Air Temperature Description and Operation

The air temperature controls are divided into 4 areas:

- HVAC Control Components
- Heating and A/C Operation
- Engine Coolant
- A/C Cycle

HVAC Control Components

The HVAC control assembly is a non-class 2 device that interfaces between the operator and the HVAC system to maintain air temperature and distribution settings. The HVAC unit is operated manually by a combination of electrical, mechanical and vacuum components. The case is of a 4-piece, plastic construction. The front and rear housing are assembled without the use of any fasteners. The front housing clips over the rear housing at 6 locations. Two equally sized recirculation doors are used to control airflow into the HVAC unit. Two air mix doors are used to control the airflow through the heater core. A single door is used to control airflow to the front defrost, floor and panel outlets. All doors excluding the air mix doors are vacuum operated. The air mix doors are operated mechanically. The blower motor/fan assembly, blower motor resistor, heater core and evaporator are all contained within the HVAC case. A vacuum tank is mounted to the left side of the case. Four externally mounted vacuum actuators are used to provide the selected ventilation modes. Contained within this assembly is a printed circuit board retained within the rear housing.

Temperature Switch

When the temperature switch is turned clockwise from the coldest position to the hottest position, the pinion and crescent gear mounted to the rear of the controller are rotated. This action simultaneously opens airflow through the heater core and cuts off vacuum to the water valve allowing heated coolant to flow through the heater core.

Cold Operation

Vacuum generated within the inlet manifold of the engine is stored within the vacuum tank mounted on the side the HVAC unit. Vacuum is retained within the HVAC system by the one way check valve and is directed to the water valve vacuum switch mounted to the rear of the HVAC controller. When the temperature switch is turned to the Full Cold position, the pinion gear rotates the crescent gear so that the ramp on the crescent gear pushes the plunger inside the water valve vacuum switch inward against spring pressure. In this position, the water valve vacuum switch allows vacuum to be directed to the water valve. When vacuum is applied to the water valve vacuum actuator, no coolant can flow through the heater core. However, coolant is still able to flow from the engine through the water valve via its engine side ports and engine side heater hoses. The crescent gear is also mechanically connected to the HVAC air mix doors via the actuating rod and levers. As well as operating the plunger of the water valve vacuum switch, the crescent gear simultaneously locates the air mix door in a position that does not allow any air to flow through the heater core in the Full Cold mode. The result is that all air entering the vehicle cabin will be cold air.

Warm Operation

When the temperature switch is turned from the Full Cold position, the crescent gear rotates backwards moving the ramp away from the plunger of the water valve vacuum switch. Spring pressure moves the plunger outward and at the third detent position, the vacuum line to the water valve actuator is vented through the exhaust port of the water valve vacuum switch. When the actuator is relieved of vacuum, the disc in the water valve will rotate and allow hot water to flow through the cabin side water valve ports and the cabin side heater hoses into the heater core. As the crescent gear rotates backward, it pulls the air mix doors open. When the temperature switch is turned to a Warm position, the air mix doors will be partially open. This will cause some incoming air to pass through the heater core and some to air to bypass the heater core. The mixture of heated and cool air will result in warm air entering the vehicle cabin.

Hot Operation

When the temperature switch is turned to in the Full Hot position the water valve vacuum switch plunger remains in the same position. Therefore, the water valve remains in the fully open position because the water valve actuator is devoid of vacuum. In the Full Hot position the crescent gear will be rotated fully rearward. This action will move the air mix doors to a position that directs all incoming air through the heater core. Therefore, all air entering the vehicle cabin will be heated air.

A/C Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5-volt reference, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0-5 volts. When the A/C refrigerant pressure is low, the signal value is near 0 volts. When the A/C refrigerant pressure is high, the signal value is near 5 volts. The PCM converts the voltage signal to a pressure value.

The pressure transducer is a sealed gage reference capacitive pressure sensor with on board signal conditioning. It provides a 0-5 volt output and requires a 5-volt regulated power supply. In operation the transducer senses applied pressure via the deflection of a 2 piece ceramic diaphragm with one half being a parallel plate capacitor. Changes in capacitance influenced by the refrigerant pressure under the ceramic diaphragm are converted to an analogue output by the transducers integral signal electronics. The pressure transducer's electronics are on a flexible circuit board contained in the upper section of the transducer. They provide linear calibration of the capacitance signal from the ceramic sensing diaphragm. Benefits of using the pressure transducer over a normal type pressure switch is that the transducer is constantly monitoring pressures and sending signals to the powertrain control module (PCM). The normal type pressure switch only has an upper and lower cut out point. The PCM will disengage the A/C compressor at low or high refrigerant pressures and electronic diagnostic equipment can be used to extract system pressure information making it easier when diagnosing problems. The A/C pressure transducer is located to the left side of the radiator assembly. Removal of the upper radiator shroud is required to gain access. As well as acting as an input to the PCM for A/C clutch operation, the PCM also uses the information provided by the pressure transducer to determine when to turn ON and OFF the 2nd Stage cooling fan operation. If there is a failure in the A/C Pressure Sensor circuit DTC P0530 A/C Refrigerant Pressure Sensor Circuit, will set.

A/C Pressure Sensor Operation
Low Pressure Cut Out 180 kPa (2600 psi)
Low Pressure Cut In 240 kPa (35 psi)
High Pressure Cut Out 2900 kPa (420 psi)

High Pressure Cut In 2000 kPa (290 psi)
1st Stage Fan Operation On 1517 kPa (220 psi)
1st Stage Fan Operation Off 1214 kPa (176 psi)
2nd Stage Fan Operation On 1758 kPa (255 psi)
2nd Stage Fan Operation Off 1517 kPa (220 psi)

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. The vehicle operator can determine the passenger compartment temperature by adjusting the air temperature switch. Regardless of the temperature setting, the following can effect the rate that the HVAC system can achieve the desired temperature:

- Recirculation actuator setting
- Difference between inside and desired temperature
- Difference between ambient and desired temperature
- Blower motor speed setting
- Mode setting

The control module makes the following actions when automatic operation is not selected, and an air temperature setting is selected:

- When the air temperature switch is placed in the warmest position, vacuum commands the air temperature door to divert maximum air past the heater core.
- When the air temperature switch is placed in the coldest position, vacuum commands the air temperature door to direct air to bypass the heater core.

The A/C system can be engaged by pressing the A/C switch. The A/C switch will illuminate when the A/C switch is pressed to the ON position. Pressing the A/C switch the control module grounds A/C request signal circuit from the powertrain control module (PCM). The following conditions must be obtained before A/C compressor engagement is allowed:

- A/C Pressure is between 180 kPa (26 psi) and 2 900 kPa (420 psi).
- Engine coolant temperature (ECT) is less than 121°C (250°F).
- Engine RPM is more than 550 RPM.
- The A/C request signal circuit is grounded.

Once engaged, the compressor clutch will be disengaged for the following conditions:

- A/C Pressure is more than 2 900 kPa (420 psi).
- A/C Pressure is less than 180 kPa (26 psi).
- Engine coolant temperature (ECT) is more than 121°C (250°F).
- Engine speed is more than 5,500 RPM.
- Throttle position is 100 percent.

- Transmission shift
- PCM detects excessive torque load.
- PCM detects insufficient idle quality.
- PCM detects a hard launch condition.

When the compressor clutch disengages, the compressor clutch diode protects the electrical system from a voltage spike.

A/C Request Signal and A/C Clutch Control

The BCM requests the PCM to turn the A/C compressor ON or OFF via the powertrain interface module (PIM) and the serial data bus normal mode message. The BCM monitors the voltage at the BCM A/C request circuit in order to determine the status of the momentary A/C switch. When the A/C switch is pressed, 12 volts is applied to the BCM A/C request circuit. The BCM sees this high voltage as an A/C switch input signal. On receiving the A/C switch input signal, the BCM requests the PCM to energize the A/C clutch via the PIM and the serial data bus normal mode message, if the ignition is ON and the blower motor is operating. The BCM also provides a ground to illuminate the A/C ON LED within the A/C switch. If the A/C switch is pressed again the BCM will request the PCM to turn OFF the A/C compressor. The operating status of the system will be remembered by the BCM, when the ignition is switched from ON to OFF or when the blower is switched OFF. If the blower is OFF and the A/C switch is pressed, then the next time the blower is switched ON the air conditioning will be turned ON. Turning the ignition OFF will cancel this button press function. The system will reset to OFF when the battery is disconnected. The PCM uses this signal to:

- Adjust the idle air control (IAC) valve position to compensate for the additional load placed on the engine by the air conditioning compressor.
- Energize the A/C compressor relay to operate the A/C compressor if the pressure in the A/C system is within the correct operating range.

The BCM monitors the blower motor switch setting to determine whether the blower motor has been selected or not. When the blower motor is running, BCM blower input circuit is pulled to ground. This causes the voltage at the BCM to change from battery voltage, +12 volts in the OFF position, to less than 0.3 volts, which is seen by the BCM as the blower ON signal. The BCM does not have any direct control over the operation of the air conditioner. When the A/C switch is turned ON at the HVAC controller, it passes this request received at the BCM to the PCM. The PCM then determines from other engine and A/C parameters whether the A/C clutch will be energized or not. Communication between the PCM and the BCM takes place via the Primary Serial Data bus.

The PCM monitors the A/C pressure sensor to determine A/C system pressure. There are 2 DTCs associated with the A/C system:

- P1539--Sets when the PCM detects voltage on the A/C clutch status terminal when the system has not requested A/C. A short to voltage at any point in the A/C status circuit, or the A/C relay contacts are stuck.
- P1546--Sets when the PCM activates the relay and does not detect the presence of a voltage at both the A/C compressor clutch and the A/C clutch status circuit at the PCM.

Heater Core

The heater core is located within the HVAC case. When the water valve is in the open position, engine coolant flows through the heater core providing heat to warm the vehicle interior and to provide windscreen defogging. The heater core is of a tube and fin design and is constructed of aluminium. It is fitted with a detachable inlet and outlet pipe assembly. Each pipe is attached and sealed to the heater core by a single screw, retaining clip and O-ring. Sealing foam is bonded to the sides and around the top of the heater core to prevent air leakage from the HVAC case and to ensure that all air passes through the heater core in the full hot mode.

Water Valve

The heater water valve is located in the engine bay. The vacuum line attached to the water valve vacuum actuator is connected to the water valve vacuum switch mounted on the HVAC controller. When full vacuum is applied to the water valve actuator, full closure of the valve occurs and no coolant will flow through the heater core.

Radiator

The condenser is mounted to the front of the radiator and is located and supported by 4 clips moulded into the front of the plastic radiator tanks. The lower clips lock the condenser in place and can be released by hand to facilitate condenser removal. The cooling fans motors are each attached by 3 screws to the one piece plastic fan shroud. The fan shroud is mounted to the rear of the radiator and is located and supported by 4 clips moulded into the rear of the plastic radiator tanks. The upper clips lock the fan shroud in place and can be released by hand to facilitate fan shroud removal. The shroud must be removed to facilitate fan motor and blade assembly removal. Two harness connectors are mounted to the upper section of the fan shroud allowing the fan motor and blade assemblies to be removed individually from the shroud. The fan motor and blade is balanced as an assembly. These 2 components are serviced only as a unit and must not be separated. The condenser, filter drier receiver, radiator and the fan motors/blades/shroud assembly can be removed and installed individually from the vehicle.

Condenser

The purpose of the condenser is the opposite of the evaporator. The condenser receives high pressure, high temperature refrigerant vapor from the compressor. It is exposed to a flow of ram air from the movement of the vehicle and as the high pressure high temperature vapor flows inside the condenser tubes, heat is given off to the cooler ambient air flowing past the condenser core. The vapor then condenses into a high pressure, high temperature liquid. Two cooling fans fitted to the rear of the radiator and are activated when required to assist in drawing cool air through the condenser. The condenser is of a parallel flow design. It has 38 horizontal, flat section tubes with side mounted header tubes. All tubes and fins are constructed of aluminium. It is mounted to the front of the radiator and is attached to the radiator tanks by 4 identical mounting clips that are assembled with screws to the condenser sides. The filter drier receiver is attached to the front of the condenser on the left side.

Evaporator

The evaporator is located inside the vehicle housed behind the instrument panel fascia in the HVAC case. It is constructed of aluminium and is of a plate and fin design. The evaporator core is the actual cooling unit of the A/C system. As the low pressure, low temperature refrigerant enters the evaporator, it begins to boil and evaporate. This evaporation process absorbs heat from the air being circulated through the evaporator core by the blower fan. Due to the evaporator being so cold, condensation forms on the surface. This condensation is moisture taken from the air (humidity). Also any dust particles in the air passing through the evaporator become lodged in the condensate water droplets, thus filtering the air from contaminants. The evaporator is constructed of aluminium and is fitted with a detachable inlet and outlet pipe assembly. It is attached and sealed to the evaporator by a single bolt and O-rings.

Filter Drier

The filter drier receiver acts as a particle filter, refrigerant storage container and most importantly a moisture absorber. Moisture, temperature and R-134a causes hydrofluoric and hydrochloric acid. The silica gel beads (desiccant) located in the filter drier receiver absorb small quantities of moisture thus preventing acid establishment.

Thermal Expansion Valve (TXV)

The thermal expansion valve (TXV) controls refrigerant gas flow to the evaporator and ensures that complete evaporation takes place. It has 2 refrigerant passages. One is in the refrigerant line from the condenser to the evaporator and contains a ball and spring valve. The other passage is in the refrigerant line from the evaporator to the compressor and contains the temperature sensing element.

TXV Opening

As the non-cooled refrigerant from the evaporator core flows through the TXV outlet (suction), it makes contact with the underside of the thin metallic diaphragm and reacts on the refrigerant contained above that diaphragm. This refrigerant then expands forcing the pin downwards moving the ball off its seat, compressing the spring and allowing more refrigerant to enter the evaporator.

TXV Closing

Operation is similar to opening but now the refrigerant from the evaporator is cold. The refrigerant contained above the diaphragm now contracts. The ball moves towards the seat aided by the compressed spring, reducing refrigerant flow. Low pressure liquid R-134a passing through the evaporator should be completely vaporized by the time it reaches the TXV outlet side. The TXV is installed in the engine bay to the right side of the instrument panel.

Compressor

The Delphi V7 compressor can match the air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with 7 axially oriented cylinders. The compressor has a pumping capacity of 179 cc.

The control valve is installed in the compressor rear head. The wobble-plate angle of the compressor, and the resultant compressor displacement, are determined by the compressor crankcase to suction pressure differential which is governed by the control valve.

When the A/C capacity demand is low, the crankcase pressure behind the pistons is equal to the pressure in front of the pistons. This forces the wobble plate to change its angle to towards vertical which reduces the stroke of the pistons and reduces the output of the compressor to approximately 14.5 cc. The evaporator cooling load is reduced, ambient temperature or blower fan speed is reduced, and therefore, the suction pressure is reduced until it reaches the control point. To reach the control point, the bellows in the control valve assembly has expanded to allow discharge pressure to bleed past the control valve ball valve seat and into the compressor crankcase. This crankcase pressure acts as an opposing force behind the compressor pistons to cause the wobble plate to change its angle towards vertical and therefore, reduce piston stroke.

When the A/C capacity demand is high, the crankcase pressure behind the pistons is less than the pressure in front of the pistons. This forces the wobble plate to change its angle away from vertical which increase the stroke of the pistons and increases the output of the compressor to approximately 164 cc. When suction pressure is above the control point, it will compress the control valve bellows. This will close off the discharge valve as the ball valve is now on its seat. The shuttle valve moves towards the suction port and opens the suction valve. Crankcase pressure will then bleed from the compressor crankcase past the suction valve to the suction port. As the crankcase pressure behind the pistons is reduced, the wobble plate will tilt from vertical causing the pistons to move towards maximum stroke. The compressor will then have a corresponding increase in its displacement.

Engine Coolant

Engine coolant is the essential element of the heating system. The thermostat controls the normal engine operating coolant temperature. The thermostat also creates a restriction for the cooling system that promotes a positive coolant flow and helps prevent cavitation.

Coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located inside the HVAC module. The ambient air drawn through the HVAC module absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC module, for passenger comfort. Opening or closing the air temperature door controls the amount of heat delivered to the passenger compartment. The coolant exits the heater core through the return heater hose and recirculated back through the engine cooling system.

Cooling Fan Operation

The cooling system includes 2 dual speed, engine cooling fan motors, both of which have drive fans with 5 asymmetrical blades to reduce air noise. The fans remove heat from both the engine coolant flowing through the radiator and the refrigerant flowing through the air conditioning condenser. The fan and motor assemblies are mounted on a common shroud, which in turn is mounted onto the engine side of the radiator. The A/C condenser is mounted to the front of the radiator.

The fan motors are 12-volt, dual speed types. The internal construction of the fan motor consists of 4 brushes and 4 permanent magnets. A 3-wire pigtail harness is permanently attached to both motors and is attached to the polypropylene fan shroud at 2 locations by integral clips moulded as part of the shroud. Both motor harnesses are connected directly to the engine harness through a 3-pin sealed connector. This enables individual removal of the left and right fan and motor assemblies when necessary. The 2 electrical connectors are attached to the shroud by way of slide lock clips. Each motor is attached to the polypropylene fan shroud by 3 bolts installed at the threaded mounting flanges, which protrude symmetrically from the rear of the fan motor housing. The enclosed fan motor housing is constructed of yellow zinc coated steel. A drain hole is located in the bottom of the housing to allow for breathing and draining of any moisture ingress. Both fan motors rotate in an anti-clockwise direction when viewed from the fan motor side. Both fan and motor assemblies are balanced as a unit. Fan blades must not be separated from their respective motors. Fan motors and blades are serviced only as an assembled unit. The central nut attaching the fan blade to the motor shaft has a left-hand thread.

--	Left Small Fan	Right Large Fan
Diameter	298	355 mm
Wattage	180	220
2nd Stage High Speed	2300 +/- 150 RPM	2750 +/- 150 RPM
1st Stage Low Speed	2050 +/- 150 RPM	2350 +/- 150 RPM

Each fan motor harness has 1 positive and 2 negative wires. To reduce the heat burden on the electrical connectors, the current draw is directed through separate negative terminals at the connector for each fan motor. The positive wire permanently connects battery voltage to the 2 positive brushes of each fan motor. The negative wires are each connected to 1 negative brush. When 1 negative wire per fan motor is grounded via the engine cooling fan relay 1, both cooling fan motors will operate at low speed. When both negative wires of each fan motor are grounded via the engine cooling fan relay 2, both cooling fan motors will operate at high speed.

Suppression capacitors located at the fan motor brush holders are incorporated. These suppression capacitors help eliminate fan motor noise through the radio speakers. If these capacitors are open, noise will be present through the radio speakers. If either of these capacitors were shorted to ground, the fan motors could run continuously or the fuses could fail. These capacitors are not serviced separately, the motor assembly must be replaced should a problem occur with either capacitor.

There are 2 relays used to control fan operation. The engine cooling fan relay 1 for low speed operation and the engine cooling fan relay 2 for high speed operation. The engine cooling fan relay 1 is energized by the body control module (BCM) in response to a request from the powertrain control module (PCM). The engine cooling fan relay 2 is energized by the PCM. After the PCM requests a change in the state of engine cooing fan relay 1, the BCM will send a serial data response message back to the PCM confirming it received the message. Serial data communication between the PCM and BCM is via the powertrain interface module (PIM). The PCM determines when to enable and disable both engine cooling fan relays based on inputs from the A/C request signal, the engine coolant temperature (ECT) sensor and the vehicle speed sensor (VSS).

Stage One -- Both Fans Operate at Low Speed

The engine cooling fan relay 1 is energized by the BCM in response to a request from the PCM. When the PCM determines that the engine cooling fan relay 1 should be enabled, the PCM will send a message on the Class 2 serial data circuit to the PIM. The PIM will then convert the PCM Class 2 message to a UART message and supply this UART message to the BCM, via a serial data Normal Mode Message. This message will request the BCM to supply the needed ground signal for the engine cooling fan relay 1 to operate.

After the BCM provides the ground signal for the engine cooling fan relay 1, the BCM will send a message back to the PIM confirming that the ground signal was commanded. A failure in this BCM response communication, will cause a PIM DTC to set.

The engine cooling fan relay 1 will be turned ON and both fans driven at low speed when the A/C request indicates YES and either:

- Vehicle speed is less than 30 km/h (19 mph).
- A/C refrigerant pressure is greater than 1,500 kPa (218 psi).
- ECT is greater than 108°C (227°F).
- If an ECT fault is detected and a DTC is set.
- When an ECT sensor failure in conjunction with an intake air temperature (IAT) sensor failure is detected by the PCM.
- When the ignition switch is turned from ON to OFF and the ECT is above 113°C (235°F), the BCM continues to energies the engine cooling fan relay 1 for 4 minutes. The low-speed cooling fan run-on time has a minimum default value of 30 seconds.

The low speed cooling fan operation is disabled when the engine cooling fan relay 1 is de-energized by the BCM via a request from the PCM. The PCM will request low speed fan disable via serial data communication to the BCM via the PIM. After the PCM requests a change in the state of engine cooling fan relay 1, the BCM will send a serial data response message back to the PCM confirming it received the message.

The engine cooling fan relay 1 will be turned OFF when any of the following conditions have been met:

- An A/C request is indicated (YES) with A/C refrigerant pressure less than 1,170 kPa (170 psi), vehicle speed greater than 50 km/h (31 mph) and the ECT less than 108°C (227°F).
- An A/C request is not indicated (NO) and the ECT is less than 104°C (219°F).

Stage Two -- Both Fans Operate at High Speed

The engine cooling fan relay 2 is controlled by the PCM. The PCM will only turn ON the engine cooling fan high speed relay fan if the engine cooling fan relay 1 has been ON for 2 seconds and the following conditions are satisfied:

- There is a BCM to PIM message response fault which will cause a PIM DTC to set.
- An ECT sensor fault is detected and a DTC is set.
- The ECT is greater than 113°C (235°F).
- The A/C refrigerant pressure is greater than 2,400 kPa (348 psi).

The engine cooling fan relay 2 will be turned OFF when any of the following conditions have been met:

- The ECT is less than 108.5°C (227.3°F).
- An A/C request is not indicated (NO).
- An A/C request is indicated (YES) and the A/C refrigerant pressure is less than 1,900 kPa (276 psi).

If the engine cooling fan relay 1 was OFF when the criteria was met to activate engine cooling fan relay 2, stage 2 fan operation will occur 1-5 seconds after the engine cooling fan relay 1 is turned ON.

If both engine cooling fan relays are ON, the PCM will turn OFF engine cooling fan relay 2 when any of the following conditions have been met:

- The engine coolant temperature is less than 108°C (227°F).
- An A/C request is not indicated (NO).
- An A/C request is indicated (YES) and the A/C refrigerant pressure is less than 1,900 kPa (276 psi).

The Stage 2 cooling fan operation has a minimum run-on time function of 30 seconds. Both cooling fans will be turned OFF if the vehicle speed is greater than 104 km/h (65 mph). Dependent upon input signals, ambient temperature, etc. the vehicle speed when all cooling fans will be turned OFF, is variable.

A/C Cycle

Refrigerant is the key element in an air conditioning system. R-134a is presently the only EPA approved refrigerant for automotive use. R-134a is a very low temperature gas that can transfer the undesirable heat and moisture from the passenger compartment to the outside air.

The A/C system used on this vehicle is a non-cycling system. Non-cycling A/C systems use a high pressure switch to protect the A/C system from excessive pressure. The high pressure switch will OPEN the electrical signal to the compressor clutch, if the refrigerant pressure becomes excessive. After the high and the low sides of the A/C system pressure equalize, the high pressure switch will CLOSE. This completes the electrical circuit to the compressor clutch. The A/C system is also mechanically protected with the use of a high pressure relief valve. If the high pressure switch were to fail or if the refrigerant system becomes restricted and refrigerant pressure continues to rise, the high pressure relief will pop open and release refrigerant from the system.

The A/C compressor is belt driven and operates when the magnetic clutch is engaged. The compressor builds pressure on the vapor refrigerant. Compressing the refrigerant also adds heat. The refrigerant is discharged from the compressor through the discharge hose, and forced through the condenser and then through the balance of the A/C system.

Compressed refrigerant enters the condenser at a high-temperature, high-pressure vapor state. As the refrigerant flows through the condenser, the heat is transferred to the ambient air passing through the condenser. Cooling causes the refrigerant to condense and change from a vapor to a liquid state.

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum tubing and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-cooled liquid refrigerant exits the condenser and flows through the liquid line to the thermal expansion valve (TXV).

The TXV is located at the evaporator inlet. The TXV is the dividing point for the high and the low pressure sides of the A/C system. As the refrigerant passes through the TXV, the pressure on the refrigerant is lowered, causing the refrigerant to vaporize at the TXV. The TXV also measures the amount of liquid refrigerant that can flow into the evaporator.

Refrigerant exiting the TXV flows into the evaporator core in a low-pressure, liquid state. Ambient air is drawn through the HVAC module and passes through the evaporator core. Warm and moist air will cause the liquid refrigerant to boil inside the evaporator core. The boiling refrigerant absorbs heat from the ambient air and draws moisture onto the evaporator. The refrigerant exits the evaporator through the suction line and flows back to the compressor in a vapor state, completing the A/C cycle of heat removal. At the compressor, the refrigerant is compressed again and the cycle of heat removal is repeated.

The conditioned air is distributed through the HVAC module for passenger comfort. The heat and moisture removed from the passenger compartment condenses, and discharges from the HVAC module as water.