Grating Design Guide
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

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PRINTING HISTORY
October 2007 Issued

Not printed with State funds
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1. Introduction

1.1 Purpose
This Practice provides guidance for the design of rectangular type welded steel grating for fabrication in accordance with *PIP STF05530*, Grating Fabrication Details.

1.2 Scope
This Practice describes the design of rectangular type welded grating and identifies information required for grating shown on design drawings. This Practice provides guidance for design of grating openings to accommodate penetrations for piping, electrical, equipment, etc. A table showing safe loads and deflections for welded steel grating is provided.

2. References
Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles will be used herein where appropriate.

2.1 Process Industry Practices (PIP)
- PIP STC01015 - *Structural Design Criteria*
- PIP STF05530 - *Grating Fabrication Details*
- PIP STS05130 - *Erection of Structural and Miscellaneous Steel Specification*

2.2 Industry Codes and Standards
- American National Standards Institute (ANSI) / National Association of Architectural Metal Manufacturers (NAAMM)
  - ANSI/NAAM MBG 531 - *Metal Bar Grating Manual*

2.3 Government Regulations
The following government document has been used as a reference in the development of this Practice.
- U.S. Occupational Safety and Health Administration (OSHA)
  - Regulations 29 CFR 1910 Subpart D (Walking-Working Surfaces)

3. Definitions

*fabricator*: The party responsible for providing fabricated structural and miscellaneous steel

*design drawings*: Drawings produced by an engineer that show the work that is to be performed. See Section 4.2 for information that should be included for the grating on the design drawings.
shop drawings: Drawings produced by a fabricator that transfer the information from the design drawings and other contract documents into accurate, detailed dimensional information to be used for the fabrication of the grating and structural steel.

4. General Design

4.1 Grating should be designed in accordance with PIP STC01015 and this Practice.

4.2 Design Loads

4.2.1 Design loads should be determined from the intended function of each platform, walkway, etc.

4.2.2 Loads from maintenance, storage, turnaround, exit requirements, vehicular loads, and owner requirements should be considered.

4.2.3 As a minimum, loads should be in accordance with PIP STC01015.

4.3 Grating Thickness and Span

4.3.1 After the design load is determined, Table 1 should be used to determine grating thickness and support beam spacing.

4.3.2 Table 1 is for plain (non-serrated) grating.

4.3.3 If serrated grating is to be specified, the required depth of serrated grating should be 6 mm (¼ inch) greater than the grating thickness shown in Table 1.

4.3.4 The loads shown in Table 1 are allowable stress (unfactored) loads.

4.4 Bearing on Supporting Steel

4.4.1 Grating should have a 25-mm (1-inch) minimum bearing on supporting steel.

4.4.2 Special consideration should be given to the width of the intermediate supports where the possibility exists for a break (joint) in the grating panel. Typically, a channel is not sufficient for these cases.
Table 1 – SAFE LOADS AND DEFLECTIONS – WELDED STEEL GRATING (TYPE W-19)

(This table has been adapted from “Load Table for Steel Grating – Type W-19 in ANSI/NAAM MBG 531”)

U = Uniform load, psf
Du = Deflection due to uniform load, inches
C = Concentrated load at mid-span
Dc = Deflection due to the concentrated load, inches

### Notes:
1. Maximum spans indicated in the table are based on 1/4” deflection under uniform load of 100 psf. Based on experience, this is the maximum deflection to afford pedestrian comfort and can be exceeded for other types of loads at the discretion of the engineer.
2. Uniform loads (U) and concentrated loads (C) with corresponding deflections (Du and Dc) shown in this table are based on a maximum bending stress of 18,000 psi for simply supported spans computed using gross sections and nominal sizes of bearing bars with bearing bars spaced at 1-3/16” OC and grating cross bars spaced at 4” OC. Uniform loads are in units of psf. Concentrated loads are at mid-span in units of pounds per foot of grating width. Deflections are in units of inches.
3. When serrated grating is specified, the depth of grating required for a specified load and deflection will be 1/4” greater than that shown in the table.

<table>
<thead>
<tr>
<th>SIZE/WEIGHT</th>
<th>MAX SPAN</th>
<th>SPAN 2'-'0&quot; 2'-'6&quot; 3'-'0&quot; 3'-'6&quot; 4'-'0&quot; 4'-'6&quot; 5'-'0&quot; 5'-'6&quot; 6'-'0&quot; 6'-'6&quot; 7'-'0&quot; 7'-'6&quot; 8'-'0&quot; 8'-'6&quot; 9'-'0&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot; x 1/8&quot;</td>
<td>3'-6&quot;</td>
<td>U 355 0.099 227 158 116 89 70 0.503 0.402</td>
</tr>
<tr>
<td>4 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot; x 3/16&quot;</td>
<td>3'-10&quot;</td>
<td>U 533 0.099 341 237 174 133 105 0.503 0.402</td>
</tr>
<tr>
<td>6 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot; x 1/8&quot;</td>
<td>4'-3&quot;</td>
<td>U 632 0.074 404 281 206 158 125 0.377 0.466 0.563 0.670</td>
</tr>
<tr>
<td>6 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot; x 3/16&quot;</td>
<td>4'-9&quot;</td>
<td>U 947 0.074 606 421 309 230 187 0.377 0.466 0.563 0.670</td>
</tr>
<tr>
<td>8 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1/4&quot; x 1/8&quot;</td>
<td>5'-1&quot;</td>
<td>U 867 0.048 789 658 564 403 243 0.298 0.360 0.429 0.504 0.584</td>
</tr>
<tr>
<td>7 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1/4&quot; x 3/16&quot;</td>
<td>5'-7&quot;</td>
<td>U 1480 0.060 947 868 743 592 368 493 0.455 0.543 0.629 0.730</td>
</tr>
<tr>
<td>9 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1/2&quot; x 1/8&quot;</td>
<td>5'-10&quot;</td>
<td>U 1421 0.050 909 832 711 568 388 240 0.376 0.447 0.524 0.608 0.689</td>
</tr>
<tr>
<td>8 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1/2&quot; x 3/16&quot;</td>
<td>6'-6&quot;</td>
<td>U 2132 0.040 1705 1421 1218 1066 853 474 0.420 0.536 0.650 0.794 0.927</td>
</tr>
<tr>
<td>11 psf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3/4&quot; x 3/16&quot;</td>
<td>7'-3&quot;</td>
<td>U 2901 0.043 2321 1934 1658 1451 1289 1161 0.306 0.360 0.417 0.479 0.545 0.615 0.688</td>
</tr>
</tbody>
</table>
5. Openings in Panels

5.1 Banding

5.1.1 Openings in grating panels for penetrating items (e.g., piping, conduit, structural members, and equipment) should be banded if greater than three bearing bars are cut.

5.1.2 Except as specified in Section 5.1.3, banding should be 6 mm (¼ inch) thick and the same height as the bearing bars.

5.1.3 If more than 25 mm (1 inch) of clear space exists between a grating opening and the penetrating item, the banding should be 6 mm x 125 mm (¼ inch x 5 inches) toe plate as shown in PIP STF05530, Figure 1 (Section A-A and B-B).

5.2 Dimensions

5.2.1 Dimensions for openings shown in PIP STF05530, Details 4, 5, and 6 should be determined during detailed design and shown on the design drawings to permit shop fabrication of the openings.

5.2.2 The dimensions for the openings shown in PIP STF05530, Details 4, 5, and 6 should be determined in accordance with the following guidelines:

a. For Detail 4, dimension “D” of each circular opening should be 100 mm (4 inches) minimum greater than the outside diameter of the pipe or other penetrating item, or if insulated, 100 mm (4 inches) minimum greater than the outside diameter of the insulation.

b. For Detail 5, dimension “D” should be 100 mm (4 inches) minimum greater than the outside diameter of the pipe, or if insulated, 100 mm (4 inches) minimum greater than the outside diameter of the insulation. Dimensions “A” and “B” should provide 50 mm (2 inches) minimum clearance to each support lug.

c. For Detail 6, dimension “D” should be 150 mm (6 inches) minimum greater than the outside diameter of the equipment, or if insulated, 150 mm (6 inches) minimum greater than the outside diameter of the insulation. Dimensions “A” and “B” should provide 50 mm (2 inches) minimum clearance to the lugs or to lug fireproofing if the lugs are fireproofed.

d. Unprotected clear space greater than 300 mm (12 inches) should have guard rail protection.

5.2.3 The guidelines in Section 5.2.2 assume that lateral movement of the penetrating item is negligible because of thermal growth. If significant movement is anticipated, the dimensions should be adjusted accordingly.

5.2.4 If insulation or fireproofing on the penetrating item includes corrugated sheathing or banding hardware that protrudes from the insulation, the dimensions in Section 5.2.2 should be adjusted accordingly.
5.3 Shop Versus Field Fabrication

5.3.1 Because smaller openings frequently are relocated late in the design life of a project, only openings 300 mm (12 inches) diameter and greater should be provided by the fabricator.

5.3.2 Openings less than 300 mm (12 inches) diameter should be field located and field fabricated in accordance with PIP STS05130.

5.4 Large Openings

5.4.1 Additional grating support beams should be added where large openings are cut into the grating.

5.4.2 Engineering judgment should be applied to large openings because the size and location of the openings both affect the need for additional support beams.

6. Design Drawings

6.1 General

6.1.1 The location and limits of grating and the direction of the span of grating bearing bars should be shown on the design drawings.

6.1.2 The appropriate detail in PIP STF05530 for each grating opening, including the opening dimensions, should be specified on the design drawings. See Figure 1 for an example method of specifying a detail.

Note: Other methods of showing this information are acceptable.

Figure 1. Example Opening Detail Specification

6.1.3 For cases where the fabricator does not have the necessary information to size openings, the design drawings should provide dimensions and details of shop fabricated openings. For example, PIP STF05530 Detail 2 may be required for an equipment support provided by the equipment vendor. In this, and similar cases, the grating opening dimensions should be provided on the design drawings.

6.1.4 If some grating openings shown on the design drawings are to be field cut, the drawings should clearly show which openings are to be fabricated in the shop and which are to be fabricated in the field.

6.2 Fastening

6.2.1 The method for fastening grating to the support steel should be specified on the design drawings.

6.2.2 If selecting the grating fastening method, the following should be considered:
a. Grating design and material of construction
b. Electrical conductivity
c. Existence of rolling loads and other usage requirements
d. Integrity of protective coatings and fireproofing
e. Is grating required to be removable?
f. Ease and safety of installation

6.3 Support Plates

6.3.1 Grating support plates, 6 mm x 75 mm (¼ inch x 3 inches), should be provided in accordance with PIP STF05530, Section C-C and Details 2, 5, and 6.

6.3.2 The design drawings should clearly show that the grating support plates are required. Showing these plates on the design drawings is important, as the grating detailer is normally different from the structural steel detailer, and these support plates will probably be missed if the structural steel detailer is expected to catch them.

6.3.3 See Figure 2 for a suggested grating support plate detail.

![Figure 2: Suggested Grating Support Plate Detail](image)
7. **Shop Drawings Reviews**

7.1 **General**

7.1.1 Grating shop drawings should be thoroughly reviewed because the openings typically change significantly during the design life of a project and the fabricator needs the latest information.

7.1.2 Also the drawings should be reviewed for interferences between structural steel and the grating because the grating is typically detailed by a different detailer than the structural steel.

7.2 **Recommended Drawing Review Checklist**

7.2.1 Grating detailer is using the latest revision of the grating design drawings.

7.2.2 Grating locations, extents, and span directions are correct.

7.2.3 Interferences with gusset plates where bracing penetrates the grating are considered by the grating fabricator.

7.2.4 Grating is being split as required so that the grating can be installed without being field cut.

7.2.5 Locations, sizes, and details of openings are correct.

7.2.6 Locations of banding and toe plate are correct.

7.2.7 25-mm (1-inch) minimum of support has been provided for the ends of the bearing bars.

7.2.8 Cutouts permit space for insulation and fireproofing.

7.2.9 Structural steel shop drawings show the 6 mm x 75 mm (¼ inch x 3 inch) plates in accordance with PIP STF05530, Section C-C, and as shown in Figure 2 of this Practice everywhere the plates are required.