CONNECT AND PROTECT

FIRE-RATED WIRING PLAYBOOK

nVent

PYROTENAX

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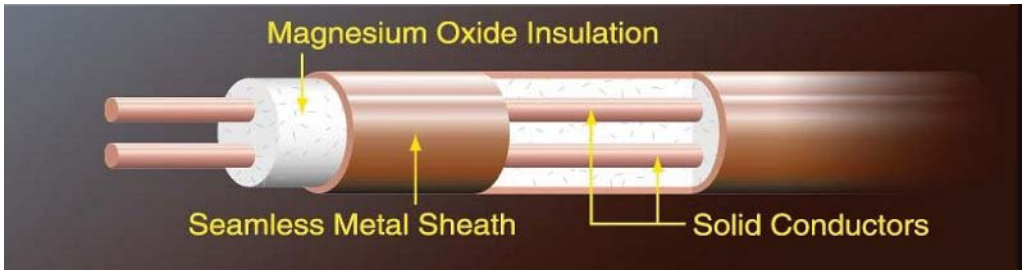
Mineral Insulated Fire Rated Cable System

CABLE CONSTRUCTION

For more than 60 years and with more than 30 Million feet installed worldwide, nVent PYROTENAX's proven inorganic wiring solutions have delivered superior critical life safety circuit performance in the event of fire and when increased ampacity is required.

Key benefits of our cable:

- Completely inorganic construction does not contribute fuel to fires or produce toxic and flammable gases when exposed to fire
- Superior mechanical strength
- Requires less space than competition
- Only UL Listed Cable with NO Limitations
- Backed by Lifetime warranty



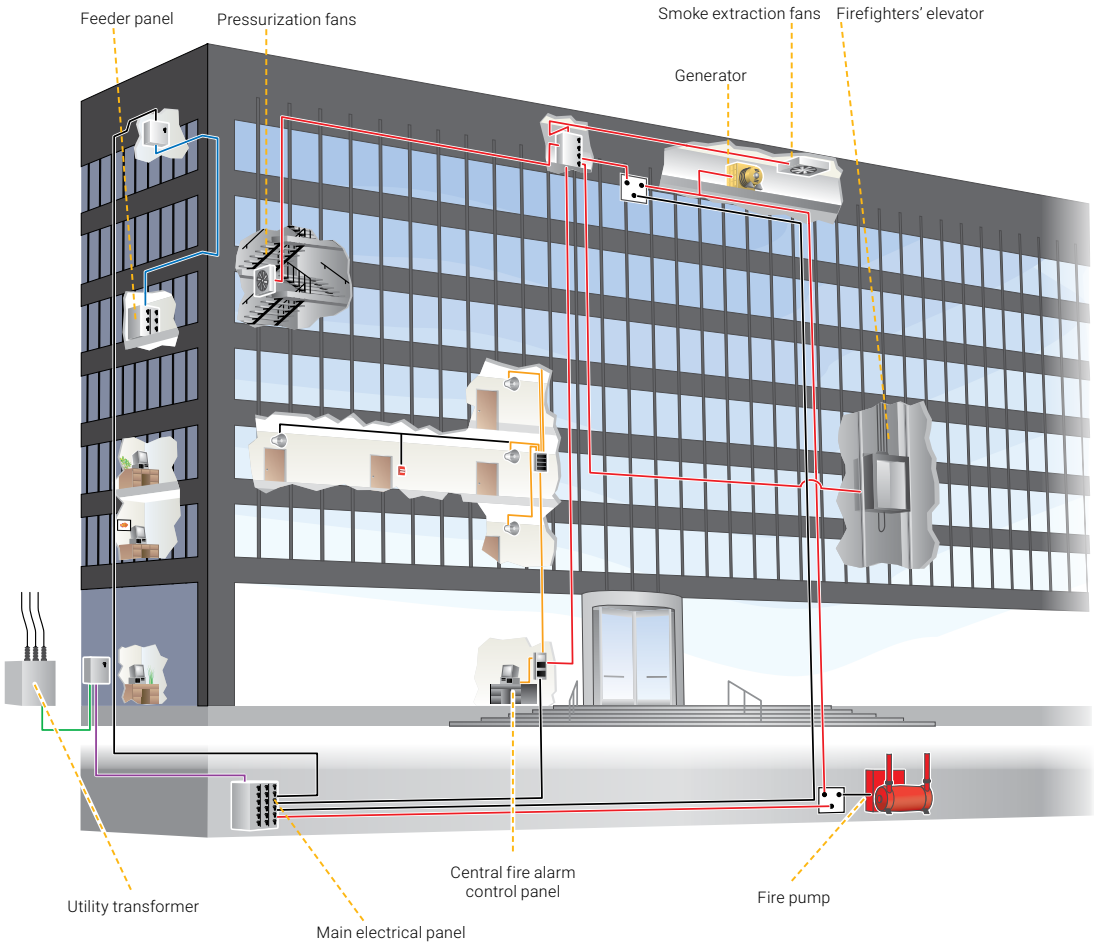
TYPICAL APPLICATIONS FOR FIRE-RATED WIRING

Our cables can be specified in the design phase or during retrofitting. They are utilized to allow for continuous operation of fire pumps, emergency generators, firefighters' elevators and smoke extraction fans during an emergency situation in the following locations:

- High-rise buildings
- Hospitals and other institutions
- Historic buildings
- Tunnels and subways
- Airports, stadiums, hotels, banks, etc.

Many of these applications are also known as **Critical Operations Power Systems (COPS)** per the 2008 NEC requirement Article 708.

Other applications include the retrofitting of electrical power feeders in commercial buildings due to increased power consumption and the elimination of the effects of electromagnetic interference (caused by high current feeders) on electronic equipment.



Power Cables

Fire Alarm Cables

Space Saving Cable System

Service Entrance Cable System

Normal Power Cables

Code Requirements for Fire Protection of Electrical Supply

CODE OVERVIEW

The **National Electrical Code (NEC), or NFPA 70**, is a standard for the safe installation of electrical wiring and equipment in the United States that is typically adopted regionally. It is part of the National Fire Code series published by the National Fire Protection Association (NFPA), a private trade association.

Despite the use of the term "national", it is not a federal law and is often adopted by states and municipalities in order to standardize their enforcement of safe electrical practices. In many situations, the NEC is amended and altered to fit the specific need. Local governing agencies may even be reject the code in lieu of regional regulations already established.

In addition to NEC (NFPA 70), you should familiarize yourself with the following codes:

- NFPA 20: "Stationary Pumps for Fire Protection"
- NFPA 72: "National Fire Alarm Code"
- NFPA 101: "Life Safety Code"
- NFPA 110: "Emergency and Standby Power System"
- NFPA 130 : "Standard for Fixed Guideway Transit and Passenger Rail Systems"
- NFPA 502: "Road Tunnels, Bridges, and Limited Access Highways"

NEC ARTICLES AND SURVIVABILITY

One recent change that has been implemented into the codes, or is in the works of being altered is moving away from a 1-hour requirement to 2-hour minimum requirement of fire protection. This is extremely significant to our business because our products already satisfy that condition.

- **NEC Article 695 "Fire Pumps"**
    - o Requires 2 hours of protection per 2008 NEC -Fire pumps must have a reliable source of power.
        - If reliable, a primary source may be independent service to the pump controller; no disconnect (i.e. a utility service, or on-site power generation)
        - When reliability cannot be obtained from a single source, stand-by power (i.e. an emergency generator) may be used as back-up, with no current protection
- **NEC Article 700 "Emergency Systems" – Includes Emergency Lighting, Ventilation, Fire Fighters Elevators, etc.**
    - o Requires 2 hours of protection per 2011 NEC
    - o Emergency systems shall meet the additional requirements for not less than 1000 persons or in buildings above 75 feet in height
    - o The 2017 NEC adds a little extra to that measure by also adding: "Educational occupancies of 300 persons and over"
- **NEC Article 708 "Critical Operating Power Systems" – Emergency Command Centers**
    - o Requires 2 hours of protection per 2011 NEC – Instituted after 9/11 and Hurricane Katrina NEC
        - Article 708.10(C) (1) "Protection Against Physical Damage"
        - Rigid metal conduit, intermediate metal conduit, or Type MI cable

Note: Neither MC Cable, EMT Conduit, or Fiberglass Conduit are accepted. Meaning no other UL Listed Systems.

• **NEC Article 728 "Fire-Resistive Cable Systems"**

o New in 2014 – Insists on no substitutions of components or accessories.

o All fire resistive cables must be installed as a complete system as listed.

o There is no interchangeable components between systems, and that means all supports, conduit, couplings, ground wires, pulling lubricants, splices, tested boxes or enclosures are specific to each and every system.

• **NEC Article 760 "Fire Alarm Systems"**

o Requires 2 hours of protection per 2005 NEC 760.176(F) Fire Alarm Circuit Integrity Cables or Electrical Circuit Protective Systems

- Circuit Integrity (CI) cables, are used for the survivability of critical circuits, shall have an additional classification using the suffix "CI". CI cables shall only be permitted to be installed in a raceway where specifically listed and marked as part of an electrical circuit protection system.

- Electrical Circuit Protective System. Cables that are part of an electrical protective system, shall be identified with the protective system number and hourly rating printed on the outer jacket of the cable and installed in accordance with the listing of the protective system.

• MI Cable is not CI cable, but it is an Electrical Circuit Protective System and meets the UL2196 Listing as a Fire Alarm Cable.

• **NEC Article 517 "Health Care Facilities"** *(per 2014 code)*

- Section 517.26 now requires that the Life Safety Branch of the essential electrical system shall meet the requirements of Article 700. This means that any health care facility that are 75 feet tall or taller or has an occupancy of 1000 persons or more must have the emergency feeders protected for 2-hours as per section 700.10(D).

- Article 517 of the NEC specifically mentions MI Cable's acceptance:

(3) Mechanical Protection of the Essential Electrical System. The wiring of the life safety and critical branches shall be mechanically protected. Where installed as branch circuits in patient care spaces, the installation shall comply with the requirements of 517.13(A) and (B). Only the following wiring methods shall be permitted:

To increase reliability of power delivery to life safety and patient care equipment, the wiring of the life safety and critical branch requires additional protection against mechanical damage that is not normally mandated for other occupancies. The wiring methods for branch circuits in patient care spaces are limited by 517.13.

(1) Nonflexible metal raceways, Type MI cable, Type RTRC marked with the suffix-XW, or Schedule 80 PVC conduit. Nonmetallic raceways shall not be used for branch circuits that supply patient care areas.

• **The National Building Code of Canada has similar requirements including:**

- Emergency Power Supply Generator to transfer switch, transfer switch to emergency distribution switch board : Ref 3.2.7.8 (3)(b) and others

- Fire pumps : Ref 3.2.5.18 and others

- Firefighter's Elevator : Ref 3.2.6.5(6) and others

Requirements listed above a partial list from the NBCC.

• **Codes and Standards Evolution.** Historically the requirement was for 1-hour, but since 2011 all Articles have moved to a 2-hour requirement.

Today's NEC	Article 695: Fire Pumps	Article 700: Emergency Systems	Article 708: Critical Operations Power Systems	Article 760: Fire Alarm Systems
	Minimum 2-hour fire rating **2008 NEC**	Minimum 2-hour fire rating **2001 NEC**	Minimum 2-hour fire rating **2011 NEC**	Minimum 2-hour fire rating 2005 NEC
Applicability	Fire pump feeder circuits where required by code	Life safety emergency power feeder circuits where required by code	'Critical Operations Power Systems' (Homeland Security)	Fire Alarm communication circuits where required by code

All now minimum 2-hour fire rating as of January 2011

A full playlist with all of our code-related videos can be found here.

MI vs. Construction Methods

SPRINKLER SYSTEMS

Electrical feeders may be directly protected by a fire suppression system. However, relying exclusively on sprinkler systems is difficult and costly to implement properly based on the requirement below:

1) **Feeder-Circuit Wiring.** Feeder-circuit wiring shall meet one of the following conditions:

I. Be installed in spaces or areas that are fully protected by an approved automatic fire suppression system.

II. Where emergency system feeders are installed above a suspended ceiling, for the system to be fully protected by a fire suppression system, **sprinklers must be provided above the suspended ceiling*** even though sprinklers might be installed below the ceiling.

GYPSUM BOARD ENCLOSURES

Although it's been around for decades and is still one of the most popular methods practiced, gypsum board enclosures must meet stringent conditions for fire protection, and they rarely live up to the conditions for the life of the building (see graphic below). There must be a dedicated assembly for life safety circuits.

MI is a more credible solution because it is Listed and the safer option.

Gypsum board enclosures are:

• NOT listed for electrical cable protection

• NOT as total installed cost effective as they are perceived to be

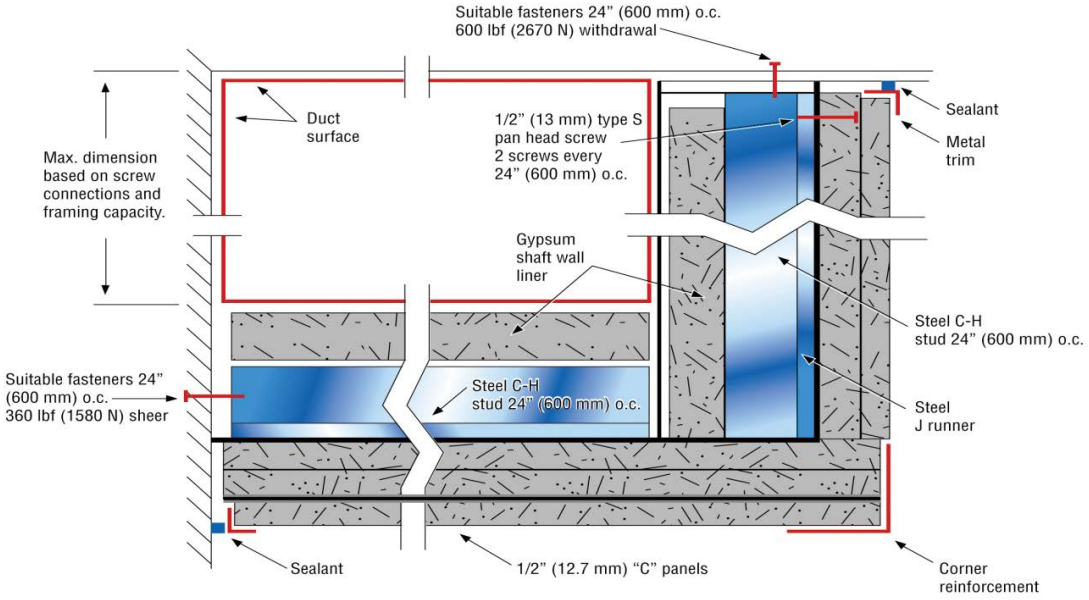
• Difficult to build and coordinate on-site

• Extremely craft sensitive, workmanship dependent

• Subject to deterioration

• Space consuming

Fire protection-horizontal service spaces

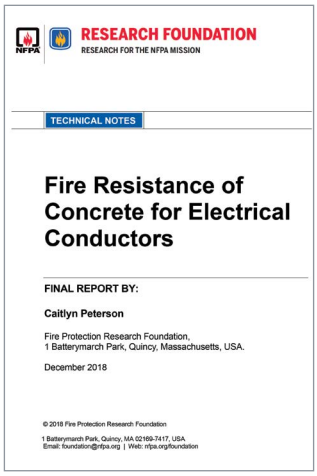


2-Hr rated assembly horizontal metalduct enclosure

CONCRETE ENCASEMENT

The current standard practice of using 2" of concrete encasement to protect emergency equipment wiring provides only 1 hour of protection. **The NFPA technical note released in December 2018 suggests that electrical feeders are to be encased in 5 inches of concrete when this is the method of fire protection.** This is because at 5 inches all types of concrete, when properly casted, have a fire resistance rating of 2 or more hours. By making the requirement 5 inches you remove the need to specify the type of concrete to use.

Our MI solutions provide 2 hours of protection, and can require significantly less space and are very cost effective when compared to 5" of concrete encasement and standard building wires. Please be sure to share the NFPA's Technical Note with customers and prospects.


RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

TECHNICAL NOTES

Fire Resistance of Concrete for Electrical Conductors

FINAL REPORT BY:

Caitlyn Peterson

Fire Protection Research Foundation,
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December 2018

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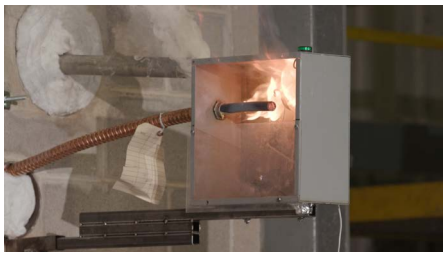
MI vs. Polymeric Fire-Rated Cables

2-HOUR FIRE-RATED CABLE OPTIONS

Many UL 2196 Listed cables use polymeric type insulation materials. These polymers are typically ceramifiable silicone rubber based materials that have serious limitations and can actually contribute to dangerous fire conditions.



- Polymeric cables can release dangerous toxic and combustible smoke and gases when heated. These gases are released as the polymers convert to their ceramic form when exposed to fire. UL 2196 currently does not test for the presence of these gases.
- Polymeric cables don't have the same mechanical strength as MI.
    - To learn more and to receive a copy of the lab report detailing these findings please visit our site go.nVent.com/NoSmoke.
- All Polymeric cables have installation limitations, MI has none!
    - No power polymeric cable can be installed vertically in EMT Conduit and meet the 2-hour UL test.
- Polymeric cables are not as easy to install as their literature claims – they are not the same as standard building wires.
    - Also refer to the MI vs. MC Fact Sheet (H60119).
- Market leading Lifetime warranty.

We are not the only 2-hour fire-rated cable on the market, but we are the best!
MI cable is the only option that does not use polymers. View our video on YouTube to learn more – search for "Beyond UL 2196: A Comparative Study of UL Listed 2-Hour Fire-Rated Cables' Properties".

MI Cable A Stand Alone System	**Metal Clad (MC) Cable** A Stand Alone System	**RHW-2 (RHH) Cable** Cables Installed in Conduit	**Circuit Integrity (CI) Cable** In or Without Conduit
			
The premier fire-rated electrical cable for over 70 years • MI cable all inorganic construction – zero smoke, zero flame, zero fuel • A tough standalone cable that can be crushed until flat and still remain operational • Uncontested electrical performance under fire conditions	Ceramifiable silicone rubber polymer insulating material in this cable can and will create toxic and flammable smoke and gases exposed to a fire. This gas and smoke will fuel a fire.	When exposed to air during fire conditions, the gases from these polymer insulated cables will contribute to the fire. When in a closed environment such as conduit, there may be insufficient oxygen to allow burning off of the volatile gases. These trapped gases can attack standard copper and cause it to lose most of it strength such that its own weight between support points can cause it to break.	When exposed to air during fire conditions, the gases from these polymer insulated cables will contribute to the fire. When in a closed environment such as conduit, there may be insufficient oxygen to allow burning off of the volatile gases. These trapped gases can attack standard copper and cause it to lose most of it strength such that its own weight between support points can cause it to break.

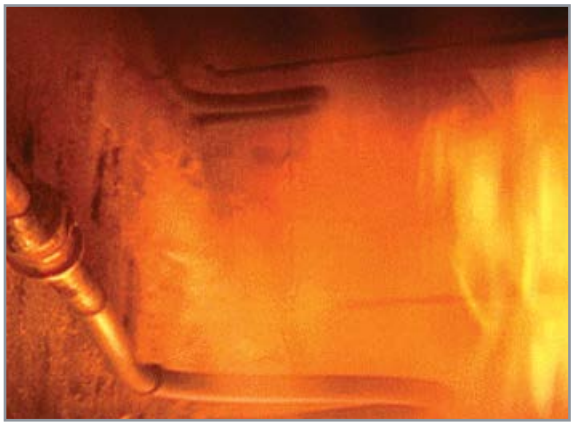
STANDARD TESTS FOR CONTINUITY

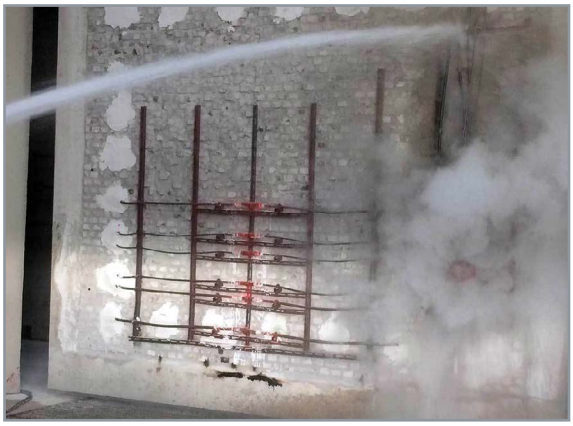
All fire resistive cables are subject to the **UL 2196 fire test:**

- **Fire exposure followed by water hose stream**
- **1850°F maximum test temperature followed by direct firefighters' hose stream exposure**

Cables are energized during fire test and after hose stream test to prove circuit integrity is maintained throughout. However, UL 2196 does not currently test for these crucial performance requirements and there are some gaps with these tests:

- There is no current requirement regarding the production of flammable and/or toxic fumes
- No additional test of mechanical integrity other than hose stream





FIRE-RATED ELECTRICAL CABLE SYSTEMS

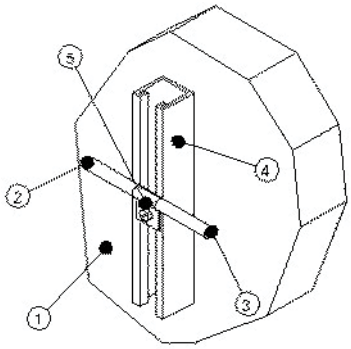
All UL 2196 Listed systems receive their own unique system number – ours is FHIT1850.

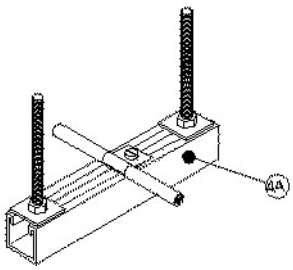
All systems can be found on the Web:

- UL On-Line Certifications / Category 'FHIT'

The system listing identifies:

- Installation requirements
- Manufacturers latest updates / changes
- Conductor sizes and configurations tested
- Splices if tested, and types of splices
- Support materials (steel, masonry or concrete) and method
- Horizontal distance between supports
- Vertical distance between supports





INSTALLATION

MI installation is a little different than other fire-rated wiring cables and standard building wires but can be mastered quickly with a little guidance.

To help you understand our MI cable, the following will be part of our field visit at no charge:

- Do a walk through to suggest easier installation methods (technicians have many years of experience and can offer ideas to help out the installing contractor)
- Introduction to MI Cable – Review how nVent PRYOTENAX cables are manufactured
- Review Installation Videos and Installation Manual
- Demonstration of the termination procedures
- Cable samples discussed and reviewed
- Review Tool List – Ensure contractor has all the tools required

Our Field Service teams are available for field site visits for installation practices of MI Cables. Read more about our Field Site Visits.

Also refer to the MI Commercial Wiring Installation Manual (H57864) for details.

We also have several videos you should watch:

NY Case Study Video	https://www.youtube.com/watch?v=kwgBqUKiQcU&t
MI Wiring Cable Installation Methods	https://www.youtube.com/watch?v=wRsPO7TXK3M&t
Terminating MI Multi-Conductor Cables	https://www.youtube.com/watch?v=rlXqZ-Ek-XQ&t
Terminating MI Single Conductor Cables	https://www.youtube.com/watch?v=izXgsdJXXcU&t
Continuity Test	https://www.youtube.com/watch?v=UvMsckUchh0
Megger Test	https://www.youtube.com/watch?v=YvloKEyeGCk&t

FACTORY PRE-TERMINATED ENDS PROGRAM

Factory Installed Pre-Terminated Ends (PTE) is highly recommended for multiple benefits. Whether single conductor, multi conductor, or twisted pair MI cables, factory installed PTE is a great way to minimize cost uncertainty in the field. No more guessing or incorrectly estimating the time needed to complete a termination. PTE limits the contractors exposure to ever changing job conditions and helps them maximize profits.

Learn more about Factory Pre-Terminated Ends and contact Pyrotenax Customer Care for specifics and quotes.

Power Stripping Kit

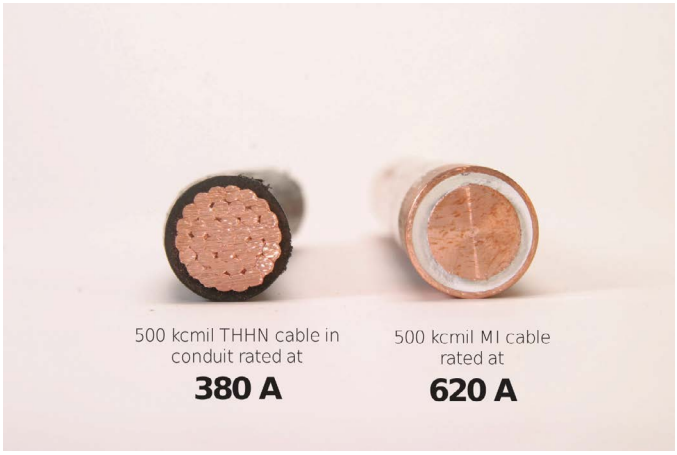
nVent Pyrotenax Power Stripping Kit improves removal of the copper sheath during termination. The PSTKIT delivers significant time saving which will help reduce total installed costs and aid contractors when quoting and budgeting for projects.

Space Saver Application

AMPACITY ADVANTAGES

Unlike a conduit and wire system, our unjacketed single conductor cables, configured according to Section 332.80(B) of the National Electrical Code, do not require derating and can be installed using the “free air” ratings of Table 310.15(B)(17)(NEC).

As an example, if you are using 500 mcm which is based on cable in conduit (RHW-2 ampacity) or the NEC Code Table 310.15(B)(16), you get 380 amps. With MI Cable you get 405 amps using 250 kcmil. Being able to use the NEC Table 310.15(B)(17) as “free air” you can use smaller size cable and get more ampacity.



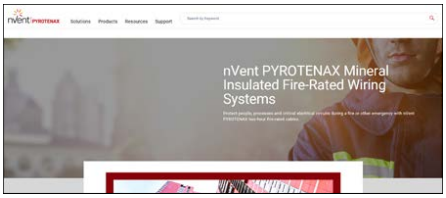
500 kcmil: At 75 C = 620 Amps MI vs. RHW/THHN 380 Amps

Our cables can save 75% of the space of equivalent conduit/wire. Refer to the Ampacity Advantages vs RHW-2 Reference Sheet (H60835) for more information.

Additional Information

DIGITAL PRESENCE

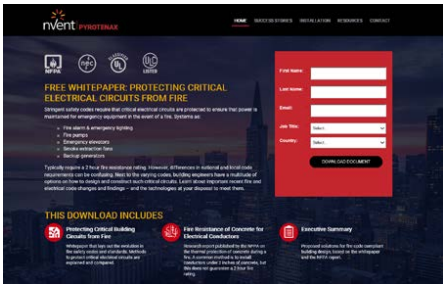
nVent PYROTENAX fire-rated cables are the benchmark of safety and reliability. Everything you need to sell this product line successfully is online.



Official Website

Our official website is the place to go to obtain specific product details and technical information. A full resource library with literature, product photos, and videos is available.

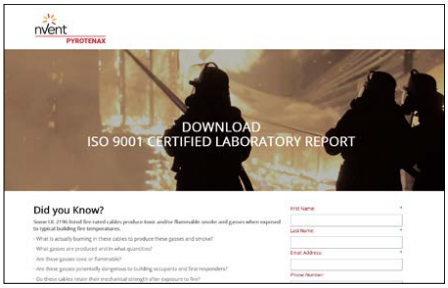
nVent.com/PYROTENAX



Fire-Rated Wiring vs. 2" of Concrete Landing Page

We have our dedicated PYROTENAX vs. Concrete website that hosts three great pieces of content: 1) Our branded Protecting Critical Building Circuits from Fire white paper, 2) the published NFPA technical report which confirms that 2" of concrete does not provide 2 hours of protection, and 3) proposed solutions for fire compliant building design based on the NFPA report.

go.nVent.com/PYROTENAX



ISO Certified Laboratory Report Landing Page

We recently partnered with a ISO 9001 certified and nationally recognized third party lab to conduct testing of the smoke and gas generation, mechanical strength, toxicity and combustibility of off-gases, and the electrical integrity of several fire-rated wiring cables. In addition to the external facing website, we created a page on Partner's Corner where these materials can be downloaded. You can also watch our video on YouTube – search for "Beyond UL 2196: A Comparative Study of UL Listed 2-Hour Fire-Rated Cables' Properties".

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Our powerful portfolio of brands:

CADDY ERICO HOFFMAN RAYCHEM SCHROFF TRACER

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