

## .005 CC/LITER DEAERATOR

### INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR DK-SYSTEM (SPLIT TANK/CONTINUOUS CIRCULATION)

#### DESCRIPTION OF EQUIPMENT

Refer to specification sheet for general description of materials furnished. Specific equipment furnished for this installation will be shown on the System Layout Drawing and Submittal Sheet included in the Instruction Manual.

#### DESCRIPTION OF OPERATION:

Basic requirements to effectively remove excess oxygen consist of:

- (1) Water must be brought to the boiling point corresponding to the pressure at which it is held in storage.
- (2) Physical shake out of entrained gas by breaking the water up into mist-like particles, and
- (3) Free venting to atmosphere to quickly remove liberated gases so as to prevent recontamination.

The first requirement of DK-5 system deaeration occurs when incoming makeup water and returns are admitted to the surge compartment through an internal vent condenser where they are pre-deaerated. The pre-deaerated water then is pumped through a heating system into a spray manifold where it is released into the deaeration compartment at 220 deg. F. The spray manifold is designed to maintain a back pressure of 10 to 12 psig. A pressure and temperature gauge is furnished at the spray manifold inlet to monitor system performance and aid in adjusting combination pressure-temperature regulator that is adjusted to maintain the required spray manifold temperature readings.

The second requirement of physical shake out is accomplished when the 220 deg. F. water is released through the spray manifold to the atmospheric pressure in the storage tank. As the temperature drops from 220 deg. F. to 212 deg. F. an explosive flashing action occurs that results in breaking the water up into a mist, thus liberating the entrained gas. Condensate in the deaerator compartment is maintained at boiling point to prevent re-absorption of gases by circulating the condensate back into the surge compartment through the internal transfer line and pumped back through the heating system back into the deaerator.

The Third requirement of removing liberated gases is accomplished in the fully vented receiver which provides an unobstructed release of gases. Because oxygen and CO<sub>2</sub> are heavier than steam, a minimum amount of steam should escape to the atmosphere to assure complete removal of gases. For additional operating features refer to bulletin no. 3000.

## **INSTALLATION, PIPING AND WIRING**

### **RECEIVING:**

The system should be carefully inspected upon arrival to make certain no damage or loss occurred during shipment. Any damage or loss should be immediately reported to the transportation company making final delivery; damage is the exclusive liability of the carrier.

### **LOCATION OF THE UNIT:**

System should be located to allow for easy access to all working parts for maintenance and adjustment. In addition, adequate clearance should be allowed for removal of the diffuser tube(s) and spray manifold, heat exchanger tube bundle. Provide adequate headroom for vent condenser, and level control(s) removal.

Motors, panels, controls and automatic equipment must be protected from excessive heat and moisture, and abnormal atmospheric conditions. If ambient temperature exceeds 105 deg. F., insulate heat sources, or provide ventilation.

### **STORAGE:**

If unit will not be installed within a reasonable period of time after delivery, it should be stored indoors, if possible, and adequately protected from accidental damage, abuse, and weather.

### **RECEIVER:**

Tank interior has been Epoxy-Glass Lined. Refer to tank warranty from before attempting to weld or flame cut.

### **RETURNS:**

High pressure-direct (above 212 deg. F.) – Connect to top of receiver. Install with gate valve and “Y” strainer with blow-down valve as close to receiver as possible.

High Pressure (above 20 psig and over 212 deg. F.) – Connect to high pressure return diffuser (if furnished).

Low Pressure – pumped (below 212 deg. F.) – Connect to blending tee (if furnished). These returns (superheated to 220 deg. F.) must be pumped to unit at a pressure of 12 PSIG MIN. Install with check valve and “Y” strainer.

Low Pressure – gravity (below 212 deg. F.) – These returns cannot be directly admitted to the unit. Provide a condensate return unit and pump these returns to low pressure pumped returns inlet.

**MAKE-UP SUPPLY:**

Run full size water supply pipe to make-up inlet connection shown on job drawing. In stall manual bypass valve and piping (when not furnished by factory).

**VENT:**

Install open vent pipe to atmosphere, size per job drawing. (Wrought iron or X-HVY pipe recommended). Vent line should be run vertically, or take most direct route to atmosphere. Excessively long horizontal runs with numerous bends, fittings will cause “traps” and will impair venting efficiency and prevent proper operation.

**OVERFLOW AND DRAIN:**

Units are factory equipped with tank drain, gate valve, and internal overflow trap with external pipe (unless otherwise specified). Connect full size drain to floor drain per job drawing. Connect drain line from heat exchanger to sewer. **DO NOT** install shut-off valve between floor drain and overflow connection.

**STEAM SUPPLY:**

Select proper size pipe for required steam flow, generally at least one size larger than the control valve. Adequately sized steam piping will help assure that the minimum supply pressure and capacity (lbs/hr) at the regulator inlet will be maintained. (Refer to design sheet or nameplate for minimum supply pressure required).

Inlet “Y” strainer and shut-off valve are factory furnished. Installation of a strainer blow-off valve and pipe to drain is recommended.

Steam piping and fittings installed should be rated for maximum steam supply pressure and capacity (lbs/hr).

**VENT CONDENSER:**

Inlet, outlet and bypass piping is factory installed. On larger units this piping may be disassembled to facilitate shipment. Re-assemble this piping as match-marked by factory.

**BOILER FEED PUMPS:**

Factory assembled units include suction lines consisting of gate valve, compression coupling, and necessary fittings.

Pump discharge piping, when furnished by factory, will be as shown on System Layout Drawings. Install square head plug cock and connect to boiler(s) as indicated on plans and spec. Pump discharge piping furnished in field should include a silent check valve, gate valve, and square head balancing valve. Balancing valve must be included and set for pump discharge pressure as indicated in submittal data.

Pipe sizing should be as indicated on plans. In general, discharge lines are to be one size greater than the pump discharge opening in order to reduce friction losses.

When feed pumps are to be run continuously, operation against a dead-end shut-off condition may exist. In such cases, a bypass orifice, spring loaded relief valve, or differential pressure regulator is required for protection of pump and motor. The relieving device, (unless factory installed), should be piped from between pump discharge opening and check valve back to tank.

### **LEVEL CONTROLS:**

(All controllers are preset and adjusted by factory unless installed by others). Level alarm controllers furnished with unit are top mounted displacer type devices. Low alarm control setting is set to "make" at a point that provides a minimum of 3" diffuser tube submergence or 6" above bottom of tank. When high alarm is furnished, it is preset to "make" at a point 2" below the tank overflow connection. To change settings, a set of new probes need to be cut.

Makeup control (or transfer valve) is always of a modulating type. On small units, the controller is a mechanical feeder factory mounted and piped. On larger units a pneumatic displacement control system is furnished. Displacer set point should be adjusted to maintain a one third water level. Proportional band should be set at approximately 30%. Refer to Manufacturers bulletin for specific setting and adjustment instructions. NOTE: Displacer type level controls are factory set and installed, then removed and packaged separately to prevent damage in shipment. They must be re-installed in field by installing contactor.

### **AIR SUPPLY:**

Control air lines and tubing are factory installed and include an air PRV and filter, set to deliver 20 psi. Connect clean air supply to air PRV inlet and install with shutoff cock for ease of maintenance. A 30 psig minimum air supply is required.

### **INSULATION:**

For optimum thermal efficiency, all tanks are recommended to be factory insulated with 2" fiberglass and clad with a metal jacket (unless otherwise specified). If not factory insulated, tanks should be insulated in the field. Heat exchanger, steam supply and related piping should be insulated or marked in field as required by safety specifications.

### **CHEMICAL TREATMENT:**

Boiler water generally requires chemical treatment in addition to the treatment provided by the deaerator. The deaerator removes oxygen from the water. However, chemicals are required to keep the oxygen out of the water and to polish the trace residuals from the water.

Chemicals also help to remove scale, prevent corrosion, prevent carryover and protect the condensate return system.

Sellers has no objection to the introduction of these chemicals directly into the deaerator providing the chemical supplier will guarantee they will not damage the deaerator. Introduction of chemicals into the deaerator does provide improved performance of the chemical treatment system.

Chemicals, however, can be damaging to the pumps, especially pump seals. Neither Sellers or most pump manufactures will honor a warranty claim on pump seals if chemicals are added to the deaerator. Chemical suppliers sometimes will offer such a pump seal warranty. If assurance or guarantees of no damage are not offered, chemicals should be injected downstream of the pumps.

At times, electronic, magnetic or similar devices are used for water treatment. Sellers does not feel these devices provide effective water treatment. If these devices are used, standard water treatment including a water softener, a deaerator and proper chemicals should be used.

**ELECTRICAL WIRING AND CONTROLS:**

Connect power leads in accordance with wiring diagram furnished with unit. Connect boiler level control leads to terminal point as indicated on wiring diagram. No other field connections should be necessary unless panel enclosure is removed from unit.

## **PUTTING THE UNIT INTO SERVICE**

### **START UP CHECK POINTS**

Package systems have been factory tested prior to shipment. It is recommended that all piping and wiring connections be checked on arrival at the jobsite, as handling during transit may have caused loosening.

Prior to start-up of your unit, all piping and wiring diagrams furnished should be carefully reviewed. All connections should be made as indicated in installation, operating and maintenance instructions. Pages 1 through 5, drawings furnished with unit, and applicable local codes.

#### **BEFORE STARTING YOUR UNIT CHECK THE FOLLOWING:**

1. Power supply connected to panel. (Disconnect(s) are "OFF").
2. Power supply and motor voltage is compatible.
3. Control transformer is wired for proper primary voltage.
4. Motor wiring in motor terminal bow has correct leads wired to panel starters.
5. Pump "Start" pressure switch, if furnished, wired to correct panel terminal points.
6. Make-up valve and controller (if electric) wired to proper panel terminal points.
7. Transformer secondary is grounded (if required by local code).
8. Boiler level controls properly wire to panel terminal strip. (NOTE: Boiler controller should have only one source of control voltage-either from deaerator panel or boiler circuit – NEVER BOTH.)
9. All terminal connections are tight. Turn control circuit switch "on" Tank level alarm controls wired to proper panel terminal points. (Depress alarm silence button if low water alarm is sounding).
10. Manhole bolts all in place and tight.
11. Pressure and temperature gauges are properly located and have correct dial ranges.
12. Open "T" cocks on all pressure gauges.
13. Are dielectric fittings installed in all non-ferrous piping to units?
14. Pump casing drain plugs are in place.
15. Pump suction and discharge lines are open.
16. Check valves are properly installed in direction of flow.
17. Check pump rotation manually to be sure there is no binding.
18. Fill tank, after closing all drains; until low water indicator lights turn off and check for leaks.
19. Check pump shaft rotation manually (suction line valves to be open). Make sure there is no binding. (Jog manual switch not longer than 2 seconds).
20. Check pump motor alignment. If mis-alignment has occurred during transit, jobsite re-alignment is necessary. Refer to pump instructions bulletin for procedure.
21. Is pump discharge piping adequately supported to eliminate strain on casing
22. Heat exchanger vacuum breaker installed. Drain plug in place.

23. Steam valve control piloting and thermostat properly installed.
24. Check level control operating mechanisms and remove shipping devices so that switches operate freely.
25. Has system been installed level? Shim, if needed.
26. Air supply to PRV Filter has been installed with "T" cock.
27. All strainer baskets installed and blowdown pipe connected.

### **START UP PROCEDURE:**

After start-up check points have been completed and necessary adjustment made, proceed to put the unit into service, as follows:

1. Closed the following hand valves:
  - -Tank and blow-down drains.
  - -Heat exchanger drain valve.
  - -Make-up (and transfer) by –pass.
  - -Strainer blowdown valves.
  - -Vent condenser bypass.
2. Open hand valves in the following sequence:
  - (When contractor installs a valve between floor drain and overflow connection please open).
  - Pump suction and discharge.
  - Makeup line valves at inlet and outlet of the automatic valves.
  - Vent condenser flow control valve.
  - Heat exchanger condensate trap, or line.
  - Water gauge cocks.
  - Steam control pilot shut-off cock.
  - Equalizing line valve on external mounted controllers.
  - Air supply cock to PRV-Filter regulator.
3. As air supply cock is opened, adjust air PRV to deliver 20 psig to Modulating controller. Modulating makeup (or transfer) valves will open and admit water to the receiver. When water reaches one third level of the gauge glass, the unit will be primed, and normal water level is attended. Check and adjust modulating controller at this time to maintain a 4-6" proportional band with respect to the tank centerline.
4. Close disconnect switch (es) to B.F. and transfer pump motor starters. Pump selector switch (es) should be in "OFF" position, and control power switch should be in "ON" position.
5. Check low water alarm circuit by opening tank drain valve and closing makeup inlet gate valve until level has receded to energize alarm horn. Close drain valve and open makeup inlet valve.

If unit is equipped with a high water alarm, open makeup bypass valve until level in tank rises to sound alarm horn. High level alarm should be set so that horn sounds when water level is approximately 2" below overflow connection. Close compartment equalizing line valve.

6. Run each pump manually momentarily ("Jog manual for no longer 2 seconds) and check for proper rotation. If rotation is incorrect, reverse any two of the three leads (three phase motors). Do not allow pump to attain full RPM in reverse direction. (Full speed in reverse direction could cause impellers to spin loose and damage pump internals).

7. After proper pump rotation has been established, continue to run pumps manually. As feed pump is discharging, adjust square head plug cock in discharge line until it reaches the rated pressure shown on the design data. Do not run pumps at pressures below or above a preset manufacturer's design point, motor overload or pump cavitation may cause irreversible damage to said equipment.

**CAUTION: NEVER RUN PUMPS DRY. SEAL FACES MAY BE DAMAGED IF OPERATED WITH OUT WATER.** After balancing valves have been set, turn pump selector switches to "OFF" position. Refer to pump manufacturer's manual for further specific instructions.

8. When steam is available, gradually open manual throttling valve in steam line to diffuser tube (auxiliary heater) until water in storage approaches boiling (212 deg. F. at sea level). Then back off throttling valve until it is approximately ¼ turn open. Final adjustment of the throttling valve will be made after automatic steam control valve is in operation. (A rumbling noise will occur during this procedure until water reaches a temperature of 180deg. F.)

9. Gradually open gate valve in main steam supply line to regulator. Be certain that tube passages in the heat exchanger are filled with cold water before admitting steam to unit. Refer to heat exchanger manufacturer's maintenance manual for specific instructions. Do not exceed design conditions indicated on heat exchanger nameplate.

10. Temperature controller and regulator are set and may need minor adjustments. Steam regulator is to maintain spray manifold inlet temperature at 220 def. F. minimum and pressure at 10-12 psig. Under rated design load. Refer to steam valve manufacturer's bulletin for proper start-up setting and adjustment procedure.

11. Set Selector switches on control panel at desired operating sequence. Refer to electrical schematic furnished with system.

12. Final adjustment of auxiliary diffuser throttling valve should be made at this time. With system operating under rated load condition, adjust this valve manually so as to maintain water in storage at boiling point, and simultaneously maintaining a slight amount of steam flow out of the vent. The type and quality of tank insulation as well as ambient temperature will be important factors in making this adjustment.

## **OPERATION AND MAINTENANCE PROCEDURE:**

1. System should go through full cycle (2 to 4 hours) before making adjustments and test. Same cycle for “Cold” starts. Constant Cold start (every 24 hours) are not recommended.
2. Check for possible leaks in all piping trains. A slight tightening will usually alleviate the problem.
3. Check if vent line is still open to atmosphere (No other line or opening should be “Open” to atmosphere), except for overflow.
4. Check all strainer screens for possible accumulation of sediment and debris. (Purge blow-down valves).
5. Sudden erratic temperature control may be caused by dirty filter and tubing at pilot valve (see instruction manual for pressure temperature regulator).
6. Check and clean all components with internal (steam regulator pilot, make-up valve, etc.) strainers and control tubing. Every 3 months during normal operation.
7. When stand by pumps are available, start and operate the pumps periodically.
8. In case of electrical component failure, do not attempt to correct unless a qualified service person is available, or call our customer service department for information.
9. Under abnormal conditions such as sudden influx of high volume super-heated condensate may cause the unit to pressurize and overflow. A flash tank or cooling tank may be necessary.
10. When condensate in the tank reaches the boiling point due to atmospheric conditions or high temperature returns a “Boil Over” condition will occur. To compensate for this problem, lower the setting on the temperature controller. Also check your building heating system for possible trap failure or leakage.
11. External float type level controllers need to be purged or blown-down periodically to remove sediment build-up.
12. Before adding extra load to the unit, check design data and consult with our customer service. The cost difference by checking could only be a small change of a component versus long downtime.

## **MAINTENANCE – RECOMMENDED SCHEDULE**

### **DAILY-**

1. Keep deaerator area clean and free of debris and clutter.
2. Inspect deaerator, valves and piping for leaks.
3. Check pumps, motors and other miscellaneous equipment for abnormal conditions.
4. Monitor the sequence of operations to verify that the deaerator is operating in accordance to boiler sequence.
5. Check pressure, temperature and water level conditions.

### **WEEKLY-**

1. Flush float chamber, strainer and equalizing lines (split tank) and tank drain
2. Check incoming make-up, steam and condensate return inlet strainers for sediment build-up (blow-down).

### **MONTHLY-**

1. Verify proper low water cutoff and alarm operation. If possible, the deaerator water level should be lowered to check this control.
2. Raise the safety relief valve lever for a few seconds. This keeps the valve clean and free of sediment and scale.
3. Test stand-by operation sequence (if any), and check magnesium anode for leakage (replace if necessary).

### **EVERYSIX MONTHS-**

1. Remove operating mechanism from any float type or external cage type controller and plugs from crosses in equalizing piping. Clean thoroughly and reassemble.
2. Check pump performance curve and amp draw, an abnormal reading could mean dirt or buildup on impellers, or clogged suction and discharge lines. Clean required.

### **EVERY YEAR-**

1. To clean deaerator interior thoroughly, remove handholes, manhole and flush sediment from tank wall, inspect heated/scrubber surface for scale or corrosion.
2. Inspect steam regulator and pilots. Check for dirty plugged air and control tubing to pilots or valves and controls. Clean as required.
3. Check all internal rods, probes, anodes, surge shields and baffles for corrosion. Replace as soon as possible.

