

SPEC No.: 10-13024

REVISION: 1.1



TECHNICAL SPECIFICATION

FOR

Optical Fiber Overhead Ground Wire (OPGW)

Designer

符晓卫

Technical Manager of ZTT
Global Market

Approver

Chief Technical Engineer of ZTT
Global Market

 ÕHENDANE ENERGIAD	Seotud projektiga: 330/110 kV Tartu-Sindi õhuliini ehitus, II ehitusetapp, Oiu - Viljandi
	Joonise nimi: OPGW tehnlaine kirjeldus Joonise number: Sidus L.Jürjan 26.11.12

1. SCOPE

This specification covers the general requirements and performance of OPGW offered by ZTT, including optical, electrical, mechanical and geometrical characteristics.

2. REFERENCES

The OPGW offered by ZTT shall be designed, manufactured and tested according to international standards as follows:

ISO 9001	Quality Management Systems
ISO 14001	Environmental Management Systems
IEEE Std 1138	IEEE standard construction of composite fiber optic overhead ground wires (OPGW) for use on electric utility power lines
IEC 60793-1	Optical fiber Part 1: Generic specifications
IEC 60793-2	Optical fiber Part 2: Product specifications
IEC 60794-4	Optical fiber cables – Part 4: Sectional specification – Aerial optical cables along electrical power lines
IEC 60104	Aluminum magnesium-silicon alloy wire for over-head line conductors
IEC 61232	Aluminum – clad steel wire for electrical purposes
IEC 60888	Zinc-coated wire for stranded conducts
IEC 60889	Hard-drawn aluminum wire for overhead line conductors
IEC 60114	Recommendation for heat-treated aluminum alloy bus bar material of the aluminum-magnesium-silicon type
IEC 61089	Round wire concentric lay overhead electrical stranded conductors
IEC 61395	Overhead electrical conductors – Creep test procedures for stranded conductors
IEC 61396	Electrical, mechanical and physical requirements and test methods of optical ground wire (OPGW)
EIA/TIA 598	Color code of fiber optic cables
ITU-T G.650	Definition and test methods for the relevant parameters of single-mode fibers
ITU-T G.652	Characteristics of a single-mode optical fiber cable
ITU-T G.655	Characteristics of a non-zero dispersion shifted single-mode optical fiber cable

3. OPTICAL FIBER: Type G. 652

The optical fiber shall be made of high pure silica and germanium doped silica. UV curable acrylate material is applied over fiber cladding as optical fiber primary protective coating. The detailed data of optical fiber performance are shown in the following table:

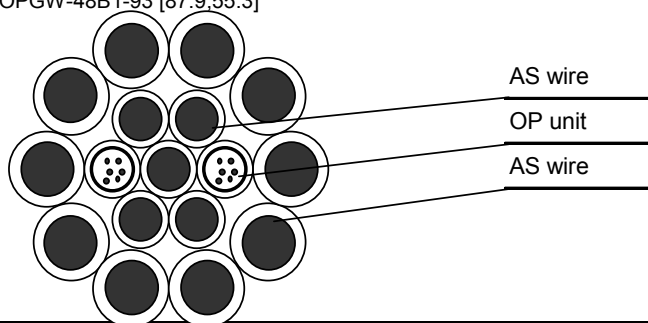
ZTT G.652D Fiber

Category	Description	Specifications	
		Before cabling	After cabling
Optical Specifications	Attenuation @1310 nm	≤ 0.34 dB/km (max.)	≤ 0.36 dB/km (max.)
	Attenuation @1383 $\pm$ 3 nm	≤ 0.32 dB/km(max.)	≤ 0.35 dB/km(max.)
	Attenuation @1550 nm	≤ 0.20 dB/km (max.)	≤ 0.22 dB/km (max.)
	Attenuation @1625 nm	≤ 0.23 dB/km	≤ 0.25 dB/km
	Zero Dispersion Wavelength	1300~1324 nm	
	Zero Dispersion Slope	≤ 0.092 ps/nm ² ·km	
	PMD Link value (M=20cables Q=0.01%) maximum PMD _Q	0.1 ps/ $\sqrt$ km	
	Cable Cutoff Wavelength (λ_{cc})	≤ 1260 nm	
	Macro bending Loss (100 turns; $\Phi 50$ mm) @1550 nm (100 turns; $\Phi 50$ mm) @1625 nm	≤ 0.05 dB ≤ 0.10 dB	
	Mode Field Diameter @1310 nm	9.2 $\pm$ 0.4 μ m	
Dimensional Specifications	Cladding Diameter	125 $\pm$ 0.7 μ m	
	Core/clad concentricity error	$\leq 0.5\mu$ m	
	Cladding Non-Circularity	$\leq 1.0\%$	
Mechanical Specifications	Proof stress	≥ 0.69 Gpa	

4. CONSTRUCTURE AND SPECIFICATIONS FOR OPGW

 ZhongTian		Serial No:	ZTT201013024
	OPGW Cable Specifications	Bid No:	OPGW

Cable Type: OPGW - 2S 2/48B1 (0/93 -55.3)
Industry standard: OPGW-48B1-93 [87.9;55.3]
Cross Section:



Structure		Material	No	Material	No.	Material Dia.	
	Fiber	G.652	48	G.655	0		
	Center	20.3%ASwire	1			Diameter	2.40 mm
	Layer1	20.3%ASwire	4	AA wire	0	Diameter	2.40 mm
		SUS Tube	2	Fibers(all tube)	48	Tube-Dia.	2.40 mm
	Layer2	30%ASwire	10	AA wire	0	Diameter	3.00 mm

Technical Data	according to IEC, IEEE standards		
	Stranded:core and layer1 greased		
	stranding direction of outer layer is right hand(Z-stranding)		
	Cable Diameter	13.20 mm	
	Cable Weight	595 kg/km	
	Supporting Cross Section	93.3 mm ²	
	Section of AS Wire	93.31 mm ²	
	Section of AA Wire	0.00 mm ²	
	Rated Tensile Strength (RTS)	87.9 kN	
	Modulus of Elasticity (E-Modulus)	139.3 kN/mm ²	
	Thermal Elongation Coefficient	13.6 ×10 ⁻⁶ /℃	
	Permissible Maximum Working Stress (40% RTS)	376.8 N/mm ²	
	Everyday Stress (EDS) (16%~25% RTS)	150.7	~235.5 N/mm ²
	Ultimate Exceptional Stress (70% RTS)	659.4 N/mm ²	
	DC Resistance	0.680 Ω/km	
	Short Time Current (1s, 20℃~180℃)	7.43 kA	
	Short Time Current Capacity I ² t	55.3 kA ² S	
	Minimum Bending Radiu Installation:	264 mm	
	Operating:	198 mm	
	Ratio between Pull and Weight	15.1 km	
Temperature Range:	Installation	-10℃ ~ +50℃	
	Transportation and Operation	-40℃ ~ +80℃	

Remarks: All Sizes and Values are Nominal Values

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5. COLOR IDENTIFICATION OF FIBER IN OPGW

5.1 Color code of fiber in OPGW shall be identified referring to the following table:

Typical number of fiber: 48

Tube 1: 24 Fibers

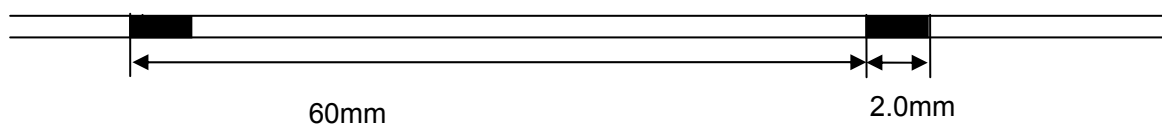
Remark	Fiber No. & Color					
Without Color Ring	1	2	3	4	5	6
	Blue	Orange	Green	Brown	Gray	White
	7	8	9	10	11	12
	Red	Black	Yellow	Violet	Pink	Aqua
With S60 Color Ring	13	14	15	16	17	18
	Blue	Orange	Green	Brown	Gray	White
	19	20	21	22	23	24
	Red	Nature	Yellow	Violet	Pink	Aqua
Remark: The black color with color ring is changed into nature color.						

Tube 2: 24 Fibers

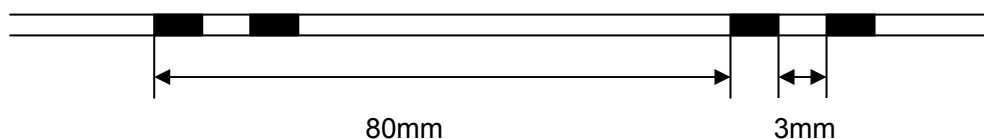
Remark	Fiber No. & Color					
Without Color Ring	25	26	27	28	29	30
	Blue	Orange	Green	Brown	Gray	White
	31	32	33	34	35	36
	Red	Black	Yellow	Violet	Pink	Aqua
With D80 Color Ring	37	38	39	40	41	42
	Blue	Orange	Green	Brown	Gray	White
	43	44	45	46	47	48
	Red	Nature	Yellow	Violet	Pink	Aqua
Remark: The black color with color ring is changed into nature color.						

Color ring method:

S60: Use single black color ring on the fiber surface with 60mm alternation:



D80: Use double black color ring on the fiber surface with 80mm alternation:



6. TEST REQUIREMENTS FOR OPGW

6.1 General

There are different test series to assure the quality of OPGW:

- Routine test (in-process testing according to internal quality plan)
- Factory acceptance test (FAT, witnessed by customer)
- Type test (only in case of a basic new design, repetition in exceptional cases)

OPGW tests shall be in accordance with applicable standards or agreements between purchaser and manufacturer.

Type test

Type test may be waived by submitting maker's certificate of the similar product performed in an internationally acknowledged independent test organization or laboratory. If type test should be performed, it will be carried out according to an extra type test procedure reached to an agreement between purchaser and manufacturer.

Routine test

The optical attenuation coefficient on all production cable lengths is measured according to IEC 60793-1-C1C (Back-scattering technique, OTDR). Standard single-mode fibers are measured at 1310nm and at 1550nm. Non-zero dispersion shifted single-mode (NZDS) fibers are measured at 1550nm.

Factory test

Factory acceptance test is carried out on two samples per order in the presence of the customer or his representative. The requirements for quality characteristics are determined by relevant standards and agreed quality plans.

6.2 Test items

The following table shows that the test items shall be carried out according to corresponding references.

Test on fibers

No	Item	Reference
1	Attenuation coefficient	IEC 60793-1-40
2	Chromatic dispersion	IEC 60793-1-42
3	Mode field diameter	IEC 60793-1-45
4	Cladding diameter	IEC 60793-1-20
5	Cladding non-circularity	IEC 60793-1-20
6	Core/clad concentricity error	IEC 60793-1-20
7	Cable cutoff wavelength	IEC 60793-1-44

Test on Aluminum alloy wire before standing

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No	Item	Reference
1	Quality o appearance	IEC 60104
2	Diameter	IEC 60104
3	Tensile and elongation test	IEC 60104
4	Wrapping test	IEC 60104
5	Resistivity	IEC 60104

Test on Aluminum clad steel wire before standing

No	Item	Reference
1	Quality o appearance	IEC 61232
2	Diameter	IEC 61232
3	Tensile stress test	IEC 61232
4	Elongation test	IEC 61232
5	Torsion test	IEC 61232
6	Resistivity	IEC 61232
7	Minimum aluminum thickness	IEC 61232
8	Stress at 1% extension	IEC 61232

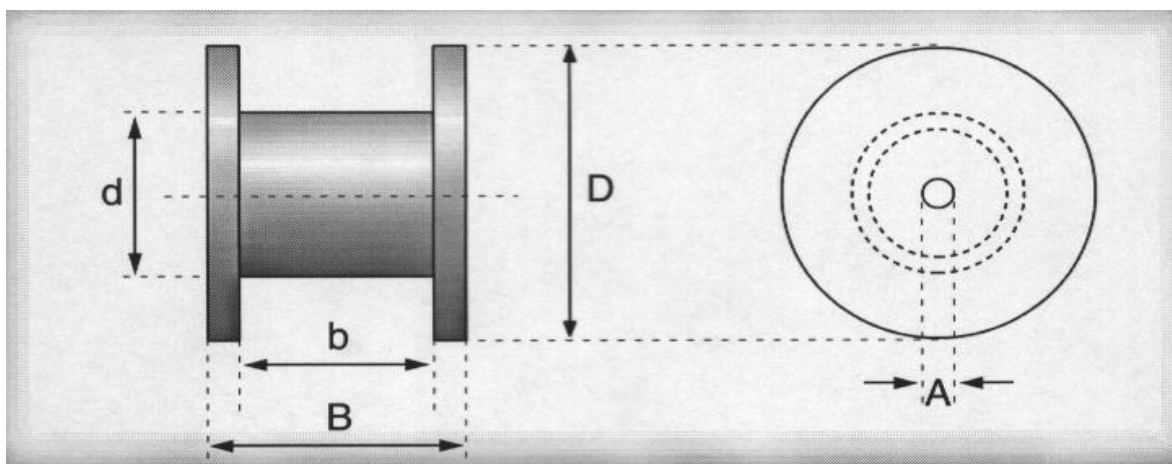
Test on finished OPGW

No	Item	Reference
1	Tensile Test	IEC-60794-4-10
2	Stress-strain test	IEC-60794-4-10
3	Crush test	IEC-60794-4-10
4	Impact test	IEC-60794-4-10
5	Temperature cycling test	IEC-60794-4-10
6	Water penetration test	IEC-60794-4-10
7	Drip test	IEC-60794-4-10
8	Sheave test	IEC-60794-4-10
9	Short circuit test	IEC-60794-4-10
10	Lightning test	IEC-60794-4-10
11	Aeolian vibration test	IEC-60794-4-10
12	Galloping test	IEC-60794-4-10
13	Creep test	IEC-60794-4-10

Note: the above-mentioned items 9-13 (bold font) which are considered as type tests will not be included in factory test report. Other items of completed OPGW can be tested and inspected in our factory.

7. PACKING AND DRUM FOR OPGW

OPGW shall be wound on a non-returnable wooden drum or iron-wooden drum. Both ends of OPGW shall be securely fastened to drum and sealed with a shrinkable cap. The required marking shall be printed with a weather-proof material on the outsides of drum according to customer's requirement.



Cable Diameter (mm)	Drum Length (m)	Drum Dimensions & Weights					
		D cm	b cm	B cm	d cm	A cm	weight kg
9.0-9.5	2000	120	90	110	80	11	200
	3000	120	90	110	80	11	200
	4000	120	90	110	80	11	200
	5000	130	90	110	80	11	210
9.5-10.0	2000	120	90	110	80	11	200
	3000	120	90	110	80	11	200
	4000	130	90	110	80	11	210
	5000	130	90	110	80	11	210
10.5-11.0	2000	120	90	110	80	11	200
	3000	120	90	110	80	11	200
	4000	130	90	110	80	11	210
	5000	140	90	110	80	11	220
11.5-12.0	2000	120	90	110	80	11	200
	3000	130	90	110	80	11	210
	4000	130	90	110	80	11	210
	5000	140	90	110	80	11	220

12.0-12.5	2000	120	90	110	80	11	200
	3000	130	90	110	80	11	210
	4000	140	90	110	80	11	220
	5000	150	90	110	80	11	230
12.5-13.0	2000	120	90	110	80	11	200
	3000	130	90	110	80	11	210
	4000	140	90	110	80	11	220
	5000	150	90	110	80	11	230
13.0-14.5	2000	130	90	110	80	11	210
	3000	140	90	110	80	11	220
	4000	150	90	110	80	11	230
	5000	160	90	110	80	11	250
14.5-15.0	2000	130	90	110	80	11	210
	3000	140	90	110	80	11	220
	4000	150	90	110	80	11	230
	5000	160	90	110	80	11	250
15.0-15.5	2000	130	90	110	80	11	210
	3000	140	90	110	80	11	220
	4000	150	90	110	80	11	230
	5000	160	90	110	80	11	250
15.5-16.0	2000	130	90	110	80	11	210
	3000	150	90	110	80	11	230
	4000	160	90	110	80	11	250
	5000	180	96	120	90	11	400
16.0-16.5	2000	130	90	120	80	11	210
	3000	150	90	120	80	11	230
	4000	160	90	120	80	11	250
	5000	180	96	120	90	11	400
16.5-17.0	2000	140	90	120	80	11	220
	3000	150	90	120	80	11	230
	4000	180	96	120	90	11	400
	5000	180	96	120	90	11	400

17.0-17.5	2000	140	90	120	80	11	220
	3000	150	90	120	80	11	230
	4000	180	96	120	90	11	400
	5000	180	96	120	90	11	400
17.5-18.0	2000	140	90	120	80	11	220
	3000	160	90	120	80	11	250
	4000	180	96	120	90	11	400
	5000	200	96	120	90	11	550
18.0-18.5	2000	140	90	120	80	11	220
	3000	160	90	120	80	11	250
	4000	180	96	120	90	11	400
	5000	200	96	120	90	11	550
18.5-19.0	2000	140	90	120	80	11	220
	3000	160	90	120	80	11	250
	4000	180	96	120	90	11	400
	5000	200	96	120	90	11	550
19.0-19.5	2000	150	90	120	80	11	230
	3000	180	96	120	90	11	400
	4000	180	96	120	90	11	400
	5000	200	96	120	90	11	550

Note: The value "D" don't contain the dimension of seal.