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

70°C	160°C	140°C						TEST	
Max temp conductor, normal regime	Max temp conductor, scc, 5 s, s ≤ 300 mm2	Max temp conductor, scc, 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) mm², 6mm², 10mm², 16mm², 25mm², 35mm²

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Properties of cable with standard BendBright®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$_e^{XS}$ 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$_e^{XS}$ 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, λ_0		nm	1300 - 1324
Zero dispersion slope		ps/(nm^2 • km)	≤ 0.092
Cut-off wavelength	IEC/EN 60793-1-44	λ_{cc} nm	≤ 1260 *
Polarisation mode dispersion (PMD) coefficient	IEC/EN 60793-1-48	ps/√km	≤ 0.1
PMD_Q 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

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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$_{\oplus}^{XS}$ 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	$1.2 \leq F_{peak,strip} \leq 8.9$
Dynamic fatigue resistance aged and unaged	IEC / EN 60793-1-33	(N_d)	≥ 20
Static fatigue, aged	IEC / EN 60793-1-33	(N_s)	≥ 23

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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^2, $6mm^2$, $10mm^2$, $16mm^2$, $25mm^2$, $35mm^2$ ($4mm^2$ 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

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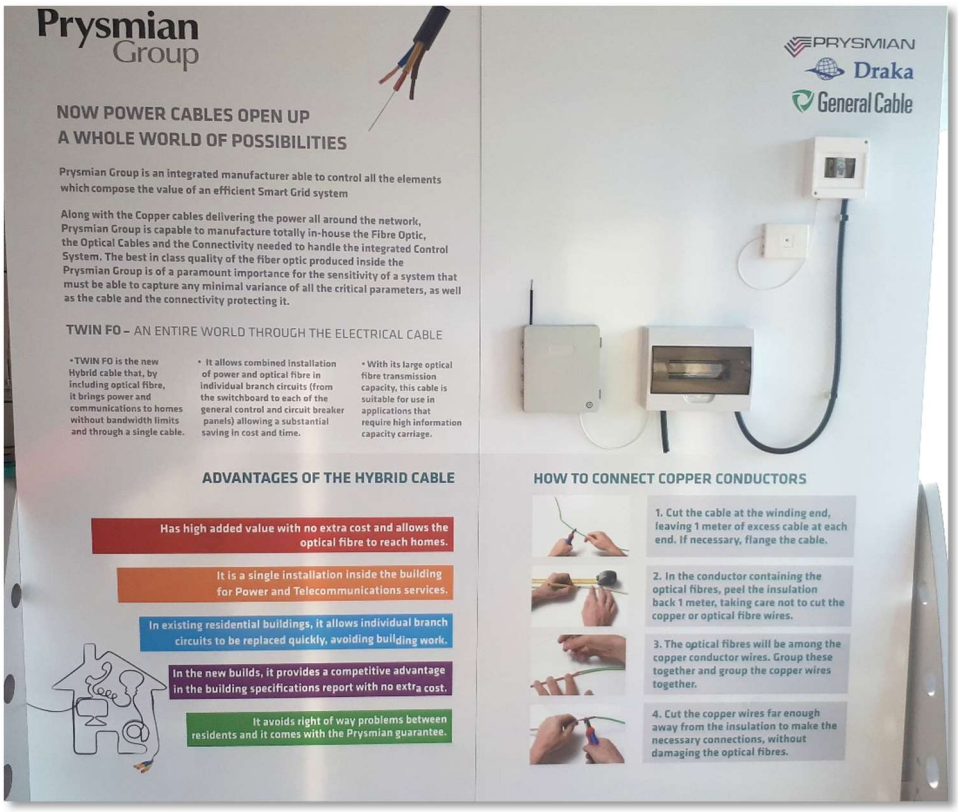
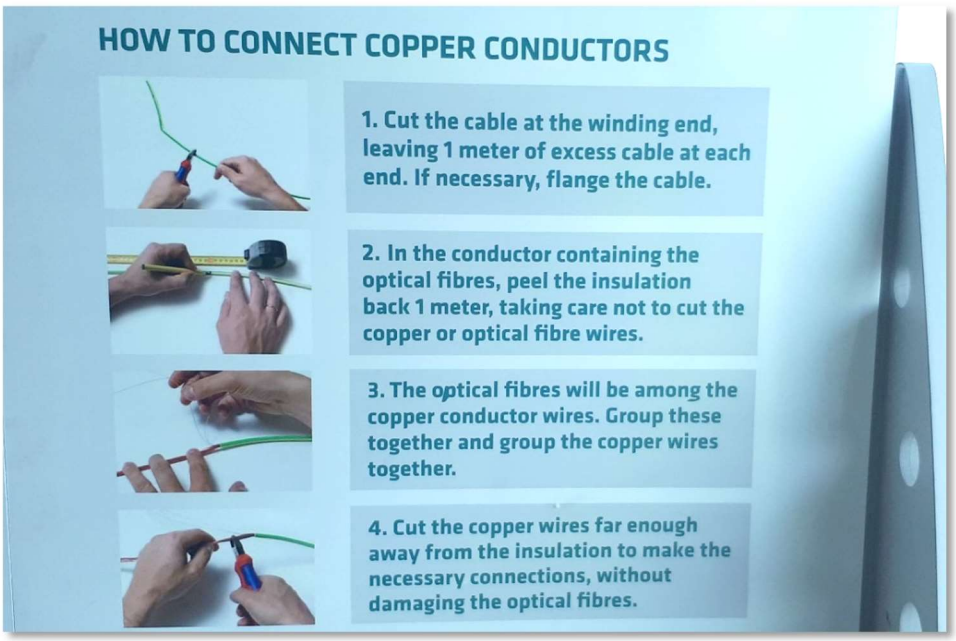
Hybrid Cable Installation Demo Kit





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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

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