TECHNICAL NEWS
from
THE OKONITE COMPANY

Engineering Information for the Professional Engineer

January 31, 2003 Edition: 0014

Power Cables - Conductor Design

Power cable sizes are generally defined as #8 AWG and larger. Today, the design of these conductors, industry wide, is likely to be compact round. What is compact round?

Compact round is a variation of the basic concentric round conductor. Concentric conductors are made up of identical wire diameters. The configuration follows a pattern of twisting six (6) wires around a straight center wire. Additional wire layers are added in multiples of six (6) to provide the necessary cross sectional area. The wire lay up pattern is concentric layers of alternate clockwise and counter clockwise twisting.

7 wire = 1 + 6 , 7X

19 wire = 1 + 6 + 12 , 19X

37 wire = 1 + 6 + 12 + 18 , 37X

61 wire = 1 + 6 + 12 + 18 + 24 , 61X

The individual wire diameter follows the industry convention of defining the wire area in circular mils. A circular mil equals the area of a circle 1 mil in diameter.

$$A = (n)x(d)^2$$

A = circular mils

n = number of wires

d = wire diameter in mils

The concentric round conductor can be designed more efficiently by removing the air spaces in the wire lay up. If the concentric diameter can be reduced by 3%, the conductor has been compressed. If the concentric diameter can be reduced up to 10%, the shape is now compact round.

Shown below is a sketch illustrating this comparison. The ASTM standards for electrical conductors permit the individual strands to be shaped for a more efficient reduction in diameter. The chart below compares the diameter of the popular sizes of conductors. More complex designs for compact round conductors can be referenced to ASTM standards for wire sizes, individual shapes and twisting methods.

Kcmil	Diameter, mils Concentric	Compressed	Compact
4/0, 19X	528	512	475
350, 37X	661	661	616
500, 37X	813	789	736
750, 61X	998	968	908

For any of the above designs, the manufactured conductor must meet the required resistance and metal weight for the size selected. For instance, a 500 kcmil design must yield a resistance of 0.021 ohms/1000' at 25C and a weight of 1544 pounds per 1000'. The only change from concentric to compressed to compact is the overall diameter.

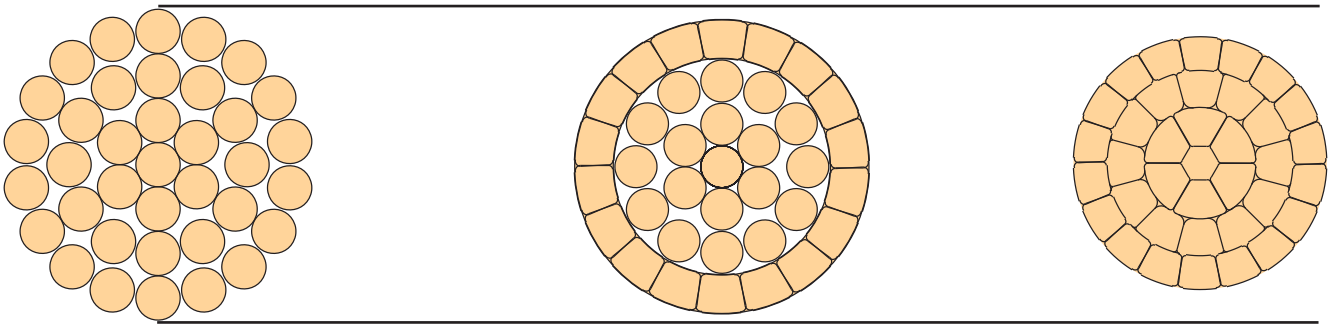
During installation, the usual cable accessories, splices and terminations, must be selected based on diameter.

Standard ASTM copper concentric references are:

B3 - Individual Wire Characteristics

B8 - Concentric/Compressed Conductors

B496- Compact Round Strand



37 Strands Concentric **37 Strands Compressed** **37 Strands Compact**

Reference Okonite's web site, www.okonite.com, select the "Engineering Technical Center" for detailed conductor characteristics; dimensions, weights and resistances.

J. V. Fitzgerald
V.P. Application Engineering