

Loose Tube Cable (Single Sheath)



HWABAEK loose tube cables provide highly reliable transmission parameters for optimum fiber performance. Each cable accommodates 2 to 288 fibers, and cables are designed to ensure continuous operation even in severe environments. HWABAEK offers the following types of loose tube cables: direct buried, duct and aerial, and cables for indoor use in conduits. The intelligent design and high quality of HWABAEK cables have also proven reliable in installations all over the world.

Key Features

- 2~288 fiber counts cable
- 1~12 fibers per jelly filled buffer tube
- Custom and composite cables
 - Hybrid with copper pairs
 - Composite single mode and multi-mode fibers
- High tensile strength design
- Excellent optical performance

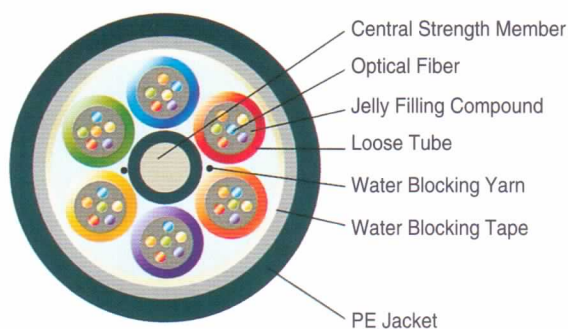
Special Construction

Other sheath constructions are available to meet specific environmental conditions.

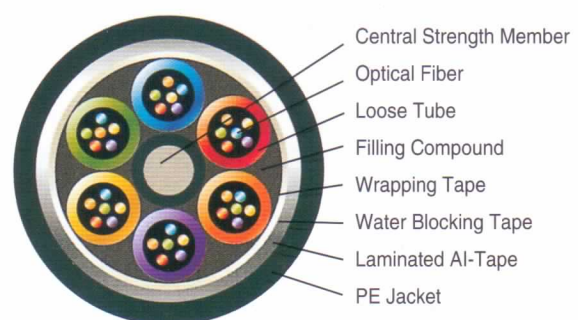
Applications

- High-speed voice, video and data communication
- Local Area Network
- Long Haul Network
 - Duct, Direct Burial, Aerial

Construction



[Dry Type]



[Jelly Tape]

Design

Optimum performance and life of an optical fiber are achieved when the fiber is strain-free in the completed cable. The best way to decouple an optical fiber from cable strain due to thermal, tensile, vibration load is to place it inside a gel-filled loose tube having an inner diameter large enough to allow the fiber to move freely within it.

Central Strength Member

Steel strength member or Fiber Reinforce Plastic (FRP) member.

Loose Buffer Tube

Jelly-filled thermoplastic tube. The buffer tube maintains optical fiber's mechanical and optical integrity.

Cable Core

Loose buffer tubes are stranded around the strength member.

Identification

By colored fibers and colored buffer tubes.

Filling Compound

Cable core is filled with a jelly compound to prevent the ingress of water.

Wrapping Tape or Reinforcements

Used as peripheral tensile strength members, aramid yarn or glass fiber reinforcements are designed to offer improved dielectric properties, increased tensile strength and added dimensional stability. Wrapping is a non-hydroscopic material.

Laminated Aluminum Tape (optional)

Applied with an overlap over cable core for metallic protection

Outer Jacket

Non-reclaimed high molecular weight polyethylene. Outer jacket is bonded to aluminum tape or steel tape having copolymer coatings on both sides.

Mechanical & Environmental Characteristics

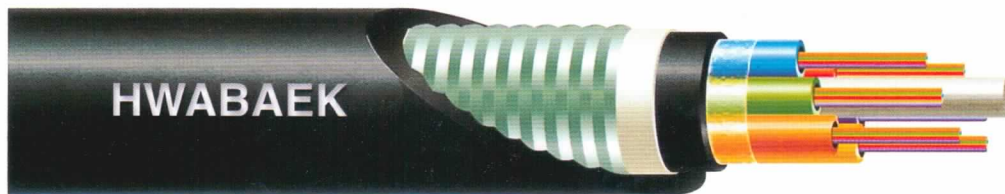
Items	Specifications
Maximum Pulling Load	2700N
Maximum Operating Load	1000N
Minimum-Bending Radius	20 x Dia.(Installation)/10 x Dia.(Installed)
Temperature Range	-50°C ~+70°C (Storage)/-40°C ~+70°C (Operating)
Crush Resistance	200N/CM
Impact Resistance	20times(@3N.m)
Maximum Vertical Rise	200m

Cable Diameter and Weight

Fibers per Tube	Fibers	Steel CSM		Dielectric CSM	
		Dia. (mm)	Wt (kg/km)	Dia. (mm)	Wt (kg/km)
6	2-36	12.5	150	12.5	140
	48	14.5	200	14.5	180
12	48-72	14.6	200	14.6	180
	74-96	16.0	250	16.0	230
	98-120	18.0	300	18.0	280
	122-144	20.5	360	20.5	330
	156-288	22.0	470	22.0	410

Note : Special No. of fibers per tube are available on request.

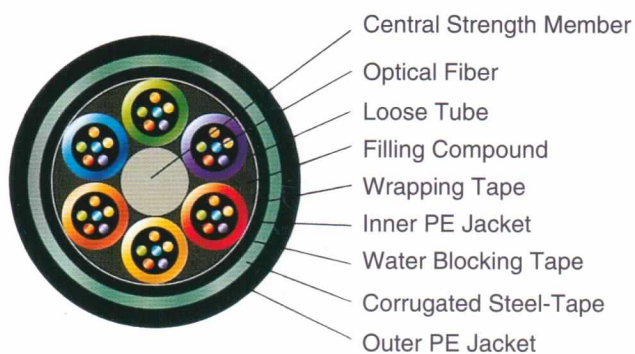
Loose Tube Cable (Double Sheath)



Design

Armored Sheath: A stainless steel shielded jacket is inside the outer jacket and provides protection from both lightning-and rodent-induced cable damage.

Construction



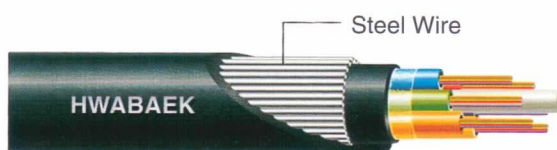
Mechanical & Environmental Characteristics

Items	Specifications
Maximum Pulling Load	2700N
Maximum Operating Load	1000N
Minimum-Bending Radius	20 × dia. (Installation)/ 10 × dia. (Installed)
Temperature Range	-50°C~+70°C (Storage)/ -40°C~+70°C (Operating)
Crush Resistance	500N/cm
Impact Resistance	20 times (@3N.m)
Maximum Vertical Rise	120m

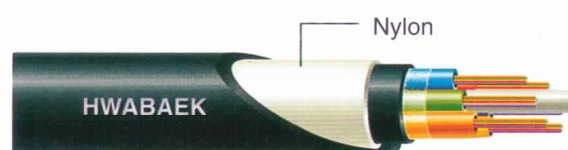
Cable Diameter and Weight

Fibers per Tube	Fibers	Steel CSM		Dielectric CSM	
		Dia. (mm)	Wt (kg/km)	Dia. (mm)	Wt (kg/km)
6	2-36	14.5	250	14.5	240
	48	16.5	310	16.5	290
	48-72	16.6	320	16.6	300
12	74-96	18.0	380	18.0	360
	98-120	20.0	420	20.0	400
	122-144	22.5	510	22.5	480
	156-288	24.0	630	24.0	560

Optional



Steel Wire Armored Cable



Nylon Sheath Cable

Unitube Cable

HWABAEK unitube cables can accommodate 2 to 12 fibers and are designed to ensure continuous operation even in severe conditions. With a light weight and small diameter, they provide easy installation in duct, underground, aerial, and indoor applications

Key Features

- 2~12 Fiber Cables
- Light weight
- Small Diameter
- Easy installation

Applications

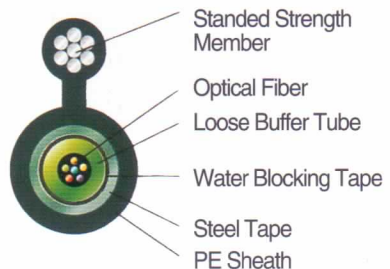
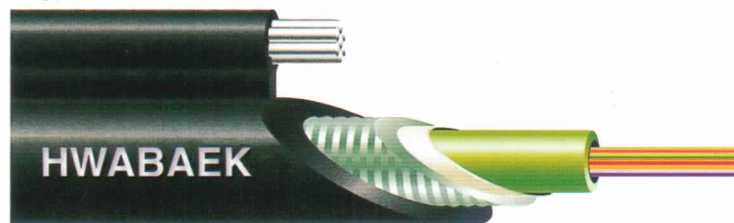
- High-speed voice, video and data communications
- Local Area Network
- Long Haul Network
 - Duct, Direct Burial, Aerial, Indoor

Construction

Type 1



Type 2



Design

Jelly Compound: Water blocking jelly-filled thermoplastic tube

Strength Member: Glass yarn or stranded steel wire

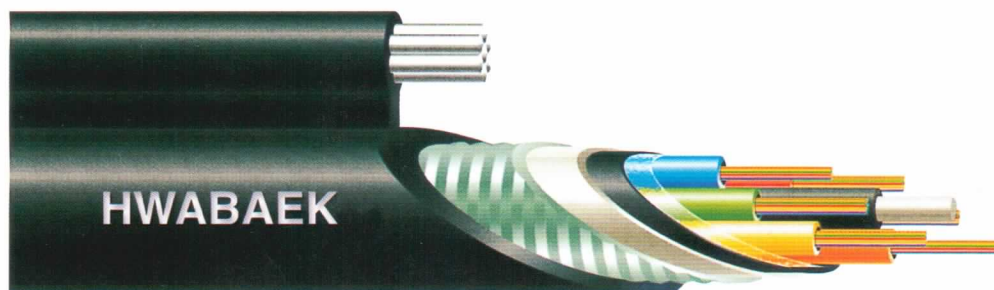
Mechanical & Environmental Specifications

Items	Type 1	Type 2
Max. Tensile Strength	1500N	2700N
Min. Bending Radius during Installation Operation	20* Cable outer Diameter 10* Cable outer Diameter	
Storage Temperature	-40°C~+75°C	-40°C~+75°C
Operating Temperature	-20°C~+75°C	-40°C~+75°C
Crush Resistance	20kg/cm	20kg/cm

Cable Diameter and Weight

Items	Type 1	Type 2
Fiber Counts	1~12	1~12
Cable Dia.	8.5	17.6 / 9.3
Cable Weight	84	132

Figure-8 Cable

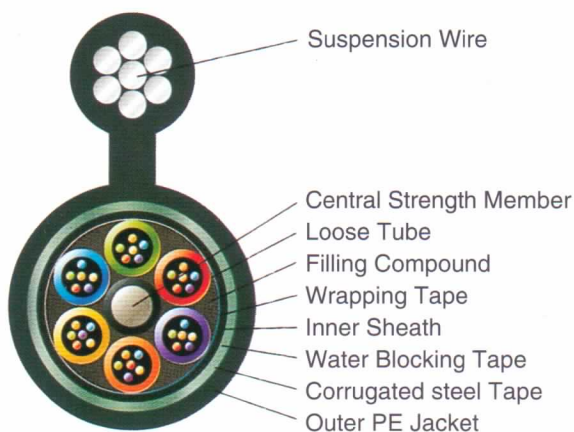


HWABAEK figure-8 cables are designed for aerial applications. This cable features an integrated steel messenger wire and polyethylene outer sheath and is able to accommodate from 2 to 144 fibers. Because of superior design, continuous performance even in the most severe conditions is ensured. For loose tube types, the fibers are inserted in loose buffer tubes filled with a water blocking compound. The cable meets NESC Rule 250 for light and heavy loading districts.

Key Features

- Self-support design
- Integral messenger saves installation time and cost
- Able to support 2 to 144 fibers

Construction



Special Construction

- Other constructions available to meet specific environmental demands upon request.

Applications

- High-speed voice, video and data communications
- Aerial installation

Design

Cable Core: Stranded loose buffer tube

Filling compound (Optional): Blocks the core interstice to prevent the ingress of water

Inner Jacket (Armored design only): Non-reclaimed high molecular weight polyethylene

Armor (Optional): A corrugated steel tape to prevent damage by rodents and insects

Outer Jacket: Non-reclaimed high molecular weight polyethylene. When used with armor the outer jacket is bonded.

Mechanical & Environmental Specifications

Items	Specifications
Maximum Pulling Load	15,000N
Maximum Operating Load	7,000N
Min. Bending Radius	20 × cable dia.
Crush Resistance	200N/cm
Storage Temperature	-50°C ~ +70°C
Operating Temperature	-40°C ~ +70°C
Impact Resistance	20 times (@3N.m)

Cable Diameter and Weight

Fiber per Tube	Fiber Counts	Diameter (mm)	Weight (kg/km)
6	2-36	17.2 × 28.2	513
	38-72	18.6 × 29.6	563
12	74-96	20.5 × 31.5	630
	98-120	21.6 × 32.6	690
	122-144	23.4 × 34.4	757

ADSS Cable

(All Di-electric Self-Supporting Cable)



ADSS (All Dielectric Self-Supporting) cables are designed for aerial applications. The cable can accommodate 2 to 144 fibers and is designed to ensure continuous operation even in severe conditions. A unique high-quality material, designed by HWABAEK, is used to make the jacket for installation on high-voltage lines.

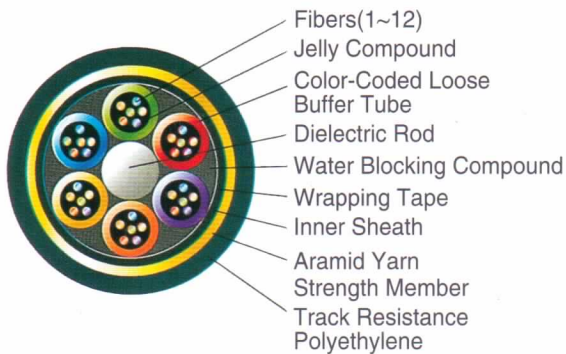
Key Features

- Self-support design
- Optimized construction for high-voltage lines
- High tensile strength design
- Non-tracking sheath design

Applications

- Aerial applications on poles or towers

Construction



Design

Cable Core: Stranded loose buffer tube

Filling compound (Optional): Blocks the core interstice to prevent the ingress of water

Inner Jacket (Armored design only): Non-reclaimed high molecular weight polyethylene

Strength Member: Aramid yarn or glass yarn

Outer Jacket: Non-reclaimed high molecular weight polyethylene or special jacket material for high-voltage lines

Mechanical & Environmental Specifications

Items	Specifications
Max. Span Length	1300m
Max. Allowable Load	40kN
Operating Temperature	-40°C ~ +70°C
Crush Resistance	400N/cm
Min. Bending Radius	100 × cable outer diameter

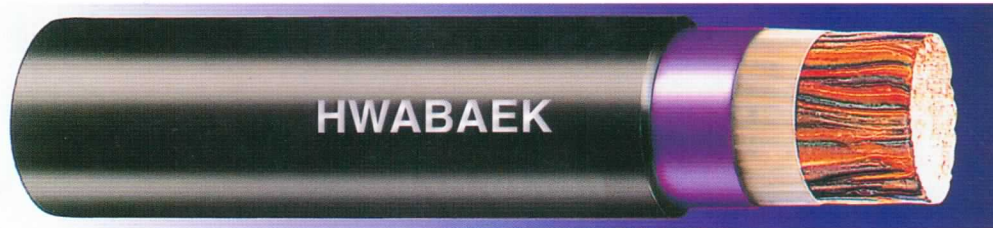
Cable Diameter and Weight

Fiber Counts	Diameter (mm)	Weight (kg/km)
12	13.0	130
24	13.5	140
36	14.0	150
48	15.0	160
96	19.0	220
144	22.0	300

FOAM / SKIN INSULATED UNIT TWIN JELLY FILLED (REA)

APPLICATION

This cable is used for distribution or junction network in exchange area and usually direct burial or underground duct application. This cable is generally based on REA Specification PE-89.



CONSTRUCTION

Conductor

Solid annealed copper, the conductor sizes are 19, 22, 24, 26 and 28 AWG.

Insulation

Dual insulation of foam PE covered with a skin of HDPE.

Twinning

Two colored insulated conductors are uniformly twisted together to form a pair. The twist length is designed to minimize the capacitance unbalance and the crosstalk.

Stranding

Twisted pairs are assembled to form a substantially cylindrical group of 25 pairs, called unit. When desired for lay-up reasons, the units are divided into two or more sub-units which are banded with durably colored polyethylene tapes and cabled to complete cable core. Super unit that is assembled with suitable number of units, sub-units may be used for manufacturing reasons.

Filling Compound

The water resistant filling compound is applied to the air space within the cable core.

Core Covering

A non-hygroscopic and dielectric tape is applied longitudinally or hellically having a suitable overlap.

Flooding Compound

Sufficient flooding compound is applied between the core wrap and shield. If inner jacket is applied under the corrugated shield, flooding compound is not applied.

Shield

A single flat or corrugated aluminium tape (0.2mm thickness of aluminium) coated on both sides with plastic is applied longitudinally over the core covering with an overlap.

Armor (optional)

A single plastic coated or bare steel corrugated armor is applied longitudinally directly over the coated aluminium shield.

Jacket

Low density or medium density polyethylene.

Identification

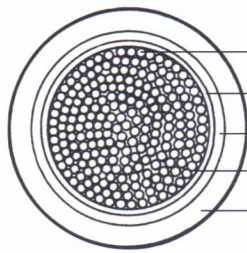
A plastic tape, durably marked with the manufacturer's name, year of manufacture and cable size, if required, is placed under the core covering.

Alternatively, these details may be printed on the outer wrappings or outside of the jacket.

Length Marking

Sequentially numbered length marking is printed on the outside of the jacket.

CROSS SECTION



- Conductor**, Foam Skin Insulated Conductor
- Core Wrapping**, Non-hygroscopic Dielectric Tape
- Shield**, Plastic Coated Aluminium Tape
- Filling Compound**, Water Resistant Compound
- Jacket**, Black PE, Compound

COLOR SCHEME FOR 25 PAIR UNITS

Pair No.	Color		Pair No.	Color	
	Tip	Ring		Tip	Ring
1	White	Blue	14	Black	Brown
2	White	Orange	15	Black	Grey
3	White	Green	16	Yellow	Blue
4	White	Brown	17	Yellow	Orange
5	White	Grey	18	Yellow	Green
6	Red	Blue	19	Yellow	Brown
7	Red	Orange	20	Yellow	Grey
8	Red	Green	21	Violet	Blue
9	Red	Brown	22	Violet	Orange
10	Red	Grey	23	Violet	Green
11	Black	Blue	24	Violet	Brown
12	Black	Orange	25	Violet	Grey
13	Black	Green			

25 PAIR UNIT IDENTIFICATION FOR CABLE UP TO 600 PAIRS

25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes	25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes
1	1-25	White-Blue	13	301-325	Black-Green
2	26-50	White-Orange	14	326-350	Black-Brown
3	51-75	White-Green	15	351-375	Black-Grey
4	76-100	White-Brown	16	376-400	Yellow-Blue
5	101-125	White-Grey	17	401-425	Yellow-Orange
6	126-150	Red-Blue	18	426-450	Yellow-Green
7	151-175	Red-Orange	19	451-475	Yellow-Brown
8	176-200	Red-Green	20	476-500	Yellow-Grey
9	201-225	Red-Brown	21	501-525	Violet-Blue
10	226-250	Red-Grey	22	526-550	Violet-Orange
11	251-275	Black-Blue	23	551-575	Violet-Green
12	276-300	Black-Orange	24	576-600	Violet-Brown

SUPER UNIT GROUP IDENTIFICATION FOR CABLE MORE THAN 600 PAIRS

Super Units	Pair count	Color Code	Super Units	Pair count	Color Code
1st. 24Groups	1-600	White	4th. 24Groups	1801-2400	Yellow
2nd. 24Groups	601-1200	Red	5th. 24Groups	2401-3000	Violet
3rd. 24Groups	1201-1800	Black			

CABLE FORMATION

These lay-ups are not requirements but illustrations only (Max. 3000 pairs)

Number of Pairs	Construction			
	Center	1 Layer	2 Layer	3 Layer
100	4 × (25)	-	-	-
150	1 × (25)	5 × (25)	-	-
150	3 × (50)	-	-	-
200	1 × (50)	6 × (25)	-	-
200	4 × (50)	-	-	-
250	3 × (25)	7 × (25)	-	-
300	1 × (50)	5 × (50)	-	-
400	1 × (100)	6 × (50)	-	-
500	1 × (100)	8 × (50)	-	-
500	3 × (50)	7 × (50)	-	-
600	1 × (100)	5 × (100)	-	-
800	4 × (50)	6 × (100)	-	-
900	4 × (50)	7 × (100)	-	-
1000	3 × (100)	7 × (100)	-	-
1200	3 × (100)	9 × (100)	-	-
1200	4 × (100)	8 × (100)	-	-
1400	4 × (100)	10 × (100)	-	-
1500	1 × (100)	5 × (100)	9 × (100)	-
1600	1 × (100)	5 × (100)	10 × (100)	-
1800	1 × (100)	6 × (100)	11 × (100)	-
2000	1 × (100)	6 × (100)	13 × (100)	-
2000	4 × (50)	6 × (100)	12 × (100)	-
2100	3 × (100)	7 × (100)	11 × (100)	-
2200	3 × (100)	7 × (100)	12 × (100)	-
2300	3 × (100)	8 × (100)	12 × (100)	-
2400	4 × (100)	8 × (100)	12 × (100)	-
2600	3 × (100)	9 × (100)	14 × (100)	-
2700	3 × (100)	9 × (100)	15 × (100)	-
2800	3 × (100)	9 × (100)	16 × (100)	-
3000	4 × (100)	10 × (100)	16 × (100)	-

ELECTRICAL CHARACTERISTICS AT 20°C

Conductor Size		AWG 28	mm 0.32	AWG 26	mm 0.4	AWG 24	mm 0.5	AWG 22	mm 0.65	AWG 19	mm 0.9
Maximum Conductor Resistance (ohms/km)		226.8		147.0		93.5		56.5		29.0	
Resistance Unbalance(%)	Max. Avg.	2.0		2.0		1.5		1.5		1.5	
	Ind. Max.	5.0		5.0		5.0		4.0		4.0	
Dielectric Strength (KV / 3sec) • Conductor to Conductor • Conductor to Ground		DC 1.5		DC 2.4		DC 3.0		DC 3.6		DC 4.5	
		DC 10.0		DC 15.0							
Average Mutual Capacitance (at 1 KHz)		52 ± 4nF / km for less than 12 pairs cable 52 ± 2nF / km for 12 pairs and larger cable									
Capacitance	Pair to Pair	Ind. Max. : 180pF / km for 12 pairs cable BMS Max. : 45.3pF / km for 12 pairs and larger cable									
Unbalance	Pair to Ground	Ind : Max. : 2625pF / km for all cable Max. Avg. : 574pF / km for 12 pairs and larger cable									
Mutual Conductance (at 1 KHz)		Max. : 2.0 μΩ / km									
Insulation Resistance		Min. : 16,000 MΩ - km									
Attenuation Nom. (dB / km)	150 KHz	15.5		11.4		8.3		6.2		4.4	
	772 KHz	27.1		22.5		18.5		14.6		10.4	

CROSSTALK LOSS

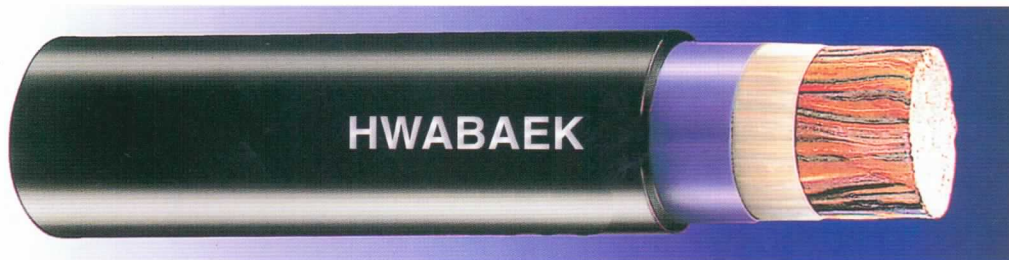
The crosstalk loss shall not be less than the values shown in the following table.

FEXT (at 150 KHz)	RMS		Min. 68dB / km
	Any Pair Combination		Min. 58dB / km
NEXT (at 772 KHz)	Unit Pair Size		M-S (dB)
	Within Unit	12 & 13	Min. 56
		25	Min. 60
	Between Unit	Adjacent 13	Min. 65
		Adjacent 25	Min. 66
		Non-Adjacent	Min. 81

SOLID POLYETHYLENE INSULATED UNIT TWIN JELLY FILLED CABLE (REA)

APPLICATION

This cable is used for distribution in exchange area and usually and direct burial application. This cable is generally based on REA Specification PE-39.



CONSTRUCTION

Conductor

Solid annealed copper. The conductor sizes are 19,22, 24 and 26 AWG.

Insulation

Solid high-density polyethylene.

Twinning

Two colored insulated conductors are uniformly twisted together to form a pair. The twist length is designed to minimize the capacitance unbalance and the crosstalk.

Stranding

Twisted pairs are assembled into unit of 25 pairs, When desired for lay-up reason, the units are divided into two or more sub-units which are binded with durably colored polyethylene tapes and cabled to complete cable core. Super unit that is assembled with suitable number of units, sub-units may be used for manufacturing reasons.

Filling Compound

The water resistant filling compound is applied to the air space within the cable core.

Core Covering

A non-hygroscopic and dielectric tape is applied longitudinally or hellically having a suitable overlap.

Flooding Compound

Sufficient flooding compound is applied between the core wrap and shield. If inner jacket is applied under the corrugated shield, flooding compound is not applied.

Shield

A single flat or corrugated aluminium tape (0.2mm thickness of aluminium) coated on both sides with plastic is applied longitudinally over the core covering with an overlap.

Armor (optional)

A single plastic coated or bare steel corrugated armor is applied longitudinally directly over the coated aluminium shield.

Jacket

Black low density or medium density polyethylene.

Identification

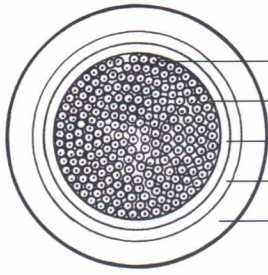
A plastic tape, durably marked with the manufacturer's name, year of manufacture and cable size, if required, is placed under the core covering.

Alternatively, these details may be printed on the outer wrappings is outside of the jacket.

Length Marking

Sequentially numbered length marking is printed on the outside of the jacket.

CROSS SECTION



- Conductor, Foam Skin Insulated Conductor
- Filling Compound, Water Resistant Compound
- Core Wrapping, Non-hygroscopic Dielectric Tape
- Shield, Plastic Coated Aluminium Tape
- Jacket, Black PE, Compound

COLOR SCHEME FOR 25 PAIR UNITS

Pair No.	Color		Pair No.	Color	
	Tip	Ring		Tip	Ring
1	White	Blue	14	Black	Brown
2	White	Orange	15	Black	Grey
3	White	Green	16	Yellow	Blue
4	White	Brown	17	Yellow	Orange
5	White	Grey	18	Yellow	Green
6	Red	Blue	19	Yellow	Brown
7	Red	Orange	20	Yellow	Grey
8	Red	Green	21	Violet	Blue
9	Red	Brown	22	Violet	Orange
10	Red	Grey	23	Violet	Green
11	Black	Blue	24	Violet	Brown
12	Black	Orange	25	Violet	Grey
13	Black	Green			

25 PAIR UNIT IDENTIFICATION FOR CABLE UP TO 600 PAIRS

25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes	25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes
1	1-25	White-Blue	13	301-325	Black-Green
2	26-50	White-Orange	14	326-350	Black-Brown
3	51-75	White-Green	15	351-375	Black-Grey
4	76-100	White-Brown	16	376-400	Yellow-Blue
5	101-125	White-Grey	17	401-425	Yellow-Orange
6	126-150	Red-Blue	18	426-450	Yellow-Green
7	151-175	Red-Orange	19	451-475	Yellow-Brown
8	176-200	Red-Green	20	476-500	Yellow-Grey
9	201-225	Red-Brown	21	501-525	Violet-Blue
10	226-250	Red-Grey	22	526-550	Violet-Orange
11	251-275	Black-Blue	23	551-575	Violet-Green
12	276-300	Black-Orange	24	576-600	Violet-Brown

SUPER UNIT GROUP IDENTIFICATION FOR CABLE MORE THAN 600 PAIRS

Super Units	Pair count	Color Code	Super Units	Pair count	Color Code
1st. 24Groups	1-600	White	4th. 24Groups	1801-2400	Yellow
2nd. 24Groups	601-1200	Red			
3rd. 24Groups	1201-1800	Black			

CABLE FORMATION

These lay-ups are not requirements but illustrations only (Max. 2400 pairs)

Number of Pairs	Construction			
	Center	1 Layer	2 Layer	3 Layer
100	4 × (25)	-	-	-
150	1 × (25)	5 × (25)	-	-
150	3 × (50)	-	-	-
200	1 × (50)	6 × (25)	-	-
200	4 × (50)	-	-	-
250	3 × (25)	7 × (25)	-	-
300	1 × (50)	5 × (50)	-	-
400	1 × (100)	6 × (50)	-	-
500	1 × (100)	8 × (50)	-	-
500	3 × (50)	7 × (50)	-	-
600	1 × (100)	5 × (100)	-	-
800	4 × (50)	6 × (100)	-	-
900	4 × (50)	7 × (100)	-	-
1000	3 × (100)	7 × (100)	-	-
1200	3 × (100)	9 × (100)	-	-
1200	4 × (100)	8 × (100)	-	-
1400	4 × (100)	10 × (100)	-	-
1500	1 × (100)	5 × (100)	9 × (100)	-
1600	1 × (100)	5 × (100)	10 × (100)	-
1800	1 × (100)	6 × (100)	11 × (100)	-
2000	1 × (100)	6 × (100)	13 × (100)	-
2000	4 × (50)	6 × (100)	12 × (100)	-
2100	3 × (100)	7 × (100)	11 × (100)	-
2200	3 × (100)	7 × (100)	12 × (100)	-
2300	3 × (100)	8 × (100)	12 × (100)	-
2400	4 × (100)	8 × (100)	12 × (100)	-

ELECTRICAL CHARACTERISTICS AT 20 °C

Conductor Size		AWG 26	mm 0.4	AWG 24	mm 0.5	AWG 22	mm 0.65	AWG 19	mm 0.9
Maximum Conductor Resistance (ohms/km)		144.4		90.2		57.1		28.5	
Resistance Unbalance(%)	Max. Ave.	2.0		1.5		1.5		1.5	
	Ind. Max.	5.0		5.0		4.0		4.0	
Dielectric Strength (KV / 3sec) • Conductor to Conductor • Conductor to Ground		DC 2.8		DC 4.0		DC 5.0		DC 7.0	
Average Mutual Capacitance (at 1 KHz)		52 ± 4nF / km for less than 12 pairs cable 52 ± 2nF / km for 12 pairs and larger cable							
Capacitance Unbalance	Pair to Pair	Ind. Max. : 180pF / km for 12 pairs cable BMS Max. : 45.3pF / km for 12 pairs and larger cable							
	Pair to Ground	Ind : Max. : 2625pF / km for all cable Max. Avg. : 574pF / km for 12 pairs and larger cable							
Mutual Conductance (at 1 KHz)		Max. : 2.0 μΩ / km							
Insulation Resistance		Min. : 16,000 MΩ - km							
Attenuation Nom. (dB / km)	150 KHz	10.9		7.5		5.7		4.0	
	772 KHz	19.5		15.4		12.4		8.6	

CROSTALK LOSS

The crosstalk loss shall not be less than the values shown in the following table.

FEXT (at 150 KHz)	RMS		Min. 68dB / km
	Any Pair Combination		Min. 58dB / km
NEXT (at 772 KHz)	Unit Pair Size		M-S (dB)
	Within Unit	12 & 13	Min. 56
		25	Min. 60
	Between Unit	Adjacent 13	Min. 65
		Adjacent 25	Min. 66
		Non-Adjacent	Min. 81

FOAM / SKIN INSULATED UNIT TWIN UNFILLED CABLE (REA)

APPLICATION

This cable is used for distribution in exchange area and usually conduit or direct burial application. This cable is generally based on REA Specification PE-22.



CONSTRUCTION

Conductor

Solid annealed copper. The sizes are 19, 22, 24, 26 and 28 AWG.

Insulation

Dual insulation of foam PE covered with a skin of HDPE.

Twining

Two colored insulated conductors are uniformly twisted together to form a pair. The twist length is designed to minimize the capacitance unbalance and the crosstalk.

Stranding

Twisted pairs are assembled into unit of 25 pairs, When desired for lay-up reasons, the units are divided into two or more sub-units which are binded with durably colored polyethylene tapes and cabled to complete cable core, Super unit that is assembled with suitable number of units, sub-units may be used for manufacturing reasons.

Core Covering

A non-hygroscopic and dielectric tape is applied longitudinally or hellically having a suitable overlap.

Shield

A single flat or corrugated aluminium tape (0.2mm thickness of aluminium) coated on both sides with plastic is applied longitudinally over the core covering with an overlap.

Armor (optional)

A single plastic coated or bare steel corrugated armor is applied longitudinally directly over the coated aluminium shield.

Jacket

Black low density or medium density polyethylene.

Identification

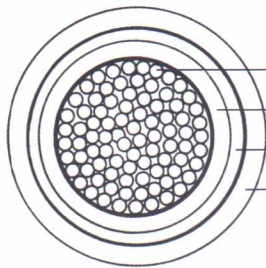
A plastic tape, durably marked with the manufacturer's name, year of manufacture and cable size, if required, is placed under the core covering.

Alternatively, these details may be printed on the outer wrappings or outside of the jacket.

Length Marking

Sequentially numbered length marking is printed on the outside of the jacket.

CROSS SECTION



- **Conductor**, Foam Skin Insulated Conductor
- **Core Wrapping**, Non-hygroscopic Dielectric Tape
- **Shield**, Plastic Coated Aluminium Tape
- **Jacket**, Black PE, Compound

COLOR SCHEME FOR 25 PAIR UNITS

Pair No.	Color		Pair No.	Color	
	Tip	Ring		Tip	Ring
1	White	Blue	14	Black	Brown
2	White	Orange	15	Black	Grey
3	White	Green	16	Yellow	Blue
4	White	Brown	17	Yellow	Orange
5	White	Grey	18	Yellow	Green
6	Red	Blue	19	Yellow	Brown
7	Red	Orange	20	Yellow	Grey
8	Red	Green	21	Violet	Blue
9	Red	Brown	22	Violet	Orange
10	Red	Grey	23	Violet	Green
11	Black	Blue	24	Violet	Brown
12	Black	Orange	25	Violet	Grey
13	Black	Green			

25 PAIR UNIT IDENTIFICATION FOR CABLE UP TO 600 PAIRS

25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes	25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes
1	1-25	White-Blue	13	301-325	Black-Green
2	26-50	White-Orange	14	326-350	Black-Brown
3	51-75	White-Green	15	351-375	Black-Grey
4	76-100	White-Brown	16	376-400	Yellow-Blue
5	101-125	White-Grey	17	401-425	Yellow-Orange
6	126-150	Red-Blue	18	426-450	Yellow-Green
7	151-175	Red-Orange	19	451-475	Yellow-Brown
8	176-200	Red-Green	20	476-500	Yellow-Grey
9	201-225	Red-Brown	21	501-525	Violet-Blue
10	226-250	Red-Grey	22	526-550	Violet-Orange
11	251-275	Black-Blue	23	551-575	Violet-Green
12	276-300	Black-Orange	24	576-600	Violet-Brown

SUPER UNIT GROUP IDENTIFICATION FOR CABLE MORE THAN 600 PAIRS

Super Units	Pair count	Color Code	Super Units	Pair count	Color Code
1st. 24Groups	1-600	White	4th. 24Groups	1801-2400	Yellow
2nd. 24Groups	601-1200	Red	5th. 24Groups	2401-3000	Violet
3rd. 24Groups	1201-1800	Black	6th. 24Groups	3001-3600	Blue

CABLE FORMATION

These lay-ups are not requirements but illustrations only (Max. 3600 pairs)

Number of Pairs	Construction			
	Center	1 Layer	2 Layer	3 Layer
100	4 × (25)	-	-	-
150	1 × (25)	5 × (25)	-	-
150	3 × (50)	-	-	-
200	1 × (50)	6 × (25)	-	-
200	4 × (50)	-	-	-
250	3 × (25)	7 × (25)	-	-
300	1 × (50)	5 × (50)	-	-
400	1 × (100)	6 × (50)	-	-
500	1 × (100)	8 × (50)	-	-
500	3 × (50)	7 × (50)	-	-
600	1 × (100)	5 × (100)	-	-
800	4 × (50)	6 × (100)	-	-
900	4 × (50)	7 × (100)	-	-
1000	3 × (100)	7 × (100)	-	-
1200	3 × (100)	9 × (100)	-	-
1200	4 × (100)	8 × (100)	-	-
1400	4 × (100)	10 × (100)	-	-
1500	1 × (100)	5 × (100)	9 × (100)	-
1600	1 × (100)	5 × (100)	10 × (100)	-
1800	1 × (100)	6 × (100)	11 × (100)	-
2000	1 × (100)	6 × (100)	13 × (100)	-
2000	4 × (50)	6 × (100)	12 × (100)	-
2100	3 × (100)	7 × (100)	11 × (100)	-
2200	3 × (100)	7 × (100)	12 × (100)	-
2300	3 × (100)	8 × (100)	12 × (100)	-
2400	4 × (100)	8 × (100)	12 × (100)	-
2600	3 × (100)	9 × (100)	14 × (100)	-
2700	3 × (100)	9 × (100)	15 × (100)	-
2800	3 × (100)	9 × (100)	16 × (100)	-
3000	4 × (100)	10 × (100)	16 × (100)	-
3200	1 × (100)	5 × (100)	10 × (100)	16 × (100)
3600	1 × (100)	6 × (100)	11 × (100)	18 × (100)

ELECTRICAL CHARACTERISTICS

Conductor Size		AWG 28	mm 0.32	AWG 26	mm 0.4	AWG 24	mm 0.5	AWG 22	mm 0.65	AWG 19	mm 0.9
Maximum Conductor Resistance (ohms/km)		226.8		147.0		93.5		56.5		29.0	
Resistance Unbalance(%)	Max. Ave.	2.0		2.0		1.5		1.5		1.5	
	Ind. Max.	5.0		5.0		5.0		4.0		4.0	
Dielectric Strength (KV / 3sec) • Conductor to Conductor • Conductor to Ground		DC 1.0		DC 1.0		DC 1.2		DC 1.5		DC 1.5	
Average Mutual Capacitance (at 1 KHz)		52 ± 4nF / km for less than 12 pairs cable 52 ± 2nF / km for 12 pairs and larger cable									
Capacitance	Pair to Pair	Ind. Max. : 180pF / km for 12 pairs cable BMS Max. : 45.3pF / km for 12 pairs and larger cable									
Unbalance	Pair to Ground	Ind : Max. : 2625pF / km for all cable Max. Avg : 574pF / km for 12 pairs and larger cable									
Insulation Resistance		Min. : 16,000 MΩ - km									
Attenuation Nom. (dB / km)	150 KHz	16.5		11.7		8.6		6.6		5.2	
	772 KHz	30.0		24.0		19.4		15.5		11.7	

CROSSTALK LOSS

The crosstalk loss shall not be less than the values shown in the following table.

FEXT (at 150 KHz)	RMS		Min. 68dB / km
	Any Pair Combination		Min. 58dB / km
NEXT (at 772 KHz)	Unit Pair Size		M-S (dB)
	Within Unit	12 & 13	Min. 56
		25	Min. 60
	Between Unit	Adjacent 13	Min. 65
		Adjacent 25	Min. 66
		Non-Adjacent	Min. 81

SOLID POLYETHYLENE INSULATED, UNIT TWIN UNFILLED CABLE (REA)

APPLICATION

This cable is used for distribution in exchange area and usually conduit or direct burial application. This cable is generally based on REA Specification PE-22.



CONSTRUCTION

Conductor

Solid annealed copper,
The conductor sizes are 19, 22, 24 and 26 AWG.

Insulation

Solid high-density polyethylene.

Twinning

Two colored insulated conductors are uniformly twisted together to form a pair. The twist length is designed to minimize the capacitance unbalance and the crosstalk.

Stranding

Twisted pairs are assembled into unit of 25 pairs. When desired for lay-up reasons, the units are divided into two or more sub-units which are banded with durably colored polyethylene tapes and cabled to complete cable core. Super unit that is assembled with suitable number of units, sub-units may be used for manufacturing reasons.

Core Covering

A non-hygroscopic and dielectric tape is applied longitudinally or hellically having a suitable overlap.

Shield

A single flat or corrugated aluminium tape (0.2mm thickness of aluminium) coated on both sides with plastic is applied longitudinally over the core covering with an overlap.

Jacket

Black low density or medium density polyethylene.

Identification

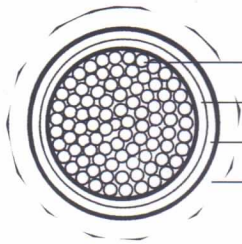
A plastic tape, durably marked with the manufacturer's name, year of manufacture and cable size, if required, is placed under the core covering.

Alternatively, these details may be printed on the outer wrappings or outside of the jacket.

Length Marking

Sequentially numbered length marking are printed on the outside of the jacket.

CROSS SECTION



- **Conductor**, Solid PE, Insulated Conductor
- **Core Wrapping**, Non-hygroscopic Dielectric Tape
- **Shield**, Plastic Coated Aluminium Tape
- **Jacket**, Black PE, Compound

COLOR SCHEME FOR 25 PAIR UNITS

Pair No.	Color		Pair No.	Color	
	Tip	Ring		Tip	Ring
1	White	Blue	14	Black	Brown
2	White	Orange	15	Black	Grey
3	White	Green	16	Yellow	Blue
4	White	Brown	17	Yellow	Orange
5	White	Grey	18	Yellow	Green
6	Red	Blue	19	Yellow	Brown
7	Red	Orange	20	Yellow	Grey
8	Red	Green	21	Violet	Blue
9	Red	Brown	22	Violet	Orange
10	Red	Grey	23	Violet	Green
11	Black	Blue	24	Violet	Brown
12	Black	Orange	25	Violet	Grey
13	Black				Green

25 PAIR UNIT IDENTIFICATION FOR CABLE UP TO 600 PAIRS

25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes	25 Pair Unit Number	Unit Pair Count	Color of Unit Identification Tapes
1	1-25	White-Blue	13	301-325	Black-Green
2	26-50	White-Orange	14	326-350	Black-Brown
3	51-75	White-Green	15	351-375	Black-Grey
4	76-100	White-Brown	16	376-400	Yellow-Blue
5	101-125	White-Grey	17	401-425	Yellow-Orange
6	126-150	Red-Blue	18	426-450	Yellow-Green
7	151-175	Red-Orange	19	451-475	Yellow-Brown
8	176-200	Red-Green	20	476-500	Yellow-Grey
9	201-225	Red-Brown	21	501-525	Violet-Blue
10	226-250	Red-Grey	22	526-550	Violet-Orange
11	251-275	Black-Blue	23	551-575	Violet-Green
12	276-300	Black-Orange	24	576-600	Violet-Brown

SUPER UNIT GROUP IDENTIFICATION FOR CABLE MORE THAN 600 PAIRS

Super Units	Pair count	Color Code	Super Units	Pair count	Color Code
1st. 24Groups	1-600	White	4th. 24Groups	1801-2400	Yellow
2nd. 24Groups	601-1200	Red	5th. 24Groups	2401-3000	Violet
3rd. 24Groups	1201-1800	Black			

CABLE FORMATION

These lay-ups are not requirements but illustrations only (Max. 3000 pairs)

Number of Pairs	Construction			
	Center	1 Layer	2 Layer	3 Layer
100	4 × (25)	-	-	-
150	1 × (25)	5 × (25)	-	-
150	3 × (50)	-	-	-
200	1 × (50)	6 × (25)	-	-
200	4 × (50)	-	-	-
250	3 × (25)	7 × (25)	-	-
300	1 × (50)	5 × (50)	-	-
400	1 × (100)	6 × (50)	-	-
500	1 × (100)	8 × (50)	-	-
500	3 × (50)	7 × (50)	-	-
600	1 × (100)	5 × (100)	-	-
800	4 × (50)	6 × (100)	-	-
900	4 × (50)	7 × (100)	-	-
1000	3 × (100)	7 × (100)	-	-
1200	3 × (100)	9 × (100)	-	-
1200	4 × (100)	8 × (100)	-	-
1400	4 × (100)	10 × (100)	-	-
1500	1 × (100)	5 × (100)	9 × (100)	-
1600	1 × (100)	5 × (100)	10 × (100)	-
1800	1 × (100)	6 × (100)	11 × (100)	-
2000	1 × (100)	6 × (100)	13 × (100)	-
2000	4 × (50)	6 × (100)	12 × (100)	-
2100	3 × (100)	7 × (100)	11 × (100)	-
2200	3 × (100)	7 × (100)	12 × (100)	-
2300	3 × (100)	8 × (100)	12 × (100)	-
2400	4 × (100)	8 × (100)	12 × (100)	-
2600	3 × (100)	9 × (100)	14 × (100)	-
2700	3 × (100)	9 × (100)	15 × (100)	-
2800	3 × (100)	9 × (100)	16 × (100)	-
3000	4 × (100)	10 × (100)	16 × (100)	-

ELECTRICAL CHARACTERISTICS AT 20°C

Conductor Size		AWG 26	mm 0.4	AWG 24	mm 0.5	AWG 22	mm 0.65	AWG 19	mm 0.9
Maximum Conductor Resistance (ohms/km)		144.4		90.2		57.1		28.5	
Resistance Unbalance(%)	Max. Avg.	2.0		1.5		1.5		1.5	
	Ind. Max.	5.0		5.0		4.0		4.0	
Dielectric Strength (KV / 3sec) • Conductor to Conductor • Conductor to Ground		DC 2.4		DC 3.0		DC 3.6		DC 4.5	
Average Mutual Capacitance (at 1 KHz)		52 ± 4nF / km for less than 12 pairs cable 52 ± 2nF / km for 12 pairs and larger cable							
Capacitance	Pair to Pair	Ind. Max. : 180pF / km for 12 pairs cable RMS Max. : 45.3pF / km for 12 pairs and larger cable							
Unbalance	Pair to Ground	Ind : Max. : 2625pF / km for all cable Max. Avg. : 574pF / km for 12 pairs and larger cable							
Insulation Resistance		Min. : 16,000 MΩ - km							
Attenuation (dB / km)	150 KHz	11.4		8.3		6.2		4.4	
	772 KHz	22.5		18.5		14.6		10.4	

CROSSTALK LOSS

The crosstalk loss shall not be less than the values shown in the following table.

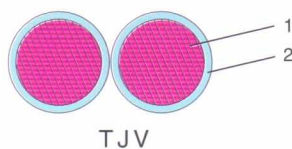
FEXT (at 150 KHz)	RMS		Min. 68dB / km
	Any Pair Combination		Min. 58dB / km
NEXT (at 772 KHz)	Unit Pair Size		M-S (dB)
	Within Unit	12 & 13	Min. 56
		25	Min. 60
	Between Unit	Adjacent 13	Min. 65
		Adjacent 25	Min. 66
Non-Adjacent		Min. 81	

TJV

PVC Insulated, Jumper Wire

The Kind of Wire	No of Wire	Color of Cores	Conductor Diameter (mm)	Insulation Thickness (mm)	Approx Overall Diameter (mm)	Core Pitch (mm)	Conductor Resistance at 20°C (Ω /km)	Insulation Resistance at 20°C (M Ω -km)	Standard Length (m)
Single	1	wh, br, gr, yl	0.5	0.2	0.9	—	96.0	20	300
Single	1	wh, bk, gr, yl	0.6	0.4	1.4	—	65.0	20	300
2 Strands	2	wh, bk	0.5	0.2	0.9	70	96.0	20	300
2 Strands	2	wh, bk	0.6	0.4	1.4	70	65.0	20	300
2 Strands	2	wh, rd	0.6	0.4	1.4	70	65.0	20	300
3 Strands	3	bk, wh, rd	0.0	0.4	1.4	80	65.0	20	300
4 Strands	4	wh, bk, gr, yl	0.6	0.4	1.4	90	65.0	20	300
5 Strands	5	wh, bk, gr, yl, gy	0.6	0.4	1.4	110	65.0	20	300
Single	1	gy	0.1	0.5	2.0	—	23.4	20	300

Note : Color Code Wh=White br=brown gr=green yl=yellow bk=black rd=red gy=gray



TJV

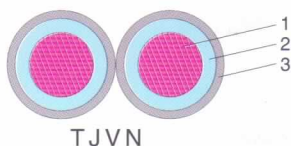
• Construction

- ① Conductor
- ② Insulation

TJVN

PVC Insulated Nylon Jacket Jumper Wire

The Kind of Wire	No. of Wires	Color of Cores	Conductor Diameter (mm)	Insulation Thickness (mm)	Nylon Jacket Thickness (mm)	Approx Overall Diameter (mm)	Core Pitch (mm)	Conductor Resistance at 20°C (Ω /km)	Insulation Resistance at 20°C (m Ω -km)	Standard Length (m)
2Strands	2	gr, wh	0.5	0.2	0.05	1.0	70	96	20	300



TJVN

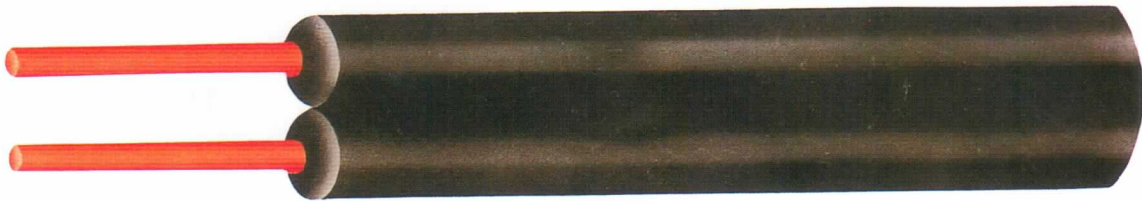
• Construction

- ① Conductor
- ② Insulation
- ③ Jacket

TIV

PVC Insulated, Indoor Telephone Wire

The Kind of Wire	Number of Wires	Color of Cores	Conductor Diameter (mm)	Insulation Thickness (mm)	Approx. Overall Diameter (mm)	Conductor Resistance at 20°C (Ω /km)	Test Voltage (V/1min.)	Insulation Resistance at 20°C (M Ω -km)	Standard Length (m)
Pair Core	2	White Grey	0.8	0.6	2.0	38.0	600	60	200
Two Core Parallel	2	Blue	0.8	0.6	2.0 X 4.2	38.0	600	60	200
Three Core Parallel	3	Grey	0.8	0.6	2.0 X 6.4	38.0	600	60	200



TOV

PVC Insulated, Outdoor Telephone Wire

Conductor Diameter (mm)	Insulation Thickness (mm)	Approx Overall Diameter (mm)	Conductor Resistance at 20°C (Ω /km)	Test Voltage (V/1min.)	Insulation Resistance at 20°C (M Ω -km)	Approx Weight (kg/km)	Standard Length (m)
1.2	1.0	3.2 X 6.9	16.5	1,500	60	41	300
1.0	1.0	3.0 X 6.4	23.8	1,500	60	31	300

