

# **TECHNICAL DESCRIPTION OF OPTICAL FIBRES**

## Optical Fibres characteristics

In each of the optical cables standardisation table optical fibres type and number are indicated.

The optical fibres must guarantee an average life of  $\geq 20$  years with a constant maximum working temperature of  $90^{\circ}\text{C}$  and must have a constant softening temperature all over the entire supply.

The optical fibres must have the building, dimensional, mechanical and transmitting characteristics shown in tables 1, 2, 3 and 4. These characteristics must be in keeping with IEC recommendations shown in the above mentioned tables.

**Table 1 – Building characteristics**

Fibre type	single mode	IEC 60793-1
Fibre component	silica / doped silica	IEC 60793-2
Fibre primary protection	double acrylic layer	IEC 60793-2

**Table 2 – Dimensional characteristics**

Primary protection diameter (uncoloured)		$245 \pm 10 \mu\text{m}$	IEC 60793-2
Mantle	diameter	$125 \pm 1 \mu\text{m}$	IEC 60793-2
	circularity error	$\leq 2\%$	IEC 60793-2
Mantle / Modal field concentricity error		$\leq 0.8 \mu\text{m}$	IEC 60793-2
Coating-cladding concentricity error		$\leq 12.5 \mu\text{m}$	IEC 60793-2

**Table 3 – Mechanical characteristics**

The optical fibres must have undergone a traction for about 1 second which has caused a minimum extension of 1%	IEC 60793-2 (par 34)
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**Table 4 Transmitting characteristics of the in-cable optical fibres (Single Mode Reduced SM-R)**

Loss 1	$\lambda = 1310 \text{ nm}$	$\leq 0.40 \text{ dB/km}$	IEC 60793-2
	$\lambda = 1550 \text{ nm}$	$\leq 0.30 \text{ dB/km}$	
Scattering centres		None	
Maximum number of concentrated loss centres (single fibre / lot)		1	IEC 60794-3
Maximum value for concentrated loss centres	$\lambda = 1310 \text{ nm}$	0.1 dB	
	$\lambda = 1550 \text{ nm}$	0.05 dB	
Linearity of characteristic loss	$\lambda = 1310 \text{ nm}$	$\pm 0.05 \text{ dB}$	IEC 60794-3
	$\lambda = 1550 \text{ nm}$	$\pm 0.05 \text{ dB}$	
Modal field diameter	$\lambda = 1310 \text{ nm}$	$9.3 \pm 0.5 \text{ }\mu\text{m}$	IEC 60793-2
	$\lambda = 1550 \text{ nm}$		
Chromatic dispersion	$\lambda = 1285\text{-}1330 \text{ nm}$	$\leq 3.5 \text{ ps/nm*km}$	IEC 60793-2
	$\lambda = 1525\text{-}1575 \text{ nm}$	$\leq 20 \text{ ps/nm*km}$	
Wavelength on edge ( $\lambda_{cc}$ )		$\leq 1280 \text{ nm}$	IEC 60794-3

#### Fibre optic

The fibre optic to be consider are the ITU-T G652 fibre and ITU-T G655 fibre. The main characteristics are reported hereafter. In presence of fibre characteristics mismatching between IEC and ITU-T, please refer to ITU-T.

The supplier shall be compliant with the requirements here specified.

**ITU-T G.652: Subcategory B (G.652.B)**

The subcategory is suitable for the transmission systems up to STM-64.

**Fibre attributes**

Attribute	Detail	Value
Mode field diameter	Wavelength	1310 nm
	Range of nominal values	8.6-9.5 $\mu\text{m}$
	Tolerance	$\pm 0.7 \mu\text{m}$
Cladding Diameter	Nominal	125.0 $\mu\text{m}$
	Tolerance	$\pm 1 \mu\text{m}$
Core concentricity error	Maximum	0.8 $\mu\text{m}$
Cladding noncircularity	Maximum	2.0%
Cable cut-off wavelength	Maximum	1260 nm
Macrobend loss	Radius	37.5 mm
	Number of turns	100
	Maximum at 1550 nm	0.50 dB
	Maximum at 1605 nm	0.50 dB
Proof stress	Minimum	0.69 GPa
Chromatic dispersion coefficient	$\lambda_{0\text{min}}$	1 300 nm
	$\lambda_{0\text{max}}$	1 324 nm
	$S_{0\text{max}}$	0.093 ps/nm <sup>2</sup> •km
PMD coefficient	M	20 cables
	Q	0.01%
	Maximum PMD <sub>Q</sub>	0.5 ps/ $\sqrt{\text{km}}$

**ITU-T G.655: Subcategory B (G.655.B)**

The subcategory is subcategory provides 100 GHz channel spacing.

**Fibre attributes**

Attribute	Detail	Value
Mode field diameter	Wavelength	1550 nm
	Range of nominal values	8-11 $\mu\text{m}$
	Tolerance	$\pm 0.7 \mu\text{m}$
Cladding Diameter	Nominal	125.0 $\mu\text{m}$
	Tolerance	$\pm 1 \mu\text{m}$
Core concentricity error	Maximum	0.8 $\mu\text{m}$
Cladding noncircularity	Maximum	2.0%
Cable cut-off wavelength	Maximum	1 480 nm
Macrobend loss	Radius	37.5 mm
	Number of turns	100
	Maximum at 1 550 nm	0.50 dB
	Maximum at 1605 nm	0.50 dB
Proof stress	Minimum	0.69 GPa
Chromatic dispersion coefficient Band: 1530-1565 nm	$\lambda_{\min}$ & $\lambda_{\max}$	1530 nm & 1565 nm
	Minimum value of $D_{\min}$	1.0 ps/nm•km
	Maximum value of $D_{\max}$	10.0 ps/nm•km
	Sign	Positive or negative
	$D_{\max} - D_{\min}$	$\leq 5.0$ ps/nm•km
PMD coefficient	M	20 cables
	Q	0.01%
	Maximum PMD <sub>Q</sub>	0.5 ps/ $\sqrt{\text{km}}$

### Reference data for design (at 1550 nm)

<b>Design with G.652 (Subcategory G.652.B) 2 fibre</b>		
Maximum loss of fibre	0.26	dB/km
Chromatic dispersion	<20	Ps/nm km
Average individual splice connection loss (#splices $\geq 16$ )	0.04	dB
Maximum individual splice connection loss (#splices < 16)	0.1	dB
Termination loss	0.6	dB
Extent length	2500	m
Lengthening factor (catenary, wrapping, etc.)	1.03	
Dielectric cable pigtail lengthening	0.5	Km
Maximum PMD <sub>Q</sub>	0.5	ps/ $\sqrt{\text{km}}$

<b>Design with G.655 (Subcategory G.655.B)3 fibre</b>		
Maximum loss of fibre	0.28	dB/km
Chromatic dispersion	<5	Ps/nm km
Average individual splice connection loss (#splices $\geq 16$ )	0.04	dB
Maximum individual splice connection loss (#splices < 16)	0.1	dB
Termination loss	0.6	dB
Extent length	2500	m
Lengthening factor (catenary, wrapping, etc.)	1.03	
Dielectric cable pigtail lengthening	0.5	km
Maximum PMD <sub>Q</sub>	0.5	ps/ $\sqrt{\text{km}}$

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2 This subcategory is suitable for the transmission systems up to STM-64.

3 This subcategory provides 100 GHz channel spacing.

**TABLE – 5**

**FIBERS COLOURS**

<b>FIBER TUBE</b>	<b>FIBER NO</b>	<b>FIBER COLOURS</b>
	1	RED
	2	YELLOW
	3	GREEN
	4	BLUE
	5	VIOLET
	6	BROWN
	7	BLACK
	8	ORANGE
	9	PINK
	10	GREY
	11	LIGHT GREEN
	12	NATURAL

**TABLE – 6**

**YARN COLOUR CODING**

<b>GROUP</b>	<b>COLOUR</b>
1	BLUE
2	ORANGE
3	GREEN
4	BROWN