Number One Air Conditioning Maker

Carrier®

Division of Carrier Corporation

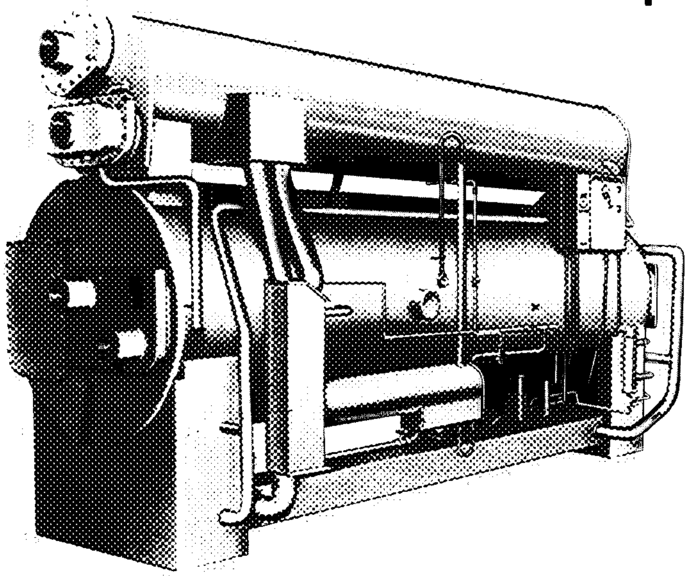
Carrier Parkway • Syracuse, N Y 13221

Start-up, Operation and Maintenance Instructions

16JB

010 thru 124

Hermetic Absorption Liquid Chillers



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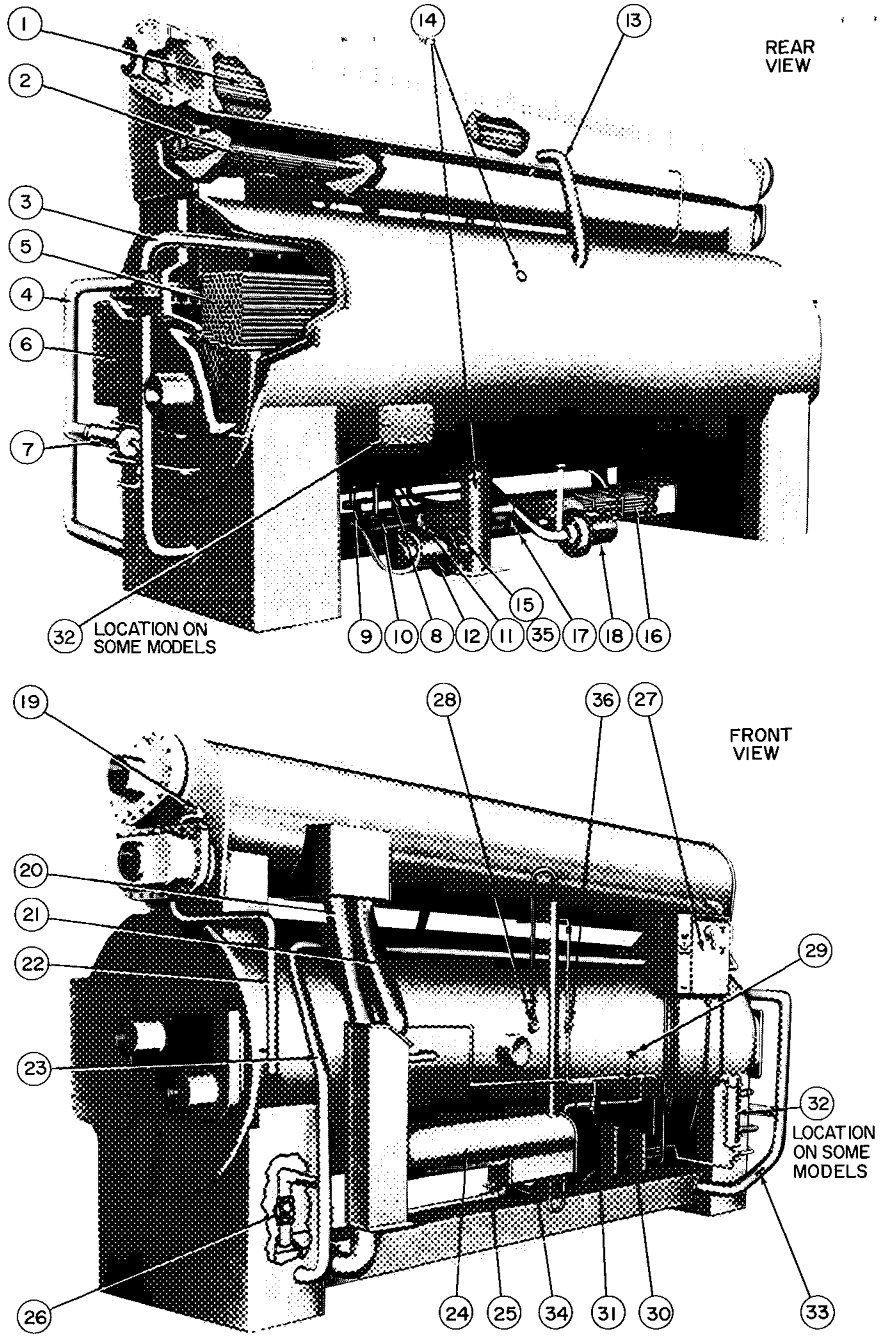
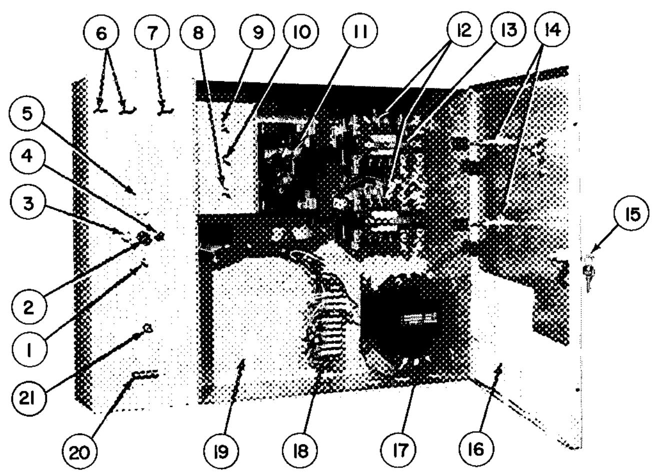


LEGEND

1 — Condenser Tubes
2 — Generator Tubes
3 — Refrigerant Spray Header
4 — Solution Spray Header
5 — Evaporator Tubes
6 — Absorber Tubes (Hidden)
7 — Absorber Valve (on some models)
8 — Cycle-Guard™ Indicator Light
9 — Low Refrigerant Level Switch
10 — Shutdown Dilution Switch (on some models)
11 — Refrigerant Pump Service Valve
12 — Refrigerant Pump
13 — Refrigerant Condensate Line
14 — Refrig Low-Temp Cutout Well (some models: on evaporator shell) (some models: on refrigerant pump sump)
15 — Cycle-Guard Valve (Hidden)
16 — Heat Exchanger
17 — Solution Pump Service Valve
18 — Solution Pump
19 — Steam Box Vacuum Breaker
20 — Strong Solution Line
21 — Strong Solution Overflow Line
22 — Steam Condensate Line
23 — Weak Solution Line
24 — Purge Storage Chamber
25 — Purge Solution Return Valve
26 — Flotender™ Valve (on some models)
27 — Control Center
28 — Purge Exhaust Valve
29 — Auxiliary Evacuation Valve
30 — Absorber Purge Device
31 — Condenser Purge Device
32 — Refrigerant Level Control (some models on evaporator shell) (some models: on tube sheet or leg)
33 — Thermoswitch Wells (2)
34 — Purge Level Switch
35 — Low-Level Control Extender Valve (Hidden — on some models only)
36 — Purge Valve (on some models)

Fig. 1 — Typical Machine Components



LEGEND

1 — Cycle-Guard Switch
2 — Control Circuit Fuse
3 — Run Light
4 — Exhaust Purge Light
5 — START-STOP Switch
6 — Thermoswitches (2, Hidden)
7 — Low Refrig Temp Switch (Hidden)
8 — Capacity Control Switch
9 — Solution Pump Switch
10 — Refrigerant Pump Switch
11 — Fused Disconnect Switch
12 — Refrig and Solution Pump Starters
13 — Ambient Compensated Overloads
14 — Starter Resets
15 — Keyed Panel Lock
16 — Wiring Diagram
17 — Multitap Voltage Transformer
18 — Terminal Strip
19 — Capacity Control Adjuster (Not Shown)
20 — Elapsed Time Indicator
21 — RESET Switch

NOTE: On some models, a combined START-STOP-RESET switch is used

Fig. 2 — Control Center Components (Typical)

PREFACE

This book provides information for all standard Model 16JB absorption chillers. Variations in machine components or control design are noted wherever applicable.

Refer to the following pages for:

Initial Start-Up Procedures . . . . pages 13 thru 21
Operating Instructions . . . . pages 22 and 23
Machine Maintenance . . . . pages 24 thru 33
Troubleshooting . . . . pages 34 thru 36
General Data . . . . pages 2 thru 12

SOME SAFETY REMINDERS

1. Open electrical disconnects when servicing equipment. Confirm that circuit has been de-energized. Place safety tag on open disconnect to prevent tampering; lock open if possible. If work is interrupted, confirm that disconnect is open before resuming.
2. Do not exceed recommended pressures when leak testing.
3. Lithium bromide solution is nontoxic but can irritate eyes and skin. Wash off any solution with soap and water. If any enters the eye, wash eye with fresh water and consult a physician immediately.
4. When welding or flamecutting, ventilate the area to remove any noxious fumes.
5. Before flamecutting purge chamber, exhaust purge to eliminate any hydrogen that might be present.

MACHINE DESCRIPTION

Basic Absorption Cycle — The 16JB absorption chiller uses water as the refrigerant in vessels maintained under a deep vacuum. The chiller operates on the simple principle that under low absolute pressure (vacuum), water takes up heat and vaporizes (boils) at a low temperature. For example: at .25 in. of mercury absolute pressure, water boils at 40 F. To obtain the energy required for boiling, it takes heat from, and therefore chills, another fluid (usually water). The chilled fluid can then be used for cooling purposes.

To make the cooling process continuous, the vaporized refrigerant water is absorbed by a lithium bromide-water solution. The removal of refrigerant vapor by absorption keeps machine pressure low enough for vaporization to continue.

The diluted lithium bromide solution is then pumped to a separate vessel where it is heated by steam or hot water to release the absorbed water vapor. Relatively cool condensing water from an outside source removes enough heat from the vapor to condense it again into liquid for reuse in the cooling cycle. The reconcentrated lithium bromide solution is returned to the absorber vessel to continue the absorption cycle.

Machine Construction — An upper and a lower shell (Fig. 1) contain the 4 major sections of the absorption machine: evaporator, absorber, generator and condenser.

The lower shell contains the evaporator section and the absorber section. In the evaporator, the refrigerant water vaporizes and in doing so, cools the fluid used in the air conditioning or cooling process. In the absorber section, the vaporized water is absorbed by lithium bromide solution.

The upper shell contains the generator section and the condenser section. Diluted lithium bromide solution is heated and reconcentrated in the generator. The water vapor released in the reconcentration process is condensed to liquid in the condenser section.

The 16JB absorption chiller also has a solution heat exchanger to improve operating economy; an external purge system to maintain machine vacuum by the removal of noncondensables; 2 hermetic pumps to circulate the solution and the refrigerant; and various operation, capacity and safety controls to provide reliable machine performance.

Flow Circuits — Figure 3 illustrates the basic flow circuits of the Carrier 16JB absorption chiller.

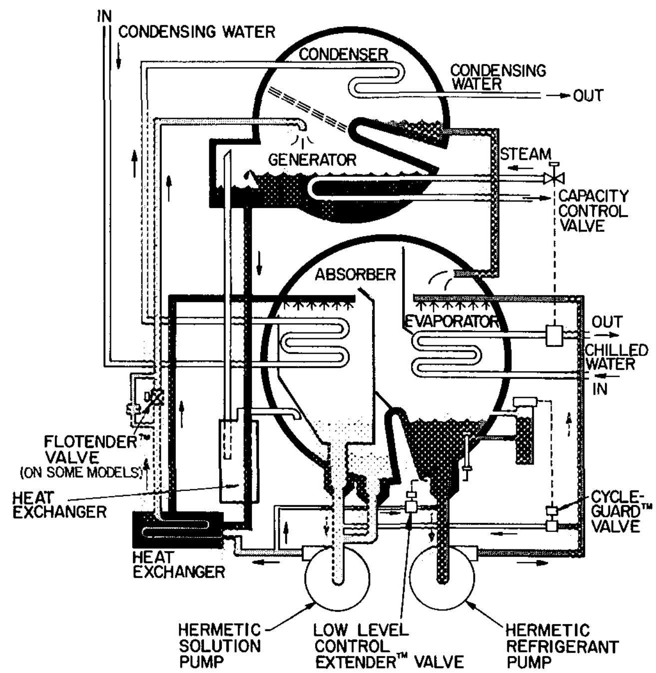


Fig. 3 — 16JB Flow Circuits (With Low-Level Control)

The liquid to be chilled is passed thru the evaporator tube bundle and is cooled by the evaporation of refrigerant water sprayed on the outer surface of the tubes. The refrigerant vapors are drawn into the absorber section and are absorbed by lithium bromide-water solution sprayed on the absorber tubes. The heat picked up from the chilled liquid is transferred from the absorbed vapor to condensing water flowing thru the absorber tubes.

The solution in the absorber becomes diluted as it absorbs water. It is therefore pumped into the generator section to be reconcentrated. In the generator, the weak (diluted) solution is heated by steam or hot water to boil out the absorbed refrigerant water. The resulting refrigerant vapor passes into the condenser section and condenses on tubes containing cooler condensing water. The condensed refrigerant liquid now flows back to the evaporator to begin a new refrigerant cycle.

The reconcentrated (strong) solution flows from the generator back to the absorber to begin a new solution cycle. On the way, it passes thru a heat exchanger where heat is transferred from the strong solution to weak solution being pumped to the generator. This heat transfer improves solution cycle efficiency by preheating the relatively cool weak solution before it enters the generator and precooling the strong solution before it enters the absorber.

Solution Cycle and Equilibrium Diagram — The solution cycle can be illustrated by plotting it on a basic equilibrium diagram for lithium bromide in solution with water (Fig. 4).

The left scale on the diagram indicates solution vapor pressure at equilibrium conditions. The right scale indicates the corresponding saturation temperatures of the refrigerant (water).

The bottom scale represents solution concentration. For example, a lithium bromide concentration of 60% means 60% lithium bromide and 40% water by weight.

The curved lines running diagonally left to right are solution temperature lines (*not to be confused with the saturation temperature lines*). The single curved line beginning at lower right represents the crystallization line. At any combination of temperature and concentration to the right of this line, the solution begins to crystallize and restrict flow.

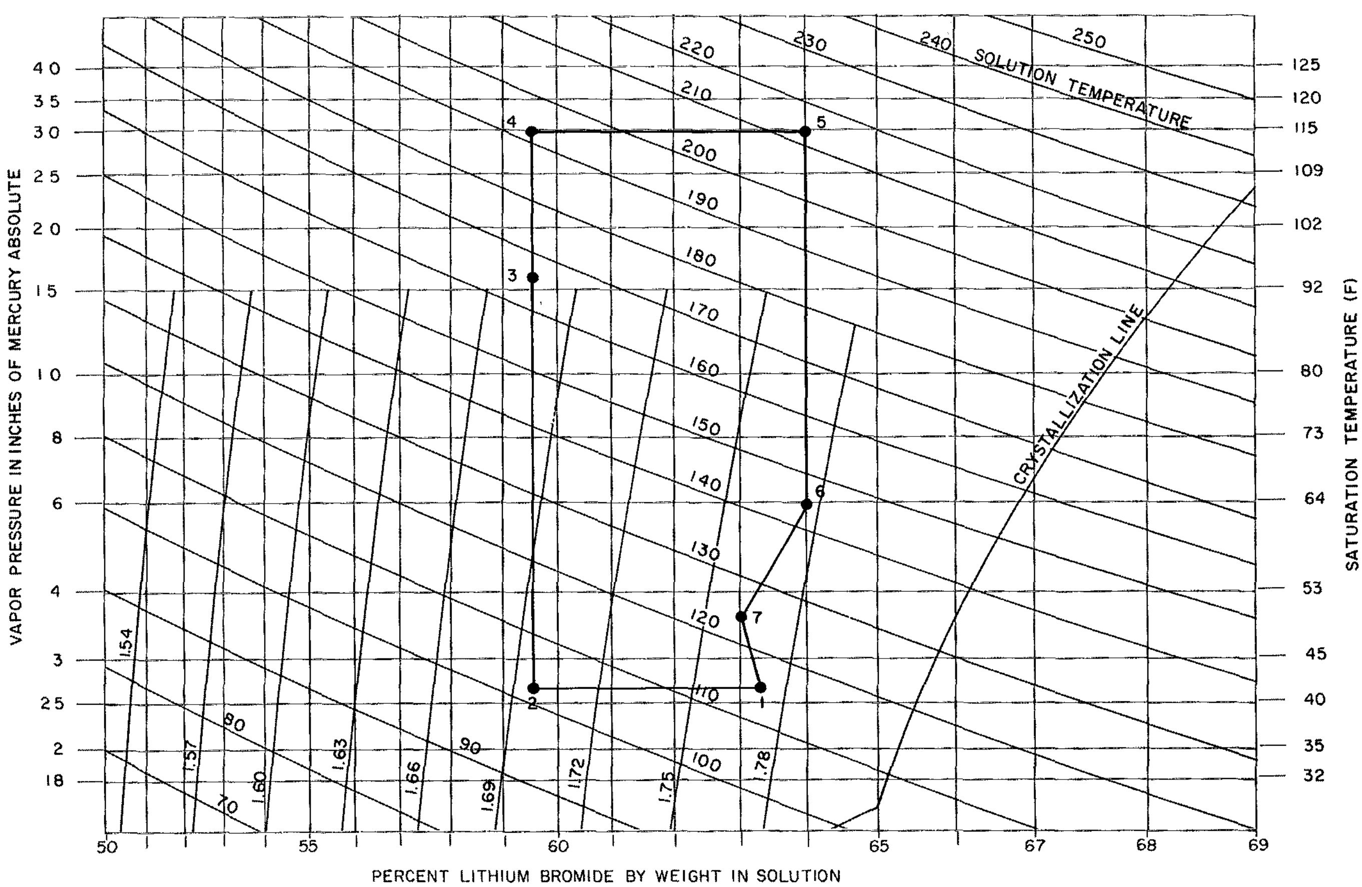
The slightly curved lines extending from the bottom of the diagram are specific gravity lines.

To determine the lithium bromide concentration, measure the specific gravity with a hydrometer, check the solution temperature and then plot the intersection point for these values on the diagram (Fig. 4). Read down to determine the % lithium bromide.

→ PLOTTING THE SOLUTION CYCLE — A typical absorption solution cycle is plotted in Fig. 4 from points 1 thru 7. Typical values for each point are given in Table 1. Note that these values will vary with different loads and operating conditions.

Point 1 represents the strong solution as it begins to absorb water vapor after being sprayed from the absorber nozzles.

Point 2 represents the diluted (weak) solution leaving the absorber and entering the heat exchanger with absorbed water vapor.



→ **Fig. 4 — Equilibrium Diagram**

Point 3 represents the weak solution leaving the heat exchanger with point 2 concentration but at a higher temperature.

Point 4 represents the weak solution in the generator after being preheated to the boiling temperature.

Point 5 represents the strong solution leaving the generator and entering the heat exchanger after being reconcentrated by boiling out refrigerant.

Point 6 represents the strong solution leaving the heat exchanger after giving up heat to the weak solution.

Point 7 represents the strong solution entering the absorber spray nozzles after being mixed with some weak solution. After leaving the nozzles, the solution is somewhat cooled and concentrated as it flashes to the lower pressure of the absorber.

→ **Table 1 — Equilibrium Cycle Data**

POINT	SOLUTION TEMP (F)	VAPOR PRESS. (in. Hg)	PERCENT LITHIUM BROMIDE SOL	SATURATED TEMP (F)
1	115	0 27	63.3	42
2	101	0 27	59 5	42
3	165	1 65	59.5	95
4	192	3 00	59.5	115
5	215	3 00	64.0	115
6	146	0 60	64.0	64
7	126	0.37	63.0	51

→ **Purge System** — The basic components and flow circuits of the 16JB motorless purge are shown in Fig. 5.

During machine operation, lithium bromide solution flows from the solution pump thru 2 transfer devices. In the absorber transfer device (A1, Fig. 5), the solution draws noncondensables from the absorber by syphon effect and is then discharged with its entrained noncondensables into the secondary heat exchanger (B, Fig. 5). Here the noncondensables separate from the solution and pass into the condenser.

The noncondensables are drawn from the condenser by the condenser transfer device (A2) and are again entrained in solution. The mixture enters the purge separation pot (C) where the noncondensables collect in a storage chamber (D) and solution flows back to the heat exchanger and absorber.

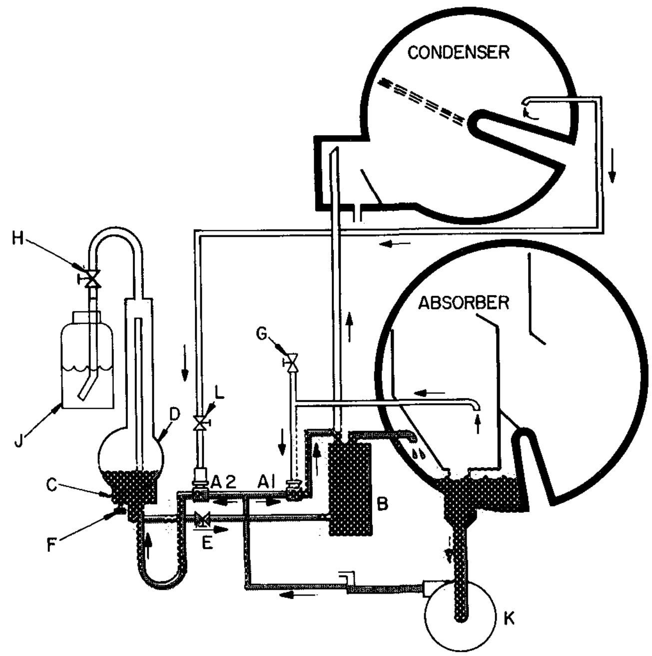
As the storage chamber fills with noncondensables, the solution level is depressed to a predetermined level near the bottom of the storage chamber. At this point, an indicator light on the machine control panel signals the need to exhaust the purge.

Purge evacuation is begun by closing the solution return valve (E) and (on later models) purge valve (L). Solution is forced into the chamber by the pump and the noncondensables are compressed to above atmospheric pressure. Exhaust valve (H) is now opened to bleed the noncondensables into exhaust bottle (J) and is then reclosed.

To return the purge to automatic operation, valve (E) is again opened to allow solution flow to the absorber and valve (L) is reopened to resume noncondensable purging.

Purge operation is automatic, motorless and continuous. The noncondensables are trapped outside the machine and cannot reenter even during shutdown.

For details of the actual Purge Exhaust Procedure, refer to the Maintenance Procedures section or to the instruction sticker on the machine.



LEGEND

A1 — Absorber Transfer Device
A2 — Condenser Transfer Device
B — Secondary Heat Exchanger
C — Separation Pot
D — Storage Chamber
E — Solution Return Valve
F — Level Indicator
G — Auxiliary Evacuation Valve
H — Exhaust Valve
J — Exhaust Bottle
K — Hermetic Solution Pump
L — Purge Valve (some models only)

Fig. 5 — 16JB Purge System

→ **Capacity Control** — A controller that senses leaving chilled water temperature governs the position of a capacity control valve. The valve, in turn, regulates the flow of steam or hot water to the generator and thus matches machine capacity to the load.

At full load conditions, the capacity control valve is wide open. As the load is reduced and chilled water temperature drops below design temperature, the valve throttles until, at no-load condition, the valve is fully closed.

Two capacity control valves are typically used on Size 16JB077 thru 124 machines. Normally, both valves open and close simultaneously. On a few applications, however, only one valve is open at low loads and, when the load increases above a predetermined point, the second valve is also energized. Both sets of pumps run at all load conditions.

The 16JB machine is available with either electronic or pneumatic capacity control.

ELECTRONIC CONTROL – A resistance thermostat measures chilled water temperature and provides a control signal. The signal is electronically amplified and is relayed to a valve motor positioner which then positions the capacity control valve as required.

The chilled water control temperature is selected manually with a control point adjuster in the machine control panel. On the 2-valve machines, Sizes 077 thru 124, the chilled water sensor positions one valve equipped with an electronic operator. A potentiometer on this first valve operator positions the electric motor operator of the second valve.

PNEUMATIC CONTROL – A pneumatic thermostat measures chilled water temperature and delivers a control signal to a pneumatic controller in the machine control panel. The pneumatic controller amplifies the control signal and generates a variable air signal for the pneumatic operator of the capacity control valve.

The chilled water control temperature is set manually on the pneumatic controller in the machine control panel. On the 2-valve machines (Sizes 077 thru 124), both capacity control valves operate from the same controller air signal.

→ **High Concentration Limit** – When the lithium bromide solution approaches overconcentration, the Cycle-Guard™ valve opens to transfer a small quantity of refrigerant into the solution circuit and thus limit the concentration. The larger machines (16JB077 thru 124) are equipped with 2 Cycle-Guard valves.

To provide step control by the Cycle-Guard device at varying condensing water temperatures, a combination of 3 refrigerant level switches and 2 solution temperature thermoswitches sense the solution concentration. The 3 level switches, located in a float chamber (item 32, Fig. 1) on the evaporator, operate on the direct relationship between refrigerant level and solution concentration. As the concentration increases, so does the refrigerant level.

The Cycle-Guard response to solution overconcentration can therefore be adjusted by setting the machine refrigerant level. This is done by trimming the refrigerant charge at machine initial start-up and whenever any solution or refrigerant has been removed from the machine.

→ **Low Concentration Control** – Low condensing water temperatures can cause overdilution of the solution in the absorber, with a resultant drop in the evaporator refrigerant level. To prevent overdilution and loss of refrigerant level, the absorber valve (item 7, Fig. 1), on some models, or the refrigerant low-level control Extender™ valve (item 35, Fig. 1), on other models, limits the dilution of the lithium bromide solution and maintains enough refrigerant in the evaporator circuit to prevent refrigerant pump cavitation. On some models, a Flotender™ valve (item 26, Fig. 1) reduces solution flow thru the generator at part load in order to increase the solution concentration.

The absorber valve is a modulating bypass valve that limits dilution by reducing solution flow from generator to absorber when the operating refrigerant level is low. The bypass valve is activated by refrigerant pump discharge pressure and is regulated by a level controller (item 32, Fig. 1) in the refrigerant float chamber.

The low-level control Extender system (item 35, Fig. 1) includes a solenoid valve that is activated by a refrigerant level switch. When refrigerant level is low, this valve transfers a small amount of lithium bromide to the refrigerant circuit. The lithium bromide increases the liquid volume in the evaporator and balances the relative saturation conditions in the absorber and evaporator.

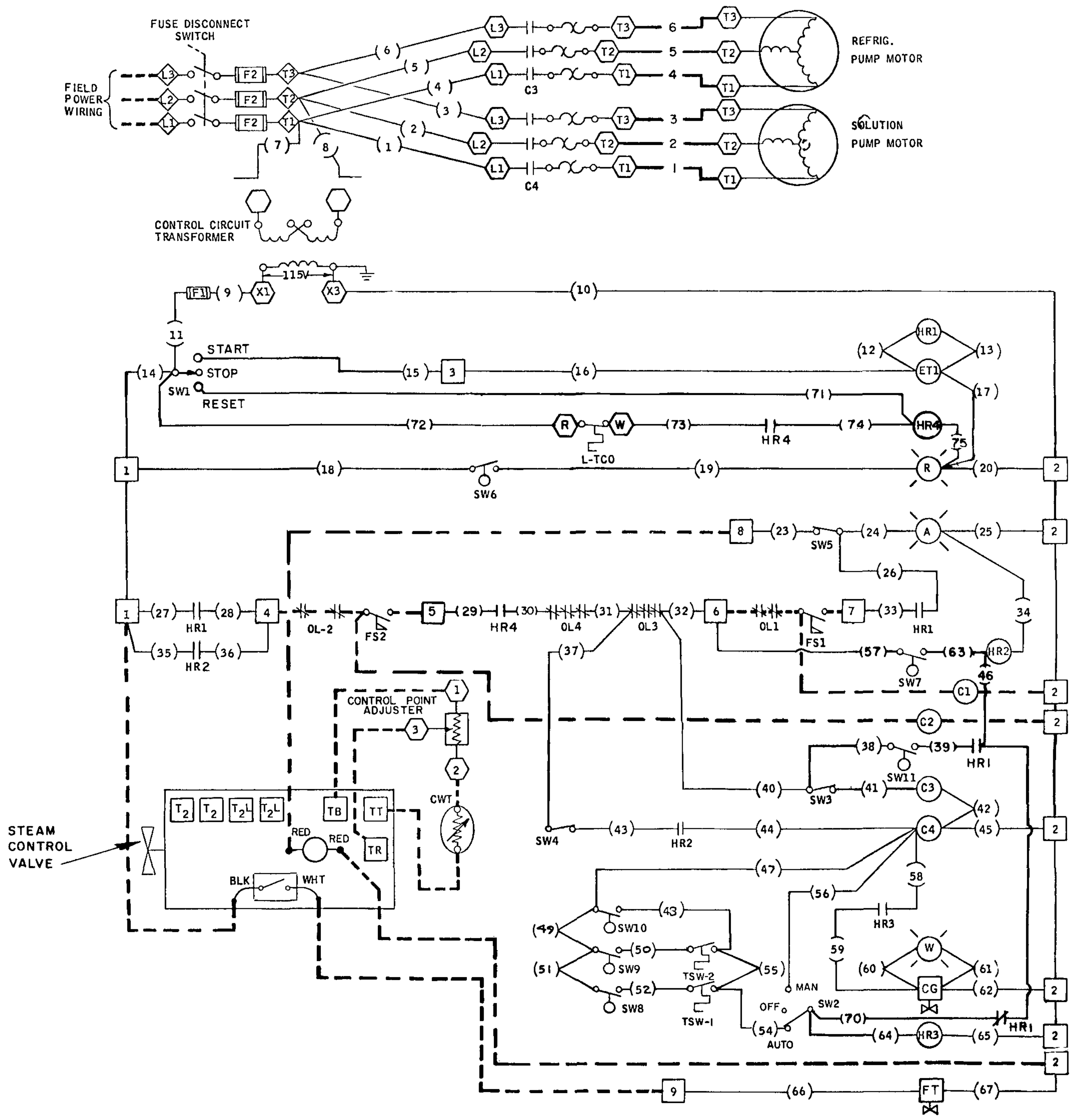
Under normal conditions, the concentration of lithium bromide in the refrigerant is adjusted automatically by changes in the volume of refrigerant without any transfer of lithium bromide into or out of the evaporator.

→ **Control Wiring** – Several control and wiring variations have been used on 16JB machines. Typical wiring diagrams for 3 basic control arrangements are presented as follows:

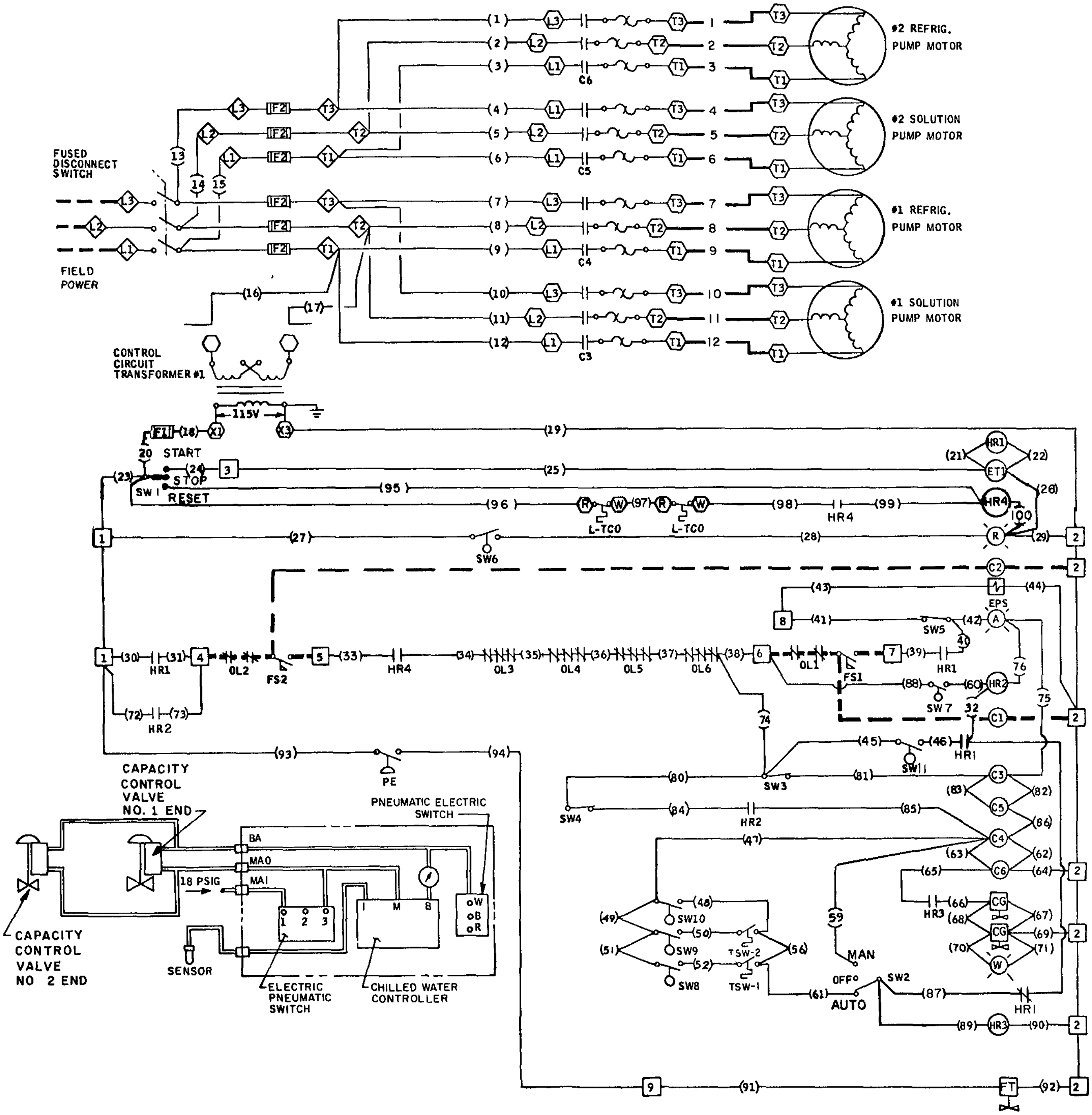
CONTROL ARRANGEMENT	CAPACITY CONTROL	
	Electronic	Pneumatic
Reset on START-STOP Switch	Fig 6	Fig 7
Separate reset switch	Fig 8	Fig. 9
Low-level control Extender	Fig 10	Fig 11

COMBINED LEGEND (Fig. 6 thru 11)

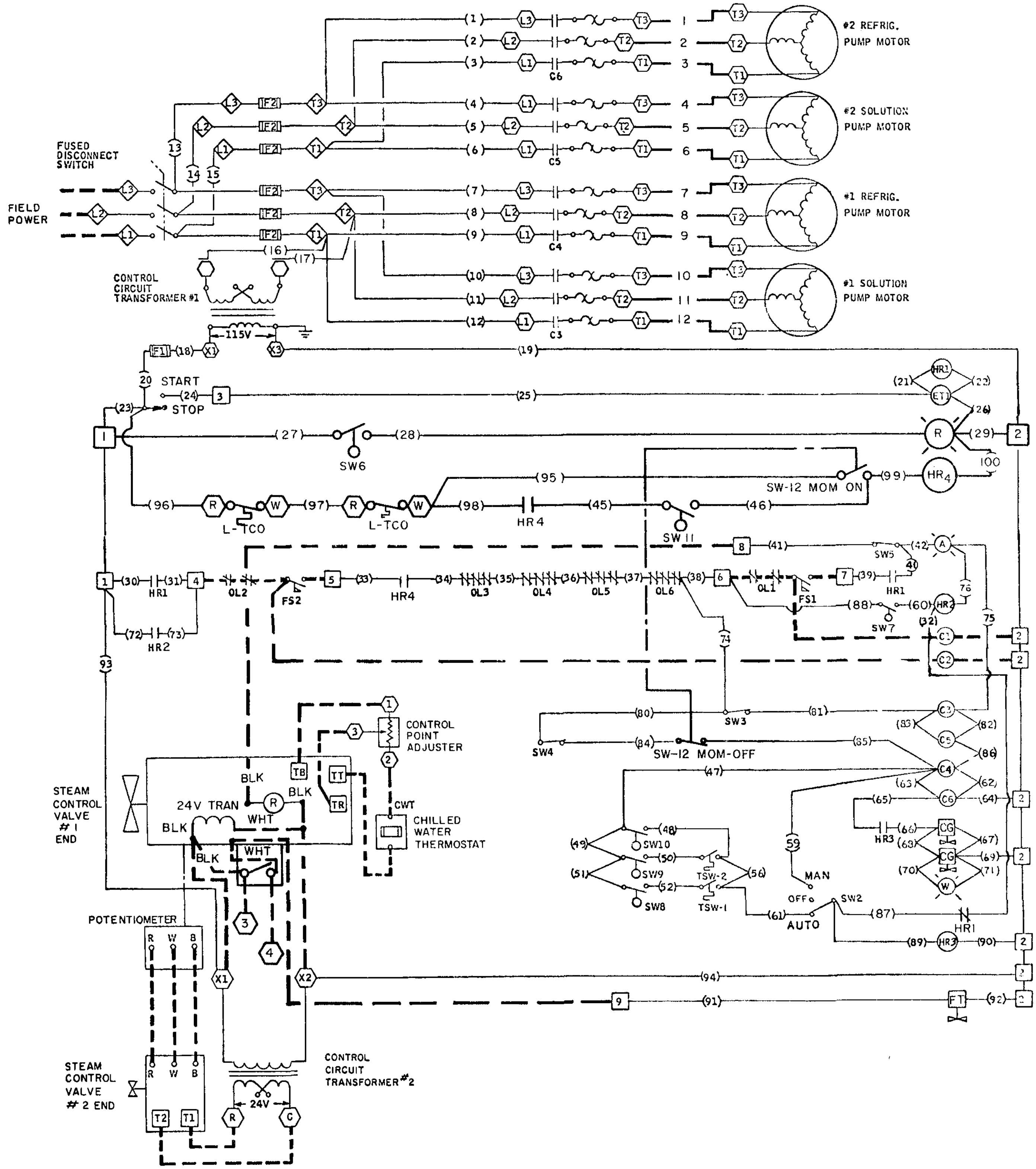
A	– Run Light	**FS_2**	– Flow Switch, Chilled Water	**SW_4**	– Refrigerant Pump Switch
BA	– Branch Air	**FDS**	– Fuse Disconnect Switch	**SW_5**	– Capacity Control Switch
C_1	– Condensing Pump Starter	**FT**	– Flotender	**SW_6**	– Purge Level Switch
C_2	– Chilled Water Pump Starter	**FU**	– Fuse	**SW_8,SW_9, SW_{10}**	– Overconcentration Control Switches
C_3	– Contactor, Solution Pump #1	**HR**	– Holding Relay	**SW_7,SW_{11}**	– Low-Level and Dilution Switch
C_4	– Contactor, Refrigerant Pump #1	**HTCO**	– High-Temperature Cutout	**TSW_1,TSW_2**	– Thermoswitches
C_5	– Contactor, Solution Pump #2	**LLC**	– Low-Level Control	**W**	– Cycle-Guard Light
C_6	– Contactor, Refrigerant Pump #2	**LTCO**	– Low-Temperature Cutout	□	Control Panel Terminal
C1 OL thru C6 OL	– Overloads, C_1 thru C_6 Starters	**MAI**	– Main Air In	○	Component Connection, Marked
CG	– Cycle-Guard Valve	**MAO**	– Main Air Out	◇	Component Connection, Unmarked
CV	– Capacity Valve	**OL_1 thru OL_6**	– Overloads, C_1 thru C_6 Starters	———	Factory Wiring
CWT	– Chilled Water Thermostat	**PE**	– Pneumatic-Electric Relay	— — —	Field Wiring
EPS	– Electric-Pneumatic Switch	**R**	– Exhaust Purge Light	——- - -	Mechanical Interlock
ETI	– Elapsed Time Indicator	**SW_1**	– Start-Stop-(Reset) Switch	═══	Pneumatic Tubing
F_1,F_2	– Fuse	**SW_2**	– Cycle-Guard Switch		
FS_1	– Flow Switch, Condensing Water	**SW_3**	– Solution Pump Switch		



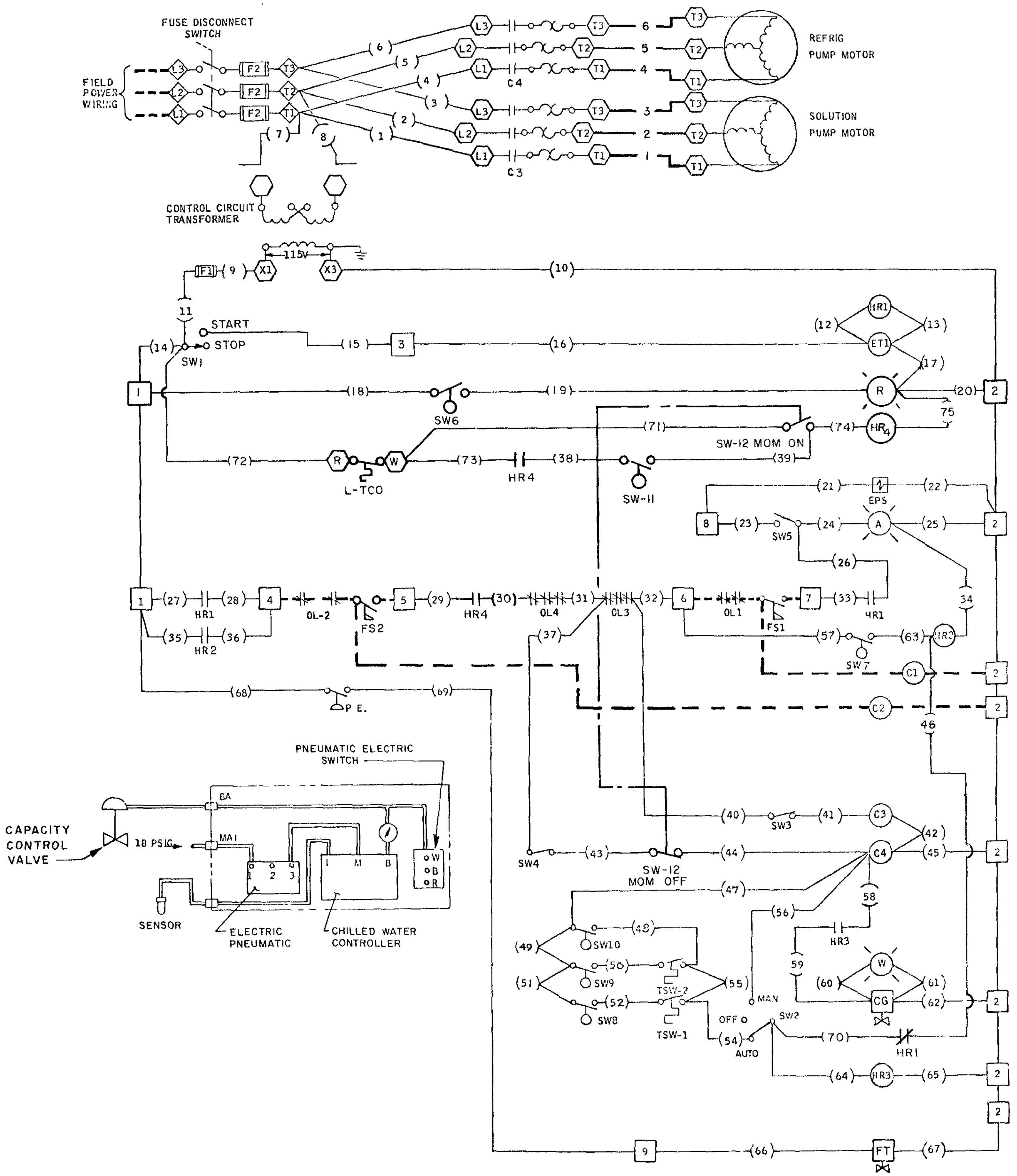
→ **Fig. 6 — Typical Wiring Schematic, Electronic Capacity Control (16JB010-068 Units with Reset on Start-Stop Switch)**



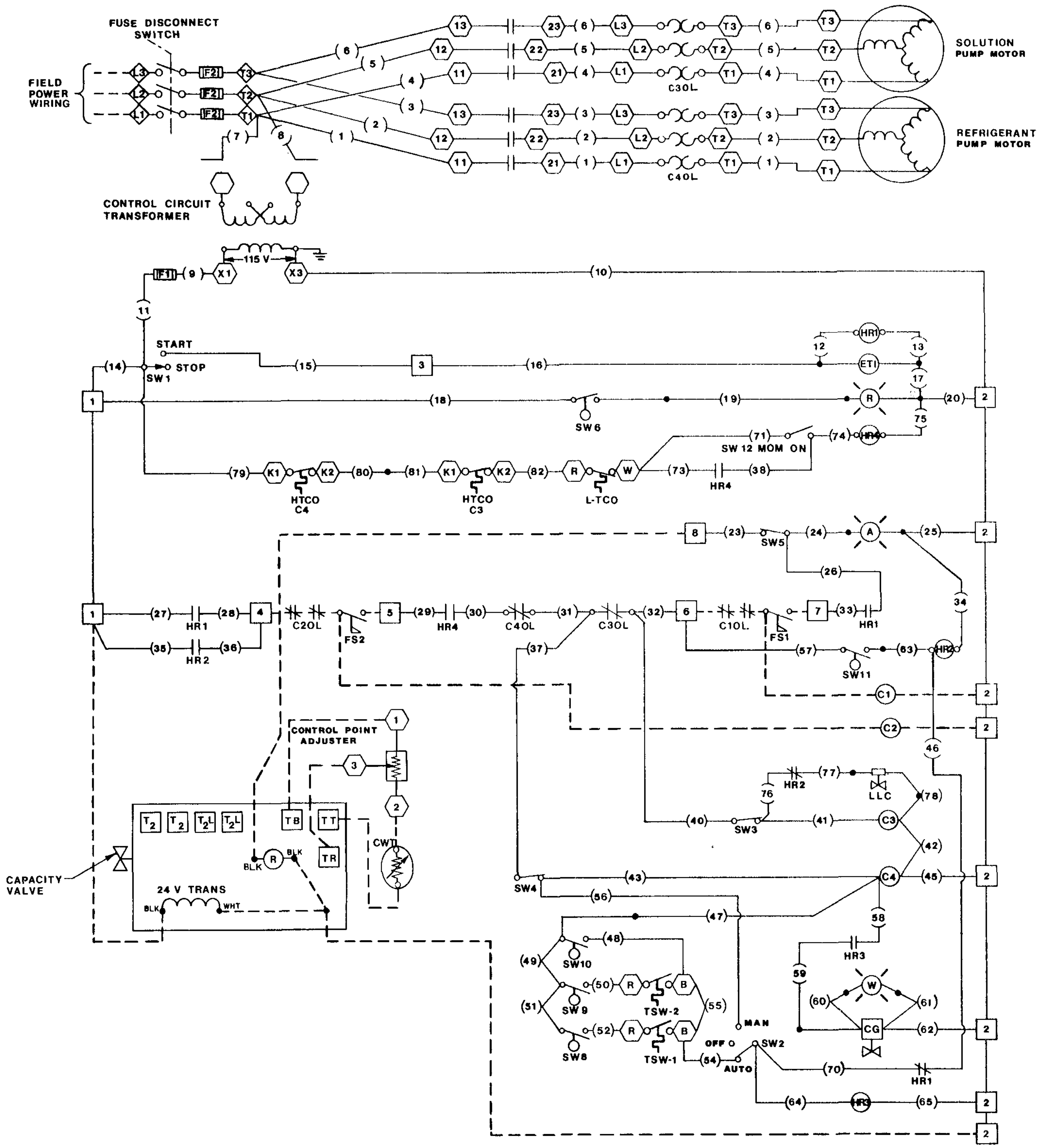
→ **Fig. 7 — Typical Wiring Schematic, Pneumatic Capacity Control (16JB077-124 Units with Reset on Start-Stop Switch)**



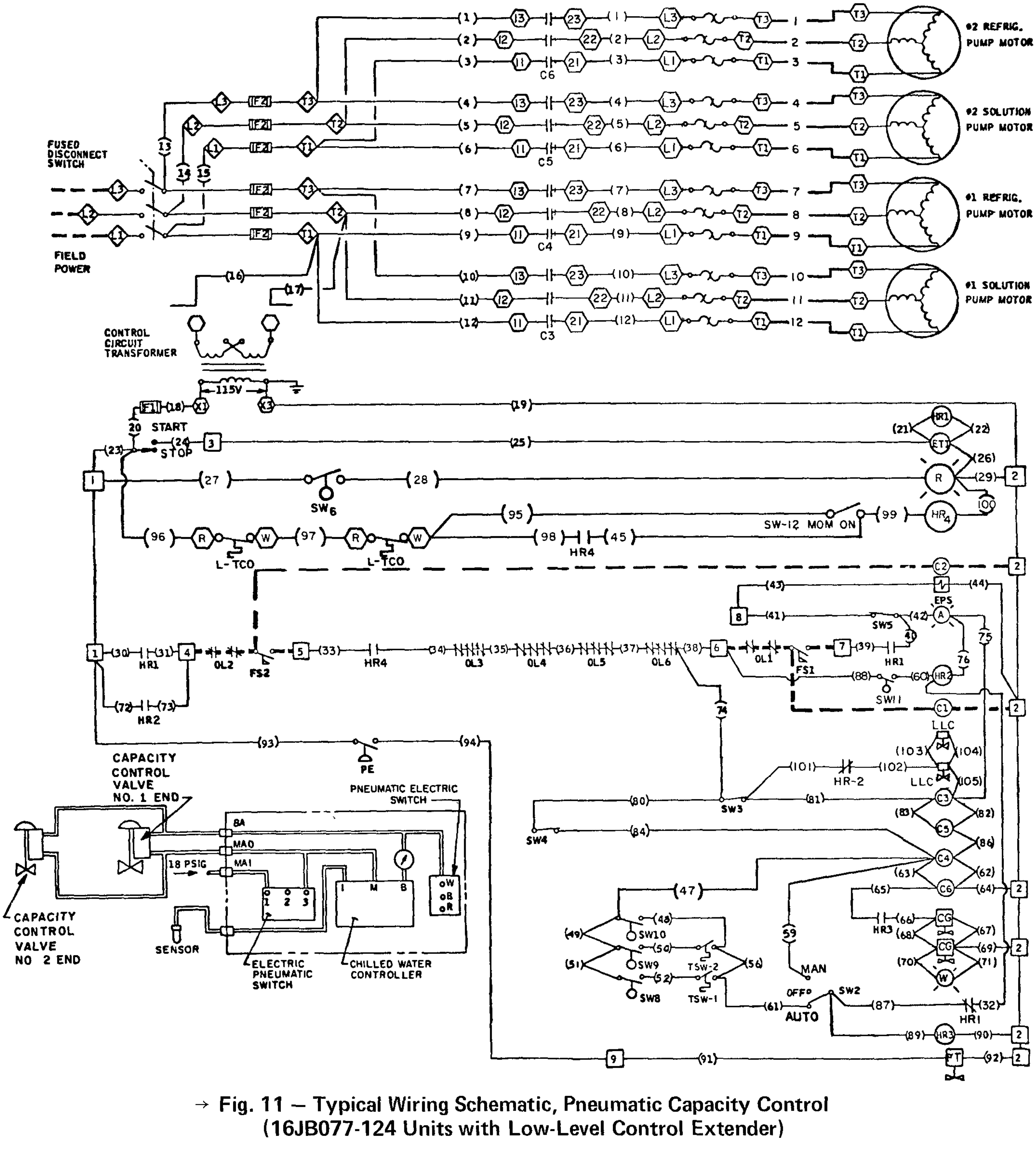
→ **Fig. 8 — Typical Wiring Schematic, Electronic Capacity Control (16JB077-124 Units with Separate Reset Switch)**



→ **Fig. 9 — Typical Wiring Schematic, Pneumatic Capacity Control (16JB010-068 Units with Separate Reset Switch)**



→ **Fig. 10 — Typical Wiring Schematic, Electronic Capacity Control (16JB010-068 Units with Low-Level Control Extender)**



→ Fig. 11 — Typical Wiring Schematic, Pneumatic Capacity Control (16JB077-124 Units with Low-Level Control Extender)

→ Typical Control Sequence — Machine Start

1. Place the following switches in the ON or AUTO. position:
   a. Cycle-Guard™ switch SW2
   b. solution pump switch SW3
   c. refrigerant pump switch SW4
   d. capacity control switch SW5
2. Press and release RESET switch SW12 (or place SW1 at RESET on some machines) in the following instances:
   a. at initial start-up
   b. for restart after power interruption
   c. after cutout on low refrigerant temperature
   d. after cutout on low refrigerant level (on some machines)

   RESET switch energizes HR4 holding relay. One set of HR4 N.O. contacts, in series with the low temperature cutout(s), closes to keep relay HR4 energized. Second set of N.O. contacts in the machine safety circuit also closes.
3. Place START-STOP switch SW1 in START position. Main holding relay HR1 and elapsed time indicator ETI are energized. Two sets of HR1 N.O. contacts in the safety circuit close. Set of HR1 N.C. contacts opens to remove Cycle-Guard relay HR3 from the dilution cycle mode.

   Control circuit is now energized thru chilled water pump starter C2.
4. Chilled water flow switch closes to energize refrigerant pump starter(s) C4 and C6, solution pump starter(s) C3 and C5 and condenser water pump starter C1. Holding relay HR2 is energized. The set of HR2 N.O. contacts closes to lock in the pump starters. On some models, a set of HR2 N.C. contacts opens to de-energize the low-level control Extender™ valve(s) until intermittently energized by a low refrigerant level.

   When the condensing water flow switch closes, the RUN light and capacity control valve operator (electronic) or EPS electric-pneumatic switch (pneumatic) are energized for capacity control response to chilled water temperature.

→ Typical Control Sequence — Machine Stop

1. Place START-STOP switch in STOP position. Elapsed time indicator ETI and holding relay HR1 de-energize. One set of contacts opens to de-energize the capacity control switch SW5 circuit. Second set of contacts in the safety circuit opens but pumps remain energized thru the set of HR2 holding contacts. The HR1 N.C. contacts close to energize relay HR3. The HR3 N.O. contacts close to energize the Cycle-Guard valve(s) and the dilution cycle begins.
2. Refrigerant is transferred thru the Cycle-Guard valve to dilute the solution and prevent shutdown crystallization. This lowers the refrigerant level in the evaporator.
3. When the refrigerant drops to a predetermined level, the dilution level switch SW7 or SW11 opens and de-energizes holding relay HR2. The normally open HR2 contacts open, the pumps stop and the machine shuts down.

BEFORE INITIAL START-UP

Job Data and Tools Required

1. Job specifications and job sheets, including list of applicable design temperatures and pressures.
2. Machine assembly and field layout drawings.
3. Controls and wiring drawings.
4. Mechanic's hand tools.
5. Absolute pressure gage or water-filled wet-bulb vacuum indicator graduated with 0.1-in. of mercury increments. *Do not use manometer or gage containing mercury*
6. Auxiliary evacuation pump (5 cfm or greater).
7. Compound pressure gage — 30-in. vacuum to 30 psig.
8. Hydrometer — specific gravity range, 1.0 to 2.0.
9. Clamp-on ammeter — scale, 0.1 to 1.0 amp.
10. Thermometer — range, 30 F to 120 F.
11. Thermometer (glass stem) — range 0°F to 300 F.
12. Charging hose consisting of 3/4-in. hose plus 1/2-in. pipe x 3 ft long, trimmed at 45-degree angle at one end.

Field Piping — Check the following items against field piping drawings. (See also Fig. 12 for a typical piping arrangement.)

1. Location and flow direction of condensing and chilled water lines are as specified on drawings and as marked on machine.
2. All water lines are vented, and properly supported to prevent stress on water box covers or nozzles.
3. All water box drains are installed.
4. Steam control valve(s) are at least 3 ft from generator nozzle(s).
5. Steam traps are located close to machine and at least 3 ft below the generator outlet.
6. Steam piping is equipped with necessary safety and relief devices.
7. Piping of hot water machine is equipped with hot water control valve.
8. Chilled water temperature sensing element is installed in the leaving chilled water piping.

Standing Vacuum Test — Before machine is charged or placed in operation, check for air leaks with a standing vacuum test. Examine the 2 test procedures described below and select the one that applies to your job situation.

LONG INTERVAL TEST — Use this test procedure if an absolute pressure reading has been recorded at least 4 weeks previously and the reading was not more than one in. of mercury.

1. Connect an absolute pressure gage to the auxiliary evacuation valve and record the pressure reading. (Do not use mercury gage.)
2. If the pressure has increased by more than 0.1 in. of mercury since the initial reading, an air leak is indicated. Leak test the machine as described in the Maintenance Procedures section; then perform the short interval test which follows.

SHORT INTERVAL TEST — Use this test procedure if:

1. No previous absolute pressure readings have been recorded, OR
2. Previous absolute pressure reading was made less than 4 weeks ago, or reading indicated a machine pressure of more than one in. of mercury, OR
3. Machine had to be leak tested after long interval test.

Procedure

1. Connect absolute pressure gage to auxiliary evacuation valve and record pressure reading.
2. If the reading is more than one in. of mercury absolute, evacuate the machine as described in the Maintenance Procedures section.
3. Record the absolute pressure reading and the ambient temperature.
4. Let machine stand for at least 24 hours.
5. Note the absolute pressure reading when ambient temperature is within 15 F of the ambient temperature recorded in step 3.
6. If there is any noticeable increase in pressure, an air leak is indicated. Leak test the machine as described in Maintenance Procedures section, then repeat short interval vacuum test to ensure results.

Machine Evacuation — When machine absolute pressure is greater than one in. of mercury absolute, machine must be evacuated as described in Maintenance Procedures section.

Solution and Refrigerant Charging — See Table 2 for machine nominal charges.

HANDLING LITHIUM BROMIDE — Solutions of lithium bromide and water are nontoxic, nonflammable and nonexplosive, and can easily be handled in open containers. The solution is chemically stable and does not undergo any appreciable change in properties even after years of use in the absorption machine.

WARNING: Lithium bromide can irritate the skin and eyes. Wash off any solution with soap and water. If any enters the eye, wash the eye with fresh water and consult a physician immediately. Lithium bromide is a strong salt solution, do not syphon by mouth.

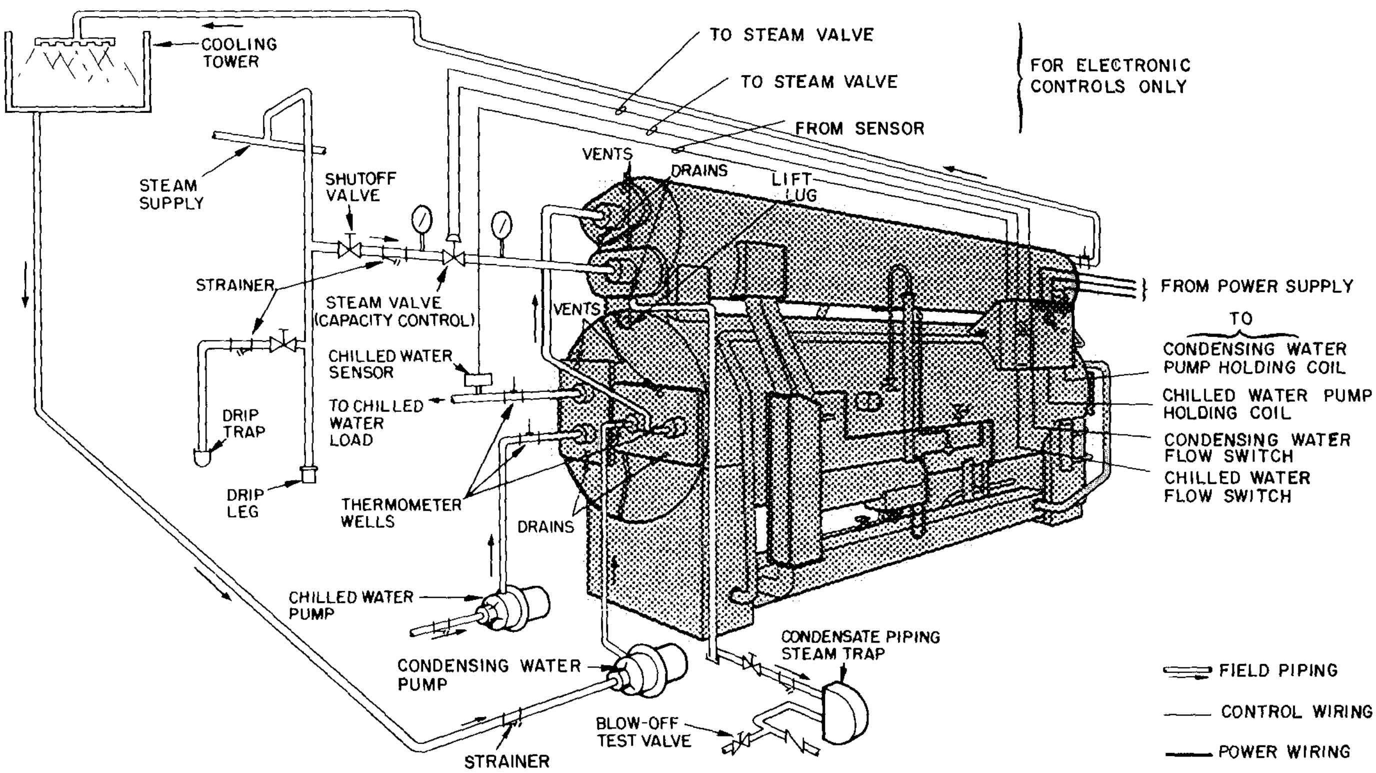


Fig. 12 — Typical Piping and Wiring

Table 2 — Machine Nominal Charges*

UNIT 16JB	LI BR SOLUTION (Gal.) Heat Exchanger Width (in.)		INHIBITOR CHARGE (No. of Bottles) PV07CZ-		INITIAL REFRIG (Gal.)
	12½	10	180	036	
010,012,014	120	110	1	3	40
018,021	170	160	2	2	50
024,028	210	200	2	4	65
032,036	260	240	3	4	70
041,047	350	330	4	4	90
	12⅝	8⅞			
054,057	360	330	5	2	175
061,068	390	360	6	4	265
077,084	540	500	8	—	320
097,107	600	540	9	2	365
115	630	570	9	2	400
124	660	600	10	—	420

(Shaded) Use only if lithium bromide container does *not* have yellow marking
*Based on solution at 53% concentration, 44 F leaving chilled water, 85 F entering condensing water and 12 psig steam (or equivalent hot water temperature)

Because lithium bromide can corrode metal in the presence of air, wipe off any solution spilled on metal parts or tools and rinse the part with fresh water as soon as possible. After rinsing, coat the tools with a light film of oil to prevent rust. After emptying metal containers of solution, rinse the container with fresh water to prevent corrosion.

Lithium bromide for absorption machine use should be kept only in the original container or in a completely clean container.

CHARGING SOLUTION

1. Determine whether inhibitor should be added to the solution:
   a. If the lithium bromide container has yellow marking and the statement "Lithium Chromate Inhibited," *do not add any inhibitor at start-up* and discard the PV07CZ-180 and -036 inhibitors that may have been supplied with the machine (see Table 2).
   b. If the container does *not* have yellow marking and there is no yellow label "Lithium Chromate Inhibited" on the control panel door, add the inhibitor listed in Table 2 to the first drum of lithium bromide. Stir until completely dissolved.
2. Connect a flexible hose to 1/2-in. pipe. Fill both pipe and hose with water.
3. Insert the 1/2-in. pipe in the container and connect the flexible hose to the *solution* pump service valve (Fig. 13). On machine sizes 077 thru 124, charge thru either solution pump service valve.
4. Open service valve. Continue charging until solution level is near bottom of container. *Do not allow air to be drawn into machine.*
5. Repeat with other containers as required until the amount specified in Table 2 has been charged into the machine.

CHARGING FOR CONDITIONS OTHER THAN NOMINAL — The solution quantity can be adjusted to compensate for other than nominal values for design chilled water temperature, or condensing water temperature or flow. *The solution quantity can be increased or decreased by up to 10% of nominal charge listed in Table 2* Adjust quantity as follows:

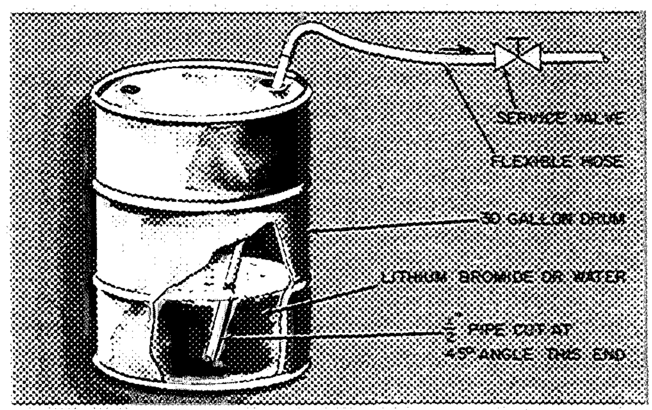


Fig. 13 — Charging Solution and Refrigerant

1. Increase (decrease) the nominal solution charge by 1% for each degree F that design chilled water temperature is below (above) 44 F.
2. Increase (decrease) the nominal solution charge by 1% for each 2 F that design condensing water temperature is above (below) 85 F.
3. Increase nominal solution charge by 1% for each 10% reduction in design condensing water flow below nominal 100%.

Do not adjust nominal charge for changes in steam pressure or hot water temperatures.

→ INITIAL REFRIGERANT CHARGING — Fill empty solution containers with clean water. Charge the water (refrigerant) thru the *refrigerant* pump service valve, following steps 2, 3 and 4 of Charging Solution. On machine sizes 077 thru 124, use either refrigerant pump service valve.

Charge in at least the amount listed in Table 2 under Initial Refrigerant (Gal.). This charge must be adjusted after start-up for optimum Cycle-Guard™ control operation (see Refrigerant Charge Final Adjustment).

INITIAL CONTROL CHECKOUT AND ADJUSTMENT

The checkout procedures in this section are for semiautomatic control systems. The purpose of the checkout is to ensure that control circuits have not been affected by shipping or installation damage nor altered in the process of making field wiring connections.

→ CAUTION: Follow the checkout sequence in detail. Machine must be charged with solution and refrigerant before starting checkout. Chilled water and condensing water circuits must be filled and operative.

Do not rotate hermetic pumps until machine is charged with lithium bromide-water solution and refrigerant.

For your machine control component arrangement, refer to wiring diagram inside machine control panel door.

Preparation — *Turn panel disconnect switch to* OPEN and open control panel door.

Remove fuses from starters for the condensing water pump motor C1 and the chilled water pump motor C2. Starters for these pumps are field supplied and are not located inside the control panel.

→ If already installed, remove overload heaters from solution pump starter(s) C3 and C5, and from the refrigerant pump starter(s) C4 and C6. *Mark for proper identification at reinstallation.* Removal will prevent hermetic pumps from being energized during control checkout.

If condensing and chilled water flow switches are used, manually block the switches closed.

Install control panel fuses if not already installed. Close the main disconnect switch to energize the control circuit by rotating switch arm counterclockwise. Then turn the low-temperature cutout adjustment knob(s) to extreme counterclockwise position.

Energize Control Circuit — Depress and release the momentary RESET switch SW12 (or place SW1 at RESET on some machines). Then place the START-STOP switch SW1 in START position to start machine. The RESET switch will be required again only if there is a power interruption or a cutout on low refrigerant temperature (and low refrigerant level also on some machines).

Place the control panel switches in the following positions:

SWITCH	POSITION
Solution Pump(s) SW3	ON
Refrigerant Pump(s) SW4	ON
Capacity Control Switch SW5	OFF
Cycle-Guard Switch SW2	OFF
START-STOP Switch SW1	START

RUN light and all pump starters are energized.

Check Solution and Refrigerant Pump Starters

1. Place solution and refrigerant pump switches in OFF position. Starters de-energize but control circuit and RUN light remain energized.
2. Place solution and refrigerant pump switches in ON position. Starters energize.
3. If starters do not energize and de-energize as described, check wiring against control panel diagram on panel door.

→ **Check Cycle-Guard™ Valve** — Valve (item 15, Fig. 1) is located in the line between refrigerant pump discharge line and solution pump sump.

1. Place Cycle-Guard switch in MAN. (manual) position. Cycle-Guard light and valve(s) energize with an audible click.
2. Place Cycle-Guard switch in OFF position. Light and valve(s) de-energize.
3. If valve(s) and light do not energize and de-energize as described, check wiring per diagram on control panel door.

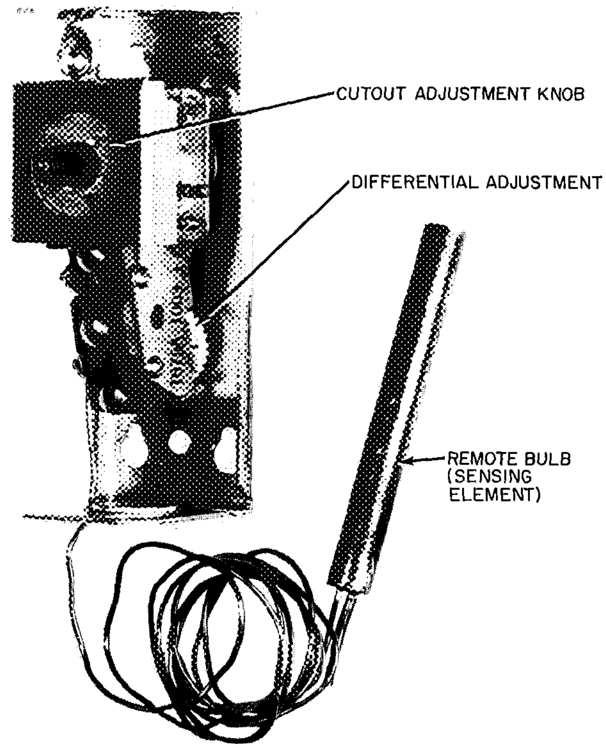


Fig. 14 — Low-Temperature Cutout (Located in Control Panel)

Check Low-Temperature Cutout(s)

1. Turn differential adjustment (Fig. 14) to no. 3 on the scale.
2. Place the control sensing bulb in a water bath maintained at 5 F below design leaving chilled water temperature (but not below 34 F).
3. Turn cutout adjustment knob (Fig. 14) slowly clockwise until contacts open. Condensing water pump starter, solution and refrigerant pump starters and RUN light de-energize.

   Marks on scale are for reference only since they may not be in exact calibration with switch action.
4. Allow the water bath to warm until contacts close. Depress and release RESET switch (or set SW1 switch in RESET position); then place START-STOP switch in START position. Starters and RUN light energize. Contacts should have a 3 F differential between open and closed position.

5. Fill the low-temperature cutout well (located next to refrigerant condensate line on some machines and on refrigerant sump pump on others) with heat conductive compound. Insert the sensing bulb in well.
6. For machines sizes 077 thru 124, repeat steps 1 thru 5 with 2nd low-temperature cutout.

→ Check Thermoswitches TSW-1 and TSW-2

1. Turn differential adjustment (Fig. 14) to 3 on scale.
2. Place TSW-1 control sensing bulb in water bath maintained at ambient temperature. Turn switch adjustment knob clockwise slowly until contacts close. Note any difference between water bath temperature and the markings on thermoswitch scale (marks on scale may not be in calibration with switch action). Allow for this difference when setting the thermoswitch control point. Set the adjustment knob so that switch contacts close at 110 F (if design conditions are nominal). If conditions are other than nominal, obtain the special switch settings from the factory.
3. Fill the thermoswitch well (item 33, Fig. 1), located on the strong solution line between heat exchanger and spray header, with heat conductive compound and insert the bulb (Fig. 14) into the well.
4. Repeat procedure with thermoswitch TSW-2 except set second switch to close at 122 F (if design conditions are nominal).

Check Rotation of Solution and Refrigerant Pumps

1. *Open main disconnect switch by rotating switch arm on control panel door clockwise.*
2. Replace the overload heaters in refrigerant and solution pump starters inside control panel.
3. Install a compound pressure gage on refrigerant pump service valve.
4. Close main disconnect switch by rotating arm counterclockwise. Depress and release RESET switch (or set switch SW1 at RESET position on some machines), then place START-STOP switch in START position.
5. Check and record refrigerant pump discharge pressure.
6. *Open main disconnect switch* and reverse any 2 motor power leads at starter to reverse pump rotation.
7. Repeat steps 4 and 5.
8. Compare the 2 discharge pressures. Use the power lead arrangement that produced the higher discharge pressure reading.
9. Repeat procedure for other pump(s).

→ Check Flow Switches or Auxiliaries

1. Place START-STOP switch in STOP position. Replace fuses in condensing water pump C1 and chilled water pump C2 starters. Unblock the flow switches.
2. *Open main disconnect switch.* Disconnect wire between condensing water pump starter C1 and terminal [2].
3. Close disconnect switch. Depress and release RESET switch (or place switch SW1 in RESET position on some machines); then place START-STOP switch in START position. Chilled water, solution and refrigerant pumps energize but condensing water pump and RUN light do not, and capacity control valves will not open.
4. Place START-STOP switch in STOP position and *open main disconnect switch* Then reconnect wire between C1 and terminal [2].
5. Disconnect wire between chilled water pump starter C2 and terminal [2].
6. Close disconnect switch. Depress and release RESET switch and then place START-STOP switch in START position. Pumps and RUN light do not energize, and capacity control valves will not open.
7. Place START-STOP switch in STOP position and *open main disconnect switch.* Then reconnect wire between C2 and terminal [2].
8. Close disconnect switch. Depress and release RESET switch and then place START-STOP switch in START position. All pumps energize.
9. If controls do not function as described, check action of flow switches, rotation of chilled water and condensing water pumps, circuit valve settings and wiring connections.

→ Preliminary Capacity Control Adjustments

ELECTRONIC CONTROLS – No preliminary adjustment of the electronic motor (Fig. 19) is necessary unless, with capacity control switch in AUTO. position, the motor cannot be made to travel from fully closed to fully open by changing the setting of the control point adjuster (CPA) in the control panel.

If adjustment is required, refer to Final Calibration of Controls section.

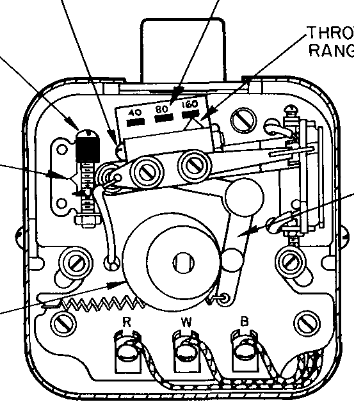


Fig. 15 — Auxiliary Potentiometer

Machine Sizes 010 thru 068

No special adjustments are required at this time.

Machine Sizes 077 thru 124

To coordinate the action of the 2 capacity control valves on these larger machines, the potentiometer (Fig. 15) on the no. 1 valve (control panel end) must be calibrated as follows:

1. Remove the cover from potentiometer and set throttling range indicator at 160 scale marking by turning throttling range adjustment screw.
2. With electronic motor in closed position, set potentiometer cam so that its lowest point is against traveler arm.
3. Hold valve at closed position and turn the start point adjustment screw on the potentiometer until electric motor of no. 2 capacity control valve (opposite control panel end) just begins to open.
4. Use the control point adjuster (CPA) in the control panel to move no. 1 valve electronic motor from fully closed to fully open while checking the relative position of both valves. Valves should open and close simultaneously. (There are some exceptions; check your Job Data.) *If necessary, readjust the start point adjustment screw so that both valves reach the fully opened position together.*

PNEUMATIC CONTROLS – Remove shipping stop from chilled water controller (Fig. 16) in control panel. Controller is factory set for direct action. Remove both front and back reverse-acting springs (Fig. 16) and the proportional band spring. Set controller proportional band at 2-1/2%.

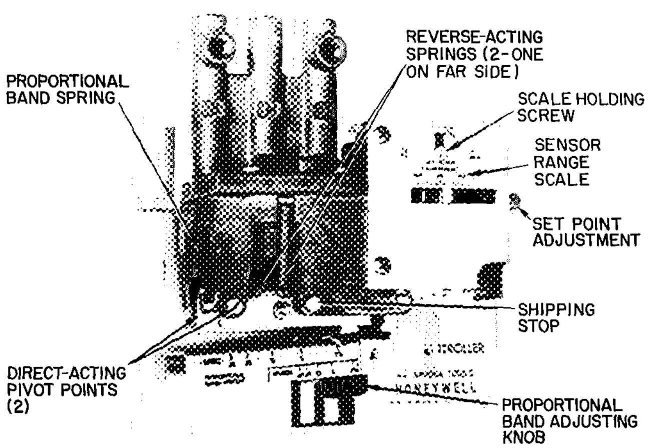


Fig. 16 – Chilled Water Controller (Pneumatic)

Machine Sizes 010 thru 068

No special adjustment is required at this time.

Machine Sizes 077 thru 124

The positioner of each of the 2 capacity control valves must be coordinated with the other as follows:

1. Locate valve (pilot) positioner (Fig. 17) on each capacity control valve. Use wrench, taped to valve, to loosen positioner cover locking screw.
2. Unscrew start point adjustment knob and read instructions inside knob.
3. Tighten *all* range adjustment screws on both valve positioners to provide 12 psi range.
4. Reinstall and bottom the knob, making sure spring is centered.
5. Back off knob until 3 psi start point on the 12 psi operating range scale lines up with the start point indicator. Retighten locking screw.

Valves should start rising at 3 ± 3/4 psig branch line pressure and should be fully extended at 15 ± 3/4 psig branch line pressure.

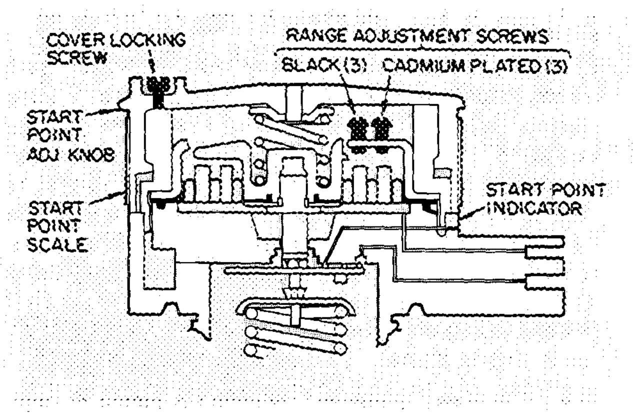


Fig. 17 – Pneumatic Valve Positioner

Check Flotender™ Valve (where applicable)

The Flotender valve (item 26, Fig. 1) is located in the weak solution line between heat exchanger and generator. When energized, the valve has a magnetic field near the top which can be sensed with any steel object such as a screwdriver.

ELECTRONIC CAPACITY CONTROL

1. Place the capacity control switch in AUTO. position. Capacity control valve(s) open. When electronic motor (Fig. 19) rotates 75 angular degrees from the closed position (45% open), the factory-set end switch (mounted on the electronic motor) closes and energizes the Flotender valve with an audible click.
2. Place the capacity control switch in OFF position. Capacity control valve(s) close. When electronic motor rotates back to 65 angular degrees from closed position, Flotender valve de-energizes.
3. → If the Flotender valve does not energize and de-energize as described, remove the end switch cover and check wiring and setting. Reset switch adjustment screw if necessary.

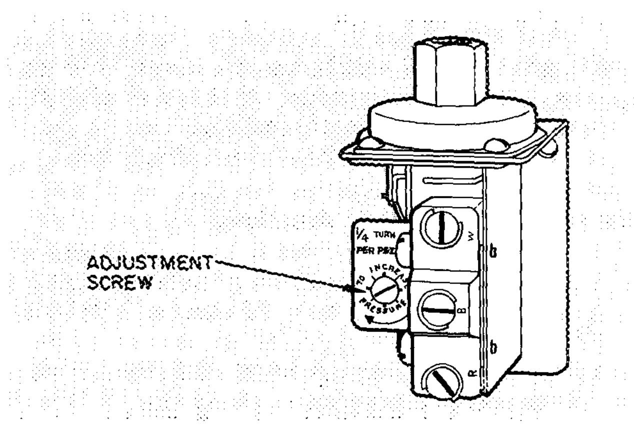


Fig. 18 – Pneumatic-Electric Relay

PNEUMATIC CAPACITY CONTROL

1. Adjust the pneumatic-electric relay (Fig. 18), inside the machine control panel, to close at 8.5 psig branch air pressure.
2. Place the capacity control switch in AUTO. position.
3. Set the chilled water controller (Fig. 16) to increase branch air pressure from 3 to 15 psig. When branch air pressure exceeds 8.5 psig, Flotender valve energizes with an audible click.
4. Set the chilled water controller to decrease branch air pressure from 15 to 3 psig. When branch air pressure drops to 6.5 - 7 psig, Flotender valve should de-energize.
5. Place capacity control switch in OFF position.

INITIAL START-UP

The following start-up procedures are based on a semiautomatic system in which all pumps energize when START-STOP switch is placed in START position.

→**Preliminary Check** — Check the operation of auxiliary equipment and status of system before starting the absorption machine.

Procedure

1. Add the amount of octyl alcohol specified in Table 3 thru the *solution* pump service valve. Refer to Adding Octyl Alcohol in the Maintenance Procedures section. *Do not allow air to be drawn into machine*
2. Supply power to control panel, chilled water and condensing water pumps.
3. Press and release RESET switch (or set switch SW1 at RESET on some machines), then place the following switches in the positions indicated·

SWITCH	POSITION
Solution Pump SW3	ON
Refrigerant Pump SW4	ON
Capacity Control Switch SW5	AUTO
Cycle-Guard Switch SW2	AUTO
START-STOP Switch SW1	START

4. When the solution becomes warm, place the capacity control switch in OFF position.
5. Determine the machine absorber loss as described in Maintenance Procedures section.

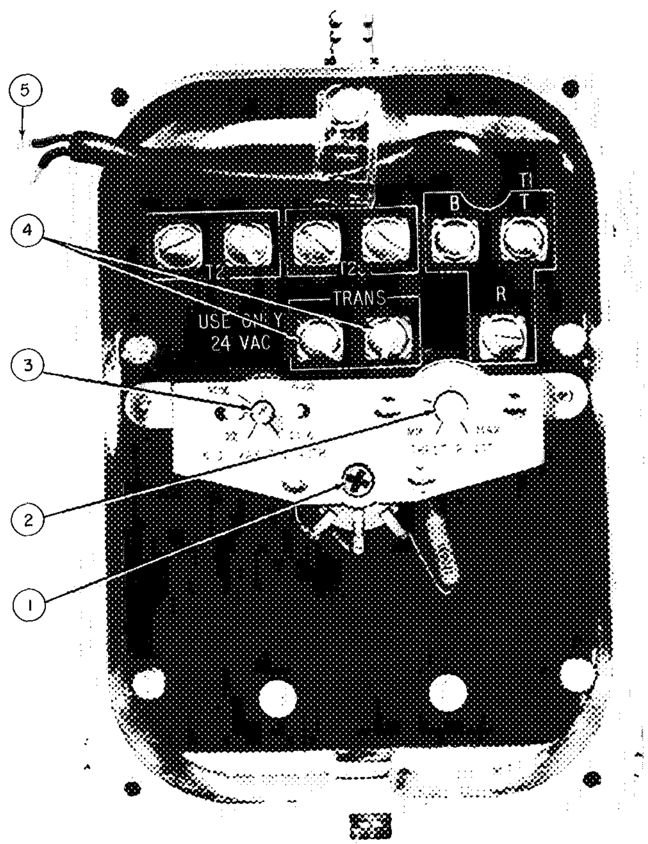
If absorber loss is 5 F or less, open capacity control valve and allow machine to operate.

→ If the absorber loss is greater than 5 F, evacuate the machine (see Maintenance Procedures section) to remove any noncondensables that might prevent normal operation. As an alternate procedure, limit steam pressure to keep strong solution temperature under 140 F and allow the purge to remove the noncondensables.

After the absorber loss has been reduced to below 5 F by either of the above procedures, place machine on automatic operation, with capacity control switch in AUTO. position and steam pressure normal. The purge will evacuate the machine to the normal absorber loss of 2 F or less.

→ **Table 3 — Octyl Alcohol Initial Charge**

UNIT 16JB	OCTYL ALCOHOL (Gal.)
010,012,014	1
018,021	1
024,028	2
032,036	3
041,047	3
054,057	3
061,068	3
077,084	4
097,107	4
115	4
124	4



LEGEND
1 — Calibration Set Point Adjustment
2 — Throttling Range Adjustment (3 F to 15 F)
3 — Authority Set Point Adjustment
4 — Transformer Secondary Terminals
5 — Motor Relay Wires (tucked inside case for shipping)

Fig. 19 — Electronic Valve Motor

Final Calibration of Controls

MACHINES WITH ELECTRONIC CONTROLS

1. Allow leaving chilled water temperature to stabilize between 40 F and 60 F. (It may be necessary to reset the chilled water control point adjuster in the control panel.)
2. Remove cover of electronic valve motor (Fig. 19) and turn authority set point adjustment fully counterclockwise to 0%.
3. Set throttling range adjustment for desired range. Scale ranges from 3 F to 15 F in 3 F increments. The minimum setting is normally used.
4. Set the chilled water control point adjuster in the control panel near the middle of the control range.
5. Turn the calibration set point adjustment on the motor fully counterclockwise. Capacity control valve opens fully.
6. Observe leaving chilled water temperature until desired temperature is reached. Then turn the calibration set point adjustment clockwise until the control valve just begins to close as the water temperature drops slightly below the selected temperature.
7. Final calibration is now complete. Throttling range control now maintains machine operating temperature.

If throttling range or authority set point (which should remain at 0%) is altered, machine operating temperatures will change and complete recalibration will be required.

MACHINES WITH PNEUMATIC CONTROLS

1. Allow leaving chilled water temperature to stabilize between 40 F and 60 F. (It may be necessary to reset the set point adjustment [Fig. 16].)
2. Turn the set point adjustment to obtain branch air pressure as follows:

MACHINE SIZE	AIR PRESSURE
010 thru 068	8 psig
077 thru 124	9 psig

3. Loosen holding screw and move sensor range scale (Fig. 16) so that temperature measured at leaving chilled water line is opposite the scale pointer. Retighten holding screw.
4. Now move the scale pointer to the selected design leaving chilled water temperature by turning the set point adjustment (Fig. 16).

→ **Refrigerant Charge Final Adjustment** should be made after:

1. Machine is operating with stable temperatures at 40–100% of full load.
2. Absorber loss is 3 F or less.
3. Refrigerant specific gravity is 1.02 or less.

The refrigerant charge is adjusted so that the Cycle-Guard™ system can limit maximum solution concentration and avoid solution crystallization. Proceed as follows:

1. *Place Cycle-Guard switch (SW2) in the OFF position.* Wait 10 minutes before proceeding.
2. Remove a solution sample from the solution pump service valve and measure the specific gravity and temperature.
3. Locate the intersection point of the specific gravity and temperature values on equilibrium diagram, Fig. 23. Read down from this point to the solution concentration scale to determine the percent lithium bromide by weight in the weak solution.
4. Determine the approximate percent of full load on the machine by comparison of chilled water temperature spread and flow in relation to design. Enter Table 4 at this percent load and find the corresponding weak solution concentration required for refrigerant charge adjustment.
5. Adjust machine operating conditions until machine operates *with stable temperatures* at *any one* of the 3 weak solution concentrations (±0.1%) listed under the selected percent load.

   To increase the concentration:

   a. Increase the load.
   b. Lower chilled water temperature (Control Point Adjuster setting).
   c. Raise condensing water temperature (or throttle condensing water flow).

   After adjusting conditions, repeat steps 2 and 3 to verify solution concentration.

   NOTE. Concentrations listed in Table 4 are for nominal design conditions. For special design conditions, obtain the special concentration settings from the factory.
6. The refrigerant charge can be adjusted *at any one* of 3 refrigerant levels described below. Use the refrigerant level in Table 4 that corresponds to the weak solution concentration at the percent load determined in step 4. Proceed as follows, at the appropriate refrigerant level.

   HIGH LEVEL – Mark the knob position on the TSW-1 and TSW-2 thermoswitch scales, then turn both knobs fully counterclockwise. This opens the thermoswitches and removes the mid-level and low-level switches from the control circuit.

   MID LEVEL – Mark the knob position on the TSW-1 and TSW-2 scales; then turn TSW-1 knob fully counterclockwise and the TSW-2 knob fully clockwise. This removes the low-level switch from the circuit and places the

→ **Table 4 — Weak Solution Concentrations for Adjusting Refrigerant Charge**

REFRIGERANT LEVEL		PERCENT LOAD ON MACHINE						
		100	90	80	70	60	50	40
		Weak Solution Concentration (%)						
High		60.0	60.4	60.8	61.2	61.6	61.9	62.2
Intermediate (Mid)	Design 1*	58.0	58.4	58.7	59.1	59.4	59.8	60.1
	Design 2*	58.5	58.9	59.2	59.6	59.9	60.3	60.6
Low		57.0	57.4	57.7	58.1	58.4	58.8	59.1

*Design 1 – Cylindrical float chamber on evaporator tube sheet or leg
Design 2 – Rectangular float chamber on evaporator shell

mid-level switch in control of the Cycle-Guard™ valve.

LOW LEVEL – Mark the knob position on the TSW-1 and TSW-2 scales; then turn TSW-1 knob fully clockwise and the TSW-2 knob fully counterclockwise. This removes the mid-level switch from the circuit and places the low-level switch in control of the Cycle-Guard valve.

7. Place Cycle-Guard switch in AUTO. position and immediately check Cycle-Guard indicating light. If it is on, immediately place Cycle-Guard switch in OFF position. This will prevent an excessive transfer of refrigerant that can alter the adjustment conditions. If the light is off, however, leave the switch in AUTO. position.
8. If the indicating light was on at step 7, there may be too much water in the machine. Remove about one gallon of water thru the refrigerant pump service valve. Repeat step 7. Continue to remove water in one-gallon increments until Cycle-Guard light remains out.
9. If the indicating light was out at step 7, there may not be enough water. Add water to machine in one-gallon increments until the light goes on. *Then immediately place Cycle-Guard switch in OFF position.* Water can be drawn into the machine thru the refrigerant pump service valve when the pump is off. Place the refrigerant pump switch in the OFF position and then add the water as quickly as possible to minimize changes in adjustment conditions while the pump is off. Fill the charging hose with water before opening the pump service valve. *Do not allow air to be drawn into the machine.* After adding water, place refrigerant pump switch in ON position. The Cycle-Guard valve cannot be energized while the refrigerant pump is off.
10. Return TSW-1 and TSW-2 thermoswitch knobs to position marked on scales in step 6. Place Cycle-Guard switch in AUTO. position.

Table 5 — Refrigerant Charge Adjustments to Change Solution Concentration by 1.0% (See Note)

UNIT 16JB	GALLONS OF REFRIGERANT (See Note)
010,012,014	3
018,021	4
024,028	6
032,036	7
041,047	9
054,057	9
061,068	10
077,084	14
097,107	15
115	16
124	17

NOTE: Addition or removal of quantity shown will change weak solution concentration by 1 0%

Table 5 shows the amount of water required to change solution concentration by 1.0%. *When adding or removing water, allow approximately 10 minutes for temperatures and concentrations to stabilize. Periodically check the weak solution concentration while adjusting the refrigerant charge. Readjust machine conditions per step 5, if necessary, to maintain controlled concentration*

Check Machine Shutdown – Place START-STOP switch in STOP position. Capacity control valve closes and Cycle-Guard valve opens to dilute solution. When solution is sufficiently diluted, a refrigerant level switch shuts down machine. Depending on solution concentration before shutdown, the shutdown can take up to 20 minutes. If machine does not shut down correctly, check operation of capacity controls, refrigerant level switches, Cycle-Guard valve, low-level control Extender™ valve and machine wiring.

→ **Check Low-Level Control Extender Valve** (on some models) – *After machine has completed a normal shutdown:*

1. Place the capacity control switch in OFF position. Then place the START-STOP switch in START position to restart the machine.
2. Place Cycle-Guard switch in MAN. (manual) position to transfer refrigerant from the evaporator until the low-level switch energizes the low-level control Extender valve(s) located in line(s) between solution pump discharge line and refrigerant pump suction line. This should occur soon after the Cycle-Guard valve is energized. Place the Cycle-Guard switch in the AUTO. position. (Because the Extender valve opens only long enough to transfer a small amount of solution, it must be checked when the Cycle-Guard switch is in MAN. position.)

   Control Extender valve(s) open with an audible click and solution is pumped into the evaporator. When energized, the control Extender valve(s) have a magnetic field near the top that can be checked by any steel object, such as a screwdriver.
3. If Extender valve does not energize as described, check low-level switch, valve and wiring.
4. Place capacity control switch in AUTO. Machine is now in normal operating condition. The solution that was transferred to the absorber is returned automatically to the absorber by the Cycle-Guard valve when needed.

→ **Determine Noncondensable Accumulation Rate** – After approximately 200 hours of machine operation, the rate of noncondensable accumulation in the purge should be measured to be sure that machine does not have an air leak. If a leak is indicated, it must be corrected as soon as possible to minimize internal corrosion damage. Refer to Noncondensable Accumulation Rate in the General Maintenance section for checking procedures.

START-STOP SYSTEMS

The type of start-stop system is selected by the customer. The most commonly used systems are described below. Review the descriptions and determine which system applies to your job.

Semiautomatic Start-Stop — In this basic system, auxiliary equipment is wired into the machine control circuit and machine is started and stopped manually with the machine START-STOP switch. Two variations are used:

WITH PILOT RELAYS — The coils for the chilled water and condensing water pump starters (or other auxiliary equipment) are wired into the machine control circuit so that the auxiliary equipment operates whenever machine operates. The starter contacts and starter overloads remain in the external pump circuits. The flow switches for each pump are also wired into the machine control circuit and must be closed for the machine to operate.

WITH MANUAL AUXILIARIES — With this system, the auxiliaries must be started manually and independently from the machine start, and they must be operating before the machine can start. As with the pilot relay system above, the flow switches are in the machine control circuit and must be closed for the machine to operate.

Full Automatic Start-Stop — This system is basically the same as the semiautomatic system with pilot relays described above. Machine and auxiliary start and stop, however, is controlled by a field-supplied thermostat, timer or other automatic device, and the machine START-STOP switch remains in the STOP position.

As with all the start-stop systems, the machine RESET switch must be pressed and released (or switch SW1 placed in RESET position on some machines) on initial start, after power interruption and after cutout on low-temperature (and low-refrigerant level on some machines).

OPERATING INSTRUCTIONS

→Operator Duties

1. Become familiar with absorption machine and related equipment before operating (see pages 2 thru 13).
2. Start and stop machine as required.
3. Inspect equipment; make routine adjustments; maintain machine vacuum and proper refrigerant level; exhaust purge as required.
4. Keep log of operating conditions and recognize abnormal readings.
5. Protect system against damage during shutdown.

→Before Starting Machine — Be sure that:

1. Power is on to condensing water and chilled water pump starters, cooling tower fan and absorption machine control panel.
2. Cooling tower has proper water level.
3. Chilled and condensing water circuits are full and valves are open.
4. Steam or hot water supply is available.
5. Air supply for pneumatic controls is adequate.

Start Machine — If machine has manual auxiliary start, first energize the auxiliaries.

To initially energize the control circuit, press and release the momentary RESET switch (or place switch SW1 at RESET on some machines. RESET *is required only for initial start, start after power interruption, or restart after cutout on low-temperature (and low-refrigerant level on some machines)*

Now follow one of the 2 procedures described below as it applies to your machine.

1. Start-Up After Limited Shutdown — if machine has been shut down for less than 3 weeks.
2. Start-Up After Extended Shutdown — if machine has been shut down for 3 weeks or more.

Start-Up After Limited Shutdown — Place the following switches in the positions indicated:

SWITCH	POSITION
Refrigerant Pump(s) SW4	ON
Solution Pump(s) SW3	ON
Capacity Control Switch SW5	AUTO.
Cycle-Guard Switch SW2	AUTO
START-STOP Switch SW1	START

Machine should start in normal manner.

If, however, machine does not lower leaving chilled water temperature to design, noncondensables may be present. In this case, take an absorber loss reading (see Maintenance Procedures section).

If absorber loss is 5 F or less, the chilled water temperature should drop to design within a short period as the automatic purge evacuates the machine. A completely evacuated machine normally has an absorber loss of 2 F or less.

If absorber loss is greater than 5 F, follow the procedure for Start-Up After Extended Shutdown.

Start-Up After Extended Shutdown (more than 21 days) — Start the machine in the normal manner by placing the following switches in the positions indicated:

SWITCH	POSITION
Refrigerant Pump(s) SW4	ON
Solution Pump(s) SW3	ON
Capacity Control Switch SW5	AUTO
Cycle-Guard Switch SW2	AUTO
START-STOP Switch SW1	START

When refrigerant pump starts and solution is warm (strong solution approximately 100 to 130 F), place capacity control switch in OFF position.

Determine machine absorber loss (see Maintenance Procedures). If absorber loss is 5 F or less, open capacity control valve by placing capacity control switch in AUTO. position and allow machine to operate. The purge will evacuate the machine to the normal absorber loss of 2 F or less.

If absorber loss is more than 5 F, evacuate machine to remove noncondensables that can prevent normal operation (see Maintenance Procedures section). An alternative procedure is to limit steam pressure so that strong solution temperature remains below 140 F while machine purge removes the noncondensables.

When absorber loss is reduced to 5 F or less, place capacity control switch in AUTO. position, return steam pressure to normal and allow purge to establish the normal 2 F or less absorber loss rate.

After evacuation, check the noncondensable accumulation rate to determine machine tightness (see Maintenance Procedures section).

Start-Up After Below-Freezing Conditions – Refill all water circuits if previously drained. Then follow procedure for Start-Up After Extended Shutdown.

Remove solution from the refrigerant circuit by following the procedure, Removing Lithium Bromide from Refrigerant, in the Maintenance Procedures section.

Machine Shutdown – Above-Freezing Conditions – Place the START-STOP switch in the STOP position. Machine goes thru automatic dilution and shuts down. Leave machine in this condition until the next start-up.

→ **Machine Shutdown – Below-Freezing Conditions** – Place the START-STOP switch in STOP position. Wait until automatic dilution is complete and all machine pumps stop. Completely drain all tube bundles and flush all tubes with an antifreeze chemical such as glycol.

In addition, the refrigerant circuit requires special treatment:

MACHINE WITHOUT EXTENDER VALVE (item 35, Fig. 1) – Fill a hose with water and connect it between solution pump and refrigerant pump service valves (on both ends of Size 077 thru 124 machines). Be sure connection between hose and fittings is vacuum tight.

Open both valves. *Do not allow any air to be drawn into machine. Place machine control switches in positions listed below.*

SWITCH	POSITION
Refrigerant Pump SW4	OFF
Solution Pump SW3	ON
Capacity Control Switch SW5	OFF
Cycle-Guard Switch SW2	OFF
START-STOP Switch SW1	START

Allow solution pump(s) to run for 8 minutes. This mixes lithium bromide solution with refrigerant and lowers the refrigerant freezing point.

Place the solution pump switch in the OFF position. Close the refrigerant pump and solution pump service valves.

Turn the refrigerant pump switch to ON and Cycle-Guard™ switch to MAN. (manual) for 30 seconds to mix the solution thoroughly. Then return the refrigerant pump switch to OFF and the Cycle-Guard switch to AUTO.

Place the START-STOP switch in STOP position. Antifreeze protection is now complete.

MACHINE WITH EXTENDER VALVE (item 35, Fig. 1) – Place machine control switches in the following positions:

SWITCH	POSITION
Refrigerant Pump SW4	ON
Solution Pump SW3	ON
Capacity Control Switch SW5	OFF
Cycle-Guard Switch SW2	ON
START-STOP Switch SW1	START

Cycle-Guard valve transfers refrigerant into the solution circuit until low-level switch energizes the Extender valve to transfer solution back into the refrigerant circuit.

Continue to operate machine for 2 minutes after the Extender valve has energized (can be sensed by steel object near top of valve). This mixes solution with refrigerant to lower freezing point.

Place START-STOP switch in STOP position. Machine now has total antifreeze protection.

PERIODIC SCHEDULED MAINTENANCE

Normal preventive maintenance for 16JB Absorption Chillers requires periodic, scheduled inspection and service. Each item in the periodic list is detailed in the Maintenance Procedures section which follows.

→ **Every Day**

1. Log machine and system readings, page 24.
2. Check the purge; exhaust if necessary, page 25.

Every Month of Operation

1. Determine absorber loss, page 25.
2. Determine noncondensable accumulation rate, page 25.
3. Check capacity control adjustment, page 26.

Every Two Months of Operation

1. Check low-temperature cutout, page 26.
2. Check Flotender™ operation (on some machines), page 26.
3. Check Cycle-Guard operation, page 28.
4. → Check low-level control Extender™ valve operation (on some machines), page 28.

Every Six Months of Operation

1. Check refrigerant charge, page 28.
2. → Check octyl alcohol, page 28.

Every Year

1. Have solution analyzed, page 28.
2. Check tubes for scale and fouling, page 29.

Every Three Years – Replace service valve diaphragms, page 29.

Every Six Years – Inspect hermetic pumps, page 29.

MAINTENANCE PROCEDURES

Log Sheets — Readings of machine and system pressure – temperature conditions should be recorded daily to aid the operator in recognizing both normal and abnormal machine conditions. The record also aids in planning a preventive maintenance schedule and in diagnosing machine problems. A typical log sheet is shown in Fig. 20.

ENGINEER ____________________

DATE ____________________

JOB NAME ____________________ SIZE __________ JOB NO. __________ MACHINE SER NO. __________

HOUR METER READING	AT TIME OF DATA										
	AT LAST PURGE DUMP										
PURGE GAS VOLUME (CC OR ML)											
STEAM	PRESS AT BOILER										
	PRESS AT MACHINE										
	VALVE POSITION										
REFRIG	TEMP										
	SPECIFIC GRAVITY										
	VAPOR COND TEMP										
CHILLED WATER	PRESS IN										
	PRESS. OUT										
	TEMP IN										
	TEMP OUT										
COND WATER	TEMP IN ABSORBER										
	TEMP OUT ABSORBER										
	TEMP OUT COND										
	PRESS. IN ABSORBER										
	PRESS OUT ABSORBER										
	PRESS. OUT COND										
WEAK SOLUTION	ACTUAL TEMP										
	SAMPLE TEMP										
	TEMP TO GENERATOR										
	SPECIFIC GRAVITY										
	ALCOHOL IN SAMPLE (YES OR NO)										
STRONG SOLUTION	TEMP OUT GENERATOR										
	TEMP TO ABSORBER										

Fig. 20 — Typical Absorption Refrigeration Log

Purge Exhaust Procedure

The purge valve mentioned in the following instructions is not used on some models (see item 36, Fig. 1). If not on your machine, ignore the references to it in following the exhaust procedure. For machine model identification and purge exhaust procedures, refer also to instructions posted on your machine.

1. Exhaust purge only when machine is operating.
2. Exhaust purge when purge exhaust light is on (item 4, Fig. 2).
3. Keep end of plastic tube (Fig. 21) below the liquid level in plastic bottle.
4. First close the purge valve (on some machines) and then close the solution return valve (item E, Fig. 5).
5. Wait approximately 5 minutes for storage chamber pressure to rise above atmospheric.
6. Open the exhaust valve slowly (Fig. 21). If the liquid level in the exhaust bottle drops, close valve and wait approximately 2 minutes.
7. Reopen exhaust valve slowly. If bubbles appear in the exhaust bottle, leave exhaust valve open until bubbles stop and solution level in bottle begins to rise. Close valve – purge is now exhausted.
8. Open the solution return valve and then the purge valve (on some machines).
9. Open the exhaust valve slowly and allow solution in the bottle to be drawn into the purge tube. Lower the solution level until bottle is 1/3 to 1/2 full. Close exhaust valve before solution level in bottle nears the tube end. *Do not allow air to be drawn into the purge tube.*
10. Log the date and time of purge evacuation to provide an indication of changes in the rate of noncondensable accumulation (see Fig. 20).

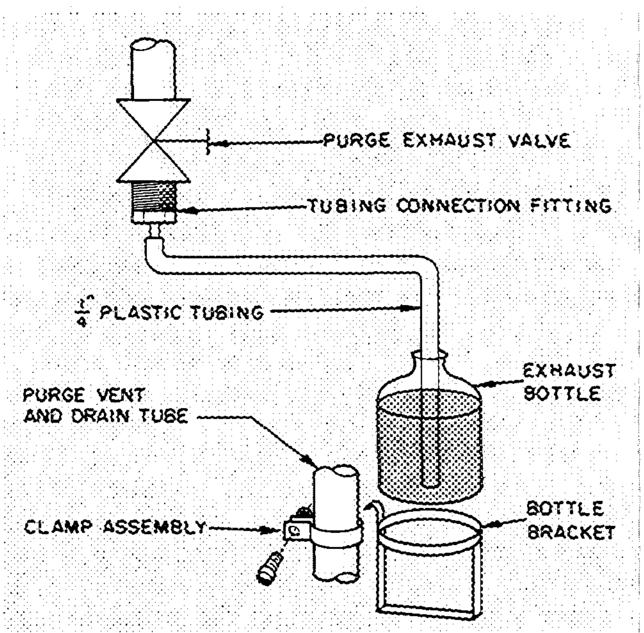


Fig. 21 – Purge Exhaust Assembly

Absorber Loss Determination – Take absorber loss readings when machine is operating with stable temperatures. On machine sizes 077 thru 124, take readings from both ends of machine.

Make sure that Cycle-Guard™ valve and low-level control Extender™ (LLC) valve are closed and have not operated for at least 10 minutes before taking readings.

Fill thermometer wells on discharge lines of solution and refrigerant pumps with oil or heat conductive compound and insert thermometers.

Take refrigerant and solution samples (see Solution or Refrigerant Sampling) and determine the specific gravity and temperature of each sample. The samples can be returned to the machine thru the purge exhaust bottle.

Using the equilibrium diagram (Fig. 23), plot the intersection point of the specific gravity and temperature of the solution sample. Extend this point horizontally to the right and read the saturation temperature. Repeat with refrigerant sample, using Fig. 24 and reading to the left for saturation temperature.

Subtract the solution saturation temperature from the refrigerant saturation temperature. The difference is the absorber loss. Repeat the readings with a second sample to verify steady state conditions. If the absorber loss is greater than 5 F, machine evacuation is necessary because excessive noncondensables may interfere with normal operation before they can be removed by the purge (see Machine Evacuation).

For probable causes and suggested remedies for high absorber loss, refer to the Troubleshooting section.

Noncondensable Accumulation Rate – The most important maintenance item on the absorption machine is the maintenance of machine vacuum within acceptable limits. Machine vacuum tightness can be checked by determining the rate at which noncondensables accumulate. Some noncondensables are normally generated within the machine, but an air leak or the need for additional inhibitor is indicated if the accumulation rate exceeds the maximum shown in Table 6.

After machine evacuation or other service, operate machine for at least 200 hours before determining noncondensable accumulation rate. Then proceed as follows:

1. Fill a length of flexible tubing with water and connect to the purge exhaust connection. Insert free end into a container of water. Exhaust purge completely (see Purge Exhaust Procedure).
2. Operate machine for 24 hours with purge operating normally.
3. Fill a 1,000 cubic centimeter (or equivalent) bottle with water and invert it in a clean container filled with water (Fig. 22).
4. Insert the free end of water-filled hose into the bottle.

5. Follow the purge exhaust procedure. Noncondensables displace water in the inverted bottle. Continue until bubbling in the bottle ceases and only solution flows from exhaust tubing.
6. Close exhaust valve and mark liquid level on inverted bottle. Remove bottle from container.
7. Return purge to normal operation. Replace exhaust bottle (Fig. 21). Open solution return valve (item E, Fig. 5) and then the purge valve (item 36, Fig. 1) found on some models.
8. Measure the amount of noncondensables removed. If a graduated bottle is used, the amount (volume) of noncondensables removed is indicated by mark on bottle. If a nongraduated bottle is used, empty the bottle and then fill the bottle with liquid to the exhaust mark. Pour the liquid into a graduated container to measure the volume displaced.
9. Refer to Table 6. If the displaced volume (representing the operating noncondensable accumulation rate per 24 hours) is greater than that listed for your machine size in Table 6, machine has an air leak or requires additional inhibitor. Have a solution sample analyzed (see Solution Analysis) to determine the proper corrective action. *If a leak is indicated, it must be found and repaired as soon as possible to minimize internal corrosion damage.*

Table 6 — Maximum Allowable Noncondensable Accumulation Rate*

UNIT 16JB	MAX ALLOW. RATE (per 24 hr)		UNIT 16JB	MAX ALLOW. RATE (per 24 hr)	
	fl oz	cc		fl oz	cc
010,012,014	3.99	118.0	054,057	11 97	353 9
018,021	5.98	177.0	061,068	15 95	471 9
024,028	7.98	235.9	077,084	18 61	550 6
032,036	10.25	302.8	097,107	26 59	786 5
041,047	13.29	393.3	115,124	29 25	865 2

*During operation

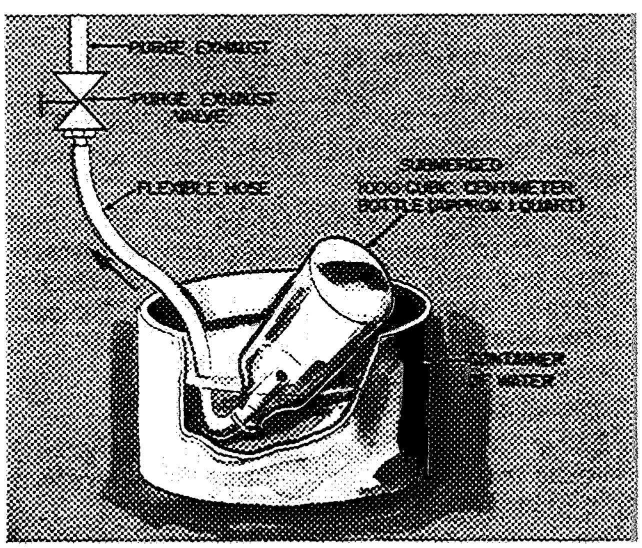


Fig. 22 — Collecting Noncondensables

Capacity Control Adjustment — Check the leaving chilled water temperature. If design temperature is not being maintained, reset the electronic or pneumatic control set point in the machine control panel.

If control is electronic, turn the control point adjuster (item 19, Fig. 2) slightly to WARMER or COLDER as required. If control is pneumatic, turn the set point adjustment shaft on the side of the controller (Fig. 16) slightly to WARMER or COLDER as required.

If machine still fails to maintain design temperature, refer to the Troubleshooting sections entitled Problem/Symptom — Leaving Chilled Water Temperature Too High, or Too Low.

Low-Temperature Cutout Adjustment — This machine safety serves to prevent freeze-up damage to the evaporator tubes. Check the cutout periodically to confirm trip at the selected setting. NOTE: If the cutout sensor has been exposed to temperatures above 120 F, the control must be recalibrated.

Remove the control sensing element(s) from the well(s) on the evaporator shell (some machines) or in the refrigerant pump sump (on other machines). Immerse the element in a container of cool water. Slowly stir crushed ice into the water so that the temperature goes down at a rate not exceeding 1°F per minute.

Observe the cutout temperature. It should be 5 F below design leaving chilled water temperature, or a minimum of 34 F. *If control fails to cut out by 34 F, stop machine immediately and recalibrate control* as described in Check Low-Temperature Cutout(s).

When control cuts out, machine shuts down immediately without going thru dilution cycle. Control cuts in when sensing element warms 3 F. If necessary, reset cutout adjustment knob (Fig. 14) and recalibrate. Then restart machine by pressing and releasing RESET switch (or placing switch SW1 in RESET position) and then placing START-STOP switch in START position. Replace sensing elements in wells.

Flotender™ Valve Operation (on some machines)

ELECTRONIC CAPACITY CONTROL — The Flotender valve (item 26, Fig. 1) should energize and open when the electronic valve motor has rotated 75 angular degrees from the closed position. When energized, a magnetic field can be sensed near the top of the solenoid with a screwdriver or any piece of thin steel. The valve should de-energize and close when the electronic valve motor rotates back about 10 degrees towards the closed position.

If the Flotender valve does not operate in the manner described above, remove the cover of the end switch, mounted on the electronic valve motor. Check the wiring; reset the switch adjustment screw if necessary, and check valve operation as described in the section, Check Flotender Valve.

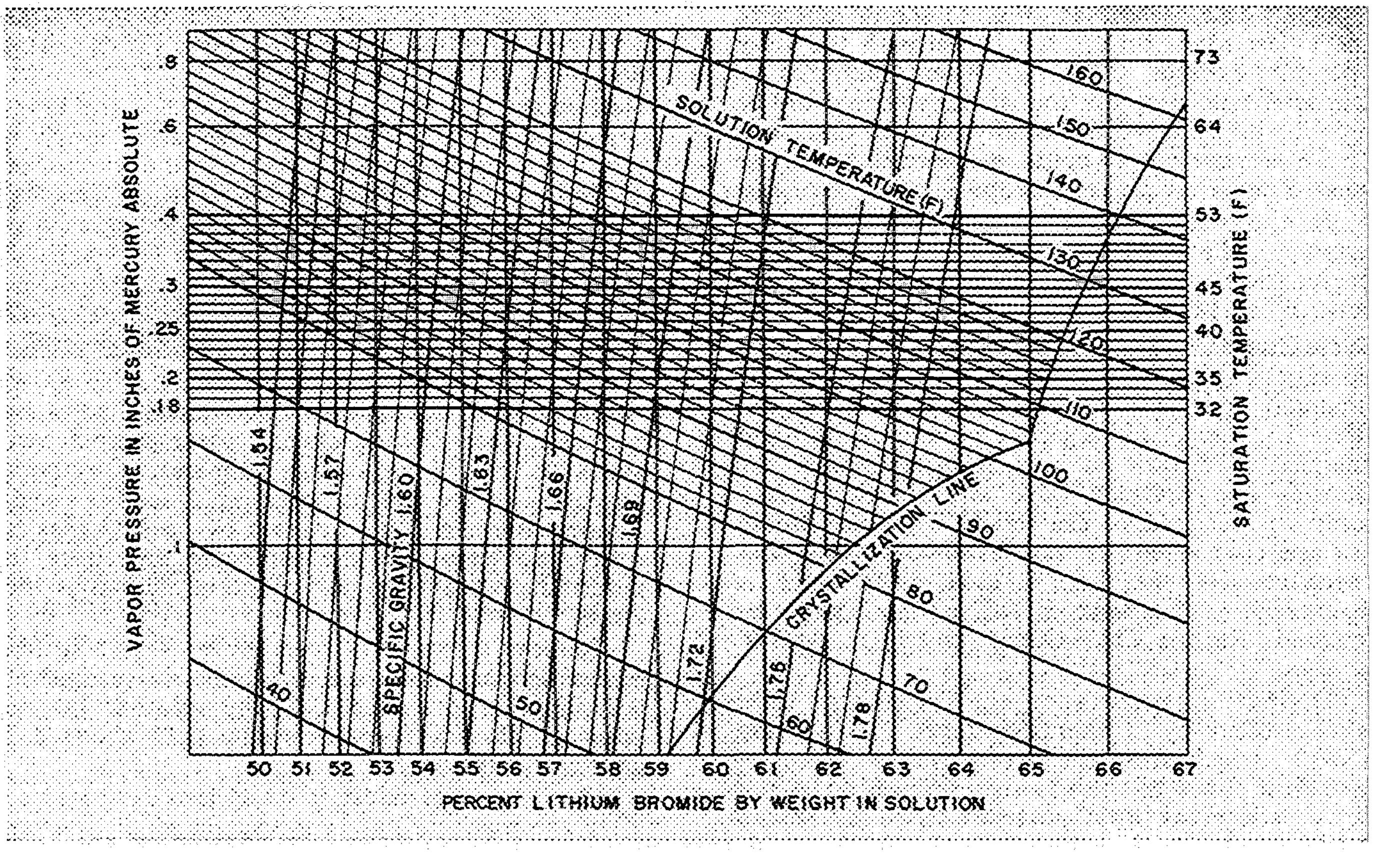


Fig. 23 – Equilibrium Diagram for Lithium Bromide in Solution

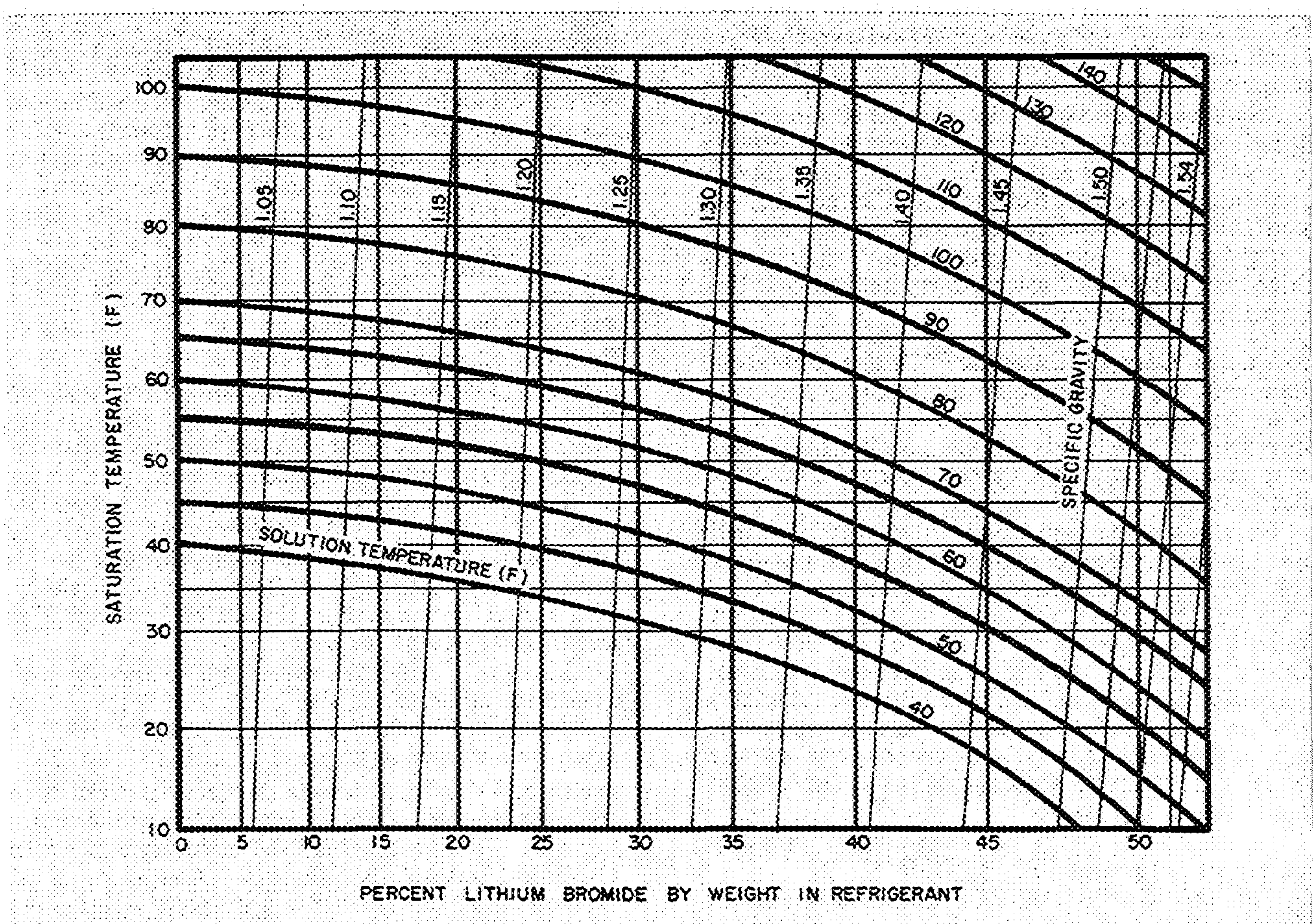


Fig. 24 – Equilibrium Diagram for Lithium Bromide in Refrigerant

PNEUMATIC CAPACITY CONTROL – The Flotender™ valve (item 26, Fig. 1) should energize and open when branch air pressure to the valve operator exceeds 8.5 psig. When energized, a magnetic field near the top of the solenoid can be sensed with a screwdriver or any piece of thin steel. The Flotender valve should de-energize and close when branch air pressure drops to about 6.5 psig.

If the valve fails to operate in the above manner, check the wiring and adjust the pneumatic-electric (PE) switch (Fig. 18) in the control panel if necessary.

Cycle-Guard™ System Operation – To check operation, place Cycle-Guard switch in MAN. (manual) position. The Cycle-Guard transfer valve (item 15, Fig. 1) and adjacent white indicator light energize. The flow of refrigerant will cause the transfer line between valve and solution pump sump to feel cold to the touch. This line should not feel cold when the transfer valve is closed (not energized). If the line is cold when valve is de-energized, the valve is leaking and must be repaired. Return Cycle-Guard switch to AUTO. position.

During normal operation, the Cycle-Guard valve is controlled by 2 thermoswitches (TSW-1 and TSW-2), which sense the strong solution temperature as it flows to the absorber spray header, and by 3 refrigerant level switches (SW8, SW9 and SW10) located in a level control chamber (item 32, Fig. 1).

For nominal operating conditions, TSW-1 and TSW-2 switches close on temperature drop below 110 F and 122 F (±F) respectively. Special operating conditions may require special settings.

Level switches SW8, SW9 and SW10 close with rising refrigerant levels corresponding to increasing solution concentrations. (See also Maintenance Procedures entitled Refrigerant Charge Adjustment, and Thermoswitch Adjustment.)

Cycle-Guard system malfunction makes machine susceptible to solution crystallization. Use Troubleshooting remedies.

Low-Level Control Extender™ Valve Operation → (item 35, Fig. 1) (on some models only) – This valve can best be checked while the machine is operating at low loads or low condensing water temperatures, or just after normal machine shutdown.

First, place the capacity control switch in OFF position and Cycle-Guard switch in MAN. position. This transfers refrigerant to the solution circuit, lowering the refrigerant level in the evaporator. When the refrigerant level reaches the low-level control Extender switch, the low-level control Extender valve (item 35, Fig. 1) opens (energizes) with an audible click. When the valve is energized, there is a magnetic field near the top of the solenoid that can be sensed with any piece of thin steel, such as a screwdriver.

Return both the Cycle-Guard and capacity control switches to AUTO. position.

Extender valve malfunction (failure to open) can be recognized by refrigerant pump discharge pressure below atmospheric. Failure to close can be recognized by excessive amounts of lithium bromide in the refrigerant (above 20% concentration when solution concentration is 58% or more). Check wiring and valve, and switch operation.

→ **Refrigerant Charge Adjustment** – Check the evaporator refrigerant (water) charge after every 6 months of operation. An increase in the amount of water in the machine indicates tube leakage. Furthermore, the correct refrigerant charge must be maintained for accurate operation of the Cycle-Guard system.

For charge adjustment, refer to Refrigerant Charge Final Adjustment, in the Initial Start-Up section.

Adding Octyl Alcohol – Octyl alcohol may be required when leaving chilled water temperature starts to rise above design temperature without alteration of the control set point. Since the rise in temperature can also be caused by fouled tubes or other problems, use the following procedure to determine whether a lack of octyl alcohol is the cause.

Remove a sample of solution from the solution pump service valve (see Solution or Refrigerant Sampling for procedure). If the solution has no odor of alcohol (very pungent), add about 1/2 gallon of octyl alcohol.

Octyl alcohol addition may also be required after the machine has been evacuated or after an extended period of operation.

Use only octyl alcohol. Other types of alcohol have a detrimental effect on machine performance.

Fill a length of flexible tubing with water and connect one end to the solution pump service valve (see Fig. 28). Insert the other end in a container of octyl alcohol. Place the solution pump switch in the OFF position to de-energize the pump. Then open the service valve to allow alcohol to be drawn into the machine. *Close valve before air can be drawn into the hose.* Return the solution pump switch to the ON position.

Solution Analysis – Laboratory analysis of a solution sample gives indication of change in solution alkalinity and depletion of inhibitor, and may indicate the degree of machine leak tightness.

Have the solution analyzed at least once a year or whenever there is an indication of a noncondensable problem. Take the sample from the solution pump service valve while the machine is running (see Solution or Refrigerant Sampling). The sample concentration should be between 58% and 62% by weight for best results.

Solution analysis should be done by an approved laboratory. The analysis interpretation and the adjustment recommendations should be made by a trained absorption specialist.

Inhibitor – A corrosion inhibitor is charged into the machine with the initial charge of lithium bromide. The inhibitor is used in conjunction with alkalinity control to minimize the amount of noncondensables normally generated within the machine. Excessive noncondensable generation interferes with machine performance.

The inhibitor is gradually depleted during machine operation and occasional replenishment is necessary. Solution alkalinity also changes over a period of time and must be adjusted (see Solution Analysis).

CAUTION: Altering the inhibitor or using solutions and internal surface treatments, not specified by the equipment manufacturer may result in performance deterioration and damage to the absorption machine.

Condensing Water Tube Scale is indicated if the temperature difference between condensing water leaving the condenser and refrigerant condensate from the condenser is greater than the normal 9 F–13 F difference at full load (capacity control valve(s) fully open). Scale reduces heat transfer, increases steam consumption and limits machine capacity. Scale can also cause serious corrosion damage to the tubes.

Soft scale can be removed from tubes with brushes. If scale is hard, it may be necessary to clean the tubes with chemicals before brushing. Adequate water treatment can minimize scale and corrosion; establish a water treatment program with the assistance of a local water treatment specialist.

Service Valve Diaphragm Replacement – To replace the valve diaphragms, break machine vacuum with nitrogen. Remove solution and refrigerant from machine. Store solution in clean containers for recharging.

Remove and replace valve diaphragms. Torque valve bolts to approximately 3 lb-ft. Test all affected connections for leakage (see Machine Leak Test). When servicing is complete, reevacuate the machine (see Machine Evacuation).

Replace the same quantity of solution and refrigerant in machine as removed.

→ **Hermetic Pump Inspection** – The pumps used on Carrier Absorption Machines are hermetic and do not require seals. Pump motors are cooled by the fluid being pumped. Pump may be of cast design (Fig. 26) or of stamped design (Fig. 27).

Disassemble, inspect and reassemble the pumps as follows:

DISASSEMBLY (Fig. 26 or 27 as applicable)

1. *Disconnect all primary power to the pumps, tag and lock all disconnect switches.*
2. Break vacuum with nitrogen if not already performed.
3. Remove solution and refrigerant from the machine. Store solution in clean containers until recharging.
4. Disconnect motor power leads at stator junction box. Mark the leads to insure proper reassembly.
5. Remove bolts (item 1) holding motor adapter flange (item 2) to pump casing (item 3). NOTE. Use blocking to support the weight of the motor stator when removing bolts.
6. Pull stator and adapter flange straight back from pump casing. If flange is frozen to casing by paint, gently pry between adapter flange and pump discharge pipe (item 4) to break paint seal.
7. Remove and discard gasket (item 5).
8. Remove impeller (item 6) by straightening locking tabs on impeller lock washer (item 7). Prevent impeller from rotating while removing locking bolt (item 8). Remove impeller key in shaft. On stamped design pump (Fig. 27), remove wearing ring (item 19).
9. Remove stud nuts (item 9).
   CAST DESIGN (Fig. 26): Insert jacking screws into tapped holes in wearing ring housing (item 10). Loosen and remove the housing.
   STAMPED DESIGN (Fig. 27): Tap and slightly twist wearing ring housing (item 10). Loosen and remove the housing.
10. Slide out rotor (item 11) carefully to avoid damage to stator can (item 12), rotor liner (item 13) or motor end bearing (item 14).
11. Remove motor end bearing and spring (item 16). On cast design pump (Fig. 26), also remove retaining clip (item 15).

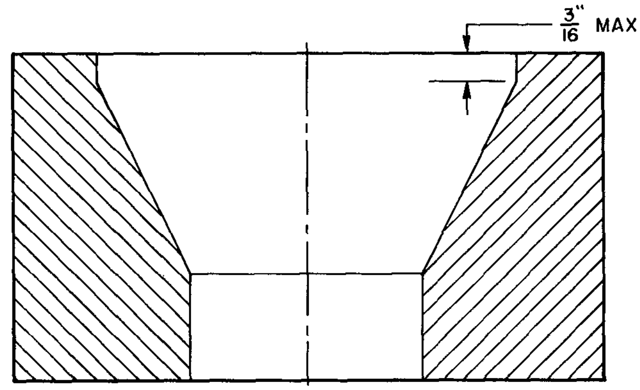
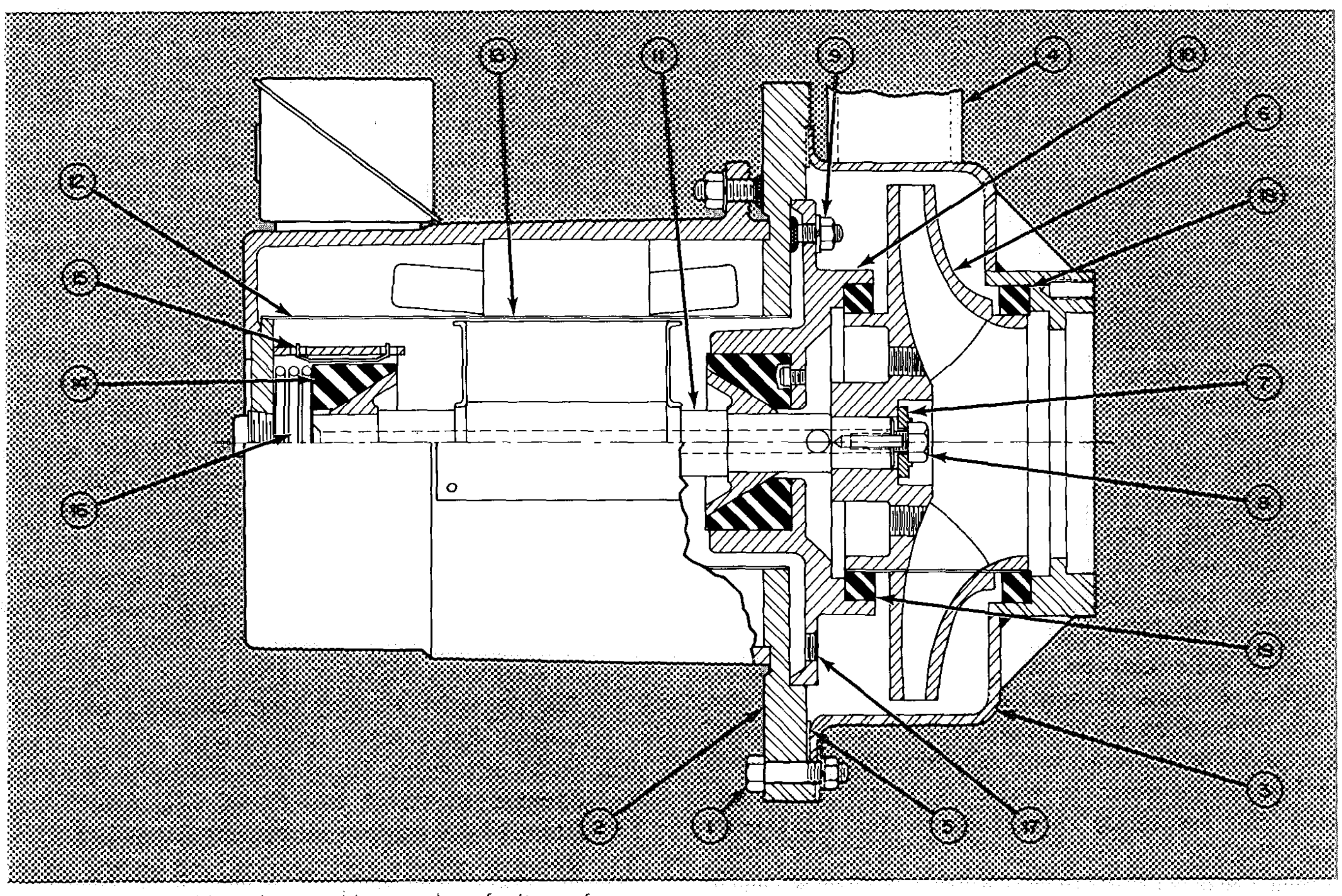


Fig. 25 – Check Bearing Axial Wear

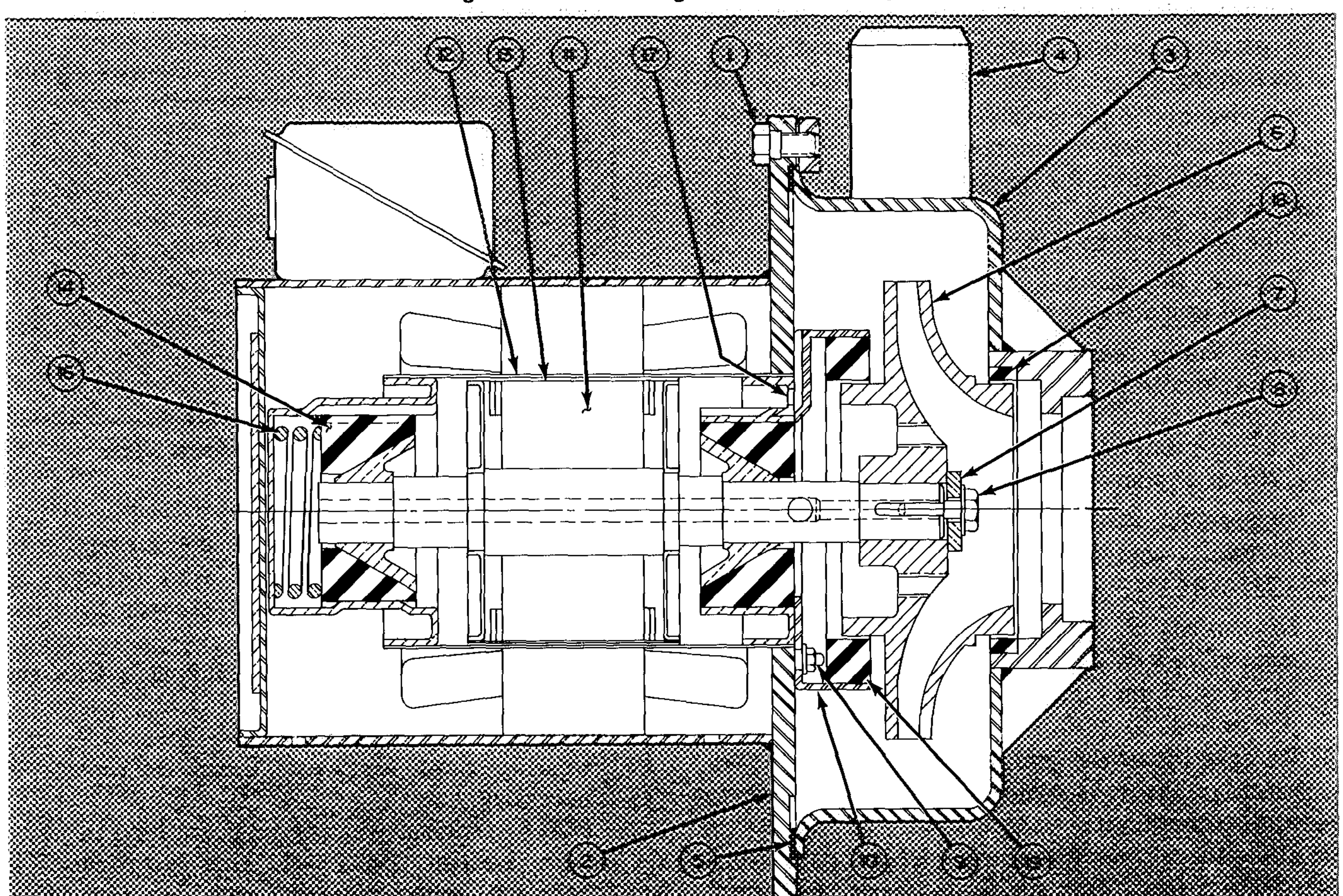
INSPECTION

1. Check for bearing wear by measuring depth from large end of cone to start of cone as indicated in Fig. 25. If wear exceeds 3/16 in., replace the bearing.
2. Check recirculation passages (item 17). Clean as required.
3. Examine impeller, stator can, rotor liner and wearing rings for wear. Clean or replace if necessary.
   NOTE: Original wearing rings are held in place with Loctite. Break old ring with chisel if necessary when replacing ring. Do not apply Loctite to new ring.



NOTE See disassembly and reassembly procedures for item references

→ **Fig. 26 – Cast Design Hermetic Pump**



NOTE See disassembly and reassembly procedures for item references

→ **Fig. 27 – Stamped Design Hermetic Pump**

4. Check spring loaded bearings for free movement within bearing housing.

REASSEMBLY (Fig. 26 or 27 as applicable)

1. Clean all parts.
2. Install retaining clip (cast pump design only) and spring in motor end bearing housing.
3. Insert motor end bearing in housing. Fit should be free sliding without excessive radial play.
4. Guide rotor into position carefully to avoid damage to rotor liner, stator can and bearing.
5. Install end bearing in the bearing and wearing ring housing. On cast design pump (Fig. 26), be sure that bearing retainer pin is in the bearing retainer hole.
6. Install bearing and wearing ring housing. Tighten stud nuts.
7. Replace both wearing rings, if required. Use hand pressure to position new rings. Do not use Loctite.
8. Install impeller with impeller key, lock washer and locking bolt. Bend washer tabs over flats of locking bolt heads.
9. Install new 1/32-in. thick EPR gasket. Remove transfer tape from adhesive side of gasket and position gasket on adapter flange periphery.
10. Be sure impeller inlet wearing ring is in place.
11. Slide motor stator housing and adapter flange assembly into pump casing. Use blocking to support the motor stator. Oil, install and tighten bolts and washers to approximately 18 lb ft torque. Remove blocking.

COMPLETION

1. Leak test affected joints to be sure all pump connections are tight (see Machine Leak Test).
2. Evacuate machine (see Machine Evacuation).
3. Recharge machine with the same quantity of solution and refrigerant as removed.
4. Reconnect motor power leads to proper motor wires and replace junction box.
5. Resupply power to pump.
6. Record inspection date and results.

Solution or Refrigerant Sampling — Take solution or refrigerant samples from the pump service valve while the pump is operating.

Before taking a sample for analysis or absorber loss determination, be sure machine is operating with steady load and that Cycle-Guard™ valve has not been energized within 10 minutes prior to sampling.

1. Attach a hose adapter to the pump service valve. *Do not use copper or brass fittings when taking samples for analysis, copper oxide can form and contaminate samples.*
2. Fill a length of flexible tubing with water and connect one end to the hose adapter. Place the free end in a container of water. Be sure end is submerged (Fig. 28).
3. Open valve slightly. When container water level rises, wait several seconds to purge the water from the tube. Then remove tube end from water and fill sample container.
4. Turn off service valve and remove hose and adapter.

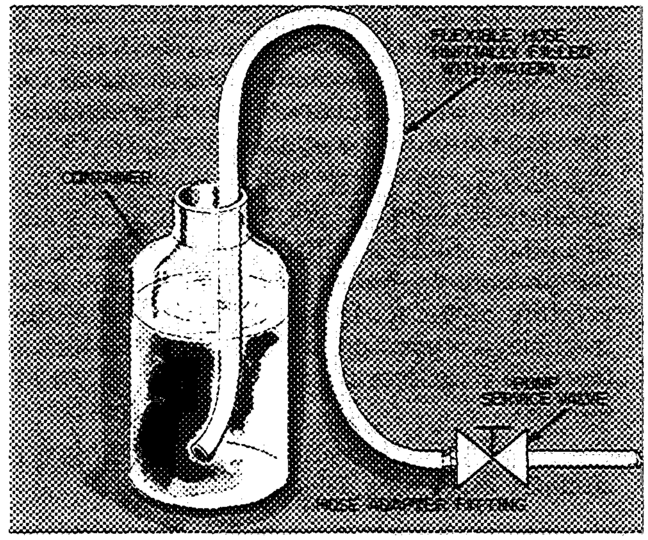


Fig. 28 — Adding or Removing Liquids

Internal Service — To prevent corrosion from air inside the machine, break vacuum with nitrogen when opening the machine for maintenance or repair.

While the machine is open, it is good practice to minimize the amount of air entering by continuously feeding nitrogen into the machine at approximately 1 psig pressure.

Perform service work promptly and efficiently and close up the machine as soon as possible. Do not rely on inhibitor for corrosion protection unless all lithium bromide and refrigerant have been removed and machine completely flooded with a lithium chromate inhibitor—water solution prior to machine opening.

Leak test the machine thoroughly after the machine has been closed up.

WARNING: When flamecutting or welding on an absorption machine, some noxious fumes may be produced. Ventilate the area thoroughly to avoid breathing concentrated fumes.

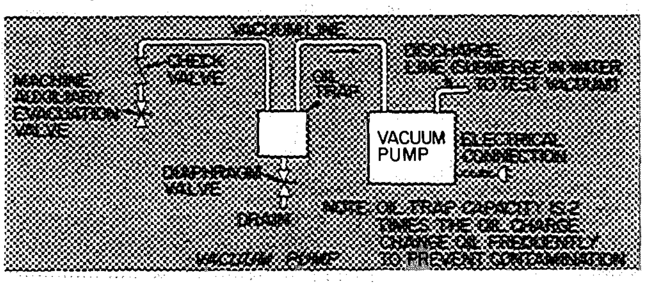
Hydrogen can form an explosive mixture in air. Never cut into purge chamber unless purge has been exhausted to remove any hydrogen gas that might be present in the chamber.

Machine Evacuation is required for the removal of excessive noncondensables from the machine. After air has entered the machine during service work, or when absorber loss is greater than 5 F during operation, the machine must be evacuated.

1. Connect an auxiliary evacuation device (Fig. 29) to the auxiliary evacuation valve (item 29, Fig. 1). Use a line size at least equal to the connection size on the auxiliary device and keep the line as short as possible. *A check valve must be used on the suction lines. Be sure all connections are vacuum tight.*

A vacuum pump oil trap can also serve as a cold trap if it has a center well to hold dry ice or a mixture of salt and ice. Any water vapor that can contaminate the oil in the vacuum pump is condensed and removed by the cold trap. The cold trap thus reduces the time required for evacuation and eliminates the need for frequent replacement of the pump oil charge.

2. Start evacuation device. After one minute, open auxiliary evacuation valve. If the machine is not operating, reduce machine absolute pressure to the pressure equivalent of the saturation temperature of the refrigerant (see Fig. 23). If the machine is operating, evacuate until absorber loss is 5 F or less (at both ends of 077-124 models).
3. Close auxiliary evacuation valve and turn off auxiliary evacuation device.
4. Machine evacuation can remove octyl alcohol. Check a solution sample for the presence of octyl alcohol and add if necessary (see Adding Octyl Alcohol).



→ **Fig. 29 — Auxiliary Evacuation Device**

Removing Lithium Bromide from Refrigerant — During normal operation, some lithium bromide may be carried over into the refrigerant. In machines with a low-level control Extender™ valve, it is normal for some lithium bromide to pass into the refrigerant circuit at low load conditions. Lithium bromide in the refrigerant is automatically transferred back to the absorber by the Cycle-Guard™ valve when it is needed. The refrigerant flows thru the Cycle-Guard valve into the solution circuit and separation is made in the generator in the normal manner.

Lithium bromide can be transferred manually by placing the Cycle-Guard switch at MAN. while the machine is running and the capacity control valve is open. When the refrigerant specific gravity drops below 1.02, return the Cycle-Guard switch to AUTO. to close the Cycle-Guard valve.

Solution Decrystallization — Crystallization occurs when strong solution concentration and temperature cross over to the right of the crystallization line on the Fig. 23 equilibrium diagram. It should not occur if machine controls are correctly adjusted and machine is properly operated. Refer to the Troubleshooting Guide for probable causes and remedies.

If it occurs, crystallization generally takes place in the shell side of the heat exchanger and blocks the flow of strong solution from the generator. The strong solution then overflows into a pipe that returns it directly to the absorber sump. The solution pump then returns the hot solution thru the heat exchanger tubes, automatically heating and decrystallizing the shell side.

If crystallization results from a long, unscheduled shutdown (such as from a power failure) without proper dilution, the solution pump may become bound and fail to rotate. This will cause the overloads to trip out. In such a case, decrystallize as follows:

1. Heat the solution pump casing and adjacent lines with steam.

Under no circumstances apply heat directly to pump motor or controls when warming the casing. Do not apply direct heat to any flange connections; high temperature can deteriorate the gasket material.

2. Rotation of a hermetic pump cannot be viewed directly. Check the solution pump rotation by installing a compound gage on the pump service valve and reading discharge pressure. Be sure to reset the pump overloads in control panel if they have tripped.

   If the pump is rotating normally, the gage will show a reading above atmospheric pressure. If the pump casing and discharge line are completely blocked, the gage will show zero atmospheric pressure. If the pump interior is only partially blocked, a deep vacuum will indicate that the pump is not rotating.

   Continue heating the casing until gage pressure shows above atmospheric pressure with pump overloads reset. *Do not reset pump overloads more than once in any 5-minute period*

   If the heat exchanger is also blocked, the decrystallization process will begin as soon as the solution pump starts rotating and the adjacent weak solution lines have decrystallized. If the heat exchanger or adjacent piping does not decrystallize automatically, heat the blocked area externally with steam or a soft torch flame. Crystallization in purge piping can be broken up by applying heat in the same manner.

3. If the strong solution line from heat exchanger to absorber spray nozzles is blocked, turn off the condensing water pump and operate the machine with capacity control valve open. Turn the Cycle-Guard switch to MAN. for 10 minutes to dilute the solution. The entire unit will pick up heat and the crystallization will dissolve.

When heating the machine in this manner, remove the low-temperature cutout (LTCO) and thermoswitch sensing bulbs from their wells and insulate them to prevent overheating. When machine temperatures return to normal, recalibrate the LTCO and thermoswitches (see Low-Temperature Cutout Adjustment, and Thermoswitch Adjustment).

→ **Thermoswitch Adjustment** — Check the TSW-1 and TSW-2 thermoswitches while machine is operating.

A thermowell is located on the absorber spray supply pipe near the thermoswitch sensing bulb wells. Place heat conductive compound or oil in the thermowell and insert a thermometer with 0°F to 300 F range (approximately).

Turn the thermoswitch adjustment knobs (Fig. 14) fully counterclockwise and then slowly clockwise until the contacts of each close. Note the difference (if any) between the actual thermometer reading and the reading on the thermoswitch adjustment scale as the contacts close. Allow for this difference in setting the thermoswitch control point. EXAMPLE: As switch contacts close, thermometer reads 110 F; thermoswitch scale reads 107 F. To have contacts close at a selected temperature of 122 F, knob must be set at scale reading of 119 F.

Allowing for any temperature difference as described above, set TSW-1 adjustment knob as required to make contacts close at 110 F thermowell temperature; set TSW-2 knob as required to close contacts at 122 F. NOTE: Special operating conditions may require other thermoswitch settings. Check your Job Data. Use same adjustment procedure.

→ **Machine Leak Test** — All joints welded at machine installation must be leak tested before initial start-up of machine. Joints must also be leak tested after repair. If there is any indication of air leakage, leak test the entire machine.

1. Be sure auxiliary evacuation valve, purge exhaust valve and all pump service valves are closed.
2. Refer to Table 7 for the amount of nitrogen and Refrigerant 12 required for leak testing.
3. Break machine vacuum with dry nitrogen. Pressurize machine to 8 psig with Refrigerant 12. Charge the nitrogen and refrigerant thru the auxiliary evacuation valve (item 29, Fig. 1).
4. Use dry nitrogen to raise machine pressure to 20 psig. *Do not exceed 20 psig.*
5. Leak test all joints with an electronic leak detector.
6. Correct all leaks; retest to ensure repair.
7. Release machine pressure and perform machine evacuation.

Table 7 — Quantity of Refrigerant and Nitrogen Required for Leak Testing

UNIT 16JB	REFRIGERANT 12 (No. of cylinders)		NITROGEN (No. of cylinders)
	25 lb	12 lb	300 cu ft vol
010 012 014	1	0	1.0
018 021	1	1	1.0
024 028	2	1	2.5
032 036	2	1	2.5
041 047	4	0	3.5
054 057	4	0	3.5
061 068	5	0	4.5
077 084	5	1	5.0
097 107	8	0	7.0
115 124	9	0	8.0

TROUBLESHOOTING GUIDE

PROBLEM/SYMPTOM	PROBABLE CAUSE	REMEDY
Machine Will Not Start or Shuts Down (Panel RUN light out, pumps off.)	No power to control panel	Check for building power failure. Check main circuit breaker.
	Control panel fuse blown	Examine circuits for ground or short. Replace fuse.
	Control panel disconnect switch open	Rotate disconnect switch arm counterclockwise to close.
	Control panel switches not set correctly	Depress and release RESET switch. Place both pump switches at ON. Capacity Control and Cycle-Guard^{TM} switches at AUTO. and START-STOP switch at START.
	Chilled water or condensing water pump overloads or flow switches open	Check chilled water and condensing water pumps, starters and valves.
	Solution pump overloads open	Push overload reset button. Measure pump discharge pressure to check for solution crystallization. (See Solution Decrystallization Section.)
	Refrigerant pump overloads open	Push overload reset button
	Low refrigerant temperature cutout	Depress and release RESET switch after refrigerant has warmed at least 3 degrees. Measure refrigerant temperature Recalibrate or replace switch if temperature is above setpoint. Check capacity control setting and operation if temperature is below switch setting. (See Final Calibration of Controls.)
	Low refrigerant level (some models)	Depress and release RESET switch. Measure refrigerant pump discharge pressure If below atmospheric pressure, the absorber valve is malfunctioning and must be corrected. If above atmospheric pressure, check the low-level switch.
Leaving Chilled Water Temperature Too High (Maching running, chilled water temperature above design.)	Control point adjuster (electronic) or controller (pneumatic) set too high	Reset control in control panel.
	Excessive cooling load (machine at capacity)	Check for cause of excessive load.
	Excessive chilled water flow (above design)	Check pressure drop per selection data and reset flow.
	Low condensing water flow (below design)	Check pressure drop per selection data and reset flow.
	High supply condensing water temperature (above design)	Check cooling tower operation and temperature controls.
	Low steam pressure or hot water temperature (below design)	Raise to design per selection data.
	Inadequate steam condensate drainage (condensate backs up into tube bundle)	Check operation of steam traps, strainers, valves and condensate receivers.
	Fouled tubes (poor heat transfer)	Clean tubes. Determine if water treatment is necessary.
	Machine needs octyl alcohol	Check solution sample and add octyl alcohol if necessary. (See Adding Octyl Alcohol.)
	Noncondensables in machine	Check absorber loss. (See Absorber Loss Determination.) If above 5 F, see Causes and Remedies under Inadequate Purging (high absorber loss).
	Capacity control malfunction	Check calibration and operation of capacity controls. (See Final Control Adjustment.)
	Solution crystallization (solution flow blockage)	See Causes and Remedies under Solution Crystallization.
	Cycle-Guard control malfunction (low solution concentration)	Check refrigerant charge and thermoswitch calibration. (See Check Refrigerant Charge Adjustment, Cycle-Guard System Operation and Thermoswitch Adjustment.)
	Absorber valve (some models) or low-level Extender^{TM} valve (some models) malfunction	Check operation of valve and low-level control.

TROUBLESHOOTING GUIDE (cont)

PROBLEM/SYMPTOM	PROBABLE CAUSE	REMEDY
Leaving Chilled Water Temperature Too Low (Machine running, chilled water temperature below design.)	Control point adjuster (electronic) or controller (pneumatic) set too low	Reset control in control panel
	Capacity control malfunction	Check calibration and operation of capacity control (See Final Control Adjustment.)
Leaving Chilled Water Temperature Fluctuates (Machine running, capacity control hunting.)	Chilled water flow or load cycling	Check chilled water system, controls and load
	Condensing water flow or temperature cycling	Check condensing water temperature control and cooling tower operation
	Steam pressure or hot water temperature cycling	Check steam pressure or hot water temperature control
	Inadequate steam condensate drainage (condensate backs up into tube bundle)	Check operation of steam traps, strainers, valves and condensate receivers.
	Capacity control malfunctions	Check calibration and operation of capacity control (See Final Control Adjustment)
Inadequate Purging (Low machine capacity and high absorber loss — see Absorber Loss Determination.)	Air leakage in vacuum side of machine (high noncondensable accumulation rate)	Have solution analyzed for indication of air leaks Leak test and repair if necessary (See Noncondensable Accumulation Rate, Solution Analysis, and Leak Test sections)
	Inhibitor depleted (high noncondensable accumulation rate)	Have solution analyzed. Add inhibitor and adjust solution alkalinity if necessary. (See Noncondensable Accumulation Rate, Solution Analysis and Inhibitor sections)
	Purge valves not positioned correctly	Check valve positions (See Purge Exhaust Procedure)
	Purge solution supply lines crystallized (not able to exhaust purge)	Heat solution supply lines. (See Purge Exhaust Procedure and Solution Decrystallization section)
Solution Crystallization During Operation (Strong solution overflow pipe hot.)	Cycle-Guard™ control malfunction (solution overconcentration)	Check refrigerant charge, thermoswitch calibration and transfer valve operation. (See Check Refrigerant Charge, Adjustment, Cycle-Guard System Operation and Thermoswitch Adjustment)
	Noncondensables in machine (high absorber loss)	Check absorber loss (See Absorber Loss Determination) If above 5 F, see Causes and Remedies under Inadequate Purging.
	High steam pressure or hot water temperature (above design)	See Selection Data Set at design
	Absorber tubes fouled (poor heat transfer)	Clean tubes Determine if water treatment is necessary
	Octyl alcohol depletion	Check solution sample and add octyl alcohol if necessary (See Adding Octyl Alcohol.)
Solution Crystallization at Shutdown (Crystallization symptoms when machine is started.)	Insufficient solution dilution at shutdown.	After shutdown, restart machine and measure concentration of weak solution. (See Solution Sampling) If above 56%, check dilution level switch and Cycle-Guard transfer valve

For replacement items use Carrier Specified Parts.