



HEATEC

CHATTANOOGA, TENNESSEE

OPERATION AND MAINTENANCE GUIDE

FOR

“HCI” & “VHCI” HEATERS

HEATEC, INC.

OPERATION, TROUBLE SHOOTING AND MAINTENANCE GUIDE

TABLE OF CONTENTS

I.	INTRODUCTION TO HEATEC HEATERS	PAGE 3
II.	HEAT TRANSFER OIL:	PAGE 6
	A. GENERAL DESCRIPTION	
	B. CHOOSING THE HEAT TRANSFER FLUID	
	C. THERMAL STABILITY	
	D. NITROGEN BLANKETING SYSTEM	
	F. CLEANING HEAT TRANSFER FLUID SYSTEMS	
III.	HEATER INSTALLATION	PAGE 10
	A. GENERAL INFORMATION	
	B. PIPING HOOK-UP	
	C. ELECTRICAL HOOK-UP	
IV.	FILLING THE SYSTEM	PAGE 11
V.	LIMIT CIRCUIT	PAGE 12
VI.	HEATER OPERATION	PAGE 13
	A. GENERAL INFORMATION	
	B. HEAT UP	
VII.	TROUBLE SHOOTING PROBLEMS AND POSSIBLE CAUSES	PAGE 15
	A. CIRCULATING PUMP (S)	
	B. BURNER BLOWER MOTOR	
	C. FUEL OIL PUMP	
	D. BURNER CYCLING	
	E. BURNER FIRING	
VIII.	PREVENTIVE MAINTENANCE	PAGE 17
IX.	INSPECTION SCHEDULE	PAGE 18

SECTION I

INTRODUCTION

Heatec's broad line of products makes it the most versatile heater manufacturer in the world. Over the years, Heatec has consistently entered new markets with technologically advanced products to solve a wide range of heating problems.

Heatec's product line includes equipment for asphalt plants, emulsion plants, roofing plants, chemical plants, refineries, citrus industries and many others.

GENERAL PRODUCT SPECIFICATION HELICAL COIL INDUSTRIAL HEATERS

GENERAL INFORMATION:

Heatec's HCI heaters are designed for liquid, gas or mixed flow in a series or parallel flow configuration. The usual is series flow utilizing the Heat Transfer Fluids and Oils, Natural Gas and Water. The standard is a packaged unit complete with a selected, forced draft burner, controls, internally insulated shell, which is all assembled on a rigid steel skid with lifting lugs.

HEATER PROPER:

1. **COIL:** This is the fluid containing section, the heat transfer section and the portion which is fabricated to the design requirements of ASME Section I or VIII (and can be stamped, as well as registered with the National Board). It is hydrostatically tested at one and one-half times its design pressure. Selection the coil size is determined by what is best for the current fluid in terms of fluid velocity, which produces acceptable pressure drops and low fluid film temperatures. The standard unit usually has a maximum, average radiant flux rate of 10,000 BTU per HR. per SQ. FT.
2. **SHELL:** The shell is a single cylinder, welded construction, not clam shell. The welded cylinder provides greater strength than a clam shell as well as better aesthetics. The standard shell is internally insulated with three (3) inches or more of Ceramic Fiber Blanket Insulation, which produces an average skin temperature of 140° F when fired at 500° F outlet temperature (or less), an ambient temperature of 70° F and an air velocity of only 1.5 feet per second.
3. **ENDS:** The end covers are fabricated, internally insulated with six (6) inches of Ceramic Fiber Blanket Insulation (the front also has a refractory combustion block 3000 to 3300°F material), and rear viewing port. The selected burner will also usually contain a viewing port. Seal plates are bolted on around the coil's entrance and exit and the easily, removable end

covers are sealed and bolted to the shell which allows for coil removal with only a wrench required, no flame cutting required.

4. **SKID:** The skid is fabricated of heavy structural members, saddles and lift lugs for a safe and easy four (4) point lift.
5. **PAINT:** The entire unit is mechanically and solvent cleaned before being coated with 2-3 mils of continental gray paint. Where temperatures are in excess of 450° F, such as the stack and thermal fluid piping, a 1-2 mil coating of high temperature aluminum is applied.
6. **SMOTHERING CONNECTION:** A connection for steam or other inert gas smothering is provided as standard on all units.

CONTROLS:

- A. **TEMPERATURE:** One temperature control modulates the burner to match the heat demand of the unit. A second output prevents the burner going to the high fire position until a predetermined temperature is obtained, this is commonly referred to as "Low Fire Hold." A third output switch turns the burner off & on when the demand is below the turndown of the burner. Standard burners provide a turndown in the range of 3-4 to 1. Higher turndown burners are available depending on the unit size, fuel and fuel pressure available. Another temperature controller monitors the stack temperature and shuts the unit down if the stack temperature gets too high.
- B. **GAUGES-PRESSURE AND TEMPERATURE:** Both the coil inlet and outlet are equipped with direct reading thermometer and pressure gauge. Each pressure gauge is installed with a gauge cock.
- C. **SWITCHES-PRESSURE:** The coil inlet and outlet are both equipped with a pressure switch. A high media pressure and a low differential pressure switch are utilized to monitor flow through the coil and shut down the burner if the flow is not proper.
- D. **BURNER:** The forced draft burner is selected from the standards of many manufacturers to provide the required input for the fuel (s) to be used. The Power Flame type "C" is our usual burner with the usual UL fuel train. Many others are also commonly used to meet available fuels, fuel pressures, insurance and turndown requirements. In this fashion we can provide a standard package burner which keeps our customer's costs for replacement parts at a minimum.
- E. **FLAME SAFETY:** The Fireye E-100 is the standard which has 42 descriptive messages that provide helpful assistance at all times. Other flame safety

management controls are used with regularity to meet customer specifications including tie-ins to PLC's or PLC's for monitoring and ancillary control.

- F. CONTROL PANEL: The control panel is usually side or front mounted for easy viewing and access and carries a NEMA 12 rating. Beyond the items already listed in "Controls", the panel also contains a distribution block, control transformer, motor starters, relays, raceways, lights and switches. All packaged items are wired to the provided wiring schematics. Customer furnished wiring is usually only the three (3) phase into the disconnect switch and inter-connecting wiring between the panel and the level control switch(s).

TESTING & GUARANTEES:

- A. TESTING: Electrical and pneumatic testing is done to simulate the customer's system to functionally adjust and test for proper control, operation and shut down. Functional testing to prove rated capacity may be performed only after installation. Customers or third party inspectors are welcomed to witness this test, other tests or fabrication at any time with notification.
- B. GUARANTEES: All units are warranted against defects of material or workmanship as stated in the quotations for a period of one (1) year from shipping date. The unit when operated properly is guaranteed to provide the rated capacity for which it was designed.

SECTION II

HEAT TRANSFER FLUIDS

A: GENERAL DESCRIPTION

Organic fluids have been used as a heat transfer medium for more than fifty years. Organic fluids fall into two groups, Petroleum based fluids called hot oils and synthetic aromatic fluids. Some of these fluids are formulated to operate in a vapor phase where thermal energy is released through latent heat during condensation of the vapors. The majority of the fluids operate in the liquid phase, where thermal energy is released as sensible heat. Fluids that operate in the vapor phase require the system to be pressurized. Systems that operate in the liquid phase can be operated at or near atmospheric pressure, provided that the head pressure on the pump is sufficient.

B: CHOOSING THE HEAT TRANSFER FLUID

The desired features of a heat transfer medium are dependent on its physical properties, its thermal stability and its adaptability to the system in which it is to be used. It is preferred that, at ambient temperatures, the fluid be in a liquid state and have a reasonably low viscosity so that it is easily pumpable. The fluid should also have a high specific heat and thermal conductivity in order that a large amount of thermal energy can be absorbed from the heat source and later be released efficiently to the user. The heat transfer fluid should have a high boiling point and exhibit low vapor pressure all through its operating temperature range. Low vapor pressure of the heat transfer medium allows the design of a low pressure, low cost system.

C: THERMAL STABILITY

The chemical structure, temperature and time determine the thermal stability of the heat transfer fluid. Proper system operation, chemical contamination prevention and the elimination of oxidation will provide maximum fluid life. Chemical contaminants can cause fouling of the heat transfer surfaces and may also react with and reduce its stability and possibly cause the formation of corrosive byproducts.

Oxidation of the heat transfer fluid occurs at elevated temperatures when air is permitted to enter the system.

D: NITROGEN BLANKETING SYSTEM

Gas blanketing is the injection of a protective gas into a storage or expansion tank vapor space. The objective of the blanketing system is to provide and maintain an artificial atmosphere above the liquid in the tank in order to prevent

the entrance of ambient air into the tank. Due to the oxygen and water content, air causes corrosion of the tank and degradation of the liquid by oxidation. Another benefit of nitrogen blanketing is the addition of NPSH on the pump where only limited elevation is available.

E: CLEANING HEAT TRANSFER FLUID SYSTEMS

Like other kinds of process equipment, HIGH TEMPERATURE HEAT TRANSFER FLUID systems require care and maintenance. On the mechanical side there are pumps, mechanical seals, valves, instruments and heaters to look after on a scheduled basis. To insure the best return on his investment, the operator must also test and evaluate the heat transfer fluid as part of his regular maintenance program.

The heat transfer fluid manufacturer usually specifies what to test for, and how, often to test. The frequency of testing the heat transfer fluid is dependent upon the system operating parameters. Two of the more important factors governing useful fluid life are the fluid film temperature and how long the fluid has been in service.

When the fluid reaches the point that it must be replaced or reclaimed it is also time to CHEMICALLY CLEAN the system. Done properly, chemical cleaning will save the operator down time, equipment repair and fluid losses.

2. WHEN TO CLEAN

A heat transfer system should be cleaned before any carbon or cake deposits can be formed. As stated above, planned preventative equipment maintenance and fluid sampling will assist the operator in determining when to chemically clean his system. For fired heaters an energy audit, from time to time, may also prove beneficial. There are four general situations when cleaning may be required.

For the new system it is obvious that mill scale, rust, weld slag and other solids must be removed prior to start-up. This is also an opportunity to test the system for leaks, check out the pumps, control valves, etc.

An operating system may become dirty in any one of several ways, singularly or in combination. Some of these are:

- a. As the system ages the heat transfer fluid undergoes a slow thermal degradation. In time, the fluid system may require special attention. Also, loss of the inert gas blanket covering the expansion tank may accelerate this process.

- b. A foreign product may find its way into the system; such as process leakage or the addition of an incompatible hydrocarbon or heat transfer fluid. Most organic contaminants are hazardous, due to their low thermal stability. As they degrade, they deposit carbon scale on the heat donor surfaces. Severe corrosion may result if a contaminant is acidic.
- c. A system upset or equipment malfunction may lead to severe general or localized overheating causing the formation of high molecular weight decomposition products, corrosive gases hard carbon deposits, etc.

When the fluid degrades to the point where it must be removed and replaced, the system should be cleaned and inspected for carbon deposits prior to refilling with new fluid. This is especially so when the new fluid is of a different chemistry. In many cases the new fluid, even of the same chemistry, will behave like a solvent loosening carbon and other deposits. It is better to remove this material first by cleaning the system.

When the system is to be converted from one heat transfer fluid to another it is often advisable to clean the system first and then fill it with the new heat transfer fluid.

WHAT WILL CHEMICAL CLEANING DO FOR THE OPERATOR?

Chemical cleaning of heat transfer systems can extend fluid life and reduce equipment maintenance and down time. Utility costs for fuel and pumping may also be improved. Chemical cleaning will not work miracles, in that it can only clean up the system, not correct any built in faults.

Chemical cleaning will remove rust, scale, pipe varnish, dissolved organics and in the same process screen/ filter out solids to sub-micron size. What cannot be cleaned is more to the point.

All other things being equal, an organic heat transfer fluid will degrade in direct proportion to its temperature. When an organic fluid is heated above it's critical temperature (even for short periods of time) there is an excellent chance that the fluid will carbonize on the heat donor surface. Even light carbon deposits on a heat donor surface are difficult, if not impossible, to remove by chemical action. Sometimes strong acids may loosen the carbon layer, but in the process surface etching may accelerate carbon deposition in the future. Most often mechanical methods, if possible, are the only way to remove carbon deposits on heat donor surfaces. If a liquid or vapor phase heat transfer system is properly maintained, and kept clean, long economic fluid and equipment life may be expected.

First, let's establish what may be cleaned; and how. In general, mill scale, rust and organic materials may be removed by Chemical Cleaning. At the same time, loose dirt, rust, welding slag and other solid materials may be flushed out of the system during the cleaning process.

The products used to remove these soils are usually alkaline in nature. Often they are combined with an organic acid and special additives package. In any cases, it is advisable to pre-test the cleaner package with a sample of the system fouling. These products are normally compatible with most of the commonly employed materials of construction. If there is any doubt, pre-test.

Heavy carbon deposits on the heat donor surfaces are difficult, if not impossible, to remove by chemical action alone. Sometimes porous layers of carbon may be cleaned off with strong acids, and time. Most often mechanical removal, if possible, is the only means.

ADDITIONAL TOPICS

1. DISPOSAL
2. CORROSION COUPONS
3. SET UP OF EQUIPMENT- PIPING SCHEMATIC
4. DRAINING - DRYING SYSTEM

SECTION III

HEATER INSTALLATION

- A. GENERAL: A heater being installed at a new installation should be set on a concrete slab or concrete footers. This allows for easy clean up should there be any type of oil spillage. Adequate room should be allowed around the heater for normal maintenance or adding oil. A minimum of 3 feet all around the heater plus coil length for coil removal if desired should be allowed.

- B. PIPING HOOK-UP: After heater is set in place, the suction line to the pump system supply line at the outlet of heater may be connected. We recommend, wherever possible, that welded connections be used. This eliminates the possibility of leakage that occurs with threaded pipe. Make sure you have enough valves to isolate any pumps or tanks before HEAT TRANSFER FLUID is added to the system. It is also recommended that 1/2" bleed lines be installed at all high points in the system to expel trapped air. It is also recommended that a 1/2" drain line be installed at all low points in the system to expel trapped water before the system is heated.

- C. ELECTRICAL HOOK-UP:
 - 1. Extreme caution should be taken when handling any electrical service. Only qualified personnel should do this.
 - 2. Make sure all switches on panel door are in the "OFF" position.
 - 3. Customer's power should be run to electrical panel on heater, and connected to the disconnect breaker. The power source is normally 460/3/60 but may be different depending on location. Once power is connected to the main breaker, shut panel door and turn the main disconnect arm to "ON" position. This will put power on entire panel and power a white light on panel door.

SECTION IV

FILLING SYSTEM WITH OIL

After all piping and electrical connections have been made the system and heater may be filled with heat transfer fluid. A fill connection with valve or blind flange may be provided on suction side of the heater-circulating pump. If valve is provided on pump suction, close valve in main return line immediately before strainer, and open the fill valve if provided. Turn heater-circulating pump to "ON" position. Visually check pump motor for proper rotation. If the circulating pump motor is turning backwards correct the problem before proceeding. This can be corrected by turning off the main breaker and carefully switching two of the three power leads going to the circulating pump breaker. Install the pump motor coupling and restart the pump and check for rotation.

When proper rotation has been established, oil can now be pumped into the system.

If no fill connection is supplied on the suction side of the pump, then the system must be filled through the tank fill connection. A secondary fill pump may be required to pump the heat transfer fluid into the tank and fill the system. Open vent on top of expansion tank. Attach hose with pipe nipple into fill valve connection, and place hose in barrel containing heat transfer fluid. This will allow you to fill the entire system.

After the system is filled and the heater expansion tank is about 1/4 full, allow the circulating pump to circulate and manually bleed off any air at high points and water at any low points. When air and water pockets are bled off, the heat transfer fluid level in the expansion tank should be approximately 1/4 full. This is the normal "cold" fluid level. The low level switch should be adjusted to make at this level. Should the heat transfer fluid level fall below this point during normal operation, the low heat transfer fluid level. Switch on the expansion tank, will trip, shutting off the burner. After the heater and system are completely full, you are now ready to proceed with start up.

SECTION V

LIMIT CIRCUIT

The burner on your HEATEC heater is wired through a series of limits. These limits act as check points or safety devices, to insure everything on your heater is working properly. The standard limit circuit includes:

A. **LOW OIL LEVEL:** The purpose of this limit is to maintain a safe operating level of oil in the heat transfer media system. It should be approximately 1/4 full when cold. In the event the level should fall below this point, the float inside the level switch will shut the burner off. Check the system for leaks and add more oil to the system to bring back to normal operating level.

B. **HIGH STACK SWITCH:** This limit monitors stack flue gas temperature leaving the heater. If the stack switch were to cause burner shut-off, this usually means there is a low oil flow condition through the heater. Check circulating pump and reset switch by pushing in reset button if applicable. Check strainer on heater for debris by unbolting bottom and removing screen. Clean and replace.

C. **BURNER LIMIT:** The burner control switch is usually internal of the modulation controller and is used for the on-off operation of the burner. The controller should never be set above the temperature range of the heat transfer fluid. The controller may be used at different set points depending on heater application. The controller should be checked periodically for proper operation and settings.

D. **HIGH OIL TEMPERATURE LIMIT:** This high oil temperature switch is used primarily as a safety back up to the burner controller switch. It should be set at approximately 25 degrees above the burner off-on temperature switch. Check the burner control switch for proper operation and setting. In the event that the burner controller switch malfunctions, this switch would shut the burner off and may have to be manually reset.

SECTION VI

HEATER OPERATION

A. GENERAL: If a Heatec serviceman or representative is to make the initial start-up, the person or persons responsible for operating and maintaining the unit should be present so proper operating and maintenance procedures can be covered at this time. A visual inspection of the installation should be made, checking all piping, gas, fuel, and hot oil lines to make sure valves are open or closed as required.

B. HEAT UP: Open the valves on the inlet and outlet of the expansion tank. Open the vent connection on top of the tank. Close the nitrogen supply valve to the tank if applicable. Close the valve between the inlet and outlet of the tank. Insure that the system has been completely filled and there is oil visible in the expansion tank sight glass. Turn the heater/pump switch to the "on" pump position. This will allow the heater pump to run, forcing the heat transfer fluid to circulate through the tank, pushing any trapped air from the system. Circulate the fluid through the tank for a minimum of one hour. Larger systems will require more time to vent the air from the system

Before initial heat up, a pressure gauge 0-100 P.S.I., should be installed on the pressure side of the circulating pump. This gauge will monitor heater pump pressure, which normally runs around 35-40 P.S.I. depending on system pressure drop and specific operating conditions.

Allow burner to light and visually check flame pattern. The burner modulation controller switch on the heater should be set at 212° F and the high limit 225° F during the initial heat up. As oil temperature rises and approaches set point or 212° F. Check to see that burner control switch shuts burner off properly. This will allow any moisture to begin to be worked out of the system without excessive steam pockets being formed. Vent valves in the high point piping should be checked for steam pockets. As the fluid heats up steam will begin to escape from the vent in top of the tank. Circulate the fluid at 212° F until vapors are no longer visible venting the tank. When vapors are no longer visible venting from the tank the temperature may be raised in 50° F increments. Keep monitoring the vent connection on the tank for vapor. Never increase temperature while vapors are exhausting the vent on the tank. When operating temperature has been reached the system should be ready to be put on line.

The "HCI" heater may also be equipped with a by-pass valve. See heater component sheet. This by-pass valve's primary purpose is to protect system in the event of a down stream or system blockage, by allowing oil to by-pass back to the suction side of the pump. If this happens, the oil in this small loop will heat up very quickly and the burner control switch will shut the burner off. Allowing the

heater to operate in this condition will cause the burner to cycle on and off very quickly, which means little oil is being circulated through the system.

If this does occur, a complete system check should be made, checking for any blockage or a closed valve. If no restrictions are found, resetting the flow controller for the by-pass valve can increase the system pressure.

SECTION VII

TROUBLE SHOOTING PROBLEMS

- A. Circulating pump will not operate with burner switch turned to "ON" position:
 - 1. Make sure breaker in electrical panel is on.
 - 2. Heaters on starter are tripped-reset starter.
 - 3. Check heat transfer fluid level in expansion tank, low level switch has power shut off.
- B. Burner blower does not operate:
 - 1. Check breaker in heater panel.
 - 2. Heaters on starter are tripped-reset starter.
 - 3. High limit controller switches open. Reset controller to restart.
- C. Fuel oil pump pressure gauge fluctuated:
 - 1. Check and tighten all fittings. Fuel pump is sucking air.
- D. Burner will cycle, but will not fire:
 - 1. Burner control switch is turned down too low.
 - 2. Air in fuel line.
 - 3. Check fuel valve on fuel tank.
 - 4. Gas pilot valve closed.
 - 5. Spark electrodes not igniting. Remove and check settings.
 - 6. Fuel solenoid or gas pilot solenoid not opening.
- E. Burner will fire, but will not run:
 - 1. Air in fuel or gas line.
 - 2. Clogged fuel filter.
 - 3. Improper air setting.
 - 4. U.V. scanner not working properly.
- F. Heater running - but smoking:
 - 1. Black smoke - low fire.
Too much fuel, increase air by opening bottom air damper on burner housing.
 - 2. Black smoke - high fire.
Too much fuel, increase air by opening top air damper on burner housing.
 - 3. White smoke - low fire.
Too much air, decrease air by closing bottom air damper on burner housing.
 - 4. White smoke - high fire.
Too much air, decrease air by closing top air damper on burner housing.
- G. Heater burns satisfactorily but cuts on stack limit.
 - 1. Check system pressure low flow.
 - 2. Remove strainer basket and clean.
 - 3. Stack switch out of calibration. Remove cover and back out small adjusting screw several turns and re-set.

H. Circulating pump packing/seal leaking excessively.

1. Packing: Tighten locknuts evenly until there is only slight drippage.

CAUTION: OVER TIGHTENING CAN DAMAGE SHAFT.

2. Seals: Check seal literature for replacement or repair.

SECTION VIII

PREVENTIVE MAINTENANCE

A preventive maintenance schedule should be set up on every heater installation. This schedule should include inspection and test on controls and safety devices as well as mechanical devices. This is practically important in atmospheres where extreme dust is present. It is important that the person responsible for maintenance be familiar with heater operation and procedures.

SECTION IX

INSPECTION SCHEDULE:

- Daily:
1. Visually check flame for good combustion.
 2. Visually check stack for any traces of smoke.
 3. Check circulating pump pressure.
 4. Check electrical panel for burned out bulbs.
 5. Check temperature setting on burner control switches.
- Monthly:
1. Add lubricant to heater circulating pump if required.
 2. Check pump coupling for wear.
 3. Clean lense on U.V. scanner.
 4. Check all pressure gauges.
 5. Check burner control switch by turning below oil temperature. It should shut off burner.
 6. Clean or replace #2 oil filter.
 7. Adjust packing gland on circulating pump.
 8. Remove rear door on burner and check fan wheel for dust build-up.
- Yearly:
1. Remove ignition electrodes, or gas pilot, check for carbon deposits and reset.
 2. Sample heat transfer oil for sludge deposits and thermal breakdown. Contact fluid supplier for sample test kit & for fluid sample analysis.
 3. Change gear oil in circulating pump.
 4. Dust out electrical panel with low pressure air hose.
 5. Check all safety limits for proper working order.