Polyvinyl Chloride - PVC Insulation

- Family: Thermoplastic
- Use: Typically used as a Low Voltage Insulation

For 70°C operation, insulations are classed as general purpose, hard or flexible. By using different plasticisers, stabilisers and other additives in the compound, different properties can be produced, such as 85°C operating temperature and low-temperature resistance.

General Properties

Introduced during WW2 as a replacement for Rubber which was in short supply after the fall of Malaysia, Polyvinyl chloride is now known as a good general-purpose thermoplastic. As the term suggests, the properties of thermoplastics vary with temperature, so at elevated temperatures, PVC's soften; conversely, at low temperatures, they become stiff and rigid. A synthetic polymer of vinyl chloride it is derived, like the vast majority of cable compound polymers, from oil. Basically a hard thermoplastic, it has many uses, including in its un-plasticised state window frames ((uPVC), pipes and bottles, and in its plasticised state cable compounds, among many others. During compounding, the raw polymer is blended with carefully

selected plasticisers, fillers and stabilisers to produce the required performance and properties.

Compounding and Processing

PVC compounds are usually compounded with carefully selected fillers, colouring pigments, stabilisers and plasticizing agents using high-speed mixers and compounding plants, although internal mixers are still used. Different plasticisers and stabilisers are available to extend the temperature range of PVC or change the hardness of the finished compound.

PVC compounds are one of the easiest materials to colour and extrude, being applied by conventional single screw extruders with cooling troughs replacing the vulcanisation tubes used to cross-link rubbers.

Specific Properties of cable compounds

The insulation resistance of PVC is lower than that of other popular insulations, but it is perfectly acceptable for most low-voltage wiring applications.

PVC has good mechanical and ageing properties, with excellent resistance to ozone.

Cables insulated and sheathed with PVC have good resistance to water, but for prolonged or permanent immersion, an alternative material such as polyethylene is required.

PVC has good resistance to chemicals but can be affected by solvents and some oils, which tend to leach out the plasticiser and can cause the PVC to crack.

PVC compounds are classed as flame retardants, being self-extinguishing when the source of the flame is removed; however, it achieves this by virtue of the chloride gas it emits when it decomposes, and so PVC is not halogen free and produces black smoke when burned. Its fire properties can be improved by special compounding resulting in what is termed "reduced smoke acid binding PVC", but the improvements in modern Low-smoke, Low-halogen compounds have effectively made these compounds redundant.

Uses of material/Cable types

The electrical properties of PVC preclude its use in high frequency or MV cables but they are perfectly acceptable in low voltage wiring, instrument and internal wiring, as well as telephone cables.

The maximum continuous operating temperature of general-purpose and flexible compounds is 70°C, heat-resisting grades have good ageing properties when operated at 85°C, and claims are made for higher operating temperatures, but these should always be checked against the stated life upon which they are based.

Unless designed for use at low temperatures, PVC cables should not be installed or flexed when the temperature is below 0₀C unless the cables have been stored above this temperature for the previous 24 hours. Failure to observe this precaution may result in cracking or shattering of the PVC. Once installed and fixed, PVC cables can withstand sub-zero temperatures.

Standards

PVC insulations are included or referenced in the following standards:

- IEC 60092 – series
- IEC 60245 – series
- IEC 60502-1
- BS EN 50525 – series
- BS EN 50363
- BS 6004
- BS 6231
- BS 6346

- BS 7655
- DIN VDE 0207 – series
- Def Stan 61-12 Part 4
- Def Stan 61-12 Part 5