Number One Air Conditioning Maker

Carrier

Division of Carrier Corporation

Carrier Parkway • Syracuse, N.Y. 13221

Start-up Instructions 17MPS/FA

Open Drive Centrifugal Liquid Chillers

A SAFETY GUIDE

Centrifugal liquid chillers are designed to provide safe and reliable service when operated within design specifications. When operating this equipment, use good judgement and safety precautions to avoid damage to equipment and property or injury to personnel.

This Safety Guide is a supplement to the machine Installation Instructions and to the Start-Up, Operation and Maintenance Instructions of the following Open-Drive and Hermetic Centrifugal Liquid Chillers:

17CB, 17DA, 17EA, 17FA, 17M,P,S and 17MA,PA,SA
19CB, 19DG, 19DH, 19EA, 19EB and 19FA

Be sure you understand and follow the procedures and safety precautions contained in the machine instructions as well as those listed in this supplement.

⚠ DANGER

DO NOT USE OXYGEN to purge lines or to pressurize a machine for any purpose. Oxygen gas reacts violently with oil, grease and other common substances.

NEVER EXCEED specified test pressures. VERIFY the allowable test pressure by checking the instruction literature and the design pressures on the equipment nameplate. When using nitrogen to pressurize the machine, *do not allow the full cylinder pressure to enter a pressurizing line.* Valve off and *disconnect* the nitrogen cylinder when the recommended test pressure is attained. Do not rely on the shutoff valve or pressure regulator.

DO NOT VALVE OFF any safety device.

BE SURE that all pressure relief devices are properly installed and functioning before operating any machine.

STAND CLEAR of turbine trip valve handles. They react in split seconds with forces up to several thousand pounds.

⚠ WARNING

DO NOT USE eyebolts or eyebolt holes to rig machine sections or the entire assembly.

NEVER OPERATE an open-drive machine, pumpout unit or other equipment without coupling (or belt) guards in place. This warning applies even to short runs such as a motor rotation check. Serious injury can result from contact with moving parts.

DO NOT work on high voltage equipment unless you are a qualified electrician.

DO NOT WORK ON electrical components, including control panels, switches, starters or oil heater until you are sure ALL POWER IS OFF and no residual voltage can leak from capacitors or solid-state components.

LOCK OPEN AND TAG electrical circuits during servicing. IF WORK IS INTERRUPTED, confirm that all circuits are de-energized before resuming work.

DO NOT syphon refrigerant by mouth.

DO NOT WORK inside any vessel without the protection of an air mask or forced air ventilation, a lifeline, and a second man on standby outside the vessel (the "buddy" system).

DO NOT ENTER any equipment room or space containing air conditioning or refrigeration machinery *after a known refrigerant spill,* until you have put on a Scott Air Pack (or equivalent), and are using the "buddy" system.

AVOID SPILLING liquid refrigerant on skin or getting it into the eyes. USE SAFETY GOGGLES. Wash any spills from the skin with soap and water. If any enters the eyes, IMMEDIATELY FLUSH EYES with water and consult a physician.

NEVER APPLY an open flame or live steam to a refrigerant cylinder. Dangerous overpressure can result. When necessary to heat refrigerant, use only warm (110 F/43 C) water.

DO NOT REUSE disposable (nonreturnable) cylinders nor attempt to refill them. It is DANGEROUS AND ILLEGAL. When cylinder is emptied, bleed off remaining gas pressure, loosen the collar and unscrew and discard the valve stem. DO NOT INCINERATE.

CHECK THE REFRIGERANT TYPE before charging machine. High pressure refrigerant in a low pressure machine can cause vessels to rupture if the relief devices cannot handle the refrigerant volume.

DO NOT ATTEMPT TO REMOVE fittings, covers, etc. while machine is under pressure or while machine is running. Be sure pressure is at zero psig before breaking any refrigerant connection.

CAREFULLY INSPECT all relief valves, rupture discs and other relief devices AT LEAST ONCE A YEAR. If machine operates in a corrosive atmosphere, inspect the devices at more frequent intervals.

DO NOT ATTEMPT TO REPAIR OR RECONDITION any relief valve when corrosion or build-up of foreign material (rust, dirt, scale, etc.) is found within the valve body or mechanism. Replace the valve.

DO NOT VENT refrigerant relief valves within a building; vent to outside. Refrigerants are heavier than air and water and will settle in all low places. The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation.

DO NOT install relief valves in series or backwards.

USE CARE when working near or in line with a compressed spring. Sudden release of the spring can cause it and objects in its path to act as projectiles.

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A SAFETY GUIDE (cont)

⚠ CAUTION

DO NOT STEP on refrigerant lines. Broken lines can whip about and cause personal injury.

DO NOT climb over a machine. Use platform, catwalk or staging. Follow safe practices when using ladders.

USE MECHANICAL EQUIPMENT (crane, hoist, etc.) to lift or move inspection covers or other heavy components. Even if components are light, use such equipment when there is a risk of slipping or losing your balance.

DO NOT WELD OR FLAME CUT any refrigerant line or vessel until all refrigerant has been removed from the vessel.

DO NOT SMOKE in an atmosphere containing refrigerant vapor.

BE AWARE that certain automatic start arrangements CAN ENGAGE THE STARTER. Open the disconnect *ahead of* the starter in addition to shutting off the machine or pump.

USE only repair or replacement parts that meet the code requirements of the original equipment.

DO NOT VENT OR DRAIN water boxes containing industrial brines, liquid, gases or semisolids without permission of your Process Control Group.

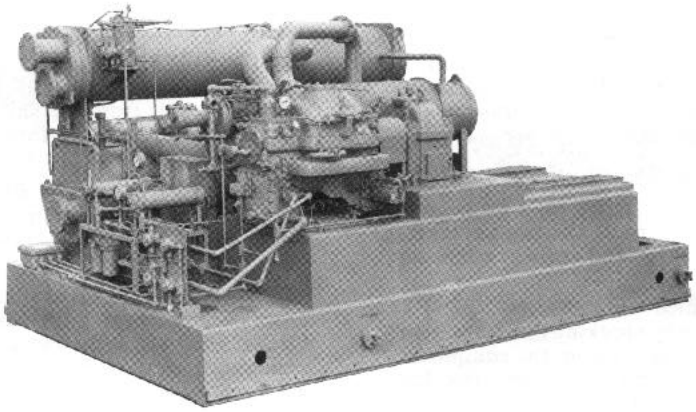
DO NOT LOOSEN water box cover bolts until the water box has been completely drained.

DOUBLE-CHECK that coupling nut wrenches, dial indicators or other items have been removed before rotating any shafts.

DO NOT LOOSEN a packing gland nut before checking that the nut has a positive thread engagement.

PERIODICALLY INSPECT all valves, fittings and piping for corrosion, rust, leaks or damage.

PROVIDE A DRAIN connection in the vent line near each pressure relief device to prevent a build-up of condensate or rain water.



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INTRODUCTION

General — These instructions and all necessary job data should be thoroughly reviewed and understood before starting the machine.

On industrial or process jobs, the refrigeration machine may be part of the process. Some knowledge of the total process system is essential in this case. Inform plant supervisory personnel of machine start-up schedule.

Because of machine design variations, some of the start-up procedures which follow are general in nature. Refer to your individual job data for specific details. *Where differences exist, follow the procedures outlined in the job data.*

For coupling, gear and drive preparation and starting techniques, refer to the manufacturer's instructions.

Job Data Required

1. Job specifications, including list of design temperatures and pressures.
2. 17MPS/FA Installation Instructions, Start-Up Instructions, Operating and Maintenance Instructions.
3. Refrigeration machine flow schematics, notes and design data.
4. Wiring and piping blueprints.
5. Prints and instructions for special controls and components.
6. Manufacturer's Installation and Start-Up Instructions for drive, and gear (if applicable).
7. Starter details and wiring diagrams.
8. 5F,H Installation Instructions (if open-drive pumpout unit is supplied).
9. Carrier Standard Service Techniques, Chapter 15, Form SM-15).

INITIAL PREPARATIONS

General — Before starting refrigeration machine, make the following checks in proper sequence.

WARNING: Do not start compressor or oil pumps, even for a rotation check, unless compressor and all other rotating equipment have been properly lubricated. Do not apply test voltage of any kind while machine is under dehydration vacuum; *motor insulation breakdown and serious damage may result.*

1. Complete all installation work as outlined in 17MPS/FA Installation Instructions and remove all construction debris from machine area.
2. Check machine tightness and confirm dehydration.

Machine must be leaktight and properly dehydrated before proceeding with initial start-up.

3. Check lubrication of compressor, gear, drive and auxiliary equipment.
4. Check machine piping and wiring against job data and as described in these instructions.
5. Check motor rotation or turbine operation with coupling disassembled.
6. Charge vessels with water and refrigerant.
7. Check coupling separation and alignment.
8. Add grout (if desired, grouting may be delayed until ready for machine operation).
9. Check safety control settings.

Machine Tightness

FIELD ERECTED MACHINES — Check to ensure that pressure testing and dehydration were completed at time of installation. If machine is still under vacuum, confirm dehydration by attaching an absolute pressure manometer to the machine cooler and comparing the present vacuum with the vacuum recorded at installation. If any vacuum has been lost, determine the loss rate:

$$\text{loss rate} = \frac{\text{vacuum difference}}{\text{no. of days between readings}}$$

If the loss rate exceeds 0.05 in. Hg per day, recheck machine for leaks and repeat vacuum test and dehydration as described in the machine Installation Instructions.

PACKAGED MACHINES — Factory assembled machines are shipped with a holding charge. Check the cooler gage reading against the reading made at time of installation. Allow for a pressure change of 0.5 psi for each 10 F change in ambient temperature.

If the holding charge pressure is unchanged or has decreased only slightly, raise the machine to the test pressure listed in Table 1, using dry air or nitrogen with refrigerant tracer. Test all joints with a halide or electronic leak detector. If leaks are found, reduce machine pressure to near 0 psig, repair leaks and then retest to ensure repair.

If the holding charge is nearly or completely gone, check for and close any open valves or other open connections. Then pressurize the machine with dry air or nitrogen, with refrigerant tracer. Test with halide or electronic leak detector at the Table 1 test pressure. Reduce pressure to near 0 psig, repair leaks and then retest. When machine is leaktight, apply vacuum test and dehydrate the machine as described in the Installation Instructions.

Table 1 — Test Pressures

REFRIGERANT	TEST PRESSURE
R-12	125 psig
R-500	125 psig
R-114	30-35 psig

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Storage Tank Safety Devices — Rupture disc or relief valve settings are summarized in Table 2. Field adjustment is not normally required. Check the device nameplate to be sure that the device is set for the pressure and temperature specified in Table 2.

Table 2 — Storage Tank Relief Device Settings

REFRIGERANT	RUPTURE DISC OR RELIEF VALVE SETTING	
R-12 R-500 R-114	185 psig 225 psig 60 psig	130 F max

Gear, Coupling and Drive Lubrication — Lubricate this equipment in accordance with the manufacturer's instructions.

Purge Lubrication — If compressor driven purge is used, check that factory oil charge is visible at center of compressor sight glass.

Machine Compressor Lubrication — Proper oil level is indicated by arrow on oil level sight glass (item 2, Fig. 2). The basic oil charge is approximately 15 gallons, but this amount must be increased when an external oil filter and/or auxiliary oil system is used.

Add oil thru the oil-fill elbow on the atmospheric oil chamber (item 9, Fig. 2). The seal oil return pump transfers the oil to the main reservoir automatically. Added oil must meet Carrier's specifications for centrifugal compressor usage at job operating temperatures.

Energize the oil heater after charging oil. Set thermostat to maintain 130 - 140 F oil temperature.

If an auxiliary oil pump is supplied, flush the oil system before machine start-up.

Flush Auxiliary Oil System

1. Add oil to machine compressor as described under Machine Compressor Lubrication.
2. Add cloth strainer *to the oil supply line to the compressor* (Fig. 1). A milk filter disc, available at dairy supply house or local dairy, is satisfactory.

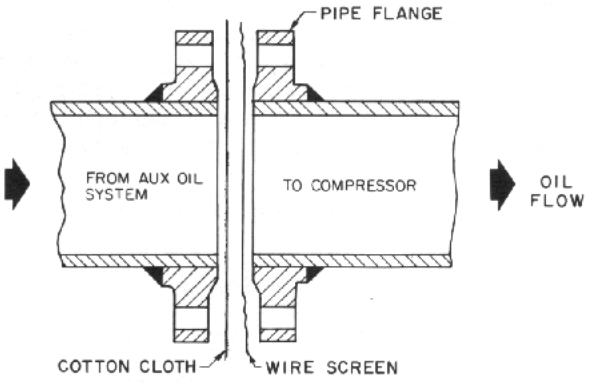

Fig. 1 — Flushing Filter

3. Momentarily energize the auxiliary oil pump. Change pump rotation if pressure does not build up.
4. Heat flushing oil to 135 - 150 F.
5. Operate auxiliary oil pump while tapping oil piping to dislodge any scale or dirt.
6. After flushing, stop pump, drain all oil, remove cloth strainer, and replace oil filter cartridge(s). *Do not keep oil heater energized after oil is drained from reservoir.*
7. Add fresh oil to machine compressor and auxiliary oil system.

Lubricate Auxiliary Equipment

1. Check all pump bearings for proper lubrication. Follow pump manufacturer's instructions.
2. Fill all oilers used on shaft seals or bearings.

At this time, also coat all valve stems and valve operators subject to frosting with coupling grease or other suitable material. Fill thermometer wells with heat conducting material suitable for the expected operating temperatures. Ethylene glycol or spray deicer may be used to protect sight glass against frosting.

Inspect Piping — Refer to job flow diagrams and piping blueprints. Inspect water circuits for cooler, condenser, oil cooler(s), and pumpout condenser.

Be sure that all piping is properly vented and supported with no stress on water box nozzles or covers. Piping must not be supported by the refrigeration machine.

Water flow direction and flow-direction decals on water box nozzles must conform with job flow diagrams.

Oil cooler water and piping must conform to job data and to the requirements listed in the 17MPS/FA Installation Instructions. Adjustment of the oil cooler plug valve to provide proper bearing oil temperature is made after compressor is operating.

If city water is used, be sure that open sight drain is provided.

Pumpout condenser water must be piped to an open sight drain. Check that field-supplied shutoff valves and controls are provided as specified in the job data.

Check that refrigerant relief valves are piped to the outdoors in compliance with all safety codes.

Inspect turbine piping for conformance with job data and turbine manufacturer's instructions.

Check that air supply to pneumatic controls is regulated to the pressure specified in the job data. Pneumatic controls may include: guide vane operator, temperature controller, level controller and valve, load limiting control, and hot gas bypass valve.

Piping to safety control panel must be in accordance with job flow diagram.

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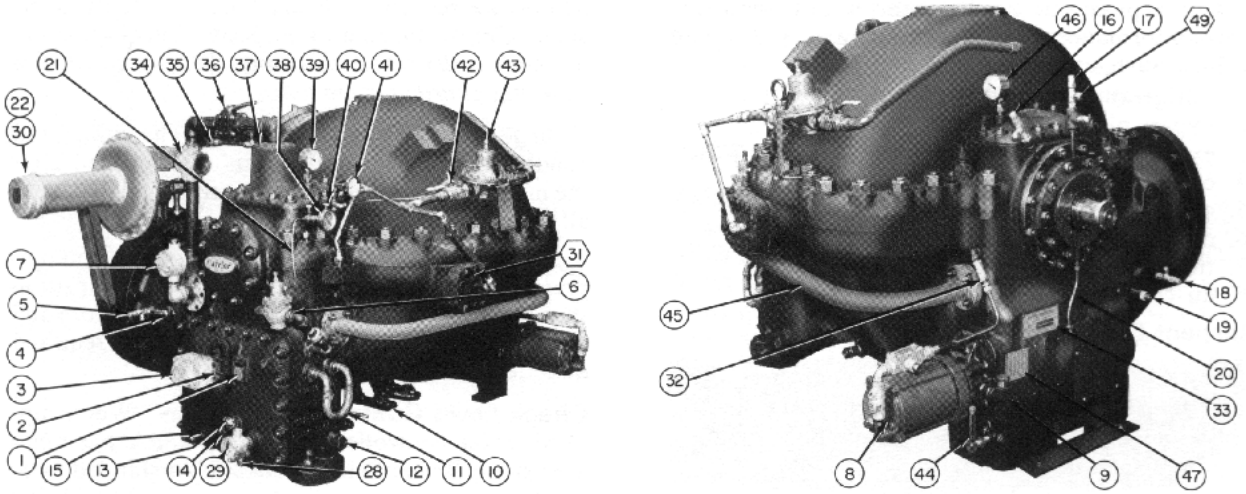
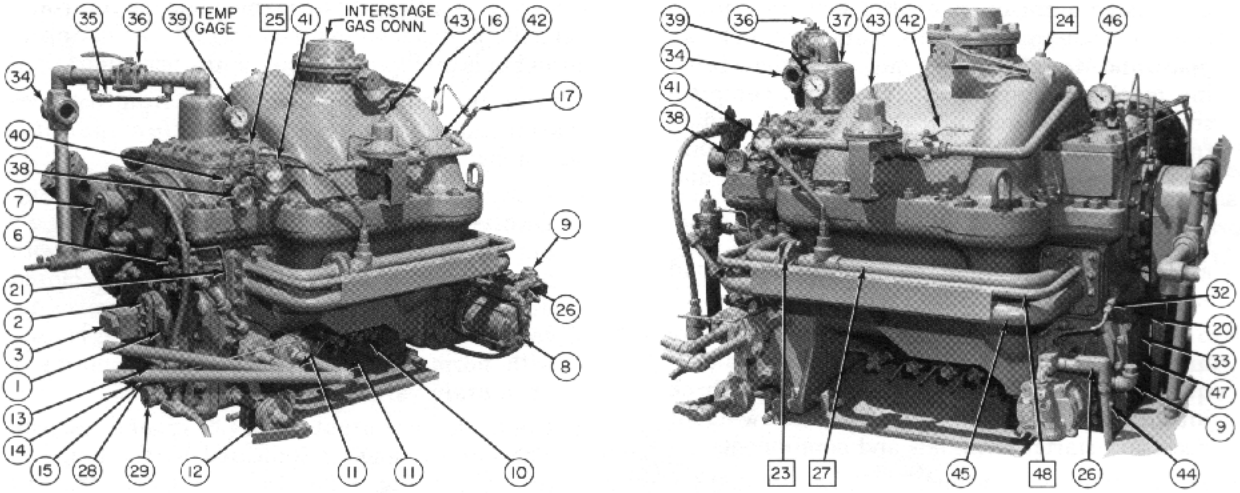


SIZE 40 COMPRESSOR



SIZE 30 COMPRESSOR

COMPONENT INDEX

1 — Oil Pump Nameplate
2 — Oil Level Sight Glass
3 — Oil Heater Terminal Box
4 — Thermometer Well, Suction Temperature*
5 — Angle Valve, 1/2-in. Flare Connection*
6 — Regulating Valve, Differential Oil Pressure
7 — Conduit Box, Shaft Movement Switch and Bearing Safeties
8 — Seal Oil Return Pump
9 — Oil Fill Elbow
10 — Stage Drain Connection
11 — Oil Loop — remove to connect auxiliary oil pump or oil filter
12 — Auxiliary Oil Pump Suction Connection, 1-in. NPT
13 — Oil Temperature Thermowell
14 — Oil Cooler Water-Out Connection, 1/2-in. NPT
15 — Oil Cooler Water-In Connection, 1/2-in. NPT
16 — Seal Supply Oil Pressure Connection, 1/2-in. Flare
17 — Seal Housing Oil Pressure Connection, 1/2-in. Flare
18 — Angle Valve, Discharge Pressure, 1/2-in. Flare*
19 — Thermometer Well, Discharge Temperature*
20 — Atmospheric Oil Drain Line
21 — Pilot Line, Differential Oil Pressure
22 — Damper Motor Flange*
23 — Blank-Off Plate
24 — Stage Pressure Connection, 3/4-in. NPT
25 — Labyrinth Seal Gas Connection (when used)
26 — Seal Oil Pump Terminal Box*
27 — Equalizing Line
28 — Oil Drain Valve
29 — Oil Thermostat Connection, 1/2-in. NPT
30 — Suction Damper Motor*
31 — Reversible Crossover Plate
32 — Seal Oil Discharge Check Valve
33 — Compressor Nameplate
34 — Oil Mist Sight Glass
35 — Labyrinth Seal Orifice
36 — Labyrinth Seal Hand Valve
37 — Oil Demister
38 — Oil Reservoir Pressure Gage
39 — Thrust-End Bearing Temperature Gage Thermometer
40 — Gage Block Valve
41 — Labyrinth Seal Differential Pressure Gage
42 — Regulator Block Valve
43 — Labyrinth Seal Differential Pressure Regulator
44 — Atmospheric Chamber Oil Sight Glass
45 — Seal-End Bearing Oil Return Line
46 — Seal-End Bearing Temperature Gage Thermometer
47 — Patent Plate
48 — Seal-End Oil Feed
49 — Auxiliary Gage Connection

□ Item callout on Size 30 compressor only

⬡ Item callout on Size 40 compressor only

*Item callout which may not be visible on one of the above units, but which are actually common to both 30 and 40 compressors.

Fig. 2 — 17MA,PA and SA Size 30 and 40 Compressors (Typical)

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Check piping to auxiliary and optional systems for conformance to job flow diagrams and piping prints. Such systems include:

1. refrigerant pumpout system
2. bypass piping and valve
3. external economizer piping
4. external oil system
5. compressor labyrinth pressurization system
6. compressor stage drain system
7. turbine stage drain system
8. air-cooled condenser

Inspect Field Wiring

WARNING: Do not check high voltage supply without proper equipment and precautions. Serious injury may result. Follow power company recommendations.

1. Examine wiring for conformance to job wiring diagrams and applicable electrical codes.
2. Check all motor nameplates to be sure that power supply is compatible with nameplate voltage, phase and Hertz. Examine motors on the following machine components: centrifugal compressor, cooler and condenser water pumps, cooling tower pump and fan, auxiliary oil pump, compressor seal-oil return pump, purge pump, and pumpout compressor.
3. Check motor starter ratings against motor voltage and amperage requirements. Motor overload relays must meet electrical code requirements.
4. Starter for centrifugal compressor motor drive must contain the components and terminals required for refrigeration machine control. Check job electrical and pneumatic control drawing for necessary starter terminals and components.
5. Be sure motors are properly lubricated and then momentarily energize each (except main drive) to determine direction of rotation. Correct as required.
6. If machine compressor is motor driven, disconnect coupling to gear. With all components properly lubricated, momentarily energize motor. Compressor rotation must be counterclockwise as viewed from drive end. *Replace coupling guard.*
7. Check oil heater for correct voltage. *Do not energize heater without oil in reservoir.*
8. Ensure that separate electrical source and/or fused disconnect are provided for electrical circuits so specified on job electrical and pneumatic control drawing.
9. Check wiring from machine control panel to all other machine components for conformance with job wiring diagrams.

Check Turbine Operation — Follow manufacturer's lubrication instructions. Then disconnect turbine coupling and operate the turbine in accordance with the manufacturer's recommendations before the refrigeration machine is initially operated. Check turbine overspeed. Turbine safety devices can be set at this time. *Be sure to replace coupling guard.*

Charge Machine with Water — The cooler and condenser water (brine) circuits can be filled after the machine has been proven leaktight and dry. Vent all lines and check for leaks.

Indicators on the coupling halves between compressor and drive or gear will indicate any position shift while the machine is being charged. Before and after indicator readings will indicate the required direction for final alignment.

Check Level Controller Settings — When supplied, level controllers for 17MPS/FA machines are usually Fisher Series 2500-249. As shipped from the factory, the controller proportional band dial (Fig. 3) is generally set at the maximum effective proportional band for the refrigerant being controlled. This setting is also stamped on the controller nameplate. It is seldom used in actual machine operation but is useful in checking controller calibration.

From the job data drawings and from the controller manufacturer's instruction manual, determine:

1. Type of controller action (direct or reverse). Direct-acting controller gives an increased air output signal as liquid level rises. It is used with normally open feed valves or normally closed drain valves. Reverse-acting controller gives decreased air output as the level rises and is used with normally closed feed valves or normally open drain valves.
2. Controller air output range (3 - 15, or 6 - 30 psi). The output range is indicated by the bourdon tube color (Fig. 3 and Table 3). Check that the range of controller matches the range of the controlled valve.

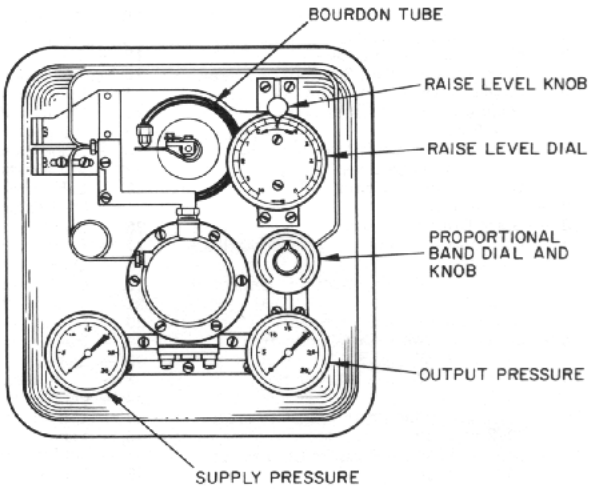

Fig. 3 — Series 2500 Level Controller

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Before the machine is charged with refrigerant, the refrigerant liquid level is zero (i.e., below the displacer cage of the controller). At this condition, the air output signal should be at its lowest point (3 or 6 psi on direct-acting controller), or at its highest point (15 or 30 psi on reverse-acting controller). With the proportional band at maximum setting as listed on the controller nameplate, check the air output pressure per Table 3. Adjust the raise level knob (Fig. 3) as required to obtain the required pressure.

Table 3 — Level Controller Pressure Settings

OUTPUT PRESS. RANGE	SET SUPPLY PRESS.	BOURDON TUBE COLOR	OUTPUT PRESS. AT LOWEST LEVEL	
			Direct Acting	Reverse Acting
3 to 15 psig	20 psig	Black	3 psig	15 psig
6 to 30 psig	35 psig	Red	6 psig	30 psig

Charge Machine with Refrigerant — If the machine is equipped with a storage tank, place the refrigerant in the tank before charging it into the machine. Mark the storage tank sight glass for future reference when the recommended charge (see job design data drawing) has been placed in tank.

To charge the machine, refer to the pumpout procedure for transferring refrigerant from storage tank to machine.

If the machine does not have a storage tank, charge the refrigerant directly into the machine cooler. The instructions which follow apply equally to machines with or without a storage tank.

Be sure that there is a full charge of oil in the compressor reservoir, oil heater energized and oil temperature at least 130 F. Water (brine) must be circulating during the refrigerant charging process.

At pressures below those listed in Table 4, liquid refrigerant flashes into gas and may cause tube freeze-up. Run water (brine) pumps and charge refrigerant as a gas until pressure in cooler rises above the Table 4 value.

To avoid liquid carry-over into the compressor at initial start-up, charge only about 2/3 of the estimated full load amount of refrigerant into the cooler before starting the compressor.

After starting the machine, continue to add refrigerant until the recommended charge *less approximately 200 lb* has been added. When machine full load is available, trim refrigerant charge and adjust level controls per Adjusting the Refrigerant Charge, and Adjusting Refrigerant Levels.

Check Coupling Separation and Alignment — Check compressor, gear and drive alignment and coupling separation after all piping to machine and drive has been installed. Angular and parallel alignment must be within coupling manufacturer's specified tolerance before machine is operated. Alignment procedures are given in Carrier Standard Service Techniques, SM-15.

Hub separation tolerances are usually stamped on the coupling. Check the separation with shafts in the following positions:

Compressor — in thrust position (away from drive)
Turbine — in thrust position (towards compressor)
Gear — low speed shaft in thrust position (towards compressor)
Motor — at magnetic center (usually indicated by scribe mark on shaft)

When limited end float couplings are used, follow motor manufacturer's recommendations for positioning shaft and coupling.

Replace coupling guards when check is complete.

Alignment must be checked again and compressor, gear and drive must be doweled after machine start-up. See sections entitled Hot Alignment Check, and Doweling.

Grouting — Grouting may be done at any time after machine alignment has been checked, but *grout must be in place when hot alignment check is made.*

Refer to job data drawings for acceptable grouting materials and for general instructions on grout placement. Grouting materials and placement procedures are also detailed in Carrier Standard Service Techniques, SM-15.

Table 4 — Refrigerant Pressure Corresponding to 32 F Saturation Temperature (Water)

REFRIGERANT	GAGE PRESSURE	
	in. Hg VAC	Psig
R-11	18.0	–
R-12	–	30.0
R-114	3.8	–
R-22	–	57.8
R-500	–	38.0

Check Safety Control Settings

Protection of machine by safety controls cannot be assumed until all settings have been confirmed.

Check and adjust the safety controls before operating the machine. Use a metered supply of air or gas, standard temperature sources such as an ice bath and warm circulating oil, and standard, calibrated thermometers.

After the machine has been put into operation, recheck all safety controls as described in Table 8.

The following setting procedures are provided as a general guide applicable to most machines. *Always follow job data instructions where they differ from those given here.*

MOTOR DRIVE — Check out safety controls without operating motor by disconnecting main motor leads at starter, or by disconnecting leads to starter holding coil. Place a volt-ohmmeter across open leads to determine that safety control circuit is de-energized as each safety control is tripped.

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TURBINE DRIVE — With main steam supply off, listen for an audible click from the solenoid trip as each safety control is tripped.

As an alternate method, remove turbine solenoid trip from electrical circuit and install volt-ohmmeter or light across leads. Trip each safety control and observe whether circuit is de-energized.

CHILLED WATER (BRINE) LOW-TEMPERATURE CUTOUT — This switch must open ahead of refrigerant low-temperature cutout or machine will not recycle automatically.

Water Chilling Duty — Set switch to open at 5 F below design leaving water temperature or 37 F whichever is higher.

Brine Chilling Duty — Set switch to open at 5 F below leaving brine temperature.

This switch may not be provided on some low temperature or gas condensing jobs.

REFRIGERANT LOW-TEMPERATURE CUTOUT

Water Chilling Duty — Set switch to open at 33 F or 1° F below design refrigerant temperature, whichever is lower.

Brine Chilling Duty — Set switch to open at brine freezing temperature or 5 F below suction temperature, whichever is higher.

This switch may not be provided on some low temperature or gas condensing jobs.

CONDENSER HIGH-PRESSURE CUTOUT — Switch setting is based on condenser design working pressure. The following table lists normal settings for *water-cooled* condensers. Check your job data for actual setting and type of reset (automatic or manual).

REFRIGERANT	CUTOUT @ (psig)	RESET @ (psig)
R-12	165	145
R-500	175	165
R-114	55	42

LOW OIL PRESSURE CUTOUT — This procedure applies to the adjustable differential-type pressure switch normally used on 17MPS/FA machines. Typical vendor is United Electric.

1. Pressurize low side of switch to 5 psig.
2. Pressurize high side to 17 - 18 psig (12 - 13 psi differential between high and low side.
3. With ohmmeter across common and normally open contacts, turn red setscrew (Fig. 4) until contacts just close.
4. Increase high side pressure to 21 - 22 psig (16 - 17 psi differential).
5. With ohmmeter across common and normally open contacts, turn white knob (Fig. 4) until contacts just close.
6. Reduce high side pressure to 17 - 18 psig (12 - 13 psi differential); contacts should open. If not, repeat procedure.

AUXILIARY OIL PRESSURE CUTOUT (if supplied)

1. Pressurize low side of switch to 5 psig.
2. Pressurize high side to 19 - 20 psig (14 - 15 psi differential between high and low side).
3. Place ohmmeter across common and normally closed contacts and turn hex-head setscrew until contacts just close.
4. Increase high side pressure to 25 - 26 psig (20 - 21 psi differential).
5. With ohmmeter across common and normally closed contacts, turn white knob until contacts just open.
6. Reduce high side pressure to 19 - 20 psig (14 - 15 psi differential); contacts should close. If not, repeat procedure.

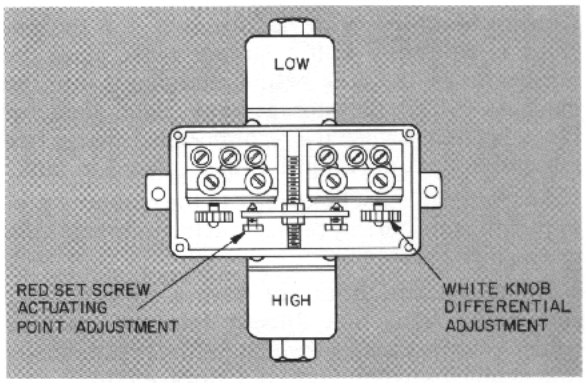

Fig. 4 — Typical Oil Pressure Switch

OTHER CONTROL DEVICES — Check the following components as described in Table 8; flow switches, purge, suction damper, hot gas bypass valve, and liquid level controller.

CHECK LOAD LIMITING CONTROL ASSEMBLY (Fig. 5) — This assembly is supplied with motor-driven compressors. The assembly will normally consist of the items listed in Fig. 5. Where there are differences, follow your job data instructions for calibration and adjustment.

Input to the control assembly includes:

1. 115-volt AC power supply to the demand limit controller (item 3, Fig. 5).
2. 3 - 5 amp AC output at 100% FLA from transformer in motor controller.
3. Supply air to electro-pneumatic transducer, 20 or 35 psig depending upon job requirements.
4. Signal air from the machine brine temperature controller.

To calibrate the load limiting control assembly:

1. Set band width at "3" on demand limit controller (item 3).
2. Operate refrigeration machine at highest possible load. (Do not exceed motor nameplate FLA.)
3. Measure motor amps at Step 2 condition.

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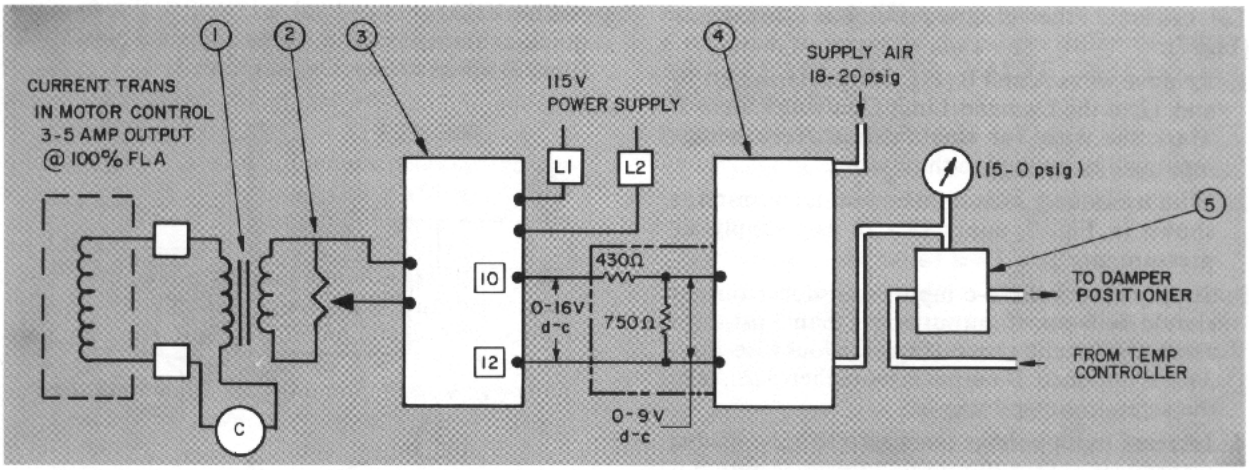

NOTE: On some transducers (item 4), wiring within phantom lines is internal.

LEGEND

1 — Current Transformer
2 — Potentiometer
3 — Demand Limit Controller
4 — Electro-Pneumatic Relay
5 — Selector Relay
□ Terminal Connection

→ **Fig. 5 — Typical Load Limiting Control Assembly**

4. Calculate the % load:

$$\%\,\text{load} = \frac{\text{measured amps}}{\text{nameplate FLA}} \times 100$$

5. Set the % load dial of demand limit controller at the calculated % load.
6. Adjust potentiometer (item 2) to the point at which the electro-pneumatic transducer (item 4) just begins to reduce its signal to the suction damper motor.
7. Set % load dial at 100%. Control assembly is now calibrated and will limit motor load to 100% FLA.

If control assembly does not limit motor amps as desired, further calibration is indicated.

Calibrate the demand limit controller (Fig. 6) as follows:

1. Set % load dial at 100%.
2. Set band width dial at "3."
3. Turn calibration adjustment screw fully clockwise.

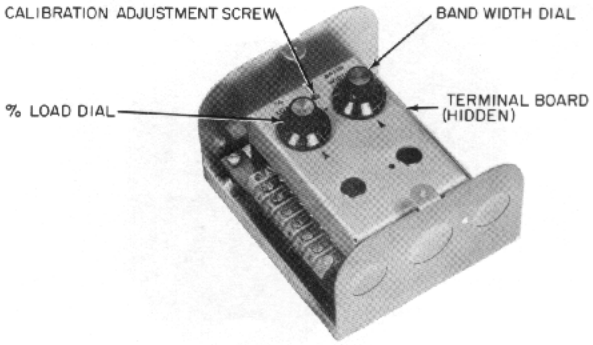

Fig. 6 — Demand Limit Controller

4. Operate machine at 100% motor nameplate FLA.
5. Turn calibration adjustment screw counterclockwise to the point at which the compressor suction damper just begins to close.
6. If damper hunts, increase the band width and repeat steps 4 and 5.

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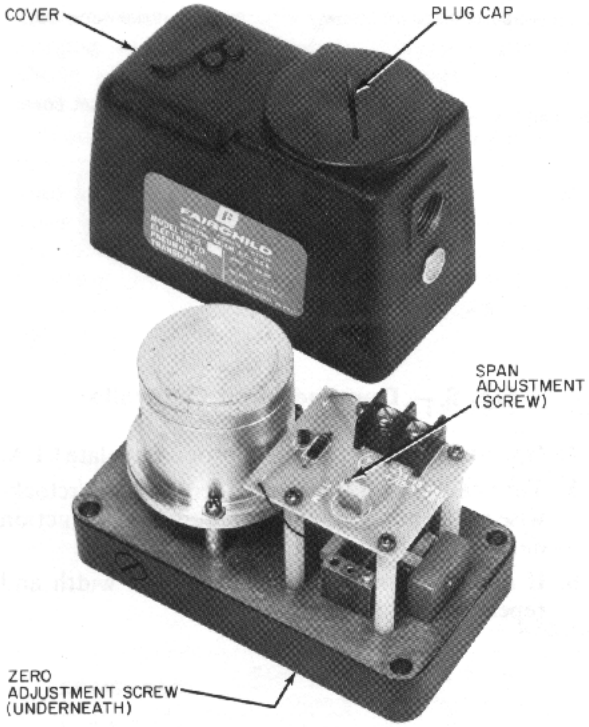
→ To calibrate the electro-pneumatic transducer (Fig. 7):

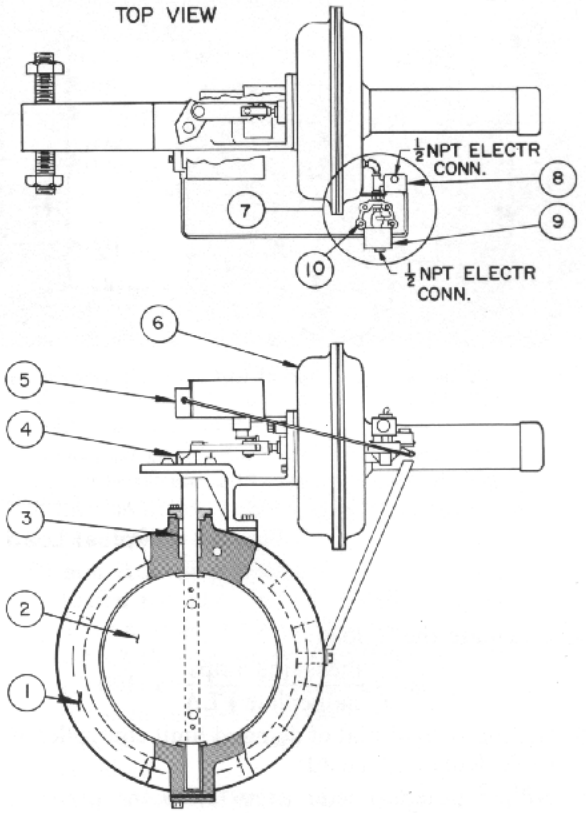
1. Remove wires A and B (Fig. 5) from terminals 10 and 12 of the Demand Limit Controller, item 3. Mark the wires for identification. Test voltage input will be applied to these wires.
2. With transducer in normal horizontal position as shown in Fig. 7, apply 18 - 20 psig supply air pressure.
3. Supply zero volts d-c input; transducer output should be 3 psi. If output is less than 3 psi, turn zero adjustment screw (Fig. 7) clockwise until 3 psi is obtained. If output is more than 3 psi, turn the screw counterclockwise.
4. Increase input voltage from zero to 16 volts d-c; transducer output should be 15 psig. If output is not 15 psig, turn the span adjustment (Fig. 7) slowly clockwise to increase the output, counterclockwise to decrease the output.
5. Recheck the output at zero volts d-c (3 psig) and at 16 volts d-c (15 psig). Repeat steps 3 and 4 as necessary.
6. Reconnect wires A and B to terminals 10 and 12 of the Demand Limit Controller.



→ **Fig. 7 — Electro-Pneumatic Transducer**

Check Suction Damper — Manually adjust the air pressure from the chilled water temperature controller until air signal pressure to suction damper is 3 psi; damper should be fully closed. Raise the air signal pressure to 15 psi; damper should open fully (unless compressor motor FLA is exceeded). Adjust damper position as required.

Check that solenoid valve 1 (item 8, Fig. 8) of the quick-exhaust assembly closes and solenoid valve 2 (item 9) opens on machine shutdown.



1 — Suction Damper Frame
2 — Suction Damper Blade
3 — Packing Assembly
4 — Position Indicating Lever
5 — Pilot Positioner
6 — Diaphragm Motor
7 — Quick Exhaust Assembly
8 — Solenoid Valve 1
9 — Solenoid Valve 2
10 — Exhaust Valve 3

Fig. 8 — Automatic Suction Damper

START-UP PROCEDURE

MACHINES WITH SPECIAL COMPONENTS AND/OR CONTROLS MAY REQUIRE SPECIAL START-UP PROCEDURES. CHECK YOUR INDIVIDUAL JOB REQUIREMENTS.

Compressor Oil Preparation — At ambient pressure and temperature, the compressor oil can absorb a significant amount of refrigerant. When machine is started at ambient, the sudden drop in pressure at compressor suction may cause oil foaming, with loss of oil operating pressure and excessive migration of oil droplets into the refrigerant system.

One or a combination of the following procedures should eliminate the problem:

1. Heating the compressor oil.
2. Quenching the oil.
3. Adjusting suction damper.
4. Pressurizing compressor labyrinths.

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HEATING THE OIL — Energize compressor oil heater (item 3, Fig. 2) for at least 3 hours before start-up to raise oil temperature to approximately 145 F and drive off absorbed refrigerant.

QUENCHING THE OIL — At initial start-up or after a lengthy shutdown, it may be necessary to heat the oil above the normal heater setting (140 - 145 F) in order to drive off sufficient refrigerant. Apply hot water to internal oil cooler coil until oil temperature is 160 F for at least 30 minutes. *Do not use steam. Damage to solder joints may result.* Just before machine start-up, shut off the oil heater and quickly lower the oil temperature to 100 F or below by running cool water thru the coil. Start compressor immediately. *Be sure to reenergize the oil heater after start-up.*

ADJUSTING THE SUCTION DAMPER — Starting the compressor at ambient temperature with a fully opened suction damper may overload the compressor drive. On the other hand, if the suction damper is closed to limit the start-up load, low suction pressure may cause oil foaming and oil loss. The degree of damper closing which will prevent high compressor loading, and at the same time avoid oil foaming and loss, must be determined from experience.

PRESSURIZING THE LABYRINTHS — With some combinations of refrigerant type, design temperatures and start-up horsepower, heating the oil and adjusting the suction damper may not fully prevent oil foaming and loss. The labyrinth seal gas system allows the operator to adjust for such conditions. Refer to Fig. 2 for item reference.

1. Open gage and regulator block valves 40 and 42.
2. Close labyrinth seal hand valve 36.
3. Insert blank-off plate (item 23) in Refrigerant Gas Equalizing Line (item 27).
4. Start machine.
5. Adjust hand valve 36 as required to keep oil foaming low (1 - 2 in. max above the oil surface) and oil loss (visible as droplets thru oil mist sight glass 34) at a minimum.

WARNING: When operating labyrinth system, massive oil loss will result if blank-off plate has not been properly installed.

Always observe the operation of the seal gas system thru several load changes and readjust hand valve 36 as required.

If hand valve 36 is left closed indefinitely after start-up, bearing chamber pressure will rise, refrigerant vapor will condense on the chamber wall and mix with the oil. *This refrigerant-oil mixture will not adequately lubricate the bearings and seal, and serious damage may result.*

Adjusting the differential pressure regulator — With hand valve 36 closed, gage 41 should register 8 - 10 psi differential regardless of machine load. Adjust the labyrinth seal differential pressure regulator 43, if required, to maintain the proper differential. DO NOT LEAVE HAND VALVE 36 CLOSED INDEFINITELY.

Before Starting Machine — Check that:

1. Power is supplied to circuit breakers, water pumps, cooling tower fan and all auxiliary equipment.
2. Cooling tower water level is adequate.
3. Compressor, gear, drive and any other rotating components are properly lubricated. Normal oil level is 1/2 sight glass unless otherwise indicated on machine.
4. Refrigerant is at selected start-up level.
5. Valves in chilled water (brine) and condenser water circuits are open and systems are properly vented.
6. Air supply to pneumatic controls is 20 or 35 psig as specified in your job data.
7. Drive equipment has been prepared for start-up per manufacturer's insructions.
8. Seal oil return hand valve (on some compressors) is open (item 38, Fig. 2).
9. Labyrinth seal hand valve (item 36, Fig. 2) is closed initially, as previously described.
10. Compressor is free of liquid refrigerant. Open vent valve of stage drain tank and then drain liquid from each compressor stage. Shut drain valves when liquid no longer appears in drain line sight glass.
11. Oil temperature is at least 140 F and oil is relatively free of refrigerant as described in section entitled Compressor Oil Preparation.
12. Motor driven purge (if supplied) is operating.
13. *All coupling guards are in place.*

To Start Machine — Examine job data for any deviation from, or additions to, the steps which follow. *Where there are differences, follow job data instructions.*

1. Close compressor suction damper as required to control oil foaming and compressor overload (see Compressor Oil Preparation).
2. Close economizer gas valves, if supplied.
3. If turbine drive, open condensate drains.
4. If wound-rotor motor drive, set drum controller at low speed condition.
5. Start water pumps and tower fan if manual start.
6. Start auxiliary oil pump just before compressor start.
7. Start drive per manufacturer's instructions.
8. *Immediately check compressor (Table 7), gear and drive oil pressures. If operating oil pressures are not present within 10 - 15 seconds, stop drive immediately.* Do not restart without correcting fault, nor restart for at least 5 minutes. If motor drive, do not restart more often than specified by the motor manufacturer.
9. Slowly open economizer gas valves, if supplied.

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10. Adjust labyrinth seal hand valve (item 36, Fig. 2) as required (see Compressor Oil Preparation).
11. Manually adjust suction damper to bring machine to design pressures and temperatures.
12. Keep oil cooler water flow low until normal oil and bearing temperatures (Table 7) are established. Then adjust water flow to maintain correct temperatures.
13. *Keep machine on manual control until machine is stabilized at normal pressures and temperatures;* then switch to automatic operation. On automatically controlled machines, opening the air supply to the temperature controller causes the machine to operate automatically.
14. Machines with liquid level control systems may require system adjustment. Refer to the section Adjusting Refrigerant Levels.
15. Energize motor driven purge and purge oil heater (if supplied).

If there is air in the condenser, surging may occur immediately after machine start. If the refrigeration machine is equipped with a motor driven purge, the air may be removed thru the purge (see Purge Operation section). On all machines, open the suction damper smoothly to reach normal condenser pressure (per job specs) and accelerate the purging of air. Do not raise condenser pressure above normal nor exceed compressor motor full load amps.

If surging continues after all air has been purged, low refrigerant charge or very light refrigeration load may be the cause. Surging under these conditions is normal, but continuous surging will cause the compressor to overheat. Adjustment of the refrigerant charge or use of a hot gas bypass may be necessary if frequent machine operation at very light loads is anticipated.

Purge Operation — The automatic thermal purge used with most 17MPS/FA machines will remove water and non-condensables from the refrigerant system automatically. Be sure any shutoff valves in purge supply and return lines are open. Operating and safety switches have been factory set as indicated in Table 5.

Machines designed for low temperature duty may be equipped with a motor-driven compression type purge. *Operate this purge continuously whenever the refrigeration machine is running.* Open all valves in the purge system except water and oil drains. Refer to Table 6 for purge pressure and temperature settings.

Oil should be visible in the purge compressor sight glass during purge operation and at shutdown. See job data for oil specifications. To add oil, shut off purge compressor, close valve in purge gas supply line from condenser and valve in liquid refrigerant return line. Remove plug at top of oil sight glass and add oil.

The motor driven purge can be used for pressurizing or evacuating the refrigeration machine. Refer to the machine Operating and Maintenance Instructions for these procedures.

Check Running System

1. Listen for any unusual sounds; if present, stop drive and determine cause.
2. Check that all operating temperatures and pressures are within the limits stated in Table 7 and listed in the job specifications.
3. Check oil and refrigerant levels; adjust if required.
4. Adjust water flow to oil coolers as required to maintain normal temperatures.
5. Make operating check of all safety controls as described in Table 8.
6. Check operation of suction damper, hot gas bypass, and liquid level controllers per Table 8.

Table 5 — Thermal Purge Settings

REFRIGERANT	OPERATING DIFFERENTIAL (psig)		SAFETY DIFFERENTIAL (psig)		BACK PRESSURE VALVE (psig)
	Contacts Open	Contacts Close	Contacts Open	Contacts Close	
R-114	8	4	11	16	*
R-12...R-500	16	8	24	32	32...42

*2.7 inches of mercury below one atmosphere (vacuum).

Table 6 — Motor-Driven Purge Settings

REFRIGERANT	COMPR HI-PRESS. CUTOUT		RELIEF VALVE (psig)	BACK PRESSURE VALVE	SUCTION PRESSURE (Max)*
	Open @	Close @			
R-12 & R-114	200 psig	150 psig	150-175	35-40 F	5 psig

*Adjust pressure regulating valve.

Table 7 — Machine Operating Temperatures and Pressures

COMPRESSOR SIZE	OIL PRESSURE REGULATING VALVE-LOCATION	SEAL HOUSING OIL PRESSURE	BEARING TEMPERATURE		OIL RESERVOIR TEMPERATURE
			Seal End	Thrust End	
30 and 40	Thrust End, Right Side	22 - 27 psid*	130 - 180 F	130 - 170 F	130 - 160 F

*Psi differential = Seal housing minus oil reservoir.

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Table 8 — Operating Checks of Machine Controls and Safety Devices

CONTROL DESCRIPTION AND SETTING	PROCEDURE
Refrigerant Low-Temperature Cutout Water Chilling — Cutout at 33 F or 1°F below design refrigerant temperature, whichever is lower. Brine Chilling — Cutout at brine freezing temperature or 5 F below suction temperature, whichever is higher.	1. Place switch at proper setting if not previously set. 2. With machine off, place jumper across Chilled Water (Brine) Low-Temperature Cutout. 3. Operate machine manually and lower refrigerant temperature slowly until cutout temperature is reached and machine shuts down. Adjust if required. Do not allow brine temperature to drop below freezing. 4. Remove jumper
Chilled Water (Brine) Low-Temperature Cutout Switch may not be provided on some low temperature or gas condensing applications. Water Chilling — Cutout at 5 F below design leaving chilled water temperature or 37 F, whichever is higher. Brine Chilling — Cutout at 5 F below design leaving brine temperature. *Switch must open ahead of refrigerant low-temperature cutout in order to have automatic machine recycle.*	1. Set switch if not previously set. 2. Operate machine manually and lower brine temperature slowly while observing brine thermometer. 3. Allow machine to shut down on switch. 4. Switch should reclose automatically at 10 F above cutout point.
Condenser High-Pressure Cutout R-12: SETTING 165 psig, RESET 145 psig R-500: SETTING 175 psig, RESET 165 psig R-114: SETTING 55 psig, RESET 42 psig	1. Set switch if not previously set. 2. Operate machine manually and throttle condenser water until pressure reaches switch cutout point. On jobs using air-cooled condensers, check job data for high-pressure cutout setting.
Low Oil Pressure Cutout (no auxiliary oil system) OPEN: 12 - 13 psid*; CLOSE: 16 - 17 psid*	1. Operate machine and observe seal housing oil pressure, oil reservoir pressure and cooler pressure. 2. Adjust compressor oil pressure relief valve until seal housing oil pressure drops to 12 - 13 psid* and machine shuts down. Do not allow 12 - 13 psid* to drop below atmospheric. 3. If switch fails to open, check and adjust per section entitled Check Safety Control Settings. 4. Readjust oil pressure relief valve to maintain 22 - 27 psid*.
Auxiliary Oil Pump Control Pressure Switch OPEN: 20 - 21 psid*; CLOSE: 14 - 15 psid* **Low Oil Pressure Cutout (with auxiliary oil system)** OPEN: 12 - 13 psid*; CLOSE: 16 - 17 psid*	1. Operate auxiliary oil pump and adjust auxiliary oil pump relief valve as required to check cutout and cut-in points. 2. If switch requires recalibration, adjust per section entitled Check Safety Control Settings. 3. Reset auxiliary relief valve to maintain 18 - 19 psid* seal housing pressure. 4. Operate machine and set compressor oil pressure relief valve to maintain 22 - 27 psid*.
Flow Switches	1. With machine off and pumps operating, manually reduce flow and observe switch for proper opening. 2. Operate machine. Reduce flow manually. Machine should shut down at selected flow level. Flow switch bellows can freeze up on low temperature brine systems. Be sure switch operates at design temperatures.
Thermal Purge Operating and Safety Switches See Table 5 for settings.	Safety switches are factory set and do not normally require field adjustment.
Back-Pressure Valve (optional)	Set per Table 5 or 6 as applicable. Check pressure/temperature on purge gage. Avoid condensation on purge chamber.
Motor-Driven Purge Settings See Table 6 for settings.	Check compressor high-pressure cutout with a metered air supply. Set relief valve while observing discharge pressure gage provided. Set pressure regulating valve while observing suction gage provided. Suction pressure should be low enough to prevent refrigerant condensation in suction line. Set back pressure valve to provide 35 - 40 F refrigerant temperature on gage provided.
Pumpout Compressor Dual Pressurestat R-12: HIGH PRESS. Cutout 165 psig, Cut-in 105 psig; LOW PRESS. Cutout 31 psig R-500: HIGH PRESS. Cutout 190 psig, Cut-in 130 psig; LOW PRESS. Cutout 40 psig R-114: HIGH PRESS. Cutout 50 psig, Cut-in 40 psig; LOW PRESS. Cutout 3.0†	Listed settings are for water chilling duty. Low pressure cutout not required on gas condensing machines.
Pumpout Compressor Oil Safety Switch CUTOUT: 12 – 13 psid‡; CUT-IN: 16 - 17 psid‡	
Automatic Suction Damper Closed: 3 psig Open: 15 psig	With machine shut down, manually regulate branch air pressure from brine controller. Set pilot positioner to recommended range. Adjust damper control travel (in positioner) while observing indicator mark on damper shaft. Adjust controller linkage if required. Follow control manufacturer's instructions.
Automatic Hot Gas Bypass Valve Closed: 9 psig Open: 3 psig	With machine shut down, manually regulate branch air pressure from brine controller. Valve is factory adjusted. Adjust positioner on valve if required. Follow valve manufacturer's instructions. Some valves require a temperature controller. Check job data for bypass arrangement.
Liquid Level Controller(s)	Refer to sections entitled Check Level Controller Settings, and Adjusting Refrigerant Levels.

*Differential pressure — Difference between seal housing pressure and oil reservoir pressure. Do not use seal supply pressure.
†Inches of mercury below one atmosphere (Hg vac).
‡Differential pressure — Pressure above pumpout compressor suction pressure.

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Hot Alignment Check — When all machine components have reached operating temperatures (after running near full load from 4 to 8 hours), a hot alignment check must be made. With the proper equipment and procedures, hot check can be made with couplings either assembled or disassembled. Procedures are detailed in Carrier Standard Service Techniques, SM-15.

A clamping tool, Part No. TS-170 is available for checking alignment with couplings assembled. Check with your local Carrier office.

Do not remove coupling guards until rotating parts have come to a complete stop. Replace guards as soon as hot alignment check has been completed.

Doweling — To maintain coupling alignment and to ensure exact repositioning if components are moved, the compressor, gear and drive must be doweled to their soleplates.

Perform doweling only after hot alignment check has been completed. Machine must be at maximum operating temperature (full load).

The doweling procedure for compressor and drive is described in Carrier Standard Service Techniques, SM-15. Check drive manufacturer's instructions for number, size and location of drive dowels.

To Stop Machine

1. Reduce machine load as much as possible; start other machines, or reduce load by shifting to manual control and reducing the air signal to suction damper.
2. Lower drive speed to minimum position. Follow drive manufacturer's instructions for any adjustments required before shutdown.
3. Switch auxiliary oil pump to "MANUAL."
4. Push machine STOP button. Drive will immediately slow down with a change in sound level. Compressor will come to rest within a few minutes. Check drive and gear to be sure that lubrication has been maintained during coastdown.
5. After compressor has coasted to a complete stop, shut off condensing water, chilled water and gear and compressor oil pumps. Follow turbine manufacturer's postlube instructions, if any.
6. Shut off cooling water to each oil cooler after the corresponding oil pump is turned off.
7. Shut off main steam valve on turbine.
8. Leave controls energized for short shutdowns.
9. *Leave oil heater energized if refrigerant is left in machine.*

Adjusting the Refrigerant Charge — After the machine has been placed in operation, it may be necessary to adjust the refrigerant charge to obtain optimum machine performance.

When machine full load is available, add or remove refrigerant slowly until the difference between leaving chilled water temperature and the cooler refrigerant temperature reaches design conditions or becomes a minimum. *Do not overcharge.*

Adjusting Refrigerant Levels

APPLICATION — Level controllers may be supplied for one or a combination of the following duties:

1. To maintain a liquid seal in the controlled vessel.
2. To keep condenser subcooler tubes immersed in liquid.
3. To prevent immersion of condensing tubes in liquid refrigerant.
4. To minimize liquid carryover into the compressor from cooler or economizer.

DESCRIPTION — The Fisher Series 2500 level controllers normally used on 17MPS/FA machines may be either direct or reverse acting, right- or left-hand mounted, and may have an output pressure range of either 3 - 15 psi or 6 - 30 psi. To adjust the controller properly, it must be identified according to the above characteristics. Refer to Check Level Controller Settings.

ADJUSTMENT — A raise level (level set) dial and a proportional band dial within the controller (Fig. 3) permit alteration of the liquid level and the level span.

Proportional Band — This dial setting determines the amount by which the liquid level in the controlled vessel can change as machine load varies from full to minimum. Higher numbers on the dial indicate larger liquid level spans.

At machine initial start-up, set the proportional band knob at "3" on the dial. This setting will allow a level change of 4 - 5 in. as machine load varies. After machine start-up, slowly narrow the proportional band (turn to smaller number) while observing the control valve action.

Generally, the proportional band knob is placed at the lowest setting (dial number) at which control valve action remains stable. (Note that valve fluctuation over a portion of its range for one or two minutes after a load change does not indicate instability.)

On large horizontal vessels such as cooler or condenser, the liquid level changes relatively slowly as the control valve opens or closes. The proportional band can invariably be reduced below the initial start-up setting of "3" without losing valve stability.

On the other hand, small economizer chambers handling the same volume of refrigerant can fill and empty quickly. A narrow proportional band may cause erratic or excessive control valve action. If this is the case, increase the proportional band only enough to eliminate the valve instability.

Raise Level (level set) — The liquid level in the controlled vessel can be raised or lowered by moving an adjustment knob around the raise level dial (Fig. 3).

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(Be sure to loosen knob locking screw.) On a high-side control (one in which the controlled liquid level is on the inlet, or upstream, side of the control valve), a liquid level selected when machine is operating at full load will be the highest level possible at that raise level setting; a level selected at minimum machine load will be the lowest possible level at that setting.

Observe controller output pressure as machine goes thru several load changes. If the output pressure does not vary over the full 3 - 15 psi (or 6 - 30 psi) range, adjust proportional band or raise level as required.

Readjust controller if any of these conditions develop in the controlled vessel or the vessel affected by controller action: liquid carryover into compressor, loss of liquid seal, immersion of condensing tubes in liquid or loss of immersion of subcooler tubes.

PUMPOUT PROCEDURES

General — The pumpout unit is used for refrigerant transfer and for machine evacuation. It may also be used for removal of contaminants. (See Distill Refrigerant Charge.)

Machines not containing refrigerant may be pressurized with the pumpout unit. Since the pressurizing agent is unprocessed air, some moisture and contaminants can be introduced into the machine by this method. Pressurizing with dry air or nitrogen is therefore recommended.

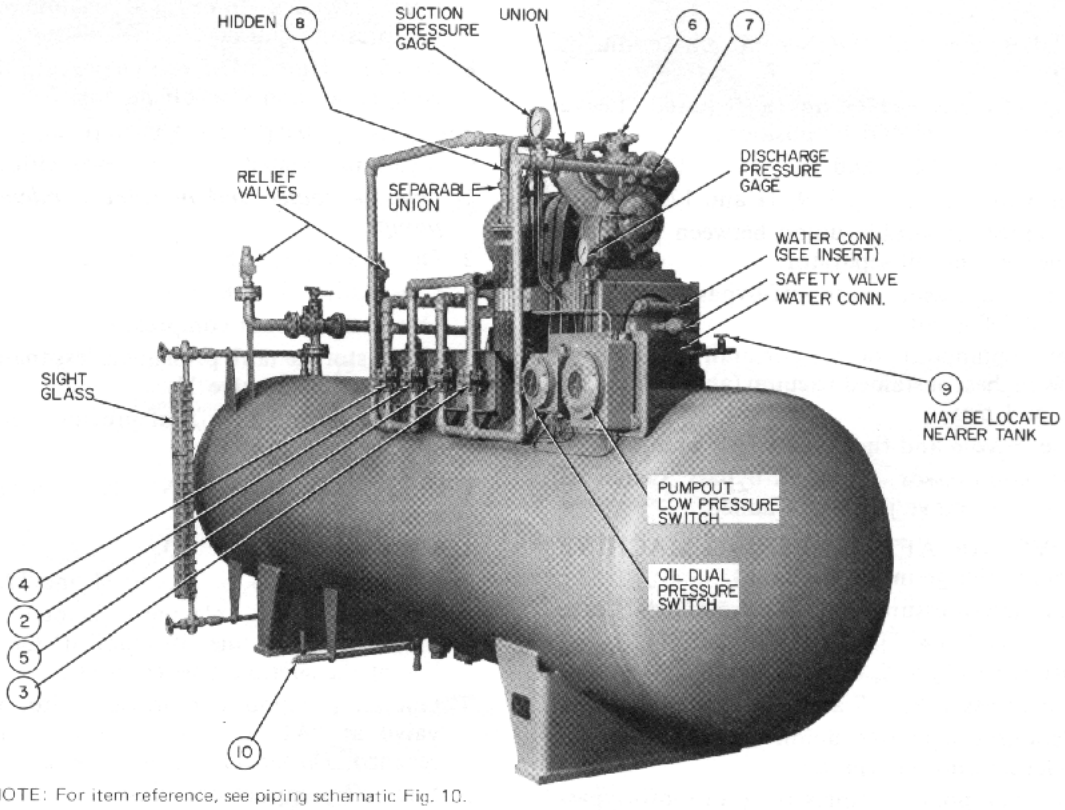
Pumpout procedures for open-drive (5F) and hermetic (6D) units are given. Procedures are based on typical piping arrangements. Check your job for any deviation which might affect procedures.

Pumpout Adjustments

LUBRICATION — Pumpout compressors are factory charged with oil in the following quantities: 5F20 open-drive, 5 pt; 5F40 open-drive, 12 pt; 6D21 hermetic, 3.5 pints. Oil level should be at center of sight glass when compressor is in shutdown condition. *Always check oil level before operating compressor.* Added oil must meet Carrier's specifications for reciprocating compressor usage. On open-drive (5F) units, refer to motor manufacturer's instructions for motor lubrication.

CONTROL DESCRIPTION — The open-drive (5F) pumpout unit is supplied with a dual pressurestat and an oil safety switch. The hermetic (6D) unit has only a high refrigerant pressure switch. Cut-in and cutout settings for each switch are listed on the job Electrical and Pneumatic Control drawing.

CONTROL SETTING — Set the 5F oil safety switch and the compressor dual pressurestat at the pressures listed in the job data by using a metered supply of air. The high-pressure switch setting may be checked by operating the pumpout compressor and throttling the pumpout condenser water. *Exercise care in performing check in this manner.*



NOTE: For item reference, see piping schematic Fig. 10.

Fig. 9 — Pumpout Unit (Typical Earlier Model 5F Unit)

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Pumpout Procedures, Earlier Model 5F Units (Fig. 9 and 10) — The 5F units without vent valve or charging connection normally use field-installed auto.-off-bypass switch for pumpout control. The "BYPASS" position allows compressor operation at the low pressures required for machine evacuation and air removal.

If the unit is not equipped with the bypass circuit, the pumpout compressor low-pressure cutout must be jumped as noted in the following procedures.

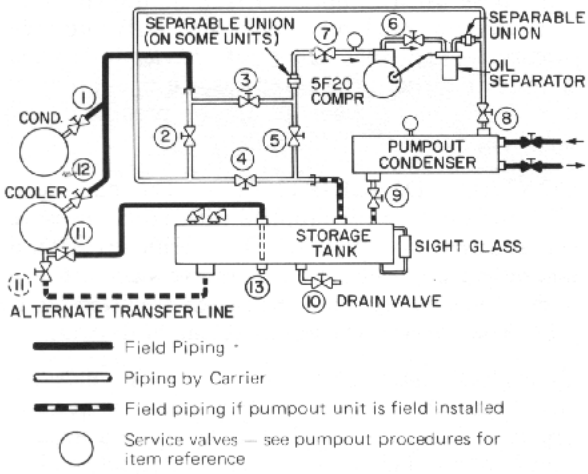

Fig. 10 — Pumpout Unit Piping, 5F Unit without Vent Valve or Charging Connection (Earlier Model)

MACHINE EVACUATION (no refrigerant in system)

1. Jump low-pressure cutout if required. Leave control switch at "OFF" position.
2. Close valves 2, 4, 8 and 10.
3. Open valves 1, 3, 5, 6, 7, 9, 11 and 12.
4. Disconnect separable union between pumpout condenser and oil separator.
5. Start compressor (auto.-off-bypass switch at "BYPASS" position).
6. Operate pumpout compressor until suction gage reads highest sustained vacuum (about 28 in. Hg vac, or 1 psia).
7. Close valve 6 and then reassemble union.
8. Stop compressor (auto.-off-bypass switch at "OFF.") Remove jumper, if added.

REMOVE AIR AFTER OPENING MACHINE (refrigerant charge in storage tank)

1. Jump low-pressure cutout if required. Leave control switch at "OFF" position.
2. Close valves 2, 4, 5, 8, 9, 10 and 11.
3. Open valves 1, 3, 6, 7 and 12.
4. Disconnect separable union between pumpout condenser and oil separator.
5. Start pumpout compressor (auto.-off-bypass switch at "BYPASS" position).
6. Operate pumpout compressor until suction gage reads highest sustained vacuum (about 28 in. Hg vac, or 1 psia).
7. Close valve 6 and then reassemble union.
8. Stop compressor (auto.-off-bypass switch at "OFF). Remove jumper, if added.

TRANSFER REFRIGERANT (from storage tank to machine)

1. *Operate cooler water pump.*
2. Open valves 3, 4, 6, 7 and 12.
3. Close valves 1, 2, 5, 8, 9, 10 and 11.
4. Operate pumpout compressor (auto.-off-bypass switch at "AUTO.").
5. Open valve 11 when cooler pressure is less than storage tank pressure and refrigerant will flow readily into machine.
6. Shut valve 11 when refrigerant reaches mark on cooler sight glass. Turn off compressor.

TRANSFER REFRIGERANT (from machine to storage tank located below machine)

1. Vent storage tank to machine by opening valves 1, 2, 4 and 12.
2. Open valve 11 and drain cooler liquid.
3. *Operate cooler water pump.*
4. Open valves 3, 6, 7, 8 and 9.
5. Close valves 2, 4, 5, 10 and 11.
6. Run cooling water thru pumpout condenser.
7. Operate pumpout compressor with auto.-off-bypass switch at "BYPASS" position (or jumper low-pressure cutout).
8. At 25 in. Hg vac (2.5 psia) close all valves, stop compressor and shut off pumps.

TRANSFER REFRIGERANT (from machine to storage tank located above or level with machine)

1. *Operate cooler and machine condenser water pumps.*
2. Open valves 1, 2, 5, 6, 7 and 12.
3. Close valves 3, 4, 8, 9, 10 and 11.
4. Operate pumpout compressor.
5. When storage tank pressure is less than machine pressure, open valve 11.
6. Follow steps 3 thru 8 of previous machine-to-storage tank procedure.

PRESSURIZE MACHINE (no refrigerant in system)

1. Close valves 3, 5 and 10.
2. Open valves 2, 4, 6, 7, 8, 9, 11 and 12.
3. Disconnect separable union in pumpout compressor suction line, if supplied. Or open the line at the suction gage connection.
4. Operate pumpout compressor (auto.-off-bypass valve at "AUTO.") until desired pressure is reached. *Do not exceed test pressure* (Table 5).
5. Shut off pumpout compressor.
6. Reassemble union.

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DISTILL REFRIGERANT CHARGE — Water and impurities can be removed from the refrigerant while transferring the charge from storage tank to machine as follows:

1. *Operate cooler and machine condenser water pumps.*
2. Open valves 1, 2, 5, 6, 7 and 12.
3. Close valves 3, 4, 8, 9, 10 and 11.
4. Operate pumput compressor (auto.-off-bypass switch at "AUTO." position).
5. When all liquid refrigerant has been removed from storage tank, stop pumpout compressor, and close valves 1, 2, 5, 6, 7 and 12.
6. Open valve 10 and sump drain 13. Drain water and impurities. *Keep storage tank above 0 psig.*
7. Close valve 10 and sump drain 13.

If, after distilling, there is excess refrigerant in the cooler over the normal operating charge, return the excess to the storage tank by the procedure, Transfer Refrigerant from Machine to Storage Tank.

Pumpout Procedures, Later Model 5F Units (Fig. 11). — The 5F units equipped with vent valve (8) and charging valve (13) use a factory-installed hand-off-auto. switch for pumpout control. The "HAND" position allows pumpout compressor operation at the low pressures required for machine evacuation and air removal by electrically bypassing the low-refrigerant pressure safety switch.

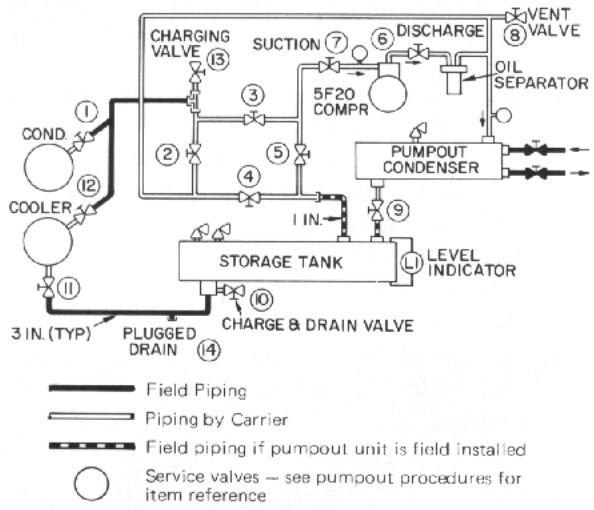


Fig. 11 — Pumpout Unit Piping, 5F Unit with Vent Valve and Charging Connection

MACHINE EVACUATION (no refrigerant in system)

1. Place control switch in "OFF" position.
2. Close valves 2, 4, 9, 10 and 13.
3. Open valves 1, 3, 5, 6, 7, 8, 11 and 12.
4. Start pumpout compressor (control switch at "HAND" position).
5. Operate pumpout compressor until suction gage reads highest sustained vacuum (about 28 in. Hg vac, or 1 psia).
6. Close valve 8.
7. Stop compressor (control switch at "OFF").

REMOVE AIR AFTER OPENING MACHINE (refrigerant charge in storage tank)

1. Place control switch in "OFF" position.
2. Close valves 2, 4, 5, 9, 10, 11 and 13.
3. Open valves 1, 3, 6, 7, 8 and 12.
4. Start pumpout compressor (control switch at "HAND" position).
5. Operate pumpout compressor until suction gage reads highest sustained vacuum (about 28 in. Hg vac, or 1 psia).
6. Close valve 8.
7. Stop compressor (control switch at "OFF").

TRANSFER REFRIGERANT (from storage tank to machine)

1. *Operate cooler water pump.*
2. Open valves 3, 4, 6, 7 and 12.
3. Close valves 1, 2, 5, 8, 9, 10, 11 and 13.
4. Operate pumpout compressor (control switch at "AUTO.").
5. Open valve 11 when cooler pressure is less than storage tank pressure and refrigerant will flow readily from storage tank to machine.
6. Shut valve 11 when refrigerant level reaches mark on cooler sight glass. Turn off compressor.

TRANSFER REFRIGERANT (from machine to storage tank located below machine)

1. Vent storage tank to machine by opening valves 1, 2, 4 and 12.
2. Open valve 11 and drain liquid from cooler.
3. *Operate cooler water pump.*
4. Open valves 3, 6, 7 and 9.
5. Close valves 2, 4, 5, 10, 11 and 13.
6. *Run cooling water thru pumpout condenser.*
7. Operate pumpout compressor with control switch in "HAND" position.
8. At 25 in. Hg vac (2.5 psia) in cooler, close all valves, stop compressor and shut off pumps.

TRANSFER REFRIGERANT (from machine to storage tank located above or level with machine)

1. *Operate cooler and machine condenser water pumps.*
2. Open valves 1, 2, 5, 6, 8 and 12.
3. Close valves 3, 4, 6, 7, 9, 10, 11 and 13.
4. Operate pumpout compressor (control switch at "AUTO.").
5. When storage tank pressure is less than machine pressure, open valve 11.
6. Follow steps 3 thru 8 of machine-to-storage tank transfer procedure above.

Contents

PRESSURIZE MACHINE (no refrigerant in system)

1. Close valves 1, 2, 5, 8, 10 and 12.
2. Open valves 3, 4, 6, 7, 9, 11 and 13.
3. Operate pumpout compressor (control switch at "AUTO.") until desired pressure is reached. *Do not exceed test pressure listed in Table 9.*
4. Stop pumpout compressor (control switch at "OFF").
5. Close valve 13.

DISTILL REFRIGERANT CHARGE — Water and impurities can be removed from the refrigerant while transferring the charge from storage tank to machine as follows:

1. Operate cooler and machine condenser water pumps.
2. Open valves 1, 2, 5, 6, 7 and 12.
3. Close valves 3, 4, 8, 9, 10, 11 and 13.
4. Operate pumpout compressor (control switch at "AUTO." position).
5. When all liquid refrigerant has been removed from storage tank, stop pumpout compressor, and close valves 1, 2, 5, 6, 7 and 12.
6. Open valve 10 and plugged drain connection 14. Drain water and impurities. Do not allow storage tank pressure to drop below 0 psig.
7. Close valve 10 and plugged drain connection 14.

If, after distilling the refrigerant, there is excess refrigerant in the cooler over the normal operating charge, return the excess to the storage tank. Follow the procedure, Transfer Refrigerant from Machine to Storage Tank.

CHARGE REFRIGERANT — The pumpout unit can aid in charging refrigerant into a dehydrated machine as follows:

Remove Noncondensable Gases (if present) — Follow the machine evacuation procedure described on page 19.

Make Connections — Using temporary charging lines, connect the vent of the refrigerant supply cylinder to valve 13 and the cylinder liquid drain to valve 10. Purge the lines as final connection is made to the valves.

Charge Liquid Refrigerant

1. Close valves 1, 3, 8, 9, 11 and 12.
2. Open valves 2, 4, 5, 6, 7, 10 and 13.
3. Drain any remaining liquid by raising cylinder pressure above storage tank pressure. Close valve 4 and operate pumpout compressor with control switch in "HAND" position.

Charge Refrigerant Vapor

1. Close valves 1, 2, 4, 5, 8, 10, 11 and 12 and stop pumpout compressor.
2. Open valves 3, 6, 7, 9 and 13.
3. *Run cooling water thru pumpout condenser.*
4. Operate pumpout compressor with control switch in "HAND" position.
5. At 25 in. Hg vac (2.5 psia) in supply cylinder, close all valves, stop compressor and disconnect temporary charging lines.

Table 9 — Refrigerant Test Pressures

REFRIG	MAX TEST PRESSURE With Relief		MAX TEST PRESSURE Without Relief		RELIEF SETTING*		
	Psig	Kg/sq cf	Psig	Kg/sq cm	Psig	Kg/sq cm	Equipment Name
R-11	10	.28	30	2.1	15	1.05	–
R-12	125	8.75	150	10.5	185	12.95	Stor. Tank
					150	10.5	Cooler
R-22	150	10.5	185	12.95	250	17.5	Cooler
					300	21.0	Stor. Tank
R-114	30	2.1	50	3.5	50	3.5	Cooler
					60	4.2	Stor. Tank
R-500	125	8.75	150	10.5	150	10.5	Cooler
					225	15.75	Stor. Tank

*Standard relief settings on Carrier machine components. Check your job data when compressor is applied with other equipment.

6D Pumpout Procedures (Fig. 12)

Valve condition at start of each procedure: valves 1, 9, 11 and 12 open; all other valves closed.

EVACUATE REFRIGERATION MACHINE (no refrigerant in system)

1. If machine is pressurized, vent pressurizing gas to atmosphere thru purge vent valve on condenser. When machine pressure reaches 0 psig, close vent valve.
2. Attach absolute pressure manometer to open connection on cooler or condenser.
3. *Turn on pumpout condenser water.*
4. Remove flare cap and crack open valve 8. *Vent refrigerant slowly to avoid water freeze-up in pumpout condenser.*
5. Turn off pumpout condenser water.
6. Open valve 3.
7. Operate pumpout compressor until manometer reads 26 in. Hg vacuum, ref 30-in. bar. (2 psia).
8. Close valve 3.
9. Shut off pumpout compressor.
10. Close valve 8 and replace flare cap.

EVACUATE STORAGE TANK

1. If tank is pressurized, vent pressurizing gas thru valve 10 until tank pressure reaches 0 psig.
2. Attach absolute pressure manometer to valve 10.
3. *Turn on pumpout condenser water.*
4. Remove flare cap and crack open valve 8. *Vent any refrigerant slowly to avoid water freeze-up in pumpout condenser.*
5. Turn off pumpout condenser water.

Contents

6. Open valves 5 and 6.
7. Operate pumpout compressor until manometer reads 26 in. Hg vacuum, ref 30-in. bar. (2 psia).
8. Close valves 5 and 6.
9. Turn off pumpout compressor.
10. Close vent valve 8 and replace flare cap.

TRANSFER REFRIGERANT FROM STORAGE TANK TO MACHINE

Equalize refrigerant pressure.

1. Be sure pumpout valve 8 is closed.
2. Open valves 3 and 6 (valve 1 is already open).
3. Turn on machine water pumps.
4. Crack open valve 5 and slowly increase machine pressure to 45 psig. Feed refrigerant slowly to avoid tube freeze-up.
5. Open valve 5 fully and open liquid line valve 7 until refrigerant pressure equalizes.

Transfer remaining refrigerant.

1. Close valve 5.
2. Open valve 4.

TRANSFER REFRIGERANT FROM MACHINE TO STORAGE TANK

Equalize refrigerant pressure.

1. Open valves 3 and 6 (valve 1 is already open).
2. Open valves 5 and 7 to allow refrigerant liquid to drain into storage tank.

Transfer remaining liquid.

1. Be sure that pumpout condenser water is off.
2. Open valve 2.
3. Close valve 3.
4. Run pumpout compressor for 30 minutes; then close valve 7.
5. Turn off pumpout compressor.

Remove any entrapped refrigerant.

1. *Run machine water pumps.*
2. Close valves 2 and 5.
3. Turn on pumpout condenser water (machine water pumps also running).
4. Open valves 3 and 4.
5. Run pumpout compressor until machine pressure drops to 45 psig. Warm condenser water will boil off any entrapped liquid refrigerant and machine pressure will rise.
6. When machine pressure rises to 50 psig, repeat step 5. Continue until pressure no longer increases; then pump out to 0 psig.
7. Close valves 3, 4 and 6.
8. Turn off pumpout condenser water and machine water pumps.

Establish vacuum for service.

Machine may be opened for service at 0 psig (condition described in step 6 above). To conserve refrigerant, pumpout compressor may be operated until machine pressure drops to 22 in. Hg vacuum, ref 30-in. bar. (4 psia) in step 6 above.

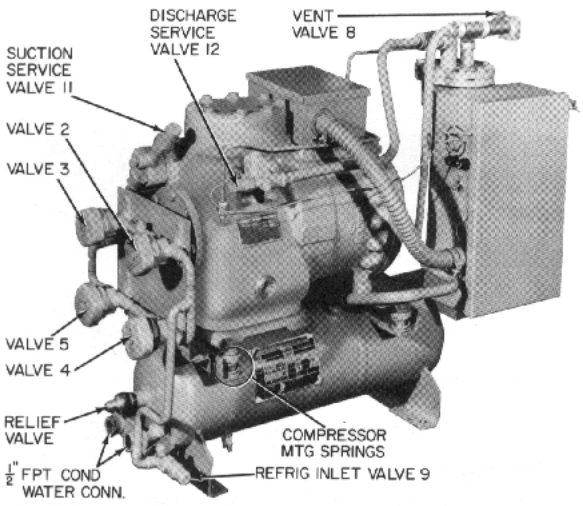
INSTRUCTING THE OPERATOR

Be sure the machine operator understands the 17MPS/FA Operating and Maintenance Instructions and all instructions on drive and gear.

Point out the following machine components and explain their function:

Cooler-Condenser-Economizer

Suction, discharge and economizer gas lines
Float chambers and float valves
Sight glasses
Level controls and bypass valve (if supplied)
Thermowells, gage and control connections



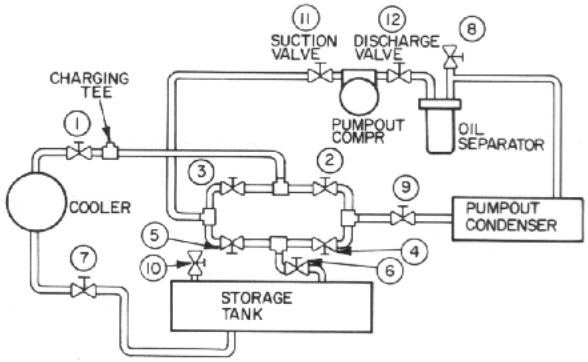


Fig. 12 — 6D Pumpout Unit and Piping Schematic (Typical)

Contents

Relief valves, refrigerant charging valve
Gage and control connections
Safety switch operation and location

Compressor Assembly

Suction damper
Contact seal, labyrinth gas seal
Gage and pressure connections
Stage drains
Inspection covers

Compressor Lubrication System

Oil pump cooler, filters
Oil cooler solenoid valve, plug valve
Oil heater, thermostat, temperature gages
Oil-charge quantity and specification
Oil level, temperature, pressure
Seal oil return pump and oil fill connection

Purge System

Importance of proper operation
Valves, operating and safety switches
Sight glasses, gage, orifice-strainer

Storage Tank

Transfer valves and pumpout procedures
Relief valves, refrigerant charging valve
Sight glass, gages

Control System

Manual switches and start-stop sequences
Gages and indicating lights
Safety and operating controls
Auxiliary and special controls

Auxiliary Equipment

Starters and disconnects
Pumps, valves, vents and drains
Cooling tower and water treatment
Auxiliary oil pump system

Drive Equipment

Motor, turbine, gear maintenance
Importance of coupling guards

Describe Refrigeration and Lubrication Cycles

Review Maintenance

Scheduled, extended shutdown, troubleshooting
Importance of log sheet, water treatment

Check Operator Knowledge

Start-stop procedure, safety and operating controls

Discuss Carrier Service

Availability, spare parts list, how to order parts

Book	2
Tab	5d

Form 17MPS-3SS Supersedes 17MPS-2SS Printed in U.S.A. 1-79 PC 211 Catalog No. 531-736

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