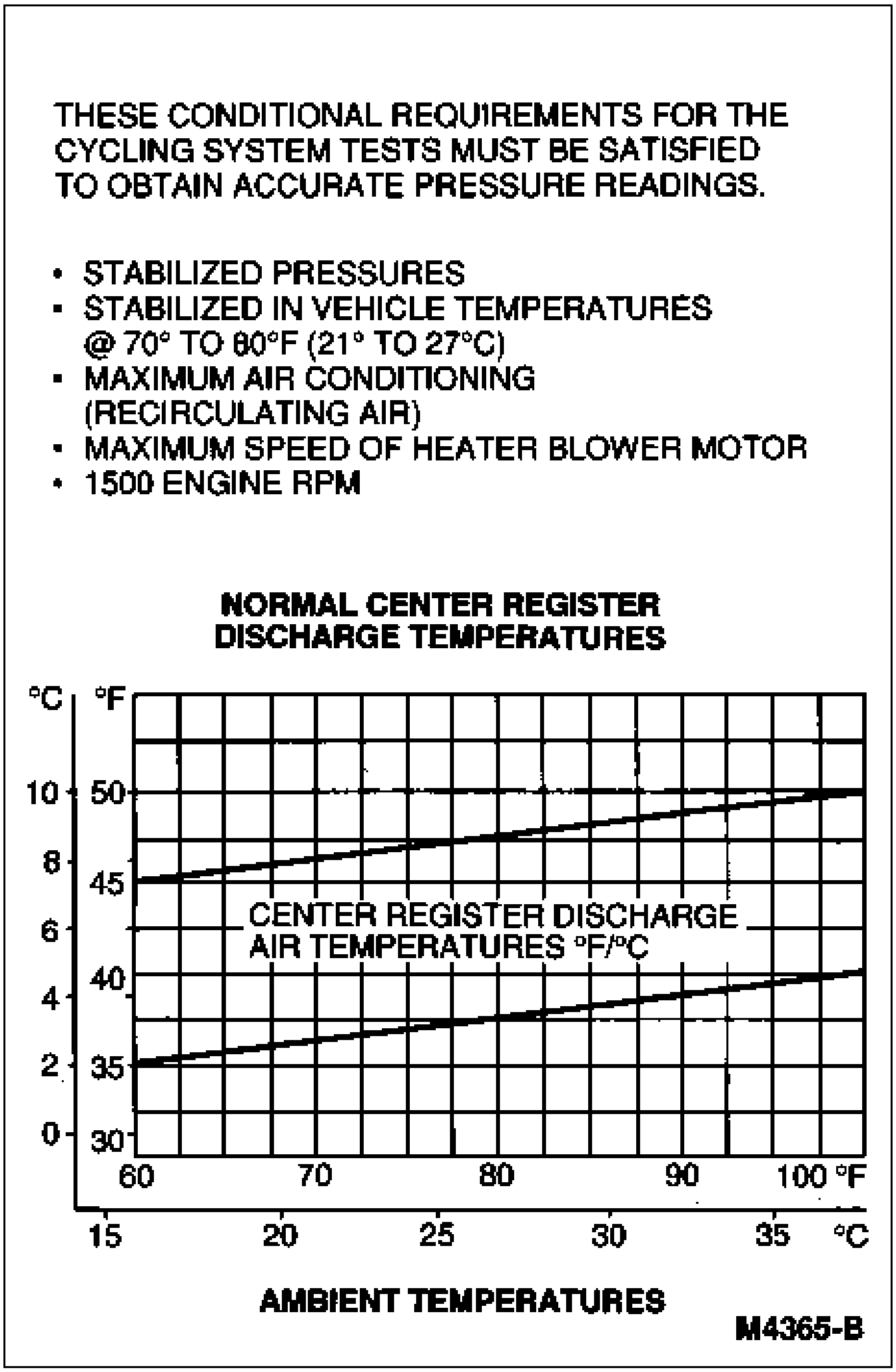
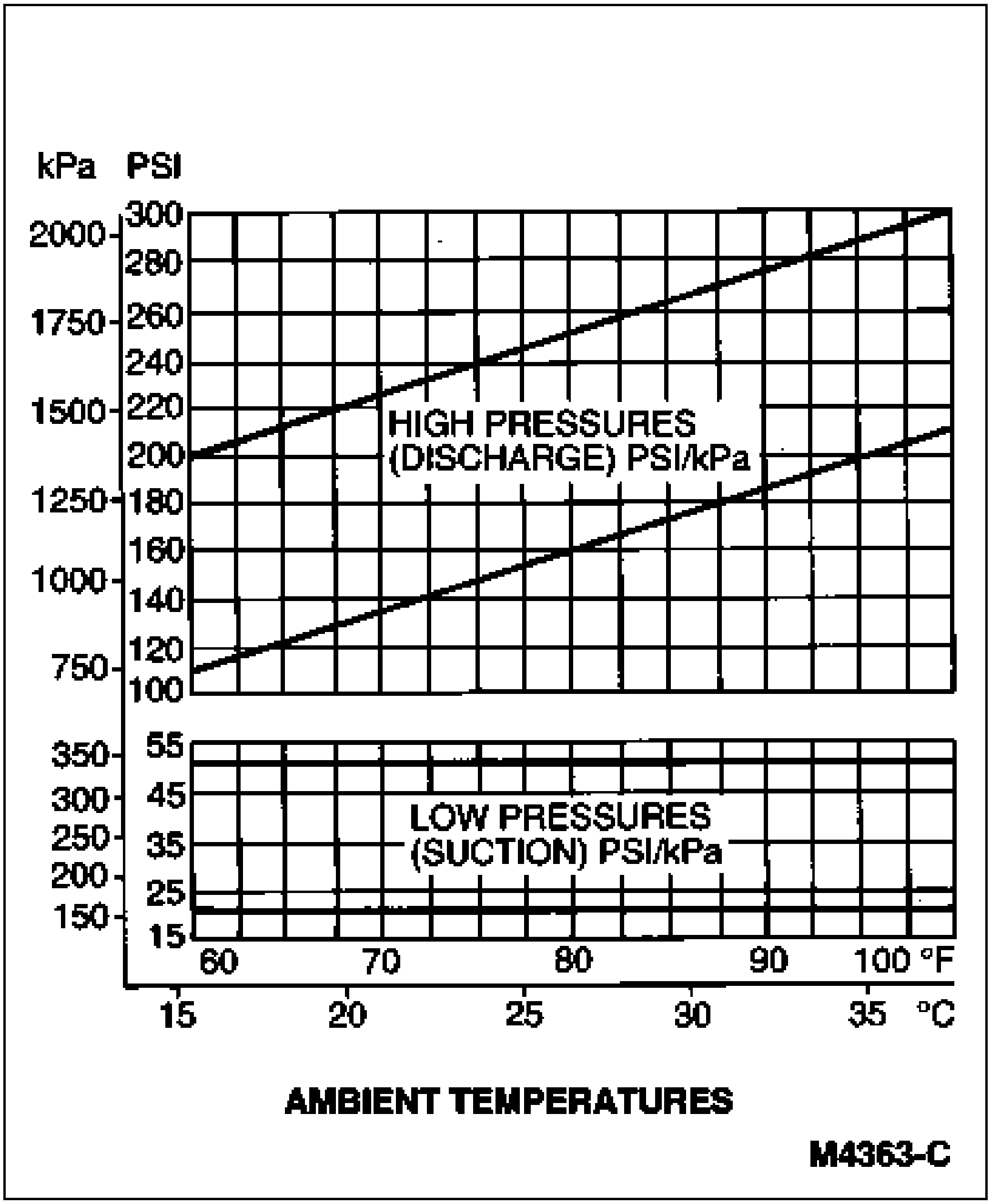
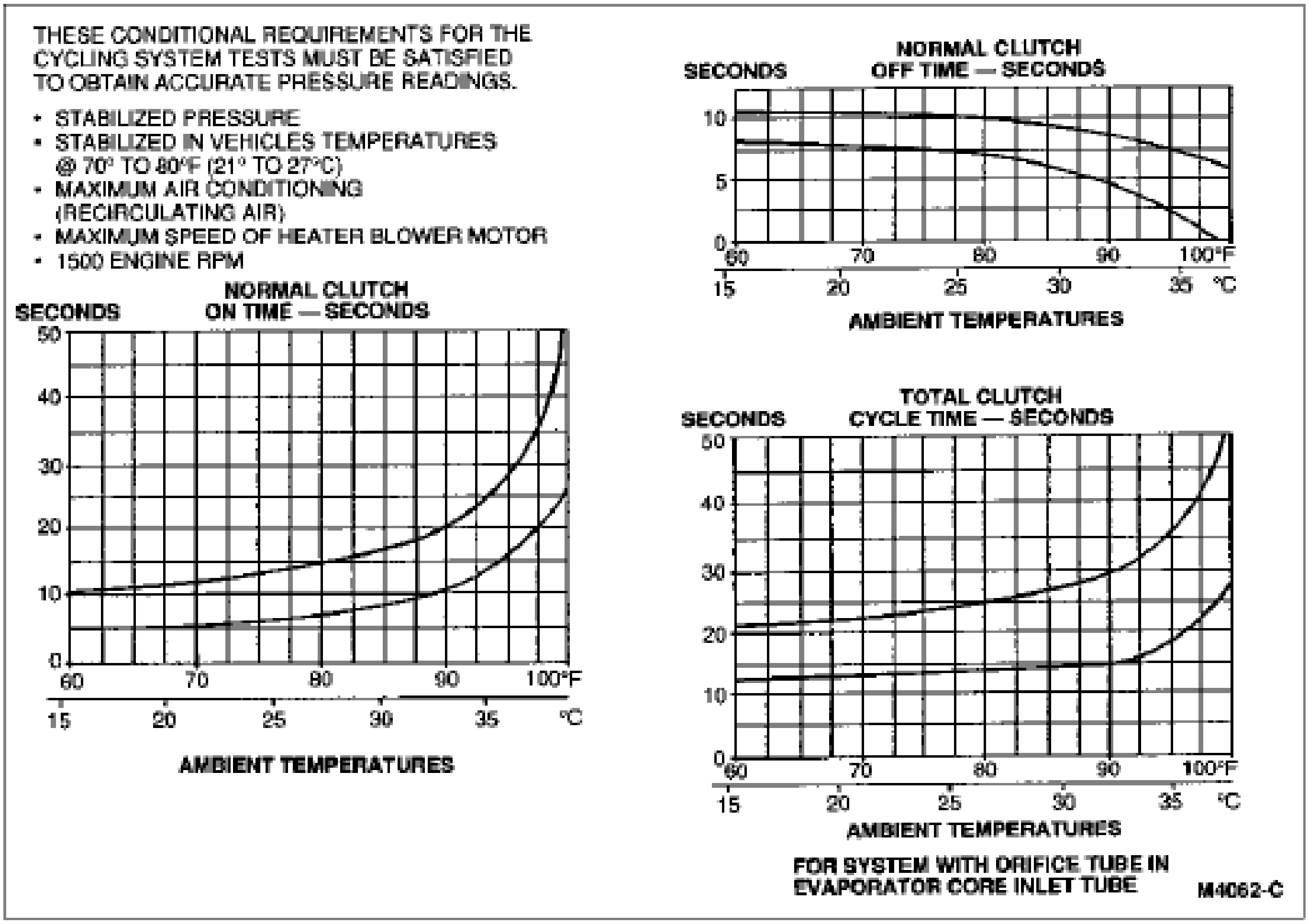
Normal Cycling, Refrigerant System Center Register Temperature Range



Normal Cycling, Refrigerant System Pressure Ranges



Normal On, Off and Total Cycling Time-Per-Second



Refrigerant System Pressure and Timing Evaluation Chart

Refrigerant System Tests

1. Connect an A/C recovery and/or charging station with gauges, or Connect an R134a manifold gauge set to the refrigerant system.
2. Set the climate control system to MAX A/C (if equipped), or select A/C and RECIRC (if equipped), at HI blower.
3. **NOTE:** When the ambient temperature exceeds 38°C (100°F), do not run the engine above normal idle speed.

   Run the engine at 1500 rpm for 10 minutes.

4. Stabilize the vehicle interior temperature at 21°C to 27°C (70°F to 80°F).

5. Record the high and low system pressures using the R134a Manifold Gauge Set, and refer to the table below.

High (Discharge) Pressure	Low (Suction) Pressure	Clutch Cycle Time			Component — Causes
		Rate	On	Off	
High	High	Continuous run			Condenser — inadequate airflow.
High	Normal to high	Continuous run			Engine overheating.
Normal to high	Normal	Continuous run			Refrigerant overcharge [a]. Air in refrigerant. Humidity or ambient temperature very high [b].
Normal	High	Continuous run			Fixed orifice tube — missing O-rings leaking/missing.
Normal	Normal	Slow or no cycle	Long or continuous	Normal or no cycle	Moisture in refrigerant system. Excessive refrigerant oil.
Normal	Low	Slow	Long	Long	A/C cycling switch.
Normal to low	High	Continuous run			Compressor — low performance.
Normal to low	Normal to high	Continuous run			A/C suction line — partially restricted or plugged [c].
Normal to low	Normal	Fast	Short	Normal	Evaporator — low or restricted airflow.
Normal to low	Normal	Fast	Short to very short	Normal to long	Condenser, fixed orifice tube, or A/C liquid line — partially restricted or plugged.
Normal to low	Normal	Fast	Short to very short	Short to very short	Low refrigerant charge.
Normal to low	Normal	Fast	Short to very short	Long	Evaporator core — partially restricted or plugged.
Normal to low	Low	Continuous run			A/C suction line — partially restricted or plugged [d]. A/C cycling switch — sticking closed.
Erratic operation or compressor not running		—	—	—	A/C cycling switch. Poor connection at A/C clutch connector or clutch cycling switch connector. A/C electrical circuit erratic — see A/C Electrical Circuit Wiring Diagram.
Additional Possible Cause Components Associated With Inadequate Compressor Operation					
• Compressor drive belt — loose • Compressor clutch — slipping • Clutch coil open — shorted, or loose mounting					

• Control assembly switch — dirty contacts or sticking open • Clutch wiring circuit — high resistance, open or blown fuse • Compressor operation interrupted by engine computer
Additional Possible Cause Components Associated With a Damaged Compressor
• Incorrect clutch air-gap • Suction accumulator — refrigerant oil bleed hose plugged • Refrigerant leaks

[a] Compressor may make noise on initial run. This is slugging condition caused by excessive liquid refrigerant.
[b] Compressor clutch may not cycle in ambient temperatures above 80°F depending on humidity conditions.
[c] Low pressure reading will be normal to high if pressure is taken at accumulator and if restriction is downstream of service access valve.
[d] Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.

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 (converts to gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (converts 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 the 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 (converts 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 in 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 (convert 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.

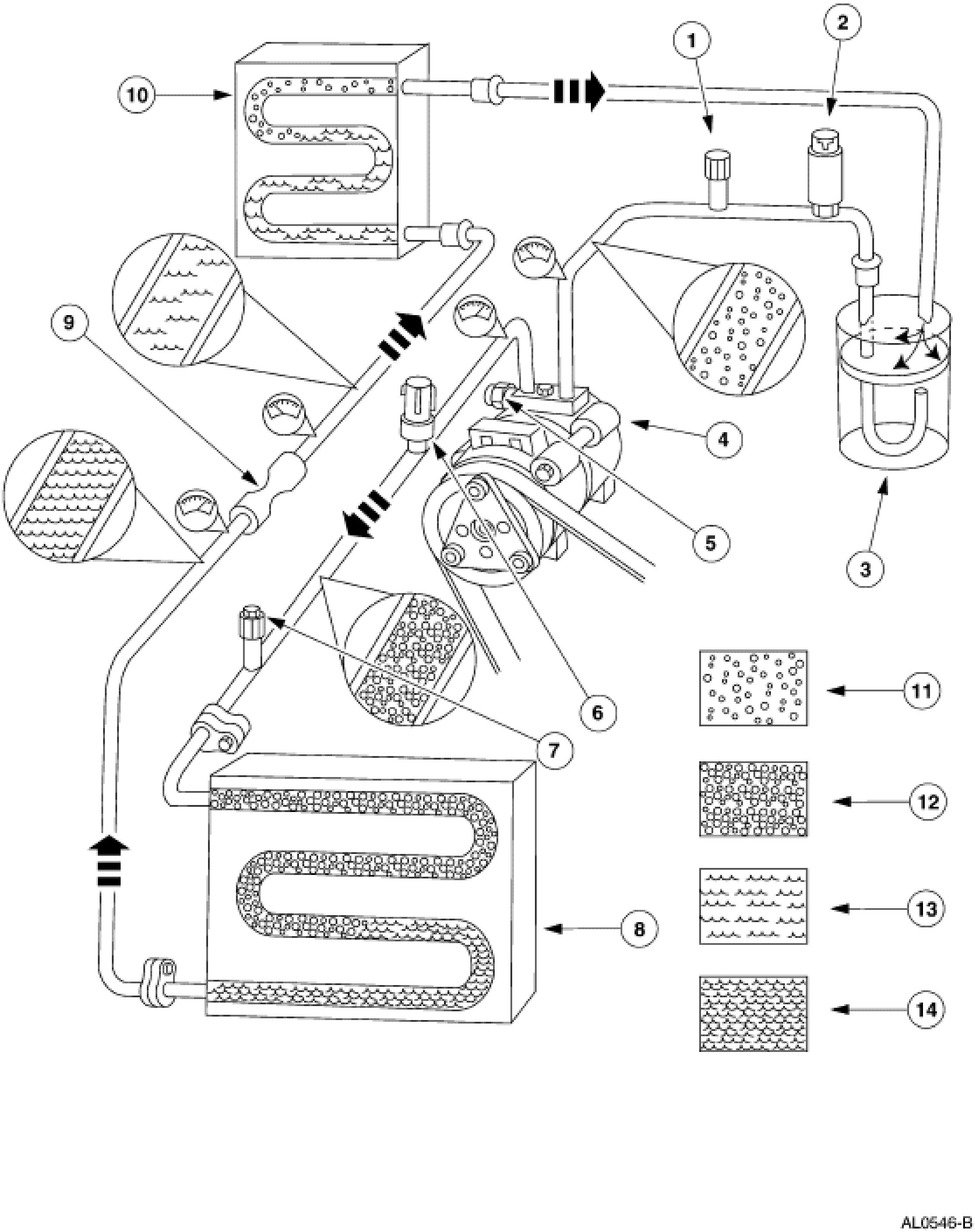
The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

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 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



Item	Part Number	Description
1	19E762	A/C charge valve port (low side)
2	19E561	A/C cycling switch
3	19C836	Suction accumulator/drier
4	19703	A/C compressor

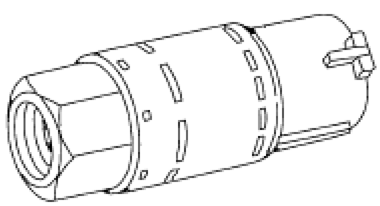
5	19D644	A/C compressor pressure relief valve
6	19D594	A/C pressure cut-off switch
7	19E762	A/C charge valve port (high side)
8	19712	A/C condenser core
9	19D990	A/C evaporator core orifice
10	19860	A/C evaporator core
11	—	Low pressure vapor
12	—	High pressure vapor
13	—	Low pressure liquid
14	—	High pressure liquid

A/C Compressor Pressure Relief Valve

An A/C compressor pressure relief valve is incorporated in the compressor A/C manifold and tube to:

- relieve unusually high refrigerant system discharge pressure buildups, (3103 kPa [450 psi] and above).
- prevent damage to the A/C compressor and other system components.
- avoid total refrigerant loss by closing after the excessive pressure has been relieved.

A/C Cycling Switch



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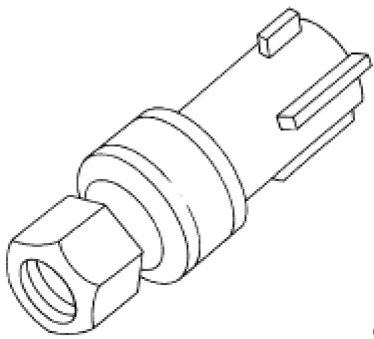
The A/C cycling switch is mounted on a Schrader valve-type fitting on the top of the suction accumulator/drier.

- A valve depressor, located inside the threaded end of the A/C cycling switch, presses in on the Schrader valve stem.
- This allows the suction pressure inside the suction accumulator/drier to control the operation of the A/C cycling switch.
- **The electrical switch contacts open when the suction pressure drops to 152-193 kPa (22-28 psi).**
- **The contacts close when the suction pressure rises to 276-324 kPa (40-47 psi).**
- When the A/C cycling switch contacts close, the signal to energize the A/C clutch is sent to the wide open throttle A/C cutoff relay.

- When the A/C cycling switch contacts open, the A/C clutch field coil is deenergized and compressor operation stops.
- The A/C cycling switch will control the A/C evaporator core pressure at a point where the plate/fin surface temperature will be maintained slightly above freezing.
- This prevents icing of the A/C evaporator core and blockage of airflow.
- **It is not necessary to discharge the refrigerant system to remove the A/C cycling switch.**

A/C Pressure Cut-Off Switch



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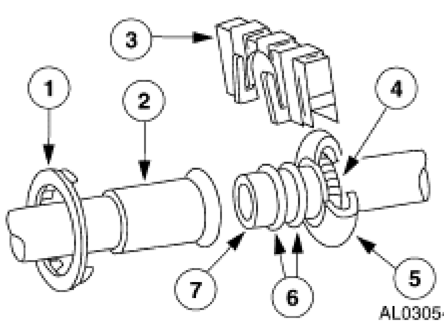
The A/C pressure cut-off switch is used to interrupt A/C compressor operation in the event of high system discharge pressures.

- The A/C pressure cut-off switch is mounted on a Schrader valve-type fitting on the high pressure side of the A/C manifold and tube.
- A valve depressor, located inside the threaded end of the A/C pressure cut-off switch, presses on the Schrader valve stem.
- This allows the A/C pressure cut-off switch to monitor the compressor discharge pressure.
- **When the compressor discharge pressure rises to approximately 2896 kPa (420 psi), the switch contacts open, disengaging the A/C compressor,**
- **When the pressure drops to approximately 1724 kPa (250 psi), the contacts close to allow operation of the A/C compressor.**
- **It is not necessary to discharge the refrigerant system to remove the A/C pressure cut-off switch.**

Spring Lock Coupling



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Item	Part Number	Description
1	—	Plastic Indicator Ring

2	—	Female Fitting
3	19E746	A/C Tube Lock Coupling Clip
4	19E576	A/C Tube Lock Coupling Spring
5	—	Cage
6	—	O-Ring Seals (2 Req'd)
7	—	Male Fitting

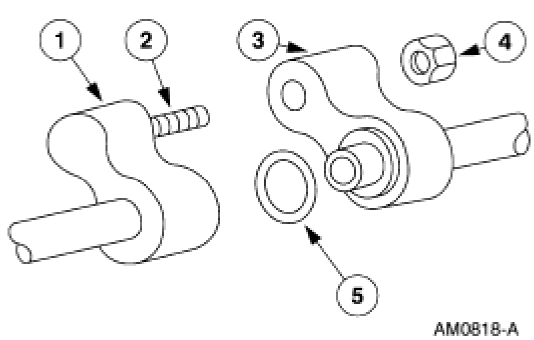
The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage.

- When the coupling is connected together, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting.
- The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.
- Three O-ring seals are used to seal between the two halves of the A/C condenser core couplings, all other couplings have two O-ring seals.
- These O-ring seals are green in color and are made of special material.
- Use only the green O-ring seals listed in the Ford Master Parts Catalog for the spring lock coupling.
- A plastic indicator ring is used on the spring lock couplings of the A/C evaporator core to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.
- The indicator ring may also be used during service operations to indicate connection of the coupling.
- An A/C tube lock coupling clip (19E746) may be used to secure the coupling but is not required.

Peanut Fitting

The A/C condenser core uses the peanut shaped refrigerant fittings instead of spring lock couplings.

- The male and female blocks of the peanut fitting are retained with a nut.
- An O-ring seal is installed around the tube on the male block.
- The female block is welded to the tube and is not adjustable.
- Support the female fitting with a wrench to prevent twisting of the tubes.
- The male block will pivot around the tube to allow for alignment with the female block during assembly.
- When properly assembled the male and female fittings should be flush.

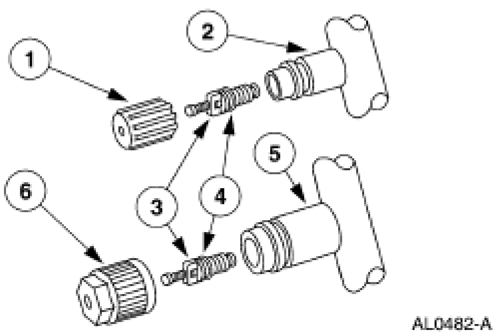


Item	Part Number	Description
1	—	Female Block (Part of Tube Assy)
2	W701890-S426	Stud (Part of Female Block)
3	—	Male Block (Part of 19712)
4	W520413-S301	Nut
5	—	O-Ring Seal

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the front A/C manifold and tube.

The low pressure service gauge port valve is located on the suction accumulator/drier.



Item	Part Number	Description
1	19D702	A/C Charging Valve Cap
2	—	Low Pressure Service Gauge Port Valve
3	—	Schrader-Type Valve
4	—	O-Ring Seal
5	—	High Pressure Service Gauge Port Valve
6	19D702	A/C Charging Valve Cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are required for both the high-side and low-side service gauge ports.
- The Schrader-type valve core can be replaced if the seal leaks.
- Always install the A/C charging valve cap (19D702) on the service gauge port valves after repairing the refrigerant system. All Schrader valves leak at an acceptable rate of up to 1/4oz. per year. The cap is the final seal and contains any leakage.

Temperature Pressure Relationship Chart

R134a

°F	HFC134A
-60	21.5*
-50	18.5*
-40	14.7*
-35	12.3*
-30	9.8*
-25	6.8*
-20	3.8*
-15	0.0
-10	1.8
-5	4.1
0	6.3
5	9.1
10	11.6
20	18.0
25	22.1
30	25.6
35	30.4
40	34.5
45	40.0
50	44.9
55	51.2

°F	HFC134A
60	56.9
65	64.0
70	70.7
75	78.6
80	86.4
85	95.2
90	104.2
95	113.9
100	124.3
105	134.9
110	146.8
115	158.4
120	171.9
125	184.5
130	199.8
135	213.5
140	230.5
145	245.6
150	264.4
155	280.9
160	301.5

R12

°F	CFC-12
-60	19.0*
-50	15.4*
-40	11.0*
-35	8.4*
-30	5.4*
-25	2.3*
-20	0.6
-15	2.4
-10	4.4
-5	6.7
0	9.2
5	11.8
10	14.6
20	21.0
25	24.6
30	28.4
35	32.6
40	37.0
45	41.7
50	46.7
55	52.1

°F	CFC-12
60	57.7
65	63.8
70	70.2
75	77.0
80	84.2
85	91.8
90	99.7
95	108.2
100	117.2
105	126.6
110	136.4
115	146.8
120	157.7
125	169.1
130	181.0
135	193.5
140	206.6
145	220.3
150	234.6
155	248.6
160	264.0