



PACIFIC ELECTRIC WIRE & CABLE CO., LTD.

26F, NO. 95, SEC. 2, DUNHUA S RD, TAIPEI CITY 106, TAIWAN, R.O.C

Messrs.	Apr. 09, 2013
	Spec. No.: TBE102011
		Design No.: CL102011
		File No.: 10012449
Purchaser	
	

Our Proforma Invoice No.

Subject :

Signalling Cable (For TTYMRT Project)

Reference to : Your attachment specification & PEWC specification
TBE102011

Signed By

C. L. Lee

Manager
Communication Cable Division



Signalling cable list

Item No.	Type	Name	Properties	Dimension mm ² ×(P、C、Q)
1	AXL1	XLPE-LSFH shielded corrugated steel tape armored cable	A、H、S、W、T、L	0.64×10P
2	AXL3		A、H、S、W、T、L	0.64×2P
3	SIG1		A、H、S、W、T、L	1.85×6C
4	SIG2		A、H、S、W、T、L	1.85×10C
5	SIG3		A、H、S、W、T、L	1.85×37C
6	TUT1		A、H、S、W、T、L	1.54×1Q
7	TUU1		A、H、S、W、T、L	1.54×4Q
8	TUU2		A、H、S、W、T、L	1.54×8Q
9	TUU3		A、H、S、W、T、L	1.54×3Q
10	SGT1	XLPE-LSFH corrugated steel tape armored cable	A、H、W、T、L	2.5×4C
11	SWT1		A、H、W、T、L	2.5×2C
12	SWT2		A、H、W、T、L	2.5×6C
13	SWM1		A、H、W、T、L	10×5C
14	SWM2		A、H、W、T、L	16×5C
15	SWM3		A、H、W、T、L	25×5C
16	SWM5		A、H、W、T、L	2.5×5C
17	SWM6		A、H、W、T、L	4×5C
18	SWM7		A、H、W、T、L	6×5C
19	SWM8		A、H、W、T、L	2.5×4C
20	SWM9		A、H、W、T、L	4×4C
21	SWM10		A、H、W、T、L	6×4C
22	SWM11	A、H、W、T、L	10×4C	

A : Armored

H : Heavy Duty (Double Sheathed)

S : Screen

L : Low Smoke Zero Halogen

W : Water Proof

T : Termite Proof



SPECIFICATION

FOR

Signalling Cable (TTYMRT)

1 Scope :

- 1.1 This specification covers the cables to be applied to the signalling system, XLPE (Cross-linked Polyethylene) as an insulator for copper conductor, Aluminum-polyester tape or laminated Aluminum tape as shielding (for shielding cable), corrugated steel tape armored and LSFH (Low Smoke Free Halogen) material as the jacket of the cable.
- 1.2 The cables have termite, rodent protected, and UV resistance.
- 1.3 The cables temperature rating: applied cross-linked polyethylene insulation, could be up to 90 °C.
- 1.4 The cables designed to 40-years of service life.
- 1.5 The cables bending radius: more than 15 times the outer diameter of the cable.

2 Cable construction and electrical properties at 20°C

Clause No.	Description	Particulars
2.1	<u>Conductor</u> 2.1.1 Material 2.1.2 Cross-sectional area mm ² 2.1.3 Configuration No./ mm 2.1.4 Diameter mm	Copper See Table 3 See Table 3 See Table 3
2.2	<u>Insulation</u> 2.2.1 Material 2.2.2 Nominal thickness mm 2.2.3 Identification	Cross-linked Polyethylene See Table 1 See Table 4
2.3	<u>Twisting or quading (for pair & quad type)</u> 2.3.1 Type	Pair 、 Quad
2.4	<u>Bed layer (for TUU2 type)</u> 2.4.1 Material 2.4.2 Color 2.4.3 Nominal thickness mm	Low smoke free halogen PE Black 0.75
2.5	<u>Stranding</u> 2.5.1 Make up of cable core 2.5.2 Fillers 2.5.3 Material of core binder	See Table 5 if necessary Polyester tape



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Clause No.	Description	Particulars
2.6	<u>Core covering</u> 2.6.1 Material 2.6.2 Nominal thickness	Polyester tape 0.025/0.050 mm
2.7	<u>Drain wire</u> 2.7.1 Material 2.7.2 Cross-sectional area 2.7.3 Configuration 2.7.4 Nominal diameter	Copper 0.64 7/0.32 0.96 mm ² No./ mm mm
2.8	<u>Shield</u> 2.8.1 Material 2.8.2 Nominal thickness 2.8.3 Wrapping type	Al-polyester tape or Laminated Al-tape See Table 6 See Table 6 mm
2.9	<u>Inner sheath</u> 2.9.1 Material 2.9.2 Color 2.9.3 Nominal thickness	Low smoke free halogen PE Black See Table 1 mm
2.10	<u>Rip cord</u> 2.10.1 Material 2.10.2 Numbers of cord	Aramid yarns 2, in separated position
2.11	<u>Armoring</u> 2.11.1 Material 2.11.2 Nominal thickness 2.11.3 Peel force at overlap	Two-sides plastic coated Electrolytic chrome corrugated steel tape 0.26 O.D ≤ 10mm : >0.2kgf O.D > 10mm : >0.4kgf mm
2.12	<u>Outer sheath</u> 2.12.1 Material 2.12.2 Color 2.12.3 Nominal thickness 2.12.4 Appearance 2.12.5 Concentricity of cable $\frac{(D_{max} - D_{min})}{D_{ave}} \times 100\%$ 2.12.6 Properties 2.12.7 Peel force to armoring 2.12.8 Nominal overall diameter	Low smoke free halogen PE Black See Table 1 < 15 Clause 5.2 Ind. min. 1.0kg/10mm Ave. 1.5kg/10mm See Table 1 mm
2.13	<u>Packing</u> 2.13.1 Cable drum 2.13.2 Length per drum 2.13.3 Covering	Wooden or iron drum 1000 Corrugated plastic plate will be wrapped around the cable M



3 Cable marking

- 3.1 Project name : As "TTYMRT SIGNAL SYSTEM"
- 3.2 Manufacture : As "PACIFIC"
- 3.3 Cable type : As "SIG1"
- 3.4 Cable specifications : As "1.85mm²×6C"
- 3.5 Year of manufacture : As "2013"
- 3.6 Sequential meter marking : As "0000M~9999M"
- 3.7 Ex : "TTYMRT SIGNAL SYSTEM PACIFIC 2013 SIG1 1.85mm²×6C 0001M" each meter

4 ELECTRICAL PROPERTIES (at 20°C)

Cross-Sectional Area	Configuration	Conductor resistance	Insulation resistance	Dielectric withstand voltage	Test method
mm ²	No/mm	Ω/km	MΩ-km	A.C. V/分	
0.64	1/0.9	max. 28.5	min. 500	3500/5	1. Conductor resistance and dielectric withstand voltage : according to IEC 60502-1 2. Insulation resistance : according to JIS C 3005
1.54	1/1.4	max. 12.1	min. 500	3500/5	
1.85	1/1.53	max. 9.85	min. 500	3500/5	
2.5	50/0.25	max. 7.98	min. 500	3500/5	
2.5	7/0.67	max. 7.41	min. 500	3500/5	
4	7/0.85	max. 4.61	min. 500	3500/5	
6	7/1.04	max. 3.08	min. 500	3500/5	
10	7/-	max. 1.83	min. 500	3500/5	
16	7/-	max. 1.15	min. 500	3500/5	
25	7/-	max. 0.727	min. 500	3500/5	

5 PHYSICALE PROPERTIES :

5.1 Physical properties of Insulation :

Item	Spec.	Test method
Tensile strength	min. 12.5 N/mm ²	According to IEC 60811-1-1 section 9.1 & IEC 60811-1-2 section 8.1
Elongation	min. 200%	
Resistance to aging	135°C×168hr	
Variation of tensile strength Variation of elongation	±25 % ±25 %	

5.2 Physical Properties of Outer Sheath (LSFH PE) :

Item	Spec.	Test method
Tensile strength	min. 9N/mm ²	According to IEC 60811-1-1 section 9.2 & IEC 60811-1-2 section 8.1
Elongation	min. 125%	
Resistance to aging	100°C×168hr	IEC 60811-1-2 section 8.1.4 Test sample containing "dumbbell" and "the whole" test
Variation of tensile strength Variation of elongation	±40 % ±40 %	
Smoke density	Dm20 max. 150 (flameless)	
Amount of halogen acid gas	max. 0.5%	IEC 754-1
Degree of Acidity	min. 4.3	IEC 60754-2
Oxygen Index	min. 30%	ASTM D 2863
Temperature index	min. 260°C	ISO 4589-3



6 Flame retardant test : Comply with IEC 60332-1 and IEC 60332-3 C class.

7 Torsion test : Comply with EIA-FOTP-85(TIA/EIA-455-85A)

8 Packing :

8.1 The cables shall be packed in wooden or metal drums in the transporting without damage.

8.2 Both ends of the cable shall be effectively sealed to prevent the entrance of moisture.

8.3 Packing and marked : In the drum of the package to the appropriate method marked with the following.

8.3.1 Cable Type 、 the number of cores 、 conductor nominal cross-sectional area or diameter.

8.3.2 Cable length

8.3.3 total weight and net weight

8.3.4 Cable scrolling direction

8.3.5 Manufacture name or logo

8.3.6 Year of manufacture

**9 Testing items and method FAT (Factory Acceptance Testing) :**

Item	Test items	Test criteria	Factory self inspection	FAT
1	Insulation and outer sheath thickness (dimension inspection)	IEC 60502-1	V	V
2	Appearance of cable (visual inspection)	According to section 2.12.4	V	
3	Concentricity of cable	According to section 2.12.5	V	
4	Outer sheath Tensile strength (before aging)	IEC 60502-1	V	V
5	Outer sheath Variation of tensile strength (after aging)	IEC 60502-1		V
6	Outer sheath Elongation (before aging)	IEC 60502-1	V	V
7	Outer sheath Variation of elongation (after aging)	IEC 60502-1		V
8	Torsion test (for finish cable)	EIA-FOTP-85 (TIA/EIA-455-85A)		V
9	Dielectric withstand voltage	IEC 60502-1	V	V
10	Insulation resistance	JIS C 3005	V	V
11	Spark test	BS 5099	V	
12	Conductor resistance	IEC 60502-1	V	V
13	Corrugated steel tape overlap peel force testing	ML 1106-0 section 4.7		V
14	Peel force between corrugated steel tape and outer sheath	ML 1106-0 section 4.6		V
15	Smoke density	ASTM E662		V
16	Amount of halogen acid gas	IEC 754-1		V
17	Combustion gas release acidity and conductivity test	IEC 60754-2		V

Description :

- A. Factory test (according to the factory quality management requirements) : in each batch of orders, factory self-testing shall be performed and submit report.
- B. FAT (sampling frequency / number as shown in Table 2) : If the customer required, the FAT shall be performed and provide test reports.
- C. Item 11_ spark test record provided by the manufacturer.



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TABLE 1
Dimension of cable

Cable type	Cross-section area	Configuration (N/mm × P/C/Q)	Insulation thickness (nom.)	Inner sheath thickness (nom.)	Outer Sheath thickness (nom.)	Overall diameter (approx.)	Weight of cable (approx.)	Standard length (M)
	mm ²		(mm)	(mm)	(mm)	(mm)	(kg/m)	
AXL1	0.64	1/0.9×10P	0.70	1.0	1.8	24.0	0.65	1000
AXL3	0.64	1/0.9×2P	0.70	1.0	1.8	16.8	0.34	1000
SIG1	1.85	1/1.53×6C	0.70	1.0	1.8	17.3	0.42	1000
SIG2	1.85	1/1.53×10C	0.70	1.0	1.8	20.6	0.58	1000
SIG3	1.85	1/1.53×37C	0.70	1.0	1.8	29.4	1.34	1000
SGT1	2.5	50/0.25×4C	0.70	1.0	1.8	16.7	0.38	1000
SWT1	2.5	50/0.25×2C	0.70	1.0	1.8	16.7	0.34	1000
SWT2	2.5	50/0.25×6C	0.70	1.0	1.8	19.1	0.51	1000
TUT1	1.54	1/1.4×1Q	0.70	1.0	1.8	16.0	0.35	1000
TUU1	1.54	1/1.4×4Q	0.70	1.0	1.8	25.8	0.80	1000
TUU2	1.54	1/1.4×8Q	0.70	1.0	1.8	31.8	1.26	1000
TUU3	1.54	1/1.4×3Q	0.70	1.0	1.8	24.1	0.68	1000
SWM8	2.5	7/0.67×4C	0.70	1.0	1.8	18.0	0.42	1000
SWM5	2.5	7/0.67×5C	0.70	1.0	1.8	19.0	0.48	1000
SWM9	4	7/0.85×4C	0.70	1.0	1.8	19.5	0.52	1000
SWM6	4	7/0.85×5C	0.70	1.0	1.8	21.0	0.59	1000
SWM10	6	7/1.04×4C	0.70	1.0	1.8	21.0	0.63	1000
SWM7	6	7/1.04×5C	0.70	1.0	1.8	22.0	0.72	1000
SWM11	10	7/-×4C	0.70	1.0	1.8	22.5	0.80	1000
SWM1	10	7/-×5C	0.70	1.0	1.8	24.0	0.95	1000
SWM2	16	7/-×5C	0.70	1.0	1.8	26.0	1.29	1000
SWM3	25	7/-×5C	0.90	1.0	1.8	31.0	1.87	1000



Table 2
FAT sampling frequency / number

Item No.	Test items	Test specification	Sampling cable specifications	Sampling frequency / quantity
1	Outer sheath thickness	IEC 60502-1	All spec.	According to IEC 60502-1
2	Insulation thickness	IEC 60502-1	All spec.	According to IEC 60502-1
3	Outer sheath Tensile strength (before aging)	IEC 60502-1	Taken from finish cable, the maximum, the middle, and the minimum of cable outer diameter.	According to IEC 60502-1
4	Outer sheath Elongation (before aging)	IEC 60502-1		According to IEC 60502-1
5	Outer sheath The rate of change of tensile strength (after aging)	IEC 60502-1		According to IEC 60502-1
6	Outer sheath Variation of elongation (after aging)	IEC 60502-1		According to IEC 60502-1
7	Torsion test (for finish cable)	EIA-FOTP-85 (TIA/EIA-455-85A)		1 drum
8	Dielectric withstand voltage	IEC 60502-1	All spec.	1 drum
9	Insulation resistance	CNS 689 或 JIS C 3005	All spec.	1 drum
10	Conductor resistance	IEC 60502-1	All spec.	1 drum
11	Corrugated strip overlap peel force testing	ML 1106-0 section 4.7	Taken from finish cable, the maximum, the middle, and the minimum of cable outer diameter.	Once
12	Peel force a corrugated steel tape and covered the body	ML 1106-0 section 4.6		Once
13	Smoke density	ASTM E662	Take LSFH compound of approx. 1 kg	Once
14	Amount of halogen acid gas	IEC 754-1	Taken from finish cable, the maximum, the middle, and the minimum of cable outer diameter.	1 drum
15	Combustion gas release acidity and conductivity test	IEC 60754-2		1 drum

Note 1 In order to improve the test period efficiently for the total project schedule, the maximum, the middle, and the minimum cable size required for test sample.

Note 2 Cable OD, as shown in Table (1) TUU2 (of 1/1.4mm × 8Q) is the maximum, the middle is SWM1 (7 / - 5C), and the minimum is TUT1 (of 1/1.4mm X 1Q)



TABLE 3
Conductor

Material	Cross-sectional area (mm ²)	Configuration (No/mm)	Diameter (mm)
Annealed copper wire	0.64	1/0.9	0.9±0.02
Annealed copper wire	1.54	1/1.4	1.4±0.03
Annealed copper wire	1.85	1/1.53	1.53±0.03
Anneal stranded copper wire	2.50	50/0.25	* 2.04
Anneal stranded copper wire	2.50	7/0.67	* 2.01
Anneal stranded copper wire	4	7/0.85	* 2.55
Anneal stranded copper wire	6	7/1.04	* 3.12
Compress stranded copper wire	10	7/-	* 3.7
Compress stranded copper wire	16	7/-	* 4.6
Compress stranded copper wire	25	7/-	* 5.8

Note 1 : “-“Means the circle compress stranded copper, its single strand diameter no restrictions.

Note 2 : “*” Refers to the "about" value

TABLE 4
Insulation identification

Cable type	Spec.	Identification of insulated
SIG- SGT- SWT-	6C 、 10C 、 37C 4C 2C 、 6C	White and printed black figures in core
AXL-	2P 、 10P	Black and white White cores printed black numbers, black cores with printed white numbers
TUT- TUU-	1Q 3Q 、 4Q 、 8Q	Core colors : blue 、 orange 、 green 、 white Q stranded at the outer wrapping Mylar bring printed black numbers. (1Q except)
SWM-	4C	Red 、 Black 、 Blue 、 White (XLPE natural)
	5C	Red 、 Black 、 Blue 、 White (XLPE natural) 、 Green



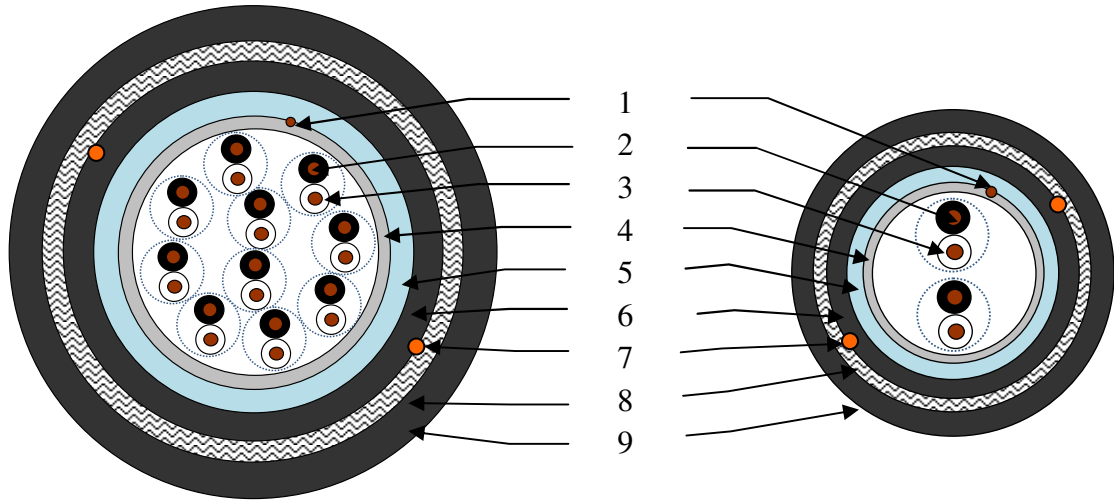
TABLE 5
Make up of cable

Spec.	Arrangement
2P	2P
10P	(2,8)P
2C	fillers+2C
4C	fillers+4C
5C	fillers+5C
6C	fillers+6C
10C	2C+fillers · 8C
37C	(1,6,12,18)C
1Q	1Q
3Q	3Q
4Q	fillers+ 4Q
8Q	(1,7) Q

TABLE 6
Shield of cable

Cable type	Material	Thickness (nominal)	Wrapping type
SIG-	Aluminum-polyester tape	0.05 mm	Horizontal
AXL-	Laminated aluminum tape	0.30 mm	Longitudinal
TUT- · TUU-	Laminated aluminum tape	0.30 mm	Longitudinal

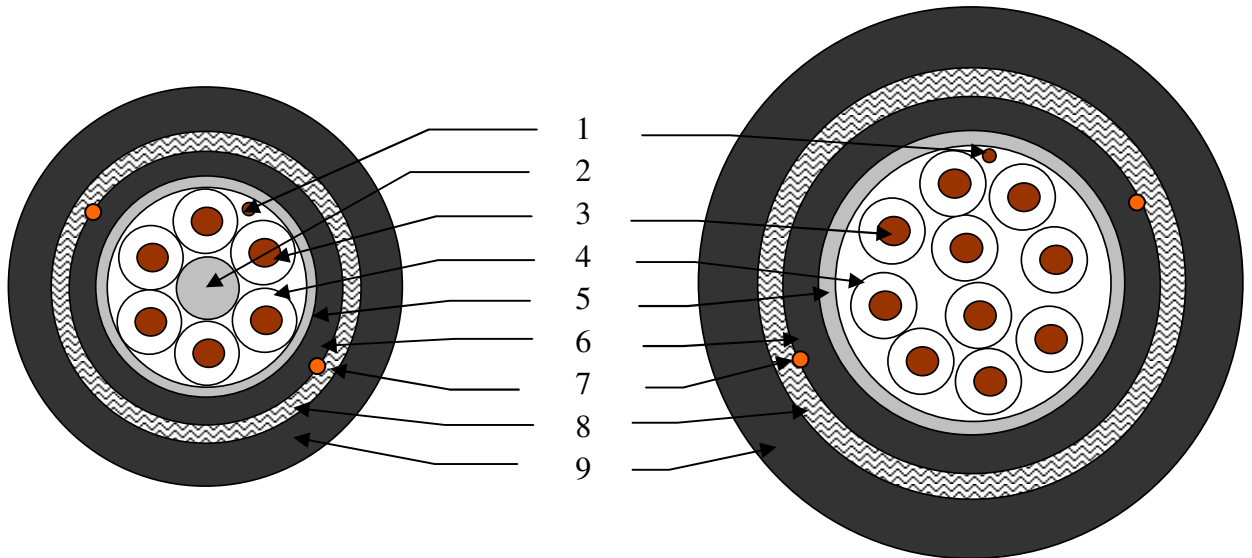
Cross sectional view of cable



AXL1 : 0.9mm×10P

AXL3 : 0.9mm×2P

Item	Description	Item	Description
1	Drain wire	6	LSFH inner sheath
2	Annealed copper wire	7	Rip cord
3	XLPE insulation	8	corrugated steel tape
4	Polyester tape	9	LSFH outer sheath
5	Laminated aluminum tape		

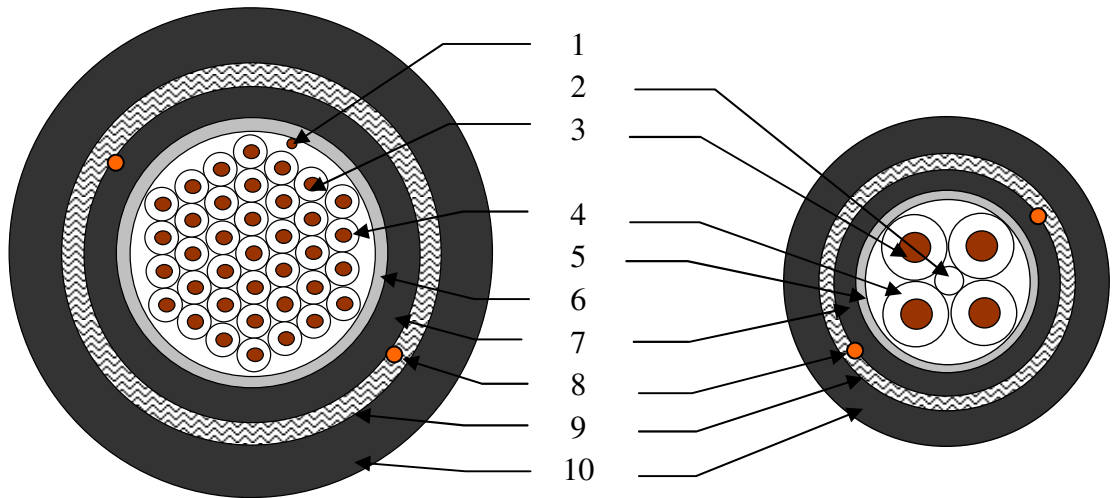


SIG1 : 1.53mm×6C

SIG2 : 1.53mm×10C

Item	Description	Item	Description
1	Drain wire	6	LSFH inner sheath
2	Filler	7	Rip cord
3	Annealed copper wire	8	corrugated steel tape
4	XLPE insulation	9	LSFH outer sheath
5	Mylar aluminum foil tape		

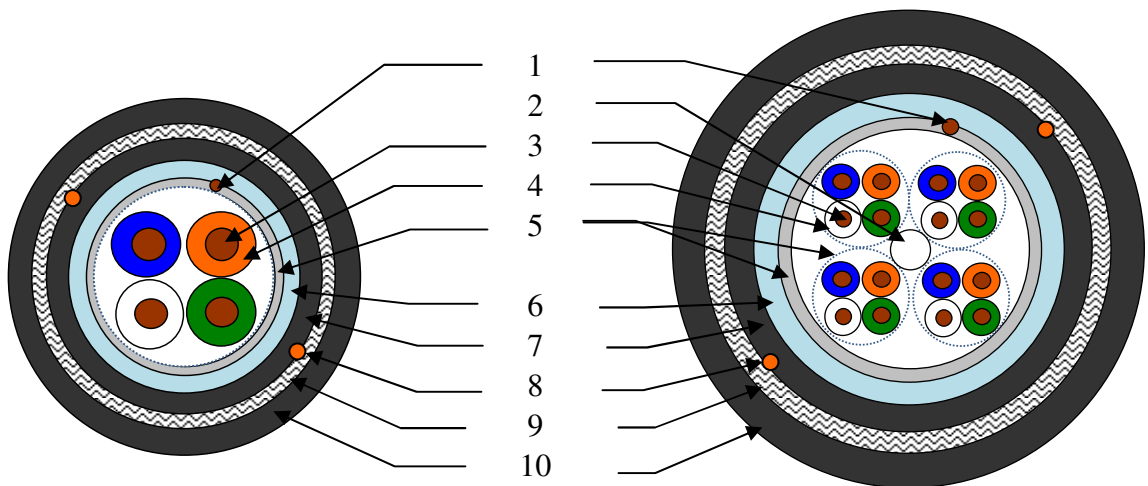
Cross sectional view of cable



SIG3 : 1.53mm×37C

SGT1 : 50/0.25mm×4C

Item	Description	Item	Description
1	Drain wire	6	Mylar aluminum foil tape
2	Filler	7	LSFH inner sheath
3	Annealed copper wire Anneal stranded copper wire	8	Rip cord
4	XLPE insulation	9	corrugated steel tape
5	Polyester tape	10	LSFH outer sheath

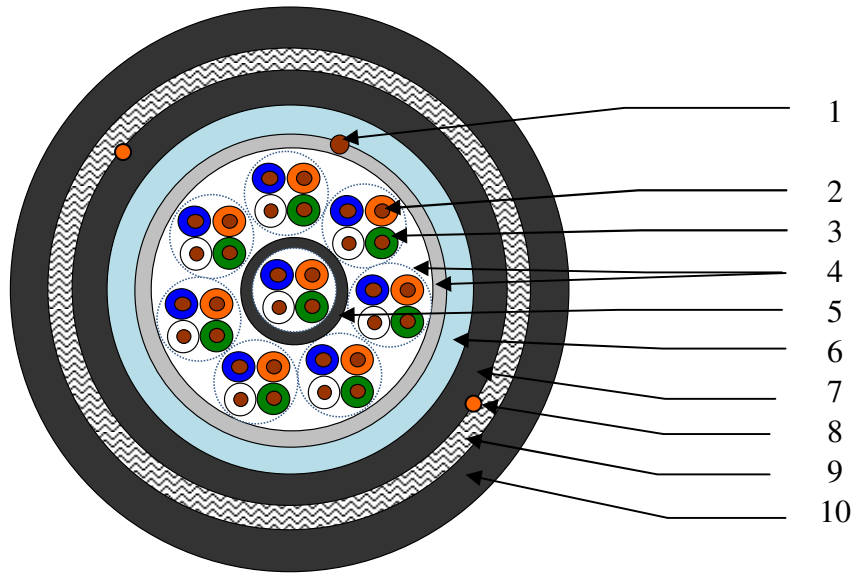


TUT1 : 1.4mm×1Q

TUU1 : 1.4mm×4Q

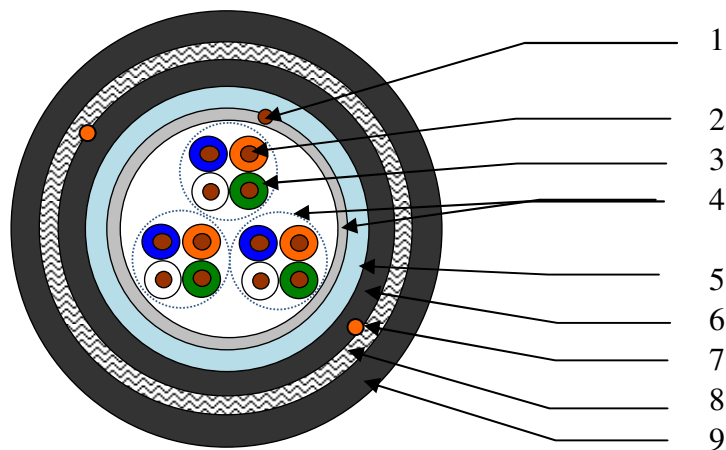
Item	Description	Item	Description
1	Drain wire	6	Laminated aluminum tape
2	Filler	7	LSFH inner sheath
3	Annealed copper wire	8	Rip cord
4	XLPE insulation	9	corrugated steel tape
5	Polyester tape	10	LSFH outer sheath

Cross sectional view of cable



TUU2 : 1.4mm×8Q

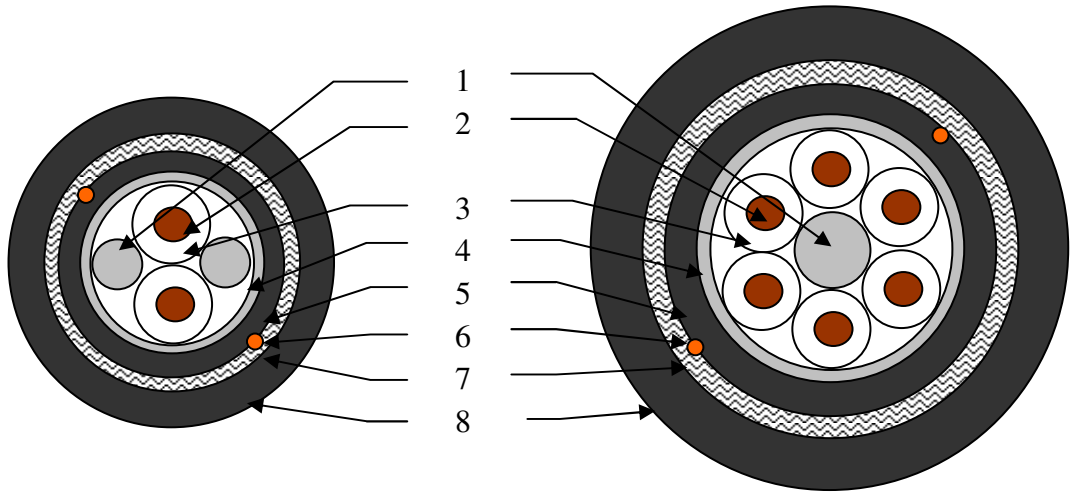
Item	Description	Item	Description
1	Drain wire	6	Laminated aluminum tape
2	Annealed copper wire	7	LSFH inner sheath
3	XLPE insulation	8	Rip cord
4	Polyester tape	9	corrugated steel tape
5	LSFH bed layer	10	LSFH outer sheath



TUU3 : 1.4mm×3Q

Item	Description	Item	Description
1	Drain wire	6	LSFH inner sheath
2	Annealed copper wire	7	Rip cord
3	XLPE insulation	8	corrugated steel tape
4	Polyester tape	9	LSFH outer sheath
5	Laminated aluminum tape		

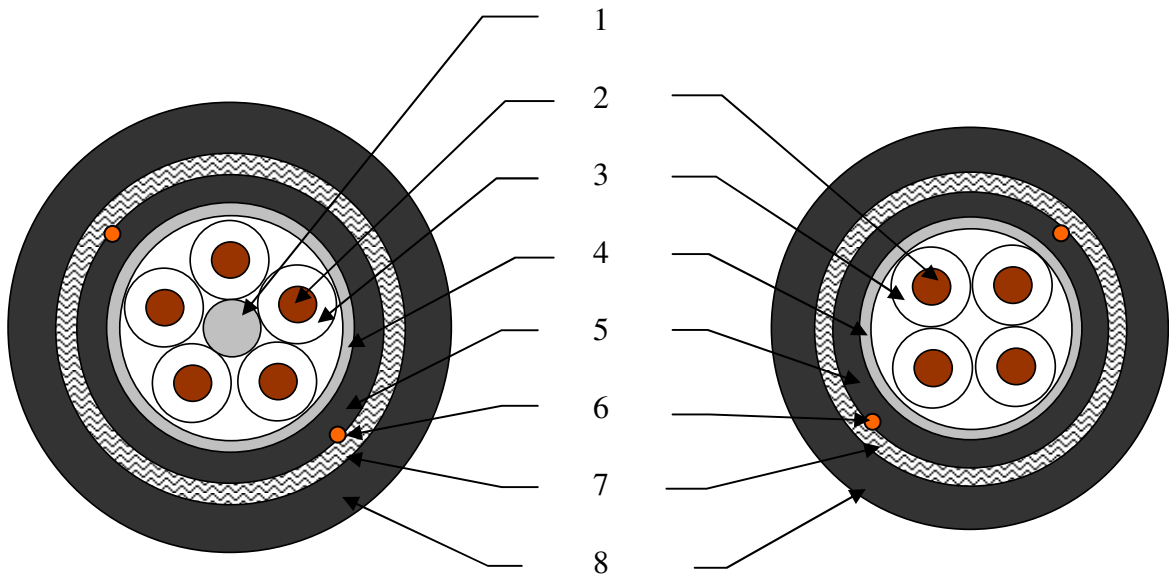
Cross sectional view of cable



SGT1 : 2.5mm×2C

SGT2 : 2.5mm×6C

Item	Description	Item	Description
1	Filler	5	LSFH inner sheath
2	Anneal stranded copper wire	6	Rip cord
3	XLPE insulation	7	corrugated steel tape
4	Polyester tape	8	LSFH outer sheath



Cable type : SWM1 、 SWM2 、 SWM3 、 SWM5 、 SWM6 、 SWM7 、 SWM8 、 SWM9 、 SWM10 、 SWM11

Item	Description	Item	Description
1	Filler	5	LSFH inner sheath
2	Anneal stranded copper wire	6	Rip cord
3	XLPE insulation	7	corrugated steel tape
4	Polyester tape	8	LSFH outer sheath