SERVICE MANUAL SECTION

HEAT VENTILATION AIR CONDITIONING (HVAC) SYSTEM - ProStar

Model: ProStar

S16039

09/20/2007

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1. SAFETY PRECAUTIONS

Refrigerant R-134a is a nonflammable, nonexplosive, and noncorrosive hydrofluorocarbon refrigerant. R-134a is heavier than air and has a slight ether-type odor. Although R-134a is classified as a safe refrigerant, the following precautions must be observed to protect the A/C system components and the person working on the system.

WARNING – To avoid property damage, personal injury, or death, park the vehicle on a flat level surface, shift transmission to park or neutral, set parking brake, and block wheels before performing diagnostic or service procedures.

WARNING – To avoid personal injury or death, refer to the manufacturer's service information before working on any high voltage equipment. By definition high voltage circuits and components contain voltage levels that may cause equipment damage, electrical shock and/or electrocution if handled incorrectly.

Only a trained technician may perform service inside high voltage components. If you work around or maintain high voltage circuits, please seek high voltage training.

WARNING – Carbon monoxide is a colorless, odorless, and dangerous gas that is present in vehicle exhaust. When it is necessary to operate the engine during vehicle service in a confined area, always use the proper equipment to vent the exhaust gasses outside of the work area.

WARNING – Safety goggles or other adequate eye protection must be worn when working with refrigerant. The temperature of liquid refrigerant is -20 degrees F (-29 degrees C). Serious injury or blindness will result from refrigerant contacting the eyes.

WARNING – If the refrigerant should contact the eyes, DO NOT rub them. Splash the eyes with cold water for at least 15 minutes to gradually get the temperature above the freezing point. See a doctor immediately.

WARNING – Wear nonporous gloves. Should liquid refrigerant come into contact with the skin, remove any contaminated clothing, including shoes; then treat the injury as though the skin had been frostbitten or frozen. See a doctor immediately.

WARNING – Be certain that pressurized refrigerant containers are not exposed to open flame or temperatures above 125 degrees F (51 degrees C). Do not discard empty refrigerant containers where they are likely to be subjected to the heat of trash burners, etc.; they may explode, resulting in personal injury or possible death. Containers must be stored, installed, and disposed of in accordance with all state and local ordinances.

WARNING – Never weld, solder, steam clean or use excessive heat on any of the air conditioning lines or equipment while the system is charged. Heat applied to any part will cause the pressure within the system to become excessive, which may result in an explosion and possible personal injury.

WARNING – Do not smoke or allow any type of fire or flame in the immediate area while servicing the air conditioning system. Refrigerant is not combustible; however, in the presence of heat it changes to a poisonous gas. Inhalation can cause death or serious injury.

WARNING – R-134a must not be mixed with air and then pressurized. When mixed with large quantities of air and pressurized, R-134a becomes combustible.

WARNING – Refrigerant must be recovered from the air conditioning system before any components of the system are removed or replaced. Removing components while pressure is in the system will cause personal injury or death.

WARNING – Do not remove the compressor oil fill plug to check the oil level in the refrigerant compressor while the A/C system is charged with refrigerant. The crankcase side of the compressor is under pressure and personal injury may result. It is not possible to check the oil level in the compressor on an A/C system that is under system pressure.

WARNING – Do not install or remove A/C testing or charging equipment while the engine is running. Serious injury may result from doing so.

WARNING – Always use approved refrigerant recycling equipment when working with R-134a to prevent accidental discharge. If released into the atmosphere, the refrigerant evaporates very quickly and may displace the oxygen surrounding the work area, especially in small or enclosed areas. This situation creates the hazard of suffocation or brain damage for anyone in the work area. If a leak should occur, avoid breathing the refrigerant and lubricant vapor. Thoroughly ventilate the area before continuing with service. Federal and state laws require that refrigerant be recovered and recycled to help protect the environment.

WARNING – While the manifold gauge set is connected to both the air conditioning system and refrigerant supply cylinder, never open the high side hand valve of the manifold gauge set while the A/C system is operating. If hot, high pressure refrigerant is forced through the gauge to the refrigerant supply cylinder; it could cause the cylinder to rupture and cause personal injury.

WARNING – When purging the system or components, do not use nitrogen at pressures over 200 psi. Personal injury or death may result from doing so.

WARNING – Always use correct replacement refrigerant hoses. Do not use hoses other than those specified for the system being serviced. The use of improper hoses may cause a hose rupture, which may result in personal injury.

CAUTION – Use only new or recycled R-134a refrigerant; not any of the so called "direct replacement" refrigerants. Use of a recovery machine dedicated for R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns.

CAUTION – Use only the specified PAG lubricant in the refrigerant system (International P/N ZGGR725028). PAG oils absorb atmospheric moisture very quickly. Never leave PAG oil exposed to air for a prolonged time. Wear nonporous gloves while handling PAG oil, and tightly reseal the oil container immediately after each use.

CAUTION – Use only MINERAL BASED refrigerant oil (International P/N ZGGR6912) to lubricate O-rings and fittings

CAUTION – Disconnect battery ground cable during service to prevent possible damage to the vehicle electrical system. If the battery must remain connected for a specific test, use extreme caution when taking measurements.

CAUTION – When purging the system, or components of the system, use only dry nitrogen. The introduction of compressed air into the A/C system may cause contamination of the system.

CAUTION – After replacing a compressor verify that the pulley alignment and belt tension are correct.

CAUTION – When charging the A/C system the refrigerant tank must be kept upright. If the tank is not in the upright position, liquid refrigerant may enter the system and cause compressor damage.

CAUTION – When pressure cleaning the A/C components under the hood, do not direct the high pressure stream directly at the actuator for the fresh air/recirculate air door.

2. GENERAL DESCRIPTION – FRONT HVAC SYSTEM

The Blend-Air air conditioning and heating system is a system of components designed to provide conditioned air to the occupants of the vehicle. The term "Blend-Air" refers to the mixing or blending together of air from the cooling and heating systems to produce a desired air temperature for the vehicle occupants. The front HVAC system is used in both day cab and sleeper cab vehicles. The rear (sleeper) HVAC system is used only in sleeper vehicles, and is described in separate sections of this manual.

The front HVAC system is comprised of two main modules, the heater module and evaporator module. These modules are mounted on opposite sides of the dash panel on the passenger side of the vehicle (Figure 1).

NOTE – The electrical control systems for the HVAC system are covered in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

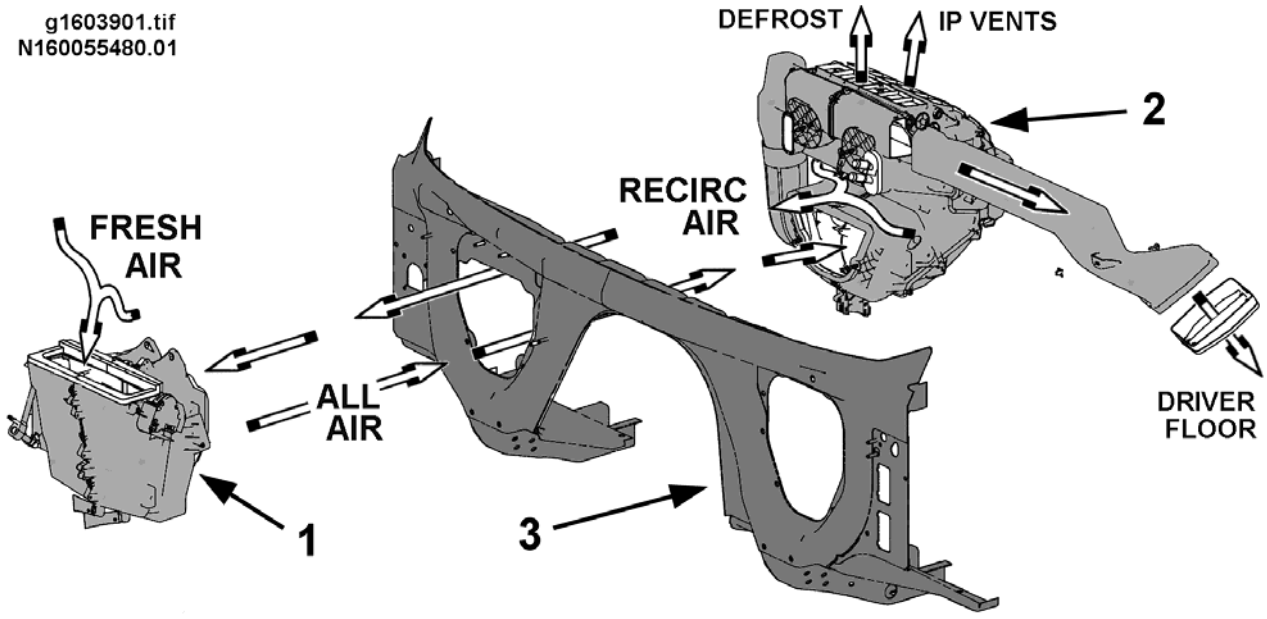


Figure 1 Heater Housing and Evaporator Housing Locations – Front HVAC System

1. EVAPORATOR MODULE
2. HEATER MODULE
3. DASH PANEL ASSEMBLY

The evaporator core, expansion valve, filter drier, thermistors, fresh/recirculate air door, air door actuator, and air filter(s) are located on, or near, the dash mounted evaporator housing on the engine side of the dash panel, under the hood (Figure 2).

The condenser, compressor, and a/c lines are also located under the hood.

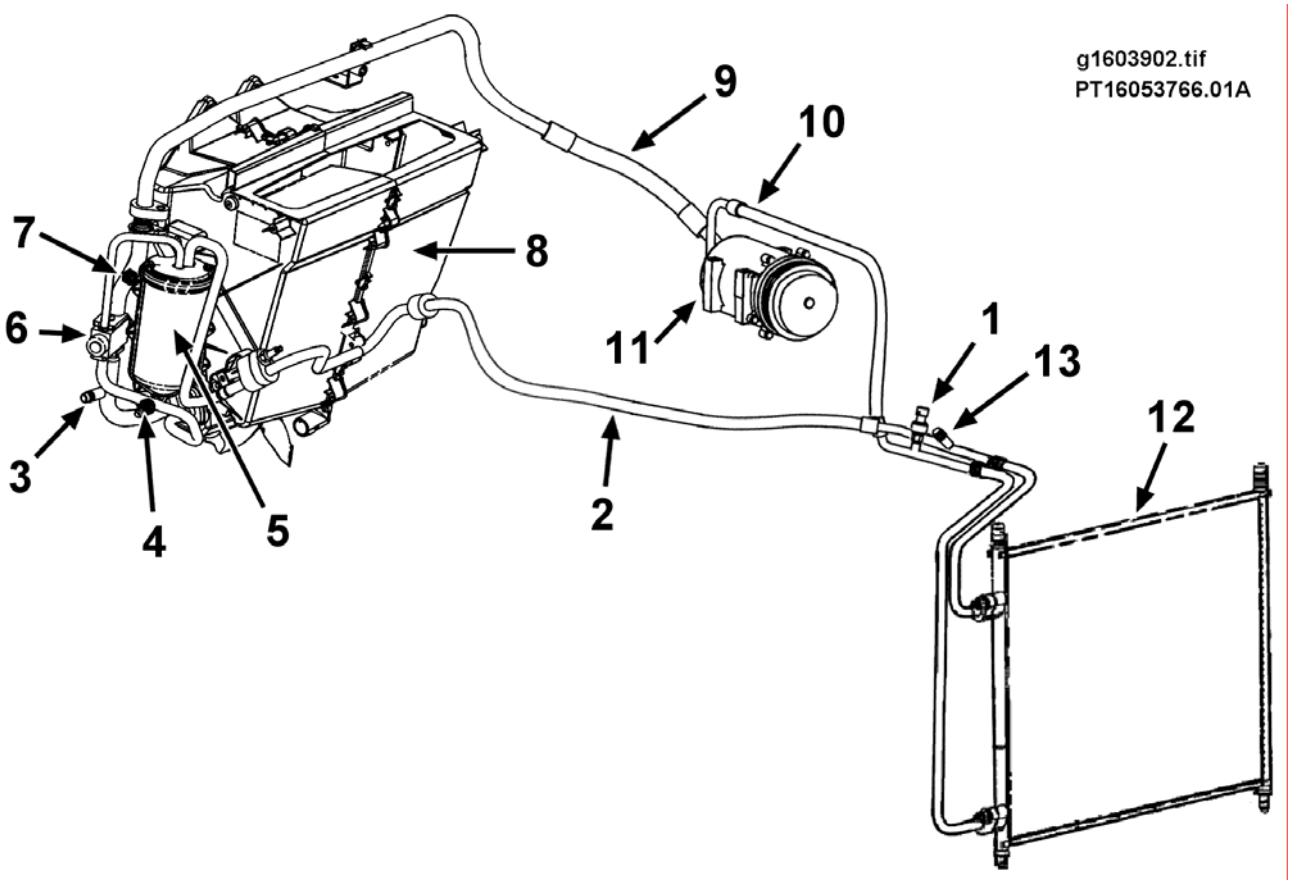


Figure 2 Under the Hood HVAC Components (Typical Configuration Shown)

1. PRESSURE TRANSDUCER
2. CONDENSER TO EVAPORATOR LINE
3. LOW SIDE SERVICE PORT
4. THERMISTOR (EVAPORATOR INLET)
5. FILTER DRIER
6. THERMOSTATIC EXPANSION VALVE (TXV)
7. THERMISTOR (EVAPORATOR OUTPUT)
8. EVAPORATOR HOUSING
9. SUCTION LINE
10. DISCHARGE LINE
11. COMPRESSOR
12. CONDENSER
13. HIGH SIDE SERVICE PORT

The front HVAC control panel (1, Figure 3) is located in the center section of the instrument panel. The heater core, blower motor, blower motor speed control module, blower air scroll housing, passenger floor duct, and air door actuators are located in (or on) the in-cab heater module and may be serviced without removing the heater module housing. The heater module (2, Figure 1) is located behind the heater trim cover (4, Figure 3).

Figure 3 In-Cab HVAC Components (Front HVAC System)

1. HVAC CONTROL PANEL
2. CENTER IP TRIM PANEL (BEZEL)
3. FUSE PANEL COVER
4. HEATER TRIM COVER

2.1. SYSTEM DESCRIPTION – FRONT HVAC SYSTEM

Air Distribution (General)

The following figure (Figure 4) is a cross-sectional view of the air-handling components of the front HVAC system, as they are mounted in the vehicle. The figure shows the system's four air doors and indicates their range of travel.

The electrically actuated fresh/recirculate air door (14, Figure 4) is located in the evaporator housing (12), and is controlled by the mode control (right knob) on the HVAC control panel. When the door is in the recirculate position, outside air is blocked by the door. Recirculation air, from the cab, enters the upper rear of the evaporator housing through the upper portion of the dash panel cutout (13). With the fresh/recirculate air door in the fresh air position, fresh outside air enters the top of the evaporator housing via an air duct which is part of the cowl drain tray (15). (The recirculate air is blocked by the fresh/recirculate air door.) In both cases the air is pulled by the blower assembly (8) through the evaporator core (10) to exit the evaporator housing through the lower portion of the dash panel cutout. The air entering the heater housing from the evaporator housing enters the dual inlet, single scroll blower assembly and is pushed through the heater housing.

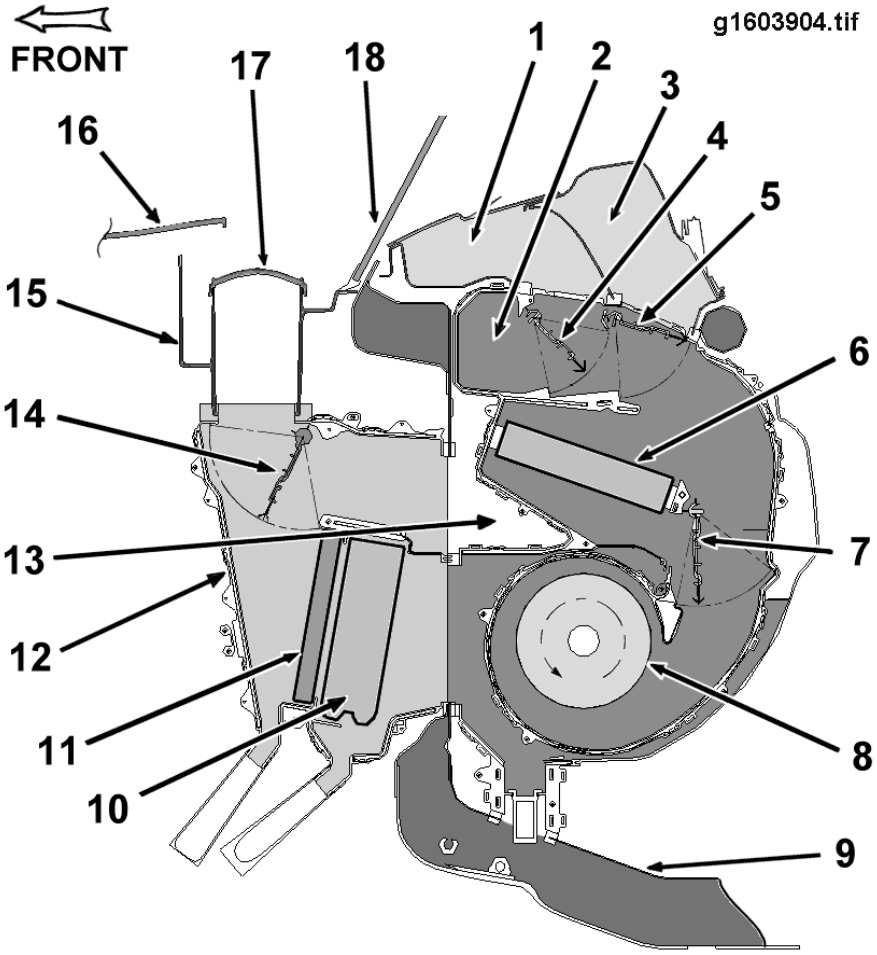


Figure 4 Cross-Section of HVAC Air Handling Components – Front HVAC System

1. DEFROST DUCT (PART OF INSTRUMENT PANEL)
2. FLOOR DUCT OUTLET FROM HEATER MODULE
3. VENT DUCT FOR INSTRUMENT PANEL
4. DEFROST/FLOOR DOOR (MODE DOOR)
5. IP VENTS/FLOOR DOOR (MODE DOOR)
6. HEATER CORE
7. TEMPERATURE BLEND DOOR
8. BLOWER ASSEMBLY
9. FLOOR (CAB INTERIOR)
10. A/C EVAPORATOR
11. AIR FILTER ELEMENT
12. A/C EVAPORATOR HOUSING
13. RECIRCULATE AIR INLET (OPEN TO CAB INTERIOR)
14. FRESH/RECIRCULATION AIR DOOR
15. COWL TRAY
16. HOOD
17. HVAC AIR INLET GRILLE/FILTER
18. WINDSHIELD

An air filter (11) is mounted vertically in front of the evaporator core, within the evaporator housing. On some vehicles, a second air filter (17) is located at the air intake of the evaporator housing, and is accessible from above the cowl drain tray.

The temperature blend door (7) is controlled by the temperature control (center knob) on the HVAC control panel. The electrically actuated temperature blend door diverts air from the blower assembly (8), either through the heater core (6), or around it depending on the temperature selected for the outlet air. Engine coolant flows through the heater core at all times. The air proceeds to the mode doors.

The two mode doors, defrost/floor (4) and IP vent/floor (5), are controlled by the mode control (right knob) on the HVAC control panel. The doors are located at the top of the heater housing and are controlled together via a gear assembly and another electrical actuator. These mode doors direct air to the air outlets (floor ducts, instrument panel vents, and/or defrost vents) based on the mode selected by the operator. The ductwork for the instrument panel vents (3) and the defrost vents (1) is integrated into the instrument panel structure. The upper surfaces of the heater housing interface with ductwork through two large openings in the bottom of the Instrument Panel. Left-hand drive (LHD) vehicles have a passenger floor duct attached to the right side of the heater housing and a driver side floor duct (2) attached to the left side of the housing.

The speed of the system blower motor, which controls the volume of air moved through the system, is selected by the fan speed control (left knob) on the HVAC control panel.

Air Distribution (Air Conditioning)

Figure 5A illustrates the system airflow when operating in the MAX A/C mode. In the MAX A/C mode the fresh/recirculate air door is in the recirculate position; outside air is blocked by the door. Recirculation air (REC), from the cab, enters the upper rear of the evaporator housing through the upper portion of the dash panel cutout. (This air inlet is located behind the heater housing.) The air is pulled by the blower assembly, through the evaporator core. The air entering the heater housing from the evaporator housing enters the dual inlet, single scroll blower assembly and is pushed through the heater housing. The temperature blend air door diverts air either through the heater core or past it depending on the temperature selected for the outlet air. Although the temperature control is operational while in the A/C modes, the temperature control is generally set to divert all air around the heater core. The air proceeds to the mode doors where all of the air is directed to the instrument panel vents.

Figure 5B illustrates the system airflow when operating in the NORM A/C mode. In the NORM A/C mode the fresh/recirculate air door is in the fresh air position. Fresh outside air enters the top of the evaporator housing via an air duct which is part of the cowl drain tray. The remainder of NORM A/C operation is identical to MAX A/C operation.

Figure 5C illustrates the system airflow when operating in the Bi-Level A/C mode. The Bi-Level A/C mode operation is identical to NORM A/C operation; except, the mode doors direct the output air to both the floor ducts, and the instrument panel vents.

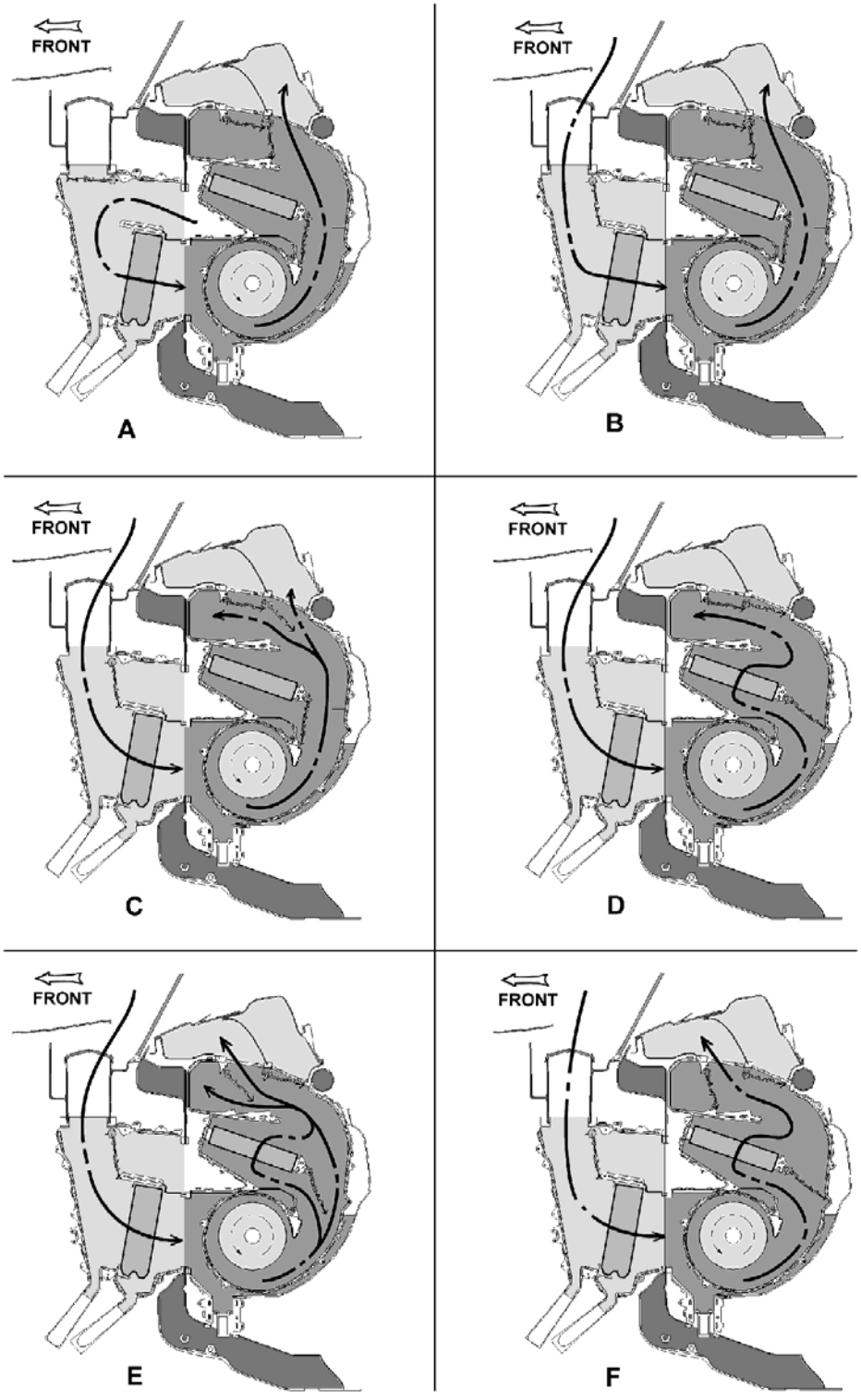


Figure 5 System Airflow by Mode – Front HVAC System

Air Distribution (Heat and Ventilation)

Figure 5B illustrates the system airflow when operating in the Heat and Ventilation Vent mode. In the Heat and Ventilation Vent mode the fresh/recirculate air door is in the fresh air position. Fresh outside air enters the top of the evaporator housing via an air duct which is part of the cowl drain tray. The air is pulled by the blower assembly, through the evaporator core. The air entering the heater housing from the evaporator housing enters the dual inlet, single scroll blower assembly and is pushed through the heater housing. The temperature blend air door diverts air either through the heater core or past it depending on the temperature selected for the outlet air. The temperature blended air proceeds to the mode doors where all of the air is directed to the instrument panel vents.

Figure 5D illustrates the system airflow when operating in the Heat and Ventilation Floor mode. The Heat and Ventilation Floor mode is identical to the Heat and Ventilation Vent mode; except, the mode doors direct all of the output air to the floor ducts.

Air Distribution (Defrost)

Figure 5E illustrates the system airflow when operating in the Bi-Level Defrost/Heat mode. In the Bi-Level Defrost/Heat mode the fresh/recirculate air door is in the fresh air position. Fresh outside air enters the top of the evaporator housing via an air duct which is part of the cowl drain tray. The air is pulled by the blower assembly, through the evaporator core. The air entering the heater housing from the evaporator housing enters the dual inlet, single scroll blower assembly and is pushed through the heater housing. The temperature blend air door diverts air either through the heater core or past it depending on the temperature selected for the outlet air. The air proceeds to the mode doors where the doors direct the output air to both the defrost ducts, and the floor ducts.

Figure 5F illustrates the system airflow when operating in the Defrost mode. The Defrost mode is identical to the Bi-Level Defrost/Heat mode; except, the mode doors direct all of the output air to the defrost ducts.

A/C Refrigerant Flow – Front A/C System

The refrigerant cycle (Figure 6) consists of four phases: compression, condensation, expansion, and evaporation. Consider the starting point at the compressor.

When any air conditioning position is selected on the HVAC control panel, the clutch assembly mounted to the front of the compressor becomes engaged. When engaged, the clutch armature assembly is magnetically drawn to the pulley assembly on the compressor shaft, thereby engaging the clutch and driving the compressor.

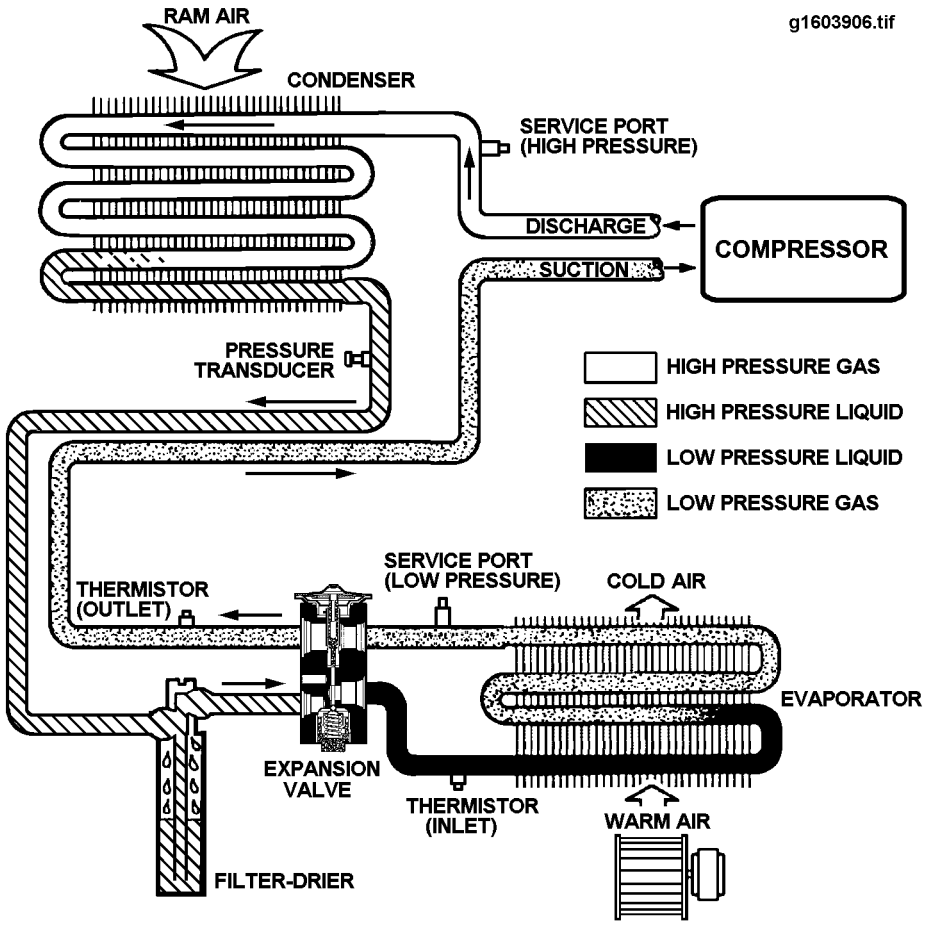


Figure 6 A/C Refrigerant Flow Diagram – Front A/C System Only

The suction side of the compressor draws low pressure refrigerant vapor (5 to 50 psi) from the low side of the system, coming from the evaporator, through the thermostatic expansion valve. The compressor then compresses the refrigerant vapor and discharges it at increased temperature and pressure (120 to 300 psi) through the high side line which connects the compressor to the condenser.

An internal lubricating system uses the suction side intake crankcase pressure differential to coat internal parts with a thin film of oil. This lubrication also travels along with the refrigerant throughout the air conditioning system to lubricate various system components.

High pressure/high temperature refrigerant vapor from the compressor enters at the top of the condenser, circulates down through the coils and exits at the bottom of the condenser as high pressure/high temperature refrigerant liquid. As the vapor condenses (changes state), some of its heat is released to the coils and fins of the condenser. This heat is continually carried away by the outside air which passes over the external fin surfaces as it flows through the condenser.

The efficiency of the condenser operation is affected by ram air flowing through the condenser. For this reason, it is important that the engine cooling fan be operating properly, and that the condenser cooling fins remain free of airborne contamination (leaves, insects, dirt, etc.) which can block the fins and cause system temperatures to run higher than normal.

When operating properly, the condenser acts as an efficient heat exchanger, containing refrigerant vapor in approximately two-thirds of the upper portion of its coils and condensed refrigerant liquid in the lower one-third portion. A pressure transducer located in the output line of the condenser is used to control system operation by providing inputs to the refrigerant control and diagnostic software within the Body Controller. The condenser passes high temperature/high pressure liquid refrigerant to the filter drier. The primary function of the filter drier is the removal of any moisture or solid contamination from the refrigerant before it can cycle through the system and cause internal damage.

The next component in the refrigerant system is the expansion valve. The expansion valve is the dividing line between the high and low pressure sides of the system. High pressure liquid refrigerant enters the expansion valve from the filter drier. The valve senses the temperature of the refrigerant leaving the evaporator core. Then, based on the sensed temperature, the valve regulates the amount of refrigerant that it passes to the evaporator core. While leaving the expansion valve, the refrigerant starts to expand, entering the evaporator core as a low pressure, low temperature liquid.

Within the evaporator core, the lower pressure permits the liquid refrigerant to boil or evaporate, changing its state from a liquid to a low pressure/low temperature vapor; and absorbing heat from the evaporator core and the air surrounding it. Cooling and dehumidifying of the cab's interior takes place as the refrigerant vapor passes through the evaporator's finned tubes and absorbs heat from the cab air pulled through the evaporator core by the system blower. Humidity condenses on the external surfaces of the cooled evaporator fins and is channeled (drained) out of the evaporator housing through drain valves. The refrigerant exits the evaporator outlet as a low pressure/low temperature vapor and is drawn through the low pressure side of the expansion valve by the suction created by the compressor.

Thermistors are located at the input and output of the evaporator to monitor the temperature or the refrigerant at these points. The inputs from these sensors are used to control system operation by providing inputs to the body controller.

The compressor repressurizes the refrigerant causing it to again become a high pressure/high temperature vapor that is pumped to the condenser, where the cycle is repeated.

2.2. COMPONENTS – FRONT HVAC SYSTEM

Refer to Figure 2 for locations of the components described in the following paragraphs (See Figure 2, page 6).

Compressor and Clutch

The system uses a Sanden Model SD7 compressor configured with a proprietary International head to accommodate the "C-plate" block-style fittings. It is mounted on the engine and is belt-driven through an electromagnetic clutch which acts to engage (turn ON) or disengage (turn OFF) the compressor in response to the air conditioning system controls (HVAC control panel and Body Controller). When engaged, the clutch armature assembly is magnetically drawn to the pulley assembly on the compressor shaft, thereby engaging the clutch and allowing the drive belt to drive the compressor. A pressure relief valve on the compressor offers protection to the compressor in extreme high pressure conditions.

Condenser

The air conditioning condenser is located at the front of the vehicle between the engine radiator and the grille. The condenser is a heat exchanger made of fin and tube construction, with "C-plate" block-style inlet and outlet fittings.

Pressure Transducer

The pressure transducer (Figure 7) is a pressure-sensing device threaded into the condenser refrigerant output line. The transducer provides an electrical signal to the Body Controller which monitors and controls the operation of the A/C system. The refrigerant system does not have to be discharged to replace the pressure transducer.

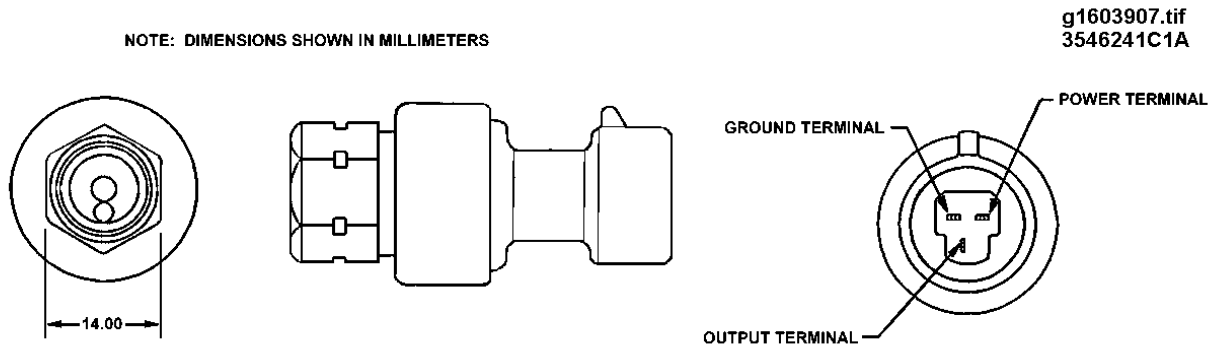


Figure 7 Pressure Transducer

Filter-Drier

The primary function of the filter-drier (Figure 8) is to remove any moisture or solid contamination from the refrigerant before it can cycle through the system and cause internal damage. A drying agent (desiccant) separates and absorbs any moisture contained in the liquid refrigerant. The desiccant also contains a dye to allow easier detection of refrigerant leaks.

The filter-drier itself is not repairable, and must be replaced if found to be defective. The filter-drier must also be replaced whenever the system becomes contaminated due to a internal compressor failure or any extended exposure to the atmosphere (30 minutes or longer). This action will help prevent subsequent corrosion and damage to the system.

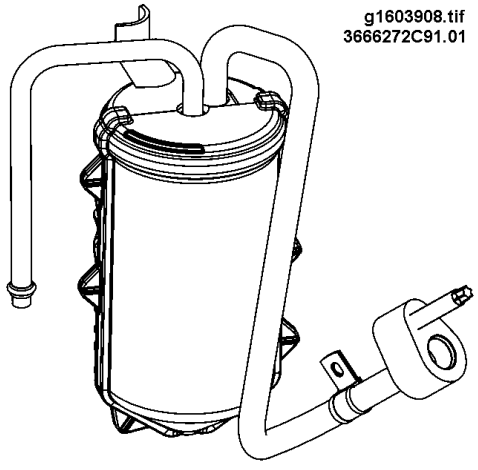


Figure 8 Filter-Drier

Thermostatic Expansion Valve (TXV) – Front A/C System

The expansion valve (Figure 9) controls the amount of liquid refrigerant that enters the evaporator core. The valve is connected to both the input and output lines of the evaporator core. By sensing the temperature of the refrigerant at the output of the evaporator, the valve determines what amount of refrigerant is needed at the evaporator input to keep the evaporator operating within operational parameters.

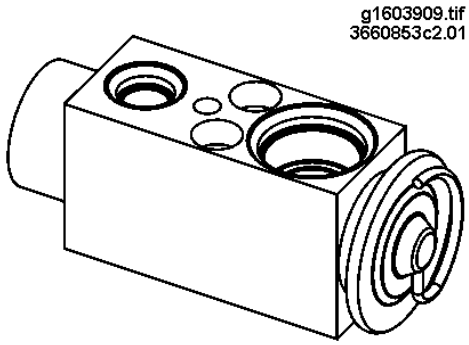


Figure 9 Thermostatic Expansion Valve – Front A/C System

Evaporator

The evaporator core (10, Figure 4) is located in the evaporator housing mounted on the engine side of the dash panel. The core is a cooling assembly made of tube and fin construction, with “C-plate” block-style inlet and outlet fittings. Drain valves for both condensate and rain water are incorporated into the bottom of the evaporator housing. Service access for the air filter is through the large fresh air inlet in the cowl tray and the top surface of the evaporator housing.

Thermistors (Evaporator Inlet and Outlet)

The inlet thermistor (Figure 10) is mounted in the evaporator inlet line. This thermistor senses the temperature of the refrigerant entering the evaporator. Another thermistor is mounted to the evaporator outlet line immediately after the TXV to sense the refrigerant temperature at the evaporator outlet. The resistance value of each thermistor is determined by the temperature of the refrigerant at its location. The resistance values of these thermistors are monitored by the software in the Body Controller which is used to control A/C system operation and detect system faults. The refrigerant system must be discharged before removing and replacing either thermistor.

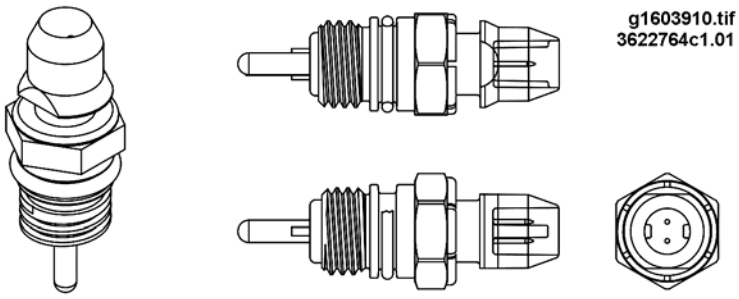


Figure 10 Thermistor

A/C Plumbing

International “C-plate” style block fittings are utilized on all refrigerant line connections except the TXV. This block fitting incorporates a secondary moisture and dirt seal within a unique plate inserted into the block

fitting. The primary O-ring seal has a large cross section for improved sealing as well. Refrigerant hose assemblies are constructed from steel tubing coupled to Goodyear Galaxy hose. This nylon barrier type of hose prevents the refrigerant from escaping through the walls of the hose into the atmosphere. When servicing air conditioning systems, use only replacement hoses approved for air conditioning systems.

Heater Core

The heater core is located in the heater housing mounted in the cab under the right side of the instrument panel. The heater core is a heating assembly made of fin and tube construction, with inlet and outlet fittings for connecting the heater hoses from the engine cooling system. The inlet and outlet fittings protrude through the cowl directly above the evaporator housing. Engine coolant flows through the heater core at all times. The temperature of the air output by the heating/air conditioning system is determined by diverting more or less of the input air through the heater core. The heater core is serviced from inside the cab.

Blower Assembly

The blower assembly is located in the blower scroll housing (part of the heater unit), mounted in the cab under the right side of the instrument panel. The blower assembly used in the heater or heater-air conditioning system consists of a permanent magnet motor attached to a balanced 'squirrel-cage' fan unit. The motor speed is controlled by the left knob on the HVAC control panel on the instrument panel. The blower provides air circulation through the heater core and evaporator, and delivery of the treated air throughout the cab interior.

Linear Power Module

The Linear Power Module (LPM) (Figure 11) is mounted to the blower scroll housing (part of the heater unit), located in the cab under the right side of the instrument panel. The LPM establishes the blower speed by reading the HVAC control panel output signal whose value is based on the setting of the blower speed control knob. As the blower speed control is turned cw the LPM increases the voltage across the blower motor, and the blower speed increases.

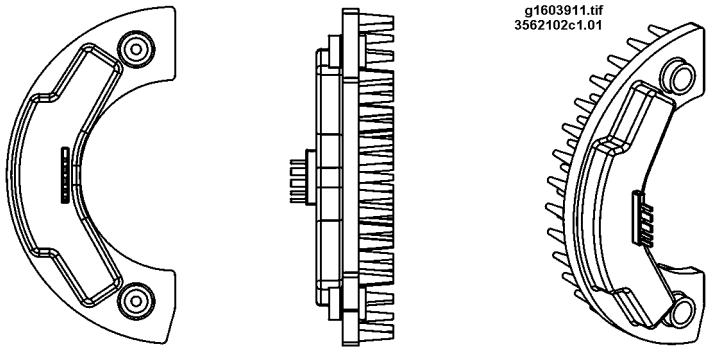


Figure 11 Linear Power Module - Front HVAC System

HVAC Control Panel – Front HVAC System

The HVAC control panel is located in the center console of the instrument panel. The control panel consists of three knobs actuating three long life potentiometers. Internally, the control panel contains circuitry that electronically controls the blower motor speed and the three air door actuator motors. The blower speed control is detented to provide seven distinct blower speeds, in addition to the OFF position. The temperature control has fifteen detents. The mode control is used to select the HVAC operating mode, indicated by seven mode icons and five dots (for 'in-between' modes). The 'heat only' system has five mode icons, and four dots for 'in-between' modes.

2.3. ELECTRICAL SYSTEM OVERVIEW – FRONT HVAC SYSTEM

The heater/ventilation/air conditioning (HVAC) system contains both mechanical and electrical components. The mechanical system is described in this manual. For information covering the electrical part of the system refer to the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

Malfunctions in the HVAC system could be attributed to either mechanical or electrical failures in the system. Diagnosis of a malfunctioning system should always begin by performing the procedures in the DIAGNOSIS AND TROUBLESHOOTING section (See DIAGNOSIS AND TROUBLESHOOTING, page 32) to determine what part of the system is malfunctioning.

General Operation Of The HVAC Electrical System – Front HVAC System

The controls on the front HVAC control head are used to adjust the cab air temperature mix, select the blower speed, and select the system operating mode, including recirculation and distribution of cab air. The blower speed is controlled by varying the amount of voltage applied to the blower motor. The temperature mix and system operating mode are selected by electronically controlling the actuators that position the air flow doors located in the evaporator and heater modules. The HVAC control head also communicates with the body controller to request compressor turn on (for AC and defrost operation).

The control head communicates fault conditions to the body controller for certain conditions monitored by the control head (operation of the air door actuator motors). If the HVAC control head detects a fault condition the body controller will log a diagnostic trouble code.

The body controller contains the circuitry and the software program that controls the cycling of the air conditioner compressor. In general the body controller monitors the refrigerant sensors (transducer and thermistors) and other system parameters to determine if all parameters are within acceptable limits. If parameters are acceptable, the body controller will turn on the compressor when requested by the HVAC control head, and will cycle the compressor to keep the system within acceptable operating parameters.

When the body controller detects readings outside of the acceptable ranges, it will generate and log a diagnostic trouble code. If the body controller determines that continued operation would be destructive, it shuts down the A/C system by preventing the compressor from turning on.

3. GENERAL DESCRIPTION – REAR HVAC SYSTEM

The sleeper Blend-Air air conditioning and heating system is a system of components designed to provide conditioned air to the occupants of the vehicle's sleeper area. The sleeper system is a subsystem of the vehicle's overall HVAC system, and therefore shares many common components. The main components of the sleeper HVAC system are contained in the rear HVAC unit located under the lower sleeper bunk, on the passenger side of the vehicle (Figure 12 and Figure 13).

NOTE – The electrical control systems for the sleeper HVAC system are covered in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

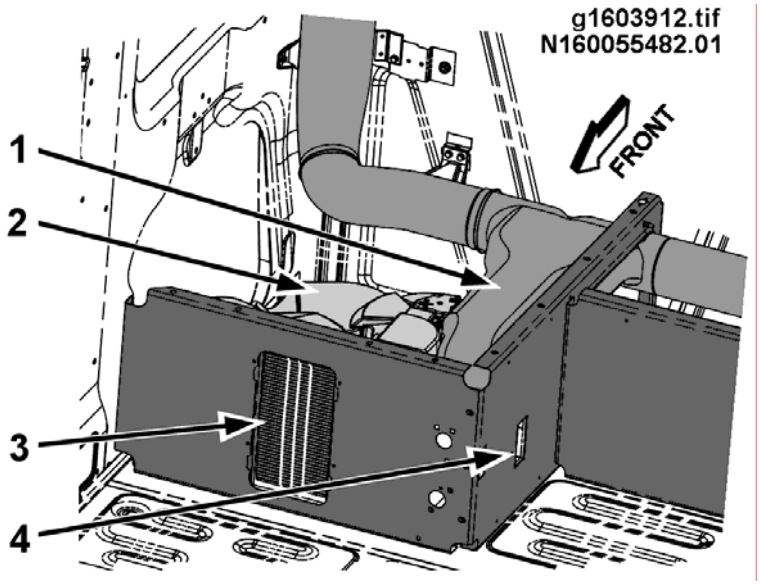


Figure 12 Location of Rear HVAC Unit

1. OUTLET DUCT, REAR HVAC UNIT
2. REAR HVAC UNIT
3. AIR INLET
4. AIR OUTLET VENT

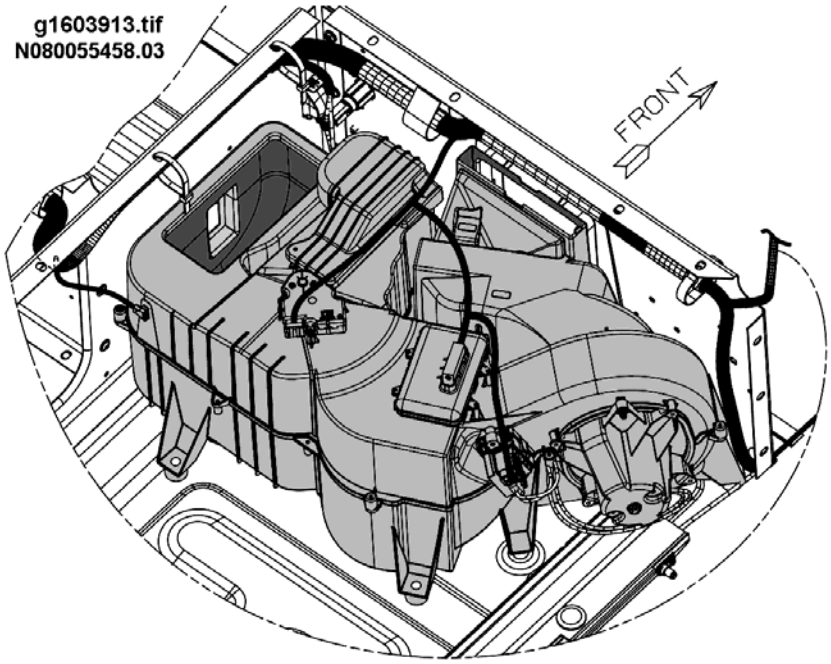


Figure 13 Rear HVAC Unit

The evaporator core, expansion valve, heater core, blend air door, air door actuator, blower, linear power module, rear HVAC controller, temperature sensor, and air filter are located in, or on, the rear HVAC unit (Figure 14).

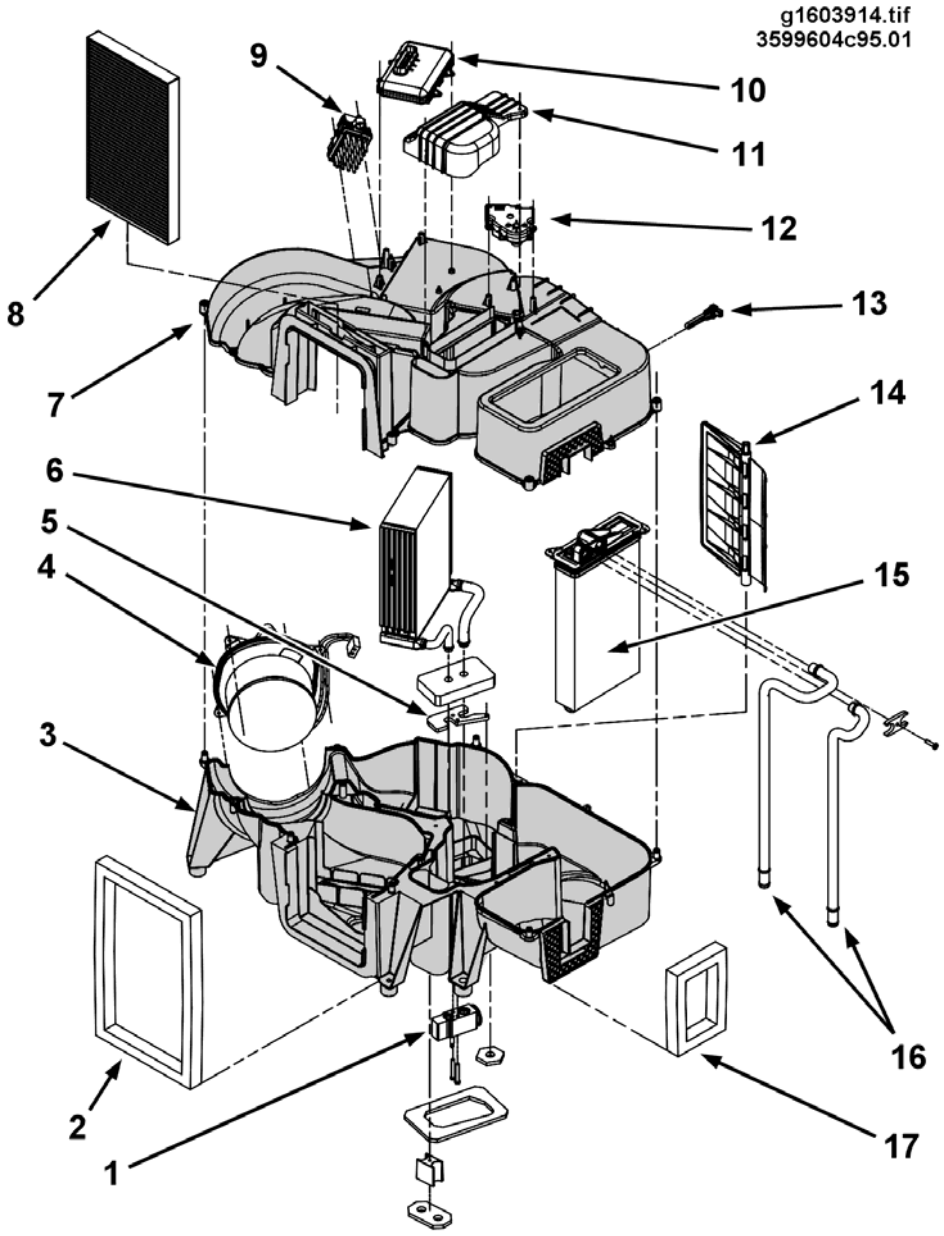


Figure 14 Major Components of the Rear HVAC Unit

1. Thermal Expansion Valve (TXV)
2. Foam Seal (Air Inlet)
3. Rear HVAC Unit Lower Housing
4. Blower Assembly
5. Upper Clamp Plate (TXV)
6. Evaporator Core
7. Rear HVAC Unit Upper Housing
8. Filter Element (Air Inlet)
9. Linear Power Module
10. Rear HVAC Controller
11. Cover, Heater Core
12. Actuator, Blend Air Door
13. Discharge Duct Temperature Sensor
14. Blend Air Door
15. Heater Core
16. Inlet/Outlet Tube for Heater Core
17. Foam Seal (Under Bunk Outlet)

The rear HVAC control panel (Figure 15) is located on the driver's side of the sleeper rear wall. These HVAC controls are available in either digital or analog form, as determined by vehicle trim level. Two switch pack switches mounted in the center console of the dash instrument panel can also be used to control the blower and temperature settings for the sleeper HVAC system.

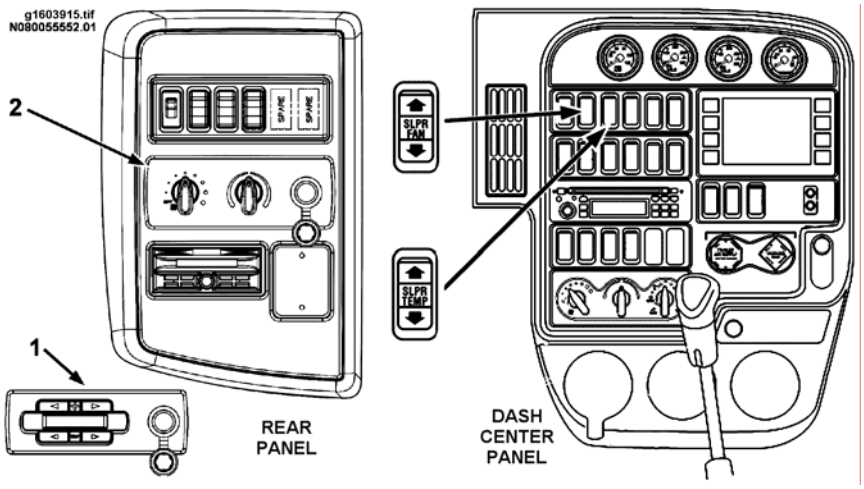


Figure 15 Sleeper HVAC Controls

1. DIGITAL CONTROL PANEL, SLEEPER CONTROL PANEL
2. ANALOG CONTROL PANEL, SLEEPER CONTROL PANEL

3.1. SYSTEM DESCRIPTION – REAR HVAC SYSTEM

Air Distribution (General)

The rear HVAC system operates in a recirculate mode 100% of the time. The blower assembly draws air into the unit through the air intake at the front bulkhead of the bunk. A filter, located at the air intake, is accessible when the bunk is raised. Air from the blower is conditioned by forcing it though the evaporator core; and, depending on the temperature setting, the heater core. Conditioned air is output from the rear HVAC unit through an under bunk floor outlet; and through the main outlet duct, which is connected to the sleeper duct system.

The temperature of the air output from the rear HVAC unit is determined by the position of the temperature blend door. The electrically actuated door diverts air from the blower assembly, either through the heater core, or around it, as determined by the rear HVAC controller. Inputs to the controller include; the temperature control on the rear HVAC control panel, the SLPR TEMP switch on the instrument panel, and the discharge duct temperature sensor. The controller sets the temperature setting of the sleeper HVAC system according to whichever sleeper temperature control was adjusted last. This allows the sleeper temperature to be controlled by either the sleeper control panel or the switch in the instrument panel. When either sleeper temperature control is adjusted, it is sensed by the rear HVAC controller, and it becomes the active control. The rear controller then adjusts the temperature blend door to match the setting of that control. Engine coolant flows through the heater core at all times (unless the vehicle is equipped with a heater shutoff valve).

The speed of the rear system blower motor, which controls the volume of air moved through the rear HVAC system, is also determined by the rear HVAC controller. The blower speed inputs to the controller include; the fan speed control on the rear HVAC control panel, the SLPR FAN switch on the instrument panel, and the engine controller (via the body controller). The controller sets the blower speed of the sleeper HVAC system according to whichever sleeper blower speed control was adjusted last. This allows the sleeper blower speed to be controlled by either the sleeper control panel or the switch in the instrument panel. When either blower speed control is adjusted, it is sensed by the rear HVAC controller, and it becomes the active control. The rear controller then adjusts the sleeper blower speed to match the setting of that control.

Air Distribution (Air Conditioning)

In the A/C mode the air is pushed by the blower assembly, through the evaporator core, to the temperature blend air door. Normally, in this mode, the door diverts all or most of the air around the heater core and out to the sleeper duct system.

Air Distribution (Heat)

In the Heat mode the air is pushed by the blower assembly, through the evaporator core, to the temperature blend air door. In this mode, the door diverts all or most of the air through the heater core and out to the sleeper duct system.

A/C Refrigerant Flow – Sleeper A/C System

The addition of the sleeper A/C system does not change the operation of the front (cab) A/C refrigerant system. Refer to A/C REFRIGERANT FLOW – FRONT A/C SYSTEM.

In general, the air conditioning mode is automatically requested by the sleeper HVAC controller whenever the active temperature control for the sleeper system is set to a temperature that is lower than the current temperature sensed by the rear HVAC unit. Upon receiving the A/C request, the body controller will energize the A/C compressor if all requirements are met. For example, to energize the A/C compressor, the blower control on the front HVAC control panel must NOT be set to OFF. The electrical control systems are covered in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

The rear thermostatic expansion valve and evaporator core are connected in parallel with the filter drier, expansion valve, and evaporator core of the front A/C system (Figure 16). With the A/C compressor energized, the rear expansion valve regulates the amount of refrigerant that it passes to the evaporator core. While leaving the expansion valve, the refrigerant starts to expand, entering the evaporator core as a low pressure, low temperature liquid. Within the evaporator core, the lower pressure permits the liquid refrigerant to boil or evaporate, changing its state from a liquid to a low pressure/low temperature vapor; and absorbing heat from the evaporator core and the air surrounding it. Cooling of the sleeper’s interior takes place as the refrigerant vapor passes through the evaporator and absorbs heat from the sleeper air pushed through the evaporator

core by the system blower. The refrigerant exits the evaporator outlet as a low pressure/low temperature vapor and is drawn through the low pressure side of the expansion valve by the suction created by the compressor.

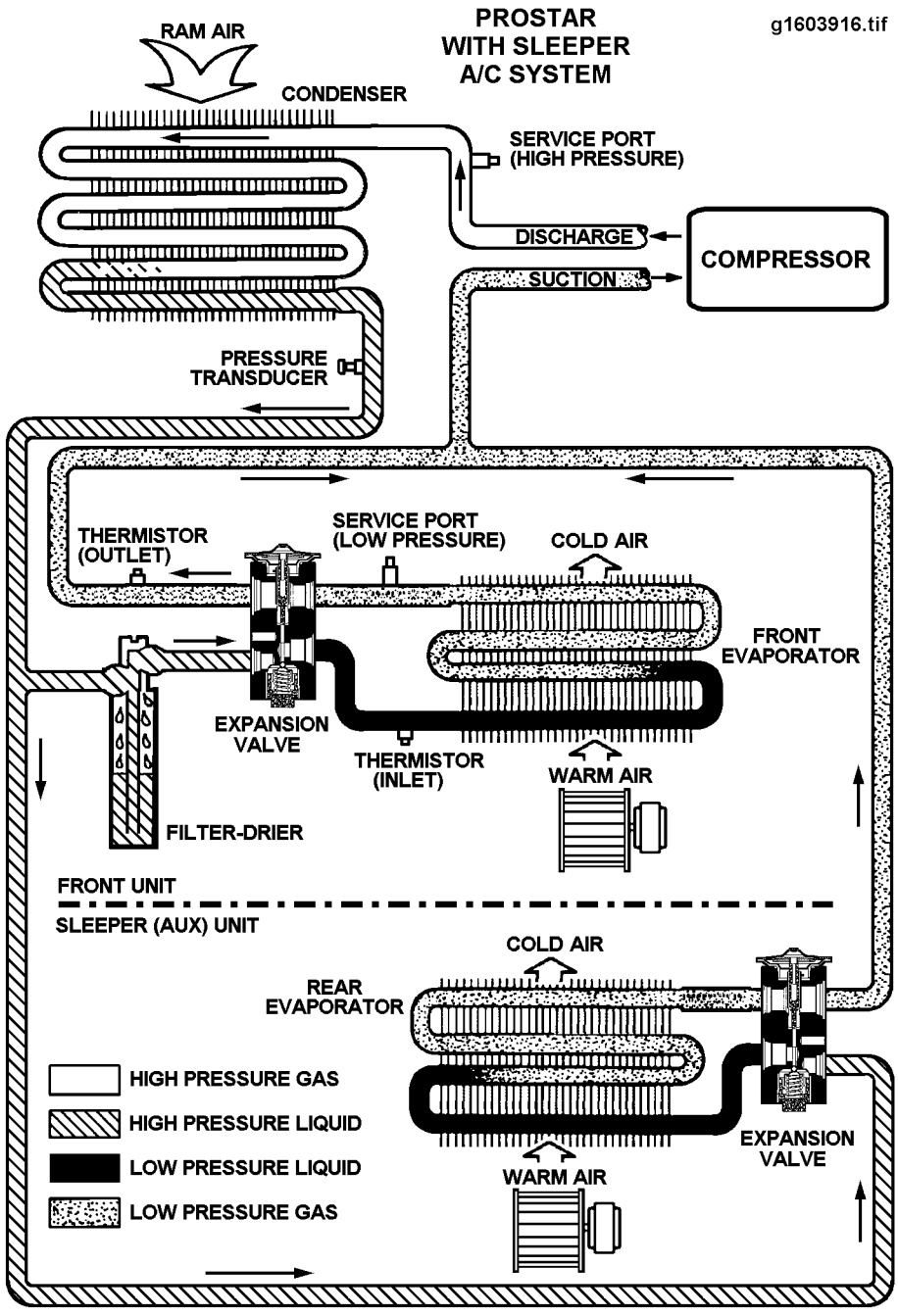


Figure 16 A/C Refrigerant Flow Diagram (with Sleeper System Shown)

3.2. COMPONENTS – REAR HVAC SYSTEM

Only those components unique to the sleeper HVAC system are described in the following paragraphs. All information covering the front HVAC system in these vehicles can be found in COMPONENTS – FRONT HVAC

SYSTEM. The electrical control systems are covered in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

Refer to Figure 14 for locations of the components described in the following paragraphs.

Thermostatic Expansion Valve (TXV)

The rear expansion valve (1, Figure 14 and Figure 17) controls the amount of liquid refrigerant that enters the rear evaporator core. The valve is connected to both the input and output lines of the evaporator core. By sensing the temperature of the refrigerant at the output of the evaporator, the valve determines what amount of refrigerant is needed at the evaporator input to keep the evaporator operating within operational parameters. The rear TXV is serviced from under the vehicle cab, after discharging the A/C system.

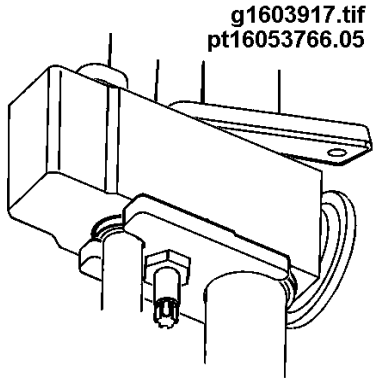


Figure 17 Rear Thermostatic Expansion Valve

Evaporator

The evaporator core (6, Figure 14) is located in the rear HVAC unit. The core is a cooling assembly made of fin and tube construction. The inlet and outlet tubes protrude through the floor of the cab for connection directly to the rear TXV. Servicing the evaporator core requires splitting the rear HVAC unit and discharging the A/C system.

Rear HVAC Plumbing

Refer to Figure 18.

Two under cab A/C lines are used to splice the rear A/C components into the front A/C lines near the front evaporator housing. International “C-plate” style block fittings are utilized on the refrigerant line connections to the front system. This block fitting incorporates a secondary moisture and dirt seal within a unique plate inserted into the block fitting. The primary O-ring seal has a large cross section for improved sealing as well. Connections at the rear TXV are via O-rings and clamping plates. Refrigerant hose assemblies are constructed from steel tubing coupled to Goodyear Galaxy hose. This nylon barrier type of hose prevents the refrigerant from escaping through the walls of the hose into the atmosphere. When servicing air conditioning systems, use only replacement hoses approved for air conditioning systems.

Two under cab heater lines connect the rear heater core in parallel with the front heater core. The lines are spliced into the front heater hoses using ’T’ fittings.

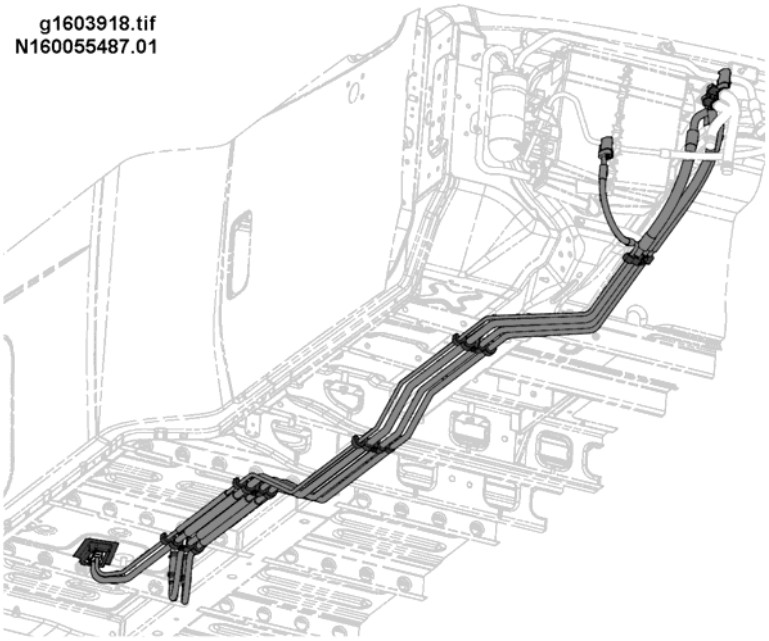


Figure 18 Under Cab HVAC Lines for Rear System

Heater Core

The rear heater core is located in the rear HVAC unit (15, Figure 14). The heater core is a heating assembly made of fin and tube construction and is connected in parallel with the front heater core. The inlet and outlet tubes protrude through the floor of the cab for connection to under cab heater lines. Engine coolant flows through the heater core at all times. The heater core can be serviced without splitting the rear HVAC unit housings.

Blower Assembly

The rear blower assembly is mounted to the rear HVAC unit (4, Figure 14). The blower assembly used in the sleeper HVAC system consists of a permanent magnet motor attached to a balanced 'squirrel-cage' fan unit. The motor speed is controlled by the rear HVAC controller. The blower provides air circulation through the evaporator and heater core, and delivery of the treated air throughout the sleeper interior. The blower assembly can be serviced without splitting the rear HVAC unit housings.

Linear Power Module

The rear Linear Power Module (LPM) (9, Figure 14 and Figure 19) is mounted to the rear HVAC unit near the blower. The LPM allows a low current signal, from the rear HVAC controller, to control the speed of the higher current blower assembly. The LPM establishes the blower speed by reading the rear HVAC controller output signal, whose value is determined by the setting of either the blower speed control in the sleeper or the SLPR FAN switch in the instrument panel (whichever was adjusted last). More information on the electrical control systems can be found in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

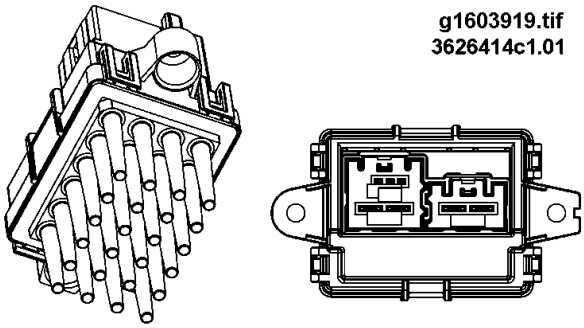


Figure 19 Rear Linear Power Module

Temperature Blend Air Door Actuator

The temperature blend air door actuator (12, Figure 14) is located on the rear HVAC unit. The actuator rotates the blend air door according to signals provided by the rear HVAC controller. The position of the blend air door determines the amount of air flowing through the heater core; and therefore, the temperature of the air being output by the rear HVAC unit.

Rear HVAC Controller

The rear HVAC controller (10, Figure 14) is mounted on the rear HVAC unit. The controller sets the blower speed, and temperature setting, of the sleeper HVAC system, based on the last sleeper HVAC control adjusted. This allows the sleeper system to be controlled by either the sleeper control panel or the switches in the instrument panel (Figure 15). When any sleeper related HVAC control is adjusted, it is sensed by the rear HVAC controller, and it becomes the active control. The rear controller then adjusts the blower speed, or blend air door, to match the setting of that control.

In general, the air conditioning mode is automatically requested by the sleeper HVAC controller whenever the active temperature control for the sleeper system is set to a temperature that is lower than the current temperature sensed by the rear HVAC unit. Upon receiving the A/C request, the body controller will energize the A/C compressor if all requirements are met. For example, to energize the A/C compressor, the blower control on the front HVAC control panel must NOT be set to OFF. More information on the electrical control systems can be found in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

Rear HVAC Control Panel

The rear HVAC control panel (Figure 15) is located on the driver’s side of the sleeper rear wall. These HVAC controls are available in either digital or analog form, as determined by vehicle trim level.

The analog control panel consists of two knobs actuating two long life potentiometers. The settings of these controls are read and interpreted by the rear HVAC controller. When these controls are active, the controller uses their settings to determine the rear blower motor speed and the position of the temperature blend air door.

The digital control panel consists of four push buttons and a digital display. The push buttons allow up and down adjustment of the temperature and the blower speed. The actuations of these controls are read and interpreted by the rear HVAC controller. The display provides two bar graphs indicating the temperature and blower speed settings, as interpreted by the controller. When one of the buttons is pressed, the controller adjusts the setting of the blower motor speed, or temperature blend air door, to reflect the button actuation.

Rear HVAC Control Switches (Located in Instrument Panel)

Two rocker switches, located in the center console of the instrument panel (Figure 15), allow the driver to adjusts the temperature setting and blower speed of the sleeper HVAC system. The rocker switches allow up and down adjustment of the temperature and the blower speed. The actuations of these switches are read and interpreted by the rear HVAC controller. When either switch is actuated, the controller adjusts the setting of the blower motor speed, or temperature blend air door, to reflect the switch actuation.

3.3. ELECTRICAL SYSTEM OVERVIEW – SLEEPER HVAC SYSTEM

The sleeper HVAC system contains both mechanical and electrical components. The mechanical system is described in this manual. For information covering the electrical part of the system refer to the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

Malfunctions in the HVAC system could be attributed to either mechanical or electrical failures in the system. Diagnosis of a malfunctioning system should always begin by performing the procedures in the DIAGNOSIS AND TROUBLESHOOTING section (See DIAGNOSIS AND TROUBLESHOOTING, page 32) to determine what part of the system is malfunctioning.

General Operation Of The Sleeper HVAC Electrical System

The rear HVAC controller adjusts the blower speed and temperature setting of the sleeper HVAC system, based on the settings of the sleeper HVAC controls. The blower speed is controlled by varying the amount of voltage applied to the blower motor, via the LPM. The temperature mix is selected by electronically controlling the actuator that positions the blend air door. When the temperature settings call for cooler temperatures, the controller communicates with the body controller to request refrigerant compressor turn on (for A/C operation).

The rear HVAC controller also communicates fault conditions to the body controller for certain conditions monitored by the controller. If the HVAC controller detects a fault condition, the body controller will log a diagnostic trouble code.

4. SYSTEM OPERATING CONTROLS – FRONT HVAC SYSTEM

The operation of the front Blend-Air system is based on standard automotive air conditioning and heating principles.

NOTE – The following paragraphs describe operation of the front HVAC system only. On vehicles equipped with sleeper cabs, separate control panels make it possible for the front and rear HVAC systems to operate in different modes and at different temperatures. For rapid heating or cooling of the entire cab/sleeper area both systems should be set to the same approximate temperature range.

4.1. CONTROL ASSEMBLY

All major functions of the front A/C-heater system are controlled from the control panel assembly (Figure 20). It consists of three rotary knobs which electronically control the blower fan speed, the A/C compressor clutch, and the actuators that move the air doors used to control system air distribution and temperature.

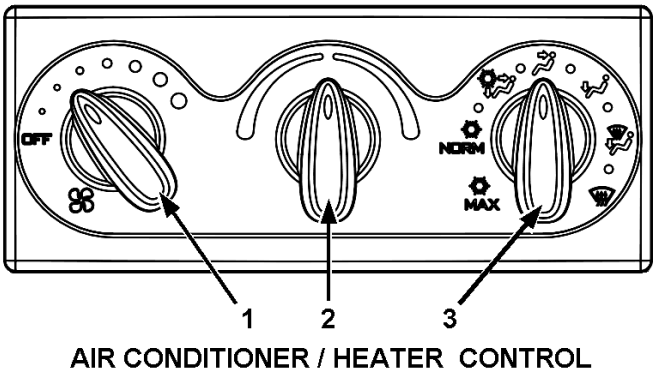


Figure 20 Front HVAC Control Panel Assembly

1. BLOWER FAN SPEED CONTROL
2. TEMPERATURE CONTROL
3. MODE CONTROL

4.2. BLOWER FAN SPEED CONTROL

This control regulates the amount of air provided to the front cab vents in any mode you select. Turn the knob clockwise to increase fan speed. Turning the control to the OFF position will shut off the fan, but does not prevent outside air from entering the vehicle. (Moving the mode knob to the MAX A/C position will close the fresh air door preventing outside air from entering the vehicle.) Turning off the fan speed control prevents the A/C compressor from operating.

4.3. TEMPERATURE CONTROL

This control regulates the temperature of the air discharged from the front cab vents. The blue area of the control indicates cooler temperatures while the red area indicates warmer temperatures. This control operates the blend door that determines what portion of the air flowing through the system is deflected through the heater core. As the temperature control is rotated clockwise more air is deflected through the heater core, increasing the temperature of the air entering the cab.

4.4. MODE CONTROL

This control selects the operating mode of the front HVAC system (HEAT, VENTILATE, DEFROST, and A/C) and controls which outlets in the cab are used to distribute the air. This is accomplished by electronically controlling the A/C compressor clutch, as well as, two air doors located in the in-cab heater housing. In addition to the modes indicated by icons, the mode control can select 'in between' modes indicated by dots. These positions allow fine tuning of the air distribution by providing a distribution mix that is between the mixes provided by the icons on either side of the selected dot (refer to Table 1).

The air conditioning settings are indicated by icons with snowflakes.

MAX Air Conditioning Mode

In this mode all airflow is directed to the instrument panel air outlets and the air is recirculated inside the vehicle. Use this mode to block out any outside odors, smoke, or dust and to cool the cab area rapidly upon initial start up in very hot or humid weather. When this mode is selected, the HVAC control panel (control head) sends a signal to the Body Controller, requesting that the A/C compressor be turned on.

NOTE – Continuous use of the Recirculate mode may make the inside air stuffy. Use of this mode for longer than fifteen minutes is not recommended.

NORM Air Conditioning Mode

In this mode all airflow is directed to the instrument panel air outlets. Fresh (outside) air is used to cool the cab area in this mode. When this mode is selected, the HVAC control panel (control head) sends a signal to the Body Controller, requesting that the A/C compressor be turned on.

BI-Level Air Conditioning Mode

In this mode 75% of the airflow is directed to the instrument panel air outlets, 25% of the airflow is directed to the floor air outlets, and fresh (outside) air is circulated inside the vehicle cab area.

Vent Mode

In this mode all airflow is directed to the instrument panel air outlets and fresh (outside) air is circulated inside the vehicle cab area.

Floor Mode

In this mode all airflow is directed to the floor air outlets and fresh (outside) air is circulated inside the vehicle cab area.

Mix Mode

In this mode 50% of the airflow is directed to the defrost and side demist air outlets, 50% of the airflow is directed to the floor air outlets, and fresh (outside) air is circulated inside the vehicle cab area. The A/C compressor turns on automatically when in this mode to reduce humidity levels and help reduce moisture build up on the windshield. To improve defroster efficiency, remove ice and/or snow from the windshield prior to starting the vehicle.

Defrost

In this mode all of the airflow is directed to the defrost and side demist air outlets, and fresh (outside) air is circulated inside the vehicle cab area. The A/C compressor turns on automatically when in this mode to reduce humidity levels and help reduce moisture build up on the windshield. To improve defroster efficiency, remove ice and/or snow from the windshield prior to starting the vehicle.

Table 1 Air Distribution Chart

CONTROL KNOB POSITION	AIRFLOW		
Front Air Conditioner Systems	Panel	Floor	Windshield
MAX A/C 	100%		
NORM A/C 	100%		
DOT 1	50%	50%	
BI-LEVEL 	75%	25%	
DOT 2	50%	50%	

Table 1 Air Distribution Chart (cont.)

CONTROL KNOB POSITION	AIRFLOW		
Front Air Conditioner Systems	Panel	Floor	Windshield
PANEL 	100%		
DOT 3	25%	75%	
FLOOR 		100%	
DOT 4		75%	25%
MIX 		50%	50%
DOT 5		25%	75%
DEFROST 			100%

4.5. DEHUMIDIFYING

In mild weather with high humidity conditions, the heater system can be operated simultaneously with the air conditioner to dehumidify moist air. Set the mode control to either the NORM or A/C bi-level position, place the fan speed control to any setting, and move the temperature control towards HOT (clockwise) until a comfortable temperature is maintained. The air conditioner will remove the humidity while the heater keeps the cab comfortable.

5. SYSTEM OPERATING CONTROLS – SLEEPER HVAC SYSTEM

NOTE – The following paragraphs describe operation of the sleeper HVAC system only. On vehicles equipped with sleeper cabs, separate control panels make it possible for the front and rear HVAC systems to operate in different modes and at different temperatures. For rapid heating or cooling of the entire cab/sleeper area both systems should be set to the same approximate temperature range.

The addition of the sleeper HVAC system does not affect the operation of the front (cab) A/C system. All information covering the front HVAC system in these vehicles can be found in SYSTEM OPERATING CONTROLS – FRONT HVAC SYSTEM. The electrical control systems for the sleeper HVAC system are covered in the applicable ELECTRICAL CIRCUIT DIAGRAMS manual and/or ELECTRICAL SYSTEM TROUBLESHOOTING guide listed in ISIS.

In general, the blower speed and air discharge temperature of the sleeper HVAC system can be adjusted from either the rear control panel or the sleeper HVAC switches located on the instrument panel. Also, the air conditioning mode is automatically requested by the sleeper HVAC controller whenever the active temperature control for the sleeper system is set to a temperature lower than the temperature currently being sensed by the temperature sensor in the rear HVAC unit. NOTE: To energize the A/C compressor, the engine must be running and the blower speed controls for both the front and rear HVAC systems must NOT be set to OFF.

For additional information, refer to the Section 3.1 (See SYSTEM DESCRIPTION – REAR HVAC SYSTEM, page 20).

6. SYSTEM MAINTENANCE

6.1. PRE-SEASON SERVICING

Experience has shown that many unsatisfactory conditions incurred with heating and air conditioning systems result from lack of regular maintenance. Preventive maintenance and cleanliness of all components within the system are extremely important. A complete step-by-step pre-season checkout of the air conditioner/heater system will substantially increase satisfactory operation during the operating season.

Perform the following procedures:

1. Check the mounting fasteners of each component for looseness.

2. Check condition, tension and alignment of all drive belts. Refer to GROUP 12– ENGINE section in the Master Service Manual.

3. Check condition of heater hoses and engine cooling system hoses. Replace if necessary.

4. Verify that the vehicle coolant level is correct.

5. Check refrigerant hose retention and condition. Look for cracks, chafing, or other damage. Inspect all tubing and hoses for dirty or loose connections. All connections must be clean and tight.

NOTE – If a patch of oily residue is found at or near a connection it may indicate a refrigerant leak. Note its location in case a system operational test indicates a refrigerant leak or a low refrigerant condition.

NOTE – Cleanliness of the air conditioner components cannot be over-emphasized. Lack of proper attention in this area is one of the major causes of costly and unsatisfactory unit operation.

> **CAUTION – Never force the fresh/recirculate air door open. If the door position must be changed; turn on key, set mode control to FLOOR, turn off key. Forcing the door will result in a broken door shaft and a costly repair.**

6. Check the filter elements in the evaporator housing and the housing air intake. If the vehicle is equipped with a sleeper HVAC system, check the rear system filter element. Clean or replace filter elements if necessary. To access the filter in the front evaporator housing, refer to REMOVE AND INSTALL, AIR FILTER (See AIR FILTER (LOCATED INSIDE EVAPORATOR HOUSING), page 81).

> **CAUTION – When using a pressure washer to clean any heat exchanger (radiator, condenser, evaporator, or charge air cooler); use caution and maintain distance from the component with the pressure washer. Do not spray the component fins at an angle as fin damage may occur and reduce efficiency.**

7. Clean all foreign material from condenser and radiator fins. As often as necessary, spray water through the condenser towards the radiator and through the radiator towards the condenser to flush debris from the fins. If necessary, spray the component with a cleaning solution, allow to soak 20 - 30 minutes, then rinse with clean water.

8. Operate front air conditioner system and check operation of controls.

9. Check operation of front blower (airflow matches selected blower speed).

10. Verify that the front system is cooling properly in the A/C modes and heating properly in the heat modes.

11. If the vehicle is equipped with a sleeper HVAC system, proceed to step 14; otherwise, continue to the next step.

12. Use Diamond Logic Builder (DLB) and the electronic service tool to verify that no HVAC Diagnostic Trouble Codes (DTC's) are currently stored in the system. For complete information on viewing DTC's refer to the applicable Electrical Troubleshooting Guide, on ISIS.

13. If no DTC's are present and the system is operating correctly, the pre-season check is completed.

    If the system appears to be malfunctioning refer to the DIAGNOSIS AND TROUBLESHOOTING section (See DIAGNOSIS AND TROUBLESHOOTING, page 32).

14. Verify that the vehicle engine is running.

15. On the **front** HVAC control panel, set the blower speed control to midrange, and the mode control to a **non-A/C** mode.

NOTE – In the following steps, bar graphs representing the set points of the blower speed and temperature controls should be displayed in the message display area of the gauge cluster. The bar graphs are displayed only during, and for several seconds after, actuation of the controls. If the vehicle is equipped with a DIGITAL rear HVAC control panel, the bar graphs will also be displayed at that location.

16. Operate the blower speed controls for the sleeper HVAC system (rear control panel **and** instrument panel switches), and verify that the system responds correctly. Leave the rear blower speed set to mid-range.

17. Using the sleeper temperature rocker switch on the instrument panel, adjust the temperature set point to its highest setting, and verify that warm air is output from the sleeper vents.

18. Using the sleeper temperature control on the rear control panel, adjust the temperature set point to its lowest (coldest) setting. Verify that within 2 minutes the A/C compressor is energized and cool air is output from the sleeper vents.

19. Use Diamond Logic Builder (DLB) and the electronic service tool to verify that no HVAC Diagnostic Trouble Codes (DTC's) are currently stored in the system. For complete information on viewing DTC's refer to the applicable Electrical Troubleshooting Guide, on ISIS.

20. If no DTC's are present and the system is operating correctly, the pre-season check is completed.

    If the system appears to be malfunctioning refer to the DIAGNOSIS AND TROUBLESHOOTING section (See DIAGNOSIS AND TROUBLESHOOTING, page 32).

6.2. OFF-SEASON CARE

This system does not require any off-season maintenance. Do not remove compressor drive belt during the off-season, as clutch and compressor bearings may become brinneled. It is not necessary to operate the A/C

system periodically during the off-season because the system uses the A/C compressor while in the defrost mode, if the ambient temperature is above freezing.

6.3. AIR FILTERS

> **CAUTION – Never force the fresh/recirculate air door open. If the door position must be changed, follow the referenced procedures. Forcing the door will result in a broken door shaft and a costly repair.**

Inspect the HVAC inlet air filter elements for dust and road dirt at the beginning of each cooling season. Clean or replace the elements as needed. More frequent cleaning and/or replacement may be required on vehicles operated in severe conditions.

A filter/grille assembly is located at the top of the fresh air intake, above the front evaporator housing. This filter is mounted to the air intake above the cowl drain tray. This filter assembly is secured with thumb screws and does not require tools for removal and installation.

Another filter element is located inside the front evaporator housing, under the fresh/recirculate air door. To replace this air filter refer to AIR FILTER, REMOVE AND INSTALL (See AIR FILTER (LOCATED INSIDE EVAPORATOR HOUSING), page 81).

If the vehicle is equipped with a sleeper HVAC system, a filter element is located at the rear HVAC unit air intake. Clean or replace with a new element if necessary. The filter element can be accessed by lifting the lower bunk.

7. DIAGNOSIS AND TROUBLESHOOTING

Diagnosis and troubleshooting of the HVAC system consists of the following steps:

- Preliminary Checks — checking for physical damage and verifying the contents of the refrigerant system.
- Diagnosis — identifying the probable causes of the system malfunction by observing diagnostic trouble codes, making physical checks, operating the system, and identifying fault symptoms during operation.
- Troubleshooting — Isolating the fault by use of the troubleshooting tables.
- A/C System Performance Test — Using test equipment to monitor A/C system parameters during operation. This is done to help identify faults during troubleshooting and to verify correct operation after repairs.

The DIAGNOSIS AND TROUBLESHOOTING FLOW CHART provides an overview of this process.

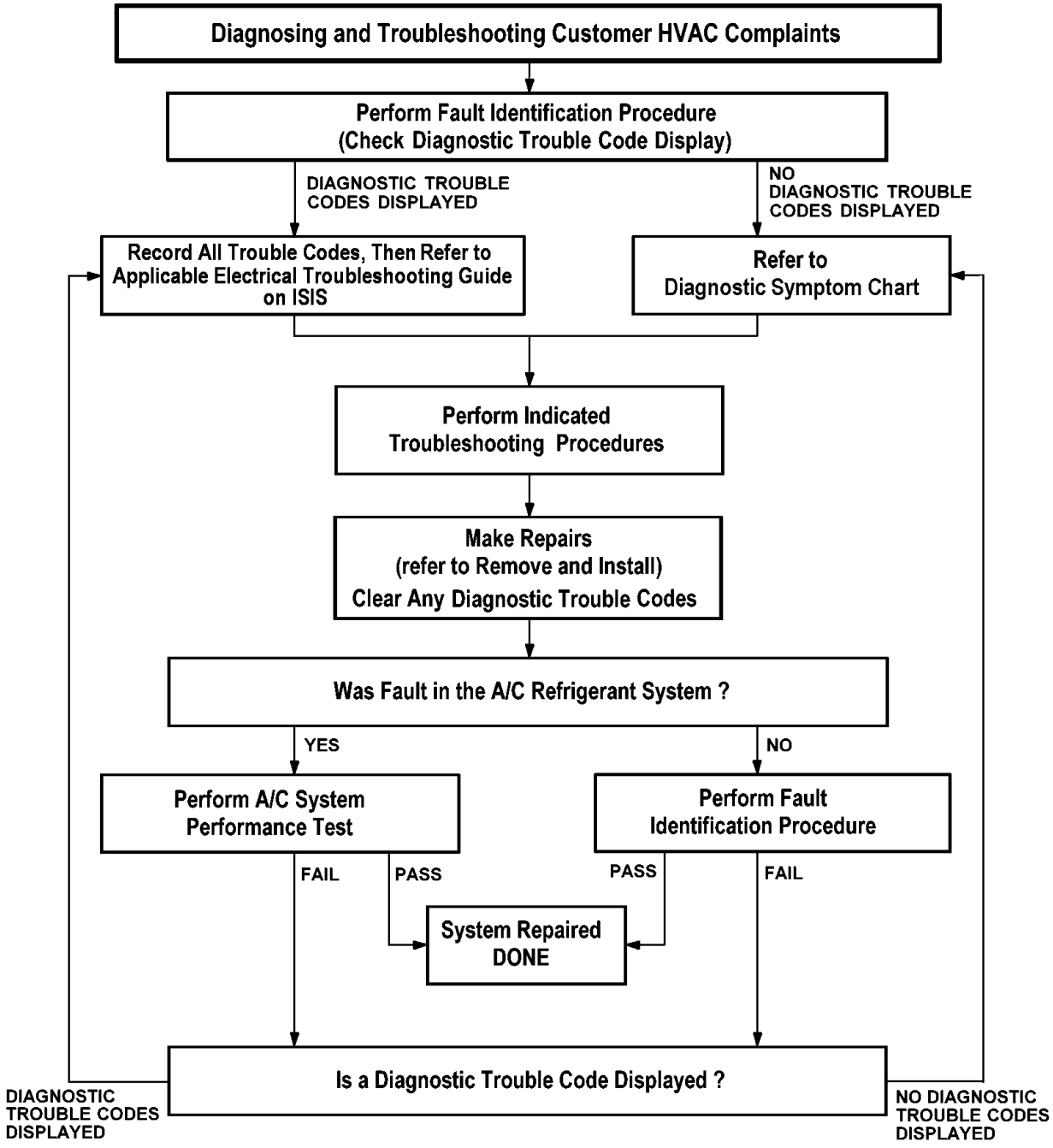


Figure 21 Diagnosis and Troubleshooting Flow Chart

7.1. PRELIMINARY CHECKS

The following preliminary checks should be performed to check for some common causes of A/C system problems.

Check for Obvious Damage

Perform a simple visual check of the HVAC system to verify that no obvious physical problems are present. With the engine off inspect the following items:

- compressor and clutch mounting
- compressor clutch coil wiring and connection
- compressor drive belt and tension
- all A/C and heater hoses and connections (including sleeper HVAC connections, if so equipped)
- condenser mounting
- condenser fins (and blockage by debris)
- receiver-drier mounting
- expansion valve (TXV) mounting (front and rear, if vehicle is equipped with a sleeper HVAC system)
- filter elements
- evaporator housing drains (including sleeper, if so equipped)
- evaporator housing mounting and overall condition
- electrical connections to pressure transducer and thermistors
- electrical connections to actuators for air flow doors: recirculate, temperature, and mode doors (front HVAC system)
- electrical connections to the rear HVAC unit: blower, controller, LPM, temperature door actuator, and temperature sensor (if vehicle is equipped with a sleeper HVAC system)
- rear HVAC unit mounting and overall condition (if vehicle is equipped with a sleeper HVAC system)
- connection of sleeper duct work to rear HVAC unit (if vehicle is equipped with a sleeper HVAC system)

Refrigerant Identification

Identify the refrigerant currently in the HVAC system to protect shop equipment and to identify a possible cause of poor system operation. Refer to REFRIGERANT IDENTIFICATION (See REFRIGERANT IDENTIFICATION, page 142).

Check for Non-Condensable Gases

Verify that the system does not contain air or some other non-condensable gas. A common cause of poor system operation. When a Refrigerant Identifier is not available, this check of the system contents should be performed (Table 2). This check can be performed in addition to refrigerant identification to check for overcharged and undercharged conditions. The A/C system **must be** at ambient temperature when performing this check.

Table 2 Check for Non-Condensable Gases

NOTE – The engine must not be running, and A/C system must be at ambient temperature for this step.	
1. Connect recovery station to A/C system. Refer to Figure 65 (See Figure 65, page 147). 2. Using a thermometer determine ambient temperature within a degree or two. 3. Record system pressures indicated on recovery station gauges. 4. Compare gauge readings to table 3.	• If gauges are >10 psig **higher** than the table listings, system contains air or some non-condensable gas. Discharge, evacuate, and recharge the system. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137). • If gauges are >10 psig **lower** than the table listings, system is undercharged. Inspect all joints and seals using a leak detector. Refer to LEAK DETECTION. Repair any leaks. Service the A/C system (discharge, evacuate, and recharge the system). Refer to SERVICE PROCEDURES FOR R-134a (See SERVICE PROCEDURES FOR R-134a, page 137).

Table 3 System Pressure Versus Ambient Temperature

Temperature °F	R134A PSIG	Temperature °F	R134A PSIG
40	35.07	80	86.99
45	40.07	85	95.23
50	45.46	90	104.3
55	51.23	95	113.93
60	57.42	100	124.12
65	64.04	105	134.92
70	71.11	110	146.33
75	78.66		

7.2. DIAGNOSIS

An HVAC system is received for service because the operator feels that the system is not operating correctly. Usually, the operator will provide a symptom describing the operation of the system. In the following procedure, diagnosis begins by observing any Diagnostic Trouble Codes logged by the body controller. If no diagnostic trouble codes are displayed, the reported fault is verified by operating the system and observing the symptoms. Because the Fault Identification Procedure, Diagnostic Symptom Chart, and Troubleshooting Tables are organized in order of increasing confidence; any fault symptom must be resolved at its first appearance.

Diagnostic Trouble Codes

The body controller monitors parameters throughout the A/C system and generates Diagnostic Trouble Codes (DTC's) whenever a monitored parameter falls outside of its specified range. When any DTC is generated it is stored in memory. Observing DTC's is one of the first steps in diagnosing a malfunctioning A/C system, as indicated in the following procedure. Always resolve active DTC's before troubleshooting symptoms.

FAULT IDENTIFICATION PROCEDURE

NOTE – The following test may not perform correctly if the ambient temperature is too cold. If the A/C compressor does not turn on when first attempted, allow the engine to warm up to operating temperature, and try again. If the A/C compressor still will not turn on, a fault probably exists.

NOTE – The cycling rate of the A/C compressor will vary with the ambient temperature. In cooler ambient temperatures the compressor may cycle up to four times a minute.

NOTE – Unless specifically identified as "sleeper" controls, assume that the controls described in this procedure are located on the front (instrument panel) HVAC control panel.

Perform the following steps to determine if any HVAC related DTC's are being generated and/or to verify a reported symptom. Resolve each fault (DTC or symptom) at its first appearance. If a DTC is present when checked, follow the instructions provided in the Electrical Troubleshooting Guide. If no DTC's are displayed, perform the remainder of the procedure and note any symptoms observed. When a symptom is noted without a DTC, proceed to the DIAGNOSTIC SYMPTOM CHART (See DIAGNOSTIC SYMPTOM CHART, page 39).

1. Check for HVAC related DTC's. Refer to the applicable Electrical Troubleshooting Guide, on ISIS.

2. If no DTC's were displayed, start the engine and set the air conditioning controls for maximum cooling, as follows.

    A. Set blower speed control to highest speed, full cw.

    B. Set temperature control for maximum cooling, full ccw.

    C. Set mode control to MAX A/C, full ccw.

    D. Set sleeper blower control to OFF (vehicles equipped with sleeper HVAC system)

    E. Set sleeper temperature control to midrange (vehicles equipped with sleeper HVAC system)

3. Set the engine speed at 1500 RPM or above.

4. While performing the following steps, run the air conditioning system for at least five minutes even if it appears that the system is not operating correctly.

NOTE – In the following step, verify only that the blower is operating and air flow is present at some instrument panel or floor outlet. The air distribution system will be checked in a later step.

5. Cycle the blower speed control through each of its settings and verify correct blower operation. (Air flow stops in the OFF position and increases as the control is rotated in a clockwise direction.)

6. Set the blower speed control to the highest setting (full cw).

NOTE – In the following step verify that the main forced air flow is through the indicated outlets. However, it is normal for a very slight amount of bleed-through air to be present at other outlets.

7. Slowly cycle the mode control through each of its settings and verify correct air distribution at the various air outlets as indicated. Also note the strength of the air flow.

    a. MAX, NORM, and Vent Only settings direct air flow through the instrument panel vents ONLY.

    b. Bi-level setting directs air flow through the instrument panel vents and the floor ducts ONLY.

    c. Floor setting directs air flow through the floor ducts ONLY.

d. Floor/Defrost setting directs air flow through the floor ducts and the defrost ducts ONLY.

e. Defrost setting directs air flow through the defrost ducts ONLY.

8. Set the mode control to the Floor setting.

NOTE – The engine coolant must be at operating temperature before the next step will work correctly.

9. Set the temperature control to the maximum heat setting (full cw), and verify that the temperature of the air flow at the floor ducts is warm to hot.

10. Set the temperature control to the maximum cooling setting (full ccw).

11. Set the mode control to the MAX air conditioning setting (full ccw), and verify that within five minutes cold air is present at the instrument panel vents.

12. Set the mode control to the Defrost setting, and verify that the compressor remains energized or cycles on within two minutes.

13. Repeat the previous step with the mode control set to the Floor/Defrost setting; the compressor should continue to operate.

14. With the engine still running, check again for DTC's. Refer to the applicable Electrical Troubleshooting Guide for complete procedures. If a DTC is present when checked, follow the instructions provided in the Electrical Troubleshooting Guide; otherwise, proceed to the next step.

15. If no diagnostic trouble codes are present, and the system is not operating correctly, find the fault symptom in the DIAGNOSTIC SYMPTOM CHART (See DIAGNOSTIC SYMPTOM CHART, page 39). If vehicle is equipped with a sleeper HVAC system, proceed to step 17, otherwise, proceed to the next step.

16. The HVAC system is operating correctly. If you are performing this test after making repairs; the fault has been repaired. Before returning the vehicle to service, perform a physical inspection of the HVAC system including a refrigerant leak test.

NOTE – The remaining steps in this procedure pertain only to vehicles equipped with a sleeper HVAC system.

17. Verify that the engine is running and set the front (instrument panel) HVAC control panel as follows.

    A. Set blower speed control to OFF, full ccw.

    B. Set temperature control to any temperature.

    C. Set mode control to direct air from the instrument panel vents (no A/C).

18. Verify that the engine speed is set at 1500 RPM or above.

19. Using the 'SLPR TEMP' rocker switch, located on the instrument panel, adjust the sleeper temperature to several settings. Verify that a bar graph corresponding to the temperature setting is displayed in the message display on the gauge cluster for several seconds after each setting change.

20. Using the 'SLPR FAN' rocker switch, located on the instrument panel, cycle the sleeper blower through its settings. Verify that a bar graph corresponding to the blower speed setting is displayed in the message display on the gauge cluster for several seconds after each setting change.

21. If the vehicle is equipped with a **digital** sleeper HVAC control panel, proceed to step **35**; otherwise, proceed to the next step.

22. On the analog sleeper HVAC control panel, adjust the temperature control through several settings. Verify that a bar graph corresponding to the temperature setting is displayed in the message display on the gauge cluster for several seconds after adjusting the control. Leave the sleeper temperature set to its maximum heat setting (full cw).

23. On the analog sleeper HVAC control panel, cycle the blower speed control through its settings. Verify that a bar graph corresponding to the blower control setting is displayed in the message display on the gauge cluster for several seconds after adjusting the control.

24. Verify that the air flow through the sleeper vents corresponds to the setting of the blower speed control. (Air flow stops in the OFF position and increases as the control is rotated in a clockwise direction.)

25. Leave the sleeper blower speed control set to a midrange speed.

26. Verify that the air from the outlet vents is warm to hot (as the engine warms up).

27. On the analog sleeper HVAC control panel, set the temperature control to its maximum cooling setting (full ccw), and verify that the temperature of the air from the outlet vents is reduced to near ambient temperature.

28. Verify that the following message is displayed in the message display on the gauge cluster: “Activate HVAC front blower.”

29. Verify that the A/C compressor **does not** energize.

30. On the **front** (instrument panel) HVAC control panel, set the blower control to the slowest speed above OFF.

31. Verify that the A/C compressor energizes within 2 minutes.

32. Verify that the temperature of the air from the sleeper outlet vents begins to cool.

33. Verify that within five minutes cold air is present at the sleeper vents.

34. Proceed to step **48**.

35. On the digital sleeper HVAC control panel, press the temperature up button several times. Verify that a bar graph corresponding to the sleeper temperature setting is displayed on the sleeper control panel display.

36. Repeatedly press the temperature up button until the temperature set point is at its warmest setting.

37. On the digital sleeper HVAC control panel, press the blower speed up and down buttons to cycle the blower through its speed settings. Verify that a bar graph corresponding to the sleeper blower speed setting is displayed on the sleeper control panel display.

38. Verify that the air flow through the sleeper vents corresponds to the blower speed set point. Leave the sleeper blower set to a midrange speed.

39. Verify that the air from the outlet vents is warm to hot (as the engine warms up).

40. On the digital sleeper HVAC control panel, repeatedly press the temperature down button until the temperature set point is at its coolest setting, and verify that a bar graph corresponding to the sleeper temperature setting is displayed on the sleeper control panel display.

41. Verify that the temperature of the air from the outlet vents is reduced to near ambient temperature.

42. Verify that the following message is displayed in the message display on the gauge cluster: “Activate HVAC front blower.”

43. Verify that the A/C compressor **does not** energize.

44. On the **front** (instrument panel) HVAC control panel, set the blower control to the slowest speed above OFF.

45. Verify that the A/C compressor energizes within 2 minutes.

46. Verify that the temperature of the air from the outlet vents begins to cool.

47. Verify that within five minutes cold air is present at the sleeper vents.

48. With the engine still running, check again for DTC’s. Refer to the applicable Electrical Troubleshooting Guide for complete procedures. If a DTC is present when checked, follow the instructions provided in the Electrical Troubleshooting Guide; otherwise, proceed to the next step.

49. If no DTC’s are present, and the system is not operating correctly, find the fault symptom in the DIAGNOSTIC SYMPTOM CHART; otherwise, proceed to the next step.

50. The HVAC system is operating correctly. If you are performing this test after making repairs; the fault has been repaired. Before returning the vehicle to service, perform a physical inspection of the HVAC system including a refrigerant leak test.

DIAGNOSTIC SYMPTOM CHART

This chart is used to determine what action is required when a fault symptom exists but no diagnostic trouble code has been logged. After locating the fault symptom in the chart, service the system as instructed in the ACTION column.

Once the system has been serviced, it should be tested to verify correct operation. If the fault was refrigerant based, verify the repairs by performing the A/C SYSTEM PERFORMANCE TEST PROCEDURE (See A/C SYSTEM PERFORMANCE TEST PROCEDURE, page 44). If the fault was not refrigerant based, verify the repairs by performing the FAULT IDENTIFICATION PROCEDURE (See FAULT IDENTIFICATION PROCEDURE, page 36).

Table 4 Diagnostic Symptom Chart

Symptom	Action
NOTE – This table is designed to be used after completing the FAULT IDENTIFICATION PROCEDURE and resolving any HVAC related Diagnostic Trouble Codes that were set. **NOTE – Resolve any HVAC related symptoms in the order that they occurred during the performance of the FAULT IDENTIFICATION PROCEDURE.**	
No Air Flow (in Cab Area)	This is an electrical problem related to the cab (front) blower circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
Wrong Air Distribution (in Cab Area)	Refer to MODE SELECTION TROUBLESHOOTING table (See Table 8, page 50).
Low Air Flow (in Cab Area)	Refer to LOW AIR FLOW IN CAB TROUBLESHOOTING table (See Table 12, page 57).
Insufficient Heat in Cab Area (Heater Mode)	Refer to INSUFFICIENT CAB HEAT TROUBLESHOOTING table (See Table 13, page 59).
Insufficient Cooling in Cab Area (A/C Mode) (Compressor may be operable or inoperable) **NOTE – If any diagnostic codes are set, refer to the Electrical Troubleshooting Guide on ISIS.**	Refer to INSUFFICIENT CAB COOLING TROUBLESHOOTING table (See Table 14, page 60).
Insufficient Defrost (Defrost Mode)	Refer to INSUFFICIENT DEFROST TROUBLESHOOTING table (See Table 15, page 64).
Compressor Has Excessive Vibration or Noise	Refer to NOISY COMPRESSOR TROUBLESHOOTING table (See Table 16, page 67).
NOTE – The following symptoms pertain only to vehicles equipped with sleeper HVAC systems.	
Sleeper HVAC System Control (Fan Speed or Temperature) Inoperative. (Instrument panel bar graph NOT displayed when sleeper HVAC control is actuated.)	This is an electrical problem related to the control circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
Sleeper HVAC System Blower not Operating Correctly. (Instrument panel bar graph IS displayed when control is actuated; but fan speed, or system air flow, does not respond correctly to control setting.)	
No Air Flow from Sleeper Vents	Refer to NO SLEEPER AIR FLOW TROUBLESHOOTING table (See Table 17, page 68).
Low Air Flow from Sleeper Vents	Refer to LOW SLEEPER AIR FLOW TROUBLESHOOTING table (See Table 18, page 69).

Table 4 Diagnostic Symptom Chart (cont.)

Symptom	Action
Insufficient Sleeper Heat (Heater Mode)	Refer to INSUFFICIENT SLEEPER HEAT TROUBLESHOOTING table (See Table 19, page 71).
Insufficient Sleeper Cooling (A/C Mode) (Compressor may be operable or inoperable) **NOTE – If any diagnostic codes are set, refer to the Electrical Troubleshooting Guide on ISIS.**	Refer to INSUFFICIENT SLEEPER COOLING TROUBLESHOOTING table (See Table 20, page 72).
Sleeper system temperature does not correctly track the temperature control setting. Temperature control requires constant adjustment.	Verify that the discharge duct temperature sensor is correctly installed in the rear HVAC unit. Refer to the temperature blend door information in the Electrical Troubleshooting Guide on ISIS.

7.3. PHYSICAL CHECKS

These Physical Checks are provided as general supplemental information. While not as precise as the step-by-step procedures, these checks provide a simple convenient method of determining the condition of the A/C refrigerant system. Perform these checks when referenced from the troubleshooting tables.

Physical Check Procedure

1. Start the engine and set the front (instrument panel) HVAC control panel for maximum cooling, as follows:
   A. Set blower speed control to highest speed, full cw.
   B. Set temperature control for maximum cooling, full ccw.
   C. Set mode control to MAX A/C, full ccw.
2. If the vehicle is equipped with a sleeper HVAC system, set the sleeper HVAC control panel as follows:
   A. Set blower speed to any midrange speed.
   B. Set sleeper temperature set point for maximum cooling.
3. Set the engine speed at 1500 RPM or above, and run the air conditioning system for at least five minutes.

> **WARNING – Avoid contact with moving belts, pulleys and/or fan when making the following checks. Beware of extremely high temperatures at compressor outlet (discharge) hoses and tubing, as personal injury may result.**

4. With the system operating, feel all air conditioning system components and refrigerant lines for proper operating temperatures, as indicated in the following paragraphs.

   In general, from the discharge side of the compressor along the high pressure line, through the condenser and up to the filter-drier, everything should be hot or warm to the touch. The filter-drier is normally at

outside temperature. The expansion valve, evaporator and all the lines on the low pressure side leading back to the compressor should be cool to the touch. Any deviation from the above conditions may indicate a malfunction in the system.

Malfunctions or stoppages may be indicated by extreme cold or frosted areas (example: a cold filter-drier frosted part way up indicates a stoppage or serious restriction in the filter-drier). A stoppage or severe restriction in the refrigerant system can be located by looking for these indications. The following is a brief description of symptoms or conditions that could exist if the vehicle air conditioning system is malfunctioning. The conditions are listed by system component.

Refrigerant Compressor

NOTE – If the ambient temperature is very low, the engine may have to reach operating temperature before the body controller will energize the A/C compressor. After warmup, underhood heat will allow the compressor to cycle on at very low ambient temperatures.

Compressor problems are usually revealed in one of five ways: abnormal noise, seizure, leakage, high suction pressure, or low discharge pressure.

CAUTION – In the following step, the A/C compressor should be turned in a clockwise (CW) direction only (as viewed from the front).

Resonant noises are not a cause for alarm. Irregular noise or rattles are likely caused by broken parts. To check for seizure, turn the engine off to de-energize the magnetic clutch and see if the drive plate can be turned. If it won't turn, the compressor has seized.

Inspect the fittings, oil fill plug, and all gasket joints on the compressor for signs of refrigerant leakage.

Verify that the wires to the compressor clutch are in good condition and have not become disconnected.

Condenser

The condenser is usually trouble-free. Normally, the temperature of the condenser outlet line is noticeably cooler than the inlet line.

When road debris (such as leaves or dirt buildup) cakes up, airflow over the condenser fins is reduced and the air is not able to absorb enough heat to turn the hot refrigerant gas into a liquid. High discharge pressure will result. In these cases, carefully clean off the outer surface of the condenser with soap and water and compressed air; be careful not to bend the fins.

High discharge pressure will also occur if the condenser's tubing is abnormally bent, restricting or blocking the flow of refrigerant. Frost will appear at the point where the flow of refrigerant is restricted.

Less common internal blockage (foreign material or metallic grit buildup) will restrict or stop the flow of refrigerant.

Inspect the fittings and the condenser tubing for signs of refrigerant leakage.

Reduced performance may also result from excess oil in the refrigerant system. This excess oil tends to collect in the bottom of the condenser.

Pressure Transducer

Verify that the wires to the pressure transducer are in good condition and have not become disconnected.

Inspect the transducer mounting for signs of refrigerant leakage.

Thermistors

Verify that the wires to the thermistors are in good condition and have not become disconnected.

Inspect the thermistor mountings for signs of refrigerant leakage.

Filter-Drier

The filter-drier is normally at or near outside temperature. To the touch, the entire length of the unit should be the same temperature. If noticeable cold spots exist, replace the filter-drier.

A blockage at the filter-drier will cause high head pressure and little or no cooling in the cab area. If the vehicle is equipped with a sleeper HVAC system, the rise in head pressure will be reduced, and the sleeper A/C may operate normally.

Thermostatic Expansion Valve (TXV)

NOTE – If the vehicle is equipped with a sleeper HVAC system, a second TXV (and evaporator) circuit is connected in parallel with the TXV/evaporator circuit that cools the cab area. Because of the parallel arrangement, the following conditions/symptoms could exist in the front, rear, or both A/C systems. If one system is cooling normally while the other system is not cooling, a TXV problem is indicated. If the problem is intermittent, moisture may be present in the refrigerant system.

Problems that start in the expansion valve show up as follows.

- When stuck closed, the evaporator core and expansion valve will be at outside temperature, and the system will not cool.
- When stuck open, both the evaporator core and the valve will be extremely cold with possible frost or ice buildup. If the vehicle is equipped with a second A/C system (front/sleeper), that system's performance may be degraded.

Because the expansion valve channels are very small, blockage in the system is usually found here (the valve is very sensitive to contamination). Usually the contamination is water. Less that a drop of water is all it takes to make the valve inoperative. When water reaches the valve, the extreme cold that results from the pressure drop freezes the water, forming an ice blockage. After the system shuts down and the valve warms up, the valve operates again, only to freeze up when the moisture returns and the temperature drops.

Intermittent expansion valve freeze up indicates that the filter-drier is not removing the moisture from the system.

Evaporator

The evaporator core is basically trouble-free when air flow over the fins is not blocked. Normally, the evaporator outlet tube will feel cool to cold. External or, less often, internal blockage of an evaporator core will cause low suction pressure in the system, as well as little or no cooling.

NOTE – If the vehicle is equipped with a sleeper HVAC system, a second TXV/evaporator circuit is connected in parallel with the TXV/evaporator circuit that cools the cab area. Because of the parallel arrangement, the described symptoms could exist in the front, rear, or both A/C systems.

Evaporator freeze-ups are the result of the moisture in the air condensing and then freezing on an evaporator core that is operating below 32°F. The ice on the fins blocks the air flow through the evaporator and stops the cooling until the ice melts. Evaporator freeze-up may be caused by a faulty TXV or a problem with the sensing circuitry that controls the cycling of the A/C compressor (input thermistor circuit or output thermistor circuit).

A flooded evaporator occurs when there is too much refrigerant flowing into the evaporator, and is generally caused by a faulty TXV. A starved evaporator occurs when there is not enough refrigerant flowing into the evaporator. Starvation can be caused by a faulty TXV or a low refrigerant charge. A starved evaporator may cause the evaporator outlet tube to feel warmer than usual: at or near ambient temperature.

If a leak exists in the system, and it cannot be traced to other parts or fittings, suspect damage to the evaporator core.

The evaporator is the most difficult of all the components to inspect visually because of its enclosed location. To detect airflow blockage due to debris, bent fins, and/or refrigerant leaks (oil smudges) inspect the inlet side of the evaporator.

CAUTION – Never force the fresh/recirculate air door open. If the door position must be changed; turn on key, set mode control to FLOOR, turn off key. Forcing the door will result in a broken door shaft and a costly repair.

To inspect the cowl mounted evaporator, the fresh air/recirculate air door must be in the open (fresh air) position (the mode control must not be set to the MAX A/C position). Remove the grille from the cowl tray air inlet, and remove the internal air filter. Using a flashlight and inspection mirror, inspect the inlet side of the evaporator core.

For vehicles equipped with a sleeper HVAC system, the inlet side of the evaporator can be inspected after removing the blower assembly from the rear HVAC unit. Through the hole left by the blower, use a flashlight and inspection mirror to inspect the evaporator core.

Line Restrictions

A restricted suction line causes low suction pressure at the compressor and little or no cooling. A restriction in a line between the compressor and the expansion valve can cause high discharge and low suction pressure, and poor cooling. Generally, if the line is not entirely blocked, the area immediately after the restriction will be cold. A completely blocked line will result in high head pressures and no cooling, but no physical symptoms at the blockage.

NOTE – If the vehicle is equipped with a sleeper HVAC system, the sleeper TXV/evaporator circuit is connected in parallel with the TXV/evaporator circuit that cools the cab area. Because of the parallel arrangement, a restriction in only one of the parallel circuits may cause only a slight change in the pressure readings. The system with the restricted A/C line will experience a loss of cooling, while the other system will operate normally.

If a restriction occurs in one of the lines common to both A/C systems, pressure readings will be affected, and both systems will experience a loss of cooling.

7.4. A/C SYSTEM PERFORMANCE TEST PROCEDURE

Perform this procedure when referenced from the troubleshooting tables. This test is used to determine if the air conditioning system is properly charged with refrigerant and the refrigerant cycle is functioning correctly.

The test is performed using a recovery/recycling/charging station (recovery station) or a manifold gauge set, two thermometers and an electronic leak detector. When a fault is detected perform the repairs indicated.

After making repairs involving the refrigerant system, repeat this test to verify correct A/C operation.

WARNING – During system pressure tests the recovery machine is only being used to read high and low pressures. DO NOT open either hand valve on recovery station for any reason. Equipment can be damaged, and personal injury can result.

CAUTION – To prevent damage to the test equipment, make sure test equipment and all connections are clear of all moving parts in the engine compartment.

NOTE – Before connecting any service equipment to the refrigerant system, the refrigerant in the system must be identified. Failure to identify system refrigerant before connecting equipment could result in contamination of your service equipment and any refrigerant stored in the equipment.

NOTE – In rare conditions, vehicles using a viscous fan drive, and being operated with no load may need to place a fan in front of the condenser large enough to develop air flow comparable to normal ram air flow.

1. If the system has not yet been diagnosed, perform step 2 with the engine and A/C system **at ambient temperature**. The engine and A/C system must NOT have been run within the last 30 minutes.

   If this test is being performed to verify a repair, skip step 2 and proceed to step 3.

2. With the engine off, connect a recovery station (with an internal gauge set) to the low and high side A/C service ports. A known good manifold gauge set may also be used. Refer to FIGURE 64 (See Figure 64, page 145) and/or FIGURE 65 (See Figure 65, page 147).
   a. Determine (and record) the ambient temperature (within a degree or two).
   b. Record the system pressures indicated on the high and low gauges connected to the A/C system. Both gauges should read close to the same value when the truck is not running.
   c. Compare the pressure readings recorded in the last step to the pressures shown in TABLE 3 (See Table 3, page 35).
   d. If the pressure on the gauges is more than 10 psig higher than the pressure listed in the chart, the A/C system contains air or some non-condensable gas in the refrigerant system. The system needs to be discharged, evacuated, and recharged using a recovery system. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137).

      EXAMPLE: If the ambient is 75°F, the A/C system pressure should be in the 78–79 psig range. If the pressure is 90 psig or higher it indicates that there is air or some non-condensable gas in the system.

      NOTE – A refrigerant identifier can also be used to verify the contents of the A/C system. Refer to SECTION 9.3 (See REFRIGERANT IDENTIFICATION, page 142).
   e. If the pressure on the gauges is more than 10 psig lower than the pressure listed in the chart, the system is undercharged. The system needs to be discharged, evacuated, and recharged using

a recovery system. Undercharged systems should be inspected for a possible leak before being discharged. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137).

f. If no faults have been noted, proceed to step 3.

3. Run the remainder of the test under the following conditions:

- Park the vehicle so there is no solar loading and no wind.
- Position a thermometer approximately 30 to 60 cm (12 to 24 inches) in front of the vehicle grille to measure ambient temperature of air entering the condenser.
- If not connected previously, connect a recovery station (with an internal gauge set) to the low and high side A/C service ports. A known good manifold gauge set may also be used. Refer to FIGURE 64 (See Figure 64, page 145) and/or FIGURE 65 (See Figure 65, page 147).
- Engage the engine cooling fan (unless the vehicle is equipped with a viscous fan drive).
- Slowly close the hood, being careful not to damage test equipment connections.
- Insert a thermometer into the passenger side, left instrument panel vent. Do not allow thermometer to touch the side of the duct. **(NOTE When testing the sleeper A/C system, place the thermometer into the lower passenger side bunk vent.)**
- Run the engine at 1500 RPM.
- Open the windows and close both cab doors.
- Set the controls on the front HVAC control panel as follows: mode control to NORM A/C, blower control to high (full cw), and temperature control to maximum cooling (full ccw).
- (Sleeper Cabs) Set the controls on the sleeper HVAC control panel as follows: blower control to high, and temperature control to maximum cooling.
- Operate the system for at least five minutes, or until the gauge readings settle. Check the gauge readings on the recovery station. If the A/C system is operating properly, the high and low pressure readings will be within the listed pressure ranges in the applicable SYSTEM PRESSURE TEST CHART. Day cab vehicles refer to Table 5 and sleeper vehicles refer to Table 6. If the gauges are not reading within the System Pressure Test Chart ranges, refer to ABNORMAL GAUGE READINGS (See ABNORMAL GAUGE READINGS, page 47).

Table 5 System Pressure Test Chart (Day Cabs)

Ambient Air Temperature		Relative Humidity	Vent Air Temperature Left Passenger		Refrigerant Pressure High Side Service Port (psig)	Refrigerant Pressure Low Side Service Port (psig)	Compressor Cycling ?
(°F)	(°C)	(% RH)	(°F)	(°C)			
70	21.1	30-50	45-51	7.2-10.5	126-146	27-32	Yes
70	21.1	70-90	45-58	7.2-14.4	133-153	31-36	Yes
80	26.7	30-50	46-56	7.8-13.3	146-166	26-31	Yes
80	26.7	70-90	44-54	6.7-12.2	153-173	32-37	Yes
90	32.2	30-50	45-53	7.2-11.7	175-195	32-37	Yes
90	32.2	70	57-62	13.9-16.7	189-209	39-44	Yes
100	37.8	30-50	54-60	12.2-15.6	209-229	38-43	Yes
100	37.8	70	67-72	19.4-22.2	232-252	47-52	Yes

Table 6 System Pressure Test Chart (Sleepers)

Ambient Air Temperature		Relative Humidity	Vent Air Temperature Instrument Panel Left Passenger		Vent Air Temperature Lower Passenger Bunk Vent		Refrigerant Pressure High Side Service Port (psig)	Refrigerant Pressure Low Side Service Port (psig)	Compressor Cycling ?
(°F)	(°C)	(% RH)	(°F)	(°C)	(°F)	(°C)			
70	21.1	30-50	41-47	5-8.3	34-40	1.1-4.4	135-155	33-38	No
70	21.1	70-90	41-54	5-12.2	30-40	–1.1 to 4.4	132-152	35-40	No
80	26.7	30-50	43-53	6.1-11.7	32-39	0-3.9	158-178	33-38	No
80	26.7	70-90	50-60	10-16.6	36-44	2.2-6.7	153-173	36-41	No
90	32.2	30-50	54-62	12.2-16.7	40-46	4.4-7.8	197-217	39-44	No
90	32.2	70	62-68	16.7-20	47-52	8.3-11.1	214-234	46-51	No
100	37.8	30-50	61-69	16.1-20.6	45-51	7.2-10.6	230-250	48-53	No
100	37.8	70	75-79	23.9-26.1	55-57	12.8-13.9	252-272	56-61	No

7.5. ABNORMAL GAUGE READINGS

WARNING – During system pressure tests, DO NOT open either hand valve on the recovery station for any reason. Equipment can be damaged, and personal injury can result.

CAUTION – To prevent damage to the test equipment, make sure test equipment and all connections are clear of all moving parts in the engine compartment.

NOTE – In rare conditions, vehicles using a viscous fan drive, and being operated with no load may need to set a fan in front of the condenser large enough to develop air flow comparable to normal ram air flow.

NOTE – On vehicles equipped with a sleeper HVAC system, the sleeper TXV/evaporator circuit is connected in parallel with the TXV/evaporator circuit that cools the cab area. Because of the parallel arrangement, a malfunction in only one of the parallel circuits may cause only a slight change in the pressure readings. The system with the restricted A/C line will experience a loss of cooling, while the other system may operate normally, or be only slightly degraded.
If a restriction (or other malfunction) occurs in one of the lines or components common to both A/C systems, pressure readings will be affected, and both systems will experience a loss of cooling.

If abnormal pressure readings are indicated during the System Performance Test Procedure, and no HVAC related Diagnostic Trouble Codes have been set, refer to the following table and review the PHYSICAL CHECKS section. For complete information on checking for Diagnostic Trouble Codes, and resolving those codes, refer to the Electrical Troubleshooting Guide on ISIS.

Table 7 Abnormal Pressure Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSES	ACTION
Low Suction - High Discharge Pressure	(1) Restriction in system between compressor discharge port and inlet of the filter-drier. **NOTE – On sleeper vehicles this symptom would occur only if the restriction occurs in the section of discharge line common to both front and rear A/C systems.**	Reference: • HIGH HEAD PRESSURE TROUBLESHOOTING table (See Table 10, page 53).
Extremely Low Suction - Normal to Low Discharge Pressure	(1) Restriction in system between outlet of the filter-drier and the compressor suction port, usually at expansion valve. **NOTE – On sleeper vehicles this symptom would occur only if the restriction occurs in the section of suction line common to both front and rear A/C systems.** (2) Low refrigerant charge. (3) Intermittent condition may indicate freezing of expansion valve due to moisture in system. **NOTE – On sleeper vehicles this symptom would occur only if BOTH expansion valves freeze up.**	Reference: • PHYSICAL CHECKS section (See PHYSICAL CHECKS, page 41). • REFRIGERANT CHARGE TROUBLESHOOTING table (See Table 9, page 51). • INSUFFICIENT CAB COOLING TROUBLESHOOTING table (See Table 14, page 60).
High Suction - Normal to Slightly Low Discharge Pressure	(1) Expansion valve stuck open. (TXV would be very cold.) (2) Compressor not functioning (suction side).	Reference: • PHYSICAL CHECKS section (See PHYSICAL CHECKS, page 41). • INSUFFICIENT CAB COOLING TROUBLESHOOTING table (See Table 14, page 60). • COMPRESSOR TROUBLESHOOTING table (See Table 11, page 56).

Table 7 Abnormal Pressure Troubleshooting Chart (cont.)

SYMPTOM	POSSIBLE CAUSES	ACTION
High Suction - High Discharge Pressure	**NOTE – These readings may indicate normal operation for a stationary vehicle. Operate a large fan in front of the condenser and recheck readings.** (1) Condenser plugged with debris. (2) Excessive air, water or oil in system. (3) Overcharged system. (4) Engine fan not operating properly.	Reference: • PHYSICAL CHECKS section (See PHYSICAL CHECKS, page 41). • REFRIGERANT CHARGE TROUBLESHOOTING table (See Table 9, page 51). • HIGH HEAD PRESSURE TROUBLESHOOTING table (See Table 10, page 53).
High Suction - Normal to Slightly High Discharge Pressure	(1) Heater core shutoff valves not shut off completely (if equipped with valves). (2) Temperature blend door not closing completely. (3) Intrusion of outside air. Open vent or window.	**NOTE – Verify all heater assembly seals and gaskets are installed correctly.** • Verify heater shut off valves are completely shut off. • Isolate fault to temperature door or temperature door actuator circuit. Refer to the Electrical Troubleshooting Guide on ISIS. • Repair cab fresh air leaks as required. Refer to GROUP 16 – CAB section in the Master Service Manual.
Low Suction - Low Discharge Pressure	(1) Low refrigerant charge. (2) Compressor not functioning properly.	Reference: • REFRIGERANT CHARGE TROUBLESHOOTING table (See Table 9, page 51). • COMPRESSOR TROUBLESHOOTING table (See Table 11, page 56).

7.6. TROUBLESHOOTING TABLES

Table 8 Mode Selection Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		Possible Causes:	• Jammed/Damaged Mode Doors or Door Gear Drive • Defective Actuator or Control Circuit • Internal Actuator Slippage			
1.	ON	Remove actuator from gear train that drives the mode doors. Set blower speed to full cw. Grasp the gear drive input shaft (normally mates to actuator) and manually rotate the shaft through its full range of movement.	Gear train for mode doors.	Rotating the gear train input shaft through its full range should move the mode doors to direct the air flow as follows: Full ccw = dash vents Full cw = defrost vents Mid position = floor ducts	Go to next step.	Isolate and clear cause of door jam or gear train jam. (If the jam cannot be cleared, replace heater housing assembly.)
2.	OFF	Inspect the gear train input shaft and mechanism for wear or damage that may cause slippage.	Gear train for mode doors.	Shaft and gear train should be free of excessive wear.	Isolate to defective mode actuator or related control circuit. Refer to the Electrical Troubleshooting Guide on ISIS.	Replace heater housing assembly.

Table 9 Refrigerant Charge Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		Possible Causes:	• Faulty Thermistor Circuit • System Leak • Improperly Charged System			
1.	ON Do not start engine.	Review diagnostic trouble codes to determine if any thermistor codes were logged. For complete information on viewing diagnostic trouble codes refer to the Electrical Troubleshooting Guide on ISIS.	Diagnostic trouble codes.	No trouble codes were logged for the thermistors.	Go to next step.	Troubleshoot the diagnostic trouble code as indicated in the Electrical Troubleshooting Guide.
2.	OFF	Connect recovery station to A/C system.			Go to next step.	
3.	OFF	**NOTE – The engine must not be running, and A/C system must be near ambient temperature for this step.** A. Determine ambient temp. within a degree or two. B. Record system pressures indicated on recovery station gauges.	Thermometer and recovery station gauges	Gauge readings must be within 10 psig of the table values.	Problem is not a refrigerant charge problem. Review Diagnostic Trouble Codes, and/or table 4 (See Table 4, page 40) for a more accurate symptom. For complete information on viewing diagnostic trouble codes refer to the Electrical	If gauges are >10 psig **higher** than the table listings, system contains air or some non-condensable gas. Discharge, evacuate, and recharge the system. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137). If gauges are >10 psig **lower** than the table listings, system is undercharged.

Table 9 Refrigerant Charge Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		C. Compare gauge readings to table 3 (See Table 3, page 35).			Troubleshooting Guide on ISIS.	Proceed to the next step.
4.	OFF	Visually inspect all joints and seals in the air conditioning system.	All refrigerant system joints and seals.	Joints and seals clean and free of oil leakage.	Go to next step.	**CAUTION – Do not direct a high pressure stream at the actuator located on the evaporator housing.** Clean area around dirty joint or seal, then go to next step.
5.	OFF	Inspect all joints and seals using a leak detector (electronic or UV style). Refer to LEAK DETECTION. Concentrate on joints that were dirty in the previous step.	All refrigerant system joints and seals.	No refrigerant leaks detected.	System was improperly charged. Discharge, evacuate, and recharge system. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137).	Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137). Discharge system and repair leak. Re-torque all fittings to specified levels (refer to Torque table). Evacuate and recharge the system.

Table 10 High Head Pressure Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – Trucks may temporarily cycle the A/C system off during stationary operation, without setting a 'High Head Pressure' trouble code. This may be normal operation. Refer to the description of the System Pressure Diagnostics located in the applicable Electrical Troubleshooting Guide on ISIS.						
		Possible Causes:	• Blocked Condenser • Restriction in High Pressure Side of System • Air/Moisture in System • Too Much Refrigerant Oil in System • Faulty Pressure Transducer • Faulty Fan or Fan Drive			
1.	OFF	Visually inspect for debris blocking air flow through condenser.	Condenser, grille, and radiator	Air flow through condenser should be unrestricted.	Go to next step.	Remove debris and re-establish airflow through condenser.
2.	OFF	Inspect condenser for bent fins.	Condenser	Condenser fins must not be crushed together. Fins should be reasonably straight and separated, allowing air flow between the fins.	Go to next step.	Straighten fins. If fins cannot be repaired condenser core must be replaced.
3.	OFF	Inspect refrigerant hoses for kinks or pinched areas.	Refrigerant lines and hoses.	Lines and hoses must be free of kinks, pinched areas, and tight bends.	Go to next step. **NOTE – If Refrigerant Identification and the check for Non-Condensable Gases were already performed, skip to step 6.**	Correct hose routing or replace damaged line or hose.

Table 10 High Head Pressure Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
4.	OFF	If a Refrigerant Identifier is not available, proceed to the next step. If a Refrigerant Identifier is available, verify the contents of the A/C system. Follow the instructions in SECTION 9.3, and those provided with the Refrigerant Identifier.	Connect the Refrigerant Identifier as directed in SECTION 9.3 (See REFRIGERANT IDENTIFICATION, page 142).	A/C system contents must be R-134a at a concentration of ≥98%.	Go to next step.	The system must be discharged, evacuated, and recharged with the correct type and amount of refrigerant. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137).
5.	ON or OFF	**NOTE – Do not start engine. A/C system must be OFF and close to ambient temperature.** Connect recovery station to A/C system. A. Determine ambient temp. within a degree or two. B. Record system pressures indicated on recovery station gauges. C. Compare gauge readings to table 3 (See Table 3, page 35).	Thermometer and recovery station gauges	Gauge readings must be within 10 psig of the table values.	Proceed to next step.	If gauges are >10 psig **higher** than the table listings, system contains air or some non-condensable gas. Discharge, evacuate, and recharge the system. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137). If gauges are >10 psig **lower** than the table listings, system is undercharged. Check for leaks, then discharge, evacuate, and recharge the system.

Table 10 High Head Pressure Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
6.	ON	Start engine. Set controls for NORM A/C operation. Inspect condenser tubing for visual damage, frost, or cold spot.	Condenser tubes.	Condenser tubes should be free of damage and should be free of cold spots. (Refer to PHYSICAL CHECKS.)	Go to next step.	Repair or replace condenser.
7.	ON	Inspect compressor -to-condenser line, condenser -to-filter drier line, and filter drier body for frost or a cold spot, indicating a restriction.	Compressor -to-condenser line, condenser -to- filter drier line, and filter drier assembly.	A/C lines should be uniform in temperature. Compressor -to-condenser line may be warmer than others. There should be no frosty or cold patches. Refer to PHYSICAL CHECKS.	Go to next step.	Replace defective component.
8.	See procedure	Check the operation of the pressure transducer circuit, the engine cooling fan, and the fan drive. For complete information refer to the Electrical Troubleshooting Guide on ISIS.	Pressure Transducer Circuit, Cooling fan, and fan drive.	Pressure Transducer Circuit, Cooling fan, and fan drive are operating correctly.	Too much moisture or oil in system. Discharge and purge system. Replace filter-drier, then recharge system. Refer to SERVICE PROCEDURES FOR R-134a (See SERVICE PROCEDURES FOR R-134a, page 137).	Repair pressure transducer circuit, cooling fan, or fan drive as indicated in the applicable Electrical Troubleshooting Guide.

Table 11 Compressor Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – A thorough understanding of the body controller's refrigerant control and diagnostics program is necessary to understand the interaction of the inputs required by the compressor circuit. The control and diagnostics program is designed to control the compressor; including removing power from the compressor when a fault is detected. **Before troubleshooting this circuit using this table, resolve any HVAC related DTC's currently in the system and insure that all previously active DTC's have been cleared. For complete information on viewing DTC's refer to the Electrical Troubleshooting Guide on ISIS.** **If no HVAC related DTC's have been logged and the system compressor AND refrigerant charge are believed to be ok, refer to INSUFFICIENT CAB COOLING TROUBLESHOOTING table (See Table 14, page 60).**						
Possible Causes: • Faulty Compressor • Faulty Compressor Control Circuit (Thermistors, Transducer, A/C Control Head, Body Controller, Clutch)						
CAUTION – In the following step, the A/C clutch should only be turned in a CW direction, as viewed from the front.						
1.	OFF	Verify that the compressor has not seized by attempting to turn the compressor clutch drive plate in a cw direction, using a clutch wrench.	A/C compressor clutch drive plate.	Drive plate should turn using a clutch wrench.	Go to next step.	Replace A/C compressor.
2.	OFF	Recover refrigerant from A/C system using recovery station. Note quantity of refrigerant recovered.	A/C system and Recovery Station.	System was adequately charged.	Replace A/C compressor.	Locate and repair leak, refer to LEAK DETECTION. Re-torque all fittings to levels specified in TORQUE CHART (See Table 22, page 168). Charge the A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

Table 12 Low Air Flow In Cab Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the cab (front) A/C system only. If the vehicle is equipped with a sleeper HVAC system, set the sleeper system blower to OFF.						
		Possible Causes:	• Blocked Recirc Air (in cab) Inlet (MAX A/C only) • Blocked Heater Core (Heat Mode only) • Dirty Air Inlet Filter Element • Blocked Evaporator Core • Faulty Blower or Blower Speed Control Circuit			
1.	ON	Check air flow with the mode control set to each mode position for about 30 seconds.	Various air outlets depending on mode selected.	Airflow is weak **only** in the MAX A/C mode.	Recirculate air inlets are blocked. (Located in cab behind heater housing.)	Go to next step.
2.	ON	Check air flow with the mode control set to each mode position for about 30 seconds.	Various air outlets depending on mode selected.	Airflow is weak **only** when the TEMPER-ATURE control is set from its midrange to its full cw position.	Heater core is blocked by debris. With the key OFF, clean heater core. Disassemble the heater housing only as far as necessary to clean the heater core. It is **not** necessary to remove the core or disconnect the heater hoses to clean the core. Refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – FRONT	Go to next step.

Table 12 Low Air Flow In Cab Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
					HVAC SYSTEM, page 104).	
3.	ON	**CAUTION – Never force the fresh/recirculate air door open. If the door position must be changed; turn on key, set mode control to FLOOR, turn off key. Forcing the door will result in a broken door shaft and a costly repair.** Remove grille from evaporator inlet on cowl tray. Remove air filter from within evaporator housing.	Evaporator air inlet.	Remove filter and check for normal air flow at high blower speed, in all modes.	Replace filter with a new filter element.	Go to next step.
4.	OFF	Using a small flashlight and an angled mirror, check for debris blocking the evaporator core in the evaporator housing.	Evaporator inlet.	Verify that the evaporator core is free of debris.	Troubleshoot the blower and blower control circuit. Refer to the Electrical Troubleshooting Guide on ISIS.	Clean the debris from the evaporator inlet. Check airflow. If not improved, troubleshoot the blower and blower control circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
If the problem is intermittent, or occurs only after a period of A/C operation the evaporator core could be icing up due to a restriction in the evaporator core or a defective component in the thermistor control circuit.						

Table 13 Insufficient Cab Heat Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the cab (front) A/C system only. If the vehicle is equipped with a sleeper HVAC system, set the sleeper system blower to OFF. **NOTE – On vehicles equipped with heater shut off valves, verify that the valves are open.**						
		Possible Causes: • Low Coolant Level or Coolant Flow • Blocked Air Flow through Heater Core • Defective Temperature Door, Door Actuator, or Control Circuit				
1.	ON	Check for correct coolant level, coolant temperature, and coolant flow through heater core. Refer to the applicable COOLING section in GROUP 12– ENGINE in the Master Service Manual.	Coolant system and heater core.	Verify correct coolant level, coolant temperature, and coolant flow through heater core.	Go to next step.	Troubleshoot coolant system problem as indicated in the applicable COOLING section in GROUP 12– ENGINE in the Master Service Manual. If heater core must be removed, refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – FRONT HVAC SYSTEM, page 104).
2.	OFF	Check for blockage of air flow through heater core. Disassemble the heater housing only as far as necessary to clean the heater core. It is **not** necessary to remove the core or disconnect the heater hoses to clean the core. Refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – FRONT HVAC SYSTEM, page 104).	Heater core.	Verify airflow through the heater core is unrestricted.	Fault is in the Temperature Door, Door Actuator, or Control Circuit. Refer to the Electrical Troubleshooting Guide on ISIS.	Heater core is blocked by debris. Clean debris from heater core, before reassembling heater housing.

Table 14 Insufficient Cab Cooling Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the cab (front) A/C system only. If the vehicle is equipped with a sleeper HVAC system, set the sleeper system blower to OFF. **NOTE – On vehicles equipped with heater shut off valves, closing the shut off valves will improve the performance of the A/C system.** **NOTE – Trucks may temporarily cycle the A/C system off during stationary operation, without setting a 'High Head Pressure' trouble code. This is normal operation.** **NOTE – A thorough understanding of the body controller's refrigerant control and diagnostics program is necessary to understand the interaction of the inputs required by the compressor circuit. The control and diagnostics program is designed to control the compressor; including removing power from the compressor when a fault is detected.** **Before troubleshooting this circuit using this table, resolve any HVAC related DTC's currently in the system and insure that all previously active DTC's have been cleared. For complete information on viewing DTC's refer to the Electrical Troubleshooting Guide on ISIS.** **NOTE – Do not start the engine until instructed to do so. Some steps in this procedure require that the engine and A/C system are at ambient temperature**						
Possible Causes: • Loose Drive Belt • Excessive Engine Temperature • Malfunctioning On/Off Fan Drive Circuit (Some Vehicles) • Fresh Air Leaking into Cab • Defective Temperature Blend Door, Door Actuator/Circuit • Defective A/C Control Head • Defective A/C Thermistor • Defective A/C Pressure Transducer • Defective Body Controller • Defective Compressor • Incorrect Refrigerant Charge						
1.	OFF	Check compressor drive belt condition and tension. Refer to COOLING section in GROUP 12– ENGINE in the Master Service Manual.	Compressor drive belt	Drive belt must be in good condition and tension must be within specified levels.	Go to next step.	Replace drive belt if required and/or set belt tension to specified level.

Table 14 Insufficient Cab Cooling Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
2.	OFF	Verify that the compressor has not seized by attempting to turn the compressor clutch drive plate in a cw direction, using a clutch wrench.	A/C compressor clutch drive plate.	Drive plate should turn using a clutch wrench.	Go to next step. **NOTE – If Refrigerant Identification and the check for Non-Condensable Gases were already performed, skip to step 5.**	Replace A/C compressor.
3.	OFF	If a Refrigerant Identifier is not available, proceed to the next step. If a Refrigerant Identifier is available, verify the contents of the A/C refrigerant system. Follow the instructions in SECTION 9.3, and those provided with the Refrigerant Identifier.	Connect the Refrigerant Identifier as directed in SECTION 9.3 (See REFRIGERANT IDENTIFICATION, page 142).	A/C system contents must be R-134a at a concentration of ≥98%.	Go to next step.	The system must be discharged, evacuated, and recharged with the correct type and amount of refrigerant. Refer to SECTION 9 (See SERVICE PROCEDURES FOR R-134a, page 137).
4.	OFF	**NOTE – A/C system should be OFF for at least 30 minutes prior to test. A/C system must be close to ambient temperature.** Connect recovery station to A/C system. A. Determine ambient temp. within a degree or two. B. Record system pressures indicated on recovery station gauges.	Thermometer and recovery station gauges	Gauge readings must be within 10 psig of the table values.	Go to next step.	If gauges are >10 psig **higher** than the table listings, system contains air or some non-condensable gas. Discharge, evacuate, and recharge the system. If gauges are >10 psig **lower** than the table listings, system is undercharged. Check for leaks, then discharge, evacuate, and recharge the system. Refer to SECTION 9 (See SERVICE

Table 14 Insufficient Cab Cooling Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		C. Compare gauge readings to table 3 (See Table 3, page 35).				PROCEDURES FOR R-134a, page 137).
5.	OFF	If not previously connected, connect recovery station to A/C system.			Go to next step.	
6.	OFF	Connect EZ-Tech service tool to diagnostic connector, to check HVAC system signals. **NOTE – After connecting EZ-Tech, turn key on but do not start engine. A/C system must be OFF and close to ambient temperature.**			Go to next step.	
7.	ON	Compare transducer signal value on EZ-Tech to recovery station high side gauge.	EZ-Tech (pressure transducer signal) Recovery station (high side gauge)	Pressure values should be within 20 psi.	Go to next step.	Repair transducer circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
8.	ON	**NOTE – The engine must not be running, and A/C system must be near ambient temperature for this step.** Use EZ-Tech to observe both thermistor signals.	Inlet and outlet thermistor signals	The difference between signal values must be ≤5°, AND should indicate the approximate ambient temp.	Go to next step.	Based on the ambient temperature, determine which thermistor circuit appears to be reading incorrectly. Repair thermistor circuit. Refer to the Electrical Troubleshooting Guide on ISIS.

Table 14 Insufficient Cab Cooling Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
9.	ON	**Start engine**. After initial warmup, verify engine operating temperature is normal. **Continue to monitor throughout test**.	Engine temperature gauge	Engine temperature gauge must indicate engine is not running hot.	Go to next step.	If engine is running hot, determine cause of excessive engine temperature. Repair if necessary.
10.	ON	Select A/C NORM mode on HVAC control head. Set fan control to mid-range. Verify A/C compressor cycles ON.	A/C Compressor	A/C compressor must cycle on and off, or run continuously, when in A/C modes.	Go to next step.	Review conditions required for compressor operation. Isolate component preventing compressor operation. Refer to the Electrical Troubleshooting Guide on ISIS.
11.	ON	Verify that recovery station gauge readings are within ranges shown in the applicable SYSTEM PRESSURE TEST CHART. Day cab vehicles refer to Table 5 (See Table 5, page 46). Sleeper vehicles refer to Table 6 (See Table 6, page 47).	Recovery station pressure gauges	Gauge readings are within ranges shown in the applicable SYSTEM PRESSURE TEST CHART.	Go to next step.	If vehicle is equipped with an On/Off fan drive, verify fan drive is operating correctly. Refer to the Electrical Troubleshooting Guide on ISIS. Otherwise, refer to the ABNORMAL PRESSURE TROUBLE-SHOOTING CHART (See Table 7, page 48), and perform

Table 14 Insufficient Cab Cooling Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		NOTE – In some conditions a stationary vehicle may temporarily shut down the A/C system as part of normal operation. Refer to the description of the System Pressure Diagnostics located in the Electrical Troubleshooting Guide on ISIS.				action listed for observed symptom.
12.	ON	Verify air temp at passenger vent is within normal range.	Thermometer in passenger air vent	Vent air temp must be within normal range.	Repair cab fresh air leaks as required. Refer to GROUP 16 – CAB section in the Master Service Manual.	**NOTE – Verify all heater assembly seals and gaskets are installed correctly.** Isolate fault to temperature door or temperature door actuator circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
If the cab takes a long time to cool down using the MAX A/C mode, the fresh air/recirc air door may be malfunctioning. Verify fresh air/recirc air door is closed when in MAX A/C mode with blower set to any position except OFF. If door is open, refer to the Electrical Troubleshooting Guide on ISIS. If the problem is intermittent, or occurs only after a period of A/C operation the evaporator core could be icing up due to a restriction in the evaporator core or a defective component in the thermistor control circuit.						

Table 15 Insufficient Defrost Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the cab (front) A/C system only. If the vehicle is equipped with a sleeper HVAC system, set the sleeper system blower to OFF.						
Possible Causes: • Insufficient Heat • Compressor or Compressor Control Circuit Failure • Defective Fresh Air/Recirc Door Actuator Circuit • Defective Mode Doors and/or Actuator Circuit						

Table 15 Insufficient Defrost Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
1.	ON	Check for normal heater operation. With the engine running at operating temperature, set the blower speed control to high speed (full cw), set the temperature control to maximum heat (full cw), and set the mode control to the floor setting.	Floor ducts	Verify that the air at the floor ducts is hot.	Go to next step.	Refer to the INSUFFICIENT CAB HEAT TROUBLE-SHOOTING table (See Table 13, page 59).
2.	ON	**NOTE – If the ambient temperature is very low, the engine may have to raise the underhood temperature before the A/C compressor can be energized.** Check for normal A/C operation. Set the mode control to NORM A/C, blower speed to high, and temperature to full ccw.	Air outlet vents.	Verify that the A/C system is cooling the air at the air outlet vents.	Go to next step.	Refer to the INSUFFICIENT CAB COOLING TROUBLE-SHOOTING table (See Table 14, page 60).
3.	ON	Check for compressor operation **while in the defrost mode**. Set the mode control to Defrost and the blower speed control to high speed.	A/C Compressor	Verify that compressor cycles regularly while in the Defrost mode.	Go to next step.	The compressor is not being enabled in the Defrost mode. Troubleshoot the HVAC control head circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
4.	ON	While in the defrost mode, check the position of the fresh air/recirc door in the evaporator housing.	Fresh Air/Recirc Door	Verify that fresh air/recirc door is open while in the Defrost mode.	Go to next step.	Troubleshoot the fresh air/recirc door control circuit. Refer to the Electrical Troubleshooting Guide on ISIS.

Table 15 Insufficient Defrost Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
5.	ON	Remove actuator from gear train that drives the mode doors. Set blower speed to full cw. Grasp the gear train input shaft (normally mates to actuator) and manually rotate the shaft through its full range of movement.	Gear train for mode doors.	Rotating the gear train input shaft through its full range should move the mode doors to direct the air flow as follows: Full ccw = dash vents Full cw = defrost vents Mid position = floor ducts	Go to next step.	Isolate and clear cause of door jam or gear train jam. (If the jam cannot be cleared, replace heater housing assembly.)
6.	OFF	Inspect the gear train input shaft and mechanism for wear or damage that may cause slippage.	Gear train for mode doors.	Shaft and gear train should be free of excessive wear.	Isolate to defective mode actuator or related control circuit. Refer to the Electrical Troubleshooting Guide on ISIS.	Replace heater housing assembly.
7.	ON	Check for an obstruction in the defrost ducts. It may be necessary to remove the heater housing.	Defrost ducts	Verify that there is no obstruction in the defrost ducts.	Mode actuator is slipping internally. Replace actuator.	Clear obstruction from defrost ducts.

Table 16 Noisy Compressor Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		Possible Causes: • Missing or Loose Compressor Mounting Bolts • Broken or Cracked Brackets or Braces • Drive Belt Idler or Pulley Loose or Damaged • Drive Belt Misadjusted, Misaligned, or Worn • Compressor Clutch Slipping • Defective Compressor/Clutch • Excessive Refrigerant Charge				
1.	OFF	Check torque on compressor mounting bolts.	Compressor mounting bolts.	Verify all compressor mounting bolts are present and torqued to the correct value: 23 to 29 N.m (17 to 21.4 lbf-ft).	Go to next step.	Replace missing mounting bolts. Tighten all mounting bolts to the correct value.
2.	OFF	Check for broken or cracked compressor mounting brackets or braces.	Compressor mounting system.	Verify that compressor mounting brackets and braces are complete and free of cracks.	Go to next step.	Replace broken or cracked components.
3.	OFF	Check compressor drive belt pulleys and idlers for damage, looseness or worn bearings.	Compressor drive belt pulleys and idlers.	Pulleys and idlers must be damage free and tight.	Go to next step	Tighten or replace loose or damaged pulleys and/or idlers as indicated in GROUP 12– ENGINE section in the Master Service Manual.
4.	OFF	Check compressor drive belt for wear, misalignment or misadjustment.	Compressor drive belt.	Belt wear, alignment and adjustment must be within acceptable limits as indicated in the GROUP 12– ENGINE section in the Master Service Manual.	Go to next step.	Replace belt, or align and adjusts the belt as indicated in the GROUP 12– ENGINE section in the Master Service Manual.

Table 16 Noisy Compressor Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
5.	ON	Check for compressor clutch slippage.	Compressor/ Clutch assembly	The clutch should engage and run with no slipping. (A slipping clutch makes a scraping noise.)	Go to next step.	Cycle clutch several times to burnish face. Recheck operation; if scrapping sound is no longer present, no further repairs are necessary.
6.	ON	Run A/C SYSTEM PERFORMANCE TEST PROCEDURE (See A/C SYSTEM PERFORMANCE TEST PROCEDURE, page 44). Check for high discharge pressure readings, indicating an excessive refrigerant charge.	A/C system, gauge set or recovery station.	Pressure readings must be within the limits indicated in test procedure table.	Replace the compressor/ clutch assembly.	Service the A/C system (discharge, evacuate, and recharge the system). Refer to SERVICE PROCEDURES FOR R-134a (See SERVICE PROCEDURES FOR R-134a, page 137).

Table 17 No Sleeper Air Flow Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the sleeper (rear) A/C system only.						
		Possible Causes: • Disconnected Sleeper Blower • Stuck Blower/Fan Assembly • Broken Fan • Faulty Sleeper Blower or Blower Speed Control Circuit				
1.	OFF	Verify that the blower motor electrical connector is plugged into the LPM on the rear HVAC unit.	LPM on the rear HVAC unit	Connector must be firmly seated.	Go to next step.	Seat connector and check for normal operation.

Table 17 No Sleeper Air Flow Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
2.	OFF	Remove blower assembly and check condition of fan wheel.	Blower/fan assembly	Fan wheel must rotate freely and be free of damage.	Go to next step.	Replace blower/fan assembly. Refer to BLOWER/FAN ASSEMBLY, REMOVE AND INSTALL (See BLOWER/FAN ASSEMBLY – REAR HVAC UNIT, page 120).
3.	OFF	Check for obstructions within the fan mounting cavity of the rear HVAC unit housing.	Rear HVAC unit housing	Rear HVAC unit housing must be free of fan obstructions.	Troubleshoot the blower and LPM output circuit. Refer to the Electrical Troubleshooting Guide on ISIS.	Remove obstructions in rear HVAC unit to allow normal operation of blower/fan assembly.

Table 18 Low Sleeper Air Flow Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the sleeper (rear) HVAC system only. Set the blower control on the cab HVAC control panel (on instrument panel) to OFF.						
		Possible Causes:	• Blocked Air Inlet • Dirty Air Inlet Filter Element • Damaged/missing Foam Seals in Rear HVAC Unit • Blocked Evaporator Core • Faulty Blower or LPM Output Circuit			
1.	OFF	Verify that the air intake for the rear HVAC unit is not blocked.	Rear HVAC unit air intake	Area in front of air intake must be relatively clear of obstructions.	Go to next step.	Clear area in front of rear HVAC unit air intake.

Table 18 Low Sleeper Air Flow Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
2.	OFF	Check condition of filter element in rear HVAC unit.	Filter element for rear HVAC unit	Filter element should be free of heavy dirt deposits. Filter element should be cleaned or replaced at regular intervals, depending on operating conditions.	Go to next step.	Clean or replace filter element.
3.	ON	With rear blower operating at maximum speed, check for air leaking from damaged or missing foam seals on rear HVAC unit components (LPM, blower, heater core cover) and duct work.	Rear HVAC unit	Little or no air should escape from the components mounted to the rear HVAC unit, including the discharge duct.	Go to next step.	Replace foam seals as necessary to correct reduced air flow problem.
4.	OFF	Remove blower assembly from rear HVAC unit. Using a small flashlight and an angled mirror, check for debris blocking the evaporator core.	Evaporator core in rear HVAC unit	Verify that evaporator core is free of debris.	Troubleshoot the blower and LPM output circuit. Refer to the Electrical Troubleshooting Guide on ISIS.	Clean the debris from the evaporator core. Check airflow. If not improved, troubleshoot the blower and LPM output circuit. Refer to the Electrical Troubleshooting Guide on ISIS.
If the problem is intermittent, or occurs only after a period of A/C operation the evaporator core could be icing up due to a malfunctioning rear TXV or a restriction in the evaporator core.						

Table 19 Insufficient Sleeper Heat Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the sleeper (rear) HVAC system only. Set the blower control on the cab HVAC control panel (on instrument panel) to OFF. **NOTE – On vehicles equipped with a heater shut off valve, verify that the valve is open.**						
Possible Causes: • Low Coolant Level or Coolant Flow • Defective Temperature Door						
1.	ON	Check for correct coolant level, coolant temperature, and coolant flow through rear heater core. Refer to the applicable COOLING section in GROUP 12– ENGINE in the Master Service Manual.	Coolant system and rear heater lines.	Verify correct coolant level, coolant temperature, and coolant flow through rear heater core.	Repair or replace the sleeper temperature door. Refer to TEMPERATURE BLEND AIR DOOR, REMOVE AND INSTALL (See TEMPERATURE BLEND AIR DOOR – REAR HVAC UNIT, page 127).	Troubleshoot coolant system problem as indicated in the applicable COOLING section in GROUP 12– ENGINE in the Master Service Manual. If rear heater core must be removed, refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – REAR HVAC UNIT, page 124). If heater lines must be removed, refer to HEATER HOSE ASSEMBLY, REMOVE AND INSTALL (See HEATER HOSE ASSEMBLY – TO REAR HVAC UNIT, page 114).

Table 20 Insufficient Sleeper Cooling Troubleshooting

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
NOTE – This table pertains to the sleeper (rear) HVAC system only. **NOTE – It is assumed that all DTC's related to the front and rear A/C systems have been noted and resolved before reaching this table. This table pertains only to cooling problems involving the sleeper HVAC system, that do NOT set a DTC.** **NOTE – It is assumed that all fault symptoms related to the front A/C system have been noted and resolved before reaching this table.** **NOTE – On vehicles equipped with a heater shut off valve, closing the shut off valve will improve the performance of the A/C system.** **NOTE – Trucks may temporarily cycle the A/C system off during stationary operation, without setting a 'High Head Pressure' trouble code. This is normal operation.** **NOTE – A thorough understanding of the body controller's refrigerant control and diagnostics program is necessary to understand the interaction of the inputs required by the compressor circuit. The control and diagnostics program is designed to control the compressor; including removing power from the compressor when a fault is detected.** **Before troubleshooting this circuit using this table, resolve any HVAC related DTC's currently in the system and insure that all previously active DTC's have been cleared. For complete information on viewing DTC's refer to the Electrical Troubleshooting Guide on ISIS.** **NOTE – Do not start the engine until instructed to do so. Some steps in this procedure require the engine and A/C system are at ambient temperature**						
		Possible Causes: • Malfunctioning Rear A/C Request Circuit • Fresh Air Leaks in Cab/Sleeper • Defective Temperature Blend Door, Door Actuator/Circuit • Incorrect Refrigerant Flow Through Rear Evaporator Core Circuit				
1.	OFF	Connect recovery station to A/C system.			Go to next step.	
2.	ON	Start engine. On **front** HVAC control panel: • Set fan control to mid-range. • Set temperature control to minimum (full ccw). • Set mode control to the VENT (non-A/C) mode.	A/C Compressor	A/C compressor must cycle on within 2 minutes of setting controls.	Go to next step.	Refer to the applicable Electrical Troubleshooting Guide on ISIS. Review conditions required for compressor operation (A/C Request). Isolate component preventing

Table 20 Insufficient Sleeper Cooling Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
		On **rear** HVAC control panel: • Set fan speed control to mid-range. • Set temperature control to the lowest temperature setting (maximum cooling). Verify A/C compressor cycles ON within 2 minutes.				compressor operation.
3.	ON	Run A/C SYSTEM PERFORMANCE TEST PROCEDURE, (starting at step 3). Verify that recovery station gauge readings **(and sleeper vent temperatures)** are within ranges shown in SYSTEM PRESSURE TEST CHART (SLEEPERS), (See Table 6, page 47). **NOTE – In some conditions a stationary vehicle may temporarily shut down the A/C system as part of normal operation. Refer to the description of the System Pressure Diagnostics located in the Electrical Troubleshooting Guide on ISIS.**	Recovery station pressure gauges and thermometer in sleeper vent.	Verify gauge readings **(and sleeper vent temperatures)** are within ranges shown in SYSTEM PRESSURE TEST CHART (SLEEPERS).	A/C system is operating correctly. Repair cab fresh air leaks as required. Refer to GROUP 16 – CAB section in the Master Service Manual.	Go to next step.

Table 20 Insufficient Sleeper Cooling Troubleshooting (cont.)

STEP	KEY	ACTION	TEST POINTS	SPEC.	YES- IN SPEC.	NO-OUT OF SPEC.
4.	ON	Remove coolant flow to rear heater core. Either close heater shut off valve or pinch rear heater lines with clamping pliers (Figure 45). After several minutes, verify that sleeper vent temperature is within range shown in SYSTEM PRESSURE TEST CHART (SLEEPERS), (See Table 6, page 47).	Thermometer in sleeper vent.	Verify sleeper vent temperature is within range shown in SYSTEM PRESSURE TEST CHART (SLEEPERS).	Isolate fault to rear temperature door or rear temperature door actuator circuit. Refer to the Electrical Troubleshooting Guide on ISIS. **NOTE – While performing checks, verify all seals and gaskets of the rear HVAC unit (and duct work) are installed correctly, and are undamaged.**	Isolate fault to rear TXV, rear evaporator core, or rear A/C lines. Refer to the PHYSICAL CHECKS section (See PHYSICAL CHECKS, page 41).
If the problem is intermittent, or occurs only after a period of A/C operation the evaporator core could be icing up due to a malfunctioning rear TXV or a restriction in the evaporator core.						

8. REMOVE AND INSTALL

WARNING – To avoid property damage, personal injury, or death, park the vehicle on a flat level surface, shift transmission to park or neutral, set parking brake, and block wheels before performing diagnostic or service procedures.

WARNING – To prevent damage to the equipment and/or personal injury, always turn the vehicle ignition key OFF before performing Removal and Installation procedures.

WARNING – To avoid personal injury or death, refer to the manufacturer's service information before working on any high voltage equipment. By definition high voltage circuits and components contain voltage levels that may cause equipment damage, electrical shock and/or electrocution if handled incorrectly.

Only a trained technician may perform service inside high voltage components. If you work around or maintain high voltage circuits, please seek high voltage training.

CAUTION – To prevent contamination of the HVAC system as well as continued leakage from an open line, always cap or plug all open tubes or ports after disconnecting components.

NOTE – Cleanliness of the air conditioner components cannot be over-emphasized. Lack of proper attention in this area is one of the major causes of costly and unsatisfactory unit operation.

NOTE – Special attention to the following, during component remove and install, will aid in avoiding unnecessary and time-consuming problems.

A. When working on the A/C system keep the work area and tools as clean as possible. Also, clean all connections, ports or fittings before disconnecting or removing components.

B. All A/C component and refrigerant line openings should be immediately covered or plugged during removal and remain so until re-installation to prevent the entry of dirt, moisture and other foreign material. Even the slightest particle can cause problems if carried to a vulnerable place within the system.

C. Never remove protective caps from components until the moment of assembly into the system.

D. Never install non-sealed components.

E. If the filter drier is one of multiple components being installed in the system, it should be the last component installed. This reduces the amount of time that the filter drier desiccant is exposed to atmospheric moisture.

F. Anytime an A/C fitting is disconnected, the O-ring and/or C-plate must be replaced (Figure 22). The new O-ring must be lubricated with **MINERAL-BASED** oil. The C-plate does not require lubrication. Never use grease, penetrating oil, motor oil, Ester or PAG oil, etc. to lubricate O-rings and fittings.

G. All refrigerant hose and tubing support clamps and strap locks must be re-installed in their original positions.

   Never bend a hose to a radius less than ten times the diameter of the hose.

   Never route a hose any closer than four inches from the exhaust manifold or related piping.

H. Whenever possible use a backup wrench when loosening or tightening fittings (Figure 23).

I. All fittings must be tightened as specified in the TORQUE CHART (See Table 22, page 168). Use only a torque wrench known to be accurate.

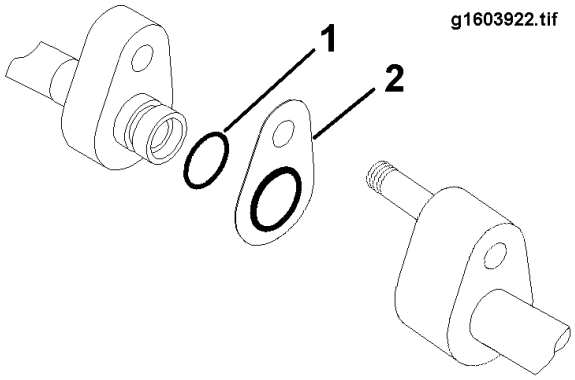


Figure 22 A/C Fitting C-Plate and O-Ring

1. O-RING
2. C-PLATE

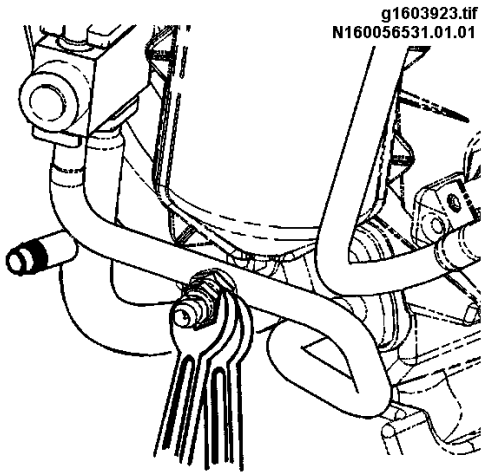


Figure 23 Use a Back-Up Wrench When Loosening or Tightening Fittings

NOTE – The following figures and procedures cover most typical engine/chassis configurations. Some configurations may differ slightly due to component mounting locations and/or hose routings.

The removal and installation procedures for this heating – air conditioning system are organized in the following order. Under hood components are covered first, followed by the in-cab components, then sleeper components.

8.1. PRESSURE TRANSDUCER

CAUTION – The pressure transducer is not interchangeable with a pressure switch. To prevent damage to the A/C system replace a defective transducer only with the recommended part.

NOTE – The pressure transducer can be removed and installed without removing the refrigerant from the A/C system.

NOTE – Refer to Figure 24 while performing the following Remove and Install procedures.

The pressure transducer is located on the condenser-to-evaporator refrigerant line.

Remove

1. Disconnect electrical connection to pressure transducer (2, Figure 24).
2. Unscrew pressure transducer from condenser-to-evaporator refrigerant line and cap open fitting.

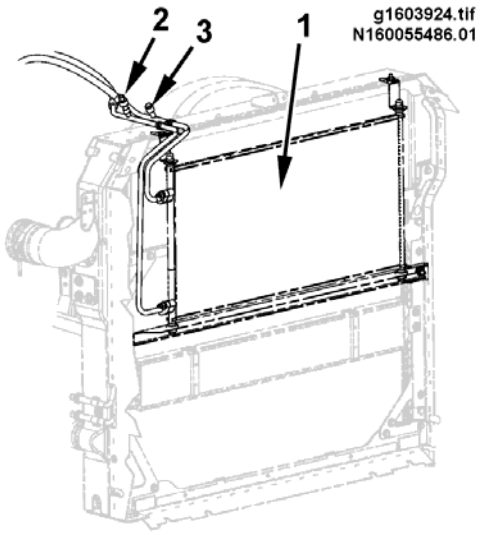


Figure 24 A/C Condenser and Pressure Transducer

1. CONDENSER
2. PRESSURE TRANSDUCER
3. SERVICE PORT (HIGH SIDE)

Install

1. Install a new O-ring on transducer fitting and lubricate O-ring and threads with mineral-based oil.
2. Screw pressure transducer onto A/C line fitting and tighten to 6.8 to 13.6 N•m. (5 to 10 lbf-ft).
3. Connect electrical connector to pressure transducer (2).

8.2. THERMISTORS

WARNING – The AC thermistors CANNOT be removed and installed without removing the refrigerant from the AC system. The procedures are the same for either thermistor.

NOTE – Refer to Figure 25 while performing the following Remove and Install procedures.

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).
2. Disconnect electrical connection to thermistor being removed.

3. Unscrew thermistor from its fitting and cap open fitting.

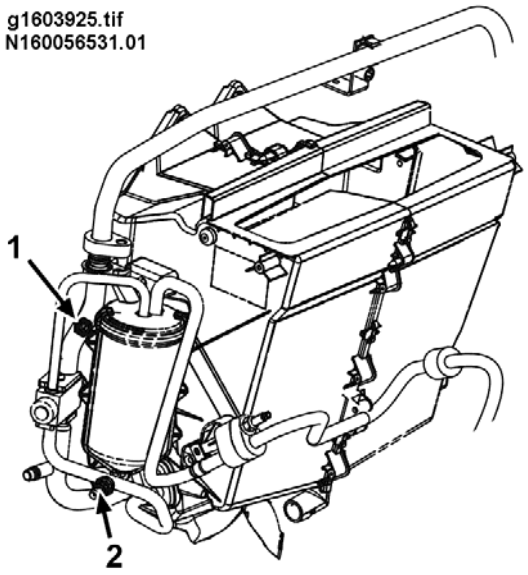


Figure 25 A/C Thermistor Locations

1. EVAPORATOR OUTPUT THERMISTOR
2. EVAPORATOR INPUT THERMISTOR

Install

1. Ensure a new O-ring is installed on the new thermistor, and lubricate O-ring and threads with mineral-based oil.

2. Screw thermistor into its fitting and tighten to 5.0 to 9.5 N.m (44.3 to 84.1 lbf-in).

NOTE – The thermistor connector is not polarized. It may be connected in either orientation.

3. Connect electrical connection to replaced thermistor.

4. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

8.3. CONDENSER CORE

Depending on the vehicle model/engine combination, replacement of certain components may require the removal of nearby assemblies to gain access to fittings, components, or mounting hardware. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – Refer to Figure 24 while performing the following Remove and Install procedures.

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

2. If necessary, unclip or unbolt condenser line support clamps and disconnect pressure transducer wiring connector to allow A/C lines to be moved out of the way.

3. Disconnect A/C line fittings from condenser and position the A/C lines out of the way.
4. Remove two bolts securing top mounting hangers to radiator frame.
5. Lift mounting hangers from top of condenser. Insure that rubber isolators remain in hanger sockets.
6. Lift condenser from sockets in bottom rail. Insure that rubber isolators remain in rail.

Install

1. Verify that rubber isolators are installed in bottom condenser support rail.
2. Insert posts on bottom of condenser into sockets until condenser is fully seated.
3. Insure that rubber isolators are installed in top hanger sockets.
4. Install top mounting hangers onto posts on top of condenser. Verify that posts are fully seated into sockets.
5. Secure top mounting hangers to radiator frame using two bolts removed earlier.
6. If the system is to be flushed or purged, perform that operation before completing reassembly. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

NOTE – Always lubricate A/C fitting O-rings with mineral-based oil during installation.

7. Using new O-rings and C-plates connect A/C line fittings to condenser. Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).
8. If removed earlier, install any condenser line support clamps in their original location and orientation. Connect wiring to pressure transducer.
9. Install any assemblies that were removed to gain access to the condenser.
10. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

8.4. A/C COMPRESSOR/CLUTCH

Depending on the vehicle model/engine combination, replacement of certain components may require the removal of nearby assemblies to gain access to compressor mounting bolts and A/C lines. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – Refer to Figure 26 while performing the following Remove and Install procedures.

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).
2. Remove or loosen compressor belt.
3. Disconnect compressor clutch wiring connector (4, Figure 26) from engine wire harness.

4. Disconnect both refrigerant line fittings at compressor.

> **CAUTION – When removing mounting bolts from side mounted compressors, support compressor to prevent possible damage to mounting bolts and/or compressor.**

5. Remove four compressor mounting bolts (5), noting location and orientation of any brackets secured by mounting bolts.

6. Remove compressor assembly (1) from engine.

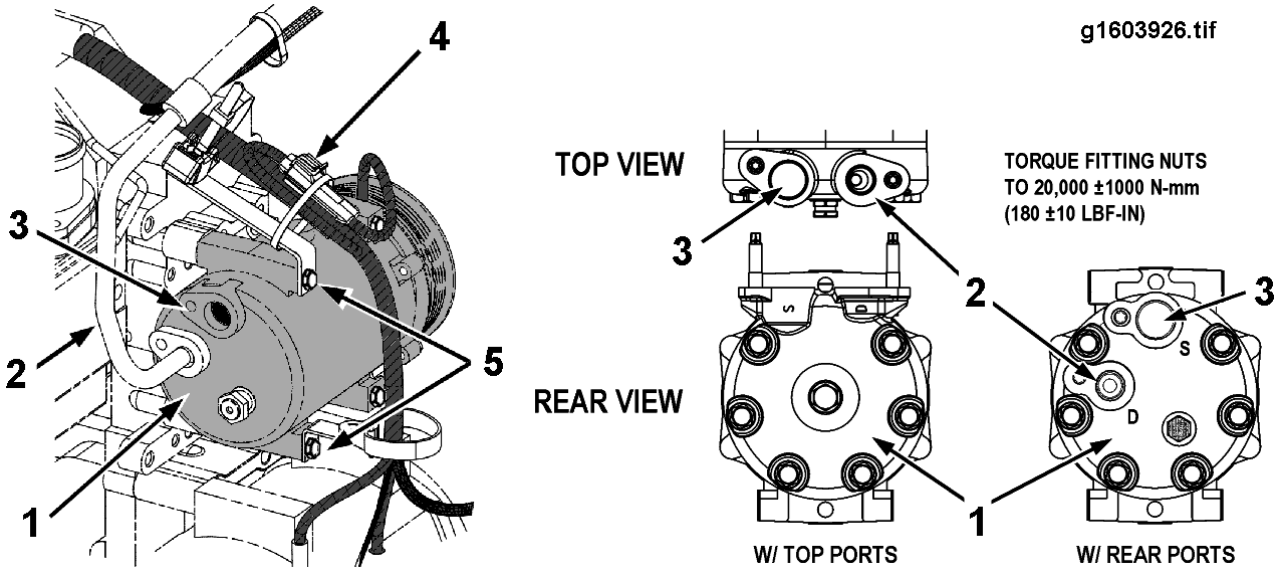


Figure 26 A/C Compressor (Typical Installation)

1. A/C COMPRESSOR
2. DISCHARGE PORT/LINE
3. SUCTION PORT/LINE
4. ELECTRICAL CONNECTOR
5. MOUNTING BOLT (QTY 4)

Install

NOTE – Verify that the clutch is installed on the compressor before performing the following installation procedure.

1. If system is to be flushed or purged, perform that operation before reassembling system. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

2. Before installing compressor, refer to OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 158). The oil shipped in new compressors must be drained when determining the correct amount of refrigerant oil to be added to the system.

3. Install compressor assembly including any brackets previously secured by the compressor mounting bolts. Tighten to 23 to 29 N.m (16.9 to 21.4 lbf-ft).

NOTE – Always lubricate O-rings with mineral-based oil during installation.

4. Using new O-rings and C-plates connect refrigerant line fittings at compressor.

5. Connect compressor clutch wiring connector to engine harness.

6. Install and align compressor belt.

7. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

8. Install any assemblies that were removed to gain access to the compressor.

8.5. AIR FILTER (LOCATED INSIDE EVAPORATOR HOUSING)

Remove

CAUTION – Never force the fresh/recirculate air door open. If door position must be changed, perform the following procedures. Forcing the door will result in a broken door shaft and a costly repair.

1. Remove grille or filter/grille covering HVAC air inlet (1, Figure 27), located in cab cowl tray at base of windshield.

2. Verify that fresh/recirculate air door is open (4, Figure 28). This can be done by looking into cowl tray air inlet.

3. If door is open proceed to next step. If door is closed, proceed as follows:

    A. Turn ignition key to ON position (it's not necessary to start engine),

    B. Set blower speed control on HVAC control panel to OFF, (the fresh/recirculate air door will open),

    C. Turn ignition key to OFF position.

4. Reaching into the HVAC air inlet, located in evaporator housing (3, Figure 28), remove air filter (5) by compressing top of filter, tipping it to the front, and lifting it straight up.

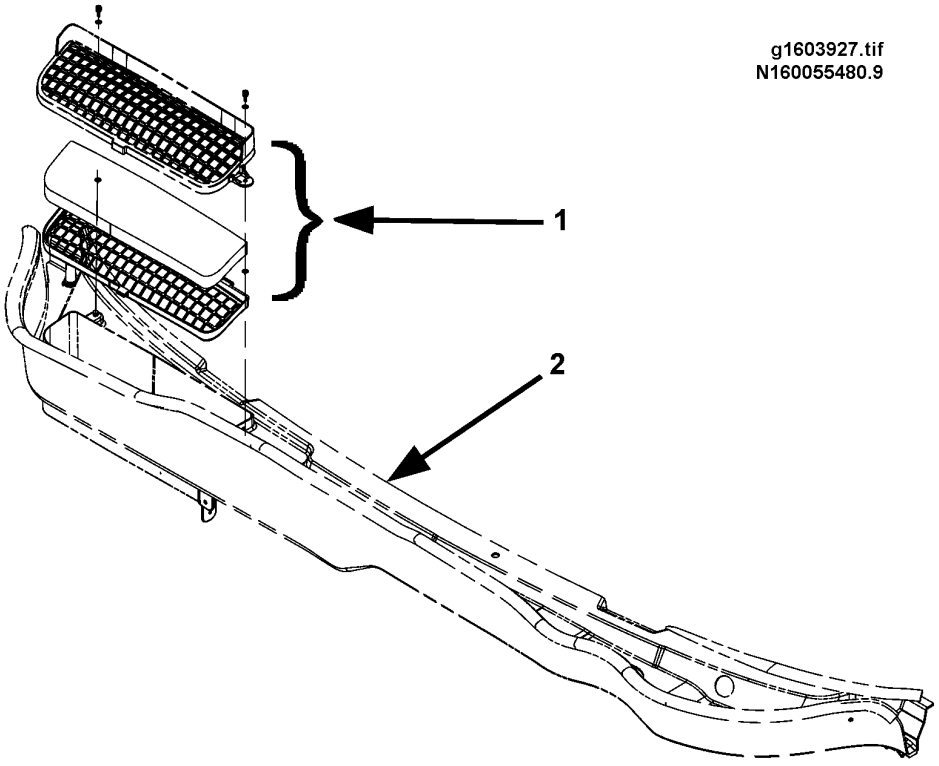


Figure 27 Location of Air Inlet Filter/Grille

1. AIR INLET FILTER/GRILLE
2. CAB COWL TRAY

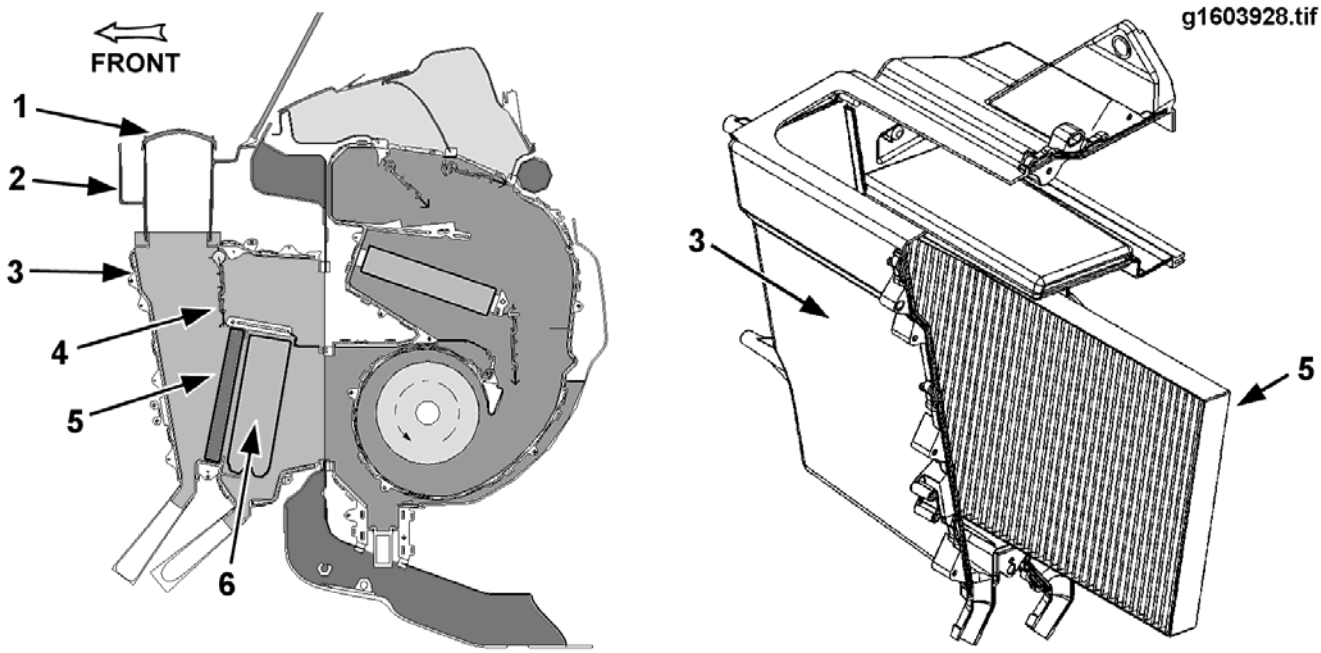


Figure 28 Cutaway View of Evaporator Housing

1. AIR INLET FILTER/GRILLE
2. CAB COWL TRAY
3. EVAPORATOR HOUSING
4. FRESH/RECIRCULATE DOOR (SHOWN IN OPEN/FRESH AIR POSITION)
5. AIR FILTER ELEMENT
6. EVAPORATOR CORE

Install

1. With the filter pleats vertical, place filter (5, Figure 28) into evaporator housing (3) through air inlet.

2. Position bottom of filter as far to the rear as possible (behind the positioning rib in the housing); then compress top of filter and push it to the rear until it is behind top positioning ribs. The filter is in place when it is set behind the positioning ribs at all four corners.

3. Fit can be verified by grasping a central pleat and gently pulling forward. The filter should be retained by the ribs.

4. Install grille or filter/grille covering HVAC air inlet (1, Figure 27).

8.6. A/C REFRIGERANT HOSES (FRONT SYSTEM LONG LINES)

The three A/C refrigerant hoses/lines (1, 2, and 4, Figure 29) are connected in the same way; however, the number of mounting straps and clamps may be different for each hose. Also, the routing of each hose varies for each vehicle model/engine combination.

Depending on the vehicle model/engine combination, replacement of specific A/C refrigerant lines may require the removal of nearby assemblies to gain access to the fittings, or to remove the A/C lines. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – Refer to Figure 29 while performing the following Remove and Install procedures.

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

NOTE – When removing Condenser-to-Evaporator Hose (4, Figure 29) disconnect electrical connection to pressure transducer (5).

2. Disconnect fitting at each end of hose/line being removed.

3. Unclip or remove all hose support clamps and strap locks used to secure hose/line. Note location and orientation of each clamp and strap lock to allow for correct routing during installation.

4. Remove A/C hose/line.

NOTE – When replacing Condenser-to-Evaporator line (4) remove pressure transducer (5) from old line for transfer to new line.

Install

NOTE – Before installing a new Condenser-to-Evaporator line (4, Figure 29) it may be necessary to transfer pressure transducer (5) from the old line to the new line.

1. If A/C system is to be flushed or purged, perform that operation before reassembling the system. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

2. Place new A/C hose/line in its approximate location.

NOTE – Always lubricate O-rings with mineral-based oil during installation.

3. Using new O-rings and C-plates connect fittings at each end of the A/C hose/line. Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).

4. Secure the hose/line using all support clamps and strap locks removed during removal.

5. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

NOTE – After installing Evaporator-to-Compressor line (1) the cab cowl tray must be installed. Refer to the appropriate CAB Section in Group 16 of the Master Service Manual for procedures covering all cab cowl trays.

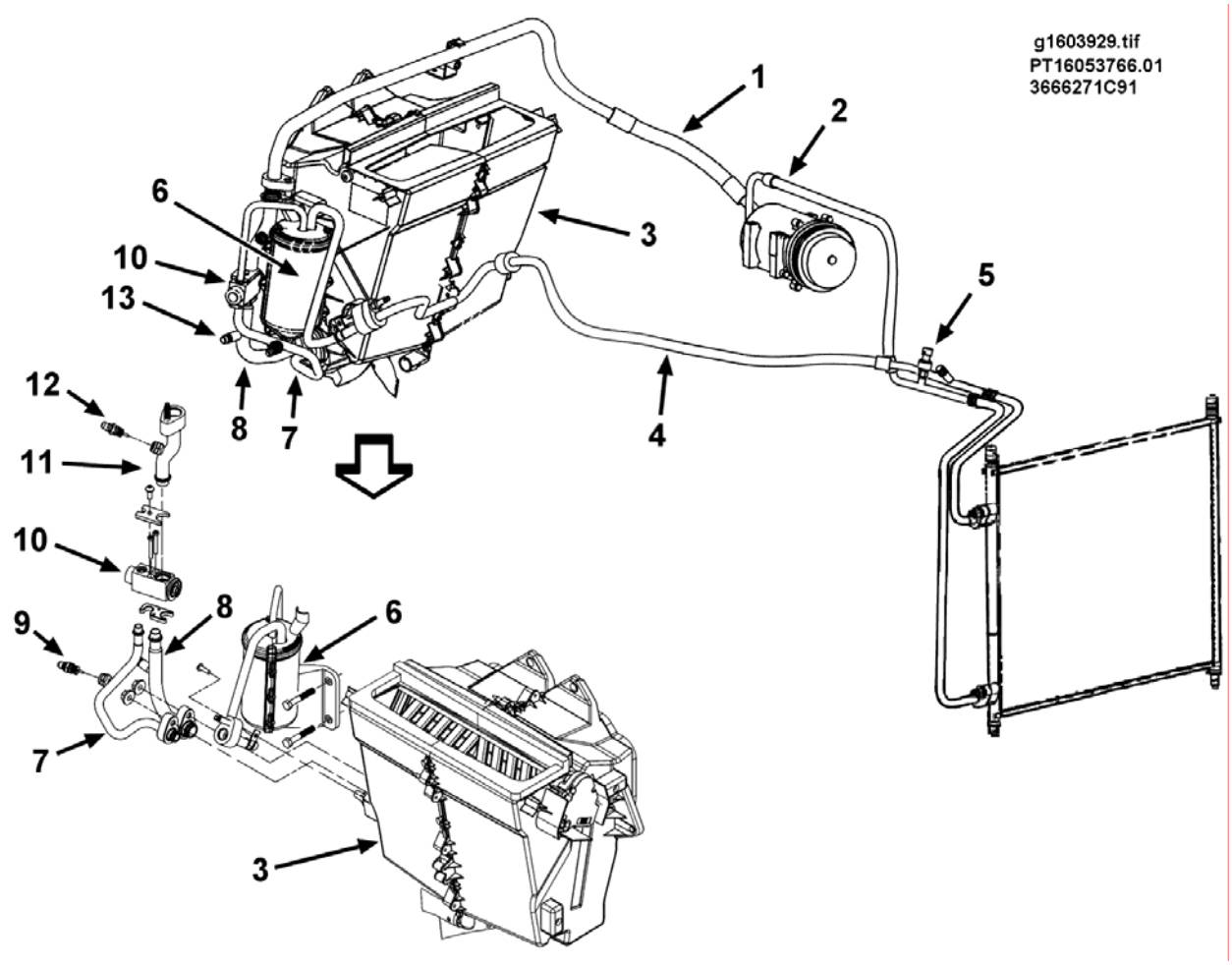


Figure 29 A/C System Components and Refrigerant Lines

1. EVAPORATOR-TO-COMPRESSOR LINE
2. COMPRESSOR-TO-CONDENSER LINE
3. EVAPORATOR HOUSING
4. CONDENSER-TO-EVAPORATOR LINE
5. PRESSURE TRANSDUCER
6. FILTER-DRIER
7. EVAPORATOR INPUT LINE
8. EVAPORATOR OUTPUT LINE
9. INPUT THERMISTOR
10. THERMOSTATIC EXPANSION VALVE
11. EXPANSION VALVE OUTPUT LINE
12. OUTPUT THERMISTOR
13. SERVICE PORT (LOW PRESSURE)

8.7. FILTER-DRIER

The filter-drier inlet and outlet lines are part of the filter-drier assembly (Figure 30).

NOTE – If the filter-drier is one of multiple components being replaced in the system, the filter-drier should be one of the last components installed. This reduces the amount of time that the filter-drier desiccant is exposed to atmospheric moisture.

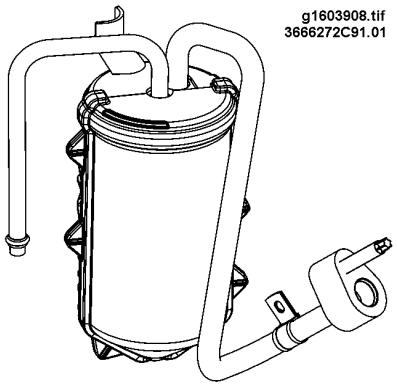


Figure 30 Filter-Drier

Depending on the vehicle model/engine combination, replacement of specific A/C refrigerant components may require the removal of nearby assemblies to gain access to the components or related A/C lines. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – Refer to Figure 29 while performing the following Remove and Install procedures.

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).
2. To allow movement of condenser-to-evaporator line (4, Figure 29), remove or loosen hose support clamps and/or strap locks used to secure line at evaporator housing (3).
3. Disconnect condenser-to-evaporator line (4) from filter-drier inlet line.
4. Remove screw securing filter-drier inlet line clamp to evaporator housing (3).
5. Remove T30 Torx head screw from locking plate on top of expansion valve (10).
6. Remove locking plate from top of expansion valve.
7. While supporting filter-drier (6), remove two mounting bolts securing filter-drier to evaporator housing.
8. Remove filter-drier by lifting it free of expansion valve.

Install

1. If A/C system is to be flushed or purged, perform that operation before reassembling the system. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

NOTE – Always lubricate O-rings on fittings with mineral-based oil during installation.

2. With a new lubricated O-ring on the filter-drier outlet tube, carefully insert tube into expansion valve (10, Figure 29) while securing filter-drier (6) to evaporator housing (3) with two mounting bolts. Tighten to 11.0 to 11.6 N.m (8.1 to 8.5 lbf-ft).

3. Position locking plate on top of expansion valve and secure with T30 Torx head (M6) screw. Tighten to 9,000 to 10,000 N.mm (80 to 90 lbf-in).

4. Install screw securing filter-drier inlet tube clamp to evaporator housing.

5. Using a new O-ring and C-plate connect condenser-to-evaporator line (4) to filter drier inlet tube. Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).

6. Secure condenser-to-evaporator line at evaporator housing using hose support clamps and/or strap locks removed earlier.

7. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

8. Install cab cowl tray, if previously raised or removed.

8.8. THERMOSTATIC EXPANSION VALVE – FRONT HVAC SYSTEM

Depending on the vehicle model/engine combination, replacement of specific A/C refrigerant components may require the removal of nearby assemblies to gain access to the components or related A/C lines. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

> **CAUTION – While handling the thermostatic expansion valve in the following procedures, it is important to keep it and the entire A/C system as dirt free as possible.**

NOTE – Refer to Figure 29 while performing the following Remove and Install procedures.

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

2. Remove filter-drier. Refer to FILTER-DRIER.

3. With top locking plate removed from expansion valve, remove two 3mm Allen head capscrews from expansion valve body. Remove and retain bottom locking plate.

4. Lift output thermistor line (11, Figure 29) from top of expansion valve. If necessary loosen or remove cowl clamp(s) securing evaporator-to-compressor line (1) to allow removal of line from expansion valve. (This requires removal or raising of cab cowl tray.)

5. Remove expansion valve.

Install

1. If A/C system is to be flushed or purged, perform that operation before reassembling the system. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

NOTE – Always lubricate O-rings on fittings with mineral-based oil during installation.

NOTE – Before installing new O-rings in the following steps, insure that the old O-rings have been removed.

2. Insure that new lubricated O-rings are installed on all lines being connected to expansion valve.
3. Position expansion valve on top of evaporator inlet and outlet lines.
4. Install bottom locking plate and secure to expansion valve with two 3mm Allen head (M5) capscrews. Tighten to 4,000 to 4300 N.mm (35.4 to 38.0 lbf-in).
5. Insert outlet thermistor line (11, Figure 29) into top of expansion valve (10).
6. Install filter-drier. Refer to FILTER-DRIER.
7. Install top locking plate and secure to expansion valve with T30 Torx head (M6) screw. Tighten to 9,000 to 10,000 N.mm (80 to 90 lbf-in).
8. Insure that all clamps securing condenser-to-evaporator line (4) to evaporator housing (3) have been installed and tightened.
9. Install and/or tighten clamp(s) securing evaporator-to-compressor line (1) to cowl.
10. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).
11. Install cab cowl tray, if previously raised or removed.

8.9. ACTUATOR, (FRESH/RECIRCULATE) AIR DOOR

Depending on the vehicle model/engine combination, replacement of certain components may require the removal of nearby assemblies to gain access to the components or mounting hardware. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – Refer to Figure 31 while performing the following Remove and Install procedures.

Remove

1. Disconnect wiring connector to actuator (1, Figure 31) for fresh/recirc air door.

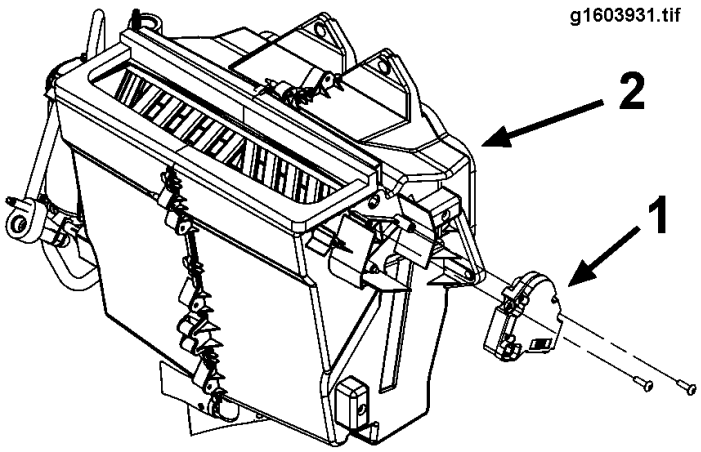


Figure 31 Actuator for Fresh/Recirc Air Door

1. FRESH/RECIRC AIR DOOR ACTUATOR
2. EVAPORATOR HOUSING

2. Remove two screws securing actuator (1) to evaporator housing (2).

3. Remove actuator.

Install

CAUTION – In the following step, never force the actuator drive collar into position. If the drive collar position must be changed, perform the following procedures. Forcing the drive collar may result in a broken actuator.

1. Install actuator by rotating door until flats on door shaft align with actuator drive collar, then carefully slip the actuator (1, Figure 31) onto end of door shaft so that mounting holes are properly aligned, if possible. If actuator drive collar must be moved to allow alignment:
   a. Place the actuator into its approximate position.
   b. Connect a 9 Volt battery across pins A and F of the actuator connector, to rotate the drive collar. (Reverse the connection to rotate the drive collar in the opposite direction.)
   c. Allow the drive collar to rotate until it is aligned with the door shaft, and the actuator mounting screws can be inserted. Then, disconnect battery.

2. Secure actuator to evaporator housing (2) using two screws.

3. Connect wiring connector to actuator for fresh/recirc air door.

NOTE – In the following step the actuator may also be recalibrated by disconnecting the vehicle battery for 15 seconds; however, this method may result in disrupting other electrical equipment (radio presets, etc.).

4. Recalibrate the fresh/recirc air door by disconnecting the HVAC control panel assembly for at least 15 seconds. Refer to HVAC CONTROL PANEL ASSEMBLY, REMOVE AND INSTALL (See FRONT HVAC CONTROL PANEL ASSEMBLY, page 112).

8.10. AIR CONDITIONER (EVAPORATOR) HOUSING

Removal and installation of the evaporator housing requires the removal of other assemblies (such as cab cowl tray). The assemblies that must be removed vary by vehicle model and engine combinations. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – If you were referenced to this procedure from the heater housing removal procedure; note that on some vehicles it may be possible to unmount the evaporator housing and move it away from the cowl enough to remove the heater housing mounting nuts (located behind the evaporator housing), WITHOUT disconnecting the A/C lines. Inspect the vehicle being serviced and review the following procedure to determine if complete removal of the evaporator housing is necessary. If it is determined that disconnection of the A/C lines is unnecessary, review the following procedures and perform only the steps required to remove the evaporator housing from the cowl. If this method is followed, it will still be necessary to unclamp A/C lines to allow movement. When positioning the evaporator housing out of the way DO NOT kink the A/C lines.

Remove

1. Remove cab cowl tray.
2. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).
3. Disconnect wiring to thermistors (2 and 5, Figure 32) and remove strap locks, as necessary, to allow connectors to be moved out of the way.
4. Unclip or remove clamps securing condenser-to-evaporator line (10) to evaporator housing (9).
5. Disconnect end of condenser-to-evaporator line from filter-drier (6).
6. Unclip clamps and/or strap locks securing evaporator-to-compressor line (7) to cowl.
7. Disconnect end of evaporator-to-compressor line from outlet thermistor line (5).

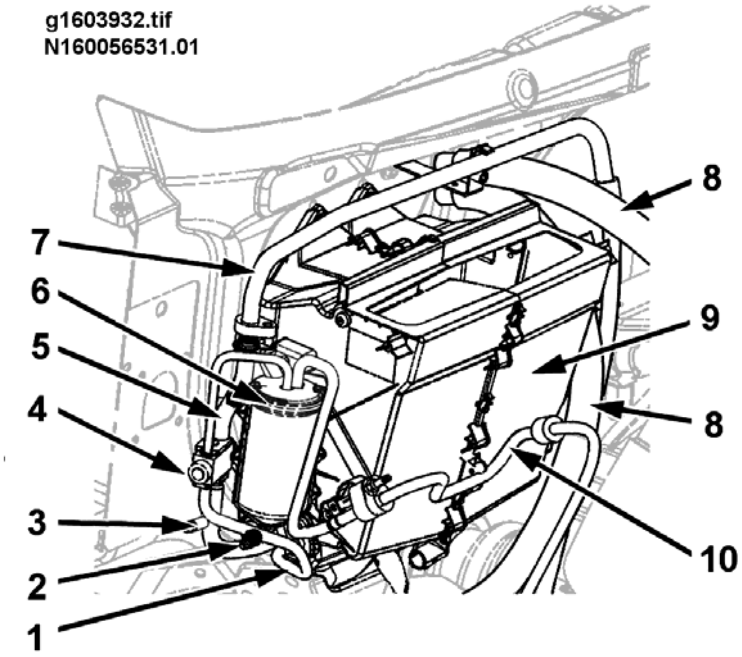


Figure 32 Evaporator Housing (Shown with Cowl Tray Removed)

1. EVAPORATOR INLET LINE (INCLUDES INPUT THERMISTOR)
2. INPUT THERMISTOR
3. EVAPORATOR OUTLET LINE (INCLUDES LOW SIDE SERVICE PORT)
4. THERMOSTATIC EXPANSION VALVE
5. OUTPUT THERMISTOR LINE (INCLUDES OUTPUT THERMISTOR)
6. FILTER-DRIER
7. EVAPORATOR-TO-COMPRESSOR LINE
8. HEATER HOSES
9. EVAPORATOR HOUSING
10. CONDENSER-TO-EVAPORATOR LINE

8. Disconnect wiring connector to actuator motor for fresh/recirc air door (16, Figure 33).

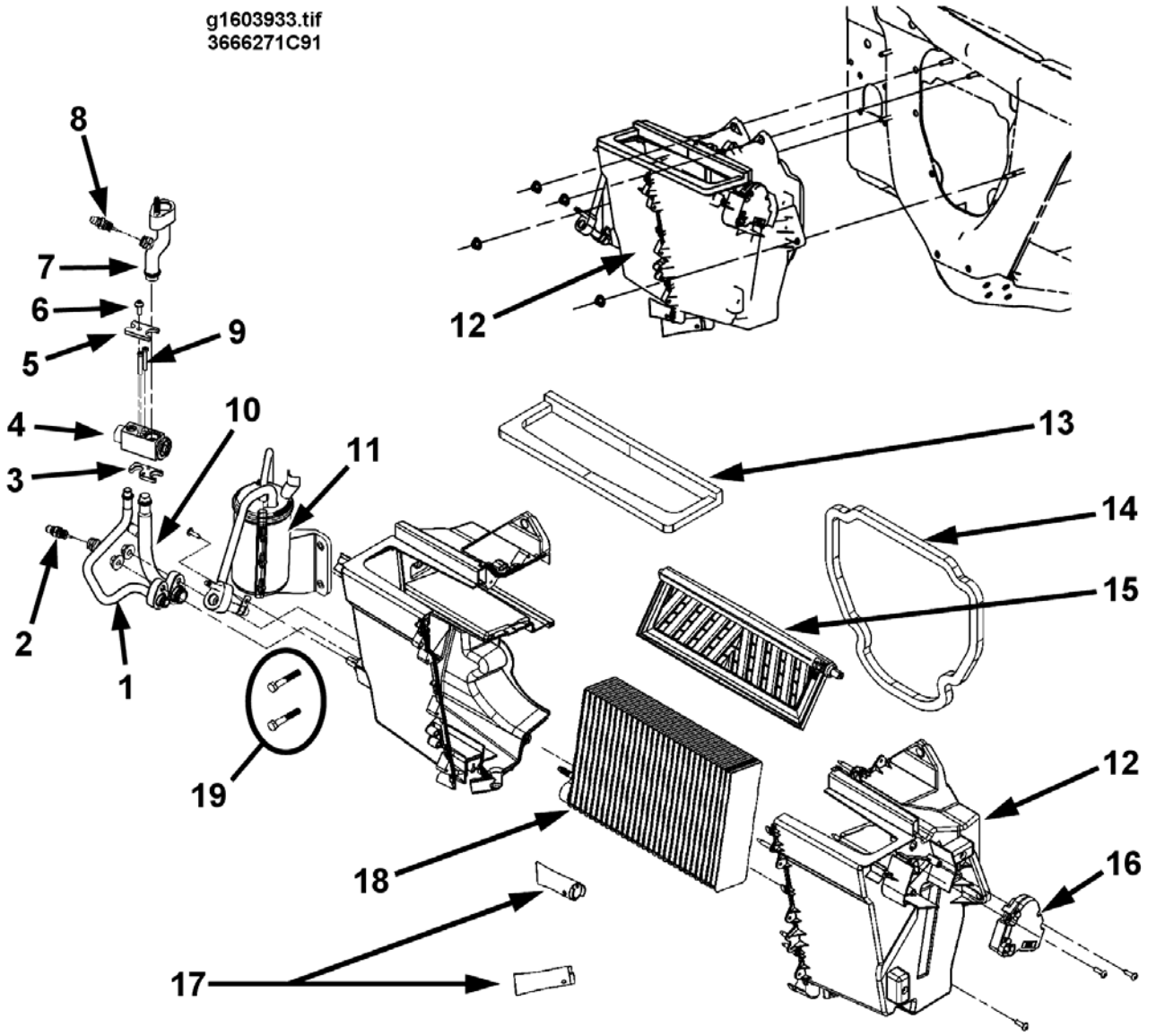


Figure 33 Evaporator Housing Mounting and Components

1. EVAPORATOR INLET LINE
2. INPUT THERMISTOR
3. BOTTOM LOCKING PLATE
4. THERMOSTATIC EXPANSION VALVE
5. TOP LOCKING PLATE
6. T30 TORX HEAD SCREW
7. OUTPUT THERMISTOR LINE
8. OUTPUT THERMISTOR
9. 3 MM ALLEN HEAD CAPSCREW (2)
10. EVAPORATOR OUTLET LINE
11. FILTER-DRIER
12. EVAPORATOR HOUSING
13. GASKET/SEAL, AIR INTAKE
14. GASKET, EVAPORATOR HOUSING
15. RECIRCULATE/FRESH AIR DOOR
16. ACTUATOR, RECIRC DOOR
17. DRAIN TUBES
18. EVAPORATOR CORE
19. BOLTS, FILTER-DRIER MTG

9. Remove four nuts securing evaporator housing (12, Figure 33) to mounting studs on cowl.

10. Carefully remove evaporator housing from cowl.

NOTE – The need to perform additional steps is determined by the specific repair being performed. Perform only the following steps that are required to transfer parts to a replacement housing or to replace parts within the removed housing.

11. To remove recirc door actuator (16, Figure 33), remove two screws securing actuator to evaporator housing (12).

12. Remove drain tubes (17, Figure 33) from evaporator housing.

13. Remove filter-drier, expansion valve, and associated a/c lines, as an assembly (Figure 34), as follows.
    a. Remove screw securing filter-drier inlet line clamp to evaporator housing.
    b. Remove nuts securing evaporator inlet and outlet lines (1 and 10, Figure 33) to the evaporator core inlet and outlet fittings.
    c. While supporting filter-drier (11, Figure 33), remove two mounting bolts (19) securing filter-drier to evaporator housing.

CAUTION – While separating evaporator housing be careful not to damage fins or fittings on evaporator core.

NOTE – The housing halves normally snap together and are secured with one screw (hi-lo thread); however, mounting tabs are provided to allow assembling the halves with additional hi-lo thread screws if the plastic snaps are damaged during disassembly. The mounting tabs are designed specifically to use only hi-lo thread screws.

14. Separate housing halves by removing one or more hi-lo thread screws, releasing snap tabs, and pulling halves straight away from each other.

15. Remove and discard mounting gaskets (13 and 14, Figure 33) if they are damaged during separation.

16. With housing separated, the evaporator core and/or fresh/recirculate air door may be removed.

NOTE – When replacing a damaged fresh/recirc air door verify that no parts remain lodged in the housing or evaporator core.

17. When replacing a damaged evaporator housing (or housing half), transfer all good components (evaporator core, fresh/recirculate door, door actuator, and drain tubes) from the damaged housing to the new housing.

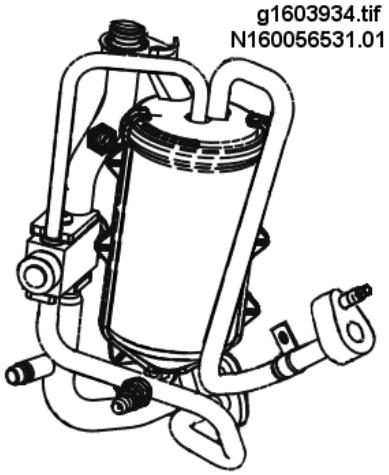


Figure 34 Filter-Drier, Expansion Valve, and Associated A/C Lines

Install

NOTE – Depending on the level of disassembly required for the repair, some of the following steps may not be necessary for each installation.

1. If refrigerant system is to be flushed or purged, perform that operation before reassembling the system. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

2. When installing a new evaporator housing or reinstalling a housing that was removed for service, verify that all internal components (evaporator core and fresh/recirculate door) are installed in the housing before joining the housing halves.

NOTE – The housing halves normally snap together and are secured with one screw (hi-lo thread); however, mounting tabs are provided to allow assembling the halves with additional hi-lo thread screws if the plastic snaps are damaged during disassembly. The mounting tabs are designed specifically to use only hi-lo thread screws.

3. Join housing halves by using snap tabs and one screw. If any snap tabs have been damaged, use additional hi-lo thread screws in the molded joining tabs to securely join housing halves.

CAUTION – In the following step, never force the actuator drive collar into position. If the drive collar position must be changed, perform the following procedures. Forcing the drive collar may result in a broken actuator.

4. If fresh/recirculate air door actuator (16, Figure 33), was previously removed, install actuator by rotating door until flats on door shaft align with actuator hub, if possible. If actuator drive collar must be moved to allow alignment:
   a. Place actuator into its approximate position.
   b. Connect a 9 Volt battery across pins A and F of actuator connector, to rotate drive collar. (Reverse connection to rotate drive collar in opposite direction.)
   c. Allow drive collar to rotate until it is aligned with door shaft, and actuator mounting screws can be inserted. Then, disconnect battery.
5. Secure actuator to evaporator housing with two screws.
6. Install drain tubes (17, Figure 33).
7. Using a new gasket/seal (14, Figure 33), install evaporator housing (12) onto mounting studs located on cowl using four nuts. Tighten to 5,400 to 7,600 N.mm (47.5 to 67.5 lbf-in).

CAUTION – In the following steps the filter-drier, expansion valve, and their associated a/c lines are treated as an assembly. When installing this assembly care must be taken to align connections properly and to not place undue stress on a/c line connections. Once the filter-drier mounting bolts are loosely installed to support the assembly, the a/c line connections should be torqued to provide proper joining and alignment, before tightening the filter-drier mounting bolts.

NOTE – Always lubricate O-rings on fittings with mineral-based oil during installation.

8. Place new O-rings and C-plates on evaporator inlet and outlet lines (1 and 10, Figure 33).
9. Place filter-drier/expansion valve assembly (Figure 34) into its approximate position by inserting evaporator inlet and outlet lines into evaporator core inlet and outlet fittings; AND loosely installing the two filter-drier mounting bolts (19, Figure 33). (Filter-drier mounting bolts must be loose enough to allow proper alignment of evaporator inlet and outlet fittings while supporting the weight of the filter-drier.)
10. Install nuts securing evaporator inlet and outlet lines to the evaporator core inlet and outlet fittings. Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).
11. Tighten two mounting bolts securing filter-drier to evaporator housing. Tighten to 11,000 to 11,600 N.mm (97 to 103 lbf-in).
12. Secure filter-drier inlet line clamp to evaporator housing using one screw.
13. Using a new O-ring and C-plate connect end of evaporator-to-compressor line (7, Figure 32) to outlet thermistor line (5). Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).
14. Secure evaporator-to-compressor line to cowl using existing clamp(s).

15. Using a new O-ring and C-plate connect end of condenser-to-evaporator line (10, Figure 32) to filter-drier inlet fitting. Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).

16. Secure condenser-to-evaporator line to evaporator housing (9, Figure 32) using existing clamps.

17. Connect wiring to thermistors (2 and 5, Figure 32) and secure wires in original position using strap locks.

18. Connect wiring connector to actuator motor (16, Figure 33) for fresh/recirc air door.

NOTE – In the following step the actuator may also be recalibrated by disconnecting the vehicle battery for 15 seconds; however, this method may result in disrupting other electrical equipment (radio presets, etc.).

19. Recalibrate fresh/recirc air door by disconnecting HVAC control panel assembly for at least 15 seconds. Refer to HVAC CONTROL PANEL ASSEMBLY, REMOVE AND INSTALL (See FRONT HVAC CONTROL PANEL ASSEMBLY, page 112).

20. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

21. Install cab cowl tray/HVAC air inlet.

8.11. FRESH/RECIRCULATE AIR DOOR

The fresh/recirculate air door can be replaced after removing and separating the evaporator housing. Refer to AIR CONDITIONER (EVAPORATOR) HOUSING, REMOVE AND INSTALL (See AIR CONDITIONER (EVAPORATOR) HOUSING, page 90).

8.12. EVAPORATOR CORE

The evaporator core can be replaced after removing and separating the evaporator housing. Refer to AIR CONDITIONER (EVAPORATOR) HOUSING, REMOVE AND INSTALL (See AIR CONDITIONER (EVAPORATOR) HOUSING, page 90).

8.13. HEATER HOSES/LINES – FRONT HVAC SYSTEM

WARNING – Allow the engine to cool down before removing the pressure cap from the deaeration tank. ALWAYS INSULATE the cap by wrapping it with a thick, heavy cloth. To prevent possible injury from scalding water or steam, DO NOT pull the pressure cap off immediately when it has been loosened to the first "notch." Pause momentarily to allow time for excess pressure to release through the overflow tube.

Engine coolant is routed to and from the heater core using a combination of hoses and hard lines that vary by vehicle model and engine. Most hoses and lines are replaced using common practices, standard hose clamps, or threaded fittings. Only new or unique equipment is described in this section. In all cases replacement hoses and lines must be routed and secured in the same manor as the original equipment. Additional information for the coolant system may be found in the appropriate section(s) in GROUP 12 of the Master Service Manual.

Some heater line connections now employ a peanut fitting (1, Figure 35) that is sealed with an O-ring (2) and secured with one nut. Before installing a peanut fitting always verify that a new O-ring is in place.

Some engine options require a flow restrictor (3, Figure 36) in the top (inlet) heater hose where it connects to the heater core at the cowl. When replacing this hose note whether the original hose contained a restrictor. If necessary, install a new restrictor into the replacement hose before installing the hose onto the vehicle.

Depending on the vehicle model/engine combination, replacement of specific heater lines may require the removal of nearby assemblies to gain access to the hoses/lines. Refer to the appropriate section(s) in the Master Service Manual for additional procedures. For information on draining and filling engine coolant, refer to the appropriate COOLING section in GROUP 12 of the Master Service Manual.

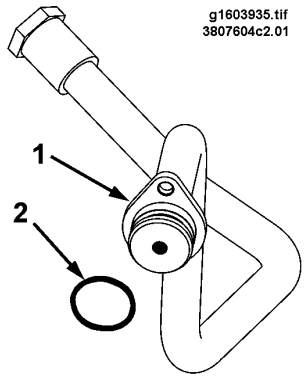


Figure 35 Typical Coolant Line Peanut Fitting

1. PEANUT FITTING
2. O-RING

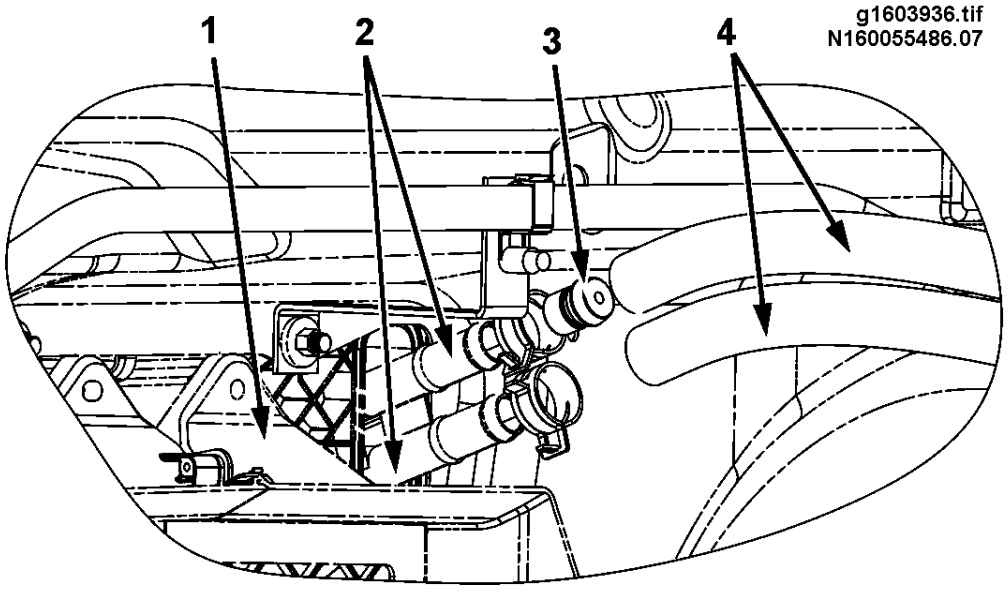


Figure 36 Flow Restrictor in Heater Hose

1. EVAPORATOR HOUSING
2. HEATER CORE TUBES
3. FLOW RESTRICTOR
4. HEATER HOSES

8.14. HEATER TRIM COVER

The heater trim cover must be removed prior to removing any of the HVAC components located under the right side of the instrument panel (IP). Removal and installation of the heater trim cover may require the removal of other trim panels. Refer to the appropriate CAB section(s) in GROUP 16 of the Master Service Manual for additional procedures.

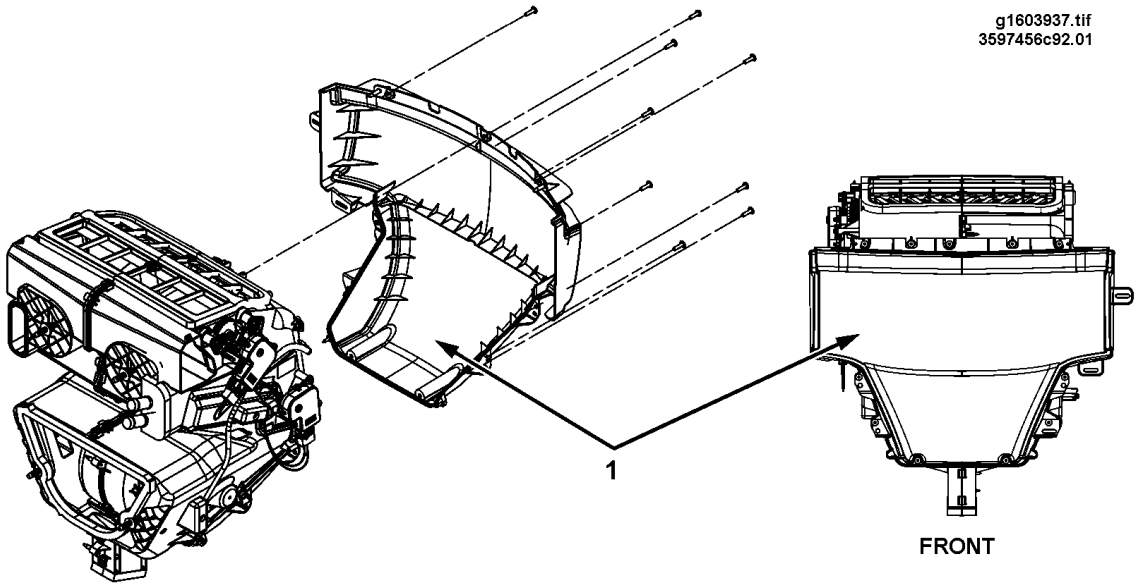


Figure 37 Heater Trim Cover

1. HEATER TRIM COVER

NOTE – Refer to Figure 37 while performing the following Remove and Install procedures.

Remove

1. Remove fuse panel cover from passenger side instrument panel by pulling top of cover away from IP to release spring clips, then lift cover up.
2. Remove trim panels, as necessary, to gain access to mounting screws for heater trim cover (1, Figure 37).
3. Remove nine screws from heater trim cover.
4. Remove cover by pulling it straight back.

Install

1. Secure heater trim cover (1, Figure 37) to heater housing with nine screws.
2. Install all additional trim panels removed to gain access to heater trim cover.
3. Install fuse panel cover by inserting two tabs at bottom of cover into sockets in IP; then press top of cover toward IP to engage spring clips.

8.15. ACTUATOR, TEMPERATURE BLEND DOOR

Accessing the temperature blend door actuator may require the removal of trim panels not described in this manual. Refer to the appropriate CAB section(s) in Group 16 of the Master Service Manual for additional procedures.

NOTE – Refer to Figure 38 while performing the following Remove and Install procedures.

Remove

1. Remove fuse panel cover from passenger side instrument panel by pulling top of cover away from IP to release spring clips, then lift cover up.
2. Remove trim panels, as necessary, to gain access to mounting screws for heater trim cover (4, Figure 38).
3. Remove nine screws from heater trim cover.
4. Remove heater trim cover by pulling it straight back.
5. Disconnect electrical plug connected to temperature blend door actuator (6).
6. Remove two screws securing actuator to blower scroll housing (3), and pull actuator straight off of temperature blend door shaft.

Install

> **CAUTION – In the following step, never force the actuator drive collar into position. If the drive collar position must be changed, follow the following procedures. Forcing the drive collar may result in a broken actuator.**

1. Install actuator by rotating door until flats on door shaft align with actuator drive collar, if possible, then carefully slip the actuator onto end of door shaft so that mounting holes are properly aligned. If actuator drive collar must be moved to allow alignment:
   a. Place actuator into its approximate position.
   b. To rotate drive collar, connect a 9 Volt battery across the active pins of the actuator connector (check mating connector if necessary). (Reverse connection to rotate drive collar in opposite direction.)
   c. Allow drive collar to rotate until it is aligned with door shaft, and actuator mounting screws can be inserted. Then, disconnect battery.
2. Secure actuator to blower scroll housing (3, Figure 38) using two screws.
3. Connect electrical control plug to temperature blend door actuator (6).

4. Secure heater trim cover (4) to heater housing with nine screws.

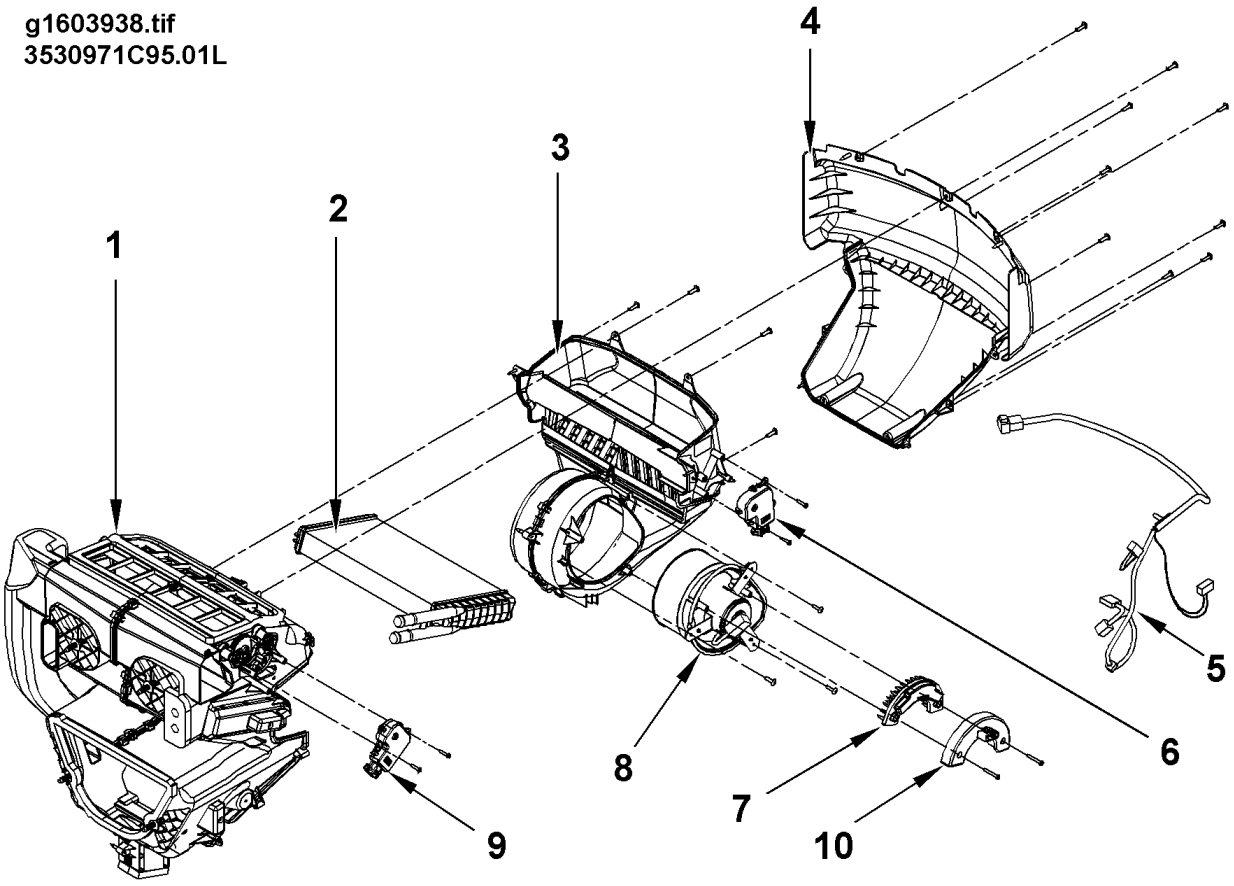


Figure 38 Heater Unit Exploded View

1. HEATER HOUSING
2. HEATER CORE
3. BLOWER SCROLL HOUSING
4. HEATER TRIM COVER
5. BLOWER WIRE HARNESS
6. ACTUATOR, TEMPERATURE BLEND DOOR
7. LINEAR POWER MODULE (BLOWER SPEED CONTROL)
8. BLOWER ASSEMBLY
9. ACTUATOR, MODE CONTROL DOOR
10. LINEAR POWER MODULE COVER

5. Install all additional trim panels removed to gain access to heater trim cover.

6. Install fuse panel cover by inserting two tabs at bottom of cover into sockets in IP; then press top of cover toward IP to engage spring clips.

NOTE – In the following step the actuator may also be recalibrated by disconnecting the vehicle battery for 15 seconds; however, this method may result in disrupting other electrical equipment (radio presets, etc.).

7. Recalibrate temperature blend door by disconnecting HVAC control panel assembly for at least 15 seconds. Refer to HVAC CONTROL PANEL ASSEMBLY, REMOVE AND INSTALL (See FRONT HVAC CONTROL PANEL ASSEMBLY, page 112).

8.16. ACTUATOR, MODE DOOR

Accessing the mode door actuator may require the removal of trim panels not described in this manual. Refer to the appropriate CAB section(s) in Group 16 of the Master Service Manual for additional procedures.

NOTE – Refer to Figure 38 while performing the following Remove and Install procedures.

Remove

1. Remove fuse panel cover from passenger side instrument panel by pulling top of cover away from IP to release spring clips, then lift cover up.
2. Remove trim panels, as necessary, to gain access to heater trim cover (4, Figure 38) mounting screws.
3. Remove nine screws from heater trim cover.
4. Remove heater trim cover by pulling it straight back.
5. Disconnect electrical plug connected to mode door actuator (9).
6. Remove two screws securing actuator (9) to heater housing (1), and pull actuator straight off of mode door shaft.

Install

> **CAUTION – In the following step, never force the actuator drive collar into position. If the drive collar position must be changed, follow the following procedures. Forcing the drive collar may result in a broken actuator.**

1. Carefully slip actuator (9, Figure 38) onto end of mode door shaft so that mounting holes are properly aligned, if possible. If actuator drive collar must be moved to allow alignment:
   a. Place actuator into its approximate position.
   b. To rotate drive collar, connect a 9 Volt battery across the active pins of the actuator connector (check mating connector if necessary). (Reverse connection to rotate drive collar in opposite direction.)
   c. Allow drive collar to rotate until it is aligned with door shaft, and actuator mounting screws can be inserted. Then, disconnect battery.
2. Secure actuator to heater housing (1) using two screws.
3. Connect electrical control plug to mode door actuator motor (9).
4. Secure heater trim cover (4) to heater housing with nine screws.
5. Install all additional trim panels removed to gain access to heater trim cover.

6. Install fuse panel cover by inserting two tabs at bottom of cover into sockets in IP; then press top of cover toward IP to engage spring clips.

NOTE – In the following step the actuator may also be recalibrated by disconnecting the vehicle battery for 15 seconds; however, this method may result in disrupting other electrical equipment (radio presets, etc.).

7. Recalibrate mode door by disconnecting HVAC control panel assembly for at least 15 seconds. Refer to HVAC CONTROL PANEL ASSEMBLY, REMOVE AND INSTALL (See FRONT HVAC CONTROL PANEL ASSEMBLY, page 112).

8.17. BLOWER SCROLL HOUSING

The blower scroll housing must be removed prior to removing the heater core, the heater core housing, or any of the components within the blower scroll housing. Accessing the blower scroll housing may require the removal of trim panels not described in this manual.

Remove

1. Remove fuse panel cover, other trim covers (as necessary), and heater trim cover. Refer to HEATER TRIM COVER, REMOVE AND INSTALL (See HEATER TRIM COVER, page 98).

NOTE – Refer to Figure 38 while performing the following steps.

2. Disconnect electrical plug connected to the temperature door actuator (6, Figure 38).

3. Remove four screws securing blower scroll housing (3) to heater housing assembly (1).

NOTE – In the following step wiring connections to linear power module and blower motor must be disconnected once blower scroll housing is partially separated from heater housing.

4. Carefully separate blower scroll housing (3) from heater housing (1).

5. With blower scroll housing removed, blower assembly (8), linear power module (7), and heater core (2) are accessible for service.

6. When replacing a damaged scroll housing, transfer all good components: blower assembly, linear power module, and temperature door actuator (6), from damaged housing to new housing. Refer to appropriate procedures in this manual for additional information.

Install

NOTE – Refer to Figure 38 while performing the following steps.

NOTE – Depending on the level of disassembly required for the repair, some of the following steps may not be necessary for each installation.

1. If removed previously, install blower assembly (8, Figure 38), using three screws.

2. If removed previously, install linear power module (7) and LPM cover (10), using two screws.

3. If temperature door actuator was removed previously, install actuator by rotating door until flats on door shaft align with actuator drive collar, if possible; then carefully slip the actuator (6) onto end of door shaft so that mounting holes are properly aligned. If actuator drive collar must be moved to allow alignment:

a. Place actuator into its approximate position.

b. To rotate drive collar, connect a 9 Volt battery across the active pins of the actuator connector (check mating connector if necessary). (Reverse connection to rotate drive collar in opposite direction.)

c. Allow drive collar to rotate until it is aligned with door shaft, and actuator mounting screws can be inserted. Then, disconnect battery.

4. Secure actuator to blower scroll housing (3) using two screws.

5. Before installing blower scroll housing, verify that heater core (2) is installed in heater housing (1). To install the heater core refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – FRONT HVAC SYSTEM, page 104).

6. Position blower scroll housing so that electrical connections to linear power module and blower motor can be connected. After making connection, secure any excess wire so that it will not interfere with installation of blower scroll housing.

NOTE – When installing the blower scroll housing in the following step, pay close attention to how the edges of the housing walls mate up with the walls of the heater housing.

7. Carefully install blower scroll housing so that housing walls interlock with walls of heater housing, and mounting holes line up.

8. Secure blower scroll housing (3) to heater housing using four screws.

9. Connect electrical control plug to temperature blend door actuator (6).

10. Install heater trim cover, other trim covers (as necessary), and fuse panel cover. Refer to HEATER TRIM COVER, REMOVE AND INSTALL (See HEATER TRIM COVER, page 98).

8.18. LINEAR POWER MODULE AND BLOWER ASSEMBLY – FRONT HVAC SYSTEM

NOTE – Refer to Figure 38 while performing the following Remove and Install procedures.

Remove

1. Remove blower scroll housing (3, Figure 38), refer to BLOWER SCROLL HOUSING, REMOVE AND INSTALL (See BLOWER SCROLL HOUSING, page 102).

2. Detach linear power module (7) and LPM cover (10) from blower scroll housing (3) by removing two mounting screws.

3. Remove blower assembly (8) by removing the three screws securing it to the scroll housing (3).

Install

1. Install blower assembly (8, Figure 38) by securing it to the scroll housing (3) with three screws.

2. Secure linear power module (7) and LPM cover (10) to blower scroll housing (3) with two screws.

3. Install blower scroll housing, refer to BLOWER SCROLL HOUSING, REMOVE AND INSTALL (See BLOWER SCROLL HOUSING, page 102).

8.19. HEATER CORE – FRONT HVAC SYSTEM

Access to the heater hoses may require the removal of nearby assemblies. The assemblies that must be removed vary by vehicle model and engine combinations. Refer to the appropriate section(s) in the Master Service Manual for additional procedures.

NOTE – Refer to Figure 39 while performing the following Remove and Install procedures.

Remove

WARNING – Allow the engine to cool down before removing the pressure cap from the deaeration tank. ALWAYS INSULATE the cap by wrapping it with a thick, heavy cloth. To prevent possible injury from scalding water or steam, DO NOT pull the pressure cap off immediately when it has been loosened to the first "notch." Pause momentarily to allow time for excess pressure to release through the overflow tube.

1. Drain engine coolant from heater core and connected heater lines. Refer to the appropriate COOLING section in GROUP 12 of the Master Service Manual.

2. Remove cab cowl tray.

NOTE – Before removing heater hoses in the following step, label hoses to insure correct installation.

3. Disconnect both heater hoses (2, Figure 39) from heater core tubes on engine side of cowl.

4. From inside cab, remove blower scroll housing. Refer to BLOWER SCROLL HOUSING, REMOVE AND INSTALL (See BLOWER SCROLL HOUSING, page 102).

NOTE – The heater core is mounted at a slight angle and therefore retains a small amount of coolant in the core. Be careful to keep the core in an upright position until the coolant can be drained.

5. Pull heater core (5) out of heater housing (6).

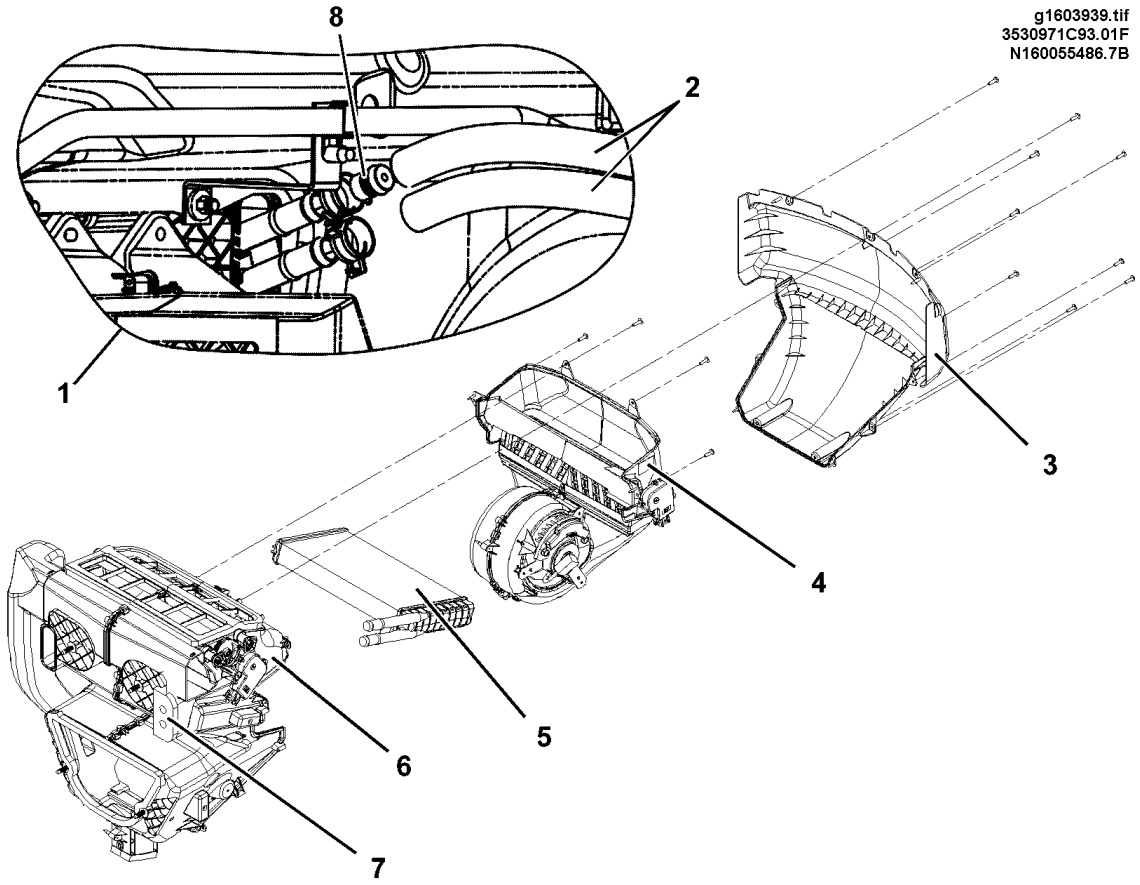


Figure 39 Heater Component Locations

1. VIEW OF COWL (UNDER HOOD)
2. HEATER HOSES
3. HEATER TRIM PANEL
4. BLOWER SCROLL HOUSING
5. HEATER CORE
6. HEATER HOUSING
7. SEAL, HEATER CORE TUBES
8. FLOW RESTRICTOR

Install

NOTE – In the following step insure that the heater housing seal that surrounds the heater core tubes does not become dislodged while installing the heater core.

1. From inside cab, carefully position heater core (5, Figure 39) in heater housing (6) so that tube ends of core protrude through dash panel seal (7).

2. Install blower scroll housing (4) and heater trim panel. Refer to BLOWER SCROLL HOUSING, REMOVE AND INSTALL (See BLOWER SCROLL HOUSING, page 102).

NOTE – In the following step position the heater hose clamps to allow easy access for their next removal.

3. On engine side of cowl, install heater hoses (2) and clamps.

4. Fill cooling system with coolant. Refer to the appropriate COOLING section in GROUP 12 of the Master Service Manual, or the Operator Manual supplied with the vehicle.

NOTE – Verify that coolant system is leak-free before proceeding to the following steps.

5. Install cab cowl tray.

8.20. HEATER HOUSING

NOTE – Removing and installing the heater housing requires detaching and raising the Instrument Panel (IP), and removing the evaporator housing from the cowl. Replacement of the heater housing is necessary only if either the mode door mechanism or the housing itself is damaged. In either case the entire heater housing is replaced as an assembly.

The Instrument Panel (IP) must be detached and raised prior to removing the heater housing. Accessing the IP mounting hardware may require the removal of trim panels not described in this manual. The procedures provided here cover a basic installation. Refer to the appropriate CAB section in Group 16 of the Master Service Manual for additional procedures.

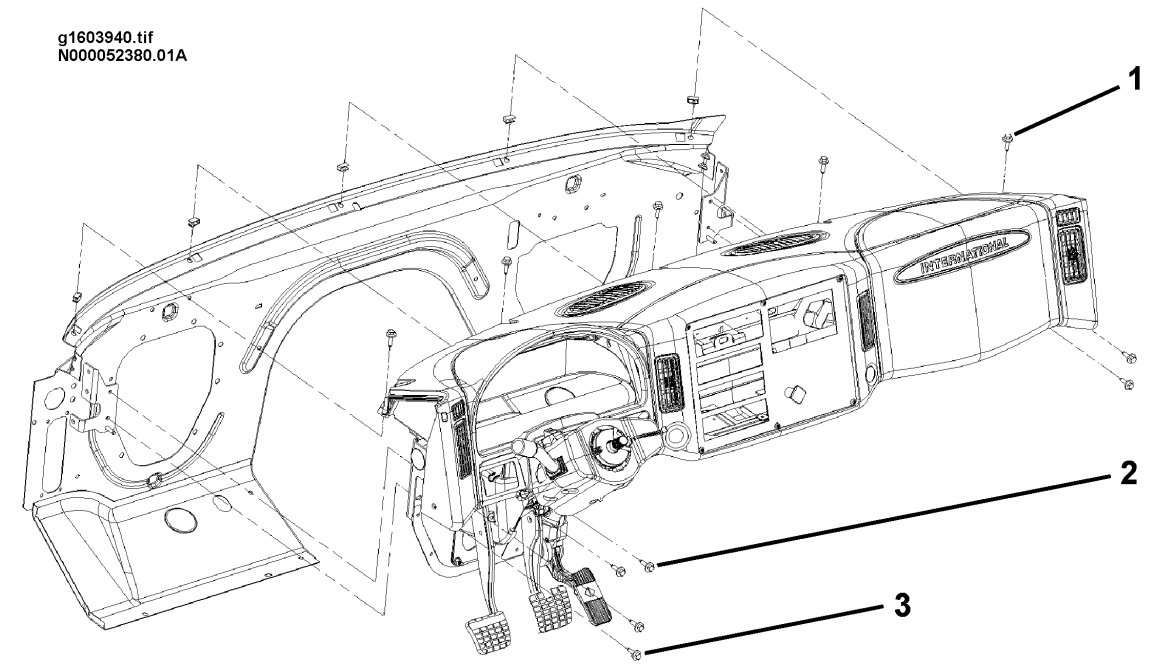
Remove

1. Inside cab, remove A-pillar trim from driver's side.

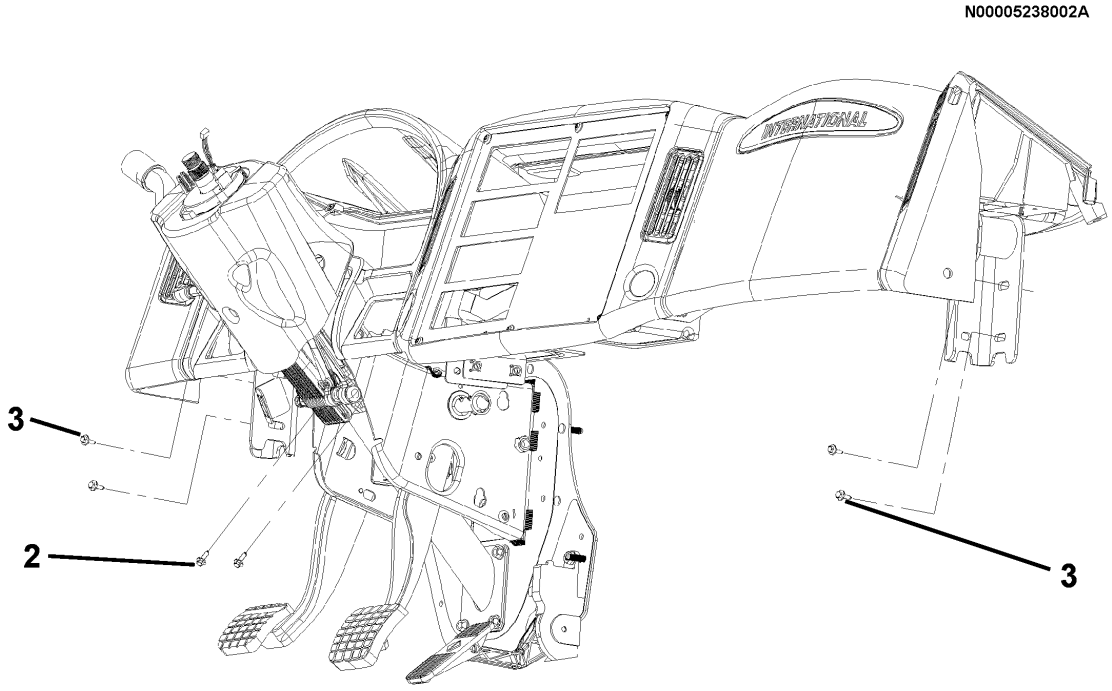
2. Remove assist handle and A-pillar trim from passenger's side.

3. Remove or disconnect trim panels from under IP to allow access to IP mounting hardware removed in the following steps.

4. Remove only the IP mounting hardware required to allow IP to be raised about one inch. More complete procedures for removing the IP can be found in the appropriate CAB section in Group 16 of the Master Service Manual. Typically, the following mounting hardware must be removed:
   a. Remove five bolts (1, Figure 40) securing top of IP to dash panel (located near windshield).
   b. Remove two bolts (2) securing steering column module to IP.
   c. Remove two bolts (3) securing each side of IP to dash panel.



TOP VIEW



BOTTOM VIEW

Figure 40 Instrument Panel Mounting

1. TOP INSTRUMENT PANEL MOUNTING BOLTS
2. STEERING MODULE BOLTS
3. SIDE INSTRUMENT PANEL MOUNTING BOLTS

5. To gain access to mounting nuts (10, Figure 41) for the heater housing (1), the evaporator housing (11) must be removed from the cowl. Refer to AIR CONDITIONER (EVAPORATOR) HOUSING, REMOVE AND INSTALL (See AIR CONDITIONER (EVAPORATOR) HOUSING, page 90).

6. Remove heater core (5) from heater housing, refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – FRONT HVAC SYSTEM, page 104).

7. Disconnect HVAC wiring harness (4) from instrument panel wiring harness.

NOTE – It may be possible to remove the heater housing without disconnecting the passenger side floor duct (6); however, the following steps are provided as an alternative.

NOTE – The driver side duct is connected to the heater housing with a snap mount (slip-lock). This duct is also mounted to the dash panel with one mounting screw.

NOTE – There are two gaskets attached to the exterior of the heater housing. There is one gasket (12) where the housing mounts to the dash panel; and another gasket (2) where the IP rests on top of the housing. If the gaskets are damaged when moving the housing or the IP, they must be replaced.

NOTE – In the following step, it will be necessary to raise the IP slightly while removing the heater housing. This may require a second or third person.

8. Lift the IP and support it so that it provides the greatest amount of clearance for removing heater housing.

9. Disconnect passenger side floor duct (Items 2, 3, and 5, Figure 42) from heater housing.
   a. Bottom section of duct is mounted to side of housing with one screw (4). After removing screw, bottom section may be removed to provide better access to top section.
   b. Top section of duct is connected to housing with a snap mount (slip-lock), and is disconnected by pulling duct away from housing.

10. Remove mounting screw (8, Figure 41) from driver side floor duct (7) and move duct left to disconnect it from housing.

11. On engine side of dash panel, remove four nuts (10) from heater housing mounting studs.

12. Pull heater housing to rear (to allow its mounting studs to clear dash panel). Heater housing (1) should now be clear to slide out from under IP.

13. If mode door actuator (3) is being transferred to a replacement heater housing, remove two screws securing actuator to housing (1), and pull actuator straight off of mode door shaft.

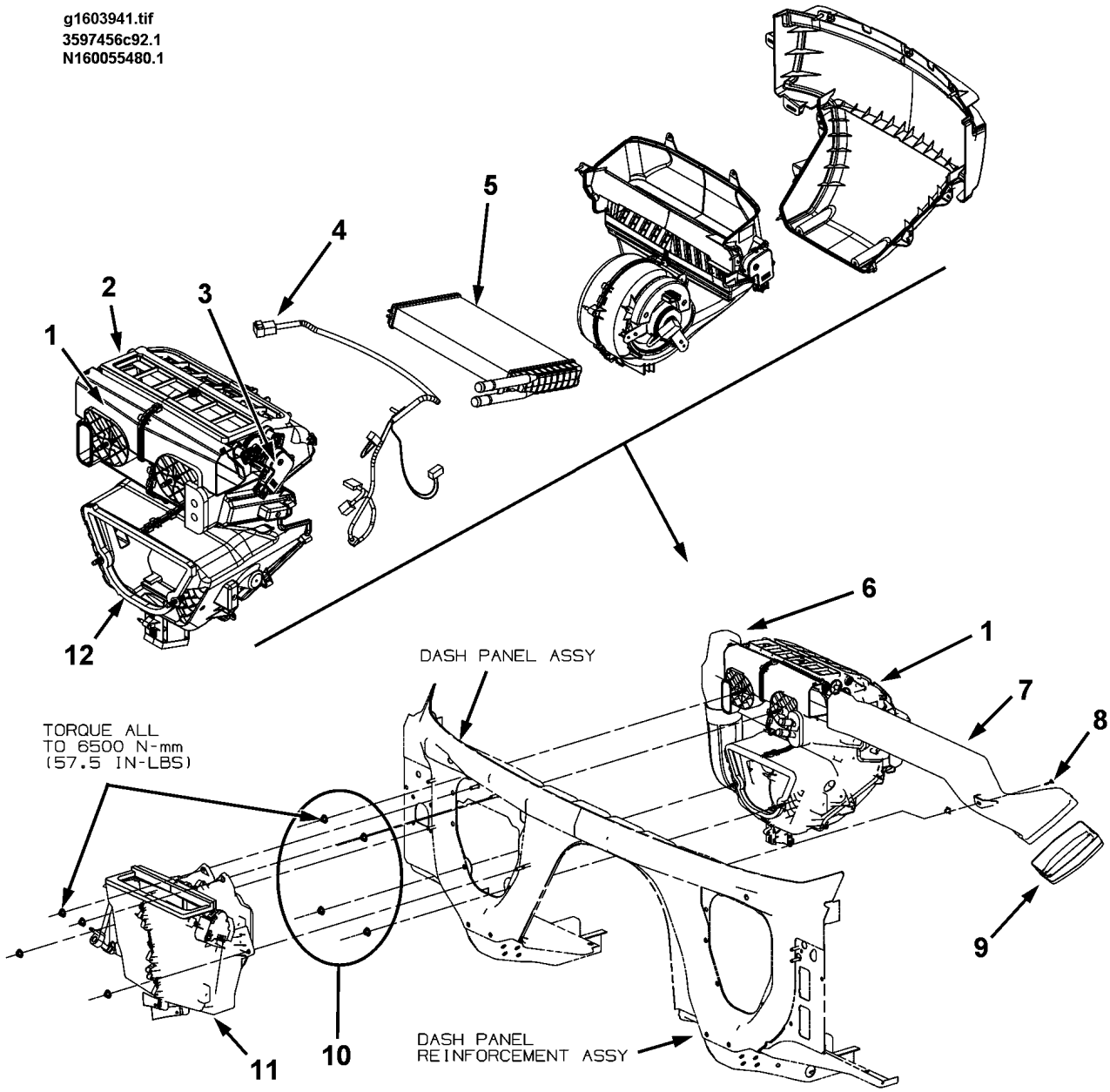


Figure 41 Heater Housing Mounting Diagram

1. HEATER HOUSING
2. GASKET/SEAL, HEATER HOUSING TOP FACE
3. ACTUATOR, MODE DOOR
4. DASH WIRING HARNESS
5. HEATER CORE
6. PASSENGER FLOOR DUCT
7. DRIVER SIDE DUCT
8. DRIVER DUCT MOUNTING SCREW
9. DRIVER SIDE DUCT DIFFUSER
10. MOUNTING NUTS, HEATER HOUSING
11. EVAPORATOR HOUSING
12. GASKET/SEAL, HEATER HOUSING COWL FACE

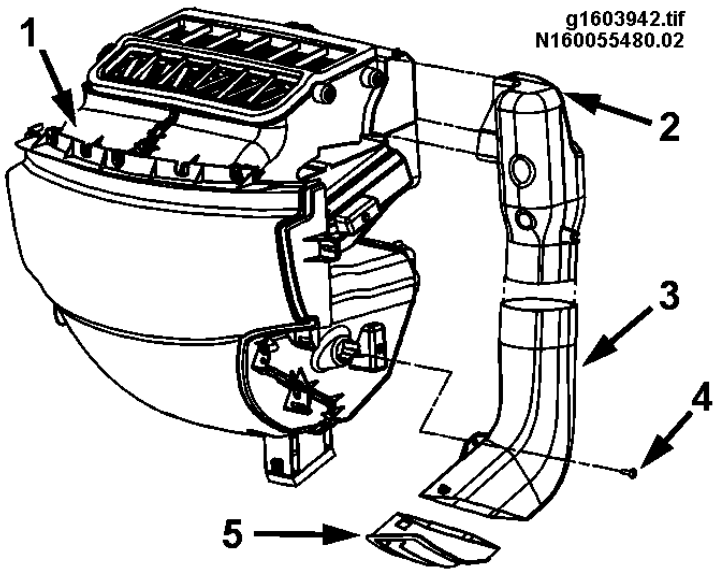


Figure 42 Passenger Side Air Duct

1. HEATER HOUSING ASSEMBLY
2. PASSENGER SIDE DUCT, UPPER
3. PASSENGER SIDE DUCT, LOWER
4. MOUNTING SCREW
5. DIFFUSER

Install

NOTE – It may be possible to install the heater housing with the passenger side floor duct already installed; however, the following procedure is provided as an alternative installation method.

1. Carefully slip mode door actuator (3, Figure 41) from removed housing, onto end of mode door shaft so that mounting holes are properly aligned, if possible. If actuator drive collar must be moved to allow alignment:
   a. Place actuator into its approximate position.
   b. To rotate drive collar, connect a 9 Volt battery across the active pins of the actuator connector (check mating connector if necessary). (Reverse connection to rotate drive collar in opposite direction.)
   c. Allow drive collar to rotate until it is aligned with door shaft, and actuator mounting screws can be inserted. Then, disconnect battery.

2. Secure actuator to heater housing using two screws.

NOTE – In the following step, the IP must be raised slightly while installing the heater housing. This may require a second or third person. To insure proper alignment and compression of the heater housing top gasket, the IP must remain raised until the heater housing is securely mounted.

NOTE – While performing the following steps be careful not to damage the gaskets when moving the heater housing or the IP.

3. Lift and brace IP so that it provides adequate clearance for installing heater housing.

4. With IP raised, carefully position heater housing (1, Figure 41) under passenger side instrument panel, so that its mounting studs protrude through matching holes in dash panel.

5. On engine side of dash panel, secure heater housing by installing four nuts (10) on mounting studs. Tighten to 5,400 to 7,600 N.mm (47.5 to 67.5 lbf-in).

6. Connect top section of passenger side floor duct (2, Figure 42) to outlet of heater housing (1). This is a slip-lock type snap joint.

7. Slip bottom section of passenger side floor duct (3) onto top section and secure to side of heater housing using one screw (4). Attach diffuser (5) if it was removed.

NOTE – The driver side duct is connected to the heater housing with a snap mount (slip-lock).

8. Connect driver's side floor duct (7, Figure 41) to heater housing by slipping end of duct over heater housing outlet. Secure floor duct to dash panel under instrument panel using its mounting screw (8). Attach diffuser (9) if it was removed.

9. Carefully allow IP to return to its normal resting position.

10. Connect HVAC wiring harness (4) to instrument panel wiring harness.

11. Install heater core (5) and all related heater components, refer to HEATER CORE, REMOVE AND INSTALL (See HEATER CORE – FRONT HVAC SYSTEM, page 104).

12. Install evaporator housing (11) onto cowl. Refer to AIR CONDITIONER (EVAPORATOR) HOUSING, REMOVE AND INSTALL (See AIR CONDITIONER (EVAPORATOR) HOUSING, page 90).

13. Install IP mounting hardware that was removed earlier. More complete procedures for installing the IP can be found in the appropriate CAB section in Group 16 of the Master Service Manual. Typically, the following mounting hardware must be installed:
    a. Install two bolts (3, Figure 40) securing each side of IP to dash panel.
    b. Install two bolts (2) securing steering column module to IP.
    c. Install five bolts (1) securing top of IP to dash panel (located near windshield).

14. Install or reconnect any trim panels under the IP that were removed to provide access to IP mounting hardware.

15. Inside cab, install assist handle and A-pillar trim on passenger's side.

16. Install A-pillar trim on driver's side.

8.21. FRONT HVAC CONTROL PANEL ASSEMBLY

NOTE – Refer to Figure 43 while performing the following steps.

Remove

> **CAUTION – Place the ignition key in the OFF position before removing or installing the HVAC control panel assembly.**

1. The decorative bezel on center section of IP is secured by spring clips. Carefully pry the bezel from center section of the IP.

2. Remove four screws securing HVAC control panel assembly to IP.

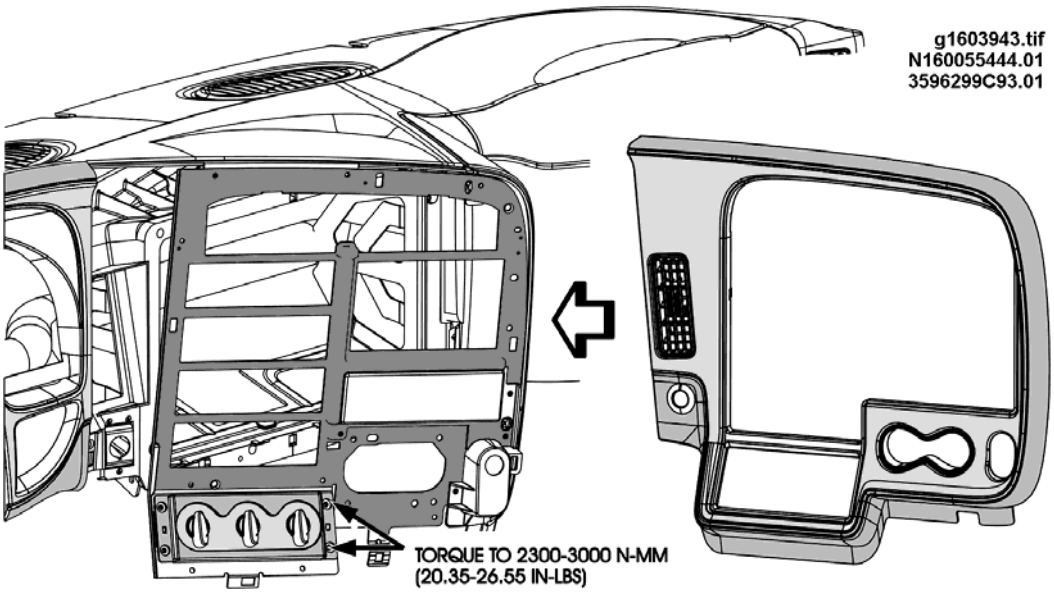


Figure 43 Control Panel Mounting – Front HVAC System

3. Remove control panel assembly from instrument panel by pulling it straight out of its IP mounting cavity.

4. Disconnect wiring connector from rear of HVAC control panel.

Install

> **CAUTION – Place the ignition key in the OFF position before removing or installing the HVAC control panel assembly.**

1. Connect wiring connector to rear of HVAC control panel.

2. With HVAC control panel assembly correctly oriented, insert it straight into IP mounting cavity.

3. Verify that control panel assembly is fully seated, then secure assembly using four screws. Tighten screws to the torque indicated.

4. Install bezel in the center section of IP by aligning spring clips and carefully pressing bezel into position.

8.22. HVAC CONTROLS (SLEEPER)

CAUTION – Place the ignition key in the OFF position before removing or installing the sleeper HVAC controls.

NOTE – Refer to Figure 44 while performing the following Remove and Install procedures.

Remove

1. Carefully pry the outer trim bezel from the sleeper control panel (4 friction clips).

2. Remove the 4 screws (1 in each corner) securing the control panel to its mounting bracket.

3. Remove the following components, as necessary.

4. Digital Control Assembly.
   a. Disconnect electrical connections to the digital panel.
   b. Remove 4 screws from the front of the control panel.
   c. Remove digital panel from the rear of the control panel.

5. Rotary (Analog) Controls.
   a. Disconnect electrical connections to the control being removed.
   b. Remove knob from control.
   c. Remove locknut from control shaft, and pull control from rear of panel. Remove remaining locknut from control shaft and retain for use during installation.

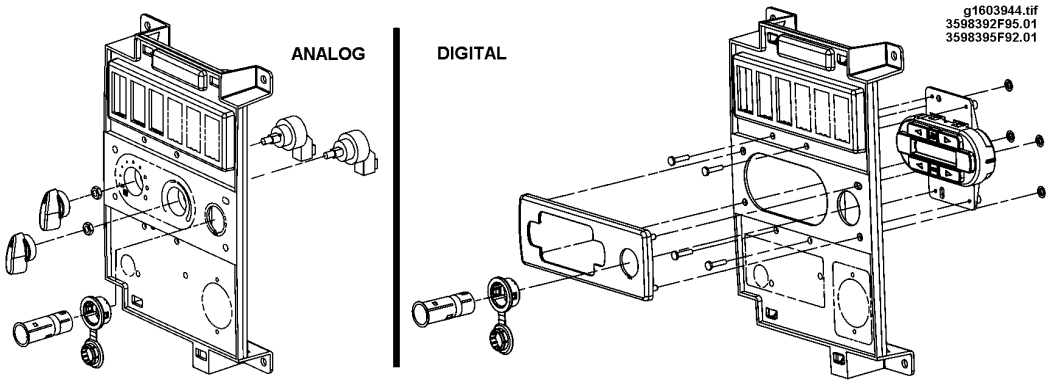


Figure 44 Sleeper HVAC Control Panels

Install, Rotary (Digital) Controls

1. Insert digital panel from the rear of the control panel and secure with 4 screws from the front of the control panel.
2. Install electrical connector to rear of digital panel. Ensure that connector locks are engaged.
3. Secure control panel to its mounting bracket with 4 screws (1 in each corner) .
4. Install the trim bezel onto the sleeper control panel.

Install, Rotary (Analog) Controls

1. Insure that one locknut is threaded onto the shaft of the new control. Transfer from removed control, if necessary.
2. Insert control from the rear of the control panel and secure with locknut from the front of the control panel.
3. Install electrical connector to control. Ensure that connector locks are engaged.
4. Install control knob.
5. Secure control panel to its mounting bracket with 4 screws (1 in each corner) .
6. Install the trim bezel onto the sleeper control panel.

8.23. HEATER HOSE ASSEMBLY – TO REAR HVAC UNIT

Remove

1. If vehicle is equipped with a heater line shut off valve, close the valve.
2. If vehicle is equipped with aerodynamic skirts, remove passenger side skirts and panels, as necessary, to gain access to the AC/heater line hangers located under the cab floor.
3. Under the cab, use clamping pliers to pinch both heater hoses closed (Figure 45). To prevent damage to the heater hose, place the clamps in the long rubber section of the lines several inches from the metal/rubber joint.
4. Place a suitable clean drain pan under the heater core connections.
5. Remove the rear AC/heater line hanger.
6. Disconnect the heater hose(s) being replaced from the heater core tube(s). Allow coolant from heater core to drain into container. Plug heater core tube(s).
7. Release the clamping pliers on the heater line being replaced. Allow coolant from heater line to drain into container.
8. Under the hood, disconnect the heater line being replaced from the ’T’ fitting where it connects to the front heater line (Figure 46). Plug all open lines.
9. Remove the front hose hanger and retain the heat shield for use during installation (Figure 46).

10. While placing as little strain on the A/C and heater lines as possible, loosen each of the remaining hose hangers enough to remove the heater line(s) from the hanger. Leave the hangers connected to provide support for the A/C lines (Figure 47).

11. Remove the disconnected line(s) towards the rear of the cab.

Install

1. With the ends sealed to prevent contamination, maneuver the new line into position from the rear (Figure 47).

2. Under the hood, connect the new heater line to the front heater line 'T' fitting (Figure 46).

3. Under the vehicle, position the heater lines in the 3 middle line hangers. Leave the hangers loose at this time.

4. Connect the heater core inlet/outlet hoses to the heater core tubes.

5. Remove all clamping pliers used to pinch the heater lines closed.

6. With the A/C and heater lines positioned correctly, loosely install the rear AC/heater line hanger.

7. Install the front hanger, including the heat shield removed earlier. Verify that heater and A/C lines are positioned correctly in hangers, without binding; then tighten hanger bolt (Figure 46).

8. Verify that heater and A/C lines are positioned correctly while tightening all remaining hanger bolts.

9. Add coolant drained during removal, to the coolant system.

10. Open heater line shut off valve, if it was closed earlier.

11. If vehicle is equipped with aerodynamic skirts, install passenger side skirts and panels.

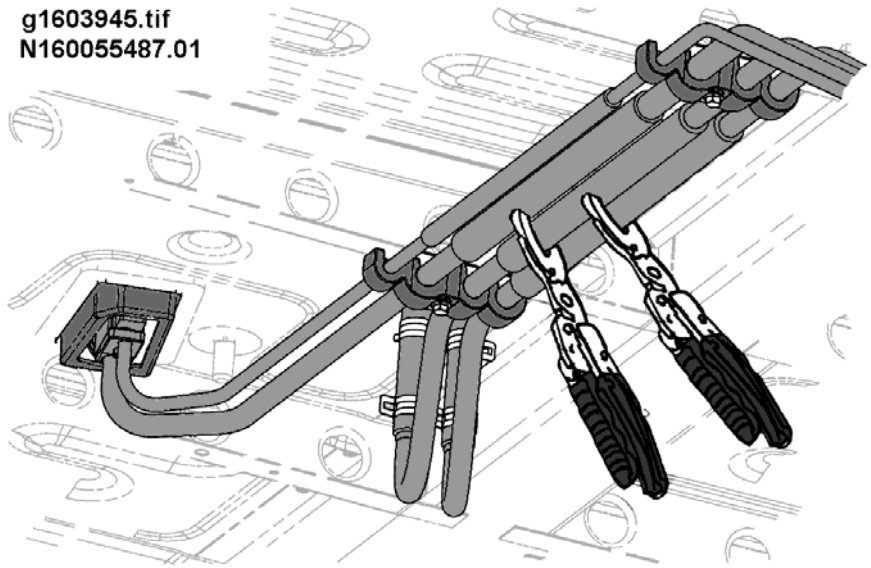


Figure 45 Heater/AC Lines Clamped Under Cab

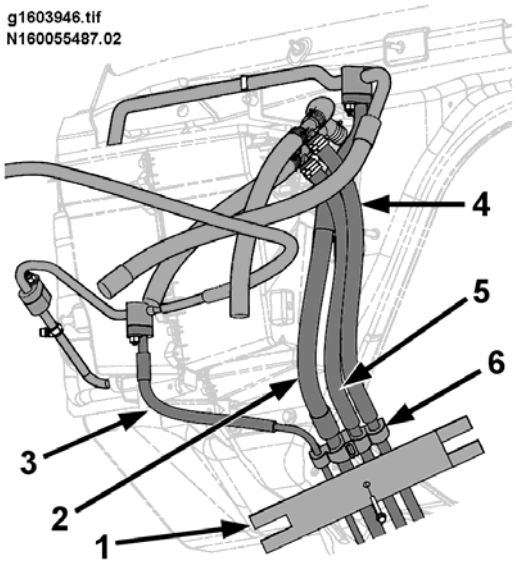


Figure 46 Heater/AC Hose Connections Under Hood

1. HEAT SHIELD
2. A/C DISCHARGE LINE
3. A/C SUCTION LINE
4. HEATER SUPPLY LINE
5. HEATER RETURN LINE
6. FRONT HOSE HANGER

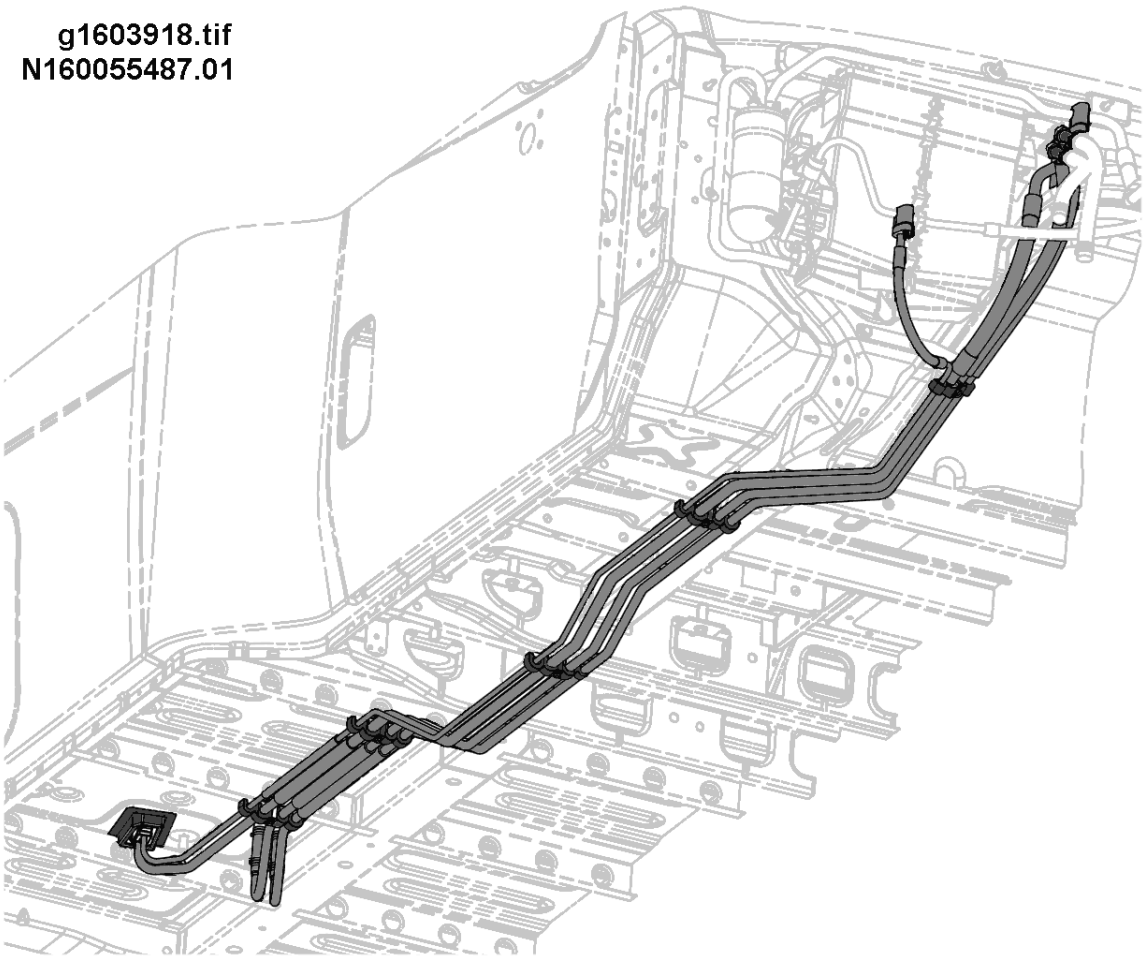


Figure 47 Heater/AC Lines Routing Under Cab

8.24. A/C HOSE ASSEMBLY – TO REAR HVAC UNIT

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

2. Under the hood, disconnect the A/C line to the rear HVAC unit where it connects to the front A/C line. Plug all open lines (Figure 46).

3. If vehicle is equipped with aerodynamic skirts, remove passenger side skirts and panels, as necessary, to gain access to the AC/heater line hangers located under the cab floor.

4. From under the vehicle, remove the rear AC/heater line hanger (Figure 48).

NOTE – In the following step the threaded stud may unscrew from the TXV body. If so, examine the condition of the stud and the retaining nut. If possible, clean the existing stud and install it into the TXV body. Otherwise, install a new threaded stud. Retain the mounting nut, or replace if necessary.

5. Disconnect the A/C lines from the Thermostatic Expansion Valve (TXV). Retain the lock plate and lock plate retaining nut. Plug all open tubes/ports (Figure 48).

6. Remove the front hose hanger and retain the heat shield for use during installation (Figure 46).

7. While placing as little strain on the A/C and heater lines as possible, loosen each of the remaining hose hangers enough to remove the A/C line from the hanger (Figure 47). Leave the hangers connected to provide support for the heater lines.

8. Remove the disconnected line(s) towards the rear of the cab.

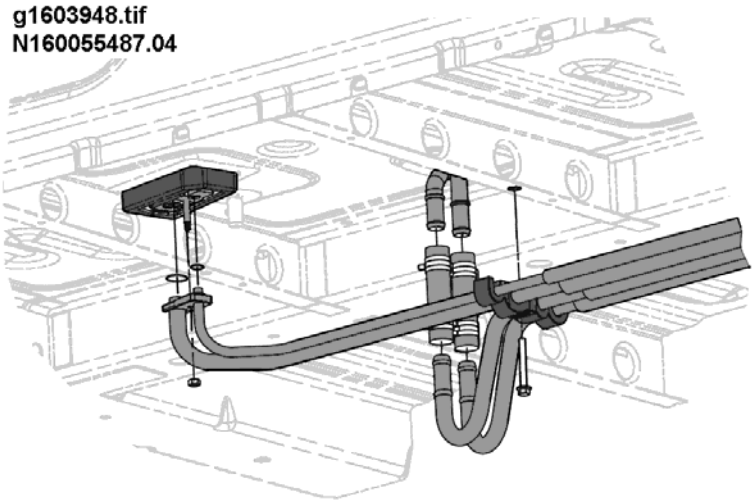


Figure 48 Rear A/C and Heater Line Connections

Install

1. With the ends sealed to prevent contamination, maneuver the new line into position from the rear.

2. Under the hood; using a new C-plate and lubricated O-ring, connect the new A/C line to the front A/C line 'splice' fitting. Tighten to 19,000 to 21,000 N.mm (170 to 190 lbf-in).

3. Under the vehicle, position the A/C lines in the 3 middle line hangers. Leave the hangers loose at this time.

NOTE – In the following step, keeping the A/C lines free of the hanger allows better alignment with the TXV during installation.

4. Before securing the A/C lines with the rear hanger, connect them to the TXV using new O-rings, the lower lock plate, and the lock plate retaining nut. Tighten to 9,000 to 10,000 N.mm (80 to 90 lbf-in). Refer to Figure 48 and Figure 49.

5. Loosely install the rear hanger.

6. Install the front hanger, including the heat shield removed earlier. Verify that heater and A/C lines are positioned correctly in hangers, without binding; then tighten hanger bolt (Figure 46).

7. Verify that heater and A/C lines are positioned correctly while tightening all remaining hanger bolts (Figure 47).

8. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

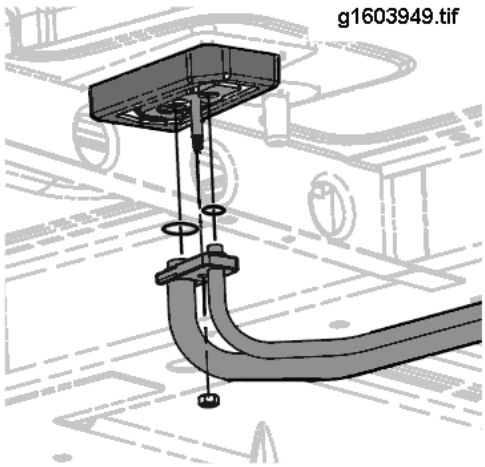


Figure 49 Connecting A/C Lines to Rear Thermal Expansion Valve

8.25. THERMOSTATIC EXPANSION VALVE – REAR HVAC UNIT

Remove

1. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

NOTE – It may be easier to disconnect the hoses in the following step if the rear AC/heater line hanger is loosened or removed.

NOTE – In the following step the threaded stud may unscrew from the TXV body. If so, examine the condition of the stud and the retaining nut. If possible, clean the existing stud and install it into the TXV body. Otherwise, install a new threaded stud. Retain the mounting nut, or replace if necessary.

2. From under the vehicle, disconnect the A/C lines from the Thermostatic Expansion Valve (TXV). Retain the lock plate and lock plate retaining nut. Plug all open A/C lines. Refer to Figure 48 and Figure 49.

3. Remove 2 Torx head screws (2, Figure 50) securing TXV to upper lock plate. Remove TXV. Plug all open A/C lines and tape over TXV ports to protect from contamination.

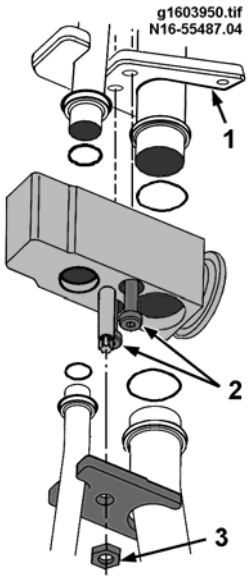


Figure 50 Installation of Rear Thermal Expansion Valve

1. UPPER LOCKING PLATE (LOCATED INSIDE REAR HVAC UNIT)
2. TORX HEAD SCREWS
3. LOCK PLATE RETAINING NUT

Install

1. From under the vehicle, install new lubricated O-rings onto the evaporator tubes; then install the Thermostatic Expansion Valve (TXV) onto the evaporator tubes. Secure the TXV to the upper locking plate with the 2 Torx head screws removed earlier. Tighten to 4,000 to 4300 N.mm (35.4 to 38.0 lbf-in) Refer to Figure 50.

2. Using new O-rings, connect the A/C lines to the TXV. Secure with the lower locking plate and the lock plate retaining nut. Tighten to 9,000 to 10,000 N.mm (80 to 90 lbf-in).

3. With the A/C and heater lines positioned correctly, install and tighten the rear AC/heater line hanger (Figure 48).

4. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

8.26. BLOWER/FAN ASSEMBLY – REAR HVAC UNIT

NOTE – Refer to Figure 51 while performing the following Remove and Install procedures.

Remove

1. Set ignition key to OFF

2. Through the passenger side access door, disconnect blower electrical connector from linear power module (6, Figure 51).

3. Remove 4 Torx head screws securing blower to rear HVAC unit.

4. Remove blower (5).

Install

1. Position the blower assembly onto the rear HVAC unit and secure with the 4 Torx head screws removed earlier.

2. Plug the blower electrical connector into the linear power module.

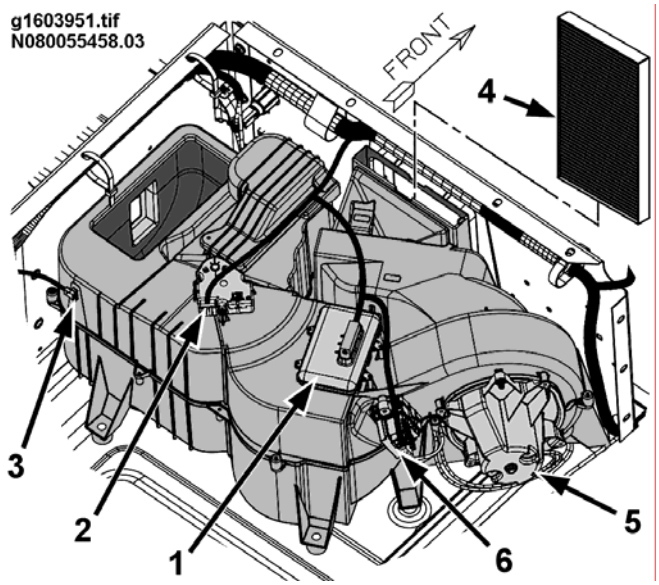


Figure 51 Rear HVAC Unit Component Locations

1. REAR HVAC CONTROLLER
2. TEMPERATURE BLEND DOOR ACTUATOR
3. OUTLET DUCT TEMPERATURE SENSOR
4. FILTER ELEMENT
5. BLOWER/FAN ASSEMBLY
6. LINEAR POWER MODULE

8.27. FILTER ELEMENT – REAR HVAC UNIT

NOTE – Refer to Figure 51 while performing the following Remove and Install procedures.

Remove

1. Raise and support bunk.

2. Remove filter element (4, Figure 51) from the cavity in the rear HVAC unit.

Install

1. With the pleats running horizontally, insert the filter element into the cavity in the rear HVAC unit.

2. Insure that the element is fully seated.

3. Carefully lower the bunk.

8.28. OUTLET DUCT TEMPERATURE SENSOR – REAR HVAC UNIT

NOTE – Refer to Figure 51 and Figure 52 while performing the following Remove and Install procedures.

Remove

1. Raise and support bunk.
2. Disconnect the electrical connector to the outlet duct temperature sensor (5, Figure 52).
3. Grasp the sensor body and pull it straight out of the rear HVAC unit housing.

Install

1. Push the sensor into the rear HVAC unit housing until it is retained by friction .
2. Connect the electrical connector to the outlet duct temperature sensor.

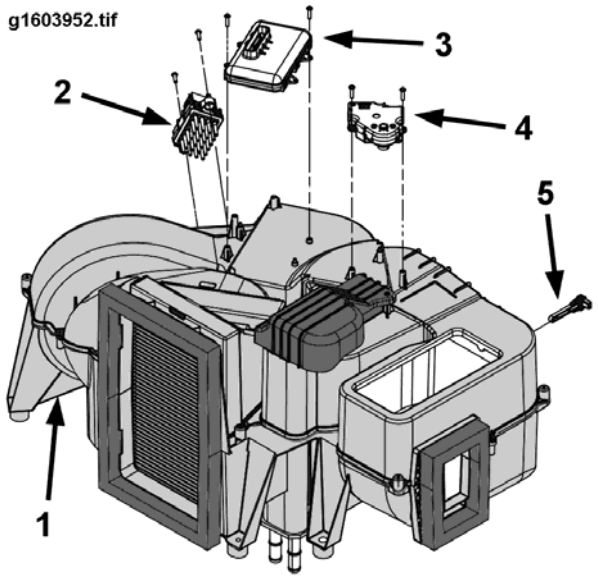


Figure 52 Rear HVAC Unit Component Mounting

1. REAR HVAC UNIT
2. REAR LINEAR POWER MODULE
3. REAR HVAC CONTROLLER
4. TEMPERATURE BLEND DOOR ACTUATOR
5. OUTLET DUCT TEMPERATURE SENSOR

8.29. LINEAR POWER MODULE – REAR HVAC UNIT

NOTE – Refer to Figure 51 and Figure 52 while performing the following Remove and Install procedures.

Remove

1. Set ignition key to OFF.
2. Through the passenger side access door, disconnect the 2 electrical connectors from Linear Power Module (LPM).

3. Remove 2 Torx head screws securing LPM (2, Figure 52) to rear HVAC unit.
4. Remove LPM.

Install

1. Position the LPM assembly onto the rear HVAC unit and secure with the 2 Torx head screws removed earlier.
2. Connect the 2 electrical connectors to the LPM.

8.30. BLEND DOOR ACTUATOR – REAR HVAC UNIT

NOTE – Refer to Figure 51 and Figure 52 while performing the following Remove and Install procedures.

Remove

1. Set ignition key to OFF.
2. Inside the sleeper, raise and support the lower bunk.
3. Disconnect the electrical connector on the blend door actuator (2, Figure 51) on the top of the rear HVAC unit.
4. Remove the 3 screws securing the blend door actuator to the rear HVAC unit. Remove the actuator (4, Figure 52).

Install

1. Position the blend door so that it will align with the drive collar on the blend door actuator as it is installed.
2. Install the blend door actuator and secure it with the 3 screws removed earlier.
3. Connect the electrical connector to the blend door actuator.
4. Calibrate the blend door actuator by unplugging the electrical connector at the rear HVAC controller for at least 10 seconds, then reconnect. Calibration will occur the next time the IGN key is set to IGN or ACCESSORY.

8.31. SLEEPER HVAC CONTROLLER – REAR HVAC UNIT

NOTE – Refer to Figure 51 and Figure 52 while performing the following Remove and Install procedures.

Remove

1. Set ignition key to OFF.
2. Raise and support bunk.
3. Disconnect the electrical connector from the rear HVAC controller (1, Figure 51).
4. Remove 2 screws securing controller to rear HVAC unit.
5. Remove controller (3, Figure 52).

Install

1. Position the rear HVAC controller onto the rear HVAC unit and secure with the 2 screws removed earlier.

2. Connect the electrical connector to the controller.

3. Calibration of the blend door actuator will occur the next time the IGN key is set to IGN or ACCESSORY.

8.32. HEATER CORE – REAR HVAC UNIT

Remove

1. Under the vehicle, use clamping pliers to pinch the rubber section of the rear heater lines closed. Place the clamps several inches from the metal/rubber joint. Refer to Figure 53.

2. Place a suitable drain pan under the heater core connections.

NOTE – It may be easier to disconnect the hoses in the following step if the rear AC/heater line hanger is loosened or removed.

3. Disconnect the rubber hoses from the heater core tubes (Figure 54). Allow coolant from heater core to drain into container.

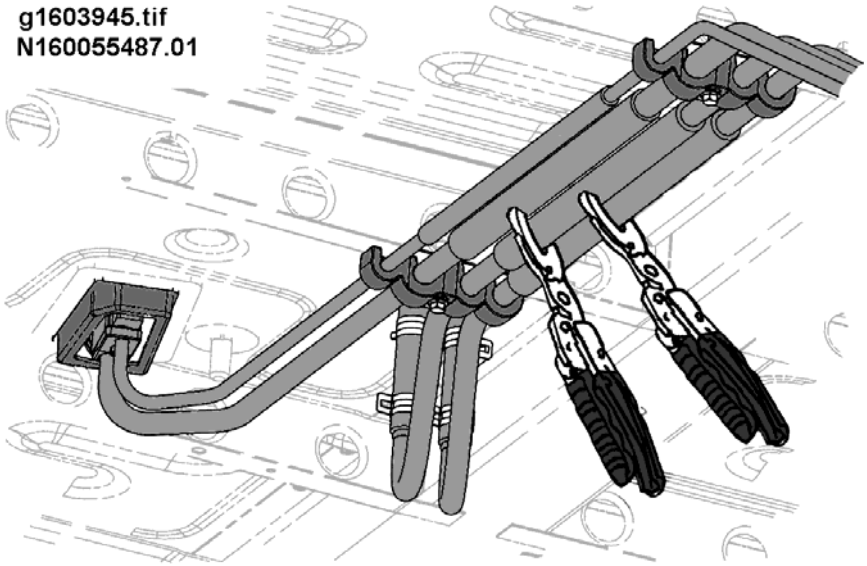


Figure 53 Heater/AC Lines Clamped Under Cab

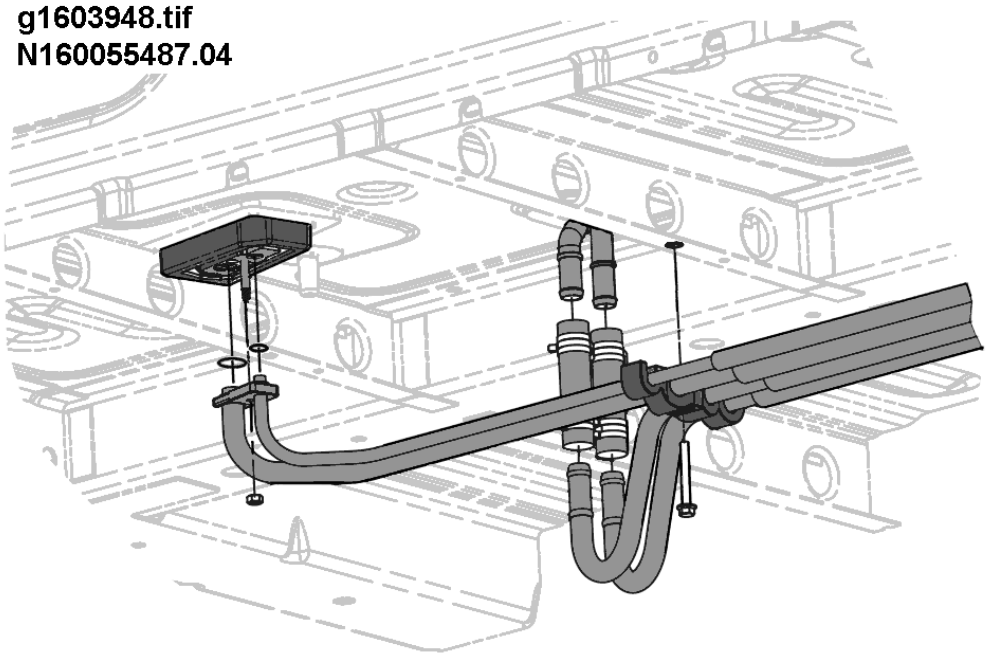


Figure 54 Rear A/C and Heater Line Connections

4. Inside the cab, raise and support the lower bunk.

5. Remove the 2 screws securing the heater core cover (1, Figure 55). Remove the cover.

NOTE – In the following step it may be easier to remove the clamp plate by raising the heater core slightly out of its cavity.

6. Remove the clamp plate (3, Figure 55) securing the heater core inlet and outlet tubes. Disconnect the tubes from the core, and rotate them out of the way.

7. Remove the heater core (2, Figure 55).

8. If necessary, remove the heater core inlet and outlet tubes (4, Figure 55).

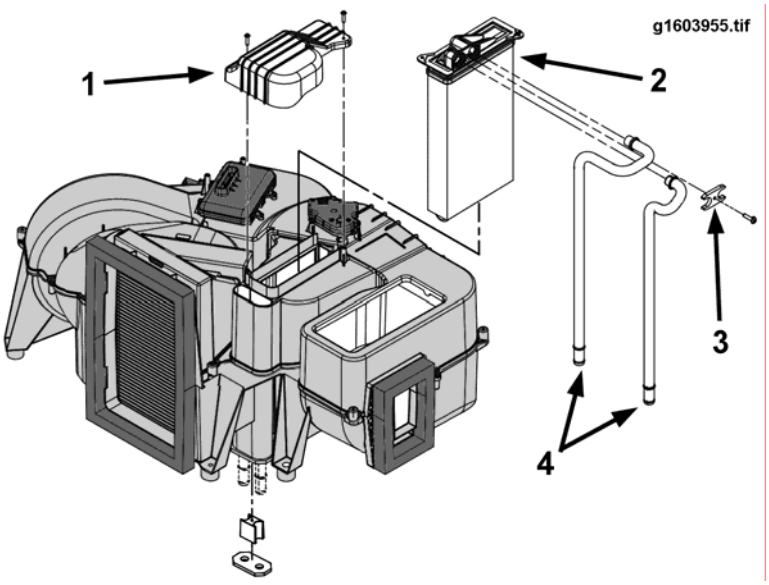


Figure 55 Rear Heater Core Installation

1. HEATER CORE COVER
2. REAR HEATER CORE
3. CLAMP PLATE FOR INLET/OUTLET TUBES
4. HEATER CORE INLET/OUTLET TUBES

Install

1. If the heater core inlet and outlet tubes were removed; note the position of the foam spacer and seal (below the housing), then carefully install the heater core inlet and outlet tubes (4, Figure 55) and rotate them out of the way.

2. Install the heater core (2, Figure 55).

   NOTE – In the following step it may be easier to insert the inlet/outlet tubes by raising the heater core slightly out of its cavity.

3. Using new O-rings, insert the heater core inlet and outlet tubes into the core and secure with the clamp plate.

4. Install heater core cover (1, Figure 55) and secure with 2 screws.

5. Under the cab, connect the heater core inlet/outlet hoses to the heater core tubes. Install or tighten the rear AC/heater line hanger (Figure 54) if removed earlier.

6. Remove the clamping pliers used to pinch the heater lines closed.

7. Add coolant drained during removal, to the coolant system.

8.33. TEMPERATURE BLEND AIR DOOR – REAR HVAC UNIT

Remove

1. Set ignition key to OFF.

2. Under the vehicle, use clamping pliers to pinch the rubber section of the rear heater lines closed. Place the clamps several inches from the metal/rubber joint. Refer to Figure 53.

NOTE – It may be easier to disconnect the hoses in the following step if the rear AC/heater line hanger is loosened or removed.

3. With a clean drain pan positioned under the heater core connections, disconnect the hoses from the heater core tubes (Figure 54). Plug all open tubes/hoses.

4. Through the passenger side access door, disconnect blower electrical connector from linear power module (6, Figure 51).

5. Remove 4 Torx head screws securing blower to rear HVAC unit, and remove blower (5, Figure 51).

6. Inside the sleeper, raise and support the lower bunk.

7. Remove the rear heater core and heater core inlet/outlet tubes (Figure 55), as follows:
   a. Remove the 2 screws securing the heater core cover. Remove the cover.

      NOTE – In the following step it may be easier to remove the clamp plate after lifting the heater core slightly out of its cavity.

   b. Remove the clamp plate securing the heater core inlet and outlet tubes to the core. Disconnect the tubes from the core, and rotate them out of the way. Retain the clamp plate and mounting screw.
   c. Remove the heater core.
   d. Remove the heater core inlet and outlet tubes.

8. Disconnect all remaining electrical connections to the rear HVAC unit.
   a. Rear HVAC controller – 1 connector
   b. blend door actuator – 1 connector
   c. outlet duct temperature sensor – 1 connector
   d. rear linear power module – 1 connector (harness), blower connector was removed with blower.

9. Remove the rear HVAC unit outlet duct (1 screw). Refer to Figure 56. NOTE: It may be helpful to loosen or remove some connected duct work.

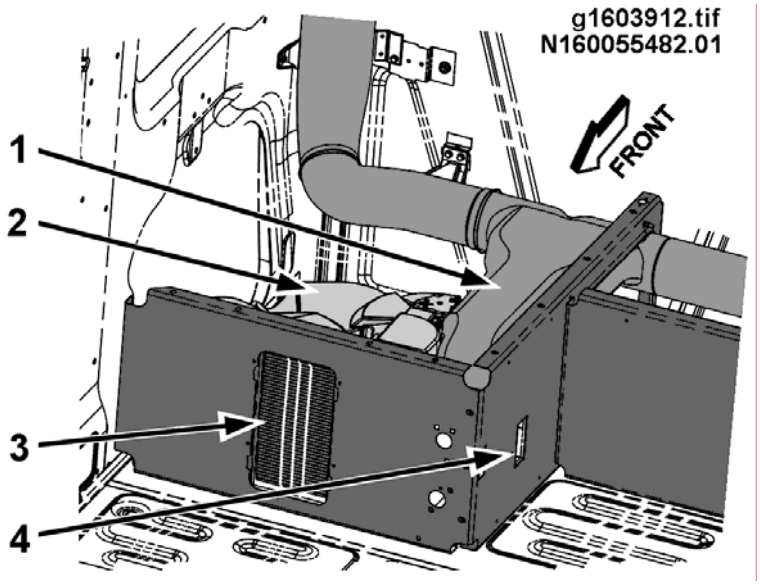


Figure 56 Location of Rear HVAC Unit

1. OUTLET DUCT, REAR HVAC UNIT
2. REAR HVAC UNIT
3. AIR INLET
4. AIR OUTLET VENT

10. Remove the filter element (3, Figure 56) from the air intake of the rear HVAC unit.

11. Remove 15 screws securing the top housing of the HVAC unit to the bottom housing. It is not necessary to remove the LPM, HVAC controller, and blend door actuator from the top housing.

NOTE – Before the top housing can be removed from the bottom housing, the foam seals at the air inlet and outlet (under bunk) must be cut near the joint between the housing halves.

NOTE – In the following step, to provide additional clearance when removing the top housing, raise the top housing enough to reach inside and disengage the blend door from the top and bottom housings. Lay the door in the bottom housing until the top housing is removed.

12. Lift the top housing off of the rear HVAC unit.

13. Remove the blend door (6, Figure 57).

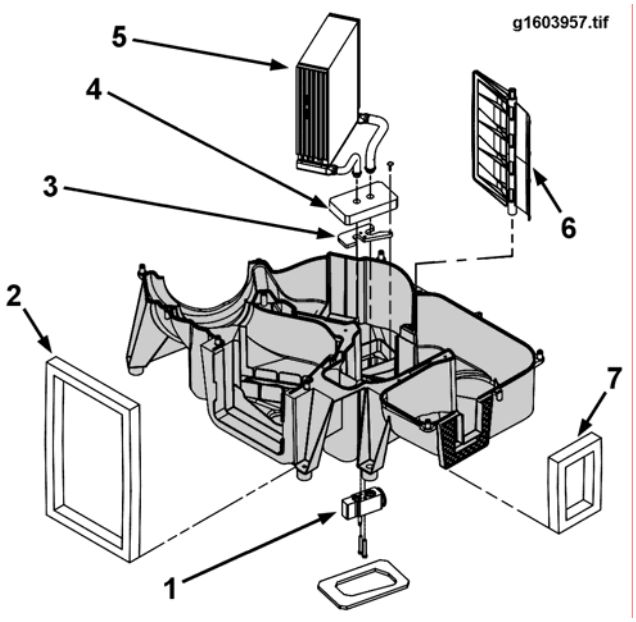


Figure 57 Internal Components of the Rear HVAC Unit

1. THERMOSTATIC EXPANSION VALVE (TXV)
2. FOAM SEAL, AIR INLET
3. UPPER LOCK PLATE FOR TXV
4. FOAM SEAL, EVAPORATOR TUBES
5. EVAPORATOR CORE
6. TEMPERATURE BLEND AIR DOOR
7. FOAM SEAL, AIR OUTLET

Install

NOTE – Before installing the top housing check the condition of the foam seals at the air inlet and outlet (under bunk). If a seal requires replacement, the bottom housing must be removed from the vehicle. The rear HVAC unit can then be reassembled on the bench (with new seals) before installation.

1. From inside the sleeper, temporarily install the blend door into the bottom housing to determine how the door is to be oriented (Figure 57).

NOTE – In the following step, it may be helpful to lay the blend door loosely in the bottom housing until the top housing is nearly in position. Then lift the top housing enough to install the blend door into its socket in the bottom housing.

2. Install the top housing onto the bottom housing so that the shaft of the blend door is inserted into the hub of the actuator mounted on the top housing. The blend door must be captured between the top and bottom housings.

3. Install 15 screws securing the top housing of the HVAC unit to the bottom housing.

4. Install the rear HVAC unit outlet air duct (1 screw). Verify that all related duct work is positioned and secured correctly (Figure 56).

5. Install the rear heater core and heater core inlet/outlet tubes (Figure 55), as follows.

a. Noting the position of the foam spacer and seal (below the housing), carefully install the heater core inlet and outlet tubes and rotate them out of the way.

b. Install the heater core.

NOTE – In the following step it may be easier to insert the inlet/outlet tubes by raising the heater core slightly out of its cavity.

c. Using new O-rings, insert the heater core inlet and outlet tubes into the core. Secure with the clamp plate and screw removed earlier.

d. Install heater core cover and secure with 2 screws.

6. Through the passenger side access door, position the blower assembly (5, Figure 51) onto the rear HVAC unit and secure with the 4 Torx head screws removed earlier.

7. Plug the blower electrical connector into the linear power module (6, Figure 51).

8. Connect all electrical connections to the rear HVAC unit.

a. blend door actuator – 1 connector

b. outlet duct temperature sensor – 1 connector

c. linear power module – 1 connector (harness), blower connector was installed with blower.

d. Rear HVAC controller – 1 connector

9. Under the vehicle, connect the heater core inlet/outlet hoses to the heater core tubes. Install or tighten the rear AC/heater line hanger, if removed earlier (Figure 54).

10. Remove the clamping pliers used to pinch the heater lines closed.

11. Add coolant drained during removal, to the coolant system.

12. Calibration of the blend door actuator will occur the next time the IGN key is set to IGN or ACCESSORY.

8.34. EVAPORATOR CORE – REAR HVAC UNIT

Remove

1. Set ignition key to OFF.

2. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

3. If vehicle is equipped with aerodynamic side skirts, remove the rear passenger side skirt.

NOTE – It may be easier to disconnect the hoses in the following step if the rear AC/heater line hanger is loosened or removed.

NOTE – In the following step the threaded stud may unscrew from the TXV body. If so, examine the condition of the stud and the retaining nut. If possible, clean the existing stud and install it into the TXV body. Otherwise, install a new threaded stud. Retain the mounting nut, or replace if necessary.

4. From under the vehicle, disconnect the A/C lines from the Thermostatic Expansion Valve (TXV). Refer to Figure 58. Retain the lock plate and lock plate retaining nut. Plug all open tubes/ports.

5. Remove 2 Torx head screws securing TXV to upper lock plate (2, Figure 59). Remove TXV and tape over ports to protect from contamination.

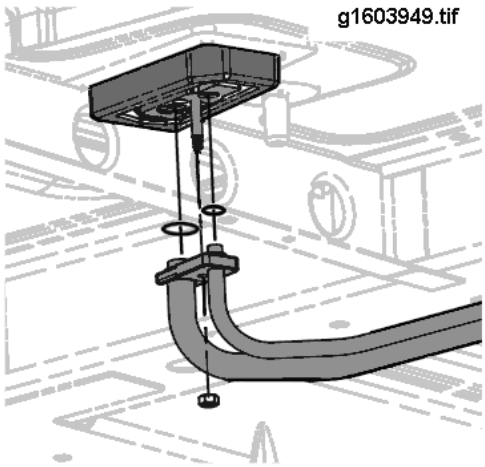


Figure 58 Connecting A/C Lines to Thermal Expansion Valve

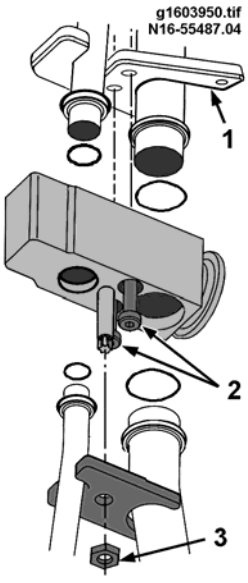


Figure 59 Installation of Rear Thermal Expansion Valve

1. UPPER LOCKING PLATE (LOCATED INSIDE REAR HVAC UNIT)
2. TORX HEAD SCREWS
3. LOCK PLATE RETAINING NUT

6. Using clamping pliers, pinch the rubber section of the rear heater lines closed. Place the clamps several inches from the metal/rubber joint (Figure 53).

7. With a clean drain pan positioned under the heater core connections, disconnect the hoses from the heater core tubes. Plug all open tubes/hoses.

8. Through the passenger side access door, disconnect blower electrical connector from linear power module (6, Figure 51).

9. Remove 4 Torx head screws securing blower to rear HVAC unit, and remove blower (5, Figure 51)..

10. Inside the sleeper, raise and support the lower bunk.

11. Remove the rear heater core and heater core inlet/outlet tubes (Figure 55), as follows:
    a. Remove the 2 screws securing the heater core cover. Remove the cover.

    NOTE – In the following step it may be easier to remove the clamp plate after lifting the heater core slightly out of its cavity.

    b. Remove the clamp plate securing the heater core inlet and outlet tubes to the core. Disconnect the tubes from the core, and rotate them out of the way. Retain the clamp plate and mounting screw.
    c. Remove the heater core.
    d. Remove the heater core inlet and outlet tubes.

12. Disconnect all remaining electrical connections to the rear HVAC unit.
    a. Rear HVAC controller – 1 connector
    b. blend door actuator – 1 connector
    c. outlet duct temperature sensor – 1 connector
    d. rear linear power module – 1 connector (harness), blower connector was removed with blower.

13. Remove the rear HVAC unit outlet duct (1 screw). Refer to Figure 56. NOTE: It may be helpful to loosen or remove some connected duct work.

14. Remove the filter element (4, Figure 51) from the air intake of the rear HVAC unit.

15. Remove 15 screws securing the top housing of the HVAC unit to the bottom housing. It is not necessary to remove the LPM, HVAC controller, and blend door actuator from the top housing.

NOTE – Before the top housing can be removed from the bottom housing, the foam seals at the air inlet and outlet (under bunk) must be cut near the joint between the housing halves.

NOTE – In the following step, to provide additional clearance when removing the top housing, raise the top housing enough to reach inside and disengage the blend door from the top and bottom housings. Lay the door in the bottom housing until the top housing is removed.

16. Lift the top housing off of the rear HVAC unit.

17. Note the location of all seals associated with the evaporator core and expansion valve. They must be replaced correctly during installation.

18. Remove 1 screw securing the expansion valve upper lock plate to the bottom housing (Figure 57).

19. Lift the evaporator core from the bottom housing. Retain the upper lock plate and all foam seals for use during installation.

Install

NOTE – Before installing the top housing check the condition of the foam seals at the air inlet and outlet (under bunk). If a seal requires replacement, the bottom housing must be removed from the vehicle. The rear HVAC unit can then be reassembled on the bench (with new seals) before installation.

1. From inside the sleeper, install the evaporator core into the bottom housing (Figure 57).

2. Insure that all seals associated with the evaporator core and expansion valve are in place. Secure the expansion valve upper lock plate to the bottom housing with the 1 screw removed earlier.

NOTE – In the following step, it may be helpful to lay the blend door loosely in the bottom housing until the top housing is nearly in position. Then lift the top housing enough to install the blend door into its socket in the bottom housing.

3. Install the top housing onto the bottom housing so that the shaft of the blend door is inserted into the hub of the actuator mounted on the top housing.

4. Install 15 screws securing the top housing of the HVAC unit to the bottom housing.

5. Install the rear HVAC unit outlet air duct (1 screw). Verify that all related duct work is positioned and secured correctly (Figure 56).

6. Install the rear heater core and heater core inlet/outlet tubes (Figure 55), as follows.
   a. Noting the position of the foam spacer and seal (below the housing), carefully install the heater core inlet and outlet tubes and rotate them out of the way.
   b. Install the heater core.

      NOTE – In the following step it may be easier to insert the inlet/outlet tubes by raising the heater core slightly out of its cavity.

   c. Using new O-rings, insert the heater core inlet and outlet tubes into the core. Secure with the clamp plate and screw removed earlier.
   d. Install heater core cover and secure with 2 screws.

7. Through the passenger side access door, position the blower assembly onto the rear HVAC unit and secure with the 4 Torx head screws removed earlier (Figure 51).

8. Plug the blower electrical connector into the linear power module.

9. Connect all electrical connections to the rear HVAC unit.
   a. blend door actuator – 1 connector
   b. outlet duct temperature sensor – 1 connector
   c. linear power module – 1 connector (harness), blower connector will be installed with blower.
   d. Rear HVAC controller – 1 connector

10. From under the vehicle, install new lubricated O-rings onto the evaporator tubes; then install the Thermostatic Expansion Valve (TXV) onto the evaporator tubes (Figure 59). Secure the TXV to the upper locking plate with the 2 Torx head screws removed earlier. Tighten to 4,000 to 4300 N.mm (35.4 to 38.0 lbf-in).

11. Using new O-rings, connect the A/C lines to the TXV. Secure with the lower locking plate and the lock plate retaining nut (Figure 58). Tighten to 9,000 to 10,000 N.mm (80 to 90 lbf-in).

12. Connect the heater core inlet/outlet hoses to the heater core tubes (Figure 54). Install or tighten the rear AC/heater line hanger, if removed earlier.

13. Remove the clamping pliers used to pinch the heater lines closed.

14. Add coolant drained during removal, to the coolant system.

15. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

16. If the vehicle is equipped with aerodynamic skirts, install the rear passenger side skirt.

17. Calibration of the blend door actuator will occur the next time the IGN key is set to IGN or ACCESSORY.

8.35. REAR HVAC UNIT, COMPLETE

In order to repair internal components, the rear HVAC unit may be disassembled in the cab or removed as a unit and disassembled on the bench. The method used depends on the repair being performed.

Removing and installing the rear HVAC unit as an assembly requires discharging the A/C system and disconnecting the rear heater core lines. All internal components of the rear HVAC unit can be replaced by removing the top of the housing while the unit is mounted in the vehicle. Removal of the entire rear HVAC unit is necessary only if the lower housing itself is damaged. In this situation, it may be beneficial to remove the entire rear HVAC unit from the vehicle so the repairs can be performed on the bench, before re-installing the unit into the vehicle. Whenever the rear HVAC unit is removed or installed, the heater core inlet/outlet tubes should be removed to prevent damage to the tubes.

Remove

1. Set ignition key to OFF.

2. Discharge A/C system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146).

3. If the vehicle is equipped with aerodynamic skirts, remove the rear passenger side skirt.

NOTE – It may be easier to disconnect the hoses in the following step if the rear AC/heater line hanger is loosened or removed.

NOTE – In the following step the threaded stud may unscrew from the TXV body. If so, examine the condition of the stud and the retaining nut. If possible, clean the existing stud and install it into the TXV body. Otherwise, install a new threaded stud. Retain the mounting nut, or replace if necessary.

4. From under the vehicle, disconnect the A/C lines from the Thermostatic Expansion Valve (TXV). Refer to Figure 58. Retain the lock plate and lock plate retaining nut. Plug all open tubes/ports.

5. Using clamping pliers, pinch the rubber section of the rear heater lines closed. Place the clamps several inches from the metal/rubber joint (Figure 53).

6. With a clean drain pan positioned under the heater core connections, disconnect the hoses from the heater core. Plug all open tubes/hoses.

7. Inside the sleeper, raise and support the lower bunk.

8. Remove the rear heater core and heater core inlet/outlet tubes (Figure 55), as follows.
   a. Remove the 2 screws securing the heater core cover. Remove the cover.

      NOTE – In the following step it may be easier to remove the clamp plate by raising the heater core slightly out of its cavity.

   b. Remove the clamp plate securing the heater core inlet and outlet tubes to the core. Disconnect the tubes from the core, and rotate them out of the way.
   c. Remove the heater core.
   d. Remove the heater core inlet and outlet tubes.

9. Disconnect all electrical connections to the rear HVAC unit.
   a. Rear HVAC controller – 1 connector
   b. blend door actuator – 1 connector
   c. outlet duct temperature sensor – 1 connector
   d. rear linear power module – 1 connector (harness). NOTE: Connector to blower can remain connected.

10. Remove the rear HVAC unit outlet duct (1 screw). NOTE: It may be helpful to loosen or remove some connected duct work.

11. Remove inlet grille from front of bunk to provide additional clearance.

12. Remove 5 bolts securing housing to floor (Figure 60).

13. Support bunk with a separate prop; then, disconnect the bottom of the bunk support strut and position it out of the way.

14. Carefully remove the rear HVAC unit through the passenger side access door.

15. Lower or secure the bunk to prevent accidental closure.

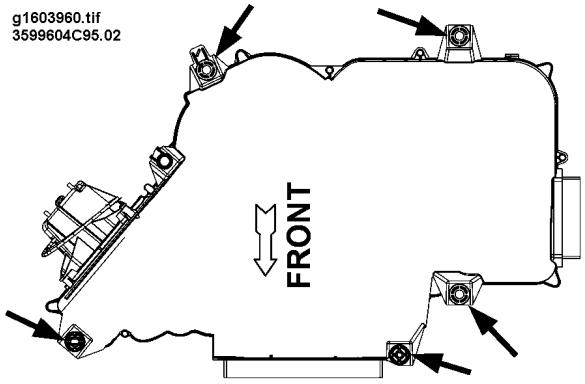


Figure 60 Rear HVAC Unit Mounting Bolt Locations

Install

NOTE – To prevent damaging the heater core inlet/outlet tubes, the heater core and tubes should not be installed into the rear HVAC unit until the unit is installed in the vehicle. If necessary remove the heater core and tubes from the rear HVAC unit prior to installing the unit into the vehicle.

1. Support bunk with a sturdy, secure prop. The bottom connection of the regular strut must be disconnected.
2. Verify that the rear HVAC unit is ready for installation, as follows.
   a. Expansion valve is installed and ready for lower locking plate.
   b. Foam seal surrounding TXV cavity is installed.
   c. Spacer and foam seal for heater core inlet/outlet tubes is installed.
   d. Foam seals at air intake and side outlet are installed and undamaged.
3. Carefully place the rear HVAC unit into the sleeper through the passenger side access door.
4. Without damaging the foam air seals, position the rear HVAC unit to align the holes for the mounting bolts (Figure 60).
5. Secure the unit to the floor with 5 bolts.
6. Install the rear HVAC unit outlet air duct (1 screw). Verify that all related duct work is positioned and secured correctly.
7. Install the inlet grille at the front of bunk.
8. Install the rear heater core and heater core inlet/outlet tubes (Figure 55), as follows.
   a. Noting the position of the foam spacer and seal (below the housing), carefully install the heater core inlet and outlet tubes and rotate them out of the way.
   b. Install the heater core.

      NOTE – In the following step it may be easier to insert the inlet/outlet tubes by raising the heater core slightly out of its cavity.

   c. Using new O-rings, insert the heater core inlet and outlet tubes into the core and secure with the clamp plate.
   d. Install heater core cover and secure with 2 screws.
9. Connect all electrical connections to the rear HVAC unit.
   a. blend door actuator – 1 connector
   b. outlet duct temperature sensor – 1 connector
   c. linear power module – 2 connectors (harness and blower, blower connector may not have been disconnected).
   d. Rear HVAC controller – 1 connector
10. Connect the bottom of the bunk support strut to its mounting plate.

11. From under the vehicle, using new lubricated O-rings, connect the A/C lines to the Thermostatic Expansion Valve (TXV). Secure the lines to the TXV using the lower locking plate and the lock plate retaining nut (Figure 58). Tighten to 9,000 to 10,000 N.mm (80 to 90 lbf-in).

12. Connect the heater core inlet/outlet hoses to the heater core tubes (Figure 54). Install or tighten the rear AC/heater line hanger, if removed earlier.

13. Remove the clamping pliers used to pinch the heater lines closed.

14. Add coolant drained during removal, to the coolant system.

15. Recharge A/C system. Refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

16. If the vehicle is equipped with aerodynamic skirts, install the rear passenger side skirt.

17. Calibration of the blend door actuator will occur the next time the IGN key is set to IGN or ACCESSORY.

9. SERVICE PROCEDURES FOR R-134A

9.1. SERVICE WARNINGS

WARNING – To avoid property damage, personal injury, or death, park the vehicle on a flat level surface, shift transmission to park or neutral, set parking brake, and block wheels before performing diagnostic or service procedures.

WARNING – Safety goggles or other adequate eye protection must be worn when working with refrigerant. The temperature of liquid refrigerant is -20 degrees F (-29 degrees C). Serious injury or blindness will result from refrigerant contacting the eyes.

WARNING – If the refrigerant should contact the eyes, DO NOT rub them. Splash the eyes with cold water to gradually get the temperature above the freezing point. See a doctor immediately.

WARNING – Wear nonporous gloves. (Nitril is the recommended material.) Should liquid refrigerant come into contact with the skin, remove any contaminated clothing, including shoes; then treat the injury as though the skin had been frostbitten or frozen. See a doctor immediately.

WARNING – Be certain that pressurized refrigerant containers are not exposed to open flame or temperatures above 125 degrees F (51 degrees C). Do not discard empty refrigerant containers where they are likely to be subjected to the heat of trash burners, etc.; they may explode, resulting in personal injury or possible death. Containers must be stored, installed, and disposed of in accordance with all state and local ordinances.

WARNING – Never weld, solder, steam clean or use excessive heat on any of the air conditioning lines or equipment while the system is charged. Heat applied to any part will cause the pressure within the system to become excessive, which may result in an explosion and possible personal injury.

WARNING – Do not smoke or allow any type of fire or flame in the immediate area while servicing the air conditioning system. Refrigerant is not combustible; however, in the presence of heat it changes to a poisonous gas. Inhalation can cause death or serious injury.

WARNING – R-134a must not be mixed with air and then pressurized. When mixed with large quantities of air and pressurized, R-134a becomes combustible.

WARNING – Refrigerant must be recovered from the air conditioning system before any components of the system are removed or replaced. Removing components while pressure is in the system will cause personal injury or death.

WARNING – Do not remove the compressor oil fill plug to check the oil level in the refrigerant compressor while the A/C system is charged with refrigerant. The crankcase side of the compressor is under pressure and personal injury may result. It is not possible to check the oil level in the compressor on an A/C system that is under system pressure.

WARNING – Do not install or remove A/C testing or charging equipment while the engine is running. Serious injury may result from doing so.

WARNING – Always use approved refrigerant recycling equipment when working with R-134a to prevent accidental discharge. If released into the atmosphere, the refrigerant evaporates very quickly and may displace the oxygen surrounding the work area, especially in small or enclosed areas. This situation creates the hazard of suffocation or brain damage for anyone in the work area. If a leak should occur, avoid breathing the refrigerant and lubricant vapor. Thoroughly ventilate the area before continuing with service. Federal and state laws require that refrigerant be recovered and recycled to help protect the environment.

WARNING – With the manifold gauge set connected to both the air conditioning system and the refrigerant supply cylinder, never open the high side hand valve of the manifold gauge set while the A/C system is operating. If hot, high pressure refrigerant is forced through the gauge to the refrigerant supply cylinder; it could cause the cylinder to rupture and cause personal injury.

WARNING – When purging the system or components, do not use nitrogen at pressures over 200 psi. Personal injury or death may result from doing so.

WARNING – Always use correct replacement refrigerant hoses. Do not use hoses other than those specified for the system being serviced. The use of improper hoses may cause a hose rupture, which may result in personal injury.

WARNING – During system diagnostic tests, DO NOT turn either hand valve on the manifold gauge set for any reason. Equipment can be damaged, and personal injury can result. When connected to the A/C system the gauges will indicate the system pressures with the valves closed (fully CW). These valves are used only while servicing the A/C refrigerant system.

CAUTION – To prevent damage to the test equipment, make sure test equipment is clear of all moving parts in the engine compartment.

CAUTION – When installing and removing any service hose or fitting, a small amount of refrigerant may escape. Always follow all safety precautions to avoid injury.

NOTE – Before connecting any service equipment to the refrigerant system, the refrigerant in the system must be identified. Failure to identify system refrigerant before connecting equipment could result in contamination of your service equipment and any refrigerant stored in the equipment.

NOTE – When servicing the A/C system, insure that the inner gaskets are present in both service port caps; and verify that the caps are installed when service is completed. The service port caps, with functioning gaskets, are an important part of maintaining a leak free A/C system.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

9.2. SERVICE PROCEDURES

The service procedures for both the day cab and sleeper versions of the ProStar HVAC system are described in this section. While the procedures for servicing the overall vehicle HVAC system (including sleeper A/C) are the same, the refrigerant charge required by each system is different. Refer to the SPECIFICATIONS table for the correct refrigerant charge values for each system.

In addition to the Service Warnings above, special attention to the following rules during servicing, and component remove and install, will aid in avoiding unnecessary and time-consuming problems.

1. Perform service inside a warm, well ventilated dry shop.

2. When working on the A/C system keep the work area and tools as clean as possible. Also, clean all connections, ports or fittings before disconnecting or removing components.

3. Never use hot steam to clean the inside of the system. Dry nitrogen cleaning is recommended for this purpose.

4. All A/C component and refrigerant line openings should be immediately plugged during removal and remain so until re-installation to prevent the entry of dirt, moisture and other foreign material. Even the slightest particle can cause problems if carried to a vulnerable place within the system.

5. Never remove protective caps from components until the moment of assembly into the system.

6. Never install non-sealed components.

7. Anytime an A/C fitting is disconnected, the O-ring and C-plate must be replaced (Figure 61). The new O-ring must be lubricated with **MINERAL-BASED** oil (International P/N ZGGR6912). The C-plate does not require lubrication. Never use grease, penetrating oil, motor oil, Ester or PAG oil, etc. to lubricate O-rings and fittings.

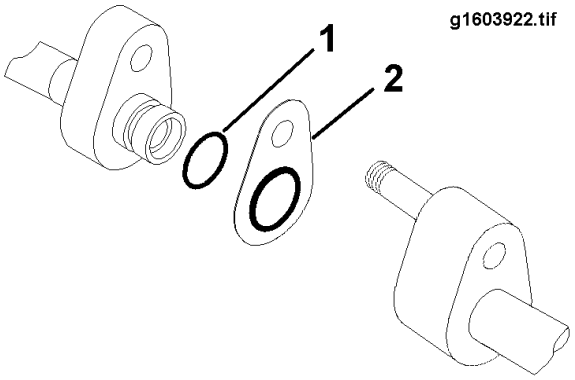


Figure 61 A/C Fitting C-Plate and O-Ring

1. O-RING
2. C-PLATE

8. All refrigerant hose and tubing support clamps and strap locks must be re-installed in their original positions.

   Never bend a hose to a radius less than ten times the diameter of the hose.

   Never route a hose any closer than four inches from the exhaust manifold or related piping.

   Periodically inspect hoses for leaks or brittleness. Replace lines immediately if damaged.

9. All fittings must be tightened as specified in the TORQUE CHART (See Table 22, page 168). Use only a torque wrench known to be accurate.

10. Whenever possible use a backup wrench when loosening or tightening fittings (Figure 62).

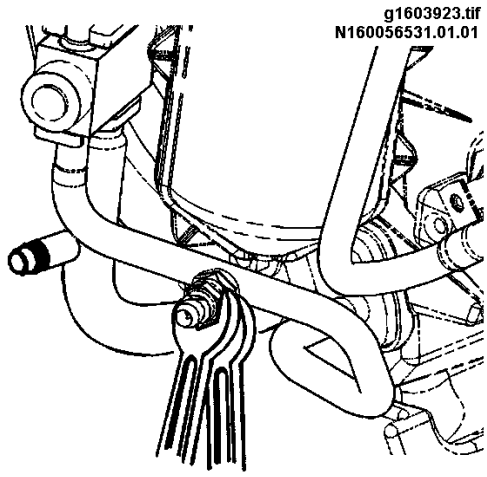


Figure 62 Use a Back-Up Wrench When Loosening or Tightening Fittings

11. Replace the filter-drier on any system which has been opened for more than a short period (approximately 30 minutes); after the system has been flushed or purged; and/or when the system has become contaminated (such as due to an internal compressor failure). If the filter-drier is one of multiple components being installed in the system, the filter-drier should be one of the last components installed. This reduces the amount of time that the filter-drier desiccant is exposed to atmospheric moisture.

12. Refrigerant oil quickly absorbs moisture. Store oil only in moisture-free containers and keep oil containers closed until ready to use. Close refrigerant oil container immediately after use.

13. The air conditioning system must be flushed or purged any time the system has become contaminated (such as due to an internal compressor failure). Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

14. Whenever the system is discharged, the refrigerant oil level must be checked and/or replaced as specified in OIL FILL GUIDELINES, (See OIL FILL GUIDELINES, page 158).

15. Any system that has been discharged due to leakage, or opened to replace a component, must be evacuated (and the system oil quantity must be returned to normal) before charging.

16. Use extreme care to prevent moisture from entering the system. Moisture can freeze at the thermostatic expansion valve and block refrigerant flow during system operation. Always properly evacuate the system after service to remove any moisture and air from the system.

17. Spare components should be sealed and stored in a warm, dry facility.

9.3. REFRIGERANT IDENTIFICATION

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Before any work is done on an HVAC system the refrigerant should be identified.

Refer to Figure 63.

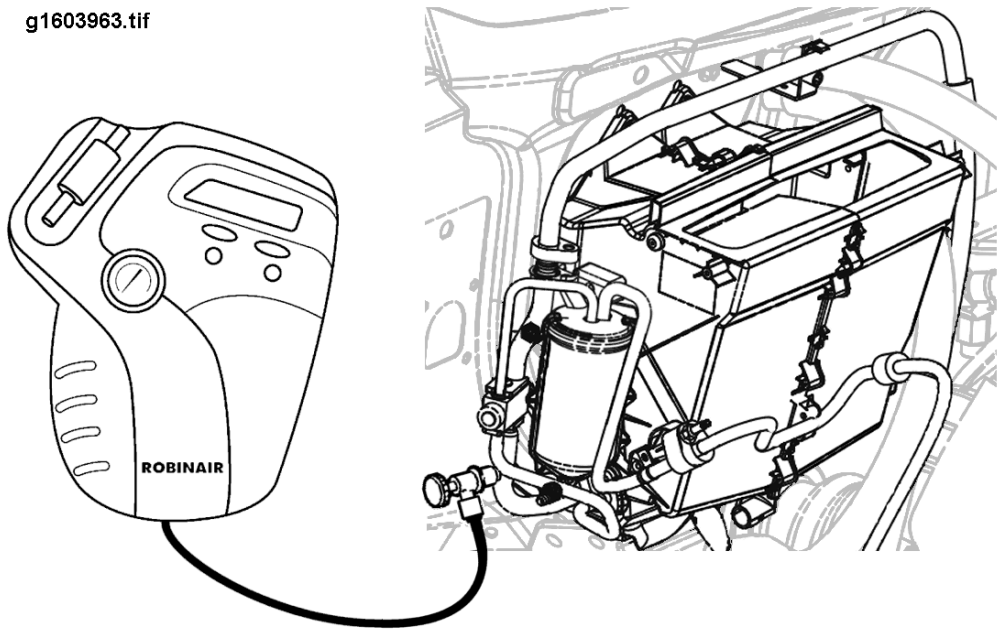


Figure 63 Refrigerant Identification Setup Diagram

1. Calibrate the Refrigerant Identifier per the manufacturer’s instructions.
2. Connect the sampling hose to the low pressure service port located on the evaporator outlet line.
3. Connect the other end of the sampling hose to the Refrigerant Identifier.
4. Open the service valve.
5. Start the sampling procedure (refer to the manufacturer’s instructions).
6. When the sampling is complete the Refrigerant Identifier will indicate a pass/fail condition, the type of refrigerant, and the percentage of concentration. International recognizes only R134a in a 98%, or greater, concentration. Anything else is considered contaminated.
7. Close the service valve and disconnect the sampling hose.
8. Verify that protective caps are installed on both vehicle service port fittings.

9.4. MANIFOLD GAUGE SET

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

NOTE – The fittings on the service hoses for R-134a air conditioning systems are standard Metric SAE quick-disconnect fittings that will work only on R-134a air conditioning systems service ports.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

This information covering the manifold gauge set hookup is provided in case service equipment with an internal gauge set is not available.

Install

Refer to Figure 64.

1. Remove the protection caps from both service ports.

2. On the Manifold Gauge Set, verify that all valves are closed.

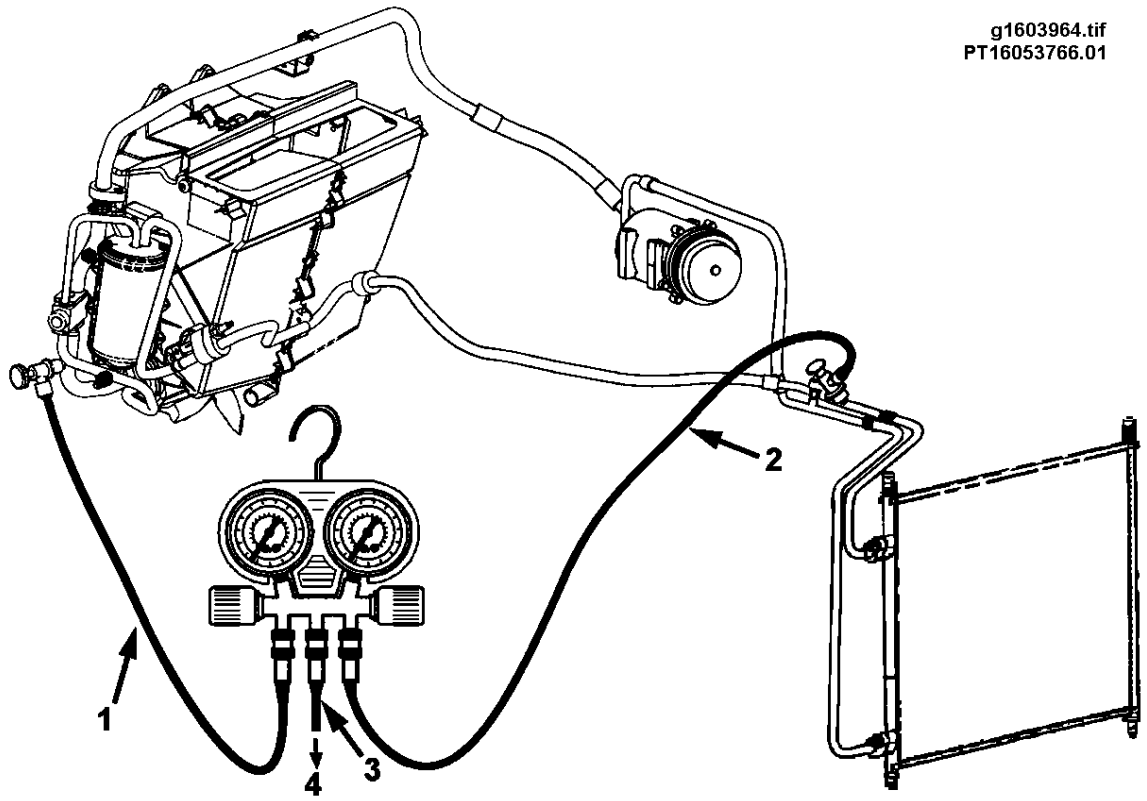


Figure 64 Typical Manifold Gauge Set Installation

1. LOW PRESSURE HOSE (BLUE)
2. HIGH PRESSURE HOSE (RED)
3. SERVICE HOSE (YELLOW)
4. CONNECT TO SERVICE EQUIPMENT

3. Connect the Manifold Gauge Set to the system as follows:
   a. Start with the **blue** manifold suction hose, and connect it to the low pressure service port located on the evaporator outlet line.
   b. Connect the **red** hose to the high pressure service port located on the compressor-to-condenser line.
   c. Connect the **yellow** hose on the center fitting of the Manifold Gauge Set following the instructions provided with the service equipment being used.

NOTE – DO NOT OPEN the valves on the manifold gauge set, or the valves on the quick-disconnect fittings, until instructed to do so in the procedures. The quick-disconnect fittings must be connected to the service ports on the vehicle; and the yellow service hose must be connected to the equipment required for each specific procedure being performed.

Once the quick-disconnect fittings are attached to the service ports, turning the knob **clockwise** (CW) pushes an internal pin down **to open** the service port valve. Turning the knob CCW raises the pin, closing the service port valve. Once closed the quick-disconnect fitting can be removed without venting refrigerant from the system.

Remove

1. Be sure the knobs on the quick-disconnect fittings, on the **red** and **blue** hoses, are set fully CCW.
2. Verify that the manifold gauge set valves, at the manifold, are set fully clockwise.
3. Remove the **blue** (low pressure) and **red** (high pressure) hoses from the vehicle service ports.
4. Verify that protective caps are installed on both vehicle service port fittings.
5. Disconnect the **yellow** hose from the service equipment currently connected to it. Follow the instructions provided with that service equipment.

9.5. DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY)

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

NOTE – If the system is being discharged because a leak is suspected, the leak must be located before discharging the system. Refer to LEAK DETECTION (See LEAK DETECTION, page 163).

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Refer to Figure 65.

1. Empty the 'recovered oil' catch bottle on the recovery station. This is necessary to determine the amount of oil recovered during the refrigerant recovery procedure.
2. Remove the protection caps from both service ports.
3. On the recovery station and hose fittings, verify that all valves are closed. The valves at the recovery station must be set to the CLOSED position. The valves at the quick-disconnect fittings must be set fully counter-clockwise (CCW).

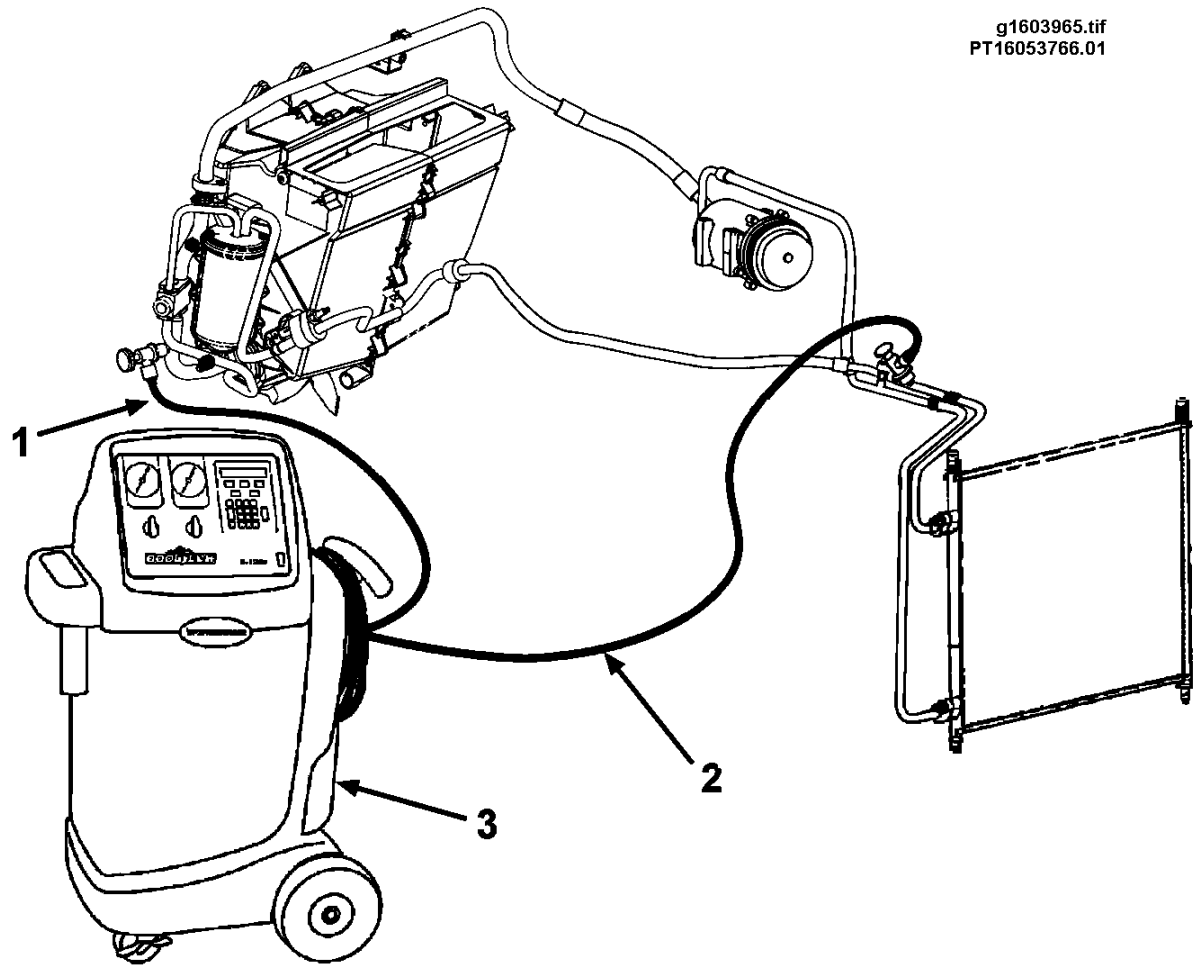


Figure 65 Typical Equipment Hookup for Servicing the System

1. LOW PRESSURE HOSE (BLUE)
2. HIGH PRESSURE HOSE (RED)
3. RECOVERY/RECYCLING/CHARGING STATION

4. Connect the recovery station to the system as follows:
   a. Start with the **blue** low pressure hose, and connect it to the low pressure service port located on the evaporator outlet line.
   b. Connect the **red** hose to the high pressure service port located on the compressor-to-condenser line.
5. Open (turn cw) the valves on the quick-disconnect fittings connected to the service ports on the vehicle.
6. Set both hand valves on the recovery station to the RECOVERY/VACUUM position.

NOTE – During the recovery process in the next step, refrigerant may become trapped in the filter-drier. Heating the filter-drier with a heat gun will force the refrigerant out of the filter-drier and assure that all of the refrigerant is recovered from the system.

WARNING – Never use an open flame torch to heat the filter-drier. Heating the filter-drier with an open flame could result in equipment damage and/or bodily injury.

7. Turn the recovery station main power switch on and press the RECOVER button. The recovery station will automatically shut off when the refrigerant in the system has been exhausted to the storage tank.

8. Close the valves on the quick-disconnect fittings by turning them fully CCW; and set both valves on the recovery station to the CLOSED position.

9. When recovering refrigerant by use of a recovery station, system oil is separated from the refrigerant during the recovery cycle. When the refrigerant recovery operation is complete, the recovery station will drain the oil into the station's calibrated catch bottle. The amount of oil recovered may be used to determine the amount of NEW oil that must be added back to the A/C system. Refer to OIL FILL GUIDELINES, (See OIL FILL GUIDELINES, page 158).

10. Disconnect the **blue** and **red** hoses from the service ports on the vehicle.

11. Work may now begin on the air conditioning system.

9.6. EVACUATING THE SYSTEM

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

CAUTION – The amount of oil lost during the recovery process, component replacement, or purging/flushing must be replaced with new oil. The method for determining how much refrigerant oil must be added to the A/C system is located in the OIL FILL GUIDELINES, (See OIL FILL GUIDELINES, page 158).

CAUTION – Use only the specified PAG lubricant in the refrigerant system. PAG oils absorb atmospheric moisture very quickly. Never leave PAG oil exposed to air for a prolonged time. Tightly reseal the oil container immediately after each use.

CAUTION – Do not re-use recovered oil. Be sure to dispose of recovered oil properly to avoid an environmental hazard.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Whenever the air conditioning system has been discharged, the system must be completely evacuated of air and moisture before being recharged. After evacuation the system vacuum should measure between 750 and 1000 microns.

1. Determine the amount of **NEW** refrigerant oil to be added to the system. Refer to OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 158). If oil is being added directly to the compressor, it must be added before starting the evacuation procedure. If oil is to be added during the evacuation/charging procedure, you must follow the instructions furnished with the recovery station, or refrigerant oil injector tool, to add the oil before the charging procedure.

2. On the recovery station and hose fittings, verify that all valves are closed. The valves at the recovery station must be set to the CLOSED position. The valves at the quick-disconnect fittings must be set fully counter-clockwise (CCW).

3. Connect the electronic vacuum gauge to the recovery station, at the vacuum manifold, using a valve and 'T' fittings (refer to Figure 66).

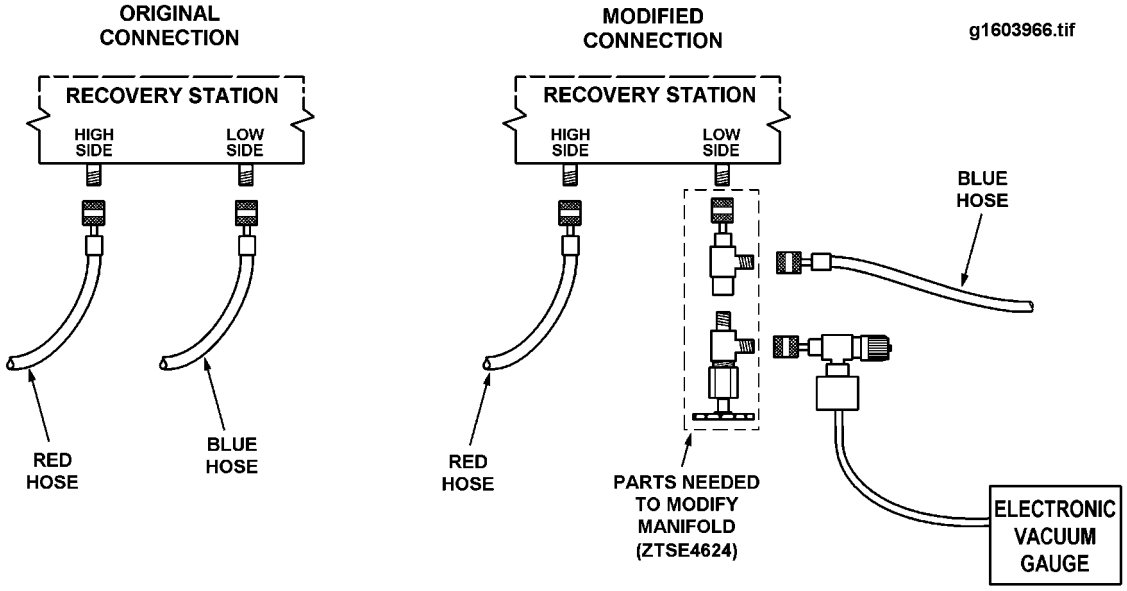


Figure 66 Connection of Electronic Vacuum Gauge

> **CAUTION – The valve for the electronic vacuum gauge must be in the closed position until instructed to open it. If the valve is open during system charging, excess pressure may damage the electronic vacuum gauge.**

4. Connect the recovery station to the system as follows (refer to Figure 65):
   a. Start with the **blue** low pressure hose, and connect it to the low pressure service port located on the evaporator outlet line.
   b. Connect the **red** hose to the high pressure service port located on the compressor-to-condenser line.

5. On the red and blue hoses, open the valves on the quick-disconnect fittings (turn the knobs fully CW).

6. On the recovery station, set both hand valves to the RECOVERY/VACUUM position.

7. On the recovery station, turn on main power switch and press the VACUUM button.

8. After the low pressure gauge on the station shows that vacuum is being established in the system, continue to operate the vacuum pump for ten minutes.

9. After ten minutes, set both valves on the recovery station to the CLOSED position, and observe low side gauge for one minute. The gauge should **not** indicate a rise of more than 2 inches-Hg. If the gauge rises more than 2 inches-Hg in one minute, the system has a leak which must be repaired. Refer to LEAK DETECTION (See LEAK DETECTION, page 163).

10. If there are no leaks:
    a. Set both hand valves on the recovery station to the RECOVERY/VACUUM position and press the VACUUM button.
    b. Open the valve connecting the electronic vacuum gauge to the recovery station low side line.
    c. Continue to operate the recovery station vacuum pump until the system has pulled a vacuum of 750 – 1000 microns as measured by the electronic vacuum gauge (10 minutes minimum).
    d. Close both hand valves on the recovery station, **AND the valve connecting the electronic vacuum gauge to the recovery station low side line**.

11. The A/C system is ready to be charged. **REMEMBER** if the full amount of refrigerant oil has not yet been added to the system, it must be added before charging the system with refrigerant, as explained in the following procedure.

NOTE – DO NOT disconnect the recovery/recycling/charging station from the A/C system before charging the system.

9.7. CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE)

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

WARNING – Do not remove the compressor oil fill plug to check the oil level in the refrigerant compressor while the A/C system is charged with refrigerant. The crankcase side of the compressor is under pressure and personal injury may result. It is not possible to check the oil level in the compressor on an A/C system that is under system pressure.

CAUTION – Use only new or recycled R-134a refrigerant; not any of the so called "direct replacement" refrigerants. Use of equipment dedicated for R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns.

CAUTION – When charging the A/C system the refrigerant tank must be kept upright. If the tank is not in the upright position, liquid refrigerant may enter the system and cause compressor damage.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

NOTE – If recycled refrigerant is to be used, follow the instructions supplied with the recycling equipment to purge the air from the refrigerant before charging the system.

Perform the Charging procedures, using new or recycled refrigerant, only after the following actions have been completed:

- System components repaired and/or replaced.
- System flushed or purged **(if required)**.
- Refrigerant oil added (**only** if oil was added directly to the compressor, see OIL FILL GUIDELINES).
- System completely evacuated.

CAUTION – If the equipment being used adds system refrigerant oil during the evacuation/charging procedure, you must first determine the amount of oil to be added (refer to OIL FILL GUIDELINES), (See OIL FILL GUIDELINES, page 158). Then follow the instructions furnished with the recovery station, or refrigerant oil injector tool, to add the correct amount of NEW oil to the system during this procedure.

1. The recovery station **blue** (suction) and **red** (discharge) hoses should still be connected as they were during the evacuation operation.

2. If necessary, add oil to return the system oil capacity to its correct level (refer to OIL FILL GUIDELINES), (See OIL FILL GUIDELINES, page 158). To add oil during the evacuation/charging process, follow the instructions furnished with the recovery station, or refrigerant oil injector tool.

> **CAUTION – Due to the density of R-134a, the amount of refrigerant required to charge a typical air conditioning system has been reduced. Overcharging the system will result in excessively high head pressures during operation and may damage the compressor. Be sure to check specifications on the vehicle being serviced. This information is often located on a label on the refrigerant compressor.**

3. Determine the amount of refrigerant needed to charge the A/C system. This information can be found in the SPECIFICATIONS section of this manual (See Table 23, page 171).

4. Following the instructions provided with the recovery station; set the recovery station to charge the system with the specified amount of refrigerant.

5. On the recovery station, set the low side valve to CLOSED, and the high side valve to CHARGE.

6. Press the CHARGE button to start the charge procedure. When the system is fully charged, the recovery station will turn off.

7. Complete the charging procedure by setting both hand valves on the recovery station to the CLOSED position.

8. Before disconnecting the recovery station from the A/C system, perform A/C SYSTEM PERFORMANCE TEST PROCEDURE (See A/C SYSTEM PERFORMANCE TEST PROCEDURE, page 44).

9. After the pressure test is completed, stop the engine and close the valves on the quick-disconnect fittings (turn fully ccw) at the vehicle A/C service ports.

10. Disconnect the **blue** and **red** hose quick-disconnect fittings from the vehicle service ports.

11. Install the protective caps on both of the vehicle service port fittings.

9.8. ADDING REFRIGERANT TO THE SYSTEM

Since the introduction of R-134a and the new PAG oil, relying on a sight glass clearing up when the system has a full charge is no longer reliable. DO NOT add refrigerant to the system in hopes of improving cooling. It's very possible that the system will be overcharged and cause component failure.

If it is found, during A/C system tests, that the system needs refrigerant; it will be necessary to perform the following procedures:

- discharge the system, refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146);
- evacuate the system, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 148);

- and recharge the system, refer to CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE) (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

9.9. PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

WARNING – Dry nitrogen gas is recommended for flushing and/or purging. Do not use nitrogen at pressures over 1378 kPa (200 psi). Personal injury or death may result from doing so. Commercial cylinders of dry nitrogen contain pressures in excess of 13780 kPa (2000 psi). This pressure must be reduced, using a pressure regulator, to 1378 kPa (200 psi) for purging.

CAUTION – When flushing and/or purging components of the system use only dry nitrogen. The introduction of compressed air into the A/C system may cause contamination of the system.

CAUTION – When flushing components, use only flushing agents approved for R-134a charged air conditioning systems (refer to the Fleetrite HVAC catalog for an approved flush solvent). R-11 and any other flushing agents that were used to flush R-12 charged air conditioning systems CANNOT be used to flush R-134a systems. The residue left by these flushing products will destroy the lubrication properties of the oil used in R-134a systems.

NOTE – A flush gun is required to inject the flushing agent into the component being flushed. Refer to FLUSH GUN (See FLUSH GUN, page 178) for complete information on this service equipment.

NOTE – Special adapters are required to connect the service equipment to the block fittings used on the A/C system components. Refer to BLOCK FITTING ADAPTERS (See Block Fitting Adapters, page 179) for complete information on these service adapters. Standard fittings and adapters can be purchased or fabricated locally. Quick disconnect fittings can reduce the time required to swap hoses, adapters and components.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Systems that have had an internal compressor failure, that have been overcharged with refrigeration oil, or that have been left open for an extended period of time, will need to be flushed, purged or both. Flushing is generally necessary only after an internal compressor failure has contaminated the refrigerant system. Flushing and purging are performed on a system after the refrigerant has been recovered and before the system is reassembled and evacuated.

Flushing removes heavy contamination, such as gritty oil and large dirt buildup, which occur after an internal compressor failure. When a part is flushed, a flushing solvent is forced through it; the liquid solvent cleans the part, picks up contaminants and flushes them out.

Purging must always be performed: after flushing the system; any time there is excessive refrigerant oil found in the system; or, when the system has been left open for an extended period of time. Purging removes flushing solvent, excessive refrigerant oil, damp air, and loose particles from A/C system components by passing a stream of inert, dry nitrogen gas through parts of the system or individual components. This assures that A/C system components are dry and free of any contaminants. If left in the system, these contaminants would have a negative effect on the life and operation of the air conditioning system.

The following procedures must be observed whenever a component or system is flushed or purged.

- Never flush or purge the entire system. Flush or purge the system in segments (never larger than one component and one hose) to lessen the chance of blowing contaminants throughout the system.
- Never flush or purge the compressor, thermostatic expansion valve (TXV), or filter-drier.
- Flush or purge each system section or component in the opposite direction of normal refrigerant flow.
- If the system requires purging only, change oil in the compressor (refer to OIL FILL GUIDELINES) (See OIL FILL GUIDELINES, page 158), reinstall the TXV, and replace the filter-drier prior to evacuating and charging the system.
- If the system requires both flushing and purging, replace the compressor, the TXV, and the filter-drier prior to evacuating and charging the system. Refer to OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 158).

NOTE – The following procedures for flushing and purging are general. The actual fittings and adapters required for each procedure will vary according to the component or components being connected.

Flushing Procedure

Refer to Figure 67.

> **CAUTION – Assemblies to be flushed must be no larger than one component and one attached hose.**

1. Disconnect both ends of the component or components to be flushed, and tightly cap the rest of the system.
2. With the tank regulator (5, Figure 67) turned off (closed), open the main nitrogen tank valve (6), and using the input gauge on the regulator, verify that enough pressure is available to perform the flushing procedure.
3. Connect the input of the flush gun (8) to the output of the supply line from the nitrogen tank. Some form of shutoff valve should be installed at the input of the flush gun.
4. Using the correct fittings or block fitting adapters (3), connect the drain line (1) to the component to be flushed. Components are flushed in the opposite direction of normal refrigerant flow.
5. Using the correct fittings or block fitting adapters, connect the flush gun output to the component to be flushed.
6. Place the outlet of the drain line into a suitable waste container.

7. Fill the flush gun tank with an appropriate amount of flushing agent.

8. Set the supply line air regulator (5) to 75 psi.

9. Open the supply line valve (4) at the output of the tank regulator.

10. Slowly open the flush gun valve and allow the flushing solvent to flow through the system until the drain line is clear; then, close the flush gun valve. If a trigger type air gun (9) is being used on the flush gun output, actuate the trigger to release all pressure from the flush gun tank.

11. Close the supply line valve (4).

WARNING – The flush gun MUST be removed from the equipment setup before performing the purge procedures. The flush gun is not designed to be used at the pressures used for the purge procedures.

12. Connect the flushing equipment to the next component to be flushed; or, empty the flush gun tank and **remove the flush gun** from the supply line.

13. Disconnect drain hose and all fittings and adapters from the component.

14. Plug the inlet and outlet of the component until it can be purged.

NOTE – After flushing a component, that component must be purged before connecting it to the air conditioning system. Refer to PURGING PROCEDURE) (See Purging Procedure, page 156).

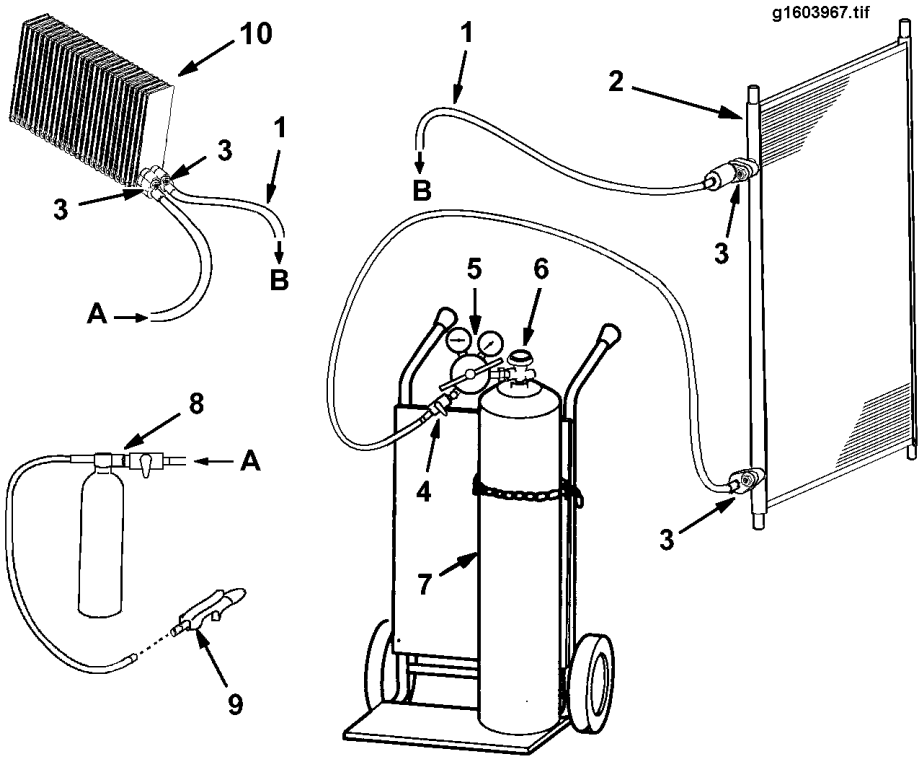


Figure 67 Typical Flushing and Purging Setup

A. NITROGEN IN
B. TO WASTE CONTAINER
1. DRAIN LINE
2. CONDENSER
3. BLOCK FITTING ADAPTERS
4. SUPPLY LINE VALVE
5. NITROGEN BOTTLE REGULATOR/GAUGES
6. NITROGEN BOTTLE CONTROL VALVE
7. NITROGEN BOTTLE
8. FLUSH GUN
9. TRIGGER TYPE AIR GUN
10. EVAPORATOR CORE

Purging Procedure

Refer to Figure 67.

> **CAUTION – Assemblies to be purged must be no larger than one component and one attached hose.**

1. Disconnect both ends of the component to be purged and tightly cap the rest of the system.

2. With the tank regulator (5) turned off (closed), open the main nitrogen tank valve (6), and using the input gauge on the regulator, verify that enough pressure is available to perform the purging procedure.

3. Using the correct fittings or block fitting adapters (3), connect the drain line (1) to the component to be purged. Components are purged in the opposite direction of normal refrigerant flow.

4. Using the correct fittings or block fitting adapters, connect the nitrogen supply line output to the component to be purged. A trigger type air gun (9) may be hand–held for some components.

5. Place the outlet of the drain line into a suitable waste container.

6. Set the supply line pressure regulator (5) to 28 kPa (4 psi).

7. Slowly open the supply line valve (4) at the output of the tank regulator. If a trigger type air gun is being used, actuate the trigger.

8. Let the dry nitrogen flow at 28 kPa (4 psi) for one to two minutes, or until there is no trace of refrigerant flushing agent or refrigerant oil flowing from the drain tube.

9. Using the pressure regulator, raise the pressure to 1378 kPa (200 psi) and let the dry nitrogen flow for 25 to 30 seconds.

10. Adjust the pressure regulator for 0 psi; then, close the supply line valve (4).

11. If a trigger type air gun is being used, actuate the trigger to release pressure in the hose.

12. Disconnect the supply and drain lines from the part, and remove all fittings and adapters (3). Tightly cap the openings of the part until you are ready to install it into the system.

NOTE – Always lubricate O-rings on fittings with mineral-based oil during installation.

13. The component is now ready to be installed into the air conditioner system using new O-rings and C-plates.

14. After purging the system, change oil in the compressor (refer to OIL FILL GUIDELINES) (See OIL FILL GUIDELINES, page 158), reinstall (or replace) the TXV, and replace the filter-drier prior to evacuating and charging the system.

9.10. OIL FILL GUIDELINES

WARNING – Before doing any of the work below, read the SERVICE WARNINGS (See SERVICE WARNINGS, page 137). Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

CAUTION – Do not re-use recovered oil. Be sure to dispose of recovered oil properly to avoid an environmental hazard.

CAUTION – Replacement compressors contain a quantity of oil when shipped. This oil must be drained from the new compressor before refilling the compressor (and system) with the correct amount of new oil.

CAUTION – During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

The correct volume of refrigerant oil in the A/C system is critical for proper system operation. Insufficient oil will result in compressor failure. Too much oil decreases cooling efficiency, resulting in poor system cooling performance. In general, when servicing the system, ensure that the amount of oil (retained or added) in the repaired system (compressor and components) equals the total system capacity indicated in AIR CONDITIONING SYSTEM SPECIFICATIONS (See Table 23, page 171). Replacement oil may be added directly into the compressor before evacuation, or injected into the system after evacuation. The following paragraphs describe how to determine the quantity of refill oil needed under the most common conditions.

NOTE – Unless stated otherwise, the following procedures assume that the system is not being flushed and/or purged.

A. If the refrigerant was only recovered for the purpose of measuring the refrigerant charge, or to replace a thermistor, add the amount of oil removed from the system during the refrigerant recovery procedure.

   - Total replacement oil quantity **=** oil from refrigerant recovery procedure.

B. If a compressor is replaced (and the system was **not** contaminated and had no leaks) refill the new compressor with the amount of oil removed from the system during the refrigerant recovery procedure, plus the quantity of oil that was contained in the old compressor. NOTE: New compressors must be drained of shipping oil before filling with new oil. Refer to CHECKING COMPRESSOR OIL LEVEL, that follows, for the procedures to drain and fill the oil in the refrigerant compressor.

   - Total replacement oil quantity **=** oil from refrigerant recovery procedure **+** oil drained from old compressor.

C. If a component other than the compressor is replaced, and there is no oil leak, add the amount of oil removed from the system during the refrigerant recovery procedure, plus the amount indicated for the replaced component in table 21.

- Total replacement oil quantity = oil from refrigerant recovery procedure + oil indicated in component table.

D. If the amount of oil in the system is unknown (due to an oil leak, ruptured hose, etc.); refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK, below.

E. Whenever the refrigerant system has become contaminated; make the necessary repairs, flush and purge the system, and replace the compressor, expansion valve, and filter-drier. The new compressor must be drained of shipping oil before filling with new oil. Refer to CHECKING COMPRESSOR OIL LEVEL, that follows, for the procedures to drain and fill the oil in the refrigerant compressor. The replacement oil may be added to the compressor before installing it. Refill the system with a full refill of new oil.

- Total replacement oil quantity = total system capacity as specified in AIR CONDITIONING SYSTEM SPECIFICATIONS (See Table 23, page 171) **minus** 0.5 fl. oz (oil film left in new compressor after draining shipping oil).
- Total replacement oil quantity = 10.14 fl. oz (300 cc) **minus** 0.5 fl. oz (15 cc) = 9.64 fl. oz (285 cc)

Table 21 Oil Capacity by Component (Including Sleeper A/C System)

Component	Typical oil amount	
	cc	fl.oz.
Evaporator (Front or Rear)	60	2.0
Condenser	30	1.0
Filter-drier	15	0.5
Expansion valve(s)	0	0
Hoses (Each)	10	0.3
Thermistor	0	0

Oil Separation During Refrigerant Recovery

The oil removed from the system during the refrigerant recovery process must be replaced. Always empty the refrigerant station oil catch bottle before recovering the refrigerant. After recovering the refrigerant, check the calibrated bottle to determine how much oil has been removed from the system. This quantity is used to help determine the amount of NEW oil that must be added to the system before or during the recharging of the A/C system. Do not use recovered refrigerant oil.

Excessive Oil Loss Due to Refrigerant Leaks

CAUTION – After servicing the A/C system, always use new O-rings and C-plates when reassembling the system components. O-rings must be lubricated with mineral oil.

When there is a significant refrigerant leak, an unknown amount of oil escapes from the system with the refrigerant. When a significant leak is detected, perform the following procedures to replace the old system oil with a full refill of new oil.

1. Use the service equipment and observation to determine the location of the leak. Refer to LEAK DETECTION (See LEAK DETECTION, page 163).

2. Discharge the system. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 146),

3. Make any necessary repairs.

4. If the system does **not** appear to be contaminated, purge the system. If the system appears contaminated, such as after an internal compressor failure, it must be flushed before purging. Refer to PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM (See PURGING OR FLUSHING THE AIR CONDITIONING SYSTEM, page 153).

5. If the removed refrigerant **was not** contaminated:

    A. Reinstall the expansion valve (removed for purging).

    B. Drain and discard the old oil from the compressor. Refer to CHECKING COMPRESSOR OIL LEVEL, that follows.

    C. Refill compressor with new oil; then, install compressor.

        Total replacement oil quantity **=** total system capacity as specified in AIR CONDITIONING SYSTEM SPECIFICATIONS (See Table 23, page 171) **minus** 0.5 fl. oz (oil film left in compressor after draining old oil).

        Total replacement oil quantity **=** 10.14 fl. oz (300 cc) **minus** 0.5 fl. oz (15 cc) **=** 9.64 fl. oz (285 cc)

    D. Install a new filter-drier.

6. If the removed refrigerant **was** contaminated:

    A. Install a new expansion valve.

    B. Add new refrigerant oil to a **new** compressor; then, install compressor. NOTE: New compressors must be drained of shipping oil before filling with new oil. Refer to CHECKING COMPRESSOR OIL LEVEL, that follows.

        Total replacement oil quantity **=** total system capacity as specified in AIR CONDITIONING SYSTEM SPECIFICATIONS (See Table 23, page 171) **minus** 0.5 fl. oz (oil film left in new compressor after draining shipping oil)

        Total replacement oil quantity **=** 10.14 fl. oz (300 cc) **minus** 0.5 fl. oz (15 cc) **=** 9.64 fl. oz (285 cc)

    C. Install a new filter-drier.

7. Evacuate the system; refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 148).

8. Charge the system; refer to CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE) (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

9. After repairing a leak, remove all traces of the fluorescent dye from the repaired area before retesting the area. The dye can be removed with UV Dye Cleaner, ZTSE4618–2.

10. After running the system, retest the repaired area to verify the repair.

9.11. CHECKING COMPRESSOR OIL LEVEL

WARNING – Do not remove the oil fill plug to check the oil level in the refrigerant compressor after the A/C system has been charged with refrigerant. The crankcase side of the compressor is under pressure and personal injury may result.

It is not possible to check the oil level in the compressor on an A/C system that is under system pressure. If it is suspected that there is not enough oil in the A/C system, it will be necessary to remove all of the oil currently in the system and refill the system with a full oil charge.

The compressor oil level can be accurately checked only by removing the compressor from the vehicle and draining the oil into a calibrated container.

1. Verify that the system is discharged.

2. Remove the compressor.

3. Remove the oil plug and drain as much oil as possible into a suitable calibrated container (refer to Figure 68).

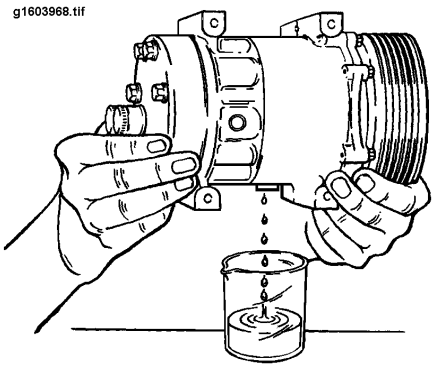


Figure 68 Drain as Much Oil as Possible

4. Remove the caps (if present) from the suction and discharge ports.

5. Drain remaining compressor oil from the suction and discharge ports, into the calibrated container, while turning the shaft (clockwise only) by hand or with a socket wrench on the armature retaining nut (refer to Figure 69). Replace the caps on the suction and discharge ports.

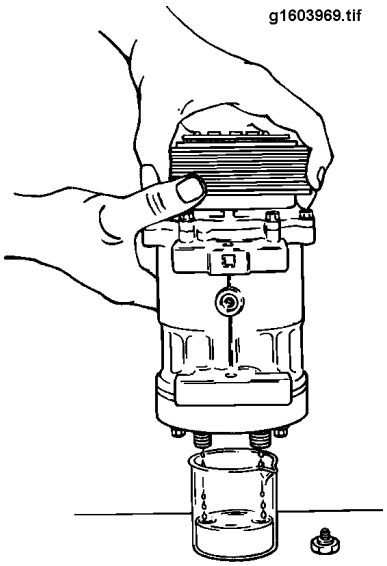


Figure 69 Drain Oil While Turning Shaft

6. Measure and record the amount of oil drained from the compressor.
7. Inspect the oil for signs of contamination such as discoloration or foreign material.
8. If the oil shows signs of contamination, replace the compressor.
9. If the oil is not contaminated, add the correct amount of new oil to the compressor as determined by the OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 158). Refer to Figure 70.

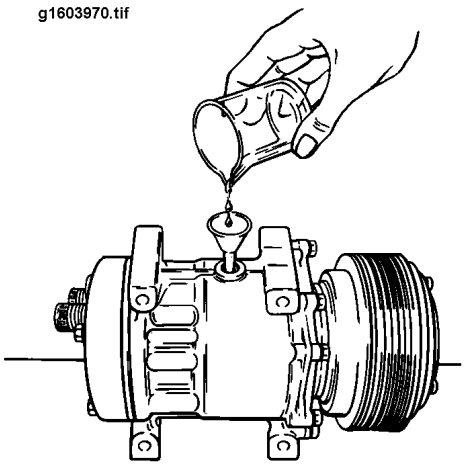


Figure 70 Add New Oil to Compressor

10. Install oil fill plug taking care not to twist the O-ring seal. Replace the O-ring if damaged. Torque oil plug to 15 to 20 N.m (11 to 15 lbf-ft). Do not over-tighten plug to stop a leak. Stop leaks first by fixing any seat damage, removing dirt and installing a new O-ring.

9.12. LEAK DETECTION

WARNING – Before doing any of the work below, read the SERVICE WARNINGS . Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

NOTE – When servicing the A/C system, insure that the inner gaskets are present in both service port caps; and verify that the caps are installed when service is completed. The service port caps, with functioning gaskets, are an important part of maintaining a leak free A/C system.

NOTE – Refrigerant leaks are often indicated by an oily residue at the point of the leak.

NOTE – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

There are several methods of refrigerant leak detection. The method used could depend on many factors including equipment availability, layout of the system being serviced, or even personal preference. The primary recommended methods are the electronic refrigerant leak detector and the phosphor dye/ultraviolet lamp method. In addition, brief descriptions are provided for two alternate methods (ultrasonic leak detection and soap solution). By using the described methods, either separately or in some combination, it should be possible to locate and verify most refrigerant leaks.

Electronic Leak Detectors

NOTE – To use the characteristics of the A/C system to your advantage while leak testing with an electronic leak detector; check the high pressure side of the system with the system running, and check the low pressure side of the system with the system (and engine) off.

In terms of sensitivity and safety, the electronic leak detector (refer to Figure 71) is excellent for finding both slow and major system leaks. Ensure that the detector being used is intended for use with R134a refrigerant. Many leak detectors intended for use with R-12 cannot detect R134a leaks. The detector is also listed in the SPECIAL TOOLS section (See SPECIAL TOOLS, page 172).

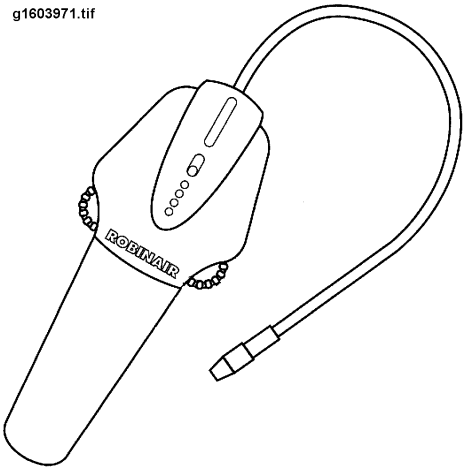


Figure 71 Electronic Leak Detector

The unit is a hand-held device having a flexible probe used to seek out refrigerant leaks. An audio leak indicator signals a warning in the presence of a leak. It is important to become familiar with the instructions for the detector being used. The speed at which the probe is moved over the component being checked is very important in locating larger than permissible leaks. Leak check procedure should be in accordance with SAE J1628.

Before starting to look for leaks, it is recommended to clean away all oil or grease, and blow away refrigerant residue from fittings and A/C components. All suspected areas should be cleaned using soap and water, not a solvent. A detected leak should be a flow of refrigerant, not a residual condition of refrigerant that is trapped under an oil film, etc. A detected leak rate in excess of 1.0 oz./year is unacceptable.

Ultraviolet Lamp Leak Testing

An alternate method to electronic leak testing is ultraviolet light. The desiccant located in the filter-drier contains a phosphor dye that will produce a bright yellow-green trace at the leak, when illuminated by an ultraviolet (UV) lamp. This dye is also included in replacement filter-driers. The kit illustrated in Figure 72 provides the UV lamp used to illuminate the suspected leaks. The kit also contains connection hoses and a dye injector, as well as, eyeglasses used to enhance the effect of the UV light on the dye. A UV dye cleaner should be used to clean the HVAC system connections after repairs have been made.

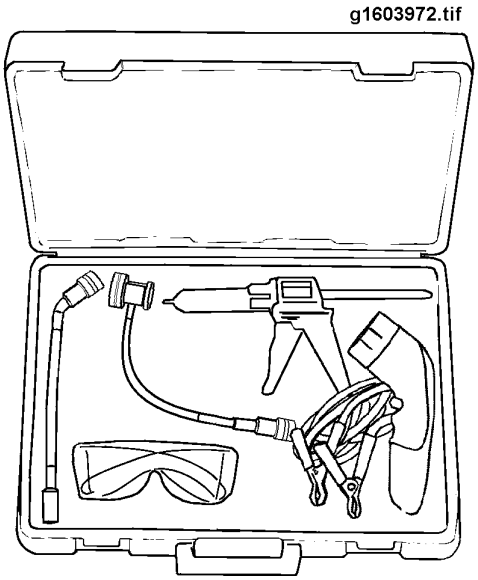


Figure 72 Ultraviolet Lamp Kit

It has been discovered during the use of UV light, and phosphor dyes, that other types of leaks also appear as a yellow-green trace when the UV light shines on them. If an UV lamp is used for leak detection, it is also recommended that an electronic leak detector be used to verify that any detected leaks are, in fact, refrigerant leaks. Refer to ELECTRONIC LEAK DETECTORS (See Electronic Leak Detectors, page 163).

Ultrasonic Leak Detectors

An ultrasonic leak detector listens for the distinctive 'sound' of a gas passing through an opening. To use this type of detector effectively, the refrigerant system is first discharged, and then pressurized to 300 psi using dry nitrogen and a manifold gauge set. Refer to REFRIGERANT LEAK TESTING WITH NITROGEN. The detector is then used to scan the suspected joints or components. Depending on the detector being used, a leak may be indicated by a visual or audible signal. Suspected leaks **should not be cleaned** with a soap solution prior to scanning with this tool, as any solution remaining at the leak site may mask the leak.

The unit is a hand-held device and may include attachments to vary the directional sensitivity of the unit. Because this type of sensor does not sample the gas used in the system, it may be used with any refrigerant system. It may also be used to detect leaks in the vehicle air system. It is important to become familiar with the instructions for the leak detector being used.

Soap Solution with Nitrogen

Another alternative method of leak detection is the soap solution method. To improve the results of this method the refrigerant system is first discharged, and then pressurized to 300 psi using dry nitrogen. Refer to REFRIGERANT LEAK TESTING WITH NITROGEN. A solution of soap and water is then sprayed on the suspected joints or components. A leak is indicated by bubbles forming at the point where the pressurized nitrogen is escaping.

Refrigerant Leak Testing with Nitrogen

NOTE – Before pressurizing the system with nitrogen the system refrigerant must be recovered.

When checking for refrigerant leaks using an ultrasonic detector or a soap solution, the refrigerant in the system must first be recovered; then, the system must be pressurized with dry nitrogen, as follows.

1. Connect a manifold gauge set to the a/c system. Refer to FIGURE 73.
   a. Initially keep both gauge valves on manifold gauge set closed.
   b. High pressure hose (red) to high pressure port on vehicle. (Open quick connect valve.)
   c. Low pressure hose (blue) is not connected. (Keep gauge valve and quick connect valve closed.) **NOTE: Opening the low pressure gauge valve while the system is pressurized may damage the low pressure gauge.**
2. Connect pressurized nitrogen cylinder to the manifold gauge set and pressurize a/c system to 300 PSI.
   a. Connect manifold gauge set yellow hose to nitrogen source.
   b. Set output pressure at nitrogen cylinder regulator to 300 PSI.
   c. Slowly open high side gauge valve on manifold gauge set to pressurize a/c system (high side gauge should read 300 PSI).
3. Test for leaks using an ultrasonic detector or a soap solution.
4. After locating the leak, set the nitrogen cylinder regulator to 0 PSI.

WARNING – In the following step, the pressure must be released in a manner that does not trap pressure in the a/c system.

5. Before disconnecting the manifold gauge set, slowly release the pressure from the a/c system by **partially** disconnecting a fitting until the pressure is released.
6. Remove the manifold gauge set from the a/c system and repair the leak.
7. Evacuate the system; refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 148).
8. Charge the system; refer to CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE) (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 151).

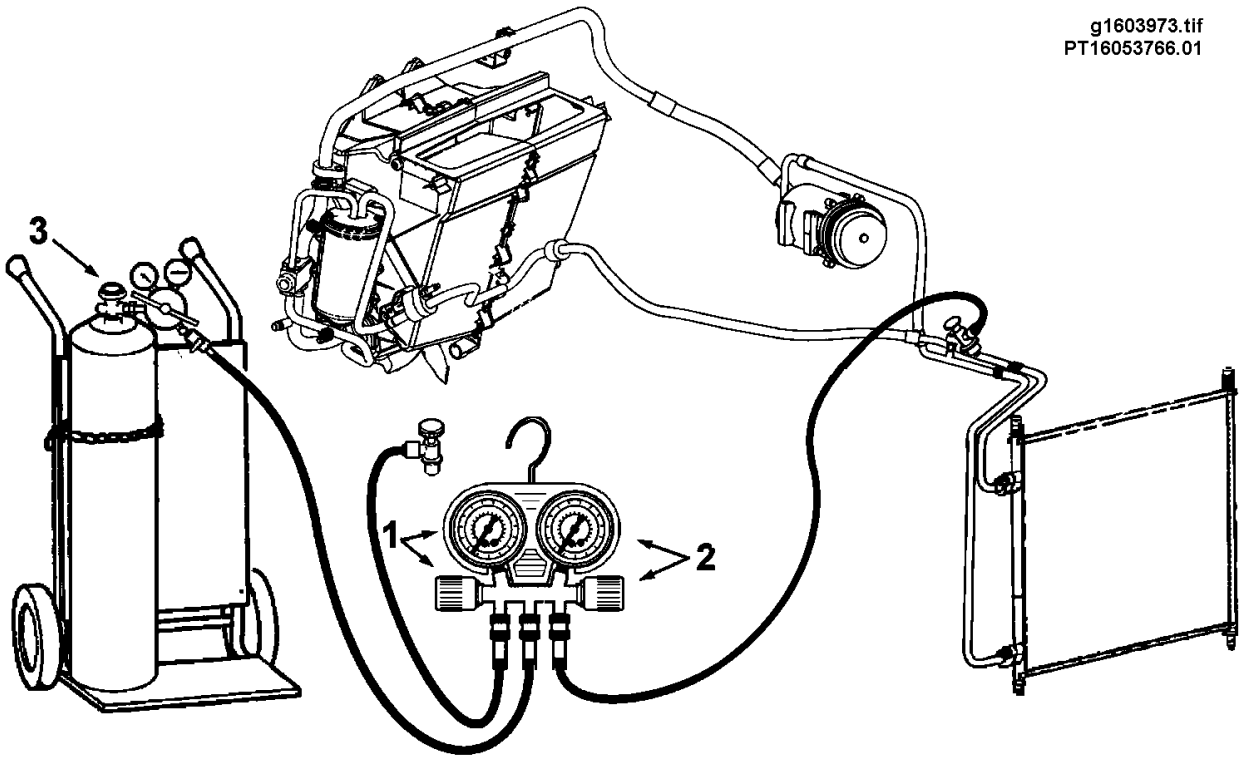


Figure 73 Using Nitrogen to Pressurize the A/C System

1. LOW PRESSURE VALVE AND GAUGE (MANIFOLD GAUGE SET)
2. HIGH PRESSURE VALVE AND GAUGE (MANIFOLD GAUGE SET)
3. NITROGEN CYLINDER AND REGULATOR

10. SPECIFICATIONS

10.1. TORQUE CHART

Table 22 Torque Chart

Item No.*	Item Description (Quantity)	Torque Value		
		N•m	Lbf-ft	Lbf-in
1	Air Conditioner Block Fittings	19 to 21	14.2 to 15.8	170 to 190
2	Refrigerant Compressor Mtg Bolts (4)	23 to 29	16.9 to 21.4	203.6 to 256.7
3	Refrigerant Compressor Oil Plug	15 to 20	11 to 15	132 to 180
4	Pressure Transducer (1)	6.8 to 13.6	5 to 10	60 to 120
5	Heater Housing Mtg Bolt (4)	5.4 to 7.6	4 to 5.6	47.5 to 67.5
6	Evaporator Housing Mtg Bolt (4)	5.4 to 7.6	4 to 5.6	47.5 to 67.5
7	Filter Drier Mtg Bolt (2)	11.0 to 11.6	8.1 to 8.5	97 to 103
8	Thermistor (2) (Located on evaporator inlet and outlet lines.)	5 to 9.5	3.7 to 7	44.3 to 84.1
9	M5 Capscrew, 3mm Allen Head (2) Secures Expansion Valve Bottom Plate (Front Expansion Valve)	3.6 to 4.3	2.7 to 3.1	31.9 to 38
10	M6 Screw, T30 Torx Head Secures Expansion Valve Top Plate (Front Expansion Valve)	9 to 10	6.7 to 7.5	80 to 90
11	M5 Capscrew, Torx Head (2) Secures Expansion Valve Top Plate (Rear Expansion Valve)	4.0 to 4.3	2.9 to 3.1	35.4 to 38.0
12	M6 Nut, Secures Expansion Valve Bottom Plate (Rear Expansion Valve)	9 to 10	6.7 to 7.5	80 to 90
13	Block Fittings for Rear Air Conditioner System	19 to 21	14.2 to 15.8	170 to 190
* Refer to the torque location diagrams (Figures 74, 75, 76, and 77) that follow this table.				

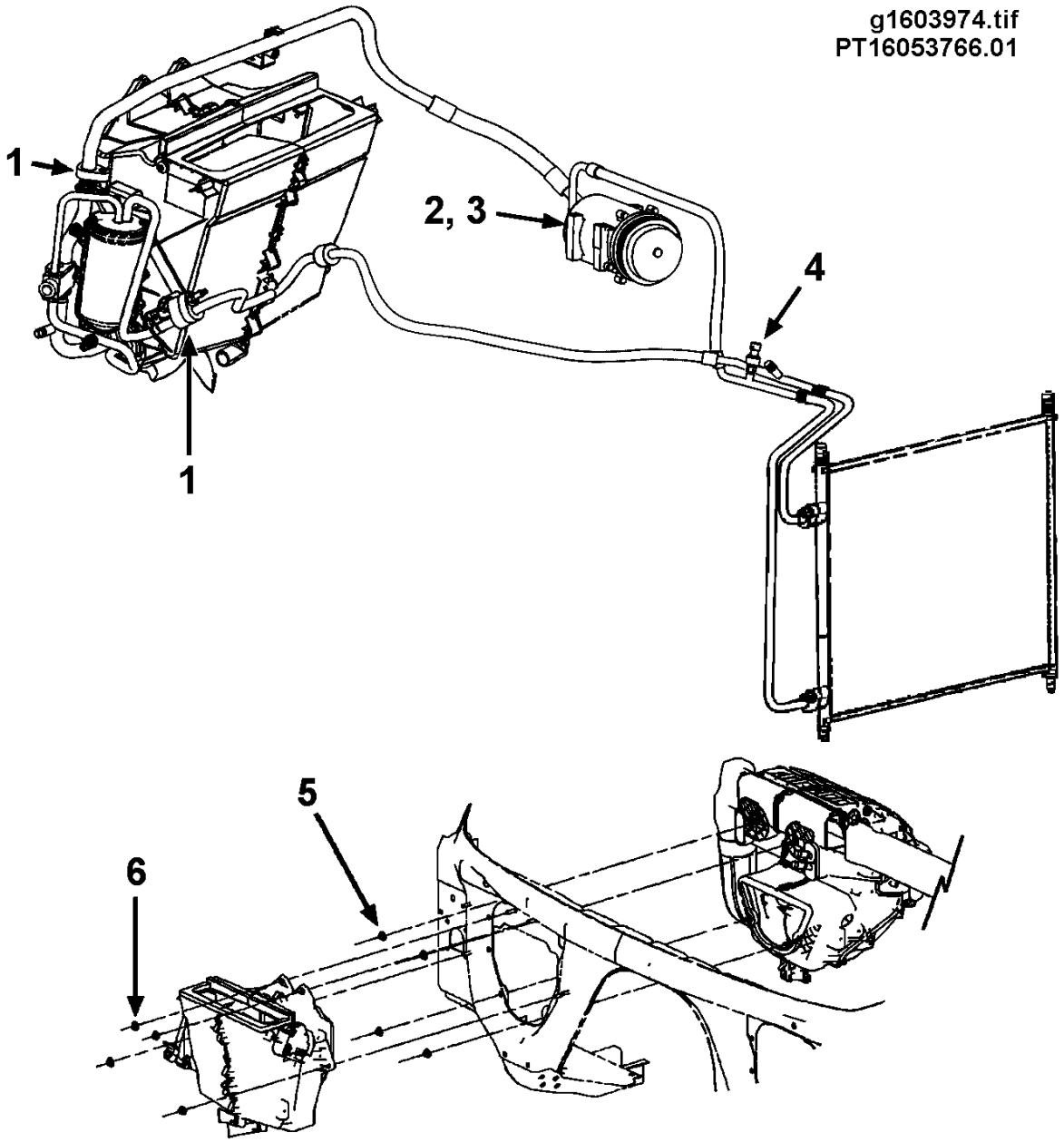


Figure 74 Torque Locations (Figure 1 of 4)

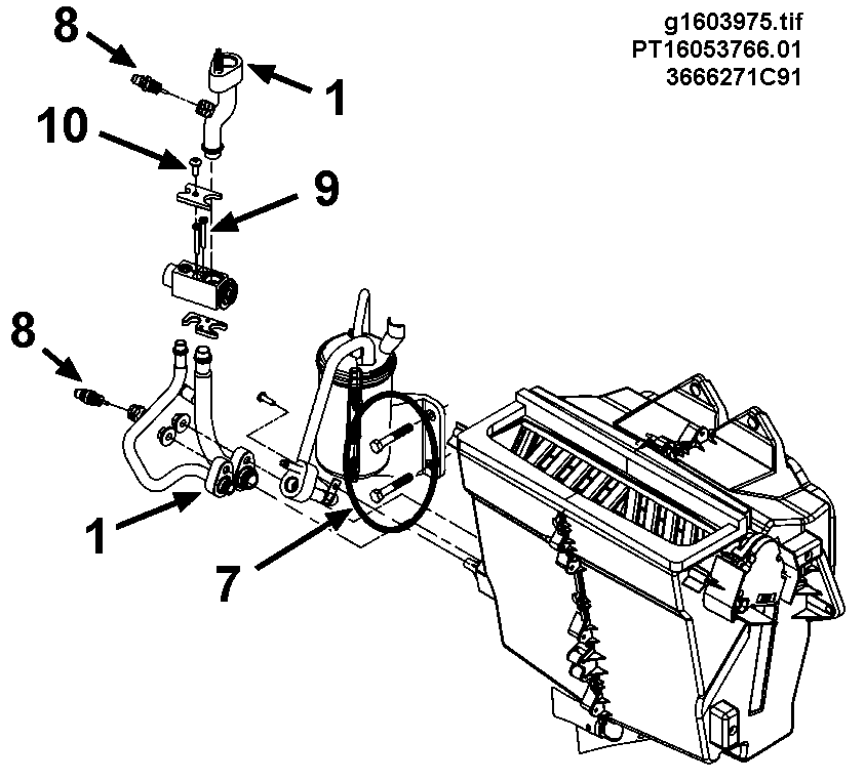


Figure 75 Torque Locations (Figure 2 of 4)

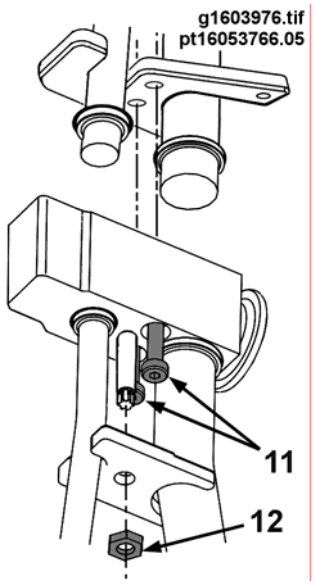


Figure 76 Torque Locations – Rear Thermostatic Expansion Valve (Figure 3 of 4)

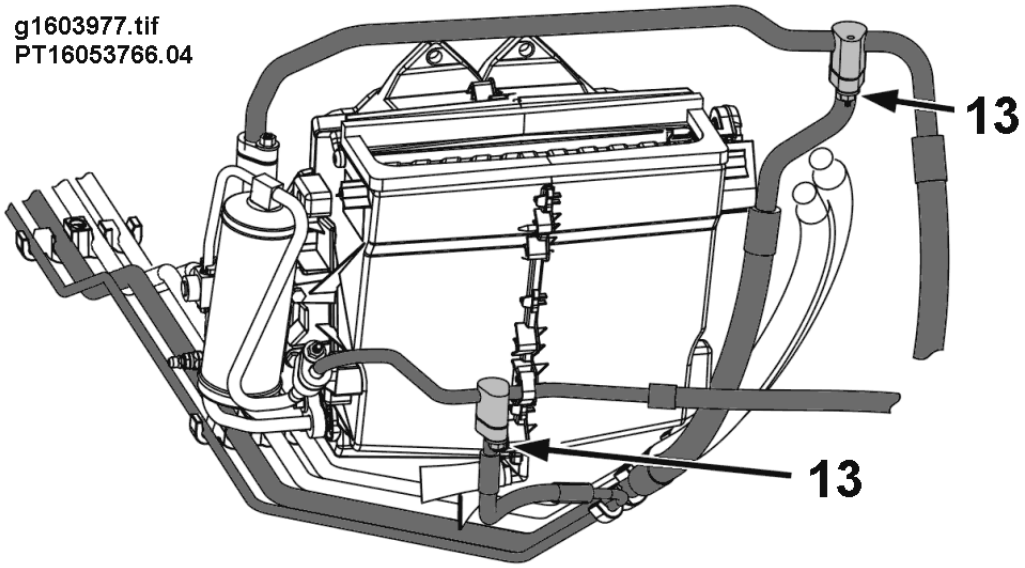


Figure 77 Torque Locations – Block Fittings for Rear A/C System (Figure 4 of 4)

10.2. AIR CONDITIONING SYSTEM

Table 23 Air Conditioning System Specifications

ITEM	SPECIFICATION
Refrigerant Type	R-134a
Refrigerant Quantity (Full Charge)	
ProStar Models (Day Cabs)	40 +2/-0 oz. (2.5 +0.125/-0 lbs) (1.13 +0.05/-0 kg)
ProStar Models (Sleeper Cabs)	48 +2/-0 oz. (3.0 +0.125/-0 lbs) (1.36 +0.05/-0 kg)
Compressor Oil Type	PAG Oil International P/N ZGGR725028
Compressor Oil Capacity (All Models)	300 cc (10.14 fl.oz.)
Lubricating Oil Type (O-rings, threads, etc.) Do NOT use as compressor refrigerant oil.	Mineral Oil International P/N ZGGR6912
Compressor Belt Drive Tension	Controlled by auto-tensioner.

11. SPECIAL TOOLS

CAUTION – The servicing tools recommended for this system were designed specifically for use with R-134a A/C systems. Servicing tools designed and/or used for R-12 A/C systems must not be used when servicing R-134a systems unless they are specifically identified as being compatible with both systems.

Servicing air conditioning efficiently and effectively requires proper tools and equipment. The recommended tools, as well as, alternate service tools are shown and discussed below.

The tools listed in the following table can be ordered through the International tool supplier. The tools shown in Figure 78 can be obtained from local sources.

Table 24 Special Service Tools

DESCRIPTION	PART NO.
Recovery/Recycling/Recharging Station (R-134a)	ZTSE4615
Manifold Gauge Set (R-134a)	ZTSE4623
Electronic Vacuum Gauge	ZTSE4620
Electronic Vacuum Gauge Manifold	ZTSE4624
Refrigerant Identifier	ZTSE4616
Electronic Leak Detector	ZTSE4617
Ultraviolet Lamp Leak Detector	ZTSE4618
Digital Thermometer	ZTSE4619
Block Fitting Adapters	
Male Adapter, ½ Inch	ZTSE4503
Male Adapter, ¾ Inch	ZTSE4501
Female Adapter, ½ Inch	ZTSE4504
Female Adapter, ¾ Inch	ZTSE4502
Electronic Service Tool (EST), EZ-Tech and Interface Communications Cable	
Dry Nitrogen, Cart, Regulator	Obtain Locally
Flush Gun	Obtain Locally
Drain Hose with Compression Fitting and Adapters	Obtain Locally

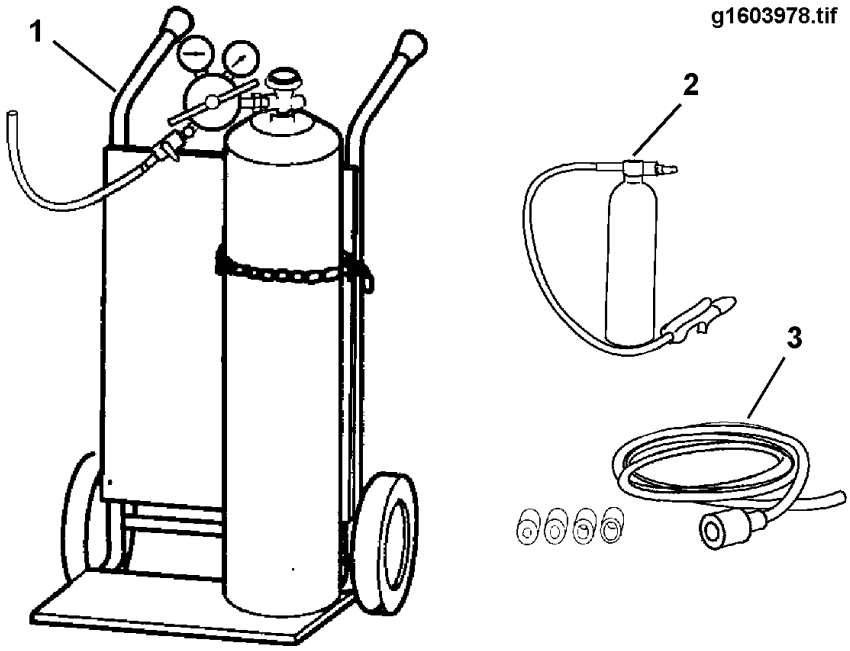


Figure 78 Service Tools that may be Obtained Locally

1. Nitrogen Cylinder, Regulator and Cart
2. Flush Gun
3. Drain Hose with Compression Fitting and Adapters

11.1. RECOVERY/RECYCLING/RECHARGING STATION

The Recovery/Recycling/Recharging Station (ZTSE4615) for R-134a is a totally integrated A/C service system, which recovers, recycles, evacuates, and recharges R-134a quickly and accurately (refer to Figure 79).

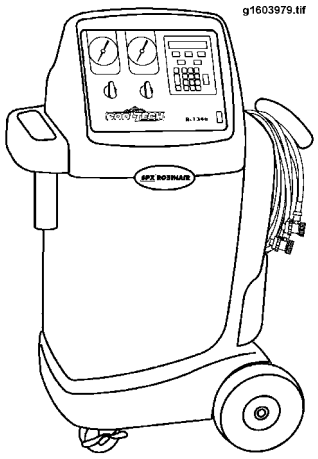


Figure 79 Recovery/Recycling and Charging Station, ZTSE4615

With its built-in manifold, all A/C service work is done with one hookup. The unit is programmed at its panel-mounted keypad. Computerized controls and solenoids precisely monitor evacuation and charging time. It is designed to automatically shut off after the recovery cycle. A moisture indicator will change from yellow to green when recycling is complete.

11.2. MANIFOLD AND GAUGE SET

The manifold gauge set (ZTSE4623) for R-134a systems consists of the necessary pressure and vacuum gauges, and control valves and fittings for evacuating and charging air conditioner systems (refer to Figure 80). The unit features sidewheel style, color-coded valve handles, 63.5 mm (2.5 inch) vibration-free gauges, hose holders, a hanging hook, and two 183 cm (72 in) color-coded hoses with Metric SAE quick-disconnect fittings (with valves). The hose connection fittings on the manifold gauge set have Acme threads.

NOTE – The manifold gauge set and service hoses must be dedicated to R-134a.

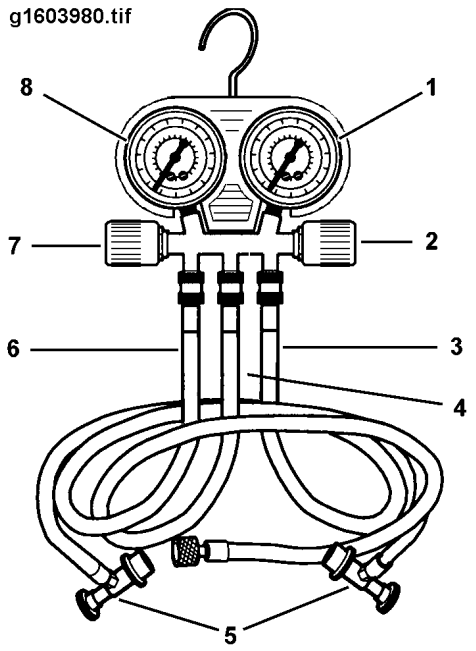


Figure 80 Manifold and Gauge Set (Shown with Hose Set and Quick-Disconnect Fittings)

1. HIGH PRESSURE GAUGE
2. HIGH PRESSURE VALVE
3. HIGH PRESSURE HOSE (RED)
4. SERVICE HOSE (YELLOW)
5. METRIC SAE QUICK CONNECT FITTINGS
6. LOW PRESSURE HOSE (BLUE)
7. LOW PRESSURE VALVE
8. LOW PRESSURE GAUGE

11.3. ELECTRONIC VACUUM GAUGE AND MANIFOLD

Before recharging the A/C refrigerant system, a vacuum must be drawn in the system to boil away all of the moisture in the system. A vacuum level of 500 to 1000 microns is sufficient to evacuate the system and remove all of the moisture. An accurate way to measure a vacuum at these levels is with an electronic vacuum gauge (refer to Figure 81). The electronic vacuum gauge (ZTSE4620) measures vacuum levels from 10 to 20,000 microns in twenty steps.

The vacuum gauge is susceptible to damage from high pressures. Therefore, it must be connected to the recovery station through a manifold that allows the gauge to be isolated from the recovery station low pressure line when high pressures are present (refer to Figure 82).

> **CAUTION – Close the valve on the electronic vacuum gauge manifold before recharging the A/C system.**

Figure 81 Electronic Vacuum Gauge, ZTSE4620

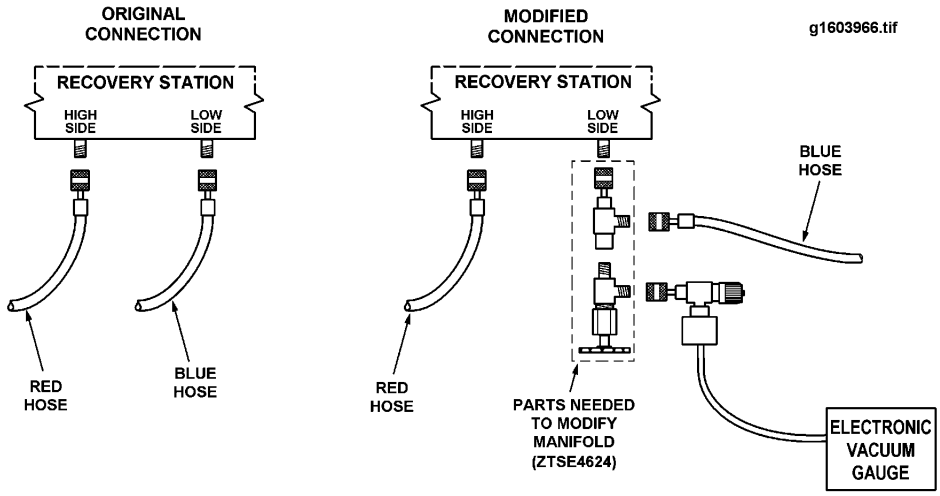


Figure 82 Electronic Vacuum Gauge Manifold, ZTSE4624

11.4. REFRIGERANT IDENTIFIER

In today's environment there are a lot of alternative and blended refrigerants; International only recognizes R-134a for this A/C system. The only way to know for sure if you can safely recover the refrigerant in an A/C system is through the use of a refrigerant identifier (refer to Figure 83). The refrigerant identifier (ZTSE4616) samples the refrigerant; then displays the type and purity of the refrigerant in the system. The refrigerant identifier is supplied as part of a kit which includes the necessary hoses and fittings.

CAUTION – When red spots or discoloration begins to appear on the white outside diameter of the filter element, THE FILTER MUST BE REPLACED. Failure to properly maintain the sample filter may result in severe instrument damage that is not covered under warranty repairs.

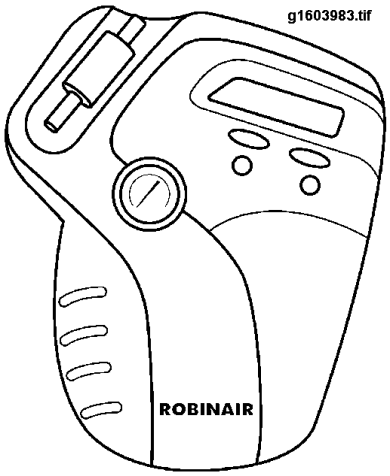


Figure 83 Refrigerant Identifier, ZTSE4616

11.5. ELECTRONIC LEAK DETECTOR

Electronic Leak Detector (ZTSE4617) detects leaks in air conditioning systems by utilizing 100 per cent solid state electronic circuitry (refer to Figure 84). An LED provides a low battery warning. The LED also indicates when calibration is accomplished without the usual, inconvenient, external reference leak source. An audio leak indicator ensures efficient operation even in bright sunlight. The power source is four "AA" alkaline batteries. This detector may be used for both R-12 and R-134a systems.

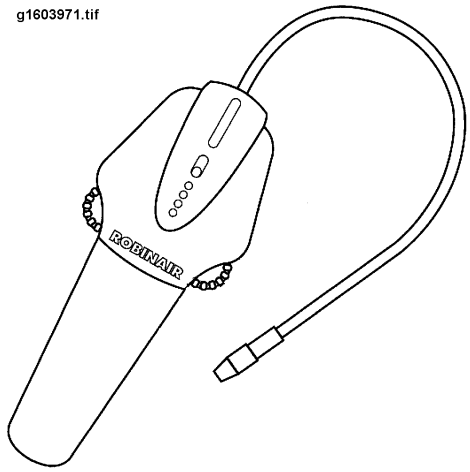


Figure 84 Electronic Leak Detector, ZTSE4617

11.6. ULTRAVIOLET LAMP LEAK DETECTOR

An ultraviolet leak detector is used with phosphor dye to detect very minute leaks. Leak Detector (ZTSE4618) is for use under all ambient lighting conditions, **except** direct sunlight (refer to Figure 85). It uses a special self-ballasted bulb, which eliminates the need for an external transformer. When this light is shined on a suspected area, leaking refrigerant will be visible as a bright yellow-green glow. The leak detector kit includes the accessories needed to inject dye into other systems.

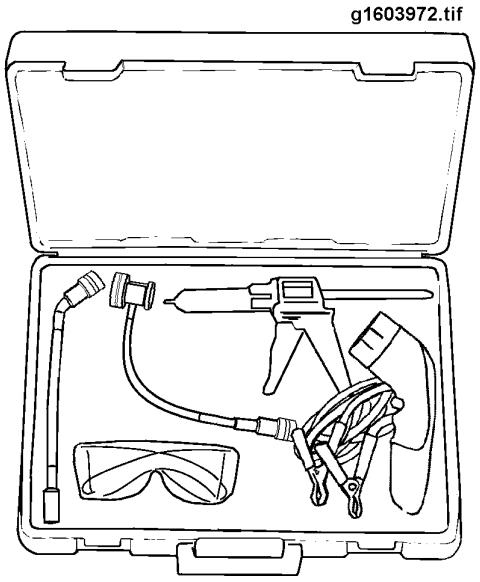


Figure 85 Ultraviolet Lamp Leak Detector, ZTSE4618

11.7. FLUSH GUN

If the refrigerant system has been contaminated, such as due to an internal compressor failure, it must be flushed and purged before it can be repaired and recharged. A flush gun (refer to Figure 86) is used, along with compressed dry nitrogen, to force a flushing agent through the hoses and components of the refrigerant system. The flush gun and drain hose with compression fitting/adapter can be obtained locally.

WARNING – The nitrogen supplied to the flush gun must not exceed 75 psi.

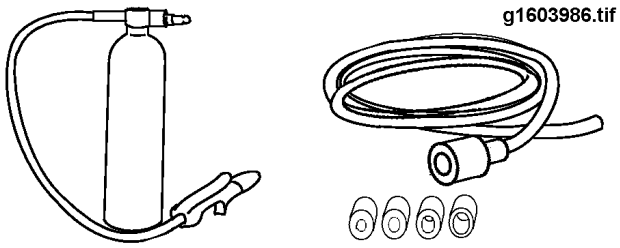


Figure 86 Flush Gun and Drain Hose (Obtain Locally)

11.8. DIGITAL THERMOMETER

Two thermometers are needed for A/C system testing and diagnostics. Digital thermometers provide a simple and accurate means of measuring air temperature (refer to Figure 87).

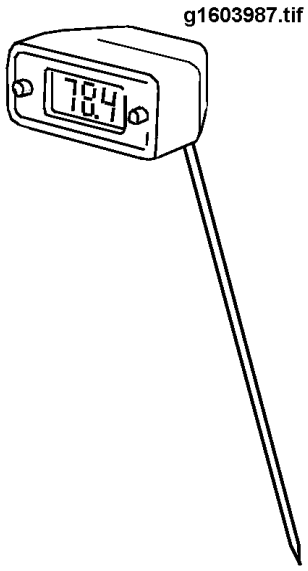


Figure 87 Digital Thermometer, ZTSE4619

11.9. BLOCK FITTING ADAPTERS

When performing flushing and/or purging operations, adapters are required to connect the service equipment to the HVAC system components (refer to Figure 88).

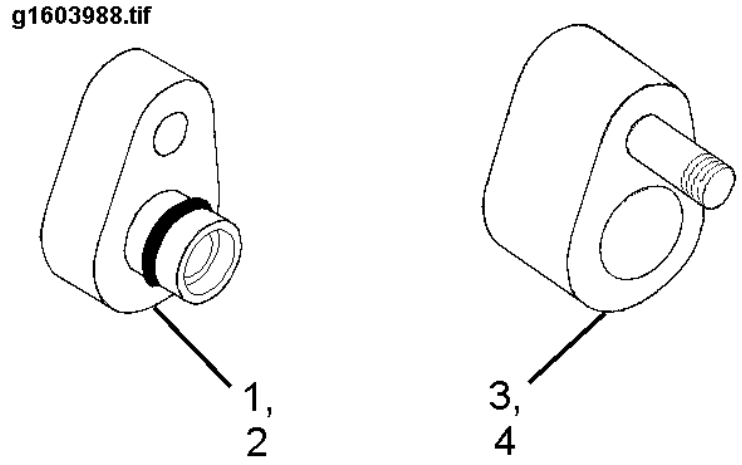


Figure 88 Block Fitting Adapters

1. MALE ADAPTER (1/2 INCH), ZTSE4503
2. MALE ADAPTER (3/4 INCH), ZTSE4501
3. FEMALE ADAPTER (1/2 INCH), ZTSE4504
4. FEMALE ADAPTER (3/4 INCH), ZTSE4502

11.10. ELECTRONIC SERVICE TOOL (EST), EZ-TECH

The EZ-Tech electronic service tool (refer to Figure 89), running diagnostic software allows the servicer to monitor the HVAC electrical circuits. The EZ-Tech is connected to the vehicle diagnostic connector through an interface communications cable. When used in conjunction with the electrical troubleshooting manual, the EZ-Tech allows the servicer to isolate electrical faults efficiently. See the diagnostic software manual for details on using the software.

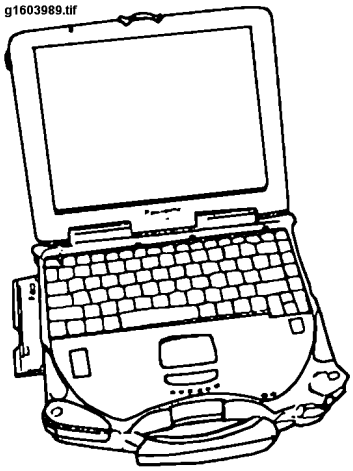


Figure 89 Electronic Service Tool, EZ-Tech

12. GLOSSARY

Refer to the following terms for a better understanding of the heater/air conditioning system.

- ACTUATOR - An electrical device that performs a mechanical action based on an electrical input, (similar to a servo motor).
- AIR CONDITIONER - A device used to control the temperature, humidity, cleanliness and movement of air.
- AIR PRESSURE - The pressure exerted in every direction at any given point. Normal atmospheric pressure (that is, the pressure caused by the weight of the atmosphere) at sea level is 101.60 kPa (14.696 psi).
- AMBIENT AIR TEMPERATURE - The temperature of air around an object; the outside temperature.
- BLOWER - A motor and fan used to draw air through the evaporator, and force it through the heater core and into the cab.
- BOILING POINT - The temperature at which a liquid changes to a gas, at a certain pressure.
- CFM - Cubic feet per minute. The metric equivalent of one CFM is 28.3 Liters per minute.
- CHARGE - A specific amount of refrigerant or oil by volume or weight. Also, the act of placing an amount of refrigerant or oil into the air conditioning system.
- COLD - The absence of heat. (The lowest possible temperature is believed to be -273 degrees C (-459 degrees F).
- COMPRESSOR - An assembly used to draw low pressure, low temperature refrigerant gas from the evaporator and squeeze it into a high pressure, high temperature gas. This causes the refrigerant to have a higher temperature than the surrounding air, allowing the condenser to change the gas back into a liquid. A secondary purpose of the compressor is to move refrigerant and oil through the system.
- CONDENSATE - Water, taken from the air, which forms (condenses) on the outer surface of the evaporator.
- CONDENSER - A heat exchanger that is used to remove heat from refrigerant, changing it from a high temperature, high pressure gas into a high temperature, high pressure liquid.
- CONTAMINANTS - Anything other than refrigerant or refrigerant oil in the system. Usually means water in the system.
- DEHUMIDIFY - To remove water from the air, at the evaporator coils.
- DESICCANT - A drying agent used in the refrigerant system (in the filter-drier) to remove moisture.
- DISCHARGE - To remove some or all of the refrigerant from the air conditioning system using a recovery/recycling station.
- DISCHARGE LINE - Connects the refrigerant compressor outlet to the condenser inlet. (High pressure line).
- DISCHARGE PRESSURE - Pressure of the refrigerant leaving the compressor; high side pressure.
- DISCHARGE SERVICE PORT - A fitting that is located in the system on the discharge (high pressure) side of the compressor. It allows the connection of service equipment for monitoring high side pressure and for performing other service related tasks.
- DRYING AGENT - See "Desiccant."
- ELECTRONIC VACUUM GAUGE - A high vacuum gauge sensitive to pressures ranging from 10 to 20,000 microns.
- EVACUATE - Evacuation pumps the contents out of the refrigerant system, creating a vacuum. It dehydrates all traces of moisture and is used to determine if the system has any leaks before installing a charge of refrigerant in the system.

- EVAPORATE - A change of state from a liquid to a gas.
- EVAPORATOR CORE - A component of the air conditioning system in which liquid refrigerant changes to a gas after it absorbs heat from the air. The external surface of the evaporator core also collects cab moisture.
- EXPANSION VALVE - See Thermostatic Expansion Valve.
- FILTER-DRIER - A combination desiccant, filter, and storage container for liquid refrigerant.
- FLUSHING - A process of forcing a solvent through a refrigerant part to remove dirt and contaminants. Flushing is used to remove heavy contamination, such as gritty oil and large dirt buildup, that cannot be removed by purging.
- FREEZE-UP - Failure of a unit to operate properly because of ice forming at the thermostatic expansion valve or on the evaporator coils or fins.
- HEAD PRESSURE - Refrigerant pressure from the discharge side of the compressor to the condenser and expansion valve inlet.
- HUMIDITY - The amount of water vapor in the air.
- LEAK DETECTOR - A device used to detect a refrigerant leak in the air conditioning system.
- LINEAR POWER MODULE - An electrical module that controls the amount of voltage going to the blower motor, based on an input signal from the HVAC control head panel (and blower speed control). The amount of voltage going to the blower motor determines the speed of the blower.
- LOW SUCTION PRESSURE - Low side pressure that is lower than normal due to a system problem.
- MAGNETIC CLUTCH - An electrical coupling device used to engage or disengage the refrigerant compressor.
- MANIFOLD GAUGE SET - A manifold that is complete with gauges and charging hoses and used to measure or test pressure.
- MICRON - A metric measurement of mercury equal to one-thousandth of one millimeter. Therefore, one-tenth of an inch of mercury equals 2540 microns. Measurement in microns is the only accurate way to determine the amount of pressure that is left in a refrigerant system by a high vacuum pump.
- MINERAL BASED OIL - A type of oil used on seals and O-rings in A/C systems to lubricate them and keep them from drying out.
- NITROGEN - A colorless, odorless, dry, inert gas that can be used to purge light contaminants from air conditioning parts.
- OVERCHARGED - Too much refrigerant or oil in an A/C system.
- PAG OIL - A specific type of oil carried by the refrigerant and used to lubricate the components of some A/C systems.
- PRESSURE TRANSDUCER - A device with electrical characteristics that vary according to the pressure it senses.
- PULSE WIDTH MODULATION - A type of electrical signal that uses pulses to represent specific values.
- PURGE - To remove damp air, traces of refrigerant, and loose dirt from a system part by blowing pressurized dry nitrogen through the part.
- REFRIGERANT (R-134a) - The cooling agent used in automotive air conditioning systems.
- REFRIGERATION CYCLE - The complete circulation of refrigerant through an air conditioning system, accompanied by changes in temperature and pressure.

- SUCTION PRESSURE - Compressor inlet pressure (the system low side pressure).
- SUCTION SIDE SERVICE PORT - A fitting that is located in the system on the suction (low pressure) side of the compressor. It allows the connection of service equipment for monitoring low side pressure and for performing other service related tasks.
- THERMISTOR - A device, used as an sensor for an electrical circuit, that changes its apparent resistance based on the temperature it senses.
- THERMOSTATIC EXPANSION VALVE - The expansion valve is the dividing line between the high and low pressure sides of the system. The valve regulates the amount of refrigerant that is routed to the evaporator core, based on the temperature of the refrigerant leaving the evaporator core. Sometimes abbreviated as TXV.
- TXV - See THERMOSTATIC EXPANSION VALVE.
- VACUUM - Refers to pressure that is less than atmospheric pressure.
- VACUUM PUMP - A mechanical device used to evacuate and place a high vacuum in the refrigerant system.
- VAPOR - The gaseous state of material.