Climate Control System

**WARNING:** To avoid accidental deployment and possible injury, the air bag system backup power supply must be depleted before repairing any climate control components. To deplete the backup power supply, disconnect the battery positive cable and wait one minute.

**CAUTION:** To avoid contaminating the A/C system:
- Keep service tools and the work area clean.
- Never open or loosen a connection before recovering the refrigerant using approved equipment.
- When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.
- Evacuate a system that has been opened to replace a component or one that has discharged through leakage before charging.
- Seal open fitting with a cap or plug immediately after disconnecting a component from the system.
- Clean the outside of the fittings thoroughly before disconnecting a component from the system.
- Do not remove the sealing caps from a replacement component until ready to install.
- Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use, and install the cap immediately after using.
- Store the oil in a clean, moisture-free container.
- Install a new O-ring before connecting an open fitting. Coat the fitting and O-ring with refrigerant oil before connecting.
- When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.
- Tighten threaded fittings only to specifications. The steel and aluminum fittings used in the refrigerant system will not tolerate overtightening.
- Do not open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature.
- This will prevent condensation from forming inside a component that is cooler than the surrounding air.

**CAUTION:** To avoid damaging the vehicle or A/C components, the following precautions must be observed:
- The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to do so can contaminate the shop bulk refrigerant and other vehicles.
- Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These two types of refrigerant must never be mixed. Doing so can damage the A/C system.
- Charge the A/C system with the engine running only at the low-pressure side to prevent refrigerant slugging from damaging the A/C compressor.
- Use only R-134a refrigerant. Due to environmental concerns, when the air conditioning system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal law requires that R-134a be recovered into appropriate recovery equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as MACS, ASI, etc. Use of a recovery machine dedicated to R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns.
- Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the air conditioning system.
- Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and higher pressures.
- A number of manufacturers are producing refrigerant products that are described as direct replacements for Refrigerant R-134a. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled Refrigerant R-134a.

**WARNING:** Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area.

**WARNING:** R-134a is classified as a safe refrigerant, but misuse can make it dangerous. The following precautions must be observed.
- Always wear safety goggles when repairing an air conditioning system.
- Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and it will freeze skin tissue.
- Never allow refrigerant R-134a gas to escape in quantity in an occupied space. R-134a is non-toxic, but it will displace the oxygen needed to support life.
- Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but when it is exposed to high temperatures, such as a torch flame, it decomposes. During decomposition it releases irritating and toxic gases (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.
- Do not allow any portion of the charged air conditioning system to become too hot. The pressure in an air conditioning system rises as the temperature rises and temperatures of approximately 85°C (185°F) can be dangerous.
- Allow the engine to cool sufficiently prior to performing maintenance or serious burns and injury can occur.

**Principles of Operation**

There are four main principles involved with the basic theory of operation:
- heat transfer
- latent heat of vaporization
- relative humidity
- effects of pressure

**Heat Transfer**

If two substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

**Latent Heat of Vaporization**

When a liquid boils (changes to gas), it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

**Relative Humidity**
The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature. The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable you feel. Removing moisture from the air lowers its relative humidity and improves personal comfort.

**Effects of Pressure on Boiling or Condensation**

As the pressure is increased on a liquid, the temperature at which the liquid boils (changes to gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

**The Refrigerant Cycle**

During stabilized conditions (air conditioning system shutdown), the refrigerant is in a vaporized state and pressures are equal throughout the system. When the A/C compressor (19703) is in operation, it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core (19712).

The A/C condenser core, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser core and enters the inlet side of the A/C evaporator core orifice (19D990).

The A/C evaporator core orifice is the restriction in the refrigerant system that creates the high pressure buildup upstream of the A/C evaporator core (19860) and separates the high and low pressure sides of the A/C system. As the liquid refrigerant leaves this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator core, it absorbs heat from the passenger compartment airflow passing over the plate/fin sections of the A/C evaporator core. This addition of heat causes the refrigerant to boil (change to gas). The now cooler passenger compartment air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The suction accumulator/drier (19C836) is designed to remove moisture from the refrigerant and to prevent any liquid refrigerant that may not have been vaporized in the A/C evaporator core from reaching the A/C compressor. The A/C compressor is designed to pump refrigerant vapor only, as liquid refrigerant will not compress and can damage the A/C compressor.

The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

The A/C cycling switch (19E561) interrupts compressor operation before the external temperature of the A/C evaporator core gets low enough to cause the condensed water vapor (excess humidity) to turn to ice. It does this by monitoring low side line pressure. It is known that a refrigerant pressure of approximately 210 kPa (30 psi) will yield an operating temperature of 0°C (32°F). The A/C cycling switch controls system operation in an effort to maintain this temperature.

The high side line pressure is also monitored so that the A/C compressor operation can be interrupted if system pressure becomes too high.

The A/C compressor pressure relief valve (19D644) will open and vent refrigerant to relieve unusually high system pressure.

**Clutch Cycling Orifice Tube Type Refrigerant System**
System Air Flow Description

MAX A/C

- The air inlet duct door is at full vacuum, closing off outside air and admitting only recirculated air.
- The heater water control valve (18495) is at full vacuum, preventing hot coolant from reaching the heater core (18476).
- The panel/defrost door is at full vacuum and the floor/panel door is at no vacuum, directing airflow to the A/C registers (19893).
- The air will be picked up at the recirc opening by the blower motor (18527). With the temperature control set for maximum cold, airflow across the A/C evaporator core will be diverted past the heater core and then directed into the passenger compartment through the instrument panel A/C registers. There is also some airflow to the side window demisters.
- Temperature control is usually set for maximum cold but because the heater water control valve is preventing hot coolant from reaching the heater core, the air cannot be heated in any temperature control position.
- The A/C compressor will be enabled when MAX A/C is selected.
- The blower motor is on.

When A/C is selected:

- The air inlet duct door is set at no vacuum, blocking off outside air and admitting only recirculated air.
- The heater water control valve (18495) is at full vacuum, preventing hot coolant from reaching the heater core (18476).
- The panel/defrost door is at full vacuum and the floor/panel door is at no vacuum, directing airflow to the A/C registers (19893).
- All other door positions are the same as described under MAX A/C.
- Temperature setting can be changed manually.
- The A/C compressor will be enabled when A/C is selected.
- The blower motor is on.
When VENT is selected:

- The air inlet duct door, with no vacuum being applied, will block recirculated air and admit outside air. From there, air flows through the system to the instrument panel A/C registers. There is also some airflow to the side window demisters.
- The floor/panel door is in the no vacuum position to block airflow to the heater outlet floor duct.
- The panel/defrost door is at full vacuum, closing off airflow to the windshield defroster hose nozzle (18490).
- The temperature can be adjusted manually to heat the air but the air cannot be cooled below the outside temperature.
- The A/C compressor will be disabled when VENT is selected.
- The blower motor is on.
When OFF is selected:

- The A/C inlet duct door is at full vacuum, closing off outside air and admitting only recirc air.
- The heater water control valve is at full vacuum, preventing hot coolant from reaching the heater core.
- The floor/panel and panel/defrost doors are at full vacuum, closing off the passages to the A/C registers.
- The blower motor and the A/C compressor are off.

When PANEL/FLOOR is selected:

- The air inlet duct door is set at no vacuum, blocking the recirc passage and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- The floor/panel air flow door is in the partial vacuum position, allowing airflow to both the A/C registers and the heater outlet floor duct.
- The panel/defrost air flow door is at full vacuum, closing off airflow to the windshield defroster hose nozzle and directing airflow to the A/C registers. There is also some airflow to the side window demisters.
- The A/C compressor will be enabled when PANEL/FLOOR is selected.
- The blower motor is on.

FLOOR
When the FLOOR is selected:

- The air inlet duct door is in the no vacuum position, blocking recirc air and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- The floor/panel air flow door is in the full vacuum position, directing all airflow to the heater outlet floor duct. There is also some airflow to the side window demisters.
- The temperature can be adjusted to mix air flowing through and around the heater core to achieve the desired temperature level.
- The panel/defrost air flow door is in the no vacuum position, blocking air circulation to the panel A/C registers.
- The A/C compressor will be disabled when FLOOR is selected.
- The blower motor is on.

**FLOOR/DEFROST**

When the FLOOR/DEFROST is selected:

- The air inlet duct door is in the no vacuum position, blocking recirc air and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- The floor/panel air flow door is in the partial vacuum position, allowing airflow to both the windshield defroster hose nozzle and the heater outlet floor duct.
- The panel/defrost air flow door is in the no vacuum position, directing airflow to the windshield defroster hose nozzle. There is also some airflow to the side window demisters.
- The A/C compressor will be enabled when FLOOR/DEFROST is selected to dehumidify the air and reduce windshield fogging.
- The blower motor is on.

**DEFROST**
When the DEFROST is selected:

- The air inlet duct door is in the no vacuum position, admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- Both the floor/panel air flow door and the panel/defrost air flow door are in the no vacuum position so that most of the incoming air is directed to the windshield defroster nozzle. There is also airflow to the side window demisters.
- The temperature setting will determine the amount of air that is directed through the heater core and the amount that bypasses the heater core.
- The A/C compressor will be enabled when DEFROST is selected to dehumidify the air and reduce windshield fogging.
- The blower motor is on.

Electrical Components

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>19980</td>
<td>Manual A/C Control Assembly</td>
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<tr>
<td>2</td>
<td>19E561</td>
<td>A/C Cycling Switch</td>
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<tr>
<td>3</td>
<td>19D594</td>
<td>A/C Pressure Cut-Off Switch</td>
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<td>4</td>
<td>12A650</td>
<td>Powertrain Control Module</td>
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<td>5</td>
<td>14B192</td>
<td>A/C Clutch Relay</td>
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<tr>
<td>6</td>
<td>19703</td>
<td>A/C Compressor</td>
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<tr>
<td>7</td>
<td>18527</td>
<td>Blower Motor</td>
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<tr>
<td>8</td>
<td>18591</td>
<td>Heater Blower Motor Switch Resistor</td>
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<tr>
<td>9</td>
<td>19E616</td>
<td>A/C Electronic Door Actuator Motor</td>
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