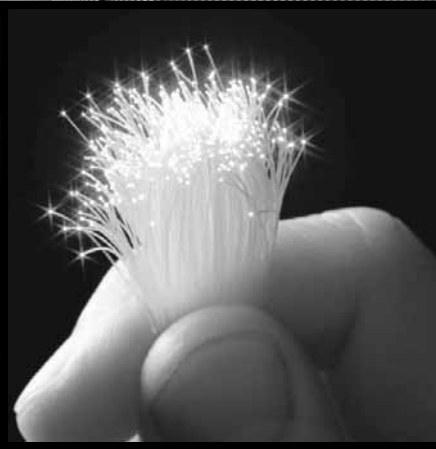
Kwikpath® Communication Raceway Systems

KWIKPATH®

Technical Guide



COMMUNICATION RACEWAY SYSTEMS

THE KWIKPATH SYSTEM – A PATHWAY TO BETTER CABLE MANAGEMENT

- Compliance to building regulations
- Easy cable installation and removal
- Reduces costs now and over long term
- Protects cable integrity

Kwikpath® Communication Raceway Systems

Technical Guide

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About IPEX

At IPEX, we have been manufacturing nonmetallic pipe and fittings for the North American marketplace since 1951. Today, we supply the widest variety of thermoplastic systems available anywhere, including complete lines of pipe, fittings, valves and custom-fabricated products.

As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technologies. We formulate most of our own thermoplastic compounds during development, and maintain strict quality control during production. Our products are then made available for distribution thanks to a network of regional stocking locations throughout North America. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience.

For specific details about any IPEX product, please contact our customer service department (you'll find contact information on the back cover).

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Table of Contents

Introduction

With the evolution of today's integrated network environments in both homes and businesses, the design of a building's cabling infrastructure has become more demanding than ever before. Not only has system performance become critical, but consumers now demand unprecedented mobility and flexibility, while maintaining low installation and maintenance costs.

Further compounding the design challenge, North American Codes have systematically introduced requirements to remove old abandoned cables from sensitive areas such as air handling plenums because of the potential fire hazard presented by not limiting the quantities of abandoned combustible cable materials in these spaces. Architects, designers, engineers and contractors installing cables in plenums now need to take the new Code requirements regarding abandoned cable into account when designing new buildings and retrofitting older ones. Raceways are the solution to the abandoned cable issue. The most convenient way to remove and replace a cable is to have it installed in a raceway.

Kwikpath Communication Raceway Systems are specifically designed for inside building fiber optic and communication cable management. Kwikpath products are approved as a communication raceway system – both conduits and corresponding fittings exceed the requirements of UL2024. Specifically the standard requires that optical fiber and communication cable raceway fittings are tested and approved in combination with the raceway with which they are being used.

Simply testing components to meet the minimum requirements for product approval does not provide assurance to the buyer, end user or the inspection authority that the products received actually meet these installed system requirements. As with many critical building products and systems, in order to provide greater assurance that the product meets the minimum performance and safety requirements of the Code, certification by a recognized certification organization is required.

As technology continues to evolve and traditional optical fiber and communications cabling methods become obsolete, designing or retrofitting buildings with optical fiber and communication cable raceways has become the solution. It combines compliance with Fire, Building and Electrical Code requirements with the demands of users to be both flexible and up-to-date with technology.

1. Understanding the Plenum and Riser Raceway Applications

The deployment of cabling systems throughout the building architecture is achieved by accessing spaces and utilizing pathways. The specific building spaces where the cabling is installed and the method by which the cabling is managed influences the product materials that may be used. Contained within walls, ceiling and floor spaces, the cabling and its supporting infrastructure must comply with life safety and construction codes.

The cabling systems installation environments can be identified as Plenum, Riser and General Purpose.

PLENUMS

Over the past few years, there has been a dramatic evolution of voice and data communications systems and an increase in the routing of voice/data cable in air handling plenums. At the same time, air handling plenums (the space above the ceiling used for air management) have become more common with the advent of integrated heating ventilation and air conditioning. From a fire safety perspective, air handling plenums present unique challenges to the prevention of the migration of fire and smoke because they usually involve large open spaces that interconnect different parts of a building. If not constructed of the right type of materials, fire and smoke can move easily to portions of the building that are remote from the area in which a fire may start. The choice of the right materials in plenums is also important because in modern buildings, many building services such as power and telecommunication cable, ducts, and even insulation materials are placed in plenum spaces for ease of access for maintenance, repair and replacement.

Prior to 1975, the National Electric Code (NEC, established by the National Fire Protection Association, NFPA No. 70) in the United States, required that all cables installed in building plenums be either encased in metal raceway or conduit, or have metal sheaths. At that time, three types of metal sheaths were accepted - mineral-insulated metal, metal clad and armored. Although the mandate to place all cables inside-metal protection made fire safety professionals feel comfortable, was it the overall best solution? Issues which could not easily be handled included the following:

- construction practices needed to be monitored closely to ensure compliance with the installation standard,
- with the dramatic proliferation of voice and data cables, a huge cost and installation time penalty was required,
- there was an inability to easily reconfigure installed voice and data cabling and,
- perhaps the most important issue - placing flammable cables inside conduit, without restricting either quantities or types of materials, did not prevent their contribution to the fuel load. Plastic cable jackets were still able to break down into flammable gaseous by-products at high temperatures, which could easily vent from joints and fittings in the conduit or sheath.

In recognition of these deficiencies, the 1975 NEC added the following wording to the cabling standard:

> "Exceptions to the conduit requirement are provided for communications, power-limited and fire alarm cables that are listed as having "adequate" fire resistant and low smoke producing characteristics".

Unlike previous editions of the code that identified specific construction details, this new approach introduced a performance requirement. But how does one test for adequate fire resistance and low smoke producing characteristics of cables?

In response to this new approach, Underwriters Laboratories in cooperation with Bell Laboratories and DuPont developed a test method to qualify cables for plenum service without metal protection, UL910. The first "plenum rated cables" were then introduced into the marketplace and the National Fire Protection Association in the U.S. recognized the new standard as part of the NFPA 90A Standard (Standard for the Installation of Air Conditioning and Ventilation Systems).

The test method became so popular that, in the early 1980s, the NFPA established its own version of UL910, "Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables used in Air Handling Spaces" as NFPA 262, which was later harmonized with UL910 in 1998. The NEC also recognized NFPA 262 and UL910 as the test method used for evaluating plenum-rated cables.

United States

This evolution was the precursor to the introduction of nonmetallic raceways for plenum use. The NEC introduced the first allowance of nonmetallic raceways in plenums in the 1999 NEC. UL subsequently developed a standard specifically for testing optical fiber and communication raceways intended for plenum use.

This new plenum raceway Standard, entitled "UL2024 – Optical Fiber Cable Raceway", defines Plenum Optical Fiber Cable Raceways and Fittings as being designed for use with optical fiber cables. Plenum Raceways and Fittings must comply with the NEC, and be evaluated for installation in ducts, plenums or other spaces used for environmental air as well as for general use applications.

Canada

In Canada, the first application of the test standard for plenum-rated cables for buildings required to be of noncombustible construction did not occur until 1997 with the introduction of the FT6 rating requirements for optical fiber cables in article 3.6.4.3 of the Ontario Building Code. Permission to use nonmetallic raceways in plenums first appears in both the National and Ontario Building Codes in the 2002 updates to the 1995 and 1997 Codes respectively.

RISERS

In most buildings, the electrical, plumbing and HVAC services start on either the main floor or the lowest floor and are distributed throughout the building in vertical and horizontal shafts. Within a single storey, these services are typically run through the horizontal space above ceiling tiles or drywall, or beneath the finish flooring. These horizontal shafts are called plenums. Similarly, Building Codes typically identify vertical shafts that house all of the building services that interconnect the stories of a building as a riser or chase. As an example, telecommunication cabling typically enters the building at a common point (i.e. telephone room). From there, cabling is distributed throughout the building. In multi-storey buildings, risers are needed. Risers do more than provide a space for building services to pass. They are also constructed so that they can prevent fire and smoke from moving from the storey that the fire originates on to other storeys within the building.

A safe alternative to constructing these vertical shafts throughout a building is to use totally enclosed raceways that can be effectively firestopped at every storey. These vertical raceways then become the Risers, which are run from floor to floor and permitted to penetrate horizontal fire separations.

UL2024 defines Riser Optical Fiber Cable and Communication Raceways and Fittings as being designed for use with optical fiber cables in accordance with the NEC, and evaluates them for installation in risers in accordance with NEC requirements, as well as general purpose applications. Raceways meeting the requirements for plenums may also be used in all riser applications.

United States

Riser Optical Fiber Cable and Communication Raceways are also evaluated by the UL2024 standard and meet the requirements for flame propagation when tested in a vertical shaft test.

The NEC, Section 770, covers the installation of optical fiber cables and raceways in risers. Riser Optical Fiber Raceways must be listed as having flame-resistant characteristics capable of preventing the carrying of fire from floor to floor within a building. This means they must meet the requirements for riser raceways in UL2024.

The NEC, Section 800, Communications Circuits, covers the installation of communication cables and raceways in risers. Riser communication cables are cables for telephone, telegraph, fire and burglar alarm systems. Communication raceways must be listed as having flame-resistant characteristics capable of preventing the carrying of fire from floor to floor. This means they must meet the requirements for riser raceways in UL2024.

Canada

Riser Optical Fiber Cable Raceways need to comply with requirements in ULC/ORD-C2024 "Standard Method of Fire Tests for Optical Fiber Cable Raceways" and meet the same requirements for flame propagation as in UL2024, when tested in a vertical shaft test.

The National Building Code of Canada, Section 3.1.5.19, does not address riser use specifically. The requirements limit the size of nonmetallic raceway (not more than 120 mm outside diameter) that can be installed within a fire compartment in a building that the Code requires to be of noncombustible construction. Optical fiber cables and electrical wires and cables can be installed in these raceways provided the raceways meet the test requirements. The raceways are not permitted to exhibit a vertical char of more than 1.5 m when tested to the Vertical Flame Test – Conduit or Tubing on Cable Tray in Clause 6.16 of CSA C22.2 No. 211.0-M "General Requirements and Methods of Testing for Nonmetallic Conduit (FT-4 Rating)".

This referenced standard is identical to the Test for Flame Propagation (Riser) in ULC/ORD-C2024 and the 2005 National Building Code will refer to ULC/ORD-C2024 instead of CSA C22.2 No. 211.0.

GENERAL PURPOSE USE

UL2024 describes general use Optical Fiber Cable and Communication Raceways as suitable for general purpose use, which excludes risers, plenums, and other spaces used for environmental air when they contain specific types of optical fiber cables. This type of raceway is resistant to the spread of fire when tested in accordance with the Vertical-Tray Flame Test (General Use) in UL2024. These types of raceway are primarily used in combustible construction, i.e. residential.

United States

The NEC, Section 770 and Section 800, defines General Purpose Optical Fiber Raceways as raceways that are listed as being resistant to the spread of fire. This means they need to meet the requirements of the Vertical-Tray Flame Test in UL2024.

Canada

Optical Fiber and Communication Cable Raceways intended for general use are evaluated in accordance with the standard ULC/ORD-C2024 Standard Method of Fire Tests for Optical Fiber Cable Raceways and meet the same requirements for flame propagation as in UL2024, when tested in the Vertical-Tray Flame Test.

The National Building Code of Canada permits general use Optical Fiber Cable Raceways in all buildings permitted to be of combustible construction, except in plenums and locations where the raceways pass through fire separations.

THE TEST STANDARDS

The test standards used for evaluating the fire resisting properties of Optical Fiber Cable Raceways are UL2024 (U.S.) and ULC/ORD-C2024 (Canada). These standards are essentially identical. Each of these test standards contains three basic tests:

1) Plenum – The Steiner tunnel test is used for evaluating flame propagation and smoke density of plenum raceways. Samples are installed horizontally full width on a metal cable tray, 24 ft. long and subjected to a combination of a 4.5 ft. long flame impingement with an exhaust air flow of 240 ft./min.

	STANDARD	UNITED STATES	CANADA
A	Plenum Test	UL2024	ULC/ORD-C2024
	Maximum flame propagation distance	5 ft.	1.5 m
	Peak Optical Density	0.50 or less	0.50 or less
	Average Optical Density	0.15 or less	0.15 or less
	Raceway Marking	Plenum	FT-6

2) Riser – The riser test is used for evaluating flame propagation of riser raceways. Samples are installed vertically in a shaft simulating a run between 2 floors, with the raceways installed full width on a 16 ft. long metal cable tray and subjected to a defined test flame at the bottom with an exhaust air flow of 700 ft./min.

	STANDARD	UNITED STATES	CANADA
B	Riser Test	UL2024	ULC/ORD-C2024
	Equivalent Standard	UL1666	Clause 6.16 of CSA C22.2 No. 211.0
	Flame propagation height	< 12 ft.	< 3.7 m
	Temperature at 3.7m (12 feet) height	850ºF	454ºC
	Difference in flame propagation heights for 2 tests	15%	15%
	Raceway Marking	Riser	FT-4

3) General Use – The Vertical-Tray Flame Test is used for evaluating flame propagation of general use raceways. Samples are installed full width on an 8 ft. long steel cable tray and are subjected to a ribbon burner flame with no air flow. Raceway fittings are then tested by putting the fittings 2 ft. above the burner attached to the raceway, facing both toward and away from the cable tray.

	STANDARD	UNITED STATES	CANADA
C	General Use Test	UL2024	ULC/ORD-C2024
	Equivalent Standard	UL1581 Vertical-Tray Flame Test	Vertical-tray flame test described in Clause 4.11.1 of CSA C22.2 No. 0.3-01
	Flame damage after 20 minutes	Shall not reach upper end of specimen	Shall not reach upper end of specimen
	Raceway Marking	None	FT-1

2. Cabling within the Raceways

PERMISSIBLE CABLING WITHIN THE RACEWAYS

United States

Chapters 3 and 9 of the NEC identify and define the types and quantities of cables that can be installed in raceways.

Raceways for Optical Fiber Cables

Plenums

According to the 2005 NEC, the following cable types are permitted to be installed in plenums in Optical Fiber Raceways:

OFNP – "Optical fiber nonconductive plenum" cables that meet the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

OFCP – "Optical fiber conductive plenum" cables that meet the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

Risers

The following cable types are permitted to be installed in risers in Optical Fiber Raceways:

OFNR – "Optical fiber nonconductive riser" cables that meet the same flame propagation requirements of riser raceways (FT- 4).

OFCR – "Optical fiber conductive riser" cables that meet the same flame propagation requirements of riser raceways (FT- 4).

OFNP – "Optical fiber nonconductive plenum" cables that meet the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

OFCP – "Optical fiber conductive plenum" cables that meet the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

General Use

The following cable types are permitted to be installed in general purpose applications in Optical Fiber Raceways:

OFNG – "Optical fiber nonconductive general purpose" cables that meet the same flame propagation requirements of general use raceways (FT-1).

OFCG – "Optical fiber nonconductive general purpose" cables that meet the same flame propagation requirements of general use raceways (FT-1).

The following table summarizes the certification markings that appear on these cable types:

Fiber Optic Cable Markings and Substitutions

Marking	Type
OFNP	Nonconductive plenum
OFCP	Conductive plenum
OFNR	Nonconductive riser
OFCR	Conductive Riser
OFNG	Non conductive
OFCG	Conductive

The table below describes the permitted substitutions for optical fiber cables:

Cable Type	Substitution
OFNP	None
OFCP	OFNP
OFNR	OFNP
OFCR	OFNR, OFCP, OFNP
OFNG	OFNR, OFNP
OFCG	OFNG, OFCR, OFNR, OFCP, OFNP

Raceways for Communication Cables

Plenum

The only cable type permitted for installation in communication raceways in plenums is the following:

CMP – "Communication Plenum" cable that meets the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

Risers

The cable types permitted for installation in risers in communication raceways are:

CMR – "Communication Riser" cable that meets the same flame propagation requirements of riser raceways (FT- 4).

CMP – "Communication Plenum" cable that meets the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

General Use

The types of cable permitted for installation in general purpose applications in communication raceways are:

CM – "Communication" cable that meets the same flame propagation requirements of general use raceways (FT-1).

CMR – "Communication Riser" cable that meets the same flame propagation requirements of riser raceways (FT- 4).

CMP – "Communication Plenum" cable that meets the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

NOTE: The NEC permits both conductive and nonconductive cables to be installed in Optical Fiber Cable Raceways. However, Underwriters' Laboratories listings for these types of raceways limit cable types to "nonconductive" only. UL's listings permit the following cable types.

For plenum applications: OFNP, CMP and CMP-OF.

For riser applications: OFNP, OFNR, CMP, CMP-OF, CMR, and CMR-OF.

For general use applications: OFNP, OFNR, OFNG, OFN, CMP, CMP-OF, CMR, CMR-OF, CMG, CMG-OF, CM, and CM-OF.

The subscript "OF" in the UL listings refers to optical fiber cables.

Abandoned Cables in Plenums

Traditionally, plenum spaces have been strictly regulated to limit fire spread and fire growth. In the event of a fire, cables abandoned and left in the plenums can become a safety hazard to the occupants of a building by unnecessarily adding to the fuel load in the plenum. With the enormous growth in the use of communication cable in recent years, the authoritative body of the Codes and Standards have recognized that some remedial action is necessary to prevent an accumulation of combustible materials in plenum spaces. As a result, in 2002, NEC took the first steps in addressing the issue of removing abandoned cables for air handling spaces by having each Article affected by this issue adopt a definition of abandoned cables, and the rule for removal.

For example, Article 770, Optical Fiber Cables and Raceways, added the following definition for Abandoned Optical Fiber Cable.

770.2 Definitions Abandoned Optical Fiber Cable. Installed optical fiber cable that is not terminated at equipment other than a connector and not identified for future use with a tag.

Spread of Fire or Products of Combustion. The requirements of 300.21 for electrical installations shall also apply to installations of optical fiber cables and raceways. The accessible portion of abandoned optical fiber cables shall not be permitted to remain.

> **Accessible (as applied to wiring methods).** Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building.

In Canada, the National Fire Code intends to introduce a similar requirement to remove abandoned optical fiber and communication cables and electrical wire and cables, with combustible insulation, jackets or sheathes, and nonmetallic raceways from plenums with the following exceptions:

(a) wire/cables that are permanently enclosed by the structure or finish of the building,
(b) wire/cables that are not capable of being removed without disturbing the building structure or finish, or
(c) their removal will risk affecting the performance of cables in use.

Several organizations such as BICSI, TIA (Telecommunications Industry Association) and NECA (National Electrical Contractors Association) are working on designing a "Tag" that would be acceptable for identifying a cable intended for future use.

Architects, designers, engineers and contractors installing cables in plenums now need to take the new Code requirements regarding abandoned cable into account when designing new buildings and retrofitting older ones. The most convenient way to remove and replace a cable is to have it installed in a raceway.

Raceways are the solution to the abandoned cable issue. As technology continues to evolve and traditional optical fiber and communications cabling methods become obsolete, buildings designed or retrofitted with raceways will easily allow compliance with Fire, Building and Electrical Code requirements while, at the same time, being up-to-date with technology.

3. Kwikpath Design Data

The physical property specifications for nonmetallic conduit are found in UL1653 Electrical Nonmetallic Tubing (United States) and (CSA C22.2 No. 227.1 Electrical Nonmetallic Tubing (Canada). This is a bi-national standard containing the requirements for both countries. Products are intended for use at a maximum continuous operating temperature of 75ºC (167º) and a maximum ambient temperature of 50ºC (122ºF).

The following properties apply to Kwikpath Communication Raceways:

A. Dimensional Criteria

Dimensional specifications are applied to nonmetallic conduit in order that they may fulfill their function of housing cabling without causing abrasion when cables are pulled through the inside of the conduit. Wall thickness is specified so that the conduit adequately protects the conductors inside from damage. Fittings are to be provided with end stops (centering stop for a coupling). The maximum inside diameter of the stop cannot exceed the minimum outside diameter of the conduit.

Inside and Outside Diameters

Table 1 – Kwikpath Plenum and Riser Internal and External Dimensions

Trade Size of Conduit (in.)	Inside Diam. mm Min	Inside Diam. mm Max	Outside Diam. mm Min	Outside Diam. mm Max	Inside Diam. in. Min	Inside Diam. in. Max	Outside Diam. in. Min	Outside Diam. in. Max
21 (¾)	19.66	21.18	25.91	26.92	0.774	0.834	1.021	1.061
27 (1)	25.40	26.90	32.64	33.65	1.000	1.060	1.286	1.326
35 (1 ¼)	33.73	35.36	41.35	42.47	1.329	1.393	1.630	1.673
41 (1 ½)	39.57	41.20	47.45	48.56	1.559	1.623	1.869	1.913
53 (2)	51.18	52.81	59.00	60.63	2.016	2.081	2.324	2.388

B. Physical Properties

Beyond the dimensional characteristics and fire resistive properties, optical fiber and communication raceways must meet specific physical and performance criterion.

General

Optical fiber and communication cable raceways shall be free of burrs and sharp edges on the interior surfaces that can cause damage to cables.

Cold Bend

After the samples have been exposed to temperatures of -20ºC (-4.0º F) for 60 minutes and within 15 seconds of being removed from the freezer, each sample shall be wrapped for one complete turn around a mandrel and maintained in that position for 60 seconds.

The raceways must be capable of returning to their original form when unwrapped from the mandrel and shall not have any splits, cracks or tears on the outside or inside surfaces.

Heat Shock

Each size of raceway shall be tested. Each test specimen shall be 1m (3 ft.) in length and wrapped for one complete turn around a mandrel with a diameter approximately 2-1/2 times the outside diameter of the raceway being tested. Tension is applied to the specimen causing the specimen to conform closely to the curved surface of the mandrel. The assemblies are placed in an air-circulating oven at a temperature of 100º C (212º F) for a period of seven hours.

The raceways must be capable of returning to their original form when unwrapped from the mandrel and shall not have any splits, cracks or tears on the outside or inside surfaces.

Fitting Pull-Out

In order to test the connection between the raceway and fitting, mechanically attached fittings are assembled to a 15 in. length of raceway of the same trade size, following the manufacturer's installation instructions. Then, after being conditioned for seven hours at 90º C, fittings must demonstrate that they will not pull away from the conduit when subjected to a direct pull.

UL and CSA requirements and testing procedures

The test standards used for testing the physical properties of optical fiber and communication cable raceway for the United States and Canada are summarized in Table 2.

Table 2 – Test Standards Used

Test	U.S.A.	Canada
Heat Shock	UL2024	ULC/ORD C2024
Cold Bend	UL2024	ULC/ORD C2024 CSA C22.2
Fitting Pull-Out	UL1653 Electrical Nonmetallic Tubing	CSA C22.1 No. 227.1 Electrical Nonmetallic Tubing

C. The Importance of Certifications

The Building Codes and Electrical Codes define the minimum set of requirements that a product must meet in order to be installed. This is done by either setting specifications such as the general purpose (FT-1), riser (FT-4) or plenum (FT-6) ratings described earlier, or by referencing standards that contain the specifications in them.

Manufacturers can conduct the tests necessary to demonstrate that they meet these requirements and show a potential user of the product a copy of the test report describing the tests conducted and the results obtained. But, is this enough?

In the case of requirements found in the National Building Code of Canada, just testing will meet the minimum requirements, but it does not provide assurance to the buyer, end user or the inspection authority that the product they receive actually meets these requirements. In order to provide greater assurance that the product meets the minimum requirements of the Code, certification by a recognized certification organization is required.

What is meant by Certification?

Certification refers to the program conducted by accredited certification organizations that have the following essential elements:

- Initial testing of the identified product to the requirements of the test standard. This means the certification organization typically witnesses or verifies production of the samples to be tested and identifies sufficient samples of the product for both the tests required by the standard and additional tests to identify the product for future production (fingerprint testing).
- Establishing a follow up service program for the product. This follow up program details the product specifications (based on the initial tests), the quality control program (required by the manufacturer), the frequency of visits to the manufacturer by certification agencies' inspectors, the required in-plant tests and sample selection by the inspectors, and the marking that must appear on the product to verify that the product meets the requirements of the applicable standard.
- Ongoing follow up service program at the manufacturer's factory for the life of the products' certification.

A key element of certification is the actual marking on the product. This marking usually entails an identifier, such as "Plenum – OFCP FT-6", along with the logo or certification mark of the certifying agency. This is the evidence provided in the field that the product meets the criteria in the Standards (i.e. "Plenum FT-6") which are required in the Codes. Inspectors, contractors and owners look for the marking to ensure that the product meets the requirements of the Code.

In the United States, the NEC specifies that Optical Fiber Cable and Communication Raceways must be "listed" as meeting the requirements of UL2024. The term "listed" means "certified" as described above. Inspectors and contractors will look for the terms plenum or riser on optical fiber cable raceway products. Only products bearing the appropriate markings will be permitted for installation in jurisdictions adopting the NEC.

D. System Approval (conduit only and conduit with fittings)

The Standards in North America for optical fiber cable raceways, UL2024 and ULC/ORD 2024, define the tests required for conduits and conduits with fittings. Fittings are not intended to be interchangeable with other conduit or raceway systems as the conduits may differ in their inside and outside diameters. As a result, optical fiber cable raceway fittings are tested in combination with the conduit with which they are intended to be used.

If fittings are molded of the same material used for the conduits and the conduits have been subjected to the flame tests – tunnel (plenum), riser or vertical-tray flame test (general use), then the fittings do not have to be tested separately to the corresponding flame test in order to be certified.

However, if the fittings are molded of a material different than what is used for the conduits, then the material used for the fitting must be molded into the same shape as the conduit, including the same inside and outside diameters, and joined to provide a sample of the length needed for the plenum test (24 ft.) and the riser test (16 ft.). The fitting samples are then subjected to the same tests as the conduits. For the vertical-tray flame test (general use), the fittings are tested with the conduit and installed 2 ft. from the bottom of the cable tray used in the test.

Kwikpath Communication Raceway Systems is a system of plenum and riser raceway and fittings. The respective plenum and riser fittings are made of the same material as the raceway and were tested in combination with the conduits to UL2024.

E. Installation

United States

The installation requirements for optical fiber cable raceways are found in Section 300 of the NEC. Specifically, the NEC indicates that optical fiber and communication cable raceway for general purpose, riser or plenum use must comply with applicable electrical nonmetallic tubing (ENT) requirements in Article 362.24 through 362.56.

Footage Markings

To assist with installation of the fiber/communication cabling raceway system, all Kwikpath raceway products are marked with foot markings along their length. This important feature provides the installer a way of determining material length remaining on reels/coils, as well as the length of a single uninterrupted run.

The pull tape supplied within Kwikpath raceway is also marked along its length with footage markings; however, the pull tape markings do not correspond to the footage marking on the raceway. Footage markings are unique to each package of Kwikpath product and as a result, users should be aware whenever systems are connected or interrupted by a connection point (i.e. junction box), the footage markings on each section of raceway will not necessarily be consecutive.

Bends

Any bends must be made so that the optical fiber and communication cable raceway will not be damaged and the internal diameter of the optical fiber and communication cable raceway will not be effectively reduced. Bends can be made manually without auxiliary equipment. However, the radius of the curve to the centerline of such bends shall not be less than shown in Table 3.

Table 3 – Radius of Bends

Conduit Size		Radius of Bends	
in.	mm	in.	mm
¾	21	5	127
1	27	6	152.4
1 ¼	35	8	203.2
1 ½	41	10	254
2	53	12	304.8

According to NEC 362.26 there shall not be more than the equivalent of four quarter bends (360 degrees total) between pull points such as conduit bodies and boxes. Engineers, architects and owners can specify more stringent requirements; for example design guidelines in TIA/EIA 569-A state: No section of conduit shall contain more than two 90º bends, or equivalent, between pull points.

Trimming

Appropriate cutting tools such as a Kwikon® pipe cutter or ratcheting style PVC cutter should be used. To ensure a clean cut and avoid fracturing the end of the raceway, the cutting tool should be spun to complete the cut rather than using a quick snapping action. Other cutting methods can be used but it is important to ensure all cut ends are trimmed inside and outside to remove rough edges.

Securing and Support

Optical fiber and communication cable raceways are installed as a complete system as described in Article 300 of the NEC, and shall be securely fastened in place and supported as described in A and B below:

(A) Securely Fastened. Optical fiber and communication cable raceway shall be securely fastened at intervals not exceeding 900 mm (3 ft.). In addition, optical fiber and communication cable raceway must be securely fastened in place within 900 mm (3 ft.) of each outlet box, device box, junction box, cabinet or terminating fitting.

(B) Supports. Horizontal runs of optical fiber and communication cable raceway which are supported by openings in framing members at intervals not exceeding 900 mm (3 ft.) and securely fastened within 900 mm (3 ft.) of termination points are also permitted.

Bushings

Unless the box, fitting or enclosure is designed to provide equivalent protection where an optical fiber and communication cable raceway enters a box, fitting or other enclosure, a bushing or adapter must be provided to protect the wire from abrasion. Kwikpath KPTA and KRTA fittings are designed for this purpose and ensure both a strong connection and cable protection.

Joints

Joints between lengths of optical fiber and communication cable raceway and joints between optical fiber and communication cable raceway and couplings, fittings or boxes must be done by an approved method. Approved methods are determined by testing the optical fiber and communication cable raceway and fittings together in the appropriate flammability and physical property tests described in Section 3 above under the System Approval.

Connecting plenum and/or riser optical fiber and communication cable raceways must be completed using approved methods. Coupling and terminating raceways using dissimilar materials (i.e. metal) or fittings not uniquely designed for corrugated nonmetallic raceways (i.e. compression couplings) are not approved unless the specific type of fitting has been tested to UL2024 in combination with the raceway.

Solvent cement fittings made of the same materials is an option, provided the fittings are approved. The use of solvent cements in enclosed environments, especially in occupied spaces, is a concern. Explicit health and safety requirements must be adhered to for handling, storage and during the installation process. It is imperative that the proper cement is used for the material type to be bonded and that the joint is given the appropriate initial set-up and curing time before being handled and installed. For these reasons, the use of mechanically attached fittings are highly recommended.

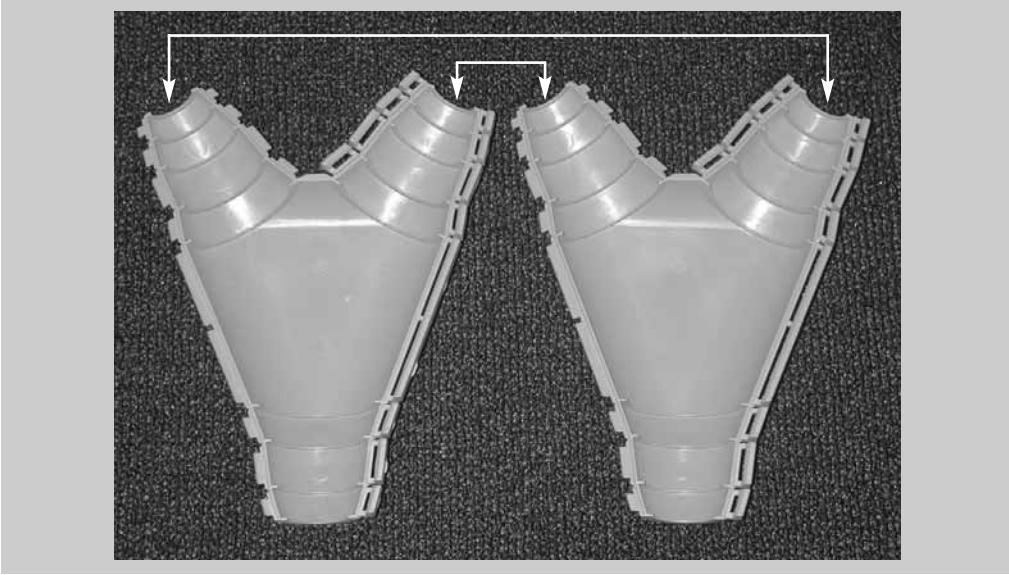
Y-Coupler

There are two scenarios that a Y-Coupler will typically be used: new raceway and cable installations; or expanding upon an existing infrastructure. It is recommended that all Y-Couplers point in the same direction to ensure the ability to fish cables in the future.

New Construction

(1) Begin by cutting the Y-Coupler along the pre-scored cut lines with a hacksaw to match the diameter of the corrugated raceway. Figure 1 shows the branches that must be cut such that the two cut branches will align properly when the coupler is snapped together.

Figure 1: Cut the Correct Branches



(2) Snap the Y-Coupler around all three raceway branches with two raceway corrugations inside each branch to ensure a solid connection and then install the cable as per regular installation practices.

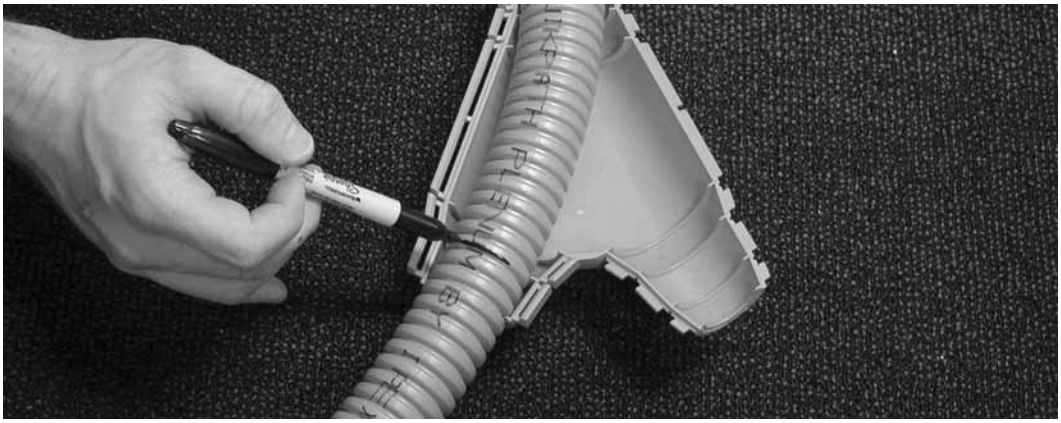
It is recommended that the raceways are labeled as stated in the **Labeling** section of the technical guide.

Retrofit or Existing Raceway and Cable Construction

(1) Begin by cutting the Y-Coupler along the pre-scored cut lines with a hacksaw to match the diameter of the corrugated raceway. Figure 1 shows the branches that must be cut such that the two cut branches will align properly when the coupler is snapped together.

(2) Cut and remove a section of the existing raceway. The size of the raceway section to be removed should be determined using the size of the Y-Coupler as a guide as shown in Figure 2. Two raceway corrugations should fit within each branch to ensure a solid connection, however, do not over insert the raceway because this may cause difficulties when fishing the pull string. Proper care must be taken not to damage any of the existing cables while cutting the existing raceway.

Figure 2: Determine Size of Section to be Removed



(3) Install the new raceway and fish a pull string through the new raceway towards the Y-Coupler.

a) If there is a pull string in the existing raceway, cut it and connect the source end (telecommunications room) to the new pull string and tie the other end to the existing cable so that it may be used for future installations.

b) If there is no existing pull string, fish the new pull string through the entire raceway from the end point back to the source (telecommunications room).

(4) Snap the Y-Coupler into place and then pull the new cable through.

Communication raceways should be labeled (see 'Labeling' in Technical Guide) and it is recommended that each Kwikpath Y-Coupler once installed, should be represented on the infrastructure drawings in a similar fashion to a pull box.

Labeling

Figure 3 demonstrates how TIA/EIA-606-A suggests pathways should be labeled. The size, color and contrast of all labels should be selected to ensure that the identifiers are easily read during installation and maintenance of the infrastructure.

Figure 3: Example of Optional Pathway Identifiers and Labeling

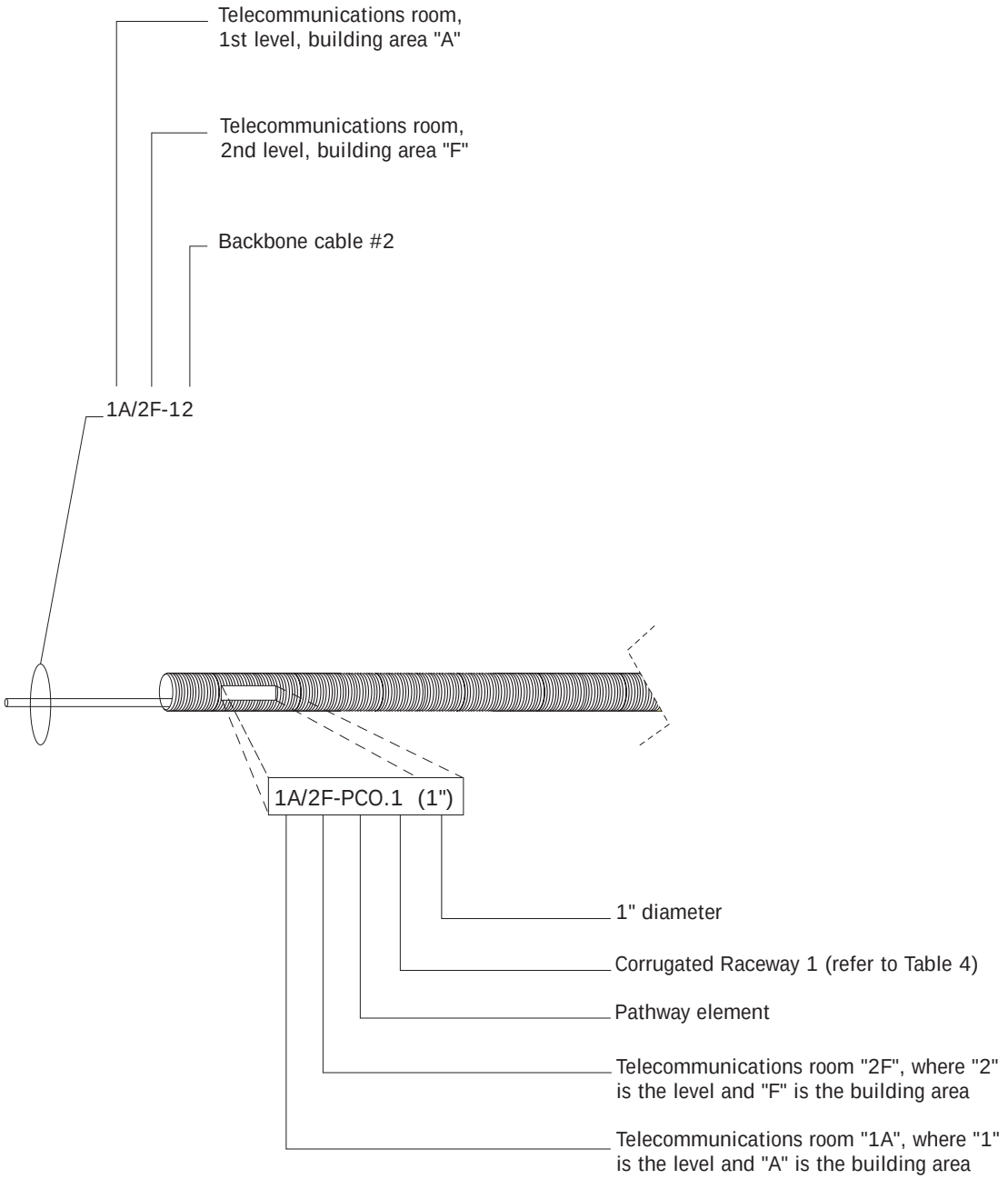


Table 4: Optional Identifiers Associated with Pathway, Device and Space Elements

Copper

C = Copper

BF	Block Field
CA	Cable
CS	Case
CC	Cross Connect
FP	Feed Pair
HP	House Pair
MS	Mechanical Splice
PL	Panel
PT	Port
SP	STP
SH	Sheath
SN	Section
TM	Termination
UP	UTP

Fiber

C = Fiber

CA	Cable
CS	Case
MM	Multi-Mode
FS	Fusion Splice
PL	Panel
PT	Port
SH	Sheath
SM	Single-Mode
SN	Section
TM	Termination

Wireless

W = Wireless

BW	Bandwidth
CH	Channel
WT	Wireless Tap

Coax

X = Coax

TP	Tap (coax)
SN	Section
TM	Termination
LG	Leg

Pathway

P = Pathway

BR	Branch Splice
BS	Bridge Splice
CB	Cabinet
CN	Conduit
CT	Cable Tray
FR	Frame
GB	Ground Bar
NT	Node
PB	Pull Box
PN	Penetration
RK	Rack
RR	Ring Rung
SL	Sleeve
SS	Straight Splice
ST	Slot
TY	Tray

The following pathway elements can also be defined as spaces if the identifier is expressed in brackets along with a site/campus and/or building identifier.

MH	Maintenance Hole
HH	Hand Hole
BR	Bridge
TN	Tunnel
TP	Telephone Pole
DB	Direct Buried Locale
SM	Submerged Locale
EN	Entrance
VL	Vault
PE	Pedestal
RT	Roof Top

Devices

A = Active Device

CMR	Camera
CS	Chassis
CI	Carrier ID
AMP	Amplifier
ANL	Analog
DIG	Digital
DLR	Dialer
FAX	Fax
GBR	Glass Break
HNS	Handset
MDM	Modem
MIC	Microphone
MNT	Monitor
PAY	Pay Phone
PC1	PC
RDR	Reader
RS	Remote Shelf
SF	Shelf
SNS	Sensor
SPK	Speaker
STK	Strike
STR	Strobe
TEL	Telephone
TTY	Tele Type
TV1	Television
WLP	Wall Phone

Spaces

S = Space

AP	Access Point
APS	Access Provider Space
CER	Common Equipment Room
CTR	Common Telecommunications Room
CO	Central Office
DM	Demarcation (NI)
ER	Equipment Room
NOC	Network Operations Center
SPS	Service Provider Space
SR	Switch Room
STAR	Logical Center of the data network
TER	Telecommunications Entrance Room
TR	Telecommunications Room
WTRS	Wireless Transmission and Reception Space
WS	Workstation Location
SZ	Serving Zone
RO	Repeater Office

F. Infrastructure Administration

TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure is a set of guidelines to maintain a proper administrative system that provides a method to find the record associated with any specific element of the telecommunication infrastructure. It is recommended that each Kwikpath Y-Coupler installed should be represented on the infrastructure drawings in a similar fashion to a pull box.

G. Code Enforcement

All jurisdictions utilize some form of permit and inspection process in order to verify compliance of products and systems being used with the Codes and the specifications submitted and approved during the Plan Review phase of a permit application. Any new building or substantial building renovation, whether it is a residential or commercial building, will typically require permits from the local municipality and/or authority having jurisdiction. This applies to the installation of electrical systems, and includes alterations, repairs, replacement, equipment, appliances, fixtures, fittings and other accessories or devices.

The authority having jurisdiction (AHJ), whether they are a building, fire, plumbing or electrical official, is authorized and directed to enforce the provisions of the Code. In addition, even if approval has previously been granted, the inspection department may reject, at any time, any installation if they find that:

(a) the equipment is substandard with respect to the sample on which approval was granted or,

(b) the conditions of use indicate that the equipment is not suitable or,

(c) the terms of the approval agreement are not being carried out.

Ultimately, the AHJ needs to be satisfied that the product or system complies with the letter or intent of the Codes.

H. Handling and Storage

Proper care should be exercised when handling and storing to ensure the material is not subject to impact, long term exposure to direct sunlight or harsh environments. Kwikpath products are packaged to minimize any concerns regarding the shipping and handling of the product but improper handling and storage may cause potential problems.

Coils are packaged individually in corrugated boxed cartons developed for ease of handling and dispensing. Designed into the cartons are two packaging features that assist with moving and dispensing the product. First, the boxes have hand holes on each end, enabling shippers and installers an easy method of handling the cartons. Secondly, marked on the front panel of each carton is the location of a dispensing hole. Using a utility knife and cutting away the disk at the marked location provides the user with a clean method of dispensing the coiled product. By using this dispensing method, only the necessary product amount is withdrawn from the carton with the balance being contained and easily managed.

Kwikpath products supplied on reels are completely wrapped with ultraviolet light resistant sheeting at the production facility, permitting the reels to be handled and stored outdoors for intermittent periods of time.

IPEX recommends that all Kwikpath products are stored indoors in a clean, dry environment. To avoid damage to packaging and product, pallet quantities of Kwikpath should not be stacked and normal care should be exercised when handling reels.

Glossary of Terms

Authority Having Jurisdiction – The officer or other designated authority charged with the administration and enforcement of the Code, or their duly authorized representative.

Backbone – The pathway, cable or conductors that connect telecommunications rooms, entrance facilities and equipment rooms within or between buildings. With today's networks, the backbone is becoming based more on fiber optic cable.

CM – "Communication" cables that meet the same flame propagation requirements of general use raceways (FT-1).

CMP – "Communication Plenum" cable that meets the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

CMR – "Communication Riser" cables that meet the same flame propagation requirements of riser raceways (FT- 4).

Combustible - (Canada) – A material that fails to meet the acceptance criteria of CAN4-S114, "Standard Method of Test for Determination of Non-Combustibility in Building Materials". An example of a combustible material would be any untreated wood product.

Combustible Construction - (Canada) – A type of construction that does not meet the requirements for noncombustible construction.

Conduit – A metallic or nonmetallic, rigid/non-rigid raceway with a circular cross-section through which cables are pulled. Conduits should not be filled beyond those limitations set out in the National Electrical Code or the Canadian Electrical Code.

Fiber Optic Cable – Fiber optics (optical fibers) are long, thin strands of very pure glass about the diameter of a human hair. They are arranged in bundles called fiber optic cables and used to transmit light signals over long distances.

Fire-Resistance Rating – The time in minutes or hours that a material or assembly of materials will withstand the passage of flame and transmission of heat when exposed to fire under specified conditions of test and performance criteria.

Fire Stop – An assemblage of specific materials or products that are designed, tested, and fire-resistance rated in accordance with the applicable test Standards to resist, for a prescribed period of time, the passage of fire through openings made in fire-resistance-rated assemblies.

Listed – See description of certification on page 15.

Noncombustible - (Canada) – A material that meets to acceptance criteria of CAN4-S114, "Standard Method of Test for Determination of Non-Combustibility in Building Materials". Examples of noncombustible materials include steel and concrete.

Noncombustible Construction - (Canada) – A type of construction in which a degree of fire safety is attained by the use of noncombustible materials for structural members and other building assemblies.

Optical Fiber Cable – A cable consisting of one or more optical fibers which transmits modulated light for the purpose of control, signaling or communications.

OFCP – "Optical fiber conductive plenum" cables that meet the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

OFCR – "Optical fiber conductive riser" cables that meet the same flame propagation requirements of riser raceways (FT- 4).

OFCG – "Optical fiber conductive general purpose" cables that meet the same flame propagation requirements of general use raceways (FT-1).

OFNP – "Optical fiber nonconductive plenum" cables that meet the same flame propagation and smoke density requirements of plenum raceways (FT- 6).

OFNR – "Optical fiber nonconductive riser" cables that meet the same flame propagation requirements of riser raceways (FT- 4).

OFNG – "Optical fiber nonconductive general purpose" cables that meet the same flame propagation requirements of general use raceways (FT-1).

Plenum – A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system. The plenum space is used typically to house communication and fiber optic cables for the building computer and telephone networks.

Raceway – An enclosed channel of metallic or nonmetallic materials designated specifically for holding wires, cables or busbars.

Riser – The system of pathways that are provided to run riser cables for one floor to another. Elevator shafts cannot be used as risers.

References

1. CSA Standard C22.1-02, Canadian Electrical Code®, Part 1, Safety Standards for Electrical Installations, Canadian Standards Association, 5060 Spectrum, Suite 100, Mississauga, ON, Canada L4W 5N6

2. CSA Standard C22.2 No. 211.0-M General Requirements and Methods of Testing for Nonmetallic Conduit (FT-4 Rating), Canadian Standards Association.

3. CSA Standard C22.2 No. 227.1 Electrical Nonmetallic Tubing, Canadian Standards Association.

4. National Building Code of Canada, National Research Council of Canada®, 1200 Montreal Road, Ottawa, ON, Canada K1A 9Z9

5. NFPA 70, National Electrical Code®, 2002, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471 USA

6. NFPA 90A Standard for the Installation of Air Conditioning and Ventilation Systems, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471 USA

   (i) NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471 USA

   (ii) Ontario Building Code, Ministry of Municipal Affairs, Planning and Development Division, Building and Development Branch, 777 Bay Street, Toronto, ON, Canada M5G 2E5

   (iii) ULC/ORD-C2024-02, Standard Method of Fire Tests for Optical Fiber Cable Raceway, Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, Canada M1R 3A9.

   (iv) UL910 Standard Test for Flame-Propagation and Smoke Density Values for Electrical and Optical Fiber Cables Used in Spaces Transporting Environmental Air, Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, USA

   (v) UL1653, Electrical Nonmetallic Tubing, 333 Pfingsten Road, Northbrook, IL 60062-2096, USA

   (vi) UL2024 Optical Fiber Cable Raceway, Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, USA

7. TIA/EIA Standard 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces, TIA 2500 Wilson Boulevard, Arlington, VA 22201 USA