Cables ,Cords

NZCEE year1

What is Conductor ?

- conductors used for the supply or interconnection of electrical equipment must offer minimum opposition to the flow of electric current.
- resistance must be low, otherwise an uneconomical power loss(P=I2R) will occur within the conductor itself.
- Ideally conductors are designed to have minimum power loss.

Conductor types

- Conductors are manufactured as bare or insulated, single-wire or stranded, and in various shapes for different purposes.
- Most conductors used in general wiring are circular and insulated.

Insulation of conductors

- Insulation of cables for use on Standard Low Voltage(SLV), is rated for 230V 1-phase .

- 400V 3-phase 4 wire systems requires a voltage rating of 600/1000V.
- the peak voltage is higher than 230/400V rms)

  i.e $V_P = V_{RMS} \times \sqrt{2}$,

- Most of the conductors are insulated using PVC (polyvinyl chloride) sheathing.
- For standard PVC insulation a maximum conductor temperature is 600°c.
- For Heat resisitant PVC the maximum temperature is 750°c.
- For XLPE(Cross-linked polyethylene) cables it is 900°c.

- Cable: A cable by definition (1.4.17) consists of at least one insulated conductor. The “functional” part of the cable consists of the cable cores, with their own insulation. Construction of the “protective” or sheathed portion .

Cable types

- Flexible Cables and Cords.
- Tough Plastic Sheath cable (TPS) cable.
- Conduit cable.
- Neutral-Screened (co-axial) Cable.
- PVC Insulated, Mains Cable

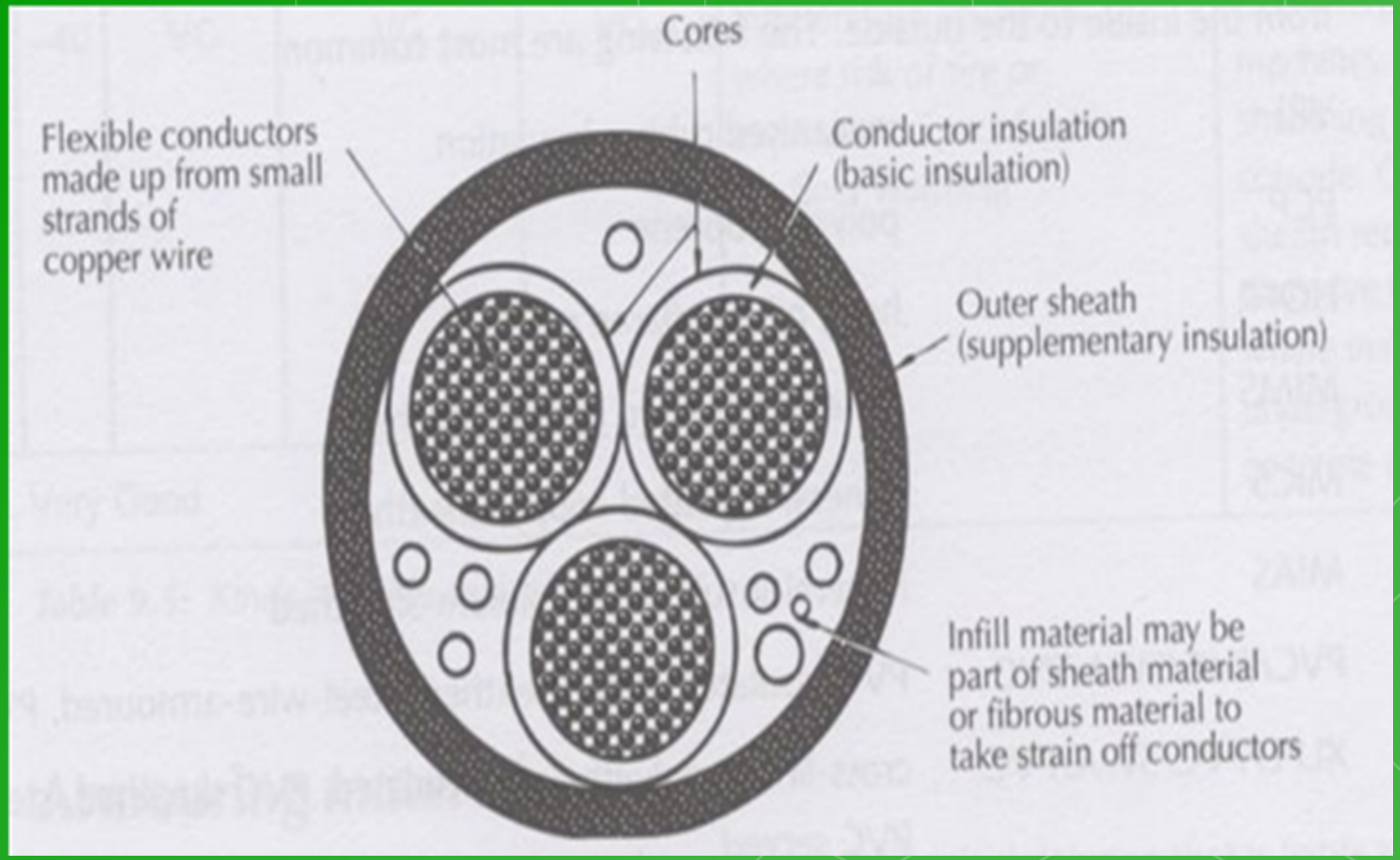
- PVC Insulated, Mains Cable.

- Mineral Insulated, Metal Sheathed Cable (MIMS)

Flexible cables and cords

- The only difference between a flexible cable and flexible cords is conductor size.
- Flexible cable is a cable consisting of one or more cores each formed of a group of wires. The diameter of the wires and the insulating material ensures flexibility.
- Flexible cord is a flexible cable in which the cross sectional area of each conductor does not exceed 4 mm^2.

- PVC (Polyvinyl Chloride) is a thermoplastic synthetic material used as insulation in flexible cords.
- Flexible cords/cable come in a variety of sizes, shapes and core numbers, and it is up to the electrical service technician to choose the correct cord fro a particular application


Cores
Flexible conductors made up from small strands of copper wire
Conductor insulation (basic insulation)
Outer sheath (supplementary insulation)
Infill material may be part of sheath material or fibrous material to take strain off conductors

- Selection criteria for cable

Selection Criteria	
A	Loading of conductors (in amps)
B	Number of cores
C	Shape of the cord (circular or flat)
D	Sheath material)to suit environment)
E	Temperature rating

- Selection criteria as per conductor size

Wattage (watts)	Current (Amperes)	Conductor size (mm2)
< 1725	< 7.5	0.75
1725 to 2300	7.5 to 10	1.00
2300 to 3400	10 to 15	1.50
3400 to 4600	15 to 20	2.50

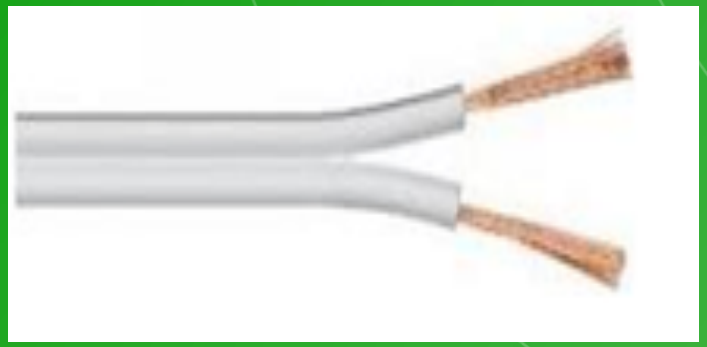
Types of flexible cords/cables

- Light and Ordinary duty pvc flex
- Heat resisting and screened pvc flex
- Tru-rip pvc flex
- PVC insulated flexible cord
- Hyperflex Welding and ordinary duty flex
- Hyperflex Heavy duty and marine flex

Types of flexible cable/cords

- **PVC (Tru-rip type cables)**

Application: Indoor dry situations with little risk of mechanical damage e.g. table lamps, radios, clocks, etc.



- **PVC/PVC**

Applications:Indoor and outdoor, damp and dry situations, e.g. washing machines, drills, vacuum cleaners, mowing machines etc

- **PVC (copper screened) PVC**

Application: Indoor and outdoor, wet and dry situations where a reasonable degree of screening is required (filling factor of screen is 0.6 minimum).

- **Heat-resisting PVC**

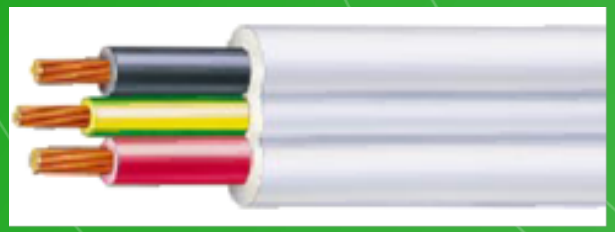
Application: Immersion heaters, storage heaters etc

- **Hyperflex (VNR) cable**

Application: Where resistance to oil, fuel and solvents is required. Good abrasion characteristics. Switchboards, earth and power leads. Suitable for use in temperatures down to -25°C

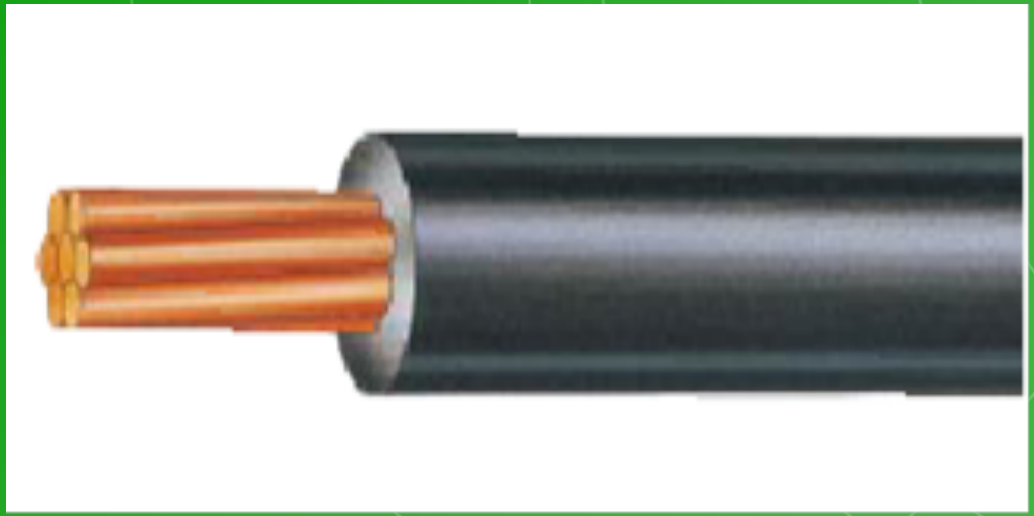
Tough Plastic Sheath cable (TPS)

- T.P.S. cables are made with single core, two core and earth, three core or three core and earth. The conductors are made of single or stranded copper conductors, each insulated with the standard colour-coded PVC



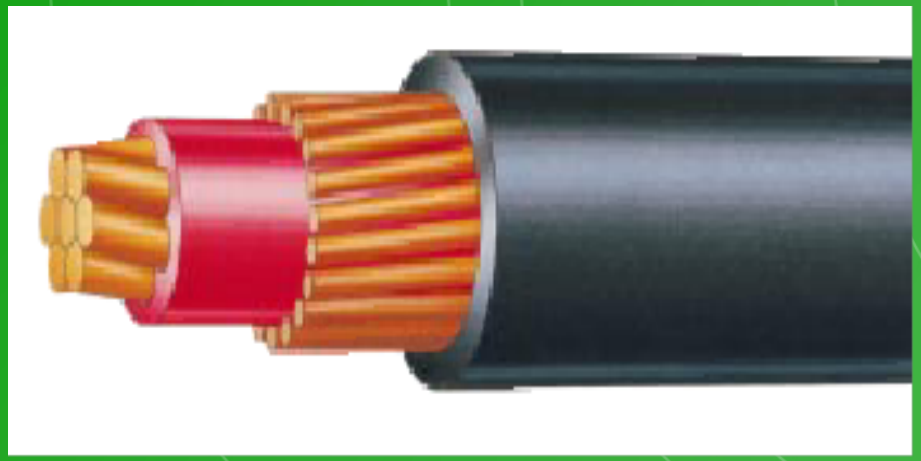
Conduit Wire

- PVC insulation without sheath, containing copper conductors.
- this type of cable has no mechanical protection and requires to be installed within a medium, such as metallic or plastic conduit or trunking systems.
- With suitable protection conduit wire is extensively used for lighting, power, and motor circuits etc.
- Available in sizes ranging from 0.5 mm^2 to 630mm



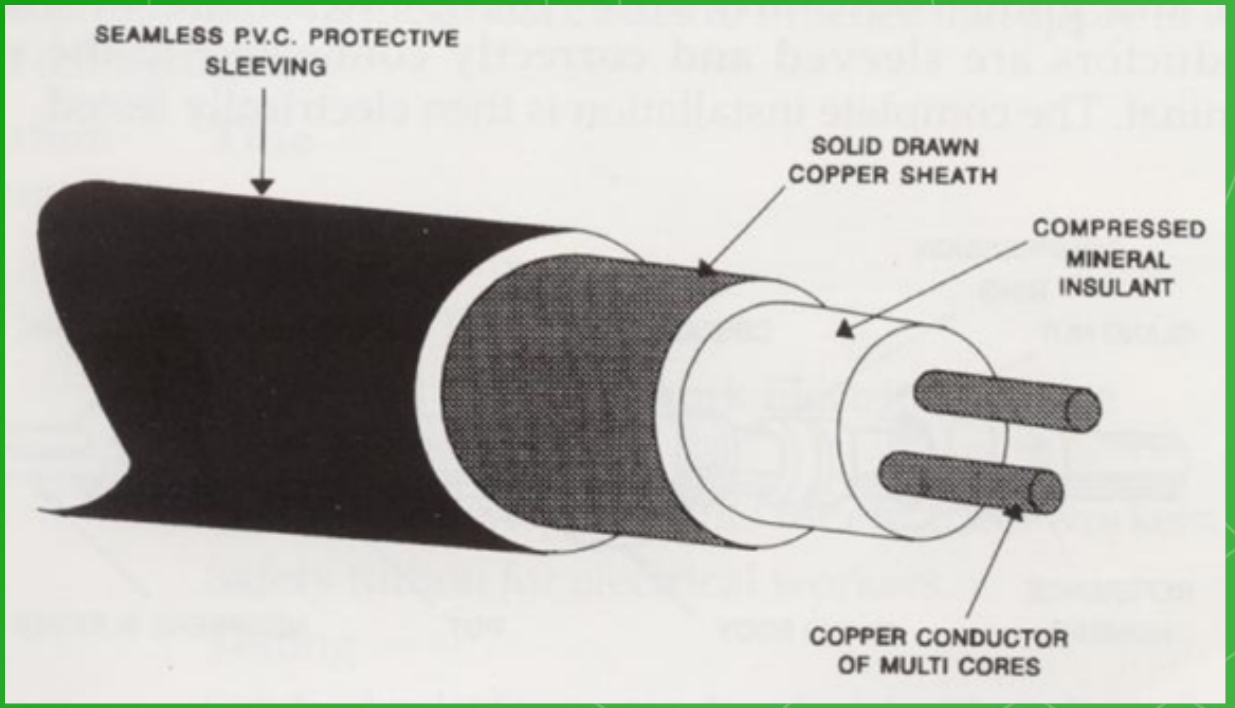
Neutral-Screened (co-axial) Cable

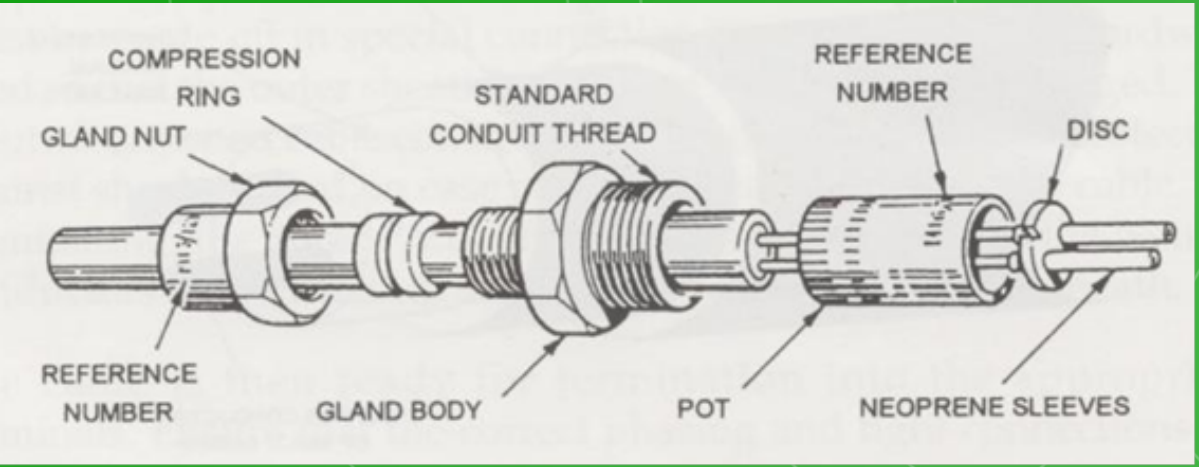
- The concept of a cable with a concentric neutral conductor was developed to provide a more economic and space saving construction.
- The copper wires of the neutral conductor are wound around the PVC insulated phase conductor then covered by an overall PVC sheath.
- The neutral-screened cable is used for service mains or sub-mains in domestic and industrial installations
- The cable termination must be made off in special connection boxes with special hardware used so that the outer sheath is clamped firmly but not damaged



Mineral Insulated, Metal Sheathed Cable (MIMS)

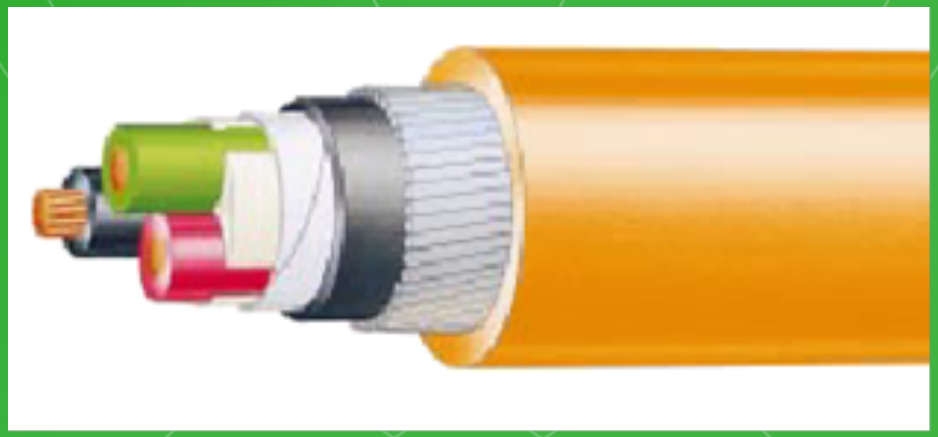
- This type of cable consists of solid copper conductors embedded in an insulation of highly compressed magnesium oxide, the conductors and insulation being contained in a seamless metal sheath.
- Aluminium or copper is the metal used for the sheath, and in some instances the sheath has a PVC covering.
- The MIMS cable is used in potentially hazardous sites such as oil refineries, gas and chemical installations.
- MIMS is also used in hotels, hospitals and high rise buildings where public safety is important or where robust mechanical protection is needed.


SEAMLESS P.V.C. PROTECTIVE SLEEVING
SOLID DRAWN COPPER SHEATH
COMPRESSED MINERAL INSULANT
COPPER CONDUCTOR OF MULTI CORES


COMPRESSION
RING
GLAND NUT
STANDARD
CONDUIT THREAD
REFERENCE
NUMBER
DISC
REFERENCE
NUMBER
GLAND BODY
POT
NEOPRENE SLEEVES

Cross-Linked Polyethylene (xlpe) Cable

- This has cable insulation that retains its strength at a higher temperature (90°C while having increased insulating properties. It is particularly useful in high voltage cables.
- Sizes are from 2.5 mm² to 300 mm².
- As for PVC mains cables XLPE cables can have copper or aluminium conductors, and may be armoured or unarmoured. The XLPE is for the conductors with the outer sheath being PVC



Voltage drop

- As per AS/NZS 3000:2018 3.6.1
- Voltage drop:Under normal service conditions, the voltage at the terminals of any power- consuming electrical equipment shall be not less than the lower limit specified in the relevant electrical equipment Standard .
- The cross-sectional area of every current-carrying conductor shall be such that the voltage drop between the point of supply for the low voltage electrical installation and any point in that electrical installation does not exceed 5% of the nominal voltage at the point of supply.

- The basic formula used in the AS/NZS 3008.1 series is— $V_d = (L \times I \times V_c)/1000$
- where
  V_d = actual voltage drop on circuit; in volts, V

L =route length of circuit; in metres, m

I = circuit current (usually maximum demand); in amperes, A

V_c =cable voltage drop per ampere-metre length of the circuit; in millivolts per ampere-metre, mV/Am

- Values of V_c are tabulated in the AS/NZS 3008.1 series.

- Calculate the voltdrop in a 0.75mm flex if a 1.8kW Load is 29.9m from a 230v supply?

Conductor Size	Current Carrying Capacity	Voltage drop per ampere per metre d.c. or single Phase a.c.
mm^2	Amps.	MilliVolts / A / M (mV / A / M)
0.5	3	86
0.75	7.5	57
1.0	10	43
1.25	13	35
1.5	16	31
2.5	20	18
4	25	11

- The Electrical regulations state that we cannot have more than a 5% voltdrop. How long can we have a 1.5mm flex if the load is 1.2kW

Conductor Size	Current Carrying Capacity	Voltage drop per ampere per metre d.c. or single Phase a.c.
mm^2	Amps.	MilliVolts / A / M (mV / A / M)
0.5	3	86
0.75	7.5	57
1.0	10	43
1.25	13	35
1.5	16	31
2.5	20	18
4	25	11