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SCOPE

- I 1.1 This practice covers the design, fabrication, inspection, testing, handling and storage of beams, trays, grids, shrouds, thermowells and other internals for fractionating and extraction towers, fixed bed and fluid bed reactors, separators, drums, and similar vessels.
- I 1.2 **An asterisk (*)** indicates that a decision by the Purchaser is required or that additional information is furnished by the Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the practices, specification and codes which shall be used with this practice.
- I * 2.2 **Table 2** lists the practices, code and standards which shall be used with this practice **as specified** by the Purchaser.

TABLE 1

PRACTICES			
IP 18-7-1	Welding Procedures	IP 20-1-1	Inspection of Equipment and Materials
SPECIFICATION AND CODES			
AISC Specification Manual of Steel Construction (ASD) - Specification for Structural Steel Buildings		ASME Codes Section II, Part D Material Properties Section VIII Division 2 - Pressure Vessels, Alternative Rules, Section IX Welding and Brazing Qualifications B31.3 Process Piping	

TABLE 2

PRACTICES			
IP 3-16-1	Flanged Joints, Gaskets, and Bolting	IP 18-12-1	Positive Material Identification
IP 15-2-1	Temperature Instruments		
CODE AND STANDARDS			
ASME Code Section VIII - Division 1 Pressure Vessels ASTM Standards A 36 / A 36M Structural Steel A 167 Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip A 176 Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip A 193 / A 193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service A 194 / A 194M Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service A 204 / A 204M Pressure Vessel Plates, Alloy Steel, Molybdenum A 240 Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels A 276 Stainless and Heat-Resisting Steel Bars and Shapes A 283 / A 283M Low and Intermediate Tensile Strength Carbon Steel Plates		ASTM Standards (Cont) A 285 / A 285M Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength A 307 Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength A 387 / A 387M Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum A 414 / A 414M Carbon Steel Sheet for Pressure Vessels A 515 / A 515M Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher-Temperature Service A 516 / A 516M Pressure Vessel Plates, Carbon Steel, for Moderate and Lower-Temperature Service A 569 / A 569M Steel, Carbon (0.15 Maximum, percent) Hot-Rolled and Strip, Commercial Quality A 570 / A 570M Hot-Rolled Carbon Steel Sheets and Strip, Structural Quality A 675 / A 675M Steel Bars, Carbon, Hot Wrought, Special Quality, Mechanical Properties B 127 Nickel-Copper Alloy (UNS N04400) Plate, Sheet and Strip B 164 Nickel-Copper Alloy Rod, Bar and Wire B 265 Titanium and Titanium Alloy Strip, Sheet and Plate B 348 Titanium and Titanium Alloy Bars and Billets	

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- I 2.3 **Fabricator's drawings** shall show all assembly and process details and the following data:
 - a. Design temperature and design loads
 - b. Extent of ultrasonic, radiography, magnetic-particle inspection, or other nondestructive tests
 - c. Stress relieving and special welding procedures
 - d. All material specifications including bolting and gaskets.
 - e. Actual total corrosion allowance for internals (i.e., total new metal thickness minus thickness required for strength).
 - f. Location and assembly details for all internals, including all tray details, and tray sectional elevations showing two or more adjacent trays. All components in the section shall be identified.
 - g. All necessary instructions and piece numbers for all parts to facilitate shop or field installation.
 - h. Positive material identification testing requirements.
- I * 2.4 **For items that cannot be completely shop fabricated** the vendor shall submit design drawings clearly designating field welds for approval by Owner.
- I 2.5 **Two copies of design calculations** made by fabricator shall be furnished with or prior to submission of prints for approval. Structural design calculations for trays and internal supports shall be included. Where calculations are made on a computer, all input data, assumptions, and summary of results shall be furnished.
- I 2.6 **Final Data** - After final approval of drawings, fabricator shall supply the following certified data:
 - a. Certified drawings containing all information required by **Pars. 2.3 and 2.4**.
 - b. Data reports executed in accordance with the applicable code shall be supplied to Owner.
- I 2.7 **Vendor certification of leakage rate.** Vendor shall certify that all bubble cap trays will meet the specified leakage rate when installed per vendor instructions and that the gasketing material and gasket to metal seal designs, if permitted, have been successfully used in similar services.

DEFINITIONS

- I 3.1 **Major Beams:** Beams 10 ft (3000 mm) and longer, or beams regardless of length that extend across a vessel without interruption. All other beams shall be considered to be minor beams.
- I 3.2 **Non-Structural Components:** Trays, decks, pans, integral minor beams, liquid redistributors, downcomers, grids, holddown grids and internal non-pressure piping.
- I 3.3 **Structural Components:** All major beams, grid support beams, bed support beams, non-integral beams, inlet distributors, outlet collector rings, tray support rings and other load bearing components welded to the shell.
- I 3.4 **Total Corrosion Allowance:** Corrosion allowance for all internals which are exposed to corrosion on all surfaces.
- I 3.5 **Tray Accessories:** Bubble caps, chimneys, weirs, baffles and entrainment screen supports.

MATERIALS

- R * 4.1 **Materials for internals** shall be specified.
- R 4.2 **Acceptable ASTM grades and specifications** for a number of standard internal materials are listed in [Table 3](#).
- R 4.3 **Free machining grades of steel** are not permitted, except that Type 416 nuts furnished to ASTM A 194 / A 194M Gr6F with Selenium are acceptable for use with ASTM A 193 / A 193M B6 bolts.
- R 4.4 **Gasket and packing material** for other than acid or caustic services shall be an asbestos substitute suitable for the process fluid and temperature to which it will be exposed.
- R 4.5 **Fiber reinforced PTFE** shall be used for acid or caustic service below 600°F (315°C).
- R 4.6 **All bolting hardware** shall be of the same nominal chemistry as the internals which they are connecting. However, 12Cr bolting hardware shall be used for carbon steel internals when the specified corrosion allowance for the internal structural component is greater than 1/8 in. (3 mm).
- M 4.7 **Bolting hardware for manways** in grids, decks and trays shall be corrosion resistant material to facilitate opening for inspection and maintenance.

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- R 4.8 **Crinkled wire mesh entrainment screens** (CWMS) shall meet the following requirements:
- Materials of the supports, rods, or straps shall be at least equivalent in terms of corrosion resistance to that of the other vessel internals.
 - Mesh shall be Type 304 stainless steel, Alloy 400, or Alloy 600. Proposals to use plastic mesh (e.g. polypropylene or polyethylene) shall be submitted to Purchaser for approval by Owner.
- R * 4.9 **Baffle plate and wear plate material** shall be of the same nominal composition as the internal structural components unless otherwise specified.

TABLE 3 - MATERIALS SPECIFICATIONS

MATERIALS	ASTM STANDARDS				
	PLATE	SHEET	STRIP	BARS	BOLTS & NUTS
Carbon Steel	A 36, A 283, A 285 / A 285M A 515 / A 515M A 516 / A 516M	A 414, A 569	A 570	A 675	A 307, Gr B
Low and Intermediate Alloy Steels		As specified for High Alloy Steels			
C-1/2Mo	A 204 / A 204M				
1-1/4Cr-1/2Mo through 5Cr-1/2Mo	A 387 / A 387M				
High Alloy Steels	A 176 and A 240, Types 405 and 410S			A 276 Type 405	A 193 / A 193M B6; and A 194 / A 194M Gr6F (with Selenium), or Gr6
12Cr welded components				A 276 Type 405 or 410	
12Cr non-welded components	A 176 and A 240, Types 405, 410 or 410S			A 276 Type 405 or 410	A 193 / A 193M B8 and A 194 / A 194M Gr8
18Cr 8Ni: Types 304, 316, 321, 347	A 167 and A 240			A 276	
Non-Ferrous	B 127			B 164	B 164
Nickel Copper (Monel)					
Titanium	B 265 Gr2			B 348 Gr2	B 348 Gr4

DESIGN

GENERAL

- M * 5.1 **All internals, except shrouds and outlet collectors**, shall be removable with vertical thermowells in place, and shall be designed to pass through the nearest manhole above their level unless otherwise specified.
- M 5.2 **All parts which are to be installed after vessel fabrication** is complete shall be designed to pass through the manways provided on the vessel.
- M 5.3 **All parts, except tray manways**, shall be designed to permit installation and removal from the top side.
- O,R 5.4 For reactors, **screens shall be attached on top of reactor grids and catalyst support hardware** to prevent inerts and catalyst from:
 - Falling through holes or slot openings
 - Blocking clearances in support hardware that are required for thermal expansion.
- O 5.5 For **reactors, bed support beams and grids** shall have a minimum open area of 50% of the total cross sectional area. Clearances between support beams and grid sections, grid sections and vessel shell, and adjacent grid sections shall be no larger than 70% of the diameter of the inert balls in direct contact with the grid. The smaller clear dimension of support grid openings shall be no greater than 1 1/2 in. (38 mm).
- O 5.6 **Bubble cap trays and chimney trays**. Seal welded chimney trays should be used for new total drawoff trays in critical vacuum services where leakage cannot be tolerated such as in Lubes Vacuum Pipestills. For other services in which bubble cap trays are used as drawoff trays (partial or total drawoff tray) they should be seal welded. Seal welding is required at all panel to panel, panel to support ring, panel to beam and chimney (riser) to panel connections, except at internal manways, to eliminate leakage. Recessed inlet boxes are not allowed for sealing the downcomers feeding drawoff trays. Gaskets and packing may be used in the assembly of bubble cap trays to meet specified leakage rates in other services.

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CORROSION ALLOWANCE

- R * 5.7 The **total corrosion allowance** (TCA) to be used for all internals shall be specified. The TCA is normally calculated as follows:

$$TCA = 2 C_r L_d$$

where:

TCA = total corrosion allowance. Note that this value may be either more or less than the default value shown below.

C_r = the corrosion rate anticipated for the material specified.

L_d = the design life for the internal component.

- For structural components, the design life should equal that specified for the vessel unless otherwise specified.
- For non-structural components and tray accessories and internal piping, the design life should equal 1/3 the value specified for the vessel unless otherwise specified.

The factor of 2 accounts for the fact that corrosion of the internal occurs from both sides.

If not specified, the default total corrosion allowance shall be as follows:

TYPE OF INTERNAL	MATERIAL OF INTERNAL	DEFAULT TOTAL CORROSION ALLOWANCE	
		Inches	mm
Structural Component	CS	0.12	3.0
	Alloy (1)	0.02	0.5
Non-Structural Component or Tray Accessory	CS	0.04	1.0
	Alloy (1)	0.007	0.2

Note:

(1) Alloy designates stainless steels (300 and 400 series), Nickel alloys, Copper alloys, Aluminum alloys.

MINIMUM METAL THICKNESS

- O,R * 5.8 For **Structural and Non-Structural Components**, the minimum required metal thickness (fully corroded) is 0.074 in. (1.9 mm). A fully corroded thickness in excess of the minimum may be used if required based on other mechanical design considerations or if increased thickness results in a more economical design.
- O,R * 5.9 For **tray accessories**, the minimum required metal thickness (fully corroded) is 0.060 in. (1.5 mm).
- O,R * 5.10 **Thickness of tower packing** including Glitsch grid, Flexi-grid, Pall rings, ballast rings, flexirings etc. shall be specified.

LOADS AND STRESSES

- R * 5.11 **Reactor internals** shall be designed to support their own weight plus the live loads specified.
- R 5.12 **Where live loads are not specified**, structural components, non-structural components and tray accessories shall be designed to support their own weight plus the following live loads at the design temperature.
- Fractionating trays.** Design live load shall be the greater of 20 psf (98 kg/m²) or the weight of water 2 in. (50 mm) over the highest weir setting.
 - Areas under downcomers.** Design live load shall be the greater of 64 psf (314 kg/m²) or a head of water one-half of the height of the downcomer.
 - Pans (drawoff and accumulation).** Design live load shall be the greater of 1 psi (700 kg/m²) or the weight of water at the maximum operating level of the pan.
 - Baffles** (including shed rows, disc, and donuts) with no normal operating liquid level shall use a design live load of 1 psi (700 kg/m²) on the projected horizontal area.
 - Entrainment screen components** shall be designed for a differential pressure of 0.1 psi (70 kg/m²) unless otherwise specified. The need for a higher differential pressure shall be based on anticipated fouling or upset conditions.

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- R 5.13 **Allowable unit stresses for non pressure containing internals** shall be per ASME Code Section VIII, Div. 2. For stresses beyond the temperature range listed in ASME Section VIII, Div. 2, ASME B31.3 shall be used.
- O 5.14 **Maximum deflection from the horizontal for trays, distributors and liquid distributor trays** under specified operating conditions shall not exceed 1/900 of the vessel diameter.
- M 5.15 **Maintenance loads.** Structural components shall be designed for a concentrated live load of 300 lb (135 kg) at any point based on the allowable stress at 100°F (38°C). This design shall be based on the fully corroded thickness of the structural components (i.e., thickness excluding total corrosion allowance). Deflection does not need to be considered for maintenance loads.

DIMENSIONAL REQUIREMENTS

- R 5.16 For reactors, **wire screen dimensions** shall be per [Table 4](#). For crinkle wire mesh screen (CWMS) dimensions see **Par. 6.9e**.
- O 5.17 **Bolt spacing** in downcomers shall not exceed 6 in. (150 mm).
- O 5.18 **Jet tray tab** dimensions shall be per [Figure 1](#).
- O 5.19 For **bubble cap trays, cap and chimney riser dimensions** shall be per [Figures 2 and 3](#). The bubble caps shall be removable. They shall be held to the chimneys by means of individual holdown bolting devices.
- M 5.20 **Maximum unsupported length** (minor dimension only) of trays, baffles, and pans shall be as limited by any access manways
- R,O 5.21 **For all trays except cartridge and pedestal tray assemblies**, the nominal tray diameter shall be determined to the nearest 1/4 in. (6 mm) per the following:

$$\text{Tray diameter} = \text{Vessel ID} - [1\% \text{ Vessel ID} + 3/4 \text{ in. (19 mm)}]$$
 For cartridge and pedestal tray assemblies, the maximum permissible radial gap between tray periphery and vessel shell is 3/16 in. (5 mm).
- R 5.22 A minimum of **3/4 in. (19 mm) overlap** shall be provided between the support ring and the OD of **trays**, decks, and grids.
- M 5.23 **Bolt hole or clamp spacing** around the edge of tray, deck, or grid sections shall not exceed 7 in. (177 mm).
- O 5.24 **Tray or deck areas blanked by structural components** shall not exceed 3 in. (75 mm) in width for minor beams and support rings, and 8 in. (200 mm) in width for major beams.
- O 5.25 The projected **cross sectional area of the packing hold down plate**, if required, shall be a maximum of 5% of the vessel cross sectional area.

STRUCTURAL

- O 5.26 The **depth of supporting members** normal to the direction of liquid flow on the tray below shall not exceed 20% of the vertical distance between trays.
- R 5.27 **Sheds and shed troughs** shall have their unsupported edges stiffened by an integral or bolted member as shown in [Figure 4](#). This stiffening member shall be through-bolted to vessel shell clips or other supporting members with sufficient clearance for thermal expansion. Holddown clamps in lieu of through-bolting are not permitted for sheds or shed troughs. Proposals to use alternative designs (e.g. use of center stiffeners in lieu of stiffeners at the edges) shall be submitted to Purchaser for approval by Owner.
- O * 5.28 **Baffle plates and wear plates** to be used with tangential nozzles for atmospheric and vacuum pipestill towers shall include the design and fabrication details shown in [Figure 5](#).
- R 5.29 **Grid support beams** shall be fabricated "T" sections or fabricated back to back channels with the flanges downward and webs intruding into the catalyst bed. The beam flanges shall be used to support bed grids and screens.
- R 5.30 **Web crippling** shall be investigated per ASD Specifications for any supporting member, except that the allowable stress per **Par. 5.13** shall be substituted for the quantity (0.75 Fy) used by ASD in the web crippling formulas.
- R 5.31 **Slotted oversize holes** shall be used to permit thermal expansion where structural components are bolted to seat pads or clips. Bolts shall be installed "hand tight", and then secured to prevent subsequent loosening.

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INTERNAL PIPES AND THERMOWELLS

- O,M 5.32 **Internal distribution pipes** shall have flanged and gasketed connections and shall have their ends blanked.
- R 5.33 **Expansion guides** shall be provided for vertical thermowell installation, per [Figure 6](#).
- O * 5.34 **Tray guides**, per [Figure 7](#) shall be provided to minimize liquid leakage at points where thermowells or catalyst dump tubes pass through trays. Highest liquid level (HLL) will be specified.

BOLTING

- R 5.35 **All bolting** for internals shall be a minimum of 3/8 in. (10 mm) nominal diameter.

ACCESS THROUGH TRAYS, GRIDS AND DECKS

- M 5.36 **Access through trays, grids and decks** shall be provided as follows:
- All trays, grids and decks in towers 3-1/2 ft (1050 mm) in diameter and larger shall be equipped with manways.
 - All trays, grids and decks in towers smaller than 3-1/2 ft (1050 mm) in diameter shall be either split or equipped with manways.
 - Trays, grids and decks having 2 or more liquid passes shall contain manways on each pass.
- M 5.37 **Tray manways** shall be as follows:
- Manways shall provide a minimum rectangular opening of 15 x 18 in. (380 x 460 mm).
 - If opening under or through major support beams is less than that in **Subpar. a**, tray manways shall be installed on both sides of the beam.
 - Tray manways shall not form a part of the downcomer seal area.
 - Tray manways (or tray sections used in lieu of manways in towers 3-1/2 ft (1050 mm) in diameter or smaller) shall be removable from both above and below the tray.
- M 5.38 **Accesses and manways** at all levels shall be vertically aligned unless otherwise specified.

DRAIN HOLES

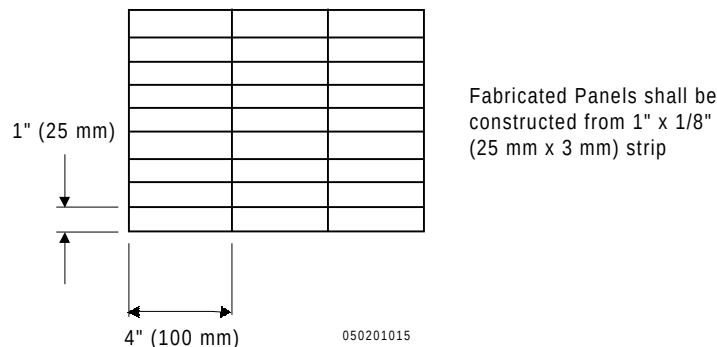
- O 5.39 For internals requiring liquid drainage, **drain holes** of 1/2 in. (13 mm) diameter shall be provided as follows:
- One hole in each tray recessed seal pan.
 - One hole per 5 ft (1500 mm) of length in the base of each inlet weir.
 - For bubble cap trays, provide one hole per 5 ft (1500 mm) of length in the base of each outlet weir.
 - Holes shall be located downstream of downcomer apron to prevent vapor from rising through downcomer liquid.
 - All boxes and pans from which liquid is normally withdrawn shall be equipped with nozzle(s) that will insure complete drainage of the box or pan. Drain holes shall not be provided in water drawoff boxes.
 - One hole in each distributor pipe where the process fluid does not discharge vertically downward.
 - Drain holes for tray or deck areas shall be:

TRAY OR DECK AREA		NUMBER OF DRAIN HOLES PER TRAY
ft ²	m ²	
≤ 30	≤ 3	1
> 30 to 100	> 3 to 9	2
> 100	> 9	3

**ADDITIONAL DESIGN REQUIREMENTS FOR
INTERNALS OF TOWERS AND DRUMS**

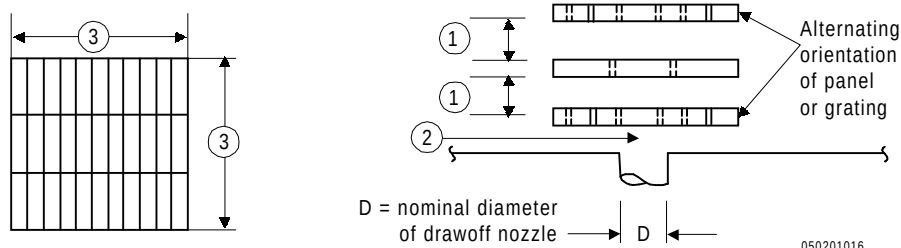
**DOWNCOMER ANTI-JUMP BAFFLES
AND ANTI-VORTEX BAFFLES**

- 6.1 **Downcomer anti-jump baffles** shall be designed with the following provisions:
 - a. Baffles shall extend across the full width of the downcomer and be parallel to the edges of the downcomer.
 - b. The bottom edge of the baffle shall be level with the top of the outlet weir (where used) or level with the tray if no weir is used.
 - c. Baffles shall contain at least one accessway, 22 in. (560 mm) long by the height of the baffle.
 - d. The top edge of the baffle shall be located a minimum of 2 in. (50 mm) below the underside of either the tray deck or support beam located above the baffle.
- 6.2 **Anti-vortex baffles** shall be designed and installed per the following criteria:
 - a. Acceptable baffle construction: "Subway" grating or panel strip per the configuration shown below; Glitsch Grid, Koch Flexigrid, Nutter Snap Grid, or Norton Intalox Grid panels constructed per these manufacturers' standards are also acceptable.



- b. Baffle design and installation shall comply with the following table and figure below:

APPLICATION > CRITICAL DIMENSIONS	VERTICAL DRUMS	BOTTOM DRAWOFFS	HORIZONTAL DRUMS	ACCUMULATOR TRAY DRAWOFFS	TOWER DRAWOFF BOXES (OTHER THAN ON ACCUMULATOR TRAYS)
Number of Tiers >	3	3	3	3	*will be specified
① Spacing between tiers	6 in. (150 mm) max. Tiers too be equally spaced and located between the drawoff nozzle D and the low liquid level. Distance from top tier to low liquid level shall be minimized within the above constraints.				
② Clearance between bottom of Tiers and Outlet Nozzle	D/2, or greater as required to accommodate baffle size		2 in. (50 mm) approx.		
③ Baffle Size (length of sides)	4D or 1/2 Drum (tower) diameter, whichever is the smaller value				



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DOWNCOMERS, SEAL PANS, DRAWOFF BOXES, ACCUMULATOR STACKS, FEED INLETS, REBOILER RETURNS

- O 6.3 **Downcomers** shall be installed with bolted joints, and shall be designed so that no vapor bypassing will occur. Stiffeners must be provided as needed to limit the horizontal movement of the bottom edge of the downcomer at any point to $\pm 1/4$ in. (± 6 mm).
- O 6.4 **All joints in areas under downcomers**, including the joint to the tray support ring, shall be continuously seal welded after installation of the tray. The joint with the contacting area of the tray shall not be welded. Bolted and gasketed construction shall not be used in areas under downcomers except in towers 3 ft (900 mm) in diameter and smaller, where removal of the downcomer seal area is required to permit access.
- O 6.5 **All joints in pans and drawoff boxes**, shall have continuous welds to prevent leakage.
- O 6.6 **Accumulator stacks on drawoff pans** shall be seal welded to the pans. Any joints in the stacks shall be seal welded.
- O 6.7 **Feed inlets and reboiler returns**. Where a stream enters a vessel, the stream shall impinge on a smooth, unobstructed surface regardless of whether it discharges against a downcomer apron or a specially provided baffle.
- O 6.8 **Trough type distributors** which are hung by a bolt/nut arrangement (rather than supported from below by a tray support ring or truss) shall be provided with lock washers, lock nuts or double nuts.

ENTRAINMENT SCREENS

- 6.9 **Crinkled wire mesh entrainment screens** (CWMS) shall meet the following requirements:
 - S a. They shall be of the sandwich type consisting of entrainment mesh, retained between welded grid supports held apart by spacer rods passing through the mesh or by formed straps, welded to the top and bottom grids.
 - O b. Support and holddown grids shall have maximum sized openings of 6 in. x 6 in. (150 x 150 mm).
 - O c. Spacer rods shall be 1/4 in. (6 mm) diameter and located on a maximum spacing of 18 in. (450 mm).
 - O d. The screen assembly shall be attached to the support beams at a minimum of four (4) points with 1/2 in. (13 mm) minimum diameter J-bolts with locknuts.
 - O e. Mesh shall be 6 in. (150 mm) thick and knitted from $0.012 \pm .002$ in. ($0.31 \pm .05$ mm) diameter wire. Mesh weight shall be 5 to 10 lb/cu ft (80 to 160 kg/m³).

ADDITIONAL DESIGN REQUIREMENTS FOR INTERNALS OF FIXED BED REACTORS

REACTOR OUTLET COLLECTOR RINGS

- R 7.1 **Web between slots** shall be analyzed for both top and side loadings in the fully corroded condition. The minimum open area shall be specified.
- R * 7.2 **Outlet collector ring construction** shall be either of the following:
 - a. Per [Figure 8](#)
OR
 - b. **Profile wire screen** which has a nominal gap equal to one-half the least dimension of the catalyst and a minimum gap of 1/32 in. (0.8 mm). The minimum open area will be specified for the individual application. Mechanical designs using this construction shall be submitted to Purchaser for approval by Owner.

CATALYST UNLOADING NOZZLES / SCALE TRAP BASKETS / SHROUDS

- R 7.3 **Bottom catalyst unloading nozzles** shall be per [Figure 9](#).
- R 7.4 **Side and angled catalyst unloading nozzles** shall be per [Figure 10](#).
- R * 7.5 **Scale-trap baskets** shall be per [Figure 11](#) or [Figure 12](#) as specified.
- R 7.6 **Shrouds** shall be continuously welded. Holes in the shroud are not permitted.
- S,R 7.7 Provision must be made to **purge gas from the space between the vessel lining and the back of the shroud**.