Preliminary Checks

Before testing the operation of the air conditioning system, check the following items:

1. Make sure the drive belt on the refrigerant compressor is not damaged. Make sure the compressor mounting capscrews are tight. The capscrews should be torqued 15 to 19 lbf·ft (20 to 26 N·m).
2. Using a feeler gauge, check the refrigerant compressor for correct clutch clearance. See **Section 83.01, Subject 140** for instructions.
3. Check for broken or cut hoses. Check for loose fittings on all parts.
4. Check for road debris buildup on the condenser coil fins. Using air pressure and a whisk broom or a soapy spray of water, carefully clean off the condenser. Be careful not to bend the fins.
5. If there is not enough airflow, make sure that leaves or other debris have not entered the fresh air ports under the windshield. If debris is present, it could clog the air inlet and block airflow. Remove the debris carefully.

   Be sure that all ducts are connected to the dash outlets.

Air Conditioning System Performance Test

If the system does not operate within the following guidelines, further diagnosis and repair may be necessary.

1. Park the vehicle out of direct sunlight, shut down the engine, and chock the tires.
2. Open the hood.

NOTE: Make a printed copy of **Table 1** to use for recording the readings taken for this procedure.

3. Record the ambient temperature and the relative humidity in **Table 1**.
4. Make sure the engine fan is engaged. If equipped with a viscous fan, the fan must be manually locked before testing the A/C system.

   To lock the fan, make two Z-shaped brackets similar to those shown in **Fig. 1**. Mount the brackets to the fan and hub 180 degrees apart. It is important to use two brackets to prevent vibration when testing. The brackets can be made by drilling and bending 3/4-inch x 1/8-inch (19-mm x 3-mm) mild steel strap.

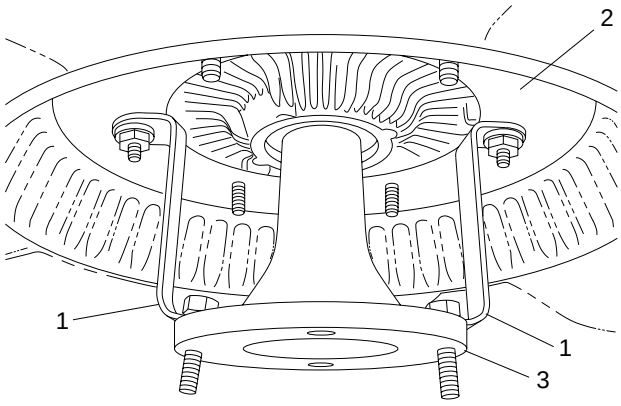


Fig. 1, Viscous Fan

WARNING

Use two brackets to lock the fan. If two brackets are not used, the bolts could shear or the fan could become unbalanced resulting in personal injury or damage to the fan.

5. Open the driver and passenger doors.
6. Connect the A/C test gauges to the refrigerant system service ports.
7. Place a thermometer in the center dash outlet.
8. Start the engine and warm it to operating temperature.
9. Set the engine speed to 1500 rpm.
10. Set the control panel to normal A/C, the recirculation to off, and the fan to the highest speed.
11. Allow time for the system to stabilize (at least 5 minutes or until the dash outlet temperature is at minimum) then record the values in **Table 1** under the "Actual Readings" heading.
12. Refer to the appropriate temperature/pressure table in **Subject 400**. Using the recorded ambient temperature and relative humidity readings, locate the values in the temperature/pressure

table and record them in **Table 1** under the "Published Readings" heading.

13. If the actual dash outlet temperature is within the range of the published values, then the system is performing satisfactorily. If the actual temperature is not within the published value, use the other readings such as high-side or low-side (suction or discharge) pressures and compressor cycling information to begin diagnosing the system.
14. If Z-shaped brackets were used to lock the viscous fan, remove the brackets.

Refrigerant Pressure Test Gauge Diagnosis

See **Table 2** for diagnosis of the system using refrigerant pressure test gauge readings. Check the specific component or condition mentioned in the Possible Cause column to help determine the cause of a problem with the system.

A/C Performance Test Data		
Test Data Item	**Published Readings (see step 12)**	**Actual Readings**
Ambient Temperature Relative Humidity (RH)		_____°F (°C) _____% RH
Center Dash Outlet Temperature	_____°F (°C) to _____°F (°C)	_____°F (°C)
High-Side Pressure	_____ psi (kPa) to _____ psi (kPa)	_____ psi (kPa)
Low-Side Pressure	_____ psi (kPa) to _____ psi (kPa)	_____ psi (kPa)
Compressor Cycling	yes/no	yes/no
Compressor On/Off Time (only if cycling)	on _____ sec off _____ sec	on _____ sec off _____ sec

Table 1, A/C Performance Test Data

System Diagnosis Using Refrigerant Pressure Readings			
Suction Pressure (low side)	**Discharge Pressure (high side)**	**Possible Cause**	**Remedy**
High	Low	Worn compressor.	Replace compressor. Be sure to identify and correct cause of failure (e.g. system contamination, incorrect oil charge, leaks, etc.)
High	Normal	Thermal expansion valve (TXV) stuck open.	Replace TXV.
High	High	Restricted condenser air flow.	Clean bugs, dirt, and any debris or obstructions blocking airflow through the condenser. Straighten condenser fins as necessary. Make sure engine fan is working properly and that fan shroud is in place.
		Air or moisture in the refrigerant.	Recover and evacuate the system, charge system with proper amount of pure R-134a refrigerant. Replace the R/D if moisture was determined to be an issue.
		System overcharged.	Recover and evacuate the system, charge system with proper amount of pure R-134a refrigerant.
		Blockage downstream of measurement point and before expansion valve.	Remove the blockage or replace the component with the blockage as necessary. Determine cause of blockage and make further repairs as required.

System Diagnosis Using Refrigerant Pressure Readings			
Suction Pressure (low side)	**Discharge Pressure (high side)**	**Possible Cause**	**Remedy**
Normal	Low	Improper belt tension.	Check belt tension, repair as necessary.
		Restricted suction line.	Remove the blockage or replace the component with the blockage as necessary. Determine cause of blockage and make further repairs as required.
		Worn compressor.	Replace compressor. Be sure to identify and correct cause of failure (e.g. system contamination, incorrect oil charge, leaks, etc.)
Normal	Normal	No problem found.	No action required.
Normal	High	Restricted condenser airflow.	Clean bugs, dirt, and any debris or obstructions blocking airflow through the condenser. Straighten condenser fins as necessary. Make sure engine fan is working properly and that fan shroud is in place.
		Slight over-charge.	Recover and evacuate the system, charge system with proper amount of pure R-134a refrigerant.
Low	Low	Blockage in system.	Remove the blockage or replace the component with the blockage as necessary. Determine cause of blockage and make further repairs as required.
		Low refrigerant charge.	Thoroughly leak test the system using approved UV dye and/or electronic detector. Repair all leaks as necessary. Charge system with proper amount of pure R-134a refrigerant.
		Frozen evaporator.	Check refrigerant charge, check evaporator probe, correct as necessary.
		Faulty thermal expansion valve (TXV).	Replace TXV.
		Faulty evaporator sensor.	Replace sensor.
Low	Normal	Blockage downstream of the measurement point and before the expansion valve.	Remove the blockage or replace the component with the blockage as necessary. Determine cause of blockage and make further repairs as required.
		Low refrigerant charge.	Thoroughly leak test the system using approved UV dye and/or electronic detector. Repair all leaks as necessary. Charge system with proper amount of pure R-134a refrigerant.
		Faulty evaporator sensor.	Replace sensor.
Low	High	Blockage downstream of the measurement point and before the expansion valve.	Remove the blockage or replace the component with the blockage as necessary. Determine cause of blockage and make further repairs as required.
		Low charge.	Thoroughly leak test the system using approved UV dye and/or electronic detector. Repair all leaks as necessary. Charge system with proper amount of pure R-134a refrigerant.
		Faulty evaporator sensor.	Replace sensor.

Table 2, System Diagnosis Using Refrigerant Pressure Readings

Troubleshooting

System Troubleshooting Tables

Problem — No Fresh Air (nonrecirculation mode)

Problem — No Fresh Air (nonrecirculation mode)	
Possible Cause	**Remedy**
Mechanical problem with the recirculation door actuator.	Inspect the recirculation door actuator for obstructions or mechanical damage. Correct as necessary.
Problem with the wiring.	Refer to "Recirculation Door Actuator Circuit Tests" for diagnosis.
The control head is not working.	
The blower motor is in protection mode.	Refer to "Blower Motor Circuit Tests" for diagnosis.

Problem — Warm Airflow When the Air Conditioner is On; A/C is Not Working; or Poor Performance of A/C

Problem — Warm Airflow When the Air Conditioner is On; A/C is Not Working; or Poor Performance of A/C	
Possible Cause	**Remedy**
Low refrigerant charge in the system.	Perform a leak test. Repair any leaks, evacuate the system, replace the receiver-drier, and add a full charge of refrigerant.
Too much refrigerant in the system.	Evacuate the system, then add a full charge of refrigerant.
Moisture in the system.	If moisture is in the system, ice crystals may form and block the flow of refrigerant at the expansion valve or other places in the system. Recover the refrigerant, replace the receiver-drier, evacuate the system, and add a full charge of refrigerant.
The refrigerant compressor is not working.	The refrigerant charge is low or high.
	The refrigerant compressor clutch or drive belt needs repair or replacement.
	Refer to "A/C Clutch Circuit Tests for Diagnosing No A/C Clutch Engagement" in this subject.
Ice has formed on the evaporator coil.	Defrost the evaporator coil before resuming operation of the air conditioner. Refer to "Evaporator Probe Circuit Tests" in this subject for diagnosis.
Temperature blend door actuator is not working.	Refer to "Temperature Blend Door Circuit Tests" in this subject for diagnosis.
	Mechanical problem with temperature blend door actuator.
Blockage in A/C system such as lines, evaporator, condenser, or expansion valve.	Remove the blockage.
The blower motor is in protection mode.	Refer to "Blower Motor Circuit Tests" for diagnosis.
The evaporator probe isn't working or is out of range.	Refer to "Evaporator Probe Circuit Tests" for diagnosis.

Problem — Low-Side Pressure Too Low

Problem — Low-Side Pressure Too Low	
Possible Cause	**Remedy**
The expansion valve is not working.	Check the expansion valve for blockage and function. Blockage may be due to moisture causing ice formation.

Problem — Low-Side Pressure Too Low	
Possible Cause	**Remedy**
There are line or component restrictions.	Remove the restrictions.
The refrigerant charge is low.	Perform a leak test. Repair any leaks, evacuate the system, replace the receiver-drier, and add a full refrigerant charge.

Problem — High-Side Pressure Too High

Problem — High-Side Pressure Too High	
Possible Cause	**Remedy**
Airflow through the condenser is restricted.	Check for and remove dirt or debris in front of the condenser and radiator.
	Check the engine fan operation.
There is an internal restriction in the condenser indicated by ice buildup on the condenser or a cool spot on the line from the condenser to the receiver-drier.	Replace the condenser. If compressor failure recently occurred, the blockage may be due to debris from a failed compressor.
Air is in the refrigerant.	Perform a leak test. Repair any leaks, evacuate the system, replace the receiver-drier if necessary, and add a full charge of refrigerant.
The engine is overheated.	Check the engine cooling system.
Restriction in the compressor discharge line.	Replace the line.

Problem — Compressor Runs Continuously

Problem — Compressor Runs Continuously	
Possible Cause	**Remedy**
Low refrigerant charge in the system.	Perform a leak test. Repair any leaks, evacuate the system, replace the receiver-drier, and add a full charge of refrigerant.
The evaporator probe isn't working.	Refer to "Evaporator Probe Circuit Tests" for diagnosis.

Problem — Little or No Heat

Problem — Little or No Heat	
Possible Cause	**Remedy**
Low engine coolant.	Check coolant level. If low, check for source of leak and repair as necessary.
Plugged heater core.	Flush or replace the heater core as necessary.
Engine thermostat is not working.	Check to see if the engine thermostat is stuck open. Refer to **Section 20.00, Subject 300** for diagnosis.
Engine fan on all the time.	Refer to **Group 20** for diagnosis.
Mechanical problem with temperature blend door actuator.	Inspect the temperature blend door actuator for obstructions or mechanical damage. Correct as necessary.
Problem with the wiring.	Refer to "Temperature Blend Door Actuator Circuit Tests" for diagnosis.
The control head is not working.	

Troubleshooting

Problem — Water or Liquid Leaking from the Air Conditioner

Problem — Water or Liquid Leaking from the Air Conditioner	
Possible Cause	**Remedy**
The drain tubes are plugged.	Clean the drain tubes.
Heater core is leaking.	Leak test and replace the heater core if necessary.

Problem — Recirculation Mode Not Working

Problem — Recirculation Mode Not Working	
Possible Cause	**Remedy**
Air selection switch is set to full or partial defrost.	Recirculation mode is not available in any of the defrost settings. This is not a problem.
Mechanical problem with the recirculation door actuator.	Inspect the recirculation door actuator for obstructions or mechanical damage. Correct as necessary.
Problem with the wiring.	Refer to "Recirculation Door Actuator Circuit Tests" for diagnosis.
The recirculation door actuator is not working.	
The control head is not working.	

Problem — Air Selection Switch Not Working

Problem — Air Selection Switch Not Working*	
Possible Cause	**Remedy**
Mechanical problem with the air distribution door actuator.	Inspect the air distribution door actuator for obstructions or mechanical damage. Correct as necessary.
Problem with the wiring.	Refer to "Air Distribution Door Actuator Circuit Tests" for diagnosis.
The control head is not working.	

* Not able to control where the air is directed.

Problem — No Cool Vent Air on a Heater-Only System

Problem — No Cool Vent Air on a Heater-Only System	
Possible Cause	**Remedy**
Mechanical problem with the temperature blend door actuator.	Inspect the temperature blend door actuator for obstructions or mechanical damage. Correct as necessary.
Problem with the wiring.	Refer to "Temperature Blend Door Actuator Circuit Tests" for diagnosis.
The control head is not working.	

Problem — No Backlighting on the Control Head

Problem — No Backlighting on the Control Head	
Possible Cause	**Remedy**
Problem with the wiring.	Refer to "Backlighting Circuit Tests" for diagnosis.
The control head is not working.	

Problem — Blower Not Working

Problem — Blower Not Working	
Possible Cause	**Remedy**
Problem with the wiring.	Refer to "Blower Motor Circuit Tests" for diagnosis.
The control head is not working.	
A fuse is blown.	
The blower motor is not working.	

Component and System Tests

Use the following component and system tests to diagnose an HVAC problem.

Receiver-Drier

To the touch, the entire length of the receiver-drier should be the same temperature. If the receiver-drier is not the same temperature, it may indicate a blockage or low charge. Any blockage can cause high head pressures.

Cooling System

Although they are not physically connected, there is a close tie between the air conditioner and the cooling system. Poor air conditioner cooling can be the result of a problem in the cooling system.

If the cooling system does not work correctly, the heat of the engine will rise to abnormal levels. The added heat will transfer to the air conditioner, other underhood parts, and maybe make its way into the cab. The added heat makes it necessary for the air conditioner to work harder and reduces the ability of the air conditioner to cool the air in the cab.

See **Group 20** for cooling system troubleshooting, and see the engine manufacturer's service manual for other details about cooling system problems.

Expansion Valve

Problems with the expansion valve may be caused by the valve being stuck closed or open. When the valve is stuck closed, the evaporator coil and the expansion valve will be at outside temperature. When the valve is stuck open, both the coil and the valve will be extremely cold with frost or ice buildup.

Because the expansion valve channels are very small, blockages in the system tend to be found here. The valve is very sensitive to contamination. The contaminant is usually water. Less than a drop of water is all it takes to make the valve stop working. When water reaches the valve, the extreme cold that results from the pressure drop freezes the water, forming a block of ice in the valve. After the system shuts down and the valve warms, the ice melts and the valve operates again, only to be blocked again when the moisture returns and freezes.

On-and-off operation of the expansion valve means that the receiver-drier is not removing moisture from the system.

Refrigerant Compressor

Compressor problems usually show in one of four ways:

- abnormal noise
- seizure
- leakage
- low suction and discharge pressures

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

Low discharge pressure may be caused by not enough refrigerant, not enough belt tension, or a blockage somewhere in the system. These things should be checked before servicing the compressor.

Evaporator

The evaporator coils are basically trouble-free when airflow over the fins is not blocked. The filter next to the evaporator removes debris. If the filter is installed, no blockage can occur.

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

Condenser

The condenser is usually trouble-free. Normally, the temperature of the condenser outlet line is noticeably cooler than the inlet line. However, when road debris such as leaves or dirt build up, the airflow over the condenser fins is blocked. Air is not able to absorb enough heat to turn the hot refrigerant gas into a liquid. High head pressures will result. In these cases, carefully clean the outer surfaces of the condenser with compressed air or a soap and water solution. Be careful not to bend the fins.

High head pressures will also occur if the condenser tubing is abnormally bent, blocking the flow of refrigerant. Frost will appear at the point where the flow is restricted.

Less common internal blockages, such as bits of foreign material or metallic grit buildup, will stop the flow of refrigerant.

When troubleshooting a suspected condenser problem, remember that the problem may be caused by the radiator transferring high levels of heat to the condenser. See **Group 20** of this manual for cooling system troubleshooting, and see the engine manufacturer's service manual for other information about cooling system problems.

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 insufficient cooling.

Areas of ice or frost buildup usually mean a blockage. Parts that often freeze are probably corroded or inoperative and should be replaced. Parts, such as the expansion valve, that freeze once in a while may do so because of moisture in the system. If this happens, recover the refrigerant charge, evacuate/recycle the system refrigerant, replace the receiver-drier, and recover, evacuate, and charge the system with refrigerant.

Temperature Blend Door Actuator Circuit Tests

The temperature blend door actuator controls the amount of air that is routed through the heater core. The temperature blend door actuator is controlled by the temperature control switch on the control head (climate control panel). The control head senses the door position by reading the feedback voltage from the actuator position sensor. The feedback voltage will be less than the 5V reference voltage sent by the control head to the sensor.

The target position is based on the temperature control switch setting and internal control head algorithms. The desired position is considered reached when one of the following conditions is true, although this does not necessarily mean that the position actually corresponds to the desired temperature setting (for example, if the actuator movement is limited due to an obstruction).

- The actuator feedback position has been reached.
- The actuator is stalled for more than 1 second; the actuator feedback position does not change for more than 1 second.
- The target position corresponds to an end stop and an additional 1 second extra drive in the same direction (to guarantee sealing) has been performed.

The temperature blend door should move from one extreme position to the other when turning the temperature control switch from cold to hot or from hot to cold.

Follow the tests in **Table 3** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check. If the temperature blend door actuator passes the tests in **Table 3** and the actuator still does not operate properly, check for mechanical problems with the actuator.

Temperature Blend Door Actuator Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
actuator motor drive circuit	key on, engine off temperature blend door actuator connector removed fan (blower) switch on low change temperature setting while observing the digital multimeter (DMM)	Measure across pins 5 and 6 of the temperature blend door actuator connector.	9V+ for about 1 second*	Check wiring between control head and temperature blend door actuator. If wiring is okay, replace the control head.
actuator position sensor reference voltage circuit	key on, engine off temperature blend door actuator connector removed	Measure between pin 7 of the temperature blend door actuator connector and the battery negative post.	5V	
actuator position sensor reference ground circuit	key on, engine off temperature blend door actuator connector removed	Measure between pin 8 of the temperature blend door actuator connector and the battery positive post.	12V*	
actuator position sensor feedback signal circuit	key on, engine off all connectors connected	Backprobe pins B11 and B5 at control head connector.	0.50V (full hot) to 4.00V (full cold)†	Check wiring between control head and temperature blend door actuator.‡ If wiring is okay, replace the actuator.‡

* The voltage should be approximately the same as the battery voltage.

† Values are approximate.

‡ It is assumed that reference voltage and ground circuits are functioning.

Table 3, Temperature Blend Door Actuator Circuit Tests

Air Distribution Door Actuator Circuit Tests

The air distribution (mode) door actuator controls the direction the air is routed through the HVAC ducts in the cab. The air distribution door actuator is controlled by the air selection switch on the control head (climate control panel). The control head senses the air distribution door position by reading the feedback voltage from the actuator position sensor. The feedback voltage will be less than the 5V reference voltage sent by the control head to the sensor.

The target position is based on the air selection switch setting and internal control head algorithms. The desired position is considered reached when one of the following conditions is true, although this does not necessarily mean that the position actually corresponds to the desired air selection setting (for example, if the actuator movement is limited due to an obstruction).

- The actuator feedback position has been reached.
- The actuator is stalled for more than 1 second; the actuator feedback position does not change for more than 1 second.
- The target position corresponds to an end stop and an additional 1 second extra drive in the same direction (to guarantee sealing) has been performed.

The air distribution door should move from one extreme position to the other when turning the air selection switch from the far left to the far right or from the far right to the far left.

Follow the tests in **Table 4** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check. If the air distribution door actuator passes the tests in **Table 4**

and the actuator still does not operate properly, check for mechanical problems with the actuator. To quickly check for normal operation, feel for air flowing from the correct outlet in each air selection setting.

Air Distribution Door Actuator Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
actuator motor drive circuit	key on, engine off air distribution door actuator connector removed fan (blower) speed on low change the air selection setting while observing the digital multimeter (DMM)	Measure across pins 5 and 6 of the air distribution door actuator connector.	9V+ for about 1 second*	Check wiring between control head and air distribution door actuator. If wiring is okay, replace the control head.
actuator position sensor reference voltage circuit	key on, engine off air distribution door actuator connector removed	Measure between pin 10 of the air distribution door actuator connector and the battery negative post.	5V	
actuator position sensor reference ground circuit	key on, engine off air distribution door actuator connector removed	Measure between pin 8 of the air distribution door actuator connector and the battery positive post.	12V*	
actuator position sensor feedback signal circuit	key on, engine off all connectors connected	Backprobe pins B10 and B5 at control head connector.	0V (far right) to 5V (far left)	Check wiring between control head and air distribution door actuator.† If wiring is okay, replace the actuator.†

* The voltage should be approximately the same as the battery voltage.

† It is assumed that reference voltage and ground circuits are functioning.

Table 4, Air Distribution Door Actuator Circuit Tests

Recirculation Door Actuator Circuit Tests

The recirculation door actuator controls the source of the air, fresh or recirculated, that is routed through the HVAC ducts in the cab. The recirculation door actuator is controlled by the recirculation button on the control head (climate control panel).

Vehicles built from May 2, 2003, have partial recirculation. For information on this feature, see **Subject 050**.

The control rules for the recirculation mode are as follows:

- The recirculation mode is not available in the defrost settings.
- The default at power up is fresh air unless the fan switch is in the off position. When the fan switch is in the off position, the recirculation mode is the default mode, but the LED is not illuminated.
- When the recirculation mode is enabled, it will remain on until one of the following occurs:
  - the air selection switch is moved to a defrost mode;
  - the recirculation button is pressed;
  - the ignition is cycled;
  - 20 minutes have passed and the recirculation timer has expired.

NOTE: On vehicles built prior to May 2, 2003, the recirculation mode is canceled until the recirculation button is pressed again. On vehicles built from May 2, 2003, the system enters partial recirculation mode for five minutes, then re-

sumes full recirculation mode for 20 minutes. This cycle repeats as long as the system remains in recirculation mode.

The control head senses the recirculation door position by reading the feedback voltage from the actuator position sensor. The feedback voltage will be less than the 5V reference voltage sent by the control head to the sensor.

The target position is based on the recirculation button setting and internal control head algorithms. The desired position is considered reached when one of the following conditions is true, although this does not necessarily mean that the position actually corresponds to the desired recirculation button setting (for example, if the actuator movement is limited due to an obstruction).

- The actuator feedback position has been reached.
- The actuator is stalled for more than 1 second; the actuator feedback position does not change for more than 1 second.
- The target position corresponds to an end stop and an additional 1 second extra drive in the same direction (to guarantee sealing) has been performed.

The recirculation door should move from one extreme position to the other when the recirculation button is pressed on and then pressed off.

Perform the tests in **Table 5** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check. If the recirculation door actuator passes the tests in **Table 5** and the actuator still does not operate properly, check for mechanical problems with the actuator. To quickly check for normal operation, set the fan switch to high and listen for a change in the sound of the blower near the HVAC unit while pressing the recirculation button on and off. The blower will be louder when recirculation is enabled.

Recirculation Door Actuator Circuit Tests

Test	Conditions	Test Point	Good Result	What to Do if Test Fails
actuator motor drive circuit	key on, engine off recirculation door actuator connector removed fan (blower) speed on low change the recirculation setting while observing the digital multimeter (DMM)	Measure across pins 5 and 6 of the recirculation door actuator connector.	9V+ for about 1 second*	Check wiring between control head and recirculation door actuator. If wiring is okay, replace the control head.
actuator position sensor reference voltage circuit	key on, engine off recirculation door actuator connector removed	Measure between pin 10 of the recirculation door actuator connector and the battery negative post.	5V	
actuator position sensor reference ground circuit	key on, engine off recirculation door actuator connector removed	Measure between pin 8 of the recirculation door actuator connector and the battery positive post.	12V*	

Troubleshooting

Recirculation Door Actuator Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
actuator position sensor feedback signal circuit	key on, engine off all connectors connected	Backprobe pins A11 and B5 at control head connector.	0.8V (recirc. on) to 4.7V (recirc. off)	Check wiring between control head and recirculation door actuator.† If wiring is okay, replace the actuator.†

* The voltage should be approximately the same as the battery voltage.

† It is assumed that reference voltage and ground circuits are functioning.

Table 5, Recirculation Door Actuator Circuit Tests

Blower Motor Circuit Tests

The blower motor power and ground are supplied directly to the blower motor assembly. The blower speed is controlled by the fan switch on the control head (climate control panel). The control head sends a pulse width modulated (PWM) signal to the blower motor. The frequency of this signal is 2000 Hz. The pulse width varies with the fan switch selection.

The protection modes for the blower motor are as follows:

- Reverse Voltage Protection—The motor will not operate if the polarity of the motor leads, circuits 98F and ground, are reversed.
- Current Protection—If the motor exceeds the maximum limit, the speed will be reduced until the current is within the limits (23.5A maximum).
- Temperature Protection—If the motor's internal temperature sensor senses that the temperature is too high, the blower speed is reduced to 1000 rpm to reduce the load on the motor and a comparison is made between the sensor reading and the maximum limit. If the temperature is still too high, the blower speed is further reduced to the minimum value of approximately 500 rpm and a temperature comparison is made to the maximum. If, after the second comparison, the temperature is still too high, the motor will shut down until it has cooled sufficiently.

Perform the tests in **Table 6** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check. If the blower motor passes the tests in **Table 6** and the blower still does not operate properly, check the blower motor. To quickly check for normal operation, set the fan switch to high and listen for a change in the sound of the blower near the HVAC unit while pressing the recirculation button on and off. The blower will be louder when recirculation is enabled.

Blower Motor Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
main power to blower motor	battery switch on (if equipped) key off blower motor connector removed	Measure between pin 4 of blower motor connector and negative battery post.	12V*	Check fuse F2 in the PDM under the hood. If the fuse is blown, check for shorted wiring or a damaged blower motor. Check for an open in circuit 98F.

Blower Motor Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
blower motor ground circuit	battery switch on (if equipped) key off blower motor connector removed	Measure between pin 3 of blower motor connector and the positive battery post.	12V*	Check for an open in blower motor ground circuit.
PWM signal from control head	battery switch on (if equipped) key on, engine off blower motor connector disconnected change the fan (blower) speed setting on the control head and observe frequency using the digital multimeter (DMM)	Probe pins 4 and 5 of the blower motor connector, harness side (DMM set to measure frequency).	0 Hz fan off 0 Hz fan on high 2000 Hz all other speeds	Check circuit 338H. Check control head.
voltage drop (power circuit)	battery switch on (if equipped) key on, engine off all connectors connected fan (blower) speed on high	Backprobe pin 4 at the blower motor connector, other lead on positive battery post.	less than 0.5V	Locate high resistance or open in circuit 98F.
voltage drop (ground circuit)	battery switch on (if equipped) key on, engine off all connectors connected fan (blower) speed on high	Backprobe pin 3 at the blower motor connector, other lead on negative battery post.	less than 0.5V	Locate high resistance or open in blower motor ground circuit.
blower motor current draw	battery switch on (if equipped) key on, engine off all connectors connected fan (blower) speed on high	Use current clamp around circuit 98F or blower motor ground wire.	less than 23.5A	Check blower motor.

* The voltage should be approximately the same as the battery voltage.

Table 6, Blower Motor Circuit Tests

Evaporator Probe Circuit Tests

The evaporator temperature sensor is a resistive element, where the resistance increases as the temperature decreases. The control head (climate control panel) uses this sensor to determine the evaporator temperature. The control head uses the temperature information to determine if the A/C compressor should be engaged or not in order to prevent the evaporator core from freezing. As refrigerant flows through the evaporator, condensation will form on the surface of the evaporator. If this condensation freezes because the evaporator temperature is too low, airflow will be restricted through the core and poor cooling will result. The control head will shut off the compressor when the evaporator temperature is near the point where freezing may occur. See **Table 7** for evaporator probe temperature versus resistance values for units manufactured up to and including January 7, 2007. See **Table 8** for evaporator probe temperature versus resistance values for units manufactured on or after January 8, 2007.

Perform the tests in **Table 9** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check.

Troubleshooting

Evaporator Probe Temperature/Resistance (up to January 7, 2007)								
Temperature		Resistance: ohms	Temperature		Resistance: ohms	Temperature		Resistance: ohms
°F	°C		°F	°C		°F	°C	
5	–15	36,780	66	19	6500	84	29	4170
14	–10	27,830	68	20	6210	86	30	3995
23	–5	21,250	70	21	5935	88	31	3828
32	0	16,360	72	22	5673	90	32	3669
41	5	12,690	73	23	5426	91	33	3518
50	10	9927	75	24	5189	93	34	3373
59	15	7823	77	25	4964	95	35	3236
61	16	7466	79	26	4751	97	36	3104
63	17	7125	81	27	4548	99	37	2979
64	18	6805	82	28	4354	100	38	2860

Table 7, Evaporator Probe Temperature/Resistance (up to January 7, 2007)

Evaporator Probe Temperature/Resistance (from January 8, 2007)					
Temperature: °F (°C)	Resistance: ohms	Temperature: °F (°C)	Resistance: ohms	Temperature: °F (°C)	Resistance: ohms
-40 (-40)	92757	41 (5)	6998	122 (50)	993.2
-31 (-35)	66870	50 (10)	5485	131 (55)	823.2
-22 (-30)	48790	59 (59)	4330	140 (60)	685.8
-13 (-25)	35937	68 (20)	3443	149 (65)	574.2
-4 (-20)	26757	77 (25)	2757	158 70)	482.9
5 (-15)	20103	86 (30)	2221	167 (75)	408.3
14 (-10)	15252	95 (35)	1800	176 (80)	346.8
23 (-5)	11664	104 (40)	1468	185 (85)	295.6
32 (0)	9000	113 (45)	1204	—	—

Table 8, Evaporator Probe Temperature/Resistance (from January 8, 2007)

Evaporator Probe Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
evaporator temperature probe	key off, engine off sensor probe removed and disconnected fill a cup with ice then add water to make an ice-water bath NOTE: use mostly ice and allow time for temperature to stabilize at 32°F (0°C) place the tip of the evaporator probe in the ice-water bath for 5 minutes before testing—leave the tip immersed while taking the resistance measurement—be sure the meter reading is stable before noting the final measurement	Measure across pins on the temperature probe.	for pre-1-8-07: 16,000 to 16,730Ω at 32°F (0°C) — for 1-8-07 on: 8910 to 9090Ω at 32°F (0°C)	Replace temperature probe.
evaporator temperature probe circuit test	battery switch on (if equipped) key on, engine off sensor probe installed, but connector is disconnected	Measure across temperature probe connector terminals.	5V	Check for an open in circuits 338K and 338GP. If wiring is okay, replace the control head.

Table 9, Evaporator Probe Circuit Tests

A/C Clutch Circuit Tests for Diagnosing No A/C Clutch Engagement

The A/C compressor clutch is controlled by the control head (climate control panel). When the control head determines that the A/C compressor is required, it grounds the A/C request input to the bulkhead module (BHM). When the BHM receives the A/C request signal from the climate control panel, it will apply power to the A/C clutch output when the following conditions are met—

- engine has been running more than 5 seconds;
- battery voltage is greater than 9.25V;
- low air pressure warning is not active on the ICU;
- A/C clutch has not been engaged in the previous 15 seconds.

NOTE: The **A/C clutch cycle timer strategy** is implemented differently, depending on BHM software versions. With BHM software version 6.1, the total A/C clutch cycle time (on + off time) is a minimum of 15 seconds. This ensures that the A/C compressor does not cycle more than 4 times per minute. With BHM software versions 6.4 and 6.5, the minimum compressor off time is 15 seconds. This means the total cycle time (on + off time) will always exceed 15 seconds. This too, ensures that the A/C compressor does not cycle more than 4 times per minute.

The BHM sends power to energize the A/C clutch. A binary switch is wired into this circuit, which will prevent the compressor clutch from engaging if the refrigerant pressure is too high or too low.

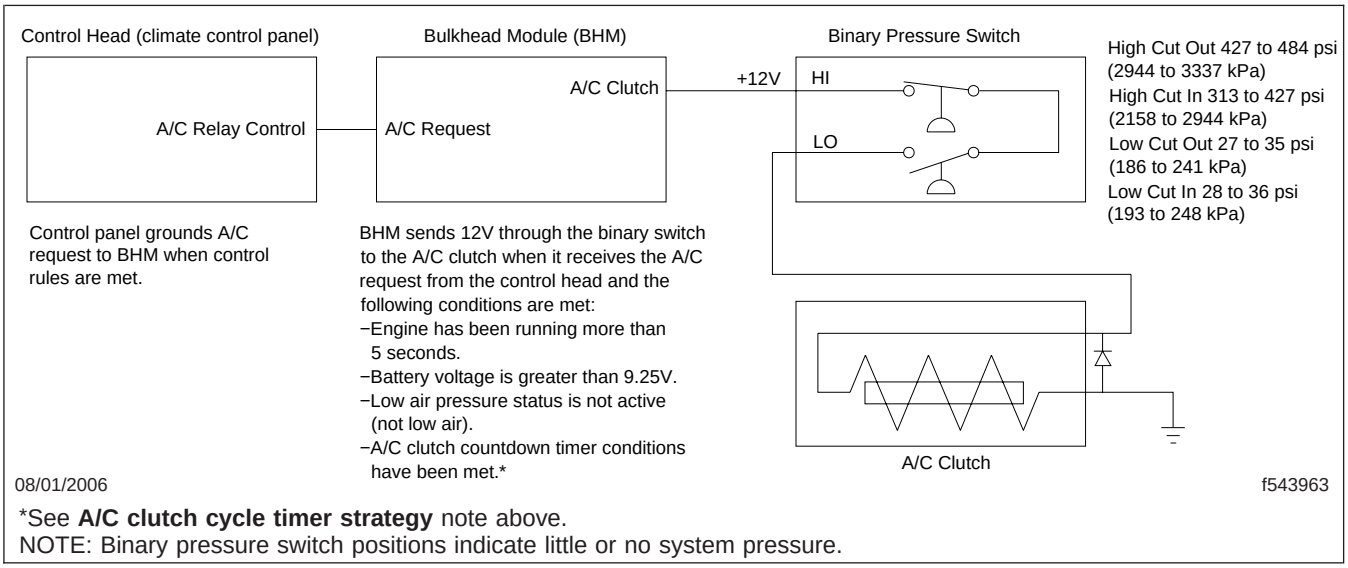
When **all** of the following conditions are met, the control head will send the A/C request signal to the bulkhead module:

- The air selection switch is in one of the A/C or defrost settings, or the recirculation mode is on.

- The fan switch is on any setting other than off.
- The evaporation sensor temperature is above 40.1°F (4.5°C).

When these conditions exist, the control head sends the A/C request signal to the bulkhead module. See **Fig. 2**.

NOTE: The A/C signal will remain active until the evaporator sensor reaches 38.3°F (3.5°C), the fan is turned off, or the air selection switch is taken out of defrost or A/C mode.



*See **A/C clutch cycle timer strategy** note above.
NOTE: Binary pressure switch positions indicate little or no system pressure.

Fig. 2, A/C Clutch Control Circuit

See **Table 10** for the A/C clutch circuit tests. Perform the tests in **Table 10** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check.

NOTE: If these tests pass and the A/C clutch still will not engage, check the following—

- make sure that the air system does not have an active low air pressure warning;
- make sure that the battery voltage to all BHM inputs is above 9.25V;
- make sure that the engine speed is available (make sure it registers on the tachometer).

Backlighting Circuit Tests

See **Table 11** for the backlighting circuit tests. Perform the tests in **Table 11** in the sequence presented. The directions under the column "What to Do if Test Fails" are sometimes dependent on good results from previous tests. If any of the tests fail, stop and perform the specified repair or check. If all of the tests pass and the backlighting at the control head still does not operate properly, check the control head.

Fault Codes

If the A/C clutch is not working, use ServiceLink to check for fault codes. See **Table 12** and **Table 13** for a description of the fault codes.

A/C Clutch Circuit Tests for Diagnosing No A/C Clutch Engagement				
Test	**Conditions**	**Test Point/Method**	**Good Result**	**What to Do if Test Fails**
A/C request input	key on, engine on air selection switch in one of A/C settings fan (blower) speed on any setting but off connect ServiceLink and use the "A/C Clutch Function" Datalink Monitor template to see if the A/C request is seen by the BHM	ServiceLink/Datalink Monitor NOTE: Make sure the Datalink Monitor template is **not** in Test Mode. The control head should request A/C. This will cause the "A/C Request" annunciator on the template to indicate that the request is on. If the annunciator does not indicate that a request for A/C is received, check the settings on the control head before proceeding with "What to Do if Test Fails."	A/C request is received by the BHM	Perform the "Evaporator Probe Circuit Tests." Check wiring between the control head and the bulkhead module. Check for an open circuit. Check the control head. Check the bulkhead module. Try to manually ground the A/C request input while observing the template to confirm.
A/C clutch circuit*	key on, engine off connect ServiceLink and use the "A/C Clutch Function" Datalink Monitor template to manually actuate the A/C clutch output	ServiceLink/Datalink Monitor NOTE: Put the template in "Test Mode" and actuate the A/C clutch by selecting the button for "Clutch On." You should hear a distinct click when the clutch engages. The A/C clutch annunciator (BHM to clutch) should turn on when the output is energized. If this annunciator indicates that the output is on but the clutch does not engage, then the problem is in the A/C clutch circuit and not with the BHM. If the A/C clutch annunciator does not indicate that the output is energized when the output is turned on and the clutch does not engage, then the problem is with the BHM.	A/C clutch should engage	Check continuity across the binary switch. If the circuit is open, check if the refrigerant pressure is within operating range of the binary switch. (Refrigerant pressure may be very low or too high.) If pressures are okay, replace binary switch. Check for faulty wiring. Check for faulty A/C clutch ground circuit. Check for faulty A/C clutch coil (coil resistance should be 3Ω ±0.5Ω). Check for faulty BHM (see note in Test Point/Method column).

* Circuit faults with the A/C clutch output may generate bulkhead module fault codes.

Table 10, A/C Clutch Circuit Tests for Diagnosing No A/C Clutch Engagement

Backlighting Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
backlighting circuit ground test	battery switch on (if equipped) key off, engine off control head connector disconnected	Measure between pin B8 of the control head connector and the positive battery post.	12V*	Check for an open in the control head ground circuit.

Troubleshooting

Backlighting Circuit Tests				
Test	**Conditions**	**Test Point**	**Good Result**	**What to Do if Test Fails**
backlighting power test	battery switch on (if equipped) key off, engine off control head connector disconnected headlight switch on	Measure voltage between pins A2 (positive lead) and B8 (negative lead) on the control head connector while toggling the dimmer switch between full dim and full bright.	voltage should be about 1.2V at full dim and 10.8V at full bright	Check circuit 29A for an open/short. If okay, refer to **Group 54** for further diagnosis.
backlighting pulse width modulated (PWM) signal test	battery switch on (if equipped) key off, engine off control head connector disconnected headlight switch on	Measure frequency between pins A2 and B8 on the control head connector.	400 Hz	Check circuit 29A for an open/short. If okay, refer to **Group 54** for further diagnosis.

* The voltage should be approximately the same as the battery voltage.

Table 11, Backlighting Circuit Tests

J1587 Fault Codes, HVAC (bulkhead module related) MID 164				
MID	**SID**	**FMI**	**Fault Description**	**Action**
164	057	05	A/C clutch output open circuit (low current)	Check circuit 98A for an open circuit. Check binary switch; it may be open. If open, check for low or high refrigerant pressure. Also check the switch itself. Check A/C clutch coil for an open circuit.
		06	A/C clutch output shorted to ground (high current)	Check circuit 98A for a short to ground.

Table 12, J1587 Fault Codes, HVAC (bulkhead module related) MID 164

J1939 Fault Codes, HVAC (bulkhead module related) Source Address (SA) 33				
SA	**SPGN**	**FMI**	**Fault Description**	**Action**
33	1550	05	A/C clutch output open circuit (low current)	Check circuit 98A for an open circuit. Check binary switch; it may be open. If open, check for low or high refrigerant pressure. Also check the switch itself. Check A/C clutch coil for an open circuit.
		06	A/C clutch output shorted to ground (high current)	Check circuit 98A for a short to ground.

Table 13, J1939 Fault Codes, HVAC (bulkhead module related) Source Address (SA) 33