Educational Session

Fire Alarm Circuit Installation vs. Circuit Performance

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1

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2

Objectives

At the end of this presentation, attendees will be able to:

- locate wiring installation requirements in the. *National Electrical Code*
- locate circuit performance requirements in the *National Fire Alarm and Signaling Code*.
- distinguish between wiring requirements and circuit performance requirements.

3

Fire Alarm Wiring

This presentation follows:
NFPA 70, National Electrical Code
Fire Alarm Wiring – Article 760
NFPA 72, National Fire Alarm and Signaling Code
Chapters 12 and 24

4

Fire Alarm Wiring

Fire alarm wiring is that which is controlled by or connected to the fire alarm system.
Wiring NOT covered by Article 760:

Elevators
HVAC/BAS wiring
Security/intrusion system
Access control system
Communications

5

Fire Alarm Wiring

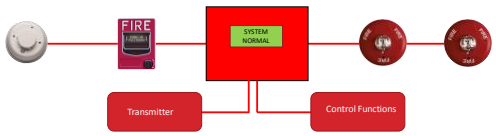
All wiring installation requirements are under the scope of NFPA 70.

All circuit performance is under the scope of NFPA 72.

6

Fire Alarm Wiring

Fire alarm systems controls monitor initiating devices (inputs), control notification appliances, and control safety functions (outputs).



7

Fire Alarm Wiring

Circuit Types

- Initiating Device Circuits (IDC) – conventional zone input circuits
- Notification Appliance Circuits (NAC) – output circuits
- Signaling Line Circuits (SLC) – addressable input/output circuits

8

Fire Alarm Circuits and Pathways

Chapter 12 of NFPA 72 provides requirements for circuit and pathway performance.

Other requirements exist in Chapters 21 and 23.

9

Fire Alarm Circuits and Pathways

Circuit Classes:

- Class A – Redundant pathway, monitored for integrity
- Class B – No redundant pathway, monitored for integrity
- Class C – Not monitored for integrity
- Class D – Fail safe
- Class E – Not monitored for integrity
- Class N – Network, not monitored for integrity
- Class X – redundant pathway with short circuit protection

12.3

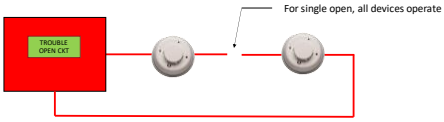
10

Class A Circuits

12.3.1

11

Class A Circuits



12.3.1

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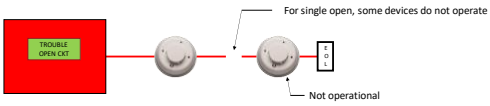
Class B Circuits

12.3.2

13

Class B Circuits



12.3.2

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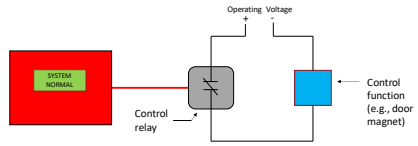
Class C Circuits

Class C circuits are not monitored for integrity
but end-to-end communications are verified.

12.3.3

15

Class D Circuits



Class D circuits are not required to be monitored for integrity. A single open results in operation of the intended function. This is "fail safe".

12.3.4

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16

16

Class E Circuits

Class E Circuits are not monitored for integrity. They are monitored by use.

12.3.5

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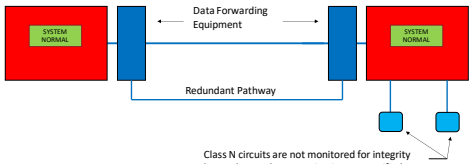
17

17

Class N Circuits



Class N circuits are not monitored for integrity but end-to-end communications are verified. Redundant pathways are required except for a single device.

12.3.6

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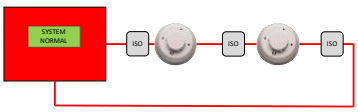
18

18

Class X Circuits



- Class X circuits have a redundant (return) pathway
- Class X circuits are monitored for integrity.
- A single open or a single short results in a trouble, but all devices or appliances operate.

12.3.7

19

Fire Alarm Wiring Installation

Fire Alarm System Requirements: NEC Article 760

- Part I – General Requirements
- Part II – Non-Power-Limited Fire Alarm Circuits
- Part III – Power-Limited Fire Alarm Circuits
- Part IV – Listing Requirements (cables)

20

Fire Alarm Wiring Installation

Other Applicable NEC Articles:

- Article 300 – General wiring methods
- Article 722 – Cables for Power-Limited Circuits and Fault-Managed Power Circuits
- Article 725 – Class 1, 2, and 3 Remote Control and Power-Limited Signaling
- Article 770 – Optical Fiber Cables
- Chapter 8 - Communications

21

Fire Alarm Wiring Installation

Nec general wiring requirements:

- Firestopping: NEC 300.21
- Ducts and Plenums: NEC 300.22
- Conduit exposed to different temperatures: NEC 300.7
- Corrosive, damp and wet locations: NEC 110.11
- Conduit as a means of support: NEC 300.11

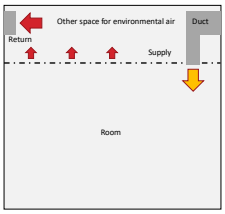
NEC 760.3

22

Fire Alarm Wiring Installation

Ducts and Plenums:

- Do not use as a convenient wire chase
- Cables in ducts or plenums must be associated with the air handling system.
- Ceilings used as air return "plenums" are actually called "other spaces for environmental air".



NEC 300.22

23

Fire Alarm Wiring Installation

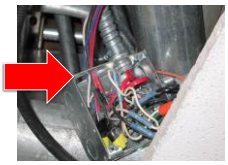
Conduit as a means of support:
Do not use other raceways or conduit as a means of support.

NEC 300.11

24

Fire Alarm Wiring Installation

Bushings or fittings are required where cables or conductors enter an enclosure or junction box.



NEC 760.3(K)

25

Fire Alarm Wiring Installation

General wiring requirements

- Access: NEC 760.21
- Working space: NEC 110.26

26

Fire Alarm Wiring Installation

Workmanship

- Cable support
- Use fittings
- Do not use other trades or other conduit
- Access (above suspended ceilings)
- Trapeze for back boxes on suspended ceilings
- Identify terminations and junction boxes

NEC 760.24

27

Fire Alarm Wiring Installation

General wiring requirements

- Mechanical execution of work.

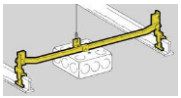
NEC 760.24

28

Fire Alarm Wiring Installation

All devices mounted on suspended ceilings must be supported by a backbox. The backbox must also be supported by either:

- Trapeze
- Threaded rod.



29

Fire Alarm Wiring Installation

Fire alarm circuits must be identified at terminal and junction box locations per NEC 760.30.

- No specific NEC requirements
- Check specifications/local amendments!

NEC 760.30

30

Fire Alarm Wiring Installation

Check your spelling

31

Fire Alarm Wiring Installation

Circuits extending beyond a building must be protected as required by NEC Parts II, III, and IV of Article 800 and must meet the installation requirements of Part I of Article 300.

- Primary protection
- Use Chapter 3 wiring methods
- Underground conduit is a wet location
- Locate primary protection close as possible to point of entry to building

NEC 760.32

32

Fire Alarm Wiring Installation

Branch circuit power wiring

- Fire alarm control unit power supply wiring must be on an individual (dedicated) branch circuit.
- The disconnecting means must be red in color
- The disconnecting means must be identified as "FIRE ALARM CIRCUIT"
- NO AFCI

NEC 760.41(B), 760.121(B)

33

Fire Alarm Wiring Installation

Non-Power-Limited
- Up to 600 Volts

Power-Limited
- Limited energy
- See tables 11A and 12A of NFPA 70
- Also see manufacturer's published instructions

34

Fire Alarm Wiring Installation

Non-Power-Limited Circuit Wiring Methods
- Option A: Power and lighting wiring methods, or
- Option B: Non-Power-Limited specialty cables
  - NPLF – general use
  - NPLFR – riser use
  - NPLFP – other space for environmental air

NEC 760.46

35

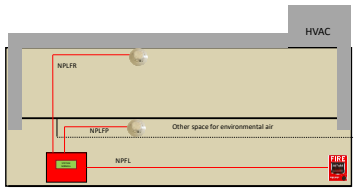
Fire Alarm Wiring Installation

Non-Power-Limited circuits may be mixed in the same cable, raceway, or enclosure with:
- Class 1 conductors where insulated for maximum voltage expected
- Power supply conductors where connected to the same equipment

NEC 760.48

36

Fire Alarm Wiring Installation



NEC 760.53

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37

37

Fire Alarm Wiring Installation

Power-Limited Circuit Wiring Methods

- Option A: Power and lighting wiring methods, or
- Option B: Non-Power-Limited specialty cables
  - NPLF – general use
  - NPLFR – riser use
  - NPLFP – other space for environmental air
- Option C: Power-Limited specialty cables
  - FPL – general use
  - FPLR – riser use
  - FPLP – other space for environmental air/plenum

NEC 760.127

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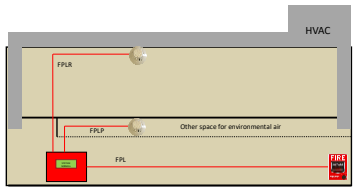
38

38

Fire Alarm Wiring Installation



NEC 760.135

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39

Fire Alarm Wiring Installation

Power-Limited circuits may NOT be mixed in the same cable, raceway, outlet box, cable tray, compartment, or enclosure with:

- Power and lighting circuits
- Class 1 conductors
- Non-power-limited conductors
- Medium powered broadband conductors

Power-Limited circuits may be mixed in the same cable, raceway, outlet box, cable tray, compartment, or enclosure where:

- Separated by a barrier, or
- Separated by at least ¼ inch (6 mm) of separation.

NEC 760.136

40

Fire Alarm Wiring Installation

Power-Limited circuits may be mixed in the same cable, raceway, outlet box, cable tray, compartment, or enclosure with:

- Class 2 circuits
- Class 3 circuits
- Low-power broadband circuits

NEC 760.136

41

Fire Alarm Wiring Installation

All fire alarm wiring must be protected to a height of 7 feet (2.1 m) where it passes through a floor or wall.

- Can "fish" cable in the wall cavity
- Equivalent guards are permitted
- Building finish may be permitted
- Hoistways require rigid threaded conduit

NEC 760.130(B)(1)

42

Fire Alarm Wiring Installation

Cable Substitutions:

FPLP	FPLR	FPL	
CMP	FPLP CMP CMR	FPLP CMP FPLR CMR CMG CM	Cable Substitutions

NEC 760.154(A)

43

Fire Alarm Wiring Performance

Circuit Integrity (CI) Cable is a product that can be used to provide up to 2 hours of fire resistance.

- Listed to UL 2196
- Circuit Integrity (CI) Cable will have a "-CI" suffix
- Must be mounted to a 2-hour rated surface
- Some products may be required to be sleeved in conduit

Circuit Integrity Type FPLP-CI 2-Hour Fire

44

Fire Alarm Wiring Performance

Class A, N, and X Separation :

Where used, Class A, N, and X circuits must have separation between outgoing and return conductors.

- Three "exceptions" to this rule.
- Intended o prevent a single event from disabling entire circuit.

12.3.8

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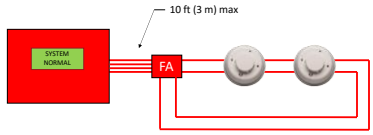
Fire Alarm Wiring Performance

Option A: Outgoing and return conductors may be run together in the same cable, raceway, or enclosure for a distance NTE 10 feet (3 m).



12.3.8.1(1)

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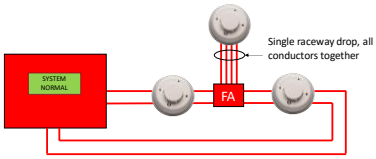
46

46

Fire Alarm Wiring Performance

Option B: Outgoing and return conductors may be run together in the same raceway for drops to a single appliance or device. No length limit.



12.3.8.1(2)

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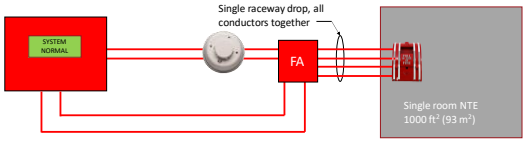
47

47

Fire Alarm Wiring Performance

Option C: Outgoing and return conductors may be run together in the same cable, raceway, or enclosure for a single room NTE 1000 square feet (93 m²). Control functions not permitted.



12.3.8.1(3)

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48

48

Fire Alarm Wiring Performance

SLC Zone Wiring:

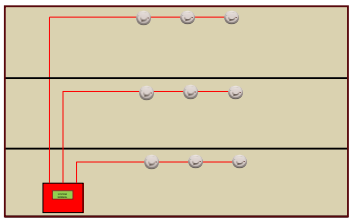
A single fault on a pathway connected to addressable devices cannot not cause the loss of the devices in more than one zone.

- Each floor is a separate zone
- Fire separated areas within a floor are separate zones

23.6.1

49

Fire Alarm Wiring Performance

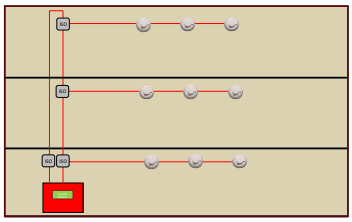


Option A: Use separate circuits for each zone/floor. Circuits traversing one floor to get to another floor will require protection.

23.6.1

50

Fire Alarm Wiring Performance

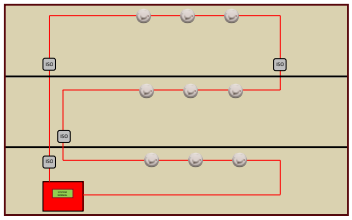


Option B: Use separate circuits for each zone/floor with a Class A backbone and isolation modules.

23.6.1

51

Fire Alarm Wiring Performance



Option C: Use one Class A circuit with isolation modules. Alternately, Class X is acceptable.

23.6.1

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52

52

Fire Alarm Wiring Performance

Survivability is only required for notification appliance circuits or data backbone circuits where partial evacuation or relocation schemes are used.

- Mass Notification Systems
- Emergency Voice/Alarm Communications Systems

Survivability is NOT required for systems using full evacuation.

24.3.14

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53

53

Fire Alarm Wiring Performance

Survivability has 5 levels (0 through 4)

Level 0 – No intended protection

Level 1 – Fully sprinklered building per NFPA 13 and all circuits in metal raceways or metal armored cables.

Level 2 – One of the following

- 2-hour fire-rated circuit integrity (CI) or fire-resistive cable
- 2-hour fire-rated cable system [electrical circuit protective system(s)]
- 2-hour fire-rated enclosure or protected area
- Performance alternatives approved by the authority having jurisdiction

Level 3 – Same as Level 2, but add full sprinkler coverage per NFPA 13

Continued on next slide.

12.4

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54

54

Fire Alarm Wiring Performance

Survivability has 5 levels (0 through 4)

Level 4 – One of the following:

- 1-hour fire-rated circuit integrity (CI) or fire-resistive cable
- 1-hour fire-rated cable system [electrical circuit protective system(s)]
- 1-hour fire-rated enclosure or protected area
- Performance alternatives approved by the authority having jurisdiction

Level 4 is not hierarchical

12.4

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55

Fire Alarm Wiring Performance

Shared Pathways (Class N and Life Safety Circuits)

Level 0. Level 0 pathways is not required to segregate or prioritize life safety data from non–life safety data.

Level 1. Level 1 pathways are not required to segregate life safety data from non–life safety data but shall prioritize all life safety data over non–life safety data.

Level 2. Level 2 pathways shall segregate all life safety data from non–life safety data.

Level 3. Level 3 pathways shall use equipment that is dedicated to the life safety system. (e.g., not shared)

12.5

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56

56

Fire Alarm Wiring Performance

Class N pathways are required to use shared pathway Level 3 except that shared pathways Level 1 and Level 2 are permitted subject to approval of the authority having jurisdiction, based on documentation of the deployment, change control, maintenance plans, management organization, network design analysis, and a risk analysis.

Class N pathways shall not be accessible to the general public or building occupants for any purpose other than specified in the network design analysis, maintenance, and deployment plans.

23.6.3

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57

57

Fire Alarm Wiring Performance

Class N Circuits

- A single fault on a Class N pathway cannot result in the loss of more than one addressable device.
- Class N devices cannot have a means to connect to other devices where it is served with a single pathway.

12.3.6

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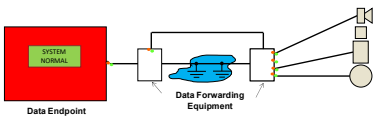
58

Fire Alarm Wiring Performance

- Any Class N segment of a path to more than one field device must be redundant, similar to Class A or X.



12.3.6

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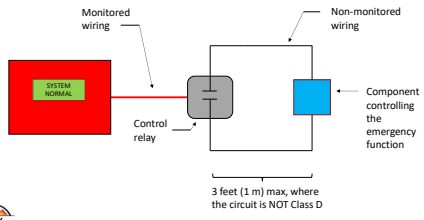
59

Emergency Control Functions



21.2.4

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60

Conclusion/Summary

The NEC provides installation requirements
NFPA 72 provides performance requirements
These are vastly different.

What would you do differently after this presentation?

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61

Questions?

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62

62

Questions

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63