

PULLING OF CONDUCTORS AND CABLES

Pulling During Installation

Tension is developed in the cable when pulled due to the friction between the outer surface of the cable and the surface over which it is pulled. Excessive lengths can lead to high tensions during pulling, creating the risk of cable damage, particularly at bends.

Some simple rules and precautions are suggested when pulling cables during installation.

- 1) Pull on the conductor, using a pulling eye wherever possible.
- 2) Do not pull directly on interlocked armour. If basket weave types of grip are used, make them as long as possible to distribute the force on the insulation, and apply a heat shrinkable tube over the armour and/or jacket to prevent damage.
- 3) Provide generous radii for bends. This will decrease the pulling tensions and the risk of armour and jacket damage.
- 4) Pull in the direction of the end with the lowest elevation, to reduce pulling forces.
- 5) Avoid sharp bends near the pulling end, as they increase the total pulling tension exponentially in the inverse of the radius of the bend. Try to line up the pull with the straightest section at the pulling end.
- 6) Provide rollers at bends wherever conditions permit, to reduce the pulling tensions due to friction.
- 7) Use approved pulling lubricants wherever possible, particularly in cramped spaces and in underground raceway.

The following formulae, extracted from the Aluminum Electrical Conductor Handbook, published by the Aluminum Association, may be used for calculation.

Pulling Tensions

1. The maximum allowable pulling tension, if the pulling eye is attached to the conductor:

$$P_m = K N A \text{ (Eq. 1)}$$

where P_m = Maximum allowable tension, lb

N = Number of conductors being pulled simultaneously

A = Circular mil area of each conductor.
(If conductors are of various sizes, add the individual NA values)

K = Conductor stress factor

(K value for NUAL conductors = .004)

2. The maximum allowable pulling tension (P_m) cannot exceed 1000 lb where cables are pulled with a basket grip: however, the tension per Eqs. 1 or 2 should not be exceeded.
3. The maximum allowable pulling tension for cable in conduit or duct bends (to prevent cable damage because of rubbing on sides of bend) must not exceed the following:

$$P_b = 100 r \text{ (Eq. 2)}$$

where P_b = Maximum allowable bend tension, lb

r = Radius of curvature of the conduit or duct bend, ft

Note: The maximum allowable tension determined from Eqs. 1 or 2 should not be exceeded.

4. For straight section of conduit or duct, the pulling tension (P_s) likely to be developed can be determined as follows:

$$P_s = L w f \text{ (Eq. 3)}$$

where P_s = Pulling tension in straight section, lb

L = Length of conduit or duct straight section, ft

w = Weight of cable (or cables), lb per ft

f = Coefficient of friction

Note: For a well constructed conduit or duct with a lubricated cable “ f ” approximates 0.5. For less favourable conditions or with considerable curvature, “ f ” may approximate 0.75.

5. For curved sections of conduit or duct, the pulling tension (P_c) likely to be developed can be determined as follows:

$$P_c = P_2 + P_1 e^{f\alpha} \text{ (Eq. 4)}$$

where P_c = Total pulling tension, lb

P_2 = Tension for straight section at pulling end, lb

P_1 = Tension for straight section at feeding end, lb

α = Angle of bend in radians
(1 radian = 57.3 deg)

e = Base of Naperian logarithms (2.718)

f = Coefficient of friction