

*CABLE
DRUM
HANDLING*

Keep the cable protected until it is used

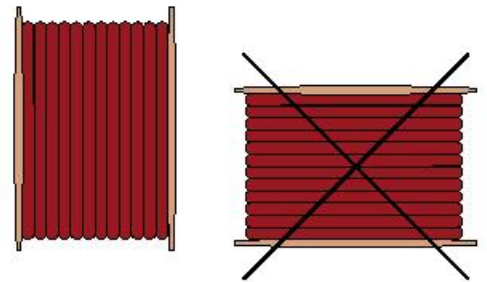
Drum handling and storage guide

A Cable is a valuable product. If handling is not done correctly, the drum and in turn the Cable wound over it can be damaged. At times, damage might not be discovered until after installation, when repairs can be extremely difficult / expensive.

The purpose of this guide is to illustrate, how damages can be avoided by correct handling and storage practices.

* Keep the drum upright

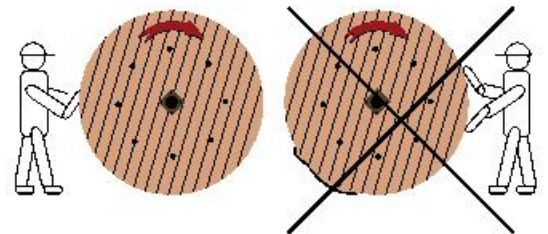
The drum is designed to be handled in upright position. It may not sustain if lifted lying flat. When kept upright, the cable layers will not get entangled. This would obviate problems during laying.



Always store and move the drum in an upright position. In no case, the drums be stored 'on the flat' that is with flange horizontal.

* Roll in direction of arrows only

When the drum must be rolled for some reason, always roll the drum in the direction of arrow. This way, the cable will not unwind or loosen on the drum.



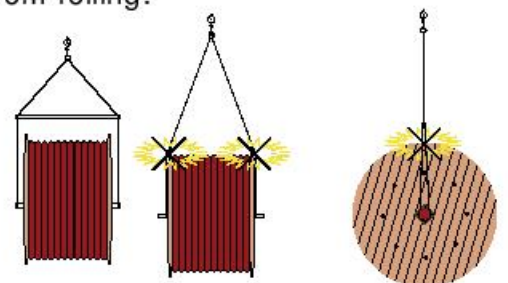
However, this does not mean that the drum can be rolled freely for any distance. Limit rolling distance to five metres. If it is rolled beyond this limit, the cable wind will come too tight and cut off the rope holding the cable end. This may deform the cable and make it unfit for use.

Once placed in position, use proper stoppers to prevent drum from rolling.

* Lift the drum without damage

When lifting the drum, use a shaft through the centre of the drum and a spreader beam.

If these are not available, lift with as long a rope as possible, so that the sides of the drum are not damaged. However, make sure that the cable head is not pinched between rope and drum.



Ensure that drum thus hoisted is well balanced. Also, ensure that it is not touching other drums.

Take care, not to give any impact to the drum being lowered. In case a cable drum must be temporarily in a waiting position, keep it hoisted. Do not repeatedly put it down.

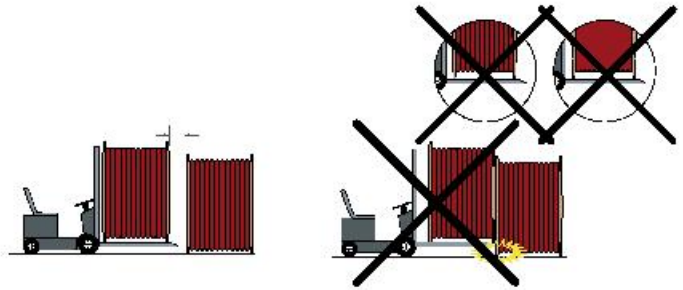
* Handling with fork lift

The forks must be longer than the width of the drum being lifted. Preferably, different widths of drums should be marked on the forks enabling the operator to select the correct position for the given drum size.

When moving the drum, tilt the truck mast so that the drum remains in the fork and the points don't touch the ground. Raise the forks of the forklift at least 6 to 8 inches above ground. Insufficient clearance may cause the drum to be dragged on the ground and eventually damaged or dropped off the forks, especially if the ground surface is uneven.

Don't release the drum until the truck has stopped completely. Don't push the drum with the truck.

Leave sufficient room between drums so that the fork doesn't damage the drum.



* Nail with caution

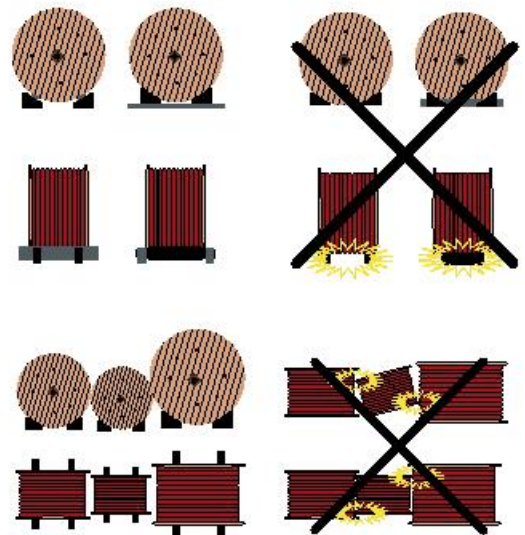
Avoid punching nails into cable drums. If nailing is utmost necessary, make sure that they don't touch the cable.

* Secure the drums firmly

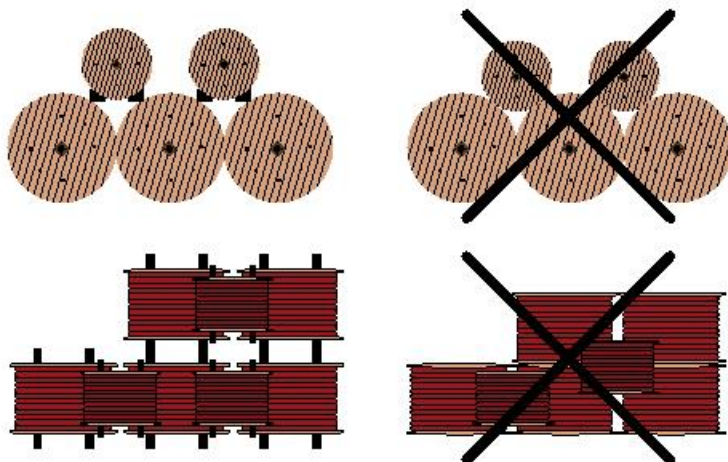
The round shaped cable drum rolls easily. It is in a very unstable state because it's centre section is vacant and the whole weight rests on it's peripheral section.

Make sure that each drum is provided with stoppers to prevent from rolling during storage.

It is preferable that large drums should be lifted from the base onto triangular or square wedges. The wedges should be positioned by the flanges or the full width of drum.



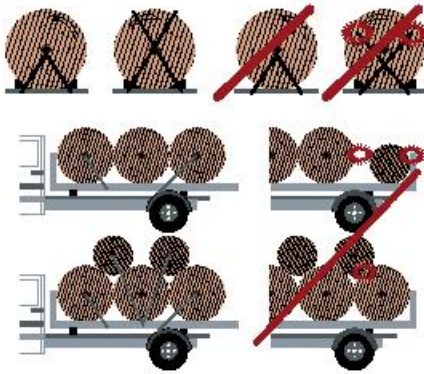
* Avoid stacking



Stacking of drums should be avoided.

* Fasten the drums firmly

During transportation, the drum shall be fastened to the base through the centre hole or across the

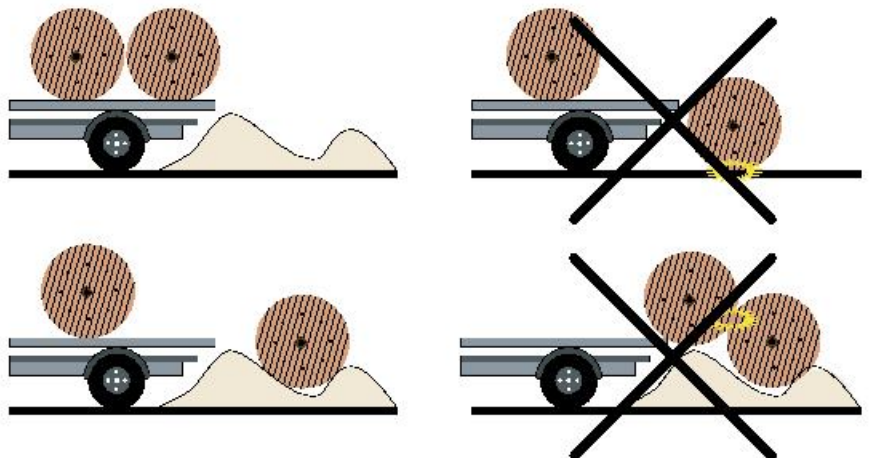


flanges with wires or ropes. To prevent movement of drums, a combination of wedges and transportation support should be used and tied down front and rear.

* Don't drop drums

The drums must not be dropped from the vehicle. The drum is to be lifted either by winch or fork-lift.

When neither of this is available, a makeshift ramp with approximate inclination of 1:4 should be constructed. The cable drum should then be rolled over this ramp by means of ropes and winches. Additionally, a sand bed at the foot of the ramp may be made to brake the rolling of cable drum.



Make sure when unloading, the drum doesn't strike another drum.

* Storage for longer periods

The site chosen for storage of cable drums must be level and dry. It should have a firm, preferably concreted surface. This will avoid sinking of the drums and difficulty in subsequent shifting.

All drums should be stored in such a manner as to leave sufficient space between them for air circulation.

During storage, the drum should be rolled to an angle of 90° once every three months. Also, tie bolts shall be checked and tightened at regular intervals.

Always turn a cable drum using turn table. Never use crow bar if turn table is not available. Two well greased plates can be used instead.

Storage of cable drums under shed is not essential unless the storage is for very long period. However, the cable drums shall be protected from direct sun light by covering them by tarpaulin or thick black polyethylene sheet.

*** Rewinding**

When for any reason, it is necessary to rewind a cable on to another drum, the barrel of the drum should have a diameter not less than that of the original drum.

It is utmost important while rewinding to avoid dragging of the cable against drum flanges or sharp edges.

Avoid pulling the cable across long unsupported spans. Provide freely rotating roller supports.

Do not pull a cable with powered vehicle.

MANUFACTURING PROCESS

XLPE Cables :

Electric power transmission and distribution from source to the user can be placed into three categories

High tension networks : Beyond 33 kV

Medium tension networks : upto 33 kV

Low voltage networks : upto 1 kV

For over a century, impregnated paper insulated cables held the sway in all the above categories. Impregnated paper has excellent electrical properties. Moreover, it has capacity to withstand a high degree of thermal overload without excessive deterioration. But it's hygroscopic nature requires the provision of a metal sheath to prevent moisture contamination.

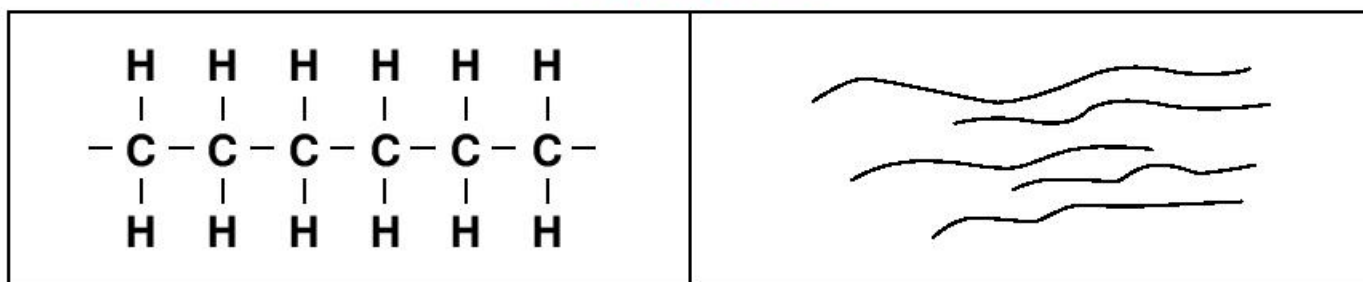
There was therefore a long felt need for power cable insulation material which has a combination of non hygroscopic nature of thermoplastic materials, electrical properties of polyethylene and operational advantages of impregnated paper.

XLPE (cross linked polyethylene) has come up as the dream material. Since several decades now, it has steadily replaced impregnated paper.

What is XLPE ?

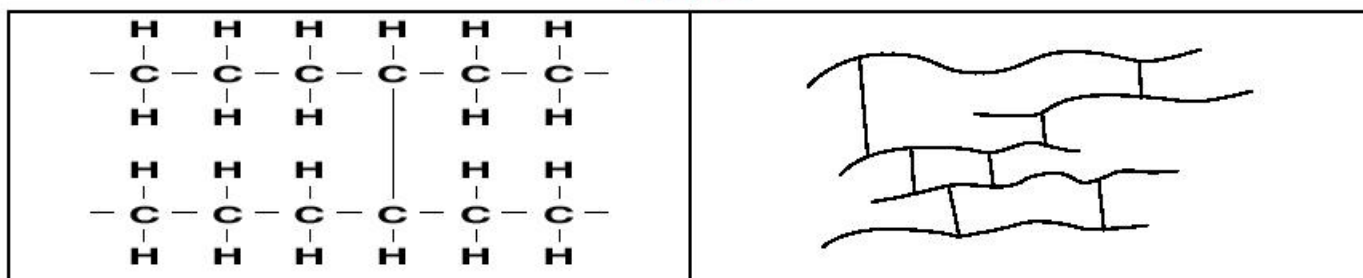
Low density polyethylene polymer is a compound of carbon and hydrogen having linear molecular structure. These long chains being independent, slide with respect to one another, resulting thermoplastic property of the material.

Polyethylene



In cross linking process, these chains are randomly bonded to one another, thus converting the independent molecules to a three dimensional linked network. Now, slippage between molecular chains is prevented and material becomes thermosetting.

XLPE



Comparison of XLPE with other insulation materials

Properties		XLPE	PE	EPR	PVC	Impreg. paper
Rated Temp °C	Normal	90	70	90	70	65
	Emergency	130	90	130	95	110
	Short Circuit	250	140	250	160	160
Mechanical Strength	Tensile Strength kg/ mm ²	2.35	1.4	0.95	1.25 to 2.5	NA
	Elongation %	500 to 600	300 to 600	300 to 800	200 to 400	3
Ageing Resistance	100 °C	Excellent	Good	Excellent	Good	Good
	120 °C	Excellent	Melts	Good	Poor	Fair
	150 °C	Good	Melts	Fair	Poor	Poor
Heat deformation at 150 °C		Good	Melts	Excellent	Poor	Good
Relative Permittivity		2.4	2.3	3.3	8.0	3.5
Specific Gravity g/cc		0.93	0.93	1.4	1.5	0.8
Solvent Resistance		Good	Good	Poor	Poor	Fair
Power Factor (tan δ)		4x10 ⁻⁴	4x10 ⁻⁴	4x10 ⁻⁴	100x10 ⁻³	2x10 ⁻³
Volume resistivity at 20 °C Ω- cm		> 10 ¹⁵	> 10 ¹⁵	> 10 ¹⁵	> 10 ¹³	> 10 ¹⁴
Dielectric Constant		2.3	2.3	3	6 to 8	3.4 to 4
Dielectric Strength kV/mm		50	50	25 to 40	20 to 35	40
Splicing & Termination		Easy	Easy	Easy	Easy	Not Easy
Environmental Stress Cracking resistance		Good	Poor	Poor	Good	NA
Necessity of hygroscopic protection		Not Regd.	Not Regd.	Not Regd.	Not Regd.	Required
Allowable bending radius	Single Core	15D-20D	15D-20D	15D-20D	15D-20D	20D-25D
	Multi Core	12D-15D	12D-15D	12D-15D	12D-15D	15D-20D

As apparent from above table, XLPE has several advantages compared to other insulation materials.

Gulf Cable has experience of manufacturing XLPE insulated Cables for over 25 years. We have supplied thousands of kilometres of low and medium voltage XLPE cables in Kuwait and neighbouring GCC countries.

LV Cables

Cable Engineering comprises of the art and science of selection of a suitable conductor, correct material and method for insulation for sheathing and for mechanical and anti-corrosive protection and finally, extension of design and manufacturing range to cover special field applications.

We have Quality Assurance System certified to ISO:9001-2000. Well defined and documented procedures cover all the stages of manufacturing, right from procuring of raw materials till dispatch of finished products.

Quality checks have been built into the system. Dimensions and Properties are closely monitored and checked at each processing stage as stipulated vide relevant Quality Assurance Plan. Only those products with "OK" status are taken to subsequent process stage. Product with "NOT OK" status are dealt with as per "non conformity handling system".

1) Incoming Raw Materials:

Cable comprises of diverse raw materials like electrical grade Copper / Aluminium, XLPE compound, various tapes, steel wires, PVC Compound ingredients etc.

Based on International specifications, customer stipulations and our long experience in the field of Cable Manufacturing, we have designed "Material Specifications" covering all the raw materials. We observe a stringent "Supplier Evaluation and Approval" procedure. Only approved raw materials are purchased from approved suppliers.

Raw materials thus procured are subjected to incoming inspection / tests and scrutiny of supplier's test certificate in line with Quality Assurance Plan(s).

2) Wire drawing process:

Aluminium rods are purchased from the market while we have our own copper rod manufacturing plant.

Copper / Aluminium rods of standard diameter are drawn down to requisite diameters.

Depending on conductor type, this may be multi stage process viz. rod break down followed by intermediate drawing followed by fine wire drawing.

3) Conductor making process:

Depending on type of cable, conductor can be either Solid circular, Circular stranded (non compacted), Circular Stranded (compacted), Stranded Sector shaped (90° / 120°) or Flexible / Extra Flexible.

Wires thus drawn are stranded together in concentric layers / bunched / compacted / shaped to form conductor.

4) Insulation:

PVC/XLPE Insulation is applied over conductor through extrusion process. Core identification is done either by colouring of insulation, skin colouring or by printing numbers.

5) Compounding:

We formulate our own recipes of various types of PVC compounds necessary. The plant is fully computerized and automatically monitors quantities / mixing of necessary Ingredients.

6) Core Stranding: (multi core cables)

Required number (2/3/4...) of such cores are stranded together to form a cable assembly.

If necessary to achieve circularity, fillers are provided in central / peripheral interstices as required.

7) Inner Sheathing:

A common covering is applied over stranded cores as above, either by extrusion of PVC Sheath or by lapping of plastic tape(s).

8) Armouring:

Mechanical protection is provided by providing Galvanized Round Steel Wires (SWA). Alternatively, steel tapes may be given (optional)

9) Outer Sheathing:

Over the armour, a PVC outer sheath is extruded. This is normally of black in colour which has best ultra violet resistance properties. Alternatively, other colours may be given as necessary.

Outer sheathing with special properties may also be given as per Customer's requirements.

10) Final Testing:

Routine Tests, Type tests, Acceptance Tests and Optional Tests (if any) are carried out so as to ensure integrity of manufactured cables.

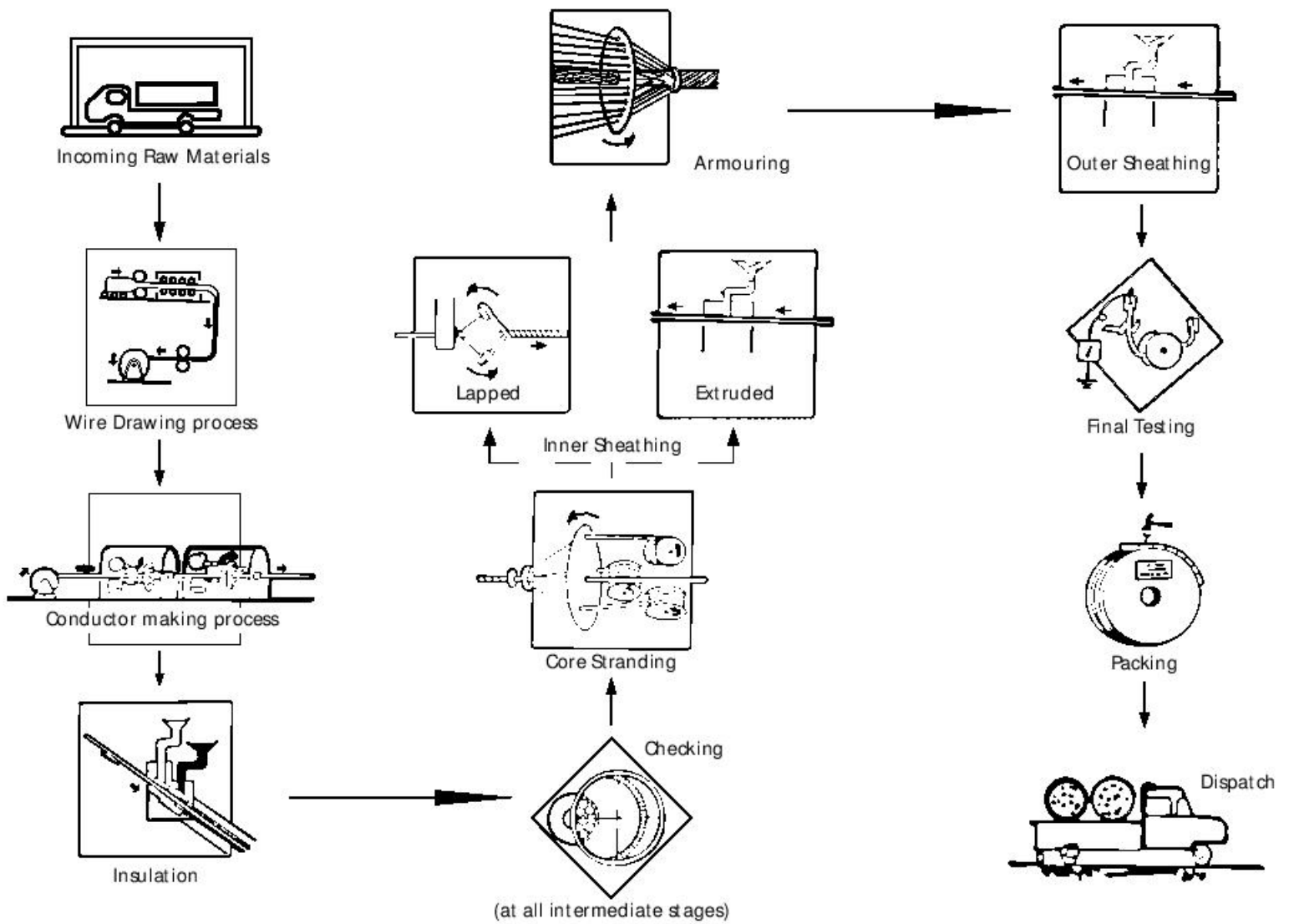
Test certificates are issued as contractually agreed.

11) Packing:

Drums containing cables are packed to obviate possibility of damage during transportation.

12) Dispatch:

Drums duly packed are sent to respective sites as contractually agreed.



MV Cables

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3) Conductor making process:

Normally for MV Cables, conductor is Circular Stranded (compacted)

Wires thus drawn are stranded together in concentric layers and compacted to form conductor.

4) Insulation:

All XLPE Cables above 3.3 kV grade are provided with both conductor shielding and insulation shielding consisting of extruded semi-conducting compound.

Conductor shielding, XLPE Insulation and Insulation shielding are all extruded in one operation by special extrusion process to ensure perfect bonding between the layers.

5) Copper Taping:

Metallic part of insulation shielding is provided by helically lapped copper tape.

6) Core Stranding: (multi core cables)

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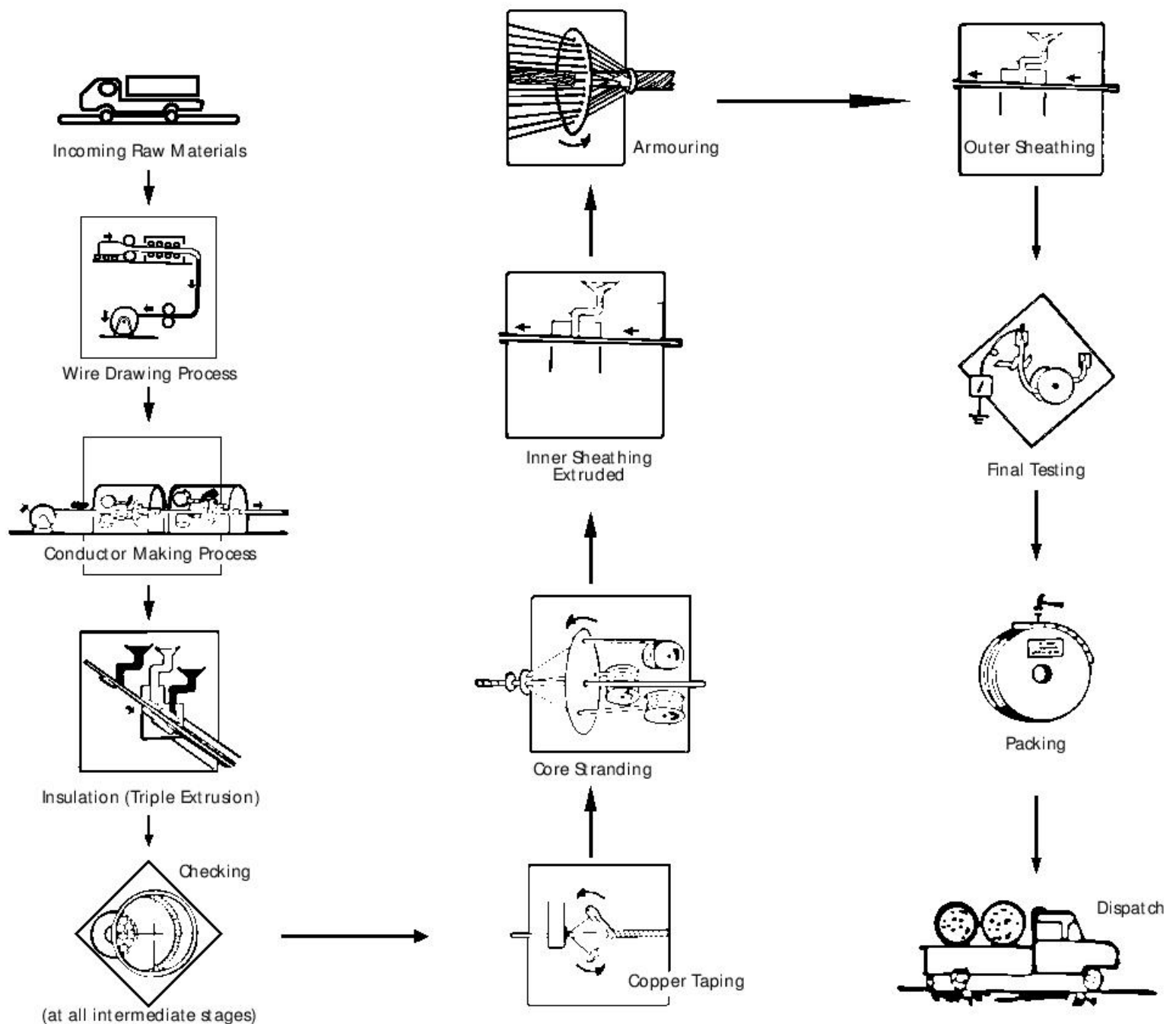
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7) Inner Sheathing:

A common covering is applied over stranded cores as above, by extrusion of PVC Sheath.

8) Lead / Lead Alloy Sheathing:

An extruded sheath of Lead / Lead Alloy is provided so as to render the cable impervious to oils / certain chemicals.



9) Separation Sheath:

Bedding of Extruded PVC sheath is applied over Lead Sheath.

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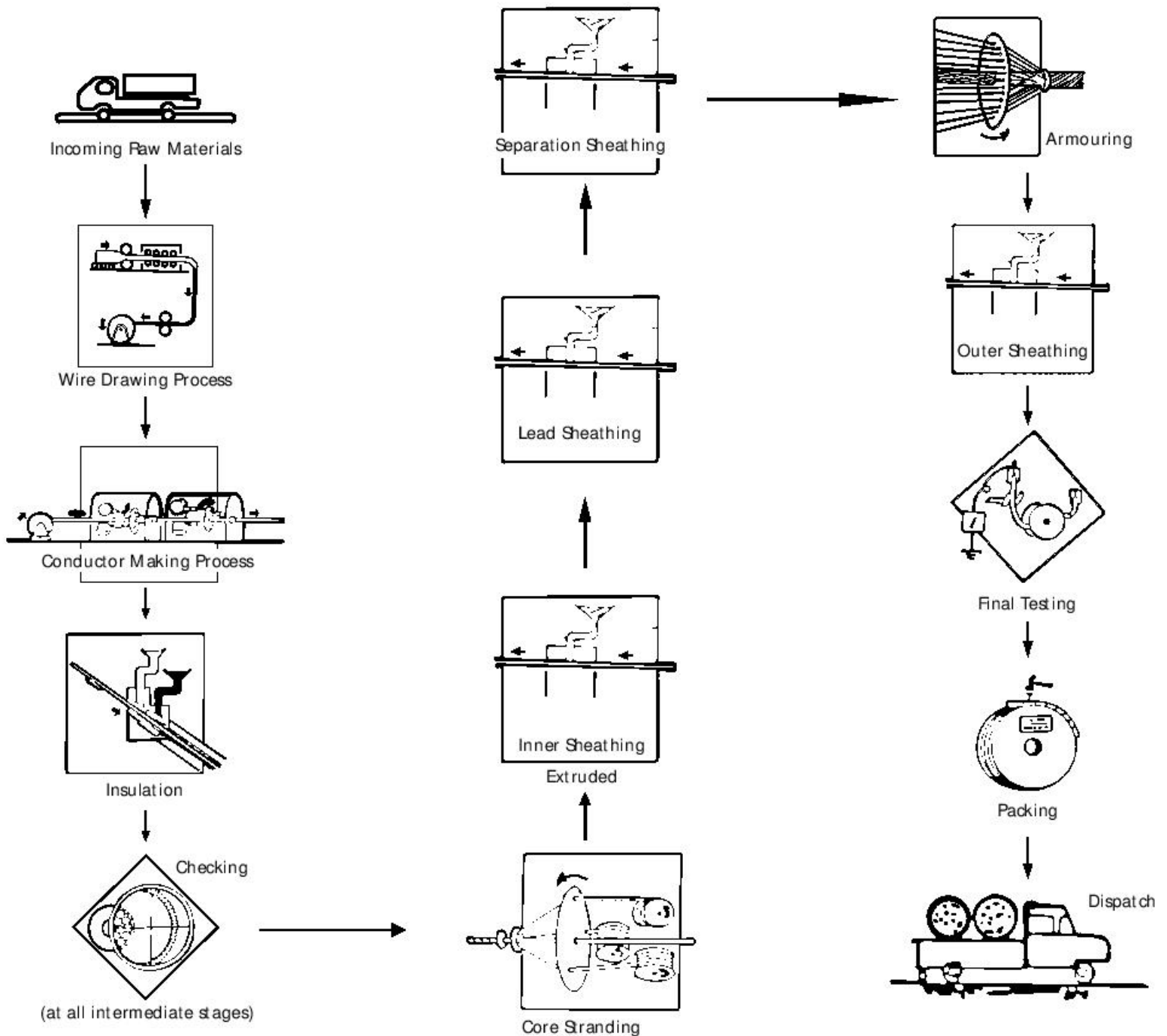
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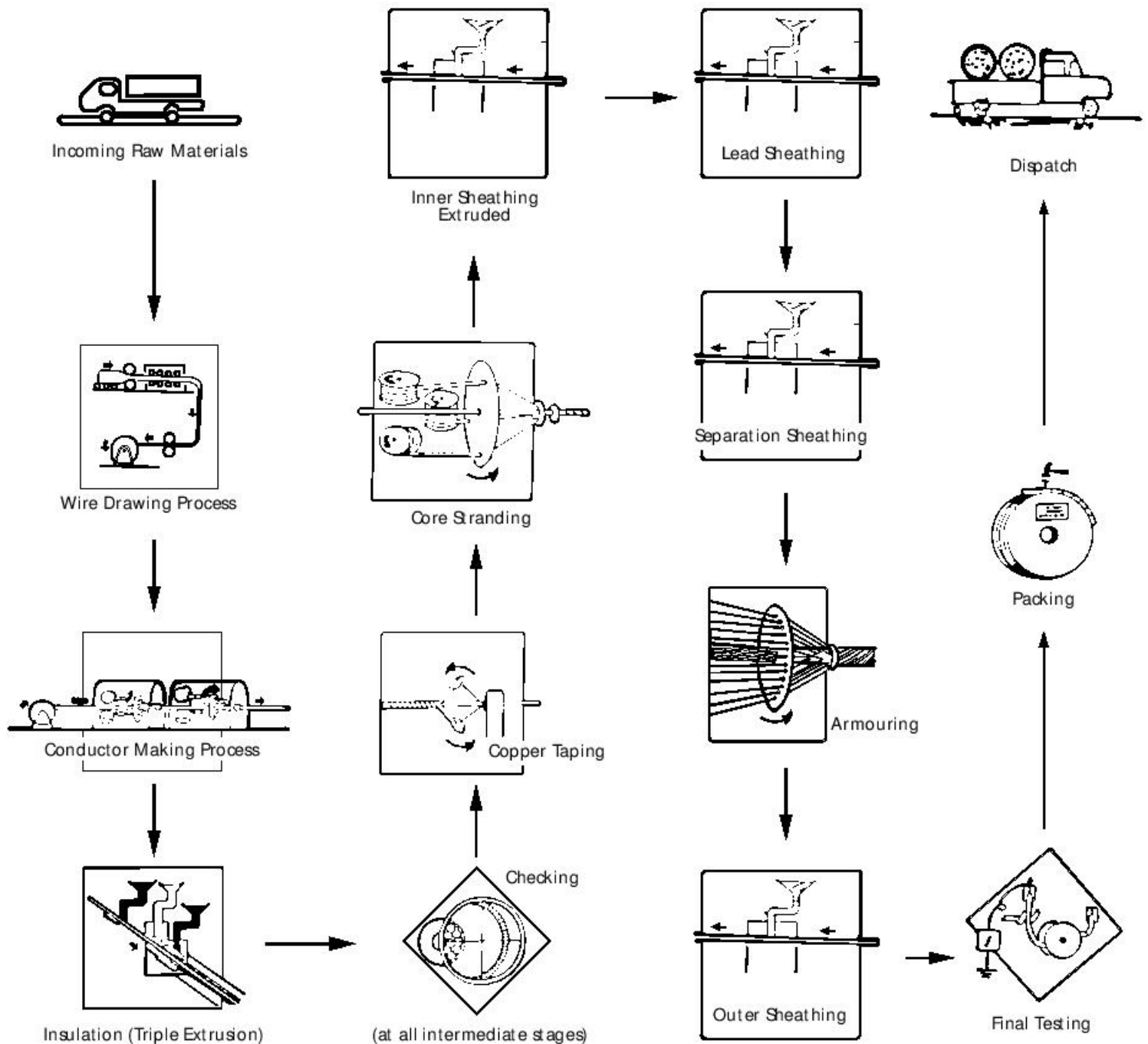
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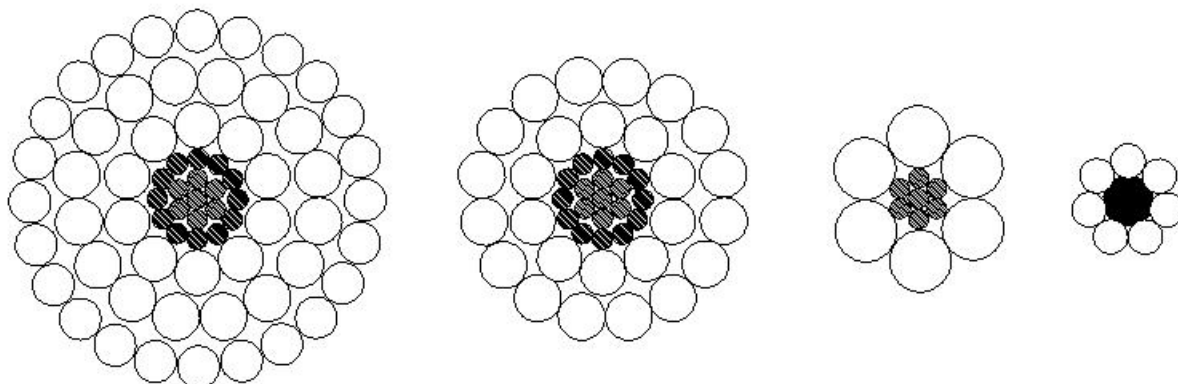
OVERHEAD CONDUCTORS

20



ACSR has long been the backbone of overhead transmission and distribution systems. It has altogether replaced older types of overhead conductors made of copper, which are now a days used only to meet specific demands.

ACSR offers optimal strength for line design. It consists of Aluminium Conductor stranded around a core made of steel wires of high tensile strength. Variable steel core stranding enables desired strength to be achieved without sacrificing ampacity. These conductor are "bare", meaning that there is no insulation or jacket covering the conductor.



OVERHEAD CONDUCTORS

In order to obviate steel oxidation (rusting) owing to weather, a coating of non-oxidizing grease is normally applied to steel cores. One or more layers of aluminium wires can, if required, be supplied partially or fully greased.

Conductor used in low voltage networks are all aluminium conductors (AAC).

The bare aluminium and ACSR conductors listed in the catalogue are suitable for installation in all practical spans on transmission towers, ranging from long distance EHV transmission lines to sub-service spans at distribution or utilization voltages.

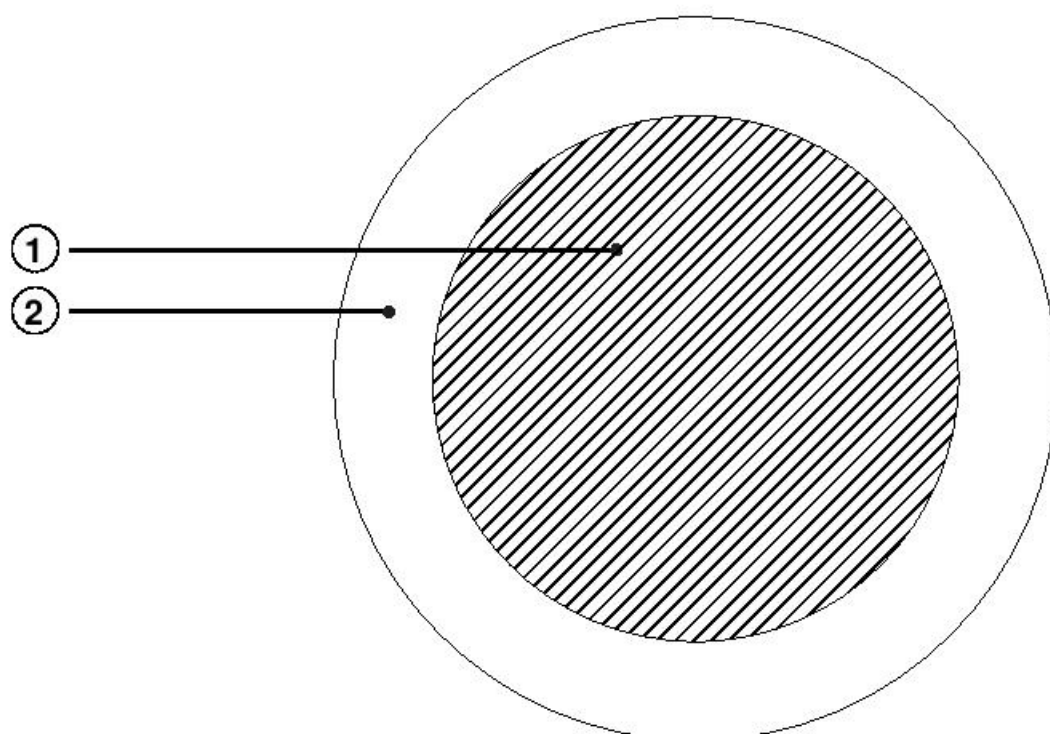
The choice of conductor size, type and strength should take into account factors such as electrical load, voltage regulation, corona losses, ice and wind loading, extreme temperatures and vibration. In case any assistance is needed for evaluation of these factors as they apply to specific installations, please do not hesitate to contact our marketing division.

Hard drawn Bare Copper conductors (HDBC), PVC covered hard drawn copper conductors (HDBC/PVC) are used for special applications.

Soft Drawn Bare Copper conductors (SDBC) are used for earthing purposes.

*CROSS
SECTIONAL
DRAWINGS*

SINGLE CORE NON SHEATHED CABLES

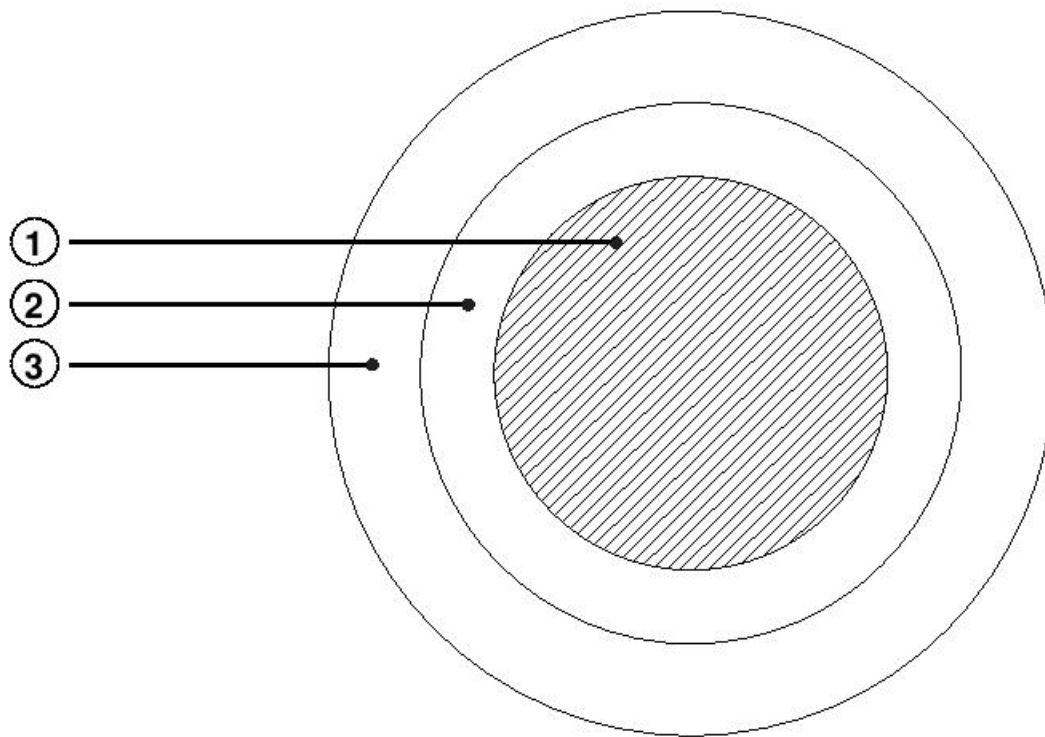


"Not to scale"

1. CONDUCTOR: STRANDED CIRCULAR COPPER

2. INSULATION: PVC.

SINGLE CORE SHEATHED CABLES



"Not to scale"

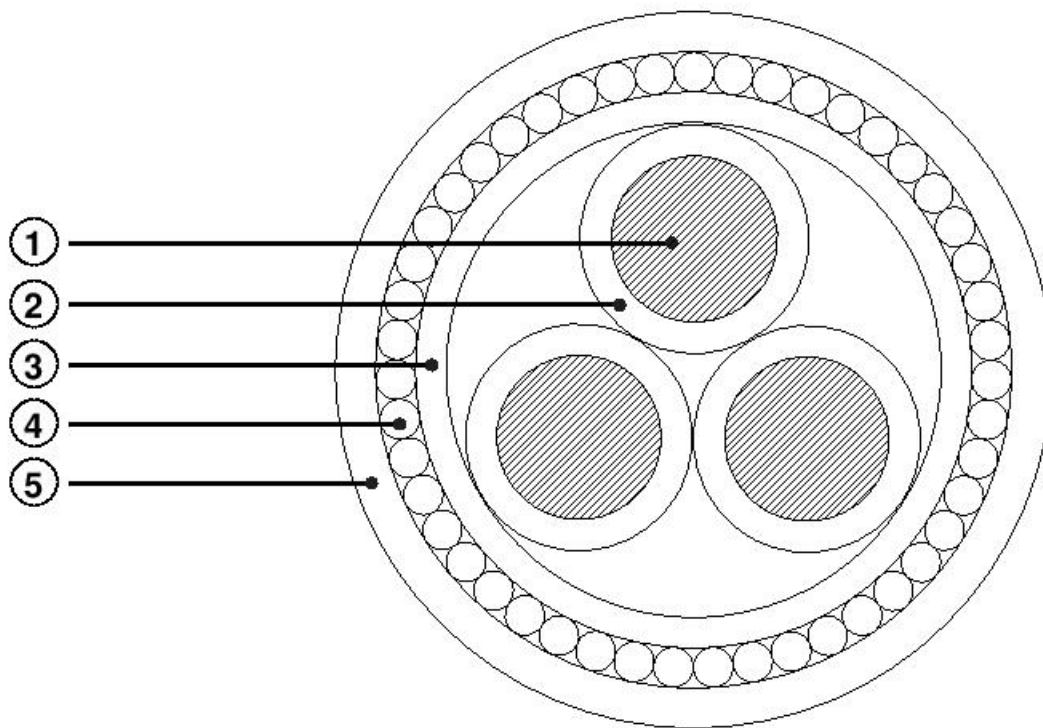


1. CONDUCTOR : STRANDED CIRCULAR (COPPER / ALUMINIUM)

2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC

3. OUTER SHEATH : PVC

3 CORE LV CABLES



"Not to scale"

1. CONDUCTER : STRANDED CIRCULAR (COPPER / ALUMINIUM)

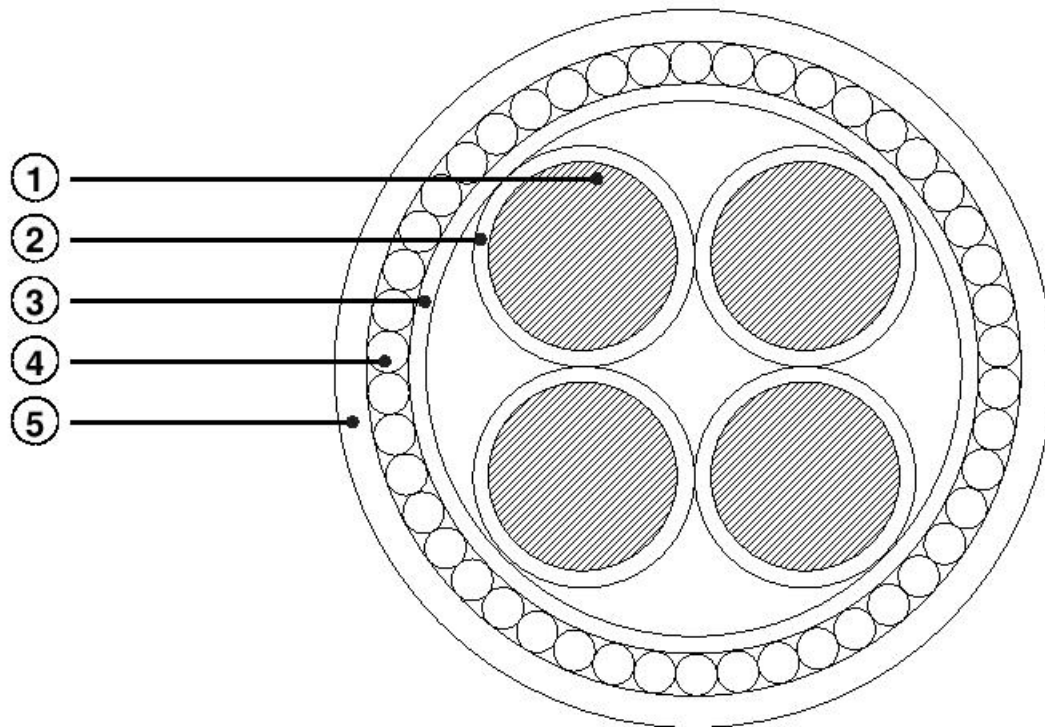
2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC

3. INNER SHEATH : EXTRUDED PVC

4. ARMOUR : GALVANISED STEEL WIRE

5. OUTER SHEATH: PVC.

4 CORE LV CABLES



"Not to scale"

1. CONDUCTOR : STRANDED CIRCULAR (COPPER/ ALUMINIUM)

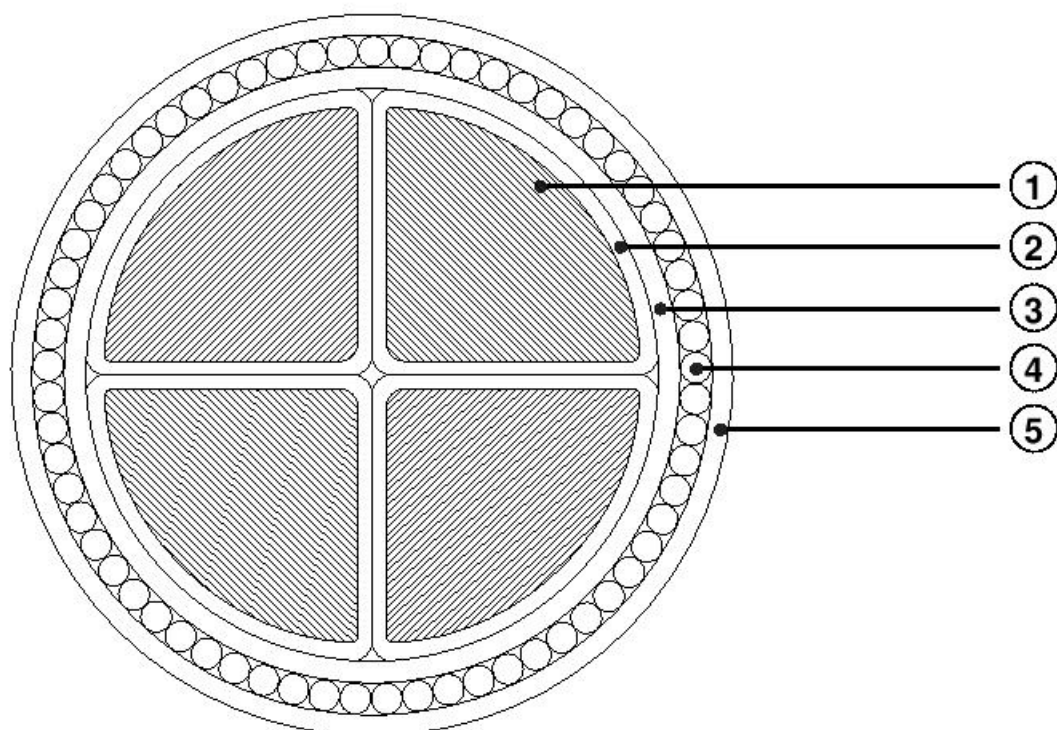
2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC

3. INNER SHEATH : EXTRUDED PVC

4. ARMOUR : GALVANISED STEEL WIRE

5. OUTER SHEATH : PVC

4 CORE LV CABLES



"Not to scale"

1. CONDUCTOR: STRANDED SECTOR SHAPED (COPPER/ ALUMINIUM)

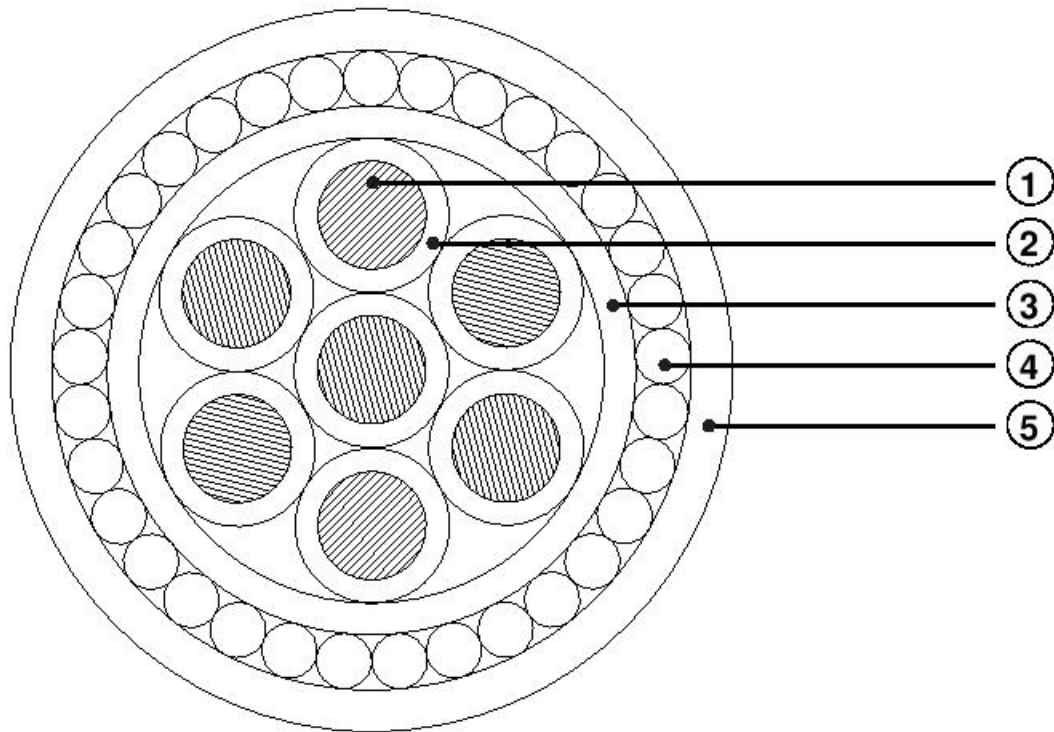
2. INSULATION: XLPE (CROSS LINKED POLYETHYLENE)/ PVC

3. INNER SHEATH: EXTRUDED/ LAPPED

4. ARMOUR: GALVANISED STEEL WIRE

5. OUTER SHEATH: PVC

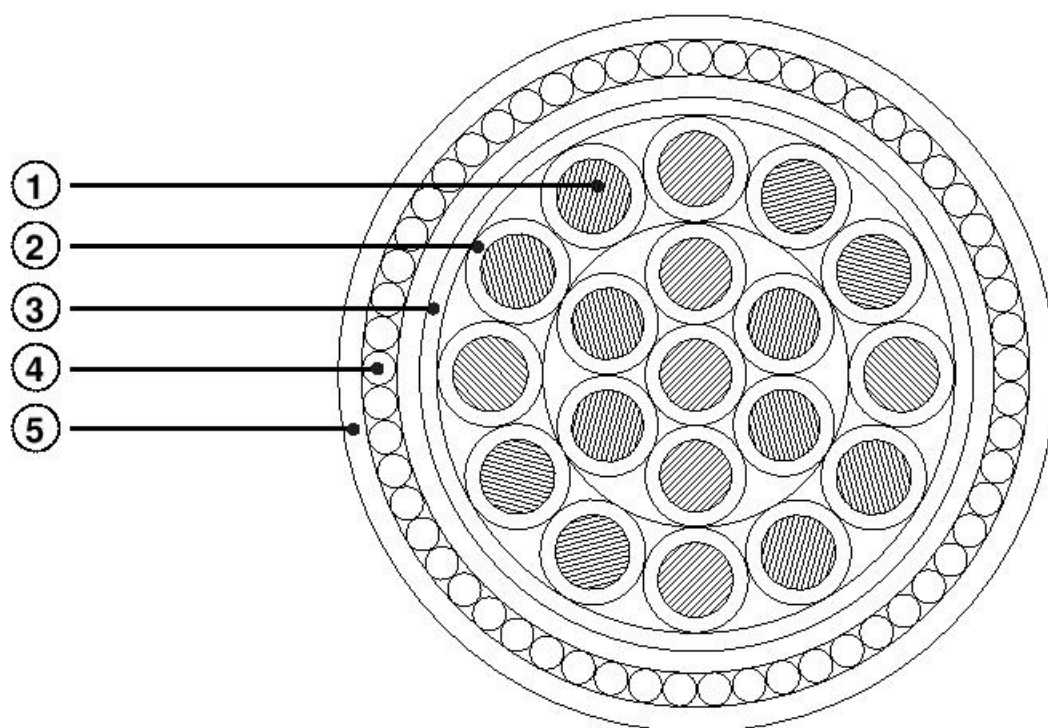
AUXILIARY CABLES (CONTROL CABLES)



"Not to scale"

1. CONDUCTOR : STRANDED CIRCULAR (COPPER)
2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC
3. INNERSHEATH : EXTRUDED PVC
4. ARMOUR : GALVANISED STEEL WIRE
5. OUTER SHEATH : PVC

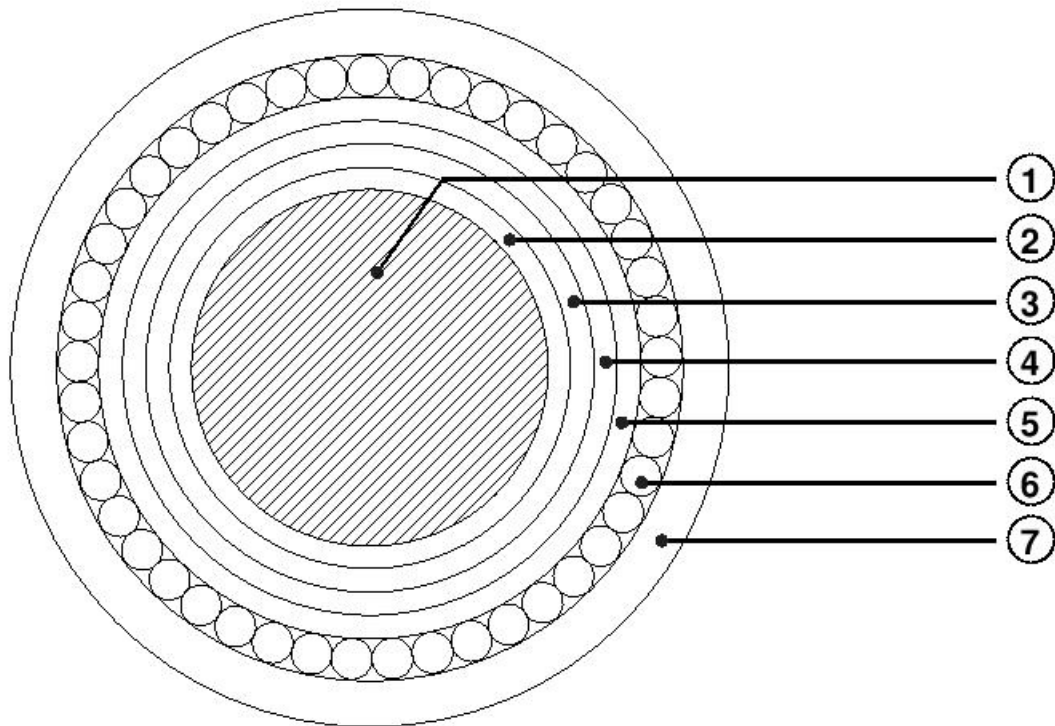
AUXILIARY CABLES (CONTROL CABLES)



"Not to scale"

1. CONDUCTOR: STRANDED CIRCULAR (COPPER)
2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC
3. INNER SHEATH : EXTRUDED PVC
4. ARMOUR : GALVANISED STEEL WIRE
5. OUTER SHEATH : PVC

SINGLE CORE LEAD SHEATHED LV CABLES

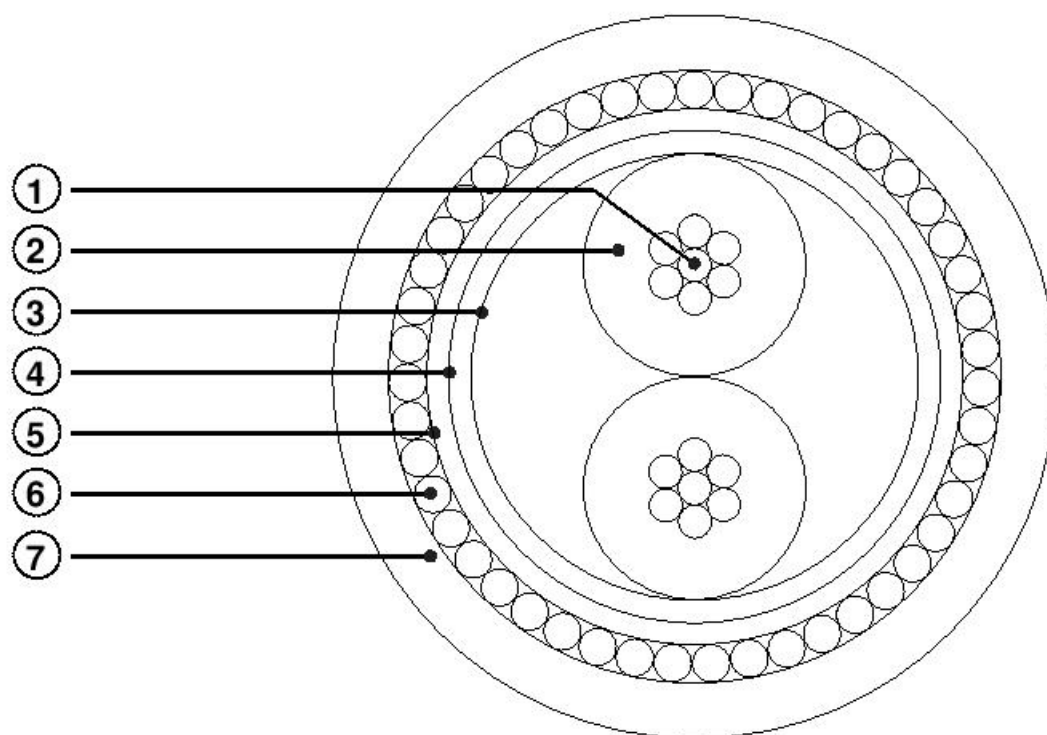


“Not to scale”



1. CONDUCTOR: STRANDED CIRCULAR (COPPER / ALUMINIUM)
2. INSULATION: XLPE (CROSS LINKED POLYETHYLENE)/ PVC
3. INNER SHEATH: EXTRUDED PVC
4. METALLIC SHEATH: LEAD / LEAD ALLOY
5. SEPERATION SHEATH: EXTRUDED PVC
6. ARMOUR: ALUMINIUM WIRE
7. OUTER SHEATH: PVC

2 CORE LEAD SHEATHED LV CABLES



31



"Not to scale"

1. CONDUCTOR : STRANDED CIRCULAR (COPPER/ ALUMINIUM)

2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC

3. INNER SHEATH : EXTRUDED PVC

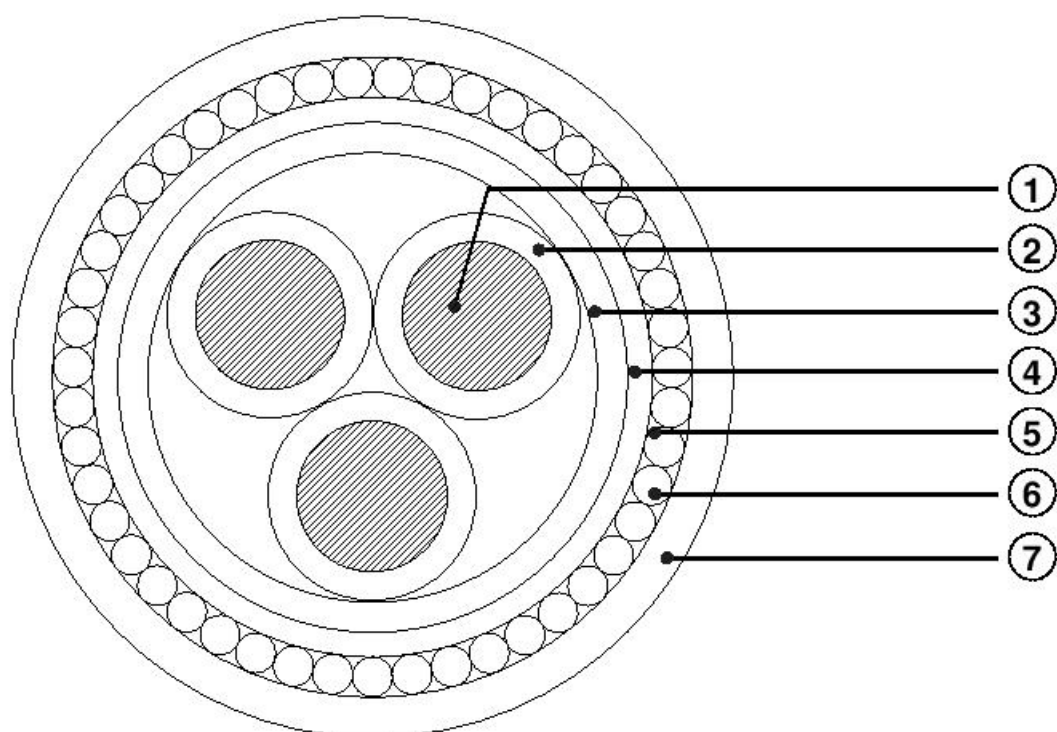
4. METALLIC SHEATH : LEAD / LEAD ALLOY

5. SEPERATION SHEATH : EXTRUDED PVC

6. ARMOUR : GALVANISED STEEL WIRE

7. OUTER SHEATH : PVC

3 CORE LEAD SHEATHED LV CABLES



"Not to scale"

1. CONDUCTOR : STRANDED CIRCULAR (COPPER / ALUMINIUM)

2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC

3. INNER SHEATH : EXTRUDED PVC

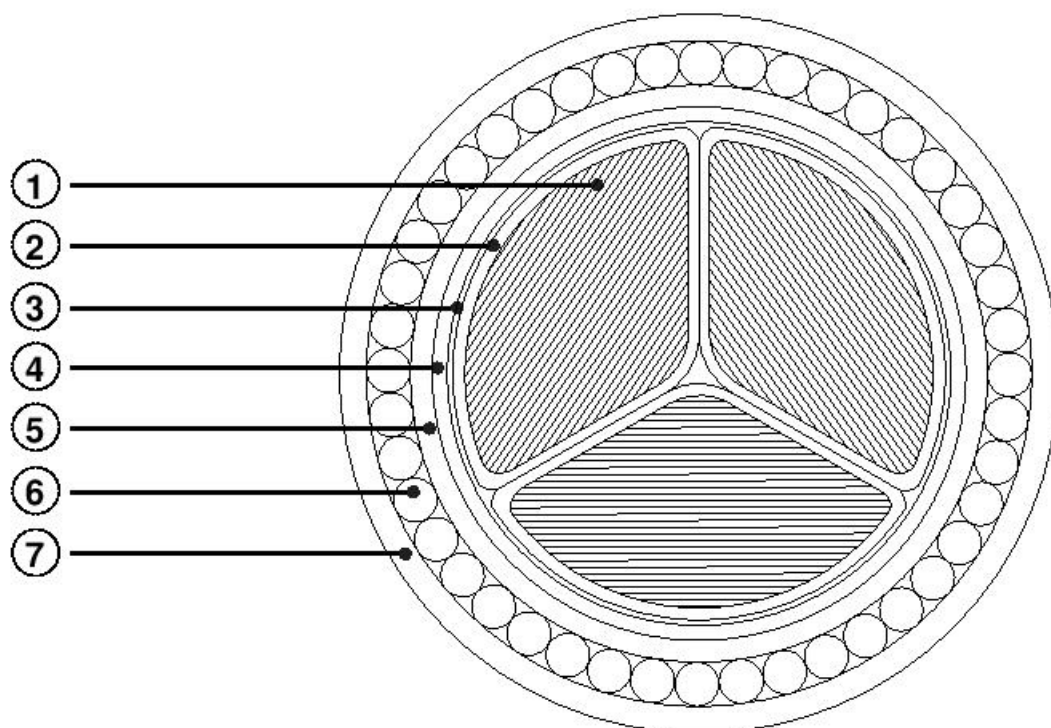
4. METALLIC SHEATH : LEAD / LEAD ALLOY

5. SEPARATION SHEATH : EXTRUDED PVC

6. ARMOUR : GALVANISED STEEL WIRE

7. OUTER SHEATH : PVC

3 CORE LEAD SHEATHED LV CABLES



"Not to scale"

1. CONDUCTOR: STRANDED SECTOR SHAPED (COPPER / ALUMINIUM)

2. INSULATION: CROSS LINKED POLYETHYLENE (XLPE) / PVC

3. INNER SHEATH: EXTRUDED PVC

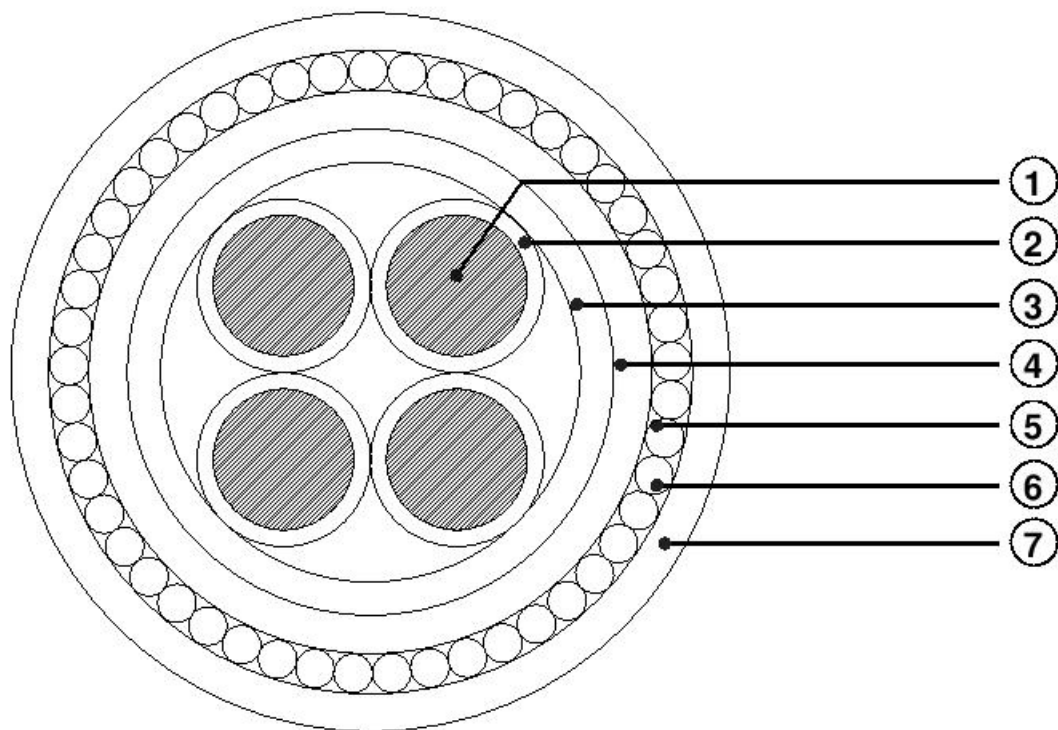
4. METALLIC SHEATH: LEAD/ LEAD ALLOY

5. SEPERATION SHEATH: EXTRUDED PVC

6. ARMOUR: GALVANISED STEEL WIRE

7. OUTER SHEATH: PVC

4 CORE LEAD SHEATHED LV CABLES



"Not to scale"

1. CONDUCTOR : STRANDED CIRCULAR (COPPER / ALUMINIUM)

2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC

3. INNER SHEATH : EXTRUDED PVC

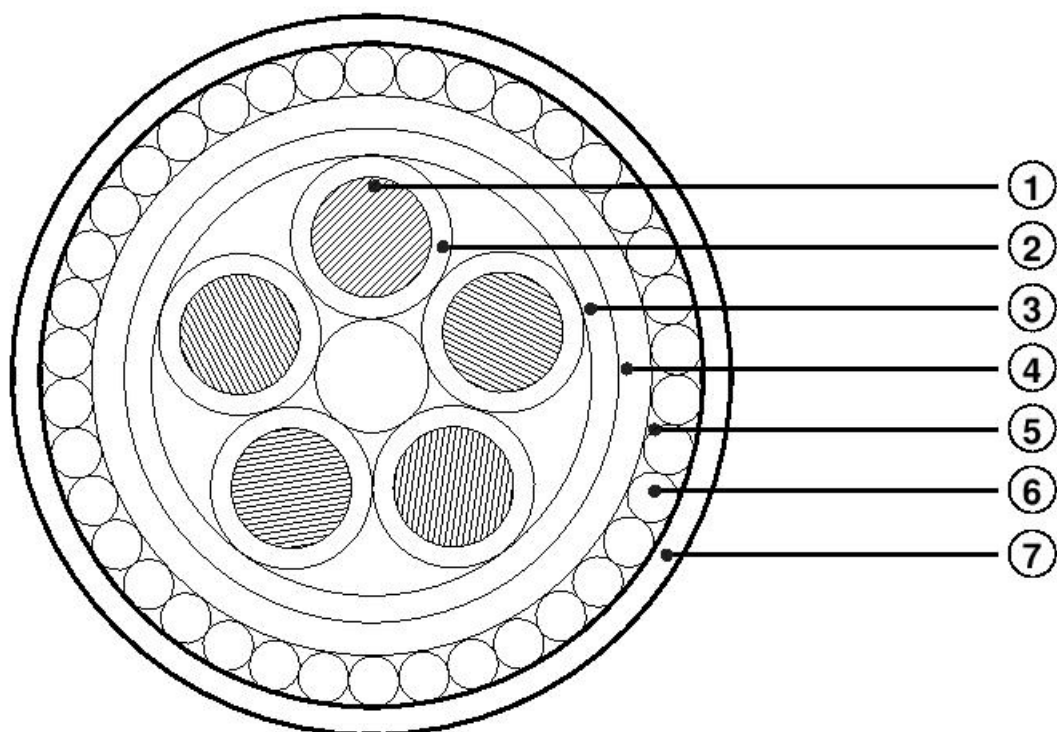
4. METALLIC SHEATH : LEAD / LEAD ALLOY

5. SEPERATION SHEATH : EXTRUDED PVC

6. ARMOUR : GALVANISED STEEL WIRE

7. OUTER SHEATH: EXTRUDED PVC.

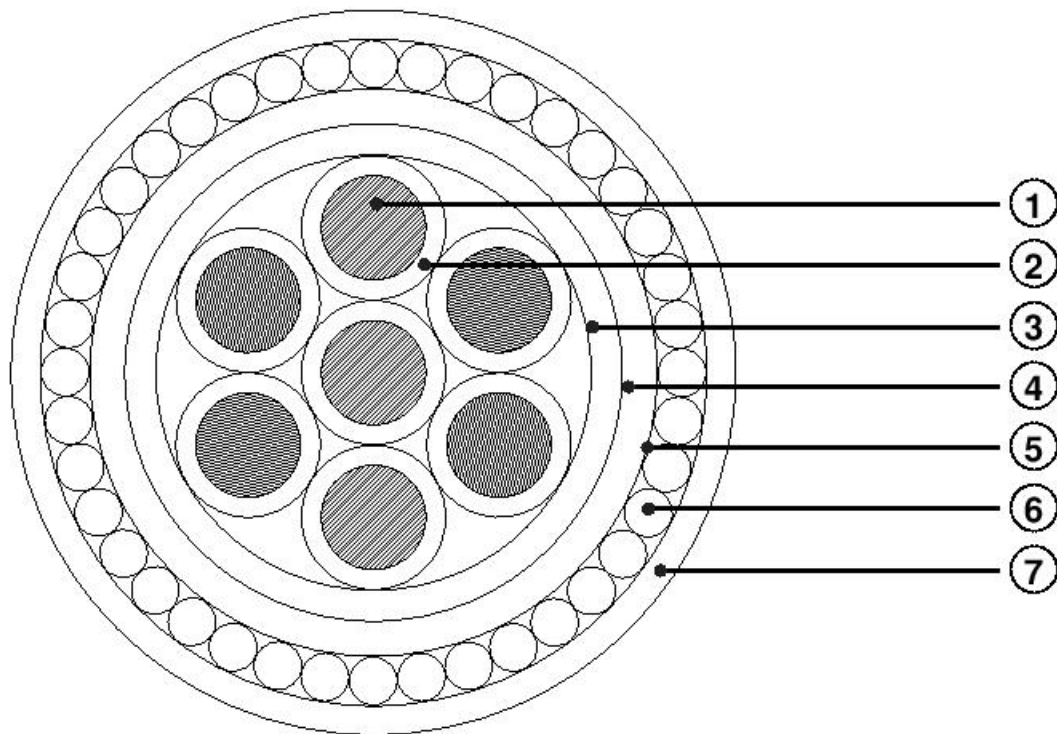
LEAD SHEATHED AUXILIARY CABLES



"Not to scale"

1. CONDUCTOR : STRANDED CIRCULAR (COPPER)
2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC
3. INNER SHEATH : EXTRUDED PVC
4. METALLIC SHEATH : LEAD/ LEAD ALLOY
5. SEPERATION SHEATH : EXTRUDED PVC
6. ARMOUR : GALVANISED STEEL WIRE
7. OUTER SHEATH: EXTRUDED PVC.

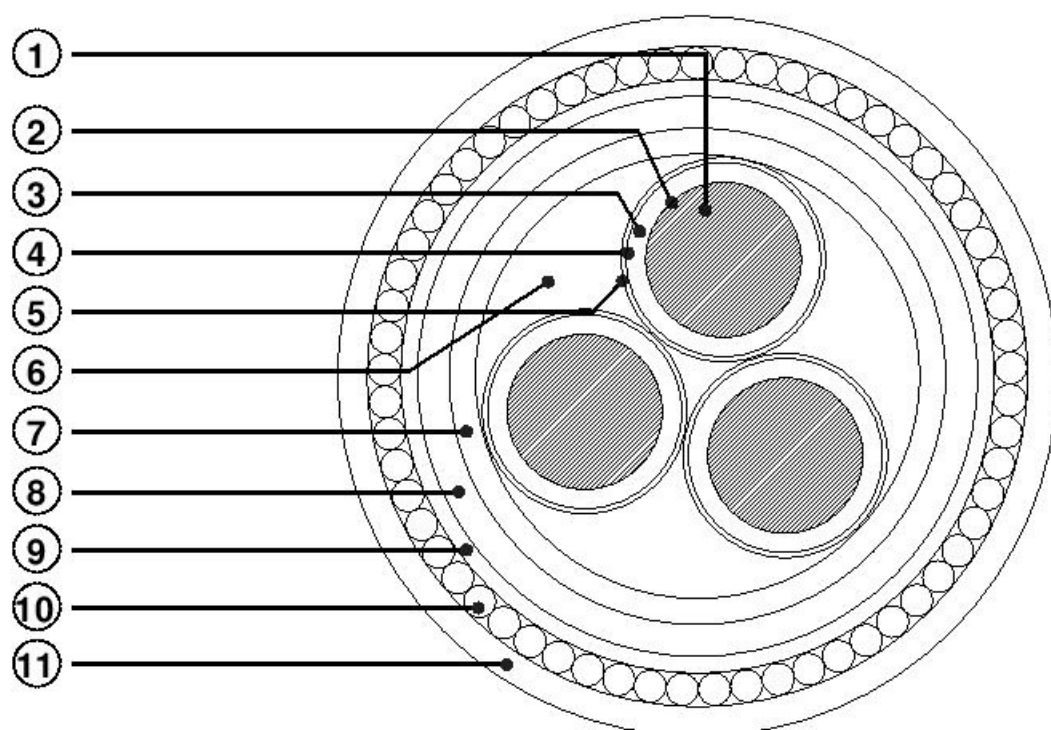
LEAD SHEATHED AUXILIARY CABLES



“Not to scale”

1. CONDUCTOR : STRANDED CIRCULAR (COPPER)
2. INSULATION : XLPE (CROSS LINKED POLYETHYLENE) / PVC
3. INNER SHEATH : EXTRUDED PVC
4. METALLIC SHEATH : LEAD/ LEAD ALLOY
5. SEPERATION SHEATH : EXTRUDED PVC
6. ARMOUR : GALVANISED STEEL WIRE
7. OUTER SHEATH: EXTRUDED PVC.

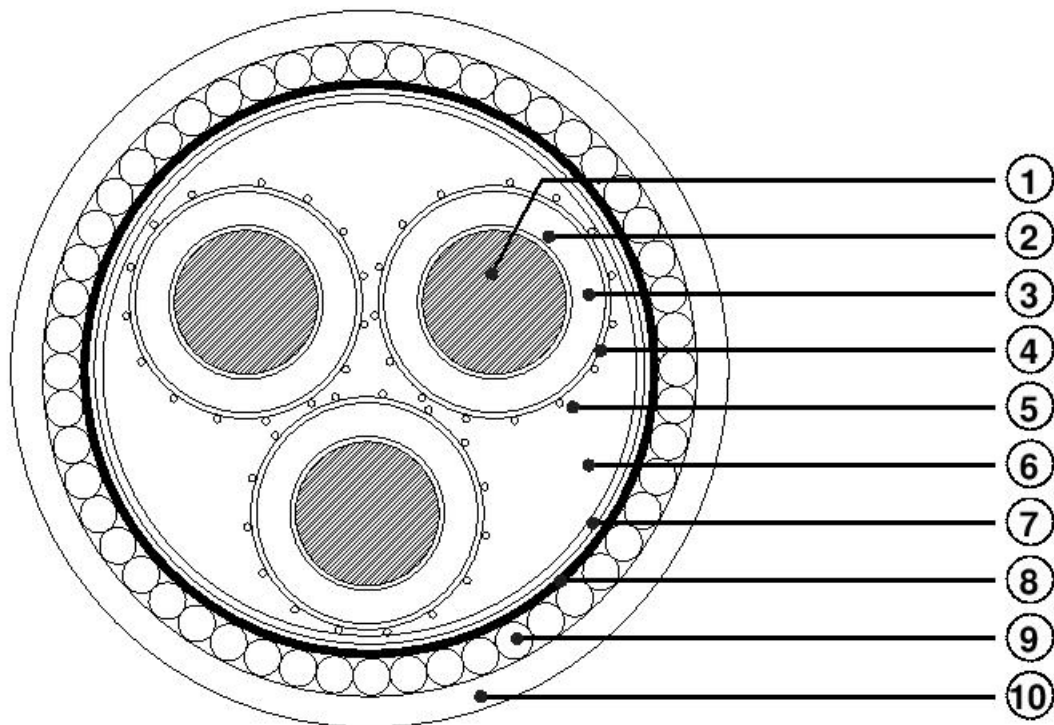
3 CORE LEAD SHEATHED MV CABLES



"Not to scale"

1. CONDUCTOR : STRANDED COM PACTED CIRCULAR (COPPER / ALUMINIUM)
2. CONDUCTOR SHIELD : EXTRUDED SEMICONDUCTING
3. INSULATION: XLPE (CROSS LINKED POLYETHYLENE)
4. INSULATION SHIELD: EXTRUDED SEMICONDUCTING
5. METALLIC SHIELD : COPPER TAPE (S)
6. FILLER : PP YARN
7. INNER SHEATH : EXTRUDED PVC
8. METALLIC SHEATH : LEAD/ LEAD ALLOY
9. SEPERATION SHEATH : EXTRUDED PVC
10. ARMOUR : GALVANISED STEEL WIRE
11. OUTER SHEATH: PVC

3 CORE M V CABLES



“Not to scale”

1. CONDUCTOR : STRANDED COM PACTED CIRCULAR (COPPER/ ALUMINIUM)

2. CONDUCTOR SHIELD : EXTRUDED SEMICONDUCTING

3. INSULATION : CROSS LINKED POLYETHYLENE (XLPE)

4. INSULATION SHIELD : EXTRUDED SEMICONDUCTING

5. METALLIC SHIELD: COPPER WIRES + COPPER TAPE (S)

6. FILLERS : PP YARN

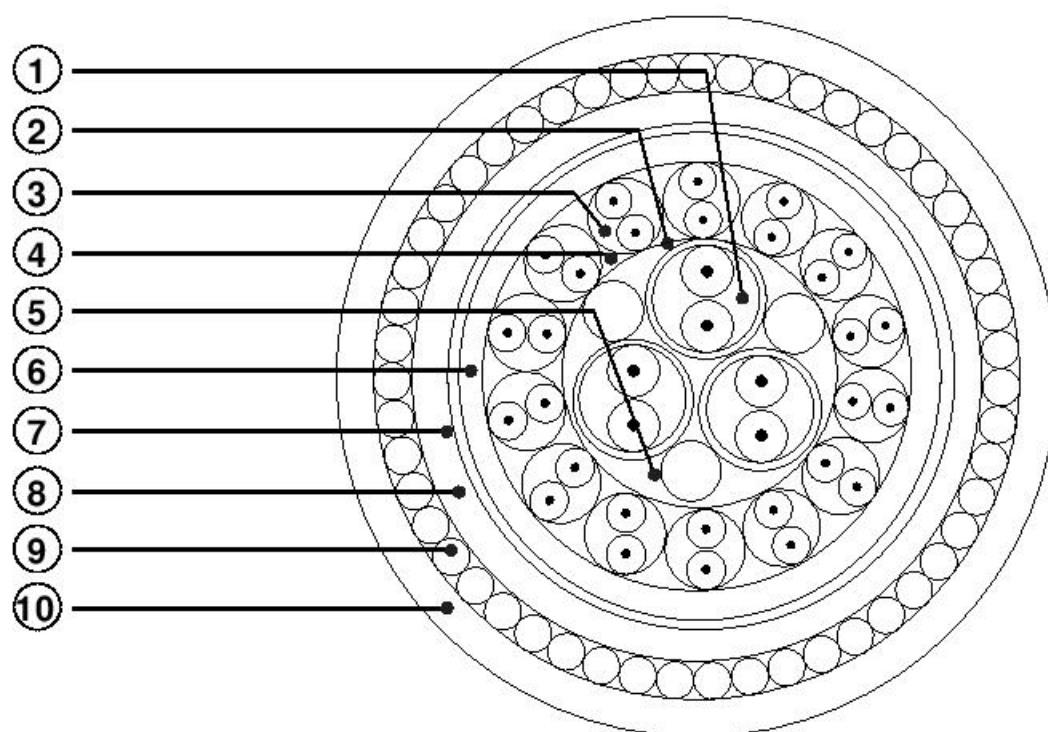
7. BINDING TAPE : FPP TAPE (S)

8. INNER SHEATH : EXTRUDED PVC

9. ARMOUR : GALVANISED STEEL WIRE

10. OUTER SHEATH : PVC

34 CORE PILOT CABLE



"Not to scale"

1. SOLKOR, INTERTRIPPING AND INTERLOCKING PAIRS, (SCREENED) 2.5 sq. mm COPPER CONDUCTOR. PE INSULATION.
2. COPPER TAPE SCREEN FOR SOLKOR, INTERTRIPPING AND INTERLOCKING PAIRS.
3. TELEPHONE AND TELEMETRY PAIRS (UNSCREENED 0.635 sq. mm. COPPER CONDUCTOR. PE INSULATION.
4. WRAPPING ON SCREENED PAIRS
5. NON HYGROSCOPIC FILLERS.
6. PE BEDDING OVER LAID UP CORES.
7. OVERALL SCREEN WITH COPPER TAPE.
8. PE INNER SHEATH.
9. GALVANISED STEEL WIRE ARMOUR
10. PVC (TYPE 9) OUTER SHEATH.