GENERAL DESCRIPTION AND SYSTEM OPERATION

THE V5 A/C SYSTEM

The V5 variable displacement compressor along with the thermal expansion valve on the evaporator, constitutes a largely self–regulating system. There is no pressure cycling switch, no high–pressure cut–off switch, and no low–pressure cut–off switch. The compressor clutch is controlled by the engine control module (ECM), which receives data from various engine systems and from a pressure transducer located in the high–pressure refrigerant pipe. In normal operation, the clutch is engaged continuously. Should one of the monitored conditions become abnormal, the ECM will disengage the compressor clutch until normal operation is restored. These conditions include the following:

- Wide–open throttle.
- High engine coolant temperature.
- High engine rpm.
- Refrigerant low pressure.
- Refrigerant high pressure.

SYSTEM COMPONENTS – FUNCTIONAL

Compressor

All compressors are belt–driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft is driven, it compresses the low–pressure refrigerant vapor from the evaporator into a high–pressure, high–temperature vapor. The refrigerant oil which is used to lubricate the compressor is carried with the refrigerant. Refer to ”V5 Air Conditioning Compressor Overhaul” in this section.

Pressure Relief Valve

The compressor is equipped with a pressure relief valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure. To prevent system damage, the valve is designed to open automatically at 3 171 to 4 137 kPa (460 to 600 psi) in an R–134a system. Conditions that might cause this valve to open, such as a defective pressure transducer, an inoperative cooling fan, etc., should be corrected. The refrigerant oil and the refrigerant should be replaced, as necessary.

Condenser Core

The condenser assembly in front of the radiator consists of coils which carry the refrigerant, and cooling fins that provide the rapid transfer of heat. The air passing through the condenser cools the high–pressure refrigerant vapor and causes it to condense into a liquid.

Expansion Valve

The expansion valve is located with the evaporator core, inside the heater/air distributor case under the instrument panel.

The expansion valve can fail in three different positions: open, closed, or restricted.

An expansion valve that fails in the open position will result in a noisy A/C compressor or no cooling. The cause can be a broken spring, a broken ball, or excessive moisture in the A/C system. If the spring or the ball are found to be defective, replace the expansion valve. If excessive moisture is found in the A/C system, recycle the refrigerant.

An expansion valve that fails in the closed position will result in low suction pressure and no cooling. This may be caused by a failed power dome or excessive moisture in the A/C system. If the power dome on the expansion valve is found to be defective, replace the expansion valve. If excessive moisture is found in the A/C system, recycle the refrigerant.

A restricted expansion valve will result in low suction pressure and no cooling. This may be caused by debris in the refrigerant system. If debris is believed to be the cause, recycle the refrigerant, replace the expansion valve, and replace the receiver–dryer.

Evaporator Core

The evaporator is a device which cools and dehumidifies the air before it enters the vehicle. High–pressure liquid refrigerant flows through the expansion tube orifice and becomes a low–pressure gas in the evaporator. The heat in the air passing through the evaporator core is transferred to the cooler surface of the core, which cools the air. As the process of heat transfer from the air to the evaporator core surface is taking place, any moisture or humidity in the air condenses on the outside surface of the evaporator core and is drained off as water.

Receiver–Dryer

The sealed receiver–dryer assembly is connected to the condenser outlet pipe. It acts as a refrigerant storing container, receiving liquid, vapor, and refrigerant oil from the evaporator.

At the bottom of the receiver–dryer is the desiccant, which acts as a drying agent for the moisture that may have entered the system. An oil bleed hole is located near the bottom of the receiver–dryer outlet pipe to provide an oil return path to the compressor. The receiver–dryer is serviceable only as an assembly.

Heater Core

The heater core heats the air before it enters the vehicle. Engine coolant is circulated through the core to heat the outside air passing over the fins of the core. The core is functional at all times and may be used to temper conditioned air in the A/C mode as well as in the heat or the vent modes.

SYSTEM COMPONENTS – CONTROL

Controller

The operation of the A/C system is controlled by the switches on the control head. This console–mounted heating–and–ventilation panel contains the following:

Three rotary control knobs

1. The rotary temperature control knob:
   - Actuates by cable.
   - Varies the mix of the fresh air from outside the vehicle with the heated air from inside the vehicle to suit individual preference.
   - Raises the temperature of the air entering the vehicle by rotation toward the right, or the red portion of the knob.
2. The rotary mode control knob:
   - Actuates by vacuum.
   - Regulates the air distribution between the windshield, the instrument panel, and the floor vents.
3. The rotary blower control knob:
   - Turns ON to operate the blower motor at four speeds.
   - Turns OFF to stop the blower.
   - Operates completely independently from both the mode control knob, that regulates the defroster door, and the temperature control knob.
   - Changes the fan speed in any mode and at any temperature setting. However, if the rotary blower control knob is OFF, the A/C system is OFF, regardless of the position of the A/C push knob.

Three push knobs

1. The A/C push knob:
   - Controls the A/C.
   - Turns the A/C ON when the push knob is pressed and the indicator lamp is illuminated. (The rotary blower control knob must be in one of its four positions for the A/C to function.)
2. The rear window defogger push knob:
   - Controls the rear window defogger.
   - Turns ON the rear window defogger when the push knob is pressed and the indicator lamp is illuminated.
3. The fresh air control push knob:
   - Switches between recirculating passenger compartment air or bringing outside air into the passenger compartment.
   - Defaults to fresh air mode. The indicator lamp is illuminated when recirculation is selected.
   - Operates the inlet air door by vacuum.

The engine cooling fans are operational any time the A/C control is on. This added feature is part of the A/C controller function and is aimed at preventing excessive compressor head temperatures. It also allows the A/C system to function more efficiently. The operation of the cooling fans is controlled by the engine control module (ECM) through the cooling fan relays.

Vacuum Lines

Vacuum lines are molded to a connector, which is attached to a vacuum control switch on the control head assembly.

In case of leakage or hose collapse, it will not be necessary to replace the entire harness assembly. Replacement can be made by cutting the hose and inserting a plastic connector. If an entire hose must be replaced, cut all the hoses off at the connector and attach hoses directly to the control head vacuum switch.

Vacuum Tank

During heavy acceleration, the vacuum supply from the manifold drops. A check valve in the vacuum tank maintains vacuum so that under load conditions vacuum will be available for continuous use.

Pressure Transducer

Pressure transducer switching incorporates the functions of the high–pressure and the low–pressure cutout switches along with the fan cycling switch. The pressure transducer is located in the high–side liquid refrigerant line behind the right headlamp, between the right front inner fender and the air filter assembly. The output from this pressure transducer goes to the ECM which controls the compressor function based on the pressure signal.

Wide–Open Throttle (WOT) Compressor Cutoff

During full throttle acceleration, the throttle position sensor (TPS) sends a signal to the ECM, which then controls the compressor clutch.

V5 COMPRESSOR – GENERAL DESCRIPTION

Vehicles using the V5 compressor may have differences between installations in the mounting brackets, the drive systems, the pulleys, the connections, and the system capacities. Basic overhaul procedures are similar between the compressors used on different vehicles.

When servicing the compressor, keep dirt and foreign material from getting on or into the compressor parts and the system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before un-

dertaking any on–vehicle repairs and before the removal of the compressor. The parts must be kept clean at all times. Any parts that are to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene, or equivalent solvents and dried with dry air. Use only lint–free cloths to wipe the parts.

The operations described are based on bench overhaul with the compressor removed from the vehicle, except as noted. They have been prepared in the order of accessibility of the components. When a compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained, measured, and recorded. This oil should then be discarded and new polyalkaline glycol (PAG) refrigerant oil added to the compressor.

Important : The oil drain plug must be removed and the oil drained through the plug opening to insure complete draining of the oil from the compressor.

V5 COMPRESSOR – DESCRIPTION OF OPERATION

The V5 is a variable displacement compressor that can match the automotive A/C demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble–plate with five axially oriented cylinders. The center of control of the compressor displacement is a billows–actuated control valve located in the rear head of the compressor that senses compressor suction pressure.

The wobble–plate angle and the compressor displacement are controlled by the crankcase suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point. The valve will maintain a bleed from crankcase to suction. With no crankcase–suction pressure differential, the compressor will have maximum displacement.

When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close off a passage from the crankcase to the suction plenum. The angle of the wobble–plate is controlled by a force balance on the five pistons. A slight elevation of the crankcase suction pressure differential creates total force on the pistons resulting in a movement about the wobble–plate pivot pin that reduces the plate angle.

The compressor has a unique lubrication system. The crankcase suction bleed is routed through the rotating wobble–plate for lubrication of the wobble–plate bearing. The rotation acts as an oil separator which removes some of the oil from the crankcase suction bleed, rerouting it to the crankcase where it can lubricate the compressor mechanism.