Fiber Optic Cable

for Warehouse Automation

AMERICAS
(North America and Latin America)

PANDUIT®
infrastructure for a connected world

Fiber Optic hardware plays a crucial role in warehouse automation by providing reliable and high-speed communication between various components of the automated systems. Warehouse automation involves the use of technologies such as robotic systems, conveyor systems, inventory management systems, and more. Partner with Panduit for best-in-class solutions throughout your inside-plant environments that scale around the globe. Panduit Fiber Optics solutions support your warehouse automation needs, so you can effectively and efficiently support your customers.

Backbone Cabling in Industrial Premises

Backbone cabling provides interconnections across telecommunications cabling system structures, including telecommunications enclosures, telecommunications rooms, equipment rooms, main terminal space and entrance facilities and cabling between buildings (ANSI/TIA-1005).

Choosing Media

User requirements and characteristics of the individual application across these factors should be considered:

• Flexibility to meet supported user services

• Expected life of the backbone cabling

• Site size and user population

• Environmental conditions

Recognized backbone cables for Optical Fiber

• Multimode optical fiber cable (OM1-OM5 glass grades)

• Single-mode optical fiber cable (OS2)

Performance Requirements

• Optical fiber cabling performance requirements are outlined in ANSI/TIA-568-C.0 and ANSI/TIA-568-C.3

• Environmental conditions may require additional enhancements or separation/isolation of cables.

Grounding and Bonding

• Grounding (earthing) and bonding systems may be required for safety and EMC compatibility per ANSI-J-STD-607-A requirements

MICE Environmental Considerations

Cabling in industrial premises environments frequently is exposed to caustic, wet, vibrating, and electrically noisy conditions. A systematic approach to make this assessment, called Mechanical Ingress Chemical/Climatic Electromagnetic (M.I.C.E.), is described in TIA-1005A and other standards ANSI/TIA-568-C.0, ODVA, ISO/IEC24702 and CENELEC EN50173-3.

M.I.C.E. assessment considers four areas:

· **Mechanical**—Shock, vibration, crush, impact

· **Ingress**—Penetration of liquids and dust

· **Chemical/Climatic**—Temperature, humidity, contaminants, solar radiation

· **Electromagnetic**—Interference caused by electromagnetic noise on communication and electronic systems

M.I.C.E. factors are graded on a severity scale from 1 to 3, where 1 is negligible, 2 is moderate and 3 is severe).

Increased Environmental Severity

Mechanical Shock + Vibration	M_1	M_2	M_3
Ingress Water + Dust	I_1	I_2	I_3
Climatic Chemical	C_1	C_2	C_3
Electromagnetic	E_1	E_2	E_3

Office   **Industrial**

How It Works

The fiber optic backbone serves as the primary means of high-speed communication across the enterprise, facility, and automation areas. Common applications and the typical cable types used:

Office Areas

Office spaces, meeting and training rooms, cafeterias areas and enclosed equipment or telecom rooms within the warehouse facilities are likely to require either a plenum rated or low-smoke zero halogen cable (depending on regional requirements). Indoor distribution cables and indoor armored cables are common in these spaces.

Facility Indoor Areas

Across the facility, riser fiber optic cable has applications routing long distances to remote equipment cabinets (called IDF enclosures) that are in areas outside of air handling spaces and considered non-plenum environments. Armored indoor cables are common in these spaces.
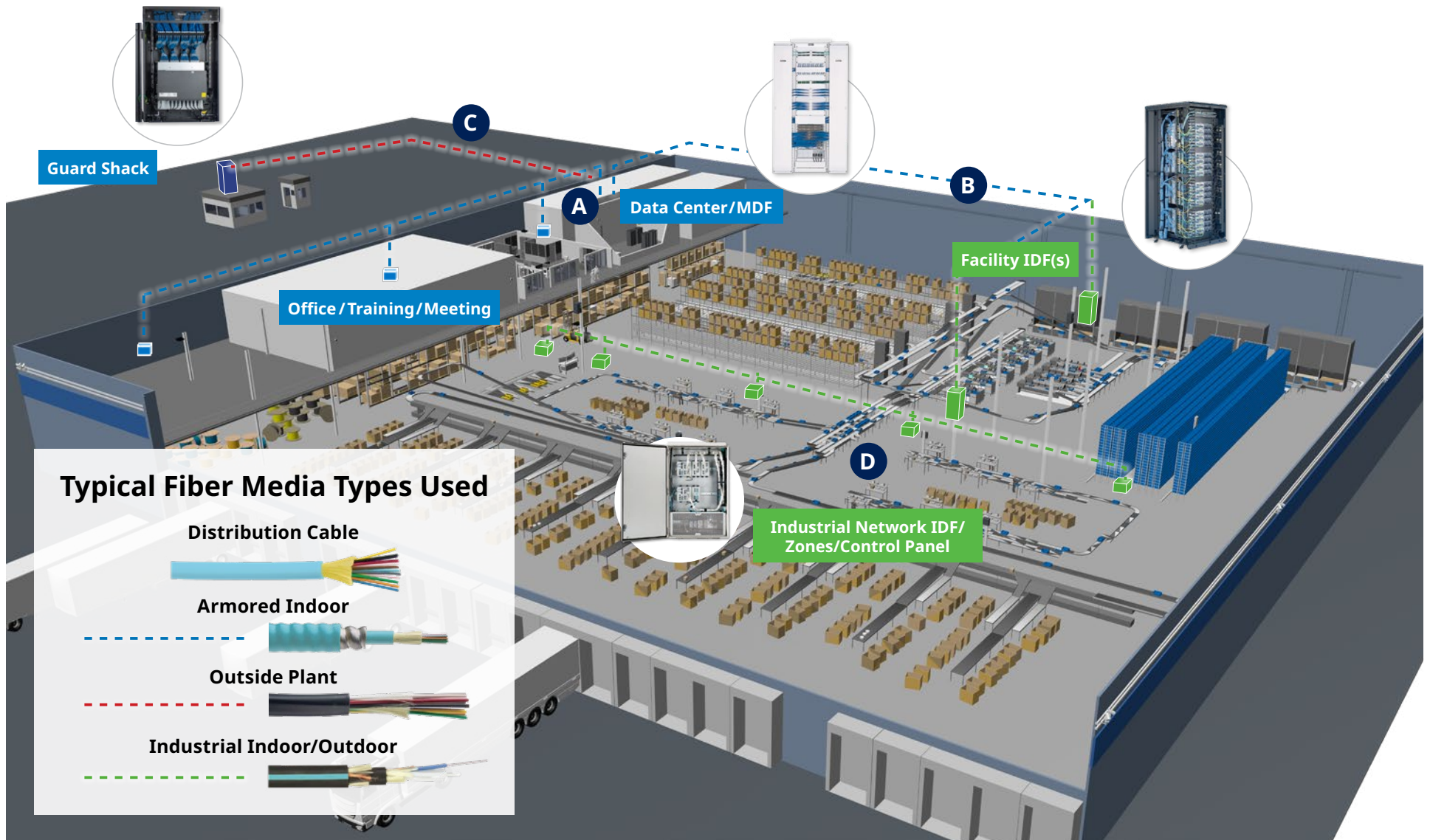
Campus / Outdoor Areas

Connections made inter-building, such as from a telecom room to an external guard shack, may use plenum or LSZH indoor-outdoor cables so they can route within plenum spaces indoors and outdoors within buried conduits. If the two connected building spaces are non-plenum, riser indoor-outdoor cabling may have application. Indoor-outdoor cables are of robust construction to address environmental factors such as UV resistance and water ingress potential.

Industrial Automation Areas

Automation or factory floor areas where in non-plenum environments will use riser fiber optic cable. Harsh environmental conditions may be present, such as mechanical vibration, ingress potential, climate extremes or chemical exposure, and electro-magnetic noise (known together as MICE), and should be considered in selecting cable type and construction.

Fiber Back Bone Connections Across Warehouse

Guard Shack

C

A

Data Center/MDF

B

Facility IDF(s)

Office/Training/Meeting

D

Industrial Network IDF/ Zones/Control Panel

Typical Fiber Media Types Used

Distribution Cable

Armored Indoor

Outside Plant

Industrial Indoor/Outdoor

A Offices   **B** Facility   **C** Campus / Outdoor   **D** Industrial Automation
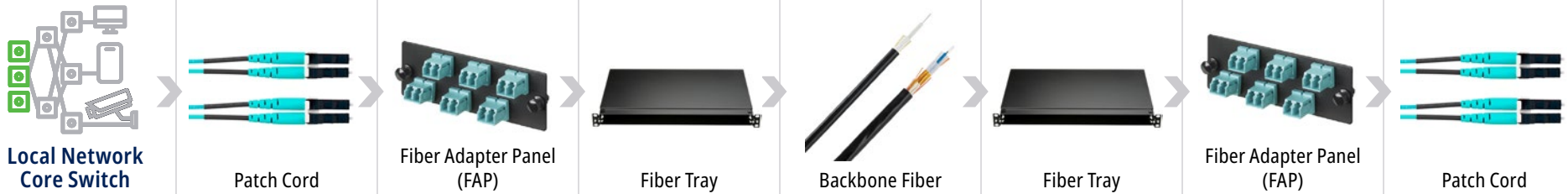
Planning the Optical Fiber Cabling Channel

Once you have selected the fiber media consider also what cords, connectors, housings and enclosures may be required. The below shows typical channel configurations across warehouse applications. Information on these components is available at www.panduit.com.

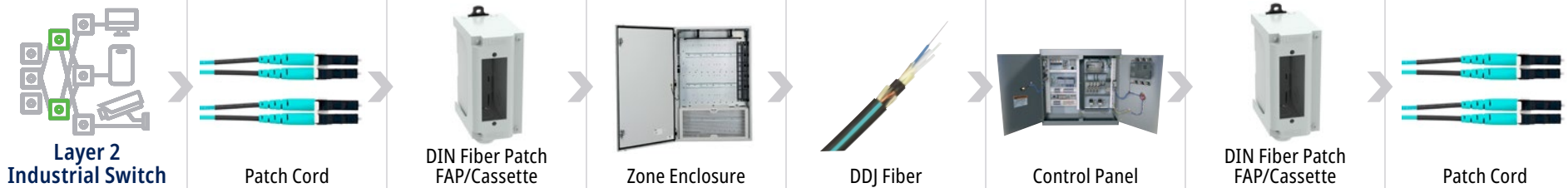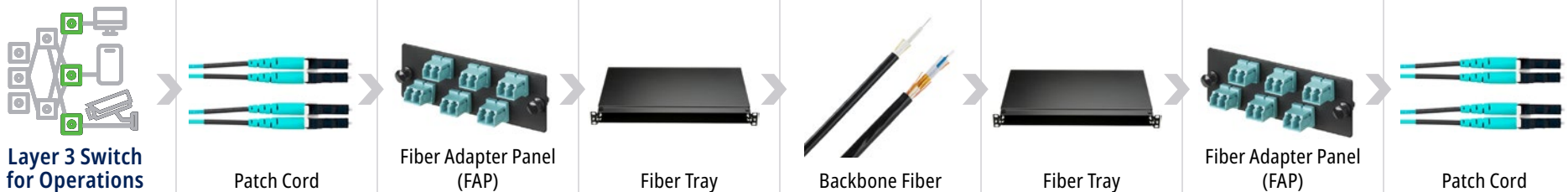## Channel Examples in Warehousing Applications

On-Premise Data Center

Cloud Server	Patch Cord	Cassette	Enclosure of Rack	Trunk	Enclosure of Rack	Cassette	Patch Cord

Enterprise Network

Local Network Core Switch	Patch Cord	Fiber Adapter Panel (FAP)	Fiber Tray	Backbone Fiber	Fiber Tray	Fiber Adapter Panel (FAP)	Patch Cord

Warehouse Industrial Network (Cold Storage Facilities)

Layer 2 Industrial Switch	Patch Cord	DIN Fiber Patch FAP/Cassette	Zone Enclosure	DDJ Fiber	Control Panel	DIN Fiber Patch FAP/Cassette	Patch Cord

Warehouse Enterprise Network (Dry Goods – Light Industrial Facilities)

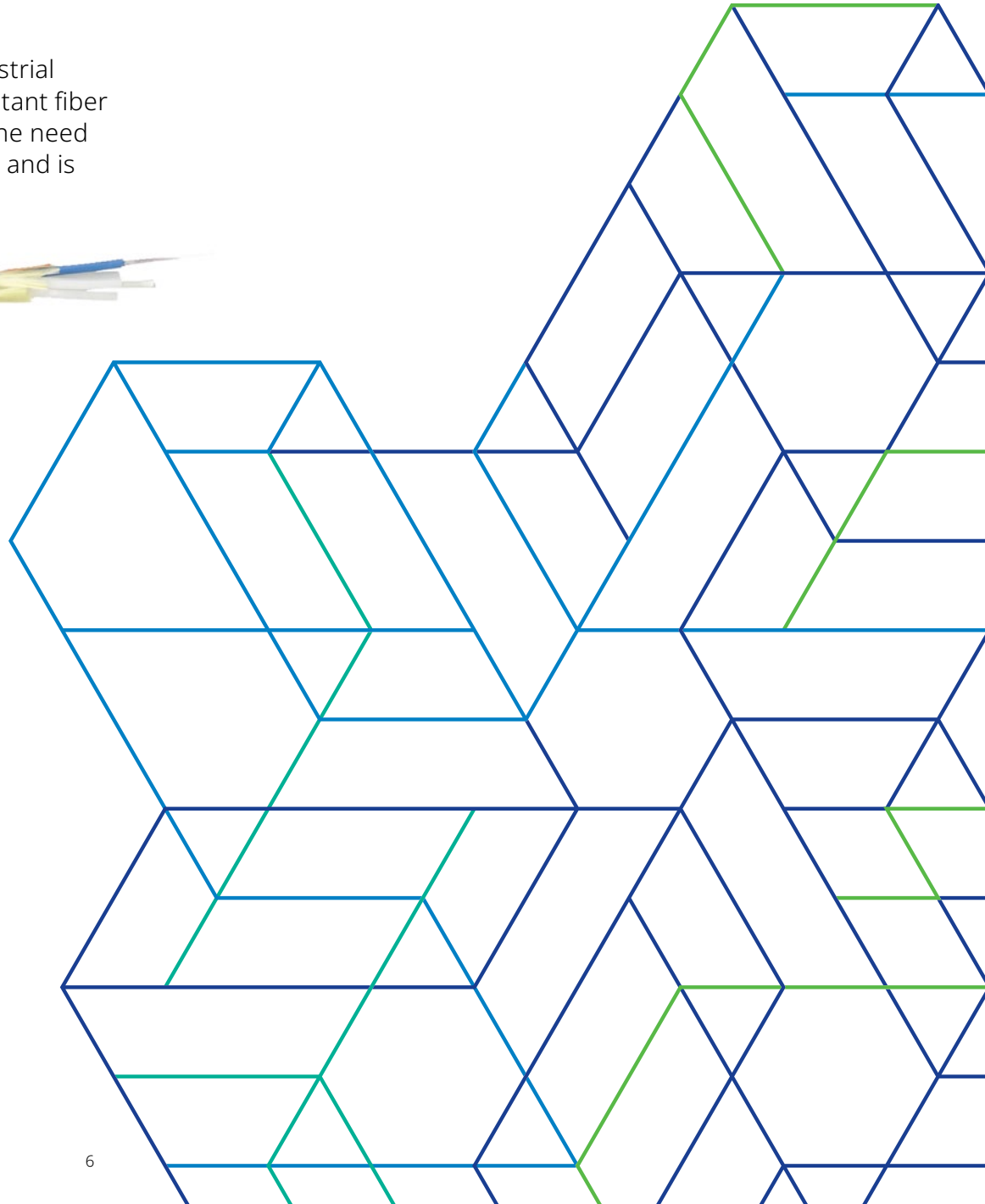| Layer 3 Switch for Operations	Patch Cord	Fiber Adapter Panel (FAP)	Fiber Tray	Backbone Fiber	Fiber Tray	Fiber Adapter Panel (FAP)	Patch Cord

Dielectric Double Jacketed Fiber Cable

What is Dielectric Double Jacketed (DDJ) Fiber Cable?

As one of the most versatile optical fiber media cables for industrial environments, DDJ is a self-supporting, crush, and impact-resistant fiber cable. The rugged Kevlar-reinforced dual jacketing eliminates the need for a defined pathway, does not require grounding or bonding, and is lightning resistant.

Dry buffer tube containing up to 12 fibers

Flame retardant tape

Inner jacket

LSZH outer jacket

Aramid strength and water blocking yarns

Central strength

Ripcord

24 Fiber Shown
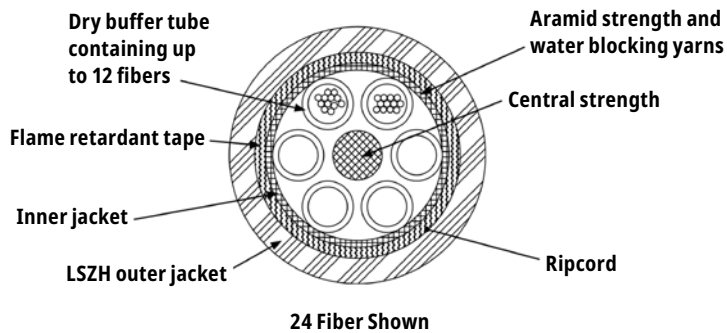
To learn more about DDJ Cable, visit the **Dielectric Double Jacketed Fiber Cable Application**.

Cable Fire Ratings Reference Guide

Cable fire ratings need to be considered when specifying cabling infrastructure to ensure local building codes are met. The below rating guide provides the information needed to determine which rating is appropriate for different installation environments.

Plenum Rated Cable, Non-Conductive (OFNP)

A Plenum Rating (OFNP) signifies cable that has passed stringent burn testing and is suitable for installation into air plenum spaces. OFNP cables have fire-resistance and low smoke production characteristics. They are typically made with PVC sheathing and can be installed in ducts, plenums, and other spaces used for building airflow. This is the highest fire rating for North America fiber cables, and no other cable types can be used as substitutes.

A Plenum Rating (OFCP) differs from OFNP in that the cable contains metallic elements, typically armor, and therefore, conducts electricity. All other aspects of this rating are the same as OFNP.

Riser Rated Cable, Non-Conductive (OFNR)

A Riser Rating (OFNR) is commonly required when cables are run between floors through open vertical shafts. OFNR cables are used in Riser areas which are building vertical shafts or run from one floor to another floor. OFNR cables cannot be installed in plenum areas since they do not have the required smoke rating as plenum rated cables. OFNP plenum cables can be used as substitutes for OFNR Riser cables.

Low Smoke Zero Halogen (LSZH)

A Low Smoke Zero Halogen Rating (LSZH) is sometimes referred to as low toxicity cable. When burned, PVC-based cables produce a cloud of toxic smoke containing corrosive compounds. LSZH cables do not contain the halogen type compounds that form these toxic substances. LSZH ratings are expressed as OFN-LS or OFNR-LS if the cable also meets the requirements of OFNR rated cable.

Multimode

Plenum

Plenum

Riser
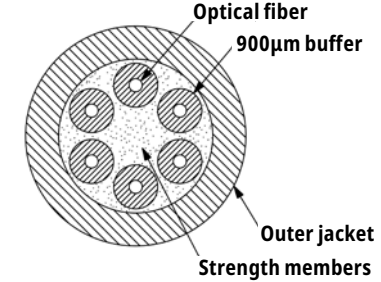
LSZH
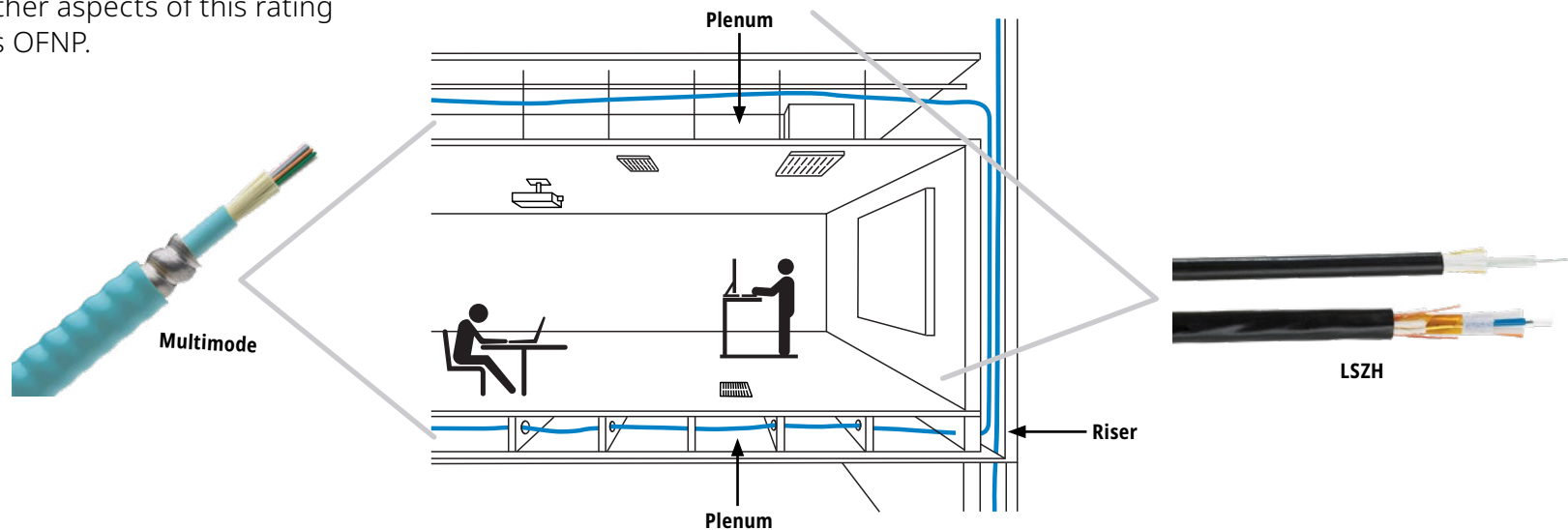
Panduit Solutions

for Warehouse Automation

Premises Bulk Fiber Optic Cables

Opti-Core Indoor Distribution Cables
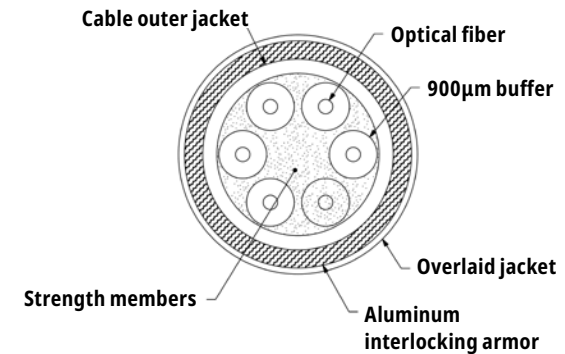
· For indoor use in intra-building backbone and horizontal installations
· Optical fiber is clad in 900μm buffer coating for easy connectorization

Optical fiber
900μm buffer
Outer jacket
Strength members

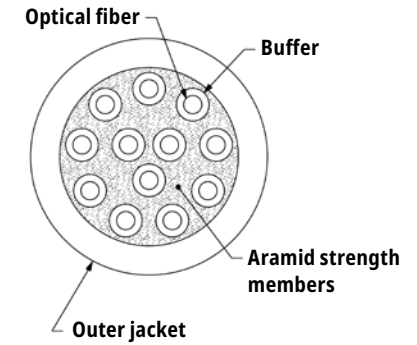|	Flame rating	6-Fiber	12-Fiber	24-Fiber	48-Fiber	72-Fiber	96-Fiber	144-Fiber
Multimode OM4	LSZH	FODLZ06	FODLZ12	FODLZ24	—	—	—	—
	Plenum	FODPZ06Y	FODPZ12Y	FODPZ24Y	FODPZ48Y	—	—	—
	Riser	FODRZ06Y	FODRZ12Y	FODRZ24Y	FODRZ48Y	—	—	—
Singlemode	LSZH	FSDL906	FSDL912	FSDL924	—	—	—	—
	Plenum	FSDP906Y	FSDP912Y	FSDP924Y	FSDP948Y	FSDP972Y	FSDP996Y	FSDP91AY
	Riser	FSDR906Y	FSDR912Y	FSDR924Y	FSDR948Y	FSDR972Y	FSDR996Y	FSDR91AY

Opti-Core Indoor Interlocking Armored Cable

· Indoor applications include intra-building backbones and horizontal installations
· Interlocking aluminum armor eliminates the need for inner ductand
  provides a small crush resistant pathway
· Optical fiber is clad in 900μm buffer coating for easy connectorization

Cable outer jacket
Optical fiber
900μm buffer
Overlaid jacket
Strength members
Aluminum interlocking armor

	Flame rating	6-Fiber	12-Fiber	24-Fiber	48-Fiber	72-Fiber	96-Fiber	144-Fiber
Multimode OM4	Plenum	FOPPZ06Y	FOPPZ12Y	FOPPZ24Y	FOPPZ48Y	—	—	—
Multimode OM4	Riser	FOPRZ06Y	FOPRZ12Y	FOPRZ24Y	FOPRZ48Y	—	—	—
Singlemode	Plenum	FSPP906Y	FSPP912Y	FSPP924Y	FSPP948Y	FSPP972Y	FSPP996Y	FSPP91AY
Singlemode	Riser	FSPR906Y	FSPR912Y	FSPR924Y	FSPR948Y	—	—	—

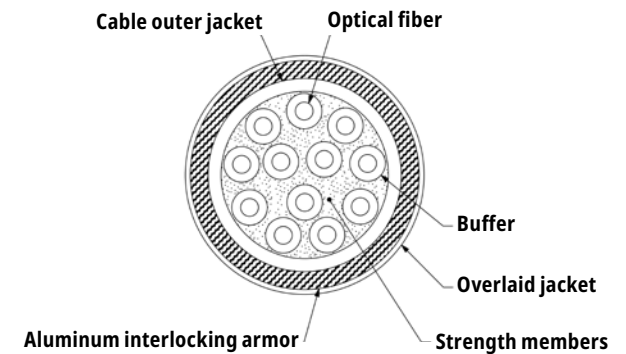# Opti-Core Indoor-Outdoor Cable with Tight Buffered Fibers

- Indoor-Outdoor 900µm tight-buffered cable provides UV resistance, dry water blocking, high density and easy installation
- All-dielectric cable provides an effective solution for inter-building, ducts and entrance facilities

Optical fiber — Buffer — Aramid strength members — Outer jacket

	Flame rating	6-Fiber	12-Fiber	24-Fiber	48-Fiber	72-Fiber	96-Fiber	144-Fiber
Multimode OM4	Plenum	FOKPZ06	FOKPZ12	FOKPZ24	FOKPZ48	—	—	—
	Riser	FOKRZ06	FOKRZ12	FOKRZ24	FOKRZ48	—	—	—
Singlemode	Plenum	FSKP906	FSKP912	FSKR924	FSKP948	FSKP972	FSKP996	—
	Riser	FSKR906	FSKR912	FSKR924	FSKR948	FSKR972	FSKR996	FSKR91A

Opti-Core Indoor-Outdoor Interlocking Armored Cable with Tight Buffered Fibers
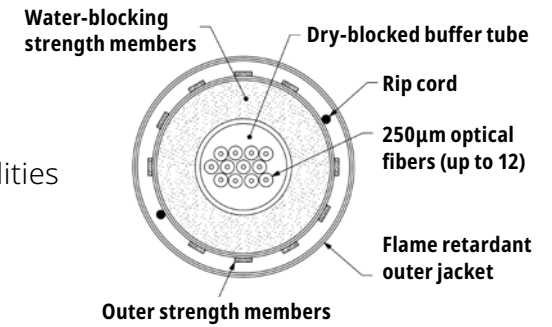
- Interlocking aluminum armor eliminates the need for inner duct or conduit and provides a smaller crush resistant pathway
- Fibers are clad with 900µm tight buffered fibers for easy connectorization
- UV-resistant outer jacket and dry water-blocking technology support outdoor use

Cable outer jacket — Optical fiber — Buffer — Overlaid jacket — Aluminum interlocking armor — Strength members

	Flame rating	6-Fiber	12-Fiber	24-Fiber	48-Fiber	72-Fiber	96-Fiber	144-Fiber
Multimode OM4	Plenum	FOLPZ06	FOLPZ12	FOLPZ24	—	—	—	—
Multimode OM4	Riser	FOLRZ06	FOLRZ12	FOLRZ24	—	—	—	—
Singlemode	Plenum	FSLP906	FSLP912	FSLP924	FSLP948	FSLP972	FSLP996	—
	Riser	FSLR906	FSLR912	FSLR924	FSLR948	FSLR972	FSLR996	FSLR91A

Opti-Core Indoor-Outdoor All-Dielectric Cable

- Flame rated cable offers UV resistance, dry water-blocking, high density and easy installation
- All-dielectric, gel-free cable provides an effective solution for inter-building, ducts and entrance facilities
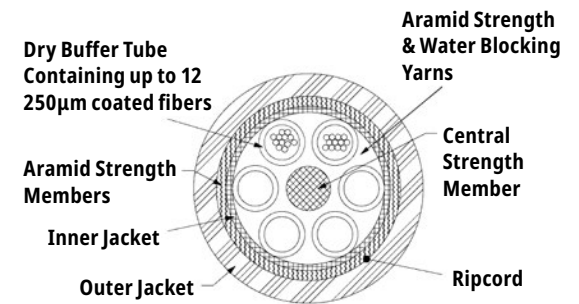- Options include central loose tube and stranded loose tube

Water-blocking strength members
Dry-blocked buffer tube
Rip cord
250µm optical fibers (up to 12)
Flame retardant outer jacket
Outer strength members

		Central tube		Stranded Tube				
	Flame rating	6-Fiber	12-Fiber	24-Fiber	48-Fiber	72-Fiber	96-Fiber	144-Fiber
Multimode OM4	LSZH	FOCLZ06	FOCLZ12	FONLZ24Y	FONLZ48Y	—	—	—
	Plenum	FOCPZ06Y	FOCPZ12Y	FONPZ24Y	FONPZ48Y	—	—	—
	Riser	FOCRZ06Y	FOCRZ12Y	FONRZ24Y	FONRZ48Y	—	—	—
Singlemode	LSZH	FSCL906	FSCL912	FSNL924Y	FSNL948Y	—	—	—
	Plenum	FSCP906Y	FSCP912Y	FSNP924Y	FSNP948Y	FSNP972Y	FSNP996Y	FSNP91AY
	Riser	FSCR906Y	FSCR912Y	FSNR924Y	FSNR948Y	FSNR972Y	FSNR996Y	FSNR91AY

Facility Industrial Network Bulk Fiber Optic Cable

IndustrialNet™ Dielectric Double Jacketed DDJ Cable

- Rugged metal-free construction is crush resistant and does not require grounding & bonding
- Dry water blocked and dual flame rated as Riser (OFNR) and Low Smoke Zero Halogen (LSZH)
- Can be installed indoors using J-Hooks or outdoors as direct bury, aerial with lashing to messenger wire

Dry Buffer Tube Containing up to 12 250µm coated fibers
Aramid Strength & Water Blocking Yarns
Aramid Strength Members
Central Strength Member
Inner Jacket
Outer Jacket
Ripcord

	Flame rating	6-Fiber	12-Fiber	24-Fiber	48-Fiber	96-Fiber
Multimode OM4	LSZH-Riser	FOJDZ06	FOJDZ12	FOJDZ24	—	—
Singlemode	LSZH-Riser	FSJD906	FSJD912	FSJD924	FSJD948	FSJD996

Partner Ecosystem

When you partner with Panduit, you have the support of a global network of leading infrastructure companies throughout the supply chain. It's a collaborative approach that allows us to engineer joint solutions, ensure interoperability, and keep you at the forefront of technology.

A culture of curiosity, a history of innovation

From the first product, a panel conduit that gave us our name, we understood the value of thinking differently. Here's where it's gotten us:

- Customers in **112** countries
- **Privately Owned**
- **2,000+** patents globally
- **91%** of Fortune 100 companies are customers
- **5,000+** infrastructure experts
- **18** Research & Development laboratories and **200** R&D personnel
- **Founded in 1955**
- Revenue exceeding **$1 Billion USD** annually

We have the knowledge
and experience to help you
make the most of your
infrastructure investment.

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