

'TORAY'

Innovation by Chemistry

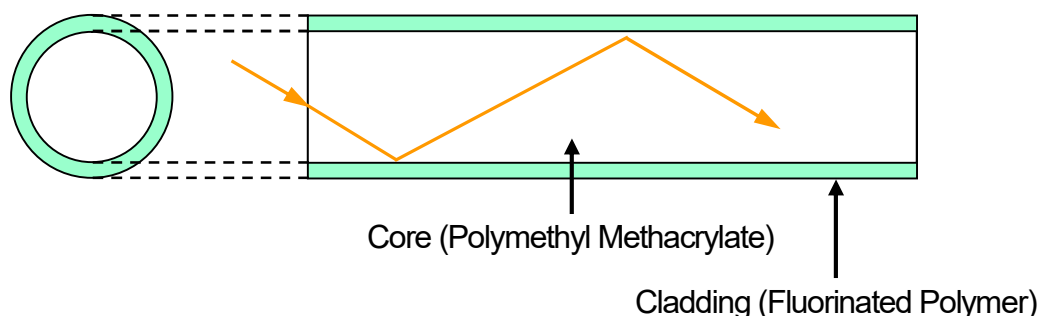


RAYTELA

Polymer Optical Fiber

Toray polymer optical fibers have been developed by Toray Industries, Inc., based on its experience in polymer and fiber manufacturing as a leading producer of synthetic fibers and plastic products in the world. Our optical fiber is step index type with core of high-purity polymethyl methacrylate and cladding of special fluorinated polymer.

We have four types of optical fiber, of which brief descriptions are given in the following table. Our optical fiber and its fabricated products are divided into three grades according to the attenuation.



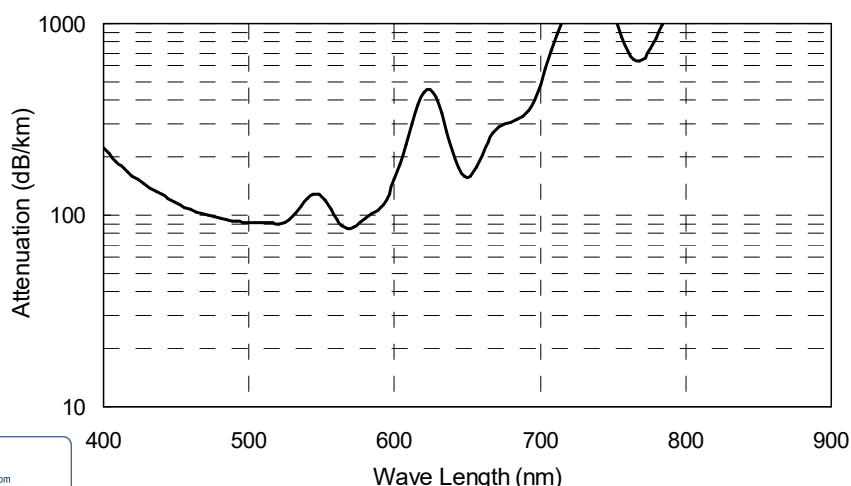
Structure of Toray Optical Fiber and Diagram of Light Transmission

● **Fiber Series**

Series		PG	PS	PF	PE
Material	Core	Polymethyl Methacrylate (PMMA)			
	Cladding	Fluorinated Polymer			
Refractive index profile		Step Index			
Numerical aperture		0.50	0.46	0.46	0.58
Acceptance angle		60°	55°	55°	71°
Available temperature range Permanent use		-55~70°C	-55~70°C	-55~85°C	-55~105°C
Main Usages		- Communication (Audio) - Optical Sensors - Lighting	- Lighting by Side Emission	- Communication (FA)	- Communication (FA, Automotive)

※Values in the table are for reference, and can vary based on the conditions and environment of use.

● **Spectral Attenuation of Optical Fiber (Typical Data)**



● Handling Precautions

I. Products

Please follow the guidelines stated below when handling Toray Raytela[®] Plastic Optical Fiber fibers, cord, cables and other processed items.
(hereinafter referred to as Raytela[®] Optical Fiber)

II. Safety Precautions

1. Usage Precautions

- (1) Raytela[®] Optical Fiber shall under no circumstance be used in applications where it will be in direct contact with food or inside the human body (including medical applications). If you wish to use Raytela[®] in a medical application, please contact our representative in advance.

2. Design Precautions

- (1) When designing a system using Raytela[®] Optical Fiber, be sure to fully review the Raytela[®] Optical Fiber characteristics, as described in the technical manuals before usage.
- (2) The characteristics shown in the technical manuals do not guarantee the safety and adaptability of the product. Please confirm the safety and adaptability of the products according to the intend use of the products.

3. Usage

- (1) Do not use the fiber under extreme temperatures. Refer to the individual Raytela[®] Optical Fiber technical specification sheets, for operational temperature requirements. If the temperature exceeds 200°C, there is a danger of gas emitting and/or ignition from the decomposition of the fiber.
- (2) When a halogen lamp or condensed sunbeams are used as a light source, a heat cut filter or cooling device needs to be used to prevent the temperature from rising past the limit of the fiber.
- (3) Avoid usage in dusty, dirty places. If dust and/or dirt adheres to the terminals of Raytela[®] Optical Fiber, the optical characteristics of the fiber may deteriorate. Furthermore, Raytela[®] Optical Fiber may melt and/or burn by igniting dust under high temperature conditions.

4. Disposal Precautions

- (1) Raytela[®] Optical Fiber contains fluorocarbon resin. Some products are also sheathed in vinyl chloride resin. When incinerated, such products may generate corrosive and poisonous hydrogen fluoride gas or hydrogen chloride gas. When disposing, incinerate in an acid-resistant incinerator equipped with a toxic substance remover/filter, or commission an industrial waste treatment specialist to bury them.
- (2) It is necessary to observe the laws and regulations of the country or providence where the fiber is to be incinerated or buried for disposal.

III. How to get the most performance out of Raytela[®] Optical Fiber

1. Precautions against physical environmental factors

- (1) Do not apply force that exceeds the maximum allowable tension factor.
- (2) Do not bend the fiber in a tight arc. If excessive stress is applied, especially near the connectors, optical characteristics may deteriorate. The radius of the arc in which the fiber is bent should not be less than the equivalent of 20 times the outside diameter of the fiber.
- (3) Do not apply tight twists to Raytela[®] Optical Fiber. The optical characteristics of Raytela[®] Optical Fiber will decline if used while being twisted.
- (4) In addition to the above, avoid applying excessive force, repetitive bending, and dropping.

2. Precautions against chemical environmental factors

- (1) Do not bring Raytela[®] Optical Fiber into contact with plasticizers (Phthalate, etc.) and/or soft PVC material (including: electric wire jacket, vinyl tape etc.). Plasticizers may move thus, the optical characteristics may deteriorate. Please test in advance to check for negative effects.
- (2) When Raytela[®] comes in contact with detergents, adhesives, oils, solvents and other chemicals, the optical characteristics may deteriorate. Verification of the resistance of Raytela[®] against these chemicals should be confirmed in the technical specification manuals.

3. Precautions against other environmental factors

- (1) Under high moisture conditions, to maintain the quality of the fiber, it is necessary to devise a cable that will keep excessive moisture out of Raytela[®] Optical Fiber.
- (2) Avoid using Raytela[®] Optical Fiber in environments where it will be exposed to ultraviolet rays, radioactive rays and other special energy rays.

The typical data contained herein are for general reference use only and are not expressed guarantees. The information is based on tests believed to be reliable but each user should conduct his own tests to determine the suitability of TORAY optical fiber in his own particular applications. All information in this guide is subject to change without prior notice.

Toray Industries, Inc.

Optical Fiber Sales Section

Electronic Materials Dept. 1

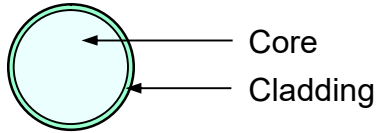
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TORAY RAYTELA®

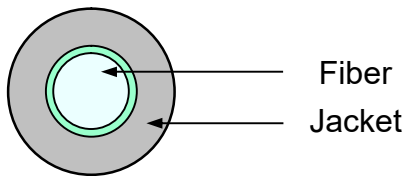
— Structure Product —

1. Fiber

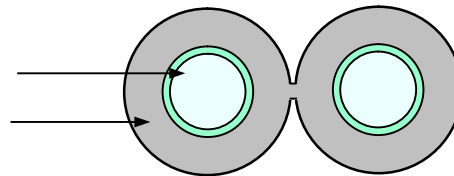


2. Cord

A. Simplex

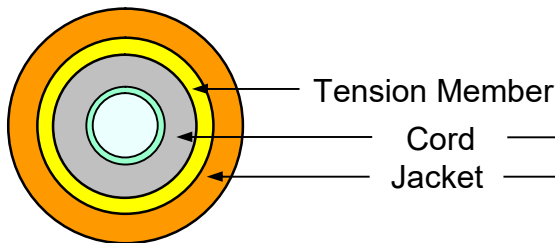


B. Duplex

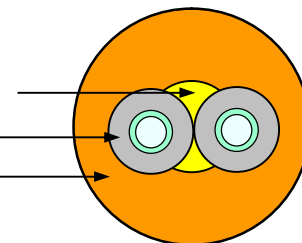


3. Cable

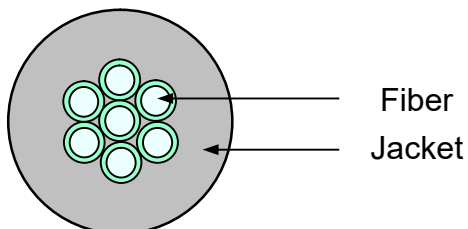
A. Simplex



B. Duplex

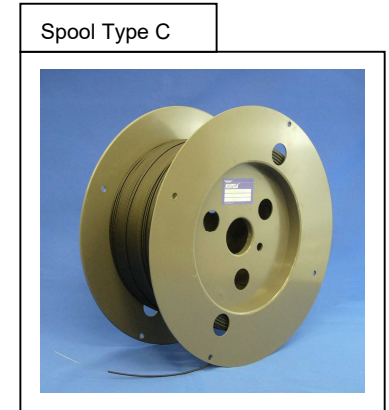
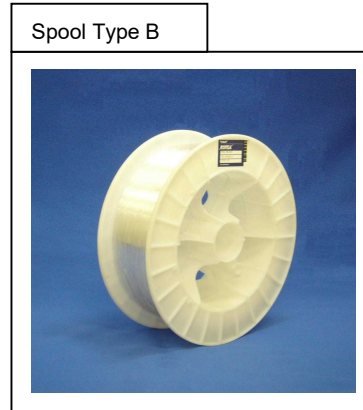
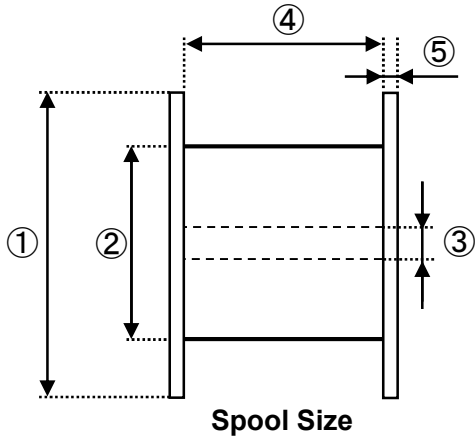


4. Light Guide



TORAY RAYTELA®

— Packing Material (Spool & Carton) —



Spool Type		Size (mm)					Weight (kg)	Material
		①	②	③	④	⑤		
Fiber	A	300	190	52	180	14	1.25	Acrylonitrile Butadiene Styrene (ABS) Polystyrene(PS)
	B	285	195	52	89	7	0.58	
Cord	C	350	210	51	140	3	0.98	Acrylonitrile Butadiene Styrene (ABS)
	D	450	210	51	140	3.5	1.53	
	E	450	315	51	141	3	1.20	Corrugated Paper Board
Cable	F	500	300	51	210	25	3.72	Acrylonitrile Butadiene Styrene (ABS)

Carton Type	Carton Size (L×W×D) (mm)	Packing Spool Type	Packing Unit (spool)
a	296 × 110 × 296	B	1
b	305 × 220 × 315	A	1
		B	2
c	420 × 310 × 302	A	2
		B	4
d	362 × 362 × 172	C	1
e	360 × 315 × 372	C	2
f	461 × 461 × 167	D	1
		E	1
g	461 × 312 × 471	D	2
		E	2
h	523 × 270 × 503	F	1

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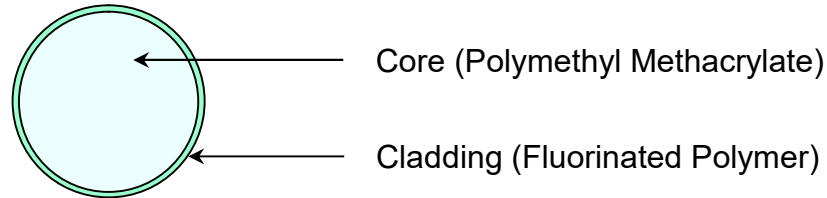
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TORAY RAYTELA®

— PG series —

1. Structure



2. Specifications

Parameter		Performance
Core	Material	Polymethyl Methacrylate (PMMA)
	Refractive index	1.49
Cladding	Material	Fluorinated Polymer
	Refractive index	1.41
Refractive index profile		Step index
Numerical aperture (NA)		0.50
Acceptance angle		60°
Available temperature range Permanent use		-55 ~ 70 °C

3. Fiber Product List

Product Code	Core Diameter (μm)	Cladding Diameter (μm)	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PG-FB 250	240	250	12,000	≦ 0.30	9
PG-FB 500	486	500	6,000	≦ 0.18	9
PG-FB 750	735	750	2,700	≦ 0.15	9
PG-FB1000	980	1,000	1,500 5,250	≦ 0.15	9
PG-FB1500	1,480	1,500	700	≦ 0.15	20
PG-FB2000	1,980	2,000	350	≦ 0.20	20
PG-FB3000	2,980	3,000	150	≦ 0.20	20

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4. Cord Product List

Product Code	Fiber/Jacket Diameter (mm)	Number of Fibers	Jacket Material	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PGU-CD 501 -10-E	0.5/1.0	1	PE	500	≤ 0.18	9
PGS-CD 501 -10-E					≤ 0.22	9
PGS-CD 751 -22-E	0.75/2.2	1	PE	500	≤ 0.18	9
PGU-CD1001-22-E	1.0/2.2	1	PE	1000	≤ 0.15	9
PGS-CD1001-22-E				500	≤ 0.18	9
PGS-CD1501-22-E	1.5/2.2	1	PE	600	≤ 0.18	20
PGU-CD 502 -10-E	0.5/1.0(2.0)	2	PE	500	≤ 0.18	9
PGS-CD 502 -10-E					≤ 0.22	9
PGU-CD1002-22-E	1.0/2.2 (4.4)	2	PE	500	≤ 0.15	9
PGS-CD1002-22-E					≤ 0.18	9

5. Light Guide Product List

Product Code	Fiber/Jacket Diameter (mm)	Number of Fibers	Jacket Material	Order Unit (m/spool)	Attenuation at 650nm (dB/m)
PGS-LG265- 4 E10	0.265/1.0	4	PE	500	≤ 0.30
PGS-LG265- 8 E13	0.265/1.3	8	PE	500	≤ 0.30
PGS-LG265-16E22	0.265/2.2	16	PE	500	≤ 0.30

6. Cable Product List

Product Code	Fiber/Cord/ Cable Diameter (mm)	Number of Fibers	Cord/Cable Material	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PGS-CL1001-22E50V	1.0/2.2/5.0	1	PE/Soft PVC	500	≤ 0.25	9

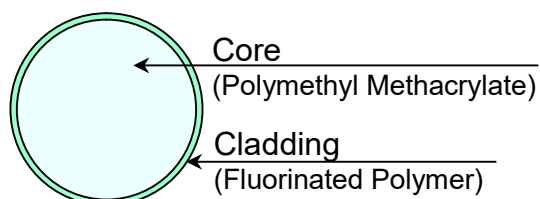
TORAY RAYTELA[®]

Side Light Plastic Optical Fiber

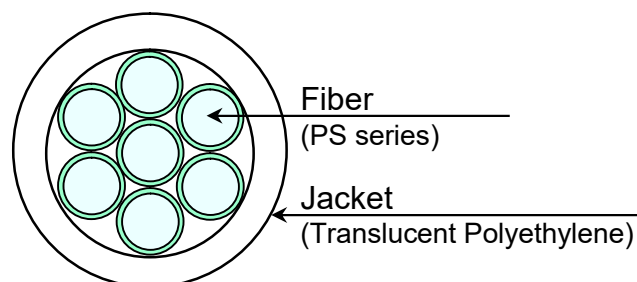
— PS series —

1. Structure

A. Fiber Products



B. Light Tube Products

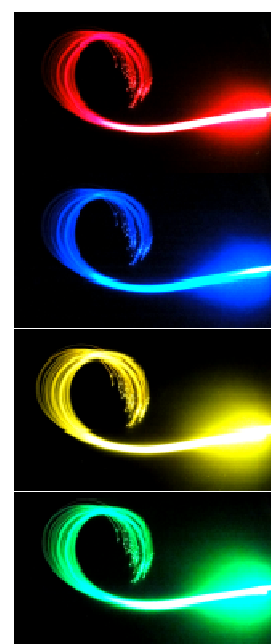


2. Specifications

Parameter		Performance
Core	Material	Polymethyl Methacrylate (PMMA)
	Refractive index	1.49
Cladding	Material	Fluorinated Polymer
Refractive index profile		Step index
Numerical aperture (NA)		0.46
Acceptance angle		55°

3. Fiber Product List

Product Code	Fiber Diameter (μm)	Order Unit (m/spool)
PS-FB 250	250	12,000
PS-FB 500	500	6,000
PS-FB 750	750	2,700
PS-FB1000	1,000	1,500



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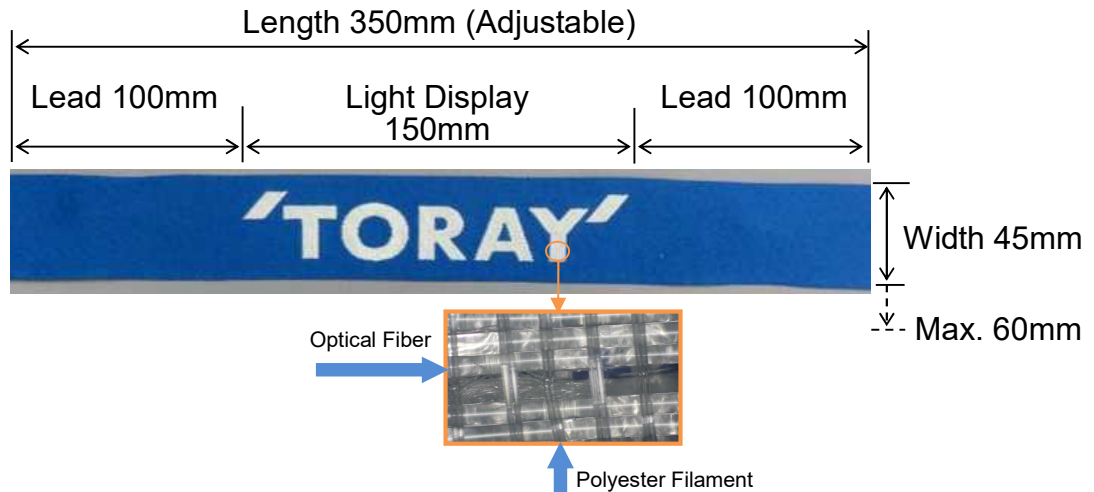
TORAY RAYTELA[®]

Side Light Plastic Optical Fiber

— Plastic Optical Fiber Ribbon —

1. Sample Structure (Made with fiber product PS-FB250)

A. Front Display



B. Reverse Side



2. Light Display

Color of light display is dependent on LED light source.



Light Display with Green LED

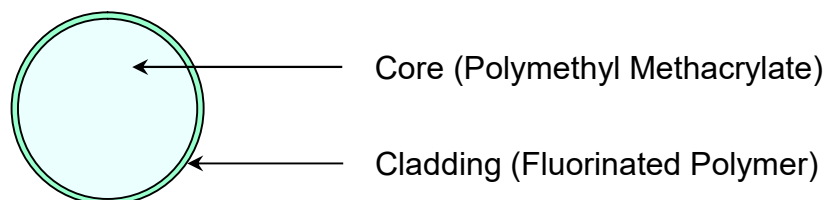


Light Display with White LED

TORAY RAYTELA®

— PF series —

1. Structure



2. Specifications

Parameter		Performance
Core	Material	Polymethyl Methacrylate (PMMA)
	Refractive index	1.49
Cladding	Material	Fluorinated Polymer
	Refractive index	1.42
Refractive index profile		Step index
Numerical aperture (NA)		0.46
Acceptance angle		55°
Available temperature range Permanent use		-55 ~ 85 °C

3. Fiber Product List

Product Code	Core Diameter (μm)	Cladding Diameter (μm)	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PF-FB 500	486	500	6,000	≤ 0.18	17
PF-FB 750	735	750	2,700	≤ 0.15	17
PF-FB1000	980	1,000	5,250	≤ 0.15	17

4. Cord Product List

Product Code	Fiber/Jacket Diameter (mm)	Number of Fibers	Jacket Material	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PFU-CD 501-10-E	0.5/1.0	1	PE	500	≤0.18	17
PFU-CD1001-22-E	1.0/2.2	1	PE	1,000	≤0.15	17
PFU-UD1001-22-E (Flame Retardant Type)	1.0/2.2	1	PE UL Grade VW-1	1,000	≤0.15	17
PFU-UD1001-22-V (Flame Retardant Type)	1.0/2.2	1	PVC UL Grade VW-1	1,000	≤0.15	17
PFU-CD1002-22-E	1.0/2.2 (4.4)	2	PE	500	≤0.15	17
PFU-UD1002-22-E (Flame Retardant Type)	1.0/2.2 (4.4)	2	PE UL Grade VW-1	500	≤0.15	17
PFU-UD1002-22-V (Flame Retardant Type)	1.0/2.2 (4.4)	2	PVC UL Grade VW-1	500	≤0.15	17

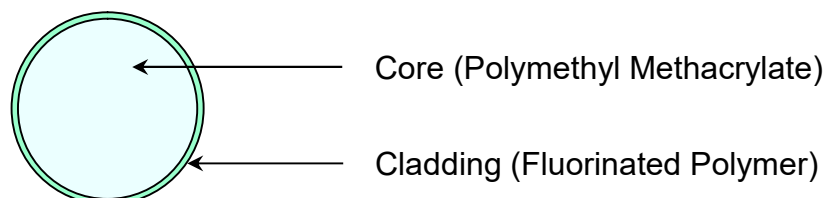
5. Cable Product List

Product Code	Fiber/Cord/ Cable Diameter (mm)	Number of Fibers	Cord/Cable Material	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PFU-CL1001-22E50VT	1.0/2.2/5.0	1	PE/Soft PVC With KEVLAR®	500	≤0.18	17
PFU-CL1002-22E60VT	1.0/2.2 (4.4) /6.0	2	PE/Soft PVC With KEVLAR®	500	≤0.18	17

TORAY RAYTELA®

— PE series —

1. Structure



2. Specifications

Parameter		Performance
Core	Material	Polymethyl Methacrylate (PMMA)
	Refractive index	1.49
Cladding	Material	Fluorinated Polymer
	Refractive index profile	Step index
Numerical aperture (NA)		0.58
Acceptance angle		71°
Available temperature range Permanent use		-55 ~ 105 °C

3. Cord Product List

Product Code	Fiber/Jacket Diameter (mm)	Number of Fibers	Jacket Material	Order Unit (m/spool)	Attenuation at 650nm (dB/m)	Allowable Bending Radius (mm)
PES-CD501-10-H	0.5/1.0	1	PE	500	≤0.25	9
PES-CD1001-22-H	1.0/2.2	1	PE	500	≤0.20	9

Distributor



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Toray Industries, Inc.

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