

NFPA 130 Wire and Cable Requirements

Agenda

Non-emergency circuits

- Chapter 12 wiring requirements – Non-emergency
- FT4/IEEE 1202 vertical flame & smoke release test
- UL 1685 vertical flame & smoke release test

Emergency circuits

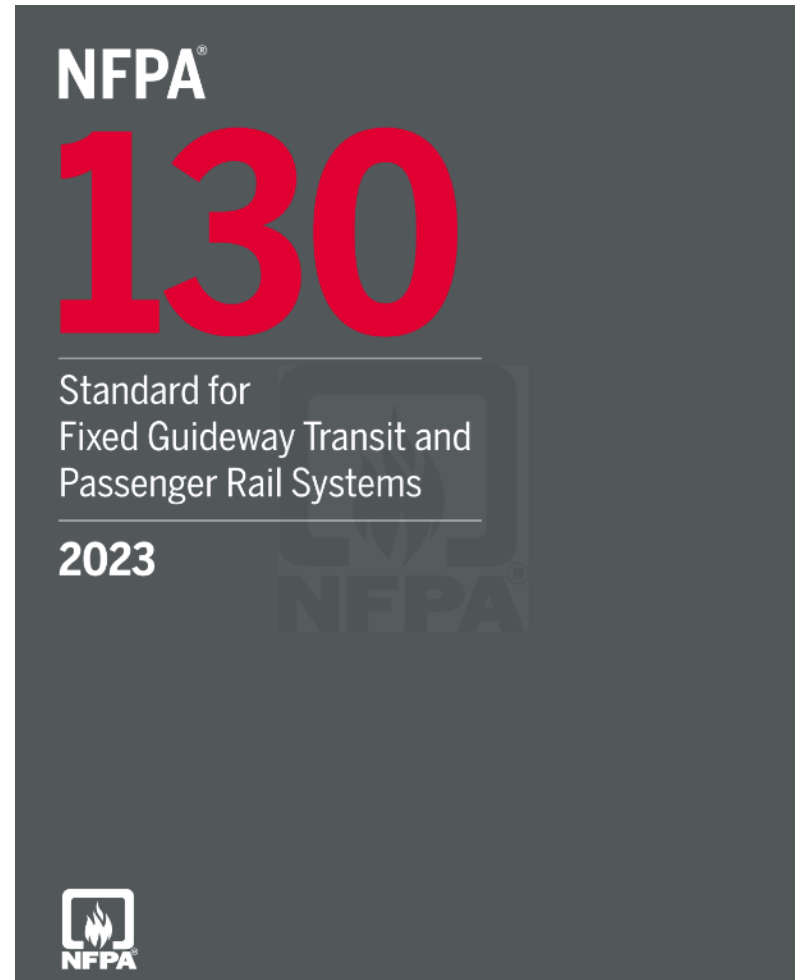
- NFPA 130 Chapter 12 wiring requirements – Emergency
- NFPA 130 Chapter 11 design and reliability
- NFPA 130 Chapter 5 & 6 emergency circuits
- NFPA 130 Chapter 10 fire alarm and communications cables
- NFPA 70 areas of assembly
- UL 2196 fire resistive certification & FHIT listings and selection
- What is a complete system?
- Known issues

Installation Pictures

Summary & NFPA 130 2020 to 2023 highlighted changes

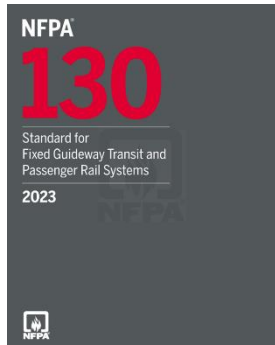
NFPA 130 Purpose and Goals

- 1.1.1* This standard shall cover life safety from fire and fire protection requirements for fixed guideway transit and passenger rail systems, including, but not limited to, **stations, trainways, emergency ventilation systems, vehicles, emergency procedures, communications, and control systems.**
- 1.2 Purpose. The purpose of this standard shall be to establish minimum requirements that will provide a reasonable degree of **safety from fire** and its related hazards in fixed guideway transit and passenger rail system environments.
- 4.2.1* The goals of this standard shall be to provide an environment for occupants of fixed guideway and passenger rail system elements that is safe from fire and similar emergencies to a practical extent based on the following measures:
 - (1) **Protection of occupants not intimate with the initial fire development**
 - (2) **Maximizing the survivability of occupants intimate with the initial fire development**
- 4.8* Fire-Life Safety System Integrity. No part of the fire-life safety system critical to the intended system function that addresses an emergency shall be vulnerable to the emergency that it is supposed to address.



NFPA 130 Chapter 12 Wire & Cable Requirements

- 12.2 Flame Spread and Smoke Release.
- 12.2.1 Except as permitted in 12.2.2, all wires and cables used in stations and trainways, including traction power cables, shall comply with one of the following:
 - 1) Must be listed as being resistant to the spread of fire (**FT4**) and as having reduced smoke emissions (**ST1/LS**) by exhibiting a **char height** less than **1.5 m (5 ft)** when measured from the lower edge of the burner face, a total **smoke** released rate over **20 min** that does not exceed **150 m²**, and a peak smoke release rate that does not exceed **0.40 m²/sec (4.3 ft²/sec)** when tested using the FT4/IEEE 1202 flame test in either **UL 1685** or UL 2556.
 - 2) Must be listed as having adequate fire resistance and low-smoke producing characteristics by exhibiting a flame travel distance that does not exceed 1.5 m (5 ft) and by generating a maximum peak optical density of 0.50 and a maximum average optical density of smoke of 0.15 when tested in accordance with NFPA 262 .
- 12.3 Temperature, Moisture, and Grounding Requirements.
- 12.3.1 Wires and cables except for optical fiber & communications cables, shall comply with both of the following temperature and moisture resistance characteristics:
 - 1) All insulations shall be a moisture- and heat-resistant type carrying a temperature rating of **90°C (194°F)**.
 - 2) All wires and cables shall be **listed** and identified for use in **wet locations**.
- 12.4.2* **All conductors for underground trainways or stations, except** radio antennas, train control (**signaling**) cables, and **traction power** cables, shall be enclosed in their entirety in **armor** sheaths, **conduits**, or enclosed raceways, boxes and cabinets, except in ancillary areas.



FT4/IEEE 1202: Flame Test of Cables

1.1 Scope

This standard provides a protocol for exposing cable samples to a theoretical 20 kW (70 000 Btu/hr) flaming ignition source for a 20 min test duration. The test determines the flame propagation tendency of single conductor and multiconductor cables intended for use in cable trays in industrial and commercial occupancies.

1.2 Purpose

The purpose of this standard is to establish a test protocol and performance criteria to determine the flame propagation tendency of cables in a vertical cable tray.

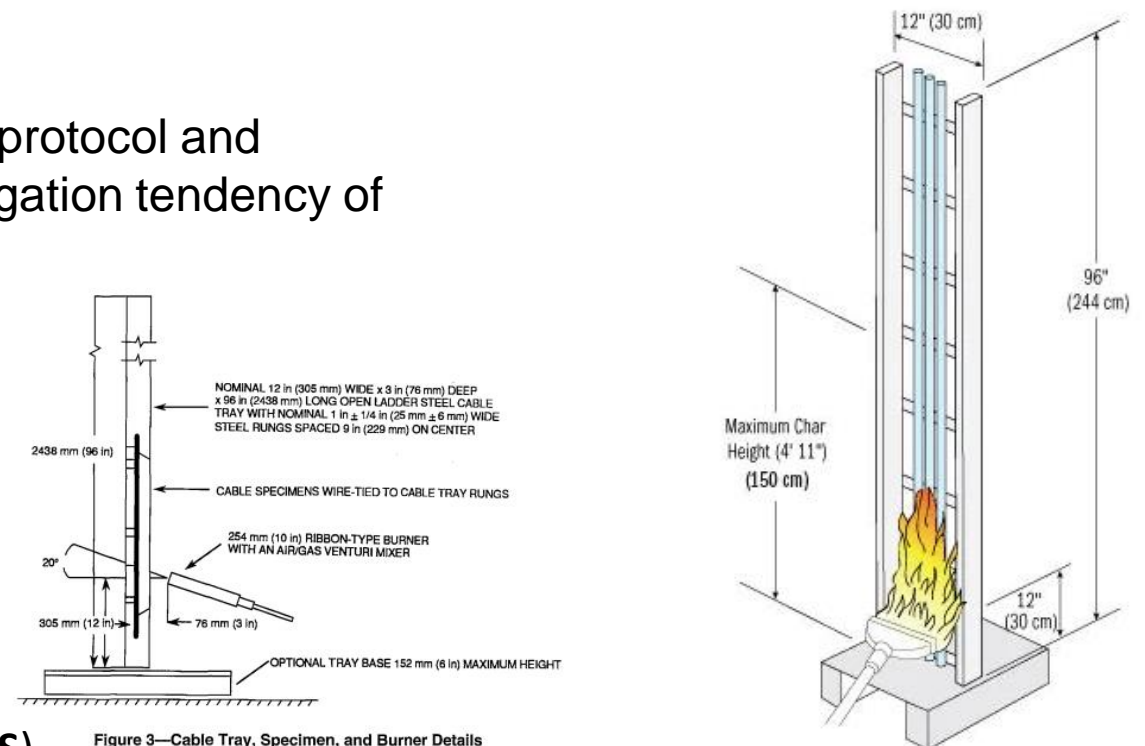
Flame test requirements:

1. Exposed to flame for 20 mins
2. Max char height of 1.5m (4.9ft)

Additional FT4 requirements:

3. Total smoke released $< 150 \text{ m}^2$
4. Peak smoke release rate $< 0.40 \text{ m}^2/\text{sec}$

Cables marked **ST1** meet smoke release “Limited Smoke” (**LS**)



Non-Emergency Circuits Summary

NFPA®

130

Standard for
Fixed Guideway Transit and
Passenger Rail Systems

2023



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Chapter 12 requirements, applicable to all wires/cables

Cables must be **90°C rated**

Cables must be **low smoke (ST1)** and **flame-retardant (FT4/UL 1685)**

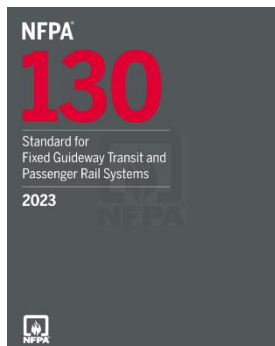
Cables must be **wet** listed (except for fiber optics & communication)

Cables must have an **armor** or be in a **raceway/conduit** [exception for train control (signal cables) and traction power]

Emergency Circuits Requirements – Chapter 12

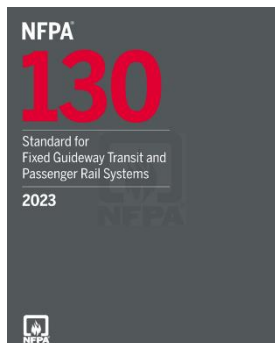
- 12.4.4 Emergency power, emergency lighting, and emergency communications circuits shall be protected from physical damage caused by normal system operations.
- 12.4.5 The circuits in 12.4.4 shall be installed in a manner to reduce the likelihood that a single fire or emergency event will lead to failure of the system by using one of or a combination of the following methods:
 - 1) **Circuits consist of fire-resistive cable systems that comply with Section 12.5.**
 - 2) *The circuits shall be encased in concrete to provide protection for 1 hour.
 - 3) The circuits shall be protected by a fire barrier system that complies with the requirements of UL 1724 when tested for 1 hour.
 - 4) *The circuits shall be redundant such that system operational capabilities continues.
 - 5) Multiple circuits shall be separated by a fire barrier with a fire resistance rating of at least 1 hour when tested in accordance with ASTM E119 or UL 263.

- 12.5 Fire-Resistive Cables.
- 12.5.1 Fire-resistive cables shall be certified or listed for no less than 1 hour of operation as tested to UL 2196 using the time-temperature curve of ASTM E119 or UL 263.
- 12.5.2 The fire-resistive cable systems shall comply with all of the following:
 - 1) **The cables shall be tested as a complete system**, in both the vertical and horizontal orientation, including all the conductors, cables, splices and raceways, as applicable.
 - 2) For fire-resistive cables intended for installation in a raceway, the **systems shall be tested in the type of raceway in which they are intended to be installed** .
 - 3) Have **installation instructions** that describe the assembly to be tested so that **only those system components included in the test assembly are installed**.



Control & Communication System Functionality, Reliability and Availability – Chapter 11

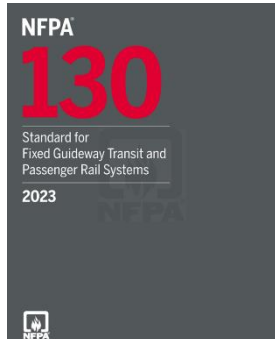
- 11.1 General. 11.1.1 Scope. This chapter defines requirements for the functionality, reliability and availability of **control systems and communication systems** when exposed to the effects of smoke and fire.
- 11.1.2 Application. These systems include the following:
 - 1) Train control (signaling systems) as described in 7.2.5, 8.9.2.3, and in this chapter
 - 2) Emergency communication systems as described in 6.4.2, 8.9.2.1, 8.9.2.2, 9.8.4, and Section 9.9
 - 3) Traction power systems as described in 6.4.2, 7.2.5, 9.13.4, and 9.13.5
 - 4) Supervisory control and data acquisition (SCADA) systems as they apply to fire emergencies
- 11.2. Train Control. 11.2.1* A reliability engineering analysis shall be performed to consider the ability of control systems to maintain communications and the ability to **reposition** vehicles during a fire emergency.
- 11.3 Functionality, Reliability, and Availability of Control Systems.
 - 11.3.1* Functionality, reliability, and availability of control systems and communications systems **during a fire** incident shall be considered **in addition to normal reliability and availability** calculations.
 - 11.3.2* To meet the goals for life safety of the occupants, the effects of **single points of failure** shall be considered.
 - 11.3.3* In addition to physical protection from incidents, **control, data, and communication cables** and related components shall **continue functionality during a fire** and shall be protected from thermal exposure that would affect their function.



Emergency Circuits in Chapters 5 & 6

Chapter 5 Stations and Chapter 6 Trainways

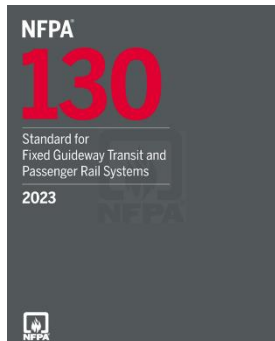
- 5.4.3 Emergency Communications System. Stations shall be provided with an emergency communications system in accordance with Chapter 10.
- 6.4.8.2 The following systems shall be connected to the emergency power system:
 - 1) Emergency lighting
 - 2) Protective signaling systems
 - 3) Emergency communication system
 - 4) Fire command center



Emergency Circuits in Chapter 10

Chapter 10 Emergency Communications System

- 10.1* General. An emergency communication system shall be provided throughout fixed guideway transit and passenger rail systems in accordance with this chapter.
- 10.4.3 Two-way wired emergency communications system telephone handsets shall be provided at the following locations:
 - 1) Fire command center, where provided
 - 2) Operations control center
 - 3) Traction power substations
 - 4) Blue light station locations
 - 5) Ventilation plant control rooms
 - 6) Ancillary rooms and spaces as determined by the authority having jurisdiction
 - 7) Other locations along the trainway as determined by the authority having jurisdictions.



Areas of Assembly – Emergency – NEC

What about “above ground” stations?

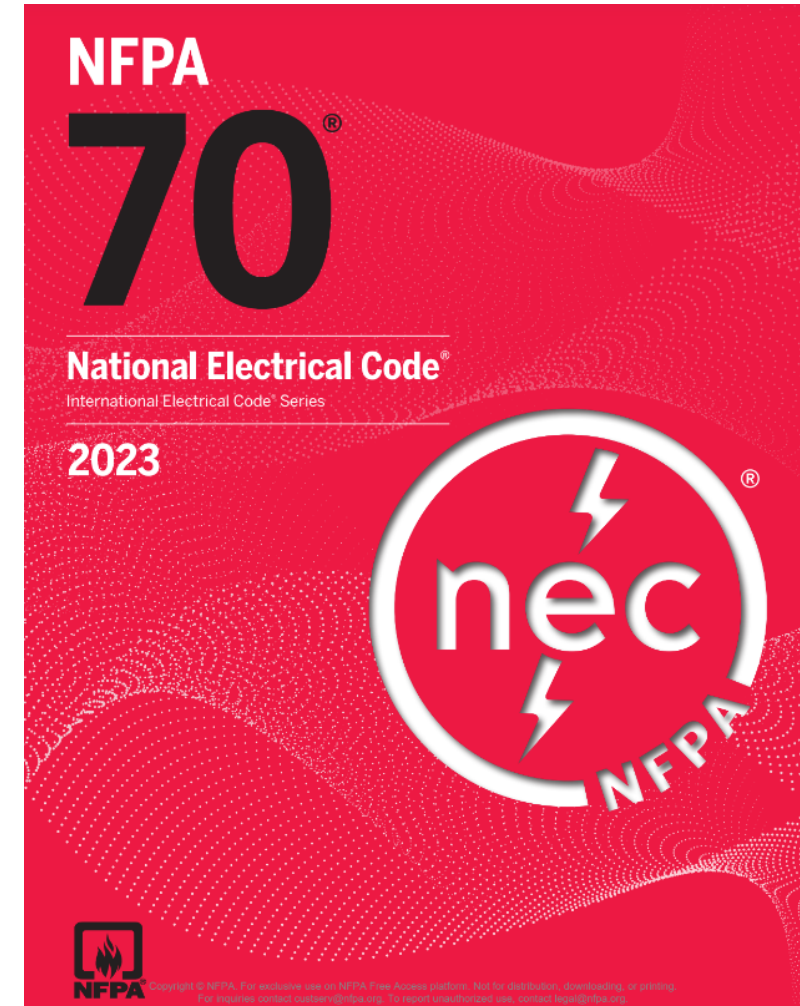
Part II. Circuit Wiring; 700.10 Wiring, Emergency System.

(D) Fire Protection. Emergency systems shall meet the additional requirements in (D)(1) through (D)(3) in the following occupancies:

1. Assembly occupancies for not less than 1000 persons
2. Buildings above 23 m (75 ft) in height
3. Educational occupancies with more than 300 occupants

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

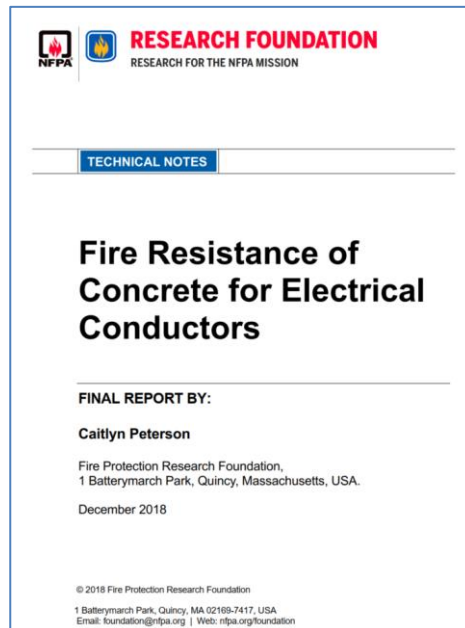
- (1) The cable or raceway is installed in spaces or areas that are fully protected by an approved automatic fire suppression system.
- (2) The cable or raceway is protected by a listed electrical circuit protective system with a minimum 2-hour fire rating.
- (3) **The cable or raceway is a listed fire-resistive cable system.**
- (4) The cable or raceway is protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours and contains only emergency circuits.
- (5) The cable or raceways is encased in a minimum of 50 mm (2 in) of concrete.



Chapter 12 – Fire resistive Function

NFPA 130: Chapter 12

Requires emergency circuits be tested to ANSI/UL 2196 following time/temperature per ASTM E119 to ensure that they perform their ***intended electrical function*** during a fire in subway tunnel or stations.



Emergency Circuits – Summary (must comply w/ non-emergency requirements as well)

NFPA®

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Standard for
Fixed Guideway Transit and
Passenger Rail Systems

2023



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Non-Emergency (Applicable to all wires/cables)

Cables must be **90°C** rated

Cables must be **low smoke** and **flame-retardant**

Cables must be **wet** listed (except for fiber optics communication)

Cables must have an **armor** or be in a **raceway/conduit** [exception for train control (signal cables) and traction power]

Emergency Circuits (1 hr. FRR)

UL 2196 1-hr Fire-resistive cable system

Concrete encasement, 1-hr protection

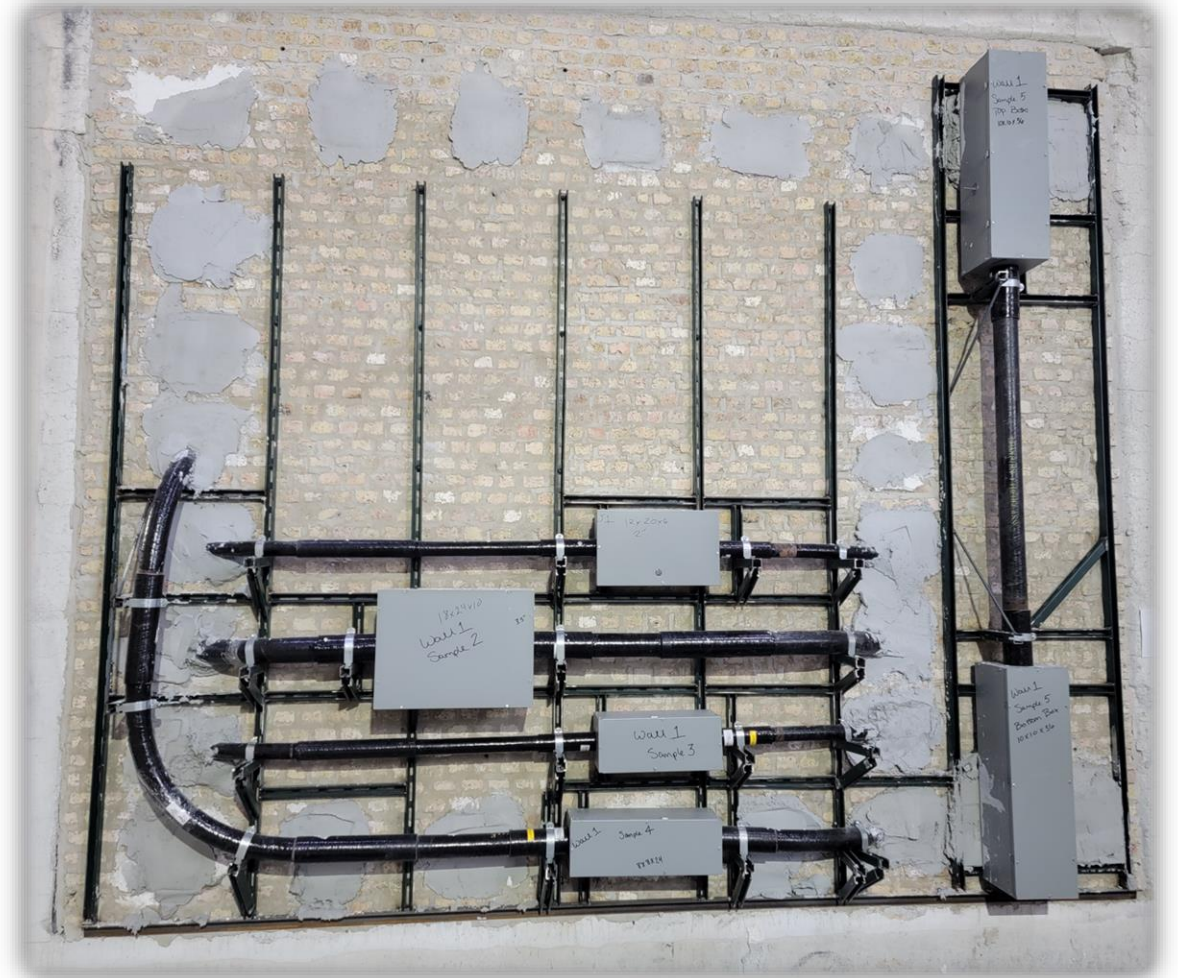
1-hr Fire-barrier per UL 1724

Redundant systems

Multiple circuits separated by 1-hr fire-barrier

Emergency Circuits – UL 2196 Testing

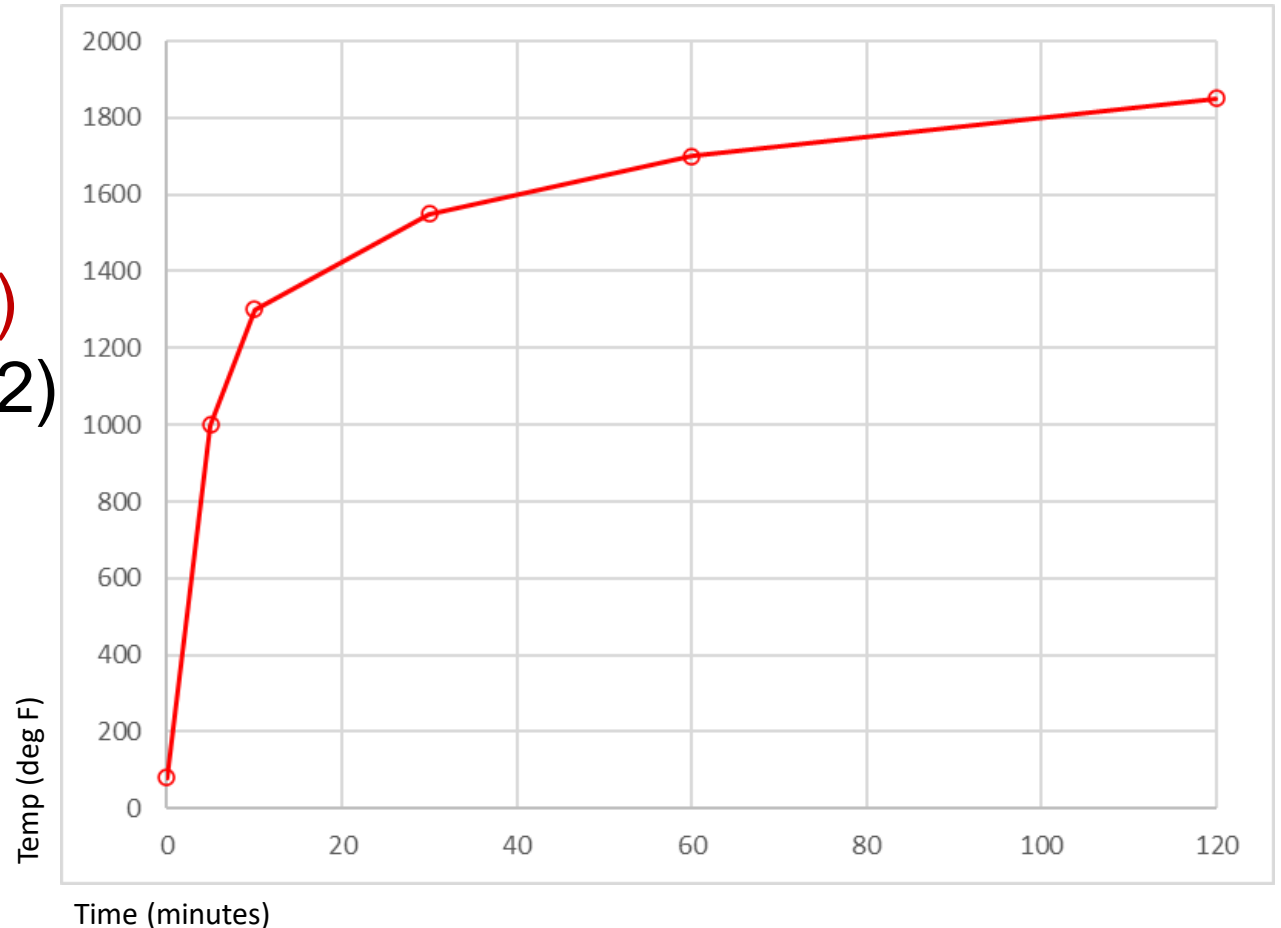
- Environment: Large scale wall oven (14 x 15 x 3 [ft])
- Temperature Profile: Slow Rise Follows ASTM E119
- Cable are energized at application voltage (50, 72, 120, 480 or 600V)
- ULc-S139 at 600V
- Water impact test after fire test



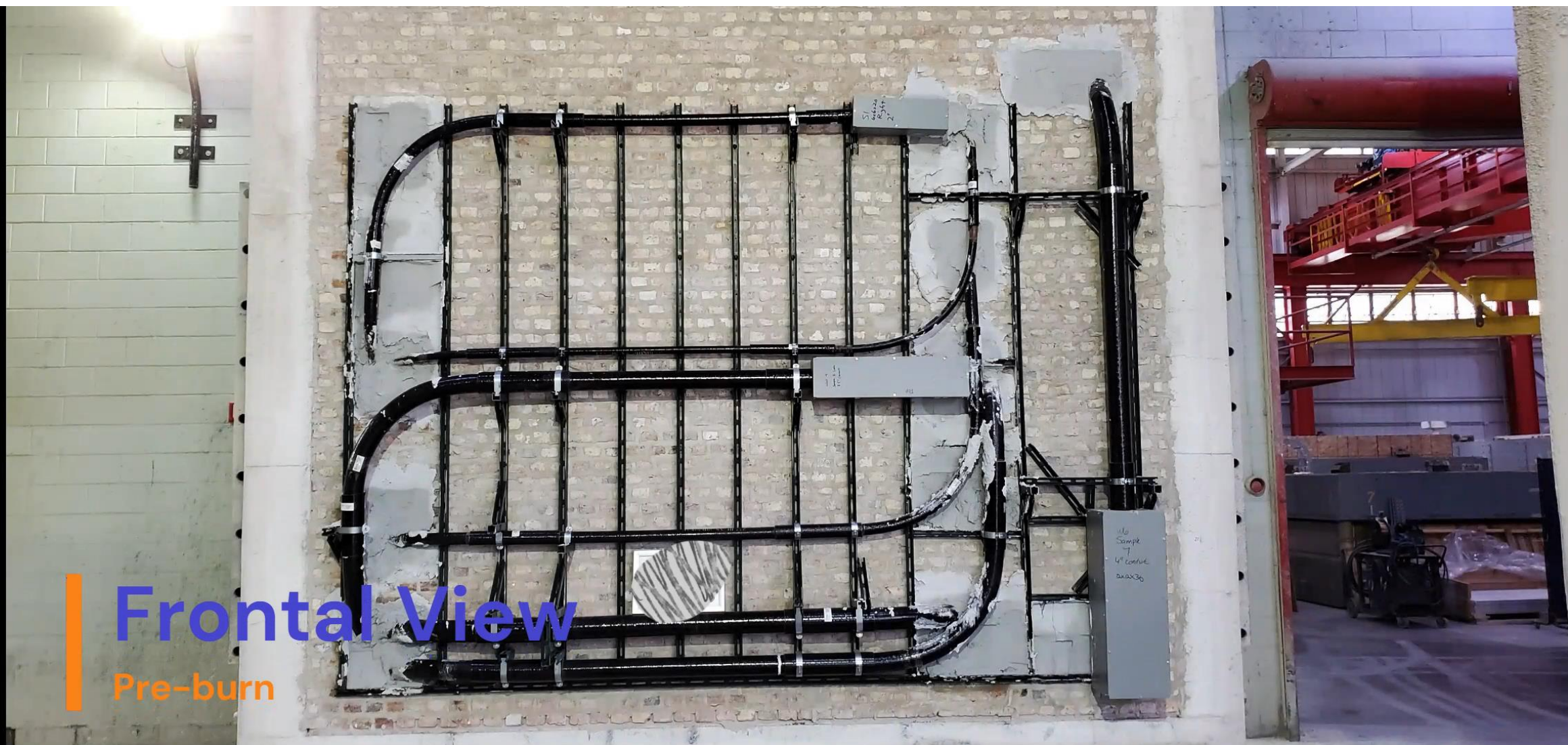
E119 Time-temperature curve

- 1000°F @ 5 minutes
- 1300°F @ 10 minutes
- 1550°F @ 30 minutes
- **1700°F @ 60 minutes (NFPA 130)**
- 1850°F @ 120 minutes (NFPA 502)

Metal	Melting Point (°F)	Melting Point (°C)
Aluminum	1,218	659
Copper	1,981	1,083
Steel	2,500	1,371



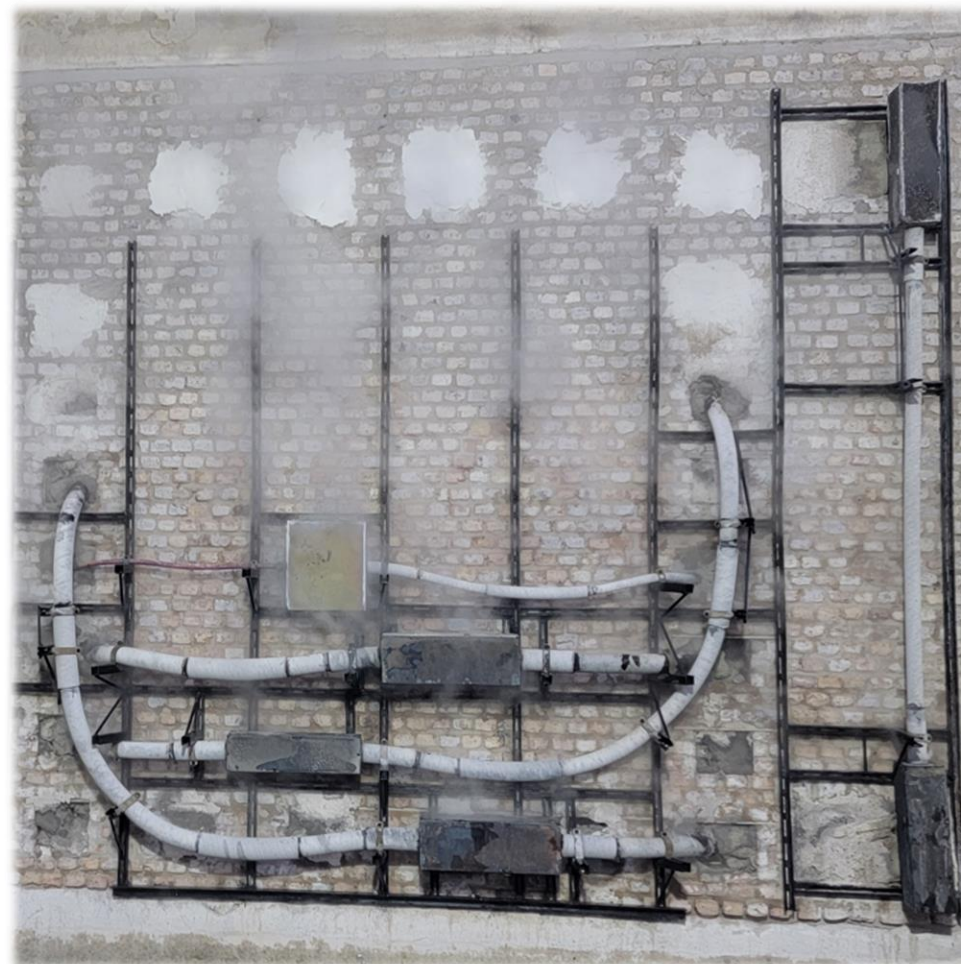
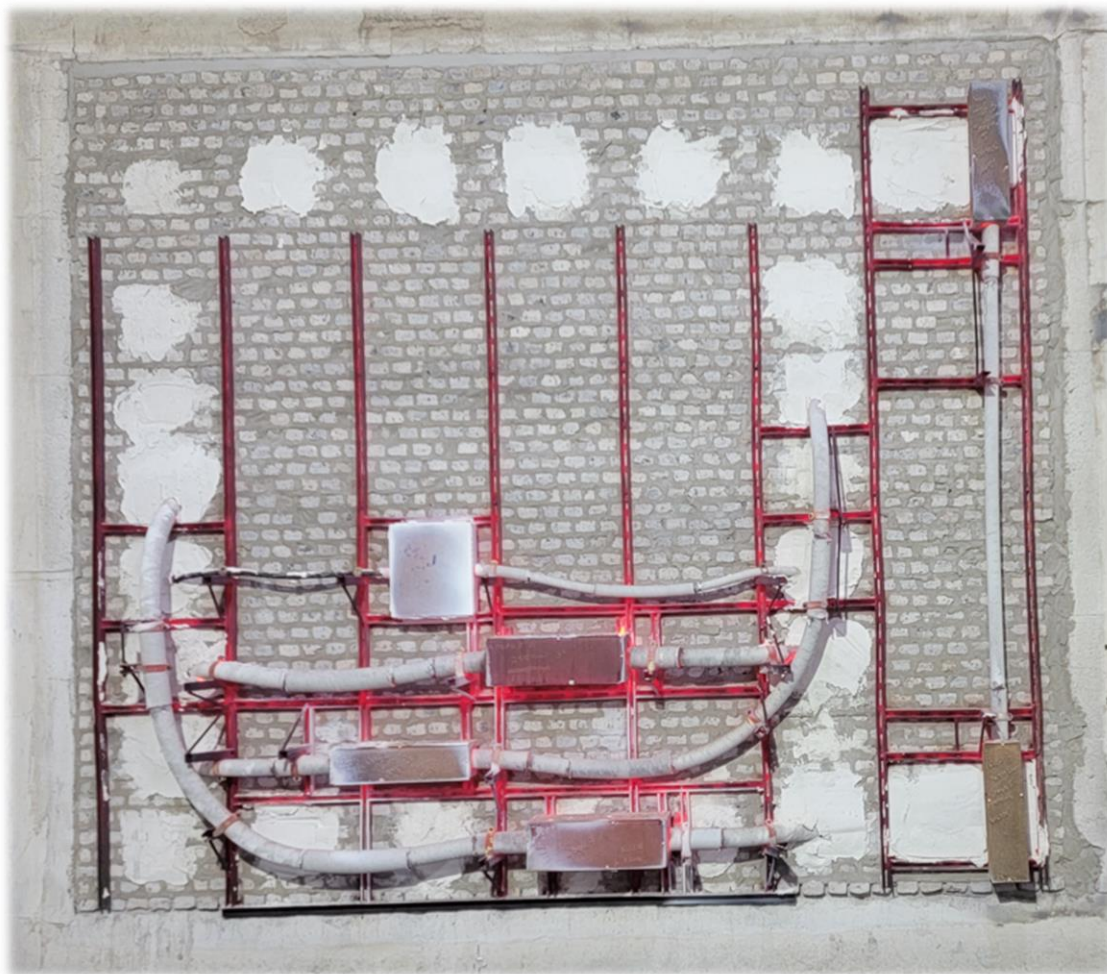
UL 2196 Test Wall Video



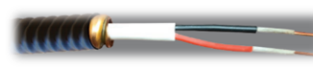
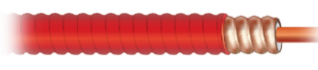
Frontal View

Pre-burn

Fire Test Certification – Furnace Aftermath



Emergency Circuit Cable Types



MC/RC90

RHW-2

Coax

Armored

Ethernet

CI/CIC

Applications:

- Emergency Power Circuits
- Emergency Lighting
- Ventilation Systems
- HVAC & Smoke EVAC Control Circuits
- Fire Alarm Backbone/Fire Alarm
- Generator Automatic Transfer Switches (ATS) Control Panel

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- Emergency Lighting
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- HVAC & Smoke EVAC Control Circuits
- Fire Alarm Backbone/Fire Alarm
- Generator Automatic Transfer Switches (ATS) Control Panel

Applications:

- BDA or DAS Systems
- Emergency Responder Radio Communication Systems (ERRCS)

Applications:

- Emergency Communication in Transit Tunnels and Platforms
- Emergency communication and emergency signal for jet fan sensors

Applications:

- Area of Refuge (AoR) 2-way Communications
- Digital Signage
- IP Cameras

Applications:

- Emergency Voice Alarm Communications (EVAC)
- Smoke & Fire Alarm Systems
- Fireman's Telephone Systems

Splicing – Per FHIT system listing & FRR information

Metal Clad cable splicing

- Block splice
- Fused block splice
- Tape splice

RHW-2 Splicing

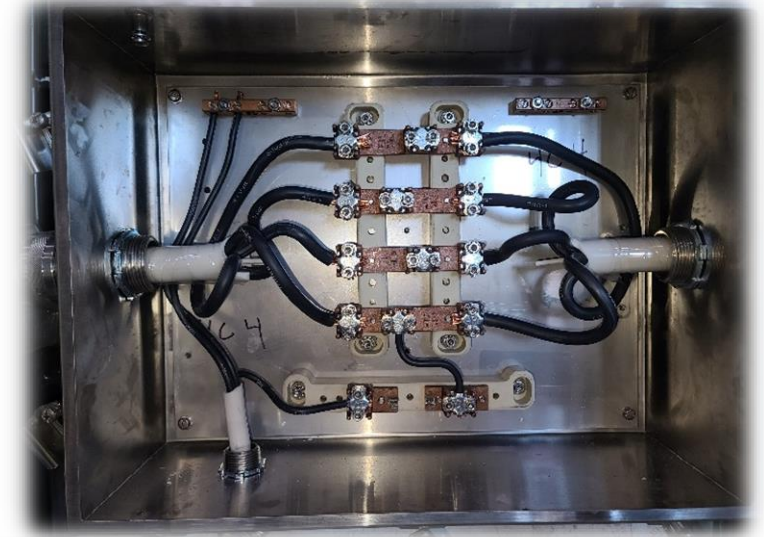
- Tape splice

Hybrid RHW-2 to MC splicing

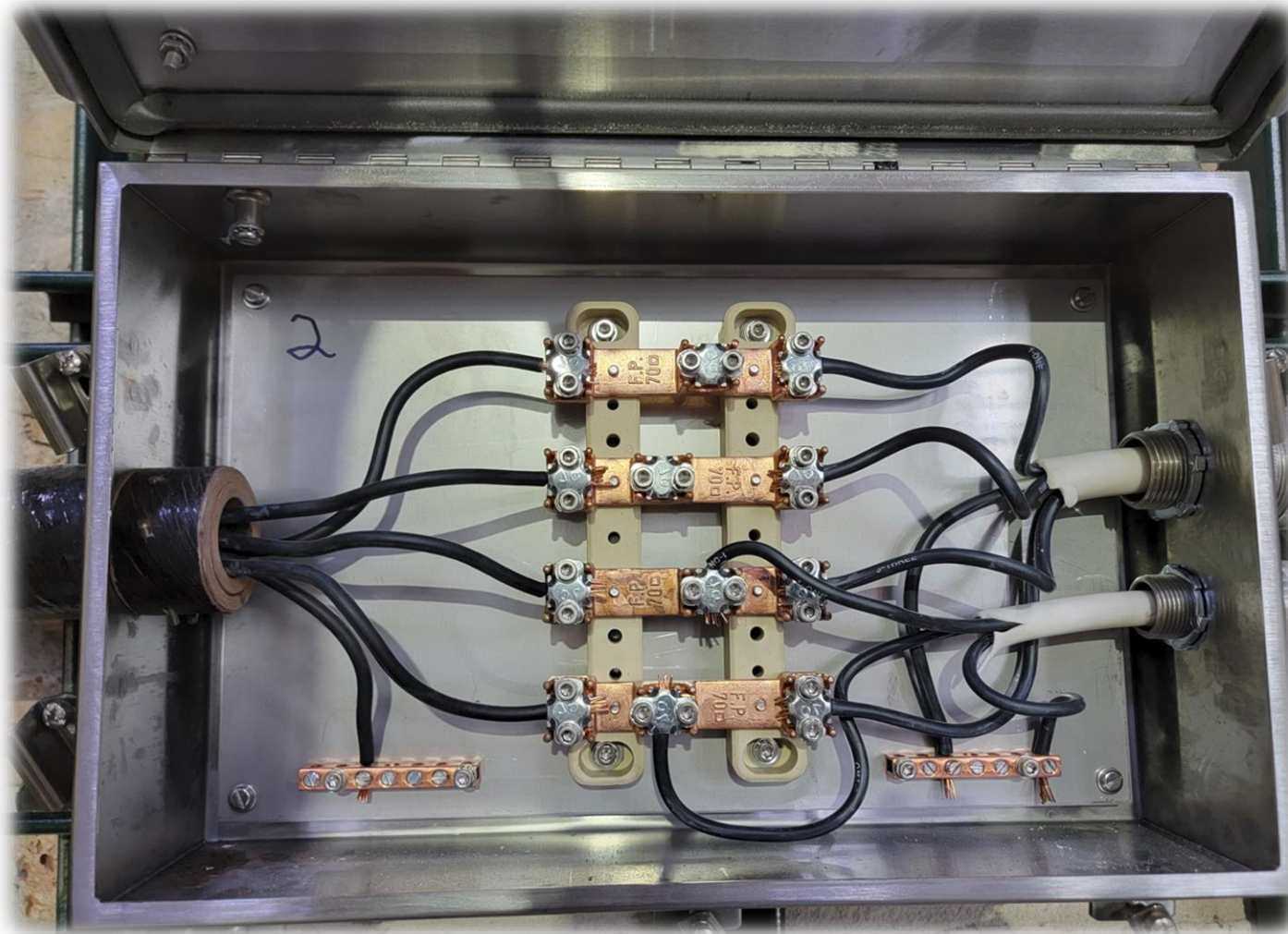
- Block splice
- Fused block splice

CI/CIC

- Tape splice



Hybrid Splice Box



What is Complete System? NEC Article 728

728.4 General. Fire-resistive cables and conductors and their components shall be tested and listed as a complete system, shall be designated for use in a specific system, and shall not be interchangeable between systems.

728.5 Installations. Fire-resistive cable systems installed outside the fire-rated rooms that they serve, such as the electrical room or the fire pump room, shall comply with the requirements of 728.5(A) through (H) and all other installation instructions provided in the listing.

(A) **Mounting.** The fire-resistive cable system shall be secured to the building structure in accordance with the listing and the manufacturer's installation instructions.

(B) **Supports.** The fire-resistive cable system shall be supported in accordance with the listing and the manufacturer's installation instructions.

(C) **Raceways and Couplings.** Where fire-resistive cable is listed to be installed in a raceway, the raceway enclosing the cable, any couplings, and any connectors shall be listed as part of the fire-resistive cable system. The raceway fill for each system shall comply with the listing requirements for the system and shall not be greater than the fill permitted in Chapter 9, Table 1.

(D) **Cable Trays.** Cable trays used as part of a fire-resistive cable system shall be listed as part of the fire-resistive cable system.

(E) **Boxes.** Boxes or enclosures used as part of a fire-resistive cable system shall be listed as part of the fire-resistive cable system and shall be secured to the building structure independently of the raceways or cables listed in the system.

(F) **Pulling Lubricants.** Fire-resistive cable installed in a raceway shall only use pulling lubricants listed as part of the fire-resistive cable system.

(G) **Vertical Supports.** Cables and conductors installed in vertical raceways shall be supported in accordance with the listing of the fire-resistive cable system and in accordance with 300.19.

(H) **Splices.** Only splices that are part of the listing for the fire-resistive cable system shall be used. Splices shall have manufacturer's installation instructions.

728.60 – Equipment Grounding Conductor.

Key points for system selection

- **NFPA 70 (NEC) article 728, NFPA 130 article 12.5.3 & UL 2196 article 5.1.1.14 all require testing fire-rated cables as a complete system.**
- Fire-rated systems must be tested as complete systems to ensure performance in the event of a fire. Changes may invalidate the listing, increasing the associated risks and liability.
 - NFPA 70, article 728.4 regarding fire-resistive cable systems does not allow interchangeability between systems (in line with the above).

Number of wires in a conduit:

- **All conductors must be accounted for the fire-load, including ground wires.**
- For instance, three-phase Y (with 3-phase-to-phase wires, 1 neutral and 1 ground, totaling 5 conductors). Some FHIT systems that allow more than 4-wires to be installed in conduit.

System connectivity & completeness:

- If branching out/splicing is needed for lights or any other loads, then a splice/junction box is needed.
- Ensure that the FHIT system has listed splice boxes if one is to be used in the project. Some FHIT systems allow it.
- Some systems may require upsizing the conduit for the vertical orientation, lowering the fill ratio.

Overcurrent protection devices:

- If the fuse is located outside the fire-rated splice box, or if one is not present, the fire will likely melt the wiring/harness and short the circuit. It would trip the overcurrent protection device at the beginning of the circuit and disable the phase down the line.

Fire-rated voltage:

- The rated voltage should be verified by inspecting the UL FHJR file (not the product catalog, which in some instances lists the standard voltage rating instead of the fire-rated circuit voltage).

Steps to locate fire-resistant cables & systems

Navigate to the UL website: <https://iq.ulprospector.com/> & filter for the FHIT category

UL Product iQ™

SEARCH MY SEARCHES MY TAGS

REFINE RESULTS

Build or filter your results by keyword and/or adding criteria like document type, file number and country name.

Keyword

Filter by Keyword Search

UL Category Control Number

× FHIT ×

Company Name

Click to view and filter values

File Number

Click to view and filter values

Location

Click to view and filter values

+ Add Filter

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▶ 41 Results :: *UL Category Control Number: FHIT*

Action ▾

Display: General ▾

« 1 2 3 »

Document Name ⇅	Company Name ⇅	Notes ⇅	UL CCN Description ⇅
FHIT.1083C	TEC International LLC		Electrical Circuit Integrity Systems
FHIT.120	Marmon Wire & Cable Inc		Electrical Circuit Integrity Systems
FHIT.120A	Marmon Wire & Cable Inc		Electrical Circuit Integrity Systems
FHIT.120AM	Marmon Wire & Cable Inc		Electrical Circuit Integrity Systems
FHIT.120M	Marmon Wire & Cable Inc		Electrical Circuit Integrity Systems
FHIT.1250	AMERICAN POLYWATER CORP RADIO FREQUENCY SYSTEMS INC ALLIED TUBE & CONDUIT CORPORATION		Electrical Circuit Integrity Systems
FHIT.130	Marmon Wire & Cable Inc CHAMPION FIBERGLASS INC AMERICAN POLYWATER CORP		Electrical Circuit Integrity Systems

FHIT Directory

Metal Clad Systems Example

Select the FHIT system to verify listed equipment, including splice boxes (examples below depicts systems from different manufacturers)

UL Product iQ™

1. **Wall or Floor Assembly*** — Minimum 2 hour fire rated concrete or masonry wall or concrete floor. Opening in wall or floor through which cable or cable tray passes is to be sized to closely follow the contour of the cable or cable tray. Through opening in wall or floor to be firestopped using a compatible firestop system. See **Through-Penetration Firestop Systems** (Guide XHEZ) category for presently Classified firestop systems.

2. **Fire Resistive Cables*** — The hourly fire rating applies to cable passing completely through a fire zone and terminating a minimum of 12 inches beyond the fire rated wall or floor bounding the fire zone. The cables as identified below may be installed in the horizontal or vertical orientations.

MARMON WIRE & CABLE INC — VITALink Type MC (copper clad) with or without polymeric jacket or Type MC-HL (copper clad hazardous locations) with polymeric jacket. To be installed as described herein and in accordance with the manufacturer's installation instructions IM-120-0 dated Feb 2021, File [FHJR.R15365](#).

3. **Strap/Clamp-type Supports** — For use with Type MC cable without polymeric jacket (Figures 1, 2 and 3) The cable(s) installed horizontally shall be secured to the steel struts by (Figure 1) two-hole steel strap, (Figure 2) Kindorf J-800 Series interlock strap, and/or (Figure 3) two-piece single-bolt pipe clamps or single-bolt saddle clamps. The cable(s) installed vertically shall be secured to the steel struts by (Figure 3) two-piece single-bolt pipe clamps. Refer to the Manufacturer's Installation Instructions for additional details.

3A. **Strap/Clamp-type Supports** — For use with Types MC with polymeric jacket and MC-HL cables with polymeric jacket (Figures 1 and 2). The cable(s) shall be secured to the surface of the wall or floor by (Figure 1) two-hole steel strap and/or (Figure 2) Kindorf J-800 Series interlock strap. Refer to the Manufacturer's Installation Instructions for additional details.

3B. **Trapeze-type Supports** — For use with all Types MC and MC-HL cables (Figures 4 and 5) The cable(s) shall be installed on/from trapeze-type supports. The trapeze-type supports shall be secured from the surface of the floor. Refer to the Manufacturer's Installation Instructions for additional details.

3C. **Cable Tray-type Supports** — For use with all Types MC and MC-HL cables (Figure 6) The cable(s) shall be installed within cables trays. The cable tray-type supports shall be secured to the surface of the wall or floor. Refer to the Manufacturer's Installation Instructions for additional details.

4. **Taped Splice** — All Types MC or MC-HL cable(s) with conductors sized 8AWG - 750kcmil, in the horizontal orientation may be installed with a straight through crimp (two-way) taped splice. The following components are required: Adalet stainless steel NEMA 4X enclosure, stainless steel breather/drain, and American Connector stainless steel MC connector-Type WT-WSE. To be installed in accordance with the manufacturer's installation instructions IM-120-1 dated Feb 2021.

UL Product iQ™

1. **Wall or Floor Assembly** — Concrete or masonry wall or concrete floor having an hourly rating corresponding to at least the FRR. Opening in wall or floor through which cable or cable tray passes is to be sized to closely follow the contour of the cable or cable tray. Through opening in wall or floor to be firestopped using a compatible firestop system. See **Through-Penetration Firestop Systems** (Guide XHEZ) category for presently Classified firestop systems.

2. Fire Resistive Cables* —

PRYSMIAN CABLES AND SYSTEMS USA, LLC — Lifeline Type MC (copper clad) with or without polymeric jacket. To be installed as described herein and in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Aug 2020, SPL-FPT-0006 dated Aug 2020, and SPL-FPT-0008 dated Aug 2020, File [FHJR.R19359](#).

3. **Supports** — (Figure 1) Min 12 gauge, by 1-1/2 in. wide or 1-5/8 in wide, painted or unpainted, slotted steel channels with hemmed flange edges. Channel bottom with or without holes. Lengths of slotted steel channels 5 ft and less shall be secured to the wall or floor with a min of two 1/4 in. diameter (or larger) by 2-1/4 in. min long concrete screws, or 1/4 in. diameter (or larger) by 1-3/4 in. long min steel masonry anchors. One screw or anchor to be located at each end of the slotted steel channel. Lengths of slotted steel channel in excess of 5 ft require a min of three screws or anchors, one at each end of the channel and one centrally located within the length of the channel. The supports shall be spaced a maximum of 4 ft. OC.

3A. **Trapeze-type Supports** — (Figure 2) The MC cable(s) shall be installed on/from trapeze-type supports by item 4. The trapeze-type supports shall be secured from the surface of the floor. The supports shall be spaced a maximum of 4 ft. OC.

4. **Clamps** — Steel 1-1/4 in. wide two-piece single-bolt pipe clamps. Size to correspond with the outside diameter of the cable and as follows: Trade size 1/2 - 2 in., min 14-gauge; Trade size 2-1/2 in. min 12-gauge; Trade size 3 in. and larger, min 11-gauge.

*Bearing the UL Certification Mark

[Last Updated](#) on 2020-09-09

Cable in Conduit Systems

Examples

Select the FHIT system to verify listed equipment, including # of conductors (examples below depicts systems from different manufacturers)

UL Product iQ™

1. **Wall or Floor Assembly** — Minimum 1 hr. fire rated concrete or masonry wall or concrete floor. Opening in wall or floor through which raceway passes is to be sized to closely follow the contour of the raceway. Through opening in wall or floor to be firestopped using a compatible firestop system. See Through-Penetration Firestop Systems (Guide XHEZ) category for presently Certified firestop systems.

2. **Raceway** — Horizontal and vertical installation
CHAMPION FIBERGLASS INC — Type XW Phenolic (3/4, 1, 1-1/4, 1-1/2 in.)

Fill Ratio: 38% Maximum

Number of Conductors in a raceway: Any combination of cable sizes not exceeding **seven** inside the raceway.

2A. **Raceway Coupling** — (Not Shown)
CHAMPION FIBERGLASS INC — XW Series Phenolic. Trade size to correspond with the raceway size.

3. **Fire Resistive Cables*** — The hourly fire rating applies to cable passing completely through a fire zone and terminating a minimum of 12 inches beyond the fire rated wall or floor bounding the fire zone. The cables as identified below may be installed in the horizontal or vertical orientations and contain bends with the minimum bend radius as described in the manufacturer's installation instructions.
MARMON WIRE & CABLE INC — VITALink 300 Type RHW-2-ST1. To be installed as described herein and in accordance with the manufacturer's installation instructions IM-130-0 dated July, 2020, File FHJR.R15365

UL Product iQ™

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1. **Wall or Floor Assembly*** — Minimum 2 hour fire rated concrete or masonry wall or concrete floor. Opening in wall or floor through which raceway passes is to be sized to closely follow the contour of the raceway. Through opening in wall or floor to be firestopped using a compatible firestop system.
 See **Through-penetration Firestop Systems (XHEZ)** category for presently Certified firestop systems.

2. **Raceway*** — Reinforced Thermosetting Resin Conduit. Horizontal or Vertical installation; or EMT type steel conduit. Horizontal installation.
FRE COMPOSITES INC — BreathSaver Brand Type XW Conduit and Type XW elbows as follows:

Minimum XW Raceway Trade Size, in.

Cable Size, AWG/ kcmil	Horizontal Installation: No. of Cables				Vertical Installation: No. of Cables			
	1	2	3	4	1	2	3	4
8	3/4	3/4	1	1	3/4	1	1-1/4	1-1/4
6	3/4	1	1-1/4	1-1/4	1	1-1/2	2-1/2	2-1/2
4	3/4	1	1-1/4	1-1/2	1-1/4	2	2-1/2	3
3	3/4	1-1/4	1-1/4	1-1/2	1-1/4	2	2-1/2	3
2	3/4	1-1/4	1-1/2	1-1/2	1-1/4	2-1/2	3	3
1	1	1-1/2	2	2-1/2	1-1/2	2-1/2	3-1/2	3-1/2

Selection Steps

FHJR Construction Information - Select based on application needs

of conductors on the left column

Cable sizes on the right column

No. of Conductors or No. of Conductors x No. of Grounds

AWG/kcmil Size

VITALink Type MC (copper clad) with or without polymeric jacket or Type MC-HL (copper clad hazardous locations) with polymeric jacket for use in System No. FHIT.120 , FRR 2h, Maximum 600 VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-120-0 and IM-120-1 dated Feb 2021; FHIT.120A , FRR 2h, Maximum 480 VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-120-2 dated Feb 2021; FHIT.60 , FRR 1h, Maximum 600 VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-60-3 dated Feb 2021. FHIT.60A , FRR 1h, Maximum 480A VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-60-1 dated Feb 2021 and IM-60-2 dated Feb 2021.	
12	14, 12, 10
10	14, 12, 10
9	14, 12, 10
8	14, 12, 10, 8
7	14, 12, 10, 8, 6
6	14, 12, 10, 8, 6, 4
5	14, 12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0
4	14, 12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 350, 400, 500
3	14, 12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 350, 400, 500, 600
2	14, 12, 10, 8, 6
1	1/0, 2/0, 3/0, 4/0, 250, 350, 400, 500, 600, 750
3 x 3	8 x 14
3 x 3	6, 4 x 12
3 x 3	3, 2, 1, 1/0, 2/0 x 10
3 x 3	3/0, 4/0, 250 x 8
3 x 3	350, 500, 600 x 6
4 x 4	8, 6, 4 x 14
4 x 4	3, 2, 1, 1/0, 2/0 x 12
Ceramic Block Splice between VITALink Type MC (copper clad) with or without polymeric jacket and VITALink 300 Type RHW-2-ST1 for use in System No. FHIT.130H , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-130-3 dated January 2023.	
1 thru 5	12 thru 2
VITALink 300 Type RHW-2-ST1 for use in System No. FHIT.130 , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-130-0 dated April 2022, IM-130-1 dated Aug 2020, and IM-130-2 dated April 2022.	
1	12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500
VITALink 502 Type RHW-2-ST1 for use in System No. FHIT.502 , FRR 2h, Maximum 480 VAC (line-to-line) when installed in accordance with manufacturer's installation instructions IM-502-0 dated January 2023.	
5	12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0
4	250, 300, 350, 400, 500

Metal Clad

Conduit Hybrid

of conductors on the left column

Cable sizes on the right column

No. of Conductors or No. of Conductors x No. of Grounds

AWG/kcmil Size

Lifeline Type MC (copper clad) with or without polymeric jacket for use in System No. FHIT.50 , FRR 2h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Apr 2022, and TIS403 dated Apr 2020; and FHIT.50A , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Apr 2022, SPL-FPT-0002 (TIS402) dated Aug 2020, SPL-FPT-0009 (TIS402-A1) dated Aug 2020, and SPL-FPT-0010 (TIS402-A2) dated Aug 2020.	
2	12, 10, 8, 6
3	14, 12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500, 600
4	12, 10, 8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500, 600
5	14, 12, 10, 8, 6, 4
7	10
Lifeline Type MC (copper clad) with or without polymeric jacket for use in System No. FHIT.50A , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Apr 2022, SPL-FPT-0002 (TIS402) dated Aug 2020, SPL-FPT-0009 (TIS402-A1) dated Aug 2020, and SPL-FPT-0010 (TIS402-A2) dated Aug 2020.	
4 x 4	2 x 10
Lifeline Type MC (copper clad) with or without polymeric jacket for use in System No. FHIT.50 , FRR 2h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Apr 2022, and TIS403 dated Apr 2020; FHIT.50A , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Apr 2022, SPL-FPT-0002 (TIS402) dated Aug 2020, SPL-FPT-0009 (TIS402-A1) dated Aug 2020, and SPL-FPT-0010 (TIS402-A2) dated Aug 2020; and FHIT.51 , FRR 2h, Maximum 600 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0011 (TIS400) dated Apr 2022.	
1	1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500, 600, 750
Lifeline Brand Type RHW-2 for use in System No. FHIT.25B , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0020 (TIS301I) dated Sep 2020, SPL-FPT-0019 dated Sep 2020.	
1	8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500, 600, 750
Lifeline Brand Type RHW-2 for use in System No. FHIT.25C , FRR 2h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0013 (TIS301H) dated March 2022.	
1	8, 6, 4, 3, 2, 1, 1/0, 2/0, 3/0, 4/0, 250, 300, 350, 400, 500, 600, 750
Lifeline Brand Type RHW-2 for use in System No. FHIT.25D , FRR 1h, Maximum 480 VAC (line-to-line) when installed in accordance with the manufacturer's installation instructions SPL-FPT-0024 (TIS301J) dated Oct 2021	
1	12, 10

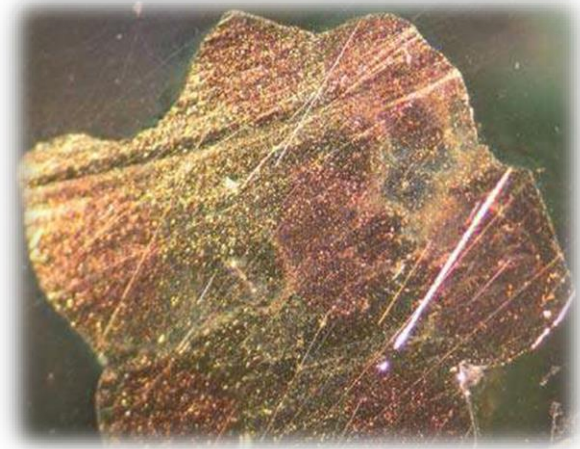
Metal Clad

Conduit

Known Issues

Empirical knowledge leading complete systems testing

- Supporting methods and distances
- Bends and routing through the walls
- Cable materials science and selection
- Galvanized / Zinc conduit



Installation Photos



Installation Photos



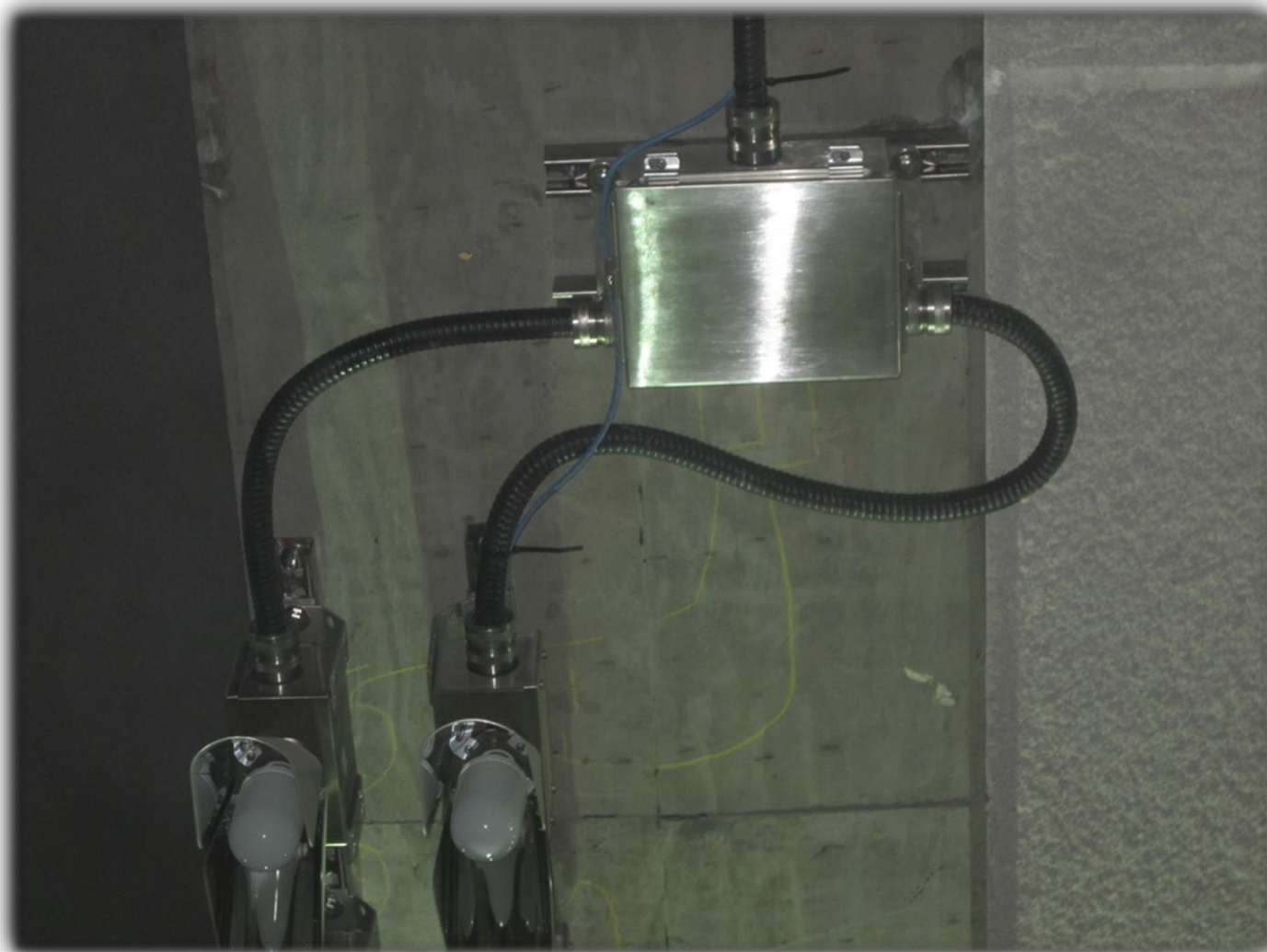
Installation Photos



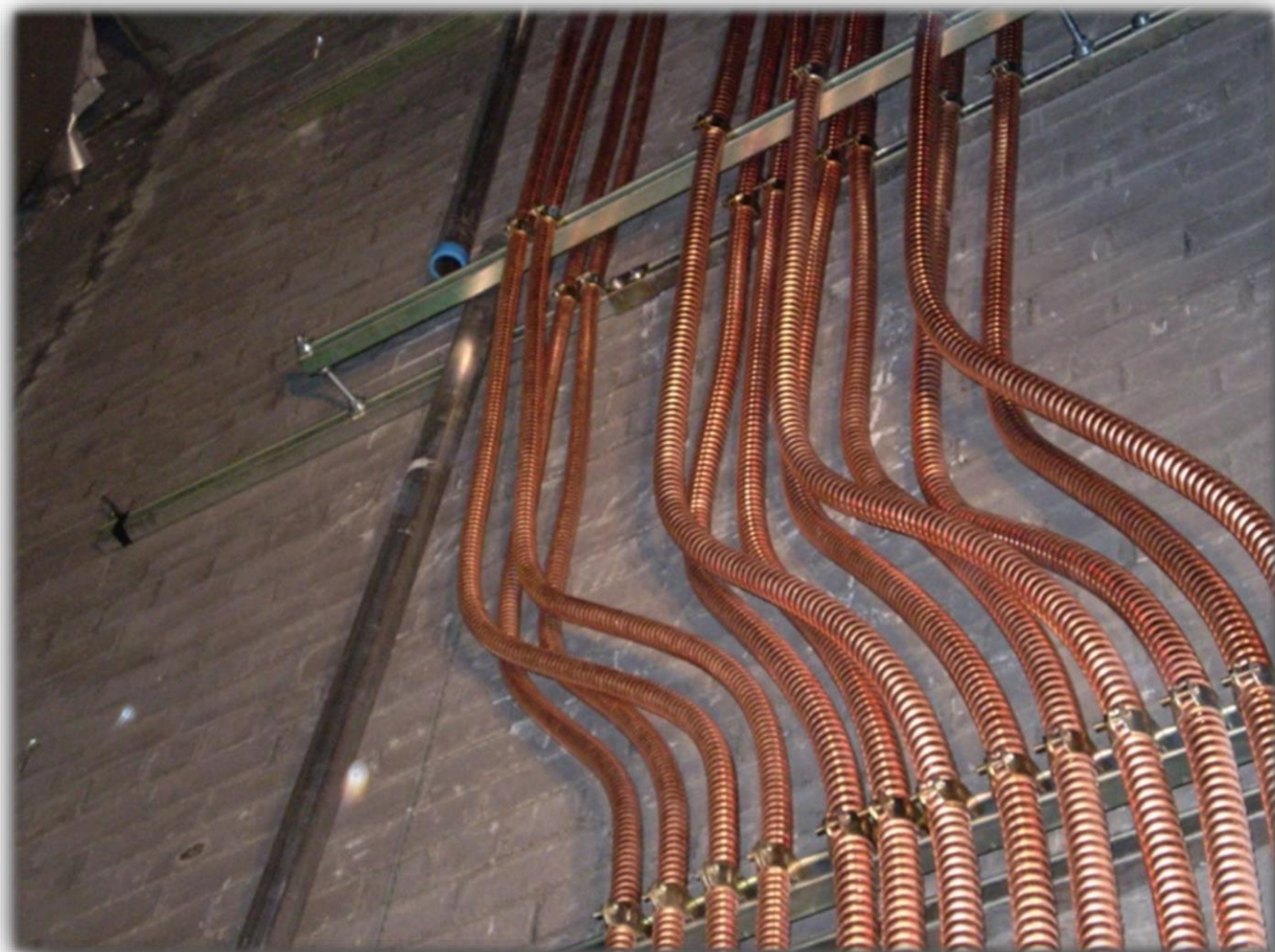
Installation Photos



Installation Photos



Installation Photos



Installation Photos



Installation Photos



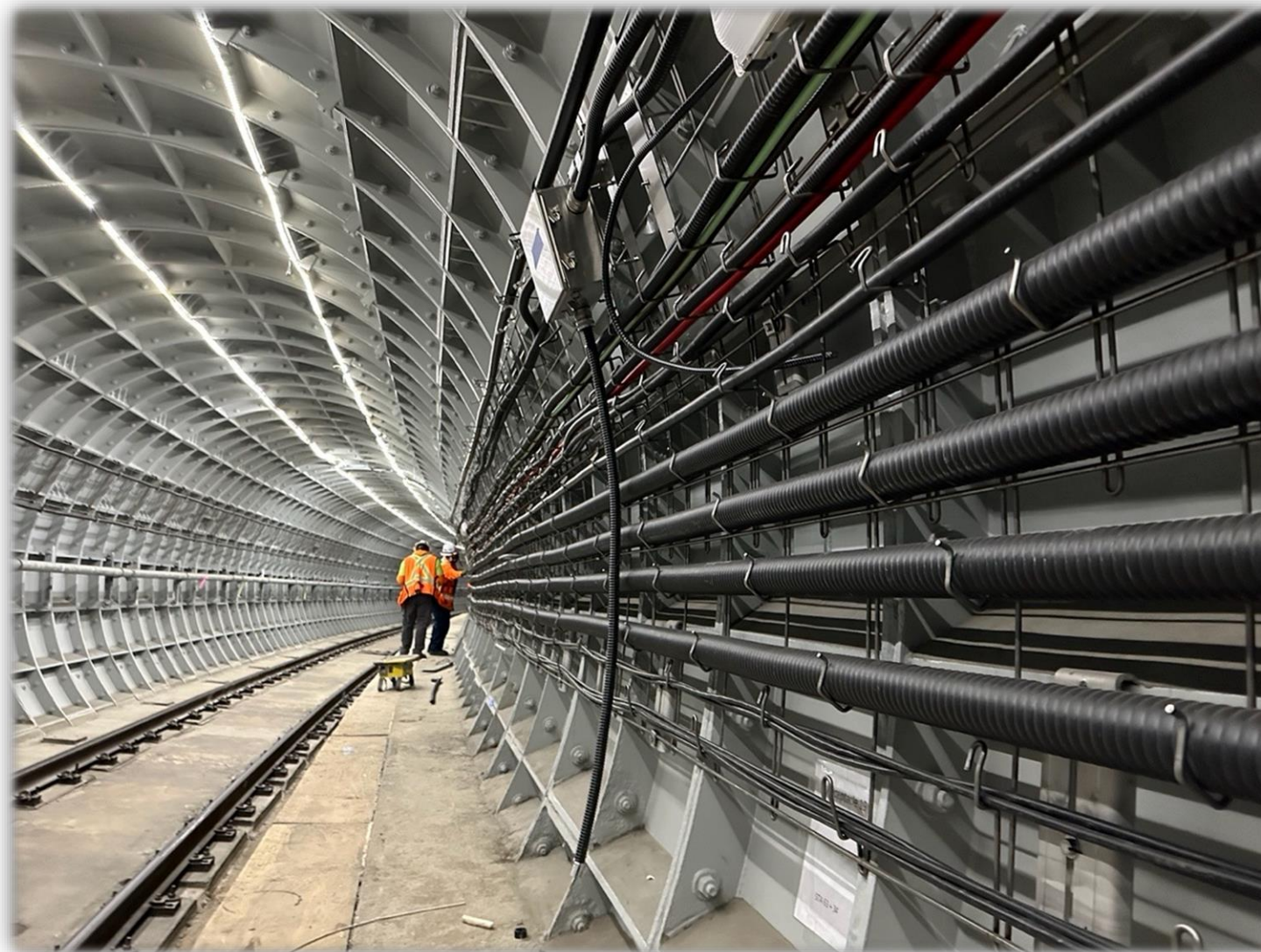
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Installation Photos



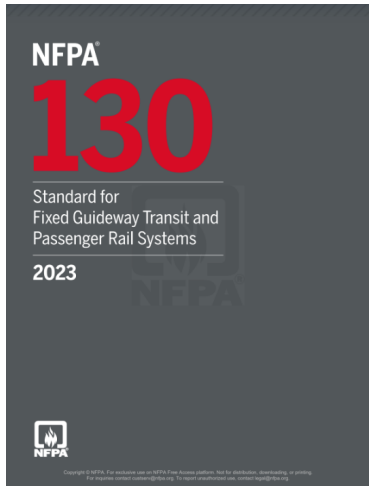
Installation Photos



Installation Photos



Wire and Cable Requirements Recap & Including a NFPA 502 Summary



Non-Emergency (Applicable to all wires/cables)

Cables must be **90°C** rated

Cables must be **low smoke (ST1)** and **flame-retardant (FT4/UL 1685)**

Cables must be **wet** listed (except for fiber optics & communication)

Cables must have an **armor** or be in a **raceway/conduit** [exception for train control (signal cables) and traction power]

Emergency Circuits (1 hr. FRR)

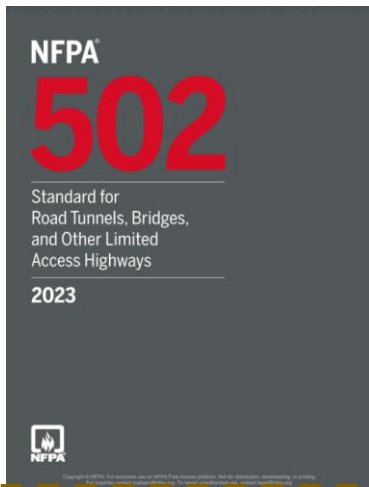
UL 2196 1-hr Fire-resistive cable system

Concrete encasement, 1-hr protection

1-hr Fire-barrier per UL 1724

Redundant systems

Multiple circuits separated by 1-hr fire-barrier



Non-Emergency (Applicable to all wires/cables)

All cables must be rated for the application temperature

All cables must be **low smoke** and **flame-retardant**

Wet listed

Cables must have a **armor** or be in a **raceway/conduit**

Shall emit **less than 2% acid gas**

Emergency Circuits (2 hr. FRR)

UL 2196 2-hr Fire-resistive cable system

2-hr Fire-barrier per UL 1724

External routing

Diversity in the system

NFPA 130 – 2023 vs. 2020 Highlights



Subject	2023 Version	2020 Version
Station definition	3.3.56 – “A building designed for the purpose of loading and unloading”...	3.3.57 – “A place designed for the purpose of loading and unloading” ...
Enclosed Station (no change)	3.3.56.1 – “A station or portion thereof that does not meet the definition of an open station”	3.3.57.1 – “A station or portion thereof that does not meet the definition of an open station”
Open Station (no change)	3.3.56.2 – “A station that is constructed such that it is directly open to the atmosphere and smoke and heat are allowed to disperse directly into the atmosphere”	3.3.57.2 – “A station that is constructed such that it is directly open to the atmosphere and smoke and heat are allowed to disperse directly into the atmosphere”
Flame Spread and Smoke Release Requirements	12.2.2 – Exceptions allowed for circuits encased in at least 2 in thick concrete and for open stations or open trainways	12.2.1 – Applicable to all wires and cables used in enclosed stations and trainways
Temperature and Moisture Requirements	12.3.1 – 90°C WET Listing exception for fiber optical & communications cables (Dec 20,2024)	12.3.1 - 90°C WET Listing exception for communications cables

NFPA 130 – 2023 vs. 2020 Highlights



Subject	2023 Version	2020 Version
Emergency power, lighting and communication circuits protection	12.4.4 – Protected against physical damage caused by normal operations	12.4.4 – Protected from physical damage by system vehicles or other normal system operations and from fires in the system for at least 1 hour...
1-hour fire conditions circuit resistance per ASTM E119 curve	<p>One or a combination of the following:</p> <ol style="list-style-type: none"> 1) Fire-resistive cable systems in accordance with Section 12.5 (UL 2196 criteria, 1 hr.) 2) Encased in concrete that provides 1 hour protection 3) Fire barrier in accordance with UL 1724 when tested for 1 hour 4) Redundant systems such that system operational capability continues 5) Multiple circuits shall be separated by a fire barrier with a fire resistance rating of at least 1 hour 	<p>Any of the following:</p> <ol style="list-style-type: none"> 1) Embedded in concrete or protected by a fire barrier in accordance with UL 1724 2) Routed outside the enclosed portion of the system 3) Diversity in routing 4) Fire-resistive cable systems in accordance with Section 12.5 (UL 2196 criteria)
Fire resistive cables	12.5.2 (1) – Cable shall be tested as complete system , in both vertical and horizontal orientation, including all the conductors, cables, splices , and raceways, as applicable.	12.5.3 (1) – Tested as complete system , in both the vertical and horizontal orientation, of conductors, cables, and raceways, as applicable.

Questions?