SECTION

IMPEDANCE HEATING

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

Impedance heating system(s) shall meet the requirements of the *National Electrical Code Article 427*, in which heat is generated in a pipeline or vessel wall by causing current to flow through the pipeline or vessel wall.

1.02 WORK INCLUDED

Provide the impedance heating system(s) to be connected to the pipeline or vessel, per NEC Article 427, and as shown on the related work specified elsewhere and as specified herein.

1.03 RELATED WORK SPECIFIED ELSEWHERE

Pipe or Vessel Size, Length, and Material Composition:
Electrical Isolation Details of Pipe or Vessel:
Thermal Insulation Specifications:
Piping Layout Drawing:
Installation , Operating, and Maintenance Instructions:
Submittal Data Including Customer Specified Process Variables:

1.04 REFERENCE STANDARD

A. National Electrical Code (NEC)

2.00 PRODUCT

2.01 ACCEPTABLE MANUFACTURERS

If it complies with these specifications, products manufactured by the following manufacturers will be acceptable.

HEATREX

2.02 IMPEDANCE HEATING SYSTEM

A. **General**
[Choose one or both as required]

- ☐ END-POINT SYSTEM – A defined length of pipe or vessel to be heated shall be established. System shall be a series connection with isolation kits provided for return conductors back to the transformer.

- ☐ MID-POINT SYSTEM – A defined length of pipe or vessel to be heated shall be established. The electrical mid-point of the system shall be established for supply conductors placement. System shall be a parallel connection with grounded system ends provided for return conductors back to the transformer.

B. **Piping**

Piping or vessel should be of continuous weld construction, fabricated according to applicable standards. Branch connections, equipment connections, and at heated section separations, isolation kits or isolation conductors should be utilized.

C. **Electrical Isolation of Piping or Vessel**

The impedance system must be electrically isolated from end to end. Pipe supports and hangers must also be electrically isolated from the impedance heated piping or vessel. Care must be taken at support points to insure that the pipe expansion will not cause accidental grounding of the circuit. Following is a list of acceptable isolation materials and maximum rated temperatures to be used:

[Choose one or multiple as required]

☐	PVC……	180° F
☐	Neoprene Rubber……	225° F
☐	Silicone Rubber…….	400° F
☐	Non-Asbestos Fiber Gasket……	700° F
☐	Mica ……...	1000° F

D. **Standard System Hardware**

- ☑ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the following components mounted into a **UL LISTED, NEMA 12** enclosure:
  - Electronic process temperature controller with thermocouple input and digital temperature indication
  - Electronic high-limit /overtemperature controller with manual or automatic reset and thermocouple input
  - 2-Pole definite purpose controlling contactor
  - Control circuit transformer with fused secondary
  - Door interlocking disconnect switch
  - Heater circuit fusing, dual element time delay class RK5
  - Illuminated ON/OFF pilot switch
  - "OVERTEMPERATURE" indication pilot light
- ☑ *System Transformer*- A step down system transformer designed for the appropriate KVA rating of the impedance heating system will be mounted in a ventilated **NEMA 3R** enclosure. Transformer shall be suitable for operation up to 104° F ambient and shall be mounted so that air circulation is not impeded. Transformer will have dual-windings and a grounded shield between the primary and secondary windings. The skin temperature of the transformer must not exceed OSHA limits, so the transformer can be located within reach of personnel. Transformer will be of the single-phase, dry-type unit which will reduce the primary supply voltage to a maximum of 30 volts applied to the pipe to generate heat. The transformer will be a muti-tap design and have six available taps starting at 100% capacity to 50% capacity.
- ☑ *Cable* – Secondary conductors ampacity shall be at least 100% of the total load of the heater. The cable is to be run in free air and strapped externally to the thermal insulation jacket, equally spaced around the circumference of the pipe and held in place every 6 to 9 feet, using aluminum or similar strap of non-ferrous material. The cable is not to be run in conduit, unless specified by HEATREX. The appropriate total length of cable for the designed system shall be provided.
- ☑ *Electrical Termination Hardware* – Standard termination hardware includes stainless steel or copper-plated carbon steel terminal plates. The terminal plates will be of the perforated design, specifically designed for the temperature, pipe size, and shape of the system. Crimped or bolted connectors shall be provided for field cable attachment. Care should be taken to insure the connectors are clean and free from foreign material before the connections are made.
- ☑ *Flanged Isolation Kit* – For systems with "tees" where current divides, and where grounded equipment is connected to pipes, isolation kits shall be provided for installation at the flanged connections. Each isolation kit shall provide a flange gasket, a set of non-conductive bolt sleeves and washers and the required bolts, washers, and nuts. Isolation kits shall be rated for the proper temperature/pressure ratings of the system.

☑ *Thermocouple Sensor* – Standard type J thermocouples, with custom designed mounting hardware, are provided to be mounted directly to the outside of the pipe, under the thermal insulation. A process and high-limit thermocouple shall be provided.

E. **Optional System Hardware**

[Choose options to be included]

☐ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the standard components mounted into a **UL LISTED, NEMA 4** enclosure.

☐ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the standard components mounted into a **UL LISTED, NEMA 4X** enclosure.

☐ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the standard components mounted into a **UL LISTED, Purged, NEMA 4** enclosure, suitable for Class I or II, Division 2 locations.

☐ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the standard components mounted into a **Cast Aluminum, NEMA 7** enclosure, suitable for Class I or II, Division 2 locations.

☐ *Control Panel* – Silicone Controlled Rectifier (SCR) controlled system with proportional process temperature control. The control panel includes the following components mounted into a **UL LISTED, NEMA 4** enclosure:

- Electronic process temperature controller with the thermocouple input and digital temperature indication
- Electronic high-limit /overtemperature controller with manual or automatic reset and thermocouple input
- Phase angle fire, single-phase SCR with soft strt (current limit)
- 2-pole definite purpose safety contactor
- Control circuit transformer with fused secondary
- Door interlocking disconnect switch
- Fan/filter assembly as required for heat dissipation
- Heater circuit fusing, dual element time delay class RK5
- Illuminated ON/OFF pilot switch
- "OVERTEMPERATURE" indication pilot light

☐ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the following components mounted into a **UL LISTED, NEMA 4X** enclosure:

- Electronic process temperature controller with thermocouple input and digital temperature indication
- Electronic high-limit /overtemperature controller with manual or automatic reset and thermocouple input
- Phase angle fire, single-phase SCR with soft start (current limit)
- 2-pole definite purpose safety contactor
- Control circuit transformer with fused secondary
- Door interlocking disconnect switch
- Panel cooling as required for heat dissipation
- Heater circuit fusing, dual element time delay class RK5
- Illuminated ON/OFF pilot switch
- "OVERTEMPERATURE" indication pilot light

☐ *Control Panel* – Contactor controlled system with on/off process temperature control. The control panel includes the following components mounted into a **UL LISTED, Purged, NEMA 4** enclosure, suitable for Class I or II, Division 2 locations.

- Electronic process temperature controller with thermocouple input and digital temperature indication
- Electronic high-limit /overtemperature controller with manual or automatic reset and thermocouple input
- Phase angle fire, single-phase SCR with soft start (current limit)
- 2-pole definite purpose safety contactor
- Control circuit transformer with fused secondary
- Door interlocking disconnect switch
- Panel cooling as required for heat dissipation

- Heater circuit fusing, dual element time delay class RK5
- Illuminated ON/OFF pilot switch
- "OVERTEMPERATURE" indication pilot light

- ☐ *Built-in Control Relay* – Defines control logic by interlocking safety devices to the system power or can provide remote alarm indication to the customer.
- ☐ *Panel Mounted Volt Meter* – Provides voltage indication on either the primary or secondary side of the step down transformer.
- ☐ *Panel Mounted Amp Meter* – Provides amperage indication on either the primary or secondary side of the step down transformer.
- ☐ *MODBUS Serial Connection* – Allows remote control of system through the electronic process controller.
- ☐ *System Transformer*- A step down system transformer designed for the appropriate KVA rating of the impedance heating system will be mounted in a non-ventilated**, NEMA 4** enclosure.
- ☐ *System Transformer*- A step down system transformer designed for the appropriate KVA rating of the impedance heating system will be mounted in a non-ventilated**, NEMA 4X** enclosure.
- ☐ *Electrical Termination Hardware* – **NEMA 7, Class I, Division II,** termination hardware includes stainless steel or copper-plated carbon steel terminal plates. The terminal plates will be of the perforated design, specifically designed for the temperature, pipe size, and shape of the system. Crimped or bolted connectors shall be provided for field cable attachment. Care should be taken to insure the connectors are clean and free from foreign material before the connections are made. Termination hardware shall include a perforated cover for arcing/sparking protection, specifically designed for the system environment.
- ☐ *Thermocouple Sensor* – Type K thermocouples, with custom designed mounting hardware, are provided to be mounted directly to the outside of the pipe, under the thermal insulation. A process and high-limit thermocouple shall be provided.
- ☐ *RTD Sensor* – RTD sensors, with custom designed mounting hardware, are provided to be mounted directly to the outside of the pipe, under the thermal insulation. A process and high-limit sensor shall be provided.

F. **Testing**

Control panel shall be functionally tested by manufacturer.

G. **NEC and UL Requirements**

Systems shall be constructed so that installation may be accomplished in accordance with the local authority and provisions of the National Electrical Code (NEC). The control panel shall be listed by Underwriters' Laboratories, Inc., bear the appropriate UL label, and comply with all applicable requirements of NEC.

H. **Capacity**

Heating systems shall have KVA and voltage ratings as specified by the manufacturer.

3.00 EXECUTION

3.01 GENERAL

The installation shall be in accordance with the manufacturer's Installation, Operating and Maintenance Instructions with regard to application, mechanical and electrical requirements. It shall be the responsibility of the contractor to carry out proper installation in accordance with the local authority and the National Electrical Code (NEC) and guarantee operational status.