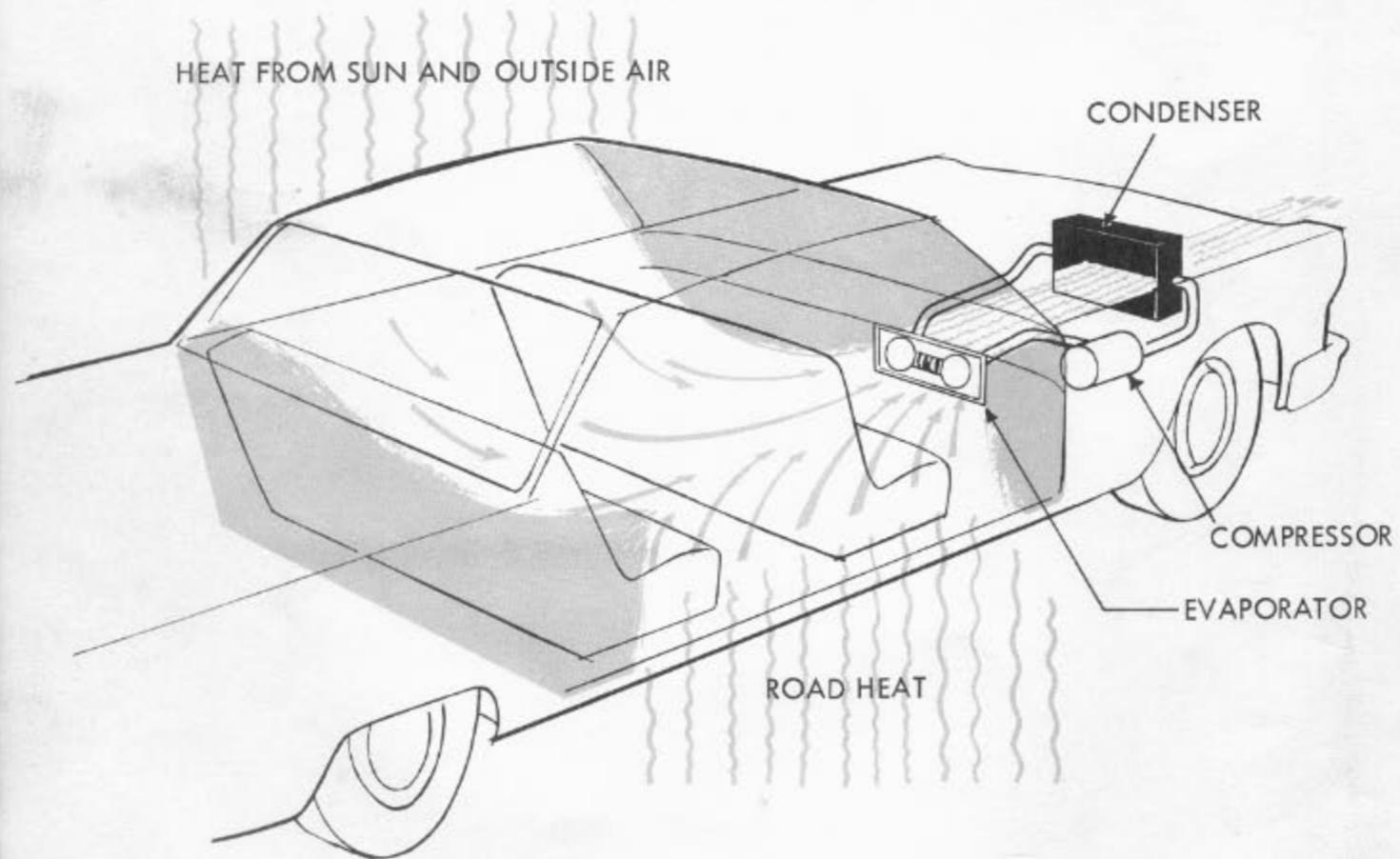


WHAT AIR CONDITIONING DOES



TEMPERATURE IN COMPARTMENT IS REDUCED BY
REMOVING HEAT FASTER THAN IT COMES IN

Automotive Air Conditioning
SERVICE PROCEDURE
MANUAL

Issued by

Industrial Education Department
Division of Extension
The University of Texas

In cooperation with

Texas Education Agency
Vocational Industrial Education Division
Austin, Texas

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**AUTOMOTIVE AIR CONDITIONING
SERVICE PROCEDURE
MANUAL**



INDUSTRIAL EDUCATION DEPARTMENT
Division of Extension, The University of Texas
Drawer V, University Station
Austin, Texas 78712

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First Edition, May 1963, 1,000
Second Edition, May 1965, 5,000

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HOW THE AIR CONDITIONER WORKS

The air conditioner is a heat transfer unit. All air conditioning systems must have four basic elements, each of which is equally as important as the others. These four components are the compressor, the condenser, the expansion valve, and the evaporator. A malfunction of any of these will interrupt the heat exchange cycle and disrupt operation of the whole system. Each of these basic units is engineered and balanced to the other units in the system to move heat from the area being cooled to the outside, where it is dissipated into the air. The following is an explanation of these elements and the function of each in the air conditioning system.

Compressor

A compressor is chosen first for its capacity. The compressor must be able to deliver the required volume of refrigerant for heat movement through the evaporator and condenser.

The overall dimensions and weight must be considered, plus the method used to drive the compressor. In most installations the compressor will be fitted into a confined area where size and weight become an important factor. The choice of compressors for automotive use narrows to two types of compressors on all installations except General Motors and Chrysler factory air systems, which use compressors of their own manufacture. All automotive compressors to date are belt driven and are of varying capacities related to the size engine that will be used to drive them.

The compressor is installed in an air conditioning system for two primary purposes. The most important of these is heat concentration by compression. Second is the circulation of refrigerant through the system.

The compressor must concentrate heat molecules contained in the low pressure refrigerant returning from the evaporator to a temperature much higher than the ambient or outside air temperature. The high temperature differential between the refrigerant and the ambient is necessary to aid rapid heat flow in the condenser from the hot refrigerant gas to the much cooler outside air. Remember, heat will flow only from the warm to the less warm.

Heat added to the refrigerant by the operation of the compressor is negligible. The heat felt on the compressor housing is caused by compression of refrigerant vapor. Some heat is lost through the walls of the compressor by radiation, which compensates for the heat resulting from friction of moving parts within the compressor. Added heat, which is very slight, is figured into only the most exacting computations and is seldom considered in average installations.

In order to create high pressure heat concentration, the compressor must rapidly move a large volume of refrigerant vapor past its discharge valve into the

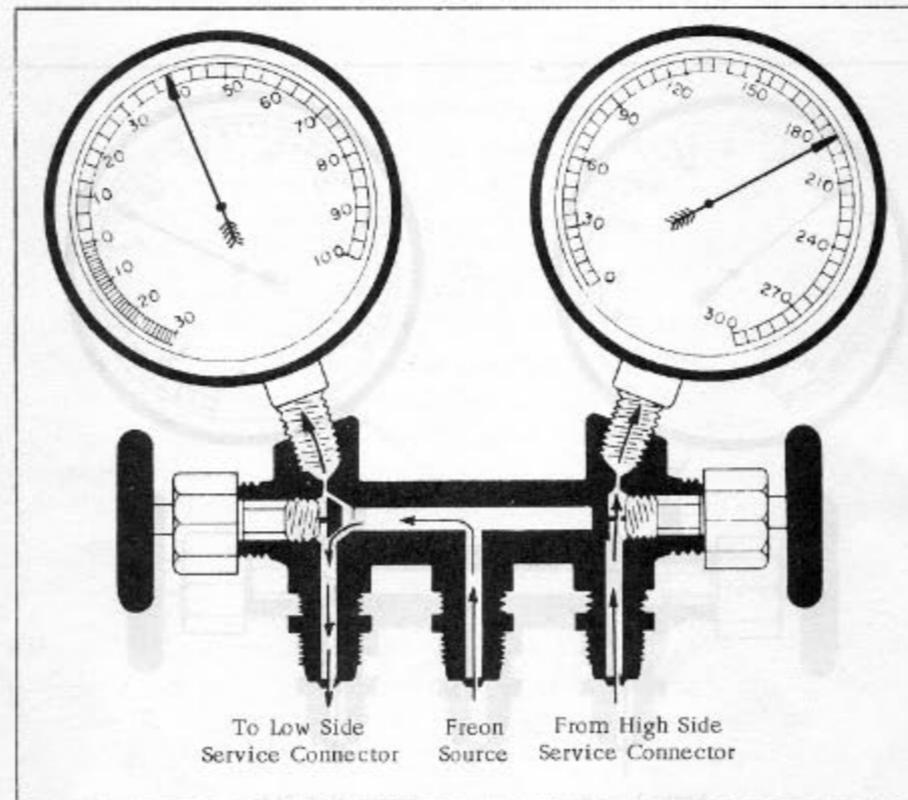


Figure 3. Refrigerant flow to gauges and through manifold while adding refrigerant with system in operation.

By controlling the position of the hand valves on the manifold, excess refrigerant may be bled out of the system, air may be bled out of the system, refrigerant may be purged from the system in preparation for performing maintenance work, air and moisture may be removed from the system during pump-down procedure, and the system may be filled with Freon.

Test Hoses

The test hoses are the connections between the gauge manifold and the air conditioning system. They are connected to the gauge manifold test hose fittings by use of a screw-on connection and sealed with an internal "O" ring. Hose connectors should be tightened only finger tight as this is sufficient to seal the hose onto the "O" ring.

4. Replace pulley bearing.

NOTE: If bearing replacement was the only service required, omit Steps 5 through 11. Reinstall pulley as outlined beginning with Step 12.

1. Remove bearing retainer snap-ring with suitable snap-ring pliers.

NOTE: Most late models use Tru-Arc rings which require internal Tru-Arc ring pliers for removal.

2. Press old bearing out of pulley.
3. Inspect bore of pulley for evidence of damage. Bearing may have ruined bore, necessitating pulley replacement.
4. Inspect contact surfaces of rotor plates. Some scoring is permissible and to be expected.
5. Press new bearing into pulley by exerting pressure on outer race.
6. Replace bearing retainer ring.

5. Remove clutch plates from compressor crankshaft.

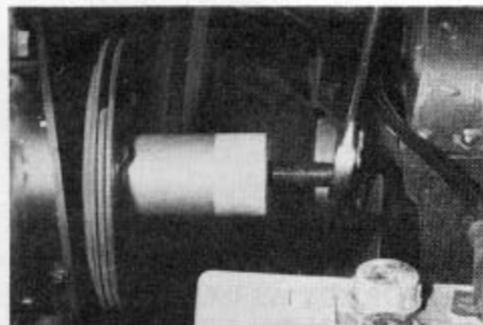


Figure 24. Remove clutch assembly from compressor crankshaft.

6. Disassemble clutch plates for inspection.

1. Slide shims and spacer from compressor crankshaft and lay to one side.
2. Install clutch remover tool onto threads of clutch hub.
3. Tighten center bolt of remover tool against end of compressor shaft to remove clutch plates from shaft.
4. Lift clutch plates and remover tool from compressor shaft and unscrew tool from clutch hub.

NOTE: It is advisable to always inspect the carbon balls and ramps for excessive wear during any service operation requiring clutch removal.

1. Carefully remove springs and inspect for breakage or collapsed condition.
2. Lift off top clutch plate.

6. Disassemble clutch plates for inspection (continued).

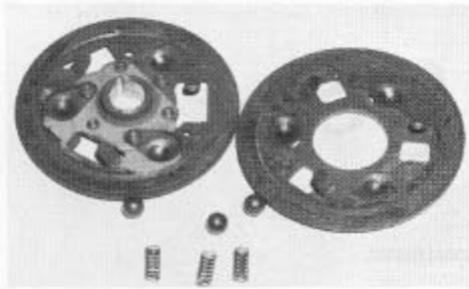


Figure 25. Disassemble clutch plates and inspect springs, balls, and ball ramps.

7. Remove rear shoe plate.

8. Inspect shims and spacer on compressor shaft.

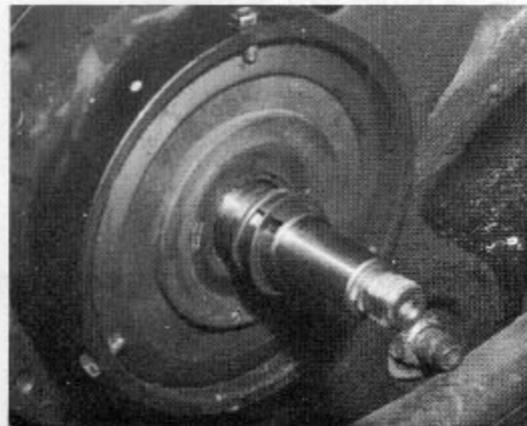


Figure 26. Inspect shims and spacer on compressor crankshaft.

9. Install rear shoe plate onto coil housing.

3. Inspect ball ramps of both plates for excessive wear.
4. Remove three carbon balls from ramps and inspect carefully for flat spots, out-of-roundness, and excessive wear.
5. Inspect clutch composition material for excessive or uneven wear, oil-soaked, glazed, or dirty condition.

NOTE: Clean clutch plates with suitable cleaner. If ball ramps or composition material is excessively worn, clutch plates must be replaced. Carbon balls and/or springs may be serviced separately.

6. Reassemble clutch in reverse order.

1. Lift shoe plate from compressor.
2. Inspect clutch contact surface for wear and excessive scoring.

NOTE: A flat type rear shoe plate may be reversed if excessively worn. Remove all paint and install on compressor.

1. Same shims should allow correct air gap for replacement of same clutch.
2. Install spacer, then add same number and thickness of shims removed.

NOTE: If examination of rear clutch plate indicates insufficient clearance between plate and coil housing, proceed as follows:

1. Place small straightedge across shim stack on compressor.
2. Use feeler gauge to determine clearance between straightedge and upper surface of inner portion of clutch coil housing.
3. Add necessary shims to obtain .025-.035 inch clearance.

1. Install with contact surface facing toward clutch plate.
2. Hang plate onto coil housing.

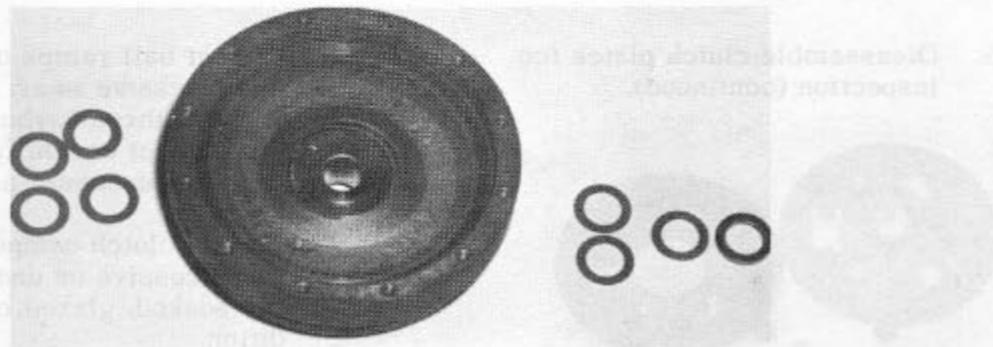


Figure 27. Pulley with spacer and shim assortment.

10. Adjust inner clutch running clearance.



Figure 28. Rotate clutch inside pulley and feel for drag.

1. Place pulley on bench with inner surface up.
2. Place spacer in center of bearing.
3. Add two shims onto spacer, place clutch, threaded hub next to shims, into pulley.
4. Align shims with finger and rotate clutch inside pulley and feel for drag.
5. Add selective shims one at a time until a very slight drag is felt.
6. Add one .010 thousandth (thinnest) and check for drag. A very slight drag while exerting heavy rotating pressure with no drag under light pressure; a rocking action of clutch inside pulley will be present.

11. Install clutch onto compressor shaft.



Figure 29. Press clutch assembly onto compressor crankshaft.

1. Align key-way in clutch hub with key in compressor shaft.
2. Use clutch installer tool as illustrated to press clutch onto compressor shaft.

CAUTION: DO NOT DRIVE CLUTCH ONTO CRANKSHAFT AS DAMAGE TO CLUTCH AND COMPRESSOR BEARINGS WILL RESULT.

NOTE: Straighten rear rotor plate before seating clutch on compressor shaft. Failure to do so can cause plate to be jammed at an angle requiring clutch to be partially removed to straighten plate.

12. Install pulley onto compressor crankshaft.

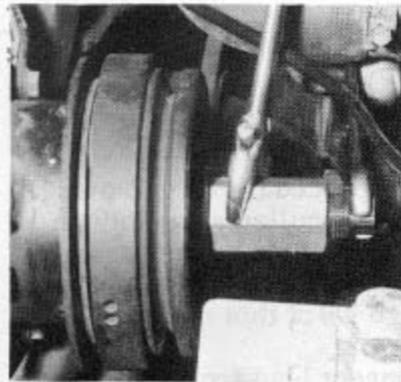


Figure 30. Press pulley onto compressor crankshaft.

13. Install rear shoe plate to compressor pulley.

14. Install lock-nut onto compressor crankshaft.

15. Continue Performance Test.

1. Install spacer and selective shims onto crankshaft as determined in Step 10 above.
2. Install pulley onto compressor crankshaft.
3. Use installer tool as illustrated to press pulley onto crankshaft.

CAUTION: DO NOT DRIVE PULLEY ONTO CRANKSHAFT.

1. Tighten cap screws 4-5 foot pounds.

1. Install lock-washer onto crankshaft.
2. Screw lock-nut onto end of crankshaft finger tight.
3. Connect jumper wire from battery to clutch coil.
4. Use wrench to tighten nut--complete tightening by striking wrench on side sharply with a hammer to tighten to 10-15 ft. lbs.
5. Check air gap between clutch plate and coil housing for .020-.050 thousandths clearance.
6. Remove clutch and add or remove selective shims to obtain proper clearance.
7. Press clutch and pulley and tighten bolts onto crankshaft.
8. Recheck for clearance as above.
9. Bend lock tangs over onto shoulder of lock-nut.

1. Continue testing system.
2. Adjust control for maximum performance.

Special tools required to perform General Motors compressor service operations are available from your local automotive jobber, Hinckley Myers Co., 28501 Mound Road, Warren, Michigan; also your local refrigeration supply, or Robinair Manufacturing Corporation, Montpelier, Ohio.

XXVII. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REMOVE AND REPLACE CLUTCH COIL ON GENERAL MOTORS COMPRESSORS THROUGH 1961 MODELS

PROCEDURE BREAKDOWN STEPS

1. Remove clutch and pulley assembly from compressor.

2. Disconnect clutch coil leads.

3. Remove clutch coil from housing.

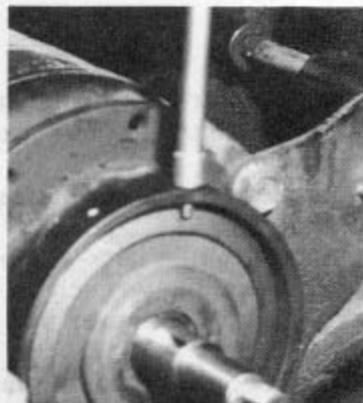


Figure 31. Remove row of screws that retain coil in housing.

4. Replace new or repaired clutch coil in coil housing.

5. Connect clutch leads.

INFORMATION

1. Follow procedure on removing clutch and pulley assembly on General Motors compressors through 1961 models as outlined on page 99 of this manual.

1. Disconnect lead from evaporator to coil.
2. Disconnect ground lead of clutch coil to compressor frame.

1. Remove row of screws or push-in pegs that retain coil in housing.
2. Lift out metal coil retainer.
3. Lift out fiber insulator.
4. Lift out clutch coil; guide leads through hole in coil housing.

1. Thread leads through hole in coil housing.
2. Press coil into place in coil housing.
3. Install fiber insulator on top of coil.
4. Install metal retaining plate and press into place on top of insulator and coil.
5. Install retaining screws or push-in pegs in outer rim of coil housing.

1. Bolt coil ground lead to compressor body.
2. Connect coil lead to lead from evaporator.

6. Install clutch and pulley assembly to compressor.

7. Continue Performance Test.

1. Follow procedure on replacing clutch and pulley assemblies on page 99 of this manual.

1. Continue testing system.
2. Adjust for maximum performance.

XXVIII. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REPLACE SEAL ON GENERAL MOTORS COMPRESSORS THROUGH 1961 MODELS

Seal replacement on the General Motors compressor requires a different procedure from other types of compressors. Care and cleanliness are absolutely necessary if successful seal replacement is to be accomplished on this compressor.

PROCEDURE BREAKDOWN STEPS

1. Isolate compressor (if refrigerant is still in system).

2. Purge system of refrigerant.

3. Remove all parts necessary to expose seal.

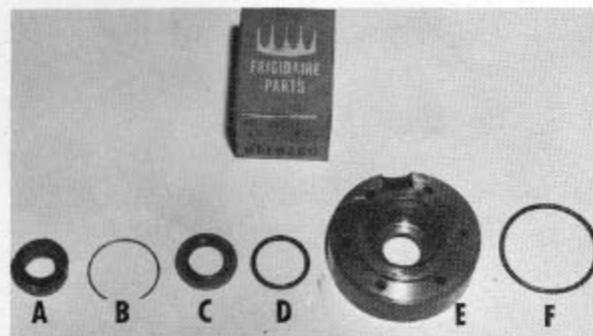


Figure 32. Seal parts: (A) Seal; (B) Seal plate retainer; (C) Seal plate; (D) Seal plate "O" ring; (E) Coil housing; (F) Coil housing mounting flange "O" ring.

INFORMATION

NOTE: The compressor must have both a high side and low side service valve to permit it to be isolated. If only one side has a valve or if none is present, omit the following and proceed to Step 2.

1. Follow procedure on isolating compressor from system as outlined on page 81 of this manual.

1. Crack open high side and low side manifold hand valves to purge refrigerant from system.

CAUTION: PURGE SLOWLY SO THAT OIL IS NOT DRAWN OUT WITH REFRIGERANT.

2. Close both valves when gauges indicate 0 psi.

1. Follow procedure for removing pulley and clutch as outlined on page 99 of this manual.
2. Follow procedure for removing clutch coil as outlined on page 104 of this manual.
3. Remove six screws holding coil housing onto compressor body and lift off housing.
4. Remove seal assembly from compressor shaft and discard.
5. Lay coil housing front side down on bench and remove seal plate snap-ring from inner bore.
6. Lift out seal plate and "O" ring and discard.
7. Remove "O" ring from mounting flange of housing and discard.

4. Install new seal in compressor.

NOTE: All seal parts and "O" rings to be liberally coated with refrigeration oil before installation.

1. Install seal plate "O" ring in coil housing.
2. Install seal plate in coil housing and install retainer snap-ring.

CAUTION: DO NOT TOUCH CARBON SEAL FACE OR SPECIALLY GROUND MATING SURFACE OF SEAL PLATE WITH FINGERS.

5. Install coil housing on compressor.

3. Install "O" ring on mounting flange of coil housing.
4. With seal protector in place on compressor shaft, slide seal into position on shaft, making sure seal assembly engages over pin in shaft.

6. Install clutch coil, clutch and pulley.

1. Position coil lead holes at correct angle.
2. Install screws and alternately torque to 20-25 ft. lbs.

7. Place system in service.

1. Follow procedure for replacing clutch coil on page 104 of this manual.
2. Follow procedure for replacing clutch and pulley on page 99 of this manual.

If system purged of refrigerant:

1. Evacuate system for moisture removal.
2. Charge system with refrigerant.

OR

If refrigerant in system:

1. Install service valves to rear of compressor using new "O" rings.
2. Purge air from compressor by cracking high side service valve and bleeding air out low side hose connector for 15 seconds.

NOTE: Use Schrader adapter if connector(s) use Schrader valves.

7. Place system in service (continued).

8. Continue Performance Test.

3. Install test gauges and mid-position service valves.

1. Continue testing system.
2. Adjust control for maximum performance.

XXIX. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REPLACE SEAL ON GENERAL MOTORS COMPRESSORS 1962 TO DATE

Seal replacement on the late model Frigidaire compressor must be performed on occasion as with any other compressor. Seal replacement on this compressor will be simpler to perform than with earlier General Motors compressors. However, failure to use the correct tools during seal replacement as with the earlier model compressor, can cause compressor damage and replacement seal failure.

PROCEDURE BREAKDOWN STEPS

INFORMATION

- | | |
|---|---|
| 1. Purge system of refrigerant. | 1. Service valves generally not installed on this compressor. |
| 2. Remove compressor from car. | 2. Follow procedure for purging air conditioning system of refrigerant as given on page 69. |
| 3. Remove oil from compressor into clean container. | 1. Oil will have been lost past seal leak. |
| 4. Remove compressor shaft self-locking nut. | 2. OIL LEVEL MUST BE CHECKED WITH COMPRESSOR OFF CAR. |
| 5. Remove hub lock-ring and washer. | 3. Follow procedure as necessary for make and year model to remove compressor. |
-
- | | |
|--|---|
| | 1. Additional oil will be lost during seal replacement and cannot be measured. |
| | 2. Follow procedure for checking and adding oil to Frigidaire compressors as given on page 54. |
| | 3. DO NOT ADD OIL AT THIS TIME. |
| | 1. Thin-wall, 9/16 deep socket required. |
| | 2. Use suitable spanner wrench engaged in at least two of three holes in compressor hub to prevent hub from rotating. |
| | 3. Discard nut if new self-locking nut available. |
| | 1. Use Tru-arc ring pliers to remove Tru-arc ring from bore of hub. |
| | 2. Invert compressor and shake out flat washer. |

The construction of the manifold is such that the test hose and connector directly below the gauge will pass refrigerant to that gauge to indicate pressure readings. Opening the hand valve on the same side as the gauge is the only way refrigerant can move in any direction other than to the gauge.

The center test hose is not connected into the air conditioning system. It is used to allow refrigerant to purge from the system, or the hose may be connected to a vacuum pump for air and moisture removal from the system. Opening the hand valves on the manifold will control pump down of the system into a vacuum for more effective moisture removal.

Hoses are available to fit service connectors with a Schrader valve. Hoses not so constructed require the use of a Schrader valve adapter on connectors using the Schrader valve. Each new model finds more widespread use of Schrader valves. The use of the Schrader valve in the service connector eliminates the need of a service valve in the system. The refrigerant is effectively sealed inside the system until the Schrader is opened by the use of an adapter in conjunction with the test hose, or if a test hose is used that has a means of opening the valve built into it.

SERVICE VALVES

The compressor service valves are a part of the air conditioning system. The function of these valves in operational checks and system repairs is equally as important as the test gauge manifold. Some units are equipped with only one service valve in the system, but most units are equipped with a compressor service valve for both the high and low sides of the system.

The service valve incorporates a three-position valve that may be used to shut off refrigerant flow, direct refrigerant to the rest of the system, or direct refrigerant flow to the system and at the same time direct flow to the test gauges through the test hose connectors on the gauge manifold.

Valve position is controlled by rotating a valve stem with a service valve wrench. The stem has as part of its construction a double faced valve. Rotating the valve stem with the wrench in a clockwise direction will seat the front face of the valve to shut off all refrigerant flow in the system. This position is called "front-seated."

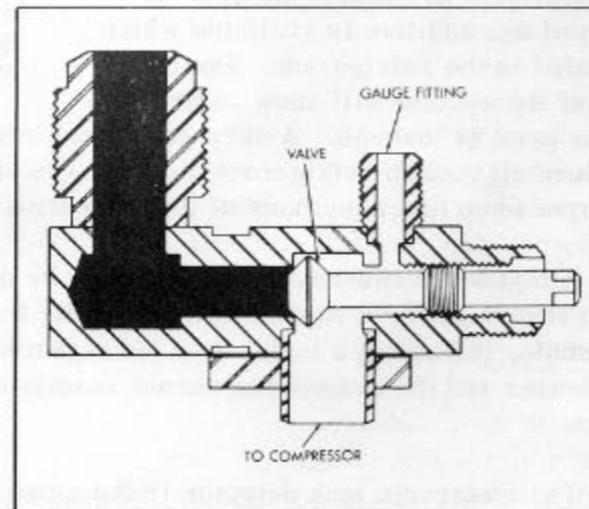
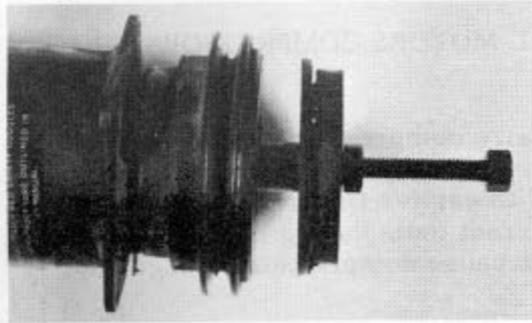


Figure 4. Service valve in front-seated or shut-off position.

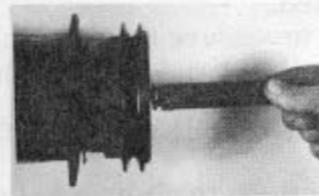
6. Remove hub drive plate from compressor shaft.



7. Remove seal seat from compressor housing.

8. Remove "O" ring from compressor housing.

9. Remove seal from compressor housing.



10. Clean, inspect and lubricate housing.

1. Thread hub pulling tool well into center of threaded hub.
2. Thread thrust bolt into center of hub pulling tool until it contacts end of compressor shaft.
3. Use correct size wrench to hold tool in hub while tightening bolt against compressor shaft.
4. Continue until hub may be lifted from compressor.
5. Remove shaft key from slot in hub or compressor shaft.

1. Use Tru-arc ring pliers to remove Tru-arc ring from housing.
2. Use hook-type tool to lift seal seat from housing.

NOTE: Most compressor seal tool kits contain a U-shaped tool with a flat hook on each end. If this tool not available, two "choke-wire" hooks may be used.

1. A thin hook may be used to remove "O" ring.
2. Disengage "O" ring from slot in wall of housing and remove.

1. Special seal removing and installing tool required.
2. Engage "T" notches of tool with "T" brackets on seal, depress tool and rotate slightly to lock tool to seal.
3. Lift tool and seal out of housing and discard seal.

1. Inspect compressor shaft for indications of wear or burrs.
2. Remove any burrs found with crocus cloth to prevent damage to new seal.
3. Excessive shaft wear will require compressor overhaul or replacement.
4. Lubricate shaft profusely with REFRIGERATION OIL only.

11. Install new seal in compressor housing.

12. Install new "O" ring in compressor housing.

13. Install seal seat in compressor housing.

14. Install seal seat retaining ring.

WARNING: DO NOT TOUCH GROUND SURFACE OF CARBON SEAL OR SEAT WITH FINGERS. BODY ACID WILL ETCH THESE SURFACES TO CAUSE SEAL FAILURE.

1. Lubricate seal profusely with refrigeration oil.
2. Engage seal onto removing and installing tool.
3. Install seal into housing over compressor shaft.
4. Rotate tool and seal slowly until flats of seal and compressor shaft align, then bottom seal in housing.
5. Counter-rotate tool slightly to unlock tool from seal and remove tool from housing.

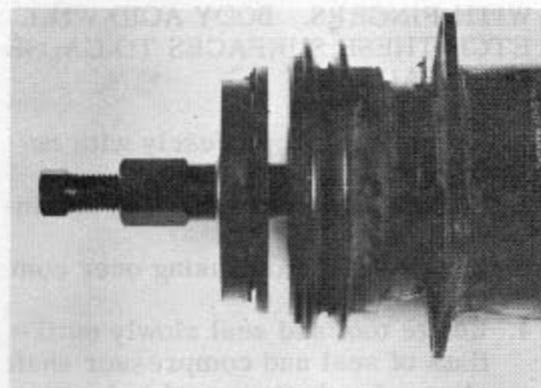
1. Lubricate "O" ring with refrigeration oil.
2. Seat "O" ring in recess in compressor housing.

1. Lubricate seal seat profusely with refrigeration oil.
2. Place on compressor shaft with ground surface toward seal and slide seat down shaft until contact is made with seal.

1. Insert Tru-arc ring well into housing **ROUNDED SURFACE OF RING UP-- FLAT SURFACE OF RING TOWARD SEAL SEAT.**
2. Use special sleeve-type ring installing tool to bottom retaining ring against seal seat.
3. A light tap against tool will allow retaining ring to snap into recess in housing.
4. Remove tool and **CAREFULLY INSPECT** retaining ring for complete engagement in slot in housing.

WARNING: FAILURE OF THE RETAINING RING TO FULLY ENGAGE IN ITS SLOT OR REVERSING THE RETAINING RING WILL ALLOW PRESSURE TO BLOW SEAL FROM POSITION DURING SYSTEM OPERATION.

15. Install hub drive plate onto compressor shaft.



16. Install new self-locking nut on compressor shaft.

17. Install specified amount of NEW 525 viscosity refrigeration oil in compressor.

18. Install compressor on car.

19. Evacuate system with suitable vacuum pump.

20. Charge system with new R-12.

21. Continue Performance Test.

1. Install drive key into slot on compressor shaft.
2. Engage hub plate onto compressor shaft aligning slot in hub with drive key on compressor shaft.
3. Thread installing tool well onto end of compressor shaft.
4. Hold center bolt of installing tool with suitable size wrench, rotate installing tool to push hub onto compressor shaft.
5. Install hub drive plate until 3/32 inch air-gap obtained between inner surface of drive plate and clutch plate.

1. Install flat washer over end of compressor shaft.
2. Hold hub and tighten lock-nut 14-16 foot pounds.

NOTE: It is advisable to use a new lock-nut as self-locking feature will have been destroyed when old nut is removed from shaft.

1. Old oil generally contaminated.
2. Follow procedure for checking and adding oil to Frigidaire compressors as given on page 54.

1. Follow procedure for make and year model to install compressor.

1. Follow procedure page 70 for evacuating system using vacuum pump.
2. Or follow procedure page 72 for evacuating system using charging station.

1. Follow procedure page 75 for charging system with refrigerant using 15-ounce container.
2. Or follow procedure page 77 for charging system with refrigerant using charging station.

1. Follow procedure page 46 for performance testing the air conditioning system.

XXX. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: CLEANING BURNOUTS IN SMALL SYSTEMS WITH A HAND PUMP SPRAYER

The following procedure is reproduced from "Sales Points," published by the "Freon" Products Division, E. I. DuPont De Nemours & Co. (Inc.)

In the last year the DuPont Flushing Unit (for information on this unit, contact your Freon wholesaler) has proved in the field that it gives service engineers the most effective method as yet devised for cleaning up after motor burnouts. However, although the unit is on wheels and therefore portable, it is still regarded by some as being rather cumbersome, and, for this reason, some service engineers are reluctant to use it on small systems.

The "Freon" Products Lab recognized this problem and has devised the following procedure for cleaning up after burnouts in small systems. This method is most effective when it is not practical to use the DuPont Flushing Unit.

This burnout flushing procedure is based on the Calclean Sprayer No. 300 shown at right. (Calgon Company, Pittsburgh 30, Pa.)

Preparing the Sprayer

1. Do NOT use the hose supplied with the sprayer. Freon 11 refrigerant will dissolve it.
2. With fittings (threaded or soldered), tee an inexpensive 0-60 psi pressure gauge (or greater) into the sprayer discharge pipe at the top end of the pipe.
3. Solder or fit a common inexpensive water valve into the discharge pipe above the pressure gauge tee.
4. To the outlet of the valve, fit or solder a line so that a hose can be connected between the sprayer discharge pipe and the refrigeration system to be cleaned.
5. Obtain hose or tubing (should be at least 3/8" diameter) to connect the sprayer to the system. Use charging lines, synthetic gasoline hose, Tygon tubing (from all laboratory supply houses), etc. If in doubt about hoses, soak hose sample in Freon 11 for 4 to 8 hours and check for discoloration of the Freon 11 and damage to the hose.



Using the Sprayer

1. Remove the pump from the sprayer: keep the pump handle crosswise to the slot in the pump top. Pulling up slightly, turn the handle counterclockwise until the entire pump is removed from the tank.

2. Add Freon 11 to the tank: pour Freon 11 into the funnel opening on the tank. Use about 15 to 20 pounds of Freon 11 per horsepower. Do NOT fill tank more than 3/4 full.
3. Reinstall the pump into the tank: lower the pump through the funnel opening. Turn the pump handle clockwise until the top of the pump locks under the inner lip of the funnel.
4. Remove the burned-out compressor from the system.
5. Using a suitable hose, connect the sprayer to the compressor discharge line on the system. Hose clamps, flares, or threaded connections can be used.
6. Add a suitable hose to the compressor suction line on the system. Run the other end of the hose to an open container about the same size as the sprayer tank.
7. Close the valve on the sprayer discharge pipe.
8. Pump the sprayer to 25 to 35 psig pressure by operating the pump handle.
9. Open the sprayer valve to allow the Freon 11 to be pushed through the system into the open container.
10. When the pressure drops to zero, remove the pump from the sprayer. Repeat Steps 2, 3, 7, 8, and 9 as necessary, usually twice, using new Freon 11 or the used Freon 11 if it appears very clean. The Freon 11 from the final flush should not show acid with DuPont Acidity Test Paper and should be clear.
11. Disconnect the sprayer and hoses from the system.
12. Purge the system with Freon 12 or Freon 22 to blow out any Freon 11 from the system.
13. Reassemble system per manufacturer's recommendations being sure to evacuate properly.

NOTE: For best results, occasionally oil the leather washer in the pump sprayer.

XXXI. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: BENCH TEST EXPANSION VALVE FOR EFFICIENCY

An expansion valve should not be condemned until subjected to a test of its operating efficiency. Partial blockage in the inlet screen or excessive moisture in the system causing internal icing in the valve orifice can indicate a defective valve. After an expansion valve that is suspected of being faulty has been removed from the system, the screen should be cleaned and the valve tested as follows.

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Prepare test gauges for expansion valve test.

1. Close high and low side gauge manifold hand valves.
2. Install 1/4" tee flare fitting to low side manifold hose connector.
3. Install test hose to lower end of 1/4" tee fitting.
4. Install test cap (drilled #71 drill) to side connection on 1/4" tee fitting.
5. Install test hose to high side manifold hose connector.

2. Install R-12 container to test manifold.

1. Install test hose from center hose connector on gauge manifold to Fitz-All valve on 15-ounce R-12 container.

OR

2. Charge charging cylinder with approximately one pound of R-12 and connect hose to center connection on gauge manifold.

OR

3. Install test hose from center connector on gauge manifold to R-12 drum.

3. Prepare hot and cold containers.

NOTE: Use thermometer to obtain exact temperatures of water used for test.

1. Place ice in a suitable container.

NOTE: If excessive heat and high humidity prevent water in container from registering 32 degrees F., add salt and stir until reading of 32 degrees F. is obtained. A cold drink may be substituted

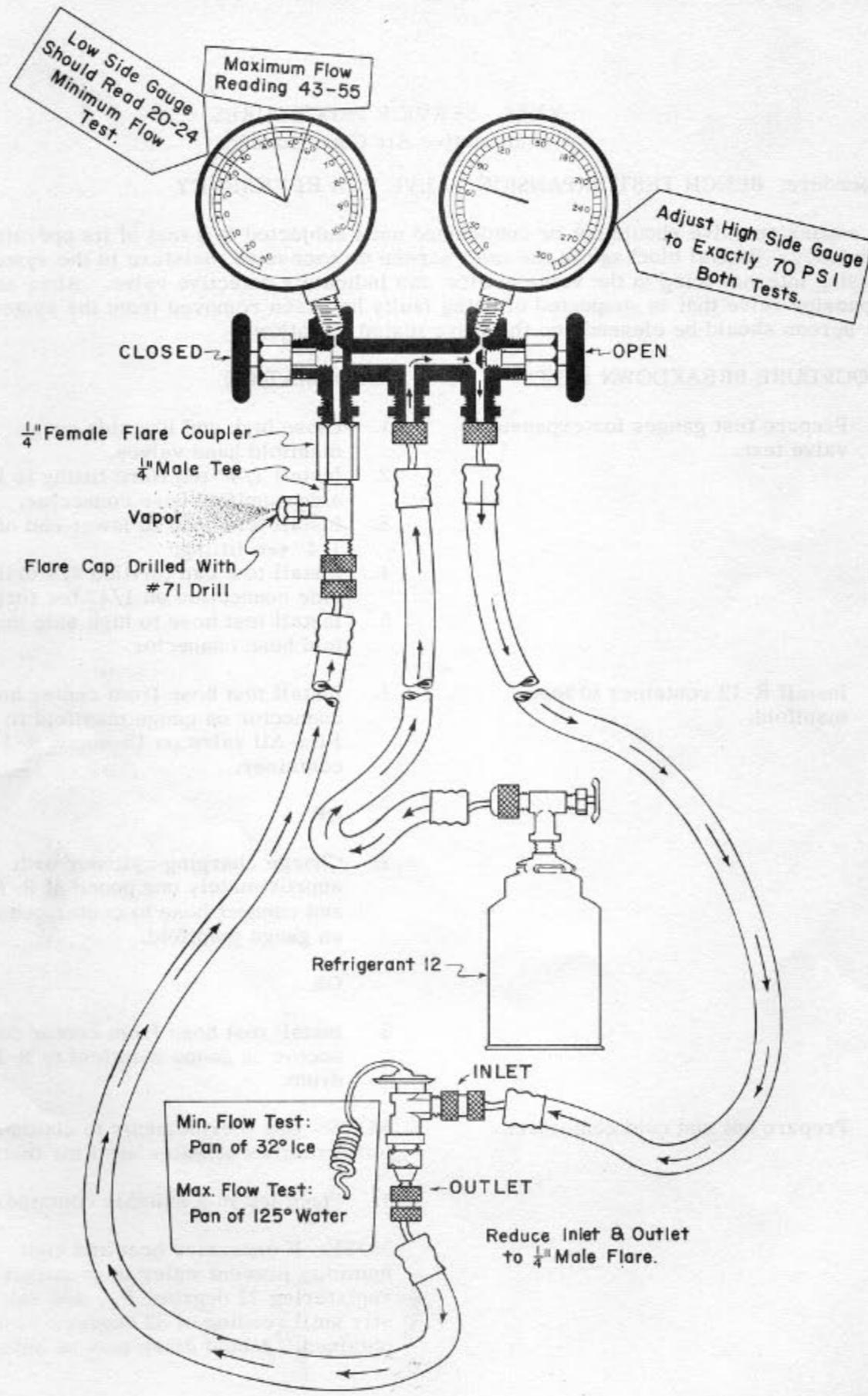


Figure 33. Bench test expansion valve.

3. Prepare hot and cold containers (continued).

4. Prepare expansion valve for test.

5. Test expansion valve for maximum flow.

6. Test expansion valve for minimum flow.

for the iced container provided its temperature is exactly 32 degrees F.

2. Heat water in second container until it reaches 125 degrees F.

NOTE: It is always advisable to remove screen from expansion valve inlet and clean carefully and reinstall before beginning this test.

1. Install 5/8" female flare x 1/4" male flare to expansion valve outlet and tighten securely.
2. On expansion valves having a 3/8" flare inlet, install 3/8" female flare x 1/4" male flare reducer and tighten securely.

NOTE: Expansion valves used on General Motors will require adapters converting "O" ring connections to flare fittings available from local refrigeration supply houses.

3. Install high side test hose to inlet fitting on expansion valve.
4. Install low side test hose to outlet fitting on expansion valve.

1. Open valve on R-12 container.
2. Check low side manifold shut-off valve for closed position.
3. Place thermal bulb of expansion valve in container of 125 degrees F. water.
4. Open high side gauge manifold hand valve slowly until high side gauge reads 70 psi.
5. Read low side gauge; should indicate 43 to 55 psi.

1. Close high side gauge manifold hand valve.

NOTE: This will release pressure on expansion valve.

2. Place thermal bulb in container of 32 degrees F. liquid.

6. Test expansion valve for minimum flow (continued).

7. Replace expansion valve.

OR

8. Install expansion valve into system.

9. Pump down and charge system.

10. Continue Performance Test.

3. Open high side gauge manifold hand valve and adjust to indicate 70 psi.
4. Read low side gauge; should indicate 20 to 24 psi.

1. Failure of valve to meet the above test conditions indicates a defective valve.
2. Replace valve.

1. An expansion valve that meets above specifications during test has correct super-heat setting, valve moving freely, and thermal bulb has not lost its charge.
2. This expansion valve is suitable for service.

1. Evacuate system as outlined on page 70 or 72.
2. Charge system with refrigerant as outlined on page 75 or 77.

1. Continue testing system.
2. Adjust control for maximum performance.

XXXII. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: VOLUMETRIC TEST OF THE AIR CONDITIONING COMPRESSOR (ALL MODELS)

PROCEDURE BREAKDOWN STEPS

1. Stabilize system at 1750 rpm.

2. Shut off car motor.

If Service Valves Not Used

3. Purge system of refrigerant slowly.

4. Isolate compressor from system.

If Service Valves Used

5. Front seat service valves.

6. Purge compressor of refrigerant.

INFORMATION

1. Gauges connected into system.
2. Adjust air conditioning controls for maximum cooling.
3. Operate 10 to 15 minutes.

1. Return to idle speed, exactly 500 rpm.
2. Shut off engine.

1. Crack valve slightly, as too rapid a release of refrigerant will carry oil out with it.
2. Open high side gauge manifold shut-off valve until pressure bleeds off.
3. Open low side gauge manifold shut-off valve until balance of pressure bleeds off.
4. Close both shut-off valves.

NOTE: Compressor may be isolated from system and substitute service valves installed to perform test.

1. Disconnect high side hose from compressor outlet and plug open end of hose.
2. Seal compressor outlet fitting with correct size flare cap.
3. Remove low side hose from compressor inlet connector and plug open end of hose.
4. Seal compressor inlet fitting with correct size flare cap.

1. Engine must be off and compressor not operating.

1. Purge slowly to prevent drawing oil from compressor.
2. Compressor discharged when both gauges read "0".

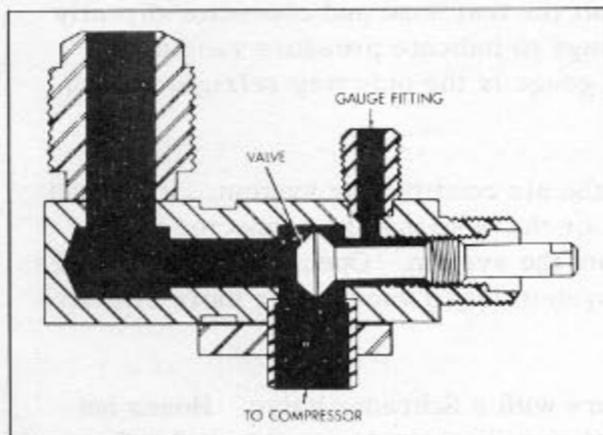


Figure 5. Service valve in mid-seated or test position.

Continued counterclockwise rotation of the valve stem will seat the rear face of the valve. This position will open the system to refrigerant flow but shut off refrigerant to the test hose connector. The third position then is called the "back-seated" or working position.

LEAK DETECTOR

Several types of leak detectors are available to the serviceman. A colored dye additive is available which is added to the refrigerant. Operation of the system will show coloration at the point of leakage. A very slight leak requiring several weeks or even months to bleed off enough refrigerant to affect system cooling can often be located using this additive when other methods of leak detection fail.

A liquid detergent type detector may be used around connections and any external point that might be a source of leak for the R-12. Escaping R-12 will cause the liquid to bubble, indicating a leak. Any parts that are not accessible such as the coils in the condenser and the evaporator cannot readily be coated with this liquid to check for leaks.

The electronic leak detector is the most sensitive of any type detector on the market. To date, the initial cost of this type detector has been a deterrent to individuals and small shops doing a minimum of air conditioning service. The

Rotating the valve stem in a counterclockwise direction with the service valve wrench will unseat the valve and open the system to refrigerant flow. The test hose connector on the service valve is now exposed to refrigerant. If this connector is not properly capped and the test hose is not connected, the refrigerant will escape through this connector into the open air. Rotating the valve stem approximately two turns from the back-seated position will position the valve in the "mid-seated" or test position. Systemic checks are performed with the service valve in this position.

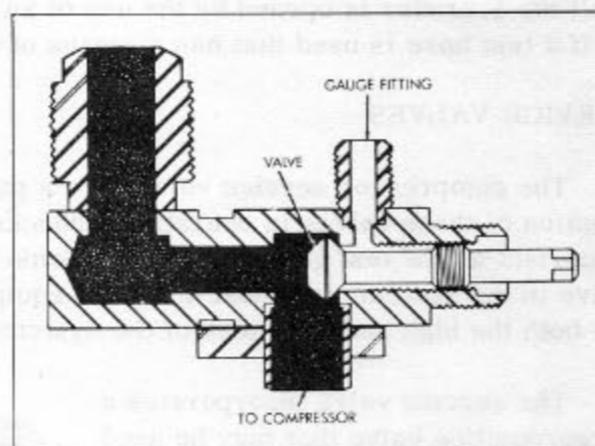


Figure 6. Service valve in back-seated or operating position.

7. Prepare gauge manifold for test.

1. Connect high side gauge hose to high side service valve or connector and open high side manifold valve.
2. Disconnect low side gauge hose from compressor and low side manifold valve.
3. Install test adapter cap on center connection of gauge manifold.

NOTE: Test adapter cap may be purchased or a 1/4" female flare cap may be drilled with a #71 drill through center of cap.

NOTE: If Schrader valve is used in low side connector, install Schrader adapter to connector to open low side of compressor to atmosphere.

8. Operate car motor at 500 rpm for 15 seconds.

1. Operate compressor as an air pump.

NOTE: Air drawn in at compressor inlet and pressurized to center of gauge manifold and high side gauge.

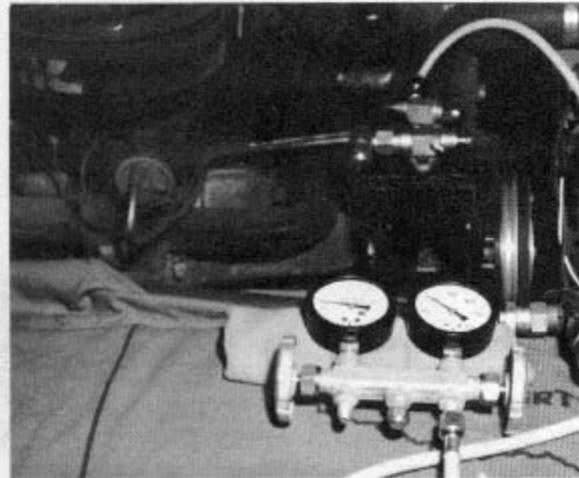


Figure 34. High side gauge should read 190-200 psi at exactly 500 engine rpm.

9. Read high side gauge.

1. Should read 190-200 psi on gauge.
2. Too low a reading indicates faulty reed valves or gasket.
3. If reading is low, repair as necessary.

10. Shut off engine and connect compressor into system.

1. Remove flare caps from high and low side of compressor.
2. Remove plugs from high and low side hoses.

10. Shut off engine and connect compressor into system (continued).

11. Install gauges for system evacuation.

12. Evacuate system or compressor.

13. Charge system with R-12.

14. Or mid-seat service valves if used on system.

15. Continue Performance Test.

3. Install high and low side hoses to high and low side compressor fittings.

4. Use refrigerant oil only as a seal and lubricant at these connections.

1. Remove adapter from center manifold connection.

2. Connect low side gauge hose to low side compressor connector.

3. Install hose from center manifold connection to vacuum pump.

1. Use suitable vacuum pump.

2. Evacuate system for a minimum of 30 minutes for moisture removal.

CAUTION: DO NOT OVERCHARGE SYSTEM.

1. Follow correct system charging procedure as outlined on page 75 or 77 whichever equipment is used.

1. Continue testing system.

2. Adjust control for maximum performance.

TROUBLE	CAUSE
<p>I. SYSTEM PRODUCES NO COOLING</p>	<p><u>Electrical</u></p> <ol style="list-style-type: none"> 1. Blown fuse. 2. Broken or disconnected electrical wire. 3. Broken or disconnected ground wire. 4. Clutch coil or solenoid burned out or disconnected. 5. Electric switch contacts in thermostat burned excessively, or sensing element defective. 6. Blower motor disconnected or burned out. <p><u>Mechanical</u></p> <ol style="list-style-type: none"> 1. Loose or broken drive belt. 2. Compressor partially or completely frozen. 3. Compressor reed valves inoperative. 4. Expansion valve stuck in open position. <p><u>Refrigeration</u></p> <ol style="list-style-type: none"> 1. Broken refrigerant line. 2. Fusible plug blown (does not apply to all units). 3. Leak in system. 4. Compressor shaft seal leaking. 5. Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.

INDICATIONS	REMEDY
<ol style="list-style-type: none"> 1. Electrical components will not operate. 2. Electrical components will not operate. 3. Electrical components will not operate. 4. Compressor clutch or solenoid inoperative. 5. Compressor clutch inoperative (applies to units having thermostatically controlled recycling). 6. Blower motor inoperative. 	<ol style="list-style-type: none"> 1. Replace fuse. 2. Check all terminals for loose connections; check wiring for hidden breaks. 3. Check ground wire to see if loose, broken, or disconnected. 4. Check current flow to clutch or solenoid--replace if inoperative. 5. Replace thermostat. 6. Check current flow to blower motor--repair or replace if inoperative.
<ol style="list-style-type: none"> 1. Visual inspection. 2. Compressor pulley slips on belt or will not turn when clutch is engaged. 3. Only slight variation of both gauge readings at any engine speed. 4. Head pressure normal, suction pressure high, evaporator flooding. 	<ol style="list-style-type: none"> 1. Replace drive belts and/or tighten to specifications. 2. Remove compressor for service or replacement. 3. Service or replace compressor reed valves. 4. Replace expansion valve.
<ol style="list-style-type: none"> 1. Complete loss of refrigerant. 2. Complete refrigerant loss. 3. No pressure on high and low gauges (applies to any system having complete loss of refrigerant). 4. Clutch and front of compressor oily; system low or out of refrigerant. 5. High gauge normal or may read high. Low gauge usually shows vacuum or very low pressure reading. Frosting usually occurs at point of blockage. 	<ol style="list-style-type: none"> 1. Examine all lines for evidence of breakage by external stress or rubbing wear. 2. Examine fusible plug--if blown, replace with correct plug. 3. Evacuate system, apply static charge, leak test system, and repair leak as necessary. 4. Replace compressor shaft seal. 5. Repair as necessary. <p>NOTE: After completing repairs of any above, system <u>must</u> have dehydrator replaced, purged, evacuated, and charged.</p>

TROUBLE	CAUSE
<p>II. SYSTEM WILL NOT PRODUCE SUFFICIENT COOLING</p>	<p><u>Electrical</u></p> <ol style="list-style-type: none"> 1. Blower motor sluggish in operation. <p><u>Mechanical</u></p> <ol style="list-style-type: none"> 1. Compressor clutch slipping. 2. Obstructed blower discharge passage. 3. Clogged air intake filter. 4. Outside air vents open. 5. Insufficient air circulation over condenser coils; fins clogged with dirt or bugs. 6. Evaporator clogged. 7. Evaporator pressure regulator, hot gas bypass valve, suction throttling valve, or selectrol defective or improperly adjusted. <p><u>Refrigeration</u></p> <ol style="list-style-type: none"> 1. Insufficient refrigerant in system. 2. Clogged screen in expansion valve. 3. Expansion valve thermal bulb has lost charge. 4. Clogged screen in receiver. 5. Excessive moisture in system. 6. Air in system. 7. Thermostat defective or improperly adjusted.

INDICATIONS	REMEDY
<ol style="list-style-type: none"> 1. Small displacement of air from discharge duct; blower motor possibly noisy. 1. Visual inspection. 2. Blower operates at high speed but air displacement very small. 3. Insufficient air displacement by blower. 4. Insufficient cooling at highway speeds. 5. Insufficient cooling at discharge outlet; excessive high pressure gauge reading; engine temperature usually excessive. 6. Fins clogged with lint, dust, or coated with cigarette tars. 7. High pressure gauge readings normal; low gauge usually reads too high. 	<ol style="list-style-type: none"> 1. Remove blower motor for service or replacement. 1. Remove clutch assembly for service or replacement. 2. Examine entire discharge passage for kinks, waddings, or failure to open passage during installation. Correct as necessary. 3. Remove air filter screens and service or replace, whichever is necessary. 4. Close air vents (adjust controls if necessary). NOTE: Some owners must be instructed on importance of keeping air vents closed when air-conditioning unit is in operation. 5. Clean engine radiator and condenser. Install heavy duty fan, fan shroud, or reposition radiator and condenser, whichever is necessary. 6. Loosen, pull down, and clean with compressed air. Use cleaning solvent to remove cigarette tars. CAUTION: Protect floor mats. 7. Repair or adjust as necessary.
<ol style="list-style-type: none"> 1. Bubbles in sight glass; high gauge readings excessively low. 2. Gauge pressures may be normal or may show slightly increased head pressure and low suction pressure; discharge output temperature higher than specified. 3. Excessively high or low gauge readings; may cool in excess or not enough. 4. High pressure gauge usually higher than normal; low pressure gauge lower than normal; receiver cold to touch and may frost. 5. Excessive head pressure gauge reading. 6. Excessive head pressure, sight glass shows bubbles or is cloudy. 7. Low gauge reading high; clutch cycles at too high a reading. 	<ol style="list-style-type: none"> 1. Recharge system until bubbles disappear and gauge readings stabilize to specifications. 2. Purge system, remove screen, clean and replace. 3. Purge system; replace expansion valve. 4. Purge system; replace receiver. 5. Purge system; replace dehydrator. 6. Purge, evacuate, and charge system. 7. Adjust or replace thermostat. NOTE: When a unit must be removed from the system for service or replacement, the system must have the dehydrator replaced also, and the system must be purged, evacuated, and recharged to remove excess moisture.

TROUBLE	CAUSE
<p>III. SYSTEM COOLS INTERMITTENTLY</p>	<p><u>Electrical</u></p> <ol style="list-style-type: none"> 1. Defective circuit breaker, blower switch, or blower motor. 2. Partial open, improper ground, or loose connection in compressor clutch coil or solenoid. <p><u>Mechanical</u></p> <ol style="list-style-type: none"> 1. Compressor clutch slipping. <p><u>Refrigeration</u></p> <ol style="list-style-type: none"> 1. Unit icing up may be caused by excessive moisture in system, incorrect super heat adjustment in expansion valve, or thermostat adjusted too low. 2. Thermostat defective. 3. Stuck hot gas bypass valve or suction throttle valve.

INDICATIONS	REMEDY
<ol style="list-style-type: none"> 1. Electrical units operate intermittently. 2. Clutch disengages prematurely during operation. 	<ol style="list-style-type: none"> 1. Remove defective part for service or replacement. 2. Check connections or remove clutch coil or solenoid for service or replacement.
<ol style="list-style-type: none"> 1. Visual inspection; operates until head pressure builds up (as viewed on high pressure gauge) at which time clutch begins slipping; may or may not be noisy. 	<ol style="list-style-type: none"> 1. Slippage over a prolonged period will require that clutch be removed for service; may require readjustment for proper spacing.
<ol style="list-style-type: none"> 1. Unit ices up intermittently. <p>NOTE: Any unit will ice up under certain ideal operating conditions of refrigerant temperature, humidity, and ambient temperature.</p> <ol style="list-style-type: none"> 2. Low side pressure may be low or excessively high; adjustments will not correct. 3. Both head and suction pressures low; moisture in system usually indicated. 	<ol style="list-style-type: none"> 1. Replace expansion valve; replace dehydrator if excess moisture present; adjust thermostat. 2. Replace thermostat. 3. Purge and evacuate and replace dehydrator to remove moisture; if still stuck, replace hot gas bypass valve.

TROUBLE	CAUSE
<p>IV, EXCESSIVELY NOISY SYSTEM</p>	<p><u>Electrical</u></p> <ol style="list-style-type: none"> 1. Defective winding or improper connection in compressor clutch coil or solenoid. <p><u>Mechanical</u></p> <ol style="list-style-type: none"> 1. Loose or excessively worn drive belts. 2. Noisy clutch. 3. Compressor noisy. 4. Loose panels on car. 5. Compressor oil level low. 6. Blower fan noisy; excessive wear in blower motor. 7. Idler pulley and bearing defective. <p><u>Refrigeration</u></p> <ol style="list-style-type: none"> 1. Excessive charge in system. 2. Low charge in system. 3. Excessive moisture in system. 4. High pressure service valve closed.

INDICATIONS	REMEDY
<ol style="list-style-type: none"> 1. Visual inspection; solenoid or clutch vibrates. 1. Belts slip and are noisy. 2. May or may not slip; noisy when engaged. 3. Loose mountings; worn parts inside compressor. 4. Excessive rattles during operation. 5. Compressor noisy and lower portion hot to touch. 6. Blower motor noisy. 7. Whining or growling noise during operation; pulley has rough feel when rotated by hand. 	<ol style="list-style-type: none"> 1. Replace or repair as necessary. 1. Tighten or replace as required. 2. Remove clutch for service or replacement as necessary. 3. Check mountings and repair; remove compressor for service or replacement. 4. Check and tighten all panels, hose hold-down clamps, or rubbing or vibrations of hoses or pipes. 5. Fill with correct specified oil. 6. Remove blower motor for service or replacement as necessary. 7. Replace bearing; inspect idler and pulley as may be worn excessively.
<ol style="list-style-type: none"> 1. Rumbling noise or vibration in high pressure line; thumping noise in compressor; excessive head pressure and suction pressure; bubbles in sight glass. 2. Hissing in evaporator case at expansion valve; bubbles or cloudiness in sight glass; low head pressure. 3. Expansion valve noisy; suction pressure low. 4. Compressor has excessive knocking noise; high pressure gauge reads above normal. 	<ol style="list-style-type: none"> 1. Discharge excess freon until high pressure gauge drops within specifications. 2. Check system for leaks; charge system. 3. Replace dehydrator; purge, evacuate, and charge system. 4. Open valve immediately.

instrument being electronic in construction cannot receive rough handling and still give accurate results. Cared for properly, the electronic detector will locate leaks quickly and accurately that are almost impossible to locate with other types of detectors.

The propane torch leak detector is the most familiar and has received the most widespread use throughout the air conditioning industry because of its ease of handling, availability of propane in disposable tanks, and low initial cost. In operation the blue flame changes color to yellow to vivid purplish blue when R-12 is picked up by the sniffer tube outside the system.

CAUTION: THE PROPANE TORCH LEAK DETECTOR MUST BE USED ONLY IN WELL VENTILATED AREAS. R-12 PASSING OVER AN OPEN FLAME GIVES OFF PHOSGENE GAS WHICH IS VERY TOXIC. DO NOT BREATHE FUMES GIVEN OFF BY THE DETECTOR.

Leak detection must be performed with the system under pressure to obtain accurate results. Very small leaks often require that the system pressure be increased above normal before they can be located. A 50% charge of refrigerant in the system is sufficient to locate most leaks. Occasionally, a stubborn small leak will be encountered which necessitates overcharging the system to bring the pressures above normal. The high side of the system might require leak testing while in operation with air flow restricted to the condenser to raise the high side pressure above normal. The low side is checked in the "off" position with the pressures equalized in both sides of the system. The serviceman working carefully and thoroughly in checking the system for leaks can eliminate all leaks from the system, thus eliminating system breakdown and customer dissatisfaction.

ABNORMAL PRESSURE GAUGE READINGS

<p>I. LOW SUCTION PRESSURE HEAD PRESSURE NORMAL</p>	<ol style="list-style-type: none"> 1. Thermostat defective. 2. Screen in expansion valve clogged. 3. Restriction between receiver and expansion valve. 4. Moisture in system. 5. Expansion valve closed if low pressure gauge reads a vacuum.
<p>II. HIGH SUCTION PRESSURE HEAD PRESSURE NORMAL</p>	<ol style="list-style-type: none"> 1. Improper operation of expansion valve. 2. Sensing element of expansion valve defective or making improper contact.
<p>III. HIGH SUCTION PRESSURE LOW HEAD PRESSURE</p>	<ol style="list-style-type: none"> 1. Compressor defective. 2. Compressor reed valve defective.
<p>IV. EXCESSIVE HEAD PRESSURE</p>	<ol style="list-style-type: none"> 1. Air in system or excessive charge of refrigerant in system. 2. Condenser air passages clogged. 3. Restriction in condenser, dehydrator, filter, or any high pressure line. 4. Excessive oil in compressor. 5. Engine overheating.

TESTING THE AIR CONDITIONING SYSTEM

The importance of a seasonal check up of the air conditioning system should be brought to the attention of the customer whenever possible. A thorough check of the system performed in a methodical manner will reveal trouble the customer is often not aware of. Locating and repairing the trouble early will usually result in savings to the customer both in time and additional troubles that too often result from neglect.

A Performance Test of the system is the only positive way in which the complete system can be checked for efficient operation. The air conditioning system should be given this test before work is begun on the system whenever possible. Many times, however, the system is completely inoperative, and repairs must be performed before the system can be properly tested. The test can uncover further work that must be performed before the system is brought to its full operating efficiency. The Performance Test should always be performed after repair work has been done and before the car is released to the customer. The serviceman performing this test carefully will insure that the repairs have been properly performed and that the system will operate satisfactorily.

The Performance Test when properly performed includes a thorough examination of the outside of the system as well as the inside. Many related parts are overlooked because it is felt they are of no importance to the system actually cooling the inside of the car. Often these outside parts have a direct bearing on the operating efficiency of the unit. For this reason, a thorough visual inspection of the complete system should be performed, followed by an operating inspection of the system.

VISUALLY INSPECT THE FOLLOWING:

1. DRIVE BELTS TIGHT WITHIN SPECIFICATIONS; NOT WORN OR FRAYED; AND LINED UP WITH OTHER PULLEYS. The compressor belt is subjected to a heavy load during operation of the air conditioning compressor. This is especially true when the head pressures build up in excess of 200 psi in hot weather city driving. The belt must be in excellent condition to withstand the strain of heavy load requirements. If the pulleys are not properly aligned, extreme side wear to the belt and pulleys will result. Too tight a belt tension will result in strain to the bearings of every unit which is operated by the compressor belt. Too loose a belt tension will result in belt slippage and poor unit performance. A belt tension gauge, of which several are available, eliminates guesswork in tightening the compressor belt. If a belt tension gauge is not available, tighten the adjustment until there is 3/8- to 1/2-inch deflection between any two pulleys that are farthest apart.

2. COMPRESSOR BRACKETS AND BRACES TIGHT AND NOT CRACKED OR BROKEN. Mounting bolts work loose, and brackets and braces often break under the vibrations and strain of operation. Failure to inspect and repair any damage at these points can result in early system failure.

3. HOSES OR COPPER LINES FOR CHAFING OR INDICATIONS OF LEAKS. Grommets and rubber pads that were originally installed to protect the hoses from contact with metal parts will deteriorate and fall off or become mispositioned. Exposing the hose or line to constant rubbing and chafing can cause deterioration and allow the refrigerant to escape. To prevent damage, some type of protective material should be reinstalled.

4. CONDENSER CLEAN AND PROPERLY MOUNTED. Bugs and dirt clog the condenser and impair air movement through the fins, interfering with proper condensing action. Bug screens in front of the condenser will prevent bugs from clogging the condenser but at the same time will prevent full air passage to the condenser coils. Any interference with full air flow over the condenser coils must be corrected to allow proper condensing action of the system.

5. COMPRESSOR OIL LEVEL. On all types of compressors having a provision to check the oil level without disconnecting the compressor from the system, an oil level check should be made using the correct type dip stick. Do not overfill system with oil as flooding of the condenser and evaporator will result.

6. DUCTS, LOUVERS AND AIR DISTRIBUTION MECHANISMS FOR SMOOTH OPERATION. Operate all lever mechanisms to insure free operation without binding and sticking.

7. EVAPORATOR. The evaporator condenses moisture which in turn traps dust and lint on the side where the air enters. The blower or fan can only be as effective as possible when evaporator passages are clear. Dust and lint should be removed.

8. BLOWER MOTOR OPERATION. Operate blower motor at all speeds. If motor is noisy or inoperative at certain speeds, repair as necessary.

9. VISUAL LEAKS. An oily spot usually indicates a refrigerant leak as oil is carried out with the escaping refrigerant.

10. AIR FILTERS. Many systems have used filters to clean the air before it goes to the evaporator coil. These have been used extensively in trunk units. The filter must be removed and cleaned, as a clogged filter will seriously affect evaporator air flow.

11. LEAK TEST SYSTEM. A leak test will verify that an oily spot indicates a leak. This test can only be performed on systems that are operative. A unit that has lost its refrigerant must be partially charged before this test can be performed.

OPERATIONAL TEST OF SYSTEM

1. SYSTEM FULLY CHARGED. The system should be operated for approximately 15 minutes to allow sufficient time for all parts to become completely stabilized. Determine if the system is fully charged by use of the test gauges and the sight glass if one is installed on the system. Head pressure will read from 180 psi to 220 psi or higher, depending upon ambient temperature and the type unit being tested. The sight glass should be free of bubbles if a glass is used in the system. Low side pressure should read approximately 15 psi to 30 psi, again depending on the ambient temperature and the unit being tested. It is impossible to give a definite reading for all types of systems used, as the type control and component installation used on a particular system will directly influence the pressure readings of the high and low sides.

The high side pressure will definitely be affected by the ambient or outside air temperature. A system that is operating normally will indicate a high side gauge reading between 150-170 psi with an 80 degree F. ambient. The same system will register 210-230 psi with an ambient of 100 degrees F. No two systems will register exactly the same, which requires that allowances for variations in head pressures must be considered. Following are the most important normal readings the serviceman will encounter during the season. These pressures and their ambient relationship should be committed to memory for quick reference.

Ambient	High Side Pressure
80° F.	150-170 psi
90° F.	175-195 psi
95° F.	185-205 psi
100° F.	210-230 psi
105° F.	230-250 psi
110° F.	250-270 psi

2. RELATIVE TEMPERATURE OF HIGH AND LOW SIDES OF SYSTEM. The high side of the system should be uniformly hot to the touch throughout. A difference in temperature will indicate a partial blockage of liquid or gas at this point. The low side of the system should be uniformly cool to the touch with no excessive sweating of the suction line or low side service valve. Excessive sweating or frosting of the low side service valve usually indicates an expansion valve is allowing an excessive amount of refrigerant into the evaporator. This condition will not necessarily be applicable to those units installed on General Motors products which use the Suction Throttling Valve. On these systems the line from the valve to the compressor will normally drop to a much lower reading than the evaporator pressure as the Suction Throttling Valve closes, resulting in the occurrence of moisture or frosting on this line. This is a normal reaction in this type system and is the result of construction and operation of the STV and the compressor having approximately 35% more capacity than previous models. These factors often cause the line from the valve to the compressor to drop into a partial vacuum under normal operation.

3. EVAPORATOR OUTPUT. At this point, provided all the above inspection tests have been performed carefully and components have been found to operate as they should, a rapid cooling down of the car interior should result. The use of a thermometer is not necessary to determine evaporator output, but its use is left to the discretion of the serviceman. Bringing all units to their correct operating specifications will insure that the evaporator performs as intended.

SERVICE PROCEDURES

DIAGNOSING THE SYSTEM

The following pages are designed to acquaint the automotive air conditioning technician with gauges as diagnostic instruments. To include all conditions of gauge readings he might encounter would require a manual too cumbersome to be effective. The most common malfunctions, therefore, are included, with their effects both on high and low side pressures. To further acquaint him with the contents of this manual, the correct Service Procedure is referred to under system repair, which will outline the correct steps he is to follow to perform necessary repairs. A careful study of these and preceding pages in this manual will eliminate the mystery of the air conditioning system.

high side of the system. The small orifice dividing the high from the low side of the system provides a pressure for the compressor to pump against. Too small an orifice or a compressor with too large a capacity could cause excessive build-up of pressure on the high side of the system. Too large an orifice in the expansion valve, a compressor with too small a capacity, or reed valve failure could prevent a buildup of pressure high enough to allow sufficient heat exchange in the condenser.

Condenser

The condenser receives high pressure, heat laden refrigerant vapor from the compressor. The condenser is designed to allow heat movement from the hot refrigerant vapor to the outside air. Cooling of the refrigerant and change of state from a vapor to a liquid result. Heat exchange in the condenser is accomplished by two general types of condensers, air cooled and water cooled. Water cooled condensers have not had application in the automotive field and will not be considered here. However, of the air cooled condensers, two basic types are in use-- ram air and forced air.

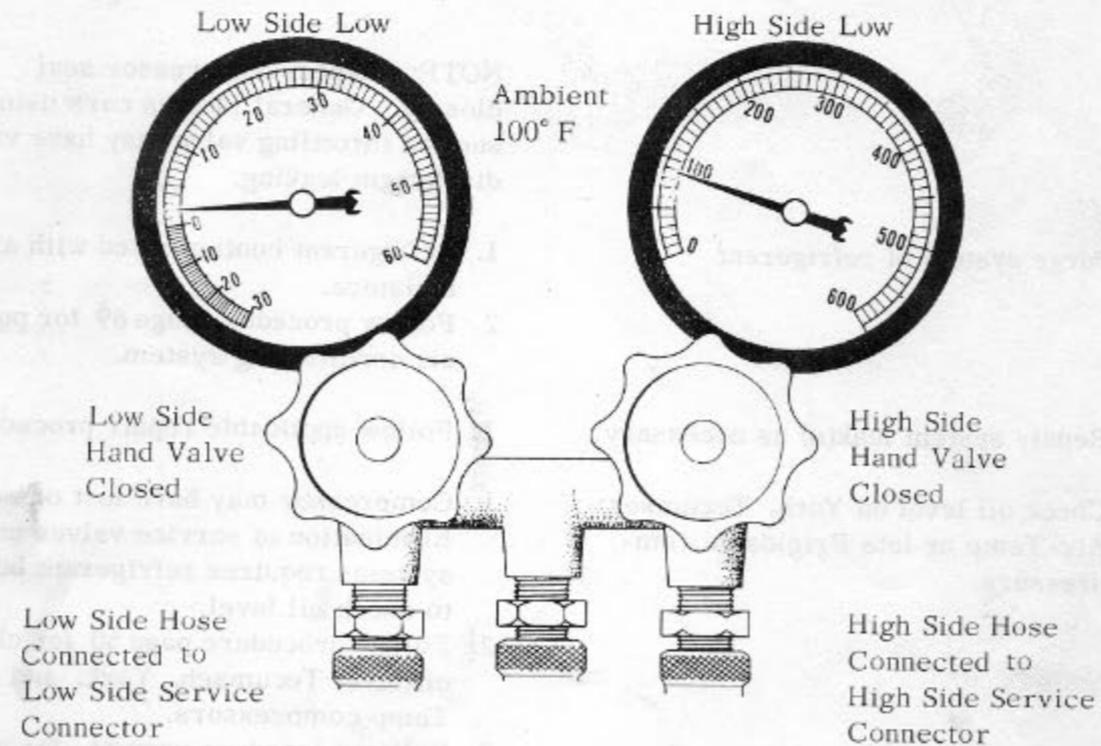
Ram air condensers depend upon vehicle movement to force a large volume of air past the fins and coils of the condenser. The engine fan is used to increase air volume at lower speeds. The viscous clutch-type fan is designed to allow the fan blades to free-wheel at higher speeds to eliminate blade drag above 45 mph. At a speed below 45 mph the fan clutch will engage the fan to increase air flow over the condenser and radiator coils.

Forced air condensers utilize an electric fan to move a large volume of air over the condenser. Trucks, taxicabs, and some automotive installations rely on both ram air and forced air to remove heat from the refrigerant. These vehicles must operate for long periods at slow speeds, which requires that additional air be forced over the condenser for efficient operation.

Condensing action is the change of state of the refrigerant from a vapor to a liquid and is controlled by pressure of the refrigerant and air flow over the condenser. Condensing pressure is the controlled pressure of the refrigerant as it condenses to a liquid, giving off large quantities of heat in the process. The condensing pressure is high enough to create a wide temperature differential between the heat laden refrigerant vapor and the air passing over the condenser fins and coils for rapid heat movement.

Excessive head pressure, which is indicated by an above normal reading on the high side gauge, could result from a restriction of refrigerant flow in the high side of the system. Restricted or insufficient air flow over the condenser could result in the same superheated condition. Poor condensing action will result in too high a condensing pressure. The upper two-thirds of the condenser coils are used to remove heat from the heat laden refrigerant vapor, while the lower third of the coils contains liquid. Too high a condensing pressure will upset this balance,

CONDITION NO. 1 LOW REFRIGERANT CHARGE



Customer Complaint: Little or no cooling from evaporator.

Diagnosis of Complaint:

1. Low side gauge reading excessively low.
2. High side gauge reading excessively low.

3. No bubbles in sight glass--no liquid.
4. Discharge air from evaporator warm.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 210-230 PSI.

NOTE: Refer to page 17 of this manual for further explanation.

3. Sight glass will show full liquid column.
4. Discharge air from evaporator will have sharp cold feel.

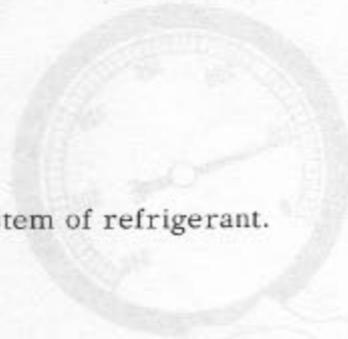
SYSTEM EXCESSIVELY LOW OF REFRIGERANT--SERIOUS LEAK INDICATED.

To Repair:

1. Leak test system--necessary to add partial refrigerant charge.

Because:

1. System has lost refrigerant.
2. Follow procedure page 79 for leak test system using propane torch Halide leak detector.



2. Purge system of refrigerant.

3. Repair system leak(s) as necessary.

4. Check oil level on York, Tecumseh, Air-Temp or late Frigidaire compressors.

5. Evacuate system using vacuum pump.

6. Charge system with NEW refrigerant page 75 or 77.

7. Continue Performance Test.

NOTE: Inspect compressor seal closely. General Motors cars using suction throttling valve may have valve diaphragm leaking.

1. Refrigerant contaminated with air and moisture.
2. Follow procedure page 69 for purging air conditioning system.

1. Follow applicable repair procedure.

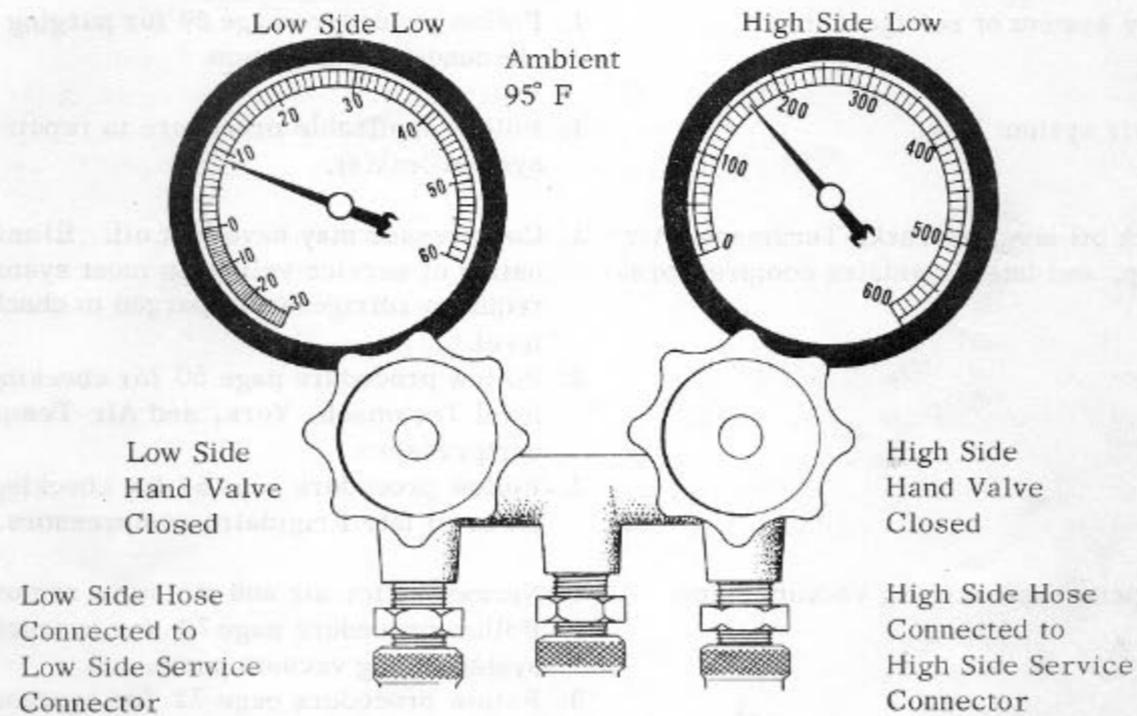
1. Compressor may have lost oil. Elimination of service valves on most systems requires refrigerant be purged to check oil level.
2. Follow procedure page 50 for checking oil level Tecumseh, York, and Air-Temp compressors.
3. Follow procedure page 54 for checking oil level late Frigidaire compressor.

1. Necessary for air and moisture removal.
2. Follow procedure page 70 for evacuating system using vacuum pump.
3. Follow procedure page 72 for evacuating system using charging station.

1. Clean, dry refrigerant a MUST for efficient system operation.
2. Follow procedure page 75 for charging system using 15-ounce containers.
3. Follow procedure page 77 charging air conditioning system using a charging station.

1. Refer to page 17 of this manual for explanation.
2. Follow procedure page 46 for performance testing the air conditioning system.

CONDITION NO. 2 INSUFFICIENT REFRIGERANT CHARGE



Customer Complaint: Air conditioner not providing adequate cooling.

Diagnosis of Complaint:

1. Low side gauge reading too low.
2. High side gauge reading too low.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 185-205 PSI.

NOTE: Refer to page 17 of this manual for further explanation.

3. Bubbles streaming in sight glass.
4. Discharge air from evaporator only slightly cool.

3. Sight glass free of bubbles.
4. Discharge air will have sharp, cold feel.

SYSTEM LOW ON REFRIGERANT-- REFRIGERANT LOSS CAUSED BY FAILURE TO OPERATE PERIODICALLY DURING WINTER SEASON OR BY SMALL LEAK.

To Repair:

1. Leak test system.

Because:

1. System has lost refrigerant.

NOTE: Generally accepted that system will lose 1/2-1 pound refrigerant between seasons.

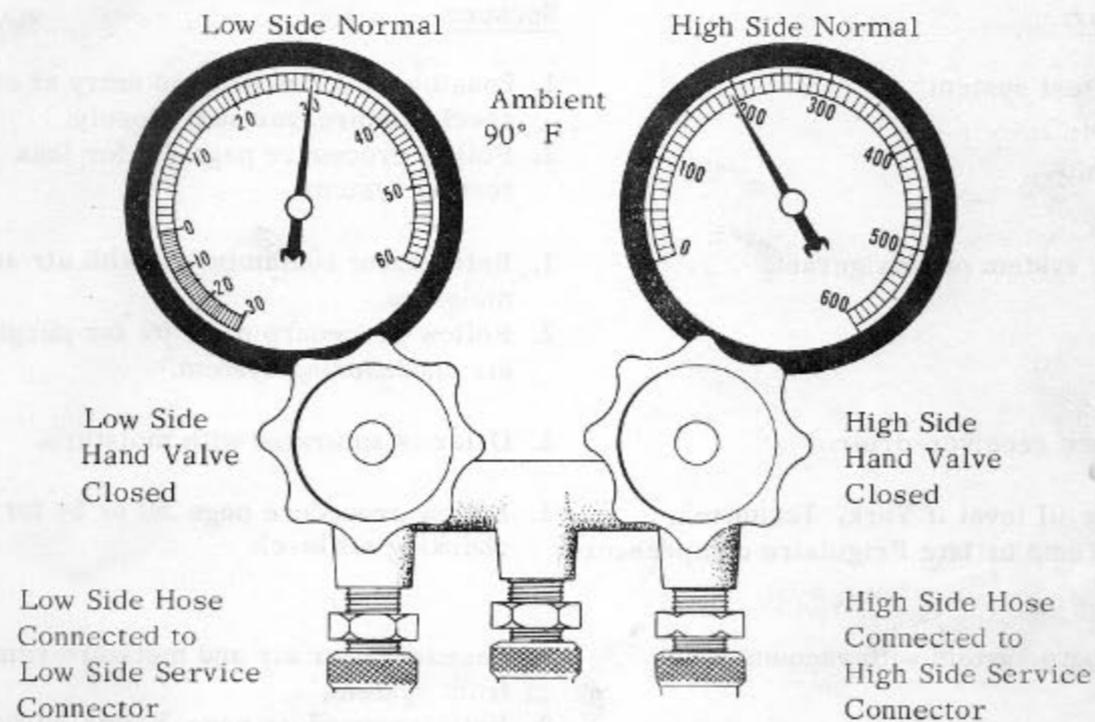
IF SERIOUS LEAK LOCATED

2. Purge system of refrigerant.
 1. Follow procedure page 69 for purging air conditioning system.
3. Repair system leak.
 1. Follow applicable procedure to repair system leak(s).
4. Check oil level on York, Tecumseh, Air-Temp, and late Frigidaire compressors.
 1. Compressor may have lost oil. Elimination of service valves on most systems requires refrigerant be purged to check oil level.
 2. Follow procedure page 50 for checking oil level Tecumseh, York, and Air-Temp compressors.
 3. Follow procedure page 54 for checking oil level late Frigidaire compressors.
5. Evacuate system using vacuum pump.
 1. Necessary for air and moisture removal.
 2. Follow procedure page 70 for evacuating system using vacuum pump.
 3. Follow procedure page 72 for evacuating system using charging station.
6. Charge system with NEW refrigerant 12.
 1. Clean, dry refrigerant a MUST for efficient system operation.
 2. Follow procedure page 75 for charging system using 15-ounce containers.
 3. Follow procedure page 77 for charging air conditioning system using a charging station.

IF NO LEAK LOCATED

7. Add refrigerant 12 to system.
 1. System must be brought up to full refrigerant charge for efficient cooling.
 2. Follow procedure page 48 for adding refrigerant to air conditioning system.
8. Continue Performance Test.
 1. Refer to page 17 in this manual for explanation.
 2. Follow procedure page 46 on performance testing the air conditioning system.

CONDITION NO. 3 AIR IN SYSTEM



Customer Complaint: Insufficient cooling from evaporator.

Diagnosis of Complaint:

1. Low side pressure constant will not drop.
2. High side pressure gauge slightly high.
3. Sight glass free of bubbles or shows only an occasional bubble.
4. Suction line warm to touch.
5. Evaporator discharge air only slightly cool.

Normal Should Be:

1. Low side pressure will drop until thermostat control cycles clutch; Suction control will show modulation; by-pass control on General Motors will be constant; Chrysler and Ford products will drop until solenoid opens.
2. High side pressure slightly lower especially if large fan used to substitute ram air.
3. Sight glass will not have trace of bubbles.
4. Suction line cool during system operation.
5. Evaporator discharge air should have sharp, cold feel.

NONCONDENSIBLES PRESENT IN SYSTEM--AIR AND MOISTURE PRESENT INSTEAD OF FULL REFRIGERANT CHARGE.

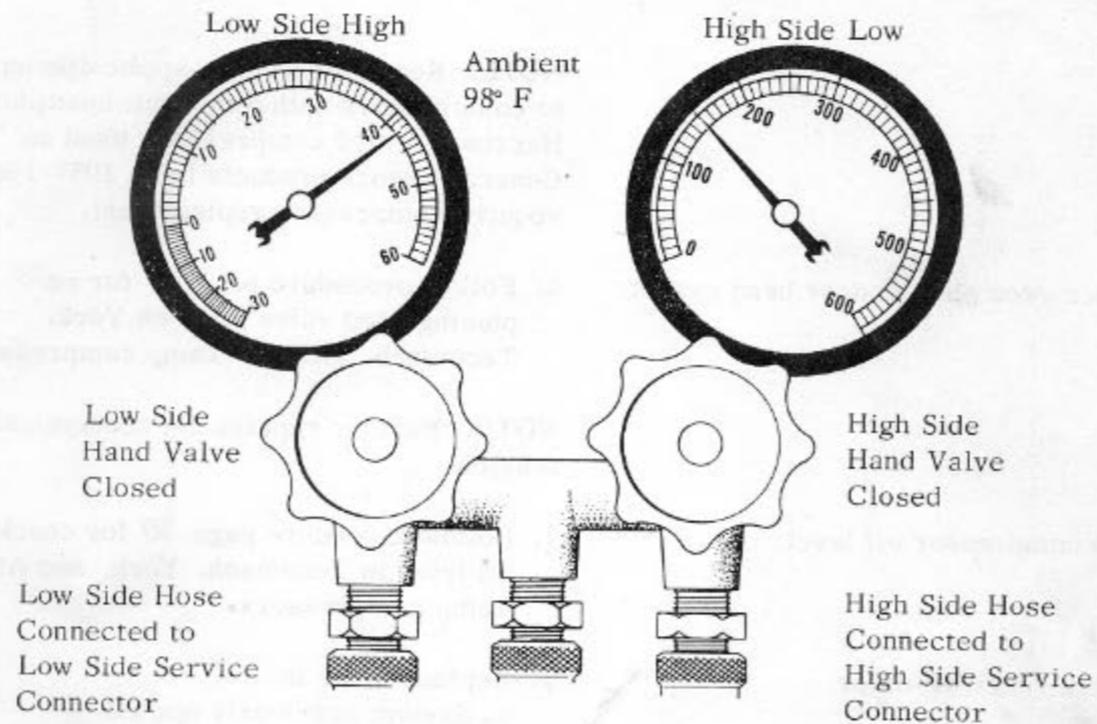
To Repair:

1. Leak test system.
2. Purge system of refrigerant.
3. Replace receiver-drier.
4. Check oil level if York, Tecumseh, Air-Temp or late Frigidaire compressor used.
5. Evacuate system with vacuum pump.
6. Fill system with new refrigerant.
7. Continue Performance Test.

Because:

1. Possible leak has allowed entry of air; check compressor seal closely.
2. Follow procedure page 79 for leak testing system.
1. Refrigerant contaminated with air and moisture.
2. Follow procedure page 69 for purging air conditioning system.
1. Drier is saturated with moisture.
1. Follow procedure page 50 or 54 for checking oil level.
1. Necessary for air and moisture removal from system.
2. Follow procedure page 70 for evacuating system.
1. Follow procedure page 75 or 77 for charging system.
1. Refer to page 17 of this manual for explanation.
2. Follow procedure page 46 for performance testing air conditioning system.

CONDITION NO. 4 COMPRESSOR MALFUNCTION



Customer Complaint: Car interior not cooling down sufficiently for comfort.

Diagnosis of Complaint:

1. Low side gauge reading too high.
2. High side gauge reading too low.
3. System is fully charged.
4. Evaporator discharge air not sufficiently cool.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 105-115 PSI.
3. Absence of bubbles in sight glass.
4. Discharge air from evaporator should have sharp, cold feel.

INTERNAL LEAK IN COMPRESSOR INDICATED--LEAKING REED VALVES, LEAKING HEAD GASKET, OR EXCESSIVELY WORN OR SCORED PISTON(S), RINGS, OR CYLINDER(S) CAUSE ABOVE INDICATIONS.

To Repair:

1. Isolate compressor (high and low side service valves present on system).

Because:

1. Compressor must be partially disassembled for inspection and repair.
2. Follow procedure page 81 for isolating compressor from system.

OR

- 1A. Purge system of refrigerant (no service valves present in system).

1. Follow procedure page 69 for purging air conditioning system.

2. Replace reed plate and/or head gasket.

3. Check compressor oil level.

4. Replace receiver-drier.

5. Pump down compressor or system according to whether step 1 or 1A was followed above.

6. Charge system with refrigerant.

7. Continue Performance Test.

NOTE: Repair procedure applicable only to compressors with removable head plates. Harrison sealed compressors used on General Motors products from 1957-1961 require compressor replacement.

1. Follow procedure page 85 for replacing reed valve plate on York, Tecumseh, and Air-Temp compressors.

NOTE: Further repairs not economically feasible.

1. Follow procedure page 50 for checking oil level in Tecumseh, York, and Air-Temp compressors.

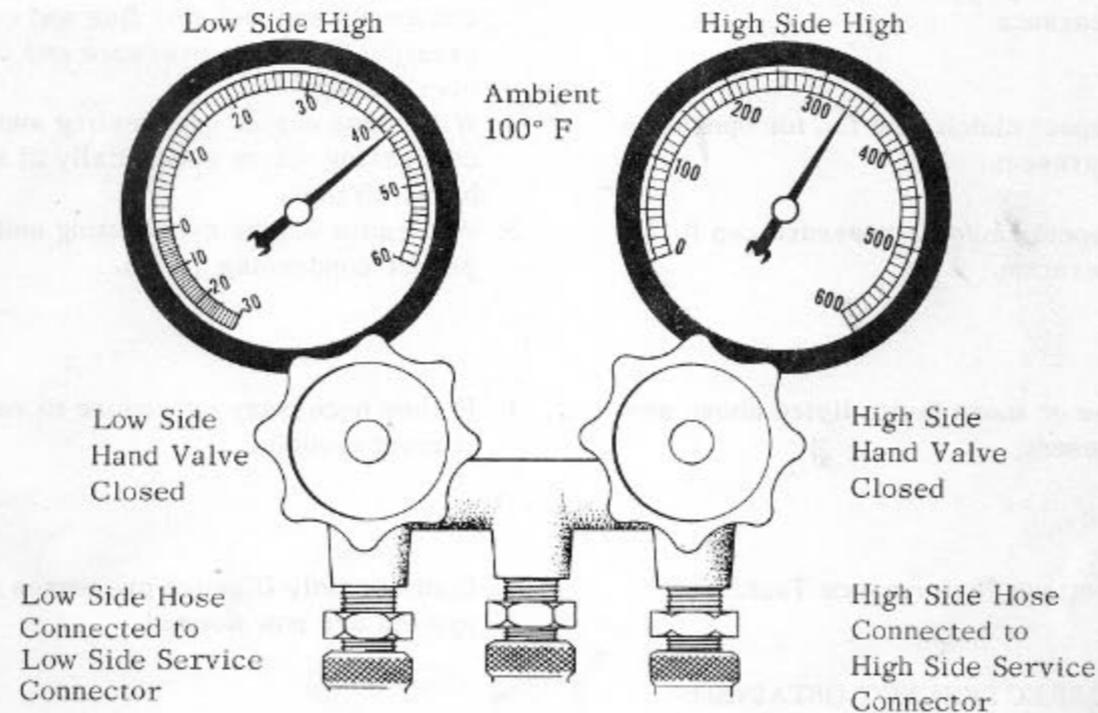
1. Replace drier if:
a. System previously opened.
b. Drier operated two or more seasons.
c. Disassembly of compressor revealed fine dessicant particles (usually golden or brown very fine particles).

1. Follow procedure page 70 for evacuating system using vacuum pump.
2. Follow procedure page 72 for evacuating system using charging station.

1. If compressor was isolated from system:
a. Back-seat service valves.
b. Open each valve approximately 1 1/2 rounds.
2. If entire system purged of refrigerant:
a. Follow procedure page 70 for charging system using a 15-ounce container.
b. Follow procedure page 72 for charging system using a charging station.

1. Follow procedure page 46 for performance testing air conditioning system.

CONDITION NO. 5 CONDENSER MALFUNCTION



Customer Complaint: Car interior will not cool. May also complain of engine overheating.

Diagnosis of Complaint:

1. Low side gauge reading excessively high.
2. High side gauge reading excessively high.
3. Bubbles may appear occasionally in sight glass. Liquid line very hot.
4. Discharge air from evaporator warm.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 210-230 PSI.
3. Sight glass free of bubbles. Liquid line warm but not hot.
4. Discharge air from evaporator should have sharp, cold feel.

IMPROPER CONDENSER OPERATION--TOO HIGH A HIGH SIDE PRESSURE DIRECT CAUSE OF LACK OF COOLING. SYSTEM WILL HAVE EITHER NORMAL OR OVERCHARGE OF REFRIGERANT.

To Repair:

1. Inspect for loose or worn drive belts.
2. Inspect condenser for clogged air passages and/or presence of bug screen.

Because:

1. Will cause engine overheating and excessive head pressure.
2. Will restrict ram air flow to cause improper condensing action and engine overheating.

resulting in superheated vapor entering the liquid hose and the expansion valve.

Compressor reed valve or piston failure can result in too low a condensing pressure. Heat exchange in the condenser will be curtailed, and excessive heat will remain in the low side of the system. This would be indicated by a higher than normal low side gauge pressure.

Expansion Valve

The expansion valve removes pressure from the liquid refrigerant to allow expansion or change of state from a liquid to a vapor in the evaporator. Household and many commercial refrigeration and air conditioning systems use a capillary tube instead of an expansion valve between the condenser and the evaporator to serve the same purpose. A capillary tube system operates efficiently only under conditions of even heat load, constant compressor speed, and condenser air flow. Initial cool-down by the evaporator is slow. The expansion valve has proven to be the most satisfactory flow control device for automotive use at present.

The high pressure liquid refrigerant entering the expansion valve will be quite warm. This may be verified by feeling the liquid line at its connection to the expansion valve. The liquid refrigerant leaving the expansion valve is quite cold. The orifice within the valve does not remove heat, but only removes pressure. Heat molecules contained in the liquid refrigerant are thus allowed to spread as the refrigerant moves out of the orifice. Under a greatly reduced pressure the liquid refrigerant is at its lowest temperature as it leaves the expansion valve and enters the evaporator.

Pressures at the inlet and outlet of the expansion valve will closely approximate gauge pressures at the inlet and outlet of the compressor in the automotive system. The similarity of pressures is caused by the close location of the components to each other. The slight variation in pressure readings of a very few pounds is due to resistance, causing pressure drop in the lines and coil lengths of the evaporator and condenser.

A more detailed function and operation of the expansion valve will be covered in a later chapter in this manual.

Evaporator

The evaporator removes heat from the area that is to be cooled. The desired temperature of cooling of the area will determine if refrigeration or air conditioning is desired. Food preservation generally requires low refrigeration temperatures, ranging from 40 degrees F. to below 0 degrees F.

3. Inspect condenser for incorrect mounting and improper radiator clearance.

4. Inspect clutch type fan for operation if present.

5. Inspect radiator pressure cap for operation.

IF:

6. One or more faults listed above are present.

THEN:

7. Continue Performance Test.

IF CORRECTION NOT OBTAINED:

8. Inspect system for overcharge of refrigerant.

9. Continue Performance Test.

IF GAUGE PRESSURES STILL TOO HIGH:

10. Remove and inspect condenser for oil clogging.

11. Continue Performance Test.

3. Incorrect clearance or mounting will cause restricted ram air flow over condenser and radiator fins and coils creating high head pressure and engine overheating.

4. Will cause engine overheating and improper condensing action specifically at speeds below 45 mph.

5. Will cause engine overheating and improper condensing action.

1. Follow necessary procedure to repair or correct trouble.

1. Continue only if gauge pressures and system are now normal.

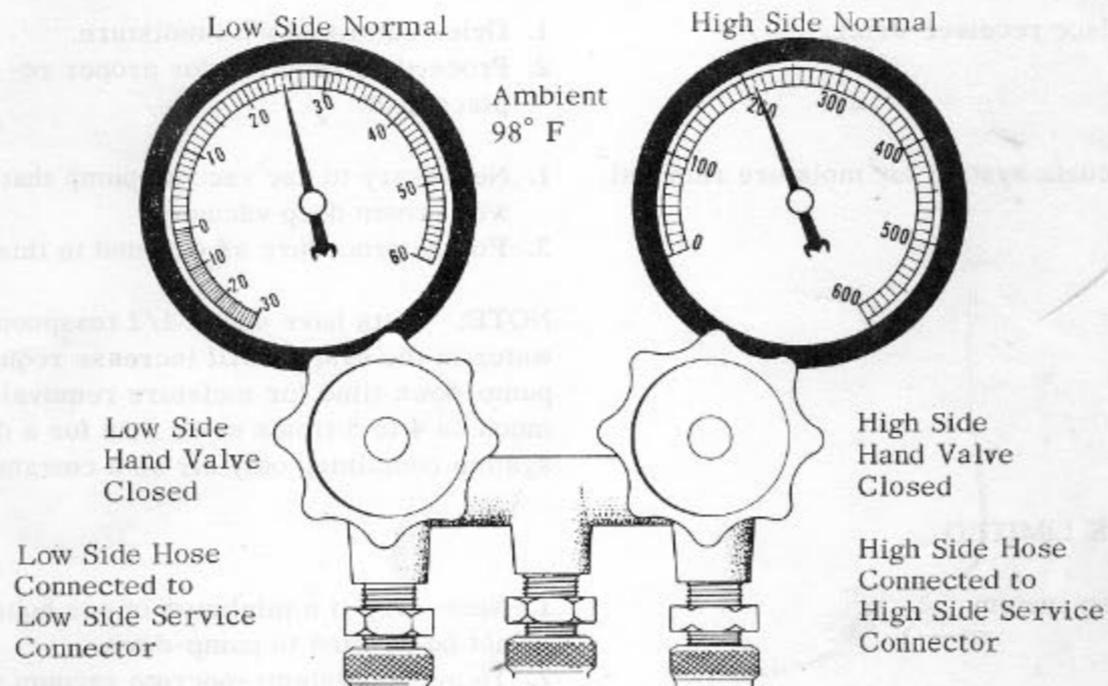
1. Excess refrigerant will cause excessive system pressures and engine overheating during low speed hot weather driving.
2. Purge refrigerant until bubbles stream in sight glass and both high and low side gauge pressures drop below normal.
3. Add refrigerant until bubbles disappear and pressures are normal.
4. Add 1/4-1/2 pound of refrigerant extra for reserve.

1. Continue only if system now normal.
2. Follow procedure in this manual.

1. Elimination of all above possibilities indicates internal oil clogging of condenser.
2. Follow applicable procedures to purge refrigerant, remove condenser using compressed air to force oil from condenser.
3. Follow applicable procedure to replace condenser, receiver-drier, evacuate and charge system.

1. Follow procedure page 46 for performance testing the air conditioning system.

CONDITION NO. 6 EXCESSIVE MOISTURE IN SYSTEM



Customer Complaint: System cools satisfactorily during early morning or late evening but does not cool during hot part of day.

Diagnosis of Complaint:

1. Low side gauge reading between 15-30 PSI may or may not drop into vacuum while testing.
2. High side gauge reading 205 PSI. If low side drops into vacuum, high side pressure will drop.
3. Discharge air feels sharp, cold--will warm while low side in vacuum.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI should never drop into vacuum.
2. High side gauge reading between 195-205 PSI will remain steady.
3. Discharge air will have constant sharp, cold feel.

DRIER SATURATED WITH MOISTURE--DRIER RELEASING MOISTURE DURING HIGH AMBIENT TEMPERATURE WHICH COLLECTS IN EXPANSION VALVE ORIFICE AND FREEZES TO STOP REFRIGERANT FLOW.

To Repair:

1. Purge system of refrigerant.

Because:

1. Refrigerant contaminated with moisture.
2. Follow correct procedure.

2. Replace receiver-drier.

1. Drier saturated with moisture.
2. Proceed as required for proper replacement.

3. Evacuate system for moisture removal.

1. Necessary to use vacuum pump that will create deep vacuum.
2. Follow procedure as outlined in this manual.

NOTE: Tests have shown 1/2 teaspoon of water in the system will increase required pump-down time for moisture removal as much as 4 to 5 times more than for a dry system containing only air as a contaminant.

IF TIME LIMITED

4. Sweep system.

1. Necessary if a minimum of one hour cannot be devoted to pump-down.
2. To sweep system--operate vacuum pump 15 minutes, then shut off pump.
3. Add 1/2 refrigerant charge.
4. Operate system for 10 minutes in maximum cooling position to allow refrigerant to pick up moisture.
5. Purge refrigerant and pump down 15 more minutes.

THEN

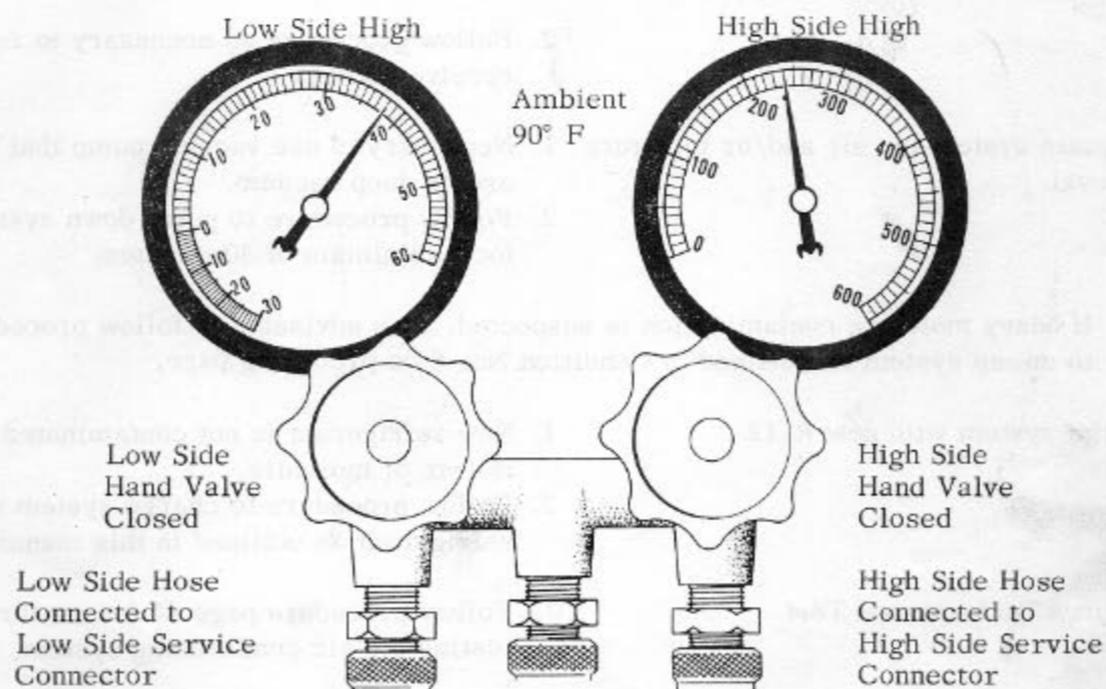
5. Charge system with new refrigerant.

1. New refrigerant is uncontaminated and moisture free.
2. Follow procedure as outlined in this manual.

6. Continue Performance Test.

1. Follow procedure page 46 for performance testing the air conditioning system.

CONDITION NO. 7 SYSTEM CONTAMINATED WITH AIR



Customer Complaint: Evaporator does not cool car.

Diagnosis of Complaint:

1. Low side gauge reading too high.
2. High side gauge reading too high.
3. Occasional bubbles present in sight glass.
4. Discharge air from evaporator not cool.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 175-195 PSI.
3. Sight glass clear of bubbles.
4. Discharge air from evaporator will have sharp, cold feel.

AIR AND/OR MOISTURE IN SYSTEM--NONCONDENSIBLES PRESENT IN AIR CONDITIONING SYSTEM WHICH HAVE DILUTED AND CONTAMINATED REFRIGERANT.

To Repair:

1. Purge system of refrigerant.
2. Replace receiver-drier.

Because:

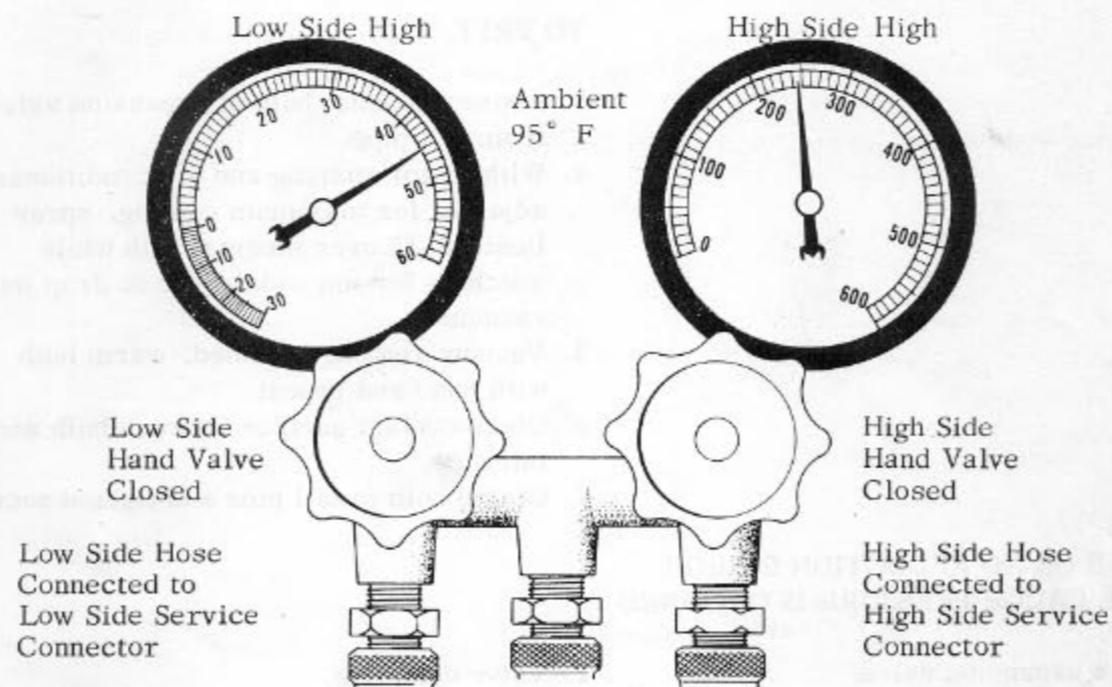
1. Refrigerant is contaminated.
 2. Follow procedure as outlined in this manual.
-
1. Dessicant will have reached saturation point and must be removed from system as evacuation cannot remove moisture from drier.

2. Follow procedure as necessary to replace receiver-drier.
3. Evacuate system for air and/or moisture removal.
 1. Necessary to use vacuum pump that will create deep vacuum.
 2. Follow procedure to pump down system for a minimum of 30 minutes.

NOTE: If heavy moisture contamination is suspected, it is advisable to follow procedure to sweep system as outlined in Condition No. 6 on preceding page.

4. Charge system with new R-12.
 1. New refrigerant is not contaminated and is free of moisture.
 2. Follow procedure to charge system with refrigerant as outlined in this manual.
5. Continue Performance Test.
 1. Follow procedure page 46 for performance testing the air conditioning system.

CONDITION NO. 8 EXPANSION VALVE MALFUNCTION



Customer Complaint: Failure of air conditioner to cool car.

Diagnosis of Complaint:

1. Low side gauge reading too high.
2. High side gauge reading too high.
3. Discharge air from evaporator warm.
4. Heavy sweat on suction hose; also heavy sweat from evaporator.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 185-205 PSI.
3. Discharge air from evaporator will have sharp, cold feel.
4. Humidity of 60% or more, light sweat on metal of suction hose. Humidity of 60% or less, very light to complete absence of sweat on suction hose connections.

EXPANSION VALVE FLOODING EVAPORATOR COIL--EXPANSION VALVE ALLOWING EXCESSIVE FLOW OF REFRIGERANT THROUGH EVAPORATOR.

To Repair:

1. Inspect expansion valve for operation.

Because:

1. Valve may be stuck in open position.
2. Thermal bulb contact to tail pipe loose or corroded.



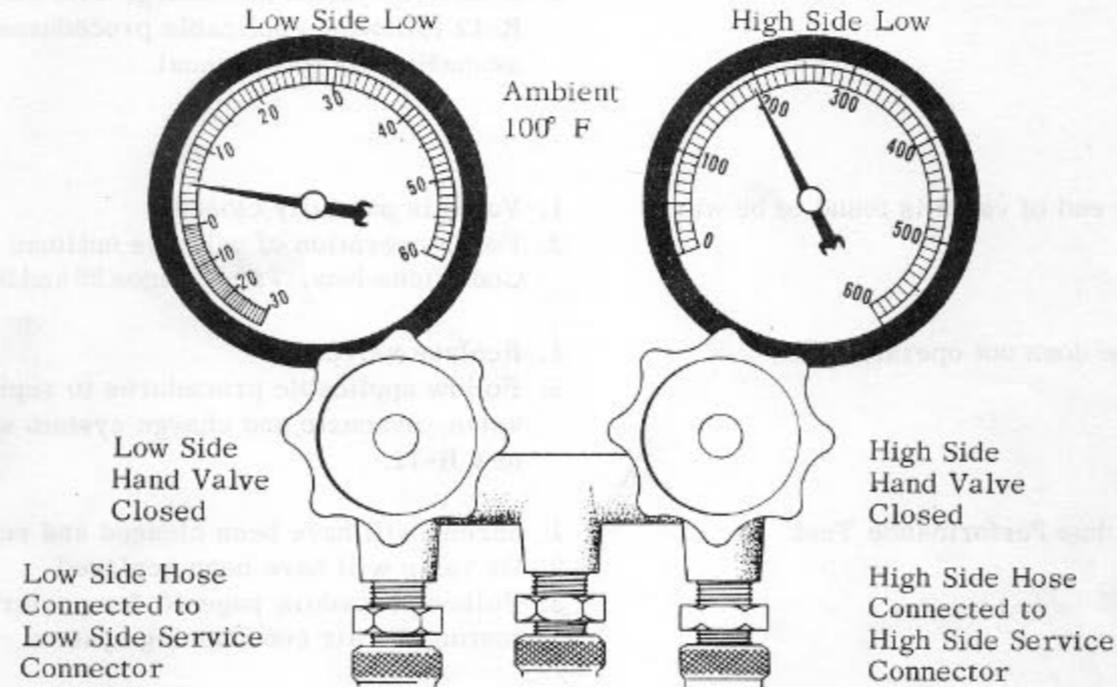
TO TEST

3. Loosen thermal bulb of expansion valve from tail pipe.
4. With motor running and air conditioner adjusted for maximum cooling, spray liquid R-12 over thermal bulb while watching for low side gauge to drop into vacuum.
5. Vacuum reading obtained, warm bulb with hand and repeat.
6. Clean contact surface between bulb and tail pipe.
7. Clamp bulb to tail pipe and tighten securely.

IF LITTLE OR NO REDUCTION IN HIGH LOW SIDE GAUGE PRESSURE IS OBTAINED

- | | |
|---|--|
| <ol style="list-style-type: none">2. Replace expansion valve. | <ol style="list-style-type: none">1. Valve defective.2. Purge refrigerant as outlined.3. Follow required procedure to replace expansion valve. |
| <ol style="list-style-type: none">3. Pump down system using suitable vacuum pump. | <ol style="list-style-type: none">1. Evacuate system following applicable procedure for type equipment used. |
| <ol style="list-style-type: none">4. Charge system with new R-12. | <ol style="list-style-type: none">1. Follow procedure as outlined in this manual. |
| <ol style="list-style-type: none">5. Continue Performance Test. | <ol style="list-style-type: none">1. Follow procedure page 46 for performance testing the air conditioning system. |

CONDITION NO. 9 EXPANSION VALVE MALFUNCTION



Customer Complaint: Lack of cooling from evaporator.

Diagnosis of Complaint:

1. Low side gauge reading too low.
2. High side gauge reading too low.
3. Discharge air from evaporator only cool.
4. Inspection may reveal heavy sweat or frost on expansion valve inlet.

Normal Should Be:

1. Low side gauge reading between 15-30 PSI.
2. High side gauge reading between 210-230 PSI.
3. Discharge air from evaporator will have sharp, cold feel.
4. Expansion valve inlet and upper half of expansion valve will be warm--approximately same temperature as liquid line.

EXPANSION VALVE RESTRICTING REFRIGERANT FLOW--HEAVY SWEAT OR FROST AT INLET, SCREEN CLOGGED; UPPER END OF VALVE WARM, VALVE STUCK CLOSED OR THERMAL BULB HAS LOST REFRIGERANT CHARGE.

To Repair:

IF

1. Valve inlet reveals sweat or frost.

Because:

1. Inlet screen clogged.
2. Purge refrigerant, remove screen, clean and REPLACE.

3. Evacuate system and charge with new R-12 following applicable procedures as outlined in this manual.

OR

2. Inlet end of valve is found to be warm.

1. Valve is partially closed.
2. Force operation of valve as outlined Conditions Nos. 7 and 8 pages 33 and 35.

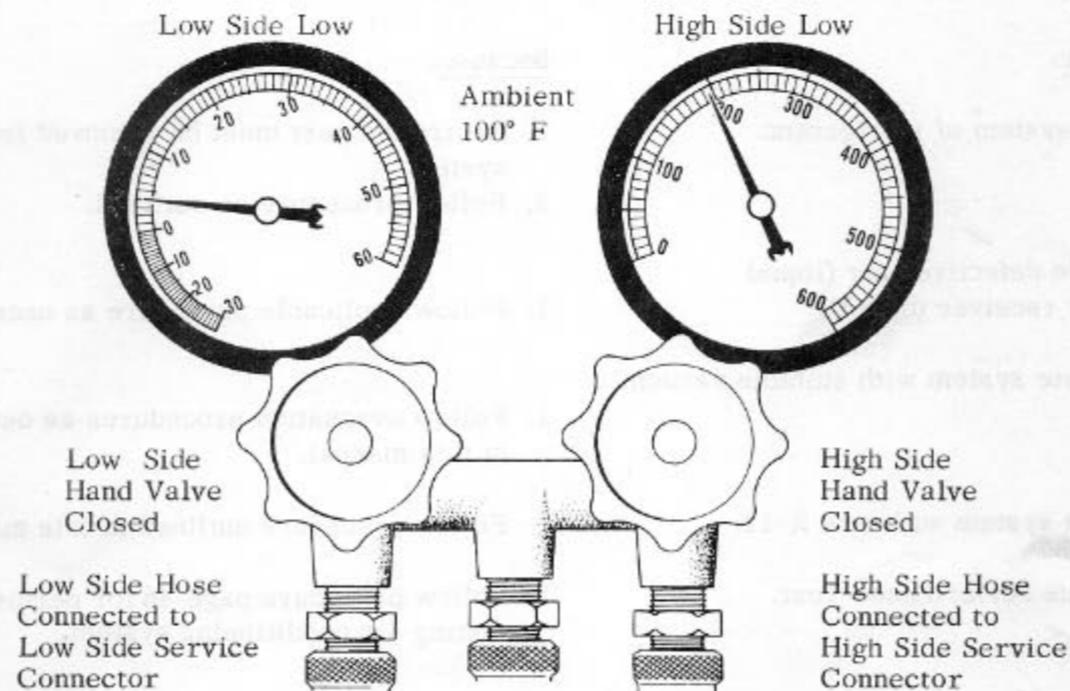
3. Valve does not operate.

1. Replace valve.
2. Follow applicable procedures to replace valve, evacuate and charge system with new R-12.

4. Continue Performance Test.

1. Screen will have been cleaned and replaced.
2. Or valve will have been replaced.
3. Follow procedure page 46 for performance testing the air conditioning system.

CONDITION NO. 10 HIGH SIDE RESTRICTION



Customer Complaint: Little cooling from evaporator.

Diagnosis of Complaint:

1. Low side reading too low.
2. High side gauge reading low.

Normal Should Be:

1. Low side reading between 15-30 PSI.
2. High side gauge reading between 210-230 PSI.

NOTE: Conditions 9 and 10 have shown restricted refrigerant flow with a below normal high pressure gauge reading. The compressor will evacuate refrigerant from the evaporator faster than it can enter, accounting for the too low a low side gauge pressure. The condenser and receiver become a storage container and hold the refrigerant charge. Ram air will subcool the refrigerant because it is not moving at a high rate of flow, and high side gauge pressure will drop. A normal capacity condenser will give the above indications. However, a too small condenser and/or receiver or an overcharged system will cause the high side gauge pressure to be normal or excessively high.

- | | |
|---|--|
| 3. Discharge air from evaporator only slightly cool. | 3. Discharge air from evaporator will have sharp, cold feel. |
| 4. Cool line, heavy sweat or frosting on receiver or liquid line. | 4. Receiver and liquid line warm to feel. |

RESTRICTION IN RECEIVER OR LIQUID LINE--RECEIVER CLOGGED OR "BUTTERFLY ACTION" FROM LOOSE RUBBER IN LIQUID LINE.

A higher temperature is required for human comfort. A large area is cooled, which requires that large volumes of air be passed through the evaporator coil for heat exchange. A blower becomes a necessary part of the evaporator in the air conditioning system. The blower fans must not only draw heat laden air into the evaporator, but must also force this air over the evaporator fins and coils-- where it surrenders its heat to the refrigerant-- and then forces the cooled air out of the evaporator into the space being cooled.

Fan speed is essential to the evaporation process in the air conditioning system. Heat exchange, as has been explained under condenser operation, depends upon a temperature differential of the air and the refrigerant. The greater the temperature differential, the greater will be the amount of heat exchanged between the air and the refrigerant. A high heat load condition, as is generally encountered when the air conditioning system is turned on, will allow rapid heat transfer between the air and the cooler refrigerant. The blower fan turned on its highest speed will deliver its greatest volume of air across the fins and coils for a rapid evaporation process. The cooling of the area under air conditioning will soon reach a temperature at which little additional cooling will result if the fan is allowed to continue its high volume flow. A reduction in fan speed will decrease volume, but the lower volume rate will allow the air to remain in contact with the fins and coils for a longer period of time and surrender its heat to the refrigerant. Both condensing and evaporating processes depend upon large temperature differentials for rapid heat exchange. A lowering of temperature of the refrigerant in the condenser will affect the condensing process, and a lowering of the temperature of the air under air conditioning will slow down the evaporating process. Cooling of the evaporator is dependent on controlled air flow over the evaporator coils by regulating fan blower speed. The coldest air temperature emitted from the evaporator results when the blower fan is operated on its lowest speed to allow the greatest heat absorption by the refrigerant from the air.

Change of state of the refrigerant in the evaporator coils is as important as air flow over the coils. Liquid refrigerant supplied to the coils by the expansion valve expands to a vapor as it absorbs heat from the air. The latent heat of evaporation is the heat absorbed by the expanding refrigerant and is the evaporation process. Some liquid refrigerant must be supplied throughout the total length of the evaporator coils for full capacity of the evaporator. A starved evaporator coil is a condition in which insufficient refrigerant has been supplied throughout total coil length. Expansion of the refrigerant has not occurred through the whole coil length, resulting in inefficient coil operation and undercapacity heat exchange.

A flooded evaporator is the opposite of the starved coil. Too much refrigerant is passed through the evaporator coils, resulting in unexpanded liquid passing into the suction line and into the compressor. Liquid refrigerant in the compressor can result in damage to the reed valves and pistons. A flooded evaporator will contain too much refrigerant for efficient heat absorption in the evaporator coil and will result in inefficient evaporation and poor evaporator cooling.

To Repair:

1. Purge system of refrigerant.
2. Remove defective part (liquid line or receiver drier).
3. Evacuate system with suitable vacuum pump.
4. Charge system with new R-12.
5. Continue Performance Test.

Because:

1. Restricted part must be removed from system.
 2. Follow procedure as outlined.
-
1. Follow applicable procedure as necessary.
-
1. Follow evacuation procedures as outlined in this manual.
-
1. Follow procedure outlined in this manual.
-
1. Follow procedure page 46 for performance testing air conditioning system.

SERVICE PROCEDURES

TESTING THE SYSTEM

The following procedures are operational checks and adjustments to be performed when testing the system and bringing it to maximum efficiency. These procedures are designed to begin with connecting the gauges into the system and carry the serviceman through adjustment of the various controls. Repairs to the system are handled separately in Parts II and III of this manual. After repairs have been completed, the system should be given a Performance Test and necessary adjustments performed using whichever procedures are applicable.

1. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: INSTALL GAUGE SET TO CHECK SYSTEM OPERATION

The following service procedure is to be followed at any time it becomes necessary to install the test gauges into the system. The service procedures on the following pages require that the gauges be installed into the system. It is to be presumed that the steps as outlined here are to be followed as necessary to perform the particular procedure. Put on face shield before starting this operation--refrigerant can blind.

PROCEDURE BREAKDOWN STEPS

1. Remove high and low side service valve stem caps.

2. Remove high and low side service connector caps.

3. Connect service gauge hoses to service connectors.

INFORMATION

1. Place fender cover on fender to protect finish.
2. Use correct size wrench on metal caps.
3. Use pliers on plastic or aluminum caps if necessary.

CAUTION: DO NOT BREAK PLASTIC CAP.

1. Remove caps slowly in event refrigerant is leaking past valve seat or Schrader valve.

NOTE: Many late model units have omitted one or both shut-off valves and use a Schrader valve in the connectors to retain refrigerant during operation. A Schrader adapter must be used when this type connector is encountered.

REMEMBER:

- a. High side service valve connects to condenser.
- b. Low side service valve connects to evaporator.
- c. High side hose below high pressure gauge.
- d. Low side hose below low pressure gauge.

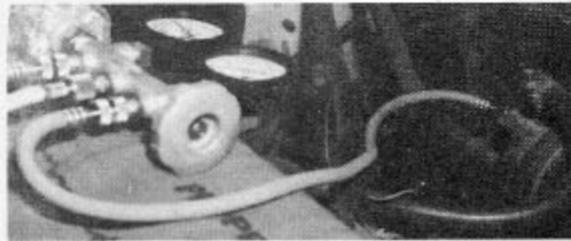


Figure 7. First identify and connect test hose into high side of system.

4. Mid-position service valves.

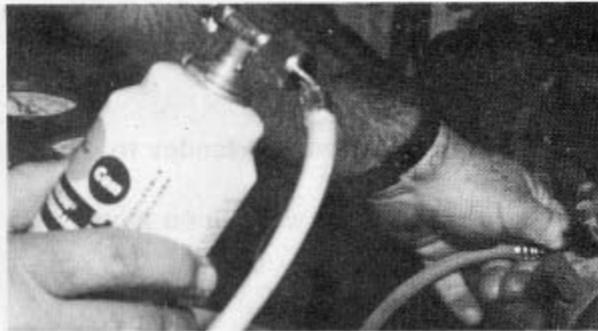


Figure 8. Using refrigerant container to purge air from test hoses.

5. Start motor and adjust to 1750 rpm.

1. Close service gauge manifold shut-off valves.
2. Connect hose to connectors finger tight.

1. Use service valve wrench.
2. Rotate service valve stem clockwise two rounds from back-seat position.

NOTE: On most installations using a Schrader valve in the service connector, the SERVICE VALVE HAS BEEN ELIMINATED FROM THE SYSTEM.

3. Purge air from high side hose by cracking high side gauge manifold hand valve for 3 seconds, then close.
4. Repeat with low side hose.

NOTE: A better method of purging air from test hoses is to use 15 oz. can or tank connected to center manifold hose. Before mid-positioning service valves, loosen hoses at service valve, open valve on can or tank. Open high side manifold valve to purge high side hose. Repeat with low side. Tighten hoses and continue. On installations using Schrader connector, purge hose to Schrader adapter before tightening on hose connector.

1. Use special throttle linkage adjuster tool or adjust idle speed screw.
2. Allow time for sufficient warm-up as necessary; if motor is cold,

- a minimum of 15 minutes is required.
- 3. Adjust air conditioning controls for maximum cold.

The following steps are outlined in the following steps as a continuation of the...
 (The text is mirrored and difficult to read due to bleed-through from the reverse side of the page.)

1. Turn the air conditioning control panel to the "ON" position.
 2. Turn the temperature control knob to the "COLD" position.
 3. Turn the fan speed control knob to the "ON" position.
 4. Turn the air conditioning control panel to the "OFF" position.
 5. Turn the air conditioning control panel to the "ON" position.
 6. Turn the temperature control knob to the "COLD" position.
 7. Turn the fan speed control knob to the "ON" position.
 8. Turn the air conditioning control panel to the "OFF" position.
 9. Turn the air conditioning control panel to the "ON" position.
 10. Turn the temperature control knob to the "COLD" position.
 11. Turn the fan speed control knob to the "ON" position.
 12. Turn the air conditioning control panel to the "OFF" position.
 13. Turn the air conditioning control panel to the "ON" position.
 14. Turn the temperature control knob to the "COLD" position.
 15. Turn the fan speed control knob to the "ON" position.



1. Turn the air conditioning control panel to the "ON" position.
 2. Turn the temperature control knob to the "COLD" position.
 3. Turn the fan speed control knob to the "ON" position.
 4. Turn the air conditioning control panel to the "OFF" position.
 5. Turn the air conditioning control panel to the "ON" position.
 6. Turn the temperature control knob to the "COLD" position.
 7. Turn the fan speed control knob to the "ON" position.
 8. Turn the air conditioning control panel to the "OFF" position.
 9. Turn the air conditioning control panel to the "ON" position.
 10. Turn the temperature control knob to the "COLD" position.
 11. Turn the fan speed control knob to the "ON" position.
 12. Turn the air conditioning control panel to the "OFF" position.
 13. Turn the air conditioning control panel to the "ON" position.
 14. Turn the temperature control knob to the "COLD" position.
 15. Turn the fan speed control knob to the "ON" position.

1. Turn the air conditioning control panel to the "ON" position.
 2. Turn the temperature control knob to the "COLD" position.
 3. Turn the fan speed control knob to the "ON" position.
 4. Turn the air conditioning control panel to the "OFF" position.
 5. Turn the air conditioning control panel to the "ON" position.
 6. Turn the temperature control knob to the "COLD" position.
 7. Turn the fan speed control knob to the "ON" position.
 8. Turn the air conditioning control panel to the "OFF" position.
 9. Turn the air conditioning control panel to the "ON" position.
 10. Turn the temperature control knob to the "COLD" position.
 11. Turn the fan speed control knob to the "ON" position.
 12. Turn the air conditioning control panel to the "OFF" position.
 13. Turn the air conditioning control panel to the "ON" position.
 14. Turn the temperature control knob to the "COLD" position.
 15. Turn the fan speed control knob to the "ON" position.

II. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: PERFORMANCE TEST THE AIR CONDITIONING SYSTEM

The Performance Test as outlined in the following steps is a continuation of the Visual Inspection and Operational Test of System as found on pages 9-11 and as referred to elsewhere in the Air Conditioning Manual. Put on face shield before starting this operation.

PROCEDURE BREAKDOWN STEPS

1. Performance test air conditioning system.

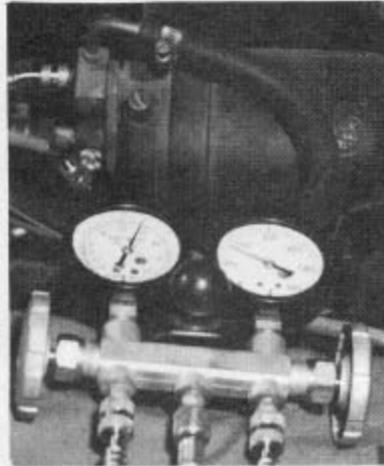


Figure 9. Read low and high side gauges to determine system's condition.

2. Inspect high side of system for even temperature.
3. Inspect low side of system for excessive sweating or frosting.
4. Test operation of control used on system.
5. Readjust motor idle to specified idle rpm.

INFORMATION

NOTE:

- a. Low pressure gauge will read from 15 to 30 psig.
- b. High pressure gauge will read from 180 to 220 psig plus, depending on ambient temperature and system under test.
- c. Discharge air from evaporator will feel quite cold. Refer to chart at end of steps.

1. Feel entire high side of system for even degree of heat; note receiver-dehydrator.
1. Feel and observe lines from evaporator to compressor.

NOTE: Too cold or too warm with a near-normal low side gauge reading indicates malfunctioning expansion valve.

1. Refer to service procedure pertaining to control used.
1. Readjust idle adjustment screw.
2. Remove special throttle linkage adjusting tool if used.

6. Back-seat service valves.
 1. Use service valve wrench.
 2. Rotate counterclockwise until valves are seated.

7. Remove service gauge hoses from service valves.
 1. Disconnect hoses from connectors.
 2. Make sure to disconnect adapter from connector using Schrader adapter.

8. Replace service valve and service connector caps.
 1. Tighten metal caps with correct size wrench, approximately 15 foot pounds.
 2. Use pliers to tighten plastic or aluminum caps if necessary.

CAUTION: DO NOT BREAK PLASTIC.

9. Deliver to customer.
 1. Remove tools and gauges from under hood.
 2. Remove fender cover and close hood.

The following is given as a reference only and will not be exact in all units. Some type systems will actually register lower temperatures than those given here due to the type construction and installation of the system. Others will not register quite this low for the same reason. These figures are to be used as a guide only in attaining maximum performance for a particular system.

Ambient Temperature °F	Relative Humidity %	Discharge Air Temperature at F°	
		Evap. Coil	R. H. Air Duct
80	50	30	41
	60	32	42
	90	34	45
90	40	32	40
	50	33	43
	60	34	48
100	20	31	41
	40	33	45
	50	35	50

III. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: ADD REFRIGERANT TO THE AIR CONDITIONING SYSTEM

A small refrigerant loss between seasons is to be expected and is seemingly accepted as normal. When connecting the gauges into the system, if the serviceman will use a 15-oz. can or the refrigerant tank to purge air from the test hoses as brought out in Installing Gauge Set To Check System Operation on page 43 of this manual, he will be prepared to add refrigerant should he find the system requires it.

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Connect manifold hose to refrigerant source.
2. Add R-12 to system.

1. Gauges connected into system.
 2. System has been stabilized.
 3. Gauges and/or sight glass indicate shortage of refrigerant.
 4. Connect hose to R-12 source and purge air from hose.
1. Air conditioning controls set for maximum cooling and motor operating at 1500-1750 rpm.
 2. Open low side manifold valve.
 3. Invert 15-oz. can and open valve not to exceed 40 psi on low side gauge.

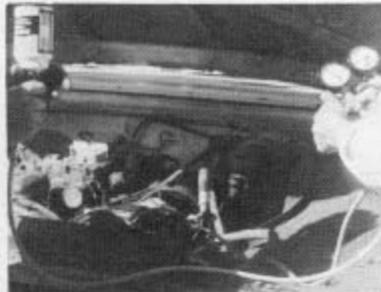


Figure 10. Add refrigerant with system in operation.

WARNING: READ THE FOLLOWING CAREFULLY! WITH THE CAN OR TANK INVERTED, REFRIGERANT VAPOR WILL RISE TO THE TOP OF THE CONTAINER AND FORCE LIQUID REFRIGERANT INTO THE HOSES. REGULATING THE VALVE ON THE CONTAINER OR THE LOW SIDE MANIFOLD HAND VALVE SO THAT THE LOW SIDE GAUGE READING DOES NOT EXCEED 40 PSI WILL INSURE THAT REFRIGERANT IN THE HOSE HAS VAPORIZED BEFORE ENTERING THE COMPRESSOR. EXCESSIVE LIQUID ENTERING THE COMPRESSOR CAN RESULT IN DAMAGE TO INTERNAL PARTS SUCH AS PISTONS AND/OR REED VALVES.

2. Add R-12 to system (continued).

CAUTION: DO NOT INVERT CONTAINER IF AMBIENT TEMPERATURE IS LOWER THAN 80 DEGREES F. ALSO, CAR MOTOR, COMPRESSOR, AND ALL PARTS MUST BE AT OPERATING TEMPERATURE, WHICH IS NECESSARY AS AN AID TO VAPORIZE REFRIGERANT.

NOTE: Below 80 degrees F. there is danger of the liquid refrigerant not being warmed sufficiently to vaporize before entering the suction side of the compressor. To speed up action during cool weather, it will be necessary to heat refrigerant container with warm water not to exceed 125 degrees F.

3. Check system for full refrigerant charge.

4. Manipulate low side service valve or valve on refrigerant container to regulate low side pressure not to exceed 40 psi to prevent liquid entering compressor.

1. Close low side hand manifold valve to check for complete charge.
2. High side gauge will show normal reading of head pressure in relation to ambient temperature.

(See Pressure Temperature Relationship chart, page 20, Air Conditioning Manual.)

4. Continue Performance Test.

3. Low side gauge will normalize at pressures of 15 to 30 psi depending on type control used on system.
4. Sight glass, if used, will be clear of bubbles.
5. Close valve on refrigerant container.

1. Check system for leaks.
2. Repair system if gauges did not normalize.
3. Deliver to customer if no further repairs are necessary.

Gauge pressure readings on the low side of the system readily indicate either condition. Too low a reading on the compound gauge accompanied by too quick frost formation on the fins with too little cool air emitted from the evaporator indicates a starved coil. A flooded coil is indicated by too high a pressure on the compound gauge and excessive sweating of the evaporator coils and suction hose accompanied by little cooling from the evaporator.

IV. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: CHECK OIL LEVEL IN TECUMSEH, YORK, AIR-TEMP COMPRESSORS

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Stabilize system at 1500-1750 rpm.

1. Gauges connected into system.
2. Adjust controls to maximum cooling.
3. Operate 10 to 15 minutes.

2. Isolate compressor.

NOTE: Not applicable to units not having a low side compressor service valve.

1. Close low side service valve slowly until pressure drops to 0 psi.
2. Shut off car engine.
3. Completely close low side service valve.
4. Close high side service valve.

3. Remove oil check plug.
Wear face shield.

CAUTION: REMOVE SLOWLY TO BLEED OFF SMALL REFRIGERANT CHARGE IN COMPRESSOR.

1. Remove cap after gauge reads 0 psi.

4. Check oil level.

1. Use correct dip stick.
2. Use chart below to determine correct oil level.
3. Add 300 viscosity refrigeration oil as necessary to bring to correct level.

CAUTION: STORE REFRIGERATION OIL IN AIR-TIGHT CONTAINER.

5. Place unit in service and continue test.

1. Replace oil check plug.
2. Mid-position service valves.

The following chart represents maximum oil levels.

York A 209	Tecumseh HA 850	Tecumseh HH	Air-Temp
Vertical--1 $\frac{1}{4}$ "	Vertical--1 to 1 $\frac{1}{4}$ "	Vertical--1 $\frac{1}{8}$ to 1 $\frac{1}{2}$ "	Right-hand mount--2 $\frac{5}{8}$ to 2 $\frac{13}{16}$ "
Inclined--2"	Horizontal--1 to 1 $\frac{1}{4}$ "	Horizontal--1 $\frac{3}{8}$ to 1 $\frac{9}{16}$ "	Left-center mount--3 to 3 $\frac{3}{16}$ "
Horizontal-- $\frac{7}{8}$ "			

V. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: CHECK OIL LEVEL IN GENERAL MOTORS COMPRESSORS THROUGH
1961 MODELS

PROCEDURE BREAKDOWN STEPS

1. Stabilize system at 1600 rpm.
2. Turn off engine.
3. Open oil test valve on compressor.



Figure 11. Checking oil level on General Motors compressors.

4. Return system to service.

OR

5. Add oil to system.

INFORMATION

1. Gauges connected into system.
 2. Adjust air conditioning controls for full cold position.
 3. Operate 10 to 15 minutes.
1. Bring to idle to prevent "dieseling."

NOTE: First surge of oil caused by oil standing in fitting. Hold in open position long enough to determine that oil is at top of fitting.

1. Use clean rag to catch the oil.
2. Allow oil to escape from test valve just long enough to indicate oil level above fitting.

1. Close oil test valve.
2. Start engine and continue testing.

1. Refer to "Add Oil to General Motors Compressors Through 1961 Models," page 52.

VI. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: ADD OIL TO GENERAL MOTORS COMPRESSORS THROUGH 1961 MODELS

PROCEDURE BREAKDOWN STEPS

1. Front-seat low side service valve.
2. Install oil charging line to gauge manifold.
3. Place oil charging line in refrigerant oil.

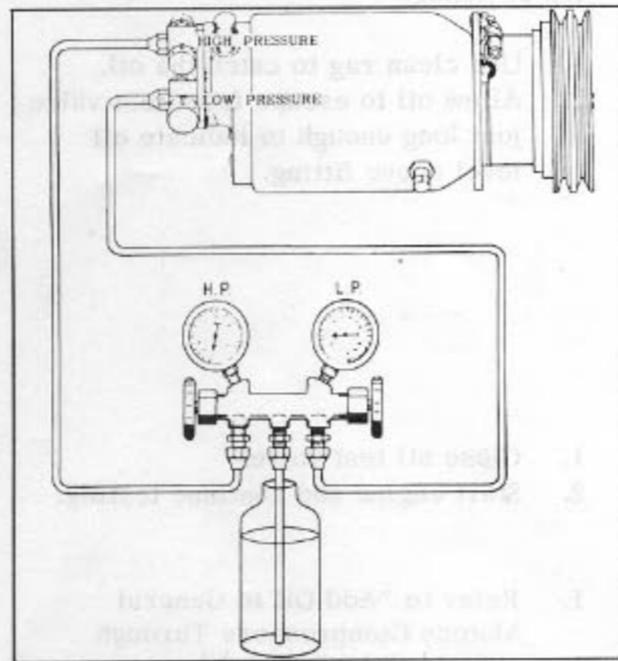


Figure 12. Add oil to General Motors compressors having a low side service valve.

4. Start engine and pump system to 10" Hg.

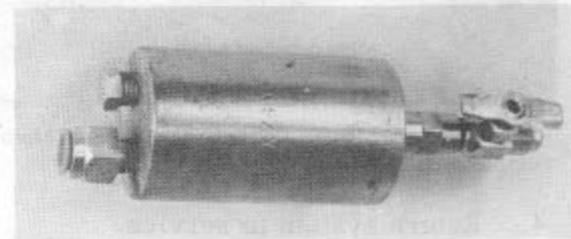
INFORMATION

NOTE: Engine off and high side service valve remains mid-positioned.

NOTE: Use 1/4" x 10 inches of copper tubing with flare fitting to connect to center manifold connector.

1. Tighten with proper size wrench.
2. Purge air from oil charging line by opening high side hand manifold valve slightly for 3 seconds.

1. Use 525 viscosity oil.
2. Place line in oil while Freon purging air from line.
3. Close high side hand manifold valve.
4. Place oil and gauge manifold in secure position.



1. Set air conditioning controls in full cold position.
2. Operate engine at idle speed.

5. Add 2 ounces of oil to system.

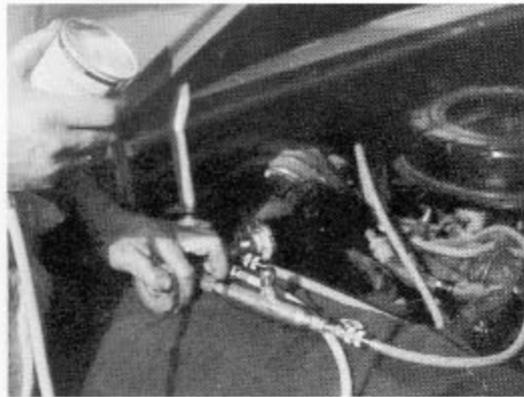


Figure 13. Use of two-ounce filler tube to add oil to General Motors compressor.

6. Purge oil from gauge manifold.

7. Stabilize system.

8. Open oil test valve.

CAUTION: IF SYSTEM DOES NOT HOLD VACUUM, CHECK AND TIGHTEN ALL CONNECTIONS.

1. Open low side manifold gauge valve and pull 2 ounces of oil into system.
2. Close valve, remove oil charging line and cap center connection and tighten securely.

NOTE: On compressors not having a low side service valve or where both service valves have been eliminated, a 2-ounce filler tube as shown in Figure 13 may be attached to the gauge manifold. Refrigerant is used to carry the oil into the low side of the compressor. When using this method, it is possible to overcharge the system. After bringing the oil to the proper level, if gauges indicate an overcharged system, excess refrigerant should be bled off until normal readings are obtained.

1. Open high side gauge manifold valve.
2. Slowly open low side gauge manifold valve.
3. Close both valves.

1. Mid-position compressor service valves.
2. Operate engine at 1600 rpm for 5 minutes.
3. Place air conditioning controls in full cold position.

1. Follow procedure, "Check Oil Level in General Motors Compressors Through 1961 Models," page 51.
2. Add oil 2 ounces at a time until correct level is obtained.

VII. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: CHECK AND ADD OIL TO LATE MODEL GENERAL MOTORS
COMPRESSORS 1962 TO DATE

The Frigidaire compressor used on General Motors vehicles has no provision to accurately check oil level on the car. Periodic inspection of oil level has therefore been eliminated from installations using this compressor. Oil level check, performed with the compressor removed from the car, is to be made only in conditions of severe oil loss caused by a compressor seal leak, broken refrigerant hose, or rupture from crash damage. The system is designed to hold 10 ounces of 525 viscosity refrigeration oil. The affinity of R-12 and refrigeration oil and the design of this compressor will prevent the full oil charge being contained in the compressor. Follow allowance for oil distribution as outlined at end of this procedure.

PROCEDURE BREAKDOWN STEPS	INFORMATION
1. Purge refrigerant from system.	1. Service valves not generally present on installations using this compressor. 2. Follow procedure as outlined in this manual to purge refrigerant.
2. Remove compressor from car.	1. Follow procedure as necessary for make and year of model.
3. Remove oil from compressor into clean container.	1. Remove plug on oil pump. 2. Pour oil from compressor into container calibrated in ounces.
4. Measure oil from compressor.	1. Determine quantity of oil contained in compressor. 2. Refer to chart to determine amount of oil required to return oil level to full.
5. Install NEW 525 viscosity oil in compressor.	1. Discard old oil removed from compressor. 2. Clean the container used to measure oil. 3. Measure out required amount of oil into clean container. 4. Use small tipped funnel inserted in drain hole to install required amount of oil. 5. Install plug and tighten.

- | | |
|---|--|
| 6. Install compressor on car. | 1. Follow procedure as necessary for make and year of model. |
| 7. Repair damage to system. | 1. Repair system as required to eliminate leak(s) in system. |
| 8. Evacuate system using a suitable vacuum pump. | 1. Follow procedure as outlined in this manual for system evacuation. |
| 9. Charge system with NEW refrigerant-12. | 1. Follow applicable procedure as outlined in this manual to charge system. |
| 10. Continue Performance Test of air conditioning system. | 1. Follow procedure page 17 for performance testing air conditioning system. |

Install New 525 viscosity refrigeration oil as follows:

Compressor Contains:	Add:	If Evaporator Replaced	If Condensor Replaced
4 ounces or more	Required oil to total 7 ounces	Plus 2 ounces	Plus 1 ounce
Less than 4 ounces	7 ounces	Plus 2 ounces	Plus 1 ounce
New compressor added	7 ounces	Plus 2 ounces	Plus 1 ounce

1. If system flushed with sufficient quantity of flushing agent that would remove oil from system, install full 10 ounces of oil.
2. On a newly installed system, install full 10 ounces of oil prior to operation.
3. On systems containing metal particles in oil, replace or overhaul compressor, replace receiver-drier and install high capacity, low pressure drop filter in liquid line to filter and protect expansion valve and new compressor from damage by foreign particles.

VIII. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: ADJUST THERMOSTAT

Thermostat-controlled recycling clutch systems require that the thermostat operation be checked periodically and occasionally adjusted. For thermostat operation, location of thermal bulb, and identification, refer to Air Conditioning Manual, pages 69-71. The following procedure will detail steps in checking the thermostat and how to adjust those types having adjustment provisions.

PROCEDURE BREAKDOWN STEPS	INFORMATION
1. Stabilize system at 1500-1750 rpm.	<ol style="list-style-type: none"> 1. Gauges connected into system. 2. Air conditioning controls adjusted for maximum cooling. 3. Operate for 10 to 15 minutes.
2. Read high side gauge for full refrigerant charge.	<ol style="list-style-type: none"> 1. Will read high side pressure approximating Pressure Temperature Relationship chart in <u>Air Conditioning Manual</u>, page 20. 2. Check sight glass for absence of bubbles.
3. Read low side gauge for thermostat operation.	<ol style="list-style-type: none"> 1. Should read from 26 psi to 14 psi after system stabilized for 10 to 15 minutes.
4. Adjust thermostat.	<p>NOTE: Thermostat should disconnect clutch for evaporator defrost between high and low readings given above. If thermostat will not recycle clutch, move temperature control toward warmer position to check for thermostat point opening.</p> <ol style="list-style-type: none"> 2. Count number pounds pressure required for warm-up until points close-- should indicate 26 to 32 lbs. rise between point opening and re-closing. 3. Check thermostat operation at least three times for consistent operation. <p>NOTE: Thermostats are generally but not always located in evaporator case. The serviceman may be required to use diligence in locating the thermostat, especially with some models of trunk units.</p>

4. Adjust thermostat (continued).

1. Remove parts as necessary to make thermostat accessible.
2. Open access door to adjustment screw.
3. Rotate adjustment screw counter-clockwise to lower point opening adjustment; clockwise to raise point opening adjustment.

NOTE: Localities having high mean humidity will require higher point opening than localities with low mean humidity. Coastal areas with point opening adjustment lower than 24 to 26 psi will result in evaporator freeze-up. So-called desert areas with very low humidity can easily tolerate point opening adjustment of 14 to 16 psi without evaporator freeze-up.

4. Check operation of thermostat for newly adjusted cycle of operation.
5. Replace thermostat if cycle of operation inconsistent or will not respond to adjustment.
6. Replace access door on side of thermostat and any parts removed to make thermostat accessible.

5. Continue Performance Test.

1. Continue testing system.
2. Remove gauges and deliver car to customer.

IX. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: CHECK AND ADJUST HOT GAS BY-PASS VALVE (EARLY GENERAL MOTORS UNITS THROUGH 1961)

Adjustment of the hot gas by-pass valve is necessary when evaporator pressure is lower or higher than 29-30 psi with the valve in minimum flow position. A setting below 29 psi can result in evaporator icing and freeze-up during operation. A setting higher than 30 psi can result in insufficient cooling of the evaporator.

PROCEDURE BREAKDOWN STEPS

1. Install compound gauge to by-pass valve (optional).
2. Stabilize system at 1500-1750 rpm.
3. Readjust engine speed and controls.
4. Note gauge readings.

INFORMATION

NOTE: Use of an additional compound gauge is recommended. Gauge at by-pass valve will indicate evaporator pressure. Gauge at compressor fitting will indicate compressor inlet pressure.

1. Install Schrader adapter on gauge hose.
2. Remove hose connector cap from valve.
3. Install gauge hose to connector and tighten finger tight.
4. Crack gauge manifold hand valve to purge hose of air for 15 seconds.
5. Close gauge manifold valve.

NOTE: A few installations on some models of General Motors cars have eliminated the low side hose connector at the rear of compressor. Whenever this installation is encountered, disregard use of additional compound gauge.

1. Gauges connected into system.
 2. Operate for 10 to 15 minutes.
 3. Adjust air conditioning controls for maximum cooling.
1. Adjust engine speed to 2000 rpm.
 2. Adjust blower motor speed to "Low."
 3. Depress recirculate button.
1. High side gauge MUST read 200 psi.

NOTE: If necessary to raise head pressure, restrict air flow over condenser. A few ounces of water trickled over condenser will lower head pressure.

4. Note gauge readings (continued).

5. Adjust by-pass valve.

6. Note gauge readings.

7. Adjust Bowden-type cable.

8. Adjust two-piece cam.

2. Compound gauge on by-pass valve should read 29-30 psi.
3. Compound gauge to compressor will read slightly lower.

NOTE: Only necessary when 29-30 psi reading is not obtained.

1. Remove Bowden cable from lever pin.
2. Remove pin from adjusting sleeve and lift off lever and cam assembly.
3. Lift out plastic spacer.
4. Use special screwdriver to adjust by-pass valve--clockwise to raise pressure, counterclockwise to lower pressure.
5. Replace above parts in reverse order.

CAUTION: IF GAUGE READINGS ARE NOT WITHIN SPECIFICATIONS, FIRST CHECK OPERATION AND POSITION OF CABLE. CHANGING INTERNAL ADJUSTMENT USUALLY REQUIRES THAT CABLE BE READJUSTED.

1. Adjust cable if necessary as in Step 7 below, then note if gauge reads to specifications.
2. Readjust by-pass valve as in Step 5 and repeat until reading of 29-30 psi is obtained.
3. Repair or replace valve if valve will not adjust to specifications.

1. Remove cable from lever pin.
2. Loosen cable clamp.
3. Move cable control to maximum cold position.
4. Move lever toward body of valve for maximum cold position.
5. Slip loop of cable onto lever pin and tighten cable clamp.

1. Loosen lock screw on lever assembly.
2. With lever against stop, position cam until it just touches nylon spacer.
3. Tighten lock screw on lever assembly.
4. Move cold control lever from stop to stop watching cam to see that it travels through full eccentric in spacer.

travels through full eccentric in space to stop working cam so see that it

4. Tighten lock screw on lever assembly.

5. Cam unit is now between nylon spacer.

6. With lever against stop position.

7. Loosen lock screw on lever assembly.

8. Tighten cable clamp.

9. Slip loop of cable over lever pin and

10. Move lever against cold position.

11. Make lever against body of valve

12. Move cable control to maximum

13. Loosen cable clamp.

14. Remove cable from lever pin.

15. Repeat or replace valve if valve

16. will not adjust to specifications.

17. Adjust cable if necessary as in

18. step 7 below, then note if gauge

19. reads to specifications.

20. Readjust by-pass valve as in step

21. 5 and repeat until reading of 29-30

22. psi is obtained.

23. Repeat or replace valve if valve

24. will not adjust to specifications.

25. Adjust cable if necessary as in

26. step 7 below, then note if gauge

27. reads to specifications.

28. Readjust by-pass valve as in step

29. 5 and repeat until reading of 29-30

30. psi is obtained.

31. Repeat or replace valve if valve

32. will not adjust to specifications.

NOTE: Only necessary when 29-30 psi reading is not obtained.

1. Remove bottom cable from lever pin.

2. Remove pin from adjusting sleeve

3. and lift-off lever and cam assembly.

4. Lift out plastic spacer.

5. Use special screwdriver to adjust

6. by-pass valve--clockwise to raise

7. pressure, counterclockwise to

8. lower pressure.

9. Replace above parts in reverse

10. order.

11. CAUTION: IF GAUGE READINGS ARE

12. NOT WITHIN SPECIFICATIONS, FIRST

13. CHECK OPERATION AND POSITION OF

14. CABLE. CHANGING INTERNAL AD-

15. JUSTMENT USUALLY REQUIRES THAT

16. CABLE BE READJUSTED.

17. Adjust cable if necessary as in

18. step 7 below, then note if gauge

19. reads to specifications.

20. Readjust by-pass valve as in step

21. 5 and repeat until reading of 29-30

22. psi is obtained.

23. Repeat or replace valve if valve

24. will not adjust to specifications.

25. Adjust cable if necessary as in

26. step 7 below, then note if gauge

27. reads to specifications.

28. Readjust by-pass valve as in step

29. 5 and repeat until reading of 29-30

30. psi is obtained.

31. Repeat or replace valve if valve

32. will not adjust to specifications.

33. Adjust cable if necessary as in

34. step 7 below, then note if gauge

35. reads to specifications.

36. Readjust by-pass valve as in step

37. 5 and repeat until reading of 29-30

38. psi is obtained.

39. Repeat or replace valve if valve

40. will not adjust to specifications.

41. Adjust cable if necessary as in

42. step 7 below, then note if gauge

43. reads to specifications.

44. Readjust by-pass valve as in step

45. 5 and repeat until reading of 29-30

46. psi is obtained.

47. Repeat or replace valve if valve

48. will not adjust to specifications.

49. Adjust cable if necessary as in

50. step 7 below, then note if gauge

51. reads to specifications.

1. Adjust two-piece cam.

2. Adjust bottom-type cable.

3. Note gauge readings.

4. Adjust two-piece cam.

5. Adjust bottom-type cable.

6. Note gauge readings.

7. Adjust two-piece cam.

8. Adjust bottom-type cable.

9. Note gauge readings.

10. Adjust two-piece cam.

11. Adjust bottom-type cable.

12. Note gauge readings.

13. Adjust two-piece cam.

14. Adjust bottom-type cable.

15. Note gauge readings.

16. Adjust two-piece cam.

17. Adjust bottom-type cable.

18. Note gauge readings.

19. Adjust two-piece cam.

20. Adjust bottom-type cable.

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22. Adjust two-piece cam.

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29. Adjust bottom-type cable.

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212. Adjust bottom-type cable.

213. Note gauge readings.

214. Adjust two-piece cam.

215. Adjust bottom-type cable.

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X. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: ADJUST SELECTROL VALVE ON MARK IV

The SelecTrol is a trade name for another type of back pressure regulator. The valve is positive in action and is manually controlled. Basic adjustment procedure is simple and is outlined here. For a cross-sectional view of the construction and operation of the valve, refer to the Air Conditioning Manual, pages 82 and 83. The education of the car owner as to the mechanics of the valve will be necessary occasionally as he must adjust the valve to suit his driving conditions or evaporator freeze-up can result.

PROCEDURE BREAKDOWN STEPS

1. Stabilize system at 1500-1750 rpm.
2. Adjust 1958 model SelecTrol (identified by a separate locking collar and two-piece adjusting screw).

INFORMATION

1. Gauges connected into system.
2. A suitable tachometer connected into system to indicate engine rpm.
3. Air conditioning controls set for maximum cooling.
4. Operate for 10 to 15 minutes.

NOTE: Because of the difference in construction of the two models of SelecTrol valves, adjustment will be considered separately.

1. Use small Allen wrench to remove SelecTrol knob.
2. Remove right-hand front louver and loosen lock-collar Allen set screw.
3. Rotate stem of SelecTrol clockwise while watching engine rpm indicator on tachometer.
4. Continue rotation until with a moderate--NOT HEAVY--pressure there is a considerable increase in engine rpm.

NOTE: Refer to illustration in Air Conditioning Manual, page 83. Valve is now in fully CLOSED position. Additional pressure will only tend to score valve seat. Refrigerant will flow through bypass hole in valve and in most instances of highway travel supply all refrigerant flow required.

5. Rotate lock-collar clockwise until pin on collar contacts pin welded inside evaporator case and tighten Allen set screw.

2. Adjust 1958 model SelecTrol (continued).

3. Adjust 1959-61 model SelecTrol (identified by a nylon bushing which supports valve stem).

4. Continue Performance Test.

6. Rotate stem counterclockwise until pins inside case contact.
7. Install knob with pointer straight up and tighten set screw.
8. Replace louver.

1. Loosen Allen screw and lift off knob of SelecTrol valve.
2. Loosen lock nut in nylon bushing.
3. Rotate valve stem clockwise, watching tachometer.
4. Moderate pressure as valve stem seats valve will cause engine rpm to increase.
5. Move nylon bushing in or out at same time rotating valve stem full travel.
6. Continue adjustment until, with knob temporarily installed in OPEN position, pointer is straight up and full clockwise travel of 7/8 turn will seat valve with only moderate pressure and increase engine rpm.
7. Tighten bushing lock nut and recheck for travel.
8. Install knob and tighten Allen screw.
9. Repeat valve operation to check for correct adjustment.
10. On models using an additional stop-pin on evaporator case, proper adjustment will, in addition to above, allow knob movement from OPEN to barely touching pin in CLOSED position.

1. Continue testing system for maximum efficiency.
2. Deliver to customer if system operation is now satisfactory.

XI. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: CHECK AND ADJUST THE SUCTION THROTTLING VALVE (STV)
(GENERAL MOTORS PRODUCTS, 1962 ON)

PROCEDURE BREAKDOWN STEPS

1. Install compound gauge to STV.

2. Stabilize system at 1500 rpm.

3. Force operation of STV.

4. Adjust STV.

INFORMATION

NOTE: The addition of a gauge to the STV will indicate evaporator pressure at this gauge. The compound gauge on the manifold will register STV pressure which may be much lower than evaporator pressure.

1. Install hose to gauge connector on STV.
2. Use Schrader adapter.

1. Gauges connected into system.
2. Adjust air conditioning controls for maximum cooling.
3. Operate for 10 to 15 minutes.

1. Move "Cold" control lever from maximum to minimum cooling or depress recirculate button.
2. Place blower fan on "Low."
3. Evaporator pressure gauge will register from a low of approximately 28 psi to a high of 35 to 40 psi.

NOTE: Too low adjustment or a defective valve can cause icing inside the STV.

3. If pressure does not change, leave control in minimum cool position for 10 minutes, then repeat above.
4. If gauge readings do not vary, repair or replace STV.

1. Adjust "Cold" control for maximum cold.
2. Use adjusting tool for units using Bowden-type control cable.
3. Loosen lock nut, rotate vacuum unit on units using vacuum control.

NOTE: Clockwise rotation will increase adjusting spring tension to increase evaporator pressure; counterclockwise

4. Adjust STV (continued).

5. Recheck operation of STV.
6. Continue Performance Test.

rotation will decrease spring tension to lower evaporator pressure.

4. Adjust STV 28-30 psi evaporator pressure as indicated by gauge to STV.

CAUTION: IF EVAPORATOR PRESSURE BECOMES TOO LOW DURING ADJUSTMENT, STV MAY FREEZE AND FURTHER ADJUSTMENT WILL BE INEFFECTIVE. MOVE CONTROL TO MINIMUM COOLING FOR A FEW MINUTES UNTIL VALVE THAWS AND RESUME ADJUSTMENT.

1. Follow as outlined in Step 3 above.
1. Continue after necessary repairs or adjustments have been accomplished.

XII. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: TEST OPERATION OF EVAPORATOR PRESSURE REGULATOR (EPR) VALVE
(CHRYSLER PRODUCTS, 1960 ON)

PROCEDURE BREAKDOWN STEPS	INFORMATION
1. Connect compound gauge to suction line on EPR valve.	<p>NOTE: Connector opposite spring and diaphragm housing will indicate compressor inlet pressure; connector below by-pass line and fitting will indicate evaporator pressure.</p> <ol style="list-style-type: none">1. Check gauge installation; high pressure gauge connected into high side of system, low side gauge to compressor inlet on EPR valve, and second low side gauge to evaporator connector on EPR valve.
2. Stabilize system at 1250 rpm.	<ol style="list-style-type: none">1. Gauges connected into system.2. Adjust air conditioning controls for maximum cooling.3. Operate for 10 to 15 minutes to stabilize.
3. Read both low pressure gauges.	<ol style="list-style-type: none">1. EPR valve operating correctly in open position when gauges read 31 psi \pm 1 or 2 psi.
4. Force operation of EPR valve.	<ol style="list-style-type: none">1. Set blower switch on "Low" speed.2. Depress "Fresh Cool" button.3. Check evaporator outlet for increased cooling.
5. Read both low pressure gauges.	<ol style="list-style-type: none">1. Evaporator pressure should drop and settle at 22 to 31 psi.2. Compressor inlet pressure will fluctuate (modulation of EPR) and settle at 15 psi or less. <p>NOTE: Increase engine speed to 2000 rpm if compressor inlet pressure will not drop to 15 psi.</p>
6. Repeat Steps 2 through 5.	<ol style="list-style-type: none">1. Repeat to insure correct operation.2. Replace EPR valve if pressures are too high or too low.

SERVICE PROCEDURES

PREPARING THE SYSTEM FOR SERVICE

Air conditioning systems require a number of special procedures when preparing the system for repair service and when placing the system back into operation. Part II is concerned with these special procedures. Each procedure is detailed separately, beginning with purging refrigerant from the system, system evacuation for moisture removal, charging the system, and includes isolating the compressor for service. The special procedures outlined in this section are necessary for satisfactory system performance.

XIII. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: PURGE AIR CONDITIONING SYSTEM

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Stabilize system at 1500-1750 rpm.

1. Gauges connected into system.
2. Adjust air conditioning controls to maximum cooling.

NOTE: Necessary when system has not been operating to return excess oil to compressor.

3. Operate 10 to 15 minutes.

2. Shut off motor and air conditioning system.

1. Adjust engine speed to slow idle to prevent "dieseling."

3. Bleed off refrigerant.

1. Open low side hand manifold valve slightly with discharge hose into a rag or container.

WARNING: DO NOT DISCHARGE REFRIGERANT 12 NEAR AN OPEN FLAME AS PHOSGENE GAS CAN RESULT.

2. Open high side hand manifold valve slightly.

CAUTION: OPEN HAND VALVES ONLY ENOUGH TO BLEED REFRIGERANT FROM SYSTEM. TOO RAPID PURGING WILL DRAW EXCESSIVE OIL FROM THE COMPRESSOR AND THE SYSTEM.

4. Close gauge manifold shut-off valves.

1. Close valves when refrigerant ceases to bleed from hose.
2. Both gauges will read 0 psi.

Adequate ventilation should be maintained during this operation.

INTRODUCTION TO SERVICE ON THE AUTOMOTIVE AIR CONDITIONER

The correct servicing of automotive air conditioning requires the use of a number of special tools and equipment. Manufacturers provide valves and fittings as part of the air conditioning system, for testing and performing service operations. Any mechanic who has been in the trade for any length of time has a major portion of the hand tools necessary for service work. However, he will require a set of manifold test gauges, a leak detector, a suitable vacuum pump, and certain special tools required for adjustment of some types of controls and compressor seal replacement. In addition, any shop contemplating installation work will require a good electric drill with an assortment of hole saws, an electric sabre saw, and other tools required by a manufacturer for installation of his particular units.

It is not the purpose of this institution to set up a mandatory requirement for any initial investment of special tools and equipment for any shop or individual to perform service work in automotive air conditioning. We, as an institution, have as our primary aim the training of service personnel to do a better job with the tools they have or choose to purchase. We do point out that the use of certain correct tools will enable the serviceman to do a more accurate job with less possibility of costly come-backs.

There is available to the service shops a wide selection of service tools and equipment from the barest essentials to the most extensive layouts. The amount of tools and equipment purchased by an individual or service shop depends on individual needs and requirements. As with any other specialized field within the automotive servicing industry, the greater the variety of tools and equipment for air conditioning service available to the serviceman, the greater the service that may be performed on the various types of automotive air conditioning systems.

This section of the manual will be devoted to service procedures of the various types of air conditioning systems installed on passenger cars. Manufacturer's recommendations for the use of special tools will be brought out under the procedure for that particular system. In many cases, a substitute manufactured by another tool company will work satisfactorily. Also, many enterprising servicemen can rework a tool they now have, or even make a special tool for a particular job that will function as satisfactorily as the special tool recommended.

Service procedures require the use of some specialized equipment. The following is a brief resume of how this equipment operates and will be used during operational checks, adjustments, and repairs of automotive air conditioning systems.

XIV. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: EVACUATE SYSTEM USING VACUUM PUMP

There are available to the air conditioning industry a number of vacuum pumps suitable for removing air and moisture from the air conditioning system. Reference will be made here to 28-29 $\frac{1}{2}$ " Hg. as the specification for system pump-down. This reading can be attained at or near sea level elevation only. For each 1000 feet of altitude this operation is being performed, the reading will be 1" Hg. higher. As an example, at 5000 feet elevation, only 23-24 $\frac{1}{2}$ " Hg. of vacuum can be obtained.

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Connect vacuum pump to gauge manifold.

1. Gauges connected into system.
2. Remove cap from vacuum pump hose connector.
3. Install center hose from gauge manifold to vacuum pump connector.
4. Mid-position high and low side compressor service valves (if used).
5. Open high and low side gauge manifold hand valves.

2. Operate vacuum pump.

1. Operate a minimum of 30 minutes for air and moisture removal.

NOTE: See Air Conditioning Manual, page 36.

2. Watch compound gauge that system pumps down into a vacuum.

NOTE: System will reach 28-29 $\frac{1}{2}$ " Hg. in not over 5 minutes. If system does not pump down, check all connections and leak test if necessary.

3. Close hand valves.

1. Close gauge manifold hand valves.
2. Shut off vacuum pump.

4. Check ability of system to hold vacuum.

1. Watch compound gauge to see that gauge does not rise at a faster rate than 1" Hg. every 4 or 5 minutes.
2. If compound gauge rises at too rapid a rate, install partial charge and leak test as per instructions in "Leak Test System," page 79, then purge system and repeat Steps 2 and 3 above.

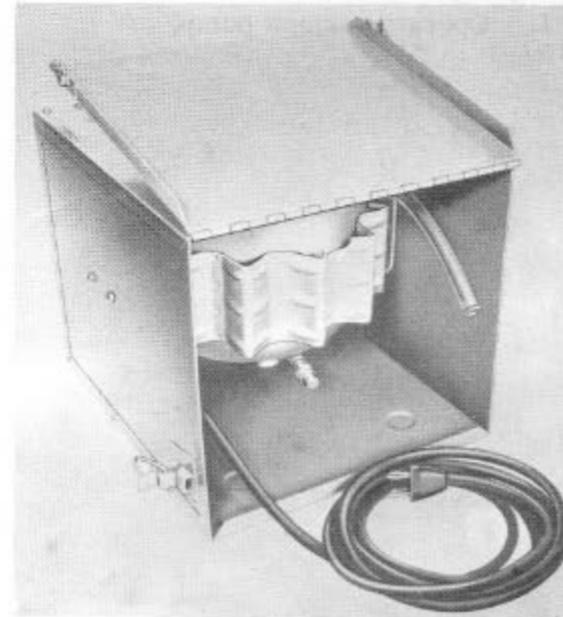
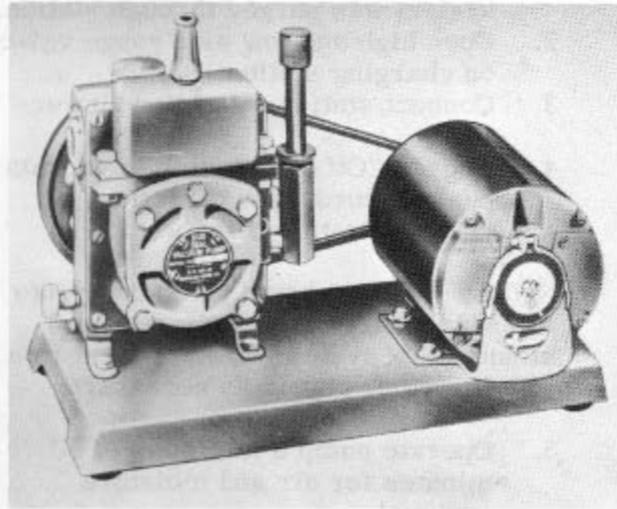
4. Check ability of system to hold vacuum (continued).

OR

3. If system holds vacuum within specifications, continue with Step 5.

5. Charge system with refrigerant.

1. Follow steps as outlined in "Charge System With Refrigerant," page 75 or 77 of this manual.



XV. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: EVACUATE SYSTEM USING CHARGING STATION

A vacuum pump is built into the charging station and is constructed to withstand repeated and prolonged use without damage. Complete moisture removal from the air conditioning system is possible only with a vacuum pump constructed for the purpose.

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Operate vacuum pump.

1. Connect hose to vacuum pump if system was purged through station.
2. Open high and low side gauge valves on charging station.
3. Connect station into 110-volt current.
4. Engage "Off-On" switch to vacuum pump according to directions of specific station being used.

NOTE: System should pump down into a 28-29 $\frac{1}{2}$ " vacuum in not more than 5 minutes. If system fails to meet this specification, repair as necessary.

2. Close hand valves.

5. Operate pump a minimum of 30 minutes for air and moisture removal.
1. Close high and low side gauge valves on charging station.
2. Open switch to turn off vacuum pump.

3. Check ability of system to hold vacuum.

1. Watch compound gauge to see that gauge does not rise at a rate faster than 1" Hg. every 4 or 5 minutes.
2. If rise rate of compound gauge is not within specifications, repair system as necessary.

OR

3. If rise rate is within specified time, continue with Step 4.

4. Charge system with refrigerant.

1. Follow steps as outlined in "Charge System Using a Charging Station," page 77.

4. Charge system with refrigerant.

1. Follow steps as outlined in "Charge System Using 15-Ounce Containers," page 75 or "Charge Air Conditioning System Using a Charging Station," page 77.

THE FOLLOWING PROCEDURE IS RECOMMENDED TO BE USED ONLY IN AN EMERGENCY. If the vacuum pump is not available, the compressor should be operated in order to remove air from the system. A vacuum pump must be used for complete moisture removal. The practice of using the car engine to operate the compressor as a vacuum pump will have detrimental effects on the compressor. The compressor manufacturer recommends this procedure for the compressor.

- PROCEDURE BREAKDOWN STEPS
1. Operate car engine at idle speed.
 2. Close hand valves.
 3. Charge system at system to hold vacuum.
- FORMATION
1. Gases condensed into system.
 2. Mid-position high and low side compressor service valves (if used).
 3. Open high side gauge manifold hand valve.
 4. Operate engine at idle speed (approx. 500 rpm).
 5. Close high side gauge manifold hand valve when compound gauge reaches 20-22" Hg.
- NOTE: When using the car engine to pump down, the compound gauge will remain at zero until below 25" Hg. Continued operation after 25" Hg. has been reached will increase wear and cause possible damage to the compressor as it operates without sufficient lubrication.
1. Shut off car engine.
 2. Watch compound gauge to see that gauge does not rise as a least rate that 1 lb. every 4 or 5 minutes.
 3. If compound gauge rises at the rate of 1 lb. every 4 or 5 minutes, stop and see that instructions in "Low Side System" page 77 and that gauge system and repair valve.
- OR
1. If gauge does not stabilize, continue with Step 4.

XVII. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: CHARGE SYSTEM USING 15-OUNCE CONTAINERS

The tendency of many servicemen is to unknowingly overfill the air conditioning system. To aid in more accurate charging and to prevent waste, refrigerant manufacturers have in recent years packaged the refrigerant in cans which contain 15 ounces. The small containers are advantageous to small shops doing only a limited amount of air conditioning service work. The small containers are handled in the same manner as the larger drums except care must be taken not to overheat the cans because of the danger of explosion.

PROCEDURE BREAKDOWN STEPS

1. Install Fitz-All valve to container(s).
2. Install charging hose to Fitz-All valve.
3. Partially charge system.
4. Complete charge of system.

INFORMATION

NOTE: The Fitz-All valve is available both for single cans and three cans. Whichever is used, preliminary installation to the can(s) is the same.

1. Install Fitz-All valve to single container of refrigerant or three cans, whichever is used.
2. Close shut-off valve on Fitz-All valve.
3. Pierce can with mechanism which is part of Fitz-All valve.

NOTE: Preparatory to charging, the system will have been pumped down.

1. Loosen charging hose at center connector on gauge manifold.
2. Crack Fitz-All shut-off valve to purge air from charging hose.
3. Tighten charging hose connection on gauge manifold and close shut-off valve.
1. Open high side gauge manifold hand valve.
2. Open shut-off valve on Fitz-All valve.
3. Invert container(s) to allow liquid Freon to enter high side of system.

CAUTION: DO NOT OVERFILL SYSTEM. USE CHART OR SERVICE MANUAL TO DETERMINE CAPACITY OF SYSTEM BEING SERVICED.

4. Complete charge of system (continued).

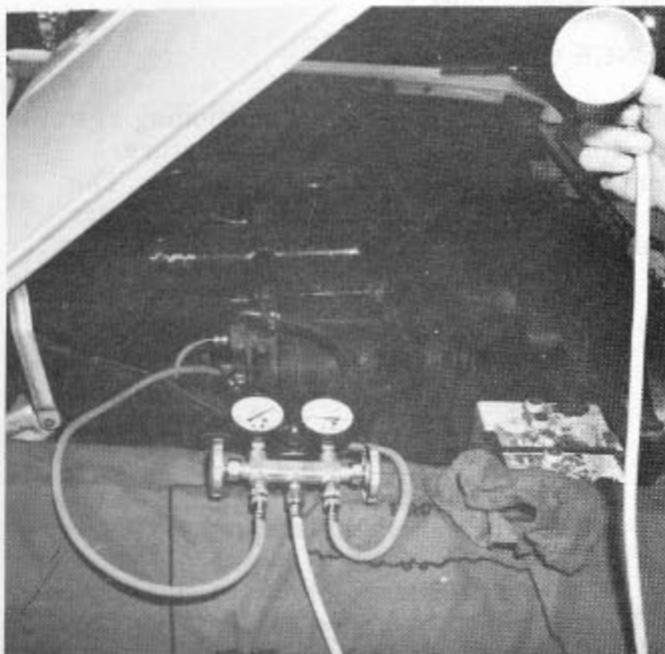


Figure 14. Add refrigerant until gauges normalize and bubbles in sight glass disappear.

5. Check refrigerant charge in system.

6. Continue Performance Test.

1. Close high side gauge manifold hand valve.
2. Start engine and adjust throttle to 1500-1750 rpm.
3. Adjust air conditioning controls for maximum cooling.
4. Open low side gauge manifold hand valve to allow refrigerant to be drawn into system.

CAUTION: REFER TO PROCEDURE ON ADDING REFRIGERANT TO AIR CONDITIONING SYSTEM, PAGE 48.

NOTE: If single containers are used, it will be necessary to replace each as it becomes empty.

5. Watch sight glass until bubbles disappear.

1. Watch for bubbles in sight glass (if used in system).
2. Read high pressure gauge reading.

NOTE: Excessive head pressure with a normal low side pressure indicates an overcharge of refrigerant or air in the system. Compressor may or may not be noisy.

3. Listen for hissing noise in expansion valve. Many systems have a hissing in the expansion valve until the system is fully charged.

1. Continue testing system.
2. Adjust controls for maximum efficiency.

XVIII. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: CHARGE AIR CONDITIONING SYSTEM USING A CHARGING STATION

Most stations contain a charging cylinder into which the exact amount of refrigerant required by the particular system being serviced may be placed while system pump-down is being performed. The refrigerant charging cylinder contained in the station is heated to the correct temperature to insure proper refrigerant flow to all parts of the system as a gas during the charging operation. Following correct evacuation procedure as to length of time for complete moisture removal, the vacuum pump will so efficiently pump down the system that opening the correct valves will completely charge the system from the high side, and the use of the compressor in the charging operation will not be required.

PROCEDURE BREAKDOWN STEPS

1. Prepare charging cylinder for filling.
2. Fill charging cylinder.
3. Charge system with refrigerant.

INFORMATION

1. Open storage drum valve.
2. Close all valves on station.
3. Read storage tank gauge pressure.
4. Rotate dial shroud on charging cylinder to correlate with pressure on gauge.
5. Open cylinder fill valve.

1. Determine system capacity by using service manual or chart.
2. Intermittently open and close pressure relief valve.

NOTE: When pressure relief valve opens, refrigerant will enter cylinder and boil. Closing the valve will increase pressure on refrigerant, changing it to a liquid to stabilize the refrigerant in the sight glass.

3. Fill to specified level in sight glass.
4. Close pressure relief valve.
1. Gauges connected into system.
2. Open refrigerant Control valve.
3. Open High Pressure valve.
4. Remove vacuum hose from pump and crack (barely open) Low Pressure valve.
5. Allow refrigerant to escape through vacuum hose for approximately 3 seconds.
6. Close High and Low Pressure valves.
7. Close refrigerant Control valve.

3. Charge system with refrigerant (continued).

NOTE: Charging cylinder should empty in approximately 90 seconds for systems of 5-pound capacity. Smaller systems will require less time.

4. Performance Test system.

1. Continue testing system.
2. Adjust control for maximum efficiency.

XIX. SERVICE PROCEDURES Automotive Air Conditioning

Procedure: LEAK TEST SYSTEM USING PROPANE TORCH HALIDE LEAK DETECTOR

The propane torch Halide Leak Detector is the most widely used of the detection devices. For that reason, only the procedure for the use of this device will be given. The procedure is the same for any electronic detector, except that the pick-up device registers the presence of refrigerant by a flashing light or high pitched squeal instead of changing the color of a flame. All other steps in preparing the system and leak testing are the same and can be followed as outlined below.

PROCEDURE BREAKDOWN STEPS

1. Stabilize system at 1500-1750 engine rpm.
2. Light leak detector.
3. Move leak detector pick-up over system.



INFORMATION

NOTE: If system is empty of refrigerant, it will be necessary to install a partial charge before continuing.

1. Gauges connected into system.
2. Adjust air conditioning controls for maximum cooling.
3. Operate 10 to 15 minutes.
4. Shut off car engine.

NOTE: For electronic tester, follow preparation procedure as given in operating instructions.

1. Open valve to a low flame that will not blow itself out.
2. Warm up until copper element turns cherry red.
3. Lower flame until flame tip is even or slightly below center of element.

CAUTION: TOO HIGH A FLAME WILL SOON BURN OUT THE ELEMENT.

1. Move pick-up under hoses, joints, seals, and any possible place for a leak to occur.

NOTE: R-12 is heavier than air and will move downward; if concentration of refrigerant is located, move pick-up upward to locate leak.

2. Watch for color change of flame-- pale blue, no refrigerant; yellow, small amount of refrigerant; purplish-blue, large amount of refrigerant.

TEST GAUGE MANIFOLD

Accurate testing requires the use of a test gauge set connected to the high and low sides of the air conditioning system. With these gauges, the serviceman can accurately pinpoint trouble within the system as well as determine if the system is operating as it should. The gauge manifold set is composed of a low side or compound gauge, a high side gauge, and the manifold to which the gauges are connected. A brief description of the gauges and their requirements are as follows:

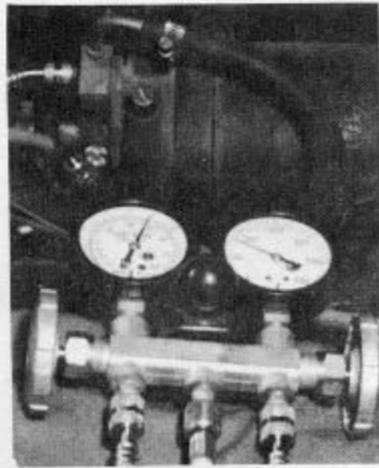


Figure 1. Test gauges show what is happening inside the system.

Compound Gauge (Low Side)

The compound gauge derives its name from its function. This gauge will register both pressure and vacuum. All air conditioning systems can, under certain conditions, drop from a pressure into a vacuum on the low side. It is necessary that a gauge be used that will show either pounds per square inch pressure (psi) or inches of mercury vacuum (Hg.).

The vacuum side of the gauge must be calibrated to show 0 to 30 inches Hg. The pressure side of the gauge must be calibrated to register from 0 psi pressure to a minimum of 60 psi. The maximum reading of the pressure should not exceed 150 psi. Practically all readings of the low side of the system will be less than 60 psi.

The scale reading preferred by the individual serviceman is left to his own choice. To accurately convert pressures to temperatures in the system, the gauge should be calibrated to a low enough scale that it will not be difficult to obtain an accurate reading. The higher the pressure scale, the more difficult it becomes to obtain accurate pressure temperature conversion.

High Pressure Gauge (High Side)

The high pressure gauge is used to determine pressures in the high side of the system. The gauge is calibrated to register from 0 psi to a minimum of 300 psi. A few systems operate under an excessively high head pressure under normal operating conditions. For this reason, the high pressure gauge should have a minimum reading of 300 psi.

Gauge Manifold

A gauge manifold is used to contain the high and low side gauges and connect the gauges into the high and low sides of the system by means of test hoses. The gauges are connected into the upper portion of the manifold by holes drilled and tapped to a

3. Move leak detector pick-up over system (continued).



Figure 15. Leak test system using propane torch detector.

4. Check sensitivity of reaction plate.

5. Resume Performance Test.

CAUTION: DO NOT INHALE FUMES PRODUCED BY BURNING REFRIGERANT.

3. Repair system as necessary if leaks are located.

1. Pass pick-up hose over empty can

OR

2. Crack open refrigerant container.
3. Flame should show violent reaction.
4. If no color change, replace reaction plate. Follow instructions accompanying leak detector.

CAUTION: TOO HIGH A FLAME WILL RESULT IN SHORT LIFE TO REACTION PLATE AND POOR REACTION.

1. Charge system if repairs to system were necessary, as outlined in procedures on charging system using 15-ounce containers or charging system using charging station, page 75 or 77.

OR

2. Complete system charge and follow steps in "Performance Test Air Conditioning System," page 46.

XX. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: ISOLATE COMPRESSOR FROM SYSTEM

On systems having both a high side and low side service valve, the compressor may be isolated and refrigerant retained in the system while service work is being performed on the compressor or the car motor. The following procedure should be followed at any time compressor isolation is required.

PROCEDURE BREAKDOWN STEPS

INFORMATION

1. Stabilize system at 1500-1750 rpm.

1. Gauges connected into system.
2. Air conditioning controls adjusted for maximum cooling.
3. Operate system for 10 to 15 minutes.

2. Isolate compressor.

1. Slowly close low side service valve until low side gauge reads 0 psi.
2. Turn off car motor.

NOTE: Return car motor to idle to prevent "dieseling."

3. Completely close low side service valve.
4. Close high side service valve.
5. Purge refrigerant from compressor by cracking low side hand manifold until both gauges read 0 psi.

NOTE: Purge refrigerant slowly to prevent pulling oil from compressor.

3. Continue service work.

1. Remove service gauges from service valves.
2. Remove service valves from compressor.
3. Perform service work as required.

4. Place compressor in system.

1. Install service valves to compressor using new gaskets or "O" rings, whichever are required.
2. Purge air from compressor by cracking high side service valve for 3 seconds with high side hose connector capped and low side hose connector open.

5. Continue Performance Test.

1. Install gauges to service valve connectors and purge air from hoses.

5. Continue Performance Test (continued).
2. Mid-position service valves.
3. Continue testing system.
4. Adjust control for maximum performance.

On systems having both a high side and low side service valves, the compressor may be isolated and refrigerant retained in the system while service work is being performed on the compressor or the condenser. The following procedure should be followed to isolate the compressor when it is required.

PROCEDURE BREAKDOWN STEPS	DESCRIPTION
1. Isolate system at 1500-1750 rpm.	1. Change compressor into system. 2. For evaporator controls adjusted for maximum cooling. 3. Operate system for 10 to 15 minutes.
2. Isolate compressor.	1. Slowly close low side service valve until low side gauge reads 0 psi. 2. Turn off condenser. NOTE: Before you make this in pressure reading. 3. Unplug low side service valve. 4. Close high side service valve. 5. Force refrigerant from compressor by cracking low side manifold until both gauges read 0 psi.
3. Continue service work.	NOTE: With large refrigerant slowly in prevent falling oil from compressor. 1. Remove service gauges from service valves. 2. Remove service valves from compressor. 3. Perform service work as required.
4. Place refrigerant in system.	1. Install service valves in compressor using one gallon of 10" pipe. 2. Turn off from compressor to avoid refrigerant. 3. Turn off high side service valve for 1 minute with high side manifold closed and low side manifold open.
5. Continue Performance Test.	4. Install gauges to service valves for indoor and purge air from system.

SERVICE PROCEDURES

SERVICING SYSTEM COMPONENTS

Each make and model of air conditioning system has its own type of construction. To cover service work on each component of all models would require a very extensive volume. An effort is made here to cover the difficulties of most frequently encountered service procedures. Most service work will be concerned with compressor service. Service work to be performed on components not found in the following pages will offer little difficulty.

XXI. SERVICE PROCEDURES
Automotive Air Conditioning

Procedure: REPLACE REED VALVE PLATE ON YORK, TECUMSEH, AND AIR-TEMP
COMPRESSORS

Reed valve replacement must be performed occasionally by the serviceman. The individual reeds are available and may be replaced separately. However, experience has shown that it is advisable to replace the complete reed plate as an assembly. New reeds are fitted to the plate and guarantee positive action. Too often the old plate has warped during service, and reuse of this plate will result in failure of the new reeds and compressor.

PROCEDURE BREAKDOWN STEPS

1. Isolate compressor from system.
2. Remove service valves.
3. Remove head from compressor.

INFORMATION

1. Follow procedure for isolating compressor from system as outlined on page 81.

OR

2. Purge system of refrigerant if compressor does not have both high and low side service valves.

NOTE: Service valves are not mounted to compressor head on Air-Temp and some models of Tecumseh compressors. On these models omit this step and continue with Step 3.

1. Remove bolts holding service valves.
 2. Lift off service valves with hoses attached.
 3. Carefully clean all of old gaskets from mounting surface of service valves and compressor.
-
1. Remove bolts holding head to compressor body.
 2. Tap extruding flange on each side of head to loosen head from compressor body.
 3. Lift valve plate and head from compressor body.
 4. Separate reed valve plate from compressor head.
 5. Clean old gasket from compressor head.
 6. Clean old gasket from compressor body.

3. Remove head from compressor (continued).

NOTE: Air-Temp compressors having two heads and reed plates will require the above for each head.

CAUTION: SEVERAL MODELS OF AIR-TEMP COMPRESSORS WITH SERVICE VALVE MOUNTED BETWEEN HEADS SEPARATE HIGH AND LOW SIDE BY SERVICE VALVE MOUNTING GASKET. FAILURE OF THIS GASKET WILL GIVE SIMILAR INDICATION OF REED VALVE AND/OR GASKET FAILURE.

4. Install reed valve plate.

NOTE: Use clean refrigeration oil only on new gaskets. Use of various sealers on gaskets will result in excess sealer being picked up by refrigerant and deposited in screens throughout system. Complete clogging of expansion valve screen will result, causing system failure.

1. Coat new gasket between reed plate and compressor liberally with refrigeration oil and install gasket on aligning pins on compressor body.
2. Install new reed plate on aligning pins of compressor body and press into place.

5. Install compressor head.

1. Coat new head gasket liberally with refrigeration oil and install on aligning pins of compressor body.
2. Install head on aligning pins of compressor body and press into place.
3. Install head bolts in compressor and tighten finger tight.
4. Torque to correct specification as listed in chart on next page.
5. Follow torque sequence as outlined in illustration.

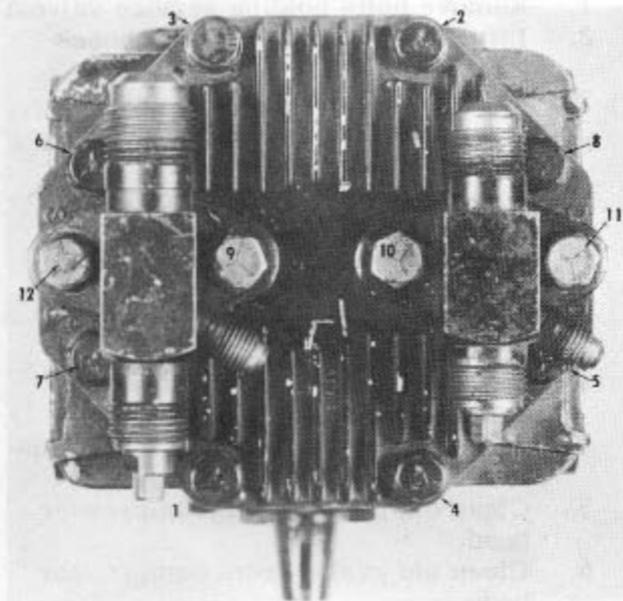


Figure 16. Torque all head bolts in sequence to proper specifications.

6. Install service valves on compressors having valve(s) mounted to head.
 1. Coat new mounting gaskets with refrigeration oil and install on compressor head.
 2. Install bolts and tighten finger tight.
 3. Torque inner bolts first, then outer bolts, to specifications listed below.

7. Return system to service.
 1. Follow procedure for isolating compressor from system as outlined on page 81.

OR

 2. Evacuate and charge system following procedure for evacuating system outlined on page 70 or 72 or procedure for charging system with refrigerant as outlined on page 77 or 79.

8. Continue Performance Test.
 1. Continue testing system.
 2. Adjust control for maximum performance.

Foot-pounds Torque Requirements for York, Tecumseh, and Air-Temp Compressors			
	York	Tecumseh	Air-Temp
Cylinder head	16-20	15-19	23-27
Service valve	16-20	15-19	12-18
Seal plate	9-12	9-12	10-13
Rear cover plate	13-15	12-14	10-13
Bottom plate	13-15	12-14	15-19
Mounting bolts	18-24	14-17	30-50
Magnetic clutch retainer bolt	15-20	15-20	15-20

XXII. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REPLACE BEARING IN EATON, WARNER, AND ELECTRO-LOCK CLUTCHES

The serviceman will be required to replace the clutch bearing more than any other part of the clutch. Though clutch assemblies differ in construction, the procedure is quite similar for all of the above named clutches with a few variations. An attempt to list these variations is made in this procedure. If a variation should be encountered by the serviceman that is not listed, no difficulty should be experienced by following a logical procedure.

PROCEDURE BREAKDOWN STEPS

1. Remove pulley from compressor.

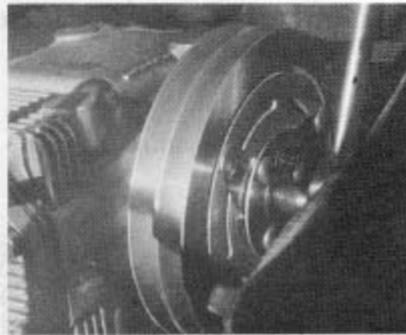


Figure 17. Use bolt to pull clutch assembly on threaded hubs.

INFORMATION

1. Remove clutch retaining bolt from compressor shaft.

NOTE: Bolt may be loosened by striking side of wrench a quick hammer blow with clutch engaged momentarily.

2. Loosen belt tension adjustment and remove belt from pulley.
3. Install 5/8 N. C. or N. F. x 2 1/2" bolt into threaded center of hub.

NOTE: Some factory installations use an N. F. thread. Check clutch to see which is used. Also, a shorter length bolt may be required on some installations because of close proximity of clutch hub to shroud.

4. Tighten bolt against end of compressor shaft until clutch assembly is loosened sufficiently to lift from compressor.

NOTE: On clutch assemblies not threaded in center of hub, omit Steps 3 and 4 and proceed as follows.

5. Unscrew clutch retaining bolt approximately half its length.
6. Use brass or steel hammer to strike bolt with light sharp blows while holding clutch assembly with one hand.
7. Remove bolt and lift off clutch assembly when clutch is loosened on shaft.

1. Remove pulley from compressor (continued).

2. Remove hub and armature from bearing inner race.



Figure 18. Remove snap-ring from hub.

3. Remove bearing from pulley.

CAUTION: DO NOT USE ARM TYPE PULLER ON PRESSED STEEL PULLEYS. UNEQUAL PRESSURE CAUSED BY THE SPRINGINESS OF THE MATERIAL CAN RESULT IN DAMAGE TO THE PULLEY AND ARMATURE.

1. Remove hub retaining snap-ring from inside clutch assembly.
2. Lift off spacer if used.
3. Thread 5/8 N. C. or N. F. x 2 1/2" bolt into hub from inside clutch assembly.
4. Drive hub out of inner race by using brass or steel hammer.
5. Remove bolt from hub and separate armature and hub from bearing.
6. Clean and inspect for excessive wear or damage and lay to one side.

NOTE: Scoring between the armature and rotor plates is to be expected and is permissible. If worn to such an extent that solid contact is not possible, the clutch assembly must be condemned.

NOTE: Clutch assemblies that do not use a lock-ring to retain the hub into the bearing inner race are constructed with a sliding fit in the bearing. When disassembling this type, omit all steps in Step 2 above and proceed as follows:

1. Press hub and armature from bearing inner race.
2. Clean and inspect as required and lay to one side.
3. Remove bearing retainer lock-ring from each side of bearing.

NOTE: Either Spira-lock or snap-rings will be used; follow removal procedure required. Instead of a retainer ring, some assemblies use a shield installed in outer side of pulley which requires that bearing be removed and installed from inner side of pulley if shield is retained by bearing.

1/8-inch pipe thread. Test hose connectors below the gauges on the lower side of the manifold direct the refrigerant through the manifold to the gauges to obtain pressure readings.

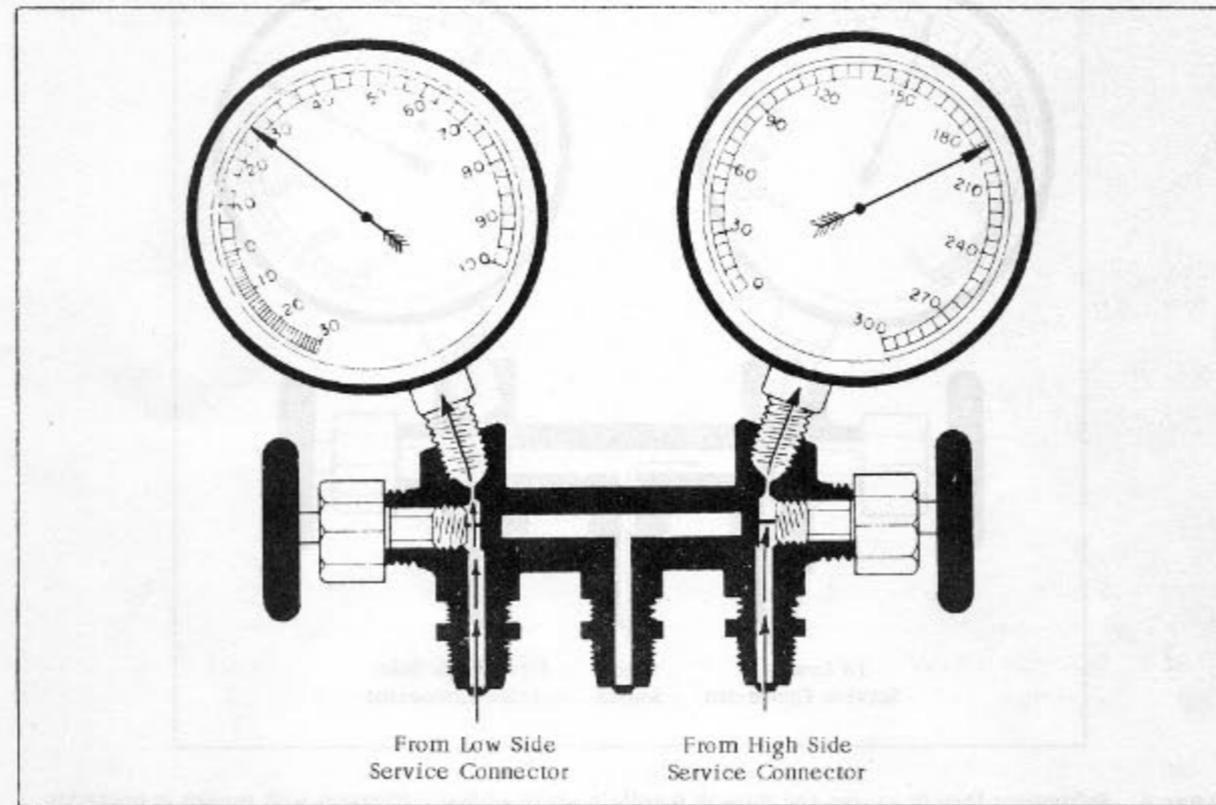


Figure 2. Refrigerant flow to gauges in performance test--both hand valves closed;

A center test hose connector on the lower side of the manifold is connected to both the high and low side pressure gauges and test hose connections by a passage within the manifold. Refrigerant flow into the high and low side is controlled by a shut-off hand valve at each end of the manifold. With both hand valves in the "closed" position, refrigerant will be shut off from the center test hose fitting but will flow to the gauges. Opening the high side hand valve will allow refrigerant to flow through the passage and out the center test hose connector and at the same time continue to the high gauge to register pressure reading. Likewise, opening the low side gauge will open the low side refrigerant to the center test hose connection and the low side gauge.

3. Remove bearing from pulley (continued).

4. Install new bearing into pulley.

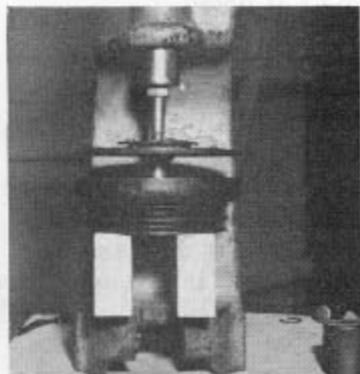


Figure 19. Press new bearing into pulley.

5. Install hub and armature into inner bearing race.

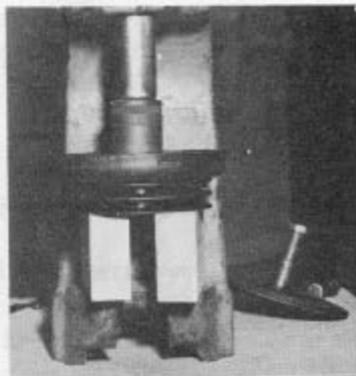


Figure 20. Press hub into inner bearing race.

6. Adjust air gap between armature and rotor.

4. Drive old bearing from pulley, being careful not to damage shield if used.
5. Clean and inspect pulley for excess wear in bearing seat. Excessive wear and damage to the pulley will require that the clutch assembly be replaced.

1. Install retainer ring or shield into outer side of pulley.
2. Press correct replacement bearing into pulley by exerting pressure on outer race of bearing until lock-ring groove is exposed.
3. Install bearing retainer ring in groove of pulley.

1. Install 5/8 N. C. or N. F. x 2 1/2" bolt into front of hub to protect springs and armature.
2. Press hub into inner bearing race supporting inner race with suitable size sleeve such as pipe or socket wrench.
3. Install spacer and lock-ring on hub if used.

NOTE: Chrysler product units have provision for adjusting this air gap. All other units are adjusted at the factory, and excess wear or damage is the only way in which this spacing is altered. A clutch that is excessively noisy and dragging must be replaced.

6. Adjust air gap between armature and rotor (continued).

7. Install clutch assembly to compressor crankshaft.

8. Continue Performance Test.

1. Loosen lock-nuts on outer face of clutch assembly.
2. Alternately adjust set-screws until .50 to .60 thousandths air gap is obtained between armature and rotor.
3. Tighten lock-nuts holding set-screw stationary.
4. Recheck air gap and readjust to correct spacing if tightening lock-nuts altered air gap.

1. Clean inner bore of hub.
2. Clean crankshaft to insure even contact between surfaces.
3. Align key-way in hub with key in crankshaft and press clutch assembly into place.
4. Install clutch retaining bolt into crankshaft and tighten to approximately 20 ft. lbs.

NOTE: Momentarily engaging the clutch with the belt installed will facilitate tightening the retaining bolt.

5. Adjust belt to correct tension.

1. Continue testing system.
2. Adjust control for maximum performance.

XXIII. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: CHECK CLUTCH COIL FOR ELECTRICAL OPERATION

The serviceman will from time to time be called upon to replace a defective clutch coil. The following procedure may be used by the serviceman as a time-saving device to determine that the coil is defective. Variations of installation will be encountered; however, the following steps are general enough in instruction to meet all requirements.

PROCEDURE BREAKDOWN STEPS

1. Determine voltage to clutch coil.

2. Determine current draw of clutch coil.

INFORMATION

NOTE: With ignition switch ON and clutch energized, battery voltage should be delivered to the coil. To prepare for test, expose connection between coil and evaporator for electrical checks.

CAUTION: DO NOT ALLOW EXPOSED WIRE TO CONTACT BODY OF CAR WHILE SWITCHES ARE IN "ON" POSITION.

1. Connect red lead of suitable Volts Amps Tester to exposed wire of connection between evaporator and clutch coil.
2. Connect black lead of voltmeter to compressor body.

NOTE: The connections as listed above are for a negative grounded system. Reverse leads for a positive grounded system.

3. Voltmeter should read battery voltage--if no voltage reading obtained, check line fuse, voltage into evaporator and to ON-OFF switch to locate and repair voltage loss.
1. Separate wires at connection between evaporator and coil.
2. Connect red lead of ammeter to exposed wire of evaporator.
3. Connect black lead of ammeter to lead to clutch coil.
4. Turn switches to ON position to energize clutch coil.

- Determine current draw of clutch coil (continued).

NOTE: The ammeter as connected is for a negative grounded system. Reverse leads for a positive grounded system.

- Ammeter should indicate 3 amps draw for a 12-volt system, 5 amps for a 6-volt system.
- 0 amps draw indicates an open circuit inside coil; excessive current draw indicates a short-circuit within coil.

- Determine ground circuit resistance.

NOTE: Performance of the resistance test requires the current draw of the coil to be within specifications.

- Connect evaporator and clutch coil wire.
- Connect red lead of voltmeter to compressor body.
- Connect black lead of voltmeter to battery post.

NOTE: Reverse voltmeter leads for a positive grounded system.

- Turn switches to ON position to energize clutch coil.
- Total resistance from compressor body to battery post cannot exceed .3 volts.
- If resistance is excessive, clean all connections and metal to metal contacts, including engine to body and compressor to motor, to reduce resistance to specifications.

XXIV. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REPLACE CLUTCH COIL ON YORK, TECUMSEH, AND AIR-TEMP COMPRESSORS

Coil replacement on any of the above compressors will offer no problem provided a certain amount of care is observed during the procedure. It is to be presumed that the serviceman has determined that the coil is defective by following the procedure on checking clutch coil for electrical operation outlined on page 92 of this manual. The two types of coils, stationary and rotating, are both covered in this procedure.

PROCEDURE BREAKDOWN STEPS

1. Remove pulley from compressor.

2. Inspect rotating type coil.

3. Inspect brush holder assembly.

INFORMATION

1. Hold pulley assembly and loosen lock-bolt. Remove bolt from end of compressor shaft.
2. Loosen belt adjustment and remove compressor drive belt from pulley.
3. Install 5/8 N. C. or N. F. x 2 1/2" bolt into threaded hub center.
4. Tighten bolt against compressor shaft and lift off pulley when loosened.

OR

5. If hub center is not threaded, re-install lock-bolt approximately 1/2 its length into compressor shaft.
6. Grasp pulley firmly and sharply strike end of bolt with hammer to loosen pulley.

NOTE: The steps as outlined here are for the rotating type coil. When servicing a stationary type coil, omit Steps 2 and 3 and continue with Step 4.

1. Inspect slip ring(s) for evidence of scoring, arcing, and general condition.
 2. Use continuity tester to check coil winding for open.
 3. Replace coil and pulley assembly if defective.
-
1. Inspect condition of brush(es).
 2. Replace brush assembly on compressor housing if defective.

4. Remove clutch coil from compressor housing.
 1. Disconnect coil lead(s).
 2. Remove coil retainer screws from seal plate and remove coil from compressor and discard.

5. Install new clutch coil onto compressor.
 1. Install coil onto seal plate and tighten bolts finger tight.
 2. Install plastic aligner ring into coil on coils which require this ring. (Ring will be included in coil package.)
 3. Alternately tighten coil retainer bolts to 9-12 ft. lbs.
 4. Connect lead wire(s).

6. Install pulley onto compressor crankshaft.
 1. Align key-way in hub with key in compressor shaft and press on shaft.
 2. Install retainer bolt into compressor shaft.
 3. Install compressor drive belt and tighten to specifications.
 4. Momentarily engage clutch coil and tighten lock-nut 20 ft. lbs.

7. Continue Performance Test.
 1. Continue testing system.
 2. Adjust system as necessary for maximum efficiency.

XXV. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REPLACE SEAL ON YORK, TECUMSEH, AND AIR-TEMP COMPRESSORS

Seal replacement will be performed frequently by the serviceman. Success of this operation will be determined by the quality of replacement parts and, even more, by the carefulness and cleanliness of the serviceman. The finest parts will not seal refrigerant if contaminated with dirt.

PROCEDURE BREAKDOWN STEPS

1. Isolate compressor or purge refrigerant.
2. Remove pulley and clutch coil.
3. Remove seal plate.
4. Remove seal from compressor shaft.

INFORMATION

1. If system has not lost refrigerant charge, follow procedure on isolating compressor from system as outlined on page 81 of this manual.
2. If system does not have service valves, purge refrigerant from system.

OR

3. If system is empty of refrigerant, disregard Steps 1 and 2 above and continue.
1. Follow procedure for removing pulley as outlined on page 99 or 104 of this manual.
2. If stationary coil is used, follow procedure on removing clutch coil as outlined on page 99.
1. Lift out key from shaft.
2. Remove remaining screws which hold seal plate to compressor.
3. Pry off seal plate by applying pressure against tangs on each side of plate.
4. Discard plate.
1. Use small screwdriver to pry seal assembly from housing.

WARNING: DO NOT SCRATCH SHAFT AS A LEAK WILL RESULT.

2. Discard old seal parts.

5. Clean and lubricate all parts before reassembly.

6. Install seal onto compressor shaft.

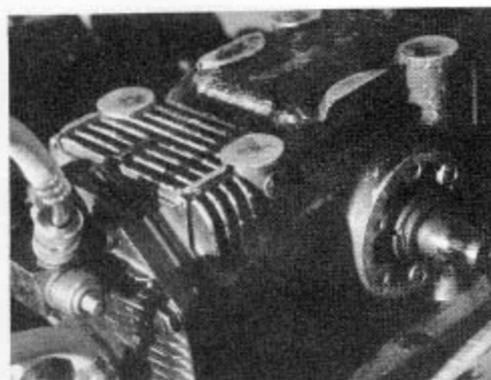


Figure 21. Install new seal onto compressor shaft.

7. Install seal plate.

1. Clean old gasket from housing.
2. Wipe compressor shaft and housing with clean dry cloth.
3. Flush all surfaces effusively with refrigerant oil to remove lint and dust.

1. Lubricate complete seal with refrigerant oil.
2. Install seal assembly onto shaft.

CAUTION: DO NOT TOUCH CARBON SEAL FACE WITH FINGERS.

3. Align seal over pins on installations requiring pin alignment.
4. Flush carbon seal face with refrigerant oil.

WARNING: DO NOT TOUCH SEAL CONTACT SURFACE WITH FINGERS.

NOTE: It is advisable to install new seal plate which comes in seal kit as two surfaces have been seated to each other.

1. Lubricate seal plate gasket with refrigerant oil and locate on compressor housing.
2. Install 2 guide studs on installations which require compression of seal assembly during assembly.
3. Lubricate seal plate surface and install on compressor housing.
4. Install all bolts finger tight.

NOTE: To prevent possibility of seal leakage due to uneven tightening, install all screws as indicated above and tighten

7. Install seal plate (continued).

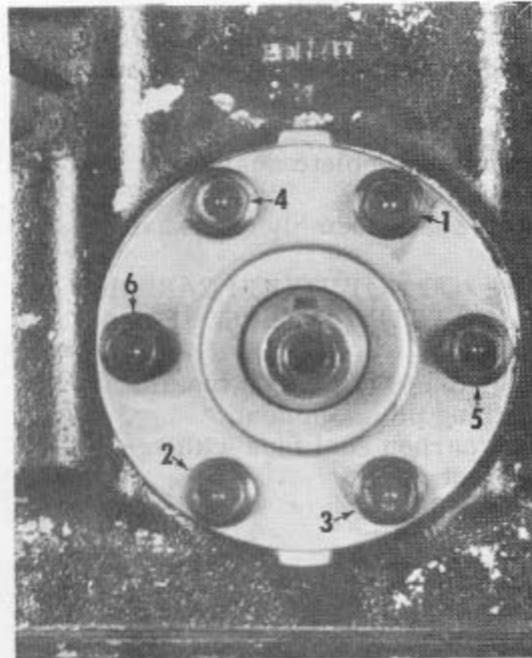


Figure 22. Torque all seal plate bolts in correct sequence to 9-12 ft. lbs.

8. Continue reassembly.

9. Continue Performance Test.

in correct sequence. Necessary screws can then be removed and coil installed, reducing chances of improper tightening.

5. Alternately tighten all face plate bolts and torque to 9-12 ft. lbs.
6. Remove three screws that hold clutch coil, install coil, and re-tighten to 9-12 ft. lbs.



1. Install pulley onto compressor shaft.
2. Purge air from compressor.

OR

3. Evacuate system for moisture removal.
4. Charge system as outlined in procedures on charging system with refrigerant, page 75 or 77 of this manual.

1. Continue testing system.
2. Adjust control for maximum performance.

XXVI. SERVICE PROCEDURES

Automotive Air Conditioning

Procedure: REMOVE AND REPLACE CLUTCH AND PULLEY ASSEMBLY ON GENERAL MOTORS COMPRESSORS THROUGH 1961 MODELS.

The General Motors clutch assembly is different in construction and requires special techniques and tools for its service. Application of this technique of clutch service is outlined as follows to remove, overhaul, and replace the clutch assembly with the compressor installed on the car.

PROCEDURE BREAKDOWN STEPS

1. Remove lock-nut from compressor shaft.
2. Separate rear shoe plate from pulley.
3. Remove pulley and bearing from compressor crankshaft.

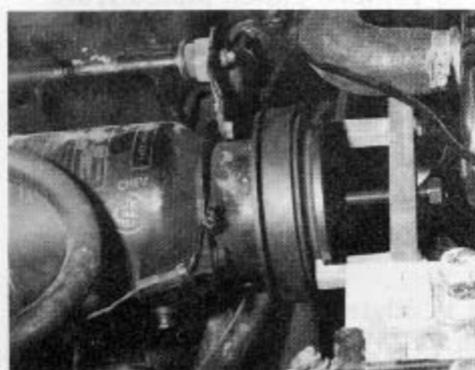


Figure 23. Remove pulley and bearing from compressor crankshaft with suitable type puller.

INFORMATION

1. Straighten lock tangs of retaining washer.
 2. Use jumper wire from battery to coil lead to engage clutch coil.
 3. Strike side of wrench while engaged to nut on crankshaft--a quick blow with hammer will loosen nut.
 4. Disengage jumper wire.
 5. Remove nut and retaining washer from end of compressor crankshaft.
-
1. Loosen belt tension adjustment and remove compressor drive belt(s) from pulley.
 2. Remove all cap screws connecting shoe plate to rear of pulley.

NOTE: A type puller as illustrated must be used.

CAUTION: DO NOT EXERT PULLING PRESSURE AGAINST REAR SHOE PLATE AND PULLEY AS CLUTCH PLATE DISTORTION WILL RESULT. REAR SHOE PLATE MUST BE SEPARATED FROM REAR OF PULLEY. DO NOT USE A HAMMER TO REMOVE OR REPLACE PULLEY OR CLUTCH.

1. Lock puller legs into position with center bolt aligned with center of crankshaft.
2. Tighten puller center bolt to exert pulling force and remove pulley from compressor crankshaft.

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