KEC INTERNATIONAL LIMITED

SUMMER INTERNSHIP - 2021

PROJECT REPORT

DEPARTMENTS COVERED –

- PRODUCTION
  - a) HT Plant
  - b) LT Plant
- MAINTAINENCE
- QUALITY
- DESIGN

Submitted by –
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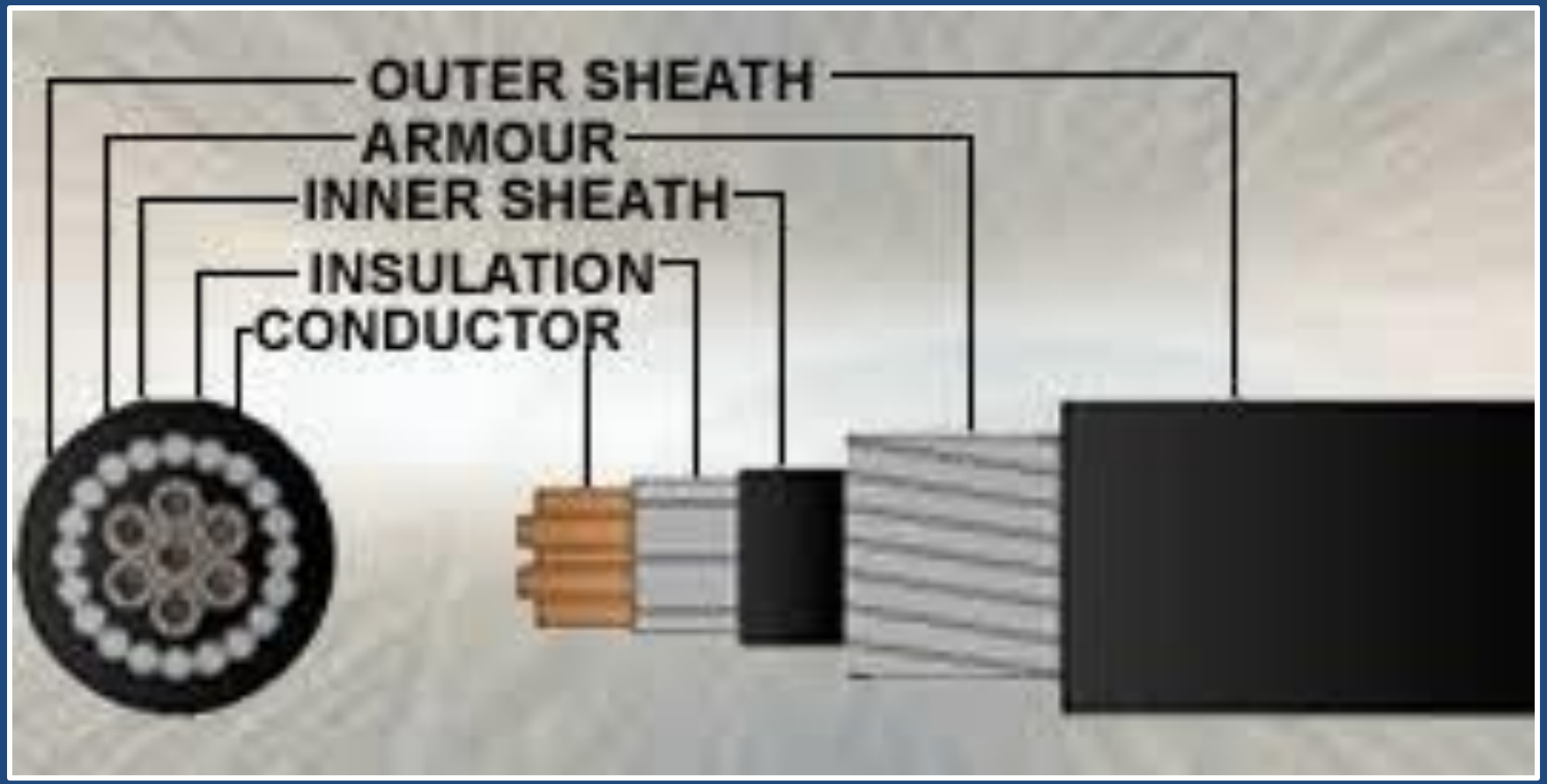
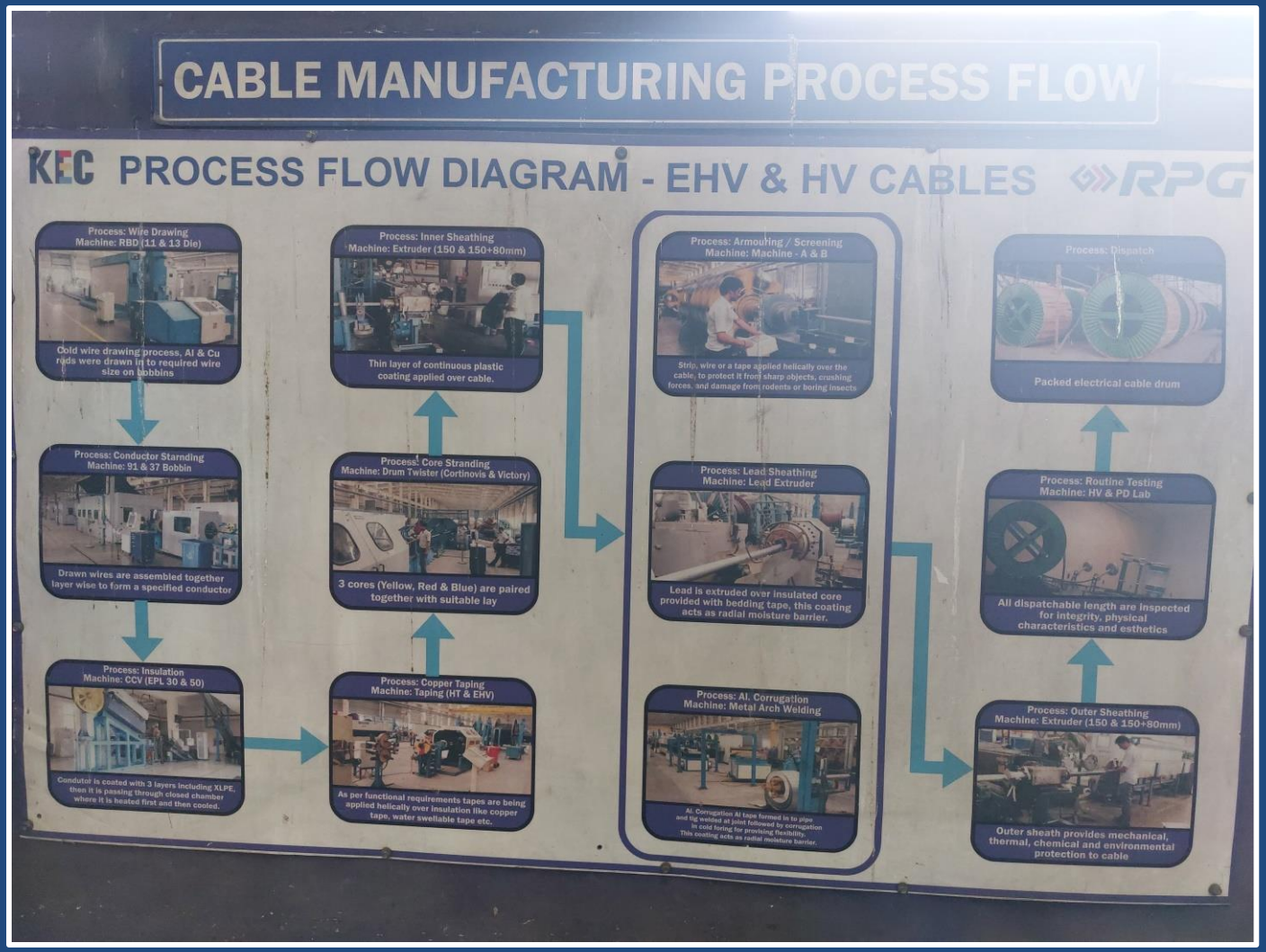
Date – 14/07/2021

BASIC STRUCTURE OF A CABLE



PRODUCTION


CABLE MANUFACTURING PROCESS FLOW
KEC PROCESS FLOW DIAGRAM - EHV & HV CABLES
RPG
Process: Wire Drawing
Machine: RBD (11 & 13 Die)
Cold wire drawing process. Al & Cu rods were drawn in to required wire size on bobbins
Process: Conductor Starnding
Machine: 91 & 37 Bobbin
Drawn wires are assembled together layer wise to form a specified conductor
Process: Insulation
Machine: CCV (EPL 30 & 50)
Condutor is coated with 3 layers including XLPE, then it is passing through closed chamber where it is heated first and then cooled.
Process: Copper Taping
Machine: Taping (HT & EHV)
As per functional requirements tapes are being applied helically over insulation like copper tape, water swellable tape etc.
Process: Core Stranding
Machine: Drum Twister (Cortinovis & Victory)
3 cores (Yellow, Red & Blue) are paired together with suitable lay
Process: Inner Sheathing
Machine: Extruder (150 & 150+80mm)
Thin layer of continuous plastic coating applied over cable.
Process: Armouring / Screening
Machine: Machine - A & B
Strip, wire or a tape applied helically over the cable, to protect it from sharp objects, crushing forces, and damage from rodents or boring insects
Process: Lead Sheathing
Machine: Lead Extruder
Lead is extruded over insulated core provided with bedding tape, this coating acts as radial moisture barrier.
Process: Al. Corrugation
Machine: Metal Arch Welding
Al. Corrugation Al tape formed in to pipe and tig welded at joint followed by corrugation in cold foring for provising flexibility. This coating acts as radial moisture barrier.
Process: Outer Sheathing
Machine: Extruder (150 & 150+80mm)
Outer sheath provides mechanical, thermal, chemical and environmental protection to cable
Process: Routine Testing
Machine: HV & PD Lab
All dispatchable length are inspected for integrity, physical characteristics and esthetics
Process: Dispatch
Packed electrical cable drum

HT PLANT
(11kV to 220kV)

1. Wire Drawing
2. Stranding
3. CCV
4. Copper Tapping
5. Drum Twister (3 Core Cable)
6. Inner Sheathing
7. Aluminum Corrogation
8. Armoring
9. Outer Sheathing

WIRE DRAWING

1. Name of Machine – Wire Drawing Machine
2. Maximum Line Speed – 21m/s
3. Input to Machine –
    a) Cu Rods – 8.5mm
    b) Al Rods – 9.0mm
4. Output From Machine – Wires of Reduced Diameters
5. Lubricant Used –
    a) Cu – Dommit 400
    b) AL – HP Oil
6. Reduction Percentage of each Die = 21%
7. Number of Machines in the Plant – 2
8. Purpose of Machine –
    a) Drawing Wires of required diameter by passing the rods through the calculated number of Dies.
    b) Annealing the drawn wire (Only Copper) to soften it for fine drawing.
9. Additional Material used – None

STRANDING

1. Name of Machine – Stranding Machine
2. Input to Machine – Drawn AL/Cu Wires
3. Output From Machine – Conductors with specified number of Strands and CS Area
4. Lubricant Used – None
5. Number of Machines in the Plant – 2
   a) 91 Bobbin Stranding Machine
   b) 37 Bobbin Stranding Machine
6. Purpose of Machine – a) Combine the specified number of strands of the given diameter to make the required Conductor.
   b) Produce Lay in the wires to keep them compact.
7. Additional Material used – Tapes.

CCV

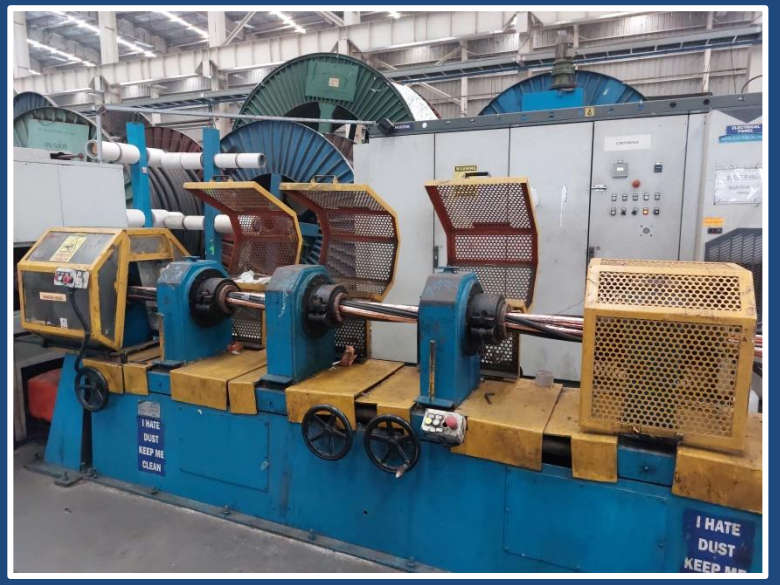
1. Name of Machine – CCV
2. Maximum Line Speed – 23m/min
3. Input to Machine – Conductors from Stranding
4. Output From Machine – Insulated Cable with Inner & Outer Protection to the Insulation
5. Coolant Used –
   a) Nitrogen
   b) Water
6. Number of Machines in the Plant – 2 Lines
   a) HT Cables
   b) EHV Cables
7. Purpose of Machine –
   a) Adding Insulation on the conductors along with its protecting Inner & Outer Layer.
   b) Use of Inner Semi-Conductor Screen is to maintain uniformity for the XLPE Layer and because it is Semi-Conducting it will not allow charge to pass, but will not hold the back voltage.
   c) The insulation thickness depends upon the Voltage to be transmitted, more the Voltage, more is the heat generated and hence, more the Insulation thickness.
   d) The purpose of Outer Semi-Conductor Screen is to reduce voltage stress at the interface between the conducting and insulating component.
8. Additional Material used – Semiconducting Material, XLPE, Nitrogen

COPPER TAPPING

1. Name of Machine – Copper Tapping Machine
2. Maximum Line Speed – 23m/min
3. Input to Machine – Cables from CCV
4. Output From Machine – Copper/Water Protective Tapped Cables.
5. Lubricant Used – None
6. Number of Machines in the Plant – 2
7. Purpose of Machine –
   a) Add Copper Tapping which precludes the charge from coming in direct contact with the earth.
8. Additional Material used – Tapes

DRUM TWISTER

1. Name of Machine – Drum Twister
2. Maximum Line Speed – 40m/min
3. Input to Machine – Copper Tapped Cables
4. Output From Machine – 3 Core Cable or Millican Conductor
5. Coolant Used – Water
6. Number of Machines in the Plant – 1
7. Purpose of Machine –
   a) Combine 3 Single Cables for the 3 Core Cable.
   b) Combine Sectors (70 & 72 Degrees) to create the Milican Conductor.
8. Additional Material used – Filler Cables, Tappes



ALUMINIUM CORROGATION

1. Name of Machine – Corrogation Machine
2. Maximum Line Speed – 3.5m/min
3. Input to Machine – Copper Tapped Cables
4. Output From Machine – Cables with coating of Aluminium Sheets with disc shapes along the length.
5. Coolant Used – Water + Dormit
6. Number of Machines in the Plant – 1
7. Purpose of Machine –
   a) Add coating of Aluminium which provides extra protection than Armoring.
   b) Add disc shape to the coating to facilitate bending by adding flexibility to the sheets.
8. Additional Material used – Aluminium Sheets, Tappes, Weld, Bitomine Compound.

ARMOURING

1. Name of Machine – Armoring Machine
2. Maximum Line Speed – 15-20m/min
3. Input to Machine – Copper Tapped Cables
4. Output From Machine – Cables with coating of Aluminium Sheets with disc shapes along the length.
5. Coolant Used – Water + Dormit
6. Number of Machines in the Plant – 1
7. Purpose of Machine –
   a) Add coating of Aluminium which provides extra protection than Armoring.
   b) Add disc shape to the coating to facilitate bending by adding flexibility to the sheets.
8. Additional Material used – Aluminium Sheets, Tappes, Weld, Bitomine Compound.

INNER & OUTER SHEATHING

1. Name of Machine – 150mm Extruder
2. Maximum Line Speed – 20m/min
3. Input to Machine –
   a) Inner Sheathing – Copper tapped Cable
   b) Outer Sheathing – Armored/Corrogated Cable
4. Output From Machine – Coated Cable with Printed Code(only after outer sheathing.
5. Coolant Used – Water
6. Number of Machines in the Plant - 2
7. Purpose of Machine –
   a) Add Protection to the cable.
   b) Outer Sheathings prints code on the cable.
8. Additional Material used – FSLR, XLPE, ZHFR, PVC.

LT PLANT
(Upto 1.1kV)

1. Wire Drawing
2. Laying Up
3. Extrusion for Insulation
4. Copper Tapping
5. Drum Twister
6. Inner Sheathing
7. Aluminum Corrogation
8. Armoring
9. Outer Sheathing

MAINTAINANCE

POWER SUPPLY FOR THE ENTIRE PLANT

GENERATORS

Details :-

- Power Rating – 1010 kVA
- Number of Units – 2
- Frequency – 50Hz
- Speed – 1500RPM

AIR COMPRESSORS

Details :-

- Motor Power – 30kW
- Number of Units – 3
- Max. Final Pressure – 7.5 bar
- Free Air Delivery – 96 l/s

NITROGEN PLANT

Details :-

- N2 Plant 1 Capacity – 40Nm3/hr
- N2 Plant 2 Capacity – 25Nm3/hr
- Max. Working Pressure – 16 bar
- Max. Working Temp. – 60°C

SCREW-TYPE AIR COMPRESSOR

QUALITY


KEC
RPG
WELCOME TO AN 'NABL'
ACCREDITED TEST LABORATORY
GOOD
HOUSEKEEPI
PREVENTS
ACCIDENTS
Daylighting
Lesser night sky pollution
KEC
RPC CABLES
WARNING
चेतावनी
24 Hr.
Video Surveillance
in Operation
24 घंटे विडियो की
निगरानी चालू है
TESTING
LAB
RESTRICTED AREA
NO UNAUTHORIZED
PERSONNEL
BEYOND THIS POINT
PUSH

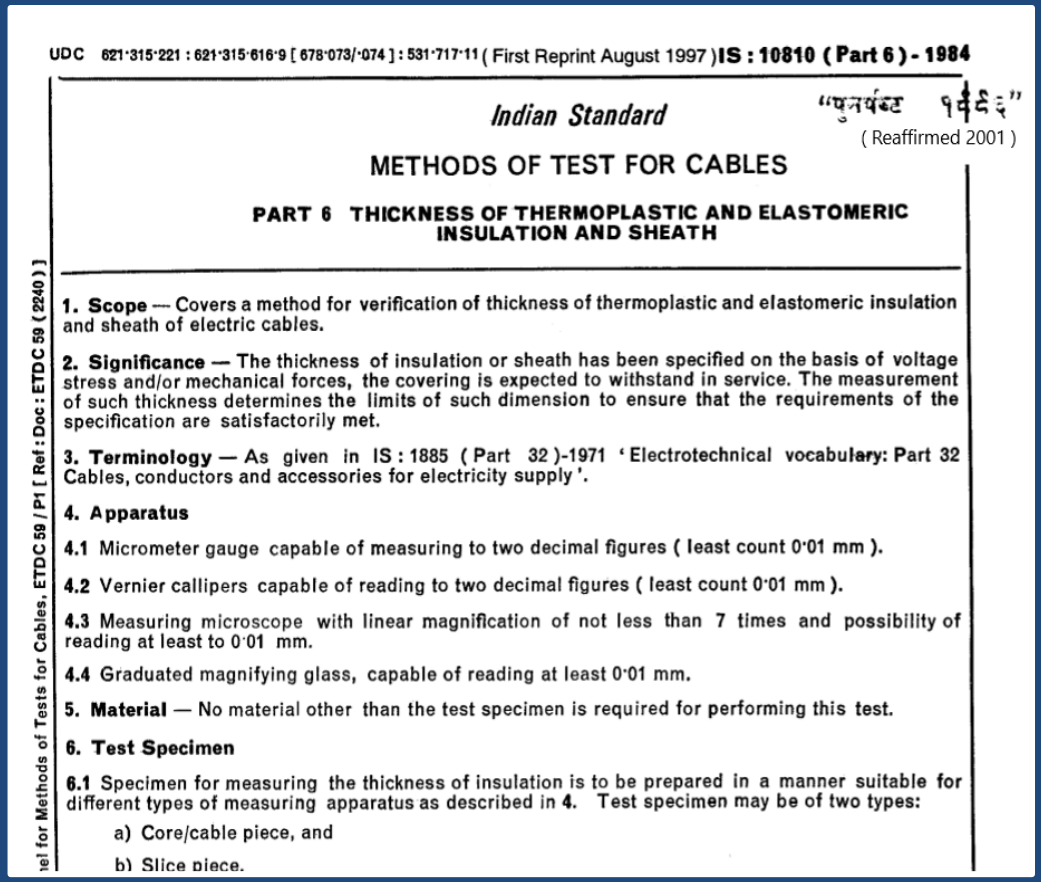
STANDARDS FOLLOWED

- No. of Times Testing takes place –

1. Testing of the Incoming Raw Materials
2. In-House Testing of Cables during various Stages of Manufacture
3. Acceptance Tests performed in front of the Inspector

- Testing of Cable –

1. HT Plant – IS 7078 Part2 (Above 3.3kV)
2. LT Plant – IS 7078 Part1 (Up to 3.3kV)
3. Method of Performing Tests – IS 10810



UDC 621·315·221 : 621·315·616·9 [678·073/·074] : 531·717·11 (First Reprint August 1997) **IS : 10810 (Part 6) - 1984**

Indian Standard

"पुनर्पुष्ट १९९६"

(Reaffirmed 2001)

METHODS OF TEST FOR CABLES

PART 6 THICKNESS OF THERMOPLASTIC AND ELASTOMERIC INSULATION AND SHEATH

1. Scope — Covers a method for verification of thickness of thermoplastic and elastomeric insulation and sheath of electric cables.

2. Significance — The thickness of insulation or sheath has been specified on the basis of voltage stress and/or mechanical forces, the covering is expected to withstand in service. The measurement of such thickness determines the limits of such dimension to ensure that the requirements of the specification are satisfactorily met.

3. Terminology — As given in IS : 1885 (Part 32)-1971 'Electrotechnical vocabulary: Part 32 Cables, conductors and accessories for electricity supply'.

4. Apparatus

4.1 Micrometer gauge capable of measuring to two decimal figures (least count 0·01 mm).

4.2 Vernier callipers capable of reading to two decimal figures (least count 0·01 mm).

4.3 Measuring microscope with linear magnification of not less than 7 times and possibility of reading at least to 0·01 mm.

4.4 Graduated magnifying glass, capable of reading at least 0·01 mm.

5. Material — No material other than the test specimen is required for performing this test.

6. Test Specimen

6.1 Specimen for measuring the thickness of insulation is to be prepared in a manner suitable for different types of measuring apparatus as described in **4**. Test specimen may be of two types:

a) Core/cable piece, and

b) Slice piece.

el for Methods of Tests for Cables, ETDC 59 / P1 [Ref : Doc : ETDC 59 (2240)]

DESIGN

DESIGN OF CABLE

- Number of Cores & Total Cross-Sectional Area of the Cable is specified by the Customer.
- Depending upon the conditions in which the Cable is to be used, the coverings are given to the Cable.
- For eg:-

I. Customer gives 5C/15mm2
II. Depending upon the Cross-Sectional Area & Geometry, the number of strands are taken. In this case, 7.
III. Now, The Diameter of each wire(d) is calculated. In this case, it comes out to be 0.7mm.
IV. Now, the diameter of each conductor is calculated (D) = 3d = 2.1mm
V. Next calculation of Diameter with the insulation is done. Assume the Diameter now, comes out to be 8.07mm.
VI. Now, assuming the thickness of Inner Sheath to be 0.4mm, the diameter now becomes = 8.87mm.
VII. Now, assuming the thickness of armour to be 1.4mm, the diameter now becomes = 11.67mm.
VIII. Now, assuming the thickness of Outer Sheath to be 1.4mm, the net diameter of Cable becomes = 14.47mm.
IX. Based on these calculated Diameters , the Weight of all the materials used per km of cable is calculated and based on that, the cost estimation is done.
X. Along with all the Diameters, the protective materials as specified by the customer are written in a PROCESS SHEET and are then sent to the Production Team for the Manufacturing to take place

XLPE & PVC FOR INSULATION

XLPE	PVC
Less thickness required	More thickness required
Less Density	More Density
Low Capacitance	High Capacitance
Less Weight	High Weight
Higher Current Carrying Capacity	Low Current Carrying Capacity
Low Shelf Life	High Shelf Life
Low Cost	High Cost

XLPE

Safe Working Temperature Limit = 90°C – 130°C

Maximum Temperature in case of Short Circuit = 250°C

PVC

TYPE - A

Safe Working Temperature Limit = 70°C

TYPE - B

Safe Working Temperature Limit = 85°C

TYPES OF PVC USED FOR SHEATHING

ST1	ST2
Working Temperature Safe Limit = 70°C	Working Temperature Safe Limit = 90°C

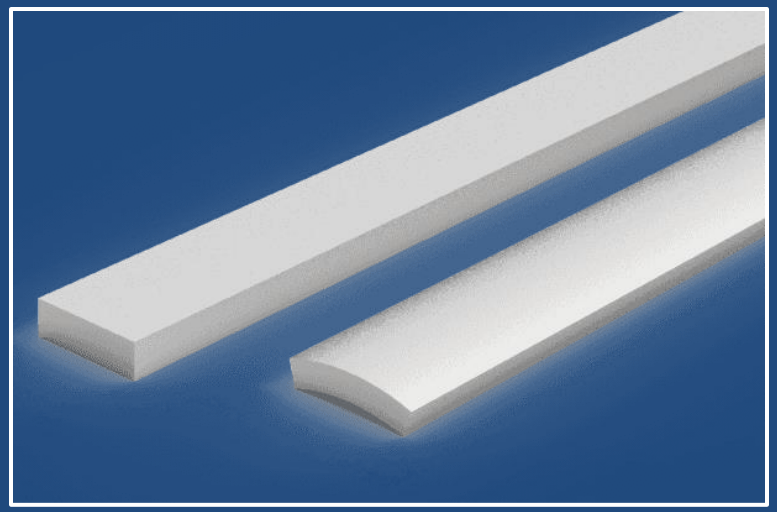
MATERIALS USED FOR SHEATHING

- PVC – Two additional types of PVCs are also used
  a) FR – Flame Retardant
  b) FRLS – Fire Retardant & Low Smoke
- ZHFR – Zero Halogen Flame Retardant

TYPES OF WIRE IN ARMOURING

- Flat Wires
- Round Wires

Flat wires have higher width than round wires. Hence, more number of wires are required in case of round wires than the Flat ones. This adds more mechanical strength to the cable.

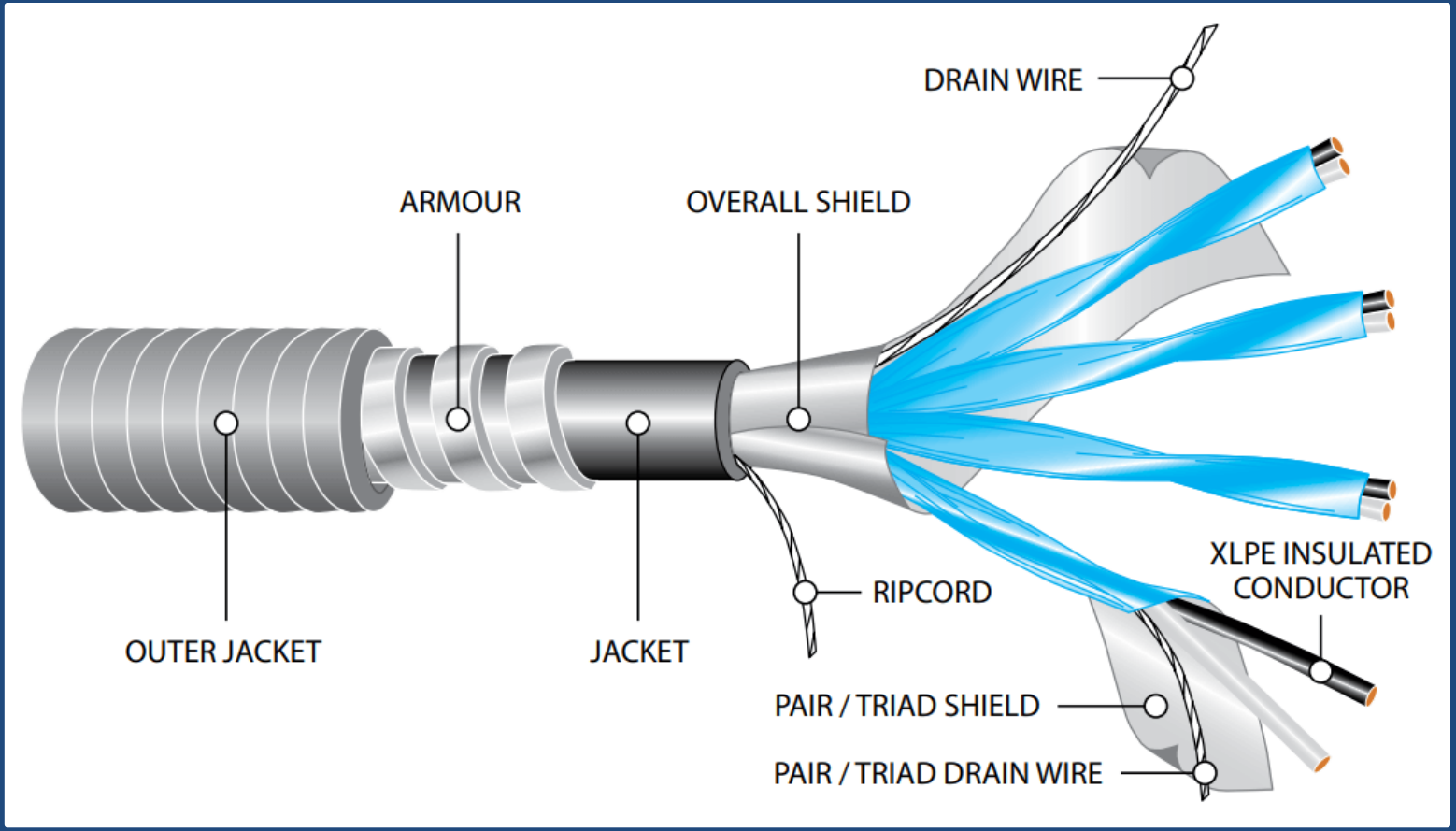


Flat Wires for Armouring

Round Wires for Armouring

INSTRUMENT CABLE

BASIC STRUCTURE



INSTRUMENT CABLE

- Used for transmitting low voltage (in the order of mV) signals or monitoring or controlling electrical power systems and their associated processes.
- They are of 2 types
  a) Pair
  b) Triad
- There is a special type of shielding provided to these cables which include –
  a) Polyester – Used for providing Mechanical Strength.
  b) Aluminium Foil – Used to protect the signals being transmitted from the *noise.*
  c) Drain Wires – Used with Aluminium Foil to ensure the continuity of Aluminium Foil.
- After this Shielding, the conventional Armouring & Sheathing is provided to the Cable.

Pair type Instrument Cable

Triad type Instrument Cable