

SELECTION OF POWER CABLES

Selection of Power cables for given purpose depends on a number of factors. Hence selection of it is never a simple task. Selection is also made difficult as there is such a large variety of cables available in the market.

Through this article we will see some of the important factors that determine selection of Power Cables.

Rated Voltage

It is necessary to select a **power cable** capable of supporting a particular system voltage.

In case of AC system, the rated voltage of power cable should always be equal to or greater than the system voltage.

To determine rated voltage consider following formula:

If V_0 is the rated cable voltage between each conductor and earth,

Then, V is the cable rated voltage between phase conductors, expressed as:

$$V = \sqrt{3} V_0$$

The exact rated voltage selection of power cable depends on earth fault withstand limits and specifications considerations that are made by the power system designers.

As per IEC standards following three classifications exist:

- Category A: The earth fault must be cleared within 1 second
- Category B: Earth fault cleared within 1 hour for IEC-183 type cables, and cleared within 8 hours for IEC-502 type cables
- Category C: All systems not covered under A and B

For categories A and B – cables with same rated voltage as system voltage can be chosen. However, for Category C, the rated voltage of cable should be higher than system voltage. E.g. for 3.3 kV system voltage, a 6.6 kV rated voltage cable should be selected.

Current Carrying Capacity

Each power cable is designed to operate under certain temperature conditions.

Current carrying capacity of power cable is also dependent on conductor material (Copper / Aluminium) and insulation type.

Thus, Copper conductor cable has greater current carrying capacity than Aluminium.

XLPE insulation is better than PVC, hence the current carrying capacity of XLPE cable is more than that of PVC insulated cable.

Operating a cable continuously beyond its rated current carrying capacity shortens the lifespan of the cable, as the insulation becomes prone to failure.

The current carrying capacity is also dependent on operating temperature. Higher the temperature, lower is the current carrying capacity of the cable and vice versa.

Derating Factor

A power cable designed with standard operating conditions may not operate so in practical.

Therefore, the current carrying capacity may get impacted due to this.

Some examples of this: Cables installed deep under the ground will have reduced current carrying capacity than cables installed in air. This is impacted due to multiple factors like soil temperature, soil thermal resistivity etc.

In order to deal with this, a Derating Factor is associated with cables to arrive at actual value of current carrying capacity.

Actual Current Carrying Capacity = Derating Factor x Cable current carrying capacity under std. conditions.

Thus for a 100 A cable with a derating factor of 0.8 the actual current carrying capacity would be: $0.8 \times 100 = 80 \text{ A}$

Voltage Drop

A power cable manufacturer provides this as part of their data sheet. A voltage drop across the length of the power cable is very important. It is expressed as: mV / A-m.

The voltage drop per unit length of cable should as minimum as possible so as to get voltage at delivery end approximately same as supply side.

Short circuit Withstand

A power cable in case of short circuit event should be able to withstand the high current values without any damage to the cable and insulation.

The selection of short circuit current withstand capacity of a power cable is directly dependent on the specification of connected protection device.

E.g. if a breaker connected to a power cable is set to trip at 1000 A in 1 second then we need to select appropriate cable that can withstand the high current of 1000 A for a period of 1 second.

Availability of Cables

This needs to be checked with manufacturer or the dealer of a particular cable. Cables are manufactured in certain minimum length segments. Therefore, it will be difficult to procure a 30 meter length of 300 sq-mm cable than a 300 meter length of same cable.

Also, the costing may vary largely between the two quantities.

Bending Radius

This can be a practical problem during installation. Large sized multi-core cables have bigger bending radius than small sized. Therefore a same size of multi-core XLPE cable has more bending radius than a PVC.

In order to overcome this, a contractor might have to opt separate single core cables.

Other Factors

Care needs to be taken while dealing with Aluminum conductor cables, as the metal tends to oxidize very fast when exposed to air and develops a thin film of dielectric coating. Aluminum conductor cables are not used in case of generating stations, substations installations.

Aluminum is preferred for other application areas due to its high conductivity-to-weight ratio.

Large sized cables are quite rigid and difficult to bend, install and terminate.

Source: <http://engineering.electrical-equipment.org/electrical-distribution/selection-of-power-cables.html>