



METAL BAR GRATING MANUAL

EIGHTH EDITION

- **Maximum Bearing Bar Depth . . . 2¹/₂" (63.5 mm)**
- **Maximum Bearing Bar Thickness**
 - Steel & Stainless Steel ³/₁₆" (4.8 mm)**
 - Aluminum ¹/₄" (6.4 mm)**
- **Maximum Depth of I-Bar 2¹/₂" (63.5 mm)**



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METAL BAR GRATING MANUAL

For Steel, Stainless Steel, and Aluminum Gratings and Stair Treads

Eighth Edition

NAAMM MBG 531

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NAAMM'S METAL BAR GRATING DIVISION

The members of the Metal Bar Grating Division of the National Association of Architectural Metal Manufacturers have supported the preparation of this Manual. All are producers and/or suppliers of products conforming to the standards and specifications contained herein. A copy of the Membership Roster of the Metal Bar Grating Division is available from NAAMM at www.naamm.org.

FOREWORD

The NAAMM Metal Bar Grating Manual provides architects and engineers with current technical data on bar gratings and stair treads of steel, stainless steel, and aluminum. The information contained is based on sound engineering principles and reflects practices recommended by leading manufacturers in the industry.

The first seven editions of the manual have been widely used by the design professions. In preparing this eighth edition, the Metal Bar Grating Division of NAAMM has reviewed its contents in detail and has made revisions to reflect current practices.

The load tables in this edition are based on the design formulas and procedures found in ANSI/NAAMM MBG 534-14 Metal Bar Grating Engineering Design Manual, which was developed to provide a clearer understanding of the procedures used in the design of grating and treads.

Also included are metric equivalents as an aid to designers who use the metric system. The system of metric measurement used is from IEEE/ASTM SI 10-2010, "Standard for Use of the International System of Units (SI): The Modern Metric System".

The stair treads shown in this standard have been tested and conform to the requirements of OSHA 29CFR 1910.24(c), IBC 2012.

Changes from the previous edition, ANSI/NAAMM MBG 531-09 are indicated by the placement of a vertical line next to the changed item.

**VALUES EXPRESSED IN THIS MANUAL ARE IN BOTH INCH-POUND UNITS AND SI UNITS.
THE VALUES STATED IN INCH-POUND UNITS ARE TO BE REGARDED AS THE STANDARD.**

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**STANDARD
MARKING
SYSTEM**

The marking system described here is the industry standard for identifying various types of bar grating. Leading manufacturers correlate their individual marking systems with this standard.

The standard marking system for metal bar gratings, as illustrated on the facing page, identifies five characteristics of the grating in the following order:

1 TYPE OF GRATING

The type of grating is indicated by a letter, as follows:

- W Welded (steel gratings only)
- P Pressure-locked
- R Riveted

(See Glossary for definitions of types)

2 BEARING BAR SPACING

Bearing bar spacing is designated by a number which indicates sixteenths of an inch, or mm.

For welded or pressure-locked grating this is the distance, in sixteenths of an inch, or mm, **center-to-center** of bars.

For riveted grating it is the distance, in sixteenths of an inch, or mm, **between bearing bar faces**.

3 CROSS BAR OR RIVET SPACING

Cross bar or rivet spacing is designated by a number which indicates inches, or mm.

For welded or pressure-locked grating this is the distance, in inches, or mm, center-to-center of cross bars. For riveted grating it is the distance in inches, or mm, **center-to-center** of rivets, measured along a single bearing bar.

4 SIZE OF BEARING BARS *

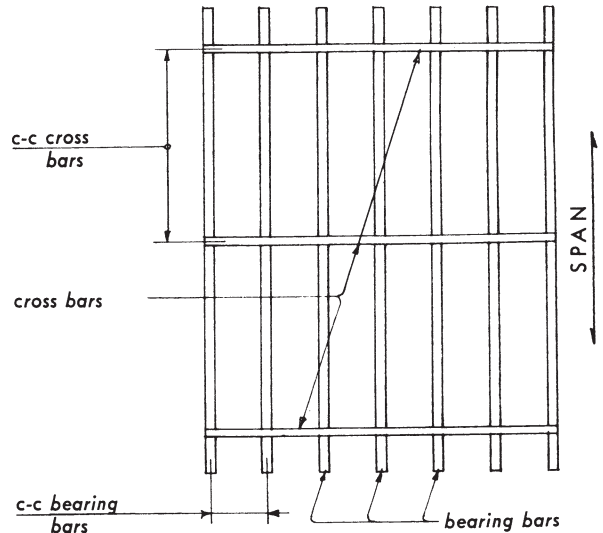
The size of bearing bars is expressed in inches of depth and thicknesses as follows:

*Equivalent bearing bar sizes in millimeters are obtained by a multiplication factor of 25.4

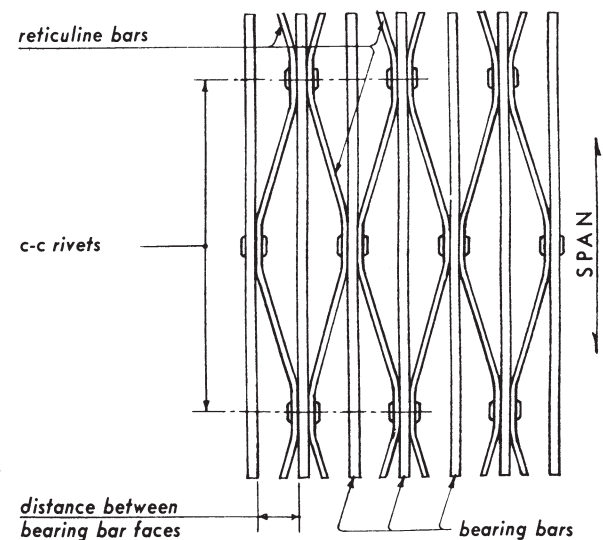
Steel / Stainless Steel		Aluminum		
$\frac{3}{4} \times \frac{1}{8}$	$1\frac{1}{2} \times \frac{1}{8}$	$1 \times \frac{1}{8}$	$1\frac{1}{2} \times \frac{1}{8}$	$2 \times \frac{3}{16}$
$\frac{3}{4} \times \frac{3}{16}$	$1\frac{1}{2} \times \frac{3}{16}$	$1 \times \frac{3}{16}$	$1\frac{1}{2} \times \frac{3}{16}$	$2 \times \frac{1}{4}$
		$1 \times \frac{1}{4}$	$1\frac{1}{2} \times \frac{1}{4}$	2" I Bar
$1 \times \frac{1}{8}$	$1\frac{3}{4} \times \frac{3}{16}$	1" I Bar	$1\frac{1}{2}$ " I Bar	
$1 \times \frac{3}{16}$				$2\frac{1}{4} \times \frac{3}{16}$
	$2 \times \frac{3}{16}$	$1\frac{1}{4} \times \frac{1}{8}$	$1\frac{3}{4} \times \frac{3}{16}$	$2\frac{1}{4} \times \frac{1}{4}$
$1\frac{1}{4} \times \frac{1}{8}$		$1\frac{1}{4} \times \frac{3}{16}$	$1\frac{3}{4} \times \frac{1}{4}$	$2\frac{1}{4}$ " I Bar
$1\frac{1}{4} \times \frac{3}{16}$	$2\frac{1}{4} \times \frac{3}{16}$	$1\frac{1}{4} \times \frac{1}{4}$	$1\frac{3}{4}$ " I Bar	
		$1\frac{1}{4}$ " I Bar		$2\frac{1}{2} \times \frac{3}{16}$
	$2\frac{1}{2} \times \frac{3}{16}$			$2\frac{1}{2} \times \frac{1}{4}$
				$2\frac{1}{2}$ " I Bar

5 MATERIAL

Grating material is designated by name, such as "steel," "stainless steel" or "aluminum".



**WELDED OR
PRESSURE-LOCKED GRATING**



RIVETED GRATING

**EXAMPLES OF
USE OF STANDARD
MARKING SYSTEM**

TYPE	DESCRIPTION OF GRATING DESIGNATED	
W-19-4 (1 x 3/16) STEEL W-30-102 (25 x 4.8)	W 19 4 (1 x 3/16) STEEL	welded bearing bars spaced 1 3/16 in. (30 mm) on center cross bars spaced 4 in. (102 mm) on center bearing bar size, 1 in. x 3/16 in. (25 mm x 4.8 mm) material
R-18-7 (1 1/4 x 1/8) STAINLESS STEEL R-29-178 (32 x 3.2)	R 18 7 (1 1/4 x 1/8) STAINLESS STEEL	riveted bearing bars spaced 1 1/8 in. (29 mm) between faces rivets spaced 7 in. (178 mm) on center bearing bar size, 1 1/4 in. x 1/8 in. (32 mm x 3.2 mm) material
P-15-2 (1 1/4 x 3/16) ALUMINUM P-24-51 (32 x 4.8)	P 15 2 (1 1/4 x 3/16) ALUMINUM	pressure-locked bearing bars spaced 15/16 in. (24 mm) on center cross bars spaced 2 in. (51 mm) on center bearing bar size, 1 1/4 in. x 3/16 in. (32 mm x 4.8 mm) material
P-19-4 (1 1/2 I Bar) ALUMINUM P-30-102 (38 I Bar)	P 19 4 (1 1/2 in. I Bar) ALUMINUM	pressure-locked bearing bars spaced 1 3/16 in. (30 mm) on center cross bars spaced 4 in. (102 mm) on center bearing bar size, 1 1/2 in. I Bar (38 mm I Bar) material

Manufacturers are equipped to produce gratings having bearing bars and cross bars of other sizes and spacings than shown in this Manual, as well as gratings of other metals, such as bronze, brass, monel, magnesium and special steel alloys. Minimum and maximum sizes and spacings are determined by equipment and/or design factors.

While gratings are normally furnished with a finish as indicated in Section V of the Standard Specifications Section, a wide variety of non-standard finishes can be applied to address specific job and/or function requirements.

Individual manufacturers should be consulted regarding all non-standard products and/or finishes.

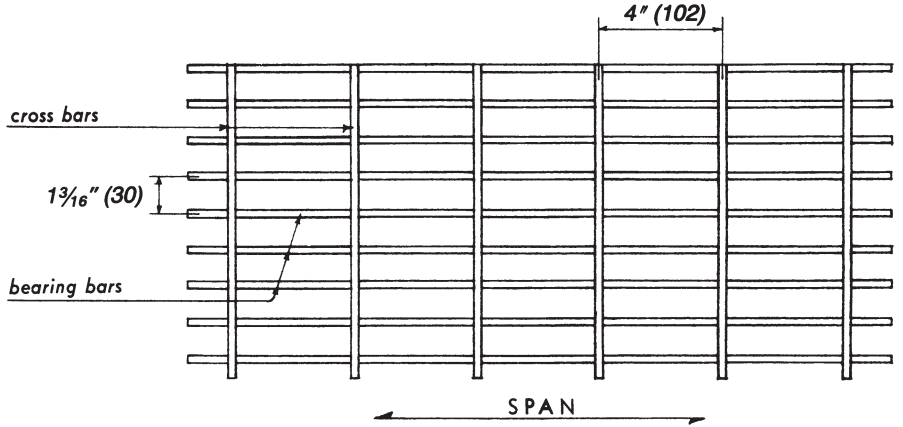


**STANDARD
GRATINGS**

See GLOSSARY OF TERMS for definitions of *Welded, Pressure-locked, and Riveted Gratings*

**WELDED
(Steel and Stainless Steel only)**

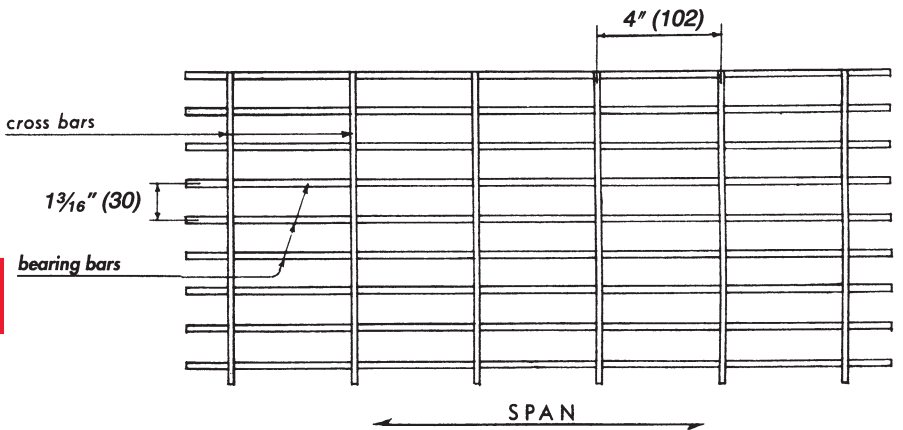
Type W-19-4
(W-30-102)



PRESSURE-LOCKED

Type P-19-4
(P-30-102)

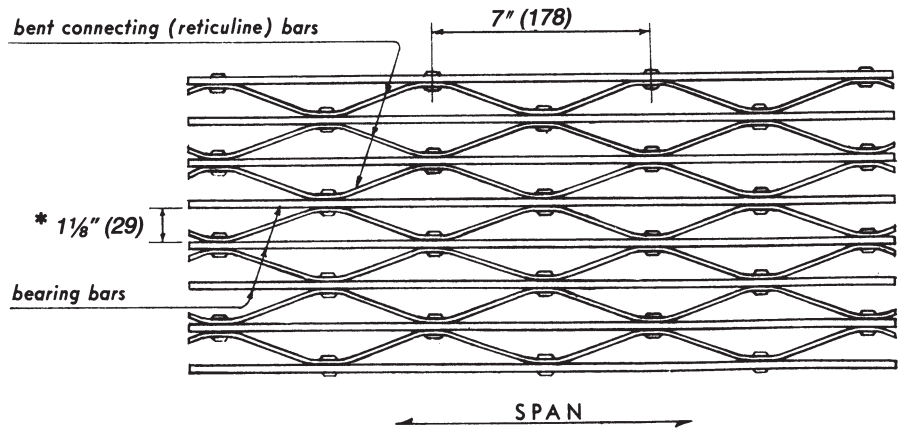
Cross bar ends are peened, bent over, welded, otherwise locked, or allowed to extend, at the manufacturer's discretion.



RIVETED*

Type R-18-7
(R-29-178)

Riveted grating is also available with a double crimp in the reticuline bar:



*Note that riveted grating marking indicates space between bearing bars

MINIMUM STANDARD SIZES AND TOLERANCES

MINIMUM STANDARD SIZES

CROSS BARS and CONNECTING BARS

STEEL / STAINLESS STEEL

WELDED*

Bearing Bars		Minimum Cross Bar Size	
Thickness in. (mm)	Depth in. (mm)	Section Area in. ² (mm ²)	Weight lb/ft (kg/m)
1/8 (3.2)	3/4 (19) thru 1 (25)	.031 (20)	.107 (.159)
1/8 (3.2)	1 1/4 (32) thru 1 1/2 (38)	.049 (32)	.167 (.248)
3/16 (4.8)	3/4 (19) thru 1 1/2 (38)	.049 (32)	.167 (.248)
3/16 (4.8)	1 3/4 (44) thru 2 1/2 (64)	.062 (40)	.211 (.314)

*Minimum size shown is for cross bars on 4 inch centers. When cross bars are on 2 inch centers, the minimum size may be reduced by 25%.

STEEL / STAINLESS STEEL / ALUMINUM

PRESSURE - LOCKED

Cross bars are made in a variety of solid and hollow shapes. They can be of any size and configuration which will provide structural stability under the stated design loads.

ALUMINUM

RIVETED

Bearing Bar Depth in. (mm)	Minimum Size of Connecting (Reticuline) Bars	
	Thickness in. (mm)	Depth in. (mm)
1 (25)	1/8 (3.2)	5/8 (16)
1 1/4 (32) thru 1 3/4 (44)	1/8 (3.2)	3/4 (19)
2 (51) thru 2 1/2 (64)	1/8 (3.2)	1 (25)

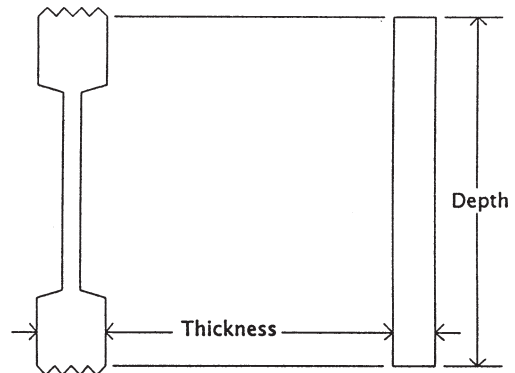
STEEL / STAINLESS STEEL

RIVETED

Bearing Bar Depth in. (mm)	Minimum Size of Connecting (Reticuline) Bars	
	Thickness in. (mm)	Depth in. (mm)
3/4 (19)	1/8 (3.2)	5/8 (16)
1 (25) thru 1 3/4 (44)	1/8 (3.2)	3/4 (19)
2 (51) thru 2 1/2 (64)	1/8 (3.2)	1 (25)

TOLERANCES - Bearing Bars

ALUMINUM	
Thickness	±0.007 in. (±0.2 mm) for 1/8" (3.2) and 3/16" (4.8) ±0.008 in. (±0.2 mm) for 1/4" (6.4)
Depth	±0.012 in. (±0.3 mm) for 1" (25) and 1 1/4" (32) depths ±0.014 in. (±0.4 mm) for 1 1/2" (38) and 1 3/4" (44) depths ±0.024 in. (±0.6 mm) for 2" (51) thru 2 1/2" (63) depths
STEEL/STAINLESS STEEL	
Thickness	±0.009 in. (±0.23 mm) for all thicknesses
Depth	±0.016 in. (±0.4 mm) for 3/4" (19) thru 1 3/4" (44) depths ±0.024 in. (±0.6 mm) for 2" (51) thru 2 1/2" (63) depths



NOTE: The following references were used as a guide in establishing the above bearing bar tolerances: ASTM A 1011A (1011M) Commercial Steel Type B, ASTM A 510 (A510M); ASTM B 221 (B221M), ASTM B 210 (B210M); Aluminum Association standards and data (extruded shapes).

LOAD TABLE
STEEL GRATING

LOAD TABLE FOR STEEL GRATING - TYPE W-19

ASTM A 1011 CS TYPE B

F=18,000psi, E=29,000,000psi

Recommended max. span (in.) for 1/4 in. deflection under uniform load of 100psf

All loads and deflections shown are based on engineering computations using gross sections and nominal sizes of bearing bars. The values listed are for design selection only and are not intended to be "absolute" since actual load capacity will be affected slightly by variations which can be expected due to material and manufacturing tolerances.

Bearing Bar Size (in)	Nominal Weight (psf)**	Span in Inches	Span in Inches														
			24	30	36	42	48	54	60	66	72	78	84	90	96	102	108
3/4x1/8 [4]	42	U	355	227	158	116	89	70									
		Du	0.099	0.155	0.223	0.304	0.397	0.503									
		Dc	0.079	0.124	0.179	0.243	0.318	0.402									
3/4x3/16 [6]	46	U	533	341	237	174	133	105									
		Du	0.099	0.155	0.223	0.304	0.397	0.503									
		Dc	0.079	0.124	0.179	0.243	0.318	0.402									
1x1/8 [6]	51	U	632	404	281	206	158	125	101	84	70						
		Du	0.074	0.116	0.168	0.228	0.298	0.377	0.466	0.563	0.670						
		Dc	0.060	0.093	0.134	0.182	0.238	0.302	0.372	0.451	0.536						
1x3/16 [8]	57	U	947	606	421	309	237	187	152	125	105						
		Du	0.074	0.116	0.168	0.228	0.298	0.377	0.466	0.563	0.670						
		Dc	0.060	0.093	0.134	0.182	0.238	0.302	0.372	0.451	0.536						
1-1/4x1/8 [7]	61	U	987	632	439	322	247	195	158	130	110	93	81				
		Du	0.060	0.093	0.134	0.182	0.238	0.302	0.372	0.451	0.536	0.629	0.730				
		Dc	0.048	0.074	0.107	0.146	0.191	0.241	0.298	0.360	0.429	0.504	0.584				
1-1/4x3/16 [9]	67	U	1480	947	658	483	370	292	237	196	164	140	121				
		Du	0.060	0.093	0.134	0.182	0.238	0.302	0.372	0.451	0.536	0.629	0.730				
		Dc	0.048	0.074	0.107	0.146	0.191	0.241	0.298	0.360	0.429	0.504	0.584				
1-1/2x1/8 [8]	70	U	1421	909	632	464	355	281	227	188	158	135	116	101	89	79	70
		Du	0.050	0.078	0.112	0.152	0.199	0.251	0.310	0.376	0.447	0.524	0.608	0.698	0.794	0.897	1.006
		Dc	0.040	0.062	0.089	0.122	0.159	0.201	0.248	0.300	0.358	0.420	0.487	0.559	0.636	0.718	0.804
1-1/2x3/16 [11]	77	U	2132	1364	947	696	533	421	341	282	237	202	174	152	133	118	105
		Du	0.050	0.078	0.112	0.152	0.199	0.251	0.310	0.376	0.447	0.524	0.608	0.698	0.794	0.897	1.006
		Dc	0.040	0.062	0.089	0.122	0.159	0.201	0.248	0.300	0.358	0.420	0.487	0.559	0.636	0.718	0.804
1-3/4x3/16 [13]	87	U	2901	1857	1289	947	725	573	464	384	322	275	237	206	181	161	143
		Du	0.043	0.067	0.096	0.130	0.170	0.215	0.266	0.322	0.383	0.450	0.521	0.599	0.681	0.769	0.862
		Dc	0.034	0.053	0.077	0.104	0.136	0.172	0.213	0.257	0.306	0.360	0.417	0.479	0.545	0.615	0.689
2x3/16 [14]	96	U	3789	2425	1684	1237	947	749	606	501	421	359	309	269	237	210	187
		Du	0.037	0.058	0.084	0.114	0.149	0.189	0.233	0.282	0.335	0.393	0.456	0.524	0.596	0.673	0.754
		Dc	0.030	0.047	0.067	0.091	0.119	0.151	0.186	0.225	0.268	0.315	0.365	0.419	0.477	0.538	0.603
2-1/4x3/16 [16]	105	U	4796	3069	2132	1566	1199	947	767	634	533	454	392	341	300	266	237
		Du	0.033	0.052	0.074	0.101	0.132	0.168	0.207	0.250	0.298	0.350	0.406	0.466	0.530	0.598	0.670
		Dc	0.026	0.041	0.060	0.081	0.106	0.134	0.166	0.200	0.238	0.280	0.324	0.372	0.424	0.478	0.536
2-1/2x3/16 [18]	113	U	5921	3789	2632	1933	1480	1170	947	783	658	561	483	421	370	328	292
		Du	0.030	0.047	0.067	0.091	0.119	0.151	0.186	0.225	0.268	0.315	0.365	0.419	0.477	0.538	0.603
		Dc	0.024	0.037	0.054	0.073	0.095	0.121	0.149	0.180	0.215	0.252	0.292	0.335	0.381	0.431	0.483

Note: The carrying capacity of a piece of grating subjected to a concentrated load over only a portion of its width is determined by the stiffness of both the bearing bars and the cross bars, and therefore differs with the type of grating used. To determine the carrying capacity of gratings subject to such loadings, the manufacturer's engineering department should be consulted.

Conversion Factors:
For gratings with other than 1-3/16" bearing bar spacing, or for different design stresses, proportionate conversion factors apply. Refer to the Metal Bar Grating Engineering Design Manual for the development of such factors.

Note: 1/4" is considered the maximum deflection consistent with pedestrian comfort, but can be exceeded for other loading conditions at the discretion of the engineer.

NOTE: For serrated grating, the depth of grating required for a specified load is 1/4" greater than in the table.

**Weights (mass/area) shown are approximate and vary with manufacturers. They are provided for preliminary design computations only and are not intended for any other purpose.

Loads above DO NOT include the dead load of the grating.

**LOAD TABLE (METRIC)
STEEL GRATING**

LOAD TABLE FOR STEEL GRATING - TYPE W-19

ASTM A 1011 CS TYPE B
F=124MPa, E=200,000MPa

Recommended max. span for 6.4mm deflected under uniform load of 4.8kPa

All loads and deflections shown are based on engineering computations using gross sections and nominal sizes of bearing bars. The values listed are for design selection only and are not intended to be "absolute" since actual load capacity will be affected slightly by variations which can be expected due to material and manufacturing tolerances.

Bearing Bar Size (mm)	Nominal Weight Kg/m ² **	U=uniform load, kPa D=deflection, mm. C=concentrated load at mid-span, kN per metre of grating width	Span in Millimeters																		
			610	762	914	1067	1219	1372	1524	1676	1829										
19x3 [20]	1054	U	17.01	10.89	7.56	5.55	4.25	3.36													
		Du	2.52	3.94	5.68	7.73	10.09	12.77													
		C	5.18	4.15	3.46	2.96	2.59	2.30													
		Dc	2.02	3.15	4.54	6.18	8.07	10.22													
19x5 [28]	1167	U	25.52	16.33	11.34	8.33	6.38	5.04													
		Du	2.52	3.94	5.68	7.73	10.09	12.77													
		C	7.78	6.22	5.18	4.44	3.89	3.46													
		Dc	2.02	3.15	4.54	6.18	8.07	10.22													
25x3 [25]	1308	U	30.24	19.35	13.44	9.87	7.56	5.97	4.84	4.00	3.36										
		Du	1.89	2.96	4.26	5.79	7.57	9.58	11.82	14.31	17.03										
		C	9.22	7.37	6.14	5.27	4.61	4.10	3.69	3.35	3.07										
		Dc	1.51	2.36	3.41	4.64	6.05	7.66	9.46	11.45	13.62										
25x5 [36]	1448	U	45.36	29.03	20.16	14.81	11.34	8.96	7.26	6.00	5.04										
		Du	1.89	2.96	4.26	5.79	7.57	9.58	11.82	14.31	17.03										
		C	13.83	11.06	9.22	7.90	6.91	6.14	5.53	5.03	4.61										
		Dc	1.51	2.36	3.41	4.64	6.05	7.66	9.46	11.45	13.62										
32x3 [30]	1546	U	47.25	30.24	21.00	15.43	11.81	9.33	7.56	6.25	5.25	4.47	3.86								
		Du	1.51	2.36	3.41	4.64	6.05	7.66	9.46	11.45	13.62	15.99	18.54								
		C	14.40	11.52	9.60	8.23	7.20	6.40	5.76	5.24	4.80	4.43	4.11								
		Dc	1.21	1.89	2.72	3.71	4.84	6.13	7.57	9.16	10.90	12.79	14.83								
32x5 [44]	1711	U	70.88	45.36	31.50	23.14	17.72	14.00	11.34	9.37	7.88	6.71	5.79								
		Du	1.51	2.36	3.41	4.64	6.05	7.66	9.46	11.45	13.62	15.99	18.54								
		C	21.60	17.28	14.40	12.34	10.80	9.60	8.64	7.86	7.20	6.65	6.17								
		Dc	1.21	1.89	2.72	3.71	4.84	6.13	7.57	9.16	10.90	12.79	14.83								
38x3 [36]	1773	U	68.04	43.55	30.24	22.22	17.01	13.44	10.89	9.00	7.56	6.44	5.55	4.84	4.25	3.77	3.36				
		Du	1.26	1.97	2.84	3.86	5.04	6.39	7.88	9.54	11.35	13.32	15.45	17.74	20.18	22.78	25.54				
		C	20.74	16.59	13.83	11.85	10.37	9.22	8.30	7.54	6.91	6.38	5.93	5.53	5.18	4.88	4.61				
		Dc	1.01	1.58	2.27	3.09	4.04	5.11	6.31	7.63	9.08	10.66	12.36	14.19	16.14	18.22	20.43				
38x5 [52]	1962	U	102.06	65.32	45.36	33.33	25.52	20.16	16.33	13.50	11.34	9.66	8.33	7.26	6.38	5.65	5.04				
		Du	1.26	1.97	2.84	3.86	5.04	6.39	7.88	9.54	11.35	13.32	15.45	17.74	20.18	22.78	25.54				
		C	31.11	24.89	20.74	17.78	15.55	13.83	12.44	11.31	10.37	9.57	8.89	8.30	7.78	7.32	6.91				
		Dc	1.01	1.58	2.27	3.09	4.04	5.11	6.31	7.63	9.08	10.66	12.36	14.19	16.14	18.22	20.43				
44x5 [60]	2203	U	138.92	88.91	61.74	45.36	34.73	27.44	22.23	18.37	15.44	13.15	11.34	9.88	8.68	7.69	6.86				
		Du	1.08	1.69	2.43	3.31	4.32	5.47	6.76	8.18	9.73	11.42	13.24	15.20	17.30	19.53	21.89				
		C	42.34	33.87	28.23	24.20	21.17	18.82	16.94	15.40	14.11	13.03	12.10	11.29	10.59	9.96	9.41				
		Dc	0.86	1.35	1.95	2.65	3.46	4.38	5.41	6.54	7.78	9.13	10.59	12.16	13.84	15.62	17.51				
51x5 [68]	2435	U	181.44	116.12	80.64	59.25	45.36	35.84	29.03	23.99	20.16	17.18	14.81	12.90	11.34	10.05	8.96				
		Du	0.95	1.48	2.13	2.90	3.78	4.79	5.91	7.15	8.51	9.99	11.59	13.30	15.13	17.09	19.16				
		C	55.30	44.24	36.87	31.60	27.65	24.58	22.12	20.11	18.43	17.02	15.80	14.75	13.83	13.01	12.29				
		Dc	0.76	1.18	1.70	2.32	3.03	3.83	4.73	5.72	6.81	7.99	9.27	10.64	12.11	13.67	15.32				
57x5 [76]	2659	U	229.64	146.97	102.06	74.98	57.41	45.36	36.74	30.37	25.52	21.74	18.75	16.33	14.35	12.71	11.34				
		Du	0.84	1.31	1.89	2.58	3.36	4.26	5.26	6.36	7.57	8.88	10.30	11.82	13.45	15.19	17.03				
		C	69.99	55.99	46.66	40.00	35.00	31.11	28.00	25.45	23.33	21.54	20.00	18.66	17.50	16.47	15.55				
		Dc	0.67	1.05	1.51	2.06	2.69	3.41	4.20	5.09	6.05	7.10	8.24	9.46	10.76	12.15	13.62				
64x5 [84]	2878	U	283.50	181.44	126.00	92.57	70.88	56.00	45.36	37.49	31.50	26.84	23.14	20.16	17.72	15.70	14.00				
		Du	0.76	1.18	1.70	2.32	3.03	3.83	4.73	5.72	6.81	7.99	9.27	10.64	12.11	13.67	15.32				
		C	86.41	69.13	57.61	49.38	43.21	38.41	34.56	31.42	28.80	26.59	24.69	23.04	21.60	20.33	19.20				
		Dc	0.61	0.95	1.36	1.85	2.42	3.06	3.78	4.58	5.45	6.39	7.42	8.51	9.69	10.93	12.26				

Note: The carrying capacity of a piece of grating subjected to a concentrated load over only a portion of its width is determined by the stiffness of both the bearing bars and the cross bars, and therefore differs with the type of grating used. To determine the carrying capacity of gratings subject to such loadings, the manufacturer's engineering department should be consulted.

Conversion Factors:
For gratings with other than 30mm bearing bar spacing, or for different design stresses, proportionate conversion factors apply. Refer to the Metal Bar Grating Engineering Design Manual for the development of such factors.

Note: 6.4 mm is considered the maximum deflection consistent with pedestrian comfort, but can be exceeded for other loading conditions at the discretion of the engineer.

NOTE: For serrated grating, the depth of grating required for a specified load is 6mm greater than in the table.

**Weights (mass/area) shown are approximate and vary with manufacturers. They are provided for preliminary design computations only and are not intended for any other purpose.

Loads above DO NOT include the dead load of the grating.

LOAD TABLE
STAINLESS STEEL GRATING

LOAD TABLE FOR WELDED STAINLESS STEEL GRATING - TYPE W-19

ALLOYS 304, 316 & 304L, 316L
F=20,000psi, E=28,000,000psi

Recommended max. span (in.) for 1/4 in. deflection under uniform load of 100psf

U=uniform load, psf
D=deflection, in.
C=concentrated load at mid-span, lb per foot of grating width

All loads and deflections shown are based on engineering computations using gross sections and nominal sizes of bearing bars. The values listed are for design selection only and are not intended to be "absolute" since actual load capacity will be affected slightly by variations which can be expected due to material and manufacturing tolerances.

Note: The carrying capacity of a piece of grating subjected to a concentrated load over only a portion of its width is determined by the stiffness of both the bearing bars and the cross bars, and therefore differs with the type of grating used. To determine the carrying capacity of gratings subject to such loadings, the manufacturer's engineering department should be consulted.

Note: 1/4" is considered the maximum deflection consistent with pedestrian comfort, but can be exceeded for other loading conditions at the discretion of the engineer.

Conversion Factors:
For gratings with other than 1-3/16" bearing bar spacing, or for different design stresses, proportionate conversion factors apply. Refer to the Metal Bar Grating Engineering Design Manual for the development of such factors.

Bearing Bar Size (in)	Nominal Weight (psf)**	U	Span in Inches						Conversion Factors					
			24	30	36	42	48	54	60	66	72	78	84	
3/4x1/8 [4]	41	U	395	253	175	129	99	78						
		Du	0.114	0.179	0.257	0.350	0.457	0.579						
		C	395	316	263	226	197	175						
3/4x3/16 [6]	46	U	592	379	263	193	148	117						
		Du	0.114	0.179	0.257	0.350	0.457	0.579						
		C	592	474	395	338	296	263						
1x1/8 [6]	51	U	702	449	312	229	175	139	112	93	78			
		Du	0.086	0.134	0.193	0.263	0.343	0.434	0.536	0.648	0.771			
		C	702	561	468	401	351	312	281	255	234			
1x3/16 [8]	56	U	1053	674	468	344	263	208	168	139	117			
		Du	0.086	0.134	0.193	0.263	0.343	0.434	0.536	0.648	0.771			
		C	1053	842	702	602	526	468	421	383	351			
1-1/4x1/8 [7]	60	U	1096	702	487	358	274	217	175	145	122	104	90	
		Du	0.069	0.107	0.154	0.210	0.274	0.347	0.429	0.519	0.617	0.724	0.840	
		C	1096	877	731	627	548	487	439	399	365	337	313	
1-1/4x3/16 [9]	67	U	1645	1053	731	537	411	325	263	217	183	156	134	
		Du	0.069	0.107	0.154	0.210	0.274	0.347	0.429	0.519	0.617	0.724	0.840	
		C	1645	1316	1096	940	822	731	658	598	548	506	470	
1-1/2x1/8 [8]	69	U	1579	1011	702	516	395	312	253	209	175	149	129	112
		Du	0.057	0.089	0.129	0.175	0.229	0.289	0.357	0.432	0.514	0.604	0.700	0.804
		C	1579	1263	1053	902	789	702	632	574	526	486	451	421
1-1/2x3/16 [11]	77	U	2368	1516	1053	773	592	468	379	313	263	224	193	168
		Du	0.057	0.089	0.129	0.175	0.229	0.289	0.357	0.432	0.514	0.604	0.700	0.804
		C	2368	1895	1579	1353	1184	1053	947	861	789	729	677	632
1-3/4x3/16 [13]	86	U	3224	2063	1433	1053	806	637	516	426	358	305	263	229
		Du	0.049	0.077	0.110	0.150	0.196	0.248	0.306	0.370	0.441	0.517	0.600	0.689
		C	3224	2579	2149	1842	1612	1433	1289	1172	1075	992	921	860
2x3/16 [14]	95	U	4211	2695	1871	1375	1053	832	674	557	468	399	344	299
		Du	0.043	0.067	0.096	0.131	0.171	0.217	0.268	0.324	0.386	0.453	0.525	0.603
		C	4211	3368	2807	2406	2105	1871	1684	1531	1404	1296	1203	1123
2-1/4x3/16 [16]	104	U	5329	3411	2368	1740	1332	1053	853	705	592	505	435	379
		Du	0.038	0.060	0.086	0.117	0.152	0.193	0.238	0.288	0.343	0.402	0.467	0.536
		C	5329	4263	3553	3045	2664	2368	2132	1938	1776	1640	1523	1421
2-1/2x3/16 [18]	112	U	6579	4211	2924	2148	1645	1300	1053	870	731	623	537	468
		Du	0.034	0.054	0.077	0.105	0.137	0.174	0.214	0.259	0.309	0.362	0.420	0.482
		C	6579	5263	4386	3759	3289	2924	2632	2392	2193	2024	1880	1754
		Dc	0.027	0.043	0.062	0.084	0.110	0.139	0.171	0.207	0.247	0.290	0.336	

NOTE: For serrated grating, the depth of grating required for a specified load is 1/4" greater than in the table.

**Weights (mass/area) shown are approximate and vary with manufacturers. They are provided for preliminary design computations only and are not intended for any other purpose.

Loads above DO NOT include the dead load of the grating.

**LOAD TABLE (METRIC)
STAINLESS STEEL GRATING**

LOAD TABLE FOR WELDED STAINLESS STEEL GRATING - TYPE W-19

ALLOYS 304, 316 & 304L, 316L
F=138MPa, E=139,000MPa

Recommended max. span for 6.4mm deflected under uniform load of 4.8kPa

All loads and deflections shown are based on engineering computations using gross sections and nominal sizes of bearing bars. The values listed are for design selection only and are not intended to be "absolute" since actual load capacity will be affected slightly by variations which can be expected due to material and manufacturing tolerances.

Bearing Bar Size (mm)	Nominal Weight (Kg/m ² *)	U=uniform load, kPa	D=deflection, mm.	C=concentrated load at mid-span, kN per metre of grating width	Span in Millimeters																
					610	762	914	1067	1219	1372	1524	1676	1829	1981	2134						
19x3 [20]	1045	U	18.90	12.10	8.40	6.17	4.73	3.73													
		Du	2.90	4.54	6.53	8.89	11.61	14.70													
		C	5.76	4.61	3.84	3.29	2.88	2.56													
		Dc	2.32	3.63	5.23	7.11	9.29	11.76													
19x5 [28]	1156	U	28.35	18.14	12.60	9.26	7.09	5.60													
		Du	2.90	4.54	6.53	8.89	11.61	14.70													
		C	8.64	6.91	5.76	4.94	4.32	3.84													
		Dc	2.32	3.63	5.23	7.11	9.29	11.76													
25x3 [25]	1297	U	33.60	21.50	14.93	10.97	8.40	6.64	5.38	4.44	3.73										
		Du	2.18	3.40	4.90	6.67	8.71	11.02	13.61	16.46	19.59										
		C	10.24	8.19	6.83	5.85	5.12	4.55	4.10	3.72	3.41										
		Dc	1.74	2.72	3.92	5.33	6.97	8.82	10.89	13.17	15.68										
25x5 [36]	1435	U	50.40	32.26	22.40	16.46	12.60	9.96	8.06	6.66	5.60										
		Du	2.18	3.40	4.90	6.67	8.71	11.02	13.61	16.46	19.59										
		C	15.36	12.29	10.24	8.78	7.68	6.83	6.14	5.59	5.12										
		Dc	1.74	2.72	3.92	5.33	6.97	8.82	10.89	13.17	15.68										
32x3 [30]	1533	U	52.50	33.60	23.33	17.14	13.13	10.37	8.40	6.94	5.83	4.97	4.29								
		Du	1.74	2.72	3.92	5.33	6.97	8.82	10.89	13.17	15.68	18.40	21.34								
		C	16.00	12.80	10.67	9.14	8.00	7.11	6.40	5.82	5.33	4.92	4.57								
		Dc	1.39	2.18	3.14	4.27	5.57	7.05	8.71	10.54	12.54	14.72	17.07								
32x5 [44]	1696	U	78.75	50.40	35.00	25.71	19.69	15.56	12.60	10.41	8.75	7.46	6.43								
		Du	1.74	2.72	3.92	5.33	6.97	8.82	10.89	13.17	15.68	18.40	21.34								
		C	24.00	19.20	16.00	13.72	12.00	10.67	9.60	8.73	8.00	7.39	6.86								
		Dc	1.39	2.18	3.14	4.27	5.57	7.05	8.71	10.54	12.54	14.72	17.07								
38x3 [36]	1757	U	75.60	48.38	33.60	24.69	18.90	14.93	12.10	10.00	8.40	7.16	6.17	5.38	4.73	4.19	3.73				
		Du	1.45	2.27	3.27	4.45	5.81	7.35	9.07	10.98	13.06	15.33	17.78	20.41	23.22	26.22	29.39				
		C	23.04	18.43	15.36	13.17	11.52	10.24	9.22	8.38	7.68	7.09	6.58	6.14	5.76	5.42	5.12				
		Dc	1.16	1.81	2.61	3.56	4.64	5.88	7.26	8.78	10.45	12.26	14.22	16.33	18.58	20.97	23.51				
38x5 [52]	1945	U	113.40	72.58	50.40	37.03	28.35	22.40	18.14	15.00	12.60	10.74	9.26	8.06	7.09	6.28	5.60				
		Du	1.45	2.27	3.27	4.45	5.81	7.35	9.07	10.98	13.06	15.33	17.78	20.41	23.22	26.22	29.39				
		C	34.56	27.65	23.04	19.75	17.28	15.36	13.83	12.57	11.52	10.64	9.88	9.22	8.64	8.13	7.68				
		Dc	1.16	1.81	2.61	3.56	4.64	5.88	7.26	8.78	10.45	12.26	14.22	16.33	18.58	20.97	23.51				
44x5 [60]	2183	U	154.35	98.78	68.60	50.40	38.59	30.49	24.70	20.41	17.15	14.61	12.60	10.98	9.65	8.55	7.62				
		Du	1.24	1.94	2.80	3.81	4.98	6.30	7.78	9.41	11.20	13.14	15.24	17.49	19.91	22.47	25.19				
		C	47.05	37.64	31.36	26.88	23.52	20.91	18.82	17.11	15.68	14.48	13.44	12.55	11.76	11.07	10.45				
		Dc	1.00	1.56	2.24	3.05	3.98	5.04	6.22	7.53	8.96	10.51	12.19	14.00	15.92	17.98	20.15				
51x5 [68]	2413	U	201.60	129.02	89.60	65.83	50.40	39.82	32.26	26.66	22.40	19.09	16.46	14.34	12.60	11.16	9.96				
		Du	1.09	1.70	2.45	3.33	4.35	5.51	6.80	8.23	9.80	11.50	13.34	15.31	17.42	19.66	22.04				
		C	61.45	49.16	40.97	35.11	30.72	27.31	24.58	22.34	20.48	18.91	17.56	16.39	15.36	14.46	13.66				
		Dc	0.87	1.36	1.96	2.67	3.48	4.41	5.44	6.59	7.84	9.20	10.67	12.25	13.93	15.73	17.63				
57x5 [76]	2636	U	255.15	163.30	113.40	83.31	63.79	50.40	40.82	33.74	28.35	24.16	20.83	18.14	15.95	14.13	12.60				
		Du	0.97	1.51	2.18	2.96	3.87	4.90	6.05	7.32	8.71	10.22	11.85	13.61	15.48	17.48	19.59				
		C	77.77	62.22	51.85	44.44	38.89	34.56	31.11	28.28	25.92	23.93	22.22	20.74	19.44	18.30	17.28				
		Dc	0.77	1.21	1.74	2.37	3.10	3.92	4.84	5.85	6.97	8.18	9.48	10.89	12.39	13.98	15.68				
64x5 [84]	2853	U	315.00	201.60	140.00	102.86	78.75	62.22	50.40	41.65	35.00	29.82	25.71	22.40	19.69	17.44	15.56				
		Du	1	1.36	1.96	2.67	3.48	4.41	5.44	6.59	7.84	9.20	10.67	12.25	13.93	15.73	17.63				
		C	96.01	76.81	64.01	54.86	48.01	42.67	38.41	34.91	32.00	29.54	27.43	25.60	24.00	22.59	21.34				
		Dc	0.70	1.09	1.57	2.13	2.79	3.53	4.35	5.27	6.27	7.36	8.53	9.80	11.15	12.58	14.11				

Note: The carrying capacity of a piece of grating subjected to a concentrated load over only a portion of its width is determined by the stiffness of both the bearing bars and the cross bars, and therefore differs with the type of grating used. To determine the carrying capacity of gratings subject to such loadings, the manufacturer's engineering department should be consulted.

Conversion Factors:
For gratings with other than 30mm bearing bar spacing, or for different design stresses, proportionate conversion factors apply. Refer to the Metal Bar Grating Engineering Design Manual for the development of such factors.

Note: 6.4mm is considered the maximum deflection consistent with pedestrian comfort, but can be exceeded for other loading conditions at the discretion of the engineer.

NOTE: For serrated grating, the depth of grating required for a specified load is 6mm greater than in the table.
**Weights (mass/area) shown are approximate and vary with manufacturers. They are provided for preliminary design computations only and are not intended for any other purpose.

Loads above DO NOT include the dead load of the grating.

LOAD TABLE
ALUMINUM GRATING

LOAD TABLE FOR ALUMINUM GRATING - TYPE P-19

F=12,000psi, E=10,000,000psi

Recommended max. span (in.) for 1/4 in. deflection under uniform load of 100psf

U=uniform load, psf
D=deflection, in.
C=concentrated load at mid-span, lb per foot of grating width

Bearing Bar Size (in)
Nominal Weight (psf)**

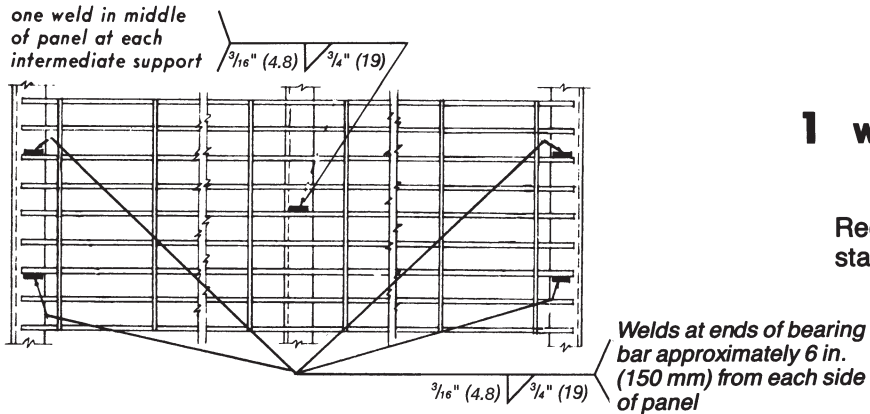
Bearing Bar Size (in)	Nominal Weight (psf)**	U	D	Span in Inches						Conversion Factors:								
				24	30	36	42	48	54	60	66	72	78	84	90	96	102	108
1x1/8 [2]	39	U	0.421	0.269	0.187	0.137	0.105	0.083										
		D	0.144	0.225	0.324	0.441	0.576	0.729										
		C	0.421	0.337	0.281	0.241	0.211	0.187										
1x3/16 or 1" I Bar [3]	44	U	0.632	0.404	0.281	0.206	0.158	0.125										
		D	0.144	0.225	0.324	0.441	0.576	0.729										
		C	0.632	0.505	0.421	0.361	0.316	0.281										
1x1/4 [4]	47	U	0.842	0.539	0.374	0.275	0.211	0.166										
		D	0.144	0.225	0.324	0.441	0.576	0.729	0.900	1.089	1.296							
		C	0.842	0.674	0.561	0.481	0.421	0.374	0.337	0.306	0.281							
1-1/4x1/8 [3]	47	U	0.658	0.421	0.292	0.215	0.164	0.130	0.105	0.087	0.073							
		D	0.115	0.180	0.259	0.353	0.461	0.583	0.720	0.871	1.037							
		C	0.658	0.526	0.439	0.376	0.329	0.292	0.263	0.239	0.219							
1-1/4x3/16 or 1-1/4" I Bar [4]	52	U	0.987	0.632	0.439	0.322	0.247	0.195	0.158	0.130	0.110	0.093	0.081					
		D	0.115	0.180	0.259	0.353	0.461	0.583	0.720	0.871	1.037	1.217	1.411					
		C	0.987	0.789	0.658	0.564	0.493	0.439	0.395	0.359	0.329	0.304	0.282					
1-1/4x1/4 [5]	55	U	1.316	0.842	0.585	0.430	0.329	0.260	0.211	0.174	0.146	0.125	0.107					
		D	0.115	0.180	0.259	0.353	0.461	0.583	0.720	0.871	1.037	1.217	1.411					
		C	1.316	1.053	0.877	0.752	0.658	0.585	0.526	0.478	0.439	0.405	0.376					
1-1/2x1/8 [3]	53	U	0.947	0.606	0.421	0.309	0.237	0.187	0.152	0.125	0.105	0.090	0.077	0.067	0.059	0.052	0.047	
		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600	0.726	0.864	1.014	1.176	1.350	1.536	1.734	1.944	
		C	0.947	0.758	0.632	0.541	0.474	0.421	0.379	0.344	0.316	0.291	0.271	0.253	0.237	0.223	0.211	
1-1/2x3/16 or 1-1/2" I Bar [4]	59	U	1.421	0.909	0.632	0.464	0.355	0.281	0.227	0.188	0.158	0.135	0.116	0.101	0.089	0.079	0.070	
		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600	0.726	0.864	1.014	1.176	1.350	1.536	1.734	1.944	
		C	1.421	1.137	0.947	0.812	0.711	0.632	0.568	0.517	0.474	0.437	0.406	0.379	0.355	0.334	0.316	
1-1/2x1/4 [5]	64	U	1.895	1.213	0.842	0.619	0.474	0.374	0.303	0.251	0.211	0.179	0.155	0.135	0.118	0.105	0.094	
		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600	0.726	0.864	1.014	1.176	1.350	1.536	1.734	1.944	
		C	1.895	1.516	1.263	1.083	0.947	0.842	0.758	0.689	0.632	0.583	0.541	0.505	0.474	0.446	0.421	
1-3/4x3/16 or 1-3/4" I Bar [5]	66	U	1.934	1.238	0.860	0.632	0.484	0.382	0.309	0.256	0.215	0.183	0.158	0.138	0.121	0.107	0.096	
		D	0.082	0.129	0.185	0.252	0.329	0.417	0.514	0.622	0.741	0.869	1.008	1.157	1.317	1.486	1.666	
		C	1.934	1.547	1.289	1.105	0.967	0.860	0.774	0.703	0.645	0.595	0.553	0.516	0.484	0.455	0.430	
1-3/4x1/4 [6]	71	U	2.579	1.651	1.146	0.842	0.645	0.509	0.413	0.341	0.287	0.244	0.211	0.183	0.161	0.143	0.127	
		D	0.082	0.129	0.185	0.252	0.329	0.417	0.514	0.622	0.741	0.869	1.008	1.157	1.317	1.486	1.666	
		C	2.579	2.063	1.719	1.474	1.289	1.146	1.032	0.938	0.860	0.794	0.737	0.688	0.645	0.607	0.573	
2x3/16 or 2" I Bar [5]	73	U	2.526	1.617	1.123	0.825	0.632	0.499	0.404	0.334	0.281	0.239	0.206	0.180	0.158	0.140	0.125	
		D	0.072	0.113	0.162	0.221	0.288	0.365	0.450	0.545	0.648	0.761	0.882	1.013	1.152	1.301	1.458	
		C	2.526	2.021	1.684	1.444	1.263	1.123	1.011	0.919	0.842	0.777	0.722	0.674	0.632	0.594	0.561	
2-1/4x3/16 or 2-1/4" I Bar [6]	80	U	3.197	2.046	1.421	1.044	0.799	0.632	0.512	0.423	0.355	0.303	0.261	0.227	0.200	0.177	0.158	
		D	0.064	0.100	0.144	0.196	0.256	0.324	0.400	0.484	0.576	0.676	0.784	0.900	1.024	1.156	1.296	
		C	3.197	2.558	2.132	1.827	1.599	1.421	1.279	1.163	1.066	0.984	0.914	0.853	0.799	0.752	0.711	
2-1/4x1/4 [8]	86	U	4.263	2.728	1.895	1.392	1.066	0.842	0.682	0.564	0.474	0.404	0.348	0.303	0.266	0.236	0.211	
		D	0.064	0.100	0.144	0.196	0.256	0.324	0.400	0.484	0.576	0.676	0.784	0.900	1.024	1.156	1.296	
		C	4.263	3.411	2.842	2.436	2.132	1.895	1.705	1.550	1.421	1.312	1.218	1.137	1.066	1.003	0.947	
2-1/2x3/16 or 2-1/2" I Bar [7]	87	U	3.947	2.526	1.754	1.289	0.987	0.780	0.632	0.522	0.439	0.374	0.322	0.281	0.247	0.219	0.195	
		D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706	0.810	0.922	1.040	1.166	
		C	3.947	3.158	2.632	2.256	1.974	1.754	1.579	1.435	1.316	1.215	1.128	1.053	0.987	0.929	0.877	
2-1/2x1/4 [9]	93	U	5.263	3.368	2.339	1.719	1.316	1.040	0.842	0.696	0.585	0.498	0.430	0.374	0.329	0.291	0.260	
		D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706	0.810	0.922	1.040	1.166	
		C	5.263	4.211	3.509	3.008	2.632	2.339	2.105	1.914	1.754	1.619	1.504	1.404	1.316	1.238	1.170	

Note: The carrying capacity of a piece of grating subjected to a concentrated load over only a portion of its width is determined by the stiffness of both the bearing bars and the cross bars, and therefore differs with the type of grating used. To determine the carrying capacity of gratings subject to such loadings, the manufacturer's engineering department should be consulted.

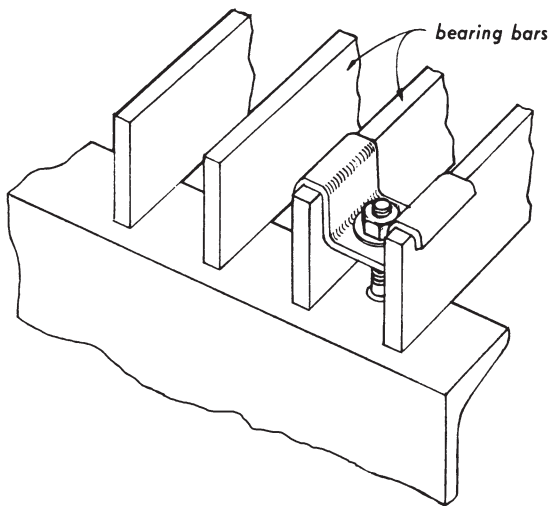
Note: 1/4" is considered the maximum deflection consistent with pedestrian comfort, but can be exceeded for other loading conditions at the discretion of the engineer.

NOTE: For serrated grating, the depth of grating required for a specified load is 1/4" greater than in the table.

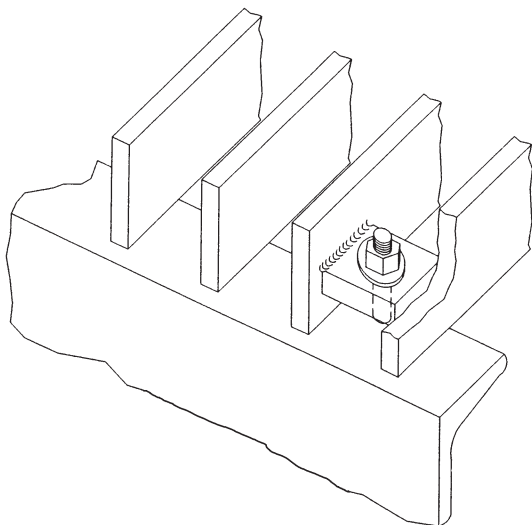
**Weights (mass/area) shown are approximate and vary with manufacturers. They are provided for preliminary design computations only and are not intended for any other purpose.

**ANCHORING
DETAILS****All gratings are to be firmly anchored to their supports by positive means.****1 WELDED ANCHORAGE**
(in field by others)

Recommended for all permanently installed gratings.

**2 SADDLE CLIPS**

Available in steel, stainless steel, and aluminum (it is sometimes necessary to cut cross bars during installation for fastener clearance).

Used for installations where grating is subject to removal. Will be in same location as welds in **1** unless otherwise specified. Fasteners are 1/4 in. (6.4 mm) diameter.**3 WELD LUGS**

shop welded to bearing bars — must be specified when ordering

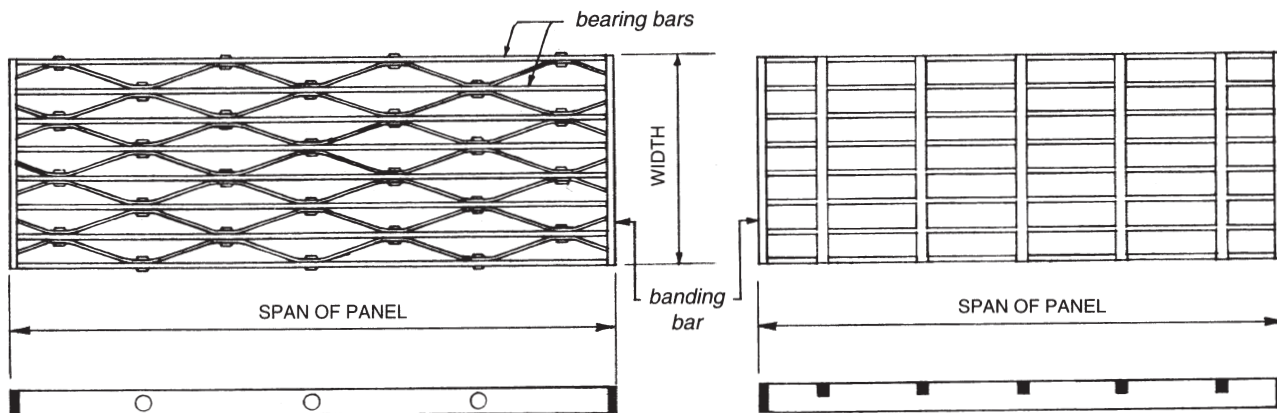
Used for installations where grating is subject to removal. Will be in same location as welds in **1** unless otherwise specified. Fasteners are 1/4 in. (6.4 mm) diameter.**4 OTHERTYPES**

Other types of anchors which have been appropriately tested and have demonstrated satisfactory performance may be used also. Included in other types are top-mounting mechanical friction anchors which can be installed without requiring access to the underside of the grating and which eliminate field welding and/or drilling. These anchors are removable and may be used where gratings are subject to frequent removal.

INSTALLATION NOTES
PANEL DIMENSIONS

GENERAL REQUIREMENTS FOR GRATING INSTALLATION

1. Unpack grating and inspect for damage.
2. Grating shall be installed with cross bars on top.
3. Preliminarily install all grating into area per layout drawing.
4. Adjust spacing between panels to allow for proper pack out and equal spacing between panels and between supports.
5. Verify that all grating is adequately supported. Notching bearing bars at supports or interrupting bearing bars with cutouts shall only occur when the system has been designed for such modification and is specified by the design engineer and indicated on the plans.
6. Securely fasten all grating as specified for project or per NAAMM recommendations.

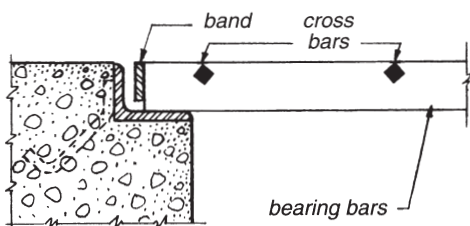


SPAN of panel is measured parallel to the bearing bars.

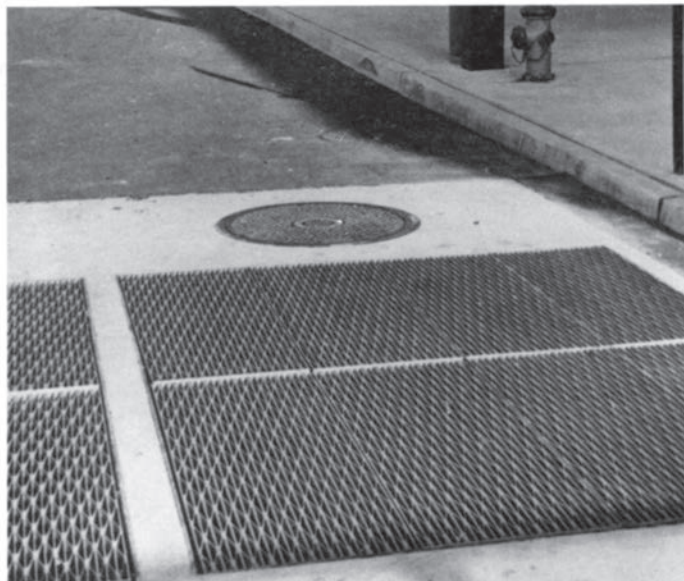
WIDTH of panel is measured perpendicular to the bearing bars, even if this dimension exceeds the panel span.

SUPPORT and BANDING of TRENCH GRATING

Each end of a metal bar grating panel installed in a trench shall be supported on an angle or other shape whose inside vertical dimension equals that of the bearing bar.

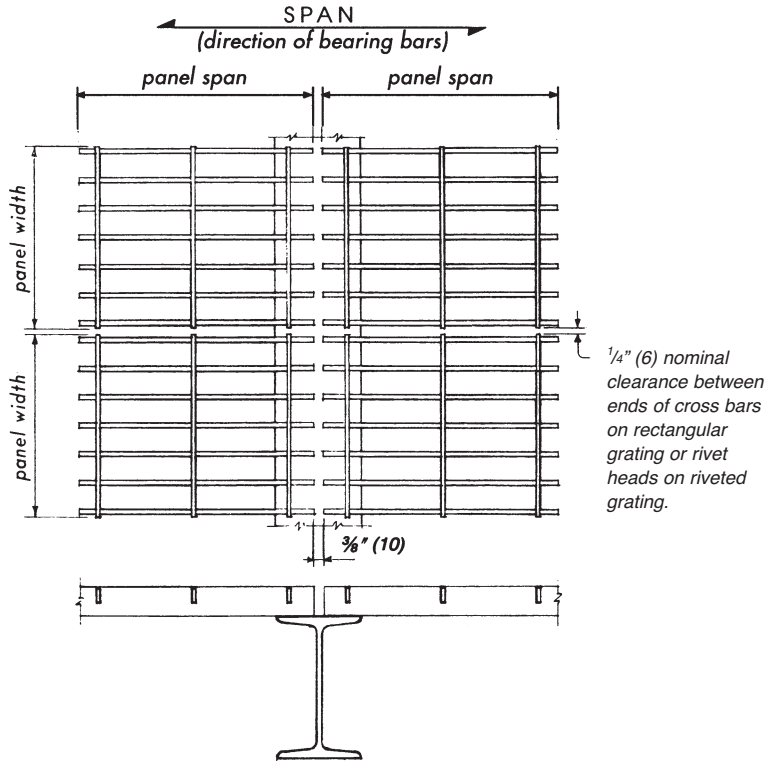


Specify banding on all gratings subject to rolling loads. Full depth band is supplied by manufacturer for all banded grating unless owner or specifier states clearly that shallow banding shall be provided.



Shallow banding bar shall be 1/4 in. (6.4 mm) to 1/2 in. (13 mm) less than depth of grating to permit drainage.

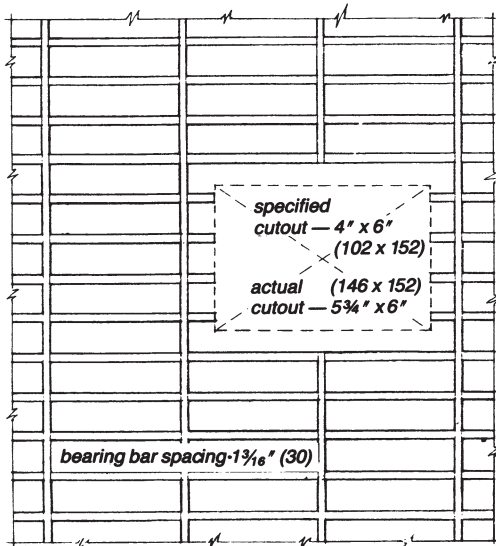
**STANDARD
INSTALLATION
CLEARANCES**



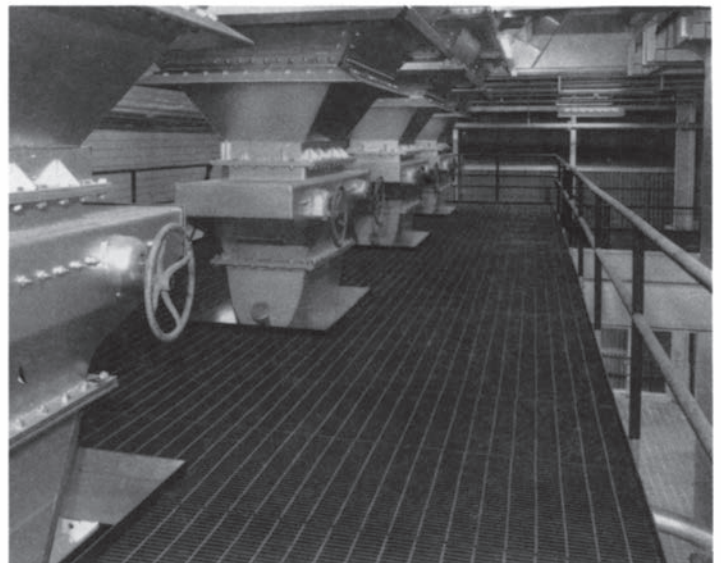
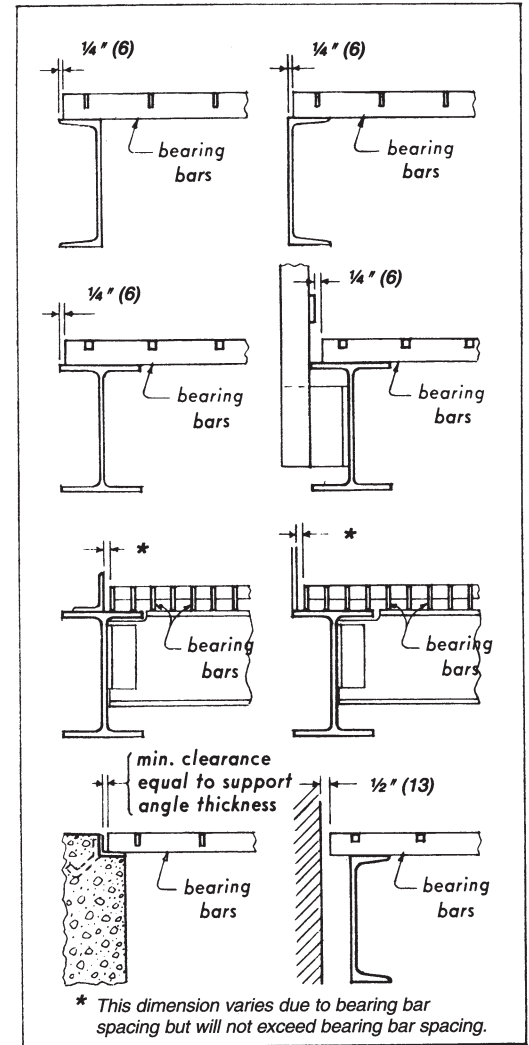
Clearances shown are recommended, but vary in accordance with dimensional tolerances shown on page 20.

Cutouts for circular obstructions are recommended to be at least 2 in. (51 mm) larger in diameter than the obstruction. It is further recommended that cutouts for all piping 4 in. (102 mm) or less in diameter be made in the field.

As shown in the drawing below, all rectangular cutouts are made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.



Metal shall be used for all grating supports and provide a 1 in. (25 mm) minimum bearing surface for depths up to 2 1/4 in. (57 mm), and 2 in. (51 mm) minimum bearing surface for depth 2 1/2 in. (64 mm) and over, at each end of span.



OPERATION AND MAINTENANCE INSTRUCTIONS

1. For pedestrian load rated grating design, grating is intended for normal walking pedestrian traffic. Precautions shall be taken to prevent wheel or other loads beyond the design load rating for the application.
2. For other uniform or concentrated load rating applications, precautions shall be taken to prevent loads beyond the design load rating for the application.
3. Periodically inspect grating for damage or excessive wear, such as corrosion, damage to the finish, deformation and excessive bearing bar lean beyond the tolerances as noted on page 20. Repair or replace any areas showing damage.
4. Periodically inspect grating to be sure that all grating is securely fastend as specified for the application or as noted on page 14, if fastening method is not specified. Replace any missing attachment hardware and tighten any loose connections.

**STANDARD
TREAD NOSINGS**

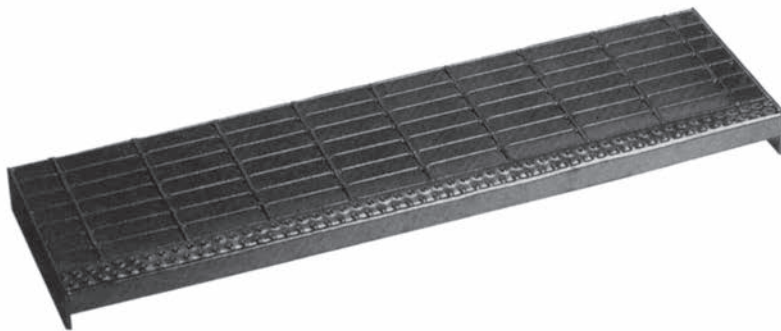
GENERAL NOTES: Nosings shall be used on treads and on grating at the head of stairs, both for visual safety and to sustain edge loads.

Nosing widths shall be between 1¼ in. (32 mm) and 1½ in. (36 mm).
(Manufacturers' standards are within these limits.)



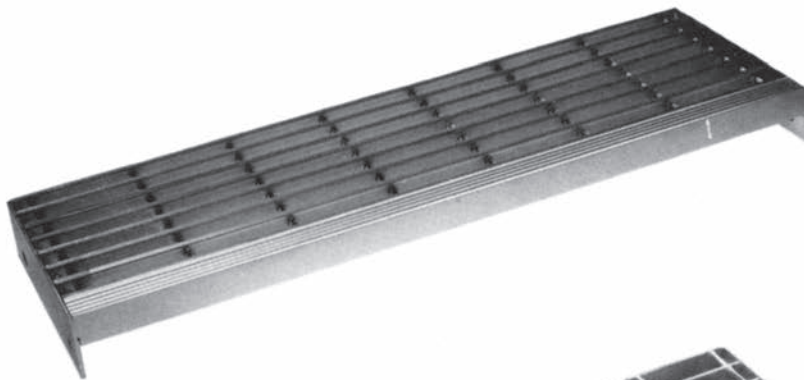
ROLLED FLOOR PLATE NOSING

available in carbon steel
and stainless steel



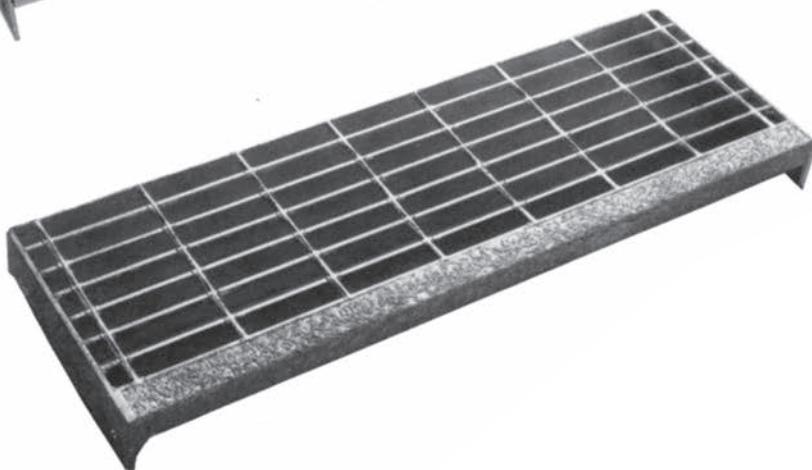
DIMPLE NOSING

available in carbon steel,
stainless steel, aluminum,
and hot-dip zinc-coated



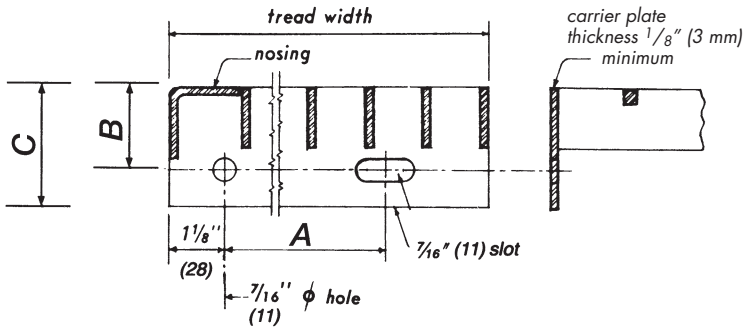
CORRUGATED NOSING

available in aluminum only



ABRASIVE NOSING

TREAD DIMENSIONS
RECOMMENDED DETAILS



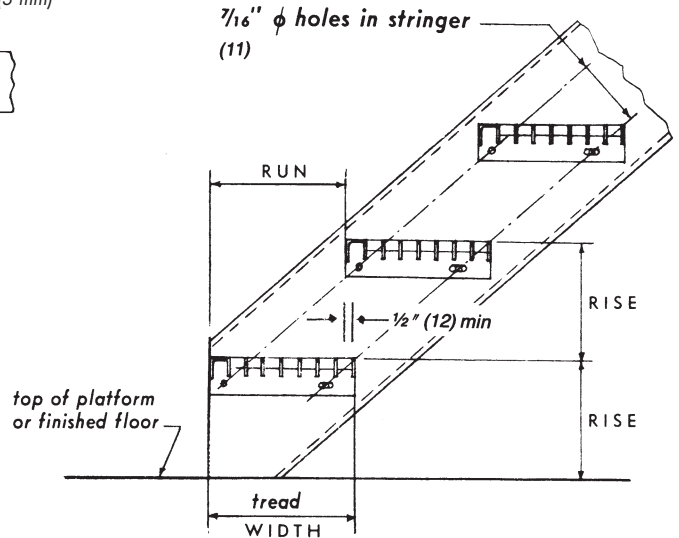
TREAD with carrier plate detail

TREAD with carrier angles available, consult grating manufacturer for details

DIMENSION A in TREAD with carrier plate detail in. (mm)

Nominal Tread Width (approximate)** Bearing Bar Centers		Dimension A
1 3/16 (30)	1 5/16 (24)	
6 1/4 (159)	6 (152)	2 1/2 (63)
7 1/4 (184)	7 (178)	4 1/2 (114)
8 1/2 (216)	9 (229)	4 1/2 (114)
9 3/4 (248)	10 (254)	7 (178)
11 (279)	10 3/4 (273)	7 (178)
12 (305)	11 3/4 (298)	7 (178)

** Consult manufacturer for exact dimension.



NOTE: Tread width should always be greater than tread run by 1/2 in. (12mm) minimum.

DIMENSION B & C in TREAD with carrier plate detail in. (mm)

Grating Depth	Dimension B	Dimension C
3/4 (19) to 1 1/4 (32)	1 3/4 (44)	2 1/2 (63)
1 1/2 (38) to 1 3/4 (44)	2 1/4 (57)	3 (76)
For aluminum and all treads over 1 3/4 (44) consult with manufacturer.		

RECOMMENDED BEARING BAR SIZES

STEEL TREADS

Bearing Bar Size in. (mm)	Maximum Tread Length*			
	@ 1 3/16 (30) o.c.		@ 1 5/16 (24) o.c.	
	Plain	Serrated	Plain	Serrated
3/4 x 3/16 (19 x 5)	2'-4" (.71m)	—	2'-8" (.81m)	—
1 x 3/16 (25 x 5)	3'-5" (1.04m)	2'-10" (.86m)	4'-0" (1.22m)	3'-4" (1.02m)
1 1/4 x 3/16 (32 x 5)	4'-8" (1.42m)	4'-2" (1.27m)	5'-1" (1.55m)	4'-6" (1.37m)
1 1/2 x 3/16 (38 x 5)	5'-6" (1.67m)	5'-3" (1.60m)	5'-6" (1.67m)	5'-6" (1.67m)

Note: When tread length exceeds 5'-6" (1.67m), design tread for 300 lb (1.33kN) concentrated loads at one-third points.

*Maximum tread length based on 300 lb (133 kN) concentrated load on front 5 in. (127 mm) of tread at center of tread length and deflection limitation of 1/240 of length. For maximum length under other loadings, consult the manufacturer.

ALUMINUM TREADS

Rectangular Bars

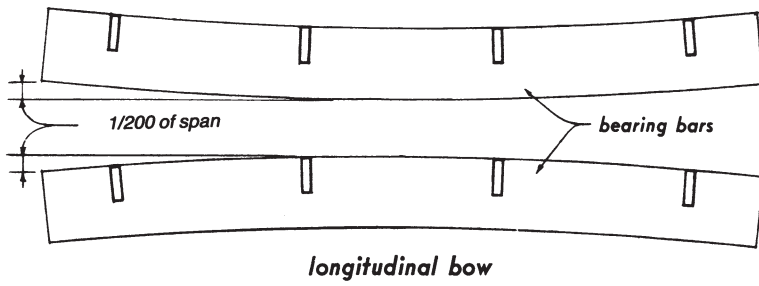
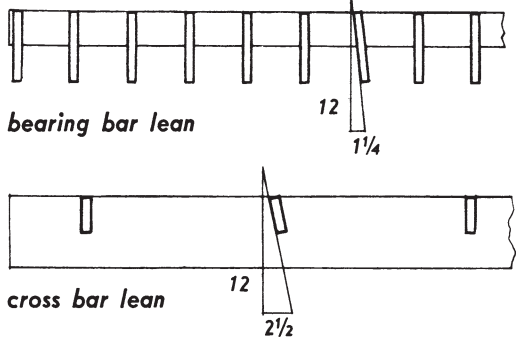
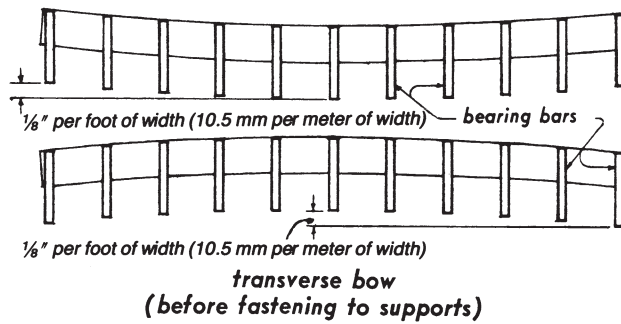
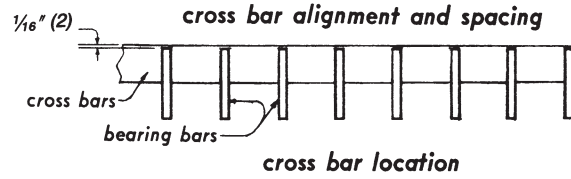
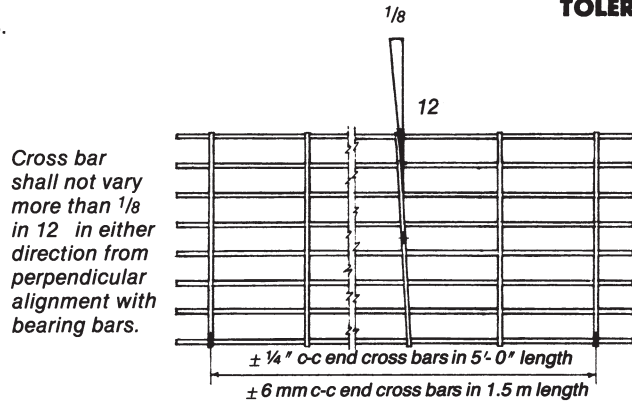
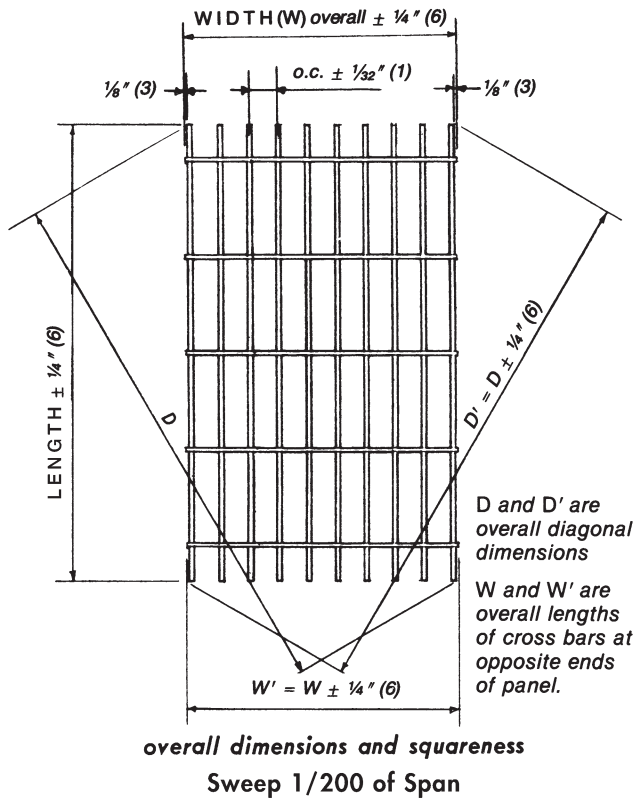
Bearing Bar Size in. (mm)	Maximum Tread Length*			
	@ 1 3/16 (30) o.c.		@ 1 5/16 (24) o.c.	
	Plain	Serrated	Plain	Serrated
1 x 3/16 (25 x 5)	2'-4" (.71m)	—	2'-6" (.76m)	—
1 1/4 x 3/16 (32 x 5)	2'-10" (.86m)	2'-7" (.79m)	3'-1" (.94m)	2'-9" (.84m)
1 1/2 x 3/16 (38 x 5)	3'-6" (1.07m)	3'-2" (.97m)	3'-10" (1.17m)	3'-6" (1.07m)
1 3/4 x 3/16 (44 x 5)	4'-3" (1.30m)	3'-10" (1.17m)	4'-8" (1.42m)	4'-3" (1.30m)

I Bars

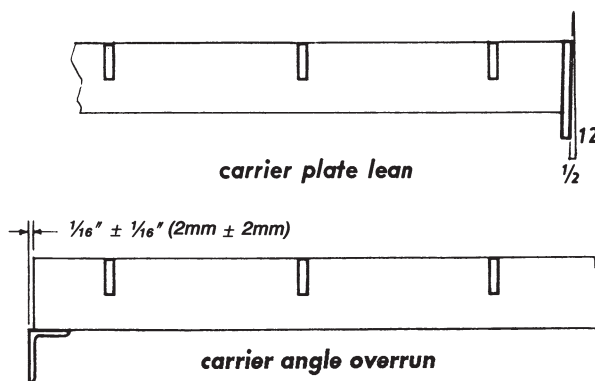
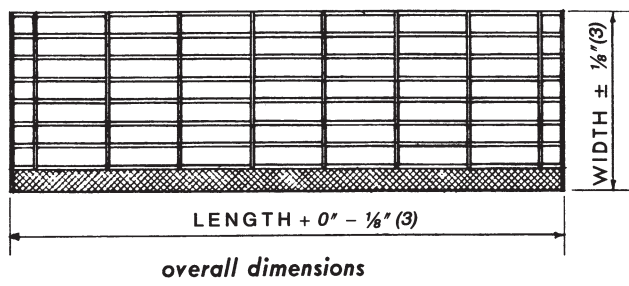
Bearing Bar Size in. (mm)	Maximum Tread Length*	
	@ 1 3/16 (30) o.c.	@ 1 5/16 (24) o.c.
1 (25) I	2'-4" (.71m)	2'-6" (.76m)
1 1/4 (32) I	2'-10" (.86m)	3'-1" (.94m)
1 1/2 (38) I	3'-6" (1.07m)	3'-10" (1.17m)
1 3/4 (44) I	4'-3" (1.30m)	4'-8" (1.42m)

MANUFACTURING TOLERANCES

All dimensions given are maximum permissible tolerances.



STAIR TREAD TOLERANCES

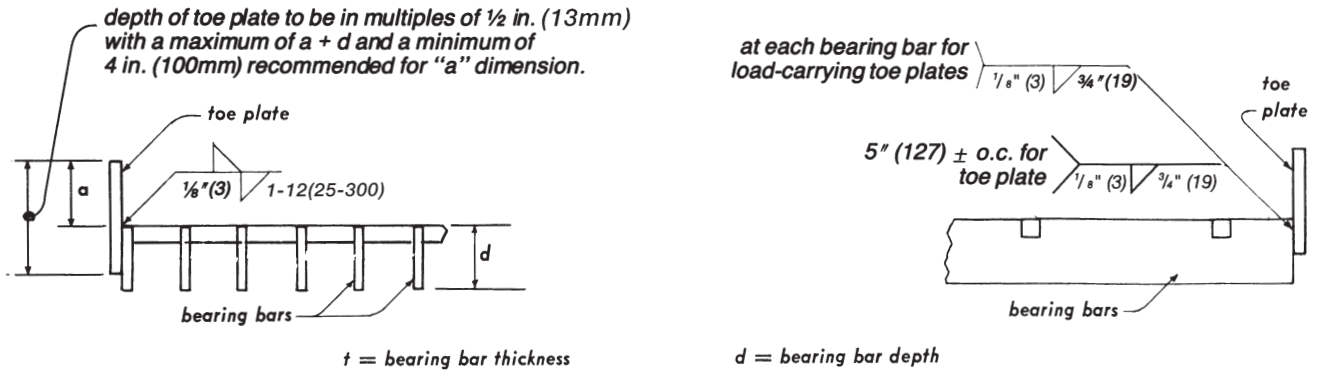


NOTE: Length of tread is distance between outer faces of carrier plates or back to back of carrier angles.

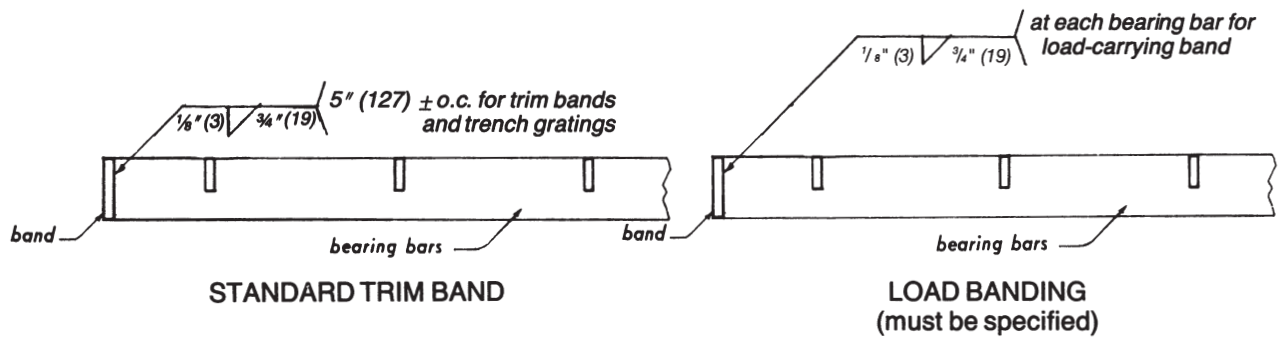
WELDING STANDARDS

The welding standards shown here apply to those gratings and treads having a clear opening of not less than 5/8 in. (16 mm) between bearing bars and those galvanized as per Specifications, page 24. See NAAMM STANDARD MBG 533 "Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating" for welding specifications and certification of welders.

TOE PLATES

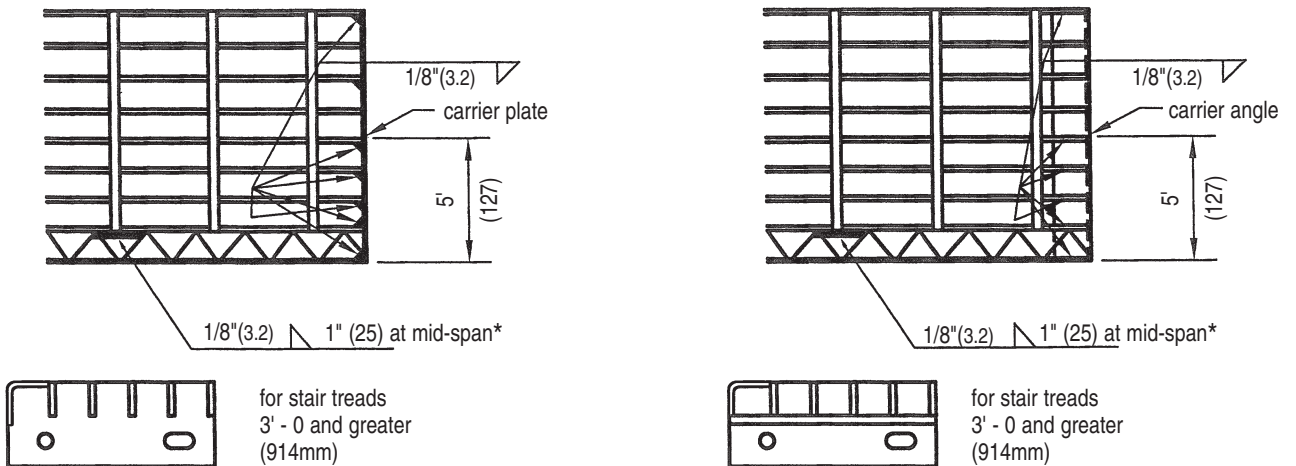


BANDING



STANDARD STAIR TREADS

(bearing bar thickness less than 1/4"(6.4mm) and bearing bar clear opening greater than or equal to 5/8" (16mm))

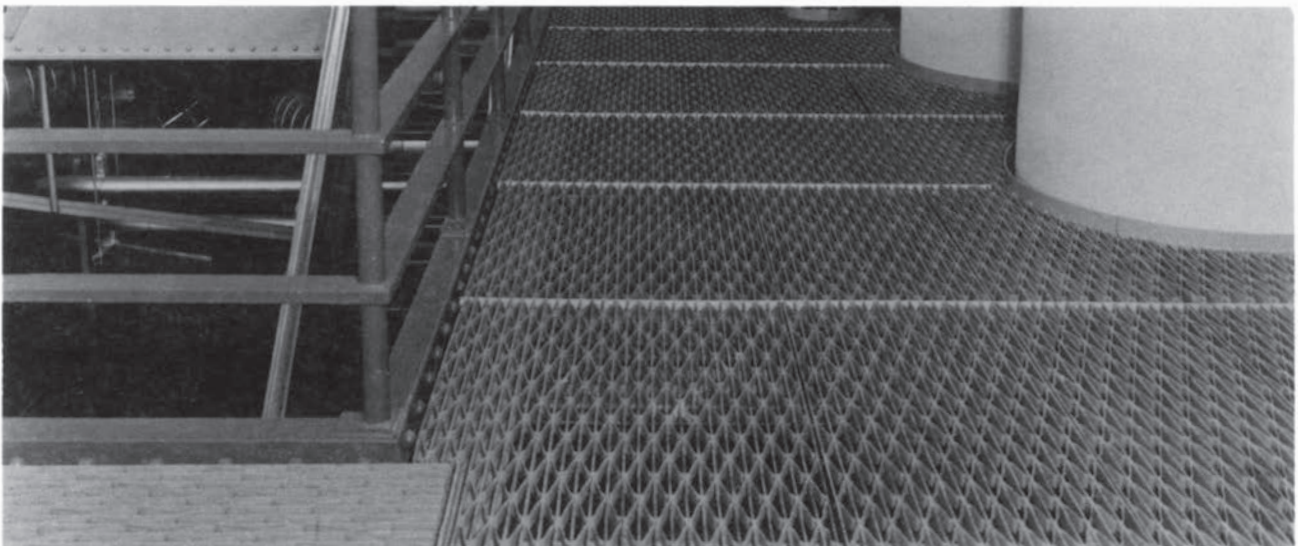


when carrier plates and carrier angles are used, the bearing bars in the front five inches, the back bearing bar, and the nosing shall be welded to the carrier plate or carrier angle as shown.

On treads over 9-3/4 in. (248) wide weld end of center bar also.
* Treads spanning 4 ft. (1.2m) or more shall have welds located at the third points.

USES FOR GRATINGS

Airplane Landing Mats	Foot Scrapers	Security Screens
Airplane Unloading Ramps	Freight Car Flooring	Snow Fences
Airport Light Guards	Freight Car Top Walkways	Solar Screens
Areaways	Ladder Treads	Stage Flooring
Boat Landing Ramps	Machine and Motor Bases	Stairs
Bridge Centerline Markers	Machinery Safety Guards	Stiles
Bridge Flooring	Material Screens	Strainers
Bridge Sidewalks	Mezzanine Floors	Temporary Wing Walls
Catwalks	Mooring Docks	Tote Trays and Boxes
Concrete Armoring	Ornamental Grills	Trap Doors
Concrete Reinforcement	Overhead Sign Platforms	Tree and Pole Guards
Cracking Plant Trays	Paint Booths	Trench Covers
Crating	Parapet Screens	Truck Beds
Crow's Nests	Partitions	Truck Radiator Grills
Deflecting Fenders	Platforms	Vault Covers
Dipping Trays	Racks and Shelving	Ventilated Bin Floors
Drainage Pit Covers	Railway Crossings	Ventilating Screens
Fencing	Ramps	Vestibule Grates
Fire Escapes	Refrigerator Car Trays	Walkways
Floor Boards	Running Boards	Wash Racks
Flooring	Scaffolding	Window Guards



**ORDERING
INFORMATION**

INFORMATION TO BE PROVIDED

when specifying or purchasing **METAL BAR GRATING:**

Description of grating (see standard marking system, page 4 of this Manual)

A drawing, showing: area to be covered (including all cutouts)
span (direction of bearing bars)
method of support
all critical dimensions
(indicate whether clearances are
taken into account)

Type of anchorage: (see page 14 of this Manual)

Finish: Steel gratings — mill finish, manufacturer's standard paint,
or galvanized as specified

Aluminum gratings — mill as fabricated

Stainless steel gratings — mill as fabricated

Shipping instructions

INFORMATION TO BE PROVIDED

when specifying or purchasing **METAL BAR GRATING TREADS:**

Description of grating (see standard marking system, page 4 of this Manual)

Type of nosing: (see page 17 of this Manual)

Dimensions: width and length of tread

Number of treads

Finish: Steel treads — mill finish, manufacturer's standard paint,
or galvanized as specified

Aluminum treads — mill as fabricated

Stainless steel treads — mill as fabricated

Shipping instructions

STANDARD SPECIFICATIONS

for Metal Bar Gratings and Treads

A Mediumscope Section under Division 5, Uniform System

I. SCOPE

These specifications apply to metal bar grating and/or metal bar grating treads as hereinafter defined and described.

II. DEFINITIONS

a) Metal bar grating is an open grid of metal bars. The bearing bars, which have a cross-sectional depth much greater than width, are held at regular spacing, usually parallel, either by:

1. Straight, sinuous or corrugated cross bars having their longitudinal axis perpendicular to the bearing bars and being connected to them by welding, forging or mechanical locking, or by
2. Bent connecting bars alternately contacting adjacent bearing bars and riveted to them at regular intervals.

b) A metal bar grating tread is a stair tread consisting of a panel of metal bar grating having a metal nosing section extending along one of its long edges and a carrier angle or plate at each end for connection to a stringer.

c) Definitions of other terms shall conform to those given in the Glossary of Terms in the Metal Bar Grating Manual.

III. MATERIALS**a) Steel gratings:**

Steel used in bearing bars, cross bars and connecting bars of rectangular section shall have mechanical properties equal to, or greater than the performance of ASTM A 1011/A 1011M Commercial Steel (Type B) for hot rolled carbon steel sheet and strip. Cross bars made of wire rod shall conform to ASTM A 510 (A 510M) for carbon steel wire rods and coarse round wire, except that permissible tolerance on diameter of coarse round wire shall be ± 0.005 in. (± 0.13 mm). Combinations of these steels are permitted to be welded together.

Rivets shall be of steel prescribed in ASTM A 575, 1/4 in. (6.4 mm) minimum diameter, flat head type.

b) Aluminum gratings:

Bearing bars shall be either alloy 6061-T6, 6105-T5, or alloy 6063-T6, conforming to ASTM B 221 (B 221M). Cross bars and bent connecting bars shall be of alloy 6061 or 6063 conforming to ASTM B 221 (B 221M), or alloy 3003 conforming to ASTM B 210 (B 210M).

Rivets shall be made of aluminum wire of alloy 6053-T61 conforming to ASTM B 316/B 316M.

c) Stainless steel gratings:

Bearing bars, cross bars, and connecting bars shall be Type 304, 304L, 316, or 316L alloy conforming to ASTM A 666.

Rivets shall be of a Type 300 series alloy as prescribed in ASTM A 493.

IV. MINIMUM SIZE OF MEMBERS

a) Size of bearing bars shall conform to the tolerances shown in the Minimum Standard Section, page 7, of the Metal Bar Grating Manual.

b) Minimum dimensions of cross bars shall be as shown on page 7 of the Metal Bar Grating Manual.

c) Banding bars shall have the following minimum thicknesses:

with rectangular bearing bars, the thickness of the bearing bars to which they are attached:

with I-bar section bearing bars, 1/8 in. (3mm).

V. FABRICATION

Basic fabrication of welded, riveted and pressure-locked grating shall be as defined in the Glossary of Terms.

a) All tolerances shall be within the limits shown on page 19 of the Metal Bar Grating Manual.

b) Bandings, nosings, carriers and toe plates, when specified, shall be attached by welding as shown on page 20 of the Metal Bar Grating Manual.

c) All cutouts where more than one bearing bar is cut and bearing bars are not supported shall be load banded.

d) Unless specifically ordered otherwise, no welds anywhere on the grating will be ground.

e) Finishes: Carbon steel gratings shall be specified unfinished, galvanized, or painted one coat of manufacturer's standard paint applied in accordance with the manufacturer's standard practice. One coat of manufacturer's standard paint is designed as an economical solution for many applications. Gratings specified to be galvanized shall have their exposed surfaces zinc-coated by the hot dip process per ASTM 123 after fabrication. Gratings and/or treads stored at the jobsite shall be covered or under roof. Required covering is not the responsibility of the grating and/or tread supplier.

Unless otherwise specified, abrasive nosings will have the manufacturer's standard finish.

Aluminum and stainless steel gratings shall have a mill (as fabricated) finish, unless otherwise specified.

VI. ANCHORS

Grating anchors shall be supplied by the manufacturer only when specified.

CODE OF STANDARD PRACTICE

CODE OF STANDARD PRACTICE

The following Code represents generally accepted standard practice in the metal bar grating industry. In order to avoid misunderstanding, these practices will apply only to manufacturers individually adopting them, and then, only to the extent each manufacturer has not made unilateral modifications. Each manufacturer is free to modify the Code generally or as it specifically agrees with any Buyer.

1. GENERAL

1.1 Scope and Application

The rules and practices contained in this Code were developed by the NAAMM Metal Bar Grating Division as standard for the industry. Unless specifically stated otherwise, they shall be considered applicable to, and a part of, all contracts relating to the purchase and supply of metal bar gratings and/or treads.

No provisions herein contained, however, shall be construed as denying the right of any company to set its own prices and terms of sale, or restricting any Buyer or Seller from voiding, by mutual agreement, any part of this Code.

1.2 Definitions

As used in this Code, the term “product” or “products” refers to metal bar gratings or metal bar grating treads, and their accessories; the term “Buyer” to the party, or authorized representative of the party, who contracts to purchase such products, and the term “Seller” to the manufacturer who contracts to supply them.

1.3 Designs and Materials

Unless otherwise specified, all designs and materials shall be in accord with the Standard Specifications for Metal Bar Gratings and Treads as published in the NAAMM Metal Bar Grating Manual, latest edition, and the NAAMM Metal Bar Grating Engineering Design Manual, latest edition.

2. QUOTATIONS

2.1 Bidding Plans

Plans intended to serve as the basis for bidding shall provide complete information as to the description of the product, the limits of areas to be covered, the direction of span of grating panels, all supporting members, all cutouts to be provided in the grating area, anchors if required, and finishes desired.

2.2 Basis of Unit Price Quotations

Quotations shall preferably be on the basis of unit price per square foot (square meter) of grating and per tread. The quoted grating price shall be for grating furnished in rectangular sections.

CODE OF STANDARD PRACTICE**2.3 Extras:**

The following are examples of items not included in unit price quotations, and shall be considered as extras in quotations:

Cutting	Degreasing or sandblasting
Banding	Special bundling or strapping other than steel strapping
Toe plates	Field measurements
Support plates or angles	Installation
Hinges	Any materials, practices or finishes not called for in the Standard Specifications for Metal Bar Gratings and Treads, in- cluding special welding if galvanized in accord with ASTM A 385.
Locking devices	
Forming, undercutting or notching	
Special drilling, punching or tapping	
Anchors	
Bolts for stair treads	

Research of structural steel detail drawings to determine the cutout dimensions for vertical bracing and moment connections when such details are not furnished prior to start of preparation of grating drawings.

3. DRAWINGS AND SPECIFICATIONS**3.1 Construction Drawings and Specifications**

The Buyer shall be expected to furnish to the Seller an electronic file of construction drawings and specifications of current issue showing the layout of supports and floor openings correctly dimensioned, together with the sizes and types of grating and treads desired. Should cutouts for vertical bracing or moment connections be required for shop fabrication, the structural steel detail drawings shall be furnished prior to the preparation of the grating drawings.

If construction drawings and specifications are not available, the Buyer shall provide complete information regarding all items listed in "Information to be Provided" as shown on page 23 of the NAAMM Metal Bar Grating Manual.

3.2 Limit of Seller's Responsibility

In the absence of written notice to the contrary, the Buyer's construction plans and specifications will be assumed by the Seller to be correct in all details, and the Seller's responsibility shall be limited to furnishing the products in accord with these documents.

3.3 Approval Drawings

If required by the Buyer, the Seller shall submit to the Buyer one electronic copy of detailed drawings in outline form for the latter's review. The Buyer shall return one copy marked with his approval or desired changes. Should changes be required which involve work not called for in the original construction plans and specifications, the Seller shall have the right to charge extra for the engineering work required to make such changes. After all necessary corrections and/or changes are made, the drawings shall be re-submitted to the Buyer for his final review. The Seller shall not proceed with any shop work until drawings are approved for fabrication.

3.4 Installation Drawings

If requested, the Seller shall furnish to the Buyer an electronic copy of all installation drawings.

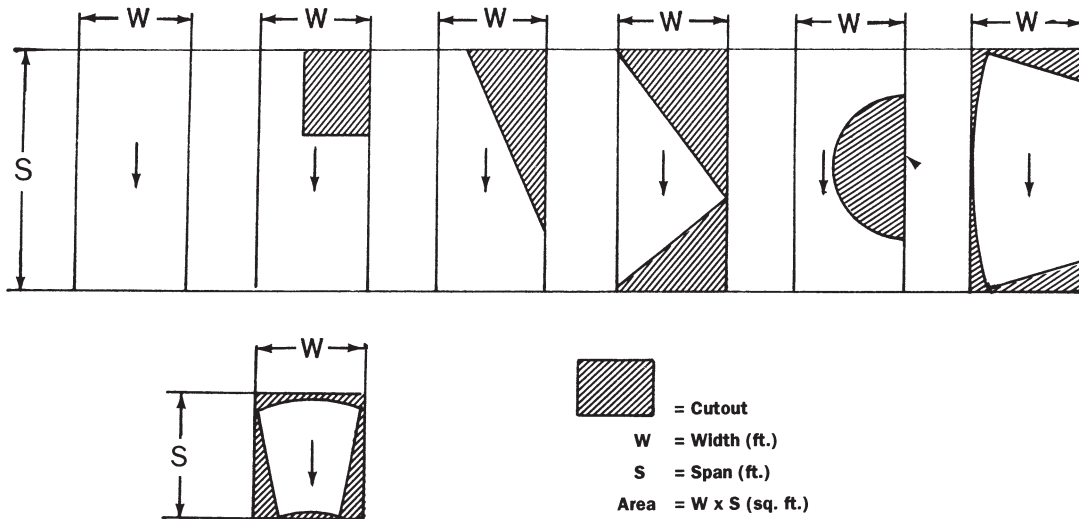
CODE OF STANDARD PRACTICE

4. GRATING MISCELLANEOUS SUPPORTS

- 4.1 When construction drawings are furnished to the Seller as per item 3.1, drawings shall show and locate all main and miscellaneous structural members intended to support the grating.
- 4.2 To facilitate installation, it may be required to cut the grating panels around penetrations, equipment supports, or other obstructions common to the grating supports. Buyer shall properly review and correct any support deficiencies when such conditions occur.
- 4.3 Seller will not accept any type of backcharges for support deficiencies as insufficient support is considered an omission at time of design.

5. QUANTITY MEASUREMENTS

- 5.1 Quantity measurements for gratings ordered to specific dimensions without drawings, shall be based on span times width of each panel, with no deduction made for cutouts.
- 5.2 Final calculated grating quantities supplied from drawings shall be on the basis of gross area measured center-to-center of supports, or back to back of supporting angles or channels, or overall dimensions of grating, whichever is larger, with no deduction for clearances. Allowances for cutouts shall be determined as follows:
- Deductions in area for circular cutouts will be allowed only when the diameter of the cutout exceeds 3' 6" (1.07m). The deduction allowance will be equal to one-half the square of the diameter of the cutout.
 - Deductions in area for cutouts other than circular will be allowed only when the cutout area exceeds nine (9) square feet (0.84 square meter).
 - No deductions will be allowed for any triangular segment or corners of gratings wasted in skew cuts.
 - For special applications, such as (but not limited to) containment areas in nuclear power plants, the final grating quantities shall be the total gross area of all the pieces furnished with no allowance for cutouts. See the following sketches.



CODE OF STANDARD PRACTICE

5.3 Measurement of cuts shall be on the basis of a minimum of one (1) lineal foot (0.30 m) per panel. Any cut in excess of one (1) lineal foot (0.3 m) shall be measured to the next higher lineal foot (0.3 m). (See diagram at the right.)

5.4 Measurement of bandings, toe plates and nosings shall be on the same basis as that of cuts, as defined in 5.3.

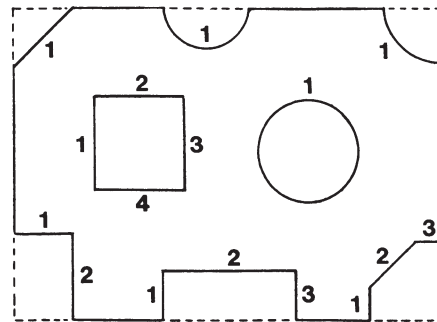


Diagram showing number of cuts required

6. CHANGES IN SCOPE OF CONTRACT

6.1 If at any time during the course of the work, the Buyer orders changes made which require materials and/or labor not called for in the original bidding plans, the cost of making such changes shall be paid by the Buyer at a price to be agreed upon.

7. FIELD WORK

7.1 The Seller shall not be responsible for taking actual measurements of construction work in the field.

7.2 Backcharges for field work of any kind are not acceptable without prior written authorization by the grating supplier.

8. BACKCHARGES

8.1 Upon discovery of unsatisfactory material, the Buyer shall immediately notify the Seller.

8.2 The Seller shall acknowledge receipt of the Buyer's complaint and initiate an investigation.

8.3 The Seller shall be given the opportunity to inspect the material PRIOR TO ANY CORRECTIVE WORK BEING DONE.

8.4 Seller is responsible for providing grating in accordance with approved drawings and specifications. Seller is not responsible for field changes, drawing changes not received and approved by Seller prior to grating fabrication, improper fabrication and/or erection of supporting members.

8.5 If the investigation and inspection confirm errors in Seller fabrication, the Seller agrees to repair and/or replace defective material at no charge to the Buyer.

**GLOSSARY
OF TERMS**

GLOSSARY OF TERMS

Commonly used in the Industry

ANCHOR — A device by which grating is attached to its supports.

BAND — A flat welded to a side or end of a grating panel, or along the line of a cutout, and extending neither above nor below the bearing bars.

Load-carrying Band: A band used to transfer the load between bearing bars.

Trim Band: A band which carries no load, but is used chiefly to improve appearance.

BEARING BARS — Load-carrying bars made from steel strip or slit sheet or from rolled or extruded aluminum and extending in the direction of the grating span.

BEARING BAR CENTERS — The distance center-to-center of the bearing bars.

CARRIERS — Flats or angles which are welded to the grating panel and nosing of a stair tread and are bolted to a stair stringer to support the tread.

CLEAR OPENING — The distance between faces of bearing bars in a rectangular grating, or between a bent connecting bar and a bearing bar in a riveted grating.

CROSS BARS — The connecting bars, made from steel strip, slit sheet, or rolled bars, or from rolled or extruded aluminum, which extend across the bearing bars, usually perpendicular to them. They may be bent into a corrugated or sinuous pattern and, where they intersect the bearing bars, are welded, forged or mechanically locked to them.

CROSS BAR CENTERS — The distance center-to-center of the cross bars.

CURVED CUT — A cutout following a curved pattern.

CUTOUT — An area of grating removed to clear an

obstruction or to permit pipes, ducts, columns, etc. to pass through the grating.

FINISH — The coating, usually paint or galvanizing, which is applied to the grating.

GRATING — An open grid assembly of metal bars, in which the bearing bars, running in one direction, are spaced by rigid attachment to cross bars running perpendicular to them or by bent connecting bars extending between them.

HINGED PANELS — Grating panels which are hinged to their supports or to other grating parts.

I-BAR — An extruded aluminum bearing bar having a cross sectional shape resembling the letter "I".

LENGTH — Refer to *Span of Grating*.

LOAD-CARRYING BAND — see Band

METRIC — The system of metric measurement used is from IEEE/ASTM SI 10-2010, "Standard for Use of the International System of Units (SI): The Modern Metric System".

NOSING — A special L-section member serving as the front or leading edge of a stair tread, or of grating at the head of a stair.

PRESSURE-LOCKED GRATING — Pressure-locked means bearing bars are locked in position by cross bar deformation instead of riveting or welding.

Several proven methods are:

- Expansion of an extruded or drawn tubular cross bar;
- Extruded cross bar deformed or swaged between bearing bars;
- Press assembly of rectangular cross bars into slotted bearing bars.

RADIALLY CUT GRATING — Rectangular grating which is cut into panels shaped as angular segments, for use in circular or angular areas.

**GLOSSARY
OF TERMS**

RETICULINE BAR — A sinuously bent connecting bar extending between two adjacent bearing bars, alternately contacting and being riveted to each.

REVERSIBLE GRATING — Grating so constructed that it may be installed either side up, with no difference in appearance or carrying capacity.

RIVET CENTERS — The distance center to center of rivets along one bearing bar.

RIVETED GRATING — Grating composed of straight bearing bars and bent connecting bars, which are joined, at their contact points, by riveting.

SERRATED GRATING — Grating which has the top surfaces of the bearing bars or cross bars, or both, notched.

SPAN OF GRATING — The distance between points of grating support, or the dimension of the bearing bars in this direction.

STRAIGHT CUT — That portion of the cut edge or cutout of a grating which follows a straight line.

SWAGING — A method of altering the cross-sectional shape of a metal bar by pressure applied through dies.

TOEPLATE — A flat bar attached flat against the outer edge of a grating or rear edge of a tread, and projecting above the top surface of grating or tread to form a lip or curb.

TREAD — A panel of grating having carriers and nosing attached by welding, and designed specifically to serve as a stair tread.

TRIM BAND — see Band

WELDED GRATING — Grating in which the bearing bars and the cross bars are joined at all of their intersections by either a resistance weld or conventional hand welding.

A resistance weld is obtained by the heat produced by the resistance of the material to the flow of electric current causing the material to become plastic. At this point, the pressure on the cross bar is rapidly increased causing the cross bar to penetrate the bearing bar so that they are fused together.

WIDTH — The overall dimension of a grating panel, measured normal to the bearing bars.

