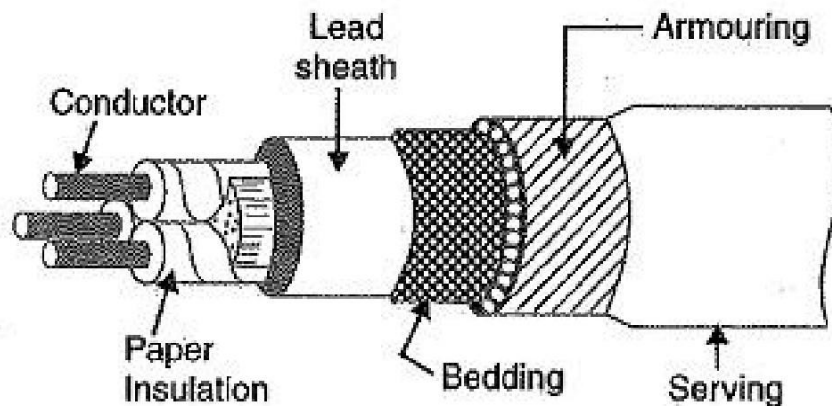


## 1.1 Underground Cables

### Construction of Underground Cables:

A cable may have one or more than one core (conductor) depending upon the type of service for which it is intended. For instance, the 3-conductor cable shown in Fig. 11.1 is used for 3-phase service. The conductors are made of tinned copper or aluminium and are usually stranded in order to provide flexibility to the cable.



**Fig. 11.1** Construction of a Cable

### Insulation

Each core or conductor is provided with a suitable thickness of insulation, the thickness of layer depending upon the voltage to be withstood by the cable. The commonly used materials for insulation are impregnated paper, varnished cambric or rubber mineral compound.

### Metallic sheath

In order to protect the cable from moisture, Conductor gases or other damaging liquids (acids or alkalis) in the soil and atmosphere, a metallic sheath of lead or aluminium is provided over the insulation

### Bedding

Over the metallic sheath is applied a layer of bedding which consists of a fibrous material like jute or hessian tape. The purpose of bedding is to protect the metallic sheath against corrosion and from mechanical injury due to armouring.

**Armouring:**

Over the bedding, armouring is provided which consists of one or two layers of galvanised steel wire or steel tape. Its purpose is to protect the cable from mechanical injury while laying it and during the course of handling. Armouring may not be done in the case of some cables.

**Serving:**

In order to protect armouring from atmospheric conditions, a layer of fibrous material (like jute) similar to bedding is provided over the armouring. This is known as serving.

It may not be out of place to mention here that bedding, armouring and serving are only applied to the cables for the protection of conductor insulation and to protect the metallic sheath from mechanical injury.

**Insulating Materials for Underground Cables:**

The satisfactory operation of a cable depends to a great extent upon the characteristics of insulation used. Therefore, the proper choice of Insulating Materials for Underground

Cables is of considerable importance. In general, the insulating materials used in cables should have the following properties :

- High insulation resistance to avoid leakage current.
- High dielectric strength to avoid electrical breakdown of the cable.
- High mechanical strength to withstand the mechanical handling of cables.
- Non-hygroscopic e., it should not absorb moisture from air or soil. The moisture tends to decrease the insulation resistance and hastens the breakdown of the cable. In case the insulating material is hygroscopic, it must be enclosed in a waterproof covering like lead sheath.
- Non-inflammable.
- Low cost so as to make the underground system a viable proposition.
- Unaffected by acids and alkalis to avoid any chemical action. No one insulating material possesses all the above mentioned properties. Therefore, the type of insulating material to be used depends upon the purpose for which the cable is required and the quality of insulation to be aimed at. The principal of Insulating Materials for Underground Cables are rubber, vulcanized India rubber, impregnated paper, varnished cambric and polyvinyl chloride.

## Classification of Underground Cables:

Classification of Underground Cables may be in two ways according to

The type of insulating material used in their manufacture

The voltage for which they are manufactured.

However, the latter method of Classification of Underground Cables is

generally preferred, according to which cables can be divided into the following groups :

Low-tension (L.T.) cables – up to 1000 V

High-tension (H.T.) cables – up to 11,000 V

Super-tension (S.T.) cables – from 22 kV to 33 kV

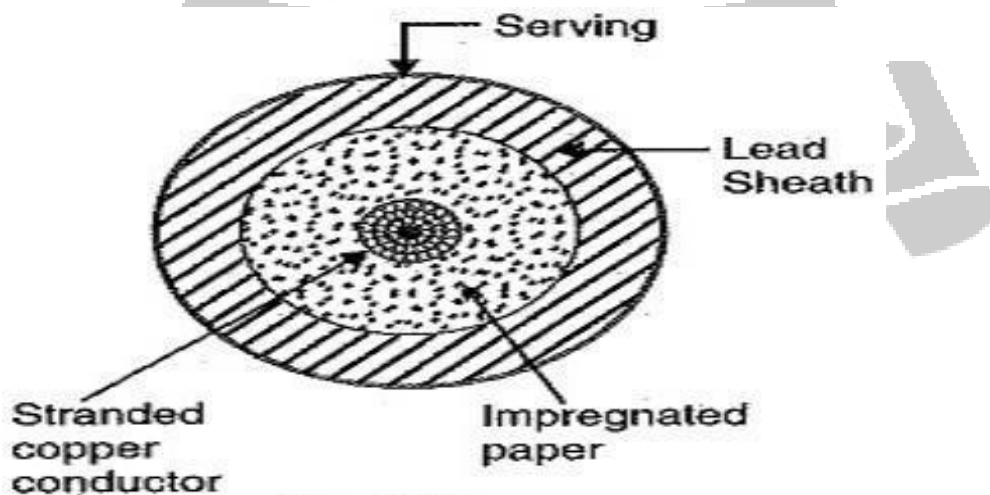
Extra high-tension (E.H.T.) cables – from 33 kV to 66 kV

Extra super voltage cables – beyond 132 kV

A cable may have one or more than one core depending upon the type of service for which it is intended. It may be

- single-core
- two-core
- three-core
- four-core etc.

For a 3-phase service, either 3-single-core cables or three-core cable can be used depending upon the operating voltage and load demand.



**Fig. 11.2**

Fig. 11.2 shows the constructional details of a single-core low tension cable. The cable has ordinary construction because the stresses developed in the cable for low voltages (up to 6600V) are generally small. It consists of one circular core of tinned stranded copper (or aluminum) insulated by layers of impregnated paper. The insulation is surrounded by a lead sheath which prevents the entry of moisture into the inner parts. In order to protect the lead sheath from corrosion, an overall serving of compounded fibrous material (jute etc.) is provided.

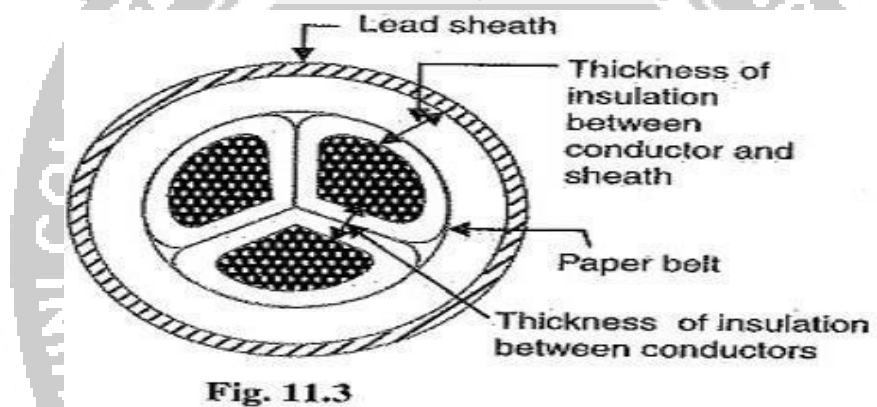


Fig. 11.3

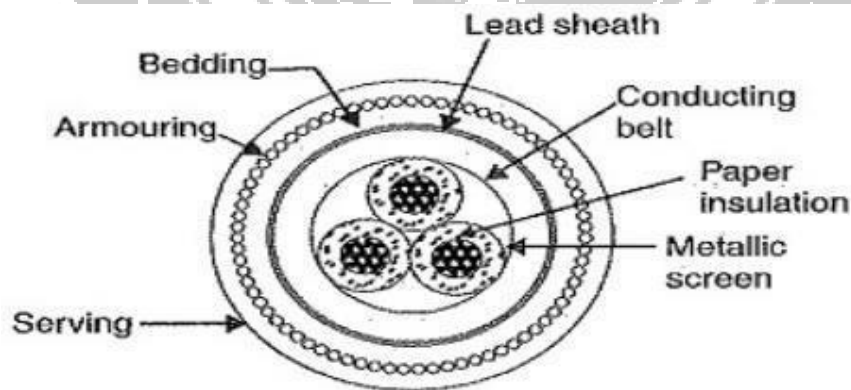


Fig. 11.4