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FILE:
TRANE REFRIGERATION PRODUCTS
RECIPROCATING COMPRESSOR
CONDENSER UNITS
Hermetic E-F
Operation – Maintenance

LITERATURE FILE NO.
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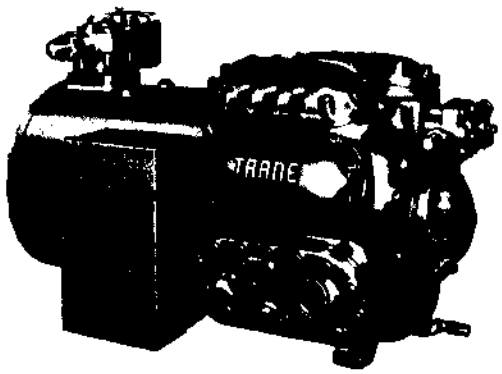

HERMETIC RECIPROCATING COMPRESSORS

MODEL E AND F

OPERATION

NORMAL OPERATING PRESSURES

When properly installed, the Trane hermetic compressors and condensing units will give long, trouble-free operation.

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-12 and Refrigerant-22 with water cooled and air cooled condensing are given in Table 1.

TABLE 1—Normal Refrigerant Pressures.

NORMAL PRESSURES	REFRIGERANT-22		REFRIGERANT-12	
	WATER COOLED CONDENSING	AIR COOLED CONDENSING	WATER COOLED CONDENSING	AIR COOLED CONDENSING
SUCTION PRESSURE	55-85	55-85*	30-50	30-50*
DISCHARGE PRESSURE	170-260	260-350**	100-160	160-210**

*For 35 to 50F suction temperature.
**For 100 to 140F condensing temperature.

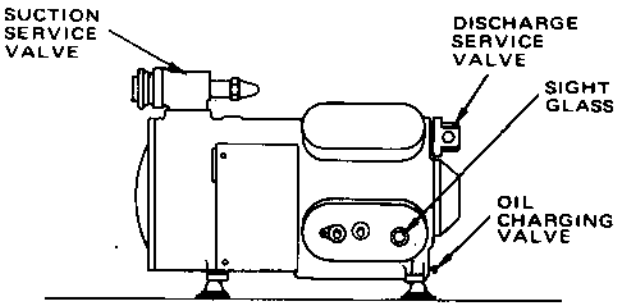

FIGURE 1—Typical Hermetic Compressor.

Oil should be visible in the compressor oil level sight glass with the compressor operating. See Figures 1 and 2.

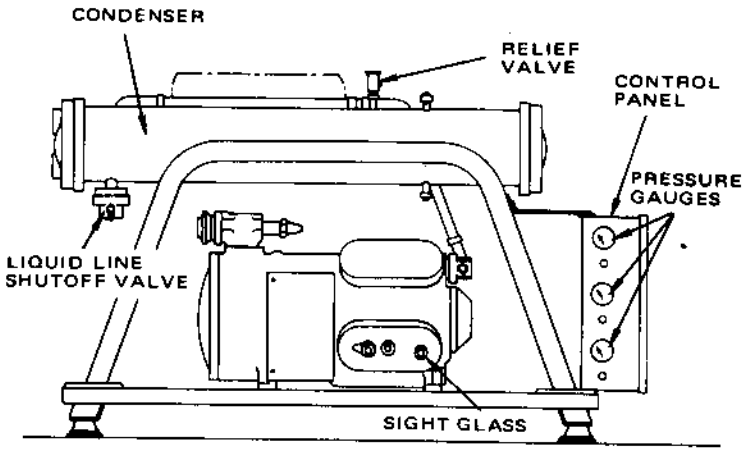

FIGURE 2—Typical Condensing Unit.

The oil pressure gauge should read 60 to 70 psig above the suction pressure gauge reading.

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 (see "Adding Oil To The Compressor" in the Compressor section).
2. Check the oil pressure.

3. The flow of refrigerant through the liquid line sight glass should be smooth and without any bubbles. The appearance of bubbles indicates a shortage of refrigerant, probably caused by a leak. Repair the leak and add refrigerant (see "Repairs and Parts Replacement" and "Adding Refrigerant").
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.
3. Start the compressor and observe the discharge pressure. If the pressure is above or below normal, see Sections G and H of the "Trouble Analysis Chart."
4. If an air cooled 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 expansion coil is used, clean it in accordance with the manufacturer's 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.
4. If a water condenser is used, completely drain the condensing water system. Inspect all valves, piping, etc. Clean the strainers. Clean the condenser 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 condenser or receiver (if used) during the off season.

1. Pump the system down (see "System Pumpdown").
2. Allow the system to stand idle for a few minutes. Pressure may build up on 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 system 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 halide torch for leaks.
   b. Close the water supply valve leading to the condenser.
   c. If the system will be subject to freezing temperatures during the shutdown period, thoroughly drain the condensing water tubes, water valve and piping. If the completeness of the draining is questionable, blow the water out with compressed air and add an adequate solution of permanent type antifreeze.
   d. If a cooling tower is used, drain the system and close the makeup water supply valve. Flush the sump and packing slats with a hose. If corrosion or rust is found, clean and paint.
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 halide torch.

   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. Inspect all air handling equipment.
2. 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.
3. If an air cooled 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.
4. Back-seat the compressor suction and discharge service valves and then crack them off the back-seat to open the suction and discharge pressure gage lines to system pressures (see Figures 1 and 2).
5. Open the shutoff valves in the refrigerant circuit.
6. Test the entire refrigerant system with a halide torch.
7. Start the unit and make sure that all of the electrically interlocked equipment is in operation.
8. After the compressor has run for fifteen or twenty minutes, check the oil level and pressure. (Oil level: visible in compressor oil level sight glass. Oil pressure: 60 to 70 psig above suction pressure.)
9. Observe the flow of refrigerant through the sight glass. If bubbles appear, retest the system for leaks. Make repairs and add refrigerant (see "Adding Refrigerant," page 11).
10. 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 current on line side of motor starter.	1. Power failure.	1. Check for blown line fuse or broken lead.	
	2. Electric circuit test shows no current on line side of motor starter.	2. Disconnect switch open.	2. Determine why switch was opened. If everything is satisfactory, close switch.	
	3. Electric circuit test shows current on line side but not on motor side of fuse.	3. Fuse blown.	3. Replace fuse. Check load on motor.	
	4. Electric circuit tester glows but not at full brilliance.	4. Low voltage.	4. Check with voltmeter. If low, call power company.	
	5. Full voltage at motor terminals but motor will not run.	5. Burned out motor.	5. Repair or replace.	
	6. Inoperative motor starter.	6. Burned out holding coil or broken contacts.	6. Repair or replace.	
	7. Compressor will not operate.	7. Frozen compressor due to locked or damaged mechanism.	7. Overhaul compressor. See "Repair and Parts Replacement—Compressor."	
	8. Discharge pressure above cut-in setting of High Pressure Cutout.	8. See Complaint G.	8. See Complaint G.	
	9. System can be restarted by resetting Oil Failure Protection Control switch, but will stop after 1 to 2 minutes of operation.	9. Oil Failure Protection Control switch has cut out.	9. Check oil level, oil pressure, wiring and control for faulty control.	
	10. Starter will not pull in.	10. Overload contacts open.	10. Reset overload contacts and determine cause of failure.	
B. Compressor "Short-Cycles."	1. Normal operation except too frequent stopping and starting.	1-a. Intermittent contact in electrical control circuit.	1-a. Repair or replace faulty electric or pneumatic-electric control.	
		1-b. Low Pressure Control differential set too close.	1-b. Reset differential in accordance with proper job conditions.	
	2. Normal operation except too frequent stopping and starting on Low Pressure Control switch.	2. Lack of refrigerant.	2. Repair refrigerant leak and recharge.	5
	3. Suction pressure too low and frosting at strainer.	3. Restricted liquid line strainer.	3. Replace strainer.	1

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
	4. Compressor will not load or unload. Cuts out on Freeze Protection Control.	4. Inoperative compressor unloading system.	4. Repair or replace faulty control. See "Repair and Parts Replacement—Compressor."	
C. Compressor Loses Oil.	1. Oil level too low.	1. Insufficient oil charge.	1. Add sufficient amount of proper compressor oil.	
	2. Oil level gradually drops.	2. Clogged strainers.	2. Replace strainers.	
	3. Oil around compressor base and low crankcase oil level.	3. Crankcase fittings leak oil.	3. Repair oil leak and add proper compressor oil.	
D. Compressor Runs Continuously.	1. High temperature in conditioned area.	1. Excessive load.	1. Check for excessive infiltration. Check for inadequate insulation of space.	
	2. Low temperature in conditioned area.	2. Thermostat controlling at too low a temperature.	2. Reset or repair thermostat.	
	3. Bubbles in sight glass.	3. Lack of refrigerant.	3. Repair leak and charge.	5
	4. Compressor noisy or operating at abnormally low discharge pressure or abnormally high suction pressure.	4. Leaky valves in compressor.	4. Overhaul compressor. See "Repair and Parts Replacement—Compressor."	
	5. Compressor fully or partially unloaded, but will not stop.	5. Solenoid stop valve leaks.	5. Repair valve.	4
E. Compressor Is Noisy.	1. Compressor cuts out on Oil Failure Protection Control.	1. Lack of oil.	1. Add oil.	
	2. Compressor knocks.	2. Internal parts of compressor broken.	2. Overhaul compressor. See "Repair and Parts Replacement—Compressor."	
	3. Abnormally cold suction line. Compressor knocks.	3. Liquid "flood back."	3. Check and adjust superheat. Check for loose remote bulb on suction line.	2, 3
	4. High head pressure. Water Valve chatters or hammers.	4. Dirty Water Regulating Valve, too high water pressure or intermittent water pressure.	4. Clean Water Regulating Valve. Install air chamber ahead of valve.	
	5. Abnormally cold suction line. Compressor knocks.	5. Expansion Valve stuck in open position.	5. Repair or replace Expansion Valve.	2
	6. Compressor jumps on base.	6. Compressor loose on base.	6. Tighten compressor hold-down bolts.	
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 strainer or solenoid stop valve.	2. Clogged strainer or solenoid stop valve.	2. Clean or replace strainer or valve.	1

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
	3. Short-cycling or continuous running.	3. Expansion Valve stuck or obstructed.	3. Repair or replace Expansion Valve.	2, 3
	4. Superheat too high.	4. Excess pressure drop in evaporator.	4. Check superheat and reset Thermostatic Expansion Valve.	3
	5. Short-cycling or continuous running.	5. Improper superheat adjustment.	5. Adjust Expansion Valve. Check superheat and reset Thermostatic Expansion Valve.	3
G. Discharge Pressure Too High.	1. Excessively warm water leaving condenser.	1. Too little or too warm condenser water.	1. Provide adequate cool water, adjust water regulating valve. Lower setting of cooling tower thermostat.	
	2. Excessively cool water leaving condenser.	2. Fouled tubes in shell-and-tube condenser.	2. Clean tubes.	
	3. Exceptionally hot condenser.	3. Air or noncondensible gas in system.	3. Purge.	7
	4. Exceptionally hot condenser.	4. Overcharge of refrigerant.	4. Remove excess or purge.	6
	5. Cooling tower (if used) appears to be operating satisfactorily yet excessive discharge pressure exists.	5. Cooling tower too small.	5. Recheck cooling tower rating table for correct size selection.	
H. Discharge Pressure Too Low.	1. Excessively cold water leaving condenser.	1. Too much condenser water.	1. Adjust Water Regulating Valve or cooling tower thermostat setting.	
	2. Cooling tower (if used) appears to be operating satisfactorily yet excessively low discharge pressure exists.	2. Cooling tower too large.	2. Recheck cooling tower rating table for correct size selection.	
J. Suction Pressure Too High.	1. Compressor runs continuously.	1. Excessive load on evaporator.	1. Check for excessive infiltration of outside air into conditioned space.	
	2. Abnormally cold suction line. Liquid flooding back to compressor.	2. Overfeeding of Expansion Valve.	2. Regulate superheat setting of Expansion Valve and check to see that remote bulb is properly attached to suction line.	3
	3. Abnormally cold suction line. Liquid flooding back to compressor.	3. Expansion Valve stuck in open position.	3. Repair or replace valve.	2
	4. Noisy compressor.	4. Broken suction valves in compressor.	4. Remove head, examine valves and replace those found to be inoperative.	8
K. Suction Pressure Too Low.	1. Bubbles in sight glass.	1. Lack of refrigerant.	1. Repair leak and charge.	5

COMPLAINT	SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION	REF. NOTE
	2. Temperature change in refrigerant line through strainer or solenoid stop valve.	2. Clogged liquid line strainer.	2. Clean strainer.	1
	3. No flow of refrigerant through valve.	3. Expansion Valve power assembly has lost charge.	3. Replace Expansion Valve power assembly.	2
	4. Loss of capacity.	4. Obstructed Expansion Valve.	4. Clean valve or replace if necessary.	
	5. Conditioned space too cold.	5. Contacts on control thermostat stuck in closed position.	5. Repair thermostat or replace if necessary.	
	6. Compressor short-cycles.	6. Compressor capacity control range set too low.	6. Reset compressor capacity control range.	
	7. Too high superheat.	7. Too much pressure drop through evaporator.	7. Check for plugged external equalizer.	

TROUBLE ANALYSIS CHART NOTES

1. CLOGGED STRAINER

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

2. THERMOSTATIC EXPANSION VALVE HAS LOST ITS CHARGE

If the Expansion Valve power unit loses its charge, the valve will either maintain an almost closed position or may close completely.

To test for inoperative power unit:

a) Stop compressor.

b) Remove temperature sensitive bulb from suction line.

c) Place bulb in ice water.

d) Start compressor.

e) Remove bulb from water and warm in hand. Immediately check suction line for rapid temperature drop, indicating a flood through of liquid refrigerant. If liquid floods through, power unit is operating correctly.

WARNING: Do not flood back through suction line any longer than is absolutely necessary. This can cause severe damage to the compressor.

3. THERMOSTATIC EXPANSION VALVE IMPROPERLY ADJUSTED

Low superheat adjustment will cause too much liquid to be passed to the chiller. The suction line will be abnormally cold and liquid may slug back to the compressor.

High superheat adjustment will cause too little refrigerant to be passed to the chiller. The suction line will be abnormally warm and the unit will lose capacity.

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 great, the compressor may be unable to cut out on low suction pressure.

5. SHORTAGE OF REFRIGERANT

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

6. OVERCHARGE OF REFRIGERANT

High head pressure indicates an overcharge of refrigerant. In extreme cases the thermal overloads in the motor starter or High Pressure Cutout may stop the compressor.

7. AIR IN SYSTEM

Air and other noncondensible 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 rise to a point where either the High Pressure Cutout or thermal overloads in the starter may stop the compressor. (See "Purging Noncondensible Gases.")

8. BROKEN VALVES IN COMPRESSOR

A rapid rise in suction pressure immediately after stopping the compressor indicates broken or leaky discharge valves. If the suction pressure rises faster than 2 pounds per minute, the discharge valves are not holding.

Before opening the compressor, determine if the rise in suction pressure is not due to a leaky Solenoid Valve.

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 300 psig on the high side or 150 psig on the low side of the system.

   Always install a pressure regulating valve in any leak testing hookup, to limit the pressure admitted to the system.
3. Before operating the system, open the compressor suction and discharge service valves and 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. This will prevent the accidental starting of the unit while the work is in progress.

CONTROL SETTING AND ADJUSTMENT

The controls were set at the time of installation to properly control the unit under the design conditions. Do not attempt to adjust the controls unless the unit operation is not satisfactory.

If any control fails to function properly after the control setting procedure has been followed, repair or replace the control (see "Repairs and Parts Replacement").

CAPACITY CONTROL (See Figure 3)

Compressor capacity must be adjusted to meet the changes in cooling load imposed on the evaporator. The point at which the compressor is to operate fully loaded or unloaded will vary with different systems. Most systems are designed so that the compressor will start unloading as the suction pressure falls below design full load conditions.

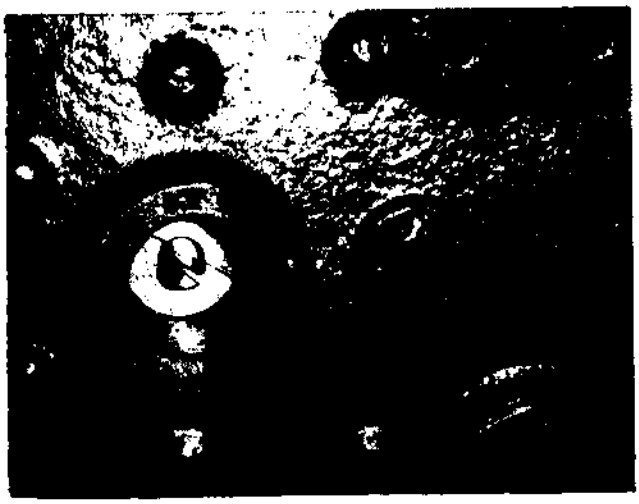

FIGURE 3—Capacity Control Adjustment Screw.

CONTROL SETTING:

1. With the system in operation, connect a clamp-on voltammeter to one of the compressor power leads.
2. Allow the system to operate until design full load suction pressure has been established.
3. Slowly turn the capacity adjusting screw clockwise until the compressor drops to the first stage of unloading. This will be indicated by a definite drop in the amperage reading.
4. Turn the capacity adjusting screw counterclockwise to the point where the compressor is just loaded. This will be indicated by an amperage reading of approximately full load amperage.

The compressor is now set to run fully loaded at design full load suction pressure and to control over a 9 to 10 pound suction pressure range.

REFRIGERANT PRESSURE CONTROL (See Figure 4)

The Refrigerant Pressure Control (RPC) stops the compressor when the suction pressure falls below design limits. It also stops the compressor when the discharge pressure becomes excessive, preventing damage to the motor or compressor.

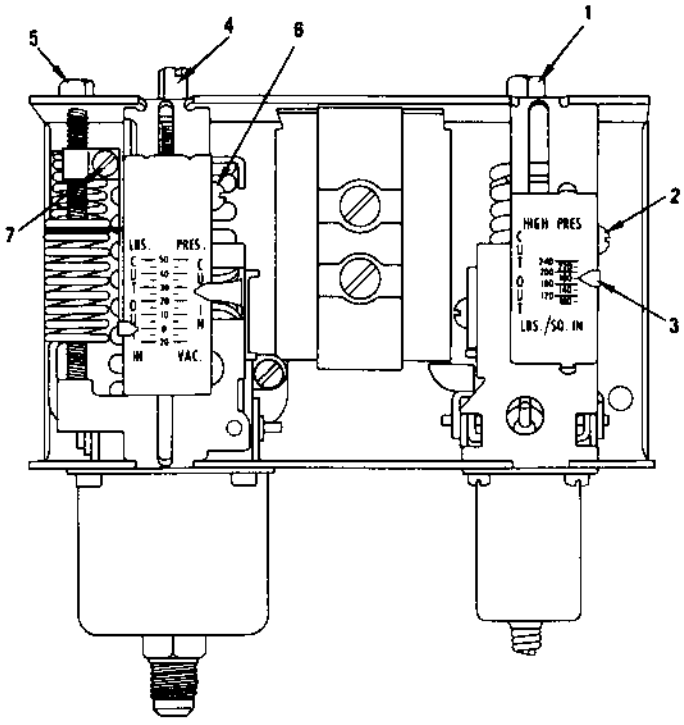

FIGURE 4—Refrigerant Pressure Control.

HIGH PRESSURE CUTOUT

Control Checkout:

1. 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.)

2. Watching the discharge pressure gauge, permit the pressure to rise until the setting of the High Pressure Cutout switch (HPC) is reached. (See 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.

Differential Checkout:

1. Open the condenser water supply valve, lowering the discharge pressure. (If an air cooled condenser is used, start the fan or remove the restriction from the coil.)

2. As the pressure falls, depress, and hold, the manual reset button located on the face of the control. The compressor should not start until the fall in pressure equals the differential of the switch (35 psig for R-12 and 50 psig for R-22).

   NOTE: The differential is fixed and is not field adjustable.

Control Setting:

If the switch failed to stop the compressor, or stopped the compressor below the cut-out setting, open the condenser water supply valve, lowering the pressure. (If an air cooled condenser is used, start the fan or remove the restriction from the coil.)

1. Lower or raise the setting of the switch, as required, by turning the High Pressure Cutout adjustment screw (1—Figure 4), and continue with the test.

2. When the switch is cutting out at the correct gauge pressure, recalibrate the scale by loosening the calibration screw (2—Figure 4) and sliding the indicator (3—Figure 4) until it indicates the gauge pressure at which the switch is cutting out.

3. Tighten the calibration screw.

LOW PRESSURE CUTOUT

Control Checkout:

1. With the system in operation, slowly close the liquid line shutoff valve, lowering the compressor suction pressure.

2. Watching the suction pressure gauge, permit the pressure to drop until the cut-out setting of the Low Pressure Cutout switch (LPC) is reached. At this point the contacts of the switch should open, stopping the compressor (see Table 2).

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

   Under no circumstances allow the suction pressure to be pumped into a vacuum.

3. Slowly open the liquid line shutoff valve, raising the suction pressure. When the pressure rises to the cut-in setting of the switch, the contacts should close, restarting the compressor (see Table 2).

TABLE 2—Refrigerant Pressure Control Settings.

CONTROL SETTINGS	REFRIGERANT-22		REFRIGERANT-12	
	WATER COOLED CONDENSING	AIR COOLED CONDENSING	WATER COOLED CONDENSING	AIR COOLED CONDENSING
HIGH PRESSURE CUTOUT				
CUT OUT	265 PSIG	365 PSIG	175 PSIG	220 PSIG
CUT IN	215 PSIG	315 PSIG	140 PSIG	185 PSIG
LOW PRESSURE CUTOUT				
CUT OUT	45 PSIG	45 PSIG	15 PSIG	15 PSIG
CUT IN	70 PSIG	70 PSIG	35 PSIG	35 PSIG

Control Setting:

1. If the switch fails to function in the manner described above, raise or lower the cut-in and cut-out pressure settings, as required, by turning the adjusting screws (4 and 5—Figure 4) and continue with the test.

2. When the switch is operating correctly, loosen the calibration screw (6—Figure 4) and slide the scale until the gauge pressure at which the compressor cuts in is indicated on the right side of scale. Loosen calibration screw (7—Figure 4) and slide the indicator to the gauge pressure at which the compressor stops.

3. Tighten the calibration screws.

OIL FAILURE PROTECTION CONTROL

(See Figure 5)

The Oil Failure Protection Control (OPC) contains a normally closed, heat actuated, time delay mechanism. When the control senses less than a minimum operating oil pressure, the time delay mechanism goes into a 85-165 second delay period. If normal operating pressure is not restored within this period, the control stops the compressor, preventing damage to the unit. This delay period provides time for the compressor oil pump to develop normal operation pressure at the time of starting and regain pressure, if temporarily interrupted, during the normal operation of the unit.

The Oil Failure Protection Control time delay period is factory set and is not field adjustable. If the control does not perform satisfactorily, replace the entire control or the defective parts (see "Repairs and Parts Replacement").

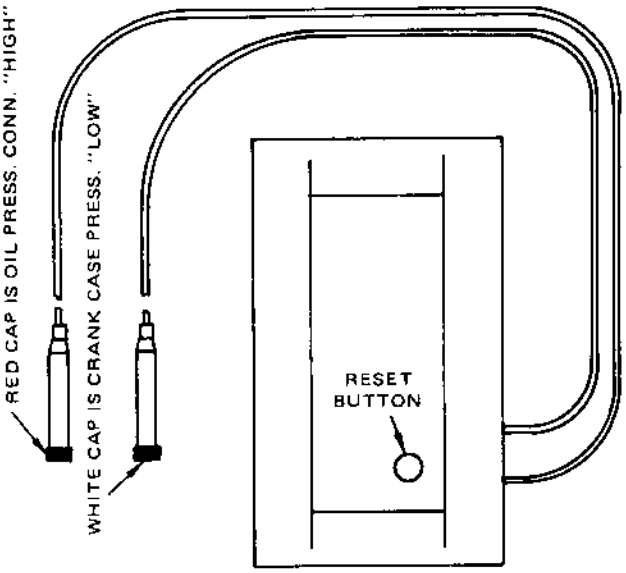

FIGURE 5—Oil Failure Protection Control.

CONTROL CHECKOUT (SINGLE COMPRESSOR):

CONTROL CHECKOUT (Single Compressor):

Control Checkout (Single Compressor):

1. To prevent the compressor from starting, open the compressor fused disconnect switch and disconnect the motor leads from the starter.
2. Close the fused disconnect switches to energize the control panel.
3. Lower the thermostat setting to energize the compressor starter. Within 85-165 seconds the timer switch in the control should open and de-energize the compressor motor starter.
4. Open the fused disconnect switches and reconnect the compressor motor leads to the starter.
5. After the control heater has cooled — about 5 minutes — push the reset button on the front of the control to reset the control contacts. Control Checkout.

VALVES

THERMOSTATIC EXPANSION VALVE

A Thermostatic Expansion Valve meters the amount of liquid refrigerant that enters the evaporator. If too little refrigerant enters, it is soon evaporated and too much of the evaporating surface becomes ineffective. If too much liquid enters, some will carry over into the suction line, possibly causing severe damage to the compressor. A proper superheat setting prevents liquid carry-over.

Superheat Checkout:

1. Remove a small patch of insulation from the suction line near the remote bulb of the Thermostatic Expansion Valve.
2. Firmly attach the bulb of an accurate thermometer to the bare line and cover the bulb with insulating material.
3. Start the unit and allow the thermometer reading to stabilize.
4. Using the saturation table for the type of refrigerant being used, R-12 or R-22, convert the suction pressure gauge reading to degrees F.
5. The degree difference between the thermometer reading and the pressure-to-temperature conversion of the suction pressure is the amount of superheat. The amount of superheat should be approximately 10 degrees.

Superheat Setting:

1. Remove the nut covering the superheat adjustment screw, located on the side of the expansion valve body.
2. Turn the adjusting screw in small increments until a stable 10 degree superheat is indicated. Wait until conditions stabilize before turning each increment (see "Superheat Checkout").

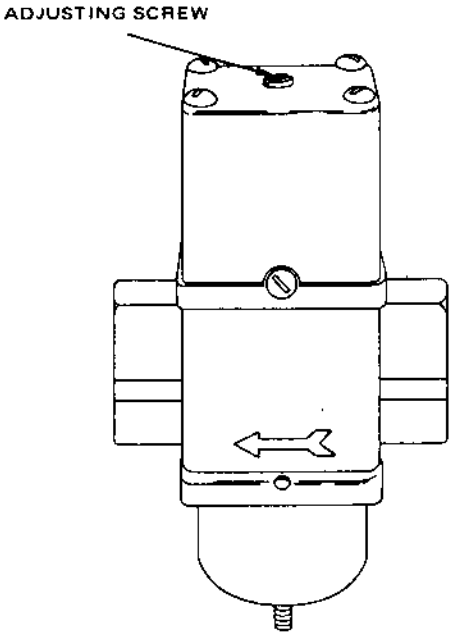

FIGURE 6—Water Regulating Valve.

WATER REGULATING VALVE (See 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.

SERVICING THE UNIT

COMPRESSOR

ADDING OIL TO THE COMPRESSOR

1. Pump the system down (see "System Pumpdown").
2. Loosely connect a suitable oil pump to the oil charging valve.

   NOTE: A dehydrator should be installed in the oil charging line.

3. Purge the charging line by allowing oil to appear at the valve connection before tightening the connection.
4. Open the oil charging valve and pump oil into the crankcase. Oil level is correct when oil is visible on the compressor oil level sight glass.
5. Close the oil charging valve and remove the oil charging equipment.

TABLE 3—Recommended Compressor Oils

1. TRANE CODE NO. 1-45008900
2. STANDARD OIL OF INDIANA-LM INDUSTRIAL OIL NO. 32-P
3. CITIES SERVICE OIL COMPANY - TRANE 1001
4. ANSUL 300

REMOVING OIL FROM THE CRANKCASE

1. Pump the system down (see "System Pumpdown").
2. Connect a flexible tube to the oil charging valve.
3. Open the oil charging valve slowly, allowing the oil to flow into a suitable container.

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

4. When sufficient oil has been drained, close the oil charging valve.
5. Start the compressor. After the compressor has run for 3 or 4 hours, recheck the oil level.

CONDENSER

WATER COOLED

If a water cooled condenser is employed, the condenser tubes may become fouled with mud, 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 supply water.
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 headers.

The condenser water circuit is composed of copper, steel and cast iron. With this information, any water treatment firm 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 7 illustrates a typical chemical cleaning hookup. All materials used 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.

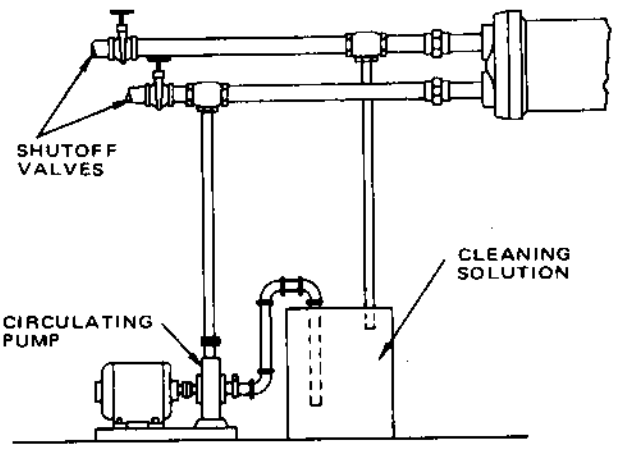

FIGURE 7—Typical Cleaning Hookup.

AIR COOLED

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

Refer to the manufacturer's instructions for additional service suggestions.

PURGING NONCONDENSIBLE 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.

Read the discharge pressure gauge.

If the pressure is 10 psig above the saturated refrigerant pressure at the ambient temperature, the system should be purged.

Procedure:

1. Pump the system down (see "System Pumpdown").
2. Allow the condenser water (or condenser fan, if used) to run.
3. After about five minutes, crack the purge valve for an instant and then close. This will vent the noncondensible gases to the atmosphere.
4. Repeat the opening of the purge valve at three or four minute intervals.

   NOTE: If the unit has no purge valve, remove the gauge connection from the back-seat port of the compressor discharge service valve. After about five minutes crack the valve off the front-seat for an instant to vent noncondensible gases through the back-seat port. Repeat the opening of the service valve at three or four minute intervals. Replace the gauge connection and back-seat the valve after purging.

5. Open the liquid line shutoff valve and return the system to regular operation.

ADDING REFRIGERANT (Low Side Charging)

This procedure is followed only when small amounts of refrigerant are to be added. If large amounts are to be added, liquid charge the system. (See "Charging the System—High Side Charging.")

1. Back-seat the compressor suction valve and remove the suction pressure gauge connection.
2. Connect the line from the refrigerant drum to the back-seat port. Purge the line before tightening the connection. Refrigerant should be charged to the system through a suitable dehydrator (see Figure 8).

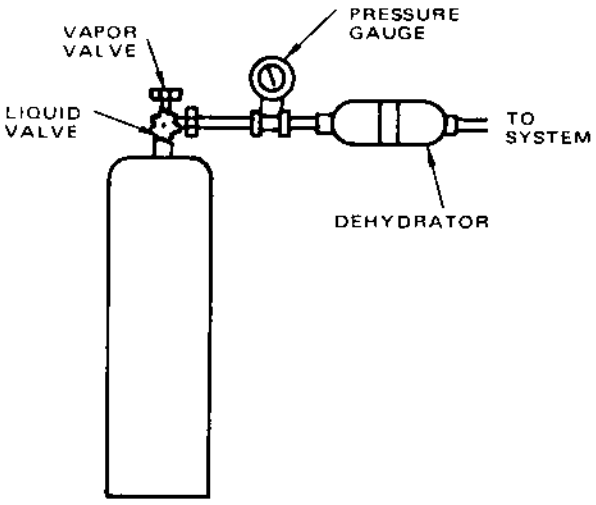

FIGURE 8—Low Side Charging.

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 refrigerant gas to be charged to the system. Be sure only gaseous refrigerant enters the system at the compressor.
5. When the charge is adequate, no bubbles will appear in 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.

SYSTEM PUMPDOWN

The purpose of the system pumpdown is to pump the greater part of the refrigerant charge into the receiver or condenser, reducing the pressure in the low side of the system. This is done before the low side is opened for service or repairs and when the system is to be shut down for long periods of time.

1. Stop the compressor.
2. Close the liquid line shutoff valve.
3. If necessary, lower the setting of the thermostat to energize the Liquid Line Solenoid Valve(s).
4. Start the system and remove the cover from the Refrigerant Pressure Control. Manually hold the Low Pressure Cutout contacts closed.
5. When the suction pressure gauge reads 2 psig, release the contacts of the Low Pressure Control and front-seat the compressor discharge and suction service valves. If an air cooled condenser is used, close the hot gas line shutoff valve also.

   WARNING: To avoid the entrance of air and moisture, always maintain a positive pressure in the low side of the system. Never pump the system down into a vacuum.

6. Open the control panel fused disconnect switch.

REPAIRS AND PARTS REPLACEMENT

IMPORTANT: Replace the dryer-strainer core whenever the system is opened for repairs.

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

LOW SIDE REPAIRS

Pump the system down (see "System Pumpdown").

Vent the low side of the system through the liquid line charging valve. Close the charging valve.

Allow the refrigerant piping to warm up to room temperature. If the piping is colder than the surrounding air, condensate will form on the inside of the open piping.

Plug the open end of all refrigerant piping immediately after opening.

Admit low pressure nitrogen (or other inert gas) through the liquid line charging valve. Shut off the gas supply before soldering the final connection.

After repairs are completed, pressure test and evacuate the low side of the system (see "Pressure Testing—Low Side" and "Low Side Evacuation").

HIGH SIDE AND EXTENSIVE REPAIRS

If the high side of the system must be opened, or if extensive repairs are to be made, it is recommended that the charge be removed.

Evacuate and recharge after the repairs are completed (see "System Evacuation" and "Charging the System").

CONTROLS

Be sure to de-energize the control circuit before removing any controls.

Pump the system down (see "System Pumpdown") before removing the Refrigerant Pressure Control or the Oil Failure Protection Control.

Cap the end of all open tubes and connections immediately after removing the control.

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.

Complete pressure controls may be ordered from The Trane Company. If repair parts are desired, contact your local Penn office, or Penn Controls, Inc., Goshen, Indiana. Give the complete part description and model number of the control.

COMPRESSOR

Consult the COMPRESSOR PARTS LIST and compressor servicing sections of the Trane Service Manual before attempting any repairs on the compressor.

Whenever the compressor is opened, the oil should be replaced. See "Adding Oil to the Compressor" in the Compressor section for recommended oil and proper procedure.

After repairs have been completed, the compressor must be evacuated before the system is returned to operation (see "Compressor Evacuation").

NOTE: If both the compressor and the low side have been opened, the compressor may be pressure tested and evacuated with the low side. Back-seat the compressor suction service valve, and proceed with the normal low side pressure testing and evacuation procedures.

LEAK TESTING (See Figure 9)

After the system has been opened for major repairs, it must be tested for leaks at joints and connections before it can be evacuated, dehydrated and charged.

Oil-pumped dry nitrogen and refrigerant are used for pressure testing the system. The recommended pressure testing hookup is illustrated in Figure 9.

Test the high and low sides of the system at the pressures dictated by local code. If the high side test pressure should equal or exceed the setting of the relief valve, remove the valve and install a plug in the valve fitting.

BE SURE TO USE A PRESSURE REGULATOR IN THE PRESSURE TESTING HOOKUP.

WARNING: UNDER NO CIRCUMSTANCES USE OXYGEN OR ACETYLENE IN PLACE OF DRY NITROGEN FOR PRESSURE TESTING. A VIOLENT EXPLOSION MAY RESULT.

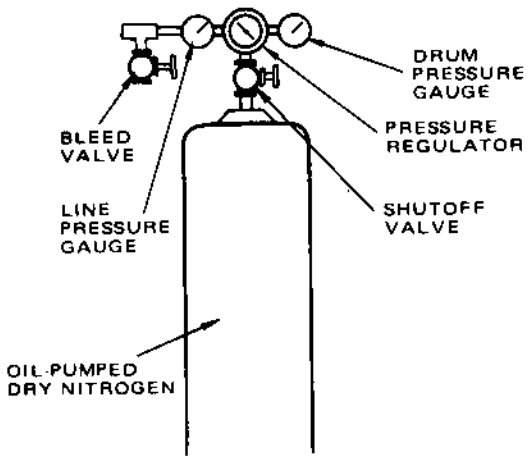

FIGURE 9—Recommended Leak Testing Hookup

1. Remove the power element and cage from the expansion valve.
2. Shape a soft wooden plug so that when it is placed on top of the valve cage seating surface within the valve, it will extend approximately 1/16 of an inch above the top flange surface of the valve body.
3. Install a gasketed flange on top of the plug and draw the flange down until the gasketed surface of the flange meets the mating flange surface of the valve.

4. Remove the external equalizer line from the power element of the valve and cap the open end of the line. The plugging of the expansion valve in this manner effectively separates the high and low sides of the system, preventing the high side test pressure from bleeding back to the low side during the test.
5. Open the liquid receiver inlet and outlet valves.
6. Since the compressor will not be included in the pressure test, tightly front seat the compressor suction and discharge service valves.
7. Install a packed angle valve in the front seat port of the compressor suction service valve and gas charge enough refrigerant into the low side of the system to raise the pressure to 12 to 15 psig.
8. Remove the refrigerant connection and bring the low side up to the required test pressure with oil-pumped dry nitrogen.
9. Repeat this procedure on the high side of the system, charging the refrigerant and nitrogen into the system through the liquid line charging valve.
10. Test the entire system for leaks with a leak detector.
11. Repair any leaks found and retest.
12. After the system is found to be free of leaks, relieve the test pressure and reinstall the relief valve, if previously removed.
13. Remove the plug and reassemble the expansion valve.

EVACUATION AND DEHYDRATION

It is imperative that all moisture and air be removed before refrigerant is charged into the system. The importance of evacuation and dehydration cannot be overemphasized.

Moisture in a refrigerant system can cause the formation of highly corrosive acids and copper plating of compressor parts. Further, moisture and/or air results in oil breakdown and sludging.

Never, under any circumstances, use the compressor as a vacuum pump. It is not designed for this purpose and if so used, may be seriously damaged. A vacuum pump capable of producing at least 1 mm Hg absolute must be used.

1. Check the oil level in the compressor. If oil is not visible in the oil level sight glass, add oil at this time. (see "Adding Oil to Compressor" in the Compressor section).

   NOTE: Oil is added at this time so that any air or moisture that may be entrapped in the oil will be removed during evacuation and dehydration.

2. Connect an accurate high vacuum manometer (Stokes, Zimmerli or Meriam) to the vacuum line. Zimmerli gauges are available through the local Trane sales offices.
3. Connect the vacuum pump to both the liquid line charging valve and the back-seat port of the compressor suction service valve. Back-seat all valves in the system and then crack the suction service valve off the back-seat to open the gauge port to the system. Make sure that the Solenoid Valve has been manually opened.
4. Operate the vacuum pump until the system is evacuated to 2.5 mm Hg absolute. To insure vaporization of all moisture in the system, keep the ambient air temperature above 60 F during the evacuation process.
5. Break the vacuum with oil-pumped dry nitrogen. Re-evacuate to 2.5 mm Hg absolute. Close the vacuum pump suction valve, stop the pump and allow the system to stand under vacuum for a minimum of 12 hours. If the pressure does not noticeably rise in 12 hours, the system may be charged.

LOW SIDE EVACUATION

The low side evacuation procedure should be followed whenever the system is opened while the refrigerant charge is pumped down into the condenser or receiver.

1. Connect a vacuum pump capable of producing 1 mm Hg vacuum to the liquid line charging valve. Connect an accurate high vacuum gauge to the vacuum line (see 2 above).
2. Start the vacuum pump and evacuate the system to 2.5 mm Hg. Close the charging valve.
3. Disconnect the vacuum pump and connect a drum of oil-pumped dry nitrogen to the charging valve. Break the vacuum with nitrogen by slowly opening the charging valve.
4. Reconnect the vacuum pump and evacuate again to 2.5 mm Hg. Allow the system to stand for a minimum of 12 hours. If no noticeable rise in pressure is observed, slowly open the liquid line shutoff valve and back-seat the compressor service valves. The system is now ready for start-up.

COMPRESSOR EVACUATION

If the compressor is opened for any reason, it must be evacuated before the unit is returned to operation.

1. Check the oil level in the compressor. If oil is not visible in the oil level sight glass, add oil at this time. (see "Adding Oil to the Compressor" in the Compressor section).
2. Connect a high vacuum pump and an accurate high vacuum gauge to the back-seat port of the suction service valve (see "System Evacuation").
3. Start the vacuum pump and evacuate the compressor to 2.5 mm Hg.
4. Connect a drum of oil-pumped dry nitrogen to the back-seat port of the discharge service valve. Break the vacuum with nitrogen.

5. Re-evacuate to 2.5 mm Hg. Allow the compressor to stand a minimum of 12 hours. If no noticeable rise in pressure is observed, slowly back-seat the service valves. The system is now ready for charging.

CHARGING THE SYSTEM

HIGH SIDE CHARGING (See Figure 8)

1. Back-seat the compressor suction and discharge service valves.
2. Manually open the Liquid Line Solenoid Valve(s).
3. Close the liquid line shutoff valve.
4. Loosely connect a drum of refrigerant to the charging valve.
5. Momentarily open the liquid valve on the refrigerant drum, purging the connection. Tighten the connection.
6. Put air conditioning and condensing systems into operation.
7. Open the refrigerant drum liquid valve so that only liquid will enter the system, and open the charging valve.
8. After a short interval of time, the compressor will start. Allow it to continue to run through the remainder of the charging operation.

   CAUTION: Do not attempt to start the compressor by blocking the safety controls. Allow the system to function in a normal manner.

9. After the estimated charge has entered the system, close the charging valve and open the liquid line shutoff valve.
10. Allow the system to continue to function for approximately 30 minutes. If, during this period, bubbles appear in the liquid line sight glass, add additional refrigerant, as required.
11. Remove charging equipment and return the Liquid Line Solenoid Valve(s) to automatic control.