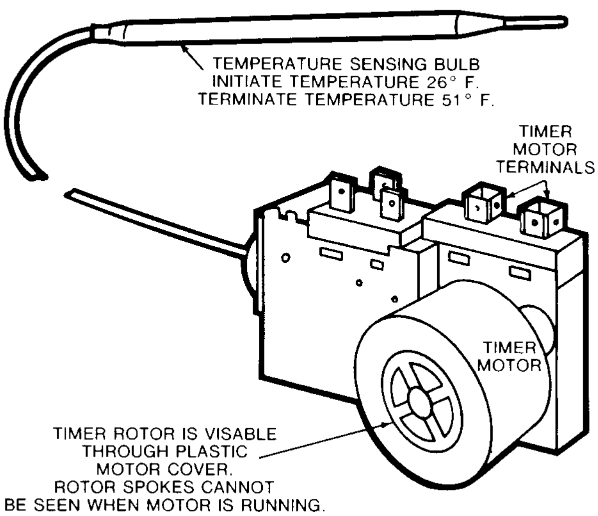
A time selector of either 30, 45, or 90 minutes is available on these timers. (Factory set at 90 minutes.)

Timer initiation is accomplished when two things occur. Timer cam slot reaches the selected defrost time and the temperature sensing bulb sees outdoor coil temperatures below 26°F.

Defrost termination is accomplished through a sensing bulb and will terminate when liquid line temperature reaches 51°F. If the liquid line fails to reach 51°F in 10 minutes the timer will terminate defrost cycle.



Ranco Type E-15 Defrost Control
Figure 410-1

Timer Motor and Drive Check Out

Make sure you have applied voltage to motor leads – 240 volts on 240 volt models. (24 volts on 480 volt models.)

Check viewing window on back of timer motor, with voltage applied rotor should be turning. (See Figure 410-1)

Using a pencil or marker, place a mark on knurled knob and on face of timer. If timer drive mechanism is operating mark on knurled knob will advance beyond mark on face of timer.

If motor does have applied voltage but is not turning or knurled knob does not turn – timer will have to be replaced.

Adjusting Time Selector and Checking Initiation (See Figure 410-2)

The time selector as it comes from the factory is set for 90 minutes. If you determine the time has to be set for something other than 90 minutes, turn the knurled knob until either end of the center shaft screwdriver slot aligns with the time desired.

CAUTION: Do not turn center shaft in counterclockwise direction.

Temperature sensing bulb must be secure to liquid line of outdoor coil. When sensing bulb sees outdoor coil temperature below 26°F and timer calls, defrost will be initiated.

If sensing bulb loses its charge the defrost cycles will not be interrupted. However, defrost will occur every 30, 45, or 90 minutes depending on what time the control is set for. Also, the defrost time will be a full 10 minutes.

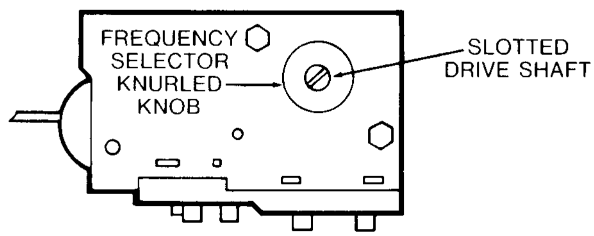


Figure 410-2

Loss of sensing bulb charge during cooling mode will cause the outdoor fan motor to cycle off each time the control reaches its defrost time setting. Also, a bank of resistance heat will be energized - possible tripping of internal pressure relief valve may occur during this time period.

To check sensing bulb charge, set room thermostat for cooling mode of operation. Advance timer manually into time defrost - system should not go into defrost.

If system does advance into defrost the complete control will have to be replaced.

Checking Defrost Through Manual Operation

Insert a screwdriver in drive shaft slot and rotate the shaft clockwise. (Advance slowly.) The screw slot is cut for clockwise rotation only. Never rotate the shaft counterclockwise with other tools, or the mechanism will be destroyed.

The temperature bulb must be below 26°F for defrost initiation. If a full revolution of the drive shaft is made and the unit will not manually defrost, disable the outdoor fan and operate the unit in the heating mode until the temperature bulb is below 26°F. An indication of bulb temperature can be determined by suction pressure. Suction pressure must be lower than 50 PSIG

(26°F saturation) before the bulb will be below 26°F. When the outdoor ambient temperature is below 40°F the temperature will normally be below 26°F.

Checking Defrost Control Switch Contacts

If defrost control contacts weld, the OD fan will continue to run during the defrost cycle.

To check defrost control switch, disconnect power, remove wires from switch and check switch terminals with an ohmmeter. Switch measurements should be made with the thermal bulb warmed to above 51°F. The bulb should be chilled to below 26°F and measurements repeated to check for welded contacts or failure of the contacts to make.

Thermal bulb above 51°F:

Terminal 2 (line) makes terminal 3 (OD) fan)

Terminal 2 to 1 – open circuit Terminal 1 to 3 – open circuit

Thermal bulb below 21°F:

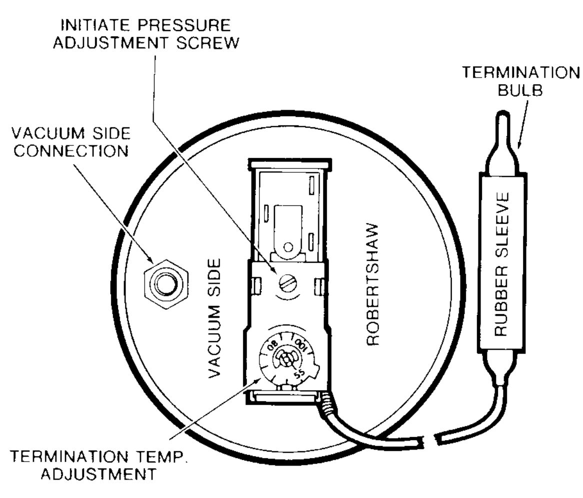
Terminal 2 (line) makes terminal 1 (defrost relay)

Terminal 2 to 3 – open circuit

Terminal 1 to 3 – open circuit

SP412 – Robertshaw Defrost Control (Air Pressure/Temperature Type)

The Robertshaw combination air pressure/temperature sensing method incorporates both the termination and initiation in one control. Its primary function is to put the unit into defrost when the outdoor coil becomes restricted with frost or ice during the heating mode of operation.



Robertshaw Defrost Control
Figure 412-1

Initiate Pressure Adjustment Screw (See Figure 412-1)

This screw determines the amount of outdoor coil blockage required to cause the unit to go into defrost.

Turning the screw clockwise will cause the unit to go into defrost with more coil blockage. If this screw is turned too far in, the coil may freeze completely before defrost, or may fail to go into defrost with 100% coil blockage.

Turning the screw counterclockwise will cause the unit to go into defrost with less coil blockage. If this screw is backed out too far, the unit may short cycle defrost or go into defrost with little or no coil blockage, possibly stay in defrost without returning to normal heating function.

Defrost Termination Temperature Adjustment

This adjustment determines when the unit will complete the defrost cycle and return the unit to normal heating function.

If the temperature setting is too high the unit may trip the high pressure cut out or compressor internal pressure relief valve before the defrost cycle is completed.

If the temperature setting is too low, the outdoor coil may not defrost completely before the unit returns to the normal heating function.

The temperature setting must be set at 55°F to 58°F after defrost adjustments have been completed.

Termination Bulb

Measures liquid line temperature and determines when defrost is complete. Liquid line temperature at which the defrost will terminate depends upon the setting of the termination dial.

The termination bulb must be fully inserted in the liquid line receptacle for proper defrost operation.

The capillary tube connecting the bulb to the control body should be routed to prevent rubbing against piping or components and be clear of the fan.

Vacuum Side Connection

Connects to piping that senses pressure at the fan hub. Sensing piping must be clear of internal obstructions for proper defrost operation. Do not bend sensing piping from original factory routing since piping is routed to present accumulation of moisture inside the piping.

Pressure Side Connection

This connection is located on the opposite side of the control from the vacuum side connection. This connection may or may not be connected to piping, depending upon the particular model heat pump to which the control is applied. If the unit is equipped with pressure side piping, the piping must be connected for proper defrost operation under normal operating conditions but must be disconnected while adjustments to the defrost control are being made.

Adjustment Procedure

Before any attempt is made to adjust the defrost control, system must be checked for proper refrigerant charge, operating pressure and temperatures.

Outdoor coil must be free of frost and dirt before adjusting defrost control. Disconnect outdoor fan and switch unit to cooling at thermostat to defrost outdoor coil. (Check liquid line temperature during this step.) Do not exceed 60°F or system will trip on high head pressure.

Disconnect pressure sensing piping from both sides of control. Blow through piping to be sure that it is not obstructed. Caution: never apply pressure in excess of ½ PSI to sensing piping while piping is connected to the control. Damage or rupture of the control diaphragm will result.

Reconnect vacuum side piping. Do not reconnect pressure side piping until control adjustment is complete. Proper adjustment cannot be made with pressure side piping connected.

Operate the unit in the heating mode.

Turn initiate pressure screw clockwise one turn.

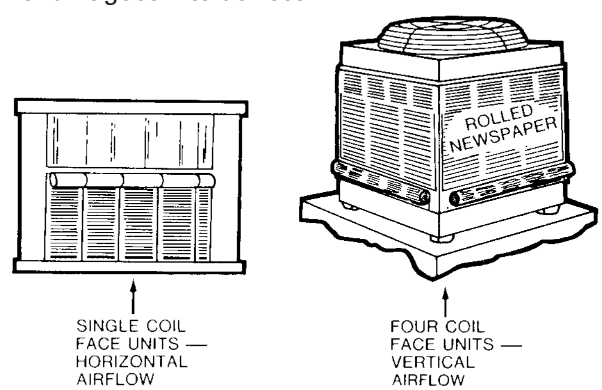
Turn termination temperature screw fully counterclockwise against the stop.

On residential unit, block 75% of outdoor coil surface. Top discharge airflow units must be blocked equally on all four sides starting from bottom of louvered panels. (See Figure 412-2). On 7½ and 10 ton (WA) heat pumps the procedure for blocking the outdoor coil is as follows:

1. All exposed louvered side panels must be blocked from top to bottom leaving the two sections of louvers closest to the control and compressor compartment free.
2. The WC 7½ and 10 ton units, and WA-180 and WA-240 heat pumps differ from the WA 7½ and WA 10 ton units, in that the (WC's) are package units and the indoor section and outdoor section are mated together by a panel across the top of the unit. On the WA-180 and WA-240 heat pumps, these units are made up of two 7½ or two 10 ton systems. These units are also joined together. The proper method for blocking the coils to simulate defrost on these models is as follows.
3. Remove the panel from the top center of the unit, block the coil located between the two sections from top to bottom, also block all louvered panels from top to bottom leaving the two sections of louvers closest to the control and compressor compartment free.

Permit unit to operate in heating mode for 5 minutes.

Slowly turn initiate pressure screw counterclockwise until unit goes into defrost.



Outdoor Coil Blockage For Control Adjustment
Figure 412-2

Immediately return the termination temperature dial to 55°F to 58°F. (Unit will trip high pressure cut-out permitted to operate in defrost for short period of time.) Important: Vertical airflow models cannot be rechecked with panels and pressure sensing tube reconnected. Repeat above procedure to verify switch adjustment. However, start blockage of coil at 50% – unit should not go into defrost. Bring blockage up to 75% and unit should go into defrost.

Do not make further adjustments to defrost control.

Replace pressure side sensing piping.

Replace all panels and covers.

If it is determined that the control is bad, the new control will require adjustment for proper defrost operation.

Control Will Not Adjust

Be sure that the outdoor coil is in the proper position in the cabinet to prevent excessive air from bypassing the coil at the top or bottom.

Checking DFC Switch Contacts

If defrost control contacts weld, the OD fan will continue to run during the defrost cycle.

To check defrost control switch, disconnect power, remove wires from switch and check switch terminals with an ohmmeter. Switch measurements should be made with the thermal bulb warmed to above 51°F. The bulb should then be chilled to above 26°F and measurements repeated to check for welded contacts or failure of the contacts to make.

Thermal bulb above 51°F:

Terminal 2 (line) makes terminal 3 (OD fan)

Terminal 2 to 1 – open circuit

Terminal 1 to 3 – open circuit

Thermal bulb below 21°F:

Terminal (2) line makes terminal 1 (defrost relay)

Terminal 2 to 3 – open circuit

Terminal 1 to 3 – open circuit

SP414 – Dwyer Defrost Sensing Switch

The Dwyer defrost sensing switch is an air sensing switch whose primary function is to put the unit into a defrost cycle when the outdoor coil becomes restricted with frost or ice during heating operation. The switch, when operating properly, should initiate a defrost cycle when the outdoor coil is not more than 90% restricted or less than 70% restricted.

A Klixon type thermostat, used for defrost termination, is wired electrically in series with the defrost sensing switch contacts and will close when the outdoor coil temperature reaches approximately 32°F.

Common Causes for Switch Not Working Properly

a. Sensing tubes blocked by ice, dirt, insects, etc. To check sensing tubes, disconnect the tubes and blow into them to see if tubes are clean.

b. Loose or broken electrical connections. To check for broken or loose electrical connections, visually inspect the wires and connections in the switch circuit.

c. Defective switch or leaking diaphragm. Check defrost control adjustment. Before defrost control adjustments are attempted, system refrigerant charge operating pressures and temperatures must be checked.

Control Adjustment

If the line voltage at the unit, with the unit operating, consistently varies more than + or – 5% of the unit nameplate voltage rating, the defrost sensing switch may require adjustment.

The initiate pressure adjustment screw determines the amount of outdoor coil blockage required to cause the unit to go into defrost.

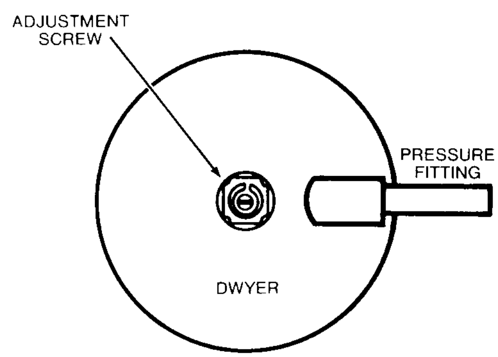
Turning this screw clockwise will cause the unit to go into defrost with more coil blockage. If this screw is turned too far in, the coil may freeze completely before defrost, or may fail to go into defrost with 100% coil blockage.

Turning the screw counterclockwise will cause the unit to go into defrost with less coil blockage. If the screw is backed out too far the unit may short cycle defrost or go into defrost with little or no coil blockage.

Control Adjustment Procedures (See Figure 414-1)

When making any adjustments on this sensing switch, should the outdoor temperature be above 40°F the defrost termination switch will need to be temporarily bypassed. This can be accomplished by placing a temporary jumper between terminal 4 of the defrost relay (D) and the white lead on the defrost sensing switch (DS).

Run the unit in the heating cycle with all panels and covers in place.

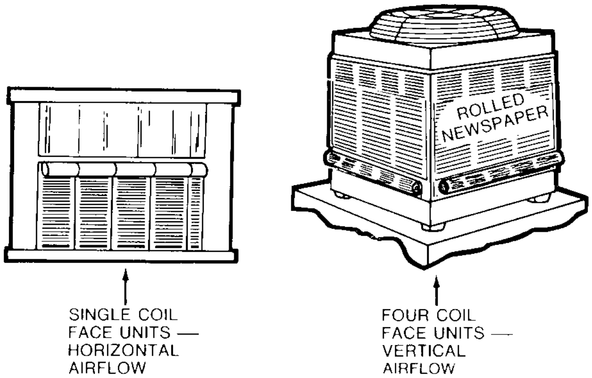


Dwyer Defrost Sensing Switch
Figure 414-1

On single coil face units (horizontal - airflow), roll up overlapped sheets of newspapers or plastic material in a roll wide enough to cover the full width of the outdoor coil. (See Figure 414-2)

Place the roll at the base of the outdoor coil and unroll the papers slowly up the coil until the sensing switch trips. The switch must trip between 70% and 90% blockage.

If the switch does not trip within the limits adjust the sensing switch as follows:



Coil Blockage For Dwyer Defrost Control Adjustment
Figure 414-2

Remove the side and control panel covers if the switch tripped too soon, turn the adjusting screw 1/2 turn clockwise to raise the trip point. If the switch tripped too late, turn the adjusting screw 1/2 turn counterclockwise to lower the trip point.

Replace the panels and repeat the previous check. Continue this procedure until the correct setting is reached.

Adjustment for 7½ and 10 Ton Models

On 7½ and 10 ton (WA) model heat pumps using the Dwyer defrost sensing switch, use the same control adjustment as outlined above with the following exceptions:

All exposed louvered side panels must be blocked from top to bottom leaving the two sections of louvers closest to the control and compressor compartment free.

With louvered panel blocked as stated above heat pump should go into defrost.

If adjustment of defrost sensing switch is necessary, follow procedure outlined in above section.

On WC 7½ and 10 ton units, and WA-180 and WA-240 heat pumps using the Dwyer defrost sensing switch, use the same control adjustment as outlined above with the following exceptions:

1. The model heat pumps listed in section (G) differs from those in section (F) in that the WC 7½ an 10 ton are package units and the indoor section and outdoor section are mated together by a panel across the top of the unit.

On the WA-180 and WA-240 heat pumps, these units are made up of two 7½ ton systems or two 10 tons systems. These units are also joined together. The proper method for blocking the coils to simulate defrost on these models is as follows:

1. Remove the panel from the top center of the unit, block the coil located between the two sections, from top to bottom, also block all louvered panels from top to bottom leaving the two sections of louvers closest to the control and compression compartment free.
2. With coil blocked as stated above heat pump should go into defrost.

Defrost Termination Switch

The defrost termination switch is a thermostatic switch used in connection with the Dwyer defrost sensing switch, and is used to terminate defrost when liquid line temperature reaches 50°F.

The defrost termination switch must close with line temperature below 32°F to initiate defrost.

Checking Defrost Termination Switch

IMPORTANT: Be sure the face of the switch has good contact with its mounting bracket. Ice or foreign matter between the switch and the bracket will cause improper operation.

The outdoor coil temperature has to be below 32°F. Operate the unit in the heating cycle and put it into defrost by blocking the outdoor coil per SP531. The unit should go into defrost and terminate after the outdoor coil is clear but before the high pressure switch (HPCO) trips.

Second method for checking this control is to check the temperature of the outdoor coil adjacent to the termination switch (This can be done by attaching a thermometer or temperature-tester lead to the coil with presstite). Operate the unit in heating and defrost cycles and compare the cut-in and cut-out temperature of the switch with those shown in the service manual, parts section.

SP416 – G.E. Morrison Defrost Control

The defrost system utilizes a timer mechanism, a temperature sensing switch and a defrost relay.

The timer is driven by a 230 volts motor connected to the load side of the compressor contactor so that the timer runs only when the compressor runs. (24 volt motor on 460 volt models)

A time selector permits selection of a 45 or 90 minute defrost frequency.

The temperature sensing switch is located at the outlet of the outdoor coil. The switch will close when the coil temperature reaches 26°F or below. The switch opens when the coil temperature is 51°F or above.

Defrost is initiated when the timer motor cam reaches the preselected defrost frequency and the coil temperature sensor is below 26°F.

Defrost initiation energizes the defrost relay which reverses the refrigerant cycle, switches off the outdoor fan and energizes the electric heaters.

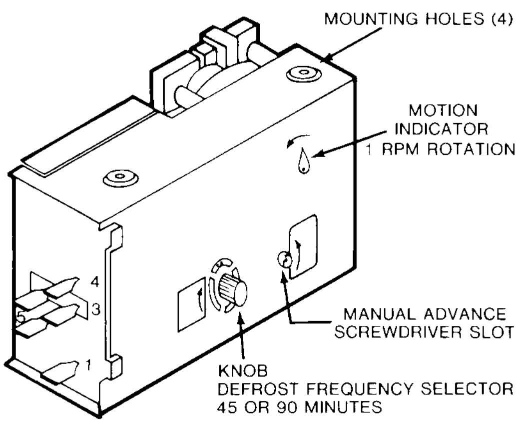
Defrost is terminated when the temperature sensing switch reaches 51°F or 10 minutes elapse whichever occurs first. The timer override cam will not permit a defrost cycle longer than 10 minutes.

Control Checkout (See Figure 416-1)

A 45 or 90 minute defrost frequency may be selected by rotating the selector knob clockwise until the desired frequency appears in the window slot.

An external motion indicator provides a visible indication that the timer motor is running. The indicator hand rotates counterclockwise at 1 RPM.

A screwdriver slot is provided for manually advancing the control. The advance screw must be turned counterclockwise only.



G.E. Morrison Defrost Control
Figure 416-1

Defrost Operation Checkout

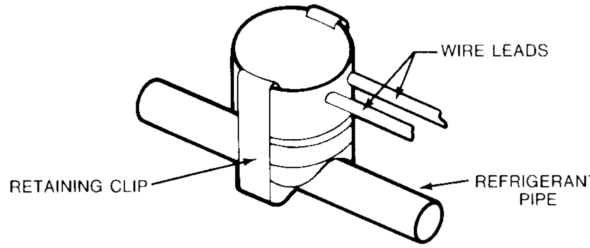
Operate the heat pump in the heating mode. Do not perform defrost checkout if the outdoor temperature is above 75°F.

Check the frequency selector window slot for desired frequency.

Check the motion indicator for rotation. If the motor fails to rotate, check voltage to the timer motor at terminals 1 and 4 on the timer.

To check defrost initiation the outdoor coil temperature must be below 26°F or the leads from the temperature sensing switch must be temporarily jumpered. (See Figure 416-2) Slowly rotate the manual advance counterclockwise until the unit goes into defrost.

Immediately remove the jumper from the temperature sensing switch leads. If the temperature sensing switch remains jumpered during defrost checkout when little or no ice is present on the outdoor coil the unit will trip the high pressure control before the 10 minute time override elapses.



Temperature Sensing Switch
Figure 416-2

Defrost will terminate when the temperature sensing switch reaches 51°F.

If the outdoor coil is badly iced, the timer will terminate the defrost after 10 minutes. If ice remains on the coil and further defrosting is required, the manual advance must be again turned counterclockwise until another defrost cycle is initiated.

If there is no ice on the outdoor coil and the high pressure control trips during the defrost cycle, check the temperature sensing switch to be sure that the contacts are closed above 51°F.

If the outdoor coil is badly iced, the external motion indicator indicates that the timer is operating and defrost will not initiate when the manual advance is rotated, check the temperature sensing switch to be sure that the contacts are closed below 26°F.

SP510 – Switchover Valve Diagnosis and Replacement

The solenoid coil operates the pilot valve only. The compressor must be operating with a diffential in head and suction pressure before the SOV will change position.

The solenoid coil operates the pilot valve only. The compressor which must be operating with a differential in head and suction pressure before the SOV will change position.

Solenoid Coil and Pilot Valve Checkout

Remove retaining nut or clip from solenoid core.

If spacer is used between coil and valve, note position of spacer which must be reinstalled in same position - spacer goes on core before coil.

Disable compressor and outdoor fan by removing one lead from motor starter relay coil.

Apply 24 VAC to solenoid coil.

Slowly slide solenoid back and forth along pilot valve core. If magnetic resistance pull is felt, coil is good.

If no pull is felt, check for 24 VAC at coil. If 24 VAC present, disconnect power, measure coil for continuity with ohmmeter.

If coil is open – replace coil.

If the coil is good, a definite clicking is heard when the coil is moved along the core. If the coil is good and no clicking is heard, the pilot valve is defective. Visually inspect the pilot core for dents or disfiguration. Small dents may be straightened by clamping a flaring block around the core and rounding the core. After straightening, recheck for clicking by moving energized coil along the core.

Problem – SOV Stuck in Cooling Position

The solenoid coil must be de-energized before the SOV will switch from cooling to heating.

Remove one lead from the solenoid coil to be sure that no voltage is present at the coil. Coil could be circuited through stuck defrost relay contacts, shorted wiring or a defective defrost control.

Be sure that a differential in head and suction pressure exists when the compressor is operating.

If at least 50 PSIG differential exists with no voltage applied to the solenoid coil and the SOV will not switch from cooling to heating; change the SOV.

Problem – SOV Stuck in Heating Position

SOV solenoid coil must be energized before SOV will switch from heating to cooling.

Check solenoid.

Be sure that a differential in head and suction pressure exists.

If at least 50 PSIG differential exists between head and suction pressure with 24 volts applied to the solenoid coil and the SOV will not switch from heating to cooling, change the SOV.

Problem – SOV Stuck Midway or Leaking High to Low Side

Compressor will run hot, may trip compressor internal overload protector.

Suction pressure will be higher than normal, head pressure lower than normal.

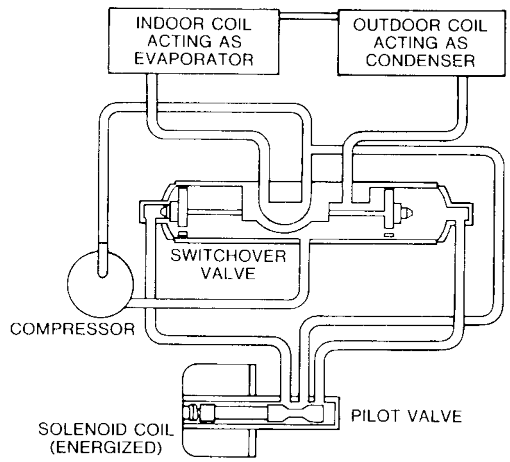
Suction line entering and leaving SOV will have noticeable temperature differential to feel or measurement.

If above combination exists, replace the valve.

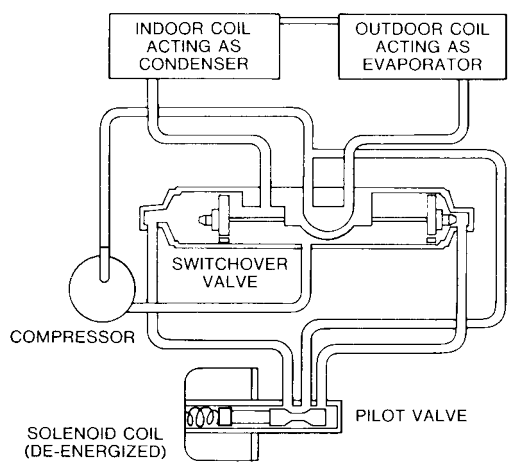
SOV Replacement

Bleed refrigerant charge per SP928.

Unbraze outer connections from SOV to outdoor and indoor coils per SP935.



Switchover Valve In Cooling Position
Figure 510-1



Switchover Valve In Heating Position
Figure 510-2

Remove Rotolock couplings from compressor discharge and suction per SP630.

Note valve position – whether pilot assembly faces toward you or away from you. Replacement valve must be installed in same position. Electrical circuits cannot be modified for proper operation if valve is installed in reverse position. Remove SOV assembly from unit.

Mark suction and discharge tubes for correct direction orientation.

Unbraze suction and discharge tubes.

Install suction and discharge tubes in replacement valve. Be sure tubes point in same direction as old valve.

Pack SOV with heat sink material. Braze tubes in place. Do not exceed 275°F on SOV body.

Return assembly to unit. Tighten suction Rotolock first.

Tighten discharge Rotolock second.

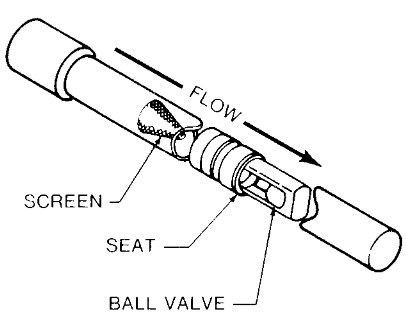
Install and braze remaining suction tubes. Keep SOV packed with heat sink material.

SP520 – Check Valves

Check valves are used with heat pump equipment to control the refrigerant flow direction. Indoor air handling equipment is common to heat pumps and cooling equipment. Cooling equipment indoor units may be equipped with check valves. (See Figure 520-1)

When a check valve malfunction is suspected, operate heat pump equipment in both the heating and cooling mode. If the equipment operates with normal head and suction pressures in either heating or cooling mode, but pressures are abnormal in the remaining mode, a check valve is the most probable fault. A restricted capillary tube per SP540 or a defective expansion valve per SP545 can cause the same symptoms as a defective check valve.

When performing check valve tests in cold weather, block the outdoor coil surface area with paper or plastic when cooling mode tests are conducted. Block the outdoor coil until head pressure is approximately 250 PSIG. Suction pressure should be within 10 PSIG of the pressure chart. Pressure charts are attached to all outdoor units.



Check Valve Construction
Figure 520-1

Outdoor Check Valve(s) Stuck Closed – Cooling Mode Operation

Suction pressure will be low, head pressure will be low.

Compressor will be hot, may trip internal overload protector.

If indoor unit is equipped with a thermostatic expansion valve, defective thermal element on the valve can cause the same symptoms.

Equipment should operate at normal pressures in the heating mode.

Indoor Check Valve(s) Stuck Open – Cooling Mode Operation

Suction pressure will be high, head pressure will be low. May be near equal pressures.

Compressor will be cool or cold.

Check for normal pressures in heating mode. Equipment should be operated at normal pressures.

Outdoor Check Valve(s) Stuck Open – Heating Mode Operation

Suction pressure will be high, head pressure will be low. May be near equal pressures.

Compressor will be cool or cold.

Equipment should operate at normal pressures in the cooling mode.

Indoor Check Valve(s) Stuck Closed – Heating Mode Operation

Suction pressure will be low, head pressure will be low.

Compressor will be hot. May trip internal overload protector.

If the outdoor unit is equipped with a thermostatic expansion valve, a defective thermal element on the valve will cause the same symptoms.

Equipment should operate at normal pressures in the cooling mode.

Indoor Check Valve Leaking – Cooling Mode Operation

Slightly high suction pressure, slightly low head pressure.

Compressor will be normal temperature or cool, depending upon leak rate.

Equipment should operate at normal pressures in heating mode.

Outdoor Check Valve Leaking – Heating Mode Operation

Slightly high suction pressure, slightly low head pressure.

Compressor will be normal temperature or cool, depending upon leak rate.

Equipment should operate at normal pressures in cooling mode.

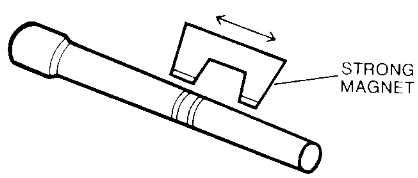
Check Valve Magnet Test

Before condemning a check valve for stuck open or closed failure; test as follows: (See Figure 520-2)

Stop the equipment and allow head and suction pressures to equalize. Pressures **must** be equalized for this test. Slide a **strong** magnet back and forth along the valve body.

If the ball valve is stuck, no sound will be heard. If the ball valve is free, a distinct clicking will be heard as the magnet is moved back and forth along the valve body.

The clicking sound indicates that the valve is good.



Testing Check Valve With A Magnet
Figure 520-2

Check Valve Replacement

Before removing suspected open or leaking check valves, pinch off the check valve body with a standard pinch off tool.

Recheck operating pressures to confirm diagnosis.

Use care installing the replacement check valve. Do not bend or deform the valve body.

Do not overheat the check valve when brazing.

Do not apply excessive brazing material.

SP530 – Liquid Line Driers

Liquid line driers are vitally important to the life expectancy of air conditioning equipment. Their purpose is to remove moisture and neutralize acid build up in the refrigerant system.

Liquid line driers should be replaced if the refrigerant charge is lost due to leaks, when a compressor is replaced, or when the refrigerant must be discharged for repairs.

Liquid line driers should never be oversized, since system refrigerant charge will be increased to accommodate the drier. Excessive refrigerant charge can cause compressor liquid slugging at start up.

Heat pump equipment may contain one or two liquid line driers. A check valve arrangement insures that liquid flow through the driers is in the same direction regardless of flow direction in the liquid line.

Replacement driers in heat pump equipment must be located in the same physical location as the original equipment drier.

Do not use commercially available two-way driers advertised for use in the liquid line outside the heat pump equipment cabinet.

Replacement driers in straight cooling equipment may be installed in the liquid line outside the equipment cabinet only if the defective drier is removed from the refrigerant circuit and replaced by refrigerant pipe.

Clogged Liquid Line Driers

Clogged liquid line driers result in low suction pressure and normal to low head pressure.

Evaporator may frost or ice.

Any measurable temperature drop across a drier indicates a clogged drier.

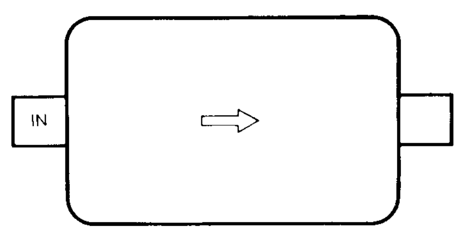
Liquid line pressure can be measured on equipment with pressure taps on the refrigerant lines or liquid line shut off valve with pressure port. Low liquid line pressure will exist with a clogged drier.

NOTE: The high pressure tap located on heat pump equipment cabinet measures head pressure at the compressor. Liquid line pressure cannot be measured at this tap.

Drier Replacement

Bleed the refrigerant charge per SP928.

Note the flow direction arrow or “in” – “out” marking on the original equipment drier(s). Replacement drier(s) must be installed in the same flow direction. (See Figure 530-1)



Flow Direction – Liquid Line Drier
Figure 530-1

Brazed driers should be removed from the refrigerant system by cutting out with a tubing cutter. Heat caused by unbrazing may drive moisture and contaminants into the system.

If it is necessary to unbraze the old drier use extreme caution. Be sure that all refrigerant has been discharged from the system. Oil may be present in the drier that can cause flaming when the drier is removed.

Fit the replacement drier(s) in place, observing flow direction arrows, and braze joints per SP935.

Where flare driers are used, oil the drier threads and flare ferrules with refrigerant oil before assembly. Do not overtighten flare fittings. Extrusion of the flare can result.

SP535 – Permanent Suction Line Drier

The suction line drier must be installed in any system that has been established as a “burnout”. (Acid test per SP932)

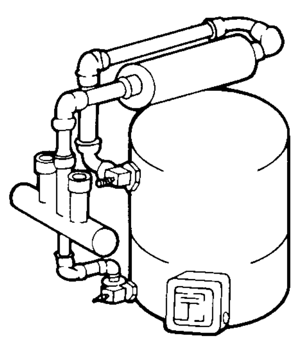
The suction line drier must be permanently installed in the suction line as near to the compressor as possible.

On heat pump units, the suction line drier must be installed between the switchover valve and compressor.

To Install Permanent Suction Line Drier (See Figure 535-1)

Install compressor, refer to appropriate installation sketch, sent with compressor for material list and suction line drier.

Install and braze drier per installation sketch and attach Rotolock coupling per SP630.



Typical Suction Line Drier Location – Heat Pump
Figure 535-1

SP540 – Capillary Tubes

The flow rate through a capillary tube depends on the pressure differential across the capillary.

The capillary tube does not, in most instances, cause liquid refrigerant to flood back to the compressor. This is caused by:

An overcharge of refrigerant.

Partial or complete loss of indoor airflow.

A check valve leaking or stuck open per SP520.

Operation at low loads and high ambients.

Conditions that Give Symptoms Similar to Capillary Tube Restriction

Low refrigerant charge per SP720, 725, 730, 735.

Clogged liquid line drier per SP530.

Check valve stuck closed per SP520.

Problem – Restricted Capillary Tube

A restricted capillary produces a low suction pressure.

Frosting of the capillary and indoor coil inlet.

Head pressure near normal.

If moisture is suspected the capillary may be heated and the restriction should disappear. If this happens:

Bleed the charge per SP928.

Change the drier.

Evacuate the system per SP930.

Recharge per SP720, 725, 730, 735.

If nothing happened when you heated the cap tube, unbraze the capillary tube from the system and remove the obstruction or replace the capillary tube.

It is permissible to cut up to one inch off an existing capillary tube if the restriction is at an end.

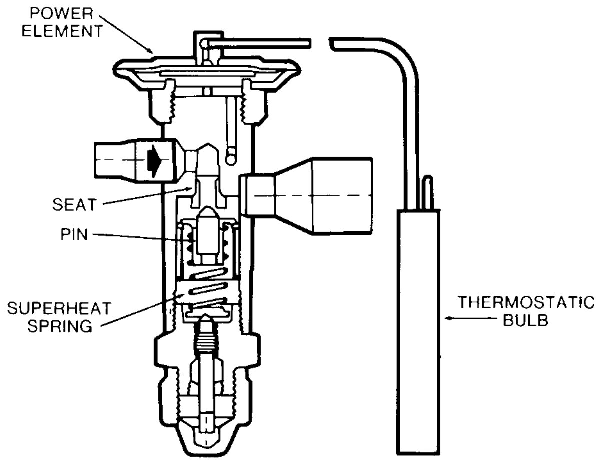
When cutting or replacing a capillary tube do not use a tubing cutter. Use a file to score the capillary tube and then break the tube at the score.

When installing the capillary tube be sure to insert the ends far enough to prevent brazing them shut.

SP545 – Expansion Valve (See Figure 545-1)

Many valves are needlessly replaced when the cause of the system malfunction is not immediately recognized.

The valve performs only one main function which is to keep the evaporator supplied with enough refrigerant to satisfy all load conditions.



Typical Thermostatic Expansion Valve
Figure 545-1

Other Causes Of Symptoms Similar to Expansion Valve Problems

Low refrigerant charge.

Clogged liquid line drier per SP530.

Check valve stuck closed, stuck open, or leaking per SP520.

Liquid line service valve not back seated.

Liquid line quick connect not bottomed out per SP625.

Bad compressor (low capacity) per SP370.

Vapor in the liquid line.

Low condensing temperature.

Expansion Valve Checkout

Determine superheat by the following method:

Measure the temperature of the suction line at the point that the thermal bulb is attached.

CAUTION: Use only superheat thermometer or thermocouple.

Read the gauge pressure at the suction schrader fitting. To that pressure, add the estimated pressure drop through the suction line between the bulb location and the suction schrader fitting (pressure loss usually 2 PSI or less).

Convert the pressure obtained above to saturated evaporator temperature by using a temperature-pressure chart.

Subtract the two temperatures. The difference is superheat.

Example:

Suction line temperature 51°F. Suction pressure 68 PSIG plus estimated suction line loss 2 PSIG equals 70 PSIG R22 at PSIG = 41°F.

Superheat = 51° – 41° = 10°F.

Problem – Dead Power Element

A dead power element produces the following symptoms:

Low suction pressure, high superheat and a hot compressor.

Valve and distributor tubes frosted or frozen.

The inlet and first few rows of the indoor coil frost or ice.

If the above combination exists, change the power element or complete valve if applicable by the appropriate service procedures.

Bleed the charge per SP928, or pump the system down per SP937.

Make the appropriate replacement. If the replacement requires brazing in a new valve, make certain that the heat is directed away from the valve body and diaphragm. Pack the valve body with a suitable heat sink material.

Leak check per SP610.

Evacuate per SP930.

Problem – Moisture in the System

Can produce similar symptoms to a dead power element.

Can prevent the expansion valve from closing, causing a high suction pressure, low superheat and a cold compressor sump.

If moisture is suspected the expansion valve can be heated and the symptom should disappear. If this happens:

Bleed the charge per SP928.

Change the drier.

Evacuate the system per SP930.

Charge per SP720, 725, 730, 735.

Problem – Foreign Matter in the Expansion Valve

Can produce symptoms similar to moisture in the system.

If foreign matter in the valve is suspected:

Bleed the charge per SP928 or pump the system down per SP937.

Disassemble and clean the valve or replace the valve if appropriate.

Follow the steps for a dead power element.

Problem – Poor Thermal Bulb Contact

Can cause high suction pressure, low superheat, and a cold compressor sump.

Correct by cleaning and securely fastening the bulb to the suction line.

If problem is not corrected, check the equalizer line between the expansion valve and suction line for restrictions.

Problem – Thermal Bulb Mounted in a Warm Location

Can cause a high suction pressure low superheat, and a cold compressor sump.

Correct by insulating the bulb so that it senses only suction line temperature.

Problem – Expansion Valve with Distributor not Feeding All Circuits

Can cause low suction pressure with a near normal superheat.

A superheat thermometer or thermocouple must be used to determine which circuit is restricted. The restricted circuit will have a high superheat reading on the suction tube leaving that circuit of the evaporator.

Bleed the charge per SP928 or pump the system down per SP937.

Unbraze the distributor and capillary tubes and remove the obstruction or replace the restricted component.

Braze the distributor and capillaries being careful not to plug them with excessive brazing material.

SP550 – High Pressure Cut-Outs

The purpose of high pressure cut-outs in refrigerant systems is to prevent excessive pressures in the system that could rupture refrigerant piping, compressor casings or other components in the system.

High pressure cut-outs should never be permanently jumpered or bypassed. Personal injury or property damage could result.

Manual Reset Cut-Outs

Manual reset high pressure cut-outs are usually set to open the switch circuit between 350 and 420 PSIG head pressure. When the cut-out trips it must be manually reset by means of a push button or lever located on the body of the cut-out.

Automatic Reset Cut-Outs

Automatic high pressure cut-outs are usually set to open the switch circuit between 350 and 420 PSIG head pressure. When the cut-out trips it will automatically reset when high side pressure is around 250 PSIG.

Cut-in and cut-out pressures for particular models are shown in the model data section of the service manual.

Checking High Pressure Cut-Outs

Disable the outdoor fan(s) by removing fan motor leads from the motor contactor. Connect a high pressure gauge to the unit's high pressure access port.

Determine from the model data section of the service manual the correct cut-out and cut-in (automatic reset only) pressures. Start the unit and observe the pressure gauge. The cut-out should trip and stop the compressor when head pressure reaches the cut-out setting of the switch. Cut-out should occur within: ±20 PSIG of the switch setting.

CAUTION: Do not permit head pressure to exceed 450 PSIG before stopping the unit.

If the cut-out does not trip below 450 PSIG, replace the cut-out. If the cut-out trips at a pressure low enough to cause nuisance tripping in hot weather, replace the cut-out.

Automatic reset cut-outs should restart the compressor when the head pressure is within ±20 PSIG of the switch cut-in setting. Units equipped with expansion valve flow control may require an extended period of time before head pressure drops to the cut-in pressure of the switch setting.

Causes for High Pressure in Refrigerant Systems

Dirty condenser coil.

Condenser fan rotation wrong.

Condenser fan not located in orifice properly.

Wrong fan blade.

Wrong fan motor speed or horsepower.

Overcharge of refrigerant.

Overloaded evaporator.

Condenser air recirculating.

Condenser entering air temperature over 115°F.

Installed in hot location (black roof top, etc.).

Also see SP555 – compressor pressure relief valve.

SP552 – Low Pressure Cut-Outs

One type of low pressure control is an adjustable bellows operated switch that is located in the electrical control box and is connected to the refrigeration system by means of a long capillary tube.

The other type of low pressure control used is the non-adjustable integral bellows operated snap action switch screwed directly to refrigeration system. Wires connect switch to remote electrical control box.

Low Pressure Control Check-Out

Refer to model data section of service manual on early units and to the specification and identification section of the manual on late model units for the correct cut-out setting and tolerances of the switch.

Connect a compound gauge to the compressor suction purge fitting, low side service valve or the low side schrader fitting.

Close or front seat liquid line valve on units with service valves. (Must be in cooling if heat pump.)

On other units, disconnect evaporator blower electrically – remove evaporator blower belt or block all air to evaporator coil.

Operate unit and observe compound gauge. Switch should trip within 5 PSIG of correct setting or at any special tolerances.

If the switch trips too early or too late, try adjustment of calibration screw if unit equipped with adjustable control. If control does not respond to adjustment, it must be replaced.

Non-adjustable control must be replaced if it does not trip at proper setting.

Low Pressure Control Replacement

NOTE: Both types of low pressure controls can be replaced without loss of refrigerant charge.

Replacement of Adjustable Low Pressure Control

Pinch shut low pressure control adapter tube at a point 2 or 3 inches from the unit suction tube.

Leave the pinch off tool locked or bolted in place and cut adapter tube on capillary or control side.

Insert new control tube in adapter tube and braze joint.

Loosen pinch off tool and rotate 90° and squeeze flattened tube to reopen. (Not necessary for tube to regain original shape or be fully open.)

Check operation of new control.

Replacement of Non-Adjustable Low Pressure Control

Have a replacement control available within your reach.

Unscrew defective control and screw on replacement. Only small amount of refrigerant will be lost as the control adapter on unit is equipped with small diameter orifice.

SP555 – Checking Compressor Pressure Relief Valve

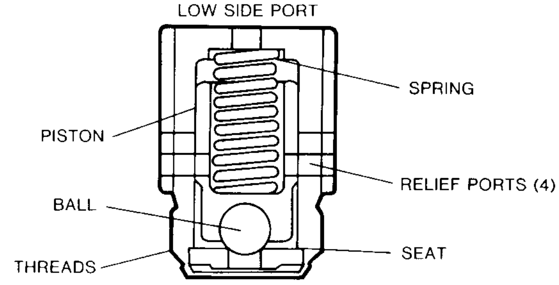
The pressure relief valve (PRV) serves the same basic function as a high pressure cut-out – to prevent excessive pressures within the refrigerant system due to loss of condenser airflow or reduction of condenser airflow to the point that the system cannot safely or properly perform.

The PRV is installed inside the compressor housing. It is a part of the discharge muffler assembly. (See Figure 555-1)

The PRV is not field serviceable or field replaceable.

The PRV is a spring loaded ball type valve, with automatic opening and re-seating features. Should the differential between compressor discharge pressure and suction pressure exceed the valve setting, the valve will open, permitting hot discharge gas to flow over the motor resulting in tripping of the compressor motor thermostat.

The PRV will fully open between 425 and 525 PSIG differential. When the compressor motor has cooled sufficiently, the motor thermostat resets and the compressor restarts.



Compressor Internal Pressure Relief Valve
Figure 555-1

Checking PRV Operation

CAUTION: When checking operation of a PRV by blocking condenser airflow or disabling the condenser fan, do not connect suction pressure gauge since damage to the gauge will result when the PRV opens.

Excessive valve leakage will result in higher than normal suction pressures and lower than normal head pressures.

If faulty PRV is suspected, check head pressure. PRV may partially open at head pressures above 400 PSIG.

If head pressure exceeds 400 PSIG:

Check for dirty or fouled condenser surface.

Check recirculation between condenser outlet and inlet air.

Entering air above 115°F may cause PRV to open.

Check fan rotation and speed.

Check for refrigerant overcharge.

If system is equipped with a field installed pump down cycle, the condenser/receiver must be of adequate size to accommodate the refrigerant charge or the PRV will open during pump down.

SP610 – Refrigerant Leaks

Equipment necessary for leak testing

General Electric type H-10 leak detector, or Tracker.

Halide torch leak detector.

Soap solution.

To Check For Leaks

Connect a pressure gauge to the low side schrader valve on unit cabinet, or pressure taps on refrigerant lines. If the gauge registers a positive pressure proceed with the test. If the gauge indicates the system is out of freon, add sufficient R-22 to pressurize the system, then proceed with the test.

Using the GE leak detector (follow the directions furnished with the detector) check all joints, pressure switch capillaries, etc., for leaks or:

Using a halide torch check all joints etc. A leak will show up as a change in the torch flame – a green flame indicates a small leak – a rising brilliant blue flame indicates larger leak, or:

Using soap solution dab solution on joints, etc. – telltale bubbles pin point the leak.

Dry nitrogen may be used to pressurize the system in locating small leaks. Do not pressurize the system above 300 PSIG. Rupture of system components can result.

Never pressurize a refrigerant system with compressed oxygen. Oil and oxygen under pressure will explode.

SP612 – Refrigerant Circuit Restrictions

Restrictions in equipment that has been operational for a period of time usually occur where a pipe or component reduces in size. Driers, capillary tubes, expansion valve screens and check valve screens are prime suspect areas.

Restrictions that appear at new equipment start up are most likely to appear at capillary braze joints, mechanical piping fittings, where field piping has been bent in short turns or where piping has been cut and brazed. Unopened or partially open refrigerant line valves are a common cause of restrictions on newly installed equipment.

A restriction in piping, joints, mechanical couplings or shut off valves can usually be detected by a temperature change across the restriction. Temperature changes across restrictions in the liquid line or evaporator coil usually show a change in sweat or frost pattern. Restrictions in condenser coils are more difficult to detect since sweat or frost is not present.

Restrictions in Liquid Lines, Flow Controls and Low Side

Connect gauges to pressure taps on the refrigerant lines or pressure ports on refrigerant line shut off valves. For the test do not connect to pressure taps on heat pump equipment cabinet. High side gauge must connect to liquid line after the drier.

Operate equipment in the cooling mode.

Be sure indoor airflow and evaporator load is near normal.

If a restriction exists in the liquid line, expansion valve or capillary – head pressure will be low, suction pressure will be low if the restriction completely blocks refrigerant flow, the evaporator will be warm, compressor will be hot (overload protector will trip periodically), suction pressure will be less than 0 PSIG. If the restriction partially blocks refrigerant flow the evaporator coil will be partially or fully frozen depending upon the extent of the restriction. If the evaporator is completely frozen, the compressor will be sweating or frosted.

Defrost the evaporator before proceeding.

With the equipment operating in the cooling mode, block the airflow at the outdoor coil until the liquid line pressure reaches 250 PSIG. Maintain this pressure with the air blockage.

If the suction pressure rises above 50 PSIG, the refrigerant charge is low. If the suction pressure remains below 40 PSIG check for restrictions.

Check along the liquid line for crimps and solder joints. Check for temperature change across crimps and joints.

Check for temperature change across mechanical coupling or solder joint where liquid line enters evaporator enclosure.

Check for expansion valve frosting or freezing at the valve inlet. Inlet screen could be clogged.

Check expansion valve thermal element for lost charge per SP545.

Check capillary tubes for sweating or frosting at the evaporator inlet. All capillaries should be sweating or frosting at the evaporator inlet. Any single capillary not sweating or frosting is blocked. If none of the capillaries are sweating or frosting, check sweat or frost patterns in the evaporator, suction line and suction line couplings for restriction indications.

Restrictions in evaporator coils can usually be located by checking sweat or frost patterns. All evaporator circuits or coil slabs should have uniform patterns from inlet toward the outlet.

Check suction line couplings for sweat or frost patterns.

Check suction line for crimps and solder joints. Definite change in sweat or frost patterns occur in suction line or coupling restrictions.

Restrictions – Outdoor Coil

Before checking outdoor coil for restrictions, check for clogged drier per SP530. On heat pump equipment, check operation of check valves per SP520.

If a restriction is present in the outdoor coil, normally the head pressure will be high, the suction pressure will be low.

On straight cooling equipment or heat pumps operating in the cooling mode, attach sensing probes of an electrical thermometer to the tube leaving each condenser circuit before the tubes enter the liquid line manifold pipe.

Operate the equipment in the cooling mode.

Observe thermometer readings.

Restricted circuit should indicate a lower temperature than non-restricted circuits.

Check crimps, solder joints and fittings in the restricted circuit.

On heat pump equipment, restrictions are easier to locate. Disable outdoor fan circuit so outdoor fan does not run.

Operate equipment in heating mode. Operate until moisture or frost appears on outdoor coil. By observation and feeling outdoor coil circuits, the restricted circuit can usually be isolated. Any circuit not sweating or frosting is restricted.

Check the restricted circuit for temperature change across crimps, solder joints and fittings.

Be sure check valves are operating properly per SP520.

SP614 – Checking For Non-Condensable Gasses

Air, nitrogen, hydrogen and other foreign gasses present in a refrigerant system are referred to as noncondensables since they will not condense at pressures encountered in a refrigerant system.

The most common cause for presence of non-condensables is introduction of air in the system during installation or servicing and the air is not removed by proper evacuation procedures.

Detecting Non-Condensables

High head pressure when the condenser is clean, airflow and refrigerant charge is correct, indicates presence of non-condensables.

Suction pressure is usually low. If non-condensables are present in quantity, the evaporator may freeze.

If the equipment has a liquid line sight glass, bubbles will be present in the glass.

Equipment with Service Valves

Connect a pressure gauge to the high side pressure tap.

Pump the system down per SP937.

Disable the compressor by removing one lead from the compressor contactor coil.

Let the condenser fan run.

Measure the air temperature entering and leaving the condenser coil.

When the entering and leaving air temperatures are equal, convert the temperature reading to pressure by using a pressure – temperature chart.

Compare the converted pressure to the measured pressure.

If the measured pressure is higher than converted pressure, the presence of non-condensables is likely.

Removing Non-Condensables from the System

Recover the refrigerant charge per SP928.

Evacuate the system per SP930.

Charge refrigerant per SP720, 725, 730, 735.

Check system performance per SP710, 715, 730, 735.

SP625 – Quik Attach Couplings (See Figure 625-1)

Make sure that no dirt, water or other foreign materials are permitted in the couplings before connection.

IMPORTANT: Oil the face and threads of the couplings with clean refrigerant oil before mating.

The hex part of the coupling that is brazed to the refrigerant pipe **MUST** be held with a wrench when tightening the union nut. If the pipe is permitted to turn during tightening, the coupling seal face may be deformed, resulting in a refrigerant restriction.

Box end wrenches should be used.

Tighten union nuts until coupling halves bottom. A firm metal-to-metal contact will be felt.

Tighten the union nut 1/4 turn after bottoming.

Overtightening or undertightening can result in a leak.

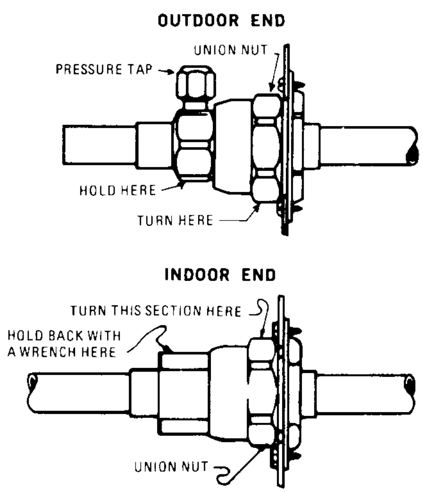


Figure 625-1

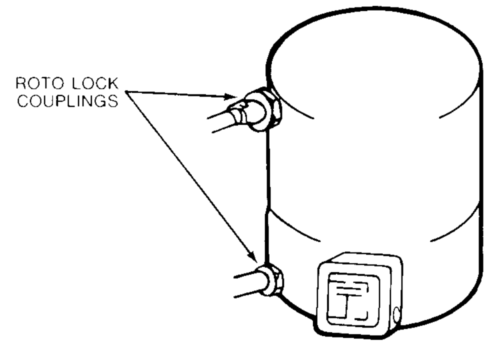
SP630 – Rotolock Compressor Couplings

To Loosen Installed Rotolock Fittings (See Figure 630-1)

Apply a small amount of refrigeration oil between the Rotolock nut and the pipe sleeve.

Lightly tap the Rotolock nut in a CCW direction with a punch and hammer to break the anti-rust paint loose.

Back off Rotolock nut with wrench.



Rotolock Compressor Couplings
Figure 630-1

To Install Rotolock Couplings

Check gaskets in female couplings on compressor. Gaskets **MUST** be completely inserted in coupling undercut.

When installing new gaskets, **ALL** old gasket material must be removed and coupling undercut **COMPLETELY** free of foreign material to prevent leaks.

Apply a small amount of refrigeration oil to the female coupling threads and between the Rotolock nut and pipe sleeve.

Align the couplings and start threading by hand.

Hold the pipe sleeve flats with a wrench while tightening Rotolock nut wit another wrench to prevent twisting of tubing.

When couplings bottom, tighten an additional one-quarter turn. **DO NOT OVERTIGHTEN.**

Leak check per SP200.

SP710 – Normal Operating Pressures – Cap Tube – Cooling

Normal operating pressure charts **MUST NOT** be used for charging capillary tube flow control systems.

Measure head and suction pressure at the external pressure taps. On heat pump systems with pressure taps on the refrigerant lines and on the outdoor unit cabinet, the pressure taps on the **OUTDOOR UNIT CABINET MUST BE USED** for accurate chart readings.

Indoor airflow must be within the limits shown on the operating pressure chart.

Normal operating pressures – Cooling mode, should be made at outdoor temperatures above 55°F only.

Use the normal operating charts attached to the unit or in the model data section of the service manual for the specific model being tested.