

1.GENERAL

1.1 SCOPE

This specification covers Optical Ground Wire Cables (OPGW) for the installation on high voltage overhead power lines. The cable contains optical fibers for data transmission and telecom purposes and is installed instead of a ground wire.

The specification describes the basic design of an OPGW-cable with its main components: the fibers, the optical fiber unit and the cable armoring. Furthermore this specification contains information concerning the quality assurance during manufacturing, the final acceptance tests, the type tests and the packaging. Any technical data mentioned in this product specification serve for describing the product only and should not be understood as an assurance of properties.

1.2 Cable Description

Cable which has the dual performance functions of a conventional ground wire with telecommunication capabilities.

1.3 Quality

KEYSTONE ensures a continuing level of quality in our cable products through several quality control programs including ISO 9001.

1.4 Reliability

KEYSTONE ensures product reliability through rigorous qualification testing of each product family. Both initial and periodic qualification testing are performed to assure the cable's performance and durability in the field environments.

1.5 Reference

The cable which KEYSTONE offered are designed, manufactured and tested according to international standards as follows:

IEC 60793-1	Optical fiber Part 1: Generic specifications
IEC 60793-2	Optical fiber Part 2: Product specifications
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 and cable
EIA/TIA 598 B	Color code of fiber optic cables
IEC 60794-4-10	Aerial optical cables along electrical power lines – Family specification for OPGW
IEC 60794-1-2	Optical fiber cables-Part 1-2: Generic specification-Basic optical cable test procedures
IEEE1138-2009	IEEE Standard for testing and performance for optical ground wire (OPGW) for use on electric utility power lines
IEC 61232	Aluminum – clad steel wire for electrical purposes
IEC 60104	Aluminum magnesium-silicon alloy wire for overhead line conductors
IEC 61089	Round wire concentric lay overhead electrical stranded conductors

2. OPTICAL FIBER SPECIFICATION-Corning SMF-28e

Fiber Attenuation

Maximum Attenuation

Wavelength (nm)	Maximum Value* (dB/km)
1310	0.33 – 0.35
1383**	0.31 – 0.35
1550	0.19 – 0.20
1625	0.20 – 0.23

*Maximum specified attenuation value available within the stated ranges.

**Attenuation values at this wavelength represent post-hydrogen aging performance.

Alternate attenuation offerings available upon request.

Attenuation vs. Wavelength

Range (nm)	Ref. λ (nm)	Max. α Difference (dB/km)
1285 – 1330	1310	0.03
1525 – 1575	1550	0.02

The attenuation in a given wavelength range does not exceed the attenuation of the reference wavelength (λ_r) by more than the value α .

Macrobend Loss

Mandrel Diameter (mm)	Number of Turns	Wavelength (nm)	Induced Attenuation* (dB)
32	1	1550	≤ 0.05
50	100	1310	≤ 0.05
50	100	1550	≤ 0.05
60	100	1625	≤ 0.05

*The induced attenuation due to fiber wrapped around a mandrel of a specified diameter.

Point Discontinuity

Wavelength (nm)	Point Discontinuity (dB)
1310	≤ 0.05
1550	≤ 0.05

Cable Cutoff Wavelength (λ_{ccf})

$\lambda_{ccf} \leq 1260$ nm

Mode-Field Diameter

Wavelength (nm)	MFD (μ m)
1310	9.2 ± 0.4
1550	10.4 ± 0.5

Dispersion

Wavelength (nm)	Dispersion Value [ps/(nm \cdot km)]
1550	≤ 18.0
1625	≤ 22.0

Zero Dispersion Wavelength (λ_0): 1302 nm $\leq \lambda_0 \leq 1322$ nm

Zero Dispersion Slope (S_0): ≤ 0.089 ps/(nm \cdot km)

Polarization Mode Dispersion (PMD)

	Value (ps/ \sqrt km)
PMD Link Design Value	$\leq 0.06^*$
Maximum Individual Fiber	≤ 0.2

*Complies with IEC 60794-3: 2001, Section 5.5, Method 1, (m = 20, Q = 0.01%), September 2001.

The PMD link design value is a term used to describe the PMD of concatenated lengths of fiber (also known as PMD_Q). This value represents a statistical upper limit for total link PMD. Individual PMD values may change when fiber is cabled. Corning's fiber specification supports network design requirements for a 0.20 ps/ \sqrt km maximum PMD.

Dimensional Specifications

Glass Geometry

Fiber Curl	≥ 4.0 m radius of curvature
Cladding Diameter	125.0 ± 0.7 μ m
Core-Clad Concentricity	≤ 0.5 μ m
Cladding Non-Circularity	$\leq 0.7\%$

Coating Geometry

Coating Diameter	245 ± 5 μ m
Coating-Cladding Concentricity	< 12 μ m

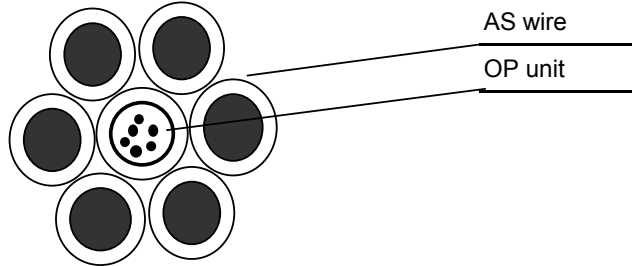
Environmental Specifications

Environmental Test	Test Condition	Induced Attenuation
		1310 nm, 1550 nm & 1625 nm (dB/km)
Temperature Dependence	-60°C to +85°C*	≤ 0.05
Temperature Humidity Cycling	-10°C to +85°C* up to 98% RH	≤ 0.05
Water Immersion	23 \pm 2°C	≤ 0.05
Heat Aging	85 \pm 2°C*	≤ 0.05
Damp Heat	85°C at 85% RH	≤ 0.05

*Reference temperature = +23°C

Operating Temperature Range: -60°C to +85°C

Cable Type: OPGW - 1C 1/24B1 (0/70 -31.2)
Industry standard: OPGW-24B1-70 [58.4;31.2]
Cross Section:



Structure	Name	No	Name	No	Material Dia.	
	Fiber	G.652	24			
Center	SUS Tube	1	Fibers	24	Tube-Dia.	3.80 mm
Layer1	30%ASwire	6			Diameter	3.85 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	11.50 mm
	Cable Weight	427 kg/km
	Supporting Cross Section	70 mm ²
	Section of AS Wire	69.85 mm ²
	Ultimate Tensile Strength (UTS)	61.5 kN
	Rated Tensile Strength (RTS)	58.4 kN
	Modulus of Elasticity (E-Modulus)	132.0 kN/mm ²
	Thermal Elongation Coefficient	13.8 ×10 ⁻⁶ /°C
	Permissible Maximum Working Stress (40% RTS)	334.4 N/mm ²
	Everyday Stress (EDS) (16%~25% RTS)	133.8 ~209 N/mm ²
	Ultimate Exceptional Stress (70% RTS)	585.2 N/mm ²
	DC Resistance	0.834 Ω/km
	Short Time Current (1s, 40°C~200°C)	5.58 kA
	Short Time Current Capacity I ² t	31.2 kA ² s
Minimum Bending Radiu Installation:	230 mm	
Operating:	172 mm	
Ratio between Pull and Weight	13.9 km	
Temperature Range:	Installation	-10°C ~ +50 °C
	Transportation and Operation	-40°C ~ +80 °C

Remarks: All Sizes and Values are Nominal Values

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

Typical number of fiber: 24

Remark	Fiber No. & Color					
	1	2	3	4	5	6
Without Color Ring	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.						

Color ring method:

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

