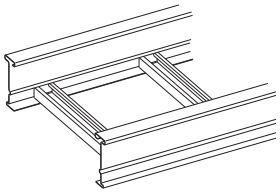
These options are in addition to the Standard Ladder Rungs, Ventilated Trough and Solid Trough type Cable Trays.

Ladder with Strut Rungs

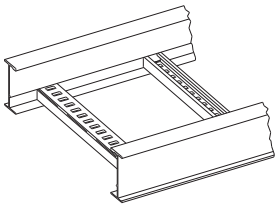


- B44 strut installed as rungs.
- Strut orientation may be channel opening up, channel opening down, or alternating - standard is alternating unless specified otherwise.
- Strut may be solid back or with slotted hole pattern "SH".
- The Cooper B-Line strut rung system offers additional cable clamping options relative to the chosen slot orientation.

Examples: 248G09B44-12-144
Strut rung on 9" centers with alternating slot orientation.

248G12B44SHDN-12-144
"SH" Strut rung on 12" centers with channel opening down (Note: replace "DN" with "UP" for channel opening up.)

Marine Rung (Available in Aluminum, HDGAF Steel and Stainless Steel)



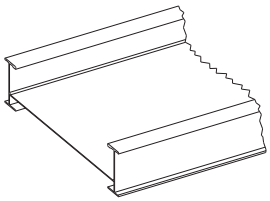
(Aluminum Shown)

- Designed for Series 3 or heavier systems.
- Special rung design to accommodate stainless steel banding of cables (U.S. Coast Guard requirement) with .25" x .69" slots.
- Has applications on land, vertical installation, any location where extra cable positioning/attachment is required.
- Rung strength - Aluminum supports 499 lbs. per rung on 36" wide system with a 1.5 safety factor. Steel supports 755 lbs. per rung on 36" wide system with a 1.5 safety factor.
- New design provides combination of strut fastening and marine rung fastening.

Example: 46A12MR-36-288 or 464G12MR-36-288

Special Rung Spacings: 4" & 18" rung spacing available upon request.

Non-Ventilated

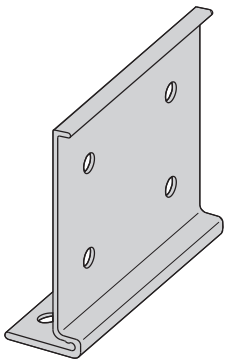


- Solid flat sheet welded into the Cable Tray above the rungs.
- Standard rung spacing is 12 inches.
- The flat sheet may be installed under the rungs, if preferred.
- The flat sheet may be installed over B54 rungs “slot down”.

Examples: 24ASB-36-144
Flat sheet bottom over standard rung on 12" spacing.

24ASBB54-36-144
Flat sheet bottom over B54 strut rung slot down on 12" spacing.

B-Line's 9A-6006 and 9A-6007 Aluminum Mid-Span Splice



Features

- Standard for H46A, H47A and 57A straight sections.
- Allows random splice location.
- Six bolt design 1/2" Stainless Steel Type 316 hardware standard.
- Available on ladder bottoms only.
  - 09" and 12" rung spacing.

Tray Series	Catalog No.
H46A	**9A-6006**
H47A	**9A-6007**
57A	**9A-6007**

The Cable Tray:

H46A

Tested to:

- 167 lbs/ft (safety factor 1.5)
- 125 lbs/ft (safety factor 2.0)
- 20 ft. simple beam test
  - 12" rung spacing • 36" wide

H47A

Tested to:

- 149 lbs/ft (safety factor 1.5)
- 112 lbs/ft (safety factor 2.0)
- 20 ft. simple beam test
  - 12" rung spacing • 36" wide

The Splice:

9A-6006

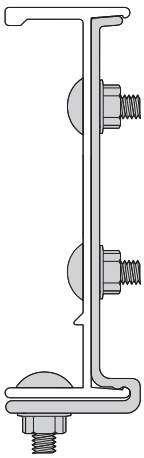
Tested to:

- 135 lbs/ft (safety factor 1.5)
- 101 lbs/ft (safety factor 2.0)
- 20 ft. simple beam test
  - mid-span splice

9A-6007

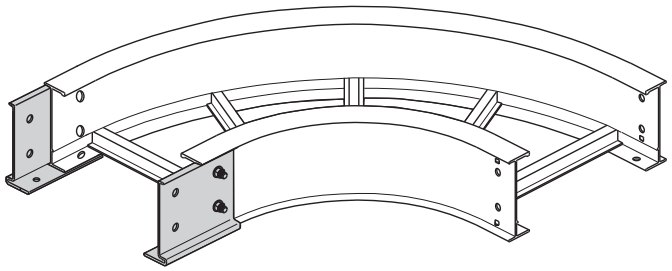
Tested to:

- 143 lbs/ft (safety factor 1.5)
- 107 lbs/ft (safety factor 2.0)
- 20 ft. simple beam test
  - mid-span splice



Options: The 9A-6006 and 9A-6007 splice is also available with B-Line's 46A and 47A series cable tray systems

- Available on ladder bottoms only (09" and 12" rung spacing).
- Available on 240" (20') or longer span straight sections.
- To order add "MS" to part number: Ex. 46AMS09-24-288.
- For standard 6A or 7A fittings with H46A or H47A systems an additional pair of standard splice plates is required (9A-1006 or 9A-1007).



One pair 9A-6006 or 9A-6007 included.

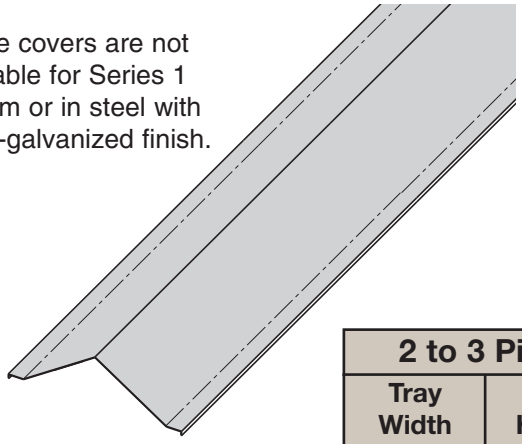
Also available:

H6A and H7A Fittings

- Ladder bottom only (09" RS).
- Incorporates the 9A-6006 or 9A-6007 splice.
- Example: H6A-12-90HB24 or H7A-12-90HB24

Special Purpose 2 to 3 Pitch Peaked Covers

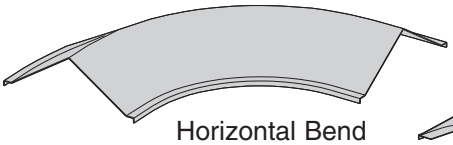
These covers are not available for Series 1 system or in steel with a pre-galvanized finish.



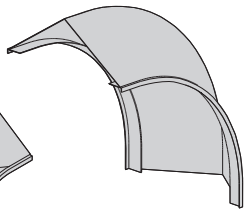
Features

- 33° slope to shed precipitants.
- Heavy construction - made for the industrial environment.
- Available in aluminum and steel; hot dip galvanized after fabrication (HDGAF ASTM A-123), 304 stainless and 316 stainless.
- Available in flanged design only.
- Fittings are in multiple piece welded construction.
- Expanding/Reducing HT and HX covers are not available.

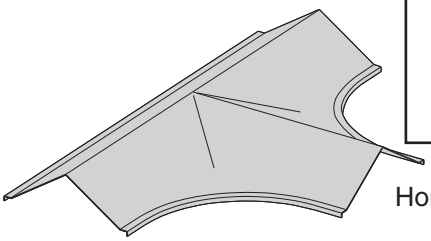
2 to 3 Pitch	
Tray Width	Peak Height
6"	2"
9"	3"
12"	4"
18"	6"
24"	8"
30"	10"
36"	12"



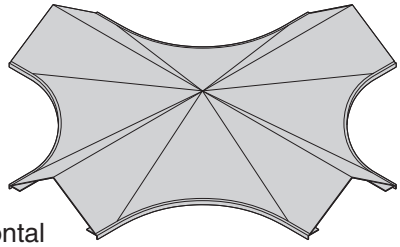
Horizontal Bend



Vertical Outside Bend



Horizontal Tee



Horizontal Cross

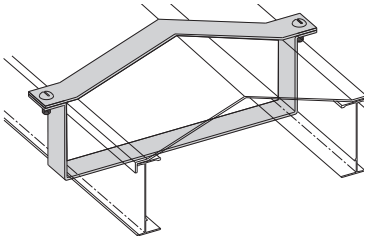
Catalog Number Selector

Example: 83 7 A 80 - 24 - 144

Cover Type	Detail	Material	Material Thickness	Tray Width	Item Description
● 83 = 2 to 3 Pitch Peaked	7 = Flanged Aluminum 2 = Flanged Steel (248, 258, 268 straight sections & fittings 3 = Flanged Steel (All straight sections except 248, 258, 268)	A = Aluminum G = HDGAF ASTM A-123 SS4 = 304 Stainless Steel SS6 = 316 Stainless Steel	80 = .080 Aluminum straight section 125 = .125 Aluminum fittings 16 = 16 Ga. Steel straight sections. 18 = 18 Ga. Steel fittings.	06 = 6" 09 = 9" 12 = 12" 18 = 18" 24 = 24" 30 = 30" 36 = 36"	144 = 12 ft. (3.66 m) 120 = 10 ft. (3.05 m) 72 = 6 ft. (1.83 m) 60 = 5 ft. (1.52 m)

2 to 3 Pitch Cover Clamp

- Recommended for outdoor service.



Side Rail Height in.	Side Rail Height mm	Catalog No. Aluminum	Catalog No. Steel	Catalog No. Stainless Steel
4	101	● 9A-(‡)-9P44	● 9G-(‡)-9P44	● 9**-(‡)-9P44
5	127	● 9A-(‡)-9P54	● 9G-(‡)-9P54	● 9**-(‡)-9P54
6	152	● 9A-(‡)-9P64	● 9G-(‡)-9P64	● 9**-(‡)-9P64
7	178	● 9A-(‡)-9P74	● 9G-(‡)-9P74	● 9**-(‡)-9P74

(‡) Insert tray width (**) Insert SS4 or SS6

● Green = Fastest shipped items ● Black = Normal lead-time items ● Red = Normally long lead-time items

Reference Material - Methods Permitted

Wiring methods permitted in cable tray per the 2005 NEC®

1. Armored cable ..... (Article 320)
2. Electrical metallic tubing ..... (Article 358)
3. Electrical nonmetallic tubing ..... (Article 362)
4. Fire alarm cables ..... (Article 760)
5. Flexible metal conduit ..... (Article 348)
6. Flexible metallic tubing ..... (Article 360)
7. Instrumentation tray cable ..... (Article 727)
8. Intermediate metal conduit ..... (Article 342)
9. Liquidtight flexible metal conduit ..... (Article 350)
10. Liquidtight flexible nonmetallic conduit ..... (Article 356)
11. Metal-clad cable ..... (Article 330)
12. Mineral-insulated, metal-sheathed cable ..... (Article 332)
13. Multiconductor service-entrance cable ..... (Article 338)
14. Multiconductor underground feeder and branch-circuit cable ..... (Article 340)
15. Multipurpose and communications cables ..... (Article 800)
16. Nonmetallic-sheathed cable ..... (Article 334)
17. Power and control tray cable ..... (Article 336)
18. Power-limited tray cable ..... (Section 725.61(C) and 725.71(E)
19. Optical fiber cables ..... (Article 770)
20. Other factory-assembled, multiconductor control, signal, or power cables that are specifically approved for installation in cable trays
21. Rigid metal conduit ..... (Article 344)
22. Rigid nonmetallic conduit ..... (Article 352)

Reference Material - Formulas

Formulas

- Allowable load: $w = \frac{F96Sx}{L^2}$

- Deflection: $\Delta = \frac{5WL^3}{384EIx}$

  $= \frac{5wL^4}{4608EIx}$

- Stress: $F = \frac{wL^2}{96Sx}$

- Deflection Multiplier (K) $= \frac{\text{deflection}}{w}$

  $= \frac{5L^4}{4608EIx}$

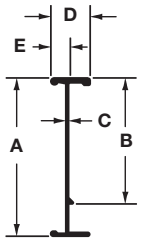
- Max. Working Load $= \frac{\text{Max. deflection}}{\text{Deflection Multiplier}}$

Legend		
w	=	load (lbs/ft)
W	=	total load across span (lbs)
F	=	design stress (lbs/in^2)
L	=	span (inches)
Sx	=	section modulus for 2 rails (in^3) (see page 366 for Sx values)
E	=	10 million for Alum. (lb/in.^{2}) 29 million for Steel (lb/in.^{2})
Ix	=	moment of inertia for 2 rails (in^4) (see page 366 for Ix values)

Cable Tray Side Rails

Design Data For One Rail

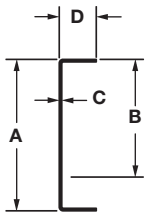
Aluminum Side Rails



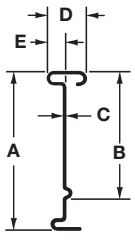
A - Side Rail Height
B - Loading Depth
C - Web Thickness
D - Flange Width

B-Line Series	Side Rail Height	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	Sx (in.^{3})	Ix (in.^{4})	Area (in.^{2})	Weight (lbs./ft.)
24	4	4.12	3.05	.060	1.75	.740	.67	1.43	.525	.62
M24	4	4.18	3.09	.080	1.75	.760	.84	1.93	.750	.83
34	4	4.20	3.08	.100	1.75	.750	1.05	2.49	.902	1.06
25	5	5.00	3.93	.068	1.75	.748	.90	2.31	.620	.72
35	5	5.06	3.96	.090	1.75	.745	1.18	3.19	.857	.98
26	6	6.12	5.04	.065	2.00	.745	1.26	3.95	.698	.82
36	6	6.17	5.06	.075	2.00	.725	1.68	5.42	.903	1.05
46	6	6.19	5.08	.085	2.00	.650	1.79	6.09	.989	1.17
M46	6	6.20	5.09	.100	2.00	.750	1.89	6.36	1.116	1.30
H46	6	6.24	5.09	.130	2.00	.750	2.67	8.65	1.473	1.74
37	7	7.14	6.05	.075	2.00	.750	1.88	6.75	.904	1.06
47	7	7.24	6.13	.100	2.00	.675	2.47	8.94	1.189	1.40
H47	7	7.24	6.09	.125	2.00	.675	3.05	11.46	1.520	1.77
57	7	7.40	6.23	.160	2.00	.875	3.86	16.43	2.114	2.46
S8A	8	8.00	6.17	.170	3.00	1.000	7.69	27.67	2.754	3.20

Steel Side Rails



Series One Rail Only



All Other Steel Rails

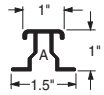
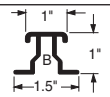
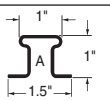
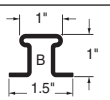
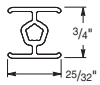
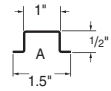
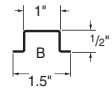
A - Side Rail Height
B - Loading Depth
C - Web Thickness
D - Flange Width

B-Line Series	Side Rail Height	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	Sx (in.^{3})	Ix (in.^{4})	Area (in.^{2})	Weight (lbs./ft.)
148	4	3.625	3.125	.048	.875	--	.25	.45	.251	.84
156	5	4.188	3.688	.060	.875	--	.36	.76	.340	1.16
166	6	5.188	4.688	.060	.750	--	.46	1.20	.385	1.31
176	7	6.188	5.688	.060	.750	--	.64	1.90	.444	1.52
248	4	4.188	3.14	.048	1.000	.392	.32	.72	.313	1.17
346	4	4.188	3.13	.060	1.500	.655	.48	1.11	.449	1.64
444	4	4.188	3.11	.075	1.500	.670	.64	1.47	.561	2.02
258	5	5.188	4.14	.048	1.000	.392	.45	1.22	.361	1.34
356	5	5.188	4.13	.060	1.500	.655	.66	1.86	.509	1.86
454	5	5.188	4.11	.075	1.500	.670	.87	2.48	.636	2.29
268	6	6.188	5.14	.048	1.000	.392	.59	1.90	.409	1.52
368	6	6.188	5.13	.048	1.500	.643	.71	2.39	.457	1.70
366	6	6.188	5.14	.060	1.500	.655	.85	2.87	.569	2.08
464	6	6.188	5.11	.075	1.500	.670	1.14	3.83	.711	2.56
378	7	7.188	6.14	.048	1.500	.643	.89	3.45	.505	1.88
476	7	7.188	6.13	.060	1.500	.655	1.07	4.15	.629	2.30
574	7	7.188	6.11	.075	1.500	.670	1.43	5.55	.792	2.83

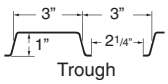
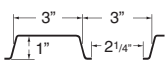
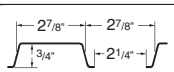
Design Factors: Ix = Moment of Inertia, Sx = Section Modulus

Cable Tray Bottom Members

Ladder Type Rungs

Rung Type	Design Factors	Material Type	Single Rung Uniform Load Capacity (in Lbs.) with safety factor of 1.5						
			Tray Width						
			6	9	12	18	24	30	36
	Ix = .0361 in.^{4} Sx = .0707 in.^{3}	Aluminum				766	575		
	Ix = .0432 in.^{4} Sx = .0877 in.^{3}	Aluminum						594	495
	Ix = .0249 in.^{4} Sx = .0528 in.^{3}	Steel	2912	1941	1456	971	728		
	Ix = .0312 in.^{4} Sx = .0661 in.^{3}	Steel						749	624
	Ix = .0450 in.^{4} Sx = .0787 in.^{3}	Aluminum Strut Rung	3328	2219	1664	1109	832	666	555
	Ix = .0445 in.^{4} Sx = .0782 in.^{3}	Steel Strut Rung	5172	3448	2586	1724	1293	1034	862
	Ix = .0130 in.^{4} Sx = .0344 in.^{3}	Redi-Rail	1480	987	740	493	370	296	224
	Ix = .0039 in.^{4} Sx = .0134 in.^{3}	Steel Series 1	981	654	491	327	245		
	Ix = .0047 in.^{4} Sx = .0164 in.^{3}	Steel Series 1						230	192
	Ix = .0353 in.^{4} Sx = .0708 in.^{3}	Aluminum Marine Rung	2996	1997	1498	999	749	599	499
	Ix = .0347 in.^{4} Sx = .0685 in.^{3}	Steel Marine Rung	4530	3020	2265	1510	1133	906	755

Corrugated Bottoms (Ventilated and Solid)

Bottom Type	Design Factors	Material Type	Single Rung Load Capacity (in Lbs.) with safety factor of 1.5						
			Tray Width						
			6	9	12	18	24	30	36
	Ix = .0455 in.^{4} Sx = .0898 in.^{3}	Aluminum	3141	2029	1491	970	726	660	594
	Ix = .0348 in.^{4} Sx = .0667 in.^{3}	Steel	2973	1946	1445	955	711	650	590
	Ix = .0185 in.^{4} Sx = .0503 in.^{3}	Series 148 Steel	2645	1763	1323	881	661		

Series 1

Steel Side Rail Weights

Tray Series		148	156	166	176
Weight for 2 Side Rails	lbs/ft	1.68	2.32	2.62	3.03
	kg/m	2.50	3.45	3.90	4.51

Example:
Weight for 148P09-12-144
= 1.68 lbs/ft + .51 lbs/ft = 2.19 lbs/ft
= (2.19 lbs/ft) (12 ft) = 26.28 lbs.

Tray Bottom Weights

Tray Width (inches)			6	9	12	18	24	30	36
All Series 1 Steel	6" Spacing Rung Weight	lbs/ft	0.38	0.57	0.76	1.14	1.52	2.25	2.70
		kg/m	0.57	0.85	1.13	1.70	2.26	3.35	4.02
	9" Spacing Rung Weight	lbs/ft	0.25	0.38	0.51	0.76	1.01	1.50	1.80
		kg/m	0.38	0.57	0.75	1.13	1.51	2.23	2.68
	12" Spacing Rung Weight	lbs/ft	0.19	0.29	0.38	0.57	0.76	1.13	1.35
		kg/m	0.29	0.43	0.57	0.85	1.13	1.68	2.01
Series 148 Steel	Vented Trough Weight	lbs/ft	0.48	0.72	0.95	1.43	1.91	2.39	2.86
		kg/m	0.71	1.06	1.42	2.13	2.84	3.55	4.26
	Solid Trough Weight	lbs/ft	0.60	0.90	1.20	1.80	2.39	2.99	3.59
		kg/m	0.89	1.34	1.78	2.67	3.56	4.45	5.34
Series 156, 166 & 176 Steel	4" Vented Rung Weight	lbs/ft	0.57	0.86	1.14	1.71	2.28	3.37	3.42
		kg/m	0.85	1.27	1.70	2.54	3.39	5.02	5.09
	Solid Bottom Weight	lbs/ft	1.01	1.51	2.01	3.02	4.02	5.20	6.25
		kg/m	1.50	2.24	2.99	4.49	5.98	7.74	9.29

When using steel tray that is hot dip galvanized after fabrication add 9.6% to weights.

Series 2, 3, 4 or 5

Aluminum Side Rail Weights

Tray Series		24	M24	34	25	35	26	36	46	M46	H46	37	47	H47	57
Weight for 2 Side Rails	lbs/ft	1.23	1.66	2.12	1.44	1.96	1.64	2.09	2.33	2.60	3.47	2.12	2.80	3.54	4.92
	kg/m	1.83	2.47	3.15	2.14	2.92	2.44	3.11	3.47	3.87	5.16	3.15	4.16	5.27	7.32

Steel Side Rail Weights

Tray Series		248	346	444	258	356	454	268	368	366	464	378	476	574
Weight for 2 Side Rails	lbs/ft	2.34	3.28	4.04	2.68	3.72	4.58	3.04	3.40	4.16	5.12	3.76	4.60	5.66
	kg/m	3.48	4.88	6.01	3.99	5.54	6.82	4.52	5.06	6.19	7.62	5.59	6.84	8.42

Series 2, 3, 4 or 5 weights continued on page 369.

Series 2, 3, 4 or 5

Tray Bottom Weights

Tray Width (inches)			6	9	12	18	24	30	36	42
All Series 2,3,4 Aluminum	6" Spacing Rung Weight	lbs/ft	0.30	0.44	0.59	0.89	1.18	1.70	2.04	2.38
		kg/m	0.44	0.66	0.88	1.32	1.76	2.53	3.04	3.54
	9" Spacing Rung Weight	lbs/ft	0.20	0.29	0.39	0.59	0.78	1.13	1.36	1.58
		kg/m	0.29	0.44	0.58	0.87	1.16	1.68	2.02	2.35
	12" Spacing Rung Weight	lbs/ft	0.15	0.22	0.29	0.44	0.58	0.85	1.02	1.19
		kg/m	0.22	0.32	0.43	0.65	0.86	1.26	1.52	1.77
	18" Spacing Rung Weight	lbs/ft	0.10	0.15	0.20	0.30	0.40	0.57	0.68	0.80
		kg/m	0.15	0.22	0.30	0.45	0.60	0.85	1.02	1.19
	Vented Trough Weight	lbs/ft	0.25	0.38	0.50	0.75	1.00	1.25	1.50	1.75
		kg/m	0.37	0.56	0.74	1.12	1.49	1.86	2.23	2.60
	Solid Trough Weight	lbs/ft	0.31	0.46	0.61	0.92	1.22	1.53	1.83	2.14
		kg/m	0.45	0.68	0.91	1.36	1.82	2.27	2.72	3.18
All Series 2,3,4,5 Steel	6" Spacing Rung Weight	lbs/ft	0.62	0.92	1.23	1.85	2.46	3.67	4.40	5.14
		kg/m	0.92	1.37	1.83	2.75	3.66	5.46	6.55	7.65
	9" Spacing Rung Weight	lbs/ft	0.41	0.62	0.82	1.23	1.64	2.45	2.94	3.43
		kg/m	0.61	0.92	1.22	1.83	2.44	3.65	4.37	5.10
	12" Spacing Rung Weight	lbs/ft	0.31	0.47	0.62	0.93	1.24	1.84	2.21	2.58
		kg/m	0.46	0.69	0.92	1.38	1.85	2.74	3.29	3.83
	18" Spacing Rung Weight	lbs/ft	0.21	0.31	0.41	0.62	0.82	1.22	1.46	1.71
		kg/m	0.31	0.46	0.61	0.92	1.22	1.82	2.18	2.54
	Vented Trough Weight	lbs/ft	0.53	0.80	1.06	1.59	2.12	2.65	3.18	3.71
		kg/m	0.79	1.18	1.58	2.37	3.15	3.94	4.73	5.52
	Solid Trough Weight	lbs/ft	0.67	1.00	1.33	2.00	2.66	3.33	3.99	4.66
		kg/m	0.99	1.48	1.98	2.97	3.96	4.95	5.94	6.93

When using steel tray that is hot dip galvanized after fabrication add 9.6% to weights.

Fiberglass

Fiberglass Side Rail Weights

Tray Series		13	24	36	46	H46	48
Weight for 2 Side Rails	lbs/ft	1.40	1.78	2.82	3.72	3.72	4.66
	kg/m	2.08	2.65	4.20	5.54	5.54	6.93

Fiberglass Bottom Weights

Tray Width (inches)			6	9	12	18	24	30	36
All Series Fiberglass	6" Spacing Rung Weight	lbs/ft	0.54	0.81	1.08	1.62	2.16	2.70	3.23
		kg/m	0.80	1.20	1.60	2.41	3.21	4.01	4.81
	9" Spacing Rung Weight	lbs/ft	0.35	.053	0.70	1.05	1.40	1.75	2.10
		kg/m	0.52	0.78	1.04	1.56	2.09	2.61	3.13
	12" Spacing Rung Weight	lbs/ft	0.27	0.40	0.54	0.81	1.08	1.35	1.62
		kg/m	0.40	0.60	0.80	1.20	1.60	2.01	2.41
	18" Spacing Rung Weight	lbs/ft	0.19	0.28	0.38	0.57	0.75	0.94	1.13
		kg/m	0.28	0.42	0.56	0.84	1.12	1.40	1.68
	6" Spacing Marine Rung Wt.	lbs/ft	0.75	1.12	1.49	2.24	2.98	3.73	4.48
		kg/m	1.11	1.67	2.,22	3.33	4.44	5.55	6.66
	9" Spacing Marine Rung Wt.	lbs/ft	0.48	0.73	0.97	1.45	1.94	2.42	2.91
		kg/m	0.,72	1.08	1.44	2.16	2.89	3.61	4.33
	12" Spacing Marine Rung Wt.	lbs/ft	0.37	0.56	0.75	1.12	1.49	1.87	2.24
		kg/m	0.56	0.83	1.11	1.67	2.22	2.78	3.33
	18" Spacing Marine Rung Wt.	lbs/ft	0.26	0.39	0.52	0.78	1.04	1.31	1.57
		kg/m	0.39	0.58	0.78	1.17	1.55	1.94	2.33

Metric Conversion Chart

To Convert From	To	Multiply By
Angle		
degree	radian (rad)	0.01745329
radian (rad)	degree	57.295780
Area		
foot^2	square meter (m^2)	0.09290304
inch^2	square meter (m^2)	0.0064516 x 10^{-2}
circular mil	square meter (m^2)	0.00005067075 x 10^{-5}
sq. centimeter (cm^2)	square inch (in^2)	0.15500030
square meter (m^2)	foot^2	10.763910
square meter (m^2)	inch^2	1550.0030
square meter (m^2)	circular mil	1973523000.0
Temperature		
degree Fahrenheit	degree Celsius	$t^{\circ}C = (t^{\circ}F - 32) / 1.8$
degree Celsius	degree Fahrenheit	$t^{\circ}F = 1.8t^{\circ}C + 32$
Force		
pounds - force (lbf)	newtons (N)	4.4482220
Length		
foot (ft)	meter (m)	0.30480
inch (in)	meter (m)	0.02540
mil	meter (m)	0.002540 x 10^{-3}
inch	micrometer (μm)	25400.0
millimeters	inch (in)	0.039370
meter (m)	foot (ft)	3.280840
meter (m)	inch (in)	39.370080
meter (m)	mil	39370.0080
micrometer (μm)	inch (in)	0.039370080 x 10^{-3}
Volume		
foot^3	cubic meter (m^3)	0.028316850
inch^3	cubic meter (m^3)	0.016387060 x 10^{-3}
cubic centimeter (cm^3)	cubic inch (in^3)	0.061023740
cubic meter (m^3)	foot^3	35.314660
cubic meter (m^3)	inch^3	61023.760
gallon (U.S. liquid)	cubic meter (m^3)	0.0037854120
Section Properties		
section modulus S (in^3)	S (m^3)	0.016387060 x 10^{-3}
moment of inertia I (in^4)	I (m^4)	0.00041623140 x 10^{-3}
modulus of elasticity E (psi)	E (Pa)	6894.7570
section modulus S (m^3)	S (in^3)	61023.740
moment of inertia I (m^4)	I (in^4)	2402510.0
modulus of elasticity E (Pa)	E (psi)	0.014503770 x 10^{-2}

Metric Conversion Chart (Cont.)

To Convert From	To	Multiply By
Bending Moment or Torque		
lbf • ft	newton meter (N•m)	1.3558180
lbf • in	newton meter (N•m)	0.11298480
N•m	lbf • ft	0.73756210
N•m	lbf • in	8.8507480
Mass		
ounce (avoirdupois)	kilogram (kg)	0.028349520
pound (avoirdupois)	kilogram (kg)	0.45359240
ton (short, 2000 lb)	kilogram (kg)	907.18470
ton (long, 2240 lb)	kilogram (kg)	1016.0470
kilogram (kg)	ounce (avoirdupois)	35.273960
kilogram (kg)	pound (avoirdupois)	2.2046220
kilogram (kg)	ton (short, 2000 lb)	0.0011023110
kilogram (kg)	ton (long, 2240 lb)	$0.98420640 \times 10^{-3}$
Mass Per Unit Length		
lb/ft	kilogram per meter (kg/m)	1.4881640
lb/in	kilogram per meter (kg/m)	17.857970
kilogram per meter (kg/m)	lb/ft	0.67196890
kilogram per meter (kg/m)	lb/in	0.55997410
Mass Per Unit Volume		
lb/ft^3	kilogram per cubic meter (kg/m^3)	16.018460
lb/in^3	kilogram per cubic meter (kg/m^3)	27679.90
kilogram per cubic meter (kg/m^3)	lb/ft^3	0.062427970
kilogram per cubic meter (kg/m^3)	lb/in^3	$0.03612730 \times 10^{-3}$
lb/ft^3	lb/in^3	1728.0
Mass Per Unit Area		
lb/ft^2	kilogram per square meter (kg/m^2)	4.8824280
kg/m^2	pound per square foot (lb/ft^2)	0.20481610
Pressure or Stress		
lbf/in^2 (psi)	pascal (Pa)	6894.7570
kip/in^3 (ksi)	pascal (Pa)	6894757.0
lbf/in^2 (psi)	megapascals (MPa)	0.0068947570
pascal (Pa)	pound-force per square inch (psi)	$0.0014503770 \times 10^{-1}$
pascal (Pa)	kip per square inch (ksi)	$0.0014503770 \times 10^{-4}$
megapascals (MPa)	lbf/in^2 (psi)	145.03770

Metric Symbols

m = meter	N = newton
cm = centimeter	kN = kilonewton
mm = millimeter	Pa = pascal
µm = micrometer	MPa = megapascal
kg = kilogram	

SECTION 16114
CABLE TRAYS

PART I - GENERAL

1.01 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete cable tray systems as shown on the drawings.

B. Cable tray systems are defined to include, but are not limited to straight sections of [ladder type] [trough type] [solid bottom type] [channel type] cable trays, bends, tees, elbows, drop-outs, supports and accessories.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ASTM A123 - Specification for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

C. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.

D. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low Alloy with Improved Formability.

E. ASTM A1008 - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

F. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

G. NEMA VE 1 - Metallic Cable Tray Systems.

H. NEMA VE 2 - Cable Tray Installation Guidelines.

1.03 DRAWINGS

A. The drawings which constitute a part of these specifications indicate the general route of the cable tray systems. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.04 SUBMITTALS

A. Submittal Drawings: Submit drawings of cable tray and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies, and fittings, showing accurately scaled components.

B. Product Data: Submit manufacturer's data on cable tray including, but not limited to, types, materials, finishes, rung spacings, inside depths and fitting radii. For side rails and rungs, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

1.05 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of cable trays and fittings of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. NEMA Compliance: Comply with NEMA Standards Publication Number VE 1, "Cable Tray Systems".

C. NEC Compliance: Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 392, NEC).

D. UL Compliance: Provide products which are UL classified and labeled.

E. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver cable tray systems and components carefully to avoid breakage, denting and scoring finishes. Do not install damaged equipment.

B. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with these specifications, cable tray and cable channel, systems to be installed shall be as manufactured by Cooper B-Line, Inc. [or engineer approved equal.]

2.02 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Materials and Finish: Material and finish specifications for each tray type are as follows:

1. Aluminum: Straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.
2. Pre-Galvanized Steel: Straight sections, fitting side rails, rungs, and covers shall be made from structural quality steel meeting the minimum mechanical properties and mill galvanized in accordance with ASTM A653 SS, Grade 33, coating designation G90. Covers for all steel trays will also be furnished from mill galvanized steel in accordance with ASTM A653 G90.
3. Hot Dip Galvanized Steel: Straight section and fitting side rails and rungs shall be made from structural quality steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 for 14 gauge and heavier, ASTM A1008, Grade 33, Type 2 for 16 gauge and lighter, and shall be hot dip galvanized after fabrication in accordance with ASTM A123. All covers and splice plates must also be hot dip galvanized after fabrication; mill galvanized covers are not acceptable for hot dipped galvanized cable tray. All hot dip galvanized after fabrication steel cable trays must be returned to point of manufacture after coating for inspection and removal of all icicles and excess zinc. Failure to do so can cause damage to cables and/or injury to installers.
4. Stainless Steel: Straight section and fitting side rails and rungs shall be made of AISI Type 304 or Type 316 stainless steel. Transverse members (rungs) shall be welded to the side rails with Type 316 stainless steel welding wire.

2.03 TYPE OF TRAY SYSTEM

A. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced [6] [9] [12] inches on center. Spacing in radiused fittings shall be 9 inches and measured at the center of the tray's width. Rungs shall have a minimum cable bearing surface of $^{7}/_{8}$" with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails.** Each rung must be capable of supporting the cable load, with a safety factor of 1.5, and a 200 lb. concentrated load when tested in accordance with NEMA VE 1, section 5.4.

***Omit text for Series 1 cable tray systems.*

B. Ventilated trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails. The peaks of the corrugated bottom shall have a minimum flat cable bearing surface of $2^{3}/_{4}$" and shall be spaced on 6" centers. To provide ventilation in the tray, the valleys of the corrugated bottom shall have $2^{1}/_{4}$" x 4" rectangular holes punched along the width of the bottom.

C. Non-Ventilated bottom trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails. The peaks of the corrugated bottom shall have a minimum flat cable bearing surface of 2 3/4" and shall be spaced on 6" centers.

D. Tray Sizes shall have [3] [4] [5] [6] inch minimum usable load depth, or as noted on the drawing.

E. Straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard [10] [12] [20] [24] foot lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on drawings.

F. Tray widths shall be [6] [9] [12] [18] [24] [30] [36] inches or as shown on drawings.

G. All fittings must have a three inch tangent and a minimum radius of [12] [24] [36] [48] inches.

H. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between an adjacent section of tray shall not exceed .00033 ohm. Splice plate construction shall be such that a splice may be located anywhere within a continuously supported span without diminishing rated loading capacity of the cable tray.

1. Aluminum Tray - Splice plates shall be made of 6063-T6 aluminum, using four square neck carriage bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633, SC1. If aluminum cable tray is to be used outdoors, then hardware shall be Type 316 stainless steel.
2. Steel (including Pre-Galvanized and Hot Dip Galvanized) - Splice plates shall be manufactured of high strength steel, meeting the minimum mechanical properties of ASTM A1011 HSLAS, Grade 50, Class 1. Each splice plate shall be attached with ribbed neck carriage bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633 SC1 for pre-galvanized cable trays, or Chromium Zinc in accordance with ASTM F-1136-88 for hot dip galvanized cable trays.

Splice plates shall be furnished with straight sections and fittings.

I. Cable Tray Supports: Shall be placed so that the support spans do not exceed the maximum span indicated on drawings. Supports shall be constructed from 12 gauge steel formed shape channel members 1 5/8" x 1 5/8" with necessary hardware such as Trapeze Support Kits (9G-55XX-22SH) as manufactured by Cooper B-Line, Inc. [or engineer approved equal]. Cable trays installed adjacent to walls shall be supported on wall mounted brackets such as B409 as manufactured by Cooper B-Line, Inc. [or engineer-approved equal].

J. Trapeze hangers and center hung supports shall be supported by 1/2" (minimum) diameter rods.

K. Barrier Strips: Shall be placed as specified on drawings and be fastened into the tray with self drilling screws.

L. Accessories: Special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of, but are not limited to; section splice plates, expansion plates, blind-end plates, specially-designed ladder drop-outs, barriers, etc.

2.04 LOADING CAPACITIES

A. Cable tray shall be capable of carrying a uniformly distributed load of _____ lbs./ft. on a _____ ft. support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE 1, section 5.2. **In addition to the uniformly distributed load the cable tray shall support 200 lbs. concentrated load at mid-point of span.** Load and safety factors specified are applicable to both the side rails and rung capacities. Cable tray shall be made to manufacturing tolerances as specified by NEMA.

***Omit text for Series 1 cable tray systems.*

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cable trays as indicated; in accordance with equipment manufacturer's instructions, and with recognized industry practices (NEMA VE 2), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

B. Coordinate cable tray with other electrical work as necessary to properly interface installation of cable tray work with other work.

C. Provide sufficient space encompassing cable trays to permit access for installing and maintaining cables.

3.02 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.

B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE 1.

END OF SECTION

Additional Cable Tray Sizing Requirements

AMPACITY:

Multiconductor Cables (2000V or Less)

Cable ampacities shall comply with Tables 310.16 and 310.18 of the NEC® subject to the provisions below:

1. If there are more than 3 current carrying conductors in a cable, derate cable ampacity per section 310.15(B)(2)(A).
2. If tray has solid covers, use 95% of the ampacity values shown in Tables 310.16 and 310.18.
3. If cables are placed in a single layer, with a maintained spacing of not less than 1 cable diameter between cables, the ampacity of the cables shall not exceed the allowable ambient temperature-corrected ampacities of multiconductor cables with not more than 3 insulated conductors in free air in accordance with Section 310.15(C) and Table B.310.3. You must use the ambient ampacity correction factors, found below Table B.310.3, for ambient temperatures other than 40°C (104°F).

Multiconductor Cables (2001 Volts and over) Type MV and Type MC Cables

1. Where cable trays are covered for more than 6 ft. with solid, unventilated covers, use not more than 95% of the ampacity values of Tables 310.75 and 310.76.
2. Where cables are installed in a single layer in uncovered trays with a maintained spacing of not less than one cable diameter between cables, you can use the ampacity values listed in Tables 310.71 and 310.72.

Single Conductor Cables

Ampacity of Cables Rated 2000 Volts or Less in Cable Tray (single conductor cables)

Cable Sizes	Solid Unventilated Cable Tray Cover ?	Applicable Ampacity Tables (*)	Mult. Amp. Table Values By	Special Conditions
600 kcmil and Larger	No (**)	310.17 and 310.19	0.75	
600 kcmil and Larger	Yes	310.17 and 310.19	0.70	
1/0 AWG through 500 kcmil	No (**)	310.17 and 310.19	0.65	
1/0 AWG through 500 kcmil	Yes	310.17 and 310.19	0.60	
1/0 AWG & Larger In Single Layer	No (**)	310.17 and 310.19	1.00	Maintained Spacing Of One Cable Diameter
Single Conductors In Triangle Config. 1/0 AWG and Larger	No (**)	310.20 [See NEC Section 310.15(B)]	1.00	Spacing Of 2.15 x One Conductor O.D. Between Cables

Ampacity of Type MV and Type MC Cables (2001 volts or over) in Cable Trays (single conductor cables)

Cable Sizes	Solid Unventilated Cable Tray Cover ?	Applicable Ampacity Tables (*)	Mult. Amp. Table Values By	Special Conditions
1/0 AWG and Larger	No (**)	310.69 and 310.70	0.75	
1/0 AWG and Larger	Yes	310.69 and 310.70	0.70	
1/0 AWG & Larger In Single Layer	No (**)	310.69 and 310.70	1.00	Maintained Spacing Of One Cable Diameter
Single Conductors In Triangle Config. 1/0 AWG and Larger	No (**)	310.67 and 310.68	1.05	Spacing Of 2.15 x One Conductor O.D. Between Cables

(*) The ambient ampacity correction factors must be used.
(**) At a specific position, where it is determined that the tray cables require mechanical protection, a single cable tray cover of six feet or less in length can be installed.

Cable Fill in Hazardous (Classified) Locations:

Section 392.3 of the NEC regulates the use of cable tray wiring systems in hazardous (classified) locations. This section states that if cable tray wiring systems are installed in hazardous (classified) locations, the cables that they support must be suitable for installation in those hazardous (classified) locations. The cable carries the installation restriction, not the cable tray except that the cable tray installation must comply with Section 392.4.

Some hazardous (classified) locations require special spacing of the cables. When installing Type MC, MI & TC cables in cable tray in Class II, Division 2 Hazardous (classified) areas, (combustible dusts), the cables are limited to a single layer with spacing between cables equal to the diameter of the largest adjacent cable. This is the only hazardous (classified) location where the spacing of the cables is required although it is recommended that this wiring method also be employed in Class III, Division I, and Class III, Division 2 (Ignitable Fibers & Flyings). Please note that this will alter the cable tray sizing information obtained from the sizing flow chart on page 36 & 37 of this catalog.

Please reference NEMA VE 2, metal cable tray installation guideline, for more complete information.
www.cabletrays.com/technica.htm

Supports - Cooper B-Line Cable Tray shall be sized and installed as a complete cable support system appropriate for the cable types installed. Recommended cable tray support locations are as shown below. Do not exceed the maximum support spacing and design load as printed on the side rail label. Refer to Canadian Electrical Code (CEC) section 12-2202 for minimum cable tray clearances.

Splice Plates - Use factory supplied splice plates only. Splice plates located at the quarter span between supports are preferred. Avoid placing splices at midspan and directly above supports. Torque all splice plate fasteners to 19 ft. - lbs. for 3/8" and 50 ft. - lbs. for 1/2". Expansion splice plate fasteners should be loosened ½ turn after reaching full torque to allow for travel. Set the side rail gap for expansion plates according to the chart on page 24 and ensure that a support is located within 2 feet on each side of the expansion splice.

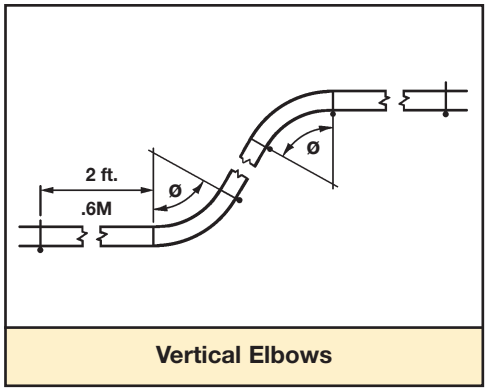
Conductors - The Cable Tray system installation shall be completed prior to pulling conductors. Cable support distances for conductor size should be referenced in CEC Part 1, Table 21. Single conductor cables placed one diameter or more apart in ventilated or ladder type tray are allowed to use the free air rating per the CEC. Any conductor in vertical runs of cable tray and all single conductor cables must be fastened to the rungs with nylon cable ties or stainless steel clamps. Carbon steel cable clamps should not be used due to induction heating, per CEC section 12-2204 (5).

Covers - Vertical cable trays which penetrate dry floors must be covered for 2m (two meter) above the floor level. All cable tray dead ends must be closed with blind ends per CEC sec 12-2202(6).

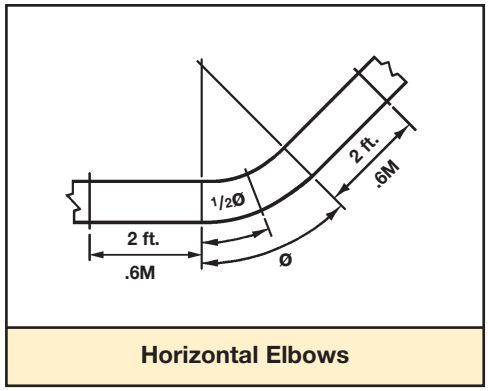
Handling - Cable tray is shipped without exterior crating, therefore careful material handling practices should be used. Cable tray straight sections should be lifted with wide slings and an overhead crane. If a crane is not available and a fork lift is to be used, only single bundles should be lifted. Ensure that each bundle is properly centered. Cable tray fittings that are not crated should be unbanded and off-loaded by hand.

Storage - All cable tray materials are subject to storage stain (white rust) if improperly stored. If cable tray is stored as shipped, it must be stored indoors. If the cable tray material must be stored outside, it must be unbanded and loosely stacked on an angle to minimize the components' contact area as well as provide for adequate drainage.

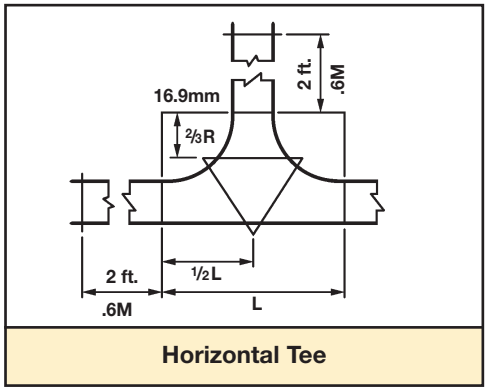
NEMA RECOMMENDED SUPPORT LOCATIONS FOR FITTINGS



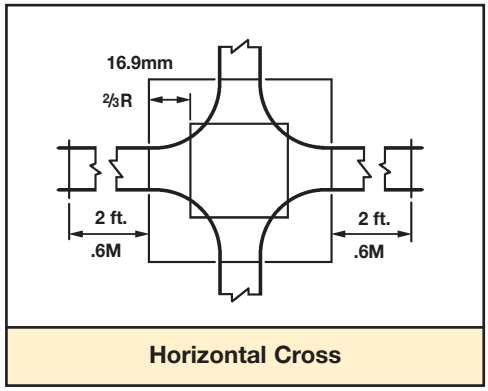
Vertical Elbows



Horizontal Elbows



Horizontal Tee



Horizontal Cross

Channel Sizes & Hole Patterns Selection Chart

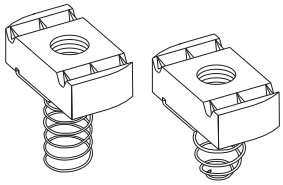
Channel Type	Channel Dimensions		Material & Thickness				Channel Hole Patterns **			
	Height	Width	1 Steel	2 Aluminum	3 Stainless Steel Type 304	4 Stainless Steel Type 316	SH	S	H17/8	TH
B11	3 1/4"	1 5/8"	12 Ga.	--	--	--	1	1	1	--
B12	2 7/16"	1 5/8"	12 Ga.	.105	--	--	1,2	1	1,2	--
B22	1 5/8"	1 5/8"	12 Ga.	.105	12 Ga.	12 Ga.	1,2,3,4	1	1,2,3,4	1
B24	1 5/8"	1 5/8"	14 Ga.	.080	14 Ga.	14 Ga.	1,2,3,4	1	1,2,3,4	--
B32	1 3/8"	1 5/8"	12 Ga.	--	12 Ga.	--	1,3	1	1,3	--
B42	1 "	1 5/8"	12 Ga.	--	12 Ga.	--	1,3	1	1,3	--
B52	13/16"	1 5/8"	12 Ga.	--	12 Ga.	--	1,3	1	1,3	--
B54	13/16"	1 5/8"	14 Ga.	.080	14 Ga.	14 Ga.	1,2,3,4	1	1,2,3,4	--

Available Finishes on Steel: Plain (Oil Coated), Dura-Green Epoxy, Pre-Galvanized, and Hot Dip Galvanized are standard.

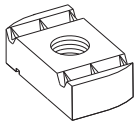
** 1 - Steel
2 - Aluminum
3 - Type 304 Stainless Steel
4 - Type 316 Stainless Steel

Channel Nuts

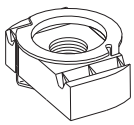
With Spring			Without Spring		Twirl Nut		FN228	Thread Size	Thickness
B11 B12	B22 B24 B32	B42 B52 B54	B11 B22 B12 B24 B32	B42 B52 B54	B11 B22 B12 B24 B32	B42 B52 B54	E-Z Twirl FN228		
N728	N228	N528	N228WO	N228WO	TN228	TN228	3/8"	3/8"-16	3/8" for all nuts
N725	N225	N525	N225WO	N525WO	TN225	TN525		1/2"-13	1/2" for N725,N225,N225WO,TN225 3/8" for N525,N525WO,TN525
N755	N255	N555	N255WO	N555WO	--	--		5/8"-11	1/2" for N755,N255,N255WO 3/8" for N555,N555WO



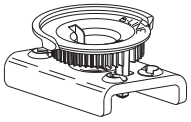
Channel Nut With Spring



Channel Nut Without Spring



Twirl Nut



FN228

For other channels, channel nuts, and fittings see B-Line Strut Systems Catalog.

Continuous Concrete Insert

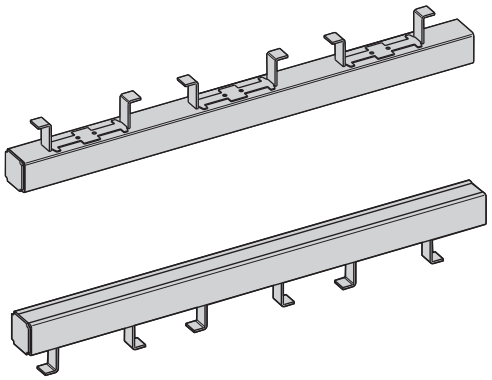
Catalog Number for Channel 120" (10 ft.)	240" (20 ft.)	Channel Size	Maximum Depth	Load
B22I-120	**B22I-240**	B22	1 5/8"	2000 lbs./ft.
B32I-120	**B32I-240**	B32	1 3/8"	2000 lbs./ft.
B52I-120	**B52I-240**	B52	13/16"	1500 lbs./ft.

Safety factor of 3 on loading.

Other lengths available upon request.

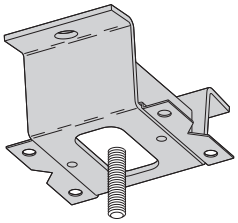
Furnished with end caps and styrofoam filler installed.

Standard finishes:
- Plain (Oil Coated)
- Dura Green Epoxy
- Pre-Galvanized
- Hot Dip Galvanized

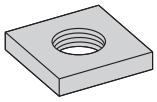


B2500 Spot Insert & N2500 Insert Nut

Standard Finish: Zinc Plated



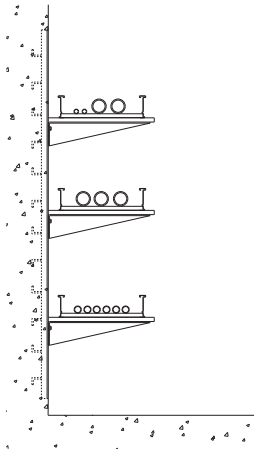
B2500 Insert



N2500 Insert Nut
Insert rod size behind part number.

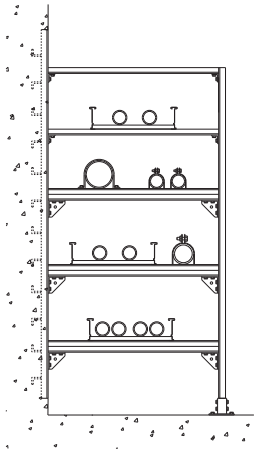
Square Nuts for Spot Inserts

Concrete Insert Applications

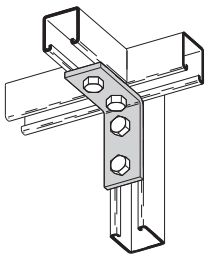


Continuous inserts used vertically are ideal mounting bases for cable tray brackets.

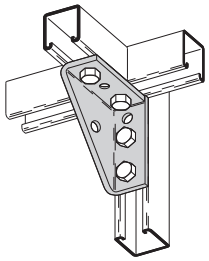
For multi-tiered tray assemblies, inserts function as the anchors for each stanchion.



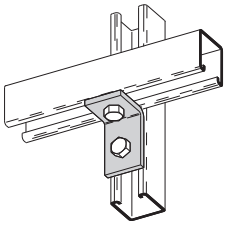
Angle Fittings



B104



B844



B101

Notes