Process Industry Practices
Vessels

PIP VEFV1100M
Vessel/S&T Heat Exchanger Standard Details
(Metric Units)
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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1. Introduction

1.1 Purpose
This Practice provides fabrication and installation details and dimensional tolerances for the design of supports and other attachments for vessels, heat exchangers and solids products containers.

1.2 Scope
This Practice describes typical fabrication and installation requirements for the following:

a. Nameplate
b. Vessel fabrication tolerances and connection orientation tolerances
c. Grounding lugs
d. Horizontal vessel saddle supports
e. Vertical vessel skirts
f. Vertical vessel leg type supports
g. Vertical vessel support lugs
h. Manway and column davits
i. Pipe supports and guides from vessels
j. Insulation and fireproofing supports
k. Vessel internals
l. Heat exchanger tube sheet locking studs and vents/drains
m. Studded joints
n. Solids product container internals and manways

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

2.1 Industry Codes and Standards
- American Society of Mechanical Engineers (ASME)
  - Boiler and Pressure Vessel Code, Section VIII, Division 1
- American Society for Testing and Materials (ASTM)
  - A143 - Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
2.2 Government Regulations

- U. S. Occupational Safety and Health Administration (OSHA)
HORIZONTAL NAMEPLATE BRACKET

VERTICAL NAMEPLATE BRACKET

FOR INFORMATION NOT SHOWN, SEE HORIZONTAL NAMEPLATE BRACKET.

NOTES:
1. "L" & "W" MAY BE ADJUSTED TO ACCOMMODATE MANUFACTURER'S AND/OR USER'S NAMEPLATE.
2. THE BRACKET MATERIAL SHALL BE STAINLESS STEEL UNLESS OTHERWISE SPECIFIED THE VESSEL DRAWING/DATA SHEET.
3. THE MANUFACTURER NAMEPLATE SHALL BE ATTACHED PERMANENTLY TO THE BRACKET, SEAL WELD IS PREFERRED; HOWEVER, STAINLESS STEEL OR MONEL RIVETS MAY BE USED. THE BRACKET SHALL BE WELDED TO THE VESSEL.
4. LOCATION OF NAMEPLATE SHALL BE AS SPECIFIED ON VESSEL DRAWING/DATA SHEET.
5. ALL THICKNESSES ARE MINIMUMS.
6. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
7. UNDERCUTTING OF SHELL SHALL BE AVOIDED WHEN WELDING BRACKET TO VESSEL.
1. HEIGHT FROM BASE LINE TO FACE OF TOP NOZZLE ± 6mm OR 4mm PER 3000mm of HEIGHT 19mm MAX.
2. NOZZLES FOR AGITATOR MOUNTING SHALL HAVE FLANGE FACE ALIGNED WITHIN 1/4 DEG. OF SPECIFIED PLANE. ALSO, SEE NOTE 28.
3. DISTANCE FROM BOTTOM TO TOP OF TRAY SUPPORTS ± 3mm
4. WEIR HEIGHT ± 1.6mm MEASURED AT HIGH POINT OF WEIR
5. VERTICAL CLEARANCE UNDER DOWNFLOW PLATE FOR INSTALLED TRAYS ± 1.6mm
6. FACE OF NOZZLE TO CENTERLINE OF VESSEL ± 3mm
7. ALIGNMENT OF FLANGE FACE OF NOZZLE SHALL BE WITHIN 1/2 DEG. OF SPECIFIED PLANE.
8. LOCATION OF SHELL NOZZLES FROM BASE LINE SHALL BE ± 6mm FOR SHOP FABRICATED VESSELS OR SUB-ASSEMBLIES AND ± 12mm FOR FIELD ASSEMBLED VESSELS, IF LOCATION IS SPECIFIED FROM OTHER REFERENCE POINTS, TOLERANCE SHALL BE ± 3mm.
9. ALIGNMENT OF FLANGE FACE OF MANWAY SHALL BE WITHIN 1 DEG. OF SPECIFIED PLANE.
10. FACE OF MANWAY TO CENTERLINE OF VESSEL ± 12mm
11. LOCATION OF MANWAYS FROM BASE LINE SHALL BE ± 12mm FOR SHOP FABRICATED VESSELS AND SUB-ASSEMBLIES AND ± 25mm FOR FIELD ASSEMBLED VESSELS.
12. BOTTOM OF VESSEL SUPPORT TO BASE LINE ± 0mm, -1mm PER 400mm OF VESSEL DIAMETER, 12mm MAX.
13. FOR SUPPORTS LOCATED ABOVE BASELINE, TOLERANCES SHALL BE ± 0mm, ± 1mm PER 400mm OF VESSEL DIAM., 12mm MAX.
14. ALIGNMENT OF CYLINDRICAL SHELL SECTIONS SHALL BE TRUE AND STRAIGHT WITHIN 1mm PER 1200mm OF HEIGHT FROM BASE LINE BUT SHALL NOT EXCEED 19mm.
15. HIGH-POINT TO LOW-POINT OF INSTALLED TRAY SHALL BE LEVEL AND WITHIN THE FOLLOWING:
   - VESSEL I.D. ≤ 1500mm
   - 1500mm TO ≤ 3000mm
   - > 3000mm
   
   CLASS A: 3mm
   
   CLASS B: 5mm

   CLASS A AND CLASS B TOLERANCES SHALL BE BASED ON TYPE OF TRAY SPECIFIED AND THE TRAY SPECIFICATION SHEET/HYDRAULICS.
16. FAR SIDE OF TOWER TO WEIR PLATE ± 3mm
17. WEIRS SHALL BE LEVEL WITHIN ± 1.6mm FROM A LEVEL PLANE AT THE MIDPOINT OF THE WEIR.
18. TRAY SPACING ± 3mm.
19. LOCATION OF TRAY PLATES FROM BASE LINE ± 3mm.
20. DEVIATION FROM AVERAGE I.D. (AS DETERMINED BY STRAPPING) FROM NOMINAL I.D. ± 6mm ASME CODE SECTION VIII SHALL APPLY TO OUT-OF-ROUNDNESS UNLESS OTHERWISE SPECIFIED.
21. PIPE OR WALKWAY SUPPORTS AND STRUCTURAL ATTACHMENTS TO VESSEL CENTERLINE ± 3mm;
   
   BASE LINE ± 6mm.
22. LOCATION OF HORIZONTAL VESSEL SUPPORT FROM VESSEL CENTERLINES ± 0mm, -3mm.
23. LOCATION OF HORIZONTAL VESSEL SUPPORT FROM BASE LINE ± 6mm;
   
   SUPPORTS LOCATED FROM OTHER REFERENCE POINTS ± 3mm.
24. LOCATION OF BOTTOM NOZZLE FLANGE FACE FROM BASE LINE SHALL BE ± 6mm.
25. LIGHT CENTER PUNCH MARK (WITH A ROUND NOSE STAMP) THE PRINCIPAL CENTER LINES SHOWN ON ORIENTATION PLAN. PUNCH MARKS SHALL BE CIRCLED WITH PAINT TO DESIGNATE LOCATION.
26. SUPPORTS OUT OF LEVEL OVER ANY DIAMETER THE GREATER OF ± 3mm OR ± 1mm PER 600mm OF VESSEL DIAMETER, 10mm MAX.
27. BOLT HOLES WITHIN 3mm OF SPECIFIED LOCATION
28. IF BOTTOM FLANGE IS USED AS FOOT BEARING MOUNT AND WITH AGITATOR MOUNTING FLANGE HORIZONTAL CENTER OF TOP FLANGE SHALL FALL WITHIN 1mm PER 500mm (OF DISTANCE BETWEEN FLANGE FACES) OF CENTER OF BOTTOM FLANGE AND BOTTOM FLANGE SHALL NOT NOT MORE THAN 1/4 DEG. OFF HORIZONTAL.

VESSEL TOLERANCES
29. HORIZONTAL CLEARANCE BETWEEN DOWNFLOW PLATE AND TOP OF INLET WEIR ± 1.6mm
30. FOR POST SUPPORTED TRAYS, CLEARANCE BETWEEN TRAY COLLAR AND SHELL 0.4mm MAX, OVER 90% OF CIRCUMFERENCE, ± 1.6mm MAX. OVER REMAINING 10%.
31. TOLERANCES APPLY TO VERTICAL AND HORIZONTAL VESSELS UNLESS OTHERWISE SPECIFIED ON VESSEL DRAWING/DATA SHEET.
VESSLE NOZZLES ORIENTATION

FLANGE BOLT HOLES ORIENTATION

NOTES:
1. LOCATION OF SADDLE FROM ORIENTATION LINE SHALL BE ± 5mm.
2. LOCATION OF CLIPS FROM ORIENTATION LINE SHALL BE ± 6mm.
3. LOCATION OF NOZZLES FROM ORIENTATION LINE SHALL BE ± 5mm.
4. LOCATION OF MANWAYS FROM ORIENTATION LINE SHALL BE ± 25mm.
5. TOLERANCE ON NOZZLE BOLT HOLE ORIENTATION ± 1.6 mm
6. ORIENTATION LINE FOR VERTICAL VESSELS IS BASED ON A DIRECTIONAL CENTERLINE (E.G. NORTH, SOUTH, ETC.). ORIENTATION LINE FOR HORIZONTAL VESSELS IS BASED ON THE VERTICAL CENTERLINE.
7. TOLERANCES APPLY TO VERTICAL AND HORIZONTAL VESSELS UNLESS OTHERWISE SPECIFIED ON VESSEL DRAWINGS/DATA SHEETS.
NOTES:
1. LUG MATERIAL SHALL BE AUSTENITIC STAINLESS STEEL IF ATTACHED TO CARBON OR LOW ALLOY STEEL PARTS. IF ATTACHED TO OTHER MATERIALS, LUG MATERIAL SHALL BE SIMILAR TO THE MATERIAL TO WHICH ATTACHED.
2. SEE VESSEL DRAWING/DATA SHEET FOR ELEVATION AND ORIENTATION.
3. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
4. GROUNDING LUG SHALL NOT BE PAINTED.
NOTES:
1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE. SEE ASME CODE SECTION VII, DIV. I APPENDIX G FOR GUIDANCE ON DESIGN CONSIDERATIONS.
2. SEE VESSEL DESIGN DRAWING/DATA SHEET FOR LOCATION, SPACING OF SADDLES, AND TYPE OF MATERIAL.
3. ANCHOR BOLT HOLES:
   A. HOLES IN FIXED END SHALL BE PROVIDED DEAS FOLLOWS:
      1" Ø FOR 3/4" Ø BOLTS
   B. SLOTTED HOLES IN SLIDING END SHALL BE PROVIDED AS FOLLOWS:
      \[ S_L = SLOT\ LENGTH,\ INCHES \]
      \[ S_L = 2D_L\alpha\Delta T \]
      \[ D_L = DISTANCE\ BETWEEN\ SADDLES,\ INCHES \]
      \[ \alpha = MEAN\ COEFFICIENT\ OF\ THERMAL\ EXPANSION\ FOR\ SHELL\ MATERIAL\ AT\ MAXIMUM\ NAMEPLATE\ TEMP. \]
      \[ \Delta T = DIFFERENCE\ BETWEEN\ MAXIMUM\ NAMEPLATE\ TEMPERATURE\ AND\ 21°C. \]
4. SADDLE MAY BE MADE WITH TWO PIECE CONSTRUCTION OR FROM BENT PLATE.
5. DIMENSION "B" SHALL BE DETERMINED BASED ON INSULATION THICKNESS (HOT OR COLD) AND NOZZLE PROJECTION. SADDLES SHALL EXTEND A MINIMUM OF 25 BEYOND THE NOZZLE FACE.
6. PROVIDE 6 Ø VENT HOLE IN LOW SPOT OF EACH SADDLE WEAR PLATE.
7. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
8. B MINUS 25 SHALL BE USED FOR SLIDING SADDLE ONLY IF A SLIDE PLATE IS USED.
HORIZONTAL VESSEL SADDLES SUPPORTED ON CONCRETE

VESSSEL \( \varphi'S \) SEE NOTE 3

OUTSIDE DIAMETER OF SHELL

RIBS TO BE EQUALLY SPACED

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NOTES:
1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE. SEE ASME CODE SECTION VII, DIV. 1 APPENDIX G FOR GUIDANCE ON DESIGN CONSIDERATIONS.
2. SEE VESSEL DESIGN DRAWING/DATA SHEET FOR LOCATION, SPACING OF SADDLES, AND TYPE OF MATERIAL.
3. 6" VENT HOLE SHALL BE PROVIDED IN LOW SPOT OF EACH SADDLE WEAR PLATE.
4. ANCHOR BOLT HOLES:
   A. HOLES IN FIXED END SHALL BE PROVIDED AS FOLLOWS: 32e FOR 1" \( \varphi \) BOLTS & 38e FOR 1-1/4" \( \varphi \) BOLTS.
   B. SLOTTED HOLES IN SLIDING END SHALL BE PROVIDED AS FOLLOWS:
      \[ S_l = \text{SLOT LENGTH}, \text{mm} \]
      \[ D_l = \text{DISTANCE BETWEEN SADDLES}, \text{mm} \]
      \[ \alpha = \text{MEAN COEFFICIENT OF THERMAL EXPANSION FOR SHELL MATERIAL AT MAXIMUM NAME PLATE TEMPERATURE} \]
      \[ \Delta t = \text{GREATEST ABSOLUTE VALUE OF AMBIENT TEMPERATURE AT INSTALLATION BUT NOT WARMER THAN 21°C} \]
      MINUS THE MAXIMUM OR MINIMUM SHELL TEMPERATURE TO BE STAMPED ON THE CODE NAME PLATE IN °C
5. DIMENSION "B" SHALL BE DETERMINED BASED ON INSULATION THICKNESS (HOT OR COLD) AND NOZZLE PROJECTION. SADDLES SHALL EXTEND A MINIMUM OF 25mm BEYOND FACE OF NOZZLE.
   COMMENT: THE FIRE RESISTANCE OF STEEL SADDLES IN FLAMMABLE AND COMBUSTIBLE LIQUID SERVICE IS AFFECTED BY THE HEIGHT OF THE SADDLE AT THE LOWEST POINT. FOR EXAMPLE, SEE OSHA 29 CFR SECTION 1910.106(b)(5)(ii), WHICH ALLOWS NO FIREPROOFING FOR SADDLES IF LESS THAN 305 HIGH.
6. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
7. B MINUS 1" SHALL BE USED FOR SLIDING SADDLE ONLY IF A FOUNDATION SLIDE PLATE IS USED.
**NOTES:**

1. The thicknesses and dimensions shown are suggested starting values for the configuration above. Required thicknesses and dimensions shall be determined by calculations using the design loads and allowable stresses at design temperature. See ASME Code Section VIII, Div. I Appendix G for guidance on design considerations.

2. See vessel design drawing/data sheet for location, spacing of saddles, and type of material.

3. No vent hole shall be provided in low spot of each saddle wear plate.

4. Anchor bolt holes:
   A. Holes in fixed end shall be provided as follows: 32" for 1" bolts & 38" for 1½" bolts.
   B. Slotted holes in sliding end shall be provided as follows:
      - Sl = Slot length, mm
      - Dl = Distance between saddles, mm
      - $\alpha_t$ = Mean coefficient of thermal expansion for shell material at maximum name plate temp.
      - $\Delta t$ = Greatest absolute value of ambient temperature at installation (but not warmer than 21°C) minus the maximum or minimum shell temperature to be stamped on the code name plate in °C.

5. "S" shall be determined based on insulation thickness (hot or cold) and nozzle projection. Saddles shall extend a minimum of 25 mm beyond face of nozzle. Comment: The fire resistance of steel saddles in flammable and combustible liquid service is affected by the height of the saddle at the lowest point. For example, see OSHA 29 CFR Section 1910.106(b)(5)(ii), which allows no fireproofing for saddles if less than 305 high.

6. All dimensions are in mm unless noted otherwise.

7. B minus 1" shall be used for sliding saddle only if a foundation slide plate is used.
SKIRT BASE PLATE TYPE A

<table>
<thead>
<tr>
<th>BOLT SIZE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>H</th>
<th>T</th>
<th>W</th>
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<tbody>
<tr>
<td>3/4&quot;</td>
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<td>42</td>
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</tbody>
</table>

NOTES:
1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.
2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.
3. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
**SKIRT BASE PLATE TYPE B**

<table>
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<tr>
<th>BOLT SIZE</th>
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<th>D</th>
<th>E</th>
<th>F</th>
<th>H</th>
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<th>T2</th>
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<td>7/8&quot;</td>
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<td>58</td>
<td>204</td>
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<td>407</td>
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<td>58</td>
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</tbody>
</table>

**NOTES:**

1. The thicknesses and dimensions shown are suggested starting values for the configuration above. Required thicknesses and dimensions shall be determined by calculations using the design loads and allowable stresses at design temperature.

2. See vessel drawing/data sheet for material.

3. Weld size "W" shall be as a minimum, the greater of 7 or 0.75 times the thickness of the thinner of the two components joined.

4. All dimensions are in mm unless noted otherwise.
**NOTES:**

1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.

2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.

3. WELD SIZE “W” SHALL BE AS A MINIMUM, THE GREATER OF 7 OR 0.75 TIMES THE THICKNESS OF THE THINNER OF THE TWO COMPONENTS JOINED.

4. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
### Skirt Base Plate Type D

<table>
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<tr>
<th>Bolt Size</th>
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<th>T2</th>
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<td>2-1/2&quot;</td>
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<td>2-3/4&quot;</td>
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<td>407</td>
<td>26</td>
<td>58</td>
</tr>
</tbody>
</table>

**NOTES:**

1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.

2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.

3. WELD SIZE "W" SHALL BE AS A MINIMUM, THE GREATER OF 7 OR 0.75 TIMES THE THICKNESS OF THE THINNER OF THE TWO COMPONENTS JOINED.

4. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
NOTCH BEAM TO CLEAR WELD SEAM (3 mm EA. SIDE OF SEAM)

PLAN VIEW OF SUPPORTS

O.D. VESSEL

1. THE THICKNESSES, DIMENSIONS AND NUMBER OF LEGS SHOWN ARE STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.
2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.
3. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

<table>
<thead>
<tr>
<th>VESSEL DIAMETER</th>
<th>SIZE &amp; TYPE OF SUPPORT LEG</th>
<th>NO. OF LEGS</th>
<th>BASE PLATE SIZE</th>
<th>BOLT SIZE</th>
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</thead>
<tbody>
<tr>
<td>2300 TO 2750</td>
<td>W6 X 20</td>
<td>4 (MIN.)</td>
<td>SEE SECT. &quot;BB&quot;</td>
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<tr>
<td>2751 TO 3050</td>
<td>W8 X 35</td>
<td></td>
<td>SEE SECT. &quot;BB&quot;</td>
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</table>
NOTES

1. THE THICKNESSES, DIMENSIONS AND NUMBER OF LEGS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.

2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.

3. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

<table>
<thead>
<tr>
<th>VESSEL DIAMETER</th>
<th>SIZE &amp; TYPE OF SUPPORT LEG</th>
<th>NO. OF LEGS</th>
<th>BASE PLATE SIZE</th>
<th>BOLT SIZE</th>
<th>X</th>
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<tbody>
<tr>
<td>300 TO 600</td>
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<td>3</td>
<td>154 X 154 X 10</td>
<td>3/4”</td>
<td>38</td>
</tr>
<tr>
<td>601 TO 915</td>
<td>3” X 3” X 3/8” ANGLE</td>
<td></td>
<td>204 X 204 X 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>916 TO 1220</td>
<td>4” X 4” X 3/8” ANGLE</td>
<td></td>
<td>204 X 204 X 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1221 TO 1675</td>
<td>4” X 4” X 1/2” ANGLE</td>
<td>4</td>
<td>204 X 204 X 13</td>
<td>1”</td>
<td>50</td>
</tr>
<tr>
<td>1676 TO 1830</td>
<td>6” X 6” X 3/8” ANGLE</td>
<td></td>
<td>254 X 254 X 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1831 TO 1980</td>
<td>6” X 6” X 5/8” ANGLE</td>
<td></td>
<td>254 X 254 X 10</td>
<td></td>
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</tr>
<tr>
<td>1981 TO 2150</td>
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</tbody>
</table>
NOTES:
1. THE THICKNESSES, DIMENSIONS AND NUMBER OF LEGS SHOWN ARE
   SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE.
   REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY
   CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE
   STRESSES AT DESIGN TEMPERATURE.
2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.
3. REINFORCING PADS SHALL BE PROVIDED IN ACCORDANCE WITH DETAIL
   SHOWN FOR:
   A. CARBON STEEL VESSELS WITH WALL THICKNESS LESS THAN 7 mm
   B. STAINLESS STEEL VESSELS WITH WALL THICKNESS LESS THAN 10 mm
   REINFORCING PAD SHALL BE SAME MATERIAL AS SHELL.
4. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

<table>
<thead>
<tr>
<th>VESSEL DIAMETER</th>
<th>SIZE &amp; TYPE OF SUPPORT LEG</th>
<th>NO. OF LEGS</th>
<th>BASE PLATE SIZE</th>
<th>BOLT SIZE X</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 TO 600</td>
<td>3&quot; x 3&quot; x 1/4&quot; ANGLE</td>
<td>3</td>
<td>154 x 154 x 10</td>
<td>3/4&quot;</td>
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<td>601 TO 915</td>
<td>3&quot; x 3&quot; x 3/8&quot; ANGLE</td>
<td></td>
<td>204 x 204 x 10</td>
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<td>916 TO 1220</td>
<td>4&quot; x 4&quot; x 3/8&quot; ANGLE</td>
<td></td>
<td>204 x 204 x 13</td>
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<td>1221 TO 1675</td>
<td>4&quot; x 4&quot; x 1/2&quot; ANGLE</td>
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<td>1676 TO 1830</td>
<td>6&quot; x 6&quot; x 3/8&quot; ANGLE</td>
<td></td>
<td>254 x 254 x 10</td>
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<td>1831 TO 2150</td>
<td>6&quot; x 6&quot; x 5/8&quot; ANGLE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SUPPORT LUG BASE PLATE TYPE A

NOTES:

1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.

2. ALL LUGS REQUIRE REINFORCING PADS IF CORRODED SHELL THICKNESS IS LESS THAN THE FOLLOWING:
   A. CARBON STEEL : 7 mm THK.
   B. DESTAINLESS STEEL : 10 mm THK.

3. REINFORCING PADS SHALL BE THE SAME MATERIAL UNLESS OTHERWISE SPECIFIED ON VESSEL DRAWING/DATA SHEET. REINFORCING PADS SHALL TO BE CHECKED PER NOTE 1.

4. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.

5. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
NOTES:

1. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR THE CONFIGURATION ABOVE. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE DETERMINED BY CALCULATIONS USING THE DESIGN LOADS AND ALLOWABLE STRESSES AT DESIGN TEMPERATURE.

2. ALL LUGS REQUIRE REINFORCING PADS IF CORRODED SHELL THICKNESS IS LESS THAN THE FOLLOWING:
   A. CARBON STEEL : 7 mm THK.
   B. STAINLESS STEEL : 10 mm THK.

3. REINFORCING PADS SHALL BE SAME MATERIAL AS SHELL, UNLESS OTHERWISE SPECIFIED ON VESSEL DRAWING/DATA SHEET. REINFORCING PADS SHALL BE CHECKED PER NOTE 1.

4. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.

5. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
1. Hinges to allow shall permit cover flange to open and close freely.
2. All thicknesses shown are based on 248 MPa yield strength.
3. Welds marked MT or PT shall be examined in accordance with ASME Code Section VIII, Div. 1 Appendix 6 or 8, respectively.
4. Axis of manway is not horizontal, forces required to open and close manway shall be considered.
ALTERNATE LOCATION FOR MANWAYS WITH LAP JOINT FLG'S

20 DIA. ROD

7 THK. END PL.

20 THK PL.

MT OR PT

6 1/4" GREASE FITTING (INSTALL AFTER PAINTING)

7 THK. BRASS WEAR PLATE

7 THK. END PL. W/ 13 DIA. DRAIN HOLE

MANWAY SIZE

CLASS 150

DAVIT ARM

2" SCH. 80

24"

DAVIT ARM

SLEEVE

2-1/2" SCH. 40

3" SCH. 80

3" SCH. 80

SLEEVE

2-1/2" SCH. 40

3" SCH. 40

3-1/2" SCH. 40

SLEEVE

3" SCH. 40

3-1/2" SCH. 40

SLEEVE

3-1/2" SCH. 40

3-1/2" SCH. 40

NOTES:
1. SEE PLAN OF VESSEL FOR TRUE LOCATION OF DAVIT.
2. ALL THICKNESSES SHOWN ARE BASED ON 248 MPa YIELD STRENGTH.
3. WELDS MARKED MT OR PT SHALL BE EXAMINED IN ACCORDANCE WITH ASME CODE SECTION VIII, DIV. 1 APPENDIX 6 OR 8, RESPECTIVELY.
4. DAVIT ARMS AND SLEEVES ARE DESIGNED USING PIPE SECTIONS. SIZES SHOWN ARE NOMINAL PIPE SIZES.
5. UNLESS OTHERWISE REQUIRED BECAUSE OF MANWAY MATERIAL, DAVIT MATERIAL SHALL BE ASME CODE APPROVED MILD CARBON STEEL.
7. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
MANWAY SIZE | CLASS 150 | CLASS 300 | CLASS 400 | CLASS 600
---|---|---|---|---
20" | 2" SCH. 80 | 1-1/2" SCH. 80 | 3" SCH. 40 | 3" SCH. 80 | 3-1/2" SCH. 40 | 3-1/2" SCH. 40
24" | 2" SCH. 80 | 2-1/2" SCH. 40 | 3" SCH. 80 | 3-1/2" SCH. 40 | 3" SCH. 80 | 3-1/2" SCH. 40

NOTES:
1. SEE PLAN OF VESSEL FOR TRUE LOCATION OF DAVID.
2. ALL THICKNESSES SHOWN ARE BASED ON 248 MPa YIELD STRENGTH.
3. WELDS MARKED MT OR PT SHALL BE EXAMINED IN ACCORDANCE WITH ASME CODE SECTION VIII, DIV. 1 APPENDIX 6 OR B, RESPECTIVELY.
4. DAVID ARMS AND SLEEVES ARE DESIGNED USING PIPE SECTIONS. SIZES SHOWN ARE NOMINAL PIPE SIZES.
5. UNLESS OTHERWISE REQUIRED BECAUSE OF MANWAY MATERIAL, DAVID MATERIAL SHALL BE ASME CODE APPROVED MILD CARBON STEEL.
7. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
NOTES:

1. SEE PLAN OF VESSEL FOR TRUE LOCATION OF DAVIT.
2. ALL THICKNESSES SHOWN ARE BASED ON 248 MPa YIELD STRENGTH.
3. 7 THK. PAD SHALL BE PROVIDED FOR HIGH ALLOY VESSELS LESS THAN 10 THK. AND FOR CARBON STEEL VESSELS LESS THAN 7 THK. (EXCLUDING CORROSION ALLOWANCE). MATERIAL SHALL BE SAME AS SHELL.
4. SURFACE PREPARATION AND PAINTING SHALL BE PER PURCHASER'S PAINT SPECIFICATION.
5. DAVIT ARM SHALL BE SHIPPED LOOSE FOR FIELD ASSEMBLY BY OTHERS.
6. DAVIT SHALL ROTATE FREELY.
7. LOADS ARE FOR DAVIT AND CLIPS ONLY. SHELL STRESSES SHALL BE CONSIDERED ON AN INDIVIDUAL BASIS.
8. WELDS MARKED MT OR PT SHALL BE EXAMINED IN ACCORDANCE WITH ASME CODE SECTION VIII, DIV. 1 APPENDIX 6 RESPECTIVELY.
9. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
1. See plan of vessel for true location of davit.
2. All thicknesses shown are based on 248 MPa yield strength.
3. 7 THK. PAD SHALL BE PROVIDED FOR HIGH ALLOY VESSELS LESS THAN 10 THK. AND FOR CARBON STEEL VESSELS LESS THAN 7 THK. (EXCLUDING CORROSION ALLOWANCE). MATERIAL TO BE SAME AS SHELL.
4. Surface preparation and painting shall be per purchaser’s paint specification.
5. Davit arm shall be shipped loose for field assembly by others.
6. Davit shall rotate freely.
7. Loads are for davit and clips only. Shell stresses shall be considered on an individual basis.
8. Welds marked MT or PT shall be examined in accordance with ASME Code Section VIII, Div. 1 Appendix 6 or B, respectively.
9. All dimensions are in mm unless noted otherwise.
TYPE 1 – SUPPORT
FOR PLAN VIEW AND DIMENSIONS,
SEE VEFV1120, PAGE 2

TYPE 2 – SUPPORT
FOR PLAN VIEW AND DIMENSIONS,
SEE VEFV1120, PAGE 2

FOR GENERAL NOTES, SEE VEFV1120, PAGE 3

LEGEND

MAX. ALLOW. LINEAL METERS OF PIPE FILLED WITH WATER
SUPPORT WEIGHT INCLUDING ANGLE CLIPS

WEIGHTS SHOWN IN TABLES ARE NET FABRICATED WEIGHTS FOR ESTIMATING PURPOSES.
ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

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<th>PIPE SIZE</th>
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<td>22 kg</td>
<td>24 kg</td>
<td>26 kg</td>
</tr>
<tr>
<td></td>
<td>508</td>
<td>20 kg</td>
<td>22 kg</td>
<td>24 kg</td>
<td>26 kg</td>
<td>28 kg</td>
</tr>
<tr>
<td>PIPE SIZE</td>
<td>6”</td>
<td>8”</td>
<td>10”</td>
<td>12”</td>
<td>14”</td>
<td>16”</td>
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<tr>
<td>SCHEDULE</td>
<td>40</td>
<td>80</td>
<td>40</td>
<td>80</td>
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<td>80</td>
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<td>WEIGHTS</td>
<td>305</td>
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<td>21 kg</td>
<td>23 kg</td>
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<td>355</td>
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**TYPE 3 - SUPPORT**

**PLAN FOR TYPE 1, 2 & 3 SUPPORTS**

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>8&quot;</th>
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</tbody>
</table>

**LEGEND**

- **45 kg, 36**: Max. allow. lineal meters of pipe filled with water support weight including angle clips.
- **All dimensions are in mm unless noted otherwise.**

**PLAN VIEW DIMENSIONS**

*CLIP ANGLE 3" X 2" X 3/8" (FURNISHED BY OTHERS) - SHIP LOOSE, FIELD WELD TO PIPE*

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>2&quot;</th>
<th>3&quot;</th>
<th>4&quot;</th>
<th>6&quot;</th>
<th>8&quot;</th>
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<th>14&quot;</th>
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<tbody>
<tr>
<td>A</td>
<td>76</td>
<td>76</td>
<td>76</td>
<td>76</td>
<td>83</td>
<td>83</td>
<td>83</td>
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<td>B</td>
<td>70</td>
<td>89</td>
<td>108</td>
<td>150</td>
<td>190</td>
<td>230</td>
<td>265</td>
<td>285</td>
<td>325</td>
<td>355</td>
</tr>
<tr>
<td>C (SEE NOTE 3)</td>
<td>225</td>
<td>254</td>
<td>280</td>
<td>333</td>
<td>390</td>
<td>450</td>
<td>500</td>
<td>533</td>
<td>585</td>
<td>635</td>
</tr>
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</table>
TYPE 4 - SUPPORT
DESIGN TO SUIT CONDITIONS
USE DOUBLE ANGLES FOR KNEE BRACES AS REQUIRED.

TYPE 5 - SUPPORT
FOR 1" & 1-1/2" PIPE ONLY

L 3" x 2" x 1/4" (MAX. LOAD OF 900# FOR 305 "L" DIMN.)

NOTES:
1. VESSEL CLIP OR PAD MATERIAL WELDED DIRECTLY TO VESSEL SHALL BE THE SAME AS THE MATERIAL TO WHICH IT IS WELDED. REINFORCEMENT PADS SHALL BE PROVIDED FOR LOAD DISTRIBUTION FOR THIN WALL VESSELS. PADS, IF USED, SHALL BE THE SAME THICKNESS AS THE SHELL IF POSSIBLE. EACH PAD SHALL HAVE A 1/4" NPT HOLE FOR VENTING / TESTING.
2. STRUCTURAL MEMBERS SHALL HAVE A MINIMUM YIELD STRENGTH OF 36 ksi.
3. DIMENSION "C" IS FOR UNINSULATED PIPE. IF REQUIRED, DIMENSION "C" SHALL BE ADJUSTED TO INCLUDE INSULATION THICKNESS. IF INSULATION IS REQUIRED, ADJUST "C" DIMENSION BY INSULATION THICKNESS X 2.
4. THE THICKNESSES AND DIMENSIONS SHOWN ARE SUGGESTED STARTING VALUES FOR ALL PIPE SUPPORTS. REQUIRED THICKNESSES AND DIMENSIONS SHALL BE CALCULATED USING THE APPLICABLE DESIGN LOADS.
5. FOR INSULATED VESSELS, THE DIMENSION SHOWN BETWEEN THE OUTSIDE OF THE INSULATION AND PIPE SUPPORT CLIP BOLTING SHALL BE CHECKED TO ASSURE THAT PIPE SUPPORT BRACKET AND BOLTING CLEAR OUTSIDE OF INSULATION, BASED ON SUPPORT MEMBER SIZE, BOLT SIZE AND WRENCH DIAMETER CLEARANCE.
6. SEE VESSEL OR LADDER AND PLATFORM DRAWING/DATA SHEET FOR ACTUAL DIMENSIONS.
7. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
PIPE GUIDES
ATTACHED TO VESSELS

SEE NOTE 2

SEE ORIENTATION PLAN

SEE ELEVATION

"L" SEE NOTE 1

64 x 13 BARS FOR TYPE 1
89 x 13 BARS FOR TYPE 2

TYPE 1 & 2

FOR GENERAL NOTES SEE VEFV1121M, PAGE 2

MAXIMUM GUIDE SPACING

<table>
<thead>
<tr>
<th>TYPE OF LINE SIZE</th>
<th>&quot;L&quot; DIMENSION – SEE NOTE 1</th>
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<tr>
<td></td>
<td>L=305 L=355 L=406 L=457 L=508 L=560 L=610 L=660 L=710 L=760</td>
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<tr>
<td>1'</td>
<td>3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>1½/II</td>
<td>4.8 4.8 4.8 4.8 4.8 4.8 4.8</td>
</tr>
<tr>
<td>2'</td>
<td>5.4 5.4 5.4 5.4 5.4 5.4</td>
</tr>
<tr>
<td>3'</td>
<td>7.6 7.6 7.6 7.6 7.6</td>
</tr>
<tr>
<td>4'</td>
<td>9.1 9.1 9.1 9.1 9.1</td>
</tr>
<tr>
<td>6'</td>
<td>12.1 12.1 12.1 12.1 12.1 12.1 12.1 12.1 12.1</td>
</tr>
<tr>
<td>8'</td>
<td>13.7 13.7 13.7 13.7 13.7 13.7 13.7 13.7 13.7</td>
</tr>
<tr>
<td>10'</td>
<td>16.7 16.7 16.7 16.7 16.7 16.7 16.7 16.7 16.7</td>
</tr>
<tr>
<td>12'</td>
<td>18.2 18.2 18.2 18.2 18.2 18.2 18.2 16.7 15.2 15.2 13.7</td>
</tr>
</tbody>
</table>
NOTES:

1. SEE VESSEL OR LADDER AND PLATFORM DRAWING/DATA SHEET FOR ACTUAL "L" DIMENSION, ORIENTATION AND ELEVATION.

2. VESSEL CLIP MATERIAL SHALL BE THE SAME AS THE MATERIAL TO WHICH IT IS WELDED. SHALL BE PROVIDED FOR ALLOY VESSELS, A POISON PAD IS OPTIONAL. REINFORCEMENT PADS SHALL BE PROVIDED FOR LOAD DISTRIBUTION REINFORCEMENT PADS ARE REQUIRED FOR LOAD DISTRIBUTION FOR THIN WALL VESSELS. PADS, IF USED, SHALL BE THE SAME ALLOY AS THE VESSEL AND OF THE SAME THICKNESS AS THE SHELL IF POSSIBLE. EACH PAD SHALL HAVE A 1/4" NPT HOLE FOR VENTING/TESTING.

3. BOLT HOLES SHALL BE 21 DIA. FOR 3/4" DIA. ASTM A325 HEAVY HEX HEAD BOLTS WITH HEAVY HEX NUTS.

4. UNLESS OTHERWISE SPECIFIED, ALL NECESSARY BARS, PLATES, CHANNELS AND BOLTING SHALL BE PROVIDED.

5. FOR INSULATED VESSELS, THE DIMENSION SHOWN BETWEEN THE OUTSIDE OF THE OUTSIDE OF THE INSULATION AND PIPE SUPPORT CLIP BOLTING SHALL BE CHECKED TO ASSURE THAT PIPE SUPPORT BRACKET AND BOLTING CLEAR OUTSIDE OF INSULATION, BASED ON SUPPORT MEMBER SIZE, BOLT SIZE, AND WRENCH DIAMETER CLEARANCE.

6. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

7. STRUCTURAL MEMBERS SHALL HAVE A MINIMUM YIELD STRENGTH OF 36 KSI.

<table>
<thead>
<tr>
<th>TYPE OF GUIDE</th>
<th>LINE SIZE</th>
<th>MAXIMUM GUIDE SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L=305</td>
<td>L=355</td>
</tr>
<tr>
<td>TYPE 3</td>
<td>14&quot;</td>
<td>21.3</td>
</tr>
<tr>
<td></td>
<td>16&quot;</td>
<td>19.8</td>
</tr>
<tr>
<td></td>
<td>18&quot;</td>
<td>19.8</td>
</tr>
</tbody>
</table>
NOTES:
1. HORIZONTAL SUPPORT SHALL BE PROVIDED FOR VESSELS 2450 DIAMETER AND LARGER.
2. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.
3. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

INSUL. THK. MINUS 13

O.S. VESSEL SPACER ROD

DETAIL "A"
10 DIA. ROUND BAR

50 (TYP.)

O.S. NOZZLE NECK

DETAIL "B"
10 DIA. C.S. ROD FLOATING RING

10 DIA. ROD SHALL BE TIED OFF FOR SHIPMENT.
NOTES:
1. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL.
2. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
DETAIL "A"

10 DIA. ROD SHALL BE TIED-OFF FOR SHIPMENT.

NOTE:
ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
DETAIL "E"
VERTICAL VESSEL WITH SKIRTS

DETAIL "F"
VERTICAL VESSEL WITHOUT SKIRTS

DETAIL "G" – HOT BOX DESIGN
VERTICAL VESSEL WITH SKIRTS

NOTE:
1. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
DETAIL "H"

NOTE:
ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
1. CLIPS SHALL BE LOCATED ON 915 MAXIMUM CENTERS FOR TYPE 1 WITH INSULATION THICKNESS UP TO 125 AND TYPE 2 WITH INSULATION UP TO 100. CLIPS SHALL BE LOCATED ON 600 MAXIMUM CENTERS FOR TYPE 1 WITH INSULATION THICKNESS ABOVE 125. CLIPS SHALL BE LOCATED ON 460 MAXIMUM CENTERS FOR TYPE 3 WITH INSULATION THICKNESS ABOVE 100. A MINIMUM OF THREE CLIPS PER SEGMENT SHALL BE PROVIDED.

2. RINGS SHALL BE LOCATED TO CLEAR VESSEL APPURTENANCES AND WELDS IF POSSIBLE. IF IMPRACTICABLE TO AVOID INTERFERENCE, A 25 MINIMUM CLEARANCE SHALL BE PROVIDED BETWEEN THE END OF THE RING AND THE INTERFERING COMPONENT AND BETWEEN THE CLIP ATTACHING WELDS AND VESSEL WELDS OR ATTACHING WELD OF ANY INTERFERING COMPONENT.

3. ALL RING HOLES SHALL BE SLOTTED FOR TYPE 3 WITH THE SLOT AT THE CENTER OF THE CLIP HOLE. ALL CLIPS SHALL BE TURNED THE SAME DIRECTION.

4. ALL MATERIAL WELDED TO VESSEL SHALL BE THE SAME MATERIAL AS THE VESSEL. ALL OTHER MATERIAL SHALL BE CARBON STEEL.

**SECTION “A-A”**

**USE ODD NUMBER OF CLIPS PER RING SEGMENT WITH 168 HOLE IN RING AT CENTER CLIP. SEE NOTE 3**

**INSULATION SUPPORT DESCRIPTIONS:**

- **TYPE 1—** SUPPORT FOR INSULATION ON DISHED HEADS
- **TYPE 2—** INTERMEDIATE SUPPORT FOR INSULATION LESS THAN OR EQUAL TO 100 THK.
- **TYPE 3—** INTERMEDIATE SUPPORT FOR INSULATION GREATER THAN 100 THK.

<table>
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<th>50</th>
<th>63</th>
<th>75</th>
<th>88</th>
<th>100</th>
<th>113</th>
<th>125</th>
<th>138</th>
<th>150</th>
<th>163</th>
<th>175</th>
<th>188</th>
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<th>213</th>
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<tr>
<td>TYPE 1—</td>
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<td>38</td>
<td>38</td>
<td>41</td>
<td>54</td>
<td>67</td>
<td>79</td>
<td>92</td>
<td>92</td>
<td>105</td>
<td>117</td>
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<td>156</td>
<td>156</td>
<td>168</td>
<td>181</td>
<td>194</td>
</tr>
<tr>
<td>TYPE 2—</td>
<td>wr</td>
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<td>38</td>
<td>38</td>
<td>41</td>
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<td>67</td>
<td>64</td>
<td>76</td>
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<td>89</td>
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<td>114</td>
<td>140</td>
<td>140</td>
<td>152</td>
<td>165</td>
<td>178</td>
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<td>TYPE 3—</td>
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<td>67</td>
<td>79</td>
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<td>92</td>
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<td>73</td>
<td>73</td>
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</table>
INSIDE BOTTOM HEAD OR SHELL

FLUSH TYPE

D = NOMINAL DIA. OF NOZZ.
"W" = 3 PLUS CORR. ALLOW.
"T" = 3 PLUS 2(CORR. ALLOW.)

(3) BLADES

(4) BLADES
SECTION "A-A"

NOTES:
1. SEE VESSEL DRAWING/DATA SHEET FOR MATERIAL AND BLADE REQUIREMENTS.
2. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
GRAB RUNG
REQUIRED UNLESS
OTHERWISE SPECIFIED.

LADDER RUNGS

150 ABOVE BOTTOM HEAD WELD
LINE OR 610 ABOVE DECK

VERTICAL VESSEL

HORIZONTAL VESSEL

NOTES:
1. LADDER RUNGS BELOW MANWAY
   SHALL BE PROVIDED WHERE SHOWN
   ON VESSEL DRAWING/DATA SHEET OR
   IF THE DISTANCE FROM THE
   CENTERLINE OF THE MANWAY TO
   LOWER HEAD OR TRAY DECK IS
   GREATER THAN 1220.
2. SEE VESSEL DRAWING/DATA SHEET
   FOR MATERIAL.
3. ALL DIMENSIONS ARE IN mm UNLESS
   NOTED OTHERWISE.

INTERNAL LADDER RUNG OR GRAB RUNG
NOTES:

1. LOCKING STUDS ARE INTENDED FOR USE WITH RE-MOVABLE TUBE BUNDLES HAVING STATIONARY TUBESHEETS WITH GASKETED FLANGED JOINTS BOTH SIDES AND THRU-FLANGE BOLTING. THEIR PURPOSE IS TO FACILITATE THE REMOVAL OF THE CHANNEL FOR INSPECTION AND MAINTENANCE WITHOUT DISTURRING THE TUBESHEET TO SHELL GASKET SEATING.

2. LOCKING STUDS IN THE JOINT ASSEMBLY SHALL BE PROPERLY IN PLACE BEFORE PRESSURE TESTING THE SHELL SIDE.

3. UNLESS OTHERWISE SPECIFIED IN THE VESSEL SPECIFICATIONS, LOCKING STUDS SHALL BE PROVIDED FOR EVERY FOURTH BOLT HOLE IN THE TUBESHEET.

4. MATERIAL SPECIFICATIONS AND STUD DIAMETER FOR THE LOCKING STUD ASSEMBLY SHALL BE THE SAME AS FOR THE OTHER BOLTING IN THE FLANGED JOINT AND SHALL BE IN ACCORDANCE WITH THE VESSEL SPECIFICATIONS.

5. JOINT ASSEMBLY SHOWN IS FOR ILLUSTRATION ONLY. ACTUAL TYPES OF FLANGES, FACINGS, GASKETS, ETC. SHALL BE AS SPECIFIED IN THE VESSEL SPECIFICATIONS.

6. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.

<table>
<thead>
<tr>
<th>STUD DIA. d</th>
<th>A (+0.8 -0 )</th>
<th>B (+0.8 )</th>
<th>C (+0.8 )</th>
<th>D (±0.8 )</th>
<th>E (MIN.)</th>
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<td>25</td>
<td>11</td>
<td>29</td>
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<td>6</td>
</tr>
<tr>
<td>3/4”</td>
<td>27</td>
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<td>30</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>7/8”</td>
<td>32</td>
<td>16</td>
<td>35</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>1”</td>
<td>37</td>
<td>17</td>
<td>40</td>
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<td>8</td>
</tr>
<tr>
<td>1-1/8”</td>
<td>40</td>
<td>19</td>
<td>43</td>
<td>22</td>
<td>8</td>
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<tr>
<td>1-1/4”</td>
<td>44</td>
<td>22</td>
<td>48</td>
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</tr>
<tr>
<td>1-3/4”</td>
<td>64</td>
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<td>67</td>
<td>33</td>
<td>14</td>
</tr>
<tr>
<td>1-7/8”</td>
<td>67</td>
<td>32</td>
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<td>2”</td>
<td>73</td>
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<td>76</td>
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<tr>
<td>2-1/4”</td>
<td>83</td>
<td>38</td>
<td>86</td>
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<tr>
<td>2-1/2”</td>
<td>90</td>
<td>41</td>
<td>94</td>
<td>44</td>
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<tr>
<td>2-3/4”</td>
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<tr>
<td>3”</td>
<td>108</td>
<td>50</td>
<td>111</td>
<td>54</td>
<td>27</td>
</tr>
</tbody>
</table>
NOTES:

1. THE MINIMUM TUBESHEET THICKNESS AT THE OUTER RIM SHALL BE THE GREATER OF THE CALCULATED THICKNESS OR 50.

2. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.

3. CLASS 6000 THRODDLET SHALL BE USED IF TUBESHEET THICKNESS IS GREATER THAN 60.
TYPE A–1 FILLET WELD ATTACHMENT DETAIL (E=0.45)
SKIRT–SHELL ATTACHMENT FOR
TORISPHERICAL AND TORICONICAL HEADS

TYPE A–2 GROOVE WELD ATTACHMENT DETAIL (E=0.60) SEE NOTE 2
SKIRT–SHELL ATTACHMENT FOR
TORISPHERICAL AND TORICONICAL HEADS

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
2. THIS DETAIL SHOULD BE USED FOR HIGH TEMPERATURE OR CYCLIC LOADING CONDITIONS.
TYPE B–1 FILLET WELD ATTACHMENT DETAIL (E=0.60) SEE NOTE 1
SKIRT–SHELL ATTACHMENT FOR
ELLIPSOIDAL OR HEMISPHERICAL HEADS

TYPE B–2 GROOVE WELD ATTACHMENT DETAIL (E=0.70) SEE NOTES 1 & 2
SKIRT–SHELL ATTACHMENT FOR
ELLIPSOIDAL OR HEMISPHERICAL HEADS

NOTES:
1. TYPICALLY, THE SKIRT O.D. MATCHES THE VESSEL O.D.
   IF THE SKIRT AND VESSEL SHELL THICKNESSES ARE SIMILAR.
2. THE TYPE B–2 ATTACHMENT SHOULD BE USED FOR HIGH TEMPERATURE OR
   CYCLIC LOADING CONDITIONS.
3. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
TYPE C INTEGRAL SKIRT ATTACHMENT DETAIL
(E = 1.0 WITH FULL RADIOGRAPHY)

NOTE:
The TYPE C ATTACHMENT SHOULD BE USED FOR HIGH PRESSURE DESIGNS, VERY HIGH TEMPERATURES, AND LARGE VERTICAL LOADINGS IF THICK WALL SHELLS AND HEADS ARE REQUIRED.
**NOTE:**

Top ring may be used to reinforce cone to shell junction.
TYPE E FILLET WELD ATTACHMENT DETAIL (E=0.60)
SKIRT-SHELL ATTACHMENT FOR
JACKETED VESSELS
STUDS AND TAPPED JOINTS—STUDDED JOINTS

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
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<tbody>
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<td>5/8-11 UNC-2</td>
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<td>17</td>
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<td>40</td>
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<tr>
<td>3/4-10 UNC-2</td>
<td>17</td>
<td>19</td>
<td>13</td>
<td>44</td>
<td>29</td>
<td>16</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>7/8-9 UNC-2</td>
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<td>21</td>
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NOTES:
1. THE TABULATED DIMENSIONS ARE IN ACCORDANCE WITH ASME CODE SECT. VII, DIV 1. PAR (UG-43)(Q) REQUIREMENTS FOR STUD MATERIALS HAVING ALLOWABLE STRESS OF 172369 KPA AND TAPPED MATERIALS HAVING AN ALLOWABLE STRESS OF 157805 KPA AT THE DESIGN TEMPERATURE OF THE JOINT. FOR MATERIALS HAVING OTHER ALLOWABLE STRESSES, DIMENSIONS SHALL BE ADJUSTED ACCORDINGLY.
2. STUDS AND NUTS SHALL BE POLYIMIDE/AMIDE COATED (232°C MAX. NAMEPLATE TEMPERATURES) OR GALVANIZED UNLESS SPECIFICALLY EXEMPTED BY THE VESSEL SPECIFICATION.
4. ALL DIMENSIONS IN MILLIMETERS.
5. EFFECTIVE STUD LENGTH MAY BE INCREASED BY INSTALLING A SPLIT RING BACKUP FLANGE BEHIND THE MATING FLANGE. BACKUP FLANGE SHALL HAVE SAME THICKNESS AS MATING FLANGE.
DEFLECTOR DETAILS
Blend Tube/Cone Intersection
A = A PRACTICAL CLEARANCE BETWEEN THE NOZZLE FLANGE (NOT SHOWN) AND TUBESHEET FLANGE.

B = \sqrt{Rt} BUT NEED NOT BE GREATER THAN 50 MM.