Specification for Heated Instrument Tubing in Process Applications* (March 29, 2007)

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). 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 heating cable shall be cabled together using an 18.00-inch "lay" to insure tube and/or electrical tracer contact is maintained throughout the length of the product. Exceptions to this will be pre-insulated tube products containing a single tube, a thermally isolated tracer tube, and/or nonmetallic tubes.

2.2 In bundles with multiple 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. The only exception will be bundles containing tubes made of fluoropolymer.

2.3 The tube(s) and electric heater cable shall be wrapped with a combination of non-hygroscopic glass fiber insulation tape and heat-reflective tape containing less that 50-ppm chloride.

2.4 The standard outer jacket material shall be black UV resistant Arctic Thermo-Plastic (ATP) compound with a maximum temperature rating 221°F (105°C) and suitable for installation in conditions as low as -40°F (-40°C). The outer jacket shall have a nominal thickness of .080". Acceptable materials are polyvinyl chloride (PVC), polyether urethane elastomer compound (TPU), or "Santoprene" elastomer.

2.5 The finished product shall be labeled its entire length with the manufacturer's name, catalog number, 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. Lengths less than 25' may be shipped as straight lengths in a 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 continuous coils of 500 feet for 1/8" O.D. through 3/4" O.D. and .028", .035", or .049" 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. Long length coils are preferred for sizes 1/8" O.D. through 3/4"O.D. and .028", .035", .049", or .065" wall thickness. Tube hardness shall be RB90 or less, suitable for bending and flaring.

3.1.3 Copper tubing shall be grade 122 soft annealed and shall meet or exceed ASTM Standards B-68 and B-75. The tubing shall be in continuous coils minimum 500' for sizes 1/4" O.D. through 3/4" O.D.

3.1.4 "Teflon" tubing shall be an extruded fluoropolymer resin. The fluoropolymer resin shall be PFA or FEP Grade. Tubing shall be in continuous coils for sizes 3/8" O.D. through 3/4" O.D. minimum wall thickness shall be .062". Minimum wall thickness for 1/4" O.D. tubing is .047" and 1/8" O.D. is .030".

3.2 Electrical Heat Tracing

The type of electrical heat tracing used in the tubing bundles is described by application below. Primary concern shall be given to system reliability and safety. Heat tracing methods not covered in this specification may be considered as an alternate where temperature and/or watt density are outside the capabilities described.

3.2.1 Freeze Protection & Low Temperature Maintenance up to 150°F (65°C).

Heat tracing shall be self-regulating, capable of maintaining process temperatures up to 150°F (65°C) and withstanding continuous exposure to tube temperatures of 185° F (85°C) while heat tracing is de-energized. Heat tracing shall be capable of being cut to length without changing its power output per unit length, and heat output shall respond to temperature change.

Long-term stability as established by the service life performance test per IEEE 515 Std-2004, with Thermon BSX self-regulating heat tracing preferred.

3.2.2 Freeze Protection & Medium Process Maintenance up to 250°F (121°C)

All heat tracing shall be self-regulating, capable of maintaining process temperatures up to 250°F (121°C) and continuous exposure to tube temperatures of 400°F (205°C) while heat tracing is de-energized. Heat tracing shall be capable of being cut to length without changing its power output per unit length, and heat output shall respond to temperature change.

Long-term stability as established by the service life performance test per IEEE 515 Std-2004, with Thermon HTSX self-regulating heat tracing preferred.

3.2.3 Freeze Protection & High Process Maintenance up to 300°F (149°C)

All heat tracing shall be self-regulating, capable of maintaining process temperatures up to 300°F (149°C) and intermittent exposure to tube temperatures of 450°F (232°C) while heat tracing is de-energized. Heat tracing shall be capable of being cut to length without changing its power output per unit length, and heat output shall respond to temperature change.

Long-term stability as established by the service life performance test per IEEE 515 Std-2004, with Thermon VSX self-regulating heat tracing preferred.

3.2.4 Freeze Protection & Process Maintenance up to 400°F (204°C)

All heat tracing shall be power-limiting and capable of maintaining process temperatures up to 400°F (204°C) and withstand continuous exposure to tube temperatures of 500°F (260°C) while heat tracing is de-energized. Heat tracing shall be capable of being cut to length without changing its power output per unit length, and heat output shall respond to temperature change.

Long-term stability as established by the service life performance test per IEEE 515 Std-2004, with Thermon HPT power-limiting heat tracing preferred.

3.2.5 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 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 sensing control is required. Depending on the application, electronic controls or mechanical thermostats can be considered.

Care shall be taken to ensure the temperature sensor is not in contact with the electrical heat tracing to create a false reading. The placement 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.

3.2.6 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). In some cases, a heated instrument enclosure such as that from Thermon or FibreForm can be powered from the electrically heated tube bundle.

3.3 Steam and Fluid Heat Tracing

Steam/Fluid traced tubing bundles shall have a tracer tube of copper or stainless steel. The heat tracing shall be 3/8" or 1/2" O.D., and shall meet this specification section 3.1.

3.4 Thermal Insulation System

The insulation system shall consist of non-hygroscopic (non-wicking) glass-fiber insulation and heat-reflective tape with total chloride content less than 50 ppm. The insulation shall be applied in sufficient thickness as to limit the outer jacket surface temperature to 140°F (60°C) maximum with an 80°F (27°C) ambient with no wind and 400°F (204°C) tube temperature.

*Also See:

"Specification for Heated Sample Lines for Gas Analyzers" ("Heated Sample Lines" are also referred to as "Heated Umbilical Lines" or "Sample Transport Bundles"), and "Specification for Freeze Protecting Super-heated Steam Sample Tubing"