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FILE:
TRANE REFRIGERATION PRODUCTS
RECIPROCATING COMPRESSOR - CONDENSER UNITS
Hermetic M-R
Operation-Maintenance

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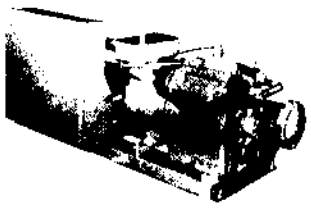


SEMI-HERMETIC RECIPROCATING COMPRESSOR AND CONDENSER UNITS

MODEL M
10-30 TONS

COMPRESSOR UNITS	CONDENSER UNITS
REFRIGERANT-12	**REFRIGERANT-12**
HCUA100-M	RWUA100-M
HCUA130-M	RWUA130-M
HCUA170-M	RWUA170-M
HCUA190-M	RWUA190-M
REFRIGERANT-22	**REFRIGERANT-22**
HCUA150-M	RWUA150-M
HCUA200-M	RWUA200-M
HCUA250-M	RWUA250-M
HCUA300-M	RWUA300-M

OPERATION

NORMAL OPERATING PRESSURES

When properly installed and operated, the Trane Model M Semi-Hermetic Compressor and Condensing Units will give long, trouble free service.

At the time of installation, the controls were adjusted and calibrated, and the unit was started and operated for a period of time to insure the proper functioning of all components. No further control adjustments are necessary unless repairs are made to the unit or unusual conditions arise.

The operating pressure ranges for Refrigerant-22 and Refrigerant-12 with air cooled and water cooled condensing are given in Table 1.

Oil should be visible in the compressor oil level sight glass with the compressor operating. See Figures 1 and 2. The oil pressure gauge should read 20-35 psig above the pressure gauge reading.

TABLE 1 - Normal Refrigerant Pressures

	REFRIGERANT 22		REFRIGERANT 12	
NORMAL PRESSURES	AIR COOLED CON-DENSING	WATER COOLED CON-DENSING	AIR COOLED CON-DENSING	WATER COOLED CON-DENSING
SUCTION PRESSURE	55-85*	55-85	30-50*	30-50
DISCHARGE PRESSURE	260-385*	170-245	160-210**	100-160

* For 35 to 50F Suction Temperature
** For 100 to 150 Condensing Temperature

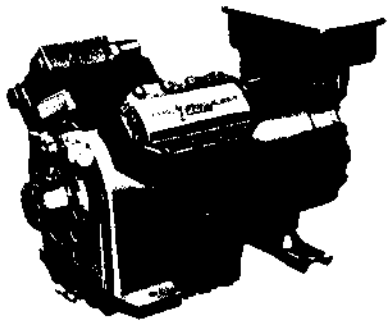


FIGURE 1 - Typical Model M Compressor

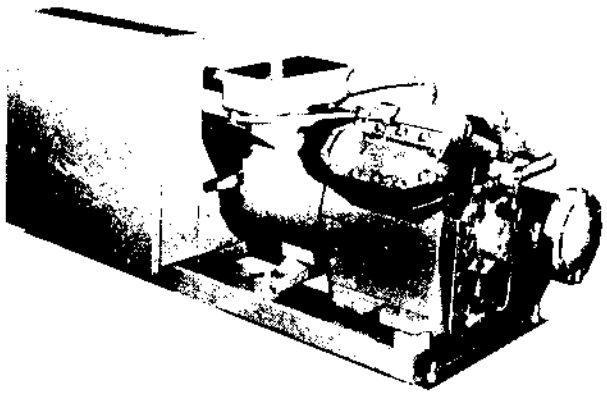


FIGURE 2 - Typical Model M Condenser Unit

MAINTENANCE

If the unit does not operate properly during these inspections, consult the "Trouble Analysis" section for the recommended action to be taken.

PERIODIC SERVICE

ONCE A WEEK

1. Check the oil level in the compressor. Before adding oil, allow the compressor to operate continuously for three or four hours checking the oil level every half hour. If the oil level does not return to the proper level, add oil (Refer to "Adding Oil", Page 10).

2. Check the oil pressure.

3. The flow of refrigerant through the liquid line sight glass should be smooth and without bubbles. The appearance of bubbles indicates a shortage of refrigerant, probably caused by a leak. Repair the leak and add refrigerant (Refer to "Repairs", Page 11, and "Adding Refrigerant", Page 10).

4. Inspect the entire system for any unusual conditions.

ONCE A MONTH

1. Perform the recommended weekly inspections.

2. Inspect all air handling equipment. Lubricate where necessary. Inspect, and if necessary, clean or replace air filters. Check the condition and tension of the evaporator unit fan belts. A one inch depression under light hand pressure is considered normal belt tension. If necessary, clean evaporator coil using a vacuum cleaner or a jet of low pressure air.

3. Start the compressor and observe the discharge pressure. If the pressure is above or below normal, see Section G and H of the "Trouble Analysis Chart".

4. If an air condenser is used, inspect the condensing coil for obstructions. If the coil is fouled, flush it with a hose using cool water, or clean it with a vacuum cleaner.

5. If a direct expension coil is used, clean it in accordance with the manufacturers instructions.

ONCE A YEAR

1. Perform the recommended weekly and monthly inspections.

2. Inspect all air handling equipment for worn or frayed belts. Replace belts where necessary.

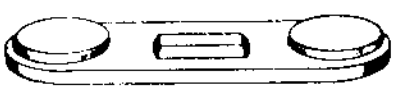
3. Inspect the contacts of the motor starters and controls. Refer to Figure 3.

4. If a water condenser is used, completely drain the condensing water system. Inspect all valves, piping, etc. Clean the strainers. Clean the condensing tubes if necessary.

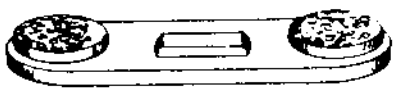
5. If a cooling tower is used, flush the tanks and pumps. Remove rust and corrosion and paint all surfaces.

SEASONAL SHUTDOWN

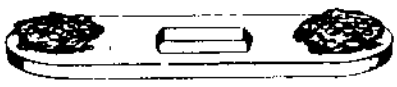
To avoid unnecessary strains on the equipment during long periods of shutdown, the system should be pumped down and the refrigerant held in the



New Contacts — Smooth surfaces, may be bright, dull or discolored by tarnish.



Normal Wear — Surfaces mildly pitted, discolored areas either black, blue or brown. 75% of mass still intact. Slight feathering of edges with no lifting. Contacts still serviceable.



Badly Worn — Surfaces badly eroded. Edges feathered and lifted. Replace contactor.

FIGURE 3 - Contact Replacement Guide

condenser or receiver (if used) during the off periods.

1. Pump the system down (Refer to "System Pumpdown", Page 15).

2. Allow the system to stand idle for a few minutes. Pressure may build up in the low side, caused by refrigerant evaporating out of the oil in the compressor crankcase.

3. Repeat the pumpdown procedure until the low side pressure holds at 2 psig when the compressor is shut down.

4. Open the master switch. Make sure that the switch will not be closed while the system is in the shutdown condition.

5. Take the following shutdown precautions with systems equipped with water-cooled condensers:

   a. Test the condenser with a leak detector.

   b. Close the water supply leading to the condenser.

   c. If the system will be subject to freezing temperatures during the shutdown period, drain the condensing water tubes, water valve and piping thoroughly. If the completeness of the draining is questionable, blow the water out with compressed air and add an adequate solution of permanent type antifreeze.

6. If an air-cooled condenser is used, valve off the condenser and receiver from the rest of the system and test them for leaks with a leak detector. Refer to the manufacturer's instructions for shutdown maintenance.

7. If a shell-and-tube evaporator is used, drain the evaporator shell, and if it will be exposed to freezing temperatures, fill it with an adequate solution of permanent type antifreeze.

SEASONAL START-UP

1. Operate the crankcase heater for 24 hours prior to starting the compressor or condenser unit.

2. In the interim, inspect all air handling equipment.

3. If a water cooled condenser is used, turn the condenser supply water on. If a cooling tower is employed, make sure that the sump is full and the circulating pump is in operating condition. Make sure that the cooling system has the proper level of water.

4. If an air cooled condenser is used, inspect the condensing unit for obstructions. If the coil is fouled, flush it with a hose, using cool water, or clean it with a vacuum cleaner.

5. Depress the oil pressure control (OPC) reset button and be sure other controls are properly set.

6. After the crankcase heater has operated for 24 hours, open the shut off valves in the refrigerant circuit.

7. Test the entire system with a leak detector.

8. If pressure gauges are not already part of the system, attach them to the back seat parts of suction and discharge service valve. Back seat the compressor suction and discharge service valves and then crack them off the back seat to open the suction and discharge gauge lines to system pressures (See Figures 1 and 2).

9. Start the unit and make sure that all the electrically interlocked equipment is in operation.

10. After the compressor has run for fifteen or twenty minutes, check the oil level and pressure. The oil level should be visable in the compressor oil level sight glass. The oil pressure should be 20-35 psig above suction pressure.

11. Observe the flow of refrigerant through the sight glass. If bubbles appear, retest the system for leaks.

Make repairs and add refrigerant (Refer to "Adding Refrigerant", Page 10).

12. Observe the discharge pressure. If the pressure is above or below normal see Sections G and H of "Trouble Analysis Chart".

TROUBLE ANALYSIS

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
A. Compressor Fails to Start	1. Electric circuit test shows no voltage on line side of motor starter.	1a. Power failure b. Disconnect switch open.	1a. Check for blown line fuse or broken lead. b. Determine why switch was opened. If everything is in working order, close switch.	
	2. Electric circuit test shows current on line side but not on motor side of fuse.	2. Fuse blown	2. Replace fuse. Check load on motor.	
	3. Electric circuit test shows current on line side but not on transformer side of fuse.	3. Fuse blown	3. Replace fuse. Check load on transformer.	
	4. Electric circuit test shows current on transformer side of fuse but not on control circuit.	4. Fuse blown	4. Replace fuse. Check continuity across each control.	1
	5. Electric circuit tester glows but not a full brilliance.	5. Low Voltage	5. Check with Volt meter. If low call power company.	
	6. Full voltage at meter terminals but motor will not run.	6. Burned out motor.	6. Repair or replace.	
	7. Test for burned-out holding coil or broken contacts.	7. Inoperative motor starter.	7. Repair or replace	
	8. Motor starter holding	8. Open control Circuit a. High Pressure Control b. Low Pressure Control c. Oil Failure Control d. Motor Protector e. Open Circuit from "Interlocking Relays" f. Control Relay	8. Locate open control and determine cause. See individual control instructions.	
	9. Compressor will not operate.	9. Frozen compressor due to locked or damaged mechanism.	9. Overhaul Compressor	
	10. Open contacts, suction pressure below cut in settings.	10. Suction pressure below cut in setting of low pressure control.	10. Check for loss of refrigerant. Repair leak and recharge. SLV not opening.	
	11. Open contacts, discharge pressure above cut-in settings.	11. Discharge pressure above cut-in setting of high pressure control.	11. See Complaint "G"	
	12. System will restart by resetting oil pressure failure control switch.	12. Oil pressure failure control switch has cut out.	12. Check oil level, oil pressure, wiring and control for faulty control.	
	13. Starter will not pull in.	13. Overload contacts open.	13. Reset overload and determine cause.	

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
B. Compressor Short Cycles	1. Normal operation except too frequent stopping and starting.	1. Intermittent contact in electrical control circuit.	1. Repair or replace faulty electrical control.	
	2. Valve may hiss when closed. Also temperature change in refrigerant line through valve.	2. Leaky liquid line solenoid valve.	2. Repair or replace.	
	3. Excessively high discharge pressure.	3. Faulty condensing.	3. Check for water failure or condenser trouble.	
	4. High discharge pressure.	4. Overcharge of refrigerant on non-condensible gas.	4. Remove excess refrigerant or purge non-condensible gases.	
	5. Normal operating except too frequent stopping and starting on low pressure control switch.	5. Lack of refrigerant	5. Repair refrigerant leak and recharge.	2
	6. High discharge pressure	6. Condenser water piping restricted or supply water pressure too low.	6. Determine cause and correct.	
	7. Suction pressure too low and frosting at dryer.	7. Restricted liquid line dryer.	7. Replace dryer core.	3
	8. Motor starts and stops rapidly.	8. Faulty motor.	8. Repair or replace faulty motor.	
	9. Compressor cuts off and on from high pressure cut-out. a. Lack of or insufficient water. b. Water pump not operating c. Condenser failed.	9. Faulty operation of condenser.	9a. Fill with water check piping system cooling tower. b. Repair faulty pump. c. Clean	
	10. Compressor will not load.	10. Inoperative compressor unloading system.	10. Repair or replace faulty control.	
C. Compressor Runs Continuously	1. High Temperature in conditioned area.	1. Excessive Load.	1. Check for excessive outdoor air infiltration. Check for inadequate insulation of space.	
	2. Low temperature in conditioned area.	2. Temperature controller set too low.	2. Reset or repair.	
	3. Low temperature in conditioned space.	3. "Welded" contacts on electrical control in motor starter circuit.	3. Repair or replace.	
	4. Compressor noisy or operating at abnormally low discharge pressure or abnormally high suction pressure.	4. Leaky valves in compressor.	4. Overhaul compressor.	
	5. Air conditioned space too cold.	5. Solenoid valve stuck open. Temperature controller faulty.	5. Repair valve or temperature controller.	4
D. Compressor Loses Oil	1. Oil level too low.	1. Insufficient oil charge.	1. Add sufficient amount of proper compressor oil.	
	2. Oil level drops gradually.	2. Clogged dryer.	2. Replace dryer.	
	3. Excessively cold suction.	3. Loose expansion valve remote bulb.	3. Provide good contact between remote bulb and suction line.	
	4. Excessively cold suction. Noisy compressor operation.	4. Liquid flooding back to compressor.	4. Readjust super heat setting or check remote bulb contact	

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
	5. Compressor starting and stopping too frequently.	5. Short cycling	5. See items under Complaint "B".	
	6. Oil around compressor base and low crankcase oil level.	6. Crankcase fittings leak oil.	6. Repair oil leak and add proper compressor oil.	
E. Compressor is Noisy	1. Compressor cuts out on oil failure control.	1. Lack of oil.	1. Add compressor oil.	
	2. Compressor knocks.	2. Broken internal compressor parts.	2. Overhaul compressor.	
	3. Abnormally cold suction line. Compressor knocks.	3a. Liquid "Floodback" b. Expansion valve stuck in open position.	3a. Check and adjust superheat. Valve may be too large or loose remote bulb on suction line. b. Repair or replace.	5 5
F. System Short of Capacity	1. Expansion valve hisses.	1. Flash gas in liquid line.	1. Add refrigerant.	
	2. Temperature change in refrigerant line through dryer or solenoid stop valve.	2. Clogged dryer or solenoid stop valve.	2. Clean or replace.	2
	3. Short cycling or continuous running.	3. Expansion valve stuck or obstructed.	3. Clean or replace expansion valve.	5
	4. Superheat too high.	4. Excessive pressure drop in evaporator.	4. Check superheat and reset thermostatic expansion valve.	5
	5. Short cycling or continuous running.	5. Improper superheat adjustment.	5. Adjust expansion valve. Check superheat and reset thermostatic expansion valve.	5
G. Discharge Pressure Too High	1. Excessively warm water leaving condenser.	1. Too little or too warm condenser water, restricted water flow.	1. Clean water strainers, check cooling tower operation.	
	2. Excessively cool water leaving condenser, small temperature rise through condenser.	2. Fouled tubes in shell-and-tube condenser.	2. Clean tubes.	
	3. High temperature water entering condenser.	3. Improper operation of cooling tower.	3. Check tower fan motor, starter and thermostat.	
	4. Exceptionally hot condenser and excessive discharge pressure.	4a. Air or non-condensible gas in system. b. Refrigerant overcharge.	4a. Purge b. Remove excess refrigerant gradually - normal subcooling is 10 degrees.	6 7
H. Discharge Pressure Too Low	1. Bubbles in sight glass.	1. Lack of refrigerant.	1. Repair leak and charge.	
	2. Entering condenser water temperature too low.	2. Cooling tower fan thermostat out of adjustment.	2. Readjust fan thermostat.	
	3. Suction pressure rises faster than 5 psig per minute after shutdown.	3. Broken or leaky compressor discharge valve.	3. Remove head examine valves and replace those found to be operating improperly.	
J. Suction Pressure Too	1. Abnormally cold suction line.	1a. Overfeeding of expansion valve. b. Expansion valve stuck in open position.	1a. Adjust superheat setting of expansion valve and check remote bulb for proper attachment to suction line. b. Repair or replace expansion valve.	5 5
	2. Noisy compressor.	2. Broken suction valve in compressor.	2. Remove head, examine valves and replace those found to be inoperative.	8

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
K. Suction Pressure Too Low	1. Bubbles in sight glass.	1. Lack of refrigerant.	1. Repair leak and charge.	2
	2. Temperature change in refrigerant line through dryer or solenoid liquid valve.	2. Clogged liquid line dryer.	2. Replace dryer.	3
	3. No flow of refrigerant through valve.	3. Expansion valve power assembly has lost charge.	3. Replace expansion valve assembly.	5
	4. Loss of capacity.	4. Obstructed expansion valve.	4. Clean valve or replace if necessary.	
	5. Conditioned space too cold.	5. Contacts on temperature controller stuck in closed position.	5. Repair or replace if necessary.	
	6. Superheat too high.	6. Excessive refrigerant pressure drop through chiller.	6. Readjust superheat.	

Trouble Analysis Chart Notes:

1. Control Circuit

To narrow the cause of compressor malfunction, check the continuity across the terminals of each control to locate the control with open contacts. Conditions which cause controls to open are:

a. Overload -- compressor drawing excessive amperage (Refer to "Voltage" Page 9 and Compressor Motor, Page 8).

b. High Pressure Control -- high condensing temperature.

c. Oil Pressure Control -- compressor is not developing design operating oil pressure. Usually caused by low oil level or faulty oil pump. Add oil if necessary (Refer to Adding Oil, Page 10). If oil is at the proper level refer to Checking Oil Pump Pressure, Page 11.

d. Motor Protector Relay -- compressor motor is not adequately cooled, or is operating under a high voltage condition (Refer to Voltage, Page 9).

2. Shortage or Refrigerant

The appearance of bubbles in the sight glass, warm suction line and low suction pressure indicate a shortage of refrigerant.

3. Clogged Dryer

The outlet piping of a clogged dryer will feel cooler than the piping at the inlet side. If the dryer is badly clogged, sweat or frost will appear at the dryer outlet.

4. Solenoid Valve Leaks

If the solenoid valve leaks while in the closed position, the liquid line leaving the valve will feel cooler than the inlet side. If the valve leakage is excessive, the compressor may be unable to cut out on low pressure or pump down.

5. Expansion Valve

Overfeeding

Overfeeding of the evaporator coil results in a low superheat condition.

This may be cuased by either an improper superheat adjustment or the remote bulb of the expansion valve not making good contact with the suction line.

Tighten the mounting bulb straps, to make certain the full length of the bulb contacts the suction line firmly. Check and, if necessary, readjust the superheat setting (Refer to Superheat Adjustment, Page 10).

If neither of these procedures corrects the condition, the valve cage is probably defective and should be replaced.

Underfeeding

Underfeeding the evaporator coil results in an abnormally low suction pressure and high superheat condition.

This may be cuased by an improper superheat adjustment, a restriction, or

an inoperative expansion valve power element.

The operation of the power element may be tested in the following manner:

1. Stop the compressor and allow the suction line to warm up to room temperature.

2. Remove the remote bulb from the suction line and place it in a container of ice water.

3. Start the compressor.

4. Remove the bulb from the container and warm it in the hand. At the same time feel the suction line. If a temperature drop is evident, the power element is operating. If there is little change in the suction line temperature, the power element is faulty and must be replaced (Refer to Repairs, Page 11).

   CAUTION: Do not allow liquid to enter the suction line for any longer than is necessary to check valve operation. Excessive floodback will damage the compressor.

   If the power element appears to be operating, readjust the superheat setting (Refer to Superheat Adjustment Page 10).

   If this fails to correct the condition, remove the cage from the valve and inspect it. Replace the cage if necessary.

6. Air in System

   Air and other noncondensable gases tend to collect in the condenser. Head pressure will rise above the pressure corresponding to the temperature at which the vapor is condensing. In extreme cases, the pressure may build up to the point where either the High Pressure Control or the thermal overloads in the starter may stop the compressor.

7. Refrigerant Overcharge

   High head pressure indicates a refrigerant overcharge. In extreme cases the thermal overloads in the motor or the High Pressure Control may stop the compressor.

8. Broken Valves

   If the operating symptoms indicate damaged or broken compressor valves, install a pressure gauge in the back seat port of the compressor suction valve and crack the valve clear of the back seat.

   1. Close the liquid line service valve.

   2. Pump the system down (Refer to System Pumpdown, Page 15).

   3. A rise in pressure as shown on the gauge indicates leaky, damaged or broken compressor valves.

   Before opening the compressor, determine first if the rise in the suction pressure is not due to a leaky solenoid valve.

MAINTENANCE PROCEDURES

Compressor Motor

If the following tests reveal shorted, grounded or open windings indicating a motor burnout, consult Motor Burnout, Page 11.

Motor Winding

Open the disconnect switch and remove the power leads from the terminals of the compressor motor.

Test the continuity of the motor windings by placing the contacts of an ohmmeter against each combination of two terminals.

In addition to testing continuity, the measured resistance through each set of motor windings should be approximately the same.

Grounded Motor

Place one of the test leads of an insulation tester or megger against bare metal and the other on each of the motor terminals in turn.

The dial reading obtained should be in the 1 megohm to infinity range. the reading is substantially below this range, a grounded wire is indicated.

Voltage

Check the voltage of the line side of the disconnect switch when the compressor is operating. If the voltage is more than 10% above or below the voltage rating of the compressor report the condition to the local power company for correction.

Overloads

Place a clamp of the voltammeter on one of the compressor leads and start the compressor. Note the amperage at which the overloads cut out.

If the amperage is below 115% of the compressor full load amperage rating, the overload is defective and should be replaced.

Cleaning Water Cooled Condenser

If a water cooled condenser is employed, the condenser tubes may become fouled with scale and other foreign matter from the condensing water. If this occurs the condenser must be cleaned.

Mechanical Cleaning

The mechanical cleaning method is used for removing mud and other loose material from the condenser tubes.

1. Turn off condenser water supply.
2. Break piping connections at unions.
3. Remove condenser headers.
4. Run a round brush through the tubes to loosen the mud.
5. Flush the tubes with water.

Chemical Cleaning

Chemical cleaning is the most satisfactory means for the removal of scale deposits from the tubes.

In this treatment, the scale is dissolved and flushed away by circulating a chemical solution through the tubes and the headers.

The condenser water circuit is composed of copper, steel and cast iron. With this information, any water treatment specialist will be able to recommend a suitable chemical for this purpose. If water treatment service is not available, a chemical supply house may be consulted.

Figure 4 illustrates a typical chemical cleaning hook-up. All materials in the external circulating system, quantity of cleaning material, duration of cleaning period and any safety precautions necessary for the handling of the cleaning agent should be approved by the company furnishing the materials for the job.

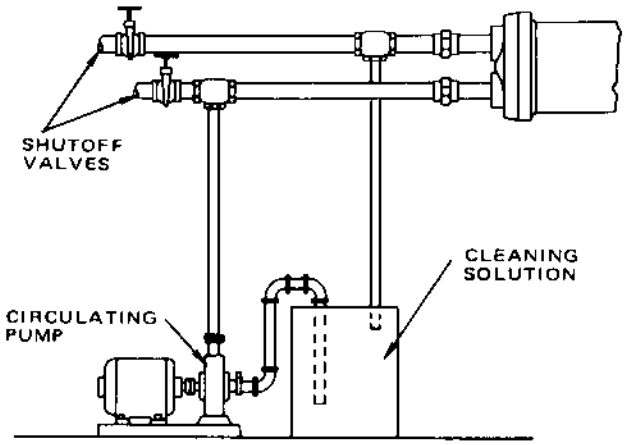


FIGURE 4 - Typical Cleaning Hookup

Air Cooled Condenser

Clean the fins of the air cooled condenser occasionally by flushing them with cool water.

Purging Non-Condensable Gases

To determine whether purging is necessary, shut down the system and allow the unit to stand until all of its parts reach the same temperature.

Place a gauge in the backseat port of the discharge service valve.

If, when the valve is cracked off the backseat, it shows a pressure 10 psig above the saturated refrigerant pressure at ambient temperature, the system should be purged.

Remove the gauge connection from the backseat port of the compressor discharge service valve. After about five minutes, crack the valve off the front seat for an instant to vent non-condensable gases through the back seat port. Repeat the opening of the service valve at three or four minute intervals.

Back seat the valve after purging.

Superheat Adjustment

Refrigerant vapor, passing through the final lengths of evaporator tubing, continues to absorb heat from the conditioned air causing the vapor to become superheated. That is, the vapor absorbs more heat than is necessary for vaporization.

A certain amount of superheat, 10F, is desirable for assurance that all of the refrigerant is vaporizing, eliminating the possibility of refrigerant carry-over. The superheat is checked as follows:

1. Attach the bulb of an accurate thermometer to the base section line near the remote bulb of the expansion valve. Insulate thermometer bulb to line.

2. Install a pressure gauge in the back seat port of the compressor suction service valve. Crack the valve clear of the back seat.

3. Start the system and allow the thermometer reading to stabilize (approximately 20 minutes).

   NOTE: Add approximately 2 to 3 psig to the suction pressure gauge reading to compensate for the pressure drop in the suction line. The degree difference between the thermometer reading and the pressure-to-temperature conversion of the suction pressure is the amount of superheat.

4. If the superheat is above or below 10F, remove the nut which covers the superheat adjustment, located on the body of the expansion valve, and make the necessary adjustment.

ADDING REFRIGERANT

Small amounts of gas may be added through the back seat port of the compressor suction valve. If large amounts of refrigerant are to be added, liquid charge the system. (Refer to Charging the System - High Side Charging).

1. Back seat the compressor suction valve and remove the suction gauge connection.

2. Connect the line from the refrigerant drum to the back seat port. Purge the line before tightening the connection.

3. Holding the refrigerant drum in a vertical position, start the compressor and open the drum vapor valve.

4. Crack the suction valve clear of the back seat allowing the refrigerant gas to be charged to the system. Be sure only the gaseous refrigerant enters the system at the compressor.

5. When the charge is adequate, no bubbles will appear at the sight glass.

6. Close the valve on the drum and back seat the compressor suction valve. Remove the charging line and replace the gauge connection.

7. Check the oil level in the compressor crankcase.

ADDING OIL

The oil level will vary, due to the load conditions of the system on which the compressor is being used, from 1/4" below the bottom to half way up the sight glass.

CAUTION: Do not operate the compressor unless some oil is visible in the oil sump. If in doubt, add some oil before proceeding.

Low oil level may be due to oil being trapped in the system. If this is suspected, operate the system continuously for 3 to 4 hours observing the level every 30 minutes. If the oil level dows not return to normal, add oil to the compressor.

To Add Oil

1. Pump down the system (Refer to System Pump Down Page 15).

2. Connect a suitable oil pump (loosely) to the compressor oil charging valve.

3. Purge the charging line of air by pumping oil until it appears at the loosened connection.

4. Tighten the connection.

5. Open the charging valve and pump oil until the proper level is obtained in the sight glass.

6. Close the oil charging valve and remove the charging equipment.

Recommended Compressor Oil:

1. Trane Code No. 45000075 (Suniso 3GS)

2. Suniso 3GE

3. Texas Capella B

4. Virginia 150

5. Mobil Gargoyle Artic 150

REMOVING OIL

An excessive oil charge is indicated when the oil level in the sight glass of a compressor operating at full load is over the half way mark.

Excess oil may be removed in the following manner:

1. Connect a flexible tube to the compressor oil charging valve.

2. Open the oil charging valve slowly.

3. With the compressor running drain sufficient oil so that the oil in the sight glass is at the half way mark.

NOTE: Unless special care is taken when draining oil, foaming may cuase it to overflow the container.

4. When sufficient oil has been removed, close the charging valve.

During the first 3 to 4 hours of operation, recheck the oil level at 30 minute intervals.

CHECKING OIL PUMP PRESSURE

To check oil pump pressure:

1. Pump down the system (Refer to System Pumpdown, Page 15).

2. Remove the oil pressure control tubing from the oil pump pressure discharge tap. See Figure 5, Page 13).

3. Connect a pressure gauge to the pressure tap.

4. Install a pressure gauge in the back seat port of the compressor suction service valve and crack the valve clear of the back seat.

5. Open the liquid line shutoff valve and the compressor discharge valve.

6. Start the system. The oil pressure gauge should register 23 to 32 psig usable oil pressure. Usable oil pressure is oil pump pressure minus suction pressure.

7. If oil pressure is less than the minimum psig, either the oil pump is faulty or the oil relief valve is stuck in the open position. Repair or replace as required. Refer to Repairs, Page 11).

8. Pump down the system, remove the gauges and reconnect the oil pressure control tubing.

MOTOR BURNOUT

The cause for a compressor motor burnout must be determined and eliminated before a replacement is installed. Failure may be due to mechanical difficulties which cause the compressor to "freeze" or electrical difficulties, such as low voltage, inoperative overloads, overloading the compressor, etc. All possible causes must be investigated to prevent future failure of the compressor.

When the motor of a hermetic compressor fails, high temperatures develop within the machine causing a breakdown of the oil and refrigerant. The resulting products -- acid, moisture and sludge are corrosive and must be thoroughly flushed from the system. Burnouts will reoccur if all the contaminents are not removed.

The Trane Company recommends the suction line filter-drier method of removing contaminents due to motor burnouts from the compressor. For specific instructions refer to Trane Service Bulletin S-15.

REPAIRS

IMPORTANT: Replace the filter-dryer whenever the system is open for repairs.

When soldering is done during system repairs, an inert gas, such as nitrogen, must continually be passed through the connection being soldered to prevent the formation of harmful oxides.

Low Side Repairs

If the evaporator, liquid line piping, expansion valve, solenoid valve suction line piping or compressor requires repair, pump down the system (Refer to System Pumpdown, Page 15) and allow the suction line and compressor to warm to the ambient temperature before opening the system. This will prevent moisture from condensing on the inside of the open system.

After completing the repairs, open the liquid line shut off valve for a moment, putting the repaired area under pressure, and check for leaks. Relieve the pressure when the check is completed.

NOTE: If the repair is located beyond the liquid line solenoid valve, manually open the valve to put the area under pressure.

Connect an absolute mercury manometer to the guage port of the liquid line shutoff valve and a vacuum pump to the back seat port of the compressor suction valve. Crack the suction service valve clear of the back seat.

NOTE: To protect the manometer, install a shut off valve in the connecting tubing between the manometer and the gauge port of the valve.

Start the pump and allow it to operate until the manometer indicates a vacuum equivalent to 2.5 to 3 mm mercury. Back seat the suction valve and stop the pump.

Remove the vacuum pump connection and connect a drain of oil-pumped dry nitrogen to the valve port.

Crack the suction valve and admit nitrogen, slowly at first to protect the manometer, until a zero gauge pressure is indicated.

Back seat the suction valve and remove the nitrogen equipment.

Reconnect the vacuum pump and allow it to operate until the vacuum gauge indicates a vacuum equal to 2.5 mm of mercury absolute.

Close the valve in the manometer connecting tubing, back seat the compressor suction valve and stop the pump.

Back seat the liquid line shutoff valve and compressor discharge valve. The system may now be returned to service.

High Side Repairs

If the condenser coil or liquid receiver require repair, the refrigerant charge must be removed from the system.

After the repairs have been completed, leak test, evacuate and charge the system in the method described under Leak Testing Page 16, Evacuation and Dehydration, Page 16 and Charging, Page 17.

COMPRESSOR REMOVAL

NOTE: If the compressor is being removed for repairs because of motor burnout, follow the instructions in Service Bulletin S-15 to save the refrigerant.

1. Remove the wiring and control line tubing from the compressor.

2. Remove the bolts that secure the suction and discharge service valves to the compressor housing.

3. Lift compressor from its mounting, and place onto suitable skid arrangement.

   NOTE: Support the compressor suction and discharge service valves to prevent an excessive amount of strain from being placed on the tubing.

COMPRESSOR REPLACEMENT

1. If a new compressor is being installed, transfer the crankcase heater and the control tube fittings from the old to the new compressor.

2. Place the new compressor in position.

3. Reinstall the suction and discharge service valves on the compressor housing using new gaskets.

Bolt Torques

Suction Valve - 20 Ton - 58 Foot Pounds

25-30 Ton - 115 Foot Pounds

Discharge Service Valve - 20 Ton - 12-14 Foot Pounds 20-30 Tons 58 Foot Pounds

4. Connect the control tubing to the fittings (Refer to Figure 5).

5. Rewire the compressor.

6. Crack the compressor suction and discharge service valves for a moment to build up pressure within the compressor.

7. Using a leak detector, check the entire compressor housing for leaks.

8. Relieve the test pressure.

NOTE: If the refrigerant charge has been removed, leak test, evacuate and charge the system in the manner described under Leak Testing, Page 16, Evacuation and Dehydration, Page 16 and Charging, Page 17.

9. Connect the vacuum pump to the back seat port of the discharge valve the the suction valve through a "Y" connection. Use an absolute mercury manometer to determine final pressure level.

10. Start the pump and evacuate the compressor to 2.5 mm of mercury absolute.

11. Close the valve in the manometer connection line, stop the pump and back seat the compressor valves. The system may now be returned to service.

12. During the first hour of compressor operation observe the system operating pressure and compressor oil level.

Normal Operating Conditions:

Oil Level - Visible in compressor oil sump sight glass.

Discharge Pressure - See Table 1, Page 1

Suction Pressure - See Table 1, Page 1

PRESSURE CONTROLS

Before attempting to replace any of the pressure controls (OPC, HPC, LPC, UPC) deenergize the control circuit and pump down the system (Refer to System Pump Down, Page 15).

When removing the control tubing from the fitting on the compressor or control, cap the fitting quickly or plug the tubing to prevent the loss of pressure within the compressor. Figures 5A, 5B and 5C illustrate the control connections.

Consult the Unit Parts List for proper replacement of each control. If the manufacturer's warranty still applies, return the entire control to The Trane Company.

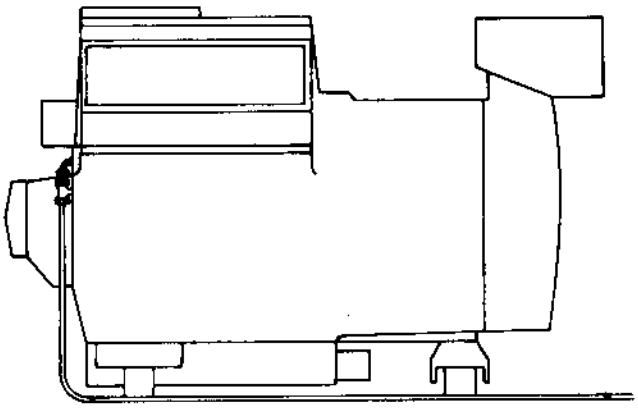


FIGURE 5A - Pressure Control Lines Compressor Unit

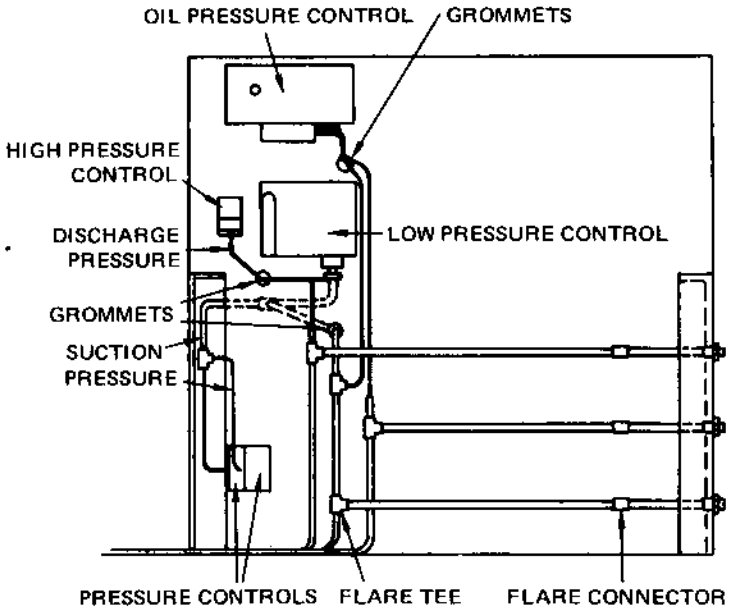


FIGURE 5B - Pressure Control Lines Front View Condenser Units

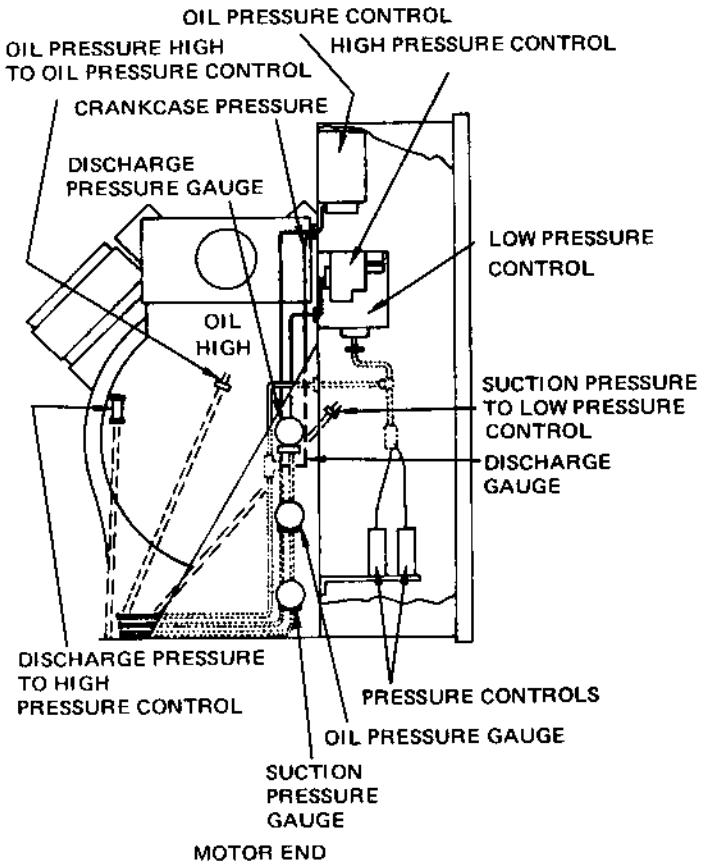


FIGURE 5C - Pressure Control Lines
End View Condenser Units

Complete pressure controls may be ordered from The Trane Company. If repair parts for the control are required, contact the manufacturer giving the complete part description and model number of the control.

After the new control has been installed check the operation in accordance with the appropriate instruction outlined under Control Testing below.

REFRIGERANT PRESSURE CONTROLS

The setting of the high and low pressure controls are shown in Table 2. These controls are factory set and are not adjustable.

TABLE 2 - Refrigerant Pressure Control Setting

CONTROL SETTING	REFRIGERANT - 22		REFRIGERANT - 12	
	WATER-COOLED CONDENSING	AIR-COOLED CONDENSING	WATER-COOLED CONDENSING	AIR-COOLED CONDENSING
HIGH PRESSURE CONTROL				
Cut Out Cut In	275PSIG 195PSIG	405PSIG 300PSIG	180PSIG 140PSIG	230PSIG 170PSIG
LOW PRESSURE CONTROL				
Cut Out Cut In	45 PSIG 70 PSIG	45 PSIG 70 PSIG	15 PSIG 35 PSIG	15 PSIG 35 PSIG

High Pressure Control (HPC)

1. Install a pressure gauge in the back seat port of the compressor discharge valve and crack the valve clear of the back seat.

2. With the system in operation throttle the flow of water to the condenser raising the compressor discharge pressure. (If, an air cooled condenser is used, stop the fan motor or block the coil).

3. Watching the discharge gauge, permit the pressure to rise until the setting of the high pressure control (HPC) is reached. Refer to Table 2. At this point the contacts of the switch should open, stopping the compressor.

   NOTE: If the compressor has not been stopped by the time the pressure reaches 10 psig above the cut-out setting, immediately open the control panel fused disconnect switch.

4. After a short period of time the discharge pressure will reduce to the cut-in point of the high pressure control. To make certain the control contacts have closed, place the on-off switch, (SW) in the off and then the on position. This will reset the contacts of the reset relay (RR) starting the compressor, provided the contacts of the High Pressure Control are closed.

Low Pressure Control (LPC)

1. Install a pressure gauge in the back seat port of the compressor suction valve and crack the valve clear of the back seat.

2. Switch the on-off switch of the unit to the off position causing the unit to pump down and observe the cut-out point of the low pressure control.

   CAUTION: If the compressor is not stopped by the time the pressure reaches "0" psig, open the disconnect switch immediately.

3. Turn on-off switch to on. When the pressure reaches the cut-in point of the control (approximately 20 psig) the control contacts should

close, restarting the compressor, causing the solenoid valve to open building pressure in the evaporator.

OIL PRESSURE CONTROL (OPC)

The oil pressure control contains a normally closed heat actuated time delay mechanism. When the control senses less than minimum operating oil pressure the time delay is actuated. If normal operating pressure is not restored within this period, contacts of the control open, stopping the compressor. This delay period provides time for the compressor oil pump to develop normal operating pressure at time of starting and regain pressure if temporarily interrupted during normal operation.

The control is factory set to begin time delay period at 9 psig (± 2 psig) and to stop time delay period, resuming normal operation at about 18 psig usable oil pressure. Nominal time at rated voltage is 70 seconds at 264 volts and 150 seconds at 180 volts.

NOTE: Usable oil pressure is the difference between suction pressure and oil pressure gauge readings.

If a prolonged period of low oil pressure causes contacts of control to open, they are again closed by operating the control reset button.

NOTE: Allow a 5 to 10 minute cooling period before resetting control contacts.

To check the time delay period of the oil pressure control:

1. Open the disconnect switch and remove the leads on the load side of the compressor contactor. Mark the leads for reassembly.

2. Energize the control circuit and close disconnect switch energizing the compressor and condenser fans if air cooled condenser is used. Within 120 to 180 seconds the timer contacts should open to de-energize the compressor contactor.

3. Open all disconnect switches and reconnect the compressor motor leads to the contactors.

4. Reset the oil pressure control after 5-10 minute cool-down period.

The time delay period of the oil pressure control is not field adjustable. If the control fails to perform in the manner described above, it must be replaced.

SAFETY PRECAUTIONS

To prevent damage to the equipment and possible personal injury, observe the following Safety Precautions while performing all operating and maintenance procedures:

1. Ventilate the equipment room when soldering or brazing, leak testing and charging.

2. When testing for leaks, do not allow the test pressures to exceed 150 psig on the low side of the systems. The high side of the system may withstand high test pressures to 300 psig but 150 psig is recommended for the whole system.

   Always install a pressure regulating valve in any leak testing hook up, to limit the pressure admitted to the system.

3. Before operating the system, open the compressor suction and discharge service valves and the liquid line shutoff valve.

4. Close the control panel door before energizing the control system.

5. Open the disconnect switches and remove the fuse blocks before performing any service or maintenance work on the unit except those requiring compressor operation. This will prevent accidental unit starting while work is in progress.

SYSTEM PUMPDOWN

To relieve the pressure, add refrigerant from the low side of the system during extended periods of shutdown or to facilitate repairs to the system, a major portion of the refrigerant charge is pumped into and held in the condenser.

1. Open disconnect to air-cooled condenser if part of the system.

2. Install a gauge in the back seat port of the compressor suction valve.

3. Close, or front seat, the liquid line shutoff valve.

4. With the temperature control system energized, close the condensing unit disconnect switch, starting the system.

5. The system will stop when the suction pressure reaches the cutout setting of the low pressure control (5 psig for DX evaporator; 45 psig for water-cooled evaporator)

   NOTE: If the suction pressure rises, repeat the pumpdown procedure until the pressure holds at 4 to 5 psig for DX evaporator ; 40 to 45 psig for water-cooled evaporator.

6. Take necessary precautions to prevent accidental starting while the system is in the pumped down condition with the liquid line shutoff valve closed.

LEAK TESTING

Leak test a repaired area using refrigerant as a tracer and oil-pumped nitrogen to develop the test pressure. Normally a 100 psig test pressure is adequate for both the high and low sides of the system.

WARNING: Under no circumstances should oxygen or acetylene be used in place of dry nitrogen for leak testing. The use of oxygen or acetylene may cause a violent explosion. Always install a pressure regulator in the test pressure hookup to prevent exposing the system to an excessive pressure.

1. Through the back seat port of the compressor suction and discharge service valves, gas charge enough refrigerant to raise the system pressure to 12 to 15 psig.

2. Remove the refrigerant connections and bring the pressure up to 100 psig with the nitrogen.

3. Using a leak detector, test for leaks.

EVACUATION AND DEHYDRATION

The equipment required to do a thorough evacuation job is a high vacuum pump capable of producing a vacuum equivalent to 2.5 mm of mercury absolute, and absolute mercury manometer and a tank of oil-pumped nitrogen.

1. Connect the manometer to the liquid line shutoff valve.

2. Connect the vacuum pump to the back seat port of the compressor suction and discharge service valves.

3. Crack the valves off their back seats, opening the ports of the system.

4. Start the vacuum pump.

5. After the system pressure has been reduced to 2.5 to 3 mm of mercury absolute, close the liquid line shut off valve, back seat the compressor suction and discharge service valves and stop the pump.

6. Remove the vacuum line from the compressor service valves and connect the drum of nitrogen loosely to the valve ports. Purge the connection line before tightening the connections. Crack the valves off their back seats, opening the ports of the system.

7. Admit nitrogen gas, slowly at first, until a zero gauge or 760 mm absolute pressure is indicated. Back seat the compressor suction and discharge service valves and remove the nitrogen connections.

8. Allow nitrogen to remain in the system one hour before releasing to the atmosphere.

9. Reconnect the vacuum, start the pump, and open the liquid line shutoff valve, and the suction and discharge service valve. Allow the pump to operate until the manometer indicates a vacuum equivalent to 2.5 mm of mercury absolute.

   NOTE: To be assured of complete vaporization, all components must be above 60 F during the entire evacuation period.

10. After evacuation has been completed,

close all the valve ports tightly and remove the evacuation equipment. Reinstall the vapor port caps and plugs.

The double evacuation procedure, described above is designed to dehydrate the system thoroughly. Any trace of moisture remaining in the system is absorbed by the dry nitrogen and removed by second evacuation.

CHARGING

The approximate weight of refrigerant charge required for each compressor and condensing unit is shown in Table 4. The additional charge required for each 100 feet of liquid and suction line sizes is shown in Tables 4 and 5.

TABLE 3 - Refrigerant Charge Weights - Lbs.

COMPRESSOR UNITS			
REFRIGERANT 12		REFRIGERANT 22	
MODEL	CHARGE	MODEL	CHARGE
HCUA 100-M	17	HCUA 150-M	15
HCUA 130-M	17	HCUA 200-M	15
HCUA 170-M	22	HCUA 250-M	20
HCUA 190-M	28	HCUA 300-M	25
CONDENSER UNITS			
REFRIGERANT 12		REFRIGERANT 22	
MODEL	CHARGE	MODEL	CHARGE
RWUA 100-M	17	RWUA 150-M	15
RWUA 130-M	17	RWUA 200-M	15
RWUA 170-M	22	RWUA 250-M	20
RWUA 190-M	28	RWUA 300-M	25

TABLE 4 - Liquid and Suction Line Charge Weights Per 100 Foot Length Lbs. R-22

LIQUID LINE		SUCTION LINE	
O.D. IN.	CHARGE LBS.	O.D. IN.	CHARGE LBS.
3/4	17	1-1/8	.85
7/8	23	1-3/8	1.30
1-1/8	40	1-5/8	1.80
1-3/8	60	2-1/8	3.20
		2-5/8	4.90
		3-1/8	7.10

TABLE 5 - Liquid and Suction Line Charge Weights Per 100 Foot Length Lbs. R-12

LIQUID LINE		SUCTION LINE	
O.D. IN.	CHARGE LBS.	O.D. IN.	CHARGE LBS.
3/4	19	1-1/8	.7
7/8	27	1-3/8	1.1
1-1/8	45	1-5/8	1.5
1-3/8	68	2-1/8	2.7
		2-5/8	4.1
		3-1/8	5.9

1. Install gauges in the back seat ports of the suction and discharge service valves.

2. Crack the service valves clear of the back seat, exposing the gauges to system pressures.

3. Connect a drum of Refrigerant-22 to the port of the liquid line shutoff valve. Before the connection is tightened, purge the air from the charging line.

4. Crack the liquid line shutoff valve clear of the back seat approximately 2 to 3 turns. This will permit the refrigerant to flow into the liquid line.

5. After the pressure within the system has stabilized, fully back seat the liquid line shutoff valve and close the unit disconnect switch starting the compressor. Allow the compressor to continue to operate throughout the remainder of the charging operation.

6. Additional refrigerant may be added in a gaseous form through the compressor suction service valve.

7. After the estimated charge has entered the system, front seat the liquid line shut off valve.

8. Allow the system to continue operation for approximately 30 minutes. If during this period, flash gas appears in the liquid line sight glass. Add refrigerant as required.

9. Remove the charging equipment.

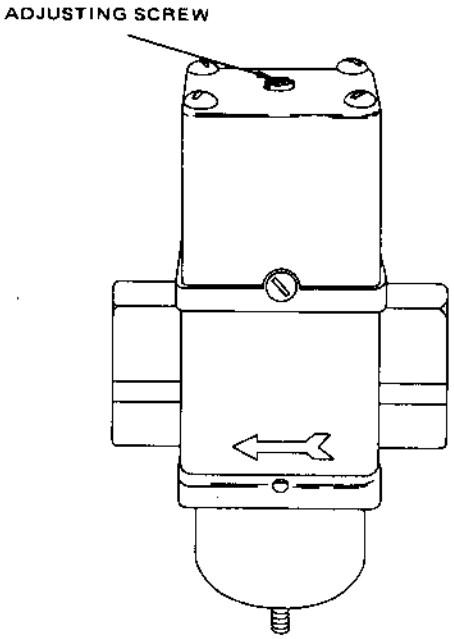


FIGURE 6 - Water Regulating Valve

WATER REGULATING VALVE (Refer to Figure 6)

A water regulating valve is employed when city water is used for condensing purposes. Correctly adjusted, the valve maintains design condensing temperature and pressure by automatically throttling the volume of water entering the condenser.

Valve Setting:

1. Start the unit.
2. Slowly raise or lower the valve flow setting until the condenser pressure gauge reading falls within the design limits.

UNIT DESIGNATION