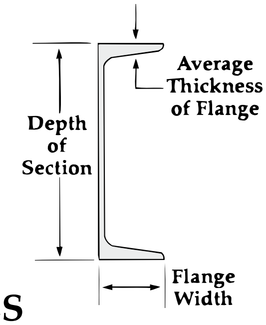
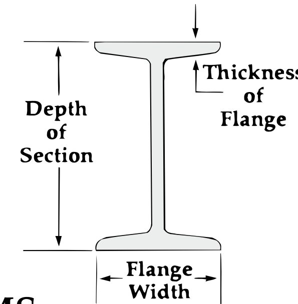
TECHNICAL DATA



CHANNELS
AMERICAN STANDARD

Depth of section	Width of Flange	Average Thickness of Flange	Wt. Per Foot (in lbs.)
3	1 3/8	.273	4.1
	1 1/2		5.0
	1 5/8		6.0
4	1 5/8	.296	5.4
	1 3/4		7.25
5	1 3/4	.320	6.7
	1 7/8		9.0
6	1 7/8	.343	8.2
	2		10.5
	2 1/8		13.0
7	2 1/8	.366	9.8
	2 1/4		12.25
	2 1/4		14.75
8	2 1/4	.390	11.5
	2 3/8		13.75
	2 1/2		18.75
9	2 3/8	.413	13.4
	2 1/2		15
	2 5/8		20
10	2 5/8	.436	15.3
	2 3/4		20
	2 7/8		25
	3		30
12	3	.501	20.7
	3		25
	3 1/8		30
15	3 3/8	.650	33.9
	3 1/2		40
	3 3/4		50
18	4	.625	42.7
	4		45.8
	4 1/8		51.9
	4 1/4		58



I BEAMS
AMERICAN STANDARD

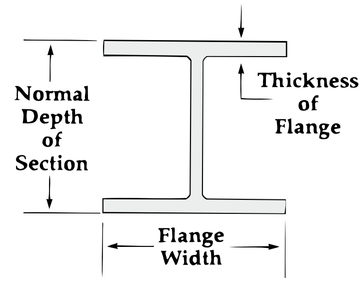
Depth of section	Width of Flange	Average Thickness of Flange	Wt. Per Foot (in lbs.)
3	2 3/8	.260	5.7
	2 1/2		7.5
4	2 5/8	.293	7.7
	2 3/4		9.5
5	3	.326	10
	3 1/4		14.75
6	3 3/8	.359	12.5
	3 5/8		17.25
7	3 5/8	.392	15.3
	3 7/8		20
8	4	.425	18.4
	4 1/8		23
10	4 5/8	.491	25.4
	5		35
12	5	.544	31.8
	5 1/8	.544	35
	5 1/4	.659	40.8
	5 1/2	.659	50
15	5 1/2	.622	42.9
	5 5/8		50
18	6	.691	54.7
	6 1/4		70
20	6 1/4	.789	65.4
	6 3/8	.789	75
	7	.916	85
	7 1/4	.916	95
24	7	.871	79.9
	7 1/8	.871	90
	7 1/4	.871	100
	7 7/8	1.102	105.9
	8	1.102	120

TECHNICAL DATA

WIDE FLANGE BEAMS

Nominal Depth of Section	Width of Flange	Thickness of Flange	Wt. Per Foot (in lbs.)
5	5	.360	16
	5	.430	19
6	4	.280	12
	4	.405	16
	6	.365	20
	6 1/8	.455	25
8	4	.255	13
	4	.315	15
	5 1/4	.330	18
	5 1/4	.400	21
	6 1/2	.400	24
	6 1/2	.465	28
	8	.435	31
	8	.495	35
	8 1/8	.560	40
	8 1/8	.685	48
	8 1/4	.810	58
	8 1/4	.935	67
10	4	.270	15
	4	.330	17
	4	.395	19
	5 3/4	.360	22
	5 3/4	.440	26
	5 3/4	.510	30
	8	.435	33
	8	.530	39
	8	.620	45
	10	.560	49
	10	.615	54
	10 1/8	.680	60
	10 1/8	.770	68
	10 1/4	.870	77
	10 1/4	.990	88
	10 3/8	1.120	100
	10 3/8	1.250	112
12	4	.265	16
	4	.350	19
	4	.425	22
	6 1/2	.380	26
	6 1/2	.440	30
	6 5/8	.520	35
	8	.515	40
	8	.575	45
	8 1/8	.640	50
	10	.575	53
	10	.640	58
	12	.605	65
	12	.670	72
	12 1/8	.735	79
	12 1/8	.810	87
	12 1/8	.900	96
	12 1/4	.990	106
	12 3/8	1.100	120
	12 3/8	1.250	136
	12 1/2	1.400	152
	12 5/8	1.730	190

Nominal Depth of Section	Width of Flange	Thickness of Flange	Wt. Per Foot (in lbs.)
14	5	.335	22
	5	.420	26
	6 3/4	.385	30
	6 3/4	.455	34
	6 3/4	.515	38
	8	.530	43
	8	.595	48
	8	.660	53
	10	.645	61
	10	.720	68
	10 1/8	.785	74
	10 1/8	.855	82
	14 1/2	.710	90
	14 5/8	.780	99
	14 5/8	.860	109
	14 5/8	.940	120
	14 3/4	1.030	132
	15 1/2	1.090	145
	15 5/8	1.190	159
	15 5/8	1.310	176
	15 3/4	1.440	193
	15 3/4	1.560	211
	15 7/8	1.720	233
	16	1.890	257
	16 1/8	2.070	283
	16 1/4	2.260	311
	16 3/8	2.470	342
	16 1/2	2.660	370
	16 5/8	2.840	398
	16 3/4	3.030	426
16	5 1/2	.345	26
	5 1/2	.440	31
	7	.430	36
	7	.505	40
	7	.565	45
	7 1/8	.630	50
	7 1/8	.715	57
	10 1/4	.665	67
	10 1/4	.760	77
	10 3/8	.815	89
	10 3/8	.985	100
18	6	.425	35
	6	.525	40
	6 1/16	.605	46
	7 1/2	.570	50
	7 1/2	.630	55
	7 1/2	.695	60
	7 5/8	.750	65
	7 5/8	.810	71
	11	.680	76
	11 1/8	.770	86
	11 1/8	.870	97
	11 1/4	.940	106
	11 1/4	1.060	119
21	6 1/2	.450	44
	6 1/2	.535	50



Nominal Depth of Section	Width of Flange	Thickness of Flange	Wt. Per Foot (in lbs.)
21	6 1/2	.650	57
	8 1/4	.615	62
	8 1/4	.685	68
	8 1/4	.740	73
	8 3/8	.835	83
	8 3/8	.930	93
	12 3/8	.875	111
	12 3/8	.960	122
	12 1/2	1.150	147
24	7	.505	55
	7	.590	62
	9	.585	68
	9	.680	76
	9	.770	84
	9 1/8	.875	94
	12 3/4	.750	104
	12 3/4	.850	117
	12 7/8	.960	131
	12 7/8	1.090	146
	13	1.220	162
27	10	.640	84
	10	.745	94
	10	.830	102
	10 1/8	.930	114
	14	.975	146
	14	1.080	161
	14 1/8	1.190	178
30	10 1/2	.670	99
	10 1/2	.760	108
	10 1/2	.850	116
	10 1/2	.930	124
	10 1/2	1.000	132
	15	1.060	173
	15	1.180	191
	15 1/8	1.310	211
33	11 1/2	.740	118
	11 1/2	.855	130
	11 1/2	.960	141
36	12	.790	135
	12	.940	150
	12	1.020	160

TECHNICAL DATA

Steel Pipe Data

SCHEDULE 40 & 80

Pipe Size	Schedule No.	O.D.	Wall Thickness	Wt. Per Foot (in lbs.)	
				Water	Pipe
3/8	40	.675	.091	.083	.567
	80		.126	.061	.738
1/2	40	.840	.109	.132	.850
	80		.147	.101	1.087
3/4	40	1.050	.113	.230	1.130
	80		.154	.186	1.473
1	40	1.315	.133	.374	1.678
	80		.179	.311	2.171
1 1/4	40	1.660	.140	.647	2.272
	80		.191	.555	2.996
1 1/2	40	1.900	.145	.882	2.717
	80		.200	.765	3.631
2	40	2.375	.154	1.452	3.652
	80		.218	1.279	5.022
2 1/2	40	2.875	.203	2.072	5.790
	80		.276	1.834	7.660
3	40	3.500	.216	3.200	7.570
	80		.300	2.860	10.250
3 1/2	40	4.000	.226	4.280	9.110
	80		.318	3.850	12.510
4	40	4.500	.237	5.510	10.790
	80		.337	4.980	14.980

Pipe Size	Schedule No.	O.D.	Wall Thickness	Wt. Per Foot (in lbs.)	
				Water	Pipe
5	40	5.563	.258	8.660	14.620
	80		.375	7.870	20.780
6	40	6.625	.280	12.510	18.970
	80		.432	11.920	28.570
8	40	8.625	.322	21.600	28.550
	80		.500	19.800	43.390
10	40	10.750	.365	34.100	40.480
	80		.593	31.100	64.400
12	40	12.750	.406	48.500	53.600
	80		.687	44.000	88.600
14	40	14.000	.437	58.500	63.000
	80		.750	51.200	107.000
16	40	16.000	.500	76.500	83.000
	80		.843	69.700	137.000
18	40	18.000	.563	97.200	105.000
	80		.937	88.500	171.000
20	40	20.000	.593	120.400	123.000
	80		1.031	109.400	209.000
24	40	24.000	.687	174.200	171.000
	80		1.218	158.200	297.000
30	20	30.000	.500	286.000	158.000
36	API	36.000	.500	417.000	190.000

Spacing of Hangers For Steel Pipe

Nominal Pipe Size, Inches	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
Maximum Span. Feet	7	7	7	7	9	10	11	12	13	14	16	17	19	22	23	25	27	28	30	32
Recommended Hanger Rod Sizes	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	3/4	3/4	7/8	7/8	1	1	1 1/8	1 1/4 OR TRAPEZE	1 1/4

Note: *Spacing and capacities are based on pipe filled with water. Additional valves and fittings increase the load and therefore closer hanger spacing is required.*

***Many Codes and specifications require pipe hangers to be spaced every 10 feet regardless of size. Check local codes.**

Technical Data

Copper Tube Data

Type L

Tube Size	Tubing O.D.	Wall Thickness	Wt. Per Foot (in lbs.) Water	Wt. Per Foot (in lbs.) Pipe
1/4	.375	.030	.034	.126
3/8	.500	.035	.062	.198
1/2	.625	.040	.100	.285
5/8	.750	.042	.151	.362
3/4	.875	.045	.209	.455
1	1.125	.050	.357	.655
1 1/4	1.375	.055	.546	.884
1 1/2	1.625	.060	.767	1.140
2	2.125	.070	1.341	1.750
2 1/2	2.625	.080	2.064	2.480
3	3.125	.090	2.949	3.330
3 1/2	3.625	.100	3.989	4.290
4	4.125	.110	5.188	5.380
5	5.125	.125	8.081	7.610
6	6.125	.140	11.616	10.200
8	8.125	.200	20.289	19.260
10	10.125	.250	31.590	30.100
12	12.125	.280	45.426	40.400

Type K

Tube Size	Tubing O.D.	Wall Thickness	Wt. Per Foot (in lbs.) Water	Wt. Per Foot (in lbs.) Pipe
1/4	.375	.035	.032	.145
3/8	.500	.049	.055	.269
1/2	.625	.049	.094	.344
5/8	.750	.049	.144	.418
3/4	.875	.065	.188	.641
1	1.125	.065	.337	.839
1 1/4	1.375	.065	.527	1.040
1 1/2	1.625	.072	.743	1.360
2	2.125	.083	1.310	2.060
2 1/2	2.625	.095	2.000	2.920
3	3.125	.109	2.960	4.000
3 1/2	3.625	.120	3.900	5.120
4	4.125	.134	5.060	6.510
5	5.125	.160	8.000	9.670
6	6.125	.192	11.200	13.870
8	8.125	.271	19.500	25.900
10	10.125	.338	30.423	40.300
12	12.125	.405	43.675	57.800

Spacing of Hangers For Copper Tubing

Tubing Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12
Span in Ft.	6	8	8	10	10	10	12	12	12	12	12	14	14	18	19

Note: *Spacing and capacities are based on pipe filled with water. Additional valves and fittings increase the load and therefore closer hanger spacing is required.*

AWWA Ductile Iron Pipe Data

Based on AWWA C108-70, Table 8.2.
Add flange weight for flanged cast iron pipe.

Nom. Pipe Size	Class	O.D. D.I. Pipe	Wall Thick.	Wt. Per Foot (in lbs.) Pipe	Wt. Per Foot (in lbs.) Water
3	53	3.96	.31	11.20	3.80
4	53	4.80	.32	14.20	5.90
6	53	6.90	.34	22.00	13.10
8	53	9.05	.36	31.00	23.00
10	53	11.10	.38	40.40	36.40
12	53	13.20	.40	50.70	52.30
14	53	15.30	.42	62.40	71.10
16	53	17.40	.43	72.80	93.10
18	53	19.50	.44	83.60	117.90
20	53	21.60	.45	95.20	145.80
24	53	25.80	.47	119.20	210.20
30	53	32.00	.51	161.30	326.50
36	53	38.30	.58	219.50	469.30
42	53	44.50	.65	285.20	634.90
48	53	50.80	.72	360.30	828.90

Glass Pipe Data

REGULAR SCHEDULE

Nom. Pipe Size	O.D.	Wall Thickness	Wt. Per Foot (in lbs.) Pipe	Wt. Per Foot (in lbs.) Water
1 1/2	1.84	.12	.64	.89
2	2.34	.14	.94	1.45
3	3.41	.17	1.60	3.19
4	4.53	.20	2.60	5.79
6	6.66	.24	4.70	12.78

HEAVY SCHEDULE

1	1.31	.16	.60	.35
1 1/2	1.84	.17	.87	.76
2	2.34	.17	1.10	1.36
3	3.41	.20	2.00	3.06
4	4.53	.26	3.40	5.44
6	6.66	.33	6.30	12.42

Spacing of Hangers for glass pipe support every 8-10 ft. Pad all hangers. Use only clevis or trapeze, do not tie down pipe.

TECHNICAL DATA

PVC Plastic Pipe Data

SCHEDULE 40 & 80

Pipe Size	Schedule No.	O.D.	Wall Thickness	Wt. Per Foot (in lbs.) Water	Wt. Per Foot (in lbs.) Pipe
1/8	40 80	.405	.068 .095	.025 .016	.043 .055
1/4	40 80	.540	.088 .119	.045 .031	.074 .094
3/8	40 80	.675	.091 .126	.083 .061	.100 .129
1/2	40 80	.840	.109 .147	.132 .101	.150 .150
3/4	40 80	1.050	.113 .154	.230 .186	.199 .259
1	40 80	1.315	.133 .179	.374 .311	.295 .382
1 1/4	40 80	1.660	.140 .191	.647 .555	.400 .527
1 1/2	40 80	1.900	.145 .200	.882 .765	.478 .639
2	40 80	2.375	.154 .218	1.452 1.279	.643 .884

Pipe Size	Schedule No.	O.D.	Wall Thickness	Wt. Per Foot (in lbs.) Water	Wt. Per Foot (in lbs.) Pipe
2 1/2	40 80	2.875	.203 .276	2.072 1.834	1.020 1.350
3	40 80	3.500	.216 .300	3.200 2.860	1.333 1.804
3 1/2	40 80	4.000	.226 .318	4.280 3.850	1.598 2.195
4	40 80	4.500	.237 .337	5.510 4.980	1.899 2.636
5	40 80	5.563	.258 .375	8.660 7.870	2.770 4.126
6	40 80	6.625	.280 .432	12.150 11.290	3.339 5.028
8	40 80	8.625	.322 .500	21.600 19.800	5.280 8.023
10	40 80	10.750	.366 .593	34.100 31.100	7.505 11.894
12	40 80	12.750	.406 .687	48.500 44.000	10.023 16.365

Spacing of Hangers For PVC Plastic Pipe

Schedule 40 Pipe Size	Support Spacings (In Feet) Temperature 20°F	40°F	60°F	80°F	100°F	110°F	120°F	130°F	140°F	150°F
1/2 to 3/4	5.00	4.75	4.50	4.25	4.00	3.75	3.33	3.00	2.66	2.00
1 to 1 1/4	5.50	5.25	5.00	4.66	4.33	4.00	3.75	3.33	2.80	2.25
1 1/2 to 2	5.80	5.50	5.25	5.00	4.66	4.33	3.80	3.50	3.00	2.50
2 1/2	6.66	6.33	6.00	5.50	5.25	4.80	4.50	4.00	3.50	2.80
3	6.80	6.50	6.25	5.80	5.50	5.25	4.75	4.25	3.66	3.00
4	7.33	7.00	6.50	6.25	5.80	5.50	5.00	4.50	3.80	3.25
6	7.80	7.50	7.00	6.80	6.33	5.80	5.33	4.80	4.25	3.50

Schedule 80 Pipe Size	Support Spacings (In Feet) Temperature 20°F	40°F	60°F	80°F	100°F	110°F	120°F	130°F	140°F	150°F
1/2 to 3/4	5.75	5.50	5.25	4.80	4.50	4.33	3.80	3.50	3.00	2.50
1	6.33	6.00	5.75	5.33	5.00	4.60	4.33	3.80	3.33	2.75
1 1/4 to 1 1/2	6.66	6.33	6.00	5.66	5.25	4.80	4.50	4.00	3.50	3.00
2	7.00	6.50	6.25	6.00	5.50	5.12	4.75	4.33	3.66	3.12
2 1/2	7.80	7.50	7.00	6.66	6.33	5.80	5.33	4.75	4.25	3.33
3	8.20	7.75	7.33	7.00	6.50	6.00	5.50	5.00	4.33	3.50
4	8.66	8.25	7.80	7.33	6.80	6.33	5.80	5.25	4.66	3.75
6	9.80	9.33	8.80	8.33	7.80	7.33	6.50	6.00	5.12	4.25

TECHNICAL DATA

Conduit Data

ELECTRICAL METALLIC TUBING DATA

Nominal Size EMT Conduit	O.D. Conduit	O.D. Coupling	Weight Conduit W/C Plg. lbs./ft.	Approx. Max. Weight Conduit and Conductor lbs./ft.	
				Lead Covered	Not Lead Covered
1/2	.706	N/A	.29	N/A	.54
3/4	.922	—	.45	—	1.16
1	1.163	—	.65	—	1.83
1 1/4	1.510	—	.96	—	2.96
1 1/2	1.740	—	1.11	—	3.68
2	2.197	—	1.41	—	4.45
2 1/2	2.875	—	2.15	—	6.41
3	3.500	—	2.60	—	9.30
3 1/2	4.000	—	3.25	—	12.15
4	4.500	—	3.90	—	15.40

Note: *2 1/2 through 4" EMT same as steel rigid conduit.*

STEEL RIGID CONDUIT DATA

Nominal Size EMT Conduit	O.D. Conduit	O.D. Coupling	Weight Conduit W/C Plg. lbs./ft.	Approx. Max. Weight Conduit and Conductor lbs./ft.	
				Lead Covered	Not Lead Covered
1/2	.840	1.010	.80	1.17	1.04
3/4	1.050	1.250	1.09	1.75	1.40
1	1.315	1.525	1.65	2.62	2.35
1 1/4	1.660	1.869	2.15	4.31	3.58
1 1/2	1.900	2.155	2.58	5.89	4.55
2	2.375	2.650	3.52	8.53	7.21
2 1/2	2.875	3.250	5.67	11.51	10.22
3	3.500	3.870	7.14	16.51	14.51
3 1/2	4.000	4.500	8.60	19.05	17.49
4	4.500	4.875	10.00	24.75	21.48
5	5.563	6.000	13.20	35.87	30.83
6	6.625	7.200	17.85	50.69	43.43

INTERMEDIATE METAL CONDUIT DATA

Nominal Size EMT Conduit	O.D. Conduit	O.D. Coupling	Weight Conduit W/C Plg. lbs./ft.	Approx. Max. Weight Conduit and Conductor lbs./ft.	
				Lead Covered	Not Lead Covered
1/2	.815	1.010	.60	.97	.84
3/4	1.029	1.250	.82	1.48	1.13
1	1.290	1.525	1.16	2.13	1.86
1 1/4	1.638	1.869	1.50	3.66	2.93
1 1/2	1.883	2.155	1.82	5.13	3.79
2	2.360	2.650	2.42	7.43	6.11
2 1/2	2.857	3.250	4.28	10.12	8.83
3	3.476	3.870	5.26	14.63	12.63
3 1/2	3.971	4.500	6.12	16.57	15.01
4	4.466	4.875	6.82	21.57	18.30

Threaded Rod Data

Nominal Rod Dia. (in inches)	Root Area Thread (in inches)^2	Max. Rec. Load/lbs.	
		650°F	750°F
1/4	.027	240	210
3/8	.068	610	540
1/2	.126	1130	1010
5/8	.202	1810	1610
3/4	.302	2710	2420
7/8	.419	3770	3360
1	.552	4960	4420
1 1/8	.693	6230	5560
1 1/4	.889	8000	7140
1 1/2	1.293	11630	10370
1 3/4	1.744	15700	14000
2	2.300	20700	18460
2 1/4	3.023	27200	24260
2 1/2	3.719	33500	29880

Cast Iron Data

SERVICE WEIGHT CAST IRON SOIL PIPE DATA (Bell & Spigot Type)

Nominal Pipe Size	O.D. of Cast Iron Pipe	Wall Thickness	Weight Per Foot (in lbs.)	
			Pipe	Water
2	2.25	.17	4.00	1.50
3	3.25	.17	6.00	3.40
4	4.25	.18	8.00	6.20
5	5.25	.18	10.40	12.30
6	6.25	.18	13.00	13.90
8	8.38	.23	20.00	25.70
10	10.50	.28	29.00	40.60
12	12.50	.28	38.00	58.20
15	15.62	.31	51.00	96.60

EXTRA WEIGHT CAST IRON SOIL PIPE DATA (Bell & Spigot Type)

Nominal Pipe Size	O.D. of Cast Iron Pipe	Wall Thickness	Weight Per Foot (in lbs.)	
			Pipe	Water
2	2.38	.190	5.00	1.60
3	3.50	.250	9.00	3.70
4	4.50	.250	12.00	6.50
5	5.50	.250	15.00	10.20
6	6.50	.250	19.00	14.70
8	8.62	.310	30.00	26.10
10	10.75	.375	43.00	40.80
12	12.75	.375	54.00	58.80
15	15.88	.440	75.00	91.80

NO-HUB CAST IRON SOIL PIPE DATA

Nominal Pipe Size	O.D. of Cast Iron Pipe	Wall Thickness	Weight Per Foot (in lbs.)	
			Pipe	Water
1 1/2	1.90	.16	2.70	3.50
2	2.35	.16	3.60	5.00
3	3.35	.16	5.20	8.30
4	4.38	.19	7.40	12.80
5	5.30	.19	9.60	17.90
6	6.30	.19	11.00	23.00
8	8.38	.23	18.00	39.50
10	10.50	.28	26.20	43.34
12	12.50	.28	35.50	62.51

TECHNICAL DATA

PHD Manufacturing, Inc. –

follows the guidelines of the Metal Framing Manufacturers Association in the manufacture and recommended use of strut systems. In all design applications using strut systems and accessories, proper engineering design practices should be applied and load limits observed. The following pages include helpful information to assist the user in the proper design of strut systems.

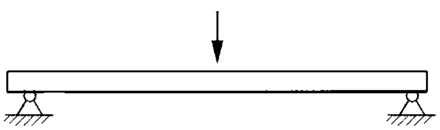
Appropriate beam and column loading information is provided with the dimensional tables accompanying each channel. In addition, the following discussion and tables are designed to assist in the proper selection and use of PHD strut products. Basic engineering information is provided to define the concepts needed to design a safe and economical strut installation.

Design of Strut Systems

PHD struts are often installed to serve either as beams or columns in structural applications. A brief discussion of these types of structural elements and their safe design follows:

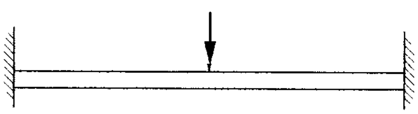
BEAMS

Structural members installed in a horizontal attitude and subject to vertical and/or horizontal loads are known as beams. The method by which a beam is mounted affects the load-carrying capability of the beam. Common mounting methods include:



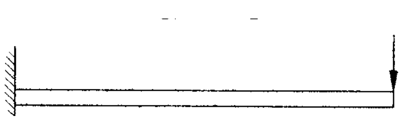
Simple Beam –

A simple beam is one that is supported at both ends without being restricted from bending or flexing. Most beams are analyzed as simply supported beams, even though they are often rigidly fixed at their supports. PHD beam load data are based upon simple beam configurations unless otherwise noted.



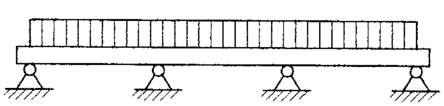
Fixed End Beam –

A fixed end beam is supported at both ends in such a way that motion or bending of the beam is restricted. An example of a fixed end beam is a strut welded at both ends to a very rigid structure. The result is a beam capable of carrying greater loads, but subject to large bending moments at the supports.



Cantilever Beam –

A cantilevered beam is one that is fixed at one end and completely unsupported at the other end.



Continuous Beam –

A continuous beam is supported at three or more points along its length. Continuous beams act similarly to simple beams, particularly at the end spans. However, the counter-balancing effect of adjacent spans restricts movement at the support, much like a fixed beam.

TECHNICAL DATA

TYPES OF BEAM LOADING

Beam Loading
Beams are loaded in several ways, as shown below.

Concentrated Load –
Also known as a point load, this type of load is applied at one point along the span of the beam. See Figure 1. A beam may have multiple concentrated loads along its span.

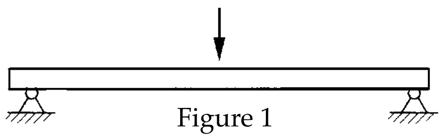


Figure 1

Uniform Load –
This is a load spread evenly over a length of the beam's span. See Figure 2. It may cover the entire span or only a portion.

Combined Load –
Concentrated loads and uniform loads may be carried simultaneously by a beam, arranged in any combination.

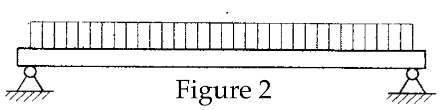
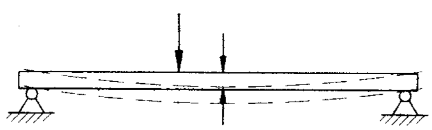


Figure 2

BEAM DEFLECTION

Deflection –
Deflection is the amount of displacement, or sag, experienced by a load-carrying beam. All loaded beams will deflect to a greater or lesser degree, depending upon:

- The size and placement of loads
- The beam material
- The manner of supporting the beam
- The stiffness of the beam



PHD provides deflection values for beams of various spans in the tables accompanying each channel shape. When determining the deflection of a strut, the rule of thumb observed by the industry is that a deflection of 1/240th of the beam's span is acceptable.

The following table of beam formulas contains factors to be applied when analyzing a strut/beam in various configurations. These factors account for the difference in deflection that will be experienced by beams mounted in various configurations and subject to various types of loads.

Also included in the tables of channel information are values for the Moment of Inertia (I) and Section Modulus (S) of the channel. These values are given for both the X-X and Y-Y axis of the channel. They are measures of the stiffness of the beam's cross-sectional shape, and are used to calculate deflection. Deflection decreases as I and S increase. The Modulus of Elasticity (E), listed below I and S, is a measure of the beam material's resistance to bending. Again, as E increases, deflection decreases.

Bending Moments & Stresses –

BENDING MOMENTS & STRESSES

When loads are placed on a beam, the effect is to flex the beam across its unsupported span. The measure of this effect is called the bending moment. Formulas for bending moments created by various load and beam support combinations are given in the following tables.

When the bending moment of a loaded beam is divided by the Section Modulus of the beam, the resulting value is called bending stress. It is this bending stress that is most commonly evaluated to determine whether a beam is strong enough for the loads it must support.

The maximum bending stress prescribed by structural codes is 25,000 psi, and this is the stress upon which PHD load figures are based.

Again, the method of supporting a beam affects the maximum bending moment of the beam. The following table gives modifying factors based upon types of beam supports. Users of PHD struts should take care to apply the proper load factor for the specific beam support configuration in order to determine the proper maximum load that the strut will safely support.

Bracing –

BRACING

For long spans and when loads are apt to cause torsion on the beam, it is a good practice to brace the beam to prevent twisting or lateral bending. PHD offers various types of braces for this purpose.

COLUMNS

Columns –

Structural members installed in a vertical attitude and subject to vertical loads are known as columns. The loads on a column have the effect of compressing the column and attempting to deflect the column laterally. As with beams, the method by which a column is mounted affects the load-carrying capability of the column. The effect of each method is quantified by the value "K", given for each support condition shown below.

Loads on a column may be concentric (directly in line with the column's vertical axis) or eccentric (offset horizontally from the vertical axis). PHD provides allowable column loads for concentric loading conditions. In addition, the tables accompanying the channels contain a value called the "radius of gyration". This value can be used by a qualified structural engineer to analyze the effect of eccentric loads on strut columns.

Common mounting methods for columns include:

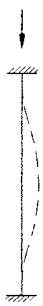


Figure 1

Fixed Top, Fixed Bottom –

Both the top and bottom of the column are rigidly mounted in such a way that rotation and displacement are prevented. The value of "K" for this configuration is .65. See Figure 1.

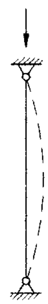


Figure 2

Pinned Top, Pinned Bottom –

Both the top and bottom of the column are mounted in such a way that rotation is permitted but displacement is prevented. The value of "K" for this configuration is 1.0. See Figure 2.

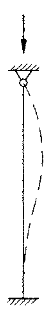


Figure 3

Pinned Top, Fixed Bottom –

The top of the column is pinned to allow rotation, and the bottom of the column is rigidly mounted in such a way that rotation and displacement are prevented. This is a common method. And is the "standard" for which PHD allowable column loads are listed. The value of "K" for this configuration is .80.
See Figure 3.

Figure 4

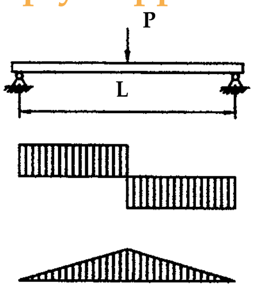
Free Top, Fixed Bottom –

The bottom of the column is rigidly mounted. The top of the column is free to move laterally, but is restrained to prevent rotation. The value of "K" for this configuration is 1.2. See Figure 4.

As stated above, allowable column loads published in this catalog are based on the "Pinned Top, Fixed Bottom" mounting configuration, which has a "K" factor of .80. For any of the other mounting configurations, a qualified design professional can use the "K" values given to calculate the allowable column load.

BEAM DIAGRAMS AND COMMON FORMULAS

Simply Supported Beams

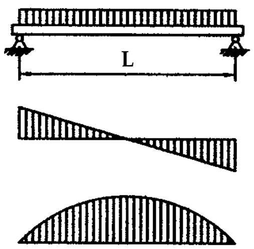


$R = P/2$

$V_{MAX} = P/2$

$M_{MAX} = PL/4$

$\Delta_{MAX} = \dfrac{PL^3}{48EI}$

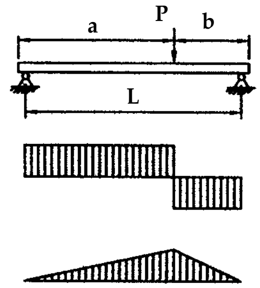


$R = W/2$

$V_{MAX} = W/2$

$M_{MAX} = WL/8$

$\Delta_{MAX} = \dfrac{5WL^3}{384EI}$



$R_1 = Pb/L$

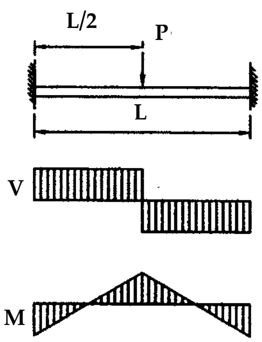
$R_2 = Pa/L$

$V_{MAX} = Pa/L$

$M_{MAX} = Pab/L$

$\Delta_{MAX} = \dfrac{Pab}{27EIL}(a+2b)\sqrt{3a(a+2b)}$

Fixed End Beams

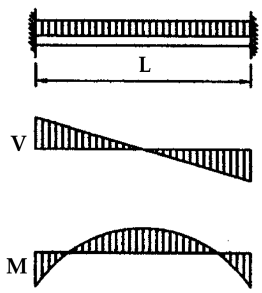


$R = P/2$

$V_{MAX} = P/2$

$M_{MAX} = PL/8$

$\Delta_{MAX} = \dfrac{PL^3}{192EI}$

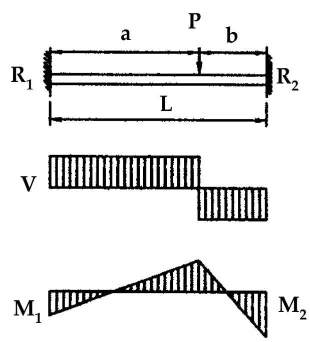


$R = W/2$

$V_{MAX} = W/2$

$M_{MAX} = WL/12$

$\Delta_{MAX} = \dfrac{WL^3}{384EI}$



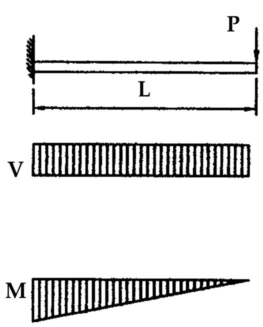
$R_1 = \dfrac{Pb^2}{L^3}(3a+b)$

$R_2 = \dfrac{Pa^2}{L^3}(a+3b)$

$M_1 = \dfrac{Pab^2}{L^2}$

$M_2 = \dfrac{Pa^2b}{L^2}$

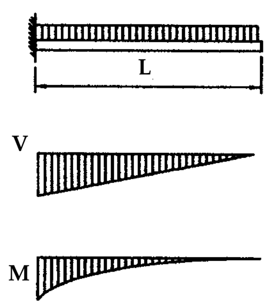
Cantilever Beams



$V_{MAX} = P$

$M_{MAX} = PL$

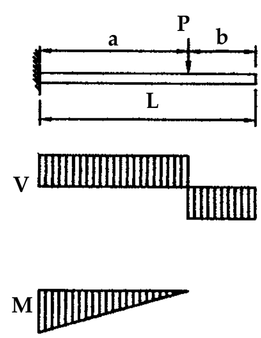
$\Delta_{MAX} = \dfrac{PL^3}{3EI}$



$V_{MAX} = W$

$M_{MAX} = WL/2$

$\Delta_{MAX} = \dfrac{WL^3}{8EI}$

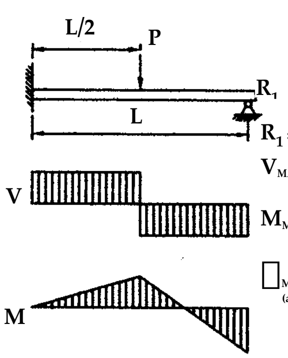


$V_{MAX} = P$

$M_{MAX} = Pb$

$\Delta_{MAX} = \dfrac{Pb^2(3L-b)}{6EI}$

Beams with one end Fixed, one end Simply Supported

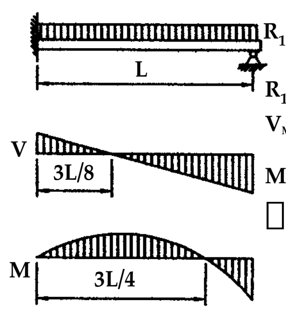


$R_1 = 5P/16$

$V_{MAX} = 11P/16$

$M_{MAX} = \dfrac{3PL}{16}$

$\Delta_{MAX\,(at\ P)} = 0.447L$

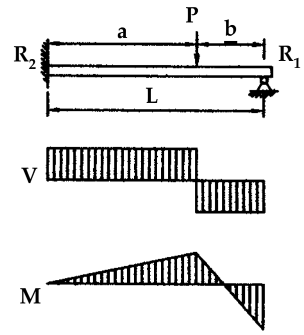


$R_1 = 3W/8$

$V_{MAX} = 5W/8$

$M_{MAX} = WL/8$

$\Delta_{MAX} = \dfrac{WL^3}{185EI}$



$R_1 = \dfrac{Pb^2}{2L^3}(a+2L)$

$R_2 = \dfrac{Pa}{2L^3}(3L^2 - a^2)$

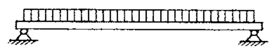
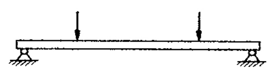
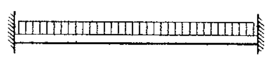
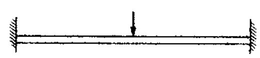
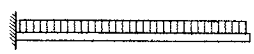
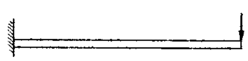
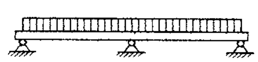
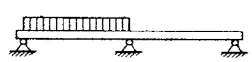
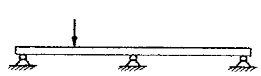
$M_{(at\ P)} = R_1 a$

$M_{(at\ R_2)} = \dfrac{Pab}{2L^3}(a+L)$

TECHNICAL DATA

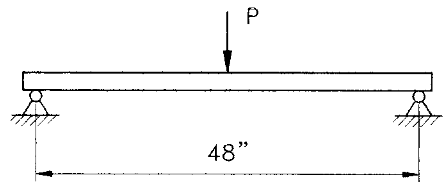
Beam Load and Deflection Conversion Factors –

The allowable beam loads listed for various spans of each channel assume that the beam is a simply supported, single-span beam. Although this is the most common condition, it is not always true. For other support conditions, multiply the listed allowable load by the factors in this table to obtain the proper load for the given mounting type.

Load & Support Configuration	Diagram	Load Factor	Deflection Factor
1) Simply Supported Beam, Uniform Load		1.00	1.00
2) Simply Supported Beam, Concentrated Load at Mid-span		.50	.80
3) Simply Supported Beam, Two equal Concentrated Loads at 1/4 Points		1.00	1.10
4) Fixed End Beam, Uniform Load		1.50	.30
5) Fixed End Beam, Concentrated Load at Mid-Span		1.00	.40
6) Cantilever Beam, Uniform Load		.25	2.40
7) Cantilever Beam, Concentrated Load at End		.12	3.20
8) Continuous Beam, Two Equal Spans, Uniform Load Both Spans		1.00	.42
9) Continuous Beam, Two Equal Spans, Uniform Load on One Span		1.30	.92
10) Continuous Beam, Two Equal Spans, Concentrated Load at Mid-span of Each		.62	.71
11) Continuous Beam, Two Equal Spans, Concentrated Load at Mid-Span of One.		.66	.48

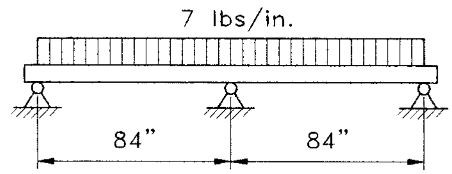
SAMPLE PROBLEMS

Problem 1
The Beam at right is a PHD 1001 Channel, simply supported. What is the maximum allowable load P? How much will the beam deflect under that load?



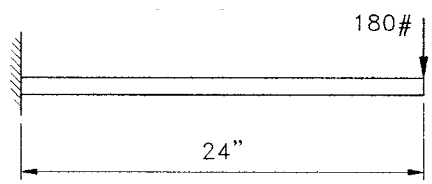
Answer
From the table of Beam and Column Loads for 1001 Channel, the load for this span is 851 lbs. and the deflection is .22". From the table of load factors above, the load conversion factor is .50 and the deflection factor is .80. Therefore the maximum load P = 851 X .50 = 425 lbs., and the deflection is .22" x .80 = .176".

Problem 2
A PHD 1001 Channel is supported at 3 points as shown, making it a continuous beam with 2 spans. The required loading condition is a uniform load of 7 lbs. per inch over both spans. Is the Channel able to safely support this load?



Answer
The entire load on one span of this beam is 7 lbs./in X 84" = 588 lbs. The allowable load is 486, and the load factor is 1.00, so the allowable load remains 486 lbs. Therefore the beam is not acceptable, since the required load exceeds the allowable load. A different PHD channel must be used, or the load must be decreased.

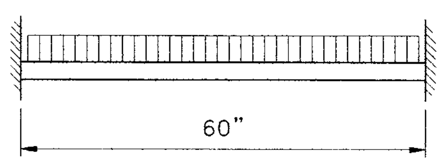
Problem 3
The cantilever beam shown at right carries a concentrated load of 180 lbs. at the end of the 24" PHD 1001 Channel. Is the load acceptable? Calculate the maximum bending moment and deflection.



Answer
The maximum load is 1702 lbs., and the load factor is .12, so the maximum load is 1702 X .12 = 204 lbs. The desired 180 lb. load is within the allowable.

From the table of beam formulas, the maximum bending moment for this support condition is M = PL. For the beam show, then, M = 180 lb. X 24" = 4320 inch-pounds. Deflection for this cantilever beam = $PL^3/3EI$. E = modulus of elasticity, which is 30×10^6 for steel. I is the Moment of Inertia, listed in the channel information as .189 in^4. The deflection then, is found by the equation $180(24)^3/3(30 \times 10^6)(.189) = .146$".

Problem 4
Determine load and deflection of a PHD 1001 Channel fixed at both ends and carrying a uniform load over its entire 60" span.



Answer
Maximum load from the chart is 681 lbs., and the load factor is 1.50, so the load for this beam is 681 X 1.50 = 1021.5 lbs. Similarly, the deflection for this beam is .35" and the deflection factor is .30, so the deflection = .35 X .30 = .105".

TECHNICAL DATA

CONVERSION FACTORS FOR UNITS OF MEASUREMENT

To Convert From	To	Multiply By	To Convert From	To	Multiply By
Length					
Inch	Millimeter	25.4	Millimeter	Inch	0.03937
Foot	Meter	0.3048	Meter	Foot	3.28084
Yard	Meter	0.9144	Meter	Yard	1.09361
Mile	Kilometer	1.6093	Kilometer	Mile	0.62137
Area					
Square Inch	Sq. Millimeter	645.16	Sq. Millimeter	Square Inch	0.001550
Square Foot	Sq. Meter	0.0929	Sq. Meter	Square Foot	10.7639
Square Yard	Sq. Meter	0.8361	Sq. Meter	Square Yard	1.19599
Square Mile	Sq. Kilometer	2.5899	Sq. Kilometer	Square Mile	0.3861
Volume					
Gallon	Liter	3.7854	Liter	Gallon	0.26417
Quart	Liter	0.9463	Liter	Quart	1.05669
Cubic Inch	Cubic Millimeter	16387.06	Cubic Millimeter	Cubic Inch	0.000061
Cubic Foot	Cubic Meter	0.0283	Cubic Meter	Cubic Foot	35.31466
Cubic Yard	Cubic Meter	0.76455	Cubic Meter	Cubic Yard	1.30795
Mass					
Ounce	Gram	28.3495	Gram	Ounce	0.035274
Pound	Kilogram	0.45359	Kilogram	Pound	2.20462
Short Ton	Kilogram	907.185	Kilogram	Short Ton	0.0011
Force					
Ounce-Force	Newton	0.278014	Newton	Ounce-Force	3.59694
Pound-Force	Newton	4.44822	Newton	Pound-Force	0.22481
Pressure					
Pound-Force per Square Inch	Kilopascal	6.894757	Kilopascal	Pound-Force per Square Inch	0.145038
Foot of Water (39.2°F)	Kilopascal	2.98898	Kilopascal	Ft. of Water	0.334562
Inch of Mercury (32°F)	Kilopascal	3.38638	Kilopascal	In. of Mercury	0.295301
Bending Moment					
Pound-Force-Inch	Newton-Meter	0.112985	Newton-Meter	Pound-Force-Inch	8.85073
Pound-Force-Foot	Newton-Meter	1.355818	Newton-Meter	Pound-Force-Foot	0.73756
Energy, Work, Heat					
Foot-Pound-Force	Joule	1.355818	Joule	Foot-Pound-Force	0.73756
British Thermal Unit (BTU)	Joule	1055.056	Joule	BTU	0.000948
Calorie	Joule	4.1868	Joule	Calorie	0.23884
Kilowatt Hour	Joule	3,600,000	Joule	Kilowatt Hour	2.78^{-7}
Power					
Foot-Pound-Force Per Second	Watt	1.355818	Watt	Foot-Pound-Force Per Second	0.73756
British Thermal Unit Per Hour	Watt	0.29307	Watt	BTU/Hr	3.41214
Horsepower	Kilowatt	0.7457	Kilowatt	Horsepower	1.341022
Temperature					
Degree Fahrenheit	Degree Celsius	(°F-32)/1.8	Degree Celsius	Degree Fahrenheit	1.8x°C + 32

MATERIAL SPECIFICATIONS

MATERIAL SPECIFICATIONS

CHANNEL

Pre-Galvanized
ASTM A-653 Grade 33 Steel Sheet Zinc Coated by Hot Dip Process

Plain, Powder Coated, or Hot Dip Galvanized
ASTM A-1011 / A-1011M Grade 33, Hot Rolled Carbon Steel Sheet and Strip, Structural Quality

Stainless Steel
ASTM A-240, Type 304, and ASTM A-240, Type 316

Aluminum
Aluminum alloy 6005-T5

ACCESSORIES

Steel
¼" thickness and below ASTM A-1011 / A-1011M 1008-1010 Grade, Commercial Quality;
⅜" thickness and above ASTM A-36, Structural Grade C.Q.

Stainless Steel
ASTM A-240, Type 304, and ASTM A-240, Type 316

Aluminum
Aluminum alloy 6005-T5 Structural Grade

PIPE CLAMPS

Steel
ASTM A-1011 / A-1011M, 1008-1010 Grade, Commercial Quality

Stainless Steel
ASTM A-240, Type 304 and ASTM A-240 Type 316

CHANNEL NUTS

Steel
ASTM A-576, Grade M1015, Case Hardened to RC25 min.

Stainless Steel
ASTM A-240, Type 304, and ASTM A-240, Type 316

Aluminum
Aluminum alloy 5052-H32

ALUMINUM

High corrosion resistance makes aluminum a good choice for many indoor and outdoor applications. The high strength to weight ratio of aluminum significantly reduces the overall cost of installation because of the ease in handling and cutting. To determine the approximate load data for strut, multiply the load data found in this catalog by a factor of 0.38.

STAINLESS STEEL

Because of its corrosion resistance, stainless steel is recommended for applications where corrosion is a problem. Load data for strut is the same as the load data in this catalog.

STEEL GAUGES

Gauge	Nominal
3	.239
7	.179
11	.120
12	.105
13	.090
14	.075
16	.060
18	.048

CHANNEL GREEN
QUALITY: POLYESTER

Powder Properties

Test Method	Powder Properties	Tolerances
ASTM D3451 (18.30)	Specific Gravity	1.33 ± 0.03
ASTM D3451 (18.30)	Theoretical Coverage	144.58 ± 4.0 FT^2/Lb/Mil.
ASTM D3451 (13)	Volatile Content	Max. 2.5%
ASTM D3451 (13)	Storage Temperature Max	80°F

Coating Properties

All tests performed on Substrate 0.032 CRS
Pretreatment Bonderite 1000

Test Method	Coating Properties	Tolerances/ Specifications
ASTM D523	Gloss 20°/60°	70-80
ASTM D2454	Over Bake Resistance Time	100%
ASTM D3363	Pencil Hardness	H - 2H
ASTM D2794 (Modified)	Direct Impact (Gardner)	80 in. Lbs.
ASTM D2794 (Modified)	Reverse Impact (Gardner)	80 in. Lbs.
ASTM D33598B	Adhesion (Cross Hatch)	Pass No Adhesion Loss
ASTM D5222	Flexibility (Mandrel)	1/8 Bend No Fracture
ASTM 117	Salt Spray	1000 Hrs.
ASTM D2247	Humidity	500 Hrs.

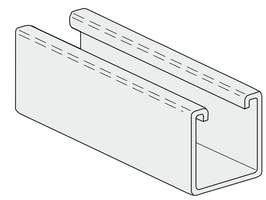
Application

Test Method	Application	Cure Schedule
Electrostatic Spray	Ambient Temperature	15' @ 190°C (375°F) Recommend Minimum Film Thickness 1.5

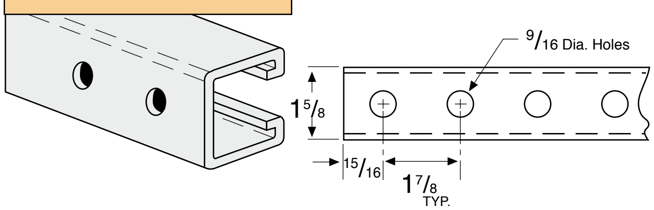
Channel

Selection Chart

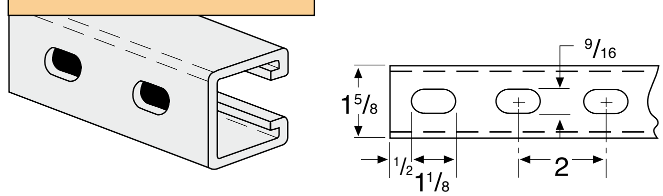
Figure Number	Width	Height	Material Size	See Page Number
1001-1042	1-5/8	1-5/8	12 Ga.	26
1101-1142	1-5/8	1-5/8	14 Ga.	28
1201-1242	1-5/8	13/16	12 Ga.	30
1301-1342	1-5/8	13/16	14 Ga.	32
1401-1442	1-5/8	1	12 Ga.	34
1501-1542	1-5/8	3-1/4	12 Ga.	36
1601-1642	1-5/8	2-7/16	12 Ga.	38
1701-1742	1-5/8	1-3/8	12 Ga.	40



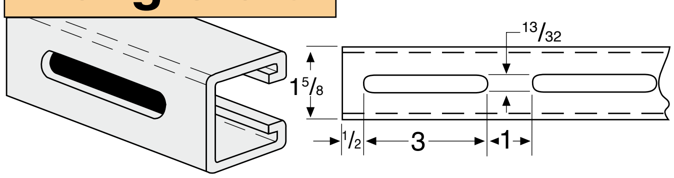
Holes



Slots



Long Slots



Knockouts