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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FOSMXXXI0901

## Technical Specification

<b>Revision/Date:</b> 02/02.17	<b>By :</b> S. AKKAŞ	<b>Date :</b> 17 February 2017
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Cable Type : Loose Tube, Indoor F/O Cable  
HES Cable Product Number : FOSMXXXI0901 (XXX: number of fiber)

### PHYSICAL DESCRIPTION

- 24-72-144 fibers indoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Polyester tape as core wrap,
- Aramid yarn as strength member,
- Outer jacket is made of halogen-free flame retardant compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	ITU-T G 652D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First Tube: Red; Last Tube: Blue; Intermediate Tubes:Natural
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling compound	-
Ripcord	Polyester cord
Tape wrap	Polyester tape
Strength elements	Aramid yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	<b>Yellow</b> HFFR, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Reel length	2000±5% m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weigth (kg/km)
24	6	-	4	2.2	2.2/2.4	2.20/1.50*	10.9*	121*
72	6	-	12	2.2	2.2/2.4	2.20/1.50*	10.9*	123*
144	12	-	12	2.2	2.2/6.5	2.20/1.50*	15.0*	216*

\*:Tolerance is ±5%.



<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	1200 N (during Installation) 890 N (during Operation)	Maximum loss:0.05 dB	IEC 60794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	150 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-10 to +60 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 60794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 μm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1 μm
Core/Clad Concentricity error (max)	1 μm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 μm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**



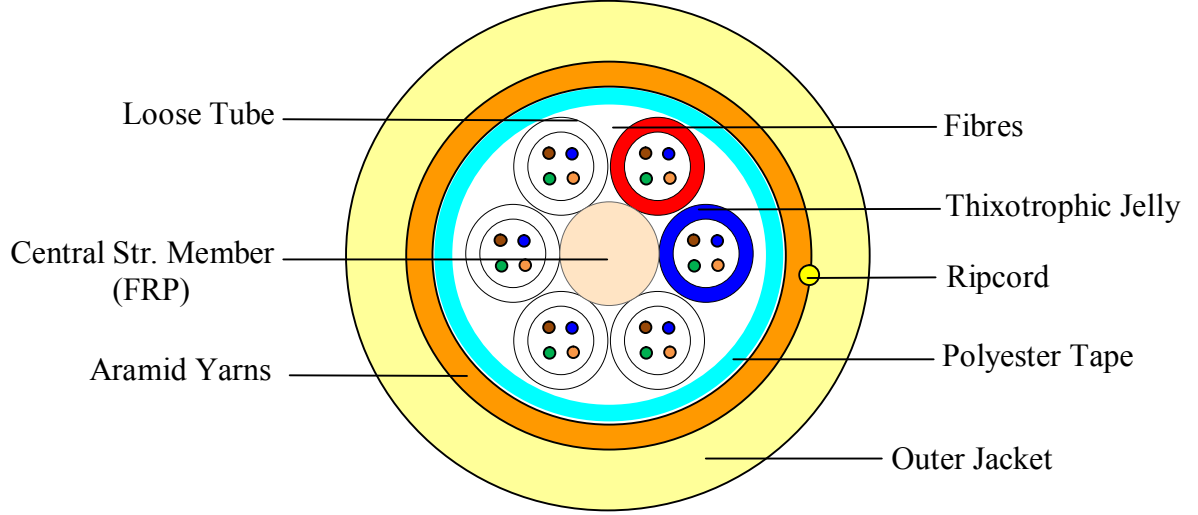
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FOSMXXXI0901

**24 fibers Cable Cross Section**





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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FOYYXXXSLI0901

## Technical Specification

<b>Revision/Date:</b> 01/02.2017	<b>By :</b> S. AKKAŞ	<b>Date :</b> 17 February 2017
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Cable Type : Single Loose Tube, Indoor F/O Cable  
HES Cable Product Number : FOSMXXXSLT0901 (XXX: number of fiber)

### PHYSICAL DESCRIPTION

- 4-6 fibers indoor-outdoor fiber optic cable,
- Thixotropic jelly filled loose tube,
- Central loose tube design,
- Water swellable tape wrapping core,
- Swellable aramid yarn as strength member,
- Outer jacket is made of HFFR compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G 657 A1
Central strength member	No Central Strength Member
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	Natural
Color of fibers(for 4 fibers)	Red, Green, Yellow, Black
Color of fibers(for 6 fibers)	Red, Green, Yellow, Pink, Orange, Blue
Color of fibers(for 12 fibers)	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling compound	-
Ripcord	Aramid or polyester cord
Tape wrap	Water swellable tape
Strength elements	Swellable aramid yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	<b>Black</b> HFFR thickness nominal 1.5±0.1 mm.
Surface marking	As a customer request
Reel length	2000 ±%5m

Fiber Count	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
4	3.0/2.0	7.0*	55*
6	3.0/2.0	7.0*	55*

\*:Tolerance ±10%



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## HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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FOYYXXXSLI0901

<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	2000 N (during Installation)	Maximum loss:0.05 dB	IEC 794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 794-1-E4
Crush Resistance	200 N/cm	No fiber break	IEC 794-1-E3
Temperature Cycling	-10 to +60 °C	Maximum loss:0.05 dB	IEC 794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 657 A</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.0±0.4 µm (1310 nm) 10.1±0.5 µm (1550 nm)
Cladding diameter	125±0.7µm
Core/Clad Concentricity error (max)	0.5 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	% 0.7
Coating diameter	242±7 µm
Cut Off Wavelength	≤1260nm
Proof Tensile Test	≥ 1% (100kpsi or 0.7GPa)
Macro bending Attenuation : (10 turn on a 15 mm radius mandrel)	≤ 0.25 dB @1550 nm

**NOTE (If any):**



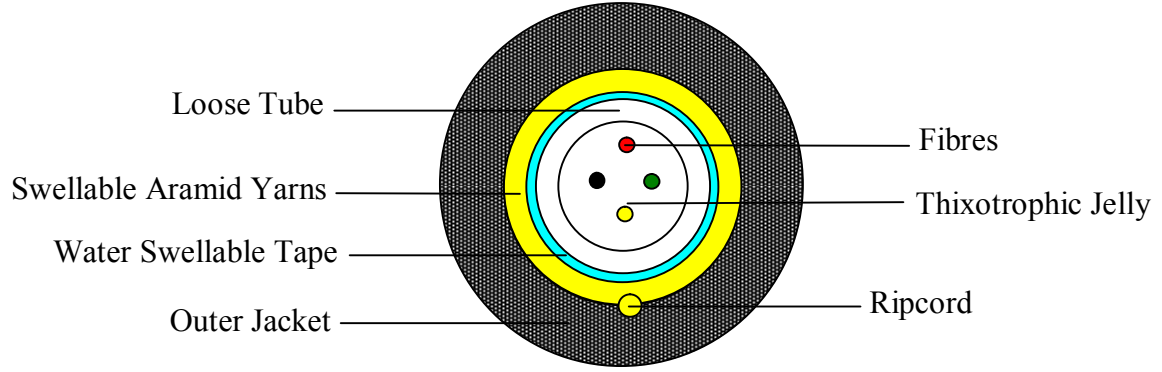
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FOYYXXXSLI0901

*Cable Cross Section*





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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FCSMXXXSLT9901

## Technical Specification

<b>Revision/Date:</b> 01/02.17	<b>By</b> S. AKKAŞ	<b>Date</b> : 08 February 2017
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Cable Type : Loose Tube, Outdoor Hybrid F/O Cable  
HES Cable Product Number : FCSMXXXSLT9901

### PHYSICAL DESCRIPTION

- 6-12 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- PVC insulated copper cables,
- Dry core design,
- Water swellable tape as core wrap,
- Swellable glass yarn as strength member,
- Outer jacket is made of HFFR compound,
- Ripcord is inserted for easy jackets removal.

Type of fiber	SM G657 A
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tube	White
Color of copper cables	White, Brown
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling	Water swellable yarn
Ripcord	Polyester cord
Tape wrap	Water swellable tape
Strength elements	Swellable glass yarns
Identification tape marking	As a customer request
Inner jacket	-
Outer jacket	Black HFFR, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Copper Cable	2x1.5mm <sup>2</sup> (0,7mm PVC insulated thickness) 2x2.5mm <sup>2</sup> (0,7mm PVC insulated thickness)
Reel length	2030±%5m

Fiber Count	Number of Tube	Copper Cables	Number of fiber in per tube	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
6	1	2x1.5mm <sup>2</sup>	6	3.3/2.3*	10.6*	145*
12	1	2x1.5mm <sup>2</sup>	12	3.3/2.3*	10.6*	145*

\*:Tolerance is ±10%.



<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	1000 N	No fiber break	IEC 60794-1-E1
Impact Resistance	10J , 3 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	200 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 657 A</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.0±0.4 µm (1310 nm) 10.1±0.5 µm (1550 nm)
Cladding diameter	125±0.7µm
Core/Clad Concentricity error (max)	0.5 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	% 0.7
Coating diameter	242±7 µm
Cut Off Wavelength	≤1260nm
Proof Tensile Test	≥ 1% (100kpsi or 0.7GPa)
Macro bending Attenuation : (10 turn on a 15 mm radius mandrel)	≤ 0.25 dB @1550 nm

**NOTE (If any):**





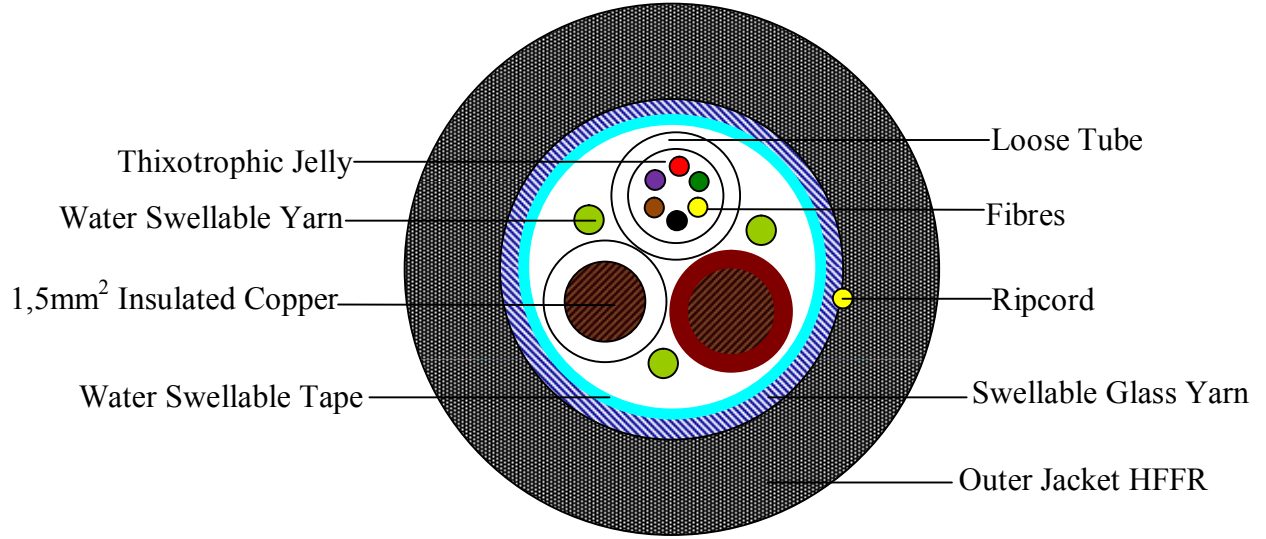
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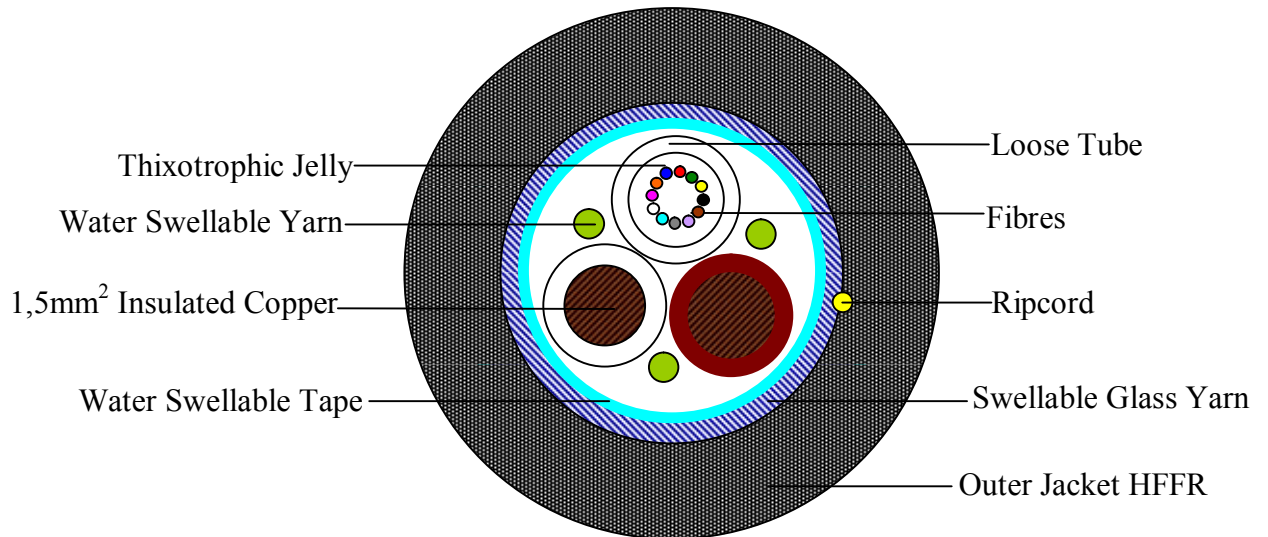
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FCSMXXXSLT9901

## 6 FO(1x6) + 2x1.5Cu Cable Cross Section



## 12 FO(1x12) + 2x1.5Cu Cable Cross Section





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<http://www.hes.com.tr>

FCSMXXXSLT9901

## Technical Specification

<b>Revision/Date:</b> 01/02.17	<b>By</b> S. AKKAŞ	<b>Date</b> : 08 February 2017
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Cable Type : Loose Tube, Outdoor Hybrid F/O Cable  
HES Cable Product Number : FCSMXXXSLT9901

### PHYSICAL DESCRIPTION

- 6-12 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- PVC insulated copper cables,
- Dry core design,
- Water swellable tape as core wrap,
- Swellable glass yarn as strength member,
- Outer jacket is made of HFFR compound,
- Ripcord is inserted for easy jackets removal.

Type of fiber	SM G657 A
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tube	White
Color of copper cables	White, Brown
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling	Water swellable yarn
Ripcord	Polyester cord
Tape wrap	Water swellable tape
Strength elements	Swellable glass yarns
Identification tape marking	As a customer request
Inner jacket	-
Outer jacket	Black HFFR, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Copper Cable	2x1.5mm <sup>2</sup> (0,7mm PVC insulated thickness) 2x2.5mm <sup>2</sup> (0,7mm PVC insulated thickness)
Reel length	2030±%5m

Fiber Count	Number of Tube	Copper Cables	Number of fiber in per tube	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
6	1	2x1.5mm <sup>2</sup>	6	3.3/2.3*	10.6*	145*
12	1	2x1.5mm <sup>2</sup>	12	3.3/2.3*	10.6*	145*

\*:Tolerance is ±10%.



<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	1000 N	No fiber break	IEC 60794-1-E1
Impact Resistance	10J , 3 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	200 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 657 A</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.0±0.4 µm (1310 nm) 10.1±0.5 µm (1550 nm)
Cladding diameter	125±0.7µm
Core/Clad Concentricity error (max)	0.5 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	% 0.7
Coating diameter	242±7 µm
Cut Off Wavelength	≤1260nm
Proof Tensile Test	≥ 1% (100kpsi or 0.7GPa)
Macro bending Attenuation : (10 turn on a 15 mm radius mandrel)	≤ 0.25 dB @1550 nm

**NOTE (If any):**



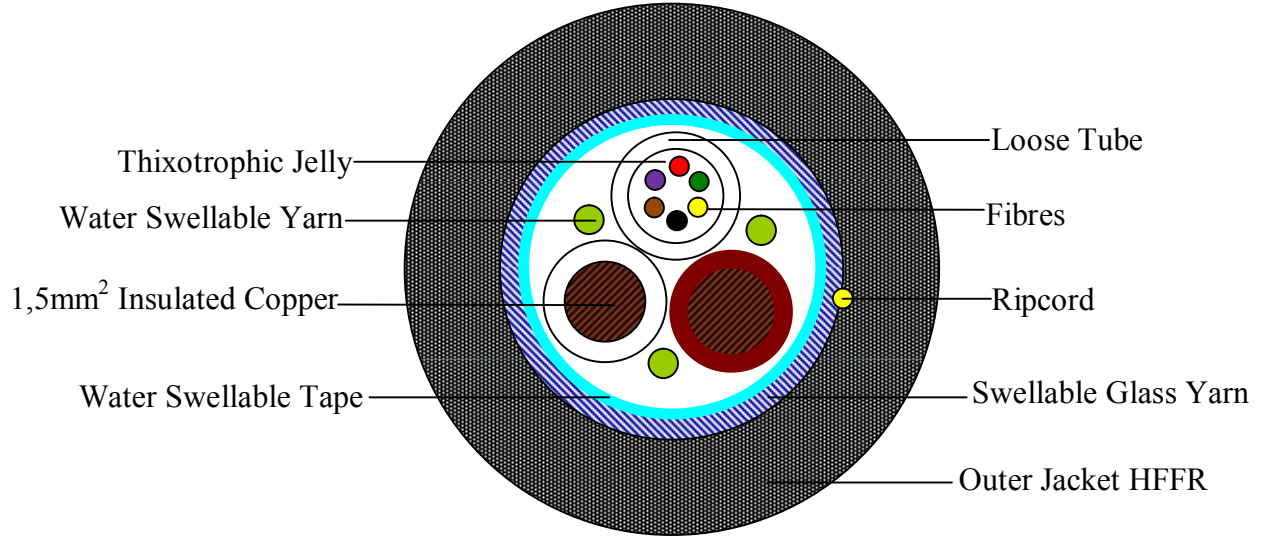
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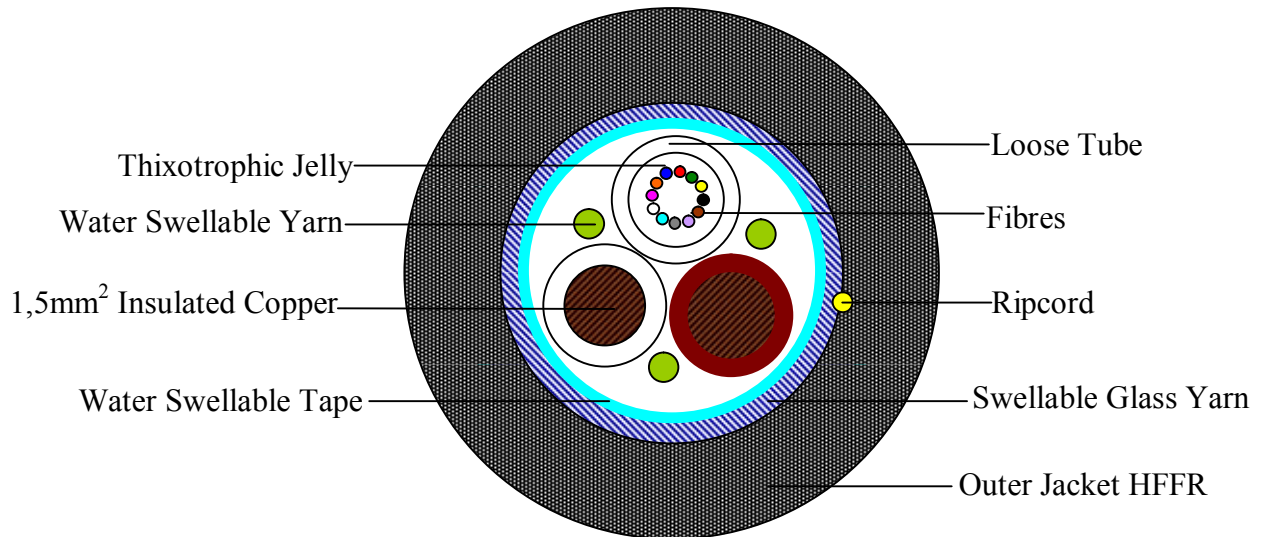
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FCSMXXXSLT9901

## 6 FO(1x6) + 2x1.5Cu Cable Cross Section



## 12 FO(1x12) + 2x1.5Cu Cable Cross Section





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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FOSM012SLT9904

## Technical Specification

<b>Revision/Date:</b> 00/02.17	<b>By :</b> S. AKKAŞ	<b>Date :</b> 8 February 2017
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Cable Type : Loose Tube, Outdoor Aerial (Fig8) F/O Cable  
HES Cable Product Number : FOSM012SLT9904

### PHYSICAL DESCRIPTION

- 12 fibers outdoor aerial figure-8 fiber optic cable,
- Thixotropic jelly filled loose tube,
- Central loose tube design,
- Water blocking tape as core wrap,
- Aramid yarn as strength member,
- Outer jacket is made of medium density polyethylene ,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G652 D
Central strength member	No Central Strength Member
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	Naturel
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Tape wrap	Water blocking tape
Strength elements	Swellable aramid yarns
Ripcord	Aramid or polyester cord
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	-
Outer jacket	Black HDPE, thickness nominal 2.2±0.2 mm
Web	Height: 2.2±0.2 mm Width: 2.2±0.2 mm
Messenger Wire	Steel; 7x0.92 mm
Surface marking	As a customer request
Reel length	2030±5% m

Fiber Count	Tube Outer/Inner Diameter (mm)	Cable Dimensions (mm)	Cable Weight (kg/km)
12	3.0/2.0*	18.3/8.6*	135*

\*:Tolerance is ±10%



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## HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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FOSM012SLT9904

<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	7000 N	Maximum loss:0.05 dB	IEC 794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 794-1-E4
Crush Resistance	25 kN/m	No fiber break	IEC 794-1-E3
Temperature Cycling	-10 to +60 °C	Maximum loss:0.05 dB	IEC 794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 µm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1µm
Core/Clad Concentricity error (max)	1 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**



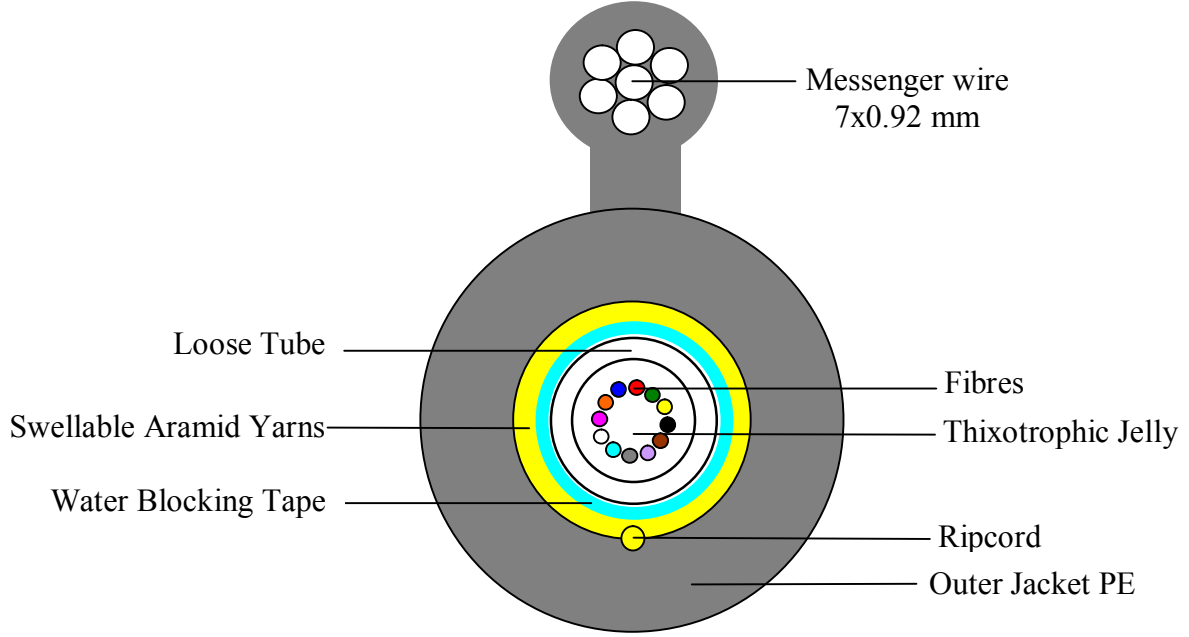
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**HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.**

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FOSM012SLT9904

**12 fibers Cable Cross Section**





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FOSM012SLT9904

## Technical Specification

<b>Revision/Date:</b> 00/02.17	<b>By :</b> S. AKKAŞ	<b>Date :</b> 8 February 2017
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Cable Type : Loose Tube, Outdoor Aerial (Fig8) F/O Cable  
HES Cable Product Number : FOSM012SLT9904

### PHYSICAL DESCRIPTION

- 12 fibers outdoor aerial figure-8 fiber optic cable,
- Thixotropic jelly filled loose tube,
- Central loose tube design,
- Water blocking tape as core wrap,
- Aramid yarn as strength member,
- Outer jacket is made of medium density polyethylene ,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G652 D
Central strength member	No Central Strength Member
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	Naturel
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Tape wrap	Water blocking tape
Strength elements	Swellable aramid yarns
Ripcord	Aramid or polyester cord
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	-
Outer jacket	Black HDPE, thickness nominal 2.2±0.2 mm
Web	Height: 2.2±0.2 mm Width: 2.2±0.2 mm
Messenger Wire	Steel; 7x0.92 mm
Surface marking	As a customer request
Reel length	2030±5% m

Fiber Count	Tube Outer/Inner Diameter (mm)	Cable Dimensions (mm)	Cable Weight (kg/km)
12	3.0/2.0*	18.3/8.6*	135*

\*:Tolerance is ±10%





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## HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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FOSM012SLT9904

<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	7000 N	Maximum loss:0.05 dB	IEC 794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 794-1-E4
Crush Resistance	25 kN/m	No fiber break	IEC 794-1-E3
Temperature Cycling	-10 to +60 °C	Maximum loss:0.05 dB	IEC 794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 µm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1µm
Core/Clad Concentricity error (max)	1 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**



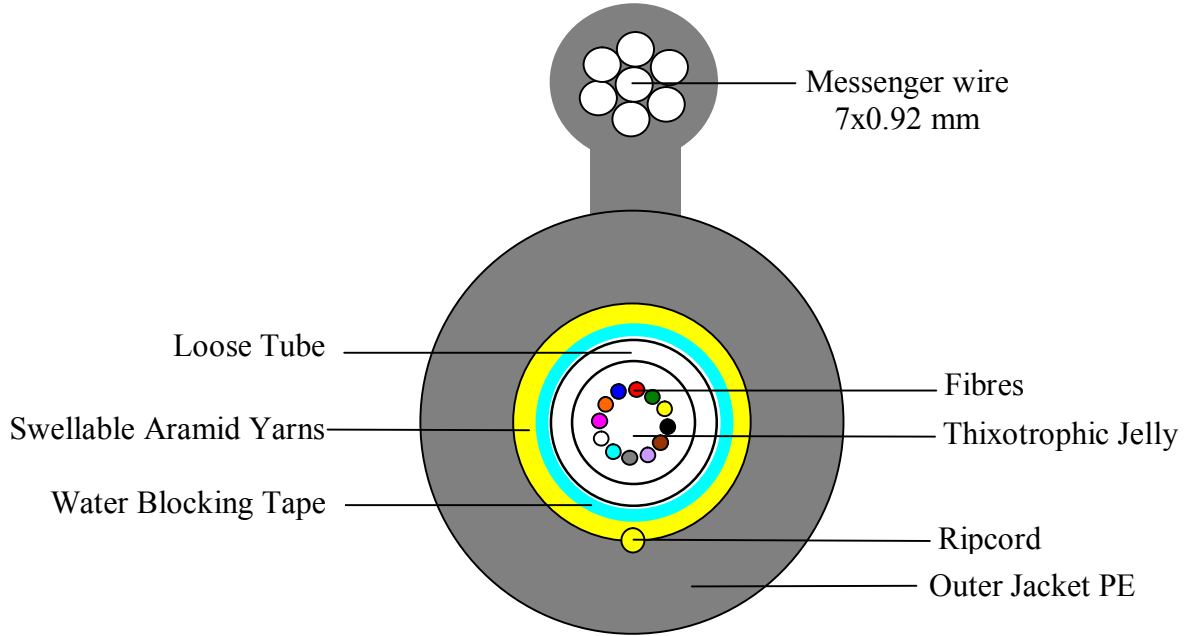
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**HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.**

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FOSM012SLT9904

**12 fibers Cable Cross Section**





"World Quality"

## Technical Specification

Revision/Date: 00/02.17

By: S. AKKAŞ

Date: 17 February 2017

Cable Type : Loose Tube, SJNA Outdoor F/O Cable

### PHYSICAL DESCRIPTION

- 12-24 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Jelly filled core,
- Polyester tape as core wrap,
- Aramid yarn as strength member,
- Outer jacket is made of halogen free flame retardant compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G652 D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First tube: Red; Last tube: Blue; Intermediate tubes: Natural
Color of fibers	Red, Green, Yellow, Black
Tube filling compound	Thixotropic jelly
Core filling compound	Jelly
Ripcord	Aramid or polyester cord
Tape wrap	Polyester tape
Strength elements	Aramid yarns
Outer jacket	UV Resistant Black HFFR , thickness nominal 1.5 ±0.2mm
Surface marking	As per costumer request
Reel marking	As per costumer request
Reel lenght	2000 ±5% $\pm$ m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
12	6	0	2	2.7	N/A	2.5/1.7*	12.0*	147*
24	6	0	4	2.7	N/A	2.5/1.7*	12.0*	148*

\*:Tolerance is ±10%.

### Mechanical and Environmental Properties

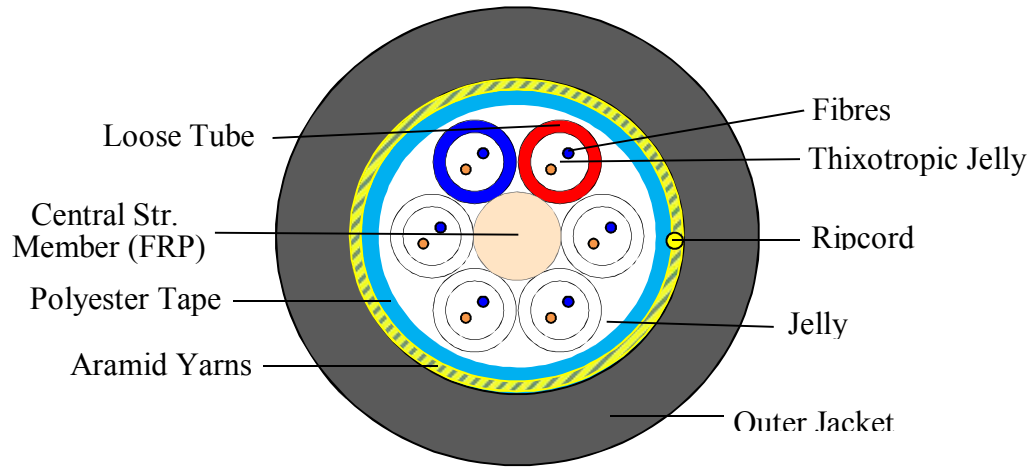
Physical tests	Conditions	Requirement	Standard
Tensile Strength (Installation)	2000 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Tensile Strength (Operation)	800 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Impact Resistance	10J, 3 impacts	No fiber break	IEC 60794-1-2 E4
Crush Resistance	2200 N/10 cm	No fiber break	IEC 60794-1-2 E3
Temperature Cycling	-40 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-2 F1

Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-2 E6
Operation Temperature	-40 to +70 °C		
Storage and Transportation Temperature	-40 to +80 °C		
Installation Temperature	-30 to +60 °C		

<b>STANDARD SM FIBER ITU-T G 652 D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.4 μm (1310 nm) 10.4±0.5 μm (1550 nm)
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±0.3μm
Core/Clad Concentricity error	≤ 0.5 μm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245±10 μm
Cut Off Wavelength	≤1260nm
Proof Test	≥ 1% (100kpsi or 0.7GPa)

**NOTE (If any):**

*Cable Cross Section*





"World Quality"

## Technical Specification

Revision/Date: 00/02.17

By: S. AKKAŞ

Date: 17 February 2017

Cable Type : Loose Tube, SJNA Outdoor F/O Cable

### PHYSICAL DESCRIPTION

- 12-24 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Jelly filled core,
- Polyester tape as core wrap,
- Aramid yarn as strength member,
- Outer jacket is made of halogen free flame retardant compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G652 D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First tube: Red; Last tube: Blue; Intermediate tubes: Natural
Color of fibers	Red, Green, Yellow, Black
Tube filling compound	Thixotropic jelly
Core filling compound	Jelly
Ripcord	Aramid or polyester cord
Tape wrap	Polyester tape
Strength elements	Aramid yarns
Outer jacket	UV Resistant Black HFFR , thickness nominal 1.5 ±0.2mm
Surface marking	As per costumer request
Reel marking	As per costumer request
Reel lenght	2000 ±5% $\pm$ m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
12	6	0	2	2.7	N/A	2.5/1.7*	12.0*	147*
24	6	0	4	2.7	N/A	2.5/1.7*	12.0*	148*

\*:Tolerance is ±10%.

### Mechanical and Environmental Properties

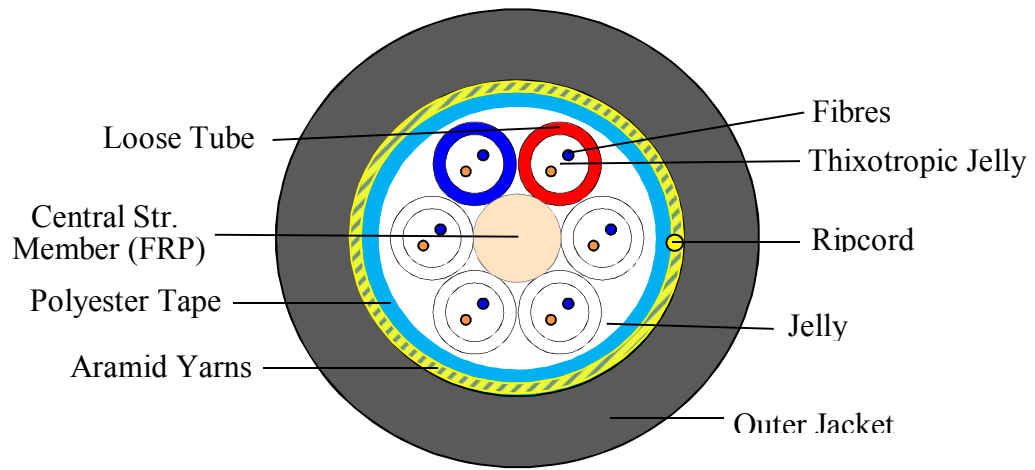
Physical tests	Conditions	Requirement	Standard
Tensile Strength (Installation)	2000 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Tensile Strength (Operation)	800 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Impact Resistance	10J, 3 impacts	No fiber break	IEC 60794-1-2 E4
Crush Resistance	2200 N/10 cm	No fiber break	IEC 60794-1-2 E3
Temperature Cycling	-40 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-2 F1

Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-2 E6
Operation Temperature	-40 to +70 °C		
Storage and Transportation Temperature	-40 to +80 °C		
Installation Temperature	-30 to +60 °C		

<b>STANDARD SM FIBER ITU-T G 652 D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.4 μm (1310 nm) 10.4±0.5 μm (1550 nm)
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±0.3μm
Core/Clad Concentricity error	≤ 0.5 μm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245±10 μm
Cut Off Wavelength	≤1260nm
Proof Test	≥ 1% (100kpsi or 0.7GPa)

**NOTE (If any):**

*Cable Cross Section*







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## Technical Specification

Revision/Date: 01/02.17

By: S. AKKAŞ

Date: 17 February 2017

Cable Type : Central Loose Tube, SJNA Indoor/Outdoor F/O Cable

### PHYSICAL DESCRIPTION

- 12-24 fibers indoor/outdoor fiber optic cable,
- Thixotropic jelly filled loose tube,
- Central loose tube design,
- Swellable aramid yarn as strength member,
- Outer jacket is made of halogen free flame retardant compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G652 D
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tube	Natural
Color of fibers	Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Pink, Aqua,Blue with black tracer, Orange with black tracer, Green with black tracer, Brown with black tracer, Slate with black tracer, White with black tracer, Red with black tracer, Natural, Yellow with black tracer, Violet with black tracer, Rose with black tracer, Aqua with black tracer
Tube filling compound	Thixotropic jelly
Ripcord	Aramid or polyester cord
Strength elements	Swellable aramid yarns
Outer jacket	UV Resistant Black HFFR , thickness nominal 1.5 ±0.2mm
Surface marking	As per costumer request
Reel marking	As per costumer request
Reel lenght	2000 ±5% m

Fiber Count	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
12	3.0/2.0*	6.6*	52*
24	3.0/2.0*	6.6*	53*

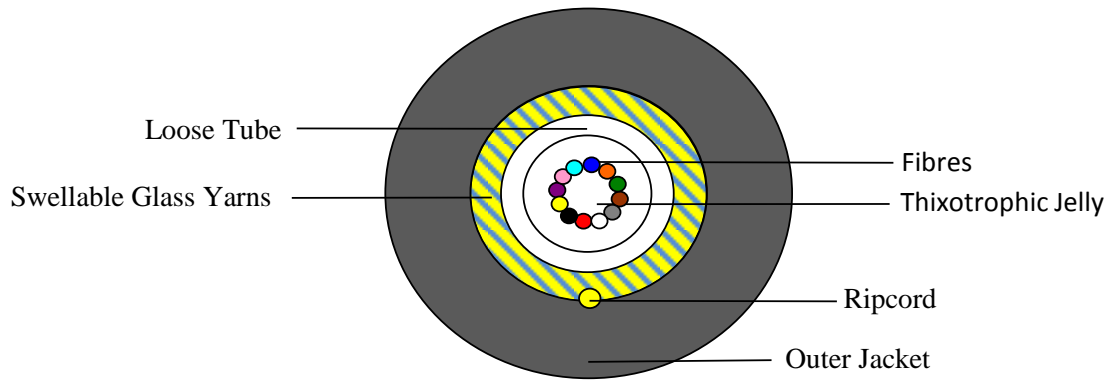
\*:Tolerance is ±10%.

<b>Mechanical and Environmental Properties</b>			
Physical tests	Conditions	Requirement	Standard
Tensile Strength (Installation)	2000 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Tensile Strength (Operation)	800 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Impact Resistance	10J, 3 impacts	No fiber break	IEC 60794-1-2 E4
Crush Resistance	2000 N/10 cm	No fiber break	IEC 60794-1-2 E3
Temperature Cycling	-40 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-2 F1
Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-2 E6
Operation Temperature	-40 to +70 °C		
Storage and Transportation Temperature	-40 to +80 °C		
Installation Temperature	-30 to +60 °C		

<b>STANDARD SM FIBER ITU-T G 652 D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.4 μm (1310 nm) 10.4±0.5 μm (1550 nm)
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±0.3μm
Core/Clad Concentricity error	≤ 0.5 μm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245±10 μm
Cut Off Wavelength	≤1260nm
Proof Test	≥ 1% (100kpsi or 0.7GPa)

**NOTE (If any):**

*Cable Cross Section*





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## Technical Specification

Revision/Date: 01/02.17

By: S. AKKAŞ

Date: 17 February 2017

Cable Type : Central Loose Tube, SJNA Indoor/Outdoor F/O Cable

### PHYSICAL DESCRIPTION

- 12-24 fibers indoor/outdoor fiber optic cable,
- Thixotropic jelly filled loose tube,
- Central loose tube design,
- Swellable aramid yarn as strength member,
- Outer jacket is made of halogen free flame retardant compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	SM G652 D
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tube	Natural
Color of fibers	Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Pink, Aqua,Blue with black tracer, Orange with black tracer, Green with black tracer, Brown with black tracer, Slate with black tracer, White with black tracer, Red with black tracer, Natural, Yellow with black tracer, Violet with black tracer, Rose with black tracer, Aqua with black tracer
Tube filling compound	Thixotropic jelly
Ripcord	Aramid or polyester cord
Strength elements	Swellable aramid yarns
Outer jacket	UV Resistant Black HFFR , thickness nominal 1.5 ±0.2mm
Surface marking	As per costumer request
Reel marking	As per costumer request
Reel lenght	2000 ±5% m

Fiber Count	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weight (kg/km)
12	3.0/2.0*	6.6*	52*
24	3.0/2.0*	6.6*	53*

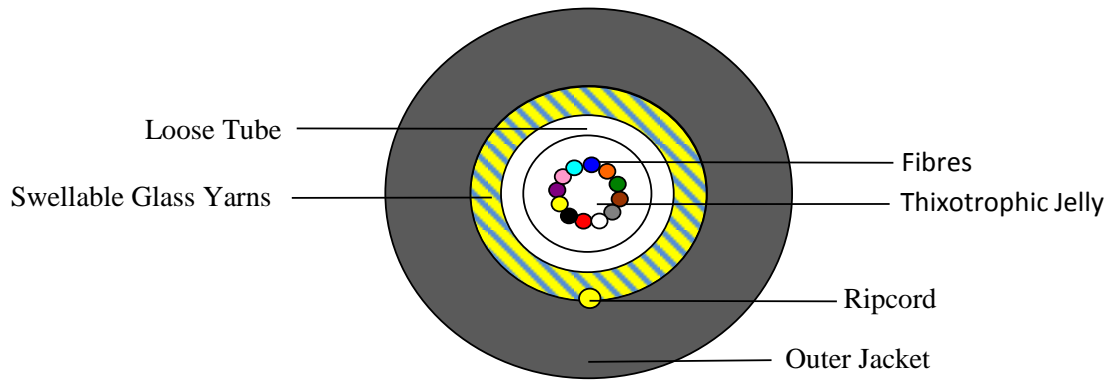
\*:Tolerance is ±10%.

<b>Mechanical and Environmental Properties</b>			
Physical tests	Conditions	Requirement	Standard
Tensile Strength (Installation)	2000 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Tensile Strength (Operation)	800 N	Maximum loss:0.05 dB	IEC 60794-1-2 E1
Impact Resistance	10J, 3 impacts	No fiber break	IEC 60794-1-2 E4
Crush Resistance	2000 N/10 cm	No fiber break	IEC 60794-1-2 E3
Temperature Cycling	-40 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-2 F1
Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-2 E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-2 E6
Operation Temperature	-40 to +70 °C		
Storage and Transportation Temperature	-40 to +80 °C		
Installation Temperature	-30 to +60 °C		

<b>STANDARD SM FIBER ITU-T G 652 D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.4 μm (1310 nm) 10.4±0.5 μm (1550 nm)
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±0.3μm
Core/Clad Concentricity error	≤ 0.5 μm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245±10 μm
Cut Off Wavelength	≤1260nm
Proof Test	≥ 1% (100kpsi or 0.7GPa)

**NOTE (If any):**

*Cable Cross Section*





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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FOSMXXXXD0901

## Technical Specification

<b>Revision/Date:</b> 05/02.17	<b>By :</b> S. AKKAŞ	<b>Date :</b> 17 February 2017
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Cable Type : Loose Tube, Outdoor F/O Cable  
HES Cable Product Number : FOSMXXXXD0901 (XXX: number of fiber)

### PHYSICAL DESCRIPTION

- 12-24-48-72-96-144-288 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Dry core design,
- Water swellable yarns as core filling,
- Water blocking tape wrapping core,
- Swellable glass yarn as strength member,
- Outer jacket is made of medium density polyethylene,
- Ripcord is inserted for easy jackets removal.

Fiber Type	ITU-T G652 D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First Tube: Red; Last Tube: Blue; Intermediate Tubes:Natural
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling compound	Water blocking yarns and tape
Ripcord	Polyester cord
Tape wrap	Water blocking tape
Strength elements	Swellable glass yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	Black MDPE, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Reel length	2030±5% m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weigth (kg/km)
12	3	3	4	2.0	N/A	1.80/1.30*	10.9*	85*
24	6	-	4	2.5	N/A	2.30/1.60*	12.4*	105*
48	6	-	8	2.7	N/A	2.50/1.70*	13.0*	118*
72	6	-	12	2.7	N/A	2.50/1.70*	13.0*	119*
96	8	-	12	2.7	4.5*	2.50/1.70*	14.8*	150*
144	12	-	12	2.7	7.5*	2.50/1.70*	17.8*	219*
288	24	-	12	2.7	5.1*	2.50/1.70*	20.4*	284*

\*:Tolerance is ±5%.



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## HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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FOSMXXXXD0901

<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	2500 N (during Installation) 890 N (during Operation)	Maximum loss:0.05 dB	IEC 60794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	150 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 60794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 µm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1µm
Core/Clad Concentricity error (max)	1 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**





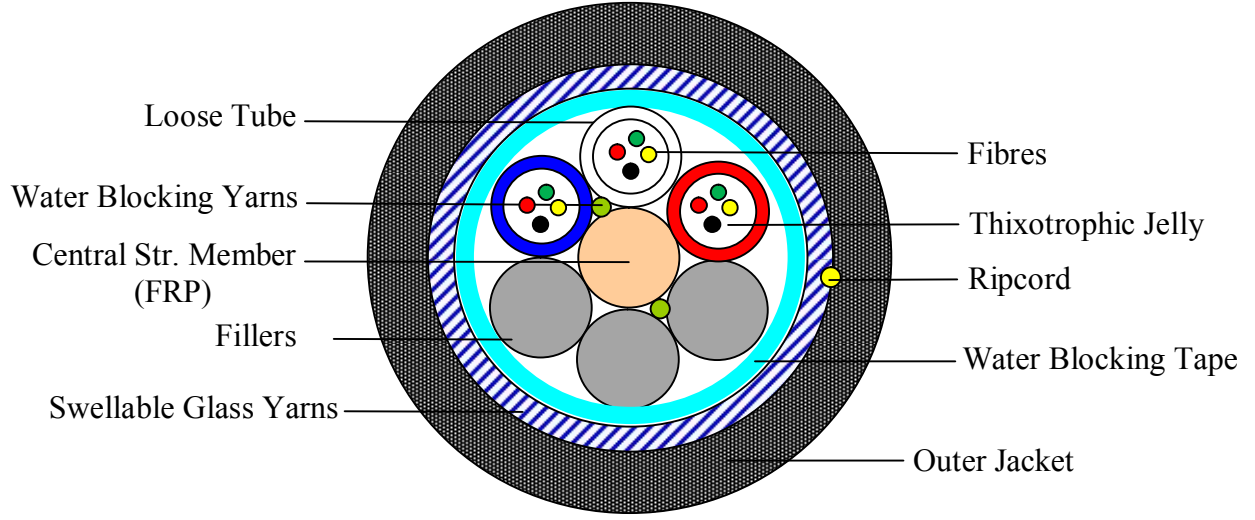
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**HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.**

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FOSMXXXXD0901

*Cable Cross Section*





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<http://www.hes.com.tr>

FOSM D0901

### Technical Specification

<b>Revision/Date:</b> 05/02.17	<b>By :</b> S. AKKAŞ	<b>Date :</b> 17 February 2017
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Cable Type : Loose Tube, Outdoor F/O Cable  
HES Cable Product Number : FOSMXXXXD0901 (XXX: number of fiber)

#### PHYSICAL DESCRIPTION

- 12-24-48-72-96-144-432 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Dry core design,
- Water swellable yarns as core filling,
- Water blocking tape wrapping core,
- Swellable glass yarn as strength member,
- Outer jacket is made of medium density polyethylene,
- Ripcord is inserted for easy jackets removal.

Fiber Type	ITU-T G652 D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First Tube: Red; Last Tube: Blue; Intermediate Tubes:Natural
Color of fibers in per tube	red, green, Yellow, black, Brown, Violet, Grey, Skay blue, White, Pink, Orange Blue red/black ring, green/black ring, Yellow/black ring, black/black ring, Transperent/black ring, Violet/black ring, Grey/black ring, Skay blue/black ring, White/black ring, Pink/black ring, Orange/black ring, Blue/black ring
Tube filling compound	Thixotropic jelly
Core filling compound	Water blocking yarns and tape
Ripcord	Polyester cord
Tape wrap	Water blocking tape
Strength elements	Swellable glass yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	Black MDPE, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Reel lenght	2030±5% $\pm$ m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weigth (kg/km)
12	3	3	4	2.0	N/A	1.80/1.30*	10.9*	85*
24	6	-	4	2.5	N/A	2.30/1.60*	12.4*	105*
48	6	-	8	2.7	N/A	2.50/1.70*	13.0*	118*



# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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72	6	-	12	2.7	N/A	2.50/1.70*	13.0*	119*
96	8	-	12	2.7	4.5*	2.50/1.70*	14.8*	150*
144	12	-	12	2.7	7.5*	2.50/1.70*	17.8*	219*
432	18	-	24	2.7	3.1*	2.50/1.70*	20.4*	292*

\*:Tolerance is  $\pm 5\%$ .

<b>Mechanical and Environmental Properties</b>			
Physical tests	Conditions	Requirement	Standard
Tensile Strength	2500 N (during Installation) 890 N (during Operation)	Maximum loss:0.05 dB	IEC 60794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	150 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 60794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
PROPERTIES	SPECIFIED VALUES
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	$9.2 \pm 0.5 \mu m$
Chromatic Dispersion (max)	3.5 ps/(nm $\times$ km)(1310 nm ) 18 ps/(nm $\times$ km)(1550 nm )
Cladding diameter	$125 \pm 1 \mu m$
Core/Clad Concentricity error (max)	$1 \mu m$
Zero dispersion wavelength	$1300 nm < < 1324 nm$
Cladding non-circularity (max)	%2
Coating diameter	$245 \pm 10 \mu m$
Cut Off Wavelength	$< 1260 nm$
Proof Test	8.4 N
Proof Test strain	%1.00



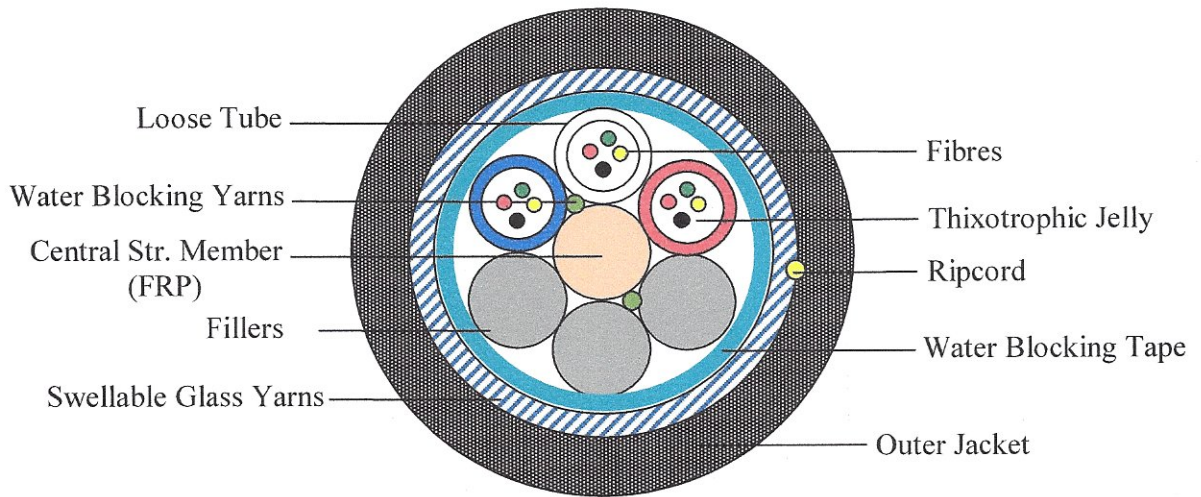
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HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FOSMXXXD0901

*Cable Cross Section*





"World Quality"

# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FCSMXXXMLT9901

## Technical Specification

<b>Revision/Date:</b> 03/02.17	<b>By</b> S. AKKAŞ	<b>Date</b> : 8 February 2017
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Cable Type : Loose Tube, Outdoor Hybrid F/O Cable  
HES Cable Product Number : FCSMXXXMLT9901

### PHYSICAL DESCRIPTION

- 24-48 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and copper cables are SZ stranded around the non- metallic central strength member (FRP),
- Dry core design,
- Water swellable tape as core wrap,
- Swellable glass yarn as strength member,
- Outer jacket is made of HFFR compound,
- Ripcord is inserted for easy jackets removal.

Type of fiber	SM G652 D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	Red, Yellow, Green, Blue
Color of copper cables	White, Yellow, Slate, Brown
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling	Water swellable yarn
Ripcord	Polyester cord
Tape wrap	Water swellable tape
Strength elements	Swellable glass yarns
Identification tape marking	As a customer request
Inner jacket	-
Outer jacket	Black HFFR, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Copper Cable	2x2.5mm <sup>2</sup> (0,7mm PVC insulated thickness) 4x2.5mm <sup>2</sup> (0,7mm PVC insulated thickness)
Reel length	2000±5% <sub>m</sub>



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Fiber Count	Number of Tube	Number of Filler	Copper Cables	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weigth (kg/km)
24	2	1	2x2.5mm <sup>2</sup>	12	2.5	N/A	2.3/1.6*	12.5*	254*
24	2	-	4x2.5mm <sup>2</sup>	12	2.5	N/A	2.3/1.6*	12.5*	258*
48	4	-	2x2.5mm <sup>2</sup>	12	2.5	N/A	2.3/1.6*	12.5*	199*
48	4	-	4x2.5mm <sup>2</sup>	12	2.2	4.8*	2.3/1.6*	14.8*	297*

\*:Tolerance is ±10%.

Mechanical and Environmental Properties			
Physical tests	Conditions	Requirement	Standard
Tensile Strength	1900 N (during Installation) 890 N (during Operation)	No fiber break	IEC 60794-1-E1
Impact Resistance	10J , 3 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	200 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

STANDARD SM FIBER ITU-T G 652 D	
PROPERTIES	SPECIFIED VALUES
Attenuation (max)	0.40 dB/km (1310 nm)
	0.25 dB/km (1550 nm)
MFD	9.2±0.4 µm (1310 nm)
	10.4±0.5 µm (1550 nm)
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm )
	18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±0.3µm
Core/Clad Concentricity error	≤ 0.5 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	≥ 1% (100kpsi or 0.7GPa)

**NOTE (If any):**



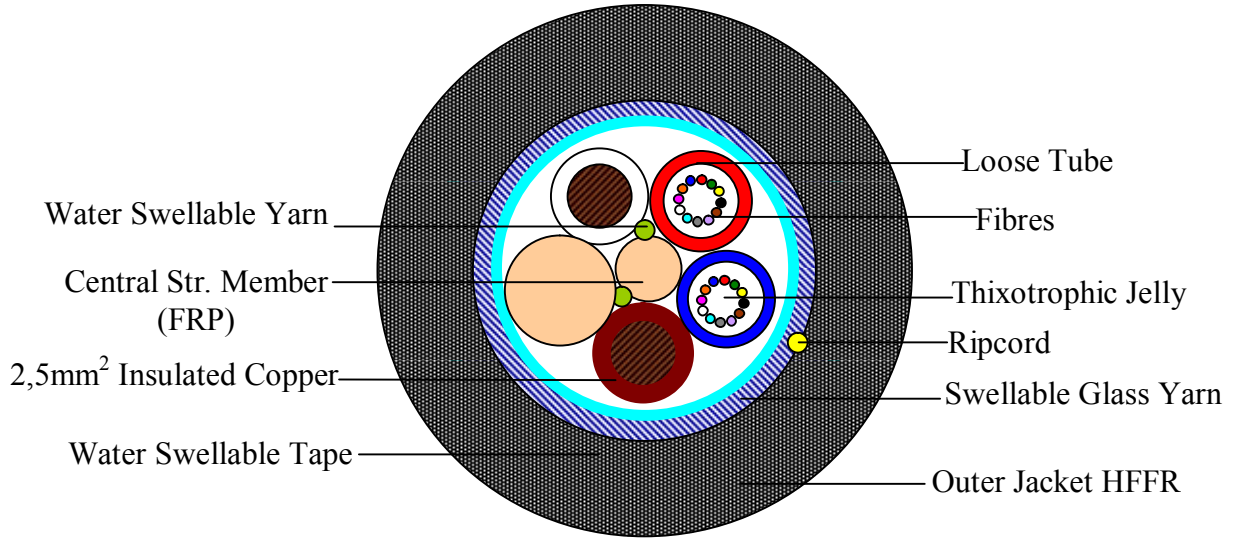
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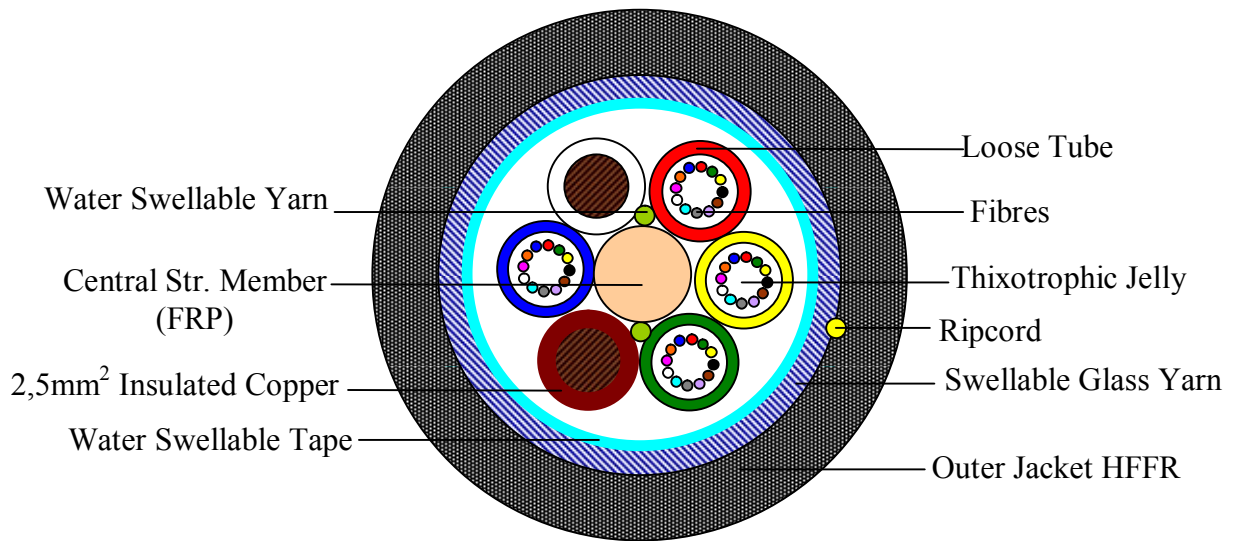
<http://www.hes.com.tr>

FCSMXXXMLT9901

*24FO(2x12) + 2x2.5Cu Cable Cross Section*



*48FO(4x12) + 2x2.5Cu Cable Cross Section*





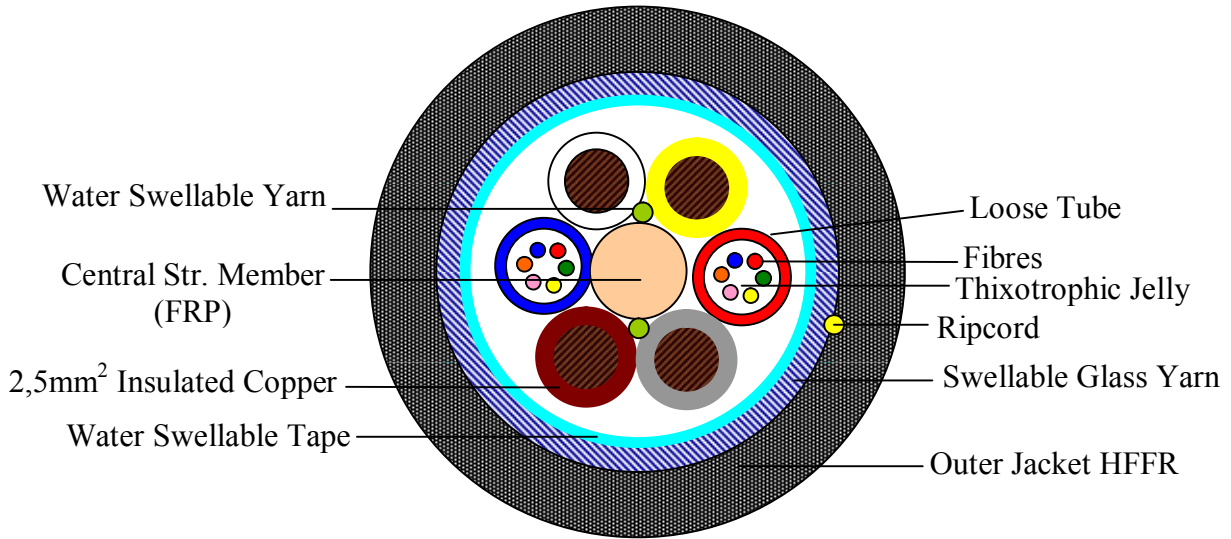
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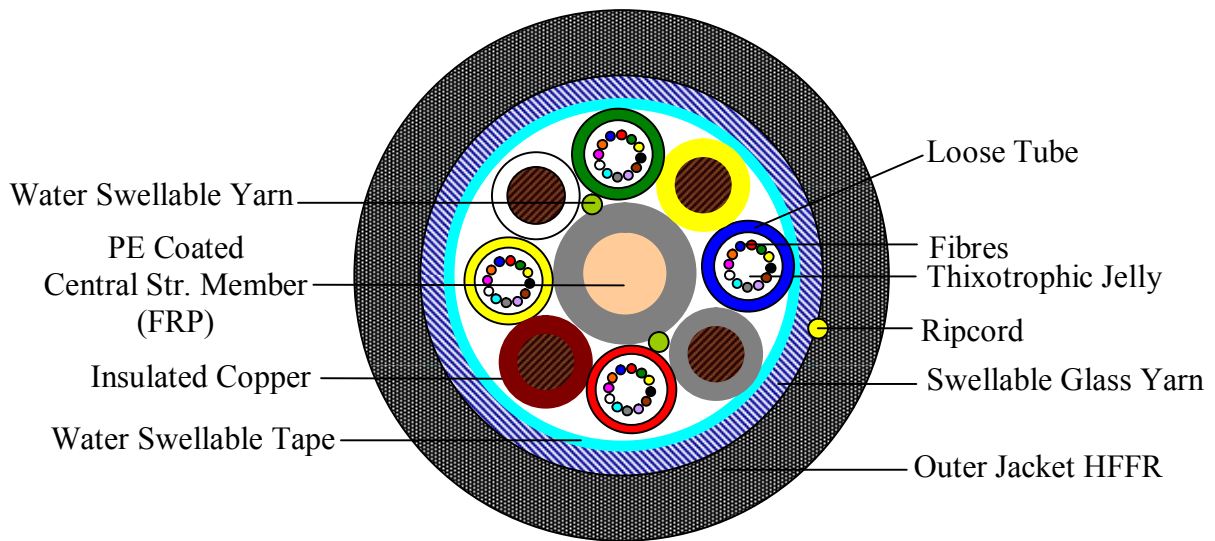
<http://www.hes.com.tr>

FCSMXXXMLT9901

*24FO(2x12) + 4x2.5Cu Cable Cross Section*



*48FO(4x12) + 4x2.5Cu Cable Cross Section*







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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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FCSMXXXMLT9901

## Technical Specification

<b>Revision/Date:</b> 03/02.17	<b>By</b> S. AKKAŞ	<b>Date</b> : 8 February 2017
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Cable Type : Loose Tube, Outdoor Hybrid F/O Cable  
HES Cable Product Number : FCSMXXXMLT9901

### PHYSICAL DESCRIPTION

- 24-48 fibers outdoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and copper cables are SZ stranded around the non- metallic central strength member (FRP),
- Dry core design,
- Water swellable tape as core wrap,
- Swellable glass yarn as strength member,
- Outer jacket is made of HFFR compound,
- Ripcord is inserted for easy jackets removal.

Type of fiber	SM G652 D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	Red, Yellow, Green, Blue
Color of copper cables	White, Yellow, Slate, Brown
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling	Water swellable yarn
Ripcord	Polyester cord
Tape wrap	Water swellable tape
Strength elements	Swellable glass yarns
Identification tape marking	As a customer request
Inner jacket	-
Outer jacket	Black HFFR, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Copper Cable	2x2.5mm <sup>2</sup> (0,7mm PVC insulated thickness) 4x2.5mm <sup>2</sup> (0,7mm PVC insulated thickness)
Reel length	2000±5% <sub>m</sub>



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Fiber Count	Number of Tube	Number of Filler	Copper Cables	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weighth (kg/km)
24	2	1	2x2.5mm <sup>2</sup>	12	2.5	N/A	2.3/1.6*	12.0*	184*
24	2	-	4x2.5mm <sup>2</sup>	12	2.5	N/A	2.3/1.6*	12.5*	254*
48	4	-	2x2.5mm <sup>2</sup>	12	2.5	N/A	2.3/1.6*	12.5*	199*
48	4	-	4x2.5mm <sup>2</sup>	12	2.2	4.8*	2.3/1.6*	14.8*	297*

\*:Tolerance is ±10%.

Mechanical and Environmental Properties			
Physical tests	Conditions	Requirement	Standard
Tensile Strength	1900 N (during Installation) 890 N (during Operation)	No fiber break	IEC 60794-1-E1
Impact Resistance	10J , 3 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	200 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	20x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

STANDARD SM FIBER ITU-T G 652 D	
PROPERTIES	SPECIFIED VALUES
Attenuation (max)	0.40 dB/km (1310 nm)
	0.25 dB/km (1550 nm)
MFD	9.2±0.4 µm (1310 nm)
	10.4±0.5 µm (1550 nm)
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm )
	18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±0.3µm
Core/Clad Concentricity error	≤ 0.5 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	≥ 1% (100kpsi or 0.7GPa)

**NOTE (If any):**



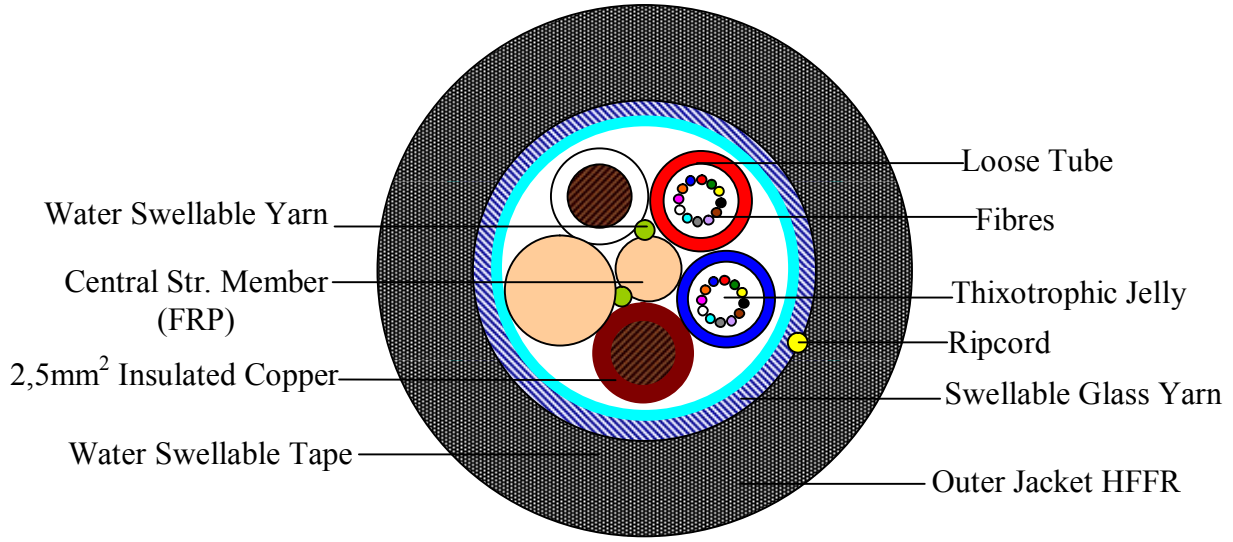
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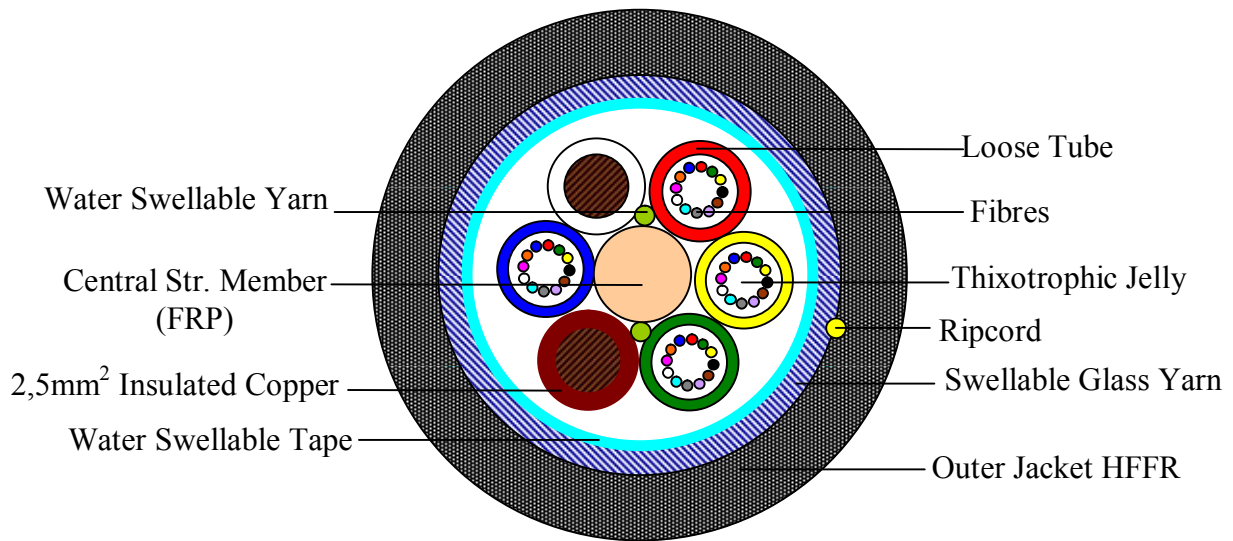
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FCSMXXXMLT9901

*24FO(2x12) + 2x2.5Cu Cable Cross Section*



*48FO(4x12) + 2x2.5Cu Cable Cross Section*





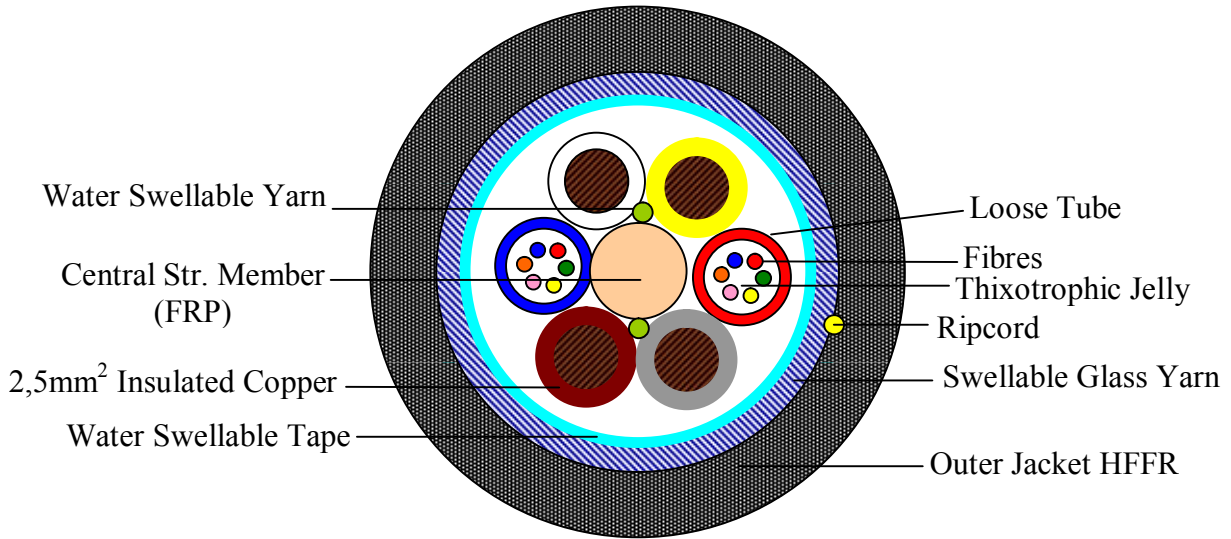
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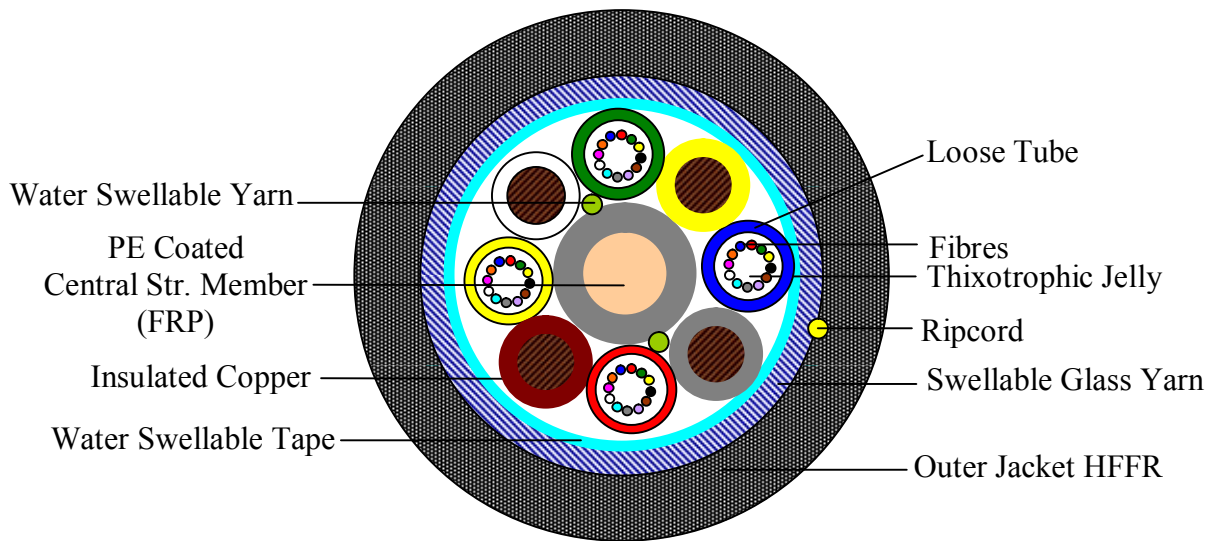
<http://www.hes.com.tr>

FCSMXXXMLT9901

*24FO(2x12) + 4x2.5Cu Cable Cross Section*



*48FO(4x12) + 4x2.5Cu Cable Cross Section*





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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

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FOSMXXXF80902

## Technical Specification

<b>Revision/Date:</b> 01/02.17	<b>By</b> S. AKKAŞ	<b>Date</b> : 17 February 2017
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Cable Type : Loose Tube, Outdoor Aerial (Fig8) F/O Cable  
HES Cable Product Number : FOSMXXXF80902 (XXX: number of fiber)

### PHYSICAL DESCRIPTION

- 24-48-72 fibers outdoor aerial figure 8 fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Dry-core design,
- Aramid yarn as strength member,
- Outer jacket is made of medium density polyethylene,
- Ripcord is inserted for easy jackets removal.

Fiber Type	ITU-T G 652D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First Tube: Red; Last Tube: Blue; Intermediate Tubes:Natural
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling compound	Water blocking yarns and tape
Ripcord	Polyester cord
Tape wrap	Water blocking tape
Strength elements	Swellable aramid yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	Black HDPE, thickness nominal 2.2±0.1 mm.
Web	Height: 2.5±1 mm Width: 2.5±1 mm
Messenger Wire	Steel; 7x1.0 mm
Surface marking	As a customer request
Reel length	2030±5% m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Dimensions (mm)	Cable Weigh (kg/km)
24	6	-	4	2.5	N/A	2.30/1.65*	13.2/23.2*	235*
48	4	2	12	2.7	N/A	2.50/1.70*	13.8/23.8*	248*
72	6	-	12	2.7	N/A	2.50/1.70*	13.8/23.8*	251*

\*:Tolerance is ±5%.



<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	7 kN	Maximum loss:0.05 dB	IEC 60794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	250 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 60794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 µm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1µm
Core/Clad Concentricity error (max)	1 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**



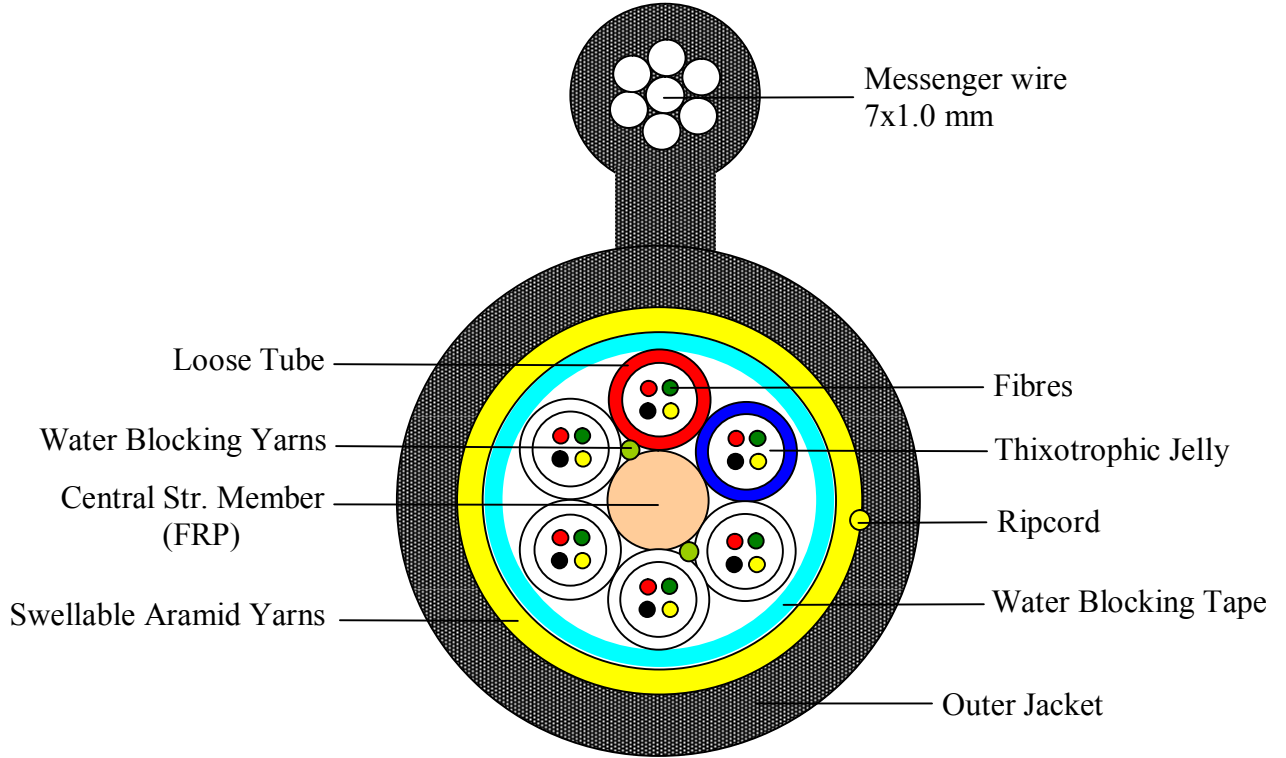
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FOSMXXXF80902

*Cable Cross Section*





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FOSMXXXF80902

## Technical Specification

<b>Revision/Date:</b> 01/02.17	<b>By</b> S. AKKAŞ	<b>Date</b> : 17 February 2017
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Cable Type : Loose Tube, Outdoor Aerial (Fig8) F/O Cable  
HES Cable Product Number : FOSMXXXF80902 (XXX: number of fiber)

<b>PHYSICAL DESCRIPTION</b>	
–	24-48-72 fibers outdoor aerial figure 8 fiber optic cable,
–	Thixotropic jelly filled loose tubes,
–	Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
–	Dry-core design,
–	Aramid yarn as strength member,
–	Outer jacket is made of medium density polyethylene,
–	Ripcord is inserted for easy jackets removal.

Fiber Type	ITU-T G 652D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First Tube: Red; Last Tube: Blue; Intermediate Tubes:Natural
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling compound	Water blocking yarns and tape
Ripcord	Polyester cord
Tape wrap	Water blocking tape
Strength elements	Swellable aramid yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	Black HDPE, thickness nominal 2.2±0.1 mm.
Web	Height: 2.5±1 mm Width: 2.5±1 mm
Messenger Wire	Steel; 7x1.0 mm
Surface marking	As a customer request
Reel length	2030±5% m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Dimensions (mm)	Cable Weigh (kg/km)
24	6	-	4	2.5	N/A	2.30/1.65*	13.2/23.2*	235*
48	4	2	12	2.7	N/A	2.50/1.70*	13.8/23.8*	248*
72	6	-	12	2.7	N/A	2.50/1.70*	13.8/23.8*	251*

\*:Tolerance is ±5%.





<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	7 kN	Maximum loss:0.05 dB	IEC 60794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	250 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-30 to +70 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 60794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 µm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1µm
Core/Clad Concentricity error (max)	1 µm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 µm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**



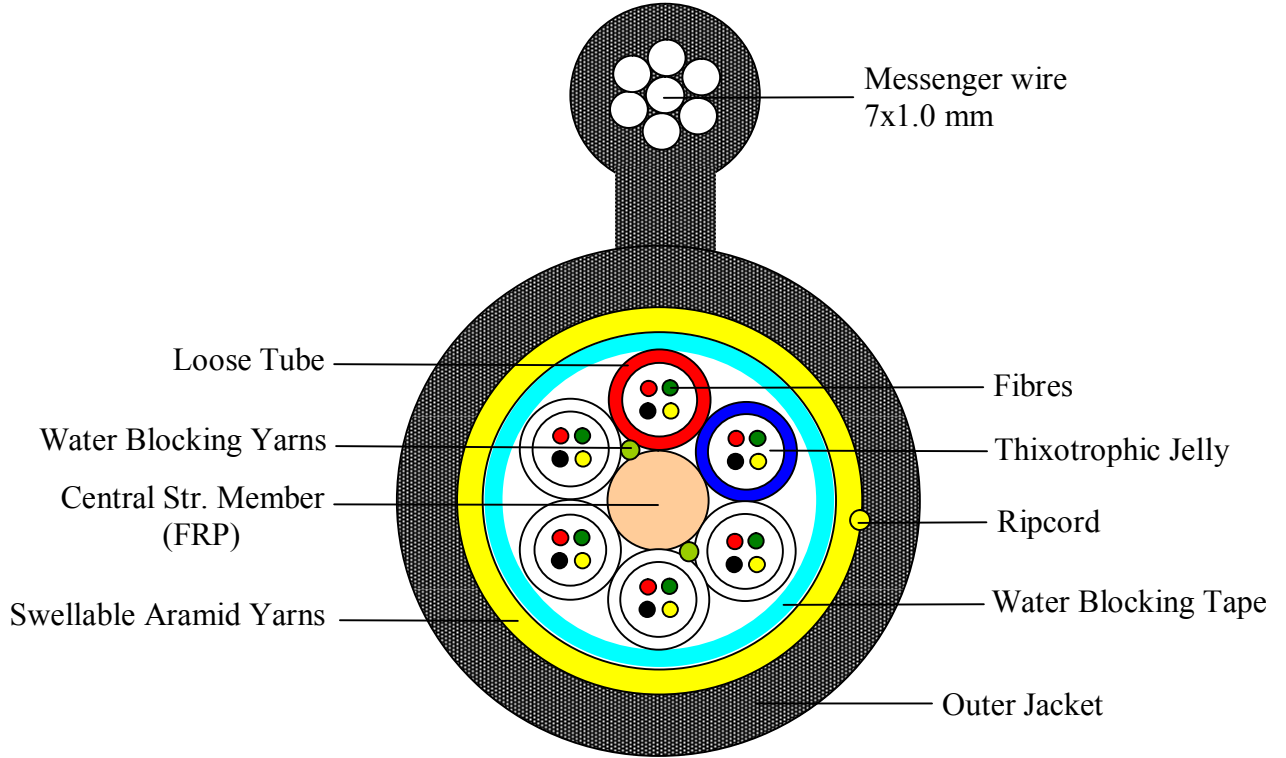
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FOSMXXXF80902

*Cable Cross Section*





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# HES HACILAR ELEKTRİK SANAYİ VE TİC.A.Ş.

<http://www.hes.com.tr>

FOSMXXXI0901

## Technical Specification

Revision/Date: 02/02.17	By : S. AKKAŞ	Date : 17 February 2017
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Cable Type : Loose Tube, Indoor F/O Cable  
HES Cable Product Number : FOSMXXXI0901 (XXX: number of fiber)

### PHYSICAL DESCRIPTION

- 24-72-144 fibers indoor fiber optic cable,
- Thixotropic jelly filled loose tubes,
- Loose tubes and filler (if any) are SZ stranded around the non- metallic central strength member (FRP),
- Polyester tape as core wrap,
- Aramid yarn as strength member,
- Outer jacket is made of halogen-free flame retardant compound,
- Ripcord is inserted for easy jackets removal.

Fiber Type	ITU-T G 652D
Central strength member	All-dielectric FRP
Tube material	PBT ( Polybutylene Terephthalate)
Color of loose tubes	First Tube: Red; Last Tube: Blue; Intermediate Tubes:Natural
Color of fibers in per tube	Red, Green, Yellow, Black, Brown, Violet, Gray, Sky-blue, White, Pink, Orange, Blue
Tube filling compound	Thixotropic jelly
Core filling compound	-
Ripcord	Polyester cord
Tape wrap	Polyester tape
Strength elements	Aramid yarns
Identification tape marking	As a customer request
Inner jacket	No inner jacket
Armor	No armor
Outer jacket	<b>Yellow</b> HFFR, thickness nominal 1.8±0.1 mm.
Surface marking	As a customer request
Reel length	2000±5% m

Fiber Count	Number of Tube	Number of Filler	Number of fiber in per tube	Central Strength Member OD (mm)	Central strength member coated OD (mm)	Tube Outer/Inner Diameter (mm)	Cable Diameter (mm)	Cable Weigth (kg/km)
24	6	-	4	2.2	2.2/2.4	2.20/1.50*	10.9*	121*
72	6	-	12	2.2	2.2/2.4	2.20/1.50*	10.9*	123*
144	12	-	12	2.2	2.2/6.5	2.20/1.50*	15.0*	216*

\*:Tolerance is ±5%.



<b>Mechanical and Environmental Properties</b>			
<b>Physical tests</b>	<b>Conditions</b>	<b>Requirement</b>	<b>Standard</b>
Tensile Strength	1200 N (during Installation) 890 N (during Operation)	Maximum loss:0.05 dB	IEC 60794-1-E1
Impact Resistance	5 impacts	No fiber break	IEC 60794-1-E4
Crush Resistance	150 N/cm	No fiber break	IEC 60794-1-E3
Temperature Cycling	-10 to +60 °C	Maximum loss:0.05 dB	IEC 60794-1-F1
Bend Radius (during installation)	15x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Bend Radius (during Service)	10x cable diameter	Maximum loss:0.05 dB	IEC 60794-1-E11
Repeating Bending	20xcable diameter between	Maximum loss:0.05 dB	IEC 60794-1-E6
Water Penetration	3 m length in 24 hour	No water leak	IEC 60794-1-F5
Reel Marking	As a customer request		
Metal Plate at drum	As a customer request		

<b>STANDARD SM FIBER ITU-T G 652D</b>	
<b>PROPERTIES</b>	<b>SPECIFIED VALUES</b>
Attenuation (max)	0.40 dB/km (1310 nm) 0.25 dB/km (1550 nm)
MFD	9.2±0.5 μm
Chromatic Dispersion (max)	3.5 ps/(nmxkm)(1310 nm ) 18 ps/(nmxkm)(1550 nm )
Cladding diameter	125±1 μm
Core/Clad Concentricity error (max)	1 μm
Zero dispersion wavelength	1300nm≤ ≤1324nm
Cladding non-circularity (max)	%2
Coating diameter	245±10 μm
Cut Off Wavelength	≤1260nm
Proof Test	8.4 N
Proof Test strain	%1.00

**NOTE (If any):**



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FOSMXXXI0901

**24 fibers Cable Cross Section**

