TECHNICAL NEWS
from
THE OKONITE COMPANY

SIDEWALL PRESSURE LIMITATIONS

It has been our experience that sidewall pressure is often the limiting factor when calculating whether a cable can be pulled in a long or multibend raceway. Sidewall pressure is the radial force exerted on the cable at a bend. As a component of the pulling tension calculations, sidewall bearing pressure is a marker indicating potential mechanical damage. Reference Okonite's "Installation Manual" for a complete treatment of cable pulling tensions.

Pressure —

The sidewall pressure (P) in general is defined as the tension out of a bend expressed in pounds divided by the inside radius of the bend expressed in feet. Equation 1a and 1b are for the "worst case" cable.

Eq.1: $P = \dfrac{T_o}{r}$ (One Single Cable)

1a: $P = \dfrac{(3c-2)}{3}\dfrac{T_o}{r}$ (Three Single Cables - Cradle Configuration)

1b: $P = \dfrac{cT_o}{2r}$ (Triangular Configuration)

P = Sidewall pressure, lbs per foot of radius
T_o = Tension (leaving the bend), pounds
c = Weight correction factor (Eq. 2 and 3)
r = Inside radius of conduit in feet (Table 1).

Weight correction factor —

This takes into account the added frictional forces that exist between triangular or cradle arranged cables resulting in a greater pulling tension than when pulling a single cable.

Values of c: (For Three Single Conductors — same diameter & weight)

Eq. 2: Cradled: $c = 1 + 4/3\left[\dfrac{d}{D-d}\right]^2$

Eq. 3: Triangular: $c = \dfrac{1}{\sqrt{1-\left[\dfrac{d}{D-d}\right]^2}}$

D = Conduit I.D.
d = Single conductor cable O.D.

Table 1
Rigid Conduit and Elbow Data

Conduit Size	Area in Sq. In.	Conduit ID in Inches	Elbow Centerline Radius in Inches								
			Std.	12	15	18	24	30	36	42	48
			Inside Radius - feet								
1/2	0.30	0.622	0.33								
3/4	0.53	0.824	0.34								
1	0.86	1.049	0.44	0.96	1.21	1.46	1.96	2.46	2.96	3.46	3.96
1 1/4	1.50	1.380	0.55	0.94	1.19	1.44	1.94	2.44	2.94	3.44	3.94
1 1/2	2.04	1.610	0.62	0.93	1.18	1.43	1.93	2.43	2.93	3.43	3.93
2	3.36	2.067	0.71	0.91	1.16	1.41	1.91	2.41	2.91	3.41	3.91
2 1/2	4.79	2.469	0.77		1.15	1.40	1.90	2.40	2.90	3.40	3.90
3	7.38	3.068	0.96			1.37	1.87	2.37	2.87	3.37	3.87
3 1/2	9.90	3.548	1.10			1.35	1.85	2.35	2.85	3.35	3.85
4	12.72	4.026	1.17				1.82	2.33	2.83	3.33	3.83
5	20.00	5.047	1.79					2.29	2.79	3.29	3.79
6	28.89	6.065	2.25						2.75	3.25	3.75

The maximum sidewall pressure that modern cables can withstand without causing incipient damage is based on the number of cables pulled together and the size of the conductors. These recommended limits are tabulated in Table 2.

Table 2
Maximum Sidewall Pressure - P $_{MAX}$
(lbs. per ft. of radius)

	Conductor Size	
Power Cables	**≤ 8AWG**	**> 8AWG**
One Single Cable	300	500
Two or More (parallel or plex)	500	1000
Multiconductor Power & Control Cable	**All Sizes**	
One Cable	500	
Two or More Cables	1000	
Instrument Cable		
Single Pair	300	
Multipair	500	

NOTE: P $_{MAX}$ limits given in Table 2 are for use with equation 1 only. If equation 1a or 1b is used the recommended maximum sidewall pressure limitation is 500 pounds per foot of radius.

Sidewall pressure limitations should not be overlooked. A graphic example of what can happen to a cable when sidewall pressure is neglected is shown in the photo below. This photo demonstrates the damage that occurred to a 15kV 500 kcmil power cable after it was pulled with high tension around a small diameter sheave. When a replacement sheave with a larger diameter was used, sidewall pressure damage was eliminated.