

Fiber Optic Cables

Introduction



Many new products have been added. Orders can be placed using either the new catalog numbers (43GR–TBB25SL) or the prior catalog numbers (99–32–1).

Fiber optic sensors permit the attachment of “light pipes” called fiber optic cables. Light emitted from the source is sent through transparent fibers in the cables and emerges at the end of the fiber. The transmitted or reflected beam is then carried back to the receiver through different fibers. Ideal for sensing small objects, fiber optic cables can be mounted in locations that would otherwise be inaccessible to photoelectric sensors. Other characteristics/advantages of fiber optic sensors include:

- Some glass fiber optic tips have the ability to withstand high temperatures (up to 900°F)
- Withstand extreme shock and vibration
- Often have the fastest response times
- Immunity to electrical interference (EMI, RFI).

Fiber Optic Cables—Types

Fiber optic cables can be made of glass or plastic and categorized as either individual (transmitted beam) or bifurcated (diffuse).

Glass fiber optic cables contain multiple strands of very thin glass fiber that are bundled together in a flexible sheath. Typically more durable than their plastic

counterparts, glass fiber optic cables will withstand much higher temperatures; glass fiber optic cables with a stainless steel sheath are rated up to 260°C (500°F). Special glass cables can be obtained with temperature ratings of up to 482°C (900°F). Most glass cables are available with a choice of PVC or flexible stainless steel sheath. While PVC-sheathed cables are typically less expensive, stainless steel sheathing offers greater durability and allows the cables to operate in higher temperatures. Glass fibers can be used with infrared or visible LED light sources.

Individual glass strand diameters range from 25μ (0.001in) to 50μ (0.003in). Light transmission is maximized with a thicker bundle diameter. It is also important to note that attenuation increases as fiber optic cable length increases. For further details, see the Application Recommendations section on page 1–295.

Plastic fiber optic cables are constructed of a single acrylic monofilament and, since plastic fibers absorb infrared light, they are most efficient when used with visible red LED sources. It is recommended that plastic fiber optic cables are used with visible light sources. Considered less durable than glass cables, plastic fibers are generally less expensive and can be

used in applications where continuous flexing of the cable is required. For that reason, coiled plastic cables are also available for such applications.

General Information

Sensor and Sensing Tip Selection page 1–293 and 1–294

Glass Fiber Optic Cables

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Plastic Fiber Optic Cables

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Selection Process

1. Determine the sensing mode (reliability)

- Transmitted beam (two separate cables required)
 - Greater distance from sensing tip to the object
 - Reflectivity of the object is low
 - Generally darker colors reflect less light.
- Diffuse (one bifurcated cable)
 - Distance from sensing tip to the object is small
 - Reflectivity of the object is high
 - Generally lighter colors reflect more light.
- Select fiber bundle size for the application.

The smaller the bundle size the smaller the light spot size for seeing smaller objects.

2. Choose between glass or plastic fiber optic cables

- Glass
 - Higher temperature rating (up to 900° F possible)
 - Used with infrared or visible red light sources
 - More expensive.
- Plastic
 - Typically used for visible light sources

- Lower temperature applications (lower than 200° F)
- Less expensive.

3. Mechanical considerations

- Glass has a more restrictive bending radii (see page 1–295)
- Select stainless steel or PVC sheathing depending on durability requirements
- Select sensing tip configuration based on mounting space availability
 - Threaded tip versus ferruled
 - Straight tip versus 45° or 90° bend
 - Straight tip with light exiting at 90°.

4. Cable length

- Determine distance from sensor to object including required bending radii
- Longer distances will reduce sensing distances as fiber optic cables have a resistance to light transfer
 - Light loss is approximately 10% per foot
- Use of extended range lens assemblies significantly increase sensing distance.

Custom Fiber Optic Cables

Rockwell Automation/Allen-Bradley can provide custom glass fiber optic cables to meet nearly any application requirement.

Typical cable modifications include:

- Custom lengths up to 15.2m (50ft)
- Custom temperature ratings up to 482° C (900° F) applies to glass fiber optic cables
- Custom configurations including multiple sensing tips
- Custom sensing end tips— nearly any modification is possible



CAUTION: Standard fiber optic cables are not recommended for explosion-proof applications in hazardous environments. The fiber optic cable can provide a path for explosive fumes to travel from the hazardous area to the safe area.

For more information contact product support at 1.800.666.0001 or +1.978.441.9500. (Reference pages 1–331 to 1–332 for glass and 1–364 to 1–365 for plastic.)

Sensing Modes

The standard photoelectric sensors, fiber optic sensors are offered in two sensing modes: transmitted beam and diffuse. Reflective sensing can be accomplished in a diffuse mode or retroreflective mode.

Standard **diffuse** sensing with fiber optic cables is similar to sensing with lensed photoelectrics. When adjusted to maximum sensitivity these sensors, using bifurcated fiber optic cables, can detect extremely small targets.

Individual fiber optic cables may be used for more specialized diffuse mode applications. For instance, aiming the two separate sensing tips of the cables at the target can create sharp cutoff, fixed focus and mechanically convergent sensing modes.

Bifurcated Cable (Diffuse Retroreflective)



Standard **retroreflective** sensing is possible with fiber optics, but polarized retroreflective sensing is not. In some applications, it will be necessary to

reduce the sensitivity of the sensor to prevent diffuse detection of the target.

Transmitted beam sensing, the most reliable sensing mode, requires two

individual fiber optic cables. Targets are detected when they break the light path established between the emitter and receiver cables.

Fiber Optic Cables

Introduction

Individual Cable (Transmitted Beam)



Sensing End Tip Selection

One of the most important decisions to be made when selecting fiber optic cables is the sensing end tip configuration. Among the many considerations:

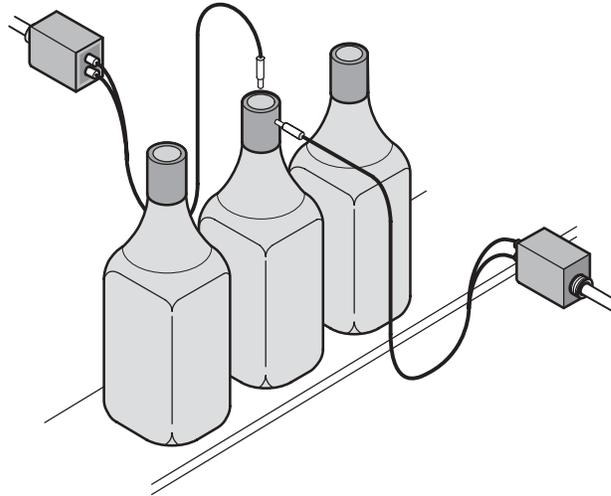
- Size of the object to be sensed
- Rate of travel of the target object
- Distance to the object

- Mounting options
- Environmental conditions
- Moving parts surrounding the object
- Sensing mode

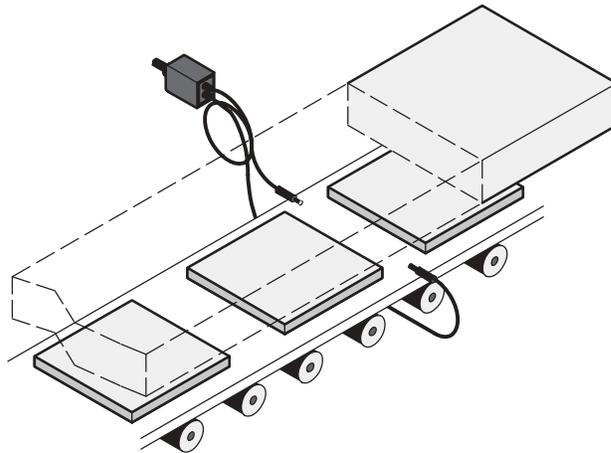
Based on these factors, there are many sensing tips to select from offering various fiber diameters and arrays,

bending radii, threaded and smooth body configurations, etc. The following pages are designed to assist in the selection of the proper sensing end tip for the application. Once a selection has been made, proceed to the fiber optic cables section to select the appropriate fiber optic cable part number.

Cork Detection with Bifurcated Fiber Optic Cables



Work Piece Detection with Individual Fiber Optic Cables



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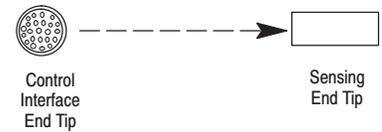
- Avoid sharp bends. The individual glass fibers in the cable can be broken. Don't exceed the following bend tolerances with PVC sheathed cables:

Minimum Cable Bend Radius

Bundle Diameter—mm (in)	Minimum Bend—mm (in)
0.68 (0.027)	12.7 (0.50)
1.16 (0.046)	12.7 (0.50)
1.6 (0.063)	15.8 (0.625)
2.28 (0.090)	15.8 (0.625)
3.17 (0.125)	19.0 (0.75)
3.96 (0.156)	25.4 (1.0)
4.57 (0.180)	31.7 (1.25)

- Glass fiber optic cables have a wide **field of view**, typically 66°. A smaller field of view can be achieved by attaching an Extended Range Lens Assembly to the sensing end of the fiber. These lens assemblies will also increase the available sensing distance. Refer to the Accessories section for more information.

- Most glass fiber optic cables have round sensing tips with the glass fibers arranged in a circular configuration. Other cables such as 43GT-FIS40SL offer sensing tips with a **rectangular shaped opening** for the glass fibers, referred to as "slotted" cables (see illustration below).



Use these equivalent diameters to determine the approximate performance of slotted cables. Refer to the Typical Response curves on page 1-296.

Slot Dimensions—mm (in)	Round Sensing Tip Equivalent Diameter—mm (in)
2.5 x 0.5 (0.1 x 0.02)	1.5 (0.06)
0.5 x 2.5 (0.02 x 0.1)	1.5 (0.06)
51 x 0.25 (2.0 x 0.01)	3.1 (0.125)
9.7 x 0.8 (0.382 x 0.032)	3.1 (0.125)
38 x 0.025 (1.5 x 0.01)	3.1 (0.125)

Formula:
Approximate diameter = 1.128 x √ Length x Width

CAUTION: Standard fiber optic cables are not recommended for explosion-proof applications in hazardous environments. The fiber optic cable can provide a path for explosive fumes to travel from the hazardous area to the safe area.

Application Recommendations

- Many glass fiber optic cables are available with different glass fiber bundle diameters.

Larger diameter bundles contain more fibers to carry light between the sensor and application. These cables will generally offer **longer sensing ranges**.

Smaller diameter bundles provide greater resolution and the ability to detect smaller targets.
- The **Typical Response curves** on page 1-296 show the performance of Allen-Bradley glass fiber optic sensors and cables. Note that different sensing distances can be achieved depending upon the cable bundle diameter. These sensing distances must be derated for adverse environments.

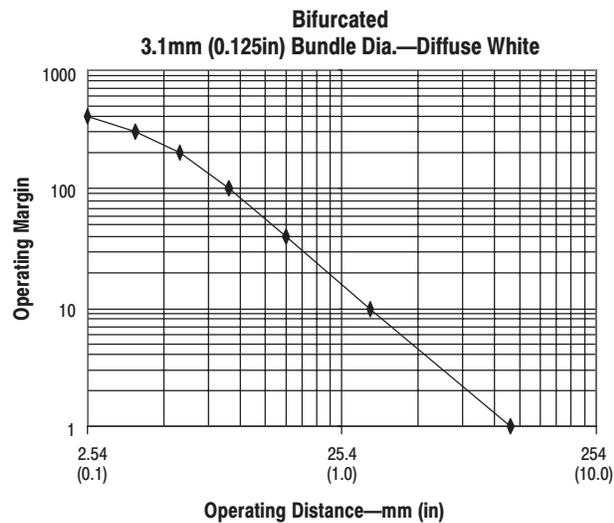
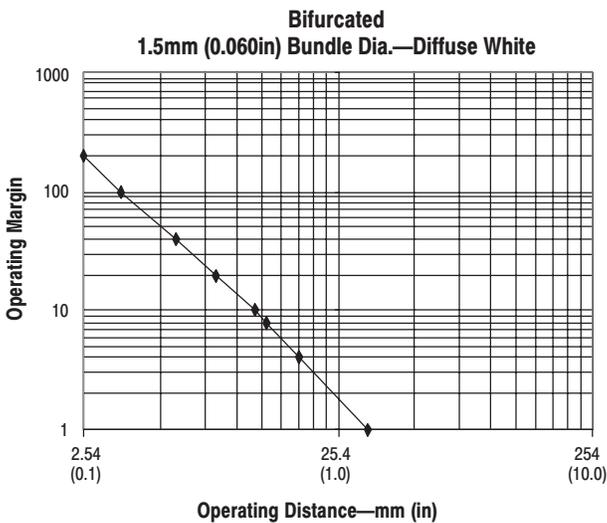
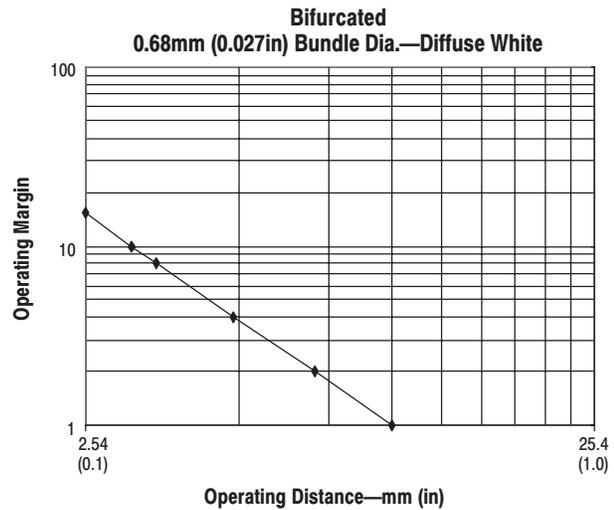
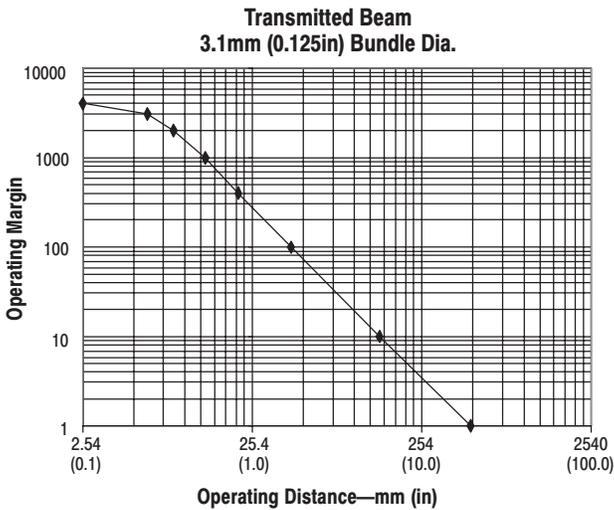
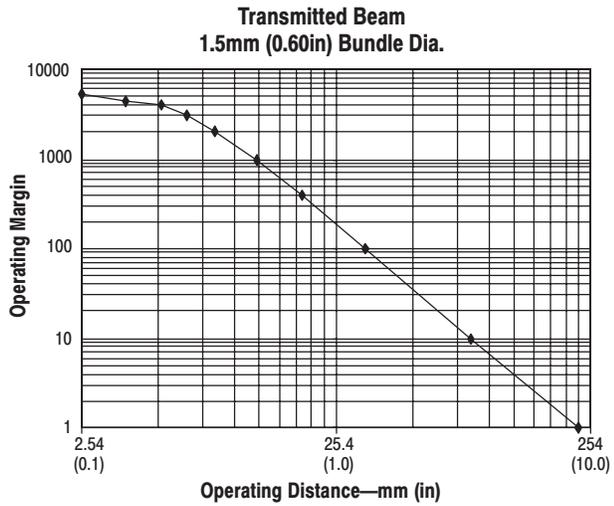
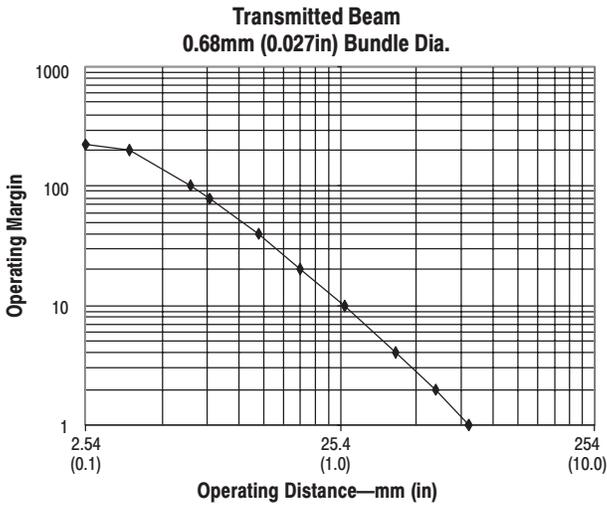
These Typical Response curves are for standard 0.91m (3ft) cable lengths. Longer custom cables will attenuate the light and reduce the operating range. Contact product support at 1.800.666.0001 or +1.978.441.9500 for application assistance.
- Glass fiber optic cables can be applied in high shock and vibration applications, but secure the cables to prevent excess flexing. Do not use glass cables in applications where they are constantly flexing. **They will break.** Plastic fiber optic cables will provide better performance in these applications.

- Glass fiber optic cables cannot be cut, spliced or repaired.
- Most sensing end tips cannot be bent. **Only special end tips can be bent** as specified in the Selection Guide. When using bendable end tips, bend should not be attempted closer than 19mm (0.75in) to the sensing end of the cable.
- Some applications call for glass fiber optic cables to be used to isolate the sensor from **high voltage**. Custom cables with special nonconductive components must be ordered for these applications.
- X-RAY or GAMMA radiation will cause glass fibers to eventually become opaque. Custom cables constructed with special optical quartz fibers must be ordered for use in areas with **high radiation**.
- Use Transmitted Beam sensing in **submerged applications** when possible. Spiral wound stainless steel sheathing is generally not suitable for wet applications. Fiber optic cables with PVC sheathing should be used for these applications.
- A glass fiber optic sensor with a **bifurcated** cable can provide **retroreflective** or **diffuse sensing** depending upon the distance to the target and the sensitivity adjustment on the sensor. If the sensor and cable are to be used for retroreflective sensing, the sensitivity of the sensor must be adjusted low enough to avoid unwanted diffuse response from the targets to be sensed.

Glass Fiber Optic Cables

Introduction

Typical Response Curves for Series 5000 Sensors



For information on how to read a response curve see page 1–22.

AB Drives

43GT Glass Fiber Optic Cables

Transmitted Beam for Small Aperture Sensors (2.2mm/0.09in)

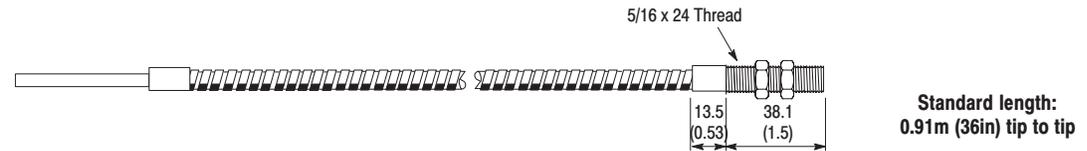
Dimensions—mm (inches)



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TAB15SS		Brass	1.6 (0.062)	Stainless Steel	215 (8.5)
43GT-TAB15MS				PVC	



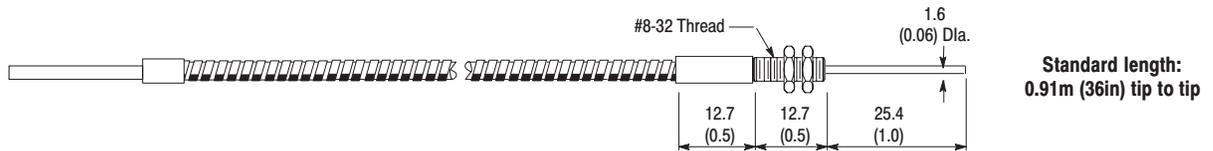
New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TAS15SS	99-714-1	Stainless Steel	1.6 (0.062)	Stainless Steel	215 (8.5)
43GT-TAS15MS				PVC	



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TBS15SS		Stainless Steel	1.6 (0.062)	Stainless Steel	215 (8.5)
43GT-TBS15MS	99-710-1			PVC	



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-XAS10SS	99-951-1	Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-XAS10MS				PVC	



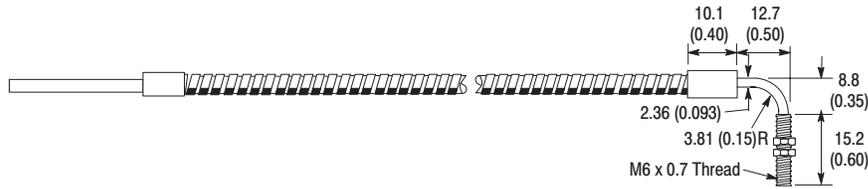
New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MRS00SS		Stainless Steel	0.7 (0.027)	Stainless Steel	Contact product support.
43GT-MRS00MS				PVC	

Note: Two transmitted beam fiber cables required for each sensor.

43GT Glass Fiber Optic Cables

Transmitted Beam for Small Aperture Sensors (2.2mm/0.09in)

Dimensions—mm (inches)



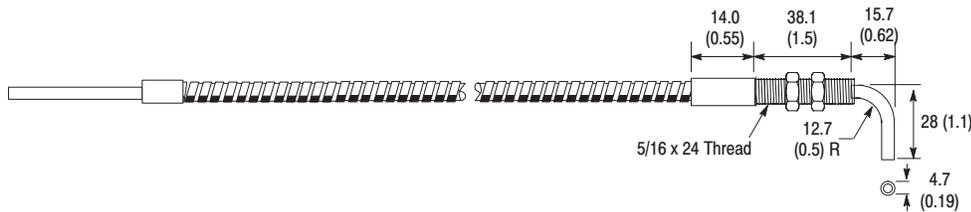
Standard length:
0.91m (36in) tip to tip

New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TIS10SS	99-952-1	Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-TIS10MS				PVC	



Standard length:
0.91m (36in) tip to tip

New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TMS15SS		Stainless Steel	1.6 (0.062)	Stainless Steel	215 (8.5)
43GT-TMS15MS	99-723-1			PVC	



Standard length:
0.91m (36in) tip to tip

New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TQS15SS		Stainless Steel	1.6 (0.062)	Stainless Steel	215 (8.5)
43GT-TQS15MS	99-718-1			PVC	



Standard length:
0.91m (36in) tip to tip

New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-TDS10SS	99-955-1	Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-TDS10MS				PVC	

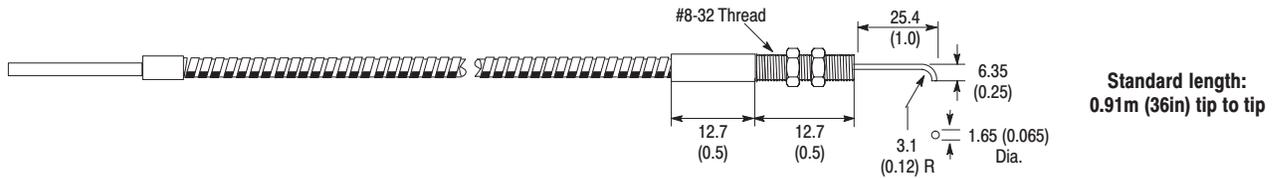
Note: Two transmitted beam fiber cables required for each sensor.

AB Drives

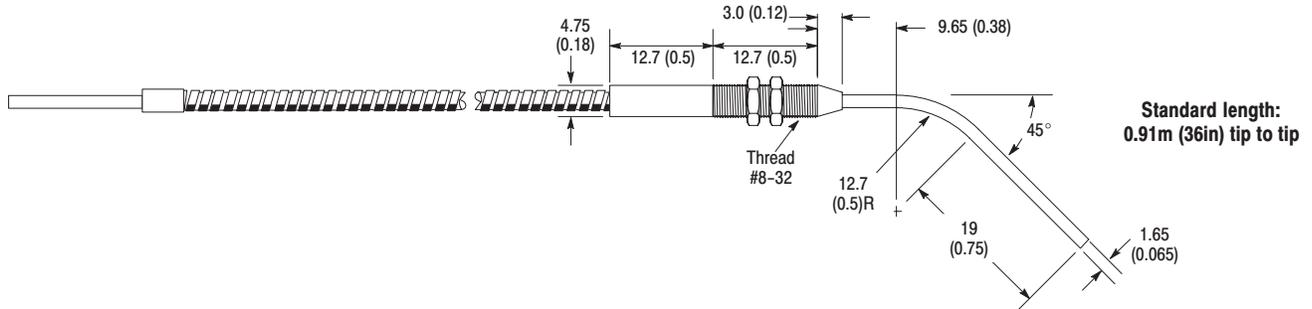
43GT Glass Fiber Optic Cables

Transmitted Beam for Small Aperture Sensors (2.2mm/0.09in)

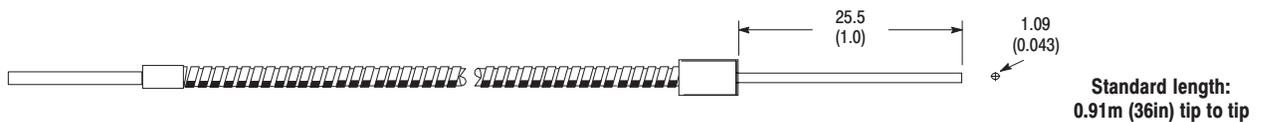
Dimensions—mm (inches)



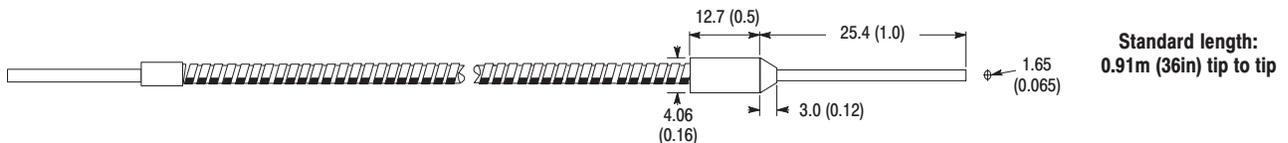
New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MUS00SS		Stainless Steel	0.7 (0.027)	Stainless Steel	Contact product support.
43GT-MUS00MS				PVC	



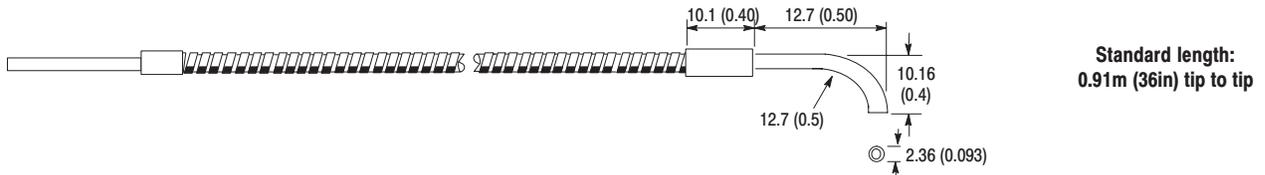
New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MSS00SS		Stainless Steel	0.7 (0.027)	Stainless Steel	Contact product support.
43GT-MSS00MS				PVC	



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MAS00SS		Stainless Steel	0.7 (0.027)	Stainless Steel	Contact product support.
43GT-MAS00MS				PVC	



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MDS10SS		Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-MDS10MS				PVC	



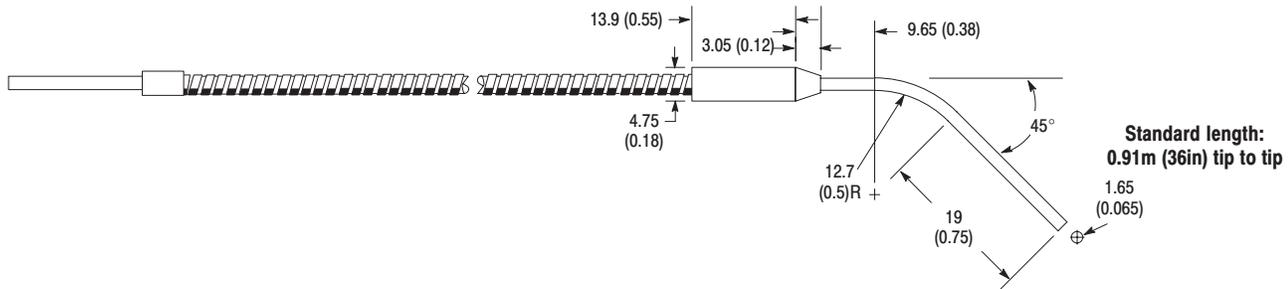
New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-FTS10SS	99-953-1	Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-FTS10MS				PVC	

Note: Two transmitted beam fiber cables required for each sensor.

43GT Glass Fiber Optic Cables

Transmitted Beam for Small Aperture Sensors (2.2mm/0.09in)

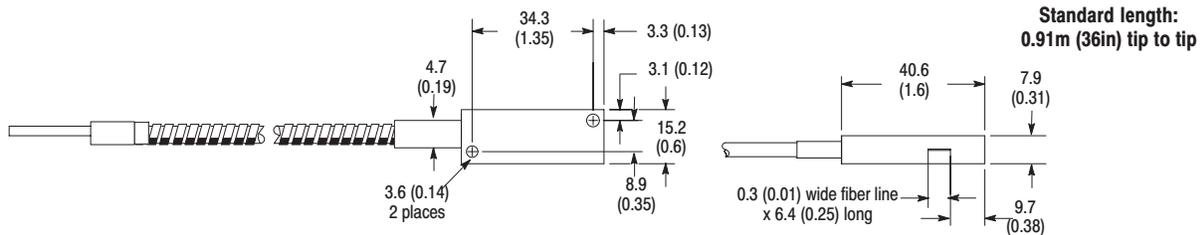
Dimensions—mm (inches)



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MJS10SS		Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-MJS10MS				PVC	



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Diameter—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-MYS10SS		Stainless Steel	1.2 (0.046)	Stainless Steel	Contact product support.
43GT-MYS10MS				PVC	



New Catalog Number	Prior Catalog Number	Sensing Tip Material	Fiber Dimensions—mm (in)	Sheathing Material	Nom. Sen. Ref.—mm (in)
43GT-BSA80SS		Aluminum	6.35 x 0.3 (0.25 x 0.012)	Stainless Steel	215 (8.5)
43GT-BSA80MS				PVC	

Note: Two transmitted beam fiber cables required for each sensor.

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