Tratos Cavi S.p.A. reserves the right to modify at any time technical dimensional and weight characteristics shown in this catalogue to improve the features of its products. However these will still be in accordance to the mentioned standards.

There is no responsibility of the manufacturer for damages to persons and property in case of improper use and/or neglecting the recommendations for using cables and norms contained in this catalogue.

Kama May 2009
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Introduction

The principles of optical communications have been known for a long time but only in the last fifteen years have there been major applications in the field of telecommunication, data and image transmission. This publication provides the main information required for good knowledge of optical core cables and their most recurrent applications.

Fibres

The fibres include a central zone of silica with a high index of refraction called core, a pure silica layer with a lower index of refraction called cladding and a coating layer. The ray of light introduced in the fibre can be of different wave-lengths called “mode” and its number depends on the technology of the fibre production. The transmission principle of the light in an optical fibre is based on the total reflection between core and cladding. Continuous developments of the material quality which constitute the fibre have permitted better performances of the signal transmitted, reducing considerably the attenuation values and consequently the necessity of the amplification signal along the line. Meanwhile a better geometry of the core, cladding and coating supports the performance of joints and terminations, excluding nearly all attenuation increase.

Design

When we design a fibre optic cable, it is necessary to take in consideration the minimum bending radius applicable, the frequency and the number of bendings, the thermal cycles and the pulling force to which the cable will be submitted during the installation. It’s important therefore that all the design parameters and the production technology ensure that the fibres are free of any mechanical loads. The reliability of the fibre, as time passes, is largely due to the way that it has been placed inside the cable, which may be considered as a container of the fibre itself. The fibres must be longer with regards to the actual length of the cable itself to avoid or, in any case, to moderate the mechanical stress and pertinent to the thermal expansion to which the fibre will be submitted during the production and usage phases, assuring therefore a long period of life.
Special features

- very large transmission capacity
- very low transmission loss
- very low dispersion
- very long line without signal amplification needs
- immune to electromagnetic interference
- non crosstalk
- suitable for data, telecomunication video, etc.
- no radiation along the cable
- flame retardant
- low smoke and toxic gas
- metal free design
- rodent proof
- light weight
- small diameter

Safety performances

In general all the cables we produce can be supplied in flame retardant version and with low emission of toxic fumes and corrosive gasses. They can pass several test levels in accordance with national and international standards. These particular performances can be achieved using special materials for inner and outer sheaths and for other materials.

Technical references

Appropriate tests in accordance with the Quality Assurance procedures ensure a good performance.
For all the material supplied to the customer, a technical documentation will be provided confirming the compliance of the product with relevant technical specifications proving the fulfilment of the constructional and performance characteristics.
Here below there are the three main technologies with which the fibre optic cables are produced: Loose Tube, Slotted Core and Ribbon

**LOOSE TUBE**

1. The fibres are situated inside small tubes together with jelly protection.
   The fibres must be free to move.
   The dimensions and the number of tubes can be different by way of the number of fibres they contain, the type of utilisation, etc.

*Figure 1 shows a traditional stranded loose tube cable core.*

**SLOTTED CORE**

2. The fibres are situated inside helical ducts of a central element (slot) together with jelly protection.
   The fibres must be free to move.
   The dimensions and the number of ducts can be different by way of the number of fibres, the cable use, spare fibres for future utilisation.

*Figure 2 shows a traditional slotted core cable.*

**RIBBON**

3. The fibres are situated in the same layer, one near to the other and resinated with special materials: with this method we obtain the “ribbon” which overlaid on each other are fitted inside tubes or slotted-core. The number of fibres for each ribbon can be different (normally from 4 up to 16 fibres) and same for the number of ribbon for each tube or duct.

*Figure 3 shows a traditional ribbon core cable.*
### TECHNICAL SPECIFICATION FOR SINGLE MODE FIBRES SM-R CONFORM TO ITU-T G652

#### OPTICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max attenuation at 1310 nm</td>
<td>dB/Km</td>
<td>0.40</td>
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<tr>
<td>Max attenuation at 1550 nm</td>
<td>dB/Km</td>
<td>0.25</td>
</tr>
<tr>
<td>Max variation at 1530-1560 nm</td>
<td>dB/Km</td>
<td>0.03</td>
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<tr>
<td>Spectral attenuation between 1285-1330 nm</td>
<td>dB/Km</td>
<td>0.1</td>
</tr>
<tr>
<td>Reflect at 1310 nm</td>
<td>dB/Km</td>
<td>0.1</td>
</tr>
<tr>
<td>Attenuation at 1393±3 nm</td>
<td>dB/Km</td>
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<td>Chromatic dispersion coefficient:</td>
<td>ps/(nm.km)</td>
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<tr>
<td>between 1285 nm and 1330 nm</td>
<td>ps/(nm.km)</td>
<td>&lt;0.092</td>
</tr>
<tr>
<td>at 1550</td>
<td>ps/(nm.km)</td>
<td>20</td>
</tr>
<tr>
<td>Zero dispersion wavelength for fibre cabled</td>
<td>nm</td>
<td>1315±10</td>
</tr>
<tr>
<td>Dispersion slope</td>
<td>ps/(nm.km)</td>
<td>&lt;0.092</td>
</tr>
<tr>
<td>Mode field diameter at 1310 nm (Peterman II)</td>
<td>micron</td>
<td>9.4±0.3</td>
</tr>
<tr>
<td>Cut-off wavelength</td>
<td>nm</td>
<td>1150±1280</td>
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<tr>
<td>Cut-off wavelengt for fibre cabled</td>
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<td>&lt;1280</td>
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#### PHYSICAL CHARACTERISTICS

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<tr>
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<tr>
<td>Cladding non circularity</td>
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<td>2</td>
</tr>
<tr>
<td>Coating diameter</td>
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#### GENERAL CHARACTERISTICS

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<tr>
<th>Characteristic</th>
<th>%</th>
<th>Value</th>
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<tr>
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<tr>
<td>Effective group index:</td>
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</tr>
<tr>
<td>at 1310 nm</td>
<td></td>
<td>1.468</td>
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<tr>
<td>Numerical aperture-indicative value</td>
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<td>Young modulus</td>
<td>Gpa</td>
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<tr>
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<td>dB</td>
<td>&lt;0.3</td>
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<tr>
<td>100 turns on 75 mm mandrel</td>
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<td></td>
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</table>

![Refractive Index Profile](image1)

![Attenuation Profile](image2)

![Spectral Attenuation Profile](image3)
OPTICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
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<tr>
<td>Max attenuation at 1550 nm</td>
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<td>Average attenuation at 1550 nm</td>
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<td>Max attenuation at 1330 nm</td>
<td>dB/Km</td>
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</tr>
<tr>
<td>Max chromatic dispersion coefficient:</td>
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<tr>
<td>between 1525 nm and 1575 nm</td>
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<td></td>
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<tr>
<td>at 1330 nm</td>
<td></td>
<td>25</td>
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<tr>
<td>Mode field diameter</td>
<td>micron</td>
<td>8.1 ± 10%</td>
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<tr>
<td>Cut-off wavelength</td>
<td>nm</td>
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PHYSICAL CHARACTERISTICS

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<tr>
<td>Mode field / cladding concentricity</td>
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<tr>
<td>Cladding non circularity</td>
<td>%</td>
<td>2</td>
</tr>
<tr>
<td>Coating diameter</td>
<td>micron</td>
<td>245±10</td>
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GENERAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
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<tbody>
<tr>
<td>Proof test</td>
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<tr>
<td>Effective group index:</td>
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<tr>
<td>at 1310 nm</td>
<td></td>
<td>1.468</td>
</tr>
<tr>
<td>at 1550 nm</td>
<td></td>
<td>1.47</td>
</tr>
<tr>
<td>Coating strippability</td>
<td>N</td>
<td>1.5</td>
</tr>
<tr>
<td>Macrobending test additional loss at 1550 nm</td>
<td>dB</td>
<td>&lt; 0.5</td>
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<tr>
<td>100 turns on 75 mm mandrel</td>
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</table>
TECHNICAL SPECIFICATION FOR MULTIMODE FIBRES MM-62.5/125 CONFORM TO ITU-T G651

OPTICAL CHARACTERISTICS

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<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Attenuation range at 850 nm</td>
<td>dB/Km</td>
<td>3.0–3.5</td>
</tr>
<tr>
<td>at 1300 nm</td>
<td>dB/Km</td>
<td>0.7–1.5</td>
</tr>
<tr>
<td>Bandwidth range at 850 nm</td>
<td>MHz.km</td>
<td>160–200</td>
</tr>
<tr>
<td>at 1300 nm</td>
<td>MHz.km</td>
<td>200–600</td>
</tr>
<tr>
<td>Numerical aperture</td>
<td></td>
<td>0.275 ± 0.015</td>
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PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
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<tbody>
<tr>
<td>Core diameter</td>
<td>micron</td>
<td>62.5 ± 3</td>
</tr>
<tr>
<td>Cladding diameter</td>
<td>micron</td>
<td>125 ± 2</td>
</tr>
<tr>
<td>Core/cladding concentricity error</td>
<td>%</td>
<td>3</td>
</tr>
<tr>
<td>Core non circularity</td>
<td>%</td>
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<tr>
<td>Cladding non circularity</td>
<td>%</td>
<td>2</td>
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<tr>
<td>Coating diameter</td>
<td>micron</td>
<td>245 ± 10</td>
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GENERAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
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<tr>
<td>Proof test</td>
<td>0  5</td>
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<tr>
<td>Effective group index:</td>
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<tr>
<td>at 850 nm</td>
<td>1.4970</td>
</tr>
<tr>
<td>at 1300 nm</td>
<td>1.4919</td>
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<tr>
<td>Coating strippability</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>1±5</td>
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</tbody>
</table>
TECHNICAL SPECIFICATION FOR MULTIMODE FIBRES MM-50/125 CONFORM TO ITU-T G651

OPTICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Attenuation range at 850 nm dBi/Km</td>
<td>2.4 ± 3.5</td>
</tr>
<tr>
<td>at 1300 nm</td>
<td>0.6 ±1.5</td>
</tr>
<tr>
<td>Bandwidth range at 850 nm MHz.km</td>
<td>200-1000</td>
</tr>
<tr>
<td>at 1300 nm</td>
<td>400-1600</td>
</tr>
<tr>
<td>Numerical aperture</td>
<td>0.2 ± 0.02</td>
</tr>
</tbody>
</table>

PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core diameter</td>
<td>micron 50 ± 3</td>
</tr>
<tr>
<td>Cladding diameter</td>
<td>micron 125 ± 2</td>
</tr>
<tr>
<td>Core/cladding concentricity error</td>
<td>% 3</td>
</tr>
<tr>
<td>Core non circularity</td>
<td>% 6</td>
</tr>
<tr>
<td>Cladding non circularity</td>
<td>% 2</td>
</tr>
<tr>
<td>Coating diameter</td>
<td>micron 245 ± 10</td>
</tr>
</tbody>
</table>

GENERAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proof test</td>
<td>% 0.5</td>
</tr>
<tr>
<td>Effective group index: at 850 nm</td>
<td>1.488</td>
</tr>
<tr>
<td>Coating strippability</td>
<td>N 1 - 5</td>
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</tbody>
</table>
TECHNICAL SPECIFICATION FOR NON ZERO DISPERSION FIBRES

OPTICAL CHARACTERISTICS
Max attenuation at 1550 nm dB/Km 0.22±0.25
Max attenuation at 1310 nm dB/Km 0.40
Max variation at 1525-1575 nm dB/Km 0.05
Max attenuation at the OH absorbing peak dB/Km 1
(1383 ± 3 nm)
Max attenuation discontinuities dB/Km 0.1
Chromatic dispersion coefficient: in nonzero region:
minimum ps/(nm.km) 0.8
maximum ps/(nm.km) 4.0
Non-zero-dispersion region nm 1540-1560
Dispersion coefficient at 1550 nm (typical) ps/sqrt(km) 0.1
Mode field diameter at 1310 nm micron 9.3 ± 0.5
Cut-off wavelength nm 1260

PHYSICAL CHARACTERISTICS
Cladding diameter micron 125 ± 1
Core / cladding concentricity error micron 0.8
Cladding non circularity % 1
Coating diameter micron 245 ± 10
Coating/cladding concentricity error micron < 12

GENERAL CHARACTERISTICS
Proof test % >> 1
Effective group index:
at 1310 nm 1.4710
at 1550 nm 1.4700
Coating strippability N 1 ± 5
Macro bending test additional loss at 1550 nm dB < 0.05
100 turns on 75 mm mandrel

---

Graphs showing optical characteristics and dispersion profile.
TIGHT FIBRES
For particular applications fibres with diameter 250 micron can be taken to 850±50 micron with a secondary tight coating.
The secondary coating is made of nylon or acrylate resin.
The tight fibre are generally used by:
- cable-equipment lines
- cable termination with terminal joint
- switching lines
- LAN network
- distribution network
- patch-cord.

<table>
<thead>
<tr>
<th>FIBRES TYPE</th>
</tr>
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<tbody>
<tr>
<td><strong>Tight Fibre</strong> 850± 0.5 micron</td>
</tr>
<tr>
<td>SMR - single mode fibre conform to ITU-T G652</td>
</tr>
<tr>
<td>SM-DS: single mode dispersion shifted conform to ITU-T G653</td>
</tr>
<tr>
<td>62.5/125 multimode fibre conform to ITU-T G651</td>
</tr>
<tr>
<td>50/125 multimode fibre conform to ITU-T G651</td>
</tr>
</tbody>
</table>
DIELECTRIC LOOSE TUBE FIBRE OPTIC CABLE

Code: TOLx yy z (w fo) T/KE

- x: elements in cable structure
- yy: fibres number of fibres
- z: number of loose tubes
- w: number of fibres in each tube
- fo: fibres type

Construction: dielectric central support (FRP), jelly filled loose tube, aramidic strength member and polyethylene outer sheath.

Application: outside duct installation

Standard: ITU-T Rec. for optical fibre
- ETSI Standards
- IEC Rec. for cable tests
- ISO 9000 Standards for raw material
- CEI-UNEL

General data:

Operating temperature: -30°C+60°C
Installation temperature: -15°C+60°C
Transport and storage temperature: -40°C+70°C
Identification: cable code
Outer sheath colour: black
Cable sheath marking: TRATOS "cable code"

### TECHNICAL TABLE

<table>
<thead>
<tr>
<th>Fibres</th>
<th>Fibres for each tube</th>
<th>Tube</th>
<th>Tube diameter</th>
<th>Central Support Diameter</th>
<th>Layer elements</th>
<th>Nominal Sheath Thickness</th>
<th>Overall Diameter Approx</th>
<th>Max. Pulling Load Static Dynamic</th>
<th>Min. Bending Radius Static Dynamic</th>
<th>Nominal Delivery Length</th>
<th>Cable Weight Approx</th>
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<tbody>
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<td>4</td>
<td>1</td>
<td>2.5</td>
<td>2</td>
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<td>1.8</td>
<td>12.5</td>
<td>1800/2500</td>
<td>300/150</td>
<td>2100</td>
<td>130G</td>
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<tr>
<td>8</td>
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<td>2</td>
<td>2.5</td>
<td>2</td>
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<td>1.8</td>
<td>12.5</td>
<td>1800/2500</td>
<td>300/150</td>
<td>2100</td>
<td>130G</td>
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<td>2</td>
<td>1</td>
<td>1.8</td>
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<td>1800/2500</td>
<td>300/150</td>
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<td>2</td>
<td>1</td>
<td>1.8</td>
<td>12.5</td>
<td>1800/2500</td>
<td>300/150</td>
<td>2100</td>
<td>130G</td>
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<tr>
<td>24</td>
<td>6</td>
<td>5</td>
<td>2.5</td>
<td>2</td>
<td>1</td>
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LOOSE TUBE FIBRE OPTIC CABLE
WITH MOISTURE BARRIER

Code: TOLx yy z (w fo) T/KH5E

- x: elements in cable structure
- yy: number of fibres
- z: number of loose tubes
- w: number of fibres in each tube
- fo: fibres type

Construction: dielectric central support (FRP), jelly filled loose tube, aramidic strength member, longitudinal thermowelded aluminium tape as moisture barrier and polyethylene outer sheath.

Application: outside duct installation

Standard:
- ITU-T Rec. for optical fibre
- ETSI Standards
- IEC Rec. for cable tests
- ISO 9000 Standards for raw material
- CEI-UNEL

General data:
- Operating temperature: -30°C+60°C
- Installation temperature: -15°C+60°C
- Transport and storage temperature: -40°C+70°C
- Identification: cable code
- Outer sheath colour: black
- Cable sheath marking: TRATOS "cable code"

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LOOSE TUBE FIBRE OPTIC CABLE
WITH METALLIC RODENT PROTECTION

Code: TOLx yy z (w fo) T/KH9E

x: elements in cable structure
yy: number of fibres
z: number of loose tubes
w: number of fibres in each tube
fo: fibres type

Construction: dielectric central support (FRP), jelly filled loose tube, aramidic strength member, longitudinal thermowelded corrugated steel tape as moisture barrier, rodent and mechanical protection, polyethylene outer sheath.

Application: outside duct installation

Standard:
ITU-T Rec. for optical fibre
ETSI Standards
IEC Rec. for cable tests
ISO 9000 Standards for raw material
CEI-UNEL

General data:
Operating temperature -30°C+60°C
Installation temperature -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification cable code
Outer sheath colour black
Cable sheath marking TRATOS "cable code"

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LOOSE TUBE FIBRE OPTIC CABLE WITH METALLIC PROTECTION

Code: TOLx yy z (w fo) T/KH6E

x: elements in cable structure
yy: number of fibres
Z: number of loose tubes
w: number of fibres in each tube
fo: fibres type

Construction: dielectric central support (FRP), jelly filled loose tube, polyethylene inner sheath, aramidic strength member, longitudinal corrugated steel sheath, as moisture barrier, rodent and mechanical protection, polyethylene outer sheath.

Application: outside duct installation, directly buried installation

Standard: ITU-T Rec. for optical fibre
ETSI Standards
IEC Rec. for cable tests
ISO 9000 Standards for raw material
CEI-UNEL

General data:
Operating temperature -30°C+60°C
Installation temperature -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification cable code
Outer sheath colour black
Cable sheath marking TRATOS "cable code"

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SLOTTED DIELECTRIC FIBRE OPTIC CABLE

Code: TOSx yy z (w fo) T/KE
- x: slots number in cable structure
- yy: number of fibres
- z: number of slots
- w: number of fibres in each slots
- fo: fibres type

Construction: dielectric central support (FRP), jelly filled plastic slotted core, aramidic strength member and polyethylene outer sheath.

Application: outside duct installation

Standard: ITU-T Rec. for optical fibre
- ETSI Standards
- IEC Rec. for cable tests
- ISO 9000 Standards for raw material
- CEI-UNEL

General data:
- Operating temperature: -30°C+60°C
- Installation temperature: -15°C+60°C
- Transport and storage temperature: -40°C+70°C
- Identification: cable code
- Outer sheath colour: black
- Cable sheath marking: TRATOS “cable code”

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<th>Layer elements</th>
<th>Nominal sheath thickness</th>
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SLOTTED FIBRE OPTIC CABLE WITH MOISTURE BARRIER

Code: TOSx yy z (w fo) T/KH5E
- x: slots number in cable structure
- yy: number of fibres
- z: number of slots
- w: number of fibres in each slots
- fo: fibres type

Construction: dielectric central support (FRP), jelly filled plastic slotted core, aramid strength member, longitudinal thermowelded aluminium tape as moisture barrier and polyethylene outer sheath.

Application: outside duct installation

Standard:
- ITU-T Rec. for optical fibre
- ETSI Standards
- IEC Rec. for cable tests
- ISO 9000 Standards for raw material
- CEI-UNEL

General data:
- Operating temperature: -30°C+60°C
- Installation temperature: -15°C+60°C
- Transport and storage temperature: -40°C+70°C

Identification: cable code

Outer sheath colour: black

Cable sheath marking: TRATOS "cable code"

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SLOTTED FIBRE OPTIC CABLE WITH METALLIC RODENT PROTECTION

Code: TOSx yy z (w fo) T/KH9E
- x: slots number in cable structure
- yy: number of fibres
- z: number of slots
- w: number of fibres in each slots
- fo: fibres type

Construction: dielectric central support (FRP), jelly filled plastic slotted core, aramid strength member, longitudinal thermowelded corrugated steel tape as moisture barrier, rodent and mechanical protection and polyethylene outer sheath.

Application: outside duct installation

Standard:
- ITU-T Rec. for optical fibre
- ETSI Standards
- IEC Rec. for cable tests
- ISO 9000 Standards for raw material
- CEI-UNEL

Operating data:
- Operating temperature: -30°C+60°C
- Installation temperature: -15°C+60°C
- Transport and storage temperature: -40°C+70°C
- Identification: cable code
- Outer sheath colour: black
- Cable sheath marking: TRATOS "cable code"

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<th>Overall diameter approx mm</th>
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SLOTTED DIELECTRIC FIBRE OPTIC RIBBON CABLE

Code: TOSx yy z (w fo) T/KE
- x: slots number in cable structure
- yy: number of fibres
- z: number of slots
- w: number of fibres in each slots
- fo: fibres type

Construction: dielectric central support (FRP), jelly filled plastic slotted core, aramidic strength member and polyethylene outer sheath.

Application: outside duct installation

Standard:
- ITU-T Rec. for optical fibre
- ETSI Standards
- IEC Rec. for cable tests
- ISO 9000 Standards for raw material
- CEI-UNEL

General data:
- Operating temperature: -30°C+60°C
- Installation temperature: -15°C+60°C
- Transport and storage temperature: -40°C+70°C
- Identification: cable code
- Outer sheath colour: black
- Cable sheath marking: TRATOS "cable code"

TECHNICAL TABLE

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<tr>
<th>Fibres cable nr.</th>
<th>Fibres for each slot nr.</th>
<th>Slots nr.</th>
<th>Slot dimension approx</th>
<th>Central support diameter mm</th>
<th>Layer elements nr.</th>
<th>Nominal sheath thickness mm</th>
<th>Overall diameter approx mm</th>
<th>Max. pulling load static dynamic N</th>
<th>Min. bending radius static dynamic mm</th>
<th>Nominal delivery length m</th>
<th>Cable weight approx kg/km</th>
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SLOTTED FIBRE OPTIC RIBBON
CABLE WITH MOISTURE BARRIER

Code: TOSx yy z (w fo) T/KH5E
x: slots number in cable structure
yy: number of fibres
z: number of slots
w: number of fibres in each slots
fo: fibres type

Construction: dielectric central support (FRP), jelly filled plastic slotted core,aramidic strength member, longitudinal thermowelded aluminum tape
as moisture barrier and polyethylene outer sheath.

Application: outside duct installation

Standard: ITU-T Rec. for optical fibre
ETSI Standards
IEC Rec. for cable tests
ISO 9000 Standards for raw material
CEI-UNEL

General data:
Operating temperature -30°C+60°C
Installation temperature -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification cable code
Outer sheath colour black
Cable sheath marking TRATOS "cable code"

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<th>layer elements</th>
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SLOTTED FIBRE OPTIC RIBBON CABLE
WITH METALLIC RODENT PROTECTION

Code: TOSx yy z (w fo) T/EKH9E

x: slots number in cable structure
yy: number of fibres
z: number of slots
w: number of fibres in each slots
fo: fibres type

Construction: dielectric central support (FRP), jelly filled plastic slotted core, polyethylene inner sheath, aramidic strength member, longitudinal thermowelded corrugated steel tape as moisture barrier, rodent and mechanical protection and polyethylene outer sheath.

Application: outside duct installation

Standard: ITU-T Rec. for optical fibre
ETSI Standards
IEC Rec. for cable tests
ISO 9000 Standards for raw material
CEI-UNEL

General data:
Operating temperature -30°C+60°C
Installation temperature -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification cable code
Outer sheath colour black
Cable sheath marking TRATOS “cable code”

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MONOTUBE DIELECTRIC FIBRE OPTIC CABLE

**Code:** TOL1 yy fo VE

yy: fibres number
fo: fibres type

**Construction:** jelly filled plastic monotube, glass fibre strength member and rats protection, polyethylene outer sheath

**Application:** outside duct installation

**Standard:** ITU-T Rec. for optical fibre
ETSİ Standards
IEC Rec. for cable tests
ISO 9000 Standards for raw material
CEI-UNEL

**General data:**

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<td>Transport and storage temperature</td>
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<th>Layer elements</th>
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**MONOTUBE FIBRE OPTIC CABLE WITH MOISTURE BARRIER**

**Code:** TOL1 yy fo VH5E  
*yy:* fibres number  
*fo:* fibres type

**Construction:** jelly filled plastic monotube, glass fibre strength member and rats protection, longitudinal thermowelded aluminium tape polyethylene outer sheath.

**Application:** outside duct installation

**Standard:** ITU-T Rec. for optical fibre  
ETSI Standards  
IEC Rec. for cable tests  
ISO 9000 Standards for raw material  
CEI-UNEL

**General data:**
- Operating temperature: -20°C+60°C  
- Installation temperature: -15°C+60°C  
- Transport and storage temperature: -40°C+70°C  
- Identification: cable code  
- Outer sheath colour: black  
- Cable sheath marking: TRATOS "cable code"

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MONOTUBE FIBRE OPTIC CABLE
WITH METALLIC PROTECTION

Code: TOL1 yy fo VEH9E

yy: fibres number
fo: fibres type

Construction: jelly filled plastic monotube, glass fibre strength member and rats protection, longitudinal thermowelded corrugated steel tape, polyethylene outer sheath.

Application: outside duct installation

Standard: ITU-T Rec. for optical fibre
ETSI Standards
IEC Rec. for cable tests
ISO 9000 Standards for raw material
CEI-UNEL

General data:
Operating temperature -20°C+60°C
Installation temperature -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification cable code
Outer sheath colour black
Cable sheath marking TRATOS "cable code"

TECHNICAL TABLE

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<th>Fibres</th>
<th>Fibres for each tube</th>
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<th>Tube diameter</th>
<th>Central support diameter</th>
<th>Layer elements</th>
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FIBRE OPTIC STEEL WIRES
ARMOURED CABLE

Code: TOLx yy z (w fo) T/H5EFE
   x: optic elements in cable structure
   yy: number of fibres
   z: number of loose tubes
   w: number of fibres in each tube
   fo: fibres type

Construction: metallic central support, jelly filled loose
tube, longitudinal thermowelded aluminium
tape as moisture barrier, polyethylene inner
sheath, steel wire armour as mechanical
protection and polyethylene outer sheath.

Application: outside duct installation, directly buried
installation

Standard: ITU-T Rec. for optical fibre
          ETSI Standards
          IEC Rec. for cable tests
          ISO 9000 Standards for raw material
          CEI-UNEL

General data:
Operating temperature -30°C+60°C
Installation temperature -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification cable code
Outer sheath colour black
Cable sheath marking TRATOS "cable code"

TECHNICAL TABLE

<table>
<thead>
<tr>
<th>fibres cable nr.</th>
<th>fibres for each tube nr.</th>
<th>tube nr.</th>
<th>tube diameter mm</th>
<th>central support diameter mm</th>
<th>layer elements nr.</th>
<th>nominal sheath thickness mm</th>
<th>overall diameter approx mm</th>
<th>max. pulling load static &amp; dynamic N</th>
<th>min. bending radius static &amp; dynamic m</th>
<th>nominal delivery length m</th>
<th>cable weight approx kg/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1</td>
<td>12</td>
<td>1.6</td>
<td>5</td>
<td>1</td>
<td>1.8</td>
<td>17.5</td>
<td>15.000/20.000</td>
<td>200/500</td>
<td>2100</td>
<td>405</td>
</tr>
</tbody>
</table>
FIBRE OPTIC & COPPER COMMUNICATION CABLE

Code: TOLx yy z (w fo) T/E nn 2Cu ss T/H5EKH6E
   x: optic elements in cable structure
   yy: number of fibres
   z: number of loose tubes
   w: number of fibres in each tube
   fo: fibres type
   nn: number of copper pairs
   ss: copper conductors section

Construction: metallic central support, jelly filled loose tube, polyethylene inner sheath. Copper pairs jelly filled layer, longitudinal thermowelded aluminium tape, intermediate polyethylene sheath, aramid strength member, longitudinal corrugated steel sheath as moisture barrier, rodent and mechanical protection, polyethylene outer sheath.

Application: outside duct installation, directly buried installation

Standard: ITU-T Rec. for optical fibre
         ETSI Standards
         IEC Rec. for cable tests
         ISO 9000 Standards for raw material
         CEI-UNEL

General data:
Operating temperature       -30°C+60°C
Installation temperature    -15°C+60°C
Transport and storage temperature -40°C+70°C
Identification               cable code
Outer sheath colour          black
Cable sheath marking         TRATOS "cable code"

TECHNICAL TABLE

<table>
<thead>
<tr>
<th>fibres cable</th>
<th>fibres for each tube</th>
<th>tube</th>
<th>tube diameter</th>
<th>central support diameter</th>
<th>layer elements</th>
<th>nominal sheath thickness</th>
<th>overall diameter approx</th>
<th>max. pulling load static dynamic N</th>
<th>min. bending radius static dynamic</th>
<th>nominal delivery length</th>
<th>nominal weight approx</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/1000.9</td>
<td>2</td>
<td>6</td>
<td>1.8</td>
<td>2.2</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>3500/4000</td>
<td>700/600</td>
<td>1050</td>
<td>1250</td>
</tr>
</tbody>
</table>


OPGW

OPTICAL PROTECTION GROUND WIRE

The complete compatibility between the electrical power carrying and the optical transmission allows to optimise the use of low and medium tension network structures already existing or of new installation. The aperture of telecommunication market to new telephone operators, data transmission and video signals represent an additional possibility to employ OPGW cable everywhere. Its structure and its performances have been designed in relation with the characteristics of overhead lines where it will be installed.

For example it has to be verified very carefully the short circuit current, which is very important for the calculation of the temperature which can develop in this case and the necessary cooling time.

Some notes for the design of OPGW conductors are listed in the following pages.

The OPGW conductor is usually composed of a central non metallic member containing the fibres, which is situated inside the steel or electro-welded tube. Over the tube are applied one or more layers of steel or aluminium, aluminium alloy and steel alloy wires. The type, the number and size of each wire is chosen on the basis of the working conditions.

In some cases it is possible to use a non metallic optical fibre cable helically wound on the protection conductor or on the phase conductor.

Some examples are shown in the following pages.

What to take in consideration for the project

- Operating voltage of the power line
- Maximum short circuit current
- Short circuit time
- Supporting structure type
- OPGW installation system
- Pole span and conductor hang
- Range of temperature for storage, installation and operation
- Ground profile
- General weather condition
- Light frequency
- Maximum wind speed
- Maximum ice load
**FIBRE**

<table>
<thead>
<tr>
<th></th>
<th>nr</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optical fibre cable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max Attenuation</strong></td>
<td>1310 nm</td>
<td>dB/Km</td>
</tr>
<tr>
<td></td>
<td>1550 nm</td>
<td></td>
</tr>
<tr>
<td><strong>Chromatic Dispersion</strong></td>
<td>1310 nm</td>
<td>ps (nm x Km)</td>
</tr>
<tr>
<td></td>
<td>1550 nm</td>
<td></td>
</tr>
</tbody>
</table>

**CABLE CORE**

<table>
<thead>
<tr>
<th></th>
<th>mm</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength member diameter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Slot diameter</strong></td>
<td></td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Aluminium tube</strong></td>
<td>mm thickness</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>mm diameter</td>
<td>7.0</td>
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</tbody>
</table>

**ARMOUR**

<table>
<thead>
<tr>
<th></th>
<th>n x mm diam</th>
<th>13 x 2.4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single layer steel alumoweld wires</strong></td>
<td></td>
<td></td>
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</tbody>
</table>

**MECHANICAL VALUES**

<table>
<thead>
<tr>
<th></th>
<th>da N</th>
<th>&gt; 7450</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breaking load</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Modulus elasticity</strong></td>
<td>da N mm²</td>
<td>10000</td>
</tr>
<tr>
<td><strong>Short circuit current</strong></td>
<td>kA/1 sec</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>kA/0.5 sec</td>
<td>10</td>
</tr>
<tr>
<td><strong>Coeff. linear expansion</strong></td>
<td>1/°C</td>
<td>16 x 10 exp-6</td>
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</table>

**DIMENSIONS**

<table>
<thead>
<tr>
<th></th>
<th>mm</th>
<th>12.5</th>
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</thead>
<tbody>
<tr>
<td><strong>Outer diameter</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Nominal weight</strong></td>
<td>Kg/m</td>
<td>0.60</td>
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### FIBRE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
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<tbody>
<tr>
<td>Optical fibre cable</td>
<td>nr</td>
<td>24</td>
</tr>
<tr>
<td>Max Attenuation</td>
<td>1310 nm</td>
<td>dB/Km</td>
</tr>
<tr>
<td></td>
<td>1550 nm</td>
<td>0.26</td>
</tr>
<tr>
<td>Cromatic Dispersion</td>
<td>1310 nm</td>
<td>ps (nm x Km)</td>
</tr>
<tr>
<td></td>
<td>1550 nm</td>
<td>20</td>
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### CABLE CORE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength member diameter</td>
<td>mm</td>
<td>1.7</td>
</tr>
<tr>
<td>Slot diameter</td>
<td>mm</td>
<td>5.3</td>
</tr>
<tr>
<td>Aluminium tube</td>
<td>mm thickness</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>mm diameter</td>
<td>7.0</td>
</tr>
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</table>

### ARMOUR

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1° layer steel alumoweld wires</td>
<td>n x mm diam</td>
<td>18 x 2.02</td>
</tr>
<tr>
<td>2° layer aluminium wires</td>
<td>n x mm diam</td>
<td>23 x 2.02</td>
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</table>

### MECHANICAL VALUES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaking load</td>
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<tr>
<td>Modulus elasticity</td>
<td>da N mm²</td>
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</tr>
<tr>
<td>Short circuit current</td>
<td>kA/1 sec</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>kA/0.5 sec</td>
<td>20</td>
</tr>
<tr>
<td>Coeff. linear expansion</td>
<td>1°C</td>
<td>17 x 10 exp-6</td>
</tr>
</tbody>
</table>

### DIMENSIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
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</thead>
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<td>Outer diameter</td>
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<tr>
<td>Nominal weight</td>
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### Fibre

<table>
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<th>Description</th>
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<tbody>
<tr>
<td>Optical fibre cable</td>
<td>nr</td>
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<tr>
<td>Max Attenuation (1310 nm)</td>
<td>dB/Km 0.43</td>
</tr>
<tr>
<td>Max Attenuation (1550 nm)</td>
<td>dB/Km 0.26</td>
</tr>
<tr>
<td>Cromatic Dispersion (1310 nm)</td>
<td>ps (nm x Km) 3.5</td>
</tr>
<tr>
<td>Cromatic Dispersion (1550 nm)</td>
<td>ps (nm x Km) 20</td>
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</table>

### Cable Core

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength member diameter</td>
<td>mm 1.7</td>
</tr>
<tr>
<td>Slot diameter</td>
<td>mm 5.3</td>
</tr>
</tbody>
</table>

### Mechanical Values

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Max applicable load</td>
<td>N 600</td>
</tr>
<tr>
<td>Max applicable load during installation</td>
<td>N 100</td>
</tr>
<tr>
<td>Minimum bending radius</td>
<td>mm 50</td>
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### Dimensions

<table>
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<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Sheaths inner mm thickness</td>
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</tr>
<tr>
<td>Sheaths diameter</td>
<td>6.6</td>
</tr>
<tr>
<td>Sheaths outer mm thickness</td>
<td>0.45</td>
</tr>
<tr>
<td>Outer diameter mm</td>
<td>7.5</td>
</tr>
<tr>
<td>Nominal weight Kg/m</td>
<td>0.55</td>
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# PACKAGING WOODEN DRUMS

## DIMENSIONS

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<th></th>
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<tbody>
<tr>
<td>BL 60</td>
<td>690</td>
<td>630</td>
<td>315</td>
<td>80</td>
<td>315</td>
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<tr>
<td>BL 70</td>
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<td>80</td>
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<tr>
<td>BL 80</td>
<td>960</td>
<td>900</td>
<td>450</td>
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<td>575</td>
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<td>BL 90</td>
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<td>BL 100</td>
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<td>1.000</td>
<td>500</td>
<td>80</td>
<td>560</td>
<td>685</td>
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<td>1.250</td>
<td>620</td>
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<td>760</td>
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<td>BL 140</td>
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<td>BL 180</td>
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<td>BL 220</td>
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<td>1.120</td>
<td>1.320</td>
<td>500</td>
<td>8.20</td>
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</tbody>
</table>

## HANDLING

- **A** - Flange diameter including circumference batten
- **B** - Flange diameter without circumference batten
- **C** - Inner barrel diameter
- **D** - Axis hole
- **E** - Inner width
- **F** - External width

### NO

- 30°

### YES

- 180°
<table>
<thead>
<tr>
<th>CABLE DIAMETER (mm.)</th>
<th>DRUM TYPE</th>
</tr>
</thead>
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<tr>
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<tr>
<td>6</td>
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<td>96</td>
<td></td>
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<tr>
<td>100</td>
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</table>
TELECOMMUNICATION CABLES

- Optical fibre cables slot type up to 100 fibres
- Optical fibre cables loose buffer tubes up to 96 fibres
- Optical fibre cables slot ribbon types up to 400 fibres
- Jelly filled telephone cables up to 1200 pairs
- Underground telephone cables without jelly filling up to 2400 pairs
- Flame retardant cables and low emission of fumes, toxic and corrosive gasses.
- Public telephone cable - home telephone cables.
- OPGW cables (Optical Protection Ground Wire)
- Signalling cables with or without screen
- Instrument cables in pairs and/or triples
- Thermocouples
- Coaxial cables
- Special cables to customer’s specifications
- Flame retardant cables and low emission of fumes, toxic and corrosive gasses.
- Fire resistant cables

QUALITY SYSTEM

Our Quality System management includes two certificates: Basesc (UK) and Aenor (E), in accordance to ISO 9001:2000 covering the production, purchasing of raw materials design and final test including various documents typologies. Tratos Quality System management is under constant control by inspectors working for the certifying bodies.

LOW AND MEDIUM TENSION POWER CABLES UP TO Uo/U 26/45 KV

- Distribution, industrial and domestic cables
- Cables with copper or aluminium conductor
- Insulated in XLPE - RUBBER - PVC
- Screened and/or armoured cables
- Cables with concentric conductor
- Flame retardant cables and low emission of fumes, toxic and corrosive gasses.
- Fire resistant cables
Tratos Cavi S.p.A. reserves the right to modify at any time technical dimensions and weight characteristics shown in this catalogue to improve the features of its products. However, these will still be in accordance with the mentioned standards.

There is no responsibility of the manufacturer for damages to persons and property in case of improper use and/or neglecting the recommendations for using cables and norms contained in this catalogue.