# Suggested Specification For Fireproofing Critical Electrical Power, Control, and Instrumentation Circuits

nVent PYROTENAX

## ALLOY 825 SHEATHED MI CABLE

### 1 SCOPE

This specification describes the minimum requirements for fireproofing critical electrical power, control, and instrumentation circuits. Critical circuits are those that are required to remain in operation for a minimum of 15 to 30 minutes, allowing for a controlled and orderly shutdown of a process unit in the event of a hydrocarbon fire. When a process is being shutdown during a fire, it is important that complete system integrity is maintained. The fire protection solution must consider all parts of the system, such as valves, actuators, switches, wiring, etc.

### 2 GENERAL

2.1 Designers should remember that fire damage causes not only capital loss but also loss of production, which in many cases far exceeds the capital loss. Therefore, any design that not only limits the capital loss, but also allows for accelerated resumption of operations after a fire, is advantageous.

2.2 At the early stages of plant layout and design, consideration shall be given to the likelihood of a localized fire causing severe plant outages due to the loss of critical electrical power, control, and instrumentation circuits.

2.3 Exposure of standard industrial equipment to fire will result in the degradation of the electrical insulation levels, rendering the equipment useless. Fireproofing design shall afford adequate protection to the critical equipment and the supporting structure in the case of exposure to fire.

2.4 Enclosures, other equipment, and structures shall be fireproofed in accordance with the requirements of the owner's fire prevention engineer.

2.5 Alloy 825 sheathed mineral insulated (MI) power, control, and instrumentation cable is the preferred wiring method for critical circuits operating up to 600 volts in fire hazard areas as it does not require fireproofing. Conventional electrical wiring, if fireproofed with thermal insulation, must be derated in ampacity. Also, following a fire the thermal insulation must be replaced before the process unit can be restarted.

2.6 For liquid hydrocarbon fuels, the fire hazard area is any location that extends approximately 20 to 40 ft (6 to 12 m) horizontally and 20 to 40 ft (6 to 12 m) vertically from the source of the liquid fuel or to a fire stop such as a concrete ceiling or other suitable fire barrier that effectively isolates the fire hazard area or any area above the direct path of equipment drainage from a fire hazard area.

2.7 Fire hazard equipment is equipment that could cause a flammable or toxic release of materials, a fire, an uncontrolled shutdown, or a significant business interruption in the event that it does not fail safe. Such equipment may include:

- Shutdown systems that do not fail safe
- Equipment having a high potential to contribute fuel to and sustain a fire
- Any added factors that limit the rapid control or extinguishing of the fire

2.8 Critical equipment includes:

- All emergency shutdown equipment such as motor-operated block valves
- Depressurizing and venting valves
- Emergency lighting equipment
- Firewater pumps and other critical equipment
- Any other monitoring equipment essential to perform a controlled and orderly shutdown due to a fire

## 3 FIREPROOFING FOR ELECTRICAL AND CONTROL SYSTEMS

The following components within a designated fire hazard area shall be fireproofed:

3.1 Distributed control system data communication highways

3.2 Critical power, control, and instrumentation cable servicing:

- All emergency shutdown equipment, such as emergency block valves
- Critical instrumentation essential to perform a controlled and orderly shutdown due to a fire
- Control cables for electrically operated actuators, solenoids, and position indicators
- Firewater pumps and other critical equipment
- Emergency lighting equipment
- Remote input/output devices that communicate with the distributed control system (DCS), programmable electronic safety system (PESS), and programmable logic control systems (PLCs).

3.3 Cables for automated valves controlling:

- Shutdown of the system
- Depressurization and venting
- Isolation and control of combustible or flammable fluids, or toxic chemicals

3.4 Cables for control of equipment that would influence uncontrolled release of harmful emissions of gases and fluids endangering personnel safety

3.5 Equipment necessary to provide protection against situations that endanger the health or lives of plant personnel

3.6 Critical service applications that may result in extended plant shutdowns and economic losses, such as:

- Main instrumentation cable run
- Equipment damage where the economic effects upon plant operation would be greater than the cost of additional fireproofing for the control and instrumentation cables

3.7 The preferred methods of fireproofing critical power, control, and instrumentation cables are:

- Install mineral insulated cables insulated with inorganic materials and enclosed in a continuous nickel based Alloy 825 sheath
- Bury the cables (cables must be derated for ampacity, accessibility for maintenance is limited)
- Protect the cables with fireproofing materials (cables must be derated for ampacity, gaps and joints in fireproofing materials protecting cables are potential failure points, accessibility for maintenance is limited)
- Route the cables outside of the fire hazard area (may not be practical, added expense)

## 4 RELEVANT CODES AND STANDARDS

4.1 Relevant fire survival standards and publications:

- UL 2196, Tests for Fire Resistive Cables (rapid temperature rise curve)
- UL 1709, Rapid Rise Fire Tests of Protection Materials for Structural Steel
- ASTM E 1529 Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies
- API 2218, Fireproofing Practices in Petroleum and Petrochemical Processing Plants

4.2 CSA Standard C22.2 No.124, Mineral Insulated Cable

4.3 Wiring shall be in accordance with the latest edition of the National Electrical Code (NEC), Canadian Electrical Code (CEC), and/or the authority having jurisdiction, and the manufacturer's recommendations.

## 5 PRODUCTS

5.1 The cable shall be nVent PYROTENAX MI cable, insulated with inorganic materials (highly compacted magnesium oxide) that prevent the flow and transmission of explosive gases through the wiring cables. The cable shall consist of one or more solid nickel-clad copper conductors (System 2000) or solid nickel conductors (System 2200) and enclosed in a continuous nickel-based Alloy 825 sheath.

5.2 System 2000 with nickel clad copper conductors shall be suitable for continuous exposure temperature of 1238°F (670 °C) and maximum exposure temperature of 2000°F (1093°C). System 2200 with solid nickel conductors shall be suitable for continuous exposure temperature of 1238°F (670°C) and maximum exposure temperature of 2200°F (1200°C).

5.3 The cable shall retain its function in a hydrocarbon fire for 15 to 30 minutes.

5.4 Cables shall be rated for operation up to 600 volts.

5.5 Cables shall be factory assembled, or optionally available for field termination, and available in the following sizes:

- 16 AWG to 2 AWG System 2000 and 1 $mm^2$ to 35 $mm^2$ System 2000 (Metric) power and control cables
- 16 AWG to 5 AWG System 2200 and 4 $mm^2$ to 9 $mm^2$ System 2200 (Metric) power and control cables

5.6 Cables shall be resistant to corrosion and degradation for the specified application.

5.7 The cable shall have a current rating in excess of the anticipated load current.

5.8 Provision shall be made during the design stage to allow for a grounding conductor. Multiconductor cables shall contain an extra conductor for this purpose or an extra cable shall be run in the case of single conductor cables.

5.9 Circuit length and conductor material shall be considered in circuit design such that voltage drop does not exceed 3%.

5.10 Cable shall be capable of withstanding mechanical shock during a fire as directed by the engineer.

5.11 In confined spaces where personnel safety is a concern, such as offshore oil platforms and mining tunnels, cables shall not produce smoke nor toxic fumes and shall provide zero fuel contribution to a fire.

5.12 All safety shutdown components such as actuators, switches, cable glands, junction boxes, and splices shall be protected for the required period with suitable fireproofing materials such as K-MASS™ intumescent material.

5.13 Cable weights and dimensions shall be furnished to assist in both weight and space savings for structural design.

## 6 TESTING

6.1 Complete factory tests shall be performed on all cables prior to shipment. Test reports shall be available for customer inspection.

## 7 EXAMINATION

Installers shall verify that:

7.1 Factory-installed terminations or end seals (for bulk cable) are intact.

7.2 Insulation resistance (IR) meets the manufacturer's minimum acceptable requirements prior to installation.

7.3 Preparation for shipment shall be in accordance with manufacturer's standards.

## 8 STORAGE

8.1 Cables shall be shipped from the manufacturer with ends sealed against moisture.

8.2 Cable shall be stored in a clean, dry location.

## 9 CABLE INSTALLATION

9.1 Pull cables into position by hand, one at a time, using a pulling rope attached to the cable sheath. When pulling around corners, hand feed cables using large sweeping bends.

9.2 Take precautions necessary to prevent damage to cable from severe blows with sharp instruments and pulling over sharp objects.

9.3 Conduit shall not be required to protect the cable.

## 10 FIELD QUALITY CONTROL

10.1 Inspect cable for physical damage and proper connection.

10.2 Verify continuity of each conductor.

10.3 Prior to energizing cables, the insulation resistance of each cable shall be checked with a 500 Vdc megohmmeter and an insulation resistance value achieved which is acceptable to the engineer. Tabulate and submit for approval.

10.4 Provide certification from cable manufacturer that installation is in accordance with their requirements

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