Cable Lore

ANACONDA

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JAM RATIO

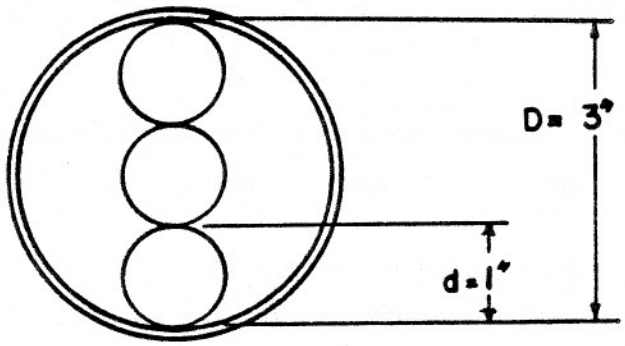
One of the most significant and least understood problems encountered when cables are pulled into duct or pipe is the jamming of conductors with subsequent damage to protective sheaths, shielding systems or insulations.

Jamming can be defined as pressing, squeezing or wedging into a close or tight position. Conditions or situations that would cause cables to jam are easily illustrated and understood with the aid of some elementary geometry.

The successful installation of cable in conduit or pipe hinges on maintaining a proper ratio between the inside diameter of the pipe (D) and the outside diameter of the cable (d). In other words, D/d.

It must be recognized that some ovality may result from necessary bending of the pipe and thus reduce the clearance in sections containing bends.

Figure 1



For illustration purposes let's consider an installation of three conductors each with an O.D. of 1 inch in a pipe with a 3 inch I.D. In this example, D/d would be 3/1 or 3.0. During an actual pull-in there is a good chance that one conductor will slip in between the other two as shown in Figure 1.

You will note there is no clearance between the cables and pipe. When, upon pulling, cables reach the ovality in a bend, they will squeeze or wedge and jam. It is obvious from this illustration that the most unfavorable ratio between D/d is 3/1 or 3.0.

There are two solutions to this problem:

(1) Use a pipe with a smaller I.D. than 3 inches.

(2) Use a pipe with a larger I.D. than 3 inches.

Solution (1) would be more economical and is usually preferred. The following examples will demonstrate how approach (1) works.

Figure 2

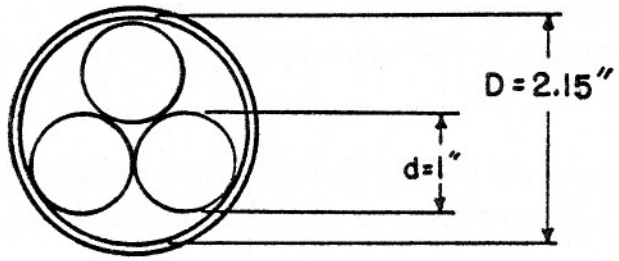
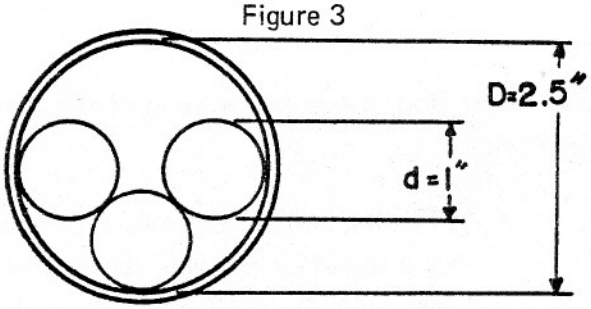


Figure 2 illustrates that three 1 inch diameter cables in a triangular configuration require a circle approximately 2.15 inches in diamter to encircle them. The solution then is to keep or train the cables in a triangular configuration during cable pull-in. If a vlaue of D/d equal to 2.15 is used, jamming of the conductors is not possible. However, with a ratio of 2.15, there is not sufficient clearance for the cables in this small duct.

Figure 3



In the third illustration (Figure 3), we have increased the I.D. of the pipe to 2.5 inches, and with the same 1 inch O.D. cables there is still no chance that one conductor will slip between the other two and jam. And with this ratio there is clearance for the cables inside the duct.

When installing cables in conduit or pipe, follow these guidelines to avoid damage caused by conductor jamming:

(1) If D/d is 3.0, one conductor may line up between the other two resulting in jamming.
(2) With ratios just under 3.0, jamming might occur because of slight ovality in bends that increase I.D. to give a ratio of 3.0.
(3) Serious jamming can probably be avoided if the ratio is less than 2.8.
(4) If D/d is less than 2.5, jamming is impossible because the cables will be confined to a triangular configuration.
(5) This configuration is also preferred because electrical losses are less in this arrangement.
(6) When using smaller conduit or larger cables to avoid the 3/1 jam ratio, observe maximum fill requirements, if any.

The discussion and illustrations are meant primarily to point out causes for cable jamming and potential solutions. The usual calculations for clearance and conduit fill should be made for specific installations.

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