure switch closes, and the module turns on the PRIMARY BRAKE warning lamp and sounds a continuous alarm.

If the engine coolant temperature rises above 107°C (225°F), the coolant temperature switch turns on the CHECK GAUGES warning lamp and sends a signal to the alarm module and sounds a tone alarm at two beats per second.

If the coolant temperature increases above 111°C (232°F), or if the oil pressure drops below 55 kPa (8 psi), the CHECK GAUGES warning lamp remains on and the tone alarm increases to five beats a second.

If the coolant level falls below the level of the coolant probe, the module allows 25 seconds for any splashing effect, and then the module sounds a tone alarm at five beats per second. This then turns on the LOW COOLANT warning lamp.

The five beats per second tone alarm signals the activation of the engine shutdown system. The engines runs for 25 seconds before the module interrupts the current flow through the fuel flow solenoid. This shuts down the engine. Restarting the engine resets the timer, but after 25 seconds, the engine will again shut off.

Hydraulic Brakes, Low Coolant, and Engine Shutdown Module

This module applies to vehicles with the optional CHECK GAUGES feature.

The brake fluid level switch turns on the PRIMARY BRAKE warning lamp on the instrument panel if the fluid in the brake master cylinder is low. If the flow of fluid from the power steering pump is low, the module turns on the PRIMARY BRAKE lamp and sounds a continuous alarm.

If the flow of fluid from the power steering pump is low, the module turns on the PRIMARY BRAKE warning lamp and sounds a continuous alarm.

If the module detects a malfunction in the auxiliary electric pump system, the module turns on the AUX BRAKE warning lamp and sounds a continuous alarm.

If the coolant level becomes very low, the module also turns on the LOW COOLANT warning lamp and sounds an alarm at five beats per second.

The module monitors the oil pressure, the coolant temperature, and the coolant level. The module also shuts down the engine as described in the air brake, low coolant, and engine shutdown module.

Hydraulic Brake Booster Reserve System

The hydraulic brake booster motor drives a hydraulic pump in order to provide a reserve power source in the event of a loss of primary hydraulic power in the brake system.

Two electrical switches (flow and stoplamp) control the booster motor. The switches are wired in series through the brake booster relay.

The flow switch senses fluid flow through the primary hydraulic power system. If the primary system drops below a minimum level (about 0.75–1.50 gallons per minute), the switch closes and provides a ground signal to the coil in the brake booster relay.

This ground signal is also applied to the alarm/brake booster module as a signal that the primary system is not operating correctly.

Whenever the brakes are applied, a brake switch inside the stoplamp switch assembly closes. Closing this switch allows battery voltage from the HYD BRK circuit breaker to be applied to the coil of the brake booster relay. This battery voltage signal is also applied to the alarm/brake booster module as an input that the brake switch is closed.

The following signals control the brake booster relay:

- Battery voltage input from the brake switch in the stoplamp switch
- A ground signal from the flow switch

The relay energizes whenever the primary hydraulic booster system is not operating correctly, and the brakes are applied. Energizing the relay applies battery voltage to the brake booster motor in order to activate the secondary brake booster system.

The fluid level switch closes when hydraulic fluid in the reservoir drops below the switch level. The ground signal from the switch turns on the PRIMARY BRAKE warning lamp in order to alert the driver of a low fluid condition.

Alarm/Brake Booster Module with Hydraulic Brakes

The alarm/brake booster module performs the following functions:

- Monitors the primary and the secondary hydraulic brake booster systems.
- Monitors the output from the following switches:
  - Oil pressure
  - Coolant temperature
  - Coolant Level
- Provides a tone signal.
- Turns on the tone signal under the following conditions:
  - The oil pressure switch indicates low oil pressure.
  - The temperature switch indicates high engine coolant temperature.
  - The low coolant probe indicates a low coolant level.

The PNK wire provides power to the alarm/brake booster module, and the BLK wire provides the system ground.

During the engine crank mode of operation, input on the YEL wire alerts the module to the START process. When the engine starts, the module receives pulsed signals from the generator. If these signals are not received, the module will not operate.

During the engine crank mode, the PRIMARY BRAKE and the AUX BRAKE warning lamps energize for four seconds in order to verify continuity. Also, during the pre-engine running stage of operation, the alarm/brake booster module performs a brake booster system check. Prior to the engine running, the flow switch is closed because there is no primary power steering fluid flow. With the switch closed, the module senses ground on the LT BLU/BLK wire. If the switch is stuck open, the module provides a signal to turn on the AUX BRAKE warning lamp. The module will also sound a constant tone alarm.

This ground signal from the flow switch is also sent to the brake booster relay on the LT BLU/BLK wire. With the brake switch open, this ground signal passes through the relay coil to the GRA wire and then to the module. If the module does not sense this ground signal, this indicates an open in the relay coil circuit. The module then provides an output to turn on the AUX BRAKE warning lamp and sounds a constant tone alarm.

With the brake booster in a de-energized state, the module senses a ground signal on the ORN wire through the motor windings and the BLK wire. If this ground is not sensed, this turns on the AUX BRAKE warning lamp and sounds a tone alarm.

When the engine is running, and the pulsed signal is received from the generator on the YEL wire, the module changes to RUN mode monitoring. If the flow switch does not open when the engine is running, the module provides an output turning on the AUX BRAKE warning lamp. This also sounds a constant tone alarm. If the ground signal on the ORN wire to the module stops, this indicates an open in the circuit through the motor windings to ground. The AUX BRAKE warning lamp then comes on and sounds a constant tone alarm.

If the flow switch closes when the engine is running, the module provides an output turning on the PRIMARY BRAKE warning lamp and sounds a constant tone alarm.

Also, during the engine-running mode of operation and when the brakes are applied, the closed stoplamp switch sends a battery voltage signal to the alarm/brake booster module on the GRA wire. At the same time, the module senses battery voltage on the WHT wire from the brake switch. If the battery voltage signal is not sensed, this indicates an open in the GRA wire to the brake booster relay. If this condition occurs, the module provides an output to turn on the AUX BRAKE warning lamp and sounds a constant tone alarm.

Check Gauges Module

The alarm/brake booster module operates as a monitor for the primary and the secondary hydraulic brake booster systems. This module also monitors the following outputs:

- The oil pressure switch
- The coolant temperature switch
- The coolant level switch

The module provides a tone signal and turns on the tone signal under the following conditions:

- The oil pressure switch indicates low oil pressure.
- The temperature switch indicates high engine coolant temperature.
- The low coolant probe indicates a low level of coolant.

The alarm module also turns on the CHECK GAUGES lamp. This tone signal is on a 50 percent duty cycle.

Air Brake Alarm System

This alarm module monitors air pressure through the air pressure switch.

Whenever the engine is running, and the air pressure drops below 455 kPa (73 psi), the air pressure switch closes. The LOW AIR warning lamp then turns on and the module sounds a continuous alarm.

Low Coolant Alarm System

A coolant probe in the radiator surge tank uses coolant in order to provide a constant ground for alternating current. The low coolant circuit in the alarm module then changes the direct current from the vehicle electrical system into alternating current. The module then activates a 25 second timer, providing a ground for the tone alarm and the circuit for the LOW COOLANT warning lamp in the instrument cluster. The lamp then turns on and a tone alarm sounds at five beats per second.

The module has a built-in 25 second delay in order to compensate for the effects of coolant splashing in the radiator and the surge tank.

Engine Low Coolant Indicator Probe (Diesel Engines Only)

The engine low coolant indicator probe is part of the coolant surge tank. If the engine low coolant indicator does not function properly, replace the coolant surge tank. Refer to *Surge Tank (Diesel) Replacement* in Engine Cooling.

Engine Alarm System

The alarm/brake booster module operates as a monitor for the primary and the secondary hydraulic brake booster systems. The module also monitors the following outputs:

- The oil pressure switch
- The coolant temperature switch
- The coolant level switch

The module provides a tone signal and turns on the tone signal under the following conditions:

- The oil pressure switch indicates low oil pressure.
- The temperature switch indicates high engine coolant temperature.
- The low coolant probe indicates a low level of coolant.

The alarm module also turns on the CHECK GAUGES lamp. This tone signal is on a 50 percent duty cycle.

Engine Alarm/Shutdown System (Diesel Engines Only)

This optional system monitors the following information:

- Engine coolant level
- Coolant temperature
- Oil pressure

If the engines encounters a high temperature or a low pressure condition, the CHECK GAUGES warning lamp comes on and the switches send a signal to the alarm module in order to activate the tone alarm. The alarm sounds at two beats per second.

However, this system may also shut down the engine should the following conditions occur:

- The engine coolant gets too hot.
- The oil pressure drops below a safe level.
- The coolant level drops below the level of the coolant probe.

If the oil pressure drops below 41 kPa (6 psi), the oil pressure switch closes. If the coolant temperature increases above 103°C (232°F), the coolant temperature switch closes. Either, or both, of these conditions sound a tone alarm at five beats per second.

If the coolant level drops below the coolant probe, the module allows 25 seconds for any splashing effects and then sounds the tone alarm at five beats per second.

Whenever the tone alarm sounds at five beats per second, a 25 second timer in the alarm module activates. The module then interrupts the current flow through the #1 relay coil, stopping the fuel flow through the solenoid. Then the module shuts down the engine.

You can start the engine again, but the engine will only run for another 25 seconds before the module shuts down the engine again.

Audible Warnings Circuit Description

Fasten Safety Belt Warning Lamp

The safety belt lamp on the instrument cluster will light when the ignition switch turns to the ON position. A timer in the instrument cluster controls the lamp. After a predetermined time, (approximately 5 seconds) the timer turns off and the lamp will remain off until the next ignition cycle.

Lamps-On Warning Alarm

The lamps-on warning alarm turns on if the headlamps or the park lamps remain on when the driver's door opens. The alarm remains displayed until the lights turn off or the driver's door closes.

Horns

Specifications

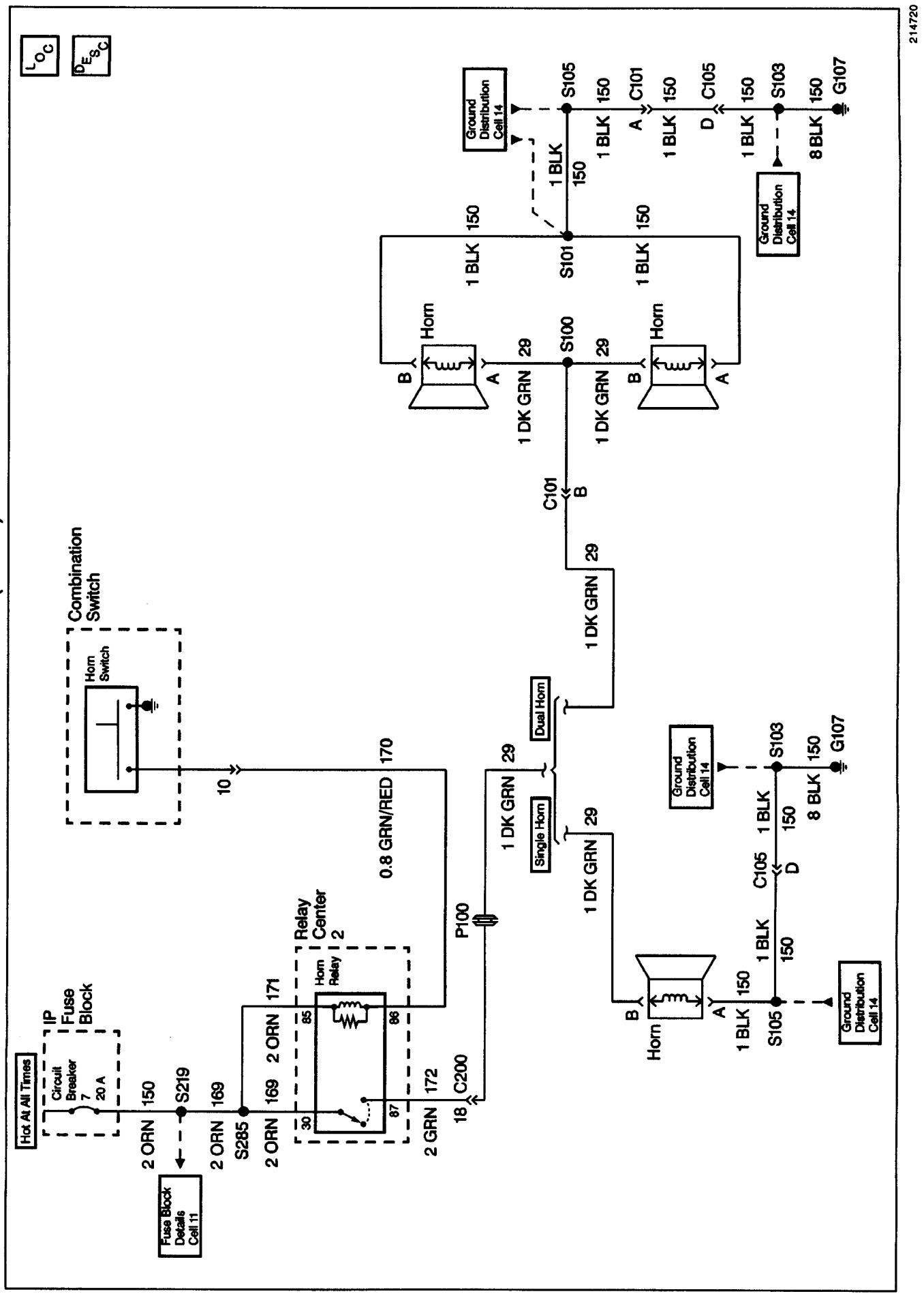
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Horn Mounting Nut	17 N.m	13 lb ft

Schematic and Routing Diagrams

Horns Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems


Horns Schematics (Cell 40)
214720
Hot At All Times
IP Fuse Block
Circuit Breaker 7 20 A
Fuse Block Details Cell 11
2 ORN 150
S219
2 ORN 169
S285
2 ORN 169
2 ORN 171
Relay Center 2
Horn Relay
85
86
30
87
2 GRN 172
18 C200
P100
0.8 GRN/RED 170
10
Combination Switch
Horn Switch
1 DK GRN 29
Dual Horn
Single Horn
1 DK GRN 29
1 DK GRN 29
C101 B
1 DK GRN 29
Horn
B
A
1 BLK 150
S100 29
1 DK GRN 29
Horn
B
A
1 BLK 150
S101 150
1 BLK 150
1 BLK 150
S105
Ground Distribution Cell 14
1 BLK 150
C101 A
1 BLK 150
C105 D
1 BLK 150
S103
Ground Distribution Cell 14
8 BLK 150
G107
Horn
B
A
1 BLK 150
S105
1 BLK 150
C105 D
1 BLK 150
S103
Ground Distribution Cell 14
8 BLK 150
G107
Ground Distribution Cell 14

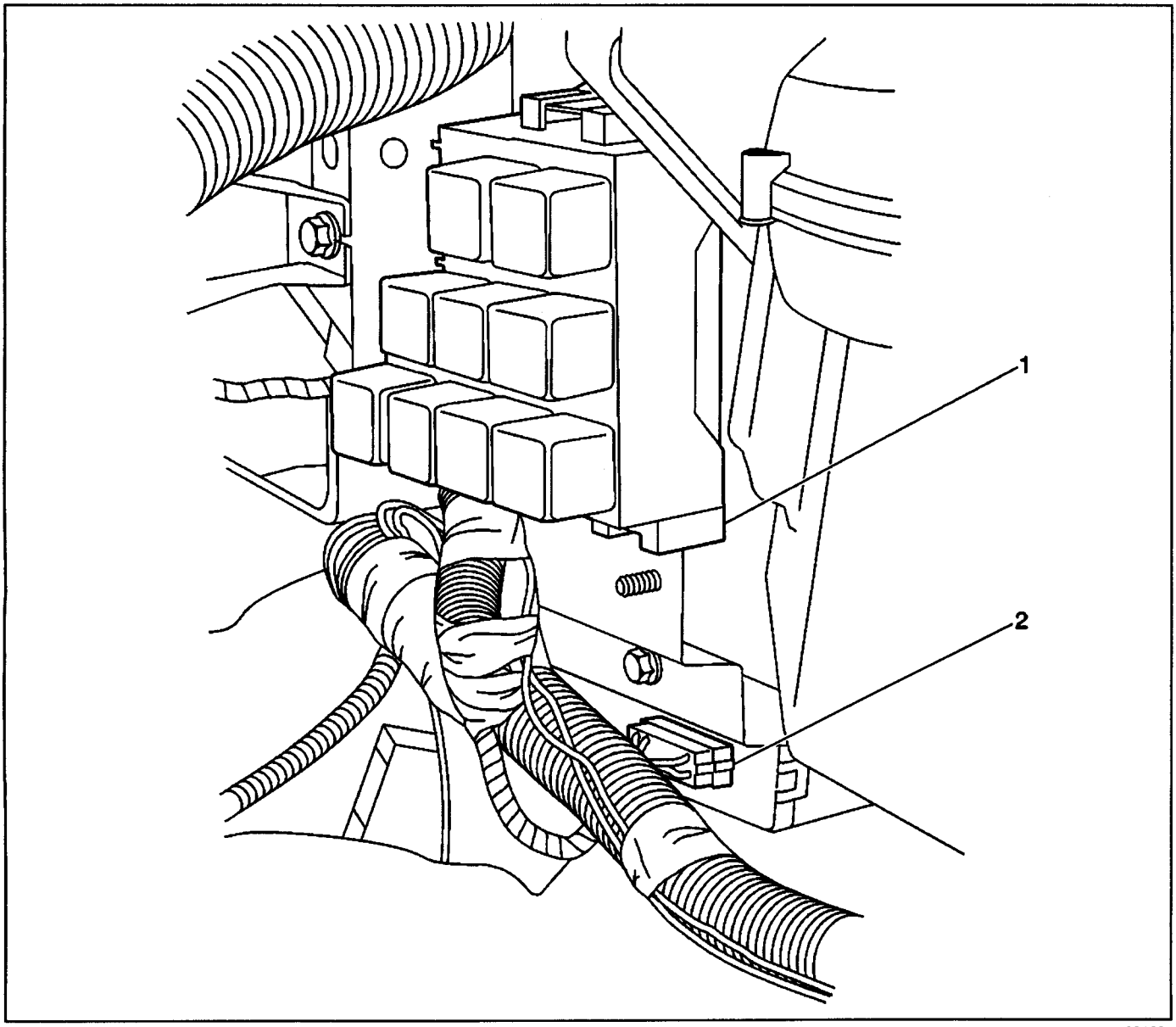
Component Locator

Horns Components

Name	Location	Locator View	Connector End View
Horn Relay	In the center of the lower IP, behind the panel, in the relay center 2	*Horns Component Views*	—
Horn Switch	In the steering wheel	*Horns Component Views*	—
Horn, A-Note (High)	Behind the left side of the front bumper impact bar	*Horns Component Views*	*Horns Connector End Views*
Horn, A-Note (High) (Dual Electric Horns)	Behind the left side of the front bumper impact bar	*Horns Component Views*	*Horns Connector End Views*
Horn, F-Note (Low) (Dual Electric Horns)	Behind the left side of the front bumper impact bar	*Horns Component Views*	*Horns Connector End Views*

Horns Component Views

Instrument Panel, Lower Right View



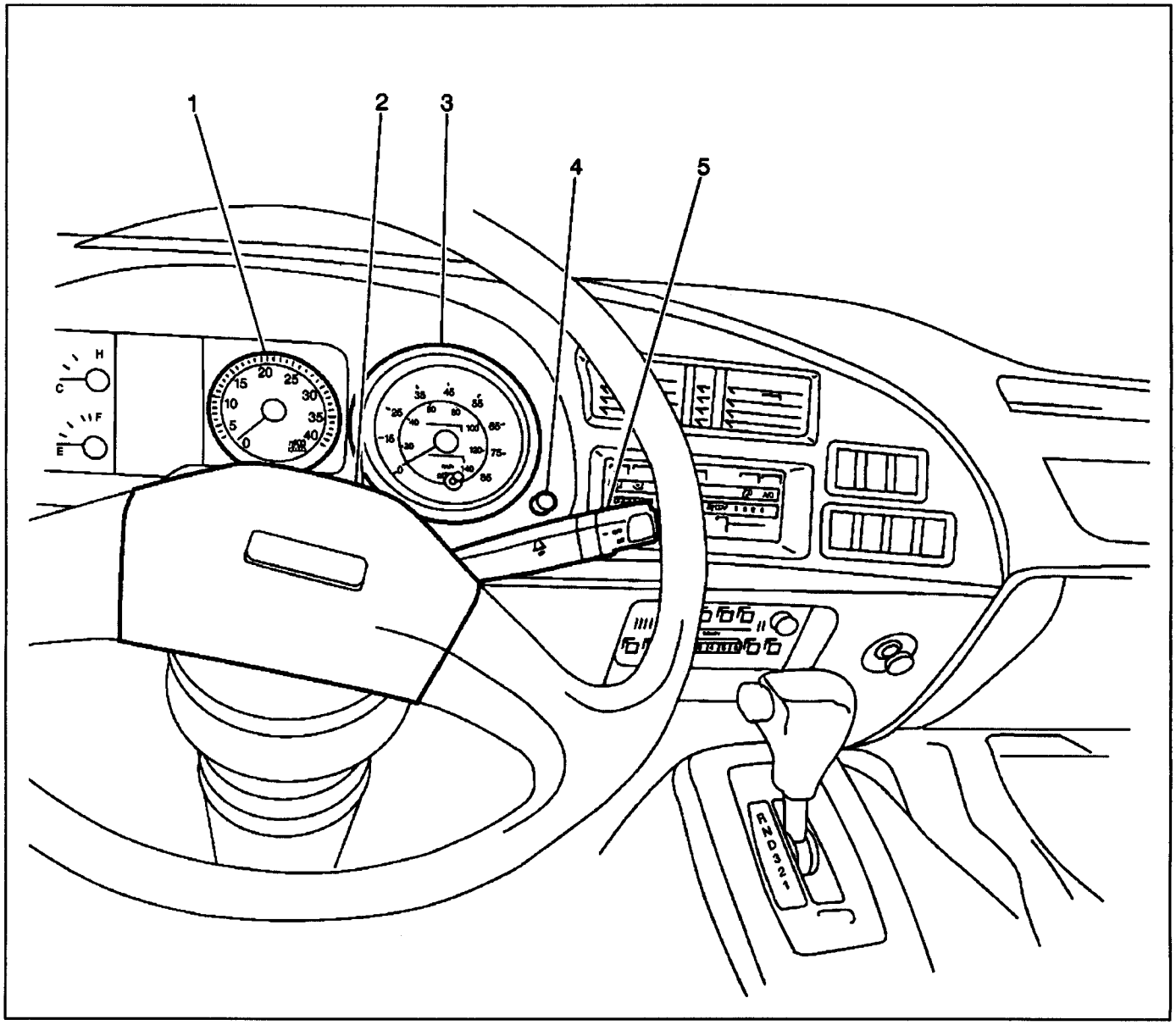
231681

Legend

(1) Relay Center 2

(2) Turn/Hazard Flasher Module

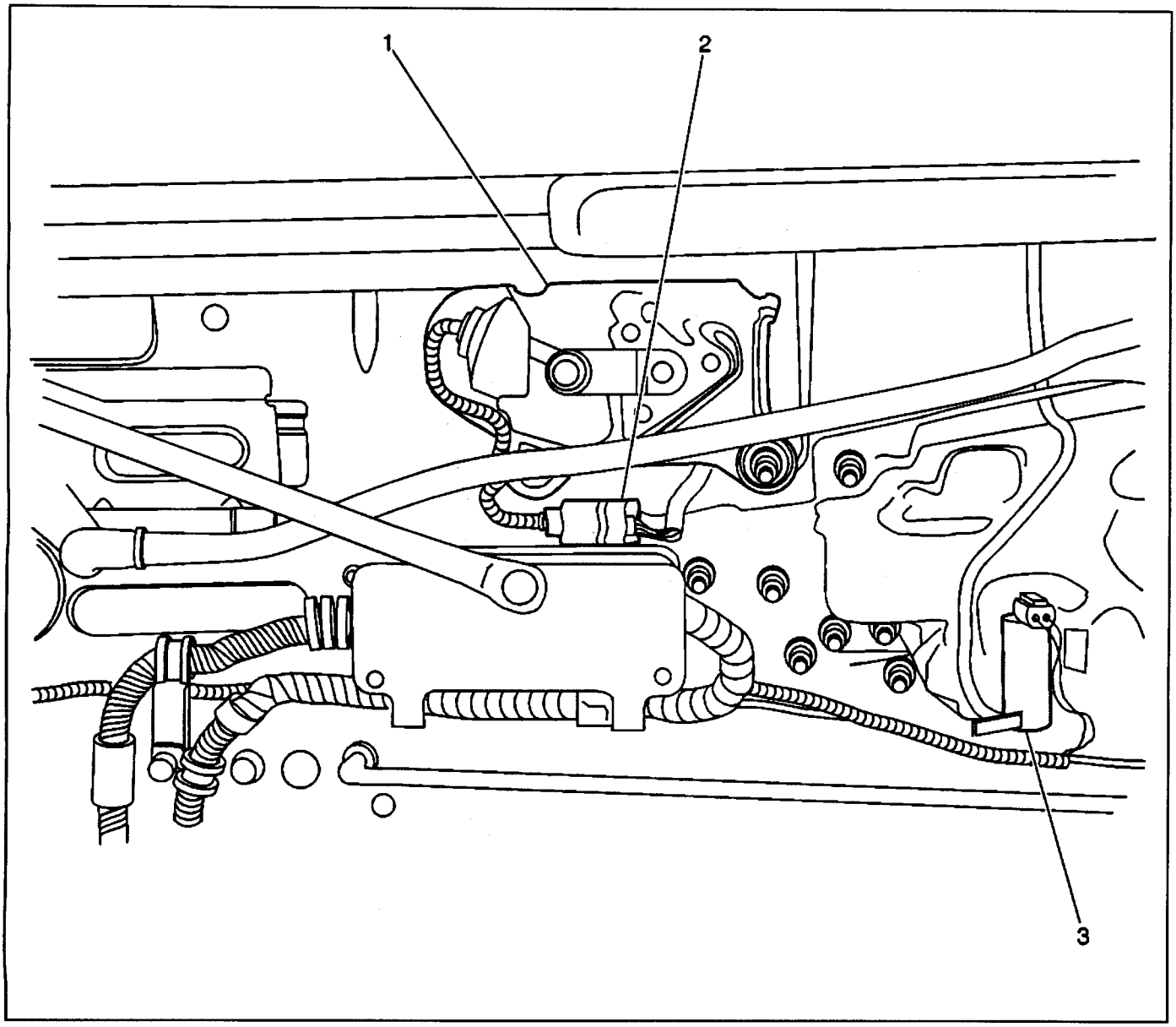
Instrument Panel



Legend

(1) Tachometer
(2) Horn Switch
(3) Speedometer
(4) IP Lamps Dimmer Control
(5) Right Multifunction Lever

Underhood View

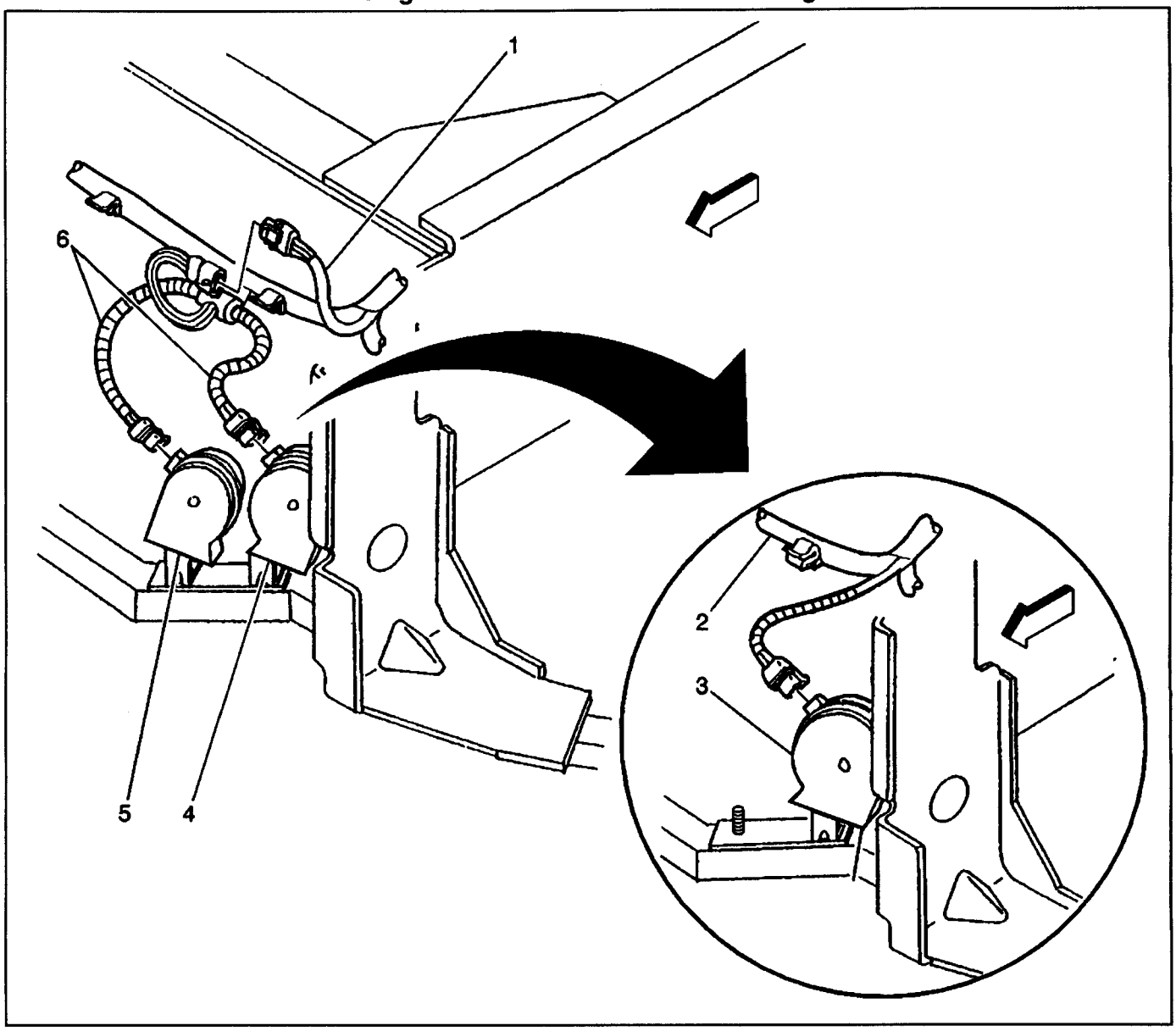


231456

Legend

(1) Windshield Wiper Motor
(2) Windshield Wiper Motor Connector
(3) Windshield Washer Pump Motor

Single and Dual Electric Horns Wiring



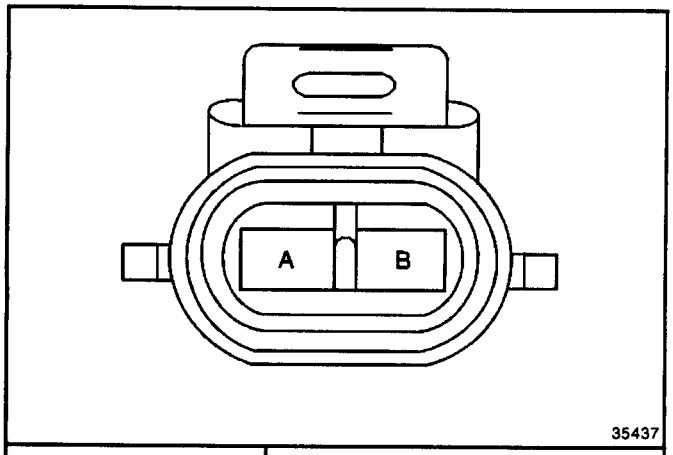
231467

Legend

(1) Front Chassis Harness (Dual Electric Horns)
(2) Front Chassis Harness (Single Electric Horn)
(3) High A-Note Horn (Single Electric Horn)
(4) High-A Note (Dual Electric Horns)
(5) Low F-Note Horn (Dual Electric Horns)
(6) Dual Electric Horns Harness

Horns Connector End Views

Horn



Connector Part Information	• 12052644 • ASM 2F M/P 250 (GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	150	Ground
B	DK GRN	29	Horn Feed

Diagnostic Information and Procedures

Horns Inoperative (Both Do Not Sound)

Step	Action	Value(s)	Yes	No
1	Use a test lamp in order to backprobe the relay center 2 from the horn relay terminal 30 to ground. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 8*
2	Use a test lamp in order to backprobe the relay center 2 from the horn relay terminal 85 to ground. Did the test lamp light?	—	Go to *Step 3*	Go to *Step 9*
3	Use a test lamp in order to backprobe the relay center 2 from the horn relay terminal 86 to B+, while pressing the horn switch. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 7*
4	Use a test lamp in order to backprobe the relay center 2 from the horn relay terminal 87 to ground, while pressing the horn switch. Did the test lamp light?	—	Go to *Step 5*	Go to *Step 10*
5	Use a test lamp in order to backprobe the horn from terminal 29 (DK GRN) to ground, while pressing the horn switch. Did the test lamp light?	—	Go to *Step 6*	Go to *Step 11*
6	Use a test lamp in order to backprobe the horn from CKT 150 (BLK) to B+. Did the test lamp light?	—	Go to *Step 12*	Go to *Step 13*
7	Use a test lamp in order to backprobe the combination switch connector from terminal 10 to B+, while pressing the horn switch. Did the test lamp light?	—	Go to *Step 14*	Go to *Step 15*

Horns Inoperative (Both Do Not Sound) (cont'd)

Step	Action	Value(s)	Yes	No
8	Locate and repair the open in CKT 169 and CKT 150 (ORN) between the IP fuse block and the relay center 2. Is the repair complete?	—	System OK	—
9	Locate and repair the open in CKT 171 (ORN) between S285 and the relay center 2. Is the repair complete?	—	System OK	—
10	Replace the horn relay. Is the repair complete?	—	System OK	—
11	Locate and repair the open in CKT 29 (DK GRN) between wire relay center 2 and the horn(s). Is the repair complete?	—	System OK	—
12	Replace the horn. Is the repair complete?	—	System OK	—
13	Locate and repair the open in CKT 150 (BLK) between the single horn and G107 or between S101 and G107 for dual horns. Is the repair complete?	—	System OK	—
14	Locate and repair the open in CKT 170 (GRN/RED) between the relay center 2 and the combination switch connector. Is the repair complete?	—	System OK	—
15	Replace the horn switch. Is the repair complete?	—	System OK	—

Horns Inoperative (One Does Not Sound)

Step	Action	Value(s)	Yes	No
1	Use a test lamp in order to backprobe the inoperative horn from CKT 29 (DK GRN) to ground while pressing the horn switch. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Use a test lamp in order to backprobe the inoperative horn from CKT 150 (BLK) to B+. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
3	Repair the open in CKT 29 (DK GRN) between S100 and the inoperative horn. Does the dual horn operate properly?	—	System OK	—
4	Replace the inoperative horn. Does the dual horn operate properly?	—	System OK	—
5	Repair the open in CKT 150 (BLK) between the inoperative horn and S101. Does the dual horn operate properly?	—	System OK	—

Horns Always On

Step	Action	Value(s)	Yes	No
1	Disconnect the combination switch connector. Did the horn stop?	—	Go to *Step 3*	Go to *Step 2*
2	Remove the horn relay. Did the horn stop?	—	Go to *Step 4*	Go to *Step 5*

Horns Always On (cont'd)

Step	Action	Value(s)	Yes	No
3	Replace the horn switch. Does the horn operate properly?	—	System OK	—
4	Test for a short to ground in CKT 170 (GRN/RED) between relay center 2 and the horn switch. Does the horn operate properly?	—	Go to *Step 6*	Go to *Step 7*
5	Locate and repair the short to voltage in CKT 29 (DK GRN) between the relay center 2 and the horn(s). Does the horn operate properly?	—	System OK	—
6	Locate and repair the short to ground in CKT 170 (GRN/RED) between relay center 2 and the horn(s). Does the horn operate properly?	—	System OK	—
7	Replace the horn relay. Does the horn operate properly?	—	System OK	—

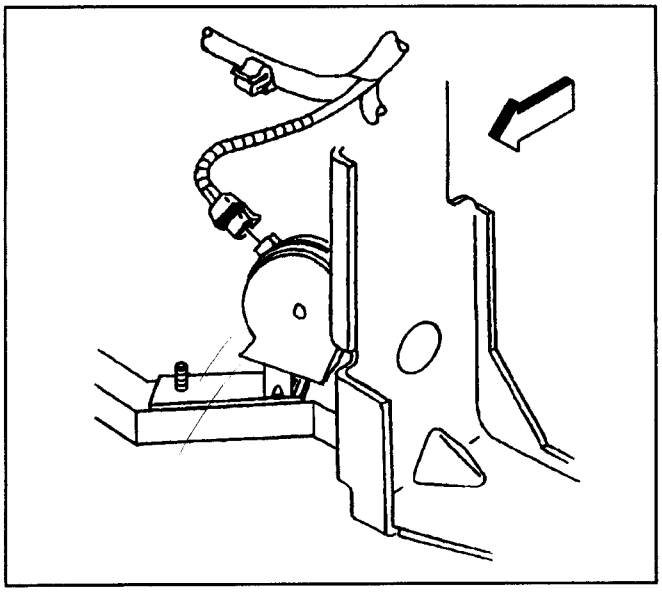
Repair Instructions

Horn Replacement (Single)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the horn wiring harness.
3. Remove the following components from the horn:
   - The nut
   - The washer
   - The mounting bolt
4. Remove the horn from the mounting bracket.



216297

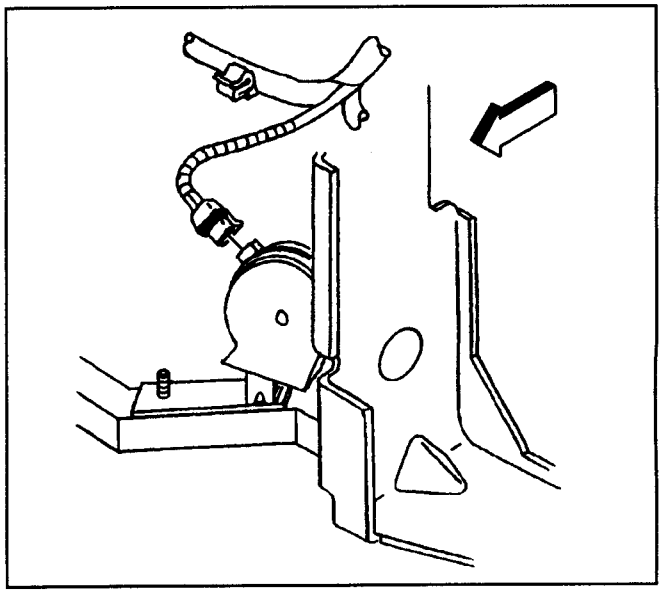
Installation Procedure

1. Install the horn to the mounting bracket.

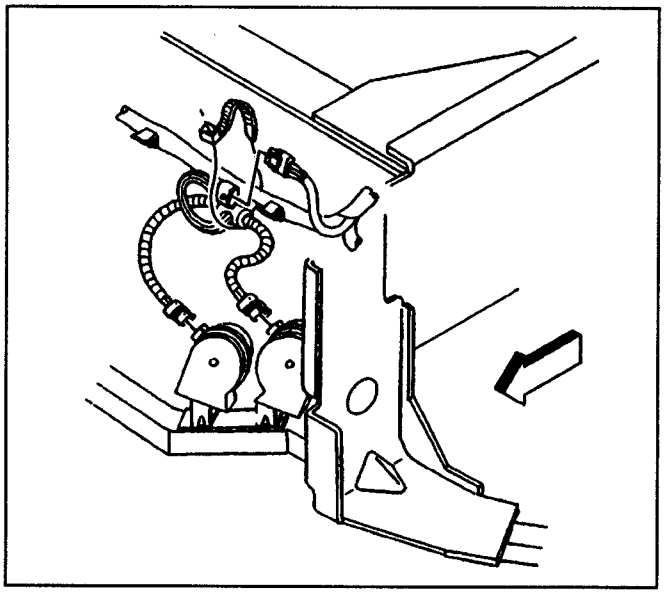
   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the following components to the horn:
   - The mounting bolt
   - The washer
   - The nut

   Tighten

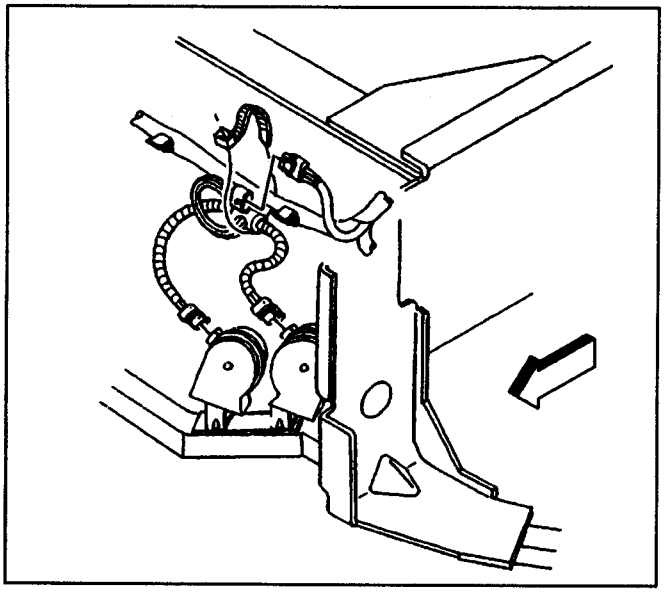
   Tighten the horn mounting nut to 17 N·m (13 lb ft).
3. Connect the horn wiring harness.
4. Reconnect the negative battery cable.



216297



216288



216288

Horn Replacement (Dual)

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the horn wiring harness.
3. Remove the following components from the horn:
   - The nut
   - The washer
   - The mounting bolt
4. Remove the horn from the mounting bracket.

Installation Procedure

1. Install the horn to the mounting bracket.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the following components to the horn:
   - The mounting bolt
   - The washer
   - The nut

   Tighten

   Tighten the horn mounting nut to 17 N.m (13 lb ft).
3. Connect the horn wiring harness.
4. Reconnect the negative battery cable.

Description and Operation

Horns Circuit Description

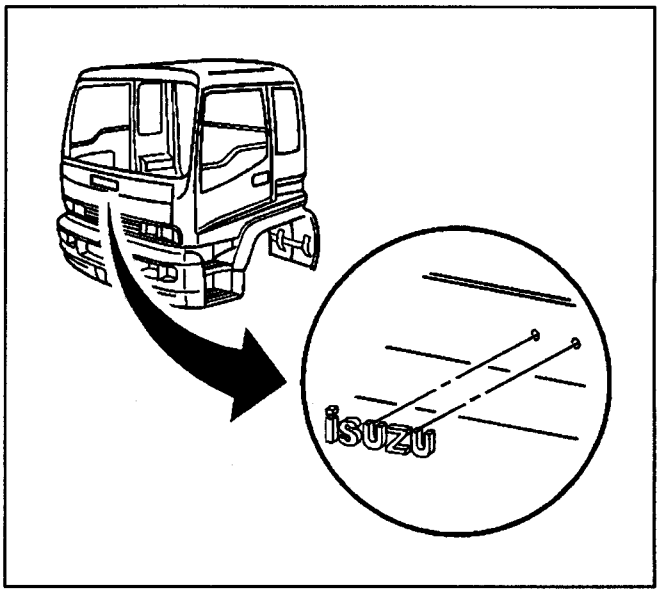
Battery voltage is applied to the horn relay at all times through circuit breaker #7. When the horn switch presses, the horn relay coil grounds. Grounding the horn relay coil energizes the horn relay. The horn relay contacts close. Voltage is applied to the horn(s). Because the horn(s) ground permanently at G107, the horn(s) will continue to sound as long as the horn switch is pressed.

Exterior Trim

Repair Instructions

Emblem/Nameplate Replacement

1. In order to achieve proper adhesion, apply name plates in an environment free of dust or dirt.
2. Clean the area where the replacement item will be mounted with a suitable solvent such as flash naphtha or a mixture of 50 percent isopropyl/alcohol and 50 percent water.
3. Dry the area thoroughly.
4. Keep the body area and name plate at a temperature range between 26–40°C (80–105°F).
5. If necessary, carefully heat the body area and apply heat to the back of the name plate.
6. Remove the protective liner from the emblem.
7. Line the name plate up with the locating holes in the hood and press into position.

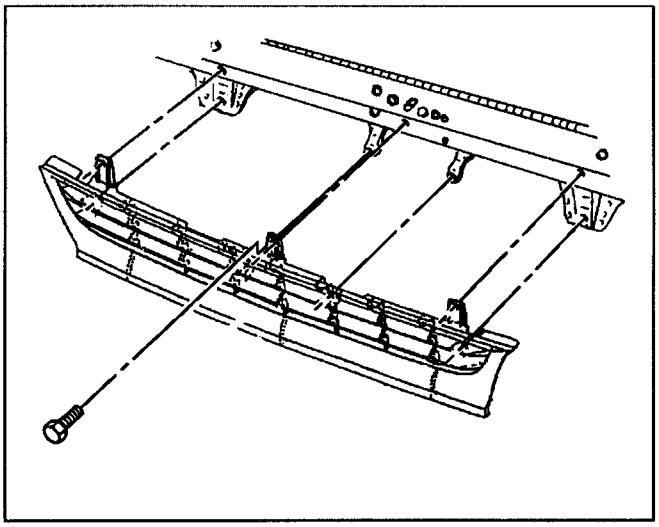


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Grille Replacement

Removal Procedure

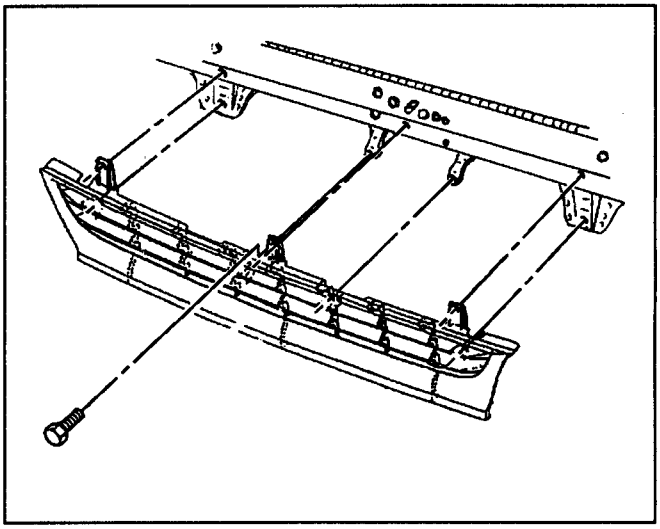
1. Raise the hood.
2. Remove the grille retaining screws.
3. Remove the grille assembly.



215839

Installation Procedure

1. Install the grille to the cab.
2. Install the retaining screws.
3. Close the hood.



215839

Washing and Waxing

Washing

Periodic washing is recommended in order to remove build-up residue and in order to eliminate any weathered appearance.

- Wash the vehicle in lukewarm or cold water.
  Do not use hot water or wash the vehicle in direct sunlight.
- Do not use strong soap or chemical detergents.
- Promptly flush all of the cleaning agents from the surface. Do not allow the cleaning agents to dry on the finish.

Waxing

Your authorized dealer offers several polishes and cleaners that have proven value in maintaining original finish appearance and durability. Protect the painted body surfaces and the chrome plating by using a coating of wax. Use any good base body wax for painted and chrome surfaces. Apply the wax immediately after the vehicle has been cleaned. Do not apply wax to the vehicle in direct sunlight or in extreme heat. Periods between applications should be short enough to ensure continuous protection of the finish.

Foreign Material Deposit Removal

Deposits of foreign material that are left on the painted surfaces of the vehicle may damage the finish. These include the following deposits:

- Calcium chloride and other salts
- Ice melting agents
- Road oil and tar
- Tree sap
- Bird droppings
- Chemicals from industrial chimneys
- Other foreign matter

In order to clean these deposits, use cleaners that are designed for painted surfaces.

Cleaning Bright Metal Parts

Clean bright metal parts regularly with water. Use chrome cleaner and polish on chrome or stainless steel trim, if necessary.

Use special care with aluminum trim. Do not use auto or chrome polish, steam, or caustic soap to clean aluminum. A coating of wax, rubbed to a high polish, is recommended for all bright metal parts.

Waterleaks

Diagnostic Information and Procedures

Waterleak Test Preparation

Caution: Standard shop practices, particularly eye protection, should be followed during these operations to avoid personal injury.

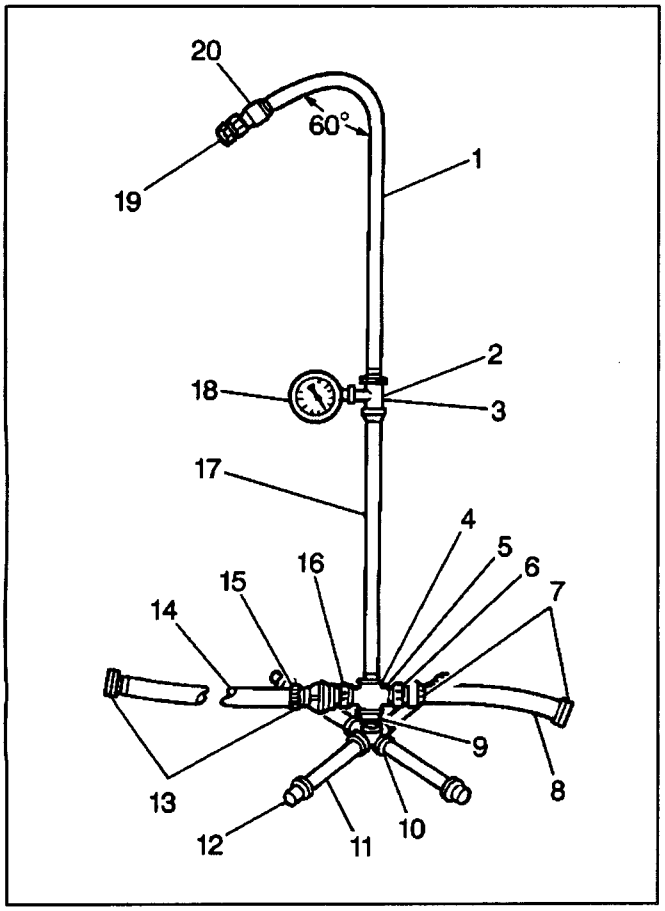
Various methods can be used to check for water leaks after the window adhesive has been allowed to dry. Use the generalized testing method whenever possible since the testing method provides a large volume of water to a general area without exceeding the sealing limitations of the glass. Refer to Generalized Testing. After finding the leak area, locate the exact entry point by using the water hose or air hose test. Refer to *Air Hose Test.*

Repair Instructions

Generalized Testing

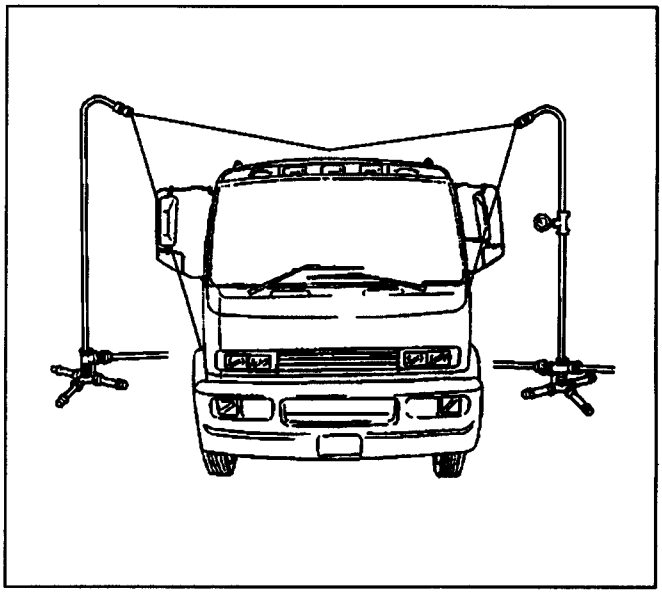
Checking with the Water Test Stands

Watertest Stand Assembly



154169

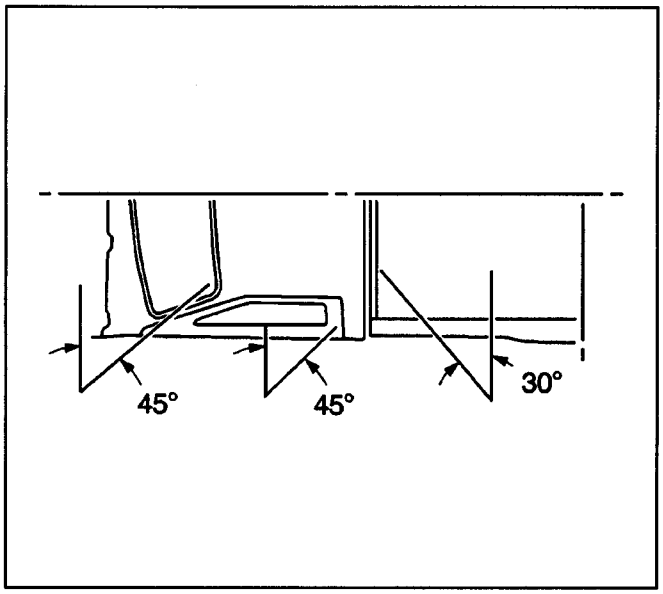
1. Assemble the water test stands.



259438

2. Position the stands one on each side of the vehicle. Water spray from the stands should overlap on the vehicle.
3. Run the water at a volume of 15 liters (3.9 gallons) per minute and at a pressure of 138 kPa (20 psi), measured at the nozzle, for at least four minutes.
4. Have someone inside the cab during the test in order to check for the location of any leaks.
5. In order to check the windshield, aim the water spray 30 degrees down and 45 degrees toward the rear.

   Aim at the corner of the windshield.



203462

6. In order to check the side windows, aim the water spray 30 degrees down and 45 degrees toward the rear.

   Aim at the center of the rear quarter.
7. In order to check the back window, aim the water spray 30 degrees down and 30 degrees toward the front.

Diagnostic Information and Procedures

Water Hose Test

Run water through a hose without the nozzle attached. Begin testing at the base of the window or windshield and slowly move the hose upward and across the top. Have someone in the cab watch for leaks.

Air Hose Test

Notice: The air hose test should only be used on fully cured urethane adhesive. Otherwise, damage to the urethane adhesive bead could result in additional leaks.

Put liquid detergent diluted with water in a squirt bottle.

Have a helper inside the cab with an air hose.

Beginning at the bottom of the window and gradually moving up the window edges and across the top, squirt soap solution on the window moldings and the glass on the outside of the vehicle.

Have a helper aim the compressed air at the same locations from the inside of the cab.

Do not allow the air pressure from the hose to exceed 205 kPa (30 psi).

Bubbles will form in the soap solution at the location of the leak.

Stationary Window Waterleak Repair

1. Depending on where the leak is located, remove either the trim molding or the headliner in order to repair the leak.
2. Determine the source of water entry.
3. If water is leaking at the top edge of the windshield, reseal the windshield using the 3M Window-Weld Resealant P/N 08633 and the applicator gun 3M 06992, or the equivalent.

   Use a "duck bill" applicator tip in order to inject the sealant under the molded glass seal.
4. If water is leaking into the vehicle at the sides of the glass, use the 3M Super Fast urethane auto glass sealant P/N 08609, or the equivalent.

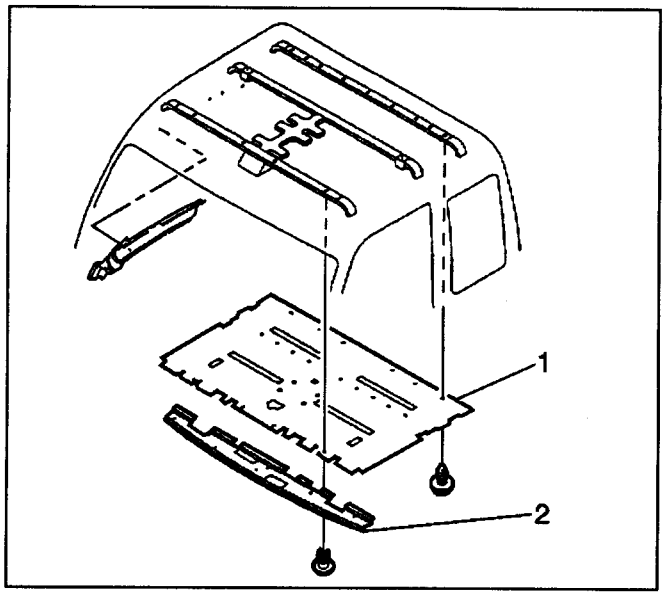
Stationary Windows

Repair Instructions

Windshield Upper Reveal Molding Replacement

Removal Procedure

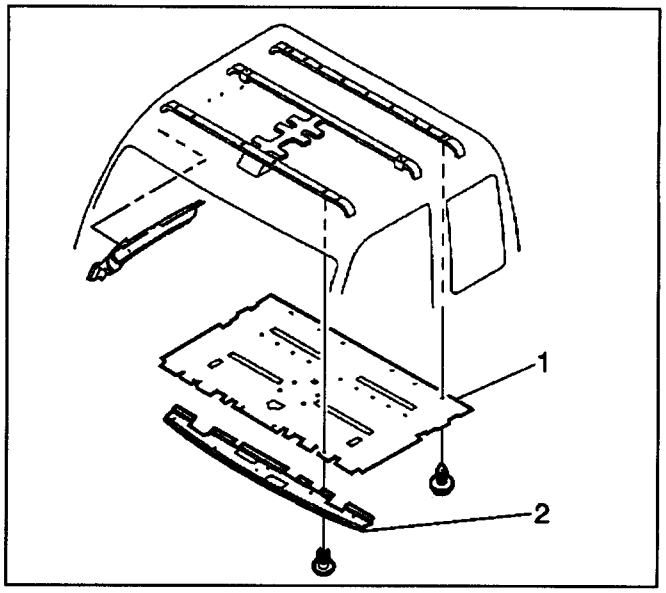
1. Remove the left and right curtain rails.
2. Remove the upper windshield molding (2) by carefully pulling the molding from beneath the windshield sealing strip.



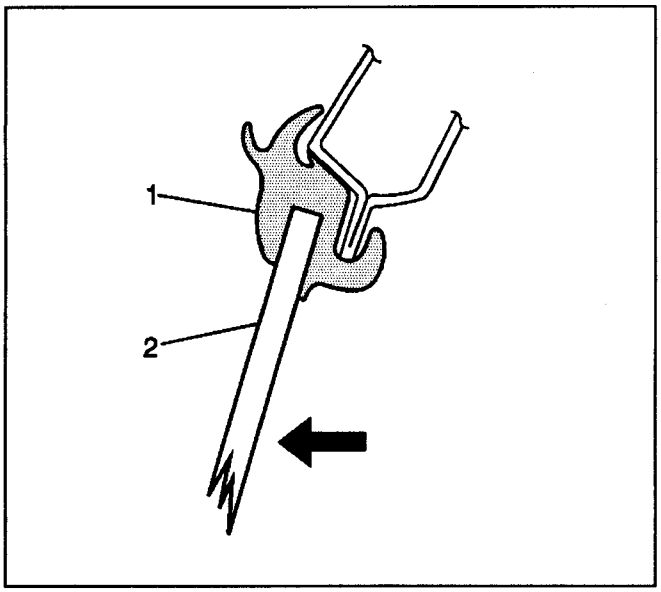
214644

Installation Procedure

1. Install the upper windshield molding (2) by pushing the molding underneath the windshield sealing strip.
2. Install the left and right curtain rails.



214644



215141

Windshield Replacement

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

When replacing a cracked windshield, correct the condition which caused the crack before installing the new glass. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to wind, extreme temperature, or rough terrain.

The glass from a broken windshield may already have fallen or been removed from the adhesive. However, remove a cracked or otherwise imperfect windshield that is still intact.

If a crack extends to the edge of the glass, use a piece of chalk to mark the point on the cab where the crack meets the molding. Start at the point marked when examining the flange of the opening for a cause of the crack.

Cover the instrument panel and the surrounding sheet metal with protective covering before removing the glass.

Removal Procedure

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

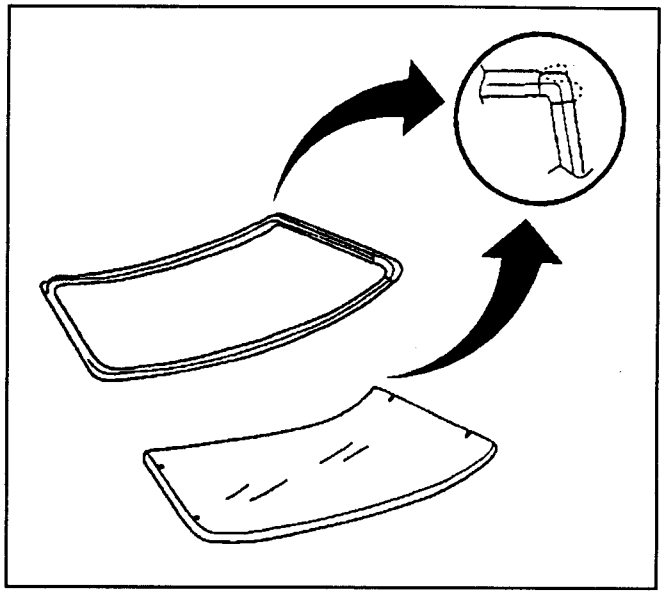
Caution: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause injuries. To help avoid personal injury, cover the defroster outlets before replacing windows.

Caution: If a window is cracked but still intact, it should be crisscrossed with masking tape in order to reduce the risk of damage or personal injury.

1. Cut the weather strip (1).
2. Use a helper to push the glass out from the inside.
3. Remove the weather strip.

Installation Procedure

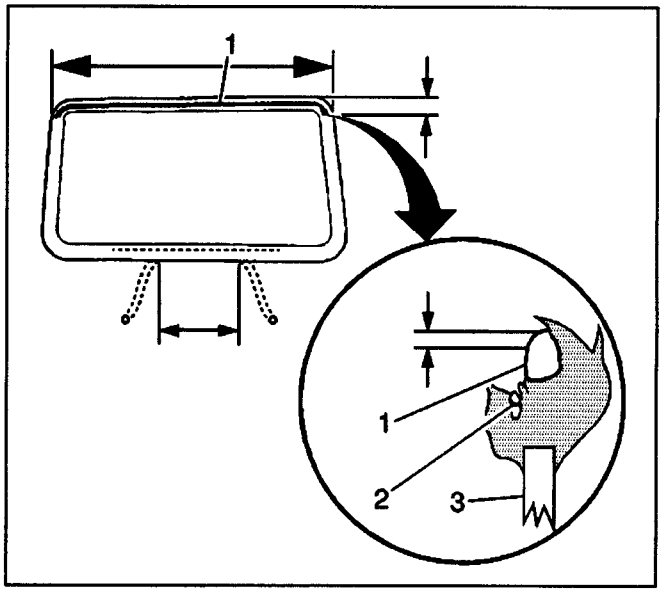
1. Install the weather strip to the glass.
2. When the weather strip and the glass are assembled together, keep the weather strip parallel with the glass.



215142

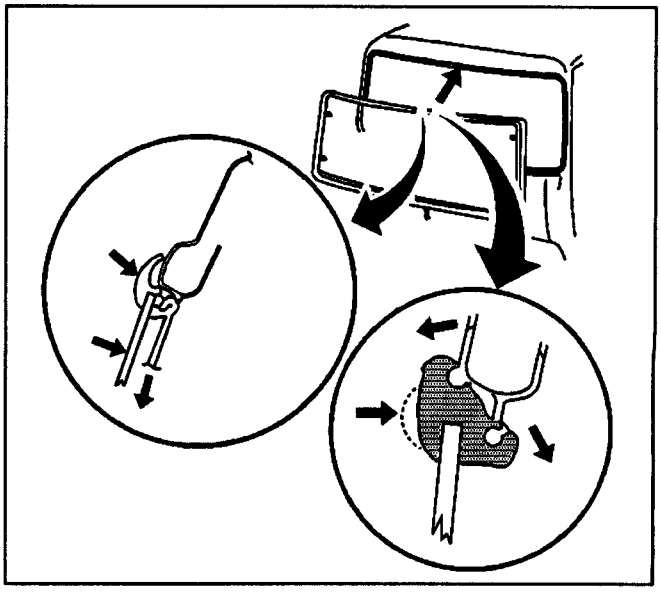
3. Insert a string (approximately 5 mm to 6 mm in diameter) in between the lips of the weather strip.
4. After installing the string around one full turn, leave the string crossed at the bottom center of the glass approximately 400 mm (15.7 in).

   Caution: At least 24 hours are required for complete curing of repair material. The repair area should not be physically disturbed until after that time. Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.
5. Apply a consistent bead of urethane adhesive (1) in between the lips of the weather strip.

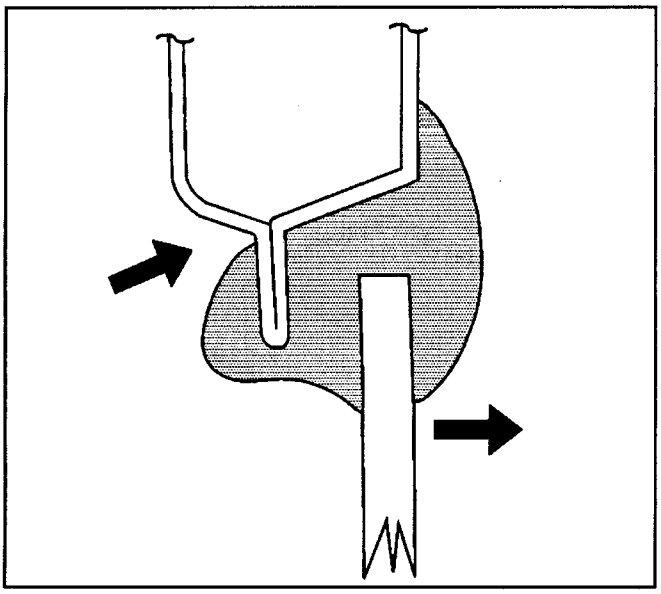


215144

6. Align the center of the glass with the body and hold the glass from the outside.
7. Using a helper inside the cab, pull the string from the inside toward the center of the glass.
   - Fit the lips gradually into the body flange.
   - In order to keep the glass from shifting to one side, support the glass securely.
8. If the weather strip swells in one area, tap lightly with a rubber mallet in order to distribute the weather strip evenly.



215145



215146

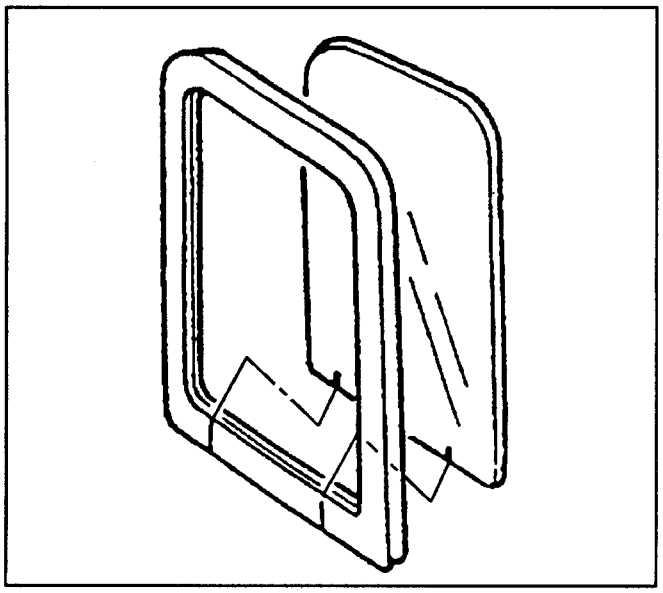
Quarter Window Replacement

Removal Procedure

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

Caution: If a window is cracked but still intact, it should be crisscrossed with masking tape in order to reduce the risk of damage or personal injury.

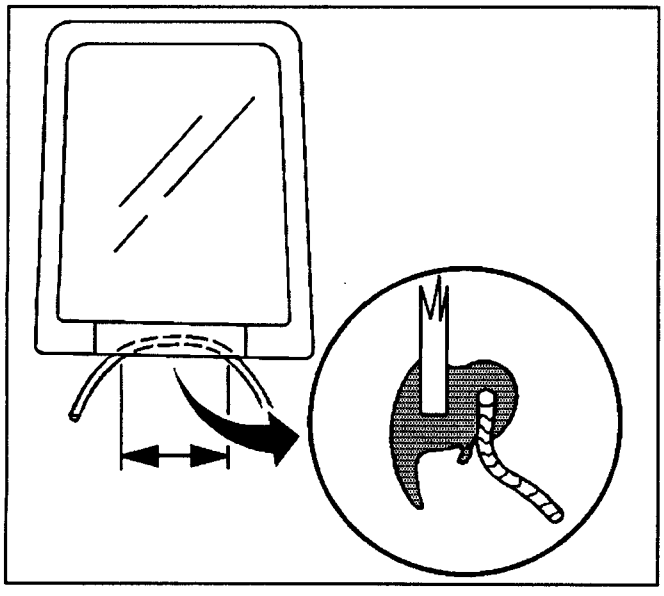
1. From inside the cab, push the weather strip out of the body flange at the two corners of the top edge of the window.
2. Push the glass out gradually from the inside.



215147

Installation Procedure

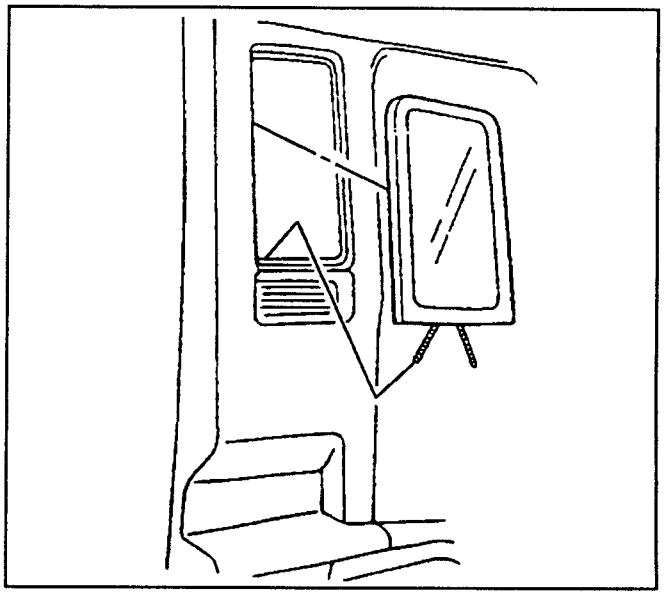
1. Install the weather strip to the glass.
   When the weather strip and the glass are assembled together, keep the weather strip parallel with the glass.



215148

2. Lay a string with a diameter measuring 4 mm between the lips of the weather strip.
3. After installing the string around one full turn, leave the string at the bottom center of the glass approximately 100 mm (4 in).
4. Clean all the dirt off the body flange and the weather strip.

5. Holding the glass from the outside, align the center of the glass with the body.
6. Using a helper inside the cab, pull the string from the inside toward the center of the glass.
   - Fit the lips gradually into the body flange.
   - In order to keep the glass from shifting to one side, support the glass securely.
7. If the weather strip swells in one area, tap lightly with a rubber mallet in order to distribute the weather strip evenly.



215149

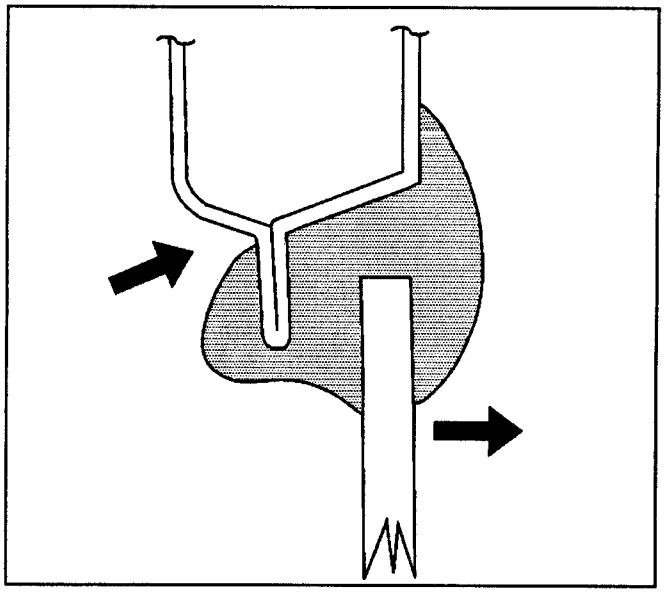
Rear Window Replacement

Removal Procedure

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

Caution: If a window is cracked but still intact, it should be crisscrossed with masking tape in order to reduce the risk of damage or personal injury.

1. Push the weather strip out of the body flange at the two corners of the top edge of the window.
2. Using a helper outside of the cab, push the glass out gradually from inside the cab.

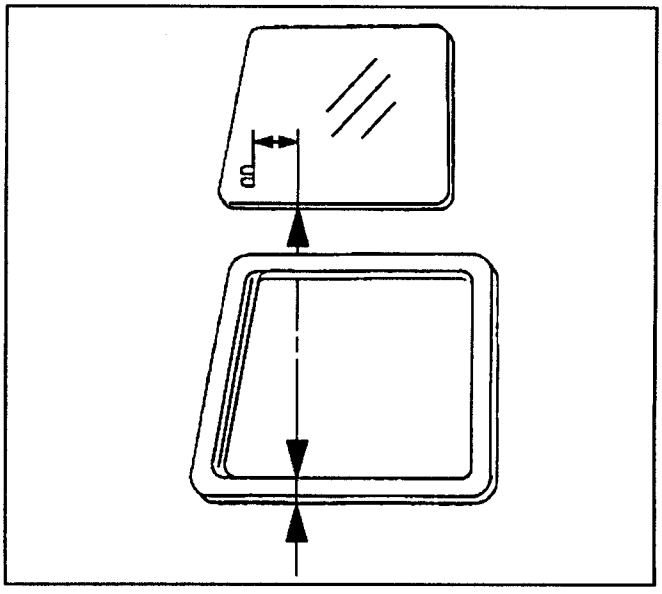


215146

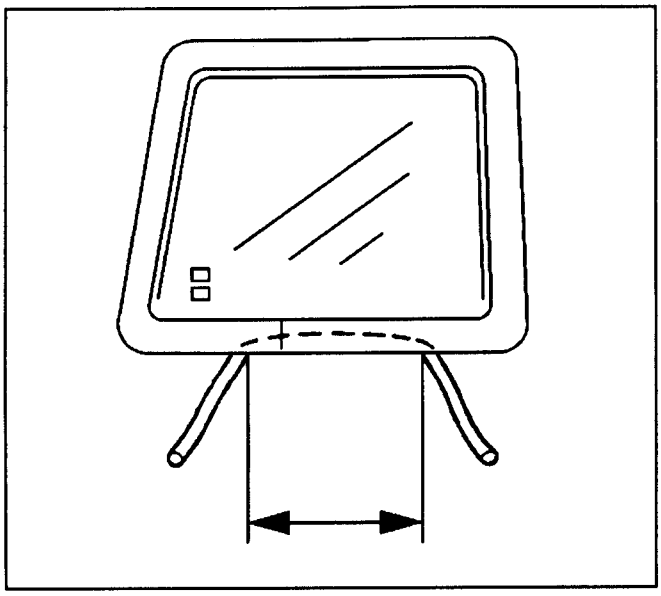
Installation Procedure

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

1. Install the weather strip to the glass.
   When the weather strip and the glass are assembled together, keep the weather strip parallel with the glass.

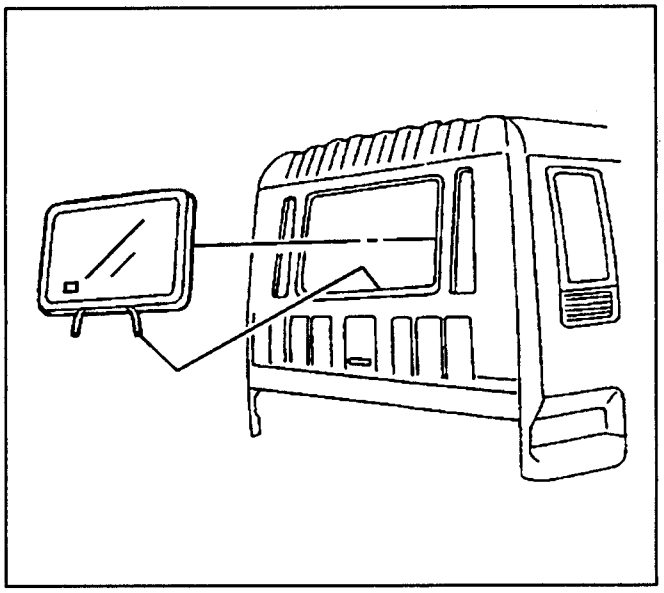


215153



215154

2. Lay a string with a diameter measuring 4 mm between the lips of the weather strip.
3. After installing the string around one turn, leave the string crossed at the bottom center of the glass approximately 200 mm (7.8 in).



215155

4. Holding the glass from the outside, align the center of the glass with the body.
5. Using a helper inside the cab, pull the string from the inside toward the center of the glass.
   - Fit the lips gradually into the body flange.
   - In order to keep the glass from shifting to one side, support the glass securely.
6. If the weather strip swells in one area, tap lightly with a rubber mallet in order to distribute the strip evenly.

Window Polishing

Minor Scratch and Abrasion Removal

Minor scratches and abrasions can be removed or reduced by following the procedure below. Use care to prevent distortions of vision. Double vision may result if an attempt is made to remove deep scratches. Deep scratches should not be removed from an area in the driver's line of vision. If deep scratches are present, the window should be replaced.

The polishing procedure that follows was developed using a cerium oxide compound. Follow the manufacturer's directions if using other materials.

The polishing should not be used on deep tinted windows. The coating on the windows could be damaged.

Recommended Equipment

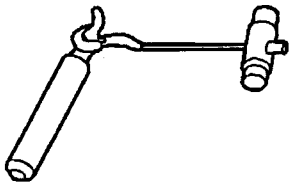
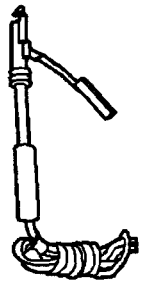
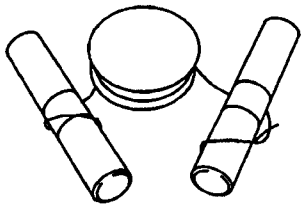
- A low speed (600–1300 RPM) rotary polisher.
- A wool, felt, rotary polishing pad 76 mm (3 in) in diameter and 51 mm (2 in) thick.
- Powdered cerium oxide mixed with water. This is an abrasive compound.
- A wide-mouth container to hold the abrasive compound.

Polishing Procedure

1. Mix at least 44 ml (1.5 oz) of cerium oxide with enough water to obtain a creamy consistency. If the mixture is too thick, the mixture cakes on the felt pad more quickly. If the mixture is too runny, more polishing time is needed.
2. Draw a circle around the scratches on the opposite side of the window with a marking crayon, or the equivalent.
3. Draw a line directly behind the scratches in order to serve as a guide for locating the scratch while polishing.
4. Cover the surrounding area with masking paper in order to catch the drippings or the spattered polish.
5. Dip the felt pad attached to the polisher into the mixture. Do not submerge the pad or allow the pad to stay in the mixture because this may loosen the bond between the pad and the metal plate.

   Notice: Never hold the tool in one spot or operate the tool on the window any longer than 30 to 45 seconds. If the window becomes hot to touch, let it air cool before proceeding further. Cooling with cold water may crack heated window. Avoid excessive pressure. It may cause overheating of the window.
6. Polish the scratched area, but note the following:
   - Agitate the mixture as often as needed in order to maintain the creamy consistency of the compound.
   - Use moderate but steady pressure.
   - Hold the pad flat against the window.
   - Use a feather-out motion.
   - Dip the pad into the mixture every 15 seconds in order to ensure that the wheel and the window are always wet during the polishing operation. A dry pad causes excessive heat to develop.
   - Keep the pad free of dirt and other foreign substances.
7. After removing the scratch, wipe the area clean of any polish.
8. Clean the polishing pad.

Special Tools and Equipment

Illustration	Tool Number/ Description
 3898	J 24402-A Glass Sealant Removal Knife
 3899	J 24709-01 Urethane Glass Sealant Remover
 204460	J 36020 Windshield Remover

Bumpers

Specifications

Fastener Tightening Specifications

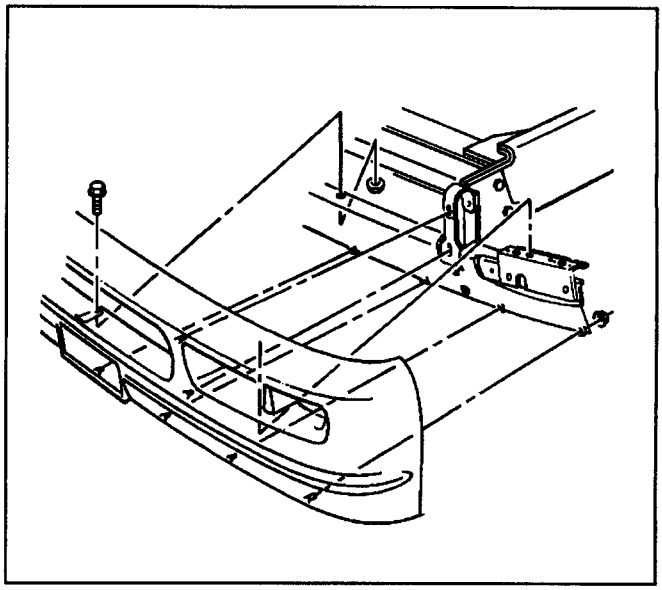
Application	Specification	
	Metric	English
Bumper Brace Bolt	9 N.m	80 lb in
Bumper Energy Absorber Nut	55 N.m	41 lb ft
Bumper Facia Nut	12 N.m	106 lb in
Bumper Impact Bar Bolt	67 N.m	49 lb ft
Bumper Impact Bar Bracket	162 N.m	120 lb ft

Repair Instructions

Bumper Replacement - Front

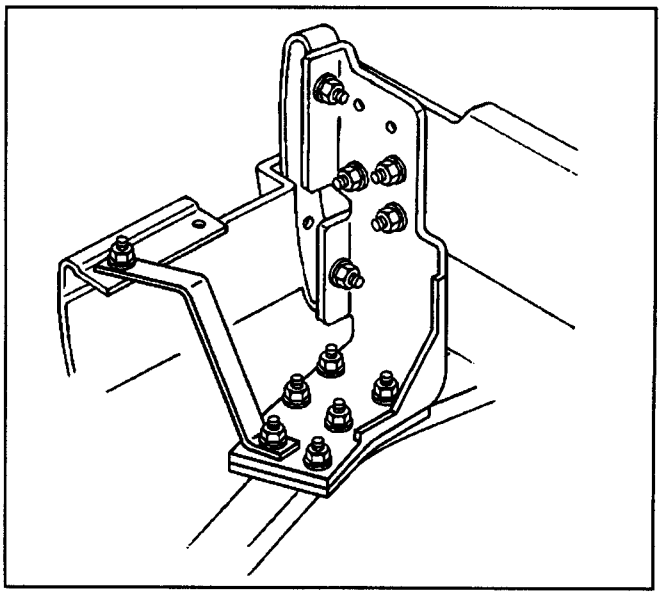
Removal Procedure

1. Remove the bumper facia.

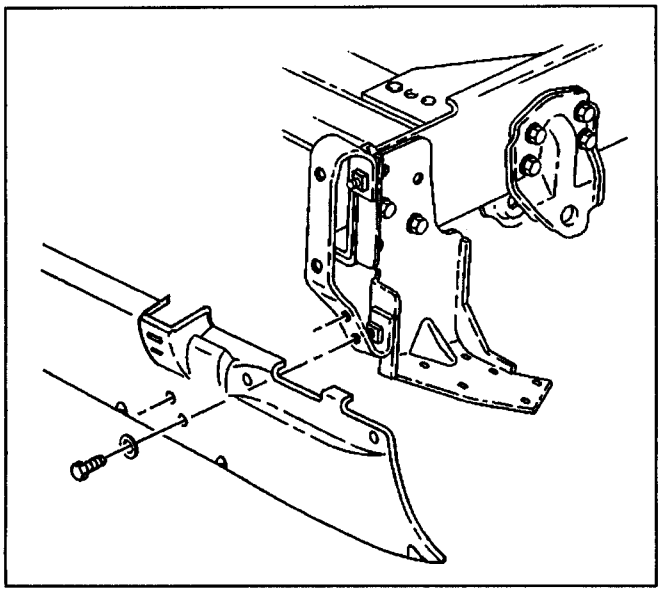


214222

2. Remove the bumper braces. Have an assistant support the bumper.

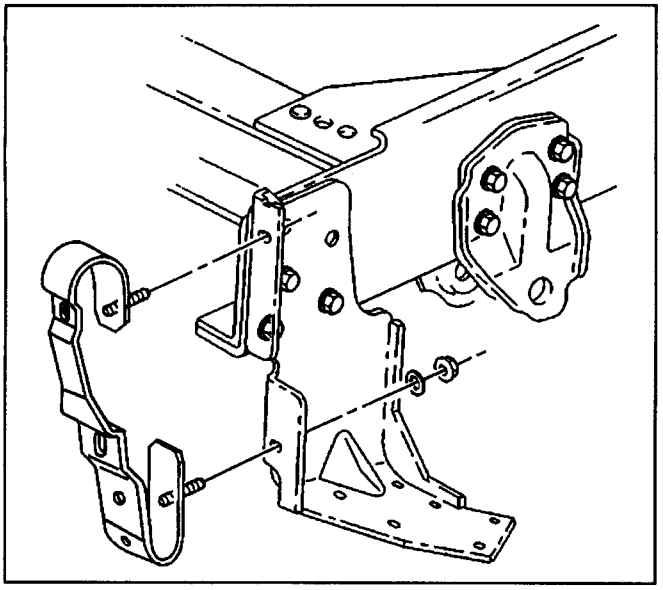


214239



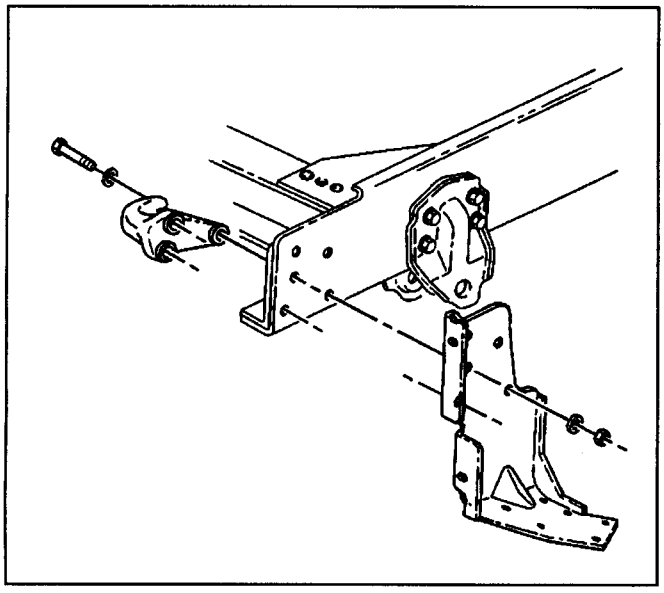
214233

3. Remove the impact bar.



214242

4. Remove the bumper energy absorber bracket.



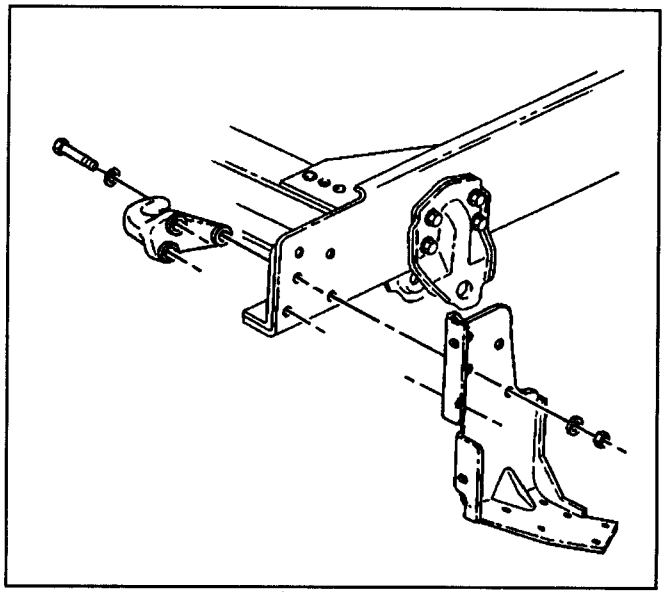
214246

5. Remove the bumper impact bar bracket.

Installation Procedure

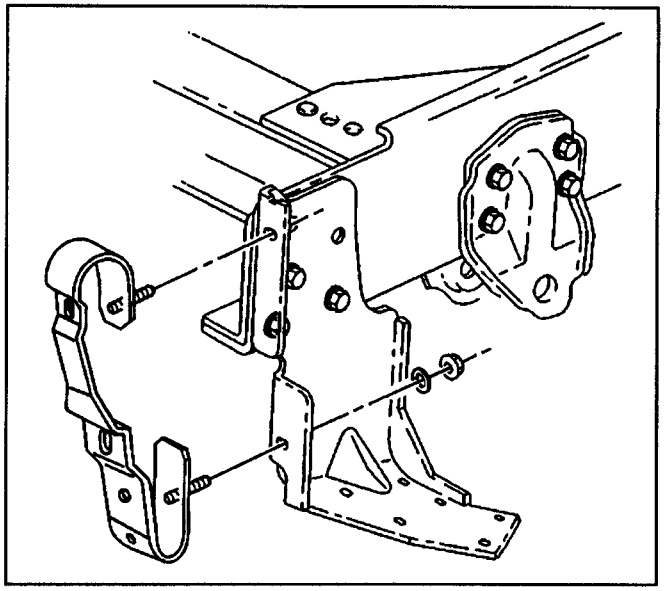
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the bumper impact bar bracket.
   Tighten
   Tighten the bolts to 162 N·m (120 lb ft).



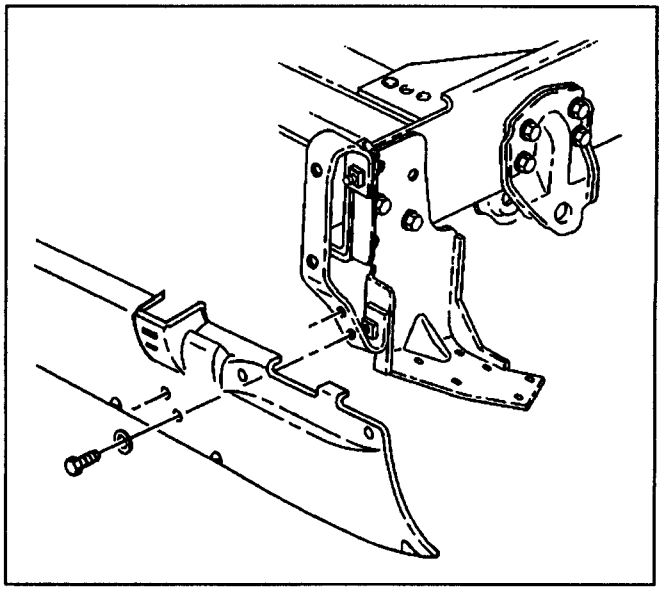
214246

2. Install the bumper energy absorber bracket. Have an assistant hold the bumper in place.
   Tighten
   Tighten the nuts to 55 N·m (41 lb ft).

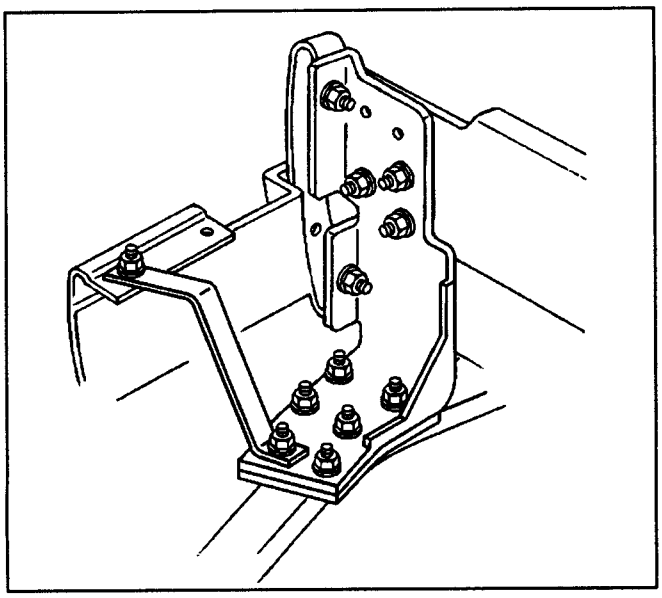


214242

3. Install the bumper impact bar.
   Tighten
   Tighten the bolts to 67 N·m (49 lb ft).

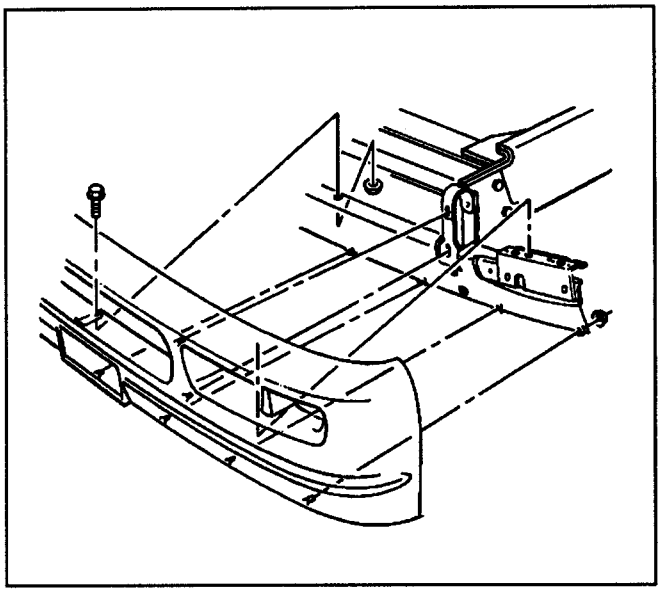


214233



214239

4. Install the bumper braces.
   Tighten
   Tighten the bolts to 9 N·m (80 lb in).



214222

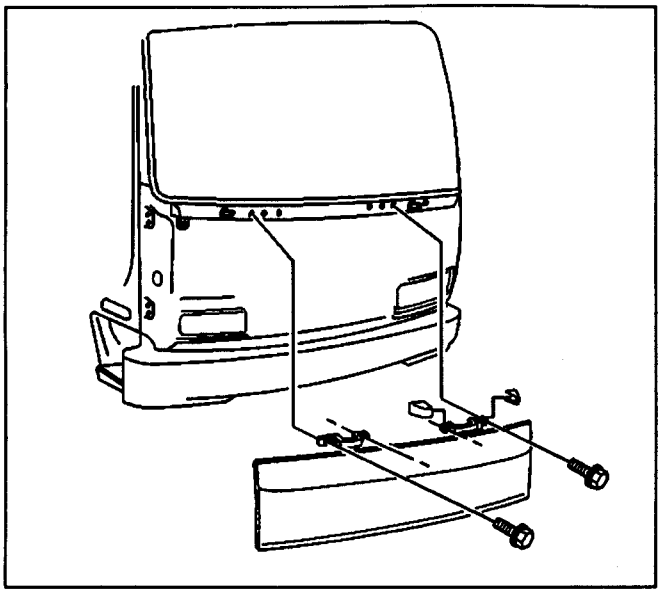
5. Install the bumper facia.
   Tighten
   Tighten the nuts to 12 N·m (106 lb in).

Body Front End

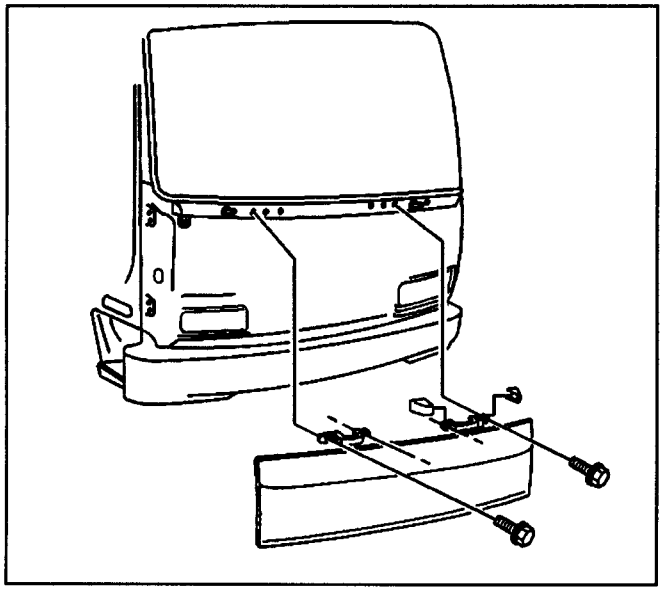
Specifications

Fastener Tightening Specifications

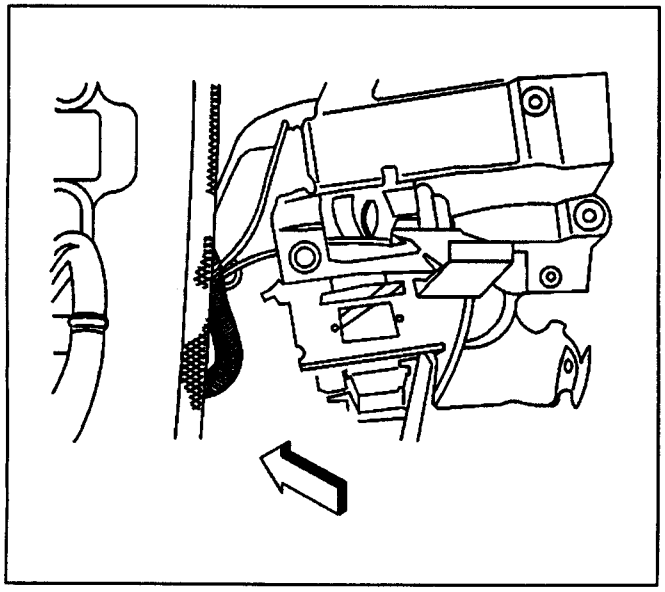
Application	Specification	
	Metric	English
Battery Box Cover Retainer Bolt	30 N.m	22 lb ft
Battery Box to Frame Nut	70 N.m	52 lb ft
Cab Lock Assembly Bolt	40 N.m	30 lb ft
Cab Tilt Support Bolt	45 N.m	33 lb ft
Component Box Nut	70 N.m	52 lb ft
Component Box Support Nut	24 N.m	18 lb ft
Fender Extension Brace Nut	70 N.m	52 lb ft
Fender Extension Bracket Nut	15 N.m	11 lb ft
Fender to Cab Bolt	13 N.m	115 lb in
Front Cab Mount Bolt	162 N.m	119 lb ft
Inner Extension Panel Bolt	9 N.m	80 lb in
Inner Fender Panel Bolt	9 N.m	80 lb in
Rear Cab Mount Bracket Bolt	15 N.m	11 lb ft
Rear Cab Mount Lower Bracket Bolt	93 N.m	69 lb ft
Rear Cab Mount Upper Bracket Nut	215 N.m	159 lb ft
Steering Shaft Bolt	61 N.m	45 lb ft
Torsion Bar Lever Bolt/Nut	37 N.m	27 lb ft
Upper Inner Fender Bolt	9 N.m	80 lb in
Upper Step Nut	23 N.m	17 lb ft
Upper Step Support Bolt	9 N.m	80 lb in



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215631

Repair Instructions

Hood Replacement

Removal Procedure

1. Pull the hood release cable inside the cab.
2. Remove the front handle bolt covers.
3. Remove the bolts from the front handles and remove the hood with the handles attached.

Installation Procedure

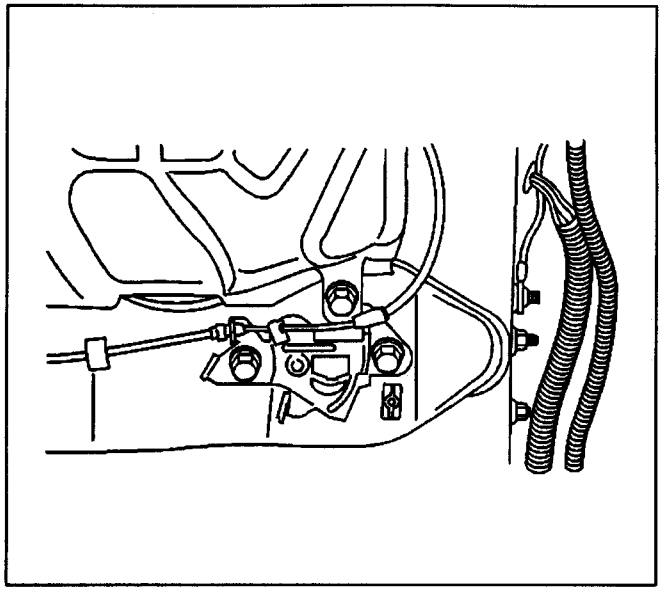
1. Install the front handle bolts.
2. Install the front handle bolt covers.
3. Close the hood.

Hood Latch Replacement

Removal Procedure

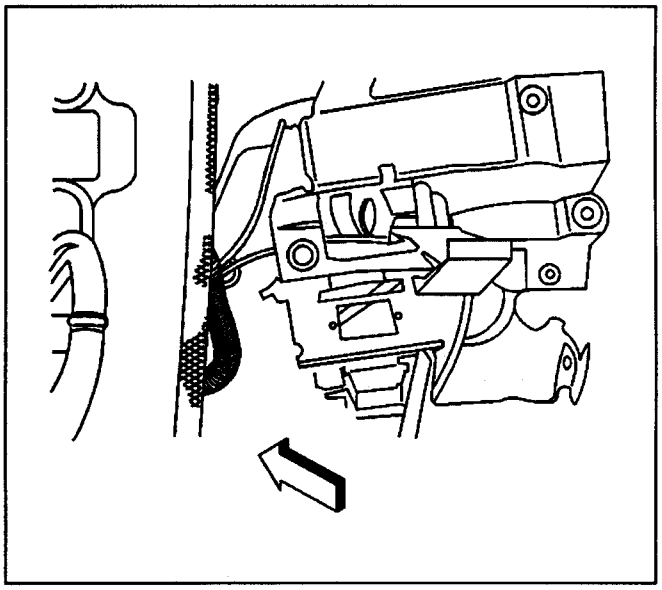
1. Raise the hood.

2. Remove the hood latch bolts.



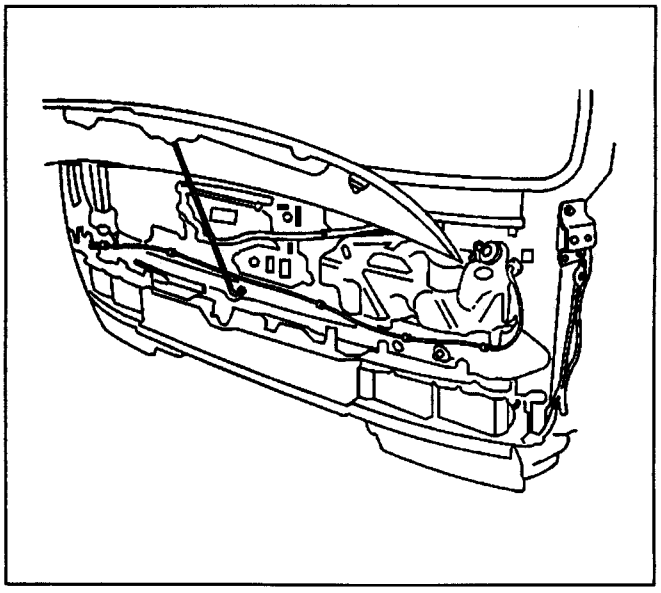
215635

3. Remove the hood release lever bolts.

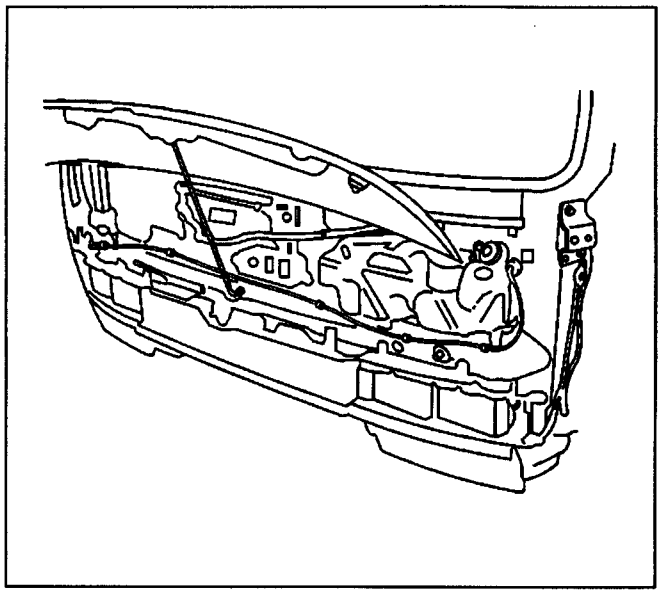


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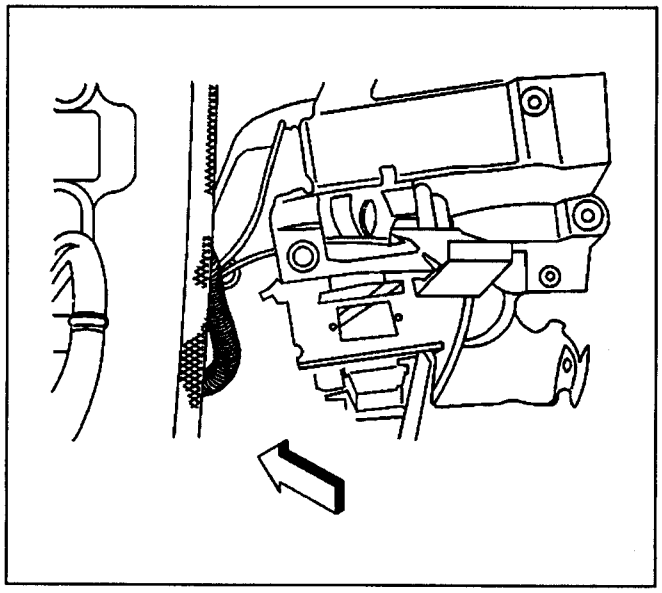
4. Remove the cable assembly.



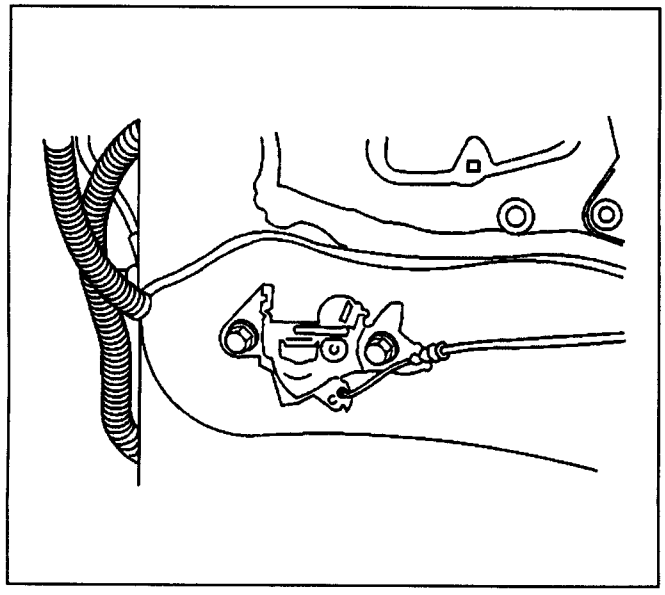
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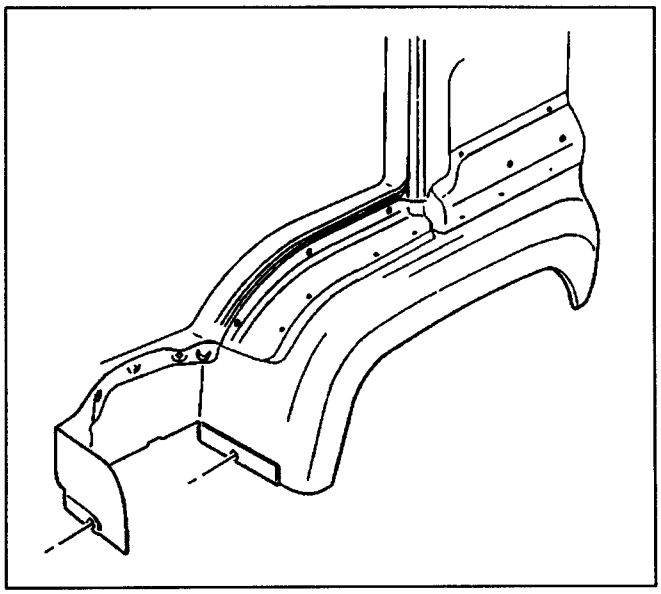
Installation Procedure

1. Install the cable assembly to the cab.
2. Install the hood release lever bolts.
3. Install the hood latch bolts.
4. Close the hood and inspect for proper engagement of the hood latch.

Fender Replacement - Front

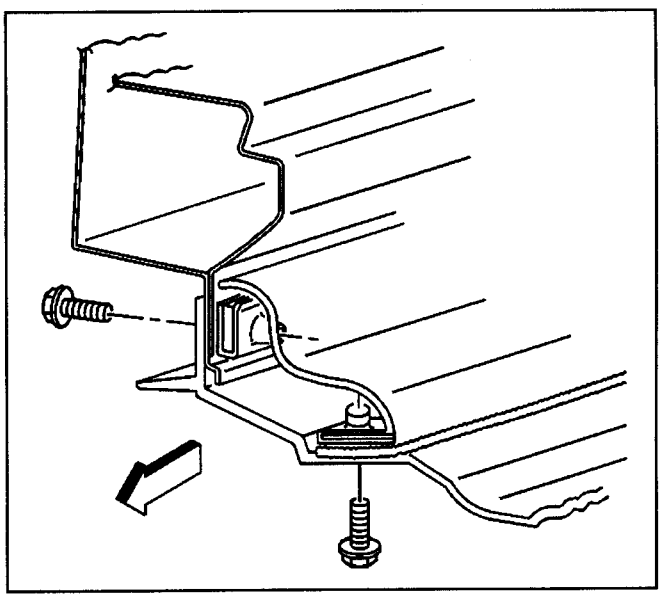
Removal Procedure

1. Remove the fender from the fender brace bolts.



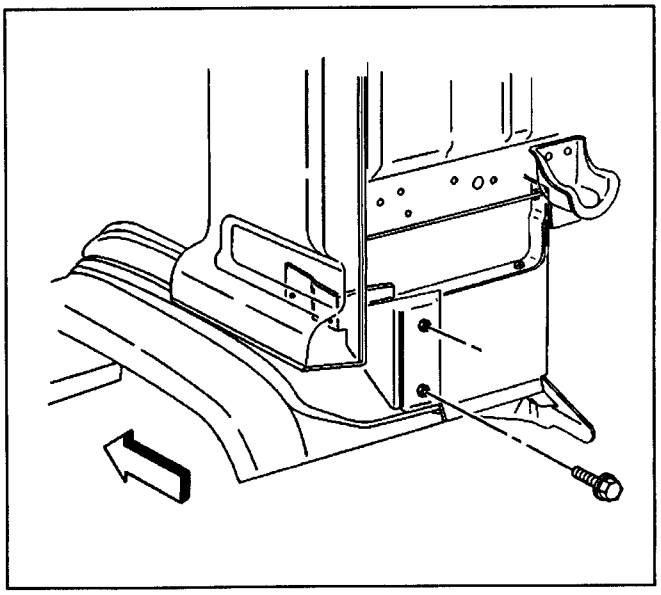
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2. Remove the fender to cab bolts.

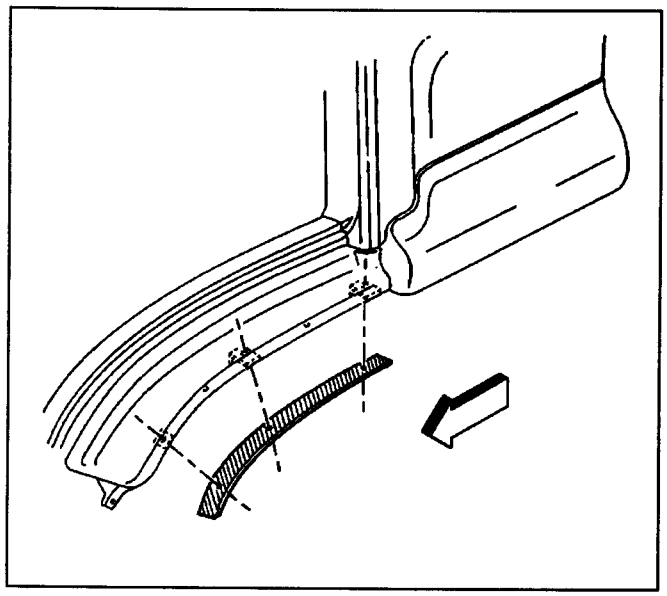


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3. Remove the fender.

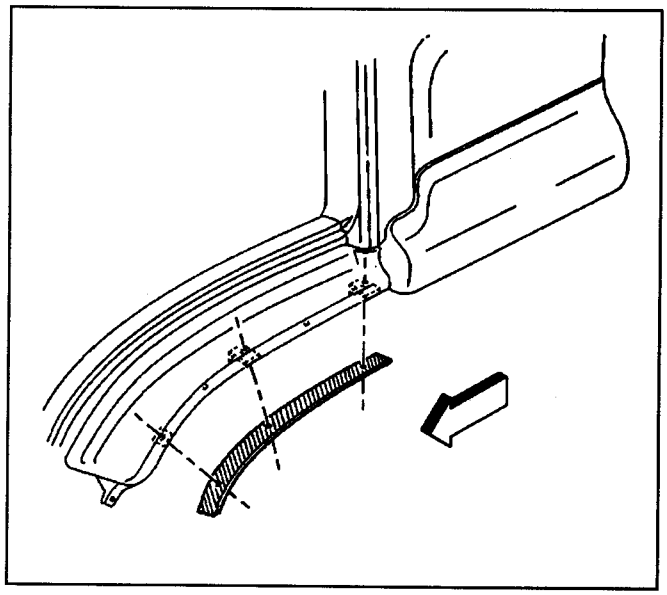


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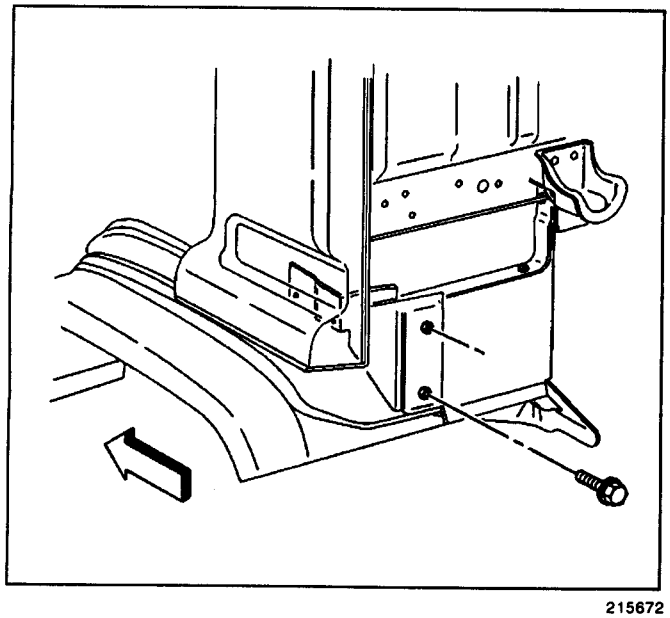
4. Remove the fender seal.



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Installation Procedure

1. Install the fender seal to rocker panel.



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2. Install the fender to the cab.

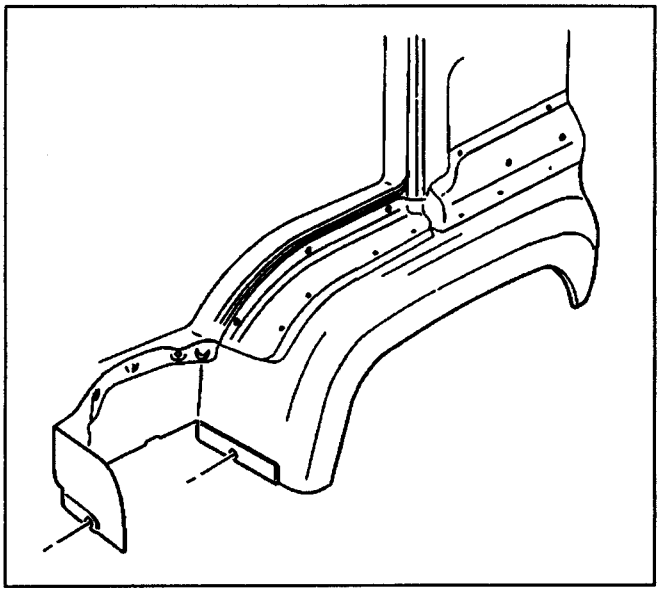
   Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the fender to cab bolts.

   Tighten

   Tighten the fender to cab bolts to 13 N.m (115 lb in).

4. Install the fender to the fender brace bolts.

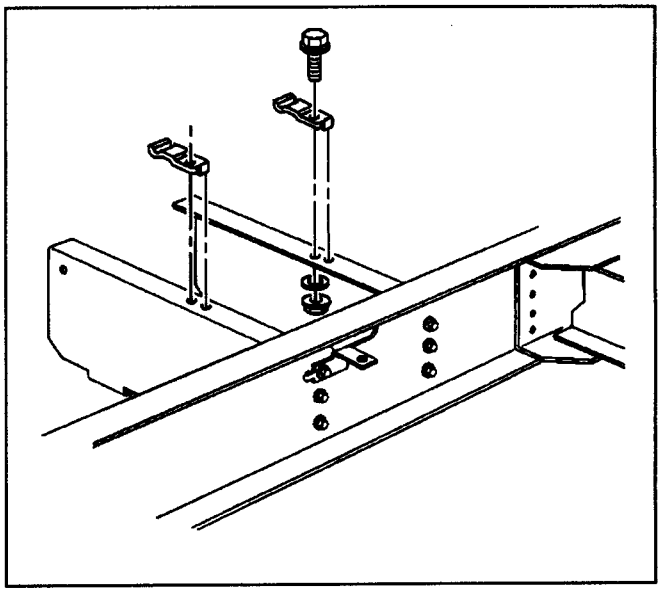


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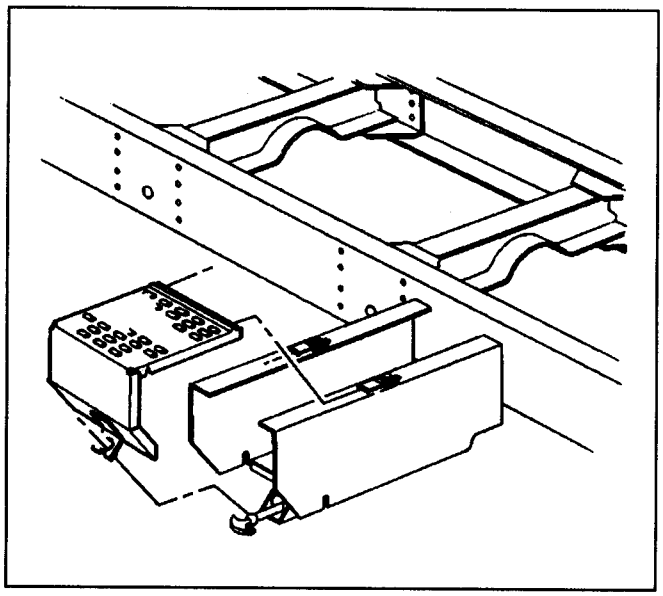
Battery Box Replacement

Removal Procedure

1. Remove the following items from the cover:
   - The bolts
   - The washers
   - The nuts
   - The retainer
2. Remove the cover bolts.
3. Remove the cover.
4. Remove the retainers and the battery or batteries. Refer to Battery Replacement in Engine Electrical.
5. Remove the battery cables from the battery box. Refer to Battery Cable Replacement in Engine Electrical.
6. Remove the following items from the battery box:
   - The bolts
   - The washers
   - The nuts



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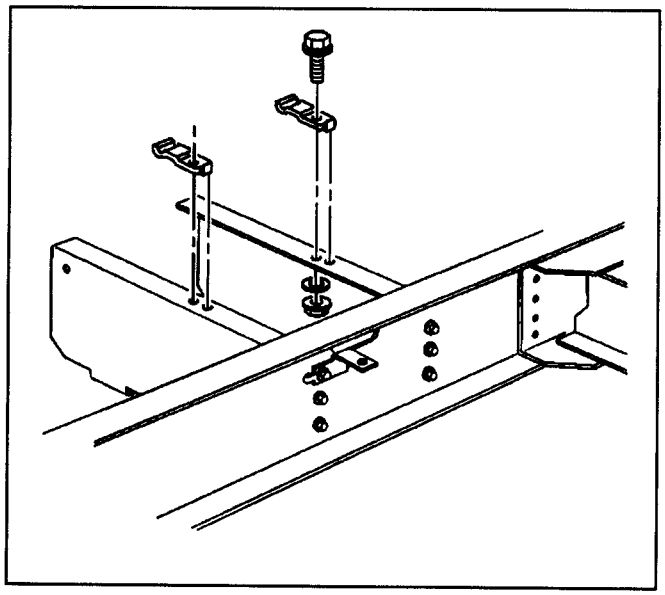
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the battery box to the frame rail with the following items:
   - The bolts
   - The washers
   - The nuts

   Tighten

   Tighten the battery box to the frame nuts to 70 N·m (52 lb ft).

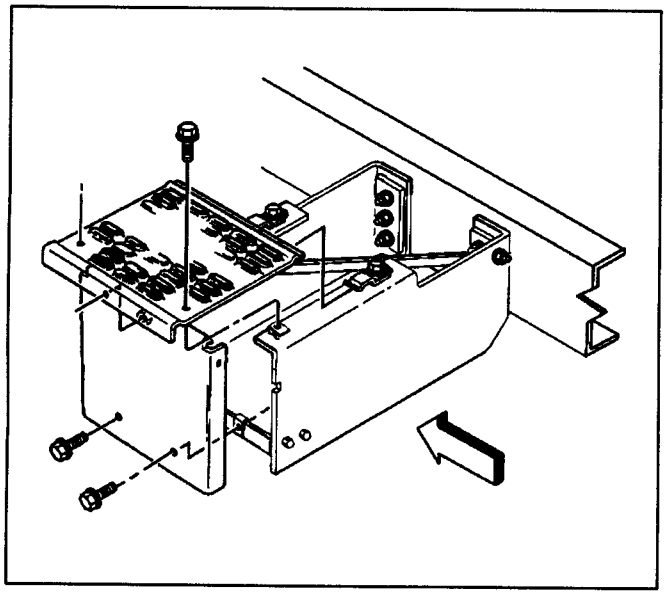


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2. Install the battery or batteries to the box with the retainers and bolts. Refer to Battery Replacement in Engine Electrical.
3. Install the battery cables. Refer to Battery Cable Replacement in Engine Electrical.
4. Install the cover.
5. Install the retainer and the bolt.

   Tighten

   Tighten the retainer bolts to 30 N·m (22 lb ft).



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Component Box Replacement

Removal Procedure

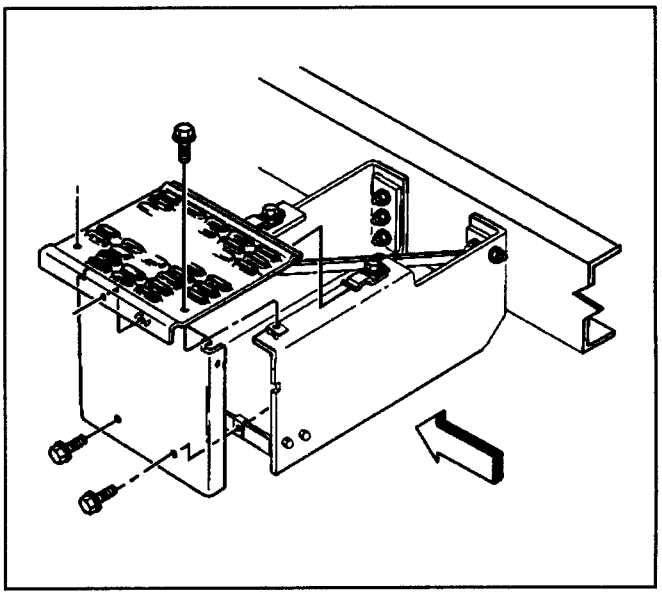
1. Remove the top and side cover bolts and the washers.
2. Remove the top cover.
3. Remove the side cover.
4. If it is necessary in order to gain access to the box, remove the components. Refer to Disc Brakes or Engine Controls.
5. Remove the following items from the brace:
   - The bolts
   - The washers
   - The nuts
6. Remove the following items from the supports:
   - The bolts
   - The washers
   - The nuts

7. Remove six bolts and washers from inside the frame rail.
8. Remove the reinforcements and box sides from the frame rail.

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the box sides and reinforcements to the frame with six bolts, washers and nuts.
   Tighten
   Tighten the component box nuts to 70 N·m (52 lb ft).
2. Install the components to the box if they have been removed. Refer to Disc Brakes or Engine Controls.
3. Install the supports to the frame with the bolts, the washers and the nuts.
   Tighten
   Tighten the component box support nuts to 24 N·m (18 lb ft).
4. Install the brace to the sides with the bolts, the washers and the nuts.
   Tighten
   Tighten the component box brace nuts to 45 N·m (33 lb ft).
5. Install the side cover and the top cover with the bolts and the washers.
6. Install the retainers to the box with the bolts.
   Tighten
   - Tighten the top and side cover bolts to 30 N·m (22 lb ft).
   - Tighten the retainer bolts to 23 N·m (17 lb ft).


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Cab Replacement

The cab replacement procedure will vary depending upon the optional equipment on the vehicle. Some steps required due to optional equipment have been included, but be sure to check the vehicle for any special steps it may require. The following procedures are intended to be used only as a guide.

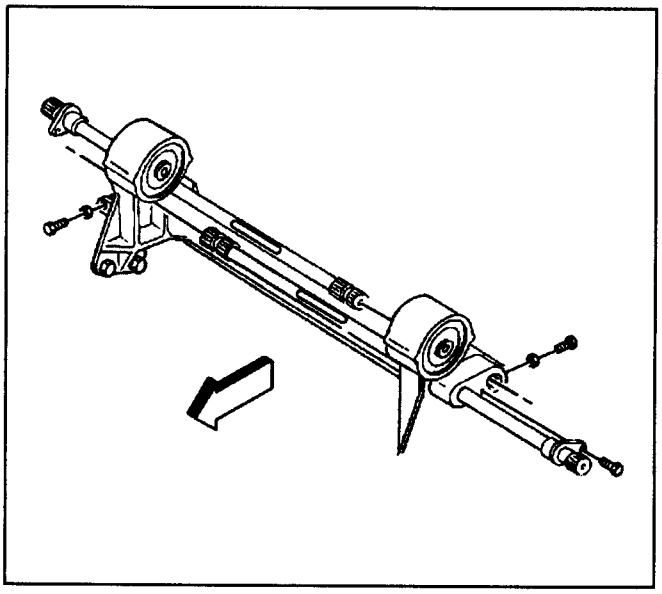
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

Important:

- Tag all lines, wires, hoses and harnesses during removal for proper location during installation.
- Block the wheels.

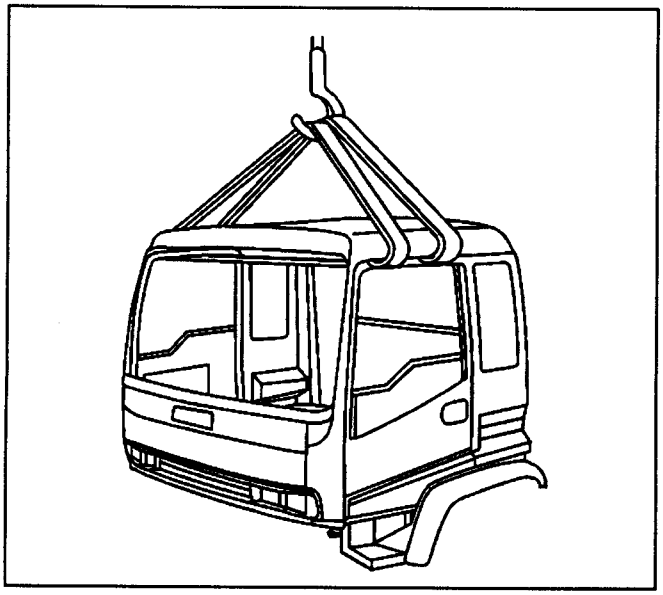
1. Disconnect the negative battery cable.
2. Open the hood.
3. Remove the grille.
4. Remove the left and the right headlamp assemblies.
5. Recover the air conditioning refrigerant.

6. Remove the air conditioning pipes and the brackets.
7. Drain the coolant.
8. Remove the heater hoses.
9. Remove the ground strap.
10. Remove the main wire harness under the hood.
11. Remove the clutch fluid pipe (if equipped).
12. Disconnect the transmission control cables.
13. Disconnect the parking brake cable.
14. Remove the throttle linkage.
15. Tilt the cab. Refer to *Cab Tilting* in General Information.



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16. Remove the air brake hoses (if equipped) or the linkage to the brake master cylinder.
17. Remove the steering shaft at the steering gear. Mark the shaft and the gear in order to aid in reassembly.
18. Remove the cab lock cover.
19. Fasten a rope securely to the cab lock. Use a hoist or chain block in order to keep the cab tilted.
20. Remove the torsion bar levers.
21. Remove the cab tilt support.
22. Lower the cab. Refer to *Cab Tilting* in General Information.
23. Remove each center pin by tapping with a hammer, while lowering the cab slowly.



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Notice: If the lifting straps encompass the door frames, the window run channels may be damaged.

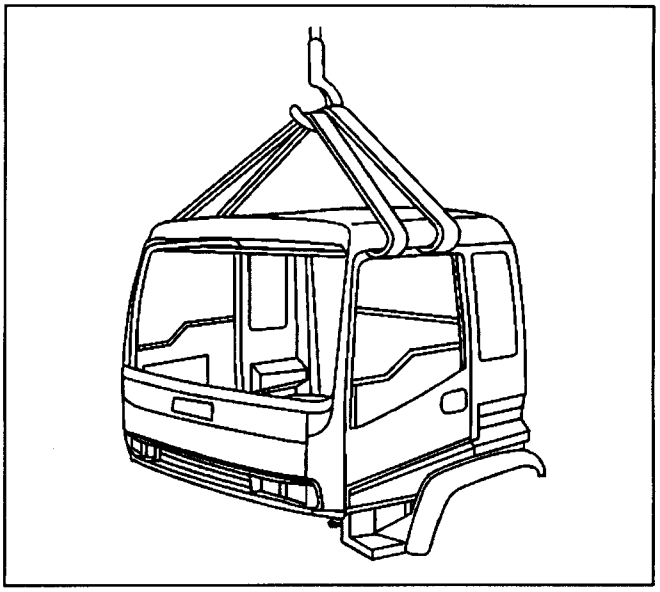
24. Perform the following procedure in order to remove the cab from the chassis. Keep in mind that the trimmed cab weighs about 1,000 lbs.
    - 24.1. Use four commercial straps that are 6 inches wide and about 10 feet long in order to lift the cab from the chassis.
    - 24.2. Pass the straps into the cab through the door on each side at the top rear of the window openings.
    - 24.3. Connect the straps in the center.
    - 24.4. Close the doors.
25. Walk around the cab in order to make sure all components have been disconnected from the chassis.
26. Raise the cab slowly. Use the aid of a helper in order to guide the cab while the cab is being lifted.

Installation Procedure

1. Block the chassis wheels.

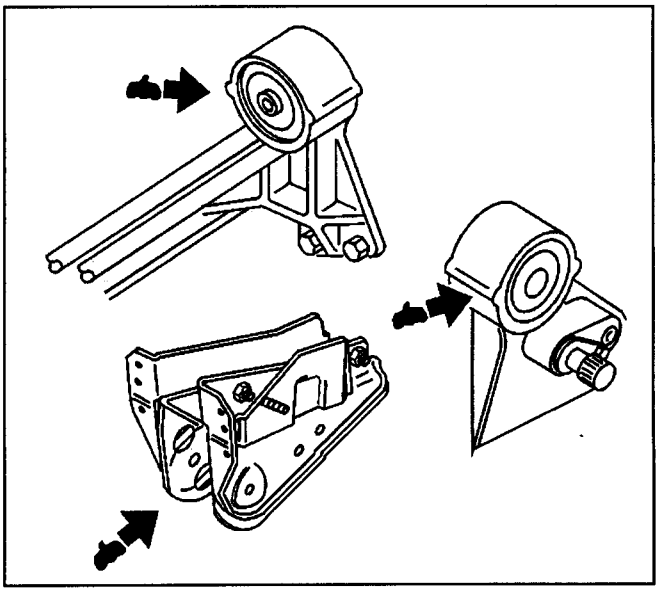
   Notice: If the lifting straps encompass the door frames, the window run channels may be damaged.

2. Perform the following procedure in order to install the cab onto the chassis. Keep in mind that the trimmed cab weighs about 1,000 lbs.
   2.1. Use four commercial straps that are 6 inches wide and about 10 feet long in order to lift the cab from the chassis.
   2.2. Pass the straps into the cab through the door on each side at the top rear of the window openings.
   2.3. Connect the straps in the center.
   2.4. Close the doors.



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3. Apply grease to the following areas of the cab mounts:
   - The circumference area of the bracket where the washer comes in contact
   - The bushing inner surface in the side where the sleeve is inserted
   - At least two areas on both inside surfaces of the bracket where the washer comes in contact

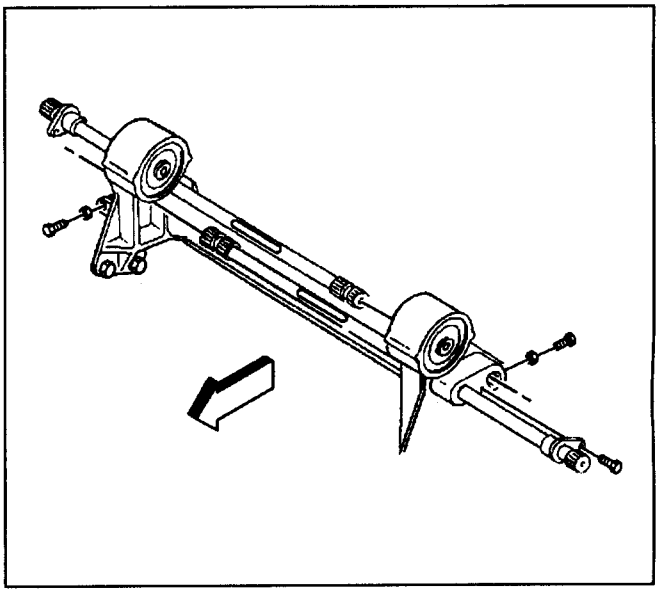


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4. Install the left and the right center pins.
5. Perform the following procedure:
   5.1. Hook a wire to the cab striker.
   5.2. Pull the safety lever.
   5.3. Tilt the cab slowly.
   5.4. Use the wire in order to keep the cab from floating up.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Extend the cab support and lock it into position.
   Tighten
   Tighten the bolts to 68 N.m (50 lb ft).



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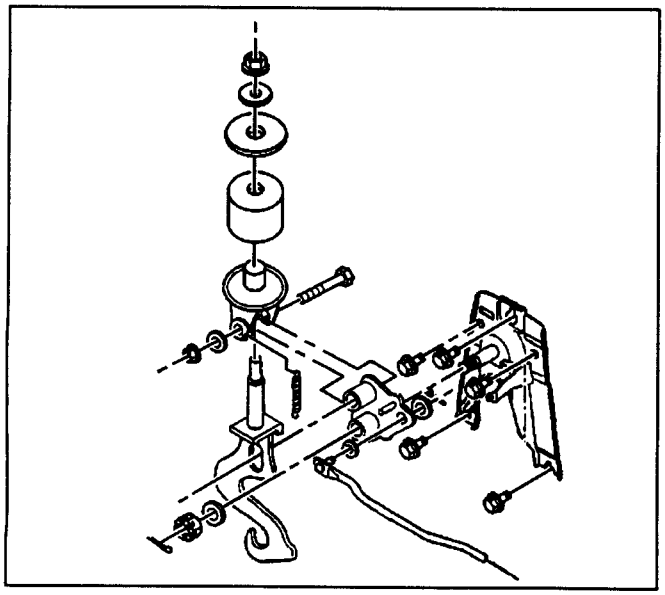
7. Perform the following in order to install the torsion bar levers.
   - Locate the left and right identification marks before installation.
   - Match the serration.
   - Install the torsion bar levers.

   Tighten

   Tighten the bolt/nut to 37 N·m (27 lb ft).
8. Use the match marks made during disassembly as a guide in order to apply grease to the steering shaft.
9. Insert the steering shaft and the steering unit securely to the far end.
10. Tighten the key bolt.

    Tighten

    Tighten the bolts to 61 N·m (45 lb ft).
11. Connect the throttle cable.
12. Connect the transmission cables.
13. Connect the air brake hoses (if equipped) or the linkage to the brake master cylinder.
14. Connect the parking brake cable.
15. Lower the cab.
16. Install the clutch fluid pipe (if equipped).
17. Install the main wire harness under the hood.
18. Install the ground strap.
19. Install the heater hoses.
20. Install the left and the right headlamp assemblies.
21. Install the grille.
22. Connect the negative battery cable.
23. Recharge the air conditioning refrigerant to specification.
24. Refill the engine coolant to proper level.
25. Bleed the clutch system.



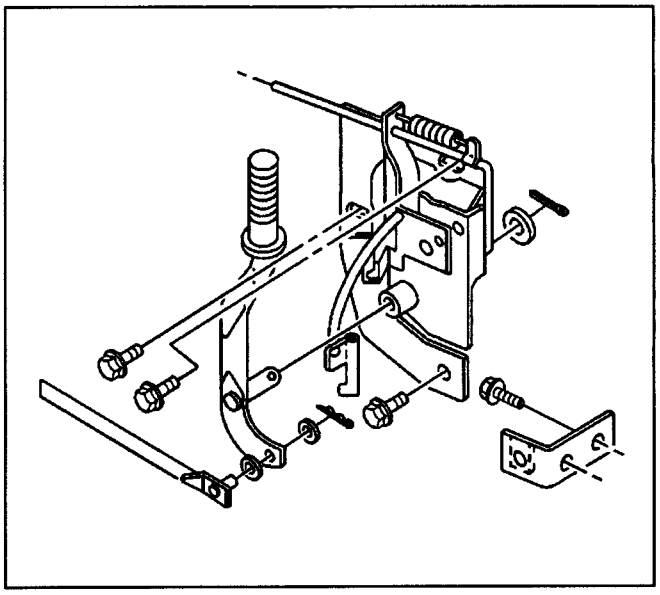
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Cab Lock Replacement

Removal Procedure

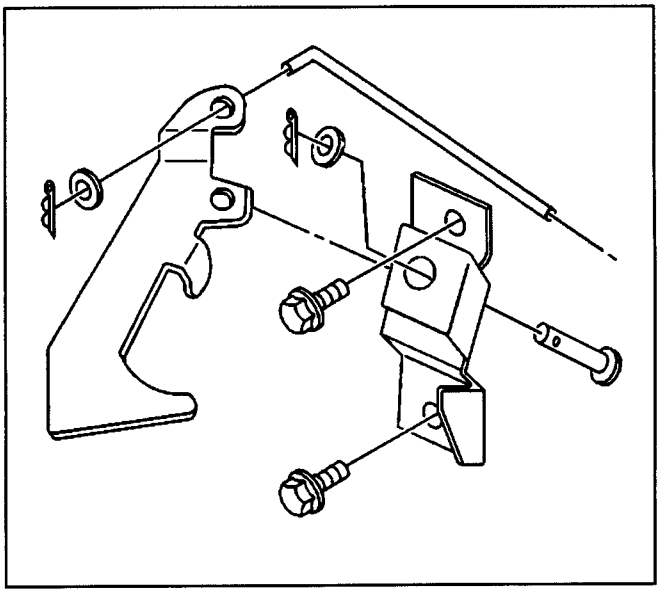
1. Remove the cushion rubber.
2. Remove the connecting rod.
3. Remove the safety rod.
4. Remove the return spring.

5. Remove the hand lever assembly.



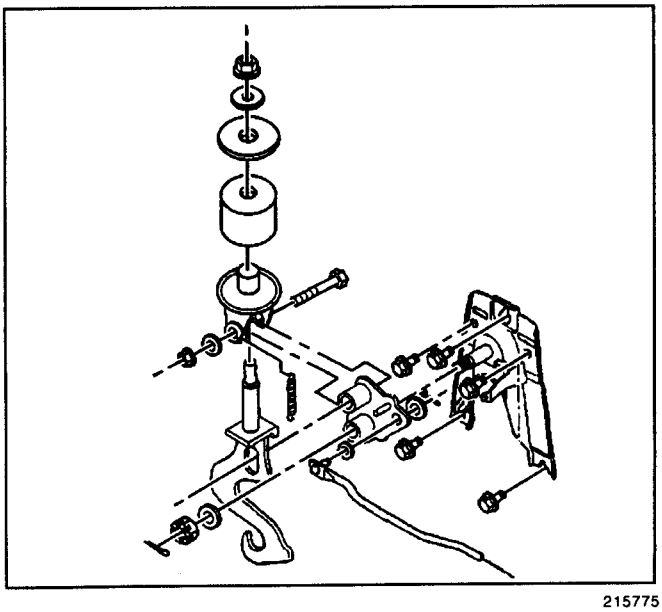
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6. Remove the safety lock assembly.
7. Remove the safety lock hook.
8. Remove the safety lock bracket.

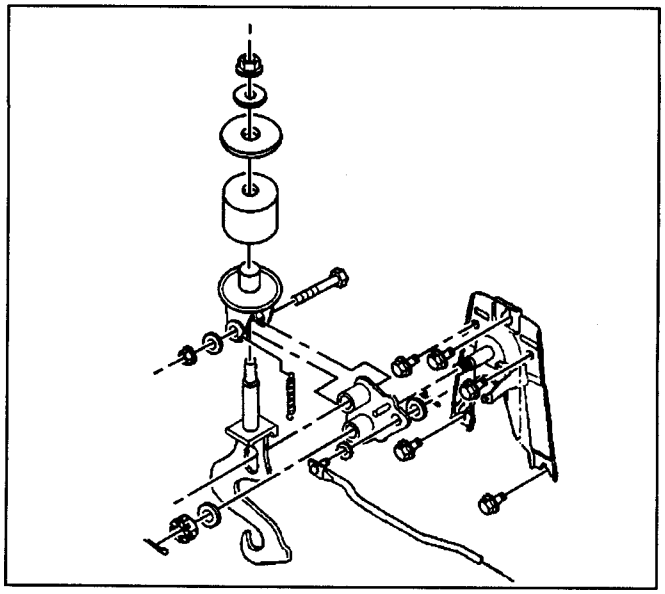


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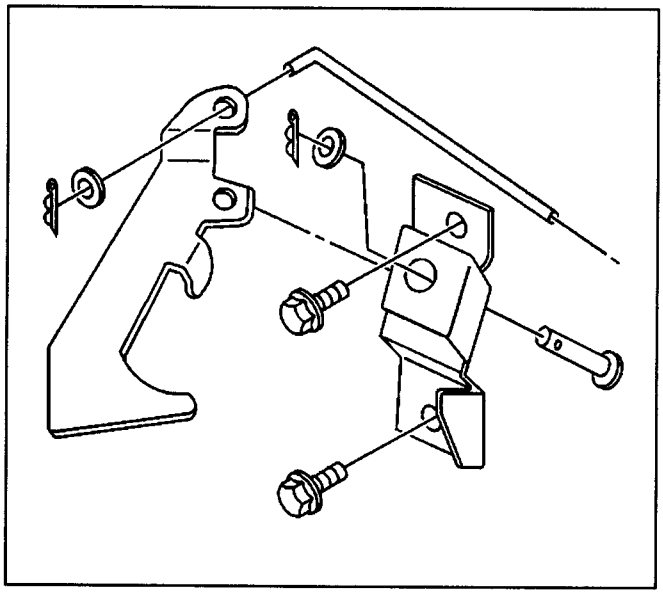
9. Remove the cab lock assembly.
10. Remove the return spring.
11. Remove the rebound rubber plate.
12. Remove the rebound rubber.
13. Remove the rebound rubber support.
14. Remove the cab lock hook.
15. Remove the link plate.
16. Remove the cab lock hook.
17. Remove the link plate.
18. Remove the cab lock bracket.
19. Remove the rear cab mount bracket.
20. Inspect the rebound rubber for any cracks or damage.



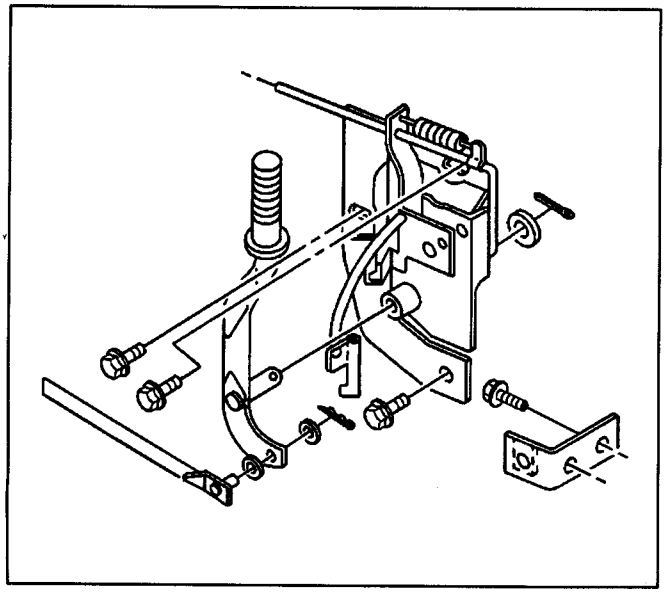
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Installation Procedure

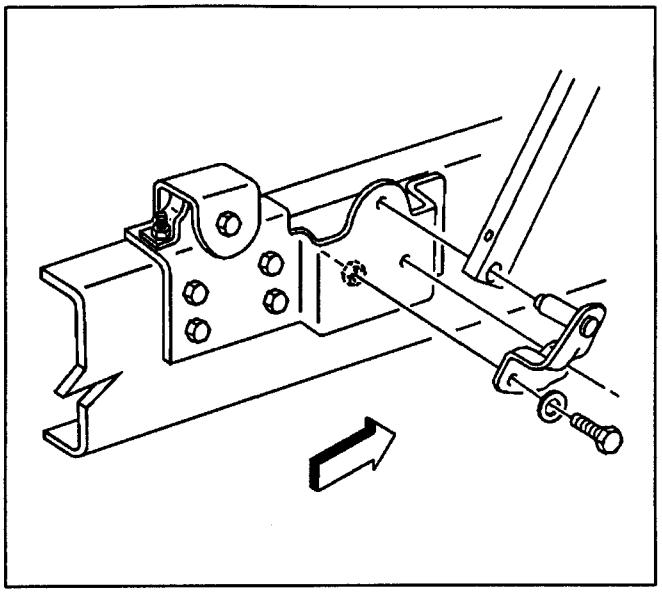
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the rear cab mount bracket.
   Tighten
   Tighten the bolts to 16 N.m (12 lb ft).
2. Install the cab lock bracket.
3. Install the link plate.
4. Apply grease to the pin of the bracket.
5. Install the cab lock hook.
6. Apply grease to the support.
7. Install the rebound rubber support.
8. Install the rebound rubber.
9. Install the rebound rubber plate.
10. Install the return spring.
11. Install the cab lock assembly.
    Tighten
    Tighten the bolts to 40 N.m (30 lb ft).
12. Install the safety lock bracket.
13. Apply grease to the hook.
14. Install the safety lock hook.
15. Install the safety lock assembly.
16. Install the hand lever assembly.
17. Install the return spring.
18. Apply grease to the safety rod.
19. Install the safety rod.
20. Install the connecting rod.
21. Install the cushion rubber.
22. Adjust the hook so that the hook rests in the center of the mounting point when latched.

Cab Tilt Support Replacement

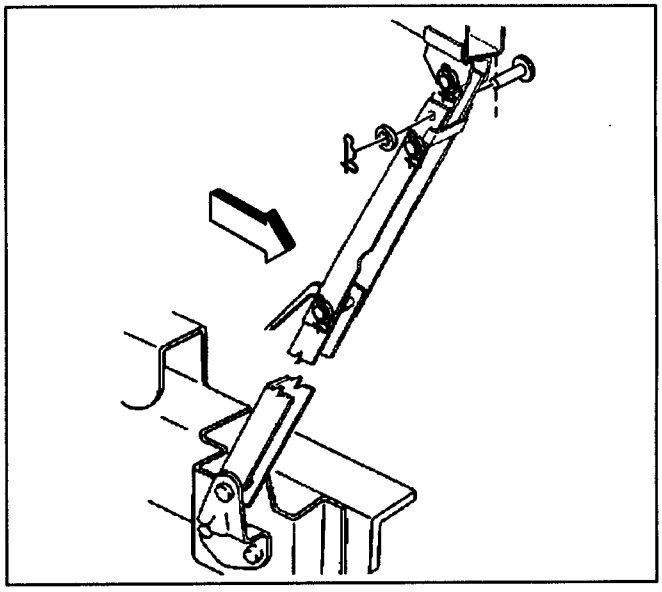
Removal Procedure

1. Raise the cab and support. Refer to *Cab Tilting* in General Information.
2. Remove the cab lock cover.
3. Securely fasten a rope to the cab lock. In order to keep the cab tilted, use a hoist or chain block.
4. Remove the following items:
   - The pin
   - The washer
   - The cotter pin
5. Remove the lower bracket.



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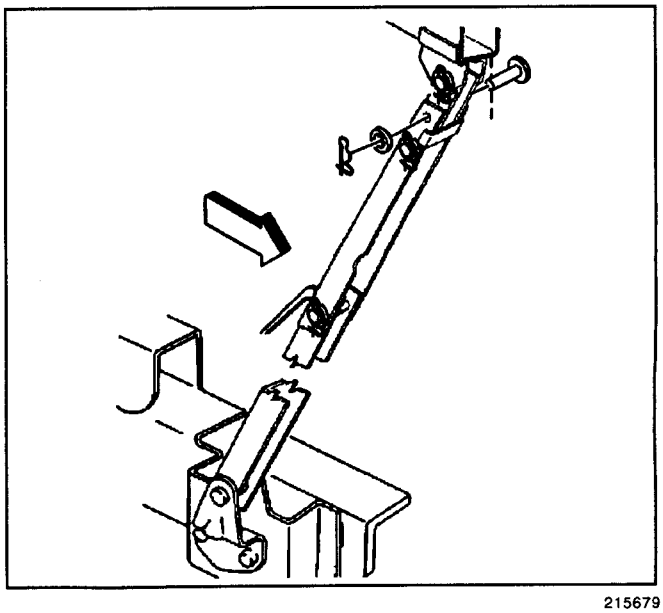
6. Remove the cab tilt support.



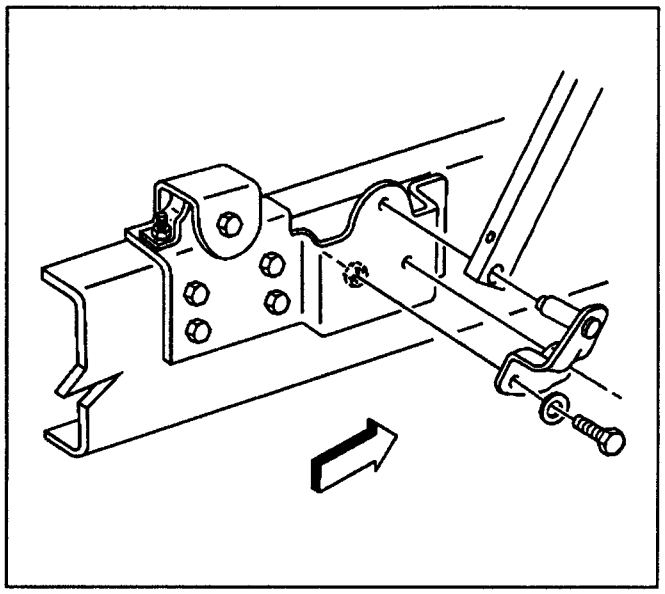
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Installation Procedure

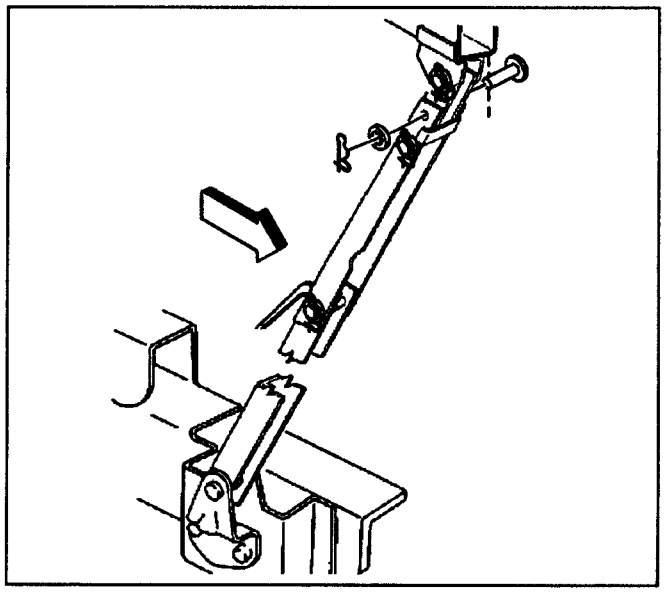
1. Connect the cab tilt support to the cab.



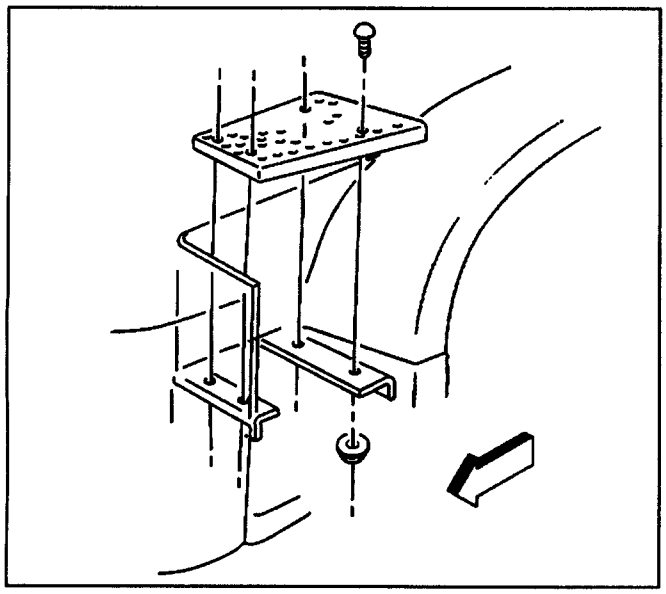
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Notice: Refer to *Fastener Notice* in Cautions and Notices.

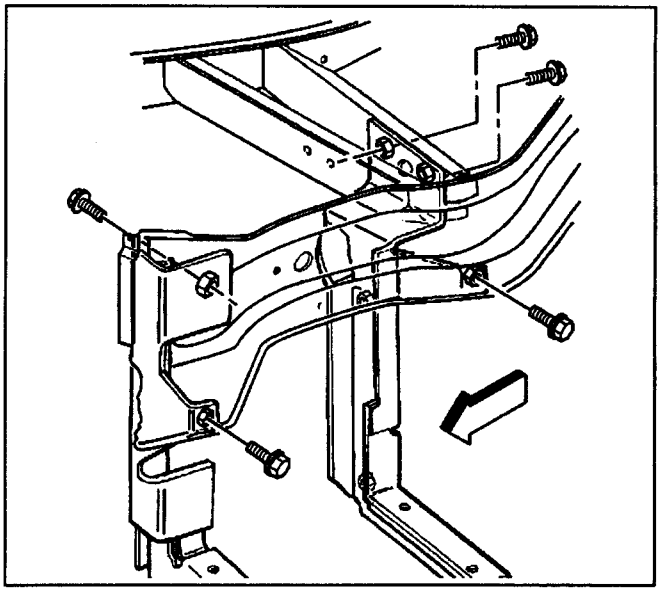
2. Install the lower bracket.
   Tighten
   Tighten the bolt to 45 N·m (33 lb ft).
3. Lower the cab until the hole in the cab support inner channel aligns with the top hole in the cab support outer channel.
4. Install the following items: pin, washer, and cotter pin.
   - The pin
   - The washer
   - The cotter pin

Step and Support Replacement - Upper

Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.
2. Remove the upper step.

3. Remove the upper step supports.

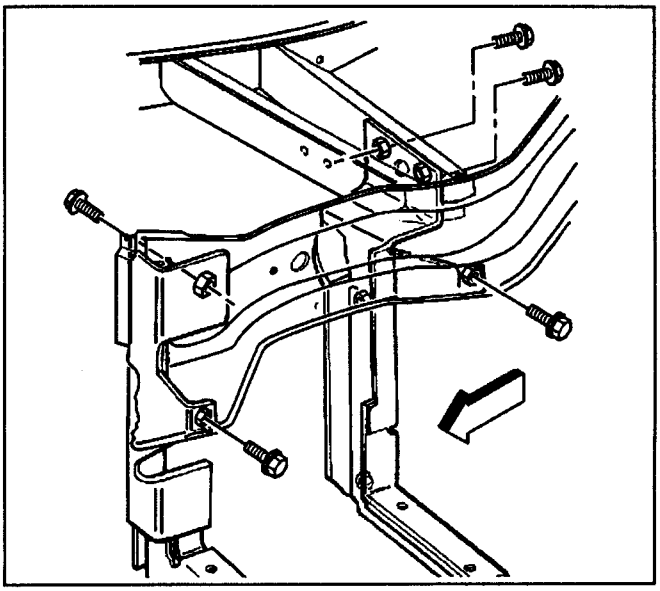


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Installation Procedure

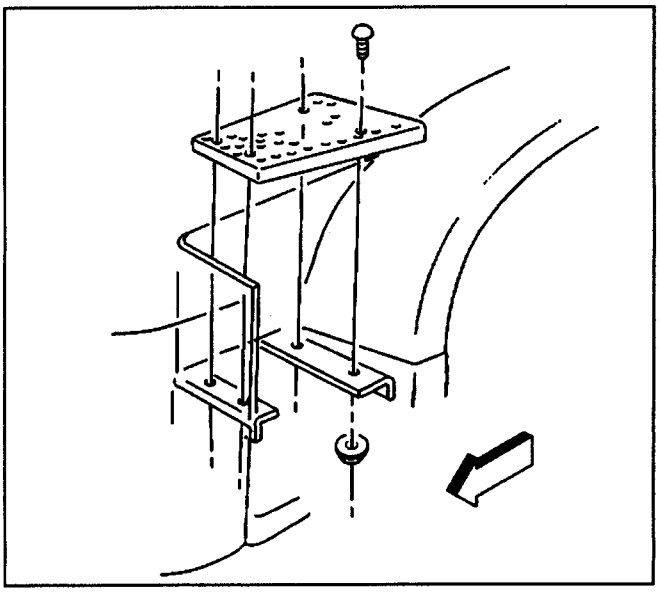
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the upper step supports.
   Tighten
   Tighten the bolt to 9 N·m (80 lb in).

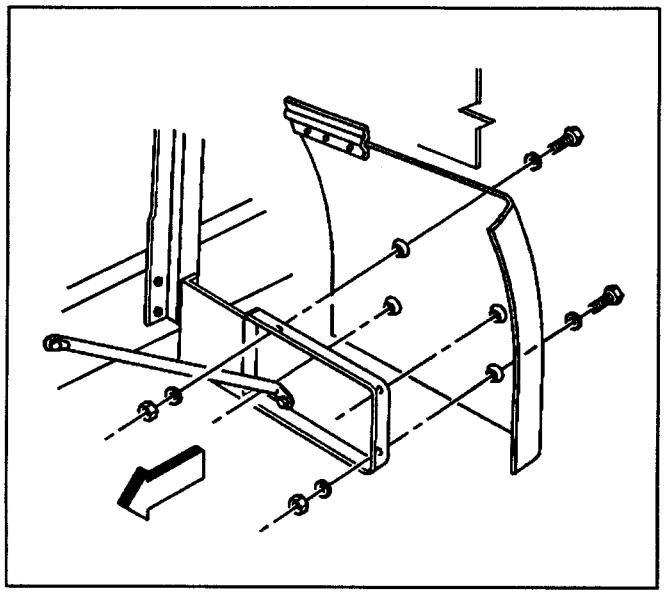


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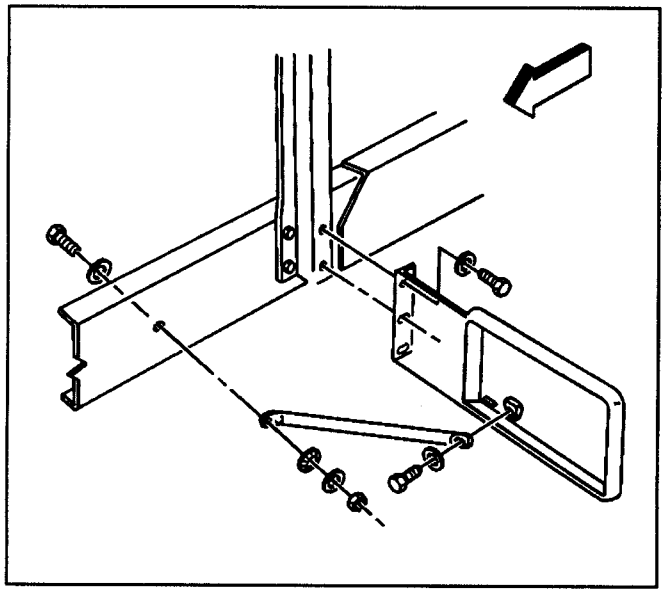
2. Install the upper step.
   Tighten
   Tighten the nut to 23 N·m (17 lb ft).



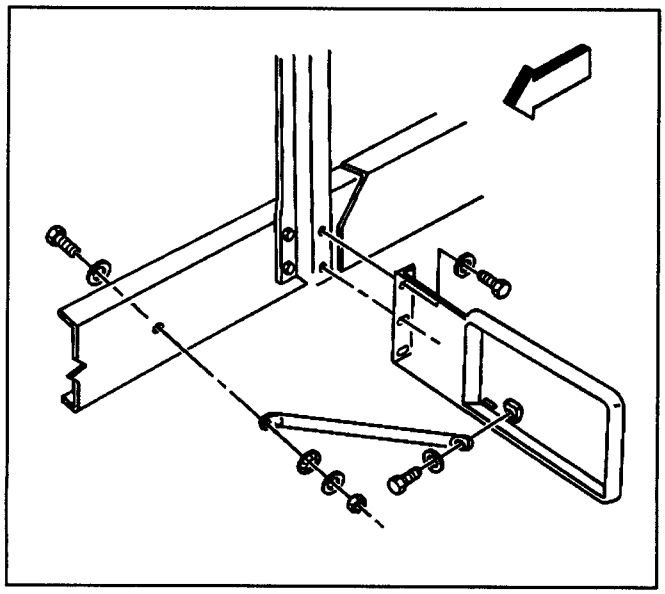
215693



215675



223322



223322

Fender Extension Bracket Replacement - Front

Removal Procedure

1. Disconnect the fender extension to the bracket bolts.
2. Remove the fender extension.
3. Remove the fender extension brace.
4. Remove the fender extension bracket.

Installation Procedure

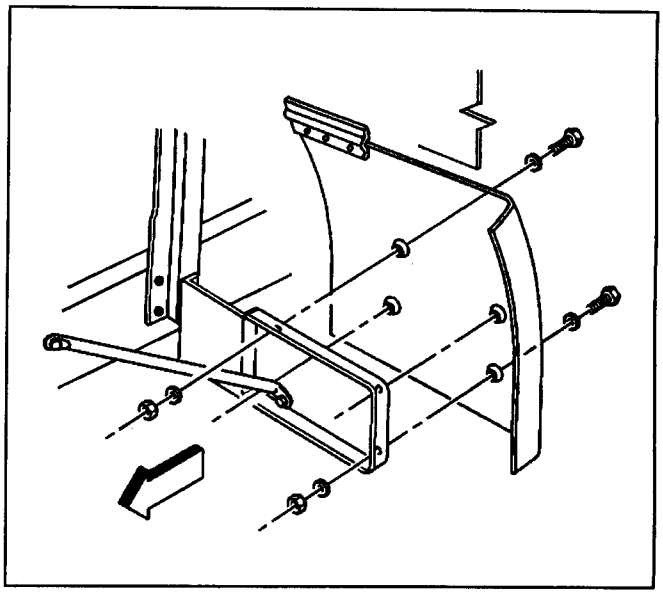
1. Install the fender extension bracket.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the fender extension brace.

   Tighten

   Tighten the nut to 70 N.m (52 lb ft).

3. Install the fender extension.
4. Connect the fender extension to the bracket bolts.
   Tighten
   Tighten the nut to 15 N·m (11 lb ft).

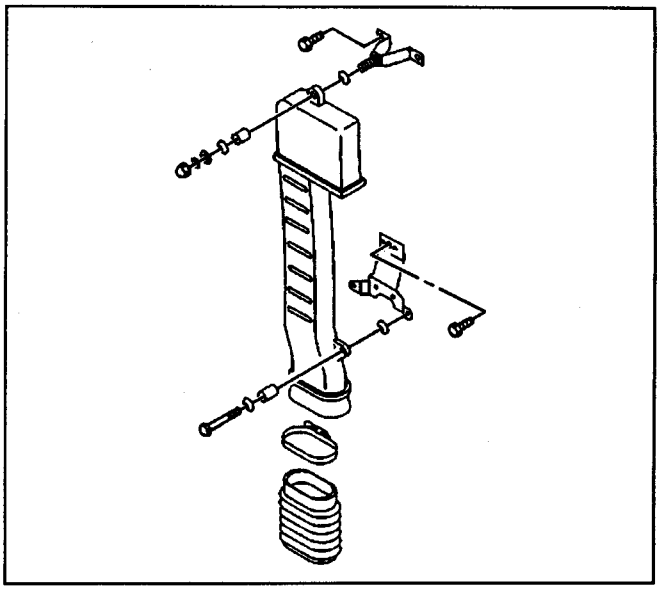


215675

Air Scoop Replacement

Removal Procedure

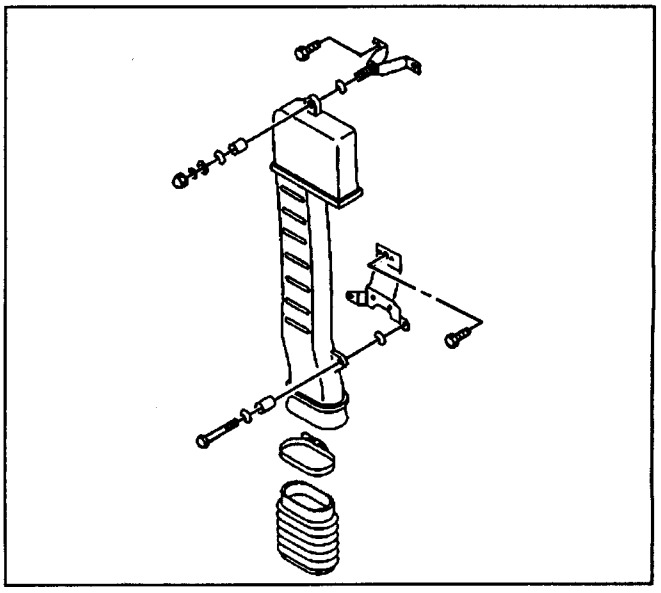
1. Loosen the upper connector clamp.
2. Remove the mounting nuts and bolts.
3. Remove the air scoop assembly.



215772

Installation Procedure

1. Install the air scoop assembly to the cab.
2. Install the mounting nuts and bolts.
3. Tighten the upper connector clamp.



215772

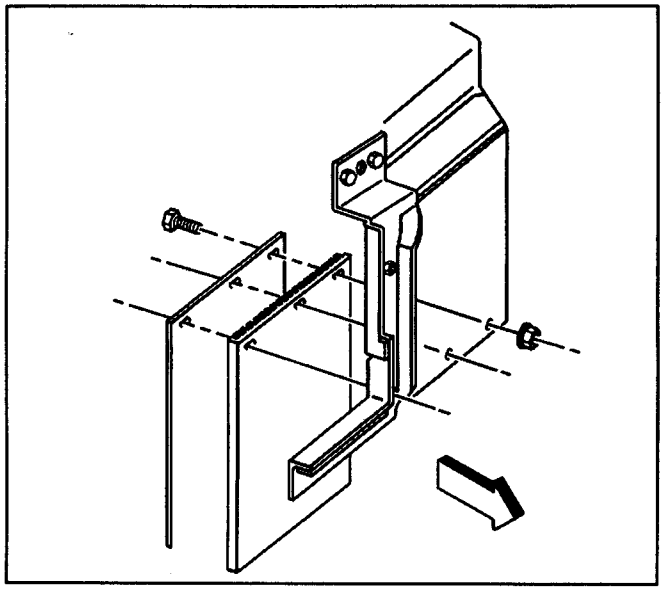
Panel Replacement - Front Side

Removal Procedure

1. Raise the hood.
2. Open the door(s).
3. Remove the side panel screws.
4. Remove the side panel.

Installation Procedure

1. Install the side panel into the position.
2. Install the side panel screws.
3. Close the door(s).
4. Close the hood.

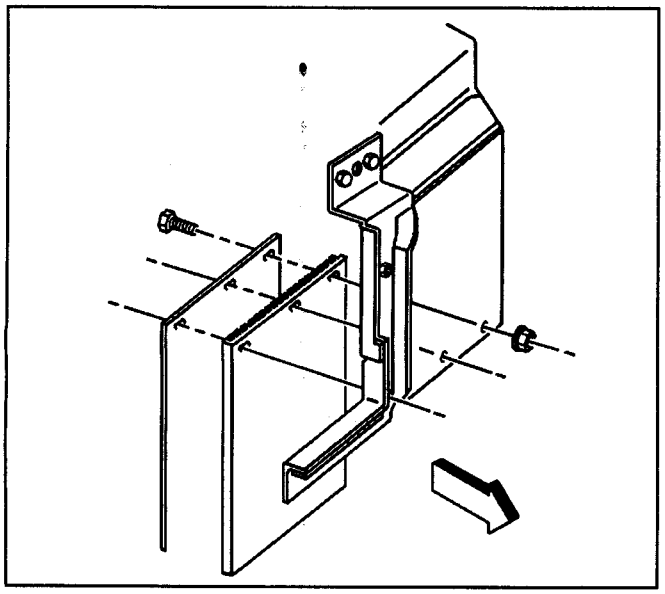


215678

Splash Shield Replacement - Condenser

Removal Procedure

1. Raise the cab. Refer to *Cab Tilting* in General Information. Support the cab.
2. Remove the splash shield/reinforcement from the inner fender panel.



215678

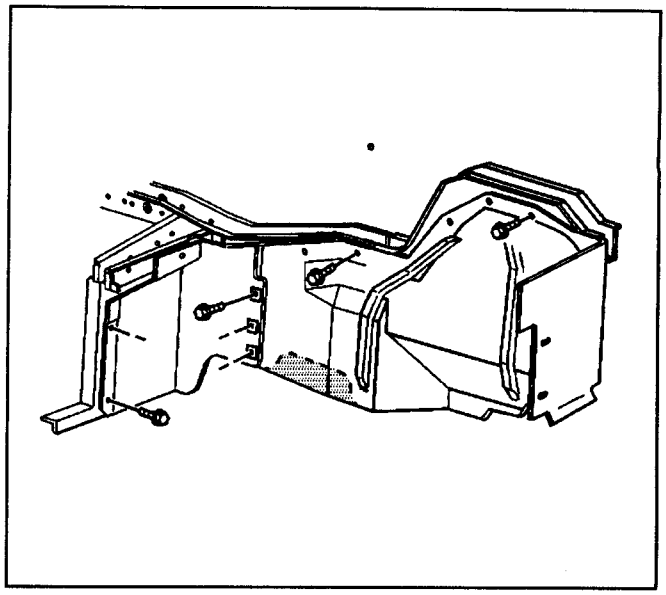
Installation Procedure

1. Install the splash shield/reinforcement to the inner fender panel.
2. Lower the cab. Refer to *Cab Tilting* in General Information.

Wheelhouse Panel Replacement (Lower)

Removal Procedure.

1. Tilt and secure the cab. Refer to *Cab Tilting* in General Information.
2. Remove the inner extension panel bolts.
3. Remove the inner extension panel.
4. Remove the inner fender panel bolts.
5. Remove the inner fender panel.



215659

Installation Procedure

1. Install the inner fender panel to the cab.

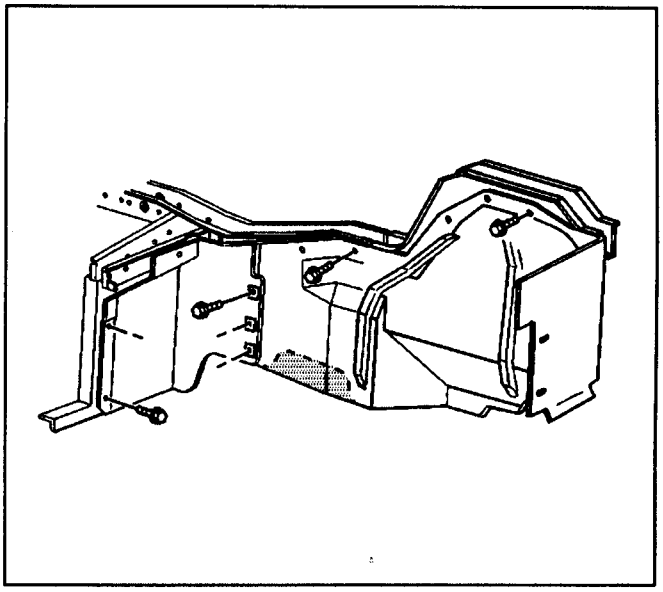
   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the inner fender panel bolts.

   Tighten

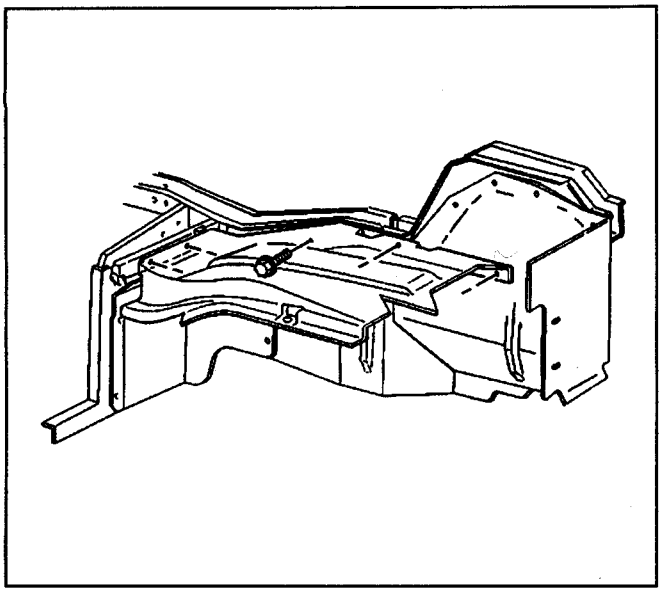
   Tighten the bolts to 9 N.m (80 lb in).
3. Install the inner extension panel.
4. Install the inner extension panel bolts.

   Tighten

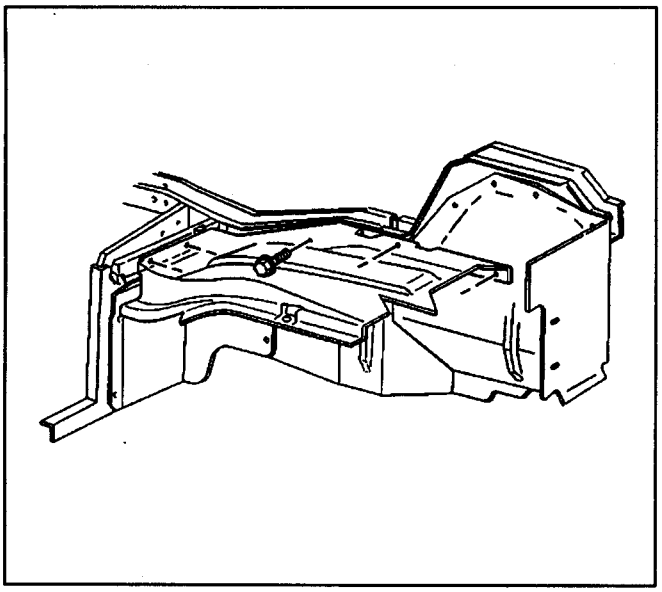
   Tighten the bolts to 9 N.m (80 lb in).



215659



215664



215664

Wheelhouse Panel Replacement (Upper)

Removal Procedure

1. Tilt the cab. Refer to *Cab Tilting* in General Information.
2. Remove the upper inner fender panel bolts.
3. Remove the upper inner fender panel.

Installation Procedure

1. Install the upper inner fender to the cab.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install upper inner fender bolts.

   Tighten

   Tighten the bolts to 9 N·m (80 lb in).

Doors

Specifications

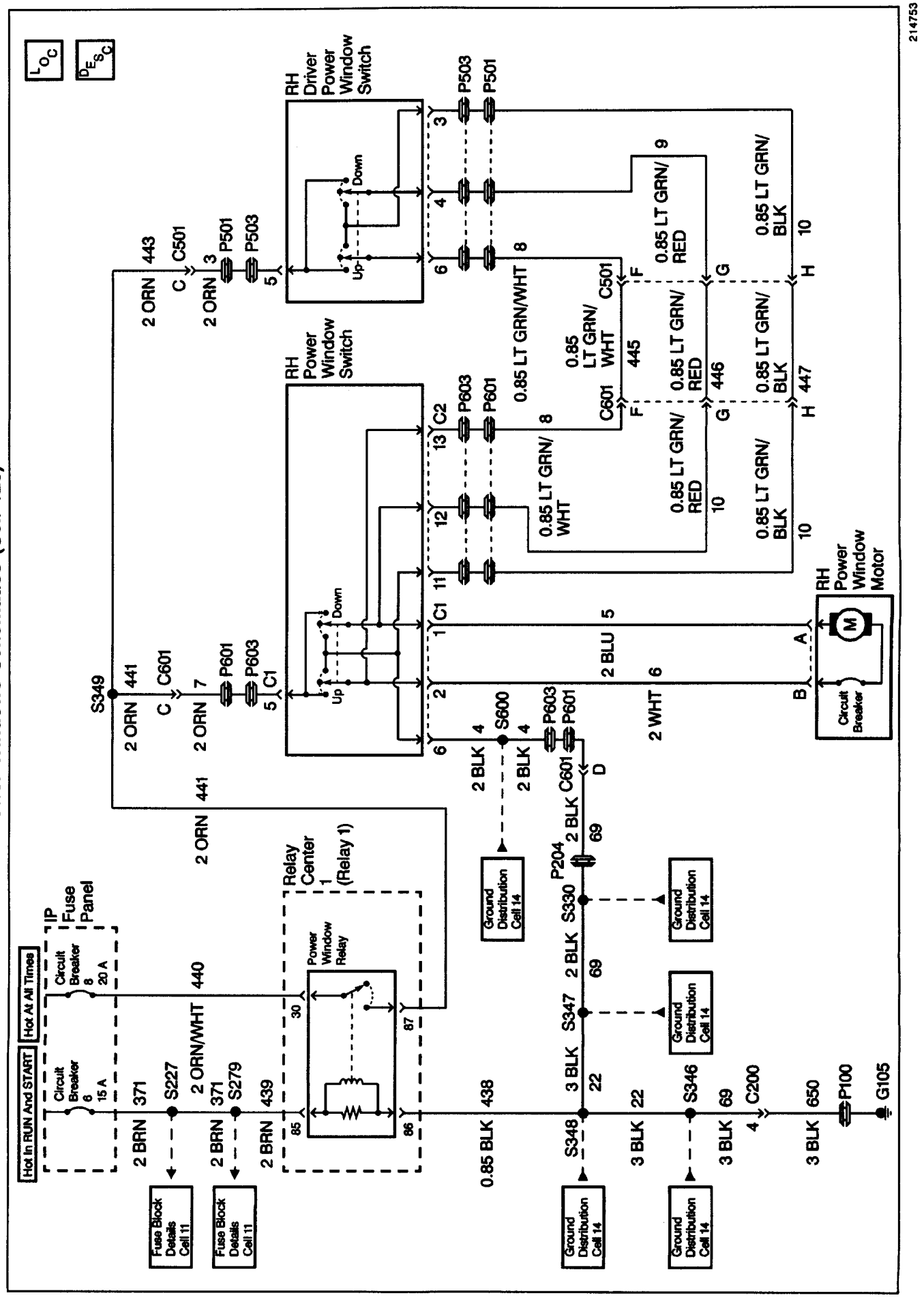
Fastener Tightening Specifications

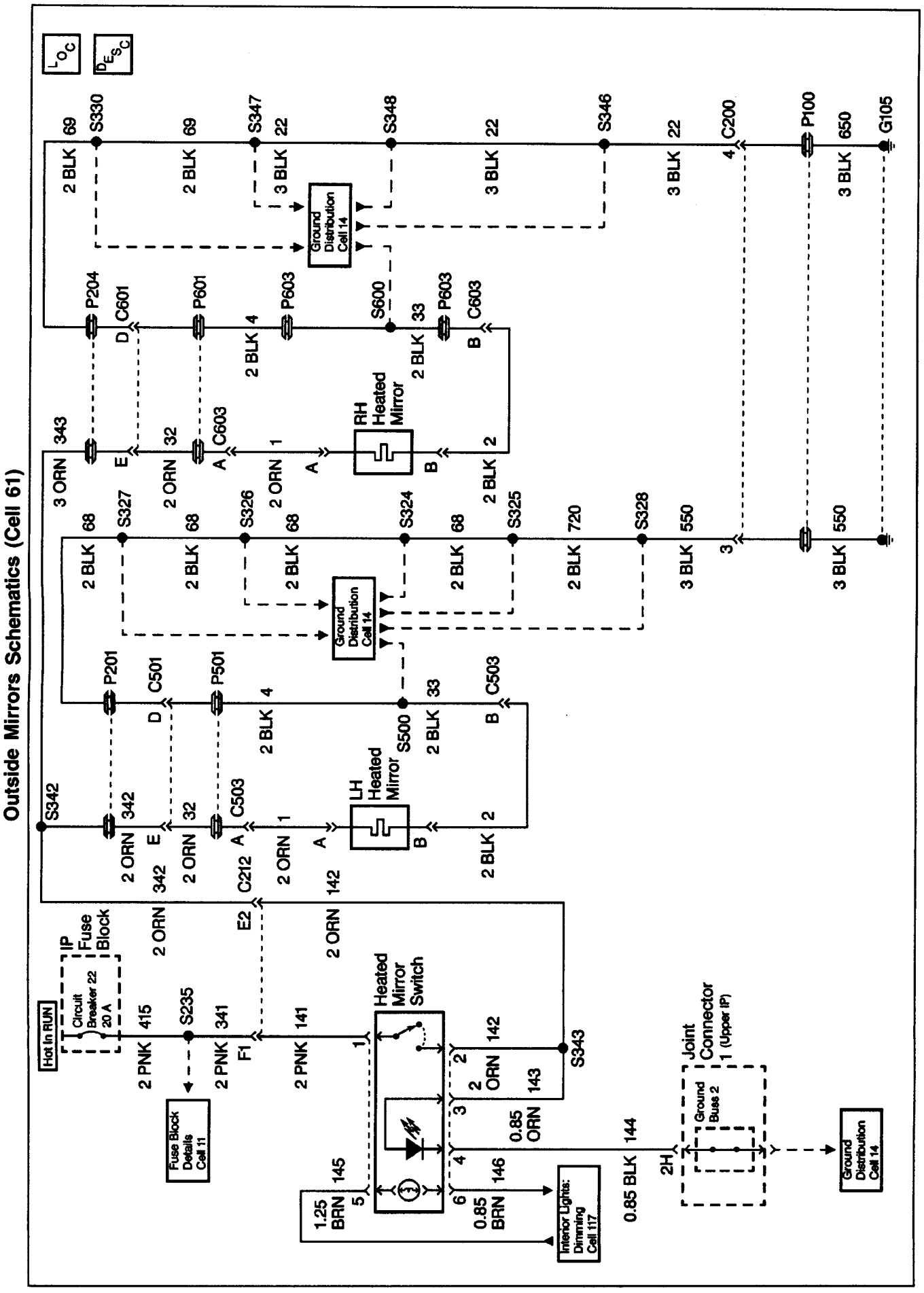
Application	Specification	
	Metric	English
Mirror Brace Nut	31 N·m	23 lb ft
Mirror Mounting Nut	13 N·m	115 lb in

Schematic and Routing Diagrams

Power Door Systems Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Wiring Systems
Interior Lights Dimming Cell 117	8—Lighting Systems


Power Windows Schematics (Cell 120)
LOC
DESC
214753
Hot In RUN And START
Hot At All Times
IP Fuse Panel
Circuit Breaker 6 15 A
Circuit Breaker 8 20 A
Relay Center 1 (Relay 1)
Power Window Relay
Fuse Block Details Cell 11
Fuse Block Details Cell 11
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
Ground Distribution Cell 14
RH Driver Power Window Switch
RH Power Window Switch
RH Power Window Motor
Circuit Breaker
Up
Down
S227
S279
S349
S600
S347
S330
S348
S346
P204
P100
G105
C200
C501
C601
C1
C2
P501
P503
P601
P603
2 BRN 371
2 BRN 371
2 BRN 439
2 ORN/WHT 440
2 ORN 441
2 ORN 443
0.85 BLK 438
3 BLK 22
3 BLK 69
3 BLK 650
2 BLK 69
2 BLK 4
2 BLK 4
2 BLK C601 D
2 WHT 6
2 BLU 5
0.85 LT GRN/WHT 8
0.85 LT GRN/ WHT 445
0.85 LT GRN/ RED 446
0.85 LT GRN/ BLK 447
0.85 LT GRN/ WHT 8
0.85 LT GRN/ RED 10
0.85 LT GRN/ BLK 10
0.85 LT GRN/ RED 9
0.85 LT GRN/ BLK 10


Outside Mirrors Schematics (Cell 61)
218181
LOC
DESC
Hot In RUN
IP Fuse Block
Circuit Breaker 22 20 A
Fuse Block Details Cell 11
Heated Mirror Switch
Interior Lights: Dimming Cell 117
Joint Connector 1 (Upper IP)
Ground Bus 2
Ground Distribution Cell 14
RH Heated Mirror
LH Heated Mirror
S330
S347
S348
S346
C200
P100
G105
P204
C601
P601
P603
S600
C603
S343
S342
P201
C501
P501
S500
C503
C212
S235
S327
S326
S324
S325
S328
2 BLK 69
3 BLK 22
2 BLK 68
3 BLK 650
3 BLK 550
3 ORN 343
2 ORN 342
2 ORN 32
2 ORN 1
2 ORN 142
2 PNK 415
2 PNK 341
2 PNK 141
2 ORN 142
2 ORN 143
0.85 ORN 144
0.85 BLK 144
1.25 BRN 145
0.85 BRN 146
2 BLK 720
2H

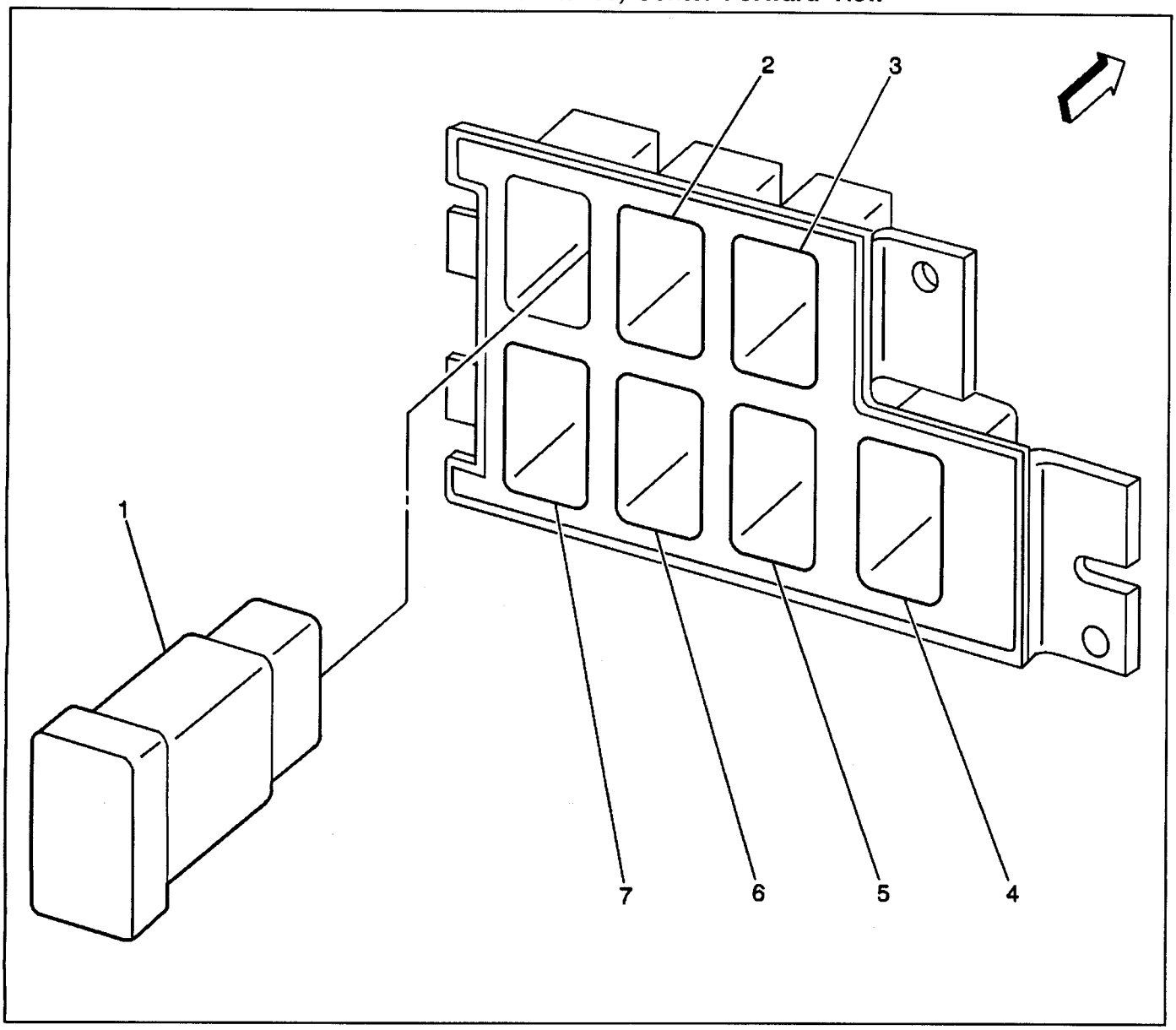
Component Locator

Power Door Systems Components

Name	Location	Locator View	Connector End View
Heated Mirror Switch	On the center of the IP	*Power Door Systems Component Views* in Doors	*Power Door Systems Connector End Views* in Doors
Heated Outside Rearview Mirror, Left Side	On the left door exterior	*Power Door Systems Component Views* in Doors	—
Heated Outside Rearview Mirror, Right Side	On the right door exterior	*Power Door Systems Component Views* in Doors	—
Heated/Lighted Mirror, Left Side	On the left door exterior	*Power Door Systems Component Views* in Doors	—
Heated/Lighted Mirror, Right Side	On the right door exterior	*Power Door Systems Component Views* in Doors	—
Power Window Motor, Right Side	Inside the right door, at the window regulator	—	*Power Door Systems Connector End Views* in Doors
Power Window Relay	On the right top of the I/P, under the access panel, in the relay center 1	*Power Door Systems Component Views* in Doors	—
Power Window Switch, Driver's Right Side	On the top of the left door panel	—	*Power Door Systems Connector End Views* in Doors
Power Window Switch, Right Side	On the top of the right door panel	—	—
Power Window Switch, Right Side C1 (6 Cavities)	In the right door harness to the power window switch	—	*Power Door Systems Connector End Views* in Doors
Power Window Switch, Right Side C2 (8 Cavities)	In the right door harness to the power window switch	—	*Power Door Systems Connector End Views* in Doors

Power Door Systems Component Views

Instrument Panel Switches, Center Forward View

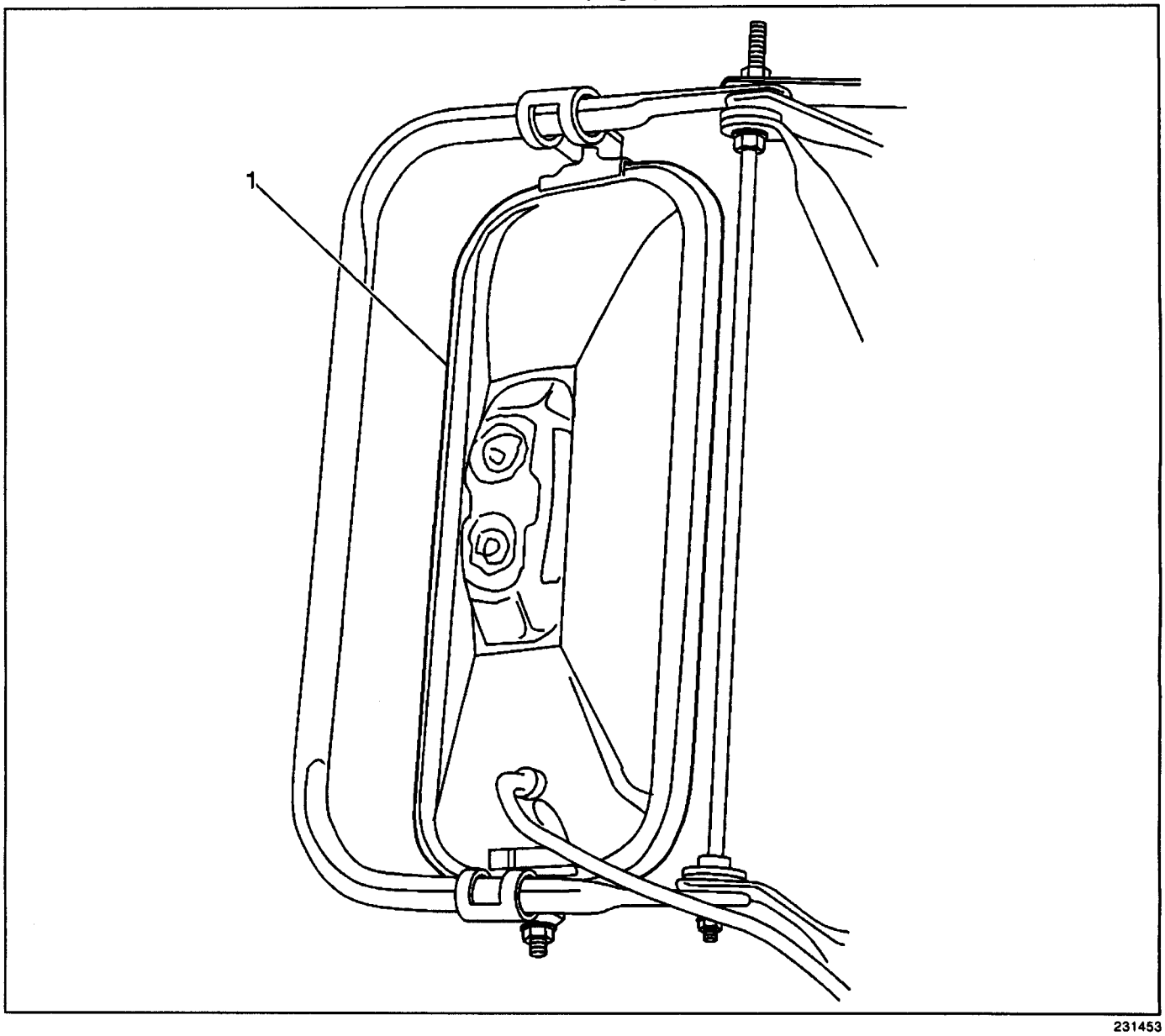


231678

Legend

(1) Exhaust Brake Switch
(2) Fast Idle Switch
(3) Heated Mirror Switch
(4) Two Speed Rear Axle Shift Switch (Automatic Transmission)
(5) Air Suspension Dump Switch
(6) Differential Lock Switch
(7) Clearance Lamps Switch

Mirror (Right)

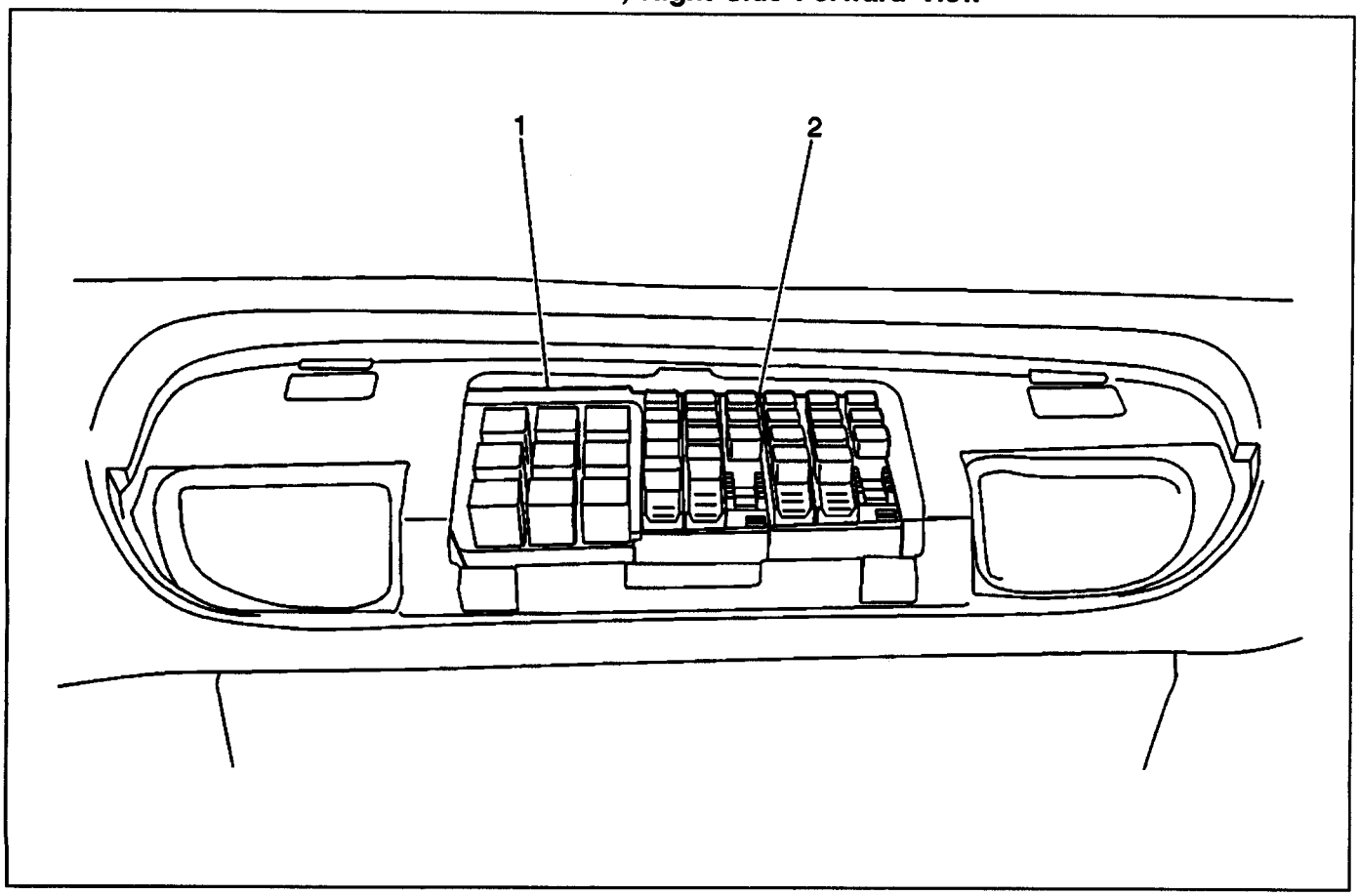


231453

Legend

(1) Right Lighted Mirror (Heated Mirror similar)

Instrument Panel, Right Side Forward View



228475

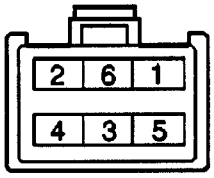
Legend

(1) Relay Center 1

(2) IP Fuse Block

Power Door Systems Connector End Views

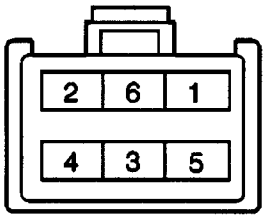
Heated Mirror Switch



237080

Connector Part Information	• 6 Way • Female		
Pin	Wire Color	Circuit No.	Function
1	PNK	141	Fuse Output Ignition
2	ORN	142	Switch Output
3	ORN	143	Switch Telltale Feed
4	BLK	144	Ground
5	BRN	145	Illumination
6	BLK/RED	146	Interior Lamps Dimming Bus

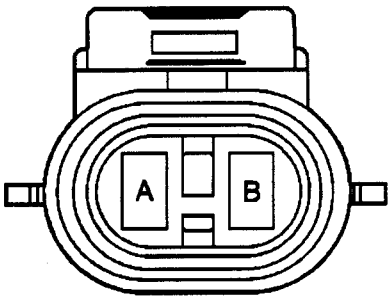
Lighted Mirror Jumper C216



246499

Connector Part Information	6 Way F (BLK)		
Pin	Wire Color	Circuit No.	Function
1	BRN	147	Illumination
2–4	—	—	Not Used
5	BRN	147	Illumination
6	—	—	Not Used

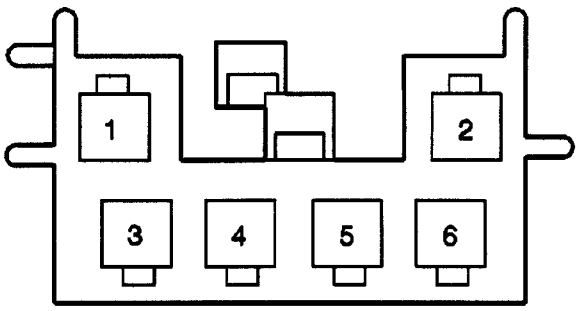
Power Window Motor (RH)



237309

Connector Part Information	• 2 Way • Female		
Pin	Wire Color	Circuit No.	Function
A	WHT	6	Power Window Motor Feed Up
B	BLU	5	Power Window Motor Feed Down

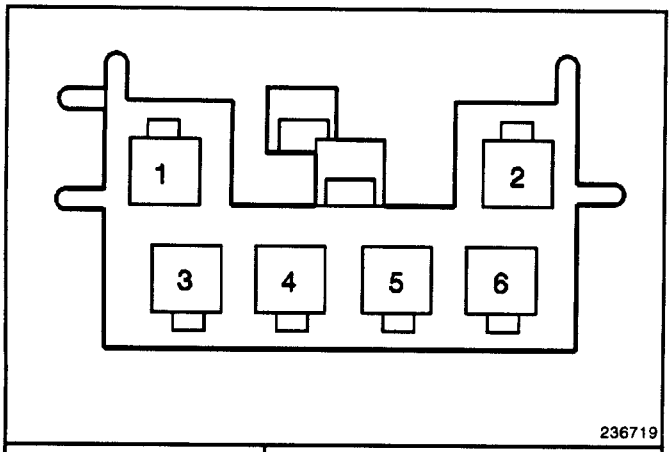
Power Window Switch, Drivers Right Hand



236719

Connector Part Information	• 6 Way • Female		
Pin	Wire Color	Circuit No.	Function
1-2	—	—	Not Used
3	LT GRN/BLK	10	Power Window Motor Feed Up
4	LT GRN/RED	9	Power Window Motor Feed Down
5	ORN	7	Fuse Output
6	LT GRN/WHT	8	Ground

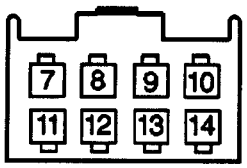
Power Window Switch, RH (C1)



236719

Connector Part Information		• 6 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BLU	5	Power Window Motor Feed Up
2	WHT	6	Power Window Motor Feed Down
3-4	—	—	Not Used
5	BRN	3	Fuse Output
6	BLK	4	Ground

Power Window Switch, RH (C2)



236713

Connector Part Information		• 8 Way • Female	
Pin	**Wire Color**	**Circuit No.**	**Function**
7-10	—	—	Not Used
11	LT GRN/BLK	10	Power Window Feed Down
12	LT GRN/RED	9	Power Window Feed Up
13	LT GRN/WHT	8	Power Window Feed Up, Drivers
14	—	—	Not Used

Diagnostic Information and Procedures

Power Windows System Check

1. Check condition of circuit breakers #6 and circuit breaker #8. If circuit breaker is open, locate and repair cause of overload. Replace circuit breaker as necessary.
2. Check that G105 is clean and tight.
3. Check for mechanical failure or binding of power windows.
4. Check condition or local circuit breaker in the RH power window motor. The local circuit breaker will reset automatically after cooling following an overload condition.
5. Check for a broken, or partially broken wire inside the insulation which could cause system malfunction but prove good in a continuity/voltage check with a system disconnected. These circuits may be interrmittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
6. Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems. Refer to *Checking Aftermarket Accessories*.

Heated Mirror System Check

1. Check condition of circuit breaker #22. If circuit breaker is open, locate and repair cause of overload. Replace circuit breaker if necessary.
2. Check that G105 is clean and tight.
3. Refer to Cell 117 (Interior Lamps-Dimming) to diagnose heated mirror switch backlighting.
4. Check for a broken, or partially broken wire inside the insulation which could cause system malfunction but prove good in a continuity/voltage check with a system disconnected. These circuits may be interrmittent or resistive when loaded, and if possible, should be checked by monitoring for a voltage drop with the system operational (under load).
5. Check for proper installation of aftermarket electronic equipment which may affect the integrity of other systems. Refer to *Checking Aftermarket Accessories*.

Power Window Inoperative - RF

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to run. 2. Backprobe the relay center No.1 with a test lamp from relay 1 terminal 85 to ground. Does the test lamp light?	—	Go to *Step 3*	Go to *Step 2*
2	1. Locate the open in CKT 439 (BRN) between the IP fuse block and the relay center No. 1. 2. Repair the open in the circuit. Is the repair complete?	—	System OK	—
3	Backprobe relay center No.1 with a test lamp from the relay 1 terminal 86 to B+. Does the test lamp light?	—	Go to *Step 5*	Go to *Step 4*
4	1. Locate the open in CKT 438 (BLK) between the relay center No.1 and G105. 2. Repair the open in the circuit. Is the repair complete?	—	System OK	—
5	Backprobe the relay center No. 1 with a test lamp from relay 1 terminal 30 to ground. Does the test lamp light?	—	Go to *Step 7*	Go to *Step 6*
6	1. Locate the open in CKT 440 (ORN/WHT) between the IP fuse block and the relay center No.1. 2. Repair the open in the circuit. Is the repair complete?	—	System OK	—
7	Backprobe the relay center No.1 with a test lamp from relay 1 terminal 87 to ground. Does the test lamp light?	—	Go to *Step 9*	Go to *Step 8*
8	Replace relay 1. Is the repair complete?	—	System OK	—
9	Backprobe the right power window switch with a test lamp from connector C1 terminal 5 to ground. Does the test lamp light?	—	Go to *Step 11*	Go to *Step 10*
10	1. Locate the open in CKT 441 (ORN) between 6 the relay center No.1 and the right power window switch. 2. Repair the open in the circuit. Is the repair complete?	—	System OK	—
11	Backprobe the right power window switch with a test lamp from connector C1 terminal 6 to B+. Does the test lamp light?	—	Go to *Step 13*	Go to *Step 12*
12	1. Locate the open in CKT 4 and CKT 69 (BLK) between the right power window switch and S348. 2. Repair the open in the circuit. Is the repair complete?	—	System OK	—
13	While pressing the right power window switch to the UP position, backprobe the right power window switch with a test lamp from connector C1 terminal 2 to ground. Does the test lamp light?	—	Go to *Step 15*	Go to *Step 14*
14	Replace the right power window switch. Is the repair complete?	—	System OK	—
15	While pressing the right power window switch to the DOWN position, backprobe right power window switch from connector C1 terminal 2 to B+. Does the test lamp light?	—	Go to *Step 17*	Go to *Step 16*

Power Window Inoperative - RF (cont'd)

Step	Action	Value(s)	Yes	No
16	Replace the right power window switch. Is the repair complete?	—	System OK	—
17	While pressing the right power window switch to the DOWN position, backprobe the right power window switch with a test lamp from connector C1 terminal 1 to ground. Does the test lamp light?	—	Go to *Step 19*	Go to *Step 18*
18	Replace the right power window switch. Is the repair complete?	—	System OK	—
19	While pressing the right power window switch to the UP position, backprobe the right power window switch with a test lamp from connector C1 terminal 1 to B+. Does the test lamp light?	—	Go to *Step 21*	Go to *Step 20*
20	Replace the right power window switch. Is the repair complete?	—	System OK	—
21	While pressing the right power window switch to the UP positon, backprobe the right power window motor with a test lamp from terminal B to ground. Does the test lamp light?	—	Go to *Step 23*	Go to *Step 22*
22	1. Locate the open in CKT 6 (WHT) between the right power window switch and the right power window motor. 2. Repair the open in the circuit. Is the repair complete?	—	System OK	—
23	While pressing the right power window switch to the DOWN position, backprobe the right power window motor with a test lamp from terminal A to ground. Does the test lamp light?	—	Go to *Step 25*	Go to *Step 24*
24	1. Locate the open in CKT 5 (BLU) between the right power window switch and the right power window motor. 2. Repair the open in the circuit. Does the test lamp light?	—	System OK	—
25	Replace the power window motor. Is the repair complete?	—	System OK	—

Power Windows Inoperative From LF Switch

Step	Action	Value(s)	Yes	No
Definition: Right Power Window Motor Does Not Operate From Driver's Switch.				
1	1. Place the ignition switch in the RUN position. 2. Backprobe the Right driver's power window switch with a test lamp from terminal 5 to the chassis ground. Does the test lamp light?	—	*Go to Step 3*	*Go to Step 2*
2	Repair the open in CKT 443 (ORN) or CKT 3 (ORN) between S 349 and the driver's Right side power window switch. Is the repair complete?	—	System OK	—
3	Backprobe the driver's Right power window switch with a test lamp from terminal 3 to B+. Does the test lamp light?	—	*Go to Step 6*	*Go to Step 4*

Power Windows Inoperative From LF Switch (cont'd)

Step	Action	Value(s)	Yes	No
4	Inspect for an open in CKT 10 or CKT 447 (LT GRN/BLK) between the driver's Right power window switch and the right side power window switch. Does an open exist in the circuits?	—	*Go to Step 5*	*Go to Step 6*
5	Replace the Right power window switch. Is the repair complete?	—	System OK	—
6	Backprobe the driver's Right side power window switch with a test lamp from terminal 6 to the chassis ground while pressing switch. Does the test lamp light?	—	*Go to Step 8*	*Go to Step 7*
7	Replace the driver's Right power window switch. Is the repair complete?	—	System OK	—
8	Backprobe the right side power window switch with a test lamp from terminal 6 to B+ while pressing the switch in the Down position. Does the test lamp light?	—	*Go to Step 10*	*Go to Step 9*
9	Replace the driver's Right power window switch. Is the repair complete?	—	System OK	—
10	Backprobe the switch with a test lamp from terminal 4 to B+ while keeping the switch operated in the Down position. Does the test lamp light?	—	*Go to Step 12*	*Go to Step 11*
11	Replace the driver's Right power window switch. Is the repair complete?	—	System OK	—
12	Backprobe the switch with a test lamp from terminal 4 to the chassis ground while keeping the switch operated in the UP position. Does the test lamp light?	—	*Go to Step 14*	*Go to Step 13*
13	Replace the driver's Right power window switch. Is the repair complete?	—	System OK	—
14	Backprobe the switch with a test lamp from connector C 2 terminal 13 to the chassis ground while keeping the switch operated in the Up position. Does the test lamp light?	—	*Go to Step 16*	*Go to Step 15*
15	Repair the open in CKT 8 and CKT 445 (LT GRN/WHT) between the driver's Right power window switch and the Right side power window switch. Is the repair complete?	—	System OK	—
16	Backprobe the Right power window switch with a test lamp from the connector terminal 12 to the chassis ground while keeping the switch operated in the Down position. Does the test lamp light?	—	*Go to Step 18*	*Go to Step 17*
17	Repair the open in CKT 9 or CKT 446 (LT GRN/RED). Is the repair complete?	—	System OK	—
18	Replace the Right power window switch. Is the repair complete?	—	System OK	—

Heated Mirrors Inoperative (Switch Indicator)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to the RUN position. 2. Backprobe the heated mirror switch with a test lamp from terminal 1 to ground. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	1. Press the heated mirror switch to the ON position. 2. Backprobe the heated mirror switch with a test lamp from terminal 2 to ground. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
3	Repair the open in CKT 141, CKT 341, or CKT 415 (PNK), between the IP fuse block and the heated mirror switch. Does the heated mirror switch indicator operate?	—	System OK	—
4	1. Locate the open in CKT 142 and CKT 342 (ORN) between the heated mirror switch and S342. 2. Repair the open in CKT 142 and CKT 342 (ORN) between the heated mirror switch and S 342. Do the heated mirrors operate?	—	System OK	—
5	1. Repair the open in CKT 142 and CKT 143 (ORN) between the heated mirror switch terminal 2 to terminal 3. 2. Replace the heated mirror switch. Do the heated mirrors operate?	—	System OK	—
6	Replace the heated mirror switch. Does the heated mirror switch indicator operate?	—	System OK	Go to *Step 8*
7	Repair the open in CKT 144 (BLK), between the heated mirror switch and splice pack No. 1. Do the heated mirrors operate?	—	System OK	—
8	Replace the heated mirror switch. Does the heated mirror switch indicator operate?	—	System OK	—

Heated Mirrors Inoperative (Both Mirrors)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to RUN position. 2. Backprobe the heated mirror switch with a test lamp from terminal 1 to ground. Does the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	While pressing the heated mirror switch,backprobe the switch with a test lamp from terminal 2 to ground. Does the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
3	Repair the open in CKT 141, CKT 341, or CKT 415 (PNK) between the IP fuse block and the heated mirror switch. Do the mirrors operate?	—	System OK	—
4	Repair the open in CKT 142 (ORN) between the heated mirror switch and S342. Do the mirrors operate?	—	System OK	—
5	Replace the heated mirror switch. Do the mirrors operate?	—	System OK	—

Heated Mirrors Inoperative (LH or RH Not Both)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to the RUN position. 2. Press the heated mirror switch to ON. 3. Backprobe the inoperative heated mirror with a test lamp from terminal A to ground. Did the test lamp light?	—	Go to *Step 2*	Go to *Step 3*
2	Backprobe the inoperative heated mirror with a test lamp from terminal B to B+. Did the test lamp light?	—	Go to *Step 4*	Go to *Step 5*
3	Repair the open in CKT 342 or CKT 343 (ORN) between S342 and the inoperative heated mirror. Does the heated mirror operate?	—	System OK	—
4	Replace the inoperative heated mirror. Does the heated mirror operate?	—	System OK	—
5	Repair the open in CKT 33 (BLK) between the inoperative heated mirror and G105. Does the heated mirror operate?	—	System OK	—

Heated Mirrors Always On

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to the RUN position. 2. Disconnect the heated mirror switch. Did the heated mirrors turn off?	—	Go to *Step 3*	Go to *Step 2*
2	Repair the short to voltage in CKT 142 (ORN) between the heated mirror switch, the left side heated mirror, and the right side heated mirror. Did the heated mirrors turn off?	—	System OK	—
3	Replace the heated mirror switch. Did the heated mirrors turn off?	—	System OK	—

Repair Instructions

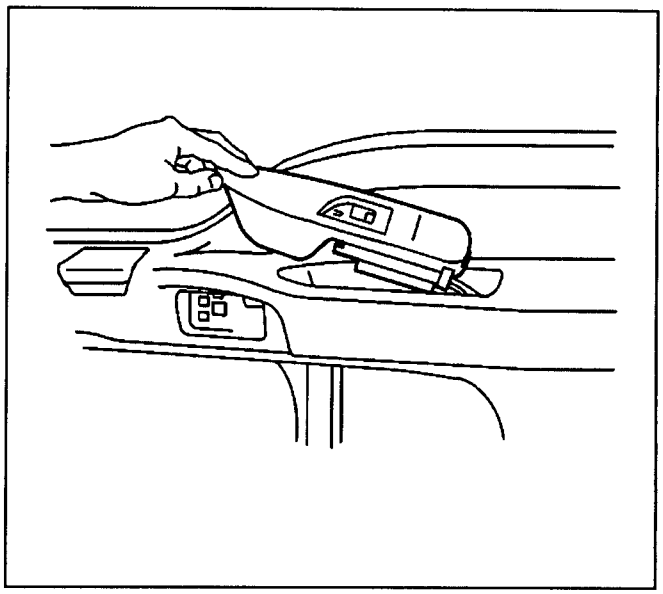
Trim Panel Replacement - Door

Removal Procedure

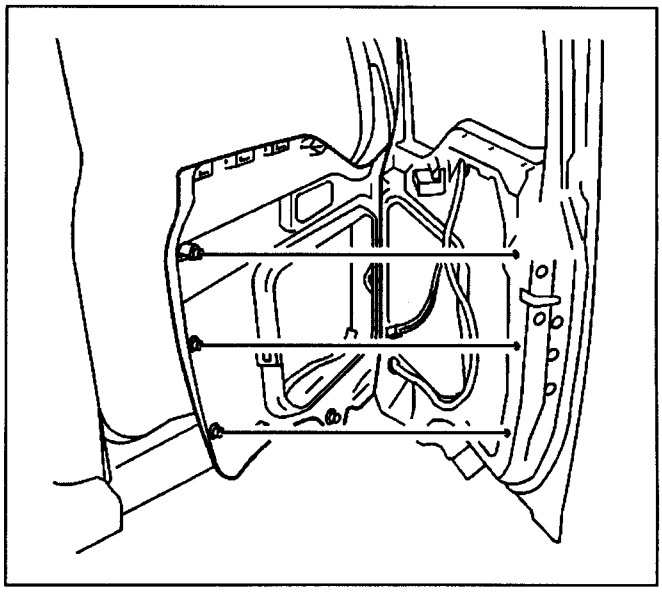
Tools Required

- *J 38778* Trim Panel Retainer Tool
- *J 9886-01* Regulator Handle Tool

1. Remove the window switch.
2. Remove the ash tray.
3. Remove the inside door handle. Refer to *Door Handle Replacement - Inside.*
4. Use the *J 9886-01* in order to remove the regulator handle left side only). Refer to *Window Handle Replacement.*
5. Remove the inner glass and the seal (right side only). Refer to *Window Replacement - Inner Lower.*
6. Use the *J 38778* in order to remove the door trim panel.



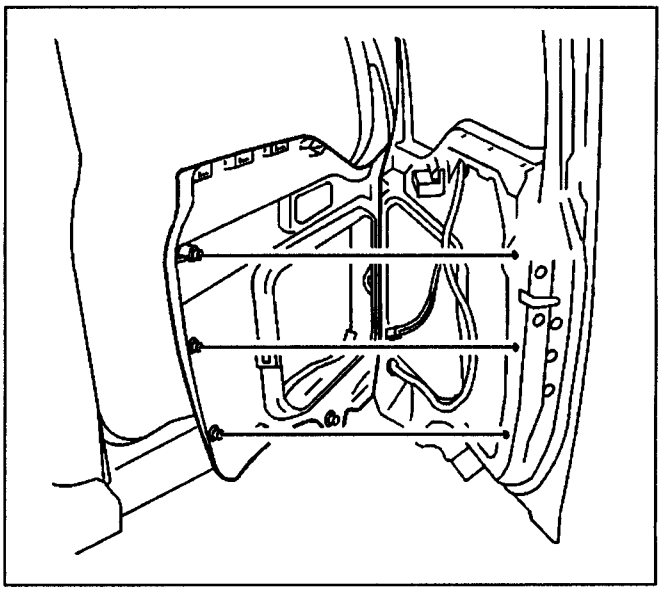
214733



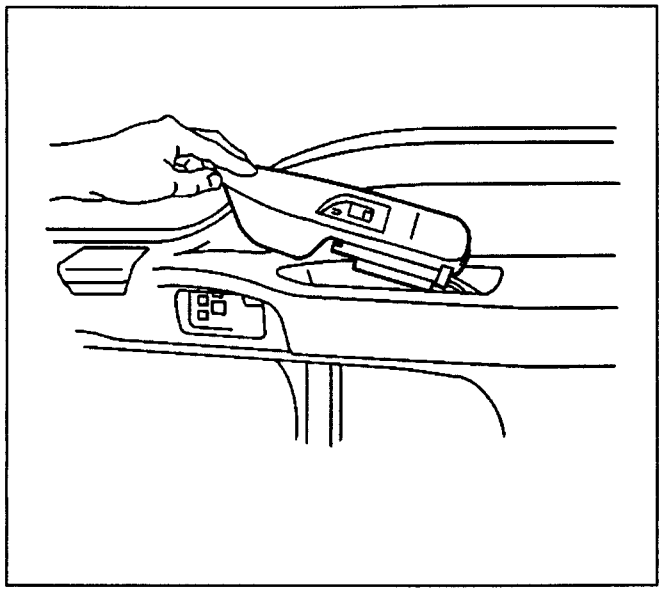
214730

Installation Procedure

1. Install the trim panel to the door.
2. Install the inner glass and the seal. Refer to *Window Replacement - Inner Lower.*
3. Install the regulator handle. Refer to *Window Handle Replacement.*
4. Install the inside door handle. Refer to *Door Handle Replacement - Inside.*
5. Install the ash tray.

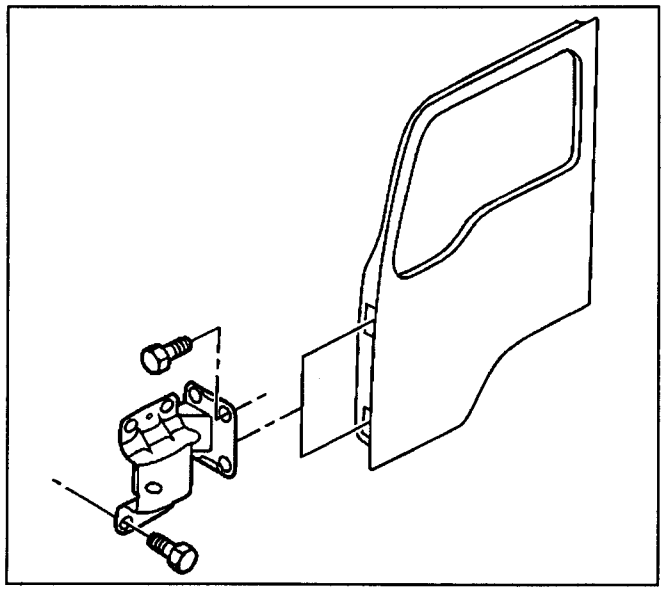


214730



214733

6. Install the window switch.



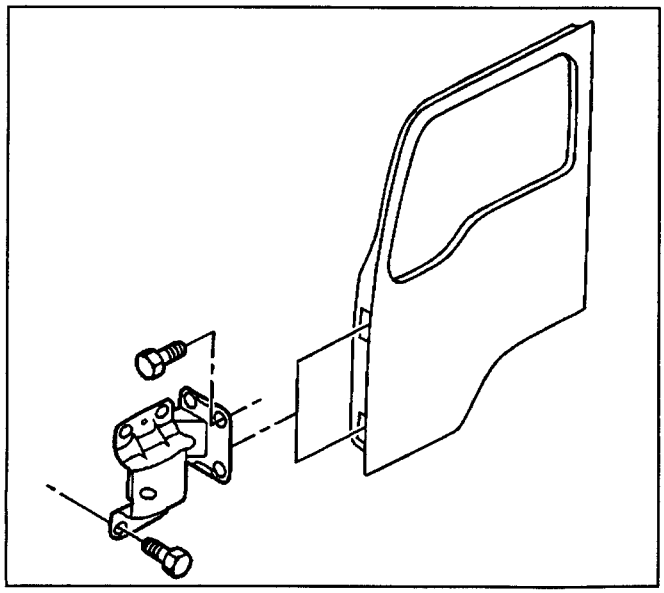
214741

Door Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the harness connectors.
3. Remove the front side panel(s).
4. Mark the location of the existing hinges on the hinge pillar and the door.
5. Remove the bolts from the hinges. Instruct an assistant to hold the door.
6. Remove the door from the vehicle.



214741

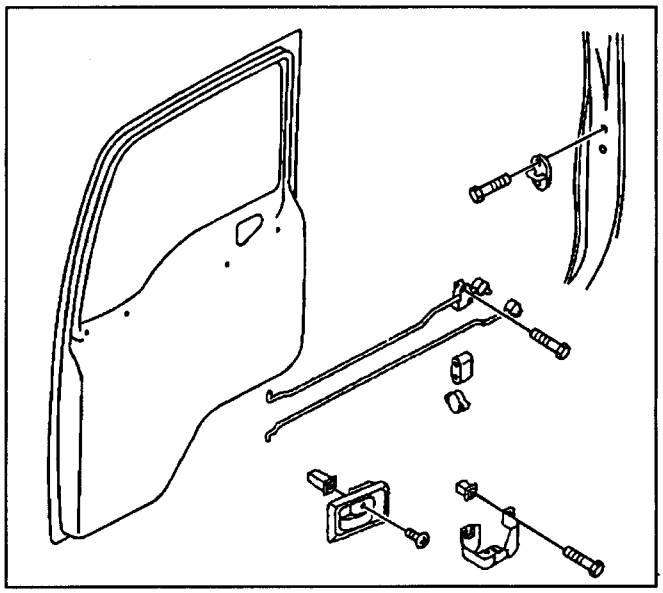
Installation Procedure

1. Install the door to the vehicle.
2. Install the bolts to the hinges.
3. Install the front side panel(s).
4. Connect the harness connectors.
5. Connect the negative battery cable.

Door Handle Replacement - Outside

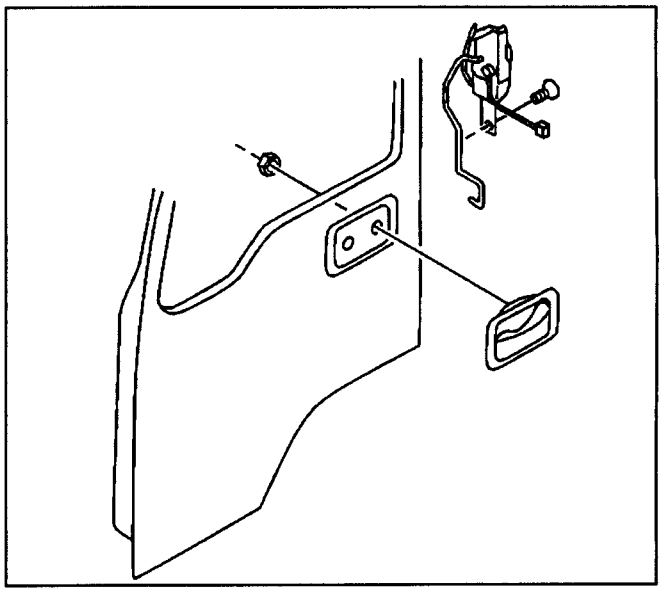
Removal Procedure

1. Remove the door trim panel. Refer to *Trim Panel Replacement - Door.*
2. Remove the water deflector.
3. Remove the lock rod from the handle.



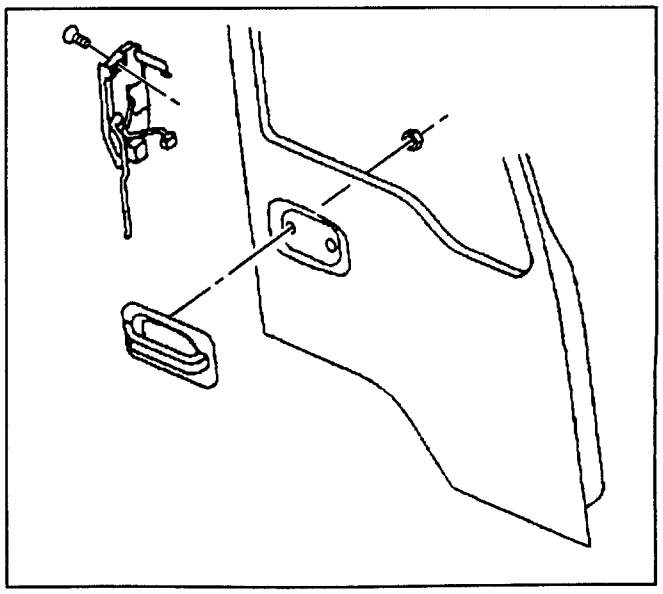
214714

4. Remove the left door handle.

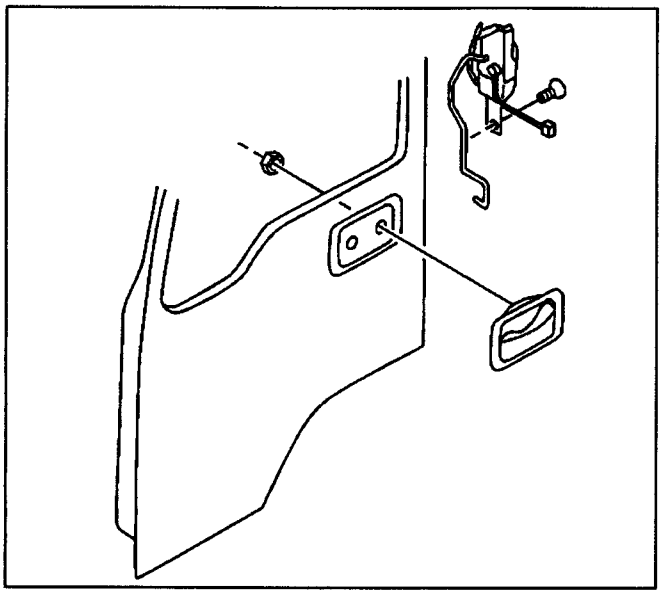


214717

5. Remove the right door handle.



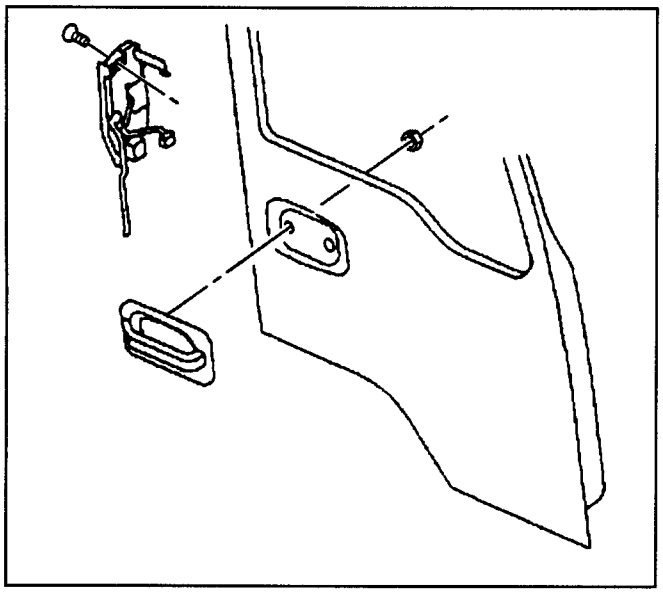
214716



214717

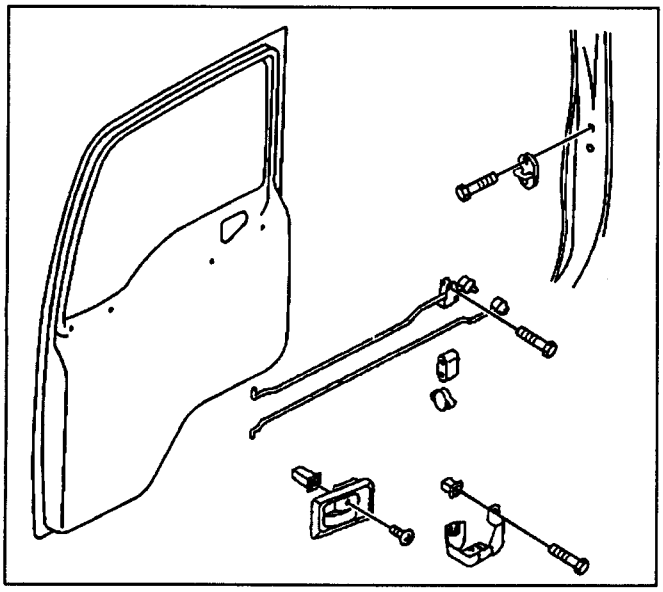
Installation Procedure

1. Install the left door handle.



214716

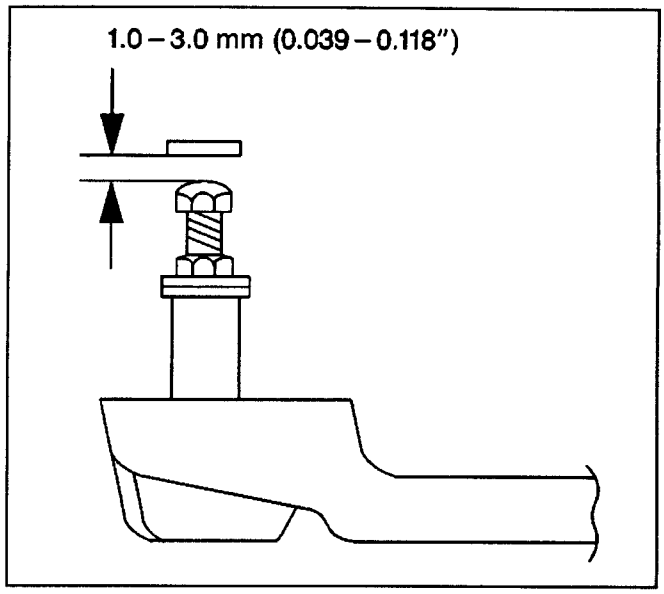
2. Install the right door handle.



214714

3. Install the lock rod to the handle.

4. Adjust the handle adjusting screw-to-lock clearance to 1.0–3.0 mm (0.039–0.118 in).
5. Install the water deflector.
6. Install the trim panel. Refer to *Trim Panel Replacement - Door.*

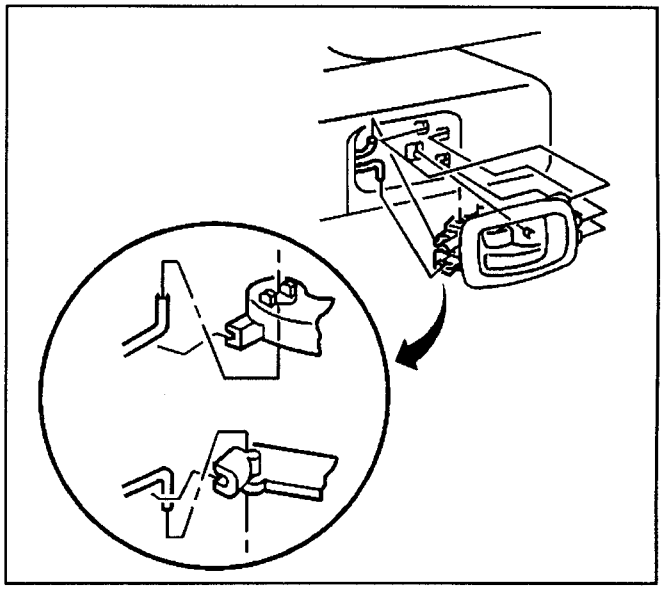


214712

Door Handle Replacement - Inside

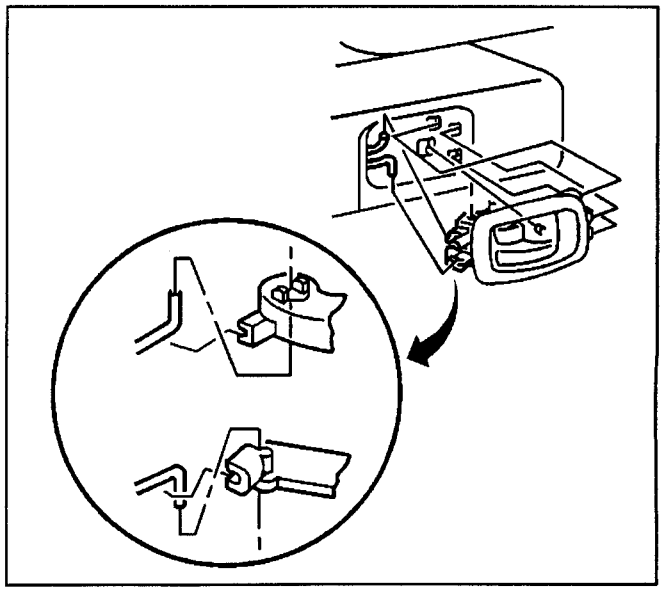
Removal Procedure

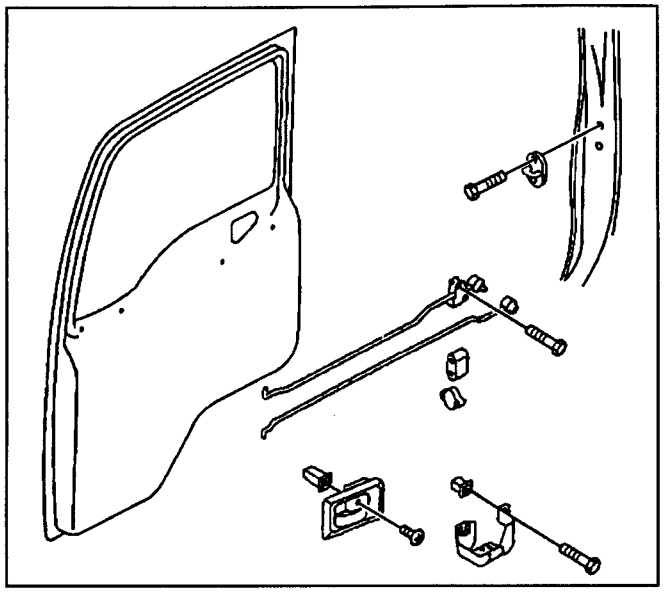
1. Remove the screw from the handle.
2. Disconnect the lock rods from the handle.
3. Remove the inner door handle.


214735

Installation Procedure

1. Install the inner door handle.
2. Connect the lock rods to the handle.
3. Install the screw to the handle.


214735

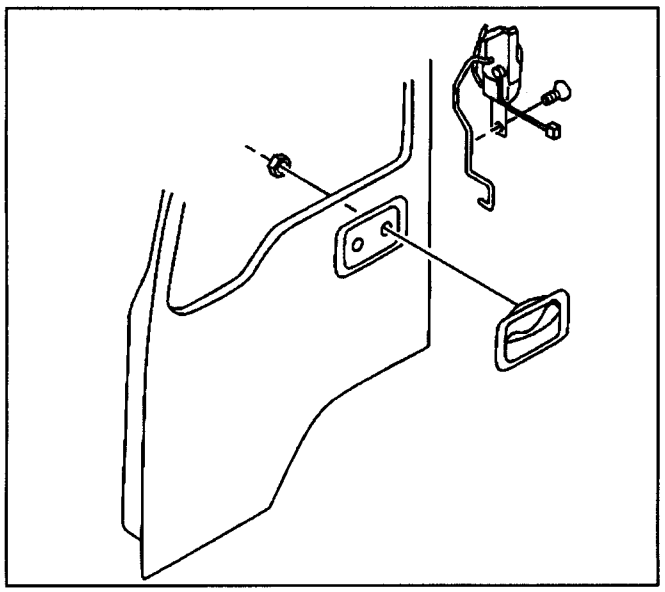


214714

Lock Replacement - Door

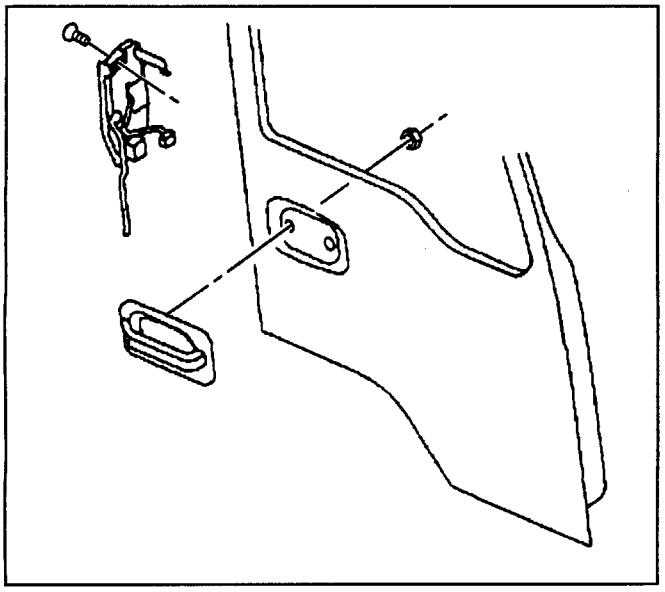
Removal Procedure

1. Remove the trim panel. Refer to *Trim Panel Replacement - Door.*
2. Remove the water deflector.
3. Remove the door window. Refer to *Window Replacement - Door.*
4. Remove the window regulator and the motor. Refer to *Window Regulator Replacement (Left Side)* or *Window Regulator Replacement (Right Side).*
5. Remove the lock rods from the lock.



214717

6. Remove the lock from the left door.

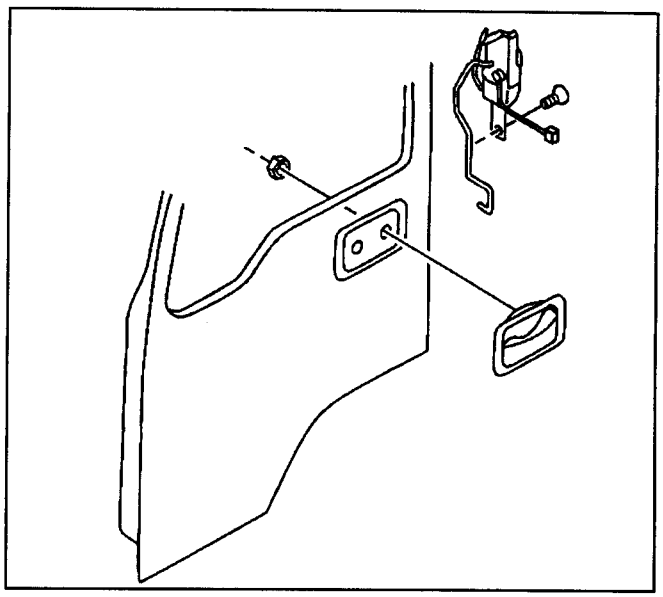


214716

7. Remove the lock from the right door.

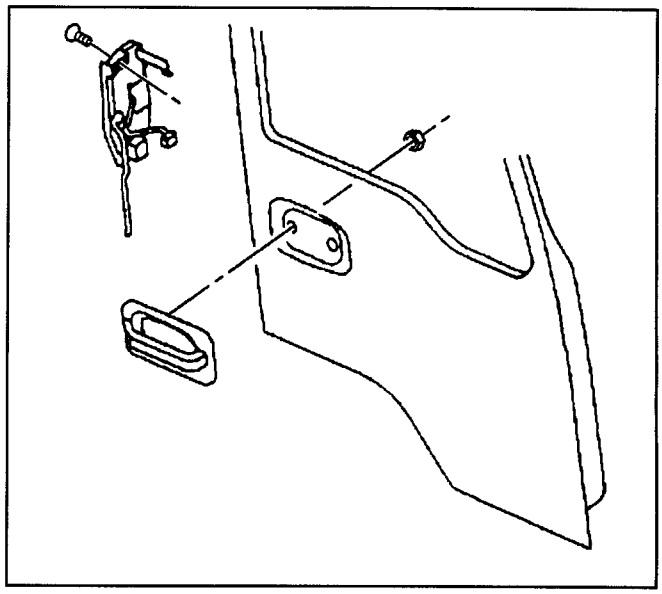
Installation Procedure

1. Install the lock to the left door.



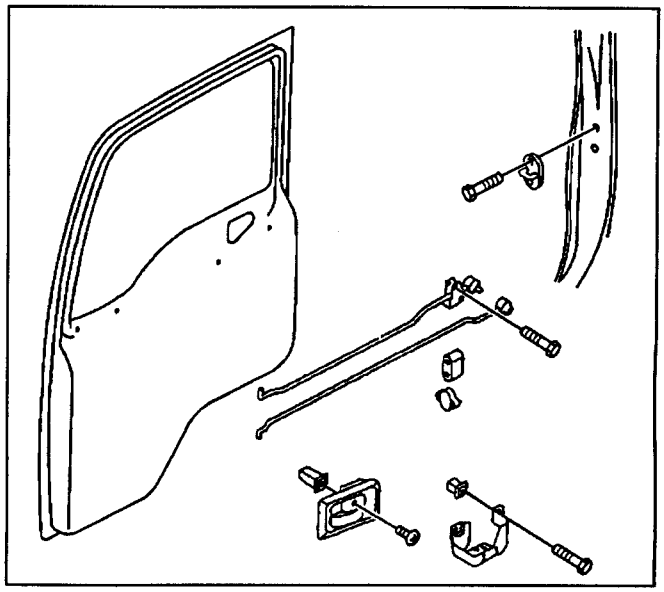
214717

2. Install the lock to the right door.

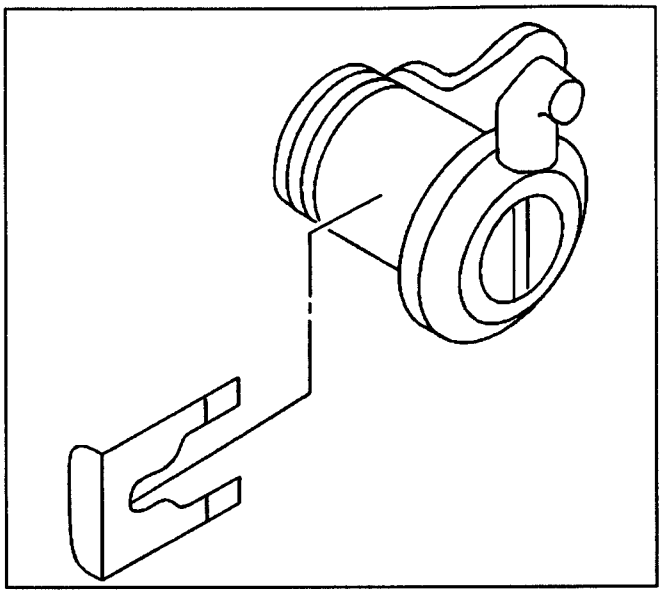


214716

3. Install the lock rods to the lock.
4. Install the window regulator. Refer to *Window Regulator Replacement (Left Side)* or *Window Regulator Replacement (Right Side).*
5. Install the door window. Refer to *Window Replacement - Door.*
6. Install the water deflector.
7. Install the trim panel. Refer to *Trim Panel Replacement - Door.*



214714

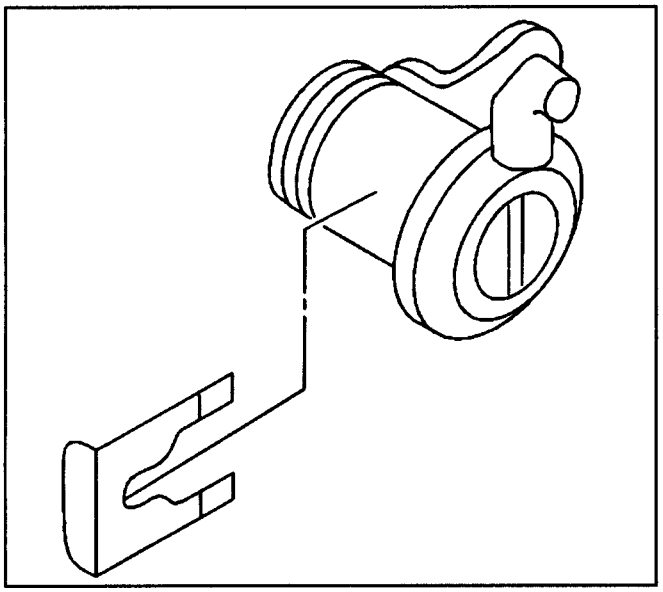


214721

Lock Cylinder Replacement - Door

Removal Procedure

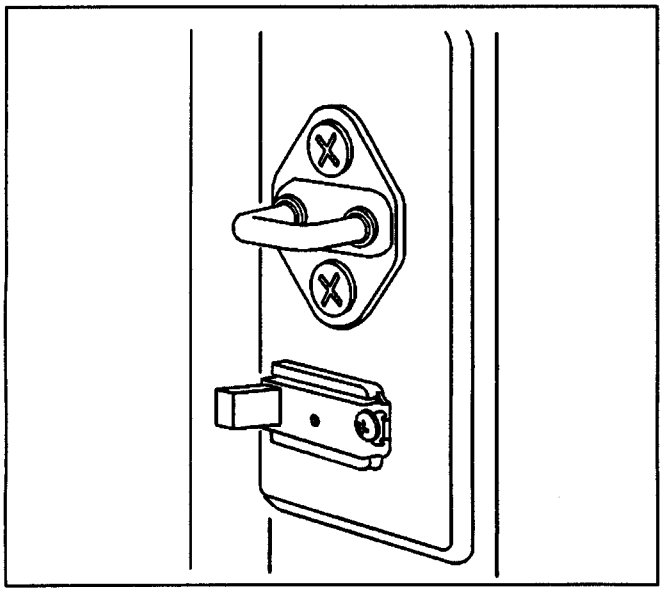
1. Remove the trim panel. Refer to *Trim Panel Replacement - Door.*
2. Remove the water deflector.
3. Remove the lock rod from the cylinder.
4. Remove the retaining clip from the cylinder.



214721

Installation Procedure

1. Install the retaining clip to the cylinder.
2. Install the lock rod to the cylinder.
3. Install the water deflector.
4. Install the trim panel. Refer to *Trim Panel Replacement - Door.*



214738

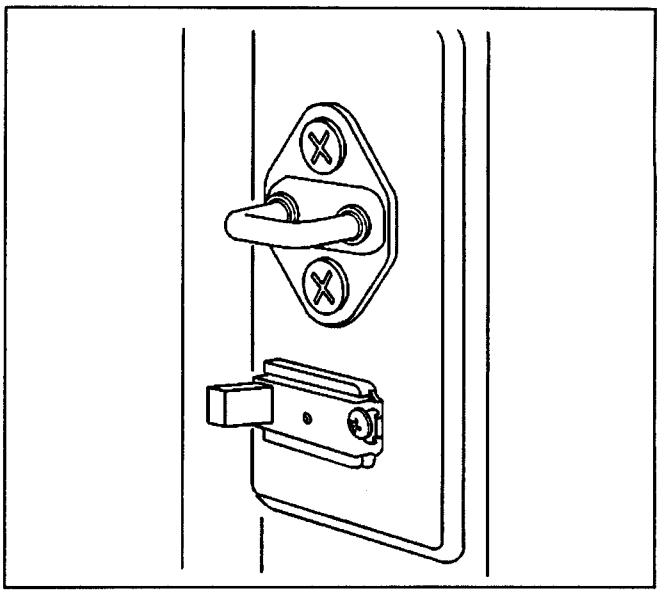
Striker Replacement - Door

Removal Procedure

1. Mark the position of the striker on the door pillar.
2. Remove the striker bolts.
3. Remove the striker from the door pillar.

Installation Procedure

1. Install the striker to the door pillar.
2. Install the striker bolts.

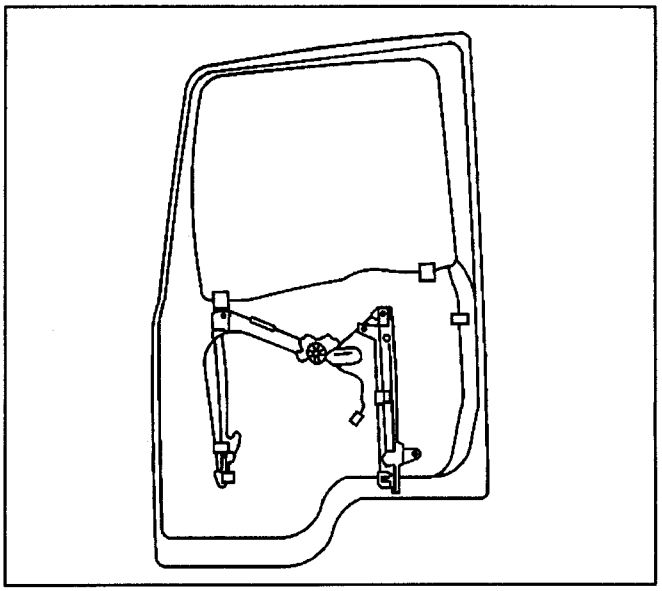


214738

Window Regulator Replacement (Right Side)

Removal Procedure

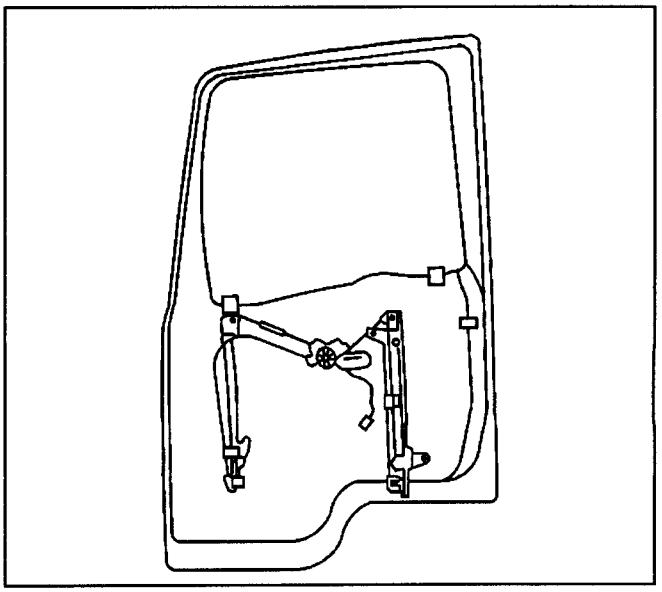
1. Remove the lower inner window. Refer to *Window Replacement - Inner Lower.*
2. Remove the trim panel. Refer to *Trim Panel Replacement - Door.*
3. Remove the water deflector.
4. Remove the door window. Refer to *Window Replacement - Door.*
5. Remove the window regulator assembly.



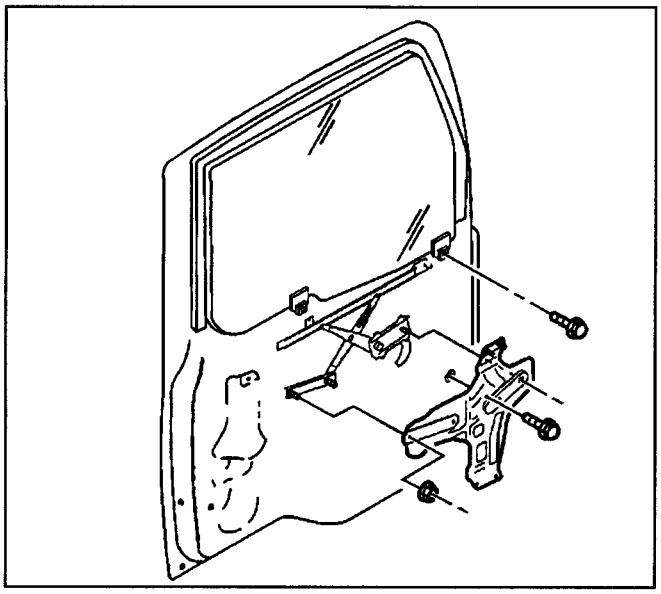
214706

Installation Procedure

1. Install the window regulator assembly.
2. Install the door window. Refer to *Window Replacement - Door.*
3. Install the water deflector.
4. Install the trim panel. Refer to *Trim Panel Replacement - Door.*
5. Install the lower inner window. Refer to *Window Replacement - Inner Lower.*



214706

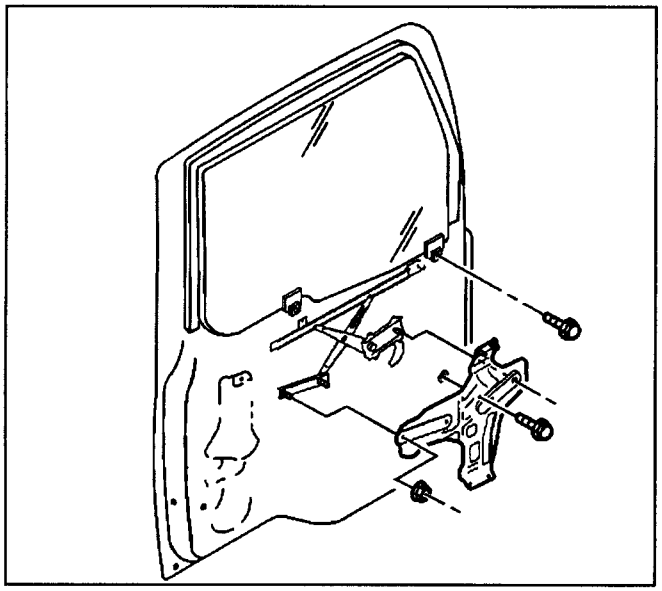


214708

Window Regulator Replacement (Left Side)

Removal Procedure

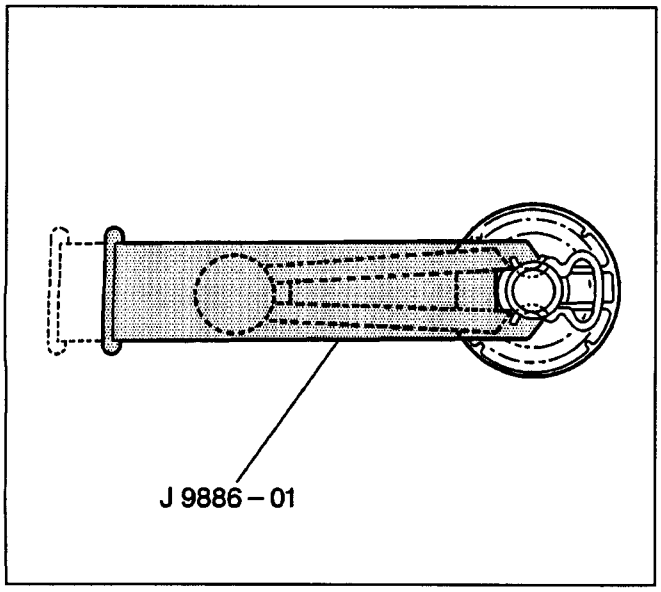
1. Remove the trim panel. Refer to *Trim Panel Replacement - Door.*
2. Remove the water deflector.
3. Remove the door window. Refer to *Window Replacement - Door.*
4. Remove the window regulator assembly.



214708

Installation Procedure

1. Install the window regulator assembly.
2. Install the door window. Refer to *Window Replacement - Door.*
3. Install the water deflector.
4. Install the trim panel. Refer to *Trim Panel Replacement - Door.*



5087

Window Handle Replacement

Removal Procedure

Tools Required

J 9886-01 Regulator Handle Tool

1. Remove the window regulator handle.
2. Insert the *J 9886-01* between the handle and the bearing plate.
3. Align the *J 9886-01* parallel with the handle. Push in the *J 9886-01* in order to disengage the clip.
4. Pull the handle from the door.
5. Remove the bearing plate.

Installation Procedure

1. Install the bearing plate to the trim panel.
2. Install the window regulator handle.
3. Raise the window.
4. Push the clip onto the handle.

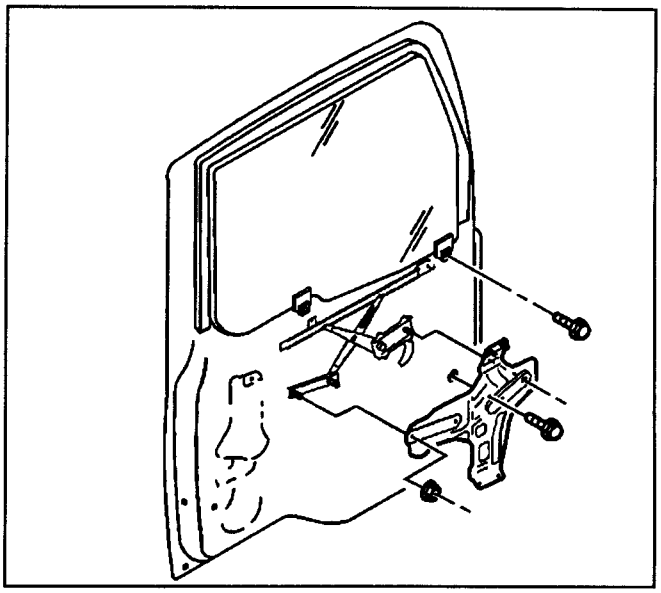
5. Insert the handle onto the regulator shaft. Ensure that the handle is horizontal with the knob pointing toward the front of the door.
6. Push the handle until the clip engages the window regulator shaft.

Window Replacement - Door

Removal Procedure

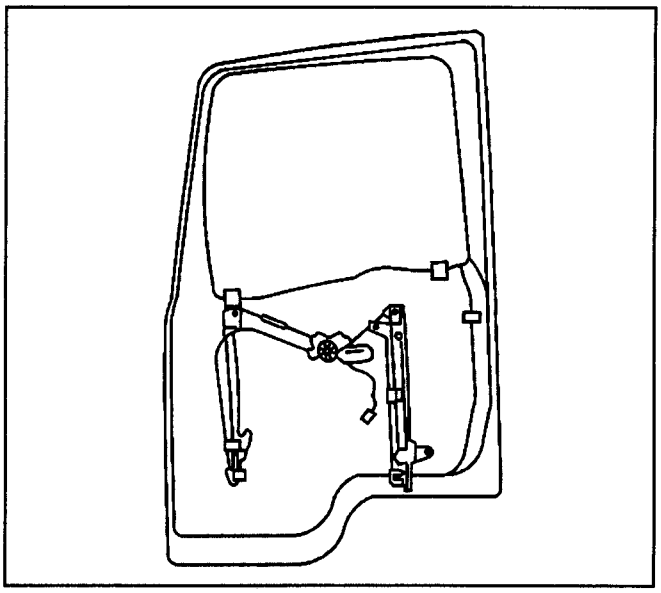
Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

1. Remove the trim panel. Refer to *Trim Panel Replacement - Door.*
2. Remove the water deflector.
3. Remove the front run channel. Refer to *Window Run Channel Replacement.*
4. Remove the rear run channel. Refer to *Window Run Channel Replacement.*
5. Remove the window from the window regulator (left side).

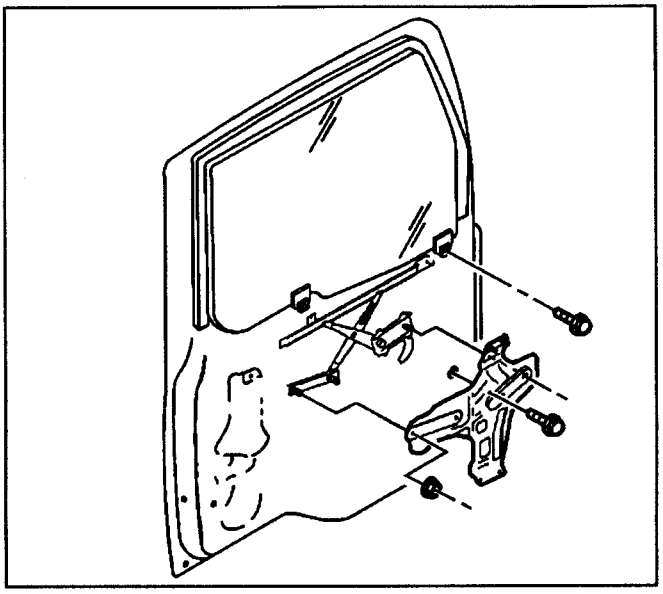


214708

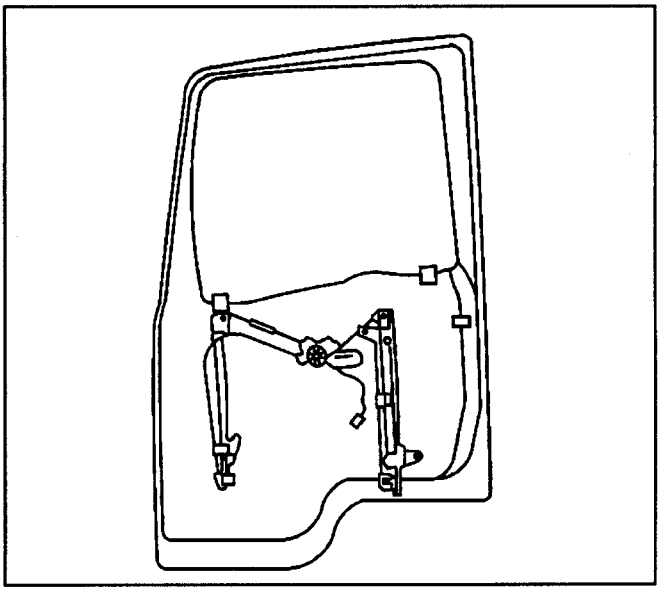
6. Remove the window from the window regulator (right side).



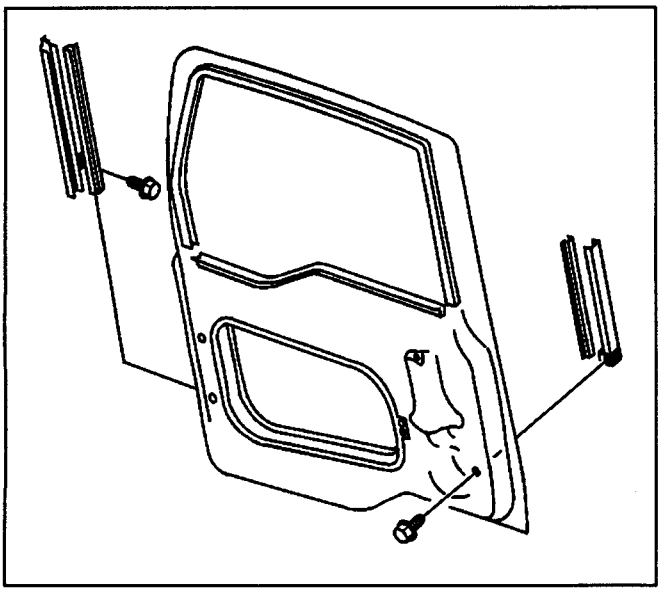
214706



214708



214706



214703

Installation Procedure

1. Install the window to the window regulator (left side).
2. Install the window to the window regulator (right side).
3. Install the rear run channel. Refer to *Window Run Channel Replacement.*
4. Install the front run channel. Refer to *Window Run Channel Replacement.*
5. Install the water deflector.
6. Install the trim panel. Refer to *Trim Panel Replacement - Door.*

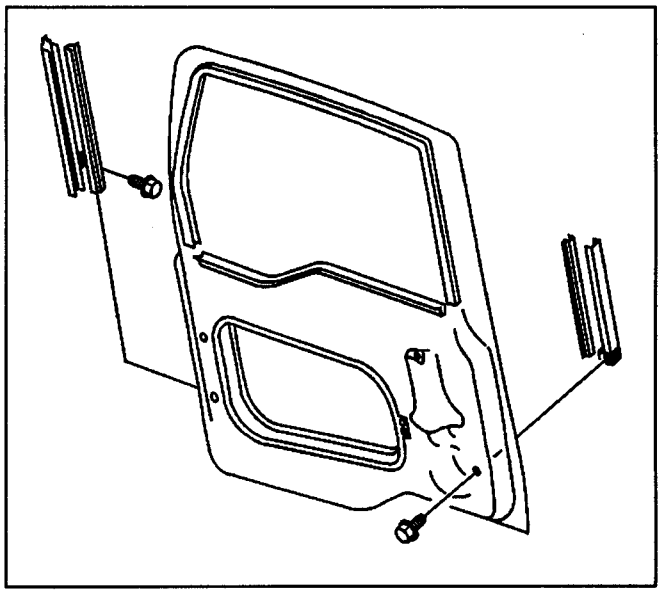
Window Run Channel Replacement

Removal Procedure

1. Remove the trim panel. Refer to *Trim Panel Replacement - Door.*
2. Remove the water deflector.
3. Remove the run channel(s) from the door.

Installation Procedure

1. Install the run channel(s) to the door.
2. Install the water deflector.
3. Install the trim panel. Refer to *Trim Panel Replacement - Door.*



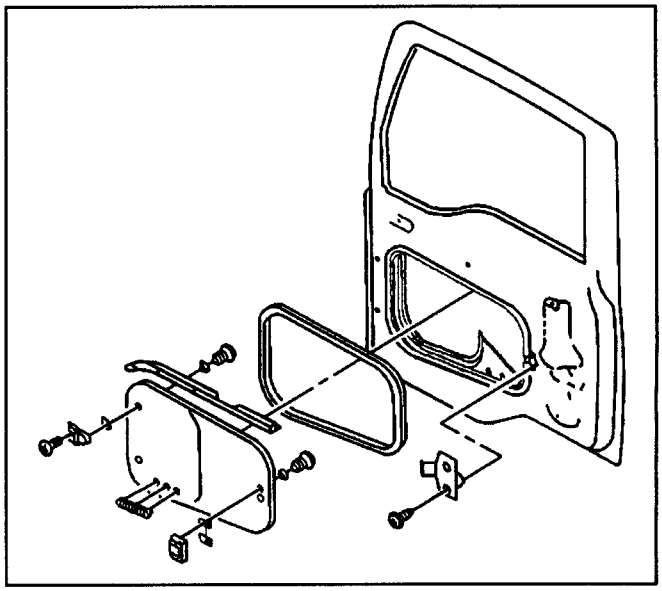
214703

Window Replacement - Inner Lower

Removal Procedure

Caution: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

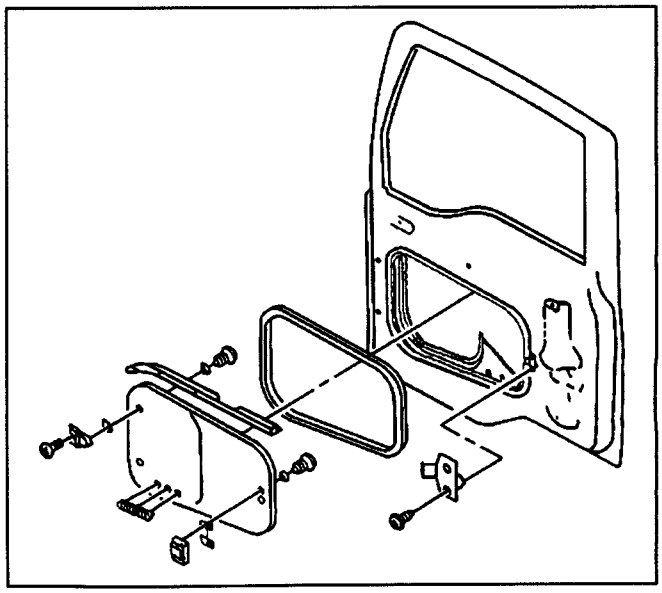
1. Open the window.
2. Remove the screws from the upper and the lower hinges.
3. Remove the window seal.



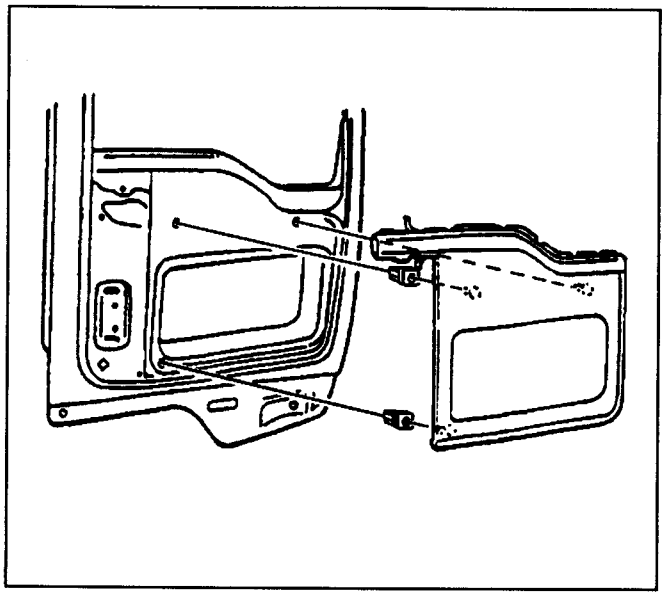
214734

Installation Procedure

1. Install the window seal.
2. Install the screws to the upper and the lower hinges.
3. Close the window.



214734



214724

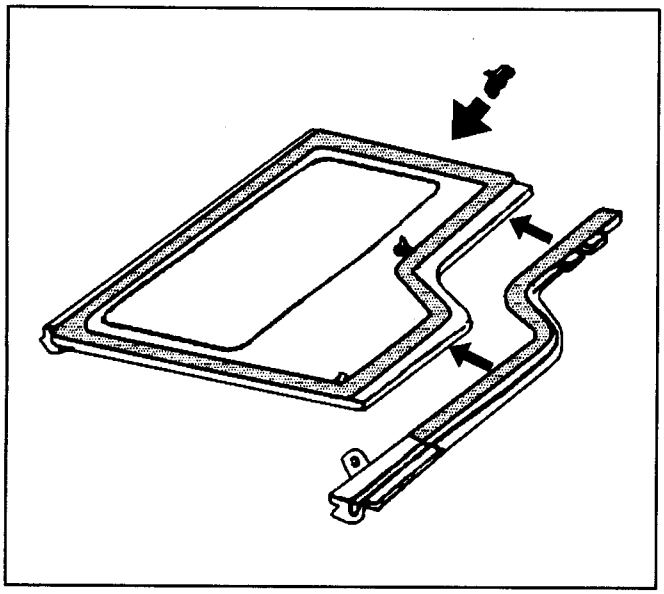
Window Replacement - Outer Lower

Removal Procedure

Tools Required
J 36020 Windshield Remover

Caution: If a window is cracked but still intact, it should be crisscrossed with masking tape in order to reduce the risk of damage or personal injury.

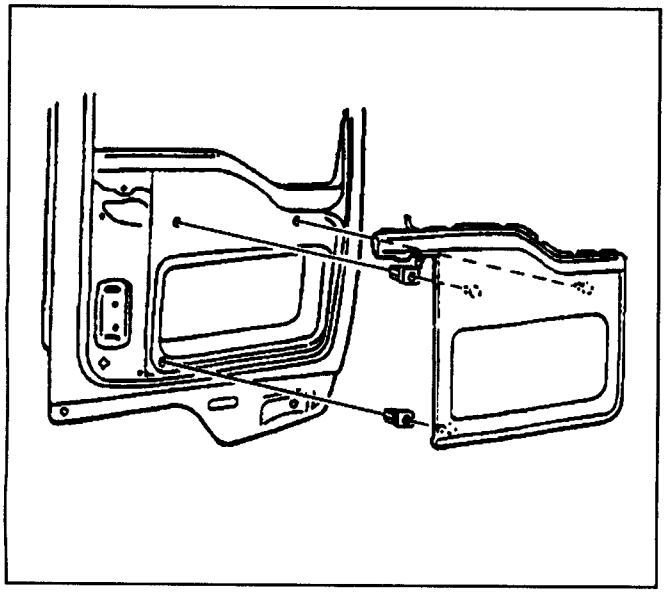
1. Use the *J 36020* in order to pass the wire through the adhesive of the door glass toward the inside of the cab.
2. Push and pull the wire alternately in order to cut off the adhesive all around the glass.
   Do not damage the locating pins or the retaining pins.
3. Clean the door and the glass mating surfaces.



214726

Installation Procedure

1. Apply primer to the glass and the door panel as shown to the areas indicated.
   Allow the primer to dry for at least 3 minutes.
2. Install the molding to the outer glass.
3. Apply adhesive to the glass and the molding as shown to the areas indicated.
   Ensure that the adhesive is an even and continuous bead.



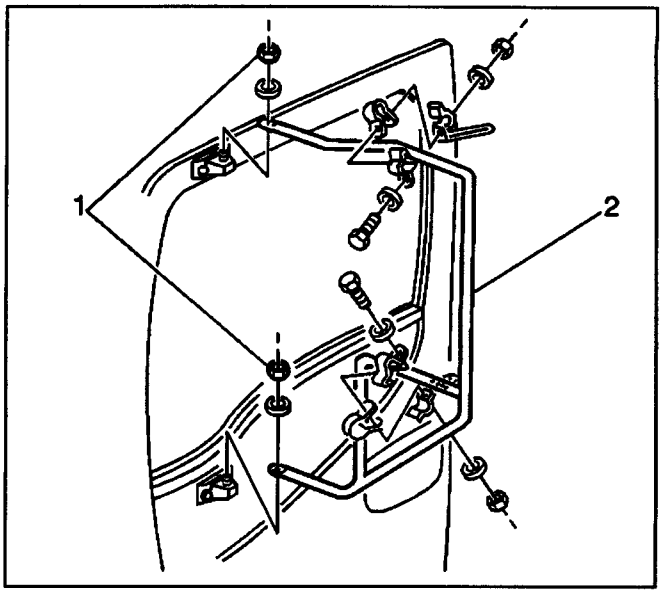
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4. Install the glass to the door panel.

Mirror Replacement

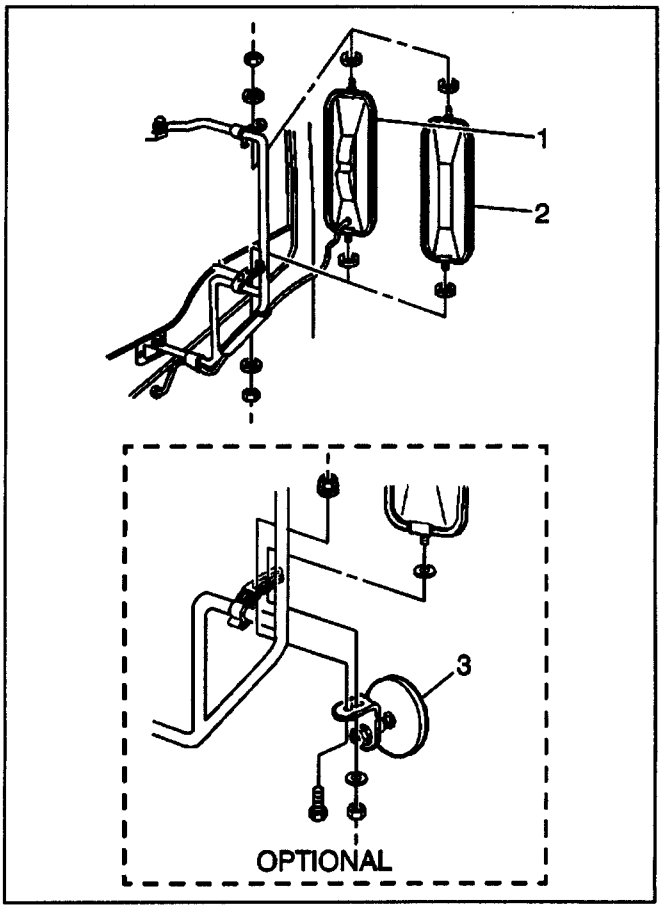
Removal Procedure

1. Disconnect the electrical connector, if equipped with a lighted or a heated mirror.
2. Remove the two nuts (1) holding the mirror brace (2) to the door.

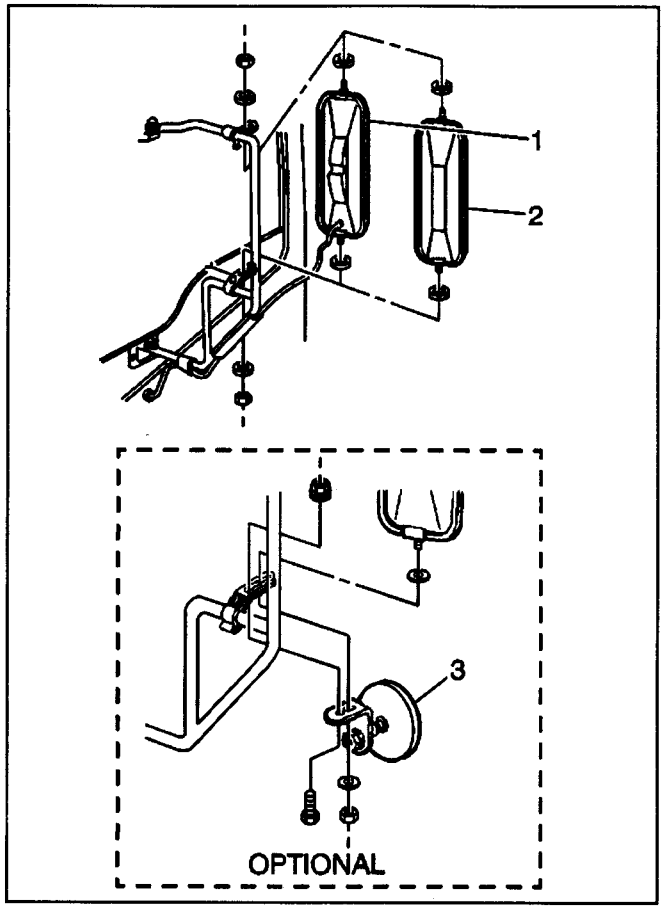


214701

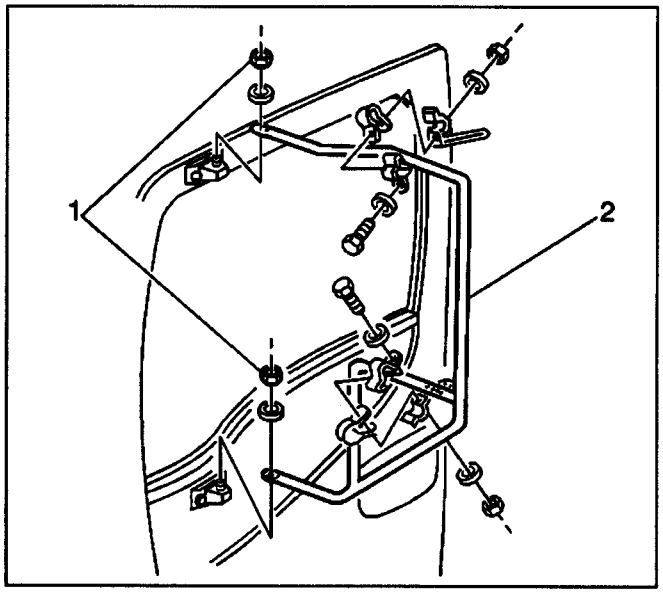
3. Remove the mirror assembly (2) or the lighted or the heated mirror assembly (1), if equipped.
4. Remove the spot mirror (3), if equipped.



214696



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Installation Procedure

1. Install the spot mirror (3), if equipped.
2. Install the mirror assembly (2) or the lighted or the heated mirror assembly (1), if equipped, to the door.
3. Install the two mounting nuts (1) to the brace (2).
4. Connect the electrical connector, if equipped with a lighted or a heated mirror.

Description and Operation

Power Windows Circuit Description

With the ignition switch in either the RUN or START position, the voltage is applied to both the power window switch through the closed contacts of relay When you press the right hand power window switch to the UP position, voltage is applied to one side of the motor through the now closed UP contacts of the switch, and the other side of the motor connects to G105 through the now closed DOWN contacts of the switch. This causes the motor to turn and raise the window. When the switch is released, the contacts return to their neutral state and nothing happens. When you press the right hand power window switch to the down position, voltage is now applied to one side of the motor through the now closed DOWN contact and the other side of the motor is connected to G105 through the now closed UP contact. This causes the motor to turn in the opposite direction which causes the window to go down.

The operation of the driver's right hand power window switch is similar to the right power window switch with the exception that the motor and ground leads of this switch are connected to the motor and G205 through the right hand power window switch. In all other ways the operation of the switches are the same.

Heated Mirror Circuit Description

Voltage is applied through circuit breaker No. 22 to the heated mirror switch when the ignition switch is in RUN position. When the switch is pressed, the switch closes, allowing voltage to be applied to the left side heated mirror, the right side heated mirror, and the heated mirror switch indicator. Since both of the heated mirrors are separately permanently grounded at G105, the heater element begins to warm. Since the indicator is permanently grounded through the joint connector No.1, the indicator will light. The heaters and indicator will remain energized until either the ignition switch is turned out of the RUN position or the heated mirror switch is moved to the OFF position.

Special Tools and Equipment

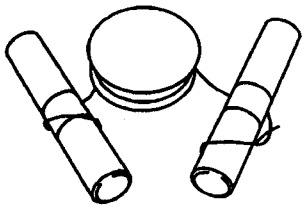
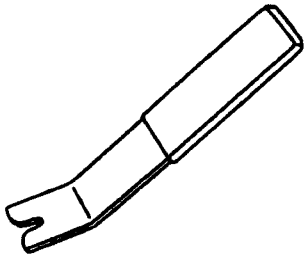
Illustration	Tool Number/ Description
 255345	J 9886-01 Regulator Handle Tool
 204460	J 36020 Windshield Remover

Illustration	Tool Number/ Description
 178589	J 38778 Door Trim Pad and Garnish Clip Remover

Seats

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Control Module Bolt	2.5 N.m	22 lb in
Center Seat Bolt	15 N.m	12 lb ft
Center Seat Nut	15 N.m	12 lb ft
Driver or Passenger Seat Nut	15 N.m	12 lb ft
Seat Riser Bolt	8 N.m	71 lb in
Seat Riser Cover Bolt	8 N.m	71 lb in
Seat Riser Nut	31 N.m	23 lb ft
Speedo Adapter Assembly Bolt	2.5 N.m	22 lb in

Diagnostic Information and Procedures

Seat - Manual Adjuster Does Not Unlock

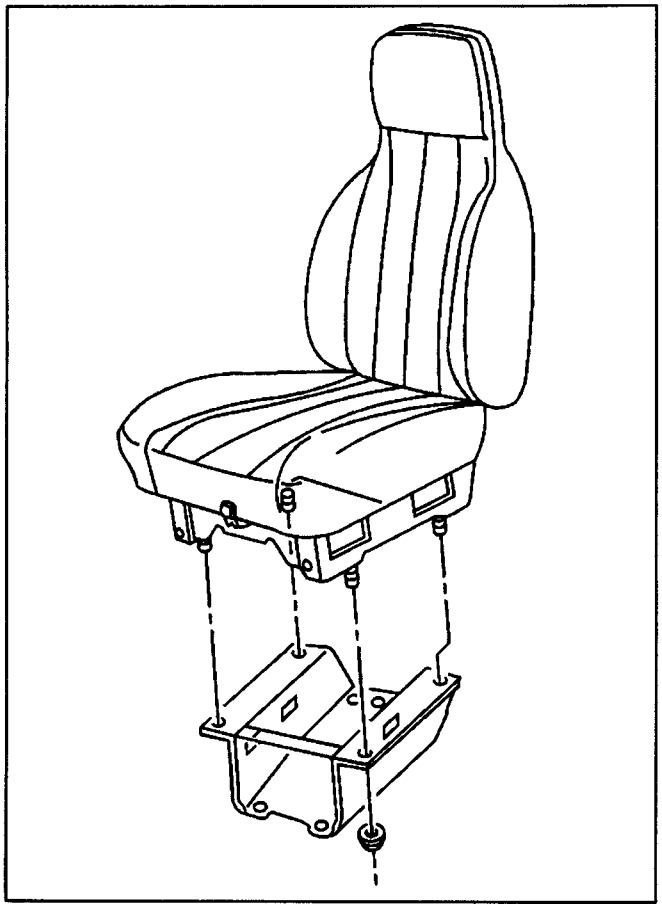
Problem	Action
The locking wire is too loose.	Tighten the locking wire.
The locking wire is disconnected or broken.	Repair or replace the locking wire.
The adjuster lock bar is sticking or binding.	Lubricate the lock bar pivot.

Seat - Manual Adjuster Between Lock Positions

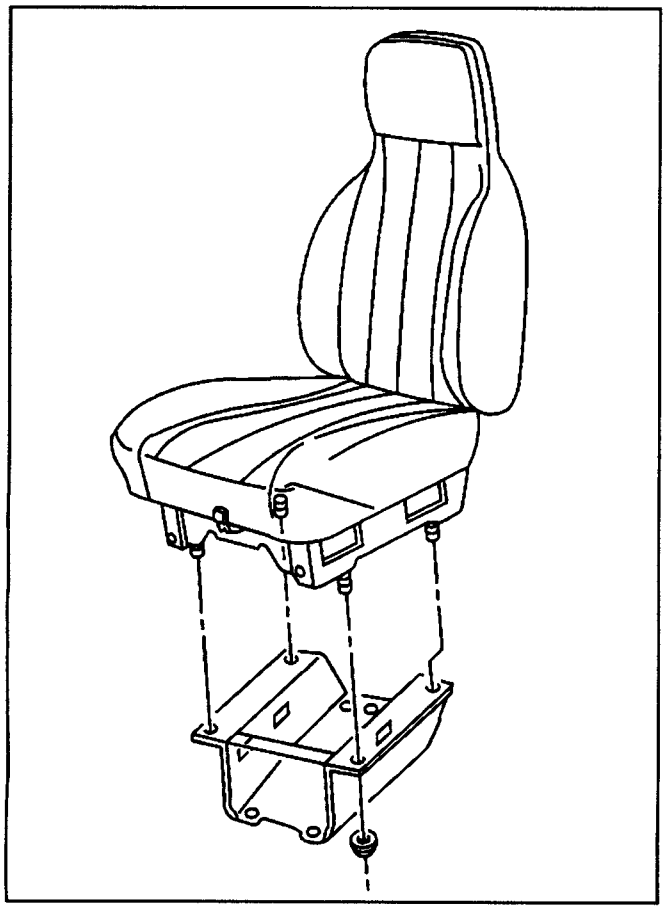
Problem	Action
Adjusters misaligned.	Align the adjusters.
Adjusters new, not broken in.	Operate the seat to the fully forward and fully rearward positions several times in order to work the tightness out of the channels.
Adjuster(s) improperly lubricated.	Lubricate the adjuster channels.
Adjuster(s) bent or damaged.	Replace the adjuster(s).
Adjusters binding or damaged.	Lubricate or replace the adjusters.
Seat components loose, damaged, or broken.	Repair or replace the seat.
Seat mounting bolts loose.	Tighten the mounting bolts to specifications. Refer to *Fastener Tightening Specifications*.

Seat - Manual Adjuster Does Not Lock

Problem	Action
Locking wire too tight.	Loosen the locking wire.
Adjuster lock bar spring disconnected or broken.	Repair or replace the spring.
Adjuster lock bar sticking or binding.	Lubricate the lock bar pivot or replace the adjuster.



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Repair Instructions

Seat Replacement

Removal Procedure

1. Remove the seat nuts.
2. Remove the seat.

Installation Procedure

1. Install the seat.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the driver or passenger seat nuts.

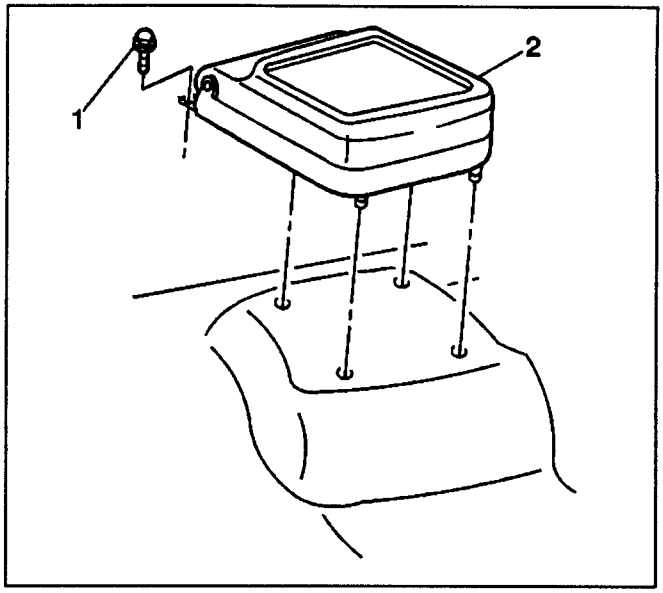
   Tighten

   Tighten the driver or passenger seat nuts to 15 N·m (12 lb ft).

Seat Replacement - Center

Removal Procedure

1. Tilt the cab forward. Refer to *Cab Tilting* in General Information.
2. Remove the seat nuts.
3. Lower the cab.
4. Lift the floor covering upward.
5. Remove the seat bolts (1).
6. Remove the center seat (2).



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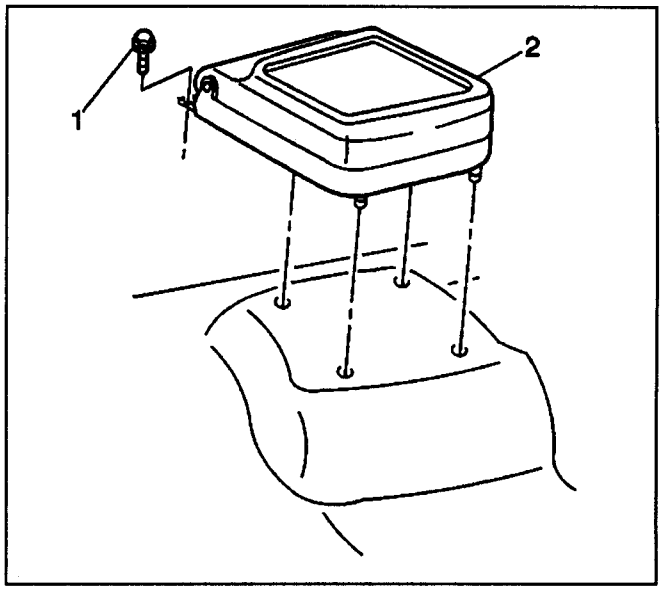
Installation Procedure

1. Install the center seat (2).

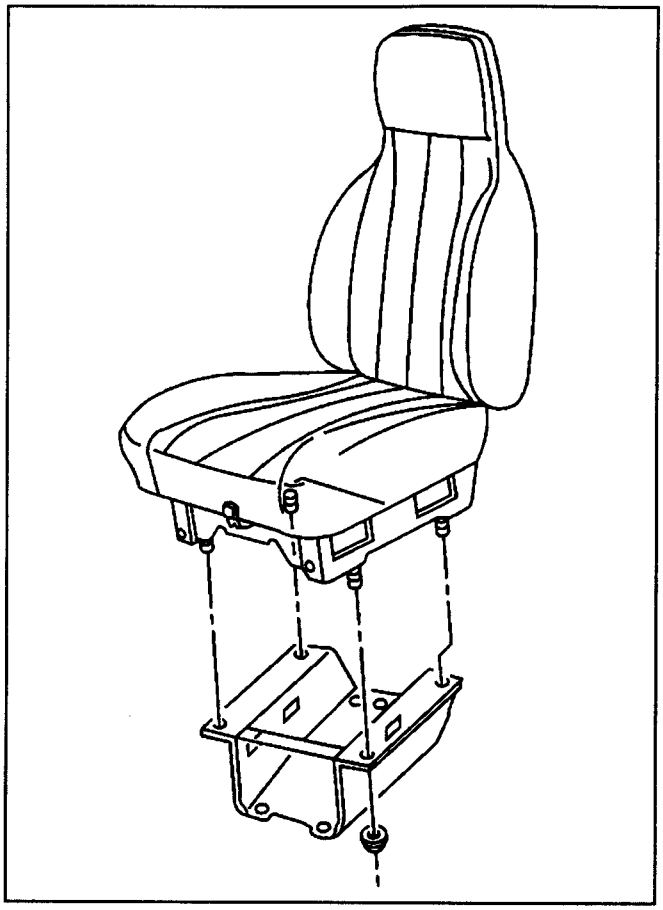
   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the seat bolts (1).
3. Tilt the cab forward.
4. Install the seat nuts.
5. Lower the cab. Refer to *Cab Tilting* in General Information.

   Tighten

   - Tighten the center seat nuts to 15 N·m (12 lb ft).
   - Tighten the seat bolts to 15 N·m (12 lb ft).



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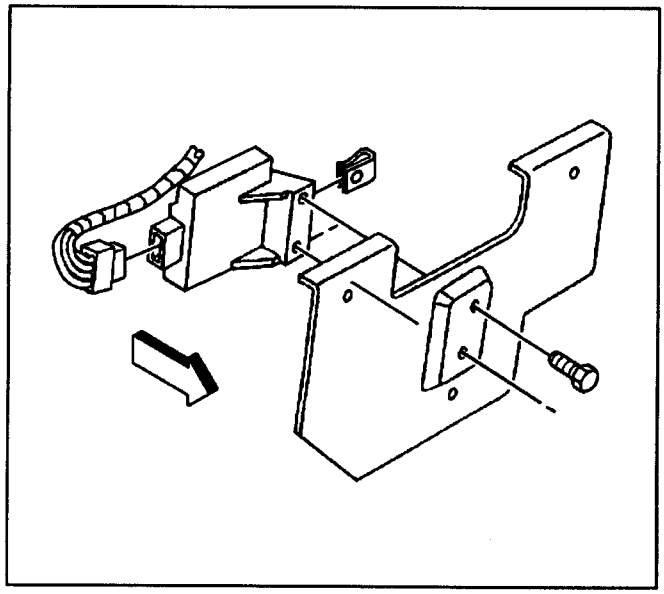


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Seat Riser Replacement (Passenger)

Removal Procedure

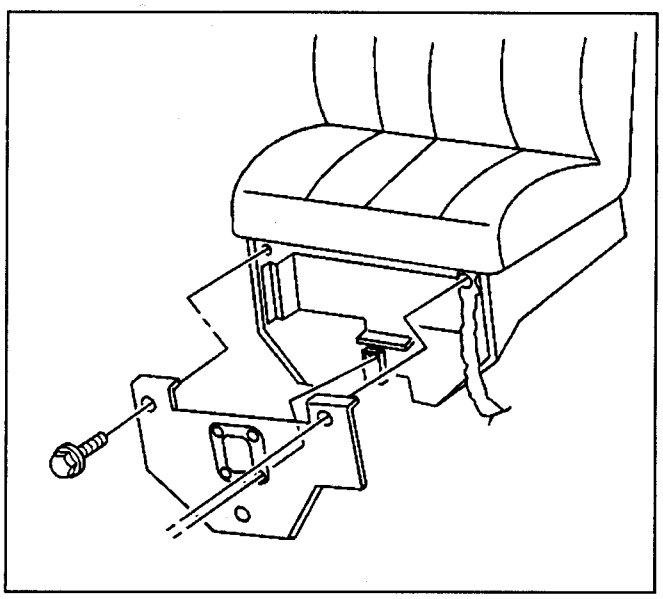
1. Remove the seat nuts.
2. Remove the passenger seat.



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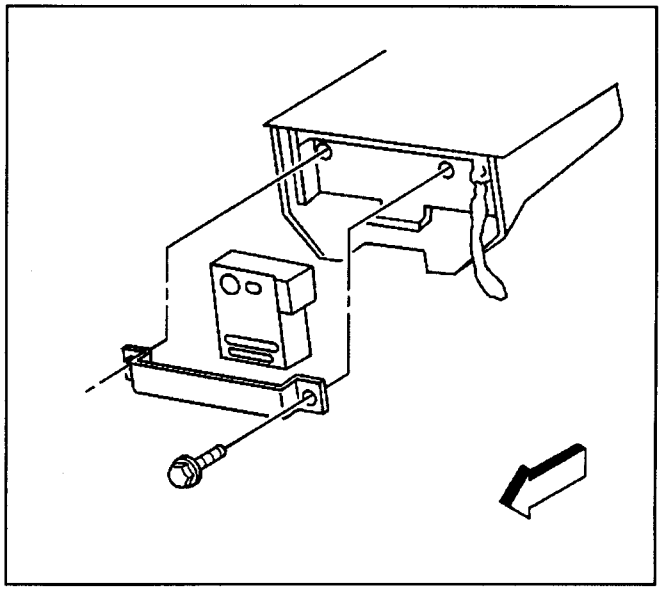
3. Remove the speedo adapter bolts.

4. Remove the riser cover bolts.
5. Remove the riser cover.



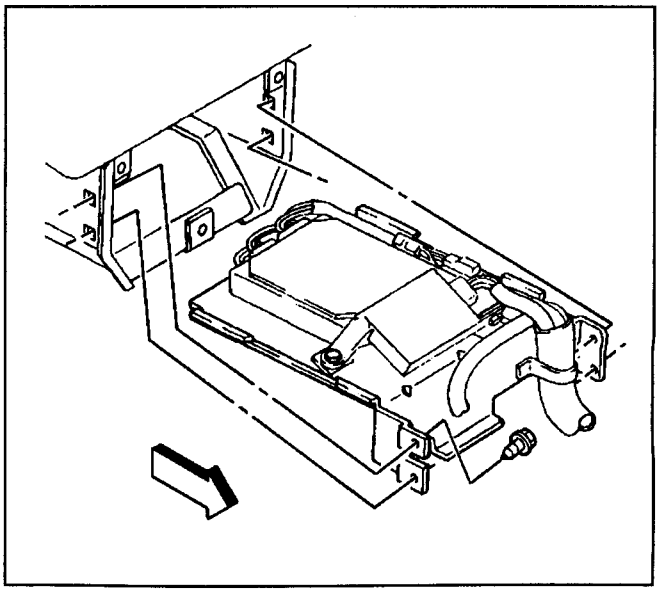
214550

6. Remove the brake control module bracket bolts.
7. Remove the brake control module bracket.

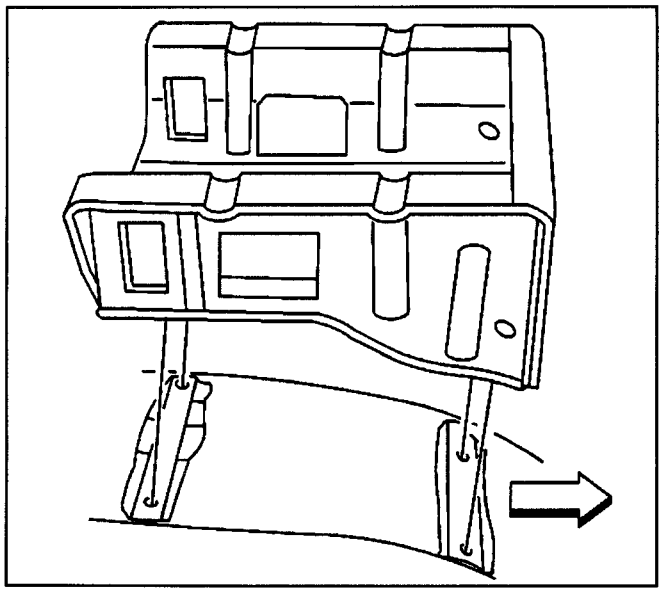


214553

8. Remove the mount bracket assembly bolts.
9. Carefully slide the mount bracket assembly forward.
10. Lift the floor covering upward.
11. Remove the riser nuts.
12. Lift the floor covering upward.
13. Remove the riser bolts.

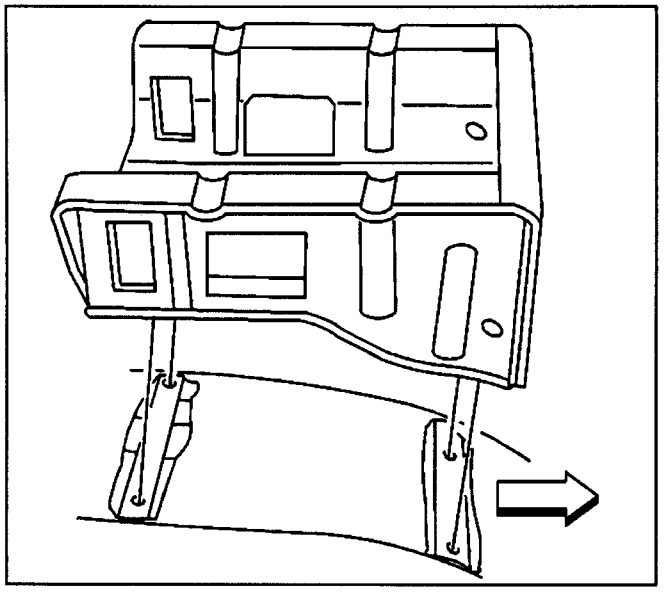


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14. Remove the riser.



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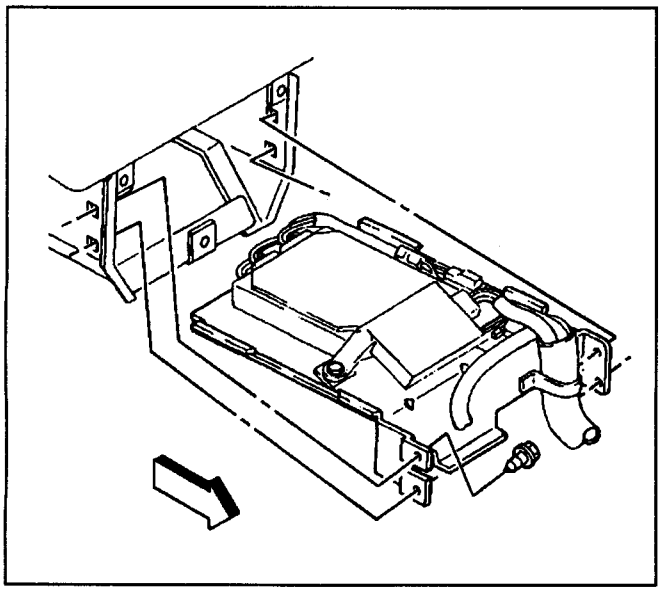
Installation Procedure

1. Install the riser.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the riser bolts.
3. Install the riser nuts.

   Tighten

   - Tighten the riser bolts to 31 N·m (23 lb ft).
   - Tighten the riser nuts to 31 N·m (23 lb ft).



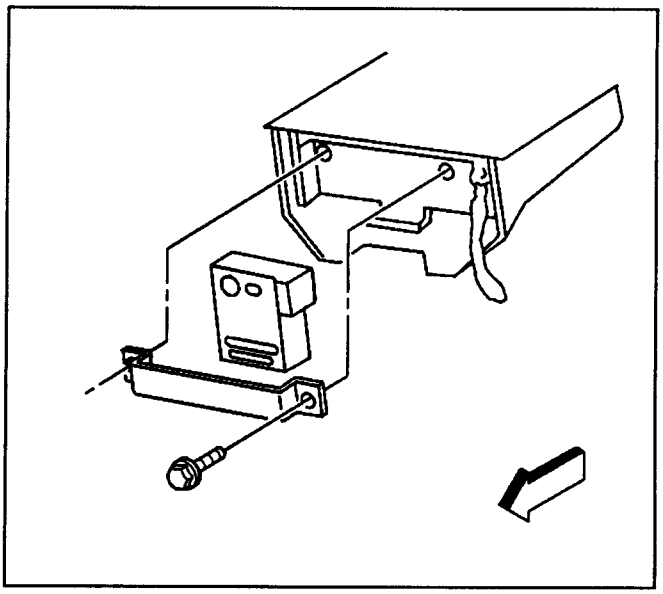
214554

4. Carefully slide the mount bracket assembly rearward.
5. Install the mount bracket assembly bolts.

   Tighten

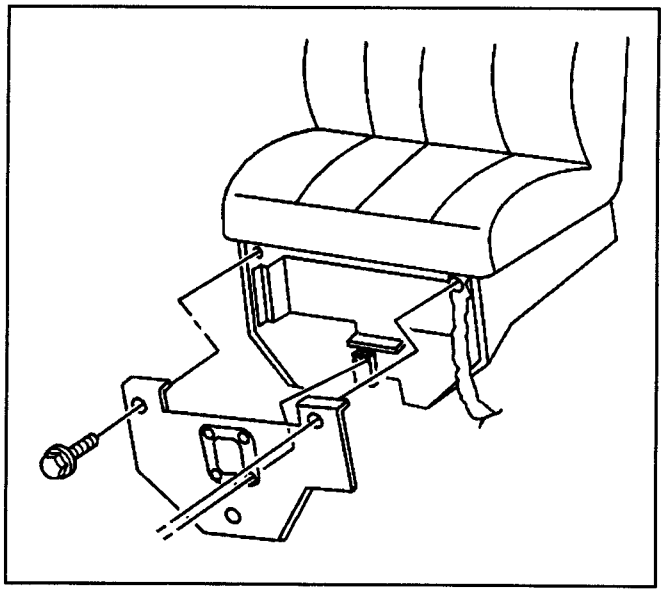
   Tighten the mount bracket assembly bolts to 2.5 N·m (22 lb in).

6. Install the brake control module bracket in the vehicle.
7. Install the brake control module bracket bolts.
   Tighten
   Tighten the brake control module bracket bolts to 2.5 N·m (22 lb in).



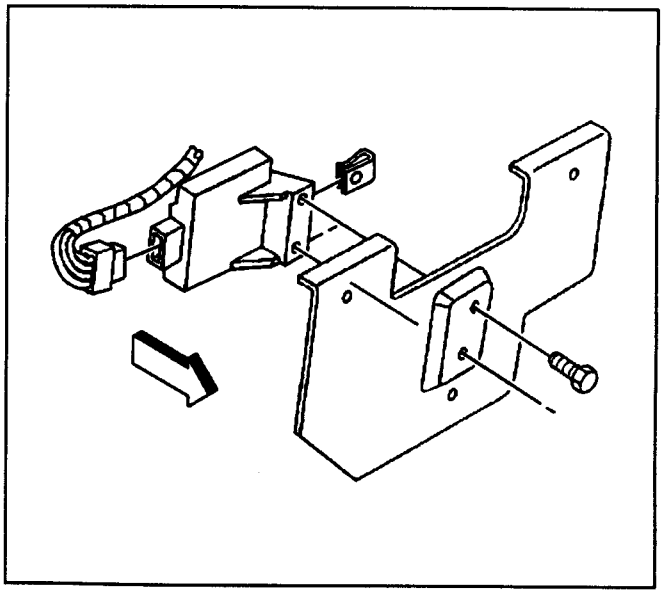
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8. Install the riser cover.

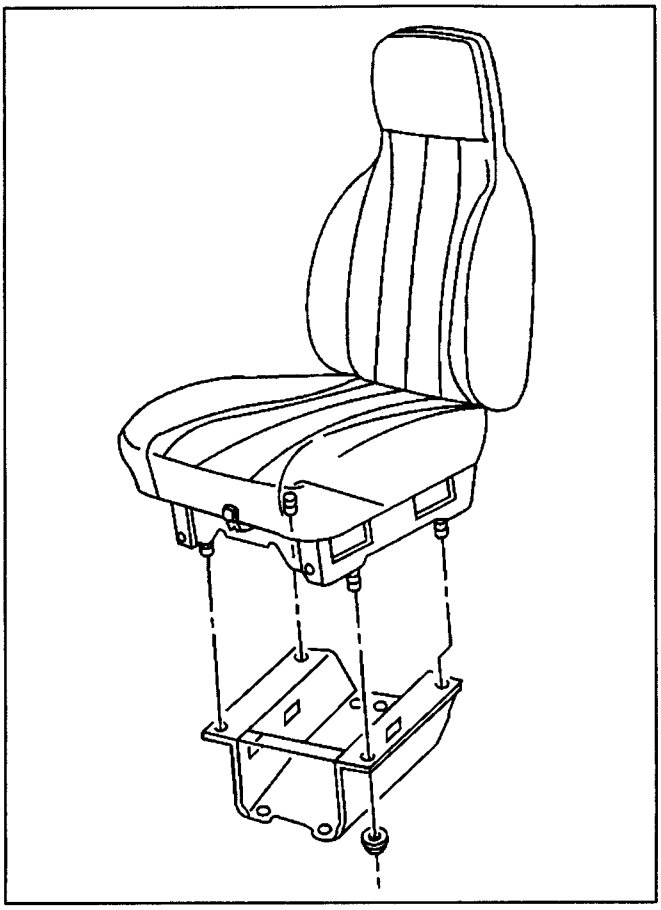


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9. Install the speedo adapter bolts.
   Tighten
   Tighten the speedo adapter bolts to 2.5 N·m (22 lb in).
10. Install the riser cover bolts.
    Tighten
    Tighten the riser cover bolts to 8 N·m (71 lb in).

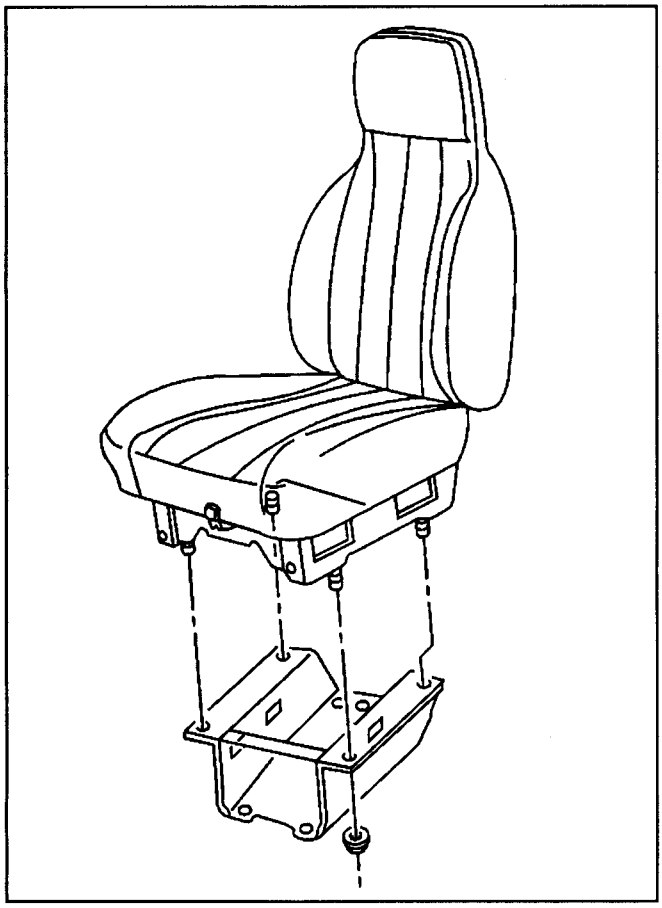


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11. Install the seat.
12. Install the seat nuts.
    Tighten
    Tighten the seat nuts to 15 N·m (12 lb ft).



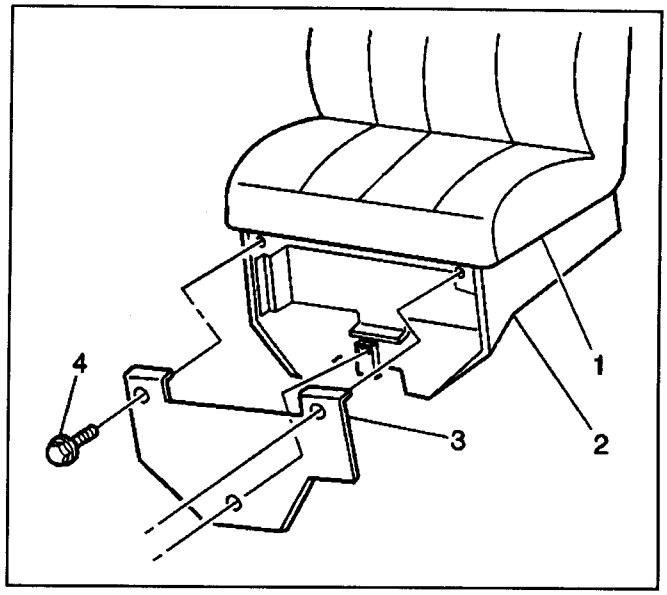
214531

Seat Riser Replacement (Driver)

Removal Procedure

1. Remove the seat nuts.
2. Remove the driver seat.

3. Remove the riser cover bolts (4).
4. Remove the riser cover (3).
5. Lift the floor covering upward.
6. Remove the riser nuts.
7. Lift the floor covering upward.
8. Remove the riser bolts.
9. Remove the riser (2).



214540

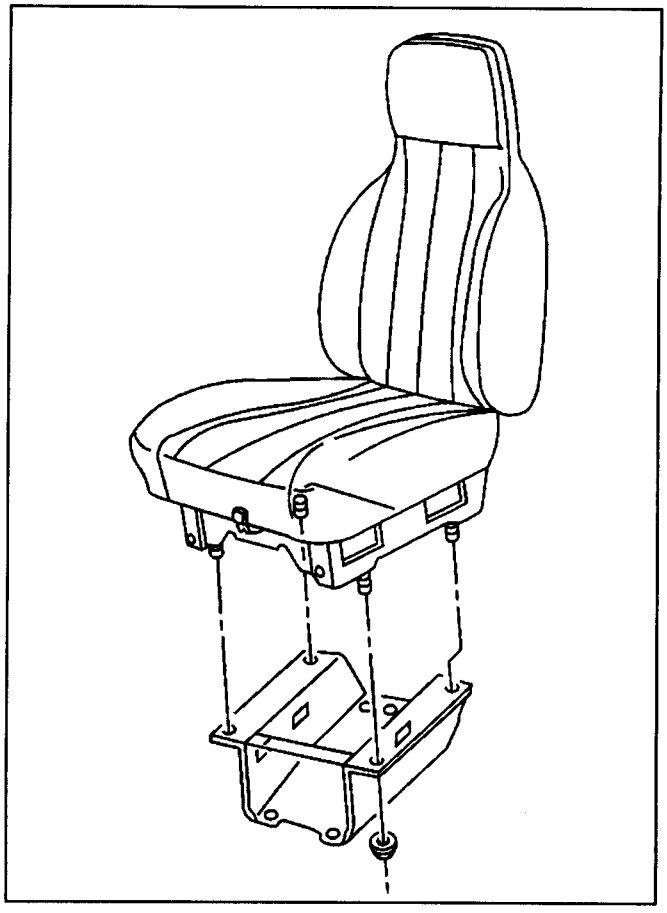
Installation Procedure

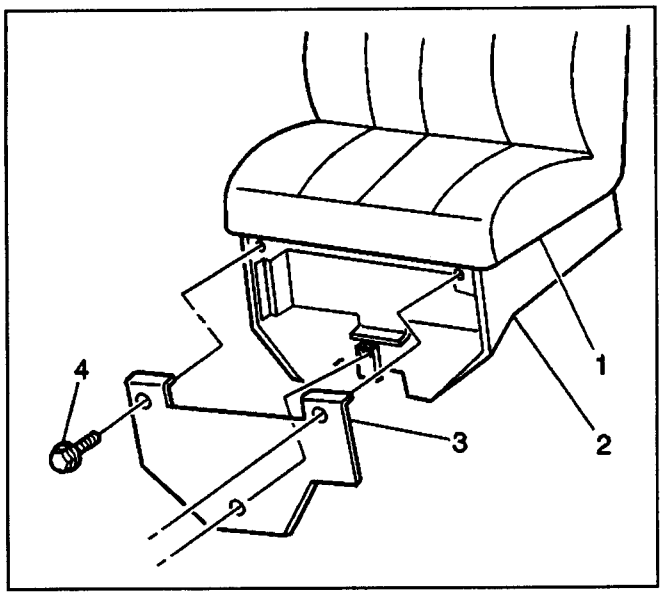
1. Install the riser.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the riser bolts.
3. Install the riser nuts.

   Tighten

   - Tighten the riser bolts to 31 N·m (23 lb ft).
   - Tighten the riser nuts to 31 N·m (23 lb ft).


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4. Install the riser cover (3).
5. Install the riser cover bolts (4).
   Tighten
   Tighten the riser cover bolts to 8 N.m (71 lb in).
6. Install the driver seat (1).
7. Install the seat nuts.
   Tighten
   Tighten the seat nuts to 15 N.m (12 lb ft).

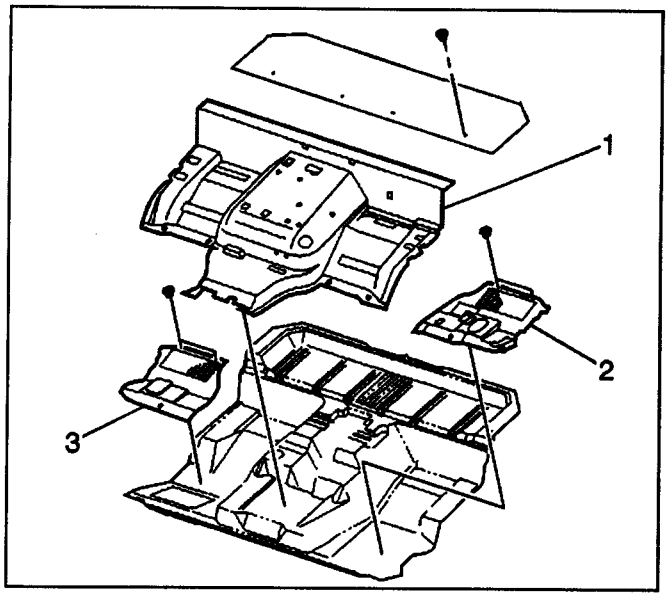
Interior Trim

Repair Instructions

Mat/Carpet Replacement - Front Floor

Removal Procedure

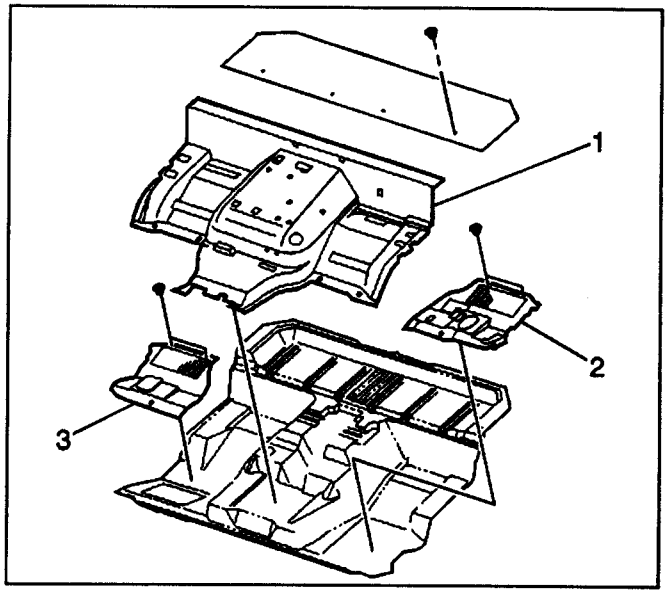
1. Remove the seats. Refer to *Seat Replacement* in Seats.
2. Remove the door sill trim plates. Refer to *Door Sill Plate Replacement.*
3. Remove the transmission control trim.
4. Remove the mat (1) from the floor.



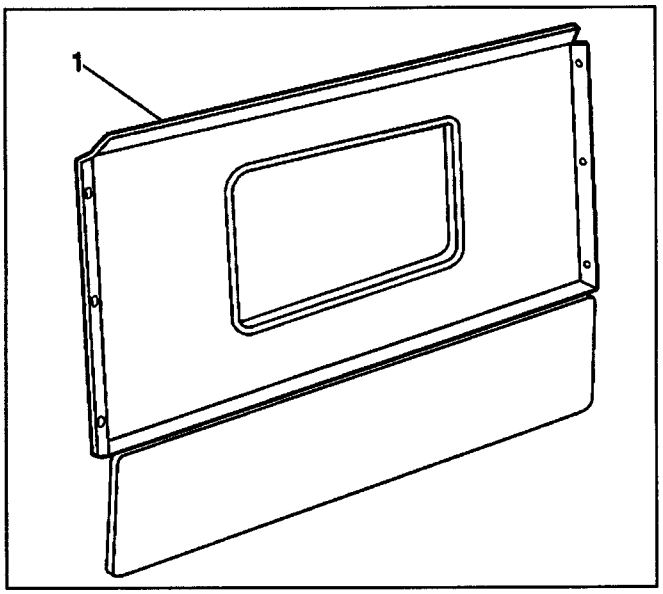
214648

Installation Procedure

1. Install the mat (1) to the floor.
2. Install the transmission control trim.
3. Install the door sill trim plates. Refer to *Door Sill Plate Replacement.*
4. Install the seats. Refer to *Seat Replacement* in Seats.



214648

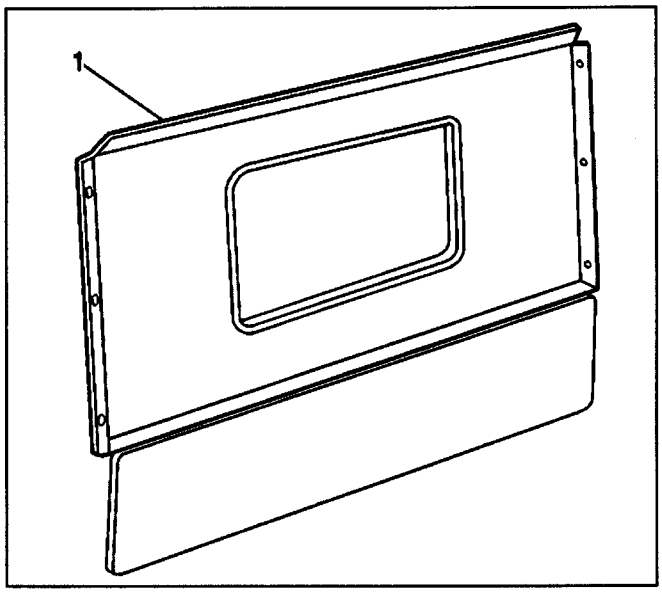


214634

Trim Panel Replacement - Cargo Area Rear

Removal Procedure

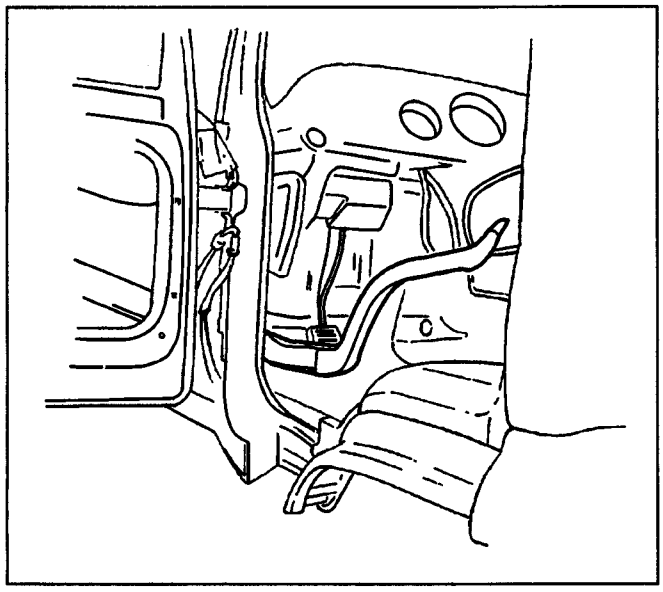
1. Remove the rear curtain rail.
2. Remove the rear window upper molding. Refer to *Rear Window Replacement* in Stationary Windows.
3. Remove the retaining screws.
4. Remove the rear panel molding (1) by pulling it away from the rear window sealing strip.



214634

Installation Procedure

1. Using a flat bladed tool, carefully position the rear panel molding (1) around the window glass under the sealing strip.
2. Install the retaining screws.
3. Install the rear window upper molding. Refer to *Rear Window Replacement* in Stationary Windows.
4. Install the rear curtain rail.



206138

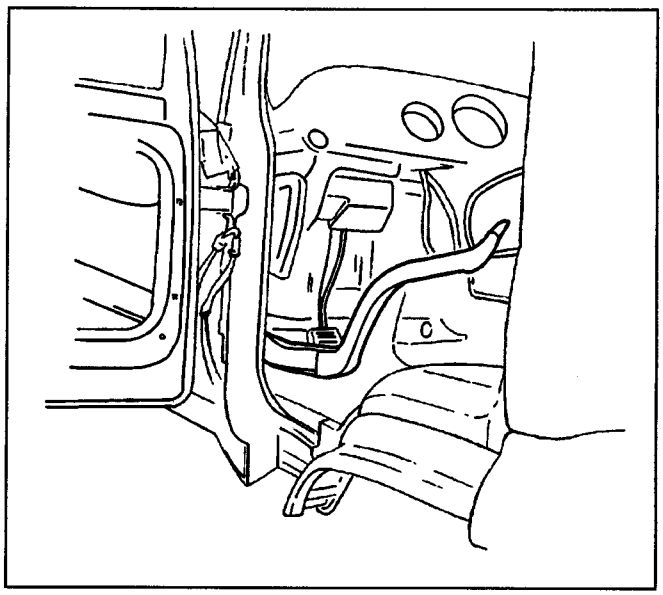
Door Sill Plate Replacement

Removal Procedure

1. Remove the four door sill trim plate screws.
2. Remove the door sill trim plate.

Installation Procedure

1. Install the door sill trim plate.
2. Install the four door sill trim plate screws.

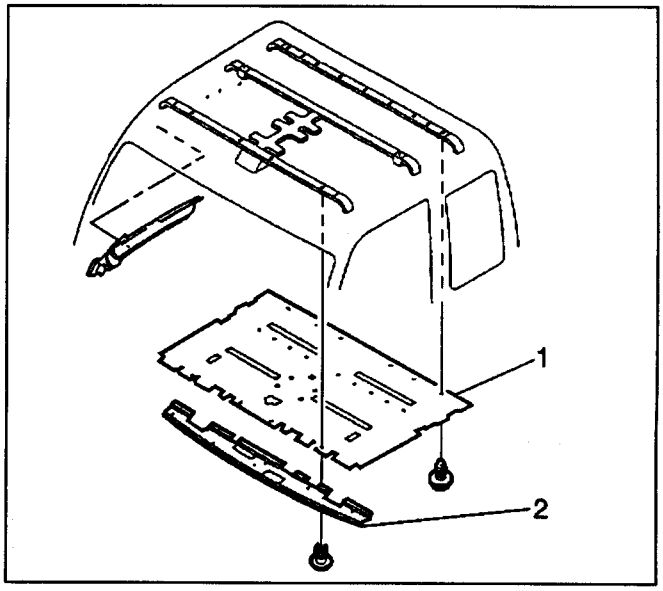


206138

Headliner Replacement

Removal Procedure

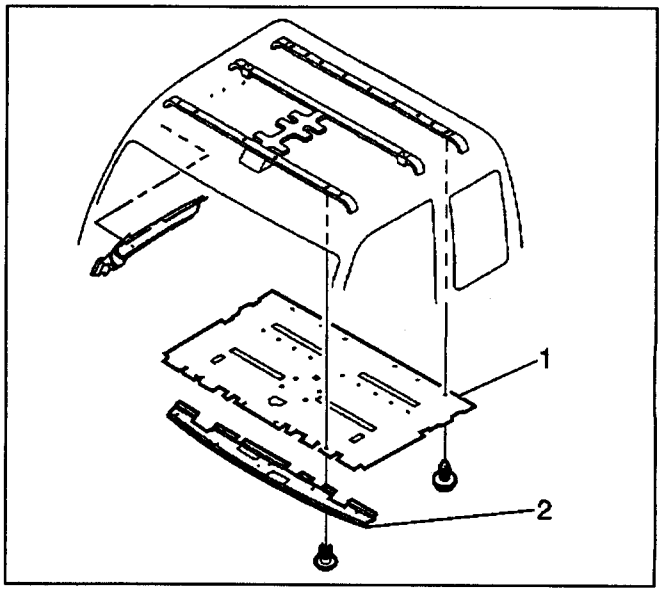
1. Remove the overhead storage compartment. Refer to *Console Replacement - Overhead.*
2. Remove the side molding from above both doors. Refer to *Garnish Molding Replacement - Side Door Upper (On Roof Panel)* or *Garnish Molding Replacement - Side Door Upper (On Body).*
3. Remove the rear window upper molding. Refer to *Molding Replacement - Rear Window Upper.*
4. Remove the front curtain rail screws.
5. Remove the headliner assembly (1) by carefully pulling the headliner down to release the retaining clips.



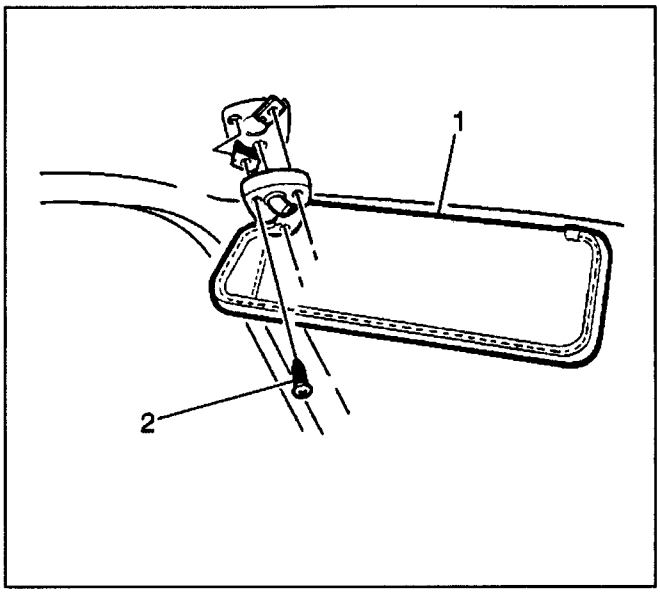
214644

Installation Procedure

1. Install the headliner assembly (1).
2. Install the front curtain rail screws.
3. Install the rear window upper molding. Refer to *Molding Replacement - Rear Window Upper.*
4. Install the side molding above both doors. Refer to *Garnish Molding Replacement - Side Door Upper (On Roof Panel)* or *Garnish Molding Replacement - Side Door Upper (On Body).*
5. Install the overhead storage compartments. Refer to *Console Replacement - Overhead.*



214644

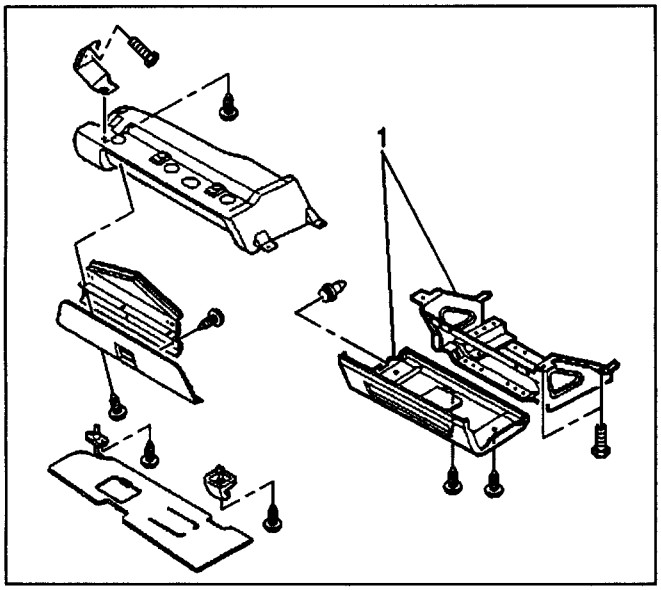


207691

Console Replacement - Overhead

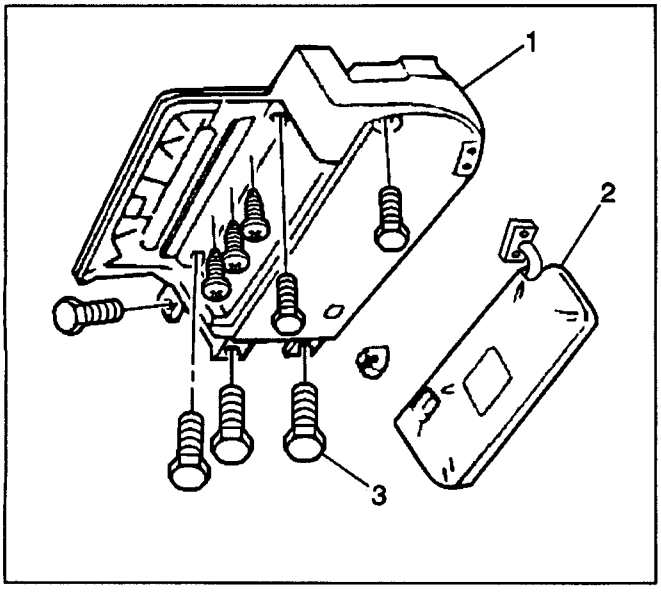
Removal Procedure

1. Remove the sunshade(s) (1).



214638

2. Remove the two retainers from in front of the dome lamp by twisting them counterclockwise.
3. Remove the dome lamp assembly.
4. Remove the center trim by carefully pulling the center trim back to release the retainers.

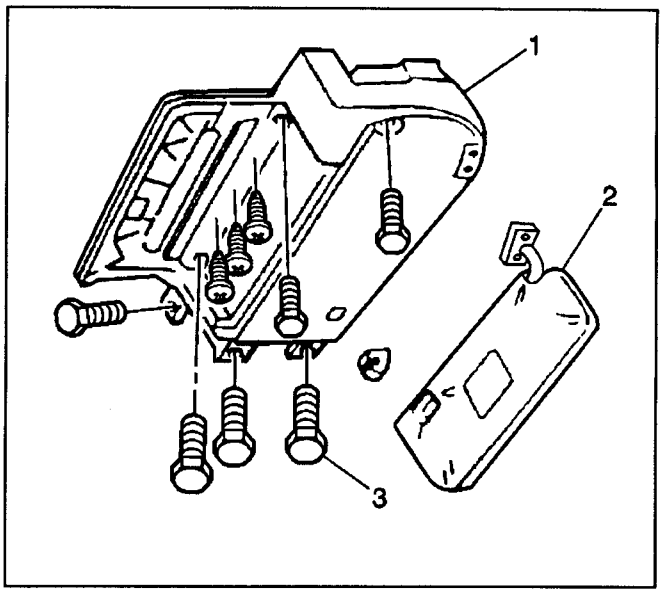


214640

5. Remove the retaining screws (3) from the storage compartment(s) (1).
6. Remove the storage compartment(s) from the roof panel.

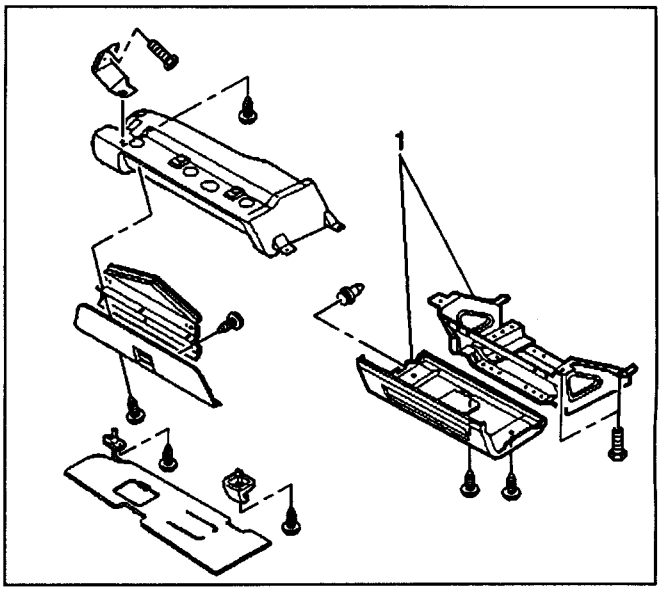
Installation Procedure

1. Install the storage compartment(s) (1) to the roof panel.
2. Install the storage compartment retaining screws (3).
3. Install the center trim by pushing the center trim into position.



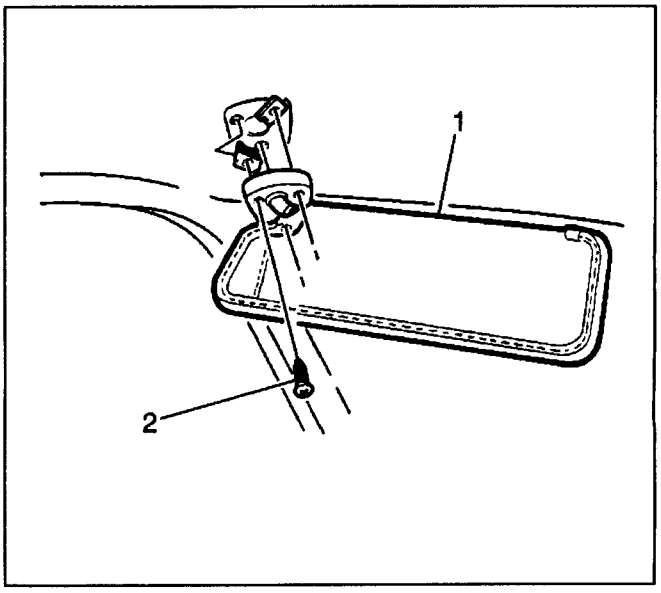
214640

4. Install the dome lamp assembly (1).
5. Install the two dome lamp trim retainers.

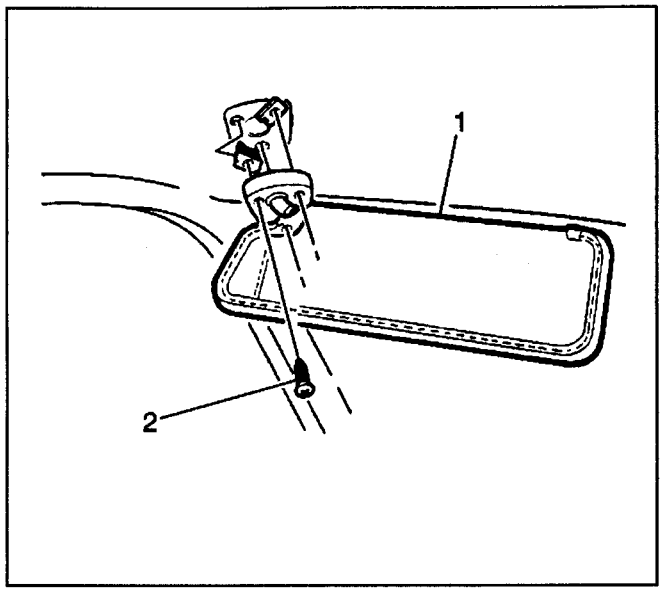


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6. Install the sunshade(s) (1).



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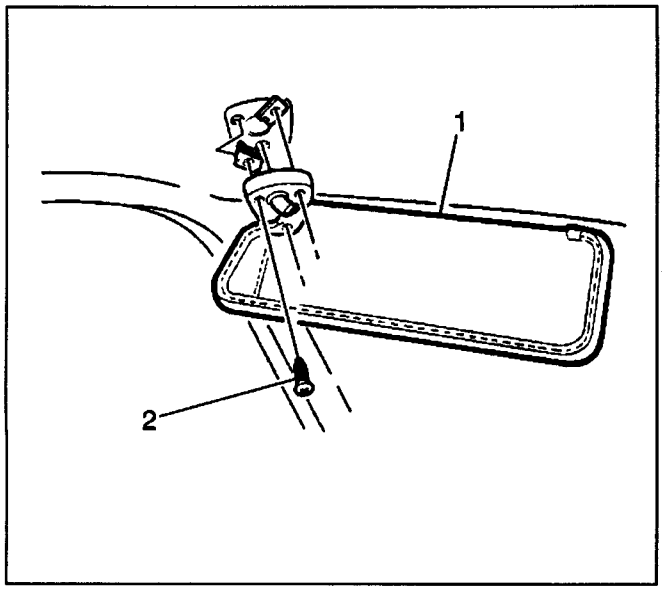


207691

Sunshade Replacement

Removal Procedure

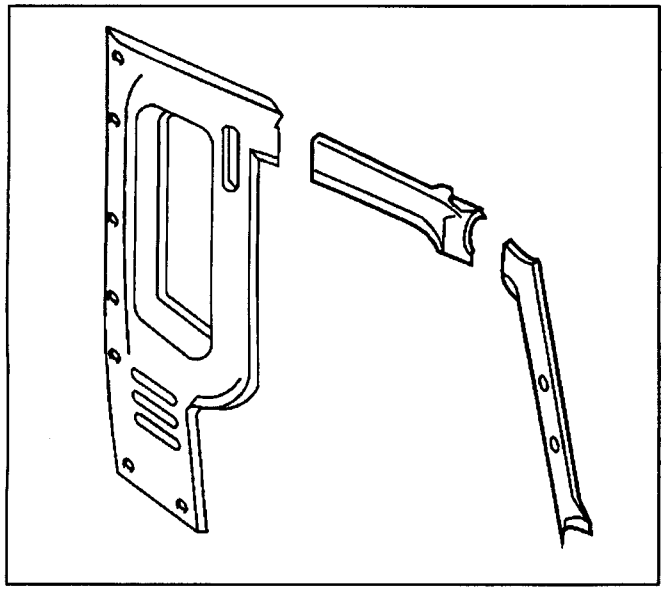
1. Remove the sunshade screws (2).
2. Remove the sunshade (1).



207691

Installation Procedure

1. Install the sunshade to the vehicle (1).
2. Install the sunshade screws (2).



215173

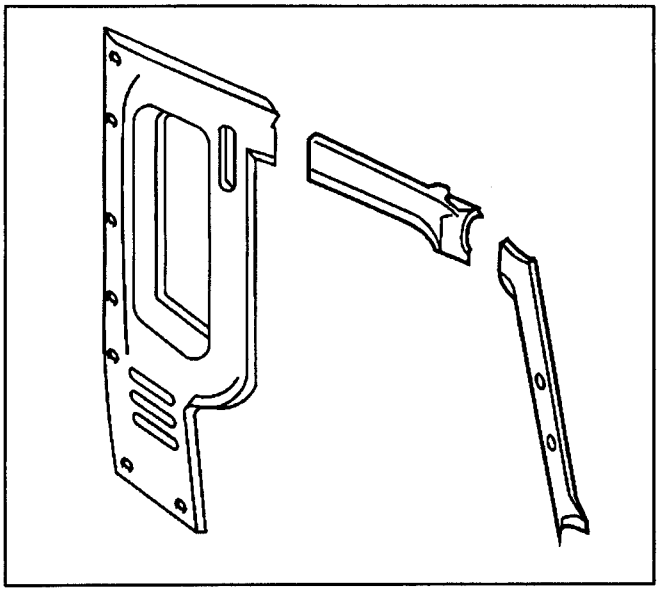
Garnish Molding Replacement - Windshield Pillar

Removal Procedure

1. Remove the assist handle, if equipped.
2. Pull down on the door opening sealing strip in order to reveal the garnish molding.
3. Remove the garnish molding.

Installation Procedure

1. Install the garnish molding.
2. Install the door opening sealing strip.
3. Install the assist handle, if equipped.



215173

Garnish Molding Replacement - Side Door Upper (On Roof Panel)

Removal Procedure

1. Remove the rear upper trim panels.
2. Remove the assist handle, if equipped.
3. Pull the side molding outward in order to release the retaining clips.

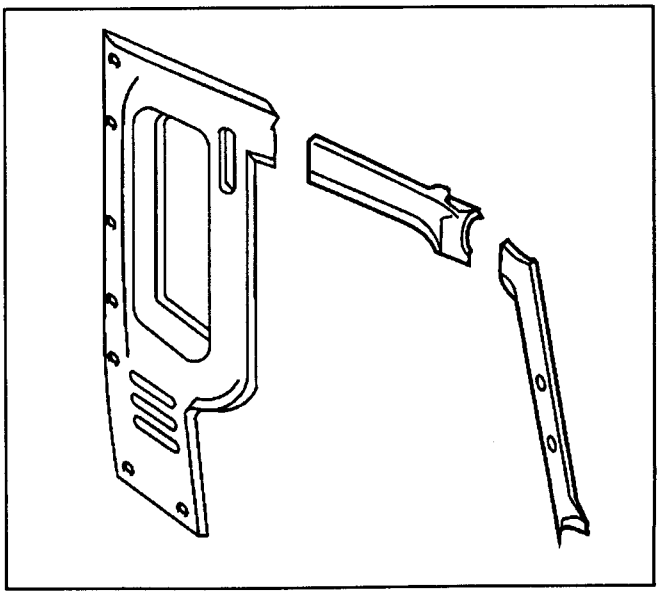
Installation Procedure

1. Push the side molding into position.
2. Install the assist handle, if equipped..
3. Install the rear trim panel.

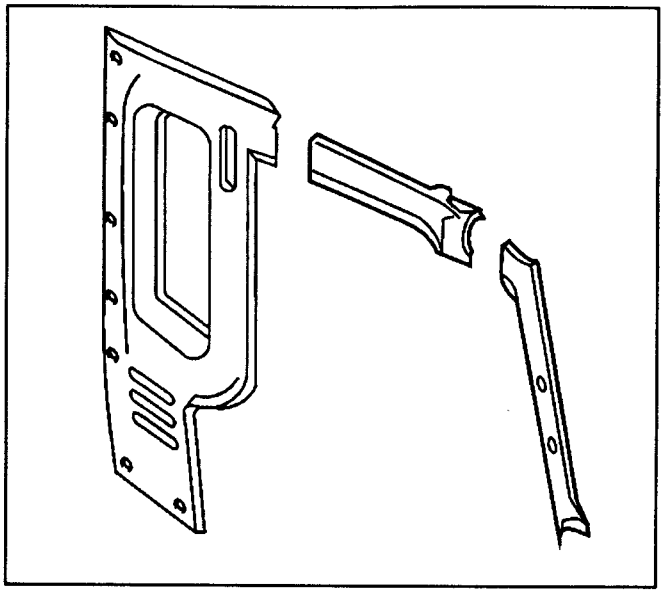
Garnish Molding Replacement - Side Door Upper (On Body)

Removal Procedure

1. Remove the curtain rails.
2. Pull down on the door opening sealing strip.
3. In order to release the adhesive, remove the side molding by carefully pulling the side molding away.



215173



215173

Installation Procedure

1. Apply adhesive to the side molding, as necessary.
2. Push the molding into position against the body of the vehicle.
3. Install the door opening sealing strip.
4. Install the curtain rails.

Molding Replacement - Rear Window Upper

Removal Procedure

1. Remove the screws from the rear trim panels.
2. Pull the rear window upper molding forward to release the retaining clips.

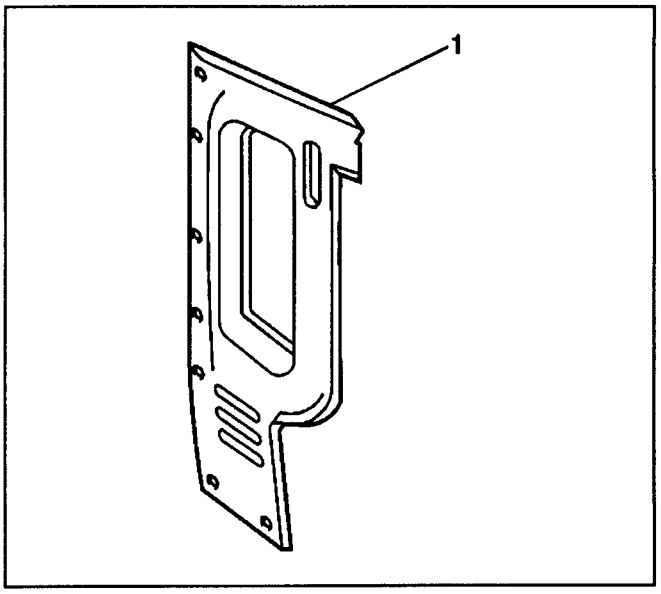
Installation Procedure

1. Align the retaining clips with the holes in the roof panel and push the upper molding into position.
2. Install the lower retaining screws.

Trim Panel Replacement - Rear Quarter

Removal Procedure

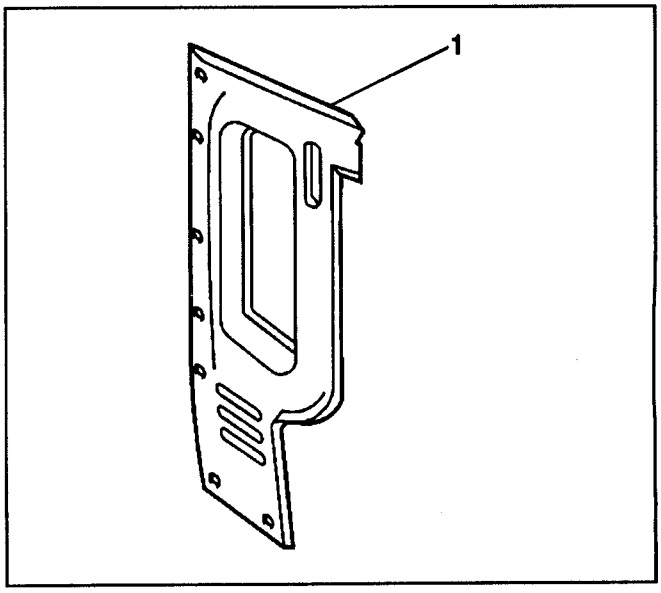
1. Remove the door opening sealing strip.
2. Remove the upper seat belt bolt.
3. Remove the assist handle.
4. Remove the molding retainers.
5. Remove the quarter window side molding (1) by pulling the molding from around the quarter glass.



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Installation Procedure

1. Using a flat-bladed tool, carefully install the molding (1) around the quarter glass under the sealing strip.
2. Install the molding retainers.
3. Install the assist handle.
4. Install the upper seat belt bolt.



214636

Cleaning Vinyl Trim

You can usually remove soilage from vinyl using warm water and mild soap.

1. Apply a small amount of soap solution.
2. Let the solution soak for a few minutes in order to loosen the dirt.
3. Rub briskly with a clean, damp cloth in order to remove dirt and traces of soap. If needed, you may repeat this several times.

Soilage from tars, asphalt, shoe polish or the like will stain if left on the trim.

- Wipe off these compounds as quickly as possible.
- Clean the area using a clean cloth dampened with Vinyl/Leather Cleaner (solvent type).

Spot Cleaning Fabric Trim

Before trying to remove a spot or a stain from the fabric, determine the type and the age of the spot or stain. Water or a mild soap solution is sufficient to remove stains of some types. Remove spots or stains as soon as possible.

Some soils or stains, such as lipstick, inks, and grease are very difficult, and sometimes impossible, to remove completely.

When cleaning this type of stain, do not enlarge the soiled area. Use a solvent type fabric cleaner in order to spot clean grease, oil, or fat stains.

1. Gently scrape any excess stain from the trim material. Use a small amount of cleaner, light pressure, and clean cloths (preferably cheesecloth) when spot cleaning.
2. Start cleaning at the outside of the stain and feather towards the center. Frequently change to a clean section of the cloth.
3. After the stain has been removed, dry the area immediately with a heat dryer or a heat lamp to help prevent a cleaning ring. Use caution when employing a heat dryer or lamp to avoid damaging the fabric.
4. If a cleaning ring forms, immediately repeat the cleaning operation over a slightly larger area of cloth with emphasis on feathering toward the stain's center.
5. If a ring still remains, mask off the surrounding trim sections. Clean the entire area using multi-purpose powered cleaner.

Cleaning Agents

Caution: Follow the manufacturer's advice when cleaning agents or other chemicals are used inside or outside of the vehicle. Some cleaners may be poisonous or flammable. Improper use may cause personal injury, paint to peel, or damage to components. When cleaning the interior or exterior of the vehicle, do not use the following cleaners except as specifically directed in the fabric cleaning procedures contained in this manual:

- ***Acetone***
- ***Alcohols***
- ***Aliphatic hydrocarbons***
- ***Aromatic hydrocarbons***
- ***Bleaches***
- ***Enamel reducers***
- ***Esters***
- ***Ethylene chloride***
- ***Ketones***
- ***Lacquer thinners***
- ***Laundry soaps***
- ***Methylene chloride***
- ***Nail polish removers***
- ***Napthas***
- ***Penetrating oils***
- ***Plasticizers***
- ***Propylene glycols***
- ***Reducing agents***
- ***Silicones***
- ***Tetrachloroethane***

Never use carbon tetrachloride, gasoline, benzene, or naphtha for any cleaning purpose.

Some after market products used to increase the gloss of the instrument panel contain some of the products listed above. It is important to only use those solutions recommeded for cleaning the identified surfaces. As a general rule, the following guidelines must be used:

1. ***Vinyl and Non-painted plastic - Use vinyl and plastic cleaners.***
2. ***Rubber - Use rubber cleaners.***
3. ***Painted Plastic Surfaces - Use only mild detergents.***

Open all vehicle doors for ventilation when any cleaning agents or other chemicals are used inside of the vehicle. Overexposure to some vapors, which is more likely to occur in small, unventilated spaces, may result in a health problem.

Notice: To avoid possible permanent discoloration of light colored seats, do not let materials with non-color fast materials come in contact with seat trim materials until totally dry. This includes certain types of clothing, such as colored denims, corduroys, leathers, and suedes.

Use the proper cleaning techniques and cleaners on the first cleaning in order to avoid the following types of staining:

- Water spots
- Spot rings
- Setting of stains

These stains are more difficult to remove in a second cleaning.

Remove any dust and loose dirt that collects on interior fabrics through frequent vacuuming or the use of a soft bristle brush.

Wipe vinyl trim regularly using a clean damp cloth.

Interior Cleaning

Use a multi-purpose powered cleaner for cleaning fabric trim and for cleaning panel sections where small cleaning rings may be left from spot cleaning.

- Vacuum and brush the area in order to remove any loose dirt surrounding the trim along stitch or welt lines.
- Clean the complete trim panel one section at a time.
- When mixing the cleaner, follow the directions on the container label.
- Use suds on a clean sponge.
- Do not saturate the material or rub the material harshly.
- Wipe off any remaining residue using a slightly damp absorbent towel or cloth.
- You may use a heat dryer or heat lamp to dry the area. Use caution with a heat dryer or lamp to prevent fabric damage.

Basic Steps Before Cleaning

- Remove stains as quickly as possible before the stains set.
- Use a clean cloth or sponge. Frequently change to a clean section of the cloth. Use a soft brush if stains persist.
- Use solvent-type cleaners in a well ventilated area. Do not saturate the stained area.
- If a ring forms after spot cleaning, immediately clean the entire area.
- Follow the manufacturer's instructions for all cleaning agents.

Cleaning Glass Surfaces

Clean glass surfaces on a regular basis. Use a glass cleaner to remove normal tobacco smoke and dust films.

Use a non-abrasive cleaner on the outside of the windshield. Clean the wiper blades using a cloth soaked in a solution of one-half water and one-half Optikleen® or equivalent. You may also use a solution of one-half water and one-half methanol alcohol. Then rinse the blade with water.

Removal of Specific Stains

Grease or Oily Stains

This cleaning procedure applies to stains caused by the following substances:

- Grease
- Oil
- Butter or margarine
- Shoe polish
- Coffee with cream
- Chewing gum
- Cosmetic creams
- Vegetable oils
- Wax crayon
- Tar and asphalt

1. Carefully scrape off the excess matter.
2. Use a solvent type fabric cleaner on the stained area. Refer to *Spot Cleaning Fabric Trim.*
3. Shoe polish, wax crayons, tar, and asphalt will stain if left on the trim. Remove these stains as soon as possible. Use care because the cleaner may cause the stains to bleed as the cleaner dissolves the stains.

Non-Greasy Stains

These stains include the following substances:

- Ketchup
- Black coffee
- Egg
- Fruit
- Fruit juice
- Milk
- Soft drinks
- Wine
- Vomit
- Blood
- Urine

1. Carefully scrape off the excess matter.
2. Sponge the stain with cool water.
3. If a stain remains, use a foam type multi-purpose powered cleaner to remove the stain. Refer to *Interior Cleaning.*
4. If an odor lingers after cleaning vomit or urine, treat the area using a water/baking soda solution of 5 milliliters (1 teaspoon) baking soda to 250 milliliters (1 cup) of lukewarm water.
5. Finally, if needed, clean lightly using a solvent type fabric cleaner.

Combination Stains

These stains include the following substances:

- Candy
- Ice cream
- Mayonnaise
- Chili sauce
- Stains of unknown origin

1. Carefully scrape off the excess matter.
2. Clean with cold water.
3. Allow the area to dry.
4. If a stain remains, clean the stain using a solvent type fabric cleaner.

Seat Belt Care

Caution: Do not bleach seat belts. Do not dye seat belts. This may severely weaken the seat belts. Damaged seat belts are a safety hazard. Keep the seat belts clean and dry.

Clean the seat belts only with mild soap and lukewarm water.

Plastic Panel Information and Repair

Repair Instructions

Flexible Plastic Part Refinishing

Notice: Use supplies, primers, basecoats and clearcoats from the same manufacturer. Do not intermix paint systems or paint damage may occur.

Follow the paint manufacturer's instructions regarding preparation, priming and refinishing when working with flexible plastic parts. These parts may require special additives in the primers and topcoat in order to prevent cracking and poor adhesion. Use the manufacturer's recommended materials. Do not intermix with other paint systems.

The Service Parts Identification Label contains all the information necessary regarding paint technology, paint codes and trim level, in order to identify the correct paint. Refer to *Label - Service Parts ID* in General Information.

BLANK

Paint/Coatings

Specifications

Clearcoat Repair Specifications - 3M Products

Paint Condition	Wet Sanding	Compounding	Rotary Polisher	Dual Action Orbital Polisher	Hand Glazing/ Polishing
New car prep or fine wheel marks	—	—	—	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit DA 6 inch Backup Pad P/N 05776	Premium Liquid/Paste Waxes P/N 0654/06055
Swirl marks, water spottting, or light oxidation	—	—	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit SBS/Perfect-It Backup Pad P/N 05717/18	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05725 Hookit DA 6 inch Backup Pad P/N 05776	Perfect-It Hand Glaze P/N 05997 or Premium Liquid/Paste Waxes P/N 0654/06055
Overspray or medium oxidation	—	Perfect-It 11 Rubbing Comp. pad P/N 059723 Perfect-It 11 Foam Comp. Pad P/N 05723	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit SBS/Perfect-It Backup Pad P/N 05717/18	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit DA 6 inch Backup Pad P/N 05776	Perfect-It Hand Glaze P/N 05997 or Premium Liquid/Paste Waxes P/N 0654/06055
Heavy oxidation or minor acid rain pitting	Micro Fine 2000	Perfect-It 11 Rubbing Comp. pad P/N 059723 Perfect-It 11 Foam Comp. Pad P/N 05723	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit SBS/Perfect-It Backup Pad P/N 05717/18	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit DA 6 inch Backup Pad P/N 05776	Perfect-It Hand Glaze P/N 05997 or Premium Liquid/Paste Waxes P/N 0654/06055

Clearcoat Repair Specifications - 3M Products (cont'd)

Paint Condition	Wet Sanding	Compounding	Rotary Polisher	Dual Action Orbital Polisher	Hand Glazing/ Polishing
Dust nibs, minor scratches, or major acid rain pitting	Micro Fine 1500 or 2000	Perfect-It 11 Rubbing Comp. pad P/N 059723 Perfect-It 11 Foam Comp. Pad P/N 05723	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit SBS/Perfect-It Backup Pad P/N 05717/18	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Perfect-It Foam Polishing Pad P/N 05776	Perfect-It Hand Glaze P/N 05997 or Premium Liquid/Paste Waxes P/N 0654/06055
Orange peel, paint runs or sags	Micro fine 1200 or 1500	Perfect-It 11 Rubbing Comp. pad P/N 059723 Perfect-It 11 Foam Comp. Pad P/N 05723	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit SBS/Perfect-It Backup Pad P/N 05717/18	Perfect-It Polishing Pad Glaze P/N 05995/05996 Perfect-It Foam Polishing Pad P/N 05776 Hookit DA 6 inch Backup Pad P/N 05776	Perfect-It Hand Glaze P/N 05997 or Premium Liquid/Paste Waxes P/N 0654/06055

Clearcoat Repair Specifications - Meguiar Products

Paint Condition	Wet Sanding	Cleaning	Polishing
New car prep or fine wheel marks	—	—	Swirl Free Polish (M-82) W-6000 Pad for DA polishers
Swirl marks, chemical spotting or light oxidation	—	—	Swirl Free Polish (No. 9) W-9000 Finishing Pad
Overspray or medium oxidation	—	Heavy-Cut Cleaner (No. 4) W-7000 Cutting Pad	Swirl Remover (M-82) W-9000 Finishing Pad
Heavy oxidation or minor acid rain pitting	—	Compound Power Cleaner (M-84) W-7000 Cutting Pad	Swirl Free Polish (M-82) W-6000 Finishing Pad
Dust nibs	2000 Grade Unigrit Sanding Block	Compound Power Cleaner (M-84) W-7000 Cutting Pad	Swirl Free Polish (M-2) W-9000 Finishing Pad
Minor scratches or acid rain pitting	2000 Grade Unigrit Sanding Paper	Compound Power Cleaner (M-84) W-7000 Cutting Pad	Swirl Free Polish (M-2) W-9000 Finishing Pad
Major runs or sags	1500 Grade Unigrit Sanding Block	Compound Power Cleaner (M-84) W-7000 Cutting Pad	wirl Free Polish (M-2) W-6000 Pad for DA Polishers
Major orange peel or acid rain pitting	1500 Grade Unigrit Sanding Paper	Compound Power Cleaner (M-84) W-7000 Cutting Pad	Swirl Free Polish (M-2) W-6000 Pad for DA Polishers
Need for protection	—	—	Quick Detailer (M-6601) will provide protection without streaking. Contains the mildest of cleaners which will insure even application of polish.

Basecoat/Clearcoat Paint Systems

Caution: Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the manufacturers of painting materials, equipment, and protective gear.

Caution: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

All paint finish repairs of rigid exterior surfaces, are to meet Isuzu standards. All approved products, including Volatile Organic Compound (VOC) - compliant regulations are listed in the system approach recommended by the individual manufacture. Refer to the manufactures instructions for the detailed procedures for materials used in there paint system in the painting repairs of rigid exterior surfaces. All components of an approved paint system have been engineered to ensure proper adhesion between layers.

Mixing paint systems or substituting a product of one manufacture for another manufacture's product is not allowed. If incompatible products are used together some problems listed can occur:

- Lifting of primer coats caused by overly aggressive solvents in subsequent layers.
- Loss of adhesion between layers due to incompatibility of resin systems.
- Solvent popping or pinholing due to inappropriate solvent selection.
- Poor through-curing due to incompatible hardener resins or insufficient reactivity.
- Gloss reduction due to incompatible resins and/or solvents.
- Gloss reduction due to incompatible resins and/or solvents.
- Poor color accuracy due to pigment interactions with incompatible resins and/or solvents.
- Film defects (craters, blisters, orange peel loss of gloss) due to the use of inferior quality raw materials in incompatible products.

Anti-Corrosion Treatment and Repair

Caution: When applying sound deadeners, or anti-corrosion materials due care and preventative measures must be exercised to prevent any material from being sprayed into door and quarter panel mechanisms such as door locks, window run channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody, particularly the parking brake cable. After material application, be sure that all body drain holes are open. Improper application may increase chance of corrosion damage or limit the operation of moving parts, resulting in personal injury.

Caution: Foam sound deadeners must be removed from areas within 6 inches of where flame is to be used for body repairs. When reinstalling foam sound deadeners, avoid inhaling fumes as bodily injury may result.

Caution: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Notice: The anti-theft label found on some major body panels MUST be covered before performing any painting, rustproofing or undercoating procedures. The mask must also be removed following those procedures. Failure to follow these precautionary steps may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

Anti-corrosion materials providing rust resistance are used on interior and exterior surfaces of metal panels. These materials include metals such as one-sided and two-sided galvanized zinc, and zinciron alloy steels. These treated metals are used on components such as fenders, doors, quarter panels, rocker panels, lids, floor pans, wheelhousings, and other critical parts.

Metal conditioners and primers are used on interior and exterior surfaces along with protective waxes on interior surfaces in areas where moisture might accumulate. Sealers are applied along exposed joints and moisture-repelling asphaltic sound deadeners are applied inside the wheel wells, doors, and on some underbody components.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anti-corrosion material is essential.

Metal conditioners and primer coatings are applied to all metal panels at the time of vehicle manufacture. After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed using a zinc chromate primer. This operation is to be performed prior to the application of sealers, waxes, deadeners, and antirust compounds. Refer to *Basecoat/Clearcoat Paint Systems*

These sealers are intended to prevent water and dust from entering the vehicle and also are anti-corrosion barriers. Sealers are applied to such areas as rear compartment lid hem flanges, wheelhouse, quarter outer, floor, cowl, roof, and various other panel to panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints, and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of the sealer to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

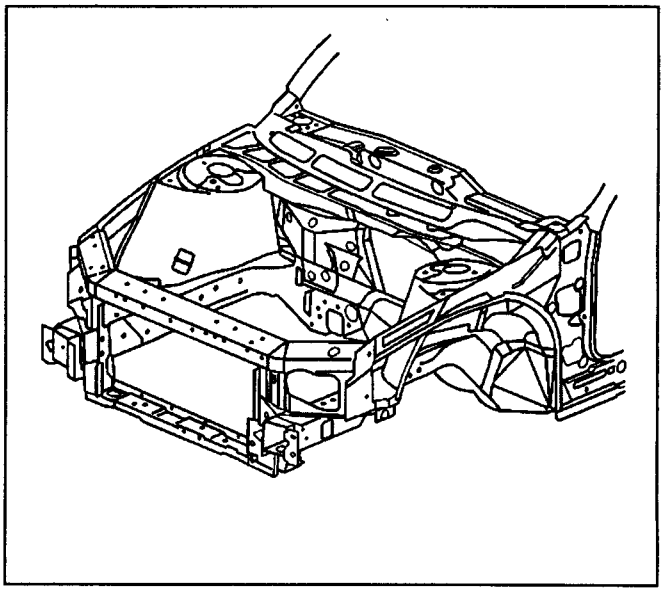
Color application may be required to restore repaired areas such as hood, fenders, doors, quarters, lid, roof, engine compartment, underbody, and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat buildup, and color application techniques should be followed. Refer to *Basecoat/Clearcoat Paint Systems*.

Deadener materials (spray-on type) are used on various metal panels to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, are removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

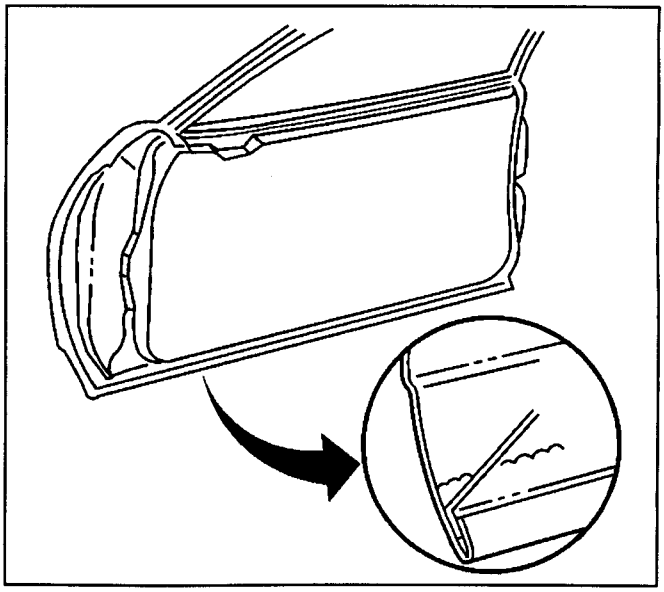
Anti-corrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch weld joints, hem flanges, and integral panel attaching points where metal surfaces are difficult to coat with conventional undercoating materials, and are inaccessible for painting. Conventional undercoating is recommended to coat large areas such as replacement door and quarter outer panels, floor pan sections, lids, hoods, fenders, etc. During undercoating operations, care should be taken to prevent the material from being sprayed into door and quarter panel hardware mechanisms such as door locks, glass run channels, window regulators, and seat belt retractors. On the underbody, the material should not be applied to any moving or rotating part, energy absorbing bumper components, or shock absorbers. After undercoating, make sure that all body drain holes are open. Refer to *Basecoat/Clearcoat Paint Systems* for the sequence of application steps for anti-corrosion materiols.

Cleaning of the interior and underbody panel surfaces is necessary when original galvanized or other anti-corrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces. One or more of the following methods will remove the residue.

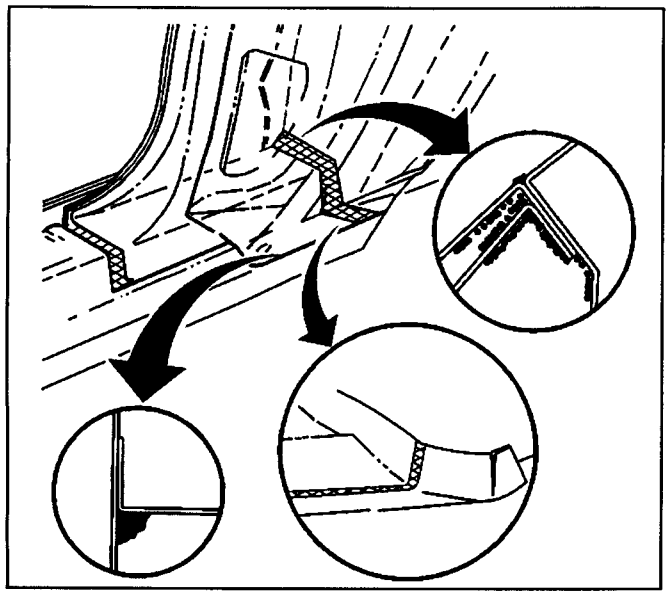
- Sandblasting is an excellent method for cleanup and preparation of open joints, underbody components, and hem flange areas. Sandblasting is most effective and should be used.
- When access is possible, scraping with a putty knife or scraper can be used.
- A jet of compressed air will remove most residue and could be effective in a limited access areas.



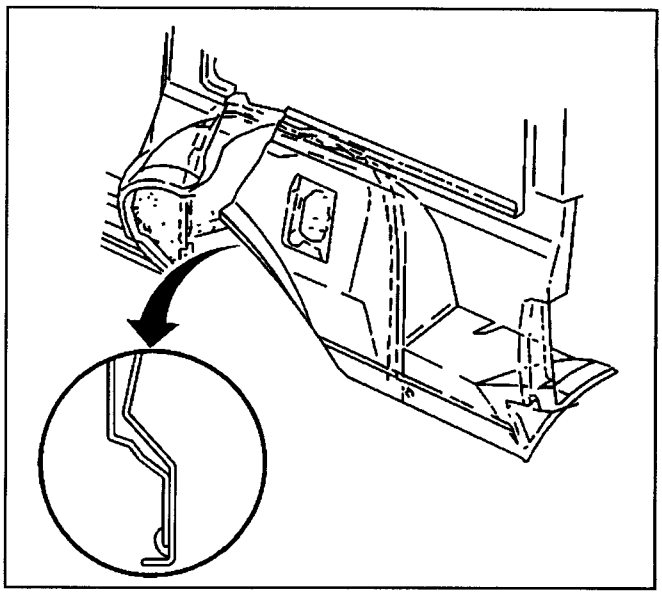
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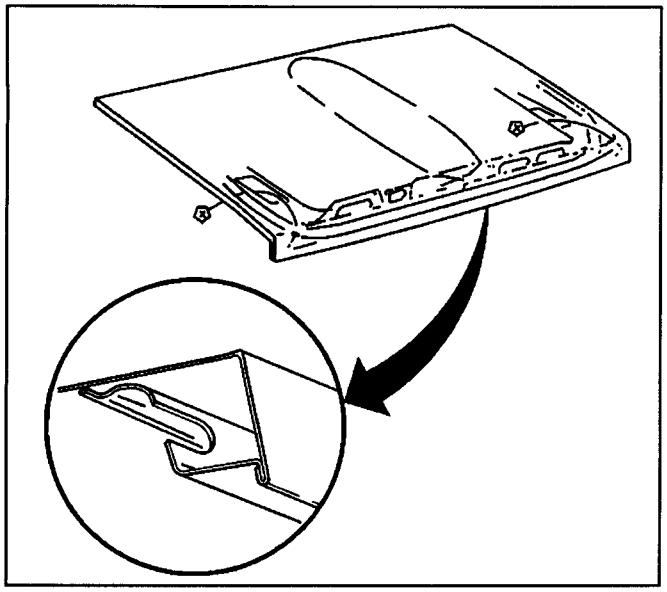
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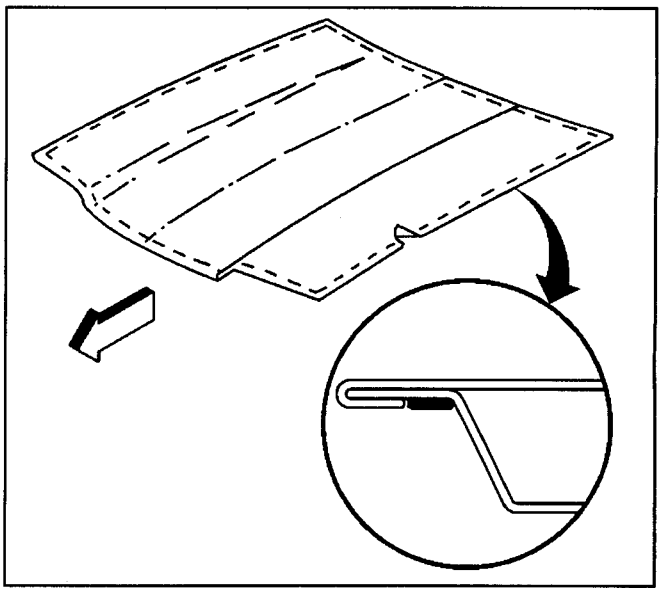
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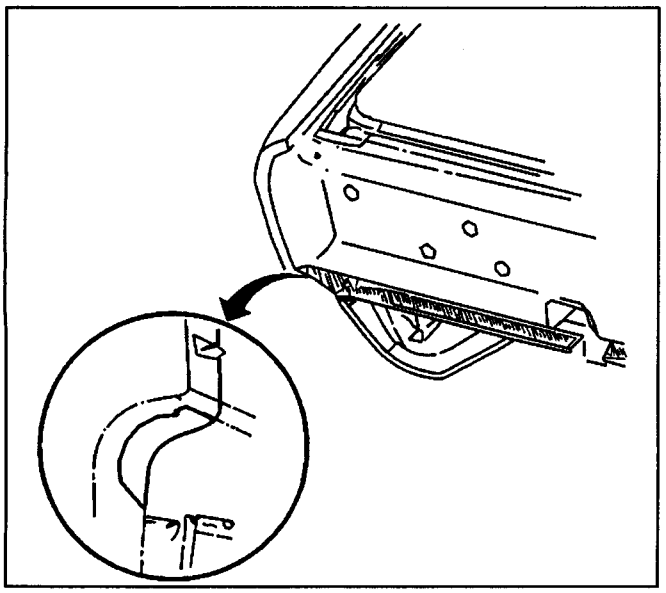
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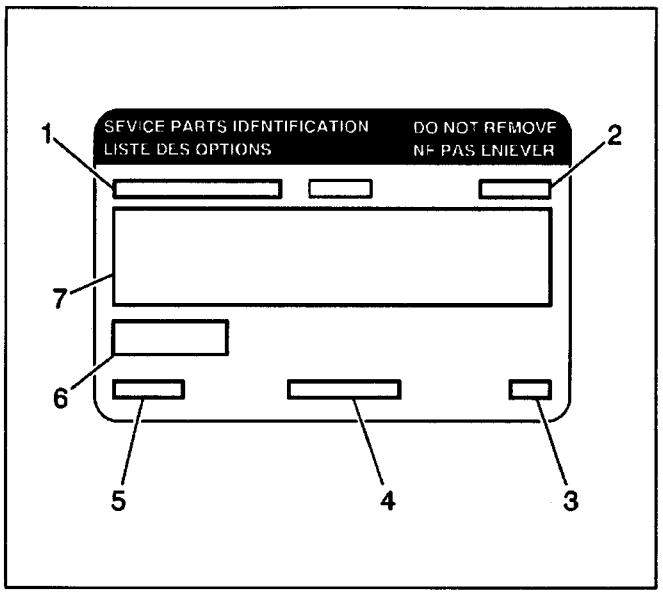


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Paint Identification

Caution: Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the manufacturers of painting materials, equipment, and protective gear.

The Basecoat/clearcoat paint is factory applied in four layers: a cathodic immersion primer, a primer/surfacer, a basecoat, and a clear top coat (clearcoat) to give the finish a high gloss look. To identify the type of top coat on the vehicle, you may refer to the Service Parts Identification Label. This label contains all paint related information for the vehicle. This includes paint technology, paint codes, trim level, and any special order paint colors.



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Legend

(1) Vehicle Identification Number
(2) Engineering Model Number (Vehicle Division, Vehicle Line and Body Style)
(3) Interior Trim and Decor Level
(4) Exterior (Paint Color) WA Number
(5) Paint Technology
(6) Special Order Paint Colors and Numbers
(7) Vehicle Option Content

Repair Instructions

Clearcoat Repair w/o Repainting

Notice: Removing too much of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

Important:

- Avoid washing vehicles in direct sunlight.
- Avoid using strong soaps or chemical detergents.
- Use brushless type automatic car wash equipment.
- Avoid using products containing acids (unless specified to correct a condition such as rail dust).
- Don't use brushes or brooms to remove snow or ice from vehicles in storage or on lots.
- Cleaning agents and water should be dried promptly and not allowed to dry on the surface.

  Drying with a soft chamois is recommended.
- Standing rinse water should be dried promptly and not allowed to dry on the surface.

  Drying with a soft chamois is recommended.
- Do not polish vehicles unless a surface condition exists that can only be corrected by polishing. Refer to *Clearcoat Repair Specifications - Meguiar Products* or *Clearcoat Repair Specifications - 3M Products.*
- If a surface condition does exist, the repair approach should be one of less is best (the very least it takes to correct the condition).
- Avoid removing too much clear coat (whenever possible, use paint gages before, during and after polishing). Refer to *Paint Gauges.*
- Use only the products recommended in this procedure (or their equivalent). Refer to *Clearcoat Repair Specifications - Meguiar Products* or *Clearcoat Repair Specifications - 3M Products.*
- Make sure that any power polishing equipment does not exceed the requirements in the polish manufacturers recommendations. The final process step typically uses an orbital type polisher with speeds of 1,500 to 2,000 R.P.M. Refer to *Clearcoat Repair Specifications - Meguiar Products* or *Clearcoat Repair Specifications - 3M Products.*
- Don't use wax or silicone type products to hide swirl marks (this damage will reappear later and cause customer dissatisfaction).
- Specific conditions on the paint (environmental damage, rail dust, etc.) can be corrected by:
  - Refer to *Environmental Fallout (Acid Rain).*
  - Refer to *Rail Dust Damage Repair.*

1. Thoroughly wash repair area with Liquid Wash and Wax.
2. Readings of the paint film build should be taken prior to the operation. Refer to *Paint Gauges.*
3. Apply a small amount of the appropriate material to repair area and smear evenly with the pad. Refer to *Clearcoat Repair Specifications - Meguiar Products* or *Clearcoat Repair Specifications - 3M Products.*
4. With the polisher running at approximately 1,500 rpm, to 2,000 rpm polish the repair area. Keep the pad flat against the panel while applying heavier pressure applied for 4–6 seconds, then polish with lighter pressure for 6–8 more seconds. Feature lines and panel edges should be hand-rubbed to avoid burn-through.
5. Check the repair area frequently and, if necessary, add more of the appropriate material if required.

6. Always blend or feather the outer edges of the repaired area.
7. After buffing, the repaired area should be inspected.
8. If swirls are still visiable, repeat the buffing procedure.
9. Clean the repaired area with a clean soft, non-scratching cloth with a 50/50 mixture of Isopropyl Alcohol and water.
10. If sanding is required, refer to *Clearcoat Repair Specifications - Meguiar Products* or *Clearcoat Repair Specifications - 3M Products*.

Corrosion Repair

Caution: When applying sound deadeners, or anti-corrosion materials due care and preventative measures must be exercised to prevent any material from being sprayed into door and quarter panel mechanisms such as door locks, window run channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody, particularly the parking brake cable. After material application, be sure that all body drain holes are open. Improper application may increase chance of corrosion damage or limit the operation of moving parts, resulting in personal injury.

Caution: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Prior to replacing exterior body parts, check the condition of the paint on all covered or hidden interior surfaces. If rust scale is found in these areas, proceed as follows:

1. Remove rust with wire brush, abrasive or liquid rust removing agent. Follow label directions.
2. If necessary, wash with detergent, rinse and dry.
3. Apply a heavy coating of anti-corrosion compound to all cleaned hidden surfaces before installing exterior body parts. Apply anti-corrosion compound to all inner surfaces of exterior body parts being installed.

Environmental Fallout (Acid Rain)

Since the severity of the condition varies from area to area, proper diagnosis of the damage extent is critical to the success of repairs. Diagnosis should be performed under high intensity fluorescent lighting, on horizontal surfaces (hood, roof panel, rear compartment lid) after they have been properly cleaned. There are three basic types of acid rain damage:

1. Surface level contamination - may be repaired by simply washing the vehicle, cleaning the surface with a silicone, wax and grease remover, neutralizing acidic residue and finesse polishing, refer to Surface Level Contamination Repair in this procedure.
2. Clearcoat etching - slight etching still noticeable after the above washing and finesse polishing procedure, refer to Slight Clearcoat Damage — Wet Sanding, Finesse Polshing in this procedure.
3. Basecoat etching - severe etching beyond the clearcoat into the basecoat, refer to *Basecoat/Clearcoat Paint Systems*.

Slight Clearcoat Damage — Wet Sanding, Finesse Polishing

Notice: Removing too much of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

Important: Always refer to manufacture's packaged instructions for the detailed procedures of materials used for compounding or polishing.

1. Select a small test area on the damaged panel.
2. Readings of the paint film build should be taken prior to the operation, refer to *Paint Gauges*.
3. Wet sand the damaged area with an ultra-fine sandpaper and rubber sponge sanding block. Refer to the manufacture instructions for detailed procedures for the materials used in the repairs. During the wet sand process:
   3.1. Use ample amounts of water.
   3.2. Go slow to prevent removing too much clearcoat.
4. Remove the excess water with rubber squeegee and inspect area. If wet sanding has repaired the damage, continue the sanding procedure on the entire panel.
5. Apply a finesse-type polish with a foam pad and remove any swirl marks with a dual action orbital polisher and foam pad. Refer to *Clearcoat Repair Specifications - 3M Products* or *Clearcoat Repair Specifications - Meguiar Products*. If (during the repair) it is suspected or observed that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding or base color is transferred to pad during polishing, the affected areas may require clearcoat/basecoat application or refinishing. Refer to *Basecoat/Clearcoat Paint Systems*.
6. Polish the entire vehicle after all damage has been repaired.

Surface Level Contamination Repair

Notice: Removing too much of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

Important: Always refer to manufacture's packaged instructions for the detailed procedures of materials used for compounding or polishing.

1. Thoroughly wash the repaired area with Liquid Wash and Wax, and dry thoroughly.

2. Clean affected area with silicone, wax and grease remover.
3. Neutralize left over acidic residue by cleaning damaged areas with mixture of baking soda and water (one tablespoon of baking soda per one quart of water). Rinse thoroughly and dry panel completely.
4. Apply finesse-type polish with foam panel. If damage has been repaired, remove any swirl marks with dual action orbital polisher and foam pad. Refer to *Clearcoat Repair Specifications - 3M Products* or *Clearcoat Repair Specifications - Meguiar Products*.
5. If some damage remains, refer to Slight Clearcoat Damage—Wet Sanding, Finesse Polishing in this procedure.

Paint Gauges

The best way to accurately measure how much clearcoat has been removed is to use a paint gauge before, during and after the sanding process. Paint gauges measure the total thickness of the finish and when used, can determine how much clearcoat has been removed during the repair process. Paint gauges range from magnetic pull type to sophisticated electronic types and are available from a variety of sources. The older magnetic type gages, at best have a 5 percent accuracy range and are not sensitive enough to detect removal of 0.020 mm 0.5 mil; (0.0005 inch) clearcoat. The newer type magnetic gauges have improved accuracy ranges. Most gauges are confined to checking either ferrous metal (steel) or non ferrous metal (aluminum) panel. At this time, there are no viable gages for reading film thickness on nonmetallic panel. The more sophisticated (ETG) Electronic Paint Thickness Gauges digital type gauges are able to read film thickness on both ferrous and non-ferrous metal panel. Digital (ETG) gages can have an accuracy range of 1 percent and include thickness standards for recalibration.

Clearcoat Thickness

The clearcoat on the vehicle is typically 0.059 to 0.078 mm (1.5 to 2 mils; 0.0015 to 0.0020 inch) thick.

Rail Dust Damage Repair

Caution: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Important: If rail dust has penetrated into the basecoat, the panel requires refinishing. Make sure all the rail dust has been removed prior to refinishing or the rust spots will return.

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of, or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust colored spots in the paint.

1. Move the vehicle to a cool shaded area and make sure the vehicle surfaces are cool during the removal process.
2. Thoroughly wash repair area with Liquid Wash and wipe dry.
3. Clean the affected area with silicone, wax and grease remover.
4. Perform the removal process according to the manufacture's directions of the type of repair material used (Gel Type Oxalic Acid or Clay Type Non-Acid Based). If, upon inspection, some particles are still present, the process can be repeated. If the damage has been repaired, complete the repair to the entire panel.
5. Polish the entire panel after the removal process, refer to *Clearcoat Repair Specifications - 3M Products* or *Clearcoat Repair Specifications - Meguiar Products*, if small pits remain in the clearcoat after all damage has been repaired. Refer to *Clearcoat Repair w/o Repainting*.

Frame and Underbody

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Assist Step Bolt	45 N.m	33 lb ft
Crossmember Bolt/Nut	70 N.m	52 lb ft
Tow Hook Bolt	163 N.m	120 lb ft

Yield Strength of Different Metals

Metal Types	Specification	
	kPa	psi
SAE J-1392-050	344,750	50,000
SAE J-1392-080	551,600	80,000
SAE 1027 (Heat Treated)	758,400	110,000

Welding Table

Materials Used	SAE J-1932-050		J-1392-080
Process	GMAW	SMAW	SNAW
Electrode	E70S-3	E7016, E7018	E11018
Minimum Yield of Electrode	413,700 kPa (60,000 psi)	413,700 kPa (60,000 psi)	668,815 kPa (97,000 psi)
Chamfer Used When Cutting Away the Sides of a Crack to Be Welded	60°	90°	90°

Electrode Table

Electrodes	E-7011, E-7016	E-7018, E-11018
Flat Welding		
Available Sizes	Current Range (Amps)	Arc Voltage
5/64 in x 9 in	30–60	20–22
5/32 in x 12 in	45–80	21–23
1/8 in x 14 in	80–115	21–23
5/32 in x 14 in	125–165	22–24
3/16 in x 14 in	160–200	22–24
7/32 in x 18 in	200–250	23–25
1/4 in x 18 in	250–320	23–25
5/16 in x 18 in	325–400	24–28
Overhead Welding		
Available Sizes	Current Range (Amps)	Arc Voltage
3/32 in x 12 in	45–75	20–22
1/8 in x 8 in	80–125	20–24
5/32 in x 14 in	120–190	21–24
3/16 in x 14 in	150–240	21–24

Plug Weld Chart

Thickness of Material	Diameter of Plug	Depth of Plug
6 mm (1/4 in)	19 mm (3/4 in)	6 mm (1/4 in)
10 mm (3/8 in)	25 mm (1 in)	10 mm (3/8 in)
13 mm (1/2 in)	29 mm (1 1/8 in)	11 mm (7/16 in)
16 mm (5/8 in)	32 mm (1 1/4 in)	13 mm (1/2 in)
19 mm (3/4 in)	35 mm (1 3/8 in)	14 mm (9/16 in)
25 mm (1 in)	38 mm (1 1/2 in)	14 mm (9/16 in)

Diagnostic Information and Procedures

Checking Frame Alignment

Checking with Gauges

The various types of frame misalignment may be divided into the following groups:

- Sag
- Buckle
- Diamond
- Side Sway
- Twist

A misaligned frame may have moved forward from, upward or downward from, or to the side of the frame's original position. Inspect the vehicle when such conditions are present. The most efficient way to check frame alignment is to use gauges. Detailed instructions are normally supplied with the gauges at the time of purchase. You can, however, check the frame alignment without gauges. Refer to Checking without Gauges.

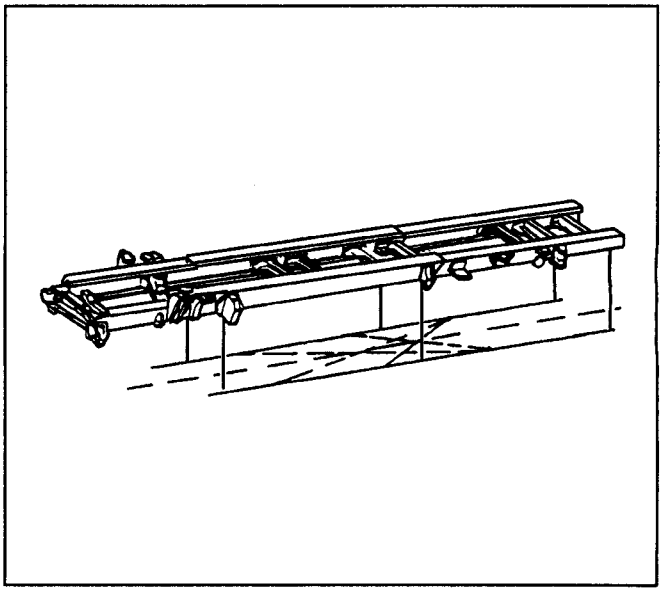
Whether you check alignment with or without gauges, park the vehicle on a level section of the floor.

Certain conditions call for some preliminary checks before actually checking the frame. Suspension or axle problems may be mistaken for frame misalignment. For example, a shifted axle may appear to be frame diamond or side sway. A weak spring may appear to be a twisted frame.

A visual inspection on the top and the bottom of the flanges of each rail may reveal an area on which sag or buckle exist. In the case of sag, wrinkles will appear on the top of the upper flange. Such wrinkles are definite evidence of sag. Wrinkles on the bottom or the lower flange are definite evidence of frame buckle.

Checking without Gauges

1. Move the vehicle to a level, well-lit section of the floor.
2. Make a diagram of the frame on the floor under the vehicle.
3. Pick several points on the bottom flange of each of the frame rails. Leave clear access from these points to the floor. Mark one point at the rear end of each of the rails. Ensure that all of the points are the same distance from the vertical part (web) of the rail.
4. Use a plumb bob to transfer the points on the rails to the floor directly beneath the rails.
5. Move the vehicle away from the points on the floor.
6. Mark a chalk line through the points representing each of the rails.
7. Measure the distance between each point and the line representing the rail. The distance should be not be more than 3 mm (0.12 in). A distance greater than 3 mm (0.12 in) indicates side sway.
8. Measure the distance between the web at the end point of the rear section of the rails. The distance should measure 851 mm (31.5 in).
9. Measure the distance between the inside of the frame rails at the front of the frame. This distance should be 851 mm (31.5 in).
10. Measure the length of each of the rail lines. Each rail line should be the same length.
11. Mark a point on one of the rail lines, a given distance from one end of the vehicle. Mark a point on at the same spot on the other rail line.
12. Mark a pair of diagonals from the two points on the rail lines to the opposite rail. Make the diagonals the same length.



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13. Mark a second pair of diagonals from the original two points on the rail lines to the opposite rails. The second pair of diagonals should be the same length as each other, but longer than the first pair of diagonals.
14. Mark a line between the points of the intersection of the two pairs of diagonals. This line should be the same distance from each of the frame rails at any given point along their edges.

The following steps offer an alternative method of checking the vertical alignment of a normally straight rail:

1. Measure the distance from the frame rail to the floor at several different points along the rail. The vehicle must be on a level section of the floor.
2. Transfer these distances, in order, to a sheet of graph paper.
3. Connect the points, representing each distance, on the graph paper.
4. If the rail is straight (vertically), the points should all lie on a straight line.

Frame

Sag

Problem	Action
The vehicle is overloaded.	Straighten and reinforce the frame. Refer to *Frame Straightening Description.*
The load distribution of the vehicle is uneven.	
Abrupt changes in section modulus.	
Improper body or accessory mounting, including the following situations: • Holes drilled in the flange of the frame rail • Too many holes in the web section of the rail • More than four holes in the same vertical line of the rail web • Welds on the flange, particularly across the flange or along the edge of the flange • Cutting holes in the rail with a torch • Cutting notches anywhere on the rails	
A vehicle fire.	
A vehicle collision.	
The use of improper equipment.	

Buckle

Problem	Action
Operating an overloaded dump truck with the box raised.	Straighten and reinforce the frame. Refer to *Frame Straightening Description.*
The surging of liquids in a tank truck.	
A vehicle collision.	
A vehicle fire.	
Abrupt changes in section modulus.	

Side Sway

Problem	Action
A vehicle collision.	Straighten and reinforce the frame. Refer to *Frame Straightening Description.*
A vehicle fire.	
Abrupt changes in section modulus.	

Diamond

Problem	Action
A vehicle collision.	Straighten and reinforce the frame. Refer to *Frame Straightening Description.*
Towing another vehicle with a chain attached to one corner of the frame.	

Twist

Problem	Action
A vehicle collision.	Straighten and reinforce the vehicle. Refer to *Frame Straightening Description.*
Operating the vehicle on excessively rough terrain.	

Improper Tracking

Problem	Action
The frame is not aligned properly.	Straighten and reinforce the frame. Refer to *Frame Straightening Description.*
Shifting of the front or rear axle.	Realign and secure the axle.
The wheels are out of alignment.	Align the wheel. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

Cracks in the Web of the Rails

Problem	Action
Loose crossmember attaching bolts.	Replace, or weld and reinforce the rail.
Stress concentration. Refer to *Minimizing Frame Service Description.*	1. Ream the bolt holes and install larger bolts if necessary. 2. Tighten the bolts. Refer to *Fastener Tightening Specifications.*

Frame Conditions

Analyzing Damage

This analysis does not cover the causes of all possible frame problems. However, it may provide valuable assistance with preparing reports.

Frame damage does not happen without a cause. The cause of damage is not always as apparent as it may be in a collision.

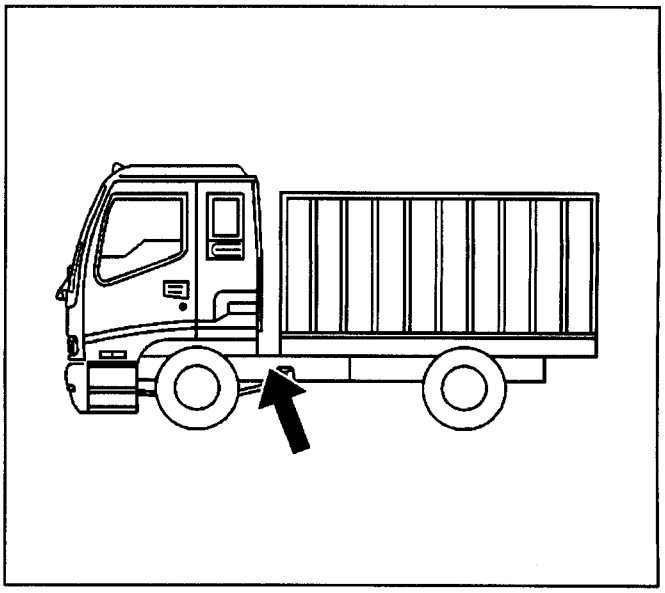
Frame damage may be broken up into the following classifications:

- Collision
- Excessive bending movement
- Localized stress concentration

Repair the damage caused by a collision by using the proper methods and reinforcements.

Excessive bending movement damage is caused by overloading, improper weight distribution, or misapplication of the vehicle. Excessive bending movement damage will occur at different areas on various types of vehicles.

Straight Trucks



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Maximum bending movement occurs in the area near the rear of the cab on vehicles that have cab or platform bodies. Overloading or loads dispersed in diminishing quantities, allowing the balance of a load to remain in the extreme front of the body, may cause damage.

Stress Concentration

Localized stress concentration failures may result from bending movement stresses. However, the stress levels would not be high enough, in the aforementioned instances, to cause any difficulty without localized stress concentration points. These localized stress concentration points may result from poor body mounting, special equipment, or defective material. They may also occur as a result of high bending loads, coupled with severe torsional loads such as off-road service.

Use wood sills between the main rails and the sub-frame on the body installation in order to ensure a satisfactory load distribution.

Special equipment or accessory installation may cause high stress concentrations due to the method of attachment or the weight of the equipment. Do not drill holes through the flanges. Avoid rapid changes to the section modulus that usually occur when large mounting plates are added for the support of special equipment. Mounting heavy equipment across the flanges or on the web of a side rail may cause enough stress concentration to cause damage at any of the following locations:

- The nearest crossmember
- The bracket
- The other frame stiffener
- Through a nearby hole in the frame flange

Repair Instructions

Frame Straightening Description

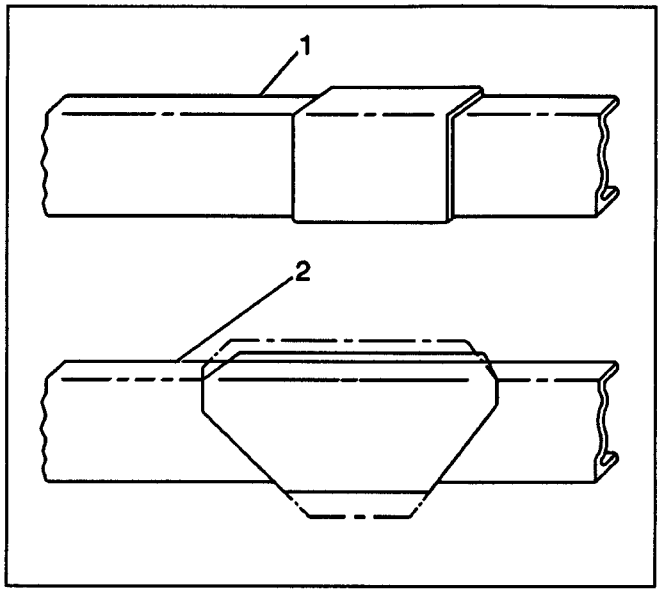
Notice: Some frames are constructed of heat-treated steel. Do not weld or drill these frames. The use of heat, in excess of 606° C (1200° F), can weaken, cause distortion and change the characteristics of the steel.

Frame straightening may be a complicated process and usually requires some special equipment. Only trained technicians should perform a frame straightening procedure.

Conduct a complete analysis of the frame condition before beginning the straightening process in order to determine the correct sequence of steps for the repair procedure. Refer to *Frame* and *Minimizing Frame Service Description*. Identify the frame material before beginning the repair procedure. Refer to *Frame and Underbody Description*.

Adhere to the following instructions while conducting the repair procedure:

- Apply pressure from different directions in order to reverse the flow of damaging forces.
- Control the temperature and the application of the heat.
- Heat the frame using a large sized tip (multi-hole heating tip) and a neutral flame. Keep the oxygen opened just enough to remove the feathers or the stringers from the blue center at the tip of the torch.
- Heat the area that will be stretched as the frame is straightened.
- Heat the area after exerting sufficient pressure. A slight checking or some silvery cracks will appear on the surface of the metal when heating it at an adequate pressure.
- Gradually increase the pressure while heating the metal.
- A red glow is an indication of overheating.



207501

Frame Repair

Reinforcement Description

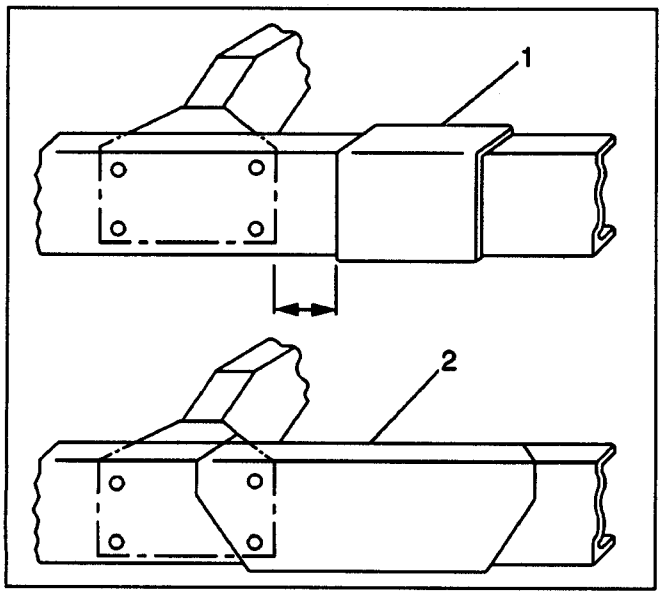
Reinforcements increase frame strength by increasing the section modulus of the reinforced area. An effective reinforcement must compensate for any factors that could cause damage to the frame, while not introducing any new factors that may cause stress concentrations. While a reinforcement is intended to make the frame (1) less flexible, an excessively stiff reinforcement may cause frame failure.

Adhere to the following guidelines when selecting the type or length of a reinforcement:

- Use reinforced rails, rather than the heavier one-piece rails, on a new vehicle. Add reinforcements if the unsupported span between the axles is too great due to a long wheelbase.
- Avoid abrupt changes in the section modulus by using tapered reinforcements.
- Use the specified practices when welding, drilling, or using bolts in a reinforcement procedure. Refer to *Welding Chart*, *Electrode Chart*, *Plug Weld Chart*, and *Fastener Tightening Specifications*.
- Metals vary in type and strength. The strength of a reinforcement should be as high as the frame that it is reinforcing. Refer to *Yield Strength of Different Metals*.

Reinforcement Types

Any incorrect (1) reinforcement practices may cause abrupt changes to the section modulus.

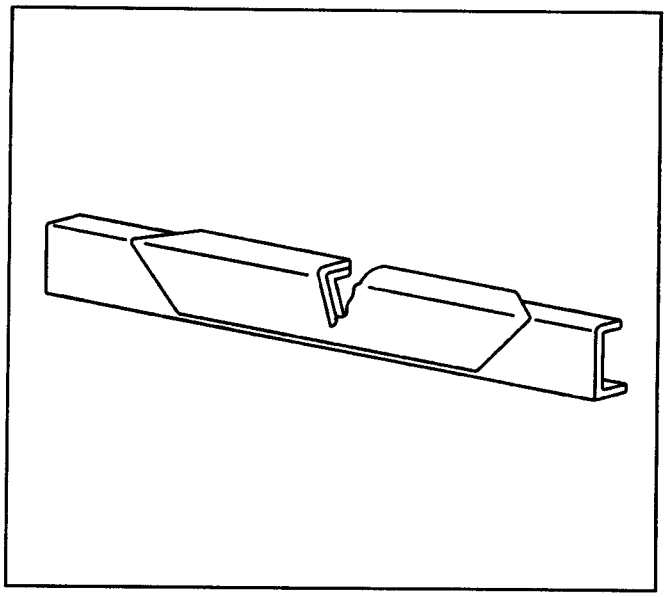


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Follow the correct (2) reinforcement practices carefully to avoid any frame damage.

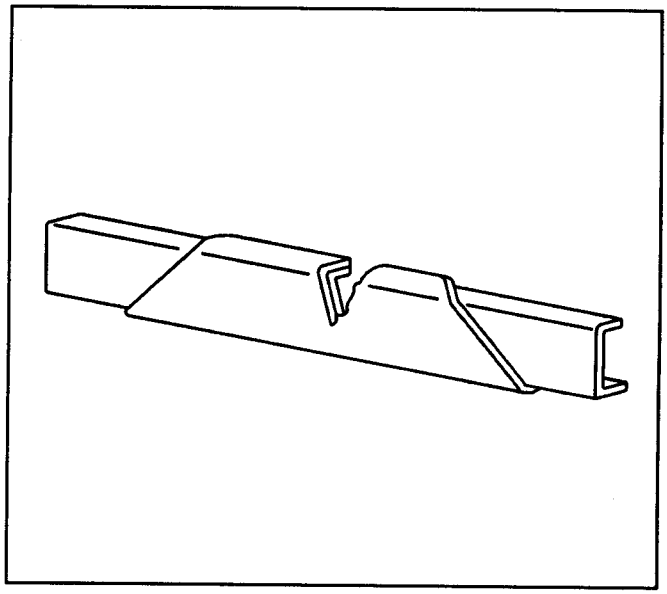
The following types of reinforcements may be combined in different ways to meet any special needs (i.e. heavy demands):

- Use an inverted L reinforcement on either the inside or the outside of the frame rail. Use the inverted L reinforcement where the maximum stress occurs on the upper flange and where the frame or hanger-bracket design does not allow the use of an upright L reinforcement.



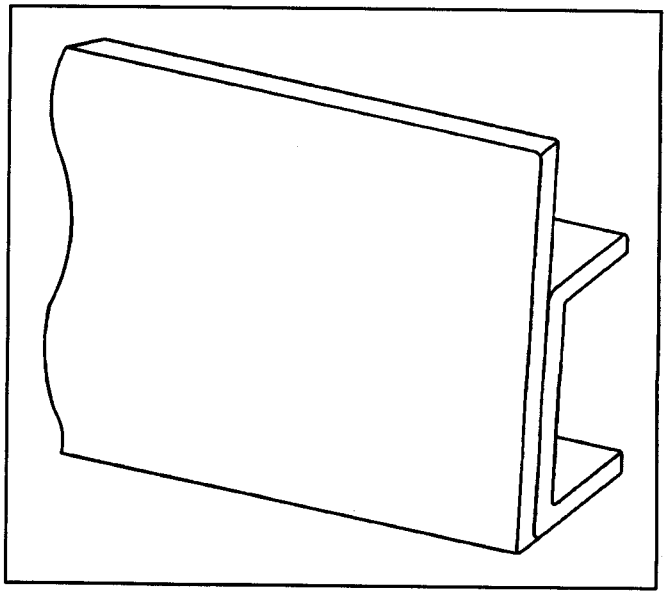
207484

- Use channel reinforcements on the inside or the outside of the frame rail in order to reinforce the flange and the web rail.

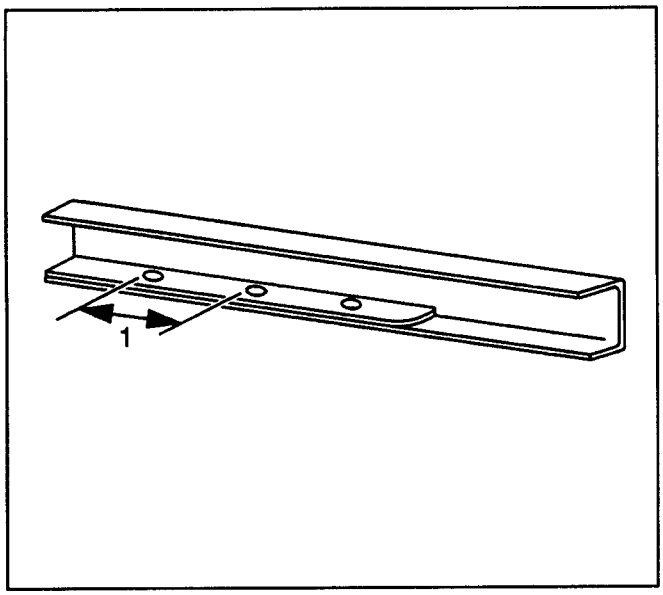


207486

- Use web reinforcements, plug welded at 200–500 mm (7.87–19.68 in), on the inside of the rail web.

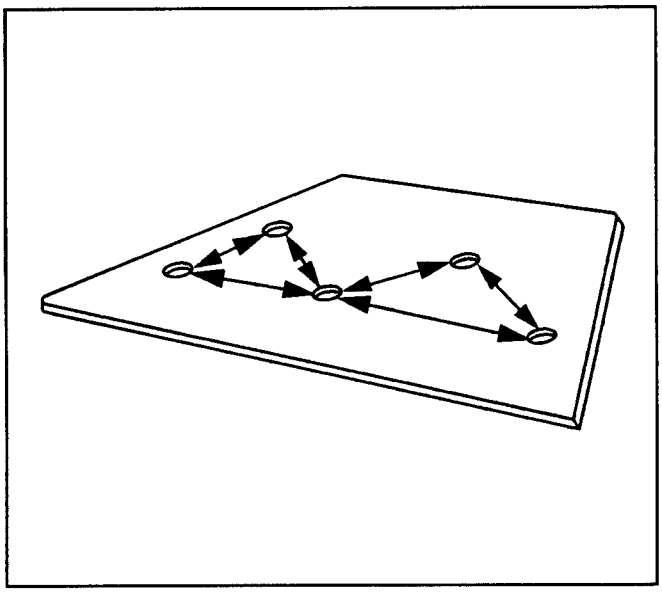


207489



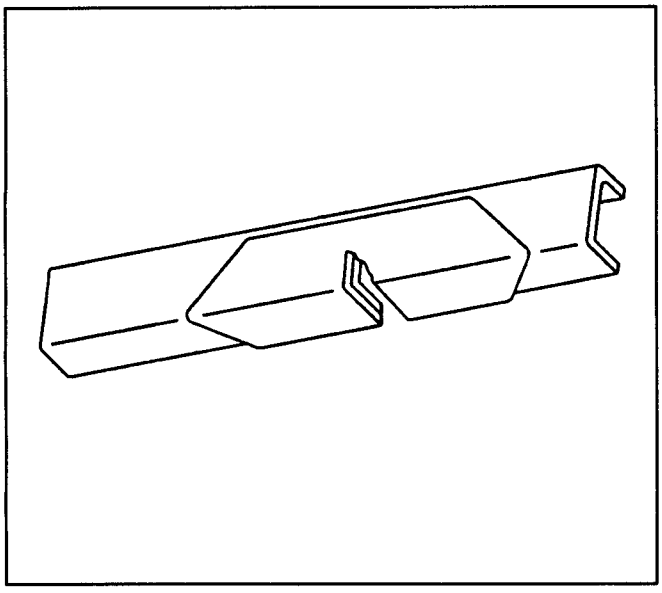
207491

- Use strap reinforcements, plug welded at 150–200 mm (5.9–7.87 in) intervals (1), on the rail flange on the inside of the channel. Do not weld across the end or along the edges of the reinforcement.



207493

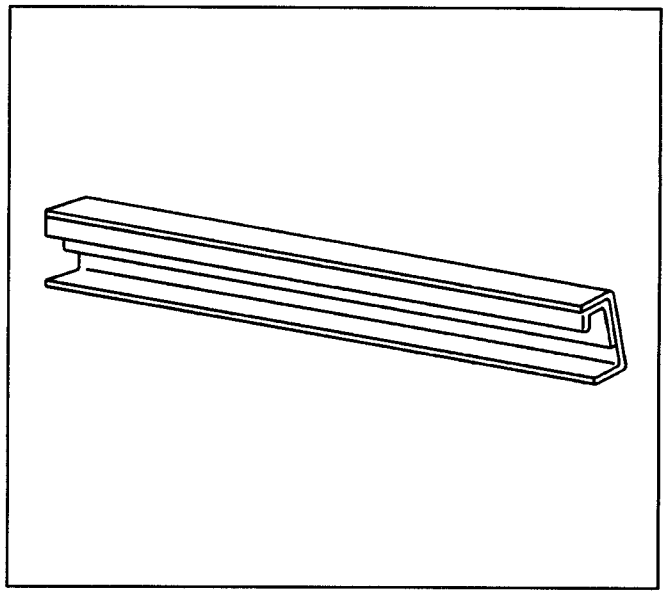
- Use fish plate reinforcements on the outside of the rail web, extending above or below the rail, to stiffen the frame.



207494

- Use an upright L reinforcement on the inside or the outside of the frame rail. Use an upright L reinforcement where the maximum stress occurs on the bottom of the lower flange.

- Use inverted J reinforcements, attaching only to the web section, on the inside of the rail channel. The inverted J reinforcement is designed to prevent any flange buckling due to high torsional inputs or shock loading during a tractor hook-up operation.

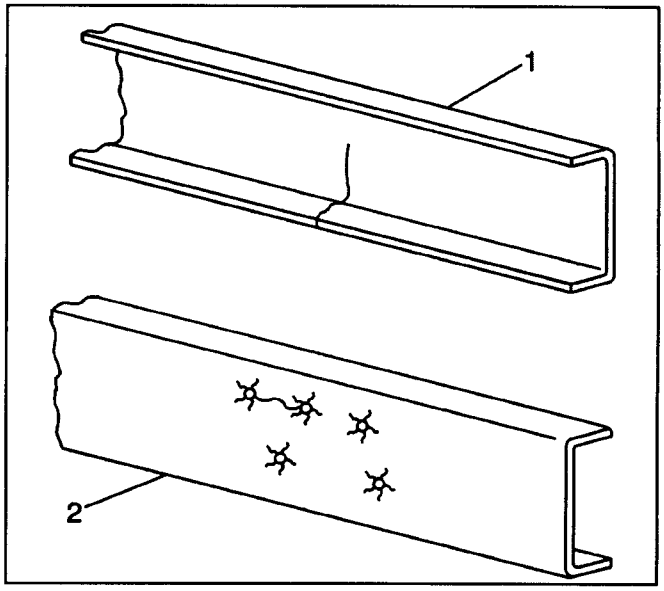


207497

Creating Reinforcements

Observe the following practices when creating a reinforcement of any type:

- Taper the reinforcement plates in order to avoid any abrupt changes in the section modulus. Ensure that the angles at the edge of a reinforcement plate are less than 45 degrees.
- Grind away any cracks, nicks, or burrs when using a cutting torch to shape the reinforcement plates. Remove any burrs from the edges of the holes.
- Avoid the gaps that may result when the reinforcements stop short of the ends of the crossmembers, gussets and brackets.
- Make the reinforcements long enough to extend beyond the critical area, after tapering.



207507

Attachment

Attach all reinforcements with rivets or, preferably, bolts. In some cases, welding may be acceptable. For example, a plug weld is used on a strap or a web reinforcement. It is acceptable to ream an enlarged or irregularly worn bolt hole in order for it to accept the next larger bolt diameter. Body-fit bolts with hardened washers may be used on critical areas. When using a body-fit bolt, ream the hole to a non-standard size to get an interference fit for the bolt. Use existing holes whenever it is possible. If it is necessary to make new holes, use a cobalt high-speed drill. Sharpen the drill to give a 150 degree included angle with a lip clearance of 7–15 degrees. Avoid enlarging a pilot hole in successive stages and also avoid breaking through to the full size at the bottom of the hole. Remove the lip of a hole with a reamer. Observe the following guidelines when attaching reinforcement:

- Bolt the reinforcements to the frame.
- Use existing holes if possible.
- Do not drill holes in heat-treated frames.
- Do not drill any holes in the frame flange.
- Make the holes as close to the neutral axis (halfway between the flanges) as possible.

- Do not make any bolt holes larger than the holes already in the frame, such as for the spring bracket bolts.
- Do not allow more than three holes on any particular vertical line of the web.
- All of the holes should be at least 13 mm (0.5 in) apart from each other.
- All of the holes in a reinforcement plate should be at least two times the material thickness from the edge of the plate.

Repairing Cracks

Straight cracks (1) and sunburst cracks (2) are the two common types of cracks found in a frame.

A straight crack usually starts from the edge of a flange, spreads across the flange, goes through the web section of the rail, and then continues through the other flange. A straight crack results from stress concentrations, excessive bending movement, and torsional loading. Refer to *Minimizing Frame Service Description.*

A sunburst crack radiates out from a hole in the web section of a rail or a crossmember. Applying a high load at a mounting bracket or a crossmember that is not securely attached to the rail may cause a sunburst crack.

If the rail and the reinforcement both crack at a particular area of the frame, repair each part separately. The flanges must react independently in order to prevent a localized stress concentration. Use a copper spacer between the flanges of cracked base rail flanges and cracked reinforcement flanges.

Use the same procedure for a crack in the crossmember mounting flange as for a crack in the side rail. However, when repairing a crack in the crossmember mounting flange, build up the weld bead in order to provide a smooth surface. Replace any excessively damaged crossmembers.

You may need to align the frame and level the rails before repairing the frame.

Use the following procedure in order to repair a crack in any rail, reinforcement, or crossmember that is not made of a heat-treated steel:

1. Remove any equipment inhibiting access to the crack.
2. Drill a 6 mm (0.23 in) hole in the extreme end of the crack.
3. V grind the entire length of the crack from the starting point to the 6 mm (0.23 in) hole in the extreme end. The angle of the V depends on the type of welding process that is used. Refer to *Welding Chart* for the appropriate angle.
4. Open up the bottom of the crack 2 mm (0.07 in) in order to allow an adequate penetration of the weld using a hack saw blade.
5. Weld the crack with the appropriate electrode and welding technique. Refer to *Electrode Chart* and *Welding Chart.*
6. Grind the weld until it is smooth on the inside and the outside of the rail or the crossmember. Remove any weld build up or notches on the edge of the flange.

Crossmember Replacement

Removal Procedure

1. Remove the wires and the cables.
2. Remove any other lines that are connected to the crossmember.
3. Remove the brackets and the valves.
4. Remove any other components that are mounted on the frame and may interfere with the removal procedure.
5. Remove the bolts or the rivets that are holding the crossmember to the frame rails. Support the crossmember while performing this step.
6. Remove the crossmember.

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Connect the crossmember to the frame rails with the bolts, the washers, and the nuts or the rivets.

   Tighten

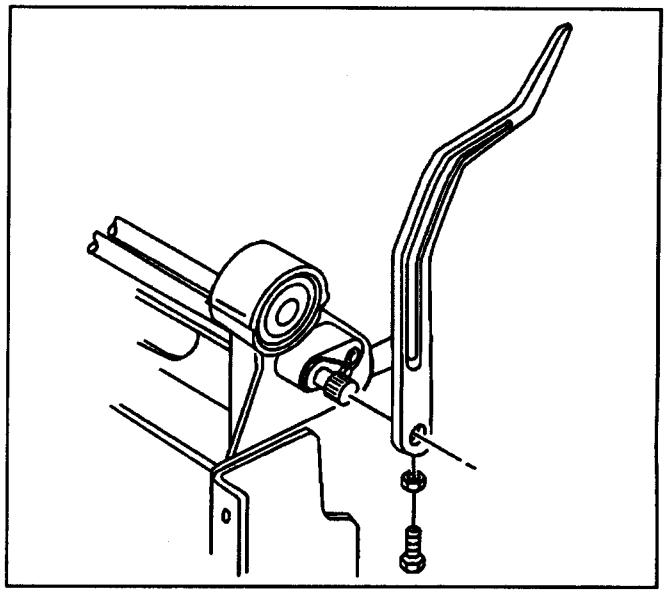
   Tighten the bolts to 70 N·m (52 lb ft).
2. Install the brackets and the valves.
3. Install any other components that were previously removed.
4. Install the wires and the cables.
5. Install any other lines that were previously removed.

Body Mount Replacement (Cab Mounts)

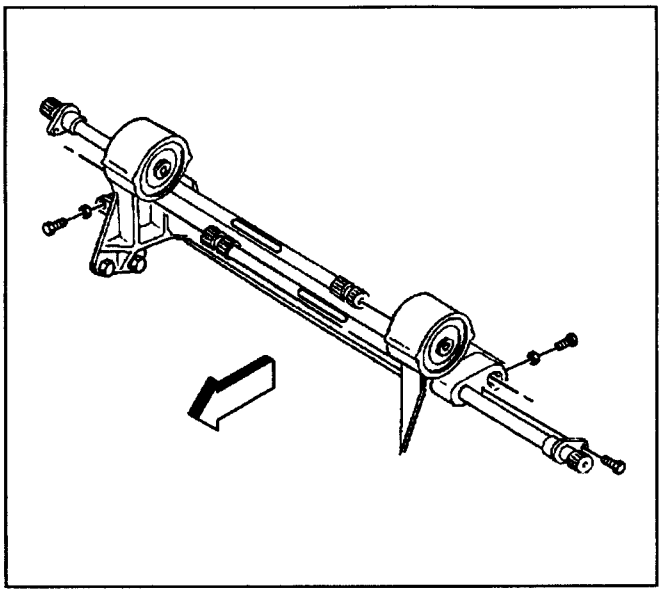
Removal Procedure

Notice: The cab must be properly supported and the weight of the cab evenly distributed during cab mount replacement. Failure to provide proper support could result in damage to the vehicle.

1. Raise the cab.
2. Mark the shaft and gear in order to aid in reassembly.
3. Remove the steering shaft at the steering gear.
4. Remove the cab lock cover.
5. Fasten a rope securely to the cable lock. Use a hoist or a chain block in order to keep the cab tilted.
6. Remove the torsion bar levers.

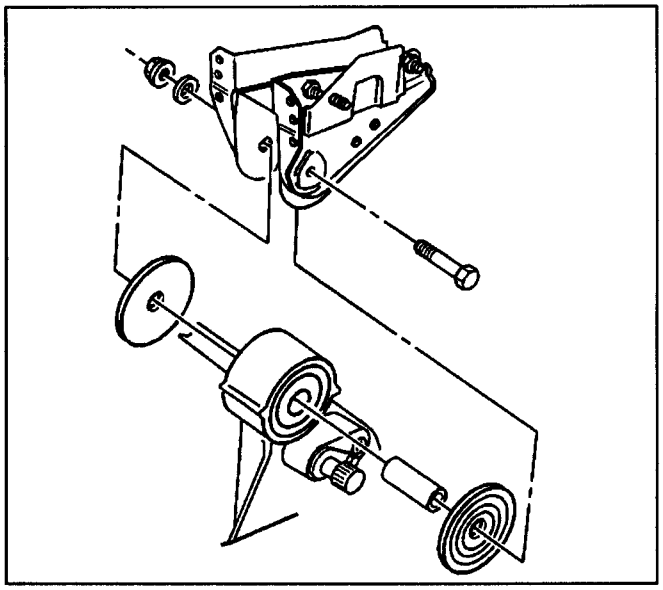


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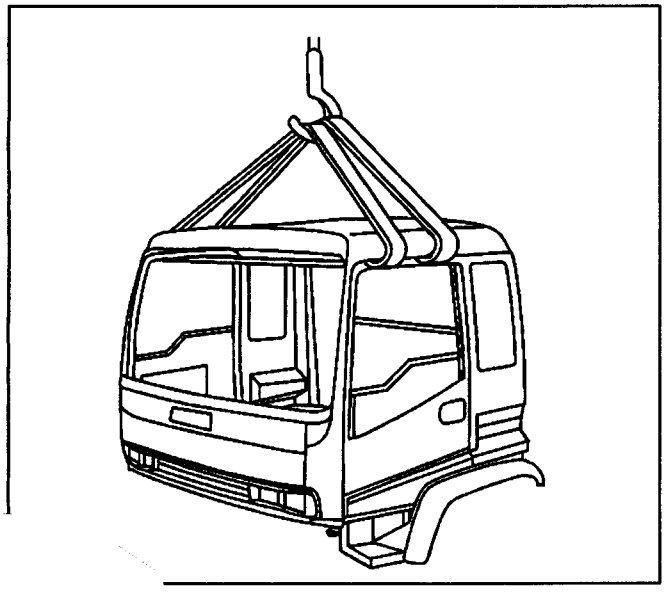
215795

7. Remove the cab tilt support.



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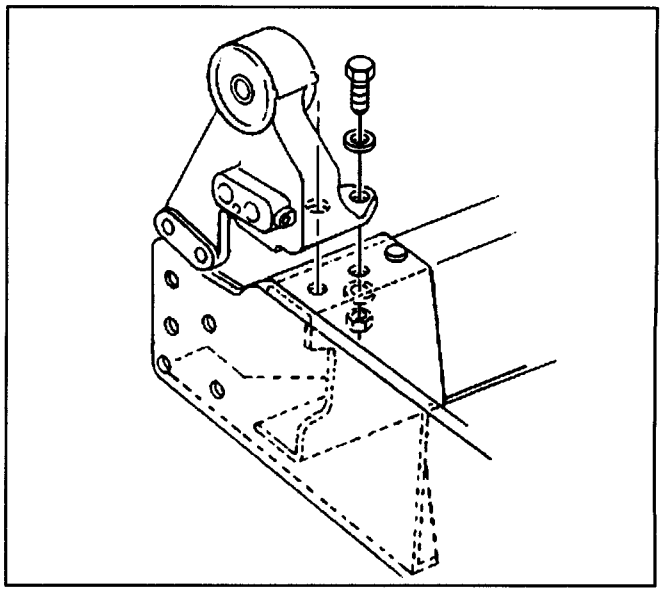
8. While slowly lowering the cab, remove each one of the center pins by tapping it with a hammer.



215784

9. Perform the following procedure. Keep in mind that the trimmed cab weighs about 1,000 lbs.
   - 9.1. Use four commercial straps that are 6 inches wide and about 10 feet long in order to lift the cab from the chassis.
   - 9.2. Pass the straps into the cab through the door on each side at the top rear of the window openings.
   - 9.3. Connect the straps in the center.
   - 9.4. Close the doors.
   - 9.5. Lift the cab from the chassis just enough to clear the mounts.

10. Remove the front cab mount assembly from the frame.



215816

Installation Procedure

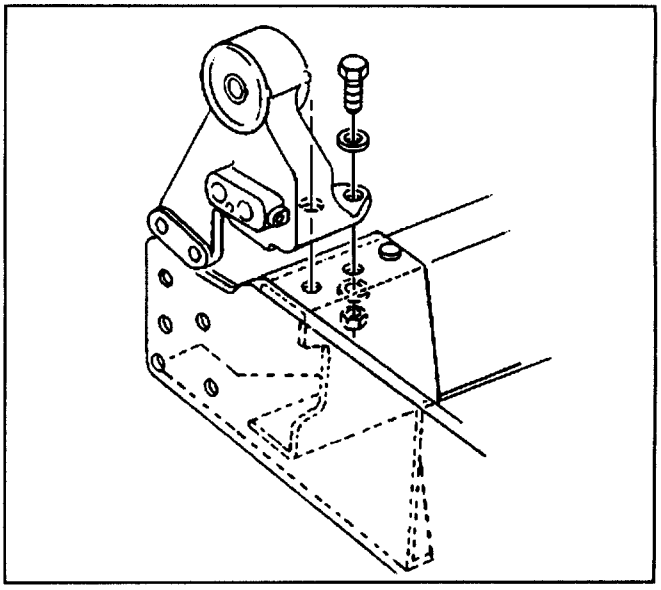
Notice: The cab must be properly supported and the weight of the cab evenly distributed during cab mount replacement. Failure to provide proper support could result in damage to the vehicle.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the front cab mount assembly to the frame.

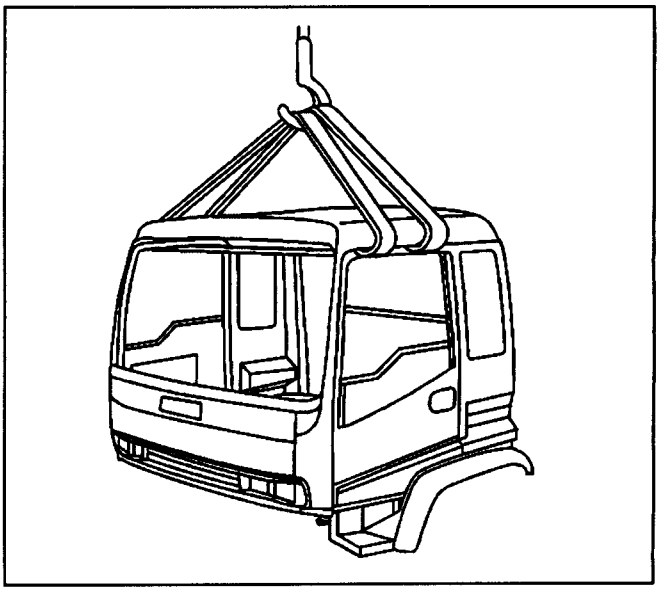
   Tighten

   Tighten the bolts to 162 N.m (119 lb ft).

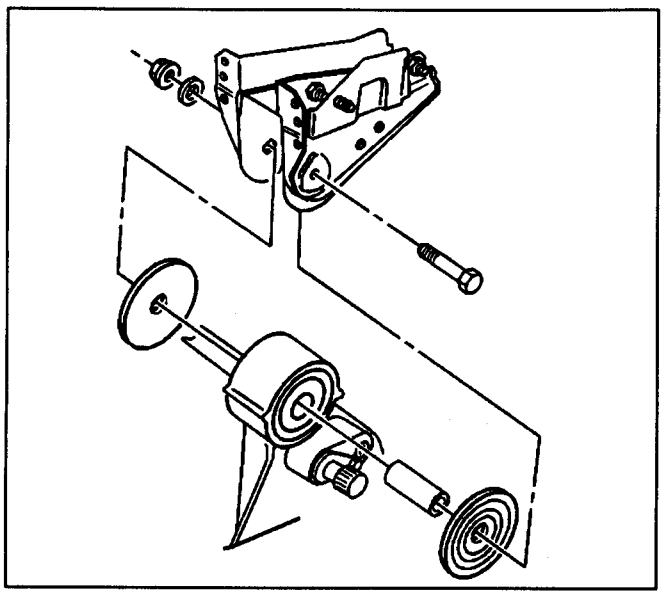


215816

2. Slowly lower the cab into position.

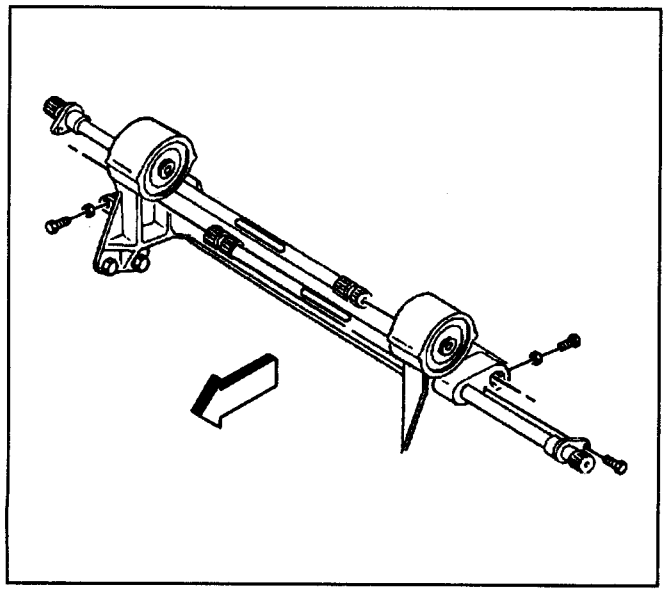


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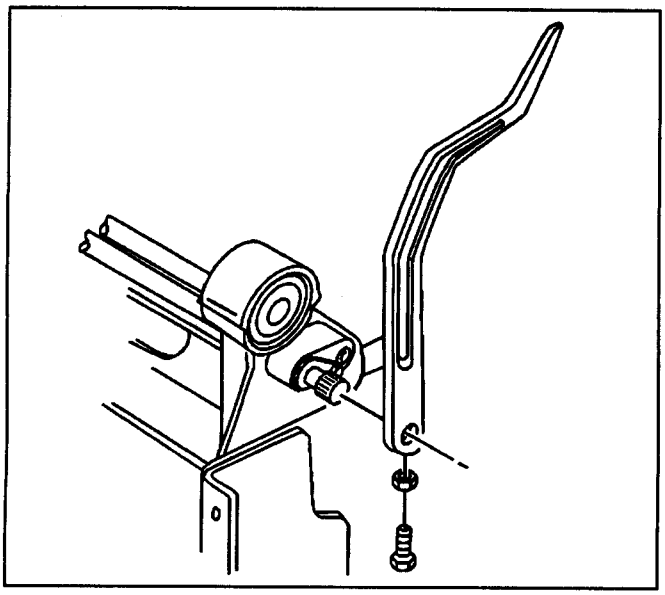
215794

3. Install the center pins (left and right).
4. Hook a wire to the cab striker, pull the safety lever, and tilt the cab slowly. Use the wire in order to keep the cab from floating up.
5. Install the cab tilt support to the cab.
6. Lower the bracket.
   Tighten
   Tighten the bolt to 45 N·m (33 lb ft).



215795

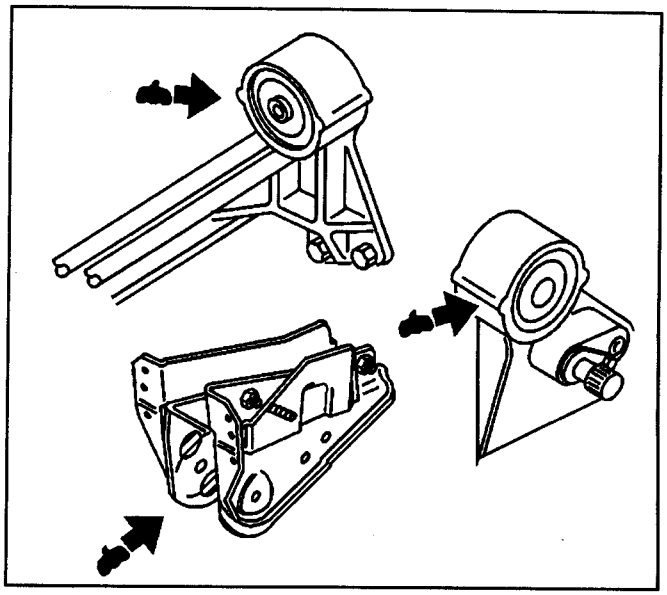
7. Lower the cab until the hole in the cab support inner channel aligns with the top hole in the cab support outer channel.
8. Install the following items:
   - The pin
   - The washer
   - The cotter pin



215792

9. Perform the following in order to install the torsion bar levers.
   - Locate the left and right identification marks.
   - Match the serrration.
   - Install the torsion bar levers.
     Tighten
     Tighten the bolt/nut to 37 N·m (27 lb ft).

10. Apply grease to the steering shaft.
11. Use the match marks made during disassembly as a guide to install the steering shaft.
12. Securely insert the steering shaft and the steering unit to the far end.
13. Tighten the key bolt.
    Tighten
    Tighten the bolt to 61 N·m (45 lb ft).
14. Lower the cab.

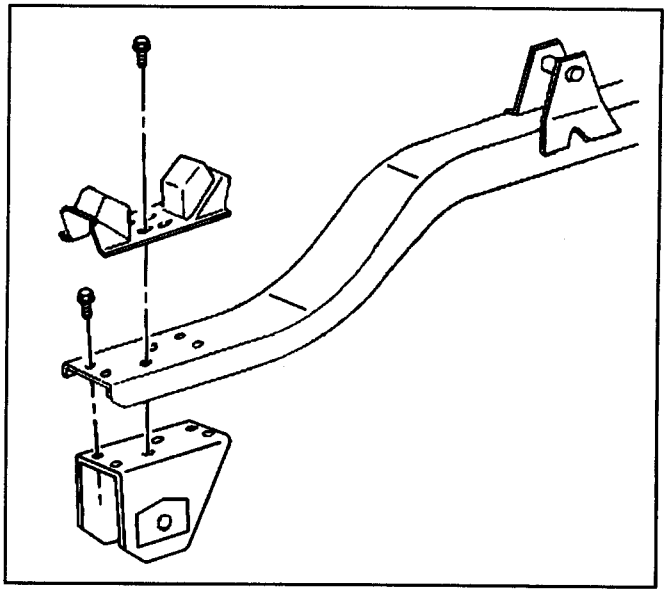


215820

Body Mount Replacement (Cab Mount)

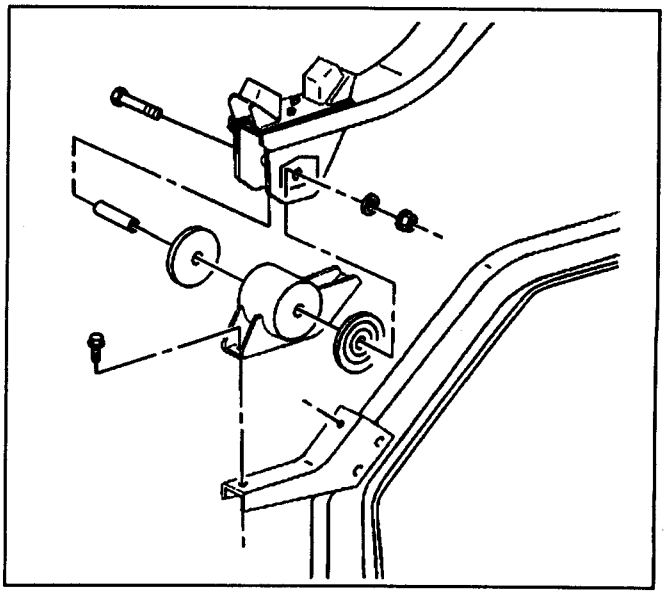
Removal Procedure

1. Raise the cab. Refer to Cab Replacement in General Information.
2. Remove the mount from the upper bracket.
3. Remove the following items:
   - The through bolt
   - The spacer
   - The washers

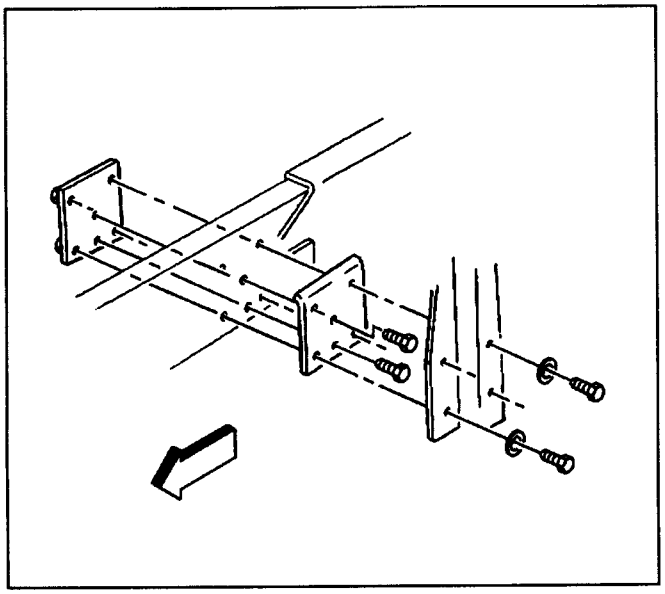


215823

4. Remove the upper bracket.
5. Remove lower bracket.

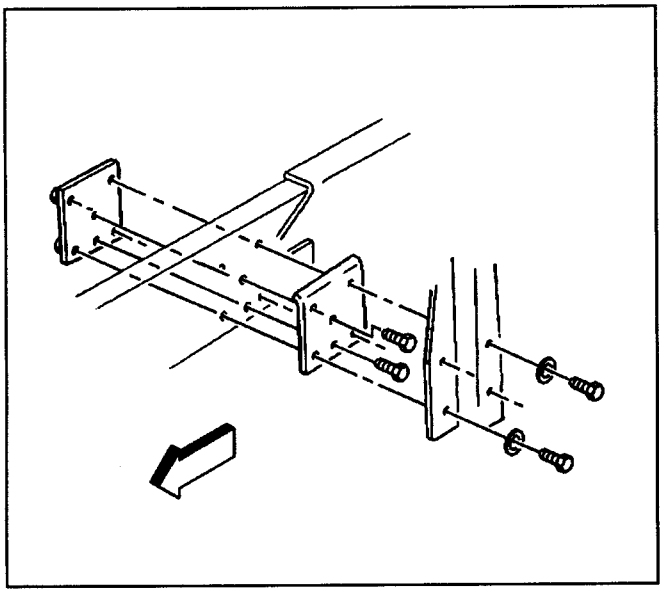


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6. Remove the rear body mount from the frame.



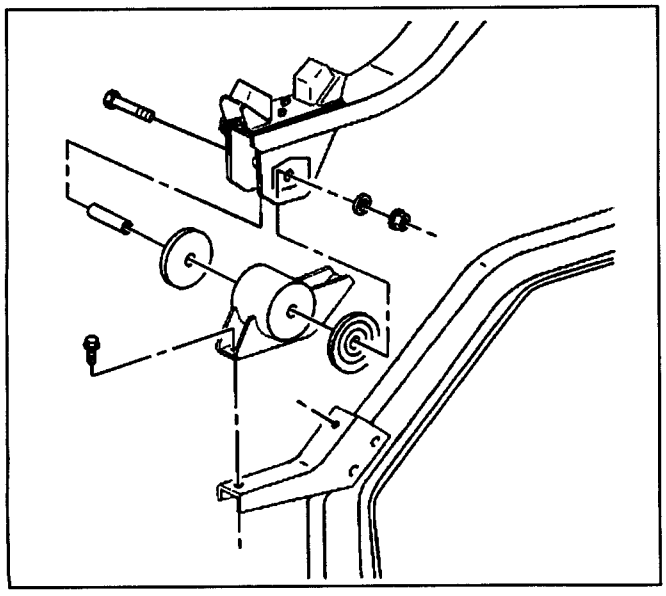
215830

Installation Procedure

Notice: The cab must be properly supported and the weight of the cab evenly distributed during cab mount replacement. Failure to provide proper support could result in damage to the vehicle.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

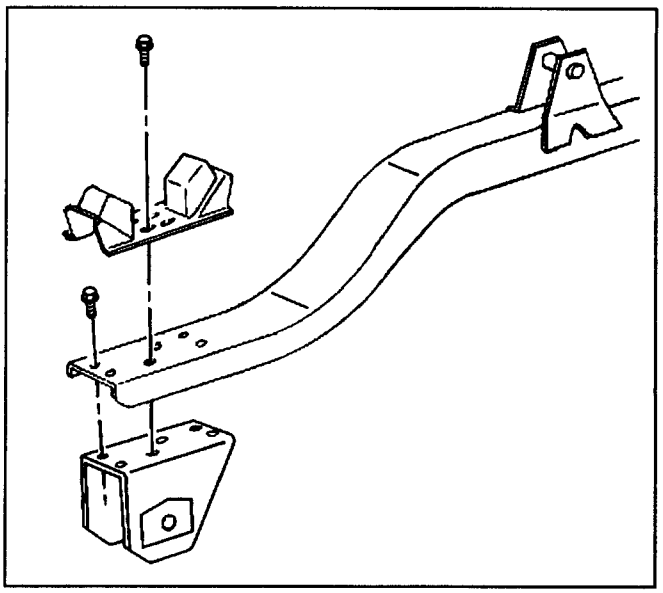
1. Install the rear body mount to the frame.
   Tighten
   Tighten the bolt to 240 N·m (177 lb ft).
2. Install the lower bracket.
   Tighten
   Tighten the bolts to 93 N·m (69 lb ft).



215826

3. Install the upper bracket.
   Tighten
   Tighten the bolt to 215 N·m (159 lb ft).
4. Install the following items:
   - The through bolt
   - The spacer
   - The washers

5. Install the mount to the upper bracket.
6. Lower the cab.

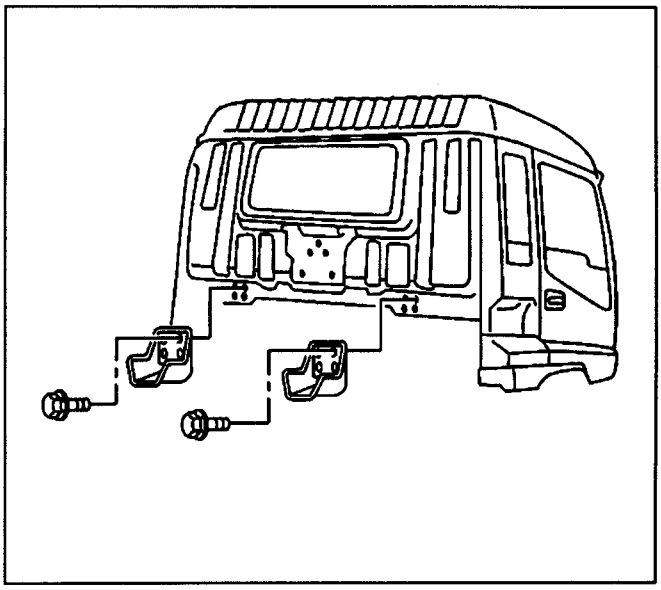


215823

Body Mount Replacement (Bracket)

Removal Procedure

1. Release the cab lock.
2. Remove the bolts from the bracket.
3. Remove the bracket from the cab.

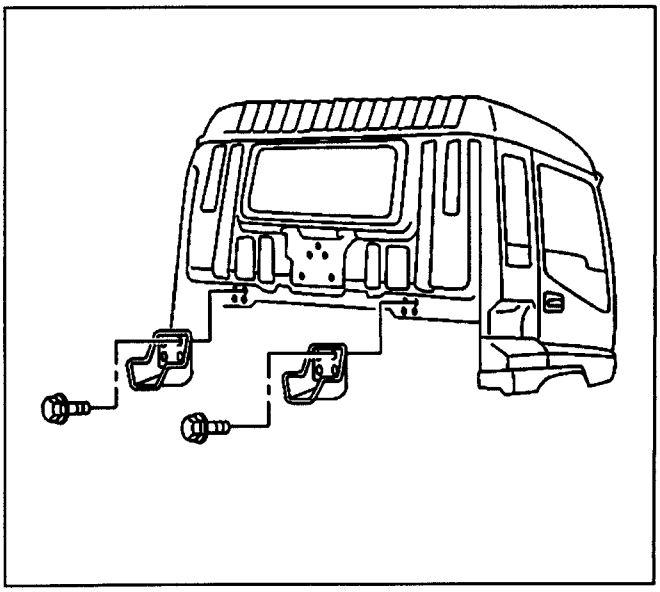


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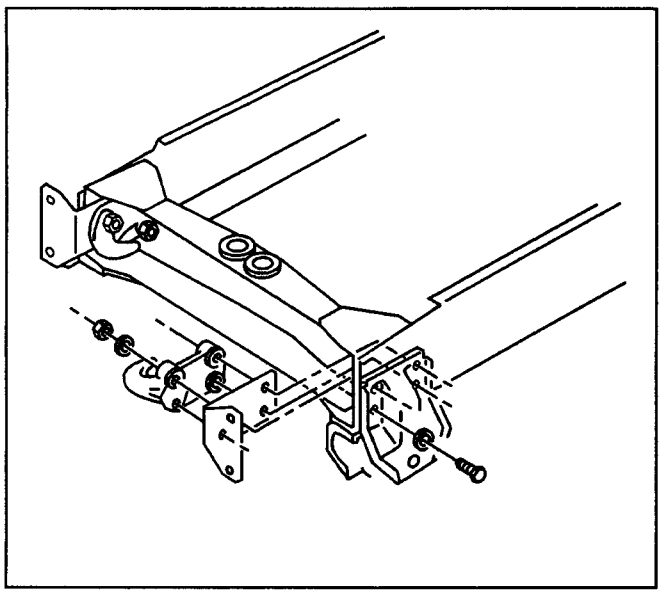
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

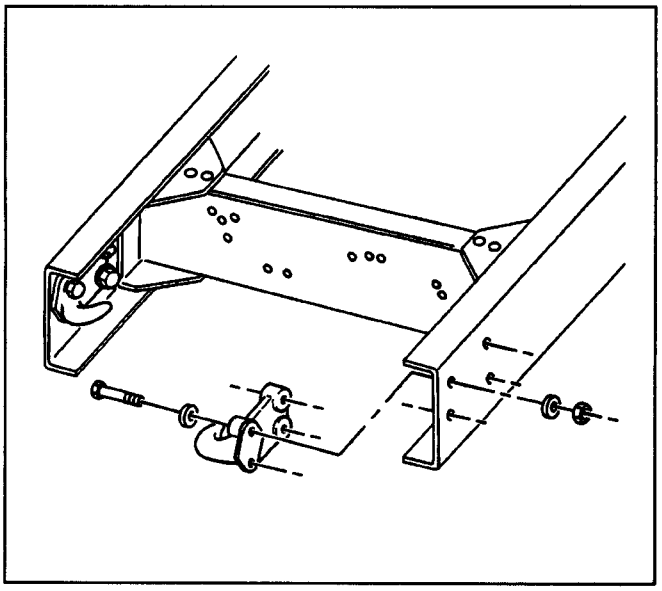
1. Install the bracket to the cab.
   Tighten
   Tighten the bolts to 15 N·m (11 lb ft).
2. Latch the cab lock.



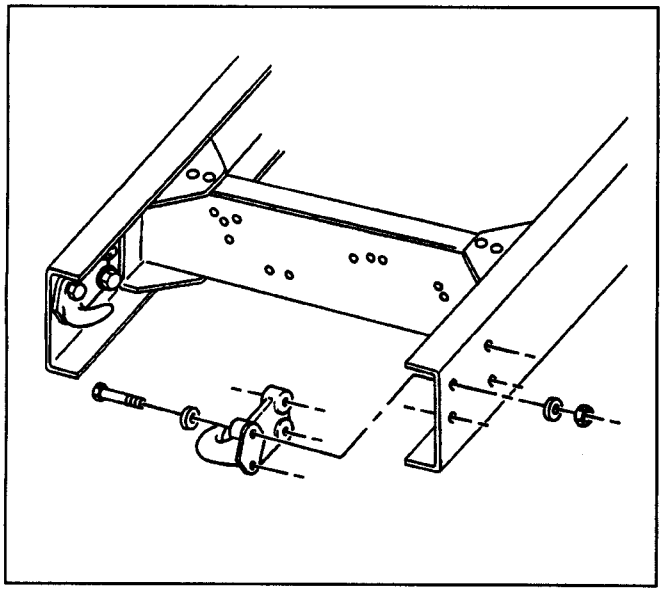
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Tow Hook Replacement

Removal Procedure

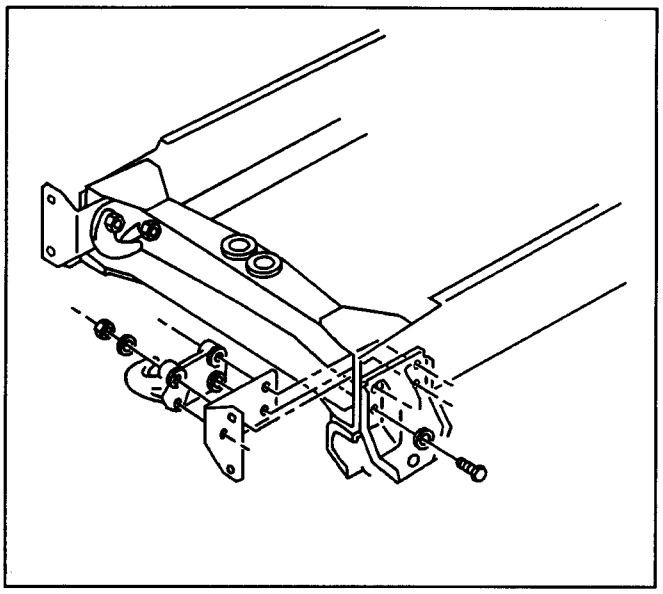
1. Remove the tow hook to frame bolts, washers, and nuts.
2. Remove the tow hooks and brackets.

Installation Procedure

1. Install the tow hooks and brackets to the frame rails.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the hook to frame bolts, washers, and nuts.
   Tighten
   Tighten the nuts to 163 N·m (120 lb ft).

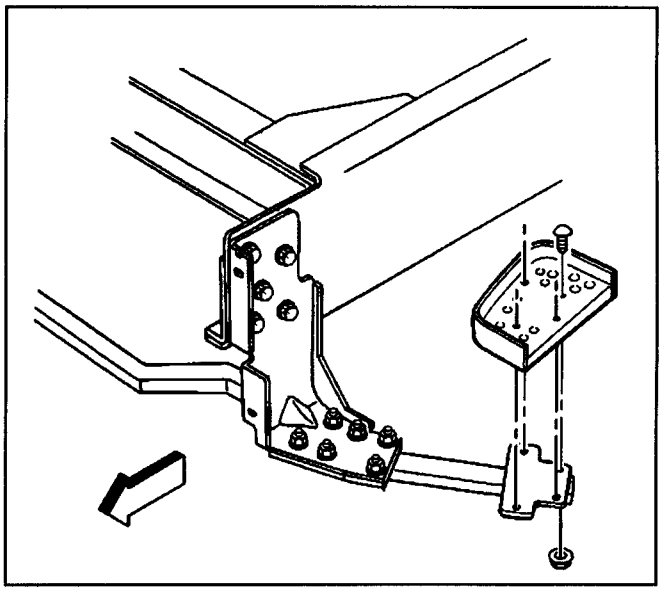


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Assist Step and Support Replacement - Lower

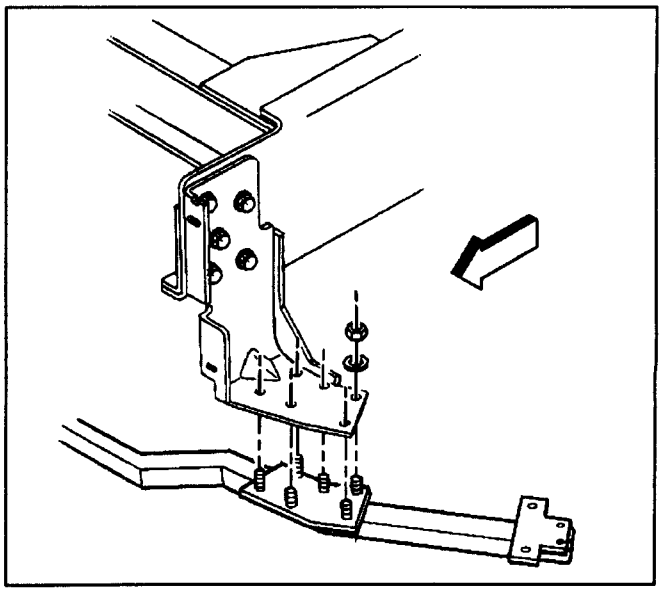
Removal Procedure

1. Remove the lower assist step from the assist step support.

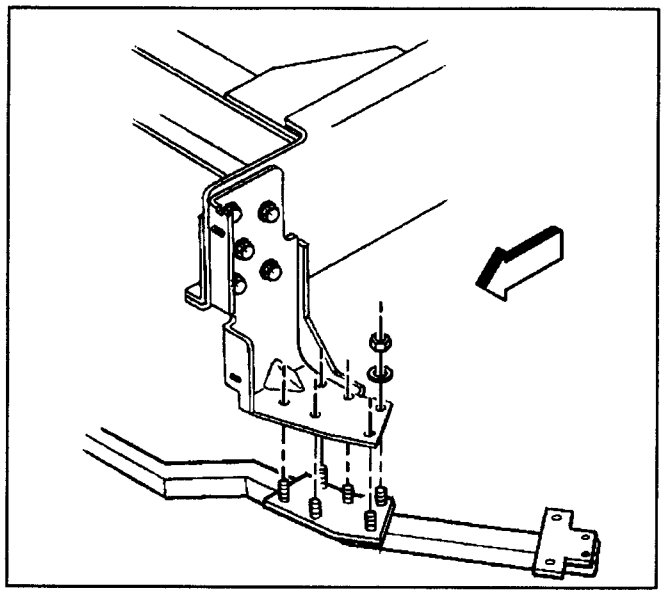


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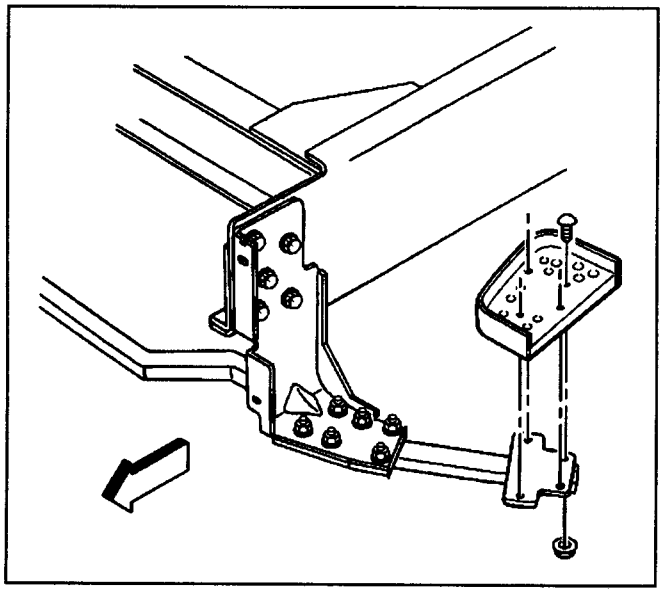
2. Remove the assist step support from the assist step support bracket.



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Installation Procedure

1. Install the lower assist step support to the assist step support bracket.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lower assist step to the assist step support.
   Tighten
   2.1. Tighten the lower assist step bolt to 45 N·m (33 lb ft).
   2.2. Tighten the lower assist step nut to 23 N·m (17 lb ft).

Description and Operation

Welding Description

Improper welding techniques often result in weld and/or frame failures. The following information describes some potential areas of difficulty and provides some general guidelines for successful frame welding. This information only pertains to steel rails that are not heat treated.

Most weld failures occur at the end of the weld in the areas of the frame that are under high levels of stress. The elimination of the ends of a weld may reduce failures. Eliminate the ends by making a hole or a slot in the part that will be attached and using a fillet weld around a slot or plug a plug weld. Do not leave a notch at the end of a weld. For a guide to the diameter and the depth of plug welds by the thickness of the welded material, refer to *Welding Chart*. In most cases, the elimination of the ends of the welds will result in less welding, lower costs, and a more successful weld.

Adhere to the following instructions while performing a welding procedure:

- Do not overweld, especially in an areas of the frame that receive high concentration of stress.
- Weld any small cracks in the crossmember. Refer to *Frame Repair*.
- Refer to *Electrode Chart* in order to determine the appropriate electrodes to use for a particular welding procedure.
- Disconnect the vehicle battery or batteries.
- Do not use any oxyacetylene welding equipment.
- Use electrodes with a smaller diameter.

  Make several passes. Do not make any more passes than necessary.
- Only use as much heat as is necessary to achieve adequate penetration.
- Make sure that the weld is free from craters and undercuts.
- Remove the scale from each successive pass.
- Grind the surface of the weld flush with the parent material when repairing a crack.
- Do not weld across the flanges when mounting any accessories.
- Do not weld within 19 mm (0.75 in) of a flange when mounting any accessories.
- Leave at least 6 mm (0.23 in) between the end of a weld and the edge of the part.
- Do not weld the cast brackets to the frame.
- Do not weld together the flanges of any cracked reinforcements and base rails.
- Do not attach the ground cable to the engine. Connect the welding machine ground cables as close to the working area as possible.
- Keep the welding cables away from the vehicle wiring. Avoid any direct contact between the welding cables and any part of the vehicle.

Frame and Underbody Description

Identification of Material

Notice: Some frames are constructed of heat-treated steel. Do not weld or drill these frames. The use of heat, in excess of 606° C (1200° F), can weaken, cause distortion and change the characteristics of the steel.

It is critical to identify the rail material before attempting to straighten or repair a frame. The use of any method that is not recommended for the material may result in damage to the frame.

All medium duty vehicles have modified SAE 1027 heat-treated SAE J-1392-050, or SAE J-1392-080 steel rails. Measure the thickness of the frame rail in order to identify the heat-treated frame. Take the measurement at the front of the frame where there is not any reinforcement. The heat-treated rail will measure 10 mm (0.39 in) thick. There should also be an identifying label on the outside of the left rail or the reinforcement forward of the rear suspension.

Refer to *Electrode Chart* for the use of the electrode and the chamfer according to the process for welding the SAE J-1392-050 and SAE J-1392-080 rails.

Frames

The components of a frame consist of the side rails and the crossmembers. The side rails carry the load and the crossmembers stabilize the rails. The frame assembly must be stiff enough to support the load it carries and flexible enough to absorb and distribute stress.

These vehicles have straight, full-channel, side rails. The rails should be parallel at all points along their length.

In order to prevent corrosion, it is necessary to apply a batten compound to the mating surfaces of dissimilar metals, such as an aluminum battery box that is mounted on a steel frame rail.

Attach the frame components by using grade 10.9 bolts or huck fasteners. Use prevailing torque nuts and hardened washers at each end of the bolts.

The proper frame alignment is critical to the durability and the function of many other parts of the vehicle. If the vehicle has been involved in a fire, a collision, or has been overloaded, check the frame alignment. Check the alignment if improper alignment is suspected for any other reason. Refer to *Checking Frame Alignment*.

Minimizing Frame Service Description

Reducing the concentration of stress in the small areas of the frame may often minimize of eliminate the occurrence of frame failure. The following information may assist in such a reduction:

- Use particular vehicles only for the purpose for which they were designed.
  - Do not overload the vehicle.
  - Load the vehicle evenly.
  - Avoid any localized overloading.
  - Use baffles in all tank trucks.
  - Do not operate the vehicle on any extremely rough terrain.
- Adhere to the following recommendations when repairing a frame and when mounting a body, or any other equipment, onto a frame:
  - Avoid any sudden changes in the section modulus.
  - Do not drill any holes in the frame rail flanges.
  - Space the holes in the web section of the rail at least 13 mm (0.5 in) apart.
  - Use existing holes whenever it is possible.
  - Do not cut the holes with a torch.
  - Do not cut any notches in the rails.
  - Do not weld on the flanges.
  - Do not allow more than four holes to exist on the same vertical line of the web.
  - Place any hole in a reinforcement at least two times the material thickness away from the edge of the reinforcement.

Collision Repair

Repair Instructions

Cab

Cab repairs may require reinforcements. Before reinforcing any part of the vehicle, find the cause of the failure. Cab panels and framing are integral, therefore driving stresses and strains are transmitted throughout the cab. Reinforcing a point of an apparent failure without correcting the underlying problem may transfer the stress to other parts of the cab, causing new failures to develop.

The use of heat when straightening structural parts of the body is not recommended. Heat will affect the structural characteristics of the material. Any parts bent or buckled enough to show strain cracks after straightening should be replaced or properly reinforced.

Any parts used that are not steel, but will contact a steel part, including bolts, washers, nuts, or rivets, should be coated with paint or plating in order to prevent corrosive action between the dissimilar metals.

To maintain proper body strength, replace the damaged panels or other structural parts with new ones.

Notice: Before welding inside the vehicle, protect the interior components from welding sparks or heat to prevent damage to the interior.

All welding should be done according to American Welding Society (AWS) standards. When welding steel panels of a conventional cab, use TIG, MIG, or stick welding. If resistance welding equipment is available, it can be used. Always use good practices as recommended by the AWS.

When welding a cut member, fill or weld the cut completely. Filler material should be of the same material as the parts being welded. Use any of the E7OS-1 through E7OS-6 electrodes.

Cab Panel

In order to maintain proper body strength, replace damaged structural members with General Motors parts or the equivalent.

Cab panels can be replaced by removing the damaged part and welding in the new piece. For proper alignment of the panel, clamp the panel in position before welding.

Any window opening should be spot welded since the window opening provides a sealing surface.

When replacing a rear pane or roof panel, give special attention to the proper sealing of joints with sealing and caulking compounds.

Hole and Crack Repair

1. Holes of less than 6 mm (1/4 in) in sheet metal panels can be welded and metal finished without backing.
   1.1. Degrease and mechanically clean the area on the panel(s) with emery cloth or an abrasive wheel.
   1.2. Weld the hole using a filler rod and any of the E7OS-1 through E7OS-6 electrodes.
   1.3. Metal finish the area if the panel surface is visible.
2. Holes greater than 6 mm (1/4 in) in diameter but less than 50 mm (2 in) in diameter can be welded by backing the hole with the same material as the parent material.
   2.1. Degrease and mechanically clean the area on the panels with emery cloth or an abrasive wheel.
   2.2. Weld in a backing plate of the same material as the parent material using a filler rod. The minimum edge overlap at the holes should be 3 mm (1/8 in).
   2.3. Metal finish the area if the panel surface is visible.
3. Cracks in the sheet metal panels that are less than 76 mm (3 in) long and 3 mm (1/8 in) wide can be welded and metal finished without backing.
   - Degrease and mechanically clean the panel(s) with emery or an abrasive wheel.
   - Establish the start of the crack with a dye-penetrant test.
   - End the split by drilling a hole at the root of the split. The diameter of the hole should be at least one-and-a-half times the metal thickness.
   - Weld the crack using a filler rod and any of the E7OS-1 through E7OS-6 electrodes.

   If the panel is visible, metal finish the area.

Cab Alignment and Straightening

Before attempting the repair of a damaged cab, the chassis must be checked and, if necessary, aligned. Refer to *Frame* in Frame and Underbody.

Do not attempt to straighten the cab unless the cab is firmly attached to the chassis. The inner paneling of the cab should be straightened first. A push-pull hydraulic jack together with an extension and adapters is recommended for this type of repair. Cross-check with an adjustable tram bar as work progresses.

After straightening, it is critical that strains set up in the frame be "normalized" or relieved. Normalizing consists of heating the areas of greatest tension with a torch. Hold the torch about 50 mm (2 in) from the metal and move it over an area of 75 to 100 mm (3 to 4 in) until the metal just begins to turn red. Cooling must be slow to avoid changing the characteristics of the metal. Apply slight heat with a torch, if necessary, to slow cooling.

Sheet Metal Repair

In order to prevent rust, special anti-corrosion materials are used on the interior surfaces of metal panels. These materials include special metals such as one-sided and two-sided galvanized, zincrometal, and zinc-iron alloy steels. These specially treated metals are used in fenders, doors, quarter panels, rocker panels, floor pans, and other critical areas.

Spray-on materials such as zinc-rich primers and waxes are also applied to interior surfaces. These are used mainly in areas where moisture might gather. Sealers are applied along exposed joints, and moisture-repelling asphaltic sound deadeners are applied inside wheel wells, doors, and on some underbody parts.

If the anti-corrosion treatments are disturbed while repairing damaged areas, the metals may be left unprotected. This may lead to corrosion. In order to prevent corrosion, recoat these surfaces with service-type anti-corrosion materials. Follow these steps in applying the materials:

Cleanup and Preparation
Depending on the location of the area, sandblasting, scraping, wire brushing, sandpaper, and steel wool can be used in order to remove residue.

Applying Primer Coats
Prime all bare metal with an acrylic chromate material.

Applying Sealers
Seal all flanged joints, overlap joints, and seams with a medium-bodied consistency sealer that stays flexible and is paintable. All open joints that require bridging of sealer to close a gap require treatment with a heavy-bodied caulking material.

Applying Color
If areas such as underbody, hem flanges, exposed joints and engine compartment need color, follow conventional refinishing preparation, undercoat build-up, and color application procedures. Rub-out and extensive sanding of the undercoats is not necessary.

Applying Deadeners
Use a heavy-bodied undercoat with a rubberized or asphaltic base. Areas for application can be determined by original production application.

Applying Anti-Corrosion Material
Use a light-bodied material designed to penetrate between close metal-to-metal surfaces such as pinch weld joints, hem flanges, and other attaching points where metal surfaces are difficult to coat with conventional materials.

Conventional Undercoating
Apply to large areas such as doors, hoods, fenders, and the like. Do not spray material into door hardware such as locks, run channels, and window regulator.

On the underbody, do not apply undercoating material to any moving or rotating parts. Do not apply undercoating to the engine exhaust system. After undercoating, make sure that all body drain holes are open.

Section 9
Restraints

Seat Belts 9-3
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BLANK

Seat Belts

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Center Seat Buckle Bolt	49 N.m	36 lb ft
Lower Anchor Bolt	49 N.m	36 lb ft
Passenger Side Buckle and Center Seat Belt Bolt	49 N.m	36 lb ft
Retractor Bolt	49 N.m	36 lb ft
Seat Belt Buckle Bolt	49 N.m	36 lb ft
Upper Anchor Bolt	49 N.m	36 lb ft

Diagnostic Information and Procedures

Operational and Functional Checks

Seat Belt Checklist

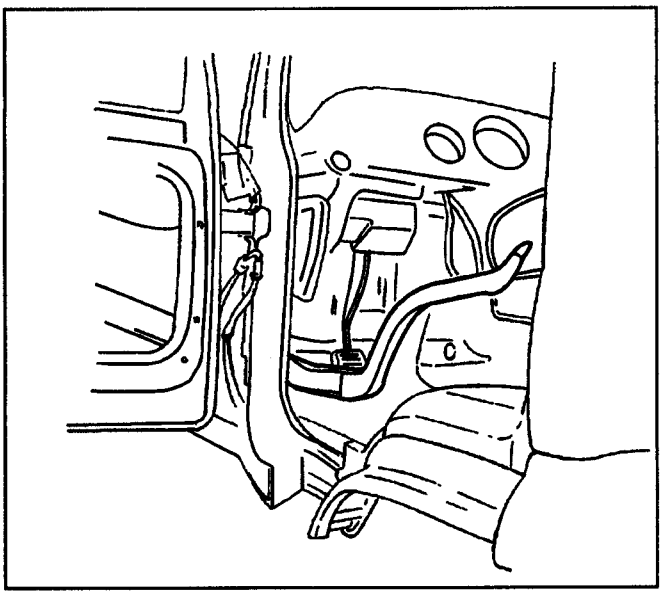
Replace the belt, the retractor and other related seat belt components if the following conditions occur:

- The belt wears due to collision.
- The belt webbing tears.
- The belt webbing becomes highly stressed.
- The seat belt buckles or the tongues corrode.
- The anchor bracket bends.
- The stitching on the seat belt's Energy Management Loop separates.
- The caution label on the belt specifies the belt replacement.
- The belt fails the following inspection:
  1. Grip the front and the rear seat belt floor attachments. Inspect the front and the rear seat belt floor attachments in order to ensure that the seat belt floor attachments are secure. Remove the seats, if necessary, in order to reach the floor attachments. Refer to *Driver or Passenger Seat Belt Replacement*, or to *Center Seat Belt Replacement*.
  2. Manually grip the retractor in order to verify that the retractor is securely fitted. Remove the trim components, if necessary, in order to reach the retractor units. Refer to Exterior/Interior Trim in Body and Accessories.
  3. Verify that the shoulder belt buckles face inboard and are reachable.
  4. Pull the shoulder belt completely out. Verify that no twists remain in the shoulder belt and that the shoulder belt may easily slide out.
  5. Buckle the belt. Firmly pull the buckle in order to ensure that the belt remains latched.
  6. Push the buckle button. Verify that the latch releases smoothly and that the button returns smoothly to the button's original position.

Repair Instructions

Seat Belt Service Precautions

- Sharp edges or faulty objects near the seat belt buckle or the latch plate may cause possible damage.
- Do not bend the seat belt buckle or the latch plate parts.
- Do not bleach or dye the belt webbing.
- Clean the belt webbing with a mild water and soap solution.
- Use the correct anchor bolts in order to tighten the bolts to the specified torque. Verify that the bolts fully seat. Allow two threads to protrude beyond the point of the nut, the anchor plate, and/or the anchoring device.
- Do not attempt to repair the following parts:
  - The retractors
  - The buckles
  - The webbing
- Replace the complete unit with a new service replacement assembly.
- Do not intermix seat belts from the different model vehicles.

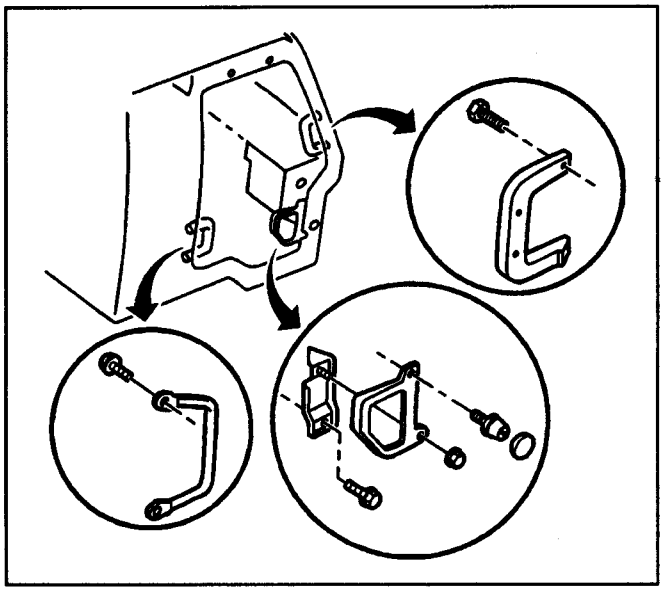


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Driver or Passenger Seat Belt Replacement

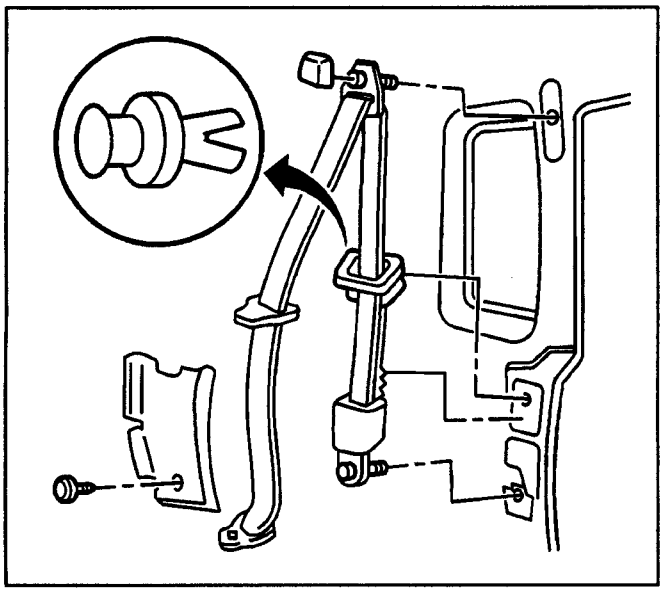
Removal Procedure

1. Remove the sill trim plate screws.
2. Remove the sill trim plate.



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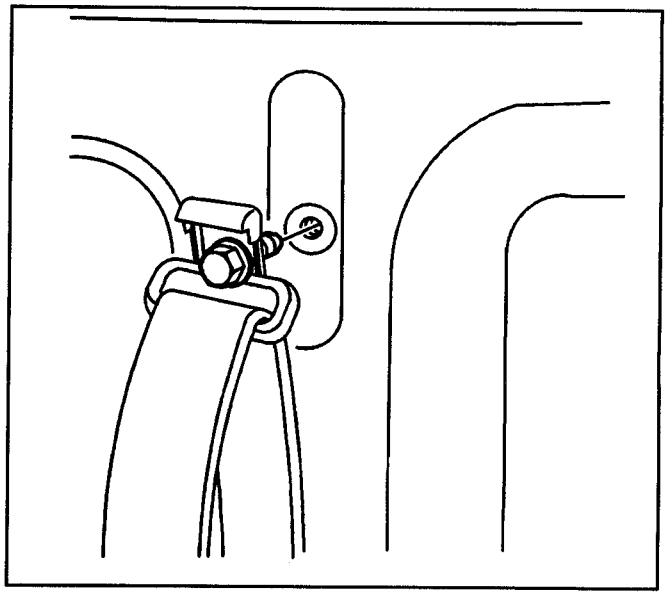
3. Remove the assist handle bolts.
4. Remove the assist handle.



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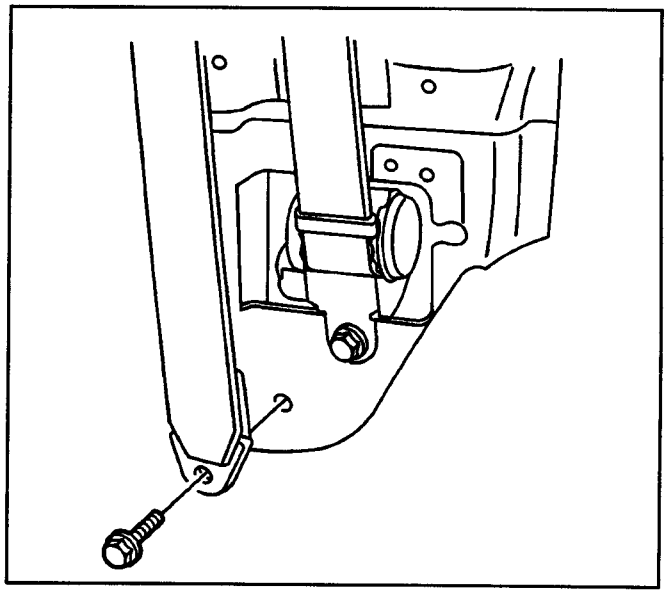
5. Remove the seat belt retractor cover screw.
6. Remove the seat belt retractor cover.
7. Remove the seat belt pass-through trim screws.

8. Carefully pull the upper anchor bolt cover in order to remove the upper anchor bolt.



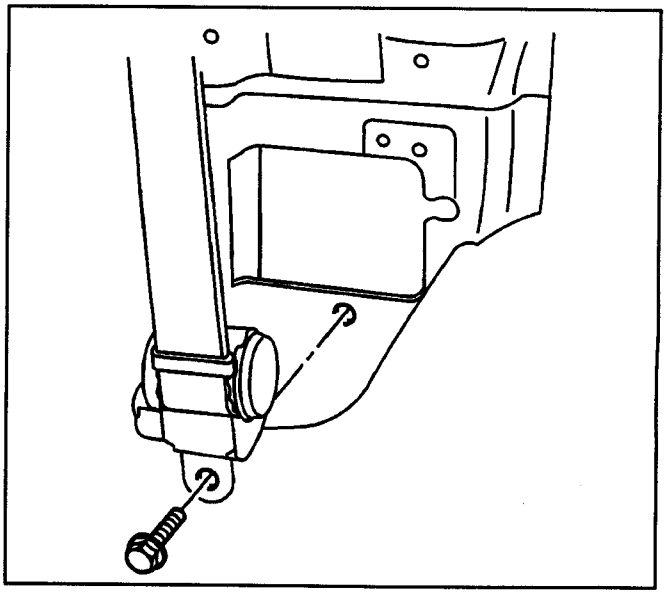
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9. Remove the lower anchor bolt.

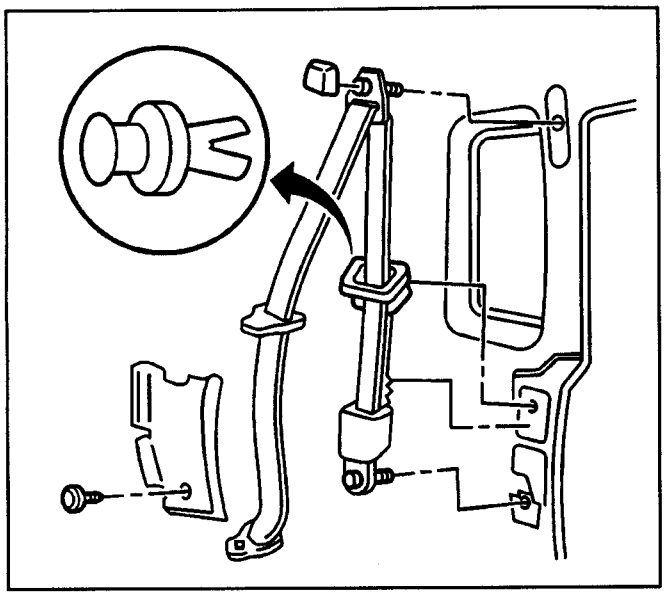


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10. Remove the retractor bolt.

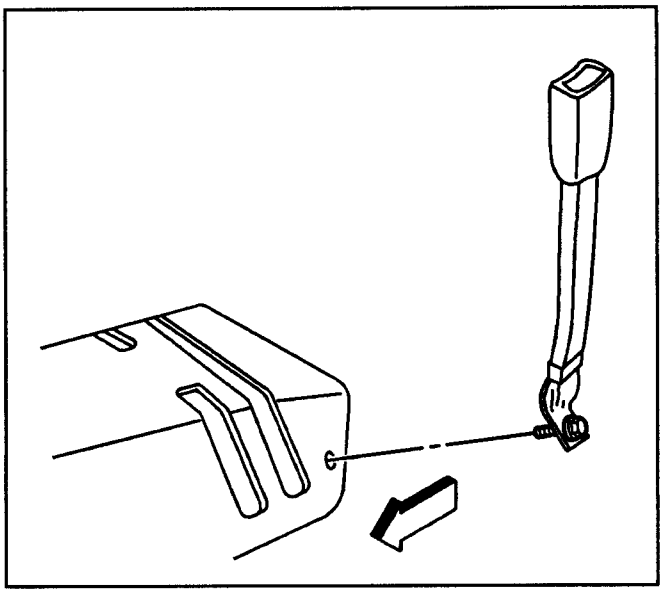


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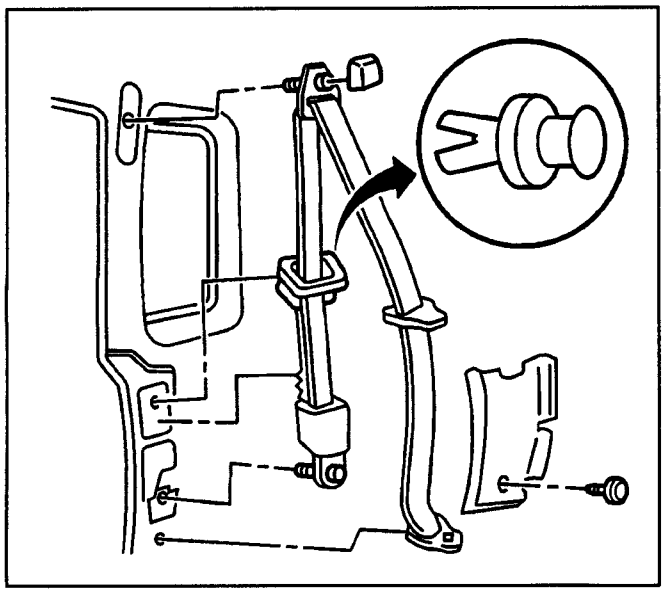
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11. Remove the driver seat belt assembly.



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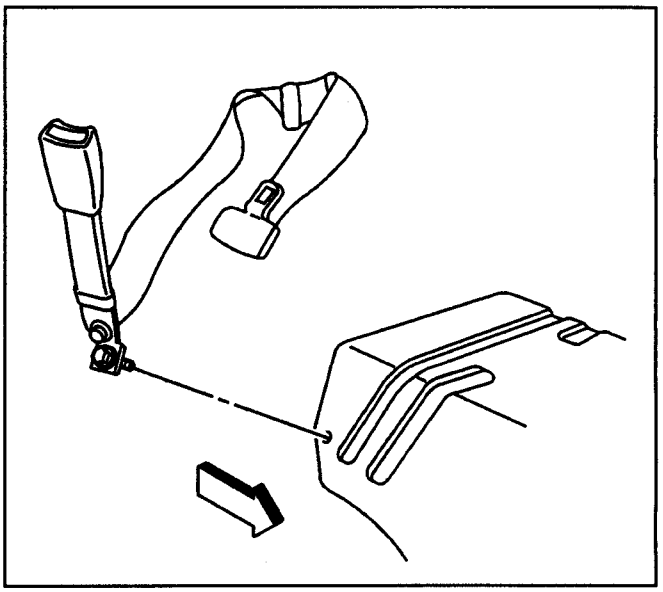
12. Remove the driver side buckle assembly bolt.
13. Remove the driver side buckle assembly.



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14. Remove the passenger seat belt assembly.

15. Remove the passenger side buckle assembly bolt.
16. Remove the passenger buckle assembly.



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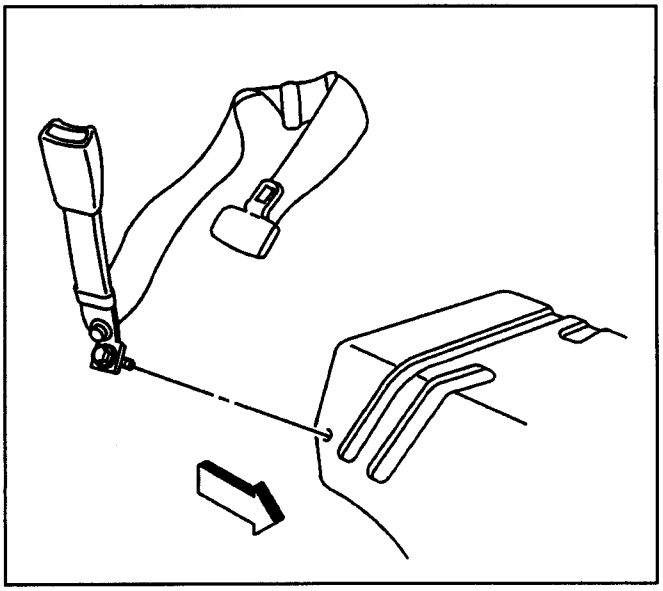
Installation Procedure

1. Install the passenger buckle assembly.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.
2. Install the passenger buckle assembly bolt.

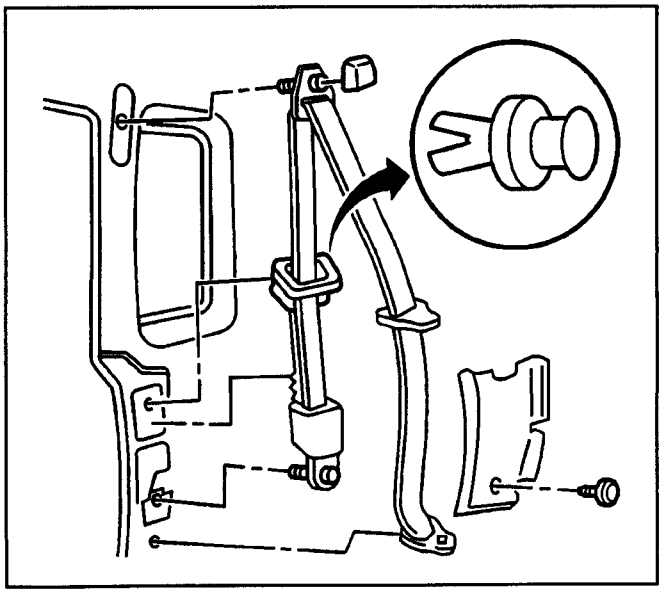
   Tighten

   Tighten the buckle bolts to 49 N.m (36 lb ft).

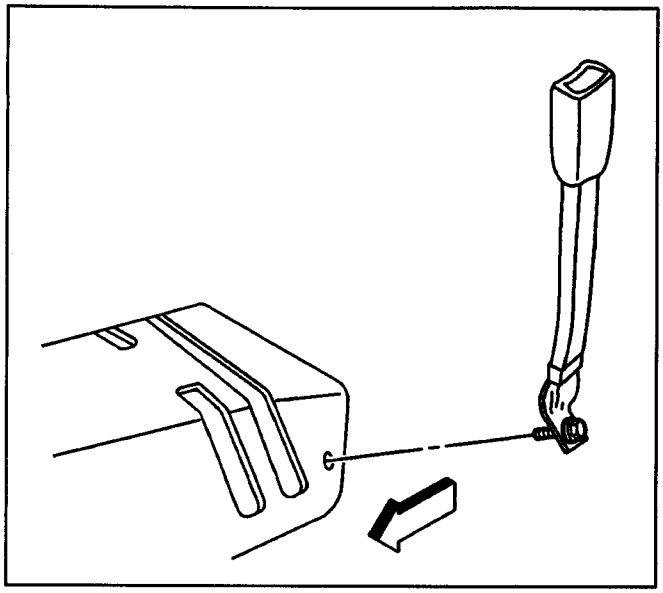


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3. Install the passenger seat belt assembly.

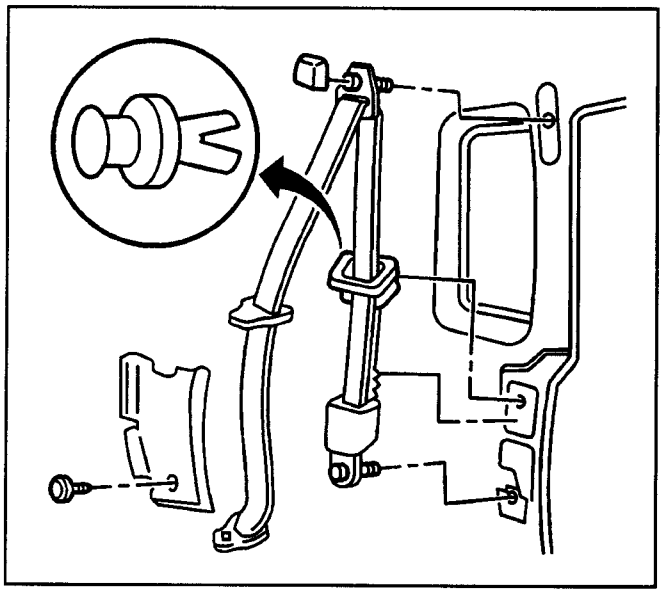


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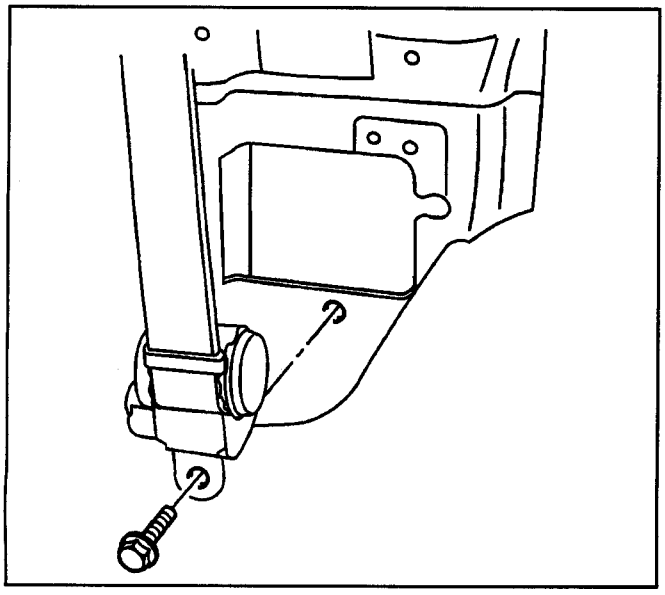
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4. Install the driver side buckle assembly.
5. Install the driver side buckle assembly bolt.
   Tighten
   Tighten the buckle bolt to 49 N.m (36 lb ft).



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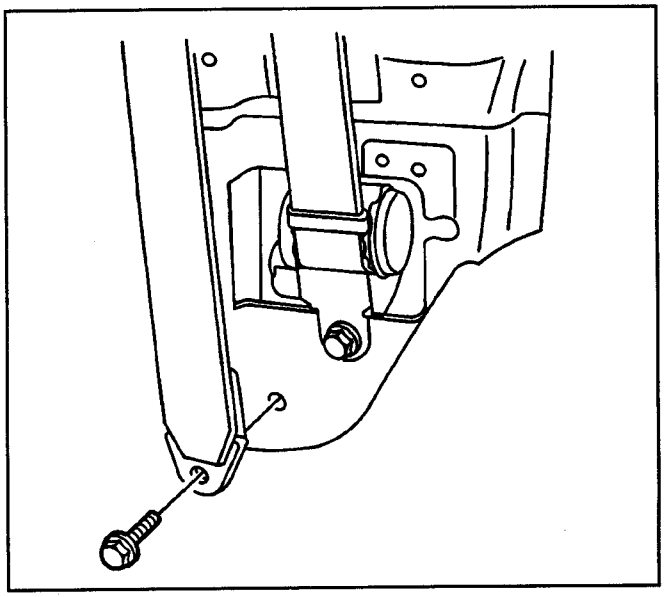
6. Install the driver seat belt assembly.



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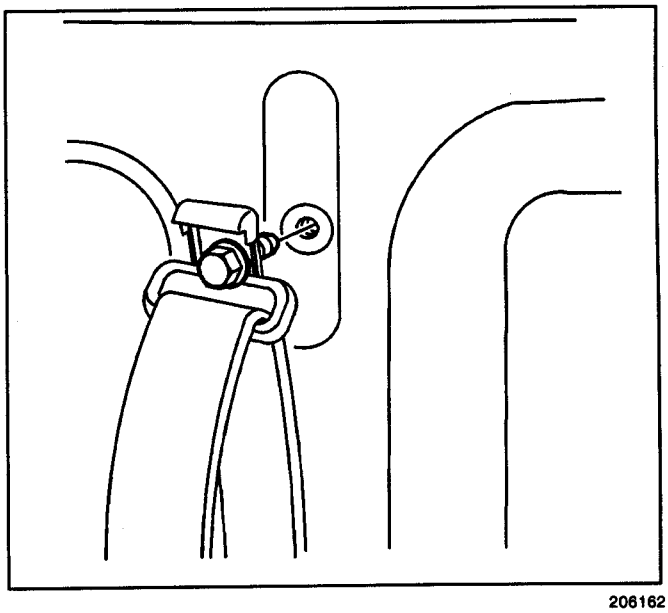
7. Install the retractor bolt.
   Tighten
   Tighten the retractor bolt to 49 N.m (36 lb ft).

8. Install the lower anchor bolt.
   Tighten
   Tighten the lower anchor bolt to 49 N.m (36 lb ft).



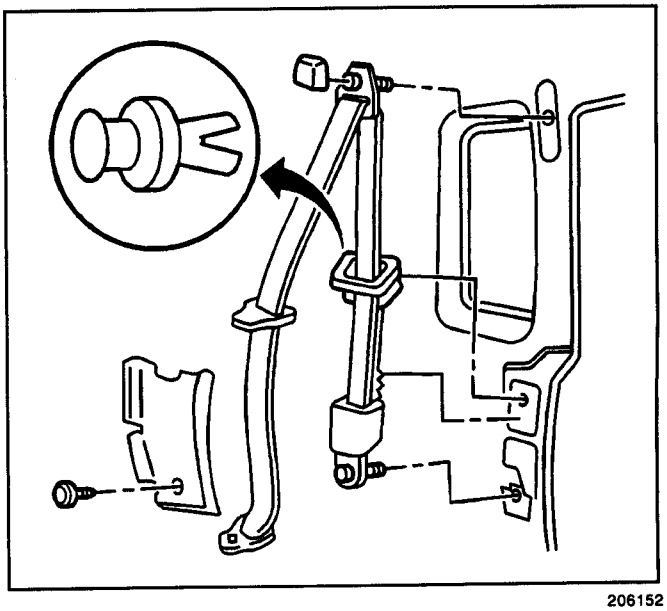
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9. Install the upper anchor bolt.
   Tighten
   Tighten the upper anchor bolt to 49 N.m (36 lb ft).
10. Carefully push the upper anchor bolt cover in order to install the upper anchor bolt cover.

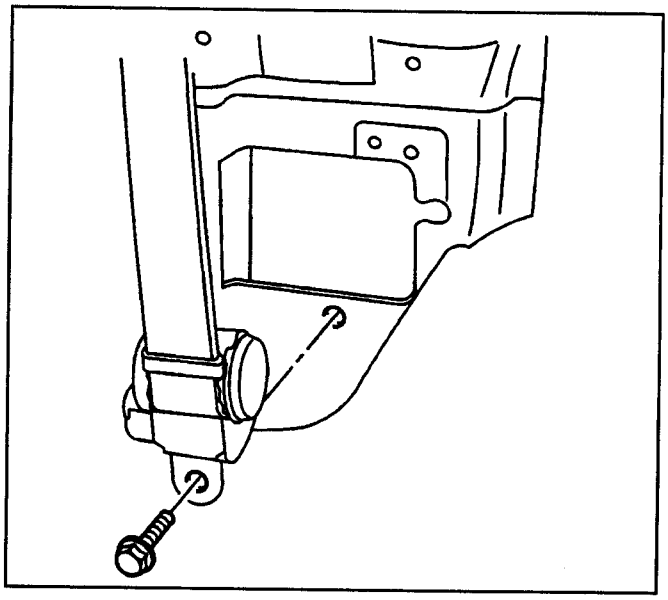


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11. Install the seat belt pass-through trim screw.

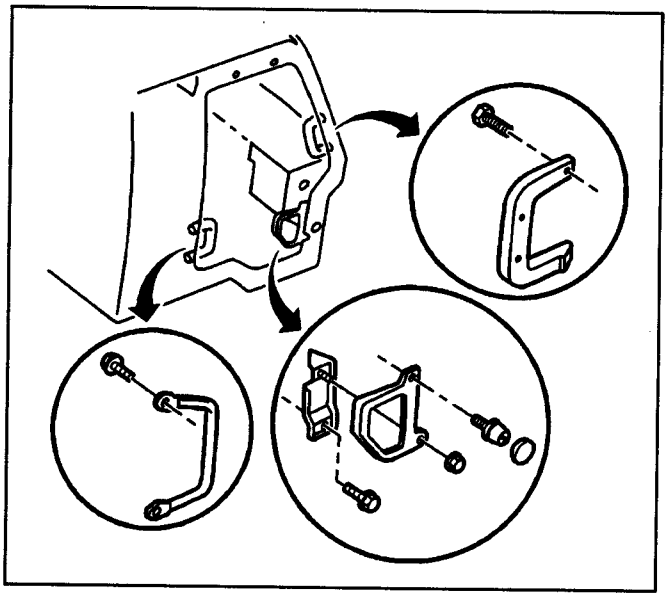


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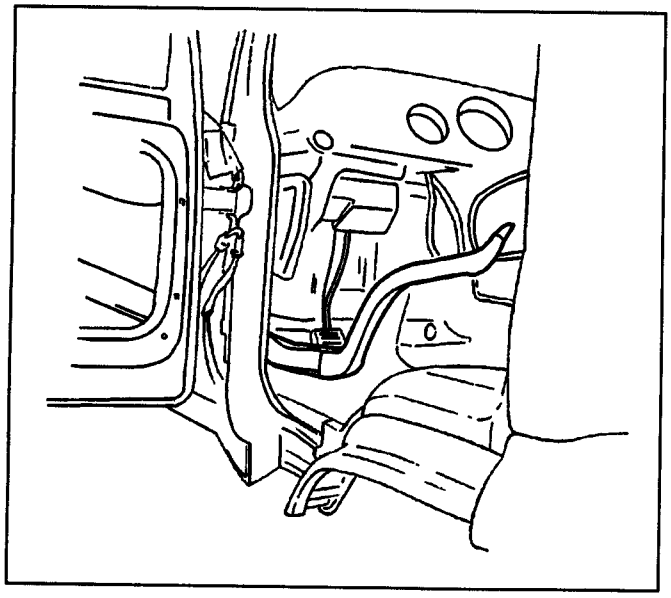
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12. Install the seat belt retractor cover.
13. Install the seat belt retractor cover screw.



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14. Install the assist handle.
15. Install the assist handle bolts.



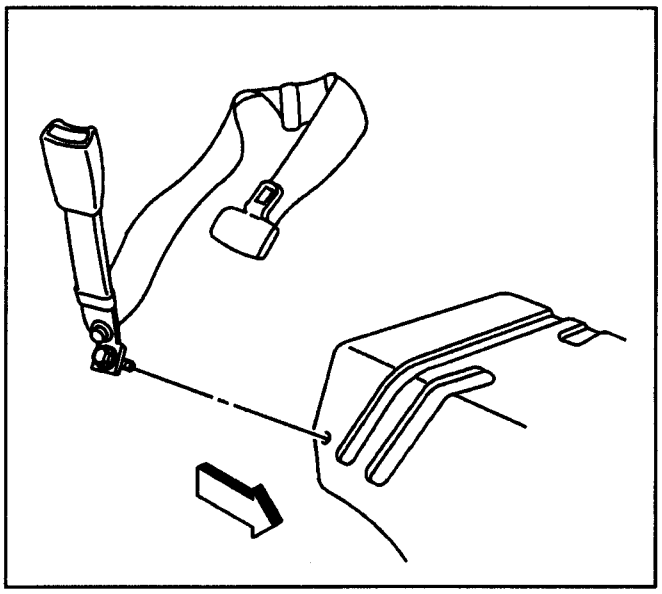
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16. Install the door sill trim plate.
17. Install the door sill trim plate screws.

Center Seat Belt Replacement

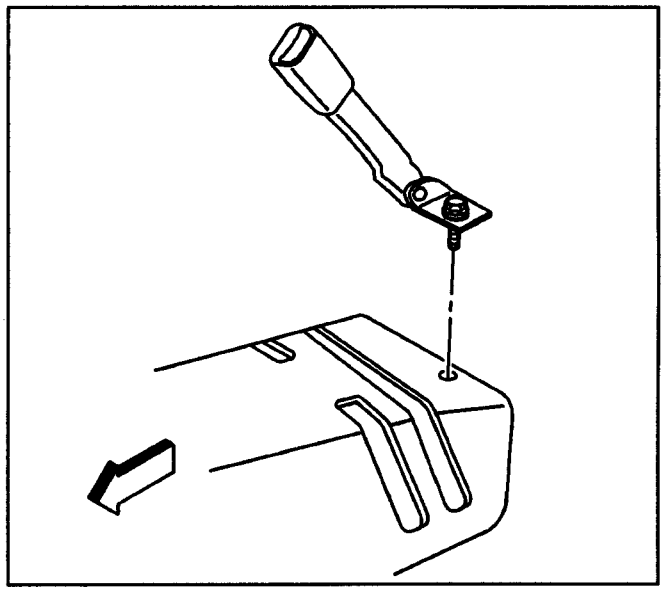
Removal Procedure

1. Lift upward on the floor covering in order to remove the passenger side buckle and the center seat belt bolt.
2. Lift upward on the floor covering in order to remove the passenger side buckle and the center seat belt.



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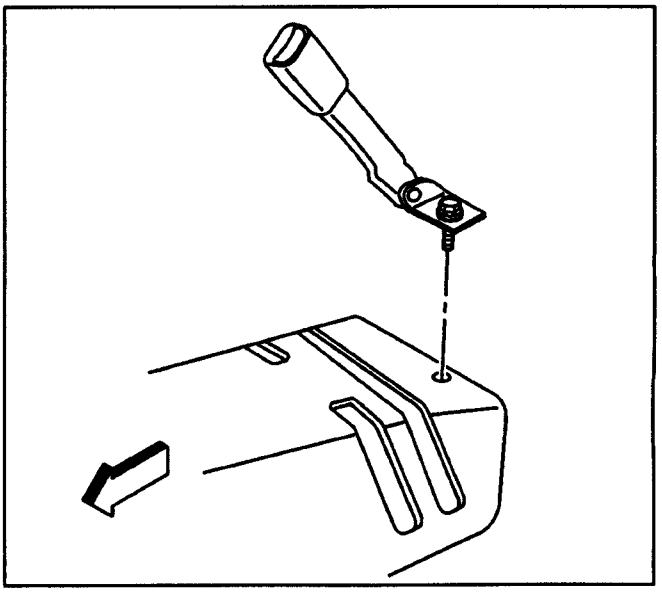
3. Remove the center seat buckle bolt.
4. Remove the center seat buckle.



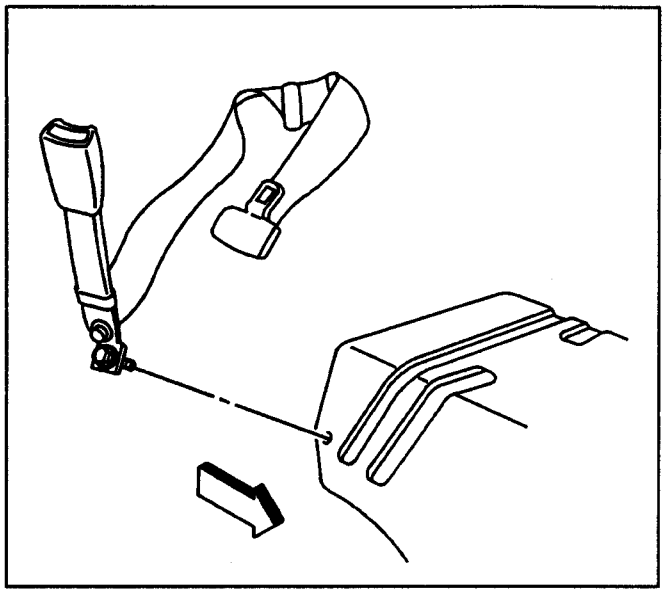
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Installation Procedure

1. Install the center seat buckle.
2. Install the center seat buckle bolt.



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3. Install the passenger side buckle and the center seat belt.

   Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the passenger side buckle and the center seat belt bolt.

   Tighten

   - Tighten the passenger side buckle and the center seat belt bolt to 49 N.m (36 lb ft).
   - Tighten the center seat buckle bolt to 49 N.m (36 lb ft).

Description and Operation

Seat Belt System Operation

The seat belt restraint system includes the front and the rear shoulder belts.

The driver seat belt includes a reminder lamp and a tone alarm in order to warn drivers that the seat belt does not buckle when the engine control switch turns to the ON position. Refer to Engine Electrical in Engine in order to diagnose a system failure for a reminder lamp and/or a tone alarm.

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