

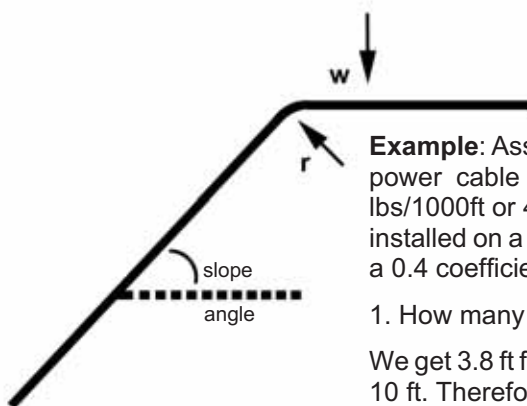
Cables Installed on an Incline

On occasion a customer or installer will inquire about the possibility of a cable slipping on an incline after installation is complete. Slipping or sliding down an incline is a function of the static coefficient of friction between the cable and the conduit or duct surface and the angle of the incline. The critical angle or “slip” angle versus the static coefficient of friction is given in Table 1 below.

Coefficient of Friction	Critical Angle in Degrees	Coefficient of Friction	Critical Angle in Degrees	Coefficient of Friction	Critical Angle in Degrees
0.05	3	0.35	20	0.65	34
0.10	6	0.40	22	0.70	35
0.15	9	0.45	25	0.75	37
0.20	12	0.50	27	0.80	39
0.25	15	0.55	29	0.85	41

In many instances, a cable installation will include a horizontal section as well as an incline section. In those cases, the weight of the cable in the horizontal section will act as a counter balance to the weight of the cable in the incline. The length of the cable in the horizontal section that is needed to counter balance the incline is again a function of the static coefficient of friction between the cable and the conduit or duct surface and the angle of the incline. Table 2 (back page) illustrates the minimum length in the horizontal section needed to counter balance the cable in the incline per 10 feet of incline.

Although the horizontal section may counter balance the cable in the incline, the sidewall pressure (SWP) on the cable in the bend must also be evaluated. The static maximum sidewall pressure for cable in a bend is 100 pounds per foot of radius.



w = weight (lb./1000ft)
r = radius of bend (ft)
SWP = sidewall pressure = W/r

Example: Assume a 1000 Cu kcmil Okoguard-Okoseal Type MV-105 15kV power cable (115-23-3244) with an approximate net weight of 4220 lbs/1000ft or 4.22 lbs/ft. and 1.86" OD (Minimum Bending Radius = 22") is installed on a 30° slope having a 100' length. For this example, we assume a 0.4 coefficient of friction.

1. How many feet of horizontal cable is needed to prevent sliding?

We get 3.8 ft from Table 2 below for a 30° incline and friction of 0.4 for every 10 ft. Therefore the horizontal length for 100 ft of cable would be:

$$L = 10 \times 3.8 = 38 \text{ ft}$$

2. What is the minimum radius of the bend?

Since the maximum SWP is 100 lbs/ft, we need to find the minimum radius the bend can have to not exceed its maximum sidewall pressure.

$$\text{SWP} = W/r \quad r = W/\text{SWP} = (100 \times 4.22 \times \sin(30^\circ))/100 = 2.1 \text{ ft}$$

Minimum radius of bend has to be 2.1 ft (25") to avoid having a sidewall pressure greater than 100 lbs/ft.

TABLE 2

Minimum length in the Horizontal Section Needed to Counter Balance the Cable in the Incline per 10 Feet of Incline

		TABLE 2 Coefficient of Friction																		
Angle (Degrees)	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	
2																				
4	4.0																			
6	11.0	0.5																		
8	17.9	4.0																		
10	24.9	7.5	1.7																	
12	31.8	11.0	4.1	0.6																
14	38.7	14.5	6.4	2.4	0.0															
16	45.5	18.0	8.8	4.2	1.4															
18	52.3	21.4	11.1	5.9	2.9	0.8														
20	59.0	24.8	13.4	7.7	4.3	2.0	0.4													
22	65.6	28.2	15.7	9.5	5.7	3.2	1.4	0.1												
24	72.2	31.5	18.0	11.2	7.1	4.4	2.5	1.0												
26	78.7	34.8	20.2	12.9	8.5	5.6	3.5	2.0	0.8											
28	85.1	38.1	22.5	14.6	9.9	6.8	4.6	2.9	1.6	0.6										
30	91.3	41.3	24.7	16.3	11.3	8.0	5.6	3.8	2.5	1.3	0.4									
32	97.5	44.5	26.8	18.0	12.7	9.2	6.7	4.8	3.3	2.1	1.2	0.4								
34	103.5	47.6	29.0	19.7	14.1	10.3	7.7	5.7	4.1	2.9	1.9	1.0	0.3							
36	109.5	50.7	31.1	21.3	15.4	11.5	8.7	6.6	5.0	3.7	2.6	1.7	1.0	0.3						
38	115.3	53.7	33.2	22.9	16.7	12.6	9.7	7.5	5.8	4.4	3.3	2.4	1.6	0.9	0.3					
40	120.9	56.6	35.2	24.5	18.1	13.8	10.7	8.4	6.6	5.2	4.0	3.1	2.2	1.5	0.9	0.4				
42	126.4	59.5	37.2	26.0	19.3	14.9	11.7	9.3	7.4	6.0	4.7	3.7	2.9	2.1	1.5	0.9	0.4	0.0		
44	131.7	62.3	39.1	27.5	20.6	16.0	12.7	10.2	8.2	6.7	5.4	4.4	3.5	2.7	2.1	1.5	1.0	0.5	0.1	
46	136.9	65.0	41.0	29.0	21.8	17.0	13.6	11.0	9.0	7.4	6.1	5.0	4.1	3.3	2.6	2.0	1.5	1.0	0.6	
48	141.9	67.6	42.9	30.5	23.0	18.1	14.5	11.9	9.8	8.2	6.8	5.7	4.7	3.9	3.2	2.6	2.1	1.6	1.1	
50	146.8	70.2	44.6	31.9	24.2	19.1	15.5	12.7	10.6	8.9	7.5	6.3	5.4	4.5	3.8	3.1	2.6	2.1	1.6	
52	151.4	72.6	46.4	33.2	25.4	20.1	16.4	13.5	11.4	9.6	8.2	7.0	6.0	5.1	4.4	3.7	3.1	2.6	2.1	
54	155.9	75.0	48.1	34.6	26.5	21.1	17.2	14.3	12.1	10.3	8.8	7.6	6.6	5.7	4.9	4.2	3.6	3.1	2.6	
56	160.2	77.3	49.7	35.9	27.6	22.0	18.1	15.1	12.8	11.0	9.5	8.2	7.2	6.3	5.5	4.8	4.2	3.6	3.1	
58	164.3	79.5	51.2	37.1	28.6	23.0	18.9	15.9	13.5	11.7	10.1	8.8	7.7	6.8	6.0	5.3	4.7	4.1	3.6	
60	168.2	81.6	52.7	38.3	29.6	23.9	19.7	16.7	14.2	12.3	10.7	9.4	8.3	7.4	6.5	5.8	5.2	4.6	4.1	
62	171.9	83.6	54.2	39.5	30.6	24.7	20.5	17.4	14.9	13.0	11.4	10.0	8.9	7.9	7.1	6.3	5.7	5.1	4.6	
64	175.4	85.5	55.5	40.6	31.6	25.6	21.3	18.1	15.6	13.6	12.0	10.6	9.4	8.5	7.6	6.9	6.2	5.6	5.1	
66	178.6	87.3	56.8	41.6	32.5	26.4	22.0	18.8	16.2	14.2	12.5	11.2	10.0	9.0	8.1	7.4	6.7	6.1	5.5	
68	181.7	89.0	58.1	42.6	33.3	27.2	22.7	19.4	16.9	14.8	13.1	11.7	10.5	9.5	8.6	7.8	7.2	6.6	6.0	
70	184.5	90.5	59.2	43.6	34.2	27.9	23.4	20.1	17.5	15.4	13.7	12.2	11.0	10.0	9.1	8.3	7.6	7.0	6.5	
72	187.1	92.0	60.3	44.5	35.0	28.6	24.1	20.7	18.0	15.9	14.2	12.8	11.5	10.5	9.6	8.8	8.1	7.5	6.9	
74	189.5	93.4	61.3	45.3	35.7	29.3	24.7	21.3	18.6	16.5	14.7	13.3	12.0	11.0	10.1	9.3	8.6	7.9	7.4	
76	191.6	94.6	62.3	46.1	36.4	29.9	25.3	21.8	19.1	17.0	15.2	13.8	12.5	11.4	10.5	9.7	9.0	8.4	7.8	
78	193.6	95.7	63.1	46.8	37.0	30.5	25.9	22.4	19.7	17.5	15.7	14.2	13.0	11.9	11.0	10.1	9.4	8.8	8.2	
80	195.2	96.7	63.9	47.5	37.7	31.1	26.4	22.9	20.1	18.0	16.2	14.7	13.4	12.3	11.4	10.6	9.8	9.2	8.6	

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