12711 TOWNEPARK WAY / LOUISVILLE, KY 40243
800-665-4251 / 502-962-2883 / FAX 502-244-4046

THERMAL FLUID SYSTEM SPECIFICATIONS

Items appearing in red are vendor data that is required with proposal.

1. Thermal Fluid Heater

The thermal fluid heater shall be a _____ (single or dual) liquid circuit helical coil type. The heater shall be designed for forced circulation of thermal fluid through a helical coil system fabricated from seamless pipe of sufficient heating surface to satisfy the heat input requirements. The heater shall be designed and constructed in accordance with the applicable ASME Boiler and Pressure Vessel Code Section VIII or Section I. The coil is to be enclosed in an insulated shell. Observation ports, manway, connections for heater coil, combustion air blower, and burner shall be provided.

1.1 Heat Exchange Coil:

1.1.1 Coil:

The heat exchange coil shall be a tangentially wound, helical coil constructed of SA-106B, seamless Schedule 40 carbon steel pipe. The coil shall be designed, constructed, tested, and inspected in accordance with ASME Code Section VIII Division I. The heat exchange coil shall have an ASME Code rating of 300 PSIG @ 800°F. Rating calculations shall include a 0.100" corrosion allowance and a 0.001" fouling factor. The coil shall receive an authorized National Board inspection and a copy of the inspection report shall be furnished to the purchaser. Hydrostatic test pressure shall not be less than 1.5 x M.A.W.P.

1.1.2 Construction:

The heat exchanger shall be constructed with expansion loops to allow for thermal expansion and contraction without transmitting stress to the heater shell. The heat exchange coil assembly shall include inlet and outlet manifolds with 300 PSIG, ANSI RFS flanged connections. The heater vendor shall manufacture, inspect, and hydrostatically test at his own plant. The purchaser or owner's agent may be present for the hydrostatic test.

1.1.3 Film Temperature:

The heat exchanger shall be specifically designed for the _____ GPM flow rate required to yield a temperature differential of _____°F through the heater. Operating under these nominal design conditions, the maximum film temperature, measured at the point of maximum radiant flux, shall not exceed _____°F at the maximum rated heater output.

1.1.4 Maxmimum Allowable Flux Rates/Vendor Data:

A. Radiant Zone: _____ btu/ft.^{2}/hr

B. Overall Average Radiant & Convection: _____ btu/ft.^{2}/hr

1.1.5 Heat Exchanger Effective Surface Area (minimum/vendor proposed):

Note: No extended surface, such as fins or studs, shall be permitted in either radiant or convection zones.

A. Radiant Zone: _____ $ft.^2$

B. Convection: _____ $ft.^2$

C. Total: _____ $ft.^2$

1.1.6 Coil Supports:

The heat exchange coil shall be supported and positioned in the heater shell by stainless steel supports and wear plates. All coil supports shall be in the heater convection section to minimize their exposure to radiant zone temperatures. Coil supports shall allow unhindered thermal expansion and contraction of the heat exchange coil.

1.1.7 Multiple Circuits:

The thermal fluid heater shall contain a maximum of two (2) liquid coil circuits. Dual circuit coils shall be parallel rolled and designed to assure equal exposure to radiant and convection heat transfer in both circuits. Vendor shall not average dissimilar fluid temperatures in the outlet manifold. Where more than one (1) liquid circuit is employed in the heater, the manufacturer shall furnish headers designed to provide equalized flow through each circuit for both heater inlet and outlet.

1.2 Heater Shell:

1.2.1 Shell Construction:

The heat exchange coil shall be enclosed in an insulated shell constructed of SA-36 carbon steel plate. Shell construction shall employ full diameter end plates and all heater joints shall be welded or gasketed "gas tight" by high temperature ceramic fiber gaskets. The shell shall not contain castable, brick, or gunnite refractory. The inside of the shell and bottom cap shall be insulated with multiple overlapping layers of ceramic fiber blanket. The blanket shall be fixed to the shell by welded stainless steel pins and retention clips. The clips shall be located on 9" centers maximum. To resist high temperature gas erosion, the pins and clips shall be covered with high temperature caulk and the entire blanket surface shall be coated with a high temperature rigidizer.

1.2.2 Horizontal Heater:

A. The heater shell shall have removable end plates flanged and bolted to provide access to the heater coil for inspection and maintenance. The rear cover plate shall have three 1" union type peepsights with Pyrex™ glass for viewing of the heat exchange coil, burner flame, and combustion block. A complete view of the burner flame shall be provided to allow operators to inspect pilot and main flame conditions and to visually check for flame impingement. One 24" diameter access door, hinged and bolted, shall be provided in the rear cover to permit internal inspection without removing the full diameter rear cover. The front end plate shall contain the burner and burner support. One fused quartz peepsight shall be installed for viewing the burner pilot and main flame at the burner. End plates shall be internally insulated with ceramic fiber modular block or blanket.

B. SKID AND SADDLES: The heater shell, coil, burner, and controls shall be mounted on structural steel saddles tied together by rugged steel channel skid rails. The combustion blower, burner, and valve trains shall be located on a steel platform welded to the front of the heater skid rails.

1.2.3 Vertical Heater:

A. LEGS AND SUPPORT STRUCTURE: The vertical heater shell and stack shall be elevated a minimum of 84" above grade by structural steel legs which are an integral part of the vertical

heater support structure. The stack may also utilize independent support from grade level. No other auxiliary heater supports, pilings, or guys shall be required. The burner shall be located under the heater for vertical firing configuration and factory-furnished shell supports shall permit full access to the burner and combustion valve trains for adjustment and maintenance.

B. TOP CAP: The heater shell shall have a full diameter removable top cap to allow access to the heater coil for inspection and maintenance. The top cover shall have three 1½" union peepsights with replaceable Pyrex™ glass and slide gates with stainless steel slides for viewing the heater internal, burner flame, and heater radiant zone. The top cover shall be internally lined with 6" of ceramic fiber modular block held in place by stainless steel pins welded to the heater cover. The top cap flange joint shall be sealed with a ceramic fiber gasket. A 24" diameter, bolted manway shall be provided to permit access to the heater radiant zone and burner.

C. BOTTOM CAP: The heater bottom cap shall contain the burner block, coil support ring, stack and heater leg support structure. The bottom cap shall be insulated with modular block ceramic fiber blanket. The hot face rating shall not be less than 2400°F.

D. STACK AND RAIN CAP: The heater shall be equipped with a _____" I.D. carbon steel stack that shall extend 15 feet above the top of the heater. The stack shall be 100% supported by the heater or grade-level support. No external support or guys shall be required. The stack shall be complete with a rain cap and all fittings and connections required to allow EPA emission testing. Stack and cap shall be designed to withstand 100 mph winds. Stack and cap shall be finished to manufacturer's standard.

E. LADDERS AND LANDINGS: The heater manufacturer shall factory-install a ladder, cage, any required intermediate landing, and top catwalk to allow access to the heater top. All equipment shall meet OSHA standards.

1.2.4 Lifting Lugs:

Lifting lugs shall be provided on the heater to assist in rigging and installing the heater.

1.3 Relief Valve:

1.3.1

The inlet of the heater coil shall be equipped with a flanged nozzle for mounting the spring-loaded pressure-relieving safety valves in accordance with the ASME Code and as described below:

A. _____" inlet 300 PSIG, ANSI, RFS flanged, x _____" outlet.

B. _____" orifice.

C. Valve set pressure: _____ PSIG.

D. The valve shall be equipped with a non-annealing alloy spring. The valve shall be installed on a _____" p.s. 300, ANSI, RFS flanged nozzle by the heater manufacturer on the heat exchange coil inlet where an increase in pressure is first sensed. The valve shall be shipped loose to minimize damage in transit. Field re-assembly shall be by others.

E. Valve sizing calculations shall be per the applicable ASME Code, Section VIII. A copy of the valve sizing calculations shall be provided to the purchaser.

1.3.2 Rupture Disc:

The safety relief valve set shall include a full pipe size, reverse buckling, 316 stainless steel rupture disc to protect the valve orifice. Rupture disc set shall include companion 300 PSIG, RFS flanges, with safety head assembly, excess flow valve, nipple and tee, 0-300 PSIG safety pressure gauge, and alloy studs and nuts.

1.4 Automatic Gas/Fuel Oil Burner Package:

1.4.1 Burner:

An industrial, forced-draft, packaged gas burner with integral combustion air blower shall be supplied and installed as an integral part of the heater by the manufacturer. Burner shall be designed for Low NOx emissions. Burner manufacturer shall be _____, Model No. _____.

1.4.2 Equipment Included:

The complete burner package shall include the following equipment all furnished, piped, wired, assembled, and installed as an integral part of the automatic heater combustion system.

A. MAIN BURNER: Includes ignition assembly with ignition transformer, spark ignition rod and high temperature ignition cable, peepsight, scanner, and integral combustion blower and controls.

B. COMBUSTION BLOWER: Complete with sheet metal scroll, air inlet ring, reverse inclined blade impeller wheel, and direct- connected _____ HP, _____ RPM, TEFC, 460/3/60, high efficiency blower drive motor. Blower operation shall be proven with a differential pressure switch furnished as an integral part of the heater vendor burner package. Should blower noise level exceed _____ DbA, a blower silencer shall be furnished by the blower manufacturer with a guarantee that the noise level will not exceed this limit. NOTE: Blower motor starter shall be furnished as an integral part of the complete heater vendor package.

C. BURNER CONTROL MOTOR: A modulating, electric burner input control motor/operator shall be furnished, mounted, wired, and mechanically connected to the fuel and combustion air input control valves. Field adjustment of linkage shall be by others.

1.5 Heater Control Cabinet:

A local control cabinet shall be furnished and mounted on the heater and contains the following:

1.5.1 Heater Main "On-Off" Switch.

1.5.2 Flame Safety Reset Switch.

1.5.3 Four (4) Operating Mode Lights:

A. Power On.

B. Burner On.

C. Call For Heat.

D. Alarm.

1.5.4 Flame Safety Programmer:

The Flame Safety Programmer shall be a Honeywell #RM7840L with UV amplifier. Flame programmer shall provide prepurge ignition, flame monitoring, and post purge as required by FM,

IRI, and NFPA. Control shall also contain a combustion fault finder to electronically assist service and maintenance.

1.5.5 Temperature Controllers:

All temperature controllers shall be thermocouple, electronic solid state, PID type with digital scale and set point.

1.5.6 Primary Indicating Liquid Temperature Controller:

The Primary Indicating Liquid Temperature Controller shall be an automatic, indicating, electric thermal liquid outlet temperature controller, installed in the heater control cabinet. The control shall be adjustable type set point and indication shall be digital readout type. Scale range shall be 0-800°F. NOTE: Temperature element with well shall be installed in the flash tank.

1.5.7 Secondary Temperature Controller:

When the system heat load requirement falls below the burner modulating input turn- down range, a secondary temperature switch shall automatically take over burner control and operate the burner in an "On/Off" mode until system demand rises above the minimum firing level of the burner. Sequencing from modulating mode to "On/Off" mode and back shall be automatic, not requiring operator monitoring.

1.5.8 High Thermal Liquid Temperature Switch (IRI and FM Required):

Mounted in the heater control cabinet shall be a high thermal liquid temperature limit switch. This limit shall be indicating, electric, with adjustable set point and 0-800°F scale range. The switch shall be wired to shut down the burner and power down the control circuit should the thermal liquid outlet temperature exceed the preset limit. Set point and read out shall be digital.

1.5.9 High Stack Temperature Switch (IRI and FM Required):

Mounted in the heater control cabinet shall be an adjustable, indicating, high stack temperature limit switch. Switch shall be wired to shut down burner and energize heater alarm and shut down circuit should preset temperature limit be exceed. High stack temperature shall shut down the heater. Control shall have both digital set point and readout dial with 0-1200°F scale.

1.5.10 Fault Annunciator System LED Type:

The control cabinet shall be equipped with a "First Out" Fault Annunciator which shall detect which safety or operating interlocks are not closed during burner start-up as well as which interlock opens first to cause burner shutdown. If more than one interlock opens, the annunciator shall alert the first one, and when that fault is corrected, it shall alert the second, third, fourth, etc. Annunciator utilizes solid state electronics for reliability and optical couplers for visualization.

1.5.11 Alarm Horn:

An alarm horn shall be provided, installed, and wired to sound on activation of the heater/combustion safety shutdown devices. These devices shall include:

1. Flame Failure.
2. Low Fuel Pressure.
3. High Fuel Pressure.
4. Low Combustion Air Pressure.

5. Low Thermal Liquid Flow.
6. High Thermal Liquid Temperature.
7. High Stack Temperature.
8. Low Thermal Liquid Level in Expansion Tank.

1.5.12 Common Alarm Contacts:

A set of dry contacts common to all of the heater safety limit devices shall be provided on the cabinet terminal strip for use by the owner for remote indication of a heater safety problem.

1.6 Control Panel Board:

A steel instrument board shall be mounted on the heater so as to provide support for the gauges and switches.

1.6.1 Differential Pressure Gauge:

A Differential Pressure Gauge with an isolating stop and bleed valve for liquid circuit shall be included to provide the operator with a visual check of the pressure drop through the heater i.e., fluid flow.

1.6.2 Low Thermal Liquid Flow Protection For Liquid Circuit:

A differential pressure switch shall be installed, mounted, and wired as an integral part of the safety system. This switch shall monitor the flow of thermal liquid through the heater. Should the differential pressure drop below the set point, the heater will be shut down and the low-flow alarm initiated.

1.7 Miscellaneous Heater Specifications:

1.7.1 Heat Transfer Surface:

The heater shall have not less than _____ ft^2 of fireside heat transfer surface.

1.7.2 Heater Liquid Fill Volume:

Vendor to state heater liquid fill in US gallons.

1.7.3 Weights and Measures:

Vendor shall state unit dry and operating weights and overall dimensions in initial proposal.

1.7.4 Heater Performance Data:

The heater manufacturer shall submit a HEATER PERFORMANCE DATA SHEET with the initial equipment proposal. Performance data to be supplied shall include, but not limited to, the following:

1. Heater Net (LHV) efficiency at 100% of rated capacity _____%.
2. Fluid Film Temperature at 100% of rated heater capacity _____°F.
3. Maximum heat exchange coil metal temperature at 100% of rated heater capacity _____°F.
4. Maximum radiant flux rate at 100% design capacity _____ BTU/Hour/°F/ft^2.

5. Stack temperature at 100% rated heater capacity _____°F.

6. Maximum heater pressure drop calculated for the _____ GPM flow at _____°F heater operating temperature _____ PSIG.

2.0 Expansion Tank

The heater manufacturer shall design, fabricate, and furnish an expansion tank of sufficient volume to contain the liquid expansion from the entire thermal liquid system. The liquid level in the expansion tank shall not exceed 75% of the tank volume when the system is operating at the specified design temperature.

2.1

The expansion tank shall be designed, manufactured, and tested in accordance with the ASME Code Section VIII, be inspected and approved by an authorized National Board inspector and display the ASME Code stamping. Thank design pressure shall be 150 PSIG at 750°F. All tank connections shall be 300 PSIG, ANSI, RFS flanged.

2.2

The expansion tank shall be arranged horizontally and have two bottom connections to the main circulating loop to permit flow-through operation. The two bottom nozzles shall not be smaller than the circulating pump suction.

2.3

The expansion tank set shall include:

2.3.1 Structural Steel Saddles:

The Structural Steel Saddles shall include center web plates. The saddles shall elevate the bottom of the tank a minimum of 24" from the bottom of the saddle.

2.3.2 Level Gauge:

The Level Gauge shall be an armored reflex gauge with integral ball check gauge cocks.

2.3.3 Low Liquid Level Switch (Required by IRI and FM):

The Low Liquid Level Switch shall be wired to shut down burner and sound alarm upon low expansion tank liquid level.

2.3.4 Inert Atmosphere Blanket System:

The Inert Atmosphere Blanket System shall maintain a blanket pressure that is a minimum of 10 PSIG in the tank. NOTE: If vaporizing type fluid is specified, the atmosphere pressure must be maintained at a minimum of 10 PSIG above the fluid vapor pressure.

1. The inert blanket system shall be designed for 150 PSIG atmosphere supply pressure.

2. The inert blanket system shall include, as a minimum, the following:

    1. Inlet stop valve.

    2. Inlet pressure regulator, field adjustable.

    3. Check valve.

4. Pressure gauge.
5. Outlet pressure relief regulator, field adjustable.

2.3.5 Tank Connections:

1. Two (2) _____" bottom connections.
2. Two (2) reflex level gauge connections.
3. One (1) 1" inert atmosphere blanket connection.
4. One (1) _____" top fill connection.
5. 3" low liquid level switch connection.
6. 1" vent connection.

2.3.6

The expansion tank shall include lifting lugs capable of lifting the entire flooded weight of the tank and accessory equipment. The lifting lugs shall be located in the top center line of the tank.

2.4

The expansion tank volume shall be based upon a jobsite thermal liquid fill of _____ U.S. gallons, not including the vendor's heating system liquid fill. The vendor shall state the tank volume and heater liquid fill in the initial proposal.

2.5

The expansion tank shall be installed and piped as an integral part of the complete vendor furnished thermal liquid heating system. The tank piping shall include two (2) risers piped to the circulating pump suction and shall include a gate valve installed between the two tank risers and other isolation valves as required by system proposed by the vendor.

3.0 Duplex Circulating Pump Set

The heater package shall be equipped with a circulating pump set designed to provide the thermal flow and pressure required by the complete thermal liquid system. The pump set shall include one (1) primary and one (1) stand-by pump with inlet and outlet manifolds and instruments mounted and supported on a common fabricated base.

3.1 Circulating Pumps:

Duplex circulating pump set shall include two (2) cast steel high temperature centrifugal centerline mounted, each complete with pump base, flexible coupling, steel OSHA type coupling guard, mechanical seal, and electric motor. Pumps are to have a casing drain, inlet and outlet nozzles drilled and tapped, all with steel plugs. Pumps may be air cooled or water cooled.

3.1.1

Pump shall be Series _____, Model No. _____, manufactured by _____.

3.1.2

Pump motors shall be _____ HP, _____ RPM, TEFC, 460 volt, 3 phase, 60 Hz. Pump HP is to be calculated for non-overloading at full run out and maximum heater outlet temperature.

3.1.3

Pump capacity shall be _____ GPM at _____ ft. TDH (_____ PSIG). Vendor shall submit a pump capacity curve marked with operating point and operating N.P.S.H.

3.2 Pump Suction Manifolds and Valves:

The vaporizer manufacturer shall furnish and assemble the suction and discharge thermal liquid pump manifolds and install these manifolds on the pumps mounted on a common fabricated steel base. Pump suction valving and pipe shall be at least one pipe size larger than pump suction connection. All pump pipe and valve support shall be included as an integral part of the pump skid package. Manifold pipe shall be schedule 40, SA106B, seamless carbon steel, welded and pressure tested per ANSI B31.1. The use of flanged joints shall be held to a minimum. However, where necessary, 300 PSIG, ANSI, RFS flanges with spiral wound mineral fiber gaskets and alloy studs/nuts shall be used. Manifold connections larger the ½" shall be flanged. Connections ½" and smaller shall be 3000# couplings and seal welded.

3.2.1 Pump Piping Manifold:

Each pump discharge shall have one (1) flexible welded metal bellows hose with double stainless steel braid, one (1) check valve, one (1) cast steel gate valve, and one (1) pressure gauge (4½" dial x ½" n.p.t. gauge with stainless steel trim and bourdon tube and steel gauge block valve).

The two (2) pump discharge trains shall be piped to one (1) common header. The common discharge header shall be factory piped to the heater inlet.

3.2.2 Pump Suction Manifold:

Each pump suction train shall include one (1) flexible welded metal bellows hose with double stainless steel braid, one (1) strainer, and one (1) cast steel gate valve.

The two (2) pump suction trains shall be connected to one (1) common inlet header containing a 5" dial bimetallic type thermometer and well and a flanged _____" connection with cast steel block valve for connection to the owner's liquid return. The pump suction header is to be piped to the expansion tank liquid return connection by the heater manufacturer.

4.0 Vendor Data to be Included in the Proposal:

The vendor shall include with his proposal the following data:

4.1

A complete description of all items to be furnished, including:

1. Horsepower of all motors.
2. Electric power consumption.
3. Maximum fuel input.
4. Cooling water flow rates.
5. Thermal liquid system fill requirement.

6. Unit and total system weights and measures.

7. Catalog brochures and data sheets for all components included in the proposal.

8. Computer analysis of heater operating at maximum design capacity. Analysis shall show gross fuel input, maximum calculated metal and fluid film temperature, calculated combustion loading, and radiant flux rates.

9. Proposal sketch showing overall plan and side elevation dimensions and weights of equipment proposed.

10. P&I sketch, illustrating the major components and instrumentation proposed and clearly defining the battery limits of the equipment quoted.

11. Pump capacity curve/BHP calculations based upon non-overloading condition at system design temperature.

12. Factory service rate sheet.

13. LIST OF EXCEPTIONS AND DEVIATIONS FROM SPECIFICATIONS: All exceptions, or suggested alternatives to specifications, shall be clearly stated in the vendor's initial equipment proposal. Where no exceptions or alternatives are stated, the equipment will conform to this specification.

5.0 Documents to be Furnished With the Heater:

The successful bidder shall provide the purchaser with the following data and documents:

5.1

Three (3) copies of the following reproducible drawings and data:

1. Control wiring diagram

2. Piping and instrumentation diagram.

3. Instrument and valve legend, keyed to control wiring and piping and instrumentation diagram.

4. Heater system general arrangement drawing.

5. Heater start-up/shutdown sequence, including flame safety logic. All drawings shall be CAD generated and suitable for use in the owner's master file. Symbols shall be ISA standards. Weights and measures shall be shown in English units.

6. Manufacturer's data report and copy of ASME Code stamping for heater coil and expansion tank.

7. Vendor shall provide purchaser with two (2) copies of a complete operating and general instruction manual for the heater package.

8. Priced list of recommended spare parts.