

TECHNICAL UPDATE - TU-5009

SUBJECT: Analyzer Umbilical Bundles and the National Electric Code

Questions arise when attempting to determine whether the umbilical lines used to connect the probe to the analyzer in a continuous emissions monitoring (CEM) system meet the requirements of the National Electric Code (NEC or Code).

An umbilical line is a multi-purpose tubing bundle that is used to connect the sample probe to the analyzer equipment. The umbilical typically contains tubes for sample collection, calibration, probe control and maintenance; temperature sensors and sensor wire for umbilical and probe control; and heating elements for maintenance of sample temperature. The umbilical may also contain control or sensor wires for sample probe operation.

The NEC details construction, installation, and safety requirements for electrical power conductors and equipment used in residential and industrial applications. In field fabricated pipe tracing applications, there is no problem interpreting the Code for each component used. The electric heater is covered under Article 427 titled, "Fixed Electric Heating Equipment for Pipelines and Vessel". Any control or sensor wiring is covered under specific Articles such as Article 300, "Wiring Methods", or Article 725 "Signal Circuits".

The problem in assessing NEC compliance for umbilical bundles comes from the fact that umbilical bundles are not covered under any article of the Code. It is not a pipeline used to transport process or heat transfer fluids, nor is it a wiring method. Due to its construction and application, the umbilical bundle must be classed as "utilization equipment" by the Code.

As utilization equipment, the umbilical must be examined as a total system rather than its discrete components.

In order to assist the customer in the inspection and certification of umbilical bundles, Unitherm has selected and sized components and materials in the bundles so that they meet the requirements of the various Articles of the NEC.

The heating elements are the same as those used in fixed applications covered under Article 427.

The insulated conductors are selected to meet the temperature and ampacity requirements for each application. Control wire sizes and insulating materials are selected in accordance with Article 300. Tray Cable and Power Limited Tray Cable bundles to Article 725 are incorporated if required by the customer. Sensor leads are selected to meet their individual temperature and signal requirements.

Jacket materials are selected from compounds approved for use as wire and cable jackets. All materials meet or exceed standards called out in ICEA S-61-402, the standard for thermoplastic insulated electric cables. The jacket wall thickness is taken from published cable standards and is greater than the thickness required for the number and type wires housed in the bundle.

Close inspection of these materials will show that they meet the specifications of many approved wire types used in industrial applications. We feel that no further covering is required to meet the requirements of the NEC.

However, customers have requested special bundle constructions including flexible metal conduit, flexible metallic tubing, or metal clad cable to allow them to meet their interpretation of the NEC requirements.

Flexible metal conduit and flexible metallic tubing have not proved feasible. The Code requires these to be ½" trade size or larger for any run longer than 6 feet, and requires a maximum fill of 40% of the conduit area. The size and fill requirements cause installation and handling problems that make this type construction unsuitable for most applications.

Metal clad cable has a "smooth and close fitting" metal sheath over the insulated conductors. To meet code, an expensive special cable must be fabricated for each application, or the customer must settle for a "standard" cable that may be more or less than he needs. This cable also requires special care during installation as the insulated wires are easily damaged when removing the metal sheath.

Again, we feel that these modifications are unnecessary. Roughly 1,000,000 feet of umbilical of our design has been installed in thousands of approved installations worldwide. This wide industry acceptance indicates to us that Code requirements have been met.