



Introduction to Class 4 - Fault Managed Power Cables

PEG Conference
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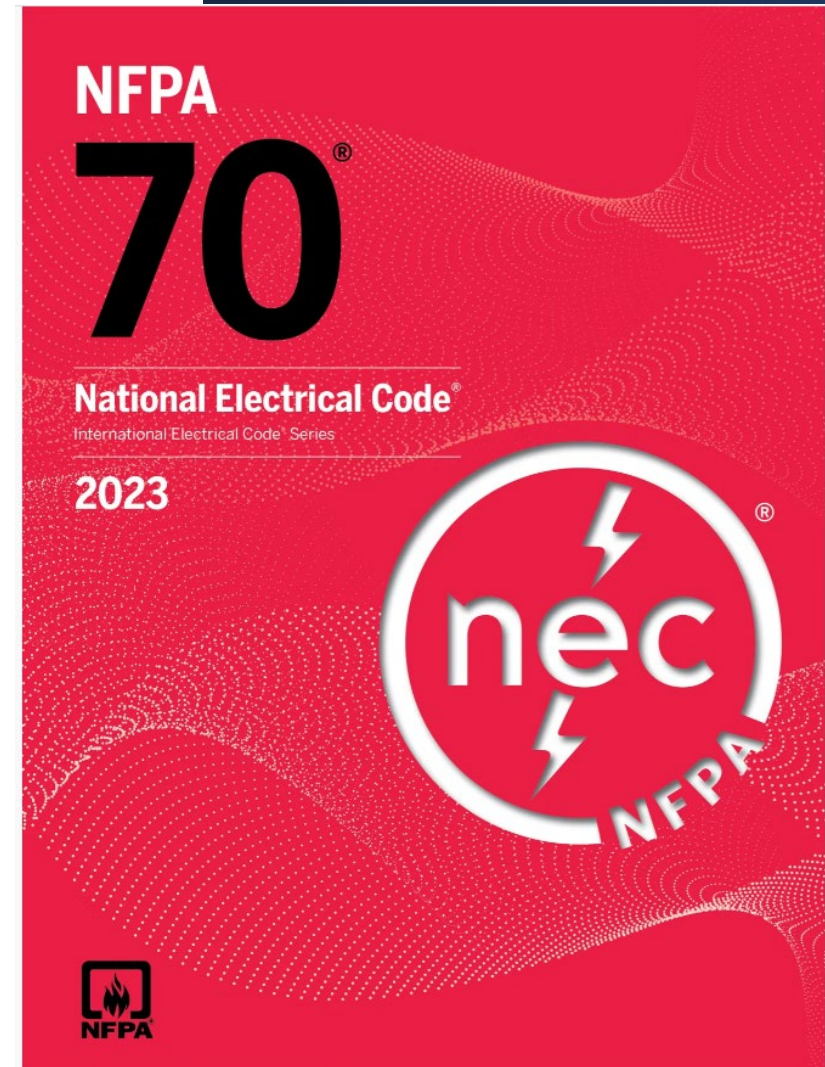
Agenda

- Installation and Use – 2023 Code Updates
- Class 4 Cabling
 - What sets it apart?
 - UL 1400-2

NFPA 70 Article 722 (new)

– Cables for fault-managed power/Class 4 circuits

- Covers general requirements for the installation of single- and multiple-conductor cables used in Class 4 fault-managed circuits, and optical fiber installations.
- Conductor sizes not smaller than 24 AWG (up to 6 AWG)
- Insulation shall be rated not less than 450 V DC
- Temperature rating shall be not less than 60 C (140 F)
- Class 4 cables are required to be listed (UL 1400-2 is referenced)



UL Solutions - Safety Standards Development

- UL worked with industry leading members to develop Safety Standards for FMPS
- Work began in earnest in March of 2021
 - Randy Ivans and Kenneth McKinney chaired 1400-1 for equipment
 - Anthony Tassone Chair of 1400-2 for cables
- Over 13 Industry members and independent engineers participated the working group:

ATIS

Corning Cable Systems

Southwire

Belden

Leviton

CommScope

Cisco

Hubbell

Daikin America

Alpha Technologies

Voltserver

Chemours

Schneider Electric

Agenda

Class 4 (CL4) Cabling

- Why is it needed??
 - UL 1400-2

Class 4 Cabling – What's different?

Based on the output voltage of the Class 4 Transmitter, and the intended installation a new Cable type needed to be developed.

Members of the Fault Managed Power Committee worked with UL on developing the requirements which are now described in UL1400-2.

January 6, 2022

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UL 1400-2

Outline of Investigation for Fault-Managed Power Systems

Issue Number: 1

January 6, 2022

Summary of Topics

This first issue of the Outline of Investigation for Fault-Managed Power Systems – Part 2: Requirements for Cables, UL 1400-2, January 6, 2022, covers cables used in fault-managed power systems.

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Class 4 Cabling Specification

UL 1400-2, Outline of Investigation for Fault-Managed Power Systems, Part 2 – General Requirements for Cables

Scope:

- 60 C to 250 C (140 F to 482 F)
- Single and multiple-conductor jacketed cables
- Intended for fixed wiring within buildings
- May be used outdoors and/or for direct burial
- For use in Class 4 circuits as described in Article 726 and other applicable parts of the National Electrical Code (NEC).
- Includes CL4P (plenum cables), CL4R (riser cables) and CL4 (general purpose cables).

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Class 4 Cabling Requirements

UL 1400-2, Outline of Investigation for Fault-Managed Power Systems, Part 2 – General Requirements for Cables

The requirements for Class 4 Cables described in UL1400-2 were based on the requirements for Class 3 cables described in UL13, the Standard for Power Limited Cables with additional requirements developed to address the technology, installation, and the 450 V rating.

The main differences between UL1400-2 and UL13 are:

- Increase in the insulation thickness due to the higher voltage rating. The cable manufacturers on the committee requested an option to permit the insulation thicknesses specified for Class 3 Cables described in UL13. A new Crush test and Dielectric Withstand was developed for “thin-wall” insulations. The tests were based on similar tests described in UL758, the Standard for Appliance wiring material.
- Cables with integral jacket/insulation are not currently permitted.
- Cable sizes range from 24 AWG to 6 AWG. The committee stated that the larger conductors are needed to limit cable loss but the most common conductor size is 18AWG.
- CL4 cables that employ conductors 18 – 24 AWG are required to comply with the cable heating test requirements. These cables would need to be marked with FMP-XXA where XX is the current rating. There is no LP rating.
- The Production Line Spark Test voltages are higher.
- A cable Part number is required.

Class 4 Category - DLPY

- This category covers Class 4 cables in 24 – 6 AWG, intended for use in Class 4 Power Systems described in Article 726 of NFPA 70, "National Electrical Code" (NEC) installed in accordance with Article 722 of NFPA 70, "National Electrical Code" (NEC).
- The cable is rated for 450V dc, but is not so marked.
- **CL4P** - intended for use within buildings in ducts or plenums or other spaces used for environmental air in accordance with the NEC. (NFPA 262)
- **CL4R** - intended for use within buildings in vertical shafts in accordance with the NEC. (UL 1666)
- **CL4** cable is intended for general use within buildings in accordance with the NEC. (UL 2556 or UL 1685)

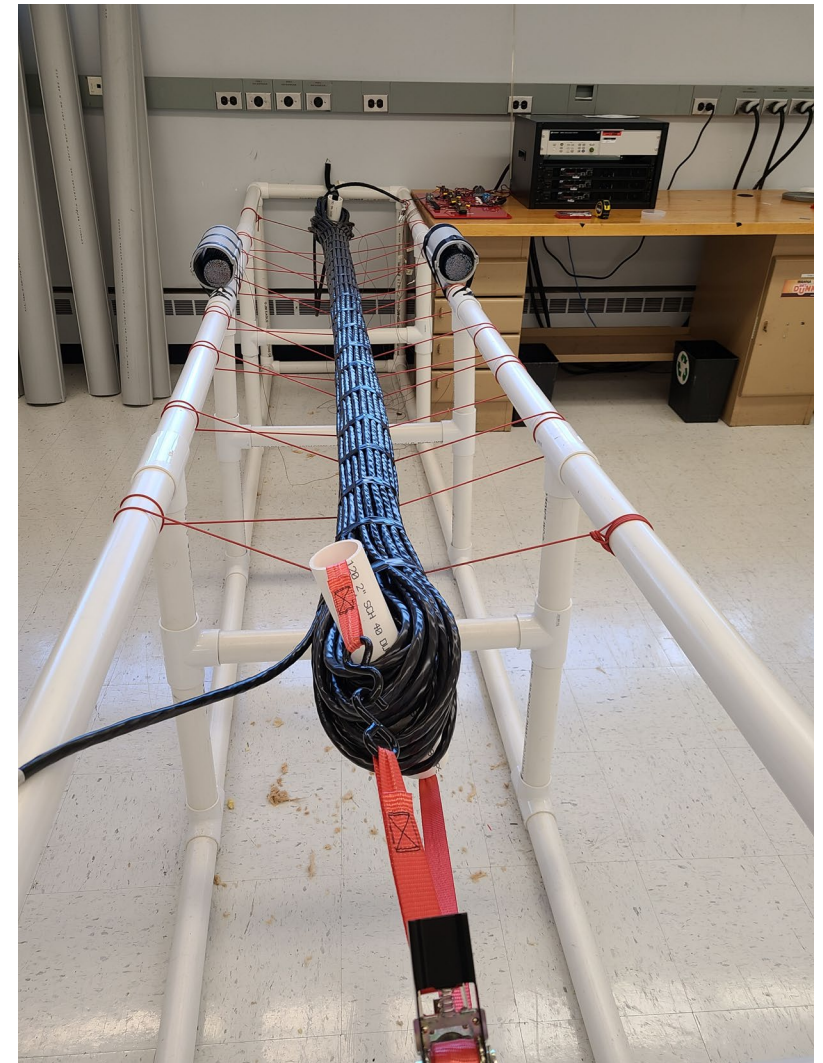
Class 4 Cabling : What about cable heating?

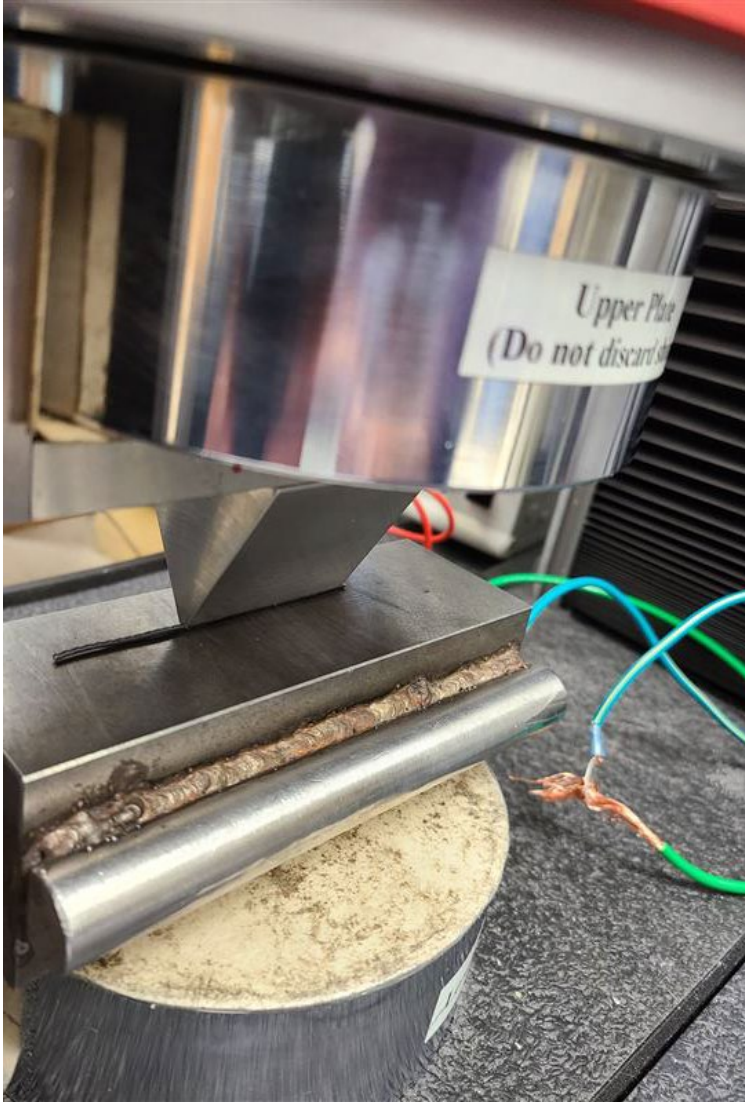
- Cables permitted to be 24- 6 AWG copper.
- Concern about heat generation
- NEC describes ampacities and includes derating factors based on installation parameters such as bundling, use in conduit etc.
- Group performed heat studies on various size cables and bundles.
- Based on the test results, a cable heating test was developed for cables employing 18 AWG – 24 AWG conductors



Class 4 Cabling Heating Test 18 AWG and Smaller

- The cables arranged in a tightly packed hexagonal bundle consisting of 37 cables.
- Represents the worst-case thermal dissipation situation and tested in free air.
- The conductors in the cables shall be electrically connected in series to a power supply capable of providing the rated current marked as part of the FMP rating.
- The cables are operated continuously until thermal stabilization





Class 4 Cabling Requirements – Thin Wall Constructions

- Wall thickness are scaled for 450V
- Concerns voiced about the impact of the increase in the insulation thickness
- New crush and dielectric withstand test developed for thin wall applications
- The tests were based on similar tests described in UL758, the Standard for Appliance Wiring Material

Class 4 Cabling Requirements – Spark Test

- Due to the higher electrical rating and increased insulation thickness requirements, the Spark test voltage is higher than the voltage required in UL13.
- The spark test is to be a dc spark test of 6000 V (2500 V in UL13) or an ac rms spark test of 4500 V (1750V in UL13)



Class 4 Additional Cabling Requirements

- To reduce the risk of electrical shock, core assembly is designed to keep circuit in pairs or in relative proximity
- For multiple-conductor cables, two or more insulated conductors shall be assembled to form a cable core.
 - A round cable core consisting of 12 or fewer pairs, or 2, 3 or 4 single insulated conductors, may have the pairs or insulated conductors laid straight.
- Optical fibers are an optional component
- Cable shall have a unique part number surface printed on the jacket.

Class 4 Cabling Requirements – Ongoing Development of Requirements

- **CL4Z – intended for outdoor deployment is under development.** - These requirements also cover cables designated as CL4Z that are intended for outdoor use only and are not to be attached to, or used within a building structure. Type CL4Z cables comply with the applicable requirements for CL4 except where otherwise specified.



Questions?