Chromalox®

SERVICE MANUAL

SERVICE REFERENCE	
DIVISION 4	SECTION
SALES REFERENCE (Supersedes PQ410-3)	PQ410-4
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Electric Fluid Heat Transfer Systems

GENERAL

This Service Manual is furnished as an aid to help start-up and service Chromalox Heat Transfer Systems. Listed below are conditions which could occur during start-up and operation.

CAUTION: ***Hazard of Electric Shock. Any installation involving electricity must be grounded to earth to eliminate shock hazard.***

1. USE THE RIGHT HEAT TRANSFER FLUID

DO read manufacturer's technical bulletins and instructions carefully. Some heat transfer fluids may ignite or burn spontaneously if not properly used.

Chromalox Fluid Heat Transfer Systems are designed for a particular heat transfer fluid or a class of heat transfer fluids. If you are not sure you are using an accepted heat transfer fluid, check with your local Chromalox sales and application engineering office listed on back cover or consult Chromalox Bulletin PQ301 for the correct heat transfer fluid.

DO NOT mix heat transfer fluids unless authorized and approved by the fluid manufacturer.

All heat transfer fluids are not compatible with each other, whether made by the same manufacturer or a different manufacturer. If you plan to switch fluids, check with the fluid manufacturer to determine the following.

A. Is the new fluid compatible with the old?

B. What is the recommended cleaning method to remove the old fluid, its sludge, or any deposits remaining in the system?

C. Does the fluid manufacturer have a reclaiming service for used fluid? Do they have a recommended procedure for disposal of used or old fluid?

CAUTION: ***To avoid possible damage to the heaters do not energize the heater unless the system is filled with fluid.***

2. PIPE STRAIN

DO provide for expansion and contraction of process piping and connections to the system. Piping strains can cause pump and motor mis-alignment, excessive wear on pump body, bearings and stuffing box packing or mechanical seal and will eventually cause failure of the pump and system.

Piping should be properly supported so pump can be removed without changing the position of the piping. If piping moves when the pump is removed, pump malfunction is probably due to stresses and twisting caused by the piping. These stresses will multiply when the system is hot due to thermal expansion.

3. PIPING RESTRICTIONS

DO provide sufficient cross sectional area in the process piping connections equivalent to the system pipes. In order to prevent undue pressure drop, maximum velocity in all piping should be less than 10 feet per second.

DO NOT use process piping connections smaller than the pipes used in the system.

If there is a high differential pressure between the inlet and outlet of the heat transfer system at operating temperature, this is probably due to a piping restriction. A continuing high differential pressure can cause excessive wear on the pump and pump stuffing box packing or mechanical seal and will eventually cause premature failure of the pump. The major causes of restrictions are:

A. Inlet and outlet pipes smaller than provided on the system.

B. Piping many processes in series with one another. To reduce the pressure drop of the system, equipment should be re-piped in balanced parallel flow.

3. PIPING RESTRICTIONS

C. The use of globe valves in the system. Globe valves have a much higher pressure drop than gate valves. Therefore use globe valves only for balancing parallel flows.

D. Small inlet and outlet connections on customer's process. Examples being:

1. The use of small rotary unions on roll applications. These should be sized properly for the actual pumping rate to give minimum pressure drop.
2. Small inlet and outlet nozzles on jacketed vessels or the use of an agitating nozzle on the inlet of a jacketed vessel. These should be sized properly for the pumping rate to give a minimum pressure drop.
3. The passageways or coring of a platen manifolded in series. These should be re-manifolded for parallel flow to give a minimum pressure drop.

DO provide for bypass of oil when using pneumatic or electrically operated process valves. System damage may occur if process piping return lines are restricted or blocked by closed valves.

4. PIPING GENERAL

DO NOT use Magnesium bed or porous insulations which can absorb oil. When oil soaked, these insulations may ignite spontaneously and burn at temperatures as low as 400°F.

DO NOT permit leaks of any heat transfer fluid to continue unattended. Periodic inspection of piping and insulation is essential.

DO NOT insulate expansion tank lines or the expansion tank. These components must be kept cool and below 130°F for most heat transfer oils. (See #6 Expansion Tank Location)

DO NOT insulate flanges, valves or other connections which may leak without being observed.

DO NOT use screwed pipe connections on any piping over 1 inch diameter. Use flanges for connections with spiral wound or Grafoil® gaskets.

DO NOT use Teflon tape or pipe seal on threaded connections on hot oil systems. Use Copalite® or SilverSeal® or other high temperature sealants compatible with heat transfer oils.

DO check all vent tubes, purge valves, and bypass relief valves at least once a month. All heat transfer oils oxidize in the presence of air and sludge can block critical piping. Blocked vent tubes may cause excessive system pressures and/or an explosion.

DO retighten all bolted connections and joints *at operating temperature.* Joints will expand and leak as they get hot. Check all threaded connections on controls, gauges, etc. for leaks.

DO vent all systems operating at atmospheric pressure properly. Vents must be rigid metal piping terminating outside the building or into a suitable container. The vent line should *never* be made of plastic, rubber or other low temperature material and should be ½ inch or larger pipe.

WARNING: ***Oil saturated insulation on piping may ignite spontaneously at elevated temperatures. Repair leaks and replace oil soaked insulation immediately!!***

5. AIR, WATER OR FOREIGN LIQUID IN THE HEAT TRANSFER FLUID

DO install bleed valves on all process piping.

The presence of air in the system is indicated by a knocking or hammering of the pump. Air bleed valves should be provided at all high points in the system and every place where the heat transfer fluid flow drops in the vertical plain. These are the places where air pockets will form.

The presence of water (does not apply to water or water-glycol systems) in the system would not normally be noticed until a temperature above 212°F is reached. Its presence would be indicated in exactly the same manner as air in the system. Follow the air removal procedure.

CAUTION: ***During the initial start-up operation, the liquid level in the expansion tank must be checked continually. This level should not exceed the three-quarter mark on the glass nor drop below the one-quarter mark.*** **Note:** If abnormal expansion of fluid is detected, this is probably due to a pocket of air or steam still present in the system. Check all bleed valves. If problem continues, de-energize pump and check bleed valves.

Foreign liquids in the heat transfer fluid may not cause trouble immediately. However, after this system has been in operation for a period of time at the normal operating temperature, the foreign liquid could cause a chemical change in the heat transfer fluid which could lead to sludging, the formation of carbon on the heating element and eventually, failure of the heating element and pump.

6. EXPANSION TANK LOCATION

DO mount expansion tank 15 feet above system.

Mount the expansion tank so it is the highest point in the system and if possible at least 15 foot above the height of the pump. To safeguard employees and equipment, run the vent line either out of the building or down into a 55 gallon drum. This vent line should be a minimum of ½" internal pipe size.

CAUTION: ***To avoid possible rupture of expansion tank due to pressure, vent line should be checked on a regular basis to be sure it is always open to the atmosphere. Failure to do so may result in rupture of the expansion tank or other parts of the system causing injury or hazard of fire.***

6. EXPANSION TANK LOCATION

Note: If the expansion tank cannot be mounted above the highest point in the system, or if the system is going to operate above the boiling temperature of the heat transfer fluid, the expansion tank will have to be pressurized with air or nitrogen. This eliminates the possibility of heat transfer fluid flashing into vapor in the heater, at the point of high velocity in the system or at the suction of the pump which will cause the pump to vapor lock due to insufficient NPSH (net positive suction head). On hot oil heat transfer systems, this pressurizing is usually done with nitrogen as this eliminates the possibility of the hot fluid coming in contact with oxygen thus reducing the possibility of oxidation, extending the life of the heat transfer fluid. This pressure should be 5-10 PSI above the vapor pressure of the heat transfer fluid at its operating temperature.

DO NOT pressurize expansion tank or system unless *proper* safety relief valves are provided.

WARNING: ***If expansion tank is to be pressurized, then it must be equipped with safety relief valve(s). If this pressure exceeds 15 PSIG, then the heat transfer system and expansion tank should be ASME coded.***

DO NOT mount expansion tank directly on top of system *unless absolutely necessary*. If mounted on system, provisions must be made for cooling of the expansion tank line. Maximum safe operating temperatures are reduced when expansion tank is mounted on system unless positive suction pressure of 2 to 3 psig is maintained on pump.

7. SYSTEMS MOUNTED ABOVE PROCESS EQUIPMENT (Ceiling or Platform mounted)

When mounting system above process equipment, check to be sure the pump will not be vapor locked. The cause for vapor lock is insufficient NPSH (net positive suction head). This problem is particularly prevalent on systems with centrifugal pumps, but also can appear on systems with positive displacement pumps. The things to check when a system is mounted above the process equipment are as follows:

A. Piping: Eliminate all unnecessary turns and restrictions in the return piping which could cause a vapor lock.

B. The expansion tank should be connected into the pump suction line and be located high enough to create the necessary NPSH (See No. 6). If the expansion tank cannot be elevated then it should be pressurized with air or nitrogen to obtain the necessary NPSH. This will create a positive head on the pump and prevent the heat transfer fluid from flashing into vapor at the pump suction when the system is operating at temperatures equal to or exceeding the vapor temperature of the heat transfer fluid.

8. PUMP ALIGNMENT

DO NOT allow pump to hammer or cavitate. Excessive vibration will damage pump and may break pump castings.

CAUTION: *All pump and motor mounts and motor-belt should be checked and tightened if necessary. These sometimes loosen during transit.*

Belt Driven — The belt has been properly aligned and adjusted for the proper deflection prior to shipment from the Chromalox factory. The proper deflection is ¼".

Direct Coupled — The pump and motor on each Chromalox heat transfer system is factory aligned prior to shipment. However, as recommended in our instruction sheet on each particular heat transfer system, the pump and motor could become misaligned in transit and therefore, should be realigned in the field after the unit has been permanently set in place. Misalignment can cause wear on the pump shaft, packing or mechanical seal and bearings. It will cause excessive stuffing box leakage and will eventually cause complete failure of the pump and in turn, the system.

To check alignment:

A. Place a straight edge across the coupling, it should be in full contact with both rims at the top, bottom and both sides. Rotate coupling by hand and repeat this check.

B. Check the ends of the meshed teeth on the coupling jaws with a feeler gage. The ends of the teeth should be equidistant around the circumference of the coupling. Do not rotate shaft when making this check. Allowance must be provided for pump shaft and motor shaft expansion.

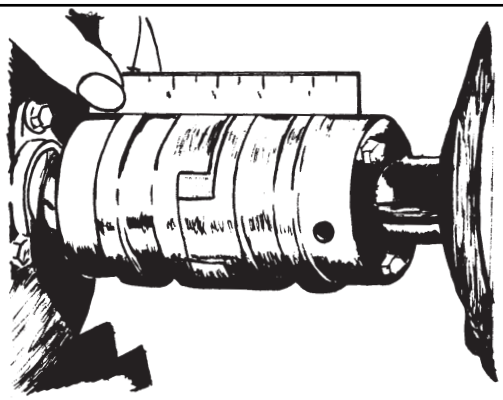

Figure 1

9. PUMP PACKING ADJUSTMENT

Pumps with packed stuffing box or seals may require adjustment during system start up. *Packed seals are designed to leak some oil for proper lubrication of the pump shaft.* Drip pans and drain connections are provided on these pumps to contain the oil and allow convenient removal.

Packed pumps will frequently leak oil at start up until the system reaches operating temperature and the seals seat on the shaft. When system reaches temperature, tighten the two packing gland nuts evenly, approximately ¼ turn at a time until the shaft seal leaks 1 to 2 drops per minute. *Do not overtighten or shaft damage will occur.*

Note: If normal oil leakage from a packed pump is unacceptable in the application, mechanical seal pumps are available at extra cost. Contact factory.

10. OPERATING ABOVE THE MAXIMUM ALLOWABLE TEMPERATURE OF THE HEAT TRANSFER SYSTEM OR HEAT TRANSFER FLUID

DO NOT attempt to operate any heat transfer system or heat transfer oil at temperatures higher than those recommended by the manufacturer.

Chromalox heat transfer systems are designed for a particular maximum temperature. If you do not know this design temperature, check with the Chromalox factory or consult the individual instruction sheet for that system. **Exceeding the designed temperature of the heat transfer system will void our warranty.**

Exceeding the temperature limits of the heat transfer fluid will cause its thermal breakdown or degradation. This will result in the formation of sludge in the system and carbon on the heating elements and eventually cause pump and heater failure. If you do not know this maximum temperature, check with the fluid manufacturer.

WARNING: ***In hazardous or explosive areas, the pipe surfaces of oil type heat transfer systems could achieve temperatures higher than allowed for Class I, Group D, Division I.***

11. INSUFFICIENT HEAT

The following are the major causes of insufficient heat:

A. Low voltage.

B. Blown fuse in heater circuit.

CAUTION: ***Hazard of Electrical Shock. Make sure all electrical power is disconnected before servicing or replacing any electrical component.***

C. System too small for application (not enough kW).
- **1.** Increased work load.
- **2.** Changed product or process.

D. Restriction in flow of heat transfer fluid to process. (See No. 3 Piping Restrictions)

E. Thermostat set too low.

F. Piping or process not insulated. This is a common fault. The piping in heat transfer systems is shipped from the factory uninsulated, only the heating chamber is insulated. The piping in the heat transfer system should be insulated at the same time the piping from the system to the process is insulated.

12. MISCELLANEOUS PROBLEMS

A. Leaking pipe joints can be caused by poor threads, using the wrong or old gaskets and unsupported piping. New gaskets should be used whenever a flanged pipe joint is made. A good rule of thumb for systems operating above 350°F is to use flanged or welded connections on all pipe larger than 3/4". On high temperature systems, threaded pipe will loosen with heating and cooling of system and in time will leak.

B. Excessive leakage at stuffing box of pump.
- **1.** Packed type — normal leakage rate is approximately five (5) drops per minute when cold, 1 — 2 when at operating temperature.

  Note: Improper tightening of stuffing box gland will always cause abnormal leakage and possible shaft damage (see Instruction Sheet for unit).
- **2.** Mechanical seal type — water cooling of mechanical seals is recommended when operating over 350°F. Most types should not leak either water or oil. However, some water cooled high temperature seals are designed to leak steam or water at a constant rate.

DO NOT connect cooling water to flush ports of mechanical seal pumps. Water will be forced thru the seals and contaminate the oil. (Check manufacturer for proper connections.)

- **3.** Misalignment of pump will cause high leakage of oil packing type stuffing box and complete failure of mechanical seal type.
- **4.** Unusually high back pressure at high temperature.

C. Pump bearing failure.
- **1.** Misalignment.
- **2.** Cavitation (for causes of pump cavitation, see sections 3, 4 and 9).
- **3.** Excessively high pressure at operating temperature. Can be caused by incorrect or poor quality heat transfer fluid. Water in a heat transfer fluid can also cause high pressure.

D. Spillage from expansion tank.
- **1.** Tank too small to accept expansion of liquid in system.
- **2.** Expanding pocket of air or steam in system forcing heat transfer fluid to back-up into expansion tank.

E. Sludging of heat transfer fluid is caused by either too high a heating element temperature or improper materials used in customer's piping or process.

DO NOT use brass valves or fittings. Generally speaking on oil type systems, no copper or copper bearing alloys should be in contact with the heat transfer fluid.

13. START UP SUPERVISION

Factory trained personnel are available upon request for those customers who are unfamiliar with the initial start-up.

Contact your local Chromalox sales and application engineer listed on back cover and request Bulletin PQ901.

14. STANDARD HEAT TRANSFER SYSTEM TROUBLE SHOOTING CHART

	Problem	Cause	Corrective Action
A	Power light off	Main power feed off	Turn on main power
		Circuit breaker off	Turn on circuit breaker
		Control transformer Primary fuse blown Secondary fuse blown Transformer bad	 Replace fuse Replace fuse Check and/or replace
		Pilot light blown	Replace bulb
B	Power light on, pump will not start	Float switch open	Add oil to system If no float switch, jumper terminals 4 & 5
		Motor overloads tripped	Reset overloads, check running current
		Motor starter bad	Check motor starter coil
C	Power light on, pump light on, motor not running	Motor fuse blown	Replace fuse, check motor overloads
		Motor burned out	Replace motor, check motor for overload
D	Power light on, pump light on, motor running, pump not running	Broken belt	Check and replace belt
		Broken coupling	Check and replace coupling
		Pump jammed by slag or foreign object	Turn off system and rotate pump by hand if jammed, disassemble and clean pump. Check and clean strainer.
E	Power light on, pump light on, motor running, pump running heat will not come on	Control relay #1 not closed	See M
		Heat on-off switch in off position	Turn switch to on
		Process control ITC-1 set too low	Set process control to desired temperature
F	Insufficient heat	No oil flow	See items, pump noisy, see O; insufficient suction pressure, see J: high discharge pressure, see K
		Process piping too small or restricted	Check process piping, check heat transfer area of platen, etc.
		Heater fuses blown	Check and replace fuses
		Heater elements burned out	Check continuity and resistance of elements
G	Pump packing gland leaking	Excessive operating pressure over 40 psig	See K
		Packing gland loose	Check and adjust packing gland nuts per manufacturer's recommendations
		Wrong pump specified	Use mechanical seals or sealless pumps where no oil leaks can be tolerated
		Improper cooling of seals	Mechanical seals on pumps should be water cooled over 350°F. Failure to do so will cause seal failure and leaks.
H	System leaks when filling	Rough handling during shipment	Check piping and flange alignment retighten and torque all bolts to specifications
I	System leaks at temperature and after cool down	Expansion and contraction due to temperature has loosened connections	Check all flange bolts and connections retighten and torque to manufacturer's specifications
		Wrong gasket materials	Replace gaskets as necessary, use spiral wound or Grafoil® gaskets

14. STANDARD HEAT TRANSFER SYSTEM TROUBLE SHOOTING CHART

	Problem	Cause	Corrective Action
J	Insufficient suction pressure (0 or vacuum), pump noisy, gauges vibrating, discharge pressure low (below 20 psig)	System temperature too high for oil causing vapor lock	See fluid manufacturer's data for maximum oil temperature
		Vapors lock due to steam or air in oil	Bleed air & steam from system, change oil if problem continues
		Net positive suction pressure too low	Raise expansion tank to increase suction head, static head should be 4-5 psig. (See expansion tank location No. 6)
		Strainer plugged	Remove and clean strainer
		Valve closed	Check all valves
K	High discharge pressure over 40 psig, pressure gauges fluctuating rapidly, pump noisy, expansion tank normal, system operating on bypass relief valve	System piping blocked or restricted	Check all valves, check strainer
		Process piping blocked or restricted	Check process piping sizing, check for closed valves or improperly installed automatic valves, check all bleed valves for air or steam
L	Expansion tank overflows or "burps" (over 220°F)	Steam or water in oil	Bleed system, change oil
		Expansion tank too low	Expansion tank should be mounted 15 ft. above system
		Expansion tank line too short	Lengthen expansion tank line to cool oil and provide cold oil seal
		Tank too small for system	Check volume on process piping
M	Control relay #1 will not close	Over-temperature control open	Set thermostat above process temperature and reset
		Pressure switch not closed	See N
N	Pressure switch will not close	Switch set wrong	Set pressure switch to approximately 5 psi over suction gauge pressure
		Pump running backwards	Check pump & motor rotation, see arrow on motor, reverse phase lead on circuit breaker
		Not enough or no fluid in system	Check fluid levels in expansion tank, make sure all valves are open
		Pump cavitating	See O
O	Pump noisy and/or cavitation	Air or steam in system	Bleed system periodically until all air or stem is removed Insufficient bleed valves in process piping to remove trapped air
		Contaminated oil	Change oil
		Pump damaged by overtightened packing gland	Replace pump
		Insufficient suction pressure	Suction pressure should be 4-5 psig

Limited Warranty:
Please refer to the Chromalox limited warranty applicable to this product at http://www.chromalox.com/customer-service/policies/termsofsale.aspx.

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