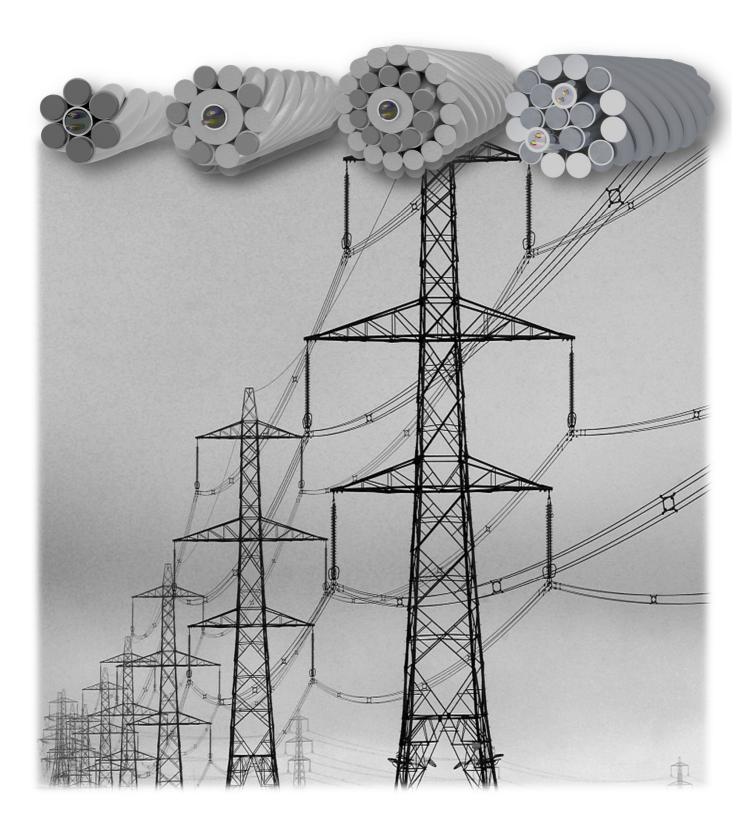


OPGW

Optic fiber Protection Overhead Ground Wire



Other Aluminium products:

AAC (All aluminium conductor)
AAAC (All aluminium alloy conductor)
AACSR (All aluminium alloy conductor steel reinforced)
ACSR (All aluminium alloy conductor steel reinforced)
Solid sector shaped aluminium conductor

Aluminium strip Aluminium wire Aluminium alloy wire







Specification:

NRS 061-1, IEC793, 794, ITU-T G 650,



Application:

OPGW Centre SUS tube single layer

OPGW conductor is strung on poles or structures in air, supporting its own weight. Grounding via Aluminium cladded steel and Aluminium alloy conductor, communication is done via optic fibres in stainless steel SUS tube.

Construction:

Centre wire: SUS tube or Al cladded SUS

1st layer: Aluminium cladded steel wires; Aluminium alloy wires; or combination of ACS & AA Wires











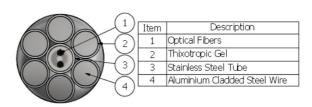


		VOY		W	W	W	0	0
			Constru	uction				
OPGW Size: short circuit rating	kA, 1sec	3.2	5	5	7	12.00	12.50	12.22
Tensile rating, RTS	kN	65	36	60	60	60	62	107
Fibres per SUS tube	number			1:	2, 24 or 48 fibr	es per SUS tub	oe.	
Number of SUS tubes	number	1	1	1	1	. 1	1	1
Fibre SUS tube outer diameter	mm	3.1	3.4	4.00	6.3	7.4	9.1	7.9
Aluminium in Al cladded SUS tube (where applicable).	mm²	0.0	0.0	0.0	18.0	29.8	51.8	35.8
			Aluminium (Clad Steel				
Number of wires	#	6	6	6	9	5	5	8
Wire diameter		3.1	3.5	4.0	3.15	3.3	3.4	3.5
Wire area	mm²	7.5	9.6	12.6	7.8	8.6	9.1	9.6
Total wire area nominal	mm²	45.3	57.7	75.4	70.1	42.8	45.4	77.0
Aluminium in ACS	mm²	19.5	32.4	32.4	30.2	18.4	13.2	33.1
Conductivity of wire @ 20 ℃	%	30	40	30	30	30	20.3	30
			Aluminiu	m Alloy				
Number of wires	#	-	-	-	-	5	6	2
Wire diameter	mm	-	-	-	-	3.3	3.4	3.5
Aluminium alloy area nom.	mm²	•	-	-	-	43	54	19
		Cond	ductor phys	ical properti	ies			
Diameter 1st layer	mm	9.3	10.4	12.0	12.6	14.0	15.9	14.9
Diameter 2nd layer	mm	-	-	-	-	-	-	-
Total weight nominal	kg/km	322	461	461	523	517	630	697
Total OPGW area (conductive components)	mm²	45	58	75	88	73	97	113
Final layer stranding direction	S/Z	S	Z	Z	Z	Z	Z	Z
* RTS (rated tensile strength)	kN	54	60	60	60	71.2	72.2	72.2
** Modulus of elasticity Initial	kgf/mm²	16,519	14,378	13,500	13,500	10,095	12,339	12,339
Modulus of elasticity lititial	Мра	162,000	141,000	132,390	132,390	99,000	121,000	121,000
** Modulus of elasticity Final	kgf/mm ²	15,693	13,659	12,825	12,825	9,590	11,722	11,722
Modulus of elasticity Final	Мра	153,900	133,950	125,770	125,770	94,050	114,950	114,950
** Coefficient of linear expansion nom.	10-6/℃	13.0	14.5	13.8	14.7	17.2	17.4	15.2
Maximum allowable temperature	℃				2	00		
·		Cond	ductor electi	rical proper	ties			
* DC Resistance @ 20 ℃	Ω/km	1.90	0.75	0.74	0.55	0.35	0.27	0.38
* Short Circuit 1.0 second	kA	3.2	5	5	7	12	12.5	12.22
* Short circuit current capacity - Initial temperature 20 ℃ - Final temperature maximum 200 ℃	kA².s	10	25	25	31	144	156	149
Continues current rating	Α							
Lightning Class: 0, 1, 2 or 3	Class	2	2	3	2	0	0	2
	Class	3	3	3	3	3	3	3
Ransfer rate (0:50C, 1:100C, 2:150C, 3:200C)				0.5 seconds				
					0 14/1 : 7	Deal O. Diesele	0. Vallow 10	Violet 11 Pir
Lightning maximum durtation	1. Blue	2. Orange 3.	Green 4. Brov	wn 5. Slate/Gr	ey 6. White /.	Red 8. Black	9. Tellow 10.	VIOLULI I I II
Lightning maximum durtation Fibre identification: In all groups		2. Orange 3.	Green 4. Brov	wn 5. Slate/Gr	ey 6. White 7.	Red 8. Black	9. reliow to.	VIOICE I I. I II
Lightning maximum durtation Fibre identification: In all groups Fiber group identification: Binder color	ur:	, i		wn 5. Slate/Gr	ey 6. White 7.	Red 8. Black	9. Yellow 10.	VIOICE TT. TII
Lightning maximum durtation Fibre identification: In all groups Fiber group identification: Binder color 1 x 12 fiber SUS tube: 12 fiber cable	ur: 12 fiber: gro	oup: no binde	er		ey 6. White 7.	Red 8. Black	9. Tellow 10.	VIOLET IT. I II
Lightning maximum durtation Fibre identification: In all groups Fiber group identification: Binder color 1 x 12 fiber SUS tube: 12 fiber cable 1 x 24 fiber SUS tube: 24 fiber cable	12 fiber: gro	oup: no binde oups: 1 st grou	er ıp (Blue), 2 nd ç	group (Yellow))			
Lightning maximum durtation Fibre identification: In all groups Fiber group identification: Binder color	12 fiber: gro	oup: no binde oups: 1 st grou	er	group (Yellow))	group (Green)		

In addition to the sizes above, any other construction can be designed and manufactured on customer request.

4.4

kg/km



Case 4 Case 4

5.0 5.3

Case 4

5.6

Revision: R03 14/06/2017

Grease filling if applicable (IEC61089)

Note: * calculated value, **data for information only

* Grease weight calculated: Nominal

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Case 4 Case 4 Case 4

7.4

4.6

5.6

M-TEC



Specification:

NR\$ 061-1, IEC793, 794, ITU-T G 650, IEEE P1138, IEC 61089

OPGW

Multi layer, inner layer SUS tube

Application:

OPGW conductor is strung on poles or structures in air, supporting its own weight. Grounding via Aluminium cladded steel and Aluminium alloy conductor, communication is done via optic fibres in stainless steel SUS tube.

Construction:

1st layer: Aluminium cladded steel wires with integrated SUS tube filled with thixotropic gel protecting the optical fibres.

2nd Layer: Aluminium alloy wires.

Illustration sketches is for reference only and may not always represent the exact conductor construction









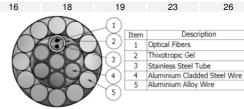






IEEE P 1 136, IEC 6 1063									
			Constru	ıction					
OPGW Size: short circuit rating	kA, 1sec	10	11	12	13	13	16	18	21
Tensile rating, RTS	kN	58	58	60	72	75	60	70	95
Fibres per SUS tube	number	12 or 24 p	er SUS tube un	der 4.00mm di	ameter or 48 f	ibres per SUS t	ube per SUS t	tube over 4.00	nm diameter
Number of SUS tubes	number	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Fibre SUS tube outer diameter	mm	2.70	3.00	3.10	3.10	3.10	3.40	3.75	4.00
			Aluminium	Clad Steel					
Number of wires	#	5	6/5	6/5	6/5	10/9	5/4	5/4	5/4
Wire diameter									
Centre		2.8	3.0	3.2	3.2	3.2	3.5	3.80	4.1
1st layer	mm	2.8	3.0	3.2	3.2	3.0	3.5	3.80	4.1
2nd layer		2.8	3.0	3.2	3.2	3.4	3.5 9.6	3.80 11.3	4.1 13.2
Wire area	mm²	6.2	7.1	8.0	8.0	3.2mm: 8.05 3.0mm: 7.07 3.4mm: 9.08	9.6	11.3	13.2
Total wire area nominal	mm²	30.8	42.4 / 35.3	48.2 / 40.2	48.2 / 40.2	79.7 / 72.6	81.2 / 76.3	92 / 84.9	101.3 / 94.2
Aluminium in ACS	mm²	13.2	12.7 / 10.6	20.8 / 17.3	14 / 11.7	34.3 / 31.2	34.9 / 32.8	39.6 / 36.5	39.2 / 36.4
Conductivity of wire @ 20 ℃	%	30	30	30	20.3	30	30	30	27
			Aluminiu	m Alloy					
Number of wires	#	12	15	12	12	7	12	12	12
Wire diameter	mm	2.8	2.36	3.2	3.2	3.4	3.5	3.80	4.1
Aluminium alloy area nom.	mm²	74	66	97	97	64	115	136	158
,		Cond	ductor phys	ical propert	ies				
Diameter 1st layer	mm	8.4	9.0	9.6	9.6	9.2	10.5	11.4	12.3
Diameter 2nd layer	mm	14.0	13.7	16.4	16.0	16.0	17.5	19.0	20.5
Total weight nominal	kg/km	424	457	551	560	646	656	771	914
Total OPGW area (conductive components)	mm²	105	149 / 142	145 / 137	188 / 180	145 / 137	412188	485878	565623
Final layer stranding direction	S/Z	Z	Z	Z	Z	Z	Z	Z	Z
* RTS (rated tensile strength)	kN	58	58	60	72	75	70	70	95
· · · · · · · · · · · · · · · · · · ·	kgf/mm²	8,900	9,900	8.800	9,280	10,500	8,800	8,800	9.000
** Modulus of elasticity Initial	Mpa	87,279	97,086	86,299	91,000	102,970	86,299	86,299	88,260
	kgf/mm²	8,455	9,405	8,360	8,816	9,975	8,360	8,360	8,550
** Modulus of elasticity Final	Mpa	82,915	92,232	81,984	86,455	97,821	81,984	81,984	83,847
** Coefficient of linear expansion nom.	10.6	18.3	17.0	18.3	17.8	16.3	18.3	18.4	18.1
Maximum allowable temperature	℃	10.5	17.0	10.5	-	200	10.5	10.4	10.1
waximum allowable temperature	J	Conc	ductor elect	rical proper		.00			
* DC Resistance @ 20 °C	Ω/km	0.40	0.37	0.27	0.29	0.35	0.23	0.19	0.17
* Short Circuit 1.0 second	kA	10	11	12	13	13	16	18	20
Short circuit current capacity Initial temperature 20 °C Final temperature maximum 200 °C	kA².s	100	121	144	174	169	256	324	441
Continues current rating	Α								
Lightning Class: 0, 1, 2 or 3 Ransfer rate (0:50C, 1:100C, 2:150C, 3:200C)	Class	1	1	1	1	1	1	1	1
Lightning maximum durtation					0.5 second	S			
Fibre identification: In all groups	1. Blue	2. Orange 3.	Green 4. Brov	vn 5. Slate/Gr	ev 6. White 7.	Red 8. Black	9. Yellow 10.	Violet 11. Pin	k 12. Agua
Fiber group identification: Binder colour					,				.4
1 x 12 fiber SUS tube: 12 fiber cable	_	oup: no binde	or						
				marine (Mallia					
1 x 24 fiber SUS tube: 24 fiber cable	12 fiber: gr	bups: 1 grou	ıp (Blue), 2 nd (group (Tellow)				

* Grease weight calculated: Nominal kg/km Note: * calculated value, **data for information only In addition to the sizes above, any other construction can be designed and manufactured on customer request.



4000

4000

Case 2 Case 2

4000

Case 2

), 3rdgroup (Green), 4th group (Brown),

), 3rdgroup (Green), 4th group (Brown),

), 3rdgroup (**Green**), 4th group (**Grey**),

4000

Case 2

), 3rdgroup (**Green**), 4th group (**Red**),

Revision: R03 14/06/2017

Shipping length

2 x 24 fiber SUS tubes: 48 fiber cable

2 x 48 fiber SUS tubes: 96 fiber cable

3 x 48 fiber SUS tubes: 144 fiber cable

Grease filling if applicable (IEC61089)

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1st tube12 fiber: groups: 1st group (Blue), 2nd group (

2nd tube 12 fiber: groups: 1st group (Blue), 2nd group (

1st tube 12 fiber: groups: 1st group (Blue), 2nd group (10

2nd tube 12 fiber: groups: 1st group (Blue), 2nd group (

3rd tube 12 fiber: groups: 1st group (Blue), 2nd group (V

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13

m

2nd tube12 fiber: groups: 1st group (Green), 2nd group (Red)

4000

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Case 2 Case 2 Case 2

1st tube 12 fiber: groups: 1st group (Blue), 2nd group (Valion), 3rdgroup (Green), 4th group (Red),

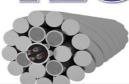
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16

4000

Case 2

M-TEC



Specification:

NRS 061-1, IEC793, 794, ITU-T G 650, IEEE P1138, IEC 61089

OPGWMulti layer, Centre SUS tube

Application:

OPGW conductor is strung on poles or structures in air, supporting its own weight. Grounding via Aluminium cladded steel and Aluminium alloy conductor, communication is done via optic fibres in stainless steel SUS tube.

Construction:

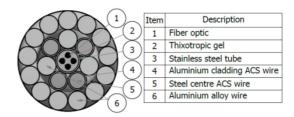
Centre wire: SUS tube filled with thixotropic gel

1st layer: Aluminium cladded steel wires; Aluminium alloy wires; or combination of ACS & AA Wires

2nd Layer: Aluminium alloy wires.

IEEE P1138, IEC 61089			Comotiv	ustian
			Constr	uction
OPGW Size: short circuit rating	kA, 1sec	10	12	
Tensile rating, RTS	kN	65	62	
Fibres per SUS tube	number	48 per S	SUS tube	
Number of SUS tubes	number	1	1	
Fibre SUS tube outer diameter	mm	3.60	3.80	
			Aluminium	Clad Steel
Number of wires	#	7	4	
Wire diameter				
Centre 1st layer	mm	2.70	2.85	
2nd layer				
Miro oron	mm²	E 7	7.1	
Wire area	mm²	5.7	7.1	
Total wire area nominal	mm²	40.1	25.5	
Aluminium in ACS	mm²	8.1	3.6	
Conductivity of wire @ 20 ℃	%	20.3	14	
			Aluminiu	m Alloy
Number of wires	#	14	16	
Wire diameter	mm	2.5	2.85	
Aluminium alloy area nom.	mm²	69	102	
		Conc	ductor phys	sical properties
Diameter 1st layer	mm	9.0	9.5	
Diameter 2nd layer	mm	14.0	15.2	
Total weight nominal	kg/km	476	473	
Total OPGW area (conductive components)	mm²	109	128	
Final layer stranding direction	S/Z	Z	Z	
RTS (rated tensile strength)	kN	65	62	
* Modulus of elasticity Initial	kgf/mm²	9,891	8,667	
,	Мра	97,000	85,000	
* Modulus of elasticity Final	kgf/mm²	9,396	8,234	
* Coefficient of linear expension nom	Mpa 10-6/℃	92,148 16.9	80,745 18.6	
* Coefficient of linear expansion nom. Maximum allowable temperature	0-6/ ℃		00	
waximum allowable temperature	U			trical properties
DC Pasistanas @ 20°C	O/Israe			incai properties
DC Resistance @ 20 ℃ Short Circuit 1.0 second	Ω/km kA	0.39 10	0.30 12	
Short circuit 1.0 second Short circuit current capacity	IV.A	10	12	
- Initial temperature 20 ℃	kA2.s	100	144	
- Final temperature maximum 200 ℃				
Continues current rating	Α			
ightning Class: 0, 1, 2 or 3	Class	1	1	
Ransfer rate (0:50C, 1:100C, 2:150C, 3:200C)	Ciass			
ightning maximum durtation		0.5 seconds	3	
Fibre identification: In all groups	1. Blue	2. Orange 3.	Green 4. Bro	own 5. Slate/Grey 6. White 7. Red 8. Black 9. Yellow 10. Violet 11. Pink 12. Aqu
Fiber group identification: Binder colour	:			
1 x 12 fiber SUS tube: 12 fiber cable		oup: no binde	r	
1 x 24 fiber SUS tube: 24 fiber cable				group (Yellov)
2 x 24 fiber SUS tubes: 48 fiber cable				ue), 2 nd group (<u>Yellow),</u> reen), 2nd group (Red)
	2 tube12 t	iber: groups:	1st group (G	
2 x 48 fiber SUS tubes: 96 fiber cable	and tube 121	fiber: groups:	group (BI	
	2 tube 12	liber: groups	. 1 group (B	lue), 2 nd group (**Lilo**), 3 rd group (Green), 4 th group (Brown), ue), 2 nd group (**Lilo**), 3 rd group (Green), 4 th group (Red),
3 x 48 fiber SUS tubes: 144 fiber cable				<i>"</i>
3 X 40 liber 303 tubes: 144 liber cable				lue), 2 nd group ("ello"), 3 rd group (Green), 4 th group (Brown), lue), 2 nd group ("ello"), 3 rd group (Green), 4 th group (Grey),
Shinning length	3" tube 121		1 group (BI 4000	ue), 2 group (renow), 3 group (Green), 4 group (Grey),

Note: * calculated value, **data for information only In addition to the sizes above, any other construction can be designed and manufactured on customer request.



Revision: R03 14/06/2017

Shipping length

Grease filling if applicable (IEC61089)

* Grease weight calculated: Nominal

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4000

10

kg/km

4000

Case 2 Case 2

13





Specification:

NRS 061-1, IEC793, 794, ITU-T G 650, IEEE P1138, IEC 61089

OPGW LT ACS / Central AA Loose tube

Application:

OPGW conductor is strung on poles or structures in air, supporting its own weight.

Grounding via Aluminium cladded steel conductor, communication is done via optic fibres in PBT Loos tubes encased in an Aluminium extruded tube.

Construction:

1st layer: Aluminium cladded steel wires with integrated SUS tube filled with thixotropic gel protecting the optical fibres.

Construction

OPGW Size: short circuit rating	kA, 1sec	10
Tensile rating, RTS	kN	58
Fibres per PBT / AA loose tube	number	48
Fibre AA loose tube outer diameter	mm	2.70

Number of wires	#	5
Wire diameter		
Centre	mm	2.8
1st layer	111111	2.0
Wire area	mm ²	6.2
Total wire area nominal	mm²	30.8
Aluminium in ACS	mm²	13.2
Conductivity of wire @ 20 ℃	%	30

Conductor physical properties

		0011
Diameter 1st layer	mm	8.4
Diameter 2nd layer	mm	15.2
Total weight nominal	kg/km	424
Total OPGW area (conductive components)	mm²	31
Final layer stranding direction	S/Z	Z
* RTS (rated tensile strength)	kN	58
** Modulus of elasticity	kgf/mm ²	8,900
Woulds of elasticity	Мра	87,279
** Coefficient of linear expansion nom.	10-6/℃	18.3
Maximum allowable temperature	%.	

Maximum allowable temperature °C 20			Conductor electrical properties	
	Maximum allowable temperature	℃		200

		Con
* DC Resistance @ 20 ℃	Ω/km	0.40
* Short Circuit 1.0 second	kA	10
* Short circuit current capacity - Initial temperature 20 °C - Final temperature maximum 200 °C	kA².s	100
Continues current rating	Α	
Lightning Class: 0, 1, 2 or 3 Ransfer rate (0:50C, 1:100C, 2:150C, 3:200C)	Class	1

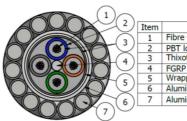
Ransfer rate (0:50C, 1:100C, 2:150C, 3:200C)	Oldos	
Lightning maximum durtation		0.5 seconds

Fibre identification: In all tubes.	1. Blue 2. Orange 3. Green 4. Brown 5. Slate/Grey 6. White 7. Red 8. Black 9. Yellow 10. Violet 11. Pink 12. Aqua
Loose Tube identification:	1. Blue 2. Orange 3. Green 4. Brown
Shipping length	m 4000
Grease filling if applicable (IEC61089)	Case 2

* Grease weight calculated: Nominal Note: * calculated value, **data for information only In addition to the sizes above, any other construction can

be designed and manufactured on customer request.

kg/km 13



Item	Description
1	Fibre Optic
2	PBT loose tube
3	Thixotropic Gel
4	FGRP
5	Wrapping tape
6	Aluminium Tube
7	Aluminium clad steel wire

Revision: R03 14/06/2017

1. GENERAL

This specification covers the design requirements and performance standard for OPGW in overhead transmission line.

1.1 Conductor Description

Loose tube conductor is a design that has high tensile strength and flexibility in a compact cable size.

The stainless steel loose tube cable provides excellent optical transmission and physical performance.

1.2 Quality

Level of quality in our cable products is ensured through several quality control program including ISO 9001.

1.3 Reliability

Product reliability is ensured 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.

2. OPTICAL FIBER

2.1 Single Mode Fiber, G652D

Single mode fiber manufactured by the vapour axial deposition (VAD) process to produce the highest quality glass with excellent geometry, high strength characteristics, and attenuation that approaches theoretical minimum. The single mode fiber is fully compatible with other commercially available single mode fibres and has the zero dispersion wavelength around 1310nm. The main operating wavelength region of the fiber is around 1310 nm and 1550 nm.

2.2 General Design

Its optical properties are achieved through a germanium doped silica based core with a pure silica cladding.

An acrylate protective coating is applied over glass cladding to provide the necessary maximum fiber lifetime.

2.3 Construction

Primary coating material UV curable acrylate

Fibre diameter $250 \pm 10 \mu \text{m}$

2.4 Optical characteristics

 $\begin{array}{lll} \mbox{Attenuation at 1310 nm} & \leq 0.36 \mbox{ dB/km} \\ \mbox{Attenuation at 1550 nm} & \leq 0.25 \mbox{ dB/km} \\ \mbox{Dispersion at 1285} \sim 1330 \mbox{nm} & \leq 3.5 \mbox{ps/(nm.km)} \\ \mbox{Dispersion at 1550 nm} & \leq 18 \mbox{ps/(nm.km)} \\ \mbox{Zero dispersion wavelength} & 1300 \sim 1322 \mbox{nm} \\ \mbox{Zero dispersion slope} & < 0.093 \mbox{ ps/(nm².km)} \\ \mbox{} \end{array}$

Cable cut off wavelength (λccf) < 1260nm

2.5 Mechanical characteristics

Fiber proof test level ≥ 1% x 1sec

Bending test (75 mm diameter mandrel 100 turns) ≤ 0.05 dB at 1550nm

2.6 Removal of primary coating

For jointing, removal of primary coating is achieved without the use of any chemicals. A simple mechanical operation is sufficient to prepare the fiber for jointing.

3. Test and Inspection

All tests and inspection shall be made in accordance with above mentioned standard specification.

4. Packing and Marking

- 4.1 Finished cable shall be delivered on wooden drum or metal drum.
- 4.2 Each dead-end of cable shall have effectively sealed with heat shrinkable cap.
- 4.3 On side of the cable drum, required marking shall be printed.
- 4.4 The barrel diameter shall not be less than 40 times of the diameter of the cable.

Dimension of Wooden Drum

[Unit: mm]

	Drum details (Nominal)									
Reel	Reel Flange		Barrel	Spindle hole	Inner width	Outer width				
Humber	diameter	diameter	diameter	diameter	Widti	Widti				
AS	1900	1900	960	90	1088	1240				
TB	2000	2000	1200	90	908	1060				
SB	1700	1700	830	90	908	1060				
SC	1600	1600	830	90	900	1052				
CB	1300	1300	700	90	900	1052				
DB	1000	1000	500	90	800	952				

- We apply ISO, BS and DEF standard for drum construction, bolt size and etc.
- The dimension of drum is nominal value and so, if necessary, it will be possible to change applicable dimensions if needed.

Revision: R03 14/06/2017







