



INDEPENDENT POWER TRANSMISSION OPERATOR S.A.

TRANSMISSION NEW PROJECTS DEPARTMENT

**TRANSMISSION LINES TOWER DESIGN
AND SPECIFICATIONS SECTION**

**TECHNICAL DESCRIPTION
OF OPTICAL FIBRES**

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ATHENS - GREECE

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 ≥ 20 years with a constant maximum working temperature of 90°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) |
|---|----------------------|

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 | $\lambda = 1310 \text{ nm}$ | $9.3 \pm 0.5 \mu\text{m}$ | 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 (λ_{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.

1 Absolute maximum value

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 μm |
| | Tolerance | $\pm 0.7 \mu\text{m}$ |
| Cladding Diameter | Nominal | 125.0 μm |
| | Tolerance | $\pm 1 \mu\text{m}$ |
| Core concentricity error | Maximum | 0.8 μm |
| 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 ² •km |
| PMD coefficient | M | 20 cables |
| | Q | 0.01% |
| | Maximum PMD _Q | 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 μm |
| | Tolerance | $\pm 0.7 \mu\text{m}$ |
| Cladding Diameter | Nominal | 125.0 μm |
| | Tolerance | $\pm 1 \mu\text{m}$ |
| Core concentricity error | Maximum | 0.8 μm |
| 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 | λ_{min} & λ_{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 |
| | $D_{\text{max}} - D_{\text{min}}$ | ≤ 5.0 ps/nm•km |
| PMD coefficient | M | 20 cables |
| | Q | 0.01% |
| | Maximum PMD_Q | 0.5 ps/ $\sqrt{\text{km}}$ |

Reference data for design (at 1550 nm)

| Design with G.652 (Subcategory G.652.B) 2 fibre | | |
|--|------|----------|
| Maximum loss of fibre | 0.26 | dB/km |
| Chromatic dispersion | <20 | Ps/nm km |
| Average individual splice connection loss (#splices >= 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 _Q | 0.5 | ps/√km |

| Design with G.655 (Subcategory G.655.B)3 fibre | | |
|--|------|----------|
| Maximum loss of fibre | 0.28 | dB/km |
| Chromatic dispersion | <5 | Ps/nm km |
| Average individual splice connection loss (#splices >= 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 _Q | 0.5 | ps/√km |

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

| FIBER TUBE | FIBER NO | FIBER COLOURS |
|-------------------|-----------------|----------------------|
| | 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

| GROUP | COLOUR |
|--------------|---------------|
| 1 | BLUE |
| 2 | ORANGE |
| 3 | GREEN |
| 4 | BROWN |