**Chapter 12 Circuits and Pathways**

12.1 Application

12.1.1

Pathways (interconnections) shall be designated based on the performance characteristics defined in this chapter.

12.1.2

The requirements of Chapter 14 shall apply.

12.2 General

12.2.1\*

Performance and survivability characteristics of signaling pathways (interconnections) shall comply with the defined designations of this chapter.

12.2.2

A pathway (interconnection) class designation shall be dependent on the pathway (interconnection) capability to continue to operate during abnormal conditions.

12.2.3

The installation of all pathway wiring, cable, and equipment shall be in accordance with NFPA 70 and the applicable requirements of 12.2.3.1 through 12.2.3.3.

12.2.3.1

Optical fiber cables installed as part of the fire alarm system shall meet the requirements of NFPA 70 Article 770, and be protected against physical damage in accordance with NFPA 70 Article 760.

12.2.3.2\*

Fire alarm system wiring and equipment, including all circuits controlled and powered by the fire alarm system, shall be installed in accordance with the requirements of this Code and of NFPA 70 Article 760.

12.2.3.3\*

Wiring methods permitted by other sections of this Code to resist attack by fire shall be installed in accordance with manufacturer's published instructions and the requirements of NFPA 70 Article 760 and Article 728.

12.2.3.4\*

Where operational capability is required to be maintained or continued during the application of a fault, the operational capability required in 10.11.1 shall be restored within 200 seconds from the time the fault is introduced.

12.2.4 Ground Connections

12.2.4.1

Unless otherwise permitted by 12.2.4.2, all fire alarm systems shall test free of grounds.

12.2.4.2

The requirements of 12.2.4.1 shall not be required where parts of circuits or equipment are intentionally and permanently grounded in order to provide ground fault detection, noise suppression, emergency ground signals, and circuit protection grounding.

12.2.4.3\*

On conductive pathways, operational capability shall be maintained during the application of a single ground connection.

12.3\* Pathway Class Designations

Pathways shall be designated as Class A, Class B, Class C, Class D, Class E, Class N, or Class X, depending on their performance.

12.3.1\* Class A

A pathway shall be designated as Class A when it performs as follows:

It includes a redundant path.

Operational capability continues past a single open, and the single open fault results in the annunciation of a trouble signal.

Conditions that affect the intended operation of the path are annunciated as a trouble signal.

Operational capability on metallic conductors is maintained during the application of a single ground fault.

A single ground condition on metallic conductors results in the annunciation of a trouble signal.

12.3.2 Class B

A pathway shall be designated as Class B when it performs as follows:

It does not include a redundant path.

Operational capability stops at a single open.

Conditions that affect the intended operation of the path are annunciated as a trouble signal.

Operational capability on metallic conductors is maintained during the application of a single ground fault.

A single ground condition on metallic conductors results in the annunciation of a trouble signal.

12.3.3\* Class C

A pathway shall be designated as Class C when it performs as follows:

It includes one or more pathways where operational capability is verified via end-to-end communication, but the integrity of individual paths is not monitored.

A loss of end-to-end communication is annunciated as a trouble signal.

12.3.4\* Class D

A pathway shall be designated as Class D when it has fail-safe operation, where no fault is annunciated, but the intended operation is performed in the event of a pathway failure.

12.3.5\* Class E

A pathway shall be designated as Class E when it is not monitored for integrity.

12.3.6 Class N

A pathway shall be designated as Class N when it performs as follows:

\* It includes two or more pathways where operational capability of the primary pathway and a redundant pathway to each device shall be verified through end-to-end communication.

Exception: When only one device is served, only one pathway shall be required.

A loss of intended communications between endpoints shall be annunciated as a trouble signal.

A single open, ground, short, or combination of faults on one pathway shall not affect any other pathway.

\* Conditions that affect the operation of the primary pathway(s) and redundant pathway(s) shall be annunciated as a trouble signal when the system's minimal operational requirements cannot be met.

\* Primary and redundant pathways shall not be permitted to share traffic over the same physical segment.

12.3.7 Class X

A pathway shall be designated as Class X when it performs as follows:

It includes a redundant path.

Operational capability continues past a single open, and the single open fault results in the annunciation of a trouble signal.

Operational capability on metallic conductors continues past a single short-circuit, and the single short-circuit fault results in the annunciation of a trouble signal.

Operational capability on metallic conductors continues past a combination open fault and ground fault.

Conditions that affect the intended operation of the path are annunciated as a trouble signal.

Operational capability on metallic conductors is maintained during the application of a single ground fault.

A single ground condition on metallic conductors results in the annunciation of a trouble signal.

12.3.8\* Class A, Class N, and Class X Pathway Separation

Class A, Class N, and Class X circuits using physical conductors (e.g., metallic, optical fiber) shall be installed so that the primary and redundant, or outgoing and return, conductors exiting from and returning to the control unit, respectively, are routed separately.

12.3.8.1

The outgoing and return (redundant) circuit conductors shall be permitted in the same cable assembly (i.e., multiconductor cable), enclosure, or raceway only under the following conditions:

For a distance not to exceed 10 ft (3.0 m) where the outgoing and return conductors enter or exit the initiating device, notification appliance, or control unit enclosures

Single drops installed in the raceway to individual devices or appliances

\* In a single room not exceeding 1000 ft2 (93 m2) in area, a drop installed in the raceway to multiple devices or appliances that does not include any emergency control function devices

12.4\* Pathway Survivability

All pathways shall comply with NFPA 70.

12.4.1 Pathway Survivability Level 0

Level 0 pathways shall not be required to have any provisions for pathway survivability.

12.4.2 Pathway Survivability Level 1

Pathway survivability Level 1 shall consist of pathways in buildings that are fully protected by an automatic sprinkler system in accordance with NFPA 13 with any interconnecting conductors, cables, or other physical pathways protected by metal raceways or metal armored cables.

12.4.3\* Pathway Survivability Level 2

Pathway survivability Level 2 shall consist of one or more 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

12.4.4\* Pathway Survivability Level 3

Pathway survivability Level 3 shall consist of pathways in buildings that are fully protected by an automatic sprinkler system in accordance with NFPA 13 and one or more of the following:

2-hour fire-rated circuit integrity (Cl) 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

12.5\* Shared Pathway Designations

Shared pathways shall be designated as Level 0, Level 1, Level 2, or Level 3, depending on their performance.

12.5.1\* Shared Pathway Level 0

Level 0 pathways shall not be required to segregate or prioritize life safety data from non-life safety data.

12.5.2\* Shared Pathway Level 1

Level 1 pathways shall not be required to segregate life safety data from non-life safety data, but shall prioritize all life safety data over non-life safety data.

12.5.3\* Shared Pathway Level 2

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

12.5.4\* Shared Pathway Level 3

Level 3 pathways shall use equipment that is dedicated to the life safety system.

12.6\* Monitoring Integrity and Circuit Performance of Installation Conductors and Other Signaling Channels

12.6.1

Unless otherwise permitted or required by 12.3.1 through 12.3.7 and 12.6.3 through 12.6.13, all means of interconnecting equipment, devices, and appliances and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path so that the occurrence of a single open or a single ground-fault condition in the installation conductors or other signaling channels is automatically indicated within 200 seconds.

12.6.2

Unless otherwise permitted or required by 12.3.1 through 12.3.7 and 12.6.3 through 12.6.13, all means of interconnecting equipment, devices, and appliances and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path so that the restoration to normal of a single open or a single ground-fault condition in the installation conductors or other signaling channels is automatically indicated within 200 seconds.

12.6.3

Shorts between conductors shall not be required to be monitored for integrity, unless required by 12.6.15, 12.6.16, and 10.19.2.

12.6.4

Monitoring for integrity shall not be required for a noninterfering shunt circuit, provided that a fault circuit condition on the shunt circuit wiring results only in the loss of the noninterfering feature of operation.

12.6.5

Monitoring for integrity shall not be required for connections to and between supplementary system components, provided that a single open, ground-fault, or short-circuit conditions of the supplementary equipment or interconnecting means, or both, do not affect the required operation of the fire alarm and/or signaling system.

12.6.6

Monitoring for integrity shall not be required for the circuit of an alarm notification appliance installed in the same room with the central control equipment, provided that the notification appliance circuit conductors are installed in conduit or are equivalently protected against mechanical injury.

12.6.7

Monitoring for integrity shall not be required for a trouble notification appliance circuit.

12.6.8\*

Monitoring for integrity shall not be required for the interconnection between listed equipment within a common enclosure.

12.6.9

Monitoring for integrity shall not be required for the interconnection between enclosures containing control equipment located within 20 ft (6 m) of each other where the conductors are installed in conduit or equivalently protected against mechanical injury.

12.6.10

Monitoring for integrity shall not be required for the conductors for ground-fault detection where a single ground-fault does not prevent the required normal operation of the system.

12.6.11

Monitoring for integrity shall not be required for pneumatic rate-of-rise systems of the continuous line type in which the wiring terminals of such devices are connected in multiple across electrically supervised circuits.

12.6.12

Monitoring for integrity shall not be required for the interconnecting wiring of a stationary computer and the computer's keyboard, video monitor, mouse-type device, or touch screen, as long as the interconnecting wiring does not exceed 8 ft (2.4 m) in length; is a listed computer/data processing cable as permitted by NFPA 70; and failure of cable does not cause the failure of the required system functions not initiated from the keyboard, mouse, or touch screen.

12.6.13

Monitoring for integrity of the installation conductors for a ground-fault condition shall not be required for the communications and transmission channels extending from a supervising station to a subsidiary station(s) or protected premises, or both, that comply with the requirements of Chapter 26 and are electrically isolated from the fire alarm system (or ) by a (s).

Interconnection means shall be arranged so that a single break or single ground-fault does not cause an alarm signal.

12.6.15

A wire-to-wire short-circuit fault on any alarm notification appliance circuit shall result in a trouble signal in accordance with Section 10.15, except as permitted by 12.6.5, 12.6.6, or 12.6.11.

12.6.16

Where two or more systems are interconnected, the systems shall be connected using Class A, B, N, or X circuits as described in Section 12.3.

12.7\* Nomenclature

The following nomenclature shall be used to identify the required properties of the system(s) interconnections and survivability:

System(s) interconnections

Survivability levels (not required if Level 0)

Shared pathway levels (not required if Level 0)