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SPECIFICATION FOR – "FREEZE PROTECTING SUPER-HEATED STEAM TUBING"*

(March 2015)

1.0 SCOPE

This specification outlines the minimum requirements for electrically traced or steam/fluid traced instrument tubing (a.k.a. "tubing bundles", traced lines, sample transport bundles, heated umbilical, and other similar industry names) specifically for this application. Acceptable suppliers are Thermon, or their authorized agents.

2.0 CONSTRUCTION

2.1 The process tube(s) and steam/fluid tracer tube and/or electric heat tracing shall be cabled together using an 18.00-24.00-inch (457-610mm) "lay" to insure tube(s) and/or electrical tracing contact is maintained throughout the length of the product. Metallic tubes up to 5/8" (16mm) OD and the tracer tube or electric heating cable shall be spiraled, unless specified otherwise on the production work order. Exceptions to this will be pre-insulated tube products containing a single tube and/or a thermally isolated tracer tube. Tubes larger than 5/8" (16mm) OD shall be run parallel, with the tracer tube or electric heater, cabling around the process tube(s), with the exception of straight lengths. For straight length tubing, the tracer, tube or electric, may run parallel with the process tube.

2.1.1 In bundles with multiple metallic tubes, each tube shall be identified by a paint or dye mark along its entire length. The paint or dye shall be compatible with the tube and insulation materials.

2.1.2 To prevent the breakdown of any binders within the fiberglass insulation (Also see Section 3.4 Thermal Insulation System for additional information) for materials rated at 500°F (260°C) or less, woven fiberglass rope shall be used to isolate the high temperature tubing from all other components. Additionally, the electrical heat trace shall be protected from exposure to temperatures above its rating of 500°F (260°C). (See Sections 3.2 and 4.0 Electrical Heat Trace for additional information on this component.)

2.1.3 The tube(s) insulated with the woven fiberglass rope, as well as the electric heat tracing, shall then be wrapped with a combination of non-hygroscopic glass fiber insulation tape (Also see Section 3.4 Thermal Insulation System for additional information) having a chloride content less than 50 ppm and heat-reflective foil.

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2.1.4 The standard outer jacket material shall be black UV resistant Arctic Thermo-Plastic (ATP) compound with a maximum temperature rating 221°F (105°C). It shall be suitable for installation in conditions as low as -40°F (-40°C). The outer jacket shall have a nominal thickness of .080". An acceptable alternative material is polyether urethane elastomeric compound (TPU).

2.1.5 The finished product shall be indelibly labeled its entire length with the manufacturer's name, product catalog number, month/year of manufacture and country of origin. Product containing electrical heat tracing cable shall also be labeled "Caution Electric" along its entire length. Long lengths of product shall be coiled and level wound on a wooden spool. When product size and length allows, it may be packaged and shipped in a corrugated box. Products manufactured from straight lengths will be packaged and shipped as straight lengths, in a comparable wooden crate.

3.0 MATERIALS OF CONSTRUCTION

3.1 Tubing

The following tubing specifications shall apply to the process and/or sample tube(s), as well as the tube for heating media in steam or fluid tracing systems. (Also addressed in section 3.3 of this specification.)

3.1.1 Welded stainless steel tubing shall be Type 316 continuous TIG welded, cold drawn and fully annealed. It shall meet or exceed ASTM Standard A-269. Tube hardness shall be RB90 or less, suitable for bending and flaring. The stainless steel tubing shall be available in minimum coil lengths of 500 feet (150 meters) for 1/4" (6mm) O.D. through 3/4" (20mm) O.D. and .035" (.89mm), .049" (1.25mm) , or .065" (1.50mm) wall thickness.

3.1.2 Seamless stainless steel tubing shall be Type 316 cold drawn and fully annealed. It shall meet or exceed ASTM Standards A-269 and A213 "EAW". Long length coils are preferred for sizes 1/4" (6mm) O.D. through 3/4" (20mm) O.D. and .028" (.70mm), .035" (.89mm), .049" (1.25mm), or .065" 1.50mm) wall thickness. Tube hardness shall be RB90 or less, suitable for bending and flaring.

3.2 Power-Limiting Heat Trace

The electrical heat tracing used in the tubing bundles described in this specification shall be power-limiting such as Thermon HPT™ Power-Limiting Heat Tracing. Primary concern shall be given to system reliability and safety. Alternative heat tracing methods not covered in this specification may be considered where temperature and/or watt density are outside the capabilities described.

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The power-limiting heat tracing assembly shall consist of two parallel nickel-plated copper bus conductors, individually insulated, and then paired together by means of a high temperature fluoropolymer jacket. At regular intervals one of the bus conductors shall be alternately exposed for connection to the coiled resistor alloy heating element described below.

The heating element shall be constructed by means of a PTC (Positive Temperature Coefficient) metallic conductor being spirally wrapped around a fiberglass carrier strand to form a coiled resistor heating element. This coiled resistor heating element shall then be helically wrapped around the insulated voltage supply bus wires making electrical contact with alternate bus wires at regular intervals to complete the heating circuit.

The coiled resistor heating element shall then be covered with a layer of fiberglass cushioning material followed by a dielectric insulating jacket of high temperature fluoropolymer. The dielectric insulation shall then be covered by means of a metallic braid of nickel-plated copper. The braid shall provide a nominal coverage of eighty percent and shall exhibit a resistance not exceeding 0.01 ohms/ft. (0.01 ohms/m). The nickel-plated copper braid shall then be covered with a corrosion resistant over-jacket of fluoropolymer.

Carbon loaded semi-conductive polymer heating elements shall not be considered for power-limiting cable applications.

Long term stability of all electrical heat tracing shall be established by the service life performance test per the most recent revision of the IEEE 515 Standard.

3.3 Steam and Fluid Heat Tracing

Steam/Fluid traced tubing bundles shall have a tracer tube of stainless steel. The tracer tube shall be 1/4” (6mm), 3/8” (10mm) or 1/2” (12mm) O.D., and shall meet the specification as outlined in section 3.1.

3.4 Thermal Insulation System

The insulation system shall consist of non-hygroscopic (non-wicking) glass-fiber insulation with a total chloride content less than 50 ppm, high temperature woven fiberglass rope insulation and heat-reflective aluminum foil. The insulation shall be applied in sufficient thickness as to limit the outer bundle jacket surface temperature to 140°F (60°C) maximum in an 80°F (27°C) ambient with no wind.

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3.5 Outer Bundle Jacket
(Refer to section 2.1.4)

4.0 APPLICATION

4.1 Freeze Protecting High Temperature Tubing up to 750°F (399°C) (Continuous Exposure)

All heat tracing in this application shall be power-limiting, capable of withstanding continuous exposure to tube temperatures of 500°F (260°C) while de-energized. The heat tracing shall be thermally isolated from the process tube(s) with sufficient insulation type and thickness (see sections 2.3 and 2.4) to insure that the heater exposure temperature remains below this limit when the process tube(s) are at 750°F (399°C). When operated with an ambient-sensing control system and the tube temperature is 750°F (399°C), the bundle design must limit the electrical heat trace to a maximum operating temperature of 400°F (204°C).

4.1.1 Freeze Protecting High Temperature Tubing up to 1100°F (593°C) (Continuous Exposure)

All heat tracing in this application shall be power-limiting, capable of withstanding continuous exposure tube temperatures up to 500°F (260°C) while de-energized. The heat tracing shall be thermally isolated from the process tube(s) with sufficient insulation type and thickness (see sections 2.3 and 2.4) to insure that the heater exposure temperature remains below this limit when the process tube(s) are at 1100°F (593°C). When operated with an ambient-sensing control system and the tube temperature is 1100°F (593°C), the bundle design must limit the electrical heat trace to a maximum operating temperature of 400°F (204°C).

4.1.2 Freeze Protecting High Temperature Tubing up to 1100°F (593°C) (Intermittent Exposure)

All heat tracing in this application shall be power-limiting, capable of withstanding continuous exposure tube temperatures up to 500°F (260°C) while de-energized. The heat tracing shall be thermally isolated from the process tube(s) with sufficient insulation type and thickness (see sections 2.3 and 2.4) to insure that the heater exposure temperature remains below this limit when the process tube(s) are intermittently at 1100°F (593°C), for a maximum duration of 2 minutes. When operated with an ambient-sensing control system and the tube temperature is 1100°F (593°C), the bundle design must limit the electrical heat trace to a maximum operating temperature of 400°F (204°C).

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5.0 CIRCUIT CONTROL - PROTECTION

5.1 Control and Monitoring for Electrically Traced Tubing

For freeze protection applications where elevated process temperature excursions and/or steam-outs do not exceed the heat tracing exposure rating of the electric tracer, while energized, ambient sensing control is acceptable. For energy conservation, “ambient proportional control” is recommended.

Where elevated excursions are expected and/or where accurate temperatures are to be maintained, tube/line sensing control is required. Depending on the application, electronic controls or mechanical thermostats can be considered.

For all tube/line sensing applications, care shall be taken to ensure that the temperature sensor is not in direct contact with the electrical heat tracing to create a false reading. The sensor type used must have an exposure temperature rating at or above the tube exposure temperature. The installation of an RTD-type sensor on the tube can be arranged by the tubing bundle manufacturer, or applied in the field.

The RTD sensor shall be connected to a microprocessor-based control and monitoring device such as the Thermon TC device. Note that the TC-101, TC-201, TC-202, and TC-1818 also provide ground leakage equipment protection functions required by most electrical codes.

5.1.1 Circuit Protection for Electrically Traced Tubing

All pertinent electrical codes shall be observed in the installation, operation, and maintenance of all electrical heat tracing installations, including heated instrument tubing. No more than five (5) instrument lines can be connected in parallel with a common electrical circuit protection device, (i.e. circuit breaker).

6.0 Accessories for Connections, Terminations, and Sealing Kits

All electrical heat tracing circuits within the tubing bundle(s) shall be fabricated with the appropriate kits designed specifically for power connections and end terminations. Where the tube sample line is to be electrically heated, the manufacturer of the pre-insulated and heat traced tubing bundle shall also be the manufacturer of the electrical heat tracing.

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*__Also See__:
“Specification for Heated Instrument Tubing for Process Applications”, and
”Specification for Heated Sample Lines for Dilution and Extractive Analytical Systems”