

# CYY-FO / CYY-F-FO (“TWIN FO”)

CEI IEC 60502-1 : 2004

**Use:** Hybrid cables are used both in AC and DC networks, ensuring the electrical energy supply and telecommunication services inside the buildings. They connect the cabinets (energy and telecom) from the ground floor of the buildings with the circuit breaker panels inside each apartment. The installation is for old buildings, with already existing path for electrical energy supply, and green-field areas, with a single path to deliver electrical energy and telecom services

## CONSTRUCTION

- CONDUCTOR:** cf. IEC 60228+A1

Phases: Copper, Round Flexible (RF) or Solid (RE)  
 Neutral conductor w/o FO element: Round Flexible (RF) or Solid (RE)  
 Neutral conductor w FO element: Round Flexible (RF)  
 Earth conductor w FO element: Round Flexible (RF)  
 FO element: 1 x TIGHT x 2FO

- INSULATION:**

PVC  
 Identification:



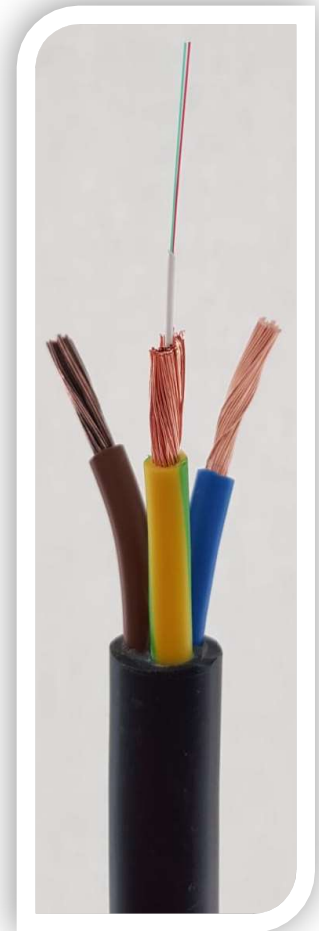
- INNER BEDDING (OPTIONAL):**

Rubber like filler, if exist, otherwise talcum powder

- OUTER SHEATH:**

PVC, black color  
 Cables type CYY-F-FO are with improve behavior for flame retardancy

Marking, i.e.: “PRYSMIAN S HYBRID CYY-F-FO 3x6RF + 1x2FO 0.6/1 kV (year) (M)m”



## CHARACTERISTICS

<b>70°C</b>	<b>160°C</b>	<b>140°C</b>							
Max temp conductor, normal regime	Max temp conductor, sec, 5 s, s ≤ 300 mm2	Max temp conductor, sec, 5 s, s > 300 mm2	Flame retardant IEC 60332-1	UV resistant	Flexible or Rigid	Min bending radius 12 x D – multi 15 x D – mono	0.6/1 kV	3-500 Veff/ 5 min	

Cables may be single phase, 1 phase + neutral + earth, 3 phases + neutral  
 The usual cross-sections will be (4) mm<sup>2</sup>, 6mm<sup>2</sup>, 10mm<sup>2</sup>, 16mm<sup>2</sup>, 25mm<sup>2</sup>, 35mm<sup>2</sup>



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## Properties of cable with standard BendBright<sup>®</sup>XS fibre

ESMF, low water peak G652D, OS2, G657A2&B2 low bend, FTTH

### General and application

The optical fibres are made of a high grade doped silica core surrounded by a silica cladding; They are coated with a dual layer, UV cured acrylate based coating.

This enhanced low macro bending sensitive, low water peak fibre, gives unsurpassed bending performance. The use of the BendBright<sup>XS</sup> fibre is in office installations, for patch cords, interconnection cables and for Fibre-to-the-Home networks, as well as access and general transport networks. The BendBright<sup>XS</sup> offers reduced bending radii for many cables types. The fibre fulfils the new ITU G.657 A2 and G.657 B2 specification, as well as G.652.D. The low macro bending sensitivity further guarantees that the 1625 nm window (L-band) will be available for future use in this bandwidth hungry environment

### Standards and Norms

IEC 60793-2-50 Category B6_a2 and B6_b2	EN 50 173-1: cat. OS2
EN 60793-2-50: Class B6_a2 and B6_b2	ISO/IEC 11801: cat. OS1
ITU Recommendation G.657.A2 and G.657.B2	ISO/IEC 24702: cat. OS2 and OS1
ITU Recommendation G.652 A, B, C and D	IEEE 802.3

### Optical properties

Attribute	Measurement method	Units	Limits
Mode field diameter at 1310 nm	IEC/EN 60793-1-45	µm	8.8 ± 0.4
Mode field diameter at 1550 nm		µm	9.8 ± 0.5
Chromatic dispersion coefficient:	IEC/EN 60793-1-42		
In the interval 1285 nm – 1330 nm		ps/km • nm	≤  3.7
At 1550 nm		ps/km • nm	≤ 18.5
At 1625 nm		ps/km • nm	≤ 23.0
Zero dispersion wavelength, $\lambda_0$		nm	1300 - 1324
Zero dispersion slope		ps/(nm <sup>2</sup> • km)	≤ 0.092
Cut-off wavelength	IEC/EN 60793-1-44	$\lambda_c$ nm	≤ 1260 *
Polarisation mode dispersion (PMD) coefficient	IEC/EN 60793-1-48	ps/√km	≤ 0.1
PMD <sub>0</sub> Link Design Value (computed with Q=0.01%, N=20)	IEC/EN 60794-3	ps/√km	≤ 0.06

\* guaranteed value according to the ITU-T (ATM G650) method

### Attenuation

Attribute	Measurement method	Units	Limits
Maximum attenuation value of cable at 1310 nm	IEC/EN 60793-1-40	dB/km	≤ 0.38
Maximum attenuation value of cable at 1383 nm*	IEC/EN 60793-1-40	dB/km	≤ 0.38
Maximum attenuation value of cable at 1550 nm	IEC/EN 60793-1-40	dB/km	≤ 0.23
Maximum attenuation value of cable at 1625 nm	IEC/EN 60793-1-40	dB/km	≤ 0.25
Local discontinuity at 1310 and 1550 nm	IEC/EN 60793-1-40	dB	max. 0.1

\* Including H2-ageing according to IEC 60793-2-50, type B.1.3, @1383nm

### Attenuation variation vs Bending

Attribute	Measurement method	Units	Limits
10 turns on a mandrel R = 15 mm, @1550nm	IEC/EN 60793-1-47	dB	≤ 0.03
10 turns on a mandrel R = 15 mm, @1625nm	IEC/EN 60793-1-47	dB	≤ 0.1
1 turn on a mandrel R = 10 mm, @1550nm	IEC/EN 60793-1-47	dB	≤ 0.1
1 turn on a mandrel R = 10 mm, @1625nm	IEC/EN 60793-1-47	dB	≤ 0.2
1 turn on a mandrel R = 7.5 mm, @1550nm	IEC/EN 60793-1-47	dB	≤ 0.5
1 turn on a mandrel R = 7.5 mm, @1625nm	IEC/EN 60793-1-47	dB	≤ 1.0



**CYY-FO / CYY-F-FO (“TWIN FO”)****Group index of refraction**

Attribute	Measurement method	Units	Values
1310 nm	IEC/EN 60793-1-22	-	1.467
1550 nm	IEC/EN 60793-1-22	-	1.467
1625 nm	IEC/EN 60793-1-22	-	1.468

**Rayleigh Backscatter coefficient (1ns pulse width)**

Attribute	Measurement method	Units	Values
1310 nm	-	dB	-79.1
1550 nm	-	dB	-81.4
1625 nm	-	dB	-82.2

**Geometrical properties**

Attribute	Measurement method	Units	Limits
Cladding diameter	IEC/EN 60793-1-20	µm	125.0 ± 0.7
Cladding non-circularity	IEC/EN 60793-1-20	%	≤ 0.7
Core (MDF) -cladding concentricity error	IEC/EN 60793-1-20	µm	≤ 0.5
Primary coating diameter – ColorLock <sup>xs</sup> and natural	IEC/EN 60793-1-21	µm	242 ± 7
Primary coating non-circularity	IEC/EN 60793-1-21	%	≤ 5
Primary coating-cladding concentricity error	IEC/EN 60793-1-21	µm	≤ 12

**Mechanical properties**

Attribute	Measurement method	Units	Limits
Proof stress level	IEC/EN 60793-1-30	GPa	≥ 0.7 (≈ 1 %)
Strip force (peak)	IEC/EN 60793-1-32	N	1.2 ≤ F <sub>peak strip</sub> ≤ 8.9
Dynamic fatigue resistance aged and unaged	IEC / EN 60793-1-33	(N <sub>e</sub> )	≥ 20
Static fatigue, aged	IEC / EN 60793-1-33	(N <sub>e</sub> )	≥ 23



## CYY-FO / CYY-F-FO (“TWIN FO”)

### The advantages of hybrid solution for green-fields projects:

- ◆ Reduce cable costs, the hybrid cable fulfills the functionality of 2 cables: electricity supply and telecom services
  - ◆ Reduce installation costs, the hybrid cable will need single installation path
- ◆ Reduce the miscellaneous materials costs, the hybrid cable will be installed on traditional energy supply path, avoiding the use of materials for second circuit meant for telecom cable (15%-20%)
  - ◆ Eliminate the long time required for legal approval/agreements to deploy telecom networks, the electrical utility can proceed without legal constraints
- ◆ Single installation team, less costs, and an opportunity to open cooperation between electrical utilities and telecom operators, new agreements

### The advantages hybrid solution for old fields projects:

- ◆ The path for electrical supply is already existing, and the energy cable can be changed with a hybrid cable, to ensure the electricity supply and telecom services in the building
  - ◆ Eliminate installation costs related to telecom cable: trays, pipes, etc.
  - ◆ Eliminate the long time required for legal approval/agreements to deploy telecom networks
- ◆ Single installation team, less costs, and an opportunity to open cooperation between electrical utilities and telecom operators, new agreements

### Issues to address by common project team: electrical utility, telecom operator, cable’s manufacturer:

- ◆ Legal frame to regulate the congruence of energy and telecom networks is still pending, but Prysmian made important steps toward involving the right decision makers from Ministries, ANRE (symposium, meetings, calls, etc.)
  - ◆ Separation of the optical fibers element from flexible conductor requires new skills for installers
    - ◆ Fibers’ welding requires specialized equipment and additional skills to run the process
    - ◆ Cable scrap from fibers element separation to be evaluated and optimized
  - ◆ Evaluate and optimize the required spaces near the centralization of counters and each apartment
    - ◆ 5-10 min additional installation time per household
    - ◆ Cable design optimization (i.e. only earth conductor flexible, the others solid, etc.)

### Opportunities

- ◆ The hybrid solution concept can be implemented for:
  - other type of cables, i.e. with XLPE / LSOH, to comply to European Regulation 305/2011 - Construction Products Regulation (CPR) describing their reaction to fire
    - cross-sections of (4) mm<sup>2</sup>, 6mm<sup>2</sup>, 10mm<sup>2</sup>, 16mm<sup>2</sup>, 25mm<sup>2</sup>, 35mm<sup>2</sup> (4mm<sup>2</sup> still under consideration)
    - aluminum and copper conductors
    - different types of fibers: SM (small bending radius), MM
  - LV hybrid cables from distribution point to the buildings (i.e. (A)CYAbY 3x16/10, 0.6/1kV)
    - LV hybrid cables from transformer to distribution point ((A)CYAbY 3x240/120, 0.6/1kV)
    - HV cables with fo thermal sensors



# CYY-FO / CYY-F-FO (“TWIN FO”)

## Hybrid Cable Installation Demo Kit

**Prysmian Group**

**NOW POWER CABLES OPEN UP A WHOLE WORLD OF POSSIBILITIES**

Prysmian Group is an integrated manufacturer able to control all the elements which compose the value of an efficient Smart Grid system



Along with the Copper cables delivering the power all around the network, Prysmian Group is capable to manufacture totally in-house the Fibre Optic, the Optical Cables and the Connectivity needed to handle the Integrated Control System. The best in class quality of the fiber optic produced inside the Prysmian Group is of a paramount importance for the sensitivity of a system that must be able to capture any minimal variance of all the critical parameters, as well as the cable and the connectivity protecting it.

**TWIN FO – AN ENTIRE WORLD THROUGH THE ELECTRICAL CABLE**

- TWIN FO is the new Hybrid cable that, by including optical fibre, it brings power and communications to homes without bandwidth limits and through a single cable.
- It allows combined installation of power and optical fibre in individual branch circuits (from the switchboard to each of the general control and circuit breaker panels) allowing a substantial saving in cost and time.
- With its large optical fibre transmission capacity, this cable is suitable for use in applications that require high information capacity carriage.

**ADVANTAGES OF THE HYBRID CABLE**

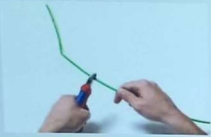

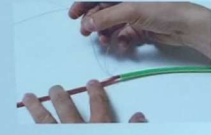
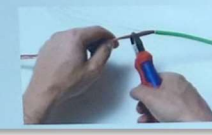
- Has high added value with no extra cost and allows the optical fibre to reach homes.
- It is a single installation inside the building for Power and Telecommunications services.
- In existing residential buildings, it allows individual branch circuits to be replaced quickly, avoiding building work.
- In the new builds, it provides a competitive advantage in the building specifications report with no extra cost.
- It avoids right of way problems between residents and it comes with the Prysmian guarantee.

**HOW TO CONNECT COPPER CONDUCTORS**

1. Cut the cable at the winding end, leaving 1 meter of excess cable at each end. If necessary, flange the cable.
2. In the conductor containing the optical fibres, peel the insulation back 1 meter, taking care not to cut the copper or optical fibre wires.
3. The optical fibres will be among the copper conductor wires. Group these together and group the copper wires together.
4. Cut the copper wires far enough away from the insulation to make the necessary connections, without damaging the optical fibres.

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Wavelength (nm): 1310

G.657A1 0.39 0.22 0.25	
Tube   Fiber	Atten. dB/Km
Blue   Blue	0.343
Blue   Orange	0.346
Maximum	0.346
Avgerage	0.345
Limit	0.390

Wavelength (nm): 1550

G.657A1 0.39 0.22 0.25	
Tube   Fiber	Atten. dB/Km
Blue   Blue	0.189
Blue   Orange	0.192
Maximum	0.192
Avgerage	0.190
Limit	0.220

Wavelength (nm): 1625

G.657A1 0.39 0.22 0.25	
Tube   Fiber	Atten. dB/Km
Blue   Blue	0.201
Blue   Orange	0.203
Maximum	0.203
Avgerage	0.202
Limit	0.250



**Prysmian**  
Group