OPTICAL CABLE CORPORATION

INDUSTRY SOLUTIONS:

# SECURITY

Optical Cable Corporation is built on a tradition of innovation and dependability for the most severe duty applications, including critical security requirements. In the early 1980s, Optical Cable Corporation was a pioneer in the design and production of special tight-buffered cables for demanding military field applications. Today, Optical Cable Corporation builds on this technology at its ISO 9001:2000 registered facility in Roanoke, Virginia, where a broad range of fiber optic cables are manufactured for high bandwidth transmission of data, video, and audio communications for today's demanding security applications. Fiber optic cable solutions for security by Optical Cable Corporation provide a comprehensive and versatile set of products to address the security industry's cabling requirements.

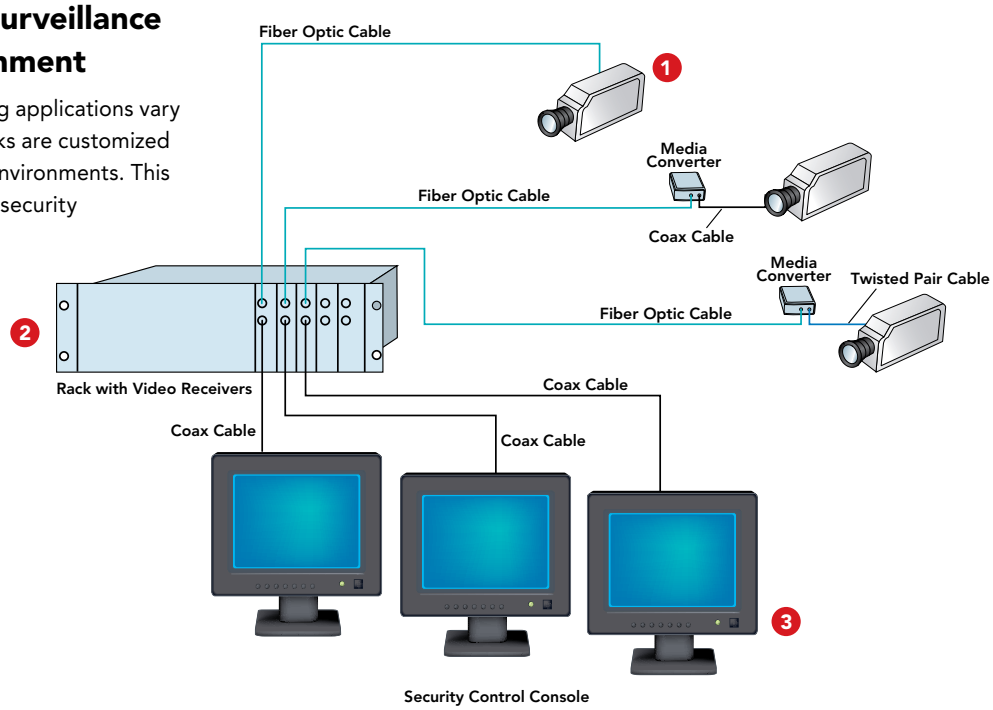
"Fiber SenSys has been a customer of Optical Cable Corporation for more than 10 years. Our need for custom cable assemblies in an environment that demands a high quality product that survives extreme environments plays on Optical Cable Corporation's strengths. We have seen rapid growth in the high-end security market and have had to deal with short lead times. Optical Cable Corporation has helped us meet our customers' time schedules without compromising quality. Fiber SenSys has benefited from our teaming with Optical Cable Corporation, and I would not hesitate to recommend them."

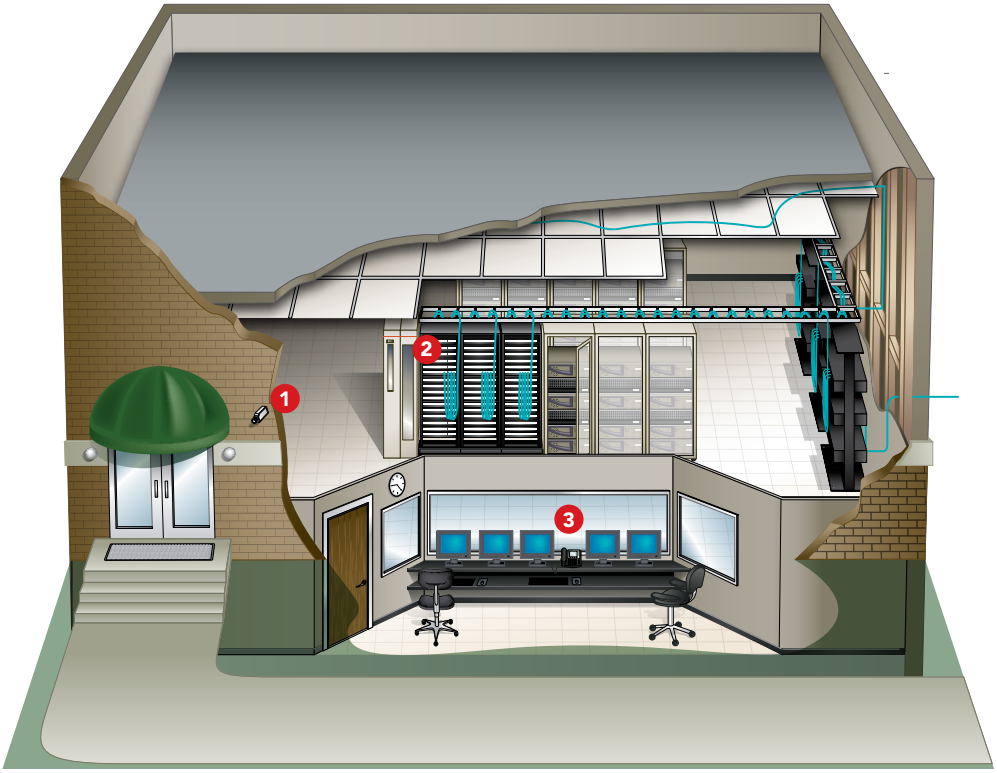
Duane Thompson, General Manager
Fiber SenSys, Inc.

## Fiber SenSys, Inc. Perimeter Security Application

## In-Building Video Surveillance and Alarms Environment

Security and video monitoring applications vary widely. Most security networks are customized to specific applications and environments. This is a typical example of how a security network may be configured:

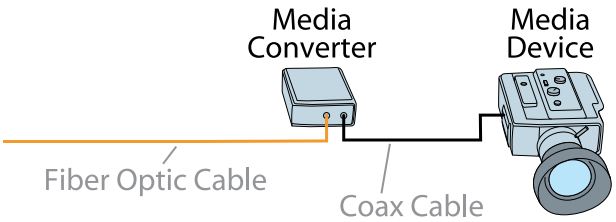


Whether extremely low or very high bandwidth, the most demanding security applications are using optical fiber. Why? Fiber optic cable provides the most reliable and secure mode for transporting signals from one place to another. Fiber's well known immunity to EMI and other interferences makes it the most reliable medium. The nature of optical fiber and light transmission make fiber optic cable naturally the most secure mode of signal transport.

Cameras and other security equipment are requiring increased bandwidth for improved resolution. Therefore, newer cameras provide built-in fiber connections via fiber interface. Older cameras are using fiber by locally installing media converters from a very large number of suppliers, connected to traditional electrical camera outputs.

Of all the alternatives, fiber optic cable is the clear choice for the transport of security signals. Media converters make concerns over protocols and other technical parameters relatively easy to address. Simply ensure the media converter bandwidth meets or exceeds the camera output.




## What is Media Conversion?

Media converters enable network administrators to connect one type of media with other, dissimilar media – for example, coax/twisted pair to fiber optic cable. Media converters are physical layer networking devices that simply receive data signals from one media, convert and transmit them to the other media, while remaining completely transparent to other networking devices and higher protocols.

## Why Media Conversion?

Distance, cost savings, and flexibility. Media conversion from copper cable to optical fiber will allow the network to extend to far greater distances. Media conversion provides flexibility by enabling seamless interoperability between legacy structured wiring systems and the latest optical switches. Media converters play an important role in today's mixed media enterprise cabling systems by satisfying the requirements for data throughput, cabling bandwidth, distance, and security.

## FIBER ADVANTAGES

- Highest signal integrity
- Greatest signal-carrying capacity (bandwidth)
- NO EMI (Electromagnetic Interference)*
- NO RFI (Radio Frequency Interference)*
- Completely unaffected by radar microwaves* (including airports, transmission towers, etc.)
- Extended transmission distances

## OPTICAL CABLE CORPORATION'S EXCELLENT CABLE DESIGN

- No lightning protection required*
- Extensively used in safe combustible areas (including oil refineries, chemical plants, ammunition and explosive storage areas, and high-risk fire or explosion zones)*
- Not susceptible to electrical charges*
- Withstands extreme environments (desert, snow, humidity, etc.)
- Works with the security equipment you already have (easily adaptable via Media Converter)
- Less time and money on fiber installation vs. copper installation

## OPTIMUM SYSTEMS

If you need maximum security at any level, there is only one choice. Fiber optic security cables are hard to tap, bypass, or intercept without detection. Contact Optical Cable Corporation for a "future-proof" cable design to match your security network requirements.

*Not applicable for fiber optic cables containing copper

The extensive use of fiber optic cables in the telecommunications industry has provided the technological and economical platform for practical deployment in many other applications. Current industries using fiber optic cables for demanding security applications include:

- Aerospace
- Bridges
- Nuclear Facilities
- Highways and Traffic Intersections
- Military Installations
- Public Transit Corridors
- Department of Energy
- Parks and Public Spaces
- Utility Substations
- Water Reservoirs and Distribution Pipelines
- Mining
- Water Treatment Plants
- Government
- Military/Secure Manufacturing Facilities
- Shipping and Docking Facilities
- Containerized Freight Handling Facilities
- Remote Communications Towers
- Airports (public, private, and freight)
- Auto and Storage Lots
- Prisons
- Private Estates/Palaces
- Embassies
- Sports Arenas
- Convention Centers
- Residential Surveillance and Alarms
- Small Business Intrusion and Video Surveillance

## TYPICAL SECURITY SYSTEMS:

- CCTV Video Surveillance
- Perimeter Intrusion Monitoring and Surveillance
- Intrusion Alarm Systems
- Process Monitoring and Alarms
- Video Motion Detection Systems
- Covert Surveillance Equipment
- Facial Recognition Systems (Biometrics)
- Access Control Systems
- Traffic Surveillance
- Traffic Signaling
- Amber Alert Systems

ENERGY ERECTORS, INC.

"Energy Erectors, Inc. has been extensively involved in the correctional market for the past ten years, and with the increase in technology, the demand for quality fiber optic cable products has increased dramatically. Optical Cable Corporation has met our demands for a cost-effective exceptional product with the quality demanded by our clients. We have utilized Optical Cable Corporation's tight-buffered fiber optic cable on three federal correctional facilities in the last three years with good success. Meeting our cost and delivery requirements, along with no quality control problems, allows Energy Erectors, Inc. to provide outstanding service to our clients."

Thomas P. Keating
Vice-President, Industrial/Power Division
Energy Erectors, Inc.

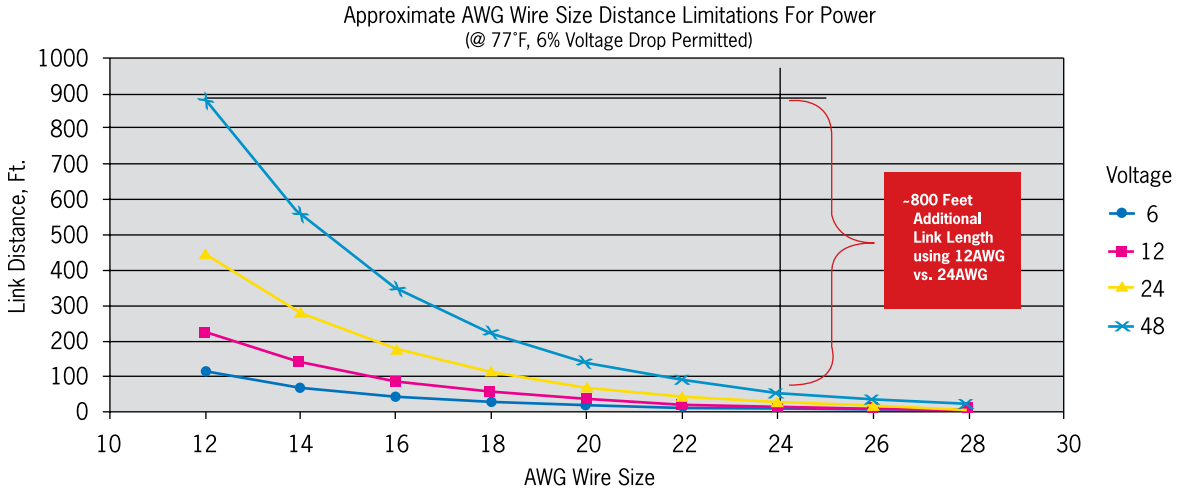
Optical fiber as a technology platform is tried and proven over time. Fiber optic security cable is now a more sensible choice for long-term "future-proofing" and scalability; especially with today's trend towards converged LAN and WAN networks, IT security systems, physical premises security systems, and building/plant automation systems.

| Feature | Coaxial Cable | CAT-5e/6 Twisted Pair | Fiber Optic Cable |
|---|---|---|---|
| Cost | $$$$$ | $$$$ | $$$$$ |
| Lightning Protection | Required | Required | Not Required |
| Ground Loop Protection | Required | Required | Not Required |
| Transmission Distance | 1,000 ft. no repeaters<br>2,400 ft. w/repeaters | 1,000 ft. w/balun<br>6,000 ft. w/balun<br>at 64k data speed | 22,140 ft.<br>No repeaters required |
| Bandwidth | 100 MHz at 1,000 ft. | 100-250 MHz at 1,000 ft. | 500 MHz at 3,280 ft. |
| Security | Not Secure | Not Secure | Secure |
| Cross-Talk | YES | YES | NO |
| Shorts and Shock Hazard | YES | YES | NO |
| System Expansion and Upgrades | NO | NO | YES |
| Multiplexing Capabilities | Fast-Scan Technology | Real Time | Real Time |
| Future Proof | No | No | Yes |

## Fiber optic security cable is now practical and preferable due to:

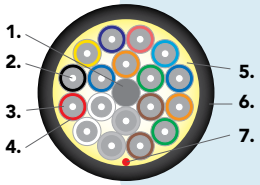
- Massive telecom fiber deployments
  – Manufacturing "economies of scale"
  – Fiber production technique improvements
- Electronics improvements, cost reductions
- Cost to increase copper bandwidth

## Go Greater Distances With Optical Cable Corporation Composite Cables



## Overview

- Multiple fibers stranded within a single jacket with common strength members
- Ideal configuration for a single security cable termination point requiring multiple fibers




1. Central Filler
2. Optical Fiber
3. Acrylate Fiber Coating
4. Color-Coded 900 µm Diameter Tight-Buffer
5. Aramid Strength Member
6. Outer Jacket
7. Ripcord

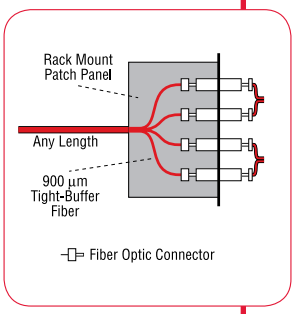
## Features

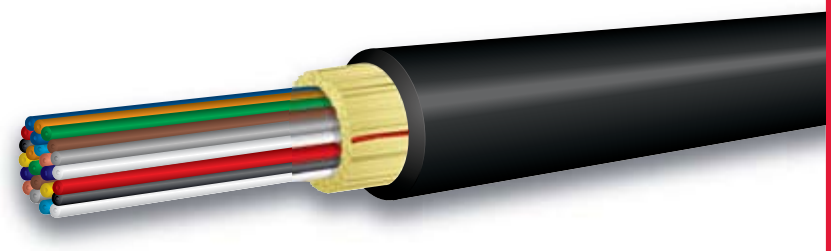
- Compact, lightweight cable design with the highest strength-to-weight ratio
- Helically stranded cable core for flexibility, survival in difficult pulls, and mechanical protection for the optical fibers
- Flexible, rugged, high strength construction for long cable pulls to multiple security devices
- May be directly terminated with connectors with physical fiber protection at security device termination points
- Lower total installed costs
- High performance tight-buffered coating on each optical fiber for environmental and mechanical protection
- Available in Indoor/Outdoor Riser and Plenum constructions and Indoor Plenum construction

## Mechanical and Environmental Performance

| | Riser | Indoor/Outdoor Plenum (K) | Indoor Plenum (S) |
|---|---|---|---|
| Minimum Bend Radius:<br>Under Installation Tensile Load<br>Under Operational Tensile Load | <br>15X outside diameter<br>10X outside diameter | <br>15X outside diameter<br>15X outside diameter | <br>15X outside diameter<br>10X outside diameter |
| Operating Temperature | -40°C to +85°C | -40°C to +85°C | -20°C to +85°C |
| Storage Temperature | -55°C to +85°C | -40°C to +85°C | -40°C to +85°C |
| Installation Temperature (cable temp.) | -10°C to +60°C | 0°C to +60°C | 0°C to +60°C |
| Impact Resistance | 1,500 impacts | 1,000 impacts | 1,000 impacts |
| Crush Resistance | 1,800 N/cm | 1,500 N/cm | 1,500 N/cm |
| Flex Resistance | 2,000 cycles | 1,000 cycles | 1,000 cycles |
| Flame Retardancy | Riser* | Plenum** | Plenum** |

**Riser: UL Listed Type OFNR (UL 1666) and FT4 (CSAC22.2 No. 232)*
***Plenum: UL Listed Type OFNP (ANSI/NFPA 262) and FT6 (CSA C22.2 No. 232)*





## Cable Characteristics: Distribution Riser Cables

| Fiber Count | Diameter mm (in) | Weight kg/km (lbs/1,000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) | Minimum Bend Radius Installation cm (in) | Minimum Bend Radius Long Term cm (in) |
|---|---|---|---|---|---|---|
| 2* | 4.8 (0.19) | 22 (14) | 660 (150) | 180 (40) | 7.3 (2.9) | 4.8 (1.9) |
| 4 | 5.1 (0.20) | 24 (16) | 1,400 (310) | 450 (100) | 7.7 (3.0) | 5.1 (2.0) |
| 6 | 5.7 (0.22) | 32 (22) | 1,400 (310) | 450 (100) | 8.6 (3.4) | 5.7 (2.2) |
| 8 | 5.9 (0.23) | 34 (23) | 1,600 (360) | 525 (120) | 8.9 (3.5) | 5.9 (2.3) |
| 10 | 7.0 (0.28) | 43 (29) | 1,800 (400) | 600 (135) | 10.6 (4.1) | 7.0 (2.8) |
| 12** | 6.5 (0.26) | 38 (25) | 2,700 (600) | 600 (135) | 9.8 (3.8) | 6.5 (2.6) |
| 12*** | 7.3 (0.28) | 43 (32) | 2,700 (600) | 600 (135) | 10.8 (4.3) | 7.3 (2.9) |
| 18 | 7.2 (0.28) | 48 (32) | 2,700 (600) | 700 (160) | 10.8 (4.3) | 7.2 (2.8) |
| 24 | 8.9 (0.35) | 67 (45) | 3,000 (670) | 1,000 (220) | 13.4 (5.3) | 8.9 (3.5) |
| 30 | 8.8 (0.35) | 75 (50) | 3,000 (670) | 1,000 (220) | 13.3 (5.2) | 8.8 (3.5) |
| 36 | 9.1 (0.36) | 73 (49) | 3,000 (670) | 1,000 (220) | 13.7 (5.4) | 9.1 (3.6) |
| 48 | 10.1 (0.40) | 93 (63) | 4,200 (940) | 1,400 (310) | 15.2 (6.0) | 10.1 (4.0) |

* -40°C to +70°C
** 62.5 µm multimode and single-mode fiber. Specifications vary by fiber type.
*** 50 µm multimode
Installation loads in excess of 2,700 N (600 lbs.) are not recommended.
Other fiber counts available upon request.

## Ordering Information

| | D | X | | | | D | | | | 9 | K | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

1 – 2 Distribution Series Ultra-Fox™ = **DX**
3 – 5 Fiber count: (See Cable Characteristics Chart) = **002-144**
6 Jacket type: PVC = **D**
7 – 9 Fiber type: (See Laser Ultra-Fox™ Fiber Performance Table - Pg. SC 21)
10 250 micron fiber with 900 micron tight buffer = **9**
11 Standard Jacket Color: Black = **K**, (other colors available upon request)
12 Rating: Riser = **R**

**Example:** 12-fiber indoor/outdoor riser cable using 62.5 µm standard laser optimized fiber, black jacket –

| D | X | 0 | 1 | 2 | D | W | L | S | 9 | K | R |
|---|---|---|---|---|---|---|---|---|---|---|---|

Optical Cable Corporation indoor/outdoor tight-buffered fiber optic tray cables meet the functional requirements of the following standards:

ICEA –S-83-596
ICEA-S-104-696
GR-409-CORE
TIA-568
TIA-598

## Cable Characteristics: Distribution Plenum Cables ("K" Jacket)

| Fiber Count | Diameter mm (in) | Weight kg/km (lbs/1,000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) | Minimum Bend Radius Installation cm (in) | Minimum Bend Radius Long Term cm (in) |
|---|---|---|---|---|---|---|
| 6 | 4.8 (0.19) | 24 (16) | 1,400 (310) | 450 (100) | 7.2 (2.8) | 7.2 (2.8) |
| 8 | 5.1 (0.20) | 30 (20) | 1,600 (360) | 525 (120) | 7.7 (3.0) | 8.1 (3.2) |
| 12 | 6.2 (0.24) | 31 (21) | 2,700 (600) | 600 (135) | 9.3 (3.7) | 9.3 (3.7) |
| 18 | 6.1 (0.24) | 42 (28) | 2,700 (600) | 600 (135) | 9.2 (3.6) | 9.2 (3.6) |
| 24 | 7.8 (0.31) | 68 (46) | 3,000 (670) | 1,000 (220) | 11.8 (4.6) | 11.8 (4.6) |
| 30 | 8.2 (0.32) | 79 (53) | 3,000 (670) | 1,000 (220) | 12.4 (4.8) | 12.4 (4.8) |
| 36 | 8.2 (0.32) | 78 (53) | 3,000 (670) | 1,000 (220) | 12.4 (4.8) | 12.4 (4.8) |
| 48 | 9.5 (0.37) | 104 (70) | 4,200 (940) | 1,400 (310) | 14.3 (5.6) | 14.3 (5.6) |

## Cable Characteristics: Distribution Plenum Cables ("S" Jacket)

| Fiber Count | Diameter mm (in) | Weight kg/km (lbs/1,000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) | Minimum Bend Radius Installation cm (in) | Minimum Bend Radius Long Term cm (in) |
|---|---|---|---|---|---|---|
| 2 | 3.9 (0.15) | 15 (10) | 1,200 (270) | 400 (90) | 5.9 (2.3) | 3.9 (1.5) |
| 4 | 4.5 (0.18) | 18 (12) | 1,200 (270) | 400 (90) | 6.7 (2.6) | 4.5 (1.8) |
| 6 | 4.7 (0.19) | 22 (15) | 1,400 (310) | 450 (100) | 7.1 (2.8) | 4.7 (1.9) |
| 8 | 5.9 (0.23) | 37 (25) | 1,600 (360) | 525 (120) | 8.9 (3.5) | 5.9 (2.3) |
| 12 | 6.2 (0.24) | 40 (27) | 1,800 (400) | 600 (135) | 9.2 (3.6) | 6.2 (2.4) |

## Ordering Information

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **D** | **X** | | | | | | | | **9** | | **P** |
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

1 – 2 Distribution Series Ultra-Fox™ = **DX**
3 – 5 Fiber count: (Indoor) = **002 - 012**, (Indoor/Outdoor) = **002 - 072**
6 Jacket type:
Flame Retardant Plenum (indoor) = **S**
Fluoropolymer (indoor/outdoor) = **K**
7 – 9 Fiber type: (See Laser Ultra-Fox™ Fiber Performance Table - Pg. SC 21)
10 250 micron fiber with 900 micron tight buffer = **9**
11 Standard Jacket Colors:
62.5 µm multimode (WLS, WLX): Orange = **O**
50 µm multimode (ALS, ALX): Orange = **O**
50 µm Ten-Gigabit multimode (ALT, ALE): Aqua = **Q**
Single-mode: Yellow = **Y**
12 Rating: Plenum = **P**

**Example:** 12-fiber indoor cable using 62.5 µm standard laser optimized fiber, orange jacket –

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **D** | **X** | **0** | **1** | **2** | **S** | **W** | **L** | **S** | **9** | **O** | **P** |

12-fiber indoor/outdoor cable using 62.5 µm standard laser optimized fiber, orange jacket –

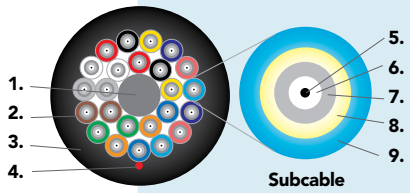
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **D** | **X** | **0** | **1** | **2** | **K** | **W** | **L** | **S** | **9** | **O** | **P** |

Optical Cable Corporation indoor/outdoor tight-buffered fiber optic tray cables meet the functional requirements of the following standards:

ICEA –S-83-596
ICEA-S-104-696
GR-409-CORE
TIA-568
TIA-598

## Overview

- Individual fibers and strength members protected in a subcable configuration
- Ideal configuration for multiple security termination point locations where subcables provide excellent strength and mechanical protection for connector termination




1. Central Filler
2. Subcable
3. Core-Locked™ Outer Jacket
4. Ripcord

**Subcable**

5. Optical Fiber
6. Acrylate Fiber Coating
7. 900 µm Diameter Tight-Buffer
8. Aramid Strength Member
9. Color-Coded Elastomeric Subcable Jacket

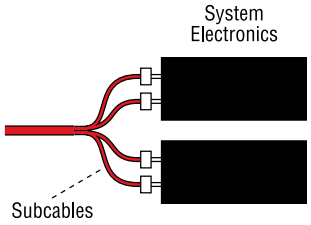
## Features

- Most rugged cable design with individual subcables for routing to diversely located security devices with direct connector termination at each device
- Helically stranded cable core for flexibility, survival in difficult pulls, and mechanical protection for the optical fibers
- High performance tight-buffered coating on each optical fiber for environmental and mechanical protection
- Fibers may be directly terminated at security devices or central locations using connectors, with no further protection required
- Core-Locked™ outer jacket on Breakout Riser cable surrounds the subcables for superior crush resistance, survivability, and use in long vertical installations
- Designed for direct lashing, horizontal, and vertical security installations
- Cable is ideal for direct pulling with wire mesh grips

## Mechanical and Environmental Performance

| | Riser | Plenum |
|---|---|---|
| Minimum Bend Radius:<br>Under Installation Tensile Load<br>Under Operational Tensile Load | <br>15X outside diameter<br>10X outside diameter | <br>15X outside diameter<br>15X outside diameter |
| Operating Temperature | -40°C to +85°C | -40°C to +85°C |
| Storage Temperature | -55°C to +85°C | -40°C to +85°C |
| Installation Temperature (cable temp.) | -10°C to +60°C | 0°C to +60°C |
| Impact Resistance | 1,500 impacts | 1,000 impacts |
| Crush Resistance | 2,200 N/cm | 2,100 N/cm |
| Flex Resistance | 2,000 cycles | 2,000 cycles |
| Flame Retardancy | Riser* | Plenum** |

**Riser: UL Listed Type OFNR (UL 1666) and FT4 (CSAC22.2 No. 232)*
***Plenum: UL Listed Type OFNP (ANSI/NFPA 262) and FT6 (CSA C22.2 No. 232)*




Fiber Optic Connector

## Cable Characteristics: Breakout Riser Cables (2.5mm Subcables)

| Fiber Count | Diameter mm (in) | Weight kg/km (lbs/1,000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) | Minimum Bend Radius Installation cm (in) | Minimum Bend Radius Long Term cm (in) |
|---|---|---|---|---|---|---|
| 2 | 7.0 (0.28) | 41 (28) | 1,200 (270) | 500 (110) | 10.5 (4.1) | 7.0 (2.8) |
| 4 | 8.1 (0.32) | 65 (44) | 2,000 (450) | 800 (180) | 12.2 (4.8) | 8.1 (3.2) |
| 6 | 9.6 (0.38) | 84 (56) | 3,000 (670) | 1,200 (270) | 14.4 (5.7) | 9.6 (3.8) |
| 8 | 11.6 (0.46) | 126 (85) | 4,000 (900) | 1,700 (380) | 17.5 (6.9) | 11.6 (4.6) |
| 12* | 13.0 (0.51) | 142 (95) | 6,000 (1,350) | 2,500 (560) | 19.5 (7.7) | 13.0 (5.1) |
| 18 | 15.3 (0.60) | 216 (145) | 8,000 (1,800) | 3,500 (790) | 23.1 (9.1) | 15.3 (6.0) |
| 24 | 17.6 (0.69) | 279 (188) | 10,000 (2,250) | 3,800 (850) | 26.5 (10.4) | 17.6 (6.9) |
| 36 | 20.3 (0.80) | 360 (242) | 14,000 (3,150) | 6,000 (1,350) | 30.6 (12.0) | 20.3 (8.0) |
| 48 | 23.6 (0.93) | 483 (325) | 18,000 (4,050) | 7,500 (1,690) | 35.5 (14.0) | 23.6 (9.3) |
| 60 | 28.5 (1.12) | 744 (500) | 22,000 (4,950) | 8,800 (1,980) | 42.7 (16.8) | 28.5 (11.2) |
| 72 | 28.9 (1.14) | 738 (496) | 26,000 (5,845) | 11,000 (2,470) | 43.4 (17.1) | 28.9 (11.4) |

**62.5 µm multimode fiber. Specifications vary by fiber type.*
Installation loads in excess of 2,700 N (600 lbs.) are not recommended.
Other fiber counts available upon request.

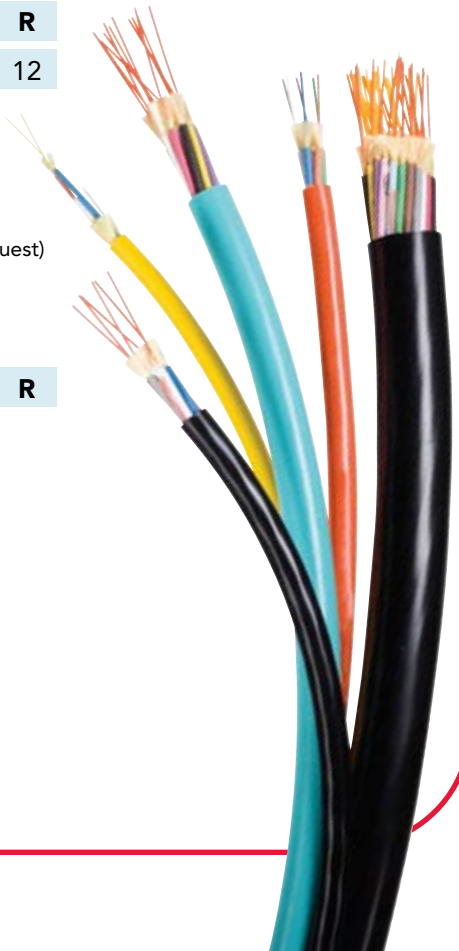
## Ordering Information

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **B** | **X** | | | | **D** | | | | **9** | **K** | **R** |
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

1 – 2 Breakout Series Ultra-Fox™ = **BX**
3 – 5 Fiber count: (See Cable Characteristics Chart) = **002 – 072**
6 Jacket type: PVC = **D**
7 – 9 Fiber type: (See Laser Ultra-Fox™ Fiber Performance Table - Pg. SC 21)
10 250 micron fiber with 900 micron tight buffer = **9**
11 Standard Jacket Color: Black = **K** (other jacket colors available upon request)
12 Rating: Riser = **R**

**Example:** 12 fiber cable using 62.5 µm standard laser optimized fiber, black jacket –

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **B** | **X** | **0** | **1** | **2** | **D** | **W** | **L** | **S** | **9** | **K** | **R** |



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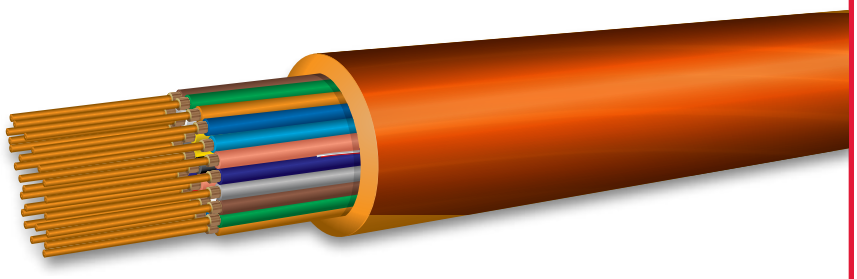
TIA-568
TIA-598



## Cable Characteristics: Breakout Plenum Cables (2.0mm Subcables)

| Fiber Count | Diameter mm (in) | Weight kg/km (lbs/1,000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) | Minimum Bend Radius Installation cm (in) | Minimum Bend Radius Long Term cm (in) |
|---|---|---|---|---|---|---|
| 2 | 6.5 (0.26) | 46 (31) | 1,600 (360) | 400 (90) | 9.8 (3.9) | 9.8 (3.9) |
| 4 | 6.5 (0.26) | 46 (31) | 1,600 (360) | 400 (90) | 9.8 (3.9) | 9.8 (3.9) |
| 6 | 7.4 (0.29) | 61 (41) | 2,400 (540) | 600 (130) | 11.1 (4.4) | 11.2 (4.4) |
| 8 | 8.7 (0.34) | 88 (59) | 3,200 (720) | 800 (180) | 13.1 (5.2) | 13.1 (5.2) |
| 12 | 9.2 (0.36) | 94 (63) | 4,800 (1,080) | 1,200 (270) | 13.9 (5.5) | 13.9 (5.5) |
| 18 | 12.2 (0.48) | 162 (109) | 6,000 (1,350) | 1,500 (340) | 18.3 (7.2) | 18.3 (7.2) |
| 24 | 14.2 (0.56) | 221 (148) | 7,200 (1,620) | 1,800 (400) | 21.3 (8.4) | 21.3 (8.4) |
| 36 | 16.2 (0.64) | 274 (184) | 9,600 (2,160) | 2,400 (540) | 23.6 (9.3) | 23.6 (9.3) |
| 48 | 18.4 (0.72) | 376 (253) | 12,000 (2,700) | 3,000 (670) | 27.6 (10.9) | 27.6 (10.9) |
| 60 | 21.5 (0.85) | 496 (333) | 14,400 (3,240) | 3,600 (810) | 32.3 (12.7) | 32.3 (12.7) |

**Note:** 2.0mm subcables standard. 2.5mm and 2.9mm subcables available by request. Contact Optical Cable Corporation for ordering details.

## Ordering Information

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **B** | **X** | | | | **K** | | | | **9** | | **P** |
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

1 – 2 Breakout Series Ultra-Fox™ = **BX**
3 – 5 Fiber count: (See Cable Characteristics Chart) = **002 – 060**
6 Jacket type: Fluoropolymer = **K**
7 – 9 Fiber type: (See Laser Ultra-Fox™ Fiber Performance Table - Pg. SC 21)
10 250 micron fiber with 900 micron tight buffer = **9**
11 Standard Jacket Colors:
62.5 µm multimode (WLS, WLX): Orange = **O**
50 µm multimode (ALS, ALX): Orange = **O**
50 µm Ten-Gigabit multimode (ALT, ALE): Aqua = **Q**
Single mode: Yellow = **Y**
12 Rating: Plenum = **P**

**Example:** 12 fiber breakout plenum cable using 62.5 µm standard laser optimized fiber, orange jacket

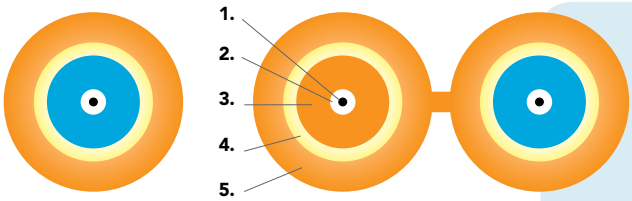
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **B** | **X** | **0** | **1** | **2** | **K** | **W** | **L** | **S** | **9** | **O** | **P** |

Optical Cable Corporation indoor/outdoor tight-buffered fiber optic tray cables meet the functional requirements of the following standards:

ICEA –S-83-596
ICEA-S-104-696
GR-409-CORE
TIA-568
TIA-598

## Overview

- Resilient and flexible for jumpers, patch cords, and pigtails
- Suitable for general purpose indoor use such as routing connections within security central locations




Simplex

Duplex Zipcord

1. Optical Fiber
2. 250 µm Acrylate Fiber Coating
3. 900 µm Diameter Tight-Buffer (standard)
4. Aramid Strength Member
5. Outer Jacket

## Features

- Short "patch cord" cables ideal for links between electronic equipment and main fiber optic cables
- Flame-retardant for indoor installations
- Compatible with all standard fiber optic connectors
- High performance tight-buffered coating on each optical fiber for environmental and mechanical protection
- Custom jacket and/or buffer colors are available to match connectors. Special print on the cable outer jacket is also available
- 1 (simplex) and 2 (duplex) fibers available
- SLA Bend-Insensitive single-mode fiber available for applications with tight bends
- Micro cables are a small size for dense usage
- Specifically designed for small form-factor simplex and duplex connectors, such as the LC and MTRJ connectors
- Micro cables are available with easy strip 900 µm tight-buffer for access to 250 µm buffered fiber

## Mechanical and Environmental Performance

| | Assembly Security Cables (AX) 2.9mm | | Micro Assembly Security Cables (AE) 2.0mm | |
|---|---|---|---|---|
| | Riser (N or D) | Plenum (S) | Riser (D) | Plenum (S) |
| Operating Temperature | -40°C to +85°C | -20°C to +85°C | -40°C to +85°C | -20°C to +85°C |
| Storage Temperature | -55°C to +85°C | -40°C to +85°C | -55°C to +85°C | -40°C to +85°C |
| Installation temperature (cable temp.) | -10°C to +60°C | 0°C to +60°C | -10°C to +60°C | 0°C to +60°C |
| Impact Resistance | 1,000 impacts | 200 impacts | 750 impacts | 150 impacts |
| Flex Resistance | 7,500 cycles | 2,000 cycles | 2,000 cycles | 1,000 cycles |
| Crush Resistance | 750 N/cm | 500 N/cm | 500 N/cm | 500 N/cm |
| Flame Retardancy | Riser* | Plenum** | Riser* | Plenum** |

**Riser: UL Listed Type OFNR (UL 1666) and FT4 (CSAC22.2 No. 232)*
***Plenum: UL Listed Type OFNP (ANSI/NFPA 262) and FT6 (CSA C22.2 No. 232)*

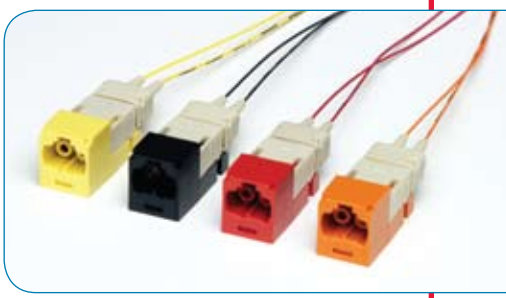
## Cable Characteristics: Assembly Cables

| | | Minimum Bend Radius | | | | | |
|---|---|---|---|---|---|---|---|
| | Fiber Count | Under Installation Tensile Load | Under Long Term Tensile Load | Diameter mm (in) | Weight kg/km (lbs/1000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) |
| AX Series 2.9mm | | | | | | | |
| Riser (N) | 1 | 5 cm | 3 cm | 2.9 (0.11) | 8 (5) | 500 (110) | 300 (70) |
| | 2 | 5 cm | 3 cm | 2.9 x 5.8 (0.11 x 0.23) | 16 (11) | 1,000 (220) | 500 (110) |
| Plenum (S) | 1 | 5 cm | 3 cm | 2.9 (0.11) | 9 (6) | 500 (110) | 300 (70) |
| | 2 | 5 cm | 3 cm | 2.9 x 5.8 (0.11 x 0.23) | 18 (12) | 1,000 (220) | 500 (110) |
| AE Series 2.0mm | | | | | | | |
| Riser (D) | 1 | 3.8 cm | 2.5 cm | 2.0 (0.08) | 4.3 (2.9) | 300 (67) | 160 (36) |
| | 2 | 3.8 cm | 2.5 cm | 2.0 x 4.5 (0.08 x 0.18) | 8.9 (5.8) | 600 (135) | 300 (67) |
| Plenum (S) | 1 | 3.8 cm | 2.5 cm | 2.0 (0.08) | 4.9 (3.3) | 300 (67) | 160 (36) |
| | 2 | 3.8 cm | 2.5 cm | 2.0 x 4.5 (0.08 x 0.18) | 9.8 (6.6) | 600 (135) | 300 (67) |

## Ordering Information

| | A | | 0 | 0 | | | | | | 9 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

1 Assembly Series = **A**
2 Diameter: 2.9mm = **X**; 2.0mm = **E**; 1.6mm = **C**
3 – 5 Fiber count: Simplex = **001**; Duplex = **002**
6 Jacket type:
Riser (2.9 mm) = **N**
Riser (Micro-Assembly 2.0mm, 1.6mm) = **D**
Plenum (2.9mm, 2.0mm, 1.6mm) = **S**
7 – 9 Fiber type: (See Laser Ultra-Fox™ Fiber Performance Table - Pg. SC21)
10 250 micron fiber with 900 micron tight buffer = **9**
250 micron fiber with 900 micron ES2 (Easy Strip) tight-buffer = **2**
11 Standard Jacket Color:
62.5 µm multimode (WLS, WLX) – Orange = **O**
50 µm multimode (ALS, ALX) – Orange = **O**
50 µm Ten gigabit (ALT, ALE) – Aqua = **Q**
Single-mode – Yellow = **Y**
12 Rating: Riser = **R**; Plenum = **P**



**Example:** 2-fiber (duplex) 2.9mm Riser assembly cable using 62.5 µm standard laser optimized fiber, orange jacket –

| A | X | 0 | 0 | 2 | N | W | L | S | 9 | O | R |
|---|---|---|---|---|---|---|---|---|---|---|---|

2-fiber (duplex) 2.0mm Riser micro assembly cable using 62.5 µm standard laser optimized fiber, orange jacket

| A | E | 0 | 0 | 2 | D | W | L | S | 9 | O | R |
|---|---|---|---|---|---|---|---|---|---|---|---|

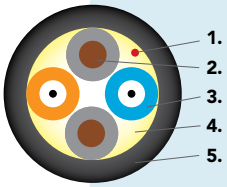
# COMPOSITE CABLES FOR SECURITY SOLUTIONS

OPTICAL CABLE CORPORATION



## Overview

- Data communication and control installations that require fiber and copper under one cable jacket

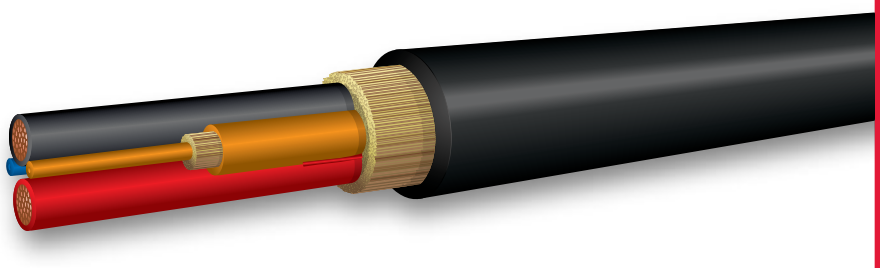



1. Ripcord
2. 2 Stranded Copper Wire
3. Optical Fiber Subcable
4. Aramid Strength Member
5. Outer Jacket

## Features

- Various combinations of copper conductors and optical fibers in a single composite cable
- Chemical-resistant outer jacket available for harsh industrial or outdoor environments
- 12, 14, 16, 18 gauge single stranded copper wire available for power, communication, control, sensing, signal, and video
- Multimode (62.5 µm or 50 µm) and single-mode fiber available – contact Optical Cable Corporation for specifications and part numbers.
- Larger gauge wires overcome powering distance limitations of unshielded twisted pair
- Copper and fiber individually sub-cabled for ease of separation, handling and termination
- Round cable design for easy installation and survivability
- Many combinations available with CL2R riser-ratings or CL2P plenum-ratings
- Also available with field-deployable flexible jacket for rugged outdoor installations
- Interlocking armor available for riser and plenum composite cables
- Composite fiber/copper cables are intended for use on Class 2 power limited circuits as described in Article 725 of the National Electrical Code

**Many combinations of optical fibers and wires can be manufactured to your specific requirements. Please contact Optical Cable Corporation for a price quotation for the Composite Fiber/Copper Cable design that meets all your special application requirements.*



## Cable Characteristics

| | Plenum (indoor/outdoor) | Riser (indoor/outdoor) |
|---|---|---|
| Minimum bend radius: | | |
| Installation load | 20X outside diameter | 20X outside diameter |
| Operational load | 15X outside diameter | 15X outside diameter |
| Flame Retardancy | CL2P-OF (UL 13) | CL2R-OF (UL 13) |

## Ordering Information: Indoor/Outdoor Riser and Plenum Composite Cables

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **C** | **X** | | | | | | | | **9** | | |
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

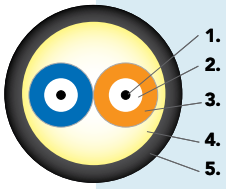
1 – 2 Composite Series Ultra-Fox™ = **CX**
3 – 5 Fiber count: Number of fibers **(002 – 036)** + Copper Conductors **(001 – 004)**
Example: 2-fiber/2-copper = **004**
6 Jacket type: Fluoropolymer indoor/outdoor plenum = **K**; PVC indoor/outdoor = **D**
7 – 9 Fiber/Copper type: Contact Optical Cable Corporation for code
10 250 micron fiber with 900 micron tight buffer = **9**
11 Standard Jacket Color:
PVC (all fiber types) – Black = **K**
Fluoropolymer = 62.5 µm multimode (WLS, WLX) – Orange = **O**
50 µm multimode (ALS, ALX) – Orange = **O**
50 µm Ten-gigabit (ALT, ALE) – Aqua = **Q**
Single-mode – Yellow = **Y**
12 Rating: Plenum = **P**; Riser = **R**

**Example:** 2-fiber/2AWG-18 indoor/outdoor plenum copper cable using 62.5 µm standard laser optimized fiber, orange jacket –

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **C** | **X** | **0** | **0** | **4** | **K** | • | • | • | **9** | **O** | **P** |


## Overview

- Multiple fibers stranded with common strength members within a tightbound jacket
- Ideal distribution configuration for most demanding security cable applications – high strength, crush, impact, bend, twist, flex, continuous movement, light weight for deployment/retrieval, etc.



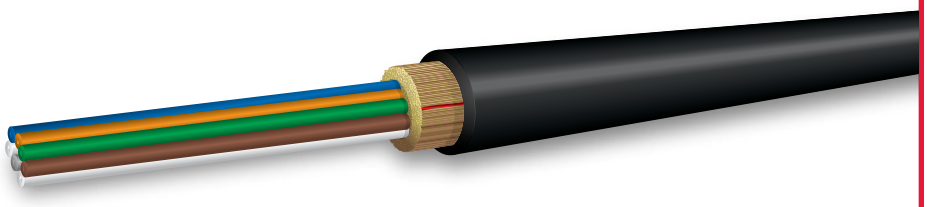

1. Optical Fiber
2. Acrylate Fiber Coating
3. Color-Coded 900 µm Diameter Tight-Buffer
4. Aramid Strength Member
5. Core-Locked™ Polyurethane Jacket

## Features

- Rugged, high-strength cable design for outdoor only applications
- Excellent for use in temporary deployment/retrieval security applications
- Designed for use in adverse outdoor environments (snow, desert, humidity, etc.)
- Helically stranded cable core for flexibility, survival in difficult pulls, and superior mechanical protection for the optical fibers
- Crush resistant, impact resistant and resilient with additional aramid strength members
- Wide operating temperature range
- Chemical resistant

## Mechanical and Environmental Performance

| | MIL-TAC |
|---|---|
| Minimum Bend Radius:<br>Under Installation Tensile Load<br>Under Operational Tensile Load | <br>16X outside diameter<br>8X outside diameter |
| Operating Temperature | -55°C to +85°C |
| Storage Temperature | -70°C to +85°C |
| Crush Resistance (TIA/EIA-455-41 military requirement) | 440 N/cm |
| Impact Resistance (EIA/TIA-455-25 military requirement) | 200 impacts |
| Flex Resistance (TIA/EIA-455-104 military requirement) | 2,000 cycles |



## Cable Characteristics: Mil-Tac Style Distribution Cables

| Fiber Count | Diameter mm (in) | Weight kg/km (lbs/1,000') | Installation Tensile Load N (lbs) | Operational Tensile Load N (lbs) | Minimum Bend Radius Installation cm (in) | Minimum Bend Radius Operational cm (in) |
|---|---|---|---|---|---|---|
| 2 | 5.0 (0.20) | 21 (14) | 1,800 (400) | 600 (130) | 8.0 (3.1) | 4.0 (1.6) |
| 4 | 5.5 (0.22) | 27 (18) | 1,800 (400) | 600 (130) | 8.9 (3.5) | 4.4 (1.7) |
| 6 | 6.0 (0.24) | 32 (22) | 1,800 (400) | 600 (130) | 9.6 (3.8) | 4.8 (1.9) |
| 8 | 6.5 (0.26) | 37 (25) | 1,800 (400) | 600 (130) | 10.4 (4.1) | 5.2 (2.0) |
| 10 | 6.5 (0.26) | 37 (25) | 2,100 (470) | 700 (160) | 10.4 (4.1) | 5.2 (2.0) |
| 12 | 6.5 (0.26) | 36 (24) | 2,100 (470) | 700 (160) | 10.4 (4.1) | 5.2 (2.0) |
| 18 | 7.5 (0.30) | 49 (33) | 2,400 (540) | 800 (180) | 12.0 (4.7) | 6.0 (2.4) |
| 24 | 8.5 (0.33) | 56 (38) | 3,000 (670) | 1,000 (220) | 13.6 (5.4) | 6.8 (2.7) |

## Ordering Information

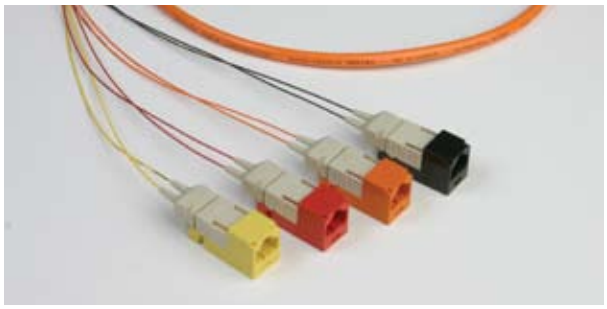
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **D** | **–** | | | | | | | | **5** | **K** | **M** |
| **Digit No:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

1 – 2 Mil-Tac Distribution Series Ultra-Fox Plus™= **D –**
3 – 5 Fiber count: (See Cable Characteristics Chart) = **002 – 024**
6 Jacket type:
Tactical Polyurethane = **C**
Flame Retardant Polyurethane = **E**
Low Smoke Zero Halogen Polyurethane = **G**
Tactical Flame Retardant Polyurethane = **V**
7 – 9 Fiber type: (See Laser Ultra-Fox™ Fiber Performance Table - Pg. SC 21)
62.5 µm multimode = **WST**
50 µm multimode = **AST**
Single-mode = **SLS**
10 500 micron fiber with 900 micron tight buffer = **5**
11 Standard Jacket Color: Black = **K**
12 Rating: Mil = **M**

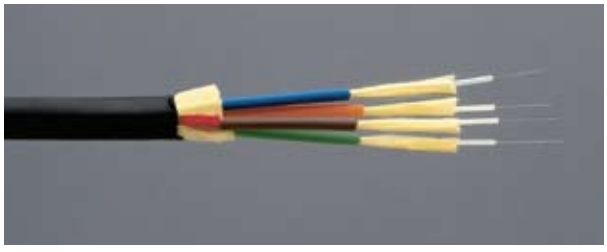
**Example:** 12 fiber Mil-Tac distribution cable using 62.5 µm fiber, black jacket –

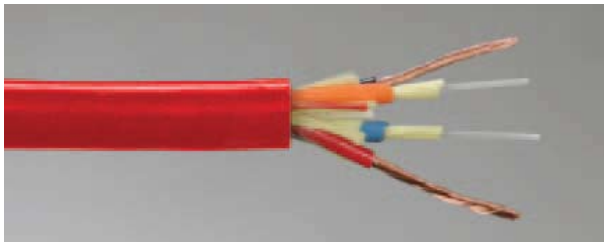
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **D** | **–** | **0** | **1** | **2** | **C** | **W** | **S** | **T** | **5** | **K** | **M** |

## In addition to Optical Cable Corporation's most popular fiber optic security cables, we also offer the following:



United States Department of Labor
MSHA
Mine Safety and Health Administration





**Color-Keyed Cables** – Many security applications include the use of special "keyed" and color-coded connectors that eliminate insertion of a security application into a non-secured transmission path. For additional ease of installation, Optical Cable Corporation offers color-coded fibers that match the color-coding of the keyed connectors. Special security markings and colored outer jacketing materials are also available to clearly differentiate security cables from voice and data cables.

**MSHA Approved Cables** – Optical Cable Corporation's MSHA fiber optic cables are typically used for mining security networks to provide reliable and error-free monitoring, automation, and control data transmission over long distances. These fiber optic cables are designed for harsh, demanding environments and are MSHA approved for intrinsically safe areas.

**TEMPEST** – This cable is designed for entrance into rooms or enclosures which are shielded against emanation of electromagnetic radiation. Cables are usually routed through shielding penetrators; short sections of waveguide placed through the TEMPEST shielding of the enclosures. This cable is also used for EMP and HEMP protection.

**Zero Halogen** – Zero Halogen cable is designed for use on security systems located in enclosed areas, such as subway/metro systems where low fire toxicity is of paramount importance.

**Alarm and Security Cables** – Special outer cable jacket colors and markings are available for identification of alarm and security cables. Composite fiber/copper cables are available in multiple varieties; many UL listed.

## Laser Ultra-Fox™ Fiber Performance

| Fiber Code | Core/Cladding Diameter (µm) | Wavelength (nm) | Industry Standard Designation | Gigabit Ethernet Distance (m) | 10-Gigabit Ethernet Distance (m) | Maximum Cabled Attenuation (dB/km) | Minimum Laser Bandwidth (MHz-km) | Minimum LED Bandwidth* (MHz-km) |
|---|---|---|---|---|---|---|---|---|
| **WLS** | 62.5/125 Standard | (850/1310) | OM1 ISO/IEC 11801 | 300/600 | 33/300^ | 3.5/1.5 | 220/500 | 200/500 |
| **WLX** | 62.5/125 XL | (850/1310) | OM1 ISO/IEC 11801 | 500/1000 | 33/300^ | 3.0/1.0 | 385/500 | 200/500 |
| **ALS** | 50/125 Standard | (850/1310) | OM2 ISO/IEC 11801 | 600/600 | 82/300^ | 3.5/1.5 | 510/500 | 500/500 |
| **ALX** | 50/125 XL | (850/1310) | OM2 ISO/IEC 11801 | 750/600 | 150/300^[2] | 3.0/1.0[3] | 950/500 | 700/500 |
| **ALT** | 50/125 (300 meter 10-GbE) | (850/1310) | OM3 ISO/IEC 11801 | 1000/600 | 300/300^[2] | 3.0/1.0[3] | 2000/500 | 1500/500 |
| **ALE** | 50/125 (550 meter 10-GbE) | (850/1310) | OM3 ISO/IEC 11801 | 1040/600 | 550[1]/300^[2] | 3.0/1.0[3] | 4700/500 | 3500/500 |
| **SLX** | 9[6]/125 Low Water Peak Single-mode | (1310/1550) | ITU-T G.652.D | 5 km[4] | 10 km[5] | 0.5/0.5 | — | — |
| **SLA** | 9[6]/125 Bend-Insensitive Single-mode | (1310/1550) | ITU-T G.657.A ITU-T G.652.D | 5 km[4] | 10 km[5] | 0.5/0.5 | — | — |
| **SLB** | 9[6]/125 Bend-Insensitive Single-mode | (1310/1550) | ITU-T G.657.A & B ITU-T G.652.D | 5 km[4] | 10 km[5] | 0.5/0.5 | — | — |

* For backward compatibility to LED based systems, overfilled launch (OFL)

^ 1310 nm CWDM lasers (10GBASE-LX4)

[1] Reach assuming 3.0 dB maximum cabled attenuation at 850 nm and 1.3 dB total connection and splice loss

[2] Supports 220 meter 10GBASE-LRM distance, or 300 meter 10GBASE-LRM distance with 300 meter capable equipment

[3] 3.5/1.5 dB/km maximum attenuation applies for DX-Series cables greater than 36 fibers, and for all DX-Series cables with armor (corrugated steel tape or interlocked armor) or any other secondary outer jacketing

[4] 10 km for 1310 nm 1000BASE-LH, and 5 km for 1310 nm 1000BASE-LX

[5] 10 km for 1310 nm 10GBASE-LR, and 40 km for 1550 nm 10GBASE-ER

[6] Nominal Mode Field Diameter at 1310 nm

**Note:** many other fiber types, fiber bandwidth, and attenuation performances are available.

## Custom Cables

Optical Cable Corporation offers tremendous flexibility in providing customers with customized tight-buffered fiber optic cables for their special requirements—not just standard off-the-shelf items. If you need a custom cable, please call Optical Cable Corporation at 1-800-622-7711 or (540) 265-0690.