Chapter 12, Circuits and Pathways

Summary. Chapter 12, Circuits and Pathways, is a new chapter. It brings together requirements that were formerly found in SIG-FUN, Fundamentals of Fire Alarm Systems regarding wiring and SIG-PRO, Protected Premises Fire Alarm Systems regarding fault tolerance. The old “Class” and “Style” assignments have been changed to reflect a performance-based description of fault tolerance using “Class” only.

Also, wiring requirements are now echoed from NFPA 70 and the description of survivability has been expanded.

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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.

A.12.2.1 In the 2007 edition of NFPA 72, initiating device circuit, signaling line circuit, and notification appliance circuit performance class/style tables were rooted in “copper” wiring methods. Fire alarm control units use new communication technologies, such as Ethernet, fiber optics, and wireless, which do not fit in the “copper” wiring methods.

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 designation of the pathways shall be permitted to also include the performance of the pathway (interconnection) to survivability from attack by fire.

12.2.4* Wiring. The installation of all pathway wiring, cable, and equipment shall be in accordance with NFPA 70, National Electrical Code, and specifically with Articles 760, 770, and 800 where applicable. Optical fiber cables shall be protected against mechanical injury in accordance with Article 760 the applicable requirements of 12.2.4.1 through 12.2.4.5.

A.12.2.4 The installation of all fire alarm system wiring should take into account the fire alarm system manufacturer’s published installation instructions, and the limitations of the applicable product listings or approvals, and communications circuit protection as required by 12.2.4.2.

12.2.4.1 Optical fiber cables installed as part of the fire alarm system shall meet the requirements of NFPA 70, National Electrical Code, Article 770, and be protected against mechanical injury physical damage in accordance with NFPA 70, National Electrical Code, Article 760.
**NFPA 72-2010 Changes**

**12.2.4.2** Where fire alarm circuits enter or exit buildings, the circuits and equipment shall be installed in accordance with the requirements of Article 760 of NFPA 70, *National Electrical Code*.

Subsection 12.2.4.2 was revised by a tentative interim amendment (TIA). See page 1.

A.12.2.4.2 Interbuilding circuits are considered to have a lightning exposure unless one or more of the following conditions exist:

1. Circuits in large metropolitan areas where buildings are close together and sufficiently high to intercept lightning.
2. Interbuilding cable runs of 140 ft (42 m) or less, directly buried or in underground conduit, where a continuous metallic cable shield or a continuous metallic conduit containing the cable is connected to each building grounding electrode system.
3. Areas having an average of five or fewer thunderstorm days per year and earth resistivity of less than 100 ohm-meters.

Such areas are found along the Pacific coast. [70:800.90(A), FPN No. 2]

It is important to protect the fire alarm system from lightning.

One of the key requirements related to transient protection is NFPA 70, *National Electrical Code*, Section 760.32, which covers installation requirements. Part of those installation requirements are the grounding and bonding rules contained in Part IV of Article 800. Connections to the building grounding electrode system should be made where the circuits enter and exit a building. To minimize potential damage from induced transients, the circuits entering and exiting a building should connect to the grounding electrode system and transient protection equipment nearest the point of entry, before being intermingled with other circuits.

NEC Section 760.32 provides references for fire alarm circuits extending beyond one building. The requirements for the installation of power-limited circuits and communications circuits are covered by Parts II, III, and IV of Article 800, Communications Circuits. The methods and equipment used for providing transient protection of circuits addressed by Article 800 are not necessarily suitable for voltages expected on all fire alarm circuits.

The requirements for the installation of non–power-limited underground outdoor circuits are found in Part I of Article 300 and the applicable sections in Part I of Article 225, Underground Branch Circuits and Feeders. It should be noted that Article 225 does not specifically require transient protection of circuits, but consideration should be given to protecting underground circuits.

In both power-limited and non–power-limited circuits, surge protective devices may be installed to protect against electrical surges. When installing surge protective devices, the requirements of NEC Article 285 should be followed.

Subsections A.12.2.4 and A.12.2.4.2 were revised by a tentative interim amendment (TIA). See page 1.
12.2.4.3* 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, *National Electrical Code.*

A.12.2.4.3 Fire alarm systems include fire detection and alarm notification, guard’s tour, sprinkler waterflow, and sprinkler supervisory systems. Circuits controlled and powered by the fire alarm system include circuits for the control of building systems safety functions, elevator capture, elevator shutdown, door release, smoke doors and damper control, fire doors and damper control, and fan shutdown, but only where these circuits are powered by and controlled by the fire alarm system. [70:760.1 FPN No.1]

Class 1, 2, and 3 circuits are defined in Article 725 (of *NFPA 70, National Electrical Code*). [70:760.1 FPN No. 2]

12.2.4.4 **Grounding.** All fire alarm systems shall test free of grounds.

*Exception: Parts of circuits or equipment that are intentionally and permanently grounded to provide ground-fault detection, noise suppression, emergency ground signaling, and circuit protection grounding shall be permitted.*

12.2.4.5* 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.

A.12.2.4.5 It is important for the intended functionality of circuit integrity cable or electrical circuit protective systems to follow manufacturer’s installation instructions. An electrical circuit protective system has detailed installation requirements, and additional requirements can be found in the manufacturer’s installation instructions, NFPA 70, *National Electrical Code,* or the listing organizations’ guide information.

12.3* **Pathway Class Designations.** Pathways shall be designated as Class A, Class B, Class C, Class D, Class E, or Class X, depending on their performance.

A.12.3 The intent of the circuit designations is not to create a hierarchal ranking; rather it is to provide guidance on the levels of performance.

The initiating device circuit, signal line circuit, and notification appliance circuit performance class/style tables from previous editions of the Code have been included as Table A.12.3(a), Table A.12.3(b), and Table A.12.3(c) but have been modified to include the enhanced class references. These tables reflect the classifications as applied to fire alarm systems. Some of the operations are a combination of the requirements of Chapter 12 in conjunction with the requirements of Chapters 10 and 23. Singular ground-fault conditions that do not affect operation of the pathway are not specifically covered in Chapter 12, but are covered by the requirements of other chapters. Users of the Chapter 12 designations should review whether there are other abnormal conditions not specified in Chapter 12 that the pathways need to annunciate and operate through for their application.
12.3.1* Class A. A pathway shall be designated as Class A when it performs as follows:

(1) It includes a redundant path.
(2) Operational capability continues past a single open.
(3) Conditions that affect the intended operation of the path are annunciated.

A.12.3.1 The Class A references for initiating device circuit and notification appliance circuit performance have been changed to eliminate the need for alarm receipt capability during a single ground or annunciation of a single ground fault. The signal line circuit performance has changed to provide a clear separation between the Class A Style 6 and Class A Style 7 performance. The Class A Style 7 performance is now defined as Class X.

Fiber optic or wireless pathways are examples of Class A circuitry not impaired by earth ground connection, and short-circuits, and therefore do not annunciate those conditions as a fault. Users of the code are advised that fire alarm circuits still require alarm receipt capability during a single ground. See Chapter 23.

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

(1) It does not include a redundant path.
(2) Operational capability stops at a single open.
(3) Conditions that affect the intended operation of the path are annunciated.

A.12.3.2 The Class B references for initiating device circuit, signal line circuit, and notification appliance circuit performance have been changed to eliminate the need for alarm receipt capability during a single ground or annunciation of a single ground fault. Users of the code are advised that fire alarm circuits still require alarm receipt capability during a single ground. (See Chapter 23.)

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

(1) 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.
(2) A loss of end-to-end communication is annunciated.

A.12.3.3 The Class C reference is new and is intended to describe technologies that supervise the communication pathway by polling or continuous communication “handshaking” such as the following:

(1) Fire control unit or supervisory station connections to a wired LAN, WAN, or Internet
(2) Fire control unit or supervisory station connections to a wireless LAN, WAN, and Internet
(3) Fire control unit or supervisory station connections to a wireless (proprietary communications)
(4) Fire control unit digital alarm communication transmitter or supervisory station digital alarm communication receiver connections to the public switched telephone network
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.

A.12.3.4 The Class D reference is intended to describe pathways that are not supervised but have a fail-safe operation that performs the intended function when the connection is lost.

Examples of such pathways include the following:
(1) Power to door holders where interruption of the power results in the door closing
(2) Power to locking hardware that release upon an open circuit or fire alarm operation

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

A.12.3.5 The Class E reference is new and is intended to describe pathways, which do not require supervision as described in 10.17.

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

(1) It includes a redundant path.
(2) Operational capability continues past a single open or short-circuit.
(3) Conditions that affect the intended operation of the path are annunciated.

A.12.3.6 The Class X reference is new and is intended to describe pathways as described as Class A Style 7 of the signal line circuit performance of Table A.12.3(b). (Also see A.12.3.)

12.4 Pathway Survivability. All pathways shall comply with NFPA 70, *National Electrical Code*.

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, *Standard for the Installation of Sprinkler Systems*, with any interconnecting conductors, cables, or other physical pathways installed in metal raceways.

12.4.3 Pathway Survivability Level 2. Pathway survivability Level 2 shall consist of one or more of the following:

(1) 2-hour fire-rated circuit integrity (CI) cable
(2) 2-hour fire-rated cable system [electrical circuit protective system(s)]
(3) 2-hour fire-rated enclosure or protected area
(4) 2-hour 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, Standard for the Installation of Sprinkler Systems, and one or more of the following:

(1) 2-hour fire rated circuit integrity (CI) cable
(2) 2-hour fire rated cable system (electrical circuit protective system(s))
(3) 2-hour fire rated enclosure or protected area
(4) 2-hour performance alternatives approved by the authority having jurisdiction

12.5 Nomenclature. To identify the properties of the system(s) interconnections and survivability requirements, the following identification nomenclature shall be used:

(1) System(s) interconnections
(2) Survivability levels (not required if Level 0)