WARNING:

Before attempting a unit startup, make sure that all fuel, electrical, exhaust and control systems are properly installed, meet all applicable codes and are safe to operate.

ALWAYS TURN OFF and LOCK OUT all electrical disconnects to the chiller and any other equipment interlocked or interconnected with the chiller when trouble shooting electrical wiring or components, when doing modifications or when installing or removing any jumpers.

NOTE: Start-Up Check List (Form 155.17-SU1) should be filled out during the following procedures.

1. Visual inspection and preparation.

   a. Make sure that the installing contractor has completed all work listed on the "Pre-Start Check List" (Form 155.17-F2). Make sure all chilled water and condenser water piping is correct, sized properly and that flow is in the correct direction.

   b. Check unit thoroughly for any signs of damage.

   c. Check unit pressure. All units are shipped from the factory charged with nitrogen to approximately 2.5 psig. The pressure is indicated by a mark on the face of the high pressure gauge. There may be a small variation from this setting due to changes in ambient temperature. If there is no pressure, check the unit for leakage. Look for any visible problems that could cause a loss of pressure such as removal of the rupture disc blanking flange, open purge valves, etc. If no visible cause for the loss of pressure is found, leak test the unit with nitrogen to locate the cause of leak. If the leak is minor, repair and continue with start-up. If the leak is due to serious damage, contact York for instructions. When pressurizing the unit, do not exceed 12 psig.

WARNING:

Do not leak test unit with more than four (4) psig of pressure with the rupture disk installed. The rupture disk burst pressure is 7.0 psig ±0.75 psi. A means of equalizing the pressure across the rupture disk or rupture disk removal is necessary when pressurizing to higher pressures.

   d. Check vacuum indicator connections. (Install mercury manometer or optional absolute pressure gauge if one has not already been installed.)

   e. Check the installation and operation of the purge (vacuum) pump. Check oil level, rotation and belt tension (between 1/4 and 1/2 inch). Check pump's capacity to draw vacuum. Acceptable performance is below 3 mm Hg within 2 minutes. Install necessary auxiliary piping to the purge pump in order to perform bubble test. Install full flow ball valve on gas ballast. Check purge system piping for air leakage. No air leakage is acceptable. Check purge valve (VP8) operation.

   f. Check all unit valves to make sure they are set correctly as shown on the Factory Test Report and that the Heating/Cooling change-over valves are properly set for either cooling or heating operation.

2. After warming the purge pump up for approximately 20 minutes, begin evacuation of the unit.

NOTE: The following evacuation instructions apply to evacuation during start-up or evacuation after pressurization for other reasons. Ensure all purge valves are placed back in their proper positions after evacuation.

   a. On N-Series units open VP9, VP2 and VP3 and purge from all sections simultaneously. If unit has optional heat exchanger, open VP6 and purge with VP9, VP2, VP3 simultaneously.

b. On G-Series units open VP2, VP3, VP4, VP5 and VP6 and purge from all sections simultaneously. (If unit has no hot water heat exchanger, there will be no VP6.)

c. On S-Series units open VP9, VP2, VP3 and VP5 and purge from all sections simultaneously. If unit has optional hot water heat exchanger, open VP6 and purge with VP9, VP2, VP3 and VP5 open simultaneously.

NOTE: Steps 3 through 7 can be done while unit is being evacuated.

3. Check all thermowells. Fill thermowells with heat conductive compound such as *Thermal Mastic* by Virginia Chemicals if not already filled from Factory Testing.

4. Check operation of all controls and interlocks.

WARNING:

The safety controls on ParaFlow units must be functionally tested and each proven to shut the unit down prior to operation. Calibration and functional check out of the controls should be repeated once per year.

a. Check LOW REFRIGERANT TEMPERATURE CUT-OUT using ice water. It should trip the unit at 39°F. (Newer units may have a lower setting of 35°F – check the latest wiring diagram for the correct setting.)Make sure that the sensing bulb is properly positioned back in its well and that the well has adequate heat conductive compound installed. Though the unit should not be insulated at this point, it is very important to insulate the LOW REFRIGERANT CUT-OUT well and surrounding area with at least 2 inches of Armaflex or similar insulation. Do not operate the unit without this insulation installed.

b. Check that REFRIGERANT TEMPERATURE THERMISTOR is properly installed in the thermowell with adequate heat conductive compound. The area around the refrigerant temperature thermister should be well insulated before running the unit in cooling operation.

c. Check that the CHILLED WATER FLOW SWITCH is properly installed and that it will trip the unit at low or no flow conditions. The chilled water flow switch should stop the unit at any time the chilled water flow drops below fifty (50) per cent of design flow.

WARNING:

Under no circumstances must a unit be operated without a properly functioning chilled water flow switch. The chilled water flow switch function should be checked annually.

d. Check that the TOWER WATER (absorber/condenser) FLOW SWITCH stops the unit if tower water flow is low or no flow occurs.

e. Check that the HOT WATER FLOW SWITCH is properly installed (if unit is equipped with hot water heating option) and stops the unit during low hot water flow or no flow when the unit is in the heating mode.

f. Check that the HIGH FIRST-STAGE GENERATOR PRESSURE cut out trips the unit at 13.7 PSIA.

g. Confirm that the HIGH FIRST-STAGE GENERATOR TEMPERATURE cut out is properly installed in its thermowell and that it trips the unit when it senses a temperature of 330°F or greater.

h. On direct-fired and heat recovery units, check the operation of the LOW SOLUTION LEVEL cut-out.

i. On direct-fired units, check the operation of the HIGH STACK TEMPERATURE cut-out.

j. On Hitachi-built unit, check the calibration and functionality of all remaining pressure and temperature controls.

k. On Direct-Fired units, perform preliminary check out of gas train, oil pump and piping (if applicable) and burner. Pilot testing may be done, but do not allow main flame to occur until the unit is ready for hot purging.

On Steam-Fired units, check the operation of the Main Steam Control valve as well as condensate piping and auxiliary equipment. Confirm steam valve stroke and setting of minimum valve position limit switch.

l. On Micro Panel equipped units, check the programmable settings related to the steam valve control or burner and perform any applicable functions. See Micro Panel Operations Manual for specific instructions.

5. Tag all valves using permanent valve tags with the proper numbers for identification.

6. On units with an optional Hot Water Heater, check that the proper relief valve has been installed in the hot water piping of the hot water heat exchanger.

7. When a good level of vacuum has been achieved (–730 mm Hg or lower in absorber and condenser sections), begin charging unit (if unit is not factory charged). Check the unit nameplate to determine the correct type of LiBr solution to charge into the unit. Use the plastic refrigerant charging cylinder shipped with the unit between the unit and solution drums to be charged so that you can change from one drum to another without getting air in to the unit. Do not allow air to enter the unit when charging. Stop simultaneous purging from all sections of the unit. Continue to purge by alternating between condenser and absorber during and after charging but NEVER at the same time.

NOTE: Refer to Factory Test Report for correct solution and refrigerant quantities. Charging quantity is based on 53% solution by weight for Nitrate inhibited units and 55% solution by weight for Molybdate inhibited units. U.S.A. built units with drums of the Factory Test Charge shipped with the unit will have drums marked with either the York Order or Serial Number. These drums are meant for a specific unit. On jobs with multiple units, be sure to identify the drums for that specific unit. If it is necessary to charge refrigerant, de-ionized water must be used.

a. Charging of N-Series Units.

(1). LiBr solution is charged through V18 valve with solution return valve closed.

(2). Charge alcohol with solution.

(3). Charge refrigerant through V11 valve (refrigerant sampling valve).

b. Charging of G-Series Units

(1). LiBr solution is charge through V14 valve.

(2). Charge alcohol with solution.

(3). Charge refrigerant through V11 valve (refrigerant sampling valve).

c. Charging of S-Series Units

(1). LiBr solution is charged through V19 valve.

(2). Charge alcohol with solution.

(3). Charge refrigerant through V11 valve (refrigerant sampling valve).

9. Check the direction of rotation of Solution and Refrigerant Pumps. (See Buffalo Pump Manual, Form 155.17-N4, for more information.) On Direct-Fired units, check the burner fan and oil pump (if applicable) rotation.

10. When the unit vacuum falls within the gray area on the chart (Figure 1), perform a bubble rate test. Once a bubble rate of 30 bubbles per minute or less from the absorber has been reached, the unit can be operated at low fire.

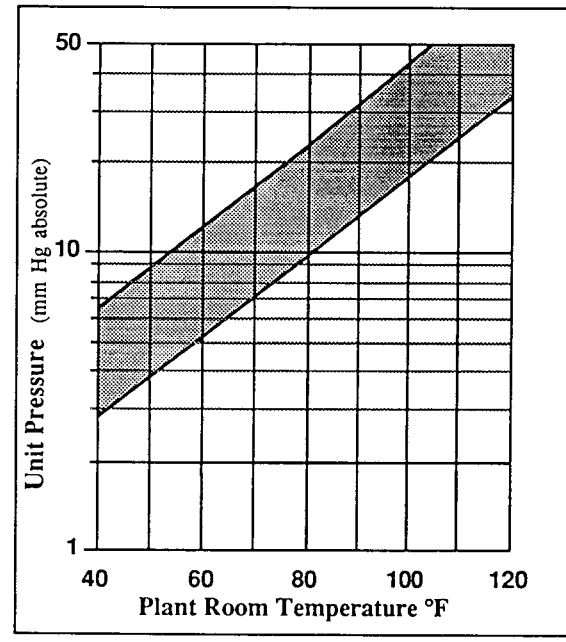

FIG. 1

a. G-Series Units

(1). While operating at low heat input, watch the solution level in the absorber sight glass. If the level drops to the lower sight glass, perform a refrigerant blowdown. (Open V8 valve, this will take refrigerant from refrigerant tank and transfer it to the absorber. When the level drops to the lower refrigerant tank sight glass, close V8 valve.)

(2). Continue purging the unit by purging from absorber for 55 minutes out of every hour and from purge tank for 5 minutes out of every hour or until the purge tank pressure is equal to 15 mm Hg absolute.

NOTE: Vp3 (purge valve from condenser) on G-Series Units should be taped over or the hand wheel removed to prevent operation after heat has been applied to the unit.

(3). When the unit begins to cool the chilled water, increase the heat input to the First-Stage Generator slowly in stages until design high fire heat input is reached. Adjust burner, steam inlet control valve or exhaust gas damper as per factory test report so that high fire heat input is achieved for cooling mode without over-firing. *The burner may be set up completely at this time on direct-fired units or if problems are encountered running for prolonged periods at high fire due to non-condensables still in the unit, the final combustion checks may be made at a later time during the start-up.*

(4). To completely purge the absorber at start-up and whenever the absorber is full of non-condensables, it may be necessary to lower the level of the solution in the absorber so that the purge header is uncovered in the absorber. This can be done by temporarily removing solution from the unit. Lowering the level and uncovering the purge header will allow a liquid vortex to form in the bottom of the absorber due to the solution pump suction. The non-condensables will be drawn into the solution in the center of the vortex and be transported to the high side of the unit. The purge header is uncovered and the vortex forms when the solution level is in the solution tank as opposed to the main shell of the absorber. The condenser purges best at low fire. Operating the unit alternately between high fire and low fire will expedite the purging operation. The solution vortex removes the non-condensables from the absorber and the purge eductor system removes the non-condensables from the condenser and stores them in the purge tank. The purge pump is then used to remove the non-condensables from the purge tank.

NOTE: S-Series and N-Series unit purge headers are not located in the bottom of the absorber, however, the vortex action of the solution pump still draws the non-condensables into the solution for transportation to the high side of the unit.

(5). When the bubble rate from the purge pump is less than the allowable rate for the applicable size of chiller over a <u>minimum of 8 hours</u> with the chiller at design high fire cooling, all water flow correct, tower inlet water at design temperature, leaving chilled water at design temperature and with full load to chiller, check and adjust solution level in absorber and refrigerant level in evaporator for overflow. The absorber solution level should be just visible in the top sight glass of the solution tank and the refrigerant should be just ready to overflow from the pan.

(6). Absorber solution level should be adjusted first. If necessary, allow unit to operate at least 20 minutes more while purging from the absorber. Then adjust refrigerant level.

(7). Fill out *Start-Up Log Sheet* (Form 155.17-LS1 for Direct-Fired units and Form 155.19-LS1 for Steam-Fired units) completely with the unit operating at steady conditions. Note any peculiarities on the sheet.

b. N-Series Units

Due to the spiral design of the solution heat exchangers, trapped non-condensables must be removed from the heat exchanger before the chiller can be operated in cooling. Operating the chiller without first removing these non-condensables will cause symptoms similar to a crystallization condition. The absorber level will drop and the solution pump will cavitate. This will damage the solution pump. The procedure for removing these non-condensables from the heat exchanger is explained in the following steps:

(1). Stop chilled, condenser and hot water flow.

(2). Close VA, VB, and VC valves.

(3). If the chiller has an optional hot water heat exchanger, place unit in HEATING MODE and temporarily jumper the external hot water flow switch terminals at the unit terminal board (refer to Wiring Diagram, Form 155.17-W1, for proper terminals). If chiller does not have a heat exchanger, remove the three wires from the bottom of the solution pump motor starter that go to the solution pump. Temporarily jumper the external chilled and cooling water flow switches. Remove cover from 69WC switch (chilled water differential pressure switch) and temporarily jumper the N.O. terminals.

(4). Operate burner, steam control valve or exhaust gas damper to attain low fire heat input to First-Stage Generator.

(5). Observe First-Stage pressure gauge until vacuum reaches 660 mm Hg absolute (or –100 mm Hg).

(6). Stop heat input to First-Stage Generator.

(7). Open VC valve.

(8). Feel solution spray line. It should be hot. If it is not hot in 15 minutes, close VC valve and repeat steps e. to h.

(9). Re-connect solution pump motor wires to (88P1) starter. Make sure wires are connected to the original terminals (so phasing will not be reversed) and pump rotation will remain correct.

(10). Remove all jumpers, place selector switch in cooling position and start chilled and cooling water pumps.

(11). Press solution pump test run button on door of Unit panel. This will start dilution cycle. Continue dilution cycle until the heat exchanger temperature drops below 110°F. Purge continuously alternating between the absorber and the purge tank until the bubble rate is 20 bubbles or less from the absorber.

Operate at low heat input and follow steps (1) through (6) above for G-Series units.

c. S-Series Units

(1). Instructions for G-Series units apply with the exception that S-Series refrigerant and solution charges are trimmed based on the sight glass levels of the absorber and evaporator.

(2). S-Series units with optional *Low Temperature Heating* use the evaporator for heating. There will be two additional valves on these style units. The refrigerant pump and solution pumps operate during the heating cycle on these units.

11. Confirm the dilution Cycle operation. Shut the unit down from full load operation and time the dilution cycle. Record the time. Inform customer personnel that this is the normal dilution time for their unit when shutting down from full load conditions. This will enable the customer to better utilize the unit when starting it and stopping it.

12. Confirm the proper programmable settings on Micro Equipped Units. Record the settings.

13. Customer Training

a. Purge Pump Maintenance

(1). Starting and Stopping

(2). Oil Changing

(3). Belt Tension

b. Daily Purging Procedures

(1). Warm up purge pump with gas ballast open.

(2). Purge 15 minutes from Absorber with gas ballast open.

(3). Pump purge tank down to 15 mm Hg Absolute only.

(4). Let purge pump run additional 15 minutes to clean up oil.

c. Refrigerant Blowdown Procedures

d. Micro Panel Operation

e. Unit Operation

(1). Normal Sounds

(2). Normal Temperatures

(3). Normal Solution and Refrigerant Levels

(4). Normal Pressures

f. Heating/Cooling Change Over

(1). Purging during Heating

g. Operational Limitations

(1). Tower Water Maximum Rate of Temperature Change

(2). Minimum Tower Water Temperature

(3). Maximum Tower Water Temperature

(4). Minimum Chilled Water Flow

(5). Minimum Tower Water Flow

(6). Maximum Heat Input

(7). Condensate Back Pressure Valve Setting (Steam Units)

NOTES

P.O. Box 1592, York, Pennsylvania USA 17405-1592

Form 155.17-SU2 (694)

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Codes: ABS, SM