

## GENERAL

### Fiberglass Conduit Specifications for Use Below Ground

The conduit shall be fiberglass conduit, also known as Reinforced Thermosetting Resin Conduit (RTRC), manufactured using the single circuit filament winding process. Multi circuit windings are not allowed. The conduit shall have a winding angle as close as possible to 54.75 degrees.

The resin system shall be epoxy based, with no fillers, using an anhydride curing agent. The fiberglass shall consist of continuous E-glass roving. The conduit shall not contain any halogen compounds containing chlorine, bromine, fluorine and iodine in more than trace amounts when burning.

Conduit and elbows shall be manufactured from the same resin/hardener/glass systems manufactured by the same filament wound system.

Fiberglass conduit fittings and accessories shall be manufactured using one of two manufacturing procedures. The first method shall use the same process, methods, and components as used to manufacture the fiberglass conduit. The second method shall use the compression molding process, Sheet Molding Compound (SMC), for the manufacture of the finished component. The SMC material shall be a vinyl ester resin with +30% reinforcement of glass. The glass fibers should be approximately 1" in length. The SMC material shall be fire resistant to UL 2515.

Conduit shall be integral bell and spigot or bonded coupling and spigot.

Conduit, elbows and fittings are specified for use throughout a temperature range of -60°F (-51°C) to 250°F (121°C).

Manufacturer shall have a current Certificate of Compliance, issued by an independent and accredited company, with an ISO 9001:2008 Quality Management System.

## ELECTRICAL PROPERTIES

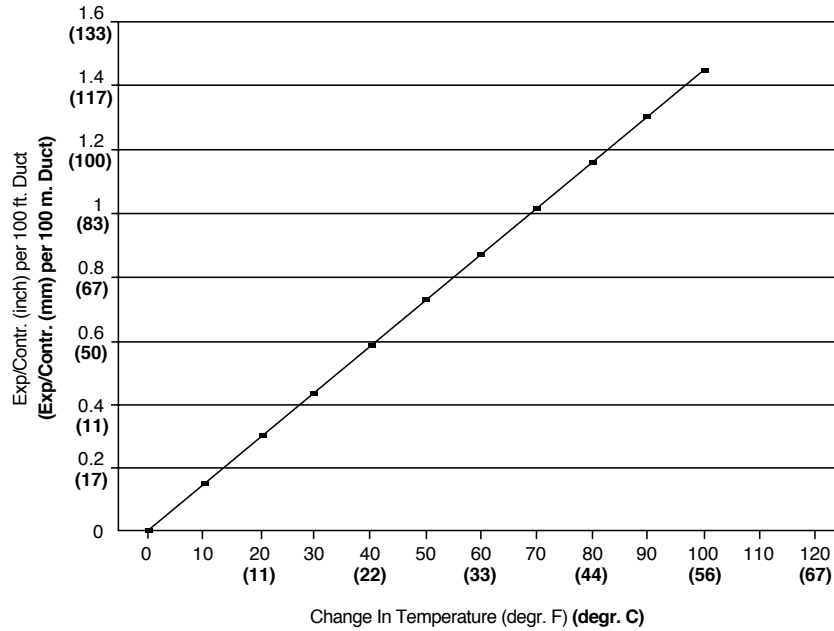
• Volume Resistivity	3.8 x 10 <sup>14</sup> ohm-cm	ASTM D 257
• Surface Resistivity	1.1 x 10 <sup>14</sup> ohms	ASTM D 257
• Dielectric Constant	3.5 (at 10 <sup>3</sup> cps)	ASTM D 150
• Dissipation Factor	0.005 (at 10 <sup>3</sup> cps)	ASTM D 150
• Dielectric Strength	500 volts/mil. (19.7 kv/mm)	ASTM D 149

## PHYSICAL AND MECHANICAL PROPERTIES

• Tensile Strength (Axial)	11,000 psi (76 MPa)	ASTM D 2105
• Compressive Strength (Axial)	12,000 psi (83 MPa)	ASTM D 695
• Ultimate Elongation	2% psi (9.6 GPa)	ASTM D 2105
• Modulus of Elasticity (4" conduit)	1.4 X 10 <sup>+6</sup> psi (9.6 GPa)	ASTM D 2105
• Thermal Conductivity	2.0 BTU/(ft <sup>2</sup> )(hr.)(°F/in) (0.3mk)	ASTM D 5930-01
• Specific Gravity	1.9	ASTM D 792
• Glass Content	70% ± 5%	API SPEC 15 LR

## PHYSICAL AND MECHANICAL PROPERTIES (CONT.)

• Water Absorption	Less than 1%	ASTM D 570
• Barcol Hardness	54 ± 2	ASTM D2583
• Flammability		
Above Ground Conduit	Conform to UL 2515 & CSA C22.2	No. 211.3-96
Below Ground Conduit	HB Rating	UL 94
• Coefficient of Thermal Expansion	1.2 x 10 <sup>-5</sup> in/in/°F (2.2 10 <sup>-5</sup> m/m/°C)	ASTM D 696



## HEAT DISTORTION

The minimum heat distortion temperature shall be 230°F (110°C) when tested at 264 psi in accordance with ASTM D 648.

## JOINT PULLOUT

A 12-inch length shall be cut from both the belled end and spigot end of a length of conduit. The two parts shall be assembled in accordance with Champion's instructions. The assembly shall be tested in accordance with ASTM D 2105 and shall meet the requirements of the table below.

Nominal Size	Interference Joint	Joint Pullout Resistance / Minimum Force - lbs (N)		
		Gasket with Interference Joint	Gasket without Interference Joint	Tight Lock Joints (Adhesive)
All	1,000 (4,450)	2,000 (8,900)	500 (2,220)	11,000 psi x (cross sectional area of conduit)

## TOXICITY

CHAMPION DUCT conduit does not contain any compounds that can release halogens - bromine or chlorine - when burning.

Gases	Values (max P.P.M.)
Hydrogen Chloride	0
Hydrogen Bromide	0
Hydrogen Cyanide	<1
Hydrogen Sulphide	0
Ammonia	0
Aldehydes as HCHO	<10
Oxides of Nitrogen	<50
Carbon Dioxide	<12,500
Carbon Monoxide	<250

## SURFACE FINISH

- Exterior Surface Normally less than 2,000 microinches (50.8 micron)
- Interior Surface Normally less than 125 microinches (3.2 micron)

## COLOR

Standard color is black, using carbon black as pigment. Optional available colors are gray, red, orange and blue. Note: When ordering optional colors, the finished product may exhibit slight to extreme color variations.

## WATER TIGHTNESS

There should be no evidence of water leakage through the joint when tested in accordance to UL 2515 and CSA C22.2 No. 2515. In order to achieve water tightness use CHAMPION MIX<sup>®</sup> or Epoxy Adhesive Kit for Tight Lock Joint. See page 47-48 of this catalog.

## COEFFICIENT OF FRICTION

The following data for static coefficient of friction is for dry conduit and non-lubricated cable at a temperature of 72° F (22° C).

Cable Material	Conduit Material					
	Epoxy Fiberglass Conduit	PVC Conduit	Steel Conduit	Aluminum Conduit	Concrete Conduit	Polyethylene Conduit
PVC	.38	.90	.55	.25	.95	1.90
XLP(Cross-linked Polyethylene)	.23	.90	.75	1.50	.75	2.00
LDPE (Polyethylene)	.25	.50	.50	.62	.60	1.70
Neoprene	.53	2.60	1.60	.26	1.35	3.30
Concentric Neutral	.16	--	--	--	--	--
Tech (Armored) Cable	.16	2.60	1.60	.26	1.35	3.30

## IMPACT RESISTANCE

The minimum impact resistance values for the conduit shall be as shown in the table below when tested in accordance with ASTM D2444.

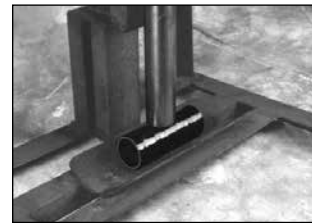
Nominal Size	At 73.4°F (23°C)				At 32°F (0°C)			
	Impact Resistance lbs. ft. (Nm)				Impact Resistance lbs. ft. (Nm)			
	SW	MW	HW	XW	SW	MW	HW	XW
¾	20 (27)	-- --	-- --	150 (202)	20 (27)	-- --	-- --	150 (202)
1	25 (34)	-- --	-- --	400 (540)	25 (34)	-- --	-- --	400 (540)
1¼	30 (41)	-- --	-- --	400 (540)	30 (41)	-- --	-- --	400 (540)
1½	35 (47)	-- --	-- --	500 (675)	35 (47)	-- --	-- --	500 (675)
2	40 (54)	-- --	-- --	550 (742)	40 (54)	-- --	-- --	550 (742)
2½	55 (75)	-- --	-- --	600 (810)	55 (75)	-- --	-- --	600 (810)
3	70 (95)	-- --	-- --	700 (945)	70 (95)	-- --	-- --	700 (945)
3½	80 (108)	-- --	-- --	850 (1,150)	80 (108)	-- --	-- --	850 (1,150)
4	85 (115)	-- --	120 (163)	1,000 (1,350)	85 (115)	-- --	120 (163)	1,000 (1,350)
5	110 (149)	140 (190)	160 (217)	1,200 (1,620)	110 (149)	140 (190)	160 (217)	1,200 (1,620)
6	130 (176)	160 (217)	200 (271)	1,300 (1,755)	130 (179)	160 (217)	200 (271)	1,300 (1,755)



For high impact situations as well as during cold weather, PVC can shatter and/or flatten.



For high impact, steel conduit will collapse and can pinch the cable. This will make repair of damaged conduit more difficult.



X-wall conduit has the highest impact value of all conduit materials available. If impacted, it will flex back close to its original diameter. SW, MW and HW will also flex back similarly after impact. They will not shatter.

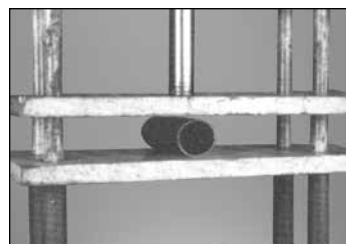
## STIFFNESS

The minimum conduit stiffness at five percent deflection for all sizes of conduit shall not be less than the values given in table below when tested in accordance with ASTM D2412

Pipe Stiffness (PS) = (F/ΔY)								
Nominal Size	At 73.4°F (23°C)				At 32°F (0°C)			
	lbf/in <sup>2</sup> (MPa)				lbf/in <sup>2</sup> (MPa)			
	SW	MW	HW	XW	SW	MW	HW	XW
¾	1,500 (10.3)	--	--	2,500 (17.5)	1,500 (10.3)	--	--	2,500 (17.5)
1	1,200 (8.3)	--	--	2,400 (16.8)	1,200 (8.3)	--	--	2,400 (16.8)
1¼	850 (5.9)	--	--	2,100 (14.7)	850 (5.9)	--	--	2,100 (14.7)
1½	600 (4.1)	--	--	2,000 (14)	600 (4.1)	--	--	2,000 (14)
2	320 (2.2)	--	--	1,300 (9.0)	320 (2.2)	--	--	1,300 (9.0)
2½	200 (1.4)	--	--	800 (5.6)	200 (1.4)	--	--	800 (5.6)
3	140 (1.0)	--	--	600 (4.1)	140 (1.0)	--	--	600 (4.1)
3½	85 (0.6)	--	--	450 (3.1)	85 (0.6)	--	--	450 (3.1)
4	50 (0.3)	--	130 (0.7)	250 (1.7)	50 (0.3)	--	130 (0.7)	250 (1.7)
5	40 (0.3)	75 (0.5)	90 (0.6)	180 (1.2)	40 (0.3)	75 (0.5)	90 (0.6)	180 (1.2)
6	30 (0.2)	55 (0.4)	65 (0.4)	150 (1.0)	30 (0.2)	55 (0.4)	65 (0.4)	150 (1.0)



**PVC Conduit**  
PVC conduit will stay compressed if it is crushed. (Same for steel conduit.)



**Fiberglass Conduit**  
Epoxy Fiberglass conduit will flex back to almost its original shape after crushing.

## WIRE FILL

Maximum allowable percentage wire fill per National Electric Code 2011 (Chapter 9, Table 1)

IPS sizes						
Trade Size	Internal Diameter in (mm)	Total Area 100% in <sup>2</sup> (mm <sup>2</sup> )	Percent of cross section of conduit & tubing for conductors			
			1 Wire 53% in <sup>2</sup> (mm <sup>2</sup> )	2 Wire 31% in <sup>2</sup> (mm <sup>2</sup> )	Over 2 Wire 40% in <sup>2</sup> (mm <sup>2</sup> )	
¾ (19)	0.910 (23)	0.650 (419)	0.345 (222)	0.202 (130)	0.260 (168)	
1 (25)	1.175 (30)	1.084 (697)	0.574 (370)	0.336 (216)	0.434 (279)	
1¼ (32)	1.520 (39)	1.815 (1170)	0.962 (620)	0.563 (363)	0.726 (468)	
1½ (38)	1.760 (45)	2.433 (1569)	1.289 (832)	0.754 (486)	0.973 (628)	
2 (51)	2.235 (57)	3.923 (2525)	2.079 (1338)	1.216 (783)	1.569 (1010)	
2½ (64)	2.740 (70)	5.896 (3805)	3.125 (2016)	1.828 (1179)	2.359 (1522)	
3 (76)	3.360 (85)	8.867 (5715)	4.699 (3029)	2.749 (1772)	3.547 (2286)	
4 (102)	4.320 (110)	14.657 (9452)	7.768 (5009)	4.544 (2930)	5.863 (3781)	
5 (127)	5.380 (137)	22.733 (14677)	12.048 (7779)	7.047 (4550)	9.093 (5871)	
6 (152)	6.435 (163)	32.523 (20970)	17.237 (11114)	10.082 (6501)	13.009 (8388)	

ID sizes					
Trade Size	Internal Diameter in (mm)	Total Area in <sup>2</sup> (mm <sup>2</sup> )	Percent of cross section of conduit & tubing for conductors		
			1 Wire 53% in <sup>2</sup> (mm <sup>2</sup> )	2 Wire 31% in <sup>2</sup> (mm <sup>2</sup> )	Over 2 Wire 40% in <sup>2</sup> (mm <sup>2</sup> )
2 (51)	2.000 (51)	3.142 (2027)	1.665 (1074)	0.974 (628)	1.257 (811)
2½ (64)	2.500 (64)	4.909 (3167)	2.602 (1678)	1.522 (982)	1.963 (1267)
3 (76)	3.000 (76)	7.069 (4560)	3.746 (2417)	2.191 (1414)	2.827 (1824)
3½ (89)	3.500 (89)	9.621 (6207)	5.099 (3290)	2.983 (1924)	3.848 (2483)
4 (102)	4.00 (102)	12.566 (8107)	6.660 (4297)	3.896 (2513)	5.027 (3243)
5 (127)	5.000 (127)	19.635 (12668)	10.407 (6714)	6.087 (3927)	7.854 (5067)
6 (152)	6.000 (152)	28.274 (18241)	14.985 (9668)	8.765 (5655)	11.310 (7297)

# CONDUIT CONDUCTOR FILL

Based on Wire Fill Data on page 58 and Table 5, Chapter 9 of National Electric Code 2011

RHW\*

Trade Size	IPS sizes											
	Allowable Conduit in <sup>2</sup>	Max. 1 Conductor Size	in <sup>2</sup> of 1 Conductor	Allowable Conduit in <sup>2</sup>	Max. 2 Conductor Size	in <sup>2</sup> of 2 Conductors	Allowable Conduit in <sup>2</sup>	Max. 3 Conductor Size	in <sup>2</sup> of 3 Conductors	Allowable Conduit in <sup>2</sup>	Max. 4 Conductor Size	in <sup>2</sup> of 4 Conductors
¾ (19)	0.345	3/0	0.3117	0.202	4	0.1946	0.260	6	0.2178	0.260	8	0.2223
1 (25)	0.575	300	0.5281	0.336	2	0.2666	0.434	2	0.3999	0.434	4	0.3893
1¼ (32)	0.962	500	0.7901	0.563	2/0	0.5248	0.726	1/0	0.6669	0.726	2	0.5333
1½ (38)	1.289	800	1.2272	0.754	4/0	0.7435	0.973	3/0	0.9352	0.973	1/0	0.8891
2 (51)	2.079	1250	1.8602	1.216	350	1.1917	1.569	250	1.3789	1.569	4/0	1.4871
2½ (64)	3.125	2000	2.7818	1.828	500	1.5802	2.359	400	1.9856	2.359	300	2.1124
3 (76)	4.699			2.749	900	2.7121	3.547	750	3.4955	3.547	500	3.1605
4 (102)	7.768			4.544	1500	4.3389	5.863	1250	5.5807	5.863	900	5.4243
5 (127)	12.048			7.047	2000	5.5636	9.093	2000	8.3455	9.093	1750	9.9091
6 (152)	17.237			10.082			13.009			13.009	2000	11.1273

RHW\*

Trade Size	ID sizes											
	Allowable Conduit in <sup>2</sup>	Max. 1 Conductor Size	in <sup>2</sup> of 1 Conductor	Allowable Conduit in <sup>2</sup>	Max. 2 Conductor Size	in <sup>2</sup> of 2 Conductors	Allowable Conduit in <sup>2</sup>	Max. 3 Conductor Size	in <sup>2</sup> of 3 Conductors	Allowable Conduit in <sup>2</sup>	Max. 4 Conductor Size	in <sup>2</sup> of 4 Conductors
2 (51)	1.665	1000	1.4784	0.974	250	0.9193	1.257	4/0	1.1153	1.257	3/0	1.2469
2½ (64)	2.602	1750	2.4773	1.522	400	1.3237	1.963	350	1.7875	1.963	250	1.8385
3 (76)	3.746	2000	2.7818	2.191	600	1.9459	2.827	500	2.3704	2.827	400	2.6475
3½ (89)	5.099			2.983	900	2.7121	3.848	800	3.6816	3.848	500	3.1605
4 (102)	6.660			3.896	1250	3.7205	5.027	1000	4.4353	5.027	800	4.9087
5 (127)	10.407			6.087	2000	5.5636	7.854	1750	7.4319	7.854	1250	7.4409
6 (152)	14.985			8.765			11.310	2000	8.3455	11.310	2000	11.1273

THHN

Trade Size	IPS sizes											
	Allowable Conduit in <sup>2</sup>	Max. 1 Conductor Size	in <sup>2</sup> of 1 Conductor	Allowable Conduit in <sup>2</sup>	Max. 2 Conductor Size	in <sup>2</sup> of 2 Conductors	Allowable Conduit in <sup>2</sup>	Max. 3 Conductor Size	in <sup>2</sup> of 3 Conductors	Allowable Conduit in <sup>2</sup>	Max. 4 Conductor Size	in <sup>2</sup> of 4 Conductors
¾ (19)	0.345	4/0	0.3237	0.202	3	0.1946	0.260	4	0.2472	0.260	6	0.2028
1 (25)	0.575	350	0.5242	0.336	1	0.3124	0.434	2	0.3474	0.434	3	0.3892
1¼ (32)	0.962	600	0.8676	0.563	3/0	0.5358	0.726	2/0	0.6669	0.726	1	0.6248
1½ (38)	1.289	900	1.2311	0.754	4/0	0.6474	0.973	4/0	0.9711	0.973	2/0	0.8892
2 (51)	2.079	1000	1.3478	1.216	400	1.1726	1.569	300	1.3824	1.569	4/0	1.2948
2½ (64)	3.125			1.828	600	1.7352	2.359	500	2.1219	2.359	400	2.3452
3 (76)	4.699			2.749	1000	2.6956	3.547	800	3.3255	3.547	600	3.4704
4 (102)	7.768			4.544			5.863	1000	4.0434	5.863	1000	5.3912
5 (127)	12.048			7.047			9.093			9.093		
6 (152)	17.237			10.082			13.009			13.009		

THHN

Trade Size	ID sizes											
	Allowable Conduit in <sup>2</sup>	Max. 1 Conductor Size	in <sup>2</sup> of 1 Conductor	Allowable Conduit in <sup>2</sup>	Max. 2 Conductor Size	in <sup>2</sup> of 2 Conductors	Allowable Conduit in <sup>2</sup>	Max. 3 Conductor Size	in <sup>2</sup> of 3 Conductors	Allowable Conduit in <sup>2</sup>	Max. 4 Conductor Size	in <sup>2</sup> of 4 Conductors
2 (51)	1.665	1000	0.3237	0.974	300	0.9216	1.257	250	1.1910	1.257	3/0	1.0716
2½ (64)	2.602			1.522	500	1.4146	1.963	400	1.7589	1.963	300	1.8432
3 (76)	3.746			2.191	750	2.0992	2.827	600	2.6028	2.827	400	2.3452
3½ (89)	5.099			2.983	1000	2.6956	3.848	900	3.6933	3.848	600	3.4704
4 (102)	6.660			3.896			5.027	1000	4.0434	5.027	900	4.9244
5 (127)	10.407			6.087			7.854			7.854	1000	5.3912
6 (152)	14.985			8.765			11.310			11.310		



## DEFLECTION

Deflection is always determined at midspan.

The empirical formula for deflection is:

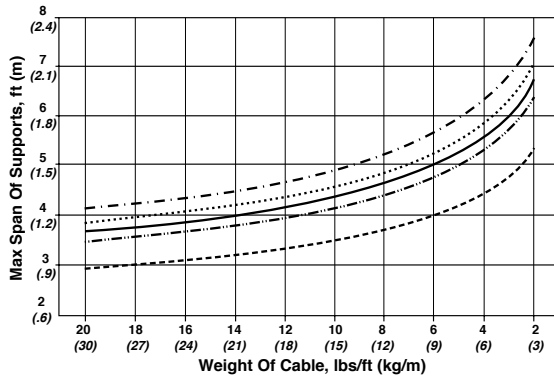
$$D = \frac{131 \cdot W \cdot L^4}{E(OD^4 - ID^4)}$$

- Where:
- D = Midspan deflection (in.)
  - OD = Outside diameter of conduit (in.)
  - ID = Inside diameter of conduit (in.)
  - E = Modulus of elasticity of conduit (psi), which is 1,400,000 for epoxy fiberglass conduit
  - L = Distance between hangers (ft.)
  - W = Total weight of cable and conduit (lbs/ft.)

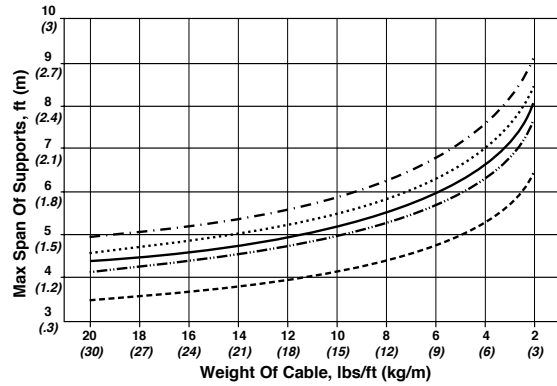
It is recommended that midspan deflection never exceeds  $\frac{1}{8}$  inches (16 mm).

Below are easy graphs for determining support distance between hangers for various diameters and wall thicknesses of conduit.

**3/4" SW DIAMETER**



**1" SW DIAMETER**



-----  
1/4" (6) Deflection

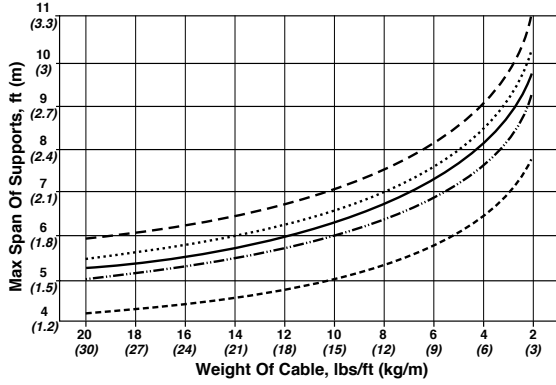
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1/2" (13) Deflection

-----  
5/8" (16) Deflection

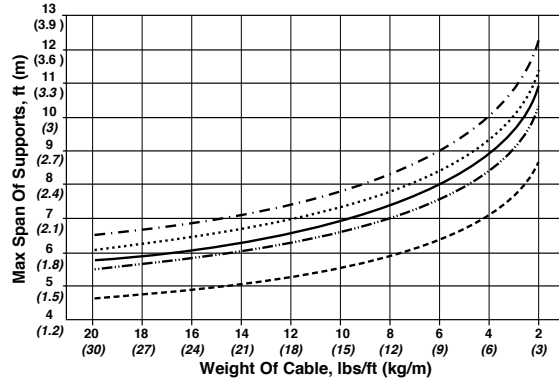
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3/4" (19) Deflection

-----  
1" (25) Deflection

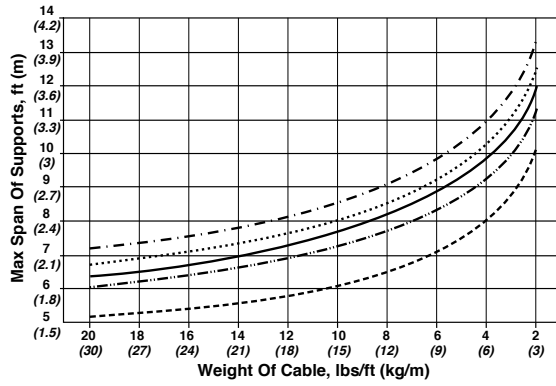
**1 1/4" SW DIAMETER**



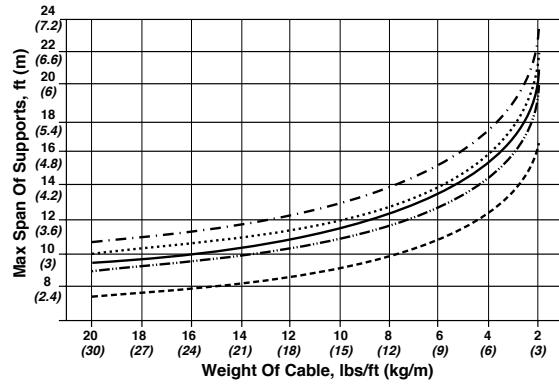
**1 1/2" SW DIAMETER**



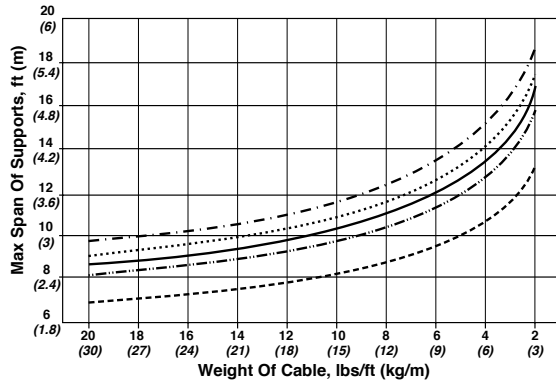
**2" SW DIAMETER**



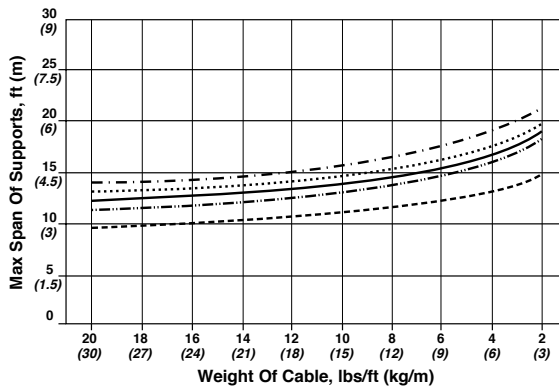
**2" XW DIAMETER**



**3" SW DIAMETER**



**3" XW DIAMETER**

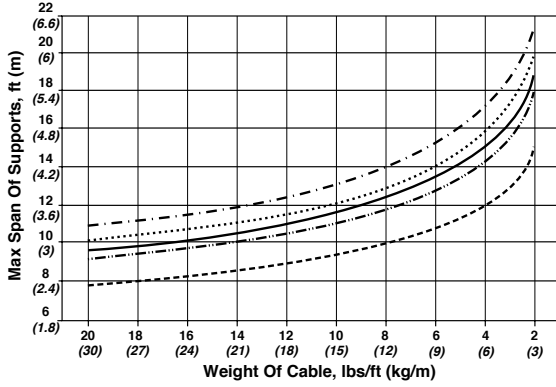


- - - - - 1/4" (6) Deflection
- · - · - · - 1/2" (13) Deflection
————— 5/8" (16) Deflection
· · · · · 3/4" (19) Deflection
- - - - - 1" (25) Deflection

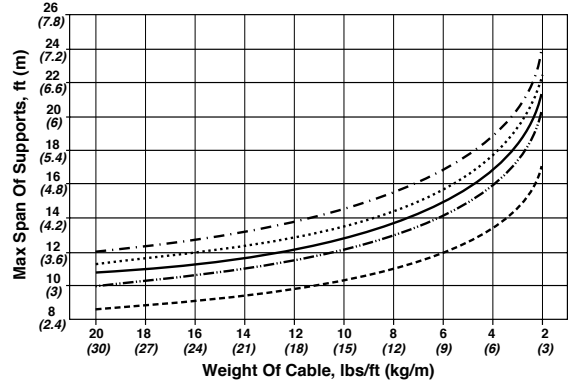




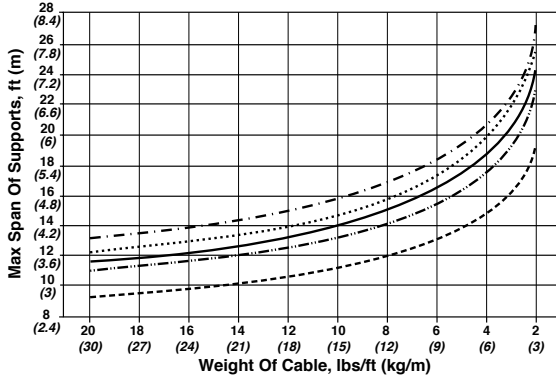
3 1/2" SW DIAMETER



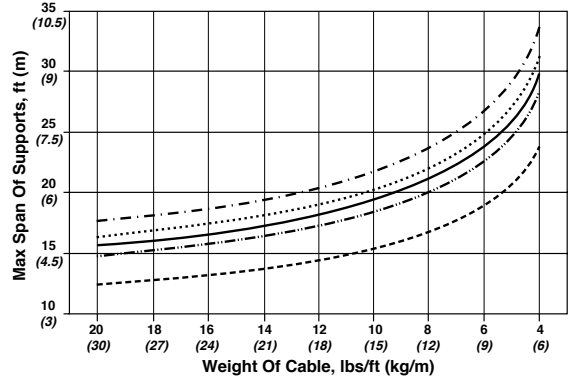
4" SW DIAMETER



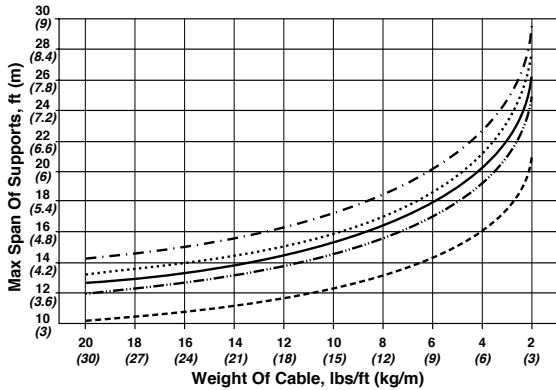
4" HW DIAMETER



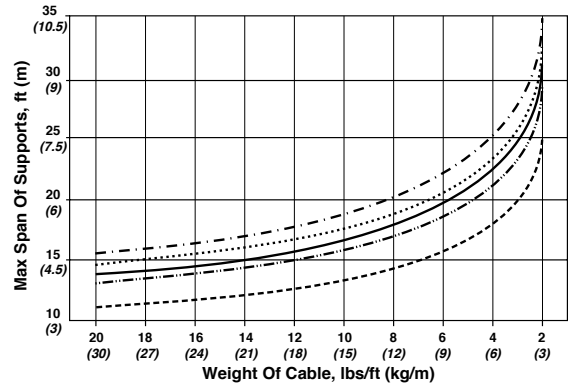
4" XW DIAMETER



5" SW DIAMETER



5" MW DIAMETER



1/4" (6) Deflection

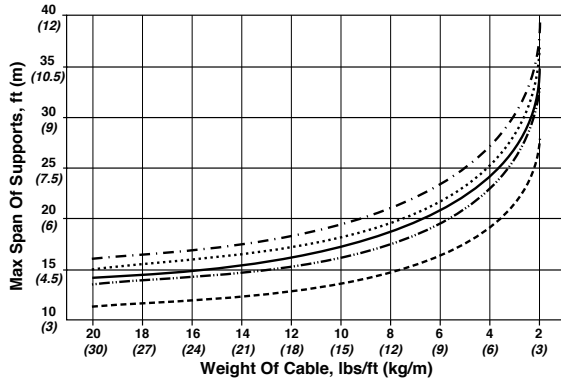
1/2" (13) Deflection

5/8" (16) Deflection

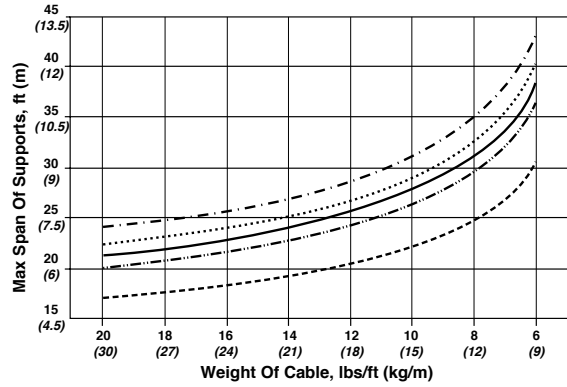
3/4" (19) Deflection

1" (25) Deflection

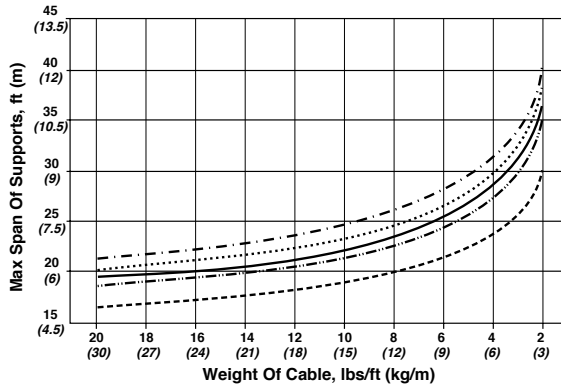
5" HW DIAMETER



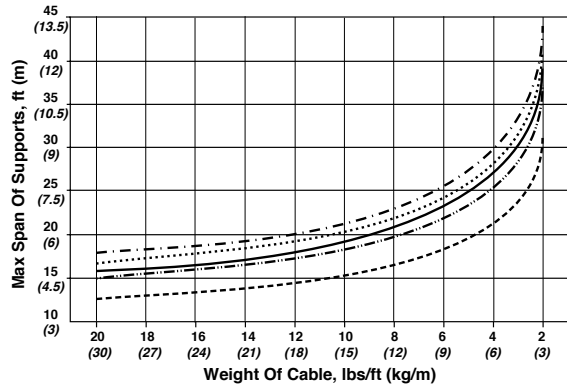
5" XW DIAMETER



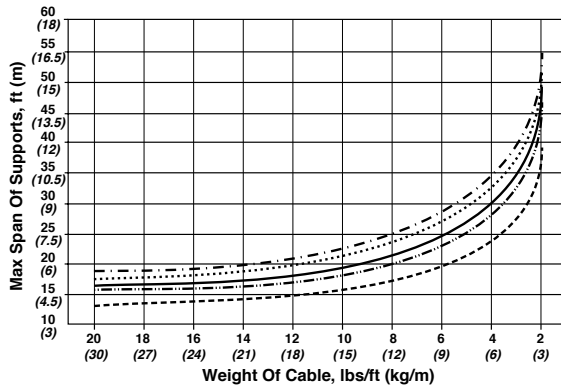
6" SW DIAMETER



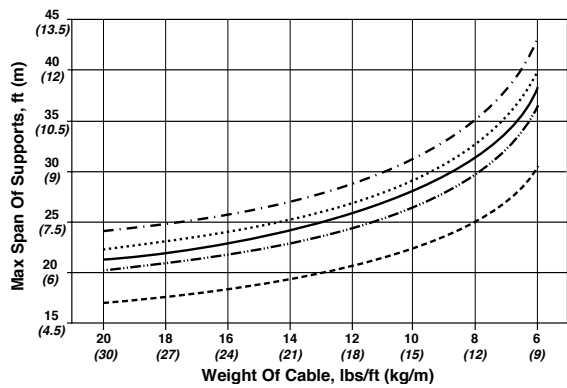
6" MW DIAMETER



6" HW DIAMETER



6" XW DIAMETER



1/4" (6) Deflection

1/2" (13) Deflection

5/8" (16) Deflection

3/4" (19) Deflection

1" (25) Deflection